

PROPOSED RESIDENTIAL DEVELOPMENT AT PETERBOROUGH ROAD
CROWLAND PE6 0BZ

FLOOD RISK ASSESSMENT



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This flood risk assessment and surface water plan has been prepared solely to support the planning application for the proposed development at Peterborough Road, Crowland. The author has made every effort to provide an accurate assessment of the flood risk but accepts no liability should the information be found to be incorrect or incomplete.

Introduction

An application is due to be submitted to South Holland District Council for planning permission for a residential development with 41 dwellings east of Peterborough Road, Crowland.

The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These maps do not take into account existing flood defences.

The Planning Application requires a Flood Risk Assessment to be carried out as required in the Technical Guidance to the National Planning Policy Framework.

The site is shown within the defended area of the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) map and is located in the North Level Internal Drainage Board district.

Application Site

The development is located east of the existing houses on Peterborough Road with an access between No 4 and No 8 Peterborough Road. The National Grid Reference of the site is 524200 309680.

The position and extent of the site is shown on the plan at the end of this document.

The proposed development is within Flood Zone 3(a) "High Probability" as detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, the site is classified as "more vulnerable" and Table 3 of the Guidance states that sequential and the exception test is required.

Sequential Test

The sequential test requires that the development is necessary, and that there should not be other reasonably available sites which are more favourably located with regard to flood risk which would meet this need.

South Holland district Council's emerging Local Plan indicates a need for an additional 300 dwellings in Crowland. Policy SG3 of the adopted Council Local Plan states that Crowland is an area centre, and that area centres should continue to provide for housing, employment and commercial development to support their roles as service centres for surrounding rural areas.

The central area of Crowland is higher than the surrounding areas and therefore has a lower flood risk. However all of the available sites are outside this higher area and are in Flood Zone 3.

Therefore the sequential test can be considered to be passed as there is a need for the housing and it cannot be accommodated in an area of lower flood risk.

Exception Test

The Sequential Test has demonstrated that it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding. Therefore the Exception Test must be applied and for this to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risks, informed by the Strategic Flood Risk Assessment; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking into account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.

Both parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

The first section will be demonstrated by the Supporting Planning Statement and compliance with South Holland District Council's planning policies.

This flood risk assessment will demonstrate that the development will be safe for its lifetime and it will not increase flood risk elsewhere.

Strategic Flood Risk Assessment

The following information about the flood risk at the location of the proposed development has been gained from the maps produced for the South Holland District Council Strategic Flood Risk Assessment:

1. Report Maps

- Map 5 indicates the site to be low or medium risk and protected by flood defences.
- Map 6 indicates the peak depth is zero for the present day 1% / 0.5% tidal event probability.
- Map 7 indicates the peak velocity is zero for the present day 1% fluvial / 0.5% tidal event probability.
- Map 12 indicates the actual risk extent for the year 2055 for the 1% fluvial / 0.5% tidal event probability is low or medium, and protected by flood defences.
- Map 13 indicates the actual risk extent site for the year 2115 for the 1% fluvial / 0.5% tidal event probability is low or medium, and protected by flood defences.
- Map 16 indicates the site is not within the rapid inundation zone.

2. Flood Maps Table D1

- The maps illustrate the actual flood hazard which is as follows:

For the present day

Depth of flooding ... zero

For year 2115

Extent of flooding .. low or medium
 Velocity ... Nil
 Depth of flooding ... Zero
 Extent of flooding ... low or medium
 Velocity ... Nil

- The maps also illustrate the residual flood hazard which is as follows:-

For the present day

Depth of flooding ... zero
 Extent of flooding .. low or medium
 Velocity .. zero

For the year 2115

Depth of flooding ... zero
 Extent of flooding .. Low to medium
 Velocity .. zero

3. Maximum flood levels:

Maximum fluvial flood levels in the River Welland at Crowland at chainages between 10km and 14km are shown in the reports as follows:

