



Streamstown Mapping Update Report

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EXECUTIVE SUMMARY

OPW commissioned RPS Consulting Engineers to review and update the flood mapping for the Streamstown area of Malahide which was produced during the Fingal East Meath Flood Risk Assessment and Management (FEM FRAM) Study, in response to objections raised during the SI Consultation in late 2015.

RPS liaised with the OPW to request the existing ISIS model, reports and other available information relevant to the study area. A walkover survey of the study area was conducted by RPS alongside OPW in order to gain an appreciation of the topography of the catchment, flooding mechanisms and the identification of key features such as structures along the watercourses.

RPS constructed an ICM model based on the existing ISIS model and new survey information provided by OPW. The model was also updated following the site walkover and model inputs were updated following consultation with the Feltrim quarry.

The updated draft model results in the Streamstown area show that no properties are at risk of flooding in the 10% AEP, whereas in the previous results, a number of properties located along Carey's Lane and Streamstown Lane were affected. The overland flow path which local residents objected to during the FEM FRAM study consultation process is no longer showing that properties are at risk in the 10% AEP event. However this overland flow path is present in the updated draft model results from the 2% AEP event, affecting properties on Streamstown Lane.

There is some uncertainty with the flood extents particularly regarding the representation of a critical structure [01STRE01085] located at the upstream extent of the new watercourse alignment. Sensitivity testing has been carried out on a number of parameters including this structure. The model parameter with the greatest influence and impact is the increase in flows. Generally, the Streamstown model can be considered to have low to moderate sensitivity to changes in model parameters.

Draft maps have been produced using the updated flood extents. These have been combined with the mapping from the FEM FRAM Study using Arc GIS.

1 INTRODUCTION

1.1 BACKGROUND

RPS were commissioned by the OPW to update flood mapping of Streamstown, Malahide, County Dublin, which was produced during the Fingal East Meath Flood Risk Assessment and Management (FEM FRAM) Study in 2010. This required a review and update of the existing hydrology and hydraulics to ultimately update the flood mapping. The Streamstown area is part of the overall Sluice model but only the Streamstown area covering the Hazelbrook Stream to its confluence with the Sluice River is included in this flood map update.

This work is being undertaken to address twelve objections received under the European Communities (Assessment and Management of Flood Risks) Regulations, S.I No 122 of 2010 as amended by S.I 295 of 2015, from owners of land/properties in the Streamstown, Malahide area. These owners indicated that it was unreasonable to include their land/properties in the flood extent scenarios shown on the draft flood hazard maps. The following is a summary of the main points of the objections received -

- Claims that the route of the watercourse is incorrect
- Queries surrounding the 1% AEP flow/Claims that flow in the drains are normally extremely low
- No historical evidence of flooding in the area/Absence of flood event records on floodmaps.ie/Claims that lands did not flood during times of extreme rainfall in 2000 and 2002
- Lands were inspected by Fingal, who agreed it was an extremely low risk area
- Claims that no insurance policy has had to pay out in respect to flooding at a specific address
- Spot levels were provided to contest the likelihood of lands flooding
- Claims that the drains are normally maintained and kept clear

These claims were investigated by RPS in the 'Streamstown Review Report' (June 2016) which concluded that the incorrect stream centreline was surveyed and modelled through the Streamstown area during the FEM FRAM Study. As a result of this, the validity and accuracy of the flood mapping produced by the FEM FRAM Study in this area can be brought into question (FEM FRAM Study mapping outputs are shown in Appendix A). RPS recommended that a model update should be carried out in the Streamstown area to correct the route of the watercourse, and to update the erroneous flood mapping for the final version. This report aims to satisfy this recommendation.

The principal watercourse flowing through Streamstown is the Hazelbrook Stream as shown in Figure 1.1. This watercourse flows along the northern side of the Feltrim Quarry and under the Feltrim Road

in an easterly direction. Upstream of Carey's Lane the watercourse turns and flows in a south-easterly direction. This stretch of the watercourse is heavily culverted as it proceeds below the Streamstown Wood housing estate and Malahide road eventually re-joining the original watercourse route at the Mabestown Road. The Hazelbrook Stream then flows south easterly until its confluence with the Sluice River.

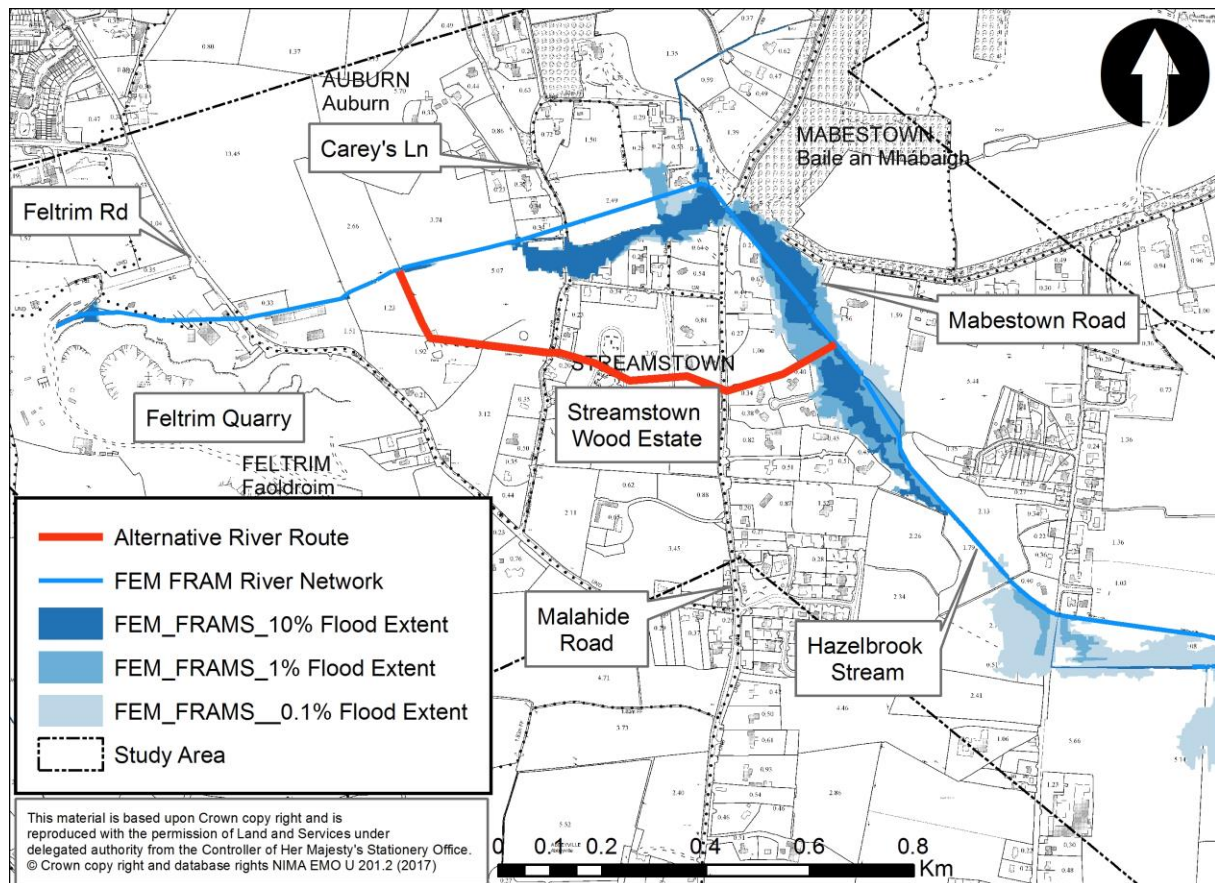


Figure 1.1 Sluice Model Flood Extent Map (SLU/HPW/EXT/CURS/003) showing Streamstown Area

1.2 AIMS AND SCOPE

The project brief included the following requirements:

- Carry out a full hydrology review and create appropriate model inflows. This analysis must take into consideration the effect that Feltrim quarry has on hydrology inputs. Design fluvial flood flows are required for the 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.1% annual exceedance probabilities.
- Produce a new model of the Streamstown area, maintaining all existing channels and including an additional watercourse alignment as per new survey information.
- Model a full suite of design flood event simulations for all current, MRFS and HEFS return periods.
- Produce a full suite of updated print ready and GIS maps to comply with the specification in CFRAMS GN26 for the new model extents, these should be combined with the existing flood hazard GIS layers from the full Sluice model.
- Prepare a brief report detailing the hydrological analysis and hydraulic model updates.

The purpose of this report is to describe the completed model with sufficient information to allow future use of the model by the OPW. This report accompanies the InfoWorks ICM model aiding future analysis, manipulations and simulations of the model.

2 DATA COLLECTION

2.1 CONSULTATION WITH THE OPW

RPS liaised with the OPW to collect all of the available information relevant to the study area. This information included:

- The existing ISIS Sluice model, produced by Halcrow Barry for the FEM FRAM Study
- PDF of map tile SLU/HPW/EXT/CURS/003, as shown in Appendix A. This mapping was produced by Halcrow Barry for the FEM FRAM Study dated 8th of August 2010.
- Survey information of the watercourse alignment, as discussed in Section 2.4.
- Existing FEM FRAMs reports, hydrology (Jan 2010), hydraulics (Sept 2011) and the FEM FRAMs Draft Final Report (Oct 2011).
- RPS Streamstown Review Report (June 2016). RPS were previously appointed by Fingal County Council to review flood maps produced in 2010 as part of the FEM FRAM Study. The validity and accuracy of the maps were called into question by local landowners in the Streamstown area. The report reviews those objections and makes recommendations.

2.2 HISTORICAL FLOODING EVENTS

RPS carried out a review of information received with regard to previous flood events, alongside desktop research, in order to determine the nature of historical flood events so as to inform model calibration and validation. Although accounts of flooding in this area are severely limited, known flood events occurred in December 2005, August 2008 and October 2011.

In December 2005, minutes taken from a meeting relating to the OPW Flood Hazard Mapping – Phase One project, report that the area from Dublin to Malahide Road, R107 (location marked on Figure 2.1) at Streamstown is prone to flooding. On this occasion (Flood ID No 1652) one house and a stretch of road was flooded. Remedial works in this area were carried out in 2004.

On the 9th August 2008, significant flooding is reported to have occurred both locally and throughout the island of Ireland. This is believed to have been the result of considerable precipitation; with Dublin Airport reporting 36mm of rainfall in the worst hour and over 76mm within the space of five hours (the second highest one day fall since records began in 1941). Malahide castle reported total precipitation for the day of the 9th August 2008 to be 75.3mm¹. However, there are no further details of flooding within the Streamstown area.

In October 2011, extreme rainfall over a number of days resulted in severe flooding due, in part, to soil saturation. Soil moisture deficit in Dublin was recorded at around 5mm on the 10th October 2011 and

at -4mm at the end of the month (several days after flooding occurred)². However, there are no further details of flooding within the Streamstown area.

