



Portadown Feasibility Study

Portadown Feasibility Report

IBE1298/July18





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DOCUMENT CONTROL SHEET

Client	Dfl Rivers					
Project Title	Portadown Feasibility Study					
Document Title	Feasibility Report					
Document No.	IBE1298/July18					
This Document Comprises	DCS	TOC	Text	List of Figures	List of Tables	No. of Appendices
	1	1	65	1	1	4

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
D01	Draft	Various	S Patterson	A Jackson	Belfast	Jan 18
D02	Draft	Various	S Patterson	A Jackson	Belfast	Apr 18
F01	Final	Various	S Patterson	A Jackson	Belfast	Jul 18

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EXECUTIVE SUMMARY

DfI Rivers commissioned RPS Consulting Engineers to identify the flood risk associated with the complex watercourse system in and around Portadown and assess options (including economic viability) for the alleviation of future flooding.

RPS liaised with DfI Rivers to request hydraulic models, flood reports, information on DfI Rivers' assets, historical flood information and any other available information relevant to the study area. A walkover survey of the study reaches was conducted by RPS alongside representatives from DfI Rivers in order to gain an appreciation of the topography of the catchment, flooding mechanisms and the identification of any key features such as structures along each of the watercourses within the study area. RPS updated the hydraulic model, with details provided in the Portadown Modelling Report.

RPS then undertook a comprehensive option development and assessment process to ensure that all potential flood alleviation measures were considered. The works involved with each proposal were incorporated into revised models. This was to ensure that the preferred options would deliver the required reduction in flood risk to the relevant properties (to at least a 1% AEP event) and would not increase the risk of flooding elsewhere in the catchment. Three potential options were considered, Option 1 being the existing regime and therefore the baseline condition. The option appraisal showed that Options 2 and 3 would achieve the primary objective of providing the design Standard of Protection and that both would have similar impacts when considering the other objectives and constraints identified.

A detailed economic appraisal to evaluate the viability of each option was completed as part of the overall study. From this Option 3 was considered to be better value for money and is therefore the recommended preferred option, consisting of flood walls and flap valves.

The vision of DfI Rivers is to manage the flood risk to facilitate the social, economic and environmental development of Northern Ireland. To support this vision, the Agency aims to reduce the risk to life and the damage to property from flooding from rivers and the sea and to undertake watercourse and coastal flood management in a sustainable manner. RPS believes that the preferred option successfully achieves these aims of DfI Rivers.

1 INTRODUCTION

1.1 BACKGROUND

The Preliminary Flood Risk Assessment (Rivers Agency, December 2011) report identified Portadown as an Area of Significant Flood Risk (APSR). The River Bann is the principle river in Portadown which generally flows in a northerly direction through Portadown. The Upper Bann watercourse flows into Lough Neagh. The area around Portadown is affected by water levels in the River Bann and there are extensive areas of floodplain upstream and downstream of Portadown. The Cushier River joins the River Bann south of Portadown and contributes to the expansive flooding of agricultural land. The Annagh River and Kilmoriarty River flow from south west of Portadown into the River Bann, joining at the north east extent of Mahon Industrial Estate. The Ballybay/Corcrair River joins the River Bann at Ulster Carpets, just downstream of Shillington Bridge. The location of these watercourses is shown below in Figure 1.3 and Figure 1.4.

Historical flooding in Portadown includes significant flood events known to have occurred in April 1986, October 1987, August 2008, October 2011, November 2014 and Winter 2015/2016 affecting both residential and commercial properties, as well as local infrastructure.

In April 1986 extensive flooding occurred in Portadown, as shown in Figure 1.1 below.



Figure 1.1 – Aerial photograph of flooding upstream of Portadown, April 1986

Similar flows (over $100\text{m}^3/\text{s}$) in the River Bann were recorded for both the October 1987 and August 2008 flood events. A review of the Moyallan gauging station indicated that the 2008 event was the largest in its 27 years of data. An estimated return period for the flood in Portadown is a 14% AEP event. During the August 2008 event severe flooding occurred throughout Northern Ireland and the

Republic of Ireland which resulted in considerable disruption to the Enterprise Service as a result of the inundation of the main North/South railway line in Portadown.

In October 2011 out-of-bank flooding and the overtopping of defences, possibly caused by a lack of capacity along the Rivers Bann and Cusher, contributed to the inundation of the North/South railway line to the south of Portadown. It also contributed towards the flooding of an industrial estate on Tandragee Road, a factory and a number of public roads. This flood is believed to have been a 3% AEP event on the Cusher and 1% AEP event on the Bann, though flooding at this location appeared to be more significant than hydrometrics data would suggest.

In November 2014 when several homes suffered flood damage in the Woodgrove/Ashgrove Road area and along Park Road where many elderly residents' homes are situated. Flooding also occurred along Lurgan Road, Gilford Road and the Bann Boulevard. This is believed to be a consequence of out-of-bank flooding from the Ballybay/Corcrair River.

Extreme flooding took place in December and January 2015/2016 along Market Hill Road, the A50 Gilford Road (near Fullerton's Trailers) and the B2 Drumnacanvey Road near Drumnacanvey Lodge. This is believed to be the result of three consecutive storms; Desmond, Eva and Frank which resulted in out-of-bank flooding from the River Bann. Figure 1.2 below shows the extent of the flooding in January 2016 upstream of Portadown.



Figure 1.2 - Flooding on the River Bann upstream of Portadown, January 2016

The majority of properties are at risk of flooding due to high water levels in the River Bann either directly from the River Bann breaking its banks or by backing up into the smaller tributaries. Flooding in Portadown is complex as there are several flood mechanisms within the urban area which includes the coming together of three streams and drainage issues.

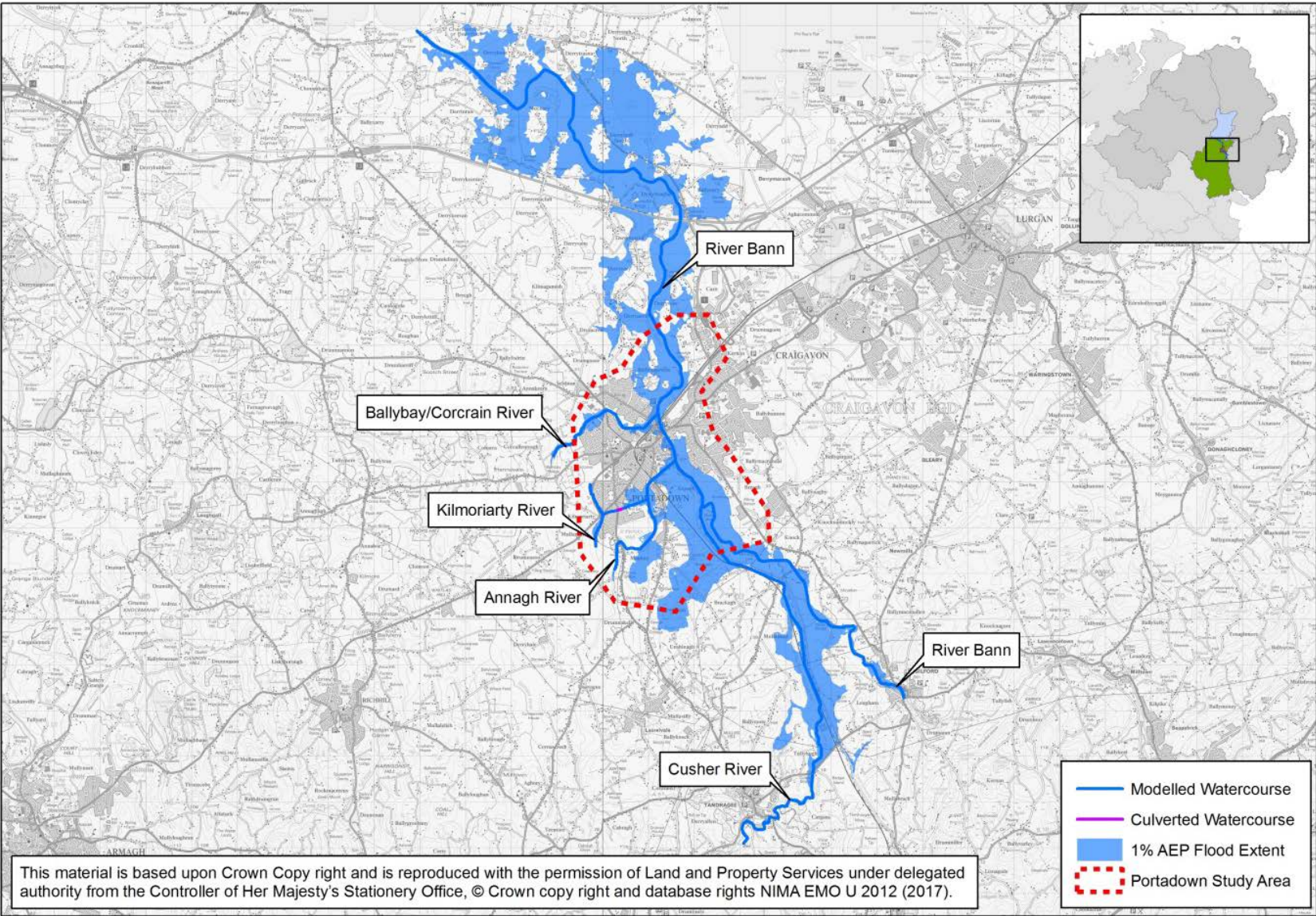


Figure 1.3 - General Location of Watercourses

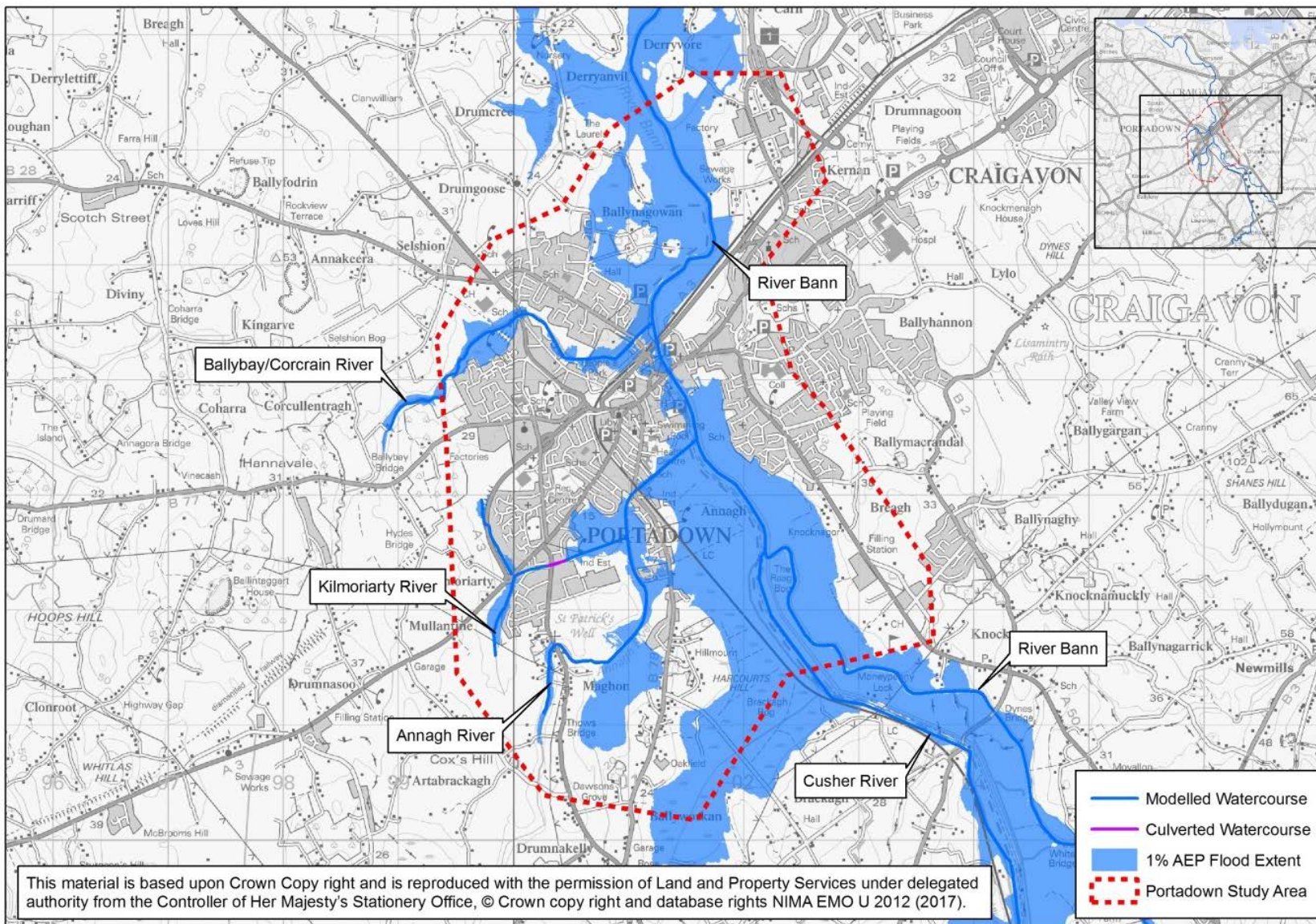


Figure 1.4 – Portadown Study Area

1.2 AIMS AND SCOPE

DfI Rivers has appointed RPS to carry out a feasibility study for the complex watercourse system in and around Portadown. The main aim of the study is to appraise flood risk and investigate options (including economic viability) which will alleviate flood risk in Portadown.

The project brief included the following requirements:

- Investigate the effect any watercourse, located within the study area, may have on flood risk to the study area;
- Assess the flood risk to infrastructure and properties from flooding during a range of flood events;
- Identify the flood risk and quantify the flood damage avoidance benefit;
- Consider a wide range of flood alleviation options (including short term (0-5 years) interim measures and medium to long term measures (5+ years)) to alleviate potential future flooding and provide protection to properties currently at risk of flooding during events up to and including the 1 in 100 year return period flood (Q100) i.e. 1% Annual Exceedance Probability;
- Consider all aspects of suitable and sustainable options proposed, including but not limited to environmental, health and safety, technical, constructability, economic, sustainability etc.;
- Undertake an Economic Appraisal in accordance with 'The NI Guide to Expenditure Appraisal and Evaluation' (NIGEAE) and the 'Flood and Coastal Erosion Risk Management - Appraisal Guidance' (published by the Environment Agency);
- Outline recommendations and present the optimum solution.

2 FLOOD RISK ASSESSMENT

2.1 INTRODUCTION

DfI Rivers commissioned RPS to carry out a feasibility study for the complex watercourse system in and around Portadown. The main aim of the study is to appraise flood risk and investigate options (including economic viability) which will alleviate flood risk in Portadown.

A flood risk assessment was carried out for the Portadown study in order to establish the risk to the various receptors located within the study area. The assessment considered the relevant economic, social and environmental receptors and their vulnerability to flooding. The overarching objective of the study is to provide protection within the study area to the 1% AEP standard of protection. However the FRA provided the information to define the specifics of this objective along with the constraints to be considered during the optioneering process.

This chapter details an overview of the flood hazard, identifying the flooding mechanisms along each of the watercourses. Details of the monetised and non-monetised risk are provided including the methods used and receptors considered. A summary of these findings are provided in this chapter and further details can be found in Appendix A and B.

2.2 OVERVIEW OF FLOOD HAZARD

In Portadown the dominant flooding mechanism originates from the River Bann which flows from south to north through the centre of Portadown before entering Lough Neagh. During a 1% AEP event, out of bank flooding would occur along the length of the modelled watercourse, causing significant overland flow. Lough Neagh at the downstream extent of the model has a significant impact during flooding, as it creates a backwater effect up the River Bann which extends into Portadown. The significant volume of water carried in the River Bann also creates a backwater effect in the tributaries of the river. When the River Bann is in peak flood, the Kilmoriarty Stream and the Annagh River both experience a backwater effect along their entire modelled length whilst the Ballybay/Corcrain River to the north west of Portadown backs up to the bridge at Corcrain Road. Each of these three tributaries also flood independently of the River Bann. In the hydraulic model, the tributaries reach peak flood and recede before the River Bann imposes its full backwater effect. Each flooding mechanism within Portadown could therefore be separated into three flood cells, as shown in Figure 2.1 below. The majority of receptors identified as at risk, are located within Flood Cell 1 which encompasses all flooding originating from the River Bann. Flood Cell 2 contains all receptors at risk from the Ballybay/Corcrain River, whilst Flood Cell 3 contains all receptors at risk of flooding from the Kilmoriarty Stream. A farmyard and farmhouse located off the Loughgall Road was also identified as at risk of flooding during the 1% AEP flood event, however following a discussion with the property owner, it was confirmed that complex flooding mechanisms affect this property. A mill race runs under the property, drains on the site are at risk of surcharging and flood risk exists from the Ballybay River. As such this property was removed from the damage assessment as the flooding mechanisms affecting the property are complex and not within the scope of this project.

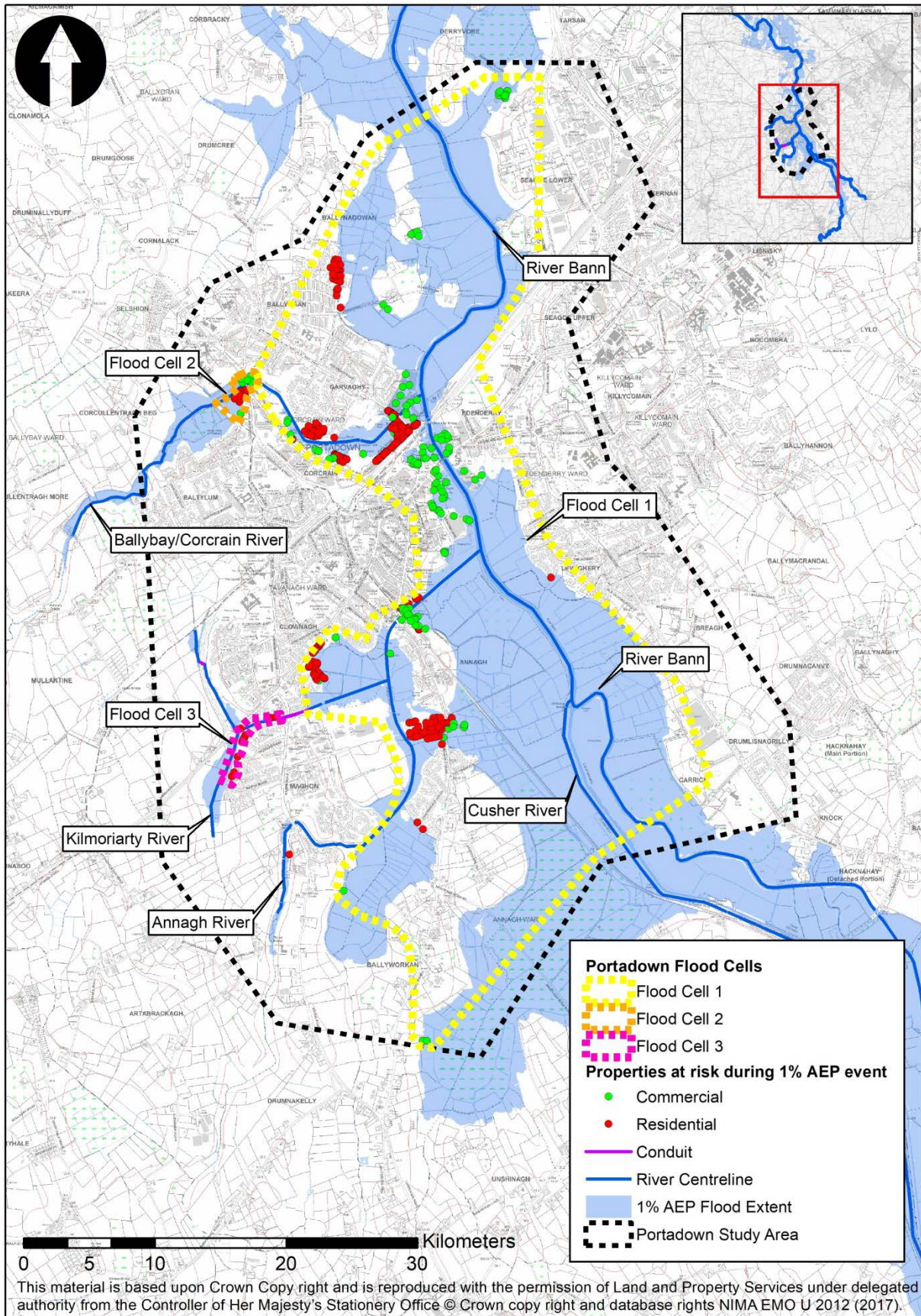


Figure 2.1 - Portadown Flood Cells

2.3 FLOOD RISK RECEPTOR GROUPS

The aim of the Flood Risk Assessment is to assess and map the potential adverse consequences (risk) associated with flooding in the study area to the three receptor groups as described in Table 2.1 below. The level of flood risk to a receptor can be affected by its location within the flood extent, the depth with which it is flooded, the frequency which it is likely to be flooded and the receptors' vulnerability to flooding.

Table 2.1 - Flood Risk Receptor Groups

Flood Risk Receptor Group	Receptor	Indicator
Social and Cultural Heritage	NI Buildings, Community Receptors Areas of Special Archaeological Interest, Areas of Archaeological Potential, Historic Parks and Gardens, Listed Buildings, Industrial Heritage Buildings	Location, type and number Location, extent and nature
Environment	Salmonid Rivers, Ancient Woodland, RAMSAR, Special Area of Conservation (SAC), Special Protected Area (SPA), Area of Natural Beauty (AONB), Area of Special Scientific Interest (ASSI)	Location, type and number
Economic	Residential and Commercial Properties	Location, type, number, depth-damage data
	Electricity Substations, Gas Lines, Wastewater Treatment Works, Water Treatment Works	Location, type and number
	Road networks, Rail networks	Location, type and number

2.4 FLOOD RISK IN PORTADOWN

Table 2.2 below summarises the flood risk to the study area.

Table 2.2 - Flood Risk within Portadown

Flood Risk Receptor Group	Receptor	Risk
Social and Cultural Heritage	NI Buildings, Community Receptors Areas of Special Archaeological Interest, Areas of Archaeological Potential, Historic Parks and Gardens, Listed Buildings, Industrial Heritage Buildings	Portadown Health & Care Centre at risk of flooding during a 1 % AEP event. Several industrial heritage assets also at risk including bridges and factories.
Environment	Salmonid Rivers, Ancient Woodland, RAMSAR, Special Area of Conservation (SAC), Special Protected Area (SPA), Area of Natural Beauty (AONB), Area of Special Scientific Interest (ASSI)	River Bann is a designated salmonid river. Areas of Special Scientific Interest (ASSI's) at risk to the north and south of Portadown. Small area of ancient woodland to the south east of Portadown also at risk during a 1% AEP event.
Economic	Residential and Commercial Properties	225 residential and 83 commercial properties are at risk from the 1% AEP flood event. Portadown Health & Care Centre at risk from the 1% AEP flood event. The total AAD from residential and commercial properties is £527,236.75.
	Electricity Substations, Gas Lines, Wastewater Treatment Works, Water Treatment Works	Several small electricity hereditaments at risk during a 1% AEP flood event.
	Road networks, Rail networks	The main North/South railway line is at risk south of Portadown. Roads at risk include Tandragee Road, Lurgan Road and Gilford Road.

2.5 MONETISED RISK - DAMAGE ASSESSMENT

As part of the economic risk assessment a monetary damage is assigned to certain receptors at risk. This damage represents the costs to the nation if the flood events being considered were to occur. The following receptors are assigned a monetary damage value:

- Residential properties
- Commercial properties

The total damage to a study area is used to quantify the economic risk and provide the amount of potential benefit that would occur if a FRM measure is put in place which would prevent the damage from occurring.

2.5.1 Damage Assessment Guidelines

The damage assessment methodology follows the guidance in "Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal" (Penning-Rowsell, *et al.*, 2013). This book is a successor to and replacement of the highly respected manual and handbook "The Benefits of Flood and Coastal Defence: A Manual of Assessment Techniques" (Flood Hazard Research Centre, Middlesex University, UK, 2005). This document was often referred to as the 'Multi-Coloured Manual' (MCM).

The new manual draws on collaboration between the Flood Hazard Research Centre, the Environment Agency, Defra and other stakeholders. Its use, accompanied by the MCM-Online, has been recommended for benefit assessment as part of a flood and coastal erosion risk management appraisal.

The MCM is a result of research carried out by Middlesex University Flood Hazard Research Centre and provides data and techniques for assessing the benefits of flood risk management in the form of flood alleviation. The MCM has focused on the benefits that arise from protecting residential property, commercial property, and road disruption amongst other areas as experience has shown that these sectors constitute the vast majority of the potential benefits of capital investment.

Based on this research the MCM provides depth damage data for both residential and commercial properties. For certain depths of flood water, a monetary damage has been assigned to a property. This damage is a combination of the likely items within the building and the building structure itself. The damage to each property is dependent on the property type, as such the MCM has categorised both the residential and commercial properties.

The updated version of the manual provides a completely new set of data on the potential flood damage to non-residential properties, methods for assessing benefits in sectors not previously covered by MCM and, access to the rationale and background on appraisal techniques, with links to the practical methods presented on a new web-based MCM.

For residential properties the new manual also incorporates the consideration of social grade and building periods. An example of the depth damage data for residential properties is shown in Figure 2.2 below.

3	Property-Type	MCM code	Property Type - Age	-0.3	0	0.05	0.1	0.2	0.3	0.6	0.9	1.2	1.5	1.8
4	Detached	111	pre-1919 Detached	1,606	1,606	15,018	26,224	43,860	54,476	64,439	71,559	78,045	85,808	94,353
5		112	1919-1944 Detached	1,009	1,009	7,046	11,355	19,934	24,468	29,727	32,245	36,222	40,039	44,545
6		113	1945-1964 Detached	884	884	8,637	13,957	23,791	28,777	34,509	37,624	41,590	45,092	49,433
7		114	1965-1974 Detached	754	754	7,117	11,402	19,934	24,427	29,758	32,315	36,033	39,049	42,763
8		115	1975-1985 Detached	792	792	7,879	12,541	21,976	27,465	33,745	37,601	41,446	44,805	48,761
9		117	utility Detached	641	641	2,485	3,606	5,154	6,410	7,305	8,599	10,442	12,473	14,903
10		118	post-1985 Detached	792	792	7,775	12,551	22,109	28,208	35,244	39,444	43,942	47,428	51,389
11	Semi-detached	121	pre-1919 Semi-Detached	1,481	1,481	6,028	9,251	15,891	19,548	24,299	26,388	29,460	32,176	35,335
12		122	1919-1944 Semi-Detached	1,507	1,507	6,735	10,613	17,474	21,123	25,875	27,950	30,873	33,292	36,273
13		123	1945-1964 Semi-Detached	1,507	1,507	6,679	10,552	17,409	21,055	25,802	27,875	30,797	33,211	36,189
14		124	1965-1974 Semi-Detached	661	661	5,381	8,745	15,229	18,690	23,313	25,222	28,329	30,994	34,375
15		125	1975-1985 Semi-Detached	629	629	5,110	8,393	14,985	18,734	23,642	25,973	28,750	30,916	33,610
16		127	utility Semi-Detached	643	643	2,434	3,583	5,092	6,385	7,330	8,530	10,030	11,727	13,648
17		128	post-1985 Semi-Detached	629	629	5,056	8,453	15,154	19,373	24,965	27,580	30,933	33,105	35,718
18	Terrace	131	pre-1919 Terrace	1,419	1,419	6,280	9,419	16,030	19,806	24,776	26,812	29,332	31,660	34,348
19		132	1919-1944 Terrace	1,468	1,468	7,043	11,261	19,328	22,966	27,797	29,843	32,646	34,805	37,541
20		133	1945-1964 Terrace	934	934	4,118	6,068	9,030	10,101	12,482	13,653	15,851	17,094	18,808
21		134	1965-1974 Terrace	723	723	5,925	9,636	16,504	20,089	24,778	26,833	29,843	32,149	35,060
22		135	1975-1985 Terrace	543	543	4,767	7,735	13,845	17,108	21,550	23,217	25,495	27,136	29,178
23		137	Utility Terrace	629	629	2,263	3,305	4,570	5,784	6,821	8,087	9,432	11,072	12,945
24		138	post-1985 Terrace	543	543	4,717	7,817	14,051	17,828	23,041	25,021	27,941	29,566	31,497
25	Bungalow	141	pre-1919 Bungalow	1,294	1,294	7,059	10,683	18,700	23,084	28,821	31,712	34,644	37,050	39,763
26		142	1919-1944 Bungalow	940	940	9,637	15,373	24,676	29,520	35,874	39,336	43,425	47,360	52,069
27		143	1945-1964 Bungalow	978	978	9,192	14,374	23,131	27,600	33,595	36,960	41,520	45,822	50,864
28		144	1965-1974 Bungalow	717	717	10,593	17,068	26,749	31,790	38,366	42,240	46,914	51,732	57,416
29		145	1975-1985 Bungalow	898	898	8,959	14,346	23,483	28,725	35,694	39,987	44,044	48,020	52,672
30		148	post 1985 Bungalow	898	898	8,844	14,538	24,117	30,630	39,452	44,548	50,161	54,181	58,656
31	Flat	151	pre-1919 Flat	1,294	1,294	5,517	8,512	14,203	17,084	21,490	22,940	24,871	26,231	27,914
32		152	1919-1944 Flat	765	765	8,362	13,632	22,101	26,319	31,905	34,431	37,142	39,560	42,437
33		153	1945-1964 Flat	765	765	4,935	7,668	13,807	16,816	21,006	22,633	24,783	26,140	27,873
34		154	1965-1974 Flat	543	543	7,232	11,859	19,519	23,411	28,735	30,987	33,642	35,849	38,565
35		155	1975-1985 Flat	543	543	5,468	8,891	15,674	19,303	24,514	26,769	28,973	30,534	32,481
36		157	utility Flat	616	616	2,058	2,987	3,967	5,038	6,096	7,369	8,553	10,145	11,971
37		158	post 1985 Flat	543	543	5,377	8,895	15,752	19,938	26,035	28,647	31,592	33,130	34,943

Figure 2.2 - MCM's Depth Damage Data for Residential Properties

2.5.2 Recording Damage Assessment Data

The damage assessment is carried out in order to quantify the economic risk to the study area. This requires many details to be recorded such as background data, interim calculations and final damage results. As such, RPS created several geo-referenced shapefiles with relevant data recorded in their attribute tables, an example of which is shown in Figure 2.3.

Two shapefiles created by RPS in order to complete the damage assessment are the buildings polygon shapefile and the Finished Floor Level (FFL) point shapefile.

The buildings polygon shapefile was created to contain background data for building polygons including building use and area.

The FFL shapefile includes data regarding the elevation mOD of doors/entries to properties within the study area. This FFL data was obtained from a threshold survey carried out.

An additional point shapefile was created to contain all information needed to complete the damage assessment. Information such as building area, FFL and water elevations from the modelled flood events (Q2, Q5, Q10, Q25, Q50, Q75 and Q100) were combined into this shapefile to give depths referenced to finished floor level for each flood event. For buildings with multiple entries, the maximum level of water above FFL was taken. This shapefile could then be used to show economic risk of properties relating to a range of flood events.

The following sections detail how the damage assessment is carried out and the data that is recorded during various processes within the shapefile attribute tables.

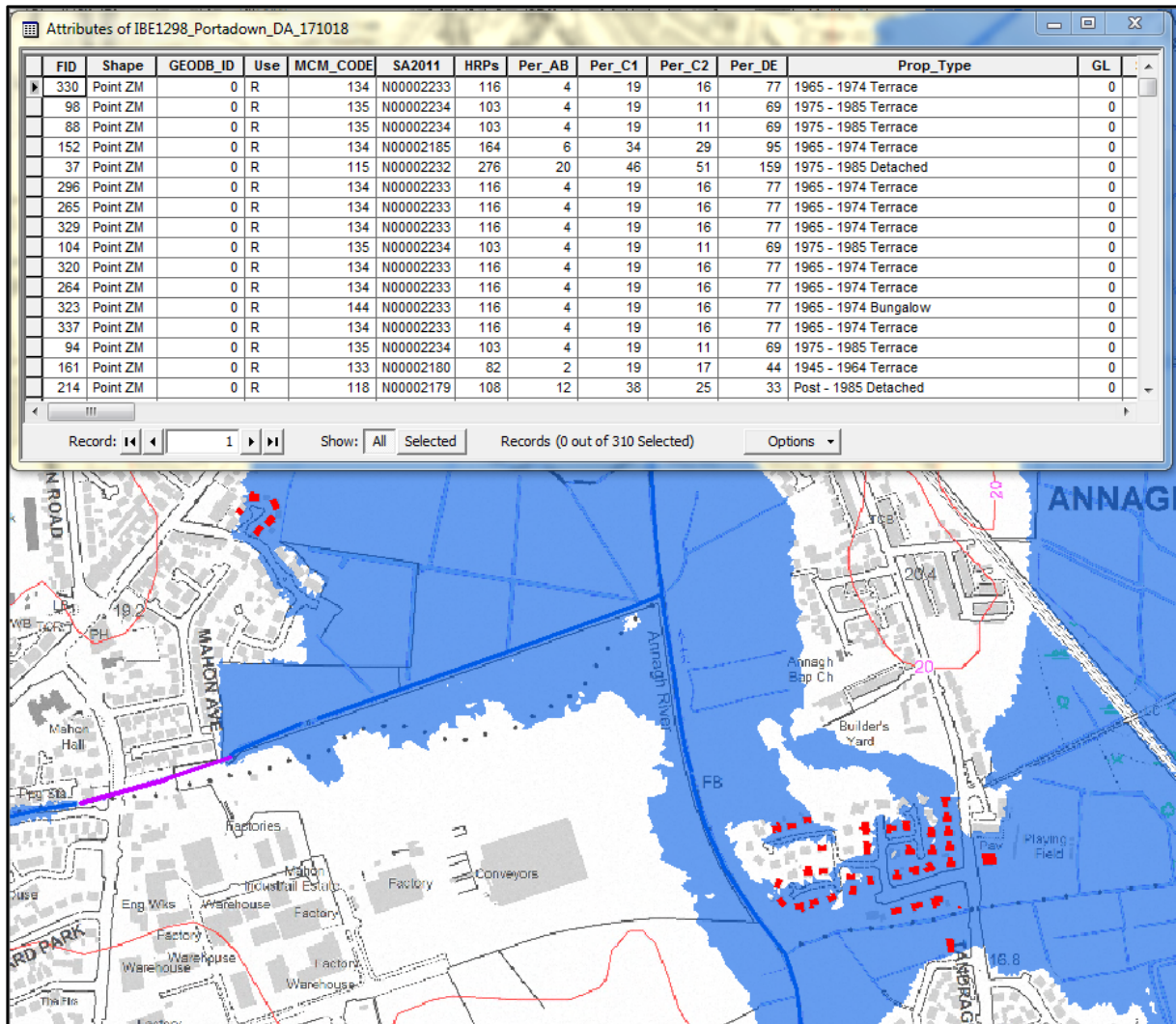


Figure 2.3 - Example shapefile with attributes showing damage assessment data

2.5.3 Categorisation of Properties

All properties within the 1 in 100 year floodplain were surveyed and classified according to MCM guidelines were included in the damage assessment. The type and age along with the social category of the occupants was noted. The MCM assigns a code to each property type to aid the damage calculations. Table 2.3 and Table 2.4 detail the various residential and non-residential property types.

Table 2.3 - Residential Properties MCM Codes

Property Type	MCM code	Property Type - Age
Detached	111	Pre-1919 Detached
	112	1919-1944 Detached
	113	1945-1964 Detached
	114	1965-1974 Detached
	115	1975-1985 Detached
	117	Utility Detached
	118	Post-1985 Detached
Semi-Detached	121	Pre-1919 Semi-Detached
	122	1919-1944 Semi-Detached
	123	1945-1964 Semi-Detached
	124	1965-1974 Semi-Detached
	125	1975-1985 Semi-Detached
	127	Utility Semi-Detached
	128	Post-1985 Semi-Detached
Terrace	131	Pre-1919 Terrace
	132	1919-1944 Terrace
	133	1945-1964 Terrace
	134	1965-1974 Terrace
	135	1975-1985 Terrace
	137	Utility Terrace
	138	Post-1985 Terrace
Bungalow	141	Pre-1919 Bungalow
	142	1919-1944 Bungalow
	143	1945-1964 Bungalow
	144	1965-1974 Bungalow
	145	1975-1985 Bungalow
	148	Post 1985 Bungalow
Flat	151	Pre-1919 Flat
	152	1919-1944 Flat
	153	1945-1964 Flat
	154	1965-1974 Flat
	155	1975-1985 Flat
	157	Utility Flat
	158	Post 1985 Flat

Table 2.4 - Non-Residential Property MCM Codes

New MCM Code	Property type	New MCM Code	Property type
2	Retail	N/A	Sport
	Shop/Store	521	Sports Grounds and Playing Fields
	(High Street) Shop	521	Golf Courses
	Superstore/Hypermarket	523	Sports and Leisure centres
	Retail Warehouse	523	Amusement Arcade/Park
	Showroom	525	Football Ground and Stadia
	Kiosk	526	Mooring/Wharf/Marina
	Outdoor market	523	Swimming Pool
	Indoor Market	6	Public Buildings
	Vehicle Services		School/College/University/Nursery
	Vehicle Repair Garage		Surgery/Health Centre
	Petrol Filling Station		Residential Home
	Car Showroom		Community Centres/Halls
	Plant Hire		Library
	Retail Services		Fire/Ambulance station
	Hairdressing Salon		Police Station
	Betting Shop		Hospital
	Laundrette		Museum
	Pub/Social club/wine bar	8	Law court
	Restaurant		Church
Café/Food Court	Industry		
Post Office	Workshop		
Garden Centre	Factory/Works/Mill		
3	Offices		Extractive/heavy Industry
	Offices (non-specific)		Sewage treatment works
	Computer Centres (Hi-Tech)		Laboratory
	Bank		N/A
4	Warehouses		910
	Warehouse	Not currently available	Public Convenience
	Electrical w/h		Cemetery/Crematorium
	Ambient goods w/h		Bus Station
	Frozen goods w/h	526	Dock Hereditament
	Land Used for Storage	960	Electricity Hereditament
	Road Haulage		
51	Leisure		
	Hotel		
	Boarding House		
	Self-catering Unit		
	Hostel (including prisons)		
	Bingo hall		
	Theatre/Cinema		
	Beach Hut		

For Portadown, all properties found within the 1 in100 year flood extent were categorised. This was carried out using data gained from site visits, surveys, OSi mapping and online mapping. The NI Buildings polygon layer was initially used to locate all the properties and provide their floor area. Sheds and garages, which have no depth damage data in the MCM guidelines, were removed and the remaining buildings categorised. Within the Portadown 1 in100 year flood extent there was a total of 448 properties (134 commercial and 314 residential), however only 308 properties incur monetary damage (83 commercial and 225 residential).

Using the FCERM 2013 Manual, residential properties in the UK can be classified by house type, age and the social grade of the occupants. Taking into account these variables allows a more accurate estimation of inventory damages based on the presence or absence of household possessions. Table 2.5 below shows the social grade categories used in the FCERM 2013 Manual.

Table 2.5 - Approximated social grade categorisation by occupation

Social Grade	Description
AB	Upper middle and middle class: higher and intermediate managerial, administrative or professional.
C1	Lower middle class: supervisory or clerical and junior managerial administrative or professional.
C2	Skilled working class: skilled manual workers
DE	Working class and those at the lowest level of subsistence: semi-skilled and unskilled manual workers, unemployed and those with no other earnings (e.g. state pensioners).

Using Small Area Census data, the flood depth damage values for each property can be adjusted based on approximate proportions of households in each social group.

The following details were recorded within the buildings point shapefile attribute table:

Table 2.6 - Categorisation of Properties Data

Data Type	Attribute Name	Data Details
Property Use	Use	"R" for residential and "C" for commercial
MCM Code	MCM_CODE	As per MCM guidelines
Property Type	Prop_Type	As per MCM guidelines
Small Area Code	SA2011	Code of Census data Small Area in which property is located
Floor Area	AREA	Floor area of the property

2.5.4 Property Threshold Level

The damage assigned to a property relates to the depth of water above floor level. As such the threshold level of all properties is required as part of the damage assessment. As a general rule most properties are constructed with the floor level raised 300mm above the adjacent ground level. This would be particularly characteristic of fluvial or coastal floodplains which are generally low lying and flat in nature. Steep topography also has an influence on finished floor levels whereby some properties have split level front doors and back doors and some properties enter at ground level but have basements below. The standard approach of adding 300mm to the average of the surrounding ground level could potentially produce some erroneous results.

To achieve an accurate finished floor level for properties within the study area a threshold survey was conducted. However, as surveyors could not enter a property's grounds, some of the data may not be representative and so it was necessary to check LiDAR defined ground levels and property entrance types in some regions.

To improve the accuracy in the assessment of threshold levels RPS have undertaken a number of exercises in this regard. These are detailed below:

A review of each property initially using Google Street view and Bing maps and a walkover check survey to establish front and back door locations.

Classification on the entrance type to each property:

- Raised = +150mm for every step above LiDAR defined ground level (where 2 more steps exist).
- Normal = +300mm above LiDAR defined ground level.
- Flat = LiDAR defined ground level taken as threshold level.
- Lowered = -150mm for every step down below LiDAR defined ground level.

A final chosen threshold level was assigned to each property by taking the worst case of the predicted flood level at both the front and back door locations.

2.5.5 Flood Depth of Properties

To estimate the damage to a property an estimation of the predicted flood depths is required for a wide range of flood events. The Project Brief requires the depths to which the properties flood during the 1 in 2, 1 in 5, 1 in 10, 1 in 25, 1 in 50, 1 in 75 and 1 in 100 year events to be calculated. The depth of flooding is calculated by finding the difference between the flood water elevation and the estimated threshold level (as described in Section 2.5.4). The flood elevation was extracted by using the triangulated model output to find the maximum depth of water touching each building polygon. This process was achieved by carrying out a statistical analysis in ArcGIS and was carried out for each property and for each flood event. Table 2.7 below shows details which were recorded within the economic risk shapefile attribute tables:

Table 2.7 - Flood Depth of Properties Data

Data type	Attribute name	Data details
Flood level for all flood events	Q100Elv, Q75Elv, Q50Elv, Q25Elv, Q10Elv, Q5Elv, Q2Elv	The maximum flood level adjacent to the building (mOD)
Flood depth for all flood events	Q100Dp, Q75Dp, Q50Dp, Q25Dp, Q10Dp, Q5Dp, Q2Dp	Difference between the flood level and FFL

2.5.6 Flood Damage to Properties

Once the depths of flooding are known the damage can be calculated using the MCM depth damage data. This is known as direct damage in that the flooding directly damages assets, it does not account for indirect damages such as heating costs to dry out the house. For each property type, a typical damage based on historical data has been assigned to a depth of flooding. These direct damage figures have been updated to 2016 pound sterling prices and are based on the square metre of the floor area of the building. An example of this data is presented in

Figure 2.2. A GIS tool has been developed which provides the direct damage in each flood event for each building in pound sterling 2016 prices per square metre by interpolating between the depth damage figures provided in the MCM guidance. This damage figure is then multiplied by the floor area of the property to give the total damage.

Table 2.8 - Flood Damage to Properties Data

Data type	Attribute name	Data details
Direct damage per meter square	Q100_M2Dm, Q75_M2Dm, Q50_M2Dm, Q25_M2Dm, Q10_M2Dm, Q5_M2Dm, Q2_M2Dm	Damage per meter square to each property according to the depth of flooding from each flood event as per MCM data. Values in pound sterling updated to 2016 costs.
Damage to property over full floor area	Q100_Dm£16, Q75_Dm£16, Q50_Dm£16, Q25_Dm£16, Q10_Dm£16, Q5_Dm£16, Q2_Dm£16	Damage per meter square multiplied by floor area of building.

2.5.7 Emergency Costs

A cost will be associated with emergency services dealing with the flood events. Following the Environment Agency's Flood or Coastal Erosion Risk Management (FCERM) appraisal guidance, which the MCM guidance has been adapted to comply with, a value of 10.7% of the residential damages has been assigned to the emergency services costs. This figure is based on data collected from previous flood events in the UK and has also been used in this damage assessment. The details in Table 2.9 were recorded within the economic risk shapefile attribute tables:

Table 2.9 - Emergency Cost Data

Data type	Attribute name	Data details
Emergency costs	Q100_emerg, Q75_emerg, Q50_emerg, Q25_emerg, Q10_emerg, Q5_emerg, Q2_emerg	Equal to 10.7% of the residential damages.

2.5.8 Intangible Impacts of Flooding

Apart from the material damages to the building structure and the goods inside the property, it is recognised that there are monetary damages associated with clean-up costs, temporary accommodation, stress, etc. The measure of 'intangible impact' is detailed in the FCERM-AG (Environment Agency, 2010a) however this method appears to contribute far too low an intangible effect. As such, the best estimate of these intangible effects is now linked to a value of £2,513 per household per event, based on future climate change metrics (Ramsbottom *et al.*, 2012). This value is comprised of a figure of £1,065 per person and the assumption that there are 2.36 persons per house from the 2001 Census (still applicable after the 2011 Census). This value was then weighted using social grade factors and the proportion of each social grade in an individual small area (using 2011 Small Area Census Data). The social grade factors are shown in Table 2.10 below.

Table 2.10 - Total weighted factors by approximated social grade

AB	C1	C2	DE
0.74	1.12	1.22	1.64

No intangible damages are assigned to commercial properties as these costs do not apply at the same level.

Table 2.11 - Intangible Damage Data

Data type	Attribute name	Data details
Intangible Damage	Q100_IntD, Q75_IntD, Q50_IntD, Q25_IntD, Q10_IntD, Q5_IntD, Q2_IntD	The equation to calculate the intangible damage is as follows: $(2513 \times 0.74 \times ([Per_AB]/[HRPs])) + (2513 \times 1.12 \times ([Per_C1]/[HRPs])) + (2513 \times 1.22 \times ([Per_C2]/[HRPs])) + (2513 \times 1.64 \times ([Per_DE]/[HRPs]))$

2.5.9 Annual Average Damage and Present Value Damage

In order to gain an appreciation of the economic risk the overall damage needs to be calculated. This is represented by assessing the likelihood of each of these flood events occurring in any given year and applying this as a percentage to the damage; this is known as the Annual Average Damage (AAD). The AAD can then be taken over the lifetime of the study that has been set at 100 years and discounted back to present day costs; this is known as present value damage (pvD). The events that were considered for this study were the 1 in 2, 1 in 5, 1 in 10, 1 in 25, 1 in 50, 1 in 75 and 1 in 100 year flood events.

The AAD can best be described by considering the graph shown Figure 2.4. The points shown represent the various design flood events where the damage has been calculated. Their position on the graph is dictated by the damage caused and the frequency of the flood event occurring in any given year. These points are joined together to create a damage curve. The area under the curve is therefore a function of the damage and the frequency and gives the AAD. The events that were considered for this study were the 1 in 2, 1 in 5, 1 in 10, 1 in 25, 1 in 50, 1 in 75 and 1 in 100 year flood events.

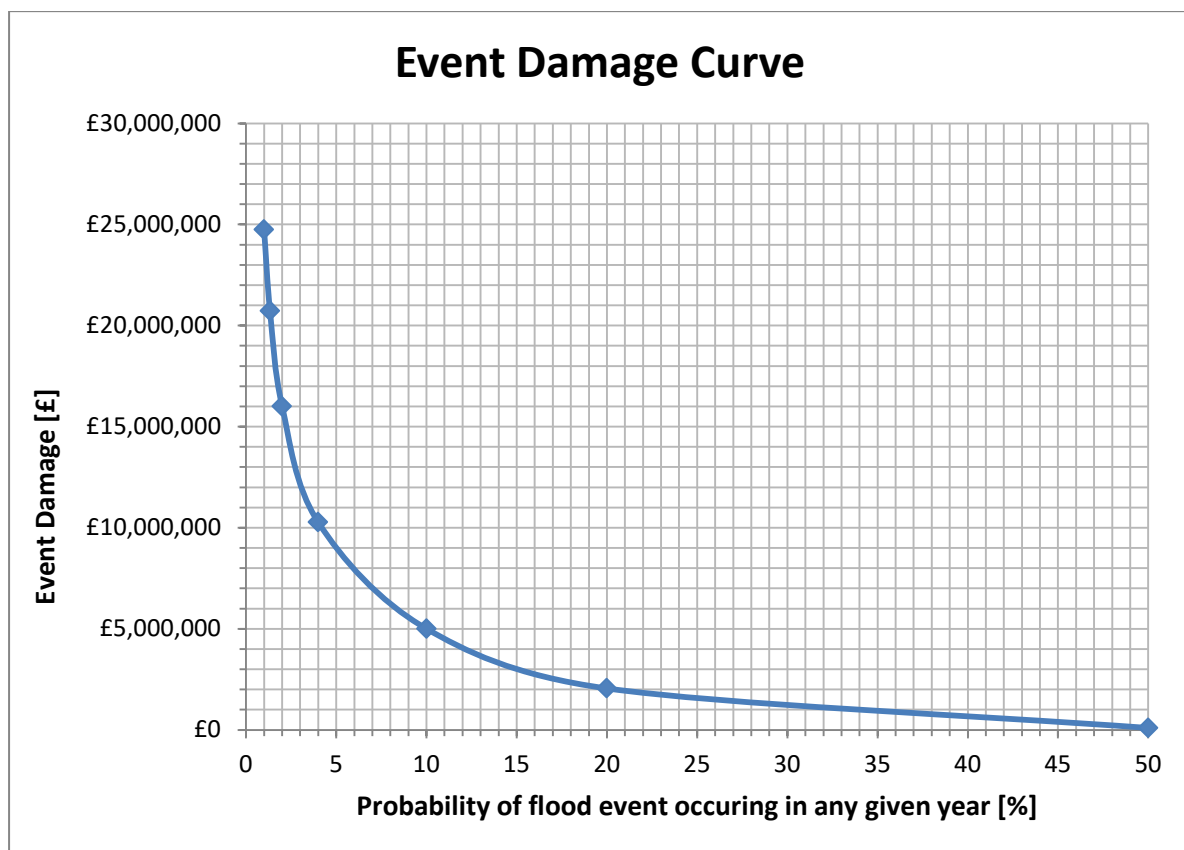


Figure 2.4 – Portadown Event Damage Curve

Once the AAD is calculated the present value damage is calculated. The present value damage calculation sums the AAD that is expected to occur for each of the 100 years being considered in this study. However in order for the damage value in each year to be comparable with each other they are discounted to represent the equivalent present damage value. Discounting damage values in the future is based on the principle that generally people prefer to receive goods or services now rather

than later. This is known as time preference. The cost therefore of providing a flood management option will also be discounted to present day values. For this project the discount rates were taken from the Treasury's 'Green Book' (HM Treasury, 2003), as shown in Table 2.12 below.

Table 2.12 - The Green Book's Long Term Discount Rate

Period of Years	0 - 30	31 - 75	76 - 125	126 - 200	201 - 300	301 +
Discount Rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

This amounted to factoring the AAD by 29.813. The AAD and pvD are calculated for the direct damages and intangible damages separately then totalled to give the overall damage available.

The following details were recorded within the economic risk shapefile attribute tables:

Table 2.13 - AAD and pvD Data

Data type	Attribute name	Data details
Annual Average Damage for direct damages, intangible damages	AAD, AADInt,	The equation to calculate the AAD is as follows: $(((Q2_EvDam]+[Q5_EvDam])/2*(0.5-0.2)+([Q5_EvDam]+[Q10_EvDam])/2*(0.2-0.1)+([Q10_EvDam]+[Q25_EvDam])/2*(0.1-0.04)+([Q25_EvDam]+[Q50_EvDam])/2*(0.04-0.02)+([Q50_EvDam]+[Q75_EvDam])/2*(0.02-0.01333)+([Q75_EvDam]+[Q100_EvDam])/2*(0.01333-0.01))$
Present value damage	pvD, pvDInt,	The AAD factored by 29.813.

