



Gavray Drive, Bicester

Flood Risk Assessment

*For . L&Q Estates, Charles Brown & Simon
Digby and London & Metropolitan
International Developments*

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1. INTRODUCTION

This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of L&Q Estates, Charles Brown & Simon Digby and London & Metropolitan International Developments in support of an Outline Planning Application to be submitted to Cherwell District Council for a proposed residential development on land to the north of Gavray Drive, Bicester.

This Flood Risk Assessment (FRA) has been prepared to address the requirements of the National Planning Policy Framework (NPPF) and associated National Planning Practice Guidance for Flood Risk and Coastal Change (NPPG). The main objectives of the report are as follows:

- » Assess whether the proposed development is likely to be affected by flooding.
- » Assess whether the proposed development is appropriate in the suggested location in accordance with planning policy.
- » Confirm the flood levels and flood depths at the site.
- » Present any flood risk mitigation measures necessary to ensure that the proposed development is suitably protected from flooding, whilst ensuring flood risk is not increased (and where possible reduced) elsewhere.

2. SITE INFORMATION

2.1 Location and Setting

The site is located around 1km to the south-east of Bicester Train Station, Bicester, Oxfordshire and is bound to the immediate south by Gavray Drive, to the north and west by an existing railway line, and to the east by Charbridge Lane.

An existing residential development, referred to as Langford Village, is beyond Gavray Drive to the south and a mixture of industrial/commercial units are beyond the railway line to the north and west. Beyond Charbridge Lane is typically undeveloped land.

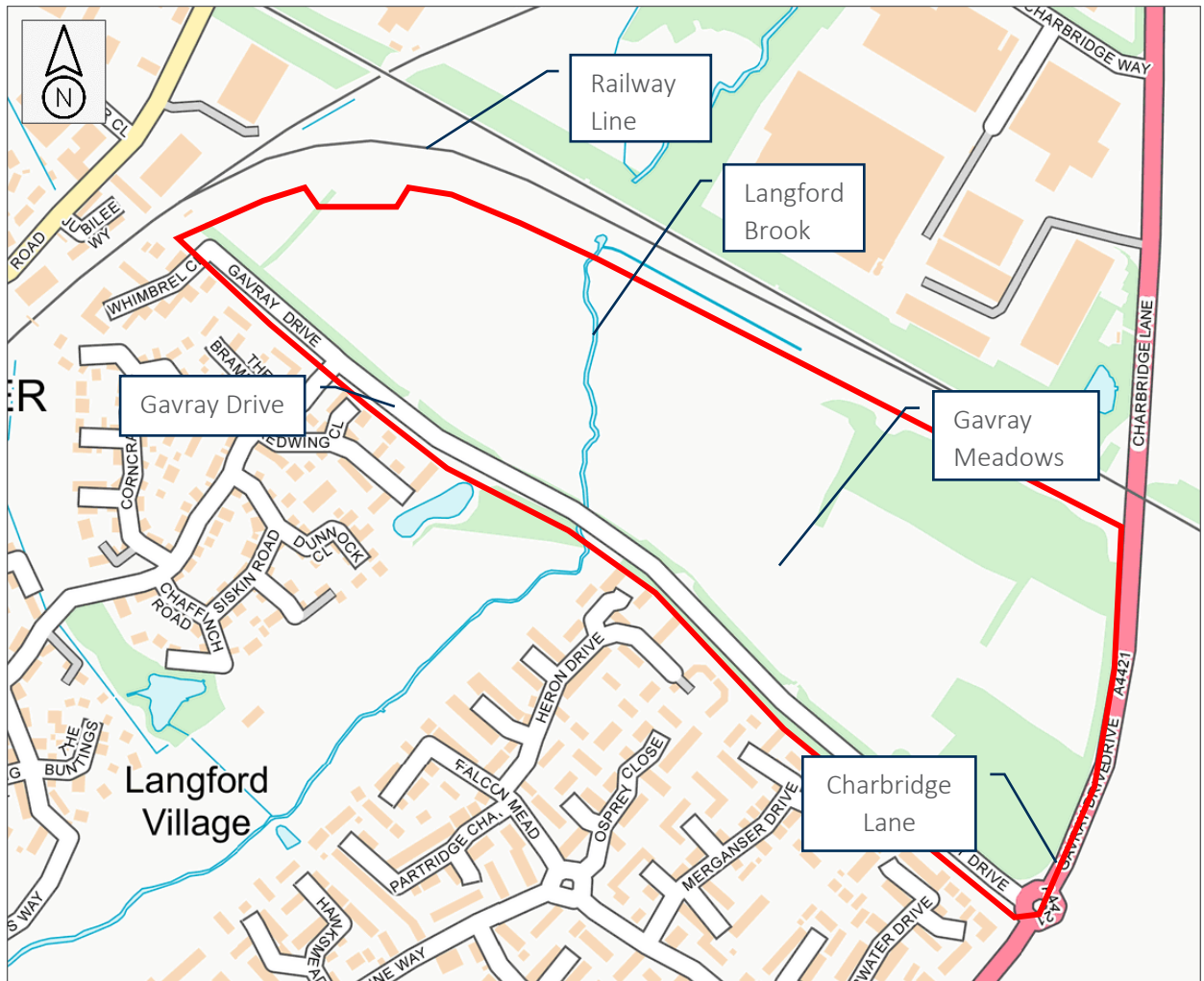
The site is currently undeveloped and crossed by the Langford Brook which flows north to south through the approximate centre of the site. Land to the west of the watercourse (referred to as 'Gavray West') is currently to agricultural uses with land to the east (referred to as 'Gavray East') being occupied by Gavray Meadows ecological area, and grassed land. This section of the site is also crossed by a number of public footpaths.

A summary of the site referencing information is provided in Table 1 and the site's location is shown in Figure 1.

