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ENGINEERING SUPPORT PARTNERSHIP LTD

**New building to house biomass boiler,
Cedar Falls Care Home, Spalding**

Flood Risk Assessment

June 2018

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New building to house biomass boilers, Cedar Falls Care Home, Spalding

Flood Risk Assessment

June 2018

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1 INTRODUCTION

1.1 General

1.1.1 Wardell Armstrong LLP has been commissioned to undertake a Flood Risk Assessment (FRA), on behalf of Engineering Support Partnership Ltd. The FRA relates to the retrospective planning application for the building (or 'biopod') to house a biomass boiler at Cedar Falls Care Home, Spalding (hereafter known as the 'Development').

1.1.2 This FRA considers both the potential flood risk to the Development and the potential risk of the Development contributing to flood risk offsite. A qualitative impact assessment has been undertaken using a combination of professional judgement, legislation and other statutory policy and guidance.

1.2 National Planning Policy

1.2.1 The Department for Communities and Local Government (DCLG) published the National Planning Policy Framework (NPPF) in March 2012. The NPPF replaces the guidance previously contained within Planning Policy Statement 25 (PPS25) – Development and Flood Risk. In March 2014, the DCLG published the Planning Practice Guidance (PPG), which replaced the Technical Guidance to the NPPF.

1.2.2 The NPPF and the accompanying PPG aim to ensure that flood risk is taken into consideration at all stages of the planning process in order to avoid inappropriate development in areas at medium to high risk of flooding.

1.2.3 The NPPF and the PPG advocate the use of a risk-based 'Sequential Test' to direct development away from areas at the highest risk of flooding. Where development is necessary in high risk areas, the NPPF aims to ensure that the development is safe without increasing flood risk and where possible, reducing flood risk overall. Table 1 is extracted from Table 1 of the Flood Risk and Coastal Change section of the PPG (Paragraph 065) and defines the levels of flood risk within England.

Table 1 Flood Zones		
Flood Zone	Flood Zone Classification	Description
Flood Zone 1	Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding (Shown as 'clear' on the Environment Agency's (EA) Flood Map – all land outside Zones 2 and 3)

Table 1 Flood Zones		
Flood Zone	Flood Zone Classification	Description
Flood Zone 2	Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (Land shown in light blue on the EA's Flood Map)
Flood Zone 3a	High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding (Land shown in dark blue on EA's Flood Map)
Flood Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. 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 EA's Flood Map)

1.2.4 As part of the Flood Risk Regulations, which implement the requirements of the European Floods Directive, the Environment Agency (EA) has produced Flood Risk Maps for England and Wales. These Flood Risk Maps¹, which are available online, include plans showing the risk of flooding from rivers and sea, surface water and reservoirs for a number of scenarios. The Flood Probability Map indicates areas which may be affected by a 1 in 100 year or greater fluvial flood or a 1 in 200 year or greater tidal / coastal flood, i.e. Flood Zone 3 as defined in the NPPF. It also indicates which areas may be affected by an extreme flood event (1 in 1,000 year), i.e. Flood Zone 2 as defined in NPPF. The EA also publishes the Flood Map for Planning² which excludes the effect of flood defences, also see Appendix 1.

2 SITE DESCRIPTION AND LOCATION

2.1 Site Location

2.1.1 The Development is located off London Road (B1172), Spalding at Cedar Falls Care Home. The Site location is shown on Drawing NT13503/059/01. The nearest postcode is PE11 2UA. Further details regarding the location of the Development are provided in Table 2.

¹ Environment Agency (2018) Interactive Map: Long Term Flood Risk Information [online]. Accessed 31/05/2018. Available at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>

² Environment Agency (2018) Interactive Map: Flood Map for Planning [online]. Accessed 31/05/2018. Available at: <https://flood-map-for-planning.service.gov.uk/summary?easting=523750&northing=321309>

Table 2 Site Summary	
Site Name	New building to house biomass boiler, Cedar Falls Care Home, Spalding
Site Address	Land adjacent to Cedar Falls Care Home, Spalding, PE11 2UA
National Grid Reference (NGR)	TF 23750 21314
Site Area	29.8m ² or 0.00298ha
Previous Land Use	Asphalt Surfacing
Current Land Use	Biopod with Biomass Boiler
Local Planning Authority	South Holland District Council
Environment Agency Region	Lincolnshire and Northamptonshire

