

# Sharpness Docks Wind Turbine Flood Risk Assessment

Level 2  
October 2011

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<b>A. Correspondence with the Environment Agency</b>	Error! Bookmark not defined.
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# Glossary

Term	Definition
AEP	Annual Exceedance Probability
FRA	Flood Risk Assessment
PfR	The Partnerships for Renewables Development Company Limited
PPS25	Planning Policy Statement 25: Development and Flood Risk
SCADA	Supervisory Control and Data Acquisition
SFRA	Strategic Flood Risk Assessment
SuD <sub>s</sub>	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
WCS	Water Cycle Study

## Annual Exceedance Probability (AEP)

The severities of the events discussed in this report are defined mainly as Annual Exceedance Probabilities (AEP). The AEP is the probability that there will be an event exceeding a particular threshold.

Annual Exceedance Probability	Probability (chance in any given year)
50%	1 in 2
10%	1 in 10
4%	1 in 25
3.3%	1 in 30
2%	1 in 50
1.33%	1 in 75
1%	1 in 100
0.5%	1 in 200
0.4%	1 in 250
0.1%	1 in 1000

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# Executive Summary

Atkins has been commissioned by the Partnerships for Renewables Development Company Limited (PfR) to complete a Level 2 Flood Risk Assessment (FRA) for the proposed development of a wind turbine at the British Waterways landholding at Sharpness Docks. The purpose of the proposed development is the generation of renewable electricity from one wind turbine capable of generating between 3.28 and 5.47 GWh of electricity per year. There is potential that the development could displace approximately between 1,412 and 2,354 tonnes of carbon dioxide emissions per year (Partnership for Renewables, 2011).

The proposed development site covers an area of just over one hectare, and therefore in line with current policy, namely Planning Policy Statement 25: Development and Flood Risk (PPS25) a site specific Flood Risk Assessment (FRA) is required. PPS25 states that a FRA must be appropriate to the scale and nature of the development and therefore it has been determined that a Level 2 FRA is appropriate for the proposed development. This Level 2 FRA provides a qualitative appraisal of flood risk to the site and scopes any potential mitigation measures to ensure that the development has an acceptable level of flood risk and will not increase flood risk to neighbouring sites.

In accordance with Table D.2: Flood Risk Vulnerability Classification of PPS25, the proposed wind turbine development is classed as 'Essential Infrastructure'. It is identified from the Strategic Flood Risk Assessment (SFRA) and Environment Agency mapping that the proposed development would be located within Flood Zone 1 (low risk from tidal and fluvial flooding). This has been confirmed by a comparison between flood levels and site topography, as requested by the Environment Agency. The flood mapping provided within the SFRA suggests that the site is potentially within a dry island, although this is contradicted by the Environment Agency mapping and the comparison of flood levels and topographic data. In any case, following correspondence with the Environment Agency it was determined that the potential location in a dry island would not cause any restrictions/requirements for the proposed development. Therefore in line with PPS25 the proposed development would be suitable based on the fluvial/tidal flood risk.

The proposed development includes a minimal increase in impermeable area on site and therefore would not cause a significant increase in surface water flood risk, either to the site or surrounding areas.

The site is currently at a low risk from groundwater flooding and the proposed development would not cause a significant impact on groundwater movements, thus the development will not cause an increased flood risk from this source.

There are no other significant sources of flood risk to site.

Climate change has the potential to cause an increase in flood risk. However this is likely to be minimal over the life time of the development.

It can be concluded from this FRA that the proposed development is suitable, has an acceptable level of flood risk and will not increase flood risk to neighbouring sites. However it is recommended that the potential for groundwater flooding within the excavations required for the wind turbine foundations should be considered prior to construction and any mitigation measures identified.

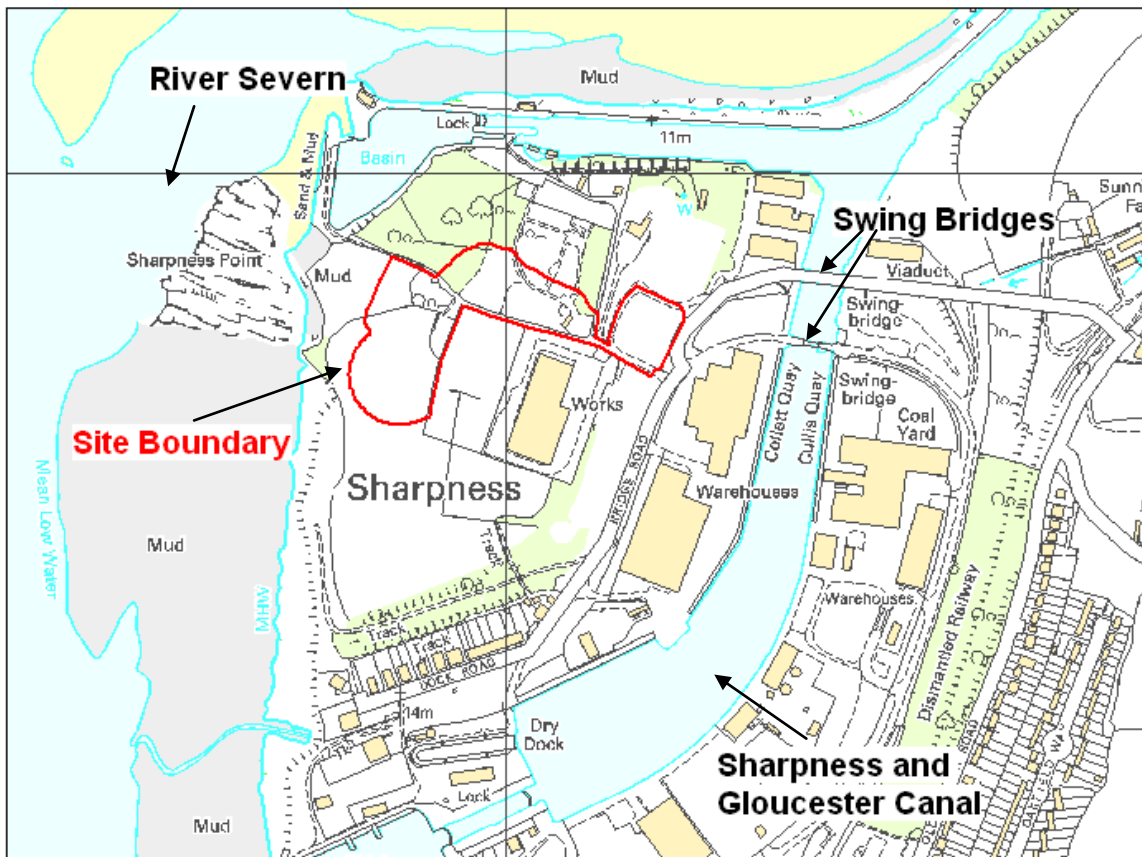
# 1. Introduction

## 1.1. Background

Atkins has been commissioned to complete this Level 2 Flood Risk Assessment for the proposed wind turbine development at Sharpness Docks, within Gloucestershire (Grid Ref SO668027). It is necessary that this FRA is completed for the proposed development to ensure that flood risk has been adequately addressed. This FRA will accompany the environmental statement and planning application to be submitted for the proposed development.

## 1.2. Site Proposals

The proposed development site is located on grassland within an island. The River Severn forms the western and northern boundaries of the island and the Sharpness and Gloucester canal for the eastern and southern boundaries. This island is connected to the other side of the canal by two swing bridges. The site location on this island is shown in Figure 1.1



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Figure 1.1 – Proposed site boundary

It is proposed that the wind turbine will be in operation for 25 years, after which time it is likely that it will be decommissioned and removed (impermeable areas will be broken up). In addition to the erection of the wind turbine, the development will include one crane pad adjacent to the turbine, on-site access tracks, temporary construction works, and an electricity sub-station with underground cabling.