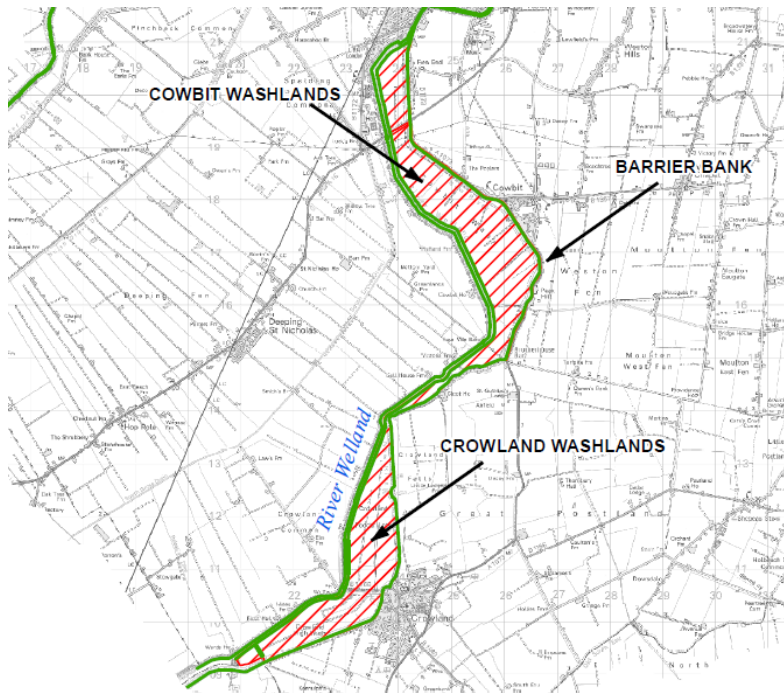
	Present	Present + Climate Change
1 in 100 year	4.76 - 4.99	4.81 - 5.03
1 in 1,000 year	4.79 - 5.03	4.82 - 5.05

The lowest level of the Barrier Bank of the River Welland stated in the SFRA is 5.81m OD at 10km and 6.08m OD at 14km.

Existing Flood Alleviation Measures

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains" and is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding due to overtopping or failures of the defences is considered to be very low.

The section of the River Welland from south of Crowland to the southern outskirts of Spalding has two washlands located on the east side of the River, called Crowland Washlands and Cowbit Washlands. These areas are designed to alleviate very high flows in the River Welland. When the water level in the River Welland reaches a level of approximately 5.10m OD large syphons are activated which discharge excess water onto the Washes. The Barrier Bank is located on the east side of the Washes to contain the water in the Washlands and is the main flood defence bank on the east side of the river.



The development site is approximately 750 metres from the Barrier Bank, the south bank of the River Welland.

Existing Ground Levels

The levels of the main area of the site east of the existing line of trees varies between 1.30m OD at the southern end to levels of just above 1.70m OD towards the north of this area of the site.

The strip of land to the west which forms the access to Peterborough Road rises from 1.80m OD to 2.10m OD near the road. Peterborough Road itself is higher at a level of 2.50m OD.

A detailed plan with levels has been produced and a smaller plan has been drawn which shows how the levels vary across the site, which is shown on page 9.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the Barrier Bank
2. Flooding from IDB Drain

1. Overtopping of the Barrier Bank.

The Barrier bank is the eastern bank of the Crowland Washes. The Washes are only flooded in extreme conditions (around 1 in 50 years) and are used the rest of the time as agricultural land. There are two syphons which operate automatically to allow water to flood on to the Washes and alleviate high water levels in the River Welland. When this occurs the level of water in the washes will quickly rise to around 5.00m OD.

