FLOOD RISK ASSESSMENT

PROPOSED RESIDENTIAL DEVELOPMENT,
PENNYFIELD,
PINCHBECK,
SPALDING,
LINCOLNSHIRE.
PE11 3SJ

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January 2017 Version 3

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INTRODUCTION

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process. This seeks to reduce the future damage to property and the risk to life from incidents of flooding. Their expectations relating to flooding are contained in the National Planning Policy Framework March 2012, (NPPF), which identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications by avoiding inappropriate development in areas at risk from flooding and to direct development away from areas at highest risk.

The NPPF provides that development in areas at risk of flooding should be avoided and seeks to direct development away from areas at highest risk. There is a sequential, risk-based approach to the location of development avoiding where possible, flood risk to people and property managing any residual risk, and taking account of the impacts of climate change.

The Environment Agency's flood maps show areas that are at risk, from fluvial and tidal flooding. These maps show the limits of the flood plain of the area which could be affected by flood events, over topping or breaching of flood defences. They are based on the approximate extent of floods with a 1% annual probability of exceedance (1 in 100-year flood) for rivers and 0.5% annual probability of exceedance (1 in 200-year flood) for coastal areas under present expectations or the highest known flood. However, they do not consider of the presence of defences or the likelihood that flood return intervals will be reduced by climate change.

This Flood Risk Assessment and Drainage Statement has been prepared in support of a planning application and considers the risk of flooding from fluvial and tidal sources in accordance with National Planning Policy Framework (NPPF). It also considers the risks of localised flooding due to inadequate Foul and Surface Water Sewers, Failure of Reservoirs, Water Main pipe bursts, Sewer Blockages, Pump Failures or High Ground Water Table etc.

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APPLICATION SITE

The site is located off Pennyfield, Pinchbeck, Spalding, Lincolnshire PE11 3SJ within the administrative area of South Holland District Council. The National Grid Reference for the middle of the site is TF23770 25099 with a site area 0.483Ha or thereabouts. **Plan 1**

The current outline planning application is for the erection of 9 No detached dwellings to consist of two storey chalet bungalows. The previous use of the site was a dairy. **Plan 2**

The Site would be classed as Non-Major Development applying the National Planning Policy Guidance (NPPG) as the site is to be developed for less than 10 dwellings.

The National Planning Policy Framework Technical Guidance NPPF defines three levels of flood risk depending upon the annual probability of fluvial flooding occurring.

Zone 1 – Low Probability (<0.1%)

Zone 2 – Medium Probability (0.1 – 1.0%

Zone 3 – High Probability (>1.0%)

The proposed development site is shown to be within Flood Zone 3a 'High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences, and as defined in Table 1 of NPPF. Map**1**

Table 1: Flood Zones Definition (Ignoring the presence of defences)

Flood Zone 3 – High Probability
Definition This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. **Appropriate uses** The water-compatible and less vulnerable uses of land (Table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. **Flood Risk Assessment requirements** All development proposals in this zone should be accompanied by a Flood Risk Assessment. **Policy aims** In this zone, developers and Local Authorities should seek opportunities to: • Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems; • Relocate existing development to land in zones with a lower probability of flooding; and • Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF the proposed residential development is classified as "More Vulnerable", with Table 1 of NPPF stating that such uses are appropriate in this zone subject to the Exception Test.

Table 2: Flood Risk Vulnerability Classification

More Vulnerable
• 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 for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and Evacuation Plan.

From the topographical survey the site is roughly rectangular in shape and reasonably level, the levels vary from 3.19mODN to 2.78mODN averaging 3.00m ODN. The road level on Pennyfield, at the site entrance, is 3.28mODN. **Plan 3**

It is proposed that the lowest ground floor level of the dwellings be raised 500mm above the existing ground level to a minimum level of 3.50mODN.

DRAINAGE AUTHORITIES

Environment Agency

The Environment Agency is responsible for reducing the risk of flooding from designated main rivers and from the sea.

The following potential sources of flooding affecting the development site have been identified as:

- From the River Welland (Tidal)
- The River Glen (Fluvial)
- Welland & Deepings Internal Drainage Board system

The Flood Zone Maps identify river catchments over 3 sq. km. These maps are a theoretical estimate of areas that could be inundated should no defence exist. In practice, current standards of protection would result in flood envelopes substantially less than shown by these maps. The maps make no allowance for local, site specific features.

The flood zone maps show that the site of the proposed development is considered at risk from flooding. These maps indicate that the area would be flooded without flood defences, which are in place, (with an annual probability of more than 0.5% i.e. return frequency of less than 1 in 200 years for tidal flooding or more than 1.33% return frequency of less than 1 in 100 years for fluvial flooding). **Map 1**

The National Flood Risk Assessment Map shows that the site is at Medium risk of flooding. Medium means that each year, this area has a chance of flooding of less than 1 in 30 (3.3%) but greater or equal to 1 in 100 (1%). This takes into account the effect of any flood defences that may be in this area. Flood defences reduce,

but do not completely stop the chance of flooding as they can be overtopped or fail. **Map 2**

River Welland

The River Welland lies some 2.35Km to the east of the site and is tidal down stream of Marsh Lane Sluice and the present day 1 in 200-year tide flood level is 5.98mODN. The tidal flood defences of the tidal River Welland consist of earth embankments which are in good condition and the crest heights are circa 7.00mODN.

From Northern Area, Tidal Modal Analysis (June 2006) **Map 3**

Peak tide levels Present Day (2006) at Marsh Road (Tidal River) 0.5% (1 in 200) = 5.98mODN

Peak tide levels (2116) at Marsh Road (Tidal River) 0.5% (1 in 200) = 5.98mODN plus climate change allowances from Table 3 of 1.21mm = 7.11mODN

Taking the precautionary approach, the Hazard Rating following a breach which in Flood Risk Assessment (FD 2320) Guidance for New Development Phase 2 R& D Technical Report these are classified as low <0.75, moderate 0.75-1.25, significant 1.25-2.50 and extreme >2.50 based upon an empirical measure of velocity and depth.

Flood Hazard value	Degree of flood hazard	Description	Indicative depth range
< 0.75	Low	Caution 'Flood zone with shallow flowing water or deep standing water'	Up to 0.25 m
0.75 – 1.25	Moderate	Danger for some (i.e. children) 'Danger: flood zone with deep or fast flowing water'	Up to 0.5 m
1.25 – 2.0	Severe	Danger for most 'Danger: flood zone with deep fast flowing water'	0.5 m to 3 m
> 2.0	Extreme	Danger for all 'Extreme danger: flood zone with deep fast flowing water'	0.5 m to over 3 m

HR = d x (v + 0.5) +DF

Where V = Flood flow velocity (m/sec)

D = Flood depth (m)

DF = A debris factor included to represent the greater damage, or risk of injury to people, that can occur if debris is swept along with the water. = 0.5 for depths <0.25 or 1.0 for depths

Flood depth (m)	All areas (rural and urban)
≤ 0.25	0.5
> 0.25	1

For the degree of Flood Hazard to be classified as low HR must be <0.75

The 2017 Update to SHDC, SFRA has carried out a Tidal Hazard Mapping, River Welland upstream of Welland Bridge, following a breach to the defences the Tidal Hazard Maps for the 1% Fluvial, 0.5% Tidal event shows that part of the site where the proposed dwellings is to be built is within a Hazard Rating Area of between 0.75 – 1.25 (Danger for Some) and part between 1.25 – 2.0 (Danger for Most), Depth 0 – 0.25m and Velocity 0 – 0.3m/sec.