It is proposed that the wind turbine will be controlled by a 'supervisory control and data acquisition' system (SCADA) which allows the wind turbine to be controlled from a central location, remote from the proposed site.

It is proposed that the wind turbine will be installed on reinforced concrete foundations, established on suitable load bearing strata (following excavation) or on pilings depending on ground conditions. The concrete foundations are typically circular with a diameter of approximately 16 meters to a depth of

approximately 3 meters. Post construction the foundations will be hidden below the surface by ground restoration. In addition a temporary working area around the foundations is required.

The crane pad located adjacent to the wind turbine will be hard standing comprising of crushed, water permeable aggregate. The primary purpose of the crane pad will be for the erection of the wind turbine, however it will remain in place following the construction stage for maintenance purposes.

It is proposed that the total area of hard standing, including the turbine foundations and the crane pad will be approximately 0.36 hectares.

To provide access to the wind turbine a new and ungraded site track will be constructed to accommodate general construction traffic.

In addition to the permanent works, temporary works are also required for the proposed development. Specifically this includes the construction of a site compound, which will occupy an area of approximately 2555 m<sup>2</sup>. This construction compound will accommodate all the required welfare facilities. There may also be the need for additional compounds to ensure the security of plant equipment, although the compounds will be defined by fencing alone and there will be no need to change the ground conditions of such compounds.

During the operational phase of the development the turbine will require servicing. It is likely that the servicing will be carried out twice a year, with a main service at 12 monthly intervals and a minor service at six monthly intervals. It is predicted that each service would take place over one day and would require on average two people.

### 1.3. Scope

It was highlighted in the Sharpness Scoping Report (Partnership for Renewables, 2011) that a qualitative assessment of flood risk is required for the proposed development. A Level 2 FRA provides a qualitative appraisal of flood risk issues relating to a proposed development.

In line with Planning Policy Statement 25: Development and Flood Risk (PPS25) (Department for Communities and Local Government, 2010) and its practice guide (Communities and Local Government, 2009) this Level 2 FRA determines the flood risk to the site; any changes in flood risk as a result of the proposed development; and potential mitigation measures that may be required.

For the purposes of the Level 2 FRA, numerous sources of data have been collected and utilised. This includes readily available information including the Gloucestershire Strategic Flood Risk Assessment (SFRA) (Gloucestershire County Council, 2008) and the Environment Agency Flood Maps and Standing Advice. The Environment Agency has also been consulted to agree their requirements for the development in relation to flood risk (per comms 21/09/11, Appendix A). In addition and in line with general practice for a Level 2 FRA, site specific data has been obtained from the Environment Agency (Appendix A).

## 2. Policy Context

PPS25 (Communities and Local Government, 2010) is the overarching document in relation to development and flood risk and sets out the Government's policy on development relating to flood risk. The aim of PPS25 is to ensure that new development is not at an unacceptable risk of flooding by steering development to areas at lowest risk. Where development is unavoidable in areas at risk from flooding, PPS25 ensures that the development is safe without increasing flood risk elsewhere and where possible reducing flood risk overall.

In accordance with PPS25 proposed development sites greater than one hectare and those which fall within either Flood Zone 2 or 3 require the submission of a FRA with the planning application. The proposed development (as shown within the red line boundary on Figure 1.1) covers an area slightly larger than two hectares and thus this FRA is required in line with PPS25.

### 2.1. Flood Zone Classification

PPS25 outlines four Flood Zone classifications of which three have been utilised by the Environment Agency in the creation of their Flood Map. These Flood Zones should be used for determining the appropriateness of a proposed development in relation to flood risk and when applying the Sequential Test. They represent flooding without flood defences in place.

The Flood Zones are defined as:

- Flood Zone 1 – Areas with a 'Low Probability' of flooding and where the annual probability of flooding is lower than 0.1% for either fluvial or sea flooding. PPS25 imposes no constraints upon the type of development within Flood Zone 1.
- Flood Zone 2 – Areas with a 'Medium Probability' of flooding and where the annual probability of flooding is between 0.1 and 1.0% for fluvial flooding or between 0.5 and 0.1% for sea flooding. PPS25 recommends that Flood Zone 2 is suitable for most types of development with the exception of 'Highly Vulnerable' (see Table 2.1) land uses.
- Flood Zone 3 – Areas with a 'High Probability' of flooding and where the annual probability of flooding is 1.0% or greater for fluvial flooding or 0.5% or greater for sea flooding. PPS25 recommends that appropriate development is based upon a further classification of Flood Zone 3 into 3a High Probability and 3b Functional Floodplain (where water has to flow or be stored in times of flood).

PPS25 classifies the proposed development of the wind turbine as 'Essential Infrastructure' (see highlighted cells and bold text in Table 2.1). This classification is based on Table D2: Flood Risk Vulnerability Classification, within Annex D of PPS25 and is included within this FRA as Table 2.1.

Table 2.2 demonstrates where development, based on the vulnerability classification shown in Table 2.1 is suitable, unsuitable and when the Exception Test is required. It can be seen from this table that the proposed development would be suitable.

**Table 2.1 – Vulnerability Classification taken from PPS25**

Land Use Vulnerability	Type of Development
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure, which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. <b>Wind turbines.</b>
Highly Vulnerable	Police Stations, Ambulance Stations, and Fire stations, Command Centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent.
More Vulnerable	Hospitals. Residential institutions such as care homes, children's homes, social services homes, prisons and hostels. Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. Non-residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short let caravans and camping, subject to specific warning and evacuation plans.
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for: shops, financial, professional, and other services; restaurants and cafes, hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except for landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment plants which do not need to remain operational during times of flood. Sewage treatment plants (if adequate pollution control measures in place).
Water Compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and Gravel workings. Docks, Marinas and Wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water based recreation (excluding sleeping accommodation). Lifeguard and coastguard operations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to specific warning and evacuation plans.

**Table 2.2 – Appropriate Development for each Flood Zone (based on Table D3 of PPS25)**

Flood Risk Vulnerability Classification (see Table D2 of PPS25)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D1 of PPS25)	Zone1 Low Probability	✓	✓	✓	✓	✓
	Zone2 Medium Probability	✓	✓	Exception Test required	✓	✓
	Zone 3a High Probability	Exception Test required	✓	x	Exception Test required	✓
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	x	x	x

✓ Development is appropriate

x Development should not be permitted

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## 2.2. Sequential Test

PPS25 states that the Sequential Test should be carried out when allocating land for development to demonstrate that there are no sites available for development in areas that are at a lower risk from flooding from all sources. When an area is at risk from either fluvial or coastal flooding then development should be located outside Flood Zones 2 and 3 where possible. If however, there are no reasonable sites for development within Flood Zone 1 then depending upon flood vulnerability, proposed development sites could be allocated in Flood Zones 2 or 3. The Sequential Test should be based on flood risk maps provided in a SFRA in preference to the Environment Agency Flood Zone mapping.

In addition it can be seen from both the SFRA and Environment Agency mapping that the proposed site is fully located within Flood Zone 1 and hence is at a low risk from tidal/fluvial flooding. This has been confirmed through the comparison of topographic data and flood levels provided by the Environment Agency (Section 3). As the site is within Flood Zone 1, it is recommended that the proposed development is sequentially acceptable.

## 2.3. Exception Test

Occasionally it is not possible to locate development in areas that are at the lowest risk of flooding through the Sequential Test. In certain circumstances the Exception Test can be carried out, which, if passed will allow development to go ahead.

The proposed development is fully located within Flood Zone 1 and therefore in line with PPS25 the development is deemed to be suitable. As a result there is no requirement to demonstrate a passed Exception Test.

## 3. Assessment of Flood Risk

### 3.1. Overview

PPS25 (Communities and Local Government, 2010) states that flood risk from all sources must be addressed within the FRA to ensure that potential flood risk has been considered during the development design and proposed works. This section therefore, outlines all the potential sources of flood risk to the site, and the implications these risks have on both the development and neighbouring sites. It is also necessary to outline any records of previous flooding events as these may identify areas vulnerable to flooding.

