



TBC

LECKWITH QUAY

Flood Advice Report





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APPENDICES

Appendix A: [NRW Flood Maps](#)

1 INTRODUCTION

WSP have been instructed by TBC to provide a Flood Advice Report (FAR), prior to the development of a Flood Consequences Assessment (FCA). This Flood Advice Report informs on the constraints, requirements and possible solutions or further works concerning the flooding aspect of the site. Following this introduction, the report first outlines the general flood risk in Section 2, followed by the current understanding of the baseline flood risk in Section 3 followed by a discussion of the proposed development Section 4 before concluding within Section 5.

Leckwith Quay is a 7.7 ha site located between the A4232, Leckwith Road and the River Ely on the outskirts of Cardiff in the Vale of Glamorgan CF11 8AU. The site is under consideration for a mixed use development consisting of commercial premises and residential dwellings along with associated public open space, amenities and including a new highway link via a bridge across the River Ely with the existing bridge being demolished along with the existing business units. The development is currently split into two parcels on either side of the proposed new bridge crossing referred to as the northern (1.3 ha) and the southern plateaus (6.4 ha). The site extends approximately 890 m along the Ely riverbank in the Vale of Glamorgan (with the opposite bank within Cardiff City Authority) and some 100 m inland. There are currently two river crossings at this location:

- Leckwith Road (B4267) roadbridge has a single span concrete arch conveying the channel itself with a springing level of 4.8 m AOD and soffit of 9.26 m AOD and includes a series of nine additional spans over the western bank as the road climbs to the higher ground.
- Historic Roadbridge (Grade II*) is a single track, triple arch, rough masonry viaduct with pedestrian refuges between each arch. The bridge sits lower than its more modern companion with each soffit approximately 7 m AOD and the parapet generally below 9.0 m AOD.

The site is some 3 km upstream of the Ely's outfall into Cardiff Bay behind the Cardiff Bay Barrage and some 700 m upstream of the Nant Cydfin's confluence with the Afon Ely which itself is just upstream of the A432 Roadbridge. Upstream there is at least one minor outfall from the features which once drained Leckwith Moors on the east bank and an unnamed watercourse draining the Leckwith & Plymouth Woods as well as the remnants of what was the Caerau Brook on the western bank. The site is also downstream of another A432 Roadbridge some 490 m upstream as well as an Ely Trail Footbridge approximately 690 m upstream.

There are also water features on site, specifically noted in the Ordnance Survey mapping towards the southern end of the site where a water feature issuing from Hillside Farm / Factory Wood flows via a waterfall before trifurcating into drains the northern two of which sink on the edge of the redline boundary with the southern flowing into a pond at the southern part of the site prior to outfalling into the River Ely.

Site levels are understood to be around 7.0 m AOD along the River Ely's Top of Bank and rising to the west. Figure 1 below shows the redline boundary.

According to the British Geological Society maps the known superficial deposits within the redline boundary are tidal flat deposits of clay silt and sand overlying the Mercia Mudstone Group with soil textures tending towards sandy in the identified floodplain and moving to a clayey loam on higher ground.