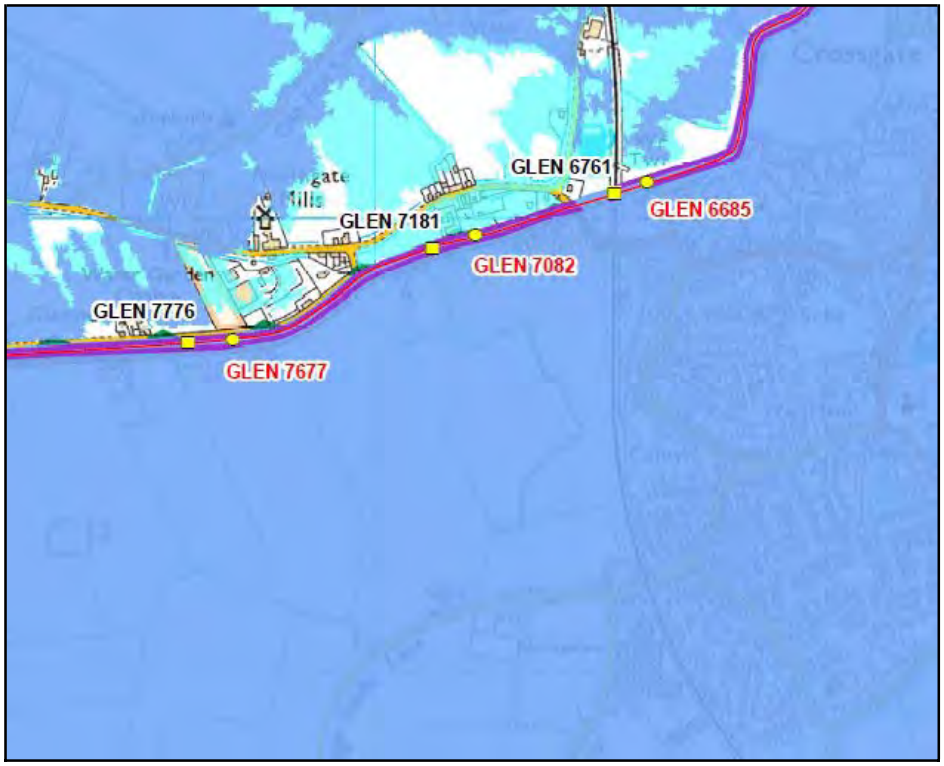
From the hazard maps, for the 1% Fluvial, 0.5% Tidal event 2115, the maps show that the site where the proposed dwellings are to be built is partly within a Hazard Rating area of between 1.25 - 2.0 (Danger for Most) and partly within a Hazard Rating area of 0.75 – 1.25 (Danger for Some) with a velocity of 0 - 0.3m/sec,

with a depth of flow 0.25 – 0.5m. **Maps 4, 5 & 6.**

River Glen

The River Glen lies some 980m to the north of the site and the present day 1 in 100-year flood level with 20% climate change is 4.87mODN. The flood defences of the River Glen between Herring Bridge and the A151 bridge consist of the B1180 Road which are in good condition and the crest heights for the right bank along this stretch of river are circa 5.90mODN. (SHDC SFRA)

The fluvial flood data for the model nodes shown on the map are set out in the tables below.



Fluvial Flood Levels (mODN)

The fluvial flood levels for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

			Annual Exceedance Probability - Maximum Water Levels (mODN)										
Node Label	Easting	Northing	50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	5% (1 in 20)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
GLEN 6685	523603	326081	4.01	4.16	4.23	4.31	4.34	4.35	4.38	4.84	4.44	4.60	4.94
GLEN 7082	523224	325963	4.04	4.17	4.25	4.32	4.36	4.39	4.41	4.87	4.49	4.70	5.01
GLEN 7677	522687	325733	4.06	4.20	4.28	4.35	4.41	4.43	4.45	4.91	4.54	4.79	5.07

Fluvial Flood Flows (m³/s)

The fluvial flood flows for the model nodes shown on the attached map are set out in the table below. They are measured in metres cubed per second (m³/s).

			Annual Exceedance Probability - Maximum Flows (m³/s)										
Node Label	Easting	Northing	50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	5% (1 in 20)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
GLEN 6761	523531	326057	25.95	29.44	31.06	33.13	34.59	35.32	35.84	43.56	38.87	48.22	56.95
GLEN 7181	523130	325934	25.69	29.20	30.85	32.93	34.37	35.09	35.60	43.18	38.62	48.05	56.90
GLEN 7776	522589	325726	25.40	29.03	30.65	32.71	34.14	34.86	35.37	42.73	38.33	48.07	56.87

This data is taken from the Welland Model (2016) and are the most up-to date currently available. The Environment Agency aim to review the models on a regular basis.

These levels are “in-channel” levels and therefore may not represent the flood level on the floodplain, particularly where the channel is embanked or has raised defences.
The site lies within the Anglian River Basin District, Peak River flows should be adjusted to reflect the latest climate change allowances. It must also be assumed, to provide a worst-case scenario, that flood defences have been raised during this period to cater for the rise in river level.

Using the Peak River Flows from the NPPF Climate change allowances shown in Table 1 in the spread sheet for the 1 in 100-year scenario. The graph and data show a prediction for the increase in river levels for the 35% and 65% increase in river level of: - **Appendix A**

EXTRAPOLATED WATER LEVEL OUTPUTS AT NODE Glen 7082		
Upper End Scenario	**5.05**	mODN
Higher Central Scenario	**4.80**	mODN
Central Scenario	**4.71**	mODN

With the crest level of the B1180 road being circa 5.90mODN the climate change river levels for the Higher Central (35%) and Upper End (65%) would remain in channel.

The greatest risk of flooding of the site would therefore be from a breach to the tide earth embankments for the River Welland.

The minimum mitigation measures required for developments that do have any ground floor sleeping shall be determined by the flood depths arising from the 2115 0.5% breach scenario. The finished floor Level FFL of any new dwellings shall be informed by the flood depths. For flood depths between 0.25 – 0.5m deep the FFL shall be set at a minimum of 500mm above the ground level.

With the main risk to flooding of the site being tidal flooding following a breach to the tidal defences, any flooding from fluvial flooding sources has been mitigated against.

With the average site ground level being 3.00mODN, the minimum floor level will be set at 3.50mODN. which is considered to be above the tidal breach level to the River Welland for 2115.

South Holland District Council

In order to inform the process of risk assessment and site selection the District Council commissioned Haskoning UK Ltd Consultants to prepare a Strategic Flood Risk Assessment in December 2002.They have carried out an update of this report and this report was published in January 2010 and this was further updated in February 2017.

This Flood Risk Assessment has taken the results of the (2017) updated South Holland Strategic Flood Risk Assessment (SHSFRA) into account in its findings.

The whole of the tidal flooding information has been replaced by the mapping from the latest Environment Agency Tidal Hazard mapping. Where the mapping for an area contains both fluvial and tidal components,

the more severe of the two has been presented.

From the Residual Flood Hazard, Depth and Velocity Spalding - Year 2115 the1% Fluvial, 0.5% Tidal Event Probability maps, from the update of strategic flood risk assessment for South Holland District Council the site is affected from a breach to the flood defences and has been used in the findings of this assessment.

Welland & Deepings Internal Drainage Board

The proposed development site is located within Catchment area of Welland & Deepings Internal Drainage Board. The Board is responsible to operate and maintain the arterial fluvial system.

The Board's nearest watercourse is the Reedy Graft Drain adjacent to the "Dairy Substation" on Pennytoft Lane. located to the north east of the site. **Map 7**

Surface Water Flooding

In a low chance of occurring surface water event, the modelling shows that the site has three patches which could be subject to surface water flooding occurring of depths less that 300mm..Most the site is shown to be at no risk from surface water with isolated small areas at risk up to 300mm deep. The site is, therefore considered to be at low risk. Low risk means that each year this area has a chance of flooding of between 0.1% and 1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. **Map 8**

FLOODING FROM OTHER SOURCES

Flooding is a natural process and can happen at any time from sources other than watercourses and the sea.

- Flooding from land can occur from intense rainfall, often over short duration of time that is unable to soak into the ground or enter the drainage system. However, with the natural topographic nature of the ground being flat, with no high ground around the site this will not cause any rapid inundation of the site and is likely only lead to local ponding of shallow depth and low velocity following the natural land contours. The properties are also raised 500mm above the average ground level. The updated SFRA concluded that flooding from this source is limited to minor isolated cases and is not of strategic significance as regards to flood risk.

- The area is not known to suffer from any groundwater problems and therefore is taken as having no strategic significance as regards to flood risk.

- Flooding from sewers can occur from over loading from heavy rainfall caused by blockages or having inadequate capacity. The resulting back pressure could cause foul sewage to flow from manholes which would flow over areas of the carriageway at a lower level and be contained within the confines of the kerb lines following the natural land contour to the south-west. The Updated SFRA

concluded that flooding from sewers is limited to minor isolated cases and is not of strategic significance as regards to flood risk.

- Non-natural or artificial sources of flooding such as reservoirs, lakes or canals where water is stored above natural ground level could cause flooding if the structure fails or is over topped.

SEQUENTIAL APPROACH

When applying the sequential approach for flood risk in accordance NPPF he site would fall into Zone 3a (High Probability) as the site is shown to be within the tidal flood plain as shown on the Environment Agency's Flood Map without defences in place.

