

Cork County Council/Office of
Public Works

**Glashaboy River
(Glanmire/Sallybrook) Flood
Relief Scheme**

Environmental assessment of the
flood risk management options

234334-00/Report/01

Issue 1 | 28 November 2016

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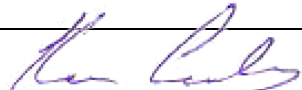
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Contents

	Page
1 Introduction	1
2 Summary of key environmental constraints	2
3 Proposed flood alleviation measures	4
3.1 Shortlisted options	4
4 Potential environmental impacts of shortlisted options	9
4.1 Terrestrial and aquatic ecology	9
4.2 Archaeology, Architectural and Cultural Heritage	46
4.3 Soils, Geology and Hydrogeology	52
4.4 Other environmental considerations	52
4.5 Cumulative impacts	53
5 Conclusions and recommendations	54

Tables

Table 1:	Key environmental constraints of the flood relief scheme
Table 2:	Flood alleviation measures – options for each area considered
Table 3:	Potential impacts on ecological receptors relevant to Option 1A
Table 4:	Potential impacts on ecological receptors relevant to Option 2A
Table 5:	Potential impacts on ecological receptors relevant to Option 2B
Table 6:	Potential impacts on ecological receptors relevant to Option 2C
Table 7:	Potential impacts on ecological receptors relevant to Option 2D
Table 8:	Potential impacts on ecological receptors relevant to Option 2E
Table 9:	Potential impacts on ecological receptors relevant to Option 2F
Table 10:	Potential impacts on ecological receptors relevant to Option 3A
Table 11:	Potential impacts on ecological receptors relevant to Options 4.1A and 4.1.B
Table 12:	Potential impacts on ecological receptors relevant to Options 4.2A and 4.2B
Table 13:	Potential impacts on ecological receptors relevant to Options 5A and 5B
Table 14:	Ecological Assessment of Options
Table 15:	Potential archaeological, architectural and cultural heritage Impacts relevant to Option 1A
Table 16:	Potential archaeological, architectural and cultural heritage Impacts relevant to Options 2A-F
Table 17:	Potential archaeological, architectural and cultural heritage Impacts relevant to Option 3

Table 18: Potential archaeological, architectural and cultural heritage
Impacts relevant in Area 4.1 and 4.2

Table 19: Potential archaeological, architectural and cultural heritage
Impacts relevant to Area 5

Table 20: Potential archaeological, architectural and cultural heritage
Impacts relevant to Area 6.

1 Introduction

The Office of Public Works (OPW) in partnership with both Cork City and Cork County Councils have recognised the high levels of existing flood risk in the River Lee Catchment and have carried out a Catchment Flood Risk Assessment and Management (CFRAM) Study for the Lee Catchment, which includes the Glashaboy River catchment. The Draft Catchment Flood Risk Management Plan, which was published in February 2010, had identified a preferred option for the alleviation of flood risk in the Glashaboy catchment.

During June 2012, significant flooding occurred in the Glanmire and Sallybrook areas in Cork. In response, Cork County Council, acting as Agents for the OPW, commissioned Arup in association with JBA Consulting to develop a Flood Relief Scheme for the Glanmire/Sallybrook areas. The scheme will be designed to provide protection to properties in the study area from the 1 in 100 year fluvial / 1 in 200 year tidal flood events.

A number of different flood alleviation options have been developed for the Glanmire/Sallybrook Flood Relief Scheme. The potential environmental impacts of the flood alleviation options have been assessed with a view to informing the selection of the preferred option. Where appropriate, relevant mitigation measures have been suggested and the preferred options identified.

This report should be read in conjunction with both the Environmental Constraints Report and the Glashaboy Options Report which provides full details of each of the flood relief options considered and presents the economic and multi-criteria assessments, which allows a preferred flood relief option to be selected.

2 Summary of key environmental constraints

A comprehensive analysis of the environmental constraints associated with the Glashaboy River (Glanmire/Sallybrook) Flood Relief Scheme was undertaken in advance of the Options Assessment and was used to inform the development of the flood alleviation options. Environmental issues that could either be affected by possible flood alleviation measures, or issues that could constrain the viability or design of these measures are described in the Environmental Constraints Report.

Table 1 below summarises the key environmental constraints associated with the Scheme.

Table 1: Key environmental constraints of the flood relief scheme

Category	Constraints
Human beings	- Primary and post-primary schools in the area - Residential and commercial properties - Drinking water supplies from The Butlerstown River (tributary of Glashaboy River) - Sports facilities and amenities such as riverside walks - Zoning objectives Cork County Development Plan 2014, the Blarney Electoral Local Area Plan 2015
Ecology (Terrestrial and aquatic)	- European Designated Sites: Cork Harbour SPA (code 004030) and Great Island Channel cSAC (code 001058) - Natural Heritage Areas: Glanmire Wood pNHA (code 1054); Dunkettle Shore pNHA (code 1082); Douglas River Estuary pNHA (code 1046); and Great Island Channel pNHA (code 1058) - Protected and notable species: otter, badger, bats, kingfisher, egret, whooper swan, and numerous Red List Birds of Conservation Concern according to Birdwatch Ireland - Intertidal Habitats - Riverine corridors and nesting habitats for breeding birds - Invasive species, such as Japanese Knotweed along certain areas of the river
Water	- Consideration of potential impact on the yields of existing groundwater abstractions from the study area, groundwater bodies and aquifer vulnerability - Objectives of the South Western Region River Basin Management Plan - Drinking water protected areas such as Glanmire Town - Nutrient sensitive area – Lee Estuary and Lough Mahon area
Soils, Geology and Hydrogeology	It is recommended that a geotechnical investigation be carried out when the preferred flood alleviation measures to inform the design.
Archaeology, Architectural and Cultural Heritage	- Two sites listed in the Register of Historic Monuments, both ringforts; one in Killalough (CO064-004) and the other in Whitechurch (CO063-015). - Ninety-five archaeological sites considered to be of regional importance - Thirty-five buildings and structures listed on the Record of Protected Structures

Category	Constraints
	Three areas of archaeological potential (Glashaboy River and two tributaries, Butlerstown River and Glenmore River)
Landscape	- The riparian wooded corridors along the rivers provide both screening to residents and are of amenity value in the suburb areas of Glanmire, Riverstown and Sallybrook. - Large houses such as Dunkettle House and historic infrastructures such as the bridge at Riverstown define the landscape character of the study area
Noise, Air Quality and Climate	Noise/vibration sensitive receptors located in proximity to works associated with the flood relief scheme – including commercial, residential, educational and others
Material Assets	- Utilities: the location of the existing watermains and underground services in the vicinity - Water: locations of abstractions of drinking water supplies should be ascertained and protected - Roads: impacts on the existing road infrastructure due to works are to be discussed with relevant authorities (Transport Infrastructure Ireland (TII) (formerly NRA) and Cork County Council) - Waste Management: the scheme should ensure that any waste produced can be correctly disposed of.