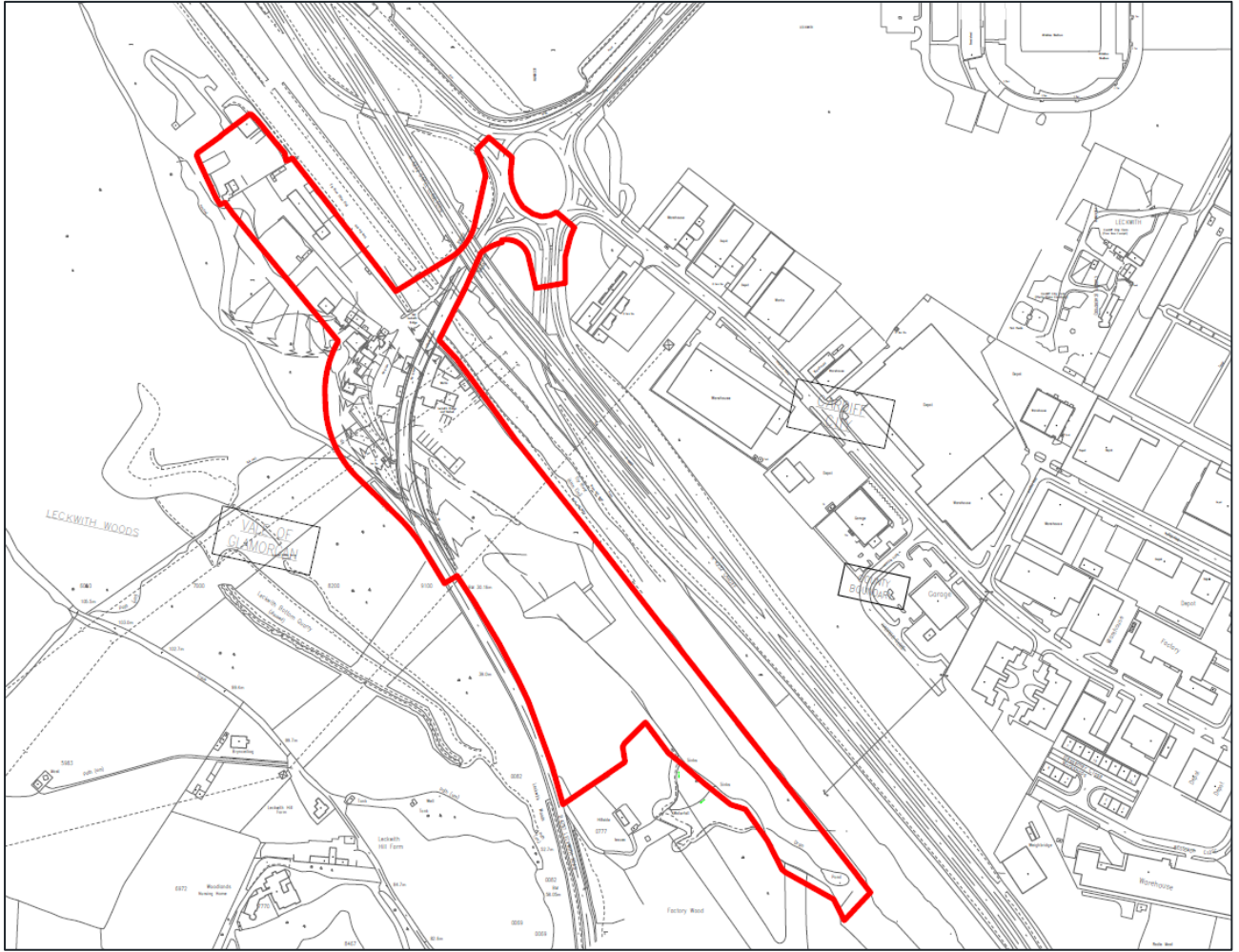


Figure 1: Red Line Boundary



Figure 2: Proposed Development

2 EXISTING UNDERSTANDING OF FLOOD RISK

Residential developments are classified as Highly Vulnerable Developments in accordance with Technical Advice Note 15 (TAN15). The current Natural Resource Wales flood maps show that the majority of the site is located within Development Advice Map (DAM) Zone C1. DAM Zone C1 is the area defined by NRW as served by significant infrastructure, including flood defences. According to TAN15, Highly Vulnerable Developments may be permissible in Zone C1, subject to: the Justification Test, acceptability of consequences and surface water requirements. Figure 3 below shows an extract from the DAM.

