Mr Joe Chapman

Proposed Residential Development
Station Road
Gunness
Scunthorpe

Flood Risk Assessment

Prepared by EWE Associates Ltd
Final RevB March 2025

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CLIENT DETAILS

Mr Joe Chapman

CONTRACT

This report describes work commissioned by Mr Joe Chapman during March 2024. Lea Favill of EWE Associates Ltd carried out the work.

Date: 10th March 2025

Prepared by: ……  Lea Favill
Director

REVISION HISTORY

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1. INTRODUCTION

Terms of Reference

This report was commissioned by Mr Joe Chapman to support a planning application for a small residential development off Station Road in Gunness near Scunthorpe. The site is currently occupied by a single residential bungalow. The site can presently be accessed from the west off Station Road. The location of the site is shown on Table 2-1.

The whole of the development site is within Flood Zone 3, being the zone with risk of 1 in 100 year (1% AEP) or greater for river flooding and 1 in 200 year (0.5% AEP) tidal/coastal flooding. The development site is within an existing developed area and is less than 1 hectare.

It is usual for the Agency to raise an objection to development applications within the floodplain or Zone 2 or 3 of the flood map until the question of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 hectare until suitable consideration has been given to surface water runoff.

Approach to the Assessment

As there are two sources of flood risk – River Trent and surface water runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from the two sources. Consideration has also been given to the site flooding from either overland flow or ponding of localised rainfall within the site.

The River Trent is Main River; the Environment Agency does have modelled flood data which may assist in predicting the design flood level for the river adjacent to the proposed development site.

The area proposed for development is partly existing dwelling and driveway and partly domestic garden areas. The impermeable area will be increased following completion of the works. Therefore, consideration will need to be given to the existing drainage route and the drainage characteristics to evaluate the impact that surface water runoff from the site will have upon the site and elsewhere.

A walk over of the site was conducted by Mr Lea Favill, a senior river engineer during October 2016; during the visit a photograph survey of the site and adjacent watercourses was undertaken. A spot level survey of the site, calibrated to OS datum was provided by the client's representative. These surveyed levels have been utilised within this report.

The requirements for flood risk assessments are generally as set out in National Planning Policy Framework (NPPF). The detail and complexity of the study required should be appropriate to the scale and potential impact of the development. For the purposes of this study, the following have been considered: -

- Available information on historical flooding in the area.
- Site level information.

- Details of structures, which may influence hydraulics of the watercourse and consideration of the effect of blockage of structures.
- Estimates of design levels, equivalent to a 200-year (coastal/tidal) and a 100-year (fluvial) return period flood event.
- Allowances for increased flows resulting from the effects of climate change.
- Allowances for sea level rise resulting from the effects of climate change.

Assess the existing runoff characteristics and the potential impact the proposed development will have on the runoff.

Further guidance is also provided in the CIRIA Research Project 624 "Development and Flood Risk: Guidance for the Construction Industry".

Application of Sequential & Exceptions Test

The development site lies within Zone 3 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 200 year (0.5% AEP) or greater for tidal/coastal flooding. The proposed development is residential, as such, considered to be more vulnerable.

Table 1-1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	**Exception Test required**	✓
	Zone 3b	Exception Test required	✓	×	×	×

✓ Development is appropriate

× Development should not be permitted

Exceptions Test

a) This FRA shows the site is safe from flood risk and will not be increased elsewhere

b) The development must be previously developed land – the site is part of an existing development.

c) The development provides wider sustainable benefits to the community that outweigh flood risk

i) The construction of the new dwelling will provide employment for local tradesmen of all ages thus local skills will be enhanced, local employment created, increased opportunities for the employment of apprentices thus improving chances of longer-term employability.

ii) The new dwelling will be within walking distance of local facilities this will thus promote a healthier community.

iii) The dwelling will be designed in accordance with police guidelines to minimise possible burglaries and thus reduce crime in the area.

iv) The new dwelling will be carbon efficient and have lower than average emissions thus making a contribution to the improvement of air quality.

v) The site is within walking distance of local facilities and amenities plus local bus routes thus will contribute to the reduction in private vehicle use and emissions.

vi) All additional housing within rural villages will contribute to the use of public transport and thus additional demand will enhance its long-term provision.

vii) All material used in construction of the building will be locally sourced thus promoting sustainability in the construction process.

viii) The construction of the new building will also increase orders for buildings materials within the local area.

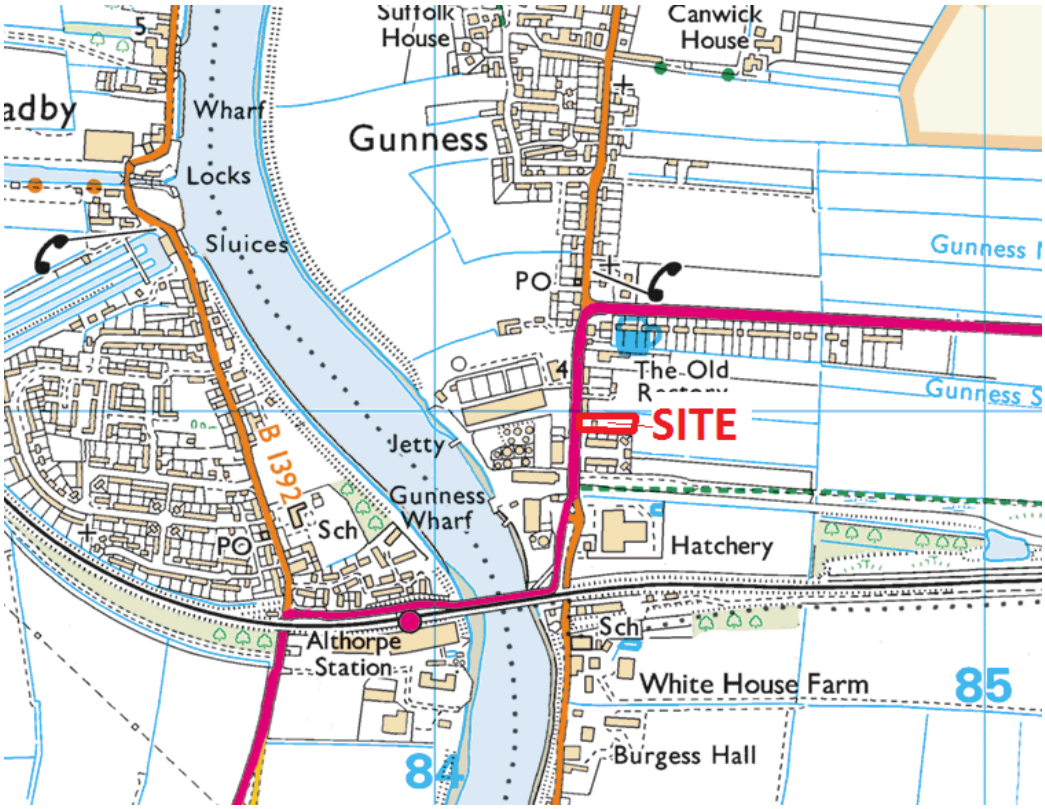
Sequential Test

The local plan adopted May 2003 and the housing and employment land allocation DPD dated 7th March 2016 do not identify any alternative sites which are available within Gunness which could accommodate 3 dwellings. Therefore, the proposed development passes the sequential test.

