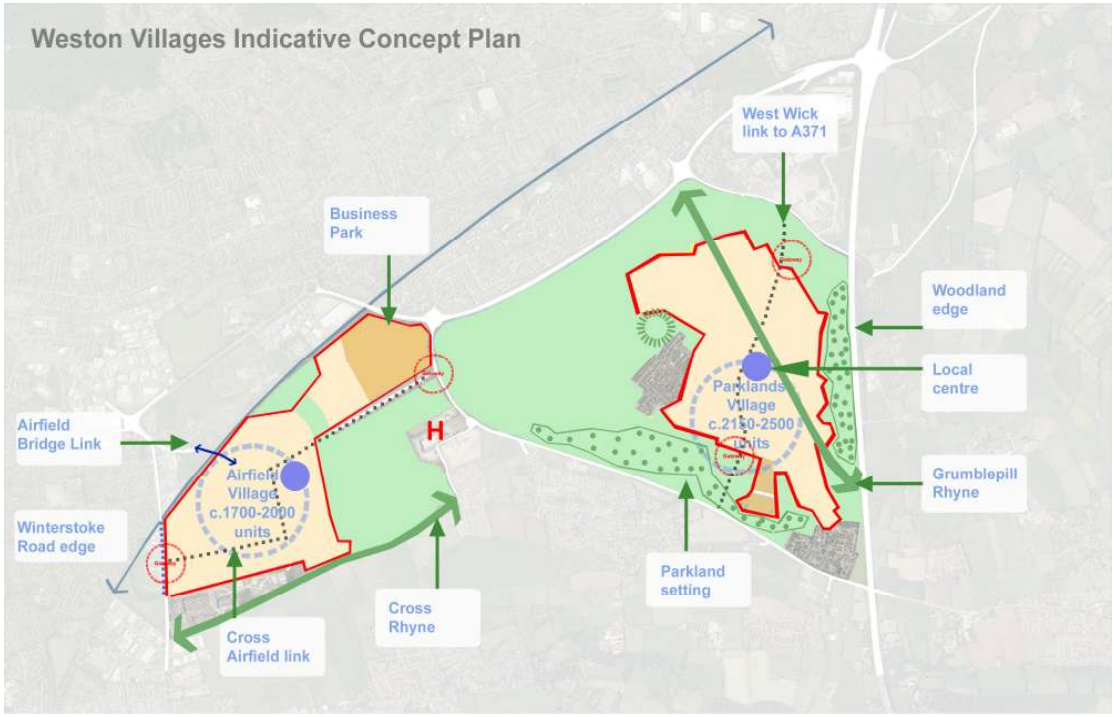

Weston-super-Mare Flood Management Study Phase III

North Somerset Council

8 November 2010
Draft Report
9V9772

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SUMMARY

Royal Haskoning were commissioned in September 2010 to undertake an assessment of the flood risk implications of reducing the scale of the proposed development, particularly with regard to the required storage volume of the super pond and whether on-site mitigation could be an alternative option. Following the abandonment of the South West Regional Spatial Strategy the current development expectations have reduced from 9,000 to approximately 5,500. Discussions were therefore held between North Somerset Council, developers and the Environment Agency, where it was decided that the possibility of on-site mitigation works should be reconsidered for the Airfield area. The preferred mitigation option on the River Banwell has also been revisited as part of this assessment.

The Standard Percentage Runoff (SPR) for a catchment is a measure of the permeability of the site, the lower the value the more permeable the ground. Generally the SPR pre development was assessed to be 30%. The changes to the development plan outline meant that the SPR was increased to approximately 43% rather than 46% as assessed in the Phase II study.

For the current arrangement the 1 in 100 year plus climate change pre development flows are approximately 22 cumecs. The previous assessment estimated this would increase to 28 cumecs post development. With the revised development outline this has been reduced slightly to 27 cumecs. The flows as a result of the new development are therefore only slightly smaller than the flows we considered as part of the Phase II study.

This small change in flow therefore means that the volume of surface water runoff that needs to be managed from the site is reduced from 210,000m^3 to 171,000m^3. This volume is the additional surface water runoff from the site when compared to the pre development scenario. Note that this is not necessarily the exact size of the storage required due to timings etc.

Even if the whole 171,000m^3 of additional runoff is attenuated on-site, there still needs to be a super pond with a capacity of 197,000m^3 to take the development areas out of the 1 in 100 year plus climate change flood extent, and therefore eliminate the need for compensatory storage.

