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ENVIRONMENTAL ASSESSMENT

Flood Risk Assessment 6092

Mill Meadows,
Bexley,
Kent,
DA5 1JX

Document Issue Record

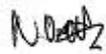
Project: Phase 1 Flood Risk Assessment

Prepared for: Cray Mill Leisure Ltd

Reference: 6092

Site Location: Mill Meadows, Bexley, Kent, DA5 1JX

Proposed Development: The area of the site being developed contains a large greenfield parcel, along with several agricultural outbuildings and stables. It is understood that the development is for the creation of two hockey pitches on the greenfield area, and the demolition of some existing outbuildings and the conversion of the existing stables and agricultural building to create an associated pavilion.

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1. Summary

- 1.1 Ambient Environmental Assessment has been appointed by Cray Mill Leisure Ltd to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at Mill Meadows, Bexley, Kent, DA5 1JX.
- 1.2 The area of the site being developed contains a large greenfield parcel, along with several agricultural outbuildings and stables. It is understood that the development is for the creation of two hockey pitches on the greenfield area, and the demolition of some existing outbuildings and the conversion of the existing stables and agricultural building to create an associated pavilion. The pavilion will be created via conversion of the existing stable with a small westward extension to replace the demolished outbuildings. Existing shed buildings in the northeast of the site will be converted to create storage units.
- 1.3 The proposed hockey pitches and pavilion buildings would be considered 'Water Compatible' under the NPPF due to being 'outdoor sports and recreation and essential facilities such as changing rooms'.
- 1.4 With reference to the Environment Agency (EA) Flood Map for Planning, the site is located in Flood Zones 1, 2 and 3. The proposed hockey pitches are primarily in Flood Zones 2 and 3, while the proposed pavilion buildings are in Flood Zone 3.
- 1.5 The EA have provided a Product 6 dataset to inform this report, which includes modelled flood level grids from their River Darent and Cray Modelling Study (2019). This provides modelled flood levels on site for a range of return periods on the River Cray which flows southwest to northeast along the east boundary of the site.
- 1.6 The EA data provided indicates that the site is partially affected in the 1:20 year flood extent and is therefore partially located in Flood Zone 3b. The proposed pavilion buildings and pitches are located partially in Flood Zone 3b. However, as a 'Water Compatible' use, such uses are appropriate in Flood Zone 3b, provided they are designed and constructed to:
 - remain operational and safe for users in times of flood;
 - result in no net loss of floodplain storage;
 - not impede water flows and not increase flood risk elsewhere.
- 1.7 Due to Green Belt issues, it is understood that it is not possible to relocate or raise the pavilion buildings above modelled flood levels. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. Therefore, it is not possible for the client to raise the buildings as they are existing and raising these could be inappropriate in Green Belt terms. As such, it is recommended that the pavilion buildings are designed to be floodable assets/ allowed to flood should the site flood, to negate displacement of flood water. This would require single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and great events.
- 1.8 It is recommended that the pavilions are closed, and the sports pitches not used upon receipt of a Flood Warning from the EA to mitigate the risk to life. The site should remain closed until the EA Flood Warning is lifted.
- 1.9 Hockey pitches are proposed as part of the planning application. The pitches are to be located on currently sloping land. It is understood that there will be a levels change to create a flat playing surface.

1.10 As such, and given that:

- The proposed development is for 'Water Compatible' outdoor sports facilities;
- Such uses could be permitted in Flood Zone 3b subject to meeting design requirements;
- Compensatory Flood Storage could be provided on site to offset displacement caused by landscaping;

Following the guidelines contained within the NPPF, the proposed development could be considered suitable assuming appropriate mitigation (including adequate warning procedures) can be maintained for the lifetime of the development.

| Development Description | Existing | Proposed |
|---|---|--|
| Development Type: | Sports pitches, large greenfield parcel, along with several agricultural outbuildings and stables | Creation of two hockey pitches on greenfield area, and demolition of some existing outbuildings and conversion of the existing stables and agricultural building to create an associated pavilion and storage units. |
| Number of Bedrooms: | N/A ² | None |
| EA Vulnerability Classification: | Water Compatible although agricultural buildings could be Less Vulnerable | Water Compatible |
| Ground Floor Level: | Topographic levels on site vary between approximately 11.70mAOD and 18.25mAOD (2m LiDAR data). | FFLs of pavilion buildings to be flush with external ground levels. Some land raising expected as part of pitch creation however provision of CFS may be possible due to large area of Flood Zone 1 on site. |
| Level of Sleeping Accommodation: | N/A ² | None |
| Impermeable Surface Area: | Approximately 890m ² | Approximately 720m ² |
| Surface Water Drainage: | N/A ² | Surface Water Drainage Strategy recommended prior to detailed design. |
| Site Size: | Approximately 3.4 hectares | No change |
| Risk to Development | Summary | Comment |
| EA Flood Zone: | Flood Zones 1, 2 and 3 | River Cray Modelled flood levels extracted from modelled flood level grids provided as part of EA Product 6 dataset from River Darent and Cray Modelling Study (2019). Flood levels are minimum, and maximum extracted within wider site boundary. Flood levels specific to the pitches and pavilion buildings discussed in Section 4 of this report. |
| Flood Source: | Fluvial | |
| 1:20 Year Flood Level: | 12.47mAOD to 13.12mAOD | |
| 1:100 Year Flood Level: | 12.74mAOD to 13.20mAOD | |
| 1:100 Year +CC (25%) Flood Level: | 12.89mAOD to 13.25mAOD | |
| 1:1000 Year Flood Level | 13.19mAOD to 13.41mAOD | |
| Recorded Flood Events in Area: | Yes | |
| Recorded Flood Events at Site: | Yes | September 1968 and August 1977 |
| SFRA Available: | Yes | London Borough of Bexley Level 1 SFRA (2010) and Level 2 SFRA (2014) |
| Management Measures | Summary | Comment |
| Ground floor level above extreme flood levels: | No | Development is Water Compatible use |
| Safe Access/Egress Route: | No | Flood hazard grids provided by the EA suggest that flood hazards at site entrance in northeast corner could exceed 0.75 (Low Hazard) in 1:100 year event. Upon receipt of Flood Warning, site should be closed, and prior evacuation sought. |
| Flood Resilient Design: | Yes | Section 7 of this report |
| Site Drainage Plan: | N/A ² | Surface Water Drainage Strategy recommended prior to detailed design. |
| Flood Warning & Evacuation Plan: | Yes | EA Flood Warning Service |
| Offsite Impacts | Summary | Comment |
| Displacement of floodwater: | Negligible | Proposal is for conversion of existing buildings and removal of some existing outbuildings. Proposed pavilion buildings to be designed to be floodable. Some land re-leveling is expected as part of pitch creation. |
| Increase in surface run-off generation: | Negligible | |
| Impact on hydraulic performance of channels: | None | Development does include conversion of existing building within approximately 3m of River Cray – Flood Risk Activity Permit (FRAP) may be required for any works within 8m of River Cray. |

Table 1 Summary of flood risks, impacts and proposed flood mitigation measures.

N/A¹ not required for this assessment; N/A² data not available.

2. Development Description and Site Area

Proposed Development and Location

- 2.1 The proposed development is located at Mill Meadows, Bexley, Kent, DA5 1JX (Figures 1 and 2).
- 2.2 The area of the site being developed contains a large greenfield parcel, along with several agricultural outbuildings and stables. It is understood that the development is for the creation of two hockey pitches on the greenfield area, and the demolition of some existing outbuildings and the conversion of the existing stables and agricultural building to create an associated pavilion. The pavilion will be created via conversion of the existing stable with a small westward extension to replace the demolished outbuildings. Existing shed buildings in the northeast of the site will be converted to create storage units.
- 2.3 Topographic levels on site vary between approximately 11.70mAOD and 18.25mAOD (2m LiDAR data). A topographic survey has been provided but does not cover the entire ownership boundary. Analysis of topographic levels indicates that the site generally slopes to the south-east (Figure 3).

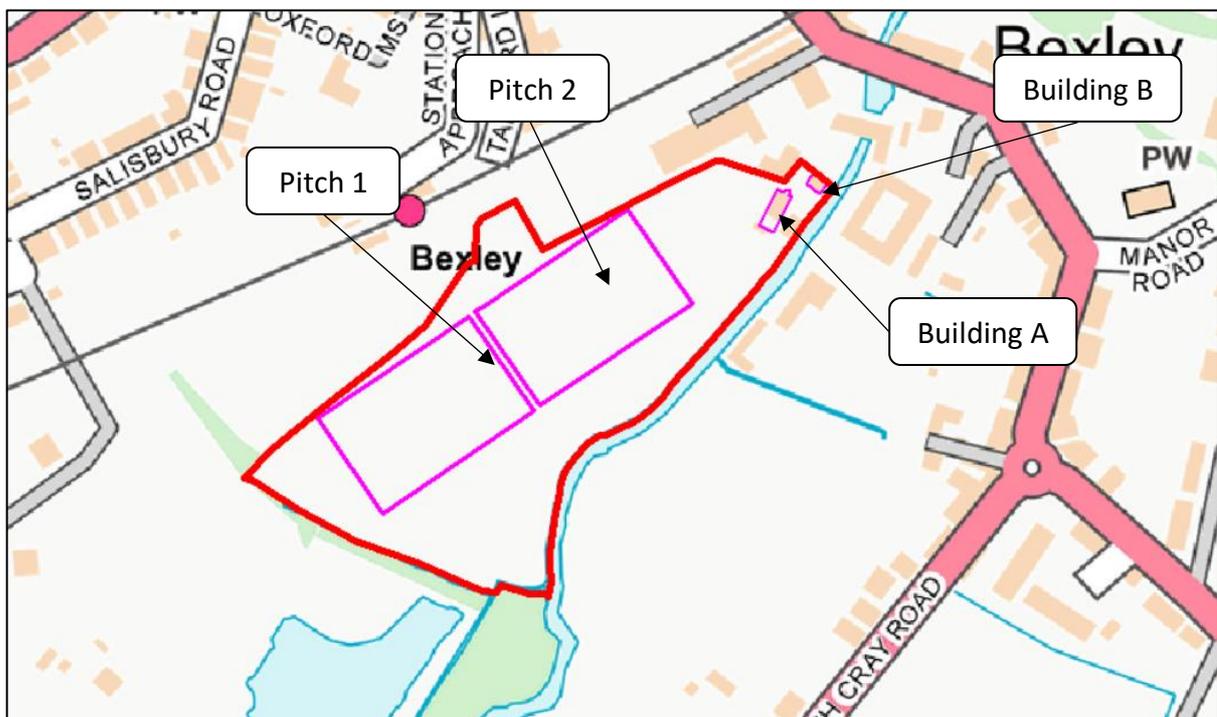


Figure 1 Location Map, identifying the location of the proposed development (Source: OS)



Figure 2 Aerial Map, identifying the location of the proposed development (Source: Global Mapper Global Imagery)