2. DETAILS OF THE SITE

Site Location

Table 2-1: Location Plan



Ordnance Survey Licence no.: WL1005160

Site Details

Table 2-2: Site Details	
Site Name	Station Road Gunness
Existing Land Use	Single Domestic Dwelling
Proposed Development	Residential
Grid Reference	SE 84306 10977
County	England
Local Planning Authority	North Lincolnshire Council
Internal Drainage Board	Scunthorpe & Messingham Internal Drainage Board
Post Code	DN15 8SU
Others	Not Applicable

Site Description

The site is located to the east of Station Road opposite the wharf to the west of Scunthorpe and to the east of the River Trent. The site is presently a single domestic dwelling which is a bungalow. The River Trent is approximately 215m to the west of the building.

The existing site is shown below. The extent of the building is shown at Appendix A of this report.

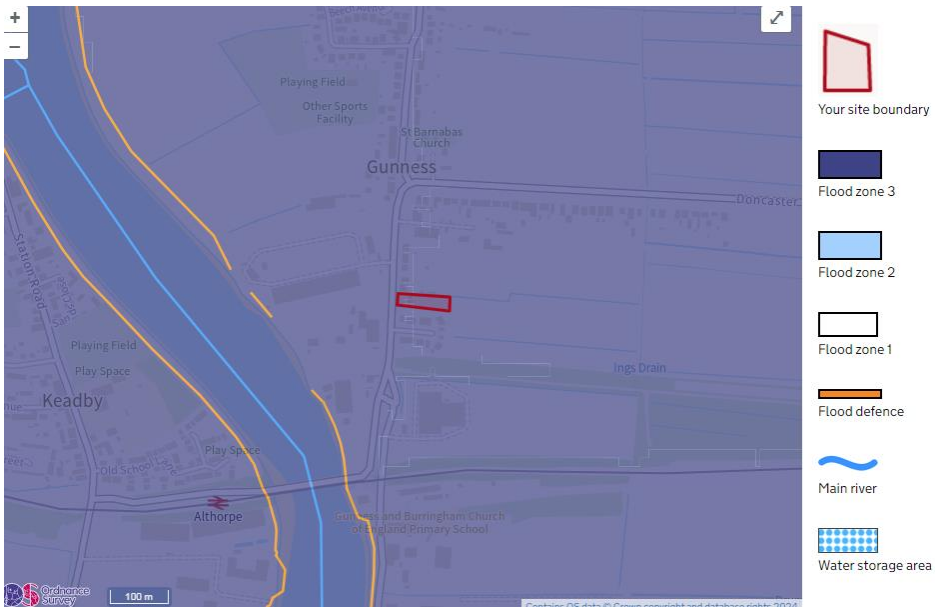
The existing ground floor level of the building is 3.08mOD and the external ground level within the site vary from 2.38mOD along the eastern boundary to 3.85mOD adjacent to Station Road. Station Road is generally above 4mOD.

The proposal is for 3 residential dwellings which include ground floor and first floor accommodation. The proposed layout is provided at Appendix B of this report.

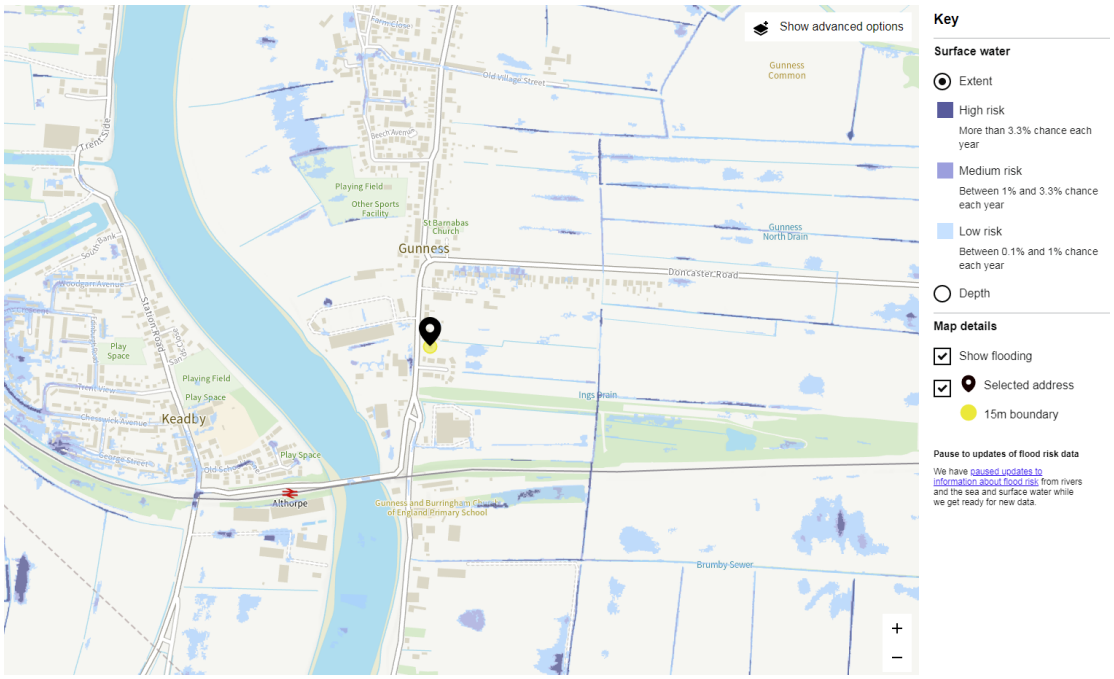
Site Photographs

3. INITIAL ASSESSMENT

Environment Agency Flood Map



Environment Agency Surface Water Flood Map



Past Flooding History

A search on the British Hydrological Society Chronology of British Hydrological Events website[1] found no records of past flooding within the Gunness area.

Undertaking an internet based search for flooding in the area found no records of past flooding within the Gunness area. However, it is local knowledge that prior to the flood defence improvements that the village would regularly flood.

SFRA Flooding History

The SFRA contained no references to the site being flooded.

Environment Agency Flooding History

The 1947 flood event did not flood Gunness, however, the parts of the surrounding area were affected.

Reservoir Flood Risk

The site is not located within an area which is at risk from reservoir breach failure.

Surface Water Flood Risk

The site is located within a low risk area based on the Environment Agency surface water flood maps.

Possible Flooding Mechanisms

As there are two sources of flood risk – River Trent and onsite runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from these sources.

The first is from the River Trent which is to the west of the proposed development. The River Trent is defended by earth embankments which extend above the natural ground level. As such, consideration will need to be given to overtopping and breach failure of the defences.

The proposed development will introduce significant impermeable areas into the site, therefore, consideration will need to be given to the existing drainage route and the drainage characteristics in order to evaluate the impact that surface water runoff from the site will have on the site and elsewhere.

Information on groundwater flooding is limited within the North Lincolnshire Council area. The SFRA provided no further information. In addition, reference to the Groundwater Vulnerability Map and Source Protection Zones produced by the

[1] http://www.dundee.ac.uk/geography/cbhe/

Environment Agency indicate that district is not underlain by an aquifer and are therefore unlikely to be source of significant flood risk.

Severn Trent Water is the statutory water undertaker and is responsible for the public sewer systems within the Gunness area. Severn Trent Water maintains a register of historical sewer flooding events (DG5 Register) within the area. There are no report incidents close to the site. The SFRA provided no further information.

