



Balmoral Drive, Southport

Due Diligence Flood Risk Assessment

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Executive Summary

Waterman Infrastructure & Environment was commissioned by Catalyst Capital to undertake a Due Diligence flood risk assessment for the land and buildings to the east of Balmoral Drive, Southport, to assess its suitability for development.

According to the Environment Agency's current Flood Map for Planning, the Site is located within Flood Zones 1, 2 and 3 and is classified as being at a 'low', 'medium' and 'high' probability of flooding. However, the Environment Agency have advised that this map will be updated later in 2015 so that it is entirely within Flood Zone 3, so as a 'high' risk of flooding, with an annual probability of tidal flooding of greater than 1 in 200 (0.5%).

The Environment Agency have confirmed that the Site is defended in all flood events up to and including the 1 in 1000 year flood event, and the Site does not flood during defended scenarios. When taking account of the defences the Environment Agency classify the risk of flooding as 'low'.

Detailed hydraulic breach modelling undertaken for the Environment Agency indicates that in the unlikely event of the defences failing at the same time as a 1 in 200 year tidal flood level, the western edge of the Site would be affected by shallow flooding to a peak water level of 4.89m AOD, i.e. to a depth of up to 350mm. However as the flood defences are regularly inspected and maintained by the Environment Agency, the probability of a tidal breach is very low.

For planning purposes, any 'more vulnerable' residential development proposed in this area would need to be set a minimum of 300mm above this flood level, i.e. no lower than 5.19m AOD. This would require localised ground raising, resulting in abnormal costs, however the area required to be raised comprises less than 10% of the overall Site area and would not require compensatory storage to be provided. Alternatively, this strip of land could be left undeveloped, or other 'less vulnerable' uses such as commercial or retail could be provided on the ground floor, which would not have any minimum floor level requirements.

The Environment Agency, Sefton Borough Council and United Utilities do not hold any records of historic tidal, fluvial, groundwater, surface water or sewer flooding at the Site and the risk of flooding from all sources has been assessed as being low.

In line with local planning policy, surface water runoff will need to be reduced by 20% of the existing rate (i.e. a restriction to 80% of the existing rate), including an allowance for climate change over the lifetime of the development. This will require attenuation to be provided using Sustainable Drainage Systems (SuDS), ideally through the more sustainable measures such as swales and balancing ponds, which will require land to be made available as part of the landscaping strategy.

The Council's Local Plan confirms that the Site has passed the Sequential Test, and therefore the principle of development is acceptable. If 'more vulnerable' uses, such as residential units, are proposed at the Site the Exception Test would need to be satisfied as part of any future planning submission, to confirm that the wider sustainability benefits to the community outweigh the risk of flooding. However, this should not be problematic.

In conclusion, there are not considered to be any significant abnormal costs or planning risks associated with flood risk.

1. Introduction

- 1.1. Waterman Infrastructure and Environment was commissioned by Catalyst Capital to undertake a Due Diligence flood risk assessment for the land and buildings to the east of Balmoral Drive in Southport (hereafter known as 'the Site').
- 1.2. This report assesses the risk of flooding to the Site from tidal, fluvial, groundwater, pluvial and artificial sources.
- 1.3. The assessment included a review of information in the public domain (see Table 1 below) and information gained from a walkover of the surrounding area.

