CHAPTER 12 - FLOOD RISK ASSESSMENT AND OUTLINE DRAINAGE STRATEGY (2015)

Executive Summary

Purpose of this report

GA Pet Food Partners operates a pet food manufacturing, storage and distribution facility at Plocks Farm, Liverpool Road, Tarleton, Lancashire PR26 9AX. The company has recently prepared a five yearly update to its ten year development plan, which revises and outlines all aspects of continued development at the site up to 2025.

This Flood Risk Assessment has been prepared to accompany a planning application for Plock’s Farm, covering the proposed new development in the updated ten year development plan. It provides an up-dated and revised assessment to that found in Chapter 12: Flood Risk Assessment of the existing Environmental Statement, Planning Application Reference 9/03/00528/FULMAJ and is prepared in accordance with the National Planning Policy Framework.

The proposed development is for the expansion of the existing facility to include a new Ingredients Kitchen, Larder, Fridge and Meat Kitchen and associated hardstanding. The total impermeable built footprint of the site would be increased by around 4.97 ha to 9.97 ha.

The proposal site is located on the banks of the River Douglas and falls within Flood Zones 1, 2 and 3 as identified by the Environment Agency Flood Risk Map for Planning (from Rivers and the sea). As it sits behind raised embankments the defined Flood Zone 3 areas constitute defended floodplain. The Environment Agency have provided revised estimates of flood levels from both river and tidal sources, which indicate maximum in-channel levels of 5.91 m AOD under the 1 in 1000 year fluvial event and 6.55 m AOD associated with the 1 in 200 year plus climate change event. These flood levels are below the proposed embankment crest level of 7.00 m AOD, which will be raised under the development works. Flooding from fluvial, artificial sources, groundwater and surface water have also been considered. Overall, findings from the report indicate a low actual risk of flooding to the site from all of the above sources. A residual risk of flooding remains under a defence failure scenario.

Appropriate flood resistant and resilient design measures have been outlined, following consultation with the Environment Agency and the Lancashire County Council. These include raising threshold levels of the buildings to 1.00 m above the existing site ground level. This would give a freeboard of 0.70 m against the Environment Agency recommended residual risk flood level of 0.30 m in the event of a defence breach. Furthermore, an outline flood evacuation plan has been provided to ensure the safety of all personnel on site.

Measures to upgrade the existing on-site drainage system to manage surface water from impermeable surfaces have also been detailed as part of the report. Specifically this includes the incorporation of a new rainwater harvesting system to allow for the control of runoff at source and to promote greywater re-use within the site. In the event of drainage system failure, whether from capacity exceedance, blockage or pump failure, it has been demonstrated that the site has sufficient capacity in low-lying areas to safely store excess water.

In summary, this Flood Risk Assessment demonstrates that the site is at a low risk of flooding from all sources and includes measures to manage the residual risk. The proposed development would not result in an increased risk of flooding to the site or to land outside of its boundary. Subsequently, the overall scope of the development works can be identified as being compatible with the National Planning Policy Framework.

Matthew Ross

Bill Finlinson

CONTENTS
Chapter 12 Flood Risk Assessment and Drainage Strategy

12.1 INTRODUCTION
12.1.1 Context
12.1.2 Sources of Data and Consultation
12.1.3 Report Structure

12.2 SITE AS EXISTING, DEVELOPMENT PROPOSAL AND PLANNING CONTEXT
12.2.1 Site as Existing
12.2.2 Development Proposal
12.2.3 Planning Context

12.3 FLOOD RISK ASSESSMENT
12.3.1 Overview of Flood Risk
12.3.2 Records of Historic Flooding
12.3.3 Fluvial and Tidal Flood Risk
12.3.4 Flood Risk from Artificial Sources
12.3.5 Surface Water Flood Risk and Drainage System Failure
12.3.6 Groundwater Flood Risk
12.3.7 Summary of Flood Risk

12.4 FLOOD RISK MITIGATION
12.4.1 Flood Resistant and Resilient Measures
12.4.2 Flood Evacuation Plan

12.5 SITE DRAINAGE ASSESSMENT
12.5.1 Overview of Site Drainage and Scope of Design
12.5.2 Existing Site Drainage System
12.5.3 Outline Drainage Strategy
12.5.4 Design for Drainage System Exceedance
12.5.5 Southern High Risk Yard Area
12.5.6 Summary of Proposed Site Drainage System

12.6 CONCLUSION

12.7 REFERENCES

Table 12.1 Consultees
Table 12.2 Flood Zones
Table 12.3 Flood Risk Vulnerability Classification
Table 12.4 Flood Risk Vulnerability and Flood Zone ‘Compatibility’
Table 12.5 Potential Sources of Flooding
Table 12.6 Summary of Site Modelled Flood Levels
Table 12.7 EA Risk of Flooding from Surface Water Categories
Table 12.8 EA Floodline Flood Warning Stages
Table 12.9 Existing Drainage System Capacity
Table 12.10 Drainage System Failure Scenario

Figure 12.1 EA Flood Zone Map for Planning (Rivers and Sea)
Figure 12.2 EA Risk of Flooding from Surface Water flood map

Appendix A Copy of the Existing Entec Flood Risk Assessment Environmental Statement Chapter (2009)
Appendix B Relevant Correspondence with Consultees
Appendix C Site Location Plan
Appendix D Site Topographic Survey
Appendix E Existing Site Layout Plan and Proposed Development
Appendix F Proposed Site Layout Plan and Elevations
Appendix G Environment Agency Product 4 Flood Risk Mapping Dataset
Appendix H Environment Agency Flood Defence Consent Application
Appendix I High and Low Risk Drainage Areas
Appendix J Windes 2013 Drainage Calculations
12.1 INTRODUCTION

12.1.1 Context

GA Pet Food Partners (GA) operates a pet food manufacturing, storage and distribution facility at Plocks Farm, Liverpool Road, Tarleton, Lancashire PR26 9AX.

The company has recently prepared a five yearly update to its ten year development plan, which revises and outlines all aspects of continued development at the site up to 2025. This plan seeks to extend the footprint of the built development within the existing site area. With regards to this flood risk assessment the development includes six key elements:

- 1. Construction of a 6,500 m² extension to an approved warehouse to form a raw materials Larder;
- 2. Replacement of an existing warehouse with a 1,200 m² Ingredients Kitchen;
- 4. Installation of a Combined Heat and Power Plant (CHPP);
- 5. Construction of an Anaerobic Digester to treat liquid waste arising from the site.
- 6. Repairs to the embankment flanking the River Douglas alongside the site to improve flood protection. A separate Flood Defence Consent (FDC) application covering these works has been submitted to, and approved by the Environment Agency (EA);
- 7. Relocation of an approved office and creation of a secure car park on-site.

The site covers all three Flood Risk Zones as defined by the EA Flood Map for Planning (from Rivers and the sea). The majority of the site can be classified as Flood Zone 1, whilst the western third, adjacent to the River Douglas, falls in Flood Zone 2. A smaller proportion of the site to the north constitutes defended Flood Zone 3.

Amec Foster Wheeler was commissioned to produce a Flood Risk Assessment (FRA) and Water Sustainability Review (WSR) for the proposed development. The FRA (this chapter) provides an update of an earlier FRA Chapter produced by Entec (now Amec Foster Wheeler) in 2009 for the previous ten year development plan. A copy of the Entec FRA Chapter is provided in Appendix A of this report.

This chapter includes an assessment of flood risk from all sources and an outline plan for sustainable drainage, in accordance with the National Planning Policy Framework (NPPF) and other relevant documents that have been published since issue of the earlier report in 2009.

12.1.2 Sources of Data and Consultation

The main consultees approached when compiling this report are largely the same as those consulted for the 2009 FRA:

The EA was approached to comment on the proposed development and to provide relevant flood risk advice in the form of river and tidal modelling data and to review the proposed flood resistant and resilient design measures. An EA Product 4 flood risk dataset was obtained including fluvial flood risk maps derived from the River Ribble Strategic Flood Risk Mapping model (SFRM, 2010) and up-to-date tidal flood maps (2014);

As Lead Local Flood Authority (LLFA), Lancashire County Council was consulted to provide LLFA requirements regarding the proposed drainage strategy;

The Canal River Trust was also contacted with regards to potential flood risk to the site originating from the Leeds and Liverpool Canal (Rufford Branch).