Table 1: Site Referencing Information

Site Referencing Information	
Site Address	Land North of Gavray Drive, Bicester, Oxon. OX26 6UG
Grid Reference	SP595224
X (Easting), Y (Northing)	459590, 222422

Figure 1: Site Location



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Note: Boundary indicative, for detailed boundary extents please refer to location plans.

2.2 Topography

A Topographical Survey has been provided for the site. This shows the ground levels to fall in a south-easterly direction from a high of approximately 69.5m AOD at the western site boundary (adjacent to the railway line) to around 65m AOD adjacent to the Langford Brook as it flows southwards through the approximate centre of the site, and then to rise eastwards from the Langford Brook to a high of around 68.2m AOD within the approximate centre of Gavray Meadows before falling again towards the eastern site boundary and Charbridge Lane with a low level of approximately 64.9m AOD.

A Topographical Survey of the site has been included within the planning submission.

2.3 Proposed Development

Outline Planning Approval is being sought for the construction of a residential development with associated internal access roads, hardstand car parking/driveways, domestic gardens and areas of open space. This development is to be split into two parcels: Gavray West and Gavray East and these will sit

either side of both Langford Brook and Gavray Meadows with each being provided with a separate vehicular access onto Gavray Drive to the south.

The Topographical Survey identifies that the railways along the northern and western boundaries are on embankments and therefore are raised above typical site levels.

The site has been allocated for residential development within the Cherwell Local Plan (2011-2031) and therefore the principle of this development is deemed acceptable.

A copy of the proposed framework plan is included within the planning submission.

3. ASSESSMENT OF FLOOD RISK

3.1 Hydrological Regime

As highlighted, the site is intersected by the Langford Brook which flows in an open channel through the approximate centre of the site in a southerly direction. The Brook enters the site through a culvert under the railway embankment and exits via a culvert under Gavray Drive on the southern site boundary. The Langford Brook ultimately drains into the River Thames via the River Cherwell and River Ray.

From a review of OS mapping and aerial imagery, a small drainage ditch is shown to run parallel to the toe of the railway embankment and along much of the northern site boundary. This provides no connectivity to the wider area and is considered as providing a conveyance route for railway drainage into the Langford Brook.

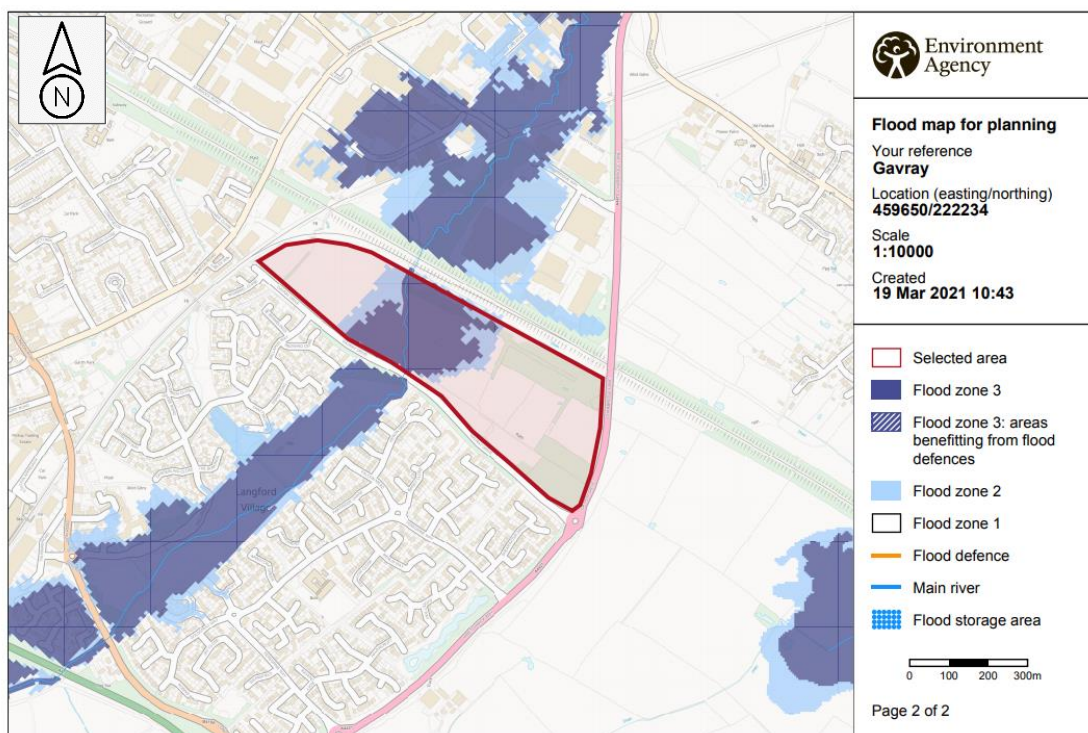
The Langford Brook is designated as a 'Main River' and the drainage ditch along the railway embankment toe is classified as an 'Ordinary Watercourse'.

3.2 Flood Zone Mapping

The Environment Agency's (EA's) Flood Map for Planning (Figure 2) shows the majority of the site to be within Flood Zone 1 (land assessed as having a less than 1 in 1,000 annual probability of fluvial flooding (<0.1%)).

The lower-lying central portion of the site, adjacent to Langford Brook, is shown to be within Flood Zone 2 (land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of fluvial flooding (1% - 0.1%) and Flood Zone 3 (land assessed as having a 1 in 100 or greater annual probability of fluvial flooding).

Figure 2: EA Flood Map for Planning



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3.3 Fluvial Flooding

The EA has provided the files for modelling of the Langford Brook undertaken by JBA Consultants. The provided information included modelled grid depth data that allows a more accurate assessment of potential flood depths through the site, whilst making an allowance for floodplain mechanisms (flow routing etc) specific to this site. The files also included an up-to-date assessment of the impacts of climate change and include a 35% and 70% increase to peak flows in line with current requirements. Following discussions, the EA has confirmed that this modelling remains fit-for-purpose and suitable for use in assessing site-specific flood risk.