### 3.2. Historic Flooding

The SFRA (Gloucestershire County Council, 2008) outlines a number of incidents of historical flooding within Gloucestershire. Historical flood extents from two events, July 1968 and December 1981, indicate that the proposed site was only inundated during the earlier of these events. It appears that inundation during this event occurred as a result of high water levels in the River Severn, which is tidally dominated at this location. Given the location of the site however, within Flood Zone 1 there is uncertainty as to the quality of the 1968 flood extent. In addition there is no mention to this potential flood event within the information supplied by the Environment Agency.

The SFRA mapping also indicates locations that have experienced flooding from other sources including impounded water bodies, artificial drainage, surface water and fluvial. There are however no records of flooding occurring within the site boundary or in adjacent areas from these sources.

The data obtained for this assessment from the Environment Agency also states that there have been no records of groundwater flooding to the site.

### 3.3. Fluvial and Tidal Flooding

The Environment Agency flood zone maps, freely available from the Environment Agency website, are the initial data source used to determine the tidal and fluvial flood risk to a site. The Environment Agency Flood Zones are shown on Figure 3.1. It can be seen from this figure that the site is fully located within Flood Zone 1, although the western border is adjacent to Flood Zones 2 and 3.

Following correspondence with the Environment Agency (per comms 21.09.11) it was identified that the primary source of flood risk to the areas surrounding the site is tidal, because the River Severn is tidally dominated at this location. The Environment Agency Flood Zone 3, as shown in Figure 3.1 therefore represents the area at risk during the 0.5% AEP tidal event.

PPS25 states that where a proposed development site is covered within an SFRA, the SFRA mapping should be utilised in preference to mapping freely available from the Environment Agency. Figure 3.2 shows the extent of the SFRA Flood Zones in proximity to the site.

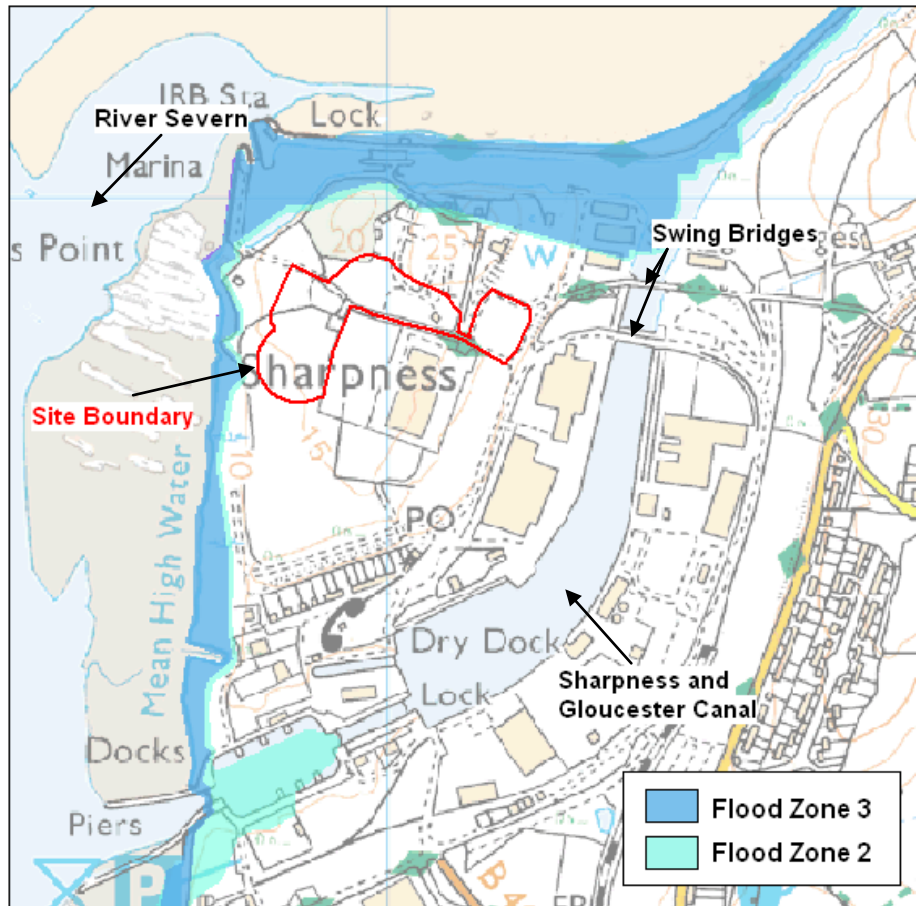
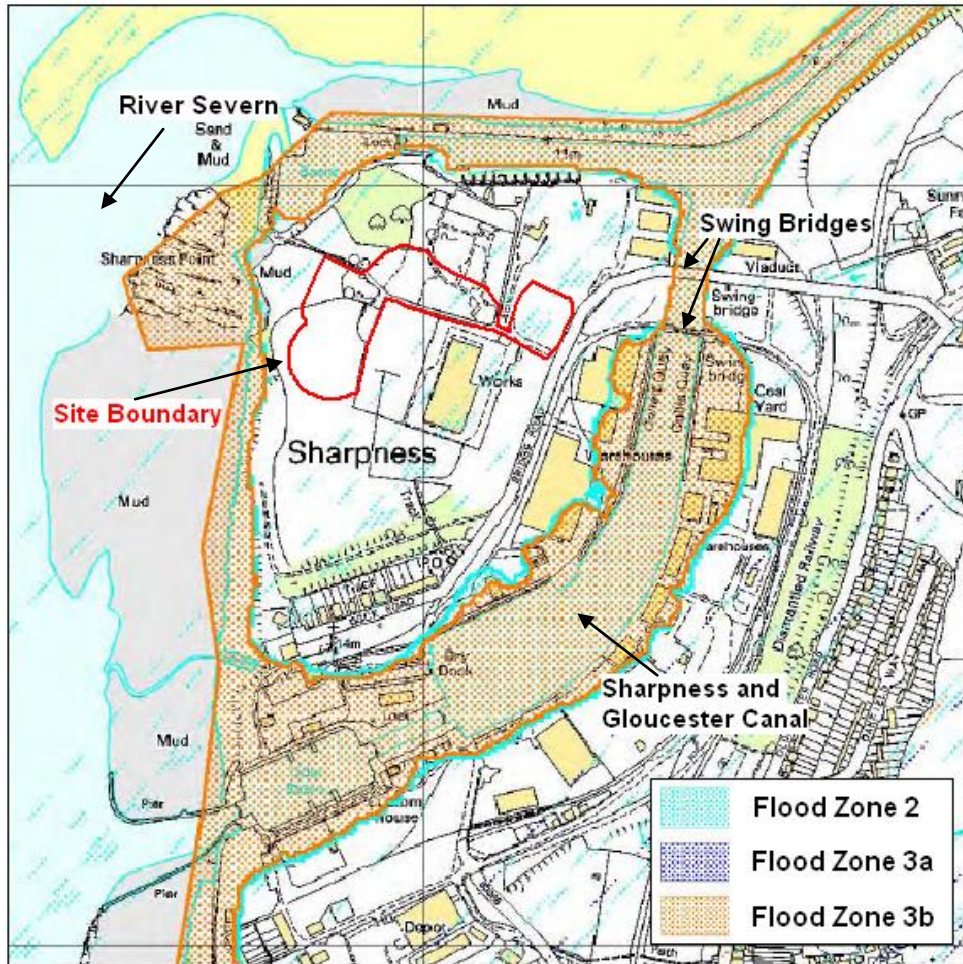


Figure 3.1 – Environment Agency Flood Zone extents



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**Figure 3.2 – SFRA Flood Zone extents**

As shown in Figure 3.1 and Figure 3.2, the Environment Agency and the SFRA mapping indicate that the site is within Flood Zone 1 and thus is at a low risk from flooding. The SFRA mapping however, unlike the Environment Agency mapping, indicates that the site is located within a dry island. Correspondence with the Environment Agency (per comms 21.09.11) has concluded that given the type of development being proposed, the site location would still be acceptable.