Table 12.1 provides a summary of the consultees and the information and/or data provided.
Table 12.1 Consultees

<table>
<thead>
<tr>
<th>Consultee</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency (EA)</td>
<td>Initial advice on the FRA</td>
</tr>
<tr>
<td></td>
<td>Flood modelling data and levels for the development proposals</td>
</tr>
<tr>
<td></td>
<td>Advice on requirements for finished floor levels</td>
</tr>
<tr>
<td>Lancashire County Council</td>
<td>Pre-application advice on drainage proposals</td>
</tr>
<tr>
<td>Canal River Trust</td>
<td>Advice on the potential flood risk from the Leeds and Liverpool Canal (Rufford Branch)</td>
</tr>
</tbody>
</table>

12.1.3 Report Structure

12.1.3.1 The flood risk assessment is structured as follows:

- Section 12.2 – provides a description of the site as existing, the development proposal and the planning context;
- Section 12.3 – summarises and assesses the flood risk to the site from all sources;
- Section 12.4 – outlines flood risk management and mitigation measures incorporated into the proposal;
- Section 12.5 – comprises a drainage assessment with calculated storage volumes;
- Section 12.6 – provides recommendations and conclusions;

12.1.3.2 There are several appendices supplied with this FRA as follows:

- Appendix A – Copy of the existing Entec Flood Risk Assessment Environmental Statement Chapter (2009)
- Appendix B – Relevant Correspondence with Consultees
- Appendix C – Site Location Plan
- Appendix D – Site Topographic Survey
- Appendix E – Existing Site Layout Plan and Proposed Development
- Appendix F – Proposed Site Layout Plan and Elevations
- Appendix G – Environment Agency Product 4 Flood Risk Mapping Dataset
- Appendix H – Environment Agency Flood Defence Consent Application
- Appendix I – High Risk and Low Risk Drainage Areas
- Appendix J – Windes 2013 Drainage Calculations
12.2 SITE AS EXISTING, DEVELOPMENT PROPOSAL AND PLANNING CONTEXT

12.2.1 Site as Existing

12.2.1.1 The proposal site is located off Liverpool Road (A59) near Tarleton, approximately 10km southwest of Preston and 9.8km northeast of Southport. The site lies within a meander bend of the River Douglas and is surrounded by large, fields on both sides of Liverpool Road (A59). To the eastern side of the road there are a few residential properties that are set within large plots of land. A site location plan is provided in Appendix C, with the planning application boundary being highlighted by the red line.

12.2.1.2 The planning authority for the site and wider surrounding area is Chorley Council although, as aforementioned, Lancashire County Council (LCC) is the Lead Local Flood Authority (LLFA) for the County’s administrative area. Water and sewerage services are managed by United Utilities.

12.2.1.3 The site itself covers approximately 28.50 ha and is set within the 1000.00 ha landholding of Plock’s Farm. The western and southern extents of the site are bordered by the River Douglas, whilst the eastern side is flanked by Liverpool Road (A59). The northern end of the site gives way to fallow agricultural land, interrupted by the Carr Brook, which flows from east to west before discharging into the River Douglas.

12.2.1.4 Site topography is characterised by two distinct areas: a relatively flat expanse of land around 5.00 m AOD to the west, closest to the River Douglas and an area of higher ground to the east which sits at around 8.00 to 9.50 m AOD. The channel of the River Douglas is separated from the area of lower ground by an extensive flood embankment that runs along the length of the river. Elevations of the embankment crest range from around 6.32 m AOD to around 6.97 m AOD at its highest point. An up-to-date topographic survey of the site is provided in Appendix D of this report and shows contour lines at 1.00 m intervals.

12.2.1.5 The site is currently used for industrial purposes in the form of a pet food manufacturing facility. The total built development of around 5.00 ha covers approximately 17.5% of the overall site area (28.50 ha). This is composed of a roofed area of around 2.70 ha and hardstanding of roughly 2.30 ha. Main buildings on the site include a mill, product store and extraction corridor (wet scrubber). Other significant built footprint on the site includes a purpose built Effluent Treatment Plant (ETP). This is used for treatment and recycling of rain water from yards and roofs, as well as waste water generated in the production process. The waste water system comprises a system of bio-beds and a lagoon, which is located close to the southern curtilage of the site. Areas of hardstanding include open air storage of materials. An existing site layout plan is provided in Appendix E. Annotations on the site layout plan show the locations of existing buildings, proposed buildings that already have planning approval and additional development as proposed by the current planning application.

12.2.1.6 Existing use of the site would fall under land use class B2 (general industrial) of the Town and Country Planning (Use Classes) Order 1987, as an express permission between GA and Chorley Council.

12.2.2 Development Proposal

12.2.2.1 The development proposal is for the erection of several new buildings in order to increase plant production. This includes a 6,503 m2 extension to an approved warehouse building to form a new raw materials Larder, the replacement of an existing warehouse with a 1,207 m2 Ingredients Kitchen, the construction of a 5,677 m2 Meat Kitchen and a new car park covering 4,640 m2. A proposed site layout plan is provided in Appendix F. It is understood that GA also intend to install an Anaerobic Digestion Plant (ADP) facility to the north of the Raw Material Store, although the proposed ADP is not shown on the proposed plans.

12.2.2.2 The increased built footprint under development would be roughly 4.97 ha, which would comprise a new roofed area of around 3.28 ha and hardstanding of 1.69 ha. Post-development, this would give a total built footprint of 9.97 ha when added to the existing impermeable area (5.00 ha).
12.2.2.3 Notably, the increased area of the development would be largely impermeable. It is proposed that the current rainwater harvesting system is extended to capture surface runoff at source and to promote greywater re-use to minimise importation of mains water. This would allow for the sustainable management of surface water on site. Drainage calculations are included in Section 12.5 of this report.

12.2.2.4 The development includes proposals to carry out repairs to the existing flood embankment adjacent to the River Douglas and ultimately to improve the defended flood level of the site by raising the embankment. A separate Flood Defence Consent Application (Reference Number NW_L_2014_191) for these works has been submitted and approved by the EA.

12.2.2.5 The proposed development would fall within the existing land use classes of the site, as outlined in sub-section 12.2.1.6. There would be no increased flood risk vulnerability due to change of land use.

12.2.3 Planning Context

12.2.3.1 Since 2009 the NPPF has replaced Planning Policy Statement 25: Development and Flood Risk as the policy guidance for flood risk in relation to new development. It states that flood risk assessments are required for development on the floodplains of rivers, sites potentially subject to coastal flooding and for developments over 1.00 ha in size. Flood risk assessments should outline whether the proposed development is likely to be affected by current or future flooding and whether it has the potential to increase flood risk elsewhere. The assessment should then demonstrate how flood risk will be managed, both in the present day and over the lifetime of the development when accounting for climate change. This should include a demonstration that the development will not increase flood risk elsewhere.

