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EX 6679

Bath Flood Risk

Review of Previous Flood Management Reports

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Project Manager	Mike Briggs
Project Director	Steven Wade

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Summary

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HR Wallingford was appointed in November 2011 by the Duchy of Cornwall to review recent reports discussing flood management issues for the River Avon in the Bath area. The review particularly focuses on a report entitled "*Bath Compensatory Storage study*" (prepared by White Young Green (WYG) in November 2011) and on a report entitled "*Bath and North East Somerset Flood Risk Management Strategy Report*" (prepared by Atkins in June 2010).

The study provides an independent review of the possibility of providing compensatory flood plain storage upstream of Bath. The concept was promoted in the Atkins report and considered further in the WYG report. The study includes brief assessments of the potential suitability of the main sites considered by WYG.

A number of key issues have been identified including general planning issues for Bath, matters related to the principles of compensatory storage and specific site issues. These are summarized below. Reference is made to the Sequential and Exception Tests and the vulnerability of developments to flooding – key elements within the national Planning Policy Statement PPS25, Development and Flood Risk.

Sequential Test
In order for their Sequential Test to be considered sound it must be accepted that Bath and North East Somerset Council (B&NES) demonstrates that its policy of directing More Vulnerable development (which includes housing) to the river corridor is reasonable from a flood risk perspective. If not, then More Vulnerable developments should be directed to lower flood risk areas. This issue is critical to the B&NES development strategy for Bath.

Exception Test
The Exception Test has three parts, all of which must be achieved for a development to pass.

For the first part the B&NES comments on the wider sustainable benefits of development in the river corridor should be substantiated.

The river corridor developments pass the second part (being on previously developed land).

In the third part an FRA is required for each development in the river corridor, demonstrating that there is no increase in flood risk. Based on the proposals to improve flood defences as part of developments it is likely that water levels will rise locally – an increase in flood risk. Although the scale of changes may be small, this has not been confirmed for any of the sites.

There is insufficient evidence to demonstrate that compensatory storage will be successful in reducing water levels in Bath to compensate for the above. There is therefore a high risk that the third part of the test, and thus the whole of the Exception Test, will fail. If this is the case then any proposed developments in the river corridor will have to be "Water Compatible" or "Less Vulnerable". Whilst excluding dwellings this would still allow for shops, offices and various other commercial uses.

Summary continued

Compensatory Storage Requirement
There are several important issues related to the principles behind the provision of compensatory storage. These include the following:

- Is the 205,000m^3 volume used by WYG the correct volume lost? Does it account for any volumes lost behind improved defences but not within specific development sites?
- The proposed compensation storage does not comply with the normal EA requirement for level-for-level compensation storage.
- A large proportion of the proposed compensatory storage is below the 2 year flood levels so may not be acceptable.
- Will there be any loss of conveyance? Are any associated effects mitigated?
- Can the proposals be demonstrated to work hydraulically?

These are all very important issues that need to be addressed. There is a high chance that one or more may not be resolved satisfactorily. This will mean that the compensatory storage strategy is not valid and the development strategy for the Bath river corridor will have to be reassessed.

Site Specific Issues
As part of a review of the proposed sites several key issues have been identified.

- Can sufficient volume at appropriate levels be found?
- Can significant site access difficulties be overcome (all sites)?
- Are there any significant environmental issues (sites and haul routes)?
- Are the sites viable economically?
- There is potentially contaminated ground at the Kensington site (an old landfill site).
- Significant protests are likely for all sites.

Again, these are all important issues, with a high chance that some may not be resolved suitably.

Summary
This independent review has considered general planning issues, the principles of compensatory storage and specific matters for potential storage sites. A number of matters must be resolved to allow More Vulnerable developments to be permitted in the Bath river corridor.

- It must be confirmed that the B&NES policies and sustainability arguments behind their **Sequential Test** are sound.
- As part of the **Exception Test** the sustainable benefits of development in the river corridor should be substantiated.
- It must be clearly demonstrated that compensatory storage will be effective, with **no increase in flood risks.** This has not been done.
- The **Environment Agency** must agree to site-specific details, not simply the high level principles so far agreed.
- There has been limited consideration of **environmental issues** for the storage sites.
- There are significant **access problems** at all of the identified sites.
- **No cost assessment** has been carried out for the sites to confirm overall viability.

There is insufficient evidence to demonstrate that a suitable compensatory storage solution will be found. On this basis the strategy of redevelopment in the river corridor is currently not robust.

Contents

1. Introduction

1.1 APPOINTMENT AND SCOPE

HR Wallingford was appointed in November 2011 by the Duchy of Cornwall to review recent reports discussing flood management issues for the River Avon in the Bath area.

The review particularly focuses on a report entitled "*Bath Compensatory Storage study*" prepared by White Young Green (WYG) in November 2011 for Bath and North East Somerset Council (B&NES) and on a report entitled "*Bath and North East Somerset Flood Risk Management Strategy Report*", prepared by Atkins in June 2010, also for B&NES. However, other reports are referred to as necessary.

The study provides an independent review of the possibility of providing flood plain storage upstream of Bath. This would seek to compensate for lost flood storage in Bath if potential developments occur in the floodplain in the city and reduce the local flood storage volume. This concept was promoted in the Atkins report and was considered further in the WYG report.

The study includes brief assessments of the potential suitability of the main sites considered by WYG.

1.2 REPORT STRUCTURE

This report describes the findings of this independent review, covering issues specific to Bath and the proposed compensatory storage sites, as well as providing background to the key flood risk issues.

Section 2 provides a brief overview of development requirements in Bath.

Section 3 provides an outline of the Atkins report, with additional information in Appendix A.

Section 4 provides an outline of the WYG report, with additional information in Appendix B.

Section 5 comments briefly on two of the other background reports.

Section 6 gives background information on national flood risk policies and the requirements of PPS25, with backup in Appendix D.

Section 7 covers the review of the three main potential compensatory storage sites considered by WYG, with further site details provided in Appendix C.

Section 8 looks in more detail at the application by B&NES of the Sequential and Exceptions Tests for Bath.

Section 9 provides a summary of the identified issues.

Section 10 outlines the overall conclusions.

2. Potential developments in Bath area

B&NES has prepared a Draft Core Strategy, which "*provides the strategic policy framework for how we manage the development and use of land up to 2026. It identifies the broad locations for new homes and offices, provides direction in our response to a changing climate, ensures the protection of key environmental assets, in order to achieve a sustainable future and enable Bath and North East Somerset to be an even better place in which to live, work and visit."*

In particular it outlines plans for developments within the Bath area, to support economic development, with provision for a net increase in employment of about 5,700. This would require additional office provision, to be focused in and near the city centre.

It also proposes the development of about 6,000 new homes within the city, most of which will be provided in the Central Area and the Western Riverside (3,500). The majority of the rest of the housing provision is proposed at surplus MoD land.

A stated objective of B&NES is to use brownfield sites for economic and residential developments, with particular emphasis on the Western Riverside area.

Many of the sites are in or near flood risk areas, so careful consideration of the proposals from a flood risk perspective is required, in accordance with PPS25 Development and Flood Risk.

It is proposed that as part of the developments improvements will be carried out to the flood defences of Bath City Centre and the Riverside, primarily by the developers. A sum of £7.6m is identified in the B&NES Draft Core Strategy for such flood mitigation works. Some or all of this sum might subsequently be recovered from developers.

The Draft Core Strategy will be examined at a public hearing during January 2012. As part of this the issue of flood risk and the sequential test will be discussed.

3. Flood Risk Management Strategy report (Atkins, June 2010)

A brief overview of this study is given below, with a more detailed summary in Appendix A.

3.1 SCOPE

The study was commissioned by B&NES to provide "*detailed solutions to flood management in Bath and North East Somerset*". As such it was intended to consider possible strategic flood risk management measures for the area as a whole, as well as smaller scale improvements that would benefit individual sites or that might benefit more than one site in an area.

3.2 SUMMARY AND CONCLUSIONS

The study concluded that there was no comprehensive strategic solution to reduce peak flows in Bath that was both technologically and economically viable. Rather, the strategy that was proposed was one of onsite improvements to flood defences associated with individual developments, to be combined with upstream compensatory storage.

This storage would offset the flood storage volumes displaced by the defences on individual sites in the city. Whilst this might not contribute to a significant reduction of the existing levels of flood risk it was considered that this approach would allow developments to proceed without exacerbating flood risks.

It was stated that a total compensatory storage volume of about 345,000m^3 would be required for all of the works associated with the anticipated developments in the floodplain. It is understood that this was equal to the total volume that might be lost at development sites. It is unclear if it included any existing storage outside of the development areas, which would also be lost due to the improvements to the flood defences. There is also no detailed assessment of how effective the replacement storage might be. Although storage is normally provided at or close to development sites, in this case it was proposed to be located upstream of the city – several kilometres away.

There was no detailed assessment carried out of any individual storage sites, or of how well any compensatory storage provision might work in practice. Whilst it is understood that the EA was consulted during the study they were not party to all of the details. Whilst they accept the principle of the storage concept they advise that it would be necessary to prove that specific proposals work, by the use of modelling techniques. This was not done.

3.3 COMMENT

In view of the difficulties and costs in implementing a single strategic flood management solution within Bath the conclusion for works within the city seems reasonable. Whilst the implementation of local works on their own might provide increased flood protection to a particular area this will result in the loss of some flood storage. There may also be a loss of some flood conveyance. Although this was not considered to be an issue in the Atkins report it will need to be reviewed in detail.

The impacts of these factors would result in increased peak flood levels in nearby areas. Whilst overall any such impacts are likely to be small, in some areas there would be an increase in the flood risk to properties and people. Thus, specific appraisals for individual proposals will be required.

In particular, the phasing of works may be very important – to ensure that peak flood levels in an area are not increased before local defences are improved.