The Environment Agency (per comms 21.09.11) has however, requested that a comparison between flood levels and topographic data is undertaken to confirm the location of the site within the Flood Zones.

The Environment Agency has provided modelled flood levels at the location of the site for various annual exceedance events and for both tidal and fluvial flooding. The flood levels in the vicinity of the site are at a higher elevation for tidal flood events in comparison to fluvial event, thus providing confirmation that flood risk resulting from the River Sever is tidally dominated in this area. The tidal flood levels have been compared to topographic data (captured using Interferometric synthetic aperture radar, IfSAR). The flood levels as provided by the Environment Agency are shown in Table 3.1 and represent the various tidal annual exceedances combined with a 20% AEP fluvial event.

**Table 3.1 – Tidal flood levels as provided by the Environment Agency**

	1.3% AEP	1% AEP	0.5% AEP	0.5% AEP with climate change allowance	0.1% AEP
Flood Level (mAOD)	9.88	9.92	10.01	10.29	10.14

The lowest elevation within the site boundary is at 13.05 mAOD and therefore using the values presented within Table 3.1 it can be confirmed that the site is located within Flood Zone 1. Even though IfSAR topographic data is not considered to be as accurate ( $\pm 0.5\text{m}$ ) as either surveyed levels or LiDAR, it can be

seen from Table 3.1 that there is a significant difference between ground elevations and flood levels (2.91m for the 0.1% AEP event) to confirm that the site is not at risk.

The topographic data was also utilised to determine whether the site is located within a dry island and hence whether mitigation measures would be required. Following inspection of the topographic data it can be seen that as long as the two bridges (namely the Swing-Bridges) across the canal are in operation, then dry access and egress is possible and hence the site would not be located within a dry island.

The comparison of flood levels and topographic data has further validated the conclusion that the site is suitable for the proposed development, without the need for any mitigation measures.

The data provided by the Environment Agency also included the requirement for consent if any works were to be carried out within 8 m of river banks or within the floodplain. The proposed development and areas required for the movement of plant equipment are neither within 8 m of the river banks or the floodplain and hence consent in line with the Environment Agency byelaws or the Water Resources Act 1991 is not required.

### **3.3.1. Flood Defence**

Information freely available on the Environment Agency website indicates that there are no schemes for flood and coastal risk management (maintained by the Environment Agency, Local Authority or an Internal Drainage Board) located in adjacent areas to the proposed development site. This was confirmed through consultation with the Environment Agency details of which are provided within Appendix A.

## **3.4. Surface Water Flooding**

Surface water flooding occurs when rainfall intensities exceed the infiltration or formal drainage capacity such that water collects on the ground surface. There is a greater risk of flooding from this source within urbanised areas where there is a higher proportion of impermeable surfacing. Similarly, areas located on heavy clay soils are also more likely to be prone to surface water runoff problems.

Currently the proposed site has a permeable surface and there have been no reports of historical surface water flooding within the site boundary. As a result, it is likely that the site has a low risk from surface water flooding. Where developments include the replacement of permeable with impermeable surfacing, the flood risk from this source may increase and impact on both the site and neighbouring sites. If there is potential for surface water flood risk to increase as a result of a development, it is required that adequate surface water management is put in place to mitigate the potential risks.

As identified within the development scoping report (Partnership for Renewables, 2011) it is proposed that the majority of the 16m diameter turbine foundation, which will be constructed from concrete, will be covered by topsoil and hence will cause a minimal impact on surface water runoff. The proposed crane pad will be constructed from crushed aggregate that will allow infiltration during rainfall event and hence will not act as an impermeable surfacing. Similarly the access road will also allow for infiltration and thus will not cause an increase in surface water runoff rates. Therefore the proposed development will cause a minimal impact on surface water flood risk (if at all) and thus Sustainable Drainage Systems (SuDS) would not be required.

It is concluded that the surface water flood risk to the site and as a result of the development is low, however if ponding is experienced during the construction phase a drainage system may be required. Within the development scoping report (Partnership for Renewables, 2011) it is proposed that where ground conditions are suitable (i.e. permeable to allow infiltration), swales will be utilised for drainage, to allow natural infiltration of surface runoff to the ground. In areas which are less free draining and where site topography permits, it is proposed that either land drains or drainage ditches are installed. In addition it is proposed that at suitable locations drainage filters will be installed to filter silts and reduce flow rates. If swales (or other infiltration methods) are proposed infiltration tests must be carried out in accordance to BRE 365 to ensure that the method is suitable based on the soil type and geology in the area.

## **3.5. Groundwater Flooding**

Groundwater flooding normally occurs where the water table meets the ground surface in low lying areas which are underlain by permeable rock known as aquifers. This tends to follow long periods of sustained rainfall, but can also be caused as a result of local obstructions to groundwater flow (e.g. following the placement of engineering structures or buildings with foundations) or by the rebound of groundwater levels after a decrease in abstraction or dewatering.

Groundwater tends to flow from areas where ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, so the additional groundwater flowing towards these areas can cause the water table to rise up to the surface causing groundwater flooding.

Groundwater flooding typically takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground. The rate at which it recedes depends on the lithology of the aquifer and the magnitude of the event, but may take weeks or even months.

It is important to recognise the risk of groundwater flooding is typically highly variable and heavily dependent on local geological, topographical and weather conditions. Groundwater flooding is hard to predict and challenging to mitigate.

The BGS Map Sheet 234 was used to consider the geological setting of the site. The site is underlain by the Raglan Mudstone Formation which consists of siltstone and mudstone. The site is also partially underlain with sand and gravel superficial deposits which are located along the western boundary and the eastern area of the site (specifically the location of the crane pad and wind turbine foundations).

The Environment Agency do not have any observation boreholes within 5 km of the site and thus no measure of geological depth or groundwater levels have been available for review as part of this FRA. Ground investigation will therefore be required to inform the design and construction of the turbine foundations.

As shown on the mapping freely available from the Environment Agency, the underlying area of the site is classed as a Secondary A Aquifer within an intermediate groundwater vulnerability zone. The Environment Agency define a Secondary A Aquifer as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Similarly the Environment Agency mapping indicates that the superficial deposits are also classed as a Secondary A Aquifer. Therefore it is likely that superficial deposits, and hence the western boundary and eastern area of the site, are in hydraulic connectivity to the River Severn. Where geology is in hydraulic connectivity with a watercourse the result can be a high water table during periods of high river levels which may amplify the speed and extent of flooding. However the entire site is identified to be at a low risk from tidal/fluvial flooding and hence this impact is likely to be low.

In addition it can be seen from the Environment Agency mapping that the site is not located within a groundwater source protection zone.

Any development below the existing ground level has the potential to be at a higher groundwater flood risk as it will be closer to the groundwater table. In addition there is potential that such development may interrupt normal groundwater movements causing an increase in groundwater flood risk elsewhere.

The only part of the proposed development which will be significantly below existing ground levels are the wind turbine foundations that will have a diameter of approximately 16 metres and have an approximate depth of 3 metres. Given the size and depth below ground level it is unlikely that the development will result in an increase groundwater risk elsewhere. No information is currently available in relation to the ground water table and therefore the potential for groundwater flooding within the excavation required for the foundations should be considered prior to the construction phase.

### **3.6. Other Sources of Flooding**

The Gloucester and Sharpness Canal is located in close proximity to the southern and eastern boundaries of the development site. For the purposes of the SFRA, British Waterways were consulted and it was determined that there had only been one incident of flooding from this source, however this event did not cause inundation to either the site or adjacent areas. In addition to the historical evidence, the topography of the land around the site would suggest that the proposed development would be at a low risk of flooding from the canal.