One of the main benefits of the super pond is that it prevents the flooding of the Airfield and therefore means this area can be developed. It also reduces the existing flood risk to properties within the catchment, particularly downstream of the site. Without the super pond the Airfield would still flood and therefore mitigation would be needed for the increase in surface water runoff and the floodplain storage lost in those areas. It is extremely unlikely that this could all be dealt with onsite, particularly as the onsite storage areas would also be likely to flood. In addition there is a high level of ground in that area and therefore large areas of land would be required for the storage.

Onsite mitigation is therefore highly unlikely to provide the necessary storage and, on its own, would not provide the other benefits that can be obtained from the super pond and substantial volumes of compensatory storage would also be required. This would be extremely difficult to provide on the development sites.

One of the major advantages of the super pond is the elimination of the need for developers to provide compensatory storage due to loss of floodplain storage as the

area would no-longer be at risk of flooding. Areas both upstream and downstream would also be at reduced flood risk with the super pond in place. This is shown on Figure 3.1.

We investigated the required size of the super pond based on the revised development figures if 100% of the increase in surface water runoff was mitigated on site and the difference in volumes were relatively small i.e. 207,000m^3 for 0% on-site attenuation compared with 197,000m^3 for 100% on-site attenuation. It is therefore suggested that it would be more suitable to focus on the one super pond rather than developing a number of onsite and off site mitigation works.

We therefore recommend that the super pond is still the most suitable mitigation for this area, taking into account all of the benefits it can provide. These benefits include:

- the reduction of the flood risk to existing properties,
- eliminating the requirement for compensatory storage for developments
- providing environmental enhancement opportunities and amenity facilities.

CONTENTS

1 INTRODUCTION

1.1 Background

Royal Haskoning were commissioned in September 2010 to undertake an assessment of the flood risk implications of reducing the scale of the proposed development, particularly with regard to the required storage volume of the super pond and whether on-site mitigation could be an alternative option. Following the abandonment of the South West Regional Spatial Strategy the development predictions have reduced from 9,000 to approximately 5,500. Discussions were therefore held between North Somerset Council, developers and the Environment Agency, where it was decided that the possibility of on-site mitigation works should be reconsidered for the Airfield area. The preferred mitigation option on the River Banwell has also been revisited as part of this assessment.

Figure 1.1 provides a location plan of the area, highlighting the revised Weston Development Area boundary.