If a breach occurred in the Barrier Bank in this scenario then flood water would flow eastwards towards the development site. In Appendix 1 (pages 12 and 13) there are predictions of the hazard and water depths that could occur at the development site if a breach occurred. These indicate the hazard is mainly in the “Low Hazard Caution” category with flood depths of approximately 400mm. However this prediction can be considered to be in excess of the true hazard because:

- 1) The flow of flood water eastwards would be held back by Peterborough Road which is higher than the level of the site. Flood water will then flow to lower areas south of the site at the southern end of Peterborough Road and this will reduce the flood depths which will affect the site.
- 2) A large breach would result in a rapid reduction in the levels in the River Welland which would reduce the computed flow through the breach.

If land levels are tabulated over the length of the flood water reaching the site (1571 metres as shown in Appendix A) then an average land level along this length of 1.23m OD can be estimated. Therefore using this an approximate maximum flood level of 1.63m OD can be worked out for the site. This can be taken as a 1 in 1000 year flood level as the flood level used for the breach calculation uses a 1 in 1000 year maximum level for the River Welland.

2. Flooding from IDB Drain

The watercourse on the north eastern boundary of the site is the upstream length of Greenbank Drain (drain 916), which is maintained by North Level IDB. There was no water in the drain when a visit to the site was made in early October but as the drain will collect surface water from the surrounding areas it would be expected to have a small depth of water in it during the winter months. The drain flows in a south easterly direction beneath James Road and the new A16 By-pass and flows into New South Eau approximately 2.5 km south east of the development site. It then flows eastwards to the North Level Main Drain and the levels of all these watercourses are controlled by the Pumping station at Tydd which is approximately 24 km east of Crowland.

Surface water from west of Peterborough Road flows into the catchment area of Newborough Pumping Station which discharges the water into the River Welland 2.5km south west of the development site.

Greenbank drain is approximately 1.5 metres deep and therefore in normal times there is at least a 1.0 metre freeboard to all of the land on the development site. IDB drains were designed to provide at least a 1 in 10 year standard of service with a freeboard of at least 900mm. This normally provides at least a 1 in 50 year standard of service against overtopping and in many cases a 1 in 100 year standard at the present time.

North level IDB have a policy of monitoring standards of protection in all their catchments and will carry out improvements to pumping stations, sluices and drainage

channels to ensure they do not fall due to higher run-offs predicted with climate change.

It is unlikely that any failure of assets such as pumping stations, sluices or drainage channels would lead to overtopping of the watercourse because North Level IDB have an excellent maintenance regime and monitor all assets with a modern telemetry system.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties having been flooded in the last 50 years. The last time that a breach occurred in the River Welland was 1947, and since that date considerable investment has been made to raise banks and provide a banks which are above the 1 in 100 year flood level.

Probabilities and Trends of Flooding

The probability of this site flooding from Environment Agency main river is very low. In an extreme event any effect on this location would not be sudden and there would be time for residents to take precautionary measures to limit the impact of any flooding that may occur.

Residual Risk

There is a residual flood risk to the site if the Barrier Bank approximately 750 metres west of the site breached when the Crowland Washes are full. Water would flood eastwards towards the proposed development site. However this flow would be arrested to a certain extent by Peterborough Road.

Conclusions

The following conclusions can be made:

- The proposed development is not in a functional flood plain as defined by the Guidance.
- Although the site is in flood zone 3, the actual risk of the site flooding from any Environment Agency water course is very low.
- There is no actual risk of flooding at the present time or in 2115.
- There is a residual risk that the site could flood if a breach occurs in the Barrier Bank after the Crowland Washes have been flooded. It is likely that flood water from this source would substantially increase the flow in IDB watercourses south of Crowland which would flood lower areas south west of the development site before the site was affected. As the risk of flooding the Crowland Washes is between 1 in 20 years and 1 in 50 years, the risk that the Barrier bank would fail is considerably less than this, and must be less than 1 in 1000 years.