However, the results of the updated SHSFRA shows that the site is located within a low/medium probability flood zone, but the area is reliant on protection by flood defences providing a standard of protection of 1 in 100 years return period.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF, the proposed residential development is classified as "More Vulnerable", with Table 1 of NPPF stating that such uses are appropriate in this zone (as summarised in Table 3 NPPF).

TABLE 3: Flood risk vulnerability and flood zones 'compatibility'

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Flood Zone 1	✓	✓	✓	✓	✓
	Flood Zone 2	✓	✓	Exception Test required	✓	✓
	Flood Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
	Flood Zone 3b Functional Floodplain	Exception Test required	✓	✗	✗	✗

The Sequential and Exception Tests are subject to a separate report and for the purpose of this flood risk assessment they are deemed to have been satisfied.

The properties will have the provision of a safe haven, at first floor level, which above the predicted flood level, for residents to await the flood level to recede or to be rescued.

DRAINAGE STATEMENT

This drainage statement, for the site, is a preliminary overview and will be subject to the detailed design being undertaken when planning permission and final layout has been determined. It is proposed to utilise attenuation techniques to reduce the storm water discharge from the proposed development and to minimise the impact of the development on the surrounding area and to comply with EA guidelines, which require at

least one workable solution for managing surface water.

From a site investigation, it would appear that the previous development, as a Dairy discharged the surface water from the site into the surface water sewer in Pennyfields, which outfalls into the IDB drain (Reedy Graft Drain) alongside Pennytoft Lane.

In accordance with recognised guidance, National Planning Policy Framework 2012, there is a hierarchy of where surface water should discharge. This hierarchy should be followed where practicable, and is as follows:

1) Infiltration
2) Watercourse
3) Public sewer

Infiltration

No infiltration methods are to be utilised on this development as the infiltration tests were negative.

Watercourse / Existing Surface Water Sewer

The pre-existing surface water connection to the sewer network for will be used as the method of disposal of surface water from the road network together with the domestic curtilage roof areas and driveways after attenuation at a maximum discharge rate of 5 litres/sec. (default Greenfield rate) The surface water manhole is located at the existing site entrance, as shown on the topographical survey.

A surface water balancing tank will provide storage at the flow control location. An orifice plate flow control device could attenuate flows down to the permitted discharge rates for 1 year, 30-year and up to the 1:100 year plus 30% climate change standard (default value 5 litres/sec). Flows for these figures would be stored in the attenuation tank where the flow would be detained, for a period of time, before draining back down. It is proposed that the attenuation storage will be by using geocellular units forming an offline attenuation tank, located under the 'spur' private drive, running parallel with Pennyfield. This is, of course subject to detailed design and may change. This will be connected into 300mm diameter sewer in the road using the existing connection which served the former dairy site. This sewer runs down Pennyfield, across the T-junction and discharges via flap-valve into the IDB watercourse (Reedy Graft Drain) on the far side of Pennytoft Lane.

The redevelopment of the site, will significantly reduce the unattenuated impermeable area from the site's previous use as a dairy (approaching 100% impermeable area) to the proposed residential use.

There is currently no intention to have the access road adopted, the geocellular storage system and the SW system will be similarly unadopted.

This statement contains schematic concept drainage proposals. The detailed road and foul and surface water sewer design for the entire development would proceed, following receipt of planning approval and drawings. A management agreement consisting of the 9 property owners will be drawn up for the maintenance of the entire surface water drainage system.

Foul Water

Foul sewers and individual property drains will be provided to serve the development and connected into the Anglian Water sewer in Pennyfields using the existing connection which served the former dairy site.

As there is a positive drainage system capable of receiving flows from the development there is no likely impact on neighbouring property.

CLIMATE CHANGE

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events as both tidal and fluvial flooding. The Climate change allowances in the NPPF Guidance was updated on the 19th February 2016.

The site is located within the Anglian River Basin, for sites within Flood Zone 3a and for "More vulnerable" land uses the Higher Central and Upper End river flow allowances figures in Table 1 should be used.

Table 1 Peak river flow allowances by river basin district (1961 to 1990 baseline)				
ver basin District	llowance category	Total potential change anticipated for '2020s' (2015 to2039)	Total potential change anticipated for '2050s' (2040 to2069)	Total potential change anticipated for '2080s' (2070 to2115)
Anglian	Upper End	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

The effect of global warming on peak rainfall allowances is given in Table 2.

Table 2 Peak rainfall intensity allowance in small and urban catchments (1961 to 1990 baseline)			
Applies across all of England	l potential change anticipated for 2010 to 2039	l potential change anticipated for 2040 to 2059	l potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Higher Central	5%	10%	20%

The annual sea rise due to climate change is given in NPPF and the recommended contingency allowances are stated in Table 3

Table 3 Peak sea level allowance for each epoch in (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)					
Area of England) (Use River Basin maps	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative Rise 1990 to 2115 (m)
East, Midlands, London, South East	4 (140mm)	8.5 (212.5mm)	12 (360mm)	15 (525mm)	1.24m

From Information requested from the Environment Agency the Main risk of flooding of the site is from the tidal River Welland which is located some 2.3 Km east of the site and is tidal down stream of Marsh Lane Sluice, the 1 in 200-year tide flood level for year Present Day (2006) at Marsh Road (Tidal River) 0.5% (1 in 200) = 5.98mODN. Peak tide levels (2116) at Marsh Road (Tidal River) 0.5% (1 in 200) = 5.98mODN plus climate change allowances from Table 3 of 1.21mm = 7.11mODN

The tidal flood defences of the tidal River Welland consist of earth embankments which are provided with a soak dyke on the landward toe, they are in good condition and the minimum crest heights are 7.57mODN. This provides a protected freeboard of 360mm.

With the floor level being decided from the breach tidal flood depths, any flooding from fluvial sources is considered to be less.

FLOOD PROTECTION

Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design and construction techniques. There are two forms of flood protection works: -

- **Flood-resistance or proofing works**: - these try to reduce the amount of water entering a building.
- **Flood-resilient works: -** these reduce the amount of damage caused by water entering the building.

The proposed property will have the following resilient measures incorporated in the construction in accordance with “Improving the flood performance of new buildings” CLG (2007).

- The lowest ground floor level for the properties is to be raised 500m above existing average ground level with a lowest level being 3.50mODN.

- Arrange for all service circuits at ground floor level to be routed at first floor level and where practical socket outlets, boilers etc. to be a minimum of 0.5m above the raised ground floor level.

- As this site is in an area that is capable of receiving flood warnings from the Environment Agency Floodline Warning Direct system. It is recommended that the individual property Owner contact the Environment Agency’s Floodline on 0845 988 1188 to register the property to receive advance warning of flooding by telephone, mobile, fax, SMS text, email or pager. The Environment Agency aim to issue a ‘severe flood warning’ approximately 2 hours before existing defences are overtopped.

CONCLUSION

- The proposed development site is shown to be within Flood Zone 3a ‘High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences.

- The site does have the protection of both tidal and fluvial flood defences which are well maintained by the Environment Agency.

- The lowest ground floor level for the properties is to be raised 500m above the existing average ground level with the lowest level being 3.50mODN, which is considered to be above the 2115 climate change breach level at the site.

- The Flood Risk Vulnerability Classification in Table 2 of NPPF Technical Guide the proposed residential development is classified as “More Vulnerable”, with Table 1 of NPPF Technical Guide stating that such uses are appropriate in this zone subject to the Exception Test.

- The drainage strategy for the development is the utilisation of on- site Suds attenuation methods.

- Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design, including such flood resilient materials and using such flood resistant construction techniques as appropriate for the properties location.

- Flooding from other sources is unlikely to affect the site.