The Environmental Constraints Report addressed these constraints in detail and should be consulted for further information if necessary.

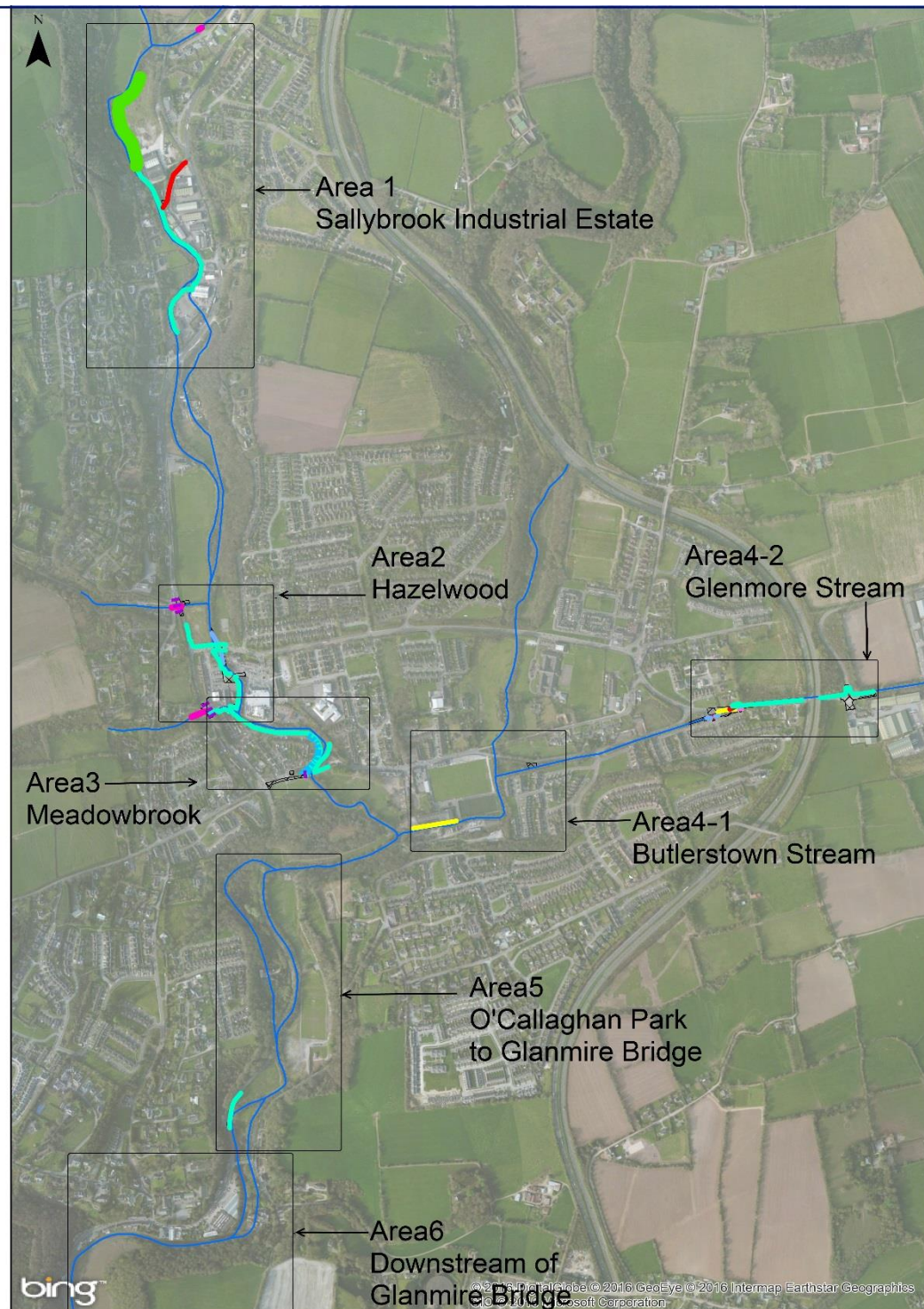
3 Proposed flood alleviation measures

3.1 Shortlisted options

The design of the flood relief scheme assessed all viable flood alleviation options for the study area. The study area was divided into 6 distinct geographical areas which were analysed in turn. Each of the possible flood alleviation options for each area was assessed in detail in the Glashaboy Options Report.

The study area for the scheme is depicted below in Figure 1.

Figure 1: Key plan of scheme areas



The shortlisted flood defence options for the six geographical areas have been developed as follows:

Table 2: Flood alleviation measures – options for each area considered

Area	Location	Option	Proposed Works
1	Sallybrook Industrial Estate	1A	Direct Defences with conveyance improvements at Bleach Hill Stream. Flood defence walls (ranging from 0.6 - 1.1m high above ground levels including 0.5m freeboard) to be constructed on the left bank approximately 600m in length from upstream of Sallybrook House to Sallybrook Bridge. Embankment formalisation to occur. A small existing channel will be culverted.
2	Hazelwood Shopping Centre	2A	Direct Defences (with conveyance improvements on Cois na Gleann Stream). Flood defence wall to be constructed on the line of existing boundary wall immediately upstream of Hazelwood Avenue Bridge. Works will be required to strengthen Hazelwood Avenue Bridge to resist water surcharge forces in the design flood event. Existing culverts will be replaced.
		2B	Conveyance improvements (Dredging). Channel dredging and underpinning of structures will be required. This will reduce river bed elevation by dredging (depth of dredging 1.2m – 1.4m).
		2C	Combination (Direct Defences and Conveyance) Arrangement 1. Replacement of existing bridges with wider bridges. Construction of defence walls along both banks for a length of 80m. Underpinning/strengthening of existing shopping centre bridge will be required. Part of the existing embankment will be removed and reconstructed. Existing culverts will be replaced.
		2D	Combination (Direct Defences and Conveyance) Arrangement 2. Replacement of existing bridges with wider bridges. Construction of defence walls along both banks for a length of 80m. Underpinning/strengthening of existing shopping centre bridge will be required. Part of the existing embankment will be removed and reconstructed. Existing culverts will be replaced.
		2E	Combination (Direct Defences and Conveyance) Arrangement 3. New flood relief culvert to be constructed on eastern side of stream. Construction of defence walls along both banks for a length of 80m. Hazelwood shopping centre bridge to be removed and replaced with an elevated footbridge. Part of the existing embankment will be removed and reconstructed. Existing culverts will be replaced.
		2F	Combination (Direct Defences and Conveyance) Arrangement 4. New flood relief culvert to be constructed on eastern side of stream.