Based on the information provided by the EA, potential flood depths have been calculated at six locations within the site. These have been taken for the upstream, downstream and approximate middle of the site for both Gavray West and Gavray East. A plan showing the location of the points is provided at Figure 3, with flood outlines for the 1 in 20 year, 1 in 100 year, 1 in 100 year plus 35% allowance for climate change, and 1 in 1,000 year flood events. Table 2 provides modelled flood levels for each of the 6 points.

Figure 3: Flood Depth Calculation Locations

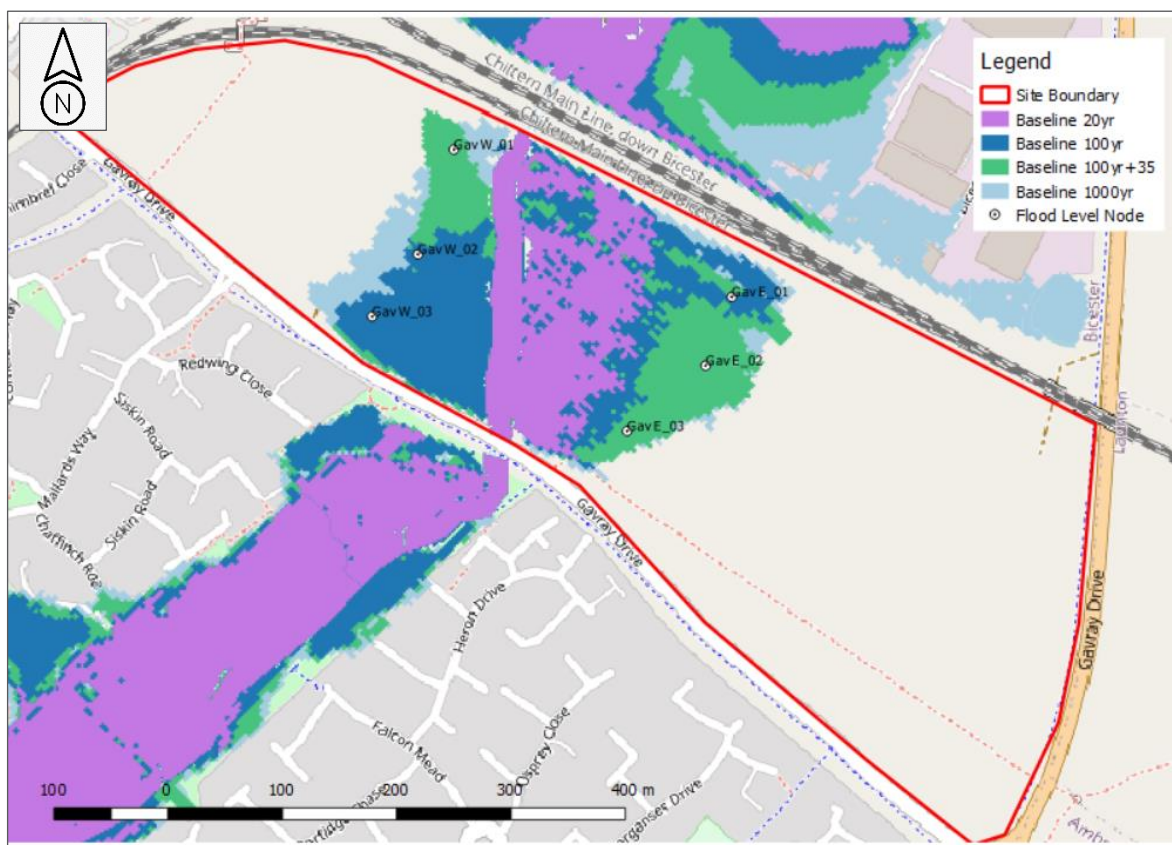


Table 2: Flood Depths at Selected Nodes

Location	1 in 20 Year Flood Level (m AOD)	1 in 100 Year Flood Level (m AOD)	1 in 100 Year + 35% Flood Level (m AOD)	1 in 1,000 Year Flood Level (m AOD)
GavW_01	Nil	Nil	67.02	67.17
GavW_02	Nil	66.89	67.02	67.15
GavW_03	Nil	66.88	67.02	67.14
GavE_01	Nil	66.95	67.01	67.15
GavE_02	Nil	Nil	67.02	67.15
GavE_03	Nil	Nil	67.02	67.14

The provided outlines closely match the outlines shown on the EA's mapping and confirm that whilst the site is predominantly shown as being within Flood Zone 1, the Langford Brook corridor is at an increased risk for all modelled events. In the worst case, the flood corridor through the site is shown to extend a total width of around 350m and be contained by the 67m AOD contour.

The flood level data provided by the EA includes flood levels for the 1 in 20 year flood event, which defines the 'functional floodplain'. Based on a comparison with existing ground levels, flooding within the site could occur in such a flood event, but will be restricted to the immediate river corridor (i.e., no more than 10m width) with 'Nil' values at the identified 6 points of interest.

For larger events the flood waters are shown to spill out of bank and to inundate the ecological area before flows back up behind the more elevated Gavray Drive, and eventually overtopping the western (right) bank and flooding sections of the Gavray West area.

In summary, the EA's modelling confirms that whilst the majority of the site is confirmed as being at 'low risk' from fluvial flooding, areas adjacent to the Langford Brook are shown as being at an increased risk. Whilst these areas are predominantly within the ecological area they do extend into the existing agricultural area to the west of the watercourse and are shown to extend into an area highlighted on the framework plan as being proposed for development. As such, mitigation measures will be necessary and these are discussed in Section 4.

3.4 Tidal Flooding

The information provided by the EA confirms that the Langford Brook is not tidally influenced at the location adjacent to the site.

