Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Flood Risk at Matlaske Road Technical Note

Revision A
March 2023
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Prepared by: **Royal HaskoningDHV**	
Approved by: **Sheery Atkins, Equinor**	Date: March 2023

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Glossary and Acronyms

Term	Definition
AP	Annual Probability is the probability of a rainfall or tidal event occurring within any one year. For example, an event of a 100 year return period has an AP of 1:100 or 1%.
BGS	British Geological Survey
CoCP	Code of Construction Practice
DCO	Development Consent Order
DTM	Digital Terrain Model (also known as Digital Elevation Model) is a format for describing the topography of a terrain in a digital format. Often a digital terrain is formatted into a regular grid.
FEH	Flood Estimation Handbook
Fluvial flooding	When flows within watercourses exceed the capacity of the watercourse causing out of bank flows.
Flood Zone 1	Low Probability - Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Flood Zone 2	Medium Probability - Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Flood Zone 3a	High Probability - Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
Flood Zone 3b	Functional Floodplain - This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)
Flood Zone Map	The Environment Agency has produced a mapping data set which covers England and provides the general extents of Flood Zones 1, 2, and 3. However, the national data set available online does not differentiate between Flood Zone 3a and 3b.
FRA	Flood Risk Assessment

Term	Definition
LiDAR	Light Detection And Ranging is an accurate ground terrain model obtained by aerial survey. The typical vertical accuracy is +/- 150 mm.
LLFA	Lead Local Flood Authority
Main River	Defined on the Main River map and relate to rivers on which the Environment Agency have permissive powers to carry out flood defence works
m ODN	Metres above Ordnance Datum Newlyn
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation
Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP
Ordinary Watercourse	Ordinary watercourses are all rivers, streams, ditches, cuts, culverts, dykes, sluices, and passages through which water flow that are not designated as Main River. The responsibility for the maintenance of the watercourse lies with the riparian owner; however, the operating authority (usually the Lead Local Flood Authority or Internal Drainage Board) has permissive powers to undertake certain works. Many watercourses are classed as ordinary watercourse in their upper reaches and designated as Main River in their lower reaches.
OS	Ordnance Survey
SuDS	Sustainable Drainage Systems, which are designed to manage surface water flows in order to mimic the Greenfield runoff from an undeveloped site.
Surface water flooding	When rainfall causes overland flows which exceed the capacity of the drainage network, causing flooding to land that is normally dry.

1 Introduction

1. The aim of this Technical Note is to provide a summary of the assessment of flood risk undertaken at Matlaske Road, south of Little Barningham. It aims to address concerns raised by the Environment Agency within their Relevant Representation [RR-032] with regards to the flood risk both to and from the Project in this location and to provide clarification that it has been appropriately considered as part of the Flood Risk Assessment (FRA) process.

2. In addition, this Technical Note provides a further response to the **Examining Authority's First Written Questions** Q1.24.1.16 [PD-010] which states:

Watercourse at Little Barningham

The EA [RR-032] raise concern specifically regarding the ordinary watercourse crossing at Little Barningham (PRoW003) and the potential increase of flood risk to several homes arising from the use of a trenched crossing technique. Can such a crossing be undertaken without increasing flood risk elsewhere?

2 Environment Agency Relevant Representation [RR-032]

3. Comments have been received from the Environment Agency as part of their **Relevant Representation** [RR-032], dated 11 November 2022. This included concerns with regard to flood risk at Matlaske Road, south of Little Barningham. These concerns have been reproduced as follows:

Chapter 18 Water Resources and Flood Risk Table 18.14

This table contains an assessment of the magnitude of effect resulting from trenched crossings of ordinary watercourses and appears to focus on impacts from habitat change. This assessment does not appear to assess the magnitude of flood risk effects resulting from trenched crossings of ordinary watercourses that are in Fluvial Flood Zones 2 and 3a.

Paragraph 98

This states that ordinary watercourses will be crossed using trenched techniques except for certain circumstances where trenchless techniques may be used. The Environment Agency does have an interest in ordinary watercourses where there is associated fluvial Flood Zones 2 and 3a.

Figure 18.5

This identifies the proposed crossing method at each location. There is a crossing of an ordinary watercourse southwest of Little Barningham where it appears that open cut trenched techniques are proposed. As noted in our comments for Table 18.14, the assessment used to determine a trenched crossing at this location didn't include an assessment of flood risk impacts. Immediately upstream of this crossing location are a number of properties in fluvial Flood Zone 3a and we also note that this area is within the flood alert area for The River Bure, Spixworth Beck and surrounding Becks.

Appendix 18.2 - Flood Risk Assessment

Paragraph 408 – 412

These paragraphs suggest the site-specific risk assessments will be carried out at the detailed design stage.

Issue, impact and solution

There is a potential increase of flood risk to several homes arising from the use of trenched techniques at this crossing. Based on the current proposal, an assessment of the flood risk impacts of this trenched crossing is required in the Flood Risk Assessment for the Environment Agency to review and agree to before the conclusion of the examination process. Alternatively, we recommend that this crossing is undertaken using trenchless techniques (HDD) to avoid flood risk impacts, which should negate the need for an assessment. We have suggested this solution the Applicant's representative and await their response.

4. Following receipt of the above **Relevant Representation** [RR-032] a meeting was held with the Environment Agency on 12th January 2023 to discuss their concerns in further detail.
5. At this meeting the Applicant provided additional clarification with regards to the assessment of flood risk in this location. It was also agreed that a Technical Note would be produced summarising the main items of discussion covered during the meeting.
6. This Technical Note comprises the output of the meeting discussion and clarifications provided as requested by the Environment Agency. It also provides further clarification on the Applicant's response to the **Examining Authority's First Written Questions** Q1.24.1.16 [PD-010].

3 Summary of Proposed Works

7. The Applicant notes that the Environment Agency concerns in this location relate to the proposed trenched crossing of the ordinary watercourse (open cut), which would be undertaken as part of the construction of the onshore cable route.
8. The construction of the ordinary watercourse crossing in the vicinity of Matlaske Road has a relatively short timeframe i.e. the proposed construction works are likely to last no longer than a period of two weeks.
9. A series of measures have been identified to ensure that during the proposed construction works there would be continued conveyance of flow along the ordinary watercourse. These are set out in **Section 6.1.8** of the **Outline Code of Construction Practice (Revision B)** [REP1-023] to be secured under Requirement 19 of the **draft DCO (Revision D)** [document reference 3.1].
10. Following construction of the onshore export cables in this location the ordinary watercourse would be reinstated to its current capacity and condition to ensure the continued conveyance of flow along the channel.
11. In addition, once operational the onshore export cables will be located entirely below ground and there will be no interaction with either the ordinary watercourse or the floodplain in this location.