The provision of compensatory storage is a commonly adopted approach. However, there are certain principles that the EA normally follows, which may affect the details and the viability or approval of this. These are discussed further in Section 6.5. In particular it is important to demonstrate that there is sufficient compensatory storage provided at appropriate levels and that the proposals will work hydraulically.

4. Compensatory storage report (WYG, November 2011)

A brief overview of this study is given below, with a more detailed summary in Appendix B.

4.1 SCOPE

The study was commissioned by B&NES, "*to investigate the provision of compensatory storage upstream of Bath city centre to balance future loss of flood storage volume when planned developments take place.*"

4.2 SUMMARY AND CONCLUSIONS

The study built on the Atkins work, seeking to identify appropriate storage locations. However, based on a review carried out by B&NES, WYG considered a compensatory storage volume of only 205,000m^3 (significantly lower than the Atkins figure of 345,000m^3). There is no indication of how much volume would be lost at different elevations.

WYG initially considered eight possible storage locations, seeking to identify preferred sites for more detailed assessment. Five sites were discounted due to insufficient storage capacity relative to the associated costs and to potential planning issues. The remaining sites were at Kensington Meadows, Batheaston and at Bathampton. These are shown on Figure 7.1.

Whilst it was recognised that there are many other key factors to be considered - such as the ecological values of the sites, costs and site access - these were only considered briefly.

In the WYG report it is stated that "*the minimum level that it is considered appropriate to reduce ground levels to, in order to provide the compensatory volume, is the 1 in 2 year flood level, although it may be feasible to provide storage below this level should site conditions permit. Ground levels below the 1 in 2 year level would inundate on a more frequent basis so may restrict the future usage of the land. Furthermore, the "top of bank" level is generally close to the 1 in 2 year level, although in some cases the bank top is lower and the flood plain beyond the bank is lower than the 1 in 2 year level*".

Thus, initially it was intended to provide storage at or above the 2 year flood level.

Based on the volumetric assessment it was concluded that the only single location with sufficient potentially available storage was Bathampton (210,000m^3). If the Kensington Meadows and Batheaston sites were both fully exploited there would be a significant shortfall. A deeper excavation, well below the initial base level of the 2 year flood level, would be required to achieve the 205,000m^3 volume. This was considered.

It was recommended that the sites be discussed amongst stakeholders (such as B&NES and the EA) to determine whether further consideration is appropriate. If a preferred site is identified then further studies would be required to confirm site suitability and feasibility.

Whilst it is reported that the EA accepts the principle of compensatory storage it has not given approval to any of the details. The EA may not accept the principle of a large amount of storage below the 1 in 2 year flood level.

Comment
Whilst the WYG study looked for specific sites, and touched on a range of issues, the main focus was on finding a certain storage volume, with limited consideration being given to many of the issues that would also be critical to the successful promotion and implementation of such a scheme. It is therefore considered that the report should be seen as an early part in the process of determining whether the proposed compensatory storage solution is viable.

It is important to recognise that there is insufficient evidence to demonstrate that a suitable compensatory storage solution will be found.

In their introduction WYG indicated that their study was Phase 1, seeking to identify technically feasible sites. Phase 2 would be an "*assessment of preferred site(s), based on deliverability*." Certainly it has yet to be demonstrated that any of the sites are deliverable.

As with the Atkins work a simple approach was taken to the provision of storage – assuming that excavation of the same volume as that lost further downstream would be sufficient, irrespective of the locations or the elevations at which it was to be provided – see Section 6.5. There was no modelling work carried out to determine whether any of the proposed works could be successfully implemented.

In addition, there was limited consideration of environmental matters - such as the ecological values of the sites, impacts on habitats, etc. – and of implementation issues such as access for construction equipment / the removal of material, costs, etc. These were mentioned briefly, although there is a significant possibility that there may be strong reasons why none of the sites are viable – see Section 7. If this is the case, then the philosophy of compensatory storage upstream is not viable and a new solution to overcome problems in Bath would be required.

5. Other reports

5.1 STRATEGIC FLOOD RISK ASSESSMENT

Based on the requirements of PPS25 a Strategic Flood Risk Assessment (SFRA) was carried out for the Bath and East Somerset area, prepared for B&NES by Capita Symonds. Initially a Level 1 study was carried out (report dated April 2008). This provided a high level assessment of all flood risks in the area. It identified that one of the main flood risk areas in the district is the urban area of Bath.

Consequently, more detailed and focused Level 2 SFRAs were carried out, for a number of parts of the catchment, including Bath (report dated July 2009). This recognised that a multi-lateral and multi-agency approach was required, and recommended the preparation of a Scoping Report to identify potential flood risk management options for Bath.

5.2 FLOOD RISK MANAGEMENT STRATEGY SCOPING REPORT

This was the pre-cursor to the Atkins study, and was carried out by Capita Symonds. The study report was prepared in May 2009. It built on existing reports and information and identified preferred options for the main flood risk areas.

For Bath the preferred option was to raise and formalise existing defences, to adopt flood resilient design and to provide a storage area downstream of the city, to offset the loss of storage associated with the developments and defence works.

6. Flood Risk Policies and Principles

6.1 INTRODUCTION

For larger developments and for developments in or close to a floodplain there are certain policies and principles that are normally considered by the local authorities when assessing planning applications. These are typically detailed in local planning policies and within PPS25. Some of the key issues are summarised below.

6.2 PPS25 - INTRODUCTION

The key national planning policy on flood risk issues is the *Planning Policy Statement (PPS25): Development and Flood Risk*. The document sets out the Government's planning policies on land use with respect to flood risk issues and is a key document used by planning authorities and the EA when determining planning applications. There is an associated Practice Guide.

These documents clarify planning policy on development and flood risk to:

- Ensure flood risk is taken into account at all stages in the planning process;
- Avoid inappropriate development in areas with a flood hazard;
- Direct development away from areas at highest risk;
- Ensure new developments take climate change into account and do not increase flood risk elsewhere.

Further details of the principles and key requirements of PPS25 are given in Appendix D.

6.3 THE SEQUENTIAL TEST

A key component of PPS25 is the sequential approach, whereby development is directed to areas with the lowest probability of flooding. Development should only be permitted in zones with greater probability of flooding if there are no suitable sites available in lower flood risk areas.

The Sequential Test considers the flood "vulnerability" of the intended use of a development and the need to match this to the level of flood risk of a site. Thus, development types that would be particularly vulnerable in the event of a flood are not normally permitted in higher flood risk areas. This is illustrated in Table 6.1.

Table 6.1 Summary of appropriate vulnerabilities and flood zones

Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Development Examples		Essential transport infrastructure. Strategic utility infrastructure.	Water-based recreation. Amenity open space.	Police stations. Emergency dispersal points. Basements.	Homes. Care homes. Hotels.	Shops. Offices. Restaurants.
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	✖	Exception Test required	✓
	Zone 3b "Functional Floodplain"	Exception Test required	✓	✖	✖	✖

As an example, homes, care homes, etc. are considered to be "More Vulnerable". Initially they should be allocated by the LPA to available flood zone 1 sites. If no suitable zone 1 sites are available then they can be allocated to flood zone 2 sites. Thus, in Table 6.1 a ✓ indicates that a particular vulnerability is appropriate for a particular flood zone. A ✖ indicates a combination that is not allowed.

When preparing land allocations the LPA should carry out the Sequential Test in conjunction with the flooding information from an SFRA and it must show that it has considered a range of possible sites in its site allocation process.

Further comments on the Sequential Test requirements and the vulnerabilities associated with different development types are given in Appendix D.

B&NES has carried out the Sequential Test and the Exception Test for Bath. This is discussed in Section 8.

6.4 THE EXCEPTION TEST

Under some circumstances other sustainability objectives may make it seem inappropriate for a development to be located in a lower flood risk area. In such cases one would seek to make exceptions to the above approach. In some, but not all, situations this may be acceptable.

Possible exceptions are indicated in Table 6.1 by the comment "Exception Test required". This test allows the disadvantages of developing in a flood risk area to be balanced against any positive contributions to sustainable development that the new development might bring.

In order for a development to pass the Exception Test the following must all apply:

1. It must give wider sustainability benefits that outweigh the flood risk.
2. It should be on previously developed land (brownfield), unless there are no reasonable brownfield alternatives.
3. It must be demonstrated to be safe, with no increase in flood risk elsewhere and if possible will reduce the overall flood risk.

In this way, if all relevant issues are considered, on balance a development may be allowed to proceed in an area that would not normally be allowed. However, there has to be a strong and clearly defined reason for this.

If applying the Exception Test it is important to note that in PPS 25 it is stated that "*the Exception Test is only appropriate for use when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons, taking into account the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during flood"*.

6.5 DEVELOPMENTS IN FLOODPLAINS

During flood conditions the floodplain adjacent to a river can act in two ways. Flood water will flow across parts of the floodplain and so this area will contribute to the overall conveyance of the river. This is referred to as the "functional floodplain" and is commonly considered to be the floodplain area that would flood during a 1 in 20 year event (flood zone 3b).

In some floodplain areas there will not be any significant flow of water. However, flood water will fill these areas, being stored until water levels subside. This is considered to be the area that floods for events with return periods of between 1 in 20 and 1 in 100 year return periods (flood zone 3a). Both types of area are very important.

If developments are built in a floodplain, or if flood defences are constructed or extended, they could potentially affect both types of floodplain area, as flow paths can be blocked and flood storage either filled or isolated behind defences.

Reduced conveyance
For reduced conveyance within the river, the water depths locally will rise to be able to accommodate the flow. There will therefore be increased flood levels, particularly upstream of the site. This causes an increased flood risk. The scale of this will depend upon the details of the work carried out, and in some cases could be significant.

It is common for the impacts of such changes to be assessed using a hydraulic model of the river and floodplain system.