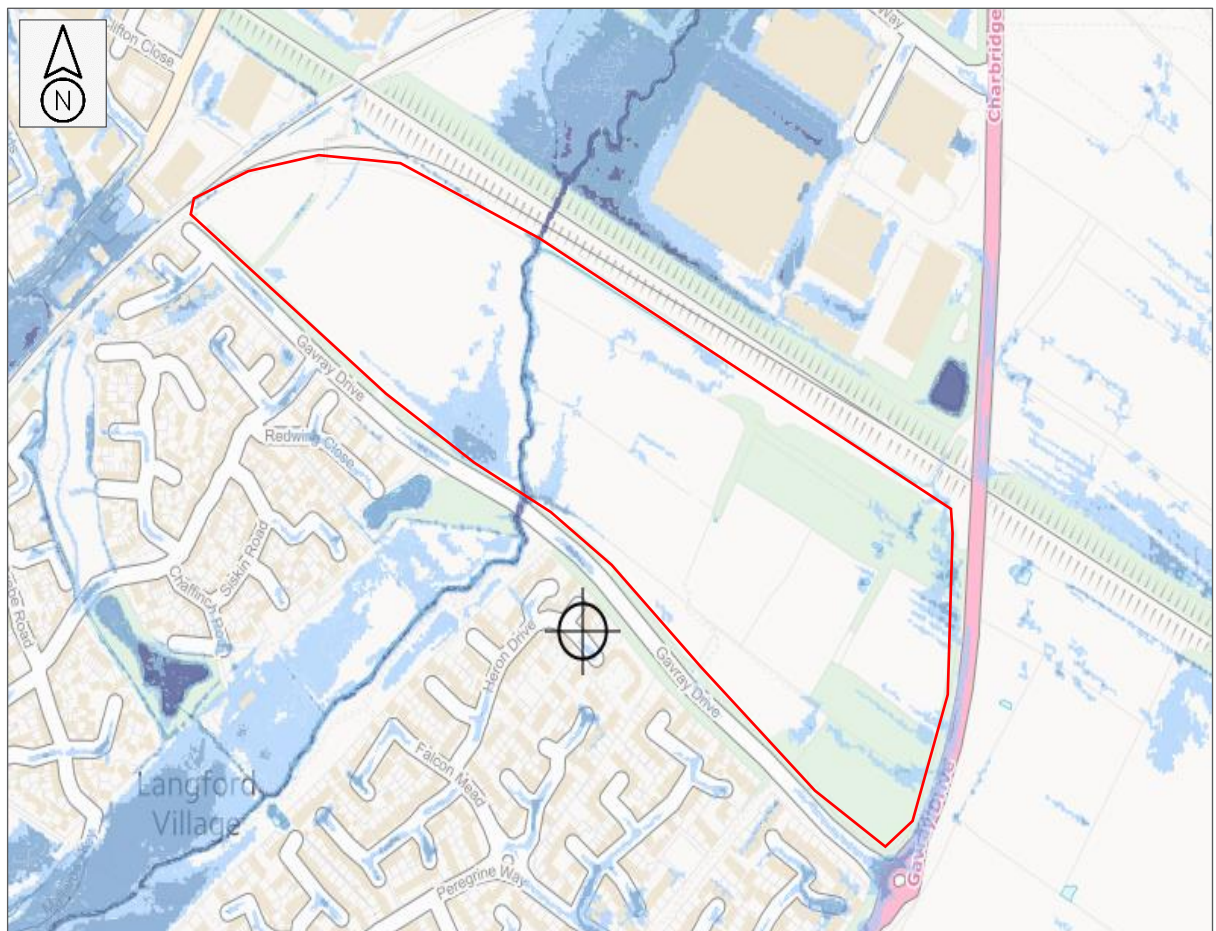
As such, the site is concluded to be at negligible risk of tidal flooding.

3.5 Surface Water Flooding

Surface water flooding occurs as the result of intense/prolonged rainfall being unable to infiltrate to ground. This can happen when the maximum soil infiltration rate or storage capacity is exceeded. Resultant overland flows can then either drain into existing land drainage features or follow the general topography which can concentrate flows and lead to localised flooding/'ponding'.

The EA's Flood Risk from Surface Water mapping (Figure 4) shows the majority of the site to be at 'very low' risk of surface water flooding, though it identifies areas at 'low' and 'medium' risk of surface water flooding.

Figure 4: EA Flood Risk from Surface Water Mapping



The areas shown as being at an increased risk are predominantly along the route of or immediately adjacent to the Langford Brook. As such, these are considered as being more representative of fluvial flows within the watercourse and falling within the fluvial floodplains.

Other isolated areas of increased risk are shown throughout the site (both to the west and east of the watercourse) but these provide no connectivity to the wider area and are typically shallow (<300mm) and therefore are considered to be representative of locally lower areas within the site and more akin to localised 'ponding'. As such, and accepting that areas adjacent to the watercourse are prone to fluvial flooding, the site is concluded as being at low risk from surface water flooding.

3.6 Groundwater Flooding

British Geological Survey mapping shows the central portion of the site, immediately adjacent to Langford Brook, to be underlain by superficial Alluvium deposits comprising Clay, Silt, Sand and Gravel. The superficial deposits are classified as a Secondary A Aquifer (defined as 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers', and, 'generally aquifers formerly classified as minor aquifers').

In terms of bedrock geology, broadly: the eastern portion of the site is shown to be underlain by the Peterborough Member comprising Mudstone; the central portion of the site by the Kellaways Sand Member, having a 'high' vulnerability (defined as 'areas able to easily transmit pollution to groundwater', and, 'likely to be characterised by high leaching soils and the absence of low permeability superficial deposits'); and the western portion of the site by the Kellaways Clay Member, which is defined as 'unproductive'.

The groundwater table will be hydraulically linked to water levels of the adjacent Langford Brook and, as such, there is potential for groundwater emergence, but this would be expected to be consistent with predicted flood outlines and to impact only a small area of the site. It is likely that any groundwater emergence would be at the boundaries in geology and therefore probably limited to the immediate river corridor. It is, however, possible that 'near surface' groundwater may be encountered within lower lying areas of the site.