4. FLOOD RISK ASSESSMENT

Requirements of the Environment Agency

The Environment Agency, as part of its development control procedures, generally require finished floor levels to be set above the 1% AEP plus 20% for climate change flood water level at the site. The development is residential in nature, as such, it is considered that access and egress from the development site will be essential during times of extreme floods.

River Trent

The River Trent is defended by flood embankments, which are 215m to the west of the proposed development site. The Environment Agency provided estimated flood water levels for the River Trent adjacent to the site. The 1 in 200 year flood level has been estimated at 6.02mOD. The crest of the flood embankment is at a level of between 6.1mOD and 6.4mOD in line with the Gunness and the site. As such, the flood water will be maintained within the channel and the site will remain safe during this event.

However, the Environment Agency has also completed overtopping analysis during the 1 in 200 year flood event. The hazard map shows that the site is within an area which could flood to a level of between 2.78mOD (east) to 3.85mOD (west). This is likely to result in the site being flooded.

The flood level data is provided at Appendix C & D of this report.

Increase in Estimated Flood Level due to Climate Change

NPPF states that *'…Flood risk assessment should be carried out to the appropriate degree at all levels of the planning process, to assess the risks of all forms of flooding to and from development taking climate change into account. The future users of the development must not be placed in danger from flood hazards and should remain safe throughout the lifetime of the plan or proposed development and land use*.'

The Environment Agency has completed overtopping analysis during the 1 in 200 year plus climate change flood event. The hazard map shows that the site is within an area which could flood to a level of between 2.93mOD (east) to 3.96mOD (west). This is likely to result in the site being flooded.

Extreme 1 in 1,000 year Flood Event

The Environment Agency has completed overtopping analysis during the 1 in 1,000 year flood event. The hazard map shows that the site is within an area which could flood to a level of between 2.86mOD (east) to 3.92mOD (west). This is likely to result in the site being flooded.

Breach Failure of the defences

Consideration has been given to a breach failure during a 1 in 200 year plus climate change event on the River Trent. This scenario would require the river level to be equivalent to the top of the flood embankment directly in line with the site. The likelihood of this flood event occurring is less than 0.5%. This flooding mechanism requires a failure of the flood embankment to also occur simultaneously with the high-water level. As the flood embankments are regularly inspected and well maintained the likelihood of this is low. The landward side of the defences is approximately 350m from the proposed site.

The Environment Agency has recently completed a breach modelling exercise along the River Trent. The breach modelling has been undertaken at specific locations along the river front, as such the location of the breach is not specific to the site and as such a more site specific breach location may result in a worst-case scenario at the proposed site. However, as the hazard mapping represents the most current information it has been used within this assessment.

The breach modelling included the 1 in 200 year plus climate change flood event. The maps are provided at Appendix C and shows that the site could flood to a level of 3.04mOD. The hazard map shows that the site is within an area which could flood to a level of between 2.93mOD (east) to 3.96mOD (west). This is likely to result in the site being flooded.

Increased Runoff due the Development

Existing Development Site

The total site area has been estimated at 2282m². This consists of 220m² of existing roofed and paved areas which are supported by formalised drainage and 2062m² of grass which don't appears to be drained. As such, the existing site is semi permeable. The whole of the site appears to drain east towards the ditch watercourse located within the northern boundary which conveys flows east towards the Internal Drainage Board system of drains.

Percolation tests have been undertaken within the site which identified low permeability soils with a high ground water level. It is therefore considered that infiltration drainage is not a practical solution for this development.

To calculate the existing runoff rate from the site it is assumed that the whole site is greenfield. The peak discharge rates from the 2282m² landscaped area is shown below in Table 4-1. The H R Wallingford Greenfield Runoff Method has been used to calculate the Greenfield runoff from the site. The calculation sheet is provided at Appendix E of this report.

Table 4-1: H R Wallingford Greenfield flows from grass land area of 2882m²

Return Period	Flow in litres per second (l/s)
Qbar	0.35
1 in 1 year	0.29
1 in 30 year	0.69
1 in 100 year	0.89

It is considered impractical to limit discharge rates below 1l/s due to blockages and failures of the control devices. As such, the discharge from this site into the adjacent ditch watercourse will be limited to 1l/s.

Proposed Drainage Strategy

The proposed development site covers an approximate area of 680m² and will discharge to the adjacent ditch watercourse at a peak rate of 1l/s. The impermeable area includes 416m² of roofed area and 609m² of paved driveway which will be constructed using permeable paving. As such, this area is assumed to be 25% contributing and will be drained via a 300mm diameter pipe. Therefore, the overall impermeable area has been estimated at 570m².

An assessment of the required balance volume has been made using the estimated post development impermeable area of 570m² (0.057 hectares). Using WinDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (40%) event.

Reference should be made to Appendix F where the drainage strategy drawing is provided and Appendix G where the calculation sheets are provided. The attenuation size has been tabulated below in Table 4-2 for the 1 in 100 year plus climate change (40%) return period.

It is estimated that during the 1 in 100 year plus climate change (40%) event that 31.0m³ of storage will be required. Therefore, a small pond will need to be construct within the site to accommodate the increased runoff during the 1 in 100 year plus climate change event. The drainage strategy drawing provided at Appendix F shows the approximate area of the pond.

Table 4-2: WinDes 1 in 100 year+CC Storage Volume

Return Period	Required Attenuation	WinDes Calculated Volume (m³)
1 in 100 year + CC	Pond 0.6m deep 107m2 1 in 3 side slopes	31.0

Sustainable Urban Drainage

The Environment Agency requires that adequate pollution control is incorporated into the proposed drainage system in order to prevent deterioration of the quality of the water environment. However, this is only applicable for surface water originating from access roads and communal parking areas, which needs to be passed through a petrol/oil interceptor or equivalent system prior to discharge into the existing surface water sewer or infiltration system. It is noted however, that this will not apply to surface water originating from roof drainage.

To reduce the impact of surface water runoff from the development in accordance with the requirements of the Environment Agency and Local Authority, the employment of SUDS techniques to limit runoff volumes and rates from the site are recommended. SUDS techniques can also be used to provide an appropriate level of treatment to the runoff.

It is normal practice to ensure that the 1 in 30 year event is maintained within the drainage system and the 1 in 100 year is permitted to flood the surface as long as there is no flooding to buildings and the flood volume is contained within the site boundary in specific areas proposed for this purpose.

The following section will provide some possible SUDS techniques which could be employed on the site to balance flows in excess of the 1 in 30 year event. SUDS techniques will also provide treatment to the runoff to remove a proportion of the pollution and protect the quality of the downstream watercourses. Following guidance from CIRIA Report C522 the following levels of treatment will be provided:

- • Roofs – 1 level
- • Driveways – 1 level
- • Roads and communal parking areas – 2 levels.

The level of treatment indicates the number of SUDS techniques that will be used to treat pollution. For example if two levels are required the runoff may enter a filter drain that leads to a basin or pond before outfall. It is recommended that source control techniques are used. In practice there will be little outflow from these techniques for a 1 in 2 year storm as most of the rainfall will be held within the system and will disperse via evapotranspiration. Further detail of the potential to use SUDS within this site it provided overleaf within Table 4-3. The precise combination of methods used will be dependent upon the site constraints identified at the final design stage.