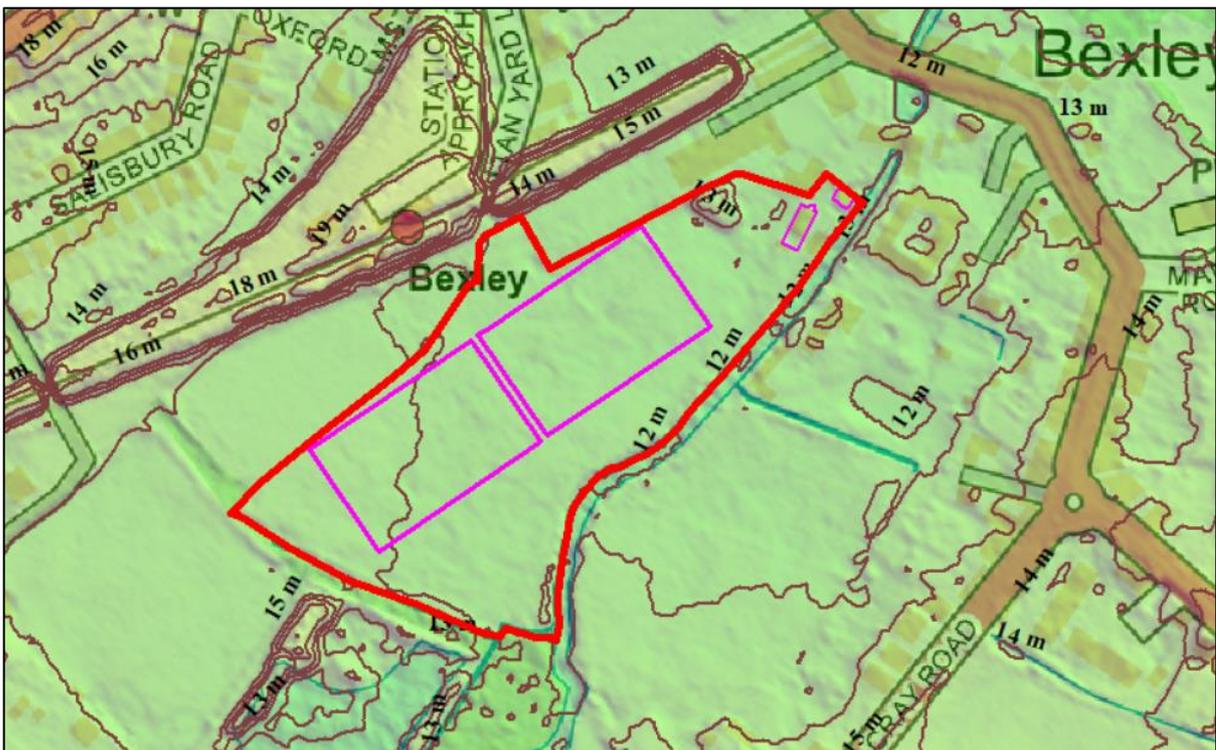


Figure 3 Topography of the site using 2m LiDAR and 1m contours (Sources: OS, EA 2m LiDAR)

Vulnerability Classification

- 2.4 The EA Flood Map for Planning (Figure 4) demonstrates that the site is within Flood Zones 1, 2 and 3. The proposed hockey pitches are primarily in Flood Zones 2 and 3, while the proposed pavilion buildings are in Flood Zone 3. Flood Zone 1 has a low probability of less than 1 in 1000 (<0.1%) of river flooding in any year.

Flood Zone 2 has a medium probability of between 1 in 1000 and 1 in 100 (0.1% to 1%) of river flooding in any year. Flood Zone 3 has a high probability of greater than 1 in 100 (1%) of river flooding in any year.

- 2.5 According to NPPF guidelines, the existing site could be considered 'Water Compatible' although the existing agricultural buildings could be classified as 'Less Vulnerable'. The proposed hockey pitches and pavilion buildings would be considered 'Water Compatible' under the NPPF due to being 'outdoor sports and recreation and essential facilities such as changing rooms'.

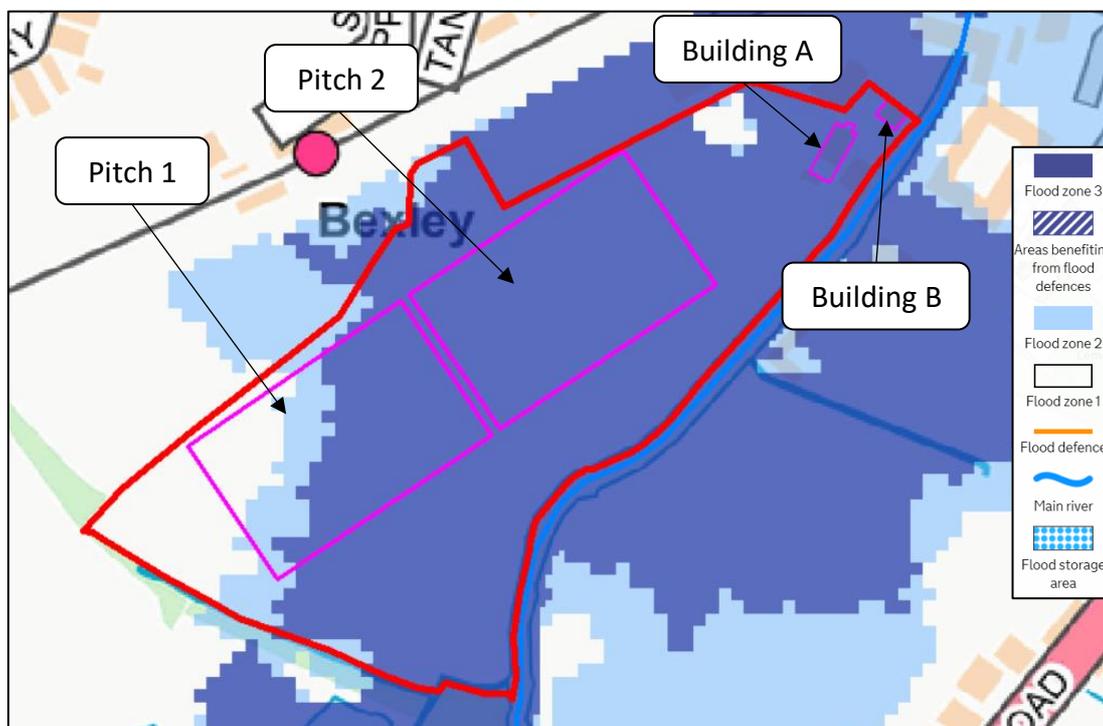


Figure 4 EA Flood Map for Planning (Source EA)

Geology

- 2.6 The British Geological Survey (BGS) Geology of Britain Viewer indicates that the bedrock underlying the site is Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation comprised of chalk (Source: BGS). This formation is considered to be a Principal aquifer (Source: EA; Magic Map online resource). A Principal aquifer is highly permeable, supporting water supply and/or river base flow on a strategic scale.
- 2.7 The British Geological Survey (BGS) Geology of Britain Viewer indicates that the superficial deposits underlying the site are Alluvium comprising clay, sand, silt and gravel; and the Taplow Gravel Member comprising sand and gravel. This formation is a Secondary 'A' aquifer (Source: EA; Magic Map online resource). A Secondary 'A' aquifer is permeable, supporting water supplies at a local scale and may contribute to base flow of rivers.
- 2.8 Source protection zones are defined around large potable groundwater abstraction sites and indicate the risk of contamination from activities in the vicinity of the abstraction site. The site is within a Zone II - Subsurface Activity. There is a predicted travel-time of 400 days for pollutants below the water table to reach the abstraction point.

3. Sequential Test/Exception Test

- 3.1 Under the NPPF, all new planning applications should undergo a *Sequential Test*. This test should be implemented by local planning authorities with a view to locating particularly vulnerable new developments (e.g. residential, hospitals, mobile homes etc.) outside of the floodplain.
- 3.2 The Flood Risk and Coastal Change Planning Practice Guidance (PPG) *Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table* is reproduced below;

| Flood Risk Vulnerability Classification | | Essential Infrastructure | Water Compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|---|---|--------------------------|------------------|-------------------------|-------------------------|-----------------|
| Flood Zone | Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Zone 2 | ✓ | ✓ | Exception Test Required | ✓ | ✓ |
| | Zone 3a | Exception Test Required | ✓ | ✗ | Exception Test Required | ✓ |
| | Zone 3b <i>Functional Floodplain</i> | Exception Test Required | ✓ | ✗ | ✗ | ✗ |

Table 2 The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF.
 Please note: ✓ means development is appropriate; ✗ means the development should not be permitted.

- 3.3 Using the principles of the PPG outlined above, the proposed 'Water Compatible' development in could be considered appropriate in Flood Zones 1, 2, 3a and 3b without the application of the Exception Test.
- 3.4 The EA data reviewed as part of this report indicates that the site is partially affected in the 1:20 year flood extent and is therefore partially in Flood Zone 3b. The proposed pavilion buildings and pitches are partially in Flood Zone 3b. However, as a 'Water Compatible' use, such uses are appropriate in Flood Zone 3b, provided they are designed and constructed to:
- remain operational and safe for users in times of flood;
 - result in no net loss of floodplain storage;
 - not impede water flows and not increase flood risk elsewhere.
- 3.5 It is envisaged that the hockey pitches would not be in use during extreme weather events/ flood events. As such, it would not need to be safe for users in times of flood as it would not be in use during flood events. It is recommended that upon receipt of an EA Flood Warning, the site is evacuated and closed, and remains closed until the Flood Warning is lifted.
- 3.6 With regards to no net loss of floodplain storage and not increasing flood risk elsewhere, due to Green Belt issues, it is understood that it is not possible to relocate or raise the pavilion buildings above modelled flood levels. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. As such, it is recommended that the pavilion buildings are designed to be floodable assets/ allowed to flood should the site flood, to negate displacement of flood water. This would require single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and great events.

4. Site Flood Hazards

Sources of Flooding

- 4.1 The proposed development is located within Flood Zones 1, 2 and 3 (low, medium and high risk of flooding) and is considered to be 'Water compatible' according to the NPPF guidelines. Table 3 summarises the potential sources of flooding to the site:

| Source | Description |
|-------------|---|
| Fluvial | River Cray – High risk to site |
| Surface | Moderate risk to site |
| Groundwater | Relatively low to moderate risk to site |
| Sewer | Low risk to site |

Table 3 Summary of flood sources.

Fluvial

- 4.2 The EA Flood Map for Planning (Figure 4) demonstrates that the site is within Flood Zones 1, 2 and 3. The proposed hockey pitches are primarily in Flood Zones 2 and 3, while the proposed pavilion buildings are in Flood Zone 3.
- 4.3 The River Cray flows from southwest to northeast along the southeast/ eastern boundary of the site. The proposed hockey pitches are located approximately 30m from the River Cray at the closest point. Building A of the pavilion area is located approximately 12m from the River Cray, however Building B is located approximately 3m from the River Cray. Building C is a conversion of an existing building, however, any works within 8m of the River Cray may require a Flood Risk Activity Permit (FRAP) from the EA and it is recommended that the developer liaise with the permitting team at the EA to ascertain if a FRAP is required.
- 4.4 The EA have provided a Product 6 dataset to inform this report, which includes modelled flood level grids from their River Darent and Cray Modelling Study (2019). This provides modelled flood levels on site for a range of return periods on the River Cray which flows southwest to northeast along the east boundary of the site.
- 4.5 The EA data provided indicates that the site is partially affected by the modelled 1:20 year flood extent and is therefore partially in Flood Zone 3b. More specifically, Pitch 1 could be partially affected whereas Pitch 2 and the proposed pavilion buildings are in Flood Zone 3b (Figure 5).