4 Environment Agency Mapping

12. The Environment Agency Flood Map for Planning shows the ordinary watercourses and residential properties (known as Mere Farm) in the vicinity of Matlaske Road to be in Flood Zone 3 and therefore at high risk of fluvial flooding.

13. However, it is noted that this mapping is based entirely on JFLOW data and therefore it is not possible to determine whether this is Flood Zone 3a or 3b.

14. Furthermore, JFLOW data has poor resolution and does not account for structures such as pipes or culverts. In addition, the use of JFLOW means that flood levels cannot be derived. An extract from the Flood Map for Planning which covers the area of interest is included in **Figure 4-1**.

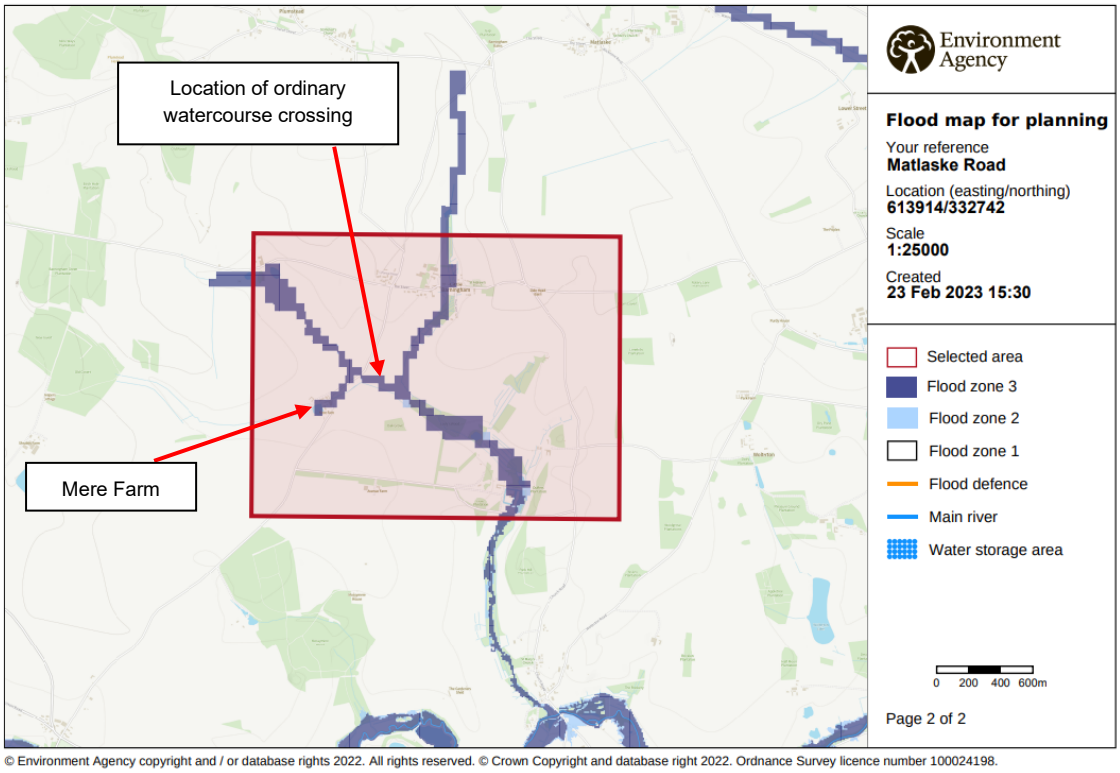

Figure 4-1: Extract from the Environment Agency Flood Map for Planning

15. A more accurate representation of flood risk in the local area is shown on the Environment Agency's Risk of Surface Water flood maps. These provide better resolution mapping and indicative flood depths. However, once again it is understood that the surface water maps do not include structures or detailed channel survey information.

16. Therefore, the additional capacity which may be provided in a culvert or accurately surveyed channel is not depicted on the maps. **Figure 4-2** to **Figure 4-5** show the Environment Agency's Risk of Surface Water flood maps for the area of interest.

17. Upon analysing the available fluvial and surface water data, it was considered necessary to visit the site to better understand the mechanisms of potential flood sources.