Initial data suggests that the site is underlain by an impermeable layer with shallow ground water which is unlikely to allow infiltration at a reasonable rate therefore making infiltration drainage impractical.

The impermeable area within the site has been estimated at 680m² following development. It is considered that the site currently drains to the ditch watercourse to the east.

The development site is considered to be small with limited space set aside, in which to incorporate appropriate SUDs techniques. As such, the following SUDS techniques shown below in Table 4-4 have been considered for use at this site.

Table 4-3: SUDS Techniques

SUDs Group	Suitability for Proposed Development
Retention	**Small pond provided within site**
Wetland	✖
Infiltration	✖
Filtration	✖
Detention	✖
Open Channel	✖
Source Control	**French drain to driveway**

5. MITIGATION MEASURES

Raising Floor Levels/Land Raising

It is considered that during a 1 in 200 year, 1 in 200 year plus climate change and 1 in 1,000 year extreme flood events within the River Trent that the flood water will overtop the existing flood defences and flood the site to a peak level of between 2.78mOD and 3.96mOD.

It is estimated that during a 1 in 200 year plus climate change breach of the defences that the existing site could be flooded to a peak level of between 2.93mOD and 3.96mOD. This is likely to result in the site being flooded.

The critical flood level for the area is estimated at 3.8mOD.

It is recommended that the habitable internal ground floor level of the buildings are elevated to 4.1mOD. The proposed site levels are shown on the plan at Appendix F.

It is also recommended that a further 300mm of flood resilience measure are incorporated into the design for extreme flood events. Hence, a level of 4.4mOD.

No bedrooms will be permitted at ground floor level.

Emergency Access & Egress

It is considered that during overtopping and breach events within the River Trent the site will be flooded to a peak level of 3.96mOD.

It is considered that the first floor level within the building will be a safe area during these flood events and that the emergency services will be able to access the site even during extreme events as flood depths on the adjacent Station Road will be shallow.

Flood Warning

This area of Gunness is covered by the Environment Agency's general early alert to possible flooding, known as Flood Watch. It is highly recommended however, that occupants of the commercial development register their interest in receiving flood warnings from the Environment Agency's Floodline Warnings Direct Service.

This service enables the Environment Agency to send a flood warning message direct to people at home or at work by telephone, fax or pager using an Automatic Voice Messaging (AVM) Service. The aim is to give two hours' notice of flooding, either day or night, to enable people to take the necessary action to protect themselves and their properties.

The Environment Agency also provides the **Floodline 0845 988 1188** service, where occupants can listen to recorded flood warning information for the area or speak to an operator for advice 24 hours a day.

Should a flood event reach the level where the site is at risk of inundation, then the Environment Agency will issue a Severe Flood Warning.

Flood Proofing

Consideration should be given to flood proofing the building to a level equivalent to 4.1mOD which is approximately 300mm above the existing ground floor level to reduce the residual damages if an extreme flood was to occur. Flood proofing is a technique by which buildings are designed to withstand the effects of flooding. There are two main categories of flood proofing, which are dry proofing and wet proofing.

Dry proofing methods are designed to keep water out of the building, and wet proofing methods are designed to improve the ability of the property to withstand the effects of flooding once the water has entered the building. Both would be required in this case, due to the possible failure of the dry proofing methods.

Where wet proofing is required it is important that a flood response plan should be prepared and practised regularly, so that any contents of the building can be moved to design flood level if required or are built to withstand immersion in water or are designed to be easily replaceable.

The differential pressures across load bearing walls and the flotation effect that will occur during flood events should be considered when considering dry proofing techniques. For most existing properties, this means that dry flood proofing should only be considered if the expected flood depth is under 0.5m, which in this case is expected to be less than 0.15m depth within the building and as such dry proofing is likely to be successful. It is therefore considered that flooding more than 500mm will cause some damage to the building; however, this is acceptable.

The following table summarises the recommendations for flood proofing measures which can be incorporated within the design of buildings[2]:

Feature	Considerations To Improve Flood Proofing
General	Waterproof construction methods should be adopted wherever practical.
External Walls	Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required. Avoid using timber frame and cavity walls. Consider applying a water resistant coating. Provide fitting for flood boards or other temporary barriers across openings in the walls.
Internal Walls	Avoid use of gypsum plaster and plasterboards; use more flood resistant linings (e.g. hydraulic lime, ceramic tiles). Avoid use of stud partition walls.
Floors	Avoid use of chipboard floors. Use concrete floors with integrated and continuous damp proof membrane and damp proof course. Solid concrete floors are preferable; if a suspended floor is to be used, provide facility for drainage of sub-floor void. Use solid insulation materials.
Fitting, Fixtures and Services	If possible, locate all fittings, fixtures and services above design floor level. Avoid chipboard and MDF. Consider use of removable plastic fittings. Use solid doors treated with waterproof coatings. Avoid using double-glazed window units that may fill with flood water. Use solid wood staircases. Avoid fitted carpets. Locate electrical, gas and telephone equipment and systems above flood level. Fit anti-flooding devices to drainage systems.

[2] Development and Flood Risk Guidance for the Construction Industry, CIRIA C624, London 2004

Pond Maintenance

Following construction regular inspection is recommended. The main concern is to reduce the level of siltation entering the pond and as such a catchpit manhole should be located directly upstream of the pond to intercept any silt being washed down the surface water system. It is recommended that this manhole is lifted and inspected on a monthly basis and any silt located in the bottom removed. Furthermore the location of the pond within the site should be clearly marked on a plan. This area should also be inspected for any deformation of the topsoil/pavement which could indicate settlement or failure. A log book should be completed which will show the inspection and maintenance history of the system. The log book, site plan and construction check list should form maintenance manual for the system.

The maintenance plan has been tabulated below and will be the responsibility of the appointed management company.

Maintenance Schedule	**Required action**	**Frequency**
Monitoring	Inspect catchpit manhole for silt and debris	Monthly
	Inspect pond locations for ground deformation	3 monthly
	Inspect pond for silt buildup	6 monthly
Regular Maintenance	Litter and debris removal from road gullies	Monthly
	Remove silt and debris from catchpit manholes	Monthly
Occasional Maintenance	Remove silt from pond	6 monthly
Remedial actions	Repair deformation of topsoil once settlement stopped	As required
	Repair deformation of paved areas once settlement stopped	As required