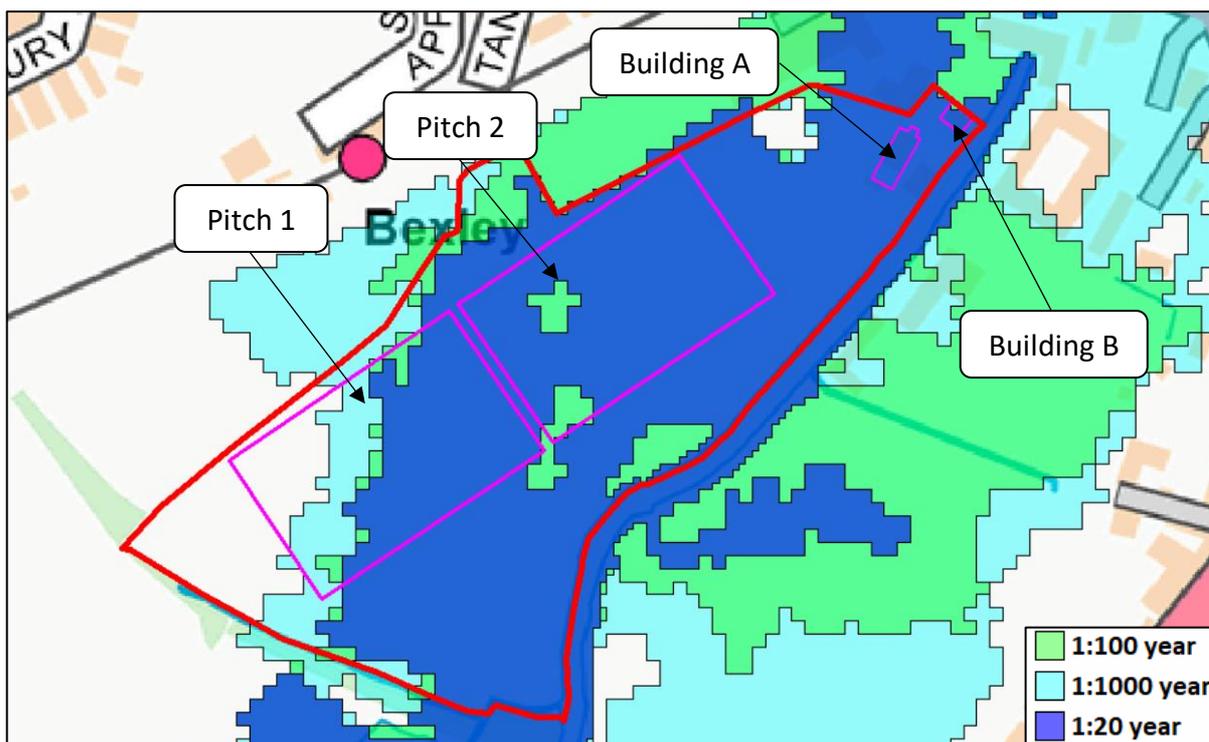


Figure 5 EA Modelled Present Day Defended Flood Extents (Sources: EA River Darent and Cray Modelling Study (2019); OS)

- 4.6 It is acknowledged that small extensions are proposed to the buildings to convert them into the pavilion use. Increases in footprint in Flood Zone 3b are not normally permitted under the NPPF.
- 4.7 However, as a 'Water Compatible' use, such uses are appropriate in Flood Zone 3b, provided they are designed and constructed to:
- remain operational and safe for users in times of flood;
 - result in no net loss of floodplain storage;
 - not impede water flows and not increase flood risk elsewhere.
- 4.8 Due to other planning matters to be addressed as part of this application such as the Green Belt, it is understood that it is not possible to relocate or raise the pavilion buildings above modelled flood levels. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. Therefore, it is not possible for the client to raise the buildings as they are existing and raising these could be inappropriate in Green Belt terms. As such, it is recommended that the pavilion buildings are designed to be floodable assets/ allowed to flood should the site flood, to negate displacement of flood water. This would require single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and greater events.
- 4.9 It is recommended that the pavilions are closed, and the sports pitches not used upon receipt of a Flood Warning from the EA to mitigate the risk to life. The site should remain closed until the EA Flood Warning is lifted.
- 4.10 Figure 5 also indicates that the proposed development site could be affected by the modelled 1:100 year and 1:1000 year events.

- 4.11 Under the EA's latest climate change guidance, a Central Allowance (25%) should be considered on the 1:100 year event for 'Water Compatible' developments in Flood Zone 3b in the Thames Basin. As discussed previously, Pitch 1 could be partially affected whereas Pitch 2 and the proposed pavilion buildings are entirely in Flood Zone 3b. As such the 1:100 year +CC (25%) event should be considered. Figure 6 indicates that the site could also be affected in the 1:100 year +CC (25%) event.

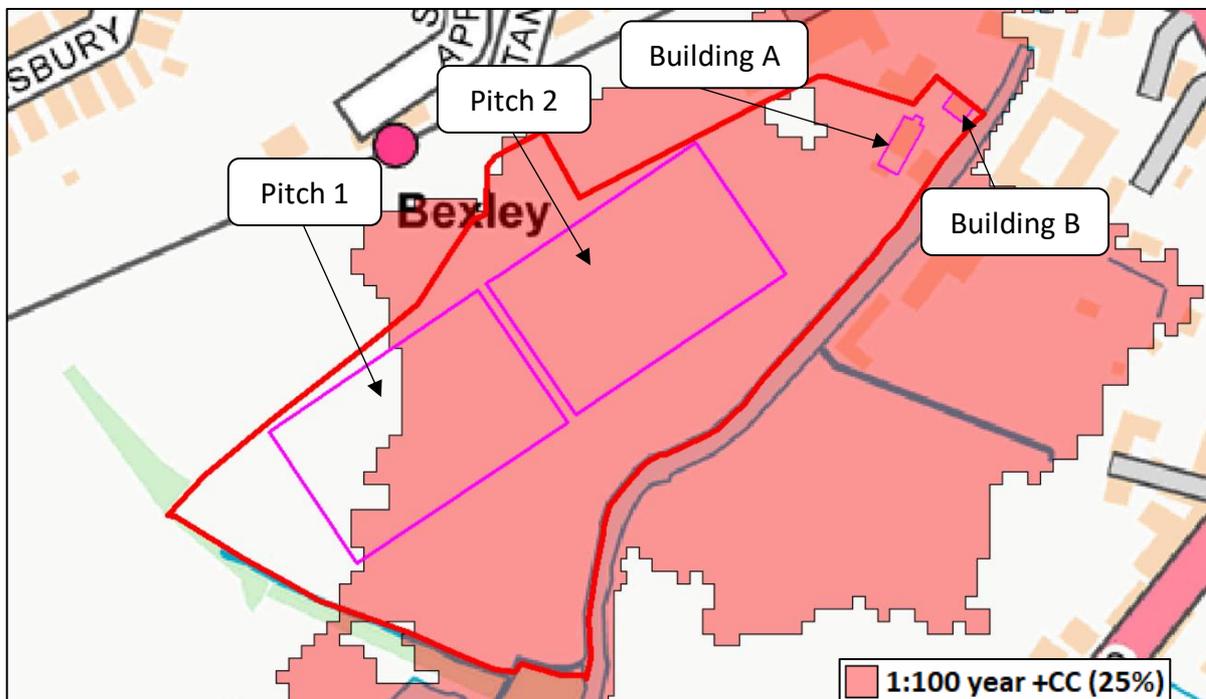


Figure 6 EA Modelled 1:100 year +CC (25%) Defended Flood Extent (Sources: EA River Darent and Cray Modelling Study (2019); OS)

- 4.12 The EA have provided modelled flood level grids for the aforementioned events. A node map and corresponding flood level table can be found in Appendix II of this report.
- 4.13 Table 4 below summarises the potential flood depths at the location of the proposed pavilion buildings based on a comparison between the relevant flood level and the minimum topographic level adjacent to the building based on the topographic survey provided.
- 4.14 It can be seen from Table 4 that depths at the proposed pavilion buildings could range from 0.23m to 0.41m in the 1:20 year event, up to 0.88m to 1.06m in the 1:1000 year events.
- 4.15 As such, the risk of flooding from fluvial sources to the proposed pavilion buildings could be considered **high**.
- 4.16 However, as a 'Water Compatible' asset, it may not be necessary to implement flood proofing measures such as raising of Finished Floor Levels (FFLs). It is recommended that the proposed buildings are of floodable design but also incorporate flood resilience measures to aid recovery after a flood event. This would require a water entry strategy as defined in the CLG Document *Improving the Flood Performances of New Buildings (2007)*. The CLG report states that a water entry strategy is where emphasis is placed on allowing water into the building, facilitating draining and consequent drying. It is recommended that the pavilion buildings are of single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and great events.
- 4.17 Hockey pitches are proposed as part of the planning application. The pitches are to be located on currently sloping land. Table 5 below summarises potential flood depths within the proposed pitch outlines based on

modelled flood level grids and minimum topographic levels based on the topographic survey provided. It can be seen from Table 5 that Pitch 1 could experience flood depths from 0.35m in the 1:20 year event up to 0.71m in the 1:1000 year event (although some of the land is above flood levels in these events); and that Pitch 2 could experience flood depths from 0.84m in the 1:20 year event up to 1.15m in the 1:1000 year event.

| Building | Minimum Topographic Level (mAOD) | 1:20 Year Flood Level (mAOD) | 1:20 Year Flood Depth (m) | 1:100 Year Flood Level (mAOD) | 1:100 Year Flood Depth (m) | 1:100 Year +CC (25%) Flood Level (mAOD) | 1:100 Year +CC (25%) Flood Depth (m) | 1:1000 Year Flood Level (mAOD) | 1:1000 Year Flood Depth (m) |
|----------|----------------------------------|------------------------------|---------------------------|-------------------------------|----------------------------|---|--------------------------------------|--------------------------------|-----------------------------|
| A | 12.18 | 12.59 | 0.41 | 12.84 | 0.66 | 12.97 | 0.79 | 13.24 | 1.06 |
| B | 12.31 | 12.59 | 0.28 | 12.83 | 0.52 | 12.96 | 0.65 | 13.21 | 0.90 |

Table 4 Summary of flood levels and depths at proposed pavillion buildings (Source: EA)

| Pitch | Minimum Topographic Level (mAOD) | 1:20 Year Flood Level (mAOD) | 1:20 Year Flood Depth (m) | 1:100 Year Flood Level (mAOD) | 1:100 Year Flood Depth (m) | 1:100 Year +CC (25%) Flood Level (mAOD) | 1:100 Year +CC (25%) Flood Depth (m) | 1:1000 Year Flood Level (mAOD) | 1:1000 Year Flood Depth (m) |
|-------|----------------------------------|------------------------------|---------------------------|-------------------------------|----------------------------|---|--------------------------------------|--------------------------------|-----------------------------|
| 1 | 12.65 | 13.00 | 0.35 | 13.06 | 0.41 | 13.12 | 0.47 | 13.36 | 0.71 |
| 2 | 12.13 | 12.97 | 0.84 | 13.02 | 0.79 | 13.07 | 0.94 | 13.28 | 1.15 |

Table 5 Summary of flood levels and depths at proposed hockey pitches (Source: EA)

4.18 As a result, the risk of flooding to the proposed hockey pitches could also be considered **high**.

Surface Water (Pluvial)

- 4.19 The Environment Agency Flood Risk from Surface Water Map (Figure 7) shows the proposed development to be within an area of 'Very Low' 'Low' and 'Medium' risk of flooding from surface water.
- 4.20 Pitch 1 is identified as 'Very Low' and 'Low' risk while Pitch 2 is considered to be at 'Low' and 'Medium' risk. The proposed pavilion buildings are in an area at 'Low' and 'Medium' risk. Areas identified to be at 'Very Low' risk have a less than 0.1% annual risk of flooding from this source. Areas identified to be at 'Low' risk have a 0.1% to 1% annual risk of flooding from this source. Areas identified to be at 'Medium' risk have a 1% to 3.3% annual risk of flooding from this source. Areas identified to be at 'High' risk have a greater than 3.3% annual risk of flooding from this source.
- 4.21 The EA Risk of Flooding from Surface Water (RoFSW) dataset indicates that the proposed pavilion buildings could remain unaffected in the 1:30 year event (Figure 8). In the same event, Pitch 1 and the majority of Pitch 2 could remain unaffected, although the RoFSW mapping indicates that a small low lying area in the northeast corner of the proposed pitch could experience depths of up to 600mm.
- 4.22 In the 1:100 year event, the RoFSW dataset indicates that more of the site could be affected (Figure 9). The proposed pavilion buildings are to be in an area that could experience flood depths of up to 600mm in this event, while a larger portion of Pitch 2 could be affected with depths of up to 300mm, and 600mm in places such as the northeast corner. The RoFSW dataset indicates that Pitch 1 may remain unaffected in the 1:100 year event.
- 4.23 The RoFSW dataset indicates that much of the site could be affected in the 1:1000 year event (Figure 10). The proposed pavilion buildings are to be in an area that could experience flood depths of up to 900mm in this event. Land between the pavilion buildings and the proposed hockey pitches could experience flood depths of 900mm to 1200mm in this event. Pitch 2 is to be located within an area that could experience flood depths of 600mm to 900mm in this event while depths at the lower parts of Pitch 1 could reach 300mm to 600mm.