2.2 Site Description

- 2.2.1 The Site currently comprises hardstanding and lies on ground at 2.7m Above Ordnance Datum (AOD) according to 1m special resolution Light Detection and Ranging (LIDAR) Digital Terrain Model (DTM).
- 2.2.2 The nearest mapped watercourse is Hill's Drain, which lies approximately 55m north-west of the Site. The River Welland is classified by the EA as a 'main river' and lies approximately 430m to the south-east of the Site.
- 2.2.3 Rainfall data for the nearest Met Office station to the Site at Holbeach³ (located at NGR TF 44197 32761) (approximately 23km to the north-east of the Site) identifies average annual rainfall to be 610mm for the period 1981 to 2010.

2.3 Drainage Regime

- 2.3.1 The runoff across the Site is currently conveyed from the Site via the existing surface water drainage system for the general urban area of the Care Home and its environs.
- 2.3.2 The Care Home operator has confirmed that there has been no previous flooding at the Site.

2.4 Ground Conditions and Geology

- 2.4.1 The Site comprises impermeable asphalt, which is underlain by loamy and clayey soils of coastal flats with naturally high groundwater⁴. The superficial deposits are made up of Tidal Flat Deposits (Clay and Silt), which are underlain by the Oxford Clay Formation (Mudstone) bedrock⁵. The EA classifies the superficial deposits (Tidal Flat

³ Met Office (2018) Spalding Climate (Holbeach – Climate Period 1981-2010) [online]. Accessed 31/05/2018. Available at: <https://www.metoffice.gov.uk/public/weather/climate/gcruk9x9k#?tab=climateTables>

⁴ Cranfield Soil and Agrifood Institute (2018) Soilscales [online]. Accessed 31/05/2018. Available at: <http://www.landis.org.uk/soilscales/>

⁵ British Geological Survey (2017) Geology of Britain Viewer 3D [online]. Accessed 31/05/2018. Available at: <http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html?>

Deposits) and the bedrock (Oxford Clay Formation) as unproductive aquifers⁶ which are described as *“geological strata with low permeability that have negligible significance for water supply or river base flow.”*⁷

- 2.4.2 The Site is not located in a Groundwater Source Protection Zone or a Drinking Water Protected Area or Safeguard Zone.

3 THE DEVELOPMENT

3.1 Description of the Development

- 3.1.1 The Development consists of a prefabricated biopod mounted on a raised concrete platform (approximately 300mm high), which is bolted to the ground (see Plate 1). The biopod houses a single biomass boiler and a storage area for biomass (wood pellets), see Appendix 2 (page 7) for further details of a typical internal layout.
- 3.1.2 There has been no change to the extent or location of impermeable surfaces onsite as a result of the Development and therefore, no overall change to the Site’s drainage.
- 3.1.3 Deliveries of biomass occur every six weeks. The biomass boiler has been designed to automatically refuel and maintenance visits are expected to occur twice a year. There is therefore only an infrequent requirement for personnel to visit the cabin. In the unlikely event that the Site is affected by floodwater, personnel would be able to exit onto London Road, from which the centre of Spalding and the A16 (road) can be reached.
- 3.1.4 The biomass stored and used onsite consists of wood pellets (ENPlus A1), which do not constitute hazardous material. The biomass is stored in a separate compartment behind a fire safe wall, which is designed to stay dry.

⁶ MAGIC (2018) MAGIC Map Application [online]. Accessed 31/05/2018. Available at: <http://www.magic.gov.uk/>

⁷ Environment Agency (2018) Aquifer Designation Map [online]. Accessed 31/05/2018. Available at: <https://data.gov.uk/dataset/ef2399f1-acf4-45a7-abf3-c7369c0c8640/aquifer-designation-map-superficial-deposits> and <https://data.gov.uk/dataset/ca82ec72-caf6-43c2-a70d-14c173c1e48f/aquifer-designation-map-bedrock-geology>