Reduced storage
In the case of reduced flood storage within the floodplain it is still necessary for the volume to be accommodated within the system. This causes local increases in water levels, with increased flow rates downstream during the first part of the storm. There will be associated increased water levels and flooding elsewhere. Whilst the impact for a single development may be small – and is often not measurable - the cumulative impacts of many developments may become significant.

Compensatory storage
It has therefore been the policy of the EA, and the National Rivers Authority previously, to require that where floodplain storage is removed, compensatory storage is provided. It is normal practice for this storage to be provided close to the site and on a level-for-level basis. For every $1m^3$ removed within a certain depth band, then at least $1m^3$ is provided at the same depth band. This is important because volume provided in a different band will be effective for different return period events.

For example, if flood storage is removed at the 100 year flood level, and compensatory storage provided at the lower 2 year flood level, the new storage will fill up early in a 100 year event, whilst water levels are still relatively low, and so will not be available to attenuate the peak of the flow. Thus, the EA normally requires demonstration that the compensatory storage proposed is sufficient for all depth bands.

In the case of all of the three sites that were considered in detail, the difference in peak water levels between the 1 in 2 year and 1 in 100 year plus climate change events was at least 3m. Any storage to be provided to compensate for lost storage at the 100 year level should therefore be 3m or more above that provided for the 1 in 2 year event. However, this is not what is proposed.

Figure 6.1 illustrates the loss of storage, the proposed provision of compensatory storage and what should be provided.

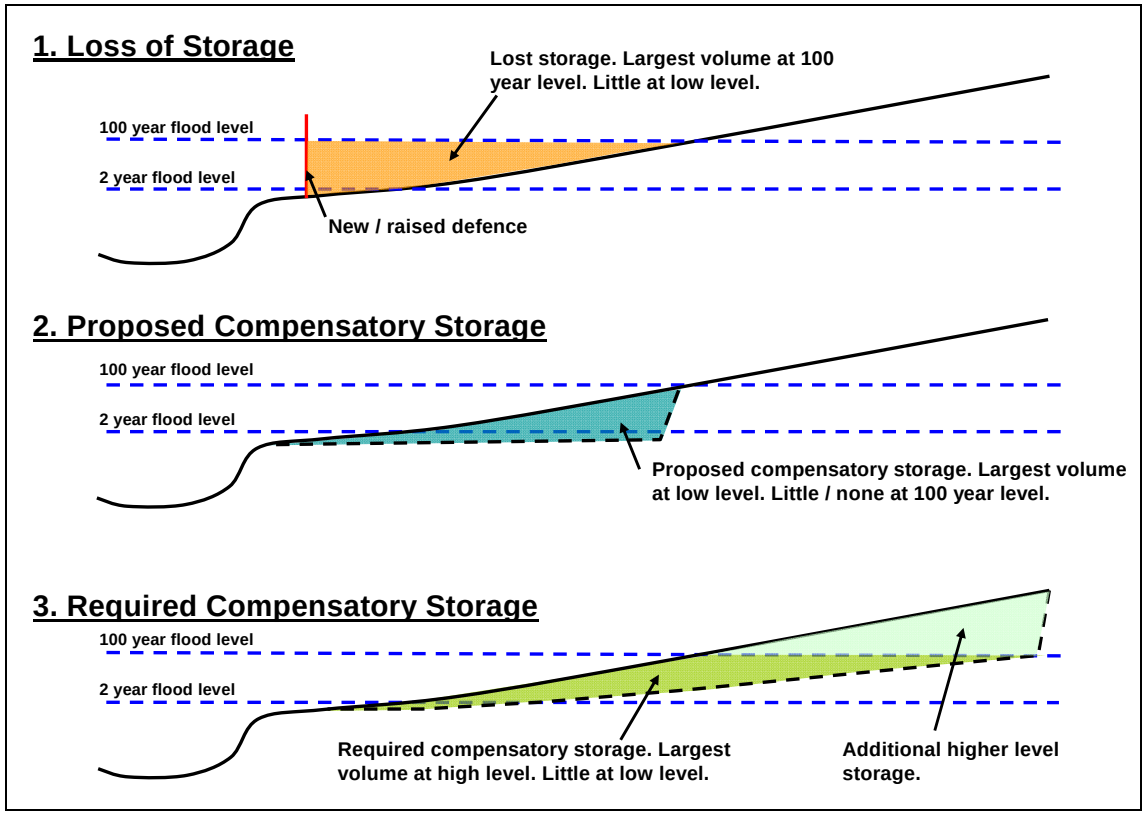

Figure 6.1 Compensatory storage requirements

The first diagram illustrates that where there are new or improved defences there is normally a small volume of existing floodplain storage lost at lower levels, whereas the volume lost at higher levels is relatively large.

The second diagram illustrates what is proposed at the three sites considered (see Section 7). This clearly illustrates that most of the compensatory storage provision is at the lower levels. It will be beneficial for low return period events, but not the more extreme ones.

The third diagram indicates what is actually needed to meet the normal EA requirements. A relatively large land-take is necessary at the 100 year level to achieve the necessary high level storage volume. The amount of excavation that occurs at lower levels is less. Consequences of this are that there is inevitably more excavated volume required than the volume that was lost and that there is additional land-take required. This can to some extent be overcome by having high level flow control banks around the new storage so that it only starts to fill at a relatively high flood return period. This is similar to an upstream storage scheme implemented in Taunton – see Appendix E for notes and key principles from the Taunton scheme.

This issue is also discussed in PPS25, which accepts the concept of compensatory storage. In section 6.22 it states that "*if an increase in the area of land is required for development, additional compensatory flood storage off-site may be needed to ensure flood risk to others does not increase. The overall approach will need to be covered in design and reflected in the FRA*".

Thus, the principle of compensatory storage is accepted, but it is important that the details are correct, to avoid any deterioration of flood risks.

6.6 SUDS

A key component in providing effective and sustainable drainage solutions for new developments is the use of Sustainable Drainage Systems (SuDS), which is required in PPS25 and which forms part of the policies of LPAs and the Environment Agency.

SuDS are used to achieve a number of purposes, including:

- Runoff reduction and attenuation – avoiding any increase in food risk.
- Water quality benefits.
- Opportunities for environmental enhancement.

Therefore, a basic requirement of any developments in Bath is the implementation of SuDS. Further comments on SuDS are given in Appendix D.

7. Review of Potential Compensatory Storage Sites

7.1 GENERAL

As part of this study a review of the three main sites from the WYG report has been carried out. This included consideration of the findings of the WYG report, internet searches and a site walkover survey. Whilst this has identified a number of issues, such a brief study is unable to identify all matters or give substantial details. However, it does assist in considering the overall viability of sites.

Should any of the sites be considered further then it will be necessary to carry out far more detailed assessments, covering all relevant issues. As part of this process environmental impacts should be assessed. However, the summaries below and in Table 7.1, plus the more detailed comments in Appendix C, provide an initial overview of some of the issues.

7.2 KENSINGTON MEADOWS

This 5.5 hectare site lies between the A4 and the River Avon, behind Kensington Place and Grosvenor Place. A residential area is adjacent to the site. The site comprises an open grassed area of 500m by about 70m, with a smaller meadow area (a local nature reserve) close to the river. This is at a significantly lower level than the playing field. The playing field site is reported to be a former tip – details of any potential contamination are unknown.

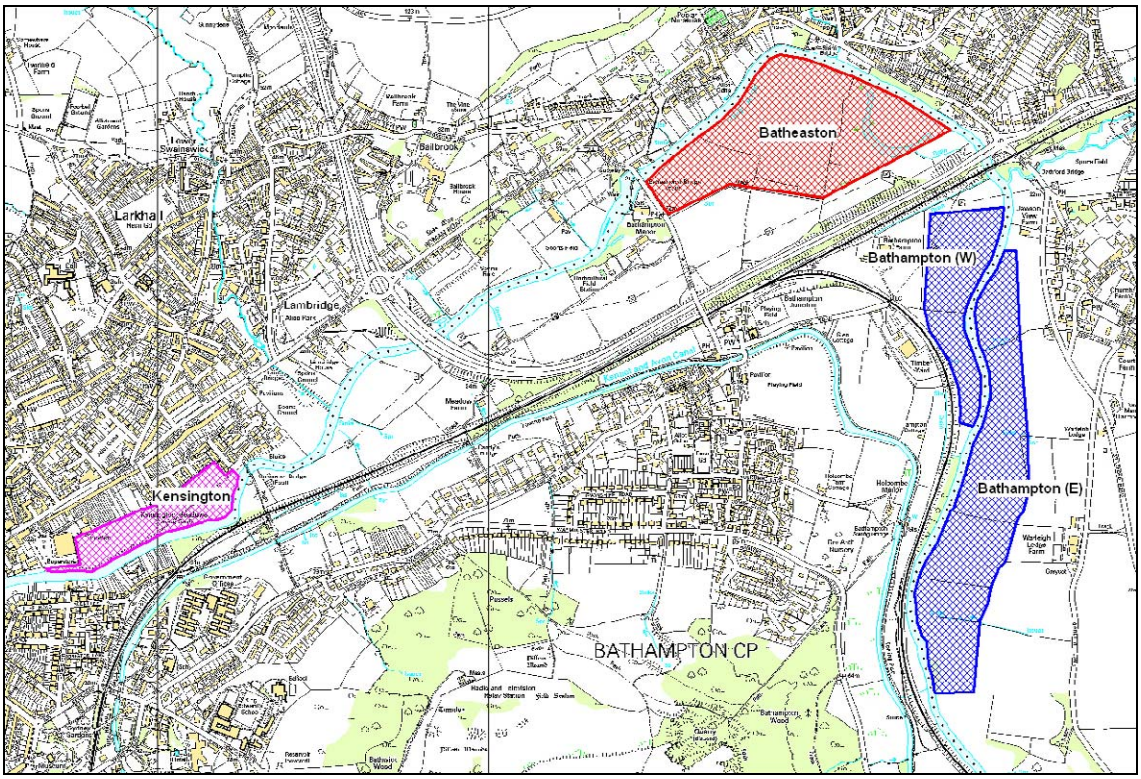

Figure 7.1 Potential upstream storage sites

WYG indicates approximately 75,000m^3 storage available above the 2 year flood level, with a further 31,000m^3 below the 2 year flood level. Achieving this latter volume would mean excavation of the nature reserve. The total suggested volume is about 50% of the volume WYG was looking to achieve.