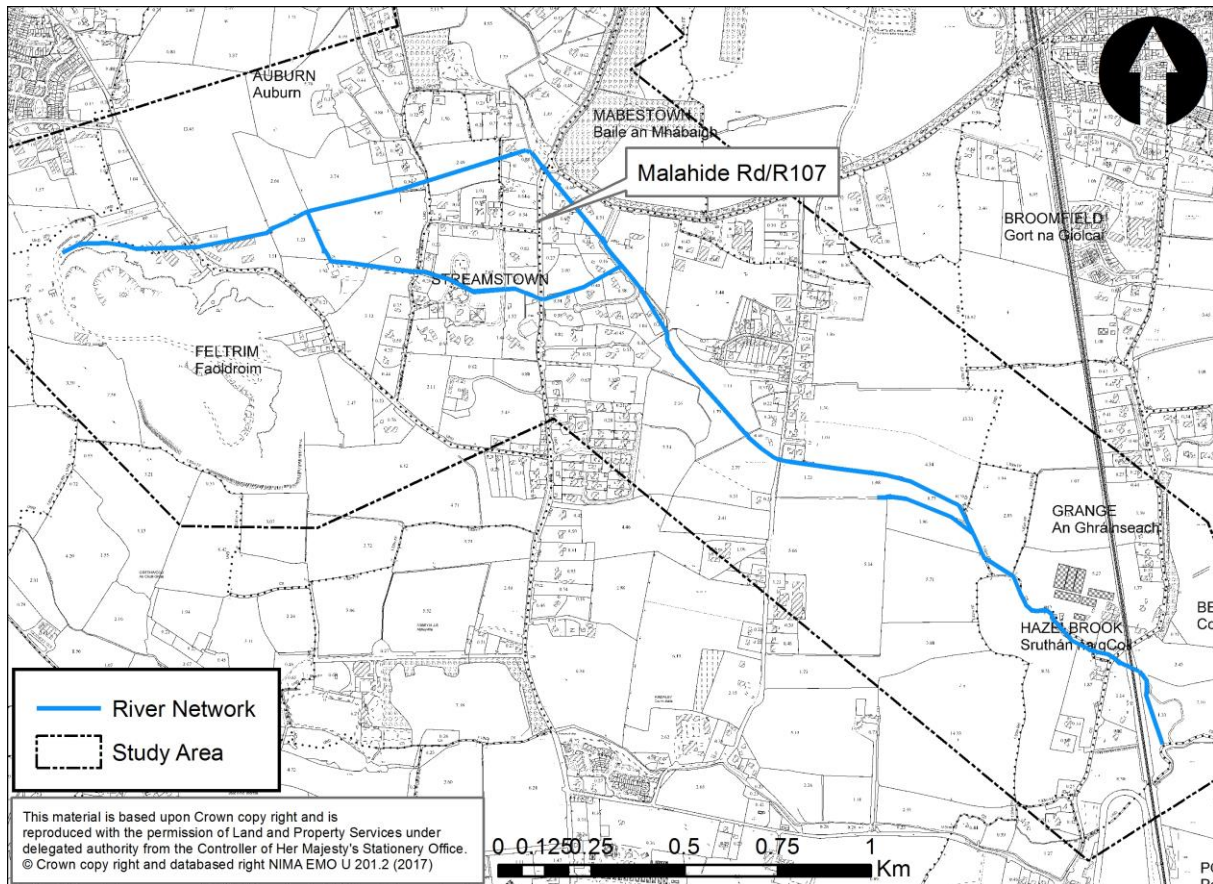


Figure 2.1 Historical Flood Locations

2.3 WALKOVER SURVEY

RPS conducted a walkover survey (20/10/17) of the reaches within the study area in conjunction with a representative from the OPW (Thomas Cooney). This enabled RPS to gain an appreciation of the catchment topography and flood mechanisms and understand the basis of the objections received during SI Mapping Consultation process. Appendix B contains photographs taken during this walkover survey. In addition, the following points were recorded:

- The new alignment of the watercourse, as discussed in Section 2.4.
- The surrounding area and control structure (as shown in Figure 2.2) which influences how much flow goes down the new watercourse alignment versus the previous watercourse route. It was noted that there is significant vegetation in the area and within the channel.

¹ <http://www.met.ie/climate-request/>

² <https://www.met.ie/climate/MonthlyWeather/clim-2011-Oct.pdf>

- It was noted that there was water flowing in the new watercourse alignment but little to no flow in the previous watercourse route.
- Along the left bank of some of the newly surveyed cross sections, the data indicates that ground levels are significantly higher than those indicated in LiDAR information. The surveyed information was confirmed to be correct, this area has been used to store soil.
- RPS/OPW consulted with a local resident whose property is located on the Malahide Road. It was noted that the resident manages flow paths around/through their property allowing flow to enter the neighbouring properties pond when the watercourse was high.

2.4 TOPOGRAPHICAL SURVEY

OPW commissioned Murphy Surveys to carry out a topographical survey of the alternative watercourse route. Figure 2.2 shows the location of the new river alignment compared to the original river alignment and cross sections taken along the new channel route. A total of 19 cross sections, 3 manholes and 7 structures were surveyed in May 2017.

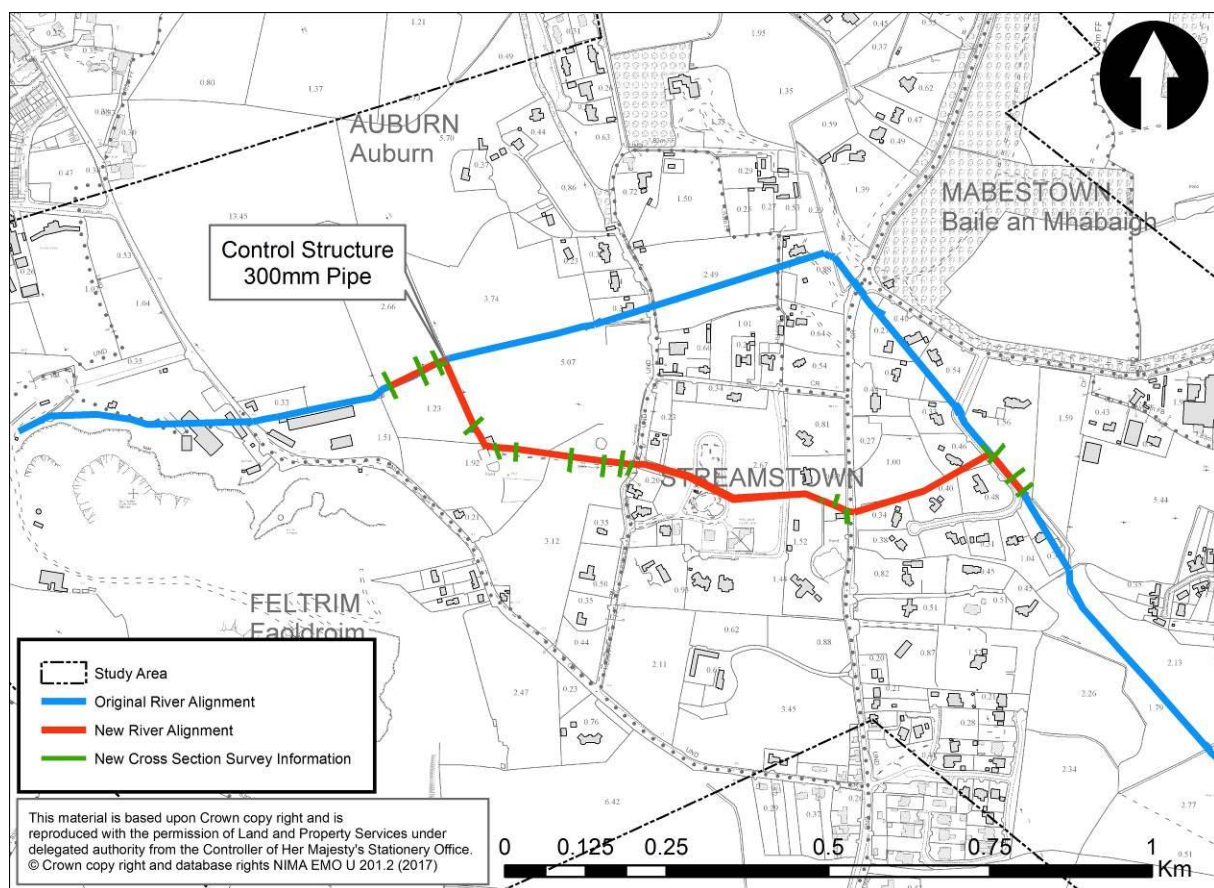


Figure 2.2 New Survey Information

3 HYDROLOGICAL ASSESSMENT

3.1 DESIGN FLOW ESTIMATION

Hydrological analysis for the Streamstown River and tributaries was undertaken in line with the FSU methodologies to provide design flows for hydraulic modelling. The events are defined in terms of Annual Exceedance Probability (AEP) % and include 50, 20, 10, 5, 2, 1, 0.5 and 0.1% events for present day conditions, the same range of events for a Mid-Range Future Scenario (MRFS) and the 10, 1 and 0.1% for a High-End Future Scenario (HEFS). The future scenarios are based on the mid-range and high-end projections for climate change and other catchment changes which may affect fluvial flows such as urbanisation of the catchment.

3.1.1 Catchment Delineation

The first stage in determining the design flows was the identification of Hydrological Estimation Points (HEPs) and the delineation of the catchments to the HEPs. This was undertaken based on a GIS analysis of the LiDAR DTM data along with mapped drainage lines. The HEPs and catchments are shown in Figure 3.1.

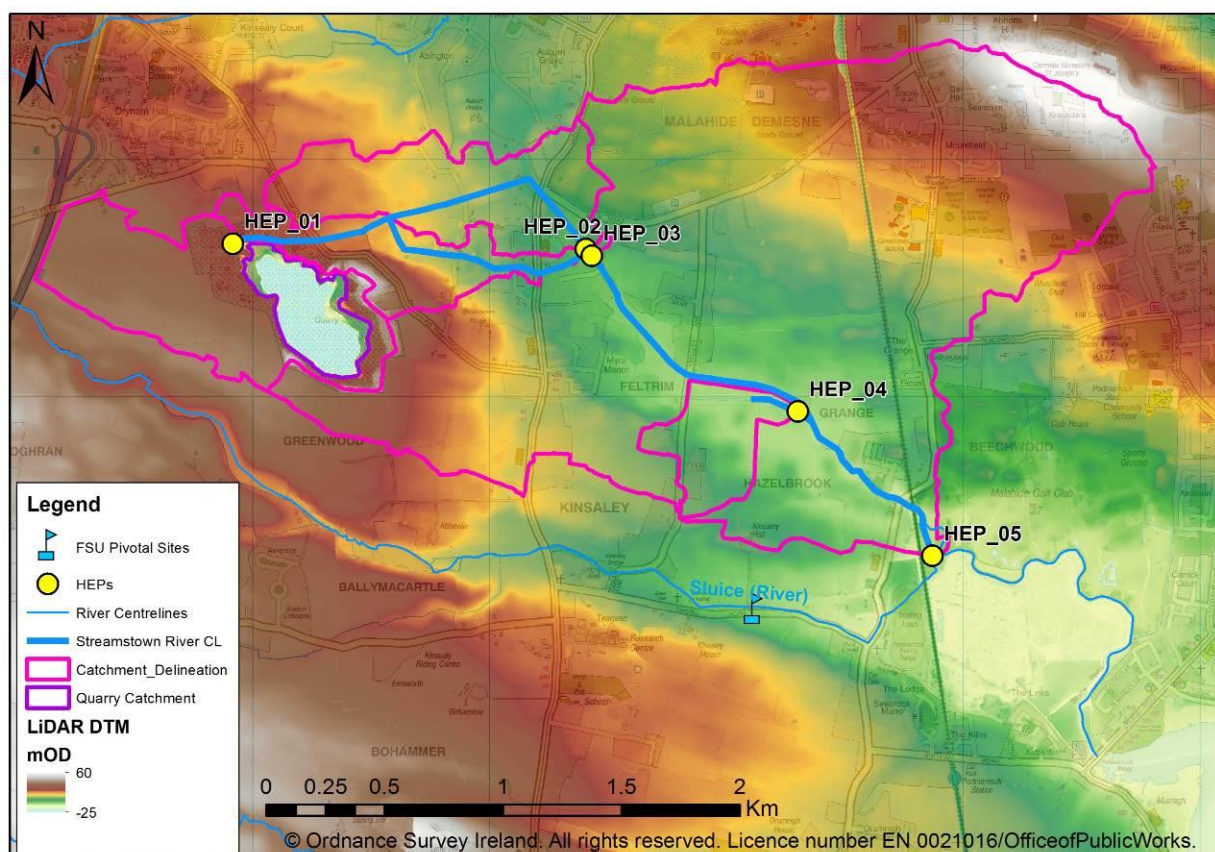


Figure 3.1 HEPs and Catchment Delineation

Only the downstream end of the catchment is delineated under FSU and a review of this catchment boundary found that it did not include the area of the catchment at the quarry and to the west beyond the quarry. Physical catchment descriptors representing each HEP/catchment were derived using various GIS datasets and, where considered representative, were borrowed from nearby adjacent FSU defined catchments.

3.2 PEAK FLOW ESTIMATION

The Streamstown catchment is essentially ungauged and as such initial estimates of the index flood flow, Q_{med} , were undertaken using the methods outlined in the FSU guidance contained within the Technical Research Report, Volume II – Flood Frequency Estimation³. A review of nearby and hydrologically similar FSU pivotal sites was undertaken to determine whether an adjustment should be applied to the initial ungauged estimates of Q_{med} . The review provided a strong case for an upwards adjustment with an average adjustment factor across the seven most geographically close sites of 1.20 and an average of 1.11 across the seven most hydrologically similar. The nearest gauging station, just to the south of the Streamstown catchment on the Sluice River at Kinsaley Hall (08005) is also the second most hydrologically similar pivotal site nationally. The adjustment factor at this station is 1.36 and it was considered appropriate that this adjustment was applied across all HEPs. Given that the catchment is a small ungauged catchment within HA09 it was considered reasonable to draw on the work undertaken in the Eastern CFRAM Study in relation to growth factors. A small catchment growth curve with a 1% AEP growth factor of 3.323 was used for all ungauged catchments under 15km² and it was considered appropriate to use the same growth curve for all of the HEPs in the Streamstown model. The peak design flows are shown in Table 3.1.