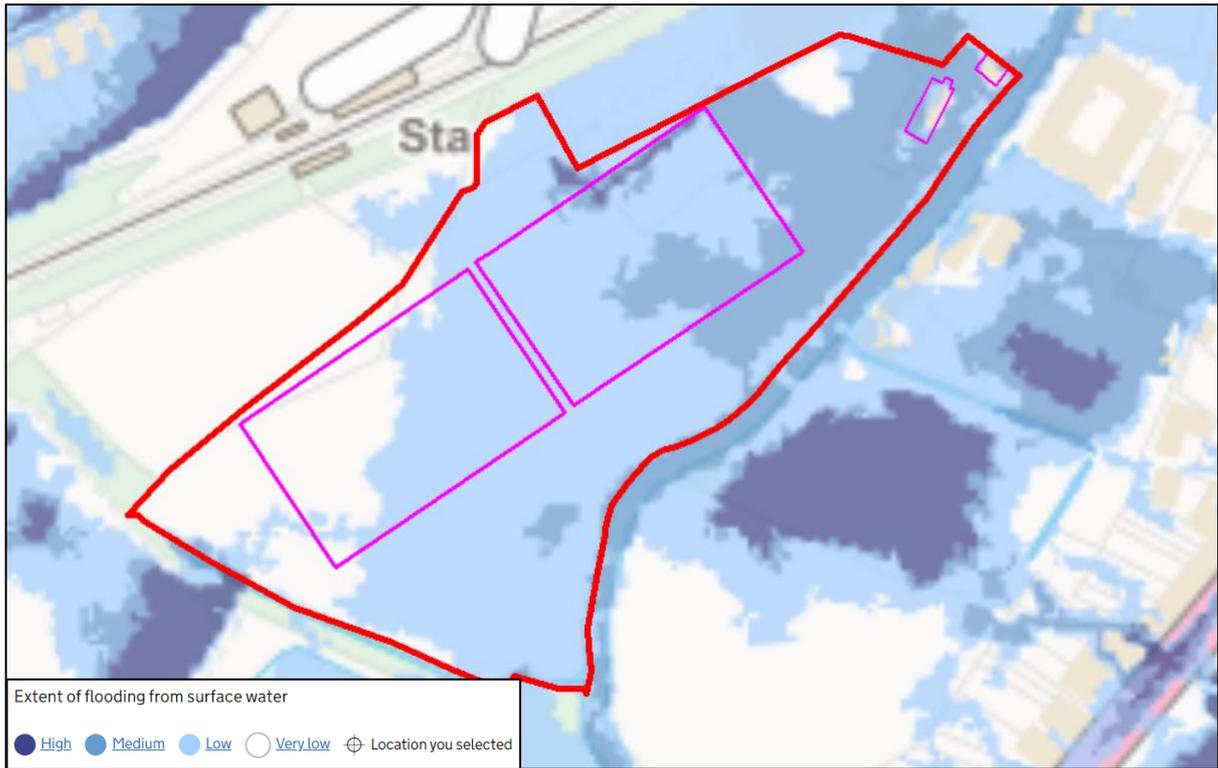


Figure 7 EA Surface Water Flood Risk Map. (Source: EA)

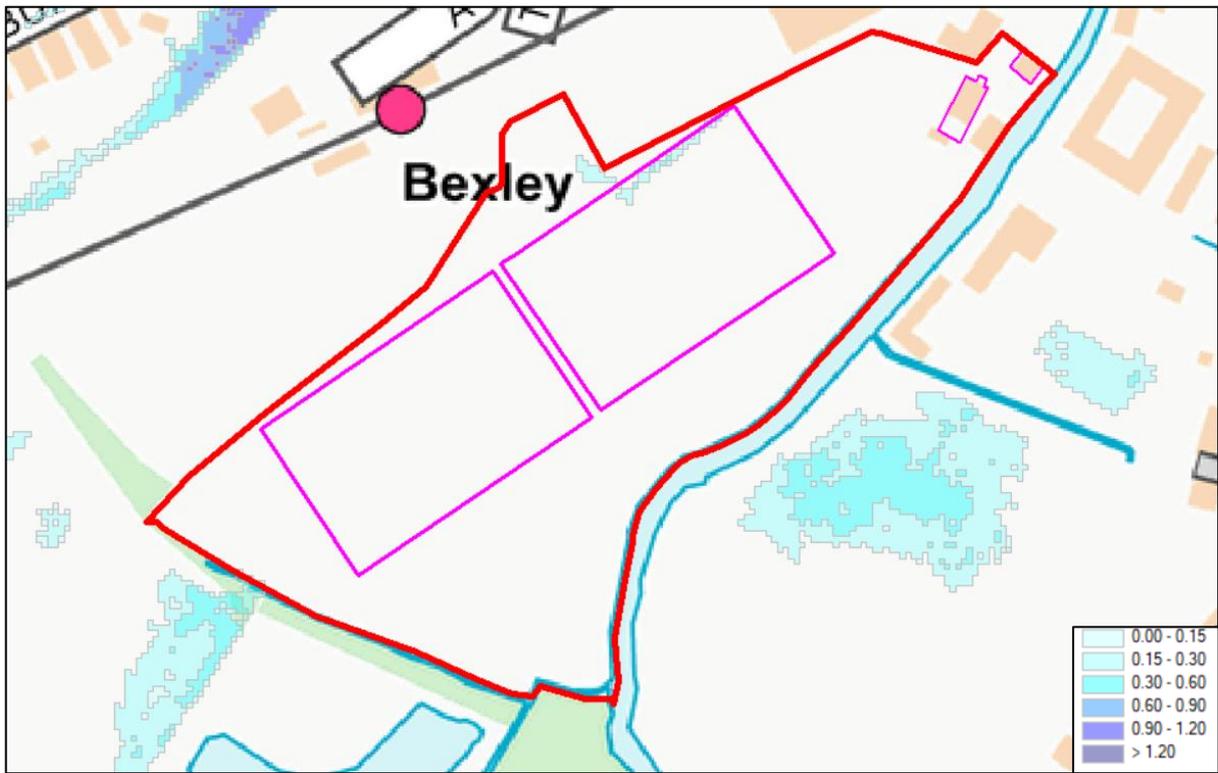


Figure 8 1:30 year pluvial flood depths (Sources: EA RoFSW, OS)

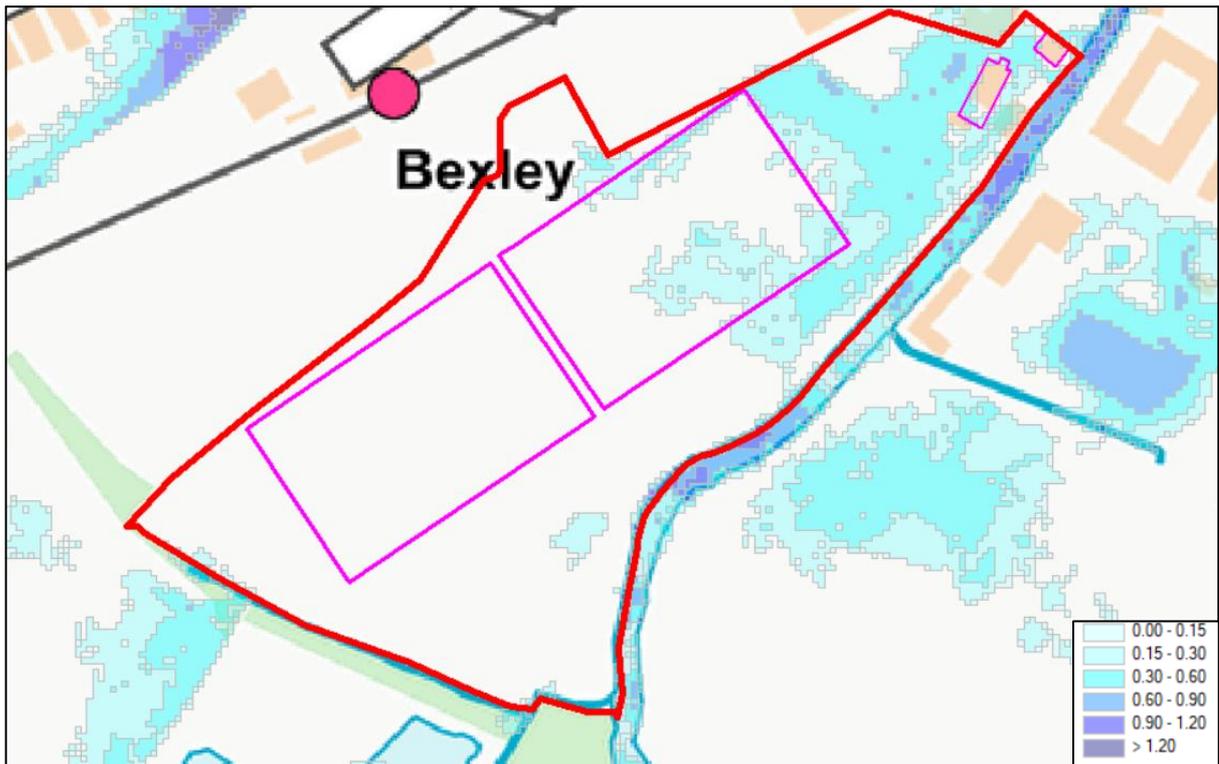


Figure 9 1:100 year pluvial flood depths (Sources: EA RoFSW, OS)

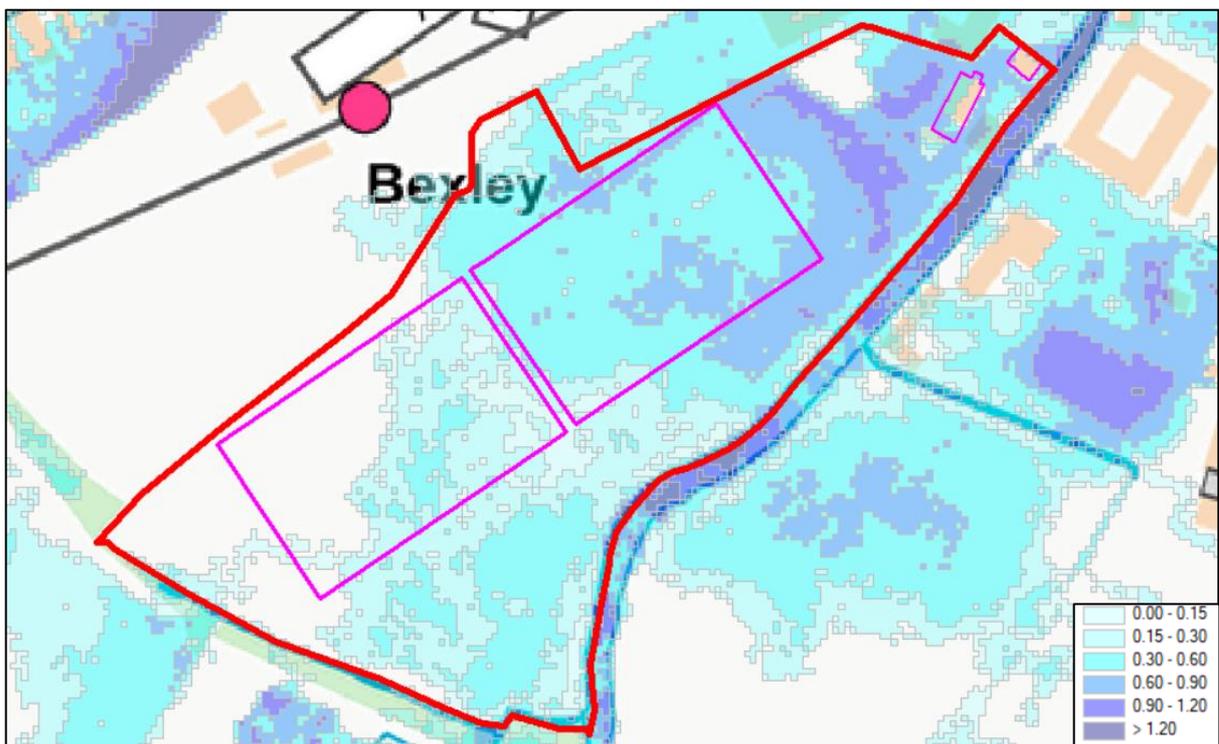


Figure 10 1:1000 year pluvial flood depths (Sources: EA RoFSW, OS)

Groundwater

4.24 The British Geological Survey (BGS) Groundwater Susceptibility dataset indicates that the proposed development is to be located within an area with potential for groundwater flooding of property situated below ground level (Figure 11).