Information freely available on the Environment Agency website has also determined that the site is not at risk of flooding from reservoirs.

There are no other known sources of flooding that pose a risk to the development site.

### 3.7. Climate Change

As a result of climate change flood risk is likely to increase.

shows the predicted changes in peak rainfall intensity and peak river flow. These values should be considered during an assessment of flood risk for the lifetime of the development, which in this case would be 25 years.

**Table 3.2 – Impact of Climate Change. Taken from Table B.1 and B.2, PPS25**

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak Rainfall Intensity	+5%	+10%	+20%	+30%
Sea Level Rise (mm/yr)	3.5	8.0	11.5	14.5
Peak River Flow	+10%	+20%		

Even though the proposed development site is located within Flood Zone 1, adjacent areas are located within Flood Zones 2 and 3. As a result there is potential that tidal flood risk to the site will increase as a result of climate change. The SFRA mapping indicates the predicted changes in Flood Zones 3a and 3b as a result of 100 years of climate change are minimal and that the development site will remain outside Flood Zone 3 taking climate change into account. Through the comparison of Environment Agency flood levels in the vicinity of the site and topographic data, it can be confirmed that the site falls outside Flood Zone 3 with an allowance for climate change. Flood levels for Flood Zone 2 with an allowance for climate change were not available and hence an accurate comparison with topography cannot be made. However given the relatively small increase for Flood Zone 3 it is possible the site remains outside Flood Zone 2 with an allowance for climate change.

As rainfall intensities increase, there is potential that surface water flood risk will increase. However the total impermeable area on site will be minimal and hence it is predicted that the surface water flood risk will remain low over the lifetime of the development.

The future risk from groundwater is more uncertain than surface water as the climate change predictions indicate that although sea levels will rise, thus possibly raising groundwater levels, overall summer rainfall will decrease, therefore having a long term effect of lowering the groundwater levels. However, long periods of wet weather, such as those experienced in the autumn and winter of 2000/2001 are predicted to increase. These are the type of weather patterns that can cause groundwater flooding to occur. Thus determining the effect climate change will have on groundwater flooding is uncertain. However given the minimal increase predicted for flood levels as a result of climate change it is likely that the increase in groundwater flood risk would also be minimal.

There are no other sources of flood risk to the site and as such the impact of climate on other sources has not been considered within this FRA.

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## 4. Conclusions and Recommendations

### 4.1. Conclusions

There are a number of conclusions that can be made from this Level 2 FRA, these are as follows:

- 1) The proposed development is classed as Essential Infrastructure in line with PPS25;
- 2) The development site is located within Flood Zone 1 and assuming the bridges across the canal (the Swing-Bridges) remain operational the site is not located within a dry island;
- 3) In line with PPS25; the development classification and its location within the Flood Zones are considered suitable based on fluvial and tidal flood risk;
- 4) The proposed development will result in a minimal increase in impermeable area on site and hence surface water flood risk. Therefore there is no requirement for SuDS to be incorporated into the detailed design of the development;
- 5) The site is at a low risk from groundwater flooding;
- 6) The site is located in close proximity to the Gloucester and Sharpness Canal. However historical records and site topography indicate that the proposed development is at a low risk of flooding from this source;
- 7) There are no other known sources of flood risk to the site;
- 8) It is proposed that the life time of the development would be 25 years after which the wind turbine would be decommissioned and removed. During this period the increase in flood risk, from all sources, as a result of climate change will be minimal;
- 9) Floodplain compensation is not required as part of the development; and
- 10) Consent in line with the Environment Agency Bylaws or the Water Resources Act is not required as development and plant movement is not proposed within either 8m of the river bank or in the floodplain.

### 4.2. Recommendations

There are a number of recommendations that can be made from this Level 2 FRA, these are as follows:

- 1) The proposed development is considered acceptable in line with the requirements of the PPS25 Sequential Test; and
- 2) The potential for groundwater flooding within the excavations required for the wind turbine foundations should be considered prior to construction and any mitigation measures identified.

---

## 5. Bibliography

Communities and Local Government. (2010). *Planning Policy Statement 25: Development and Flood Risk*.

Communities and Local Government. (2009). *Planning Policy Statement 25: Development and Flood Risk Practice Guide*.

Department for Communities and Local Government. (2010). *Planning Policy Statement 25: Development and Flood Risk*.

Gloucestershire County Council. (2008). *Gloucester Strategic Flood Risk Assessment. Completed by Halcrow on behalf of Gloucester County Council*.

National SuDS Working Group. (2004). *Interim Code of Practice for Sustainable Drainage Systems*.

Partnership for Renewables. (2011). *Sharpness Dock Wind Energy Development. Scoping Report*.

# Appendices

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## A. Correspondence with the Environment Agency

## Tilbrook, Elizabeth

---

**From:** Foulds, John [john.foulds@environment-agency.gov.uk]  
**Sent:** 22 September 2011 15:39  
**To:** Tilbrook, Elizabeth  
**Subject:** RE: Planning advice for a wind turbine development

Liz

Thank you for your email regarding the above I can confirm the following;

We have no objections in principle to the location of a wind turbine in Flood Zone 1 even if the site becomes isolated by flooding, as a single turbine is not considered as essential infrastructure but would compliment existing supplies, therefore while the risk should be highlighted within the FRA this would be solely from an operational perspective.

I can confirm that the area is not protected by any formal flood defences.

Flood levels for the modelled 1 in 200 year tidal/1 in 5 year fluvial event (including an allowance for climate) are available for this location and can be obtained by forwarding a request to our external relations team at the following email address;

[midswest@environment-agency.gov.uk](mailto:midswest@environment-agency.gov.uk)

There may be a small charge for this information.

I hope the above is adequate.

Regards

John

### John Foulds

Development & Flood Risk Engineer  
Midlands Region  
West Area

Direct Tel No. 01684 864352

Riversmeet House, Northway Lane, Newtown Industrial Estate, Tewkesbury, Gloucestershire, GL20 8JG



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---

**From:** Tilbrook, Elizabeth [mailto:Elizabeth.Tilbrook@atkinsglobal.com]  
**Sent:** 21 September 2011 10:45  
**To:** Foulds, John  
**Subject:** Planning advice for a wind turbine development

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John,

Thank you for your advice earlier today in regards to the proposed development of a wind turbine in Sharpness. Please can I confirm that I have the correct understanding of the points discussed and the Environment Agency requirements in relation to the FRA.

Firstly, because the development is for a wind turbine which would not be classed as critical infrastructure, there are no concerns that the site is potentially located within the a dry island. Therefore there are no specific requirements (such as mitigation) required for incorporation within the development in respect to the sites potential location within a dry island.

Secondly that there are no raised defences which may have implications on the development.

And thirdly that flood levels are available for the River Severn in proximity to the site. These levels can be used in comparison to the site levels to define the Flood Zone extents on a site specific basis for the development. I have now submitted a data request to external relations to obtain these levels.

If you could respond to let me know whether you agree with the above it would be much appreciated.

Kind regards  
Liz

**Liz Tilbrook (BSc, MSc)**  
Assistant Hydrologist, Rivers and Coastal

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## Tilbrook, Elizabeth

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**From:** Weston, Matthew [Matthew.Weston@environment-agency.gov.uk]  
**Sent:** 07 October 2011 13:58  
**To:** Tilbrook, Elizabeth  
**Subject:** ERW/756: Flood Risk information and Environment Search for a proposed wind turbine in Sharpness, Gloucestershire.  
**Attachments:** Standard Notice 2011.doc.pdf; Guidance for Developers Note Dec 09 Tewkesbury.doc; FRA Advisory text.pdf

ERW/756  
07 October 2011

Dear Elizabeth Tilbrook

**Flood Risk information and Environment Search for a proposed wind turbine in Sharpness, Gloucestershire. NGR: SO 66871 02771.**

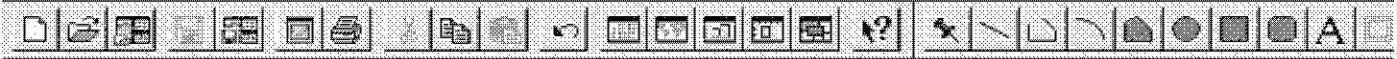
Thank you for your request of 21 September 2011 to use Environment Agency data, in the development of the flood risk assessment (FRA) for a proposed wind turbine in Sharpness, Gloucestershire. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments.