12.2.3.2 The online Environment Agency Flood Zone Map for Planning (Rivers and Sea) is provided in Figure 12.1, with the site outlined highlighted in red. It shows the main body of the site adjacent to Liverpool Road (A59) can be classed as Flood Zone 1, with a low annual probability of flooding. The south eastern and western third of the site is highlighted as Flood Zone 2 – the medium probability risk area and roughly a quarter of the site is Flood Zone 3 – Area Benefitting from Defences (ABD). There is a small area of undefended Flood Zone 3 to the north of the site. Flood Zone definitions are provided in Table 12.2 below.
Table 12.2  Flood Zones¹

<table>
<thead>
<tr>
<th>Flood Zone</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Zone 1</td>
<td>The low probability flood risk area. Land with an annual probability of flooding from rivers or the sea less than 1 in 1000.</td>
</tr>
<tr>
<td>Flood Zone 2</td>
<td>The medium probability flood risk area. Land with an annual probability of river flooding between 1 in 100 and 1 in 1000; or with between a 1 in 200 and 1 in 1000 annual probability of sea flooding.</td>
</tr>
<tr>
<td>Flood Zone 3a</td>
<td>The high probability flood risk area Land having a 1 in 100 or greater annual probability of river flooding; or a 1 in 200 or greater probability of sea flooding.</td>
</tr>
<tr>
<td>Flood Zone 3b</td>
<td>The active floodplain – land where water has to flow or be stored in times of flood</td>
</tr>
</tbody>
</table>

¹ Taken from Table 1: Flood Zones of the NPPF online flood risk matrix
12.2.3.3 Under the Flood Risk Vulnerability Classification table of the NPPF online flood risk matrix (reproduced in Table 12.3 below) the site as existing would be classified as being ‘less vulnerable’ to flooding. This classification would not be changed following the proposed development.

Table 12.3 Flood Risk Vulnerability Classification

<table>
<thead>
<tr>
<th>Land use and Vulnerability</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Infrastructure</td>
<td>Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility and infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.</td>
</tr>
<tr>
<td>Highly Vulnerable</td>
<td>Police and ambulance stations; fires stations and command centres; telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as ‘Essential Infrastructure’).</td>
</tr>
<tr>
<td>More Vulnerable</td>
<td>Hospitals. Residential institutions such as residential care homes, children’s homes social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non-residential uses for health services, nurseries and educational establishments. Landfill* and sites used for waste management facilities and hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.</td>
</tr>
</tbody>
</table>

2 Reproduced from Table 2: Flood Risk Vulnerability Classification of the NPPF online flood risk matrix
### Less Vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the ‘More vulnerable’ class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewerage during flooding events are in place.

### Water-Compatable Development

- Flood Control Infrastructure
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastal stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports such as recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

* Landfill is as defined in Schedule 10 to the Environmental Permitting (England and Wales) Regulations 2010.

12.2.3.4 Table 12.4: Flood Risk Vulnerability and Flood Zone ‘Compatibility’ illustrates that ‘less vulnerable’ infrastructure is compatible with all Flood Zones apart from Flood Zone 3b (the active floodplain). As the site comprises Flood Zone 1, Flood Zone 2 and defended Flood Zone 3 (Flood Zone 3a) it can therefore be deemed compatible with the requirements of the NPPF. Furthermore, a sequential approach to the design and layout of the proposed development within the site has been made.
Chapter 12 Flood Risk Assessment and Drainage Strategy (Amec Foster Wheeler)

Table 12.4 Flood Risk Vulnerability and Flood Zone ‘Compatibility’

<table>
<thead>
<tr>
<th>Flood Zones</th>
<th>Essential infrastructure</th>
<th>Highly vulnerable</th>
<th>More vulnerable</th>
<th>Less Vulnerable</th>
<th>Water compatible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Zone 1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flood Zone 2</td>
<td>✓</td>
<td>Exception Test required</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flood Zone 3a</td>
<td>Exception Test required</td>
<td>×</td>
<td>Exception Test required</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flood Zone 3b*</td>
<td>Exception Test required</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>

12.2.3.5 Additional flood zone maps for the Bretherton area are provided in Appendix C-3 of the Central Lancashire Strategic Flood Risk Assessment Level 1 (SFRA, 2007). The map shows the proposal site to be located entirely within Flood Zone 3b, the functional floodplain. However, this broad-scale mapping is based on modelled 1 in 25 year flood levels only. In those areas where no levels were available, including the site at Plock’s farm, all areas of Flood Zone 3 were conservatively upgraded to Flood Zone 3b. Moreover, the SFRA (2007) maps have since been superseded by the Environment Agency Flood Map for Planning (Rivers and Sea) which is provided in Figure 12.1 of this report. This map represents the most up-to-date modelling of the site area.

12.2.3.6 Finally, it should be noted that due to the presence of flood defences adjacent to the banks of the site, water is actively excluded from the area behind the defences (i.e. the site). The area behind these structures should not be defined as functional floodplain.

3 Reproduced from Table 3: Flood Risk Vulnerability and Flood Zone ‘Compatibility’ of the NPPF online flood risk matrix.
12.3 FLOOD RISK ASSESSMENT

12.3.1 Overview of Flood Risk

12.3.1.1 The potential sources of flooding that are assessed as part of this report are summarised in Table 12.5. This revised list corresponds with that in the previous FRA (Entec, 2009):

Table 12.5 Potential Sources of Flooding

<table>
<thead>
<tr>
<th>Flood Source</th>
<th>Risk Identified</th>
<th>Source</th>
<th>Pathway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluvial</td>
<td>Yes</td>
<td>River Douglas/Carr Brook</td>
<td>River</td>
</tr>
<tr>
<td>Tidal</td>
<td>Yes</td>
<td>River Douglas</td>
<td>River</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Yes</td>
<td>Tidally influenced sands and silts underlie the site</td>
<td>Ground</td>
</tr>
<tr>
<td>Sewers</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Yes</td>
<td>Risk of surface water runoff due to impervious surfaces on site</td>
<td>Overland</td>
</tr>
<tr>
<td>Artificial Sources</td>
<td>Yes</td>
<td>Leeds and Liverpool Canal (Rufford Branch).</td>
<td>River</td>
</tr>
</tbody>
</table>

12.3.2 Records of Historic Flooding

12.3.2.1 The SFRA (2007) documents historic instances of flooding within the River Douglas catchment area. Appendix F: Records of Historic Flooding (SFRA, 2007) details one instance of historic flooding along the River Douglas/Carr Brook within the Leyland Area. In August 1987 industrial units on Mill Lane were affected when a culvert was overwhelmed along Swansey Lane; following this flood alleviation works were implemented along Carr Brook, the culvert was modified and a bypass channel created. The SFRA (2007) records do not indicate whether the proposal site was affected, however, based on site specific flood records obtained from GA this is not believed to have been the case.

12.3.2.2 The Lancashire and Blackpool Flood Risk Management Strategy 2014-2017 (LBFRMS, 2014) provides information on more recent flood events: in June 2012 heavy rain resulted in river flooding of 15 properties in Leyland; in September 2012 heavy rain resulted in localised surface water flooding, as well as surcharging of ordinary watercourses and culverts. Like the 1987 flood, it is not believed that the proposal site was severely affected by this flood event.

12.3.2.3 Specific to the site, in winter 2013 there was a small breach of the embankment caused by tidal overtopping of a section of the flood embankment. This resulted in isolated flooding within the lower part of the site but this was not extensive. This overtopping event stimulated the review of the existing defences and the subsequent works outlined as part of the current development proposal.
Prior to this the site had not flooded due to overtopping for 56 years, as noted in the previous FRA (Entec, 2009).

12.3.2.4 Appendix D: United Utilities DG5 Data of the SFRA (2007) illustrates sewer flooding incidents between October 2006 and April 2007. The External DG5 data register indicates 1-2 incidents within the wider site area, whilst the internal DG5 Register indicates 2-3 incidents. As noted in the SFRA (2007), the rural nature of the region and the data format makes it difficult to identify specific areas of flooding. However, the proposal site is not served by or located adjacent to a public sewer; the nearest sewer is at North Road, roughly 1.00 km to the east of the site. By virtue of the distance of the site from the sewer, any associated flooding from this source is very unlikely to affect the site.

12.3.3 Fluvial and Tidal Flood Risk

12.3.3.1 Actual Risk of Flooding

The primary risk of fluvial (river) or tidal flooding to the site comes from the River Douglas, which flows from south to north, and meanders around the western end of the site before meeting the River Ribble 6 km downstream. Accordingly, the main risk of tidal flooding comes from downstream, whereas the biggest threat of fluvial flooding is from upstream.