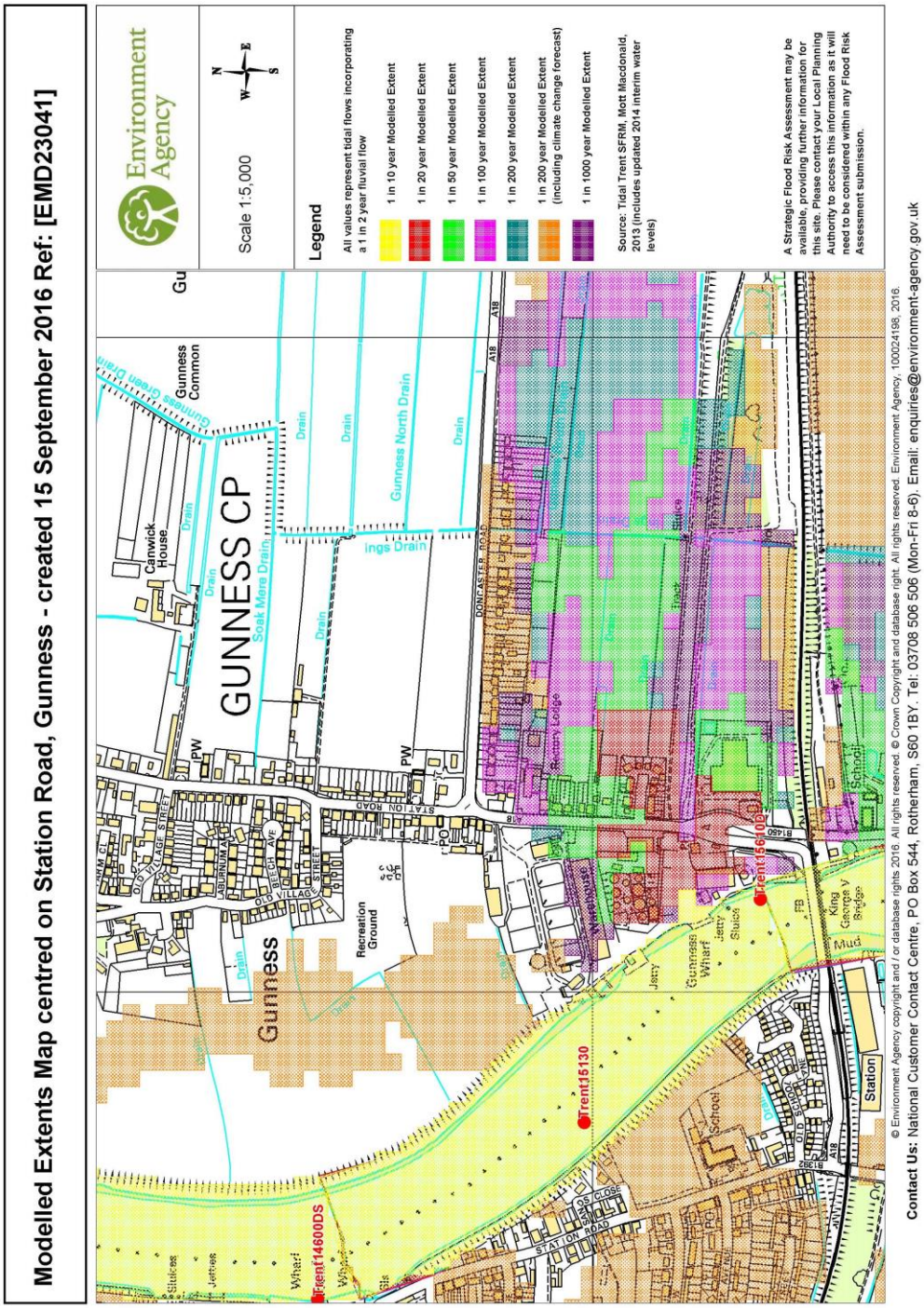
6. CONCLUSION

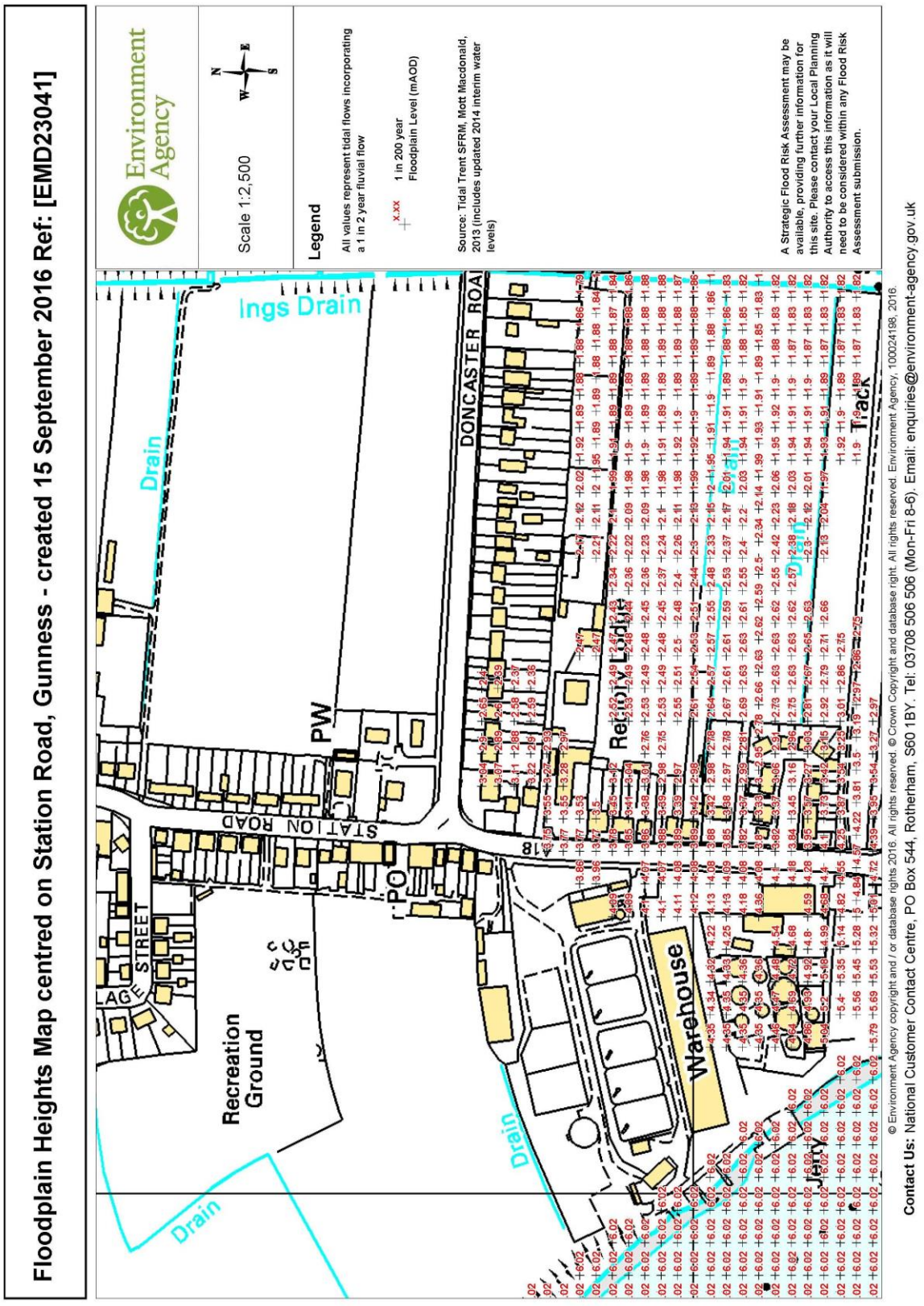
It is concluded that there is a risk of flooding from the nearby River Trent, however; the mitigation measures recommended in section 5 of this report should ensure that the risk is reduced to an acceptable level.