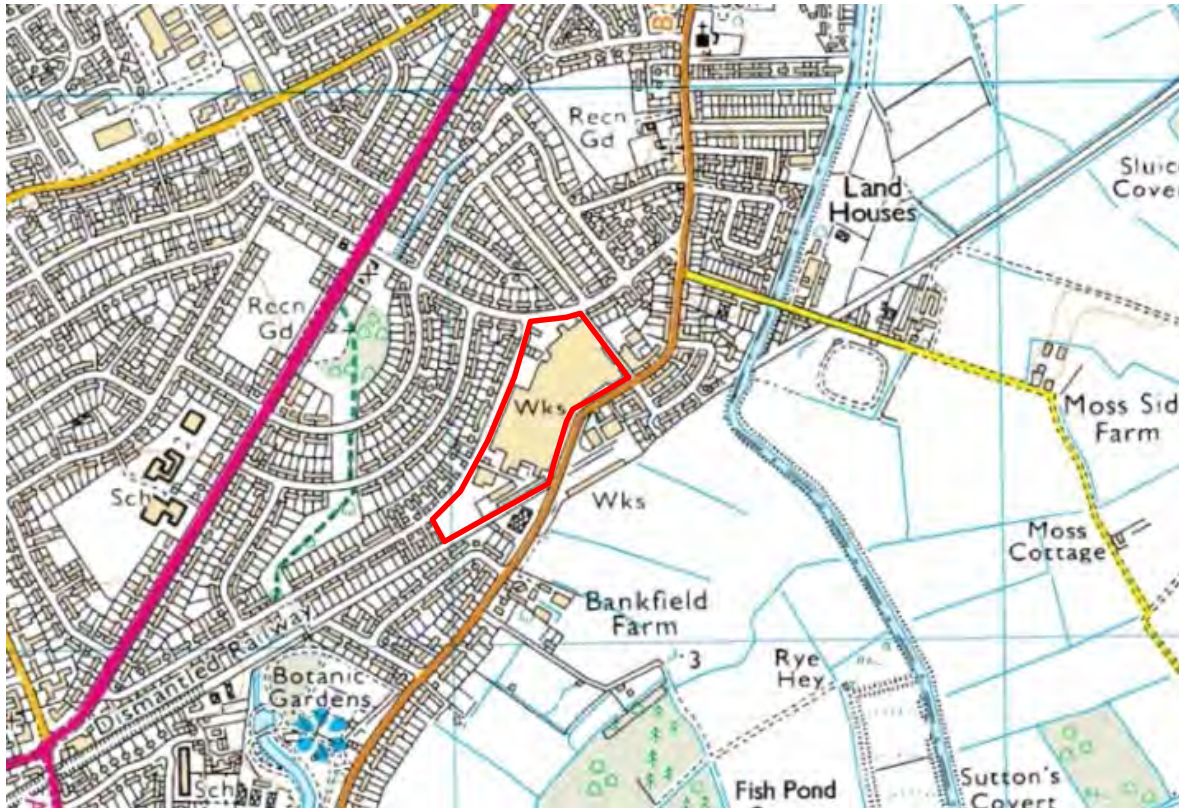
Table 1: Data Sources

Source	Yes	No
Local planning policy	✓	
Environment Agency Website	✓	
Environment Agency Enquiry	✓	
Local Council Enquiry (Sefton Borough Council)	✓	
Sewerage Undertaker Enquiry (United Utilities)	✓	
BGS Information	✓	
Site check & Historical Mapping	✓	
Topographic Survey		✓
LiDAR Data (Geomatics Group)	✓	

Site Description

- 1.4. The existing Site is approximately 6.05 hectares (ha) in size and comprises concrete and tarmac hard standing. The Site was recently demolished in the latter part of 2014, where offices and factory units were removed. The Site is centred at National Grid Reference 337175, 419495 as shown in Figure 1 (overleaf).

Figure 1: Site Location Plan



Key

 Site Location

Source: Bing maps (<http://www.bing.com/maps/>)

- 1.6. The Site is bounded by North Road to the north, Balmoral Drive to the west, and Rufford Road to the east. A dismantled railway is present to the southwest, and Slackey Lane is located to the northeast.

Site History

- 1.7. The Site previously consisted of offices and factory units, with some areas of hard standing. In the latter part of 2014, the Site office blocks and factory units were demolished. The Site now consists entirely of hard standing.

Planning Policy and Guidance

National Planning Policy Framework

- 1.8. The National Planning Policy Frameworkⁱ (NPPF) states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk. Where development is necessary, it must be made safe without increasing flood risk elsewhere.
- 1.9. The NPPF clarifies that the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. In addition, development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. If, following application of the Sequential Test, it is not possible (consistent with wider sustainability objectives) for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. For the Exception Test to be passed:
- A site-specific FRA must demonstrate that the development would be safe for its lifetime, taking account of the vulnerability of its users without increasing flood risk elsewhere, and, where possible, would reduce flood risk overall; and
 - It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.
- 1.10. The NPPF states that when determining planning applications, Local Planning Authorities (LPA) should ensure that flood risk is not increased elsewhere and only consider development in areas at risk of flooding where it can be demonstrated that:
- Within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location; and
 - Development is appropriately flood resilient and resistant, includes safe access and escape routes where required, any residual risk can be safely managed (including emergency planning), and priority is given to the use of Sustainable Drainage Systems (SuDS).
- 1.11. The Planning Practice Guidance (PPG)ⁱⁱ that accompanies the NPPF includes advice on flood risk vulnerability and flood zone compatibility. The following flood zones refer to the probability of river and sea flooding, without the presence of defences:
- Zone 1 - low probability: less than 1 in 1000 annual probability of river or sea flooding (<0.1%) in any year;
 - Zone 2 - medium probability: between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% to 0.1%) in any year;
 - Zone 3a - high probability: 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability flooding from the sea (>0.5%) in any year; and
 - Zone 3b - the functional floodplain: where water has to flow or be stored in times of flood; identification should take account of local circumstances but would typically flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme 1 in 1,000 (0.1%) flood.

