Technical Note
Weston-super-Mare Comparative Assessment of Surface Water Mapping

North Somerset Council

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1 INTRODUCTION

This technical note sets out the results of the Comparative Mapping Assessment of the Environment Agency updated Flood Maps for Surface Water (uFMfSW) and the surface water modelling generated as part of the Surface Water Management Plan (SWMP) for Weston-super-Mare (WsM).

Modelling of WsM was undertaken as part of the SWMP carried out by Royal HaskoningDHV during 2010. The SWMP report was produced with information from the previous versions of the Environment Agency surface water maps, 1st generation Areas Susceptible to Surface Water (AStSW) and 2nd generation Flood Map for Surface Water (FMfSW). Following this, the uFMfSW were published in December 2013.

The purpose of this technical note is to evaluate the best representation of surface water flood risk in WsM and identify possible locations for further more detailed modelling. The uFMfSW allows the incorporation of local, more detailed mapping that best represents surface water flooding in the area, in to the mapping revisions. The compatibility of local agreed modelling with the National Mapping will be suggested.

2 DATA

2.1 Updated Flood Map for Surface Water (uFMfSW) – National Mapping

The uFMfSW contains banded vector data for depth, extent, hazard and velocity for floods with the following chance of occurring in any given year (annual probability in brackets):

- 1 in 30 (3%)
- 1 in 100 (1%)
- 1 in 1000 (0.1%)

The uFMfSW provide more reliable flood water depth and velocity information to the previous national surface water mapping – Areas Susceptible to Surface Water (AStSW) and Flood Map for Surface Water (FMfSW). The objective is to show the worst case flood extents, depths, velocities (both magnitude and direction of flow) and hazard rating associated with each return period (Environment Agency, 2013a).

The aim of uFMfSW was to be the best single source of information on surface water flooding for England and Wales, superseding the 1st generation Areas Susceptible to Surface Water (AStSW) and Flood Map for Surface Water (FMfSW). During the development of the uFMfSW, Local Authorities were requested to provide local information to inform the development of the mapping. North Somerset Council did not submit any local information at this stage so the mapping for the area is based on national parameters only.

2.2 SWMP Mapping

The modelling that was undertaken for the SWMP includes depth and hazard for the following return periods:

- 1 in 5 year (20%)
- 1 in 10 year (10%)
• 1 in 20 year (5%)
• 1 in 30 year (3%)
• 1 in 50 year (2%)
• 1 in 100 year (1%)
• 1 in 30 plus climate change (3% plus 30% climate change)
• 1 in 100 plus climate change (1% plus 30% climate change)

These return periods were also mapped for three different scenarios for:
• Drainage system operating as designed
• Tide locked scenario
• Saturated ground simulating an intense storm following a period of continuous rainfall.

The catchment and rhyes are particularly sensitive to tide locking and so these additional scenarios were included to ensure a worst case scenario was modelled. The main focus of the study was on the drainage system operating as designed which will be the focus for the assessment.

2.3 Water Company Sewerage Flooding Locations

Data was obtained from Wessex Water from the DG5 register for internal flooding for 1 in 10 and 1 in 20 year events. There were no events in the study area for 2 in 10 year events. This data provides information on the occurrence of flooding from the sewer network for internal flooding only. Data for external flooding from the sewer network was not included in this assessment due to the unavailability of up-to-date data.

Data was provided from Wessex Water modelling of the surcharge rates from manholes from the sewerage system. This data has been included in the mapping comparison to provide additional information of risk and vulnerability in the sewerage system.

2.4 Local Authority Recorded Flood Events

North Somerset Council provided data of recorded locations of flooding for both internal and external flooding from local sources of flooding (surface water, ordinary watercourse flooding and groundwater flooding). These flood incidents recorded fall over a period of approximately 15 years in North Somerset. For the purposes of this study and in the absence of event return periods, these flood records will be compared against the 1 in 30 mapping in the absence of lower order return event national mapping. These data sets were used in order to provide a sense check of the flood maps and assess the performance of both models against actual flooding information.

