Land North of West Moor Park, Armthorpe, Doncaster
Proposed Development of Commercial Use

Appraisal of Flood Risk

Prepared by: Kevin Tilford BSc MSc PhD MBA CEnv CWEM FCIWEM Managing Director
Project ref: 2310 Land North of West Moor Park, Armthorpe
Date: 26 October 2020
Version: Final v1.0

This document presents a summary of an assessment of flood risk to the site within the context of its suitability for development of commercial/industrial use. It has been prepared by Dr Kevin Tilford on behalf of West Moor Holdings.

Statement of Experience: I am Managing Director of Weetwood Services Ltd, a consultancy firm specialising in flood risk and drainage. I hold a BSc(Hons) in Environmental Science from the University of Lancaster, an MSc(Eng) in Water Resources Technology from the University of Birmingham, a PhD from the University of Salford (1991) and an MBA from Cranfield School of Management (2006). I am a Chartered Water and Environmental Manager and Fellow of the Chartered Institution of Water and Environmental Management, the leading royal chartered professional body dedicated to sustainable management and the environment. I am also a Chartered Environmentalist. I have worked in the field of hydrology, water engineering and flood risk management for over thirty years and worked on a wide range of development projects. As well as undertaking flood risk and drainage assessments for planning applications, I also act as an expert witness on planning appeals.

Overview/Executive Summary

1. The land to the north of West Moor Park (“the site”) is adjacent to and north-west of the A630 and M18 Junction 4 (refer Figure 1). The site has an area of approximately 92 hectares (refer Figure 1).

2. The proposals are to develop the site for commercial/industrial use. The illustrative masterplan indicates approximately 2.5 million sq ft of space provided in 25 units ranging in size from 18,000 sq ft to 560,000 sq ft. The units are located either side of West Moor Drain (see para. 10 below) with the drain forming a “blue spine” through the site; other drains would be realigned as required to accommodate the necessary development platforms.

3. The Environment Agency Flood Map for Planning indicates that the site is located in flood zone 3 i.e. at a high risk of flooding from rivers and/or the sea. Having undertaken the assessment I believe that the mapping misrepresents actual flood risk at the site because it does not consider the presence of formal flood defences.

4. The site is indicated to be at the edge of the Isle of Axholme Residual Risk Area. This confirms that the principal source of flood risk to the site is the residual risk associated with a failure of pumping stations in the Isle of Axholme. These pumping stations are all owned/maintained by either the Environment Agency or the Doncaster East Internal Drainage Board. The risk of failure is therefore considered to be very low, and it is noted that the Environment Agency has an extensive programme of pump improvement and renovation works that will ensure that this continues to be the case.

5. The assessment is supported by the fact that there are no records of the site having flooded, even though large tracts of the borough have experienced significant and in places severe flooding, including in 1947, 2007 and most recently in November 2019.

6. The assessment presented in this document indicates that the (residual) risk of flooding at the site could be appropriately mitigated such that the proposed development would be safe for its lifetime and would not increase flood risk elsewhere, i.e. the proposed development would, in respect of flood risk, be in accordance with local and national planning policy.

7. It is concluded that the site could be developed for commercial/industrial use and that there are no grounds for excluding the site on flood risk ground.
Site Characteristics

8. The site topography is presented on the digital terrain map shown in Figure 2. The DTM indicates that the site is relatively flat and low lying, with ground levels gradually increasing from the north-west to east/south-east, from 1.5 m AOD along the north-western boundary of the site to 3.0 m along the southern and eastern boundaries.

9. According to British Geological Survey mapping, the site is underlain by superficial deposits of silts and clays (eastern half) and peat (western half). The superficial deposits are underlain by a bedrock of pebbly/gravelly sandstone. Cranfield University’s Soilscape mapping indicates the soil type at the site to comprise of slowly permeable seasonally wet loamy and clayey soils with impeded drainage.

10. Flood risk in the Doncaster borough is associated with the River Trent and River Don river systems, and the River Ouse/ Humber (refer Figure 3); there is also an extensive network of open land drains:

- The River Torne is to the south, south-east and east of the site, and at its closest is approximately 4.0 km from the site. The river flows within a continuous embankment in a north-easterly direction to its confluence with the tidal River Trent at Keadby, 3 km west of Scunthorpe and 20 km from the site. The pumped outfall to the River Trent, Keadby pumping station, is owned and operated by the Environment Agency.