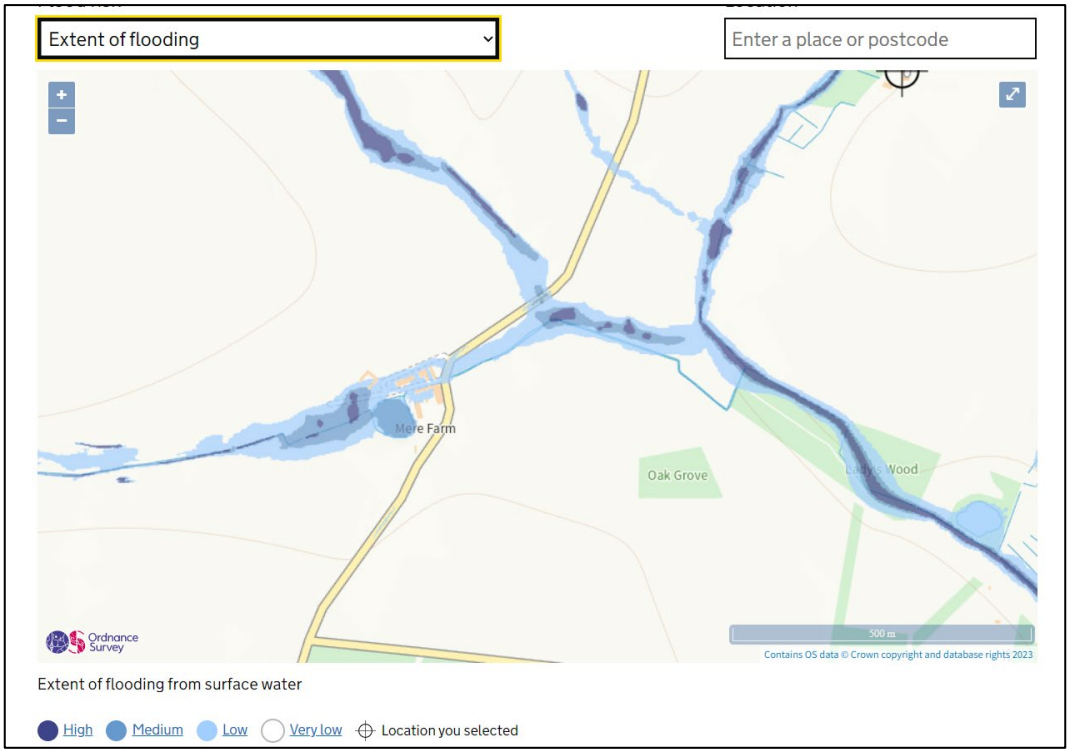

Figure 4-2: Environment Agency Surface Water Extent Map

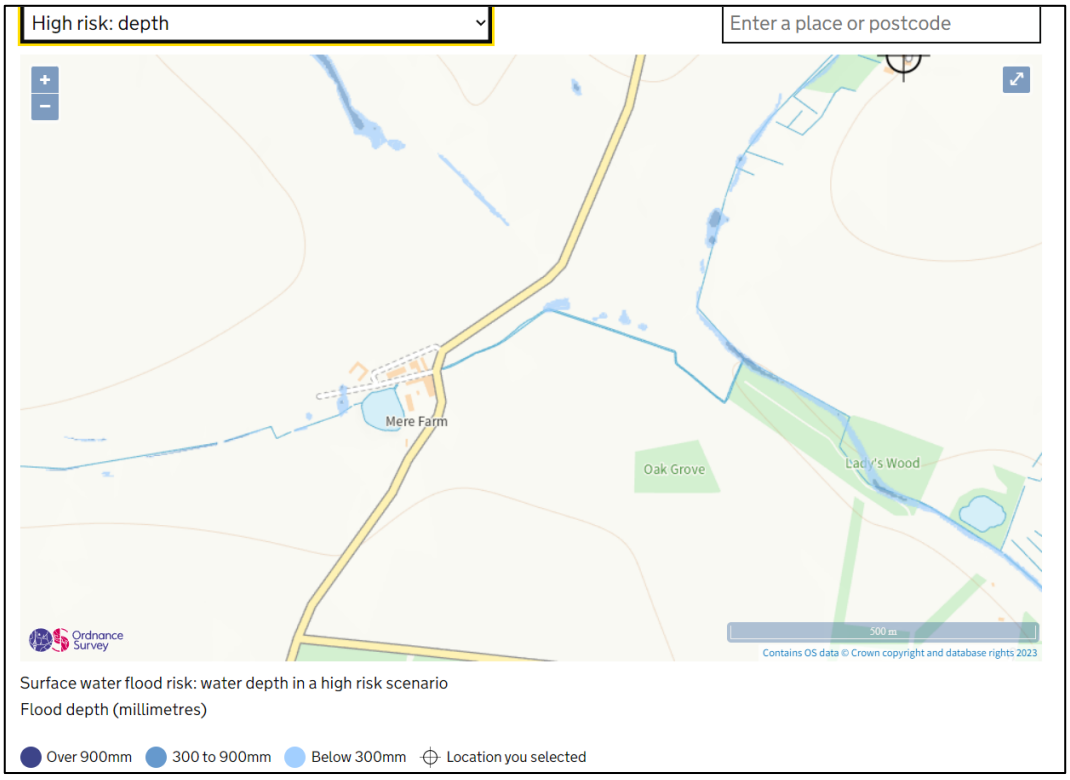

Figure 4-3: Environment Agency Surface Water Map – High Risk (1 in 30)

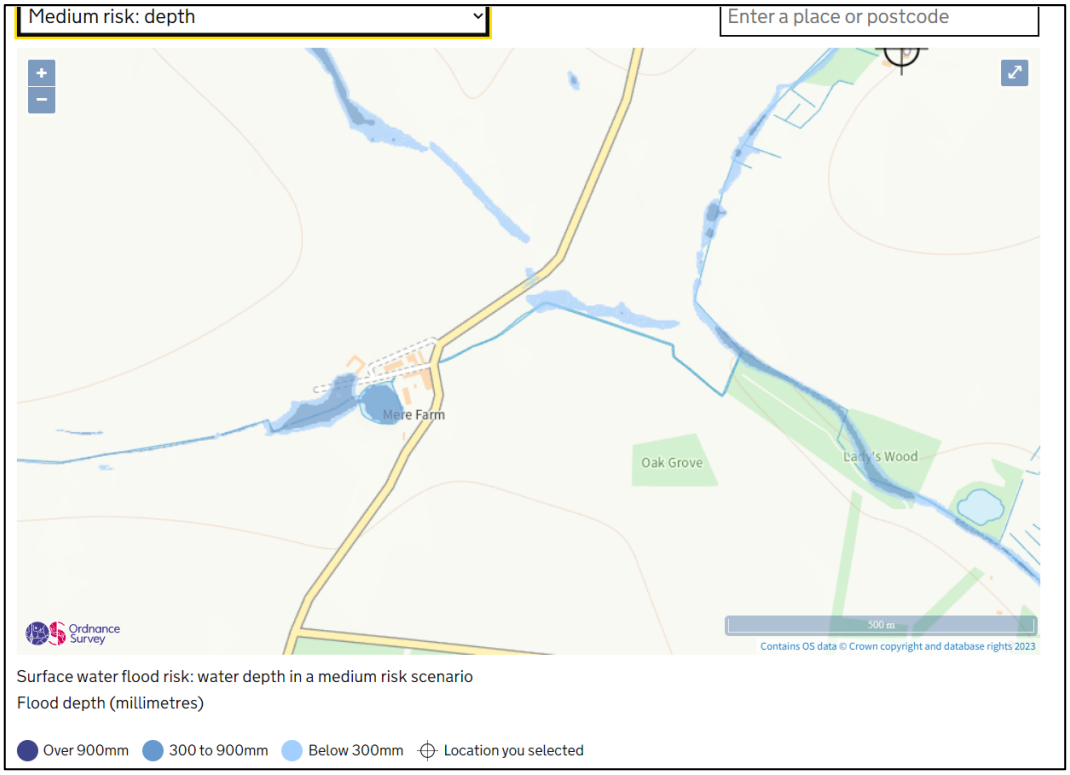

Figure 4-4: Environment Agency Surface Water Map – Medium Risk (1 in 100)