Sefton Borough Strategic Flood Risk Assessment

- 1.12. Sefton Borough Council's (SBC) Level 1 Strategic Flood Risk Assessment (SFRA)ⁱⁱⁱ was published in March 2013 to determine the variation in flood risk across the borough.
- 1.13. The main objective of the SFRA is to inform revision of the borough's flood policies, including the allocation of land for future development, for use within the emerging Local Development Framework. It aims to:
 - Assist the Council in developing policies which will underpin decision making within the borough, especially in areas that are affected by (and/or may adversely impact upon) flooding;
 - Assist the development control process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the borough;
 - Help identify and implement strategic solutions to flood risk and provide the basis for possible future flood attenuation works; and
 - Support/assist in the production of the Council's emergency planning response to flooding.
- 1.14. Information from the SFRA regarding tidal, fluvial, surface water, sewer and groundwater flooding is included within Chapter 2 of this report.

2. Flood Risk

- 2.1. SBC, the Environment Agency (EA) and United Utilities have been contacted in order to obtain information in relation to tidal, fluvial, groundwater, pluvial and artificial sources of flooding (i.e. reservoirs and canals). Consultation responses have been received from all parties.

Tidal and Fluvial Flooding

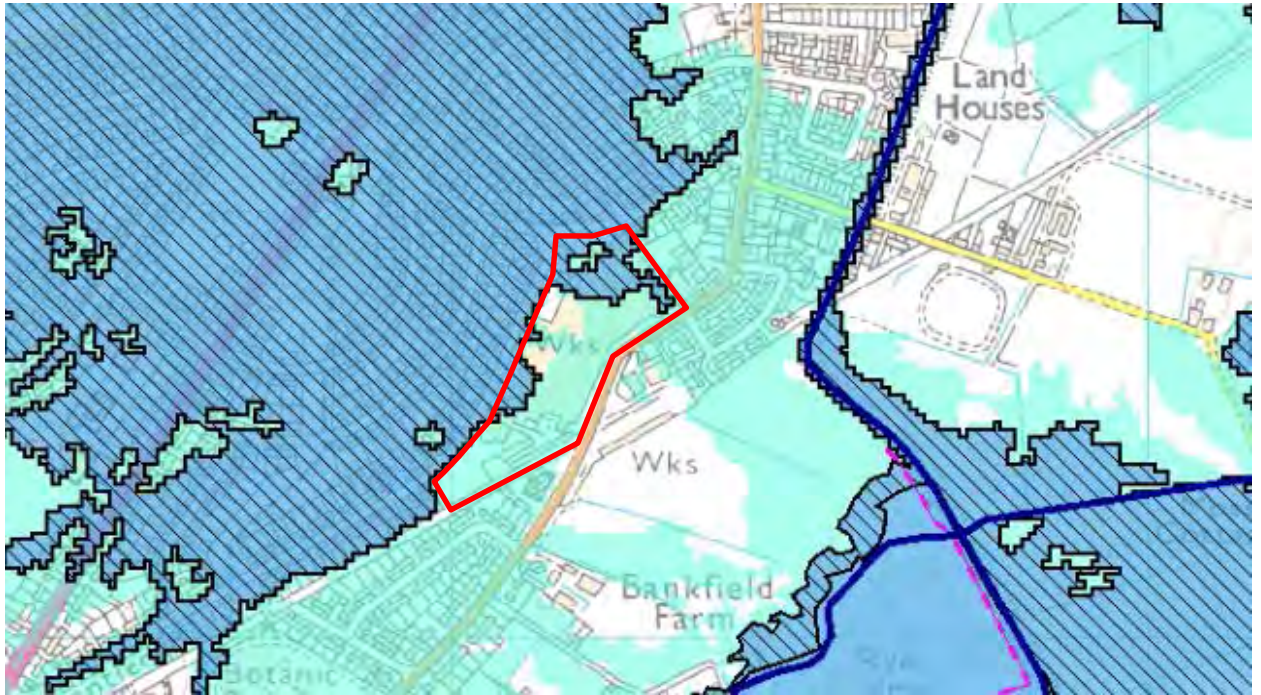
Flood Mapping

- 2.2. According to the EA's current Flood Map for Planning indicated in Figure 2 (overleaf), the Site is located within Flood Zones 1, 2 and 3 and is classified as being at a 'low', 'medium' and 'high' probability of flooding.
- 2.3. However, as shown in the EA correspondence in Appendix A, the EA have advised that this map will be updated later in 2015 so that it is entirely within Flood Zone 3, so as a 'high' risk of flooding, with an annual probability of tidal flooding of greater than 1 in 200 (0.5%).
- 2.4. The EA have confirmed that the Site is defended in all flood events up to and including the 1 in 1000 year (0.1% annual probability) flood event, and the Site does not flood during defended scenarios. When taking account of the defences the Environment Agency classify the risk of flooding as 'low'.
- 2.5. The Flood Map for Planning is used for planning purposes as a conservative means of determining flood risk to new development. However through interrogation of the maps, a second data set can be acquired. This additional information describes the likelihood of flooding, taking into account the location, type and condition of flood defences, based on the EA's National Flood Risk Assessment. The likelihood of flooding to property is classified as either 'very low', 'low', 'medium' or 'high'.