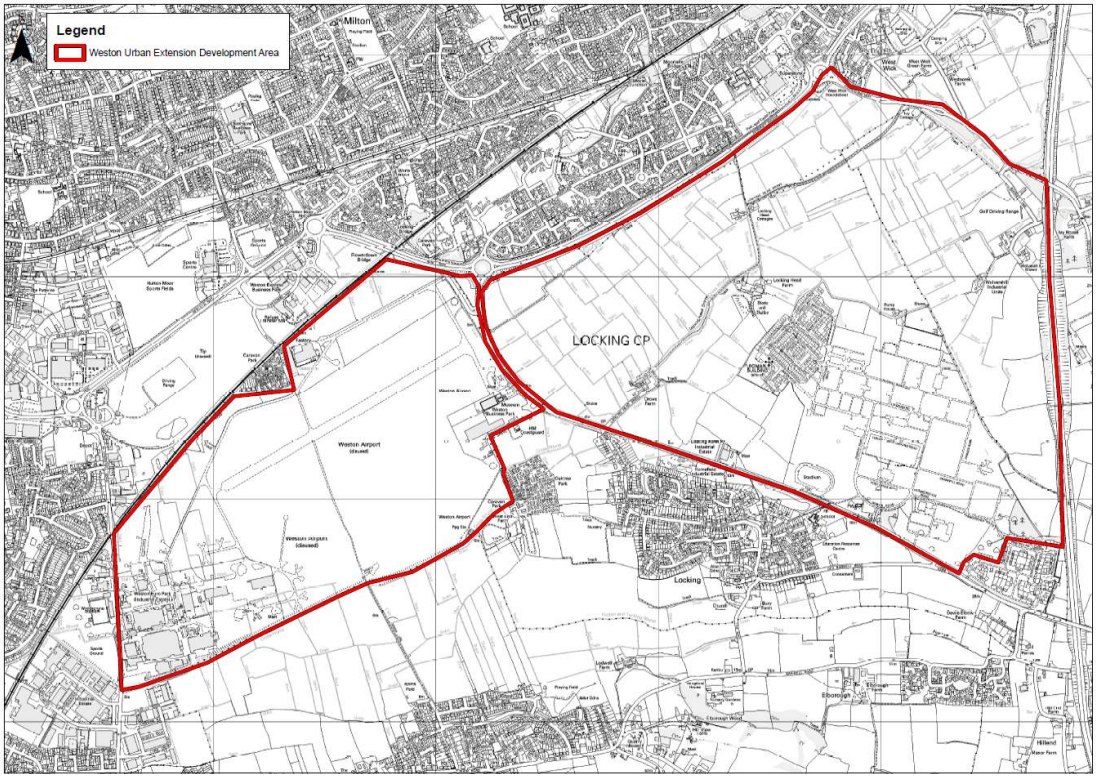

Figure 1.1: Location plan

1.2 Previous studies

There have been numerous investigations undertaken in the Weston-super-Mare area, particularly focussing around the Weston Urban Extension.

Initially the Weston Flood Management Study Phase I was completed in April 2006. The aim of Phase I was to undertake a pre-feasibility study for a strategy for delivering a comprehensive flood defence scheme for the Weston Vision area. Separate pre-feasibility studies were undertaken for the River Banwell and for the Uphill Great Rhyne catchment. The Phase I study was then developer further in the Weston Flood Management Study Phase II, which was finalised in 2007. The Phase II study aimed to

develop a comprehensive flood management scheme in Weston-super-Mare to both protect existing properties and to assess and facilitate the development of 9,000 dwellings in the area around the former sites of Weston Airfield and RAF Locking.

The 9,000 dwellings formed the urban extension as proposed in the draft South West Regional Spatial Strategy (SWRSS). The Coalition government have now abandoned Regional Spatial Strategies and so there was a need to review the conclusions of the Weston Flood Management Study in the light of a potentially smaller scale of development at Weston.

Large areas of the Weston Urban Extension are subject to a risk of fluvial (river) and/or tidal flooding from the watercourses in the area. Given the flood risk issues relevant to Weston-super-Mare, a holistic approach has been advocated by the Environment Agency to promote a comprehensive flood management scheme. The Weston Flood Management Study examined twenty four flood risk improvement options. These options were assessed in terms of technical performance, environmental impact and economics to identify a preferred option.

The preferred options from the Weston FMS Phase II study were as follows:

<u>For the Uphill Great Rhyne Catchment -</u> Provision of a large online flood storage area (super pond) and associated channel works, with opening up of the Airfield culvert.

This lake will be created by diverting flows from Cross Rhyne along a new channel running through an area of wetland and then into a lake which will provide online storage as well as the potential for recreational facilities and environmental / biodiversity enhancement. The lake would also be fed from the freshwater stream which flows into Hutton and Locking Rhyne to help to maintain water quality. The required volume of the lake is between 170,000m^3 and 210,000m^3. The precise volume, location and design of the control structures, and the potential and scale for recreation and amenity provision will all need to be determined at an appraisal stage. A location plan of the proposed works taken directly from the Phase II study is shown in Figure 1.2. Note that the wetland area is no-longer included in this option.

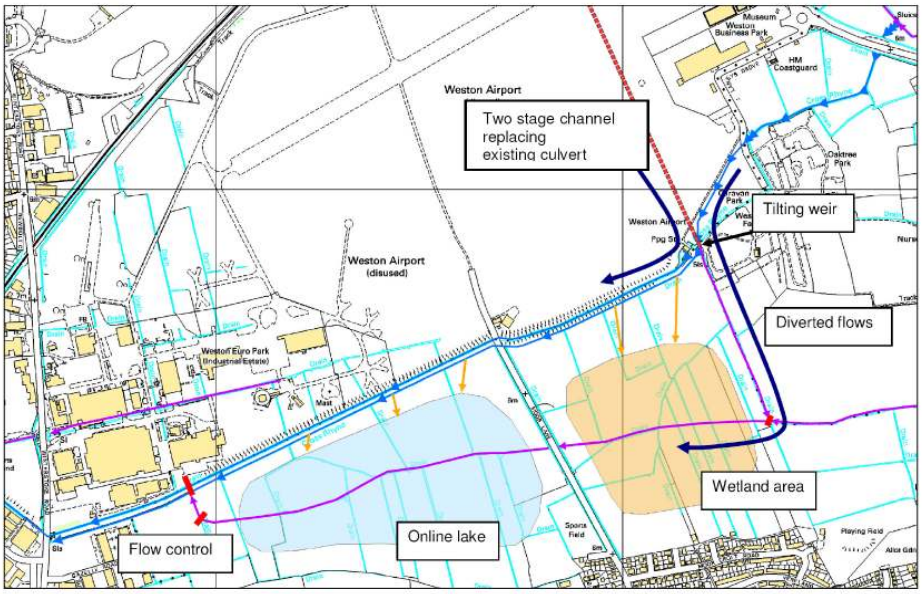

Figure 1.2: Uphill Great Rhyne preferred option from Phase II study

<u>For the River Banwell Catchment -</u> Provision of a widened two-stage channel with local bank raising.