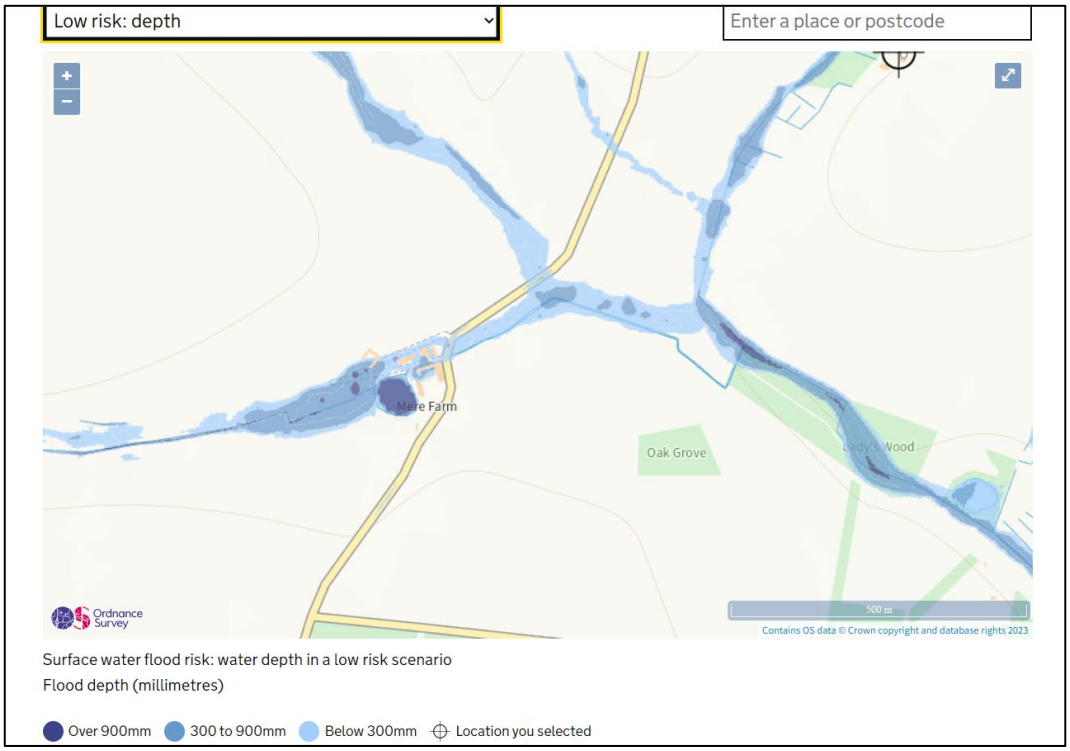

Figure 4-5: Environment Agency Surface Water Map – Low Risk (1 in 1,000)

5 Summary of Site Walkover

18. A site walkover was carried out on 5th January 2023 to investigate the ordinary watercourses and culverts in the local area. The preceding weather conditions throughout December 2022 had been relatively wet, as summarised in the nearby weather station data (ID: INORW159 – Aldborough), in **Figure 5-1**.

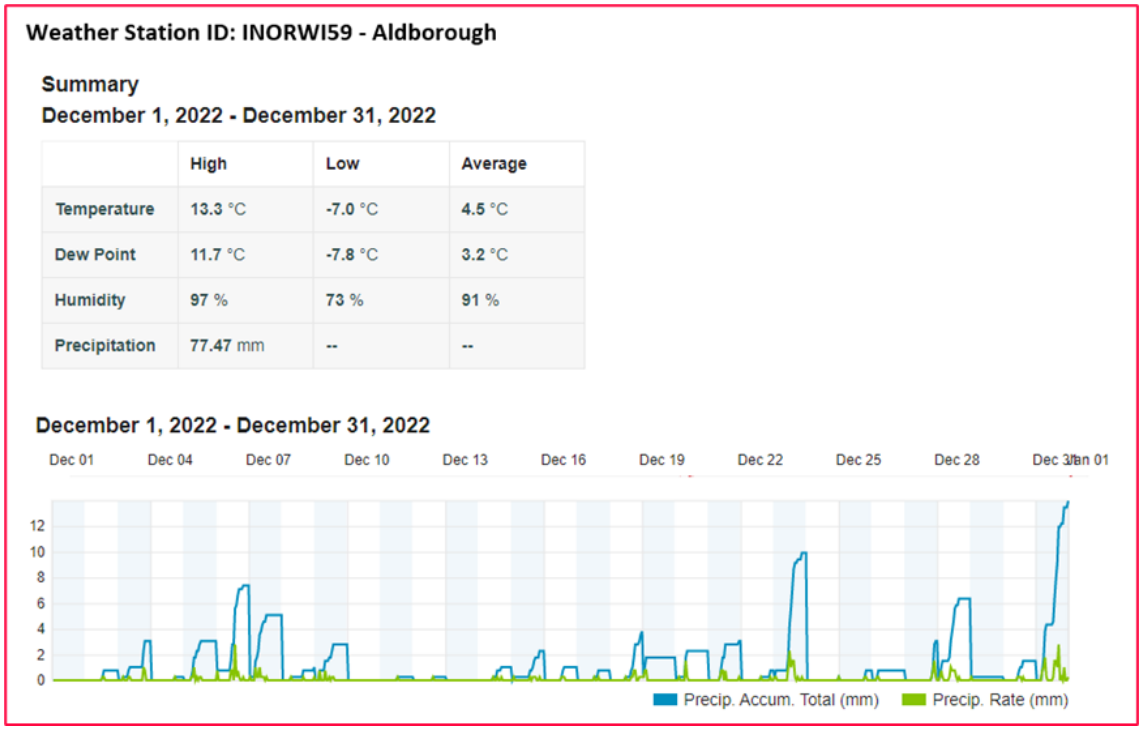

Figure 5-1: December 2022 Weather Summary (Station ID: INORW159 – Aldborough)

19. These preceding weather conditions provided an opportunity to observe the ordinary watercourses in 'wet weather', although not 'extreme' conditions.

20. During the site walkover, the Applicant's Engineer visited various points in the local area relevant to the Order Limits and potential receptors. At each location the Applicant's Engineer took a number of photographs and made observations. These locations are shown on **Figure 5-2** and discussed below.