Whilst there is a significant volume potentially available at lower levels there is no storage volume available near the 100 year level. This site could therefore provide some benefits at lower levels, but none at higher levels.

A new access will be required, probably through the adjacent Morrison site. Up to 10,000 lorry loads will exit the site onto a busy urban section of the A4.

The Kensington Meadows is a local nature reserve, with areas of fen and woodland and it supports a diverse population of plants and animals, being used by otters, bats and kingfishers. A detailed ecological assessment will be required.

Key issues to consider include the following:

- Only part of the required volume is available. Another site will be required.
- Much of the storage would be at low levels, with no benefit for severe events.
- Will the storage be effective hydraulically? Will the EA approve of this?
- Can a suitable access be negotiated?
- Is the removal of material through a busy urban area acceptable?
- What issues will there be associated with the landfill material?
- Can all environmental issues be identified and overcome?
- Is this solution economically viable?

7.3 BATHEASTON

This is a 21 hectare rural site between the River Avon, the A46 Batheaston bypass and Mill Lane. The site is open farmland (grade 4), used for grazing. Six hectares of it are within the Bathampton Meadows Nature Reserve – created in 1996 to provide flood relief for the A46 bypass.

Whilst the site rises gently away from the river about 50% of the site is below the 1 in 2 year flood level. It is all well below the 100 year plus climate change peak flood level. Indeed, it is lower lying than much of the downstream Kensington site.

WYG states that approximately 60,000m^3 of storage is potentially available above the 2 year flood level, with a further 113,000m^3 below the 2 year flood level. The total suggested volume is about 80% of the volume that WYG was looking to achieve.

Whilst there appears to be a large volume available at lower levels it is unlikely that so much excavation at the lower level is acceptable. There is no storage volume available near the 100 year level. This site could therefore provide some storage benefits at lower flood levels but none at higher levels.

There are significant access issues with this site (4 tonne weight limit on one bridge, difficult alignments at another canal bridge and narrow, windy and steep roads). A temporary access route to the A46 would probably be required, for up to 17,000 lorry loads of excavated material.

Whilst the field area is open there are many trees along the edge of the river. The meadow is a local nature reserve and it is understood that it and the surrounding area support a diverse population of plants and animals, including otters, bats, kingfishers and herons. The Bathampton Meadow is understood to attract a variety of migrant water birds. A detailed ecological assessment will be required.

Major protests should be anticipated against use of this site for flood storage – there was previously strong local opposition to the adjacent Batheaston bypass and to the proposed park and ride scheme (now shelved).

Key issues to consider include the following:

- Only part of the required volume is available. Another site will be required.
- Much of the storage would be at low levels, with no benefit for severe events.
- Will the storage be effective hydraulically? Will the EA approve of this?
- Can a suitable access be negotiated?
- Can all environmental issues be identified and overcome?
- Can anticipated protests be managed and overcome?
- Is this solution economically viable?

7.4 BATHAMPTON

This is a 28 hectare rural site on either side of the River Avon, to the east of Bathampton. The site is open farmland (grades 3 and 4), used for grazing. Approximately 25% of the site is on the western side of the river.

The site rises gently away from the river. Whilst about 50% of it is below the 1 in 2 year flood level there is still a large area above this level. However, all of the currently defined site is below the 100 year plus climate change peak flood level.

WYG states that approximately 210,000m^3 of storage is potentially available above the 2 year flood level, although there is potentially an error in the calculation of this figure. No volume below this level is reported. The reported volume available just exceeds the volume that WYG was looking to achieve. Of the three sites considered this provides the best spread of storage volume with respect to depth.

Access to the main eastern part of the site is good. However, as with the nearby Batheaston site there are significant access issues with the western area (4 tonne weight limit on one bridge, difficult alignments at another canal bridge and narrow, windy and steep roads). A temporary access route to the A46 would probably be required for the western area.

Whilst there appear to be no specific environmental designations for the site it is understood that it and the surrounding area support a diverse population of plants and animals, including otters, bats, kingfishers and herons. The nearby Bathampton Meadow is understood to attract a variety of migrant water birds. A detailed ecological assessment will be required.

Major protests should be anticipated against use of this site for flood storage – there was previously strong local opposition to the nearby Batheaston bypass and to the proposed park and ride scheme (now shelved).

In many ways this appears to be the best site of the three considered, for the following reasons:

- Largest available storage volume – although potential error in calculation.
- Greater proportion of storage at a higher level.
- Easy access for the larger eastern area.

However, key issues to consider include the following:

- The site is furthest from the proposed developments, with attenuation meaning it may not be so efficient.
- Will the storage be effective hydraulically? Will the EA approve of this?
- Can a suitable access for the western area be negotiated?
- Can all environmental issues be identified and overcome?
- Can the anticipated protests be managed and overcome?
- Is this solution economically viable?

Table 7.1 Summary of proposed storage sites

	Kensington Meadows	Batheaston	Bathampton
Size / Land Use	5.5 ha. of playing fields & meadow.	21 ha. of grazing land (grade 4).	28 ha. of grazing land (grade 3 / 4).
Available volume *(Figures from WYG, for **above 2year flood** / below 2 year flood / total)*	**75,000m^3** / 31,000m^3 / 106,000m^3 Actual available volume likely to be less, so site can provide only a small part of the required volume.	**60,000m^3** / 113,000m^3 / 173,000m^3 Low level excavation less appropriate – so total volume available may be significantly less than the suggested 173,000m^3.	210,000m^3 / NA / 210,000m^3 The volume appears adequate to meet the objective, but it is possible that the western area (approx. 25% of site area) cannot be exploited economically (access issues).
Storage level	Mainly at a low level. This is ineffective during severe floods.	Vast majority at a very low level – ineffective for severe floods.	This site is likely to offer the best spread of storage over different levels.
EA approval	Will require demonstration that the proposed works are suitable hydraulically.		
Future land use	Site will flood more frequently & will be wetter – so of less value to local community.	Site will flood more frequently & will be wetter. Likely to be of less agricultural value.	Site will flood more frequently & will be wetter. Likely to be of less agricultural value.
Access	Existing access inadequate. Temporary access through nearby Morrisons site will require negotiation.	Existing access inadequate. Temporary access from A46 bypass probably required.	Existing western access inadequate. Agreement on crossing railway line required, with temporary access to / from A46 bypass. Eastern access readily achievable.
Traffic	Removal of excavated material along busy urban A4. Up to approx. 10,000 lorry loads (less if scale of excavation is reduced).	Up to about 17,000 lorry loads taken off site (less if the scale of the excavation is reduced).	Up to about 21,000 loads (less if scale of the excavation is reduced / material is deposited on adjacent land). Approx. 25% in west.
Ecological	Detailed environmental assessments to identify existing habitats & confirm potential impacts (bats, otters, etc).		
Material Type / Use	Site was former tip – details unknown. Potential contamination issues. Possibly special measures for material disposal.	Geology not known – likely to be alluvial deposits. Proportion of material that would be suitable for ground-raising is unknown.	Geology not known – likely to be alluvial deposits. Proportion of material that would be suitable for ground-raising is unknown.
Construction impacts	Site close to residential area - particular concern for noise, dust, etc. Restricted working hours likely.	Less direct impacts on people likely than Kensington – but depends on access route.	Less direct impacts on people likely than Kensington – but depends on access route.
Costs	Full & detailed cost assessments required.		
Potential protests	Protests from local residents & community should be anticipated.	Major protests anticipated – previous strong opposition to Batheaston bypass & park & ride scheme.	Major protests anticipated – previous strong opposition to nearby Batheaston bypass & park & ride scheme.

8. Sequential and Exception Tests

8.1 INTRODUCTION

In November 2010 B&NES published their Core Strategy Information Paper 2, entitled "Flood Risk: Sequential and Exception Tests". This forms part of the Local Development Framework documentation.

The methodology was based on guidance and requirements within PPS25. It is stated that the methodology and the report were agreed with the EA. The work built on work carried out for an interim version of the Sequential Test and Exception Test – report published in November 2009.

In Section 3.5 of the report it is recognised that flood risk is "*one of the major constraints to the regeneration of Bath*".

8.2 STRATEGIC HOUSING LAND AVAILABILITY ASSESSMENT

The report refers to the Strategic Housing Land Availability Assessment (SHLAA) prepared in December 2010. This identified what were considered to be suitable, available and deliverable / developable sites. It was estimated that 6,213 homes could be delivered in Bath and 11,342 in the district as a whole. This would be able to meet the required provision of approximately 11,000 new homes for the district.

Whilst none of the proposed new homes in Bath are in flood zone 3b, nearly 1,100 were in sites that are all or partly in flood zone 3a. All of these are in the Bath River Corridor re-development area. None are in the outer area. A further 230 new homes were at sites all or partly within flood zone 2.

The Sequential Test requires that new developments are provided in the lowest flood risk zone possible. In the case of Bath there are additional flood zone 1 areas available, which were not allocated homes in the SHLAA – such as an area to the west of Twerton. Whilst this appears to be contrary to the principles of the Sequential Test the decision was made on the basis that B&NES has set a high priority on the regeneration of previously developed urban areas, above development of greenfield land. In addition, B&NES has an intention of resisting urban extensions. It is stated that their approach is supported by many objections to possible urban extension sites.

