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Mountmellick
FLOOD RELIEF SCHEME

# Options Report

Final Report

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OPW Oifig na nOibreacha Poiblí Office of Public Works

# JBA Project Manager

Richard Buck
Unit 8, Block 660
Greenogue Business Plaza
Rathcoole
Dublin
D24 YN81

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# Contract

This report relates to the Mountmellick Flood Relief Scheme commissioned by Laoise County Council, on behalf of the Office of Public Works. Elizabeth Russell, Conor O'Neil, Hannah Chisnall and Richard Buck of JBA Consulting and Eoin Dunphy of JB Barry carried out this work.

Prepared by ..... Richard Buck BEng CEng MICE
Consultant

Reviewed by ..... Bernadette O'Connell BA MSc CMLI

Managing Director, Environmental Consultant

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# Index

# List of Figures

# List of Tables

# Abbreviations

| | |
|---|---|
| AA | Appropriate Assessment |
| AAD | Annual Average Damage |
| ACA | Architectural Conservation Area |
| AEP | Annual Exceedance Probability |
| CBR | Cost Benefit ratio |
| CEMP | Construction Environmental Management Plan |
| CFRAM | Catchment Flood Risk Assessment and Management |
| DoEHLG | Department of the Environment, Heritage and Local Government |
| EcIA | Ecological Impact Assessment |
| ECoW | Ecological Clerk of Works |
| EIA | Environmental Impact Assessment |
| EPA | Environmental Protection Agency |
| FHRC | Flood Hazard Research Centre |
| FRM | Flood Risk Management |
| FRS | Flood Relief Scheme |
| HEFS | High End Future Scenario |
| HMWB | Heavily Modified Water Body |
| IFI | Inland Fisheries Ireland |
| LAP | Local Area Plan |
| MCA | Multi Criteria Analysis |
| MCM | Multi Coloured Manual |
| mOD | Meters above Ordnance Datum |
| MRFS | Mid-Range Future Scenario |
| NBS | Nature Based Solutions |
| NIAH | National Inventory of Architectural Heritage |
| NIS | Natura Impact Statement |
| NPV | Net Present Value |
| OPW | Office of Public Works |
| OSI | Ordinance Survey Ireland |
| PCD | Public Consultation Day |
| PPD | Public Participation Day |
| PDV | Present Day Value |
| pNHA | proposed Natural Heritage Area |
| RMP | Record of Monuments and Places |
| RPS | Record of Protected Structures |
| SAC | Special Area of Conservation |
| SPA | Special Protection Area |
| SoP | Standard of Protection |
| SuDS | Sustainable Drainage Systems |
| TAG | Technical Advisory Group |

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|---|---|
| WFD | Water Framework Directive |

# 1 Introduction

## 1.1 Context

Mountmellick is located in Co Laois within the River Barrow catchment. Several tributaries of the River Barrow flow near and through the town. Historically, the town has been subject to fluvial flooding and as such Mountmellick was part of the Office of Public Works (OPW) Catchment Flood Risk Management (CFRAM) study programme. The Preliminary Options Report from this study concluded that a flood relief scheme would be viable and effective for the local community. The viable scheme option for Mountmellick, as identified in the CFRAM Options Report, included a series of hard defences consisting of flood embankments, walls, and raised roads.

Since the publication of the Preliminary Options Report (June 2016), Mountmellick experienced an extreme flood event (November 2017) and the town was prioritised for a flood relief scheme assessment. Mountmellick was also subject to flooding of roads and public and private land in February 2020 as a result of Storm Ciara.

The overall purpose of the Mountmellick Flood Relief Scheme (FRS) project is to design and build flood defences that will protect properties, businesses and critical infrastructure in future flood events. Accordingly, following a public competition, a joint venture of JBA Consulting/JB Barry and Partners, were commissioned by Laois County Council (LCC) to provide engineering and environmental services for the Mountmellick Flood Relief Scheme (the Scheme).

There are five stages in the project:

- Stage I: Development of a number of flood defence options and the identification of a preferred Scheme.
- Stage II: Part 10 Planning.
- Stage III: Detailed Design & Tender.
- Stage IV: Construction.
- Stage V: Project Close-Out (Handover to Client).

This Options Assessment Report is produced as part of Stage I of the project. It follows on from work carried out to date and the report should be read in conjunction with the earlier Constraints Study[1].

## 1.2 Project Objectives

The overarching objective of the project is to assess, develop and design an appropriate viable, cost-effective and sustainable flood relief scheme which aims to minimise risk to human beings, the existing community, social amenity, environment and landscape character.

The scheme is to be developed primarily to protect the affected areas against fluvial flooding. In addition, consideration will be given to the potential impact of any flood relief scheme on groundwater and pluvial flood risk. This scheme will be designed to provide protection to properties in the study area from the 1% Annual Exceedance Probability (AEP) fluvial flood event (1 in 100-annual probability).

## 1.3 Scope of Report

The purpose of this report is to outline the development of possible flood relief options that could be implemented in Mountmellick and to describe the procedure for options assessment and selection of a preferred option.

The process is outlined as follows:

- An initial screening was carried out on alternative Flood Risk Management Approaches to set the strategic context for the different measures and options to manage flood risk. An extensive list of possible flood risk management measures, grouped by their approach to flood risk management and the spatial scale of benefits, are assessed against a predetermined set of criteria, to determine their viability;
- A technical assessment of potentially viable flood risk management measures was undertaken;
- Potential flood relief options for all locations around the site were developed using combinations of those flood risk management measures which were determined to be technically viable. Each flood relief option was assessed from an environmental, engineering and economic perspective;
- The flood relief options were then subjected to a multi-criteria assessment consisting of technical, economic and environmental criteria;
- The public were consulted on the options, including the emerging preferred option;

1 Constraints Study for Flood Relief Scheme at Mountmellick, P01, JBA Consulting and JB Barry for Laois County Council

- The preferred option was selected taking consideration of the following:
  - Multi Criteria Analysis;
  - Feedback from the Public and other stakeholders;
  - Cost benefit assessment;
  - Consideration of wider LCC objectives for the area;
  - Professional judgement of the project Technical Advisory Group (TAG).

## 1.4 Study Area

Mountmellick town lies within the shadow of the Slieve Bloom mountains situated in the River Barrow catchment. It is a large service town within Co Laois and is located along the N80 connecting it to other towns such as Portlaoise and Tullamore. The study area is shown in Figure 1.1 below.

There are four key watercourses within the area. The largest of these is the River Barrow which flows in an easterly direction to the north of the town. A number of tributaries of the Barrow flow through, or near the townland. Of note are the Owenass, Pound and Triogue Rivers, these are all fed by smaller watercourses that also flow through the area. These watercourses originate in the higher elevation areas associated with the foothills of the Slieve Bloom mountains and are the main source of flood risk to the town.

The Study Area, as defined in the brief, covers the AFA that was the core of the CFRAM. This covers the town of Mountmellick which includes residential, commercial and industrial properties. However, as investigation into the potential measures progressed, the benefits of extending the study area further upstream was highlighted and resulted in an increase in the study area. This resulted in an increase in the initial scope of a number of studies and assessments, including the environmental and ecological baseline surveys and the Site Investigation works; unless specifically detailed, it is the extended study area that is discussed in the body of this report.

