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CIVIL & STRUCTURAL
CONSULTING ENGINEERS

Masterplan Area Flood Risk Report

Project:

Holy Cross College SHD

19.253

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APPENDICES

1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION & BACKGROUND

1.1.1 CWTC Multi Family ICAV acting on behalf of its sub-fund DBTR DR1 Fund are applying for planning permission for a residential development at lands at Holy Cross College, Clonliffe Road, Dublin 3 and Drumcondra Road Lower, Drumcondra, Dublin 9.

1.1.2. There is a masterplan for the area comprising 14.76ha. The CWTC Multi Family ICAV site comprises 7.74 ha. (herein referred as the Hines lands), with the balance of the lands within the masterplan area owned by the GAA, 7.02 ha (herein referred as the GAA lands).

1.1.3. A separate site specific flood risk assessment has been carried for the Hines lands (refer BMCE document ref. CLN-BMCEW-ZZ-ZZ-RP-C-02 Site Specific Flood Risk Assessment). It important to note that the Hines lands are all located within Flood Zone C and as such there is negligible flood risk associated with the proposed residential development, and negligible flood risk to surrounding areas arising from the proposed Hines development.

1.1.4 Dublin City Council drainage division has stated that they require a high level flood risk assessment to be carried out on the GAA lands, and this is the subject of this report. DCC have requested as follows:

'……Masterplan

Further consideration shall be given to the overall surface water management strategy in terms of increased use of natural water retentions measures to ensure an appropriate level of treatment prior to discharge to the River Tolka and in keeping with the existing environment.

The Developer shall submit a flood risk assessment for the masterplan lands, ensuring an appropriate level of assessment with reference and implementation of the recommendations as set out in the Strategic Flood Risk Assessment that forms part of the current Development Plan 2016- 2022. Detail of the findings of the report and how it influenced the layout of the proposed development shall be provided ensuring there shall be no development in Flood Zones A or B.

The impact of global warming in relation to increased river flows shall also be assessed in accommodating the possible extension of Flood Zone B within the Masterplan lands. No development shall be located in areas that would reduce natural storage of the existing site.

The Masterplan shall be developed further to outline the proposed sustainable surface water management strategy that will be implemented for the entire Masterplan lands in order to mitigate against any increase in flood risk or further deterioration of the water quality in the river Tolka in accordance with the Water Framework Directive and Flood Directive. In particular, detail of the proposed development on the GAA site and associated flood risk/flood storage and surface water management plan shall be provided…..'

1.1.5. It is important to note that the GAA lands do not actually form part of the SHD planning application. The GAA lands will be the subject of a separate, future planning application.

The development will consist of the construction of a Build To Rent residential development set out in 12 no. blocks, ranging in height from 2 to 18 storeys, to accommodate 1614 no. apartments including a retail unit, a café unit, a crèche, and residential tenant amenity spaces. The development will include a single level basement under Blocks B2, B3 & C1, a single level basement under Block D2 and a podium level and single level basement under Block A1 to accommodate car parking spaces, bicycle parking, storage, services and plant areas. To facilitate the proposed development the scheme will involve the demolition of a number of existing structures on the site.

The proposed development sits as part of a wider Site Masterplan for the entire Holy Cross College lands which includes a permitted hotel development and future proposed GAA pitches and clubhouse.

The site contains a number of Protected Structures including The Seminary Building, Holy Cross Chapel, South Link Building, The Assembly Hall and The Ambulatory. The application proposes the renovation and extension of the Seminary Building to accommodate residential units and the renovation of the existing Holy Cross Chapel and Assembly Hall buildings for use as residential tenant amenity. The wider Holy Cross College lands also includes Protected Structures including The Red House and the Archbishop's House (no works are proposed to these Structures).

The residential buildings are arranged around a number of proposed public open spaces and routes throughout the site with extensive landscaping and tree planting proposed. Communal amenity spaces will be located adjacent to residential buildings and at roof level throughout the scheme. To facilitate the proposed development the scheme will involve the removal of some existing trees on the site.

The site is proposed to be accessed by vehicles, cyclists and pedestrians from a widened entrance on Clonliffe Road, at the junction with Jones's Road and through the opening up of an unused access point on Drumcondra Road Lower at the junction with Hollybank Rd. An additional cyclist and pedestrian access is proposed through an existing access point on Holy Cross Avenue. Access from the Clonliffe Road entrance will also facilitate vehicular access to future proposed GAA pitches and clubhouse to the north of the site and to a permitted hotel on Clonliffe Road.

The proposed application includes all site landscaping works, green roofs, boundary treatments, PV panels at roof level, ESB Substations, lighting, servicing and utilities, signage, and associated and ancillary works, including site development works above and below ground.

Figure 1.1 Site Location Map Data © 2020 Google

1.2 SCOPE OF THIS REPORT

1.2.1. This report outlines the findings of a stage 2 flood risk assessment carried out for the GAA lands, and takes cognisance of the following relevant guidelines and policies:

- Department of the Environment Heritage and Local Government (DEHLG) and the Office of Public Works (OPW) Guidelines for Planning November 2009 on *'The Planning System and Flood Risk Management Guidelines for Planning Authorities'.*
- The Planning and Development Act 2000 (as amended).

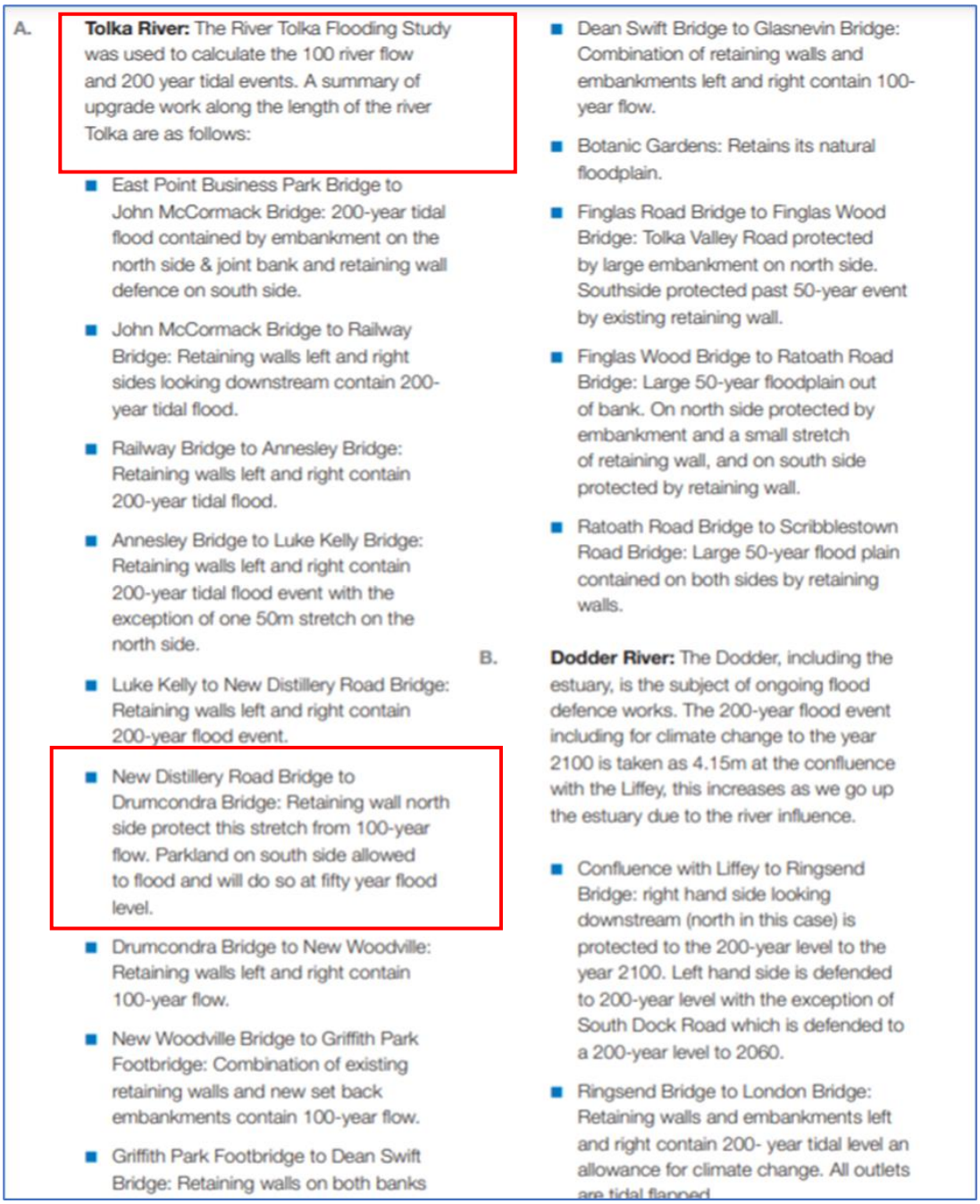
1.2.2. The stages involved in the assessment of flood risk are listed in the guidelines as follows:

- Stage 1: Flood Risk Identification
- Stage 2: Initial Flood Risk Assessment
- Stage 3: Detailed Flood Risk Assessment

1.2.3. The OPW and DEHLG's publication also outlines a sequential approach for determining whether a particular development is appropriate for a specified location in terms of flood risk. The categorisation of the subject site in terms of the OPW and DEHLG's sequential approach is further outlined in Section 2.0

2.0 DUBLIN CITY COUNCIL DEVELOPMENT PLAN 2016-2022 – VOLUME 7 – STRATEGIC FLOOD RISK ASSESSMENT

It is known that the low lying area along the northern boundary of the Holy Cross lands is (in part at least) a floodplain associated with the River Tolka. The area in question is indicated within Volume 7 'Strategic Flood Risk Assessment' of the DCC Development Plan 2016-2022. Appendix 1 of Dev Plan Volume 7 sets out the existing flood defence infrastructure across the city. Part A thereof deals with the Tolka River. We highlight the relevant text below.