Area	Location	Option	Proposed Works
			Construction of defence walls along both banks for a length of 80m. Hazelwood shopping centre bridge to be removed and replaced with an elevated footbridge. Regrading of the road on either side of the bridge. Part of the existing embankment will be removed and reconstructed. Existing culverts will be replaced.
3	Meadowbrook	3A	Direct Defences (with conveyance improvements on Springmount Stream). Existing flood walls to be replaced. New flood walls to be built above road level. Conveyance improvement to Riverstown Bridge and regrading of the existing footpath on the eastern bridge. Replacement of existing culverts.
4	Butlerstown	4.1A	Conveyance Improvements. A new flood relief culvert to be constructed at Butlerstown and Coppervalley Bridge to be cleared of silt and debris.
		4.1B	Direct Defences. New 150m long flood defence embankment along the road and the line of the local access road, which is to be reinstated along the embankment.
		4.1C	Overland flow management. Removal/ alteration to boundary wall at Lidl to maintain existing overland flood flow route.
	Glenmore	4.2A	Overland flow management. Installation of new rectangular flood relief culverts at the Butlerstown Stream. Brooklodge Grove Bridge to be cleared of silt and debris. The Brooklodge Grove Bridge will be allowed to overtop in the design flood event and local ramps and defence embankments to manage overland flood flow.
		4.2B	Conveyance Improvements. Replacement of Brooklodge Grove culvert and Copper Valley Vue culvert with 10m wide clear span culverts, as well as local stream widening and clear out.
5	O'Callaghan Park - Glanmire Bridge	5A	Direct Defences – The Grove and IPP at St. Patrick's Mills. New 100m long flood defence at The Grove. Individual Property Protection measures, approximately 0.6m high, to be installed locally around the residence building at St. Patrick Mills. Non-return valves on drainage lines and ducts to be installed.
		5B	Direct Defences only. This option consist of the same direct defences measures as Option 5A but without the IPP measures at St Patricks Mills.
6	Downstream Glanmire Bridge	6A	¹ IPP for a residential property “The Fountains”

¹ At the time of carrying out the environmental assessment of the options, IPP was considered at The Fountains only in Area 6. Subsequently, IPP was also considered at a derelict property at Barrys Terrace and was therefore not initially included in the environmental assessment. IPP at the

A description of the works associated with each of the aforementioned flood defence options considered is presented in more detail in the Glashaboy Options Report. Please refer to Section 4 of the Glashaboy Options Report for further information.

Barrys Terrace property was subsequently ruled out for other reasons. Refer to the options report for further details.

4 Potential environmental impacts of shortlisted options

A detailed multi-criteria analysis (MCA) of the shortlisted options was carried out in 2015. This was reviewed and updated in November 2016 to take account of revised Options and is discussed and presented in Section 6 of the Glashaboy Options Report. The flood risk management options considered in the MCA included environmental objectives.

The main environmental objectives listed in the MCA included the protection of ecology and archaeological, architectural and cultural heritage. Other environmental objectives included consideration of landscape character, visual amenity, water quality and social objectives.

Each objective was weighted to reflect their importance and/or sensitivity, and to ensure that the objectives most relevant to the location under consideration were given priority in the decision-making process. Refer to Section 7 of the Glashaboy Options Report for full details.

The main potential environmental impacts arising from each of the shortlisted flood defence options are discussed under the following headings:

- Terrestrial and aquatic ecology
- Archaeology, Architectural and Cultural Heritage
- Soils, Geology and Hydrogeology
- Human Beings

4.1 Terrestrial and aquatic ecology

4.1.1 Area 1: Sallybrook Industrial Estate

4.1.1.1 Option 1A: Direct defences with conveyance improvements at Bleach Hill Stream

The potential terrestrial and aquatic impacts of this option are given in **Table 3**. The impacts in relation to the relevant environmental objectives covered in the MCA are summarised as follows.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed measures for Sallybrook Option 1A for the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited.

It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. Operational impacts include the impacts on water flows, fish passage, fisheries and aquatic invertebrates that may indirectly impact on bird species of Cork Harbour SPA. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The potential impacts on the Natura 2000 sites will be assessed in detail in the Screening for Appropriate Assessment of the preferred scheme.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Sallybrook. The main impacts relate to the defence walls and the exclusion of the mill race and its associated species and habitat which is likely to be an important wildlife corridor in an urban setting. This measure will also result in the removal of some riparian edges along the Glashaboy which are likely to be important to species such as Otter and bats. There is also potential for pollution/sediment release locally to the river, disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option may impact on river flows due to flood defences and these may affect fisheries habitat. The potential to affect some fish species passage through the Mill Race cannot be excluded. The potential spread of Japanese Knotweed may also impact on fisheries through increased sediment release due to bank erosion when the weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries.

Table 3: Potential impacts on ecological receptors relevant to Option 1A

Options	Impacts		Ecological Sensitive Receptors			
1A Sallybrook Industrial Estate	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Flood Defence Walls (0.8 -1m)	Pollution Disturbance	Habitat Loss (Riparian) Species loss (Mill race) Habitat Fragmentation (Mill race and River) Alterations to river flows and habitat and species Spread of Invasive Species Japanese Knotweed (JKW)	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Embankment	Pollution Disturbance	Opportunity to create riparian edge habitat along embankment Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
Channel Culvert	Pollution	Habitat Loss Habitat Fragmentation Restriction to Fish Passage	Otter Fish species Riparian Birds	Otter Salmon Lamprey	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA
Control Measures - non return valves		Spread of Invasive Species JKW	Riparian Habitat	Eel Kingfisher Bats		Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.2 Area 2: Hazelwood Shopping Centre

4.1.2.1 Option 2A: Direct Defences with conveyance improvements in Cois na Gleann Stream.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on Natura 2000 sites, the Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed Hazelwood Option 2A for the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. Operational impacts include the impacts on fisheries and aquatic invertebrates that may indirectly impact on bird species of Cork Harbour SPA. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The potential impacts on the Natura 2000 sites will be assessed in detail in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Hazelwood 2A due to the defence walls at Hazelwood Shopping Centre south of Hazelwood Bridge. There is also potential for pollution/sediment release locally to the river, disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may also impact on fisheries through increased sediment release due to bank erosion when the weed dies off in winter.

Consultation with Inland Fisheries has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries. However, this option is not considered to have as significant an effect on fisheries as the dredging option at Hazelwood (2B).