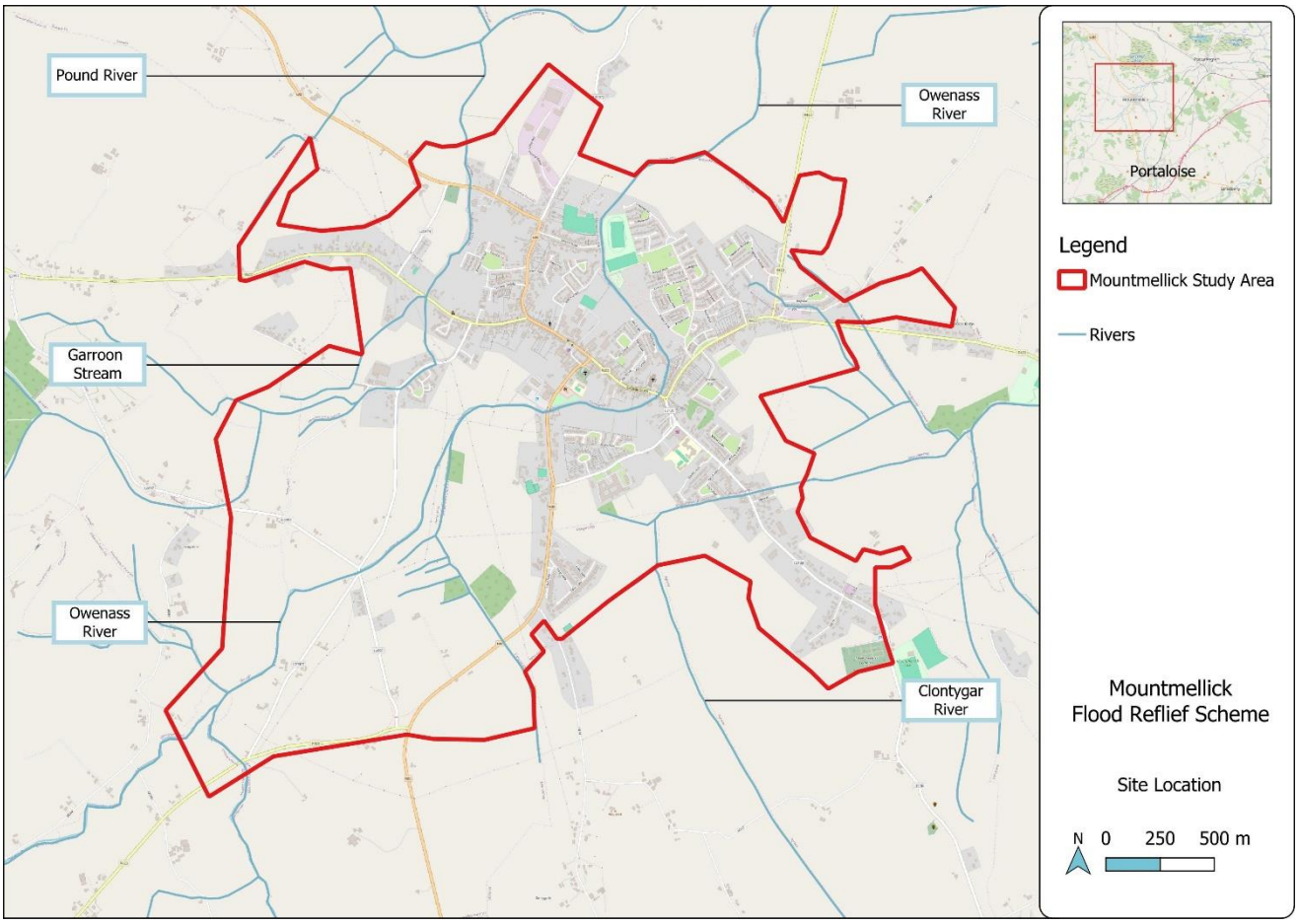



Figure 1-1: Mountmellick study area

# 2 Constraints and Stakeholder Input

## 2.1 Constraints Study

The Constraints Study was the first step in determining the key environmental constraints and drivers which would inform the development of potential flood relief options and will ultimately inform the preparation of an Environmental Impact Assessment Report (EIAR) for the final Mountmellick Flood Relief Scheme. The purpose of the Constraints Study was to determine what constraints (physical, procedural, legal, environmental etc.) exist that could affect the design of the scheme, might delay the progress of the scheme and could influence the cost of the scheme.

While the Constraints Study is not a statutory document, the EPA's Draft Guidelines on the Preparation of Environmental Impact Assessments (2017) do recommend that a study should be completed and as such, the Guidelines were used as a template for the study. The headings used in the Constraints Study, repeated here, are:

- Human Beings
- Material Assets
- Waterbodies
- Biodiversity
- Soils and Geology
- Landscape and Visual Amenity
- Cultural Heritage
- Air and Noise

A summary of the Constraints Study key findings is presented below in Sections 2.1.1 to 2.1.8. This information was used by the design team during the development of potentially viable measures e.g. diversion of flow, containment of flood levels, conveyance of flow etc., and the development of potential options (groupings of potentially viable measures together). A detailed assessment of the preferred options, building on the information gathered at the Constraints Study stage, is in Section 6 of this report.

### 2.1.1 Human Beings

The Mountmellick Local Area Plan (LAP) 2018-2024 and Laois County Development Plan 2021 - 2027 have identified the importance of local employment for the future prosperity and development of the town, with lands currently zoned for industry and enterprise to the south of the town. The LAP notes that while much of the lands susceptible to flooding around the town are zoned as Open Space and Amenity, an area zoned for Industrial and Warehousing to the southwest of the town is an exception. Several areas are also zoned as New Proposed Residential or Strategic Residential Reserve.

The Mountmellick Amenity Area is an important facility for local residents, providing a playground, outdoor gym, and picnic area. The Amenity Area has previously been flooded during the November 2017 flood event. Equally important are the River Owenass walkway and Mountmellick Heritage Trail.

### 2.1.2 Material Assets

Constraints to material assets will be restricted to any coincidence with sewer, electricity, gas, or telephone networks. Mapping for these networks has either been collected or collection is ongoing.

Seven surface drainage outfalls into the River Owenass in Mountmellick, as well as an outlet from the Mountmellick Urban Wastewater Treatment Plant (WWTP). The River Pound also has seven surface drainage pipe outlets flowing into it in the town. Foul and storm sewers in Mountmellick generally follow the road network, with some foul water pipe exceptions, running through greenfield sites. The layout of foul and storm water sewers has been provided by LCC and Irish Water.

The Mountmellick Urban WWTP was upgraded in 2018 to a capacity of 8,000PE. This is sufficient capacity for current population levels, but extra capacity is required to implement the policies and objectives of the Mountmellick LAP.

The N80 national route passes north-south through Mountmellick. The town is also serviced by two regional routes, the R422 and the R423.

### 2.1.3 WFD status

The objectives of the Water Framework Directive (WFD) are to protect or enhance all waterbodies, to achieve 'Good' status for all waterbodies, and to take a catchment-scale management approach to water quality in Ireland.

There are three WFD waterbodies in the scheme area; OWENASS_020 (Moderate WFD Status, At Risk) flowing north through the town centre, BARROW_040 (Moderate WFD Status, At Risk) which includes the Pound River/Manor House Stream and the River Barrow to the north of the town, and TRIOGUE_040 (Poor WFD Status, At Risk), flowing in an easterly direction away from the town. Currently, all waterbodies are considered "At Risk" due to agricultural pressures, attributed to high levels of phosphorus and ammonia from agricultural runoff.

Mountmellick is situated within two groundwater bodies (IE_SE_G_096 and IE_SE_G_107), both of which are at Good Status and are considered 'Not At Risk'.

During construction, there is a risk of accidental release of contaminants into surface and groundwater, or the mobilisation of nutrients and suspended solids. This could have an adverse impact on water quality, negatively impacting on the WFD status of the waterbody and preventing the waterbody from achieving its WFD objectives. Such release of contaminants can also impact the habitats and species of the River Barrow and River Nore SAC.

Flood Relief Schemes have the potential to cause WFD Status deteriorations, either during construction or operation. A deterioration in WFD Status must not be allowed to occur as a result of the scheme, otherwise an Article 4(7) exemption under the WFD is required.

### 2.1.4 Biodiversity

The River Barrow and River Nore SAC runs centrally through the town along the River Owenass. FRS construction works may lead to potential impacts (direct physical disturbance or loss of habitat, i.e., disturbance of bank burrows/holts and/or removal of trees/roosts) on protected terrestrial/aquatic species (e.g., Otter). Additionally, potential mobilisation of nutrients and suspended solids during construction may impact protected aquatic habitats and species (e.g., Salmon spawning gravels). The alteration of flood regimes upstream and downstream of the town may negatively impact on protected bird species.

8.6km upstream of Mountmellick on the River Owenass is Slieve Bloom Mountains SPA. The Appropriate Assessment (AA) process (outlined below) will examine the potential for negative impacts on the SAC or SPA as a result of the FRS. The SPA may be an opportunity for nature-based solutions, as flood storage areas in the SPA could help reduce flooding downstream on the Owenass as well as enhance habitat areas in the SPA.