It should be noted that this data set includes other sources of flooding to surface water flooding and also flooding that is caused by maintenance and malfunctioning issues within the system rather than solely capacity issues.

3 METHODOLOGY

Qualitative comparisons were made between the 1 in 30 and 1 in 100 year return periods for both the maps for surface water produced by modelling done for the draft SWMP and the uFMfSW. For simplicity and ease of comparison, the extents and
depths were used for the assessment. The scenario, ‘drainage system operating as designed’ was used as the most similar comparative scenarios.

Table 1 below summarises the comparisons that were undertaken as part of the assessment as well as where comparisons were not possible:

<table>
<thead>
<tr>
<th>SWMP Modelling</th>
<th>uFMfSW</th>
<th>Local Authority and Water Company Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 10</td>
<td></td>
<td>DG5 internal flood record – 1 in 10</td>
</tr>
<tr>
<td>1 in 20</td>
<td></td>
<td>DG5 internal flood record – 1 in 20</td>
</tr>
<tr>
<td>1 in 30</td>
<td>1 in 30</td>
<td>Local Authority Recorded Flood Events</td>
</tr>
<tr>
<td>1 in 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 in 100</td>
<td>1 in 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 in 1000</td>
</tr>
</tbody>
</table>

Table 1: A summary of the mapping comparisons available between the various data sets

Even though the 1 in 30 return period is the most appropriate return period for the Local Authority recorded flood events, they were used as a sense check against all the comparisons to visualise where actual flooding has occurred in the catchment at the 1 in 100. The 1 in 10 and 1 in 20 return periods were not looked at in detail due to the lack of comparative mapping. Map appendices 1 and 2 show the comparison overlays for the 1 in 30 and 1 in 100 year maps respectively.

4 MAPPING COMPARISON

4.1 Surface Water Maps

The SWMP mapping predicts greater flooding at each respective return period compared to the National Mapping. There is a rough correlation between the national flood map and the SWMP maps for the 1 in 30 and 1 in 100 year return periods (map appendices 1 and 2) with a greater correlation at deeper flooding spots. The SWMP maps have greater coverage of shallow water flooding that ponds in small areas and greater runoff in the steeper areas compared with the National Mapping. The difference in grid size used between the models results in a more detailed visual representation of the flooded areas in the National Mapping. There is better correlation between areas of more significant and deeper flooding. However, the SWMP mapping does highlight additional areas that the National Mapping does not consider a risk up to a 1 in 100 year event. These additional areas are mainly in the upland areas showing runoff and ponding particularly in the disused quarries to the north, at the foot of Whorley Hill. Flood depths are overestimated in the areas at the foot of steep slopes, as well as along railway and road cuttings. This is due to the workings of Tuflow leading to greater water depth at the foot of steep slopes.

When the national flood map at 1 in 1000 year return period is compared with the SWMP map for 1 in 100 (map appendix 3), similar extents and results for the significant surface water flooding are seen but the 1 in 1000 year depths are the greater depth band i.e. approximately 0.3m greater. This does suggest that both models are predicting similar mechanisms of flooding but do not agree on the severity at each return period. The small and shallow flooding do not always correlate and can be explained by the differences in the model parameters as discussed in section 5.
There is little correlation between the national flood map and the locations of flood events recorded by the Council at the 1 in 30 and 1 in 100 year return periods which are scattered throughout the urban areas with limited clustering. It is important to bear in mind that the flood records do include flood incidents as a result of maintenance and system failure incidents (e.g. blocked gullies) rather than solely capacity issues. It is not possible to differentiate with confidence between maintenance and capacity reports of flooding from this dataset. Therefore we have not refined this list further for the purposes of this study. From the correlation in the comparison maps for the 1 in 30 and 1 in 100 year events (see appendices 1 and 2) would suggest that the national modelling is underestimating the flood extents compared to the SWMP modelling.