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APPENDIX

Document 1	Climate Spreadsheet & Graphs.
Map 1	Extract from Environment Agency Flood Zone and Node Point Map.
Map 2	Flooding from Rivers and Sea Map.
Map 3	Tidal Model Analysis 2006 Map.
Map 4	South Holland SFRA Residual Flood Hazard Spalding year 2115 (1% Fluvial 0.5% Tidal 0.5 %) Event Probability
Map 5	South Holland SFRA Residual Peak Depth Spalding year 2115 (1% Fluvial 0.5% Tidal 0.5 %) Event Probability
Map 6	South Holland SFRA Residual Peak Velocity Spalding year 2115 (1% Fluvial 0.5% Tidal 0.5 %) Event Probability
Map 7	Welland & Deepings IDB Drainage Plan
Map 8	Surface Water Flood Map
Plan 1	Location Plan
Plan 2	Proposed Layout Plan
Plan 3	Topographical Survey

Site Name	**Pennyfield Pinchbeck**
Date	**Dec-17**
Comments:	**FRA**
Environment Agency CCN Number	**CCN-2017-39799**

INPUT DATA TO BLUE CELLS ONLY

Model Information

OUTPUTS IN YELLOW CELLS

Model Name	**Welland model**
Date of Model	**Jul-05**
Model Node	**Glen 7082**

Modelled Results

Re-order based on Flow	FLOW	LEVEL
2	25.69	4.04
5	29.20	4.17
10	30.85	4.25
22	32.93	4.32
50	34.37	4.36
75	35.09	4.39
100	35.60	4.41
200	38.62	4.49
100+20	43.18	4.87
1000	48.05	4.7
1000+20	56.90	5.01

Attenuation Factor

-1.07 % FOR 1:100

1.34 % FOR 1:1000

Note: Higher attenuation factors mean results through extrapolation. will be over estimated

River Basin	Anglian	
Time Horizon	Up to 2115	
AEP Scenario	100	AEP

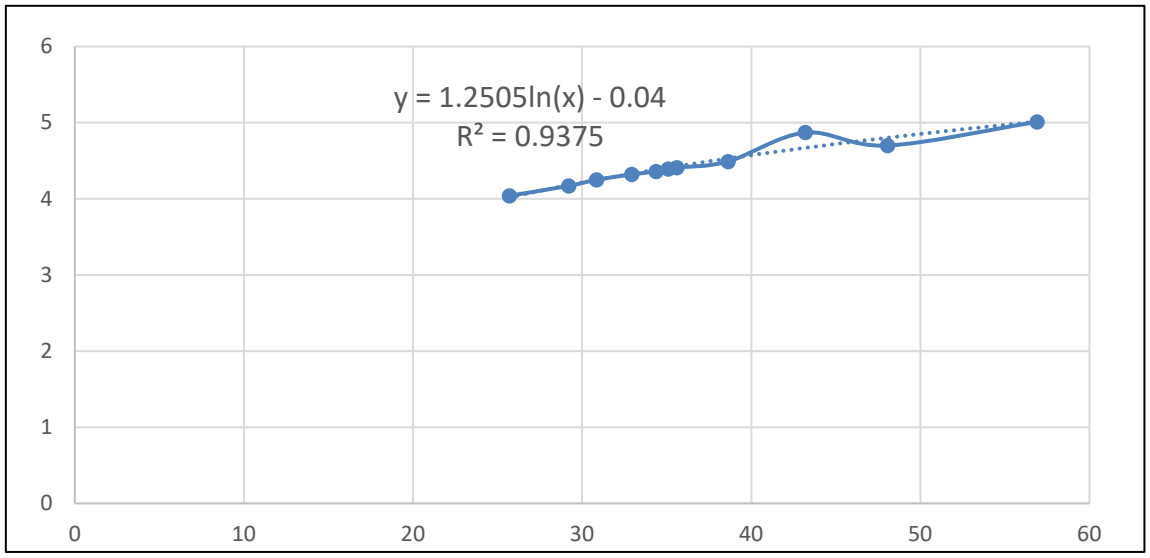
MAKE SURE YOU COPY THE FORMULA VARIABLES AND R2 ON THE GRAPHS TAB!

EXTRAPOLATED WATER LEVEL OUTPUTS AT NODE		
Upper End Scenario	**5.05**	mODN
Higher Central Scenario	**4.80**	mODN
Central Scenario	**4.71**	mODN

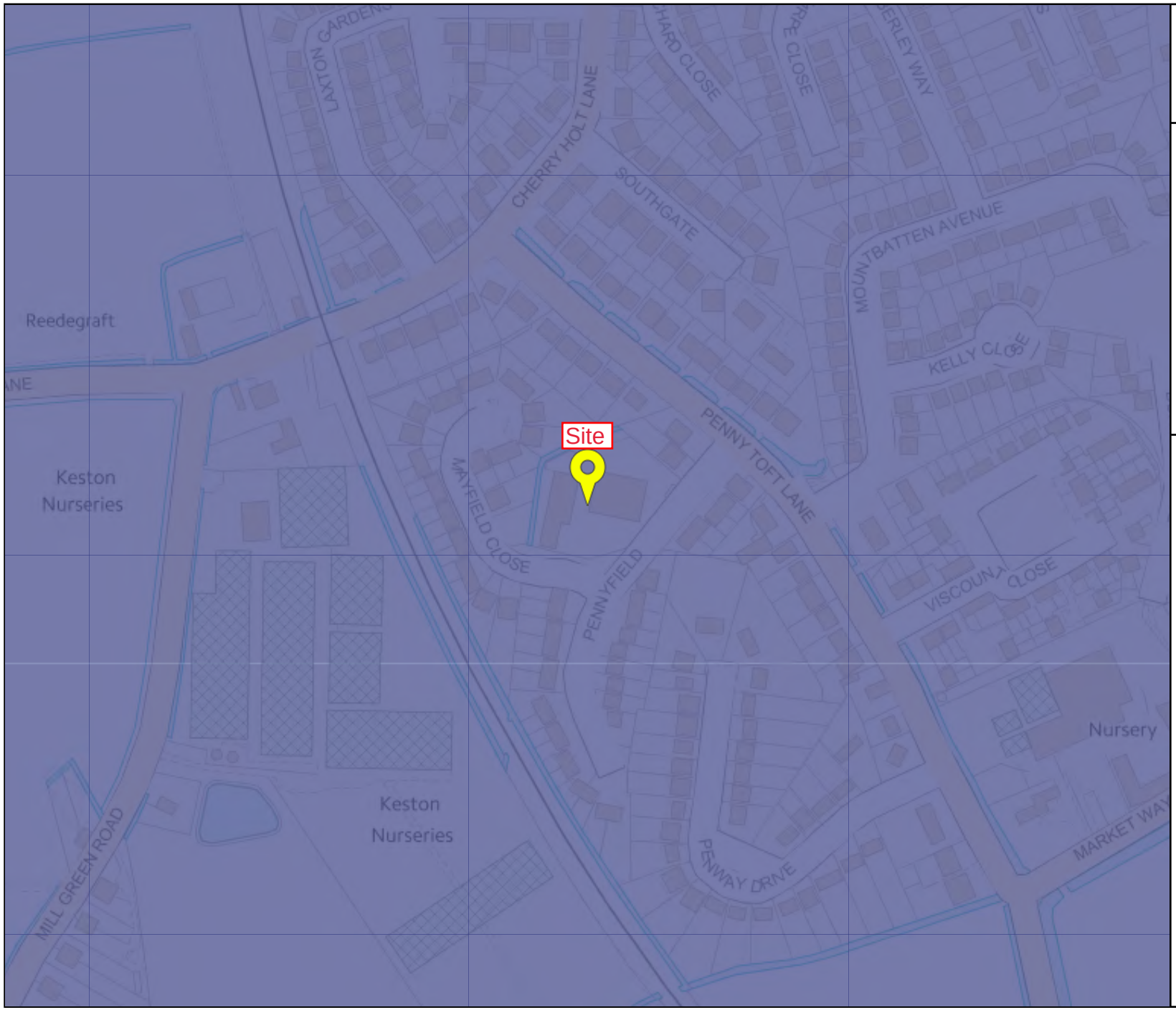
Log Interpolation

EQUATION > **1.2505** **-0.04** < include sign ie +/-

	1 in 100		1 in 1000	
	FLOW	**LEVEL**	**FLOW**	**LEVEL**
65%	58.74	5.05	79.28	5.43
35%	48.06	4.80	64.87	5.18
25%	44.50	4.71	60.06	5.08