Appendix A: - Existing Site Plan

Appendix B: - Proposed Layout Plan

Appendix C: - Environment Agency Flood Data




Floodplain Heights Map centred on Station Road, Gunness - created 15 September 2016 Ref: [EMD23041]
Environment Agency
Scale 1:2,500
Legend
All values represent tidal flows incorporating a 1 in 2 year fluvial flow
X.XX
1 in 200 year Floodplain Level (mAOD)
Source: Tidal Trent SFRM, Mott Macdonald, 2013 (includes updated 2014 interim water levels)
A Strategic Flood Risk Assessment may be available, providing further information for this site. Please contact your Local Planning Authority to access this information as it will need to be considered within any Flood Risk Assessment submission.
Ings Drain
Drain
DONCASTER ROA
STATION ROAD
A18
PW
PO
Recreation Ground
Warehouse
Track
Drain
Drain
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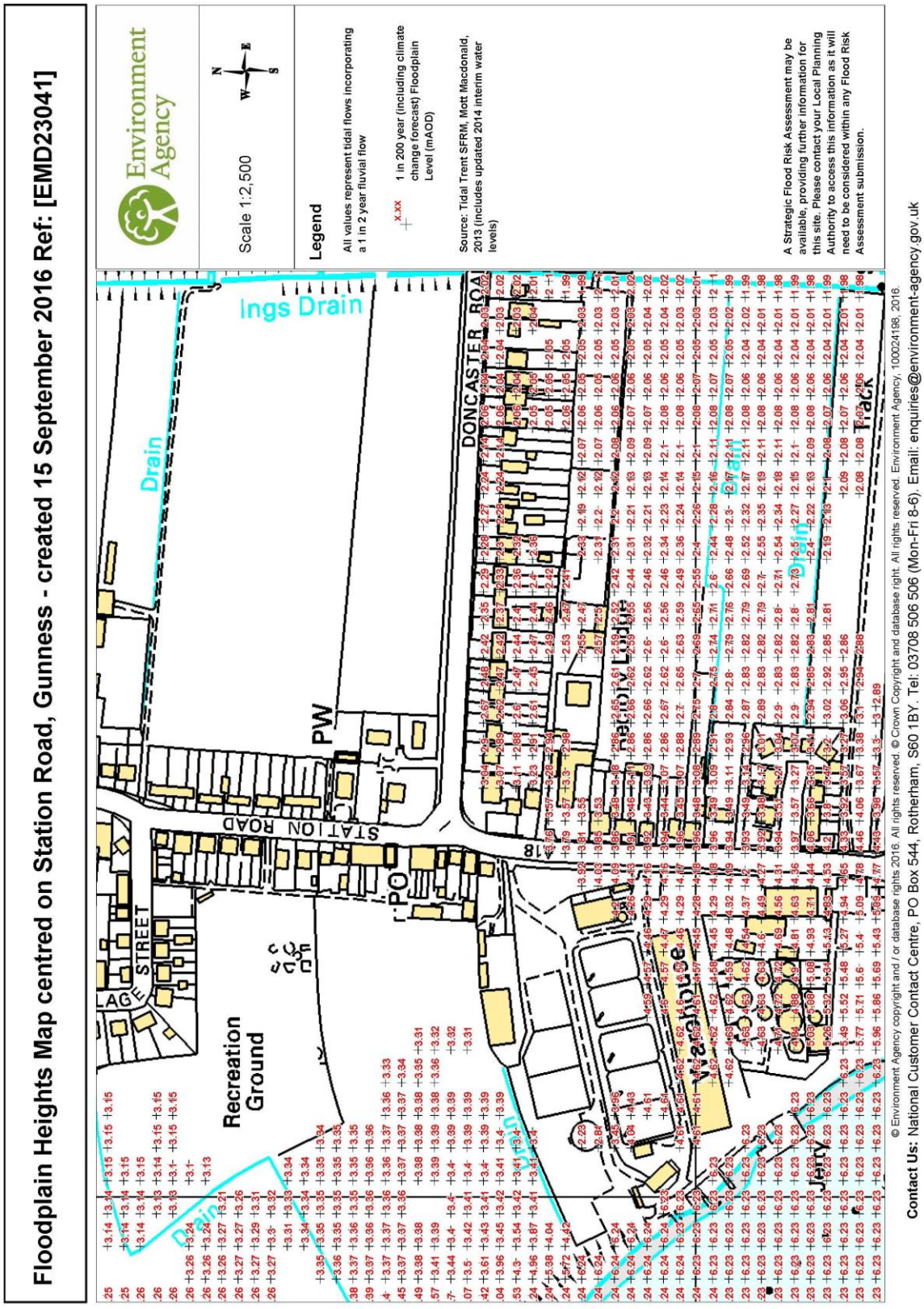
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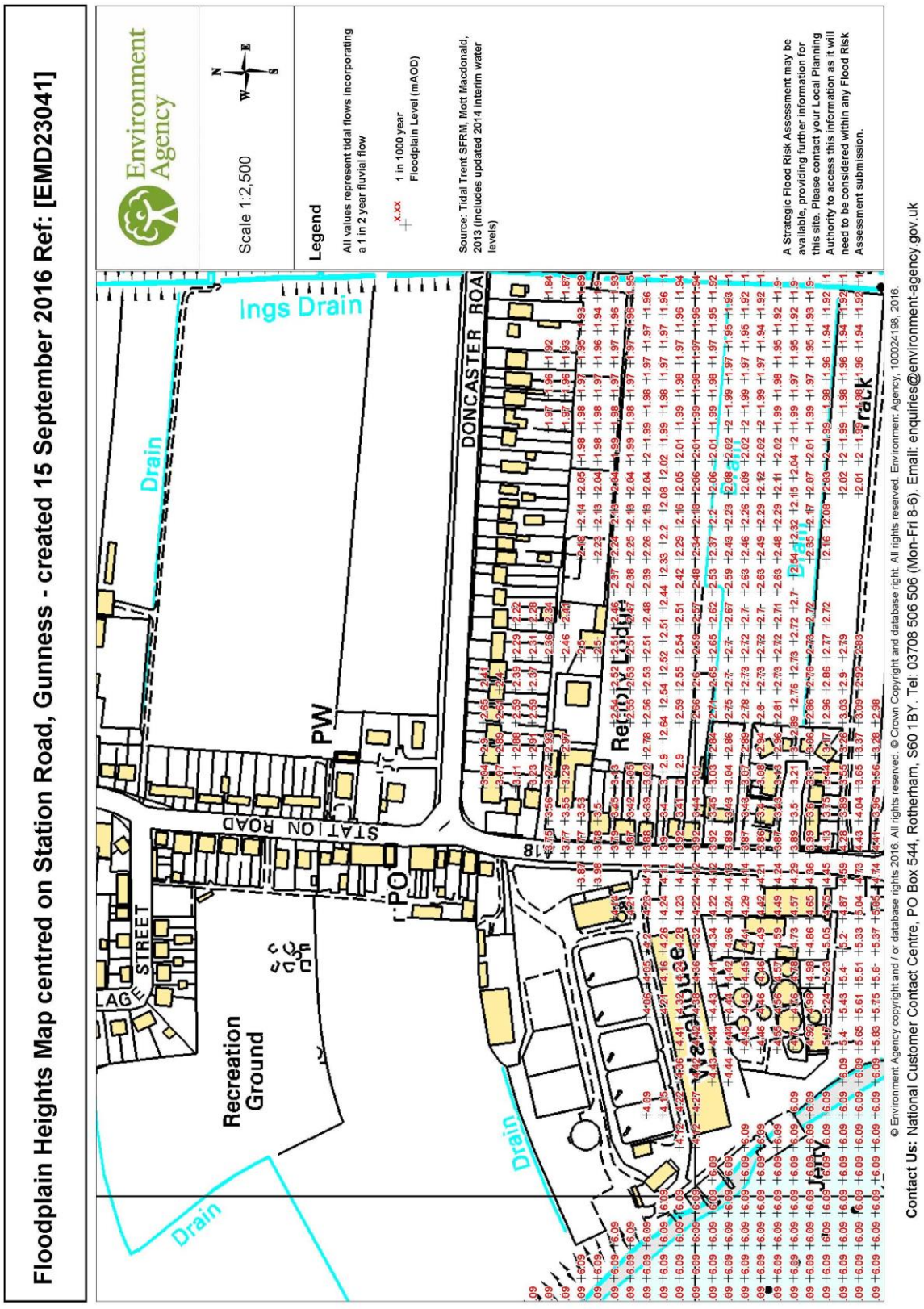
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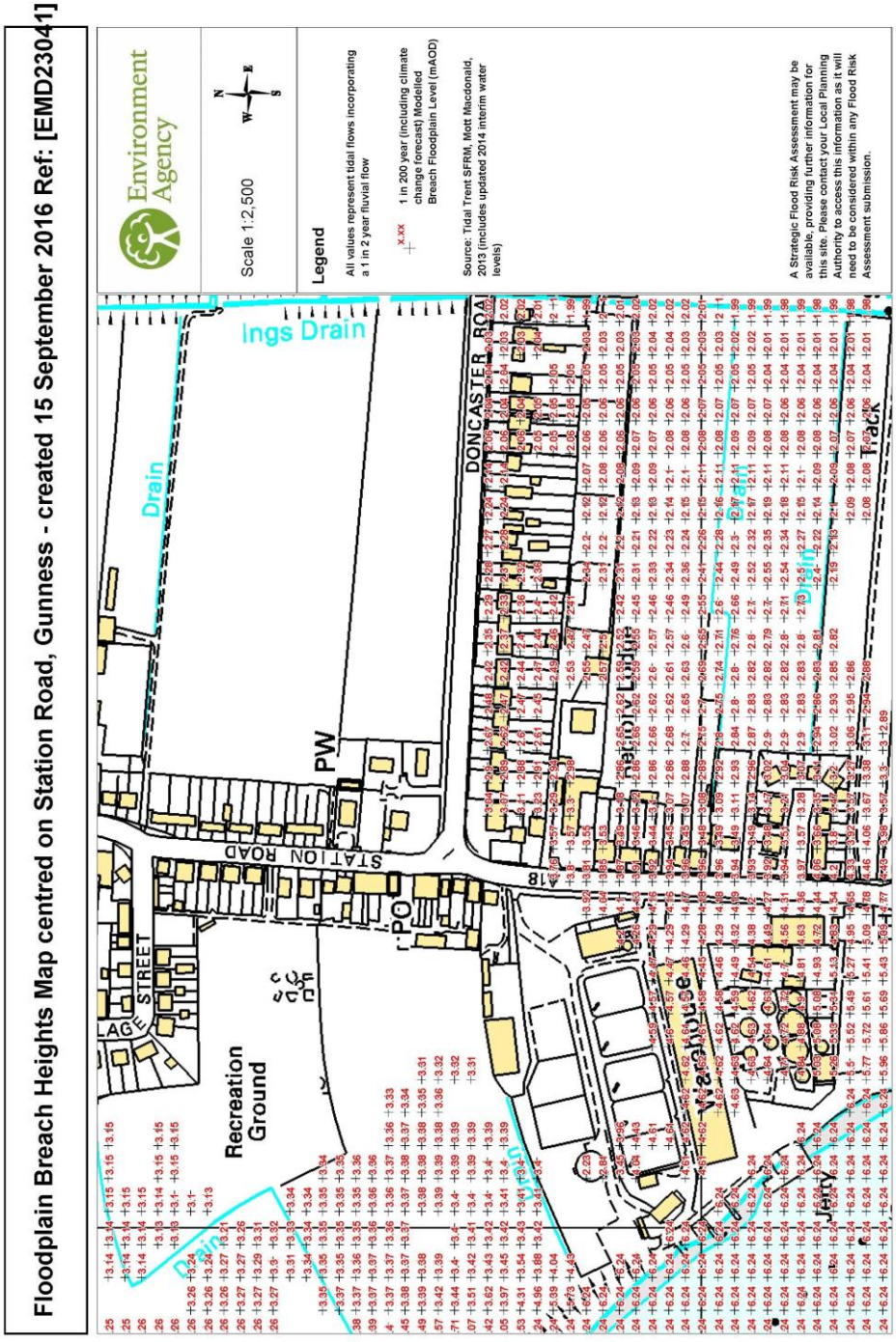
Appendix D: - Environment Agency Breach Data