8.3 SEQUENTIAL TEST

In the Sequential Test it is stated that even if all sites with planning permissions and all flood zone 1 sites are developed there is a shortfall in housing (approximately 1,250 units). This is the justification for considering sites within the river corridor, and thus applying the Exception Test. However, as part of this it is important to clearly demonstrate that there are no reasonably available sites in flood zones 1 or 2. Whilst this requirement is accepted in the report it is not specifically demonstrated.

Thus, in order for the Sequential Test to be considered to be sound B&NES should clearly demonstrate this. As part of this it is important to demonstrate that their policies of directing development to the river corridor, where there is a far higher flood risk, is reasonable from a flood risk perspective.

8.4 EXCEPTION TEST

For the river corridor sites to be considered acceptable it must also clearly be demonstrated that all of the requirements of the Exception Test are met. There are three parts to the test, which are outlined below. This issue is covered in Section 7 of the B&NES Sequential and Exception Tests report.

Part 1: Wider sustainable benefits
Several reasons are given to support the requirement that "*the development provides wider sustainable benefits to the community that outweigh flood risk*". These include comments on:

- Regeneration in a highly accessible location
- Contribution to economic prosperity
- Provision of affordable housing
- Redevelopment of derelict areas, enhancement of the World Heritage Site and protection of Green belt areas
- Protection and enhancement of the river corridor.
- Development close to the centre of Bath – accessible to sustainable transport.
- Maintain Bath as a tourist destination
- Potential for district heating networks, contributing to reduced carbon emissions.

Whilst some of these may appear appropriate it is important that they are substantiated far more clearly, so that the scale of any sustainable benefits is understood.

Part 2: Previously developed land
It is noted that the areas are previously developed land that is considered to be developable. Based upon the information in Appendix I of the Atkins report this appears to be the case for all of the riverside sites being considered.

Part 3: Safety, with no increase in flood risk, and preferably a reduction
This test requires that a site-specific flood risk assessment is produced that demonstrates the following:

- The development will be safe with respect to flood risk.
- There will be no increase in flood risk elsewhere.
- If possible there will be a reduction in flood risk overall.

In many cases it is likely that various actions can be carried out to provide a safer environment during flood events – ground raising, improvements to flood defences, provision of safe access during floods, flood warnings, flood resistant and resilient construction, etc. However, some of these issues have to be considered on a site-specific basis. Thus, this test may be passed for some sites but not for others. This part of the test therefore has to be considered on a site by site basis, and addressed in the FRA.

The issue of no increase in flood risk elsewhere is very important. As noted in Section 6.5, raising land as part of a development and raising local defences, with no mitigation measures, will raise flood levels and so increase flood risks for others. Thus, mitigation measures are required, or this part of the test will fail and the development must not be approved.

Against this test B&NES refers to the Atkins Flood Risk Management Strategy report. This concluded that local flood defences should be improved and that compensatory storage be provided. This storage would have to be implemented prior to the development proceeding. However, as discussed in this report, it has not yet been demonstrated that a compensatory scheme for Bath is viable. Indeed, as discussed in Section 7 there is a high chance that it will not be viable.

There are several elements affecting peak levels at any particular site. Even if a scheme is promoted it is important to confirm that it will work for individual sites, taking into account associated changes to local flood defences. There is a very significant risk that this part of the test, and thus the whole of the test, will fail.

If this test fails then any proposed developments in the river corridor will have to be "Water Compatible" or "Less Vulnerable". Whilst excluding dwellings this would still allow for shops, offices and various other commercial uses.

9. Summary of Issues

During this review a number of key issues have been identified. These include general planning issues for Bath, as well matters related to the principles of compensatory storage and specific site issues.

9.1 SEQUENTIAL TEST

In order for the Sequential Test to be considered sound it must be accepted that B&NES clearly demonstrates that its policy of directing More Vulnerable development (which includes housing) to the river corridor, with its high associated flood risk, is reasonable from a flood risk perspective. If not, then More Vulnerable developments should be directed to lower flood risk areas.

There are many sustainability issues that may be relevant to the Sequential Test and thus to assessing the suitability of the B&NES objectives. However, making a comprehensive assessment of these is beyond the scope of this review.

9.2 EXCEPTION TEST

For any development to pass the Exception Test it must pass all of the three parts. Whilst the proposed river corridor developments pass the second part (being on previously developed ground) there are questions about the other two parts.

Wider sustainable benefits
The B&NES comments on the wider sustainable benefits of development in the river corridor should be substantiated, so that the scale of any sustainable benefits is understood.

No increase in flood risk
On the issue of flood risk an FRA will be required for each development. Whilst in many cases local flood risks to developments may be mitigated this must be clearly confirmed. In addition it is vital to demonstrate that there will be no increase in flood risk elsewhere.

Based on the proposals to improve flood defences as part of developments it is likely that water levels will rise locally – an increase in flood risk. Although the scale of changes may be small, this has not been confirmed.

Whilst the principle of compensatory storage is proposed there is insufficient evidence to demonstrate that this will be successful in reducing water levels in Bath. Indeed, there is a very significant risk that this part of the test, and thus the whole of the test, will fail.

If the test fails then any proposed developments in the river corridor will have to be "Water Compatible" or "Less Vulnerable". Whilst excluding dwellings this would still allow for shops, offices and various other commercial uses.

9.3 COMPENSATORY STORAGE REQUIREMENT

There are several important issues related to the principles behind the provision of compensatory storage. These include the following:

- Is 205,000m^3 the correct volume lost? Does it account for any volumes lost behind improved defences but not within specific development sites?
- The proposed compensation storage does not comply with the normal EA requirement for level-for-level compensation storage.
- A large proportion of the proposed compensatory storage is below the 2 year flood levels so may not be acceptable.
- Will there be any loss of conveyance? Are any associated effects mitigated?
- Can the proposals be demonstrated to work hydraulically?

These are all very important issues that need to be addressed. There is a high chance that one or more may not be resolved satisfactorily. This will mean that the compensatory storage strategy is not valid and the development strategy for the river corridor will have to be reassessed.

9.4 SITE SPECIFIC ISSUES

As part of a review of the proposed sites several key issues have been identified.

- Can sufficient volume at appropriate levels be found?
- Can significant site access difficulties be overcome (all sites)?
- Are there any significant environmental issues (sites and haul routes)?
- Are the sites viable economically?
- Potential contaminated ground at Kensington site?
- Significant protests likely for each site.

Again, these are all very important issues that need to be addressed. There is a high chance that one or more may not be resolved satisfactorily.

10. Conclusions

This independent review has considered general planning issues for Bath, the principles of compensatory storage and specific issues for potential compensatory storage sites.

In order for More Vulnerable developments to be permitted in the river corridor in Bath a number of issues must be resolved.

- It must be confirmed that the B&NES policies and sustainability arguments behind their **Sequential Test** are sound.
- As part of the **Exception Test** the sustainable benefits of development in the river corridor should be substantiated.
- It must be clearly demonstrated that compensatory storage will be effective, with **no increase in flood risks.** This has not been done.
- The **Environment Agency** must agree to site-specific details, not simply the high level principles so far agreed.
- There has been limited consideration of **environmental issues** for the storage sites
- There are significant **access problems** at all of the identified sites.
- **No cost assessment** has been carried out for each of the potential sites to confirm overall viability.

In summary, there is insufficient evidence to demonstrate that a suitable compensatory storage solution will be found.

Appendices

Appendix A Summary of Bath and North East Somerset Flood Risk Management Strategy Report

Bath and North East Somerset Flood Risk Management Strategy Report

Final Report

Atkins

June 2010

Study Purpose
This study was commissioned by B&NES to provide "*detailed solutions to flood management in Bath and North East Somerset*". It considers the possibility of strategic flood risk management measures, investigating potential improvements to benefit individual and localised sites, and also schemes that might benefit more than one site.

The study is partly in response to the Bristol Avon Catchment Flood Management Plan, which has a policy for Bath of acting to reduce flood risk. This requires the identification of an overall strategy, as well as making improvements to existing assets through development opportunities.

Background
Prior to the study it was known that there was a varying level of flood protection provided across the centre of Bath, with flooding in many areas during events well below a 1 in 100 year return period. Previous improvements had varying levels of performance – see Section 4.6 of Atkins report. As with any modern city a high level of flood protection should be provided. This aspiration is strengthened by the unique heritage of Bath. Thus, the implementation of an appropriate flood risk management strategy was considered to be very important, to seek to minimise flood risks within the city.

In addition, there are many potential development sites within the city located close to the River Avon. B&NES is keen to develop such sites (many of which are brownfield sites) as part of its regeneration ambitions for the district. As many are wholly or partly within Flood Zone 3 (predicted to flood during a 1 in 100 year flood event) it is necessary that flood risk issues are considered in detail. Should such sites be developed there must be no adverse impacts on flood risk at the sites themselves, or in other areas.

This study benefits from previous flood risk studies that had been carried out, including the Strategic Flood Risk Assessment (SFRA) work carried out by Capita Symonds.

Methodology
The methodology for the study is discussed in the report. Key points noted are as follows:

- Identify flood risk management options for each development site.
- Assess options, considering:
  - The Sequential Test.
  - Urban sustainability.
  - Economic development.
  - Social benefits.
  - Flood defence standards of protection.
  - Construction costs against the value of damages to be avoided.
- The options considered fell into one of the following categories:
  - Strategic options: single scheme for a whole area.
  - Sub-strategic options: 2 or more developments working together to provide improved flood protection for a greater area.
  - Site specific options: works at individual sites, providing only local flood protection.

- High level appraisal of selected options, including:
  - Reference to requirements of the Exception Test.
  - Viability test developed.
  - Deliverability test developed.
- Detailed economic assessment, comparing capital & maintenance costs and the achievable benefits.
- Inclusion of B&NES, EA & Wessex Water staff at different stages of the process.