A. **Tolka River:** The River Tolka Flooding Study was used to calculate the 100 river flow and 200 year tidal events. A summary of upgrade work along the length of the river Tolka are as follows:

- East Point Business Park Bridge to John McCormack Bridge: 200-year tidal flood contained by embankment on the north side & joint bank and retaining wall defence on south side.
- John McCormack Bridge to Railway Bridge: Retaining walls left and right sides looking downstream contain 200-year tidal flood.
- Railway Bridge to Annesley Bridge: Retaining walls left and right contain 200-year tidal flood.
- Annesley Bridge to Luke Kelly Bridge: Retaining walls left and right contain 200-year tidal flood event with the exception of one 50m stretch on the north side.
- Luke Kelly to New Distillery Road Bridge: Retaining walls left and right contain 200-year flood event.
- New Distillery Road Bridge to Drumcondra Bridge: Retaining wall north side protect this stretch from 100-year flow. Parkland on south side allowed to flood and will do so at fifty year flood level.
- Drumcondra Bridge to New Woodville: Retaining walls left and right contain 100-year flow.
- New Woodville Bridge to Griffith Park Footbridge: Combination of existing retaining walls and new set back embankments contain 100-year flow.
- Griffith Park Footbridge to Dean Swift Bridge: Retaining walls on both banks
- Dean Swift Bridge to Glasnevin Bridge: Combination of retaining walls and embankments left and right contain 100-year flow.
- Botanic Gardens: Retains its natural floodplain.
- Finglas Road Bridge to Finglas Wood Bridge: Tolka Valley Road protected by large embankment on north side. Southside protected past 50-year event by existing retaining wall.
- Finglas Wood Bridge to Ratoath Road Bridge: Large 50-year floodplain out of bank. On north side protected by embankment and a small stretch of retaining wall, and on south side protected by retaining wall.
- Ratoath Road Bridge to Scribblestown Road Bridge: Large 50-year flood plain contained on both sides by retaining walls.

B. **Dodder River:** The Dodder, including the estuary, is the subject of ongoing flood defence works. The 200-year flood event including for climate change to the year 2100 is taken as 4.15m at the confluence with the Liffey, this increases as we go up the estuary due to the river influence.

- Confluence with Liffey to Ringsend Bridge: right hand side looking downstream (north in this case) is protected to the 200-year level to the year 2100. Left hand side is defended to 200-year level with the exception of South Dock Road which is defended to a 200-year level to 2060.
- Ringsend Bridge to London Bridge: Retaining walls and embankments left and right contain 200- year tidal level an allowance for climate change. All outlets are tidal flapped

Figure 2.1 - DCC Dev Plan 2016-2022 Vol. 7 Appendix 1 Part A (extract)

It is noted in Dev Plan Vol 7 that between New Distillery Road bridge to Drumcondra Road bridge, a retaining wall on the north side of the Tolka protects this stretch from 100-year flow.

Parkland on the south side (ie part of the GAA lands) allowed to flood and will do so at fifty year flood.

Appendix 3 of Dev Plan Volume 7 sets out the justification test tables for various zones. Site 20 represents Tolka: Dublin Port to Drumcondra Bridge. We highlight the relevant extracts below. It is noted that the Tolka is tidal up as far as Drumcondra Bridge (and hence tidal along the stretch that bounds the subject site).

Furthermore, flood defences incorporating 200 year tide level, plus 300mm free board, plus allowance for fluvial surcharge at high tide, have been constructed from East Wall Road to Drumcondra Bridge. The old Distillery Bridge was removed and a new one was put in at a higher level.

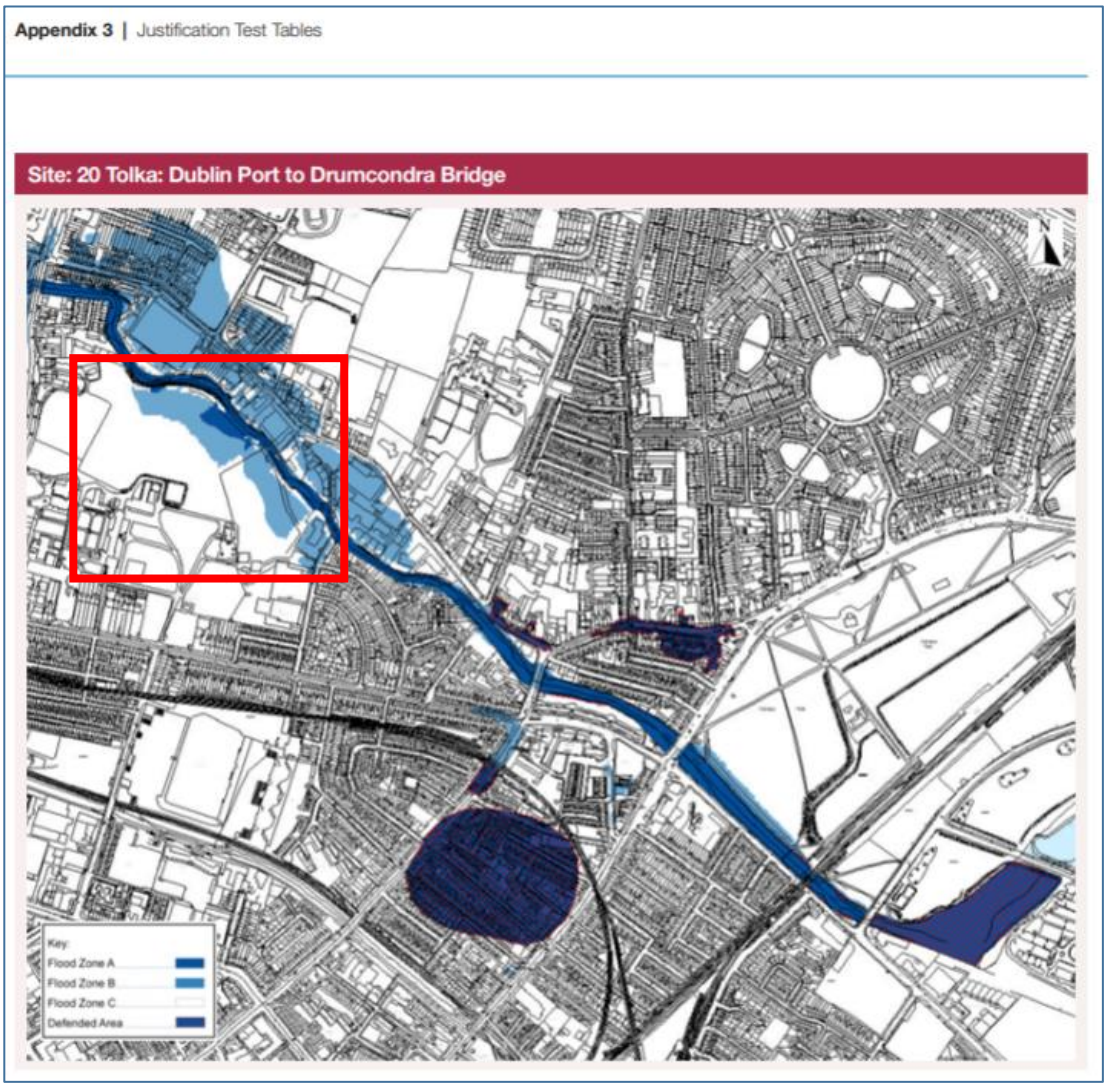
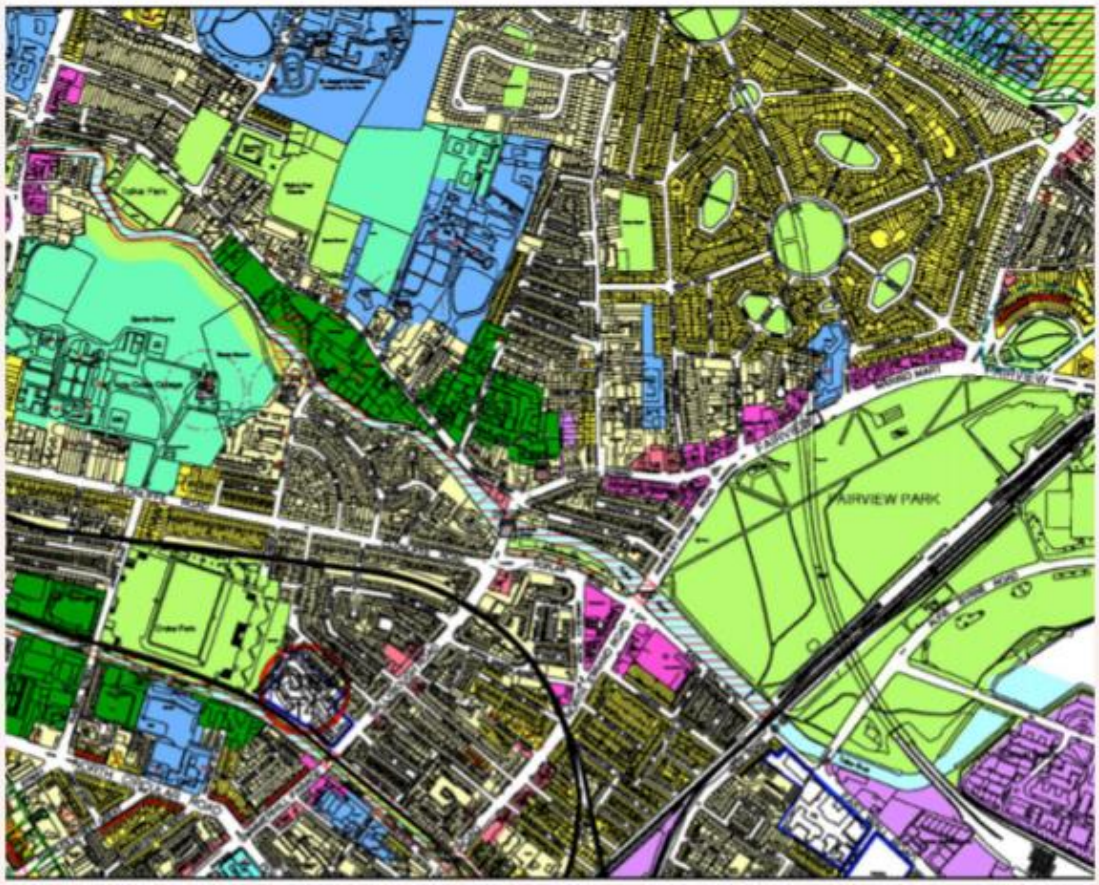