Appendix E: - Existing Runoff

hrwallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	lea favill
Site name:	Station Road
Site location:	Gunness

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.58823° N
Longitude:	0.72472° W
Reference:	3921379010
Date:	Apr 12 2024 14:07

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.23

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	595	595
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

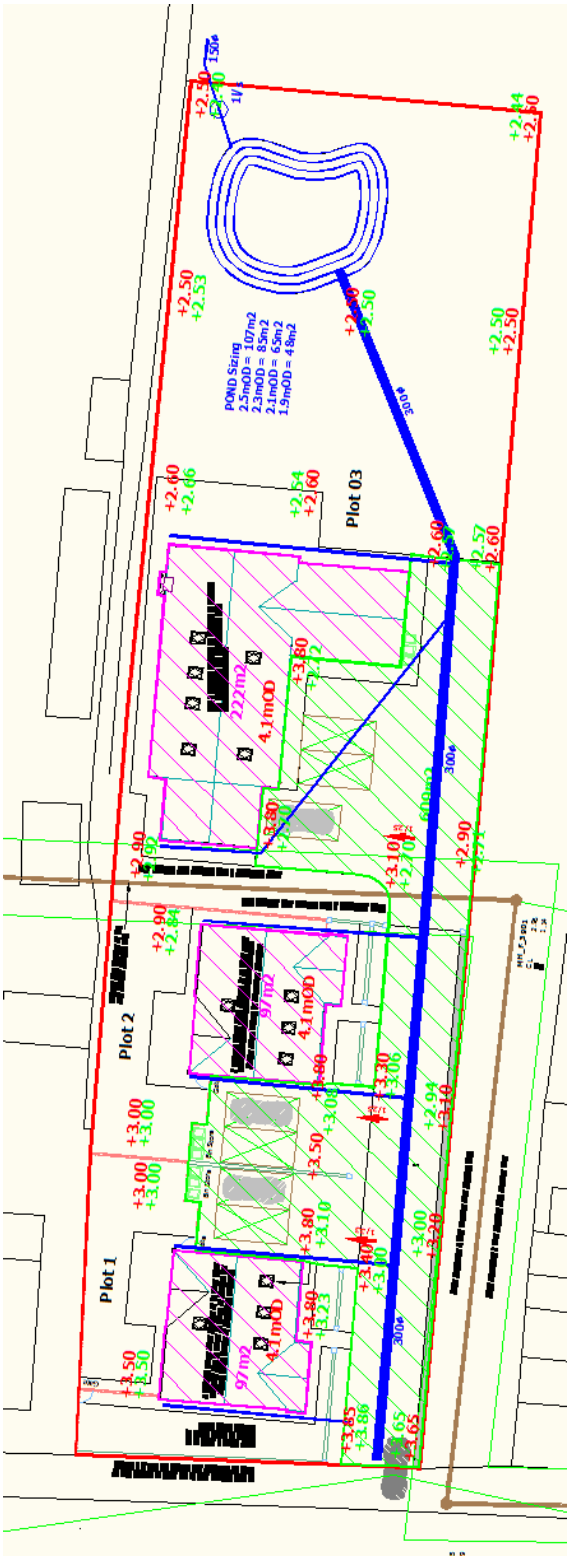
Greenfield runoff rates

Default Edited

Q_{BAR} (l/s):	0.35	0.35
1 in 1 year (l/s):	0.29	0.29
1 in 30 years (l/s):	0.69	0.69
1 in 100 year (l/s):	0.89	0.89
1 in 200 years (l/s):	1.05	1.05