3.7 Infrastructure Failure Flooding

Given the existing undeveloped nature of the site, an existing engineered sewerage system is not expected to be present within the site itself. The surrounding area is however served by an extensive surface and foul water drainage system and there is consequently the potential for the sewer network to fail / surcharge and result in overland flows.

Cherwell District Council's Strategic Flood Risk Assessment (SFRA) records no such incidents, and on this basis the site is concluded to be at low risk of sewer failure flooding.

A review of the EA's Flooding from Reservoirs map indicates that the site is not within the maximum extent of flooding in the event of a failure of any artificial source.

The site is therefore concluded to be at low risk of artificial source / infrastructure failure flooding.

3.8 Historical Flooding

Following conversations with local residents and stakeholders it has been reported that the Langford Village area has previously experienced flooding, with the most recent event being in December 2020. In this flood event 'a number' of properties experienced internal flooding, with large areas adjacent to the Langford Brook also being 'in flood'. Photographs showing this flooding are provided in Figures 5 and 6 and, where possible, the location of the site has been indicated.

Figure 5: Local Resident Provided Photographs - Number 1



Figure 6: Local Resident Provided Photographs - Number 2



Inspection of the photographs demonstrates that, whilst out of bank flows were experienced within the site, it appears that the flood extents are consistent with those shown on the EA's mapping and are

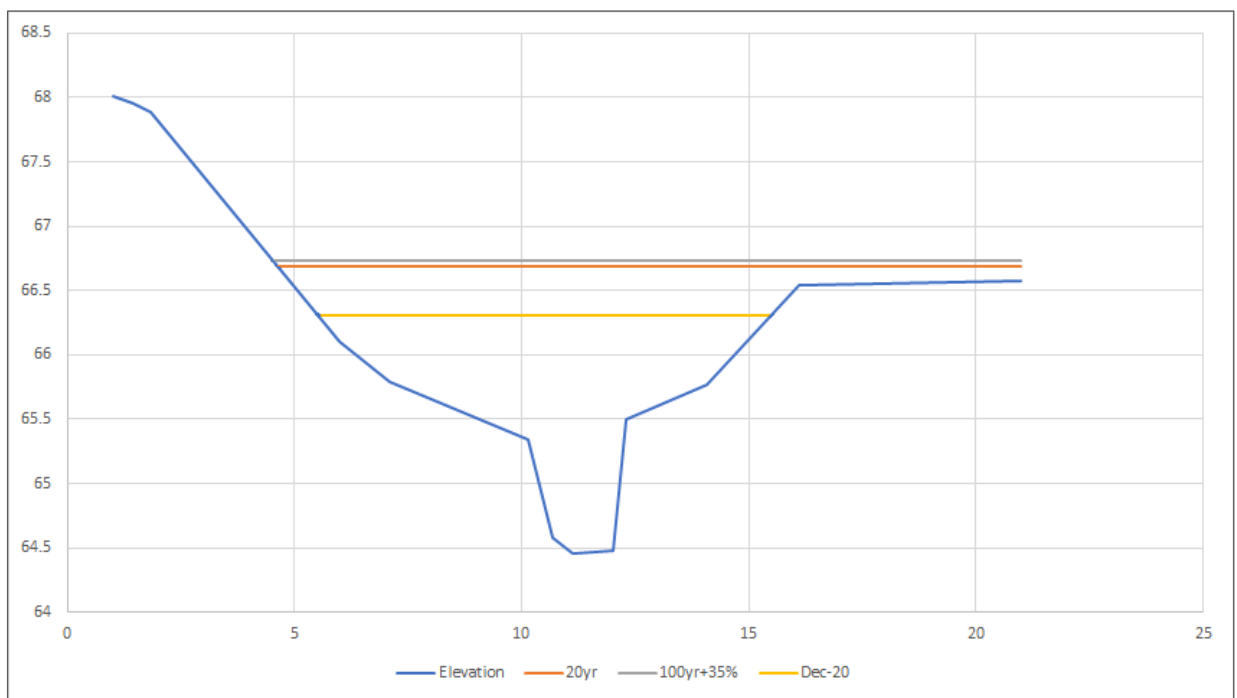
contained within the lower-lying ground adjacent to the watercourse. This is especially shown in Figure 6 where 'ponding' is shown in the south-eastern corner of Gavray West.

These photographs have provided a useful tool to 'sanity check' the model outputs., It should be noted, however, that at the time of writing the magnitude of the event experienced (i.e., return period event) is unknown and due to a lack of gauged/record flow data any calculations based on this information would be subject to a high level of uncertainty.

Whilst recorded flows are unavailable, a depth gauge is located immediately downstream of Gavray Drive (Langford Brook @ Langford Village) and this provided a maximum recorded height of 1.85m during the December 2020 event (24th December).

The Langford Brook depth gauge is shown to be located close to the modelled flood node ref. LA.3057. In order to better understand the potential magnitude of this event the recorded flood level has been compared to the predicted maximum flood levels for node ref. LA.3057 (taken from the approved modelling) for both the 1 in 20 year and 1 in 100 year plus 35% allowance for climate change event and this is shown on Figure 7 below.

Figure 7: EA Flood Risk from Surface Water Mapping



Analysis of the December 2020 flood level (66.307m AOD) has shown that the December 2020 event was around 0.38m below levels predicted for a 1 in 20 year event (66.689m AOD) and 0.43m below maximum levels predicted for a 1 in 100 year plus 35% allowance for climate change event (66.734m AOD). As such, and accepting out of bank flows were experienced, the event would be considered as 'minor' and therefore cannot provide a guide to the more 'extreme' events other than to reinforce the importance of maintaining flood volumes within the lower-lying areas adjacent to the watercourse (and of on-going management/clearance of potential blockages).

4. NPPF REQUIREMENTS

4.1 Sequential and Exception Tests

The site is allocated for residential development within the Cherwell Local Plan, 2011-2031.

Paragraph 033 of the NPPG states that *“The Sequential Test does not need to be applied for individual developments on sites which have been allocated in development plans”*, and on this basis the further application of the Sequential Test is concluded to not be required in this instance.