Plate 1 Photographs of Exterior of Biopod



3.2 Vulnerability Classification

- 3.2.1 Flood zones, land use vulnerability classifications and corresponding land use compatibility with flood zones are specified in the Flood Risk and Coastal Change section of the PPG.
- 3.2.2 The EA's mapping shows that the Site lies within fluvial Flood Zone 3. According to Table 1 (above) which is taken from Table 1 of the PPG (Paragraph 065) 'Flood Zones', the Site has a 1 in 100 or greater annual probability of river flooding.
- 3.2.3 Table 2 of the PPG (Paragraph 066) 'Flood Risk Vulnerability Classification' indicates that the vulnerability class for the Development is 'Less Vulnerable'.
- 3.2.4 Table 3 of the PPG (Paragraph 067) 'Flood Risk Vulnerability and Flood Zone Compatibility' shows that this 'Less Vulnerable' development is a suitable use of land for Flood Zone 3.

3.3 The Sequential Test and Exception Test

- 3.3.1 The sequential test, as set out in the PPG, aims to steer development to areas with the lowest risk of flooding (i.e. to direct developments to Flood Zone 1 where possible). The Site is located in Flood Zone 3; however, it is a requirement of the Development that it is connected to the Care Home. There are no other suitable locations within close proximity of the Care Home that are not in Flood Zone 3. It is considered on this basis that the requirement of the sequential test has been met.
- 3.3.2 As the Development is considered to be 'Less Vulnerable,' although located in Flood Zone 3, the Exception Test is not required for the Development.

4 DRAINAGE

- 4.1.1 There has been no change to the extent of impermeable surfacing at the Site and no change to the existing drainage regime as a result of the Development. Rainfall continues to reach the drainage system operating at the Care Home and its environs.

5 FLOOD RISK

5.1 Flood Risk from External Sources

- 5.1.1 Potential sources of flooding are fluvial (rivers), tidal waters, pluvial (surface water), groundwater, sewers / drains and artificial sources such as canals or reservoirs.
- 5.1.2 An assessment of the flood risk associated with each potential source of flooding is discussed in the following sections and is summarised in Table 4.

Tidal Flooding

- 5.1.3 The local watercourses are non-tidal and the Site is not located in a coastal zone. Therefore, there is no risk of flooding from this source.

Fluvial Flooding

- 5.1.4 The Site is shown to be entirely within Flood Zone 3 (i.e. land having a 1 in 100 or greater annual probability of river flooding) as shown on the EA's flood map².
- 5.1.5 The EA has provided modelled river levels and flows for the River Welland (see Appendix 1), Table 3 provides the maximum water level and maximum flow rate for nodes located upstream and downstream of the Site for a number of annual exceedance probabilities.
- 5.1.6 The ground level at the Site is 2.7m AOD and the biopod is elevated approximately 300mm above the ground; therefore, the biopod has a floor elevation of 3.0m AOD. Although the values for maximum water level for the annual exceedance probabilities are typically 1.5m above the biopod's estimated floor level, there are areas of higher ground (approximately 4.5-5m AOD) and a number of buildings and roads (which are likely to have drainage systems) located between the Site and the River Welland, which may reduce the velocity and extent of any flooding.

Table 3 Max Modelled Water Levels and Flow Rate for the River Welland				
Annual Exceedance Probability	Max Water Level (m ODN)		Max Flow (m³/s)	
	Upstream Node: Welland 15724	Downstream Node: Welland 15344	Downstream Node: Welland 15534	Upstream Node: Welland 15220.5
50% (1 in 2 yrs)	3.69	3.68	61.39	61.82
1% (1 in 100 yrs)	4.52	4.51	114.41	113.08
0.5% (1 in 200 yrs)	4.53	4.52	114.28	114.22
0.1% (1 in 1000 yrs)	4.54	4.54	113.66	113.66

- 5.1.7 Hill's Drain lies approximately 55m north-west of the Site. As this drain is not an EA designated 'main river', flood levels and flow rates have not been modelled by the EA for this watercourse. The base of ditch has been estimated from LIDAR DTM data to be at approximately 1.3m AOD, while the bank top closest to the Site is at approximately 2.8m AOD, with the ground levels rising to approximately 3m AOD closer to the Site. As discussed in para 5.1.6, the biopod's floor level is approximately 3m AOD and therefore above the height of the bank top. The drain is also located approximately 55m from the Site, which also reduces the risk of flood waters from the drain reaching the Site.