R2 value **0.9375**



Environment Agency

Flood map for planning

Your reference
Pennyfields

Location
523756/325091

Scale
1:3125

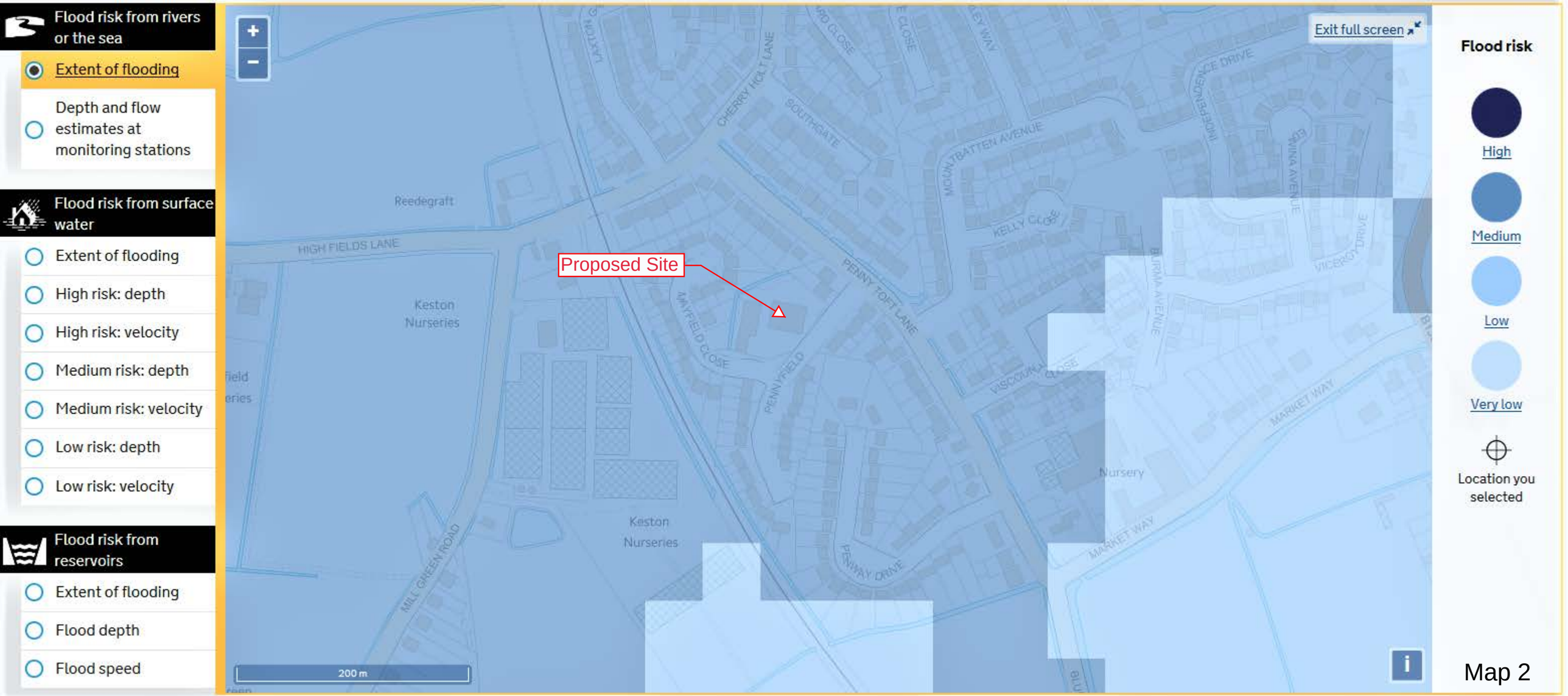
Created
10 Jan 2018 3:49

- Development location
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 50 100 150m

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Map 1


Flood risk from rivers or the sea
Extent of flooding
Depth and flow estimates at monitoring stations
Flood risk from surface water
Extent of flooding
High risk: depth
High risk: velocity
Medium risk: depth
Medium risk: velocity
Low risk: depth
Low risk: velocity
Flood risk from reservoirs
Extent of flooding
Flood depth
Flood speed
Exit full screen
Proposed Site
Reedegraft
HIGH FIELDS LANE
Keston Nurseries
Keston Nurseries
Nursery
MILL GREEN ROAD
MARKET WAY
PENNY FOFT LANE
PENNYFIELD
PENWAY DRIVE
MOUNTBATTEN AVENUE
KELLY CLOSE
BURMA AVENUE
MYFIELD CLOSE
SOUTHGATE
CHERRY HOLT LANE
200 m
Flood risk
High
Medium
Low
Very low
Location you selected

Map 2

Tidal Level Location Map
Lincolnshire & Northamptonshire Area



Map 3

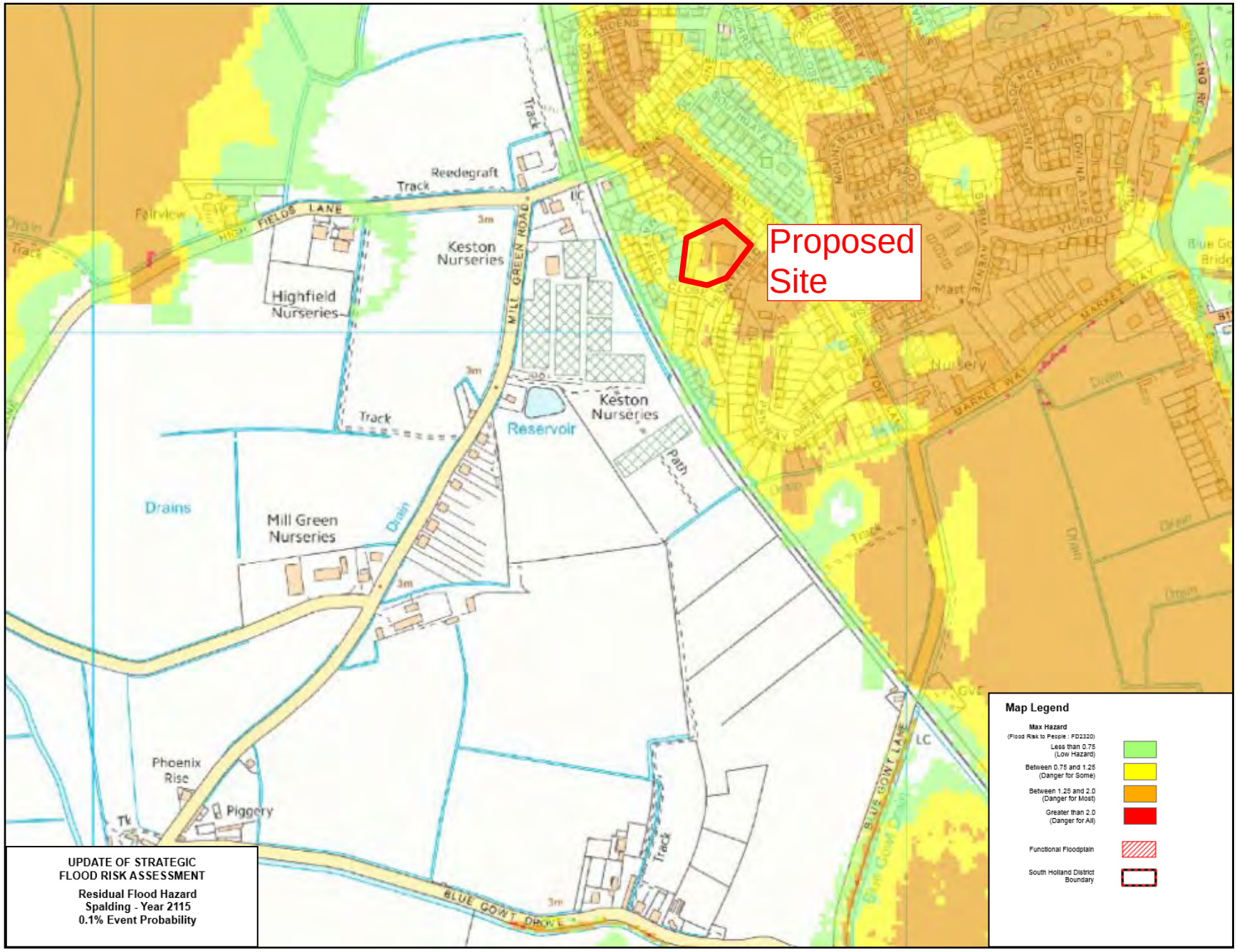
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Tidal Water Levels for the South Humber, East Coast and The Wash