- The breach calculations for the Barrier Bank have been carried out using 1 in 1000 year levels for the River Welland. Therefore the flood depths predicted will be 1 in 1000 year flood depths.
- Calculations of flows and flood levels are shown in Appendix 1 (pages 12 to 14). These indicate that the maximum predicted level of flood water following a breach would be 1.60m OD. As many of the parameters are estimated it is reasonable to take a precautionary approach and recommend all properties should have a minimum floor level of 1.75m OD.
- In a flood risk area there is always a risk of an event occurring of greater magnitude than has been considered in this flood risk assessment.

Recommendations

In an area where there is a flood risk, however small, it would be preferable that new buildings should be designed with all sleeping accommodation located on the first floor. However the developer has proposed that eight of the dwellings should be bungalows similar to adjacent buildings in the south western corner of the development.

The EA have stated that the minimum mitigation measures required for single storey developments, or developments that include ground floor sleeping accommodation, should be informed by the flood depths arising from the 2115 0.1% breach scenario.

The floor level of the proposed new dwellings should be raised above existing ground levels to at least a level of 1.75m OD.

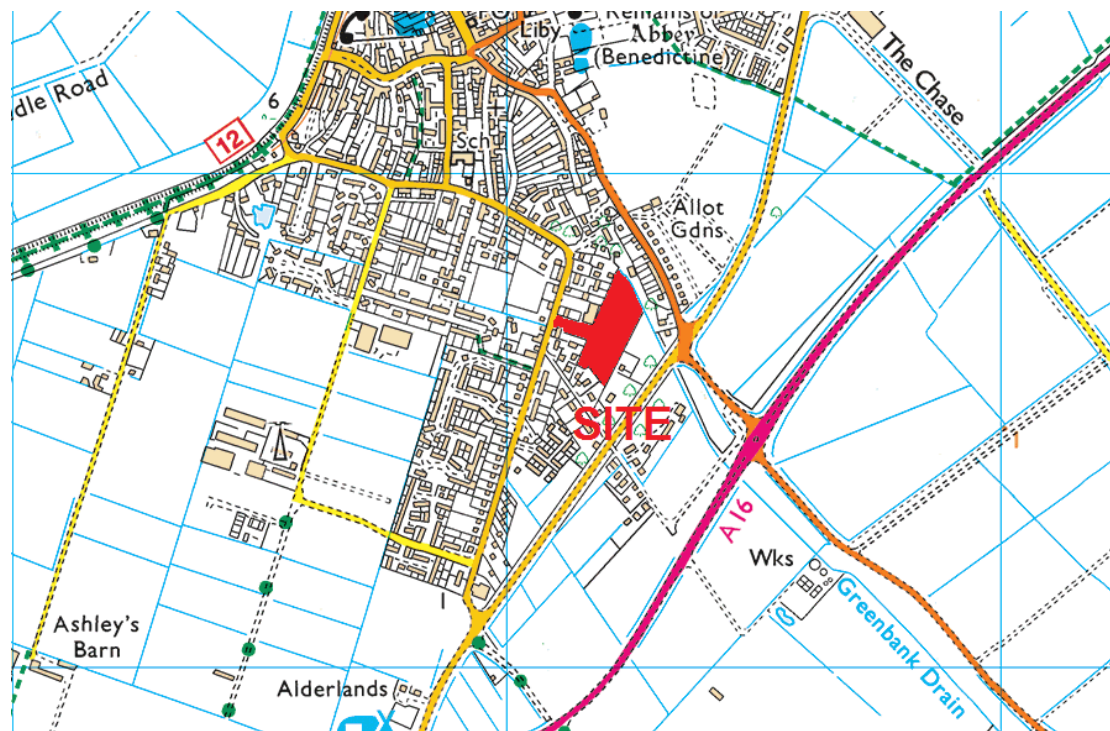
Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service.

All future owners and occupiers of the dwellings should be given a copy of the Flood Risk Assessment so that they are fully aware of the risk of flooding in this area.