- 5.1.8 The South East Lincolnshire Strategic Flood Risk Assessment's Update of Strategic Flood Risk Assessment maps do not show that the Site is at risk of tidal or fluvial flooding.⁸
- 5.1.9 The EA's flood map, which takes into account the presence of flood defences¹ puts the Site in the 'Very Low' risk category⁹; however, this classification does not take into account if the flood defences are overtopped or fail. The EA has reported (Appendix 1) that *"the fluvial defences reducing the risk of flooding to this site consist of flood embankments and flood storage reservoirs. They are in fair condition and reduce the risk of flooding to a 1% (1 in 100) chance of occurring in any year."*
- 5.1.10 In the event that floodwaters were to enter the biopod, the fire safe wall separating the biomass storage area from the rest of the internal cabin would prevent water from mixing with the biomass and, therefore, the release of the biomass into the floodwaters and offsite drainage systems.
- 5.1.11 The risk of fluvial flooding to the Development is considered to be high. However, as discussed in Section 3.2, although the Site is located in Flood Zone 3 the development type is 'Less Vulnerable'; therefore, according to Table 3 of the PPG the development is acceptable.

Groundwater Flooding

- 5.1.12 Groundwater flooding can occur when groundwater levels rise up through permeable strata and exceed ground levels. The presence of the impermeable asphalt surface beneath the biopod will prevent groundwater from reaching the ground surface and causing flooding. Therefore, it is considered that the risk of groundwater flooding is low.

⁸ South East Lincolnshire Joint Planning Unit (2017) South East Lincolnshire Strategic Flood Risk Assessment [online]. Accessed 04/06/2018. Available at:
Report: https://www.sholland.gov.uk/media/7937/South-East-Lincolnshire-SFRA-Report-March-2017-including-guidance-on-applying-the-Sequential-Test-for-planning-applications-/pdf/SE_Lincolnshire_SFRA_2017_v6.pdf

Appendix A: <http://www.southeastlincslocalplan.org/south-east-lincolnshire-strategic-flood-risk-assessment-march-2017-appendix-a-fluvial-tidal-hazard-mapping/>

Appendix B: <http://www.southeastlincslocalplan.org/south-east-lincolnshire-strategic-flood-risk-assessment-march-2017-appendix-b-fluvial-tidal-depth-mapping/>

Appendix C <http://www.southeastlincslocalplan.org/south-east-lincolnshire-strategic-flood-risk-assessment-march-2017-appendix-c-standing-advice-other-maps/>

⁹ Environment Agency (2018) Long term flood risk information: Learn more about the ways we describe flood risk [online]. Accessed 01/06/2018. Available at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/risk-types>

Flooding from Sewers and Drains

5.1.13 Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system or water main, exceeds its discharge capacity or the drain is blocked by debris or high water levels in a receiving watercourse. As there has been no change to the extent of impermeable surfacing onsite there has been no change to the peak or volume of runoff reaching sewers / drains. In addition, during installation there was no requirement to remove or alter the impermeable asphalt surfacing (i.e. no groundworks); therefore, there is limited potential for flow from burst pipes to reach the Site. Therefore, the risk to the Site from this source is considered to be low.

Pluvial Flooding (Surface Water Flooding)

5.1.14 On land where there is an impermeable surface or where the ground infiltration capacity is exceeded by rainfall, there is the potential for ponding of surface water runoff, which can lead to localised flooding.

5.1.15 According to the EA's surface water flood map¹, there is an area at Low Risk of pluvial flooding within the Site, with a flood depth of less than 300mm and a flood velocity of less than 0.25m/s. Therefore, surface water has the potential to accumulate at the Site.

5.1.16 The biopod is elevated 300mm above the hard surfacing which benefits from a drainage system. Therefore, the risk of flooding to the Development from this source is considered to be low.