2.5.10 Capping Damages

It is recognised that for certain properties the overall damage associated with it can far exceed the market value of the property. This can be due to either the depth to which it floods or the frequency with which it floods or a combination of both factors. Where such a situation occurs it is necessary to cap the damages at the market value.

When capping damages for a property, the regional average risk free market value is used. Detailed research was carried out in order to establish an accurate and robust representation of property values. For residential properties in Portadown the 2017 Quarter 2 Standardised House Price for Armagh City, Banbridge & Craigavon was used. This information was produced by Land and Property Services and released under the Open Government License v3.0.

For a non-residential property its rateable value multiplied by a factor which reflects the added value of percentage rental yield from that property is used. Research was carried out to identify both the rateable value and the average rental yield for commercial properties in the region. Again detailed research was undertaken to identify robust rateable values for commercial properties in the region. Data produced by the Department of Finance detailing the prime rate per square metre for shops, offices, warehouses and factories in January 2017 was obtained. Relevant wards and therefore properties could be identified within the document. An average rate (£/m²) for each property type across the relevant wards was calculated and used for the assessment.

For percentage rental yield, an average for Northern Ireland of around 6.9% was identified using data produced by Savills, 2017, therefore using MCM guidance a multiplier of 16.7 would be appropriate.

The methods used to acquire robust values for capping damages were recommended in the FCERM Manual 2013 and the MCM 2016.

The approach taken in this study is to cap the direct damages and the intangible damages separately before totalling up the overall damages.

The following details in Table 2.14 were incorporated within the economic risk shapefile attribute tables:

Table 2.14 – Portadown Capping Damages Data

Data type	Attribute name	Data details
Capped damages for direct and intangible	pvD_Cap, pvDInt_Cap,	Residential property damages over £115,404 are capped at this value. Commercial property damages capping value = rateable value x % rental yield

Table 2.15 – Portadown Commercial Capping Damages Data

MCM_Code	Property Type	Capping Value /m ²
2	Shops	£97.21 x 16.7 = 1623.41
3 51 6	Offices Leisure Public Buildings	£57.07 x 16.7 = 953.07
4 8 910 960	Warehouses Industry Car Park Electricity Hereditament	£26.77 x 16.7 = 447.06

2.5.11 Damage Assessment Review

A review of the damage assessment was carried out to quality check the data being used. This was carried out by reviewing the properties that contribute over 1% of the capped PvD. The review consists of checking the property type and the finished floor level including split levels, the footprint areas and the depth damage being applied.

2.5.12 Summary of Damage Assessment

The field 'PvBFinal' in the attribute table of the economic benefit shapefile is the total potential avoided damage which sums the capped present value direct damages and the uncapped present value intangible damages. This gives the overall present value damage. The table below summarises the damages associated with Portadown.

Total AAD	Total PvB
£527,236.75	£15,718,509.27

2.6 NON-MONETISED RISK

2.6.1 Economic Receptors

Economic receptors which were considered within this study include Residential and Commercial Properties, Wastewater Treatment Works and Water Treatment Works, Electricity Substations, Gas Lines, Roads and Railways. Figure 2.5 below gives an example of the economic risk maps created for Portadown and highlights some of the receptors which were located within the Portadown Study Area. All other economic risk maps may be found in Appendix B.

During the design flood event 225 residential properties and 83 non-residential properties were identified as at risk of incurring monetary damage during a 1% AEP flood event. In addition to these properties, approximately 1.9km of the railway line and roads such as Tandragee Road and Corcraun Road have also been identified as at risk of flooding. Meadow Lane, in front of Portadown Health & Care Centre, is not at risk of flooding during a 1% AEP flood event, however it does allow water to seep through its structure from the adjacent fields, therefore causing the health centre to flood. Meadow Lane is highlighted in Economic Risk Map 4 of 9, found in Appendix B and above as Figure 2.5.

Several small electricity hereditaments were also identified as at risk during the design flood event. Other receptors such as Wastewater Treatment Works and Water Treatment Works were not identified as at risk of inundation. A NIW Pumping Station located behind Annaghview Court was identified within the 1% AEP flood extent however is not considered to be at risk of inundation as the property's Finished Floor Level is raised above the Q100 flood elevation. This pumping station is highlighted in Economic Risk Map 5 of 9, found in Appendix B.

2.6.2 Social Receptors

Social receptors considered within this study include Industrial Heritage Buildings, Listed Buildings, Historic Parks and Gardens, Areas of Archaeological Potential, Areas of Archaeological Interest, Community Receptors and Residential and Commercial Properties. Figure 2.6 below gives an example of the social risk maps created for Portadown and highlights receptors which were located within the Portadown Study Area. All other social risk maps may be found in Appendix B.

Several bridges within the flood extent were identified as industrial heritage structures. While the bridges are considered flood resilient and would not require protection, the status of the structures should be considered during optioneering to avoid alteration or damage if possible.

Portadown Health Centre is at direct risk of flooding during a 1% AEP event and so should be carefully considered during the optioneering phase to ensure access may be maintained. Other receptors such as the police station, fire station, schools and residential/nursing homes are not at direct risk of flooding but should be considered during the optioneering phase to ensure access to them is maintained.

Portadown has recently had areas regenerated such as the tow path, Old Town Quay and the Historic Pump House. These areas along the River Bann have had significant investment and so is it important that there is continued public access to the river.

2.6.3 Environmental Receptors

Environmental Receptors which were considered within this study include Salmonid Rivers, Ancient Woodland, RAMSAR, Areas of Specific Scientific Interest (ASSI), Areas of Natural Beauty (AONB), Special Areas of Conservation (SAC) and Special Protection Areas (SPA). Figure 2.7 below gives an example of the environmental risk maps created for Portadown and highlights some receptors which were located within the Portadown Study Area. All other environmental risk maps may be found in Appendix B.

The River Bann is designated as a salmonid river. As such the implications of any option during construction, maintenance and operation will need to be considered. Disturbance to the River Bann should be kept to a minimum. Two Areas of Specific Scientific Interest (ASSI) were also identified within the study area; one area to the north of Portadown (Derryvore) and one to the south of Portadown (Brackagh Bog). An area of Ancient Woodland is also present to the southeast of the study area. Consideration should be given to these areas during the optioneering process.

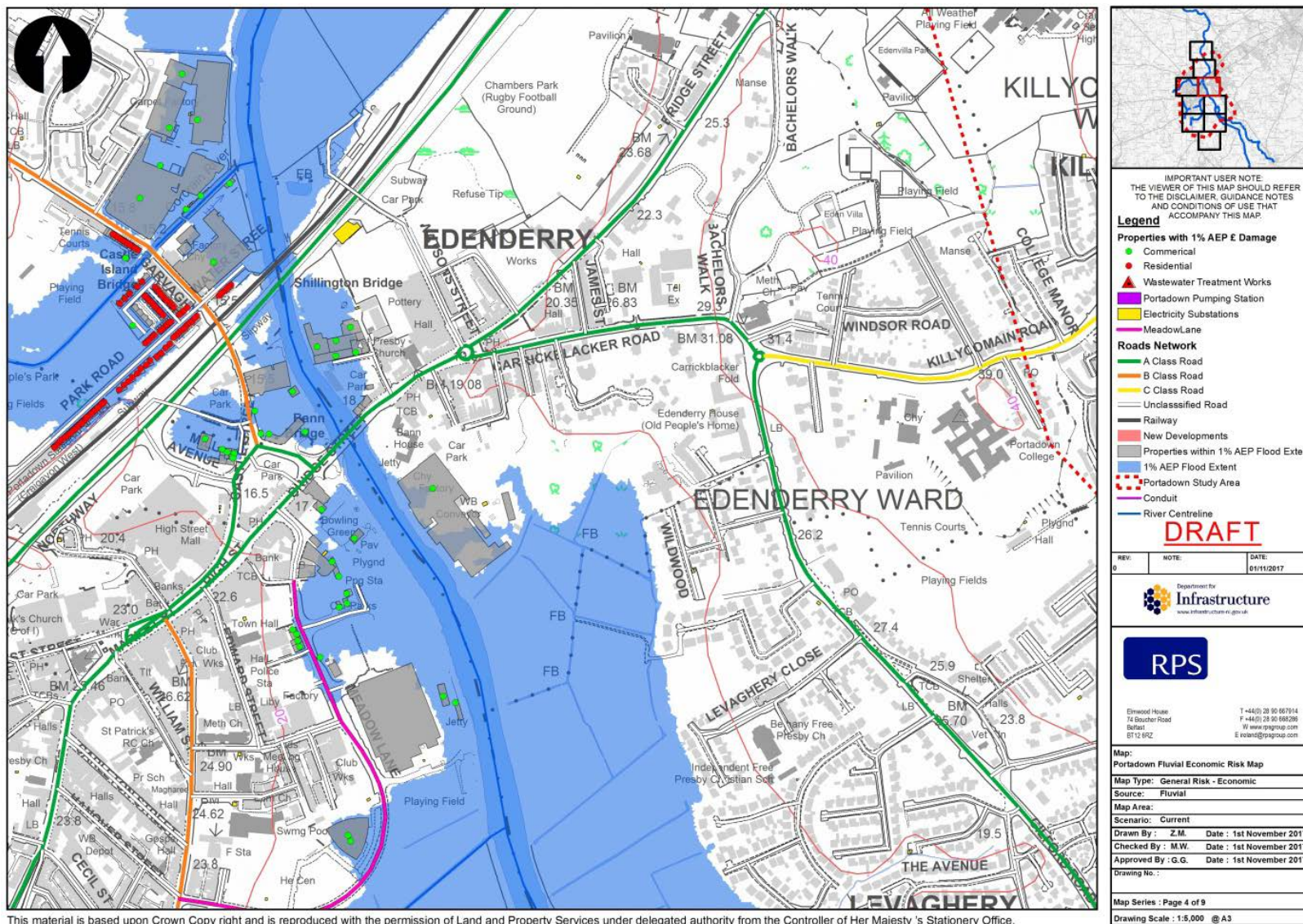


Figure 2.5 – Summary of Flood Risk to Economic Receptors in Portadown Study Area

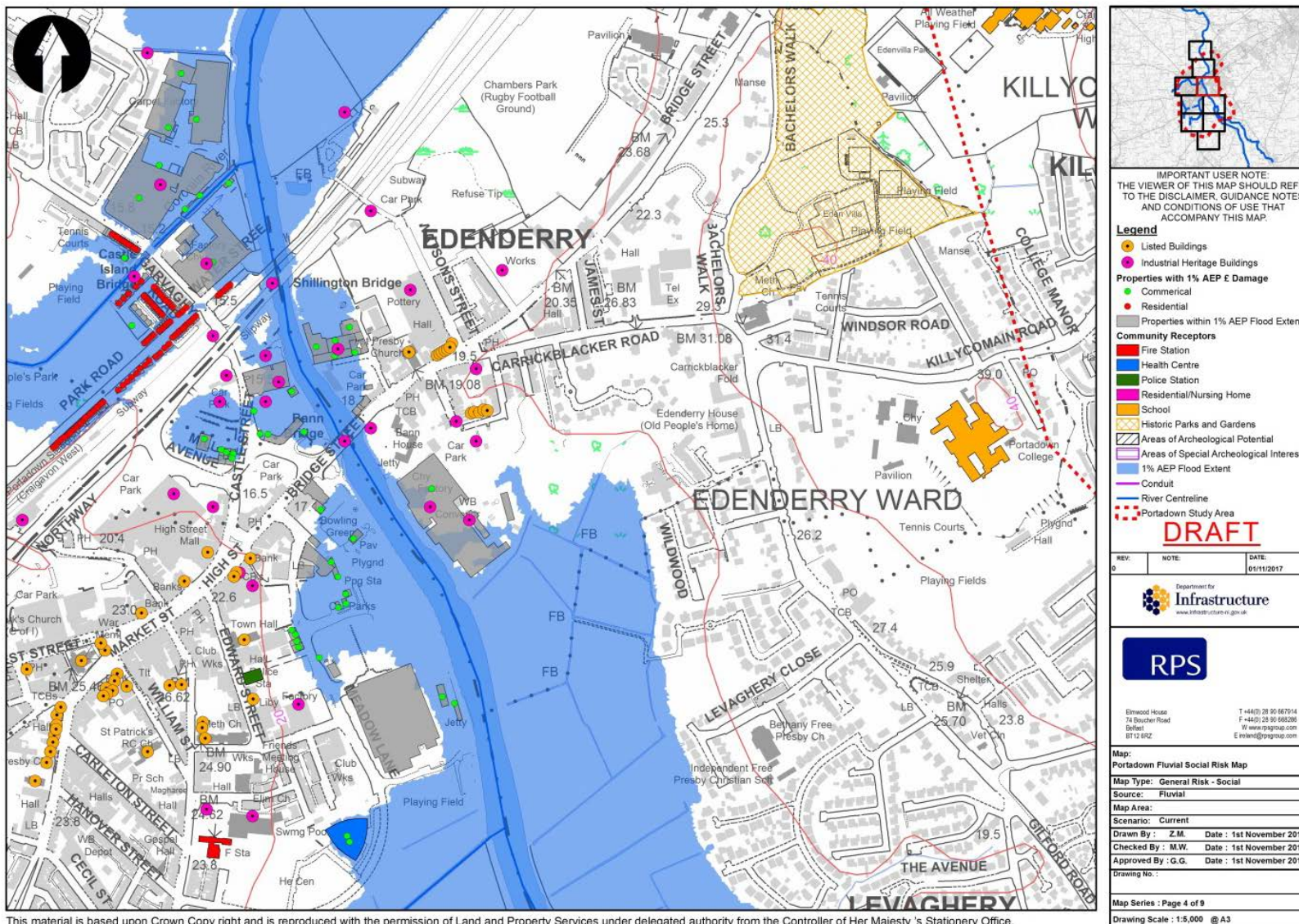


Figure 2.6 - Summary of Flood Risk to Social Receptors in Portadown Study Area

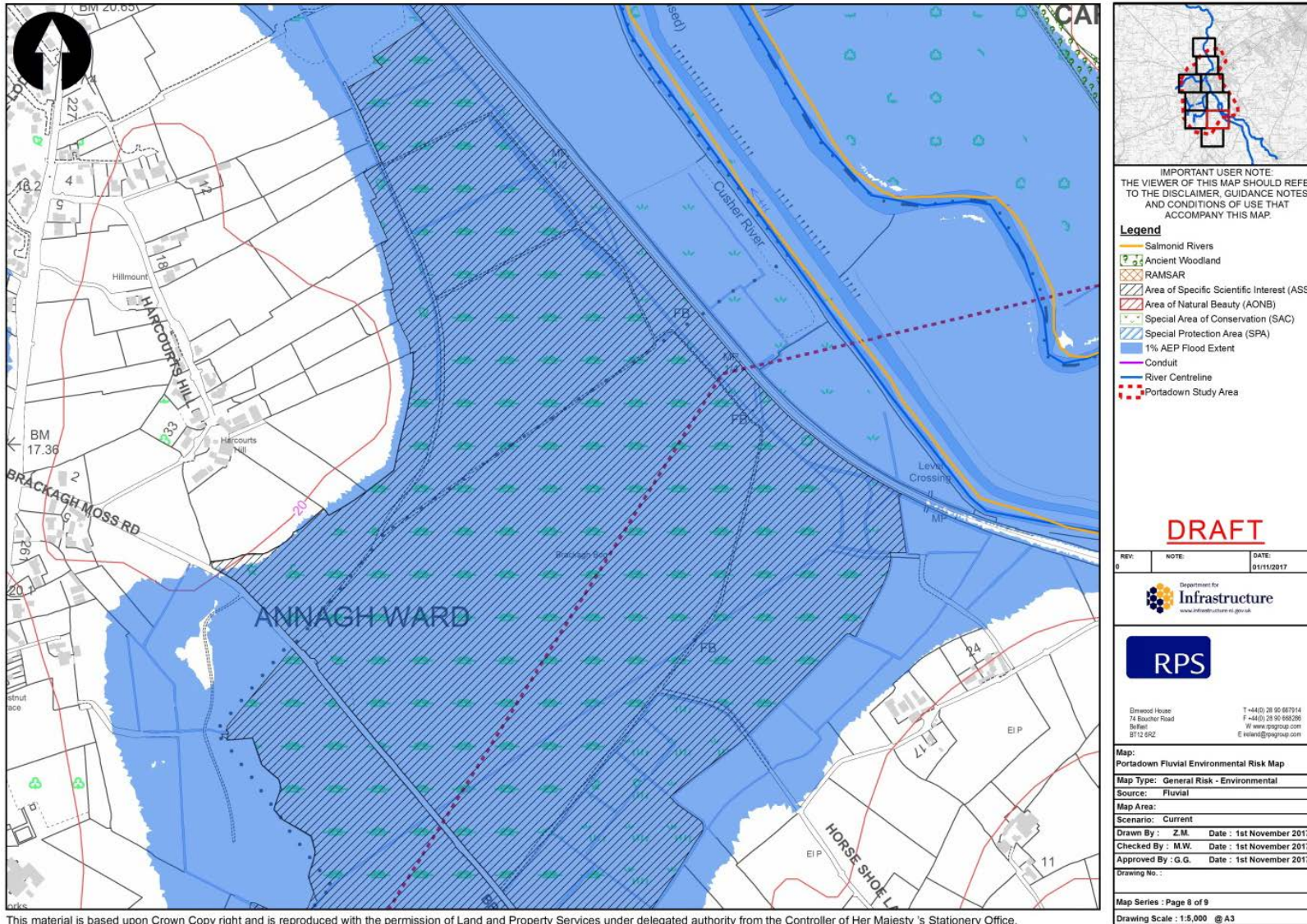


Figure 2.7 - Summary of Flood Risk to Environmental Receptors in Portadown Study Area

2.6.4 Summary of Non-Monetised Risk

The following receptors in Table 2.16 were identified as at flood risk during the design flood event or at potential risk during the construction, maintenance and operation of the preferred option.

Table 2.16 – Summary of Non-Monetised Risk in Portadown

Risk Category	Receptor	Risk type
Economic	225 residential properties	At risk from flooding
Economic	83 non-residential properties	At risk from flooding
Economic	Tandragee Road Corcrain Road Meadow Lane	At risk from flooding
Social	Portadown Health Centre	At risk from flooding
Social	Several bridges and industrial heritage buildings	Listed buildings/structures at risk of damage or modification during construction, maintenance and operation.
Environmental	River Bann Derryvore ASSI Brackagh Bog ASSI	Salmonid river at risk of disturbance during construction, maintenance and operation. Impact to ASSI during optioneering to considered.

3 OBJECTIVES AND CONSTRAINTS

The following objectives and constraints have been identified from the project brief, reviewing the flooding mechanisms and the Flood Risk Assessment.

3.1 OBJECTIVES

The scope of services detailed the need to consider a wide range of flood alleviation options including short-term (0-5 years) measures and long-term (5+ years) measures for the Portadown Study Area. The long term measures should alleviate potential future flooding and provide protection to properties currently at risk of flooding during events up to and including the 1 in 100 year return period flood for the life time of the scheme. The primary objectives are therefore:

- Reduce the flood risk through short-term measures
- Provide the design SoP through long-term measures.

These remain the primary objectives of this study however other objectives and constraints have been identified from the flood risk assessment and are detailed according to the categories set out below.

3.1.1 Reduce the Flood Risk to Receptors in Portadown

As discussed earlier in Section 2.5, a damage assessment was carried out which determined that during a current 1 in 100 year flood event, there are 308 properties which incur a monetary damage – 83 commercial properties and 225 residential properties. Flood risk areas in Portadown are a result of out of bank flooding from the River Bann and backing up of water from the River Bann into smaller watercourses such as Annagh River, Kilmoriarty River and Ballybay River. The recommended options should seek to reduce this flood risk as much as possible.

3.1.2 Technical Objectives and Constraints

Technical objectives and constraints consider any factor that needs to be accounted for or that may cause limitations to the design, construction or maintenance of the proposed option. The following objectives or constraints have been identified:

- There should be no increase in flood risk to any other flood vulnerable receptor within Portadown.
- Reduce backwater effect of River Bann in smaller tributaries.
- The flood alleviation option should provide or be readily adaptable to provide future climate change protection.
- The flood alleviation option should have few and/or managed health and safety issues regarding construction, maintenance and operation.

3.1.3 Social Constraints

Social constraints consider any social receptor or receptor used for social purposes that may be affected by the design, construction and maintenance of the proposed option. The following objectives or constraints have been identified:

- Access to the parts of the study area would be via residential areas. The impact to residents would need to be considered during constructions, maintenance and operation.
- Some areas zoned for flood alleviation measures are private land. The proposed works would be proceeding under the goodwill of the private land owner. The proposed measures should have as limited impact as possible to the landowners current use of the land and also future use.
- Continued access to socially important receptors during flood events should be maintained. These include Portadown Health Centre, Fire Station, Police Station, Schools and Residential/Nursing Homes.
- The Historic Pump House in Portadown and walkways along the River Bann have recently been refurbished therefore the aesthetics of these areas should be maintained along with access to the River Bann.
- Portadown Boat Club requires access to the adjacent slipway and so this access should be maintained.

3.1.4 Environmental Constraints

Environmental constraints consider any environmental receptor or receptor with environmental significance that may be affected by the design, construction and maintenance of the proposed option. The following objectives or constraints have been identified:

- The River Bann which runs through Portadown is a salmonid river and as such any in-channel works or any works which may involve modification to the river bed should be avoided.
- There are two Areas of Specific Scientific Interest (ASSI) within the study area; one area to the north of Portadown (Derryvore) and one to the south of Portadown (Brackagh Bog). As such any works in these areas should be avoided.
- An area of Ancient Woodland is present to the southeast of the study area which should be considered during the optioneering process.

3.1.5 Economic Constraints

Economic constraints consider current cost to operations relative to the estimated costs of any proposed option in relation to the available budget and achieving value for money. The following objectives or constraints have been identified:

- As this project has been commissioned by a public organisation, the objective is to identify the most economically viable option and at a minimum have a benefit cost ratio (BCR) greater than unity.
- It is desirable if possible to prevent flooding to Tandragee Road and Corcraun Road.
- It is desirable to provide protection to several small electricity hereditaments.

4 OPTION DEVELOPMENT AND ANALYSIS

4.1 OPTION IDENTIFICATION

There are various ways to manage the flood risk within any study area. These methods can be grouped into four areas.

- **Protect methods:** reduce the likelihood of flooding. Methods include flood walls, flow diversion and upstream storage.
- **Prepare methods:** reduce the impact of flooding. Methods include individual property protection, flood forecasting and public awareness campaigns.
- **Prevent methods:** avoids future flood risk. Methods include planning and development control.
- **Permit methods:** accepts that flooding will occur. Methods include maintaining the existing regime and doing a minimal amount of maintenance.

The main aim of the Portadown study is to assess whether an economical, environmentally and socially sensitive scheme can be produced which will alleviate the flood risk to affected properties, infrastructure and businesses in the study area. This would, in general, entail providing 'protect' methods over 'prepare' methods and avoiding 'permit' methods where possible. Prevent methods should always be included to prevent an increase in future flood risk.

4.1.1 Shortlist of Options

The aim of the screening process is to ensure the widest possible range of flood management options are considered in the assessment process while the rejection of any methods shall be robust and with clear and transparent reasoning. The long list of methods considered is presented in Table 4.1 below.

Table 4.1 - Long List of Potential Methods

Option	Method type	Description
Do Nothing	Permit	Implement no new flood risk management measures and abandon any existing practices.
Maintain Existing Regime	Permit	Continue any existing flood risk management practices, such as reactive maintenance.
Do Minimum (Temporary Defences)	Permit	Implement additional minimal measures to reduce the flood risk in specific problem areas without introducing a comprehensive strategy.
Planning and Development Control	Prevent	Zoning of land for flood risk appropriate development, prevention of inappropriate incremental development, review of existing planning policies.

Land Use Management	Protect	Changing how the land is used in order to store or slow surface water runoff and slow in channel and out of bank flow along the river in order to store flood water in suitable locations. This may consist of the creation of wetlands, restoring river meanders, increasing the amount of boulders and vegetation in channel, perpendicular hedges or ditches in the floodplain, tree rows and planting in floodplain to either slow flow or direct flow, planting along banks parallel to flow, fencing off livestock from riparian strip, changing agricultural practices to decrease soil compaction and increase water infiltration.
Maintenance Programme	Protect	Increased frequency of routine maintenance, targeting of problem culverts, bridges or other control structures, removal of debris and rubbish tipping, desilting of sedimentation prone areas.
Upstream Storage/Storage	Protect	Large scale dam and reservoir, offline wash lands (embanked areas of floodplain to store water during larger flood events).
Tidal Barrage	Protect	A fixed or moveable barrier across the river to prevent tidal water progressing upstream.
Improvement of Channel Conveyance	Protect	Deepening of channel bed, widening of channel, realigning long section profile, removal of constraints, lining or smoothing channel. Increasing the capacity of existing culverted watercourses.
Hard Defences	Protect	Reinforced concrete walls, earth embankments, demountable barriers.
Relocation of Properties	Protect	Abandoning flood risk area and properties within and providing alternative properties in suitable area.
Diversion of Flow	Protect	Removing flow from the watercourse via a diversion and discharging to a suitable river or coastline or reintroducing the flow further downstream. This may consist of a culvert, an open channel or using the existing topographical features of the floodplain to convey out of bank flow and discharge to other suitable rivers, the coast line, further downstream on the same river or to an open area for storage. This may consist of fields, park land, roads, etc.
Sealing Manholes	Protect	Preventing pressurised culverts from surcharging through manholes and flooding the surrounding area.
Flood Warning/Forecasting	Prepare	Installation of flood forecasting and warning system and development of emergency flood response procedures.
Public Awareness Campaign	Prepare	Informing public who live, work or use a flood risk area on risks of flooding and how to prepare for flooding.
Individual Property Protection	Prepare	Flood protection and resilience methods such as flood gates, vent covers, use of flood resilient materials, raising electrical power points, etc.

Each of these methods has been reviewed against its applicability for the Portadown area and those which are obviously unsuitable have been removed. Table 4.2 below indicates those methods which have been included and excluded.

Table 4.2 - Applicable list of methods to the Portadown Study Area

Option	Review Comment	Applicable?
Do Nothing	Required to maintain the watercourses and remove blockages etc. under the requirements of the Drainage (Northern Ireland) Order 1973. Therefore cannot carry out the Do Nothing or walk away method.	✗
Maintain Existing Regime	Baseline condition, consider further.	✓
Do Minimum (Temporary Defences)	Consider further.	✓
Planning and Development Control	Consider further.	✓
Land Use Management	Consider further.	✓
Maintenance Programme	Consider further.	✓
Upstream Storage/Storage	Consider further.	✓
Tidal Barrage	Not applicable - principle source of flooding is fluvial.	✗
Improvement of Channel Conveyance	Consider further.	✓
Hard Defences	Consider further.	✓
Relocation of Properties	Consider further.	✓
Diversion of Flow	Consider further.	✓
Sealing Manholes	Consider further.	✓
Flood Warning/Forecasting	Consider further.	✓
Public Awareness Campaign	Consider further.	✓
Individual Property Protection	Consider further.	✓

4.1.2 Technical Review of Options

All methods which have been considered as applicable are reviewed on their technical merits and their ability to alleviate the specific mechanisms of flooding that exist in the Portadown area. This is based on engineering judgement, information from DfI Rivers staff, flood mapping and through review of animations output from the hydraulic model. The following sections give a technical review of all applicable methods. The methods have been considered according to their flood cells (see Figure 2.1) and flooding mechanisms which are:

Flood Cell 1.	River Bann
Flood Cell 2.	Ballybay River
Flood Cell 3.	Annagh River & Kilmoriarty Stream

4.1.2.1.1 Additional Maintenance

This method considers whether improvements can be made to augment the existing maintenance regime which will provide a significant beneficial impact on flood risk in the area. A review was carried out of the existing watercourse network. This included assessing the channel vegetation, the amount of debris present in the channels and the likelihood of structures becoming blocked. Although additional maintenance could be carried out, it was concluded that this would not help to reduce the risk of flooding to receptors in Portadown in any of the flood cells and so was not considered further within this study.

4.1.2.1.2 Temporary Defences

This option includes interim methods which could be implemented as a short-term flooding solution to offer protection to individual properties such as sand bags or small earth bunds. A review was carried out to identify suitable areas for temporary defences. This review considered the flow path of the flood waters and the depth of water at various locations. To avoid the risk of sudden failure, depths of over 0.6m were considered unsuitable for temporary defences.

Flood Cell 1

Temporary Defence methods such as sandbags would not be suitable for the majority of flooding experienced within Flood Cell 1 as flooding is so expansive and depths are generally greater than 0.6m; however some small areas were identified where this method could be implemented. In all areas identified, sandbags work most effectively if joined together and placed on footpaths surrounding properties.

There is a small group of properties on Meadow Lane where surrounding water depths are less than 0.6m, and sandbags may be a suitable interim method. This is shown in Figure 4.1 below. On Park Road, some properties may be suitable for flood protection from sandbags; however the water depth increases towards the centre of the road and so may not be effective in these areas, as shown in Figure 4.2. At Parkside there are a number of properties at risk of flooding, as shown in Figure 4.3. The depth is generally less than 0.3m therefore making sandbags an appropriate flood defence method. On the Ashgrove Road some properties are at risk of flooding where flood depths are low, and sandbags may be an appropriate interim defence method.

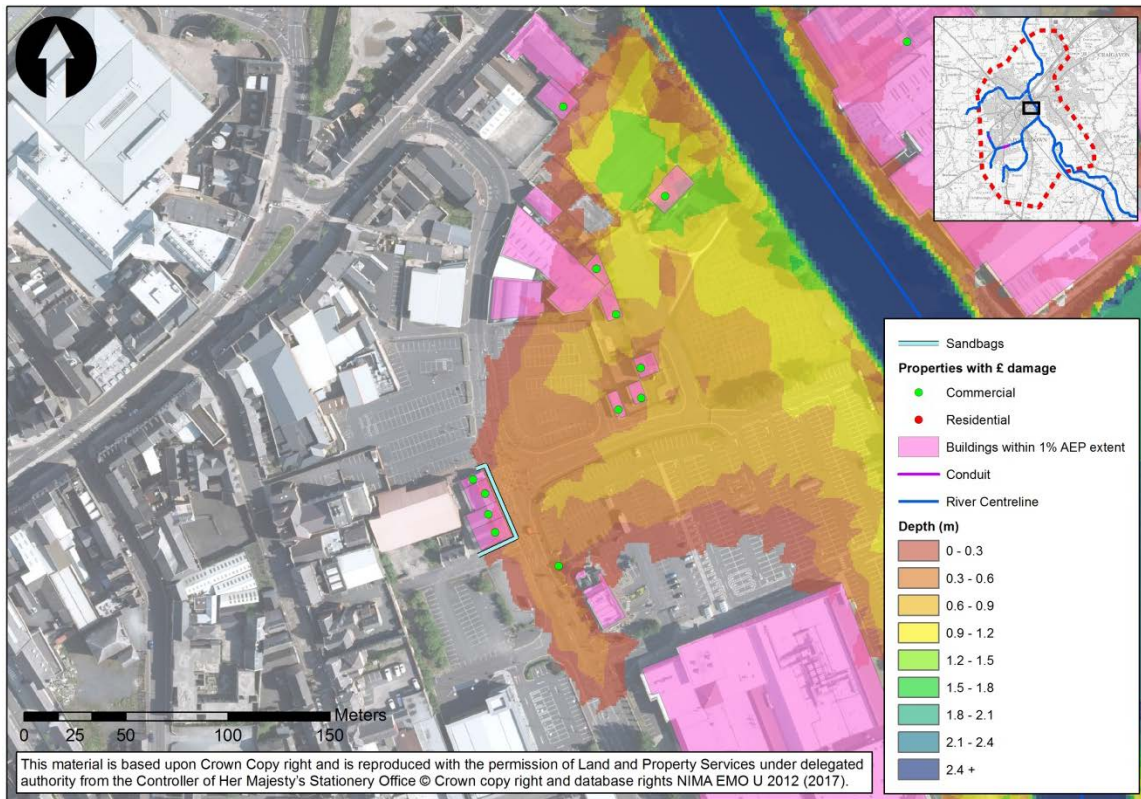


Figure 4.1 - Potential for use of sandbags on Meadow Lane

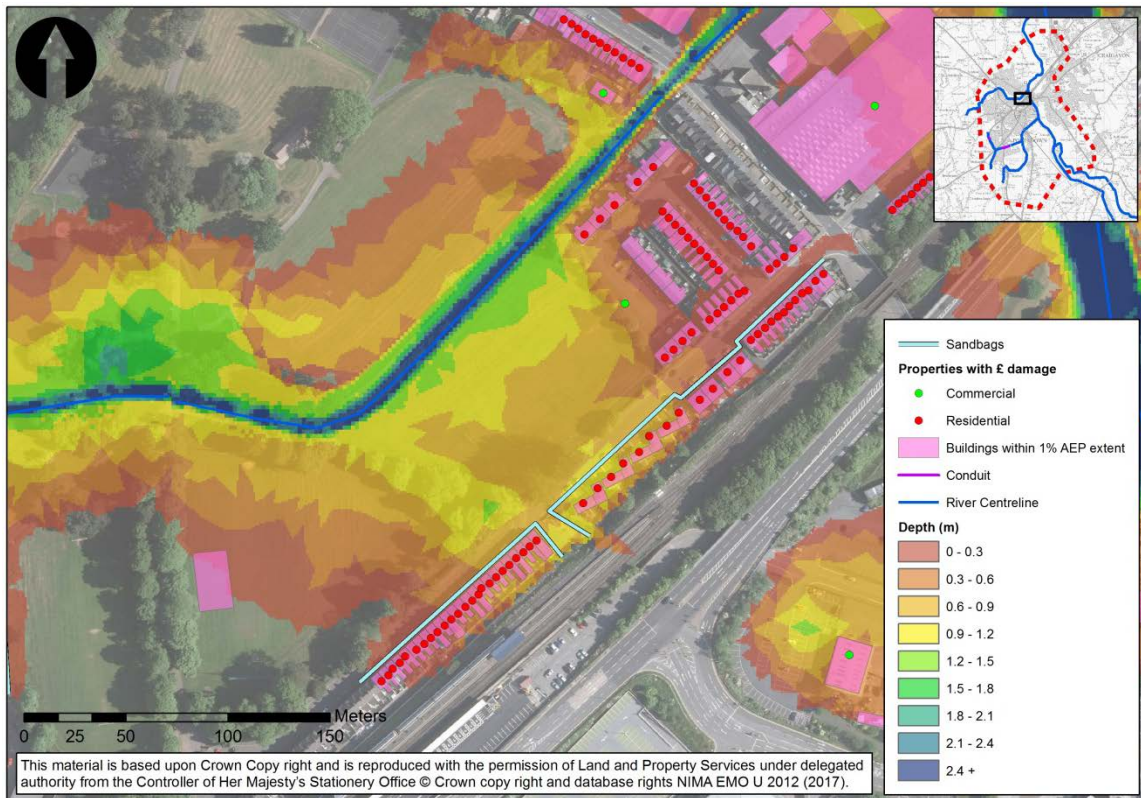


Figure 4.2 - Potential for use of sandbags on Park Road

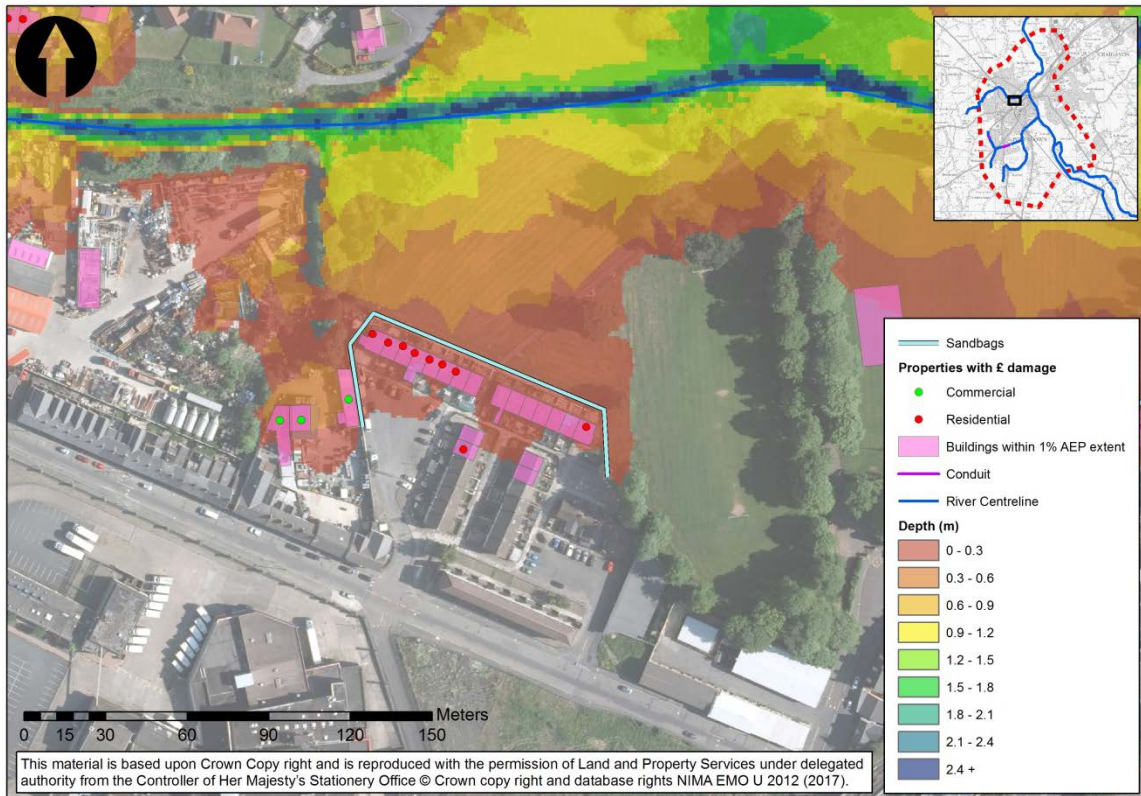


Figure 4.3 - Potential for use of sandbags at Parkside

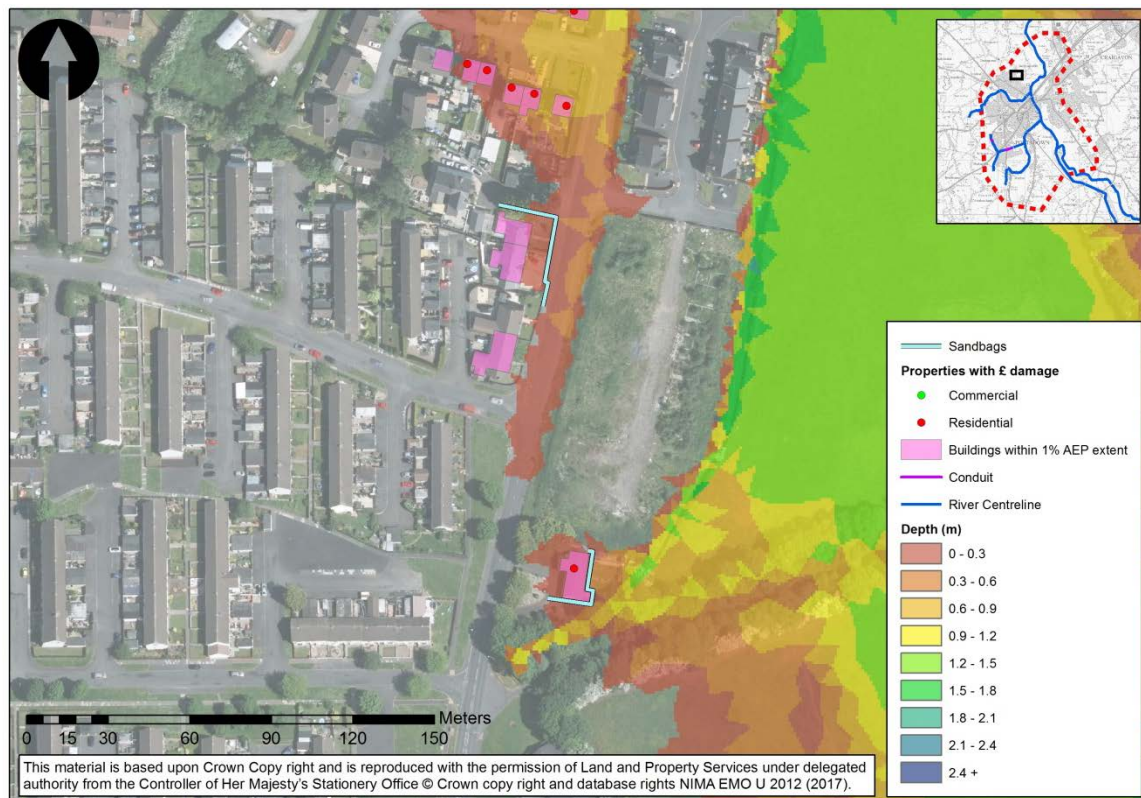


Figure 4.4 - Potential for use of sandbags on Ashgrove Road

Flood Cells 2 & 3

Upon review it was found that Flood Cell 2 was not suitable for temporary defence methods, as the water depth in these areas exceed 0.6m. However, in Flood Cell 3 it was found that temporary defence methods may be suitable as the water depth is low in these areas. The Kilmoriarty Stream runs along the back of these properties, causing them to flood through their rear entrances. As the water depths do not exceed around 12cm at the back of the properties, it may be most appropriate to place sandbags at the back doors of the affected homes.

4.1.2.1.3 Planning and Development Control

Portadown’s urban area is already largely developed so this method may not help resolve flooding issues. There are several areas zoned for development within Portadown Study Area as shown in Figure 4.5 and Figure 4.6 below. These areas do not lie within the current 1 in 100 year flood extent and so any properties built here in the future will not be at risk of flooding up to a 1% AEP event.

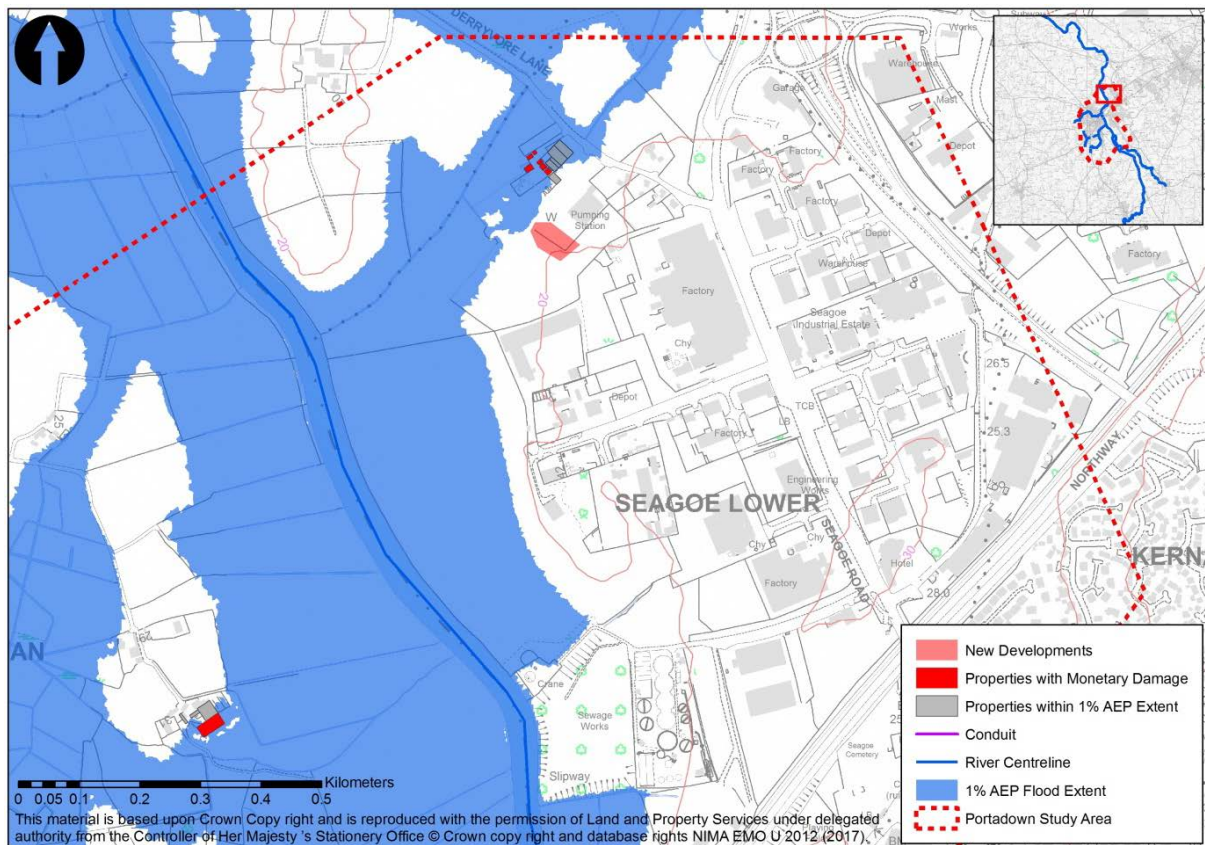


Figure 4.5 - Areas zoned for development within Portadown Study Area - Seagoe

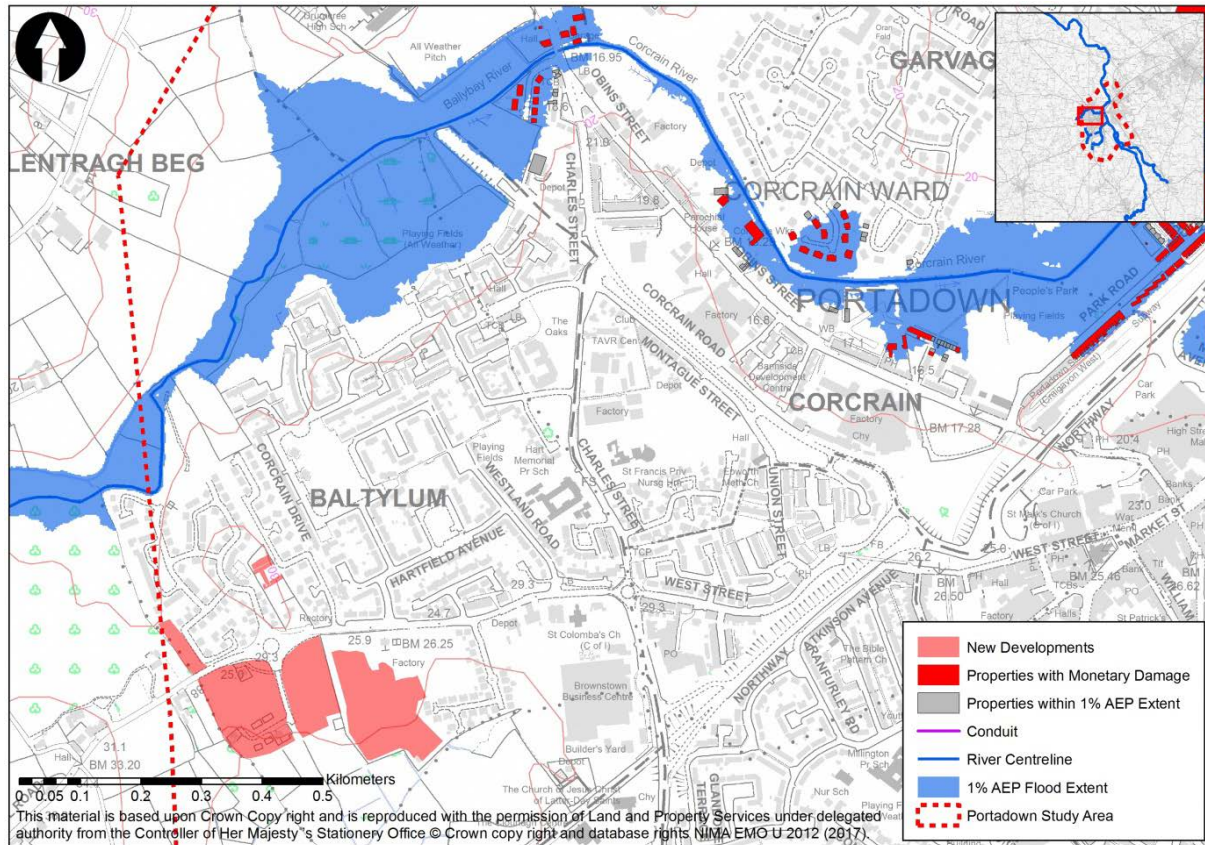


Figure 4.6 - Areas zoned for development within Portadown Study Area – Ballylum

4.1.2.1.1 Land Use Management

The River Bann has a large catchment and for Land Use Management to be effective would require many areas within the catchment to change their land use and many Natural Flood Management (NFM) features to be implemented throughout the catchment requiring the positive contribution of many land owners. However, Forest Research which is the Research Agency of the Forestry Commission has undertaken significant research into opportunities for woodland creation to reduce flood risk in Northern Ireland. One map which Forest Research have produced (shown as Figure 4.7 below) shows high priority areas for planting floodplain, riparian, and wider catchment woodland to reduce downstream flood risk. A total of 2,493 km² or 17.6% of Northern Ireland is identified as priority areas for woodland planting to reduce downstream flood risk, comprising 1,721 km² for wider woodland, 110 km² for riparian woodland and 663 km² for floodplain woodland. Currently, only 4.7% of Northern Ireland’s floodplain is covered with woodland. Almost 44% of the floodplain is free from constraints to woodland planting, highlighting opportunities to significantly increase the floodplain woodland cover in Northern Ireland, from 71 km² to 663 km².

Flood Cell 1

On the River Bann in the Portadown Study Area, a review was carried out to ascertain if land use and/or watercourse routes have changed over time. Historically it was found that most of the land surrounding the Bann was agricultural land and the majority of the land use has remained the same over the last century. The route of the watercourse has also not changed significantly.

Defra's Sustainable Agricultural Land Management Strategy also highlighted a key feature of sustainable land management in Northern Ireland as: '*Properly located woody riparian strips in overland flow pathways to reduce nutrient and sediment loss to waterways to improve biological water quality*'. This for example could be implemented along the River Bann to help alleviate flood risk to Portadown. Agro forestry was also suggested in the strategy, where trees may be integrated within crop or livestock farming systems. As there are large areas of agricultural land along the River Bann this is an NFM which may reduce flood risk, as well as reducing soil erosion and providing shelter for livestock.