- 2.6. The EA's website and confirmation from the EA (Appendix A) indicates that the probability of flooding at the Site is 'low', where the chance of flooding in any year is greater than 1 in 100. This means that members of the Association of British Insurers (ABI) are highly unlikely to refuse flood cover on building and contents policies to homeowners and small businesses.
- 2.7. Figure 3 and 4 of the SBC SFRA^{iv} published in March 2013 (Appendix B) indicates that the Site lies within the extent of tidal Flood Zone 3 and Flood Zone 2.








Planning Policy Guidance

- 2.8. As the Site is located in Flood Zone 3, the flood risk vulnerability and compatibility must be discussed so that inappropriate development is not proposed in areas at the highest risk of flooding.
- 2.9. Flood risk vulnerability is split into five classifications in Table 2 of the PPG, as follows, and the compatibility of these within each Flood Zone is set out in Table 3 of the PPG:
- Essential Infrastructure, e.g. essential transport and utility infrastructure, wind turbines;
 - Highly Vulnerable, e.g. emergency services (those required to be operational during flooding), basement dwellings;
 - More Vulnerable, e.g. residential dwellings, hospitals, schools, hotels, drinking establishments;

Figure 2: Environment Agency Flood Map for Planning



Key

-  Site Location
-  Flood Zone 3, High probability of flooding from rivers or the sea, without the presence of defences
-  Flood Zone 2, Medium probability of flooding from rivers or the sea, without the presence of defences
-  Flood Zone 1, Low probability of flooding from rivers or the sea
-  Flood defences
-  Areas benefiting from flood defences
-  Main River

Source: <http://maps.environment-agency.gov.uk>

- Less Vulnerable, e.g. retail, offices, storage and distribution, leisure, restaurants; and
- Water-Compatible Development, e.g. docks, marinas, wharves.

Table 2: PPG (Table 3) Flood Risk Vulnerability Classification

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	x	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	x	x	x	✓*

Key:

✓ Development is appropriate

x Development should not be permitted.

- 2.11. The EA flood mapping indicates that the Site is defended and remains unaffected by flood events in defended scenarios.
- 2.12. According to the SBC SFRA, the following would apply to the Flood Zones in this area:
- Flood Zone 3b is defined as any area located within the defended 1 in 20 year flood extent where available. The Site is not affected by Flood Zone 3b.
 - Flood Zone 3a is defined as any area located within the 1 in 200 year flood extent where available. **The Site is located entirely within Flood Zone 3a.**
 - Flood Zone 2 is defined as any land assessed as having between a 1 in 200 and 1 in 1000 annual probability of sea flooding.
 - Flood Zone 1 is defined as any land assessed as having less than 1 in 1000 annual probability of river or sea flooding in any year.
- 2.13. Table 3 of the PPG states that 'less vulnerable' development types **are appropriate** for this Site. However 'more vulnerable' residential development would need to pass the Exception Test.