³ [http://opw.hydronet.com/data/files/Technical%20Research%20Report%20-%20Volume%20II%20-%20Flood%20Frequency%20Estimation\(1\).pdf](http://opw.hydronet.com/data/files/Technical%20Research%20Report%20-%20Volume%20II%20-%20Flood%20Frequency%20Estimation(1).pdf)

Table 3.1 Peak Design Flows at each HEP

HEP	AREA (km ²)	Qmed	Flows for AEP							
			50% (2)	20% (5)	10% (10)	5% (20)	2% (50)	1% (100)	0.5% (200)	0.1% (1000)
HEP_01	0.708	0.16	0.16	0.22	0.26	0.31	0.39	0.46	0.54	0.79
HEP_02	0.504	0.18	0.18	0.26	0.32	0.39	0.49	0.59	0.70	1.05
HEP_03	1.523	0.38	0.38	0.56	0.69	0.84	1.07	1.28	1.52	2.28
Lateral between HEP_01 & HEP_03	0.311	0.09	0.09	0.126	0.156	0.189	0.241	0.288	0.343	0.513
HEP_04	0.199	0.05	0.05	0.07	0.09	0.11	0.14	0.16	0.20	0.29
HEP_05	5.802	1.29	1.29	1.872	2.317	2.812	3.584	4.282	5.105	7.636
Lateral between HEP_03 & HEP_05	4.080	1.06	1.06	1.534	1.898	2.303	2.936	3.508	4.181	6.254

	Input Flows
	Lateral Flows
	Check Flows

3.3 ACCOUNTING FOR THE EFFECT OF THE QUARRY IN THE DESIGN FLOWS

It was initially assumed that the hydrological effect of the Quarry, located within the sub-catchment to HEP_01, was not significant in relation to overall flood risk. Review of the initial flood maps indicated however that flooding in the upper catchment was overestimated and after considering model calibration parameters it was determined that the most likely source of this overestimation was the scale of the design flows entered in the model. From the high ground around the quarry sides all run-off drains to the quarry lake where it is then pumped out over time. It is envisaged that the run-off from this quarry sub-catchment is effectively attenuated by the quarry lake and pump system and this must be quantified.

RPS contacted the quarry operators, Roadstone, to discuss the maximum discharges to the top of the Streamstown watercourse from the quarry lake pumping system. It was confirmed that a daily maximum volume is allowed of 1500m³. This is equivalent to 17l/s if averaged over an entire day but it is possible that in a flood situation the quarry may seek to achieve their maximum allowable volume within a much shorter time period. RPS discussed this possibility with Roadstone who indicated that the pumps are not capable of pumping over the allowable daily volume and that the lake has such a large storage volume that would not be a need for short term high rate pumping.

The quarry catchment was assessed and found to be 23% of the catchment area of HEP_01 and as such the peak flows as shown in Table 3.1 for HEP_01 represent a reduction by 23% from the initial estimates. A continuous flow hydrograph was then added to the reduced HEP_01 hydrograph to represent a continuous pumped discharge of the maximum allowable volume over a 12 hour period.

This resulted in a reduced peak to the flow hydrograph for HEP_01 but an increased base flow. The design hydrographs for the 1% AEP event are shown in Figure 3.2. Hydrographs were generated using the FSU hydrograph shape generation tool (v5) produced by OPW. An initial estimation of shape parameters was derived for each HEP and then an adjustment applied based on a pivotal site. The Sluice gauging station was not considered an appropriate site for hydrograph shape generation due to uncertainty in the observed hydrograph data. Two small catchment pivotal sites remote from Streamstown were used as pivotal sites, 22009 and 26022, as they were deemed to be hydrologically similar. The hydrograph shapes were compared to the available data from the Sluice station and found to be similar in shape albeit the volumes under the hydrograph are much smaller as would be expected in proportion to the relative catchment sizes.

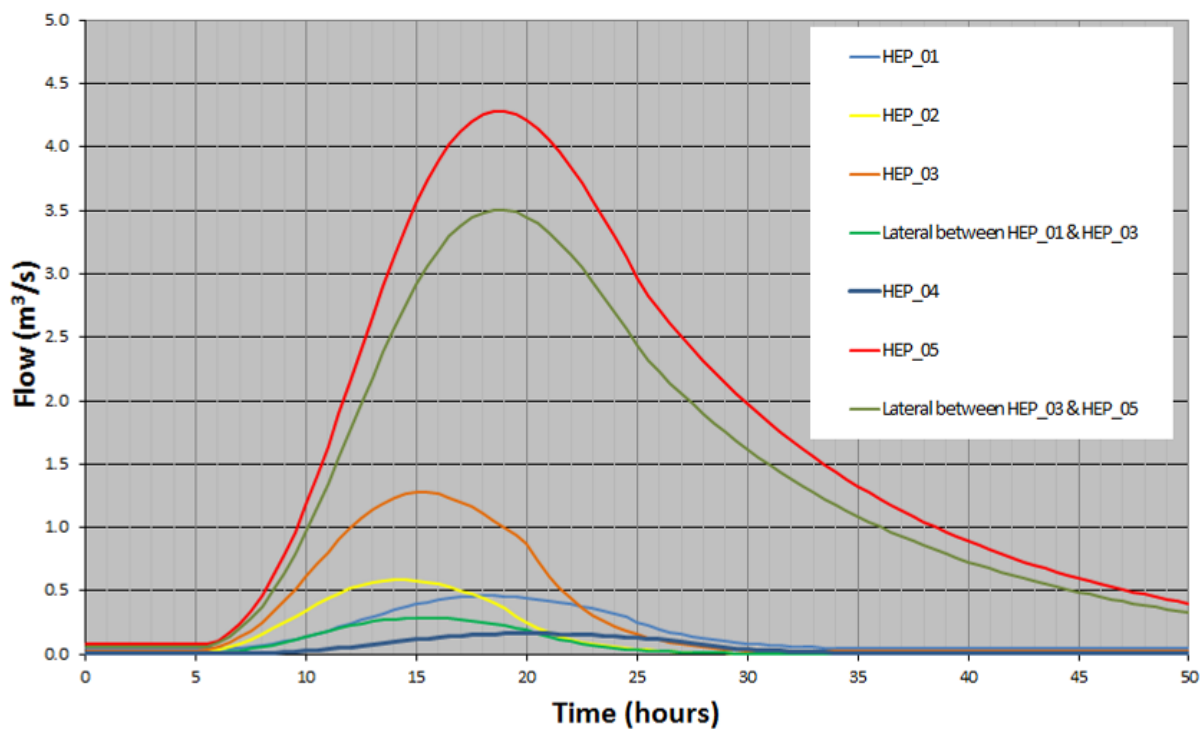


Figure 3.2 1% AEP Design Hydrographs

3.4 COMPARISON OF FLOW WITH THE FEM FRAM STUDY

From the updated flows for streamstown, HEP_03 is most comparable to the flows from node 2SAAZ1030 from the previous FEM FRAMS study. Table 3.2 shows the percentage difference between the two points.

Table 3.2 Percentage difference between Streamstown HEP_03 flows and FEM FRAMS 2SAAZ1030 flows.

	10% AEP FLOW	1% AEP FLOW	0.1% AEP FLOW
HEP_03	0.69	1.28	2.28
2SAAZ1030	0.71	1.23	1.89
% Diff	-3%	4%	20%

While the flows from each study are similar, further comment can not be made on these differences as there is no reference in the FEM FRAM hydrology report to catchment descriptor details or catchment boundary locations to compare to the catchment descriptors used within the Streamstown study.

4 COMPUTATIONAL MODELLING

4.1 MODEL CONSTRUCTION AND UPDATE

A review of the existing ISIS Sluice model by RPS concluded that it would be preferable to construct a new 1D-2D coupled InfoWorks ICM 7.5 river model of the Streamstown area (instead of updating the existing model). Cross section information and downstream boundary conditions were extracted from the existing ISIS model. As discussed in Section 2.4, the OPW provided RPS with survey information of the additional watercourse alignment which has been incorporated into the model as per the project scope. Figure 4.1 shows the new model extents.

The entire model extent is constructed as 1D-2D with 2m LiDAR information being used to create the 2D mesh. The model contains 117 nodes, 26 conduits, 1 orifice and a trash screen. A number of weirs and inline banks are used as overtopping features for structures. Buildings are represented in the 2D domain as porous polygons, allowing flow to pass through buildings rather than obstruct flow paths.

Results from preliminary model simulations showed that out of bank flooding still occurred from the 10% AEP event even with the new watercourse alignment incorporated into the model. Initial model outputs were reviewed with the OPW and following the site walkover survey, the model was further updated to ensure an accurate representation of flood mechanisms. The model was updated with the following changes:

- The 2D mesh resolution was increased (maximum triangle size was reduced from 100m² to 25m²), with an even higher resolution of 2D zone applied over the junction of the new watercourse alignment and previous flow path (maximum triangle size of 5m²), as shown in Figure 4.2. This was to ensure that any overland flow finds the lowest points within the topography and the correct overland flow path.
- Roughness zones were applied to the 2D mesh using the CORINE dataset rather than an overall roughness value. A specific roughness zone (set to Manning's n of 0.5 to represent the hedgerow) as shown in Figure 4.2, was created at the junction to influence overland flow paths.
- Contact was made with the Feltrim quarry to gather further information on storage and discharge operations; this has been discussed in Section 3.