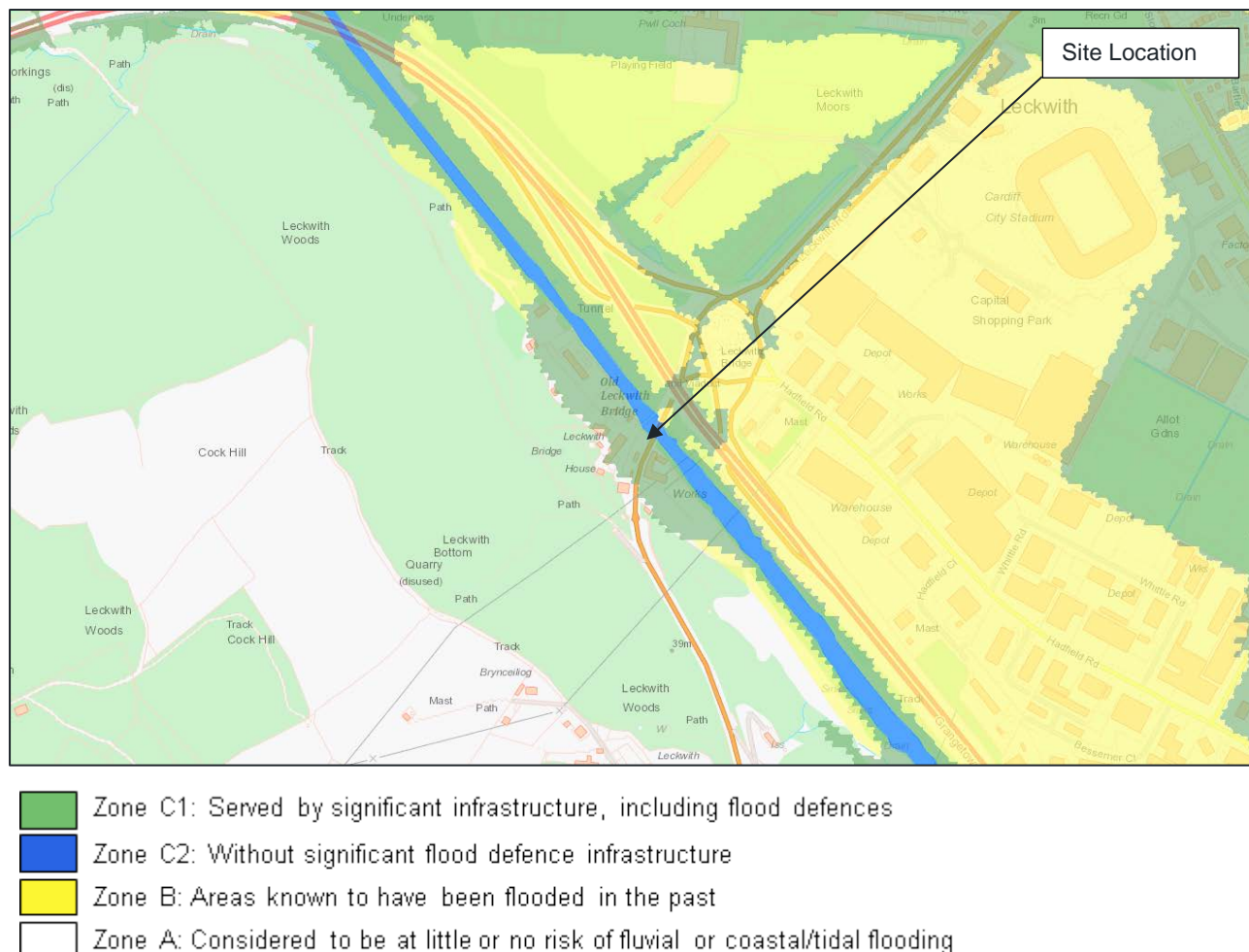


Figure 3: Development Advice Map

Figure 4 below shows an extract from the NRW Flood Zone map with the full set of flood risk maps included in Appendix A. The map shows that the site is within an area benefitting from flood defences but is otherwise predominantly within Flood Zone 3 with a larger extent in Flood Zone 2. Flood Zone 3 is the area NRW predict would flood either with a probability of greater than 1% from fluvial sources or 0.5% from tidal or with those probabilities from both sources. Flood Zone 2 is the area outside of Flood Zone 3 which NRW predict would flood with a probability of greater than 0.1% from either fluvial or tidal sources or from both sources.

Additionally of note are the flood defences present along the west bank of the Ely upstream of the Leckwith Road roadbridge. A review of the NRW data set indicates that this is assessed as protecting up to the 25 year event (i.e. the 4% probability event) and is in good to fair condition. It does not necessarily follow that the Ely will flood the site, only that the onset of flooding to the river's floodplain is likely to commence from an event of this magnitude.