Sequential Test

- 2.14. The aim of the Sequential Test is to ensure that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The Flood Zones which are refined in the SFRA for SBC provide a basis for applying the test. The aim of this is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, SBC in their decision making have taken flood risk and vulnerability of land uses and have considered reasonably available sites in Flood Zone 2.
- 2.15. The SBC Local Plan assesses a number of Sites within the Southport area considering the wider sustainability benefits and constraints to development including flood risk. The report states that as the Phillip's Site, Balmoral Drive (ref: AS28) does not flood during defended scenarios, this is deemed to have passed the sequential test within the Local Plan, defined by policy reference MN2.3. The Local Plan also confirms that the Site can be used to allocate housing.
- 2.16. As 'more vulnerable' uses such as residential are proposed at the Site the Exception Test would also need to be passed. This would include the following:
- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA; and
 - A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.

Flooding History

- 2.17. Figure 16 of the SBC Level 1 SFRA (Appendix B) confirms that the Site has not been affected by any historic fluvial flooding.

Existing Tidal Defences

- 2.18. The EA have confirmed that the Site is protected by formal coastal flood defences. The EA is responsible for managing the risk from the sea, Main Rivers and reservoirs and has a strategic overview role for all flood risk management.
- 2.19. EA have confirmed that this area is defended in all modelled flood events, therefore the tidal flood defences in this location offer up to and including a 1 in 1000 year standard of protection.
- 2.20. The nearest Main Rivers to the proposed site are Captains Watercourse and Three Pools Watercourse. The closest is the Three Pools watercourse which is approximately 190 metres to the south east of the Site.

Flood Levels and Flood Mapping

- 2.21. The EA have provided a range of flood levels for different return periods for the Site (see Table 3). The Flood Map at this location will be updated in the latter part of 2015 with detailed tidal and fluvial modelling from the Lancashire Tidal Model (2014).

Table 3: Environment Agency Flood Levels

Return Period	Undefended Model Flood Levels (m AOD)	Defended Model Flood Levels (m AOD)	Breach Inundation Model Flood Levels (m AOD)
1 in 200 year	5.84	No Flooding	4.89
1 in 200 year + CC	6.43	No Flooding	Not Provided
1 in 1000 year	6.07	No Flooding	Not Provided

Source: Environment Agency (Lancashire Tidal Modelling 2014) Flood Levels

- 2.22. The EA study was produced using 1D/2D flood modelling software to map areas at risk from fluvial and tidal flooding; the floodplain has been modelled in detail to assess key flow routes and depths.
- 2.23. The EA have confirmed that they will be updating the online flood map later in 2015 to represent their more detailed flood modelling study.

Site Impacts

- 2.24. Tidal flooding impacts to the Site vary upon flood levels, ground levels and flood velocities. The EA flood extents show that during a 1 in 200 year breach scenario (Appendix A) shallow flooding on the western and northern edges of the Site occurs up to a depth of up to 0.35m.
- 2.25. An airborne (LIDAR) topographic survey (Appendix C) was acquired on the 10th of February 2015 to gain a more detailed understanding of the variation in ground levels across the Site, and hence the risk of flooding to the Site. Topographic survey was not available for the Site but it is recommended that this information is collected before any development takes place.
- 2.26. The LIDAR survey confirms a general fall in ground levels in a northeast direction, from approximately 5.5m AOD in the southwest of the Site to a low point of 4.73m AOD in the northeast of the Site.
- 2.27. The breach flood level advised by the EA has been contoured across the Site using the LiDAR data. A comparison of the potential flood extent based on the LiDAR data and EA breach map can be seen below in Figure 3 (overleaf). This identifies that the two extents are relatively similar.