This information is provided subject to the enclosed Standard Notice, which you should read.

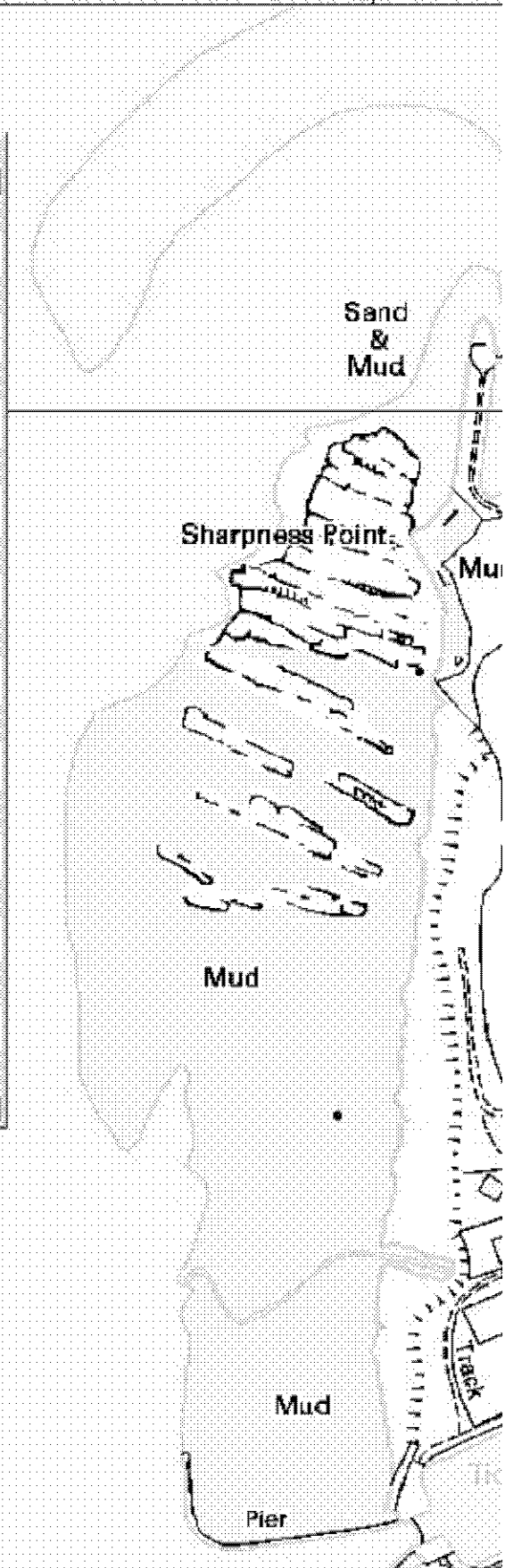
**Supporting Information:**  
**Flood Map**

Please find below an extract of the Environment Agency Flood Map.



Info Tool	
NODE:	62
X:	366,694
Y:	202,481
Flow_5yrF_75yrT:	22,117.8
Level_5yrF_75yrT:	9.88
Flow_5yrF_100yrT:	22,295.9
Level_5yrF_100yrT:	9.92
Flow_5yrF_200yrT:	22,513.6
Level_5yrF_200yrT:	10.01
Flow_5yrF_200yrT_CC:	25,342.3
Level_5yrF_200yrT_CC:	10.29
Flow_5yrF_1000yrT:	25,297.3
Level_5yrF_1000yrT:	10.14
Flow_75yrF_2yrT:	20,760.7
Level_75yrF_2yrT:	9.41
Flow_100yrF_2yrT:	20,760.7
Level_100yrF_2yrT:	9.41
Flow_100yrF_2yrT_CC:	25,345.1
Level_100yrF_2yrT_CC:	9.77
Flow_200yrF_2yrT:	20,829.1
Level_200yrF_2yrT:	9.41
Flow_1000yrF_2yrT:	25,046.7
Level_1000yrF_2yrT:	9.42

\_1D ISIS In Channel Results



## **Flood Defences**

There are no Environment Agency maintained flood defences in the <place name> area and no information is available for the standard of protection offered by other flood defences or natural channels to this area.

## **Development & Flood Risk**

### Site Development

We would expect any new development to incorporate Sustainable Drainage (SuDs) techniques. These may include:

- preventative measures (e.g. rainwater harvesting, recycling, good practice design and maintenance)
- the use of permeable surfaces (e.g. porous pavements)
- soakaways/infiltration ditches, conveyance swales, etc.
- detention and retention pools and wetland areas etc.

The application of these techniques has a number of advantages, which include:

- avoiding new or minimising existing localised flooding problems
- reducing pollution risk and improving the quality of run-off.
- encouraging groundwater recharge where land not contaminated.
- minimising disruption of existing drainage patterns
- enhancing the amenity and ecological value of developments by providing ponds, green swales, etc.

The adoption of these measures improves the sustainability of developments and may reduce costs to the developer as well as the overall costs to society of a new development. The design of features should include an allowance for climate change.

## **Water Quality – Chemical**

Some of our information, including river water quality and GQA chemical grading data for Rivers - can be found on our internet site at [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk).

Also, please look at the WFD River Basin Plan - again on our website - classification and objectives. Some useful links below.

<http://www.environment-agency.gov.uk/research/planning/33260.aspx>

<http://wfdconsultation.environment-agency.gov.uk/wfdcms/en/severn/Intro.aspx>

<http://www.environment-agency.gov.uk/homeandleisure/37793.aspx>

## **Groundwater - Geology**

The above site is located on Raglan Mudstone Formation which is Secondary A aquifer. At the grid reference given for this site (66871 02771) there appears to be no superficial deposits overlying the solid geology, however the mapping maybe inaccurate. There is a good possibility that either Holt Heath Member sands and gravels (Secondary A aquifer) may overlay the Raglan Mudstone in this location or tidal Flat deposits in the form of clay, silt and sand (Secondary undifferentiated) may overlay the Raglan Mudstone.

## **Groundwater - SPZ**

This site and is not within a Source Protection Zone.

We hold no information on groundwater levels within 5km of the site as unfortunately there are no groundwater observation boreholes in the near vicinity. It is likely that there will be perched groundwater within superficial deposits. Groundwater are likely to be shallow and may be subject to quite an amount of fluctuation due to the close proximity to the River Severn.

There are 5 deregulated groundwater abstractions within 5km of the site. The 2 on the same side of the estuary have GRs 3680, 2031 (18ft deep) and 3698, 2027 (15ft deep). The 3 on the other side of the estuary are 3664, 2053 (150ft deep), 36635 20460 (no depth info) and 3669 2076 (20ft deep).

There are 2 licensed groundwater abstractions: 3628, 2043 (groundwater issues from a mineshaft) and 36313, 20165 (60m deep). This latter borehole which is 60m deep was drilled in 1998 and is logged as 0-13.7m 'alluvium/clay' and 13.7m-60m 'sandstone'.

The British Geological Society (BGS) have got a greater dataset of boreholes as we only have information on licensed and deregulated abstractions. The BGS will be able to provide the borehole logs for the majority of their records, where as the Agency do not hold all of the borehole records as they aren't always submitted.