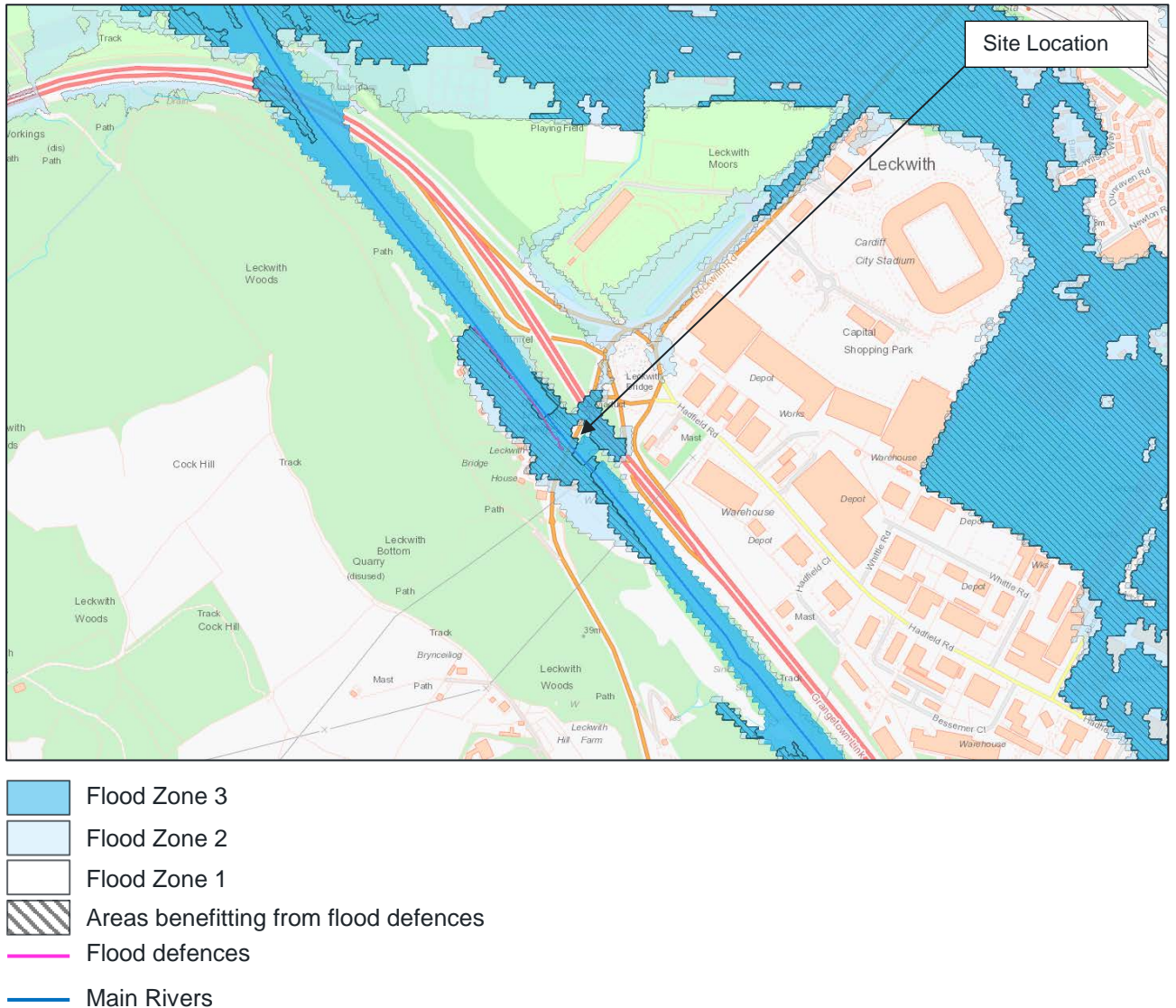


Figure 4: NRW Flood Zone Map

The set of NRW flood maps in Appendix A also illustrate that:

- The site is predicted to have a low risk of flooding from rivers and/or the sea.
- The site is located within a flood warning area.
- Isolated spots within the site have a low risk of surface water flooding, however these areas appear to be locally arising within the site.
- The site is at risk of flooding from the Pontsticill (Taf Fechan) Reservoir were it to fail catastrophically with flood waters predicted to be up to 2 m deep at a velocity of up to 0.5 m/s.

3 BASELINE FLOOD RISK

According to the flood map for planning the site is located within Flood Zone C1. The development classification based on usage is Highly Vulnerable.

There are a number of ways in which the likelihood or probability of a flood can be described. It is standard practice within the UK to refer to a flood in terms of its return period, which is the average interval in years between consecutive events exceeding a specified magnitude. However as the public may find this concept unintuitive, it is also possible to express an event in terms of its Annual Exceedance Probability (AEP). The AEP is the percentage chance that a flood of a specified magnitude or greater may occur in any given year. For fluvial flood events there are two events which need particular consideration, the hundred year event (1% AEP) with a climate change allowance referred to as the key event or design event and the thousand year event (0.1% AEP) referred to as the extreme event. For tidal flood events there are also two events which need particular consideration, the two-hundred year event (0.5% AEP) with a climate change allowance referred to as the key event or design event and the thousand year event (0.1% AEP) referred to as the extreme event.

Table 1: Annual Exceedance Probability - Return Period Equivalence

AEP (%)	50	20	10	3.3	2	1	0.5	0.1
Return Period (years)	2	5	10	30	50	100	200	1000

3.1 FLUVIAL FLOOD RISK

It is anticipated that the proposed development is at risk of flooding, this is principally from the overtopping of the riverbank alongside the Afon Ely, complicated by the afflux (backwater) resulting from the Historic Roadbridge.

Table 2: Predicted Fluvial Stage Levels

Event (Return Period Years)	Predicted Stage Level (m AOD)			
	Upstream Extent	Upstream of Bridges	Downstream of Bridges	Downstream Extent
100 (defended)	7.40	7.33	7.08	6.90
100 (undefended)	7.19	7.14	6.95	6.83
100 (defended with climate change)	8.14	8.11	7.94	7.88
1000 (defended)	8.00	7.92	7.40	7.16
1000 (undefended)	8.07	7.99	7.36	7.08

It should be noted that as the results in the above table were created in October 2013 a now obsolete value for climate change (20% uplift to flow) would have been applied. The current uplift for climate change for these rivers is 25% (but is under review at time of writing) and hence flood levels are also anticipated to be higher than those in the table. By extrapolating the stage / flow relationship estimates can be made as to the stage level for the 100 year event. Although there is significant uncertainty with extrapolation of data in this fashion the increase in depth ranges from 3 to 4 cm upstream of the bridges where the effect of increased flow is muted by the afflux to 12 to 16 cm downstream of the bridges. However it should be noted that it is atypical for the 100 year event with climate change to produce a higher stage level than the thousand year event, whilst not unheard of; therefore it is recommended that these data points are confirmed with NRW in case they are anomalous results.