The suitability of the proposed development has been reviewed against Table 3 of the NPPG. Residential development is considered to be ‘More Vulnerable’ development in accordance with Paragraph 066 of NPPG, with the NPPG defining such a use to be ‘appropriate’ in Flood Zones 1 and 2, but requiring that the Exception Test be applied for such proposals in Flood Zone 3.

Based on the assessment of fluvial risk, the majority of the proposed development is confirmed as adopting a sequential approach to site use, being located within areas of the site at low risk. However, the latest framework plan highlights that for Gavray West both the proposed vehicular access onto the site and areas of residential development are within areas of Flood Zone 3 for both the present day and when making an allowance for climate change.

On the basis of the above, the proposed development is subject to the requirements of the Exception Test. Part ‘a’ is to be covered by the planning consultant whereas Part ‘b’ is to be addressed within this report.

Mitigation measures are also required to ensure the development will be safe for its lifetime without increasing flood risk elsewhere and, where possible, will reduce flood risk overall, in accordance with the requirements of part ‘b’ of the Exception Test, as outlined in the NPPF. The mitigation considered as being required is outlined in the following sections.

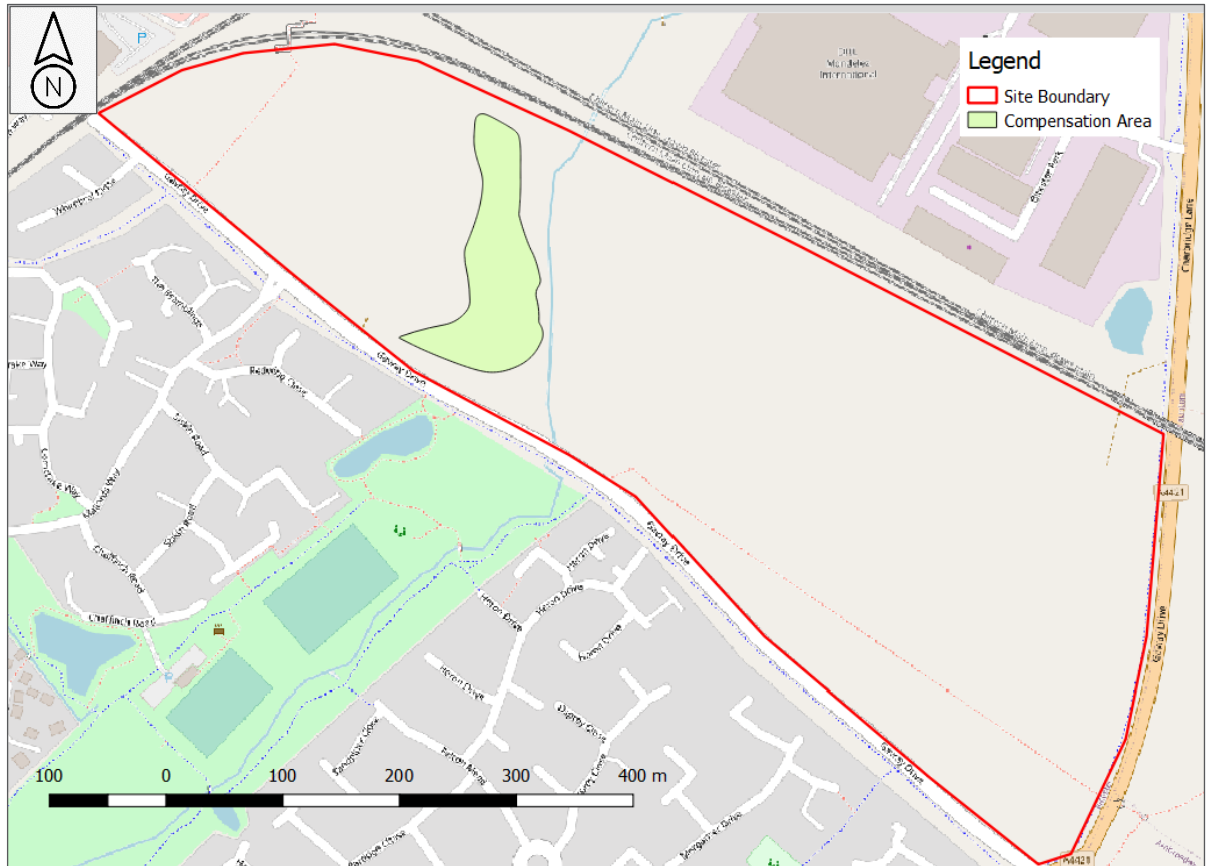
4.2 Mitigation

The provided framework plan avoids, as far as possible, those areas of the site assessed to be at risk of flooding from Langford Brook. The only area where this is unavoidable is at the eastern limit of the Gavray West development where development is proposed within an area shown as being within Flood Zone 3 (both present day and with climate change). This area contains the proposed vehicular access into the site along with residential units and associated access roads etc. As such, and in line with best practise, these sections of the site should be raised to ensure all finished floor levels are a minimum of 600mm above the 1 in 100 year plus 35% allowance for climate change event and set no lower than 67.62m AOD. It is also recommended that all ground levels (including access roads, domestic garden, drainage infrastructure etc) be set a minimum of 300mm above the 1 in 1,000-year flood levels which would be a minimum level of 67.47m AOD.

Where the required levels result in ground raising this would effectively result in a ‘loss’ of floodplain storage and a scheme of floodplain compensation would be required to ensure no increase in flood risk and, where possible, a betterment elsewhere.