The maps correlate well on the larger areas of flooding in the lowland area. The site to the south of the old Weston airfield is already identified for the construction of Strategic Surface Water Ponds. Both maps support the surface water flow and accumulation in this area.

4.2 Property Counts

In order to quantify the differences between the maps, a count of properties was undertaken for a range of return periods. It is standard practice to assume that properties have a threshold of approximately 300mm above ground level. Therefore only properties with a depth of flooding greater than this threshold are included within the property count. Both residential and commercial properties were included in the total count and are summarised below in Table 2.

<table>
<thead>
<tr>
<th>Return Period (years)</th>
<th>Total Number of properties at risk (residential and commercial)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flood Map for Surface Water</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>138</td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Comparison in the number of properties at risk between uFMfSW and SWMP Mapping. (The numbers at risk from the SWMP mapping are extracted from the draft SWMP report (Royal HaskoningDHV, 2010) and National Mapping numbers provided by CH2M Hill as part of North Somerset Local Flood Risk Management Strategy, 2014).

The reasons for the differences in risk between the maps are discussed in section 5.

5 MODEL APPROACHES

5.1 Model Parameters

In order to understand and explain the differences between the maps, it is important to understand the differences between the approaches used in developing the models. Table 3 summarises and compares the inputs used in developing the two models. The
uFMISW parameters are based on information contained within the Environment Agency (2013a) ‘National Scale Surface Water Flood Mapping Methodology’.

<table>
<thead>
<tr>
<th>Item</th>
<th>uFMISW</th>
<th>SWMP Modelling</th>
<th>Modelling Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydraulic Modelling</strong></td>
<td>2D overland flow modelling</td>
<td>2D overland flow modelling</td>
<td></td>
</tr>
<tr>
<td><strong>Hydrological Modelling</strong></td>
<td>Direct rainfall approach with allowances for the sewer network and infiltration:</td>
<td>Direct rainfall approach with allowances for the drainage system:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• England and Wales classified as either rural or urban based on manmade area coverage as defined in OS MasterMap Topography Layer on 250m x 250m grid.</td>
<td>• 25% runoff coefficient was applied (no distinguish between rural and urban areas).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In rural areas, ReFH losses model is applied and is parameterised using NSRIs ‘SERIES Hydrology’ data.</td>
<td>• Drainage rate of 23.8 mm/hr was applied.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In urban areas, a default loss rate of 12 mm/hr and 70% runoff coefficient is applied</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Runoff parameters adjusted by local drainage information where available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>JFlow + (Shallow Water Equation – based)</td>
<td>Tuflow package (Shallow Water Equation – based)</td>
<td></td>
</tr>
<tr>
<td><strong>Hydraulic Model Parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Digital Elevation Model</strong></td>
<td>Bare earth LIDAR/NEXTMap composite DTM at 5m horizontal resolution provided by Geomatics in 2010 to create a common 2m resolution.</td>
<td>LIDAR from 2007-2010 at 2m resolution</td>
<td></td>
</tr>
<tr>
<td><strong>Grid Size</strong></td>
<td>2m regular grid</td>
<td>10m regular grid (compromise between accuracy and representation of terrain and model run times)</td>
<td></td>
</tr>
<tr>
<td><strong>Model step time</strong></td>
<td>2 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Representation of buildings</strong></td>
<td>Use of an approximately 0.3m “up-stand” and depth-varying roughness coefficients within the</td>
<td>Buildings were represented by Manning coefficient (n) as 0.05.</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>uFMfSW</td>
<td>SWMP Modelling</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>OS MasterMap building footprint (as per Drain London specification) Complex rules were developed to ensure that building footprints did not “cut” into the DTM but did always protrude at the upstream face of the building.</td>
<td></td>
<td>Filtered and unfiltered LiDAR was used to give a best representation of structures</td>
<td></td>
</tr>
<tr>
<td>Representation of structures DTM was manually edited in over 91,000 locations to improve flow through ‘flyover’ features, such as rail/road embankment culverts, bridges etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representation of other features Areas of the DTM covered by the road network were lowered by 0.125m</td>
<td></td>
<td>Roads were not represented due to grid size Filtered and unfiltered LiDAR was used to give a best representation of other features</td>
<td></td>
</tr>
<tr>
<td>Manning’s n values Varied by OS MasterMap Topography Layer Feature Code as per Drain London specification</td>
<td></td>
<td>Roughness values have been applied based on land use categories defined and delineated by OS Mastermap data.</td>
<td></td>
</tr>
<tr>
<td>End of simulation criteria Rainfall event duration + 3hrs (therefore up to a maximum of 9 hours for the 6 hour storm duration)</td>
<td></td>
<td>Simulation run for 16 hours to allow time for water to drain away where possible</td>
<td></td>
</tr>
</tbody>
</table>

