Shimna River
Flood Alleviation Scheme

Environmental Statement - Appendices

Department for Infrastructure (DfI) Rivers

August 2018

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Loughry
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Appendices

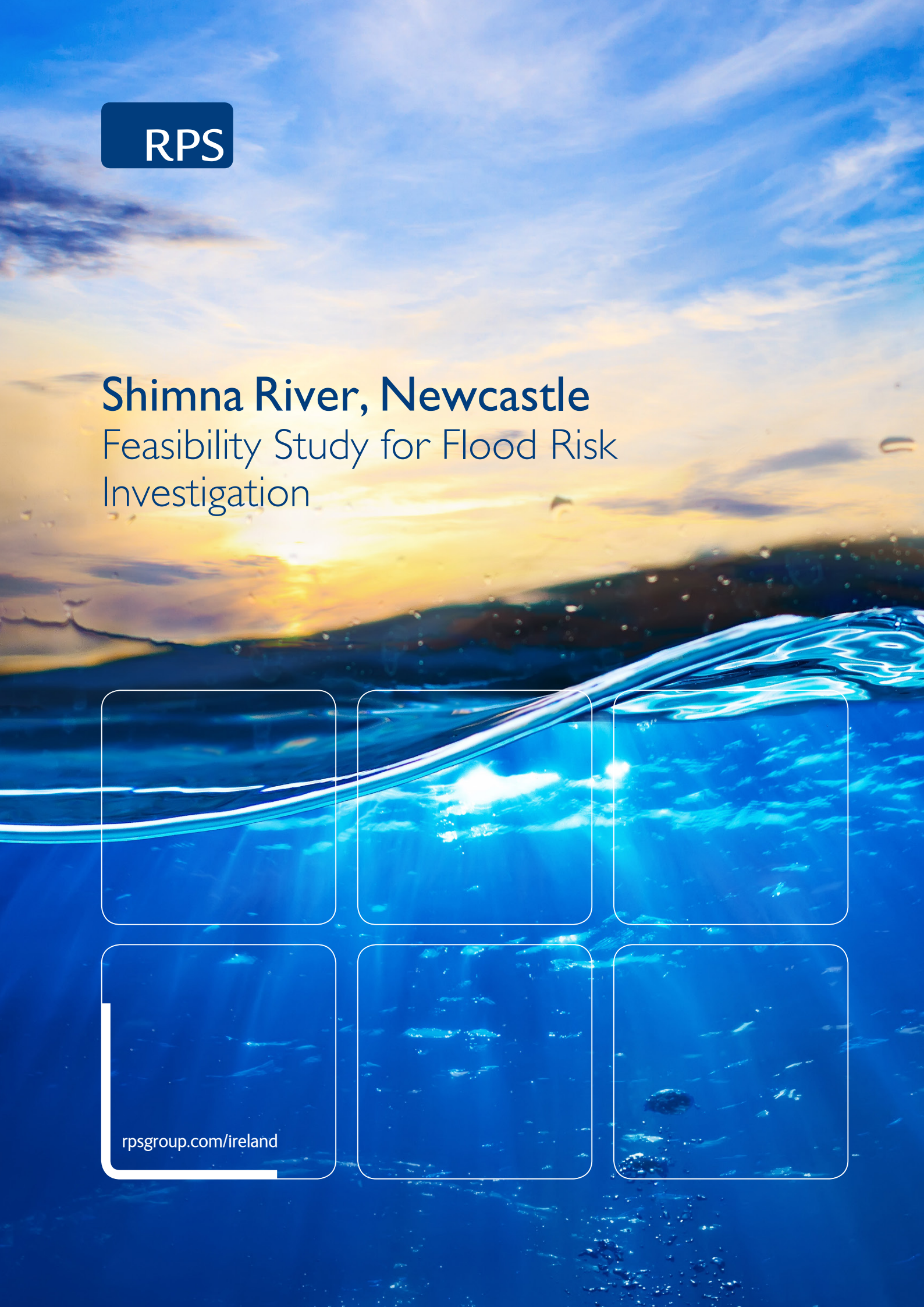
Appendix 1:Introduction

Annex A: '*Shimna River, Newcastle Feasibility Study for Flood Risk Investigation*' (2015);

Annex B: EIA Screening Report (February 2018); and

Annex C: Belfast Gazette Advertisement.

Annex A: '*Shimna River, Newcastle Feasibility Study for Flood Risk Investigation*' (2015)



RPS

Shimna River, Newcastle

Feasibility Study for Flood Risk Investigation

rpsgroup.com/ireland

Feasibility Study for Flood Risk Assessment
Shimna River, Newcastle

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EXECUTIVE SUMMARY

DARD Rivers Agency commissioned RPS to identify the flood risk associated with the Shimna River in Newcastle and assess options (including economic viability) for the alleviation of future flooding.

RPS have previously carried out various flooding and feasibility studies, EIAs and flood mapping projects on the Shimna, Burren, Leitrim and Tullybranigan Rivers, as well as coastal modelling to provide model downstream boundaries. The most recent study included the completion of flood mapping for Newcastle as part of the Rivers Agency's flood mapping programme. This study included a hydrological assessment, construction of a computational model of the Shimna River, and production of flood maps. The results of the flood mapping study were then used for this feasibility study.

The mapping study identified the main flooding mechanism from the Shimna River. Initial flooding begins around the Bryansford Road Bridge. The flood water then flows across Bryansford Avenue into Beechfield Park and towards the Bryansford Avenue Bridge. The Bryansford Avenue Bridge acts as an aqueduct and conveys water over the Burren River to the eastern part of Newcastle causing flooding along Shimna Road and Shimna Vale. These mechanisms were seen during the August 2008 flood event.

RPS undertook a rigorous process to ensure that all potential flood alleviation measures were considered. The most feasible option is the provision of hard defences to prevent water from leaving the Shimna River at Bryansford Road bridge. Various methods of construction of hard defences were costed as the ground conditions were unknown at that time.

The works involved with the proposed option of flood defences was incorporated into a revised model. This was to ensure that the proposed option 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. The height of the embankments and walls in the model included a 600mm freeboard above the predicted 1% AEP flood levels for the undefended model. The model run showed that the works prevented flooding of the properties for a 1% AEP event and they did not significantly increase the risk of flooding elsewhere in the catchment.

The proposed option was reviewed by DARD Rivers Agency Environment Section, who indicated that the proposed works may have to consider the impact on the mature trees along the river embankments. Discussions were also held with Down District Council.

A detailed economic appraisal to evaluate the viability of the proposed options was completed as part of the overall study. This is presented in a separate Economic Appraisal report. As there was such a variation in the economic viability of the scheme depending on the method of construction required,

DARD Rivers Agency instructed RPS to procure a ground investigation. The results of this showed sand and gravel in the shallow strata, and therefore sheet piles would be required to prevent water flow beneath the wall. The choice of options would therefore be Options 2C and 2D, as Options 2A and 2B do not allow for a sheet pile cut-off. Option 2C, reinforced concrete walls with sheet piles at all locations, would therefore be the preferred option as it has a slightly higher benefit/cost ratio of 1.48.

The Rivers Agency's vision 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 believe that the preferred option successfully achieves these aims of the Rivers Agency.

1 INTRODUCTION

1.1 BACKGROUND

The Shimna River rises in the Mourne Mountains and flows to Newcastle through Tollymore Forest Park. Within the town of Newcastle, the Shimna River meets the Burren River in Islands Park. Further downstream of the confluence with the Burren, the Shimna is joined by the Tullybranigan River in the vicinity of the boating lake in Castle Park, before discharging to the Irish Sea.

Historical flooding has occurred regularly over the last 40-50 years in Newcastle. Local newspapers have carried reports of storms during 1968, 1978/79, 1987, 1988 and 1994. Other significant flood events are known to have occurred during 1982, 1986, 1990 and 1997. The extreme flood event of 16/17 August 2008 caused significant flooding in the Bryansford Avenue and Shimna Road areas where flood water from the Shimna River crossed catchments, to pond within the Burren catchment, behind the recently constructed Burren River flood defences. This area comprises primarily residential properties, schools and Islands Park. Many properties were flooded badly during this event.

It was apparent from this event and previous analysis that at the lower end of the Burren and Shimna Catchments the interaction of the two rivers needs to be considered carefully when assessing the flood risk in this area. The August 2008 flooding was severe, and subsequently water from the Shimna effectively flowed out of catchment into the Burren catchment and ponded behind the defences, thus highlighting the relationship between the two rivers. All of these factors contribute to some degree to the flooding over the lower reaches of the Shimna.

The upper reaches are relatively steep and there are limited properties at risk as the river runs predominantly through a steep sided ravine and woodland. So while it is important to assess the river all the way from Priest's Bridge the majority of the risk will be at the lower downstream end.

Flooding in Newcastle is a major issue for those residents and business owners directly affected by it, the local Councillors and Politicians who represent them and the various government agencies who deal with aftermath of many of the flood events. The formation of the Newcastle Flood Forum is another reflection of the concern there is locally for flooding.

1.2 AIMS AND SCOPE

DARD Rivers Agency have appointed RPS to carry out a feasibility study on the Shimna River from Priests Bridge to Castle Bridge. The main aim of the 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 from the Shimna River. Figure 1.1 provides a plan of the area indicating the route of the Shimna River.

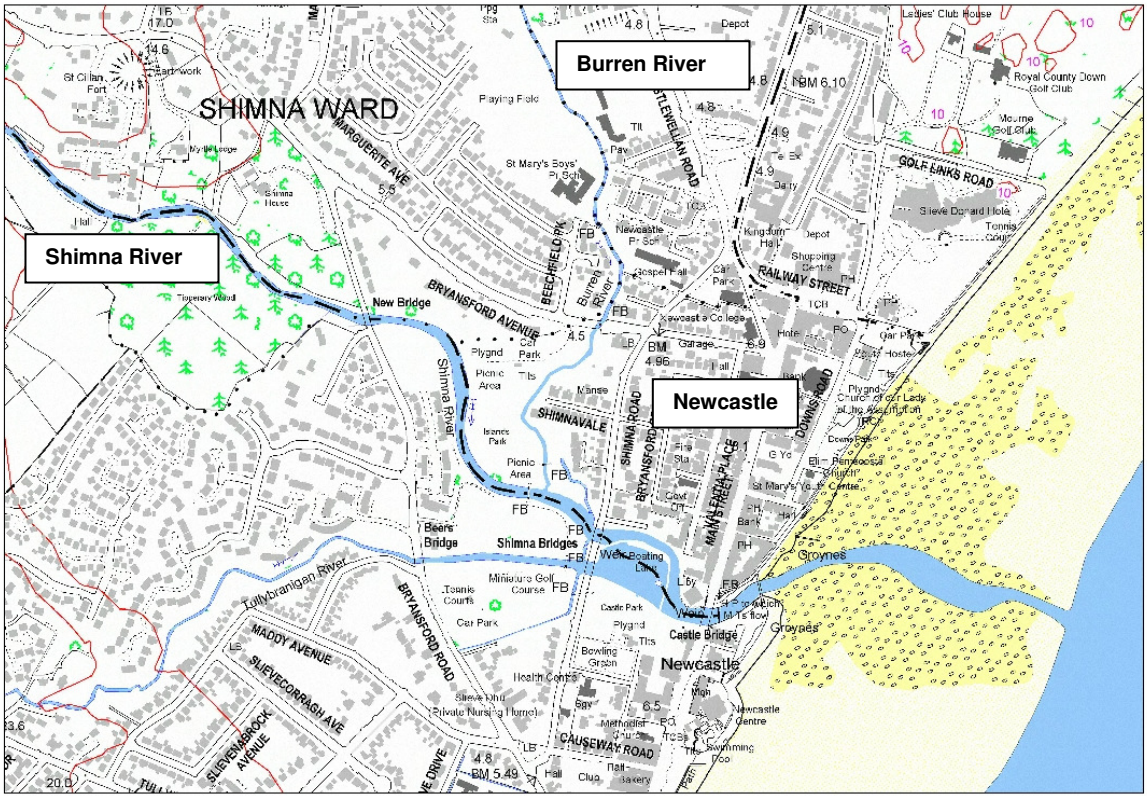


Figure 1.1 Location of Shimna River in Newcastle

The project brief included the following requirements:

- investigate the affect any watercourse located within the study area may have on flood risk to the study area;
- identify and produce flood risk/hazard maps of areas/roads/properties which would be affected by the following design flows (undefended and defended as appropriate)- present day Q10 (10% AEP), Q100 (1% AEP), Q1000 (0.1% AEP) return periods and the Q100 climate change (year 2030) scenario;
- for the complete study area consider a wide range of flood alleviation options in order to compile a sifted list of suitable and sustainable options with costs, and identify the areas/roads/properties protected from flooding by such options for a range of design flows;
- undertake an Economic Appraisal with recommendations in accordance with the 10-step approach outlined in the NI Preface to the Green Book, and the Green Book: Appraisal and Evaluation in Central Government, 2003 (3rd Edition), and FCDPAG3 Flood and Coastal Defence Project Appraisal Guidance, Economic Appraisal. It should be noted that The Northern Ireland Practical Guide to the Green Book has been replaced by the NI Guide to

Expenditure Appraisal and Evaluation (NIGEAE), and the FCDPAG3 has been replaced by Flood and Coastal Erosion Risk Management Appraisal Guidance, Economic Appraisal (FCERM-AG). The Economic Appraisal was prepared in accordance with these documents;

- preparation of Shimna River Feasibility Report supported by drawings, calculations, cost estimates and photographs. The associated Economic Appraisal is contained in a separate document.

2 PREVIOUS STUDIES

RPS have previously carried out various flooding and feasibility studies, EIAs and flood mapping projects on the Shimna, Burren, Leitrim and Tullybranigan Rivers as well as coastal modelling to provided model downstream boundaries. Two of these recent studies are described below.

2.1 BURREN & SHIMNA RIVERS FLOOD INVESTIGATION (2009)

Following the severe flooding in August 2008, Rivers Agency appointed RPS in 2009 to carry out a post flood investigation of the Burren and Shimna Rivers in Newcastle, the aims of which were:

- to investigate the source, causes and flooding mechanism of the fluvial flood event of 16th and 17th August 2008;
- to identify the properties affected by that flood and the extent of fluvial flooding at each;
- to identify possible outline solutions to reduce future fluvial flood risk and to provide outline cost estimates of each;
- to assess the performance of the Burren Flood Alleviation Scheme during the flood event.

Through a data collection process and a computational model constructed for this report it was shown that areas protected by the Burren Flood Alleviation Scheme could still be flooded from the Shimna River (this could only be prevented by raising the level of the Bryansford Avenue road bridge). The main source of flooding in these areas is water from the Shimna River flooding through Islands Park then over and along Bryansford Avenue. Flood water can then flow over the Bryansford Avenue Road bridge and flood properties within the Burren catchment, along the Shimna Road and in Shimna Vale as illustrated by the arrows on Figure 2.1. The area of flooding predicted by the model and that observed during the flood event, also included properties along Bryansford Road.

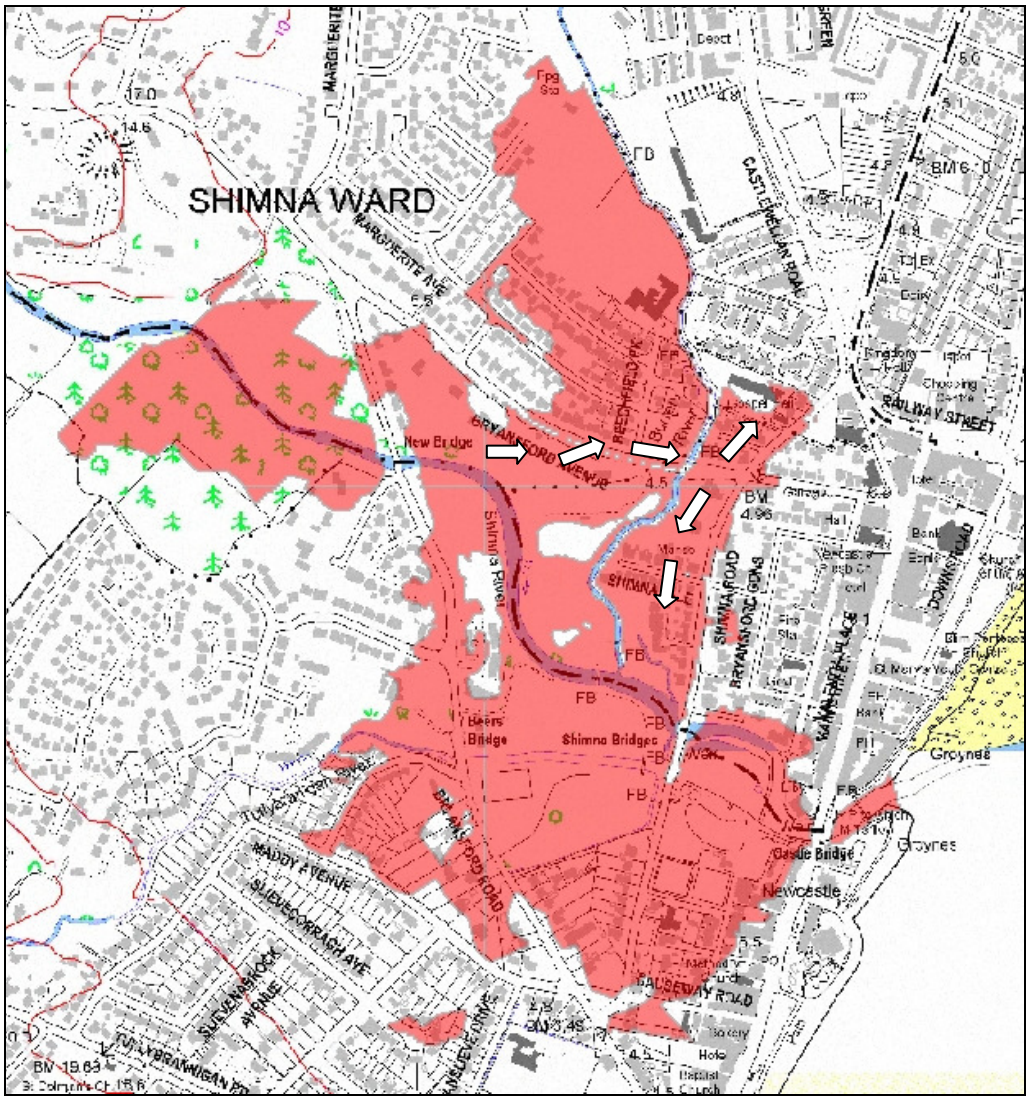


Figure 2.1 Predicted Flood Outline with Bryansford Avenue Flow Path (August 16th 2008)

2.2 NEWCASTLE RIVER MODELLING AND FLOOD MAPPING (2013)

Preliminary Flood Risk Assessments (PRFA) prepared by Rivers Agency have identified Newcastle as an Area of Potential Significant Flood Risk (APSR). Subsequently more detailed hydrodynamic modelling was required in order for Rivers Agency to meet the requirements of the Floods Directive in the production of Flood Risk and Flood Hazard Maps, and Flood Risk Management Plans.

Under a separate commission to this Feasibility Study, Rivers Agency appointed RPS in 2011 to produce up to date river models for Newcastle. The project required the modelling and mapping of the Shimna River from its mouth to the upstream face of Priests Bridge, the Burren River from its confluence with the Shimna River to the upstream face of the Road Bridge, and the Leitrim River from its mouth to upstream of Annsborough. The modelling also includes urban drainage modelling of the

Rivers Agency designated watercourse network within the urbanised area of Newcastle. Figure 2.2 illustrates the model extents for the Newcastle area. This study was completed in 2013. Two separate reports have been produced and submitted to Rivers Agency: a Hydrology Report and a Hydraulics Report. The outputs from the Modelling and Flood Mapping Study have been used in this Feasibility Study.

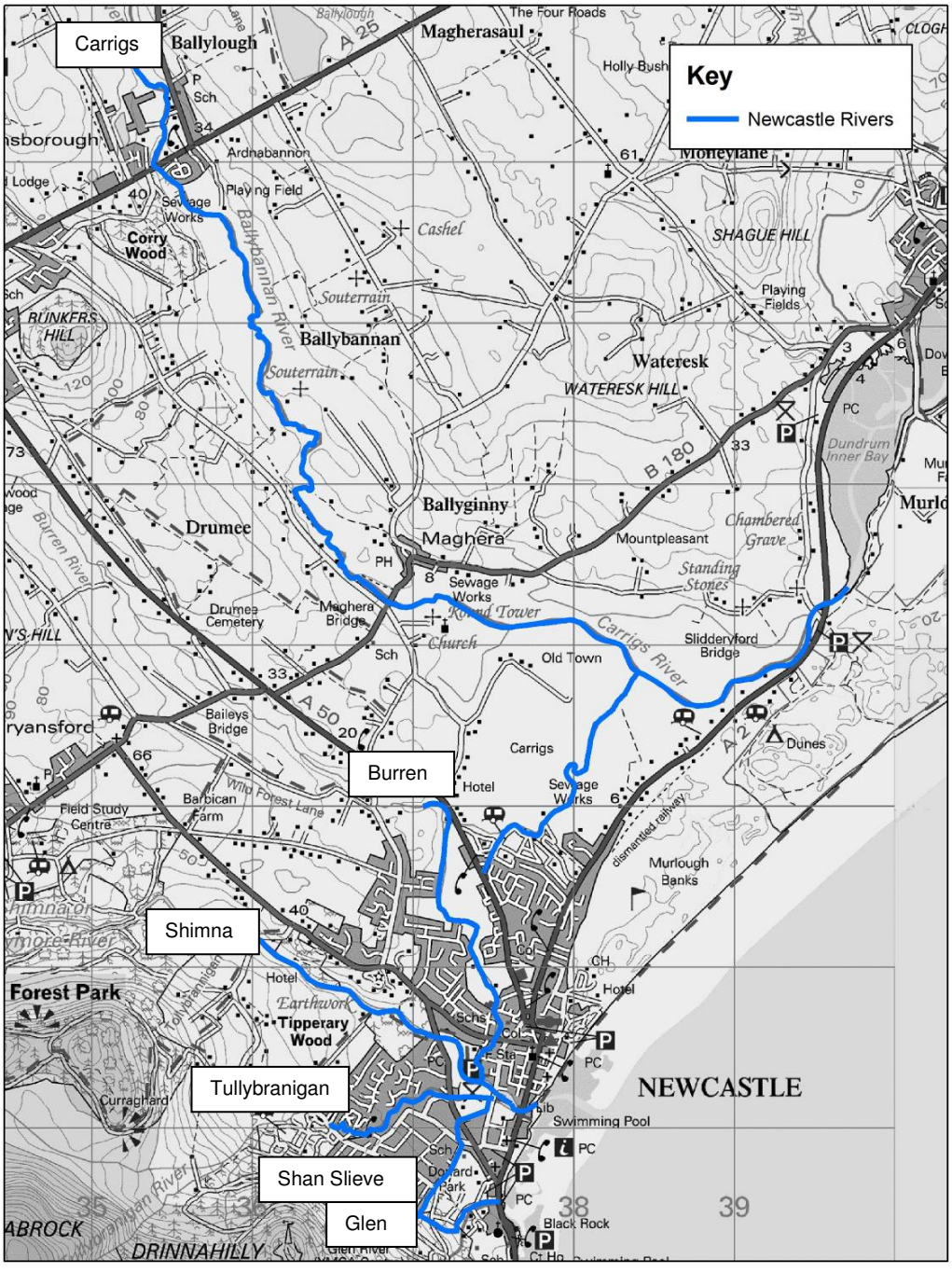


Figure 2.2 Newcastle Rivers Model Extents

3 HYDROLOGICAL ASSESSMENT

3.1 METHODOLOGY

A full hydrological assessment was completed for the Newcastle Modelling & Flood Mapping Study and the output from this was used for this Feasibility Study. The catchment assessed is shown in Figure 3.1. The relevant industry standard software/techniques, FEH (Flood Estimation Handbook) Statistical Method utilising WINFAP and the Revitalised FEH Rainfall Runoff Method (ReFH), were used to predict design flows. The hydrological assessment was carried out for five distinct sub-catchments, three of which are applicable to this Feasibility Study: the Shimna-Burren- Tullybranigan Catchment, the Glen Catchment, and an Unnamed FEH catchment, believed to be the Shan Slieve Drain. The hydrological analysis was undertaken at the points detailed below.

Shimna-Burren Tullybranigan Catchment

- Shimna River (labelled U3102) upstream catchment at Priest Bridge NGR 336025 332155.
- Shimna River confluences with Burren River, Shimna catchment taken to foot bridge at NGR 337400 331300.
- Burren River (labelled MW3107) upstream catchment at Tollymore Bridge NGR 336755 332990.
- Burren River confluences with Shimna River, Burren catchment taken to foot bridge at NGR 337480 331360.
- Tullybranigan River shown to have a confluence with a tributary, believed to be the Cherrymount Stream. Upstream catchment of Tullybranigan to this confluence at NGR 336625 330970.
- Tullybranigan River confluences with Shimna River, Tullybranigan catchment taken to foot bridge at NGR 337560 331170.
- Downstream of Shimna Burren Tullybranigan catchment NGR 337745 331100.

Glen Catchment

- Glen River (labelled as U3103) is a stand alone catchment discharging to Newcastle Bay at NGR 337527 330542.

Unnamed FEH Catchment

- Distinct stand alone catchment displayed on FEH CDROM at NGR 337612 330760, believed to be the Shan Slieve Drain.

3.2 RESULTS

A summary of the results of the hydrological assessment for the Shimna-Burren-Tullybranigan Catchment, the Glen Catchment and the Shan Slieve Catchment is presented in Tables 3.1-3.2. Full details on the flow estimation method and calculations including catchment descriptors, WINFAP pooling groups and range of flow estimations and ReFH flow estimations can be found in the Appendices to the Newcastle Catchment Hydrology Report.