The Carr Brook, a smaller tributary that drains into the River Douglas to the north of the site, poses a secondary risk of flooding from both fluvial and pluvial sources. However, the presence of a tidal flap acts to prohibit floodwaters from propagating upstream and on to the main body of the site. A further source of flood risk is presented by an unnamed brook that flows within the southern part of the site before being culverted under the site and into the Douglas. However, the site topography generally slopes toward the watercourse and there is an embankment either side of the channel. Channel capacity exceedance (i.e. overtopping) would result in small-scale, localised flooding. It can be considered a secondary source of flooding to that from the River Douglas or the Carr Brook.

As indicated in sub-section 12.2.3.6 the proposal site is at a low actual risk of fluvial or tidal flooding from the River Douglas because of the presence of the main flood embankment that runs along the length of the river within the site boundary. This embankment is partially depicted as a dashed pink line on the Environment Agency Flood Map for Planning (Rivers and Sea). A footnote to the flood map states that not all defences may be shown but the defence asset locations are continually being updated. This may explain why the full extent of the defences is not displayed on the current version of the online flood map.

Detailed Environment Agency Product 4 Flood Risk Mapping Data (referred to hereafter as EA Product 4 data) for the River Douglas at Tarleton has been obtained from the EA for as part of this report and is attached in Appendix G. It includes a Fluvial Flood Level Map, Tidal Flood Level Map, Flood Defence Asset Location Map and Flood Defence Data. This represents the most detailed available flood modelling data for the site and provides considerable betterment over the data available for the previous FRA (Entec, 2009).

The Fluvial Flood Risk Map (in Appendix G) represents the best available mapping of the site area and is at higher resolution than the Environment Agency Flood Map for Planning (Rivers and Sea). The flood zone extents of the Fluvial Flood Risk Map are broadly coincident with those of the Environment Agency Flood Map for Planning (Rivers and Sea). However, the Fluvial Flood Risk Map includes detailed flood levels for a range of return period events.

Flood levels provided in the table within the Fluvial Flood Risk Map (Appendix G) represent in-channel flood levels (in m AOD) for several model node points along the River Douglas taken from the SFRM (2010). Node Point 1 is the closest upstream point to the site and gives the highest values; it represents the maximum modelled flood risk to the site and is therefore the most relevant in context of this report. Under an undefended scenario (i.e. if flood defences were not present) the 1 in 100 year plus climate change (Q100+CC) return period would result in a flood level of 5.03 m AOD, the tidal 1 in 200 year (Q200) event would give a level of 4.95 m AOD and the 1 in 1000 year (Q1000) event would reach 5.44 m AOD.
12.3.3.7 Under the defended flood scenario, the flood levels are higher than in the undefended scenario as the model accounts for the presence of defences, constraining water within the river channel. For the same Node Point, defended scenario flood levels of 5.82 m AOD, 5.81 m AOD and 5.92 m AOD would be associated with the Q100+CC, Q200 and Q1000 events, respectively. This would represent the actual flood risk to the site when accounting for defences.

12.3.3.8 The Tidal Flood Level Map (in Appendix G) indicates tidal flood levels (m AOD) from the most recent EA model. Undefended tidal flood levels for the site range from 5.11 m AOD in the ABD under the 1 in 100 year tidal event (T100) and up to 5.73 m AOD under the 1 in 200 year plus climate change event (T200+CC). For the defended scenario the maximum downstream flood level would be 6.55 m AOD under the T200+CC.

12.3.3.9 The Flood Defence Asset Location Map (reference CL4416SR) shows relevant infrastructure within the site vicinity. Specifically it displays the flood embankments (red line) either side of the River Douglas. It also indicates two tidal outfalls within the site area which are shown as purple circles: one to the north along the Carr Brook and one to the south along the River Douglas. All are designed for the 1 in 100 year fluvial flood event (1% Annual Exceedance Probability, or AEP) event and are rated with a condition grade 3. This indicates a higher standard of defence than assumed by the previous FRA (Entec, 2009). Assets are rated from Excellent (1) to Very Poor (5). The assigned rating indicates that the defences are in a moderate state of repair.

12.3.3.10 A summary of defended flood levels for the fluvial and tidal flood events is provided in Table 12.6. It shows that all of the modelled flood levels would be contained within the river channel under a present day flood scenario due to the presence of the flood defences. Ultimately, this means that there is a low actual risk of flooding to the site in the present day. However, the T200+CC flood level (6.55 m AOD) may overtop some areas of the flood embankment which sit at around 6.32 m AOD. In addition to this, there is a residual risk of flooding should the defence be breached, either through failure of the embankment or by overtopping.

<table>
<thead>
<tr>
<th>Event Return Period</th>
<th>Fluvial Flood Level (m AOD)</th>
<th>Tidal Flood Level (m AOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 100 year</td>
<td>--</td>
<td>5.71</td>
</tr>
<tr>
<td>1 in 100 year +CC</td>
<td>5.82</td>
<td>--</td>
</tr>
<tr>
<td>1 in 200 year</td>
<td>5.81</td>
<td>5.84</td>
</tr>
<tr>
<td>1 in 200 year +CC</td>
<td>--</td>
<td>6.55</td>
</tr>
<tr>
<td>1 in 1000 year</td>
<td>5.91</td>
<td>6.10</td>
</tr>
</tbody>
</table>

12.3.3.11 When compared with the flood maps and levels provided in the previous FRA (Entec, 2009) of 6.91 m AOD for the 0.5% AEP tidal event and 7.02 m AOD for the 0.1% AEP, the Product 4 data indicates that the new flood levels have been revised downwards. Consultation with the EA has confirmed that this is due to enhancements in the mapping process and the availability of higher resolution mapping.

**Residual Risk of Flooding**

12.3.3.12 Defence breach modelling is not provided as part of the EA Product 4 dataset. Correspondence with Ian Caunce of the EA (included in Appendix B) has revealed that this has not yet been undertaken for the River Douglas adjacent to the site. Furthermore the EA states that in the event of a breach:
‘... flood levels would depend on various factors such as the size of the breach, timing of the breach on the flood hydrograph, and the duration of the flood. All of these factors will vary the spillage volume on to the food plain and therefore dictate water level.'

In the absence of modelled breach data, the EA has conservatively prescribed that building threshold levels should be placed a minimum of 0.3 m above existing ground level in those low-lying areas of the site (at 5.00 m AOD) that are at risk of flooding from an embankment breach.

12.3.13 Appropriate flood resistant and resilient design to mitigate the residual risk of flooding for the proposed development will be outlined in Section 12.4 of this report.

12.3.14 Due to the enclosed topography of the site it essentially acts as a closed flood cell. Elevations fall westwards from Liverpool Road (A59) to the east of the site and the flood embankments prevent any overland flows from the site from reaching the channel of the River Douglas. To this end any prospective floodwaters that may enter the site in the event of defence failure or from the smaller watercourses within the site boundary, would be contained within the site curtilage. They would not present an increased flood risk beyond the site boundary.

12.3.4 Flood Risk from Artificial Sources

Risk of Canal Failure

12.3.4.1 The Rufford Branch of the Leeds and Liverpool Canal runs past the site, on the left bank of the River Douglas. The Canal itself is raised above the River Douglas by several metres and is regulated by a system of 8 locks. The previous FRA (Entec, 2009) explains there is a low risk of flooding from this source.

12.3.4.2 In order to confirm the current status of canal failure risk, Amec Foster Wheeler contacted the Canal and River Trust and a record of correspondence is provided in Appendix B of this report.

12.3.4.3 Ken Fowler, Principal Engineer of North West, North East and East Midlands Waterways confirmed that the Canal and River Trust do not have any records of overtopping from or breaches of the Rufford Branch. The Canal and River Trust guidance notes for flood risk assessments also states that breaches of the entire British Waterways canal network occur on an average rate of three per year. This indicates a low actual and residual risk of flooding from this source.

12.3.4.4 In the unlikely event of a canal breach or capacity exceedance, any flood waters are likely to enter the River Douglas and would not directly inundate the site. There remains a residual risk of flooding in the event that water levels in the River Douglas are already raised in conjunction with tide locking. Only under this extremely low probability scenario would there be any potential risk of flooding to the site but even so, flood depths would be dispersed across the areas with elevations of 5.00 m AOD and would likely be shallow and restricted to this zone.