Figure 2.2 DCC Dev Plan 2016-2022 Vol. 7 Appendix 3 Site 20

Site: 20 Tolka: Dublin Port to Drumcondra Bridge



Dublin City Council Development Plan 2016–2022 (zoning map key at back of tables)

Site Description	The area on the Tolka Estuary goes from the Dublin Port to Drumcondra Bridge. It crosses under Alfie Byrne Road, the Dublin – Belfast Railway line and Annesley Bridge. It is adjacent to East Wall Road from Alfie Byrne Road, the western end of Fairview park, Poplar Row, Cadogan Road, Luke Kelly Bridge, Orchard Road, Tolka Road, Distillery Road and Bridge. It is also adjacent to Richmond Road, Tolka Park, the Arch Bishop's House and Cian Park. It is currently tidal to approximately 100m below Drumcondra bridge. Development in this area is a mixture of high and low density commercial and residential with infill development of both. There are a number of parks beside the Tolka River which are natural flood plains.
Benefitting from Defences (flood relief scheme works)	Flood defences incorporating 200-year tide level, plus 300mm freeboard, plus allowance for fluvial surcharge at high tide have been constructed from East Wall Road to Drumcondra Bridge. The old Distillery Bridge was removed and a new one was put in at a higher level. These defences incorporate the latest design and together with a flood gate at the pedestrian bridge on East Wall Road to Fairview Park provide the statutory level of protection.
Sensitivity to Climate Change	Significant, particularly where likely sea level rise exceeds the height of existing defences.

Figure 2.3 - DCC Dev Plan 2016-2022 Vol. 7 Appendix 3 Site 20

Site: 20 Tolka: Dublin Port to Drumcondra Bridge	
Residual Risk	An appropriate assessment of residual risk of defence failure should be carried out. A structural inspection of all new defences is carried out each year.
Historical Flooding	The flood maps attached are consistent with previous flooding of this section of the River Tolka in 1954 and 2002. The highest recorded tide (3rd January 2014) was contained by the new flood defences.
Storm (surface) water	All storm (surface) water in this area needs to be carefully managed and provision made for significant rainfall events during high tides. A five year high tide event should be assumed during a 100-year rainfall event. Should development be permitted, best practice with regard to storm (surface) water management should be implemented across the development area, to limit storm (surface) water runoff to current values. Separation of storm (surface) water and foul sewage flows should be carried out where possible.
	All Developments shall have regard to the Pluvial Flood Maps in their Site Specific Flood Risk Assessment, see Flood ResilienCity Project, Volume 2 City Wide Pluvial Flood Risk Assessment at http://www.dublincity.ie/main-menu-services-water-waste-and-environment-drains-sewers-and-waste-water/flood-prevention-plans

Commentary on Flood Risk:
The flood extents indicate flow paths generally coming directly out of the tidal region. These can be compounded with local pluvial flooding if heavy rainfall coincides with a high tide. Wave action is not deemed significant in this section of the Tolka Estuary.

The flood maps were produced based on the OPW CFRAM Study and checked against historic flooding in the area.

Development Options:
High density Commercial and Residential development (some infill) would be a natural extension of existing development.

Justification Test for Development Plans

1. **Section 1 is covered elsewhere in this SFRA Justifying all of Dublin City**

2. **The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:**

(i) **Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement**
Answer: Yes: This area is an established residential part of Dublin City. The River flows from Drumcondra Bridge through the Tolka Estuary to Dublin Port. It crosses under Alfie Byrne Road, Dublin – Belfast Railway Line and Annesley Bridge. It flows adjacent to East Wall Road from Alfie Byrne Road, the western end of Fairview Park, Poplar Row, Cadogan Road, Luke Kelly Bridge, Orchard Road, Tolka Road, Distillery Road and Bridge. It is also adjacent to Richmond Road, Tolka Park, the Arch Bishop's House and Cian Park. The area is essential for the expansion of Dublin City and comprises a mixture of high and low density Commercial and Residential with infill development of both. There are a number of parks which are natural flood plains also in this area.

Figure 2.4 DCC Dev Plan 2016-2022 Vol. 7 Appendix 3 Site 20

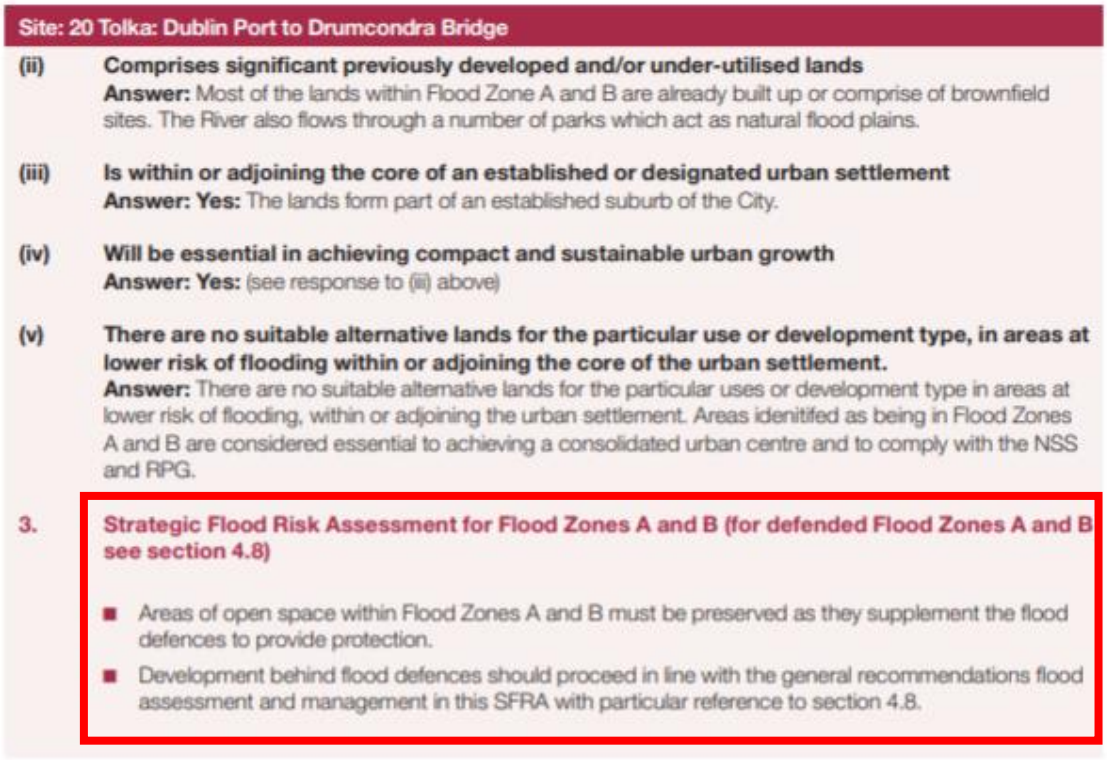


Figure 2.5 DCC Dev Plan 2016-2022 Vol. 7 Appendix 3 Site 20

In terms of the flood zones, these are categorised as follows:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);

Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 100 year and 1% or 1 in 1000 year for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 year for coastal flooding); and

Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). It is important to note that Flood Zone C covers all areas which are not in Flood Zones A or B.