#### 2.1.4.1 Appropriate Assessment

The EU Habitats Directive requires an Appropriate Assessment (AA) to be carried out where a plan or project is likely to have a significant adverse effect on a Natura 2000 site. The Natura 2000 network of European sites in Ireland comprises Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

There are four steps to the Appropriate Assessment process as follows:

1. Screening for Appropriate Assessment,
2. Appropriate Assessment,
3. Alternative Solutions
4. Imperative Reasons of Overriding Public Interest (IROPI).

For those sites where potential adverse effects are identified, either alone or in combination with other plans or projects, further assessment is necessary to determine if the proposals will have an adverse impact on the integrity of a European designated site and therefore, must proceed to a more in-depth evaluation of the project, i.e. Appropriate Assessment.

In the selection of options, where adverse impacts on the integrity of Natura 2000 sites are identified, and mitigation to avoid or reduce such adverse impacts cannot be satisfactorily implemented, alternative ways of achieving the objectives of the Scheme, which avoid adverse impacts, need to be considered. If none can be found, the process proceeds to IROPI. Therefore, it is important at the options appraisal stage to consider the potential impacts of proposed options.

In the case of Mountmellick Flood Relief Scheme, potential adverse impacts are anticipated, given the presence of a Natura 2000 site within the study area i.e. River Barrow and River Nore SACs and the scale of the Scheme. The preferred option will have to undergo Appropriate Assessment and mitigation measures drawn up to ensure no significant impact is caused to a Natura 2000 site as a result of the Scheme.

#### 2.1.4.2 Invasive Species

The invasive plant Japanese Knotweed (JKW) is present at various locations around Mountmellick town. These were identified at pre-tender stage and surveyed during the preparation of the Constraints Report. The proposed flood defence works require that these plants be managed in accordance with the guidance that will be set out in the Environmental Impact Assessment Report (EIAR). The JKW is currently in year 3 of a 3-year inspection/treatment/eradication plan. The progress of this plan should be monitored and used to inform the approach for Invasive Species management in the Flood Relief Scheme.

### 2.1.5 Soils and Geology

Mountmellick is underlain by a Locally Important Aquifer, which is moderately productive in local zones only. Aquifer vulnerability in the study area is mainly Moderate, with some High vulnerability at the northern edge of the site, and a small section of rock at or near the surface in the southeast corner of the scheme area. Construction work and changes to flow regimes could result in changes to groundwater flows, with further impacts on groundwater quality.

Subsoils in the vicinity of the FRS are shown in STYLEREF 1 \s . The river corridors are mainly underlain by alluvium, with the surrounding land mainly limestone till, with significant areas of cutover peat and limestone sands and gravels. The use of heavy machinery during the construction phase could result in compaction of soil.

Different soil types can act as constraints, as well as potential areas for nature-based solutions. Floodplain reconnection can be considered in areas with alluvial soils, which can indicate the extent of former floodplains. Other soils to note in the area are the areas of peat, which can have potential for restoration, water storage, and carbon sequestration, and gravels, which are porous and thus susceptible to groundwater infiltration.

### 2.1.6 Landscape and Visual Amenity

There are no designated scenic views or prospects within the Mountmellick study area or the surrounding environs, however views along the River Owenass are important locally, with a pedestrian walkway running along the river between Mill Bridge and Convent Bridge providing a good visual amenity. A low stone wall runs along this walkway. Constraints relate to views enjoyed from this walkway and by residential properties of Mountmellick.

### 2.1.7 Cultural Heritage

There are several constraints relating to archaeology and architecture in Mountmellick.

There are 78 Protected Structures listed in the Record of Protected Structures (RPS) located within the study area. They predominantly comprise of houses and commercial buildings arranged along the principal streets of Mountmellick, with some structures related to the industrial heritage of the area on the fringes of town. Most of the Protected Structures date to the 19th century, with some of 18th century or early 20th century date. Three Protected Structures which are located outside of the original study area are in areas affected by flood waters or within 100m of proposed defences. They comprise a railway bridge (RPS 829), a thatch house (RPS 857) and a no-longer-extant thatch house (RPS 553). However, the thatched house to which this record referred collapsed in 1997 and it has not been removed from the RPS.

There are 71 sites listed by the National Inventory of Architectural Heritage within the study area. Of these 68 are also designated RPS sites (with the caveat that RPS no. 37A and 37B are recorded with a single NIAH number 12900365). For fourteen of these sites, while they have been assigned reference numbers within the NIAH, they are sites which have been rated of local importance and have been removed from the online database. Their numbers are included here as they were cited in the RPS records for County Laois. It is possible that further sites of local importance have been removed from the online database which are not listed in the RPS and which are therefore not noted in this report.

There are no sites within the study area listed within the NIAH Garden Survey. This is a paper survey which was conducted through consultation of historic mapping and records the condition and survival of historic gardens. Eighteen of the Protected Structures and one NIAH only site is within 100m of proposed flood relief measures.

Mountmellick is also archaeologically important, with a designated Zone of Archaeological Potential (ZAP) meaning the town centre has statutory protections and the potential for undiscovered archaeological remains. Three RMP sites, including the ZAP, within the study area, including the town itself (RMP no.: LA008-032) and the associated church and graveyard (RMP no.: LA008-032001/2). The small number of sites is due to the post medieval date for the development of the town of Mountmellick, having been founded in the 17th century as an English colony.

### 2.1.8 Air and Noise

Constraints relating to air and noise would be temporary in nature, during the construction phase. Mitigation measures could be implemented during construction to limit any impacts.

### 2.1.9 Hydromorphology

There are no hydromorphology pressures identified in the River Basin Management Plan (RBMP) for the reaches in the study area. Constraints to hydromorphology will be limited to impacts on the river system from construction works and operational effects, which have the potential to change the sedimentary processes and associated in-river habitats. Any works undertaken in close proximity to riverbanks therefore has the potential to impact on

hydromorphological processes once the scheme is operational. A WFD Assessment will be needed as part of this FRS.

Once operational, the scheme has potential to result in changes to the hydromorphological regime of the River Owenass. Changes in flow patterns as a result of defences, particularly any in-stream works or changes to floodplains, could have further impacts both upstream and downstream. Changes to the hydromorphology of the watercourse could have significant effects on sediment transport, with knock-on effects on habitats and species.

## 2.2 Hydromorphology Review

A catchment hydromorphological audit was undertaken with the goal to develop a baseline understanding of sediment dynamics and hydromorphological pressures within the Owenass catchment and within the FRS study area. This understanding can then be used to inform the potential impact of the proposed options on hydromorphological processes and consequences for future WFD status. The hydromorphology review includes a summary of catchment sediment dynamics in the Owenass and Pound Rivers, assessment of hydromorphological pressures within the scheme area, and summary of constraints and opportunities for the scheme.

### 2.2.1 Catchment sediment audit

The catchment sediment audit focuses primarily on the Owenass River and its tributaries, and the Pound River, which discharges into the Barrow just north of the Owenass. For the purposes of this assessment, only waterbodies contributing to the Owenass and the Pound Rivers were included in the catchment sediment audit. Additional tributaries contributing to the overall functioning of catchment sediment dynamics are shown in Figure 2-2. The system functionality is described below.

#### Owenass River

The Owenass River (IE_SE_14O010300) is a diverse river system that rises in the Slieve Bloom Mountains, flowing in a northeasterly direction through a steep bedrock channel, then meandering through agricultural lands, passing eventually through the town of Mountmellick and discharging into the Barrow River to the Northeast of the town. Through the catchment, 7 reaches of the Owenass River were delineated to describe geomorphic functionality, with the lower 4 of these within the scheme area.

The upper reach, Owenass 7, forms a steep headwater channel (approximately 2.0% gradient) comprising a cobbled bed with primarily riffle and cascade bed forms. The channel is narrow and well-connected to the floodplain in a wide valley, alternating through areas of natural broadleaf woodland and coniferous plantation. This reach provides coarse material from the Slieve Bloom Mountains to the system and delivers it downstream into the lower reaches of the Owenass.