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2nd November 2015

LOCATION PLAN

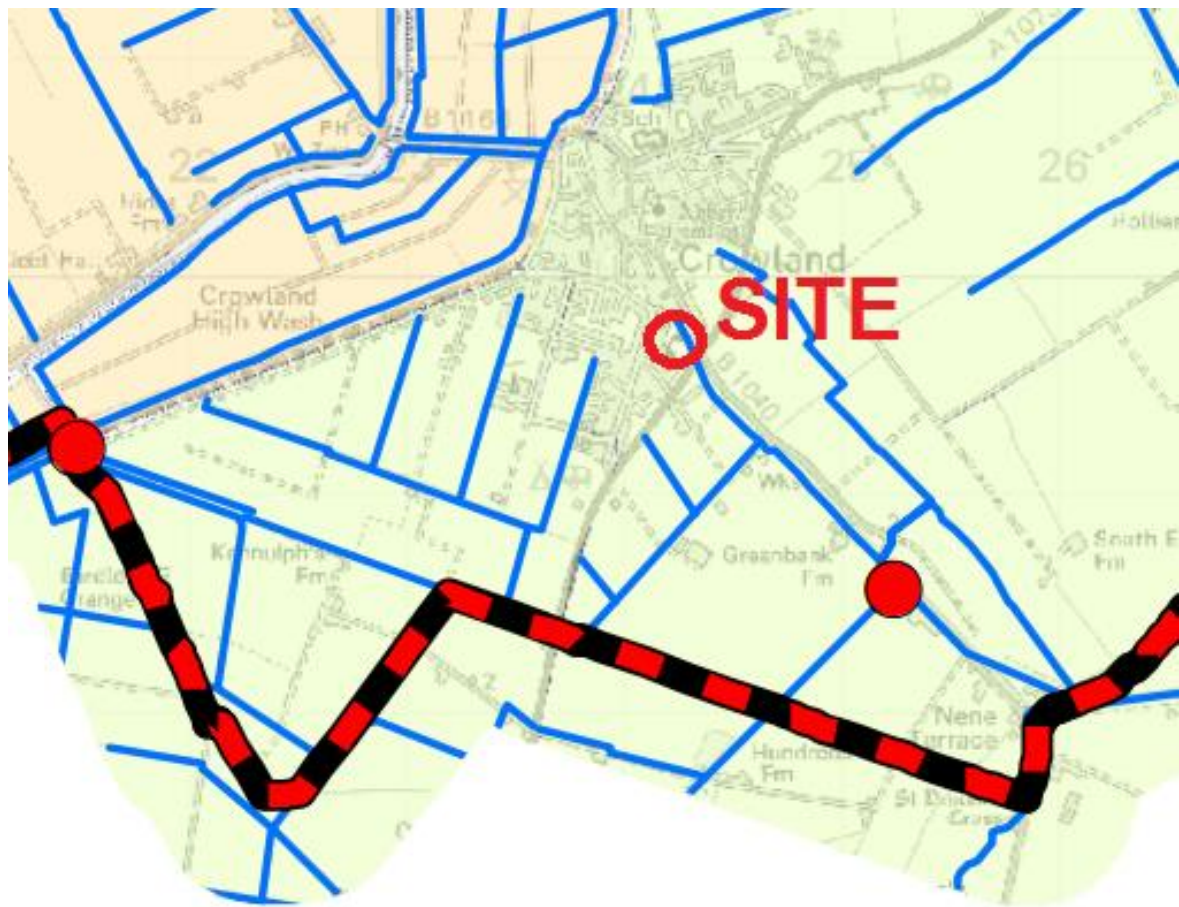


PLAN OF PROPOSED DEVELOPMENT

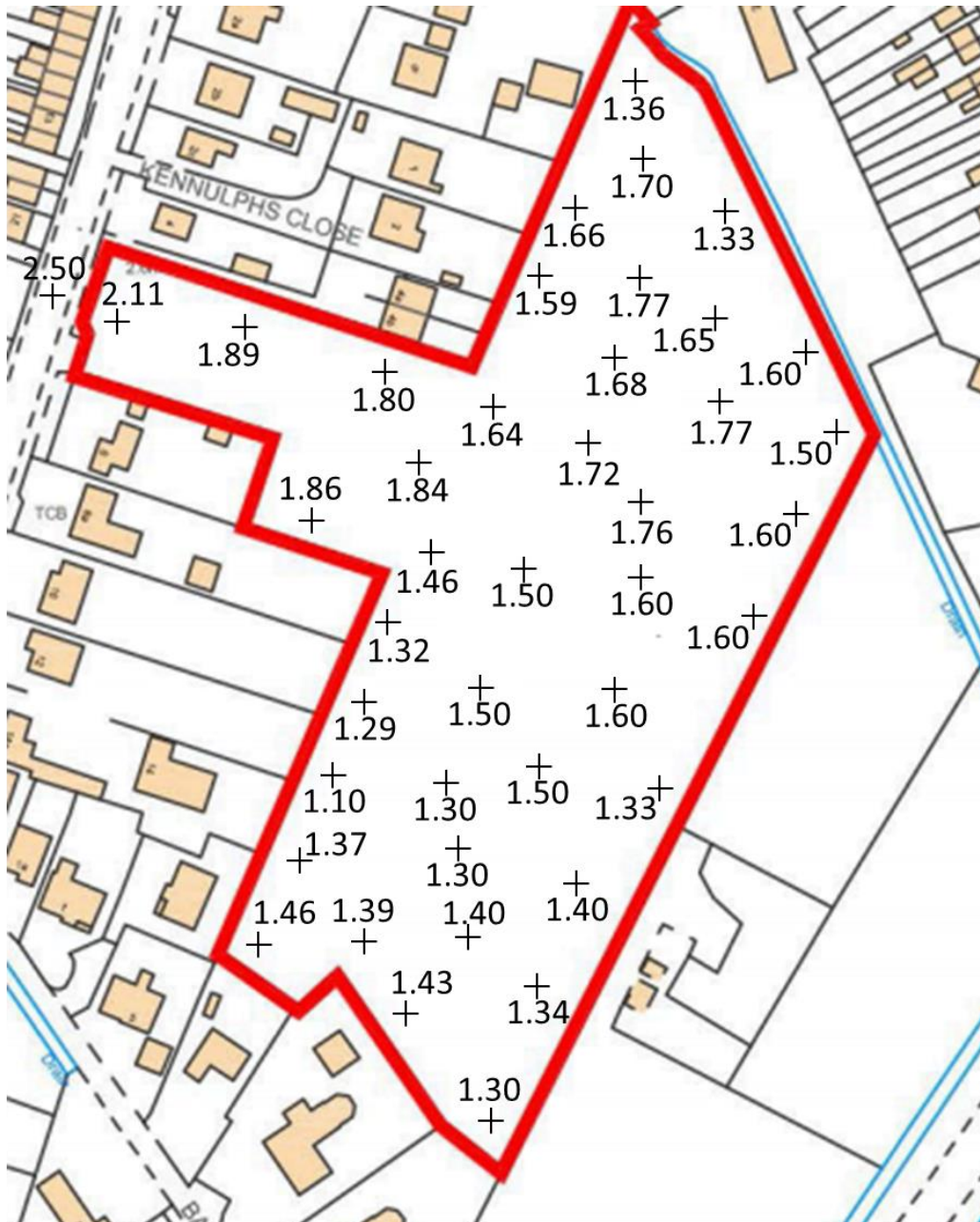


Proposed Bungalows shown "B"

PLAN OF IDB WATERCOURSES



SITE PLAN SHOWING EXISTING GROUND LEVELS



APPENDIX 1

BREACH CALCULATIONS FOR BARRIER BANK

This calculation will work out an assumed volume that will flow through a 40 metre wide breach of the Barrier Bank when the water level in the flood storage area is the maximum 1 in 100 year level in 2115.