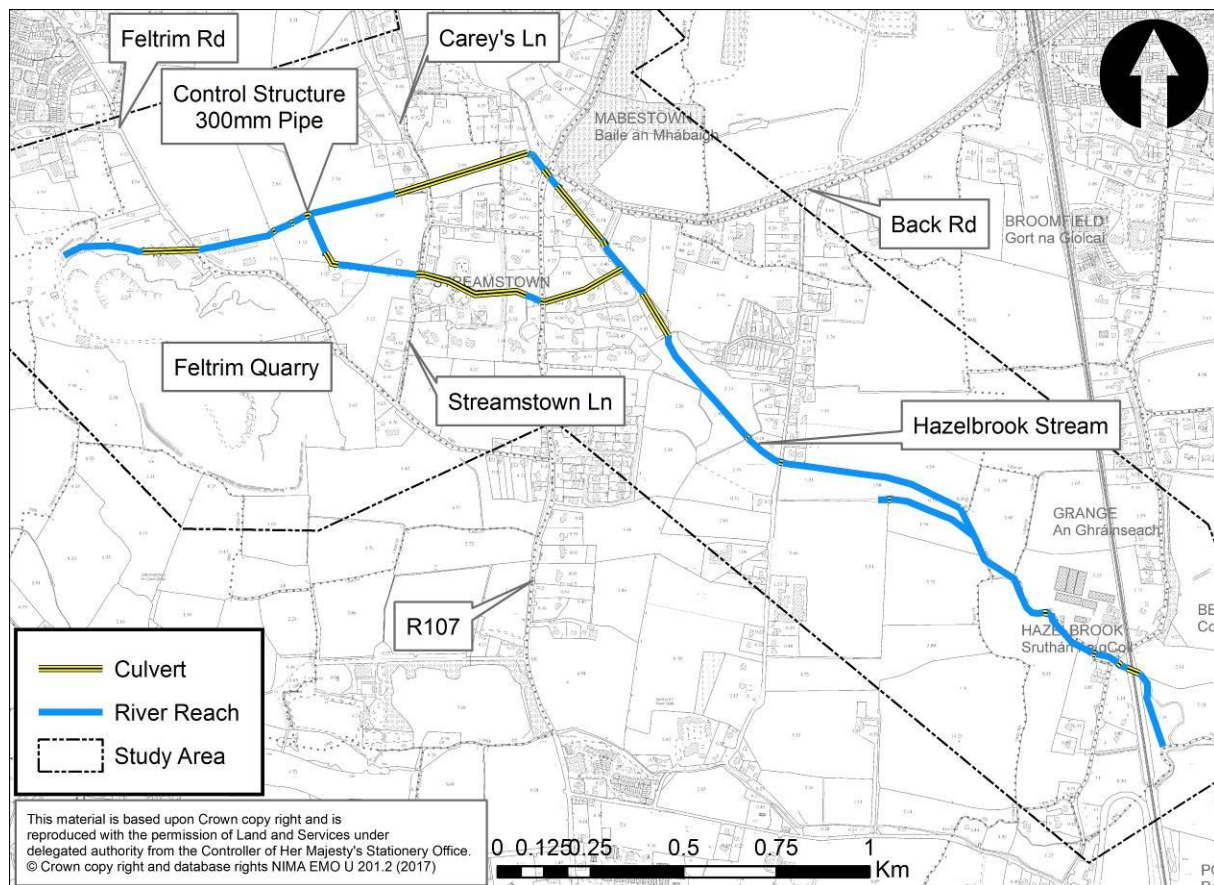


Figure 4.1 Streamstown Model Extents

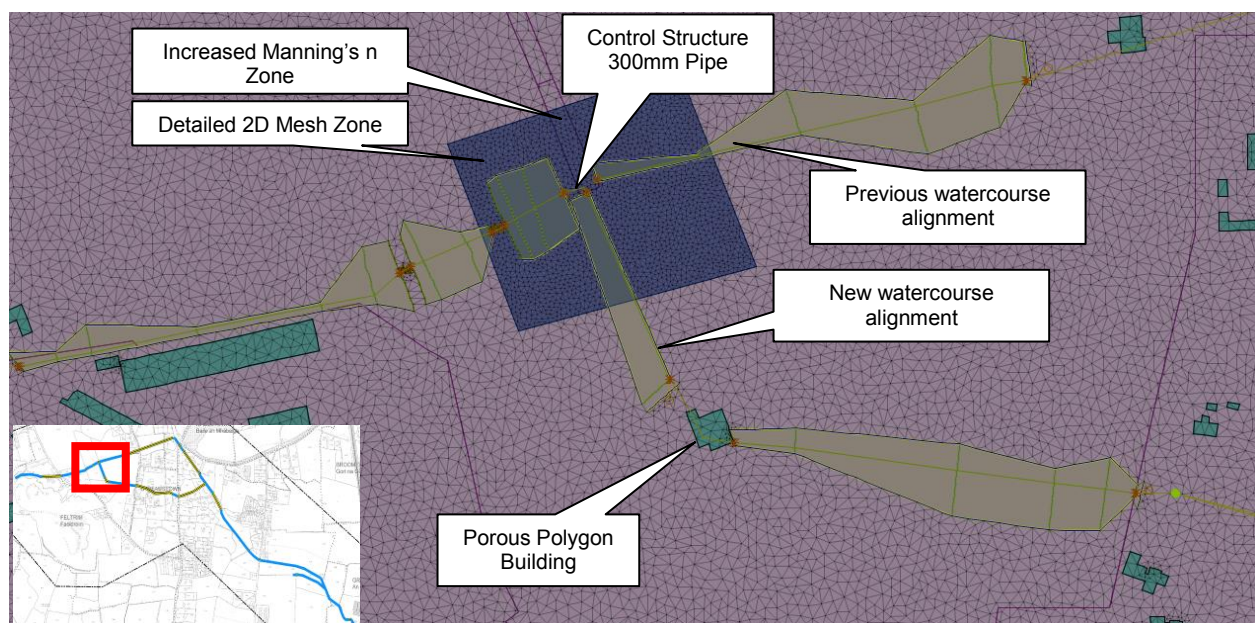


Figure 4.2 Streamstown ICM Network at Structure 01STRE0185

4.2 MODEL CALIBRATION & VERIFICATION

RPS attempted to compare modelled flood extents with previous flood events. However there is very limited data available. Data was available within the FEM FRAM Study hydrology report however the information is not specific enough to identify exact flooding locations. There are no gauge locations within the updated model extents and there has potentially been further works in the Streamstown area (as stated in Section 2.2).

As the objections received during the SI mapping consultation of FEM FRAMs were concerned that the incorrect river centre line had been applied to the model, RPS concentrated on accurate representation of the control structure and over land flow paths between the original route and the new alignment.

4.3 MODEL OUTPUTS

Overall, RPS have made best use of the available information and feel that the model is performing satisfactorily for design event simulation. There remains some uncertainty with the flood extents particularly regarding the representation of the critical structure 01STRE01085, sensitivity testing has been carried out on the structure which is discussed in Section 4.5.

RPS reproduced the mapping tile SLU/HPW/EXT/CURS/003 (as shown in Appendix A), splitting the extents onto three maps (as shown in Appendix C). Additional pages were required as the previous mapping (produced in August 2010) had been produced at a scale of 1:10,000 however there has since been updated guidance and the new maps were produced to a scale of 1:5,000. Maps were produced using the updated flood extents combined with the previous model outputs using Arc GIS. Figure 4.3 shows the extent of the updated model outputs and where they are combined with the FEM FRAM Study outputs. The updated model outputs cover the Streamstown area and Hazelbrook Stream to the railway bridge.

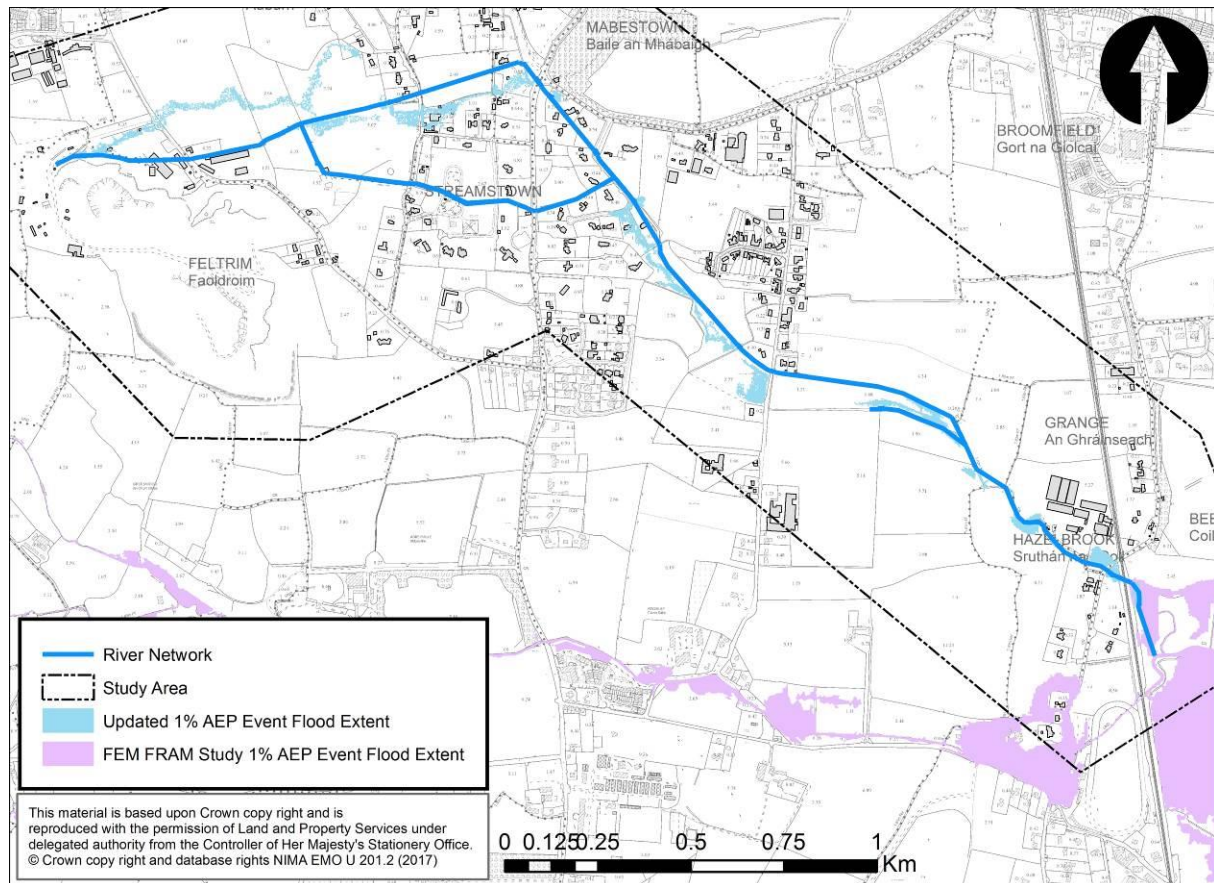


Figure 4.3 Streamstown Mapping Overlap between FEM FRAMs Study Outputs and Updated Outputs for the 1% AEP Event

Maps presented in Appendix C are currently draft and are subject to review before finalisation. The final maps will be available on-line on the OPW website: www.floodinfo.ie once approved. Updated model results show that with the new watercourse alignment and critical structure 01STRE01085 included, no properties are at risk of flooding in the 10% AEP, whereas in the previous FEM FRAM Study mapping, a number of properties located along Carey's Lane and Streamstown Lane were affected by an overland flow path in the 10% AEP. Therefore the flow path identified in the objections received from local residents during the National Flood Map Consultation process in 2015 is no longer presenting a risk in the 10% AEP event. However the aforementioned overland flow path is present in the updated model results from the 2% AEP event onwards, affecting properties on Streamstown Lane.

Full results are available in Appendix C, however Figure 4.4 shows the properties in Streamstown which are at risk of flooding during the 1% AEP flood event.

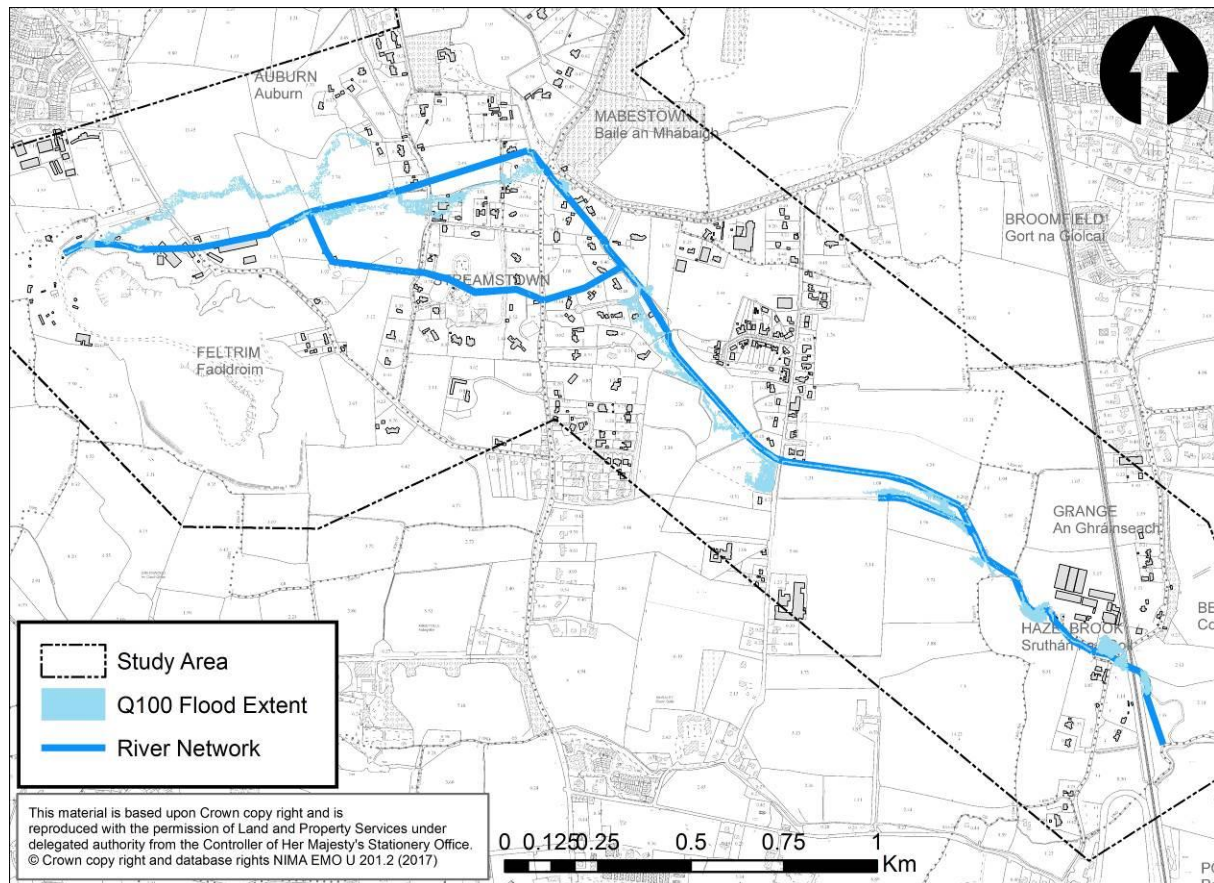


Figure 4.4 Streamstown Flood Risk in 1% AEP Flood Extent

4.4 MODEL PERFORMANCE

The performance of the 1% AEP model has been checked for any significant instabilities and none have been observed. A mass balance check has also been carried out on the 1% AEP model to ensure that the total volume of water entering and leaving the model at the upstream and downstream boundaries balances the quantity of water remaining in the model domain at the end of a simulation. Generally mass errors should be less than 2%. If the mass error is greater than 2%, the cause and location of the mass error within the model schematisation should be identified and the consequence of this error assessed and improvements to the model considered. If the mass error is greater than 5%, then it suggests that the model schematisation is not robust and needs to be reviewed (Environment Agency, 2010). The Infoworks ICM model generates the mass balance automatically and the 1% AEP Streamstown model has a mass balance error of 0%.