- The River Don is located to the west and north of the site and at its closest is approximately 4 km west of the site. The river flows in a northerly/north-easterly direction to its confluence with the River Ouse at Goole approximately 20 km north-east of the site.

- The site is in an area served by an extensive network of open land drains and the site is crossed by several, including the principal drain in the network, West Moor Drain after which the drainage system is named. The West Moor Drain system is a pumped land drainage system and water levels in the drains are controlled via a series of structures and pumping stations (including a pumping station at West Moor to the west of the site) maintained by the Doncaster East Internal Drainage Board. The system drains in an easterly direction, outfalling to the River Trent at Keadby (described above). (The land drainage system is not shown on Figure 3).

- The River Trent is located to the east of the site and at its closest is approximately 19 km from the site. The river is contained within a continuous raised embankment and flows in a northerly direction to its confluence with the River Ouse and River Humber immediately north-west of Alkborough, approximately 28 km north-east of the site.

- The River Ouse/River Humber is located approximately 20 km north-east of the site. The rivers are contained within earth embankments.

Flood Risk from Rivers (Fluvial and Tidal)

11. The Flood Map for Planning (Rivers and Sea)¹ (Figure 4) indicates that the site is located in flood zone 3. Table 1 of the NPPG defines flood zones as follows²:

- Flood zone 1: Low Probability. Land having a less than 1 in 1,000 annual probability of river or sea flooding
- Flood zone 2: Medium Probability. Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding
- Flood zone 3a: High Probability. Land having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of sea flooding
- Flood zone 3b: Functional Floodplain. In the Doncaster district, the functional floodplain is defined as land having a 1 in 20 or 1 in 25 annual probability of river flooding but excluding currently developed land or areas that benefit from raised flood defences.

¹ https://flood-map-for-planning.service.gov.uk/
12. Flood zones 1, 2 and 3 are presented on the Environment Agency Flood Map for Planning (Rivers and Sea). The flood zones shown on the flood map are defined by the predicted extent of flooding during the present day 1 in 100 (non-tidal rivers), 1 in 200 (tidal rivers and sea) and 1 in 1,000 (rivers and sea) annual exceedance probability (AEP) events.

13. The Flood Map does not differentiate between flood zones 3a and 3b. Nor do the flood extents presented on the map take account of the presence of flood defences or increased flood risk in the future due to the effect of climate change.

14. The flood outlines presented on the Flood Map for Planning are also presented on the Flood Zone Layer of the 2015 Level 1 Strategic Flood Risk Assessment - Interactive Map (refer Figure 5). However, the 2015 Level 1 SFRA Flood Zone Map also disaggregates flood zone 3, and presents the extent of land in the functional floodplain (flood zone 3b) and land in flood zone 3c but not in the functional floodplain (flood zone 3a).

15. According to the Flood Map for Planning, the site is located entirely in flood zone 3. The 2015 Level 1 SFRA Flood Zone Map confirms that none of the site is in the functional floodplain, hence the site is located in flood zone 3a.

16. Flood risk from rivers across the borough is associated with direct risk of flooding from any of the many rivers and drains in the borough, and the residual risk of flooding associated with a failure of flood defences, e.g. overtopping of structural failure (breach) of flood walls/embankments, or a failure of pumping systems. Due to the topography of the borough, particularly the eastern part (and land further east), flood risk can be due to watercourses outside of the borough, as far as the River Trent to the east and River Ouse to the north.

17. The 2015 Level 1 SFRA states (Section 5.2) that “The majority of fluvial flood risk comes from the River Don and its tributaries to the north of Doncaster …… Fluvial risk from the River Torne is much lower”. This statement is supported by historical flooding in the borough (refer para. 23-25 below).

18. Analysis undertaken by Weetwood in March 2019 of peak modelled river levels provided by the Environment Agency, confirms that the site is not at risk of flooding from the River Don due to the presence of a ridge of high ground between the site and the river (to the west/north-west of the site).

19. The Environment Agency has also confirmed that its hydraulic modelling of flood risk indicates that the site is not at risk of flooding from the River Torne3.

20. The 2015 Level 1 SFRA states (Section 5.2) “Tidal flood risk from the Humber Estuary is apparent in the north eastern and eastern parts of the borough, within the low-lying tidal floodplain. The topography in the tidal floodplain is below sea level in some places with extreme tidal flood levels extending inland up to 8 m AOD”. Notwithstanding this, outputs from the Environment Agency Upper Humber model (2016) confirm that no flooding of the site occurs for the 1 in 1000 AEP event when the presence of defences is considered.