In the Banwell catchment area there is only a small increase in flood risk due to the proposed development. The flood risk strategy therefore aims to mitigate and reduce flood risk to existing properties such as in the St Georges area. At the present level of development it is not felt that there are sufficient grounds in terms of potential flood risk to provide any formalised storage across the catchment. The compound channel will be constructed downstream of the M5 motorway with a lowered berm extending laterally for 50m on the right bank of the channel over a 1,900m reach of channel. This will provide additional storage at times of high flow with minimal disruption to the existing agricultural land use (grazing). At certain points along the left bank of this channel the defence is known to have low points which will require a small increase in elevation to the existing banks. A location plan of the proposed works taken directly from the Phase II study is shown in Figure 1.3.

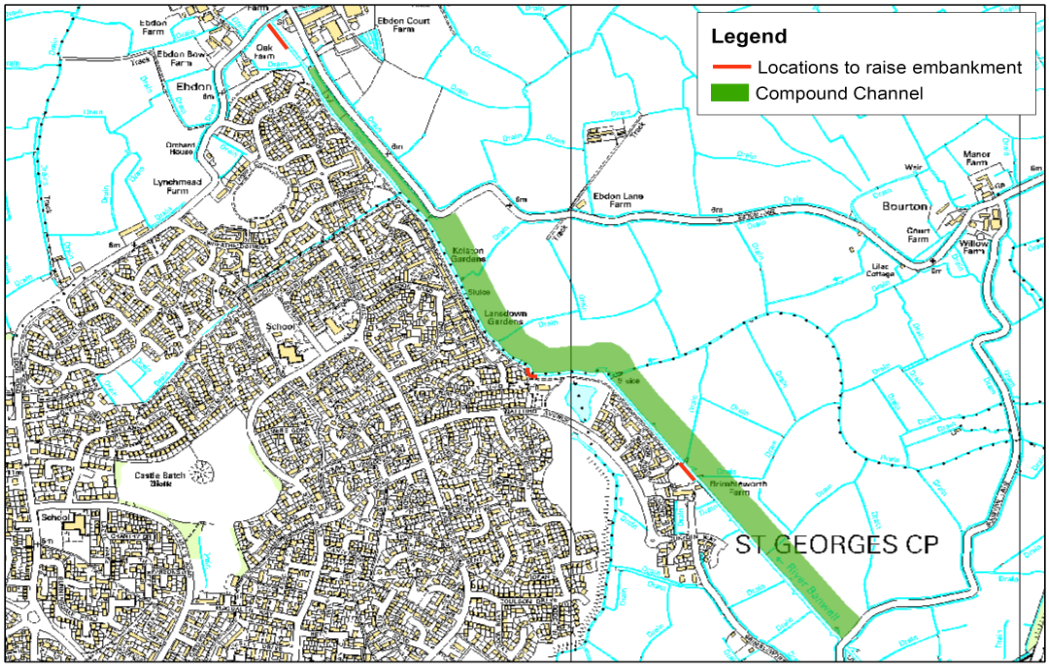

Figure 1.3: River Banwell preferred option from Phase II study

The main details of the modelling, hydrology and options are provided in the Weston-super-Mare Flood Management Study Phase II Options Report, October 2007. This addendum report provides an update based on the adjusted development figures.

1.3 Changes to the proposed development

The Weston-super-Mare Flood Management Study Phase II was based on 9,000 dwellings within the Weston Urban Extension area. Following the changes with the RSS, work is progressing on a smaller Weston Urban Extension which, although focusing on the same general area, will consist of two urban villages on the former Weston Airfield and RAF Locking site. The total capacity will now be between 5,200 and 5,700 dwellings. Figure 1.2 below shows the latest concept plan.