4.25 BGS borehole ref TQ47SE125 was located on the Mill Meadows site. This borehole record indicates that groundwater was encountered at 4m below ground level and stood at 3.6m below ground level on completion. This borehole was located at the lower lying east of the site. However, the proposed pavilion buildings will not have a basement level.

4.26 As such, the risk of flooding from groundwater could be considered **moderate**.

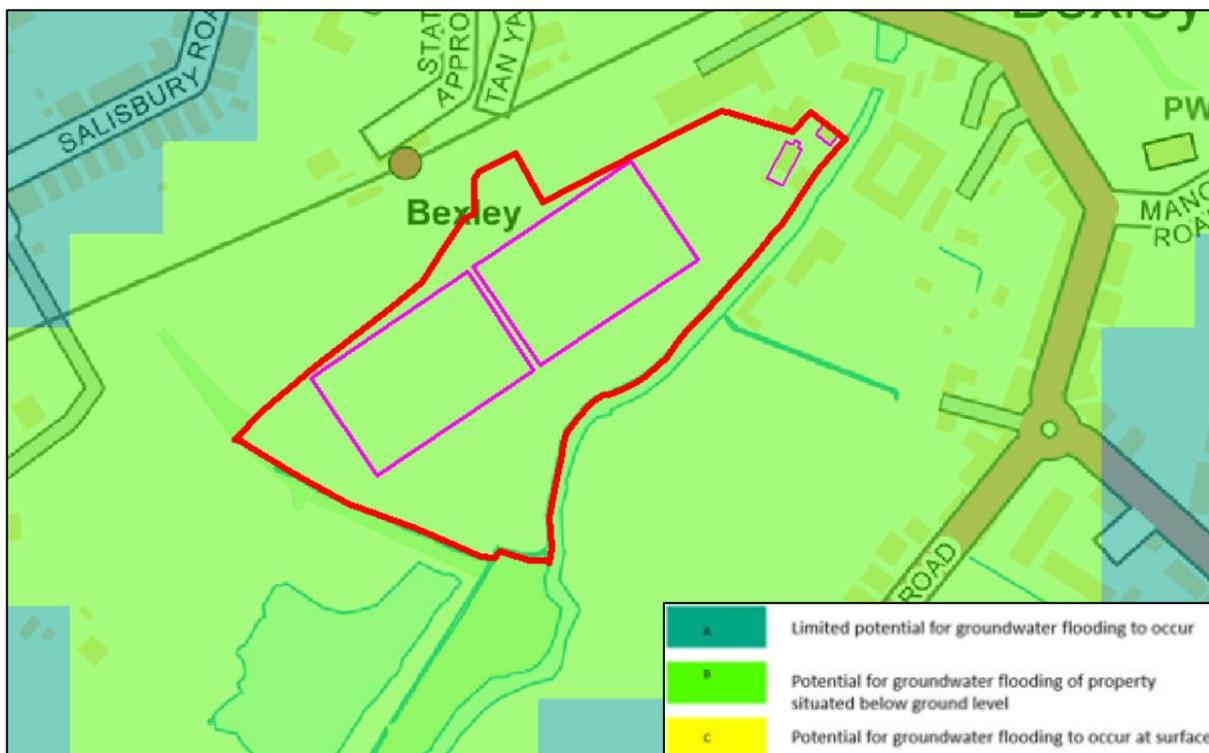


Figure 11 Groundwater Susceptibility. (Sources: OS, BGS)

Sewer

4.27 The London Borough of Bexley PFRA (2011), based on the Thames Water DG5 register, identifies 1-5 sewer flooding incidents within the vicinity of the site for the 10 years preceding 2010 (Figure 12).

4.28 The location of the previous incidents within the DA5 3 postcode area with regard to the site are unknown. No records could be found to indicate historic sewer flooding at the site. Furthermore, as the site is predominantly greenfield, it could be considered unlikely that these areas have been subject to sewer flooding previously.

4.29 As such, the risk of flooding from sewer sources could be considered **low**.

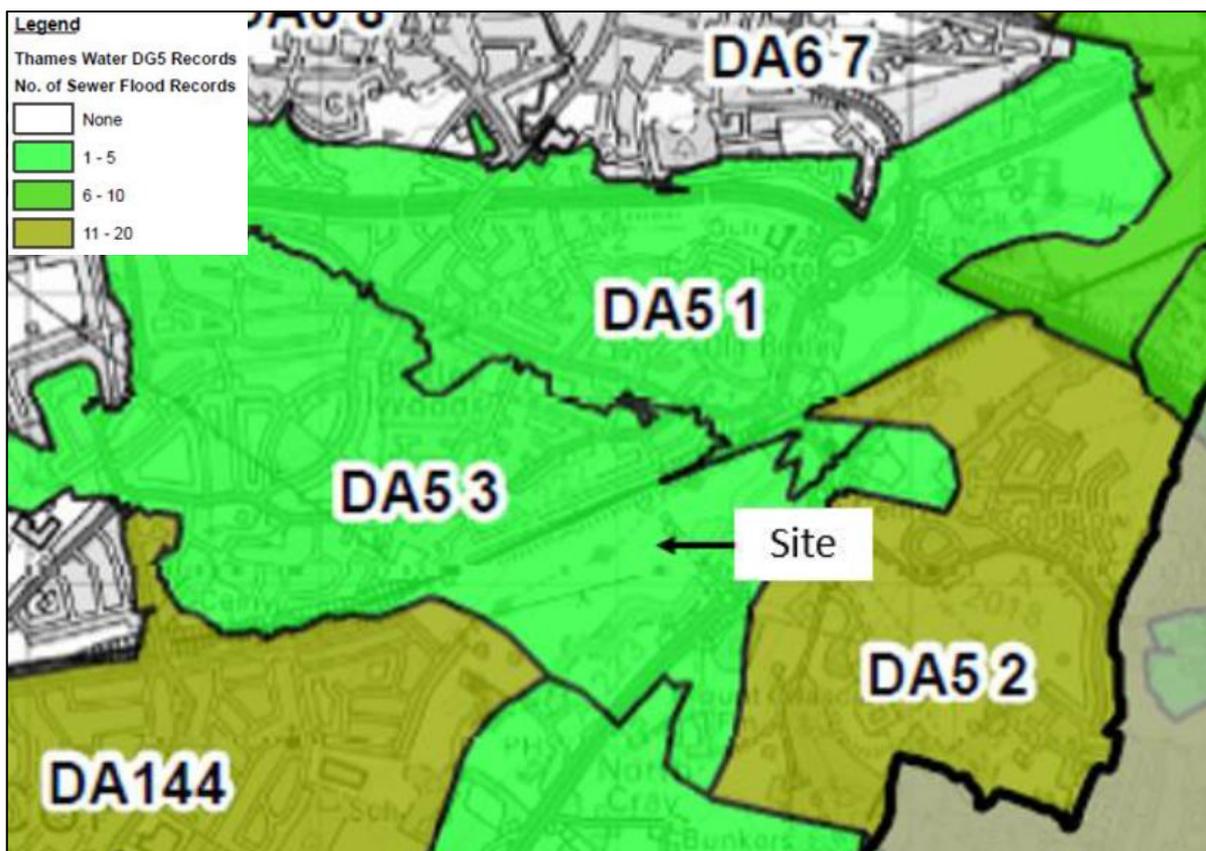


Figure 12 Historical sewer flooding by postcode. (Source: Thames Water DG5 Register, Bexley PFRA (2011))

Surface Water Drainage Strategy

- 4.30 It is understood that Pitch 1 will be an artificial pitch. The client has advised that this pitch will be freely draining. As Pitch 2 will be a grass playing surface, runoff could dissipate as per the existing situation.
- 4.31 With regards to the proposed pavilion buildings, the pavilions will be created through the conversion and extension of existing agricultural buildings on site. Plans provided by the client also indicate that formal parking will be provided adjacent to the pavilion buildings. It is recommended that a drainage strategy for the proposed pavilion buildings is produced prior to detailed design.

Records of Historical Flooding

- 4.32 Historical Fluvial Flood data provided by the EA indicates fluvial flooding at the site in 1968 and 1977 (Figure 13).
- 4.33 No records could be found to indicate that the proposed development site had flooded from any other source historically.

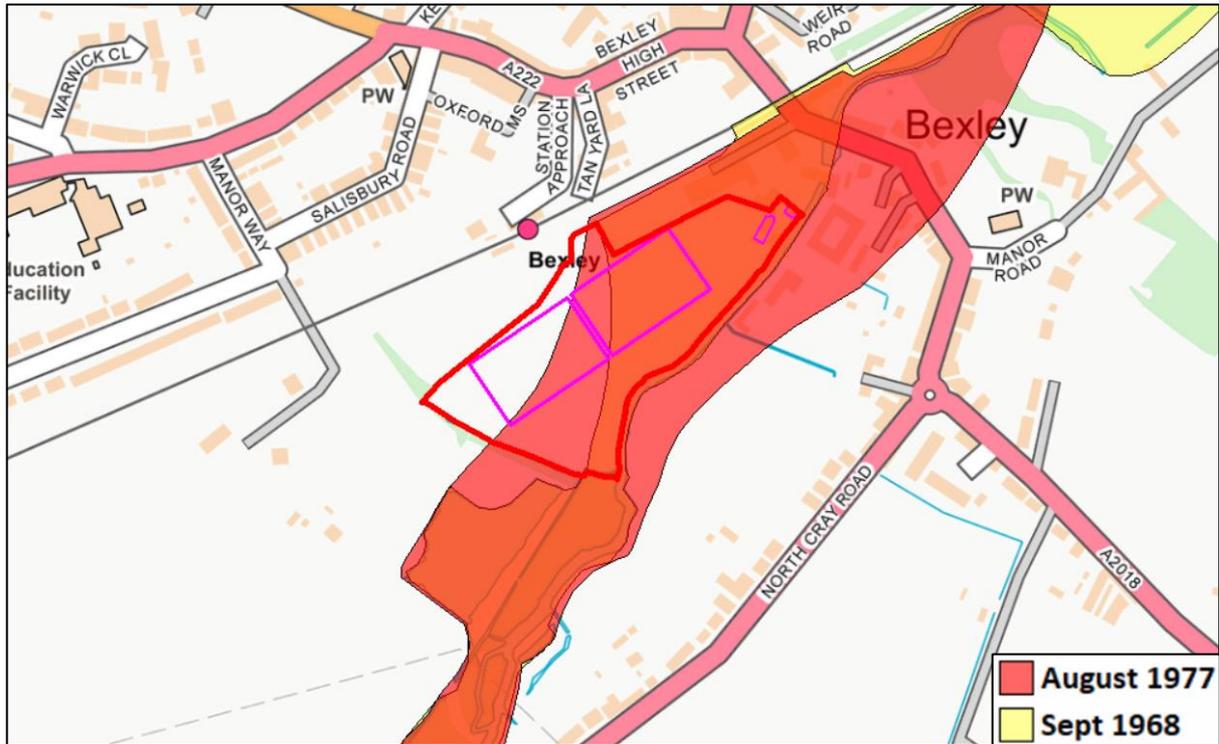


Figure 13 Historical Flooding. (Sources: EA OS)