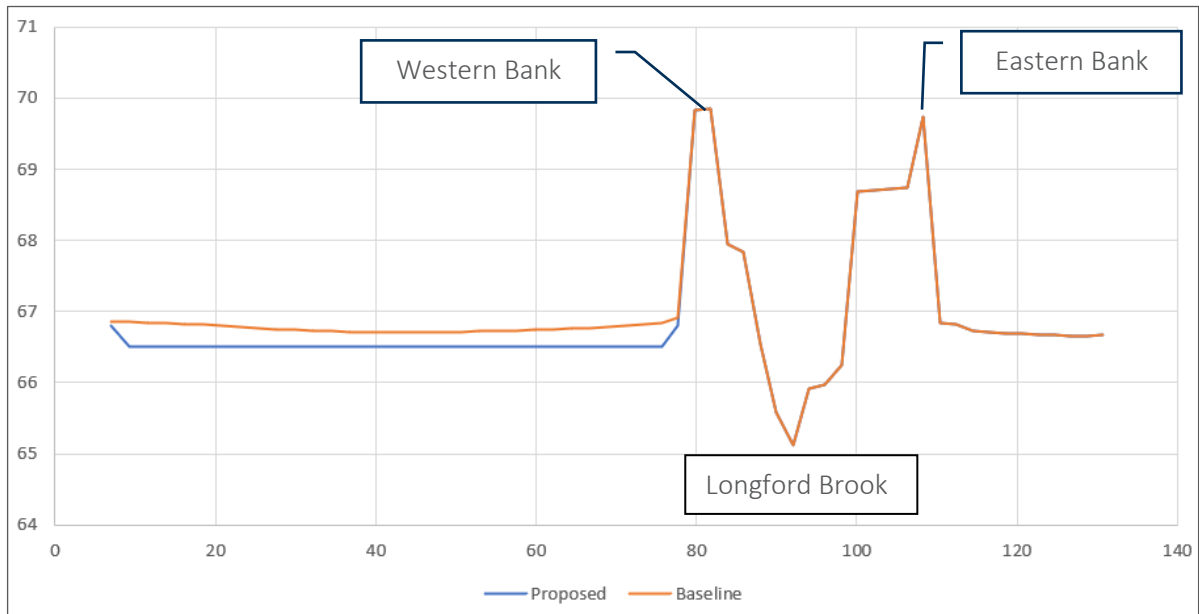
Such works comprise the lowering of ground levels between the Gavray West development parcel and the Langford Brook to a level of 66.5m AOD to tie in with the proposed surface water drainage outfall. The area of proposed lowering has been identified in Figure 8.

Figure 8: Location of Proposed Ground Lowering.



The 'Compensation Area' shown on Figure 8 is to be lowered to a constant level of 66.5m AOD and would represent only a small lowering compared to existing levels, with levels then being graded back up towards the proposed location of the development. Figure 9 below provides a comparison of the pre- and post- development ground levels through the proposed compensation area.

Figure 9: Pre- and Post- Development Level Comparison through Compensation Feature



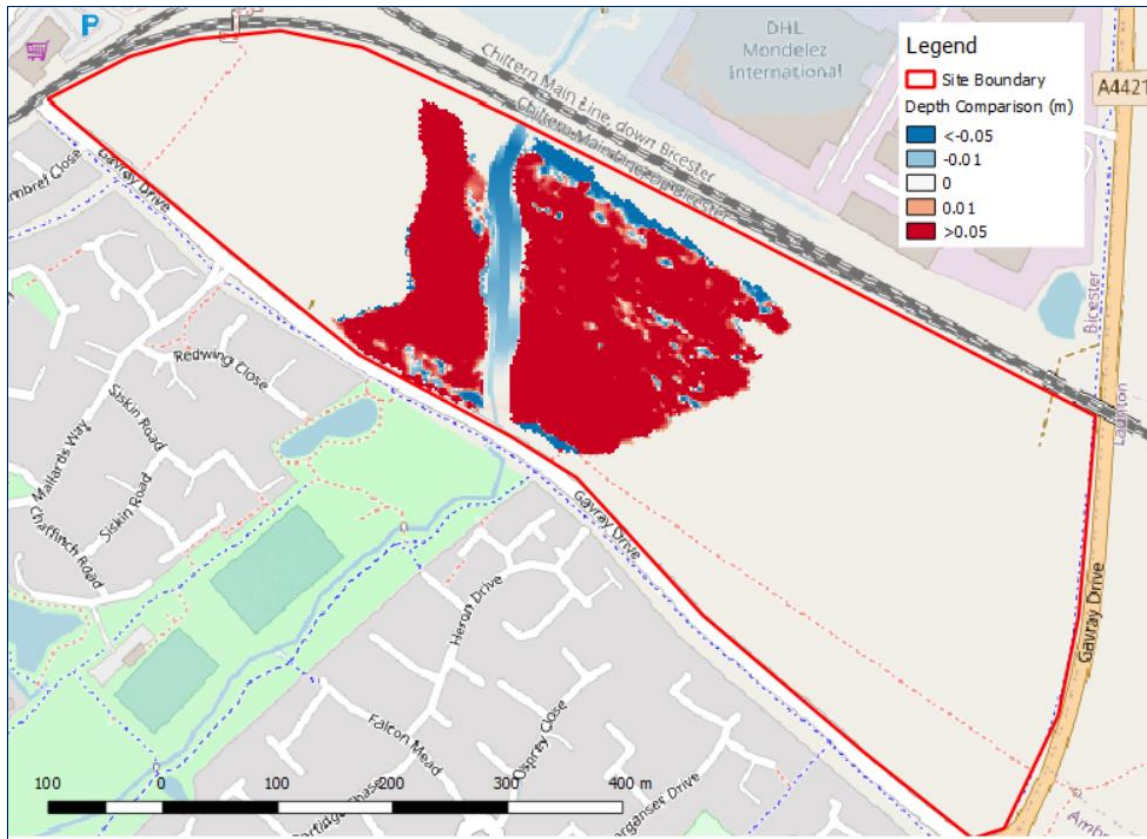
As part of the proposals, there is to be no alteration within 8.0m of the Langford Brook (to ensure an uninterrupted easement is provided in line with EA requirements) or within the ecological area, and these will remain 'as existing'. The area being lowered is limited to existing agricultural land and has been highlighted as being of 'low' value and therefore suitable for lowering.