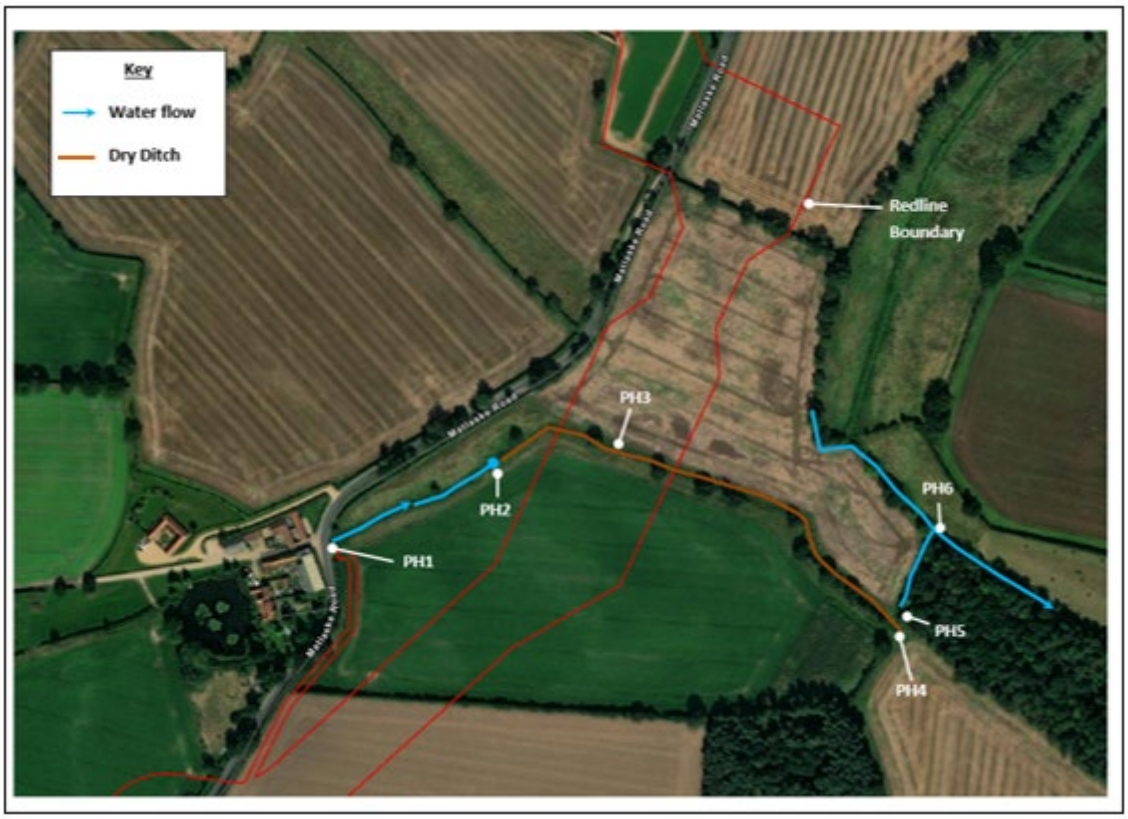

Figure 5-2: Overview of Ordinary Watercourses and Photograph Locations (Order Limits shown in red)

21. During the site walkover, it was not possible to view or confirm the location of the upstream end of the culvert (i.e. upstream of PH1) as it is located along a private access road related to the farm buildings, known as Mere Farm.

22. However, water appears to discharge from the pond to the west of these buildings or in that general area. Notably, aerial mapping also indicates an ordinary watercourse which is flowing west to east and appearing to discharge into the pond to the west of these buildings.

23. The site walkover concluded that the culvert is likely to run from the pond, along the line of the access road between the buildings, under Matlaske Road before discharging on the eastern side of the road. As such the culvert capacity in this location is likely to be a significant constraining factor with regards to the volume of water reaching the downstream channel.

24. PH1 was taken at the downstream end of the culvert, adjacent to Matlaske Road. **Figure 5-3** shows the downstream end of the culvert, which appears to be a 1,200mm culvert. It was heavily silted (estimated at 75% silt) but the water was still flowing. Looking north east from the culvert towards the receiving ordinary watercourse, the water was flowing and was estimated to be 100mm deep.

Figure 5-3: PH1 Images of culvert outfall and ordinary watercourse

25. The images in PH2 (**Figure 5-4**) show the downstream end of the ordinary watercourse where the water within the channel seems to disappear. The channel is then dry as it extends to the north east, before heading east, crossing the Order Limits.

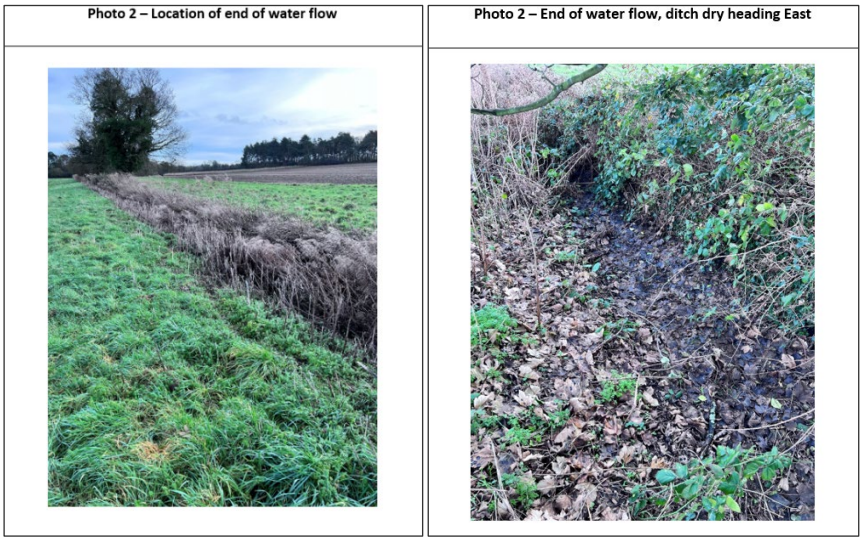

Figure 5-4: PH2 Images of dry channel extending across fields

26. PH3 (**Figure 5-5**) shows the channel which is dry from the centre of the Order Limits. It appears to be approximately 600mm to 900mm deep, with a shallower bank on the left bank (northern side) than the right bank (southern side).