Conclusions

The Flood Risk Management Strategy concluded that there was no comprehensive strategic solution to reduce peak flows in Bath that was both technologically and economically viable. Rather, the report identified that the preferred solution to allow development of sites in Bath that lie below the 1 in 100 year (+20% for climate change) flood level is a combination of local on-site flood defences / defence improvements funded by developers and the provision of a compensatory storage area upstream of Bath.

Further work would be required to identify suitable sites for the storage and to confirm that this was a viable scheme.

The purpose of the compensatory storage is to offset the volume of water displaced by the defences on site. It was calculated that in order to achieve this for all of the anticipated developments in the floodplain a compensatory storage volume of about 350,000m^3 would be required. It appears that this may relate solely to the sum of the volumes lost from the development sites themselves, rather than the total volume displaced. This should include any additional volumes lost due to the improvements to local flood defences.

Whilst compensatory storage is normally provided at or close to development sites, in this case it was considered that offsite storage would be more cost effective than onsite storage. Indeed, costs of onsite storage might in some cases be prohibitive, with some developments not being viable. This approach should also allow for greater flexibility in planning of the re-developments.

Whilst the improvements to local defences would be funded directly by developers when individual developments proceed, compensatory storage work would have to be carried out first, initially funded by B&NES.

In promoting this strategy it was recognised that there were associated risks and challenges. For example, the compensatory storage works may prove not to be appropriate due to costs, technical issues, permissions, etc. In addition, there was a risk that developers might not agree to “buy” their storage requirement, with a consequent shortfall in the overall developer contributions.

It is also noted that if the strategic compensation is not delivered then space will be required for storage compensation on a site by site basis, which would reduce the development capacity of river corridor sites.

Appendix B Summary of Bath Compensatory Storage study

Bath Compensatory Storage study

Phase 1 – Final Report

White Young Green (WYG)

November 2011

Study Purpose
This was a study commissioned by B&NES "*to investigate the provision of compensatory storage upstream of Bath city centre to balance future loss of flood storage volume when planned developments take place*."

Background
The previous Atkins Flood Risk Management Strategy Report (FRMS) had given a preferred solution of allowing development within Bath in areas that would flood during a 1 in 100 year plus climate change flood event. In order to overcome the associated reductions in flood storage within the city an equivalent volume of compensatory storage would be required elsewhere. With no suitable areas available within the city centre it was considered that the necessary storage would be required upstream.

A required volume of approximately 345,000m^3 had previously been identified by Atkins. However, following a review of the potential development sites by B&NES this was reduced to approximately 205,000m^3. This is the volume that WYG worked with.

Whilst Atkins had identified possible sites at Kensington Meadows and Batheaston the WYG study was to consider various locations, identifying technically feasible upstream sites and to comment on one or more preferred sites, for more detailed assessment.

Methodology:
The methodology for the study is not described in detail. However, some key points are noted and others that can be inferred are as follows:

- No hydraulic modelling was carried out during the study. It is presumed that the predicted peak flood levels for different return periods at different locations were obtained from previous modelling.
- The compensation storage volume required was taken as a single volume, without consideration of how much storage might be required at different elevations associated with different flood return periods.
- There is no detailed back up provided to justify the new volume.
- The method for calculating the available volumes at different sites is not described in detail. However, it seems that available volumes at each site were calculated quite simply, as the volume of material between the 1 in 2 year flood level and the ground surface, up to the 1 in 100 year plus climate change flood level.
- In addition, the volumes associated with a further 1m depth of excavation below the 2 year flood level were considered.
- The assessment made use of LiDAR (aerial survey) data.
- WYG carried out a high level assessment of the sites from a hydraulic perspective. There was no detailed review of other constraints that might impact on the storage provision – e.g. services.
- Only brief consideration was given to transportation issues – site access, etc.
- No detailed environmental assessment was carried out.
- If possible all the storage should be provided at one site – or at a limited number of sites.
- Following an initial assessment of potential sites some were selected for further review.
- There was no detailed assessment of costs or timescales associated with the necessary works.

Summary of Findings and Conclusions

- Five of the sites that were initially considered were discounted due to insufficient potential storage capacity relative to the associated costs and potential planning issues.
- The three remaining sites (Kensington Meadows, Batheaston and Bathampton) were reported to have low ecological value. However, no detailed assessments were carried out to substantiate this view. Various environmental issues were noted but none were considered in detail. These included:
  - Loss of trees along the river bank.
  - Impacts on habitats – bats and otters are likely at one or more of the sites.
  - It was noted that Kensington Meadows had previously been used as a tip, which could lead to material contamination and associated cost issues.
  - Potentially serious difficulties with site access were noted. However, these were not considered in any detail.
- The only location to have sufficient storage available was the Bathampton site (210,000m^3, all above the 2 year flood level).
- Even if the Kensington Meadows and Batheaston sites were both used there would need to be additional capacity excavated below the 2 year flood level.
- It was recommended that the sites be discussed amongst stakeholders such as B&NES and the EA to determine whether further consideration is appropriate.
- If a preferred site is identified further studies would be required to confirm site suitability and feasibility. This would include studies of the following issues:
  - Land ownership.
  - Land contamination.
  - Topography.
  - Geology and underlying soils.
  - Underground infrastructure.
  - Ecology impacts.
  - Sustainability and biodiversity.
- In addition, detailed hydraulic modelling would be required to confirm that the proposals worked hydraulically.

More details of the individual sites are included in Appendix C.

Appendix C Review of Potential Storage Sites

Kensington Meadows (owned by B&NES)

1. Location

Between the A4 and the River Avon, behind Kensington Place and Grosvenor Place, close to many residential properties.

2. Land Use

Currently it is mainly an open playing field, with a lower meadow area adjacent to the river. The meadow area has many trees and other vegetation – including a tree-lined river bank. The site is used for recreation purposes – children's play area, football and other games, dog walking, fishing, etc. The meadows has recently received a Green Flag Award – a national standard for parks and green spaces.

Noticeboards at the site state that it has been previously used as a tip. Observations during the walkover survey support this – it is an unnaturally flat and open site and there is a stone slope protection between the playing field and the lower meadow level (presumably for protecting the raised fill area from erosion due to flows in the lower flood plain). There is also lower ground in gardens further from the river, between the playing fields and Kensington Place, implying raised ground levels at the playing fields, but not in the gardens.

Plate 1: Kingston Meadows playing field

Kensington Meadows (owned by B&NES)

3. Size

This is the smallest of the three main sites considered by WYG.

The site area is approximately 5.5 hectares. The playing field is approximately 500m by typically 70m (two-thirds of the total area), with the lower meadow being about 300m by 80m maximum.

4. Access

The current access for maintenance vehicles, etc. to the playing field is via a gate from Ringswell Gardens. However, this would be unsuitable for construction traffic and for a haul route for the removal of material. There are narrow routes up to the nearby A4, with very difficult junctions.

Site access is very important but was not considered in detail by WYG.

Temporary access would probably have to be negotiated with Morrisons (they have a supermarket immediately beyond the western end of the site), through their car park. Whilst there is a suitable junction to the A4 this is on to a very busy part of that route.

5. Habitats

An ecological assessment has not been carried out. However, the Kensington Meadows is a local nature reserve, with areas of fen and woodland. It supports a diverse population of plants and animals, being used by otters, bats and kingfishers.

This part of the river is one of the few areas in Bath where the river has natural banks. It would be reasonable for the meadow area to not be excavated, to seek to preserve existing habitats. Because of the existing low ground levels at the meadow there is limited potential storage in this area anyway.

Plate 2: Lower area at Kingstown Meadows

Kensington Meadows (owned by B&NES)

6. Geology and Materials

Details of the local geology are not known. However, if this site is to be considered further a clear understanding of the nature of the fill material is required.

There is potential for contamination, which could require treatment of the excavated material, as well as appropriate disposal. This would increase costs substantially and could make the site non-viable, irrespective of any other issues. Depending upon the type of fill material it may not be suitable for use in raising ground levels at any of the proposed development sites, irrespective of any contamination issues. This requires appropriate investigation.

7. Levels, Flood Zones and Storage

WYG reports that ground levels at the playing field vary between 20.0m and 21.8m. The local 100 year plus climate change peak flood level is 22.66m. The whole of the upper part of the site lies in Flood Zone 3a (predicted to flood between a 1 in 20 and a 1 in 100 year flood event). Peak flood depths for the 100 year plus climate change event are between 0.9m and 2.7m.

The meadow area is all below the 2 year flood level of 19.21m – so is all in the functional floodplain.

For the excavation works at this site to be effective all of the excavated material will have to be removed from the site. There is no suitable adjacent area that could be raised.

WYG states three different values for the available volume above the 2 year flood level – varying between 68,000m^3 and 84,000m^3. The reason for the differences is not known. An additional 31,000m^3 is reported to be available below the 2 year flood level. The total reported volume represents about 50% of the volume that WYG advises is required.

Whilst the proposed excavation would provide a significant volume it would be mainly at lower levels, providing benefits for the lower return period events but not for the more severe events.

As a consequence of the various site issues the available storage may be significantly lower than that indicated by WYG.