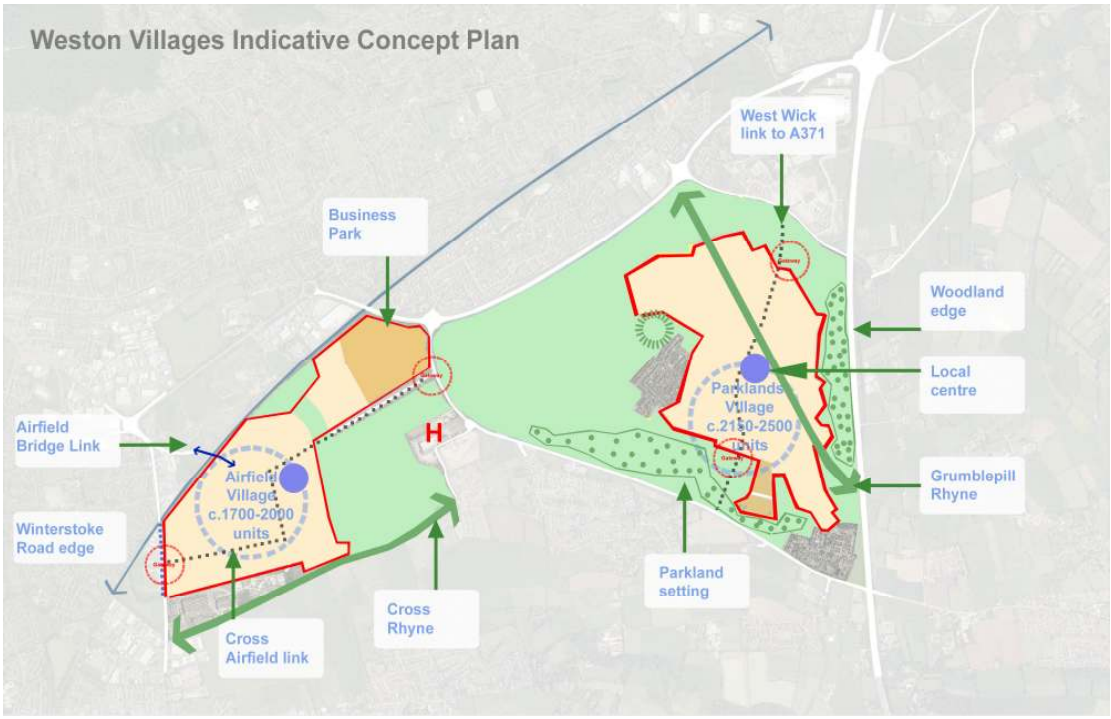

Figure 1.2: Weston Urban Villages Concept Plan presented to NSC Executive on 20th July 2010

The latest draft proposals for the two urban villages differ slightly from the above concept plan and are detailed in Table 1.1.

Airfield Village	Parkland Village
• Approx 2,400 dwellings • Two Primary Schools • Cross Airfield Link Road • 34 hectares of employment • District Centre to include a range of other supporting community uses including a library, health centres • On site flood mitigation	• Approx 3,000 dwellings • Two Primary Schools • Secondary School • Leisure Centre • Minimum of 4 hectares of employment • District Centre to include a range of other supporting community uses including a library, health centres

Table 1.1: Draft proposals for the two urban villages

One of the biggest changes from previous plans is that the flood mitigation works associated with the Uphill Great Rhyne are now proposed to be provided on the Airfield site. This means that as part of the current proposals there is no intention to provide off-site storage or attenuation. The arrangements for the development land that drains into the River Banwell will remain the same.

This change has been prompted by the smaller scale of development and the increasing cost burden of the infrastructure associated with the development. In addition there was considerable public opposition to the proposed wetland area.

CURRENT APPLICATION

Persimmon have submitted a planning application for 900 dwellings, primary school and district centre on the western section of the Airfield. This application is planned to be determined in November 2010 and does not include any referencing to off site flood mitigation. All the flood mitigation works are on site in the form of wetlands on the southern part of the Airfield.

1.4 Aims of this study

The objective of this Phase III study was to examine if the flood management associated with the Uphill Great Rhyne could be dealt with totally on site without regard to the wider catchment i.e. as proposed by the current application. In particular the study has examined:

i. whether on site mitigation works are appropriate to overcome the flood management issues associated with the Uphill Great Rhyne;

ii. what should the on site mitigation works consist of e.g. pond/wetland;

iii. what land take will be required for the on site flood mitigation works;

iv. where on the Airfield is the most appropriate location for the flood mitigation works;

v. if on site mitigation does not provide the total solution whether very much scaled down off site works e.g. a swale between Hutton and the Airfield would also need to be provided and at what stage in the development.