3.0 STAGE 1: FLOOD RISK IDENTIFICATION

3.1 General

Stage 1 identifies whether there are any flooding or surface water management issues at the subject site location and whether a flood risk assessment is required. This involves review of desk study information available as outlined in the following headings.

Table 3.1 The possible sources of flood water

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Tidal	Overtop Breach	Property	Very remote	High	Low
Fluvial	Overtop Breach	Property	Medium	High	Medium
Groundwater	Rising groundwater levels	Property	Very remote	Medium	Low
Pluvial Surface water	Overflow / Blockage	Property	Possible	Medium	Medium

3.2 HISTORICAL FLOODING

3.2.1. The Tolka River runs the full length of the northern boundary of the masterplan lands. The River Tolka has a history of flooding following heavy rainfall. A number of studies were commissioned including the Greater Dublin Strategic Drainage Study (GDSDS) in 2001-2005 and the Tolka Flood Study in 2002. At that time, the aim of the study was to identify works that could be undertaken straight away to reduce the risk of flooding in the worst affected areas. Works began in the Dublin City and County Meath areas in 2003 and were completed in 2011. Works near to the subject site included the construction of a wall to the north and south east of the Sports Ground, a new bridge at Distillery Road, a low crest level weir and 20m of river channel widening. A statement from the Government website Gov.ie as quoted *'Since the Scheme was completed there have been no reports of flooding from the River Tolka in these areas.'*

3.2.2. A review of the OPW Historical Flood Maps online was carried out and indicates a number of past flooding events reported in the vicinity (within 2.5km) of the subject site. Refer Figure 3.1.

3.2.3. The first report dates back to November 1901 and the source of flooding was the River Tolka. The site which was flooded is located approximately 500m north west of the proposed development.

The second flooding event was in November 1965 and the source of flooding was the River Tolka. The site which was flooded is located approximately 300m east of the subject site.

The third flooding incident in the vicinity was in August 1986 and the source of flooding was the River Tolka during hurricane Charley. A number of sites in the vicinity were flooded including a site north west and another north east of the proposed development.

There is a report of a flooding event on Jones Road in July 2013 with very little information on the source of flooding. The single event is shown south east of the proposed development.

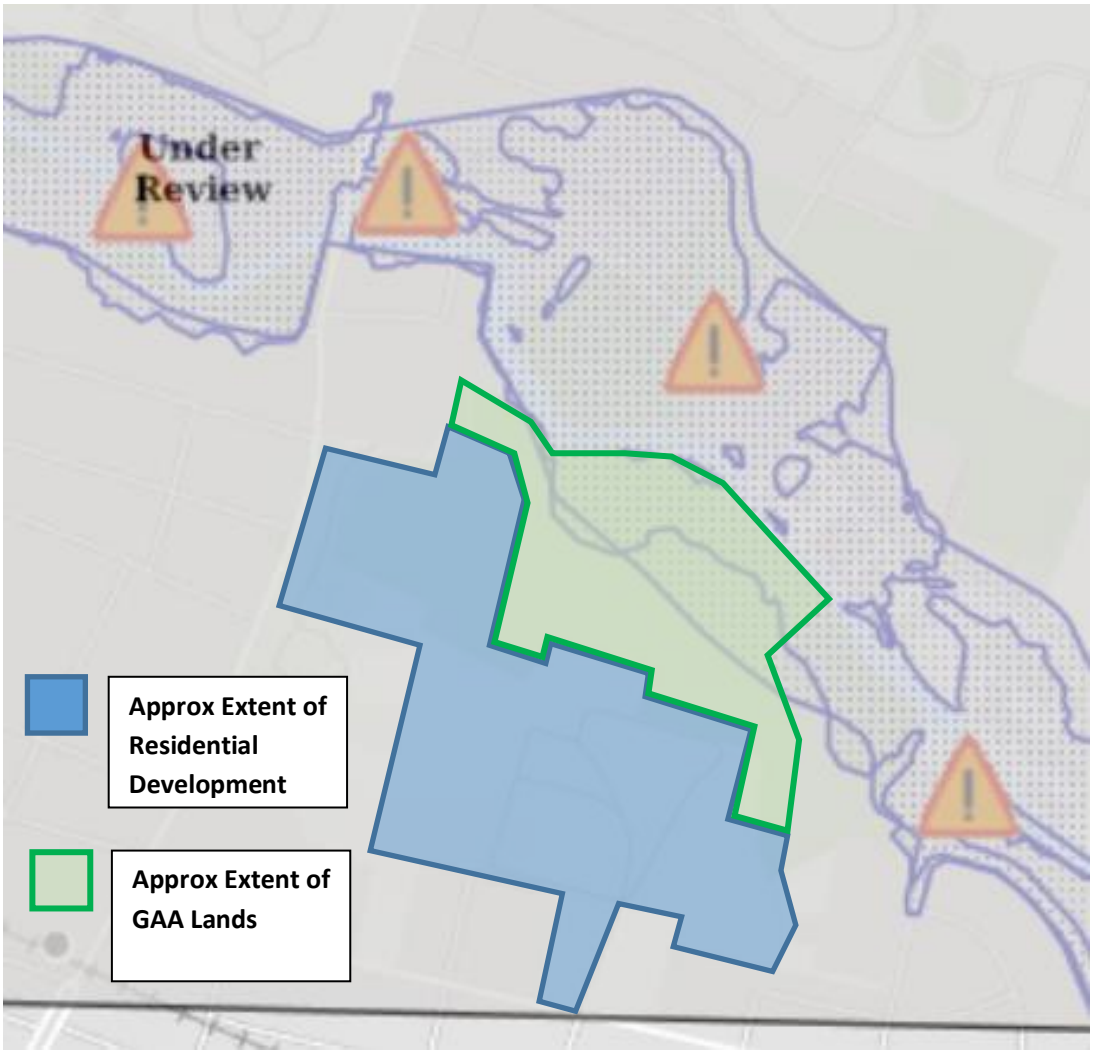


Figure 3.1 Extent of Recorded Past Flood Events in Proximity to Site (Source: OPW – www.floodinfo.ie)

3.3 COASTAL FLOODING

3.3.1 Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels or overcome coastal defences where these exist. A review of the OPW Tidal Flood Extents Mapping was carried out and indicates no coastal flooding at the subject site for the following flood event probabilities (Refer Figure 3.2):

- 10% Tidal AEP (Annual Exceedance Probabilities) or 1 in 10 year return period.
- 0.5% Tidal AEP or 1 in 200 year return period.
- 0.1% Tidal AEP or 1 in 1000 year return period.

Therefore, the risk of tidal flooding is considered low as the subject site lies outside the 0.1% AEP. The OPW tidal flood extents map near the subject site area is included in Appendix II for further information.

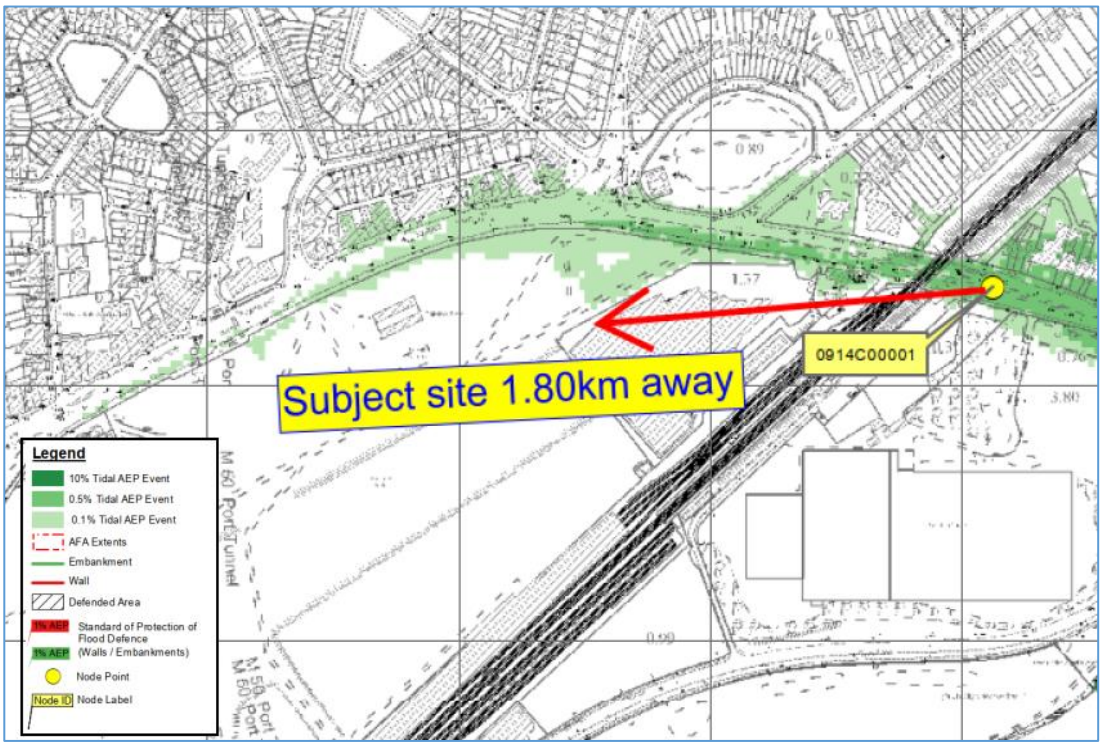


Figure 3.2 Clontarf Tidal Flood Extents (Source: OPW Eastern CFRAM Study)

3.4 FLUVIAL FLOODING

3.4.1. Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas. The River Tolka runs the full length of the northern boundary of the GAA lands. The river flows in a south easterly direction before entering the sea at Clontarf. A review of the OPW fluvial flood extents maps of the River Tolka was carried out and this area is currently noted as 'under review'. Older information including the Tolka Flood Study in September 2010 carried out by RPS for DCC / OPW was reviewed and it indicates that the GAA lands lie partially within the 1 in 1000 year fluvial combined with the 1 in 2 year tidal. Refer Figure 2.1 above. Refer also to Figure 3.3 below taken from the DCC Dev Plan Volume 7.