Table 4: Potential impacts on ecological receptors relevant to Option 2A

Options	Impacts		Ecological Sensitive Receptors			
	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
2A Direct Defences with conveyance improvements in Cois na Gleann Stream						
Flood Defence Walls	Pollution Disturbance	Small Habitat Loss (Riparian) Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Embankment	Pollution Disturbance	Opportunity to create riparian edge habitat along embankment Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species	Otter Salmon	Cork Harbour SPA - Birds and supporting wetlands	Glanmire Wood pNHA Dunkettle Shore pNHA

Options	Impacts		Ecological Sensitive Receptors			
			Riparian Birds Riparian Habitat	Lamprey Eel Kingfisher	Great Island Channel cSAC	Douglas River Estuary pNHA Great Island Channel pNHA

4.1.2.2 Option 2B - Conveyance improvements (Dredging).

The potential impacts of this option are given in **Table 5**. The relevant environmental objectives covered in the MCA are summarised here.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed measures for Hazelwood Option 2B for the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream as a result of dredging and through channel alterations, habitat loss and impact on species also. This will then have indirect impacts on the birds of the SPA. The possible need for on-going maintenance will also have long-term impacts for the river and the SPA. Given the current Good ecological status of the Glashaboy downstream of Hazelwood and the importance of the river for fisheries, and for the birds of the SPA, impacts of dredging are outlined further here.

Typical impacts of dredging on fish

- Substrate removal will inevitably affect spawning, which takes place in gravel substrates, and juvenile fish which inhabit the substrate.
- Substrate siltation is the settling of fine sediment on to the substrate. This is known to affect the spawning, incubation and emergence of some species of fish, such as salmonids. Fine sediment can reduce the suitability of gravels for spawning and as a habitat for young fish by:
 - Reducing the intergravel flow and therefore the oxygen supply, and increasing the temperature in the gravel; the lower lethal temperature for trout (*Salmo trutta*) incubation is about 1.4°C, and the upper limit is 15-16°C;
 - Infilling the interstitial spaces and thus trapping eggs and young fish; and
 - Reducing cover and food source for mature fish; females may be prevented from digging a redd and laying eggs.

Suspended sediment in the water affects the respiratory system of fish. Growth may also be affected since food supply and feeding success are reduced in the turbid conditions. Trout have been found to have a lower resistance to disease in high suspended sediment concentrations. The varying nature and size of the suspended sediment, along with the sensitivity of different species, mean that impacts are also varied; salmonids are more susceptible than coarse fish, for example.

Increased turbidity reduces light penetration and therefore primary productivity, which has a knock-on effect throughout the food chain. Most fish species will migrate under increased turbidity conditions and many will have a reduced capacity to find and capture prey

Channel morphology alteration can have a number of impacts on local fish populations:

- Disturbance of bank vegetation or the substrate removes cover and shade; this makes fish more susceptible to predators, and increases light penetration and hence water temperature, which will cause fish to migrate;
- Loss of redd sites in gravel substrates; these are required by salmonids, in particular, and are usually situated at the upstream end of riffles/downstream end of pools, where there is a downward movement of water; and
- Reduction in areas of shelter from high velocity flows.

Impacts of dredging on Macroinvertebrates

Substrate siltation. Species such as mayflies (*Ephemeroptera*), caddisflies (*Trichoptera*) and stoneflies (*Plecoptera*) are adapted to live in crevices beneath and between stones, particularly in riffle areas. The presence of silt on stones is capable of reducing invertebrate abundances for prolonged periods. The major impacts of siltation are to increase species mortality and to alter community structure by:

- Blocking interstitial spaces, causing oxygen-depletion and hence species mortality;
- Coating stones and thereby reducing the number of attachment points for larvae and reducing their feeding success;
- Allowing benthic species, such as chironomids, to survive in preference to attachment species, such as ephemeroptera;
- Reducing interstitial volume available to invertebrates.
- Increases in suspended sediment and turbidity will:
- Reduce primary productivity, thus reducing the amount of energy available to macroinvertebrates and organisms higher up the food chain;
- Tend to induce invertebrate drift, thus reducing instream benthos populations in the dredged reach and possibly also downstream; and
- Clog the food filtering and trapping apparatus of stream insects, for example black-flies (*simuliidae*).

There is limited information on the physical habitat requirements of macro invertebrates, but shallower water depth will favour some species due to the associated increase in temperature.

The potential to impact on the Natura 2000 sites may also occur through the temporary impacts of pollution downstream during dredging. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works for access etc.

The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed dredging. Reduced primary productivity and reduced invertebrate and fish populations can affect local mammal and bird populations which rely on these sources of food. There is also potential for pollution/sediment release locally to the river, disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option is likely to significantly affect river habitats, flows and fisheries. The potential spread of Japanese Knotweed may also impact on fisheries through increased sediment release due to bank erosion when the weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries. However, Inland Fisheries commented that this option is not a desirable option and alternative options should be considered in its place.

Table 5: Potential impacts on ecological receptors relevant to Option 2B

Options	Impacts		Ecological Sensitive Receptors			
Option 2B Conveyance Improvements (Dredging)	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Dredging	Pollution Disturbance	Instream Habitat and Species Loss Changes to water flows Recurring disturbance due to maintenance Sediment Release Spread of Invasive Species JKW	Fish species Aquatic Invertebrates River bed and associated habitats	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.2.3 Option 2C - Combination (Direct Defences and Conveyance) Arrangement 1

The potential ecological impacts of this option are given in **Table 6**. The relevant environmental objectives covered in the MCA are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed measures for Option 2C Hazelwood of the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Hazelwood 2C due to the defence walls at Hazelwood Shopping Centre south of Hazelwood Bridge that may cause fragmentation of the riparian habitat and wildlife corridor in this very built up area. There is also potential for pollution/sediment release locally to the river during the bridge widening works which will include the widening of the channel above low flow levels. There may also be disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may also impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries. However, this option is not considered to have a significant effect on fisheries as the dredging option at Hazelwood (2B).

Table 6: Potential impacts on ecological receptors relevant to Option 2C

Options	Impacts		Ecological Sensitive Receptors			
Option 2C Combination (Direct Defences and Conveyance) Arrangement 1	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Flood Defence Walls	Pollution Disturbance	Small Habitat Loss (Riparian) Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Bridge Widening and Road Raise	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
Embankment	Pollution Disturbance	Opportunity to create riparian edge habitat along embankment Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.2.4 Option 2D - Combination (Direct Defences and Conveyance) Arrangement 2

The potential ecological impacts of this option are given in Table 7. The relevant environmental objectives covered in the MCA are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed options for Option 2D Hazelwood of the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works. The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Hazelwood 2D due to the defence walls at Hazelwood Shopping Centre south of Hazelwood Bridge that may cause fragmentation of the riparian habitat and wildlife corridor in this very built up area. However, the provision of a side channel and flood relief culvert would help to provide access under the road and through the area with the exception of during very high floods. There is also potential for pollution/sediment release locally to the river during the excavation of a new channel. There may also be disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries. IFI has indicated that this is not a favoured option. However, this option is not considered to have as a significant effect on fisheries as the dredging option at Hazelwood (2B).