4.5 SENSITIVITY ANALYSIS

Sensitivity analyses were conducted on the model in order to understand the level of uncertainty in the modelling. This involved adjusting key parameters within the model to determine the model sensitivity against the chosen parameters. Factors investigated included increase in flow, 2D roughness, 1D roughness and critical culvert parameters. The sensitivity and impact is generally assessed on the 1% AEP event however one test has been repeated with the 10% AEP event. The following sensitivity analysis model simulations have been undertaken:

- a) Increase in flow – The 1% AEP event flows were increased by 10%, this resulted in a large increase in flood extents. Fifteen additional receptors are impacted by the changes, these are located in the rural area north of the modelled watercourses (in the vicinity of Auburn Grove) and the Back Road. With 15 additional properties being affected, this accounts for an increase of 100% when compared to the 15 properties which are affected during the 1% AEP design event (located in the vicinity of Streamstown Lane and Mabestown Road). Figure 4.5 illustrates that the model has a high sensitivity to increase in flow.

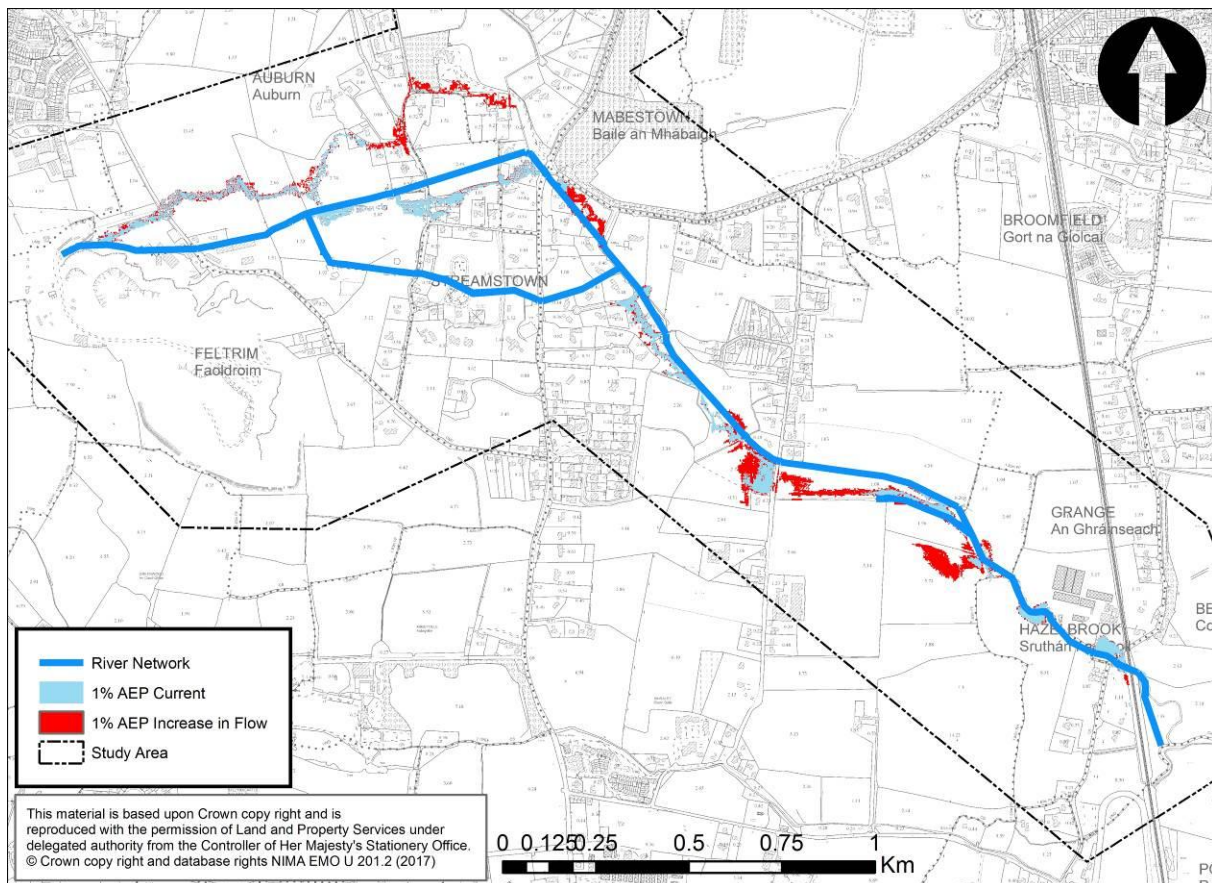


Figure 4.5 Comparison between 1% AEP Design Event and 1% AEP Increase in Flow Sensitivity Event

- b) Floodplain Roughness Decreased – The Manning's n value of the 2D mesh was reduced by 20%. These changes resulted in a small change in flood extents. There is a minimal increase in flood extents within the modelled area, as shown in Figure 4.6. The model is considered to have a low sensitivity to floodplain roughness, one additional receptor is impacted by the increase of flood extents (located on the Back Road).

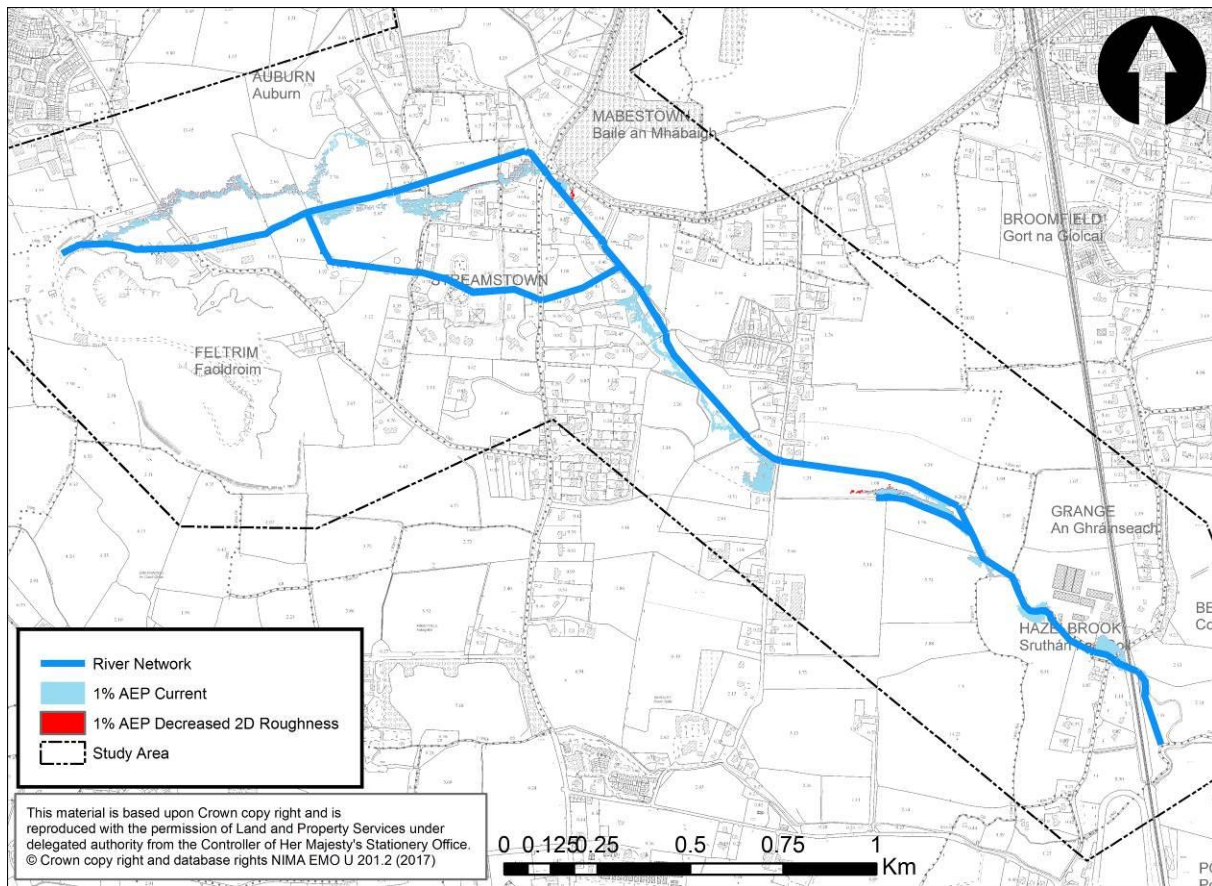


Figure 4.6 Comparison between 1% AEP Design Event and 1% AEP Change in 2D Roughness Parameters Sensitivity Event

- c) Channel Roughness Increased – The Manning's n values of cross sections were increased by 20%. These changes resulted in a moderate change in flood extents. An additional 2 receptors (located on Auburn Grove) are impacted by the increase in flood extents, accounting for a change of 13% when compared to the 1% AEP design event. Figure 4.7 illustrates that the model has a moderate sensitivity to 1D roughness edits.

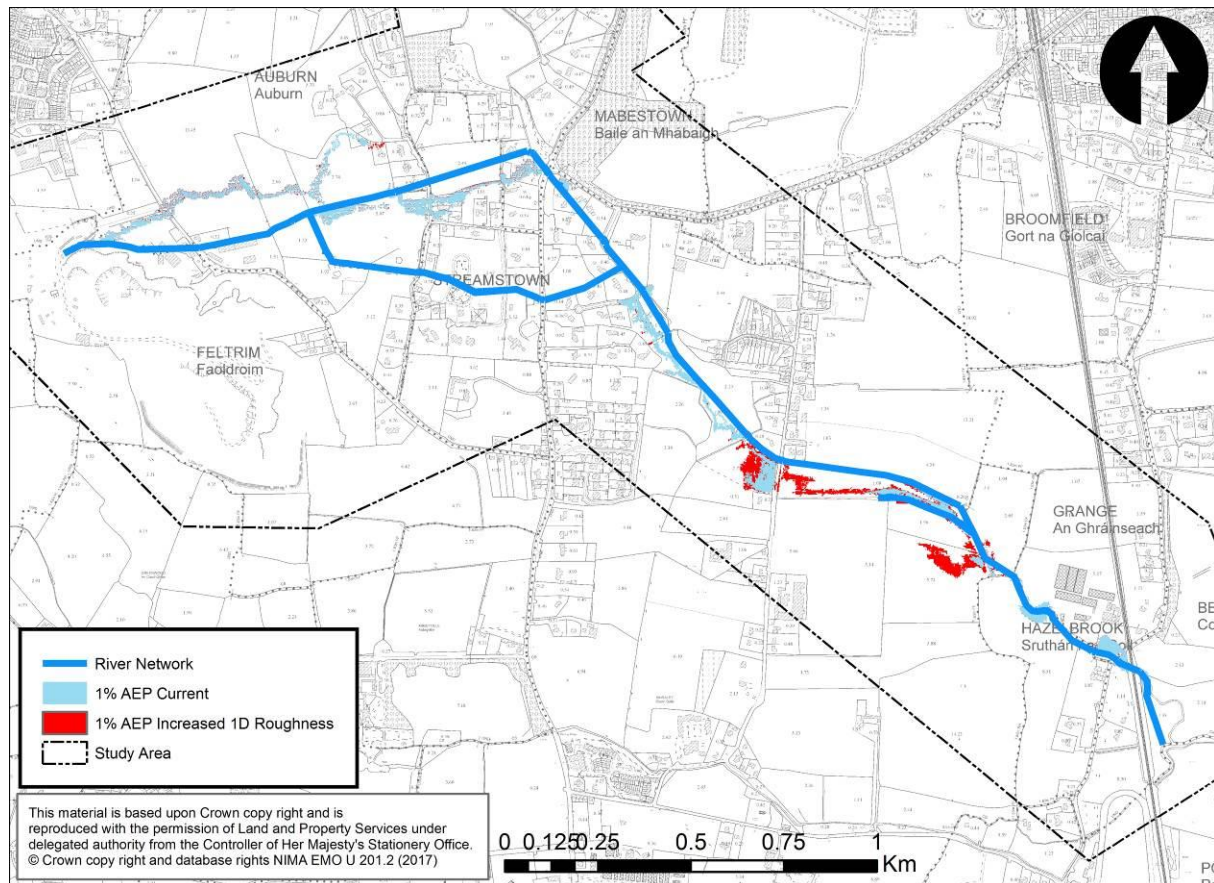


Figure 4.7 Comparison between 1% AEP Design Event and 1% AEP Increased 1D Roughness Sensitivity Event

- d) Increase 01STRE01085 Culvert Size – The critical structure (01STRE01085) which controls flow going towards the new watercourse alignment and previous watercourse was increased (from 300mm to 600mm) to assess if more flow could be directed down the new watercourse route. The change resulted in a small change in flood extents during the 1% AEP event, as shown in Figure 4.8. There is less flow and therefore out of bank flooding downstream of the culvert with more flow able to follow the new watercourse route. No properties benefited from the reduced flood extents.