The study concluded as quoted *'Further to the review of the flood mapping in September 2010 by DCC and OPW, it was concluded that the 0.1% AEP fluvial coupled with the 50% AEP tidal event was the most appropriate to apply to Tolka River for the Dublin City area.'*

3.4.2 The existing riverbank's levels adjacent to the GAA lands vary from circa 5.70 – 4.30mOD. Depending on the final proposed pitch levels, the proposed pitch development has the potential to result in a loss of flood storage volume from the lower level flood plain, unless mitigation measures are put in place.

3.4.3 One of the other surface water bodies in the vicinity is the Royal Canal, located approximately 500m south of the GAA Lands. The Royal Canal flows in a south easterly direction and into the River Liffey. The Royal Canal is a manmade waterway channel and water levels in the canal is regulated via series of locks. Therefore, the risk of flooding may arise when locks malfunction or from vandalism. However, in such event, the canal will drain towards the River Liffey and away from the GAA lands. Therefore, the risk of flooding from the Royal Canal is considered low.

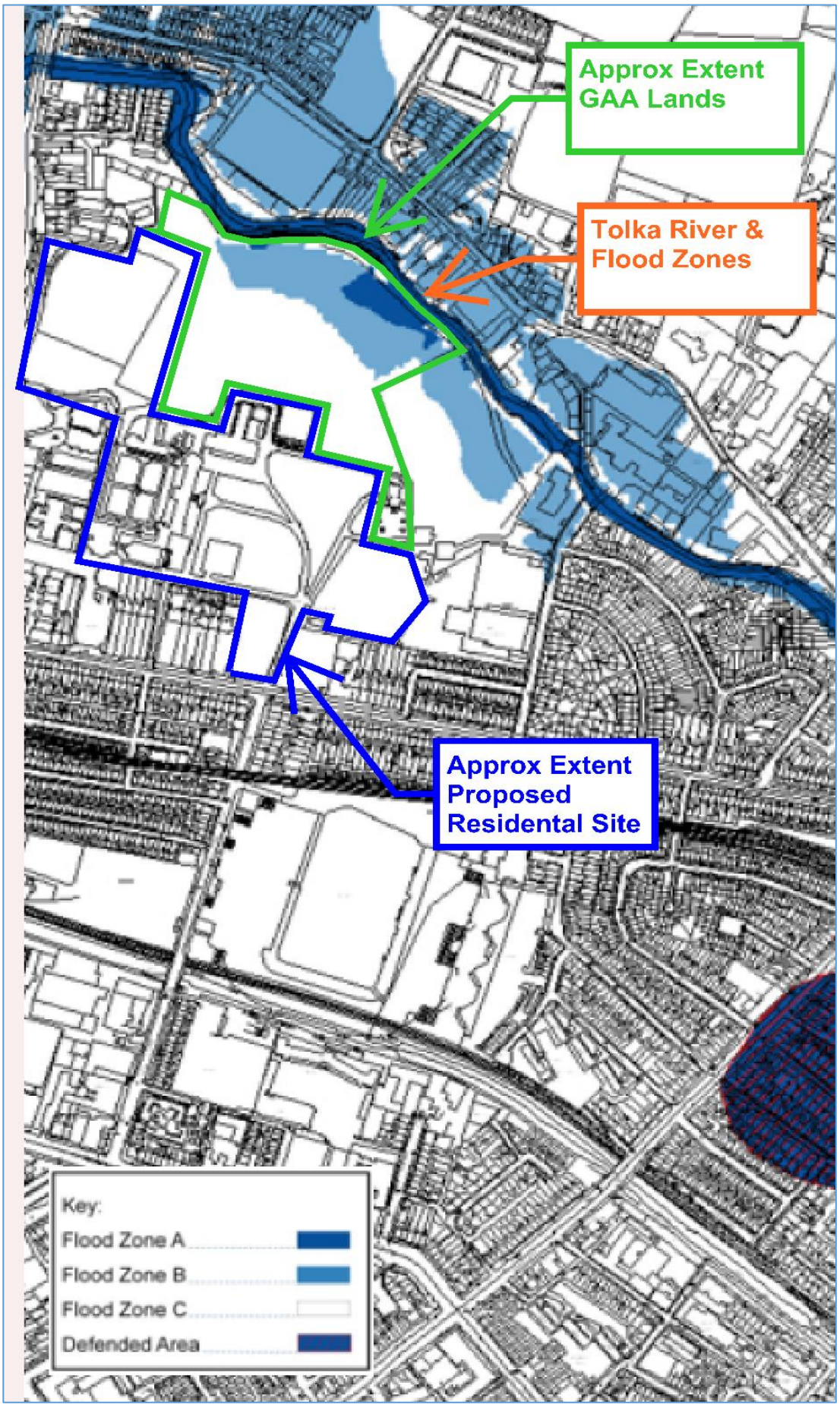


Figure 3.3 Tolka River Flood Extents for 0.1% AEP – Source Dublin City Council

3.5 GROUND WATER

3.5.1. Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall, to meet the ground surface and flows out overground.

3.5.2. The proposed development comprises 3G/4G playing pitches and changing rooms. There are no basements proposed.

3.5.3. The topography of the site is such that it is within a natural depression.

3.5.4. It is likely that ground levels will be raised somewhat to form the pitches and the floor level of the changing room is likely to be elevated for fluvial flooding reasons.

3.5.5. A review of the groundwater vulnerability data from the Geological Survey Ireland (GSI) website was also carried out and the model indicates low risk of groundwater contamination. The map identifies how susceptible areas are to groundwater contamination.

3.5.6. Given the above factors, the risk of flooding due to ground water ingress to the proposed development is considered low.

Figure 3.4 Groundwater Vulnerability (Source: GSI Data Viewer Map)

3.6 PLUVIAL FLOODING

3.6.1. Pluvial flooding occurs when the amount of rainfall exceeds the capacity of urban water drainage systems or the ground to absorb it. A review of the DCC / IW records for the area, indicate that there is a 675mm diameter combined sewer traversing GAA lands from NW to SW. Refer to Figure 3.5. This sewer connects to the sewers in Clonliffe Road future to the East and connects to the Poplar Row pumping station, from where foul waste is pumped to Ringsend Wastewater Treatment plant. From our discussions with Irish Water we understand that this sewer does surcharge during certain storm events, however out of manhole flooding has not been experienced. The GAA lands will not discharge any surface water to this IW combined sewer and hence will not affect the current performance of the sewer.

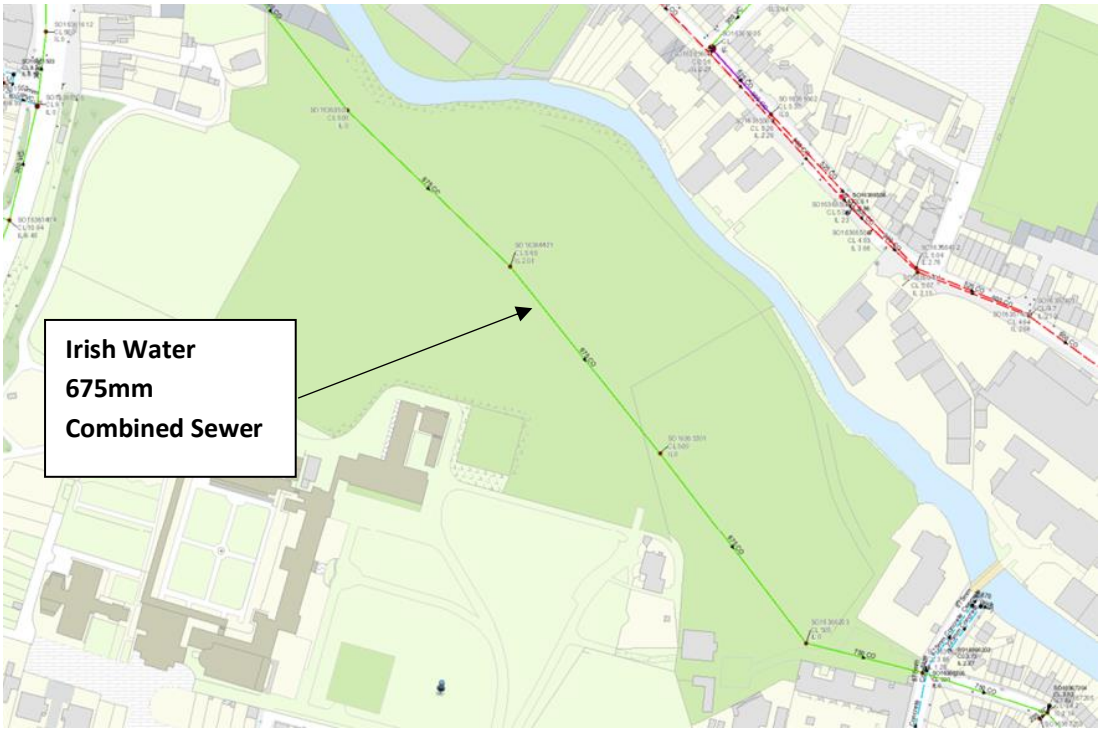


Figure 3.5 Extract from IW / DCC Drainage Record indicating 675mm combined sewer traversing GAA lands

Furthermore the existing drainage on Hines residential site will be improved as a result of the proposed works including the removal of the surface drainage system from the combined network on Clonliffe Road, which will result to substantially reduce both the peak and volume of runoff into the public network.