Flood Constraints

- 2.28. Detailed hydraulic breach inundation modelling undertaken for the EA indicates that in the event of the defences failing at the same time as a 1 in 200 year tidal flood level, the western edge of the Site would be affected by shallow flooding to a peak water level of 4.89m AOD, i.e. to a depth of up to 0.35m. However as the flood defences are regularly inspected and maintained by the EA, the probability of a tidal breach is very low.
- 2.29. For planning purposes, any 'more vulnerable' residential development in the affected area would need to be set a minimum of 300mm above this flood level, i.e. no lower than 5.19m AOD, requiring localised ground raising.

- 2.30. Although this would result in abnormal costs, the area required to be raised comprises less than 10% of the overall Site area and would not require compensatory storage to be provided.
- 2.31. Alternatively, this strip of land could be left undeveloped, or other 'less vulnerable' uses such as commercial or retail could be provided on the ground floor, which would not have any minimum floor level requirements.

Figure 3: Comparison of Flood Extent between Contoured LiDAR data and EA Breach Mapping



Key

-  Site Boundary
-  1 in 200 year (0.5% AEP) flood extent.

Source: Environment Agency Flood Levels in the 1 in 200 year breach inundation model

Groundwater Flooding

- 2.32. A review of the British Geological Society (BGS) online "Geology of Britain" and borehole data from the BGS website indicates that the Site geology is likely to comprise Made Ground over Tidal Flat Deposits over Mudstone.
- 2.33. There are no online BGS borehole records located within the Site itself. However, from a borehole located approximately 20m from the Site, the following underlying stratum is assumed (Appendix E). There was no groundwater encountered within this borehole.

Table 4: Existing Site Geology

Stratum	Approximate thickness (m)
Light Brown Sand	1.68
Sand and Peat	0.38
Grey Clayey Silt	0.53

Brown Peat	1.07
Blue Grey Clayey Silt	1.98
Brown to Grey Clayey Silt	2.13
Sand and Gravel	0.91
Brown Sandy Clay	0.46
Sandy Grey Silt	0.91
Brown Sandy Silt	0.76
Compact Brown Sand	1.52
Brown Sandy Boulder Clay	4.42

- 2.34. The EA have confirmed that they have no record of groundwater flooding at the Site (Appendix A). Furthermore the SBC SFRA (Appendix B) does not show any instances of groundwater flooding in the vicinity.
- 2.35. Therefore, based on the above information, it is likely that the Site is at a low risk of groundwater flooding and this would cause no constraints to development.


Pluvial Flooding


- 2.36. Pluvial (surface water) flooding occurs when natural and engineered systems have insufficient capacity to deal with the volume of rainfall. Pluvial flooding can sometimes occur in urban areas during an extreme, high intensity, low duration summer rainfall event which overwhelms the local surface water drainage system, or in rural areas during medium intensity, long duration events where saturated ground conditions prevent infiltration into the subsoil. This flood water would then be conveyed via overland flow routes dictated by the local topography.
- 2.37. The EA's Risk of Flooding from Surface Water Map shown in Figure 4 (overleaf) indicates that the majority of the Site would be at a 'very low' risk of surface water flooding. However, some areas along the periphery of the Site (in the northeast, southeast and southwest) are shown to be at a 'low' to 'medium' risk of flooding. Balmoral Drive to the west is indicated to be at a 'low' to 'high' risk of flooding. There are also some nominal areas within the Site itself (between the previous buildings), where a 'medium' risk is identified.
- 2.38. The Risk of Flooding from Surface Water maps provided by the EA and SBC (Appendix B and C) identifies that there could be a risk of surface water flooding in localised areas of the Site.
- 2.39. It should be noted that the EA's Risk of Flooding from Surface Water maps simply indicate where surface water is likely to flow and pond based on aerial topographic data. Therefore, low lying areas at and around the Site would automatically appear to be at significant risk. In addition, the EA state that this mapping is of a coarse nature and should therefore not be utilised to assess the risk of surface water flooding to individual properties.

Figure 4: Environment Agency Risk of Surface Water Flooding Map





Key

 Site Location

 High Risk

 Medium Risk

 Low Risk

 Very Low Risk

Source: <http://watermaps.environment-agency.gov.uk>

- 2.40. SBC have also provided their Sefton Surface Water map for the Site (Appendix D). This shows that some nominal areas along the eastern boundary of the Site could be at risk of surface water flooding in the 1 in 100 year event with an allowance for climate change. Flood depths are likely to range between 0.3m and 0.6m in this event.
- 2.41. However, potential flow routes onto the Site should be considered when setting appropriate Finished Floor Levels and access/egress routes. In line with general good practice, external areas should fall away from proposed buildings. No new flow routes should be created. This could be achieved by locating raised pedestrian crossings and/or speed humps at entrances to reduce the potential for overland surface water runoff to enter the Site.