### Rainfall and Hydrology

**Design Rainfall**

- FEH depth-duration-frequency parameters defined on a regular 5km grid:
  - 1 in 30, 1 in 100, 1 in 1000 rainfall probabilities
  - Storm durations of 1, 3 and 6hrs were used for all scenarios
  - 50% summer storm profile used
  - No aerial reduction factor applied

- FEH depth-duration-frequency parameters defined on a regular 1km grid:
  - 1 in 5, 10, 20, 30, 50, 100 rainfall probabilities
  - Storm duration of 60 minutes
  - No aerial reduction factor applied

**Inflows from outside of study area**

- None

**Downstream**

- Free overflow

- Model domain includes the entire study area and has been adjusted to include those points from which rainfall would flow into the study area based on the topography.


### Validation of results and sensitivity testing

<table>
<thead>
<tr>
<th>Item</th>
<th>uFMfSW</th>
<th>SWMP Modelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>boundary conditions</td>
<td>effects were not noticeable</td>
<td></td>
</tr>
</tbody>
</table>

**Validation**

- Nationally undertaken for three pilot areas using historical observations and local modelling data but not undertaken for Weston-super-Mare area.

- Local knowledge has been utilised throughout the model build and verification of the model outputs.

**Sensitivity Testing**

- None

  **Sensitivity testing was carried out on the main assumptions:**
  - Drainage coefficient
  - Depth varying Manning’s n for permeable areas
  - Length of model run
  - Terrain smoothing

Table 3: Comparison in model approaches and parameters for the uFMfSW and the SWMP model

Tuflow and JFlow + are both 2D overland flow models and surface water equation based. The differences between the model packages, Tuflow versus Jflow+, are not considered a factor to produce significant differences, particularly where there is relatively flat topography, as both models are designed to simulate the movement of water over the ground (no river channels were represented). In some of the steeper areas of the catchment, there may be slight differences inherent to the model types.

The Environment Agency undertook a comparison of model types ‘Benchmarking the latest generation of 2D hydraulic modelling packages (Report – SC120002)’ to ensure the 2D flood inundation modelling packages used for flood risk management were capable of adequately predicting the variables on which flood risk management decisions are based. The evidence suggests that most modelling packages “predicted similar results in terms of peak water levels within a range of a few centimetres” (Environment Agency, 2013b).

The differences in mapping are therefore attributed to the different parameters and assumptions used in each model. Both models take a broad scale modelling approach and therefore make crude assumptions to reflect the catchment. The large scale of the National Mapping as a result has cruder assumptions that may not reflect the local conditions in comparison to the SWMP modelling. These are discussed further below.