This sensitivity test was also completed for the 10% AEP event. The change resulted in a small change in flood extents during the 10% AEP event, as shown in Figure 4.9. Again there is less flow downstream of the culvert and no out of bank flooding, as more flow is able to follow the new watercourse route. No properties benefited from the reduced flood extents.

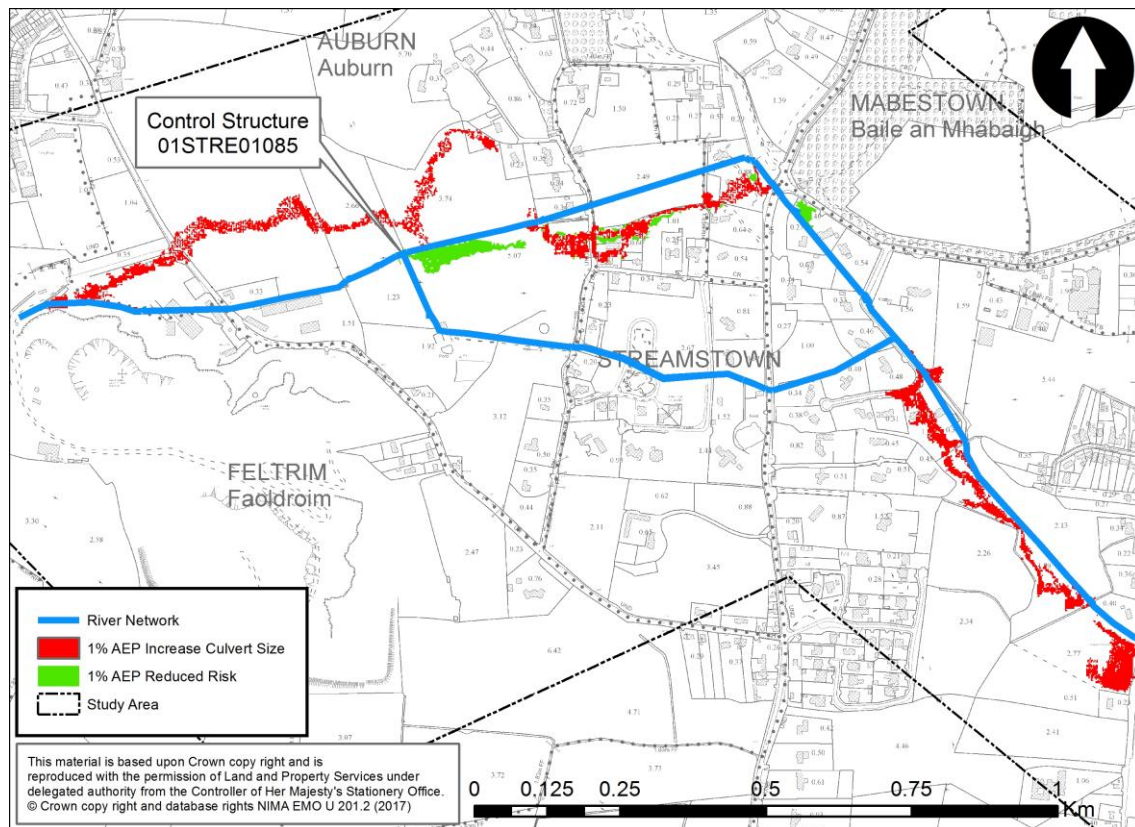


Figure 4.8 Reduced 1% AEP Risk due to Increase in 01STRE01085 Culvert Size Sensitivity Event

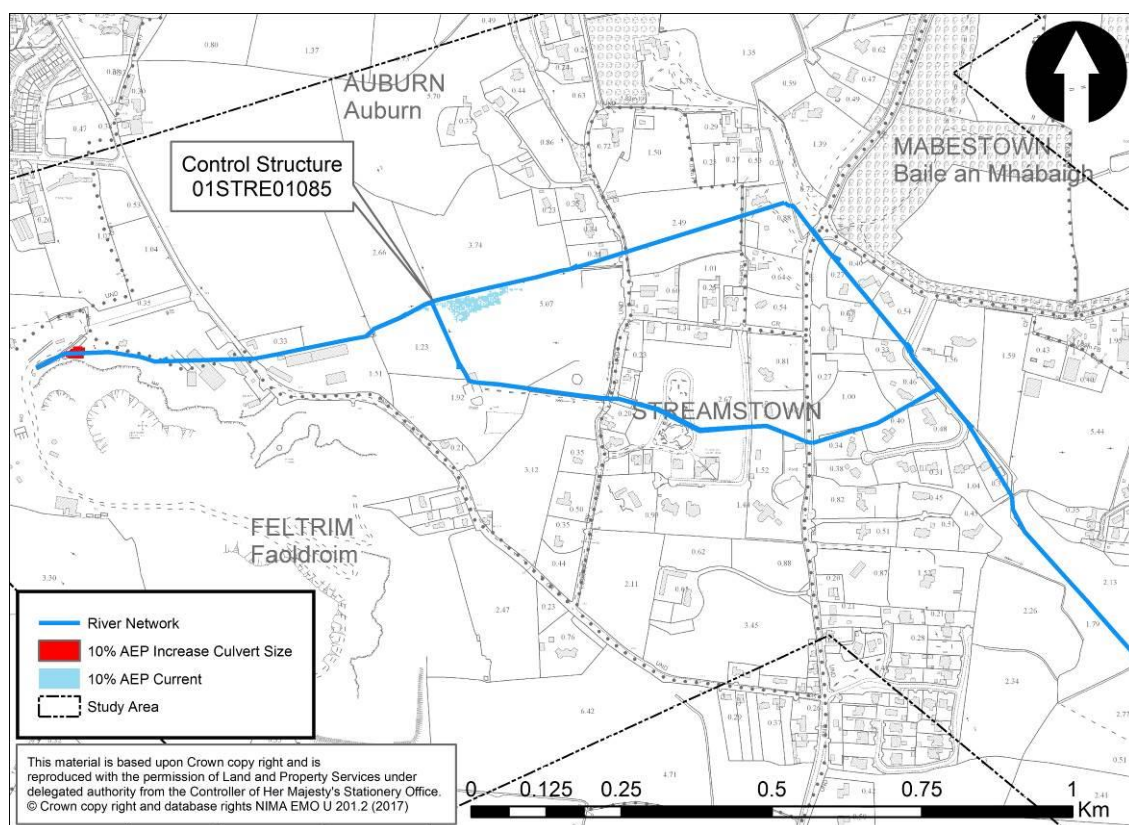


Figure 4.9 Comparison between 10% AEP Design Event and 10% AEP Increase in 01STRE01085 Culvert Size Sensitivity Event

Table 4.1 summarises the outcomes of the above sensitivity simulations. Of the parameters, the model is most sensitive to an increase in inflows. The model is less sensitive to the other parameters, with the resulting analysis identifying low to moderate increases in flood extents and receptors. Generally, the Streamstown model can be considered to have low to moderate sensitivity to changes in model parameters.

Table 4.1 Sensitivity Summary

Sensitivity Simulation	Sensitivity	Impact
Increase in Flow	High	High
Decreased Floodplain Roughness	Low	Low
Increase 1D Roughness	Moderate	Low
Increase in Culvert 01STRE01085 Size – 1% AEP Event	Moderate	Low
Increase in Culvert 01STRE01085 Size – 10% AEP Event	Low	Low

4.6 MODEL LIMITATIONS

There are inherent assumptions, limitations and uncertainty associated with hydraulic modelling including;

- Hydrology assumptions made in relation to the quarry (retention of flow and pumped discharge) in the upper catchment;
- The project brief states, ‘the exact alignment and details of some of the culverts could not be obtained’, this was due to access restrictions during the surveying. RPS have used professional judgment based on information available and from the site walkover;
- schematisation decisions regarding out-of-bank flow routes;
- culvert/bridge schematisation (including skew angle considerations);
- data sources;
- changes to parameters from default.

RPS employed best practice in the computer modelling of watercourses and used anecdotal evidence to compare flood extents and depths.

5 CONCLUSIONS

This study was undertaken to update one mapping tile covering Streamstown, Malahide, County Dublin, which was produced during the FEM FRAM Study in 2010. This required a review and update of the existing hydrology and hydraulics to ultimately update the flood mapping. Hydraulic analysis was undertaken in order to identify the location and frequency of flooding within the Streamstown area. The analysis consisted of creating an Infoworks ICM computational model based on cross-sections extracted from an existing model and new detailed topographical survey information, and updated hydrological inputs to determine the flood risk in the area.

There was limited information on historical flood events to calibrate or validate the model.

There is a moderate to high level of uncertainty in the hydrological analysis. The Streamstown River catchment itself is ungauged however there is one FSU gauging station on the neighbouring Sluice catchment just to the south. This has been used to inform the design flows with some confidence as the Sluice catchment can be considered hydrologically similar and geographically close. The modelled catchment and sub-catchments are not well defined within the FSU and there is some uncertainty in the upper catchment due to the hydrological effect of Feltrim Quarry within the sub-catchment.

There is moderate confidence in the hydraulic assessment of the Streamstown study area - it is considered to be performing satisfactorily for design event simulation. However further data collection such as resurvey of locations which were inaccessible, during winter months when there is less vegetation prohibiting access, or flow monitors on watercourses downstream of the critical structure 01STRE01085, could aid future calibration and validation thereby increasing confidence in the model outputs.

The final model was used to simulate 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.1% AEP events. There is a significant reduction in flood risk during the 10% AEP event when comparing results from the previous model and the updated model. No properties are shown to be affected at Streamstown Lane in the updated model outputs during the 10% AEP event.