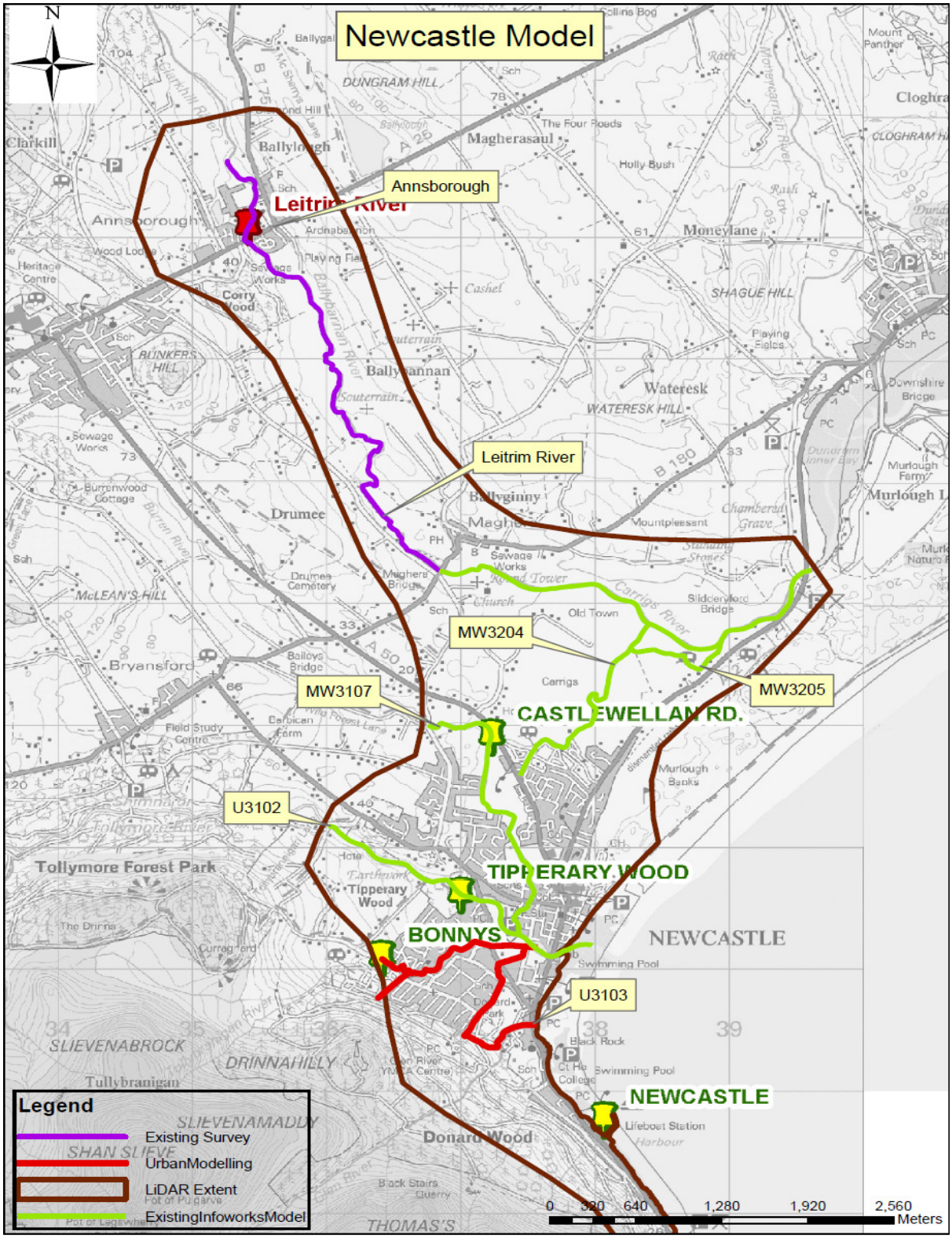


Figure 3.1 Newcastle Catchment Area

Table 3.1 Summary of Flows in Shimna-Burren-Tullybranigan Catchment

Name	U3102 Priest Bridge	U3102 Shimna Footbridge	MW3107 Tollymore Bridge	MW3107 Burren Footbridge
River Type	**Shimna Main River**	**Shimna Main River**	**Burren River**	**Burren River**
Description	Catchment taken to just d/s of Priests Bridge	Catchment taken to approx. location of footbridge	Taken to just d/s of Tollymore Road Bridge	Catchment taken to approx. location of footbridge
Type	Inflow	Point Source	Inflow	Point Source
10% AEP Flow (m^3/s)	44.78	0.45	11.06	0.59
1% AEP Flow (m^3/s)	74.78	1.93	17.75	0.90
1% AEP + 20% (CC) Flow (m^3/s)	89.74	2.32	21.29	1.08
0.1% AEP Flow (m^3/s)	123.15	5.55	27.48	1.35
Approx. Model Input Location	336025 332155	337405 331275	336755 332990	337430 331320

Name	Tullybranigan Confluence	Tullybranigan Footbridge	Full catchment
River Type	**Tullybranigan River**	**Tullybranigan River**	**Tributary (Cherrymount Stream)**
Description	Taken to where confluence with tributary	Catchment taken to approx. location of footbridge	Taken to downstream most point of full catchment
Type	Inflow	Point Source	Point Source
10% AEP Flow (m^3/s)	7.29	1.23	0.04
1% AEP Flow (m^3/s)	11.83	1.98	0.06
1% AEP + 20% (CC) Flow (m^3/s)	14.19	2.37	0.08
0.1% AEP Flow (m^3/s)	20.57	3.49	0.10
Approx. Model Input Location	336625 330960	337460 331170	337745 331100

Table 3.2 Summary of Flows in Glen and Shan Slieve Catchments

Name	**U3103**	
River Type	**Glen Main River**	**Shan Slieve Drain**
Description	Taken to where confluence is shown with unknown tributary	Catchment identified from FEH CDROM
Type	Inflow	Point Source
10% AEP Flow (m^3/s)	8.02	1.22
1% AEP Flow (m^3/s)	13.01	1.98
1% AEP + 20% (CC) Flow (m^3/s)	15.61	2.38
0.1% AEP Flow (m^3/s)	22.68	3.46
Approx. Model Input Location	337030 330435	337310 330890

4 COMPUTATIONAL MODELLING

4.1 MODEL CONSTRUCTION

A computational model was constructed for the Newcastle Modelling & Flood Mapping Study and the outputs from this were used for this Feasibility Study.

Rivers Agency supplied existing river cross-sectional data from their archive and survey works commissioned in previous studies. Existing cross-sections were available for the Shimna and Burren Rivers. Cross section data for the remainder of the study area was required to be procured. Coordinate Surveys carried out the topographical river survey of the Newcastle urban tributaries between July 2011 and January 2012. Newcastle has extensive flood defences along the Burren River, as constructed drawings of the defences were used to provide level and location data for the model construction. Rivers Agency supplied LiDAR (Light Detection and Ranging) survey data acquired in 2009 to supplement the channel cross-section information to enable floodplain flows paths to be determined. This data was also used to determine bank levels where data was not captured during the topographic survey.

The Shimna River, the Burren River and other urban watercourses were modelled in InfoWorks ICM. In addition to survey data, the Rivers Agency InfoNet database provided data for the ICM models. One InfoWorks ICM 1D/2D hydrodynamic model was prepared for the Newcastle study area combining the Shimna River, Burren River, Tullybranigan River, Glen River and Shanslieve Drive Stream study reaches into one model.

The modelled reach of the Shimna River begins just upstream of the Newcastle urban limits, its upstream catchment is predominately rural and mountainous. The Shimna discharges to the Irish Sea and is tidally influenced at its downstream boundary. The downstream boundary for the river model was generated from a coastal modelling study which assessed return period water levels for the Newcastle area. For modelling purposes a 50% AEP tidal level was assumed as the downstream boundary.

The Burren River is a tributary of the Shimna flowing in from the north of Newcastle and discharging at Islands Park upstream of the boating pond. The upstream extent of the Burren model is adjacent to the Burrendale Hotel with the upstream catchment being essentially rural.

The Tullybrannigan River flows through the south west of Newcastle with the upstream model extents located adjacent to Bonny's Caravan Park on the Tullybrannigan Road. The upstream catchment of the Tullybrannigan is entirely mountainous, flowing from Tullybrannigan Hill and Shan Slieve.

The modelled reach of the Shan Slieve Drive Stream begins adjacent to Slieve Shannagh Park and flows north through Newcastle, discharging to the Tullybrannigan River just upstream of the boating pond. Its upper catchment is entirely mountainous flowing through Donard Wood at the foot of Shan Slieve. Historically, the majority of the flow from the Shan Slieve has been diverted to the Glen River via the Shan Slieve Diversion, and the Shan Slieve channel itself is dry except in times of heavy rainfall when local drainage discharges to it. The full flow from the Shan Slieve has therefore been included in the Glen River model.

The Glen River flows through the southern tip of Newcastle discharging to the Irish Sea at Pattons Bridge. Its upper catchment is entirely mountainous much of which is dominated by Slieve Donard and Slieve Commedagh.

The upstream boundary conditions consisted of the hydrographs created during the hydrological analysis stage of the study (Section 3.0). Table 4.1 provides details of the inflow boundaries to the model and Figure 4.1 illustrates the location of the inflow boundaries and the extent of the modelled reach. Further information on the construction of the model and its verification is provided in the Newcastle Modelling & Flood Mapping- Hydraulics Report (RPS, 2013).

Table 4.1 Newcastle Urban Area Boundaries

Inflow Boundary	Description	Location
NW941	Shimna Upstream Boundary	336016, 332172
BU2150	Burren Upstream Boundary	337066, 332997
US1	Tullybrannigan Upstream Boundary	336477, 331034
US2	Cherrymount Stream Upstream Boundary	336415, 330786
US3	Shan Slieve Drive Stream Upstream Boundary (assumed to take no flow from Shan Slieve catchment)	337028, 330462
US4	Shan Slieve Drive Stream Diversion Upstream Boundary (assumed to take full flow from Shan Slieve catchment)	337048, 330452
Bridge5_Break_DS	Glen River Upstream Boundary	337274, 330355

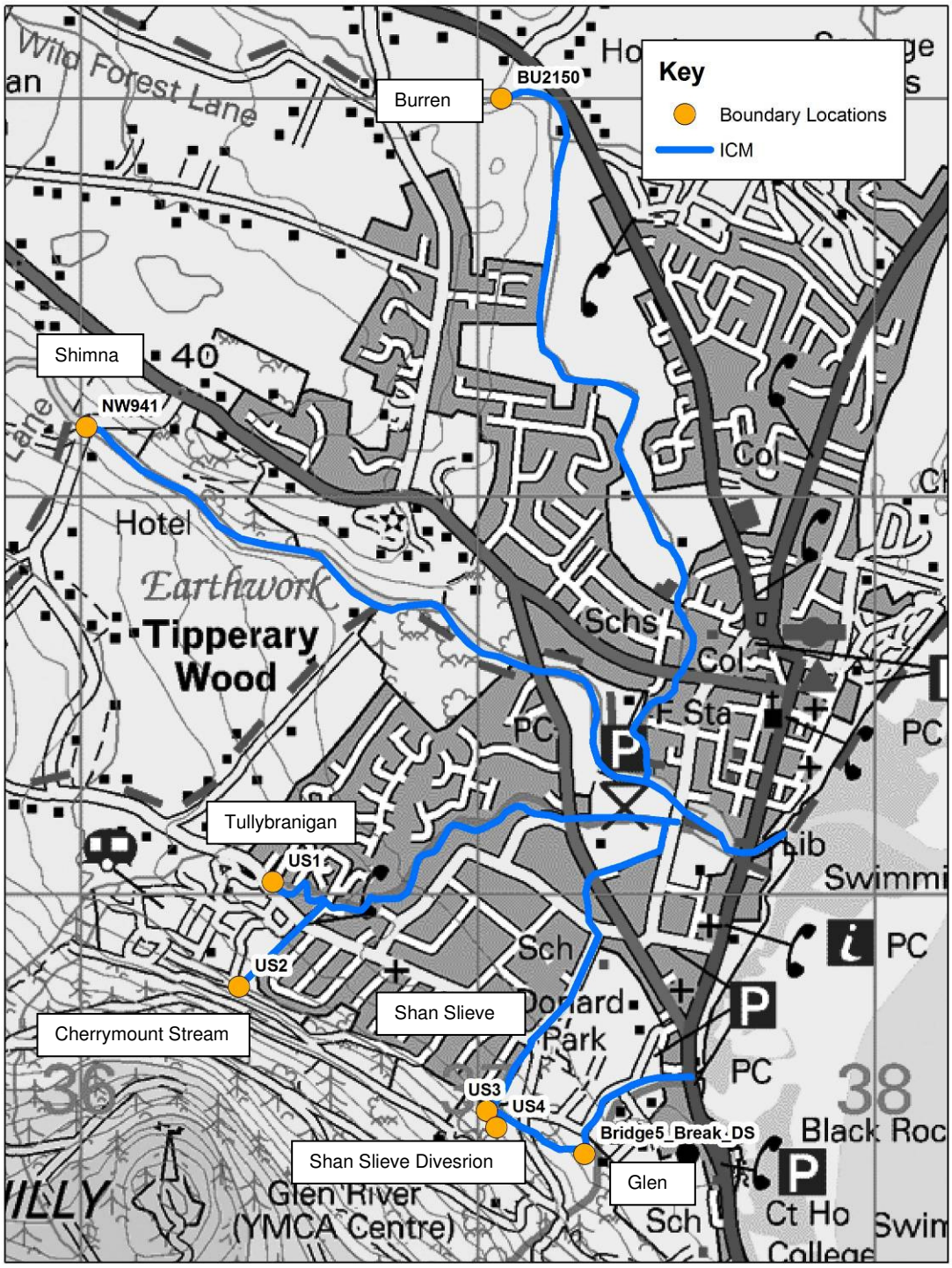


Figure 4.1 Newcastle Urban River Boundary Locations

4.2 FLOOD MAPPING OF EXISTING FLOOD RISK

The calibrated river model was run to determine water levels for a range of storm events for both the present day and future scenarios. The flood levels generated from the model simulations were plotted onto maps of the area in order to show the floodplains created from the various events. The flood maps created are:

- Q10 (10% AEP);
- Q100 (1% AEP);
- Q1000 (0.1% AEP);
- Q100 with climate change (2030 scenario).

These flood maps depict the 'Do Minimum' scenario, where it is assumed that regular routine maintenance is carried out on the watercourses. All of the above maps for the study area can be found in Appendix A.

For the Shimna River Feasibility Study, these flood maps form the basis for the outline design of a flood protection scheme and the economic assessment of flood risk and the benefits of such a scheme.

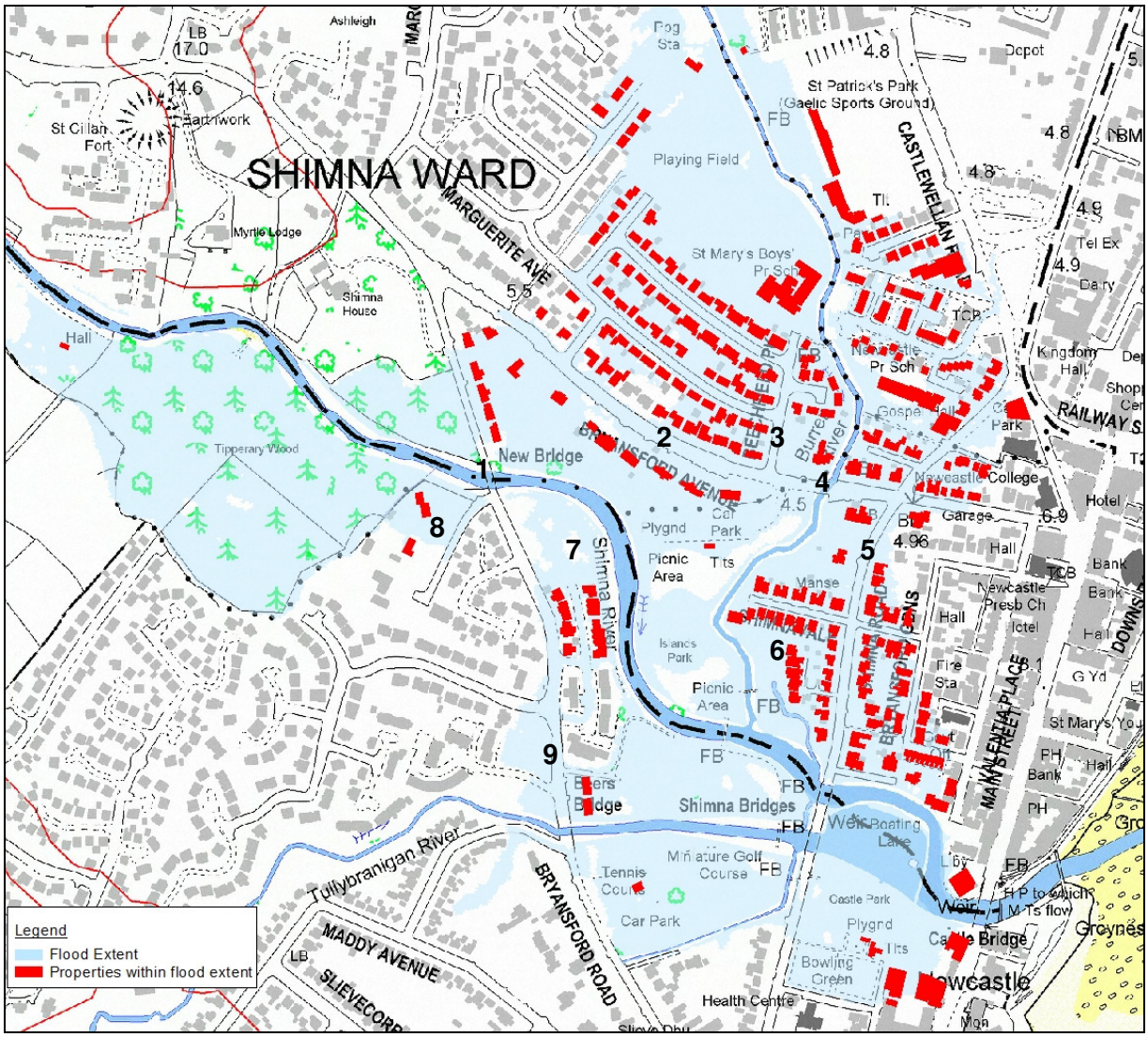
4.3 FLOOD MECHANISMS

Figure 4.2 illustrates the predicted flood risk in Newcastle posed by the 1% AEP flood event on the Shimna River. 312 properties were identified as being at risk of inundation by a 1% AEP flood event.

The majority of properties at risk are on the left bank of the river. Initial flooding begins around the Bryansford Road Bridge (marked as 1 on Figure 4.2). The flood water then flows across Bryansford Avenue (2) into Beechfield Park (3) and towards the Bryansford Avenue Bridge (4). The Bryansford Avenue Bridge acts as an aqueduct and conveys water over the Burren River to the eastern part of Newcastle causing flooding along Shimna Road (5) and Shimna Vale (6). These mechanisms were seen during the August 2008 flood event. The Burren River flood defences do not get overtopped from the 1% AEP event in the Shimna River.

A smaller number of properties on the right bank of the Shimna River are also at risk from flooding. These are in Shimna Mile (7), Riverside Park (8) and Bryansford Road (9).

Figure 4.2 Shimna River, Newcastle 1% AEP Flood Extent



Key to map locations:

(1) Bryansford Road Bridge
(2) Bryansford Avenue
(3) Beechfield Avenue
(4) Bryansford Avenue Bridge
(5) Shimna Road
(6) Shimna Vale
(7) Shimna Mile
(8) Riverside Park
(9) Bryansford Road

5 OPTION DEVELOPMENT AND ANALYSIS

5.1 OPTION DEVELOPMENT PROCESS

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 Shimna River 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 from the Shimna River. 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.

5.2 SCREENING OF FLOOD RISK MANAGEMENT OPTIONS

5.2.1 Long List 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 measures considered are presented in Table 5.1.

Table 5.1 Long List of Potential Measures

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. Maintenance regime to remain as currently undertaken.

Option	Method type	Description
Do Minimum	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.
Building Regulations	Prevent	Regulation relating to floor levels, flood proofing, flood resilience, sustainable drainage systems, prevention of reconstruction, or redevelopment in flood risk areas.
Catchment Wide SuDS	Prevent	Implement attenuating infrastructure to the existing drainage system in order to reduce the flow entering the river network. This may consist of swales, french drains, soak aways, larger culverts, underground storage tanks, ponds, green roofs, etc.
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.
Strategic Development Management	Prevent	Management of necessary floodplain development (proactive integration of structural measures into development designs and zoning, regulation on developer-funded communal retention, drainage and/or protection systems).
Watercourse Maintenance	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 washlands (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.
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.
Culverting	Protect	Routing the watercourse underground through culvert to prevent out of bank flooding along a specific stretch.
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 or an open channel.

Option	Method type	Description
Overland Flood Routing	Protect	Using 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.
Rehabilitation of Existing Defences	Protect	Improvement of existing flood defences.
Localised Protection Works	Protect	Minor raising of existing defences/levels, infilling gaps in defences, etc.
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 measures such as flood gates, vent covers, use of flood resilient materials, raising electrical power points, etc

5.2.2 Applicability Review of Options

Each of these measures has been reviewed against its applicability for the Shimna catchment and those which are obviously unsuitable have been removed. Table 5.2 indicates those measures which have been included and excluded.

Table 5.2 Applicable list of measures to Shimna catchment

Option	Review Comment	Applicable?
Do Nothing	Baseline condition, consider further	✓
Maintain Existing Regime	Consider further	✓
Do Minimum	Consider further	✓
Planning and Development Control	Consider further	✓
Building Regulations	Consider further	✓
Catchment Wide SuDS	Consider further	✓
Land Use Management	Consider further	✓
Strategic Development Management	Consider further	✓
Watercourse Maintenance	Consider further	✓
Upstream Storage/Storage	Consider further	✓
Tidal Barrage	Not applicable- principal source of flooding is fluvial	×
Improvement of Channel Conveyance	Consider further	✓

Option	Review Comment	Applicable?
Hard Defences	Consider further	✓
Relocation of Properties	Consider further	✓
Culverting	Consider further	✓
Diversion of Flow	Consider further	✓
Overland Floodways	Consider further	✓
Sealing Manholes	Not applicable- principal source of flooding is fluvial	×
Rehabilitation of Existing Defences	No flood defences currently exist. Measure unacceptable	×
Localised Protection Works	No existing defence infrastructure exists which could be altered by minor works to alleviate flooding. Measure unacceptable	×
Flood Warning/Forecasting	Consider further	✓
Public Awareness Campaign	Consider further	✓
Individual Property Protection	Consider further	✓

5.2.3 Technical Review of Options

All options which have been considered as applicable, are then reviewed on their technical merits and their ability to alleviate the specific mechanisms of flooding that exist in the Shimna catchment. This is based on engineering judgement, information from Rivers Agency staff, flood mapping and reviewing animations of model output. Table 5.3 provides the technical review of the applicable measures.

Table 5.3 Technical Review of Applicable Options

Option	Review comment	Feasible?
Do Nothing	Baseline Condition Measure can continue through screening process	✓
Maintain Existing Regime	May limit damage, however it will not resolve all flooding	×
Do Minimum	Will not solve all flooding issues. Not considered further	×
Planning and development control	Area already extensively developed. Not considered further	×
Building regulations	Area already extensively developed. Not considered further	×
Retro-fitted SuDS	Not technically possible to introduce across all of Newcastle. Not considered further	×
Land use management	Area already extensively developed Not considered further	×
Strategic Development Management	No Strategic Development envisaged for Newcastle that would require this measure	×
Watercourse Maintenance	May limit damage, however will not resolve all flooding issues and proactive maintenance programme must be developed Measure can continue through screening process	✓

Option	Review comment	Feasible?
Upstream storage/storage	No appropriate areas of land can be identified upstream. Not considered further	×
Improvement of channel conveyance	No improvements could be made that would have a significant effect on water levels Not considered further	×
Hard defences	Hard defences would consist of flood walls and embankments. Approximately 1km of flood defence would be required Measure can continue through screening process	✓
Relocation of properties	312 properties would be required to be relocated. While technically feasible, this would be a socially complex measure to implement in practice Not considered further	×
Culverting	Existing watercourses are open within the study area. No possible culvert routes identified Not considered further.	×
Diversion of flow	No possible diversion routes readily identified Not considered further	×
Overland floodways	Due to the area being extensively developed, no floodways can be identified Not considered further.	×
Flood warning/forecasting	May limit damage, however will not resolve all flooding issues Measure can continue through screening process	✓
Public awareness campaign	This would have limited impact on reducing the flood risk Measure can continue through screening process	✓
Individual property protection	May limit damage, however will not resolve all flooding issues Measure can continue through screening process	✓

5.3 DEVELOPING POTENTIAL OPTIONS

The options that have progressed through the screening are divided into two categories; primary and secondary options. Primary options are those that which will be considered as having a reasonable likelihood of providing the required standard of protection to the majority of properties at risk from a 1% AEP event. Secondary options may have some technical merit and could solve some localised flooding issues but will not resolve all the identified flooding issues. It is intended to develop a solution for flooding from the Shimna River which will be a combination of both primary and secondary options.

The do-nothing scenario will be considered as the base case against which other options are compared. The base case should generally be the 'status quo' option, which should represent the genuine minimum input necessary to maintain services at, or as close as possible to, their current level. In this scenario no action is taken to sustain, maintain or improve existing flood defences. If no works were undertaken, the threat of overtopping of the banks of the Shimna River would remain resulting in the possibility of frequent flooding damage to property in addition to causing considerable anxiety to local residents. This will be taken forward as Option 1.

As described above, RPS considered a wide range of potential flood risk management options for preventing flooding in Newcastle from the Shimna River during high return period events. However given the geography of the catchment and the extensively developed urban areas, the most feasible option is the provision of hard defences to prevent water from leaving the Shimna River, both upstream and downstream of the Bryansford Road bridge. This will be taken forward as Option 2.

Hard defences include the construction of new flood walls or embankments. Where possible hard defences should be set back from the channel banks to allow space for flood waters and reduce the impact of the flood defence scheme on water levels upstream and downstream of the proposed defence location. Setting defences back from the channel also improves access to rivers and helps minimise the visual impact of a flood defence scheme. The choice of flood defence structure (i.e. flood wall, flood embankment, etc.) along with the alignment of defences is based on space constraints, visual impact and the results of the hydraulic modelling of options.

The locations of where flood defence structures are required are presented in Figure 5.1. On the left bank of the Shimna River this option involves the construction of flood defences for approximately 125m along Bryansford Road from New Bridge (A-A on Figure 5.1), and construction of flood defences downstream of the bridge for approximately 220m parallel to Bryansford Avenue (B-B). On the right bank a flood defence will be constructed from New Bridge for approximately 600m downstream (C-C), and another will be constructed for approximately 240m upstream (D-D).

There are alternative methods of construction that can be considered for flood defences which will depend on various factors including the ground conditions. Flood walls will generally be constructed from reinforced concrete, but where ground conditions are poor sheet piles or bored piles may be required below ground. Where space permits, flood embankments can be constructed from clay, but again where ground conditions are poor a sheet pile core may be required. Various methods of construction have been costed at this stage as ground conditions are unknown. The options costed are:

- **Option 2A**: reinforced concrete flood walls at all locations;
- **Option 2B**: reinforced concrete flood walls on right bank, reinforced concrete flood walls on left bank upstream of bridge, clay embankments on left bank downstream of bridge (within Islands Park);
- **Option 2C**: reinforced concrete flood walls with sheet pile below ground level at all locations;
- **Option 2D**: reinforced concrete flood walls with sheet pile below ground on right bank, reinforced concrete flood walls with sheet pile below ground on left bank upstream of bridge, sheet pile core embankments on left bank downstream of bridge (within Islands Park).

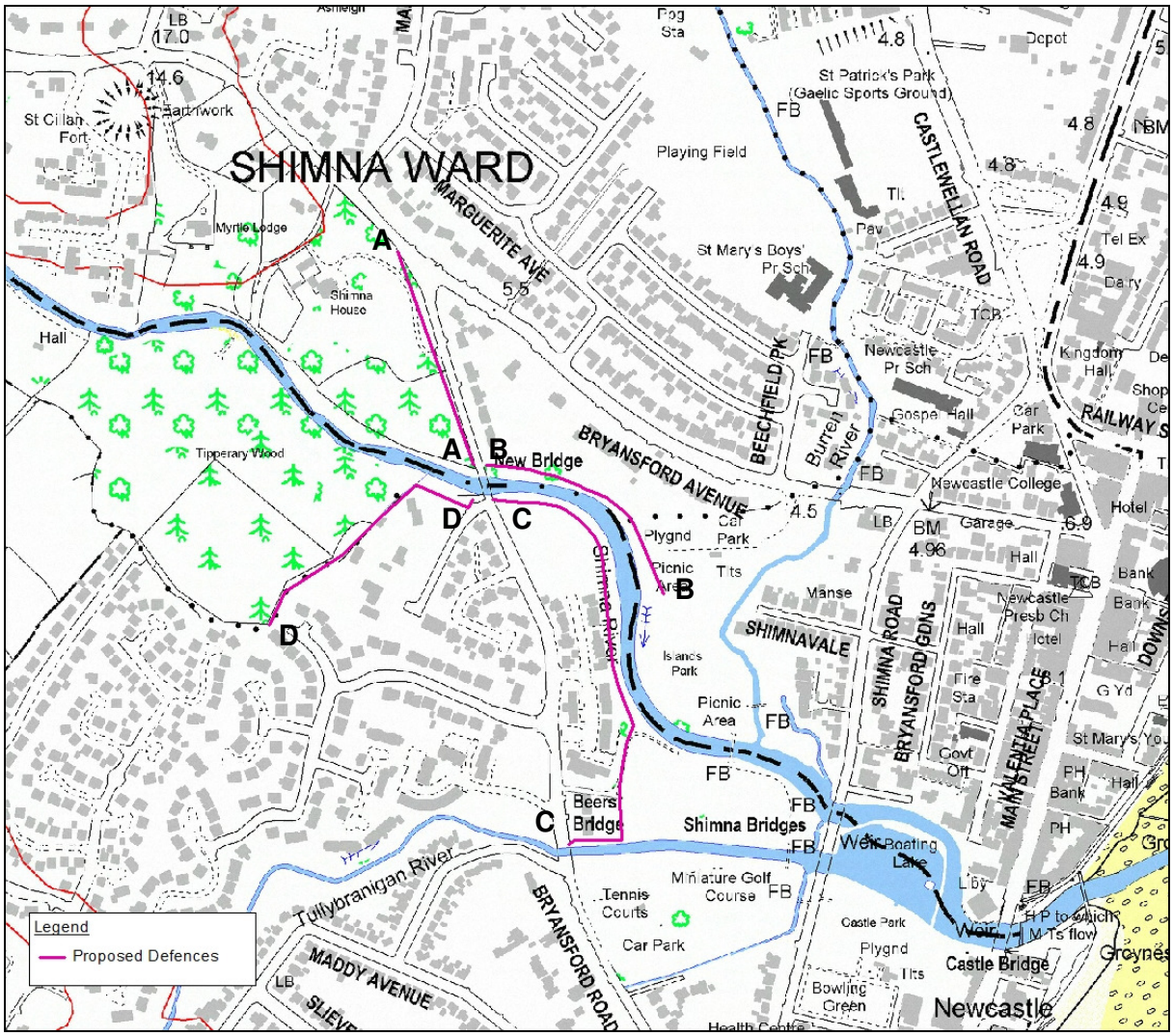


Figure 5.1 Proposed Locations of Hard Defences

In addition to construction of the flood defences, amendments would be required to the internal drainage. Any drainage pipes that currently outlet to the Shimna River will need to be retained through the defences. Where several pipes outlet to the river in close proximity to each other, these pipes can be collected together by an interceptor pipe, and outlet to the river at one point. If flood defences are constructed it will be necessary to drain the hinterlands to reinstate the natural drainage to the river. Land drains can be installed where necessary that will discharge to the river. All new and remaining unflapped outlets to the river should have flap valves installed.