5. Probability of Flooding

Flood Zones

- 5.1 According to the EA Flood Map for Planning, the site is located within Flood Zones 1, 2 and 3 (low, medium and high risk of flooding).
- 5.2 The EA Flood Map for Planning has been produced in part using a relatively coarse, national scale flood modelling strategy, and in part by detailed modelling. It is important to note that only the potential floodplain is modelled; **the mitigating effects of any flood defences currently in place are not considered.** For reference, the definition of the NPPF flood risk zones is included below.

| Zone | Description |
|------|--|
| 1 | Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). |
| 2 | Medium Probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year. |
| 3a | High Probability. 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. |
| 3b | The Functional Floodplain. This zone comprises land where water has to flow or be stored in times of flood. SFRA's should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA, including water conveyance routes). |

Table 6 Definition of the NPPF Flood Zones. (Source: EA)

Climate Change on Site

- 5.3 Under the EA's latest climate change guidance, a Central Allowance (25%) should be considered on the 1:100 year event for 'Water Compatible' developments in Flood Zone 3b in the Thames Basin. As such, the 1:100 year +CC (25%) event has been considered in Section 4 of this report.
- 5.4 The data reviewed as part of this report indicates that in the 1:100 year +CC (25%) event, Building A could experience flood depths of up to 0.61m, Building B could experience flood depths of up to 0.79m, and Building C could experience flood depths of up to 0.65m.
- 5.5 Furthermore, based on current ground levels, Pitch 1 could experience flood depths from 0.35m in the 1:20 year event up to 0.71m in the 1:1000 year event and Pitch 2 could experience flood depths from 0.84m in the 1:20 year event up to 1.15m in the 1:1000 year event.

6. Residual Risks

Identification of Residual Risks

6.1 Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir, or;
- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

Defence Breach

6.2 The proposed development site is not within an area benefitting from the presence of flood defences according to the EA Flood Map for Planning. As such, the residual risk of flooding following defence breach/failure could be considered negligible.

Reservoir Failure

6.3 The EA Flood Risk from Reservoir Map (Figure 14) demonstrates that the site is outside flood extents in the event of reservoir flooding.

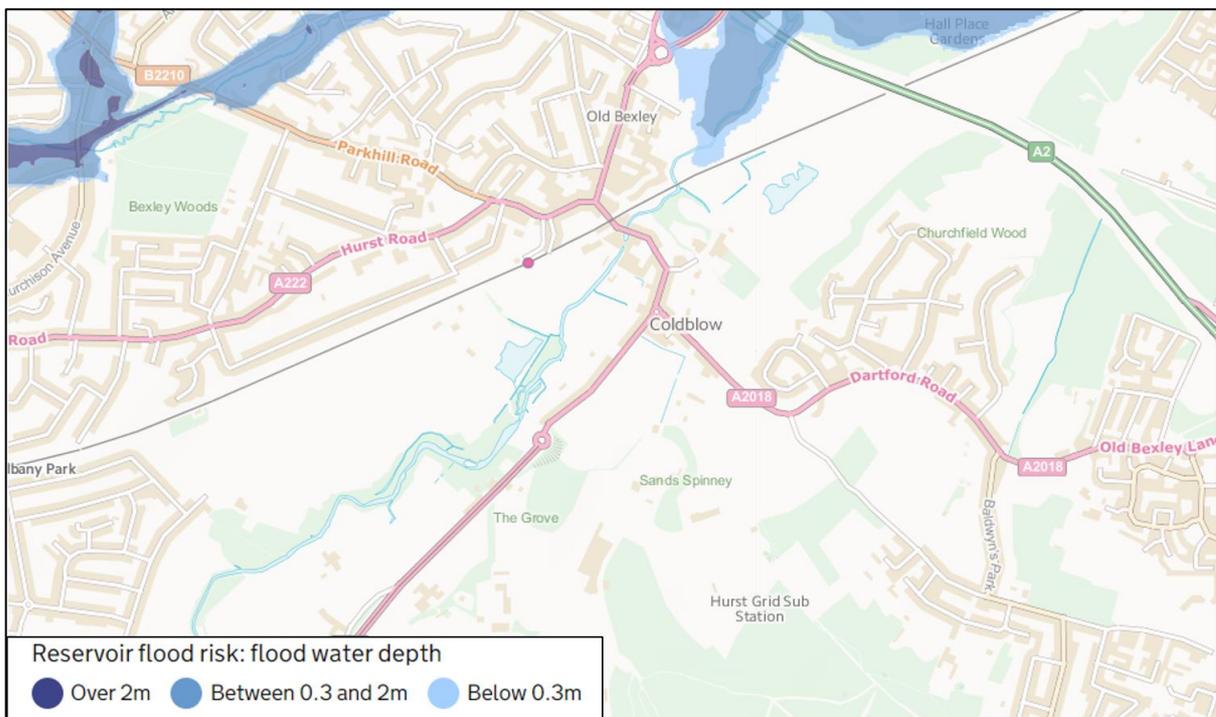


Figure 14 Flood Risk from Reservoirs (Source: EA)

Drainage Exceedance

6.4 In the event of drainage exceedance, overland flows could be dictated by external topography. A review of 2m LiDAR indicates that the site slopes down to the east. As such, overland flows could be directed towards the pavilion buildings. Although the proposed pavilion buildings are to be designed to be floodable assets,

it is recommended that the ground floor thresholds are raised 150mm above ground level to mitigate against overland flows in exceedance events. Given that flood depths at the building locations are to be at least 0.23m in the 1:20 year event, flood water could still ingress during this event even if thresholds are raised 150mm above ground levels.

7. Flood Risk Management Measures

Flood Risks

- 7.1 Analysis within this report has indicated that the proposed development site is partially in Flood Zone 3b. Given that the proposed development is considered 'Water Compatible' flood mitigation measures may not be required. However, although 'Water Compatible' uses are appropriate in Flood Zone 3b, they are required to be designed and constructed to:
- remain operational and safe for users in times of flood;
 - result in no net loss of floodplain storage;
 - not impede water flows and not increase flood risk elsewhere.
- 7.2 It is envisaged that the hockey pitches would not be in use during extreme weather events/ flood events. As such, it would not need to be safe for users in times of flood as it would not be in use in flood events. It is recommended that upon receipt of an EA Flood Warning, the site is evacuated and closed, and remains closed until the Flood Warning is lifted.
- 7.3 Due to other planning matters to be addressed as part of this application such as the Green Belt, it is understood that it is not possible to relocate or raise the pavilion buildings above modelled flood levels. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. Therefore, it is not possible for the client to raise the buildings as they are existing and raising these could be inappropriate in Green Belt terms. As such, it is recommended that the pavilion buildings are designed to be floodable assets/ allowed to flood should the site flood, to negate displacement of flood water. This would require single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and greater events.
- 7.4 Section 6.5.2 of the CLG Document *Improving the Flood Performances of New Buildings (2007)* includes details of wall constructions that would be suitable for a water entry structure. For example, for a water entry strategy which is aimed at allowing water passage through the property, concrete blocks are recommended. External renders should not be used as they provide a barrier to water penetration and may induce excessive differences in depth between outside and inside of the property resulting in possible structural problems. With regards to internal linings, internal cement renders should be avoided as these can prevent effective drying; the CLG report recommends the use of standard gypsum plasterboard up to the predicted flood level (13.24m AOD) plus 50mm freeboard as a sacrificial material.
- 7.5 Hockey pitches are proposed as part of the planning application. The pitches are to be located on currently sloping land. It is understood that there will be a levels change to create a flat playing surface.
- 7.6 As such, the following measures/ procedures are recommended:
- Proposed pavilion buildings to be of floodable design adopting a water entry strategy (single skin construction, flood grilles around perimeter);
 - All floors to be finished with waterproof screed (where possible);
 - Electrical sockets should be raised as high as possible;
 - Boilers, control and water storage / immersion to be installed at raised level (where possible);
 - Gas meter to be installed at raised level (where possible);

- All plumbing insulation to be of closed-cell design;
- Non-return valves to be fitted to all drain and sewer outlets;
- Manhole covers to be secured;
- Anti-syphon fitted to all toilets;
- Internal furnishings/ units to be raised on legs above plinth;
- Site owners/ management/ staff sign up to EA Flood Warning Service;
- Site to be evacuated and closed upon receipt of Flood Warning, and not reopen until Flood Warning is lifted.

Flood Warning Service

- 7.7 The EA operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. Further information can be found on www.environment-agency.gov.uk/floodline. Floodline Warnings Direct is a free service operated by the EA that provides flood warnings direct to occupants by telephone, mobile phone, fax or pager.
- 7.8 The proposed development site is located within the EA Flood Warning Service Area *River Cray in St Marys Cray, Sidcup, Bexley and Crayford* (Figure 15). As such, it is recommended that site owners, management and staff sign up to this service.

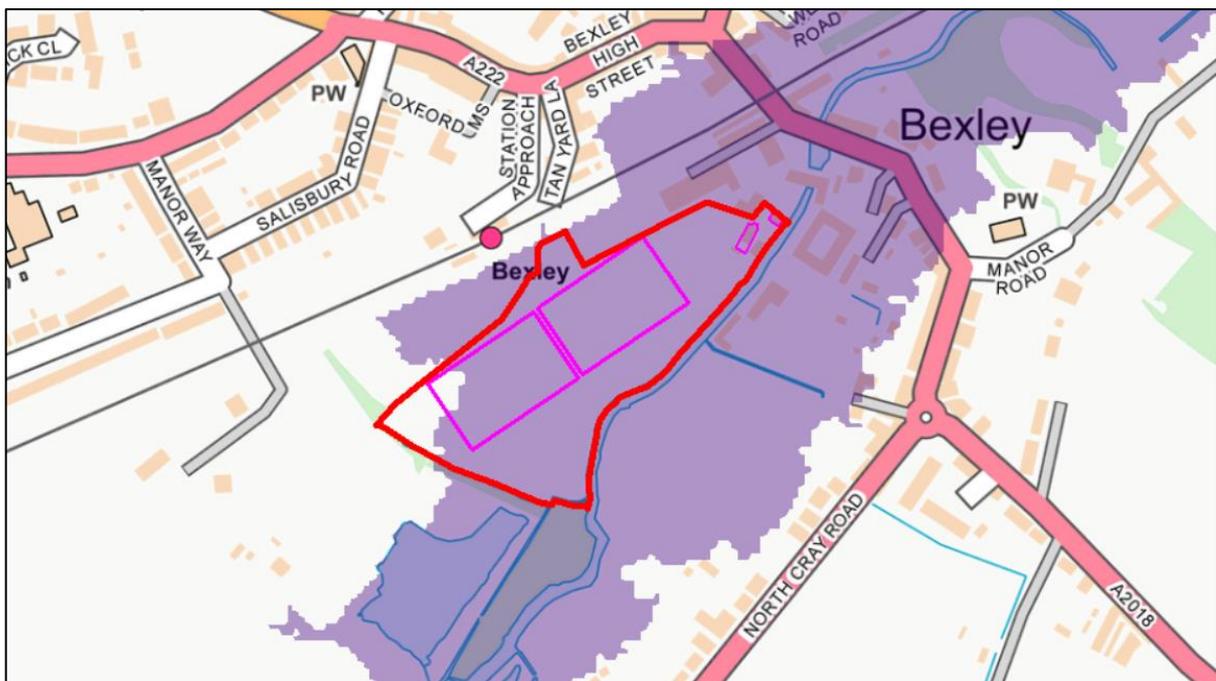


Figure 15 EA Flood Warning Service Area (Sources: OS, EA)

Flood Evacuation Plan

- 7.9 As a water entry strategy is proposed for the proposed pavilion buildings, it is acknowledged that safe refuge on site in the event of a flood may not be possible.
- 7.10 As such, it is essential that prior evacuation is sought prior to flood waters reaching the site.