3.7 CLIMATE CHANGE

3.7.1 All new developments are required to take climate change into consideration when assessing the flood risk of a site. When designing for extreme rainfall events an allowance of 20% additional flow should be taken. In due course, the design of the surface water drainage system for the GAA lands should be designed for storms up to and including the 1 in 100 year storm and 20% extra for climate change

4.0 STAGE 2: INITIAL FLOOD RISK ASSESSMENT

4.1 GENERAL

The purpose of an initial flood risk assessment is to examine flood risk issues highlighted as part of Stage 1 Flood Risk Identification.

Based on available recorded information as outlined in Stage 1, there is a risk of fluvial flooding to part of the site, which lies within the 0.1% AEP fluvial coupled with the 50% AEP tidal flood extents, associated with the River Tolka.

4.2 SEQUENTIAL APPROACH

The sequential approach used in this assessment follows the guidelines from The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009, see Figure 4.1 for a graphical representation.

As outlined in the OPW and DEHLG publication, new developments are divided into three categories which are as follows:

- Highly Vulnerable Development (i.e. power stations, residential)
- Less Vulnerable Development (i.e. retail, leisure)
- Water-Compatible Development (i.e. car parking, recreational space)

The proposed use (3G/4G playing pitches, associating changing rooms and site car parking) comes under the heading of 'less vulnerable' / 'water-compatible' development.

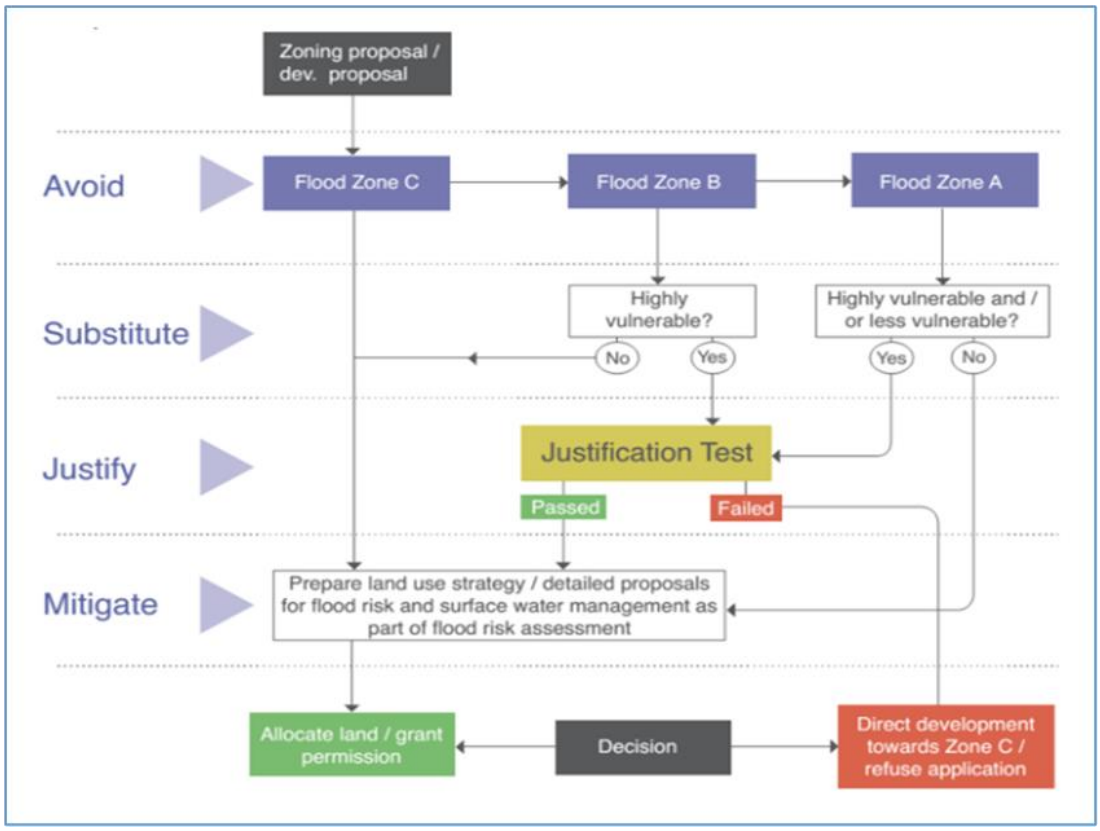


Figure 4.1 Sequential Approach (Source: Guidelines for Planning Authorities, 2009)

Table 4.1 Matrix of vulnerability versus flood zone (Source: Guidelines for Planning Authorities, 2009)

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	**Appropriate**	Appropriate
Water compatible development	Appropriate	**Appropriate**	Appropriate

Geographical areas are similarly divided into three categories, based on their risk of river and tidal flooding. The three categories are as follows:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding).
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding).
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding i.e. all areas which are not within zone A or B).

Based on the flood risk identification in Stage 1, the proposed development falls partly into Flood Zone B (refer Fig 3.3 above), however the proposed development type is within the 'less vulnerable' / 'water-compatible' category. Hence, the proposed development is deemed 'Appropriate' in accordance with the guidelines of the OPW's publication. Therefore, no 'Justification Test' and / or Stage 3 Detailed Flood Risk Assessment is required.

4.3 FLOOD STORAGE VOLUMES

Given the above, as part of the strategic flood risk assessment exercise for the masterplan lands, a number of key questions arise:

1. What flood volume is accommodated on the GAA lands, in their present undeveloped state?
2. What flood volume is accommodated on the GAA lands, in their proposed developed state (based on proposed pitch levels provided by SSA Architects on behalf of the GAA)? and therefore what would be the potential loss of flood volume, if the site is developed as presently proposed?
3. What proposed pitch levels would be required to minimise the loss of flood storage volume?

We have interpolated the flood zone extents indicated in Fig 3.3 above, and superimposed these onto the 3D topographical survey of the existing site. Using Civil 3D software we have estimated the volume of flood storage for each of the above scenario's 1,2 and 3.

Attached Drg 1060 **(Appendix 1)** addresses question 1. Based on the existing site levels, it is estimated that the GAA lands provide approximately 7128 m3 of flood storage volume, and the flood level for flood zone B is estimated at +5.40m OD.

Attached Drg 1061 **(Appendix 2)** addresses question 2. Based on the currently proposes levels of the pitches, it is estimated that the GAA lands would provide approximately 5639m3 of flood storage volume – resulting is a lost 1489m3

Attached Drg 1062 **(Appendix 3)** addresses question 3. In this scenario, the lower pitch is further lowered and is permitted to flood for 1 in 1000 year event (0.1% AEP – Annual Exceedance Probability). Based on the lowered pitch levels, it is estimated that the GAA lands would provide approximately 6306 m3 of flood storage volume – resulting is a loss of 822m3.

In each of the above scenario's, it is assumed that the changing room FFL would be kept elevated at a level above the 1 in 1000 year flood level.

It is important to note that this is not a detailed flood risk assessment and that hydraulic modelling of the River Tolka has not been carried out. The attached drawings are a volumetric exercise and rely on interpolation of the modelled flood extents which are illustrated with DCC Dev Plan Vol.7. The purposes of this exercise is to provide an order of magnitude estimate of the flood volumes associated with the site.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 As per the separate site specific flood risk assessment carried out for the proposed residential site (Hines) at Clonliffe, the residential site is within Flood Zone C and as such there is negligible flood risk associated with the proposed residential development, and negligible flood risk to surrounding areas arising from the proposed Hines development.

5.2 The balance of the masterplan lands at Clonliffe are known as the GAA lands. The masterplan proposes that the GAA lands would be utilised for synthetic pitches, changing rooms and associated surface car parking.

5.3 This report outlines the findings of the Stage 2 FRA carried out for the proposed GAA lands. This FRA was carried out in accordance with the DEHLG Guidelines for Planning 2009 and The Planning and Development Act 2000 (as amended).