Figure 2-1. Upper tributaries (Owenass 7) are steep with cobbled bed and dense riparian woodland

Owenass 6 sees the river transition into a bedrock step-pool channel (gradient of approximately 2.4%), that is heavily confined within a steep valley system. This has areas of natural waterfalls, including the Cathole Falls recreation area, and a dense riparian woodland. The bed through this reach is stable due to the coarse nature of the materials, with very little signs of adjustment. This reach also provides a coarse sediment supply to downstream reaches. There is one major bed modification noted, a weir placed in the Cathole Falls area, which acts as a sediment trap, trapping both coarse and fine materials in the backwater area between the falls and the weir. Downstream of this area, there is additional length of bedrock channel that provides a source of coarse material to the system.

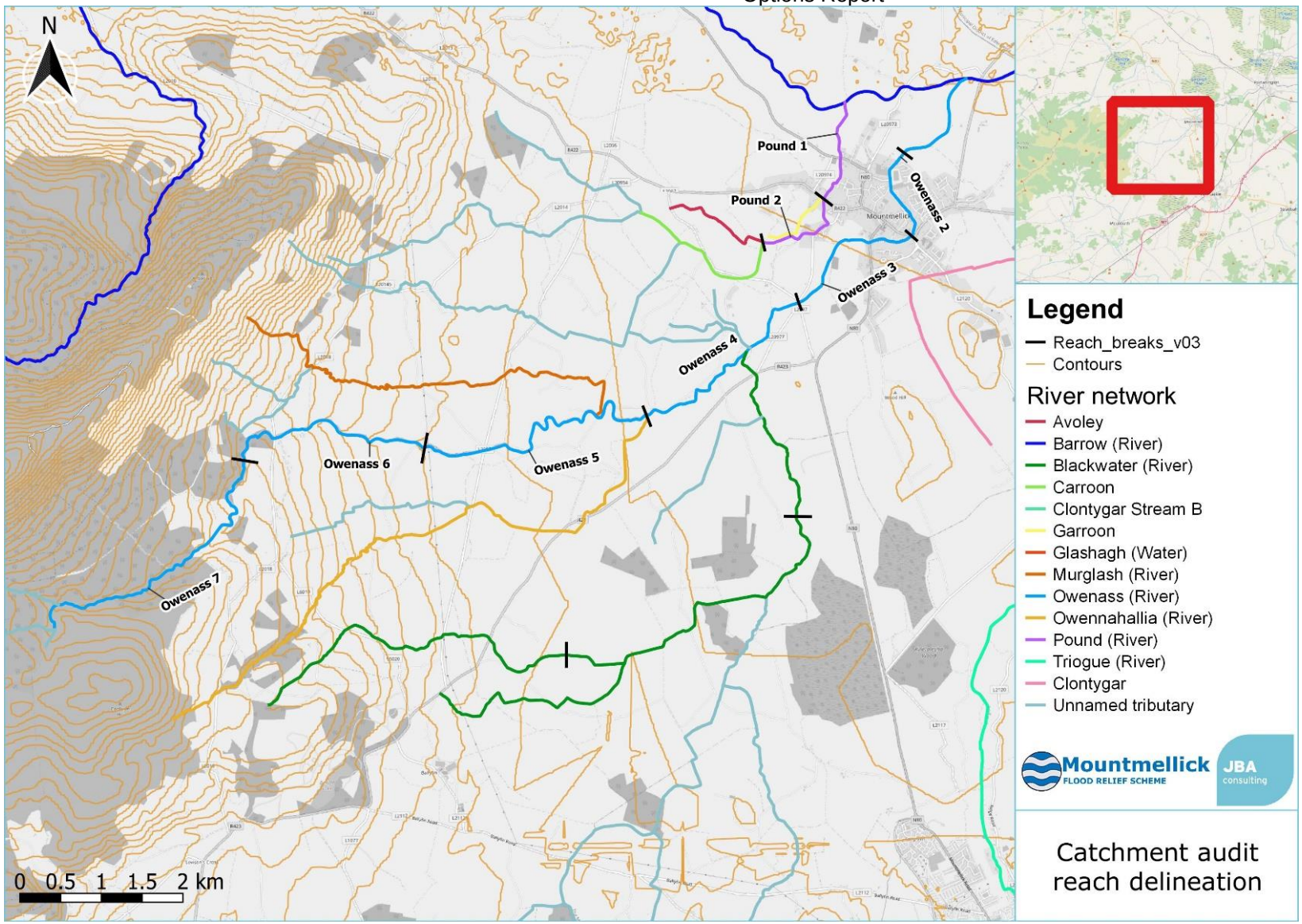



Figure 2-2. Reach delineation for catchment audit of the Owenass and Pound Rivers

Figure 2-3. Owenass 6 contains a bedrock step-pool channel (left) and areas with waterfalls such as the Cathole Falls recreation area (right)

Figure 2-4. Sediment built up between Cathole Falls and a manmade weir

Owenass 5 is much more unconfined in its valley form, transitioning into a single thread alluvial channel with a more moderate bed gradient of 0.6%. The bed is mostly formed of gravel and cobble material, with a moderate amount of fine sediments accumulating across the bed. The reach is exhibiting signs of both deposition and incision (shown in Figure 2-5) including perched bridge apron and undercutting banks, indicating that the sediment balance of the reach is out of regime. This indicates that there is an over-supply of fine sediments, and limited supply of coarse sediments (potentially caused by the barriers noted in upstream sections).

Figure 2-5. The bed of the channel in Owenass 5 exhibiting signs of instability through incision of bridge aprons (left) and siltation of the bed substrate (right)

The upper tributaries include the Murglash and Owennahallia Rivers, which discharge into Owenass 5. The Murglash passes through predominantly agricultural lands but has a wide buffer of natural broadleaf woodland along much of its length. The upper headwaters have been converted to coniferous plantation in recent years. Parts of the river have been straightened to accommodate agricultural development. The Owennahallia River has seen a similar trend.

The resulting bed of the channel is mostly clean gravels, although some areas of bank poaching do exist which contribute fine sediments into the channel, these are not significant. The River Blackwater is another tributary to the Owenass, and exhibits similar pressures of forestry and agricultural land drainage/runoff as the other tributaries, discharging into Owenass 4.

Figure 2-6. The Owennahallia River contains some areas of bank poaching by cattle (left), but overall the bed and banks are stable with clean gravels (right)

Owenass 4 was showing similar processes to those observed in the reach above, with signs of incision and lateral adjustment, as well as fine sediment deposition on the bed. Despite the low quality substrate, a number of fish were observed through the reach during the walkover survey. The right bank, in particular near the Owenass Bridge, is experiencing erosion, through a private residence to the southwest of the bridge. The river Blackwater sub-catchment has surrounding land uses of primarily agriculture and forestry, with cut bog in the upper catchment. It flows north before discharging into Owenass 4. The Blackwater has experienced minor bed degradation/incision, indicating that the sediment transport and supply is out of regime, likely attributed to high flows in the catchment and modification of the river system through land drainage and historic channel straightening.

Figure 2-7. The right bank of the channel is eroding and migrating toward a private residence (left), while the bed is highly depositional (right)

The bed of Owenass 3 is primarily gravel (sized 5mm to 20mm) and sand along its entirety though a mix of unsorted boulder, cobble, gravel and sand was observed along the length of the reach. During a winter site visit, gravels were mostly clean, however the summer site visit showed moderate siltation on the bed, indicating that higher winter flows are sufficient to flush fine sediments through the system. The banks are uniformly straight and steep, and in localised areas lined with concrete or rock armour. Gravel deposits were observed on inside bends and in mid-channel bars near bridges. In the middle of the reach, there is a riffle-pool sequences created by the rock weirs present on the bed. These rock weirs are composed of boulders approximately 200mm to 300mm in size and provide a gradient and transition to areas of shallow, fast flow, providing some hydromorphological naturalness and diversity.