3.2 TIDAL & OVERTOPPING FLOOD RISK

The site is understood to have a reduced risk of flooding from tidal sources in the present day due to the presence of the tidal barrage. The barrage is understood to protect against the 1000 year return period event (0.1% AEP). It is noted that the modelled tidal event (0.5% AEP) combined with a 30 year (3.3% AEP) fluvial event floods the site. Furthermore it should be recognised that the risk of tidal flooding may increase over the lifetime of the development depending on the rate of sea level rise. The results from this event are identified in Table 1 below. This report would estimate the undefended design flood level for the 200 year return period in 2019 at 9.6 m AOD and in the extreme flood event i.e. the 1000 year return period (0.1% AEP) in 2119 as 10.1 m AOD (at the seafront).

Table 3: Predicted Tidal Stage Level

Event (Return Period Years)		Predicted Stage Level (m AOD)			
Fluvial	Tidal	Upstream Extent	Upstream of Bridges	Downstream of Bridges	Downstream Extent
30	200	8.06	8.05	7.97	7.95

3.3 PLUVIAL & SURFACE WATER RISK

The site is identified as having isolated areas of low risk from surface water flooding, however waters appear to arise on site and the models used to inform the NRW map do not typically account for local drainage systems. Subject to a suitable SuDS scheme this risk is likely to be considered satisfactory.

3.4 GROUNDWATER FLOOD RISK

The site is not understood to be within a groundwater source protection zone. The Vale of Glamorgan Local Flood Risk Management Strategy¹ identifies that the risk of groundwater flooding is poorly understood.

Groundwater flood risk in the Vale is currently poorly understood. Very little historic evidence of this type of flooding is available and the predicted future impacts are primarily based on generic national geological mapping.

Section 2.3.2 (pg 21)

From Figure 2-4 of the report the site is located within a grid square identified as having between 25% and 50% susceptibility to groundwater flooding.

Furthermore, as identified in the Cardiff SFCA², which specifically considers the Ely Catchment groundwater flooding is not generally considered a concern in Cardiff.

The Taff and Ely CFMP states that groundwater flooding is not considered to be a significant issue within the catchment. It is noted that a large groundwater control scheme was introduced as part of the Cardiff Barrage scheme. There is a groundwater control system built into the Millennium Stadium. There are other similar schemes dotted throughout the low lying areas, designed to keep the groundwater levels low. It is not perceived that groundwater flooding would be a significant issue for the study sites. However,

¹ Capita (December 2013) *Local Flood Risk Management Strategy V.1.1* Vale of Glamorgan Council

² Atkins (November 2011) *Cardiff Strategic Flood Consequences Assessment Phase 2 Part 1 Update Extend Development Lifetime to 2110 Areas A, G, H and I* Cardiff Council Ref: 5097656-DG-017

risks associated with groundwater should be investigated as part of site-specific FCAs. It is recommended that assessments should be made of additional control measures which may be required for specific sites.

Section 5.4.3 (pg 54)

However as the site is anticipated to be situated on tidal and alluvial deposits which may, depending on their exact composition be susceptible to groundwater movements. Although the groundwater table would be anticipated to be dominated locally by the Afon Ely, water features are noted as issuing and sinking around the southern part of the site and it is strongly recommended that the assessment of groundwater risk is revisited once the results of ground investigations are available.

3.5 RESERVOIR & INFRASTRUCTURE FLOOD RISK

- The site is understood to be at risk of flooding from reservoirs as described previously.
- Based on a review of mapped data the site is not expected to be at any significant risk of flooding from ponds, lakes or other such bodies of water; however further consideration of the pond identified in the mapping may require further consideration if it is found to be elevated or embanked.
- The site is not anticipated to be at risk of flooding from a canal.
- The current site may have a risk of flooding from a burst water main.
- A blockage on either the Historic Roadbridge or the Leckwith Road roadbridge or indeed the proposed viaduct would be expected to increase the risk of flooding at the site.
- The wording from the Cardiff SFCA suggests there may be an elevated risk of flooding from sewers in the region, it is suggested that this should be further considered following the survey of the existing drainage network and design of the proposed network. It is identified from available data sets that DCWW may not hold any sewers on this development parcel though a private surface water outfall (975 mm diameter concrete pipe) is noted on the opposite bank downstream of the Leckwith Road roadbridge.

4 PROPOSED DEVELOPMENT/FLOOD MITIGATION

The proposal is to redevelop the site to include mixed use residential and commercial properties. Residences are classified as Highly Vulnerable.

According to Section 9 of TAN15 Highly Vulnerable developments may be permissible in Flood Zone C1, subject to: the Justification Test, acceptability of consequences and surface water requirements. Given the level of risk it is considered that mitigative measures to reduce the level of risk and the consequences of flooding will need to be incorporated into the design.