We consider the model parameters resulting in the most significant differences are:

- Differences in DTM manipulation
- Differences in grid size used
- Design Storm utilised
- Locally significant assumptions
5.2 Digital Terrain Model (DTM) Manipulation

Small differences in predicted water elevation and micro-topographic barriers can combine in urban settings to give significant differences in predicted inundated area. The Digital Terrain Model (DTM) was manipulated differently in each model which can give rise to significant differences in the flood extents, flow paths and therefore the number of properties at risk. The National Modelling undertook manipulation of the DTM to lower the roads and enhance the effect of buildings to ensure the water flowed down highways and around structures as would be experienced in reality. The SWMP modelling represented structures to manipulate the flow by representation of a manning's coefficient. The 10m grid is coarse and therefore detailed features including the road network are not represented. From a visual comparison of the maps (refer to map appendices 1 and 2), the method used for the national modelling results in a greater channelling effect than the method used for the SWMP modelling. During the SWMP modelling, different methods and levels of terrain smoothing were investigated to allow realistic flow paths and depths to occur. In urban flood problems, this may affect flow predictions as flow depths are often very shallow. Without further modelling, it is difficult to determine which is giving the most realistic scenario.

5.3 Design Storm

Based on the nature of the study area and previous studies it was determined that surface water flooding was a result of short, intense bursts of rainfall due to convective systems in the catchment. Therefore short, intense rainfall events would produce the greatest flood risk in WsM. Wessex Water modelling has shown that the catchment flood response is most sensitive to short duration (15-120 minutes range) rainfall events. The SWMP modelling was therefore based on the assumption that all of the rainfall fell in a 1 hour period. The National Modelling uses a multi-rainfall event duration of 1, 3 and 6 hours and the worst case result in each grid cell is used. This should produce a comparative design storm but without access to the rainfall calculations of the National Modelling to compare the storm rates, it is not possible to determine with confidence whether one model is based on a more significant rainfall event than the other.

5.4 Locally Significant Characteristics

The National Modelling was undertaken to produce flood maps for the whole of England and Wales for all catchments greater than 3 km² in a consistent manner. The method is very generalised and therefore does not take account of information that may be very significant locally. Within the Weston-super-Mare catchment, the Rhynes network is very sensitive in respect of ‘tide locked’ conditions. As part of the SWMP modelling, the tide locked and saturated scenarios are therefore important to understand the risk in the area. During the SWMP model development, different methods and levels of terrain smoothing were investigated to allow realistic flow paths and depths to occur and for the best local representation.

5.5 Limitations

Both models have limitations due to constraints of cost, time and available data. The coarse method applied by both models is very generalised and therefore should be used as an indication of where more detailed flood risk assessments are required.
The limitations of both models include:

- Effects of bridges and other structures including flood defences are not taken into account in detail.
- The effect of reservoirs and urban drainage and other man made influences on the flow regime are only taken into account in a very general sense.
- Absorption factors are considered in a very general sense as rural vs urban rates.
- Neither modelling takes into account watercourses nor other sources of flooding. Watercourses, drainage systems and pumping stations are therefore not fully represented.

6 AREAS OF INTEREST

The uFmFSW does not include any locally specific information. The modelling undertaken for the SWMP was a catchment wide study to indicate the scale and nature of flooding. For the design of significant schemes, such as flood storage or drainage improvements it is recommended that more detailed small scale modelling of the drainage network in the area of interest be undertaken. This was beyond the scope of the SWMP modelling.

The areas of key concern and identified within the Council's Local Flood Risk Management Strategy are the Central and West area and Milton Hill. These areas are discussed in more detail below.

6.1 Key area 1 – Milton Hill

Spring Hill, Milton Hill area is a known risk area and is visible in the map appendix 2 and corroborated with Council flood reports and manhole surcharging from the Wessex Water system (map appendices 1 and 2). In 2011, a 125m³ storage tank was constructed in Milbury Gardens to alleviate flooding to 5 properties in Upper Bristol Road and Spring Hill. Further improvements are planned for this area of Milton Hill to provide further storage and alleviate flooding to the risk areas of Spring Hill and Spring Valley (as identified by the Wessex Water flooding points on the maps appendices 1 and 2), due to take place for 2014/15 and 2015/16. This mitigation scheme involves the installation of one or two storage tanks to provide further storage of 600-800m³, upgrading surface water sewers, installing cross-drains on the highway, modifying the road profile and upgrading road drainage. Due to the planned programme of work and extensive modelling undertaken by Wessex Water to support the scheme development, it is not considered necessary to undertake further modelling in this area until the work has been completed. The scheme is planned to resolve internal (DG5) flooding for the 10 and 20 year return period critical storms.