In addition to the primary options above there are a number of secondary options that should also be implemented. These options may reduce the impact of flooding or may be required in order to comply with National or Regional Policies. The actions required for each option are discussed in Table 5.4.

Some of these options, such as individual property protection and watercourse maintenance, can be progressed as Interim Measures

Option	Action
Watercourse Maintenance	Regular maintenance of the Shimna River will ensure that there are no obstructions in the river channel that may cause an increased risk of flooding
Flood warning/forecasting	Rivers Agency could consider the installation of a flood forecast and warning system on the Shimna River upstream of Newcastle
Public Awareness Campaign	Rivers Agency is currently completing a Pilot project in another area that if successful could be applied to the Newcastle area.
Individual Property protection	Rivers Agency can provide advice on precautions that residents can take to protect their property. Sandbags may be provided to houses that are in imminent danger of flooding

Table 5.4 Secondary options

5.4 MODELLING AND MAPPING OF THE OPTIONS

The location and heights of the flood defences were incorporated into a revised model. The height of the embankments and walls in the model included a 600mm freeboard above the predicted 1% AEP flood levels for the undefended model. The defended model was run to ensure that the proposed 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.

The model run showed that the flood defence works prevented flooding of properties for a 1% AEP event. Two properties to the south of the Tullybranigan River were identified on the flood maps as being at increased risk of flooding due to the construction of the proposed flood defences (Spelga Avenue and Shimna Road). However, when the floor levels of these properties were checked they were found to be above the 1% AEP flood level by greater than 300mm, and therefore not at risk of flooding. The predicted 1% AEP floodplain following the implementation of the proposed option is shown in Appendix B.

5.5 ENVIRONMENTAL SCOPING OF THE PROPOSED OPTION

The proposed option of hard defences was reviewed by DARD Rivers Agency Environment Section. They indicated that the proposed works may have an impact on three mature Scots pines along the river banks downstream of Bryansford Road bridge. To allow these mature trees to remain, the embankment has been changed to a flood wall for a section. In addition, they have indicated that trees should not be removed between 1st March and 31st August, in line with the bird nesting guidance provided by DARD.

5.6 LIAISON WITH DOWN DISTRICT COUNCIL

A meeting was held on site with a representative of Down District Council (DDC) to discuss the proposed option, in particular what requirements DDC may have for maintenance. The following points were noted following the discussion:

- there is a mature oak tree on the river bank downstream of Bryansford Road bridge, so the line of the embankment has been amended to avoid this;
- an existing path runs along the river bank and this will be replaced by a 2m wide path on top of the flood defences;
- the slope of the embankments will be 1 in 2.5 to allow for maintenance;
- a 1m level area will be maintained between the base of the embankment and the natural barrier;
- at least one manhole is required to be raised;
- a hand rail may be required along the floodwall section that passes the Scots pines.

All of the above points were included in the modelling and costing of the proposed option.

5.7 ECONOMIC ANALYSIS

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

This approach ensures a clearly identified audit trail which transparently shows how the preferred option would be cost-effective and delivers real value for the community of Newcastle.

Full details of the Economic Appraisal can be found in a separate report. Table 5.5 below summarises the results of the Economic Appraisal.

Table 5.5 Summary of Economic Appraisal

	Costs (£)				
	Option 1	**Option 2A**	**Option 2B**	**Option 2C**	**Option 2D**
Construction costs from estimates	0	1,631,275	1,537,645	3,110,304	3,266,557
Optimism Bias Adjustment	0	841,738	793,425	1,604,917	1,685,543
Maintenance Costs (NPV over 100 years)	0	47,402	63,694	47,402	63,694
Total Present Value Costs	0	2,520,415	2,394,764	4,762,623	5,015,794
	Benefits (£)				
	Option 1	**Option 2A**	**Option 2B**	**Option 2C**	**Option 2D**
Present Value Damage (including emergency services)	6,089,649	580,901	580,901	580,901	580,901
Present Value Damage Avoided	0	5,508,748	5,508,748	5,508,748	5,508,748
Intangible Benefits	0	1,547,862	1,547,862	1,547,862	1,547,862
Total Present Value Damage Avoided	0	7,056,610	7,056,610	7,056,610	7,056,610
	Benefit Cost Ratio				
	Option 1	**Option 2A**	**Option 2B**	**Option 2C**	**Option 2D**
Average benefit/cost ratio	-	2.80	2.95	1.48	1.41

The results from the economic appraisal indicate that the economic viability of the scheme varies with the method of construction used for the hard defences. If ground conditions allow reinforced concrete

walls to be used then the scheme has a high benefit/cost ratio, whereas if sheet piles are required the benefit/cost ratio decreases to close to 1.

5.8 GROUND INVESTIGATION

As there was such a variation in the economic viability of the scheme depending on the method of construction required, DARD Rivers Agency instructed RPS to procure a ground investigation. Geotechnical and Environmental Services (GES) completed the ground investigation in November 2014, which comprised 5 No. boreholes with associated in-situ testing and sampling, as assessment to the permeability of the strata encountered, geotechnical and laboratory testing, and factual and interpretative geotechnical reporting. A copy of the Site Investigation is provided in Appendix C. The following general ground conditions were encountered:

- TOPSOIL;
- MADE GROUND: Soft grey brown slightly sandy slightly gravely SILT with roots and rootlets. Also containing occasional crockery and red brick remnants/ Grey brown silty sandy fine to coarse GRAVEL/ gravely fine to coarse SAND;
- Very loose to very dense grey brown silty gravelly fine to coarse SAND/ sandy fine to coarse GRAVEL;
- Very soft grey sandy SILT;
- Stiff to very stiff grey brown slightly sandy gravely SILT with cobble content.

The results of this ground investigation shows that sand and gravel is found in shallow strata. If a flood wall or embankment is constructed without sheet piles there is likely to be a massive amount of piping and water flow beneath the defences which can cause flooding. This would be the case with Options 2A and 2B, and these therefore would not provide adequate protection. Options 2C and 2D allowed for 4m deep piles, and this depth of pile seems a reasonable maximum assumption from a preliminary consideration of the site investigation. Detailed design would be required to confirm the depth of piles, but it is unlikely to be deeper than 4m.

5.9 PREFERRED OPTION

Following the site investigation, either Option 2C or 2D would be required as these allow for sheet piles below the defences. Option 2C, reinforced concrete walls with sheet piles at all locations, would be the preferred option as it has a slightly higher benefit/cost ratio of 1.48.

6 SUMMARY AND RECOMMENDATIONS

Historical flooding has occurred regularly over the last 40-50 years in Newcastle with the extreme flood event of 16/17 Aug 2008 being the most severe. This caused significant flooding in Bryansford Avenue and Shimna Road areas where flood water ponded behind the recently constructed Burren Flood defences. This area comprises primarily of residential properties, schools and Islands Park. Many properties were flooded badly during this event.

It was apparent from this event and previous analysis that at the lower end of the Burren and Shimna Catchments the interaction of the two rivers needs to be considered carefully when assessing the flood risk in this area. The August 2008 flooding was severe, and subsequently water from the Shimna effectively flowed out of catchment into the Burren catchment and ponded behind the defences, thus highlighting the relationship between the two rivers. All of these factors contribute to some degree to the flooding over the lower reaches of the Shimna.

RPS have previously carried out various flooding and feasibility studies, EIAs and flood mapping projects on the Shimna, Burren, Leitrim and Tullybranigan Rivers as well as coastal modelling to provided model downstream boundaries. The most recent study included the completion of flood mapping for Newcastle as part of the Rivers Agency's flood mapping programme. This study included a hydrological assessment, construction of a computational model of the Shimna River, and production of flood maps. The results of the flood mapping study were then used for this feasibility study.

The mapping study identified the main flooding mechanism from the Shimna River. Initial flooding begins around the Bryansford Road Bridge. The flood water then flows across Bryansford Avenue into Beechfield Park and towards the Bryansford Avenue Bridge. The Bryansford Avenue Bridge acts as an aqueduct and conveys water over the Burren River to the eastern part of Newcastle causing flooding along Shimna Road and Shimna Vale. These mechanisms were seen during the August 2008 flood event.

RPS undertook a rigorous process to ensure that all potential flood alleviation measures were considered. The most feasible option is the provision of hard defences to prevent water from leaving the Shimna River at Bryansford Road bridge. Various methods of construction of hard defences were costed as the ground conditions at that time were unknown. As there was such a variation in the economic viability of the scheme depending on the method of construction required, DARD Rivers Agency instructed RPS to procure a ground investigation. The results of this showed sand and gravel in the shallow strata, and therefore sheet piles would be required to prevent water flow beneath the wall. The choice of options would therefore be Options 2C and 2D, as Options 2A and 2B do not allow for a sheet pile cut-off and would therefore not provide adequate protection. Option 2C, reinforced concrete walls with sheet piles at all locations, would therefore be the preferred option as it has a slightly higher benefit/cost ratio of 1.48.

The preferred option of flood defences was modelled to confirm that it would offer flood protection to the properties at risk from a 1% AEP event. The modelling also demonstrated that the preferred option does not increase the risk of flooding elsewhere in the catchment.

The Rivers Agency's vision 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 believe that the preferred options successfully achieve these aims of the Rivers Agency.

Annex B: EIA Screening Report (February 2018)

Shimna River Flood Alleviation Scheme

EIA Screening

Department for Infrastructure (DfI) Rivers

February 2018

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Quality information

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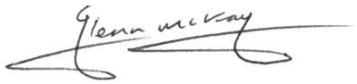	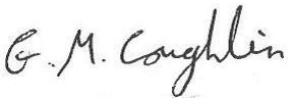	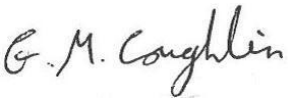
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1. Introduction

AECOM was commissioned by the Department for Infrastructure (DfI) - Rivers to provide a range of engineering and environmental design services in relation to the Shimna Flood Alleviation Scheme. Part of this commission requires the preparation of an Environmental Impact Assessment (EIA) Screening to determine whether a full EIA and subsequent Environmental Statement (ES) is required.

1.1 Project Description

The road bridge on the Bryansford Road (New Bridge) is the hub point of the scheme. The scheme proposes construction of four separate flood defences, each starting at the bridge (Figure 1). On the north bank of the Shimna River there would be construction of a flood defence from Bryansford Road Bridge (New Bridge), running parallel to the Bryansford Road for approximately 115m, then turning and running perpendicular to the road, for approximately 70m. On the north bank of the Shimna River, there would be construction of a flood defence from New Bridge, running downstream and parallel to Shimna River within Island Park over approximately 250m. On the south bank of the Shimna River, there would be construction of a flood defence from New Bridge, running downstream and parallel to Shimna River over approximately 645m across to Beers Bridge, and, on the south bank of the Shimna River, there would be construction of a flood defence from New Bridge, running upstream, parallel, then perpendicular to Shimna River for approximately 290m.

1.2 Legislative Context

The requirement to carry out a statutory EIA and publish a formal ES only applies to certain projects that are deemed to exceed certain thresholds and are predicted to have a significant effect on the environment.

The Planning Reform (Northern Ireland) Order 2006 ended the Crown's immunity from planning control. Crown bodies have to apply for planning permission like any other developer, unless a scheme is classified as 'permitted development' as defined by the Planning (General Development) Order (Northern Ireland) 1993 (as amended by the Planning (Application of Subordinate Legislation to the Crown) Order (Northern Ireland) 2006).

Part 24 of the Schedule to the Planning (Application of Subordinate Legislation to the Crown) Order (Northern Ireland) 2006 describes permitted development rights exercisable by the Department for Infrastructure (hereafter referred to as the Department) for the purposes of drainage works. The proposed scheme qualifies as a Class A 'permitted development' under this schedule, as it would require carrying out drainage works by or on behalf of the Department as per the meaning assigned to it by Schedule 2 of the Drainage (Northern Ireland) Order 1973 [as amended]. This includes new construction works such as:

- *the building of embankments and walls for the prevention of flooding or erosion.*

Under the provisions of the Drainage (Northern Ireland) Order 1973 [as amended], in determination of whether a drainage scheme has significant effects on the environment, the Department shall determine before the date of publication of details of the scheme whether or not it falls within Annex I or Annex II to Directive 2011/92/EU of the European Parliament and of the Council on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU of the European Parliament and of the Council (hereafter referred to as the EIA Directive).

The EIA Directive (Directive 85/337/EEC) on "*The assessment of the effects of certain public and private projects on the environment*" came into effect in Europe in July 1988 and initiated a formal approach to environmental assessment throughout the European Community. The Directive requires an environmental assessment to be carried out, prior to a development consent being granted, for certain types of major projects judged likely to have significant impacts on the environment.

The EIA Directive of 1985 has been amended three times; in 1997, in 2003 and in 2009. The initial Directive of 1985 and its three amendments have been codified by Directive 2011/92/EU of 13th December 2011. Directive 2011/92/EU was amended in 2014 by Directive 2014/52/EU which entered

into force on 15th May 2014 and transposed in national legislation by The Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017, becoming operational on 16th May 2017.

These Regulations implement, for Northern Ireland, Council Directive 2011/92/EU (as amended by Council Directive 2014/52/EU) on the assessment of the effects of certain public and private projects on the environment, in respect of drainage schemes and drainage works. They also revoke and re-enact, with amendments, the Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2006. The Regulations require the Department, in the execution of certain drainage works and drainage schemes, to produce an Environmental Statement and, on the basis of that statement, to decide whether or not to proceed with the drainage works or drainage schemes in question.

2. Determination

The process for determining whether it is necessary to carry out an EIA and publish an ES is termed Screening. The Screening process establishes:

1. whether the project falls within Annex I or Annex II to the EIA Directive;
2. whether an Annex II project represents a 'relevant project';
3. the 'determination' for the purposes of The Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017 whether the project should be subject to an EIA; and
4. reporting the determination.

Where the Department has to make a determination whether there may be significant effects on the environment, it shall provide the following information on the proposed drainage scheme of the type listed in Annex II to the Directive:

a. *a description of the project, including in particular:*
   i. *a description of the physical characteristics of the whole project and, where relevant, of demolition works; and*
   ii. *a description of the location of the project, with particular regard to the environmental sensitivity of geographical areas likely to be affected;*
b. *a description of the aspects of the environment likely to be significantly affected by the project;*
c. *a description of any likely significant effects, to the extent of the information available on such effects, of the project on the environment resulting from:*
   i. *the expected residues and emissions and the production of waste, where relevant;*
   ii. *the use of natural resources, in particular in soil, land, water and biodiversity.*

The criteria of Schedule 2B to the Drainage (Northern Ireland) Order 1973 [as amended] shall be taken into account, where relevant, when compiling the information in accordance with points (a) to (c) above.

2.1 Step 1 – Deciding if the project falls within Annex I or Annex II of the EIA Directive

The first screening decision is identifying whether the project falls within Annex I or Annex II of the EIA Directive. Certain types of projects are listed within Annex I and for these, EIA is mandatory and no determination is necessary.

Does the project fall within Annex I of the EIA Directive?	**Yes**		**No**	ü

If yes, a formal EIA is required. If no, continue to Step 2.

2.1.1 Comments

This project is not of a type listed in Annex I of the EIA Directive considered as having significant effects on the environment and requiring a mandatory EIA. The road bridge on the Bryansford Road ("new" bridge) is the hub point of the scheme. The scheme proposes the construction of four separate flood defences, each starting at the bridge (Figure 1). On the north bank of the Shimna River there would be construction of a flood defence from Bryansford Road Bridge (New Bridge), running parallel to the Bryansford Road for approximately 115m, then turning and running perpendicular to the road, for approximately 70m. On the north bank of the Shimna River, there would be construction of a flood defence from New Bridge, running downstream and parallel to Shimna River within Island Park over approximately 250m. On the Southbank of the Shimna River, there would be construction of a flood defence from New Bridge, running downstream and parallel to Shimna River over approximately 645m across to Beers Bridge, and, on the south bank of the Shimna River, there would be construction of a flood defence from New Bridge, running upstream, parallel, then perpendicular to Shimna River for approximately 290m.

2.2 Step 2 – Deciding if an Annex II Project is a 'Relevant Project'

Projects listed under Annex (or Schedule) II of the EIA Directive may require an EIA if it is concluded that the project will exceed certain limits or thresholds. To determine whether or not Annex II projects are relevant, thresholds of project size and environmental sensitivity exist in the EIA Regulations. Annex II projects will normally require an EIA where any part of the development is likely to be carried out in a sensitive area.

As a flood alleviation scheme, it is categorised as:

- Annex II (10) Infrastructure Project (f) Inland-waterway construction not included in Annex I, canalisation and flood-relief works.

As per European Commission Report '*Interpretation of Definitions of Project Categories of Annex I and II of the EIA Directive*' (2015), canalisation and flood relief works are interpreted as including works for retaining water and preventing floods.

Regulation 7 of the Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017 states that the Department must provide specified information on proposed drainage works of the type listed in Annex II to the Directive and consider the selection criteria in Schedule 2B to the Drainage Order when deciding if there are any likely effects of the drainage works on the environment. Schedule 2B of the Drainage Order adopts the criteria referred to in Article 4(3) of the EIA Directive, as set out below.

2.2.1 Characteristics of drainage works or drainage schemes "the works"

The characteristics of drainage schemes must be considered having regard, in particular, to:

- the size and design of the whole works;
- their cumulative effects with other existing or approved works;
- the use of natural resources, in particular land, soil, water and biodiversity;
- the production of waste;
- pollution and nuisances;
- the risk of major accidents or disasters which are relevant to the works concerned, including those caused by climate change, in accordance with scientific knowledge, having regard in particular to substances or technologies used; and
- the risks to human health (for example due to water contamination or air pollution).

2.2.2 Location of drainage works or drainage schemes

The environmental sensitivity of geographical areas likely to be affected by the works must be considered, having regard in particular to the:

- *existing and approved land use;*
- *relative abundance, availability, quality and regenerative capacity of natural resources (including soil, land, water and biodiversity) in the area and its underground; and*
- *absorption capacity of the natural environment, paying particular attention to the following areas:*
  - *wetlands, riparian areas, river mouths;*
  - *coastal zones and the marine environment;*
  - *mountain and forest areas;*
  - *nature reserves and parks;*

- *areas classified or protected under European Economic Area (EEA) States' legislation, Natura 2000 areas designated by EEA States pursuant to Directive 92/43/EEC and Directive 2009/147/EC;*
- *areas in which there has already been a failure to meet the environmental quality standards, laid down in Union legislation and relevant to the project, or in which it is considered that there is such a failure;*
- *densely populated areas; and*
- *landscapes and sites of historical, cultural or archaeological significance.*

2.2.3 Type and characteristics of the potential impact

The likely significant effects on the environment must be considered in relation to the criteria set out under Sub-Sections 2.2.1 and 2.2.2 with regard to the impact of the works on the factors specified in Article 3(1) of the Directive, and having regard, in particular, to the:

- magnitude and spatial extent of the impact of the works (for example the geographical area and size of the population likely to be affected);
- nature of the impact;
- transboundary nature of the impact;
- intensity and complexity of the impact;
- probability of the impact;
- expected onset, duration, frequency and reversibility of the impact;
- accumulation of the impact with the impact of other existing and/or approved projects; and
- possibility of effectively reducing the impact.

3. EIA Screening

The Checklist in Table 1 below for the Shimna River Flood Alleviation Scheme has been prepared as per the requirements of Regulation 7 of the Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017 which state that the Department must provide specified information on proposed drainage works of the type listed in Annex II to the EIA Directive and consider the selection criteria in Schedule 2B to the Drainage Order when deciding if there are any likely effects of the drainage works on the environment.

Table 1. EIA Screening Checklist in relation to the characteristics of the Scheme

Characteristics of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
(a) Size of the scheme			
Will the development be out of scale with the existing environment?	Yes	The project is a flood alleviation scheme for the Shimna River which flows through Newcastle, County Down and will include provision of hard defences (flood walls and embankments) along or close to both banks of the river, upstream and downstream of Bryansford Road Bridge. The undulating nature of the local terrain, the extent of surrounding built development, maturity of vegetation and existing nearby flood defences adjacent to the Burren River will all help with the naturalisation and absorption of this development into the existing landscape. The key to reducing environmental impact would be minimising the potential loss of existing mature woodland and riparian vegetation during construction of the flood defences. As a heavily tree-lined watercourse, retention of existing mature vegetation would serve to maximise potential visual screening.	Potentially - the area is a substantially wooded corridor of high environmental quality and visual amenity, providing a good visual entrance feature into Newcastle. Significant losses of mature trees from the wooded corridor may limit the ability of the landscape to absorb this development. On this basis, as much vegetation should be retained as is practicable. No retained tree shall be cut down, uprooted or destroyed or have its roots damaged within the crown spread, nor shall arboricultural work or tree surgery take place on any retained tree be topped or lopped other than in accordance with the approved plans and particulars without the written approval of the Council. Any arboricultural work or tree surgery approved shall be carried out in accordance with British Standard 3998 2010 Recommendations for Tree Work.
Will it lead to further consequential development or works (e.g. new roads, extraction of aggregate, provision of new water supply, generation or transmission of power, increased housing and sewage disposal)?	Yes	The Ards and Down Area Plan 2015 notes that flooding is a constraint to development adjacent to some of the main rivers within Newcastle. It is acknowledged within the plan that the recently completed Burren River flood alleviation scheme provided the opportunity to release land for development. It would be reasonable to assume that flood protection measures adjacent to the Shimna River may also do the same (e.g. for housing).	No - the existing zonations and areas of developmental constraint identified within the Area Plan should limit inappropriate development in this area. Planning for any new consequential development would normally be determined in accordance with the policies contained within the plan and other material planning considerations.
(b) Cumulation with other development			
Are there potential cumulative impacts with other existing development or development not yet begun but for which planning permission exists?	No	A review of planning applications online via the PublicAccess Website has confirmed that no potential cumulative impacts can be expected in the local area with existing development or development not yet begun, but for which planning permission exists.	N/A

Characteristics of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
Should the application for this development be regarded as an integral part of a more substantial project? If so, can related developments which are subject to separate applications proceed independently?	No	Whilst this project is associated with other flood alleviation schemes which have been constructed in the Newcastle area (i.e. Burren River Flood Alleviation Scheme), there are no other live applications for similar schemes to make this an integral part of a more substantial project.	N/A
(c) Use of natural resources			
Will construction or operation of the development use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply? · land (especially undeveloped or agricultural land)? · water? · minerals? · aggregates? · forests and timber? · energy including electricity and fuels? · any other residues?	Yes	The use of natural resources would be minimal apart from the constitute elements of manufactured products (e.g. concrete, steel sheet piles, stone cladding, etc.) to facilitate construction of the flood walls. Different grades of aggregate would likely be required for foundations and drainage. Appropriately classed fill material would be required for formation of flood embankments (in particular clay), which may be sourced locally. Timber will be used for formwork during the construction phase. There will be land take from public areas (i.e. parkland, forestry, public amenity space) and private gardens of residences which back onto the river corridor to accommodate the flood walls and embankments. Energy will be expended during the construction phase due to plant and machinery operation, though there would be no operational phase energy requirements.	No - a mitigation strategy would be developed to minimise impacts upon existing land uses. The appointed contractor shall be required to operate under an accredited Environmental Management System (EMS). It shall be developed to avoid wherever possible environmental accidents and pollution, to encourage reduced consumption of resources, to restrict the production of waste, and to promote good relationships with the relevant authorities / environmental bodies. An Environmental Management Plan (EMP) shall be prepared to manage this process.
(d) Production of waste			
Will the development produce wastes during construction or operation or decommissioning? · spoil, overburden or mine wastes? · municipal waste (household and/or commercial)? · hazardous or toxic wastes (including radioactive)? · other industrial process wastes? · surplus product? · sewage sludge or other sludges from effluent treatment? · construction or demolition wastes? · redundant machinery or equipment? · contaminated soils or other material? · agricultural wastes? · any other solid wastes? · liquid or solid wastes in suspension?	Yes	Minimal physical waste would be generated from the scheme, as it will be procured and managed to ensure it is developed as sustainably as is reasonably practicable. Typical scheme waste would include sheet pile off cuts for recycling (possible re-use), emissions from plant and machinery (e.g. cranes, excavators, lorries). Unsuitable fill material encountered on-site will be re-used (e.g. for landscaping purpose) where possible.	As part of the EMP, a Site Waste Management Plan (SWMP) would implement where possible cost-effective methods of good practice waste minimisation during the design of the project and thereafter during construction. The Contractor would be required to make every effort to re-use as much of the material as possible within the area of the construction site. Any material to be re-used, which is wet, should be stockpiled to allow it to dry out. Stockpiling should be well away from any sensitive areas of ecological or archaeological interest, or watercourses where pollution could occur.
(e) Pollution and nuisances			

Characteristics of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
Will the development release pollutants or any hazardous, toxic or noxious substances to air? Emissions from: · combustion of fossil fuels from stationary or mobile sources? · production processes? · materials handling including storage or transport? · construction activities including plant & equipment? · dust or odours from handling of materials including construction materials, sewage & waste? · incineration of waste? · burning of waste in open air (e.g. slash material, construction debris)? · any other sources	Yes	The scheme will not produce any operational phase emissions to air. All emissions from the scheme would be limited to the construction or maintenance phases. This would include emissions from vehicles and plant, and dust raising activities from earthworks and construction processes utilising concrete and aggregates. Dust and air pollution, including odours, can cause disruption to properties and the public adjacent to the construction works and can also have adverse impacts upon other environmental receptors, including watercourses and ecologically designated sites.	No - the appointed contractor will be required to implement measures to minimise the amount of dust and emissions (including odour) produced during the construction phase. There will be a Duty of Care on the Contractor to ensure that dust-raising activities are located away from sensitive receptors as much as feasibly possible and duration kept to a minimum when in proximity to a receptor. Mitigation measures would be implemented so that construction works are carried out in such a manner that emissions of dust and other pollutants are limited, and that best practicable means are employed to minimise disruption, risks to human health, and to avoid unnecessary impacts on sensitive ecological habitats. This would be an important aspect to be developed as part of the EMP.
Is there a potential risk from: · leachates? · Escape of wastes or other products/by products that may constitute a contaminant in the environment?	Yes	A review of NIEA – Land & Resource Management Unit's database of sites where, based on their historic land use, there is potential for contamination to be present, would indicate that there is minimal risk of encountering contaminated land during the works. There does however remain a risk of encountering invasive species (e.g. Japanese knotweed or Himalayan balsam), during the works, particularly as this is a riparian environment. The presence of such species shall only be established by undertaking the necessary ecological surveys.	No – the EMP would provide details of environmental control measures to deal with any contaminated land encountered during the site operations and shall be implemented by the appointed contractor. Measures (mechanical or chemical) shall be undertaken to prevent the spread of invasive species during construction or maintenance of the scheme where they are encountered.
Will the development cause noise and vibration or release of light, heat energy or electromagnetic radiation? · from operation of equipment e.g. engines, ventilation plant, crushers? · from industrial or similar processes? · from blasting or piling? · from construction or operational traffic? · from lighting or cooling systems? · from sources of electromagnetic radiation (effects on nearby sensitive equipment as well as people)? · from any other sources?	Yes	The scheme will not produce any noise and vibration or release of light, heat energy or electromagnetic radiation during the operational phase. The primary impacts would be limited to the construction phase, in particular noise and vibration generated from piling activities.	No – the transient impacts of construction-related noise and vibration would not result in significant effects. Best practicable means of minimising noise on the site must be adopted by the appointed contractor. Typical measures would include positioning of static plant as far away from receptors, using well-maintained plant, temporary screening, enclosures, restricting works and staggering high vibration activities such as piling. It will be necessary for the contractor to liaise with the Environmental Health Unit within the Council and the local community, to ensure that noise and vibration during construction is effectively managed.
(f) Risk of accidents, having regard in particular to substances or technologies used			
Will there be a risk of accidents during construction or operation of the development which could have effects on people or the	Yes	There is a risk of construction accidents if there is poor management and implementation of control systems such as injury or fatality due to construction traffic,or release of	No - the EMP shall include site-specific method statements for all operations where there is a risk of environmental damage. These shall show how the