12.3.4.5 The overall risk of flooding to the site from canal breach can be considered to be very low.

12.3.5 Surface Water Flood Risk and Drainage System Failure

Surface Water Flood Risk

12.3.5.1 Surface water flooding occurs following periods of heavy rainfall when the rate of rainfall on the surface exceeds the rate at which water can infiltrate into the ground. This can be exacerbated when rainwater is prevented from entering the ground due to impermeable conditions. This may be due to the geological characteristics of an area, frozen ground or to man-made interventions, such as compacted ground, concrete hardstanding or paved areas. Surface water flooding may also be caused by severe storms that exceed the surface water drainage network capacity.

12.3.5.2 The Environment Agency Risk of Flooding from Surface Water flood maps are a national-scale dataset, updated in 2013 to provide an indication areas that are vulnerable to flooding associated with rainfall. The maps cover flooding scenarios for the following annual exceedence probability events: 1 in 30 year (3.3%), 1 in 100 year (1%) and 1 in 1000 year (0.1%). For each scenario the

---

4 Ian Caunce Environment Agency. See email chain in Appendix B.
map provides information on flood extent, depth, velocity and hazard (as a function of depth and velocity). The level of flood risk displayed on the maps is grouped into one of four categories, as summarised in Table 12.7.

### Table 12.7  EA Risk of Flooding from Surface Water Categories

<table>
<thead>
<tr>
<th>Flood Risk Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>Less than 1 in 1000 (0.1%) chance of flooding in any given year</td>
</tr>
<tr>
<td>Low</td>
<td>Chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) in any given year</td>
</tr>
<tr>
<td>Medium</td>
<td>Chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) in any given year</td>
</tr>
<tr>
<td>High</td>
<td>Chance of flooding greater than 1 in 30 (3.3%)</td>
</tr>
</tbody>
</table>

12.3.5.3 An excerpt of the Environment Agency Risk of Flooding from Surface Water flood map, centred on the proposal site is provided in Figure 12.2 for illustrative purposes. It shows the majority of the site to be at a Very Low risk of flooding, with several discrete areas of Low risk associated with the lowest areas of elevation on the site, including the ABD and the channel of the small unnamed brook to the south eastern end of the site. Sitting within the aforementioned Low Risk areas there are smaller zones of medium and high risk. There is an additional linear band of high risk flanking the eastern side of the Blending and Intake Buildings (buildings 17 and 24 on the Existing Site Layout and Proposed Development in Appendix E).
12.3.5.4 Under a low probability surface water flood event, the areas identified as being at risk of flooding would be associated with flood depths of up to 0.30 m. Within the ABD depths would rise to between 0.30-0.90 m and, finally, depths in excess of 0.90 m are indicated near to the unnamed brook and to the southern waste water treatment yard area (see annotation number 13 of the Existing Site Layout and Proposed Development in Appendix E). Velocity estimates provided on the map indicate water being directed toward the western periphery of the site and away from existing buildings. It would be prevented from leaving the site by the flood embankment. Velocities would largely be below 0.25 m/s, with the exception of the ABD where they are estimated to exceed this value in places.

12.3.5.5 It should be noted that the Environment Agency Risk of Flooding from Surface Water flood map does not represent all existing development on site, as some additional buildings have been completed since production of the maps in 2013. More specifically, it does not consider the presence of the Bio Beds (building 32 on the Existing Site Layout and Proposed Development in Appendix E). Nor does it account for the present drainage system on the site.

**Drainage System Failure (exceedance)**

12.3.5.6 Drainage system failure can occur as the result of exceedance of the drainage capacity or due to blockage or pump failure. There have been no historic instances of drainage system failure at the site and regular maintenance and monitoring of the system is undertaken by site staff. However, it is still necessary to consider and design for the hypothetical event of drainage system failure.

12.3.5.7 The current surface water drainage system has a capacity of 1,100 m³, provided by two storage tanks which receive water via a pumping system. Should the drainage system fail, overland runoff would follow the topographic gradient of the site and would be constrained within the areas of
lowest elevation, which sit at around 5.00 m AOD. Outfall is controlled by a series of tidal flaps, which allow for outfall into the River Douglas. There is potential for ponding in these areas under a tide-lock scenario. The extent of the flooding would be predictable and prior evacuation from the affected areas of the site possible. Drainage system failure would not present an increased flood risk within the site or beyond its boundary.

12.3.6 Groundwater Flood Risk

12.3.6.1 Groundwater flooding can occur as the result of water rising from below the ground surface, generally following periods of heavy rainfall which causes a rise in the water table. Areas that are most vulnerable to groundwater flooding are typically low-lying and underlain by permeable geologies and/or regional aquifers.

12.3.6.2 An assessment of the site geology has been made using the British Geological Survey (BGS) Geology of Britain Viewer. This BGS dataset shows the site and wider area to be underlain by a bedrock geology of Sidmouth Mudstone Formation – Mudstone and Halite-stone of the Triassic Period. Sedimentary bedrock of this type and age is characterised by low to very low permeability according to the BGS Guide to Permeability Indices (Lewis et al., 2006).

12.3.6.3 Superficially, the BGS dataset highlights three geologies on the site: to the west and south east (roughly coincident with the areas of lowest elevation) the geology comprise Tidal Flat Deposits, 1 – Silt, Clay and Sand. Normally this is formed from soft silty clay with layers of peat, sand and basal gravel. This layer is likely to be marked by low permeability associated with the peats and clays, but higher permeability in the lenses of sands and gravels. The second geology, located to the east of the site’s centre is Shirley Hill Sand Formation, sands. This is composed of moderately to well-sorted fine grained sand with peat layers in the lower part. Sand is a highly permeable material. Finally, the north eastern and south eastern fringes of the site are overlain by Till, Devonian – Diamicton (typically glacial deposits) of low permeability.

12.3.6.4 The BGS also keep records of borehole logs for the UK, which can be used to provide more detailed insight into the geology below the site. BGS Borehole ID 1097292, reference SD42SE37 taken from the south east of the site shows the following stratigraphy:

- Brown Clay to 12.00 m depth; Gravel to 12.40 m depth; Clay to 17.50 m depth; Crunchy to 18.00 m depth; Clay marl to 20.00 m depth; Clay and crunchy layers to 26.00 m depth; Brown and grey hard Mudstone to the bottom of the borehole at 78.00 m depth.
- BGS Borehole ID 4469, reference SD42SE22 is taken from the north western end of the site, just below the meander bend in the River Douglas. It is detailed below:
  - Grass on topsoil to 0.30 m depth; soft to firm brown indistinctly laminated silty Clay with occasional silty partings to 1.00 m depth; soft brown very silty Clay with some fine and medium gravel sized pockets of silt and with occasional plant matter to 2.00 m depth. This becomes grey with some organic plant remains below 1.90 m and gives way to; soft brownish black silty sandy Clay with occasional fine to coarse sub-angular gravel below 3.00 m, and becoming greyish black, slightly sandy with some medium gravel sized pockets of silt and some fine to coarse sub-angular to sub-rounded gravel below 3.70 m; from 4.50 m there is firm reddish brown slightly sandy silty Clay with occasional fine and medium sub-rounded gravel to the end of the borehole at 6.00 m depth.

12.3.6.5 Additionally, a geotechnical study was undertaken by Worms Eye Lt in November 2007 and was referenced in the 2009 FRA. It documents the groundwater conditions within the sands and silts layer. A summary of the report findings from the previous FRA (Entec, 2009) is provided below:

- ‘...Groundwater levels within the sands and silts are complex in detail but appear to lie between 1.65 and 2.00 m below ground level. Groundwater level data from the survey of tidal influence on the water table suggests a maximum gradient of 0.50 m in 50 m (say 1 in 100) from south to north... In addition the data presented in the report suggests that groundwater within the sands and silts is affected by the tide although the tidal response is likely to be damped and delayed.’
12.3.6.6 Generally, the actual risk of groundwater flooding can be considered to be low due to the high clay component of the superficial geologies across the site, which will act as an impermeable cap. However, there remains a residual risk of emergence from the sandy and gravel lenses and layers. Similar to the surface water flood risk, the topography of the site would moderate the overall extent of groundwater flooding. There is potential for limited ponding in those areas of lowest elevation.