A calculation of this volume will then be carried out at the development site to work out probable water depths, velocities and hazard rating for the site in this situation.

Maximum level of the River Welland = 5.03m OD (1 in 1000 year flood)

The level of Low Road behind the earth embankment protecting the southern part of the village can be seen to be 3.50m OD and 3.20m OD further south west. Therefore the maximum depth of the breach will be taken to be 1.85 metres.

Width of breach = 40 metres

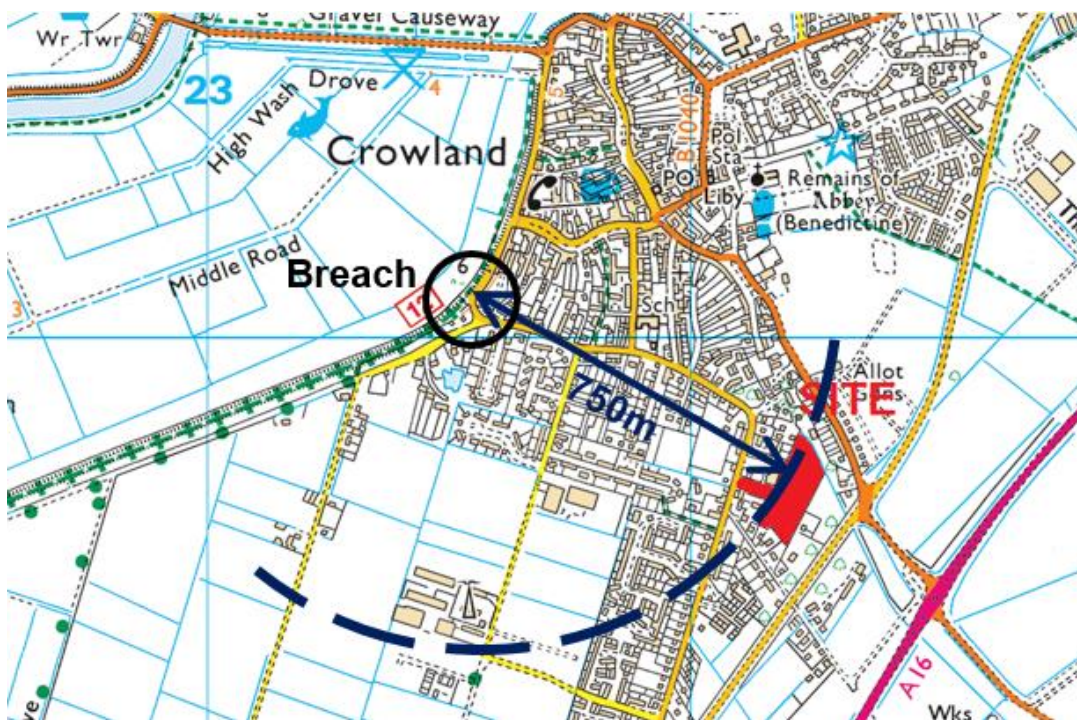
Assume the breach is a broad crested Weir

Maximum Volume through Breach = $1.7 \times b \times H^{3/2}$

$$= 1.7 \times 40 \times 1.85^{3/2}$$

$$= \underline{171.1 \text{ cumecs}}$$

Velocity of water through breach = $171.1 / (40 \times 1.85) = \underline{2.3 \text{ m/sec}}$



The site is approximately 750 metres from the assumed breach position.

Assume that water will be flowing away from the breach along the dotted blue line at the same depth and velocity. Flood water will not flow northwards as the central part of Crowland is much higher than the area to the south. A short section adjacent to the Barrier bank will also be ignored as it is higher than the land to the south east.