### **Flood Warning Service**

Your site may be covered by the Environment Agency's Flood Warning Service. If you are unsure and/or you wish to register for this free service please contact Floodline on Telephone: 0845 988 1188.

### **Future Planning Advice:**

This letter provides information on River Flooding only. It does not constitute a Flood Risk Assessment (FRA) or state that the site is not at risk from flooding. There are different forms of potential flooding that we do not hold records of.

The attached 'Guidance for Developers' note is to assist you with advice on when a FRA will be required, what it may need to consider, and who might prepare them. It also includes links to internet sources of information. If informal Planning advice on a draft FRA or development proposals is required please contact our **Planning Team** by e-mailing [westareaplanning@environment-agency.gov.uk](mailto:westareaplanning@environment-agency.gov.uk) with your information.

### **Future advice on the potential need for Flood Defence Consent or Surface Water requirements:**

If your proposal would involve works in any river or within 8 metres of the top of a main river bank or within the floodplain of a main river then permission may also be required from us before you start work. For advice on this please contact our **Development and Flood Risk Team** on telephone: 01743 283522 or by emailing [dfr.midswest@environment-agency.gov.uk](mailto:dfr.midswest@environment-agency.gov.uk)

This response contains answers to the specific questions contained in your correspondence. I hope this information meets your needs. If you need to discuss anything further please contact us at the address below.

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey - we use every piece of feedback we receive.  
<https://web.questback.com/isa/qbv.dll/SQ?q=8w2Qkfx%2BivseokDpT0B63BP0agrq9DGn8gYcey cBYJx1hQ%3D%3D>

Regards  
Matthew Weston  
External Relations Officer  
Midlands

[midswest@environment-agency.gov.uk](mailto:midswest@environment-agency.gov.uk)

Direct Dial: 01743 283412

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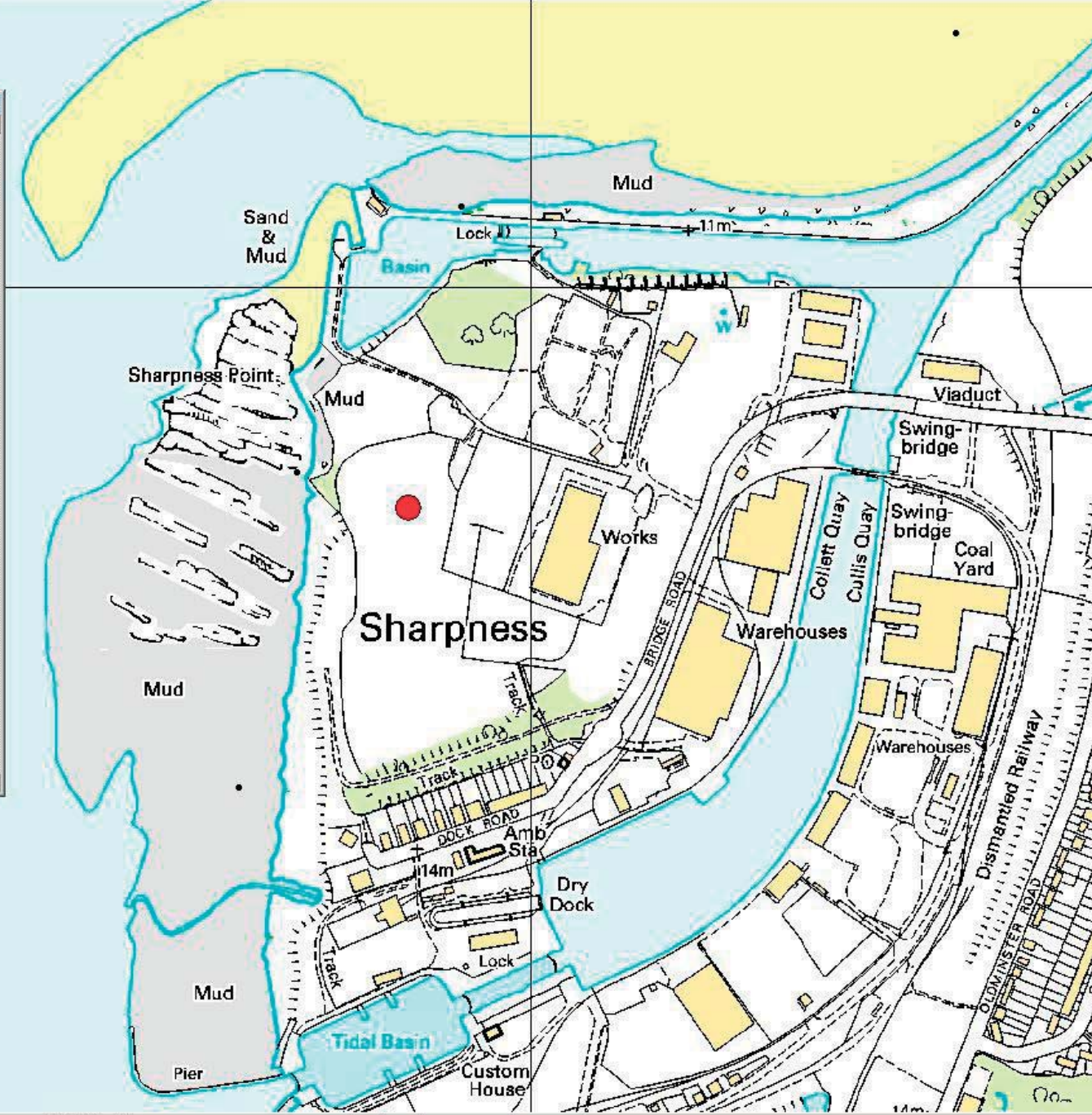
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Flow_5yrF_100yrT:	22,295.9
Level_5yrF_100yrT:	9.92
Flow_5yrF_200yrT:	22,513.6
Level_5yrF_200yrT:	10.01
Flow_5yrF_200yrT_CC:	25,342.3
Level_5yrF_200yrT_CC:	10.29
Flow_5yrF_1000yrT:	25,297.3
Level_5yrF_1000yrT:	10.14
Flow_75yrF_2yrT:	20,760.7
Level_75yrF_2yrT:	9.41
Flow_100yrF_2yrT:	20,760.7
Level_100yrF_2yrT:	9.41
Flow_100yrF_2yrT_CC:	25,345.1
Level_100yrF_2yrT_CC:	9.77
Flow_200yrF_2yrT:	20,829.1
Level_200yrF_2yrT:	9.41
Flow_1000yrF_2yrT:	25,046.7
Level_1000yrF_2yrT:	9.42

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## **Use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments**

### **Important**

If you have requested this information to help inform a development proposal, then you should note the following:

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice and PPS25 and its associated Practice Guide for information about what flood risk assessment is needed for new development in the different flood zones. These documents can be accessed via:

<http://www.environment-agency.gov.uk/research/planning/82587.aspx>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide>

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

In **Wales**, you should refer to TAN15 for information about what flood consequence assessment is needed for new development in the different flood zones

<http://new.wales.gov.uk/topics/planning/policy/tans/tan15?lang=en>

You should also refer to any Strategic Flood Consequence Assessment produced by your local planning authority.

In **both England and Wales** you should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a flood risk or flood consequence assessment (FRA/FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires a FRA/FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with the local planning authority.

***This note provides guidance on environmental planning and regulatory issues, and may be of use at a pre-application/application stage and for the lifetime of your activities. It is not exhaustive, and if you have any other queries please contact the Environment Agency (EA) on 08708 506506 for further assistance.***

### **Flooding and Flood Risk Assessments (FRAs)**

You can obtain information on which 'flood zone' your site is located in via <http://www.environment-agency.gov.uk> Planning Policy Statement 25 (Development and Flood Risk) (PPS25) provides very important guidance on consideration of fluvial, tidal and surface water flood risk. It includes information on climate change (Appendix B); the Sequential & Exception Tests and vulnerability of land use types (Appendix D); preparation of FRAs (Appendix E).