Table 7: Potential impacts on ecological receptors relevant to Option 2D

Options	Impacts		Ecological Sensitive Receptors			
Option 2D Combination (Direct Defences and Conveyance) Arrangement 2	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Flood Defence Walls	Pollution Disturbance	Small Habitat Loss (Riparian) Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Embankment	Pollution Disturbance	Opportunity to create riparian edge habitat along embankment Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
New Flood Relief Culvert and Channel	Pollution Disturbance	Opportunity to create riparian edge habitat And mitigates caused by flood walls habitat fragmentation Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.2.5 Option 2E - Combination (Direct Defences and Conveyance) Arrangement 3

The potential impacts of this option are given in Table 8. The relevant environmental objectives covered in the MCA are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed options for Option 2E Hazelwood of the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works. The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Hazelwood 2E due to the defence walls at Hazelwood Shopping Centre south of Hazelwood Bridge that may cause fragmentation of the riparian habitat and wildlife corridor in this very built up area. However, the provision of a side channel and flood relief culvert would help to provide access under the road and through the area with the exception of during very high floods. There is also potential for pollution/sediment release locally to the river during the excavation of a new channel. There may also be disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries. Given the similarity of this option to Option 2D it is unlikely that this will be favoured by IFI. However, this option is not considered to have as a significant effect on fisheries as the dredging option at Hazelwood (2B).

Table 8: Potential impacts on ecological receptors relevant to Option 2E

Options	Impacts		Ecological Sensitive Receptors			
Option 2E Combination (Direct Defences and Conveyance) Arrangement 3	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Flood Defence Walls	Pollution Disturbance	Small Habitat Loss (Riparian) Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Embankment	Pollution Disturbance	Opportunity to create riparian edge habitat along embankment Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
New Flood Relief Culvert and Channel	Pollution Disturbance	Opportunity to create riparian edge habitat And mitigates caused by flood walls habitat fragmentation Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Bridge Removal and replacement		Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.2.6 Hazelwood Option 2F - Combination (Direct Defences and Conveyance) Arrangement 4

The potential impacts of this option are given in Table 9. The relevant environmental objectives covered in the MCA are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed options for Option 2F Hazelwood of the flood relief scheme. The potential to impact on the Natura 2000 sites is mainly through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works. The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Hazelwood 2F due to the defence walls at Hazelwood Shopping Centre south of Hazelwood Bridge that may cause fragmentation of the riparian habitat and wildlife corridor in this very built up area. However, the provision of a side channel and flood relief culvert would help to provide access under the road and through the area with the exception of during very high floods. There is also potential for pollution/sediment release locally to the river during the excavation of a new channel. There may also be disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries. Given the similarity of this option to earlier options it is unlikely that this will be favoured by IFI. However, this option is not considered to have as a significant effect on fisheries as the dredging option at Hazelwood (2B).

Table 9: Potential impacts on ecological receptors relevant to Option 2F

Options	Impacts		Ecological Sensitive Receptors			
Option 2F Combination (Direct Defences and Conveyance) Arrangement 4	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Flood Defence Walls	Pollution Disturbance	Small Habitat Loss (Riparian) Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Embankment	Pollution Disturbance	Opportunity to create riparian edge habitat along embankment Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
New Flood Relief Culvert and Channel	Pollution Disturbance	Opportunity to create riparian edge habitat And mitigates caused by flood walls habitat fragmentation Spread of Invasive Species JKW	Otter Fish species Aquatic Invertebrates	Otter Salmon Brown Trout Eel	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Bridge Removal and replacement		Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.3 Area 3: Meadowbrook

4.1.3.1 Option 3A – Direct defences (with conveyance improvements on Springmount Stream)

The potential ecological impacts of this option are given in **Table 10**. The relevant environmental objectives are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC located downstream of the proposed options for Option 3A Meadowbrook of the flood relief scheme. The flood defence wall along this stretch of the river and the pumping station discharging to the Glashaboy River further south may cause alterations to water flows and instream habitats, thereby impacting on fisheries and aquatic invertebrates. There is potential to indirectly impact on Cork Harbour SPA as these form the prey items for some of the bird interests of the SPA. The potential to impact on the Natura 2000 sites may also occur through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at Meadowbrook 3A due to the defence walls along the river edge that may cause fragmentation of the riparian habitat and wildlife corridor in this very built up area that links to the woodland and parkland just south of Meadowbrook. There is also potential for pollution/sediment release locally to the river during the excavation of a new channel. There may also be disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above the Glashaboy is an important river for fisheries. This option may affect river flows, water quality and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter.

Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries.

Table 10: Potential impacts on ecological receptors relevant to Option 3A

Options	Impacts		Ecological Sensitive Receptors			
Option 3A Direct defences (with conveyance improvements on Springmount Stream)	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Flood Defence Walls	Pollution Disturbance	Habitat Loss (Riparian) Habitat Fragmentation Alterations to water flows Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Collector Drain and Pumping Station	Pollution Disturbance	Spread of Invasive Species JKW Alterations to water flows	Otter Kingfisher Fish species Aquatic Invertebrates	Salmon Lamprey Eel Otter Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
Culvert Upgrade	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.4 Area 4: Butlerstown

4.1.4.1 Option 4.1A(conveyance improvements), 4.1B (direct defences) and 4.1C (overland flow management)

The potential ecological impacts are the same for Option 4.1A and 4.1B and are given in Table 11. The alternative Option 4.1C consists of minor works to a boundary wall with no significant ecological impacts. The relevant environmental objectives are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC (located downstream of the proposed options) for Butlerstown Glenmore Option 4A of the flood relief scheme. The potential to impact on the Natura 2000 sites are mainly through the temporary impacts of pollution/sediment downstream during construction of the flood relief channel and culverts and also the replacement of channel walls. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option mainly through the temporary impacts of pollution/sediment downstream during construction of the flood relief channel and culverts and also the replacement of channel walls. There may also be disturbance to species at a local level due to works and the potential spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above, the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter. Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries.