Flooding from Artificial Sources

5.1.17 The EA's 'flood risk from reservoirs' map¹ shows that the Site is at risk of flooding from reservoirs. At the Site the flood depth is modelled to be between 0.3 to 2m while the flood speed is modelled to be between 0.5 and 2m/s. The nearest reservoirs is Rutland Water located at NGR SK 91289 06387 and lies approximately 32km southwest of the Site. However, as the EA state *"if a location is at risk, flooding from reservoirs is extremely unlikely [due to stringent design standards adopted in reservoir construction and operation]. There has been no loss of life in the UK from reservoir flooding since 1925. An area is considered at risk if peoples' lives could be threatened by an uncontrolled release of water from a reservoir."*⁹

5.1.18 Therefore, it is considered that the risk flooding from artificial sources is medium.

Summary

Table 4 Sources of Flood Risk to the Site			
Flood Source	Potential Presence at the Site?	Potential Risk	Description
Tidal	No	None	The local rivers are non-tidal and the Site is not located in a coastal zone. The Site is not affected by tidal water.
Fluvial	Yes	High	The Site is shown to be within Flood Zone 3.
Groundwater	Yes	Low	Asphalt surfacing will prevent groundwater from reaching the ground surface and causing flooding.
Sewers and Drains	Yes	Low	Impermeable surfacing would prevent water from a burst pipe from reaching the Site. There has been no change to the extent of impermeable surfaces onsite and therefore no change to the amount of water discharging to receiving drains / sewers.
Pluvial (Surface Water)	Yes	Low	The Site is at low risk of surface water flooding according to the EA's map. ¹ The elevated position of the biopod and the surface water drainage system would provide a degree of mitigation for any flood event.
Artificial Sources	Yes	Medium	Site is at risk of flooding from reservoirs according to the EA map ¹ .

5.2 Flood Risk from the Development

- 5.2.1 As there has been no change to the extent of impermeable surfaces onsite it is not expected that the Development would contribute to offsite flooding risk.

Floodplain Storage

- 5.2.2 Although the Development is located in Flood Zone 3 (land having 1 in 100 or greater annual probability of river flooding), it is located approximately 55m from Hill's Drain and 430m from the River Welland. There has been no change to the extent of impermeable surfaces or ground levels within the floodplain. Therefore, there has been no change to the flood storage capacity of the floodplain and there is no need for any compensatory floodplain storage.

6 RESIDUAL RISKS

- 6.1.1 There is always a possibility of a flood in excess of that allowed for, which might conceivably cause flooding to the Development. However, such an event would have a very low probability of occurrence and the risk of flooding to the Development is, therefore, also considered to be extremely low.

7 SUMMARY AND CONCLUSION

- 7.1.1 This report gives details of the Flood Risk Assessment, which has been carried out in relation to the Development.
- 7.1.2 The Development is located in fluvial Flood Zone 3 (land having 1 in 100 or greater annual probability of river flooding). However, fluvial defences (flood embankments and flood storage reservoirs) reduce the risk of flooding to the Site. The EA has reported that the fluvial defences are in fair condition and reduce the risk of flooding to a 1% (1 in 100) chance of occurring in any year. The risk of flooding to the Development from tidal flows is considered to be absent. The risk of flooding to the Development from sewers and drains, pluvial (surface water) and groundwater is considered to be low. The risk of flooding from artificial sources (reservoirs) is considered to be medium, while the risk of fluvial flooding (rivers) is high.
- 7.1.3 There has been no change to the extent or location of impermeable surfaces onsite as a result of the Development and, therefore, no overall change to the Site's drainage. There is an infrequent requirement for personnel to visit the cabin. In the unlikely event that the Site is affected by floodwater, personnel would be able to exit onto London Road, from which the centre of Spalding and the A16 (road) can be reached.
- 7.1.4 The biomass stored and used onsite consists of wood pellets, which do not constitute hazardous material. The biomass is stored in a separate compartment behind a fire safe wall, which is designed to stay dry.
- 7.1.5 The vulnerability class of the Development is 'Less Vulnerable.' Table 3 of the Planning Practice Guidance (Paragraph 067), indicates that such developments are suitable for sites classified as Flood Zone 3.
- 7.1.6 As there has been no change to the extent of impermeable surfaces at the Site or to floodplain storage, it is considered that there would be no discernible increase in flood risk on or off the Site as a result of the Development. The Site is, therefore, considered suitable, in terms of flood risk, for the development.