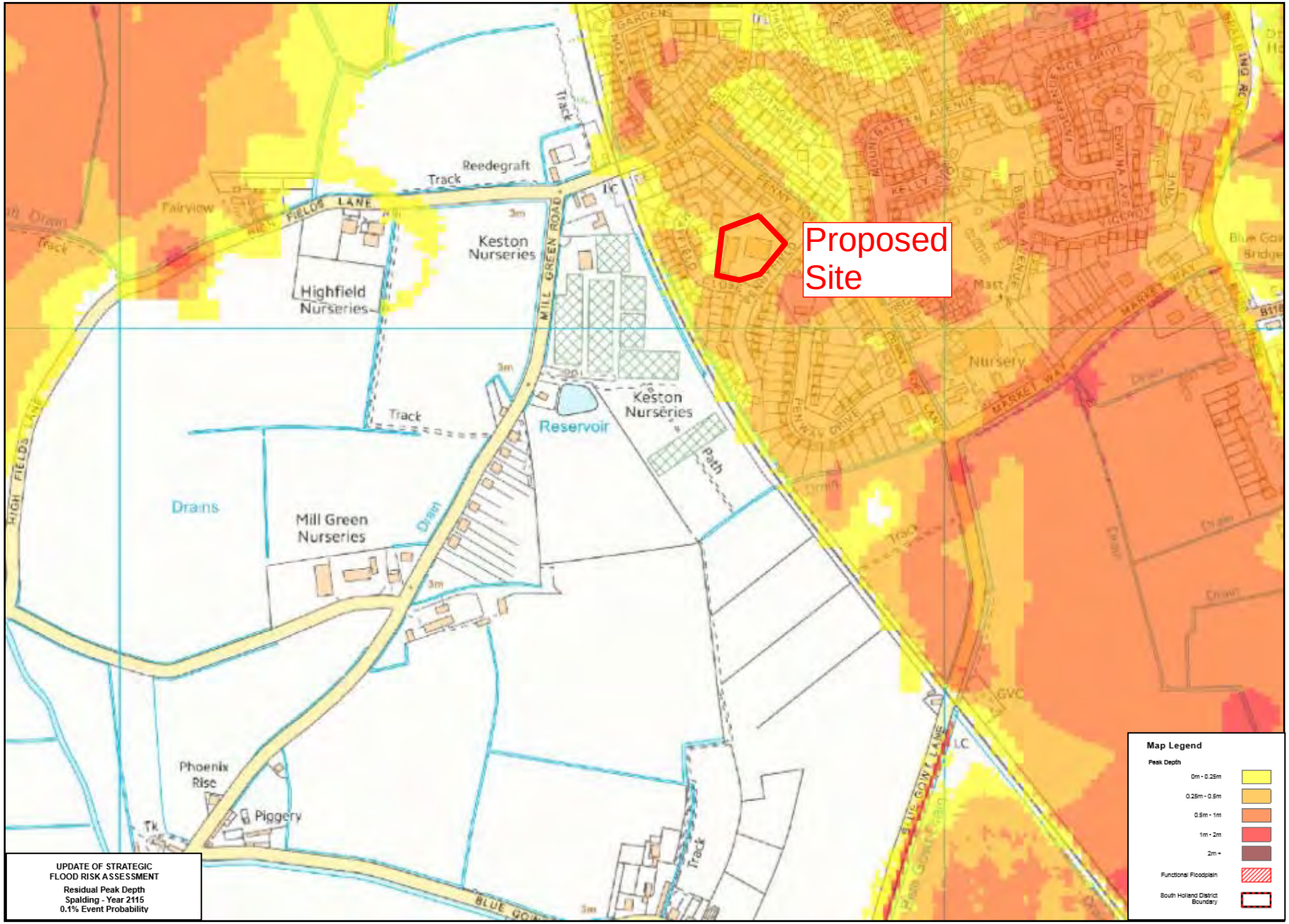
The table below shows still water levels for locations, from the above location map, around the South Humber Estuary, East Coast and The Wash. It is important to note the following:

- The base date for the data is 2014 for the South Humber and 2006 for the East Coast and The Wash.
- The data are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- The water level quoted is the 'Best Estimate' water level. Depending on the use of the data it may be necessary to carry out sensitivity testing. Upper and Lower 95% confidence bandings are available upon request.
- Levels for other annual chance scenarios are available if required.

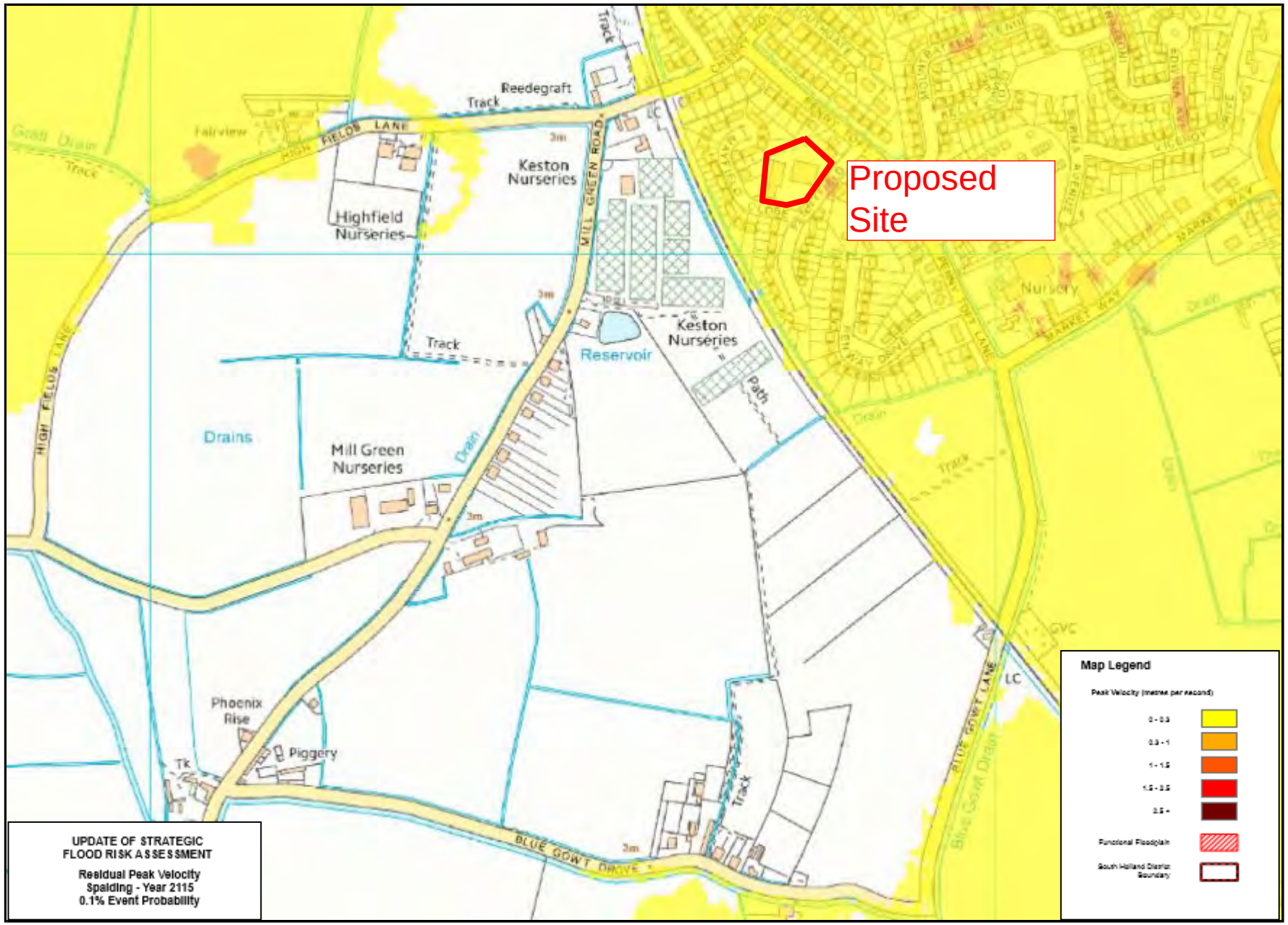
Ref	Location	Easting	Northing	Annual Chance (1 in x) of Tide Level metres ODN					
				1	10	50	100	200	1000
HUMBER									
H030	Tetney	535420	403180	3.94	4.29	4.56	4.69	4.82	5.15
H050	Buck Beck	532700	406580	4.03	4.36	4.62	4.74	4.87	5.18
H060	Grimsby	527878	411346	4.10	4.43	4.70	4.82	4.95	5.27
H080	Haborough Marsh	520790	415740	4.26	4.61	4.88	5.01	5.14	5.47
H090	Immingham	519141	417449	4.26	4.61	4.88	5.01	5.14	5.47
H100	South Killingholme	518700	417120	4.41	4.77	5.05	5.18	5.32	5.66
H130	North Killingholme	516530	420000	4.51	4.87	5.15	5.28	5.42	5.77
H150	East Halton	514450	422870	4.59	4.96	5.25	5.39	5.53	5.89
H170	Goxhill	511970	425440	4.67	5.04	5.34	5.47	5.61	5.95
H200	New Holland	508020	424330	4.87	5.26	5.55	5.68	5.81	6.12
H210	Barrow Haven	506380	422620	4.92	5.31	5.60	5.73	5.86	6.17
H220	Ferriby	497550	421150	5.04	5.42	5.67	5.77	5.86	6.04
H230	Winterton	493420	422830	5.14	5.51	5.74	5.83	5.90	6.02
H250	Blacktoft	484247	424190	5.25	5.62	5.83	5.90	5.96	6.04
H270	Goole	474857	422960	5.46	5.85	6.07	6.15	6.21	6.29
East Coast									
~	Great Eau	545500	393800	3.80	4.19	4.46	4.57	4.69	4.96
~	Boygrift	553300	379800	3.84	4.24	4.53	4.65	4.77	5.05
~	Burgh Sluice	555190	358620	4.26	4.45	4.76	4.90	5.03	5.34
Wash									
~	Hobhole	536610	339940	4.82	5.30	5.64	5.78	5.93	6.27
~	Lawyers Sluice	540750	334550	4.84	5.32	5.66	5.80	5.95	6.29
~	West Lighthouse	549150	325750	4.88	5.37	5.71	5.86	6.01	6.35
~	Grand Sluice	532400	344500	4.88	5.33	5.65	5.78	5.93	~
~	Fosdyke Bridge	531700	332200	4.91	5.38	5.71	5.85	5.99	~
~	Marsh Road	526000	324000	5.04	5.44	5.73	5.85	5.98	~
~	Wisbech	546100	310000	4.83	5.25	5.53	5.66	5.78	~
~	Dog In Doublet	527300	299300	3.67	4.00	4.22	4.32	4.42	~