27. Despite the preceding heavy rainfall, the accumulation of vegetation, leaves and other debris within the channel indicates limited flow at this location.

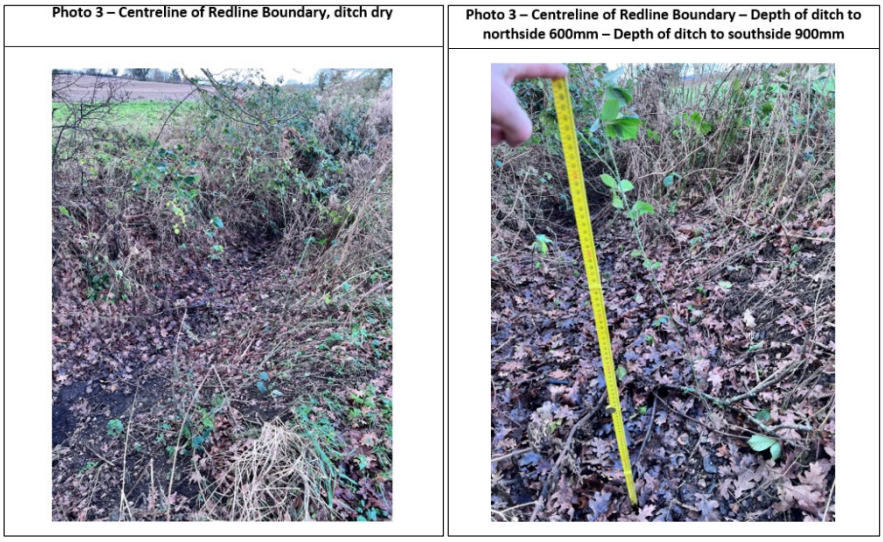

Figure 5-5: PH3 Images of dry channel in the centre of the Order Limits

28. PH4 and PH5 (shown in **Figure 5-6**) were taken at the eastern side of the Order Limits. These images still indicate limited flow within the ordinary watercourse, with the culvert beneath the Public Right of Way being broken. The culvert below the Public Right of Way is estimated to be 900mm diameter.

29. Another ordinary watercourse appears to begin at PH5 which flows towards Mannington Hall. The water in this section appeared to be backing up from the junction with a second ordinary watercourse to the north east.

Figure 5-6: PH4 and PH5 Images of broken culvert and section of ordinary watercourse leading towards Mannington Hall

30. The information obtained during the site walkover indicates that the ordinary watercourse passing through the Order Limits is ephemeral in nature and that even following times of increased rainfall there is limited flow.

6 Review of LiDAR and Ground Elevations

31. Open source LiDAR data was obtained from the Defra Survey Data Download website (https://environment.data.gov.uk/DefraDataDownload/?Mode=survey). For the area of interest, the most detailed resolution of LiDAR data available was 1m DTM.

32. An exercise was carried out to review the LiDAR available within the area of interest to estimate the likely ground levels and flood levels in the local area.

33. Analysis of the 1m DTM LiDAR indicates that the ground level in the vicinity of Mere Farm, the properties identified by the Environment Agency as being potential receptors, is around 32.5m ODN, as shown on **Figure 6-1**.

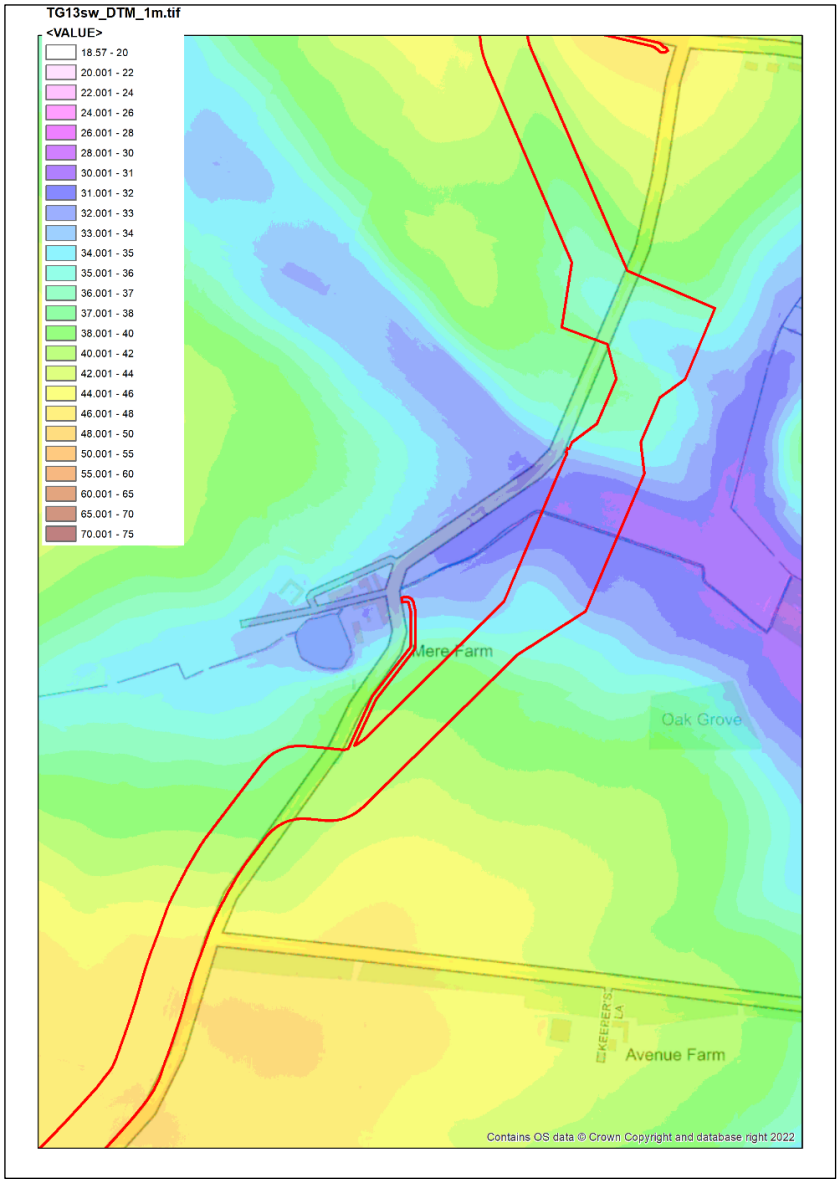

Figure 6-1: 1m LiDAR Coverage within the Order Limits

34. Within the Order Limits, the ground level is approximately 31.2m ODN on the land adjacent to the left bank of the ordinary watercourse whilst it is 31.5m ODN on the land adjacent to the right bank. This is in accordance with the observations during the site walkover, as seen in **Figure 5-5**, and noted in **Section 5**, whereby the ordinary watercourse on the left bank appears to be 600mm deep compared with 900mm on the right bank.