12.3.7 Summary of Flood Risk

12.3.7.1 This Section has assessed the flood risk to the site from all sources given in Table 12.5. It indicates that there is a low risk of fluvial or tidal flooding to the site under a present day flood scenario owing to the presence of the flood embankment. When accounting for climate change it is noted that the T200+CC flood level of 6.55 m AOD would currently exceed the existing flood defence level in some sections of the embankment. There remains a residual risk in the event of defence breach in both the present day and in future flood scenarios.

12.3.7.2 Ancillary sources of flooding come from the Carr Brook to the north of the site and from the unnamed brook that flows through the site. Giving due consideration to site topography it has been demonstrated that any flooding originating from these sources would be constrained to the areas of lowest elevation on the site and the risk would therefore be manageable.

12.3.7.3 Areas of prospective surface water flooding have also been identified as well as the potential for drainage system exceedance/failure, along with limited potential for groundwater emergence from the superficial geologies of the site.

12.3.7.4 Flood mitigation measures for the development proposal will be considered within Section 12.4.
12.4 FLOOD RISK MITIGATION

12.4.1 Flood Resistant and Resilient Measures

12.4.1.1 Section 12.3 has identified a residual risk of flooding to the site in the event of flood defence failure and also from other sources including surface water and groundwater. This section outlines measures taken in order to manage the level of risk under the development proposal.

Improvements to Flood Defences

12.4.1.2 Following the overtopping event in winter 2013, GA applied for a Flood Defence Consent in order to improve the existing defences on the site. Application reference NW_L_2014_191 was approved by the EA in November 2014. It proposes the raising of existing flood defence embankments from approximately 6.00 m AOD to standard 7.00 m AOD. A copy of the approved application form is included in Appendix H.

12.4.1.3 The proposed defence level of 7.00 m AOD exceeds all of the EA fluvial and tidal flood levels provided as part of the Product 4 dataset (outlined in Section 12.3 of this report). This includes the present day Q1000 (5.91 m AOD) and T1000 (6.10 m AOD) flood levels but also the Q100+CC (5.82 m AOD) and T200+CC (6.55 m AOD) levels.

12.4.1.4 Subsequently, the only risk of overtopping would come from more extreme flood events such as the Q1000+CC and T1000+CC which have not been modelled as part of the EA Product 4 dataset. The risk of a defence breach would remain under all flood return periods but the overall standard of defences would be increased as a result of the works.

Sequential Approach to Design

12.4.1.5 In-line with the Central Lancashire and Blackpool Outline Water Cycle Study (CLBWCS, 2011) a sequential approach has been taken with regard to site design and layout.

12.4.1.6 As shown on the proposed development plans, only those buildings that are located within the areas of lowest elevation and immediately behind the embankment will be at a residual risk of flooding. As noted in sub-section 12.3.3.12, correspondence with the EA has established a prospective flood level of 0.30 m above site ground level to allow for the event of a defence breach.

12.4.1.7 As shown by the proposed site layout and elevations in Appendix F the ground levels where the new buildings are to be located will be raised by 1.00 m as part of the construction process with threshold levels being set at 6.00 m AOD. This exceeds the advised 0.30 m height and would provide an additional freeboard of 0.70 m. It has been agreed with the EA that this is an acceptable mitigation measure to manage the residual flood risk (see correspondence in Appendix B).

12.4.1.8 Due to the proposed elevation of the buildings to 1.00 m above existing site ground level, other flood resistant and resilient measures would not be required. It is understood that a ground supported concrete floor would be used with damp proof membranes (d.p.m). Impermeable polythene membranes should be at least 1200 gauge in order to minimise ripping.

12.4.2 Flood Evacuation Plan

12.4.2.1 The proposed buildings within the residual flood risk area of the site will have a mixture of uses relating to the overall production plant. Some of these will require staff to be present regularly, whilst others will involve automated processes and will only need occasional access by maintenance workers. Due to an identified risk in the event of a defence breach, a flood evacuation plan is required and is outlined below.

12.4.2.2 The EA offers a flood warning system for England and Wales; Floodline Warnings Direct. This free service allows residential homeowners and business to receive direct flood warnings for flooding from rivers and the sea. It does not provide warnings for localised flash flooding, groundwater or sewer flooding or defence breach.

12.4.2.3 Flood warnings can be issued by telephone, email, SMS text message or fax. Registration can be completed online at https://fwd.environment-agency.gov.uk/app/olr/register or by calling Floodline on 0345 988 1188. The Floodline number also provides a recorded message detailing flood
warnings that is updated 24 hours. A live flood warning map is also available at https://flood-warning-information.service.gov.uk/.

12.4.2.4 The EA Floodline flood warning system has four categories that are outlined in Table 12.8:

<table>
<thead>
<tr>
<th>Flood Warning Stage</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Flood Warning</td>
<td>Severe flooding, Danger to life</td>
</tr>
<tr>
<td>Flood Warning</td>
<td>Flooding is expected. Immediate action required</td>
</tr>
<tr>
<td>Flood Alert</td>
<td>Flooding is possible. Be prepared</td>
</tr>
<tr>
<td>Warnings no longer in force</td>
<td>Flood warnings and flood alerts have that have been removed in the last 24 hours</td>
</tr>
</tbody>
</table>

12.4.2.5 The proposal site lies within the following flood warning areas: the Ribble Estuary at Freckleton Marsh, Riversway Docklands, Lower Penwortham, Hutton Marsh, Becconsall Marsh, Much Hoole Marsh, Bretherton eyes, Croston Finney, Hesketh Out Marsh and Hundred End; and the Lower River Douglas – River Douglas and other watercourses from Parbold to the confluence with the River Ribble including Rufford, Mawdesley, Hesketh and Longton.

12.4.2.6 It is recommended that the GA site manager be signed up to the Floodline Warnings Direct service. The site manager would be responsible for regularly monitoring flood warning updates and, ultimately, for implementing evacuation/containment measures if needed.

12.4.2.7 Although the service cannot give advance warning of a defence breach, it can indicate periods of heightened flood risk to the site (e.g. high tide or river levels) during which a breach is more likely to occur. As the site is defended it is not anticipated that staff would need to be evacuated from the lower parts of the site whenever a flood warning is issued, merely that they should be extra vigilant as to the possibility of a breach event.

12.4.2.8 In the event of an unanticipated breach it may still be possible to safely evacuate workers to the eastern end of the site (Flood Zone 1), depending on the size of the breach and the depth and velocity of the floodwaters. Failing the possibility of evacuation, containment of site workers within the new buildings would be possible; threshold levels of these buildings would be well above the 0.30 m residual flood level advised by the EA. In this scenario, workers would remain within the buildings until flood waters had subsided and a safe path of evacuation was presented.

12.4.2.9 Although the likelihood of overtopping will be reduced due to the proposed upgrade of flood defences at the site, there is still the possibility of a flood occurring through a higher flood or breach of the defences. However, provided that the flood warning measures outlined above are put into effect, evacuation from at-risk areas of the site should be possible prior to flooding of this nature.

12.4.2.10 The above flood evacuation plan has outlined safe and robust measures to manage the residual flood risk on site and to protect site workers in the event of flood defence failure.
12.5 SITE DRAINAGE ASSESSMENT

12.5.1 Overview of Site Drainage and Scope of Design

12.5.1.1 As stated earlier in this report, Plock’s Farm has an existing drainage system that handles all surface water from the site and combines both roof runoff and yard runoff. As the development proposal would see an increase in the overall built footprint by 4.97 ha the total impervious area on site would rise to 9.97 ha. In-line with the NPPF flood risk guidance and that of LCC, any proposed development must not increase the risk of flooding either internally to the site, or to properties elsewhere. To this end the sustainable management of surface water generated on the site must be demonstrated.