- 7.11 Site owners/ management should sign up to the EA Flood Warning Service. Upon receipt of a Flood Warning, if the site is not currently being use. The site owners/ management should notify all expected site users (staff, players etc) of the EA Flood Warning and keep them updated as the situation changes. The site should remain closed and no one should seek to access the site until the Flood Warning is lifted. The site owners/ management should inform site users that the site is safe to use again once the EA Flood Warning has been lifted.
- 7.12 If the site is in use when the EA issue a Flood Warning, all site activity should cease immediately, and the site should be evacuated and closed.
- 7.13 The EA have provided modelled flood hazard grids as part of the Product 6 dataset. The EA data indicates that in the 1:100 year +CC (25%) event, flood hazards on site could reach 1.25 to 2.00 (Danger for Most), although ratings at the site entrance in the northeast corner could be less than 0.75 (Low Hazard) and 0.75 to 1.25 (Danger for Some) as shown in Figure 16. Although, it may be possible to exit the site via the cricket pitch entrance in the northwest corner.
- 7.14 As such, safe access/ egress may not be possible in the 1:100 year +CC (25%) event if flood waters have already reached the site. As a result, it is essential that the prior evacuation procedures are implemented.

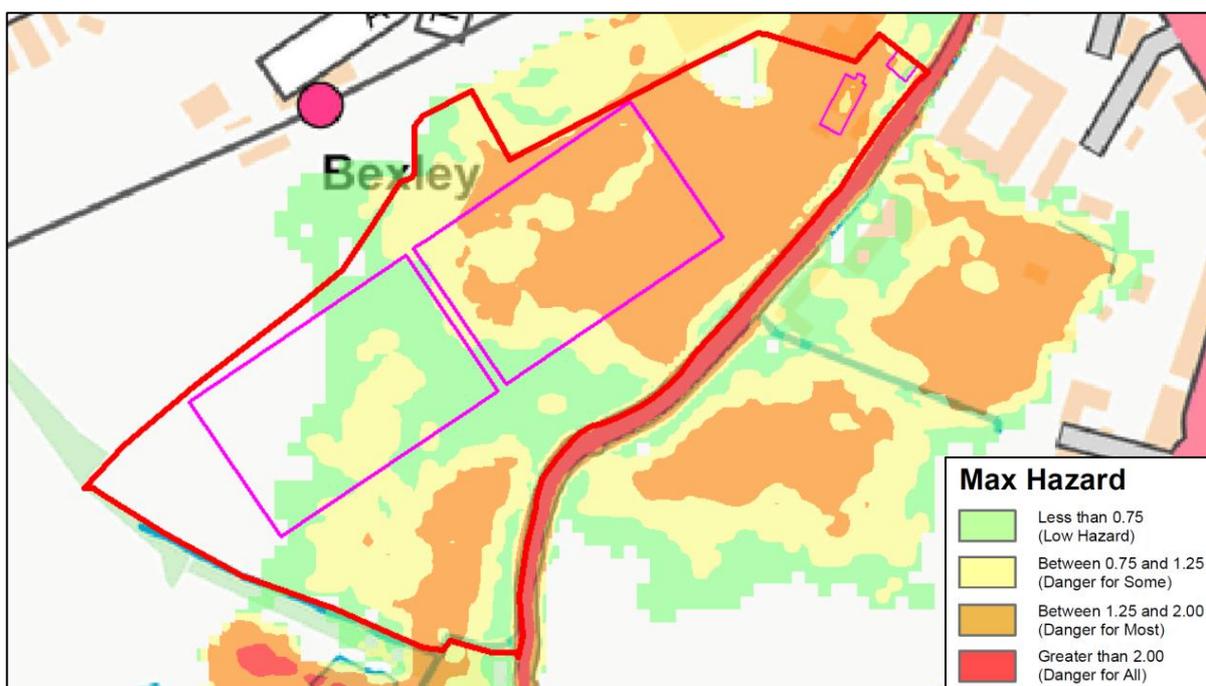


Figure 16 EA Modelled 1:100 year +CC (25%) Flood Hazard Grid (Sources: OS, EA)

8. Off Site Impacts

Impact to Flood Risk Elsewhere

- 8.1 The proposed development site is partially in Flood Zone 3b. It is acknowledged that small extensions are proposed to the buildings to convert them into the pavilion use. Increases in footprint in Flood Zone 3b are not normally permitted under the NPPF.
- 8.2 However, as a 'Water Compatible' use, such uses are appropriate in Flood Zone 3b, provided they are designed and constructed to:
- remain operational and safe for users in times of flood;
 - **result in no net loss of floodplain storage;**
 - **not impede water flows and not increase flood risk elsewhere.**
- 8.3 Due to other planning matters to be addressed as part of this application such as the Green Belt, it is understood that it is not possible to relocate or raise the pavilion buildings above modelled flood levels. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. Therefore, it is not possible for the client to raise the buildings as they are existing and raising these could be inappropriate in Green Belt terms. As such, it is recommended that the pavilion buildings are designed to be floodable assets/ allowed to flood should the site flood, to negate displacement of flood water. This would require single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and greater events.
- 8.4 Section 6.5.2 of the CLG Document *Improving the Flood Performances of New Buildings (2007)* includes details of wall constructions that would be suitable for a water entry structure. For example, for a water entry strategy which is aimed at allowing water passage through the property, concrete blocks are recommended. External renders should not be used as they provide a barrier to water penetration and may induce excessive differences in depth between outside and inside of the property resulting in possible structural problems. With regards to internal linings, internal cement renders should be avoided as these can prevent effective drying; the CLG report recommends the use of standard gypsum plasterboard up to the predicted flood level (13.24mAOD) plus 50mm freeboard as a sacrificial material.
- 8.5 Hockey pitches are proposed as part of the planning application. The pitches are to be located on currently sloping land. It is understood that there will be a levels change to create a flat playing surface.

Generation of Runoff

- 8.6 It is understood that Pitch 1 will be an artificial pitch. Given the nature of artificial sports pitches, a drainage design will be required to provide adequate drainage of the playing surface. As the details of the pitch are not confirmed at this stage, it is envisaged that the drainage design for Pitch 1 would be done at the detailed design stage. As Pitch 2 will be a grass playing surface, runoff could dissipate as per the existing situation.
- 8.7 With regards to the proposed pavilion buildings, the pavilions will be created through the conversion and extension of existing agricultural buildings on site. Plans provided by the client also indicate that formal parking will be provided adjacent to the pavilion buildings. It is recommended that a drainage strategy for the proposed pavilion buildings is produced prior to detailed design.