Characteristics of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
environment? · from explosions, spillages, fires etc. from storage, handling, use or production of hazardous or toxic substances? · from events beyond the limits of normal environmental protection e.g. failure of pollution control systems? · from any other causes? · could the development be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslip, etc.)?		pollutants into the Shimna River for example. Working near or within a watercourse also poses risks to humans and the water environment itself, particularly in light of the extent to which the public (including vulnerable users) utilise this area recreationally and the ecological sensitivity of the watercourse itself. There is a particularly high risk of accidental root damage for existing vegetation to be retained within the site. Disruption or destruction of important mature trees should be avoided where possible.	proposed methods of construction shall restrict impacts on the environment, and how contingency plans and emergency procedures shall limit damage caused by accidents, spillage or any other unforeseen events. The method statements shall include notification procedures to the relevant authorities/environmental bodies. The Contractor shall liaise with the local community during the Contract and the Council to facilitate ongoing usage of the area as much as is practicably possible during construction. The Contractor shall ensure that any trees or vegetation to be retained are afforded suitable protection for the nature of the site work being undertaken in that area.
Will the development involve use, storage, transport, handling or production of substances or materials which could be harmful to people or the environment (flora, fauna, water supplies)? · use of hazardous or toxic substances? · potential changes in occurrence of disease or effect on disease carriers (e.g. insect or water borne diseases)? · effect on welfare of people (e.g. change of living conditions) · effects on vulnerable groups (e.g. the elderly)?	Yes	The mobilisation of suspended sediments (SS) due to site works in general is the greatest pollution risk during construction. Pollution of the Shimna River by mobilised SS can have significant adverse ecological (flora & fauna) impacts. Salmonids are particularly sensitive to reductions in water quality, and habitats can be damaged by siltation from settlement of SS. Any construction activities carried out within or close to the Shimna River involve a risk of pollution due to accidental spillage. While liquids such as oils, lubricants, paints, bituminous coatings, preservatives and weed killers present the greatest risk, other materials such as cement can also have serious environmental effects. The refuelling of general construction plant also poses a significant risk of pollution, depending on how and where it is carried out.	No – the appointed contractor shall be required to undertake due care and attention when working in the vicinity of the Shimna River and associated tributaries and where necessary, a wide range of prescriptive mitigation measures shall be implemented to ensure protection of the water environment. Being in a very sensitive water environment, it will be necessary for the Contractor to undertake all works in a precautionary manner, specifically targeted to avoid pollution of the water environment. On this basis, the Contractor shall be required to prepare a Pollution Control and Contingency Plan (incorporating a Silt Management Plan) to appropriately manage the works.
Other characteristics: potential physical changes (topography, land use, changes in water bodies etc.) from construction, operation or decommissioning of the development: · permanent or temporary change in land use, land cover or topography including increases in intensity of land use? · clearance of existing land, vegetation & buildings? · Peat land disturbance and/ or degradation leading to; carbon release, damage to habitats, affecting land stability or hydrology? · creation of new land uses? · pre-construction investigations e.g. boreholes, soil testing? · construction or demolition works? · temporary sites or housing for construction workers? · above ground buildings, structures or earthworks including	Yes	The proposed works extend out in various directions over an overall distance of approximately 1200m, requiring linear access and storage points on both sides of the river. However, access / storage requirements will be temporary. The defences will be set back from the river bank where possible, therefore requiring land not previously used for defences. The proposed works would have to consider the impact on the mature trees within the river corridor. This has the greatest potential for long-term impacts. Accordingly, the design has been modified in places to allow these mature trees to remain. This includes changing a flood embankment to a flood wall to minimise land take and potential encroachment. Liaison with the local council has taken place in regards to these matters. There would be no direct hydromorphological impacts within	No - the Contractor should be able to mitigate land use requirements through proper planning and programming. The EMP will set out procedures, standards, work practices and management responsibilities for the implementation of specified mitigation measures developed to address environmental impacts. It shall: · act as a continuous link and main reference document for environmental issues between the design, construction, maintenance and operation stages of the project; · demonstrate how construction activities and supporting design shall properly integrate the requirements of environmental legislation, policy, good practice, and those of the regulatory authorities and third parties; · record environmental risks and identify how they will be managed during construction;

Characteristics of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
linear structures, cut & fill or excavations? · facilities for storage of goods or materials? · facilities for treatment or disposal of solid wastes or liquid effluents? · impounding, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers? · stream crossings? · changes in water bodies or the land surface affecting drainage or run-off? · transport of personnel or materials for construction, operation or decommissioning? long term dismantling or decommissioning or restoration works? · introduction of alien species? · loss of native species or genetic diversity? any other changes?		the wetted area of the Shimna River, as all works would be set back from the watercourse. As noted previously, the area is extensively utilised for recreational and amenity purposes. It is likely that there would be temporary footway closures during the works and the playground within Island Park may be directly affected to construct a flood wall and temporarily closed. Additional traffic would be generated during the construction phase. However, this is unlikely to be significant. There may also be direct impacts upon existing services and utilities to accommodate the works.	· record the objectives, commitments and mitigation measures to be implemented together with programme and date of achievement; · identify key staff structures and responsibilities associated with the delivery of the project and environmental control and communication and training requirements as necessary; · describe the Contractor's proposals for ensuring that the requirements of the environmental design are achieved, or are in the process of being achieved, during the Contract Period; · act as a vehicle for transferring key environmental information at handover; and · provide a review, monitoring and audit mechanism to determine effectiveness of, and compliance with, environmental control measures and how any necessary corrective action shall take place.

Table 2. EIA Screening Checklist in relation the location of the Scheme

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
(a) Existing Land Use			
Are there existing land uses on or around the location which could be affected by the development , e.g. homes, gardens , other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, water catchments, functional floodplains, mining or quarrying?	Yes	As outlined above, the proposed works extend out in various directions from Bryansford Road Bridge to an overall distance of approximately 1200m, requiring linear access and storage points on both sides of the Shimna River. However, access and storage requirements will be temporary and the Contractor should be able to mitigate land use requirements through proper planning and programming. The flood defences will be set back from the river bank where possible, therefore requiring land not previously used for defences. The riparian corridor of the Shimna River is backed onto by a number of private residences along Bryansford Avenue, Bryansford Road, Shimnamile, Riverside Park and Alfred Crescent. The scheme will result in modification to the boundary of the curtilages of these properties; however significant disruption to existing land uses is not envisaged. Temporary disruption to land may be much more significant due to the constrained working environment and limited points of access. On the south bank of the river, the works would occupy the area where residential properties (some of which are still at subfloor level) meet the mature woodland that bounds the river and Tipperary Wood. In general, trees may require felling where new walls are being constructed. As noted previously, the proposed works would have to consider the impact on the mature trees within the river corridor. This has the greatest potential for long-term impacts. Accordingly, the design has been modified in places to allow these mature trees to remain, as noted previously. On the upstream side of Bryansford Road Bridge, on the north bank of the river, a planning application has been approved for residential and associated development comprising the erection of 7 detached houses, 20 semi-detached houses, 7 terraced houses, 30 apartments, and conversion of an existing house to 4 apartments. Whilst only part of the site has been developed, there is the possibility that the flood wall may impact upon the site layout and affect current development proposals. On the downstream side of the bridge, on the north bank of the river, the works will directly affect Island Park which is considered a valuable area of active open space and recreation, as designated within the Ards and Down Area Plan 2015. The works would likely result in the temporary closure of the children's play area within the	No – the appointed contractor shall ensure that all areas of land which have been occupied to provide the site or carry out accommodation works are reinstated to the satisfaction of the affected landowner, occupier and the Employer. Working areas will need to be clearly defined to prevent access to the river channel and riverbank vegetation. The site should be fenced and access for plant, vehicles and workers to banks outside the site should be prohibited. Following construction, any disturbed bankside vegetation outside the crossing footprint should be restored. A "no access" buffer shall be implemented along the Shimna River, to prevent damage to banks and to prevent disturbance of riparian habitats. No retained tree shall be cut down uprooted or destroyed or have its roots damaged within the crown spread, nor shall arboricultural work or tree surgery take place on any retained tree be topped or lopped other than in accordance with the approved plans and particulars without the written approval of the Council. Any arboricultural work or tree surgery approved shall be carried out in accordance with British Standard 3998 2010 Recommendations for Tree Work. The erection of fencing for the protection of any retained tree shall be undertaken in accordance with the approved plans and particulars before any equipment machinery or materials are brought on to the site for the purposes of the development and shall be maintained until all equipment machinery and surplus materials have been removed from the site. Nothing shall be stored or placed in any area fenced in accordance with this condition and the ground levels within those areas shall not be altered, nor shall any excavation be made or any other works carried out or fires lit without the written consent of the Council. See below for comments regarding Island Park.

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
		park and disrupt a number of walking routes along the river corridor.	
Are there any areas on or around the location which are occupied by sensitive land uses e.g. hospitals, schools, places of worship, community facilities,which could be affected?	Yes	The proposed scheme would provide flood alleviation for a predominantly residential part of Newcastle. There is no sensitive land uses that could be affected other than community facilities associated with Island Park. Located between Bryansford Avenue and the Shimna River, the park is considered a valuable area of active open space and recreation, as designated within the Area Plan. As detailed within the Area Plan, the town has developed adjacent to a number of rivers which contribute to the setting of the urban area. The opportunity exists to protect and enhance the recreational potential of the river corridors by protecting and providing natural pedestrian links through the town, particularly from the Town Centre, to other attractions for example, Tollymore Forest Park and the seafront.	No – the children's park would be accommodated in the long-term and likely subject to improvement as a result of the encroachment of the flood wall. The park would also be protected from flood events, which is not currently the case. Whilst walking/rambling routes will be affected in the short-term, it is envisaged that in the long-term continued through access along the river would not be hindered, nor would it negate the potential for establishing extension or improved linkages within this area.
Is the development located in a previously undeveloped area where there will be loss of greenfield land?	No	N/A	N/A
(b) Relative abundance, quality and regenerative capacity of natural resources in the area			
Are there any areas on or around the location which contain important, high quality or scarce resources which could be affected by the development? · groundwater resources · surface waters · forestry · agriculture · fisheries · tourism · minerals	Yes	The Shimna River is an important river for salmonids and other species, and forms an effective wildlife corridor. The river is in a highly natural state due to limited human interference. It is of particular note for the naturalness of the river channel, which exhibits all the physical attributes of in-channel features, flow and riverbed types, typical of unaltered upland rivers. It has been designated as an Area of Special Scientific Interest (ASSI) as detailed below. The Shimna River provides excellent habitat for spawning salmonids, with populations of Atlantic Salmon, Brown Trout and Sea Trout present. Marginal semi-natural vegetation along the Shimna River is limited, except at its headwater, and is generally confined to a narrow belt of woodland. This woodland is mainly confined to the riverbank and adjacent slopes. Upstream of Bryansford Road Bridge, on the south bank of the river is Tipperary Wood, which is Forest Service woodland, heavily utilised by the community for walking, biking, etc. It is also utilised as a scout camp. The walking routes along the river are a valuable tourism asset within the Newcastle area, which forms a hub point for services and hospitality on a range of rambling and walking routes through the Mourne Mountains, a significant number of which pass directly through the scheme area.	No – there would be no instream works and the appointed contractor shall be required to undertake due care and attention when working in the vicinity of the Shimna River and associated tributaries. Where necessary, a wide range of prescriptive mitigation measures shall be implemented to ensure protection of the water environment. Being in a very sensitive water environment, it will be necessary for the Contractor to undertake all works in a precautionary manner, specifically targeted to avoid pollution of the water environment. On this basis, the Contractor shall be required to prepare a Pollution Control and Contingency Plan (incorporating a Silt Management Plan) to appropriately manage the works. Specific method statements will be produced for each site works area, detailing the work to be undertaken, the risk to the environment (whether ecological or water etc.) and detail the pollution control measures to be implemented. Potentially - the area is a substantially wooded corridor of high environmental quality and visual amenity, providing a good visual entrance feature into Newcastle. Significant losses of mature trees

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
			from the wooded corridor may limit the ability of the landscape to absorb this development. On this basis, as much vegetation should be retained as is practicable. No retained tree shall be cut down, uprooted or destroyed or have its roots damaged within the crown spread, nor shall arboricultural work or tree surgery take place on any retained tree be topped or lopped other than in accordance with the approved plans and particulars without the written approval of the Council. Any arboricultural work or tree surgery approved shall be carried out in accordance with British Standard 3998 2010 Recommendations for Tree Work. Whilst walking/rambling routes will be affected in the short-term, it is envisaged that in the long-term continued through access along the river would not be hindered, nor would it negate the potential for establishing extension or improved linkages within this area.
(c) Absorption capacity of the natural environment			
Are there any areas on or around the location which are protected under international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the development?	Yes	The works would have a direct impact upon Shimna River ASSI, which has been designated for the physical features of the river and associated riverine flora and fauna. The works proposed may constitute operations and activities which would appear to DAERA likely to damage the flora, fauna and physiographical features of the area. The Shimna River is also zoned as a Site of Local Nature Conservation Importance (SLNCI) for similar reasons as to those described above. Although not directly affected by the works, a hydrological pathway could be established to Murlough Special Area of Conservation (SAC)/ASSI as it is located approximately 800m downstream of the site.	Potentially – the alignment and position of the flood walls/embankments would reduce the potential for direct encroachment within the ASSI. Nevertheless, the works would effectively contain the designated area upstream and downstream of Bryansford Road Bridge. Whilst no instream works are expected (minimising the potential for adverse fisheries impacts), it could not be ruled out at this stage that adverse impacts upon a range of other protected habitats and species may occur with the works, considering the area's ecological sensitivity. Given the sensitivity of the receiving water environment, particularly the selection features of the ASSI, an enhanced system of ecological supervision shall be implemented during installation of mitigation measures and monitoring provision. The Contractor shall consult and comply with the requirements of DAERA with respect to the site or species protected by law, which are likely to be affected by the construction, establishment and maintenance of the site. Specific method statements will be produced for each site works area, detailing the work to be

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
			undertaken, the risk to the environment (whether ecological or water etc.) and detail the pollution control measures to be implemented.
Are there any areas on or around the location which are protected under international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the development?	Yes	The works would have a direct impact upon Local Landscape Policy Area (LLPA) 2 Bryansford Road – Enniskeen Hotel and large houses and Shimna River Corridor, as designated within the Ards and Down Area Plan 2015. Within the study area, it is designated for: · areas of woodland and important tree groups - substantially wooded corridor of high environmental quality and visual amenity provides a good visual entrance feature into town; · original character defined by low density housing and areas of fine wooded landscape; · river significant for salmon fishing and breeding and local nature conservation interest - river and trees support a range of habitats and species; · public access along river alongside Tipperary Wood linking to Tipperary Lane with potential for extension and linkage with Tollymore Forest Park; and landform backdrop to river emphasises visual significance of the area. The Northern Ireland Landscape Character Assessment describes the town's dramatic mountain setting and the strong contrasts between the mountains, the flat dune landscape at the shore, and the series of river valleys which radiate inland from the town. It refers to areas of locally distinctive landscape within the town, including the Shimna valley, Tipperary Wood and Donard Park and the river corridors associated with the Glen, the Tullybrannigan and the Burren rivers. The area is also located within the Mourne Area of Outstanding Natural Beauty (AONB). It is not located within a Marine Conservation Zone (MCZ).	Potentially – the alignment and position of the flood walls/embankments would reduce the potential for direct encroachment within the LLPA. Nevertheless, the works would effectively contain the zoned area upstream and downstream of Bryansford Road Bridge, potentially having an adverse impact upon character and landscape quality. The position and aesthetic finish of the flood defence structures will be critical to minimising adverse impacts. Whilst no instream works are expected (minimising the potential for adverse fisheries impacts), it could not be ruled out at this stage that adverse impacts upon a range of other protected habitats and species may occur with the works, considering the area's ecological sensitivity. Whilst public access will be affected in the short-term, it is not envisaged that in the long-term continued through access along the river would not be hindered, nor would it negate the potential for establishing extension or improved linkages within this area.
Are there any other areas on or around the location which are important or sensitive for reasons of their ecology: · wetlands, watercourses or other water bodies; · the coastal zone; · mountains, forests or woodlands; · nature reserves and parks.	No	The main aspects of ecological importance and sensitivity have been addressed above.	See comments made above.
Are there any areas on or around the location in which species and habitats of Local Biodiversity Action Plan importance are present?	Yes	The Newry, Mourne and Down Local Biodiversity Action Plan (LBAP) 2017-2022 identifies the importance of fish species and the risks associated with physical degradation of habitats, with the Department identified as a key body to improve habitats where	Potentially – note previous comments. A programme of tree planting and habitat creation may be carried out to mitigate any loss of habitat, and take opportunities to carry out work to advance the

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
		appropriate. It also identifies the importance of woodland, in particular mixed ashwoods, as found in the Newcastle Valleys. Key threats include habitat loss and/or fragmentation, and local action includes increasing the woodland cover and new woodland planting schemes on publically accessible land.	LBAP where possible.
Are there any areas on or around the location which are used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected?	Yes	A flora and fauna survey prepared by Corvus Consulting for the housing development at 78 Bryansford Road (Shimna House) identified the following: · the key ecological features of this site are the Shimna River and the semi-natural mixed woodland. To a lesser extent, the plantations of mixed exotic species have some value for birds. The long-term management goal for the site should be the management and optimisation of the site for protected species. · areas of the site are composed of semi improved neutral grassland, which is a relatively useful habitat type for badgers and birds. · the site is locally important for breeding and foraging birds, breeding and foraging bats, foraging and potentially breeding badger and red squirrel. Otter use the boundary of the site along the River Shimna. The findings of this report would likely be equally transferable to the works area from an important or sensitive species of fauna or flora perspective.	Potentially – note previous comments.
Are there any inland, coastal, marine or underground waters on or around the location which could be affected?	Yes	There are no works planned which are likely to take place within the river channel, however the proximity of the works to the Shimna River has the potential to establish preferential pathways and cause pollution and disturbance to the water environment and flora and fauna. Control measures will be implemented for working in and around the water environment to minimise this risk. The scheme will not irreversibly change the geomorphology of the river.	See comments made above.
Are there any groundwater source protection zones or areas that contribute to the recharge of groundwater resources?	No	N/A	N/A
Are there any areas or features of high landscape or scenic value on or around the location which could be affected?	Yes	The works would have a direct impact upon Local Landscape Policy Area (LLPA) 2 Bryansford Road – Enniskeen Hotel and large houses and Shimna River Corridor, as designated within the Ards and Down Area Plan 2015. It is also located within the Mourne AONB.	Potentially – note previous comments.
Are there any routes or facilities on or around the location which are used by the public for access to recreation or other	Yes	The works will directly affect Island Park which is considered a valuable area of active open space and recreation, as designated	No – the children's park would be accommodated in the long-term and likely subject to improvement as

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
facilities,which could be affected?		within the Ards and Down Area Plan 2015. The works would likely result in the temporary closure of the children's play area within the park and disrupt a number of walking routes along the river corridor. A multitude of walking/rambling routes pass along the river corridor and through the works area, including the Ulster Way, Mourne Way and Newcastle Way.	a result of the encroachment of the flood wall. The park would also be protected from flood events, which is not currently the case. Whilst walking/rambling routes will be affected in the short-term, it is envisaged that in the long-term continued through access along the river would not be hindered, nor would it negate the potential for establishing extension or improved linkages within this area.
Are there any transport routes on or around the location which are susceptible to congestion or which cause environmental problems,which could be affected?	No	N/A	N/A
Is the development in a location where it is likely to be highly visible to many people?	No	The extent of existing mature woodland that bounds the Shimna River would screen the flood defences from the majority of visual receptors. Those worst affected by the scheme would be transient users who are either passing through the area or utilising Island Park.	No - no retained tree shall be cut down, uprooted or destroyed or have its roots damaged within the crown spread nor shall arboricultural work or tree surgery take place on any retained tree be topped or lopped other than in accordance with the approved plans and particulars without the written approval of the Council. Any arboricultural work or tree surgery approved shall be carried out in accordance with British Standard 3998 2010 Recommendations for Tree Work.
Are there any areas or features of historic or cultural importance on or around the location which could be affected?	No	The only known area or feature of historic or cultural importance on or around the location which could be affected is the Bryansford Road Bridge (the New Bridge), which is an industrial heritage feature. Whilst the bridge will not be modified, the flood walls will tie directly into its abutments. The closest archaeological site is the Scheduled St Cillan's Fort fronting onto Bryansford Road, approximately 350m north-west of the site. There is no other known area or feature of historic or cultural importance on or around the location which could be affected.	No – Historic Environment Division shall be consulted on the implications of tying the flood walls directly into the bridge. The appointed contractor must properly assess and plan for the archaeological implications of the project where development may affect land with archaeological significance or potential. The Contractor shall ensure that the destruction of archaeological remains will be avoided wherever possible and should never take place without prior archaeological excavation and recording.
Are there any areas on or around the location which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected?	No	N/A	N/A
Is the location of the development susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the development to present environmental problems?	No	The area is susceptible to flooding but the scheme will alleviate this.	N/A

Location of the Scheme	Yes/No	Brief Description	Is the effect likely to be Significant?
(d) Transboundary nature of the impact			
Is there potential for transboundary impact?	No	N/A	N/A

4. Consideration whether proposed drainage works have significant effects on the environment

4.1 EIA Screening Conclusions

As per the requirements of Regulation 7 of the Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017, the specified information on proposed drainage works of the type listed in Annex II to the Directive, and the selection criteria in Schedule 2B to the Drainage Order, have been screened within Tables 1 and 2.

In consideration of this, it is concluded that the likelihood of significant environmental effects cannot be ruled out in light of the physical characteristics of the whole project and the environmental sensitivity of the geographical area likely to be affected. In particular, this has been concluded on the basis that the works area would be located within the Shimna River ASSI and Mourne AONB, and although would not directly affect Murlough SAC/ASSI, it would be hydrologically connected to it. Whilst it is envisaged that a robust and prescriptive mitigation strategy would minimise the risk of adverse effects within this environmentally sensitive environment, the particular requirements (i.e. mitigation measures for protected species) cannot be established without further investigation and assessment.

It is therefore recommended that an EIA is undertaken, and published within an ES.

4.2 Notice of Determination

Pursuant to Regulation 7 of the Drainage (Environmental Impact Assessment) Regulations (Northern Ireland) 2017, the Department having taken into account, so far as relevant, the criteria set out in Schedule 2B to the Drainage Order (as detailed above) and the available results of other environmental assessments required under Union legislation (other than legislation implementing the requirements of the Directive), shall determine that the proposed drainage works are likely to have significant effects on the environment.

In light of this, the Department shall by general and local advertisement:

a. describe briefly the nature, size and location of the proposed drainage works in question;

b. state that the proposed drainage works are likely to have significant effects on the environment, state the main reasons for requiring an assessment with reference to the relevant criteria listed in Schedule 2B to the Drainage Order, and that the Department intends to prepare an Environmental Statement in respect of them;

c. state that any person may obtain information from, or make representations in writing to, the Department in relation to the likely environmental effects of the proposed drainage works at an address specified in the notice within 30 days of the date of the publication of the notice in the Belfast Gazette;

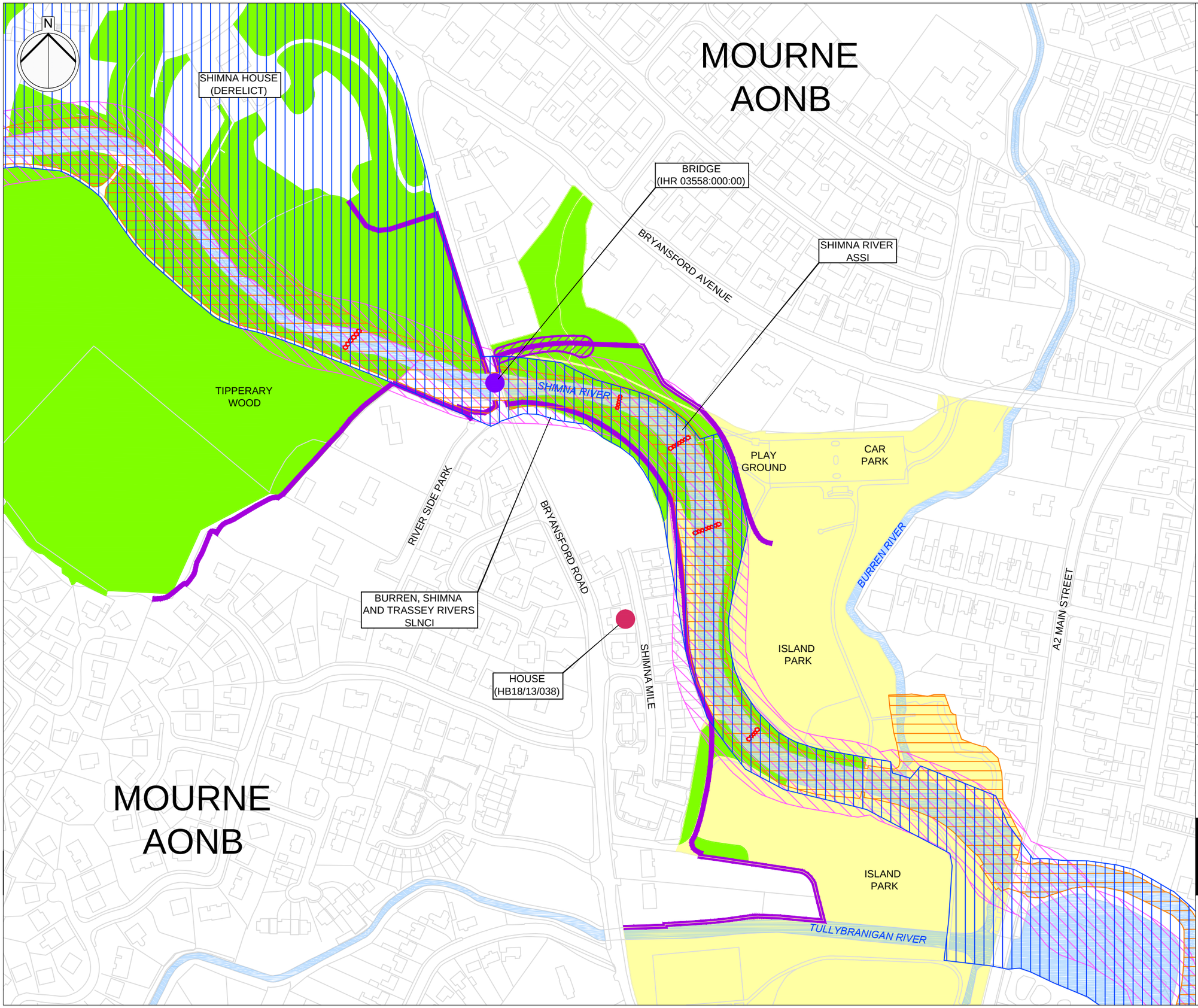
d. indicate the nature of the information in question and the times where and means by which it will be made available;

e. state the nature of the possible decisions that may be made in the case or, if there is one, the draft decision; and

f. indicate whether the proposed drainage works are likely to have significant effects on the environment in another EEA State.

Where the Department publishes an advertisement (as set out above), it shall, on or before the date of the publication of the notice in the Belfast Gazette, send a copy of that notice to each of the consultation bodies.

The Department shall make available to the public concerned any additional information which is relevant to a case to which this regulation applies but which only becomes available after the publication of the advertisements.



Project Title

SHIMNA
FLOOD ALLEVIATION SCHEME
NEWCASTLE, CO. DOWN

Client

Department for Infrastructure An Roinn Bonneagair

Drawing Title

ENVIRONMENTAL CONSTRAINTS

KEY

- FISH WEIR
- PROPOSED EMBANKMENT WITH SHEET PILE CORE
- PROPOSED STEEL SHEET PILE FLOOD WALL WITH CLADDING
- AREA OF SPECIAL SCIENTIFIC INTEREST (ASSI)
- SITE OF LOCAL NATURE CONSERVATION IMPORTANCE (SLNCI)
- WOODLAND
- INDUSTRIAL HERITAGE SITE
- LISTED BUILDING
- EXISTING AMENITY OPEN SPACE AND RECREATION
- LOCAL LANDSCAPE POLICY AREA (LLPA)
- WATERCOURSE

Scale @ A3
1:2500

AECOM Internal Project Number
60556684

FIGURE 1

AECOM Infrastructure & Environment UK Limited
Beechill House
Beechill Road
Belfast
BT8 7RP
T: +44 (0)28 9070 5111
www.aecom.com

AECOM

Annex C: Belfast Gazette Advertisement

OTHER NOTICES

COMPANY LAW SUPPLEMENT

The Company Law Supplement details information notified to, or by, the Registrar of Companies. The Company Law Supplement to *The London, Belfast and Edinburgh Gazette* is published weekly on a Tuesday.

These supplements are available to view at https://www.thegazette.co.uk/browse-publications.

Alternatively use the search and filter feature which can be found here https://www.thegazette.co.uk/all-notices on the company number and/or name. (3035190)

DURASTIC ROOFING AND CLADDING (NORTHERN IRELAND) LIMITED

(Company Number NI035378)

NOTICE IS HEREBY GIVEN, PURSUANT TO SECTIONS 1064 AND 1077 OF THE COMPANIES ACT 2006, THAT IN RESPECT OF THE UNDERMENTIONED COMPANY NOTICE OF APPOINTMENT OF A LIQUIDATOR WAS REGISTERED RECEIVED BY ME ON 21/05/2018 AND REGISTERED ON 22/05/2018.