12.5.1.2 As part of the WSR, Amec Foster Wheeler has considered then sizing of an appropriate rainwater harvesting system for the new roofed footprint. A detailed assessment of the water cycle and calculation for surface water storage has been made as part of the WSR. This chapter is concerned only with extreme exceedance events in which flooding may occur.

12.5.2 Existing Site Drainage System

12.5.2.1 The existing drainage system on the site serves a catchment area of 5.00 ha; equivalent to the existing built footprint. At present the roofed catchment from the existing buildings and all yard runoff is positively drained to a manhole within the site before being pumped up to a balance tank with a storage volume of 300 m$^3$. When this capacity is reached, water drains to a balance tank with 800 m$^3$ additional storage: giving a total of 1,100 m$^3$. A separate tank (of 300 m$^3$) is provided for the wet scrubber and also drains into the balance tank when capacity is available. All stored water is then treated by the ETP.

12.5.2.2 When the existing drainage system is exceeded rainfall runoff and excess yard runoff are discharged into the River Douglas at the Greenfield runoff rate of 10.00 l/s/ha as set by the EA and noted in the previous FRA (Entec, 2009). If discharge to the river is prohibited due to tide-locking, then the lowest areas of the site below 5.00 m AOD are allowed to flood in a controlled manner. This results in the mixing of roof runoff, and low and high risk runoff as overland flow.

12.5.3 Outline Drainage Strategy

Sustainable Drainage Systems

12.5.3.1 As defined by the CIRIA SUDS Manual C697 (CIRIA, 2011) Sustainable Drainage Systems (SuDS) are designed to manage both the environmental risks of resulting from urban runoff and to contribute to environmental enhancement where possible. The underlying philosophy of SuDS is to replicate natural drainage of a site before development as closely as possible through the effective control of runoff at source. In-line with CIRIA guidance, the NPPF states that the order of preference for drainage of a developed site should be for the use of infiltration systems, then for discharge to either an open watercourse, surface water sewer or a combined sewer.

12.5.3.2 As noted above, in general terms, preference is for the use of infiltration systems. CLBWCS (2011) outlines surface water management requirements at the local level and notes that, due to permeable geologies, there is generally good potential for infiltration within the wider area surrounding Plock’s Farm.

12.5.3.3 Given specific consideration to the proposal site, although some areas of the site are underlain by permeable superficial geologies, BGS records show an impermeable mudstone bedrock that would not be conducive for the use of infiltration systems such as soakaways. This is also supported by the high clay component identified in the BGS boreholes in sub-section 12.3.6.4 of this chapter. Finally, as referenced in the previous FRA (Entec, 2009) site investigation survey highlighted a high, tidally influenced water table. Both of the above points would indicate that the use infiltration systems would not be appropriate in this instance.

12.5.3.4 It should be noted, however, that some of the access paths shown on the site plans will be made of gravel. This permeable medium will allow for localised infiltration and would constitute source control of runoff.
Drainage System Design

12.5.3.5 The proposed drainage system will adhere to SuDS principles through the incorporation of source control and re-use of water on site with three main aspects: rainwater harvesting of new roof water; collection of existing roof and low risk yard water and; trapping of high risk yard water for treatment.

12.5.3.6 A rainwater harvesting system has been sized as part of the WSR chapter and is designed to capture runoff from the new roofed footprint to include the Ingredients Kitchen, Larder, Fridge and Meat Kitchen. Roof water from these buildings will be stored in above ground tanks. The collected roof water will be free of contaminants and will be consistently used at a rate of 40m³ per day by on site facilities. Required storage volumes have been sized under the WSR.

12.5.3.7 The existing roofed footprint and low risk yard areas will be collected separately under a new collection system and pumped to tanked storage that is proposed, in addition to the existing 1, 100 m³ tanked storage on the site. Runoff from the newly proposed car park would also be drained and stored under this system. The need for any further storage requirement as part of this system has been assessed under the WSR.

12.5.3.8 All high risk yard runoff is to drain to the current ETP. As and when the ADP is installed, the total untreated high risk yard runoff will be pumped to the northern end of the site for treatment at the ADP. An additional divert tank to serve the ADP has been sized by the WSR in order to provide temporary storage of high flows in the event of a plant outage. The ADP would have capacity to treat up to 450 m³ water per day, which would be re-used within the manufacture process on site.

12.5.3.9 The proposed drainage system is designed to accommodate the 1 in 2 year flood and exceedance of the system will occur for storms that have a higher return period (e.g. the 1 in 30 year event).

12.5.3.10 For the purpose of considering flows in excess of system capacity, the site can be divided into three main catchment areas based on topography:

- The high risk yard area to the north of the site in which the ADP is to be installed will comprise a sub-catchment of 0.22 ha. As this sub-catchment will be surrounded by a reinforced concrete bund of around 2.00 m in height it will be effectively be a self-contained catchment.

- The majority of the site containing the majority of the new and existing buildings and low risk yard areas will drain to the west, towards the lowest areas of elevation.

- Finally, the existing high risk yard area to the south of the site will drain as normal but will be secured by a bund once the ADP has been commissioned, and sorted within a proposed 1, 500 m³ Divert Tank that will be used to provide temporary plant storage and to contain the extreme (1 in 100 year) rainfall event.

Greenfield Runoff Rates

12.5.3.11 As referenced in the previous FRA (Entec, 2009) the existing rate of discharge from the site has been set at the Greenfield runoff rate of 10.00 l/s/ha. Revised calculations have been made following the IH124 method; these are included in Appendix J of this report. They indicate a Greenfield runoff rate of 2.5 l/s/ha. This is lower than that from the previous FRA (Entec, 2009) and thus, the proposed drainage scheme outlined below would provide betterment from this perspective. The permissible runoff for would be 21.04 l/s for the whole catchment area that is to be positively drained (8.60 ha).

Drainage System Calculations

12.5.3.12 Calculations have also been carried out for the whole built area of the site (i.e. the roofed area, low-risk and high risk yard areas) using proprietary Windes 2013 software in order to assess the capacity of the existing ETP. Calculation results are provided in Appendix J.

12.5.3.13 The first scenario assumes that the full 1,100 m³ tanked storage is available and that discharge to the River Douglas is possible at the Greenfield rate. Simulations have been provided for the 1 in 1 year, 1 in 2 year, 1 in 30 year and 1 in 100 year + 30% climate change events, in-line with LCC pre-application standing advice.

12.5.3.14 Results show that in this situation the existing system would cope with all the event durations for the 1 in 1 year and the 1 in 2 year rainfall events, with discharge being limited to 21.04 l/s.
However, the Greenfield runoff rate would be exceeded under the 120 minute Summer event and storage capacity exceeded under the 480 minute Winter storm events for the 1 in 30 year return period. A summary of the results is provided in Table 12.9.

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Storm Event</th>
<th>Max Control (l/s)</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 1 year</td>
<td>1440 min Winter</td>
<td>17.30</td>
<td>OK</td>
</tr>
<tr>
<td>1 in 2 year</td>
<td>960 min Winter</td>
<td>18.90</td>
<td>OK</td>
</tr>
<tr>
<td>1 in 30 year</td>
<td>120 min Summer</td>
<td>21.30</td>
<td>OK</td>
</tr>
<tr>
<td>1 in 30 year</td>
<td>480 min Winter</td>
<td>25.90</td>
<td>FLOOD</td>
</tr>
<tr>
<td>1 in 100 year</td>
<td>+CC 60 min Summer</td>
<td>26.80</td>
<td>FLOOD</td>
</tr>
</tbody>
</table>

The Windes 2013 calculations in Table 12.9 suggest that the current storage volumes on site could cope with up to the 1 in 2 year rainfall event. However, a permissible rate of discharge would be exceeded by the 120 minute Summer 1 in 30 year event which would reach 21.30 l/s. The existing storage capacity would also be exceeded by the 480 minute Winter rainfall event.