- 2.42. United Utilities sewer records (Appendix F) indicate that there are both combined and surface water sewers in the vicinity of the Site. Foul sewers are also indicated as being present to the east of the Site.
- 2.1. Figure 16 in the SFRA shows that there are records of historic sewer flooding on the Site where 2-3 incidents of flooding were reported, however it does not state the exact location of this occurring. SBC have confirmed that they hold records of blocked gully issues which relate to this figure, however the exact location of this has not been confirmed.
- 2.2. Consultation with United Utilities (Appendix F) indicates that the risk of surcharged sewers in the area is considered to be low, and they have no records of internal flooding at the Site.
- 2.3. Based on this information, the Site appears to be at a low risk of pluvial flooding, and any new development should be designed appropriately to avoid ingress of overland flows.

Reservoir Flooding

- 2.4. Mapping shown on the EA website indicates the largest area that could be affected by flooding if a reservoir were to fail.
- 2.5. EA mapping (included in Figure 5) shows that the Site would not be subject to flooding due to failure of the reservoirs in the area. The EA note that this is a worst case prediction and any flood event is unlikely to be this large.
- 2.6. There are no other artificial bodies of water in the vicinity of the Site, and based on the information above, the Site appears to be at a low risk of flooding from artificial sources.

Figure 5: Environment Agency Risk of Flooding from Reservoir Map



Key



Site Location



Maximum Extent of Flooding

Source: <http://maps.environment-agency.gov.uk>

3. Surface Water Drainage

Current Drainage Regime

- 3.1. From the United Utilities drainage records (Appendix F), it is assumed that surface water runoff from the Site connects into the surrounding public sewers in Balmoral Drive, Rufford Road, North Road and Slackey Lane. A Site specific drainage survey should be undertaken prior to submitting a future planning application to confirm the ultimate connections.

Proposed Drainage and Attenuation Requirements

- 3.2. It is proposed to mimic the existing situation post development, and drain surface water from the Development to these public sewers.
- 3.3. In line with the NPPF, in order to ensure that flood risk is not increased to others, the rate of surface water runoff into the sewers needs to be restricted to the existing rate up to the 1 in 100 year event, allowing for the impacts of climate change for the lifetime of the development. In addition to this, correspondence received from the council confirms that they would request a 20% improvement in runoff, i.e. a restriction to 80% of the existing rate.
- 3.4. Commercial developments are assumed to have a design life of 60 years, which equates to a 20% allowance for climate change. Residential development are assumed to have a lifespan of 100 years, which equates to a 30% increase in rainfall intensity/allowance for climate change.
- 3.5. This would require attenuation to be provided to sufficiently restrict the flow of surface water runoff from the Site.

Sustainable Drainage Systems

- 3.6. The most sustainable way to drain surface water and appropriately restrict the rate of runoff is through the use of SuDS, which need to be considered in relation to site-specific constraints.
- 3.7. SuDS work by mimicking the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk these features can improve water quality and provide biodiversity and amenity benefits.
- 3.8. A variety of SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 5 outlines each of the SuDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C697^v.

Table 5: SUDS Hierarchy

Type	Device	Description
Source Control	Living roofs	Provide soft landscaping at roof level which reduces surface water runoff.
	Infiltration devices, soakaways	Store runoff and allow water to percolate into the ground through natural infiltration.
	Pervious surfaces	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.
	Rainwater harvesting	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g. toilet flushing or irrigation.
Permeable Conveyance	Swales	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).
	Filter drains & perforated pipes	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas), that convey runoff whilst allowing infiltration.
	Filter strips	Wide gently sloping areas of grass or dense vegetation that remove pollutants from runoff from adjacent areas.
End of Pipe Treatment	Infiltration basins	Depressions in the surface designed to store runoff and allow infiltration.
	Wet ponds & constructed wetlands	Provide water quality treatment & temporary storage above the permanent water level.
	Attenuation tanks	Stores runoff and restricts the rate of runoff, but provides no water quality benefits. Used when the SuDS listed above cannot be installed with sufficient volumes to restrict to the required rate.