Flood risk modelling of the proposed levels has been undertaken (i.e., with ground raising and floodplain compensation works 'in place') and this demonstrates that there is no adverse effect on flood risk downstream (i.e. within Langford Village) and the changes result in a betterment (i.e. reduction in predicted depths) upstream of the railway line.

A volumetric assessment has also been conducted for the post development scenario based on the maximum pre- and post- development fluvial flood volumes during the 1 in 100-year event plus 35% climate change. This assessment indicates a requirement for flood water storage of 21,603m³ and 23,569m³ for pre- and post-development respectively. As such, an additional 1,966m³ of storage is necessary in the post-development scenario (as shown on Figure 9). In respect of floodplain volumes, the proposed compensation scheme provides a betterment when compared to the existing scenario.

Whilst, on balance, there is a betterment to the wider area, a comparison of the proposed and baseline scenario flood depths has shown a slight increase in flood depths within the ecological area (and all within the application boundary). These increases are generally considered to be low, with a maximum increase of around 80mm and short lived - lasting around 22hours of the 38hour 1 in 100 year plus 35% allowance for climate change hydrograph. Whilst depths have increased, the flood extent is unchanged. Figure 10 provides a comparison of flood depths between the proposed and baseline scenarios. This approach has been discussed and agreed as acceptable with the ecologists.

Figure 10: Flood Level Comparison for Pre and Post Development Scenarios.



Detailed modelling of the proposed floodplain compensation scheme has demonstrated the site will not increase flood risk within the catchment through a loss of floodplain storage or impedance of flood flows. Whilst increases are shown in flood depths these are only within the site boundary and are temporary in nature. A betterment in flood depths is also provided upstream through an increase in volumetric storage.

4.2.1 Safe Access and Egress

Access to the site will be via the existing surrounding highway network which, through the proposed works (i.e. ground raising around the proposed vehicular access), is indicated to be at low risk of flooding.

As such, a safe/dry access and egress is considered to be possible to and from the site.

4.2.2 Surface Water Drainage Strategy

Separate drainage strategy reports, as listed below, have been prepared for the site and these have been included within the planning submissions.

- 15114-HYD-XX-XX-RP-D-5600 for Gavray West
- 15114-HYD-XX-XX-RP-D-5500 for Gavray East

In summary, the proposed drainage strategies have been prepared on the basis of restricting post development discharge rates to mimic the existing greenfield conditions. In providing a restriction, attenuation storage is required and will be provided where possible through the use of above ground open features sized to accommodate volumes up to and including the 1 in 100 year plus 40% allowance

for climate change event. Such an approach has been discussed and agreed in principle with Oxfordshire County Council in their role as the Lead Local Flood Authority, and will ensure no detrimental impact as a result of the development. It is also noted that, through the restriction of discharge to the greenfield run off rate, this would also reduce the rate at which flows enter the receiving networks and would therefore provide a betterment during such events.

5. CONCLUSIONS

This report has considered the flood risk posed to the proposal site from a variety of sources of flooding, as defined by the NPPF.

The report has confirmed that the whilst the majority of the site is located within Flood Zone 1 and is at low risk, the central section of the site (adjacent to the Langford Brook) is shown as being at an increased risk and affected by all modelled flood events, for both the present day and when making an allowance for climate change through the development design life.

Based on the assessment of fluvial risk, the majority of the proposed development is confirmed as adopting a sequential approach to site use, being located within areas of the site at low risk. However, the latest framework plan highlights that for Gavray West both the proposed vehicular access onto the site and areas of residential development are within areas of Flood Zone 3 for both the present day and when making an allowance for climate change.

On the basis of the above, the proposed development is subject to the requirements of the Exception Test. Part 'a' is to be covered by the planning consultant whereas Part 'b' is to be addressed within this report and through the proposed compensation flood storage area.

Flood levels obtained as part of this assessment have confirmed that the eastern limit of the proposed Gavray West is located within areas shown as being at risk of flooding from the 1 in 100 year plus 35% allowance for climate change and 1 in 1,000 year events. As such, mitigation measures are required to ensure the proposals are safe, that they result in no detrimental impact to third party land and that, where possible, they provide a betterment. In order to achieve this the following recommendations have been made:

- Finished Floor Levels should be set a minimum of 600mm above the 1 in 100 year plus 35% allowance for climate change event and no lower than 67.62m AOD.
- All ground levels (including access roads, domestic garden, drainage infrastructure etc) should be set a minimum of 300mm freeboard above the 1 in 1,000 year event and no lower than 67.47m AOD.
- Lifting ground levels to ensure the proposals are safe and in line with recommendations will result in a 'loss' of floodplain storage. As such, and in order to ensure the development remains safe for its design life, compensation storage will be provided up to the 1 in 100 year plus 35% allowance for climate change event. This is to be achieved through lowering a section of the site to 66.5m AOD. This area is located between the Gavray West development and the Langford Brook. Detailed modelling has demonstrated that this results in no increase in flood depths downstream of the site and provides a betterment in flood depths to the north (upstream). Whilst there is a small increase in predicted flood depths, this is all within the development boundary and is temporary in nature and does not increase the flood extents when compared to the baseline scenario.
- Calculations undertaken have also confirmed that the proposed compensation area provides a volumetric betterment of circa 2,000m³ when compared to the baseline scenario.

Given the proposed mitigation measures, it has been demonstrated that there will be no net loss of floodplain storage as a result of the proposed development.

This report therefore demonstrates that, in respect of flood risk, the proposed residential development at this site:

- Is suitable in the location proposed.
- Will be adequately flood resistant and resilient.
- Will not place additional persons at risk of flooding, and will offer a means of safe access and egress.
- Will not increase flood risk elsewhere as a result of the proposed development through the loss of floodplain storage or impedance of flood flows.
- Will put in place measures to ensure surface water is appropriately managed.

As such, the Application is concluded to meet the flood risk requirements of the NPPF.

Hydrock Consultants Limited