Table 11: Potential impacts on ecological receptors relevant to Options 4.1A and 4.1.B

Options	Impacts		Ecological Sensitive Receptors			
	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Options 4.1B (direct defences) and 4.2B (conveyance improvements)						
Clean out bridge eye	Pollution Disturbance		Fish species Aquatic Invertebrates Riparian birds	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Replace existing channel walls	Pollution Disturbance		Fish species Aquatic Invertebrates Riparian birds	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
Embankment	Pollution Disturbance	Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Replacements	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.5 Area 4.2: Glenmore

4.1.5.1 Option 4.2A(overland flow management), 4.2B (conveyance improvement)

The potential ecological impacts are the same for Option 4.2A and 4.2B and these are given in Table 12. The environmental objectives are outlined below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC (located downstream of the proposed options). The potential to impact on the Natura 2000 sites are mainly through the temporary impacts of pollution/sediment downstream during construction of the flood relief channel and culverts and also the replacement of channel walls. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The impacts on the Natura 2000 sites will be assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option mainly through the temporary impacts of pollution/sediment downstream during construction of the flood relief channel and culverts and also the replacement of channel walls. There may also be disturbance to species at a local level due to works and the potential spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above, the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter. Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries.

Table 12: Potential impacts on ecological receptors relevant to Options 4.2A and 4.2B

Options	Impacts		Ecological Sensitive Receptors			
Options 4.2A (overland flow management) and Option 4.2B (conveyance improvements)	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Clean out culvert	Pollution Disturbance		Fish species Aquatic Invertebrates Riparian birds	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Strengthen existing channel walls	Pollution Disturbance		Fish species Aquatic Invertebrates Riparian birds	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

Options	Impacts		Ecological Sensitive Receptors			
Direct Defences	Pollution Disturbance	Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA
Culvert Replacements	Pollution Disturbance	Spread of Invasive Species JKW	Otter Fish species Riparian Birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.6 Area 5: O'Callaghan Park to Glanmire Bridge

4.1.6.1 Option 5A (Direct Defences and IPP) and Option 5B (Direct Defences only)

The potential ecological impacts of this option (providing direct defences at The Grove and individual property protection measures (IPP) at St. Patricks Mills are given in Table 13. The relevant objectives are summarised below.

Objective 4B: Support the objectives of the Habitats and Birds Directives

There is potential for negative impacts on the Natura 2000 sites of Cork Harbour SPA and Great Channel Island SAC (located downstream of the proposed options) for O'Callaghan Part to Glanmire Bridge Option 5A of the flood relief scheme. The flood defence wall along this stretch of the river may cause alterations to water flows and instream habitats, thereby impacting on fisheries and aquatic invertebrates. There is potential to indirectly impact on Cork Harbour SPA as these form the prey items for some of the bird interests of the SPA. The potential to impact on the Natura 2000 sites may also occur through the temporary impacts of pollution/sediment downstream during construction. This may have a negative impact on the habitats of the SPA that support the bird interests for which the designation is cited. It may also impact on the habitats of the Great Channel Island SAC, however this is less likely given the distance of the SAC from the proposed works but potential impacts cannot be ruled out. There is also potential for disturbance and spread of invasive species, mainly Japanese Knotweed during the course of the works.

The impacts on the Natura 2000 sites are assessed in detail for the preferred scheme in the Screening for Appropriate Assessment.

Objective 4C: Avoid damages to, and where possible enhance, the flora and fauna of the catchment

There are a number of protected species that occur in the catchment including Otter, Eel, Atlantic Salmon, Brown Trout, Kingfisher and bat species. All of these species and other locally important species/ habitats could be potentially impacted by the proposed option at The Grove due to the defence walls along the river edge that may cause fragmentation of the riparian habitat and wildlife corridor. There is also potential for pollution/sediment release locally to the river during the construction of the defence wall. There may also be disturbance to species at a local level and the spread of invasive species, mainly Japanese Knotweed during the course of the works.

All of these species and other locally important species/ habitats could be potentially impacted by the proposed option mainly through the temporary impacts of pollution/sediment downstream during construction of the flood defences. There may also be disturbance to species at a local level due to works and the potential spread of invasive species, mainly Japanese Knotweed during the course of the works.

Objective 4D: Protect and where possible enhance fisheries resource within the catchment

As noted above, the Glashaboy is an important river for fisheries. This option however is unlikely to significantly affect river flows and fisheries. The potential spread of Japanese Knotweed may impact on fisheries through increased sediment release due to bank erosion when this weed dies off in winter. Consultation with Inland Fisheries Ireland (IFI) has indicated that more detail on the proposed option is required before IFI can assess the potential impacts on fisheries.

Table 13: Potential impacts on ecological receptors relevant to Options 5A and 5B

Options	Impacts		Ecological Sensitive Receptors			
	Temporary Impacts	Operational Impacts	Non-Designated Habitat and Species	Protected Habitats and Species	Natura 2000 Sites	Nationally Designated Sites
Options 5A (direct defences and IPP) and Option 5B (direct defences only)						
Flood Defence Walls	Pollution Disturbance	Habitat Loss (Riparian) Habitat Fragmentation Alterations to water flows Spread of Invasive Species JKW	Fish species Aquatic Invertebrates Riparian birds Riparian Habitat	Otter Salmon Lamprey Eel Kingfisher Bats	Cork Harbour SPA - Birds and supporting wetlands Great Island Channel cSAC	Glanmire Wood pNHA Dunkettle Shore pNHA Douglas River Estuary pNHA Great Island Channel pNHA

4.1.7 Area 6: Downstream of Glanmire Bridge

Individual Property Protection in Area 6 consist of local measures to one residential property, The Fountains. It is not envisaged at this stage that there would be significant ecological impacts associated with this option.

4.1.8 Summary of Ecological Assessment of the Options

The most preferred and least preferred flood alleviation options for each of the areas in relation to ecological impacts are summarised in the below table.

Table 14: Ecological Assessment of Options

Area	Most Preferred Option	Least Preferred Option	Reasoning
1 – Sallybrook Industrial Estate	1A	N/A	There is only one viable option in this area
2 – Hazelwood Shopping Centre	2A, 2C, 2D, 2E and 2F results in same level of low negative ecological impact	2B	Option 2B has a considerably higher potential for negative impacts than the remaining options. This is due to the extensive significant impacts caused by conveyance improvements (dredging), which constitute the entirety of the works in Option 2B.
3 - Meadowbrook	3A	N/A	There is only one viable option for this area
4.1 Butlerstown	4.1C	4.1A	Option 4.1C consist of local measures to a boundary wall with no environmental impact. Option 4.1A is least preferred as it is associated with higher potential for negative impacts due to in-stream works.
4.2 Glenmore	4.2A	4.2B	Option 4.2A (overland flow management) has considerably lower potential for negative impacts than Option 4.2B (culvert upgrades). This is due to the fact that the 4.2B works consist of more extensive in-stream works in the Glenmore Stream.
5 – O’Callaghan Park Glanmire	N/A	N/A	There is no significant difference in the potential ecological impacts between Option 5.A and 5B.
6 – Downstream Glanmire Bridge	N/A	N/A	There is only one viable option in this area

4.1.9 Mitigation Measures

For any of the options chosen, a suite of mitigation measures would be required in order to minimise impacts on protected species, habitats and water quality both for the construction and operational phases. Once a preferred option is chosen and detailed design prepared, then site specific and method specific mitigation measures will be formulated.