NI035378 DURASTIC ROOFING AND CLADDING (NORTHERN IRELAND) LIMITED

HELEN SHILLIDAY, REGISTRAR OF COMPANIES (3035192)

ROBERT J HALL LIMITED

(Company Number NI000845)

NOTICE IS HEREBY GIVEN, PURSUANT TO SECTIONS 1064 AND 1077 OF THE COMPANIES ACT 2006, THAT IN RESPECT OF THE UNDERMENTIONED COMPANY NOTICE OF APPOINTMENT OF A LIQUIDATOR WAS REGISTERED RECEIVED BY ME ON 21/05/2018 AND REGISTERED ON 22/05/2018.

NI000845 ROBERT J HALL LIMITED

HELEN SHILLIDAY, REGISTRAR OF COMPANIES (3035193)

THE DEPARTMENT FOR INFRASTRUCTURE
NOTIFICATION OF DETERMINATION
THAT PROPOSED FLOOD ALLEVIATION SCHEME IS LIKELY TO HAVE SIGNIFICANT EFFECTS ON THE ENVIRONMENT
SHIMNA RIVER FLOOD ALLEVIATION SCHEME, NEWCASTLE, CO. DOWN

The Department for Infrastructure hereby gives notice, in pursuance of Article 12B of the Drainage (Northern Ireland) Order 1973 (as amended) that it proposes to carry out a flood alleviation scheme on the Shimna River in Newcastle, Co. Down.

The proposed scheme will involve the construction of flood alleviation measures to reduce the risk of flooding from the Shimna River to protect existing properties in the town. The works will extend both upstream (into Tipparary Wood) and downstream (into Island Park) from New Bridge on the Bryansford Road. The proposed works will include:

- Demolition of a number of property boundary walls and fences
- Felling of a number of mature trees
- Relocation of one drainage ditch
- 1430m of Brick/Concrete clad sheet piles
- Construction of a new pathway
- Re-allignment of an existing pathway
- Erection of one floodgate

Having taken account of the characteristics of the works in the proposed scheme, their locations and potential impacts, the Department considers the proposed scheme is likely to have significant environmental effects and intends to prepare an Environmental Statement.

A copy of the proposed scheme will be available for inspection at the addresses below, from 28th May 2018 to 29th June 2018, during normal opening hours at:

- Newry, Mourne and Down District Council, District Council Offices, O'Hagan House, Monaghan Row, Newry, BT35 8DJ.
- Newcastle Centre, 10-14 Central Promenade, Newcastle, Co Down, BT33 0AA.
- DfI Rivers HQ, 49 Tullywiggan Road, Loughry, Cookstown, BT80 8SG.

In addition to the display an information day will be held in the Newcastle Centre on Tuesday 5th June where staff will be available for consultation.

In accordance with Article 12B (2), representations may be made in writing to the Department in relation to the likely environmental effects of the proposed scheme.

Also, in accordance with Article 12B (2), any person who considers that their interests will be prejudicially affected by the proposed scheme may make representations to the Department at the address given below. The closing date for receipt of representations is 29th June 2018.

Any representations should be sent to: -

Mr Ian Coulter, DFI Rivers, 49 Tullywiggan Road, Loughry, Cookstown, Co. Tyrone, BT80 8SG.

Following consideration of all representations an Environmental Statement will be made publically available at a later date. (3035191)

ENFORCEMENT OF JUDGMENTS OFFICE NOTICE OF GRANT OF A CERTIFICATE OF UNENFORCEABILITY
RULE 83 OF THE JUDGMENTS ENFORCEMENT RULES (NI) 1981

	Debtor Num	Case Num	Forenames	Surname	Address Line 1	Address Line 3	Address Line 5	Post Code	Occupation	Amount Recoverable '£'	Certificate Date
1	1053017	C/15/-03786	SARAH	MCCONNELL	7 CHERRYMOUNT PARK	BANGOR		BT20 4PS	CARE ASSISTANT	460.10	16-May-2018
2	1059489	C/08/-00880	CAROL	MOORE	4D QUEEN STREET	CARRICKFERGUS		BT38 8AP	HAIRDRESSER	2915.87	16-May-2018
3	1103566	C/17/-06796	CAMPBELL	SLOAN	3A DONAGHADEE ROAD	BANGOR	GROOMSPORT	BT19 6LG	TAXI DRIVER	2868.65	16-May-2018
4	1108151	C/14/-02370		RAINBOW GRAPHICS PAVEMENT SIGNS LTD	91-97 ORMEAU HOUSE SUITE 5	BELFAST		BT7 1SH		718.95	16-May-2018
5	1108151	C/14/-06257		RAINBOW GRAPHICS PAVEMENT SIGNS LTD	91-97 ORMEAU HOUSE SUITE 5	BELFAST		BT7 1SH		1601.53	16-May-2018
6	1123626	C/14/-05806	SANDRA	CONLANE	16 TEMPLEMORE CLOSE	BELFAST		BT5 4SY	CASHIER	1446.62	16-May-2018

Appendix 3: Alternatives Considered

Annex A: ‘Shimna River, Newcastle Flood Risk Assessment Economic Appraisal’ (October 2016)

.

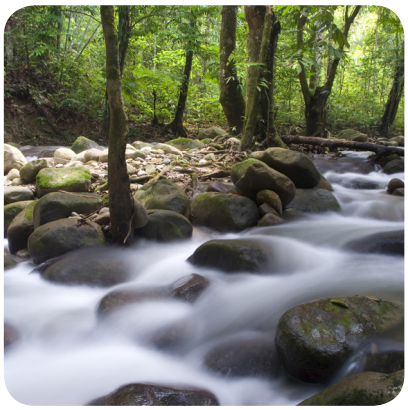
Shimna River, Newcastle FRA

Economic Appraisal

IBE0754/ October 2016







rpsgroup.com/ireland

Shimna River, Newcastle
Flood Risk Assessment
Economic Appraisal

DOCUMENT CONTROL SHEET

Client	Rivers Agency					
Project Title	Shimna River, Newcastle Flood Risk Assessment					
Document Title	Economic Appraisal					
Document No.	IBE0754/October 16					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	51	1	1	4

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
0	Draft	D McGinnis	A Jackson	G Glasgow	Belfast	Jan 14
1	Draft	D McGinnis	A Jackson	G Glasgow	Belfast	March 15
2	Final	D McGinnis	A Jackson	G Glasgow	Belfast	May 15
3	Final	D McGinnis	A Jackson	G Glasgow	Belfast	June 16
4	Final	D McGinnis	A Jackson	G Glasgow	Belfast	Sept 16
5	Final	D McGinnis	A Jackson	G Glasgow	Belfast	Oct 16
6	Final	D McGinnis/ F Carragher	A Jackson	G Glasgow	Belfast	Oct 16

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1 INTRODUCTION

1.1 BACKGROUND

RPS were commissioned by Rivers Agency in 2013 to investigate the flood risk associated with the Shimna River in the vicinity of Newcastle, County Down, and to assess options (including economic viability) for the alleviation of any future flooding.

The project brief is described in the Shimna River Feasibility Report (2015), and required an Economic Appraisal to be undertaken in accordance with the Northern Ireland Practical Guide to the Green Book and the Green Book: Appraisal and Evaluation in Central Government, 2003 (3rd Edition) version and FCDPAG3 Flood and Coastal Defence Project Appraisal Guidance, Economic Appraisal.

The Northern Ireland Practical Guide to the Green Book has been replaced by the NI Guide to Expenditure Appraisal and Evaluation (NIGEAE), although the basic steps of appraisal and evaluation remain fundamentally unchanged. The FCDPAG3 has been replaced by Flood and Coastal Erosion Risk Management Appraisal Guidance, Economic Appraisal (FCERM-AG). This appraisal has been prepared in accordance with these documents.

This revision of the document has been prepared to take account of comments received from the Department of Finance Economists in August 2016.

1.2 NORTHERN IRELAND GUIDE TO EXPENDITURE APPRAISAL AND EVALUATION

NIGEAE is the primary guide for Northern Ireland Departments on the appraisal, evaluation, approval and management of policies, programmes and projects. NIGEAE sets out the general principles to be applied by approving authorities when approving capital projects and other expenditure. The NIGEAE sets out ten basic steps, summarised below, which will be addressed throughout this report.

Step 1: Explain the Strategic Context

Step 2: Establish the Need for Expenditure

Step 3: Define the Objectives and the Constraints

Step 4: Identify and Describe the Options

Step 5: Identify and Quantify the Monetary Costs and Benefits of Options

Step 6: Appraise Risks and Adjust for Optimism Bias

Step 7: Weigh up Non-Monetary Cost and Benefits (Including Sustainability, Equality & Lifetime Opportunities)

Step 8: Calculate Net Present Values and Assess Uncertainties

Step 9: Assess Affordability and Record Arrangement for Funding, Management, Procurement, Marketing, Benefits Realisation, Monitoring and Ex Project Evaluation

Step 10: Assess the Balance of Advantage between the Options and Present the Results and Conclusions

1.3 FLOOD AND COASTAL EROSION RISK MANANGEMENT APPRAISAL GUIDANCE

The Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG) has been produced by the Environment Agency for England and Wales. It provides best practice implementation guidance on appraisal and supports the Defra Policy Statement on Appraisal (June 2009). As a similar document does not exist for Northern Ireland, Rivers Agency have chosen to use this guidance for appraisal of their flood risk management schemes.

Project appraisal for flood risk management uses a risk-based approach. This means that both the probability and the consequences (positive and negative impacts) of flooding and erosion are taking into account. The guidance aims to help users undertake efficient appraisals and encourages experience and knowledge to be applied at all stages. It has been designed based on the following key principles and to help practitioners to:

- undertake appraisals that reduce the threat to people and their property and deliver the greatest environmental, social and economic benefits in line with the Government's sustainable development principles;

- engage through an open and transparent process with those affected by flooding, erosion or their management activities to enable full account to be taken of social, environmental and economic issues and to build trust with local communities;

- identify what level of information and effort is needed. The guidance recognises that proportionality is needed in the effort expended on addressing uncertainty within appraisals;

- identify and assess solutions that could provide benefits wider than just those associated with managing the risk of flooding or erosion;

- identify who benefits and who loses from a particular solution and where contributions could fund delivery;

- promote approaches which reflect both national and local priorities;

- identify and assess sustainable, adaptable and flexible solutions that work with natural processes;

- understand how change (including climate change) could affect future flood and erosion risk and how to identify and appraise options that enable adaptation to changing risk; and

- promote partnership working to deliver wider benefits.

The guidance describes how to undertake an appraisal that meets these key principles.

2 EXPLAIN THE STRATEGIC CONTEXT

In order to assess any potential capital and maintenance works within the Shimna River catchment in a wider, strategic context, it is necessary to explain the drivers for the work and the associated higher level directives and policies.

Rivers Agency is the statutory drainage and flood protection authority for Northern Ireland. Under the Drainage (Northern Ireland) Order 1973 the department has discretionary powers to:

- Maintain watercourses and sea defences which have been designated by the Drainage Council for Northern Ireland;
- Construct and maintain drainage and flood defence structures;
- Administer advisory and enforcement procedures to protect the drainage function of all watercourses.

The aim of the Agency is to reduce the risk to life and damage to property from flooding from rivers and the sea and to undertake watercourse and coastal flood management in a sustainable manner.

In support of these aims the Agency's objectives are to:

- to deliver sustainable flood risk management policies to meet society's social, environmental and economic needs;
- to implement the requirements of the European Directive for the assessment and management of flood risks;
- to reduce the number of properties currently at risk of flooding from rivers and the sea;
- to maintain flood defence and drainage infrastructure in a satisfactory condition;
- to operate to resource limits;
- to support and motivate all our people to achieve the Agency's objectives;
- to deliver quality services for our customers and stakeholders in a fair and equitable way.

The anticipated capital works within the Shimna River catchment would reduce the flood risk to properties in the surrounding area and consequently would contribute to the aims and objectives discussed above.

3 ESTABLISH THE NEED FOR EXPENDITURE

3.1 HISTORY OF FLOODING

Historical flooding has occurred regularly over the last 40-50 years in Newcastle. Local newspapers have carried reports of storms during 1968, 1978/79, 1987, 1988 and 1994. Other significant events are known to have occurred during 1982, 1986, 1990 and 1997.

The extreme flood event of 16/17 August 2008 was the most severe. This caused significant flooding in the Bryansford Avenue and Shimna Road areas where flood water from the Shimna crossed catchments to pond behind the recently constructed Burren River flood defences (completed 2007). This area comprises primarily of residential properties, schools and Islands Park. Many properties were flooded badly during this event. The post-flood investigation completed by RPS in 2009 revealed that approximately 36 properties suffered flood damage during the August 2008 flood event. These were in Marguerite Avenue, Elmgrove Park, Burren Park, Dunwellan Park, Riverside Drive and Shimna Park. Figure 3.1 shows a photograph of flooding on Bryansford Avenue.

Figure 3.1 Flooding on Bryansford Road (August 2008)

A Preliminary Flood Risk Assessment (PFRA) prepared by Rivers Agency has identified Newcastle as a Significant Flood Risk Area (SFRA). Flooding in Newcastle is a major issue for those residents and business owners directly affected by it, the local Councillors and Politicians who represent them and the various government agencies who deal with the aftermath of many of the flood events. The formation of the Newcastle Flood Forum is another reflection of the concern there is locally for flooding.

3.2 EXTENT OF POTENTIAL FLOODED AREA

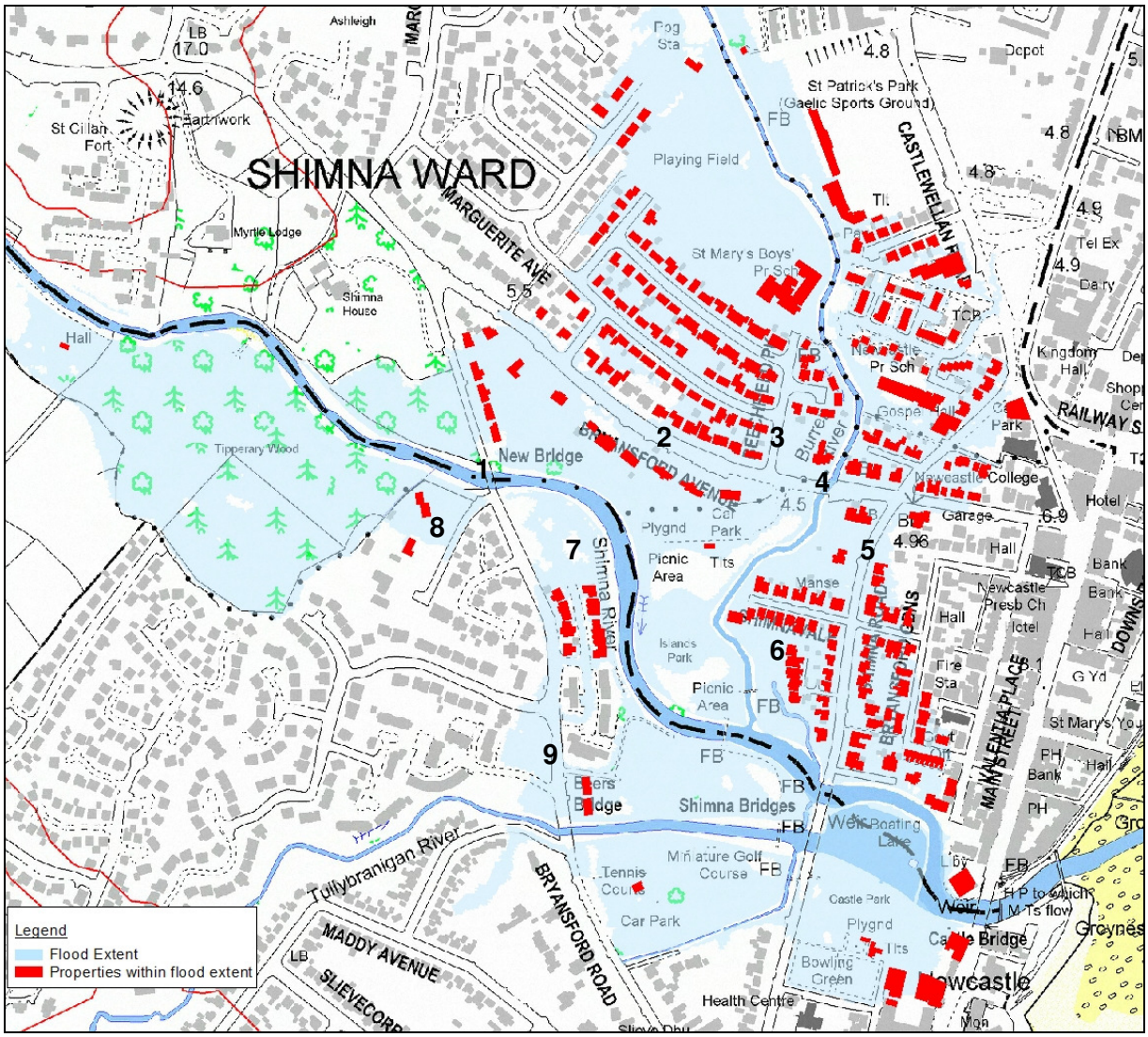
An analysis was carried out by RPS in 2013 to identify the properties in Newcastle at risk of flooding from a 1% Annual Exceedance Probability (AEP) water level event (also defined as a 1 in 100 return period event). This represents the probability of an event of this, or greater, severity occurring in any given year. The 1% AEP event is used as a standard world-wide for identifying, mapping and managing flood risk, and offers a reasonable estimate of future flood risk. The 1% AEP flood event relates to the desired standard of protection afforded to urbanised areas by Rivers Agency. This analysis is described further in the main Shimna River Feasibility Report (2015).

A hydrodynamic river model was used to assess the extent of and the damages caused by flooding in the study reach. The extent of the flood and the properties affected by the 1% AEP event are shown in Figure 2.1. The model included the Burren River Flood Defence scheme that was completed in 2007.

A detailed survey was carried out to identify the individual properties which would be affected by a range of storm events. The model showed that flooding first occurs to properties in a 0.05% AEP event. In total, 312 properties were identified at being at risk of inundation by a 1% AEP flood event.

The majority of properties at risk are on the left bank of the river. Initial flooding begins around the Bryansford Road Bridge (marked as 1 on Figure 3.2). The flood water then flows across Bryansford Avenue (2) into Beechfield Park (3) and towards the Bryansford Avenue Bridge (4). The Bryansford Avenue Bridge acts as an aqueduct and conveys water over the Burren River to the eastern part of Newcastle causing flooding along Shimna Road (5) and Shimna Vale (6). These mechanisms were seen during the August 2008 flood event. The Burren River flood defences do not get overtopped from the 1% AEP event in the Shimna River. A smaller number of properties on the right bank of the Shimna River are also at risk from flooding. These are in Shimna Mile (7), Riverside Park (8) and Bryansford Road (9).

Figure 3.2 Shimna River, Newcastle 1% AEP Flood Extent



Key to map locations:

(1) Bryansford Road Bridge
(2) Bryansford Avenue
(3) Beechfield Avenue
(4) Bryansford Avenue Bridge
(5) Shimna Road
(6) Shimna Vale
(7) Shimna Mile
(8) Riverside Park
(9) Bryansford Road

In order to meet the aims and objectives described in Section 3.1, capital works should be implemented to afford the existing properties protection from a flood event with a return period of at least 1% AEP. It is important to recognise that low probability floods considered over a long time have a significant likelihood of happening. A 1% AEP flood has a 25% chance of occurring at least once

during a 30 year period (a typical mortgage duration) and a 50% chance of occurring at least once in a 70 year period (a typical human lifetime).

4 DEFINE THE OBJECTIVES AND CONSTRAINTS

The principal aim of this economic appraisal is to determine whether a viable option exists to reduce the impact of flooding from the Shimna River, Newcastle.

4.1 PROJECT OBJECTIVES

The overall objective of this proposal is for Rivers Agency to reduce the risk of flooding to over 300 properties from the Shimna River.

The main objectives based on the SMART principles are:

- provide flood protection to the 312 properties at risk of flooding within Newcastle, by January 2020. The protection provided should prevent inundation in the event of a 1% Annual Exceedance Probability (AEP) water level. This is the standard that Rivers Agency uses for the design of their defences. The flood protection measures should not increase the flood risk elsewhere in the catchment;

- deliver the project within the budget approved within the economic appraisal;

- complete a Post-Project Evaluation (PPE) for the scheme which will be scheduled for one year after the completion date of the scheme works;

- provide a sustainable and environmentally acceptable solution by January 2020;

- carry out the works within the required timescales as outlined in the Contract Data Part 1 and accepted programmes. All works to be completed by January 2020;

- carry out the works in an environmentally sensitive manner in conjunction with the Rivers Agency Conservation Officer, and in accordance with European and National directives and legislation including Water Framework Directive, Floods Directive, Habitats Directive, etc;

- minimise disruption to residents/public during and post works through regular liaison with residents and statutory stakeholders;

- achieve value for money for whole-life costs;

- undertake works with full regard for health and safety;

- Post works- regular inspection and maintenance of the flood defence infrastructure.

These objectives are achievable and will be met by programming the proposed scheme components using existing and future programmes and work schedules.

A Post-Project Evaluation (PPE) will be completed one year after the completion date for the scheme, and will include a discussion on the achievements and failures of the project objectives.

4.2 PROJECT CONSTRAINTS

Constraints to the completion of the anticipated capital works will include environmental considerations and, to some degree, funding availability.

The project will be subject to approval from the Drainage Council for Northern Ireland. This is a non-departmental public body constituted under the Drainage (NI) Order 1973. The Drainage Council is charged with considering all works/schemes that Rivers Agency proposes to undertake at public expense to ensure impartiality and value for money. An Environmental Statement may be required to be prepared for the scheme.

If the works involve construction on private lands, negotiations will be required with the landowners and Riparian Agreements will have to be in place before any work can commence.

Any works that affects New Bridge on Bryansford Road will require TAS approval from Transport NI.

Whilst a preliminary ground investigation has been undertaken, a detailed ground and service investigation will be required during detailed design.

5 IDENTIFY AND DESCRIBE THE OPTIONS

Comparison of alternative courses of action is at the heart of appraisal. It is only by comparing the alternatives that the real merits of any particular course of action are exposed.

5.1 OPTION DEVELOPMENT PROCESS

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 Shimna River 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 from the Shimna River. 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.

5.2 SCREENING OF FLOOD RISK MANAGEMENT OPTIONS

5.2.1 Long List 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 measures considered are presented in Table 5.1.

Table 5.1 Long List of Potential Measures

Option	Method type	Description
Maintain Existing Regime (Status Quo)	Permit	Continue any existing flood risk management practices. Maintenance regime to remain as currently undertaken.
Planning and Development Control	Prevent	Zoning of land for flood risk appropriate development, prevention of inappropriate incremental development, review of existing planning policies.
Building Regulations	Prevent	Regulation relating to floor levels, flood proofing, flood resilience, sustainable drainage systems, prevention of reconstruction, or redevelopment in flood risk areas.
Catchment Wide SuDS	Prevent	Implement attenuating infrastructure to the existing drainage system in order to reduce the flow entering the river network. This may consist of swales, french drains, soak aways, larger culverts, underground storage tanks, ponds, green roofs, etc.
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.
Strategic Development Management	Prevent	Management of necessary floodplain development (proactive integration of structural measures into development designs and zoning, regulation on developer-funded communal retention, drainage and/or protection systems).
Watercourse Maintenance	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 washlands (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.
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.
Culverting	Protect	Routing the watercourse underground through culvert to prevent out of bank flooding along a specific stretch.
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 or an open channel.

Option	Method type	Description
Overland Flood Routing	Protect	Using 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.
Rehabilitation of Existing Defences	Protect	Improvement of existing flood defences.
Localised Protection Works	Protect	Minor raising of existing defences/levels, infilling gaps in defences, etc.
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 measures such as flood gates, vent covers, use of flood resilient materials, raising electrical power points, etc

5.2.2 Applicability Review of Options

Each of these measures has been reviewed against its applicability for the Shimna catchment and those which are obviously unsuitable have been removed. Table 5.2 indicates those measures which have been included and excluded.

Table 5.2 Applicable list of measures to Shimna catchment

Option	Review Comment	Applicable?
Maintain Existing Regime	Baseline condition, consider further	✓
Planning and Development Control	Consider further	✓
Building Regulations	Consider further	✓
Catchment Wide SuDS	Consider further	✓
Land Use Management	Consider further	✓
Strategic Development Management	Consider further	✓
Watercourse Maintenance	Consider further	✓
Upstream Storage/Storage	Consider further	✓
Tidal Barrage	Not applicable- principal source of flooding is fluvial	×
Improvement of Channel Conveyance	Consider further	✓
Hard Defences	Consider further	✓
Relocation of Properties	Consider further	✓

Option	Review Comment	Applicable?
Culverting	Consider further	✓
Diversion of Flow	Consider further	✓
Overland Floodways	Consider further	✓
Sealing Manholes	Not applicable- principal source of flooding is fluvial	×
Rehabilitation of Existing Defences	No flood defences currently exist. Measure unacceptable	×
Localised Protection Works	No existing defence infrastructure exists which could be altered by minor works to alleviate flooding. Measure unacceptable	×
Flood Warning/Forecasting	Consider further	✓
Public Awareness Campaign	Consider further	✓
Individual Property Protection	Consider further	✓

5.2.3 Technical Review of Options

All options which have been considered as applicable, are then reviewed on their technical merits and their ability to alleviate the specific mechanisms of flooding that exist in the Shimna catchment. This is based on engineering judgement, information from Rivers Agency staff, flood mapping and reviewing animations of model output. Table 5.3 provides the technical review of the applicable measures.

Table 5.3 Technical Review of Applicable Options

Option	Review comment	Feasible?
Maintain Existing Regime	Baseline Condition Measure can continue through screening process	✓
Planning and development control	Area already extensively developed so not possible to implement Not considered further	×
Building regulations	Area already extensively developed so not possible to implement Not considered further	×
Retro-fitted SuDS	Not technically possible to introduce across all of Newcastle Not considered further	×
Land use management	Area already extensively developed so not possible to implement Not considered further	×
Strategic Development Management	No Strategic Development envisaged for Newcastle that would require this measure	×
Watercourse Maintenance	May limit damage, however will not resolve all flooding issues and proactive maintenance programme must be developed Measure can continue through screening process	✓
Upstream storage/storage	No appropriate areas of land can be identified upstream Not considered further	×
Improvement of channel conveyance	No improvements could be made that would have a significant effect on water levels	×

Option	Review comment	Feasible?
	Not considered further	
Hard defences	Hard defences would consist of flood walls and embankments, approximately 1km of flood defence would be required Measure can continue through screening process	✓
Relocation of properties	312 properties would be required to be relocated, and while technically feasible, this would be a socially complex measure to implement in practice Not considered further	×
Culverting	Existing watercourses are open within the study area and the surrounding area is extensively developed so no possible culvert routes identified Not considered further	×
Diversion of flow	No possible diversion routes readily identified as surrounding area is extensively developed Not considered further	×
Overland floodways	Due to the area being extensively developed, no floodways can be identified Not considered further	×
Flood warning/forecasting	May limit damage, however will not resolve all flooding issues Measure can continue through screening process	✓
Public awareness campaign	This would have limited impact on reducing the flood risk Measure can continue through screening process	✓
Individual property protection	May limit damage, however will not resolve all flooding issues Measure can continue through screening process	✓

5.3 DEVELOPING POTENTIAL OPTIONS

The options that have progressed through the screening are divided into two categories: primary and secondary options. Primary options are those that will be considered as having a reasonable likelihood of providing the required standard of protection to the majority of properties at risk from a 1% AEP event. Secondary options may have some technical merit and could solve some localised flooding issues but will not resolve all the identified flooding issues. The secondary options are listed in Table 5.4. Some of these options such as individual property protection and watercourse maintenance can be progressed as interim measures.

Option	Action
Watercourse Maintenance	Regular maintenance of the Shimna River will ensure that there are no obstructions in the river channel that may cause an increased risk of flooding
Flood warning/forecasting	Rivers Agency could consider the installation of a flood forecast and warning system on the Shimna River upstream of Newcastle
Public Awareness Campaign	Rivers Agency is currently completing a Pilot project in another area that if successful could be applied to the Newcastle area.
Individual Property protection	Rivers Agency can provide advice on precautions that residents can take to protect their property. Sandbags may be provided to houses that are in imminent danger of flooding

Table 5.4 Secondary options

'Maintain existing regime' is the baseline option will be used to compare all other options against This is the 'status quo' option, which represents the genuine minimum input necessary to maintain services at, or as close as possible to, their current level. This will be included to provide a benchmark so that the value for money of the 'do something' options may be judged by reference to current service provision. Rivers Agency undertakes maintenance responsibilities on watercourses that are designated by the Drainage Council for Northern Ireland. The Shimna River is only designated under the Drainage (NI) Order 1973 downstream of New Bridge, Bryansford Road, and Rivers Agency therefore currently provide routine inspection and maintenance to this stretch of river only. For the remaining stretch of the river within the study area, Rivers Agency could offer emergency assistance during flood events but this would depend on the availability of resources. Rivers Agency could serve notices for improvement where defects present a threat to public health and Safety. Under this option, the threat of overtopping of the banks of the Shimna River would remain resulting in the possibility of frequent flooding damage to property in addition to causing considerable anxiety to local residents. This will be taken forward as **Option 1**.