Proposed Site
Reedegraft Track
HIGH FIELDS LANE
MILL GREEN ROAD
Keston Nurseries
Highfield Nurseries
Keston Nurseries
Reservoir
Track
Path
Drains
Mill Green Nurseries
Drain
Phoenix Rise
Piggery
BLUE GOWT DROVE
BLUE GOWT LANE
Fairview
Nursery
MARKET WAY
Map Legend
Max Hazard
(Flood Risk to People : FD2320)
Less than 0.75 (Low Hazard)
Between 0.75 and 1.25 (Danger for Some)
Between 1.25 and 2.0 (Danger for Most)
Greater than 2.0 (Danger for All)
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Flood Hazard
Spalding - Year 2115
0.1% Event Probability

Map 4


Proposed Site
Reedegraft Track
Fairview
HIGH FIELDS LANE
Keston Nurseries
Highfield Nurseries
MILL GREEN ROAD
Track
Reservoir
Keston Nurseries
Path
Drains
Mill Green Nurseries
Drain
Phoenix Rise
Piggery
Tk
Track
BLUE GOWT LANE
LC
GVC
Nursery
MARKET WAY
Mast
Map Legend
Peak Depth
0m - 0.25m
0.25m - 0.5m
0.5m - 1m
1m - 2m
2m +
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Peak Depth
Spalding - Year 2115
0.1% Event Probability

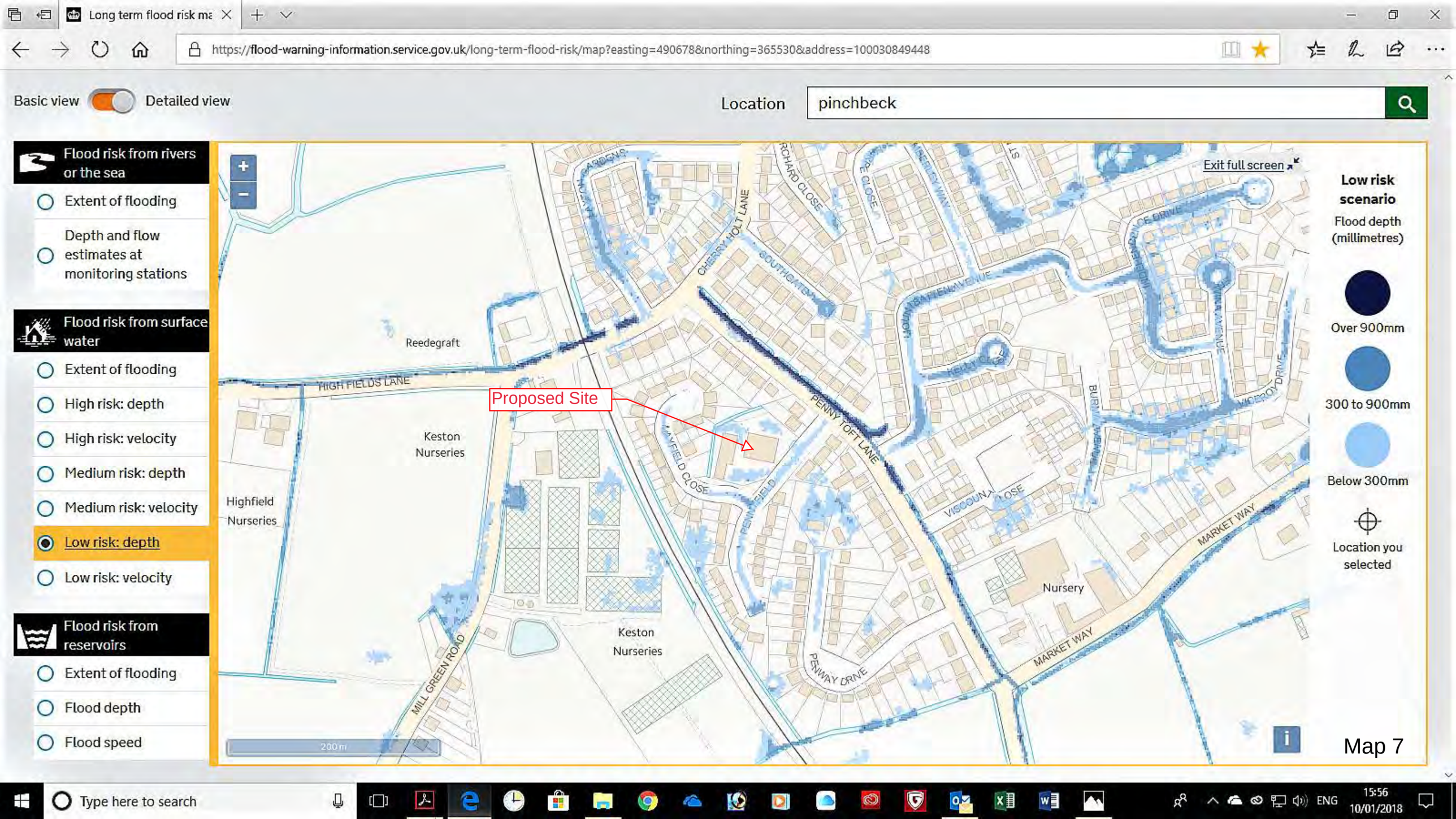
Map 5


Proposed Site
Reedegraft Track
HIGH FIELDS LANE
Keston Nurseries
Highfield Nurseries
MILL GREEN ROAD
Track
Reservoir
Keston Nurseries
Path
Drains
Mill Green Nurseries
Drain
Phoenix Rise
Piggery
Track
BLUE GOWT DRIVE
BLUE GOWT LANE
Blue Gowt Drain
Nursery
Map Legend
Peak Velocity (metres per second)
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Peak Velocity
Spalding - Year 2115
0.1% Event Probability

Map 6


Reedy Graft Drain
Reedy Graft 87
Site
Keston Nurseries
Keston House
North Holland
Gate House
Reedegrah
Track
Drain
3.4m
3.7m
Lc
LAXTON GARDENS
CHERRY HOLT LANE
SOUTHGATE
Glynde Bourne
088-P05
088-P04
088-P03
088-P02
088-P01
MOUNTBATTEN AVENUE
KELLY CLOSE
PENNY FORT LANE
MAYFIELD CLOSE
PENNYFIELD
VISCOUNT CLOSE
PENWAY DRIVE
Play Area
Dairy
Ppg Sta
Tank
Mast (Telecommunication)
Nursery
Reedy Graft Drain
Reservoir
Path
Rosedene Cottage
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Ordnance Survey 0100002490
N
S
E
W
125
62.5
0 Meters

Map 8


Long term flood risk ma
https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=490678&northing=365530&address=100030849448
Basic view
Detailed view
Location
pinchbeck
Flood risk from rivers or the sea
Extent of flooding
Depth and flow estimates at monitoring stations
Flood risk from surface water
Extent of flooding
High risk: depth
High risk: velocity
Medium risk: depth
Medium risk: velocity
Low risk: depth
Low risk: velocity
Flood risk from reservoirs
Extent of flooding
Flood depth
Flood speed
Exit full screen
Low risk scenario
Flood depth (millimetres)
Over 900mm
300 to 900mm
Below 300mm
Location you selected
Proposed Site
Reedegraft
HIGH FIELDS LANE
Keston Nurseries
Highfield Nurseries
Keston Nurseries
MILL GREEN ROAD
CHERRY HOLT LANE
SOUTHGATE
PENNY TOFT LANE
HAYFIELD CLOSE
PENNFIELD
PENWAY DRIVE
MARKET WAY
Nursery
200 m
Map 7
Type here to search
ENG
15:56
10/01/2018

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BLOCK PLAN
1:500



LOCATION PLAN
1:500

LINDUM BMS

Client: Co-op

Project: Pennyfield, Pinchbeck

Drawing: Existing Site Plans

Date: Feb 2017 | Scale: As Shown | Drawn: SR | Checked: IH | Size: A2

Status: PLANNING

Drawing No.: 3146 402 01 | Revision: –

Existing Site Plans
Co-op, Pennyfield, Pinchbeck

N

0 50metres

PENNYFIELD

1.
2.
3.
4.
5.
6.
7.
8.
9.