Figure 2-8. Substrate is primarily gravel, with sand deposited on site bends

Figure 2-9. Signs of bank degradation in Owenass 3 include ad-hoc concrete and possibly historic town defences (left), and signs of historic poaching and slumping (right)

The river in Owenass 3 is historically straightened, with bank infrastructure in place to maintain the channel width and position (concrete walls, rock armour, etc.). There are a number of signs of bank instability where the river is attempting to move laterally, including localised areas of rock armour through fields, fragments of one old concrete weir that has failed (historic mapping shows that this dates from 1837), and slumping adjacent to the walkway downstream of the N80 bridge. The left bank contains some areas of concrete wall and rock armour, with some open grassy areas where gardens backed onto the riverbank. Where there was no concrete or rock walls, scour was observed on the left bank exposing steep clay faces.

Figure 2-10. Owenass 3 has been historically straightened/channelised (left), with little riparian vegetation and bank instability (right)

Two drains were also noted on the right bank: (1) immediately upstream of the bridge is producing fine sediments and causing build up and macrophyte growth, with a foul smell (suggesting that it may be sewage), and (2) an agricultural drain was observed further upstream adjacent to a field containing cattle.

Owenass 2 spans from the bridge over R422/Sarsfield Street (Convent Bridge) to the Mountmellick WWTP. This reach was confined with high, steep, uniform banks along the entire length. Vegetation on the banks included grasses with some shrubs and small trees. Rock armour was present in localised areas on both banks, with concrete armouring the low banks where the river runs behind houses near the R422 crossing.

The bed was primarily composed of gravel and sand with some mid-channel bars (some vegetated) and sand deposits on the lower bank margins and on inside bends. This reach has been historically modified/channelised but despite this has heterogeneity in its flow and depths (similar to riffle-pool sequence, but artificially created from boulder weirs), suggesting that it is effective in managing a sediment regime through a balance of erosion, deposition and transportation processes.

Figure 2-11. Heterogeneous flows created by boulder weirs (left) and evidence of sand deposition on bank margins (right)

### Pound River

This stream is known locally as the Pound River, though it is named Manor House Stream (IE_SE_14B010500) in the EPA River Network. Tributaries of the Pound River originate to the west of Mountmellick town, meeting just upstream of the L2097. The Pound River flows relatively parallel to the east of the Owenass, and deposits directly into the Barrow River.

The upper reaches of the Pound (including the Avoley Stream and the Garroon, as well as upper headwater tributaries) flow through predominantly agricultural lands and are straightened and deepened to accommodate land drainage. The few agricultural drains observed were contributing fine sediment to the system. In the upper tributaries and interspersed throughout the sub-catchment there are patches of coniferous plantation.

Figure 2-12. Fine sediment deposition observed in the Garroon Stream from agricultural drainage (left) and in other unnamed tributaries in the upper Pound sub-catchment

Within the Manor Grove Estate (Pound 2), the river is highly channelised and culverted, and runs underground within a concrete-based channel. Gullies or grates are present which allow drainage into the river in multiple places along the footpath and the road. The bed is composed of a mix of sand, fine sediment (silt), and gravels. Large bars of fine sediment were observed along the toe of the walls and on inside bends, as well as a small amount of instream vegetation growing on these depositional areas.

Figure 2-13. Showing extent of channelisation and vegetation growth observed at toe of bank (left) and fine sediment deposition observed on inside bends, toe of banks, and around structures (right)

Downstream of the Manor Grove Estate, the Pound River flows north through agricultural lands to its confluence with the Garroon Stream at the R422 crossing. At this crossing, poaching from cattle and agricultural runoff are inputting fine sediments into the system.

Figure 2-14. Bed is a mix of gravel and sand with fine sediment deposited on inside bends and at structures (left), and evidence of cattle poaching contributing fine sediments to the system at the R422 crossing (right)

A large deposit of fine sediment was observed upstream of the bridge at N80/Chapel Street (Pound 1), in an area where concrete blocks were previously dumped into the channel bed. A low embankment on one bank shows evidence of where previous channel maintenance/dredging likely occurred in the past.


Figure 2-15. Low embankment beside river shows signs of previous dredging/maintenance works (left), with fine sediment deposits observed on bed (right)

#### Summary of system functioning

The Owenass River receives coarse sediment primarily from the low hills at the foot of the Slieve Bloom Mountains. In the main channel, materials are transported downstream and become trapped behind a weir at the Cathole Falls recreation centre. This coarse sediment starvation is causing localised incision of the bed, particularly in reach 5. Despite this barrier to sediment transport, gravel materials are transported into the Owenass further downstream from the Owennahallia, Murglash, and Blackwater Rivers in Owenass 4. These tributaries also contribute fine sediments into the Owenass catchment, which in the lower reaches (Owenass 4 and Owenass 3) contain a moderate amount of fine sediment burying the cobbles and gravels.

Despite the trend of deposition, the lower reaches of the Owenass are also experiencing incision and bank instability, indicating that the system has unnaturally high loads of fine sediment, as well as a starvation of coarse sediment, and potentially a change in flood peaks causing higher flows. This would be expected, due to the trend of land drainage seen throughout the catchment to accommodate agricultural and forestry uses. Through Mountmellick town, the bed of the Owenass is primarily gravel with unsorted cobble. The bed contains sections of uniform bed features, with some sections of shallower faster flow, and deeper slower flows created by manmade boulder weirs. The bank condition through Mountmellick town is poor, with several instances of bank instability and bank collapse observed. The scheme will require consideration of this observed channel adjustment to ensure that changes to the flow regime do not put infrastructure or habitats at risk of further evolution.

The Pound River system has a similar trend of agricultural and forestry land use in the upper part of the catchment but is contributing much higher fine sediment loads into the system in comparison to the Owenass. The river has been historically straightened and deepened, and as a result the channel is disconnected from its floodplain. Fine sediment inputs are causing a build of up fine sediments on the bed of the lower reaches from the Manor Grove Estate (Pound 2) to the downstream sections in Pound 1, however the flows are not sufficient to flush these out. The consequence is fine sediment build up around structures, including through the uniform channel bed of the Manor Grove Estate, upstream of bridges, and on the inside of bends. The presence of old ad hoc embankments along Pound 1 indicates that historically the channel was likely straightened and deepened, and consequently required regular maintenance and dredging. The absence of maintenance works without measures to manage fine sediment in the upper catchment has caused a build-up in the lower reaches.

### 2.2.2 Hydromorphological pressures

Currently, none of the waterbodies within the catchment are considered "At Risk" due to hydromorphological pressures. There are, however, some issues to the sediment dynamics that were noted within the various waterbodies that could be exacerbated by the proposed scheme. These pressures should be considered with regards to their impact on future WFD status and instream habitat more generally.

Pressures in the Pound River include:

- High fine sediment loads are entering the channel from agricultural runoff, this has consequences for both physical instream habitat and water quality.
- Historic straightening and deepening of the channel have caused the river to be disconnected from the floodplain, causing fine sediments to be trapped in the channel as opposed to dispersing through the

floodplain during high flows. This is particularly an issue through the Manor Grove Estate and at bridges where sediments have built up in the channel.

- The riparian habitat is generally poor along the length of the river and there is a consequential lack of hydromorphological naturalness and diversity of instream habitats.

Pressures in the Owenass River include the following:

- The lower reaches of the Owenass are experiencing incision (erosion and lowering of the bed) due to a lack of coarse sediment supply and deepening of the channel (particularly in Owenass 3, 4, and 5), which causes a positive feedback of sediment imbalances due to increased shear stress applied to the bed at high flows.
- Bank instability has been observed, particularly in Owenass 3 through the scheme area in Mountmellick town. This is likely a consequence of incision, lack of riparian vegetation and rooting structures to hold banks in place, historic poaching, and natural channel migration.
- Poor riparian habitats in Mountmellick town detract from the river's ability to provide good physical instream habitat.
- Fine sediment deposition observed on the bed in Owenass in summer indicates that fine silt materials are being released from the upper catchment, from both agricultural and forestry lands. Winter flows are sufficient to flush these silts and transport them lower into the catchment and into the River Barrow.
- There is a general lack of diversity and naturalness of bed forms downstream of Mountmellick 5, likely due to historic straightening of the channel, over-widening, and deepening.

### 2.2.3 Opportunity for the scheme

There are opportunities within the scheme to restore sediment imbalances within the system, mitigate potential impacts of the engineered scheme, and improved instream and riparian habitats along the Owenass and Pound river systems.