The preferred option from the Phase II study for the River Banwell has also been revisited to check that it is still appropriate based on the proposed development changes.

2 ASSESSMENT

2.1 Proposed development changes

The proposed development in the study area will alter the ratio of permeable to impermeable land. Currently the majority of the land is grassland and therefore the overall permeability of the area is high. The development outline provided by North Somerset Council was digitised and the proposed new ratio of permeable to impermeable land was calculated. Note this is based on concept plans rather than a detailed site layout, but gives an adequate representation of the potential loss of permeable area.

Table 2.1 shows the changes to the permeability of the area with the proposed development in place. Note this is just based on the revised development proposals. This highlights that there will be a significant increase in the amount of impermeable land within both village areas.

	Area (km2)	Pre development		Post development	
		% permeable	% impermeable	% permeable	% impermeable
Airfield Village	2.0	92	8	39	61
Parkland Village	3.65	90	10	49	51
Whole WDA	5.65	91	9	45	55

Table 2.1: Changes to land permeability pre and post development

2.2 Confirmation of catchment boundary location

There has previously been some uncertainty regarding the catchment boundary between the Uphill Great Rhyne and the River Banwell. The location of this boundary needs to be confirmed to enable North Somerset Council to collect contributions from developers for the works required in the two catchments. Further analysis of the location of the flow split was therefore undertaken for this study using LIDAR data and the previous consultations with West Mendip Internal Drainage Board. The LIDAR data was reviewed and contour data was produced, and then the boundary line confirmed to be as previously agreed.

2.3 Change in percentage runoff due to development

The results shown in Table 2.1 were taken forward into the assessment of the increase in surface water runoff that could be expected from the sites due to the increased impermeability. The catchment boundaries and inflow locations used in the Phase II study were kept the same and then the approach undertaken in the Phase II study was repeated here with the revised ratios. There are four catchments that are affected by the proposed development. For each catchment the ratio of permeable to impermeable land was calculated and a revised standard percentage runoff (SPR) value was calculated. Table 2.2 shows the SPR for each sub-catchment pre and post development for both the original and modified development proposals.

Sub-catchment Inflow chainage	SPR (%)		
	Pre development	Post old development (Phase II)	Post new development (Phase III)
5553	26.7	52.5	47.3
4669	30.94	41.1	38.7
3228	27.95	41.3	41.3
2861	28.8	49.3	46.0

Table 2.2: Comparison of SPR values pre and post development based on both the Phase II development outline and the revised Phase III outline

Table 2.2 shows that the revised development has a smaller increase in the amount of surface water runoff from the sites, although the scale of development still results in a significant increase from the pre development situation.

For the River Banwell the amount of urbanisation is approximately the same for the previous Phase II outline and the new Phase III outline and therefore the results from the Phase II assessment still stand.

2.4 Impact of development on flow and runoff volume

The adjusted SPR values were then input into ISIS FEH boundary unit to determine a post development peak flow and hydrograph. The peak flow values pre and post development are shown in Table 2.3. Once again the Phase II post development flows are included for comparison. Note that all of the flows are the 1 in 100 year flow including an allowance for climate change.

Sub-catchment Inflow chainage	1 in 100 year plus climate change peak flow (m^3/s)		
	Pre development	Post old development (Phase II)	Post new development (Phase III)
5553	3.0	5.0	4.6
4669	13.4	16.5	15.8
3228	3.7	4.7	4.7
2861	1.5	2.0	1.9

Table 2.3: Comparison of the resulting peak flow pre and post development based on both the Phase II development outline and the revised Phase III outline.

Table 2.3 shows that pre development the total flow contribution from the inflows mentioned above is approximately 22 cumecs, whilst the previous post development flow was 28 cumecs and the new post development peak flow is approximately 27 cumecs. There is therefore still a relatively large increase in peak flow due to development and only a minor reduction in the peak flows compared to the previous Phase II assessment.

Current Government Guidance, Planning Policy Statement 25 (PPS25) states that the volume of surface water runoff from a site post development must not exceed the volume pre development. The additional volume of surface water runoff from the development sites compared to the pre development situation therefore needs to be stored or attenuated on site. Table 2.4 shows the volumes of surface water runoff for the pre and post development scenarios based on the SPR changes detailed in Table 2.2.