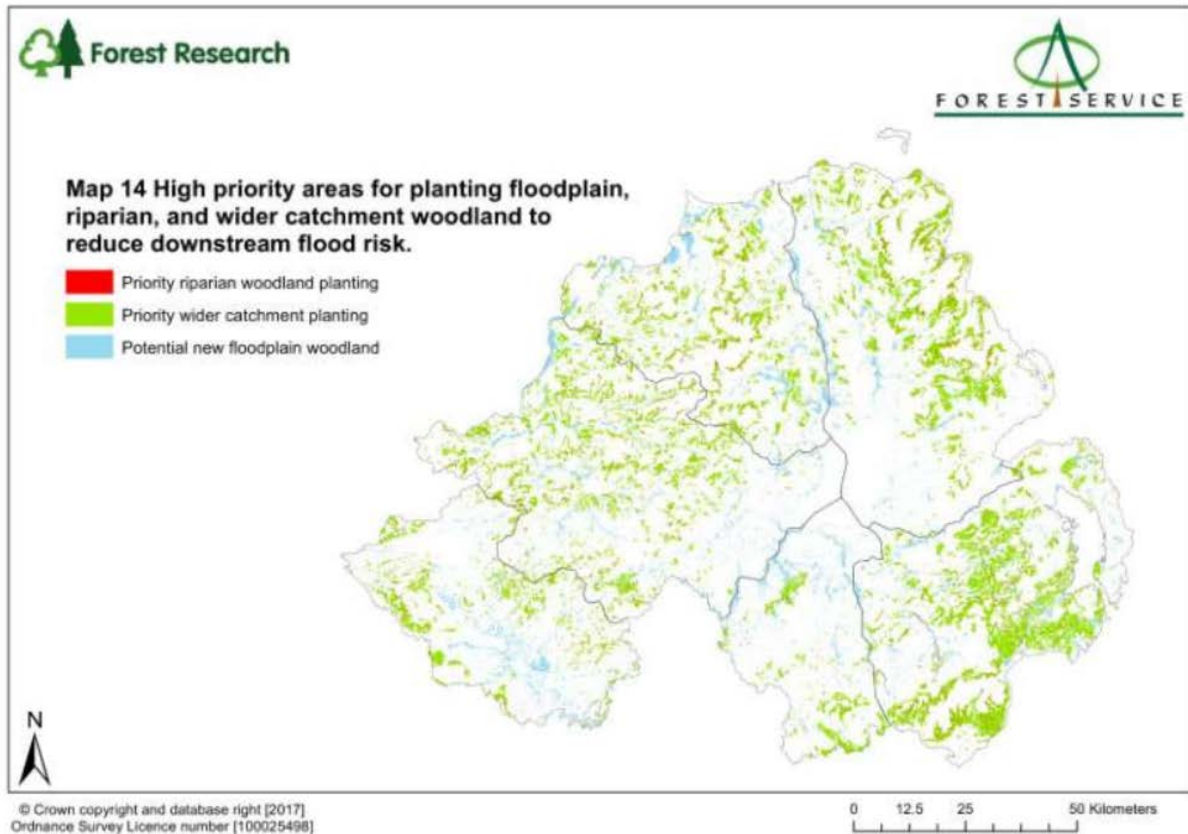


Figure 4.7 - High priority areas for planting floodplain, riparian and wider catchment woodland to reduce downstream flood risk

Flood Cells 2 & 3

Land Use Management was considered for the Annagh River, Kilmoriarty Stream and Ballybay River. A historical review was carried out to ascertain if the land use and/or watercourses have changed over time. The OSNI Historical Mapping 1905-1957 indicated that the Maghon area around Annagh River and Kilmoriarty Stream was partially planted with trees, possibly for use as an orchard. To the south and north of this the historical mapping shows that the area was used largely as agricultural land. Figure 4.8 below shows the areas which have changed land use. Nowadays, the majority of this land has been improved to allow for the development of housing. The route of the watercourses has not significantly changed however there are now some small culverted sections due to the development of new road infrastructure.

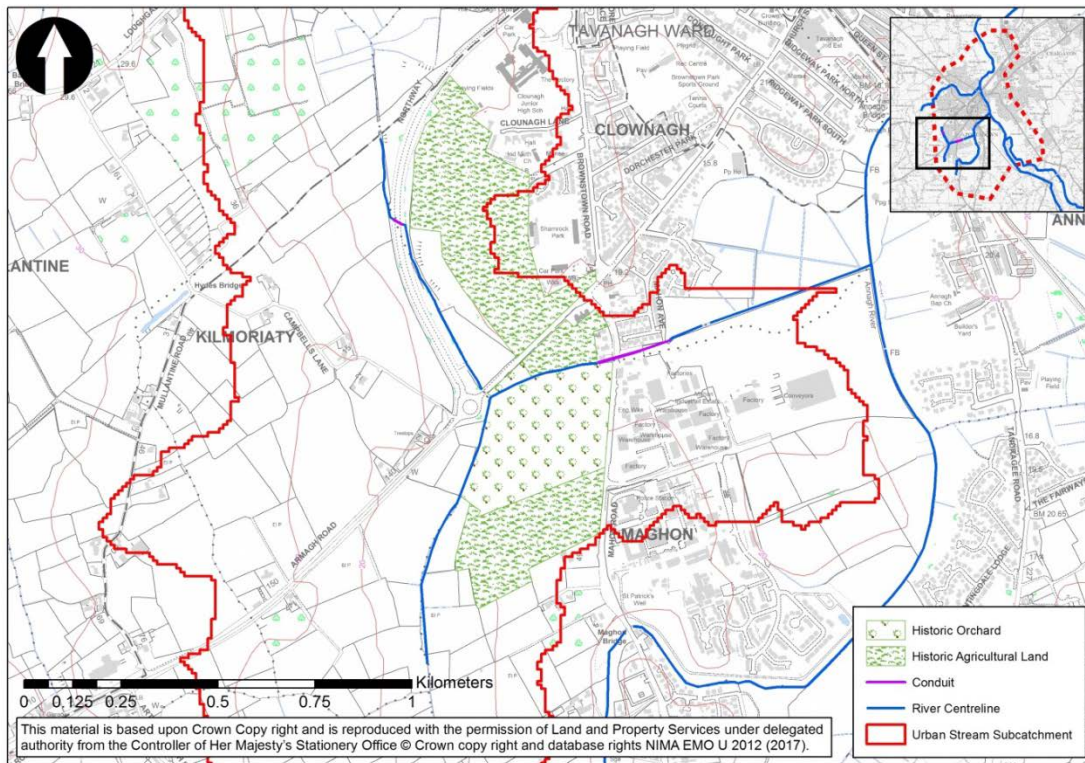


Figure 4.8 - Kilmoriarty Stream land use 1905-1957

Similarly at the Ballybay River, historical maps from 1905-1957 indicate that the area surrounding Ballybay River which has now been largely developed for housing, was previously agricultural land and tree planted/ nursery areas. Figure 4.9 below shows the areas which have changed land use. These changes could contribute to an increased runoff rate resulting in flashier flood events with higher peak flows.

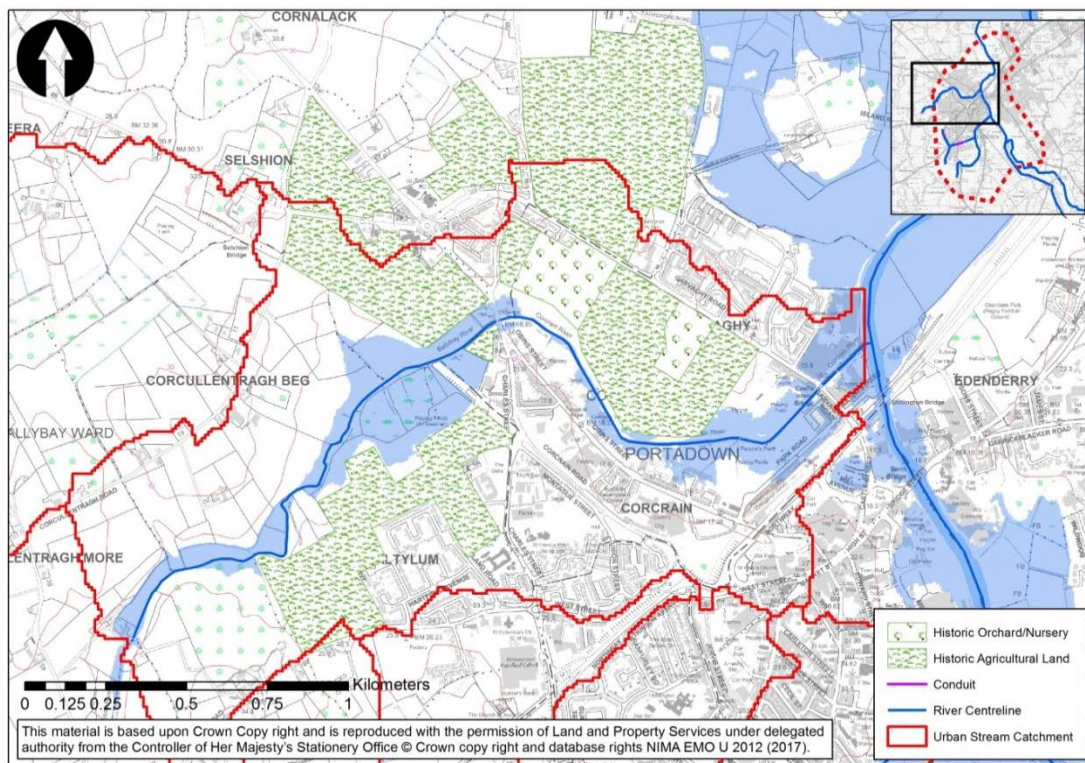


Figure 4.9 - Ballybay River land use 1905-1957

This method seeks to find ways to revert the effects of these changes through the restoration, enhancement and alteration of the existing natural features and characteristics. This could involve retaining water and slowing run-off in the catchment thereby lowering water levels and reducing the associated flood risk within the watercourses. This can be achieved by a number of techniques for example planting, restoring meanders and attenuation ponds. Land use management methods can be applied to any catchment with characteristics that provide favourable conditions to make land use management an effective method in managing the flood risk.

As the majority of the catchment is highly urbanised there would be little scope to change the land use. Any open space available would not be conducive with storing water. It may be possible to fit underground tanks in strategic places however this would be technically difficult to achieve and expensive to construct. It is therefore considered that land use management methods are not suitable in urban areas.

4.1.2.1.2 Upstream Storage

This method considers areas where flood water can be stored and then released at a controlled rate therefore reducing the flow rate through the study area and reducing the level of flood risk. This can be achieved by using existing depressions to create online or offline storage areas or by identifying pinch points which could be dammed such as a restricted point along a valley. Storage areas can be effective either upstream of the risk areas or within the risk area where parks or open areas are located.

Flood Cell 1

Upstream storage was not considered for the River Bann as there is already an extensive floodplain, and the downstream end is already carefully controlled by structures at Lough Neagh.

Upstream Storage was considered unfeasible for Portadown due to the significant backwater effect from Lough Neagh. Relative to the scale of risk at Portadown and the potential benefiting areas, a large area would be required to store the water and an extensive dam structure needed to regulate the flow. This method is therefore not proportionate to the scale of the study and would be economically expensive to implement. If additional storage areas were created this may not help to relieve flooding in Portadown as Lough Neagh would fill up any available space. Upstream storage on the River Bann is therefore considered to be unfeasible.

Flood Cells 2 & 3

A review was carried out to identify if any areas which may be suitable for storage exist naturally in the topography around Annagh River, Kilmoriarty Stream or Ballybay River. Two areas were identified where culvert sizes could be decreased restricting the flow through the structures and therefore causing water to be stored upstream.

The first location where this may be possible is on the Ballybay River at the bridge passing underneath Corcraun Road. The second location where this may be possible is on the Kilmoriarty Stream at the culverted section passing underneath the A27, behind Orchard Drive. These scenarios were simulated in a hydraulic model to determine their effectiveness.

The capacity of the arched bridge at Corcrain Road was reduced in order to reduce the flow downstream and attenuate the flood water upstream. A box culvert 2.8m x 1.5m was found to reduce the flow enough so as protect approximately 12 properties downstream in the Parkside area off Obins Street, however Hard Defences would still be required on the Ballybay River due to the backwater effect of the River Bann. Additionally the water attenuated upstream of the Corcrain Road bridge would increase the flood extent so as to place properties at risk in the Corcrain Avenue area. Due to the increase flood risk this method was considered unacceptable and not considered any further. Figure 4.10 below highlights the difference in flood extents from the present day 1% AEP flood event and the Upstream Storage 1% AEP flood event on the Ballybay River.

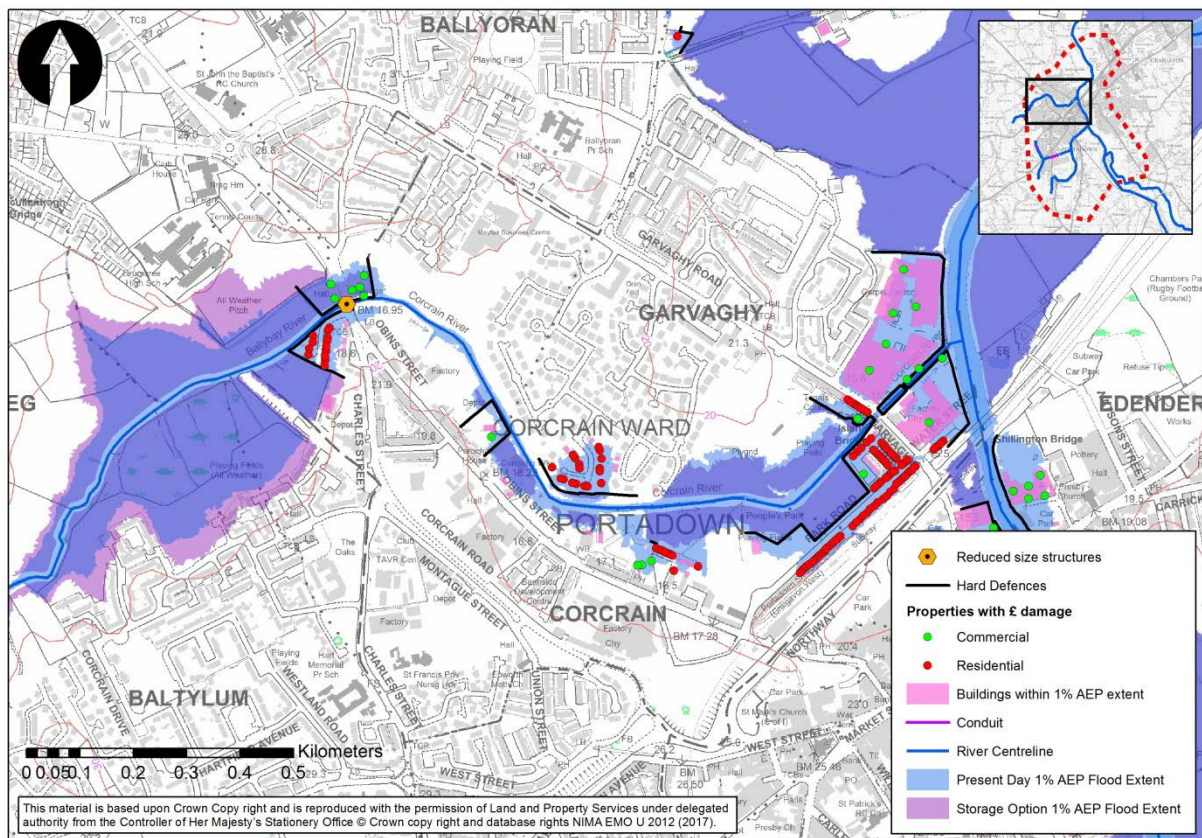


Figure 4.10 - Upstream Storage through reducing structure size on Ballybay River

The culvert on the Kilmoriarty Stream was reduced from a 1.2m diameter to 1.05m diameter, the location of which is shown in Figure 4.11 below. The result of this simulation showed no significant difference in flood extent from the present day 1% AEP event and was therefore considered unfeasible.

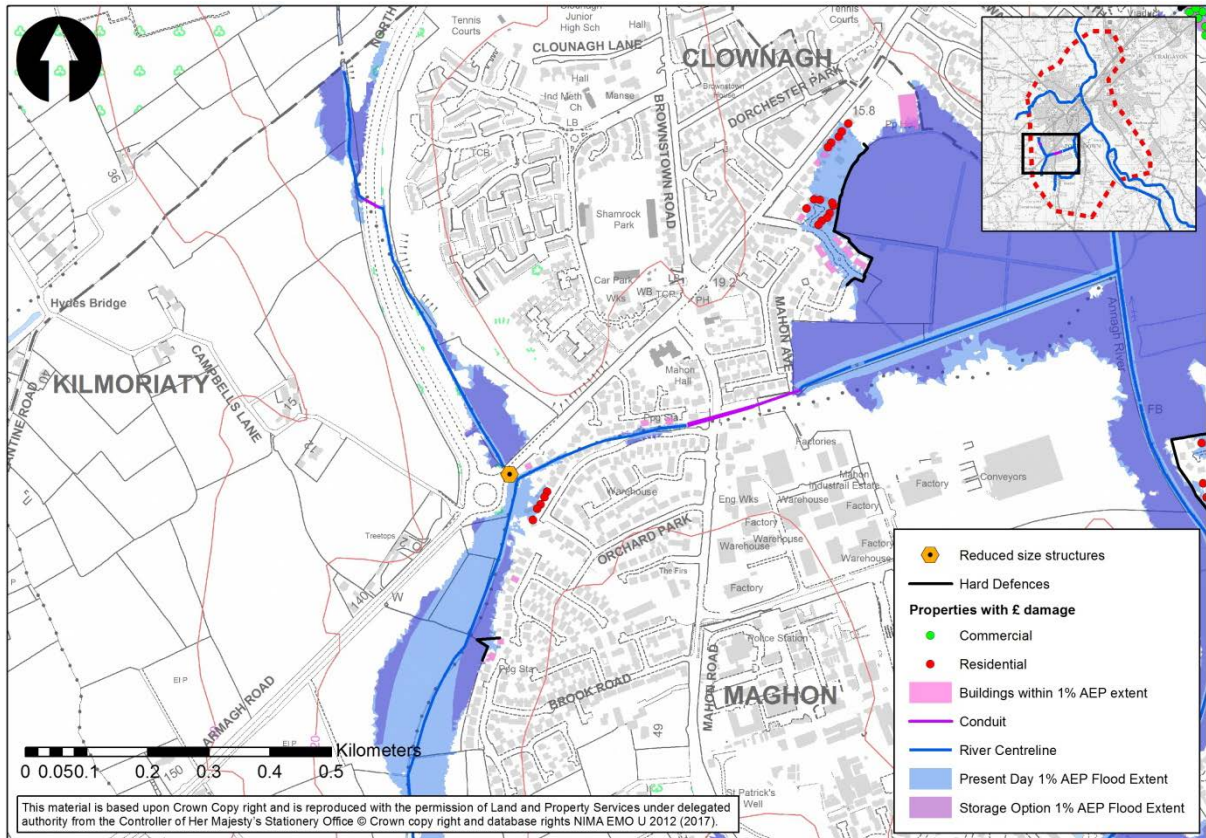


Figure 4.11 - Upstream storage through reducing structure size on Kilmoriarty Stream

4.1.2.1.3 Improvement of Channel Conveyance

This method focuses on increasing watercourse conveyance thereby lowering water levels and reducing the associated flood risk. This can be achieved by lowering the bed level, widening/reshaping channels, removing channel/structure constrictions, culverting reaches of watercourse or upgrading existing culverts and reducing roughness of the channel.

Flood Cell 1

This method was not considered appropriate for the River Bann due to the large volume of water in the river during a 1% AEP flood event. Any modifications to the channel would not be significant enough to provide any benefit to receptors in Portadown and there are already many structures in place along the watercourse so the channel could not be significantly altered.

Flood Cells 2 & 3

For Flood Cells 2 & 3 the modelled tributaries have little scope for this method to be applied. The main cause of flooding is due to the dominating backwater effect of the River Bann; therefore improving conveyance in the tributaries may not help to alleviate flood risk to receptors.

4.1.2.1.4 Hard Defences

Hard Defences refer to physical barriers which prevent water from entering an area such as flood walls, embankments and barrages. As a general rule Hard Defences are kept as far back from the river channel or coast line as possible allowing the floodplain function to remain active. Where this is not possible, due to flood risk receptors being located within the floodplain, Hard Defences are placed around the property boundary to afford it protection. Where space allows flood embankments are used but where space is restricted flood walls are utilised.

Flood Cell 1

A review was carried out for Flood Cell 1 to ascertain where hard defences would be required to protect properties at risk during a 1% AEP flood event within the Portadown study area. To determine the effectiveness of the hard defences, a hydraulic model was constructed to simulate the method of protection. The locations of the hard defences used for flooding from the River Bann are shown in Figure 4.12, Figure 4.13, Figure 4.14, Figure 4.15, Figure 4.16 and Figure 4.17 below. The model showed that the hard defences would protect all receptors to the 1% AEP event.

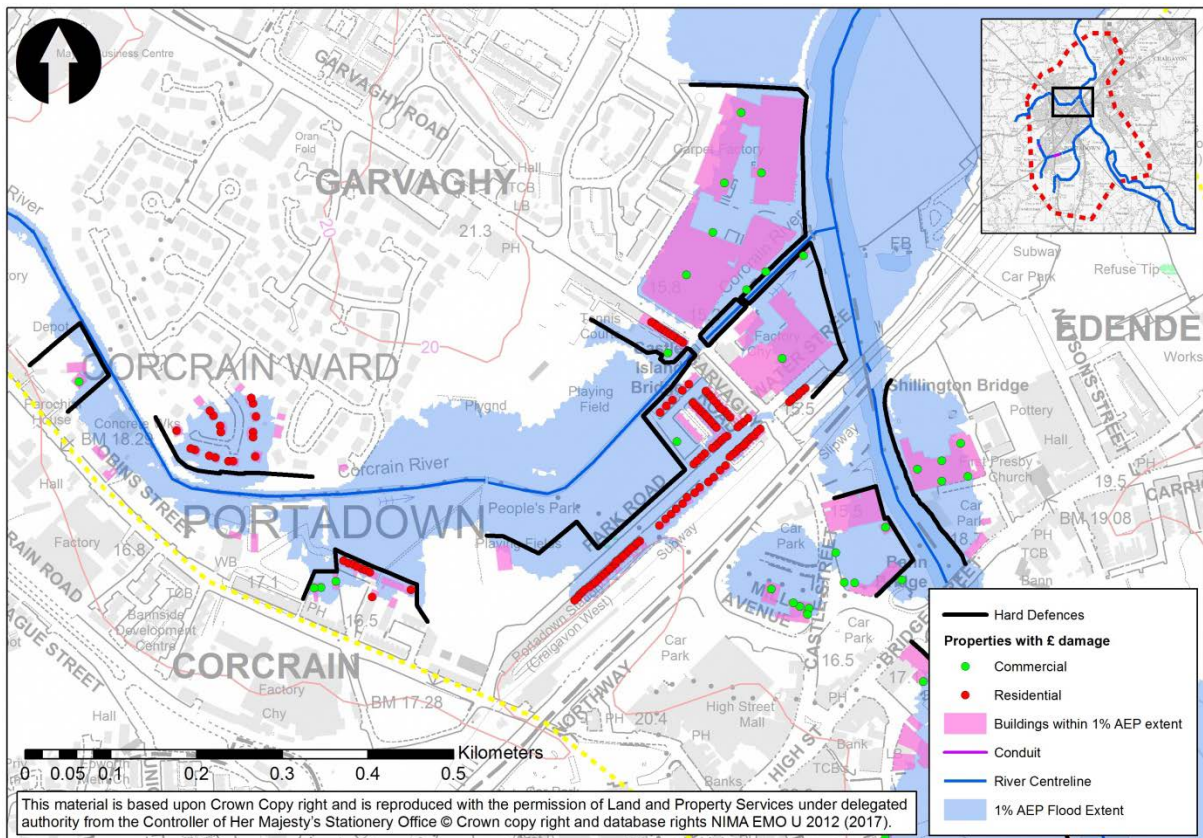


Figure 4.12 - Proposed Hard Defences for Flood Cell 1 - River Bann

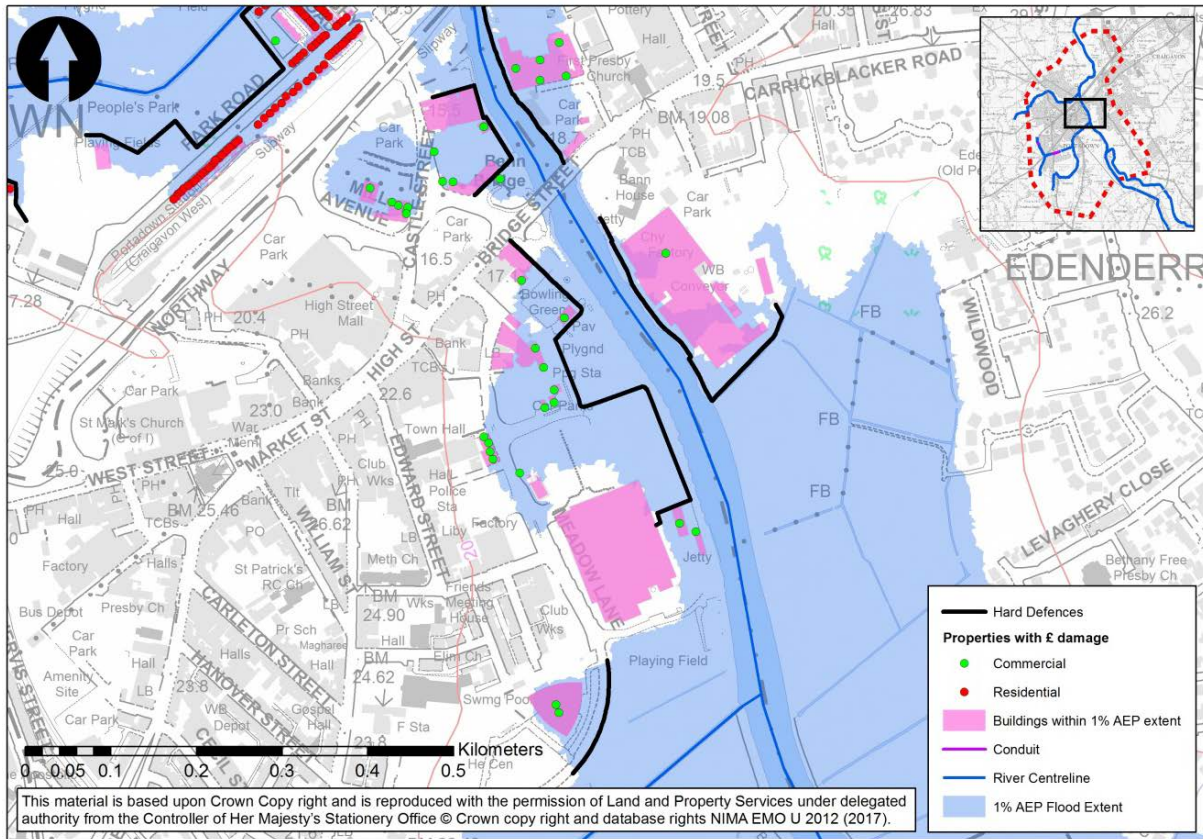


Figure 4.13 - Proposed Hard Defences for Flood Cell 1 – River Bann

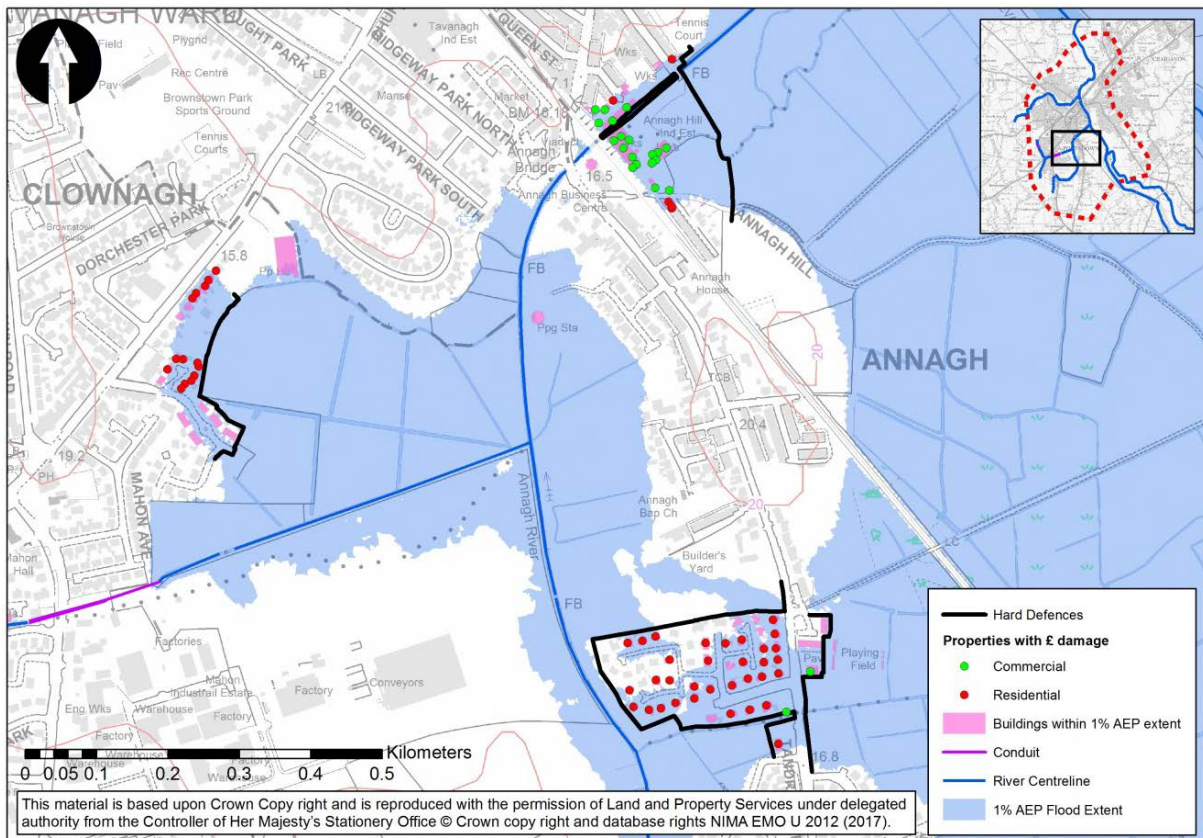


Figure 4.14 - Proposed Hard Defences for Flood Cell 1 – River Bann

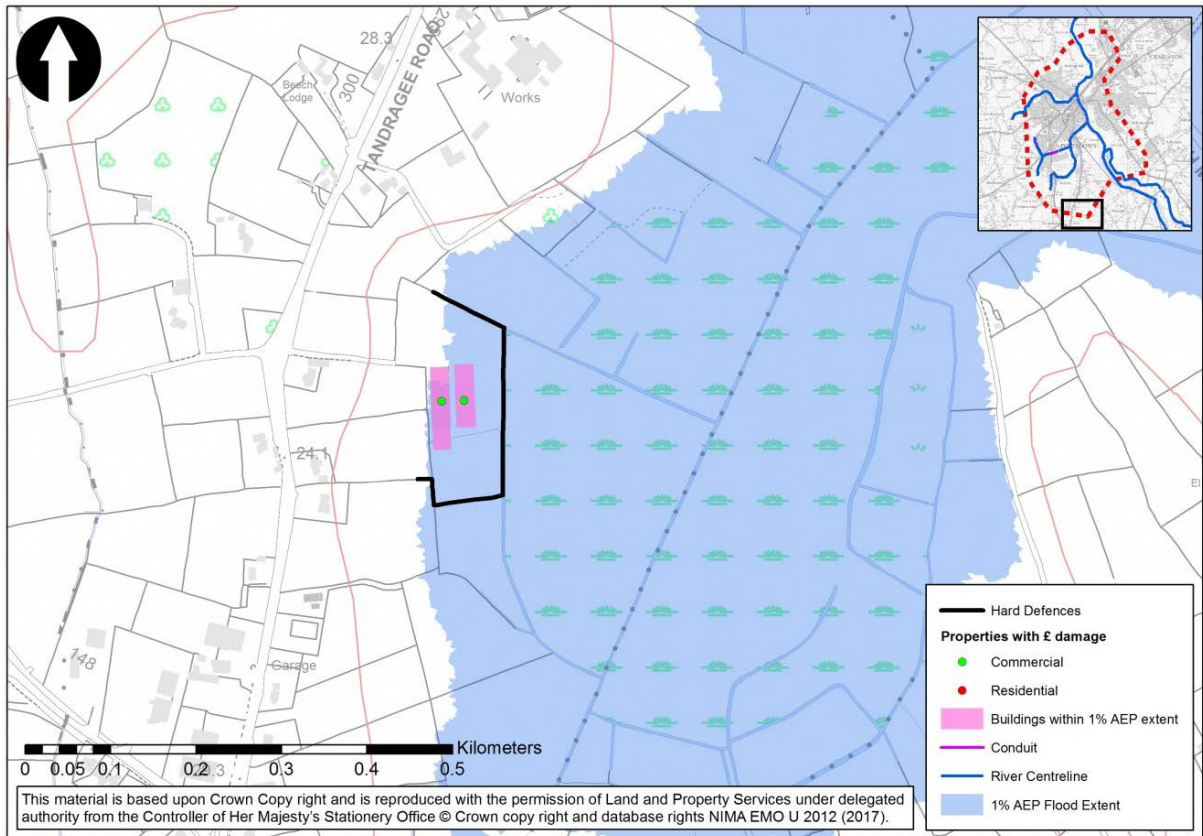


Figure 4.15 - Proposed Hard Defences for Flood Cell 1 – River Bann

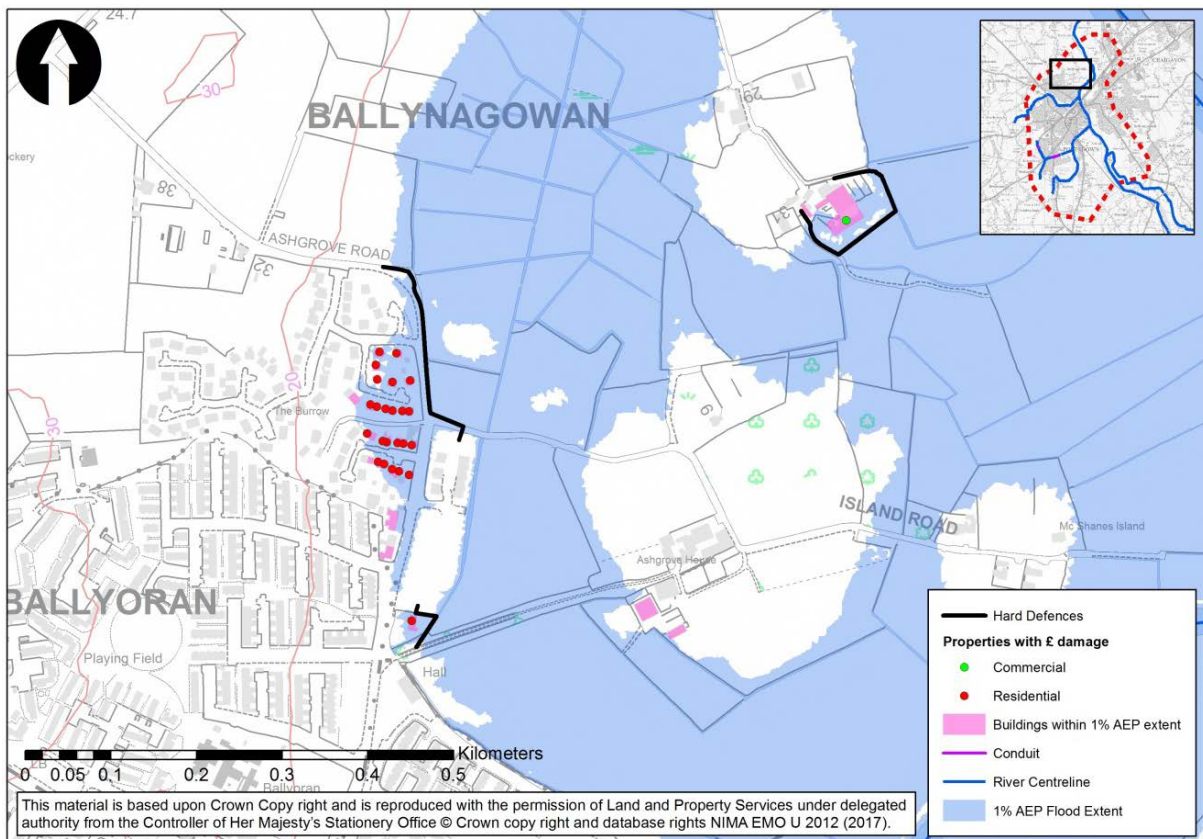


Figure 4.16 - Proposed Hard Defences for Flood Cell 1 – River Bann

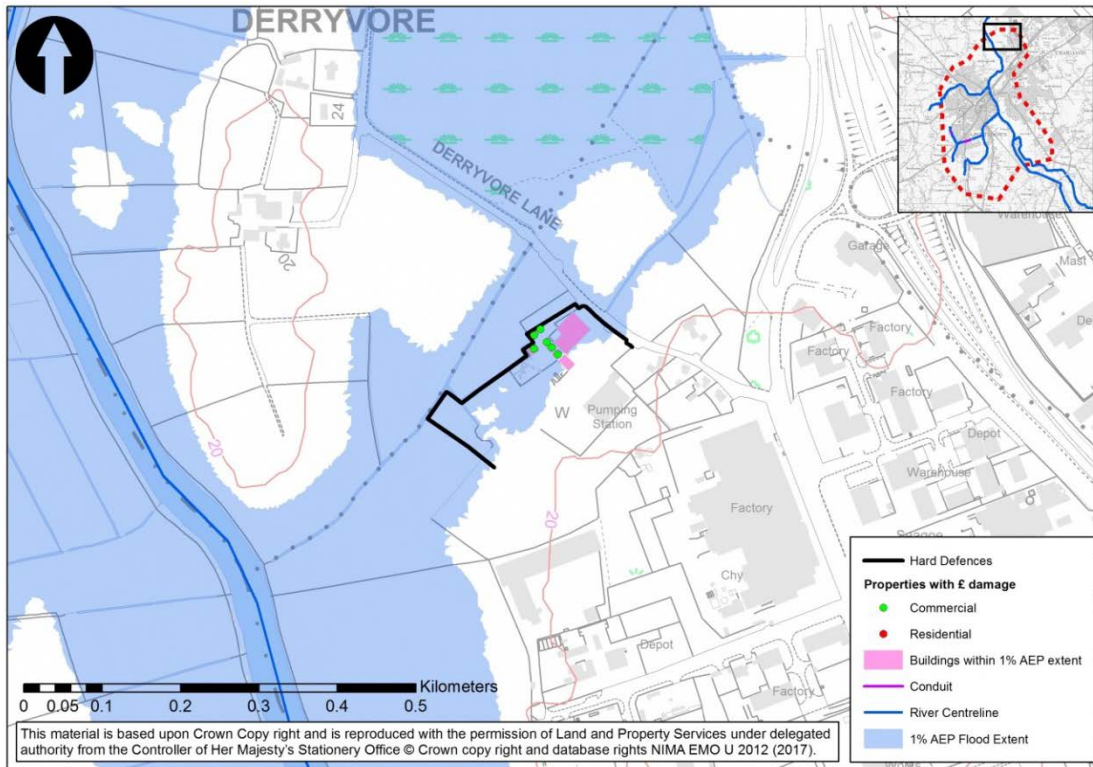


Figure 4.17 - Proposed Hard Defences for Flood Cell 1 – River Bann
Flood Cells 2 & 3

On the tributaries, a hydraulic model was simulated with hard defences in place to protect receptors identified as at risk of flooding during a 1% AEP event. Figure 4.18 and Figure 4.19 below show the walls which were simulated to protect receptors in Flood Cell 2 and Flood Cell 3 respectively.

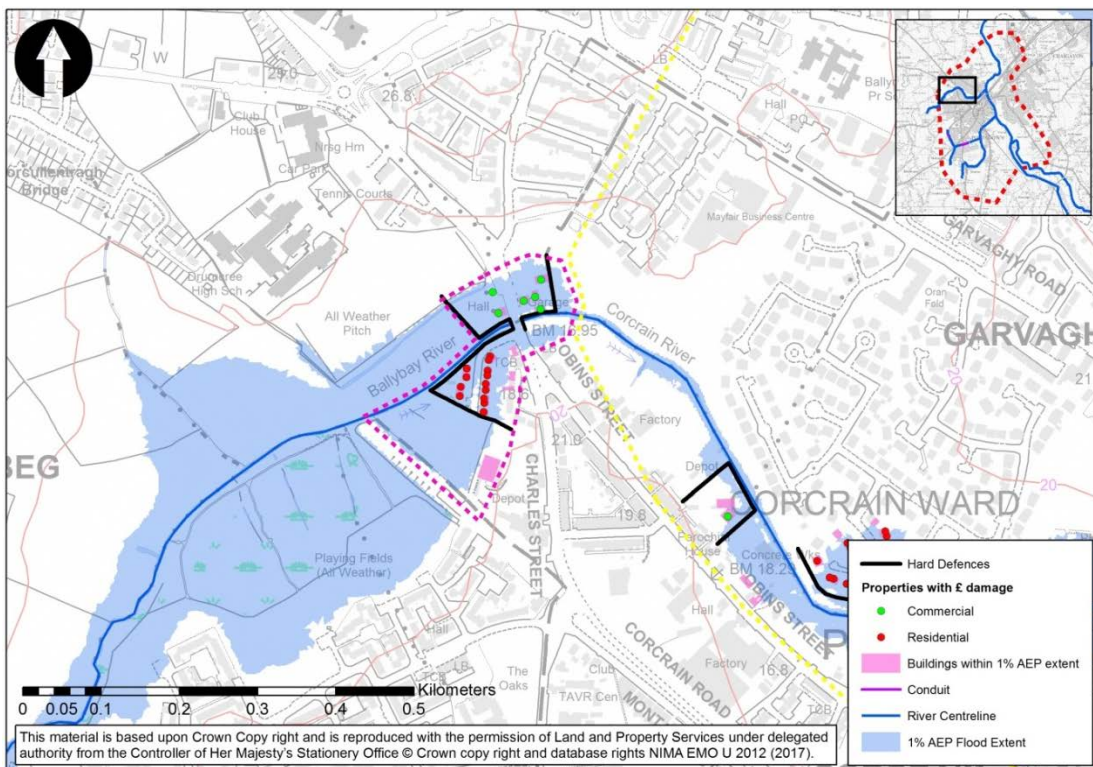


Figure 4.18 - Proposed Hard Defences for Flood Cell 2 - Ballybay River

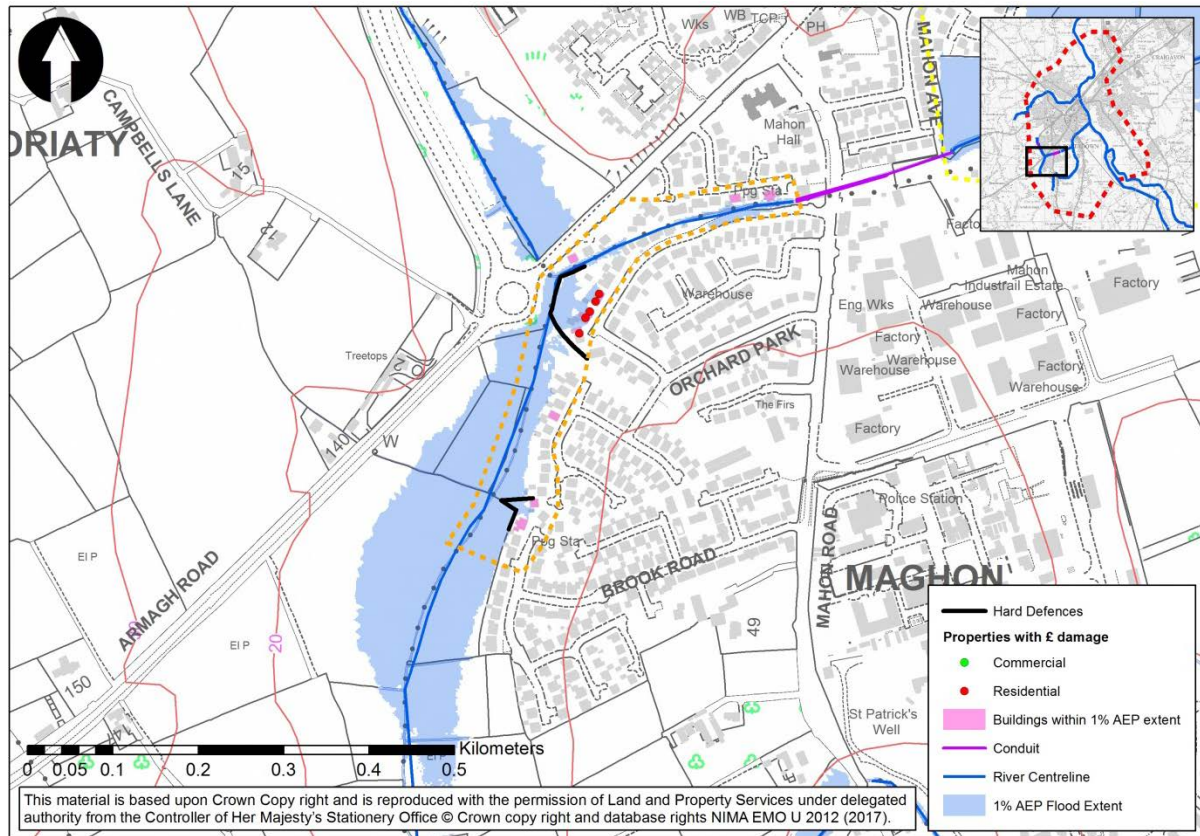


Figure 4.19 - Proposed Hard Defences for Flood Cell 3 - Kilmoriarty Stream

The walls simulated proved to provide protection to the receptors during a 1% AEP event. The walls varied in height from 0.15m to 3.45m.

4.1.2.1.5 Relocation of Properties

To relocate a property is to abandon the existing at risk property and provide an alternative in a location not at risk. While this method is, in theory, possible, it is not practical for a whole town of many at risk properties. Its use is more applicable for discrete areas where single properties or clusters of properties are located.

Flood Cell 1

This method was considered socially unacceptable for flooding on the River Bann due to the large number of properties which would need to be relocated and therefore the scale of disruption it would cause to the people of Portadown. This method would also be economically unviable as the total cost to relocate all properties at risk of flooding from the River Bann (i.e. all properties within Flood Cell 1) is approximately £135,031,560 compared to the damages incurred by these properties during a 1% AEP event of £15,289,563.

Flood Cells 2 & 3

There are some small groups of properties in Flood Cell 2 and Flood Cell 3 which may be considered for relocation. However upon economic review it was found that the cost to construct a hard defence to protect the properties would cost £481,052 and it was estimated that to relocate the properties it would potentially cost £4,792,332. Therefore while it would be technically feasible to relocate these properties it would not be economically viable.

4.1.2.1.6 Diversion of Flow

This method involves directing some of the floodwater via a new route thereby reducing flow and associated flood risk along the original route. The new flow route would normally consist of a constructed open channel and/or culvert system or an existing linear feature able to convey the flow to a designated discharge point.

Flood Cell 1

This method was considered technically unfeasible for the River Bann due to the large size of the watercourse and the catchment topography not providing an alternative route into Lough Neagh.

Flood Cells 2 & 3

No Diversion of Flow routes were identified for the tributaries of Portadown in Flood Cells 2 & 3. It would not be feasible to redirect flow into the River Bann as its backwater effect is so significant that an additional channel would not be beneficial.

4.1.2.1.7 Flood Warning/ Forecasting

For a flood warning/forecasting system to be effective there needs to be adequate warning time for appropriate action to be taken. As the flood risk in Portadown is partly associated with the smaller watercourses which have a flashy response time, there would not be adequate flood warning time to allow a forecasting system to be effective. However for the River Bann to reach full flood there would need to be a significant amount of rainfall over an extended period. Therefore, it may be possible to issue a flood warning to alert business and homeowners and allow individuals to take action to help prevent flood waters from entering their properties.

Flood Cell 1

Upon review of rainfall data and hydrology for the River Bann it was found that there would be a flood warning time of between 6 to 9 hours, from time of peak rainfall to time of peak flow in the river, depending on where rainfall gauges are located. This would give enough time for a flood warning to be issued and if used, for demountable defences to be erected.

If this method were to be taken forward, to increase accuracy it would be necessary to build a rainfall model for the area and to place additional gauging stations along the River Bann. The cost of implementing a flood warning system was estimated at £41,600. This would include three rain gauges, three river gauges, hydrological model build/ calibration and testing/configuration of the system.

This method would only be included as part of the final option if demountable defences were to be used rather than hard defence methods due to political/social constraints.

Flood Cells 2 & 3

Considering Flood Cells 2 & 3, the duration of the flood events on each watercourse is relatively quick and a suitable warning time would therefore be difficult to achieve. It is therefore considered that Flood Warning would not be an effective method for Flood Cells 2 & 3 and was not considered further.

4.1.2.1.8 Public Awareness Campaign

A public awareness campaign would be useful in Portadown to alert residents and business owners to the types and sources of flooding in their area. This would allow individuals to take informed actions to help prevent their property from flooding.

4.1.2.1.9 Individual Property Protection

Individual property protection could consist of flood gates and vent seals on the building structure itself. Where flood depths are over 0.6m this method becomes unfeasible and flood resilience techniques would be recommended over flood gates. As this method is temporary and relies on human intervention there is an element of uncertainty as to whether the full SoP will be met for every flood event. As such it is assumed that 20% of the flood damage will be avoided.

Flood Cell 1

Due to the scale of flooding originating from the River Bann, most receptors at risk of flooding are surrounded by flood waters of depth greater than 0.6m and therefore would not be suitable for Individual Property Protection. The newly refurbished Historic Pumping Station on the banks of the River Bann may have potential for IPP however the water depths are around 0.6m so its effectiveness is uncertain. As this property has been recently redeveloped so as to make the most of the river views, IPP has been considered the most suitable flood defence method.

Flood Cells 2 & 3

Some receptors which are at risk of flooding in Flood Cells 2 & 3 along the tributaries of Portadown may be suitable for Individual Property Protection. Along Kilmoriarty Stream, the depths of flooding are generally less than 0.1m and so flood gates or flood barriers may be appropriate. However as the depths are low, sandbags may also be effective and so temporary defences may be a more economically viable option.

On the Ballybay River and the Annagh River, flood depths are generally greater than 1m and so Individual Property Protection would not be technically feasible.

4.1.2.1.10 Other Works

Flood Cell 1

Other potential works on the River Bann could involve making properties flood resilient. Portadown Boat Club is located on the River Bann, behind Tesco. Due to their location beside the river and their need to access the slipway, making the boat club's properties flood resilient was considered the most appropriate flood defence method. After carrying out a walkover survey, it was found that the boat club may already be flood resilient as the windows on the ground floor are raised, and equipment at risk of flood damage is kept on the first floor, as shown in Figure 4.20. Other works which would increase a property's flood resilience include separating electrical circuits on upper and lower floors and raising electrical sockets on lower floors.

If a suitable method to protect the historic pump cannot be found then flood resilience methods should be considered to reduce the damage incurred.



Figure 4.20 - Portadown Boat Club

In Flood Cell 1 other works were identified on the lower reaches of the Annagh River and Ballybay River where the River Bann causes a backwater effect. The Garvaghy Road and Tandragee Road have created artificial barriers to the River Bann floodplain. Inundation of the floodplain beyond these roads can only occur through culverts or in one location on the Tandragee Road by overtopping the road.

By fitting flap valves on the road culverts this inundation can be prevented (along with some hard defences where the Tandragee Road is overtopped). However the floodplain behind the roads will then have to accommodate the flow from the Ballybay River or Annagh River and Kilmoriarty Stream, while the flap valves are closed. A hydraulic model was run to simulate these scenarios and the resulting flood extent examined. Figure 4.21 and Figure 4.22 below show the difference in the 1% AEP flood extent resulting from the flap valves and where hard defences would still be required.

The hydraulic model results showed that the flood extent would increase along the Ballybay River if a flap valve were fitted at the Garvaghy Road. This is due to a lack of storage available in the lower reaches of the Ballybay River. A flap valve fitted to the Garvaghy Road culvert is therefore technically unfeasible.

The hydraulic model results showed that the flood extent would decrease along the lower reaches of the Annagh River if a flap valve were fitted at the Tandragee Road, along with hard defences to prevent overtopping. This method is therefore technically feasible and should be considered further.