21. There is no evidence that the site would flood in the event of a breach in defences, although it is accepted that the southern limit of the Upper Humber model is to the north of the site (roughly along a line running east-west from Stainforth to Scunthorpe). It is noted that the 2009 Level 1 SFRA stated “The Doncaster MBC area is located approximately 7 km from the River Ouse, 10 km from the River Trent and 15 km from the Humber Estuary. Given these distances, the risk that overtopping of the tidal defences outside of the Borough of Doncaster would lead to serious flooding within the Borough of Doncaster is considered very small. Given the limited duration of the tidal cycle, it is also considered highly unlikely that a breach of the tidal defences would result in flooding in the Doncaster MBC area. There is no evidence to suggest that this is still not the case.

22. In respect of the River Trent, the Environment Agency has advised4 “Armthorpe lies well outside the current 1 in 1000 year breach extent from the Tidal Trent Strategy Modelling (Black and Veatch, 2005)” whilst the 2009 Level 1 SFRA stated “The River Trent is heavily defended … with wide flat floodplains. The defended floodplains of the River Trent cover a considerable proportion of the north-eastern parts of the Borough of Doncaster, influencing flood risk in locations such as the M18 corridor (Junctions 4 and 5) and towns such as Thorne. At the closest point, the River Trent is approximately 10 km from the border of the Borough of Doncaster and the potential for breach of the Trent defences to result in flooding within the Doncaster MBC area is considered to be negligible.”

---

3 Letter from EA Midlands region to Weetwood dated 8 February 2019
4 Email from EA Midlands region to Weetwood dated 8 February 2012
23. The principal source of flood risk to the site is therefore indicated to be not from the many main rivers in or to the east of the borough but due to the (residual) risk of failure of pumping stations in the Isle of Axholme area. This is confirmed within Section 5.2.4 of the 2015 Level 1 SFRA which confirms the affected area to be located on the western edge of the Isle of Axholme Residual Flood Risk Zone (refer Figure 6).

24. The Environment Agency has an ongoing programme of flood risk management works which according to Section 5.6.4 of the 2015 Level 1 SFRA includes:

- “Isle of Axholme, Keadby PS Improvements - although the pumping station is not within Doncaster’s area, it does provide a significant management of flood risk within our area, planned delivery 2015 onwards, total project expenditure £47,000,000.
- 12 Pumping Stations in the Danvm and Doncaster East Internal Drainage Board area which require refurbishment – total project expenditure £1,357,700, planned delivery 2020/21 onwards”.

25. In respect of historic flooding, the 2015 Level 1 SFRA states: “The HFM [Environment Agency Historical Flood Map] shows that there has been widespread flooding of the borough in the past with the major source coming from the fluvial Don and numerous drains throughout the agricultural land to the north of Doncaster. Historic fluvial flooding from the River Went, Hampole Dike, Old Ea Beck and the River Dearne is also apparent from the HFM. Historic tidal flooding appears less apparent with small areas around the tidal Don and in the south east of the borough, though affecting agricultural land only”.

26. However, even though large tracts of the borough have experienced significant, and in places severe flooding, including in 1947, 2007 and most recently in November 2019, there are no records of historic flooding of the site either in the 2015 Level 1 SFRA or in the Environment Agency’s Recorded Flood Outlines database (database checked on 20 October 2020).5

27. This is well illustrated on Figure 5.1 of the 2015 Level 1 SFRA (refer Figure 7), which clearly shows that historical flooding in the borough is associated with the River Don and associated watercourses, and that there are no records of any residential flooding in the Armthorpe Ward.

28. The measures required to mitigate flood risk at the site are guided by the 2011 SFRA for North & North East Lincolnshire 2011. This states that the critical flood level for land located within the Isle of Axholme Residual Flood Risk Zone is 4.1 m AOD, with finished floor levels being 300 mm above this. However, as stated in Section 6.4.1 of the 2015 Level 1 SFRA, because this is a residual source of flood risk, this level is “… a starting point … and it is acknowledged that viability issues and existing AOD may result in lower finished floor levels which will need to be confirmed through a site-specific flood risk assessment…”.