Sub-catchment Inflow chainage	Approximate volumes of surface water runoff (m^3) 1 in 100 year plus climate change		
	Pre development	Post old development (Phase II)	Post new development (Phase III)
5553	94,300	157,000	144,400
4669	423,600	524,800	500,900
3228	107,500	138,400	138,400
2861	41,500	56,900	54,500
TOTAL	**666,900**	**877,100**	**838,200**
Difference from pre development		**210,200**	**171,300**

Table 2.4: Comparison of the resulting volume of surface water runoff pre and post development based on both the Phase II development outline and the revised Phase III outline.

Table 2.4 shows that previously it was estimated that approximately 210,000m^3 of surface water runoff needed to be dealt with post development (Phase II). This value decreases to 171,000m^3 with the reduced scale of development, although this is still a significant volume of water.

3 POTENTIAL MITIGATION OPTIONS

3.1 Appropriateness of on-site mitigation works

As shown in Section 2 the change to the proposed development has meant that the peak flow estimate and volume of surface water runoff to be stored has reduced compared to the previous Phase II assessment. However, there is still a significant quantity of water that would need to be stored or attenuated.

A large proportion of the development area is currently at risk from a 1 in 100 year flood event plus climate change. Mitigation would therefore also be required to provide compensatory storage for the loss of floodplain storage. As the majority of the site is within the 100 year plus climate change flood extent, it will be extremely difficult to provide on-site compensatory storage unless pumping to an impounded storage area was considered. This seems highly unlikely.

The preferred option from the Phase II study also offered a number of other benefits including:

- the reduction of the flood risk to existing properties,
- eliminating the requirement for compensatory storage
- providing potential environmental opportunities and amenity facilities.

Purely on-site mitigation measures will not provide the same level of benefits and therefore would not be a suitable or realistic option for this area.

3.2 Requirements of off-site mitigation works

The last aim of this investigation was to determine if smaller off-site mitigation could be provided in combination with elements of on-site attenuation. To assess this possibility the preferred Uphill Great Rhyne option has been assessed with new development assuming 100% of the runoff leaves the site and then compared with 100% of the runoff being managed on site. The issue of compensatory storage has not been considered.

With no on-site attenuation the volume required to be stored in the “super pond” is approximately 207,000m^3 whereas if 100% of the additional surface water runoff from the development site is attenuated on-site then the volume required to be stored in the “super pond” is approximately 197,000m^3. This is only a minimal difference, which would result in only minor cost savings for the storage pond works, and therefore it is recommended that it would be more cost efficient to invest in one “super pond” rather than a slightly smaller pond combined with a number of on-site mitigation works.

The flood extents for the post development scenario with and without on-site attenuation are shown in Figure 3.1.