Ha
Ke
'B'
Am

Revision A - Plot 1 type amended. MJE 10/11/17

F1738 SK01A PROPOSED SKETCH LAYOUT
PENNYFIELDS, PINCHBECK
1:500 at A3

Framework Architects

Plan 2

NORTH

DENSE TREES & VEGETATION (INDIVIDUAL TREES NOT SURVEYED) IN THIS AREA

DENSE TREES & VEGETATION (INDIVIDUAL TREES NOT SURVEYED) IN THIS AREA

DENSE BUSHES

HEDGE

OVERHANGING TREES

TOE TO BAL CONTOURS

FN TOP 5.00

CLOSE BOARD WOODEN FENCE

WALL CONTINUES

WALL (WITHIN DENSE VEGETATION)

BANK BOTTOM

POSTS

BRICK WALL

RIDGE 8.89

DWELLING

TIMBER SHED

WL TOP 9.13

DRIVEWAY

TARMAC PATH

KERBS / CHANNELS

GY

LARGE BUSH

FMH
CL 3.33
IL 0.57 (225Ø)
IL 0.43 (LARGE Ø7 PIPE)

STRM 300Ø

TARMAC ENTRANCE

METAL GATES

TARMAC FEDRE

KERB ROAD

ROOT

GRASS VERGE

TARMAC PATH

STRM

PENNYFIELD

CHANNELS ONLY

FMH
CL 3.24
IL 1.40

150Ø

SMH
CL 3.27
IL 1.87

BTMH

EAVES 5.87

NEIGHBOURING DWELLINGS

RIDGE 8.19

EAVES 5.83

RIDGE 8.11

NEIGHBOURING DWELLINGS

MH
CL 3.35
HIGHWAY DRAIN

FH

WTR

ROUGH GROUND (AREA NOT CONTOURED DUE TO VERY UNEVEN TOPOGRAPHY. UNABLE TO GIVE TRUE REPRESENTATION OF NATURAL SURFACE)

HEAP

CHILDRENS PLAY AREA

MH WITHIN HEDGE (UNABLE TO SURVEY)

METAL FENCE

BRICK WALL

FLOOD LIGHT

WL TOP 9.16

GRASS AREA

GRASS AREA

MH
CL 3.27

TARMAC PATH

KERBS • CHANNELS

MAYFIELD CLOSE

RS

FMH
CL 3.24
IL 1.37

SMH
CL 3.27
IL 1.90

1500

2250

KERBS • CHANNELS

TARMAC PATH

EAVES 5.80

RIDGE 7.89

NEIGHBOURING DWELLINGS

E537200.00 E537400.00 E537600.00 E537800.00 E538000.00 E538200.00 E538400.00

N325140.00 N325120.00 N325100.00 N325080.00 N325060.00 N325040.00

NOTES

ABBREVIATIONS & SYMBOLS

AV	AIR VALVE	OHC	OVERHEAD CABLE
BH	BORE HOLE	PB	POST BOX
BOL	BOLLARD	PINV	PIPE INVERT LEVEL
CATV	CABLE TV MH	PM	PARKING METER
CCTV	SECURITY CAM	PO	POST
CL	COVER LEVEL	PT	PIPE TOP LEVEL
CH	CHANNEL	P/R	POST & RAIL FENCE
COL	COLUMN	P/W	POST & WIRE FENCE
DC	CABLE TV LID	RD	EDGE OF ROAD/NO KERB
DP	DOWN PIPE	RE	RODDING EYE/POINT
DR	DRAIN	RL	RIDGE LEVEL
EL	EAVES LEVEL	RP	REFLECTIVE POST
EP	ELECTRIC POLE	RS	ROAD SIGN
ER	EARTH ROD	SLVL	STONE LEVEL
FB	FLOWER BED	SOFF	SOFFIT LEVEL
FH	FIRE HYDRANT	SV	VALVE
FFL	FINISHED FLOOR LEVEL	SW	SURFACE WATER
FP	FLAG POLE	Tac	TACTILE PAVING
FW	FOUL WATER	TH	TRIAL HOLE
GV	GAS VALVE	TL	TRAFFIC LIGHTS
HW	HEADWALL	TLVL	TARMAC LEVEL
IC	INSPECTION COVER	TOW	TOP OF WALL LEVEL
IL	I NVERT LEVEL	TP	TELEGRAPH POLE
KB	KERB BOTTOM	TRK	TRACK
KO	KERB OFFLET	UTL	UNABLE TO LIFT
KT	KERB TOP	VP	VENT PIPE
LP	LAMP POST	WL	WATER LEVEL
LC	LIGHT COLUMN	WLVL	WATER LEVEL
MH	MANHOLE	WM	WATER METER
MP	MARKER POST	WO	WASH OUT POINT

FENCE, HEDGE, ELECTRIC, BANK EDGE, STORM LINE, FOUL LINE, TELECOM LINE, GAS LINE, LARSON PILES, CHANNELS, WATER MAIN

TREE, BOREHOLE, STATION, TBM, MANHOLE, GULLY, BATTER, WATER LVL, GATE

1. THE POSITION OF THIS SURVEY IS BASED ON GPS OSTN15 GRID.

2. ALL LEVELS RELATE TO GPS DATA ACQD USING TRIMBLE VRS.

3. TREES SPREADS ARE DRAWN TO SCALE AND SHOW THE GENERALAVERAGE CANOPY SPREAD.

4. ALL BELOW GROUND LEVEL INFORMATION INCLUDING VOIDS, DRAINAGE & SERVICES HAVE BEEN IDENTIFIED FROM THE SURFACE LEVEL ONLY. THEREFORE PIPE SIZES ETC ARE ESTIMATIONS ONLY. ALL CRITICAL DIMENSIONS SHOULD BE CHECKED PRIOR TO THE COMMENCEMENT OF ANY SITE WORKS

5. EVERY EFFORT HAS BEEN MADE TO LOCATE AND SURVEY ALL VISIBLE FEATURES. IT SHOULD BE NOTED THAT SOME ITEMS MAY HAVE BEEN OBSCURED AT THE TIME OF THE SURVEY AND THEREFORE NOT SHOWN ON THIS DRAWING.

6. PHYSICAL BOUNDARY FEATURES SHOWN ON THIS DRAWING DO NOT NECESSARILY REPRESENT THE ACTUAL LEGAL BOUNDARIES. THIS INFORMATION SHOULD BE CONFIRMED WITH THE RELEVANT DOCUMENTATION.

7. THE CONTRACTOR MUST CHECK AND VERIFY ALL SITE LEVELS, DIMENSIONS, UTILITIES AND DRAINAGE DETAILS PRIOR TO THE COMMENCEMENT OF ANY SITE WORKS. ANY DISCREPANCIES MUST BE NOTIFIED TO DANIEL CHARLES SURVEYS LTD.

8. ALL SURVEY STATION CONTROL POINTS MUST BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING ANY SITE WORKS.

SURVEY CONTROL POINT INFORMATION.

Point	Easting	Northing	Elevation
9000	523796.102	325069.973	3.374
9002	523823.187	325102.293	3.329

SURVEY DATE	02/03/2017	INITIALS	SRW/MJW

REV	AMENDMENTS	DRN	DATE

Client: LINDUM

Project Title: FORMER DAIRY SITE, PENNYFIELD, PINCHBECK

Drawing Title: TOPOGRAPHICAL SURVEY

Scale @ A1:	1:200	Date:	02/03/2017
Drawing No:	17 - 51 - 01	Rev:	
C.A.D.Title:	lindum pinchbeck dairy\master topo (17-51-01).mjo		
Drawn By:	SRW/MJW	Checked By:	MJW/SRW

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