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix F: -Drainage Strategy Drawing



Appendix G: - Storage Calculation

EWE Associates Ltd		Page 1
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
Date 05/12/2024 08:47	Designed By Lea	
File 100yr+CC40% pond ...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	2.321	0.321	0.8	19.9	Flood Risk
30 min Summer	2.354	0.354	0.9	22.5	Flood Risk
60 min Summer	2.384	0.384	0.9	25.0	Flood Risk
120 min Summer	2.405	0.405	0.9	26.7	Flood Risk
180 min Summer	2.409	0.409	0.9	27.0	Flood Risk
240 min Summer	2.406	0.406	0.9	26.8	Flood Risk
360 min Summer	2.398	0.398	0.9	26.1	Flood Risk
480 min Summer	2.388	0.388	0.9	25.3	Flood Risk
600 min Summer	2.379	0.379	0.9	24.5	Flood Risk
720 min Summer	2.369	0.369	0.9	23.7	Flood Risk
960 min Summer	2.349	0.349	0.9	22.1	Flood Risk
1440 min Summer	2.312	0.312	0.8	19.2	Flood Risk
2160 min Summer	2.262	0.262	0.8	15.6	O K
2880 min Summer	2.217	0.217	0.8	12.4	O K
4320 min Summer	2.115	0.115	0.8	6.1	O K
5760 min Summer	2.076	0.076	0.7	3.9	O K
7200 min Summer	2.064	0.064	0.6	3.2	O K
8640 min Summer	2.057	0.057	0.6	2.9	O K
10080 min Summer	2.052	0.052	0.5	2.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	191.868	19
30 min Summer	110.704	33
60 min Summer	63.874	62
120 min Summer	36.854	122
180 min Summer	26.716	180
240 min Summer	21.264	222
360 min Summer	15.415	280
480 min Summer	12.269	344
600 min Summer	10.278	412
720 min Summer	8.894	482
960 min Summer	7.071	618
1440 min Summer	5.117	894
2160 min Summer	3.704	1296
2880 min Summer	2.945	1676
4320 min Summer	2.111	2336
5760 min Summer	1.667	2944
7200 min Summer	1.388	3672
8640 min Summer	1.196	4400
10080 min Summer	1.054	5136

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Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 05/12/2024 08:47	Designed By Lea	
File 100yr+CC40% pond ...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	2.352	0.352	0.9	22.3	Flood Risk
30 min Winter	2.388	0.388	0.9	25.3	Flood Risk
60 min Winter	2.422	0.422	0.9	28.2	Flood Risk
120 min Winter	2.447	0.447	1.0	30.4	Flood Risk
180 min Winter	2.454	0.454	1.0	31.0	Flood Risk
240 min Winter	2.453	0.453	1.0	30.9	Flood Risk
360 min Winter	2.442	0.442	1.0	30.0	Flood Risk
480 min Winter	2.432	0.432	0.9	29.0	Flood Risk
600 min Winter	2.419	0.419	0.9	27.9	Flood Risk
720 min Winter	2.406	0.406	0.9	26.8	Flood Risk
960 min Winter	2.378	0.378	0.9	24.5	Flood Risk
1440 min Winter	2.325	0.325	0.8	20.2	Flood Risk
2160 min Winter	2.253	0.253	0.8	14.9	O K
2880 min Winter	2.180	0.180	0.8	10.0	O K
4320 min Winter	2.071	0.071	0.7	3.6	O K
5760 min Winter	2.057	0.057	0.6	2.9	O K
7200 min Winter	2.050	0.050	0.5	2.5	O K
8640 min Winter	2.046	0.046	0.4	2.3	O K
10080 min Winter	2.042	0.042	0.4	2.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	191.868	18
30 min Winter	110.704	33
60 min Winter	63.874	62
120 min Winter	36.854	118
180 min Winter	26.716	176
240 min Winter	21.264	230
360 min Winter	15.415	294
480 min Winter	12.269	368
600 min Winter	10.278	446
720 min Winter	8.894	520
960 min Winter	7.071	672
1440 min Winter	5.117	954
2160 min Winter	3.704	1380
2880 min Winter	2.945	1788
4320 min Winter	2.111	2248
5760 min Winter	1.667	2936
7200 min Winter	1.388	3672
8640 min Winter	1.196	4360
10080 min Winter	1.054	5144

EWE Associates Ltd		Page 3
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 05/12/2024 08:47	Designed By Lea	
File 100yr+CC40% pond ...	Checked By	
Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	484300 410450 SE 84300 10450
C (1km)	-0.024
D1 (1km)	0.317
D2 (1km)	0.313
D3 (1km)	0.290
E (1km)	0.294
F (1km)	2.468
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time / Area Diagram

Total Area (ha) 0.057

Time (mins)	Area (ha)
0-4	0.057

EWE Associates Ltd		Page 4
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 05/12/2024 08:47	Designed By Lea	
File 100yr+CC40% pond ...	Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 2.500

Tank or Pond Structure

Invert Level (m) 2.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	48.0	1.400	107.0	2.800	107.0	4.200	107.0
0.200	65.0	1.600	107.0	3.000	107.0	4.400	107.0
0.400	85.0	1.800	107.0	3.200	107.0	4.600	107.0
0.600	107.0	2.000	107.0	3.400	107.0	4.800	107.0
0.800	107.0	2.200	107.0	3.600	107.0	5.000	107.0
1.000	107.0	2.400	107.0	3.800	107.0		
1.200	107.0	2.600	107.0	4.000	107.0		

Hydro-Brake® Outflow Control

Design Head (m) 0.500 Hydro-Brake® Type Md4 Invert Level (m) 2.000
Design Flow (l/s) 1.0 Diameter (mm) 43

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.6	3.000	2.5	7.000	3.8
0.200	0.7	1.400	1.7	3.500	2.7	7.500	4.0
0.300	0.8	1.600	1.8	4.000	2.9	8.000	4.1
0.400	0.9	1.800	1.9	4.500	3.1	8.500	4.2
0.500	1.0	2.000	2.0	5.000	3.2	9.000	4.3
0.600	1.1	2.200	2.1	5.500	3.4	9.500	4.5
0.800	1.3	2.400	2.2	6.000	3.5		
1.000	1.4	2.600	2.3	6.500	3.7		