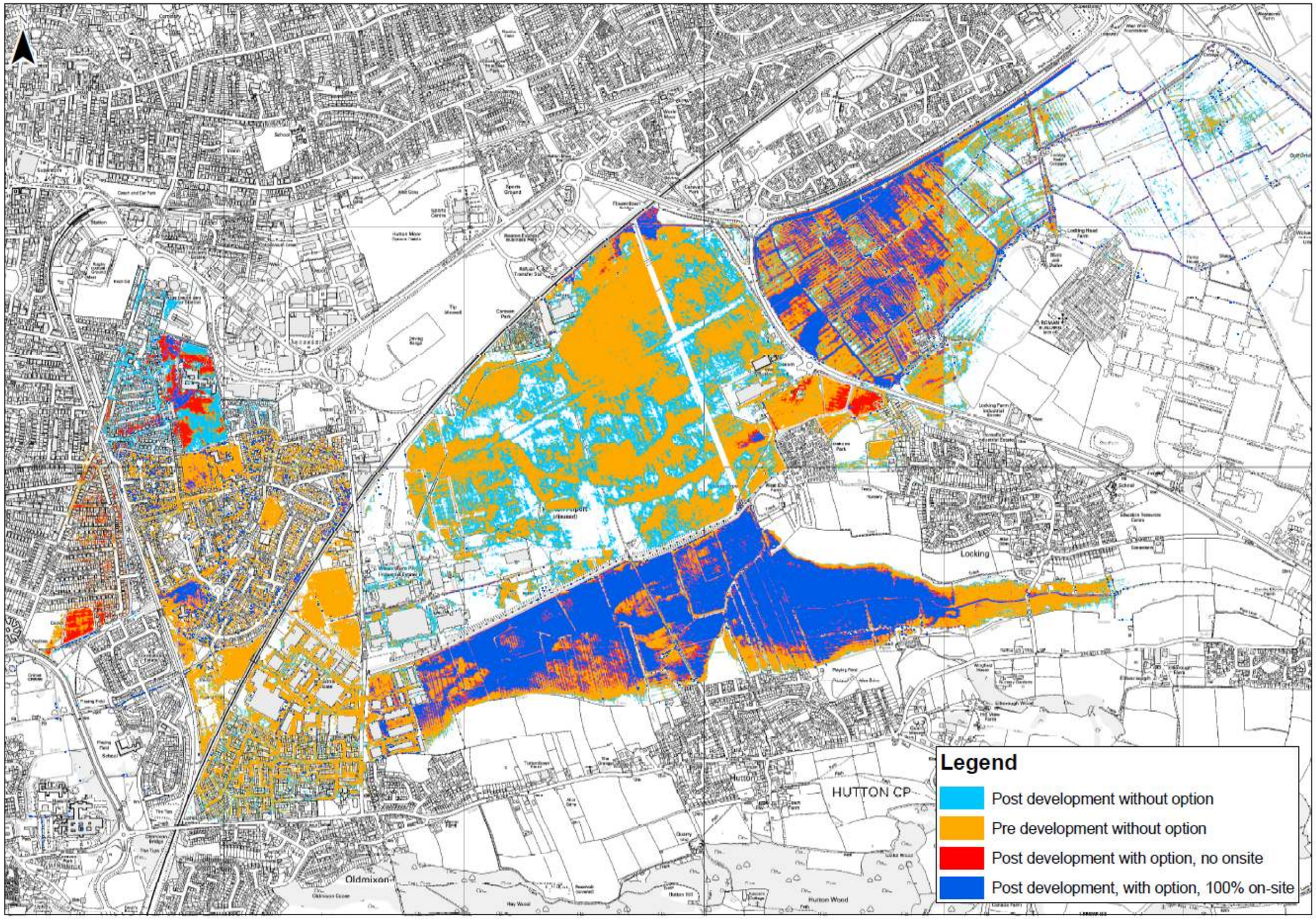

Figure 3.1: Flood extents

4 CONCLUSIONS & RECOMMENDATIONS

4.1 Conclusions

Generally the SPR pre development was 30%. The changes to the development plan outline meant that the SPR would increase to approximately 43% rather than 46% as assessed in the Phase II study.

The pre development 1 in 100 year plus climate change flows are approximately 22 cumecs. The previous assessment estimated this would increase to 28 cumecs post development. With the revised development outline this has been reduced slightly to 27 cumecs. The flows as a result of the new development are therefore only slightly smaller than the flows we considered as part of the Phase II study.

This small change in flow therefore means that the volume of increased runoff is only slightly reduced from 210,000m^3 to 171,000m^3 and remains significant.

Even if the whole 171,000m^3 of additional runoff is attenuated on-site, there still needs to be a super pond with a capacity of 197,000m^3 to take the development areas out of the 1 in 100 year plus climate change flood extent, and therefore eliminate the need for compensatory storage.

One of the main benefits of the super pond is that it prevents the flooding of the Airfield and therefore means this area can be developed. It also reduces the existing flood risk to properties within the catchment, particularly downstream of the site. Without the super pond the Airfield would still flood and therefore mitigation would be needed for the increase in surface water runoff and the floodplain storage lost in those areas. It is extremely unlikely that this could all be dealt with onsite, particularly as the onsite storage areas would also be likely to flood.

Onsite mitigation is therefore highly unlikely to provide the necessary storage and, on its own, would not provide the other benefits that can be obtained from the super pond and substantial volumes of compensatory storage would also be required. This would be extremely difficult to provide on the development sites.

One of the major advantages of the super pond is the elimination of the need for developers to provide compensatory storage due to loss of floodplain storage as the area would no-longer be at risk of flooding.

We investigated the required size of the super pond if 100% of the increase in surface water runoff was mitigated on site and the difference in volumes were relatively small, a reduction of 10,000m^3 to 197,000m^3 (5%). It is therefore suggested that it would be more suitable to focus on the one super pond rather than developing a number of onsite and off site mitigation works.

4.2 Recommendations

Based on the conclusions listed above, we strongly recommend that the super pond is still the most suitable mitigation for this area, taking into account all of the benefits it can provide. These benefits include:

- the reduction of the flood risk to existing properties,
- eliminating the requirement for compensatory storage
- providing potential environmental opportunities and amenity facilities.

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