4.1 DEVELOPMENT LEVELS

TAN15 requires that finished floor levels be flood free in a fluvial 1%AEP + Climate Change event as well as the tidal 0.5%AEP + Climate Change event, which for the proposed highly vulnerable development will be calculated for a lifetime of 100 years. It also contains guidance on the maximum depth and velocity of flooding during a 0.1%AEP event.

A freeboard allowance of some 300 mm (depending on confidence and impact on flood storage) should be included above the predicted design flood level (1%AEP + Climate Change) resulting in an expectation that the minimum FFLs will be approximately in accordance with Table 3 below, provided the assumptions on the extrapolation discussed in Section 3.1 are valid, including the possibility that the design flood level is not based on anomalous results.

Table 4: Predicted Minimum Finished Floor Levels

Predicted Stage Level (m AOD)			
Upstream Extent	Upstream of Bridges	Downstream of Bridges	Downstream Extent
8.47	8.45	8.36	8.34

With a predicted 0.1%AEP flood level lower than the design flood level, the TAN15 requirement to keep the development flood free in the design event would simultaneously meet the requirement to keep the maximum depth of flooding to less than 600 mm in the extreme event.

Based on the provided topographic survey the effect of the design flood level, were lower areas to be strictly avoided, would be to sterilise a significant portion of the proposed development including almost the entirety of the northern plateau earmarked for development. There are a number of potential measures which can be considered to prevent sterilisation of the lower areas:

- Table 3 above provides a prediction of the FFLs, given uncertainties with the data these are estimates only and whilst it would be preferable for the entire development plateaus to be at these levels, it may be possible to agree that external areas do not need to include a freeboard level.
- The considerations and levels within this report assume a Highly Vulnerable development; it may be agreed that (although not explicitly TAN15 designations) ancillary areas, public open spaces and water compatible developments can flood to greater depths, frequency or both.
- It is noted that the current proposals include the removal of Leckwith Road roadbridge, whilst the Historic Roadbridge is the primary flow constriction raising water levels, the Leckwith Road roadbridge will have an influence on flow. Therefore, its replacement may result in lower upstream flood levels.
- Given that a new viaduct at this location will involve a substantial amount of work and presuming that the Historic Roadbridge can neither be removed nor modified to alleviate its constriction on flow, a system which bypasses the Historic Roadbridge (e.g. a flood relief culvert) could potentially be included within the design which would act to lower flood levels upstream of this structure.

- Table 3 above provides a prediction of the FFLs, there are uncertainties with the data and, given that hydraulic modelling of the proposal will almost certainly be required to satisfactorily determine the effect of the removal of Leckwith Roadbridge and creation of the new viaduct, these levels will be refined, via modelling of the latest allowances for climate change.
- As discussed in Section 4.2 below, it is possible that flood compensatory measures may either reduce local flood levels or facilitate raising levels on site such that they no longer flood or both.

4.2 FLOOD COMPENSATION

Given the predicted flood levels it is probable that ground levels will need to be raised in order for the site to comply with the requirements of TAN15. Raising the site could result in flood water being displaced and hence some compensatory storage may be necessary to prevent 3rd party impacts, which are not permissible under TAN15. Compensatory storage would generally be located as near to the point of displacement as possible and ideally on a level for level basis. It should be noted that the high ground within the site could theoretically be modified, dependent on slop stability and hence by carefully designing the developable area, it should be possible that no significant displacement should follow; although, the developable area will still be constrained by the displacement of floodwaters and any required compensatory volume. The viability of flood compensation typically has to be evidenced via a hydraulic modelling study to the satisfaction of Natural Resources Wales.

4.3 ACCESS & EGRESS

Considering the proposed layout, access into the site appears to be located on existing ground levels at approximately 7.5 m AOD, therefore it is anticipated that access and egress would be affected in a design flood event and likely severed.

TAN15 only provides descriptive advice on access requirements as it suggests determinations are made by the Local Authority (LA) based upon what is sensible. The Local Authority will need to determine what is considered acceptable access for this specific site, including whether safe refuge or evacuation are suitable procedures. Given the presence of flood warnings, evacuation of the development may be achievable prior to the access route being affected. This will require further consideration subject to further information such as the time and duration of flooding, and predicted depths/velocities on access roads which would be best informed by hydraulic modelling. The Local Authority will make their determination on access/egress as advised by TAN15, NRW, a site specific flood action plan and the site specific FCA.

4.4 SURFACE WATER DRAINAGE

Surface water runoff should be carefully considered such that there is no increased risk to third parties. Should investigation determine that soakaways are not suitable, then the SuDS hierarchy should be followed giving preference to soft engineered and environmentally beneficial solutions. It is considered that there is opportunity for a suitable SuDS scheme to be implemented and that this is desirable and achievable. Any existing drainage designs and connections should be confirmed/investigated, then once an approved drainage scheme has been designed and properly implemented this should satisfactorily address this aspect of risk to the development. The design of the drainage system should ensure there is no increase in runoff and will require approval by the SAB.