5.4 Based on the flood risk identification in Stage 1, part of the GAA lands is liable to pluvial flooding. Part of the GAA lands is within Flood Zone B, however the proposed development type is deemed to be 'less vulnerable' / 'water compatible' and therefore the proposed development is deemed 'Appropriate' in accordance with the guidelines of the OPW's publication, without the need for a justification test.

5.4 Development of the GAA lands will potentially result some loss of flood storage associated with the River Tolka, unless mitigation measures are taken. The extent to which the development might affect flood storage volume, depends largely on the choose levels for the pitches. These levels have not been firmly set as of yet. Within this FRA document BMCE have considered two possible pitch level scenarios, and for an estimated flood level we have carried out a volumetric calculation of the displaced flood volume.

5.5 The scenarios are as follows (note that these are based on CFRAM predicted flood levels overlaid with the existing topograghical survey):

Option 1

1. Maintain the proposed pitch levels at the higher levels presently proposed.
2. Maintain the changing room floor level at a level above the 0.1%AEP level.
3. The estimated loss of flood storage is c.1489m3
4. Hydraulic modelling of the Tolka River could be carried out to establish if this loss of flood storage volume would be acceptable. If not, consideration would have to be given to using flood storage tanks under the pitches.

Option 2

1. Lower the proposed levels of the second (lower) pitch, and in doing so accept that part of the pitch is at risk of flooding.
2. Maintain the changing room floor level above the 0.1%AEP level.
3. The approximate loss of flood storage associated with this scenario is c.822m3.

5.6 At the time of bringing forward the planning application for the GAA lands, a 'Stage 3' detailed flood risk assessment may be carried out to further assess the above options. A stage 3 assessment will only be required if the applicant wishes to more definitively establish flood levels (and flood volumes) by way of hydraulic flood modelling of this section of the River Tolka. In addition, it should agreed at that stage whether any required compensatory flood storage should be based on 1% AEP or 0.1% AEP flood levels.

5.7 In addition, we recommend the following site measures:

- Surface water outflow from the GAA lands should be limited to 2 litre/sec/ha as per GDSDS, and the proposed development should make use of a suite of SuDS measures.
- All manholes within the GAA lands should have covers bolted down (including the Irish Water combined sewer which traverses the site).

5.8 We recommend the following measures should be considered in respect of the changing rooms:

- Consider whether the changing rooms could be relocated further south and at a higher level near to the entrance to the GAA pitches).
- Use flood resilient construction within the changing rooms such as following.
- Use continuous concrete raft slab / ground floor slab construction and monolithic concrete upstand to the inner leaf of perimeter walls. Apply radon barrier, insulation and concrete floating screed on top of mon
- Use traditional blockwork masonry walls throughout with waterproof plaster (no stud partitions and minimise use of gypsum plasterboard).

- Avoid use of brick for outer leaf.
- Avoid insulated render
- Tiled floors with waterproof adhesive and grout.
- Tiled skirtings.
- No low level windows.
- Flood resilient doors and windows
- Minimise door openings around the perimeter of the building.
- Fit any doors with flood barriers.
- Keep mechanical and electrical equipment and sockets are high level where possible.
- Put kitchen appliances (if any) on timber carcass plinths.
- Construct pump sump in ground floor slab, for ease of dewatering in event of flood.
- Fit non return valve to foul sewers.
- Minimise extent of services within ground floor / screed build up (with cabling and pipework in drops from high level).
- Consider closed cell flood resilient insulation.
- Minimise extent and number of services penetrations into the building. Consider an external enclosure such that services enter the building envelope at a higher level.
- Keep rainwater downpipes outside the building envelope.

5.9 DCC Drainage Division have raised concern in relation to the potential for wash out of the infill 'crumb' material which is typically used in certain modern synthetic pitches, and the potential for same to be washed into the River Tolka, with potential environment impact on water quality. It should be noted that the detailed design proposals for the pitches have not been developed yet by GAA and no formal decisions have been made in respect of the type of synthetic pitches to be developed (the GAA lands are at masterplanning stage).

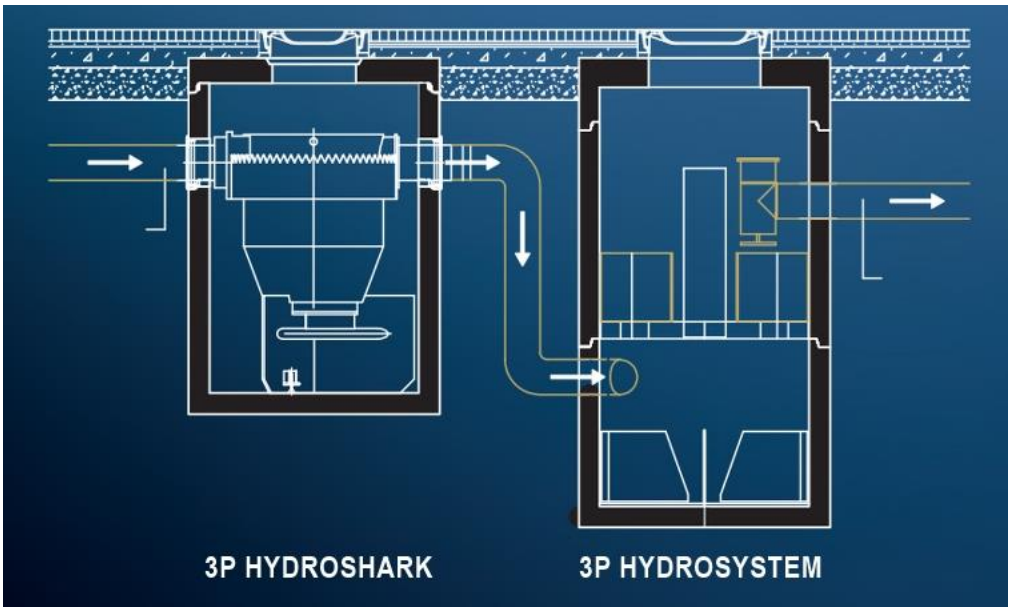
There are a range of material options for the infill used on synthetic pitches including:

- Rubber crumb (SBR rubber)
- Coated rubber crumb (coated with polymer)
- EPDM crumb (ethylene propylene diene monomer)
- TPE crumb (thermoplastic elastomer)
- Natural crumbs (cork, wood, coconut husk – recyclable, expensive and with shorter life span than the man-made alternatives).
- Composites (natural and man-made materials)

At the time of bringing forward a planning application in respect of the GAA lands a detailed risk assessment should be carried out in respect of the above concern raised by DCC drainage. Measures which could be considered to mitigate risk include:

- Design features into the pitches which mitigate contamination of rubber or fibre fragments into the environment
- Use of natural materials for crumb infill.
- Continuous and uninterrupted upstand kerb (say 150mm) around the pitches to retain crumb on the pitch surfaces.
- Use of a dedicated, controlled and fenced off entrance/exit lobbies to access the pitches, within which pitch users can remove footwear / brush off any crumb.
- Increased cleaning regime to road gullies.
- Consider not carrying out physical snow removal from pitches during winter (which can trap and migrate the crumb material). See below.
- Detail pitches so that there is no physical drainage features (channels / gullies) within the pitch perimeter. See below.

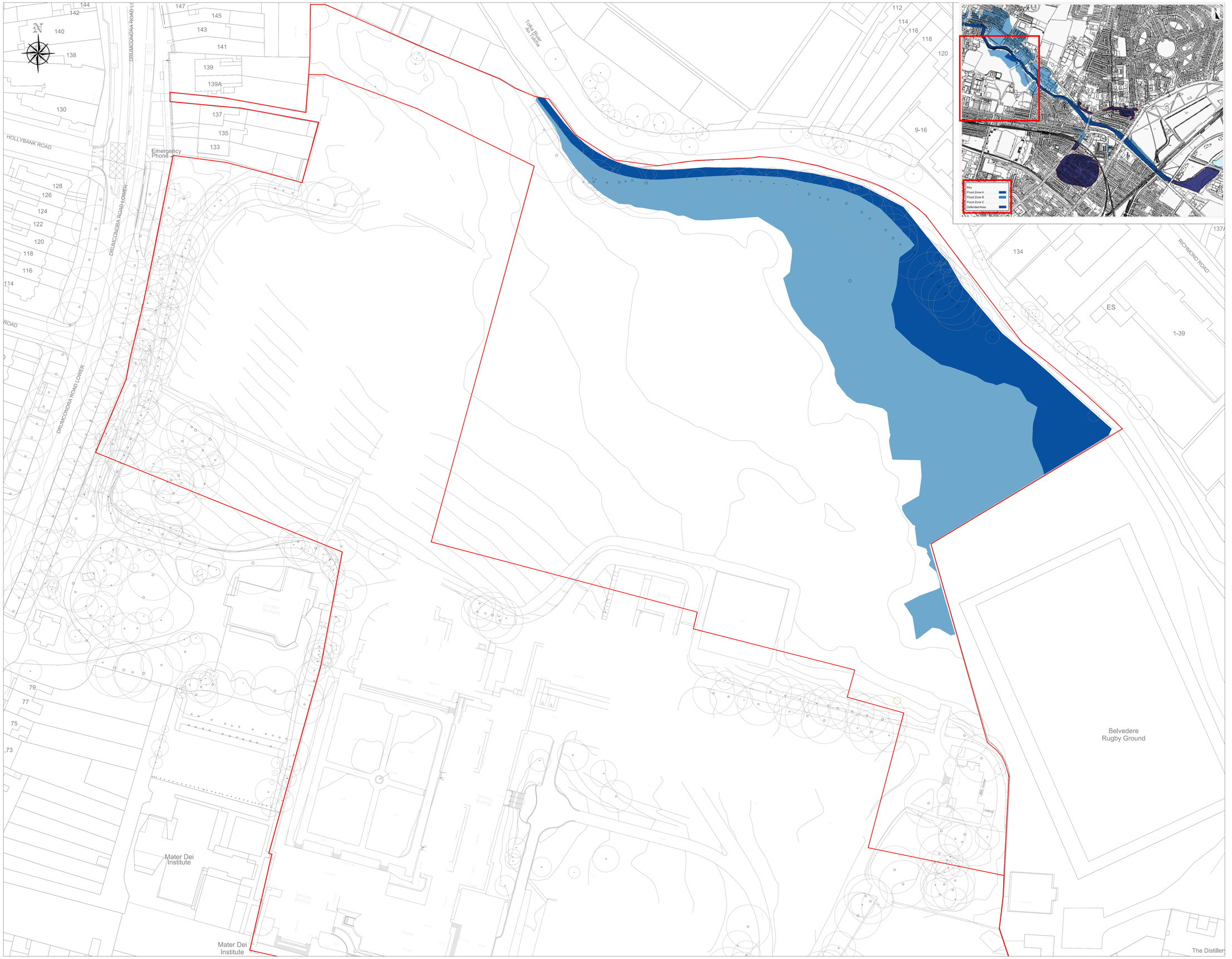
- Use of microplastic removal system specifically on surface water outfall from GAA lands. Systems such as the 3P Technik Hydroshark and Hydrosystem, or equal, can be deployed to separate microplastics from surface water