12.5.4 Design for Drainage System Exceedance

12.5.4.1 Further Windes 2013 calculations have been undertaken in order to ensure that water in excess of drainage system capacities can be managed and stored safely within the site area, without risk to the existing/ proposed development, site workers and/ or third parties either on or off site.

12.5.4.2 The strategy for drainage system failure is as follows: excess water from all roofed areas (existing and proposed), and from the low risk yard areas will be held in low-lying areas on the site. High risk yard areas to the northern and southern ends of the site will be held within their respective bunds; these areas will effectively act as sub-catchments as they are isolated from the main body of the site.

12.5.4.3 Due to the closed-cell nature of the site all rainwater generated runoff and any subsequent flows would be contained within the site perimeter. It is proposed that in those events in which the proposed drainage system capacity is exceeded, the low-lying areas of the site (i.e. those lying below 6.00 m AOD) are allowed to flood in a controlled manner. Flood waters would be contained in these areas owing to topography and would discharge via the tidal flaps in to the River Douglas when the river levels fall below the outfall level at 2.90 m AOD. There would be no increased flood risk beyond the site boundary.

12.5.4.4 As explained earlier, the threshold levels of the buildings in this area of the site would be 1.00 m above ground level at a level of about 6.00 m AOD and provided this level is not exceeded the buildings would act as a safe place of refuge. However, it is anticipated that all areas of the site below 6.00 m AOD would be evacuated following periods of intense rainfall. As a result, drainage system failure would be managed internally within the site and there would be no increased flood risk to the development from this perspective.

12.5.4.5 In order to ensure the integrity of design, the worst case scenario has been assumed in which tide locking prevents the discharge of any water from the site to the River Douglas and that all existing
Proposed Developments at QA Pet Food Partners, Plocks Farm Bretherton
2015 Update of the 2009 EIA Environmental Statement, comprising Supplementary Information

12.5.4.6 The area of the site lying between 5.00 and 6.00 m AOD has been estimated to be 47,255 m\(^2\), excluding the existing and proposed building footprints. This would give an available storage volume of 47,255 m\(^3\). For the purposes of calculation the main body of the site has been treated as a single basin and assumes that no discharge is possible from the tidal flaps. Based on the previous FRA (Entec, 2009) it is assumed that the critical rainfall event duration is 6 hours (360 minutes); this therefore represents the most likely duration of tide locking. Full calculations and results are provided in Appendix J.

12.5.4.7 A summary of the maximum flood depths encountered under a tide locking scenario for the 360 minute Winter storm for each return period are shown in Table 12.10. In the event of unexpected drainage failure, for example due to blockage, the maximum flood depths associated with the 1 in 1 year and 1 in 2 year events would be 0.034 m and 0.041 m, respectively. This would increase to 0.079 m for the 1 in 30 year and the maximum potential flooding would be 0.139 m under the 1 in 100 year + CC event.

Table 12.10 Drainage System Failure Scenario

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Storm Event</th>
<th>Flood depth (m)</th>
<th>Calculated Volume (m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 1 year</td>
<td>360 min Winter</td>
<td>0.034</td>
<td>1606.7</td>
</tr>
<tr>
<td>1 in 2 year</td>
<td>360 min Winter</td>
<td>0.041</td>
<td>1937.5</td>
</tr>
<tr>
<td>1 in 30 year</td>
<td>360 min Winter</td>
<td>0.079</td>
<td>3733.1</td>
</tr>
<tr>
<td>1 in 100 year + CC</td>
<td>360 min Winter</td>
<td>0.139</td>
<td>6568.4</td>
</tr>
</tbody>
</table>

12.5.4.8 In addition to the main body of the site, there are two identified high risk drainage areas to the north and south of the site (depicted on the map in Appendix I). The northern high risk yard area will feature a 2.00 m high reinforced concrete bund to prevent the leakage of effluent onto the main body of the site, in the event that the storage tanks are breached. Based on a catchment area of around 2,200 m\(^2\) behind the bund, this would give a total storage volume of roughly 4,400 m\(^3\).

12.5.4.9 Calculations in Windes have been undertaken for the northern high risk yard area to ensure that this system has the storage capacity to cope with the 1 in 100 year rainfall event + CC, occurring in conjunction with a breach of the storage tank. As shown in Appendix J respective depths of 0.243 m and 0.480 m for the 360 minute and 10080 minute Winter events of this return period could more than be contained by 2.00 m high reinforced bunds. In the worst case scenario this would equate to a maximum flood volume of 1,056 m\(^3\), plus up to 1,500 m\(^3\) from the effluent storage tank: a total flood volume of 2,556 m\(^3\).

12.5.5 Southern High Risk Yard Area

12.5.5.1 It is understood that a similar reinforced bund structure will surround the existing high risk yard area to the south of the site; the bund would need to enclose an area of at least 6,000 m\(^2\). There is no change to the impermeable footprint of this area under the development proposal and the southern high risk yard area will be positively drained to the northern high risk yard area by a pumping system.
12.5.5.2 An estimated residual risk storage volume of 12,000 m³ would be available behind the bund in the southern high risk yard area the event that the pumping system failed. Calculations for the 360 minute Winter 1 in 100 year flood + CC would give a flood depth of 0.904 m and volume of 5,425 m³.

12.5.6 Summary of Proposed Site Drainage System

12.5.6.1 An outline drainage system has been proposed that would allow for the sustainable management of surface water on site, including allowance for drainage system failure.

12.5.6.2 The outline surface water drainage system proposed in this report is conceptual and may be subject to change dependent upon the final drainage system design and the final site layout. The above calculations and design is intended for indicative purposes only and full, detailed drainage system design would be required once outline planning permission has been granted.
12.6 CONCLUSION

12.6.1.1 The development proposal is for the expansion of an existing storage and distribution facility at Plocks Farm. The total impermeable footprint of the site would be increased from around 5.00 ha to around 9.97 ha.

12.6.1.2 The proposal site is located primarily in Flood Zone 1 but includes areas of Flood Zones 2 and defended Flood Zone 3. The entire site is defended by a raised embankment, which it is anticipated will be heightened to 7.00 m AOD as part of the development works. An assessment of flood risk from fluvial and tidal sources, artificial sources, groundwater and surface water has been made. Overall the site is at a low 'actual' risk of flooding from all of the above sources. However, a residual risk of flooding remains in the event of flood defence failure.

12.6.1.3 Appropriate flood resistant and flood resilient design measures have been proposed to mitigate this residual risk by raising the threshold and finished floor levels of the proposed buildings to 1.00 m above the existing site level on the site. This would provide a freeboard of 0.70 m above the Environment Agency recommended residual flood level of 0.30 m above existing ground level. An outline flood evacuation plan has also been included as part of this report to ensure that the residual level of risk can be managed safely.

12.6.1.4 An outline drainage system has been proposed for the management of surface water within the site boundary through the use of rainwater harvesting and existing site storage volumes. This would provide storage capacity for up to the 1 in 2 year flood. Under extreme rainfall scenarios, in which this storage capacity is exceeded or the drainage system fails, the lowest parts of the site would be allowed to flood in a controlled manner, with overland flow being constrained by topography. It has been demonstrated that these low-lying areas have sufficient storage volume available to contain the 1 in 100 year flood plus climate change event under tide-lock conditions, and without causing flood levels to exceed building threshold levels. There would be no increased flood risk either to the site or elsewhere.

12.6.1.5 In conclusion this report demonstrates the compliance of the proposed development with the NPPF and it should be allowed to proceed on this basis.

12.6.1.6 A summary of key points are bulleted below:

- The site has been identified to be at a low 'actual' risk of flooding from all sources.
- A residual risk of flooding remains in the event of flood defence failure but appropriate mitigation measures to manage this risk have been incorporated into the site layout and design.
- A new sustainable drainage strategy has been designed for the site to reduce demand for mains water and to allow for re-use of greywater within the production process.
12.7 REFERENCES