8. Summary of Issues

There are many significant issues to be taken into account if this site is considered further as a possible site for compensatory storage. These include the following:

- **Available volume:** likely to provide only a relatively small part of the required volume.
- **Storage level:** primarily at a low level (much of it being below the 2 year flood level). This is ineffective for the more severe floods. Such low excavation may not be acceptable.
- **Local flood risk**: reduction of ground levels at the playing field may increase the probability of flooding in the adjacent low lying gardens.
- **EA approval:** can it be demonstrated that the works are suitable hydraulically?
- **Future land use:** the playing field and meadow would flood more frequently and generally be wetter. They will be less available for community use.
- **Access:** existing access is inadequate. A temporary access will require negotiation.
- **Traffic:** lorries would remove materials along a busy urban part of the A4. Up to about 10,000 lorry loads required (less if the scale of excavation is reduced).
- **Ecology:** detailed environmental assessment required – impacts on habitats, etc., including bats and otters.
- **Landfill issues:** potential contamination. Associated special measures for material disposal may be required.
- **Temporary construction impacts:** working close to residential area (noise, dust, restricted working hours, etc.).
- **Potential protests:** one should anticipate protests from the local residents & community.
- **Costs:** a full and detailed cost assessment is required.

These are all significant issues that must be considered in detail. Where possible they should resolved before it can be confirmed that compensatory storage at Kensington Meadows is viable.

Batheaston (owned by B&NES)

1. Location

Rural area to the east of Bath, between the River Avon, the A46 Batheaston bypass and Mill Lane. Water levels in the adjacent river are controlled by the adjacent toll bridge structure and a weir a short distance downstream of it.

2. Land Use

Currently it is primarily open agricultural land, used for grazing (agricultural grade 4). There are only a few hedges and trees within the site. The riverside is used for fishing.

Plate 3: Batheaston fields adjacent to River Avon

The eastern part of the site forms the Bathampton Meadows Nature Reserve, created in 1996 to provide flood relief for the A46 bypass. This included the excavation and re-profiling of land and providing a large pond. A significant volume of material was removed from the site. The meadow is managed by the Avon Wildlife Trust.

3. Size

The overall area is approximately 21 hectares (about 6 hectares of this is within the nature reserve).

Plans for a park and ride scheme on slightly higher ground immediately to the south of the proposed storage site were recently shelved by B&NES. It is therefore possible that the proposed site area could be expanded, with an increase in the available storage.

Batheaston (owned by B&NES)

4. Access

Current access to the fields is off Mill Lane. However, it should be noted that for large / heavy vehicles and plant there are significant difficulties gaining access to Mill Lane itself.

From the north it is accessed from the old A4 via a steep, narrow, windy road, and then across the Batheaston to Bathampton toll bridge. However, this has a 4 ton weight limit. From the south access is from the A36, via steep and narrow roads within the residential area of Bathampton village. There is also a narrow bridge across the Kennet and Avon canal, with very tight vertical and horizontal alignments, presenting major difficulties for construction traffic. There is also a narrow bridge over the Bath to Swindon railway line to the south of the site.

Whilst access was required during the creation of the nature reserve this would have been possible from the site of the new road, whilst it was under construction.

Existing routes are unsuitable for construction traffic and for the removal of material. A new access route will therefore be required. Whilst presenting some difficulties the most appropriate access may be the creation a temporary haul route off the A46 bypass, a short distance from the Batheaston roundabout.

5. Habitats

An ecological assessment has not been carried out.

Whilst the field area is open there are many trees along the edge of the river. The Meadow is a local nature reserve and it is understood that it and the surrounding area support a diverse population of plants and animals, including otters, bats, kingfishers and herons. The Bathampton Meadow is understood to attract a variety of migrant water birds.

Plate 4: Meadows at Batheaston site

Batheaston (owned by B&NES)

6. Geology and Materials

Details of the local geology are not known. However, being close to the river it is likely to be alluvial deposits. The proportion of excavated material that would be suitable for ground raising in Bath is not known. A spring was noticed on site nearer the higher ground.

7. Levels, Flood Zones and Storage

The site is quite flat, rising gently to the south. WYG reports that ground levels vary between 20.4m and 21.6m - lower than much of the downstream Kensington Meadows site. Consequently about half of the site is at or below the 2 year flood level of 20.49m. The local 100 year plus climate change flood level is reported to be 23.56m, so the whole site is well below the 100 year plus climate change peak level.

For any excavation works to be fully effective the excavated material must be removed from the site. Whilst some materials could perhaps be placed on the higher land to the south of the site it would probably not be able to accommodate the full proposed amount.

WYG states that there is approximately 60,000m^3 available volume above the 2 year flood level. An additional 113,000m^3 is reported to be available below the 2 year flood level. Whilst the total is in excess of 80% of the volume that WYG advises is required, about two-thirds is below the 2 year flood level, so most will be ineffective for the more severe events. This is a serious shortcoming of this site.

8. Summary of Issues

There are many significant issues to be taken into account if this site is to be considered further as a possible site for compensatory storage. These include the following:

- **Available storage:** proposal includes some low excavation, below the 2 year flood level, which is not good for several reasons. The actual volume available may be significantly less than the suggested 173,000m^3.
- **Storage level:** the vast majority of the storage is at a low level – so it would be ineffective for the more severe floods.
- **EA approval:** can it be demonstrated that the works are suitable hydraulically?
- **Future land use:** site likely to generally be wetter, with more frequent flooding. Agricultural value likely to reduce.
- **Access:** existing access is inadequate. A temporary route from the bypass will be required.
- **Traffic:** lorries would remove material from the site, with up to about 17,000 lorry loads taken off site (less if the scale of the excavation is reduced).
- **Soils**: local geology is not known – anticipated to be alluvial deposits. The proportion of the excavated material that is likely to be suitable for ground raising in Bath is not known.
- **Ecology:** detailed environmental assessment required – impacts on habitats, etc., (including bats and otters).
- **Potential protests:** major protests should be anticipated – previous strong local opposition to the Batheaston bypass and to the park and ride scheme.
- **Costs:** full and detailed cost assessment required.

These are all significant issues that must be considered in detail. Where possible they should resolved before it can be confirmed that compensatory storage at the Batheaston site is viable.

Bathampton (third party owner)

1. Location

Rural area east of Bathampton. There are two parts to this site – the smaller western area between the River Avon and the Bath to Bradford-on-Avon railway line and the larger eastern area between the River Avon and Warleigh Lane. This site is the furthest from the proposed developments.

2. Land Use

Currently it is primarily open agricultural land, used for grazing (agricultural grades 3 and 4). There are a number of hedges and trees within the two sites. There is a transmission pylon within the site, which will locally affect the possible storage details.

Plate 5: Bathampton western area, from railway bridge

3. Size

The western part of the site has an area of approximately 7.5 hectares, with the eastern area being about 21 hectares.

Whilst it might be possible to expand the western area slightly it is constrained by railway embankments (northern and western sides) and by the river (eastern edge). However, potentially the eastern part of the site could be expanded into the higher ground further from the river.

4. Access

The current access to the fields on the west is via a narrow lane off Mill Lane. Immediately adjacent to the site there is the Bath to Bradford-on-Avon railway line to cross – either via a level crossing or through a narrow underbridge (approximately 3m wide) to the south. Agreement with the rail authorities would be required. Once onto Mill Lane there are still significant difficulties for large / heavy vehicles and plant to gain access to the main road system, as noted for the Batheaston option (4 ton limit on toll bridge (northern route), very tight alignments for the canal bridge (southern route), steep and narrow

Bathampton (third party owner)

roads within the residential area of Bathampton village, etc.).

Existing routes are unsuitable for construction traffic and the removal of material, so a new route will be required. It may be most appropriate to create a temporary haul route onto the A46 bypass through / close to the Batheaston site, accessing the bypass a short distance from the Batheaston roundabout.

Plate 6: Canal bridge and road junction on Bathampton west access

There is no immediately available suitable access for construction plant to the fields on the eastern side. However, access could be provided relatively easily onto the main road at the bottom of Bathford Hill, at Jewson View Farm, at the northern end of the site.

5. Habitats

An ecological assessment has not been carried out.

Whilst the field areas are open there are many trees along the edge of the river. The river environment is likely to support a diverse population of plants and animals, including otters, bats and kingfishers – all reported in the surrounding area.

6. Geology and Materials

Details of the local geology are not known. However, being close to the river it is likely to be alluvial deposits. The proportion of excavated material that would be suitable for ground raising in Bath is not known.

Bathampton (third party owner)

7. Levels, Flood Zones and Storage

WYG reports that ground levels vary from 21.4m to 24.2m - all below the 100 year plus climate change level of 24.33m. However, there appears to be an error in their lower figure, as WYG Figure 5.4 shows that more than 50% of the site is lower than the reported 2 year flood level of 21.21m.

For any excavation works to be fully effective the excavated material needs to be removed from the site. Whilst some materials could possibly be placed within the site, to raise some areas, this would reduce the area available for excavation. Thus, to be fully effective the excavated material would have to be removed for reuse / disposal elsewhere, or placed on the higher farm land to the east of the site.

WYG states that there is approximately 210,000m^3 (or 223,000m^3 stated in another part of the report) available volume above the 2 year flood level. This is very similar to the total volume that WYG advises is required. It is not clear whether the level error noted above affects this volume calculation.

Plate 7: Bathampton east site

This is the largest site and offers the greatest volumetric benefit, generally at higher levels than at the other 2 sites. This will give some benefits for the more severe events.

8. Summary of Issues

There are many significant issues to be taken into account if this site is to be considered further as a possible site for compensatory storage. These include the following:

- **Storage volume:** whilst the volume appears adequate to meet the objective, it may be found that the western area (about 25% of the overall site area) cannot be exploited economically – primarily due to access issues. There is also potentially an error in the calculation.
- **Beneficial effects:** due to attenuation issues the beneficial effects of storage reduce with distance from the development site. This is the furthest away proposed storage site.