The length of the dotted blue line is $120/360 \times 3.142 \times 750 \times 2 = \underline{1571 \text{ metres}}$

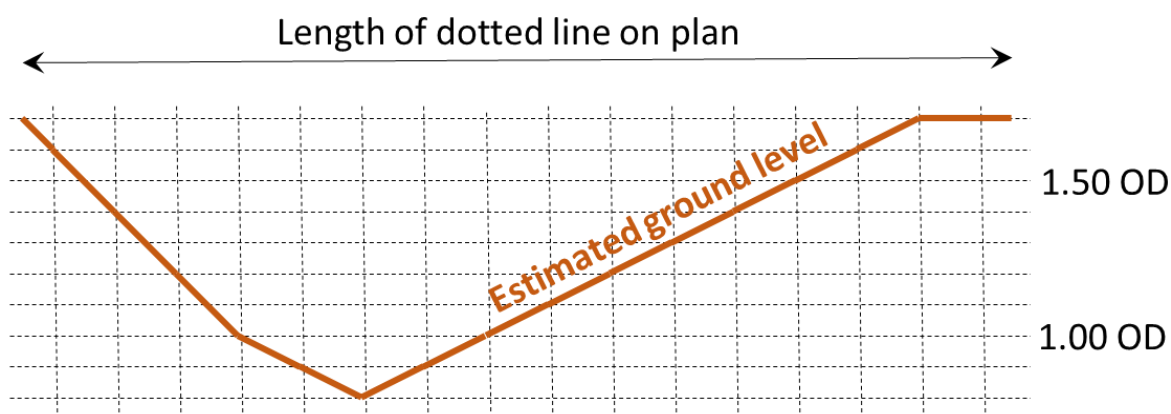
Therefore if we assume the same volume (171.1 cumecs) is flowing through the blue line we can work out flood depths for different chosen velocities.

For example choose velocity of 0.2 m/sec, therefore area of flow = 856 sm

Therefore flood depth = $856/2618 = \underline{0.684 \text{ metres}}$

Velocity	Flow area	Flood depth	Hazard Rating	Hazard
0.2	856	545mm	$(0.326 \times 0.7) + 0.5 = 0.88$	Moderate Hazard
0.3	570	363mm	$(0.218 \times 0.8) + 0.5 = 0.79$	Moderate Hazard
0.4	428	272mm	$(0.163 \times 0.9) + 0.5 = 0.74$	Low Hazard Caution
0.5	342	217mm	$(0.131 \times 1.0) + 0.5 = 0.72$	Low Hazard Caution
0.6	285	181mm	$(0.181 \times 1.1) + 0.5 = 0.70$	Low Hazard Caution

The land levels along the dotted blue line can be estimated as shown below:



Using the above levels the area of flow at various flood levels can be estimated as shown below:

Land Levels	1.6	1.4	1.2	1.0	0.9	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.7	
Flood Level	Areas of flow for various flood levels																Total
1.6	0	20	40	60	70	80	70	60	50	40	30	20	10	0	0	0	550
1.65	5	25	45	65	75	85	75	65	55	45	35	25	15	5	0	0	620
1.7	10	30	50	70	80	90	80	70	60	50	40	30	20	10	0	0	690
1.75	15	35	55	75	85	95	85	75	65	55	45	35	25	15	5	5	770
1.8	20	40	60	80	90	100	90	80	70	60	50	40	30	20	10	10	850

If this analogy is used then the highest predicted flood level would be 1.60m OD.

The hazard has been worked out following the guidance shown in the Supplementary Note to FD2320 and FD2321 on Flood Hazard Ratings and Thresholds for Development Planning.

It can be seen that for all velocities of 0.4m/sec and above the hazard rating falls within the range of "Low hazard" and only velocities of 0.2 and 0.3m/sec fall just within the rating of moderate hazard, as recommended by FD2321.