Where possible, the scheme should aim to take measures that:

- Improve river-floodplain connection on the Owenass upstream of the town of Mountmellick, particularly in reaches 3, 4, and 5. This could be achieved through raising of the channel bed, lowering of the immediate floodplain into a two-stage channel, and/or or setting back of defences to allow flooding to occur.
- Control and reduce fine sediment inputs into both the Owenass and Pound river tributaries through alternative land management practices and/or nature-based solutions to trap fine sediment in the floodplain, particularly in the upper and middle parts of the catchment.
- Improve riparian habitat on both river systems by planting appropriate native tree species that are tolerant to both wet and dry conditions.
- Undertake, or ensure that measures will not prevent in the future, works to improve instream habitat diversity and naturalness, for example through restoration of a more sinuous channel or through installation of boulder or flow deflection features.

## 2.3 Architectural and archaeological sites in Mountmellick

In so as far as is practicable, flood defence proposals have considered the preliminary constraints identified in the preparation of the ‘Mountmellick Flood Relief Scheme Constraints Study’. A summary of the main design constraints are as follows:

- Construction works may impact the Mountmellick Heritage Trail, Mountmellick Playground, the River Owenass bank walkway and the plans for the proposed inner relief road.
- The existing Owenass Bridge would need to be replaced with a structure with greater hydraulic capacity to prevent increase in scour risk and damage due to increase hydraulic loading.
- Mountmellick has a notable amount of cultural heritage, with a Zone of Archaeological Potential in the town centre; 3 Recorded Monuments; 71 National Inventory of Architectural Heritage (NIAH) sites; 78 Protected Structures; and a potential Architectural Conservation Area yet to be designated. These may be impacted by the FRS.
- The installation of FRS options may impact and/or reduced view of the River Owenass along the riverbank walkway, at bridges and from a small number of residential properties; and generally, impact views from a larger sub-set of residential properties.

## 2.4 Public Consultation

Proactive consultation was a key requirement of the project. The purpose of the consultation is to obtain feedback on the proposals from all relevant affected stakeholders and landowners who might be impacted by the Scheme. Feedback throughout the project has been taken seriously, carefully considered, and where appropriate has influenced decisions on the final FRS. The goal is that this ensures the public's opinion is taken into consideration when developing the plan and that people are informed of the influence they have had. The methods of consultation that have taken place include but were not limited to:

- A Public Engagement Day (PED) - This was held at the Mountmellick Development Association (MDA) on 13 November 2019 and was attending by 90 members of the public.
- An Emerging Options Engagement Event - This was a virtual event because of the COVID restrictions in place at the time and ran over a longer period from 16 April to 10 May 2021. It gave the public the opportunity to join virtual meeting rooms at pre-publicised times to learn about, ask questions a pass comments on the emerging options.
- A Public Information Day (PID) - This event took place on 12 September 2023 and, as with the PED, was also held at the MDA and gave the public the opportunity to meet and question the project design team about the preferred option. 88 people attended the event and a total of sixteen questionnaires were submitted during and in the period following the event.

Detailed consultation planning for the project has been developed stage-by-stage, and is updated when necessary, in partnership with the Technical Advisory Group (TAG).

### 2.4.1 Ongoing Consultation

Comprehensive communication and engagement plans have been developed and adopted by the team, including the development, and maintenance of a project website, direct emails, newsletters, local media, and public consultation among other approaches as listed in Table 2-1 below.

Key elements of the project include the establishment of social media forums, such as a Facebook project page and website. The purpose of the social media accounts is to maintain communication flow and provide updates for all interested stakeholders that have access to it; it can be a faster and more efficient way to keep the public informed of the progress of the project and is already established as a method of communication amongst community groups in the town.

A Scoping Report for the EIAR has been shared with Statutory Bodies, non-statutory bodies, and interested stakeholders for feedback. Their views will be considered in the preparation of the EIAR.

Table 2-1: Mountmellick FRS Communication and Consultation Approaches

| Communication Activity | Details and Purpose |
|---|---|
| Project website | www.mountmellickfrs.ie<br>To promote and provide information to stakeholders about the project.<br>It provides a source of information that stakeholders and members of the public can download and review.<br>It gives a means of consultation and allows stakeholders to ask questions or submit information. |
| Direct email | Where stakeholders have supplied their contact details, we notify of project updates, invitations to consultation events via email.<br>Statutory consultees were also notified of the commencement of the project and of the consultation events. |
| Social Media | Facebook page was established alongside the website to reach residents and community groups. This page is updated with key project stages and used as a rapid reach tool, supporting the website. |
| LCC website | News headlines, links to project website, publicise consultation events. |
| Local Media<br>TV, radio, newspapers, magazine or publications | Press releases are prepared in advance of public meetings and distributed to the media.<br>Media is monitored periodically for news and articles relating to the scheme. |
| Local community publications such as parish newsletters | Press releases are prepared in advance of public meetings and distributed to local community groups, churches etc. |
| Public Engagement Days / workshops - held at a community venue. | Consultation exhibitions / events offer a more extensive and open form of engagement on a personal basis. They provide opportunities for members of the public to express views on the consultation subject area, ask questions, take on board the information at their leisure, discuss any concerns, provide a view and receive feedback on the issues they raise. |
| Community groups and forums | Community groups provide opportunities to reach a wider community. Meetings can be used as an opportunity to promote a project event. |
| Council meetings | Council meetings can provide opportunities to promote the study and website via meetings and newsletters. Engagement with elected members also allows for promotion of the scheme and engagement events within the wider community. |
| Telephone calls and direct messages | Where a relationship with an interested party has been formed, phone calls and text messages are used to provide short updates or seek feedback on specific aspects of the project. |

### 2.4.2 Public Engagement Day

Shortly after project commencement, the first Public Engagement Day (PED) event was held in Mountmellick with the aim of meeting with stakeholders that may be directly or indirectly affected by the FRS. The goal of the event

was to find out more about the flooding history of the town, elicit early opinions and to start to build a relationship with members of the local community. The event was open to any and all interested parties.

The PED took place on 13 November 2019 and ran from 3pm to 8pm. It was held at the Mountmellick Development Association (MDA), Irishtown, Mountmellick. The event was set-up in a drop-in format, the exhibition room had information stands and posters, a registration table, one-to-one and small group discussions, and questionnaires to be completed or taken away for later submission. Due to an early influx in attendees, a presentation was also given, providing an overview of the stages and aims of the scheme.

The promotion of the public consultation workshop was carried out through various means such as posters, social media, traditional media (newspaper, radio), leaflet drop and word of mouth.

Nearly 100 people attended the event, with 26 questionnaires returned either on the day, or subsequently to the JBA office. The feedback provided on the day, and in following conversations, has been useful in developing the flood relief scheme. There was a lot of genuine interest in the works, and particularly in the timeline for construction. However, the feeling from most attendees was that a solution was needed, and there were concerns about what would happen until the scheme was finished. Calls for river maintenance were widely heard. There was also a lot of discussion of flooding from the combined system, with a number of attendees reporting this is the mechanism that caused flooding, rather than the river directly.

There was also a good representation from residents outside Mountmellick, particularly in Derrycloney, many of whom nearly flooded in 2017 and where concerned about the impact of a scheme on future flooding.

It was interesting to note that the forestry practices in the Slieve Blooms were widely discussed and were seen to have exacerbated runoff over recent years.

### 2.4.3 Emerging Options Engagement Event

A second engagement event was held in April 2021. Due to COVID-19 restrictions, this event was held on-line with a virtual meeting room set up as part of the project website. As with the PED, the event was promoted through the traditional media, social media (Facebook and website) an extensive paid-for leaflet drop, posters in the town and word of mouth, particularly following a briefing of elected members prior to the event launch.

The event was launched on 16 April 2021 and ran officially until 10 May 2021, although submissions via email and phone were received for some time after this date.

As well as a video presentation and documents available within the meeting room, there were opportunities for interested parties to return a questionnaire or request a follow up call / Teams meeting to discuss particular areas of interest.