Further to the risk at Spring Hill, the maps show an additional risk area to the South and East of Milton Hill at Worle High Street and Nutwell Road (shown in figure 2). This area is unrelated to the issues and planned works being undertaken in Spring Hill, Milton Hill, area (discussed above).

At a 1 in 30 year return period, the National Mapping suggests the flooding sticks mainly to highway flow paths but is at a depth of greater than 0.3m which based on common
practice, would be the depth at which flood water would start to flow internally to properties. At a 1 in 100 year rainfall event the pattern of flooding is similar between the SWMP mapping and National Mapping, although, consistent with the overall picture, the extent of flooding is greater with the SWMP mapping. Comparing the progression of the flooding outlines from the 1 in 100 to the 1 in 1000 year events from the National Mapping, we see similar extents but the 1 in 1000 year depths are in a depth band greater i.e. 0.3 -0.6m band compared to 0.15 – 0.3m.

Figure 1: a) - uFMfSW 1 in 100 year flood depths for west Milton Hill; b) - uFMfSW 1 in 1000 year flood depths for east Milton Hill; c) - SWMP mapping 1 in 100 year depths for east Milton Hill.

The flooding shown around Milton Road and New Bristol Road are as would be expected in reality as this area is at the foot of the incline to the north. There are limited flooding reports in the vicinity of the deep flooding area shown in figures 2 to the north of New Bristol Road, Worle. The reports of flooding at Coronation Street and Nutwell Road have been attributed to flooding off the Highway and due to blocked culverts/gullies. This is corroborated with flood reports from Wessex Water (discussions with Andy Bolden, Wessex Water – March 2014) who also have only a small number of reports in the area which indicate flooding off the Highway.
The Wessex Water model results (shown in appendices 1 and 2) indicate surcharging north and uphill of the main modelled flood areas (up to 100m³ for a 1 in 30 year event and . As the Wessex Water model does not include routing of flood water downstream to the next node, these surcharging events would result in flooding at the bottom of the incline and therefore correlates with the modelled mapping showing flooding around Milton Road and New Bristol Road.

In 2012, Wessex Water undertook a flooding scheme in Coronation Road to upsize the foul sewer which alleviated flooding issues to Coronation Road. The highway flood events recorded in Nutwell Road coincide with dates of known heavy rainfall in the area. Properties themselves were not affected. At this point the surface water sewer goes from a 450mm sewer to a 1050mm sewer to join the culverted Madam Rhyne and drains to the East of the area. The culverted Madam Rhyne will not have been taken into account in either the National Modelling or SWMP modelling.

The absolute cause of this flooding has not been defined and a detailed model has not been developed. Wessex Water undertook a High Level Appraisal of the Nutwell Road area identifying a number of options. Based on local knowledge and details of flood reports, the capacity of the sewer is not considered an issue but flooding from the highway may be due to local issues such as inadequate highway drainage, bends on connections, slow flow rates or maintenance. The risk of flooding identified by the maps is likely due in part to a natural low spot in the topography. The cost-benefit of developing a detailed model or undertaking works in this area would not stack up and is therefore not recommended at this stage. The risk should continue to be monitored by Wessex Water and North Somerset Council. A school 'Mendip Green First School' is within the mapped flooded area which should be considered when monitoring the risk.

6.2 Key area 2 – Central and West

The SWMP mapping shows ponding of water south of Milton Road in the Central and West area at 1 in 100 year event (Figure 2). The comparative National Mapping event does not show the same extent of flooding with flow sticking to the modelled flow paths. At the 1 in 1000 year event, the National Mapping shows the same pattern of ponding but with greater depths.