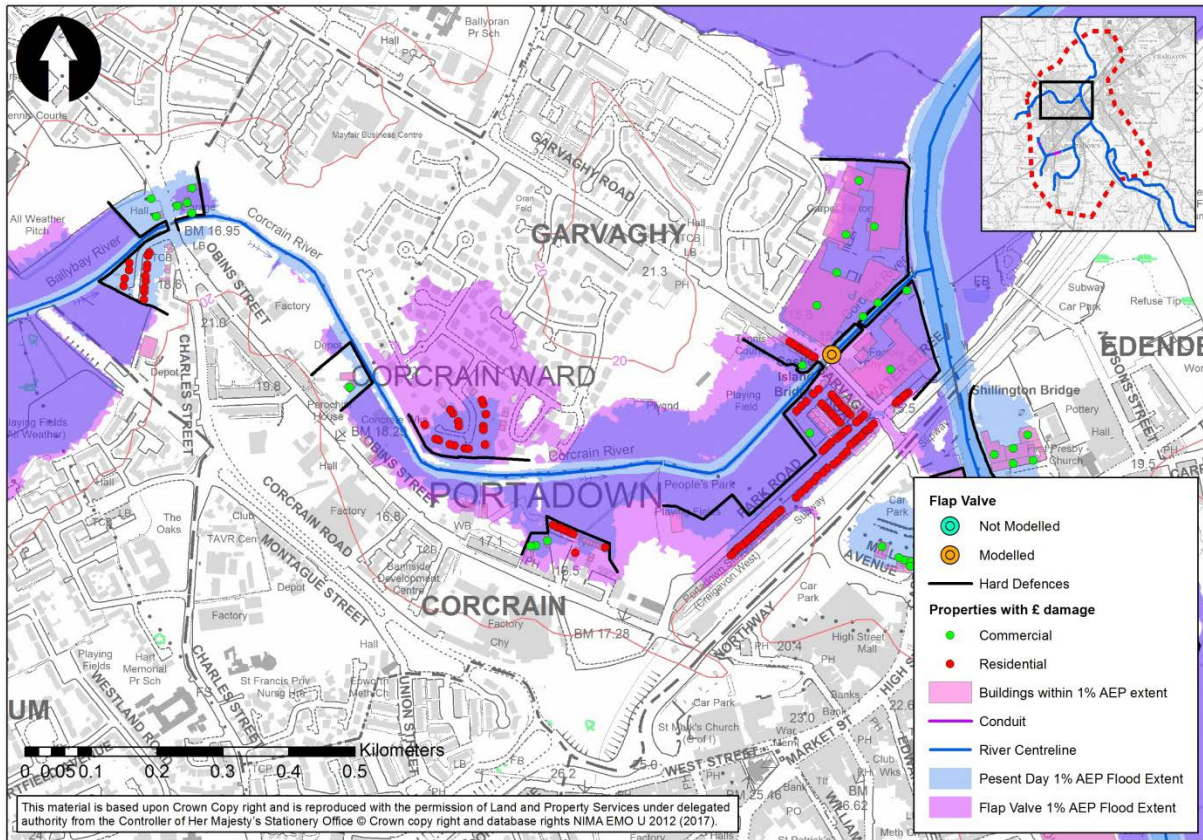


Figure 4.21 - Proposed Flap Valve on Ballybay River

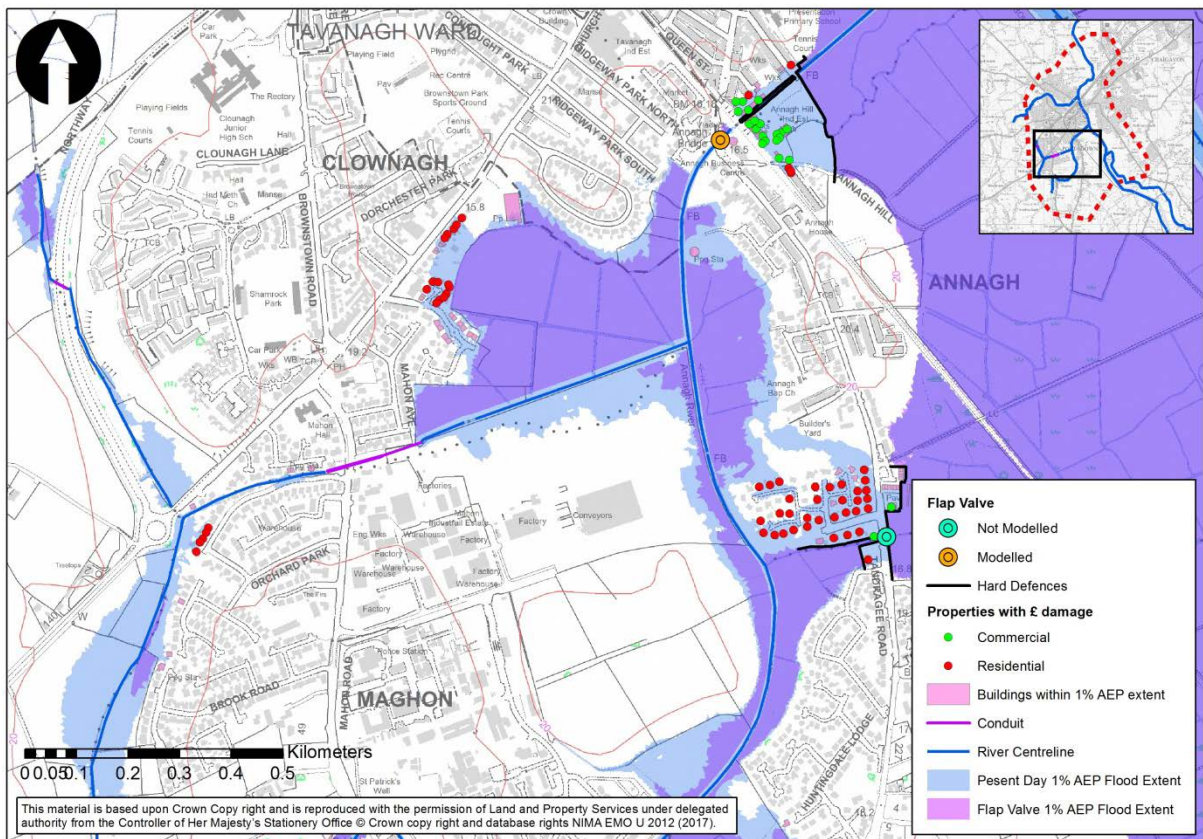


Figure 4.22 - Proposed Flap Valve on River Annagh

4.2 DEVELOPMENT OF OPTIONS

In Portadown, areas at risk of flooding have been identified to result from two main flooding mechanisms. One area at risk results from out of bank flooding and a backwater effect from the River Bann (Flood Cell 1) whilst the other areas at risk results in out of bank flooding from the tributaries; the Annagh River, Kilmoriarty Stream and Ballybay/Corcrair River (Flood Cells 2 & 3). In order to develop options each flooding mechanism was considered separately during the screening of methods and the results are shown below. Two types of options have been considered, short-term solutions or “quick-wins” and long-term solutions. The “quick-win” options may not provide the full SoP but aim to reduce the flood risk in the interim period before a long-term solution can be implemented. Interim methods are discussed in Section 4.6. Long-term solutions should provide the design SoP.

4.2.1 Suitable methods for the River Bann (Flood Cell 1)

Method	Screening	Explanation
Do nothing	✘	Technically unfeasible
Additional Maintenance	✘	Technically unfeasible
Temporary Defences	✓	Short term solution
Planning and Development Control	✓	Short term solution
Land Use Management	✘	Technically unfeasible
Upstream Storage	✘	Technically unfeasible
Improvement of Channel Conveyance	✘	Technically unfeasible
Sealing Manholes	✘	Technically unfeasible
Hard Defences	✓	Long term solution
Relocation of Properties	✘	Economically unviable
Diversion of Flow	✘	Technically unfeasible
Flood Warning/Forecasting	✓	Technically feasible
Public Awareness Campaign	✓	Short term solution
Individual Property Protection	✓	Short term solution
Other Works	✓	Long term solution

The following long-term methods have been carried forward to address the flood risk arising from the River Bann:

- Hard Defences
- Flood Warning/Forecasting
- Other Works (Flood resilient properties and flap valves)

The following short-term methods have been carried forward to address the flood risk arising from the River Bann:

- Temporary Defences
- Planning and Development Control
- Public Awareness Campaign
- Individual Property Protection (Historic Pumping Station)

4.2.2 Suitable methods for the Annagh River, Kilmoriarty River and Ballybay River (Flood Cells 2 & 3)

Method	Screening	Explanation
Do nothing	✗	Technically unfeasible
Additional Maintenance	✗	Technically unfeasible
Temporary Defences	✓	Short term solution
Planning and Development Control	✓	Short term solution
Land Use Management	✗	Technically unfeasible
Upstream Storage	✗	Technically unfeasible
Improvement of Channel Conveyance	✗	Technically unfeasible
Sealing Manholes	✗	Technically unfeasible
Hard Defences	✓	Technically feasible
Relocation of Properties	✗	Technically unfeasible
Diversion of Flow	✗	Technically unfeasible
Flood Warning/Forecasting	✗	Technically unfeasible
Public Awareness Campaign	✓	Short term solution
Individual Property Protection	✓	Technically feasible
Other Works	✗	Technically unfeasible

The following long-term methods have been carried forward to address the flood risk arising from the Annagh River, Kilmoriarty River and Ballybay River:

- Hard Defences

The following short-term methods have been carried forward to address the flood risk arising from the Annagh River, Kilmoriarty River and Ballybay River:

- Temporary Defences
- Planning and Development Control
- Public Awareness Campaign

4.2.3 Potential Options

A review was carried out of the screened methods in order to develop potential long-term options. In Flood Cell 1 the only method that will provide the design SoP by itself is Hard Defences. Portadown Boat Club is an exception to this and Flood Resilience methods will be required for the buildings in this property. For Flood Cells 2 & 3 the only long-term method identified was also Hard Defences. Therefore Hard Defences with Flood Resilience can provide a potential option. The other methods that were identified would have the effect of reducing the length and height of the Hard Defences required.

A flap valve could be fitted on the River Annagh at the Tandragee Road culvert which would reduce the amount of Hard Defences required behind the road.

Flood Warning / Forecasting, while technically feasible, could only be utilised as part of an option if a warning was required to put defences in place. If flood gates or demountable defences are required as part of the preferred option then Flood Warning/Forecasting should be included.

Three potential options have therefore been identified and summarised below.

Option 1:

- Maintain Existing Regime (Baseline Scenario)

Option 2:

- Hard Defences
- Flood Resilience

Option 3:

- Hard Defences
- Flood Resilience
- Flap Valves (Tandragee Road culvert)

4.3 APPRAISAL OF OPTIONS

Table 4.3 below provides a qualitative assessment of the anticipated performance of each option considering the relevant objectives and constraints. [✓ to ✓✓✓] represents a moderately good to very good performance. [-] represent a neutral outcome. [x to xxx] represents a moderately negative to very negative performance.

Table 4.3 - Qualitative assessment of options for Portadown

Objectives/Constraints	Option 1	Option 2	Option 3
Provide design SoP to all properties	xxx	✓✓✓	✓✓✓
Complexity of option	-	x	x
Impact to road drainage	-	✓	✓
No increase in flood risk to other receptors	-	x	x
Reduce backwater effect in tributaries	-	x	✓
Adaptability to climate change	-	✓✓	✓
Health and Safety issues	-	x	x
Impact to residential areas	-	xx	x
Impact to private land owners	-	x	x
Impact to socially important receptors	-	✓	✓
Impact to the salmonid River Bann	-	x	x
Impact to ASSI's & Ancient Woodlands	-	-	-
Reduced risk to roads	-	✓	✓
Impact to recently refurbished areas	-	x	x
Value for money	-	✓	✓✓

The qualitative assessment shows that both Option 2 and 3 would produce a significant improvement to the flood risk in Portadown compared to the baseline Option 1. Both Option 2 and 3 would provide the design SoP to a 1% AEP flood event.

The remainder of the qualitative assessment compares Option 2 and 3 in order to identify the preferred option. Option 2 has been marked down on impact to residential areas whilst Option 3 is less readily adaptable to climate change. Option 3 would relieve some of the backwater effect of the River Bann in the Annagh River and Kilmoriarty Stream through implementation of a flap valve.

Both Options 2 and 3 could be readily adapted to increase the SoP in order to account for climate change however Option 3 is less readily adaptable as the flap valve and culvert are not as easily modified as the hard defences used in Option 2.

Both options will have their inherent health and safety issues. Option 2 consists of a series of reinforced concrete walls ranging from 0.15m to 3.4m in height. Option 3 also mainly consists of Hard Defences in the form of reinforced concrete walls, however the addition of a flap valve on the Annagh River at the Tandragee Road culvert reduces the number of walls needed downstream of this.

As many of the walls are located in residential areas, there may be significant disruption to residents during construction.

There are socially important receptors in Portadown that flooding may prevent access to. Both options would improve this situation by protecting the road network in Portadown.

Consultation with Northern Ireland Water confirmed that they have identified two schemes in the Portadown area, which should be considered at detailed design stage. The first scheme is at Meadowlane (near to the health centre) where NIW are closing CSO's and installing pumping stations. The second is at Annagh, in the area of the park.

The River Bann is designated as a salmonid river. Both Option 2 and 3 included hard defences in the form of walls along the banks of the River Bann. Although the method may cause some disruption to the salmonid River Bann during construction, this would be kept to a minimum.

Both Option 2 and 3 have similar impacts to recently refurbished areas in Portadown.

The cost was estimated for both Option 2 and 3. Option 2 was estimated to cost £9.80million whilst Option 3 was estimated to cost £7.85million. Therefore Option 3 offers better value for money.

4.3.1.1 Review of Options

The following section details design issues or health and safety issues that were identified during the optioneering process.

The placement of walls throughout Portadown was considered carefully so as no new problems would be created.

The industrial estate to the north of Portadown on Derrylvore Lane would have its current entrance blocked along with a warehouse and a field access to the rear of the estate. There is an opportunity to relocate this entrance to the right of the warehouse, if a section of the land could be purchased from the adjacent land owner. The field access could also be rerouted around the proposed defence as shown in Figure 4.23 below.

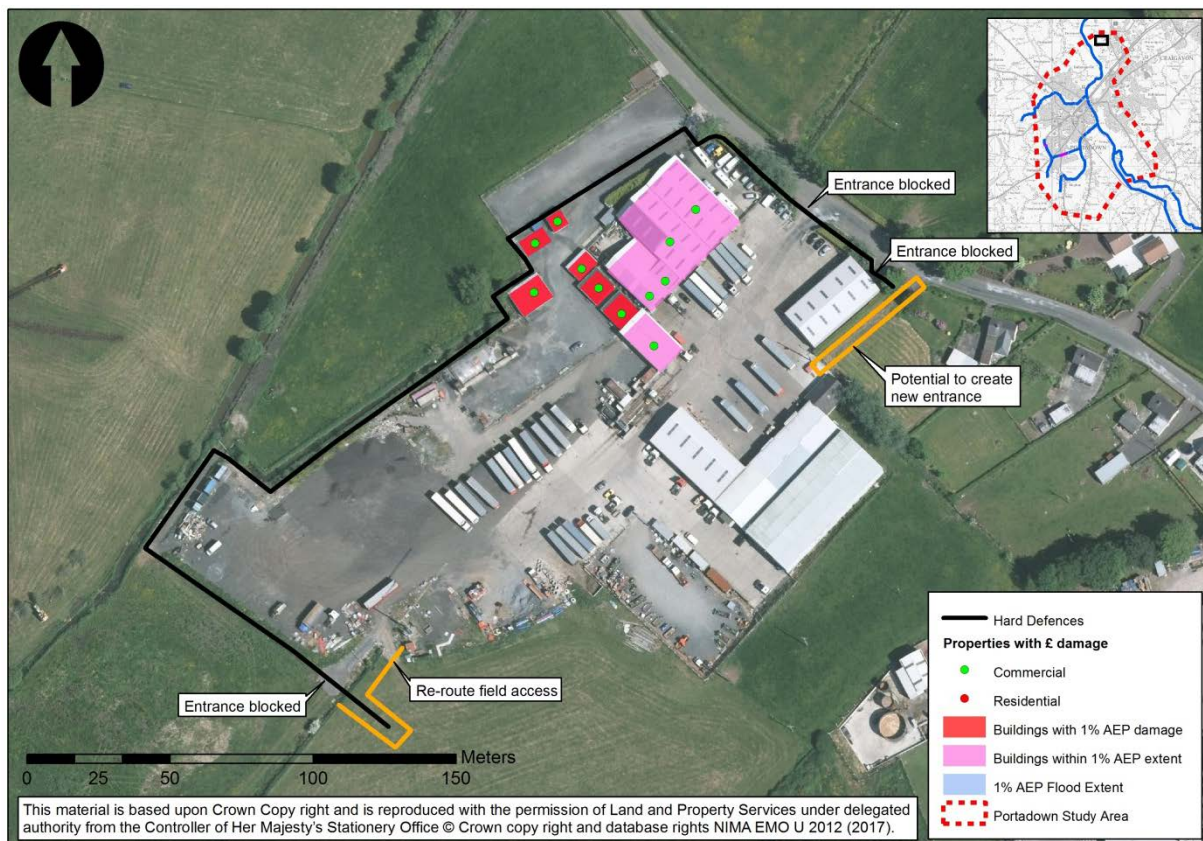


Figure 4.23 - Proposed hard defences blocking entrances

Other constraints with the proposed hard defences include the newly refurbished walkway along the River Bann in the centre of Portadown. Walls were placed as far back from the river as possible to ensure that the walkways could still be accessed, as shown in Figure 4.24 below. The Historic Pump House has also been newly refurbished and is to open as a café. The extension added to the back of the pump house features floor to ceiling glass windows overlooking the River Bann, and so Demountable Defences or Flood Resilient methods may be more suitable as a permanent hard defence may spoil the views over the river.

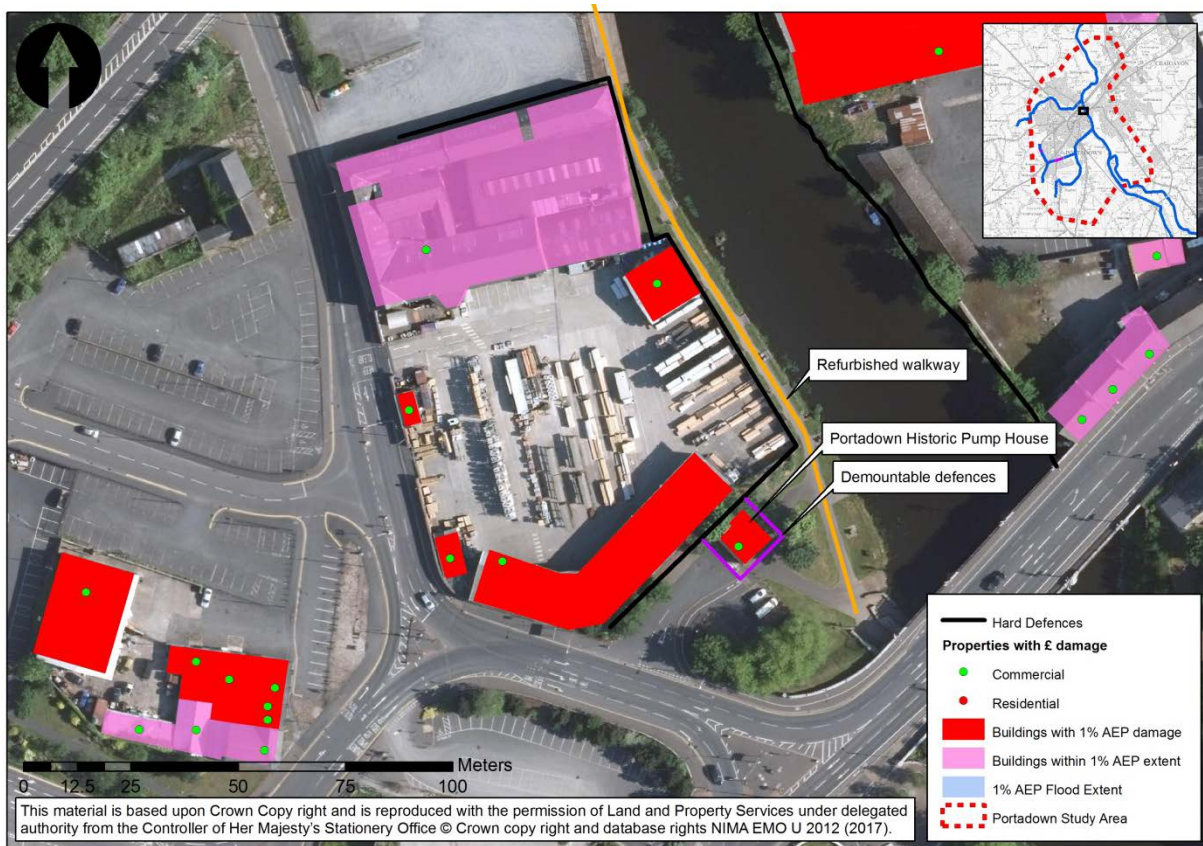


Figure 4.24 - Proposed defences at Haldane Fisher and Historic Pump House

At the People’s Park a hard defence was proposed alongside the existing path as shown in Figure 4.25. The existing wall along the park boundary has holes at its base to allow excess surface water to drain from Park Road. With the proposed hard defence in place, surface water from the road would still be able to drain onto the path in the People’s Park, however, flood waters from the other side of the defence would also be prevented from leaving the park and flooding properties on Park Road. Some alteration to a footbridge in the People’s Park will be required to allow access over the flood wall and Ballybay River.

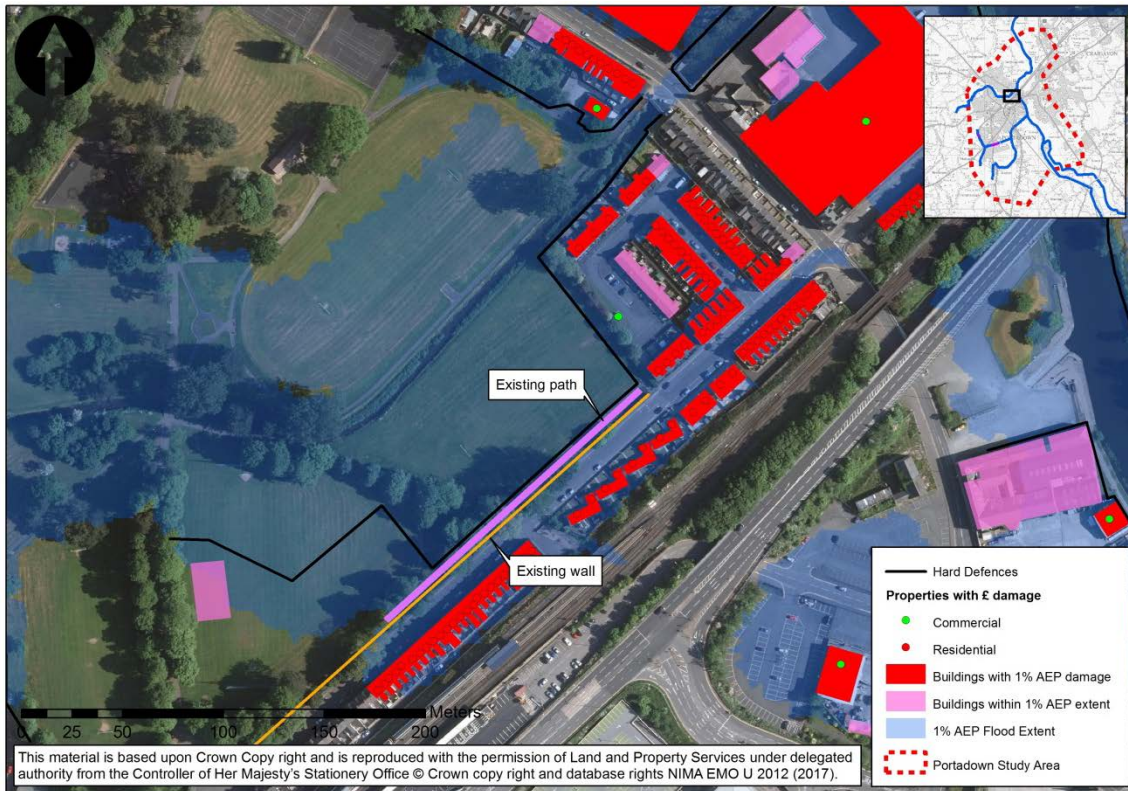


Figure 4.25 - Proposed hard defences at the People's Park, Portadown

Other issues which may be caused due to the placement of the proposed defence include the blocking of an access to agricultural land. However, the entrance may be easily diverted around the defence, as shown in Figure 4.26 below.

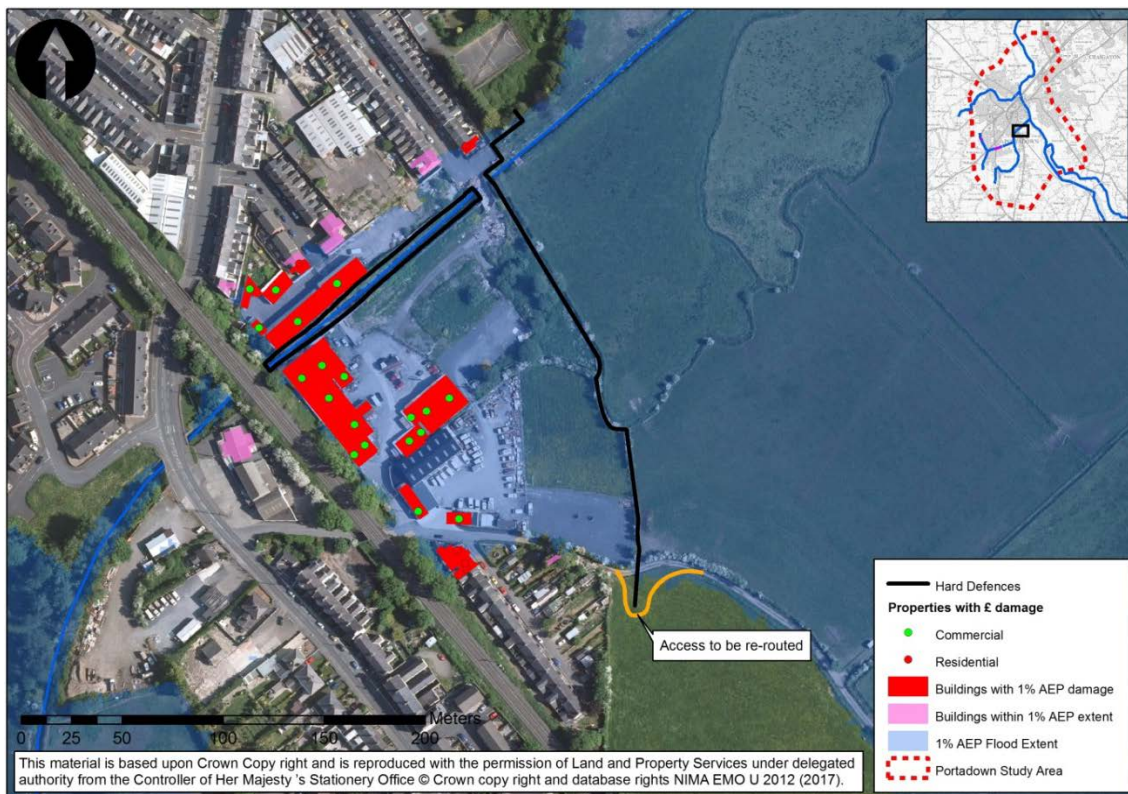


Figure 4.26 - Proposed Hard Defences at Annagh Hill

4.4 CONSIDERATION OF LAND USE MANAGEMENT

Land Use Management methods were considered the Annagh River, Kilmoriarty River and Ballybay River in Portadown.

The proposed land use management method consists of various NFM features such as vegetation strips, storage bunds, and woodland creation such as agro forestry. The implementation of some or all of these features would have a cumulative effect of reducing flood risk to Portadown. It is however difficult to quantify this reduction in flood risk through a hydraulic model and is outside the extent of this model. Given the uncertainty then associated with this method it is not appropriate to recommend it as part of the preferred option.

However, when considering climate change and the predicted increase in flood risk in the future, it has been commented, in the appraisal of options section, that both of the proposed options may need to be adapted in the future for climate change. It is therefore anticipated that the preferred option will not be able to provide the design SoP in the future (1% AEP plus climate change). As such the proposed NFM features would be an appropriate method to implement. In order to ascertain the effectiveness of these features monitoring would be required using data before and after the features have been placed. River gauges should therefore form part of the preferred option. The location of these gauges should be assessed in order to measure the effectiveness of the NFM features. It is also recommended that a long-term strategy be carried out working with the land owners to “buy in” to using their land for NFM. Other interested parties such as NIEA and available schemes such as the Environmental Farming Scheme should form part of this long-term strategy.

4.5 ECONOMIC ANALYSIS

RPS undertook a preliminary benefit-cost analysis to demonstrate the economic case for the identified options. This involved an assessment of the benefits (i.e. reducing flood impact) and the costs of the options over a 100 year design life span. This approach ensures that DfI Rivers has a robust economic argument which shows that the preferred option provides best value for money.

Full details of the Economic Appraisal can be found in the Portadown Economic Appraisal Report. Details of the option costing and damage assessment assumptions are presented in Appendix C and Appendix D. Table 4.4 below summarises the results of the Economic Appraisal.

Table 4.4 - Summary of Economic Appraisal

	Costs (£)		
	Option 1	Option 2	Option 3
Construction costs from estimates	0	6,626,147	5,296,387
Optimism Bias Adjustment	0	3,101,037	2,478,709
Maintenance Costs (NPV over 100 years)	29,813	71,251	71,251
Total Present Value Costs	29,813	9,798,435	7,846,347
	Benefits (£)		
	Option 1	Option 2	Option 3
Present Value Damage	15,290,800	0	0
Present Value Damage Avoided	0	15,290,800	15,290,800
Intangible Damage	427,709	427,709	427,709
Total Present Value Damage Avoided	0	15,718,509	15,718,509
	Benefit Cost Ratio		
	Option 1	Option 2	Option 3
Average benefit/cost ratio	-	1.60	2.00

The results from the economic appraisal indicate that both options identified are economically viable. Option 2 has a BCR of 1.6 whilst Option 3 has a BCR of 2 therefore Option 3 offers better value for money and is the recommended preferred option for the Portadown Study Area.

4.6 SHORT TERM OPTIONS

RPS also considered the potential of interim or short-term methods that could be employed to reduce the flood risk to properties, without significantly increasing the risk of flooding elsewhere in the catchment.

4.6.1 River Bann (Flood Cell 1)

The following short-term methods have been carried forward to address the flood risk arising from the River Bann:

- Temporary Defences
- Public Awareness Campaign
- Planning and Development Control
- Individual Property Protection

4.6.1.1 Assessment of Short-Term Methods for River Bann

In the short-term, Temporary Defences using sandbags would provide immediate protection to the properties highlighted earlier in the technical review of options which are affected by flooding from the River Bann. The recently refurbished Historic Pumping Station may be suitable for Individual Property Protection methods, however as the water depths are around 0.6m it is unknown how effective this type of protection would be. IPP methods also depend on persons implementing this protection and so may not be reliable. A Public Awareness Campaign would not provide any formal protection to the areas at risk from out of bank flooding from the River Bann; however it would help residents take informed actions to protect their own properties. Planning and Development Control is a method which should be considered to ensure no further properties are constructed within the floodplain in Portadown. As such this method will not alleviate flood risk to those receptors already identified as at risk within the 1% AEP event. These methods would be relatively inexpensive to complete and would not have any adverse impacts.

4.6.2 Annagh River, Kilmoriarty River and Ballybay River (Flood Cells 2 & 3)

The following short-term methods have been carried forward to address the flood risk arising from the Annagh River, Kilmoriarty River and Ballybay River:

- Temporary Defences
- Public Awareness Campaign
- Planning and Development Control

4.6.2.1 Assessment of Short-Term Methods for Annagh River, Kilmoriarty River and Ballybay River

In the short-term, the Temporary Defences method would provide a 'quick-win' through the use of sandbags around properties in Flood Cell 3. These methods may be implemented quickly to provide immediate protection to properties at risk of flooding in the Orchard Drive area. The water depths here during a 1% AEP event do not exceed around 12cm and so protection could be provided to the required SoP. Implementation of these methods may create a small negative impact to residents, but

only throughout the duration of flooding. A Public Awareness Campaign would help to inform residents so that they may take informed actions to protect their own properties. Planning and Development Control is a method which should be considered to ensure no further properties are constructed within the floodplain in Portadown. As such this method will not alleviate flood risk to those receptors already identified as at risk within the 1% AEP event.

4.6.3 Short-Term Options

From review of the methods appropriate for each flood mechanism, a preferred option was developed for short-term alleviation of flood risk.

Option 1:

- Temporary Defences
- Public Awareness Campaign
- Planning and Development Control
- Individual Property Protection

One preferred option was identified for the short-term alleviation of flood risk in Portadown. A combination of Temporary Defences and Individual Property Protection were considered the best method to protect properties at risk of flooding to depths less than 0.6m. No interim methods were identified to protect properties which were identified as at risk of flooding to depths greater than 0.6m. Public Awareness Campaigns and Planning & Development Control were also deemed to be suitable methods for reducing flood risk in the short-term in Portadown.

5 RECOMMENDATIONS AND CONCLUSIONS

The option appraisal showed that both options would achieve the primary objective of providing the design Standard of Protection. Both options would have similar impacts when considering the other objectives and constraints identified however Option 3 is considered to be better value for money. Option 3 is therefore the recommended preferred option for the Portadown Study Area.

Option 3 would provide the best cost beneficial solution. The total cost of the option was estimated to be £7.85million compared to the £9.80million estimated for Option 2. The total potential benefit was estimated at £15.72million therefore giving a cost benefit ratio of 2 for Option 3.

It is recommended that Land Use Management and NFM features be considered to provide further protection in the future. Recently there has been significant research into such methods for example the report prepared by the Research Agency of the Forestry Commission, Forest Research, titled '*Opportunity mapping for woodland creation to reduce flood risk in Northern Ireland*'. This report identified high priority areas for planting floodplain, riparian and wider catchment woodland to reduce downstream flood risk. Such methods could be implemented in the areas surrounding the River Bann to help reduce flood risk to receptors in the area. As the effectiveness of these methods will likely rely on monitoring, river gauges would be required to be installed along with the short-term or long-term options.

Subject to approval from the Department for Infrastructure Economics Branch and the Department of Finance, Option 3 could progress to detailed design, subject to competing priorities and resources.

6 REFERENCES

Pre-Feasibility Report – Portadown, Department for Infrastructure DfI Rivers, (2015)

The Northern Ireland Guide to Expenditure Appraisal and Evaluation (NIGEAE), Department of Finance (2009)

Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG), Environment Agency (2010)

Preliminary Flood Risk Assessment & Methodology for the Identification of Significant Flood Risk Area, Rivers Agency (2011)

Flood and Coastal Erosion Risk Management - A Manual for Economic Appraisal, Flood Hazard, Research Centre, Middlesex University (2013). Often referred to as the Multi Coloured Manual (MCM).

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Supplementary Green Book Guidance on the treatment of optimism bias, HM Treasury (2002)

Opportunity mapping for woodland creation to reduce flood risk in Northern Ireland, Forest Research (The Research Agency of the Forestry Commission) (2017)

Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland, Defra (2016)

APPENDIX A

CLASSIFICATION OF PROPERTIES AND DEPTHS OF FLOODING

FID	Use	MCM CODE	SA2011	Property Type	GL	Steps	Raised	FFL	AREA	Q100_Dp	Q75_Dp	Q50_Dp	Q25_Dp	Q10_Dp	Q5_Dp	Q2_Dp
0	C	4	N00002197	Warehouse	15.12	0	0	15.12	89.02	-0.24	-999	-999	-999	-999	-999	-999
1	C	4	N00002197	Warehouse	15.19	0	0	15.19	80.78	-0.31	-0.39	-999	-999	-999	-999	-999
2	C	4	N00002197	Warehouse	15.13	0	0	15.13	617.72	-0.25	-0.33	-0.45	-999	-999	-999	-999
3	C	4	N00002197	Warehouse	15.78	0	0	15.78	446.4	-0.9	-0.98	-1.1	-999	-999	-999	-999
4	C	4	N00002197	Warehouse	15.98	0	0	15.98	192.04	-1.1	-1.18	-1.3	-1.45	-1.69	-1.87	-2.17
5	C	4	N00002233	Warehouse	14.5	0	0	14.5	111.28	0.67	0.6	0.5	0.32	0.05	-0.14	-999
6	C	8	N00002233	Industry (Factory/Works/Mill)	15.08	0	0	15.08	2855.62	0.07	0	-0.1	-0.27	-999	-999	-999
7	C	8	N00002233	Industry (Factory/Works/Mill)	15.06	0	0	15.06	6361.83	0.12	0.04	-0.06	-0.23	-0.51	-999	-999
8	C	8	N00002233	Industry (Factory/Works/Mill)	14.9	0	0	14.9	1369.61	0.25	0.18	0.08	-0.09	-999	-999	-999
9	C	4	N00002233	Warehouse	14.97	0	0	14.97	43.04	0.18	0.11	0.01	-999	-999	-999	-999
10	C	8	N00002233	Industry (Factory/Works/Mill)	14.75	0	0	14.75	5950.39	0.41	0.34	0.24	0.06	-0.21	-0.4	-0.68
11	C	8	N00002233	Industry (Factory/Works/Mill)	14.91	0	0	14.91	11780.42	0.27	0.2	0.09	-0.09	-0.36	-0.55	-0.83
12	C	4	N00002233	Warehouse	14.12	0	0	14.12	45.45	1.05	0.98	0.87	0.7	0.43	-999	-999
13	C	4	N00002233	Warehouse	13.96	0	0	13.96	44	1.21	1.14	1.03	0.86	0.59	-999	-999
14	C	8	N00002291	Industry (Factory/Works/Mill)	15.01	0	0	15.01	12095.81	0.56	0.47	0.23	0.01	-0.3	-0.5	-999
15	C	2	N00002307	Retail	0	0	0	14.91	500.66	-0.09	-0.16	-0.26	-0.4	-0.62	-0.78	-999
16	C	2	N00002307	Retail	0	0	0	14.9	202.58	-0.07	-0.14	-999	-999	-999	-999	-999
17	C	3	N00002307	Offices	14.63	0	0	14.63	80.62	0.2	0.13	0.03	-0.11	-999	-999	-999
18	C	3	N00002307	Offices	14.43	0	0	14.43	76.71	0.4	0.33	0.23	0.09	-0.13	-999	-999
19	C	3	N00002307	Offices	14.22	0	0	14.22	53.03	0.61	0.54	0.44	0.29	0.08	-0.08	-999
20	C	3	N00002307	Offices	14.33	0	0	14.33	117.13	0.5	0.43	0.33	0.19	-0.03	-0.19	-0.44
21	C	3	N00002307	Offices	14.25	0	0	14.25	59.23	0.58	0.51	0.41	0.27	0.05	-0.11	-0.36
22	C	3	N00002307	Offices	14.1	0	0	14.1	33.32	0.72	0.65	0.55	0.41	0.2	0.03	-999
23	R	145	N00002197	1975 - 1985 Bungalow	0	0	0.3	15.73	140.93	-0.85	-0.93	-999	-999	-999	-999	-999
24	R	145	N00002197	1975 - 1985 Bungalow	14.77	2	0.3	15.07	152.66	-0.19	-0.27	-0.39	-0.54	-999	-999	-999
25	R	145	N00002197	1975 - 1985 Bungalow	0	0	0.3	15.73	107.31	-0.85	-0.93	-1.05	-999	-999	-999	-999
26	R	148	N00002197	Post - 1985 Bungalow	0	0	0.3	16.2	165.99	-1.32	-999	-999	-999	-999	-999	-999
27	C	6	N00002202	Community Centres/Halls	0	0	0	16.35	154.5	0.79	0.69	0.54	0.22	-0.21	-0.5	-999
28	C	2	N00002202	Retail (Petrol Filling Station)	0	0	0	16.55	122.65	0.57	0.47	0.32	-999	-999	-999	-999
29	C	4	N00002202	Warehouse	16.53	0	0	16.53	173.65	0.59	0.49	0.34	-999	-999	-999	-999
30	C	2	N00002202	Retail (Restaurant)	0	0	0	16.55	102.56	0.57	0.47	0.32	-999	-999	-999	-999
31	C	2	N00002202	Retail (Petrol Filling Station)	16.56	0	0	16.56	131.62	0.56	0.47	0.32	-999	-999	-999	-999
32	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.69	50.58	0.41	0.3	0.11	-999	-999	-999	-999
33	R	145	N00002232	1975 - 1985 Bungalow	0	0	0.3	17.61	51.04	-0.51	-0.62	-999	-999	-999	-999	-999
34	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.87	48.92	0.24	0.12	-0.07	-999	-999	-999	-999
35	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.99	49.37	0.14	0.05	-999	-999	-999	-999	-999
36	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	17.79	48.57	-0.69	-999	-999	-999	-999	-999	-999
37	R	115	N00002232	1975 - 1985 Detached	0	0	0.3	17.39	57.49	-0.26	-0.35	-0.5	-0.82	-999	-999	-999
38	R	145	N00002232	1975 - 1985 Bungalow	0	0	0.3	17.09	79.46	0.04	-0.05	-0.2	-0.52	-999	-999	-999
39	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	17.63	45.38	-0.53	-999	-999	-999	-999	-999	-999
40	R	145	N00002232	1975 - 1985 Bungalow	0	0	0.3	17.21	79.43	-0.09	-0.18	-0.33	-0.66	-999	-999	-999
41	R	145	N00002232	1975 - 1985 Bungalow	0	0	0.3	16.97	80.83	0.15	0.06	-0.09	-0.42	-999	-999	-999
42	R	145	N00002232	1975 - 1985 Bungalow	0	0	0.3	17.49	55.21	-0.39	-0.5	-0.7	-999	-999	-999	-999
43	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.79	49.66	0.31	0.21	0.01	-999	-999	-999	-999
44	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	17.01	48.71	0.11	0.01	-0.21	-999	-999	-999	-999
45	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.68	47.25	0.42	0.32	0.12	-999	-999	-999	-999
46	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.73	48.59	0.37	0.27	0.07	-999	-999	-999	-999
47	R	145	N00002232	1975 - 1985 Bungalow	0	0	0.3	17.1	81.23	0.03	-0.06	-0.21	-0.55	-999	-999	-999
48	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	16.76	47.15	0.34	0.23	0.04	-999	-999	-999	-999
49	R	125	N00002232	1975 - 1985 Semi-Detached	0	0	0.3	17.67	77.13	-0.56	-0.68	-999	-999	-999	-999	-999
50	C	960	N00002202	Electricity Hereditament	16.4	0	0	16.4	19.49	0.73	0.64	0.48	0.16	-0.26	-999	-999
51	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	15.45	121.96	-0.57	-0.65	-0.77	-999	-999	-999	-999
52	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	14.8	58.92	0.08	0	-0.12	-0.28	-0.51	-999	-999
53	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	14.98	44.64	-0.1	-0.18	-0.3	-0.46	-999	-999	-999
54	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	15.74	49.82	-0.86	-0.94	-1.06	-999	-999	-999	-999
55	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	14.73	54.88	0.15	0.07	-0.05	-0.21	-999	-999	-999
56	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	15.2	44.51	-0.32	-0.4	-0.52	-0.68	-999	-999	-999
57	R	118	N00002197	Post - 1985 Detached	0	0	0.3	14.91	84.09	-0.03	-999	-999	-999	-999	-999	-999
58	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	14.68	59.05	0.2	0.12	0	-0.16	-0.39	-999	-999
59	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	14.8	61.3	0.08	0	-0.12	-0.28	-999	-999	-999
60	R	118	N00002197	Post - 1985 Detached	0	0	0.3	15.08	73.74	-0.2	-999	-999	-999	-999	-999	-999
61	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	14.63	58.82	0.25	0.17	0.05	-0.11	-0.34	-999	-999
62	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	15.05	48.27	-0.17	-0.25	-0.37	-0.53	-999	-999	-999
63	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	15.02	53.63	-0.14	-0.22	-0.34	-0.5	-0.73	-999	-999
64	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	14.85	51.43	0.03	-0.05	-0.17	-0.33	-0.56	-999	-999
65	R	118	N00002197	Post - 1985 Detached	0	0	0.3	14.98	75.01	-0.1	-0.18	-0.3	-0.46	-999	-999	-999
66	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	14.64	59.94	0.24	0.16	0.04	-0.12	-0.35	-999	-999
67	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	14.83	49.29	0.05	-0.03	-0.15	-0.31	-0.54	-999	-999
68	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	14.91	51.2	-0.03	-0.11	-0.23	-0.39	-999	-999	-999
69	R	118	N00002197	Post - 1985 Detached	0	0	0.3	15.07	92.6	-0.19	-0.27	-0.39	-0.55	-999	-999	-999
70	R	128	N00002197	Post - 1985 Semi-Detached	0	0	0.3	14.69	55.27	0.19	0.11	-0.01	-0.17	-0.4	-999	-999
71	R	118	N00002197	Post - 1985 Detached	0	0	0.3	15.14	70.37	-0.26	-0.34	-0.46	-999	-999	-999	-999
72	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	15.07	61.03	-0.19	-0.27	-0.39	-0.55	-0.78	-999	-999
73	R	125	N00002197	1975 - 1985 Semi-Detached	0	0	0.3	15.03	46.44	-0.15	-0.23	-0.35	-0.51	-999	-999	-999
74	R	115	N00002197	1975 - 1985 Detached	0	0	0.3	15.09	51.95	-0.21	-0.29	-0.41	-0.57	-0.8	-999	-999
75	R	118	N00002197	Post - 1985 Detached	0	0	0.3	14.74	71.75	0.14	0.06	-0.06	-0.22	-0.45	-999	-999
76	R	115	N00002197	1975 - 1985 Detached	0	0	0.3	14.86	51.55	0.02	-0.06	-0.18	-0.34	-0.57	-999	-999
77	C	4	N00002232	Warehouse	18.35	0	0	18.35	640.92	-1.22	-999	-999	-999	-999	-999	-999
78	C	4	N00002232	Warehouse	16.28	0	0	16.28	255.69	-0.31	-0.4	-0.54	-999	-999	-999	-999
79	C	4	N00002232	Warehouse	15.83	0	0	15.83	105.22	-0.19	-0.29	-999	-999	-999	-999	-999
80	C	8	N00002232	Industry	0	0	0	15.25	204.96	0.57	0.49	0.38	0.19	-999	-999	-999
81	C	4	N00002232	Warehouse	15.98	0	0	15.98	176.44	-0.3						

86	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.43	62.71	0.12	0.02	-999	-999	-999	-999	-999
87	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.79	44.8	-0.26	-0.36	-999	-999	-999	-999	-999
88	R	128	N00002229	Post - 1985 Semi-Detached	15.61	0	0.3	15.91	70.61	-0.28	-0.37	-999	-999	-999	-999	-999
89	R	128	N00002229	Post - 1985 Semi-Detached	15.78	0	0.3	16.08	66.36	-0.45	-0.54	-0.67	-999	-999	-999	-999
90	R	128	N00002229	Post - 1985 Semi-Detached	14.98	0	0.3	15.28	68.54	0.35	0.26	0.13	-999	-999	-999	-999
91	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.93	41.96	-0.4	-0.5	-999	-999	-999	-999	-999
92	R	118	N00002232	Post - 1985 Detached	0	0	0.3	15.88	135.34	-0.25	-0.34	-999	-999	-999	-999	-999
93	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.79	55.11	-0.26	-0.36	-999	-999	-999	-999	-999
94	R	128	N00002232	Post - 1985 Semi-Detached	0	0	0.3	15.43	68.86	0.2	0.11	-0.02	-999	-999	-999	-999
95	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.63	43.93	-0.08	-0.18	-999	-999	-999	-999	-999
96	R	128	N00002229	Post - 1985 Semi-Detached	15.63	0	0.3	15.93	68.4	-0.3	-0.39	-999	-999	-999	-999	-999
97	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.79	43.08	-0.26	-0.36	-999	-999	-999	-999	-999
98	R	135	N00002234	1975 - 1985 Terrace	15.62	0	0.3	15.92	43.65	-0.39	-999	-999	-999	-999	-999	-999
99	R	118	N00002229	Post - 1985 Detached	15.19	0	0.3	15.49	88.67	0.14	0.05	-0.08	-999	-999	-999	-999
100	R	128	N00002229	Post - 1985 Semi-Detached	15.74	0	0.3	16.04	69.3	-0.41	-999	-999	-999	-999	-999	-999
101	R	133	N00002232	1945 - 1964 Terrace	0	0	0.3	16.63	55.77	-0.83	-0.91	-999	-999	-999	-999	-999
102	R	128	N00002229	Post - 1985 Semi-Detached	0	0	0.3	16.35	73.06	-0.8	-0.89	-1.02	-999	-999	-999	-999
103	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.78	46.91	-0.25	-999	-999	-999	-999	-999	-999
104	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.9	55.35	-0.37	-0.47	-999	-999	-999	-999	-999
105	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.87	43.47	-0.34	-0.44	-999	-999	-999	-999	-999
106	R	128	N00002232	Post - 1985 Semi-Detached	0	0	0.3	15.3	69.79	0.33	0.24	0.11	-999	-999	-999	-999
107	R	133	N00002232	1945 - 1964 Terrace	0	0	0.3	16.66	67.46	-0.86	-999	-999	-999	-999	-999	-999
108	R	128	N00002229	Post - 1985 Semi-Detached	15.8	0	0.3	16.1	65.74	-0.47	-0.56	-0.69	-999	-999	-999	-999
109	R	128	N00002229	Post - 1985 Semi-Detached	15.62	0	0.3	15.92	68.38	-0.29	-999	-999	-999	-999	-999	-999
110	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.84	41.96	-0.31	-0.41	-999	-999	-999	-999	-999
111	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.63	44.09	-0.08	-0.18	-999	-999	-999	-999	-999
112	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.92	43.77	-0.39	-0.49	-999	-999	-999	-999	-999
113	R	128	N00002232	Post - 1985 Semi-Detached	15.39	0	0.3	15.69	70.26	-0.06	-0.15	-0.28	-999	-999	-999	-999
114	R	128	N00002232	Post - 1985 Semi-Detached	15.38	0	0.3	15.68	67.07	-0.05	-0.14	-0.27	-999	-999	-999	-999
115	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.87	46.62	-0.34	-999	-999	-999	-999	-999	-999
116	R	135	N00002234	1975 - 1985 Terrace	15.72	0	0.3	16.02	44.84	-0.49	-999	-999	-999	-999	-999	-999
117	R	128	N00002232	Post - 1985 Semi-Detached	0	0	0.3	15.49	72.01	0.15	0.05	-0.08	-999	-999	-999	-999
118	R	128	N00002229	Post - 1985 Semi-Detached	15.91	0	0.3	16.21	62.22	-0.58	-999	-999	-999	-999	-999	-999
119	R	128	N00002229	Post - 1985 Semi-Detached	14.95	0	0.3	15.25	68.83	0.38	0.29	0.16	-999	-999	-999	-999
120	R	128	N00002232	Post - 1985 Semi-Detached	0	0	0.3	15.58	68.59	0.06	-0.04	-0.17	-999	-999	-999	-999
121	R	118	N00002229	Post - 1985 Detached	15.71	0	0.3	16.01	97.45	-0.38	-999	-999	-999	-999	-999	-999
122	R	128	N00002232	Post - 1985 Semi-Detached	0	0	0.3	15.39	70.07	0.25	0.15	0.02	-999	-999	-999	-999
123	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.66	44.62	-0.13	-0.23	-999	-999	-999	-999	-999
124	R	128	N00002232	Post - 1985 Semi-Detached	0	0	0.3	15.52	68.02	0.12	0.02	-0.11	-999	-999	-999	-999
125	R	135	N00002234	1975 - 1985 Terrace	0	0	0.3	15.61	62.76	-0.07	-0.16	-999	-999	-999	-999	-999
126	C	3	N00002232	Offices	0	0	0	17.59	140.22	-1.77	-1.85	-999	-999	-999	-999	-999
127	C	4	N00002232	Warehouse	15.17	0	0	15.17	75.55	0.38	0.29	-999	-999	-999	-999	-999
128	C	4	N00002234	Warehouse	15.24	0	0	15.24	120.57	0.31	0.22	-999	-999	-999	-999	-999
129	C	4	N00002232	Warehouse	15.38	0	0	15.38	126.24	0.17	0.08	-999	-999	-999	-999	-999
130	C	2	N00002212	Retail (Superstore/Hypermarket)	0	0	0	15.89	1476.21	-0.31	-0.4	-0.53	-0.79	-1.12	-999	-999
131	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.9	61.94	-0.32	-0.41	-0.54	-999	-999	-999	-999
132	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.92	51.29	-0.34	-0.43	-0.56	-999	-999	-999	-999
133	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.76	43.09	-0.18	-0.27	-0.4	-999	-999	-999	-999
134	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.96	46.49	-0.38	-0.47	-999	-999	-999	-999	-999
135	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	16.15	55	-0.57	-999	-999	-999	-999	-999	-999
136	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.94	63.7	-0.36	-0.45	-0.58	-999	-999	-999	-999
137	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.79	52.89	-0.21	-0.3	-0.43	-999	-999	-999	-999
138	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.79	55.06	-0.21	-0.3	-0.43	-999	-999	-999	-999
139	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.77	48.14	-0.19	-0.28	-0.41	-999	-999	-999	-999
140	R	123	N00002212	1945 - 1964 Semi-Detached	0	0	0.3	15.91	37.69	-0.33	-0.42	-0.55	-999	-999	-999	-999
141	R	148	N00002297	Post - 1985 Bungalow	0	0	0.3	17.32	153.55	-1.74	-1.83	-999	-999	-999	-999	-999
142	C	8	N00002187	Industry (Sewage Treatment Works)	15.28	3	0.45	15.73	260.82	-0.15	-0.24	-0.37	-0.63	-999	-999	-999
143	C	2	N00002185	Retail	0	0	0	14.32	292.58	1.26	1.17	1.04	0.81	0.49	0.26	-999
144	C	2	N00002187	Retail	0	0	0	14.62	367.81	0.96	0.87	0.74	0.51	0.19	-0.04	-999
145	C	2	N00002180	Retail (Vehicle Repair Garage)	0	0	0	14.39	220.48	1.19	1.1	0.97	0.74	0.42	0.19	-999
146	C	2	N00002187	Retail	0	0	0	14.64	69.22	0.94	0.85	0.72	0.49	0.17	-999	-999
147	C	8	N00002185	Industry	0	0	0	14.53	211.79	1.05	0.96	0.83	0.6	0.28	0.05	-999
148	C	8	N00002180	Industry (Workshop)	0	0	0	14.39	218.72	1.19	1.1	0.97	0.74	0.42	0.19	-999
149	C	4	N00002180	Warehouse	14.64	0	0	14.64	32.31	0.94	0.85	0.72	0.49	0.17	-0.06	-999
150	C	2	N00002187	Retail	0	0	0	16.37	196.45	-0.8	-0.89	-1.02	-1.27	-999	-999	-999
151	R	134	N00002185	1965 - 1974 Terrace	0	0	0.3	15.85	43.04	-0.28	-0.37	-0.5	-0.75	-999	-999	-999
152	R	134	N00002180	1965 - 1974 Terrace	0	0	0.3	15.72	38.09	-0.17	-0.25	-0.39	-0.63	-999	-999	-999
153	R	133	N00002180	1945 - 1964 Terrace	0	0	0.3	15.43	89.39	0.15	0.06	-0.07	-999	-999	-999	-999
154	R	134	N00002185	1965 - 1974 Terrace	0	0	0.3	16.02	39.24	-0.45	-0.54	-999	-999	-999	-999	-999
155	R	134	N00002180	1965 - 1974 Terrace	0	0	0.3	16.54	48.75	-0.99	-999	-999	-999	-999	-999	-999
156	R	133	N00002180	1945 - 1964 Terrace	0	0	0.3	15.88	49.19	-0.3	-999	-999	-999	-999	-999	-999
157	R	154	N00002185	1965 - 1974 Flats	0	0	0.3	16.13	72.65	-0.56	-0.65	-0.78	-1.03	-999	-999	-999
158	R	154	N00002185	1965 - 1974 Flats	0	0	0.3	16.13	72.65	-0.56	-0.65	-0.78	-1.03	-999	-999	-999
159	R	133	N00002185	1945 - 1964 Terrace	15.74	0	0.3	16.04	36.88	-0.47	-999	-999	-999	-999	-999	-999
160	R	133	N00002180	1945 - 1964 Terrace	0	0	0.3	15.88	45.62	-0.3	-0.39	-0.52	-999	-999	-999	-999
161	R	134	N00002180	1965 - 1974 Terrace	0	0	0.3	16.18	48.96	-0.62	-0.71	-0.85	-999	-999	-999	-999
162	C	4	N00002180	Warehouse	14.8	0	0	14.8	22.67	0.78	0.69	0.56	0.33	0.01	-999	-999
163	C	2	N00002185	Retail	0	0	0	14.95	216.5	0.65	0.56	0.42	0.16	-0.17	-0.38	-0.72
164	C	2	N00002185	Retail	14.92	0	0	14.92	32.71	0.65	0.56	0.43	0.18	-0.14	-999	-999
165	C	960	N00002180	Electricity Hereditament	16.17	0	0	16.17	16.16	-0.59	-0.68	-999	-999	-999	-999	-999
166	C	2	N00002185	Retail	15.3	0	0	15.3	120.5	0.27	0.18	0.05	-0.2	-999	-999	-999
167	C	2	N00002185													