4.5 PROPOSED VIADUCT ADVICE

The proposed viaduct structure has, at time of writing, yet to be fully designed. Typical advice for the design of a new viaduct is to ensure that it does not increase flood risk to third parties and that this should be evidenced to the satisfaction of the NRW. It needs to be noted however that by complying with the standard advice for the design of this structure alongside the removal of the existing roadbridge will likely result in third party effects. It may be arguable that removal of the existing roadbridge does not increase risk downstream and not being a flood control structure merely restores the risk prior to its construction, however it is strongly recommended that this position is agreed with NRW and the Welsh Government prior to committing to it. Further to the above it is recommended that among other aspects of the design:

- If possible the structure's abutments and supports should be located outside of and above the design flood event,
- The deck should have a suitable freeboard above the design water level,
- If the bridge is not intended for use in a flood event this should be clearly displayed in warning notices and preferably a procedure for closure developed,
- The bridge should avoid generating an afflux that affects any third party flooding,
- Abutments should be set back a metre from the top of the bank and provide suitable headroom for maintenance of the bridge soffit/bearings,
- The bridge should provide a clear span across the river and ideally the entirety of Flood Zone 3,
- There should be adequate consideration of local scour to piers and abutments,
- The use of soft inverts should be considered to allow the natural river bed to be retained,
- The design requirement of the abutments and footings should be based on civil engineering requirements appropriate for the location; however, a solid invert or piers for design would not typically be expected.

4.6 EXISTING ONSITE WATERFEATURES ADVICE

Whilst not a flood issue per se, general advice on the existing water features can be provided. The River Ebbw is a main river, works effecting it and its flood plain will, other than for specific exemptions, require an environmental permit (formerly flood defence consent)³ from NRW. Additionally, NRW will likely hold a standard easement from the riverbank for maintenance (approximately 8 m). The other waterfeatures are likely ordinary watercourses and the responsibility of the lead local flood authority, however it should be noted that there is a general presumption against culverting and these should be kept as open as possible. Works effecting ordinary watercourses typically require an ordinary watercourse consent from the lead local flood authority (LLFA). We would also recommend a suitable buffer to reduce the impact of localised flooding from these features and also to provide opportunity for ecological and water quality improvements.

4.7 COMPLIANCE WITH TAN15

Section 9 of TAN15 summarises: the planning requirements, acceptability criteria and development advice for a Highly Vulnerable development in Flood Zone C1. This summary is replicated in this section and discussed for completeness.

4.7.1 PLANNING REQUIREMENTS

For developments in Flood Zone C1 the planning requirements are: that the Justification Test is applied, the consequences are acceptable and that surface water requirements are met.

Section 6 of TAN15 outlines the Justification Test, it states:

'Development, including transport infrastructure will only be justified if it can be demonstrated that:

- i. Its location in zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; or,*
- ii. Its location in zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region.*

And:

- iii. It concurs with the aims of PPW and meets the definition of previously developed land (PPW fig 4.1); and,*
- iv. The potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and appendix 1 found to be acceptable.'*

³ <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>

Although we would defer to the advice of the Local Authority, the Local Development Plan suggests that the site is within special landscape and semi-natural woodland constraints in addition to the flood constraint without specifically being noted as a housing opportunity, this does increase the difficulty of arguing that this development meets point i of the above test without wholly undermining the argument. The presence of the existing buildings suggests that the majority of the site comprises previously developed land under point iii, however point iv may be difficult to satisfy under a strict interpretation as discussed within this report.

Section 7 of TAN15 outlines the acceptability of consequences particularly within 7.2 and 7.3:

Under Section 7.2 of TAN15 the three key criteria of acceptability are whether:

1. the consequence of flooding can be managed down to an acceptable level including its effects on existing development,
2. safe access can be achieved, and
3. timely flood warnings can be provided.

Section 7.3 of TAN15 notes that if a development is justified, mitigation measures should be incorporated into the design to make it as safe as possible and that there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally, and;
- Minimal disruption to natural heritage.

Further criteria describing the acceptability of flood consequences are set out in Appendix 1 of TAN15. Whilst there is some overlap with the above these have been listed below for completeness.