The flooding is mainly confined to south of Milton Road as the topography flattens out at this point allowing the runoff to accumulate and pond, although the velocities of the flooding to the North of Milton Road may pose an additional hazard. Under the National Modelling 1 in 1000 year event, Ashcombe Primary School is affected to a depth of 0.3 – 0.6m. The Wessex Water modelling shows significant discharge volumes in this area (>1000m³ at 1 in 100 year - see map appendices 1 and 2) suggesting the surcharging of the sewer system is contributing to the flooding issues at this location.

Due to the economic importance of the Central and West area and the proposed development of the town centre and sea front regeneration area, further modelling of a higher resolution could be undertaken in this area to understand the risk at lower return periods. This could be used to develop potential schemes to take forward for Flood Defence Grant in Aid or opportunities to promote as part of the proposed development. The sewerage system should be incorporated into any further modelling due to its significance at this location.
Figure 2: a) - uFMfSW 1 in 100 year flood depths for Central and West area; b) – uFMfSW 1 in 1000 year flood depths for Central and West; c) - SWMP modelling 1 in 100 year flood depths for Central and West.

6.3 Locking

The settlement of Locking shows the location of some deep flooding and is also supported by several internal flooding reports (figure 4). If the history of flooding is worthy of developing a scheme to manage flooding, small scale, higher resolution modelling could be undertaken to understand the flooding mechanisms and damage estimates to support the funding of a flood protection scheme.
Figure 3: a) uFMISW 1 in 100 year event at Locking; b) SWMP modelling 1 in 100 year event at Locking.

6.4 Development Areas

Proposed development areas from North Somerset Local Plan (2007) are shown in Figure 4. The SWMP modelling that was undertaken is based on current permeability. Therefore any change to ground permeability particularly at large Greenfield developments e.g. Rhynes Neighbourhoods, Airfields Neighbourhoods, RAF Urban Locking Village and parts of West Wick and Worle would potentially affect the risk elsewhere in the catchment.

Figure 4: Development areas in Weston-super-Mare from North Somerset Local Plan (2013)

Further detailed modelling to understand risk to these development sites could be undertaken to support the Strategic Flood Risk Assessment (SFRA) and seek
opportunities to minimise flood risk in the local area from strategic surface water management.

7

COMPATIBILITY OF LOCAL INFORMATION

The National Mapping is planned to be the best single source of information on surface water flooding for England and Wales. This mapping has now been made publicly available and is therefore the source of information used by the public to understand and assess risk to their properties.

Any additional modelling undertaken will need to conform with Appendix B of the Guidance on surface water flood mapping for Lead Local Flood Authorities (Version 2, December 2012) to ensure the modelling is compatible and can be used to update the uFMI SW.

More detailed modelling should be undertaken at a high resolution, at least 2m grid. Significant differences can be attributed to the different approaches used to process the topography. The Environment Agency report (Report – SC120002) suggests a 2m grid may be insufficiently fine for high resolution modelling of shallow urban flows particularly if accurate velocity predictions are expected.

We propose that aspects of the previous modelling can be used in an additional modelling study with consideration of the following parameters to determine the worst case, locally significant scenario:

- Incorporate tidal blocking and consider joint probabilities between tides/surges and rainfall events
- Inclusion of watercourses, the drainage system and pumping facilities
- Include saturated ground conditions
- Grid resolution of at least 2m
- Ensure large features such as railway embankments, significant bridges, motorways and other similar features do not artificially block the movement of water through allowing flow routes (lowering of grid or introduction of culverts) and ensure low lying areas (for example underpasses) are identified from the DTM.

8

RECOMMENDATIONS

The SWMP mapping and National Mapping both take a coarse model approach with generalised assumptions. They show a broad correlation in areas at risk but do not correlate in terms of the severity and depths at the same return periods due to the different parameters used in the models. It is proposed the National Mapping underestimates the risk to properties at the return periods due to lack of locally significant assumptions and no local validation.