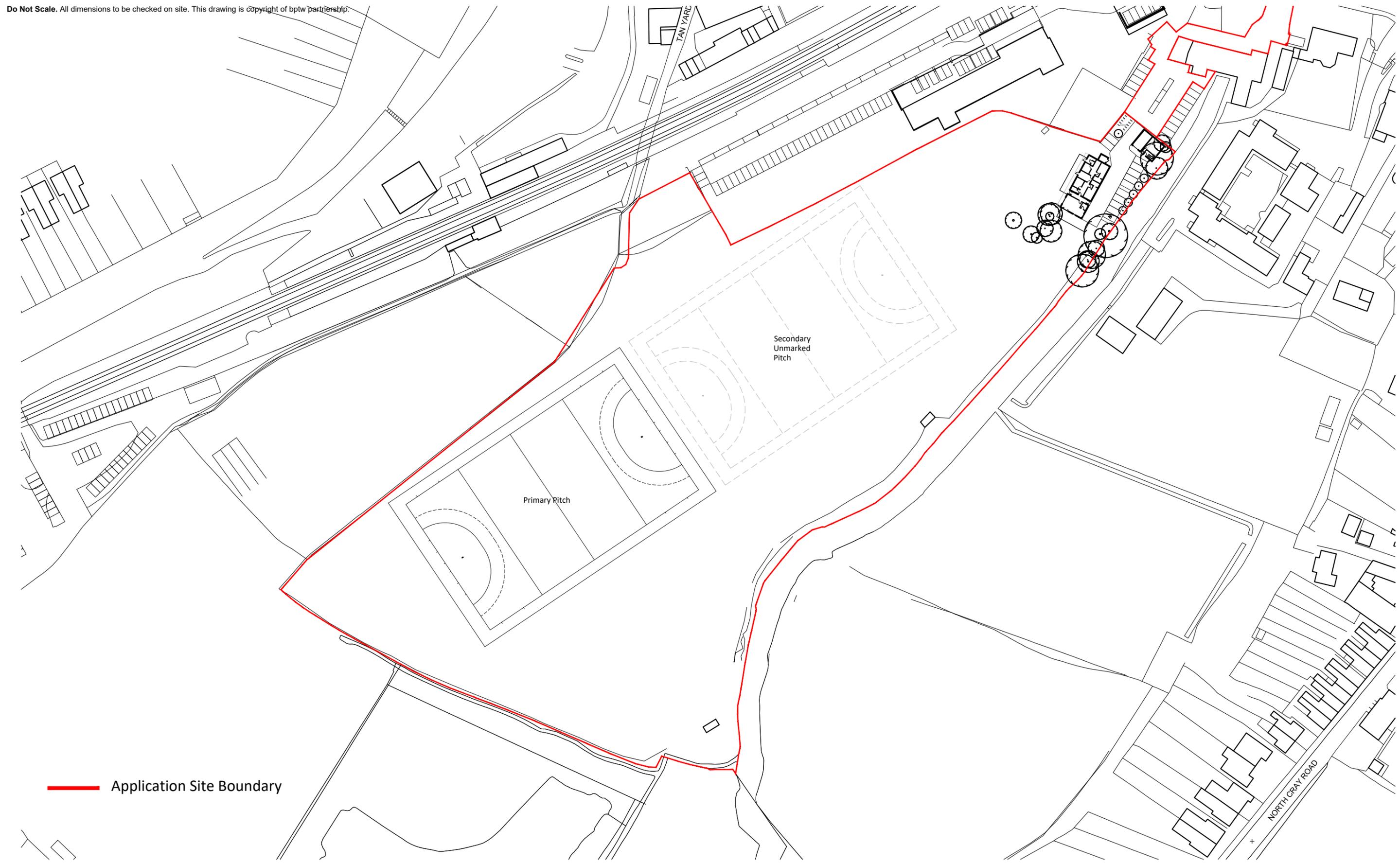
9. Conclusion

- 9.1 Ambient Environmental Assessment has been appointed by Cray Mill Leisure Ltd to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at Mill Meadows, Bexley, Kent, DA5 1JX.
- 9.2 The area of the site being developed contains a large greenfield parcel, along with several agricultural outbuildings and stables. It is understood that the development is for the creation of two hockey pitches on the greenfield area, and the demolition of some existing outbuildings and the conversion of the existing stables and agricultural building to create an associated pavilion. A new building of approximately 55m² will be constructed adjacent to the main pavilion also, to provide similar uses.
- 9.3 The proposed hockey pitches and pavilion buildings would be considered 'Water Compatible' under the NPPF due to being 'outdoor sports and recreation and essential facilities such as changing rooms'.
- 9.4 With reference to the Environment Agency (EA) Flood Map for Planning, the site is located in Flood Zones 1, 2 and 3. The proposed hockey pitches are primarily in Flood Zones 2 and 3, while the proposed pavilion buildings are in Flood Zone 3.
- 9.5 The EA have provided a Product 6 dataset to inform this report, which includes modelled flood level grids from their River Darent and Cray Modelling Study (2019). This provides modelled flood levels on site for a range of return periods on the River Cray which flows southwest to northeast along the east boundary of the site.
- 9.6 The EA data provided indicates that the site is partially affected in the 1:20 year flood extent and is therefore partially in Flood Zone 3b. The proposed pavilion buildings and pitches are partially in Flood Zone 3b. However, as a 'Water Compatible' use, such uses are appropriate in Flood Zone 3b, provided they are designed and constructed to:
- remain operational and safe for users in times of flood;
 - result in no net loss of floodplain storage;
 - not impede water flows and not increase flood risk elsewhere.
- 9.7 Due to other planning matters to be addressed as part of this application such as the Green Belt it is understood that it is not possible to relocate or raise the pavilion buildings above modelled flood levels. It is also important to note that the pavilion buildings will be conversions of the existing buildings on site. As such, it is recommended that the pavilion buildings are designed to be floodable assets/ allowed to flood should the site flood, to negate displacement of flood water. This would require single skin construction (similar to the existing structures) with flood grilles around the perimeter to allow flood water to penetrate the structure in the 1:20 year and great events.
- 9.8 It is recommended that the pavilions are closed, and the sports pitches not used upon receipt of a Flood Warning from the EA to mitigate the risk to life. The site should remain closed until the EA Flood Warning is lifted.
- 9.9 Hockey pitches are proposed as part of the planning application. The pitches are to be located on currently sloping land. It is understood that there will be a levels change to create a flat playing surface.
- 9.10 As such, and given that:
- The proposed development is for 'Water Compatible' outdoor sports facilities;

- Such uses could be permitted in Flood Zone 3b subject to meeting design requirements;
- Compensatory Flood Storage could be provided on site to offset displacement caused by landscaping;

Following the guidelines contained within the NPPF, the proposed development could be considered suitable assuming appropriate mitigation (including adequate warning procedures) can be maintained for the lifetime of the development.

Appendix I - Site Plans



Application Site Boundary

Notes

ALL DETAILS TO BE CHECKED AND APPROVED BY SPECIALIST CONTRACTOR AND INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS DESIGN AND SPECIFICATION

Notes/revisions:

| Rev | Date | Drwn | Chkd |
|-----|------------|------|------|
| A | 11.06.2021 | NM | |

BPTW PLANNING ISSUE

| | |
|--------------------|---------------------------------|
| Date: JAN 2021 | Client: David & Derek Ovenell |
| Drawn: NM | Project: Mill Meadows, Bexley |
| Check: | Title: Proposed Wider Site Plan |
| Scale: 1:1250 @ A3 | Dwgno: 16-193 / D010 |
| Revision: A | |

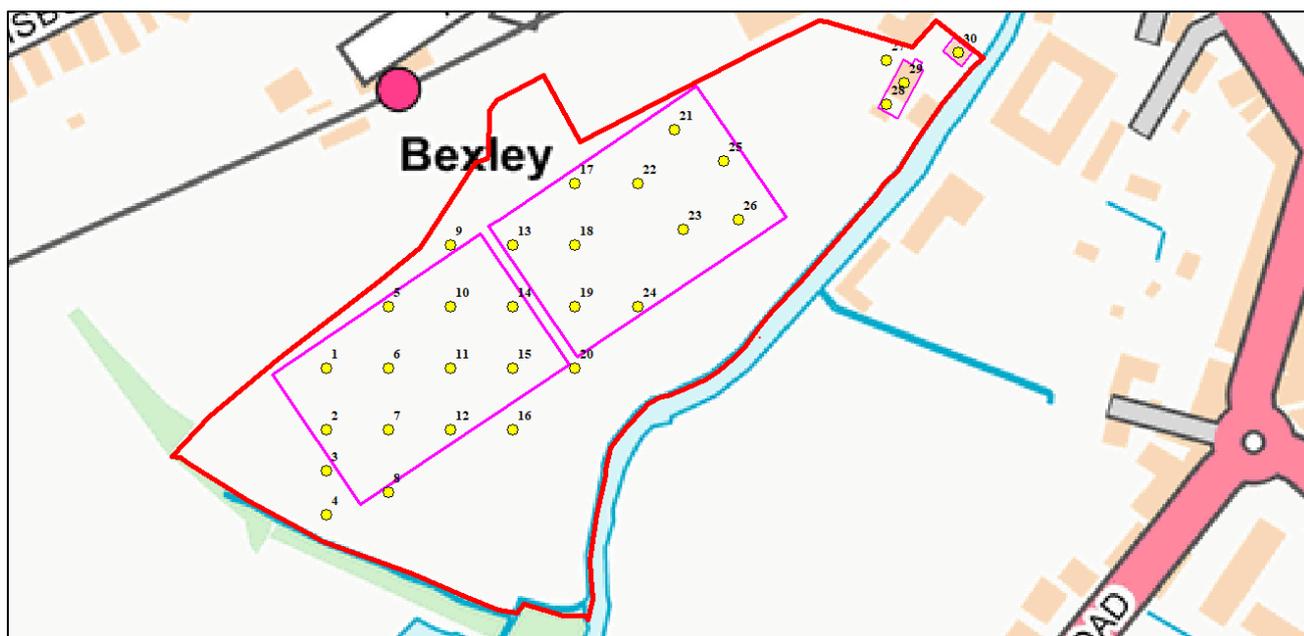


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Appendix II - EA Data

| Flood Risk Assessment (FRA) Checklist | |
|---|---|
| <p>This document should be attached to the front of the Flood Risk Assessment (FRA) issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. This document is not a substitute for a FRA. Please note, under our responsibilities as a statutory consultee we will review any submitted FRA only in respect to fluvial and tidal risk. Your FRA should also consider other sources of flooding such as surface water, drainage, and ground water flooding.</p> | |
| 1. Development Proposal | |
| Site name | Mill Meadows, Bexley, DA5 1JX |
| National Grid Reference (NGR) | 549595 173449 |
| Flood Risk Assessment | Reference/Title: 6092 Date: 17/03/2021 |
| Existing site use & vulnerability classification | The area of the site being developed contains a large greenfield parcel, along with several agricultural outbuildings and stables. These could be considered Less Vulnerable. |
| Proposed site use & vulnerability classification | It is understood that the development is for the creation of two hockey pitches on the greenfield area, and the demolition of some existing outbuildings and the conversion of the existing stables and agricultural building to create an associated pavilion. These would be considered Water Compatible under the NPPF |
| 2. Flood Risk | |
| Flood Zone(s) affecting the site/property | Flood Zones 1, 2, 3a and 3b |
| Sources of flooding affecting the site | Fluvial – River Cray |
| Have you considered flood storage compensation? | Yes. Hockey pitches are proposed as part of the planning application. The pitches are to be located on currently sloping land. It is understood that there will be a levels change to create a flat playing surface. |
| 3. Please provide a node map and accompanying table in the Flood Risk Assessment similar to the example given (see Appendix A). You should clearly demonstrate the highest and most representative flood levels for your proposed development. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate. | |
| 4. Mitigation | |
| Finished floor levels (in mAOD) for each proposed floor. | Not proposed to raise FFLs for pavilion as they are Water Compatible use |
| Have you considered a freeboard for these Finished Floor Levels?*** | |
| Drawing reference showing Finished Floor Levels for proposed development | Unknown |
| Have you considered suitable internal and external access for safe refuge above the flood level? | No. Site to be closes upon receipt of Flood Warning and prior evacuation sought |
| 5. Proximity to the watercourse/ flood defence/ culvert | |
| Are the proposed developments on, over, under or within 8 metres of a fluvial main river or 16 metres of a tidal main river or flood defence? | Building C is located approximately 3m from the River Cray. Building C is a conversion of an existing building, however, any works within 8m of the River Cray may require a Flood Risk Activity Permit (FRAP) from the EA and it is recommended that the developer liaise with the permitting team at the EA to ascertain if a FRAP is required. |



| Node | 1:20 year flood level (mAOD) | 1:100 year flood level (mAOD) | 1:100 year +CC (25%) flood level (mAOD) | 1:100 year +CC (35%) flood level (mAOD) | 1:100 year +CC (70%) flood level (mAOD) | 1:1000 year flood level (mAOD) |
|------|------------------------------|-------------------------------|---|---|---|--------------------------------|
| 1 | Unaffected | Unaffected | Unaffected | Unaffected | Unaffected | Unaffected |
| 2 | Unaffected | Unaffected | Unaffected | Unaffected | Unaffected | Unaffected |
| 3 | Unaffected | Unaffected | Unaffected | Unaffected | Unaffected | 13.33 |
| 4 | Unaffected | Unaffected | Unaffected | Unaffected | 13.26 | 13.35 |
| 5 | Unaffected | Unaffected | Unaffected | Unaffected | Unaffected | 13.27 |
| 6 | Unaffected | Unaffected | Unaffected | Unaffected | 13.20 | 13.29 |
| 7 | Unaffected | Unaffected | Unaffected | Unaffected | 13.22 | 13.31 |
| 8 | 13.00 | 13.06 | 13.12 | 13.15 | 13.24 | 13.33 |
| 9 | Unaffected | Unaffected | 13.00 | 13.04 | 13.16 | 13.26 |
| 10 | 12.96 | 13.00 | 13.06 | 13.08 | 13.18 | 13.27 |
| 11 | 12.98 | 13.03 | 13.08 | 13.11 | 13.20 | 13.29 |
| 12 | 12.98 | 13.04 | 13.10 | 13.16 | 13.21 | 13.31 |
| 13 | 12.72 | 12.86 | 13.00 | 13.04 | 13.15 | 13.26 |
| 14 | 12.88 | 12.92 | 13.01 | 13.05 | 13.16 | 13.26 |
| 15 | 12.97 | 13.02 | 13.07 | 13.10 | 13.19 | 13.28 |
| 16 | 12.97 | 13.04 | 13.10 | 13.12 | 13.21 | 13.30 |
| 17 | 12.61 | 12.86 | 12.99 | 13.03 | 13.15 | 13.26 |
| 18 | Unaffected | 12.86 | 12.99 | 13.04 | 13.15 | 13.26 |
| 19 | 12.67 | 12.86 | 12.99 | 13.06 | 13.15 | 13.26 |
| 20 | Unaffected | 12.97 | 13.03 | 13.03 | 13.17 | 13.27 |
| 21 | 12.60 | 12.85 | 12.99 | 13.03 | 13.15 | 13.25 |
| 22 | 12.60 | 12.85 | 12.99 | 13.03 | 13.15 | 13.26 |
| 23 | 12.60 | 12.86 | 12.99 | 13.03 | 13.15 | 13.26 |
| 24 | 12.70 | 12.86 | 12.99 | 13.03 | 13.15 | 13.26 |
| 25 | 12.59 | 12.85 | 12.99 | 13.03 | 13.15 | 13.25 |
| 26 | 12.60 | 12.85 | 12.99 | 13.03 | 13.15 | 13.25 |
| 27 | 12.59 | 12.84 | 12.97 | 13.01 | 13.13 | 13.23 |
| 28 | 12.59 | 12.84 | 12.97 | 13.02 | 13.13 | 13.24 |
| 29 | Unaffected | 12.84 | 12.97 | 13.01 | 13.13 | 13.23 |
| 30 | 12.58 | 12.83 | 12.96 | 13.00 | 13.10 | 13.20 |