4.2 Archaeology, Architectural and Cultural Heritage

Potential impacts on sites of archaeological, architectural and cultural heritage interest will need to be considered, in the course of the design and construction of the proposed flood scheme.

The potential archaeology, architectural and cultural heritage impacts arising from the flood defence options, are described for each of the areas in the tables below.

The assessments for archaeology, architectural and cultural heritage were made against the following objectives:

- Avoid damage to or loss of features of cultural heritage importance and their setting, and improve their protection from extreme floods.
- Avoid damage to or loss of features of architectural value and their setting, and improve their protection from extreme floods where this is beneficial
- Avoid damage to or loss of features of archaeological value and their setting, and improve their protection from extreme floods where this is beneficial.

Sections of the Glashaboy, Butlerstown and Glenmore Rivers are the subject of this study and, as rivers, are considered to be Areas of Archaeological Potential and key constraints. It is likely that the rivers have been impacted in localised areas in the past when they were used as a power source for various mills and industrial activities. It is recommended that further proposed works to the rivers should be archaeologically assessed in advance of works taking place

For any of the options chosen, a suite of mitigation measures would be required in order to minimise impacts on archaeological, architectural and cultural heritage both for the construction and operational phases. Once a preferred option is chosen and detailed design prepared, then site specific and method specific mitigation measures will be formulated. Generic mitigation measures will include the following:

- Any of the options which require in stream works will require licensed archaeological wading survey and where necessary a full dive survey may be required in advance of commencement of works and in the case of proposed dredging of the river archaeological monitoring of the dredging process may be appropriate.
- Where works adjacent to the river may impact the bed or banks of the river a licensed archaeological wading survey and where necessary a full dive survey may be required in advance of commencement of works.
- Where possible archaeological testing in advance of proposed works may be appropriate alternatively licensed archaeological monitoring of the ground disturbance associated with the proposed works should be carried out. Any features revealed should be fully resolved to professional standards following consultation with the relevant authorities. It is noted that archaeological testing adjacent to the river may not be possible in advance of works in some areas.

- Any features revealed should be fully resolved to professional standards following consultation with the relevant authorities. Archaeological testing adjacent to the river may not be possible in advance of works.

4.2.1 Area 1: Sallybrook Industrial Estate

Table 15: Potential archaeological, architectural and cultural heritage Impacts relevant to Option 1A

Option Description	Potential Impacts
Option 1A: Direct Defences with conveyance improvements at Bleach Hill Stream	Curtilage of Protected Structures RPS00390 paper mill and RPS 00389 cloth mill will be changed by works to mill races The setting of two Recorded Monuments RMP CO063-069 and RMP CO063-094 will be changed by works to the mill races. Construction of flood defence walls adjacent to the River Glashaboy, an Area of Archaeological Potential (AAP1) will impact the river.

4.2.2 Area 2: Hazelwood Shopping Centre

Table 16: Potential archaeological, architectural and cultural heritage Impacts relevant to Options 2A-F

Option Description	Potential Impacts
Option 2A: Direct Defences (with conveyance improvements on Cois na Gleann Stream)	No effect on architectural heritage Setting of Glashaboy River AAP1 will be changed by construction of flood defence wall and reconstruction of existing embankment.
Option 2B: Conveyance improvements (Dredging)	No effect on architectural heritage Dredging the Glashaboy River AAP1 will modify the riverbed.
Option 2C: Combination (Direct Defences and Conveyance) Arrangement 1	No effect on architectural heritage Setting of Glashaboy River AAP1 will be changed by construction of flood defence wall and reconstruction of existing embankment. Construction of relief channel will modify the bed of the river, AAP1.

Option Description	Potential Impacts
Option 2D: Combination (Direct Defences and Conveyance) Arrangement 2	No effect on architectural heritage Setting of Glashaboy River AAP1 will be changed by construction of flood defence wall and reconstruction of existing embankment. Construction of relief channel will modify the bed of the river, AAP1
Option 2E: Combination (Direct Defences and Conveyance) Arrangement 3	No effect on architectural heritage Setting of Glashaboy River AAP1 will be changed by construction of flood defence wall and reconstruction of existing embankment. Construction of relief channel will modify the bed of the river, AAP1.
Option 2F: Combination (Direct Defences and Conveyance) Arrangement 4	No effect on architectural heritage Setting of Glashaboy River AAP1 will be changed by construction of flood defence walls and reconstruction of existing embankment and associated works. Construction of the flood relief channel and replacement Hazel Shopping Centre Bridge will modify the bed of the river, AAP1.

4.2.3 Area 3: Meadowbrook

Table 17: Potential archaeological, architectural and cultural heritage Impacts relevant to Option 3

Option Description	Potential Impacts
Option 3A: Direct Defences (with conveyance improvements on Springmount Stream)	Flood defence wall will be abutting the Protected Structure Riverstown Bridge RPS 00394 and Recorded Monument RMP CO064-111. Impact on architectural heritage Setting of Glashaboy River AAP1 will be changed by construction of flood defence wall.

4.2.4 Area 4: Butlerstown (4.1) and Glenmore (4.2)

Table 18: Potential archaeological, architectural and cultural heritage Impacts relevant in Area 4.1 and 4.2

Option Description	Potential Impacts
Option 4.1A: Conveyance Improvements	No effect on architectural heritage. Construction of flood relief channel and culvert will change the Butlerstown River AAP2. Construction of relief channel and replacing channel railing with crash barriers will change the Glenmore River AAP3002E.
Option 4.1B: Direct Defences	Construction of flood defence embankment to southwest of Riverstown House will change the curtilage and setting of the Protected Structure RPS00395. Construction of embankment to the southwest of Riverstown House Recorded Monument RMP CO064-051 will change the setting of the monument. Setting of Butlerstown River AAP2 will be changed by construction of embankment.
Option 4.1C: Overland Flow Management	Local modification to boundary wall only. No potential for environmental impacts.
Option 4.2A: Overland Flow Management	No effect on architectural heritage. Construction of flood relief channel and culvert will change the Glenmore River AAP3. Construction of relief channel and replacing channel railing with crash barriers will change the Glenmore River AAP3002E.
Option 4.2B: Conveyance Improvements	No effect on architectural heritage. Construction of relief channel and replacing channel railing with crash barriers will change the Glenmore River AAP3.