The options for which maps to use within the SWMP report and take forward as locally agreed information are:

1. Use SWMP mapping – this will mean that the SWMP report will not need to be updated further. However, as this mapping does not conform to Environment Agency guidance, the National Mapping could not be updated with the SWMP
mapping. The National Mapping is publicly available and therefore there would be differences between the mapping used by the public and that agreed and used by the Risk Management Authorities (RMAs).

2. Use uFMfSW – this will require the SWMP report to be fully updated with the National Mapping and will therefore have an additional cost to the Council to update and finalise the SWMP report. However, the mapping used by the public and RMAs will form a consistently understood idea of the risk.

3. Different mapping used for different areas of WsM – it is not possible to ascertain with certainty which mapping is most appropriate for individual areas without undertaking further detailed analysis. Local knowledge does provide certainty around the extent and flow paths but not to the detail of flood depths for different return periods.

Additional modelling at a greater resolution is recommended at the following locations to understand the risk:

i. The key area of Central and West to more accurately map the surface water flooding.

ii. The development sites to understand risk and identify opportunities to manage surface water for new development.

iii. Risk areas that are supported by recorded flooding of properties to understand mechanisms, develop damage estimates and support the allocation of funding for local flood protection schemes.

Any additional modelling undertaken should conform to Environment Agency guidance for compatibility and to ensure the uFMfSW can be updated with the local model. This additional modelling should be undertaken at a grid resolution of at least 2m and include parameters to simulate locally significant characteristics as discussed in section 7.

References


Environment Agency (2013b) Benchmarking the latest generation of 2D hydraulic modelling packages (Report – SC120002)
Title: SWMP Modelling 1 in 30 Year Flood Depth and uFMfSW 1 in 30 Year Flood Depth Comparison
Project: Weston Super Mare Surface Water Management Plan (SWMP)
Client: North Somerset Council
Date: 28/03/2014
Scale @ A3: 1:31500

Legend
- Internal Flooding Reports
- External Flooding Reports
- 1 in 10 Year Event
- 1 in 20 Year Event
- Sub Areas

**SWMP Modelling, 1 in 30 Flood Depth (m)**
- 0.00 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- >1.20

**uFMfSW, 1 in 30 Flood Depth (m)**
- 0.10 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- >1.20

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**Restrictions**
RESTRICTED - COMMERCIALLY SENSITIVE
Figure 2

Date: 28/03/2014
Scale: A3
1:31500

Legend

- Internal Flooding Reports
- External Flooding Reports
- Sub Areas
- Weston Super Mare Area

Wessex Water Modelling
Manhole Surchage Flood Volumes

SWMP Modelling, 1:100 Flood Depth (m)
- 0.10 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

uFMfSW, 1:100 Flood Depth (m)
- 0.10 - 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 0.90
- 0.90 - 1.20
- > 1.20

RESTRICTED - COMMERCIALLY SENSITIVE

Title
SWMP Modelling 1 in 100 Year Flood Depth and uFMfSW 1 in 100 Year Flood Depth Comparison

Project
Weston Super Mare Surface Water Management Plan (SWMP)

Client
North Somerset Council

Checked by
NW
Version
1
Figure 3

Date: 11/03/2014
Scale @ A3: 1:31500

Title:
SWMP Modelling, 1 in 100 Year Flood Depth and uFMfSW 1 in 1000 Year Flood Depth Comparison

Project:
Weston Super Mare Surface Water Management Plan (SWMP)

Client:
North Somerset Council

Legend:
- Internal Flooding Reports
- External Flooding Reports
- Weston Super Mare Area
- uFMfSW, 1 in 1000 Flood Depth (m)
  - 0.00 - 0.15
  - 0.15 - 0.30
  - 0.30 - 0.60
  - 0.60 - 0.90
  - 0.90 - 1.20
  - > 1.20

Scale @ A3: 1:31500

Date: 11/03/2014

Checked by:
NW

Version:
1