- A1.3** The mechanisms likely to cause flooding must first be fully understood.
- A1.4** It is important that uncertainties are acknowledged and taken into account.
- A1.5** A proposed development must provide a safe living environment throughout its life. Those living on the site must, as far as is practical, have an appreciation of the dangers.
- A1.6** During extreme flood events the landscape may physically change. Consideration should be given to the possibility of flooding caused by blockages. This may well require modelling a blockage on the Historic Roadbridge to consider the effect of this situation.
- A1.7** The adequacy of existing flood defences must be carefully considered under a range of flood conditions, particularly those which cause overtopping of the defences. Where breach scenarios exist consideration should be given to the adoption of a suitably sized buffer zone within which no development should be allowed.
- A1.8** Measures taken to ensure flood consequences are managed to acceptable levels must be indicated and planning conditions or a S106 should be applied to require implementation.
- A1.9** Particular attention should be given to the impact of the development on flood risk elsewhere on the flood plain. It may not always be possible to manage these dangers.
- A1.10** Assessment must be undertaken by a suitably qualified person carrying an appropriate Professional indemnity.
- A1.11** New development on the flood plain will generally result in additional risks. NRW will advise the LA on their acceptability.
- A1.12** To satisfy these criteria a site should only be considered for development if the following conditions can be satisfied:
 - Flood defences must structurally adequate.
 - The cost of future maintenance for mitigation must be agreed with the Environment Agency [sic].
 - The developer must ensure that future occupiers are aware of flood risks and consequences.
 - Effective flood warnings are provided at the site.
 - Access routes are operational under all conditions.
 - Flood emergency plans and procedures produced by the developer must be in place.
 - The development allows the occupier to rapidly move possessions away from floodwaters.
 - The development is designed to minimise structural damage and is flood proofed to facilitate reoccupation.
 - No flooding elsewhere.
- A1.13** NRW will advise the Local Authority whether the above criteria have been satisfied.

A1.14 Residential development should be flood free in the 100 year fluvial event (1%) as well as the 200 year tidal event (0.5%).

A1.15 Where flooding occurs in the extreme event indicative figures have been provided as to what may be considered acceptable (N.B. These values are descriptive not prescriptive).

- Maximum flood depth (property access) 600 mm
- Maximum rate of rise 0.1 m/hr
- Maximum speed of inundation 4 hours
- Maximum velocity of floodwaters 0.15 0.3 m/s

A1.16 Local Authorities should require that developments in flood zones incorporate physical features to highlight the risk.

Although a full site specific FCA will still be required, based on a high level consideration of the above, points 1 and 2 may be achievable as the land contains higher ground as well as an existing building footprint and the local authority may accept the access arrangements, if further investigations suggest they remain viable in an emergency and/or safe refuge is readily achievable. Point 3 and points A.1 through to A.11, A.13 and A.16 are also likely to be achievable presuming the development is suitably designed. A.12 will present difficulties to meet a strict interpretation of, given the current access requirements and A.15 will require specific data licenced from the NRW to establish whether these criteria are likely to be met.

4.7.2 ACCEPTABILITY CRITERIA

For developments in Flood Zone C1 the acceptability criteria according to Section 9 are that:

- Acceptable consequences for nature of use;
- Flood defences adequate;
- Agreement for construction and maintenance costs secured;
- Occupiers aware of flood risk;
- Escape/evacuation routes present;
- Effective flood warning provided;
- Flood emergency plans and procedures;
- Flood resistant design, and;
- No increase in flooding elsewhere.

4.7.3 DEVELOPMENT ADVICE

For developments in Flood Zone C1 the development advice according to Section 9 is that:

'Plan allocations and applications for all development can only proceed subject to justification in accordance with section 6 and acceptability of consequences in accordance with section 7 and Appendix 1.'

5 CONCLUSIONS

Highly Vulnerable developments may be permissible in Flood Zone C1, but are subject to the Justification Test, acceptability of consequences and surface water requirements. The proposed development in its current configuration is unlikely to be compliant with TAN15, suggestions which should improve the likelihood of compliance have been made throughout this report. This is true regardless as to whether the design levels themselves are misreported from NRW data as the spread of the other data sets still suggest a non-compliant scheme. It is suggested that the proposal is reviewed in light of the advice contained within this report and the design philosophy agreed with NRW via their developer advice service. Following the implementation of these considerations hydraulic modelling of the Ely is likely to be required to evidence compliance.

Given the presence of the Cardiff tidal barrage, the primary source of flood risk to the site is fluvially driven, and an initial estimate of the design flood levels have been identified; however hydraulic modelling, which will be required to inform the design of the new viaduct, should be undertaken to provide a better defined value. It would be anticipated that the development levels would need to be set at or above the design flood level ideally with a suitable freeboard allowance with as minimum safe refuge above the extreme event, but preferably dry access. The proposed development may however struggle to comply with a strict interpretation of the requirements of TAN15, in its current configuration.

It should however be noted that third party impacts are difficult to anticipate prior to a model study and that it may be possible to minimise these to an acceptable level by adjusting the extent of the net developable area and by the incorporation of other mitigation.

The Local Authority are responsible for determining the acceptability of access/egress and any mitigation measures (such as an actively managed site and/or a specific flood action plan).

Appendix A

NRW FLOOD MAPS







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