- At design / tender / procurement stage within the procurement strategy, highlight microplastics as a potential issue and value strategies which reduce the risks of contamination within the tender process.
- At construction stage, operate a careful, tidy and diligent site at installation – force measures to minimize contamination of the environment with infill and other sources of plastic.
- At operational stage, prepare and operate a maintenance plan for the pitches and engage a specialist maintenance operator.
- At operational stage, conduct proper maintenance when caring for the pitches by introducing a brush, hoover, and filter arrangements onto the maintenance equipment.
- At the end-of-life, employ strategies which stop old infill and turf contaminating the area around the field due to poor handling and disposal approaches.

Appendix 1

Drawing 1060



NOTES

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2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.

3. FLUVIAL FLOOD EXTENTS APPROXIMATED TO (**+05.40 mOD**) TAKING FLOOD MAPS AS A REFERENCE FROM THE ARTICLE "THE RIVER TOLKA FLOOD STUDY 10 YEARS ON - A CASE STUDY ON HOW CATCHMENT BASED FLOOD RISK MANAGEMENT WORKS" PUBLISHED ON 2014.

4. THE PREVIOUSLY MENTIONED ARTICLE WAS BASED ON A REVIEW OF THE FLOOD MAPPING IN SEPTEMBER 2010 BY DCC AND OPW, AND IT WAS CONCLUDED THAT THE 0.1% AEP FLUVIAL COUPLED WITH THE 50% AEP TIDAL EVENT WAS THE MOST APPROPRIATE TO APPLY TO TOLKA RIVER FOR THE DUBLIN CITY AREA. THIS COMBINATION OF FLUVIAL AND TIDAL EVENTS WAS FOUND TO PRODUCE THE HIGHEST ESTUARY LEVELS, MAKING IT THE CRITICAL DESIGN 0.1% AEP EVENT.

5. EXISTING TOPOGRAPHICAL INFORMATION RECEIVED **21st FEBRUARY 2020**.

FLOOD PLAIN RANGES

DEPTH (m)	RANGE COLOUR
FLOOD ZONE A	
FLOOD ZONE B	
FLOOD ZONE C	
EXISTING FLOOD VOLUME WITHIN THE BOUNDARY LINE	7 128.63 m^3

- **APPROXIMATED FLOOD EXTENT LEVEL (ZONE B) (+05.40 mOD)**
- **Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);**
- **Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 100 year and 1% or 1 in 1000 year for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 year for coastal flooding); and**
- **Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).**

It is important to note that Flood Zone C covers all areas which are not in Flood Zones A or B.

FLUVIAL FLOOD EXTENTS AS PER TOPOGRAPHICAL INFORMATION

SCALE @ A0: 1:250
SCALE @ A2: 1:500

ISSUE	DATE	DESCRIPTION	DRN / CHKD	P.E / P.D.
PL1	28.05.21	DRAFT PLANNING APP.	SM / SJ	MH / SM
P02	18.02.21	ISSUED FOR INFORMATION	SJ / MJ	MH / SM
P01	20.01.21	ISSUED FOR INFORMATION	SJ / MJ	MH / SM

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CLIENT: **CWTC Multi Family ICAV acting on behalf of its sub-fund DBTR DR1 Fund**

PROJECT TITLE: **Holy Cross College SHD**
BM PROJECT No.: **19.253**

MODEL REFERENCE: **CLN-BMCE-00-ZZ-DR-C-1060**
MODEL REV.: **P01**
SUITABILITY:

DRAWING TITLE: **FLUVIAL FLOOD EXTENTS AS PER TOPOGRAPHICAL INFORMATION.**

DRAWING No.: **CLN-BMCE-00-ZZ-DR-C-1060**
ISSUE: **PL1**

Appendix 2

Drawing 1061

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - ASK'.
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5. EXISTING TOPOGRAPHICAL INFORMATION RECEIVED **21st FEBRUARY 2020**.

FLOOD PLAIN RANGES

DEPTH (m)	RANGE COLOUR
FLOOD ZONE A	
FLOOD ZONE B	
FLOOD ZONE C	
EXISTING FLOOD VOLUME WITHIN THE BOUNDARY LINE	**5 639.42 m³**
TOTAL VOLUME DISPLACED	7 128.63 m³ - 5 639.42 m³ = **1 489.21 m³**

- **APPROXIMATED FLOOD EXTENT LEVEL (ZONE B) (+05.40 mOD)**
- **Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);**
- **Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 100 year and 1% or 1 in 1000 year for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 year for coastal flooding); and**
- **Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).**

It is important to note that Flood Zone C covers all areas which are not in Flood Zones A or B.

FLUVIAL FLOOD EXTENTS AS PER TOPOGRAPHICAL & PROPOSED LEVELS INFORMATION (OPTION 1)

SCALE @ A0: 1:250
SCALE @ A2: 1:500

ISSUE	DATE	DESCRIPTION	DRN	CHKD
PL1	28.05.21	DRAFT PLANNING APP.	SM	MH / SM
P02	18.02.21	ISSUED FOR INFORMATION	MJ	MH / SM
P01	20.01.21	ISSUED FOR INFORMATION	MJ	MH / SM

DRAWING STAGE: **PLANNING**

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PROJECT TITLE: **Holy Cross College SHD** — BM PROJECT No.: **19.253**

MODEL REFERENCE: **CLN-BMCE-00-ZZ-DR-C-1060** — MODEL REV.: **P01** — SUITABILITY:

DRAWING TITLE: **FLUVIAL FLOOD EXTENTS AS PER TOPOGRAPHICAL & PROPOSED LEVELS INFORMATION (OPTION 1)**

DRAWING No.: **CLN-BMCE-00-ZZ-DR-C-1061** — ISSUE: **PL1**

Appendix 3

Drawing 1062

NOTES

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5. EXISTING TOPOGRAPHICAL INFORMATION RECEIVED **21st FEBRUARY 2020**.

FLOOD PLAIN RANGES

DEPTH (m)	RANGE COLOUR
FLOOD ZONE A	
FLOOD ZONE B	
FLOOD ZONE C	
EXISTING FLOOD VOLUME WITHIN THE BOUNDARY LINE	**6 306.19 m³**
TOTAL VOLUME DISPLACED	7 128.63 m³ - 6 306.19 m³ = **822.44 m³**

- **APPROXIMATED FLOOD EXTENT LEVEL (ZONE B) (+05.40 mOD)**
- **Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);**
- **Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 100 year and 1% or 1 in 1000 year for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 year for coastal flooding); and**
- **Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).**

It is important to note that Flood Zone C covers all areas which are not in Flood Zones A or B.

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DRAWING STAGE: **PLANNING**

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PROJECT TITLE: **Holy Cross College SHD** | BM PROJECT No.: **19.253**

MODEL REFERENCE: **CLN-BMCE-00-ZZ-DR-C-1060** | MODEL REV.: **P01** | SUITABILITY:

DRAWING TITLE: **FLUVIAL FLOOD EXTENTS AS PER TOPOGRAPHICAL & PROPOSED LEVELS INFORMATION (OPTION 2)**

DRAWING No.: **CLN-BMCE-00-ZZ-DR-C-1062** | ISSUE: **PL1**

FLUVIAL FLOOD EXTENTS AS PER TOPOGRAPHICAL & PROPOSED LEVELS INFORMATION (OPTION 2)

SCALE @ A0: 1:250
SCALE @ A2: 1:500

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