4.2.5 Area 5: O'Callaghan Park – Glanmire Bridge Option 5A – Direct Defences at The Grove and IPP at St. Patrick's Mills and Option 5 B – Direct Defences only at the Grove

Table 19: Potential archaeological, architectural and cultural heritage Impacts relevant to Area 5

Option Description	Potential Impacts
Option 5A: Direct Defences and IPP	Curtilage of St Patricks Mills (Curtilage of Protected Structure RPS00484 corn mill) will be changed by works to the mill race and IPP. The setting of Recorded Monument RMP CO075-002001 (St Patricks Mills) will be changed by works to the mill race and IPP. Setting of River Glashaboy AAP1 will be changed due to the construction of flood defence walls at The Grove
Option 5B: Direct Defences only	As above but excluding IPP

4.2.6 Area 6: Downstream Glanmire Bridge

Table 20: Potential archaeological, architectural and cultural heritage Impacts relevant to Area 6.

Option Description	Potential Impacts
IPP at The Fountains	The setting of Recorded Monument RMP CO2 80 – 121 (Fountains Mills and Mill Race) will be changed by the IPP works. The curtilage of Ballinglanna Flour Mill / The Fountains (RPS 00485 and CO075-002001) will be changed due to the IPP works

4.3 Soils, Geology and Hydrogeology

Geological Survey of Ireland (GSI) online mapping indicates the dominant rock types in the southern portion of the study area to be '*Sandstone with mudstone and siltstone*' (Gyleen Formation), '*Flaser-bedded sandstone and minor mudstone*' (Old Head Sandstone Formation), '*Flaser-bedded sandstone and mudstone*' (Cuskinny Member), '*Purple mudstone and sandstone*' (Ballytrasna formation). The dominant rock type in the northern portion of the study area is '*Sandstone and siltstone*' (Gortanimill Formation).

GSI online Quaternary data (Teagasc Subsoil data) indicates that the soils in the study area comprise '*Alluvium*' (gravelly), '*Tills*' (*undifferentiated Till*), '*Rock*' (*bedrock at surface*), '*Glaciofluvial sands and gravels*' (*undifferentiated*).

Geological Survey of Ireland (GSI) online mapping (Groundwater Public Viewer) indicates that the aquifer in the study area is classified as '*Li – Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones*'. Aquifer vulnerability is indicated on GSI online mapping as '*H - High*', '*E – Extreme*' '*X- (Rock near Surface or Karst)*' and '*M – Moderate*'.

The GSI online mapping (Groundwater Public Viewer) also indicates that the study area comprises a number of groundwater bodies, including 'Cork City 1' and 'Glanmire Town 1'. These groundwater bodies in the study area are classified on GSI Groundwater Public Viewer mapping as 'Poorly productive bedrock'. Online EPA '*My Local Environment – Timpeall an Ti*' data states that the status of the groundwater bodies of Cork City 1 and Glanmire Town 1 is 'good' (date 22.06.2011).

Appendix 3.1 of the South Western RBD Management Plan includes tables of sensitive and protected areas and identifies a number of 'Drinking Water Protected Areas- Groundwater' bodies (page 94 of the Plan) in the study area, including Cork City 1 and Glanmire Town 1.

The predominant impacts on soils, geology and hydrogeology will likely be the same for each of the options. They relate primarily to physical excavation works which will disturb the soil. Where the channel needs to be widened or deepened to accommodate either the provision of the larger culvert or the open channel, this will have an impact on the ground. Any regrading or in-channel works will also impact on soils and may cause instability.

A relevant construction environmental management plan (CEMP) will be drawn up in order to correctly manage the soils and ground. The CEMP will make provision for the safe and proper reuse or disposal of any soils requiring removal from site as a result of excavation.

4.4 Other environmental considerations

- Landscape character and visual amenity will require consideration along many sections of the scheme.

The riparian wooded corridors along the rivers provide both screening to residents and are of amenity value in the areas of Glanmire, Riverstown and Sallybrook. The potential impact on protected structures will require consideration.

- It is recommended that the existing and proposed location of watermains and underground services in the vicinity of any proposed flood relief scheme be ascertained as part of the Engineering Study. It is recommended that Cork City and County Councils and other utility providers with services in the study area be consulted regarding the location and priority of existing and proposed services. It is further recommended that the services be protected as part of any proposed flood relief scheme.
- It is recommended that Cork City and County Councils and the National Roads Authority be consulted in relation to any effects on the existing and proposed roads infrastructure in the study area from any proposed flood relief scheme.
- It is recommended that the requirements of the Cork County Council Development Plan be observed in relation to waste management assessments.

Please refer to the EIS for further information.

4.5 Cumulative impacts

Cumulative impacts are those resulting from a combination of two or more of the flood alleviation measures. Many of the cumulative impacts of a flood relief scheme are positive. However these are not covered in the context of the environmental constraints. The following is a list of the constraining cumulating impacts likely to arise as a result of the proposed scheme:

- Disruption to local road users and utilities as a result of the construction works. The duration of this is therefore short-term.
- The works may generate suspended solids and possibly hydrocarbon pollution depending on the design and management of the construction works. This can have negative short-term impacts on aquatic flora and fauna. Salmonids are particularly vulnerable to any cement solids or hydrocarbon residues that may be introduced into the waterways.
- Mechanical works alongside the river bank could potentially have adverse, long-term impacts on in-channel flora and fauna. Works along the river could potentially have impacts downstream, e.g. fluvial transport of knotweed remnants that may introduce the plant to areas where it was not present previously.

5 Conclusions and recommendations

The analysis of the environmental impacts highlighted that the impacts could be classified on the basis of severity and duration. No significant negative environmental impacts was identified on the preferred option at options stage. Further environmental surveys were carried out on the preferred option and this is reported on in the EIS.

There are no viable alternatives for Area 1 and 3 therefore it is determined that these are preferred.

In Area 2, Option Hazelwood 2B Conveyance improvements (Dredging) shows the greatest potential for negative impacts on the Glashaboy River and its protected habitats and species. All the remaining options were determined to have similar environmental impacts with Option 2C scoring slightly better from an environmental perspective.

In Area 4.1 Butlerstown, Option C (Overland Flow Management) has considerably lower potential for negative impacts than Option A (Conveyance Improvement) and Option B (Direct Defences). In Area 4.2 Glenmore, Option A (Overland Flow Management) has somewhat lower potential for negative impacts than Option B (Conveyance Improvements). Option B is preferred however and adequate mitigation measures have been specified.

Any works to protected structures and recorded monuments will require careful consideration to ensure that the works are in keeping with the character and setting of these structures