### 2.4.4 Public Information Day

The Public Information Day (PID) took place on 12 September 2023 and ran from 3pm to 8pm. It was held at the Mountmellick Development Association (MDA), Irishtown, Mountmellick. The purpose of the event was to inform the public about the preferred option – how it was developed, why it was chosen and the impact it would have on flood risk in the town and the area upstream of the town. event was set-up in a drop-in format, the exhibition room had information stands and posters, a registration table, one-to-one and small group discussions, and questionnaires to be completed or taken away for later submission.

The promotion of the public consultation workshop was carried out through various means including a newsletter, the scheme website, press release, social media, radio and word of mouth.

88 people attended the event, with 16 questionnaires returned either on the day, or subsequently to the JBA office. In addition, ten members of the project Design Team were present at the event (three from JBA, two from JBB, three from LCC and two from OPW) to discuss the project on a one-to-one basis with the attending public. This resulted in a further 21 issues being raised.

The display materials used at the event were uploaded to the project website, www.mountmellickfrs.ie immediately following the event.

The feedback provided on the day is to be used in developing and finalising the preferred option of the flood relief scheme and progressing into Stage 2 - Planning.

# 3 Baseline Flood Hazard, Exposure, Vulnerability and Risk

## 3.1 Introduction

An understanding of the existing risk and flood mechanisms is required before considering a scheme to defend against flood risk. By examining the current flood risk within the catchment, a more focused approach to the development of the scheme targeting the key causes of flooding can be made. This section discusses the baseline flood mechanisms for the Mountmellick scheme area and their impacts to provide context to the logic of the measures tested.

## 3.2 Baseline design event

The design flood event for the Mountmellick FRS is the 1% AEP event. The aim of the scheme is to provide protection to risk receptors up to and including this event. Figure 3-1shows the extents for the 1% AEP event with additional detail for key areas provided in the following sections.

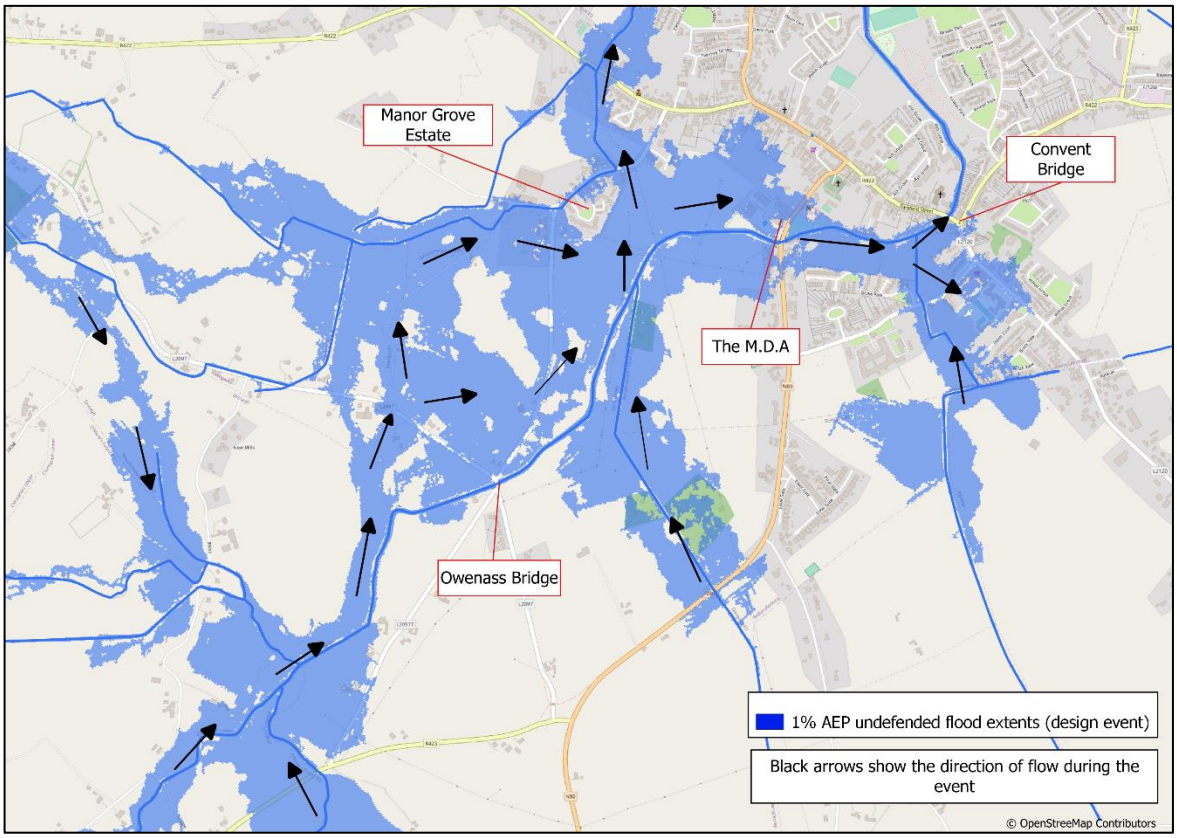



Figure 3-1: Design flood event - 1% AEP event baseline scenario

## 3.3 Performance of existing flood defences and influence other non-flood defence infrastructure on flood hazard and risk

There are currently no formal flood defences within the Mountmellick AFA.

A single area of wall was retained in the baseline scenario to ensure the onset of flooding is realistic: The walls along the Pound river at Manor Court (refer to Figure 3-2). A sensitivity test with these walls removed was run for the 1% AEP event. The removal of the walls on the Pound resulted in an increased area of flooding and to a greater depth highlighting that the walls, while not formal do provide some level of protection. These walls have been included in all the baseline modelling and establishment of the 1% AEP flood extents.

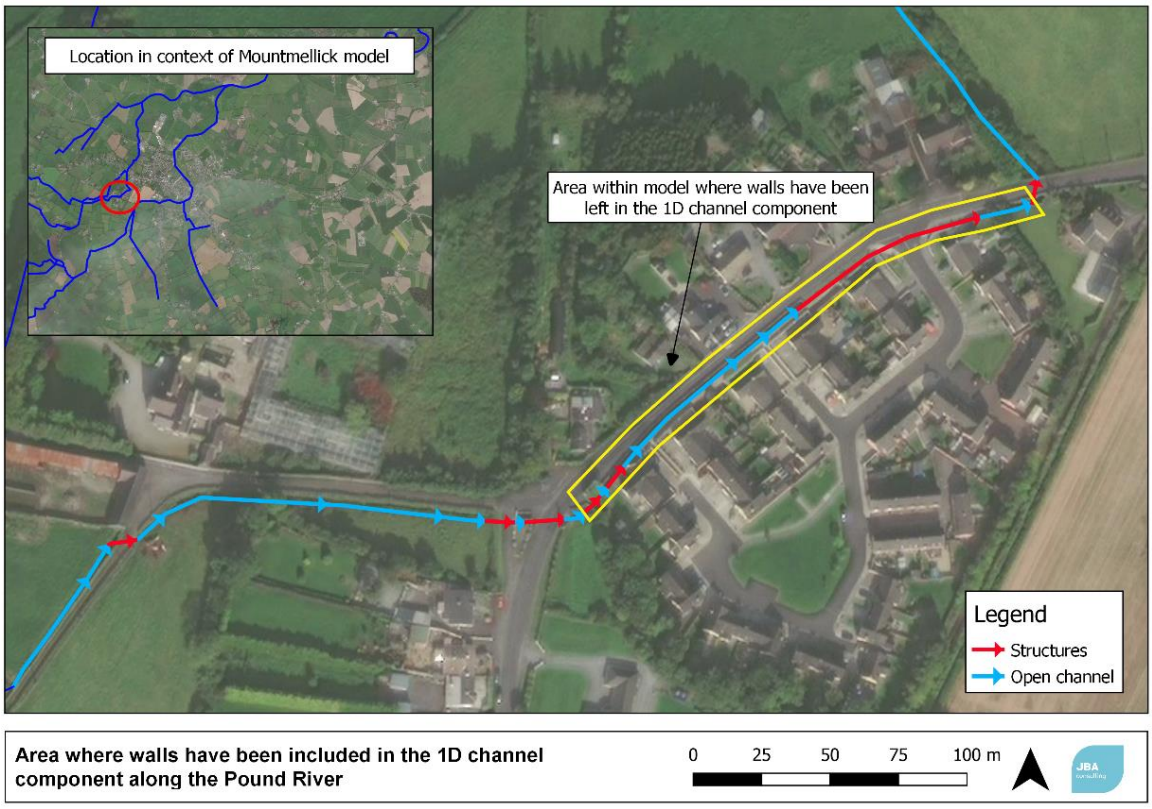



Figure 3-2: Area where walls have been included in the 1D channel component along the Pound River

## 3.4 Definition of Flood Cells and Flood Mechanisms

For examining the baseline scenario flood extents for the 1% AEP event a single Flood Cell has been defined that encompasses the entire scheme area. A single Flood Cell has been defined as there is cross flow within the catchment meaning that the flood mechanisms for the Mountmellick area are all interconnected. Figure 3-3 shows the single Flood Cell. Discussion of the various flood mechanisms within the scheme area is found in the following sections.