FRAs must assess the risks of fluvial, surface water and other sources of flooding. Sustainable Drainage Systems (SuDS) should be included in development wherever possible to reduce surface water run-off. (This also helps with protecting water quality and adding amenity value to development.) For guidance: <http://www.ciria.org.uk/suds/>

Standing advice can be viewed at: <http://www.environment-agency.gov.uk/> (search for 'FRSA'). In this Area, we are using a local version of the standing advice which means we may not be consulted on flood risk matters by the Local Authority or provide detailed application or pre-application flood risk comments on some types of development (such as development less than 5 hectares which is not in the floodplain). This does not negate the need to submit FRAs for consideration by the Local Authority. To request pre-application advice on FRAs please contact our Area Planning Team at [westareaplanning@environment-agency.gov.uk](mailto:westareaplanning@environment-agency.gov.uk)

You might also contact Local Authority Land Drainage engineers to determine any localised flooding problems from ordinary watercourses within the vicinity of your proposals, and to confirm that proposed surface water disposal would not cause or exacerbate flooding. Where we do not offer advice on FRAs we may have flood level data to assist in preparing a FRA: This information may be provided for a fee from our Area External Relations Team on 08708 506506, [midswest@environment-agency.gov.uk](mailto:midswest@environment-agency.gov.uk) For information: we do not recommend individual FRA consultants but the following website link is provided to help you to source a suitably qualified person <http://www.ciwem.org/directory/index.asp>

### **Land Contamination**

Planning Policy Statement 23: Planning and Pollution Control (PPS23) takes a precautionary approach to land contamination. Before the principle of development can be determined, land contamination should be investigated to see whether it could preclude certain development due to environmental risk or cost of clean up (remediation).

Where contamination is known or suspected, a desk study, investigation, remediation and other works may be required to enable safe development. (Table 2.1 in Annex 2 of PPS23 gives examples of potentially contaminating uses of land <http://www.communities.gov.uk/documents/planningandbuilding/pdf/pps2annex2> ). As guided by PPS23, our minimum requirements for submission with a planning application are a desk study and preliminary risk assessment, such as a site walkover or conceptual model. Site Investigation and Remediation Strategy reports may be required for submission with a planning application for sensitive land use types or where significant contamination or uncertainty is found. We recommend that you contact the Local Authority Environmental Health team who may hold records on known/potential land contamination. If during site works, contaminated material is suspected, you are advised to stop works and seek further guidance. Remediation of contaminated land may also require an authorisation under environmental permitting legislation (formerly waste management legislation) Please refer to section overleaf regarding Environmental permits.

For information: we do not recommend individual environmental consultants but the following website link is provided for environmental consultants that undertake contaminated land assessments <http://www.endsdirectory.com/>

### **Foul Drainage**

Government policy states that, where practicable, foul drainage should be discharged to the mains sewer. Where this is not possible and private sewage treatment / disposal facilities are utilised, they must be installed and maintained in accordance with British Standard 6297 and Approved Document H of the Building Regulations 2000. You should also have regard to Circular 3/99 in respect of planning requirements for non mains sewerage. For planning purposes we have provided a Foul Drainage Assessment Form to assist in your consideration of these matters. You may wish to submit this to the Council with your application. Alternatively, the Local Authority may have its own assessment form. PPS23 provides further advice on pollution issues.

### **Water Resources**

We encourage water efficiency in all development. For residential, we recommend a minimum standard of Level 3 of the Code For Sustainable Homes.

[http://www.planningportal.gov.uk/uploads/code\\_for\\_sustainable\\_homes\\_techguide.pdf](http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf)

For commercial, we recommend rainwater harvesting and grey water recycling. Development should endeavour to meet the 'very good' rating under the BREEAM Standard for non-residential development. [www.breeam.org](http://www.breeam.org)

## Landfill/Landfill Gas

The location of authorised landfills is shown upon <http://www.environment-agency.gov.uk> Your Local Authority has a list of closed (historic) landfill sites. You might refer to the landfill gas website (which includes policy and guidance) for further information on proposed development within 250 metres of a landfill site. <http://www.landfill-gas.com/html/search.html>

## Pollution Prevention

You should incorporate pollution prevention measures to protect ground and surface water. We have produced a range of guidance notes giving advice on statutory responsibilities and good environmental practice which include Pollution Prevention Guidance Notes (PPG's) targeted at the specific activities listed below. Pollution prevention guidance can be viewed at: <http://www.environment-agency.gov.uk/business/topics/pollution/39083.aspx>

### Consent Requirements – separate to Planning Permission

## Flood Defence Consents

Any works (including temporary works) in, under, over or adjacent to a watercourse may require us to give formal permission in the form of a Flood Defence Consent before you start any work. We operate a “no-culverting” policy and Consent for culverting will only normally be granted for site access purposes. Our Development & Flood Risk Team will be able to help with this. Please phone 08708 506506 and ask to be put through to the team that covers your area if you would like further advice or to apply for a Consent.

## Consent to Discharge (Effluent)

You will need to apply for a Consent if you wish to discharge anything apart from uncontaminated surface water to a watercourse/ditch. You may also need to apply for a Consent from our National Permitting Team to allow certain discharges to ground. You must obtain any necessary Consent prior to works starting on site. For advice, contact our National Permitting Team. Ring 08708 506506.

## Environmental Permits (EPs) (formerly Waste Management Licences + Pollution Prevention Control permits)

Waste arising from development, must be handled in accordance with relevant environmental permitting legislation. Waste must be minimised and options for reuse or recycling should be investigated before it is sent for disposal. Importation of waste material onto site (e.g. hardcore for construction) will require a waste authorisation, which may be an EP, although in most cases will be the registration of an exemption from the need for an EP. If the purpose of development is to create a waste management facility (e.g. landfill, incinerator, transfer/recycling centre, scrapyards, contaminated land remediation or composting plant), some form of waste management authorisation will be required, in the form of an EP (previously WMLs or PPC permits). For further information contact our National Permitting Team. Ring 08708 506506.

**Other Consents** may also be required – e.g. to **Abstract surface or groundwater and EPs for Industrial and Intensive Pig & Poultry** (formerly Integrated & Pollution Prevention Control Permits). Contact 08708 506506 for advice in the first instance.

## Further Information

Information on protecting and enhancing the environment, and the location of features such as **Source Protection Zones**, can be obtained from <http://www.environment-agency.gov.uk/business/444251/444731/ppg/>

### **Pollution Prevention Guidance Notes (PPG's) are available on the following topics:**

*PPG01 General guide to the prevention of water pollution*

*PPG02 Above ground oil storage tanks*

*PPG03 The use and design of oil separators*

*PPG04 Disposal of sewage where no mains drainage available*

*PPG05 Works in, near or liable to effect watercourses*

*PPG06 Working at construction and demolition sites*

*PPG07 Refuelling facilities*

*PPG08 Storage and disposal of used oils*

*PPG09 Pesticides*

*PPG10 Highway depots*

*PPG11 Preventing pollution of industrial sites*

*PPG12 Sheep dipping*

*PPG13 High pressure water and steam cleaners*

*PPG14 Marinas and craft*

*PPG15 Retail stores*

*PPG16 Schools and other educational establishments*

*PPG17 Dairies and other milk handling operations*

*PPG18 Control of spillages and fire fighting run-off*

*PPG19 Garages and vehicle service centres*

*PPG20 Dewatering underground ducts and chambers*

*PPG21 Pollution incident response planning*

*PPG22 Dealing with spillages on highways*

*PPG23 Maintenance of structures over water*

*PPG24 Stables, kennels & catteries*

*PPG25 Hospitals and health care establishments*

*PPG26 Storage and handling of drums & immediate bulk containers*

*PPG27 Installation, decommissioning and removal of underground storage tanks*

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