As described above, RPS considered a wide range of potential flood risk management options for preventing flooding in Newcastle from the Shimna River during high return period events. However given the geography of the catchment and the extensively developed urban areas, the only feasible option is the provision of hard defences to prevent water from leaving the Shimna River, both upstream and downstream of the Bryansford Road bridge. Hard defences include the construction of new flood walls or embankments. Where possible hard defences should be set back from the channel

banks to allow space for flood waters and reduce the impact of the flood defence scheme on water levels upstream and downstream of the proposed defence location. Setting defences back from the channel also improves access to rivers and helps minimise the visual impact of a flood defence scheme. The choice of flood defence structure (i.e. flood wall, flood embankment, etc.) along with the alignment of defences is based on space constraints, visual impact and the results of the hydraulic modelling of options.

The locations of where flood defence structures are required are presented in Figure 5.1. On the left bank of the Shimna River this option involves the construction of flood defences for approximately 125m along Bryansford Road from New Bridge (A-A on Figure 5.1), and construction of flood defences downstream of the bridge for approximately 220m parallel to Bryansford Avenue (B-B). On the right bank a flood defence will be constructed from New Bridge for approximately 600m downstream (C-C), and another will be constructed for approximately 240m upstream (D-D).

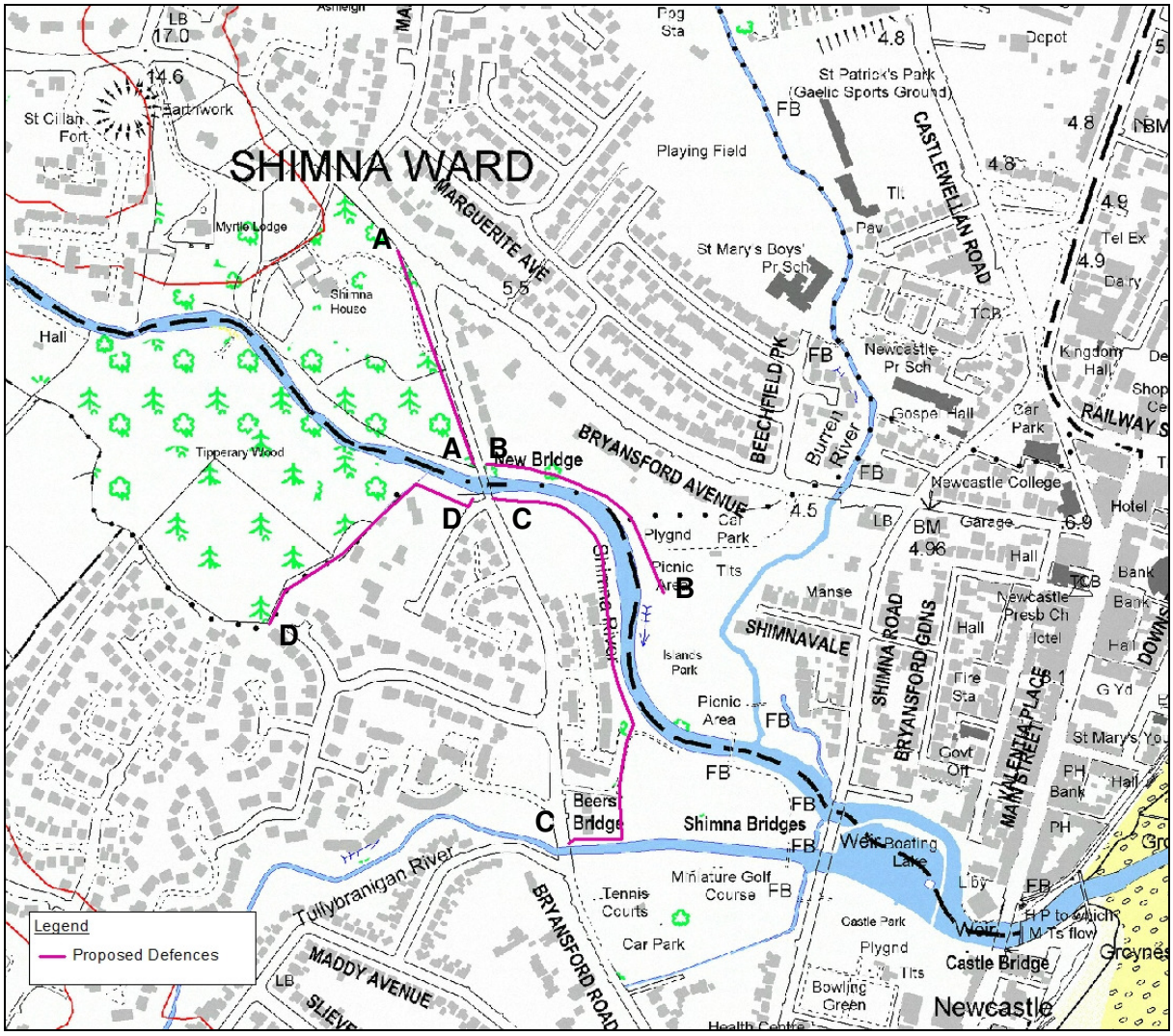


Figure 5.1 Proposed Locations of Hard Defences

There are alternative methods of construction that can be considered for hard flood defences which will depend on various factors including the ground conditions. Flood walls will generally be constructed from reinforced concrete, but where ground conditions are poor sheet piles or bored piles may be required below ground. Where space permits, flood embankments can be constructed from clay, but again where ground conditions are poor a sheet pile core may be required.

Rivers Agency instructed RPS to procure a ground investigation to determine the preferred method of construction. The results of this ground investigation showed that sand and gravel is found in shallow strata. If a flood wall or embankment is constructed without sheet piles there is likely to be a massive amount of piping and water flow beneath the defences which can cause flooding. The two options that were therefore taken forward for costing are:

- **Option 2**: reinforced concrete flood walls with sheet pile below ground level at all locations;

- **Option 3**: reinforced concrete flood walls with sheet pile below ground on right bank, reinforced concrete flood walls with sheet pile below ground on left bank upstream of bridge, sheet pile core embankments on left bank downstream of bridge (within Islands Park).

It should be noted that these options are both for the construction of sheet piled core flood defences. The only difference is the above ground finish, where Options 2 has concrete walls for the entire length, and Option 3 has embankments where possible instead of the concrete walls.

6 IDENTIFY & QUANTIFY THE MONETARY COSTS & BENEFITS OF OPTIONS

6.1 METHODOLOGY

An Economic Appraisal is a technique that can be used to aid and improve decision making about investment in policies, plans or schemes to alleviate flooding. The assessment involves quantifying, as far as is possible, the benefits that would accrue by the avoidance of flood damage associated with various return period flood events. The accumulated benefits are discounted over the lifespan of the alleviation scheme, using Test Discount Rates (currently 3.5% for years 0-30, 3.0% for years 31 – 75 and 2.5% for years 76 - 125), to determine the present value of the benefit. This present value of benefits is then compared with the discounted capital cost of providing flood defence works plus the cost of maintenance of the proposed defences over their 'whole life', and the scheme's effectiveness computed in relation to the baseline "do nothing" option.

The damage assessment methodology follows the guidance in 'Flood and Coastal Erosion Risk Management- A Manual of Assessment Techniques' (Flood Hazard Research Centre, Middlesex University, 2010). This document is often referred to as the Multi Coloured Manual (MCM).

The MCM is the 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 damage figure 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 damage assessment is carried out in order to quantify the economic risk to the study area. This requires a lot of details to be recorded such as background data, interim calculations and final damage results. As such RPS have created geo-referenced shapefiles, known as economic risk shapefiles, with the relevant data recorded in the attribute tables. The damage data for residential properties, commercial properties and utility infrastructure have been grouped into a single polygon file for each study area.

6.2 ASSESSMENT OF COSTS

The whole life costs of the options are made up from several components including the initial capital cost (construction cost) and maintenance costs.

6.2.1 Construction costs

The initial capital costs for Options 2 and 3 were determined from current market values and RPS' extensive experience of flood alleviation works. The costs were calculated in 2013. In addition to the costing of materials, allowances have been made for preliminaries, site investigation, design fees and supervision. Details of the costs and these allowances for the two options are presented in Appendix A. A full list of assumptions used in the calculation of defence costs can be found in Appendix B. The capital costs will be spent over the construction period, which is expected to be over two financial years. Details of the construction costs are summarised in Table 6.1.

Table 6.1 Summary of Estimated Construction Costs

Option	Construction Costs (£)
Option 1- Status Quo	0
Option 2- Reinforced concrete walls with sheet piles	3,110,304
Option 3- Reinforced concrete walls with sheet piles, and sheet pile embankments	3,202,050

6.2.2 Maintenance Costs

For the baseline option, Option 1, Rivers Agency will carry out routine inspection and maintenance of the designated stretch of the Shimna River, downstream of New Bridge, Bryansford Road. The maintenance and operational costs have been supplied by Rivers Agency.). A full list of assumptions used in the calculation of maintenance costs can be found in Appendix B. Maintenance/inspection costs have been included at £1,000 per year.

The proposed option of hard defences will require maintenance to be included in the costing. The maintenance cost will include regular inspections of the watercourse as described above, but must also include inspection and maintenance of the defence assets. As a general rule it is anticipated that embankments will require more extensive maintenance every 5 years to repair deterioration due to

human and animal activity. Flood walls are more robust and will require more extensive maintenance every 20 years. The annual maintenance cost assigned to Options 2 and 3 allow for increased annual inspection/maintenance for the lifetime of the defences (100 years). A full list of assumptions used in the calculation of maintenance costs can be found in Appendix B. Maintenance/inspection costs have been included at £2,000 per year and £5,000 every 20 years for floodwalls; and £2,500 per year and £5,000 every 5 years for embankments.

For the three options, the present value of the maintenance costs have been calculated over the lifetime of the scheme (assumed to be 100 years). Details of this are summarised in Table 6.2.

Table 6.2 Summary of Estimated Maintenance Costs for Alternative Options (PV)

Option	Maintenance Costs (£)
Option 1- Status Quo	31,996
Option 2- Reinforced concrete walls with sheet piles	62,618
Option 3- Reinforced concrete walls with sheet piles, and sheet pile embankments	75,689

6.2.3 Financial Spend Profile

Table 6.3 shows the financial spend profile over the lifetime of the scheme (assumed to be 100 years).

Table 6.3 Financial Spend Profile

Option	Year 0	Year 1	Year 2	Years 3-100
Option 1- Status Quo	0	0	0	Maintenance/inspection cost £1,000 per annum
Option 2- Reinforced concrete walls with sheet piles	Design fees £50,000	Capital cost £1,244,122	Capital cost £1,866,182	Maintenance/inspection cost £2,000 per annum and £5,000 every 5 years
Option 3- Reinforced concrete walls with sheet piles, and sheet pile embankments	Design fees £50,000	Capital cost £1,280,820	Capital cost £1,921,230	Maintenance/inspection cost £2,500 per annum and £5,000 every 20 years

6.3 ASSESSMENT OF DAMAGES

The damage assessment is carried out in order to quantify the economic risk to the study area. This requires a large amount of detail to be recorded such as background data, interim calculations and final damage results. As such RPS created a geo-referenced shapefile, known as an economic risk shapefile, with the relevant data recorded in its attribute table.

6.3.1 Categorisation of Properties

All properties within the 1% AEP floodplain were surveyed and classified according to Multi Coloured Manual guidelines. 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. This was carried out using data gained from site visits, surveys, OS and online mapping. The finished floor levels were obtained using LiDAR data and adding 300mm. This method was checked by surveying floor levels at a number of properties and found to be acceptable. The details of each property were recorded within the economic risk shapefile attribute tables. Within the 0.1% AEP flood extent 688 residential and commercial properties were categorised.

6.3.2 Flood Depths & Damages

The method of assessment of the total cost of the property damage due to flooding used in this analysis is that set out in the Multi Coloured Manual. Flood damage to individual properties in Newcastle was assessed, based on data which was collected in the UK for the purpose of producing average depth damage statistics. The Multi Coloured Manual contains tables of average depth

damage figures for 2010 which were increased to a 2013 baseline using a consumer price index multiplier of 1.097. Consumer Price Indices (CPIs) measure the average changes in the prices of consumer goods and services purchased by households. The damages were capped for each property type based on house prices obtained from the Median Sale Price of Residential Properties (July 2012 - June 2013) from Land & Property Services and capped for non-residential properties using data on rates obtained from Land & Property Services. 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, etc.

The flood damage caused to each property depends on its land use code and the depth and duration of flooding. Water levels predicted by the hydrodynamic model were used to calculate the depth of flooding for each of the 50%, 20%, 10%, 4%, 2%, 1%, 0.5% and 0.1% AEP events. The results of a GIS database showing the classification of properties/assets and depths of flooding for various return periods are presented in Appendix C. It should be noted that due to the calculation methods used, a value of '-999.0' in the table implies that there is no damage to that property at that return period.

6.3.3 Emergency Costs

A cost will be associated with emergency services dealing with the flood events. Following the EA'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.

6.3.4 Annual Average and Present Value Damages

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 the 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). This can then be taken over the lifetime of the scheme which 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 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.1% AEP flood events.

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 rates presented in the NIGEAE were used;

0-30 years	3.5%
31-75 years	3.0%
76-125 years	2.5%

Table 6.4 summarises the property damages associated with flooding in Newcastle from the Shimna River. Note that Options 2 and 3 provide the same level of protection and therefore have the same damage figures. The total PVD has been calculated by summing the capped present value direct damages and the present value emergency costs.

Table 6.4 Summary of Property Damages

Option	Total AAD	Total PVD (Capped)	Total PVD including emergency services
Option 1- Status Quo	£312,026	£5,501,038	£6,089,649
Option 2- Hard Defences	£13,335	£524,753	£580,901
Option 3- Hard Defences	£13,335	£524,753	£580,901

6.4 INTANGIBLE IMPACTS OF FLOODING

The intangible impacts of flooding consist of increased stress, health effects and loss of memorabilia for which it is difficult to assign a monetary value. Research by a joint Defra/Environment Agency research project into economic valuation of human related intangible impacts of flooding in project appraisal was carried out and published in the PCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities (2004).

The results of the research concluded that the value of avoiding the health impacts of fluvial flooding is of the order of £200 per year per household. This is a weighted average value derived from a very wide range of responses. When incorporating the intangible damages into an economic appraisal it is recommended to use the Risk Reduction Matrix as presented in Table 5.3. The intangible benefits

associated with the prevention of certain flood events can be applied to the total number of households at risk.

The intangible benefits were calculated for each option using Table 6.5. The standard of protection afforded to each household before and after the option is included was used to give a damage value per household per year. This was then factored up depending on the number of households being protected. As each option is designed to alleviate flooding up to a 1% AEP event the maximum damage that can be afforded to a household per year is £200. The results of these calculations are presented in Table 6.6 and apply to both Options 2 and 3.

			Standard of Protection After - AFP (RP in Years)							
Standard of Protection Before - AFP (RP in Years)			0.007 (150)	0.008 (125)	0.010 (100)	0.013 (75)	0.020 (50)	0.033 (30)	0.05 (20)	0.1 (10)
	1	(1)	£218	£215	£200	£153	£73	£25	£12	£5
	0.1	(10)	£214	£210	£195	£148	£68	£21	£8	£0
	0.05	(20)	£206	£202	£188	£141	£60	£13	£0	
	0.033	(30)	£193	£189	£175	£128	£47	£0		
	0.020	(50)	£145	£142	£127	£80	£0			
	0.013	(75)	£65	£62	£47	£0				
	0.010	(100)	£18	£15	£0					
	0.008	(125)	£4	£0						

AFP - Annual Flood Probability

RP - Return Period

Annual Benefits = Damages (before) - Damages (after)

Table 6.5 Intangible Benefits Associated With Flood Defence Improvements

Option	Standard of Protection Before	No of Properties Affected	Standard of Protection After	Intangible Benefits Associated with Improvements (£)	Intangible Benefits (£)
Option 2- Hard Defences	< 1 in 2 year	4	100 year	200	800
	≥ 1 in 5 year	29		199.4	5,782.60
	≥ 1 in 10 year	61		197.8	12,065.80
	≥ 1 in 25 year	77		195	15,015
	≥ 1 in 50 year	53		181.5	9,619.50
	≥ 1 in 100 year	68		127	8,636
				Total	£51,918.90
				Present Value Intangible Benefit	£1,547,862

Table 6.6 Intangible Benefits (Options 2 and 3)

6.5 ADDITIONALITY

As described in the NIGEAE, the success of government intervention through financial assistance is usually assessed in terms of its 'additionality'. This is its net, rather than its gross, impact after making allowances for what would have happened in the absence of the intervention. It is the extent to which an activity takes place at all, or is undertaken on a larger scale, or earlier, or to a higher standard, or within a policy target area, as a result of public sector intervention.

This scheme is regarded as fully additional in that without government assistance a flood alleviation scheme will not be constructed. The proposed scheme will not cause any offsets in output or employment elsewhere.

6.6 DISPLACEMENT

Consideration should also be given to 'displacement'. This is the degree to which a promoted activity will be offset by reductions in activity elsewhere. It is important to assess this because appraisal is about identifying a proposal's net impact on Northern Ireland.

Rivers Agency's role does not affect displacement. Displacement would occur if Rivers Agency protected a business which became more productive at the expense of businesses located outside of the protected area. Where the majority of properties within the flooded area are mainly residential, as is the case in the Shimna catchment, then displacement is not an issue. In this particular case, the status quo is being maintained with respect to businesses in the flooded areas.

7 APPRAISE RISKS AND ADJUST FOR OPTIMISM BIAS

7.1 IDENTIFY AND ANALYSE RISKS

The NIGEAE highlights the importance of risk identification as there is always likely to be some difference between what is expected and what eventually happens. A vital step in the analysis is to identify the risk and uncertainties for each option which helps to inform the adjustments for optimism bias.

Table 7.1 shows the risks with Option 1 (Status Quo). The greatest risk is that an extreme weather event will occur, causing flooding to a number of properties. As well as causing distress and anxiety to the residents this risk will lie with Rivers Agency, who will be responsible for emergency response and clean-up operations.

Table 7.2 details the risks for both Option 2 and 3.

Table 7.1 Risk Log (Option1)

Risk ID	Type	Description	Likelihood (High, Medium or Low)	Expected Impact (Low, moderate or Severe)	Bearer of Risk (Client, Consultant, Both or Other)	Mitigation / Counter Measures	Risk Status
1	Economic	Extreme weather event will occur, causing flooding to a number of properties	M	S	Client	Monitor weather events	Open
2	Financial	Flooding will require emergency response and clean up operations from Rivers Agency	M	M	Client	Early response to area	Open

Table 7.2 Risk Log (Options 2 and 3)

Risk ID	Type	Description	Likelihood (High, Medium or Low)	Expected Impact (Low, moderate or Severe)	Bearer of Risk (Client, Consultant, Both or Other)	Mitigation / Counter Measures	Risk Status
1	Structural	Defences fail before construction is completed	L	M	Client	Monitoring of defence should be carried out during the construction process	Open
2	Construction	Construction / implementation of option proves more difficult than anticipated and construction costs escalate	L	S	Client	Early contractor involvement	Open
3	Design	Suggested method is inadequate to provide the required level of protection	L	S	Client	Design review and early contractor involvement	Open

Risk ID	Type	Description	Likelihood (High, Medium or Low)	Expected Impact (Low, moderate or Severe)	Bearer of Risk (Client, Consultant, Both or Other)	Mitigation / Counter Measures	Risk Status
4	Environmental	Environmental damage caused during the construction works	M	M	Other	Ensure all reasonable steps have been undertaken to reduce possibility of environmental damage	Open
5	Structural	Ground conditions require additional works to be carried out escalating the construction costs	M	M	Client	Undertake an adequate ground investigation and provide structural core if required i.e. sheet piles	Open
6	Economic	Economic climate becomes very poor and no funding is available to undertake the works	M	S	Client	Try to ensure that funding is secured in advance	Open
7	Financial	A financially justifiable option cannot be found	L	M	Client	Ensure all possibilities are assessed	Open
8	Financial	Material costs rise prior to construction increasing the overall cost of option implementation and reducing the cost benefit	M	M	Client	If an extended period of time is taken between cost benefit analysis and option implementation, revise the cost benefit analysis to present day prices.	Open
9	Environmental	Option implementation is hindered by environmental concerns from interested parties	L	M	Client	Ensure a comprehensive environmental scoping exercise is carried out and that all interested parties are consulted accordingly	Open

7.2 ADJUSTING FOR OPTIMISM BIAS

Optimism bias is the tendency for appraisers to be overly optimistic in early assessments of project costs, time scales and benefits in comparison to the final values. To counter this HM Treasury issues guidance in the form of a percentage to increase the costs by depending on the uncertainty surrounding the estimates. FCERM-AG recommends that an optimism bias of 60% is used for projects at an early stage of consideration (initial feasibility study). This would apply to this project as no design has been completed and therefore cost estimates are based on broad assumptions about the scope and nature of work. This percentage is added to the original estimate and used in the cost-benefit calculations.

FCERM-AG lists four steps that should be followed if determining an optimism bias values that differs from 60%. These are as follows:

- Step 1: identify best estimates of capital, operating and maintenance costs for each option;

- Step 2: assume an optimism bias of 60% of total present value costs (including capital, operating and maintenance costs over the whole life of the option);

- Step 3: refer to the HM Treasury supplementary guidance to the Green Book entitled 'Supplementary guidance on the treatment of optimism bias' which sets out key components of risk. Assess whether the contributions of these components should be higher or lower. Where demonstrable action has been taken to minimise individual risks, the relevant component(s) may be reduced. Conversely, if a project is riskier than average in certain areas (perhaps because of innovation), then the relevant risk component contributions should be increased. If there is no evidence either way, leave the default risk component percentages unchanged; and

- Step 4: rework the overall optimism bias factor including any revisions. Apply the revised optimism bias factor including any revisions. Apply the revised optimism bias factor as a percentage uplift to total present value costs (in place of any contingency estimate).

RPS considered contributory factors as defined in the Supplementary Note to FCDPAG3 published by DEFRA in March 2003. The factors were then reduced according to the amount of confidence the appraiser has in each factor, as shown in Tables 7.3 and 7.4 for the proposed options. The adjustment to the optimism bias was carried out for the proposed option and shows the initial percentage weighting of each of the factors, the adjusted percentage weighting considered appropriate by the appraiser to each of the factors and an explanation into the rationale behind any reduction.

Table 7.3 Optimism Bias Component Weighting Option 2

Risk Components contributing to Optimism Bias Factor		% Contribution to Optimism Bias	Adjusted %	Comments
Procurement	Late Contractor involvement in design	1	1	No contractor involvement to date
	Dispute and claims occurred	11	10	Disputes and claims may arise due to unforeseen circumstances
	Other	1	1	
Project Specific	Design complexity	4	2	Design is relatively simple
	Degree of innovation	4	2	No unproven methods being used
	Environmental impact	13	11	Substantial construction works adjacent to watercourse channels but consideration will be given to environmental constraints
	Other	9	9	
Client Specific	Inadequacy of the Business Case	23	15	Project scope well defined
	Funding availability	2	2	Unsure of funding availability in current economic climate
	Project team management	1	1	Project team not defined for construction works
	Poor project intelligence	8	4	Preliminary ground investigation carried out
Environment	Public Relations	5	3	Construction work may disrupt local community but scheme will reduce fear of flooding
	Site Characteristics	4	2	Site well known to client, no issues identified from site characteristics
External Influence	Economic	5	3	Unstable economic climate
	Legislation/ regulations	4	2	No changes to legislation foreseen
	Technology	4	2	Traditional construction methods required
	Other	1	1	
TOTAL		100	71	

Optimism bias factor for scheme costs= 60%

New optimism bias= 71/100 x 60= 42.6%

Table 7.4 Optimism Bias Component Weighting Option 3

Risk Components contributing to Optimism Bias Factor		% Contribution to Optimism Bias	Adjusted %	Comments
Procurement	Late Contractor involvement in design	1	1	No contractor involvement to date
	Dispute and claims occurred	11	10	Disputes and claims may arise due to unforeseen circumstances
	Other	1	1	
Project Specific	Design complexity	4	2	Design is relatively simple
	Degree of innovation	4	2	No unproven methods being used
	Environmental impact	13	9	Substantial construction works adjacent to watercourse channels but consideration will be given to environmental constraints. Some planted embankments included
	Other	9	9	
Client Specific	Inadequacy of the Business Case	23	15	Project scope well defined
	Funding availability	2	2	Unsure of funding availability in current economic climate
	Project team management	1	1	Project team not defined for construction works
	Poor project intelligence	8	4	Preliminary ground investigation carried out
Environment	Public Relations	5	3	Construction work may disrupt local community but scheme will reduce fear of flooding
	Site Characteristics	4	2	Site well known to client, no issues identified from site characteristics
External Influence	Economic	5	3	Unstable economic climate
	Legislation/ regulations	4	2	No changes to legislation foreseen
	Technology	4	2	Traditional construction methods required
	Other	1	1	
TOTAL		100	69	

Optimism bias factor for scheme costs= 60%

New optimism bias= 69/100 x 60= 41.4%

8 WEIGH UP NON-MONETARY BENEFITS

8.1 METHODOLOGY

As with many construction projects there are non-monetary impacts which must be taken into account to allow a full assessment of any option to be completed. These non-monetary impacts such as environmental, social political, aesthetic and disruption effects should not be assumed to be any less important than the monetary aspects of an appraisal. The non-monetary benefits of the proposed option have been assessed under a number of criteria. Below is a brief summary of the scoring system applied in the benefits and costs tables.

The benefits are scored from 0 to 5 where a score of 0 indicates the option does not provide any benefit in this category and 5 indicates the option provides a lot of benefit. Table 8.1 provides an explanation for each benefit being assessed. Each category has been weighted according to its importance and impact.

Table 8.1 Benefit Category Weightings

Category	Weighting	Rationale
Reduction in risk/ fear of flooding	3	Reduction in the risk and fear of property flooding in the public's perception reduces stress and anxiety, and may improve health
Reduced fear of loss of livelihood	3	Reduced risk of loss of earnings and/or land damage due to flooding
Reduction in risk to transport links	2	Local roads could be disrupted in the event of flooding
Ensure continued use as a public amenity	2	A number of recreational and public areas are currently affected by flooding
Protect flora and fauna and enhance biodiversity	2	Options may have the potential to create or enhance existing riverine habitats
Protect and enhance landscape character and visual amenity	2	Site is in view of public road and park. Non-obstructive structures are desireable

8.2 NON-MONETARY BENEFIT SCORING

Table 8.2 contains the comparative scoring for Options 1-3, and provides an overall ranking of the options in terms of their impacts on non-monetary benefits.

Table 8.2 Non-monetary Benefits

Benefit	Option 1 Status Quo	Option 2 Hard Defences	Option 3 Hard Defences
Reduction in risk/ fear of flooding (3)	0 Risk/ fear of flooding remains	5 (15) Risk/fear of flooding is significantly reduced to a large number of residential properties	5 (15) Risk/fear of flooding is significantly reduced to a large number of residential properties
Reduced fear of loss of livelihood (3)	0 Risk/ fear of loss of livelihood remains	3 (9) Risk/fear of loss of livelihood is significantly reduced, however mostly residential properties at risk	3 (9) Risk/fear of loss of livelihood is significantly reduced, however mostly residential properties at risk
Reduction in risk to transport links (2)	0 Risk to transport links remains (Bryansford Road and Avenue)	4 (8) Risk to transport links is significantly reduced	4 (8) Risk to transport links is significantly reduced
Ensure continued use as a public amenity (2)	0 No impact on Islands Park	2 (4) Partial flood protection provided to Islands Park	2 (4) Partial flood protection provided to Islands Park
Protect flora and fauna and enhance biodiversity (1)	2 (2) Maintenance will ensure that river is kept clean along designated section	0 No benefits provided	0 No benefits provided
Protect and enhance landscape character and visual amenity (1)	2 (2) Maintenance will be carried out to maintain the landscape along designated section	0 No benefits provided	0 No benefits provided
Benefit Score	4 (4)	14 (36)	14 (36)
Ordinal Rank	3	1=	1=

Option 1 (Status Quo) provides the benefit of protecting existing flora and fauna, and not altering the visual landscape but does not provide any reduction/risk of flooding.

Options 2 and 3 provide significant benefits through a reduction in the risk/fear of flooding to properties, businesses and transport links as 1% AEP flood protection would be provided. Figure 8.1 below shows the flood extent following the construction of the proposed hard defences. This can be directly compared to Figure 3.2 to show the impact of the defences.