173	R	145	N00002220	1975 - 1985 Bungalow	0	0	0.3	15.8	78.2	-0.21	-999	-999	-999	-999	-999	-999
174	R	145	N00002220	1975 - 1985 Bungalow	0	0	0.3	15.82	75.93	-0.23	-999	-999	-999	-999	-999	-999
175	R	145	N00002220	1975 - 1985 Bungalow	0	0	0.3	15.75	74.16	-0.16	-999	-999	-999	-999	-999	-999
176	R	145	N00002220	1975 - 1985 Bungalow	0	0	0.3	15.67	84.17	-0.08	-999	-999	-999	-999	-999	-999
177	R	148	N00002214	Post - 1985 Bungalow	0	0	0.3	16.42	103.52	-0.83	-999	-999	-999	-999	-999	-999
178	R	118	N00002214	Post - 1985 Detached	0	2	0.3	16.32	85.96	-0.73	-0.82	-999	-999	-999	-999	-999
179	R	145	N00002220	1975 - 1985 Bungalow	0	0	0.3	15.85	96.03	-0.26	-999	-999	-999	-999	-999	-999
180	R	128	N00002220	Post - 1985 Semi-Detached	0	0	0.3	16.39	51.52	-0.8	-0.92	-999	-999	-999	-999	-999
181	R	128	N00002220	Post - 1985 Semi-Detached	0	0	0.3	16.46	53.72	-0.87	-999	-999	-999	-999	-999	-999
182	R	118	N00002213	Post - 1985 Detached	17.89	0	0.3	18.19	144.54	-999	-999	-999	-999	-999	-999	-999
183	C	4	N00002213	Warehouse	15.85	0	0	15.85	325.78	-0.27	-0.36	-0.49	-999	-999	-999	-999
184	C	960	N00002179	Electricity Hereditament	14.23	0	0	14.23	7.8	1.36	1.27	1.13	0.89	0.57	0.33	0.01
185	C	523	N00002181	Sports Centre	0	0	0	15.32	227.12	0.27	0.18	0.04	-0.19	-999	-999	-999
186	R	118	N00002179	Post - 1985 Detached	15.66	2	0.3	15.96	99.61	-0.37	-0.46	-0.6	-999	-999	-999	-999
187	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.2	48.23	-0.61	-0.7	-999	-999	-999	-999	-999
188	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.72	93.46	-0.14	-0.24	-999	-999	-999	-999	-999
189	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.13	48.18	-0.54	-0.63	-0.77	-999	-999	-999	-999
190	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.18	48.07	-0.59	-0.68	-999	-999	-999	-999	-999
191	R	118	N00002179	Post - 1985 Detached	15.46	2	0.3	15.76	101.55	-0.17	-0.26	-0.4	-999	-999	-999	-999
192	R	118	N00002179	Post - 1985 Detached	15.58	0	0.3	15.88	83.03	-0.29	-0.39	-999	-999	-999	-999	-999
193	R	118	N00002179	Post - 1985 Detached	15.45	2	0.3	15.75	153.56	-0.16	-0.25	-0.39	-0.64	-999	-999	-999
194	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.68	84.88	-0.1	-999	-999	-999	-999	-999	-999
195	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.5	94.62	0.08	-0.01	-999	-999	-999	-999	-999
196	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	15.98	48.38	-0.39	-0.48	-0.62	-999	-999	-999	-999
197	R	118	N00002179	Post - 1985 Detached	15.63	2	0.3	15.93	100.08	-0.34	-0.43	-0.57	-999	-999	-999	-999
198	R	112	N00002181	1919 - 1944 Detached	0	0	0.3	15.31	143.01	0.28	0.18	0.05	-0.2	-0.53	-0.75	-999
199	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.83	82.85	-0.25	-999	-999	-999	-999	-999	-999
200	R	118	N00002181	Post - 1985 Detached	0	0	0.3	15.41	101.41	0.18	0.09	-0.05	-0.28	-999	-999	-999
201	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.72	148.23	-0.13	-0.23	-999	-999	-999	-999	-999
202	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.69	79.45	-0.11	-0.2	-999	-999	-999	-999	-999
203	R	118	N00002179	Post - 1985 Detached	15.53	2	0.3	15.83	104.14	-0.24	-0.33	-0.47	-999	-999	-999	-999
204	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.05	48.35	-0.46	-0.55	-0.69	-999	-999	-999	-999
205	R	118	N00002179	Post - 1985 Detached	15.45	2	0.3	15.75	100.29	-0.16	-0.26	-999	-999	-999	-999	-999
206	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.17	48.06	-0.58	-0.67	-0.81	-999	-999	-999	-999
207	R	118	N00002181	Post - 1985 Detached	0	0	0.3	15.65	101.76	-0.06	-0.15	-0.29	-999	-999	-999	-999
208	R	118	N00002181	Post - 1985 Detached	0	0	0.3	15.55	98.27	0.04	-0.05	-0.19	-999	-999	-999	-999
209	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.6	85.23	-0.01	-0.11	-999	-999	-999	-999	-999
210	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.87	120.46	-0.29	-999	-999	-999	-999	-999	-999
211	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.23	48.11	-0.64	-0.73	-0.87	-999	-999	-999	-999
212	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.72	81.34	-0.14	-999	-999	-999	-999	-999	-999
213	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.87	81.19	-0.29	-999	-999	-999	-999	-999	-999
214	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.65	82.85	-0.07	-0.16	-999	-999	-999	-999	-999
215	R	118	N00002179	Post - 1985 Detached	15.42	2	0.3	15.72	101.49	-0.13	-0.23	-999	-999	-999	-999	-999
216	R	118	N00002181	Post - 1985 Detached	0	0	0.3	15.51	102.29	0.08	-0.01	-0.15	-999	-999	-999	-999
217	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.75	158.77	-0.16	-999	-999	-999	-999	-999	-999
218	R	118	N00002179	Post - 1985 Detached	15.65	2	0.3	15.95	115.54	-0.36	-0.45	-0.59	-999	-999	-999	-999
219	R	118	N00002179	Post - 1985 Detached	15.46	2	0.3	15.76	101.14	-0.17	-0.27	-0.4	-999	-999	-999	-999
220	R	118	N00002179	Post - 1985 Detached	15.6	2	0.3	15.9	102.64	-0.31	-0.41	-0.54	-999	-999	-999	-999
221	R	118	N00002179	Post - 1985 Detached	0	1	0.3	15.53	81.83	0.05	-0.04	-999	-999	-999	-999	-999
222	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.85	77.82	-0.26	-999	-999	-999	-999	-999	-999
223	R	118	N00002179	Post - 1985 Detached	15.46	3	0.45	15.91	135.29	-0.32	-0.42	-0.55	-999	-999	-999	-999
224	R	118	N00002179	Post - 1985 Detached	15.29	3	0.45	15.74	98.36	-0.15	-0.25	-0.38	-0.64	-999	-999	-999
225	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.19	48.16	-0.6	-999	-999	-999	-999	-999	-999
226	R	118	N00002179	Post - 1985 Detached	15.54	2	0.3	15.84	96.52	-0.25	-0.34	-0.48	-999	-999	-999	-999
227	R	118	N00002179	Post - 1985 Detached	15.55	2	0.3	15.85	103.56	-0.26	-0.36	-999	-999	-999	-999	-999
228	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	16.14	48.16	-0.55	-0.64	-0.78	-999	-999	-999	-999
229	R	118	N00002179	Post - 1985 Detached	15.57	2	0.3	15.87	98.49	-0.28	-0.38	-999	-999	-999	-999	-999
230	R	118	N00002181	Post - 1985 Detached	0	0	0.3	15.5	102.33	0.09	0	-0.14	-999	-999	-999	-999
231	R	118	N00002179	Post - 1985 Detached	15.44	3	0.45	15.89	108.12	-0.3	-0.4	-0.53	-999	-999	-999	-999
232	R	118	N00002179	Post - 1985 Detached	0	0	0.3	15.53	93.46	0.05	-999	-999	-999	-999	-999	-999
233	R	138	N00002179	Post - 1985 Terrace	0	0	0.3	15.98	48.64	-0.39	-0.48	-999	-999	-999	-999	-999
234	C	525	N00002179	Sports Stadium	14.44	0	0	14.44	7.44	1.15	1.06	0.92	0.7	0.37	0.12	-0.2
235	C	525	N00002179	Sports Stadium	14.5	0	0	14.5	22.05	1.09	1	0.86	0.64	0.31	0.06	-0.26
236	C	525	N00002179	Sports Stadium	15.11	0	0	15.11	62.29	0.48	0.39	0.25	-999	-999	-999	-999
237	C	525	N00002181	Sports Stadium	15.38	0	0	15.38	56.32	0.21	0.12	-0.02	-999	-999	-999	-999
238	C	525	N00002179	Sports Stadium	14.35	0	0	14.35	7.71	1.24	1.15	1.01	0.79	0.46	0.21	-0.11
239	R	118	N00002181	Post - 1985 Detached	0	2	0.3	17.2	117.59	-1.62	-1.71	-999	-999	-999	-999	-999
240	R	118	N00002181	Post - 1985 Detached	0	2	0.3	16.41	72.66	-0.83	-999	-999	-999	-999	-999	-999
241	C	960	N00002234	Electricity Hereditament	15.08	0	0	15.08	7.13	0.39	0.28	0.13	-0.1	-999	-999	-999
242	C	3	N00002233	Offices	15.27	0	0	15.27	537.25	-0.09	-0.17	-0.27	-0.45	-999	-999	-999
243	C	3	N00002233	Offices	15.29	0	0	15.29	220.7	-0.12	-0.19	-999	-999	-999	-999	-999
244	C	4	N00002183	Warehouse	15.24	0	0	15.24	94.54	-0.06	-999	-999	-999	-999	-999	-999
245	C	2	N00002291	Retail (Restaurant)	0	0	0	18.75	172.77	-3.43	-3.5	-3.62	-3.82	-999	-999	-999
246	C	2	N00002183	Retail	0	0	0	15.75	2384.64	-0.43	-0.51	-0.63	-0.85	-1.13	-1.33	-999
247	C	2	N00002183	Retail	14.49	0	0	14.49	171.65	0.83	0.75	0.64	0.42	0.13	-999	-999
248	C	4	N00002291	Warehouse	14.2	0	0	14.2	981.04	1.09	1.01	0.9	0.71	0.42	0.23	-0.07
249	C	3	N00002183	Offices	15.21	0	0	15.21	28.87	0.11	0.03	-0.08	-999	-999	-999	-999
250	C	2	N00002291	Retail	0	0	0	17.41	193.79	-2.09	-999	-999	-999	-999	-999	-999
251	C	4	N00002183	Warehouse	14.82	0	0	14.82	53.85	0.5	0.42	0.31	-999	-999	-999	-999
252	C	8	N00002183	Industry	15.19	0	0	15.19	844.3	0.14	0.06	-0.05	-0.25	-999	-999	-999
253	C	2	N00002183	Retail	0	0	0	14.73	427.98	0.45	-999	-999	-999	-999	-999	-999
254	C	2	N00002183	Retail (Vehicle Repair Garage)	15.21	0	0	15.21	128.66	-0.03	-999	-999	-999	-999	-999	-999
255	C	3	N00002291	Offices	0	0	0	18.68	50.							

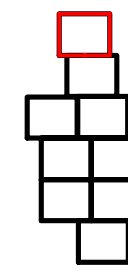
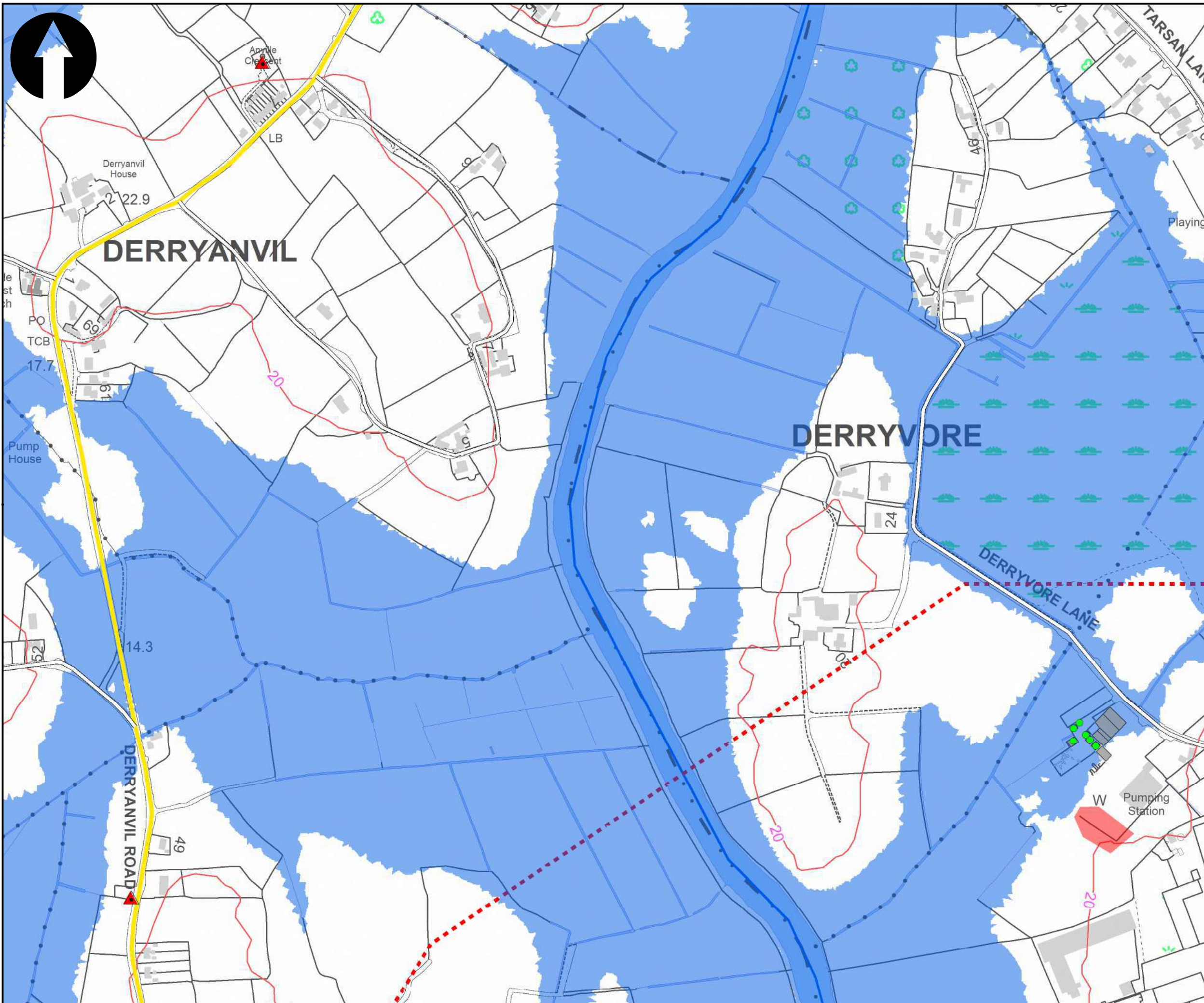
260	C	8	N00002291	Industry (Workshop)	0	0	0	16.53	76.74	-1.21	-1.29	-1.4	-1.6	-999	-999	-999
261	C	2	N00002183	Retail	0	0	0	15.54	103.34	-0.36	-999	-999	-999	-999	-999	-999
262	C	2	N00002183	Retail (Vehicle Repair Garage)	0	0	0	14.68	117.68	0.5	-999	-999	-999	-999	-999	-999
263	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.56	44.56	-0.25	-0.35	-999	-999	-999	-999	-999
264	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.59	45.19	-0.28	-0.38	-999	-999	-999	-999	-999
265	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.42	63.28	0.05	-999	-999	-999	-999	-999	-999
266	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.6	56.1	-0.13	-999	-999	-999	-999	-999	-999
267	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.63	36.99	-0.16	-999	-999	-999	-999	-999	-999
268	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.94	44.87	0.53	0.43	0.27	0.04	-999	-999	-999
269	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.12	59.5	0.35	0.25	0.09	-999	-999	-999	-999
270	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.57	56.14	-0.1	-999	-999	-999	-999	-999	-999
271	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.79	78.31	-0.32	-0.43	-0.58	-999	-999	-999	-999
272	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.8	49.67	-0.49	-999	-999	-999	-999	-999	-999
273	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	14.73	50.44	0.74	0.63	0.48	0.25	-0.17	-999	-999
274	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.3	25.66	-0.12	-0.2	-999	-999	-999	-999	-999
275	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.31	45.41	0.16	0.06	-0.1	-999	-999	-999	-999
276	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.9	69.16	0.57	0.47	0.31	0.08	-0.2	-999	-999
277	R	135	N00002233	1975 - 1985 Terrace	0	1	0.3	15.55	50.62	-0.08	-0.19	-999	-999	-999	-999	-999
278	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	16	80.45	-0.53	-0.64	-999	-999	-999	-999	-999
279	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.53	50.62	-0.06	-0.17	-999	-999	-999	-999	-999
280	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.34	45.01	0.13	0.03	-999	-999	-999	-999	-999
281	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.56	41.13	-0.1	-999	-999	-999	-999	-999	-999
282	R	135	N00002233	1975 - 1985 Terrace	0	1	0.3	15.62	47.97	-0.15	-0.26	-0.41	-999	-999	-999	-999
283	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.63	75.68	-0.17	-0.27	-0.46	-999	-999	-999	-999
284	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	15.67	77.5	-0.2	-0.31	-0.46	-999	-999	-999	-999
285	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.25	75.06	0.22	0.11	-0.04	-0.34	-0.6	-0.79	-999
286	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.55	43.39	-0.08	-0.19	-999	-999	-999	-999	-999
287	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.24	29.2	-0.06	-0.14	-999	-999	-999	-999	-999
288	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	16.12	62.39	-0.65	-999	-999	-999	-999	-999	-999
289	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.24	44.93	0.23	0.13	-0.03	-999	-999	-999	-999
290	R	135	N00002233	1975 - 1985 Terrace	0	1	0.3	15.64	48.88	-0.17	-0.28	-0.43	-0.66	-999	-999	-999
291	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	15.63	76.23	-0.16	-0.27	-0.42	-999	-999	-999	-999
292	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.57	54.63	-0.1	-999	-999	-999	-999	-999	-999
293	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.53	58.65	-0.06	-999	-999	-999	-999	-999	-999
294	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.16	32.7	0.02	-0.06	-0.16	-999	-999	-999	-999
295	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.57	41.65	-0.26	-0.36	-999	-999	-999	-999	-999
296	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.64	45.41	-0.17	-999	-999	-999	-999	-999	-999
297	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.53	44.09	-0.06	-999	-999	-999	-999	-999	-999
298	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.55	45.58	-0.08	-999	-999	-999	-999	-999	-999
299	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	14.92	48.93	0.55	0.44	0.29	0.06	-999	-999	-999
300	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.43	41.06	0.04	-999	-999	-999	-999	-999	-999
301	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.4	52.72	0.07	-0.04	-999	-999	-999	-999	-999
302	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.59	73.55	-0.13	-0.39	-0.52	-999	-999	-999	-999
303	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.44	41.77	0.03	-999	-999	-999	-999	-999	-999
304	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.55	47.08	-0.08	-999	-999	-999	-999	-999	-999
305	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.45	39.28	0.02	-999	-999	-999	-999	-999	-999
306	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.62	46.67	-0.15	-999	-999	-999	-999	-999	-999
307	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.49	40.9	-0.02	-999	-999	-999	-999	-999	-999
308	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.54	41	-0.07	-999	-999	-999	-999	-999	-999
309	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.4	51.15	0.07	-0.04	-999	-999	-999	-999	-999
310	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.48	52.55	-0.17	-0.27	-999	-999	-999	-999	-999
311	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.51	47.91	-0.04	-0.15	-999	-999	-999	-999	-999
312	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.62	43.31	-0.15	-999	-999	-999	-999	-999	-999
313	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.47	50.54	-0.16	-0.26	-999	-999	-999	-999	-999
314	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.54	52.7	-0.07	-999	-999	-999	-999	-999	-999
315	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.46	51.09	0.01	-0.1	-0.25	-999	-999	-999	-999
316	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.53	45.13	-0.06	-0.17	-999	-999	-999	-999	-999
317	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.91	40.03	0.56	0.46	0.3	0.07	-999	-999	-999
318	R	138	N00002233	Post - 1985 Terrace	0	0	0.3	15.33	99.23	-0.02	-0.12	-0.26	-0.48	-999	-999	-999
319	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.26	26.6	-0.08	-999	-999	-999	-999	-999	-999
320	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.5	59.32	-0.03	-999	-999	-999	-999	-999	-999
321	R	138	N00002233	Post - 1985 Terrace	0	0	0.3	15.45	43.94	-0.14	-0.24	-0.38	-999	-999	-999	-999
322	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	15.7	80.75	-0.23	-0.34	-0.49	-0.72	-999	-999	-999
323	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.98	44.34	0.49	0.39	0.23	0	-999	-999	-999
324	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.55	51.42	-0.08	-999	-999	-999	-999	-999	-999
325	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.93	47.92	0.54	0.44	0.28	0.05	-0.23	-999	-999
326	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	14.64	54.24	0.83	0.72	0.57	0.34	-0.07	-999	-999
327	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.53	41.97	-0.06	-0.17	-999	-999	-999	-999	-999
328	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.28	26.05	-0.1	-999	-999	-999	-999	-999	-999
329	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.66	28.35	-0.19	-999	-999	-999	-999	-999	-999
330	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.56	37.98	-0.09	-999	-999	-999	-999	-999	-999
331	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	15.14	47.83	0.33	0.22	0.07	-0.16	-999	-999	-999
332	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.51	49.23	-0.05	-999	-999	-999	-999	-999	-999
333	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.57	50.14	-0.11	-999	-999	-999	-999	-999	-999
334	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.76	45.38	-0.29	-999	-999	-999	-999	-999	-999
335	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.42	45.49	0.05	-0.05	-999	-999	-999	-999	-999
336	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.65	36.66	-0.18	-999	-999	-999	-999	-999	-999
337	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.22	32.49	-0.04	-0.12	-0.22	-999	-999	-999	-999
338	R	135	N00002233	1975 - 1985 Terrace	0	1	0.3	15.62	48.68	-0.15	-0.26	-0.41	-999	-999	-999	-999
339	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.48	67.12	-0.01	-0.11	-0.27	-999	-999	-999	-999
340	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.54	37.27	-0.07	-999	-999	-999	-999	-999	-999
341																

347	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.87	57.8	0.6	0.5	0.34	0.11	-999	-999	-999
348	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.7	46.23	-0.23	-0.34	-999	-999	-999	-999	-999
349	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.52	45.68	-0.05	-999	-999	-999	-999	-999	-999
350	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.64	37.55	-0.33	-999	-999	-999	-999	-999	-999
351	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	14.66	55.3	0.81	0.7	0.55	0.32	-0.1	-999	-999
352	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.21	73.66	0.26	0.15	0	-0.31	-0.56	-999	-999
353	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	14.92	57.46	0.55	0.45	0.29	0.06	-999	-999	-999
354	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.52	46.62	-0.05	-999	-999	-999	-999	-999	-999
355	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.45	42.93	0.02	-0.09	-999	-999	-999	-999	-999
356	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.38	45.11	0.09	-0.01	-0.17	-999	-999	-999	-999
357	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.46	55.52	0.01	-0.09	-0.25	-999	-999	-999	-999
358	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.49	35.32	-0.02	-999	-999	-999	-999	-999	-999
359	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.5	42.15	-0.19	-0.29	-999	-999	-999	-999	-999
360	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.75	56.17	-0.44	-0.54	-999	-999	-999	-999	-999
361	R	138	N00002233	Post - 1985 Terrace	0	0	0.3	15.4	43.31	-0.09	-0.19	-0.33	-999	-999	-999	-999
362	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	14.79	50.7	0.68	0.57	0.42	0.19	-0.23	-999	-999
363	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.6	59.82	-0.13	-999	-999	-999	-999	-999	-999
364	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.2	74.75	0.27	0.16	0.01	-0.22	-0.5	-0.71	-1
365	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.35	43.36	0.12	0.02	-999	-999	-999	-999	-999
366	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.48	41.02	-0.17	-0.27	-999	-999	-999	-999	-999
367	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.41	50.7	0.06	-0.05	-999	-999	-999	-999	-999
368	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.27	33.64	-0.09	-0.17	-0.27	-999	-999	-999	-999
369	R	133	N00002234	1945 - 1964 Terrace	0	0	0.3	15.06	43.99	0.41	0.31	0.15	-0.08	-999	-999	-999
370	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.62	50.06	-0.15	-999	-999	-999	-999	-999	-999
371	R	144	N00002234	1965 - 1974 Bungalow	0	0	0.3	15.82	78.33	-0.35	-0.46	-0.61	-999	-999	-999	-999
372	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.45	46.33	0.02	-999	-999	-999	-999	-999	-999
373	R	134	N00002233	1965 - 1974 Terrace	0	0	0.3	15.46	55.01	0.01	-999	-999	-999	-999	-999	-999
374	R	138	N00002233	Post - 1985 Terrace	0	0	0.3	15.47	46.5	-0.16	-0.26	-0.4	-999	-999	-999	-999
375	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	15.01	52.22	0.46	0.35	0.2	-0.03	-999	-999	-999
376	R	144	N00002233	1965 - 1974 Bungalow	0	0	0.3	14.89	54.62	0.58	0.47	0.32	0.09	-999	-999	-999
377	C	4	N00002183	Warehouse	14.86	0	0	14.86	37.56	0.47	0.39	0.28	0.08	-999	-999	-999
378	C	4	N00002183	Warehouse	0	0	0	15.43	65.55	0.04	-0.04	-0.17	-0.4	-999	-999	-999
379	C	4	N00002183	Warehouse	13.09	0	0	13.09	102.9	2.38	2.3	2.17	1.94	-999	-999	-999
380	C	960	N00002183	Electricity Hereditament	15.03	0	0	15.03	5.53	0.44	0.36	0.23	0	-999	-999	-999
381	C	523	N00002183	Sports Centre	0	0	0	15.18	254.1	0.29	0.2	0.08	-0.15	-0.47	-0.67	-999
382	C	2	N00002183	Retail (High Street) Shop	0	0	0	15.21	151.53	0.26	0.18	0.05	-0.18	-999	-999	-999
383	C	2	N00002183	Retail	0	0	0	15.82	1070.25	-0.35	-0.43	-0.56	-0.79	-1.11	-999	-999
384	C	2	N00002183	Retail	0	0	0	15.66	164.6	-0.19	-0.28	-999	-999	-999	-999	-999
385	C	2	N00002183	Retail (Vehicle Repair Garage)	0	0	0	16.1	469.33	-0.63	-0.71	-0.84	-999	-999	-999	-999
386	C	2	N00002183	Retail (Restaurant)	0	0	0	15.36	52.14	0.11	0.03	-0.1	-999	-999	-999	-999
387	C	3	N00002183	Offices	15.49	0	0	15.49	15.02	-0.02	-0.1	-999	-999	-999	-999	-999
388	C	2	N00002183	Retail	0	0	0	15.25	219.74	0.22	0.13	0.01	-0.22	-999	-999	-999
389	C	3	N00002183	Offices (Bank)	0	0	0	15.33	182.19	0.14	0.06	-0.07	-0.3	-999	-999	-999
390	C	6	N00002183	Community Centres/Halls	0	0	0	17.3	241.79	-1.83	-1.92	-2.04	-999	-999	-999	-999
391	C	2	N00002183	Retail (Cafe/Food Court)	0	0	0	17.06	241.79	-1.59	-1.68	-1.8	-999	-999	-999	-999
392	C	2	N00002183	Retail (Betting Shop)	0	0	0	17.32	241.79	-1.85	-1.94	-2.06	-999	-999	-999	-999
393	C	2	N00002183	Retail (Restaurant)	0	0	0	15.98	264.24	-0.51	-0.59	-999	-999	-999	-999	-999
394	C	4	N00002183	Warehouse	15	0	0	15	87.1	0.47	0.39	0.26	0.03	-0.29	-0.49	-999
395	C	4	N00002183	Warehouse	0	0	0	15.05	69.11	0.42	0.34	0.21	-0.02	-999	-999	-999
396	C	8	N00002291	Industry (Factory/Works/Mill)	15.6	0	0	15.6	500.03	-0.04	-999	-999	-999	-999	-999	-999
397	C	2	N00002183	Retail (Superstore/Hypermarket)	0	0	0	16.13	13849.09	-0.65	-0.73	-0.86	-1.09	-999	-999	-999
398	C	523	N00002180	Sports Centre	0	0	0	15.21	364.09	0.31	0.22	0.09	-0.13	-0.49	-999	-999
399	C	8	N00002291	Industry (Factory/Works/Mill)	16.17	0	0	16.17	456.08	-0.6	-999	-999	-999	-999	-999	-999
400	C	523	N00002180	Sports Centre	14.86	0	0	14.86	204.3	0.66	0.58	0.45	0.22	-0.09	-999	-999
401	C	960	N00002212	Electricity Hereditament	15.61	0	0	15.61	5.99	-0.03	-0.12	-999	-999	-999	-999	-999
402	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.5	68.82	0.08	-0.01	-0.14	-999	-999	-999	-999
403	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.06	61.53	0.52	0.43	0.3	0.04	-999	-999	-999
404	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.98	53.92	-0.4	-999	-999	-999	-999	-999	-999
405	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.2	51.92	0.38	0.29	0.16	-0.1	-999	-999	-999
406	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.95	54.72	-0.37	-0.46	-0.59	-999	-999	-999	-999
407	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.14	100.64	-0.56	-0.65	-0.78	-999	-999	-999	-999
408	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.1	51.89	0.48	0.39	0.26	0	-0.33	-999	-999
409	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.21	50.58	0.37	0.28	0.15	-0.11	-999	-999	-999
410	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.46	53.72	0.12	0.03	-0.1	-0.36	-999	-999	-999
411	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.34	65.55	-0.76	-0.85	-0.98	-999	-999	-999	-999
412	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.1	52.11	0.48	0.39	0.26	0	-999	-999	-999
413	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.33	98.62	-0.75	-0.84	-0.97	-999	-999	-999	-999
414	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.24	98.91	-0.66	-0.75	-0.88	-999	-999	-999	-999
415	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.79	53.5	-0.21	-0.3	-0.43	-999	-999	-999	-999
416	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.2	101.56	-0.62	-0.71	-0.84	-999	-999	-999	-999
417	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	15.98	99.59	-0.4	-0.49	-0.62	-999	-999	-999	-999
418	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.41	66.16	-0.83	-0.92	-1.05	-999	-999	-999	-999
419	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.08	49.92	0.5	0.41	0.28	0.02	-999	-999	-999
420	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	15.96	100.77	-0.38	-0.47	-999	-999	-999	-999	-999
421	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.02	112.63	-0.44	-0.53	-999	-999	-999	-999	-999
422	R	128	N00002212	Post - 1985 Semi-Detached	0	0	0.3	15.91	51.5	-0.33	-0.42	-999	-999	-999	-999	-999
423	R	148	N00002212	Post - 1985 Bungalow	0	0	0.3	16.04	101.07	-0.46	-0.55	-0.68	-999	-999	-999	-999
424	C	4	N00002182	Warehouse	15.49	0	0	15.49	1546.26	0.1	0.01	-0.12	-0.35	-0.68	-999	-999
425	C	3	N00002183	Offices	0	0	0	15.06	133.91	0.41	0.33	0.2	-0.03	-999	-999	-999
426	C	4	N00002183	Warehouse	0	0	0	14.82	129.79	0.65	0.57	0.44	0.21	-0.11	-0.31	-999
427	C	2	N00002183	Retail	0	0	0	14.86	39.87	0.32	-999	-999	-999	-999	-999	-999
428	C	4	N00002291	Warehouse	0	0	0	15.04	274.82	0.28	0.2	0.09	-0.11	-999	-999	-999
429	C	4	N00002291	Warehouse	14.75	0	0	14.75	372.5</							

434	C	2	N00002307	Retail	0	0	0	14.94	427.42	-0.12	-0.19	-0.29	-0.43	-0.65	-0.81	-999
435	C	2	N00002307	Retail	0	0	0	14.95	112.86	-0.13	-0.2	-0.3	-0.44	-0.66	-999	-999
436	C	2	N00002307	Retail	0	0	0	14.95	203.25	-0.12	-0.19	-0.29	-0.44	-0.65	-999	-999
437	C	2	N00002185	Retail	0	0	0	14.32	543.78	1.26	1.17	1.04	0.81	0.49	0.26	-999
438	C	2	N00002185	Retail	0	0	0	14.32	196.93	1.26	1.17	1.04	0.81	0.49	0.26	-0.09
439	C	2	N00002187	Retail	0	0	0	14.64	47.33	0.94	0.85	0.72	0.49	0.17	-999	-999
440	C	4	N00002182	Warehouse	14.49	0	0	14.49	1681.84	1.1	1.01	0.88	0.65	0.32	0.04	-999
441	C	4	N00002197	Warehouse	14.71	0	0	14.71	835.06	0.17	0.09	-0.03	-0.19	-999	-999	-999
442	C	6	N00002180	Health Centre	14.02	5	0.75	14.77	2609	0.76	0.67	0.54	0.32	0	-0.21	-0.54
443	C	910	N00002180	Car Park	13.45	0	0	13.45	2609	2.08	1.99	1.86	1.64	1.32	1.11	0.78
444	R	128	N00002220	Post - 1985 Semi-Detached	0	0	0	16.14	61.96	-0.55	-0.64	-0.77	-1.03	-1.36	-1.57	-1.9
445	R	128	N00002220	Post - 1985 Semi-Detached	0	0	0	16.1	64.41	-0.51	-0.6	-0.73	-0.99	-1.32	-1.53	-1.86
446	R	118	N00002219	Post-1985 Detached	0	0	0	16.99	92.32	-1.4	-1.49	-1.62	-1.88	-2.21	-2.42	-2.74
447	R	123	N00002212	1945 - 1964 Semi-Detached	15.58	1	0.15	15.73	31.69	-0.15	-0.24	-0.37	-999	-999	-999	-999
448	C	523	N00002234	Sports/Leisure Centre	0	0	0	15.73	483.56	-0.25	-0.35	-999	-999	-999	-999	-999

APPENDIX B

RISK MAPS



IMPORTANT USER NOTE:
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TO THE DISCLAIMER, GUIDANCE NOTES
AND CONDITIONS OF USE THAT
ACCOMPANY THIS MAP.

Legend

- Properties with 1% AEP £ Damage**
 - Commercial
 - Residential
 - ▲ Wastewater Treatment Works
 - Portadown Pumping Station
 - Electricity Substations
 - Meadow Lane
- Roads Network**
 - A Class Road
 - B Class Road
 - C Class Road
 - Unclassified Road
 - Railway
 - New Developments
 - Properties within 1% AEP Flood Extent
 - 1% AEP Flood Extent
 - Portadown Study Area
 - Conduit
 - River Centreline

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REV: 0	NOTE:	DATE: 01/11/2017
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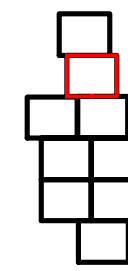
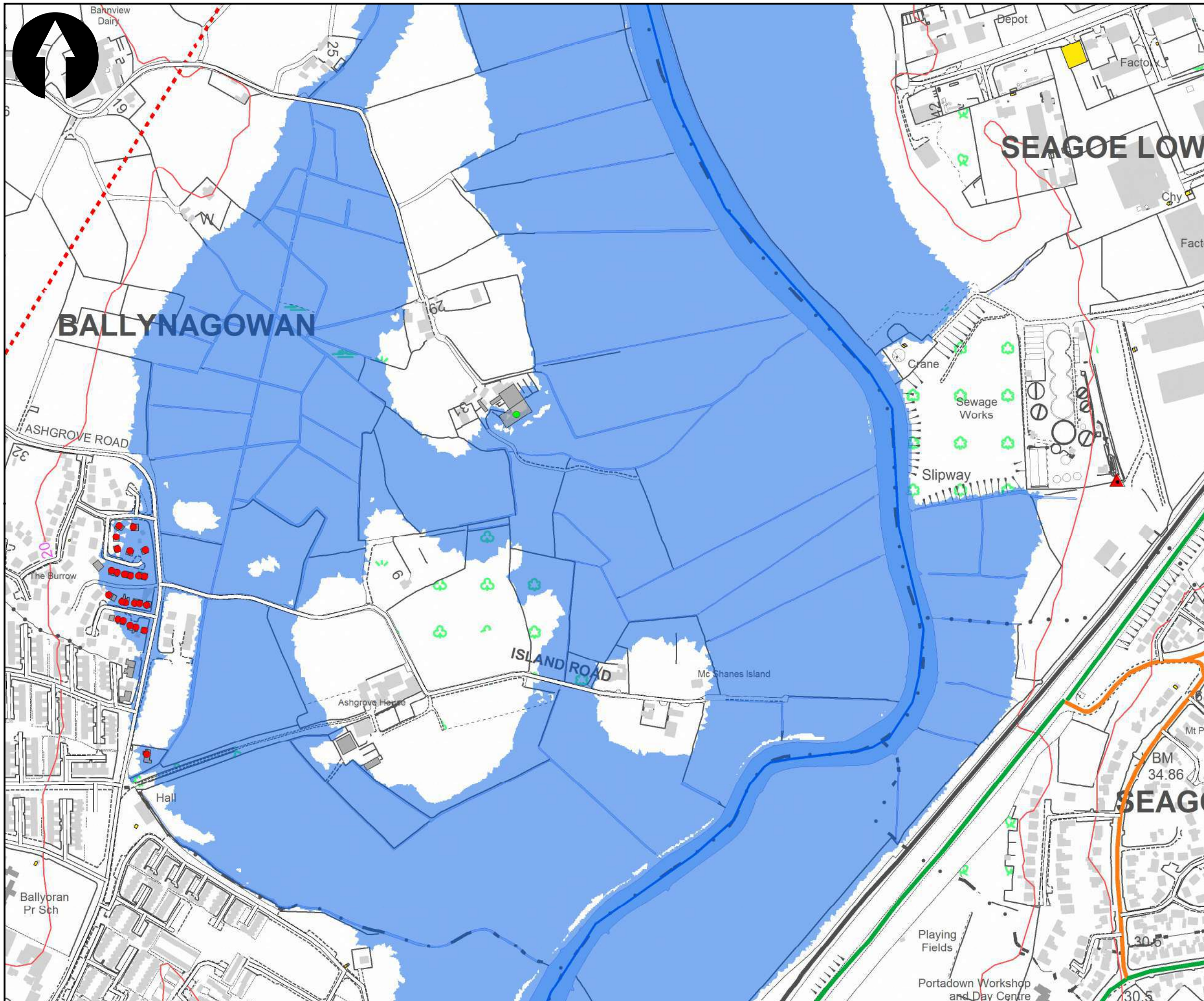


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Map: Portadown Fluvial Economic Risk Map	
Map Type: General Risk - Economic	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By : Z.M.	Date : 1st November 2017
Checked By : M.W.	Date : 1st November 2017
Approved By : G.G.	Date : 1st November 2017
Drawing No. :	

Map Series : Page 1 of 9
Drawing Scale : 1:5,000 @ A3



IMPORTANT USER NOTE:
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TO THE DISCLAIMER, GUIDANCE NOTES
AND CONDITIONS OF USE THAT
ACCOMPANY THIS MAP.

Legend

- Properties with 1% AEP £ Damage**
- Commercial
- Residential
- ▲ Wastewater Treatment Works
- Portadown Pumping Station
- Electricity Substations
- MeadowLane
- Roads Network**
- A Class Road
- B Class Road
- C Class Road
- Unclassified Road
- Railway
- New Developments
- Properties within 1% AEP Flood Extent
- 1% AEP Flood Extent
- Portadown Study Area
- Conduit
- River Centreline

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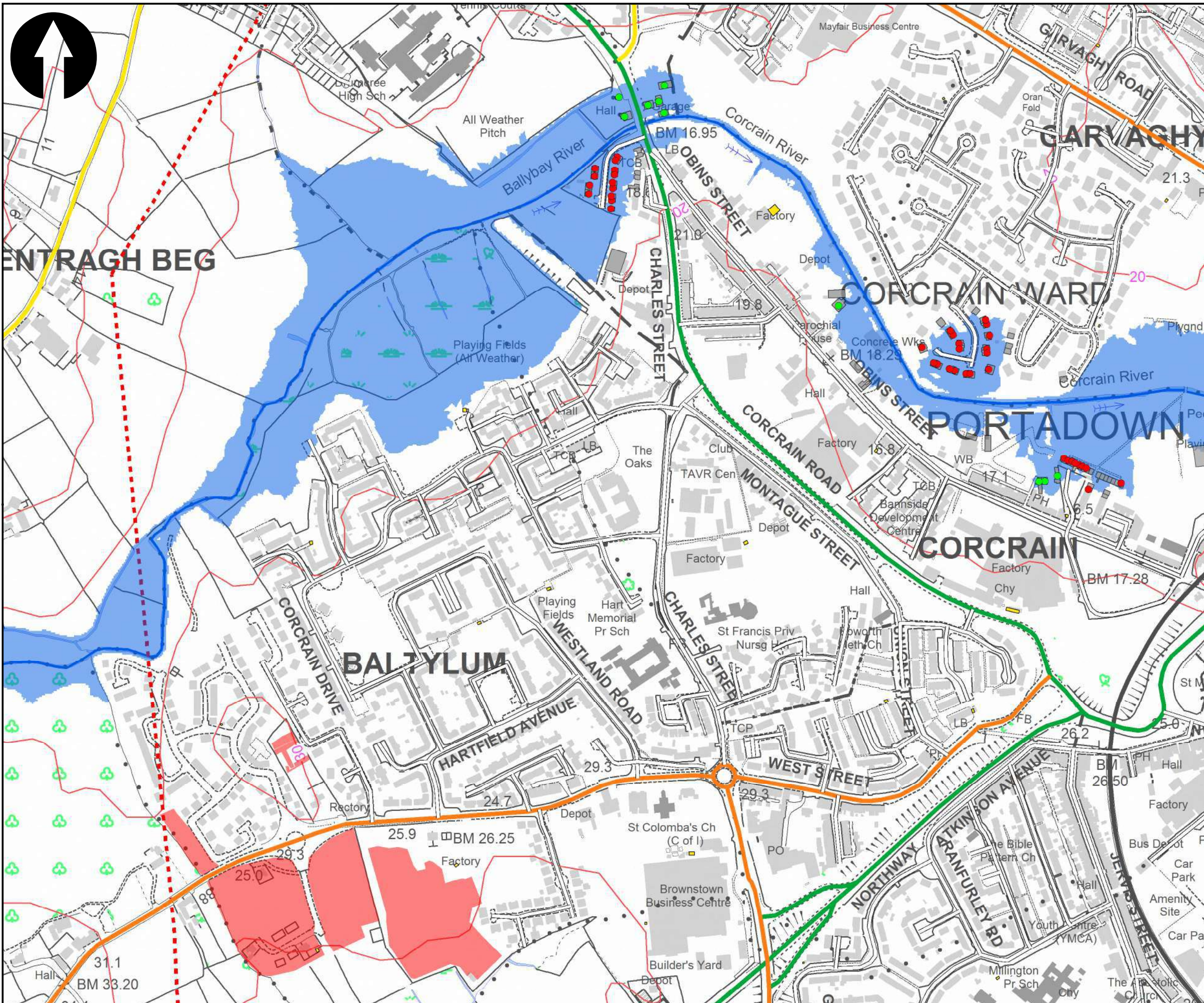
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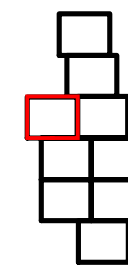
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Map: Portadown Fluvial Economic Risk Map	
Map Type: General Risk - Economic	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By : Z.M.	Date : 1st November 2017
Checked By : M.W.	Date : 1st November 2017
Approved By : G.G.	Date : 1st November 2017
Drawing No. :	
Map Series : Page 2 of 9	
Drawing Scale : 1:5,000 @ A3	



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AND CONDITIONS OF USE THAT
ACCOMPANY THIS MAP.