Bathampton (third party owner)

- **EA approval:** can it be demonstrated that the works are suitable hydraulically?
- **Future land use:** site likely to generally be wetter, with more frequent flooding. Agricultural value likely to reduce.
- **Access:** existing access to and from the west is inadequate. Agreement on crossing the Bath to Bradford-on-Avon railway line would be required, along with a temporary access from the A46 bypass.
- **Traffic:** lorries would remove material from site with up to about 21,000 loads (less if the scale of the excavation is reduced / material is deposited on adjacent land).
- **Soils**: local geology is not known – anticipated to be alluvial deposits. The proportion of the excavated material that is likely to be suitable for ground raising in Bath is not known.
- **Ecology:** detailed environmental assessment required – impacts on habitats, etc., including bats and otters.
- **Potential protests:** major protests should be anticipated – there has been previous strong local opposition to the nearby Batheaston bypass and the park and ride scheme.
- **Costs:** full and detailed cost assessment is required.

Whilst this may seem the most favourable site in many respects these are all significant issues that must be considered in detail. Where possible they should resolved before it can be confirmed that compensatory storage at the Bathampton site is viable.

Appendix D Overview of Flood Risk & Planning Policy

1. PPS25 - Introduction

The *Planning Policy Statement (PPS25): Development and Flood Risk* was published in December 2006 by the Department for Communities and Local Government (DCLG) and updated in March 2010. The document sets out the Government's planning policies on land use with respect to flood risk issues, and as such is a key document used by planning authorities and by the EA when determining planning applications. A Practice Guide was published in June 2008 (updated December 2009).

These documents strengthened the role of the planning system in managing flood risk and they clarified planning policy on development and flood risk to:

- Ensure flood risk is taken into account at all stages in the planning process.
- Avoid inappropriate development in areas with a flood hazard.
- Direct development away from areas at highest risk.
- Ensure new developments take climate change into account and do not increase flood risk elsewhere.

Local Planning Authorities (LPAs) are required to consult the Environment Agency on all applications for development in flood risk areas (except for minor development), including those in areas with critical drainage problems, and for any development on land exceeding 1 hectare outside flood risk areas. The Environment Agency may object to major developments in flood risk areas.

2. Flood Zones, Vulnerability & the Sequential Test

Key components of PPS25 are the Sequential and Exception Tests. The Sequential Test is the mechanism for directing development vulnerable to the impacts of flooding to sites with lower risk. The risk of flooding is defined according to the flood zones shown on the Environment Agency flood map (and outlined in Table D1 in PPS25), where:

- **Zone 1** is land with an annual probability of river flooding of less than 1 in 1,000 (or < 0.1%) in any year;
- **Zone 2** comprises land that has between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability of river flooding, or between a 1 in 200 (0.5%) and 1 in 1,000 (0.1%) annual probability of sea flooding in any year;
- **Zone 3a** comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of sea flooding (>0.5%) in any year;
- **Zone 3b** is defined as "functional floodplain", and comprises land where water has to flow or be stored in times of flood. SFRAs will identify this land as having an annual probability of 1 in 20 (5%) or greater in any year.

Based on the above, development should be directed to areas with the lowest probability of flooding and should only be permitted in zones with greater probability of flooding if there are no suitable sites available in lower risk areas. The Sequential Test also considers the flood vulnerability of the intended use of the development and the need to match this to the flood risk of the site. Tables D1 and D2, taken from PPS25, set out the categories of flood vulnerability and the linking of these to the flood zones.

As an example of this mapping of vulnerability, a new, small housing development lying close to a Main River should locate the dwellings in zone 2 (outside the 100 year flood outline). However, an associated recreation area with changing rooms could be located in either zone 3a or 3b, although 3a would be preferable, to avoid loss of designated floodplain and to avoid areas that are likely to be more waterlogged.

An LPA must show that it has considered a range of possible sites in conjunction with the flooding information from an SFRA, in the site allocation process. The Sequential Test should also be used where LDD policies have not applied the Sequential Test when allocating sites. In this case it is the responsibility of the developer to provide the appropriate information for their site to enable the LPA to apply the test.

Table D1 Flood Risk Vulnerability Classification

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Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, & strategic utility infrastructure, including electricity generating power stations and grid & primary substations.
Highly Vulnerable	• Police stations, Ambulance stations & Fire stations & Command Centres & telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes & park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons & hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; & hotels. • Non–residential uses for health services, nurseries & educational establishments. • Landfill & sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans & camping, **subject to a specific warning & evacuation plan.**
Less Vulnerable	• Buildings used for: shops; financial, professional & other services; restaurants & cafes; hot food takeaways; offices; general industry; storage & distribution; non–residential institutions not included in 'more vulnerable'; & assembly & leisure. • Land & buildings used for agriculture & forestry. • Waste treatment (except landfill & hazardous waste facilities). • Minerals working & processing (except for sand & gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).

Water-Compatible Development	• Flood control infrastructure. • Water transmission infrastructure &pumping stations. • Sewage transmission infrastructure & pumping stations. • Sand & gravel workings. • Docks, marinas & wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing & dismantling, dockside fish processing & refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard & coastguard stations. • Amenity open space, nature conservation & biodiversity, outdoor sports &recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning & evacuation plan.**

Table D2 Flood Risk Vulnerability and Flood Zone "Compatibility"

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Flood Risk Vulnerability classification (see Table 2.2)		**Essential Infrastructure**	**Water Compatible**	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b "Functional Floodplain"	Exception Test required	✓	×	×	×

3. The Exception Test

Following application of the Sequential Test the Exception Test may be applied. This allows the disadvantages of developing in a flood risk area to be balanced against potential positive contributions to sustainable development that new development can bring. Therefore issues such as providing wider community benefits and using previously-developed land may outweigh flood risk issues. Further details of the Exception Test can be found in paragraphs D9 to D14 of PPS25.

4. Production of Flood Risk Assessments (FRAs)

It is the responsibility of those proposing or considering a development to ensure that an appropriate assessment of the flood risk issues has been undertaken. A properly prepared FRA will inform the whole decision-making process at all stages of the planning and construction process. It is the responsibility of the developer to consider the specific flood risks pertaining to a site, particularly prior to purchase of the land and infrastructure. The scope of any site-specific FRA should be agreed with the LPA, and the developer is strongly urged to consult with the Environment Agency, to address and resolve the key flood issues that may pertain to the site.

The FRA needs to be undertaken by competent people, as early as possible in the planning process, so that it can inform the emerging development proposal. In addition to considering the current flood hazard from all sources, it needs to include the scenarios for future climate change, as set out in the latest Defra guidance and in PPS25, for a planning horizon appropriate to the development under consideration. This needs to consider, depending on the context, the impacts of predicted changes in sea level rise, rainfall, river flow and wave generation. The FRA also needs to consider whether the development itself could affect the flood risk to others both upstream and downstream of the site.

Further advice on preparing FRAs is contained in the CIRIA report C624 (Development and flood risk: Guidance for the construction industry), and in the PPS25 Practice Guide.

5. Sustainable Drainage Systems (SUDS)

Flooding results from both sources external to a development site and rainfall falling onto and around the site. The sustainable management of this rainfall, termed surface runoff, is an essential element in reducing flood risk to both the site and adjacent areas. Guidance has been produced by Defra / Environment Agency (2005) to advise on the management of stormwater drainage for developments and in particular to assist in the sizing of storage elements for the control and treatment of stormwater runoff. Assessment of surface runoff and drainage is often a key part of an FRA.

A key component in providing effective and sustainable drainage solutions for new developments is the use of Sustainable Drainage Systems (SUDS), which form part of the policies of LPAs and the Environment Agency. SUDS cover the whole range of sustainable approaches to surface water management, including:

- Source control, including rainwater harvesting
- Infiltration devices, such as soakaways
- Filter strips and swales
- Filter drains and porous pavements
- Basins and ponds to detain water temporarily after rainfall, and allow controlled discharge that prevents flooding.

A large amount of guidance exists to help in the choice and design of SUDS for any site, and this should be considered at a very early stage of the development proposal, so that site layout can accommodate the most appropriate solution.

Appendix E Taunton Vision – Long Run Farm

1. Introduction

Compensatory storage is often provided in conjunction with the development of a site. In most cases this is provided within or close to the development area, on a level-for-level basis. The post-development performance will therefore be very similar to the pre-development performance. However, for urban redevelopments it is not always easy to find appropriate areas for such storage, and a different location will be required.

This was the case for the Taunton Vision Project.

Some of the issues related to this project are outlined below. These comments are based on information from staff at Taunton Deane Borough Council and the Environment Agency.

2. Taunton Development

Proposals were prepared for the redevelopment of parts of the centre of Taunton. However, there were significant associated flood risk issues, as substantial volumes of flood storage would be removed, causing local flood risks to increase. If a solution could not be found then developments could not proceed.

3. Upstream Storage

As there were no suitable storage sites in the central area it was recognised that upstream works would be required. Initially the possibility of attenuation storage behind dams was considered. However, this would require several significant structures and would be too expensive and time consuming to implement.

The adopted solution was to create a new area of upstream flood storage at Long Run Farm, close to the river.

The approval of the EA to the proposed works was sought and obtained.

4. Implementation

Ground levels at Long Run Farm, upstream of Taunton, were re-profiled to create new flood storage areas, with appropriate perimeter bunds used to control the flows. It was designed so that it starts to fill when river levels reach the 1 in 75 year flood level. Flows are discharged to the river later in the event, as water levels in it drop.

5. Key Issues From the Taunton Experience

- It was considered that the excavation of part of an existing floodplain was not appropriate to create more storage, as the new storage would be at a relatively low level and would be ineffective for the more extreme events.
- The new storage was gained from land originally outside of the flood plain.
- It was inappropriate to excavate too deeply, as groundwater might enter the storage area and in effect remove some of the new storage.
- When planning the scheme any potential changes to flow hydrographs due to the distance between the compensatory and lost storage sites were considered.
- The compensation storage provided exceeded the lost volume significantly.
- It was demonstrated using modelling techniques that for all return period events the predicted peak levels in Taunton are as good as or better than before.
- Whilst the available storage has been sold to developers the ownership – and thus legality of selling such storage - has been challenged elsewhere.