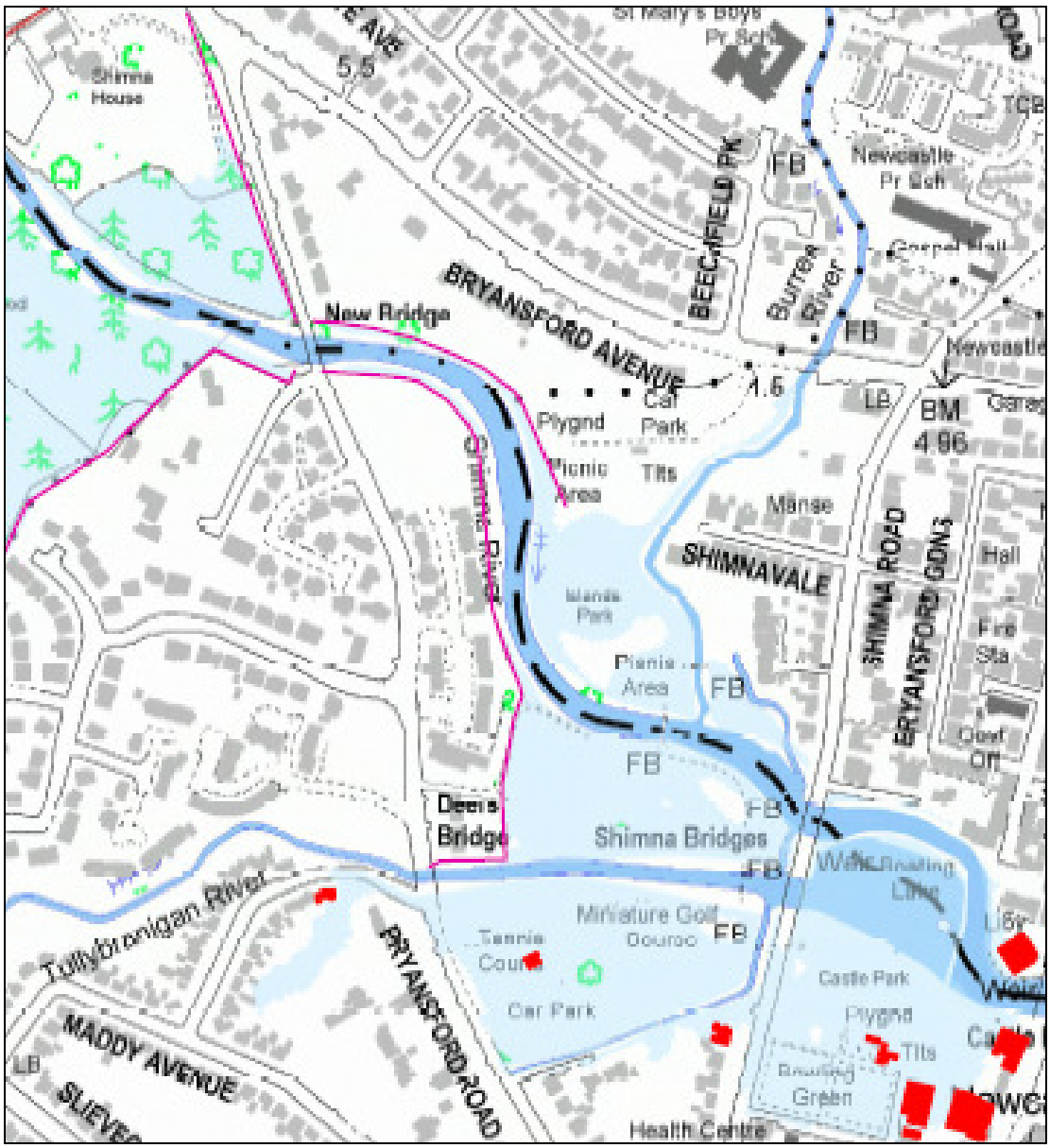


Figure 8.1 Flood extents with hard defences

9 CALCULATE NET PRESENT VALUES & ASSESS UNCERTAINTIES

9.1 NET PRESENT VALUES

In order to assess whether a scheme is economically beneficial, the capital cost of providing a flood alleviation scheme is compared with the damages and losses it will prevent or delay. The benefits and costs are summated in the prescribed manner and discounted over a life span using a Test Discount Rate to give the present value of the scheme. The Net Present Value (NPV) is the sum of the discounted benefits of an option less the sum of the discounted costs. The NPV is the primary criterion for deciding whether action can be justified. The benefit cost ratio is the ratio of the present value of discounted benefit to the capital cost of works. The discounted costs, benefits, NPV and benefit/cost ratios for each option and are presented in Table 9.1.

Table 9.1 Summary of Present Value Costs and Benefits and Net Present Values

	Costs (£)		
	Option 1	**Option 2**	**Option 3**
Construction costs from estimates	0	3,110,304	3,202,050
Optimism Bias Adjustment	0	1,324,990	1,325,649
Maintenance Costs (NPV over 100 years)	31,996	62,618	75,689
Total Present Value Costs	31,996	4,497,912	4,603,388
	Benefits (£)		
	Option 1	**Option 2**	**Option 3**
Present Value Damage (including emergency services)	6,089,649	580,901	580,901
Present Value Damage Avoided	0	5,508,748	5,508,748
Intangible Benefits	0	1,547,862	1,547,862
Total Present Value Damage Avoided	0	7,056,610	7,056,610
	Benefit Cost Ratio		
	Option 1	**Option 2**	**Option 3**
Average benefit/cost ratio	-	1.57	1.53

Table 9.1 indicates that both options have very similar positive benefit cost ratios, with Option 2 having the a slightly greater benefit cost ratio of 1.57.

9.2 ASSESS UNCERTAINTIES

The NIGEAE states that the future is inherently uncertain therefore no matter how thoroughly costs, benefits, risks and timings are identified and analysed, and even after best efforts have been made to adjust for optimism bias, there will remain uncertainty over the accuracy of the assumptions made. It is essential to test how these uncertainties may affect the choice between options.

In this case, the two options are so similar that any uncertainty in one will similarly affect the other so a sensitivity analysis has not been completed.

10 ASSESS AFFORDABILITY AND RECORD ARRANGEMENTS FOR FUNDING, MANAGEMENT, PROCUREMENT, MARKETING, BENEFITS REALISATION, MONITORING & EX POST EVALUATION

10.1 AFFORDABILITY & FUNDING

Rivers Agency is the lead authority in Northern Ireland for the management of fluvial and coastal flood risk. In fulfilling this role the Rivers Agency has commissioned this Shimna River Economic Appraisal together with all previous and relevant Feasibility Reports. Rivers Agency will also be responsible for financing the delivery and future maintenance of the flood risk management works recommended by this Report. The scheme is high priority for Rivers Agency and is urgently required to be completed.

Rivers Agency is centrally funded and receives an annual capital works budget of around £8million. The Shimna Flood Defence Scheme has been ranked on Rivers Agency's Capital Works Prioritisation, and money has been made available to commence the detailed design stage in the next financial year (2017/18) and to progress to construction stage within the next three years.

10.2 MANAGEMENT

The individual (Project Sponsor) within Rivers Agency who is responsible for managing and delivering the feasibility study, and any subsequent design and construction of works relating to the Shimna River Flood Defences, is:

Mr Alan Reddick
Business Unit Manager - Capital Procurement Unit (CPU)
Rivers Agency
4 Hospital Road
Hydebank
Belfast BT8 8JP

10.3 PROCUREMENT

As a department within DfI, Rivers Agency is guided by clear definitions from Northern Ireland Public Procurement Policy. Best value is defined as the most advantageous combination of cost, quality and sustainability. The project will be procured as a two stage 'restricted' competition, consisting of prequalification and tender processes.

10.4 BENEFITS REALISATION PLAN

A benefits realisation plan is used to track and overview the delivery of benefits or benefit milestones. It achieves this by measuring the benefits at appropriate milestones within the project's lifespan. By identifying the benefits between delivery and outcomes it provides cost transparency by contracting upon business outcomes. The benefits realisation plan is used throughout the project and includes the post evaluation stage as it provides a clear method of measuring and monitoring the performance that the planned benefits are being delivered. The Benefits Realisation Plan is presented in Appendix D for both monetary and non-monetary benefits.

10.5 MONITORING

The delivery of the works is likely to be undertaken by specialist Engineering Designers/ Consultants and Contractors, appointed by the Rivers Agency. However it will be the Rivers Agency's responsibility to continually monitor a number of key factors throughout project delivery; a list of these is provided in Table 10.1 below. It should be borne in mind that the Rivers Agency may opt to delegate some of its responsibilities to more suitable companies or individuals. For example, responsibility for ensuring the construction is in compliance with the design specification may be delegated to the Engineering Designers / Consultants.

Table 10.1 Key Factors to be Monitored During Project Delivery

Factor	Monitoring During Which Delivery Phase		Monitoring Interval	Responsible for Monitoring
	Design	Construction		
Monitoring Expenditure	✓	✓	Monthly	Project Sponsor CPU Rivers Agency Hydebank Belfast
Project Out-turn Cost	✓	✓	Monthly	
Programme of Delivery	✓	✓	Monthly	
Design Compliance with FCERM-AG and Government Guidance	✓		As Required	
Consultation with Statutory and Key Stakeholders	✓	✓	Monthly	
Compliance with Design Specification		✓	Weekly	
Method Statements for Construction Activities		✓	As Required	
Environmental Impact Assessment Compliance	✓		Monthly	Conservation Officer Environment Section Rivers Agency Hydebank Belfast
Construction Design and Management (CDM) Regulations	✓	✓	Monthly	Project Sponsor / Consultant / Contractor – all as required
Effectiveness of project in minimising flooding	✓	✓	Monthly	Project Sponsor CPU Rivers Agency Hydebank Belfast

10.6 EVALUATION

A post project evaluation should be carried out upon completion of works relating to the Shimna River Flood Defences to ensure compliance with the necessary statutory requirements and business case assumptions. It will also provide 'out turn' data which could help verify future, similar feasibility studies being promoted by the Rivers Agency.

Rivers Agency would propose to undertake a Post Project Evaluation after 1 year has elapsed following completion of construction. This process will review the project, achievement of objectives,

and overall success, etc. It will also highlight any 'lessons learnt' in undertaking the project which could enhance how similar projects are done in the future.

Table 10.2 below summarises this evaluation process and identifies those responsible for the different elements. It should be borne in mind that the Rivers Agency may opt to delegate some of its responsibilities to more suitable companies or individuals. For example, responsibility for ensuring the necessary information is provided for the evaluation may be delegated to the Engineering Designers / Consultants who undertook the scheme design.

Table 10.2 Post Project Evaluation Process

Evaluation Process		Specific Tasks and Responsibilities
Title	**Description of Tasks**	
Delivery	Ensure the Post Project Evaluation is undertaken.	The Rivers Agency Project Sponsor has responsibility for ensuring the Post Project Evaluation Process is undertaken and the appropriate information provided.
Information Supply	Ensure the necessary and appropriate information for the Evaluation is provided.	
Deliver Evaluation	Individual responsible for undertaking the project evaluation.	Either officer within CPU or Consultant appointed by Project Sponsor (who has not been involved in the management or implementation of the works).
Date of Delivery	Date when the evaluation process needs to be completed by.	The evaluation process should be undertaken no later than 1 year after completion of the works.
Evaluation Scope	The scope of works for the post project evaluation.	The precise scope will be determined upon successful delivery of the works but should include the following tasks: Projected cost against actual Projected programme against actual Projected benefits against actual Compliance with required mitigation measures. Compliance with statutory H&S requirements.
Dissemination of Results	How the results will be disseminated.	Those to receive a copy of the post project evaluation's results should be agreed with the Department of Infrastructure Economists
Evaluation objectives achieved	Evaluate whether the scope is actually achieved.	The Rivers Agency Project Sponsor has responsibility for ensuring the scope is actually achieved
Evaluation Unforeseen circumstances	Evaluate and unforeseen benefits and lessons learnt	The Rivers Agency Project Sponsor has responsibility for evaluation and will take place during design, construction and post construction phases.

11 ASSESS THE BALANCE OF ADVANTAGE BETWEEN THE OPTIONS & PRESENT THE APPRAISAL RESULTS & CONCLUSION

11.1 SELECTION OF A PREFERRED OPTION

Good decisions come from considering the economic, environmental, social and technical issues that affect the choice of a solution, together with proper consideration of risk and uncertainty. The selection of a preferred option must be based on technical and environmental viability as well as economic justification under the analysis carried out in the previous chapters. A preferred scheme must therefore satisfy a number of criteria as follows:

1. achieve the objectives set out in Chapter 2;
2. provide the best value for money whilst also being economically justified;
3. have minimal or acceptable environmental and social impacts during both the construction and operational phases.

In order for an option to be recommended as the preferred option it must:

- provide flood protection against 1% AEP flood event with appropriate allowances for uncertainty;
- have a benefit cost ratio over 1 (unless considering maintenance of watercourse);
- be environmentally and socially acceptable.

In this case there are two options that will provide the required level of protection. As Table 9.1 shows, each of the two construction options for hard defences provides a benefit/cost ratio greater than 1. There is very little difference between the two options as both options have similar risks and non-monetary benefits. Option 2, reinforced concrete walls with sheet piles at all locations, would be the preferred option for monetary reasons as it has a slightly higher benefit/cost ratio of 1.57.

11.2 TIMING OF THE PROJECT

The proposed timings for taking the project forward are presented in Table 11.1.

Table 11.1 Proposed Timings for Project Delivery

Project Step	**Start Date**	**Completion Date**
Approval of Shimna Feasibility Study and Economic Appraisal by Rivers Agency	-	June 2016
Approval by DFP	June 2016	December 2016
Appointment of Design Consultant	January 2017	June 2017
Completion of detailed design and required consents by Design Consultant	June 2017	June 2018
Approval of design by Client	June 2018	August 2018
Tender contract and appoint contractor	August 2018	January 2019
Construction of works	January 2019	January 2020

It should be noted that these dates assume that the project progresses without delays. However, all Rivers Agency projects are subject to prioritisation and the availability of resources and capital funding, any of which may affect the ability to deliver the project.

As with the costs discussed previously, there is a demonstrated, systematic tendency for project appraisers to be overly optimistic and underestimate timescales. 'The Supplementary Guidance on the treatment of optimism bias' provides adjustment percentages for generic project categories to apply for estimating the length of time it will take to complete the capital works. Once an initial estimate is made, the upper bound optimism bias percentage should normally be applied. For a Standard Civil Engineering project this is 20%. If this is applied to the contract duration stated in the table above then the completion date would extend to March 2020.

11.3 RECOMMENDATION AND CONCLUSIONS

A hydraulic analysis of the Shimna River identified that 292 residential and 20 commercial buildings would be affected during a 1% AEP flood event. The areas identified as being at risk of flooding include Bryansford Road, Bryansford Avenue, Beechfield Park, Shimna Vale, Shimna Road, Castlewellan Road, Shimna Mile and Riverside Park.

A range of flood alleviation options were considered for preventing flooding in Newcastle from the Shimna River during high return period events. The most feasible option is provision of hard defences to prevent water from leaving the Shimna River both upstream and downstream of the Bryansford

Road bridge. The results of a ground investigation showed sand and gravel in the shallow strata, and therefore sheet piles would be required to prevent water flow beneath the wall. Two methods of construction of hard defences were considered, which allowed for sheet piles to a depth of 4m.

The cost of damages for various return periods were calculated based on the Multi-coloured Manual and discounted over a period of 100 years in order to determine the present value benefits of the proposed option.

Option 2, reinforced concrete walls with sheet piles at all locations, would be the preferred option as it has a slightly higher benefit/cost ratio of 1.57, with similar risks and benefits to Option 3.

Following completion of the detailed design a Pre-tender estimate will be prepared. At this stage Rivers Agency will not proceed to tender unless the scheme is still cost beneficial. Likewise after tender return but before award Rivers Agency will again review the costs and will not proceed to award unless the scheme is viable.

12 REFERENCES

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)

Burren & Shimna Rivers Flood Investigation- 16 August 2008. RPS (2009)

Shimna River, Newcastle Feasibility Study for Flood Risk Investigation. RPS (2015)

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

Flood and Coastal Erosion Risk Management- A Manual of Assessment Techniques. Flood Hazard Research Centre, Middlesex University (2010). Often referred to as the Multi Coloured Manual (MCM)

Flood and Coastal Defence Project Appraisal Guidance, FCGPAG3 Economic Appraisal, Supplementary Note to Operating Authorities. Defra (2004)

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

Appendix 8: Cultural Heritage

Annex A: Gazetteer of Heritage Assets

Appendix 8.1: Gazetteer of Recorded Monuments and Buildings Record Sites

NI Monuments and Buildings Record Reference	Site Type	Site Description	Period	Condition	Designation
DOW049:007	Rath – St. Cillan's Fort	An impressive rath sited on the W edge of a valley, on ground sloping W. The site is very overgrown making measuring difficult. It is enclosed by a large earthen bank with a possible entrance ramp at NW. At ditch encloses the site S-W-NW & is absent elsewhere. The site is 48m N-S x 52m E-W. The bank is 2m above the interior, 9m wide & 3.5m above the ditch which is 4m wide & 2m deep. A sewer has been dug in the bottom of the ditch & covered with hard core. Monitoring of topsoil stripping on a site 50m NE of the rath uncovered a spread of what appeared to be burnt mound material, consisting of a black sticky clay containing burnt stones. The spread was 11m long x 6m wide. Excavation revealed it to be very shallow, no more than 0.12m deep & it appeared to be mixed with old topsoil/ploughsoil which produced post-medieval pottery. No other archaeological features or artefacts were found. [ADS, 2003]. Further stripping on the SE corner of the development site was carried out under archaeological supervision; no archaeological deposits or artefacts were uncovered. [ADS, Aug. 03]	Early Christian	Substantial remains	Scheduled
HB18/13/038	Currraghard Lodge 109 Tullybrannigan Road Tullybrannigan Newcastle Co Down BT33 0PW	Largely single storey Regency style hipped roof villa of c.1835-40 with return wings and gabled entrance porch. A storey was added to one of the wings in the 1930s. To the rear there is a collection of hipped roof outbuildings including a small store for game.	19th century	Substantially unchanged	Listed- B1
DOW049:004	Castle	The castle was destroyed in 1830 to build the present hotel, which is a Listed Building. According to Harris (1744) there was a date of 1588 over the door, but another source has it as 1433. No further details available at present.	Late medieval	Destroyed	Not applicable
Newcastle	Battle	Siege in 1642 whereby the Irish garrison defending the castle were besieged by a force of English troops under Sir James Montgomery. Montgomery was successful in capturing the castle	Post-medieval	No visible remains	Not applicable
03558:000:00	Bridge	Carries the Bryansford Road over the Shimna River. The bridge was first shown on the Ordnance Survey second edition map sheet (1862) with steps marked at the location on the previous Ordnance Survey first edition map sheet (1834).	19th century	Substantial remains	Not applicable

03560:000:00	Bridge	Carries the Shimna Road over the Shimna River. The road was constructed during the first half of the 20th century with the bridge marked on the Ordnance Survey fourth edition map sheet (1938) onwards.	20th century	Substantial remains	Not applicable
03570:000:00	Bridge	Carries Bryansford Avenue over the Burren River. It is known as Hagan's Bridge and was marked on all Ordnance Survey map editions from 1834 onwards	19th century	Substantial remains	Not applicable

Appendix 9: Biodiversity – Terrestrial Ecology

Annex A: Zone of Influence (ZoI) informing the assessment

Annex B: Site Photographs

Annex C: Species Lists

Annex D: CEDaR data request results

Annex A: Zone of Influence (ZoI) informing the assessment

Appendix A – **Annex A: ZoI informing the assessment**

Table A.1: Zones of Influence informing the assessment – habitats.

Habitats	Type of potential impact	ZoI (m) for potentially significant effects	Rationale
'Terrestrial' habitats and plant species without high groundwater or surface-water dependency (i.e. relative to examples below).	Direct habitat loss	Footprint of construction (only)	No habitat loss / damage predicted beyond this area. Assumes no indirect and / or far-field effects, e.g. from flooding or shading arising as a result of the proposed development.
Habitats and plant species with relatively high ground-water dependency relative to 'terrestrial' habitats above (e.g. turloughs, petrifying springs, petalwort).	Direct habitat loss or indirect impacts to groundwater supply or yield.	Groundwater body in which the development is located.	Assumes no significant impacts predicted on flow or yield of groundwater to groundwater-dependent habitats beyond this area.
Habitats and plant species with relatively high surface-water dependency relative to 'terrestrial' habitats above (e.g. rivers, mudflats, saltmarsh, reefs).	Direct habitat loss	Footprint of construction for direct impacts.	No habitat loss / damage predicted beyond this area.
	Indirect pollution impacts	Entire downstream catchment of proposed scheme	Assumes pollutants will settle and/or be adsorbed such that significant volumes/concentrations of pollutants do not cross catchment boundaries.

Table A.2: Zones of Influence (ZoI) informing the assessment – Fauna.

Fauna species and their habitat features	Type of potential impact	ZoI (m) for potentially significant effects	Rationale
Bats and their roosts (direct effects)	'Direct' disturbance of roost sites including noise, vibration, or light spill.	Typically estimated as 50 m from potential or confirmed roost sites, but informed by light modelling on a case-by-case basis.	Professional judgement, having regard for Collins (2016).
Bats and their roosts (indirect effects)	Fragmentation of foraging / commuting habitats.	Varies by bat species; at least 13 km in the case of long-distance foraging of Irish Leisler's bats.	Leisler bats have been radio-tracked to demonstrate movements of at least 13 km from nursery roost to feeding site (Shiels *et al.*, 2006).
Breeding or resting sites of otter, badger,	Physical disturbance to breeding or resting sites including 'entombment 'in	Breeding/resting sites within at least 50 m of earthworks	Distances are subject to case-by-case assessment of local ground conditions

Fauna species and their habitat features	Type of potential impact	ZoI (m) for potentially significant effects	Rationale
	the case of otter and badger (i.e. following collapse of hole / nest due to vibration).	Breeding/resting sites within up to 150 m of disturbance in the case of blasting/rock-breaking/piling.	(e.g. holes in unstable clay substrates are more sensitive than those protected from vibration from sheet rock).
Birds	Nesting birds including any singing males potentially affected by noise.	Territories within 100 m of disturbance.	Professional judgement for distance within which territorial singing may be impacted.
Invertebrates including butterflies	Direct loss of habitat or injury.	Footprint of construction for direct impacts.	Similarly to habitats; no habitat loss / direct injury predicted beyond this area.

Annex B: Site Photographs

Appendix A – **Annex B: Site photographs**

Plate Error! No text of specified style in document.**.1: Amenity grassland dominated the scheme area. Dense scrub to the background fringes the Shimna River.**

Plate Error! No text of specified style in document.**.2: Shimna River where it flows under Bryansford Road. Water levels were low during survey. Broadleaved semi-natural woodland fringes the river.**

Plate Error! No text of specified style in document.**.3: Paths are present associated with Islands Park. This path leads through a pocket of broadleaved woodland.**

Plate Error! No text of specified style in document.**.4: Coniferous plantation woodland to the north of the scheme.**

Plate Error! No text of specified style in document.**.5: Example of ephemeral/short perennial habitat in the wider area.**

Plate Error! No text of specified style in document.**.6: Areas of dense/scattered scrub area present across the surveyed area.**

Annex C: Species Lists

Appendix A – **Annex C:Species lists**

Table A.3: Woodland species list.

Scientific name	Common name
Acer campestre	Field maple
Acer platanoides	Norway maple
Acer pseudoplatanus	Sycamore
Achillea millefolium	Yarrow
Aegopodium podagraria	Ground-elder
Agrostis sp.	Bent
Allium ursinum	Ramsons garlic
Alnus glutinosa	Alder
Angelica sp.	Angelica
Anthoxanthum odoratum	Sweet vernal grass
Apium graveolens	Wild celery
Arum maculatum	Lord's and Ladies
Betula pendula	Silver birch
Betula pubescens	Downy birch
Borago officinalis	Borage
Brachypodium sylvaticum	False brome
Bromus hordeaceus	Soft brome
Bromus sp.	Brome
Carex sp.	Sedge
Carex sylvatica	Wood sedge
Circaea lutetiana	Enchanter's nightshade
Cirsium sp.	Thistle
Conium maculatum	Hemlock
Cornus sanguinea	Dogwood
Corylus avellana	Hazel
Cotoneaster sp.	Cotoneaster (cultivar)
Crataegus monogyna	Hawthorn
Crocosmia x crocosmiiflora	Montbretia
Dactylorhiza fuchsii	Sp.otted orchid
Digitalis purpurea	Foxglove
Epilobium montanum	Broad-leaved willowherb
Fagus sylvatica	Beech
Festuca altissima	Wood fescue
Festuca sp.	Fescue
Filipendula ulmaria	Meadowsweet
Fraxinus excelsior	Ash
Galium aparine	Cleavers
Galium uliginosum	Fen bedstraw
Gallium sp.	Gallium
Geranium robertianum	Herb Robert
Geum urbanum	Wood avens
Hedera helix ssp. *helix*	Ivy
Heracleum sp.hondylium	Common hogweed
Holcus lanatus	Yorkshire fog
Hyancinthoides non-scripta	Bluebell
Hypericum androsaemum	Tutsan
Ilex aquifolium	Holly
Juncus sp.	Rush
Lapsana communis	Nipplewort
Larix sp.	Larch
Larix decidua	Common larch
Leucanthemum vulgare	Ox-eye daisy
Leycesteria formosa	Himalayan honeysuckle
Ligustram sp.	New Zealand privet
Linaria purpurea	Purple toadflax
Lonicera periclymenum	Honeysuckle
Luzula campestris	Field wood-rush
Luzula sp.	Wood-rush
Luzula sylvatica	Great wood-rush
Oxalis acetosella	Wood sorrel
Petasites fragrans	Winter heliotrope
Petasites hybridus	Butterburr
Phalaris arundinacea	Reed canary grass
Phyllitis scolopendrium	Hart's-tongue fern
Picea sp.	Sp.ruce
Pinus resinosa	Norway pine
Pinus sylvestris	Scots pine
Plantago lanceolata	Ribwort plantain
Prunus laurocerasus	Cherry laurel
Prunus sp.	Cherry
Pteridium aquilinum	Bracken
Rhododendron ponticum	Rhododendron
Rosa canina	Dog rose
Rosa sp.	Rose
Rose rugosa	Japanese rose
Rubus fruiticosus agg.	Bramble
Rubus idaeus	Rasp.berry
Rumex crispus	Curled-leaved dock
Rumex sp.	Dock
Salix caprea	Goat willow
Salix sp.	Willow
Sambucus nigra	Elder
Senecio jacobea	Common ragwort
Sonchus sp.p.	Generic sow thistle
Sorbus aria	Whitebeam (common)
Sorbus aucuparia	Rowan
Stachys sp.	Woundwort
Taxus baccata	Yew
Tsugasp.	Hemlock sp.ruce
Ulmus sp.	Elm
Urtica dioica	Common nettle
Vicia sativa	Common vetch
Vicia sepium	Bush vetch
Viola riviniana	Common dog-violet
x Cupressocyparis leylandii	Leyland cypress

Table A.4: Grassland species list.

Scientific name	Common name
Acer pseudoplatanus	Sycamore
Achillea millefolium	Yarrow
Agrostis capillaris	Common bent
Agrostis sp.	Bent
Alnus glutinosa	Alder
Anthriscus sylvestris	Cow parsley
Arrhenatherum elatius	False oat-grass
Bellis perennis	Daisy

Anthoxanthum odoratum	Sweet vernal grass
Betula pendula	Silver birch
Calystegia sepium	Hedge bindweed
Centaurea nigra	Common knapweed
Chamerion angustifolium	Rosebay willowherb
Bromus sp.	Brome
Cirsium sp.	Thistle
Cupressus sp.	Cypress
Cytisus scoparius	Common broom
Daucus carota	Wild carrot
Crocosmia x crocosmiiflora	Montbretia
Fagus sylvatica	Beech
Fraxinus excelsior	Ash
Galium aparine	Cleavers
Knautia arvensis	Field scabious
Geranium robertianum	Herb Robert
Lolium perenne	Perennial ryegrass
Molinia caerulea	Purple moor grass
Heracleum sp.hondylium	Common hogweed
Holcus lanatus	Yorkshire fog
Phleum pratense	Timothy-grass
Hypericum androsaemum	Tutsan
Plantago major	Greater plantain
Populus sp.	Poplar
Populus tremula	Asp.en
Lapsana communis	Nipplewort
Quercus robur	Pedunculate or English oak
Ranunculus repens	Creeping buttercup
Leucanthemum vulgare	Ox-eye daisy
Rumex obtusifolius	Broad leaved dock
Silene dioica	Red campion
Picea sp.	Sp.ruce
Stellaria media	Common chickweed
Taraxicum agg.	Dandelion
Pinus sylvestris	Scots pine
Trifolium pratense	Red clover
Trifolium repens	White (Dutch) clover
Ulmus procera	English elm
Plantago lanceolata	Ribwort plantain
Prunus sp.	Cherry
Vicia sp.	Vetch
Rumex crispus	Curled-leaved dock
Rumex sp.	Dock
Salix sp.	Willow
Senecio jacobea	Common ragwort
Sorbus aucuparia	Rowan
Stachys sp.	Woundwort
Betula sp.	Birch
Urtica dioica	Common nettle
Quercus rubra	Red oak
Trifolium sp.	Trefoil
Lythrum salicaria	Purple loosestrife
Abies sp.	Fir
Fagus sylvatica f. purpurea	Copper beech
x Cupressocyparis leylandii	Leyland cypress

Table A.5: Tall ruderal species list.