Legend

- Properties with 1% AEP £ Damage**
 - Commerical
 - Residential
 - ▲ Wastewater Treatment Works
 - Portadown Pumping Station
 - Electricity Substations
 - MeadowLane
- Roads Network**
 - A Class Road
 - B Class Road
 - C Class Road
 - Unclassified Road
 - Railway
 - New Developments
 - Properties within 1% AEP Flood Extent
 - 1% AEP Flood Extent
 - Portadown Study Area
 - Conduit
 - River Centreline

DRAFT

REV: 0	NOTE:	DATE: 01/11/2017
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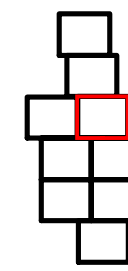
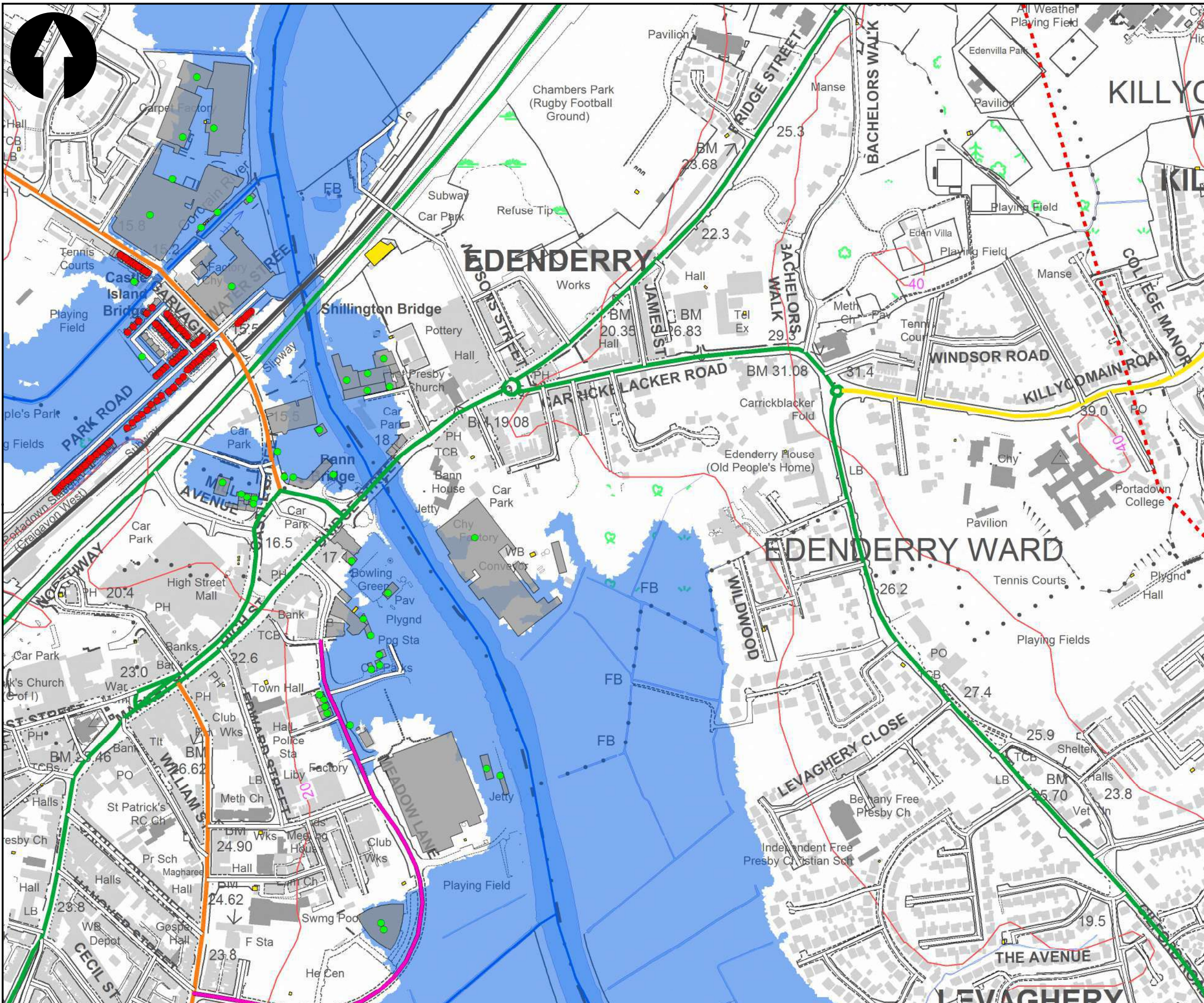


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Map: Portadown Fluvial Economic Risk Map	
Map Type: General Risk - Economic	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By: Z.M.	Date: 1st November 2017
Checked By: M.W.	Date: 1st November 2017
Approved By: G.G.	Date: 1st November 2017
Drawing No.:	

Map Series : Page 3 of 9
Drawing Scale : 1:5,000 @ A3



IMPORTANT USER NOTE:
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Legend

- Properties with 1% AEP £ Damage**
- Commercial
 - Residential
 - ▲ Wastewater Treatment Works
 - Portdown Pumping Station
 - Electricity Substations
 - MeadowLane
- Roads Network**
- A Class Road
 - B Class Road
 - C Class Road
 - Unclassified Road
 - Railway
 - New Developments
 - Properties within 1% AEP Flood Extent
 - 1% AEP Flood Extent
 - Portdown Study Area
 - Conduit
 - River Centreline

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REV: 0	NOTE:	DATE: 01/11/2017
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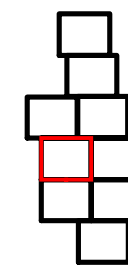
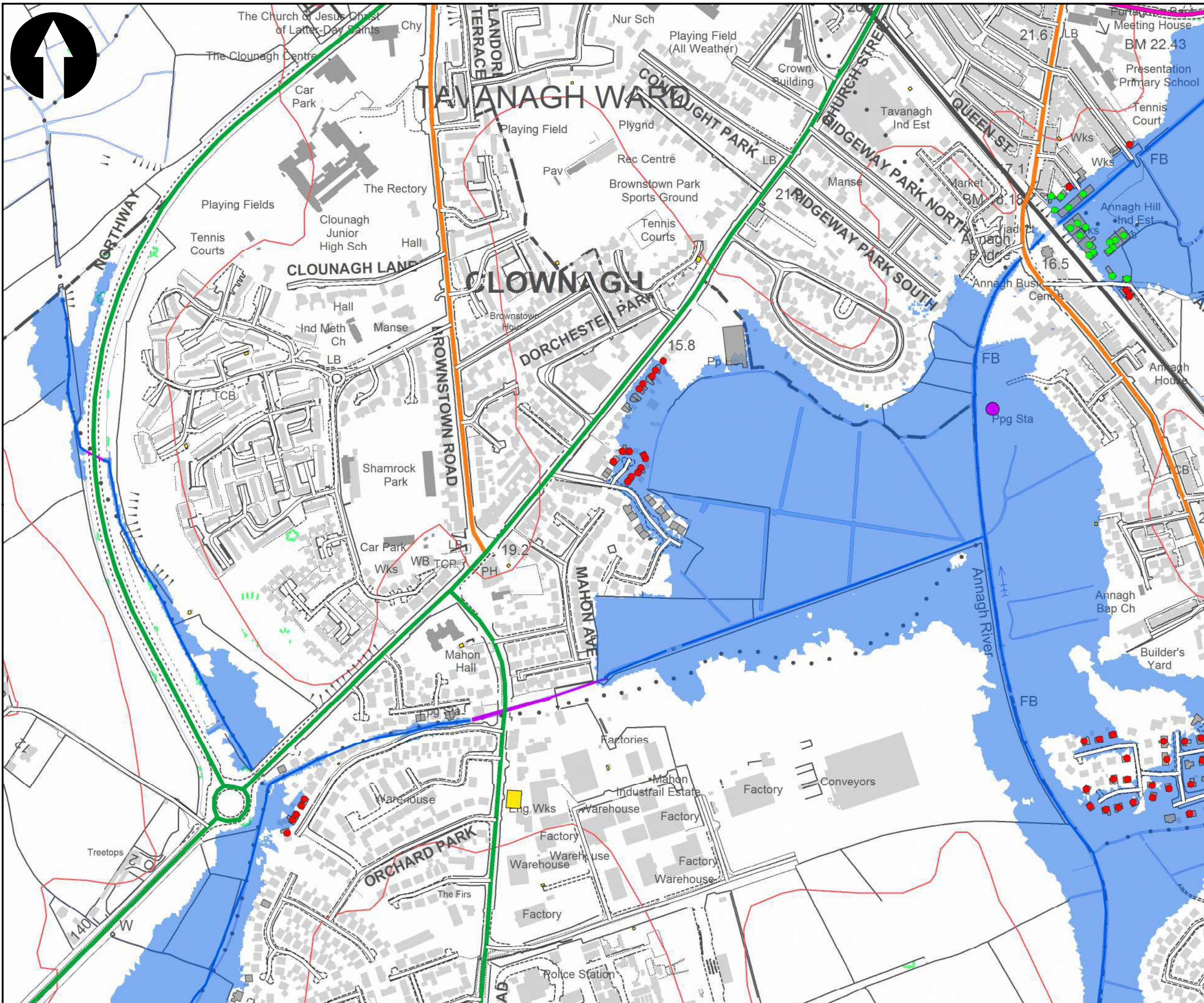


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Legend

- Properties with 1% AEP £ Damage**
- Commerical
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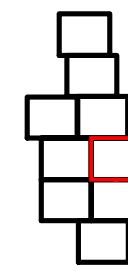
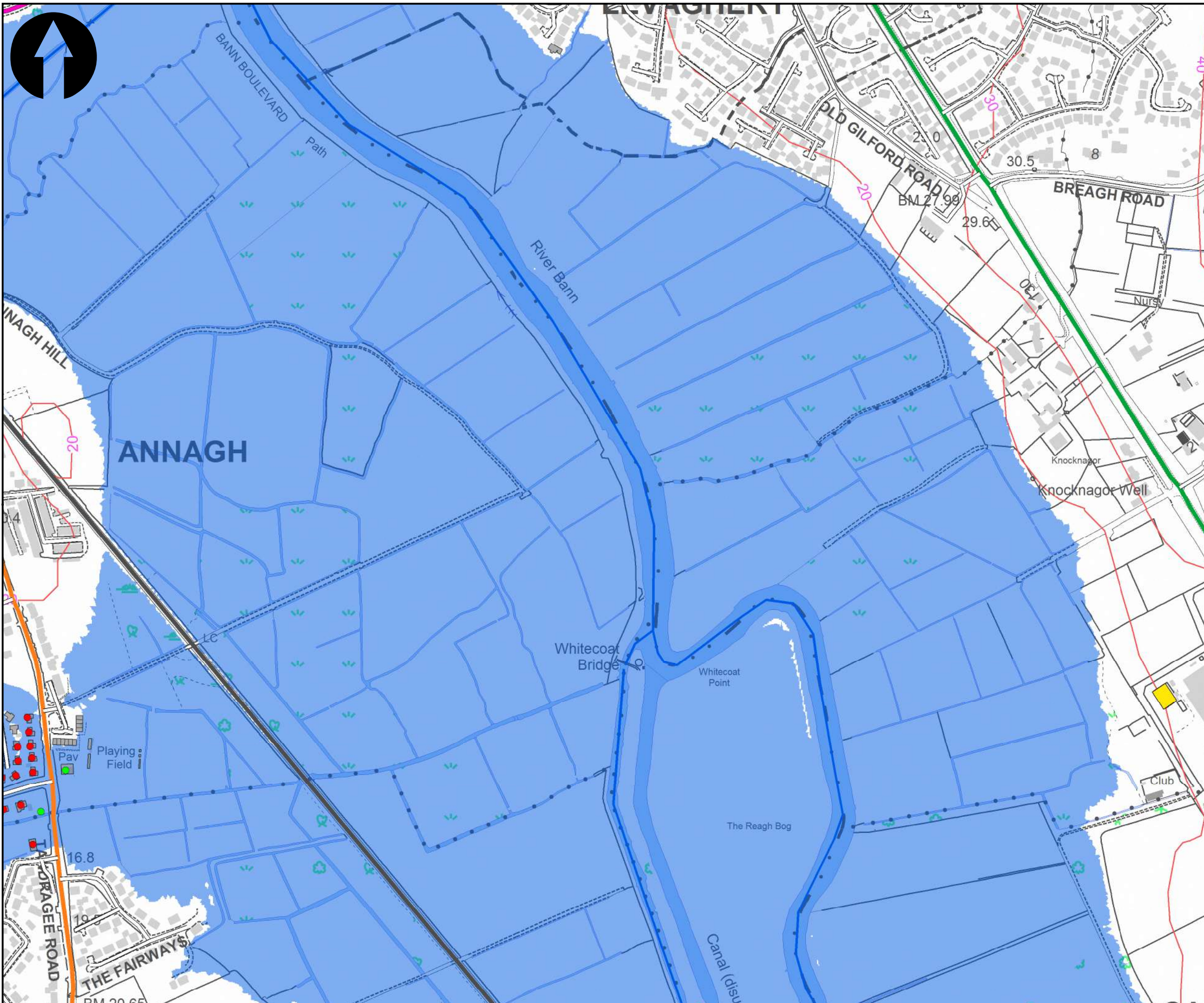


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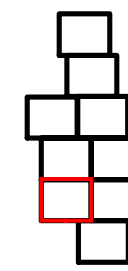
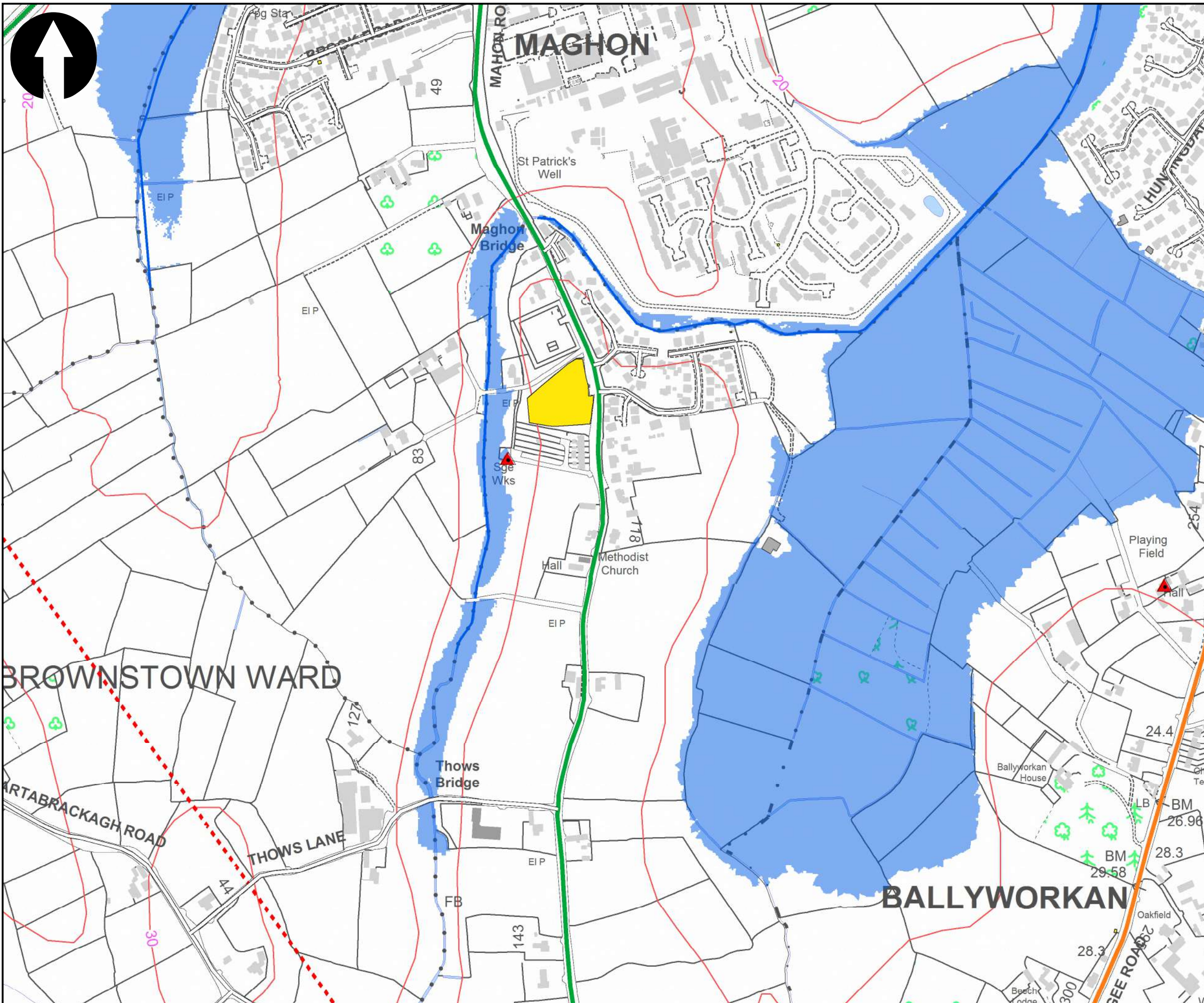


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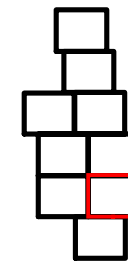
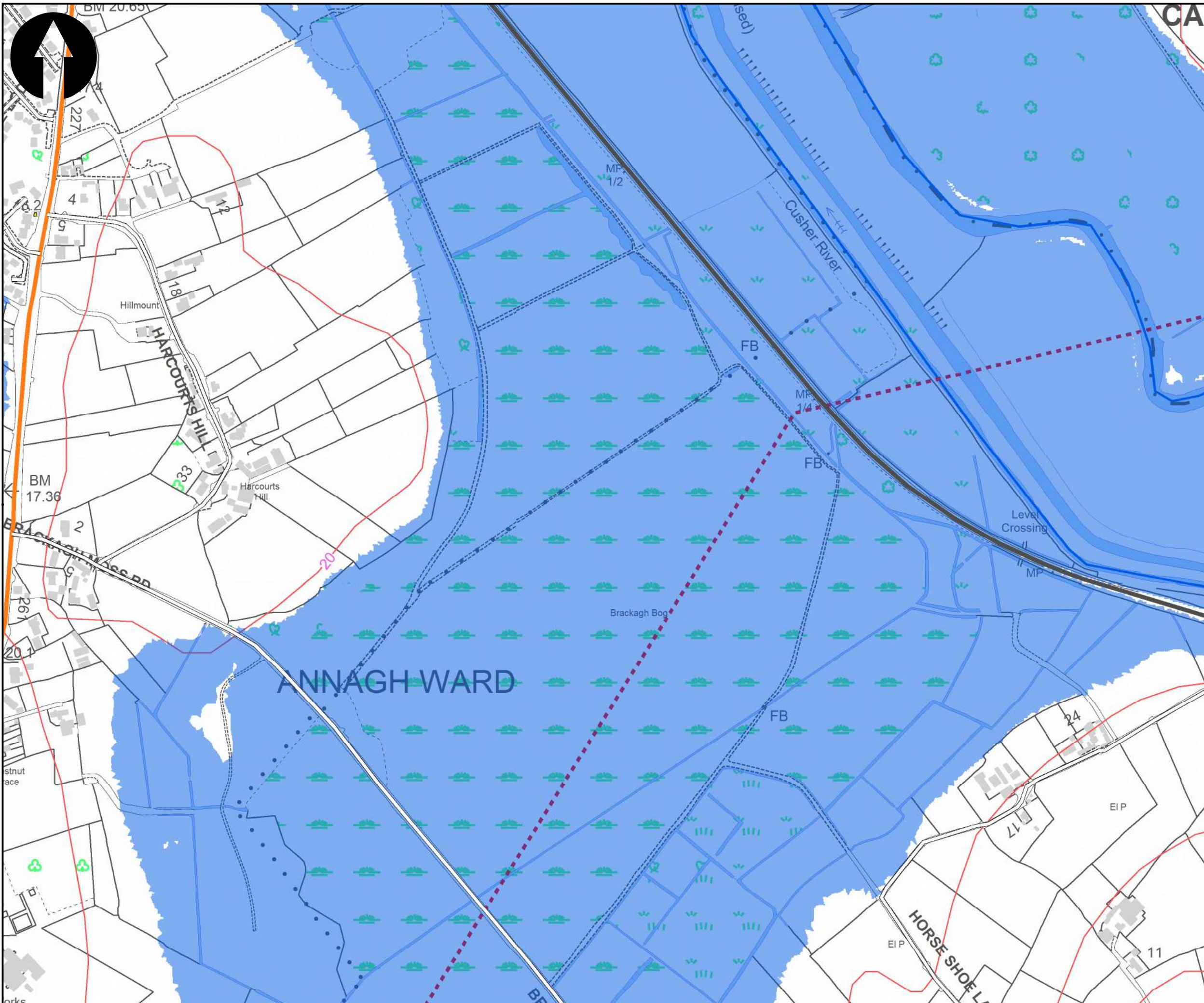


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Legend

Properties with 1% AEP £ Damage

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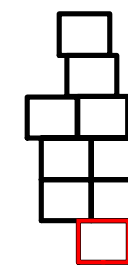
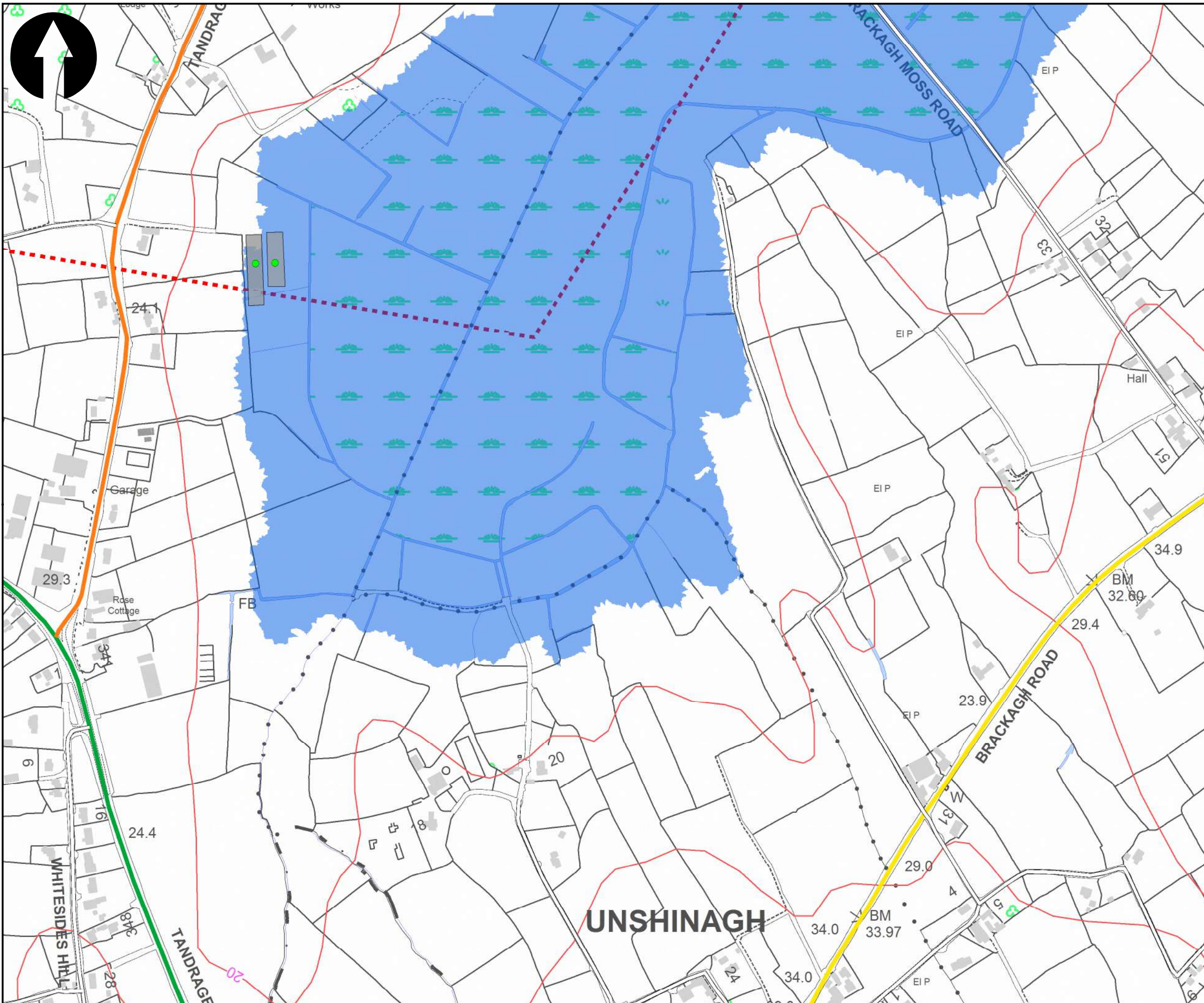
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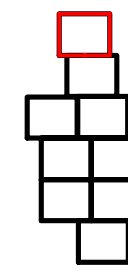
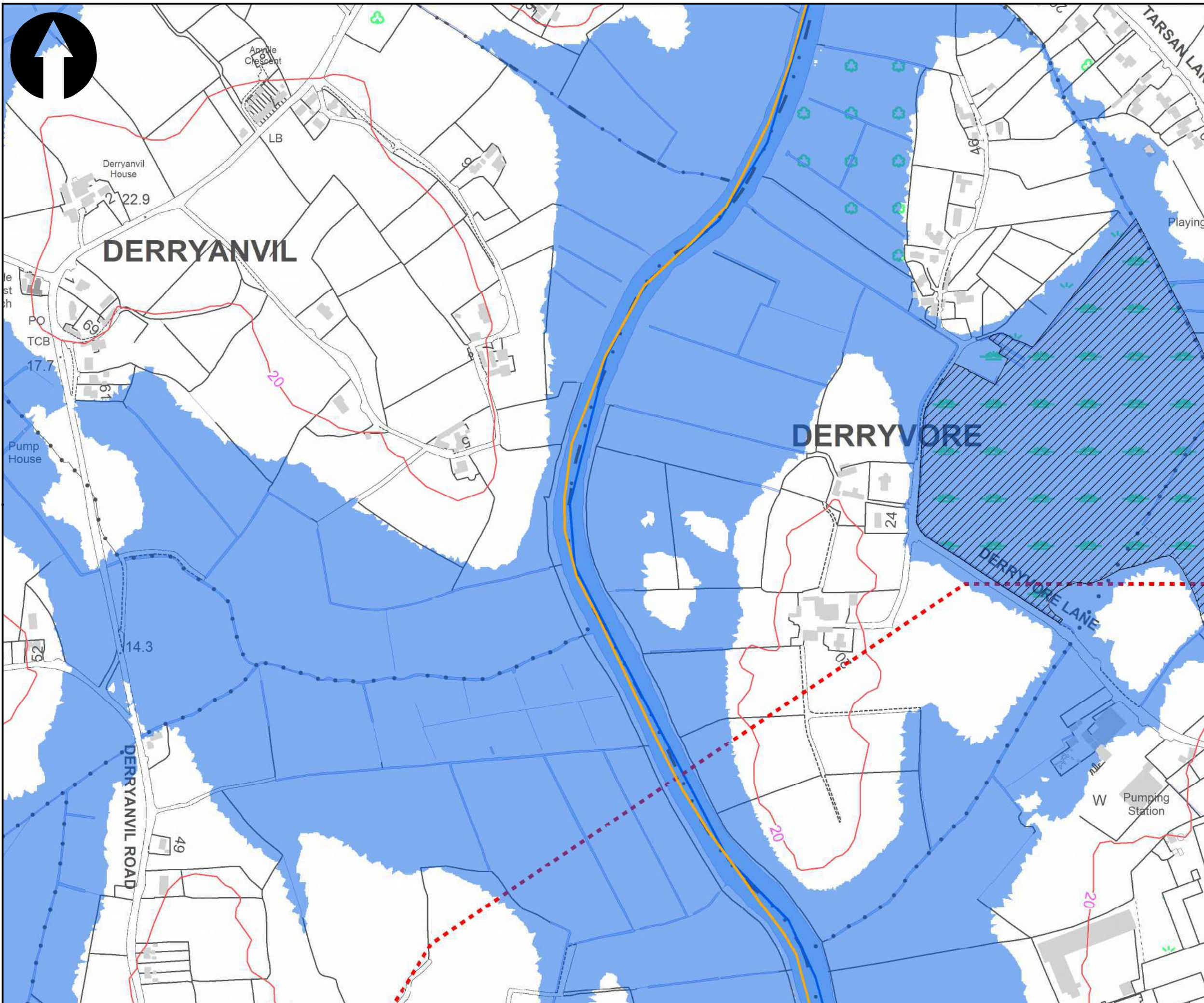


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Map: Portadown Fluvial Economic Risk Map	
Map Type: General Risk - Economic	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By: Z.M.	Date: 1st November 2017
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Map Series: Page 9 of 9
Drawing Scale: 1:5,000 @ A3



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Legend

- Salmonid Rivers
- Ancient Woodland
- RAMSAR
- Area of Specific Scientific Interest (ASSI)
- Area of Natural Beauty (AONB)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- 1% AEP Flood Extent
- Conduit
- River Centreline
- Portadown Study Area

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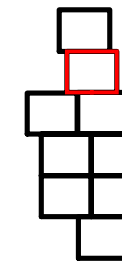
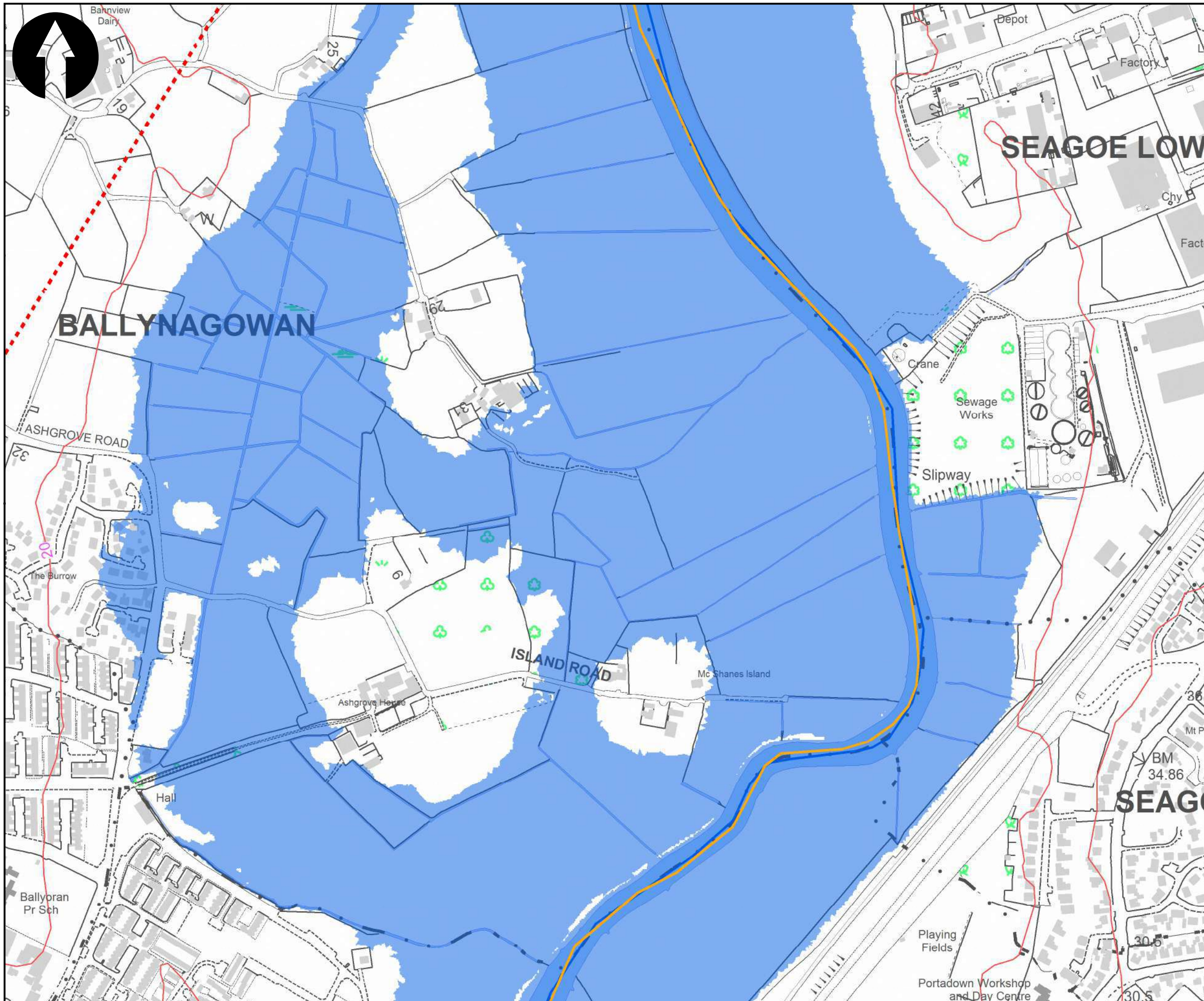


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Map: Portadown Fluvial Environmental Risk Map	
Map Type: General Risk - Environmental	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By : Z.M.	Date : 1st November 2017
Checked By : M.W.	Date : 1st November 2017
Approved By : G.G.	Date : 1st November 2017
Drawing No. :	

Map Series : Page 1 of 9
Drawing Scale : 1:5,000 @ A3



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Legend

- Salmonid Rivers
- Ancient Woodland
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- Area of Specific Scientific Interest (ASSI)
- Area of Natural Beauty (AONB)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- 1% AEP Flood Extent
- Conduit
- River Centreline
- Portadown Study Area

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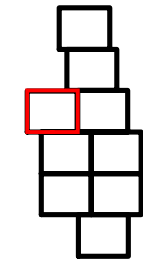
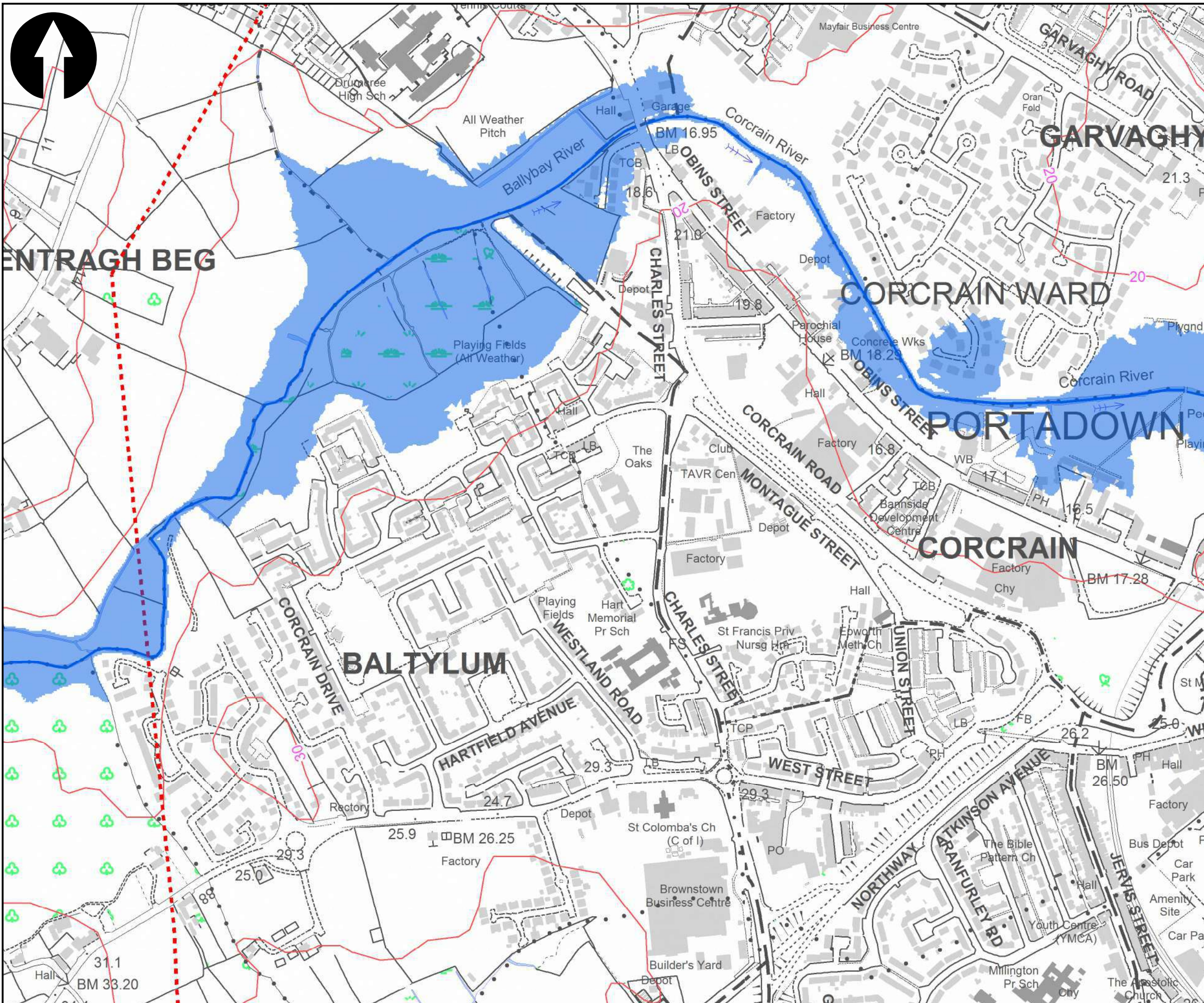
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Map: Portadown Fluvial Environmental Risk Map	
Map Type: General Risk - Environmental	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By: Z.M.	Date: 1st November 2017
Checked By: M.W.	Date: 1st November 2017
Approved By: G.G.	Date: 1st November 2017
Drawing No.:	
Map Series: Page 2 of 9	
Drawing Scale: 1:5,000 @ A3	



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Legend

-  Salmonid Rivers
-  Ancient Woodland
-  RAMSAR
-  Area of Specific Scientific Interest (ASSI)
-  Area of Natural Beauty (AONB)
-  Special Area of Conservation (SAC)
-  Special Protection Area (SPA)
-  1% AEP Flood Extent
-  Conduit
-  River Centreline
-  Portadown Study Area

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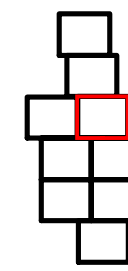
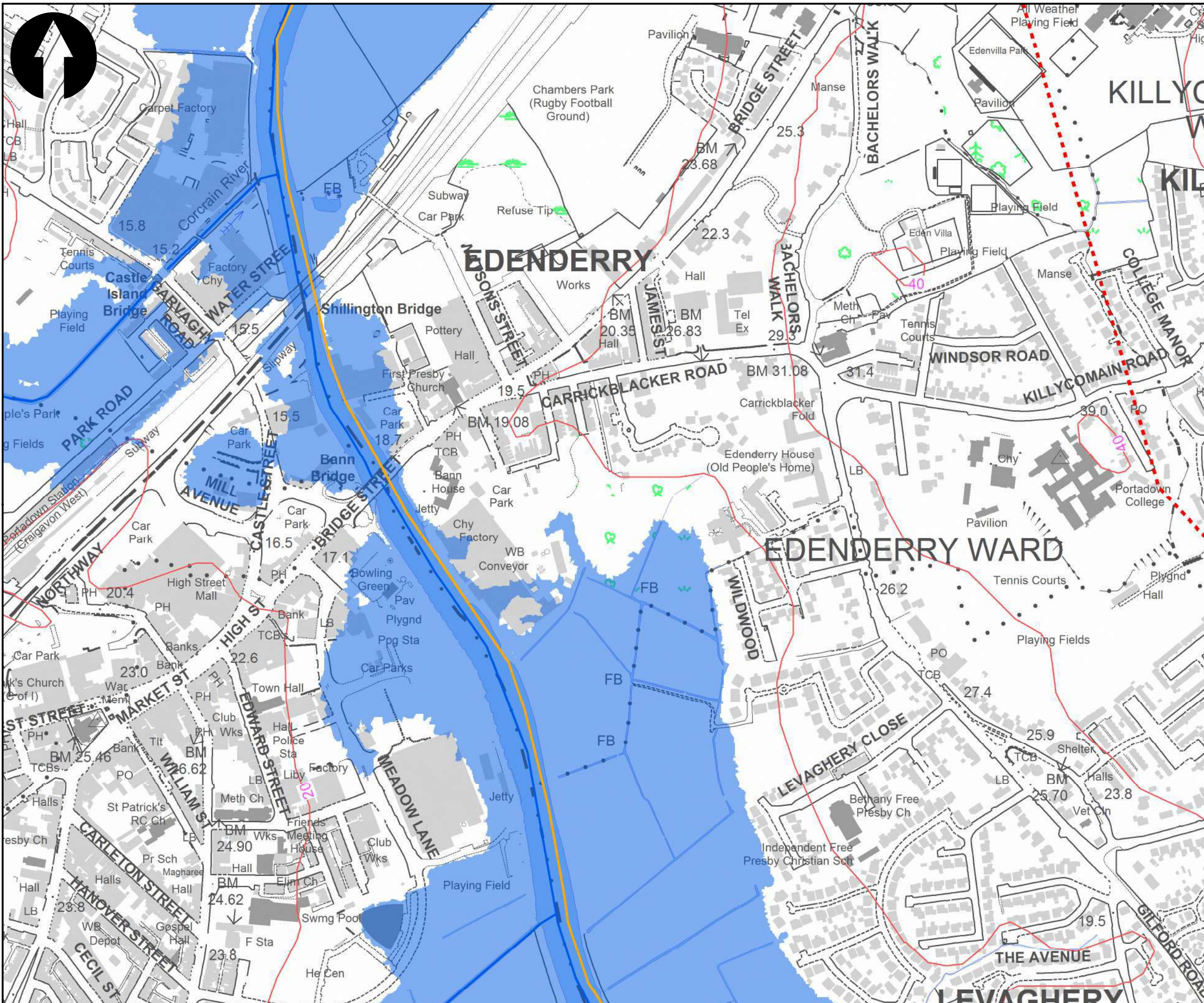
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Map Series: Page 3 of 9
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- Legend**
- Salmonid Rivers
 - Ancient Woodland
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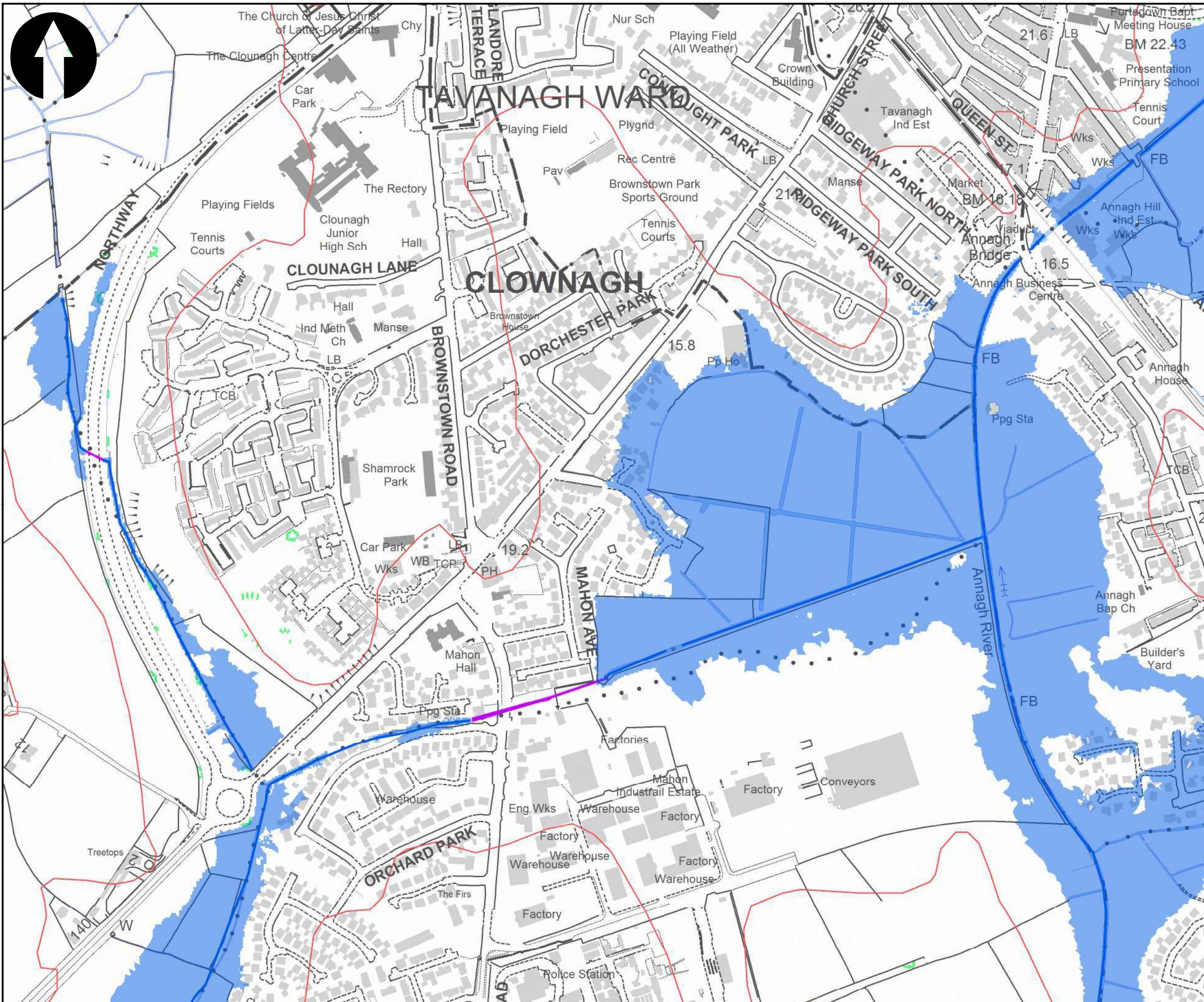


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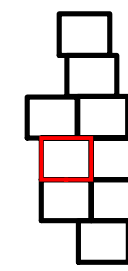
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Map: Portadown Fluvial Environmental Risk Map	
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Map Series : Page 4 of 9
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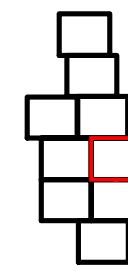
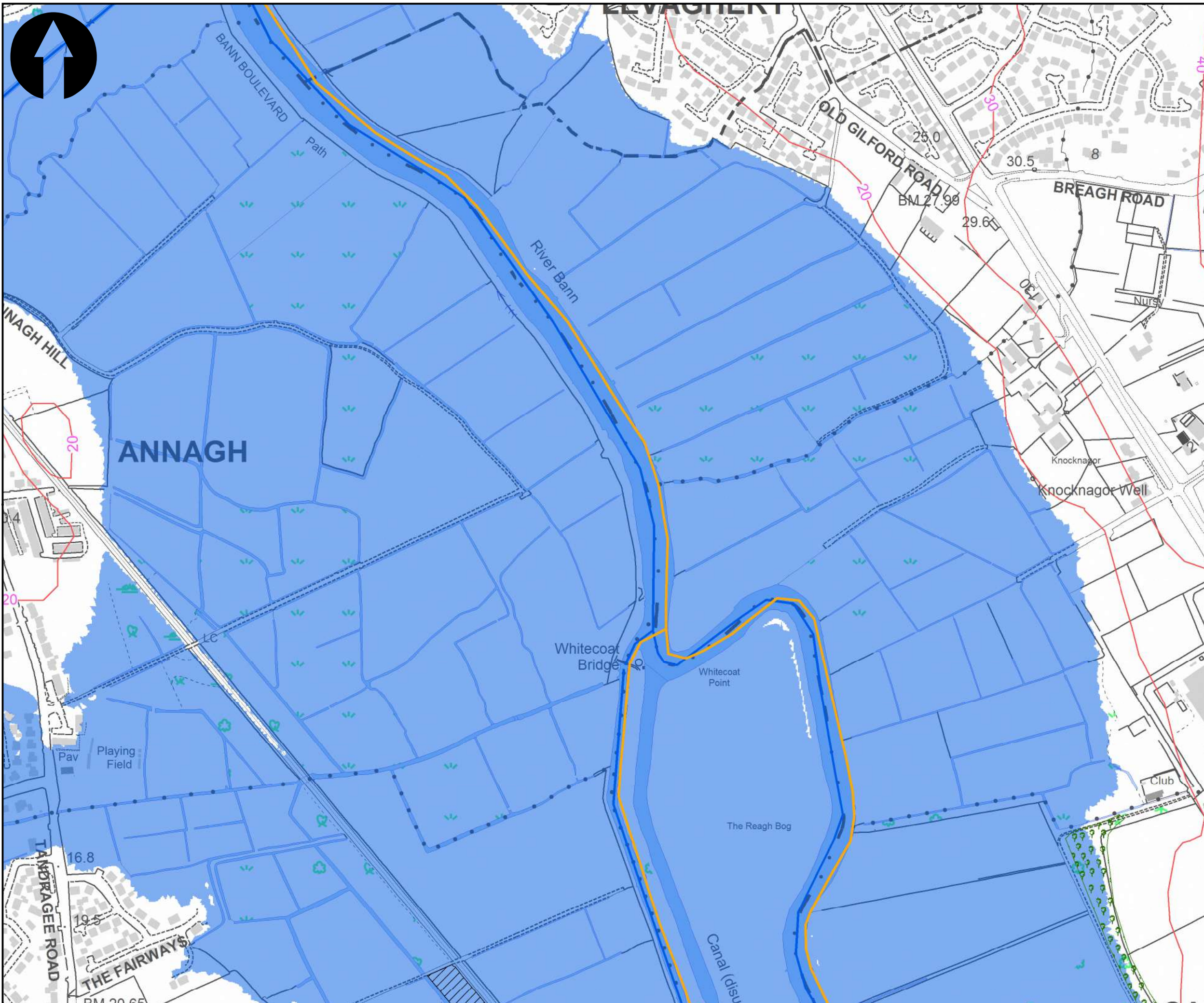
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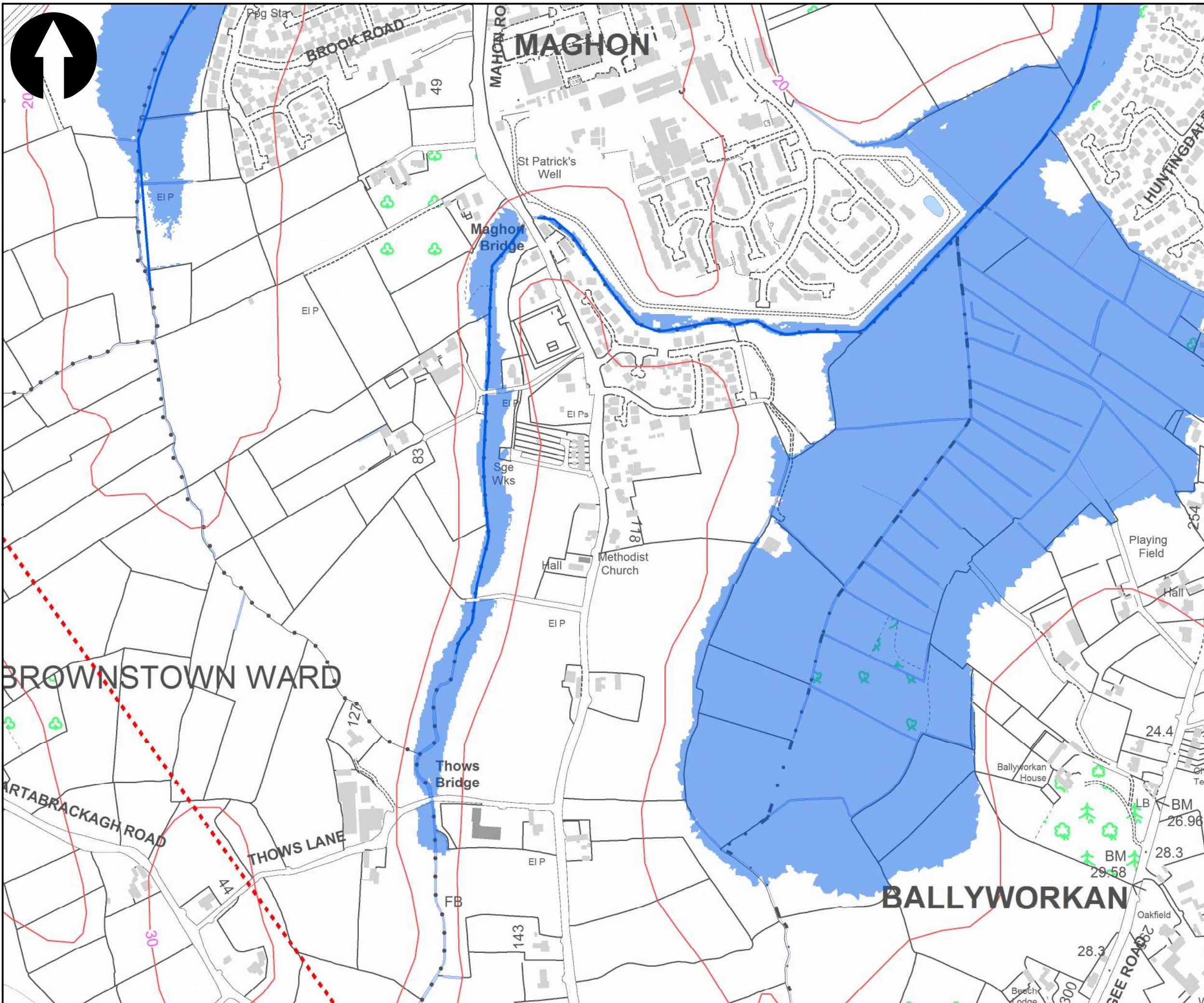
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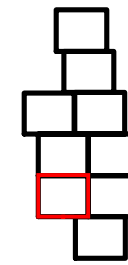
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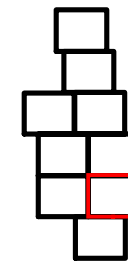
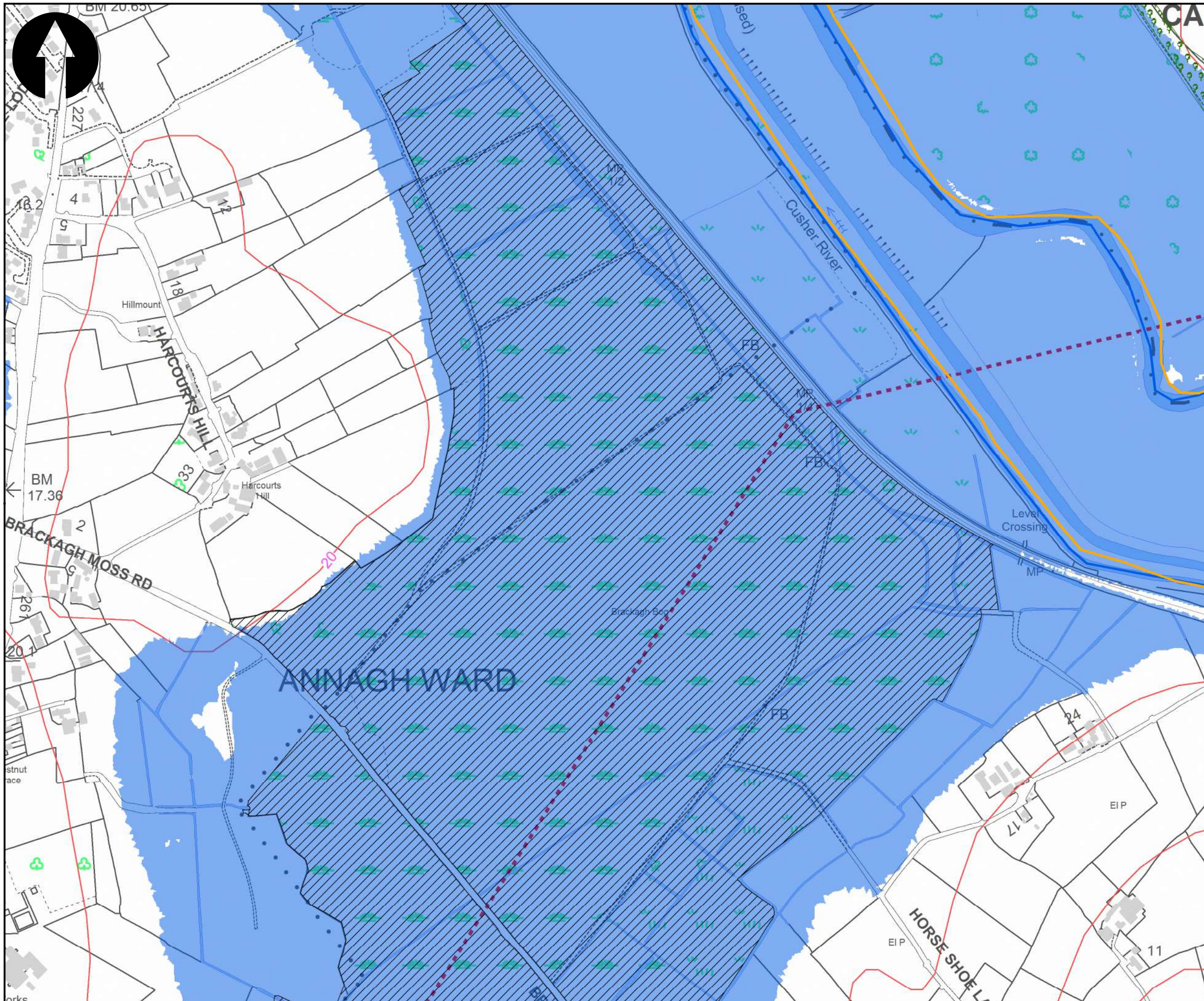