Sensitivity tests have been conducted for the model. Parameters selected for the analysis included:

- Increase in Flow – 1% AEP Event
- Decreased Floodplain Roughness – 1% AEP Event
- Increase 1D Roughness – 1% AEP Event
- Increase in Culvert 01STRE01085 Size – 1% AEP Event
- Increase in Culvert 01STRE01085 Size – 10% AEP Event

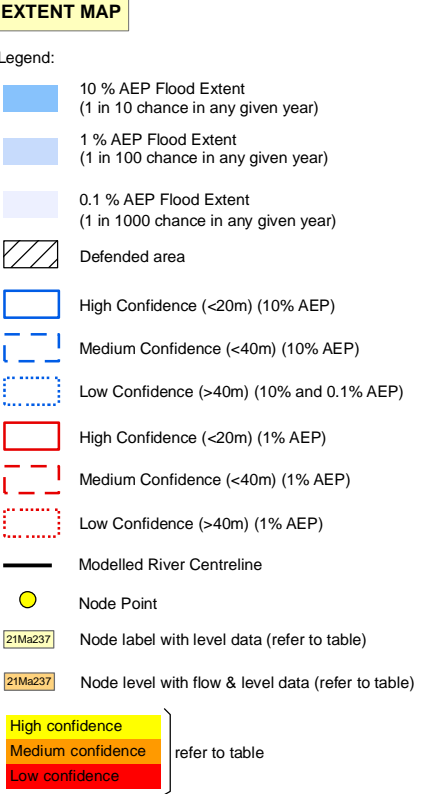
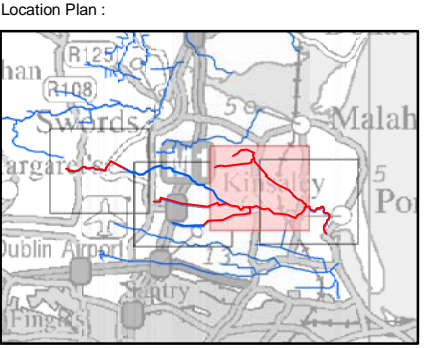
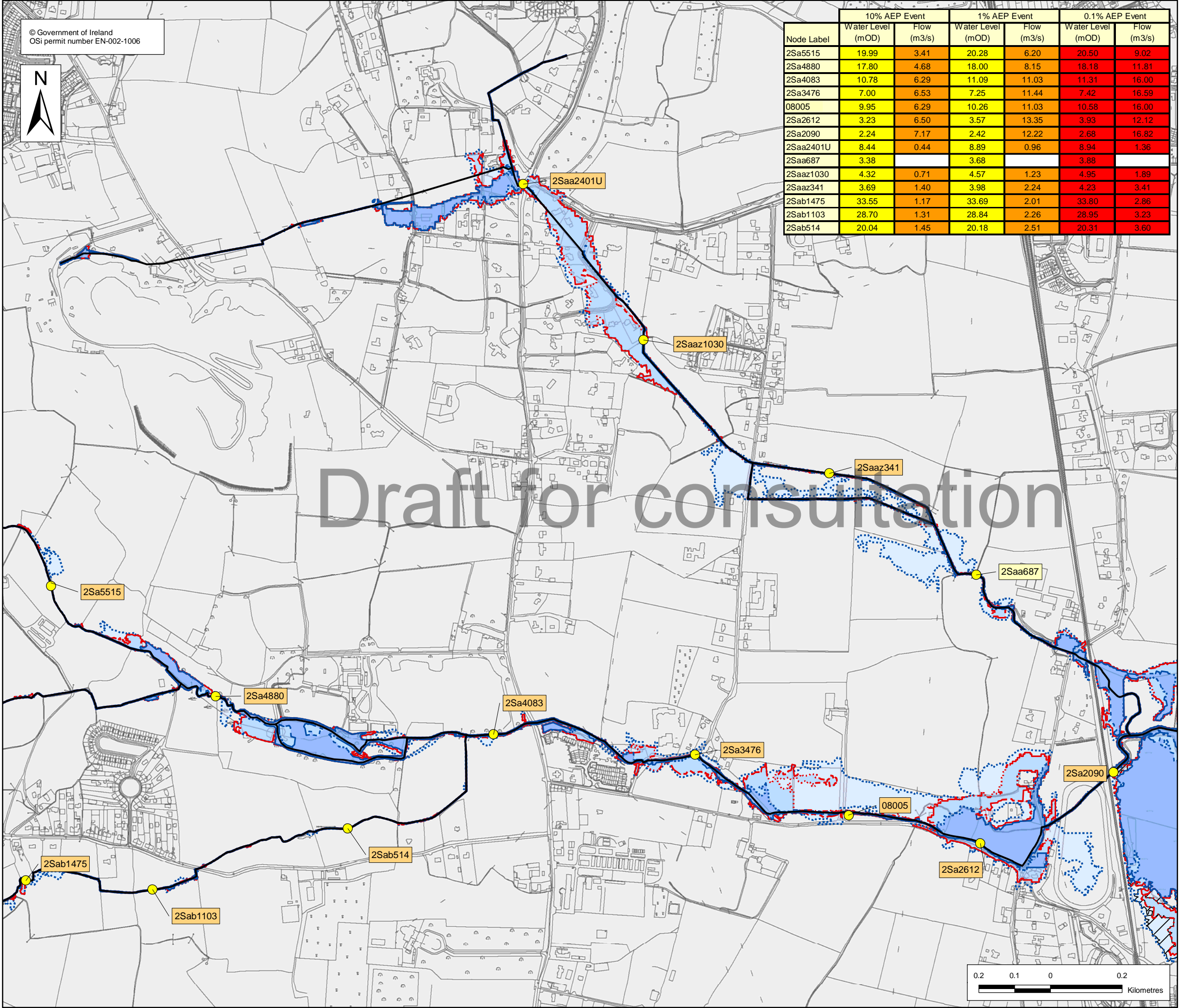
It was concluded from the sensitivity analysis that the model parameter with the greatest influence is the increase in flows. Generally, the Streamstown model can be considered to have low to moderate sensitivity to changes in model parameters.

The main objective of the study was to provide an updated model (incorporating a new watercourse alignment) of the watercourses in Streamstown. The outputs of the model were then combined with the model outputs of the overall Sluice model to produce updated flood mapping. Given the detailed hydrological and hydraulic modelling analysis undertaken for the Streamstown study area, it is concluded that the assessment satisfies the requirements of the project brief.

APPENDIX A

SLUICE MODEL FLOOD EXTENT MAP

FROM FEM FRAM STUDY



USER NOTE:

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Clients :

Fingal County Council
Camrante Celtic Fibre Gold
Malahide Community Council
OPW

Project :
FEM FRAMS

Map :
SLUICE MODEL FLOOD EXTENT MAP

Map Type : FLOOD EXTENT

Source : FLUVIAL FLOODING

Map area : HIGH PRIORITY WATERCOURSE

Scenario : CURRENT

Figure By : Mara Ruiz Date : 8 August 2010

Checked By : Sergio Herbón Date : 8 August 2010

Approved By : Clare Dewar Date : 8 August 2010

Figure No. :
SLU/HPW/EXT/CURS/003

Revision
0

Drawing Scale : 1:10,000 Plot Scale : 1:1 @ A3

APPENDIX B

SITE WALKOVER



A.1 Outlet of Structure 01STRE00970



A.2 Watercourse upstream of 01STRE01085



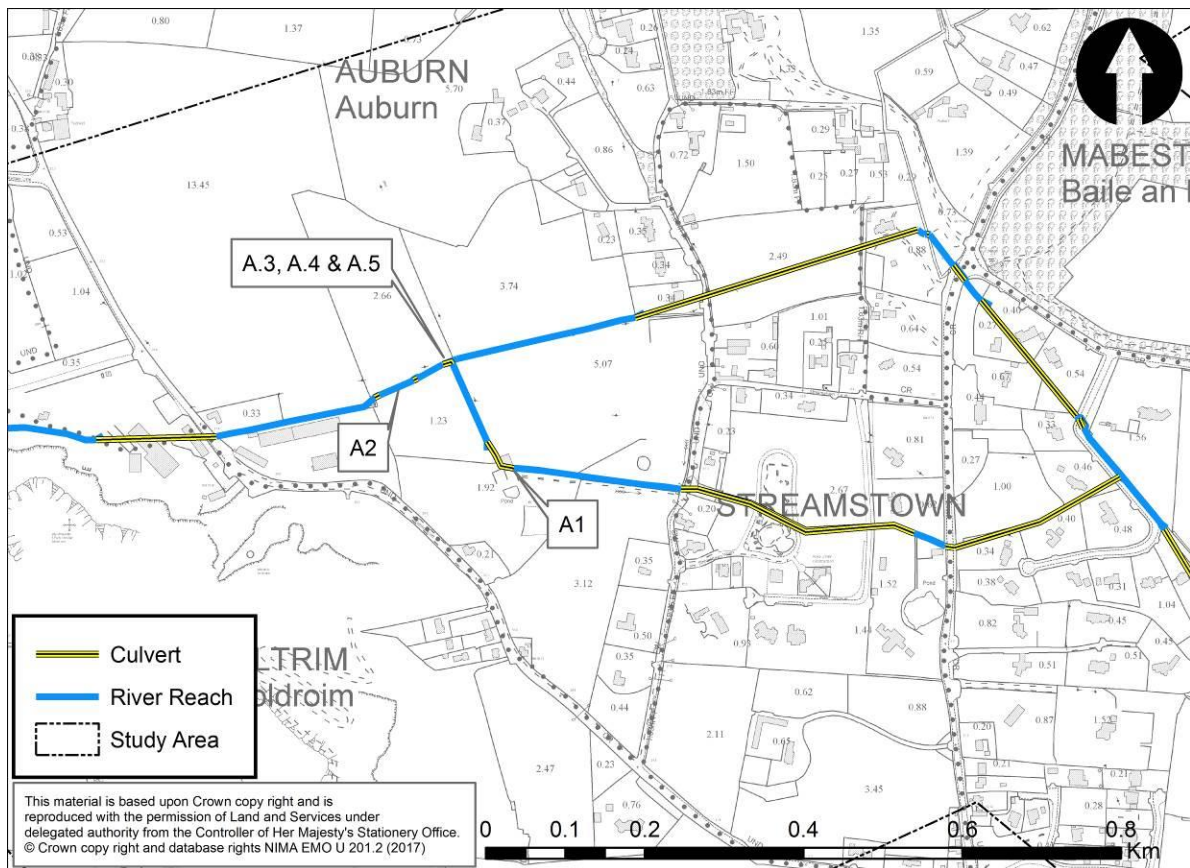
A.3 Looking towards inlet of 01STRE01085



A.4 Looking towards outlet of 01STRE01085



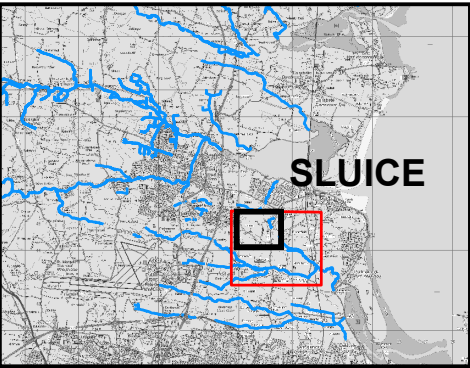
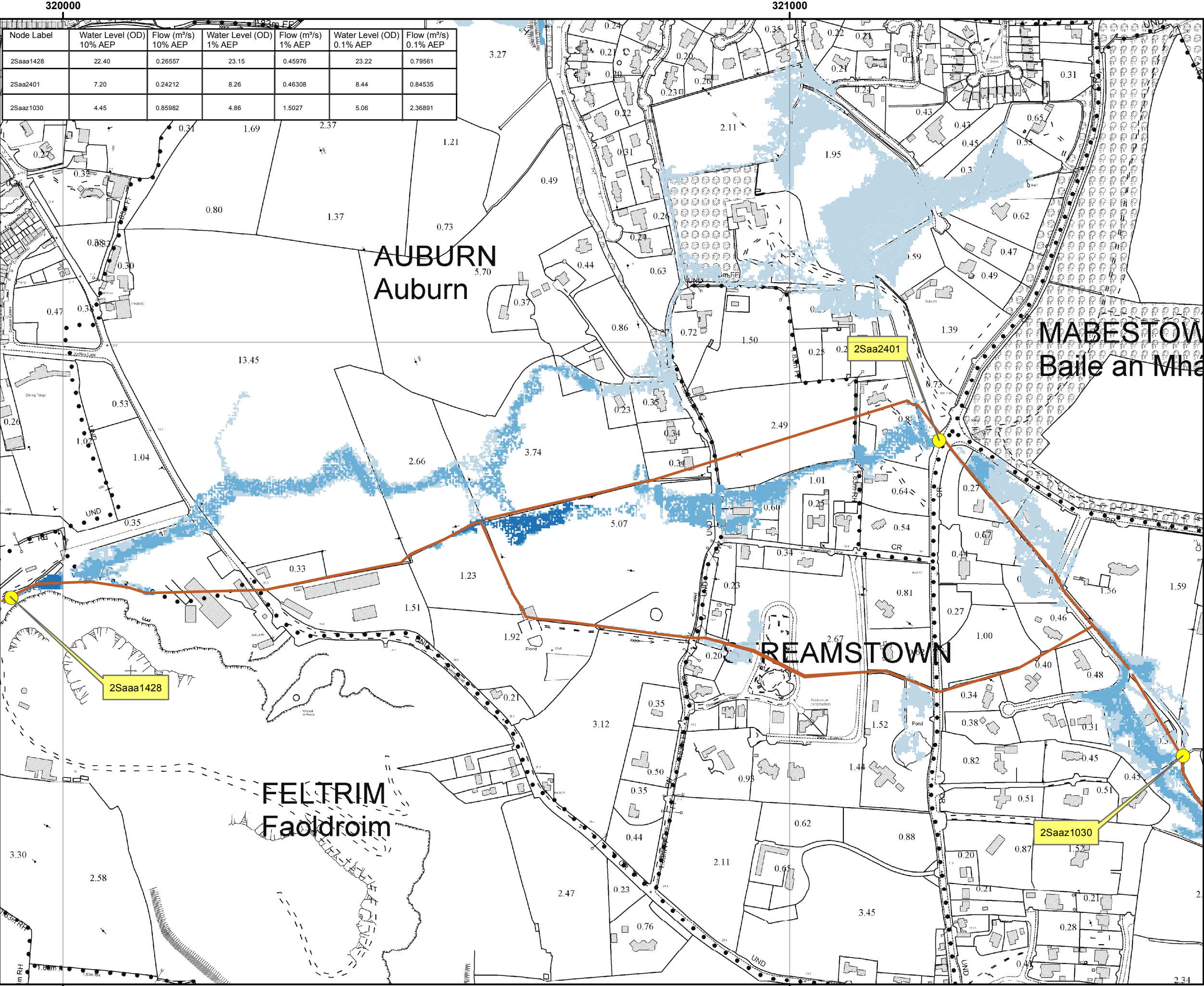
A.5 Inlet of 01STRE01085