29. It is concluded that whilst the potential depth of flooding across the site could be significant, the likelihood of the residual risk(s) being realised is very low and could be appropriately and effectively mitigated through the implementation of a package of measures including raising finished floor levels, incorporating flood reliance into the design of buildings and implementing a flood management plan.

Other Sources of Flood Risk

30. The Flood Risk from Surface Water map (Figure 8) indicates that most of the site is at a Very Low risk of flooding from surface water i.e. would not flood even during the 1 in 1,000 AEP storm event, and that surface water is only indicated to potentially accumulate during extreme rainfall along the lowest lying part of the site along the western boundary.

31. According to the Environment Agency Groundwater Susceptibility map (presented in 2015 Level 1 SFRA interactive map (Susceptibility to Groundwater Flooding layer) (refer Figure 9), the site is at Low to Medium susceptibility to groundwater flooding.

32. These sources of flood risk could be readily and effectively mitigated in accordance with planning policy.

5 https://data.gov.uk/dataset/16e32c53-35a6-4d54-a111-ca09031eaaaf/recorded-flood-outlines
Summary and Conclusions

33. The Environment Agency Flood Map for Planning indicates that the site is located in flood zone 3, i.e. at a high risk of flooding from rivers or the sea. However, a review of all available hydraulic model information indicates that unlike much of the Doncaster borough, the site is not at a direct risk of flooding from the main river systems that affect the borough i.e. the River Don and tributaries and the River Trent and tributaries.

34. It is concluded that the Environment Agency Flood Map for Planning significantly overstates flood risk at the site. This is because the mapping ignores the presence of formal flood defences.

35. The site is indicated to be at the edge of the Isle of Axholme Residual Risk Area. This confirms that the principal source of flood risk to the site is the residual risk associated with a failure of pumping stations in the Isle of Axholme. These pumping stations are all owned/maintained by either the Environment Agency or the Doncaster East Internal Drainage Board. The risk of failure is therefore considered to be very low, and it is noted that the Environment Agency has an extensive programme of pump improvement and renovation works that will ensure that this continues to be the case.

36. The assessment is supported by the fact that there are no records of the site having flooded, even though large tracts of the borough have experienced significant and in places severe flooding, including in 1947, 2007 and most recently in November 2019.

37. The assessment presented in this document indicates that the (residual) risk of flooding at the site could be appropriately mitigated and that the proposed development would be safe for its lifetime (taking into consideration the vulnerability of the proposed use and the future effects of climate change) and would not increase flood risk elsewhere, i.e. the proposed development would, in respect of flood risk, be in accordance with local and national planning policy.

38. I conclude that the site could be developed for commercial/industrial use and that there are no grounds for excluding the site on flood risk ground.
Figure 1. Location of Application Site

Figure 2. Topography in Vicinity of the Site
Derived from Environment Agency LIDAR data
Figure 3. Principal Watercourses
(Site location indicated by red block)

Figure 4. Flood Map for Planning (Rivers and Sea)
Source: https://flood-map-for-planning.service.gov.uk; Accessed 20 October 2020
Figure 5. Flood Zones
Source: 2015 Level 1 Strategic Flood Risk Assessment - Interactive Map (Flood Zone Layer)

Figure 6. Extent of Isle of Axholme Residual Flood Risk Zone
Source: 2015 Level 1 Strategic Flood Risk Assessment - Interactive Map (Residual Flood Risk Zone Layer)
Figure 7. Historical Flooding of Residential Properties in the Borough
Source: 2015 Level 1 Strategic Flood Risk Assessment -Figure 5.1

Figure 8. Flood Risk from Surface Water
Source: https://flood-warning-information.service.gov.uk; Accessed 20 October 2020
Figure 9. Susceptibility to Groundwater Flooding

Source: 2015 Level 1 Strategic Flood Risk Assessment - Interactive Map (Susceptibility to Groundwater Flooding Layer)
Delivering client focussed services from offices in Leeds, London and Mold

- Flood Risk Assessments
- Flood Consequences Assessments
- Surface Water Drainage
- Foul Water Drainage
- Environmental Impact Assessments
- River Realignment and Restoration
- Water Framework Directive Assessments
- Environmental Permit and Land Drainage Consent Applications
- Sequential, Justification and Exception Tests
- Utility Assessments
- Expert Witness and Planning Appeals
- Discharge of Planning Conditions

www.weetwood.net