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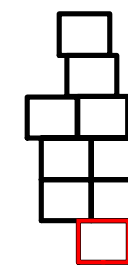
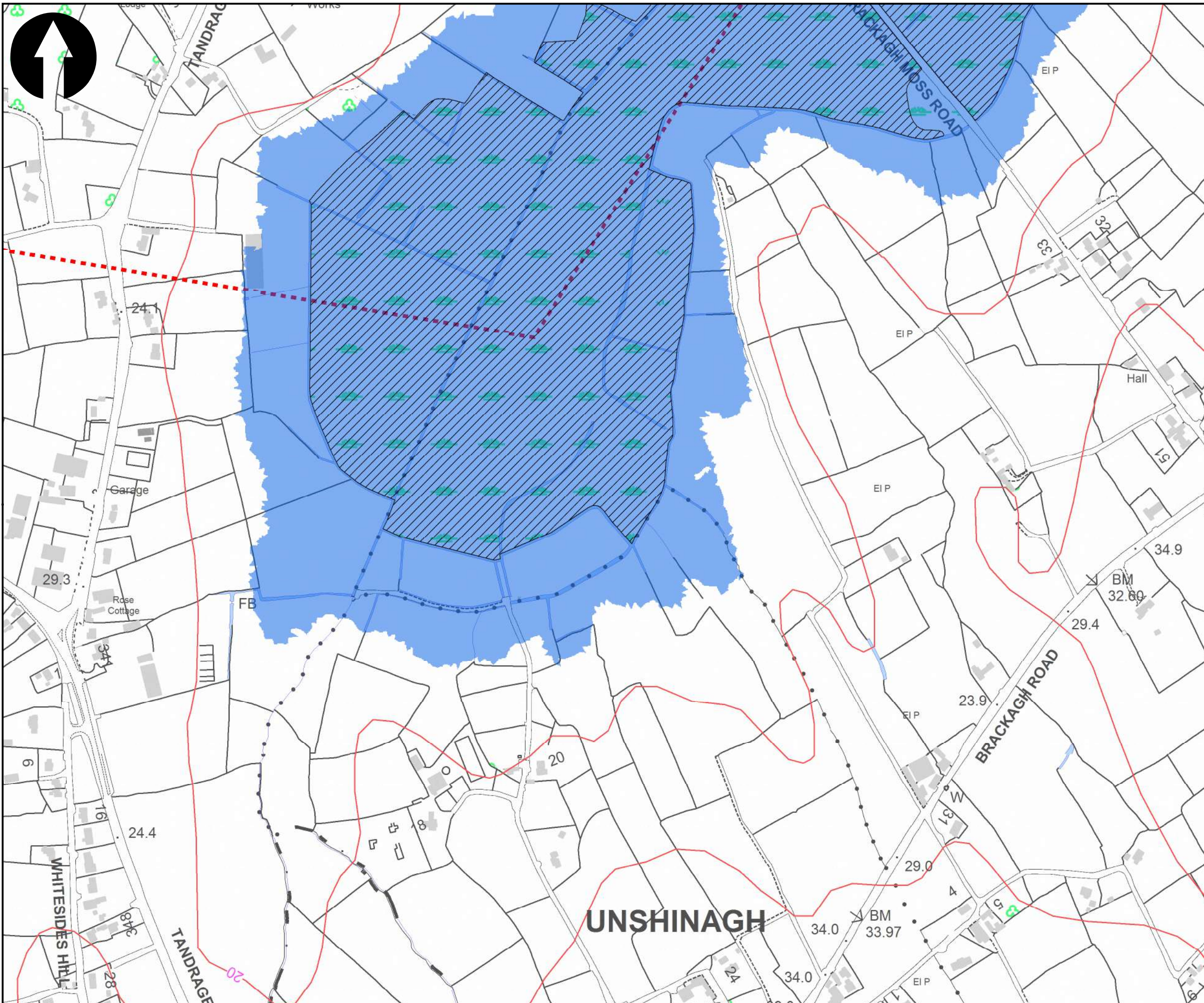


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Map: Portadown Fluvial Environmental Risk Map	
Map Type: General Risk - Environmental	
Source: Fluvial	
Map Area:	
Scenario: Current	
Drawn By : Z.M.	Date : 1st November 2017
Checked By : M.W.	Date : 1st November 2017
Approved By : G.G.	Date : 1st November 2017
Drawing No. :	

Map Series : Page 8 of 9
Drawing Scale : 1:5,000 @A3



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- Legend**
- Salmonid Rivers
 - Ancient Woodland
 - RAMSAR
 - Area of Specific Scientific Interest (ASSI)
 - Area of Natural Beauty (AONB)
 - Special Area of Conservation (SAC)
 - Special Protection Area (SPA)
 - 1% AEP Flood Extent
 - Conduit
 - River Centreline
 - Portadown Study Area

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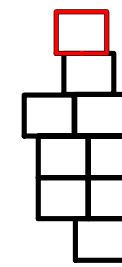
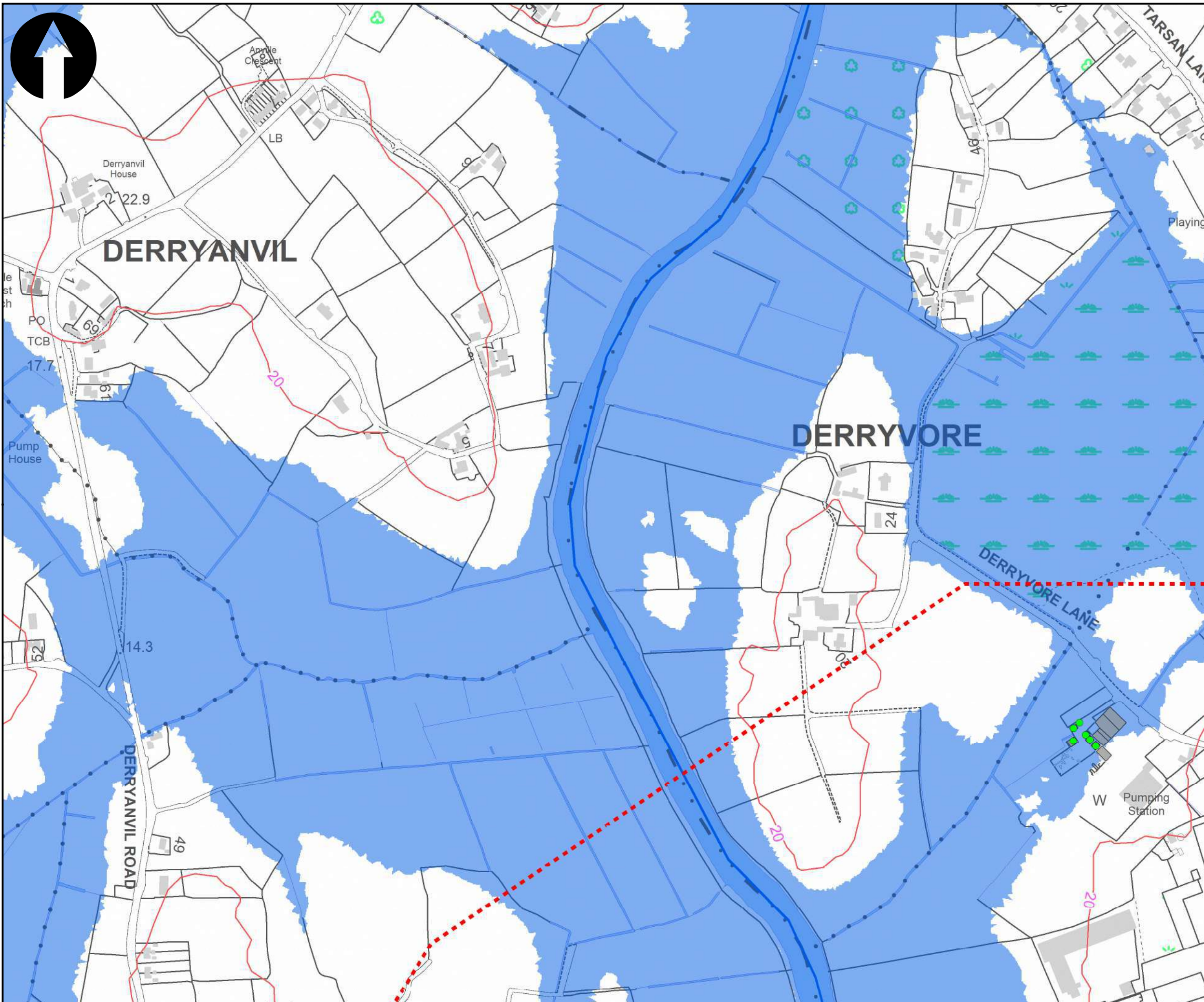
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Map:
Portadown Fluvial Social Risk Map

Map Type: General Risk - Social

Source: Fluvial

Map Area:

Scenario: Current

Drawn By: Z.M. **Date:** 1st November 2017

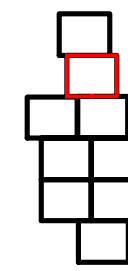
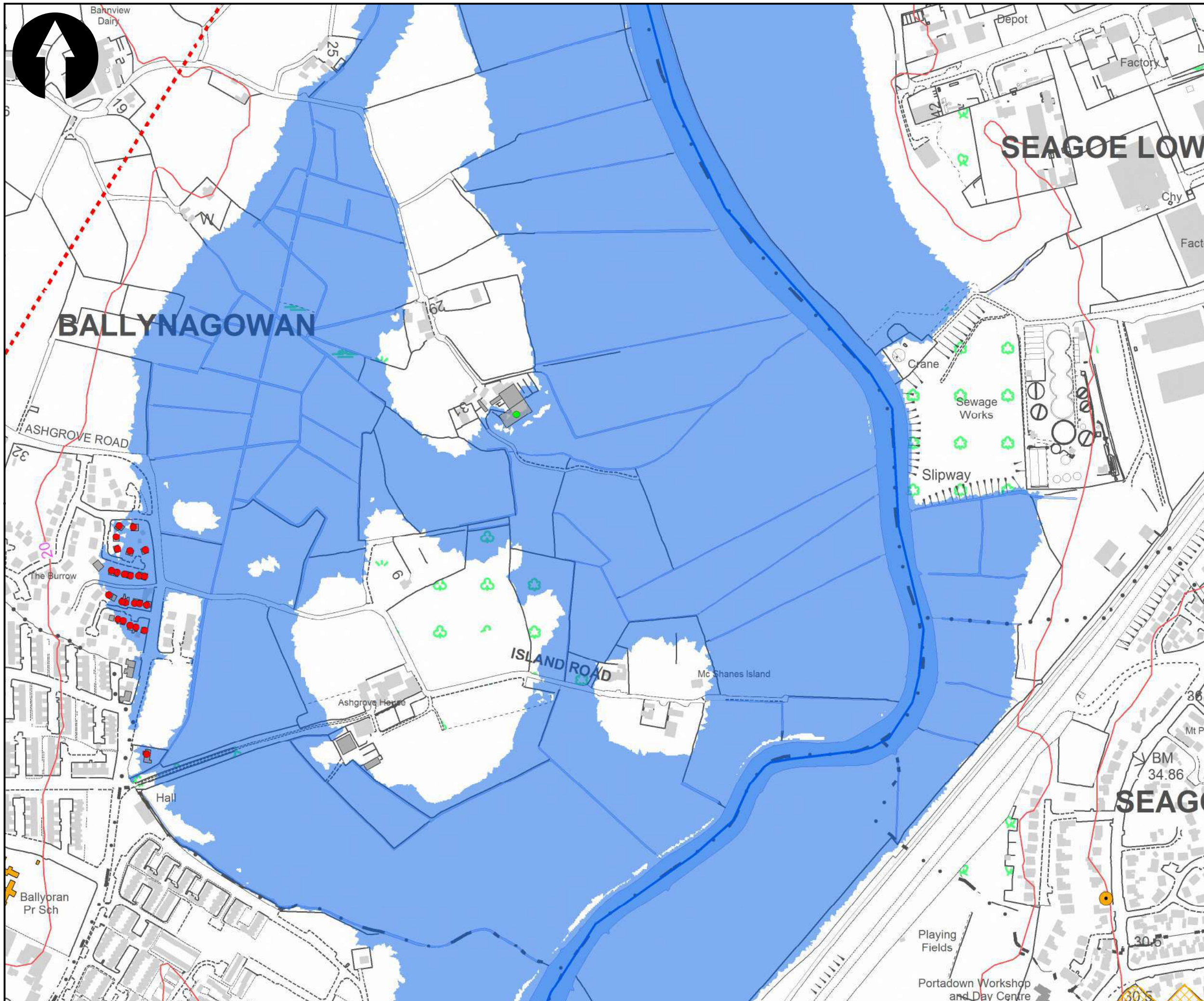
Checked By: M.W. **Date:** 1st November 2017

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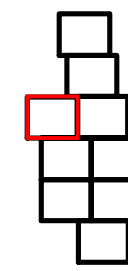
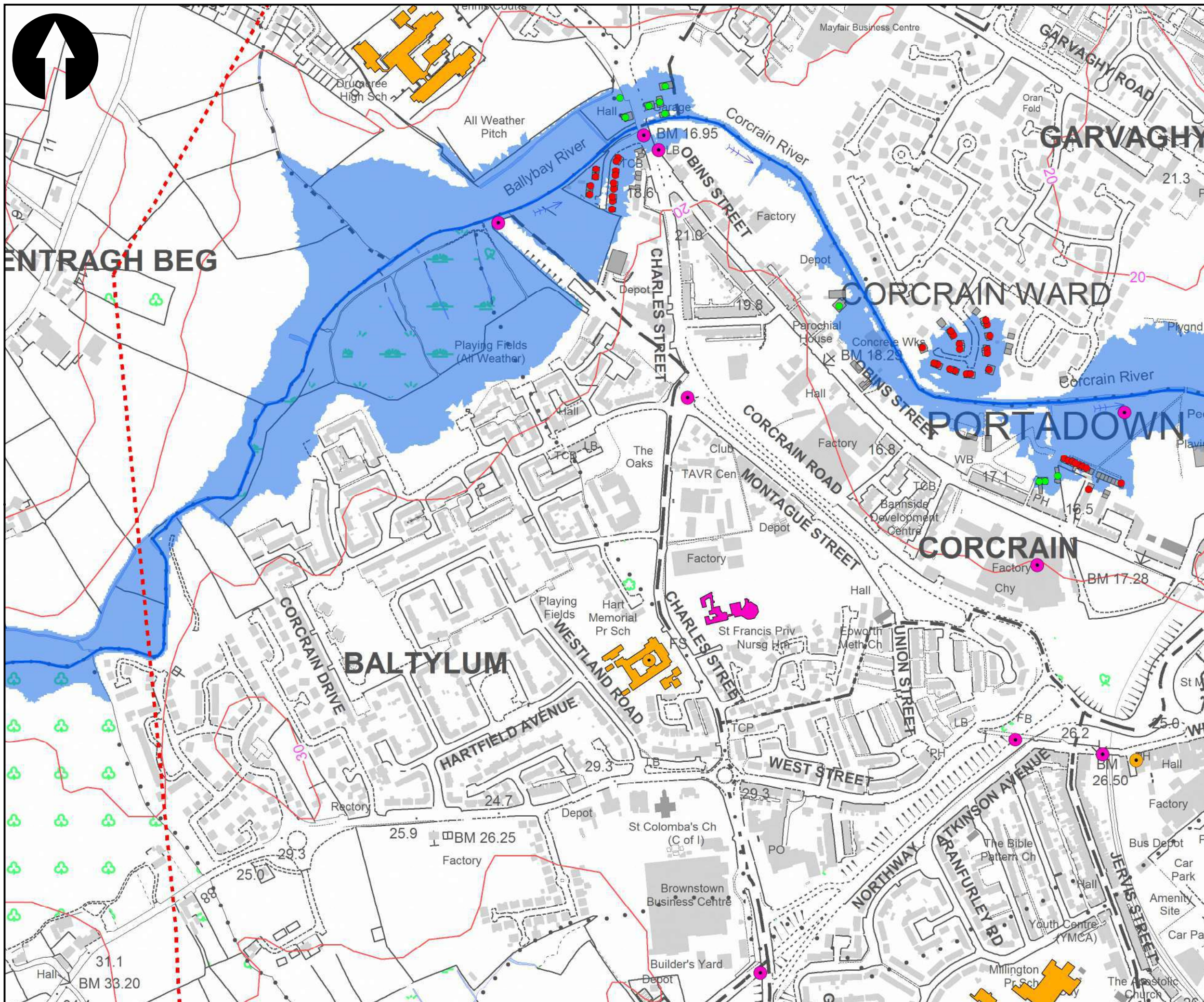
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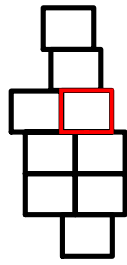
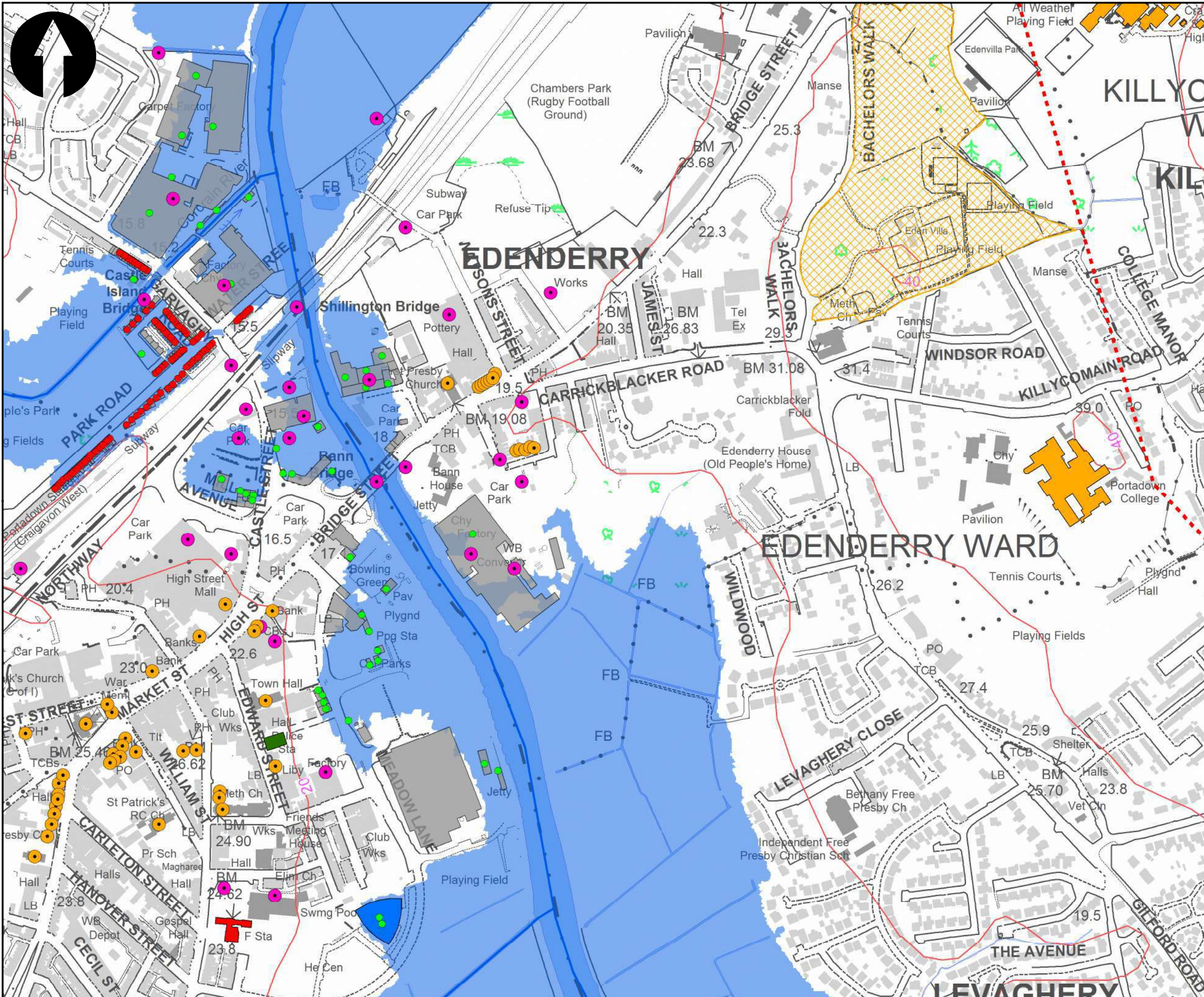


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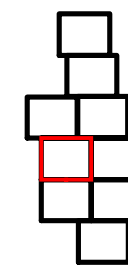
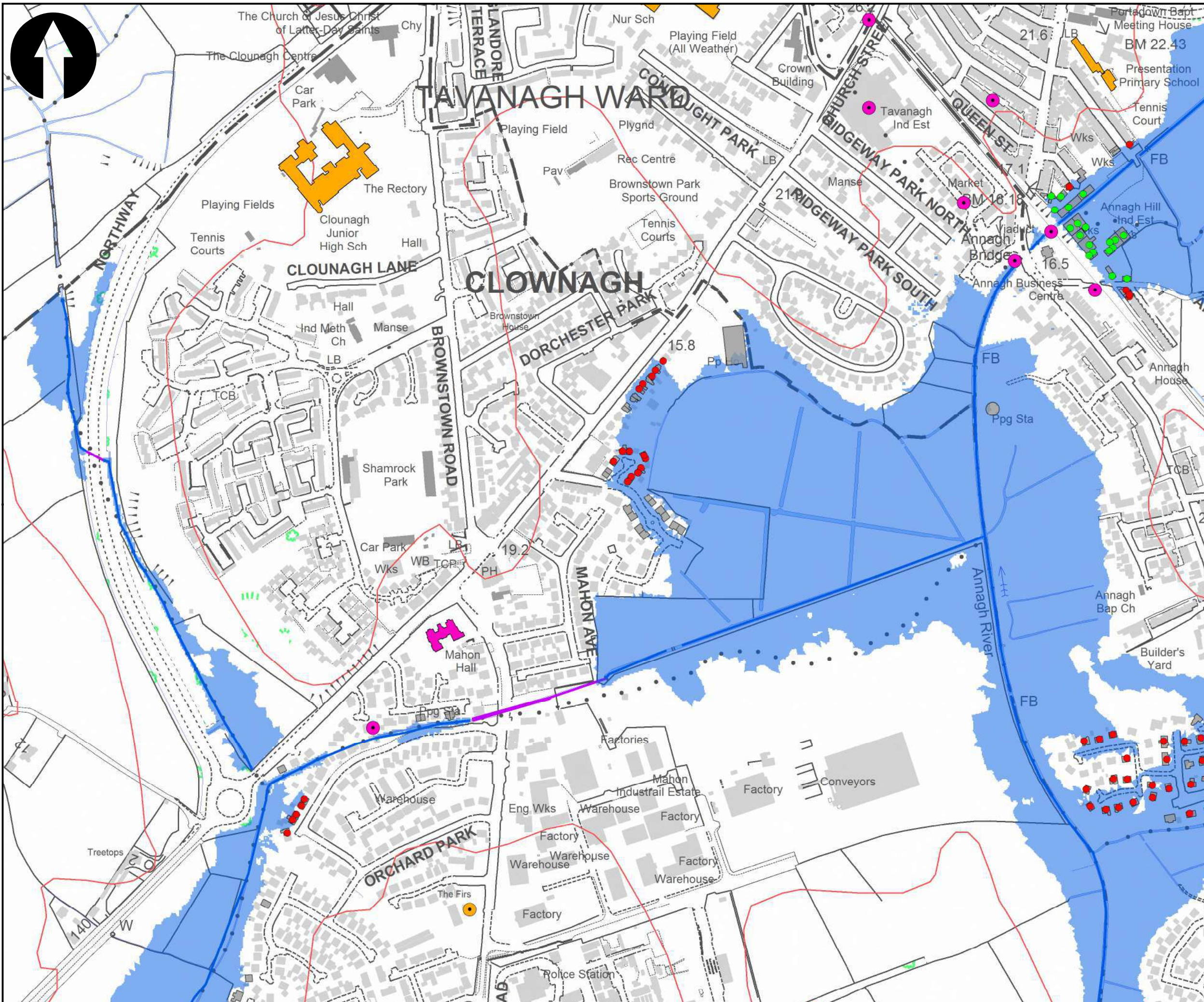


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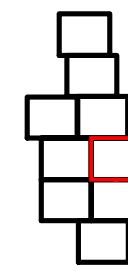
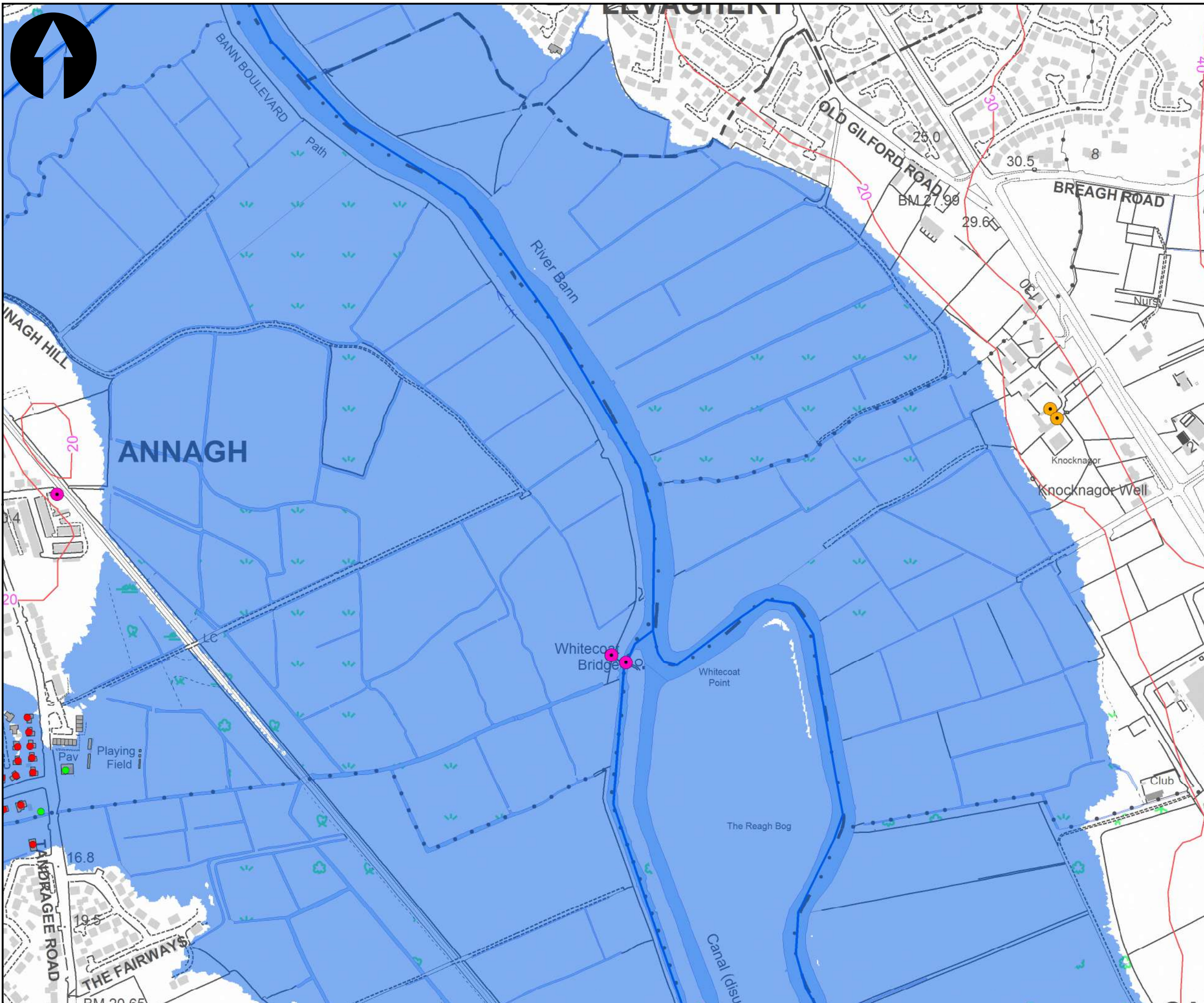


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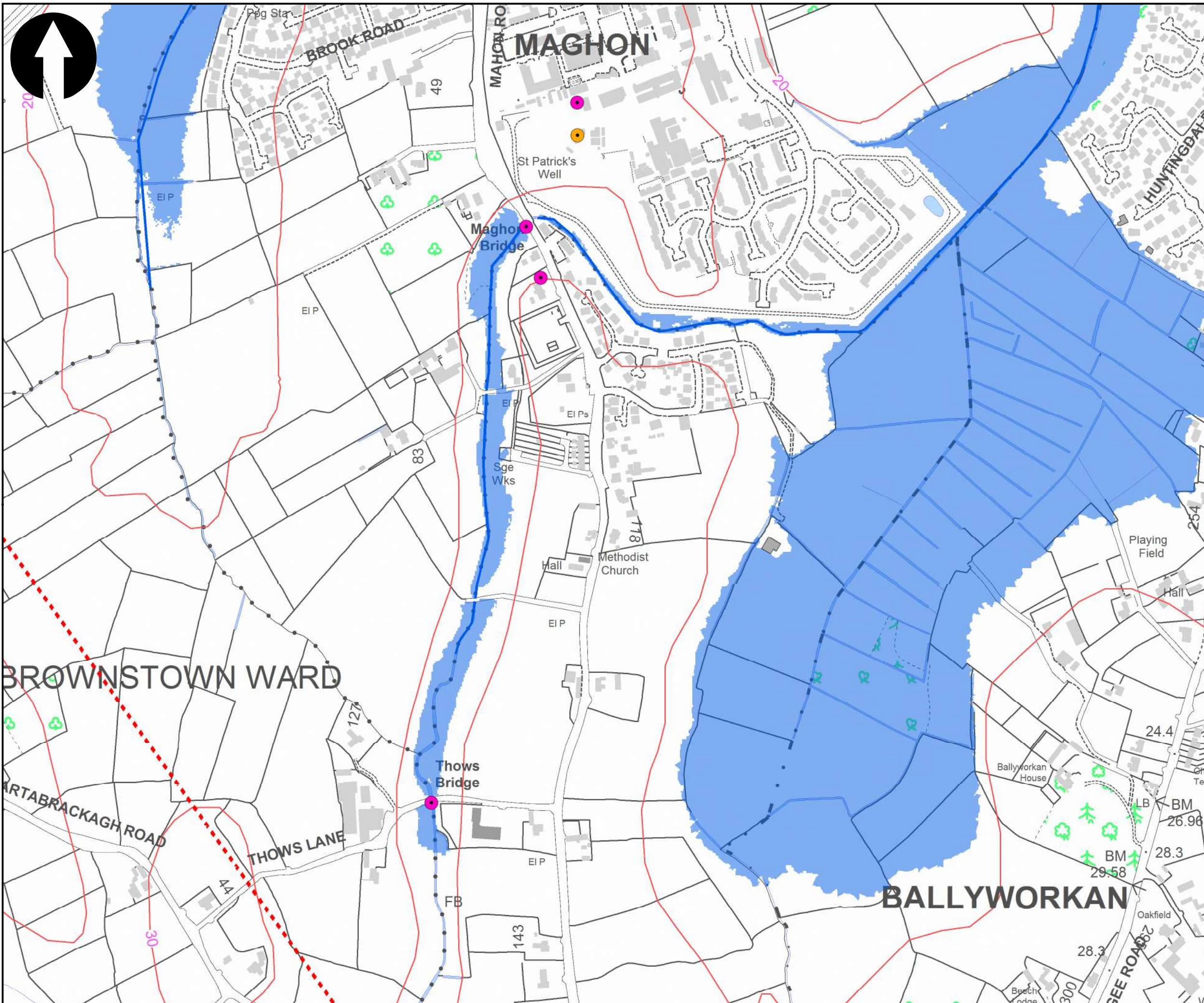
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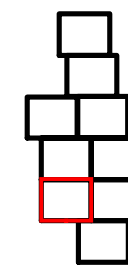
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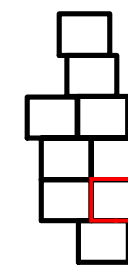
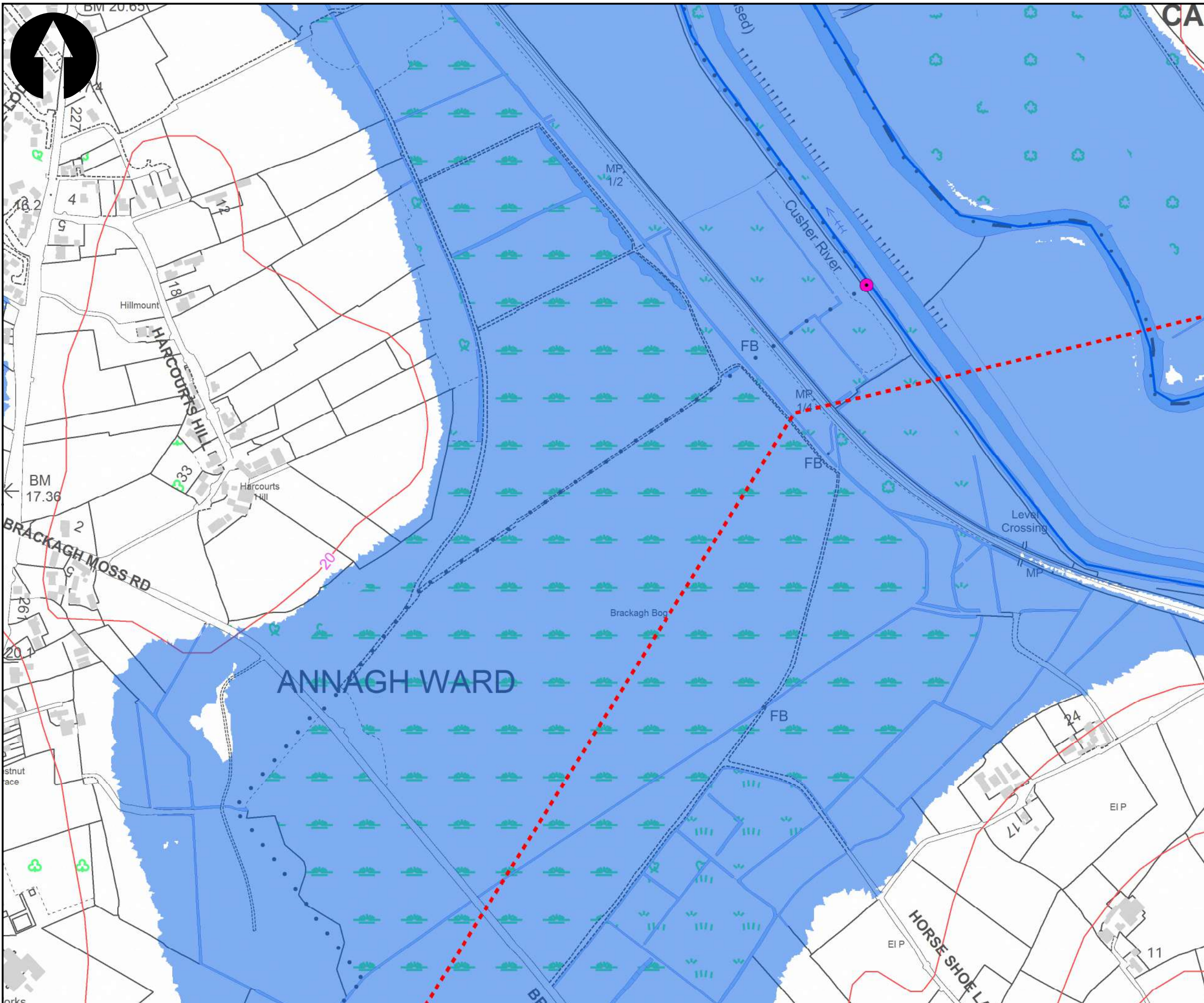


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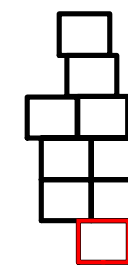
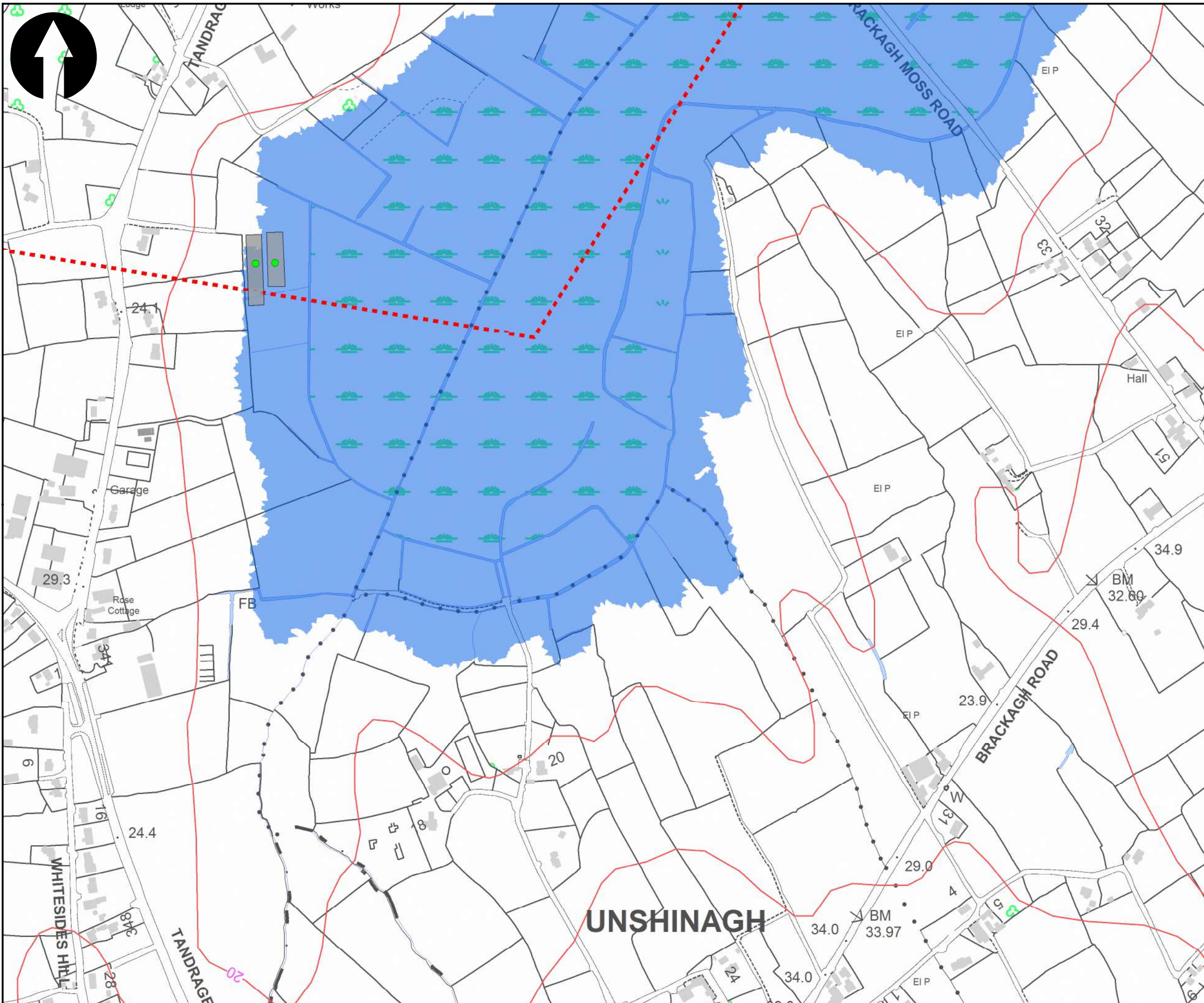
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APPENDIX C

DAMAGE AND DEFENCE COSTS ASSUMPTIONS

COST & DAMAGE ASSUMPTIONS

Assumptions made on maintenance/inspection costs

The maintenance and operational costs have been supplied by DfI Rivers. The annual maintenance costs have been calculated as follows:

Inspections at £405 per day x 0.15 day	£61
Maintenance at £405 per day x 2.5 day	£1,012

The total estimated annual inspection/maintenance cost is therefore £1,073 (approximated to £1,000)

Assumptions made on defence costs

The following assumptions were made in the calculation of the defence costs.

Reinforced concrete walls only:

- Flood wall thickness assumed to be 300mm;
- Base thickness of floodwall assumed to be the same as the stem (300mm);
- Height of the proposed floodwall calculated on the assumption that the top of the base is 1m below GL;
- Base width of floodwall assumed to be base thickness + wall height.

Earth embankment:

- Slope of embankment assumed to be 1:3;
- Assume constructed using impermeable clay material;
- Assume depth below ground level of 4m;
- Width and depth of capping beam assumed to be 800mm.

All:

- An additional 15% has been added to the costs to cover the preliminaries. This includes items associated with: Establishment of the site; Insurance, permits, paperwork, etc.; Site running costs; Handover of site; Supervision, labourers, etc.; and Overheads or others costs;
- An additional 10% has been added for fees and contingencies. This cost is included to cover consultancy and design fees and an allowance for the unknown risk associated with a project.
- The lifespan of the scheme is assumed to be 100 years;
- Maintenance costs have been included at £2,000 per year and £5,000 every 5 years for flood defences.

The following rates have been used (2016):

Item	Assumption	Rate	Unit
Clearance - vegetation killing		£230	ha
Clearance - site clearance & disposal	Allowance for tree, plant & scrub removal	£5	m ²
Excavation - topsoil strip & stockpile	Assumed 300mm depth	£3	m ²
Provision & placing of concrete	Assumed Grade 40	£110	m ³
Reinforcement (provision & fix)	Assumed 1t per 9m ³ of reinforced concrete	£900	t
Trenchfill (Grade C20)	Allowance made for 1m depth (throughout length & width)	£75	m ³
Formwork (plain)		£50	m ²
Formwork (moulded feature)		£75	m ²
Granite finish to wall		£80	m ²
Filling - provision of topsoil		£16	m ³
Filling - topsoil	Assumed 300mm depth	£8.50	m ³
Finishing- grassing out		£1.05	m ²
Filling - provision of clay fill		£25	m ³
Filling - clay fill		£8.50	m ³
Geotextile mat		£3	m ²
Drainage		£35	m
Flap Valve	1800mm	£10,333.93	-

Assumptions made on Damage Assessment

The following assumptions and methods were used in the damage assessment:

- The damage assessment follows the MCM guidance;
- Finished floor levels of properties were taken to be 300mm above ground level;
- The average flood depth for any given event was taken at the centre of the property;
- Damage values were based on the MCM 2016 data;
- Intangible benefits were assumed and were calculated according to DEFRA Flood and Coastal Defence Project Appraisal Guidance (FCDPAG3), Economic Appraisal Supplementary Note to Operating Authorities, Revisions to Economic Appraisal on: Reflecting socio-economic equity in appraisal and Appraisal of human related intangible impacts of flooding;
- Damage values to houses and commercial properties were capped at their market value according to data supplied from Land & Property Services.