Scientific name	Common name
Achillea millefolium	Yarrow
Alnus glutinosa	Alder
Arrhenatherum elatius	False oat-grass
Anthoxanthum odoratum	Sweet vernal grass
Apium graveolens	Wild celery
Buddleja davidii	Butterfly bush
Calystegia sepium	Hedge bindweed
Carex pendula	Pendulous sedge
Centaurea nigra	Common knapweed
Chamerion angustifolium	Rosebay willowherb
Cirsium sp.	Thistle
Cytisus scoparius	Common broom
Dipsacus fullonum	Teasel
Epilobium hirsutum	Great willowherb
Equisetum sp.	Horsetail
Filipendula ulmaria	Meadowsweet
Fraxinus excelsior	Ash
Lolium perenne	Perennial ryegrass
Heracleum sp. *hondylium*	Common hogweed
Holcus lanatus	Yorkshire fog
Potentilla anserina	Silverweed
Rumex obtusifolius	Broad leaved dock
Ulex europaeus	Gorse
Rosa sp.	Rose
Rubus fruiticosus agg.	Bramble
Stachys sp.	Woundwort
Betula sp.	Birch
Senecio aqauticus	Marsh ragwort
Urtica dioica	Common nettle

Table A.6: Scrub species list.

Scientific name	Common name
Acer pseudoplatanus	Sycamore
Alnus glutinosa	Alder
Arrhenatherum elatius	False oat-grass
Apium graveolens	Wild celery
Buddleja davidii	Butterfly bush
Calystegia sepium	Hedge bindweed
Hebe sp.	Hebe
Fraxinus excelsior	Ash
Gallium sp.	Gallium
Hedera helix ssp. *helix*	Ivy
Holcus lanatus	Yorkshire fog
Hypericum androsaemum	Tutsan
Quercus sp.	Oak sp..
Leycesteria formosa	Himalayan honeysuckle
Pinus sylvestris	Scots pine
Ulex europaeus	Gorse
Prunus sp.	Cherry
Rosa sp.	Rose
Rubus fruiticosus agg.	Bramble
Salix caprea	Goat willow
Salix sp.	Willow
Sorbus aucuparia	Rowan

Urtica dioica	Common nettle
trifolium sp.	Trefoil
Agrostis gigantea	Black bent

Table A. 7: Ephemeral / short perennial species list.

Scientific name	Common name
Agrostis sp.	Bent
Anagallis arvensis	Scarlet pimpernel
Apium graveolens	Wild celery
Centaurea nigra	Common knapweed
Centranthus ruber	Red valerian
Chamerion angustifolium	Rosebay willowherb
Equisetum sp.	Horsetail
Fumaria officinalis	Common fumitory
Matricaria discoidea	Pineapple weed
Juncus sp.	Rush
Plantago major	Greater plantain
Rumex obtusifolius	Broad leaved dock
Trifolium pratense	Red clover
Trifolium repens	White (Dutch) clover
Tussilago farfara	Colts foot
Plantago lanceolata	Ribwort plantain
trifolium sp.	Trefoil
Epilobium hirsutum	Hairy willowherb
Euphrasia sp.	Eyebright
Alchemilla sp.	Lady's mantle

Annex D: CEDaR data request results

Appendix A – **Annex D: CEDaR data request results**

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
Accipiter nisus	Sparrowhawk	18/12/2010 - 01/01/2013	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.36 SE	Six records, potential to forage over site.
Ardea cinerea	Grey heron	25/02/2012	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.56 SSW	One record, potential to occur on site.
Asio otus	Long-eared owl	10/05/2005	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	1.92 SW	One record, usually breeds in the lowlands, often in conifers. Could potentially occur on site.
Buteo buteo	Buzzard	17/09/2011 - 06/11/2013	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.56 SSW	Two records, potential to forage over site.
Loxia curvirostra	Crossbill	13/02/2003 - 12/04/2013	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	1.26 WNW	Three records, potential to occur close to the scheme. Breeds and feeds in coniferous woodland.
Mergus merganser	Goosander	07/08/2013 - 08/12/2013	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.58 SE	Three records, unlikely to occur close to the scheme. Breeds in freshwater lakes.
Primula vulgaris	Primrose	13/04/2004 - 13/04/2005	The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 2)	0.56 NW	Three records, potential to occur on site.
Celastrina argiolus	Holly blue	05/05/2010 - 02/04/2017	The Wildlife (Northern Ireland) Order 1985 (Schedule 5)	0.16 SSE	Six records, recorded very close to the scheme and likely to occur on site.
Gonepteryx rhamni	Brimstone	Unknown	The Wildlife (Northern Ireland) Order 1985 (Schedule 5)	0.20 SW	One record very close to the scheme but the date is uncertain. This butterfly is not believed to breed in Northern.
Meles meles	Badger	04/08/1995 - 08/10/2002	The Wildlife (Northern Ireland) Order 1985 (Schedule 5)	0.57 SSE	Six records. Could occur near scheme. A previous survey identified an outlier sett nearby.
Halichoerus grypus	Grey seal	11/12/1997	The Wildlife (Northern Ireland) Order 1985 (Schedule 5), The Conservation (Nature Habitats, etc.) Regulations (Northern Ireland) - Schedule 3, Habitats Directive Annex 2 - non-priority species	1.02 SE	One record, unlikely to occur on site.
Alcedo atthis	Kingfisher	13/01/2002 - 14/01/2011	Birds Directive Annex 1, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.08 SE	Seven records, including one 0.36 SE. Potential to occur on site.
Falco peregrinus	Peregrine	30/12/2004 - 27/05/2010	Birds Directive Annex 1, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.56 SSW	Two records, potential to forage in the area.
Gavia stellata	Red-throated diver	09/12/1995 - 20/04/2017	Birds Directive Annex 1, The Wildlife (Northern Ireland) Order 1985 (Schedule	0.58 SE	23 records; potentially be present at the coast in winter not likely within the scheme area.

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
			1, part 1)		
Sterna sandvicensis	Sandwich tern	25/03/2006 - 03/10/2011	Birds Directive Annex 1, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.08 SE	Three records, unlikely to breed on the site.
Pandion haliaetus	Osprey	01/04/2010	Birds Directive Annex 1, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.56 SSW	One record, unlikely to occur in scheme area.
Circus cyaneus	Hen harrier	10/06/2015	Birds Directive Annex 1, NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	1.55 S	One record, breeds in upland areas, unlikely to be present near scheme.
Gavia arctica	Black-throated Diver	22/01/2010 - 15/11/2015	Birds Directive Annex 1, NI Priority Species	1.02 SE	Seven records; potentially present at the coast in winter not likely within the scheme area.
Branta leucopsis	Barnacle goose	28/02/2012	Birds Directive Annex 1	0.87 E	One record, unlikely to be present on site.
Egretta garzetta	Little egret	17/01/2015	Birds Directive Annex 1	0.36 SE	One record, potential to be present in the lower parts of the river.
Gavia immer	Great northern diver	30/10/1998 - 15/11/2015	Birds Directive Annex 1	0.56 SSW	24 records, could be present at the coast in winter but the scheme area would not be important for this species.
Larus melanocephalus	Mediterranean gull	02/04/1996 - 07/01/2017	Birds Directive Annex 1	0.08 SE	15 records; potentially present at the coast in winter not likely within the scheme area.
Milvus milvus	Red kite	04/03/2009 - 14/05/2017	Birds Directive Annex 1	0.56 SSW	Three records, potential to forage near scheme, but unlikely to nest.
Lutra lutra	Otter	17/08/1980 - 16/06/2010	Habitats Directive Annex 2 - non-priority species, The Conservation (Nature Habitats, etc.) Regulations (Northern Ireland) - Schedule 2, NI Priority Species	0.06 SW	Eight records. Otter have been recorded in the Shimna river.
Petromyzon marinus	Sea lamprey	19/08/2014	Habitats Directive Annex 2 - non-priority species	1.36 N	One record from the Burren River, potential to occur on site but does not appear to have been previously recorded in the Shimna.
Phocoena phocoena	Common porpoise	19/11/2010	Habitats Directive Annex 2 - non-priority species, NI Priority Species, The Conservation (Nature Habitats, etc.) Regulations (Northern Ireland) - Schedule 2	1.55 S	One record, unlikely to occur on site.
Salmo salar	Atlantic salmon	May 1970-12/07/1999	Habitats Directive Annex 2 - non-priority species, NI Priority Species, The Conservation (Nature Habitats, etc.)	0.50 SE	Six records, known to be present in Shimna River.

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
			Regulations (Northern Ireland) - Schedule 3		
Delphinus delphis	Common dolphin	10/09/2010	Habitats Directive Annex 4, NI Priority Species, The Conservation (Nature Habitats, etc.) Regulations (Northern Ireland) - Schedule 2	0.56 SSW	One record, unlikely to occur on site.
Martes martes	Pine marten	10/02/2009 - 14/07/2016	Habitats Directive Annex 5, NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 5), The Conservation (Nature Habitats, etc.) Regulations (Northern Ireland) - Schedule 4	1.42 NNW	Four records, suitable habitat present near scheme.
Cladonia portentosa	Reindeer moss	07/10/1992	Habitats Directive Annex 5	0.98 ENE	One record, unlikely to occur on site.
Rana temporaria	Common frog	19/02/1997 - 07/03/2017	Habitats Directive Annex 5	1.00 S	Four records, potential to occur near scheme.
Calidris alpina	Dunlin	23/01/2000 - 08/01/2014	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.08 SE	23 records, unlikely to make much use of the site but potential to be present in winter at the lower end of the river.
Melanitta nigra	Common scoter	09/12/1995 - 23/01/2015	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.56 SSW	26 records, could be present at the coast in winter but the scheme area would not be important for this species.
Turdus pilaris	Fieldfare	19/12/2010 - 22/12/2010	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 1)	0.36 SE	Five records, unlikely to be present near scheme. Overwinters in fields.
Aythya marila	Scaup	09/02/2002 - 19/02/2012	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 2)	0.56 SSW	Two records, potential to be present in winter at the lower end of the river.
Bucephala clangula	Goldeneye	23/12/2010 - 24/12/2010	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 1, part 2)	0.56 SSW	Two records, potential to be present in winter at the lower end of the river.
Sciurus vulgaris	Red squirrel	10/12/1982 - 28/03/2017	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 5)	0.07 NW	28 records. Has been recorded very close to the scheme.
Teesdalia nudicaulis	Shepherd's cress	1957	NI Priority Species, The Wildlife (Northern Ireland) Order 1985 (Schedule 8, part 1)	0.56 SSW	One record of the species. Unlikely to occur in the site.

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
Larus argentatus	Herring gull	30/04/2017	NI Priority Species	0.51 NE	Two records, unlikely to breed on site, could forage on the lower end of the river.
Acanthis cabaret	Lesser redpoll	20/12/2010 - 23/12/2010	NI Priority Species	0.56 SSW	Three records, potential to occur close to the scheme. Breeds in coniferous woodland and overwinters in lowland areas.
Acronicta psi	Grey dagger	04/07/2006 - 21/07/2016	NI Priority Species	0.58 SSW	55 records
Acronicta rumicis	Knotgrass	12/06/2006 - 04/06/2015	NI Priority Species	0.75 ENE	20 records, potential to occur on site, this moth is found in woodlands and gardens. The larvae feed on willow, hawthorn, bramble and plantain.
Agrochola helvola	Flounced chestnut	Unknown	NI Priority Species	0.56 SSW	One record from pre-1970, unlikely to occur on site.
Agrochola lychnidis	Beaded chestnut	01/10/2015	NI Priority Species	1.22 NE	1 record, found in a variety of habitats. Potential to occur on site. Larvae feed on grasses.
Allophyes oxyacanthae	Green-brindled Crescent	12/10/2013	NI Priority Species	1.31 NE	One record.
Anguilla anguilla	Eel	01/07/1995 - 25/09/2013	NI Priority Species	0.06 WNW	Eight records, has been recorded in the Shimna River.
Apamea remissa	Dusky brocade	12/06/2006 - 10/07/2016	NI Priority Species	0.75 ENE	81 records, found in several habitats including woodlands. Larvae feed on grasses. Potential to occur on site.
Apus apus	Swift	08/05/2011 - 04/06/2017	NI Priority Species	0.56 SSW	Three records, may forage on in the area but breeding locations would not be effected by the scheme.
Arctia caja	Garden tiger	22/07/2006 - 06/07/2016	NI Priority Species	0.75 ENE	17 records, found in various habitats and could occur near the scheme.
Aythya fuligula	Tufted duck	10/01/2011	NI Priority Species	0.58 SE	One record, unlikely to breed on site, may occur on the lower part of the river.
Branta bernicla subsp. hrota	Pale-bellied brent goose	07/03/1993 - 31/01/2014	NI Priority Species	0.56 SSW	15 records, unlikely to use site.
Calidris canutus	Knot	17/03/1994 - 08/01/2014	NI Priority Species	0.08 SE	16 records, though this has species been recorded close to the scheme area it is unlikely to be important to this species.
Caradrina morpheus	Mottled rustic	23/06/2010 - 10/07/2016	NI Priority Species	0.75 ENE	38 records, larvae feed on nettle and dandelion. Found in a variety of habitats and has potential to occur on site.
Helotropha leucostigma	Crescent	13/08/2009 - 11/08/2013	NI Priority Species	0.75 ENE	Seven records, potential to occur on site, often found in wet woodland and wetland. Larvae feed on iris, rushes and sedges.
Ceramica pisi	Broom moth	15/06/2006 - 04/07/2016	NI Priority Species	0.75 ENE	26 records, potential to occur on site. This species is found in a variety of habitats and the larvae feed on broom, gorse, bracken,

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
					bramble and other plants.
Coenonympha pamphilus	Small heath	21/05/1960 - 14/06/2015	NI Priority Species	0.98 ENE	19 records.
Cuculus canorus	Cuckoo	09/05/2011 - 23/05/2017	NI Priority Species	0.56 SSW	Nine records.
Diarsia rubi	Small Square-spot	19/08/1997 - 30/08/2016	NI Priority Species	0.75 ENE	43 records, potential to occur on site. Larvae feed on dandelion and dock.
Ecliptopera silaceata	Small phoenix	18/05/2010 - 31/08/2015	NI Priority Species	0.31 NE	Eleven records, potential to occur on site. Larvae feed on willowherbs.
Emberiza citrinella	Yellowhammer	25/12/2010	NI Priority Species	0.98 ENE	One record, unlikely to use site.
Ennomos quercinaria	August thorn	19/08/1997 - 09/10/2015	NI Priority Species	0.75 ENE	Four records, potential to occur near scheme. Larvae feed on oak, beech, birch and hawthorn.
Entephria caesiata	Grey mountain moth	1941	NI Priority Species	0.56 SSW	One record, an upland species so unlikely to be present on site.
Erinaceus europaeus	Hedgehog	04/08/1995 - 01/10/2013	NI Priority Species	0.29 SE	Ten records, including from 0.46 N, 0.47 E, 0.53 ESE of the scheme. Potential to occur near the scheme.
Eugnorisma glareosa	Autumnal rustic	19/09/2016	NI Priority Species	1.22 NE	One record, a species of woodland, bogs and heaths. The larvae feed on a wide variety of plants. Potential to occur on site.
Graphiphora augur	Double dart	30/06/2012 - 11/07/2015	NI Priority Species	0.75 ENE	Twelve records
Hepialus humuli	Ghost moth	27/06/2006 - 21/07/2012	NI Priority Species	0.75 ENE	Seven records.
Hipparchia semele	Grayling	04/09/1994	NI Priority Species	0.98 ENE	One record, this butterfly is usually found on heaths and sand dunes. Its larvae feed on fescues. It is unlikely to occur on site.
Hoplodrina blanda	Rustic	22/07/2006 - 11/07/2015	NI Priority Species	0.75 ENE	25 records, potential to occur in the area. This moth is found in a variety of habitats. Its larvae feed on plantains and docks.
Hydraecia micacea	Rosy rustic	08/08/2010 - 02/09/2016	NI Priority Species	0.75 ENE	33 records, potential to occur on site. Larvae feed on a variety of herbaceous plants.
Lasiommata megera	Wall	04/09/1994	NI Priority Species	0.98 ENE	One record, unlikely to occur on site, has declined severely in Northern Ireland. Larvae feed on a variety of grasses.
Leucania comma	Shoulder-striped Wainscot	01/06/2014 - 21/06/2016	NI Priority Species	0.75 ENE	Ten records, potential to occur in scheme area. Larvae feed on cock's-foot.
Limax	Ash-grey slug	20/09/1975	NI Priority Species	1.45 S	One record, a species recorded in old woodland, potential to occur

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
cinereoniger					on site.
Litoligia literosa	Rosy minor	25/07/2014 - 26/07/2014	NI Priority Species	0.75 ENE	Two records, potential to occur on site, larvae feed on grasses.
Mniotype adusta	Dark brocade	11/06/2016	NI Priority Species	0.75 ENE	One record, potentially could occur near scheme, as found in wet woodlands and larvae feed on grass.
Orthonama vittata	Oblique carpet	06/06/2010	NI Priority Species	1.15 NE	One record, unlikely to occur on site, mostly a species of bog and marshland.
Orthosia gracilis	Powdered quaker	18/04/2010 - 29/04/2014	NI Priority Species	0.75 ENE	Three records, potential to occur near scheme. Larvae feed on oak and willow.
Passer domesticus	House sparrow	23/12/2002 - 23/05/2016	NI Priority Species	0.56 SSW	Three records, scheme area unlikely to be important to this species.
Passer montanus	Tree sparrow	20/12/2010	NI Priority Species	0.56 SSW	One record, limited potential to occur in area.
Pyrrhula pyrrhula	Bullfinch	17/12/2010 - 25/01/2011	NI Priority Species	0.56 SSW	Two records, potential to occur near the scheme.
Racomitrium canescens	Hoary Fringe-moss	August 1921- 12/05/1991	NI Priority Species	0.56 SSW	Three records, this is a lichen mostly recorded from sand dunes such as nearby Murlough. Unlikely to occur on site.
Salmo trutta	Trout	1970 - 2014	NI Priority Species	0.24 WNW	Four records, known to be present in the Shimna River
Scotopteryx chenopodiata	Shaded Broad-bar	02/08/2008 - 05/08/2016	NI Priority Species	0.75 ENE	Six records, this moth can be found by woodland edges and gardens. Its larvae feed on clovers and vetches. Potential to occur near scheme.
Spermodea lamellata	Plated snail	04/04/1975	NI Priority Species	1.35 S	One record, a woodland species, potential to occur in the scheme area.
Spilosoma lubricipeda	White ermine	12/06/2006 - 13/06/2016	NI Priority Species	0.75 ENE	57 records, likely to occur near scheme, feeds on variety of garden and wild plants
Spilosoma lutea	Buff ermine	31/05/2014 - 30/07/2016	NI Priority Species	0.75 ENE	61 records, potential to occur on site, feeds on a wide variety of herbaceous plants.
Stercorarius parasiticus	Arctic skua	13/08/1993 - 19/08/2011	NI Priority Species	0.87 E	Two records, unlikely to occur on site.
Tyria jacobaeae	Cinnabar	25/07/1999 - 14/06/2015	NI Priority Species	0.67 NE	40 records, likely to occur on site.
Vicia lathyroides	Spring vetch	07/10/1992	NI Priority Species	0.98 ENE	Two records, occur in Northern Ireland mostly found in sand dunes. Unlikley to occur on site
Xanthorhoe	Dark-barred	11/08/2009 -	NI Priority Species	0.75 ENE	Two records, larvae feed on dock and bedstraws and are found in a

Scientific name	Common name	Date	Designation	Closest distance (km) and direction	Association with the site
ferrugata	Twin-spot Carpet	12/08/2011			variety of habitats. Potential to occur on site.
Tholera cespitis	Hedge rustic	19/08/2012 - 28/08/2016	NI Priority Species	0.75 ENE	Five records, this moth is found in grassy habitats in coastal areas. Potential to occur on site.
Tringa totanus	Redshank	20/09/2008 - 06/08/2016	NI Priority Species	0.56 SSW	32 records, unlikely to occur in scheme area.
Turdus iliacus	Redwing	12/12/2010 - 05/02/2011	NI Priority Species	0.36 SE	16 records, unlikely to occur in area.
Turdus philomelos	Song thrush	24/11/2013	NI Priority Species	0.17 ESE	One record, potential to occur near the scheme.
Sturnus vulgaris	Starling	27/12/1995 - 18/07/2017	NI Priority Species	0.47 E	Eight records, potential to occur near the scheme.

Appendix 14: Geology & Soils

Annex A: Ground Investigation Report (2018)

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Shimna Flood Alleviation Scheme – Ground Investigation

Client:	Department for Infrastructure - Rivers
Client's Representative:	Aecom
Report No.:	18-0143
Date:	May 2018
Status:	Final for issue

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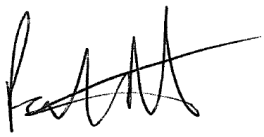
CONTENTS

APPENDICES

Document Control Sheet

Report No.:		18-0143			
Project Title:		Shimna Flood Alleviation Scheme			
Client:		Department for Infrastructure - Rivers			
Client's Representative:		Aecom			
Revision:	A01	**Status:**	Final for issue	**Issue Date:**	29 May 2018
Prepared by:		**Reviewed by:**		**Approved by:**	
 Paul McNamara BEng MICE		 Matthew Gilbert MEarthSci FGS		 Paul Dunlop BEng PhD CEng	

The works were conducted in accordance with:

UK Specification for Ground Investigation 2nd Edition, published by ICE Publishing (2012)

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377-2:1990, BS EN ISO 17892-1:2014, and BS EN ISO 17892-2:2014

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
Abbreviations relating to rock core – reference Clause 44.4.4 of BS 5930: 2015	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.

Shimna Flood Alleviation Scheme

1 AUTHORITY

On the instructions of Aecom Consulting Engineers, ("the Client's Representative"), acting on the behalf of Department for Infrastructure - Rivers ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed flood alleviation scheme along Shimna River in Newcastle.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes, trial pits, slit trenches, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted adjacent to Shimna River in Newcastle Co. Down. The site is generally overgrown with woodland along the river banks consisting of mature trees and saplings, heavy undergrowth, bushes, brambles and rough grassland.

At the eastern end of the site the area opens up to Islands Park on the north river bank and a mini-golf course to the south river bank linked by a pedestrian footbridge. Towards the west of the site a forest plantation is located to the west of Bryansford Road. Adjacent land use is mainly residential properties and recreational areas.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 6th and 30th March 2018, comprised:

- seven cable percussion boreholes
- seven cable percussion boreholes with rotary follow-on drilling
- three boreholes by dynamic (windowless) sampling methods with rotary drilling at one location and dynamic probe follow on at two locations
- a standpipe installation in five boreholes
- eight machine dug slit trenches

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

A total of seventeen boreholes were put down in a minimum diameter of 150mm through soils and rock strata to their completion depths by a combination of methods, including light percussion boring using Dando Terrier rigs, light cable percussion boring by Dando 2000 and 3000 rigs, and rotary drilling (by Comacchio 205 tracked rotary drilling rigs).

The borehole logs state the methodology and plant used for each location, as well as the appropriate depth ranges.

A summary of the boreholes, subdivided by category in accordance with the methods employed for their completion, is presented in the following sub-sections.

4.2.1 Cable percussion boreholes

Seven boreholes (BH101 to BH104, BH106, BH113, and BH115) were put down to completion in minimum 200mm diameter using Dando 2000 and Dando 3000 cable percussion boring rigs. All boreholes were

terminated either at their scheduled completion depths, or else on encountering virtual refusal on obstructions, including large boulders and weathered bedrock.

Hand dug inspection pits were carried out between ground level and 1.2m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within cohesive soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals using the split spoon sampler (SPT(s)) or solid cone attachment (SPT(c)). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix H.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Appendix B presents the borehole logs.

4.2.2 Boreholes by combined percussion boring and rotary follow-on drilling

Seven boreholes (BH105, BH107, BH108, BH114, BH116, BH117 and BH118) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques with core recovery in bedrock. Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

Hand dug inspection pits were carried out between ground level and 1.2m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals throughout the overburden using the split spoon sampler (SPT(s)) or solid cone attachment (SPT(c)). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix H.

The core was extracted in up to 1.5m lengths using a metric T2-101 core barrel, which produced core of nominal 84mm diameter, and was placed in triple channel wooden core boxes.

Appendix B presents the borehole logs, with core photographs presented in Appendix C.

4.2.3 Dynamic sampled boreholes

Three boreholes (BH109 to BH111) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

Hand dug inspection pits were carried out between ground level and 1.0-1.2m depth to ensure boreholes were put down clear of services or subsurface obstructions. The boreholes were taken to depths ranging between 2.45m and 7.00m by cased full-hole drilling to 10.00m.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals using the split spoon sampler (SPT(s)) or solid cone attachment (SPT(c)). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The *N*-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix H.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by the Client's Representative. Undisturbed (U100) samples were taken as appropriate within cohesive strata.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Details of the water strikes are presented on the individual borehole logs.

Appendix B presents the borehole logs.

4.3 Dynamic probes

Two dynamic probes were conducted as a follow on from two boreholes (BH109 and BH111) using the DPSHB method as described in BSEN ISO 22476-2. The method entails a 63.5kg hammer falling 0.75m onto a 90° cone of 50.5mm diameter.

Appendix B provides the dynamic probe logs on the sheet following the relevant borehole log in the form of plots, against depth, of the number of blows per 100mm penetration.

4.4 Standpipe installations

A groundwater monitoring standpipe was installed in boreholes BH101, BH104, BH106, BH108 and BH116.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.5 Slit trenches

Eight slit trenches (ST01 – ST08) were excavated using a combination of hand digging and mechanical excavation using a compact 3t tracked excavator fitted with a 600mm wide toothless bucket, to locate and identify buried services at the site. Slit trench logs are presented in Appendix D.

Drawing of the trenches and the locations of services encountered during excavation are shown on the slit trench logs in Appendix E, with photographs presented in Appendix F.

4.6 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish National Grid and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **soil chemistry:** pH and water soluble sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute (1990) *BS 1377:1990, Methods of test for soils for civil engineering purposes. Parts 1 to 9.*

The test results are presented in Appendix G.

5.2 Environmental laboratory testing of soils

Environmental testing, as specified by the Client's Representative was conducted on selected environmental soil samples by Chemtest at its laboratory in Newmarket, Suffolk.

Testing was carried out for a range of determinants, including:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cyanides
- Asbestos screen
- pH

Results of environmental laboratory testing are presented in Appendix H.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise alluvial and raised beach deposits. These deposits are underlain by greywacke, siltstone and mudstone of the Hawick Group.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Paved surface:** boreholes BH114 & BH115 and ST101 to ST103 encountered macadam surfacing, in depths ranging from 0.10m to 0.20m.

- **Topsoil:** encountered typically in 300mm thickness across much of the site.

- **Made Ground (sub-base):** Aggregate fill beneath the paved surface in all area ranging in thickness from 0.30m to 1.45m.

- **Made Ground (fill):** encountered throughout the investigation in several areas ranging from silty sandy gravel with fragments of pipe and glass in BH101 to a silty fine to coarse sand in ST06. A reworked clay fill was also encountered in ST08.

- **Alluvial/Beach deposits:** typically medium dense to dense sands and gravels together with soft to firm silt and clay.

- **Bedrock (Greywacke, Mudstone & Siltstone):** Rockhead was encountered at depths ranging from 3.60m in BH108 to about 8.30m in borehole BH116.

6.3 Groundwater

Groundwater was encountered throughout the investigation during percussion boring through soil as water strikes. Water strikes were encountered at depths ranging from 2.30m to 9.80m. Several boreholes encountered multiple water strikes. Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any groundwater strikes encountered and the possibility of encountering groundwater during excavation works should not be ruled out. It should also be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium. Seasonal variation in groundwater levels should also be factored into design considerations.

7 REFERENCES

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1: 2002: Geotechnical investigation and testing - Identification and classification of soil. Part 1 Identification and description. British Standards Institution.

BS EN ISO 14688-2:2004+A1:2013: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.