Photograph Locations

APPENDIX C

RPS MODEL OUTPUTS



The viewer of this map should refer to the Disclaimer, Guidance Notes and Conditions of Use that accompany this map. This draft map is for consultation purposes only, and should not be used for any other purpose.

Legend

10% Fluvial AEP Event

1% Fluvial AEP Event

0.1% Fluvial AEP Event

Modelled River Centreline

AFA Extents

Node Point

Node ID

Node Label

DRAFT FINAL

REV:	NOTE:	DATE:
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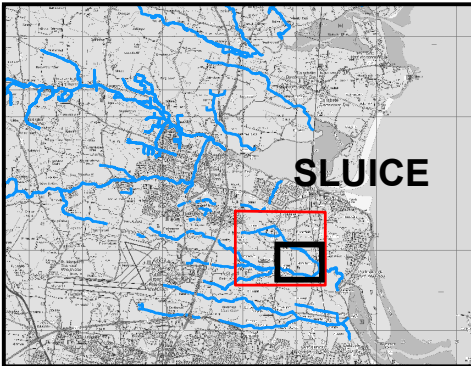
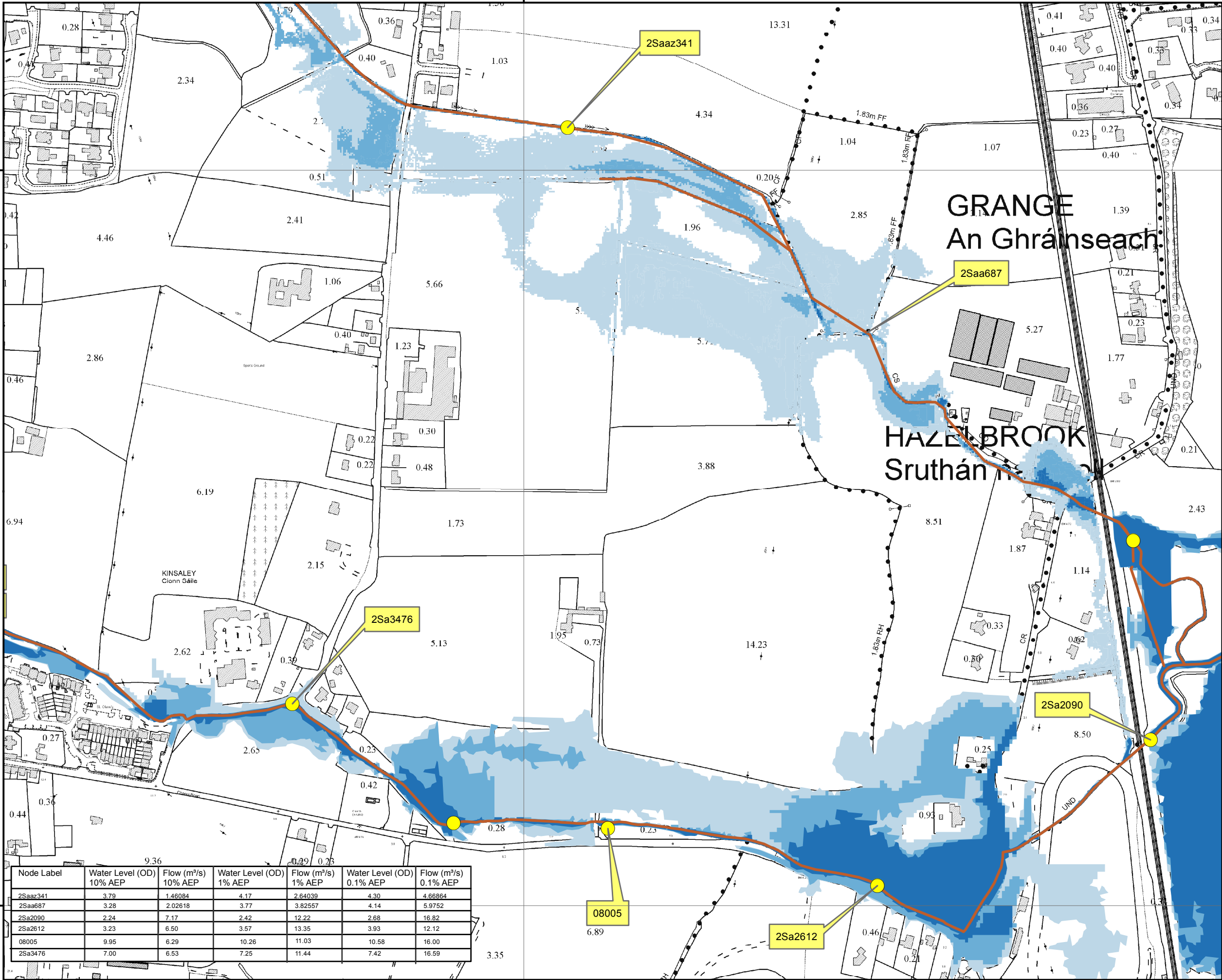
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Map:	
Sluice Model Fluvial Flood Extents	
Map Type: EXTENT	
Source: FLUVIAL	
Map Area: HPW	
Scenario: CURRENT	
Drawn By : N.M.	Date : 12 February 2018
Checked By : T.D.	Date : 12 February 2018
Approved By : G.G.	Date : 12 February 2018
Drawing No. :	
SLU/HPW/EXT/CURS/003	
Map Series : Page 3a of 4	
Drawing Scale : 1:5,000 @ A3	





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- Legend**
- 10% Fluvial AEP Event
 - 1% Fluvial AEP Event
 - 0.1% Fluvial AEP Event
 - Modelled River Centreline
 - AFA Extents
 - Node Point
 - Node ID Node Label

DRAFT FINAL

REV:	NOTE:	DATE:
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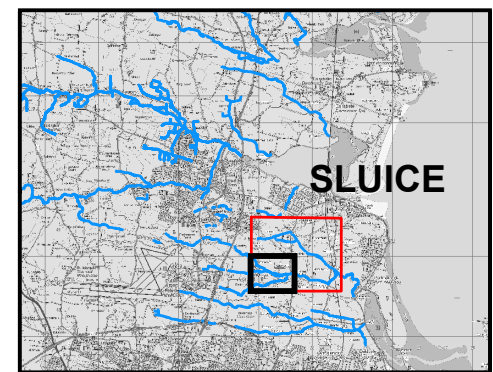
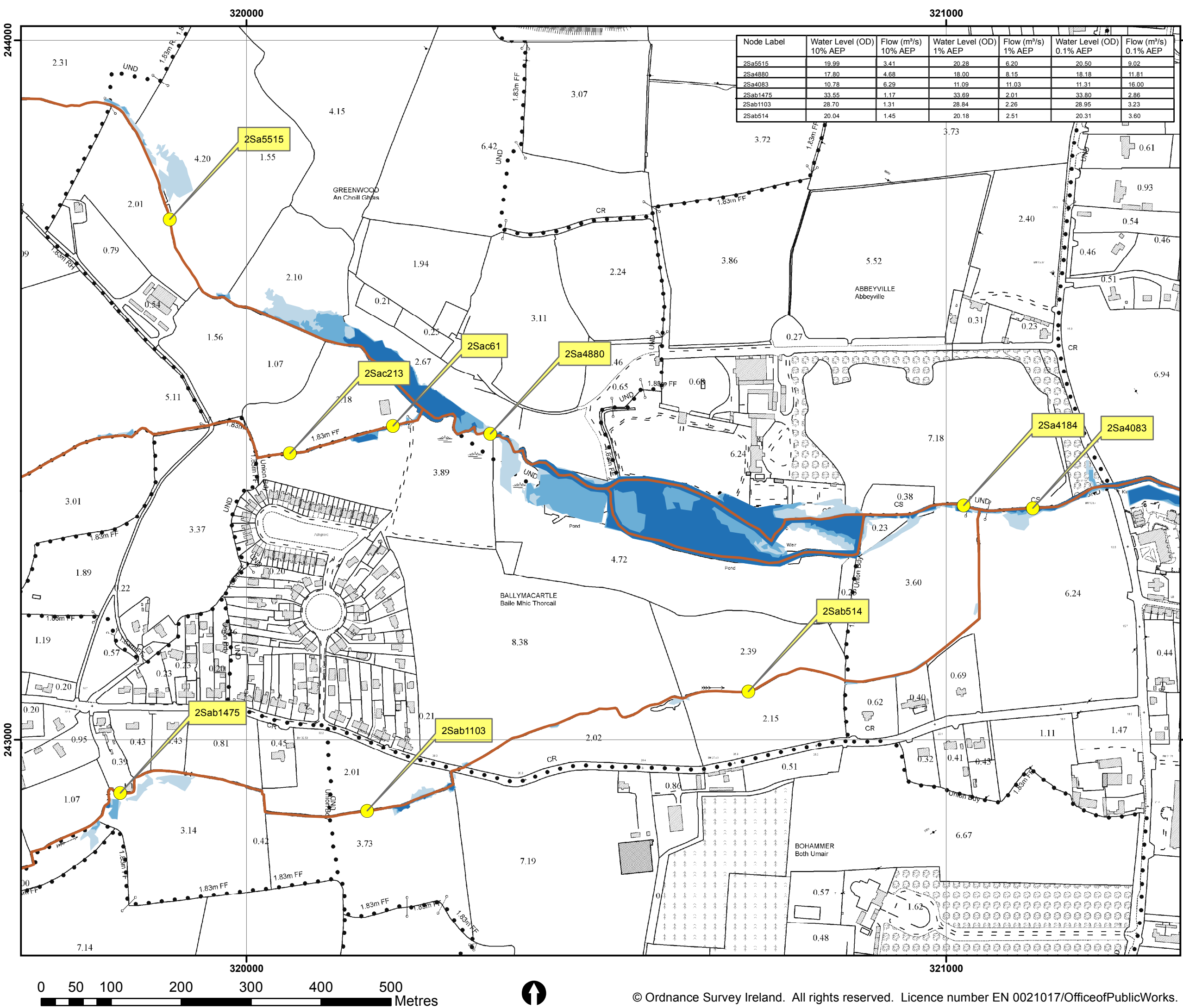
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Source: FLUVIAL	
Map Area: HPW	
Scenario: CURRENT	
Drawn By : N.M.	Date : 12 February 2018
Checked By : T.D.	Date : 12 February 2018
Approved By : G.G.	Date : 12 February 2018
Drawing No. :	
SLU/HPW/EXT/CURS/003	
Map Series : Page 3b of 4	
Drawing Scale : 1:5,000 @ A3	

0 50 100 200 300 400 500 Metres





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Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

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Map Series : Page 3c of 4	
Drawing Scale : 1:5,000 @ A3	