APPENDIX D

CONSTRUCTION COSTS

OPTION 2: CONCRETE WALLS

	Rate	Units	FID 0		FID 1		FID 2		FID 3		FID 4		FID 5		FID 6		FID 7		FID 8		FID 9		FID 10		FID 11		FID 12		FID 13		FID 14			
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost		
Reinforced concrete retaining wall																																		
Wall thickness		m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3		
Base thickness		m	0.30	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.30	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3		
Wall height		m	0.65	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	1.04	0.68	
Base width		m	0.954	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	1.336	0.975	
Length of section		m	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	50	19.69	
Main Elements																																		
Clearance - Vegetation killing	£230.00	ha	0.00	0.43	0.01	1.54	0.00	1.46	0.00	1.38	0.01	4.12	0.01	3.20	0.01	2.48	0.01	2.07	0.01	2.38	0.01	3.96	0.01	2.62	0.01	2.43	0.00	0.68	0.01	4.00	0.01	3.87		
Clearance - Site clearance & disposal	£5.00	m²	18.79	93.94	66.80	334.00	31.82	318.23	30.00	300.00	89.55	895.50	69.55	695.47	53.85	538.50	44.95	449.50	51.75	517.50	86.10	861.00	113.85	569.25	105.65	528.25	14.29	142.92	86.95	869.50	84.10	841.00		
Excavation - Topsoil strip & stockpile	£3.00	m²	18.79	56.36	66.80	200.40	31.82	95.47	30.00	90.00	89.55	268.65	69.55	208.64	53.85	161.55	44.95	134.85	51.75	155.25	86.10	258.30	113.85	341.55	105.65	316.95	14.29	42.87	86.95	260.85	84.10	252.30		
Base Slab - Provision & placing of concrete	£110.00	m³	5.64	620.01	20.04	2204.40	9.55	1050.16	9.00	990.00	26.87	2955.15	20.86	2295.05	18.16	1777.05	13.49	1483.35	15.53	1707.75	25.83	2841.30	34.16	3757.05	31.70	3486.45	4.29	471.62	26.09	2869.35	25.23	2775.30		
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	0.63	563.64	2.23	2004.00	1.06	954.69	1.00	900.00	2.99	2686.50	2.32	2096.41	1.80	1615.50	1.50	1348.50	1.73	1552.50	2.87	2583.00	3.80	3415.50	3.52	3169.50	0.48	428.75	2.90	2608.50	2.80	2523.00		
Base Slab - Trenchfill (Grade C20)	£75.00	m³	18.79	1409.11	66.80	5010.00	31.82	2386.73	30.00	2250.00	89.55	6716.25	69.55	5216.01	53.85	4038.75	44.95	3371.25	51.75	3881.25	86.10	6457.50	113.85	8538.75	105.65	7923.75	14.29	1071.86	86.95	6521.25	84.10	6307.50		
Base Slab - Formwork	£50.00	m²	11.82	590.82	30.00	1500.00	19.58	979.17	30.00	1500.00	30.00	1500.00	26.54	1327.23	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00
Wall - Provision & placing of concrete	£110.00	m³	2.09	230.07	11.04	1214.40	3.67	403.91	0.00	0.00	17.87	1965.15	12.90	1419.07	7.16	787.05	4.49	493.35	6.53	717.75	16.83	1851.30	25.16	2767.05	22.70	2496.45	1.66	182.28	17.09	1879.35	16.23	1785.30		
Wall - Reinforcement (Provision & Fix)	£900.00	t	0.23	209.15	1.23	1104.00	0.41	367.19	0.00	0.00	1.99	1786.50	1.43	1290.07	0.80	715.50	0.50	448.50	0.73	652.50	1.87	1683.00	2.80	2515.50	2.52	2269.50	0.18	165.71	1.90	1708.50	1.80	1623.00		
Wall - Formwork (textured on one side)	£75.00	m²	13.94	1045.75	73.60	5520.00	24.48	1835.94	0.00	0.00	119.10	8932.50	86.00	6450.34	47.70	3577.50	29.90	2242.50	43.50	3262.50	112.20	8415.00	167.70	12577.50	151.30	11347.50	11.05	828.56	113.90	8542.50	108.20	8115.00		
Drainage	£35.00	m	19.69	689.29	50.00	1750.00	32.64	1142.37	50.00	1750.00	50.00	1750.00	44.24	1548.44	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00
Traffic Management		Sum		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00		10000.00
Additional Work																																		
Sub-total				5508.57		30842.74		9535.32		7781.38		29460.32		22539.92		16463.88		13223.87		15699.98		28204.36		37734.77		44790.78		4285.07		28513.80		27476.27		
Preliminaries				826.29		4626.41		1430.30		1167.21		4419.05		3380.99		2469.58		1983.58		2354.91		4230.65		5660.22		6718.62		642.76		4277.07		4121.44		
TOTAL				£6,334.85		£35,469.15		£10,965.61		£8,948.59		£33,879.37		£25,920.91		£18,933.46		£15,207.45		£18,054.29		£32,435.01		£43,394.98		£51,509.40		£4,927.83		£32,790.87		£31,597.71		

	Rate	Units	FID 15		FID 16		FID 17		FID 18		FID 19		FID 20		FID 21		FID 22		FID 23		FID 24		FID 25		FID 26		FID 27		FID 28		FID 29	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Reinforced concrete retaining wall																																
Wall thickness		m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Base thickness		m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Wall height		m	0.99	0.79	0.75	0.60	0.34	0.56	0.00	0.88	0.00	0.49	0.00	1.66	0.00	1.66	0.00	1.66	0.00	1.66	0.00	1.66	0.00	2.08	0.00	1.22	0.00	0.96	0.00	0.61	0.00	
Base width		m	1.292	1.091	1.048	0.904	0.638	0.50	0.862	0.00	1.183	0.00	0.791	0.00	1.955	0.00	1.955	0.00	1.955	0.00	1.955	0.00	1.955	0.00	2.379	0.00	1.517	0.00	1.256	0.00	0.913	0.00
Length of section		m	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Main Elements																																
Clearance - Vegetation killing	£230.00	ha	0.01	2.97	0.01	2.51	0.01	2.41	0.00	2.08	0.00	1.47	0.00	0.99	0.01	1.36	0.00	1.07	0.01	1.45	0.01	4.09	0.00	1.74	0.01	5.47	0.01	3.49	0.01	2.89	0.00	2.10
Clearance - Site clearance & disposal	£5.00	m²	64.60	646.00	54.55	545.50	52.40	524.00	45.20	452.00	31.90	319.00	43.10	215.50	59.15	295.75	23.22	232.25	97.75	977.50	88.87	888.69	37.75	377.50	118.95	1189.50	75.85	758.50	62.80	628.00	45.65	456.50
Excavation - Topsoil strip & stockpile	£3.00	m²	64.60	193.80	54.55	163.65	52.40	157.20	45.20	135.60	31.90	95.70	43.10	129.30	59.15	177.45	23.22	69.67	97.75	293.25	88.87	266.61	37.75	113.25	118.95	356.85	75.85	227.55	62.80	188.40	45.65	136.95
Base Slab - Provision & placing of concrete	£110.00	m³	19.38	2131.80	16.37	1800.15	15.72	1729.20	13.56	1491.60	9.57	1052.70	12.93	1422.30	17.75	1951.95	6.97	766.41	29.33	3225.75	26.66	2932.67	11.33	1245.75	35.69	3925.35	22.76	2503.05	18.84	2072.40	13.70	1506.45
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	2.15	1938.00	1.82	1636.50	1.75	1572.00	1.51	1356.00	1.06	957.00	1.44	1293.00	1.97	1774.50	0.77	696.74	3.26	2932.50	2.96	2666.07	1									

Rate	Units	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost									
Reinforced concrete retaining wall																																		
Wall thickness	m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3								
Base thickness	m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3								
Wall height	m	1.66	0.00	1.29	0.00	0.58	0.00	0.98	0.00	2.47	0.00	2.92	0.00	1.44	0.00	0.56	0.00	3.28	0.00	2.72	0.00	3.13	0.00	3.26	0.00	1.51	0.00	1.41	0.00	1.77	0.00			
Base width	m	1.96		1.593		0.878		1.282		2.771		3.22		1.737		0.861		3.58		3.024		3.432		3.561		1.806		1.713		2.068				
Length of section	m	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00			
Main Elements																																		
Clearance - Vegetation killing	ha	0.01	4.51	0.01	3.66	0.00	0.11	0.01	2.95	0.01	6.37	0.02	7.41	0.01	4.00	0.00	0.24	0.02	4.12	0.02	6.96	0.02	7.89	0.02	8.19	0.01	3.60	0.01	3.94	0.01	4.76			
Clearance - Site clearance & disposal	m ²	98.00	980.00	79.65	796.50	2.37	23.66	64.10	641.00	138.55	1385.50	161.00	1610.00	86.85	868.50	10.30	51.51	179.00	895.00	151.20	1512.00	171.60	1716.00	178.05	1780.50	78.20	782.00	85.65	856.50	103.40	1034.00			
Excavation - Topsoil strip & stockpile	m ²	98.00	294.00	79.65	238.95	2.37	7.10	64.10	192.30	138.55	415.65	161.00	483.00	86.85	260.55	10.30	30.91	179.00	537.00	151.20	453.60	171.60	514.80	178.05	534.15	78.20	234.60	85.65	256.95	103.40	310.20			
Base Slab - Provision & placing of concrete	£110.00	29.40	3234.00	23.90	2628.45	0.71	78.98	19.23	2115.30	41.57	4572.15	48.30	5313.00	26.08	2868.05	3.09	339.96	53.70	5907.00	45.36	4989.60	51.48	5662.80	53.42	5875.85	23.46	2580.65	25.70	2828.45	31.02	3412.20			
Base Slab - Reinforcement (Provision & Fix)	£900.00	3.27	2940.00	2.66	2389.50	0.08	70.89	2.14	1923.00	4.62	4156.50	5.37	4830.00	2.90	2605.50	0.34	309.06	5.97	5370.00	5.04	4536.00	5.72	5148.00	5.94	5341.50	2.61	2346.05	2.86	2569.50	3.45	3102.00			
Base Slab - Trenchfill (Grade C20)	£75.00	m ²	98.00	7350.00	79.65	5973.75	2.37	177.47	64.10	4807.50	138.55	10391.25	161.00	12075.00	86.85	6513.75	10.30	772.64	179.00	13425.00	151.20	11340.00	171.60	12870.00	178.05	13353.75	78.20	5865.12	85.65	6423.75	103.40	7755.00		
Base Slab - Formwork	£50.00	m ²	30.00	1500.00	30.00	1500.00	1.62	80.85	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	7.18	358.95	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	25.98	1299.03	30.00	1500.00	30.00	1500.00		
Wall - Provision & placing of concrete	£110.00	m ²	20.40	2244.00	14.90	1638.45	0.22	24.72	10.23	1123.30	32.57	3582.15	39.30	4323.00	17.06	1876.05	0.94	103.05	44.70	4917.00	36.36	3999.60	42.48	4672.80	44.42	4885.65	15.67	1723.29	16.70	1836.45	22.02	2422.20		
Wall - Reinforcement (Provision & Fix)	£900.00	t	2.27	2040.00	1.66	1489.50	0.02	22.48	1.14	1023.00	3.62	3256.50	4.37	3930.00	1.90	1705.50	0.10	93.69	4.97	4470.00	4.04	3636.00	4.72	4248.00	4.94	4441.50	1.74	1566.63	1.86	1669.50	2.45	2202.00		
Wall - Formwork (textured on one side)	£75.00	m ²	136.00	10200.00	99.30	7447.50	1.50	112.38	68.20	5115.00	217.10	16282.50	262.00	19650.00	113.70	8527.50	6.25	468.43	298.00	22350.00	242.40	18180.00	283.20	21240.00	296.10	22207.50	104.44	7833.15	111.30	8347.50	146.80	11010.00		
Drainage	£35.00	m	50.00	1750.00	50.00	1750.00	2.70	94.33	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	11.97	418.78	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	43.30	1515.54	50.00	1750.00	50.00	1750.00
Traffic Management		Sum																																
Additional Work																																		
Sub-total			32536.51		25856.26		692.16		20195.35		47298.57		55471.41		28477.40		2947.20		71125.12		51903.76		59330.29		61678.39		25749.68		28040.54		34502.36			
Preliminaries			4880.48		3878.44		103.82		3029.30		7094.79		8320.71		4271.61		442.08		10668.77		7785.56		8899.54		9251.76		3862.45		4206.08		5175.35			
TOTAL			£37,416.98		£29,734.70		£795.99		£23,224.65		£54,383.36		£63,792.12		£32,749.00		£3,389.29		£81,793.88		£59,689.32		£68,229.84		£70,830.15		£29,612.13		£32,246.62		£38,677.71			

Rate	Units	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost							
Reinforced concrete retaining wall																																
Wall thickness	m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3						
Base thickness	m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3						
Wall height	m	1.60	0.00	1.64	0.00	1.51	0.00	0.58	0.00	0.40	0.00	0.95	0.00	1.10	0.00	1.05	0.00	1.87	0.00	1.86	0.00	2.14	0.00	1.87	0.00	2.53	0.00	1.47	0.00	1.05	0.00	
Base width	m	1.896		1.939		1.808		0.875		0.702		1.248		1.404		1.353		2.172		2.157		2.442		2.172		2.831		1.766		1.354		
Length of section	m	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	
Main Elements																																
Clearance - Vegetation killing	ha	0.01	4.36	0.01	4.46	0.01	2.08	0.00	1.01	0.00	1.61	0.01	2.87	0.01	3.23	0.01	3.11	0.01	5.00	0.01	4.96	0.01	5.62	0.01	5.00	0.00	1.05	0.01	2.03	0.01	3.11	
Clearance - Site clearance & disposal	£5.00	m ²	94.80	948.00	96.95	969.50	90.40	452.00	43.75	218.75	35.10	351.00	62.40	624.00	70.20	702.00	67.65	676.50	108.60	1086.00	107.85	1078.50	122.10	1221.00	108.60	1086.00	45.46	227.32	88.30	441.50	67.70	677.00
Excavation - Topsoil strip & stockpile	£3.00	m ²	94.80	284.40	96.95	290.85	90.40	271.20	43.75	131.25	35.10	105.30	62.40	187.20	70.20	210.60	67.65	202.95	108.60	325.80	107.85	323.55	122.10	366.30	108.60	325.80	45.46	136.39	88.30	264.90	67.70	203.10
Base Slab - Provision & placing of concrete	£110.00	m ²	28.44	3128.40	29.09	3199.35	27.12	2983.20	13.13	1443.75	10.53	1158.30	18.72	2059.20	21.06	2316.60	20.30	2232.45	32.58	3583.80	32.36	3559.05	36.63	4029.30	32.58	3583.80	13.64	1500.28	26.49	2913.90	20.71	2234.10
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	3.16	2844.00	3.23	2908.50	3.01	2712.00	1.46	1312.50	1.17	1053.00	2.08	1872.00	2.34	2106.00	2.26	2029.50	3.62	3258.00	3.60	3235.50	4.07	3663.00	3.62	3258.00	1.52	1363.89	2.94	2649.00	2.26	2031.00
Base Slab - Trenchfill (Grade C20)	£75.00	m ²	94.80	7110.00	96.95	7271.25	90.40	43.75	3281.25	35.10	2632.50	62.40	4680.00	70.20	5265.00	67.65	5073.75	108.60	8145.00	107.85	8088.75	122.10	9157.50	108.60	8145.00	45.46	3409.73	88.30	6622.50	67.70	5077.50	
Base Slab - Formwork	£50.00	m ²	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	9.64	481.77	30.00	1500.00	30.00	1500.00
Wall - Provision & placing of concrete	£110.00	m ²	19.44	2138.40	20.09	2209.35	18.12	1993.20	4.13	453.75	1.53	168.30	9.72	1069.20	12.06	1326.60	11.30	1242.45	23.58	2593.80	23.36	2569.05	27.63	3039.30	23.58	2593.80	10.75	1182.31	17.49	1923.90	11.31	1244.10
Wall - Reinforcement (Provision & Fix)	£900.00	t	2.16	1944.00	2.23	2008.50	2.01	1812.00	0.46	412.50	0.17	153.00	1.08	972.00	1.34	1206.00	1.26	1129.50	2.62	2358.00	2.60	2335.50	3.07	2763.00	2.62	2358.00	1.19	1074.83	1.94	1749.00	1.26	1131.00
Wall - Formwork (textured on one side)	£75.00	m ²	129.60	9720.00	133.90	10																										

Description	Rate	Units	FID 123		FID 124		FID 125		FID 126		FID 127		FID 128		FID 129		FID 130		FID 131		FID 132		FID 133		FID 134		FID 135		FID 136		FID 137	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Reinforced concrete retaining wall																																
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Base thickness	£5.00	m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Wall height		m	1.57	0.00	2.25	0.00	1.64	0.00	1.45	0.00	3.45	0.00	1.95	0.00	2.51	0.00	1.86	0.00	1.23	0.00	1.38	0.00	0.50	0.00	0.38	0.00	1.21	0.00	1.55	0.00	1.52	0.00
Base width		m	1.874		2.551		1.936		1.748		3.746		2.251		2.805		2.162		1.533		1.682		0.803		0.675		1.513		1.846		1.816	
Length of section		m	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	11.40	0.00	50.00	0.00	50.00	0.00	22.79	0.00	50.00	0.00	50.00	0.00	26.52	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00
Main Elements																																
Clearance - Vegetation killing	£230.00	ha	0.01	4.31	0.01	5.87	0.01	4.45	0.01	4.02	0.00	1.96	0.01	5.18	0.01	6.45	0.00	1.13	0.01	1.76	0.01	3.87	0.00	0.98	0.00	1.55	0.01	3.48	0.01	4.25	0.01	4.18
Clearance - Site clearance & disposal	£5.00	m²	93.70	937.00	127.55	1275.50	96.80	968.00	87.40	874.00	42.70	427.00	112.55	1125.50	140.25	1402.50	49.27	246.33	76.65	383.25	84.10	420.50	21.29	106.45	33.75	168.75	75.65	378.25	92.30	461.50	90.80	454.00
Excavation - Topsoil strip & stockpile	£3.00	m²	281.10	843.30	127.55	382.65	96.80	290.40	87.40	262.20	42.70	128.10	112.55	337.65	140.25	420.75	49.27	147.80	76.65	229.95	84.10	252.30	21.29	63.87	33.75	101.25	75.65	226.95	92.30	276.90	90.80	272.40
Base Slab - Provision & placing of concrete	£110.00	m²	28.11	3092.10	36.27	4009.15	29.04	3194.40	26.22	2884.20	12.81	1409.25	33.77	3714.15	42.08	4629.25	14.78	1625.76	23.00	2529.45	25.23	2775.30	6.38	702.62	10.13	1113.75	22.70	2496.45	27.69	3045.90	27.24	2996.40
Base Slab - Reinforcement (Provision & Fix)	£300.00	t	3.12	2811.00	4.25	3825.50	3.23	2904.00	2.91	2622.00	1.42	1281.13	3.75	3375.00	4.68	4207.50	1.64	1477.96	2.56	2299.50	2.80	2523.00	0.71	638.75	1.13	1012.50	2.52	2269.50	3.08	2789.00	3.03	2724.00
Base Slab - Trenchfill (Grade C20)	£75.00	m²	93.70	7027.50	127.55	9566.25	96.80	7260.00	87.40	6555.00	42.70	3202.83	112.55	8441.25	140.25	10518.75	49.27	3694.91	76.65	5748.75	84.10	6307.50	21.29	1596.87	33.75	2531.25	75.65	5673.75	92.30	6922.50	90.80	6810.00
Base Slab - Formwork	£50.00	m²	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	6.84	342.00	30.00	1500.00	30.00	1500.00	13.67	683.61	30.00	1500.00	30.00	1500.00	15.91	795.45	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00
Wall - Provision & placing of concrete	£110.00	m²	19.11	2102.10	29.27	3219.15	20.04	2204.40	17.22	1894.20	10.76	1183.53	24.77	2724.15	33.08	3638.25	10.68	1174.58	14.00	1539.45	16.23	1785.30	1.61	177.62	1.13	123.75	13.70	1506.45	18.69	2055.90	18.24	2006.40
Wall - Reinforcement (Provision & Fix)	£900.00	t	2.12	1911.00	3.25	2926.50	2.23	2004.00	1.91	1722.00	1.20	1075.93	2.75	2476.50	3.68	3307.50	1.19	1067.80	1.56	1399.50	1.80	1623.00	0.18	161.48	0.13	112.50	1.52	1369.50	2.08	1869.00	2.03	1824.00
Wall - Formwork (textured on one side)	£75.00	m²	127.40	9555.00	195.10	14632.50	133.60	10020.00	114.80	8610.00	71.73	5379.66	165.10	12382.50	220.50	16537.50	71.19	5338.99	93.30	6997.50	108.20	8115.00	10.77	807.38	7.50	562.50	91.30	6847.50	124.60	9345.00	121.60	9120.00
Drainage	£35.00	m	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	11.40	399.00	50.00	1750.00	50.00	1750.00	22.79	797.55	50.00	1750.00	50.00	1750.00	26.52	928.03	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00
Traffic Management		Sum																														
Additional Work																																
Sub-total				30971.11		43294.07		32099.65		28677.62		14830.45		37833.38		47917.45		16256.42		34379.11		27476.27		6085.96		9146.55		24400.08		30461.45		29915.38
Preliminaries				4645.67		6494.11		4814.95		4301.84		2224.57		5675.01		7187.62		2438.46		5156.87		4121.44		912.89		1371.98		3660.01		4569.22		4487.31
TOTAL				£35,616.78		£49,788.18		£36,914.60		£32,979.26		£17,055.01		£43,508.38		£55,105.07		£18,694.89		£39,535.98		£31,597.71		£6,996.85		£10,516.54		£28,060.09		£35,030.66		£34,402.68

Description	Rate	Units	FID 138		FID 139		FID 140		FID 141		FID 142		FID 143		FID 144		FID 145		FID 146		FID 147		FID 148		FID 149		FID 150		FID 151		FID 152	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Reinforced concrete retaining wall																																
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Wall height		m	1.63	0.00	0.30	0.00	2.65	0.00	2.07	0.00	1.83	0.00	1.05	0.00	0.30	0.00	0.67	0.00	1.09	0.00	1.41	0.00	1.65	0.00	1.94	0.00	1.63	0.00	2.32	0.00	2.58	0.00
Base width		m	1.931		0.6		2.949		2.372		1.351		0.965		1.385		1.71		1.951		1.71		1.951		2.24		1.928		2.624		2.876	
Length of section		m	50.00	0.00	4.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	7.62	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00
Main Elements																																
Clearance - Vegetation killing	£230.00	ha	0.01	4.44	0.00	0.11	0.01	3.39	0.01	2.73	0.01	4.90	0.00	0.21	0.00	2.22	0.01	3.19	0.01	3.93	0.01	4.49	0.01	5.15	0.01	2.22	0.01	3.02	0.01	6.61		
Clearance - Site clearance & disposal	£5.00	m²	96.55	965.50	2.40	24.00	147.45	737.25	118.60	593.00	106.60	533.00	67.55	337.75	45.72	228.60	69.25	346.25	69.25	346.25	85.50	427.50	97.55	487.75	112.00	560.00	96.40	482.00	131.20	656.00	143.80	719.00
Excavation - Topsoil strip & stockpile	£3.00	m²	96.55	289.65	2.40	7.20	147.45	442.35	118.60	355.80	106.60	319.80	67.55	202.65	45.72	137.16	48.25	144.75	69.25	207.75	85.50	256.50	97.55	292.65	112.00	336.00	96.40	289.20	131.20	393.60	143.80	431.40
Base Slab - Provision & placing of concrete	£110.00	m²	28.97	3186.15	0.72	79.26	44.24	4865.85	35.58	3913.80	31.98	3517.80	20.27	2229.15	1.37	150.88	14.48	1592.25	20.78	2285.25	25.65	2821.50	29.27	3219.15	33.60	3696.00	28.92	3181.20	39.36	4329.60	43.14	4745.40
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	3.22	2896.50	0.08	72.05	4.92	4423.50	3.95	3558.00	3.55	3198.00	2.25	2462.50	0.15	137.16	1.61	1447.50	2.31	2077.50	2.85	2565.00	3.25	2926.50	3.73	3360.00	3.21	2892.00	4.37	3936.00	4.79	4314.00
Base Slab - Formwork	£50.00	m²	96.55	4827.50	2.40	120.00	147.45	7372.50	118.60	5930.00	106.60	5330.00	67.55	3377.50	45.72	2286.00	69.25	3462.50	69.25	3462.50	85.50	4275.00	97.55	4877.50	112.00	5600.00	96.40	4820.00	131.20	6560.00	143.80	7190.00
Wall - Provision & placing of concrete	£110.00	m²	30.00	3300.00	2.40	264.00	120.00	1320.00	30.00	3300.00	30.00	3300.00	30.00	3300.00	30.00	3300.00	6.84	748.80	30.00	3300.00	30.00	3300.00	30.00	3300.00	30.00	3300.00	30.00	3300.00	30.00	3300.00	30.00	3300.00
Wall - Reinforcement (Provision & Fix)	£900.00	t	19.97	17973.00	0.00	0.00	35.24	317.16	26.58	2392.20	22.98	20683.80	11.27	10143.00	4.57	4113.00	5.48	4932.00	11.78	10602.00	16.65	15000.00	20.27	18243.00	24.60	22140.00	30.36	27324.00	34.14	30750.00	37.50	33750.00
Wall - Formwork (textured on one side)	£75.00	m²	2.22	166.50	0.00	0.00	3.92	2940.00	2.95	2212.50	2.55	1912.50	1.25	937.50	0.00	0																

OPTION 3: REINFORCED CONCRETE WALLS & FLAP VALVE

	Rate	Units	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost					
Reinforced concrete retaining wall																																	
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3				
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3				
Wall height		m	0.78	0.00	0.90	0.00	1.47	0.00	1.82	0.00	1.92	0.00	1.69	0.00	1.56	0.00	0.63	0.00	0.45	0.00	0.99	0.00	1.15	0.00	1.10	0.00	1.92	0.00	1.91	0.00			
Base width		m	1.056		1.197		1.765		2.217		1.99		1.859		0.927		0.748		1.294		1.45		1.402		2.222		2.207		2.493				
Length of section		m	1.13	0.00	19.77	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00			
Main Elements																																	
Clearance - Vegetation killing	£230.00	ha	0.00	0.03	0.00	0.54	0.01	4.06	0.01	4.87	0.01	5.10	0.01	4.58	0.01	4.28	0.00	2.13	0.00	1.72	0.01	2.98	0.01	1.67	0.01	1.61	0.01	5.11	0.01	5.08	0.01	5.73	
Clearance - Site clearance & disposal	£5.00	m²	1.19	5.97	23.66	118.29	88.25	882.50	105.95	1059.50	110.85	1108.50	99.50	995.00	92.95	929.50	46.35	463.50	37.40	374.00	64.70	647.00	72.50	362.50	70.10	350.50	111.10	1111.00	110.35	1103.50	124.65	1246.50	
Excavation - Topsoil strip & stockpile	£3.00	m²	1.19	3.57	23.66	70.98	88.25	264.75	105.95	317.85	110.85	332.55	99.50	298.50	92.95	278.85	46.35	139.05	37.40	112.20	64.70	194.10	72.50	217.50	70.10	210.30	111.10	333.30	110.35	331.05	124.65	373.95	
Base Slab - Provision & placing of concrete	£110.00	m²	0.36	39.38	7.10	780.74	26.48	2912.25	31.79	3496.35	33.26	3658.05	29.85	3283.50	27.89	3067.35	13.91	1529.55	11.22	1234.20	19.41	2135.10	21.75	2392.50	21.03	2313.30	33.33	3666.30	33.11	3641.55	37.40	4113.45	
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	0.04	35.80	0.79	709.76	2.94	2647.50	3.53	3178.50	3.70	3325.50	3.32	2985.00	3.10	2788.50	1.55	1422.00	1.25	1122.00	2.42	2135.10	2.42	2175.00	2.34	2103.00	3.70	3333.00	3.68	3310.50	4.16	3739.50	
Base Slab - Formwork (Grade C20)	£75.00	m²	1.19	89.50	23.66	1774.40	88.25	6618.75	105.95	7946.25	110.85	8313.75	99.50	7462.50	92.95	6971.25	46.35	3476.25	37.40	2805.00	64.70	4852.50	72.50	5437.50	70.10	5257.50	111.10	8332.50	110.35	8276.25	124.65	9348.75	
Base Slab - Provision & placing of concrete	£50.00	m²	0.68	33.90	11.86	592.95	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	
Wall - Provision & placing of concrete	£110.00	m²	0.15	17.00	3.54	389.39	17.48	1922.25	22.79	2506.35	24.26	2668.05	20.85	2293.50	18.89	2077.35	4.91	539.55	2.22	244.20	10.41	1145.10	12.75	1402.50	12.03	1323.30	24.33	2676.30	24.11	2651.55	28.40	3123.45	
Wall - Reinforcement (Provision & Fix)	£900.00	t	0.02	15.46	0.39	353.99	1.94	1747.50	2.53	2278.50	2.70	2425.50	2.32	2085.00	2.10	1888.50	0.55	490.50	0.25	222.00	1.16	1041.00	1.42	1275.00	1.34	1203.00	2.70	2433.00	2.68	2410.50	3.16	2839.50	
Wall - Formwork (textured on one side)	£75.00	m²	1.03	77.29	23.60	1769.96	116.50	8737.50	151.90	11392.50	161.70	12127.50	139.00	10425.00	125.90	9442.50	32.70	2452.50	14.80	1110.00	69.40	5205.00	85.00	6375.00	80.20	6015.00	162.20	12165.00	160.70	12052.50	189.30	14197.50	
Wall - Granite finish	£80.00	m²			-2.04	-162.86																											
Drainage	£35.00	m	1.13	39.55	19.77	691.78	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	
Traffic Management		Sum				10000.00																											
Additional Work																																	
Sub-total				357.45		17089.91		28987.06		35430.67		37214.50		33082.58		30698.08		13733.53		10475.32		20413.78		22889.17		32027.51		37305.51		37032.48		42238.33	
Preliminaries				53.62		2563.49		4348.06		5314.60		5582.17		4962.39		4604.71		2060.03		1571.30		3062.07		3433.38		4804.13		5595.83		5554.87		6335.75	
TOTAL				£411.07		£19,653.40		£33,335.12		£40,745.27		£42,796.67		£38,046.96		£35,302.79		£15,793.56		£12,048.62		£23,475.84		£26,322.54		£36,831.64		£42,901.34		£42,587.35		£48,574.08	

	Rate	Units	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost		
Reinforced concrete retaining wall																																
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Wall height		m	1.92	0.00	2.58	0.00	1.52	0.00	1.11	0.00	0.61	0.00	0.79	0.00	1.30	0.00	1.49	0.00	0.99	0.00	0.36	0.00	1.07	0.00	1.46	0.00	1.61	0.00	1.18	0.00	1.29	0.00
Base width		m	2.223		2.883		1.818		1.405		0.914		1.088		1.595		1.785		1.29		0.661		1.366		1.758		1.905		1.477		1.594	
Length of section		m	50.00	0.00	16.06	0.00	50.00	0.00	50.00	0.00	50.00	0.00	4.27	0.00	50.00	0.00	50.00	0.00	50.00	0.00	4.01	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00
Main Elements																																
Clearance - Vegetation killing	£230.00	ha	0.01	5.11	0.00	2.13	0.01	4.18	0.01	3.23	0.00	2.10	0.00	0.11	0.01	1.83	0.01	4.11	0.01	2.97	0.00	0.12	0.01	3.14	0.01	4.04	0.01	4.38	0.01	3.40	0.01	3.67
Clearance - Site clearance & disposal	£5.00	m²	111.15	1111.50	46.30	462.98	90.90	909.00	70.25	702.50	45.70	457.00	4.65	23.25	79.75	398.75	89.25	892.50	64.50	645.00	2.65	26.53	68.30	683.00	87.90	879.00	95.25	952.50	73.85	738.50	79.70	797.00
Excavation - Topsoil strip & stockpile	£3.00	m²	111.15	333.45	46.30	138.89	90.90	272.70	70.25	210.75	45.70	137.10	4.65	13.95	79.75	239.25	89.25	267.75	64.50	193.50	2.65	7.96	68.30	204.90	87.90	263.70	95.25	285.75	73.85	221.55	79.70	239.10
Base Slab - Provision & placing of concrete	£110.00	m²	33.33	3667.95	13.89	1527.94	27.27	2999.70	21.08	2318.25	13.71	1508.10	1.39	153.42	23.33	2581.75	26.78	2945.35	19.36	2128.50	0.83	87.56	20.49	2253.90	28.58	3143.25	22.16	2437.05	23.91	2630.10	29.71	3263.10
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	3.71	3334.50	1.54	1388.94	3.03	2727.00	2.34	2107.50	1.52	1371.00	0.15	139.47	2.66	2392.50	2.98	2677.50	2.15	1935.00	0.09	79.60	2.28	2049.00	2.93	2637.00	3.18	2857.50	2.46	2215.50	2.66	2391.00
Base Slab - Formwork (Grade C20)	£75.00	m²	111.15	8336.25	46.30	3472.36	90.90	6817.50	70.25	5268.75	45.70	3427.50	4.65	348.68	79.75	5981.25	89.25	6693.75	64.50	4837.50	2.65	198.99	68.30	5122.50	87.90	6592.50	95.25	7143.75	73.85	5538.75	79.70	5977.50
Base Slab - Formwork	£50.00	m²	30.00	1500.00	9.64	481.77	30.00	1500.00	30.00	1500.00	30.00	1500.00	2.56	128.19	30.00	1500.00	30.00	1500.00	30.00	1500.00	2.41	120.42	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00
Wall - Provision & placing of concrete	£110.00	m²	24.35	2677.95	11.00	1209.87	18.27	2009.70	12.08	1328.25	4.71	518.10	6.81	749.37	14.93	1641.75	17.78	1955.25	10.35	1138.63	0.07	8.08	11.49	1263.90	17.37	1910.70	19.58	2153.25	13.16	1447.05	14.91	1640.10
Wall - Reinforcement (Provision & Fix)	£900.00	t	2.71	2434.50	1.22	1099.88	2.03	1827.00	1.34	1207.50	0.52																					

	Rate	Units	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost			
			FID 63	FID 64	FID 65	FID 66	FID 67	FID 68	FID 69	FID 70	FID 71	FID 72	FID 73	FID 74	FID 75	FID 76	FID 77																
Reinforced concrete retaining wall																																	
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		
Wall height		m	2.24	0.00	2.55	0.00	1.28	0.00	2.20	0.00	2.60	0.00	3.34	0.00	2.73	0.00	0.52	0.00	2.14	0.00	1.28	0.00	1.02	0.00	0.72	0.00	0.68	0.00	0.00		0.00		
Base width		m	2.54		2.85		1.58		2.497		2.578		2.904		3.643		3.147		3.026		2.441		1.322		1.579		1.022		0.975		0.00		
Length of section		m	50.00	0.00	32.62	0.00	50.00	0.00	50.00	0.00	50.00	0.00	42.33	0.00	50.00	0.00	50.00	0.00	39.31	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00		
Main Elements																																	
Clearance - Vegetation killing	£230.00	ha	0.01	5.84	0.01	4.28	0.01	3.63	0.01	5.74	0.01	5.93	0.01	6.65	0.02	8.38	0.02	3.62	0.01	2.74	0.00	1.88	0.01	5.61	0.01	3.63	0.01	3.04	0.00	0.87	0.00	2.24	
Clearance - Site clearance & disposal	£5.00	m²	127.00	1270.00	92.97	929.73	79.00	790.00	124.85	1248.50	128.90	1289.00	122.91	1229.12	182.15	1821.50	157.35	786.75	118.95	594.75	40.85	408.50	122.05	1220.50	78.95	789.50	66.10	661.00	18.97	189.72	48.75	487.50	
Excavation - Topsoil strip & stockpile	£3.00	m²	127.00	381.00	92.97	278.92	79.00	237.00	124.85	374.55	128.90	386.70	122.91	368.74	182.15	546.45	157.35	472.05	118.95	356.85	40.85	122.55	122.05	366.15	78.95	236.85	66.10	198.30	18.97	56.92	48.75	146.25	
Base Slab - Provision & placing of concrete	£110.00	m²	38.10	4191.00	27.89	3068.10	23.70	2607.00	37.46	4120.05	36.87	4053.00	36.87	4053.00	54.65	6010.95	47.21	5192.55	35.68	3925.32	12.26	1348.05	36.62	4027.65	23.69	2605.35	19.83	2181.30	5.69	626.09	14.63	1608.75	
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	4.23	3810.00	3.10	2789.18	2.63	2370.00	4.16	3745.50	4.37	3967.00	4.10	3687.35	6.07	5464.50	5.25	4720.50	3.96	3568.47	1.36	1225.50	4.07	3661.50	2.63	2368.50	2.20	1983.00	0.63	569.17	1.63	1462.50	
Base Slab - Trenchfill (Grade C20)	£75.00	m³	127.00	9525.00	92.97	6972.95	79.00	5925.00	124.85	9363.75	128.90	9667.50	122.91	9218.39	182.15	13661.25	157.35	11801.25	118.95	8921.18	40.85	3063.75	122.05	9153.75	78.95	5921.25	66.10	4957.50	18.97	1422.93	48.75	3656.25	
Base Slab - Formwork	£50.00	m²	30.00	1500.00	19.57	978.66	30.00	1500.00	30.00	1500.00	30.00	1500.00	25.41	1269.75	30.00	1500.00	30.00	1500.00	23.59	1179.27	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	11.14	556.92	30.00	1500.00	
Wall - Provision & placing of concrete	£110.00	m²	29.10	3201.00	22.02	2422.18	14.70	1617.00	28.46	3130.05	29.67	3263.70	29.26	3218.05	45.65	5020.95	38.21	4202.55	28.61	3147.00	3.26	358.05	27.62	3037.65	14.69	1615.35	10.83	1191.30	2.35	258.52	5.63	618.75	
Wall - Reinforcement (Provision & Fix)	£900.00	t	3.23	2910.00	2.45	2201.99	1.83	1470.00	3.16	2845.50	3.30	2967.00	3.25	2925.50	5.07	4564.50	4.25	3820.50	3.18	2860.91	0.38	325.50	3.07	2761.50	1.63	1468.50	1.20	1083.00	0.26	235.02	0.63	562.50	
Wall - Formwork (textured on one side)	£75.00	m²	194.00	14550.00	146.80	11009.99	98.00	7350.00	189.70	14227.50	197.80	14835.00	195.00	14627.52	304.30	22822.50	254.70	19102.50	190.73	14304.55	21.70	1627.50	184.10	13807.50	97.90	7342.50	72.20	5415.00	15.67	1175.10	37.50	2812.50	
Wall - Granite finish	£80.00	m²																															
Drainage	£35.00	m	50.00	1750.00	32.62	1141.77	50.00	1750.00	50.00	1750.00	50.00	1750.00	42.33	1481.38	50.00	1750.00	50.00	1750.00	39.31	1375.82	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	18.56	649.74	50.00	1750.00	
Traffic Management		Sum																															
Additional Work																																	
Sub-total				43093.84		31797.68		25619.63		42311.14		43785.53		42087.54		63170.98		53352.27		50236.83		11731.28		41291.81		25601.43		20923.44		5741.01		14607.24	
Preliminaries				6464.08		4769.65		3842.95		6346.67		6567.83		6313.13		9475.65		8002.84		7535.53		1759.69		6193.77		3840.21		3138.52		861.15		2191.09	
TOTAL				£49,557.92		£36,567.33		£29,462.58		£48,657.81		£50,353.36		£48,400.67		£72,646.63		£61,355.11		£57,772.36		£13,490.97		£47,485.59		£29,441.65		£24,061.96		£6,602.16		£16,798.33	

	Rate	Units	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost		
			FID 78	FID 79	FID 80	FID 81	FID 82	FID 83	FID 84	FID 85	FID 86	FID 87	FID 88	FID 89	FID 90	FID 91	FID 92															
Reinforced concrete retaining wall																																
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Wall height		m	0.78	0.00	0.89	0.00	0.99	0.00	0.99	0.00	1.92	0.00	2.75	0.00	2.88	0.00	2.77	0.00	2.81	0.00	2.72	0.00	1.80	0.00	0.42	0.00	0.62	0.00	1.57	0.00	2.24	0.00
Base width		m	1.056		1.19		1.19		0.887		2.122		3.054		3.153		3.069		3.114		3.017		1.897		0.715		0.916		1.569		2.544	
Length of section		m	18.05	0.00	50.00	0.00	45.43	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	18.78	0.00	50.00	0.00	50.00	0.00	50.00	
Main Elements																																
Clearance - Vegetation killing	£230.00	ha	0.00	0.88	0.01	2.74	0.01	1.24	0.00	1.02	0.01	4.88	0.02	7.02	0.02	7.25	0.02	7.06	0.02	7.16	0.02	6.94	0.01	4.36	0.00	0.62	0.00	1.05	0.01	2.15	0.01	5.85
Clearance - Site clearance & disposal	£5.00	m²	19.07	190.65	59.50	595.00	54.11	270.56	44.35	221.75	106.10	1061.00	152.70	1527.00	157.65	1576.50	153.45	1534.50	155.70	1557.00	150.85	1508.50	94.85	948.50	13.43	134.26	45.80	229.00	93.45	467.25	127.20	1272.00
Excavation - Topsoil strip & stockpile	£3.00	m²	19.07	57.20	59.50	178.50	54.11	162.34	44.35	133.05	106.10	318.30	152.70	458.10	157.65	472.95	153.45	460.35	155.70	467.10	150.85	452.55	94.85	284.55	13.43	40.28	45.80	137.40	93.45	280.35	127.20	381.60
Base Slab - Provision & placing of concrete	£110.00	m²	5.72	629.15	17.85	1963.50	16.23	1785.69	13.31	1463.55	31.83	3501.30	45.81	5039.10	47.30	5202.45	46.04	5063.85	46.71	5136.10	45.26	4978.05	28.46	3130.05	4.03	443.04	13.74	1511.40	28.04	3083.85	38.16	4197.60
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	0.64	571.95	1.98	1785.00	1.80	1623.36	1.48	1330.50	3.54	3183.00	5.09	4581.00	5.26	4729.50	5.12	4603.50	5.19	4671.00	5.03	4525.50	3.16	2845.50	0.45	402.77	1.53	1374.00	3.12	2803.50	4.24	3816.00
Base Slab - Trenchfill (Grade C20)	£75.00	m³	19.07	1429.88	59.50	4462.50	54.11	4058.39	44.35	3326.25	106.10	7957.50	152.70	11452.50	157.65	11823.75	153.45	11508.75	155.70	11677.50	150.85	11313.75	94.85	7113.75	13.43	1006.92	45.80	3425.00	93.45	7038.75	127.20	9540.00
Base Slab - Formwork	£50.00	m²	10.83	541.62	30.00	1500.00	27.26	1363.02	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	11.27	563.31	30.00	1500.00	30.00	1500.00	30.00	1500.00
Wall - Provision & placing of concrete	£110.00	m²																														

	Rate	Units	FID 123		FID 124		FID 125		FID 126		FID 127		FID 128		FID 129		FID 130		FID 131		FID 132		FID 133		FID 134		FID 135		FID 136		FID 137			
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost		
Reinforced concrete retaining wall																																		
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
Wall height		m	1.19	0.00	1.71	0.00	1.13	0.00	2.60	0.00	3.03	0.00	1.51	0.00	0.62	0.00	3.35	0.00	2.79	0.00	3.20	0.00	3.32	0.00	1.56	0.00	1.36	0.00	1.80	0.00	2.34	0.00		
Base width		m	1.485		2.012		1.425		2.898		3.334		1.811		0.924		3.651		3.093		3.501		3.617		1.858		1.662		2.099		2.638			
Length of section		m	50.00	0.00	9.17	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	11.97	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	43.30	0.00	50.00	0.00	50.00	0.00	50.00	0.00		
Main Elements																																		
Clearance - Vegetation killing	£230.00	ha	0.01	3.42	0.00	0.85	0.01	3.29	0.01	6.67	0.02	7.67	0.01	4.17	0.00	0.51	0.02	4.20	0.02	3.56	0.02	8.05	0.02	8.32	0.01	3.70	0.01	3.82	0.01	4.83	0.01	6.07		
Clearance - Site clearance & disposal	£5.00	m²	74.25	742.50	18.46	184.58	71.25	712.50	144.90	1449.00	166.70	1667.00	90.55	905.50	11.06	110.56	182.55	912.75	154.65	773.25	175.05	1750.50	180.85	1808.50	80.45	804.50	83.10	831.00	104.95	1049.50	131.90	1319.00		
Excavation - Topsoil strip & stockpile	£3.00	m²	74.25	222.75	18.46	55.37	71.25	213.75	144.90	434.70	166.70	500.10	90.55	271.65	11.06	33.17	182.55	547.65	154.65	463.95	175.05	525.15	180.85	542.55	80.45	241.36	83.10	249.30	104.95	314.85	131.90	395.70		
Base Slab - Provision & placing of concrete	£110.00	m²	22.28	2450.25	5.54	609.12	21.38	2351.25	43.47	4781.70	50.01	5501.10	27.17	2988.15	3.32	364.84	54.77	6024.15	46.40	5103.45	52.52	5776.65	54.26	5968.05	24.14	2654.96	24.93	2742.30	31.49	3463.35	39.57	4352.70		
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	2.48	2227.50	0.62	553.74	2.38	2137.50	4.83	4347.00	5.56	5001.00	3.02	2716.50	0.37	331.67	6.09	5476.50	5.16	4639.50	5.84	5251.50	6.03	5425.50	2.68	2413.60	2.77	2493.00	3.50	3148.50	4.40	3957.00		
Base Slab - Trenchfill (Grade C20)	£75.00	m³	74.25	5568.75	18.46	1384.36	71.25	5343.75	144.90	10867.50	166.70	12502.50	90.55	6791.25	11.06	829.17	182.55	13691.25	154.65	11598.75	175.05	13128.75	180.85	13563.75	80.45	6033.99	83.10	6232.50	104.95	7871.25	131.90	9892.50		
Base Slab - Formwork	£50.00	m²	30.00	1500.00	5.50	275.22	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	7.18	358.95	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	25.98	1299.03	30.00	1500.00	30.00	1500.00	30.00	1500.00		
Wall - Provision & placing of concrete	£110.00	m²	13.28	1460.25	3.89	427.47	12.38	1361.25	34.47	3791.70	41.01	4511.10	18.17	1996.15	1.16	127.93	45.77	5034.15	37.40	4113.45	43.52	4786.65	45.26	4978.05	16.34	1797.60	15.93	1732.30	22.49	2473.35	30.57	3362.70		
Wall - Reinforcement (Provision & Fix)	£900.00	t	1.48	1327.50	0.43	388.51	1.38	1237.50	3.83	3447.00	4.56	4101.00	2.82	1816.50	0.13	116.30	5.09	4576.50	4.16	3739.50	4.84	4351.50	5.03	4525.50	1.82	1634.18	1.77	1593.00	2.50	2248.50	3.40	3057.00		
Wall - Formwork (textured on one side)	£75.00	m²	88.50	6637.50	25.91	1943.05	82.50	6187.50	229.80	17235.00	273.40	20505.00	121.10	9082.50	7.75	581.50	305.10	22862.50	249.30	18697.50	290.10	21757.50	301.70	22627.50	108.96	8170.90	106.20	7965.00	149.90	11242.50	203.80	15285.00		
Wall - Granite finish	£80.00	m²																																
Drainage	£35.00	m	50.00	1750.00	9.17	321.09	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	11.97	418.78	50.00	1750.00	50.00	1750.00	50.00	1750.00	50.00	1750.00	43.30	1515.54	50.00	1750.00	50.00	1750.00	50.00	1750.00		
Traffic Management		Sum																																
Additional Work																																		
Sub-total				23890.42		6143.47		22798.28		49610.27		57546.47		29824.37		3273.37		62399.65		62382.91		60586.25		62697.72		26569.38		27112.22		35066.63		44877.67		
Preliminaries				3583.56		921.52		3419.74		7441.51		8631.97		4473.65		491.01		9359.95		9357.44		9087.84		9404.66		3985.41		4066.83		5259.99		6731.65		
TOTAL				£27,473.98		£7,064.99		£26,218.02		£57,051.81		£66,178.44		£34,298.02		£3,764.37		£71,759.60		£71,740.34		£69,674.19		£72,102.38		£30,554.79		£31,179.06		£40,326.62		£51,609.32		

	Rate	Units	FID 138		FID 139		FID 140		FID 141		FID 142		FID 143		FID 144		FID 145		FID 146														
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost													
Reinforced concrete retaining wall																																	
Wall thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3
Base thickness		m	0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3		0.3
Wall height		m	2.18	0.00	1.36	0.00	1.51	0.00	1.79	0.00	1.36	0.00	0.65	0.00	1.26	0.00	0.15	0.00	0.62	0.00	0.92	0.00	0.82	0.00	0.91	0.00	0.91	0.00	0.91	0.00	0.91	0.00	
Base width		m	2.463		1.683		1.805		2.029		1.662		0.946		1.564		0.454		0.915		1.564		0.454		0.915		1.564		0.454		0.915		1.564
Length of section		m	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	2.70	0.00	36.27	0.00	14.20	0.00	22.49	0.00	22.49	0.00	22.49	0.00	22.49	0.00	22.49	0.00	22.49	0.00	22.49	0.00	
Main Elements																																	
Clearance - Vegetation killing	£230.00	ha	0.01	5.66	0.01	3.87	0.01	2.08	0.01	2.33	0.01	3.82	0.00	0.12	0.01	2.61	0.00	0.30	0.00	0.95	0.00	0.95	0.00	0.95	0.00	0.95	0.00	0.95	0.00	0.95	0.00	0.95	
Clearance - Site clearance & disposal	£5.00	m²	123.15	1231.50	84.15	841.50	90.25	451.25	101.45	507.25	83.10	831.00	2.55	25.49	56.73	567.29	6.45	64.45	20.58	205.81	20.58	205.81	20.58	205.81	20.58	205.81	20.58	205.81	20.58	205.81	20.58	205.81	
Excavation - Topsoil strip & stockpile	£3.00	m²	123.15	369.45	84.15	252.45	90.25	270.75	101.45	304.35	83.10	249.30	2.55	7.65	56.73	170.19	6.45	19.34	20.58	61.74	20.58	61.74	20.58	61.74	20.58	61.74	20.58	61.74	20.58	61.74	20.58	61.74	
Base Slab - Provision & placing of concrete	£110.00	m²	36.95	4063.95	25.25	2776.95	27.08	2978.25	30.44	3347.85	24.93	2742.30	0.76	84.13	17.02	1872.07	1.93	212.70	6.17	679.18	6.17	679.18	6.17	679.18	6.17	679.18	6.17	679.18	6.17	679.18	6.17	679.18	
Base Slab - Reinforcement (Provision & Fix)	£900.00	t	4.11	3694.50	2.81	2524.50	3.91	2707.50	3.38	3043.50	2.77	2493.00	0.98	76.48	1.89	1701.88	0.21	193.36	0.69	617.43	0.69	617.43	0.69	617.43	0.69	617.43	0.69	617.43	0.69	617.43	0.69	617.43	
Base Slab - Trenchfill (Grade C20)	£75.00	m³	123.15	9236.25	84.15	6311.25	90.25	6768.75	101.45	7608.75	83.10	6232.50	2.55	191.21	56.73	4254.71	6.45	483.41	20.58	1545.58	20.58	1545.58	20.58	1545.58	20.58	1545.58	20.58	1545.58	20.58	1545.58	20.58	1545.58	
Base Slab - Formwork	£50.00	m²	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	30.00	1500.00	1.62	80.85	21.76	1088.16	8.52	425.91	13.50	674.79	13.50	674.79	13.50	674.79	13.50	674.79	13.50	674.79	13.50	674.79	13.50	674.79	
Wall - Provision & placing of concrete	£110.00	m²	27.95	3073.95	16.25	1786.95	18.08	1988.25	21.44	2357.85	15.93	1752.30	0.28	30.77	10.49	1153.88	-0.62	-68.40	2.13	233.81	2.13	233.81	2.13	233.81	2.13	233.81	2.13	233.81	2.13	233.81	2.13	233.81	
Wall - Reinforcement (Provision & Fix)	£900.00	t	3.11	2794.50	1.81	1624.50	2.01	1807.50	2.38	2143.50	1.77	1593.00	0.03	27.97	1.17	1048.99	-0.07	-62.18															

Present Value Costs for all options

Client/Authority DfI Rivers		Results £																															
Project name Portadown Feasibility Study		Option 1 Do-nothing 29,813					Option 2 Option 2 6,847,979					Option 3 Option 3 5,424,088					Option 4 Option 4 0					Option 5 Option 5 0											
Project reference Base date for estimates (year 0) Scaling factor (e.g. £m, £k, £) Initial discount rate		PV total costs					PV total costs					PV total costs					PV total costs					PV total costs											
IBE1298 Jan-2017 £ 3.5%		Option 1					Option 2					Option 3					Option 4					Option 5											
		Capital	Maint.	Other	Negative costs	TOTALS:	Cash	Capital	Maint.	Other	Negative costs	TOTALS:	Cash	Capital	Maint.	Other	Negative costs	TOTALS:	Capital	Maint.	Other	Negative costs	TOTALS:	Cash	Capital	Maint.	Other	Negative costs	TOTALS:				
cash sum		0	100000	0	0	100000.00	0	0	0	0	0	0	6668803	253000	333440.15	0	7255243.15	6443287.92	71250.60	333440.15	0	0	0	5267589	253000	263379.45	0	5783968.45	5089457.97	71250.60	263379.45	0	0
year	Discount Factor																																
0	1.000					1000.00						333440.15					333440.15													263379.45			
1	0.966	1000				1000.00						6668803					6668803													5267589			
2	0.934	1000				1000.00						2000					2000.00													2000			
3	0.902	1000				1000.00						2000					2000.00													2000			
4	0.871	1000				1000.00						2000					2000.00													2000			
5	0.842	1000				1000.00						2000					2000.00													2000			
6	0.814	1000				1000.00						2000					2000.00													2000			
7	0.786	1000				1000.00						2000					2000.00													2000			
8	0.759	1000				1000.00						2000					2000.00													2000			
9	0.734	1000				1000.00						2000					2000.00													2000			
10	0.709	1000				1000.00						2000					2000.00													2000			
11	0.685	1000				1000.00						5000					5000.00													5000			
12	0.662	1000				1000.00						2000					2000.00													2000			
13	0.639	1000				1000.00						2000					2000.00													2000			
14	0.618	1000				1000.00						2000					2000.00													2000			
15	0.597	1000				1000.00						2000					2000.00													2000			
16	0.577	1000				1000.00						5000					5000.00													5000			
17	0.557	1000				1000.00						2000					2000.00													2000			
18	0.538	1000				1000.00						2000					2000.00													2000			
19	0.520	1000				1000.00						2000					2000.00													2000			
20	0.503	1000				1000.00						2000					2000.00													2000			
21	0.486	1000				1000.00						5000					5000.00													5000			
22	0.469	1000				1000.00						2000					2000.00													2000			
23	0.453	1000				1000.00						2000					2000.00													2000			
24	0.438	1000				1000.00						2000					2000.00													2000			
25	0.423	1000				1000.00						2000					2000.00													2000			
26	0.409	1000				1000.00						5000					5000.00													5000			
27	0.395	1000				1000.00						2000					2000.00													2000			
28	0.382	1000				1000.00						2000					2000.00													2000			
29	0.369	1000				1000.00						2000					2000.00													2000			
30	0.356	1000				1000.00						2000					2000.00													2000			
31	0.345	1000				1000.00						5000					5000.00													5000			
32	0.336	1000				1000.00						2000					2000.00													2000			
33	0.326	1000				1000.00						2000					2000.00													2000			
34	0.317	1000				1000.00						2000					2000.00													2000			
35	0.307	1000				1000.00						2000					2000.00													2000			
36	0.298	1000				1000.00						5000					5000.00													5000			
37	0.290	1000				1000.00						2000					2000.00													2000			
38	0.281	1000				1000.00						2000					2000.00													2000			
39	0.273	1000				1000.00						2000					2000.00													2000			
40	0.265	1000				1000.00						2000					2000.00													2000			
41	0.257	1000				1000.00						5000					5000.00													5000			
42	0.250	1000				1000.00						2000					2000.00													2000			
43	0.243	1000				1000.00						2000					2000.00													2000			
44	0.236	1000				1000.00						2000					2000.00													2000			
45	0.229	1000				1000.00						2000					2000.00													2000			
46	0.222	1000				1000.00						5000					5000.00													5000			
47	0.216	1000				1000.00						2000					2000.00													2000			
48	0.209	1000				1000.00						2000					2000.00													2000			
49	0.203	1000				1000.00						2000					2000.00													2000			
50	0.197	1000				1000.00						2000					2000.00													2000			
51	0.192	1000				1000.00						5000					5000.00													5000			
52	0.186	1000				1000.00						2000					2000.00													2000			
53	0.181	1000				1000.00						2000					2000.00													2000			
54	0.175	1000				1000.00						2000					2000.00													2000			
55	0.170	1000				1000.00						2000					2000.00													2000			
56	0.165	1000				1000.00						5000					5000.00													5000			
57	0.160	1000				1000.00						2000					2000.00													2000			
58	0.156	1000				1000.00						2000					2000.00													2000			
59	0.151	1000				1000.00						2000					2000.00													2000			
60	0.147	1000				1000.00						2000					2000.00													2000			
61	0.143	1000				1000.00						5000					5000.00													5000			
62	0.138	1000				1000.00						2000					2000.00													2000			
63	0.134	1000				1000.00						2000					2000.00																