35. In the event that there was a blockage or failure to convey flow in the section of the ordinary watercourse within the Order Limits it would be necessary for water to 'back-up' within the channel and across the immediate floodplain to a depth of between 1.0m and 1.3m before it reached the typical ground level at Mere Farm (i.e. 32.5m ODN).

36. In addition, the water would need to flow across the floodplain across a distance of around 300m to reach Matlaske Road prior to passing over this and reaching the farm buildings.

37. Furthermore, levels along Matlaske Road are approximately 32.6m ODN, in the vicinity of the location where the culvert is passing under it. Therefore, in order for flood water to reach the properties on the western side of Matlaske Road flood water would also need to collect to a depth of between 1.1m and 1.6m before it would be able to flow over the road.

38. A comparison was made between the LiDAR and the Flood Zone 3 extent, which is shown in **Figure 6-2**. This comparison shows that some of the areas appearing to fall within Flood Zone 3, are at a higher elevation than some areas shown to be outside of Flood Zone 3.

39. For example, land immediately south of Barningham Green Farm is at an elevation of approximately 34.0m ODN to 35.0m ODN, however, it appears to be within Flood Zone 3.

40. In comparison, immediately to the east of Mere Farm the ground level is approximately 31.0m ODN to 32.0m ODN. However, this appears to be outside of the Flood Zone 3 extent.

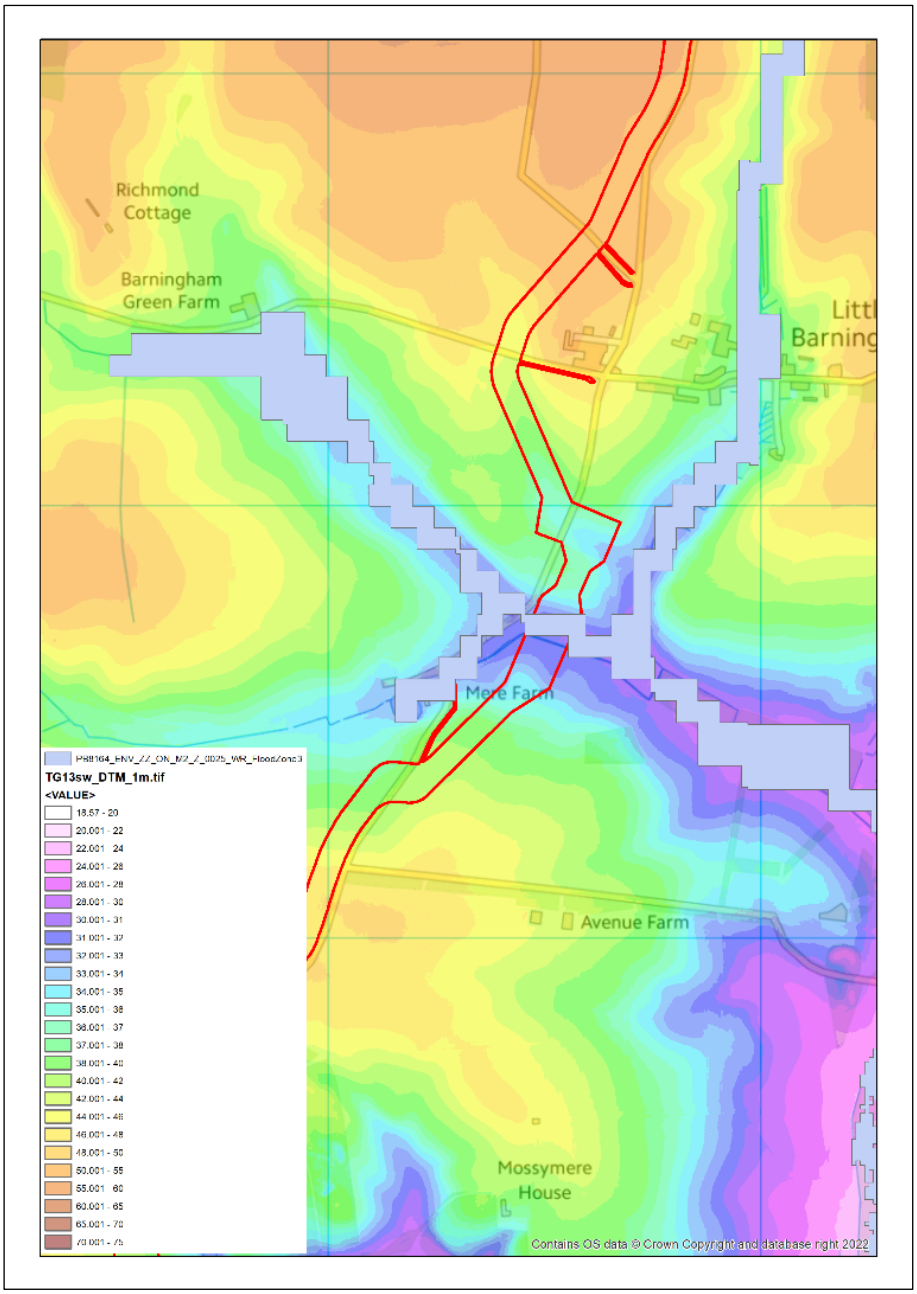

Figure 6-2: Flood Zone 3 extent and 1m LiDAR Comparison

41. This comparison highlights the relatively poor resolution of the JFLOW mapping which also appears to be inconsistent with the topography in this local area, potentially incorrectly identifying flood risk receptors.

42. Given the left bank of the ordinary watercourse, within the Order Limits is lower than the right bank, the limited connectivity with the downstream floodplain and depth of water required to flood the farm buildings at Mere Farm, it is considered that the flood risk in this location is not as extensive as the Environment Agency Flood Map for Planning, based on the JFLOW outputs.

7 Summary of Flood Risk

43. The observations during the site walkover as well as the LiDAR comparison discussed in **Section 6** above demonstrates that the representation of Flood Zone 3 on the Environment Agency's Flood Map for Planning in this area and specifically upstream of the Order Limits is very variable and unlikely to be accurate.