- 3.9. The most effective way to reduce surface water runoff is through infiltration into the subsoil which reduces the total volume of runoff, rather than simply reducing peak flows. This can include techniques such as infiltration trenches, soakaways, permeable paving and infiltration basins.
- 3.10. The potential for infiltration is unknown at this stage and the potential would need to be established during any future planning applications.
- 3.11. In lieu of infiltration, space would need to be made available within the landscape proposals to provide sufficient attenuation. The EA would ideally request balancing ponds and swales, as these provide biodiversity benefits in addition to providing attenuation. If Site constraints mean that these more sustainable forms of attenuation are not feasible, more traditional urban SuDS such as permeable paving (lined if infiltration is not possible) and attenuation tanks could be considered. If

the more sustainable SuDS are deemed impractical to incorporate, the reasoning behind this would need to be justified to the EA.

- 3.12. When locating the required attenuation, a gravity connection should be provided to the attenuation features, and also from the features themselves to the receiving sewers. This would remove the requirement for pumping, which is considered highly unsustainable.

4. Conclusions

- 4.1. Waterman Infrastructure & Environment was commissioned by Catalyst Capital to undertake a Due Diligence flood risk assessment for the land and buildings to the east of Balmoral Drive, Southport, to assess its suitability for development.
- 4.2. According to the Environment Agency's current Flood Map for Planning, the Site is located within Flood Zones 1, 2 and 3 and is classified as being at a 'low', 'medium' and 'high' probability of flooding. However, the Environment Agency have advised that this map will be updated later in 2015 so that it is entirely within Flood Zone 3, so as a 'high' risk of flooding, with an annual probability of tidal flooding of greater than 1 in 200 (0.5%).
- 4.3. The Environment Agency have confirmed that the Site is defended in all flood events up to and including the 1 in 1000 year flood event, and the Site does not flood during defended scenarios. When taking account of the defences the Environment Agency classify the risk of flooding as 'low'.
- 4.4. Detailed hydraulic breach modelling undertaken for the Environment Agency indicates that in the unlikely event of the defences failing at the same time as a 1 in 200 year tidal flood level, the western edge of the Site would be affected by shallow flooding to a peak water level of 4.89m AOD, i.e. to a depth of up to 350mm. However as the flood defences are regularly inspected and maintained by the Environment Agency, the probability of a tidal breach is very low.
- 4.5. For planning purposes, any 'more vulnerable' residential development proposed in this area would need to be set a minimum of 300mm above this flood level, i.e. no lower than 5.19m AOD. This would require localised ground raising, resulting in abnormal costs, however the area required to be raised comprises less than 10% of the overall Site area and would not require compensatory storage to be provided. Alternatively, this strip of land could be left undeveloped, or other 'less vulnerable' uses such as commercial or retail could be provided on the ground floor, which would not have any minimum floor level requirements.
- 4.6. The Environment Agency, Sefton Borough Council and United Utilities do not hold any records of historic tidal, fluvial, groundwater, surface water or sewer flooding at the Site and the risk of flooding from all sources has been assessed as being low.
- 4.7. In line with local planning policy, surface water runoff will need to be reduced by 20% of the existing rate (i.e. a restriction to 80% of the existing rate), including an allowance for climate change over the lifetime of the development. This will require attenuation to be provided using Sustainable Drainage Systems (SuDS), ideally through the more sustainable measures such as swales and balancing ponds, which will require land to be made available as part of the landscaping strategy.
- 4.8. The Council's Local Plan confirms that the Site has passed the Sequential Test, and therefore the principle of development is acceptable. If 'more vulnerable' uses, such as residential units, are proposed at the Site the Exception Test would need to be satisfied as part of any future planning submission, to confirm that the wider sustainability benefits to the community outweigh the risk of flooding. However, this should not be problematic.
- 4.9. In conclusion, there are not considered to be any significant abnormal costs or planning risks associated with flood risk.

5. References

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- i Department for Communities and Local Government, March 2012. *National Planning Policy Framework*
 - ii Department for Communities and Local Government, March 2014. *Planning Practice Guidance*
 - iii Capita Symonds on behalf of Waverley Borough Council, June 2010 *Waverley Borough Strategic Flood Risk Assessment*
 - iv CIRIA, 2007. *CIRIA C697 The SUDS Manual*