44. Furthermore, the 1,200mm culvert beneath Matlaske Road is likely to create a restriction to flow, with water backing up within the ordinary watercourse to the west of the buildings, before it reached the closest receptors (Mere Farm and surrounding buildings). This is unrelated to the capacity of the channel downstream of the buildings and within the Order Limits.

45. Given the high level of silt within the existing culvert as observed during the site walkover, the culvert is likely to become blocked despite the downstream channel being relatively clear.

46. In addition, the ground level difference between the Order Limits and the closest receptors (between 1.00m and 1.30m) would mean that a significant depth of flooding would be required in the wider floodplain prior to water reaching a level such that Mere Farm and the other buildings could flood.

47. The site walkover also identified this section of the ordinary watercourse to comprise a dry channel, at the location of the Order Limits and for some distance either side.

48. A review of the British Geological Survey mapping from their online viewer ([redacted]) shows the route of the ordinary watercourse to be located above chalk bedrock with alluvium or head deposits, comprising clay, silt, sand and gravel.

49. Therefore, it is possible that the infiltration rate in this area is high and this could result in day to day flows infiltrating into the ground below rather than causing significant volumes of water within the ordinary watercourse and nearby network.

50. Given that the preceding weather conditions were wet, and this section of the ordinary watercourse remained a dry channel, this suggests that the infiltration rate may be particularly high in the vicinity of the Order Limits.

51. The evidence from the site walkover and follow up analysis of the available data therefore indicates the ordinary watercourse to be an ephemeral stream.

52. In very wet weather, this could result in flow within the channel, but day to day, some sections of the channel remain dry.

53. Therefore, it is concluded that in the existing situation the combination of conditions required to create a flood risk to the buildings upstream of the Order Limits would be difficult to achieve and, as such, the existing flood risk to these receptors is low.

54. Notwithstanding the above the potential flood risk to these buildings as a result of the proposed trenched crossing of the ordinary watercourse (open cut) has been considered and a series of mitigation measures identified.

8 Proposed Mitigation Measures

55. As noted in the preceding section , several mitigation measures are proposed to ensure that any flood risk arising from the proposed trenched crossing of the ordinary watercourse (open cut), as part of the Project are appropriately managed.

56. This is to limit the flood risk both to the Project but also to any potential off-site receptors i.e. properties and people.

57. These mitigation measures are set out in **Section 6.1.8** of the **Outline Code of Construction Practice (Revision B)** [REP1-023] to be secured under Requirement 19 of the **draft DCO (Revision D)** [document reference 3.1].

58. In addition, for the proposed trenched crossing of the ordinary watercourse (open cut) in the vicinity of Matlaske Road, it is confirmed that the construction works are likely to last no longer than a period of two weeks. This relatively short timeframe will minimise the window of time whereby the site and adjacent area is vulnerable to heavy rainfall.

59. As this is an ordinary watercourse, the appropriate permitting will be obtained prior to the works, which will include appropriate Construction Method Statements. The Construction Method Statement will consider the need for over pumping and if this is needed, then the capacity of this pump will at least match the capacity of the 1,200mm diameter culvert upstream, as this comprises the constraining factor with regards to flow along the ordinary watercourse.

9 Conclusions

60. Comments have been received from the Environment Agency as part of their **Relevant Representation** [RR-032], dated 11 November 2022. This included concerns with regard to flood risk at Matlaske Road, south of Little Barningham.

61. In addition, within the **Examining Authority's First Written Questions** Q1.24.1.16 [PD-010], the Examining Authority also raised a question with regards to the Watercourse at Little Barningham.

62. This Technical Note provides a summary of the assessment of flood risk undertaken at Matlaske Road, south of Little Barningham and aims to address the concerns raised by the Environment Agency and subsequently the Examining Authority question.

63. The Applicant notes that the proposed construction works in this location comprise the trenched crossing of an ordinary watercourse (open cut). They are temporary in nature and comprise a relatively short timeframe i.e. the proposed construction works are likely to last no longer than a period of two weeks.

64. Information obtained by the Applicant's Engineer during a site walkover indicates that the ordinary watercourse passing through the Order Limits is ephemeral in nature and that even following times of increased rainfall there is limited flow.

65. Furthermore, a review of the LiDAR and ground elevations adjacent to the ordinary watercourse and around Mere Farm highlighted the relatively poor resolution of the JFLOW mapping which appears to be inconsistent with the topography in this local area, potentially incorrectly identifying flood risk receptors.

66. Given the ground level difference between the Order Limits and the potential off-site receptors (between 1.00m and 1.30m) this would mean a significant depth of flooding would be required in the wider floodplain prior to water reaching a level such that Mere Farm and the other buildings could flood. Therefore, it is considered that the existing flood risk in this location is not as extensive as the mapping indicates.

67. Furthermore, the 1,200mm culvert beneath Matlaske Road is likely to create a restriction to flow, with water backing up within the ordinary watercourse to the west of the buildings, before it reached the closest receptors (Mere Farm and surrounding buildings). This is unrelated to the capacity of the channel downstream of the buildings and within the Order Limits.

68. Given the high level of silt within the existing culvert as observed during the site walkover, the culvert is likely to become blocked despite the downstream channel being relatively clear.

69. Notwithstanding the above, the Applicant has identified a series of mitigation measures to further reduce the potential flood risk to off-site receptors during the proposed construction of the trenched ordinary watercourse crossing.

70. With these measures in place and given the understanding of the likely flood risk in this location, the Applicant concludes that the flood risk to the nearby buildings at Mere Farm is not as extensive as that shown on the Environment Agency Flood Map for Planning, based on the JFLOW outputs.

71. Furthermore, should there be a risk to these receptors it can be appropriately managed during the short timeframe required for the construction works, whilst maintaining a trenched crossing approach in this location.

72. As such, the Applicant concludes that the flood risk to off-site receptors, such as Mere Farm, during the construction of the trenched ordinary watercourse crossing would not be increased as a result of the Project.

73. In addition, once the onshore export cables have been constructed and the existing ordinary watercourse channel, and its capacity, reinstated there will be no flood risk to these receptors. This is on the basis the onshore export cables will be located entirely below ground and there will be no interaction with either the ordinary watercourse or the floodplain in this location.