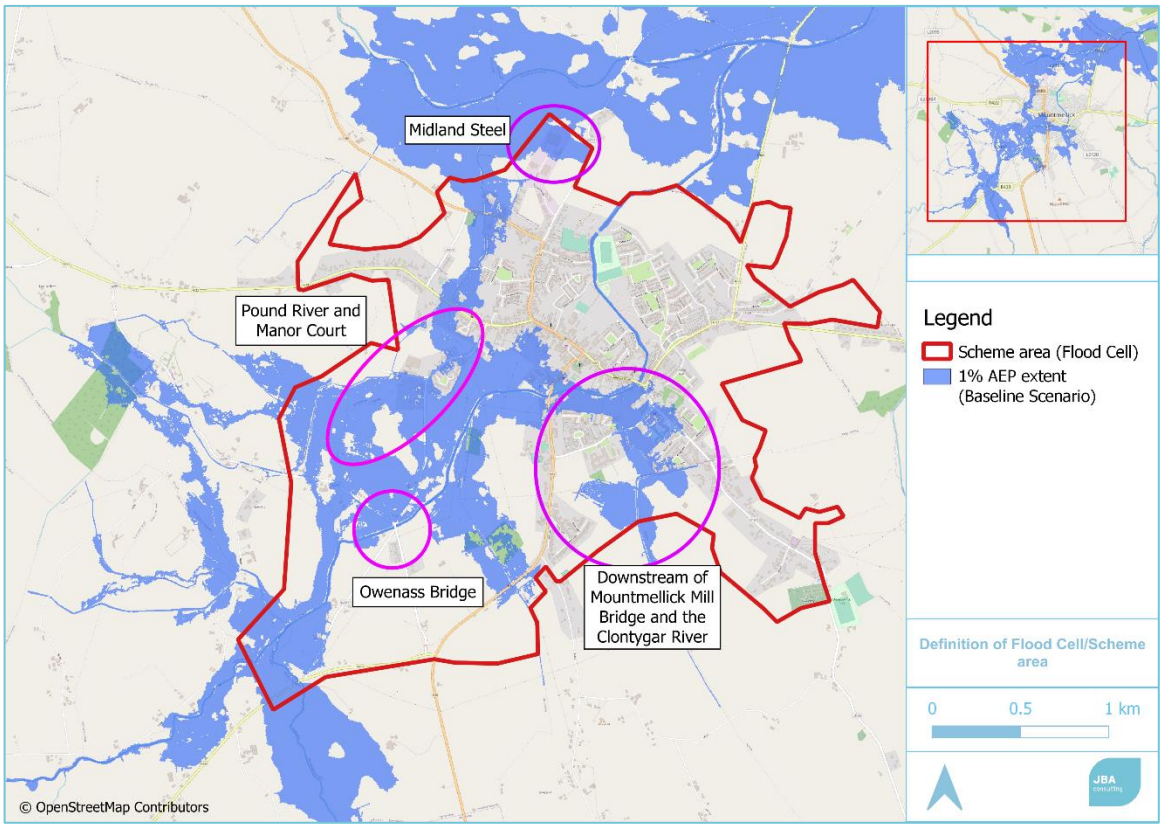



Figure 3-3: Definition of Flood Cell/Scheme area

### 3.4.1 Flood Mechanisms

The key flood mechanisms for the scheme area are the constriction of the system and the interaction between watercourses due to cross flow.

#### 3.4.1.1 Constriction of the Pound River at Manor Court

Along Manor Road the Pound is confined to a narrow concrete channel with several small bridges and culverts present along the reach, as well as a 75m long culvert (refer to Figure 3-4). In higher frequency events, the Pound can convey flows through this engineered reach. In lower frequency events, with the addition of cross flow from the Owenass and cumulative backwater effects from these structures, the conveyance capacity of this reach is exceeded, with the culverts and bridges surcharging. This results in out-of-bank spill emerging from the short sections of open channel between culverts and bridges, flowing down the road, into Manor Court estate and around the estate across the Owenass-Pound flood plain.

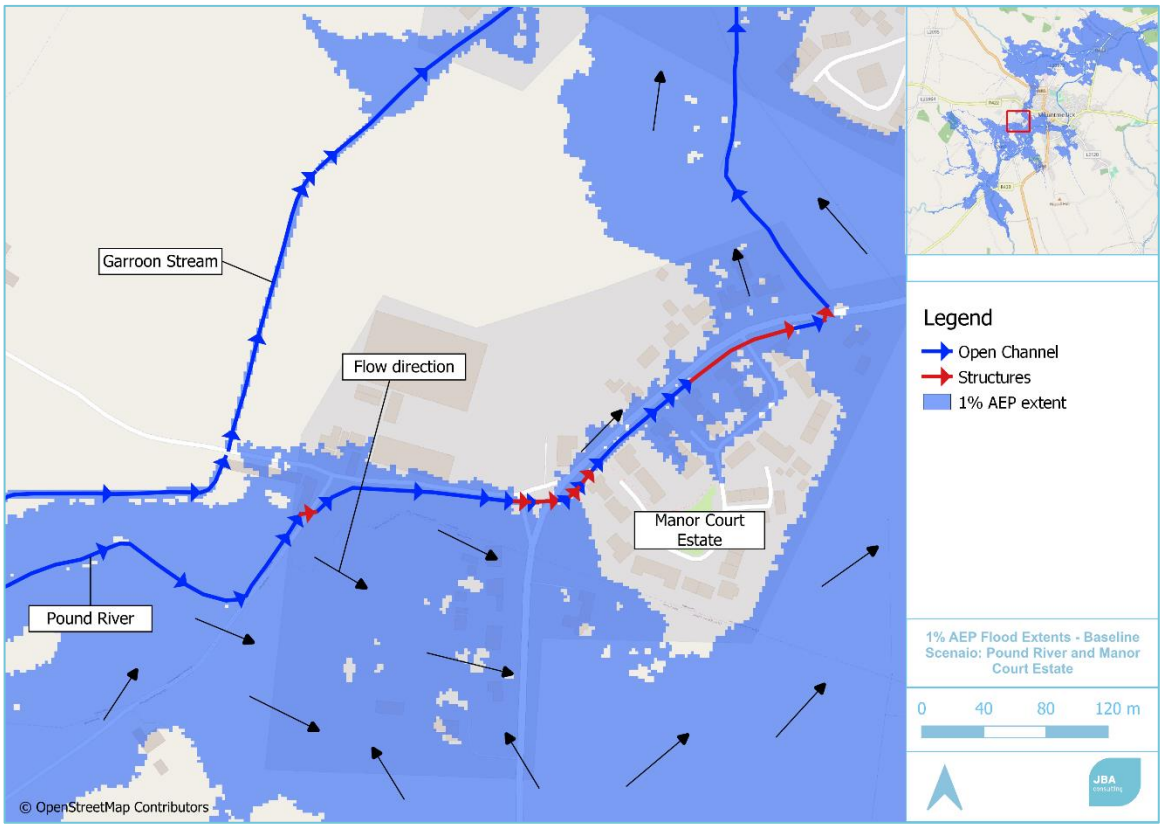



Figure 3-4: 1% AEP Flood Extents - Baseline Scenario: Pound River and Manor Court Estate

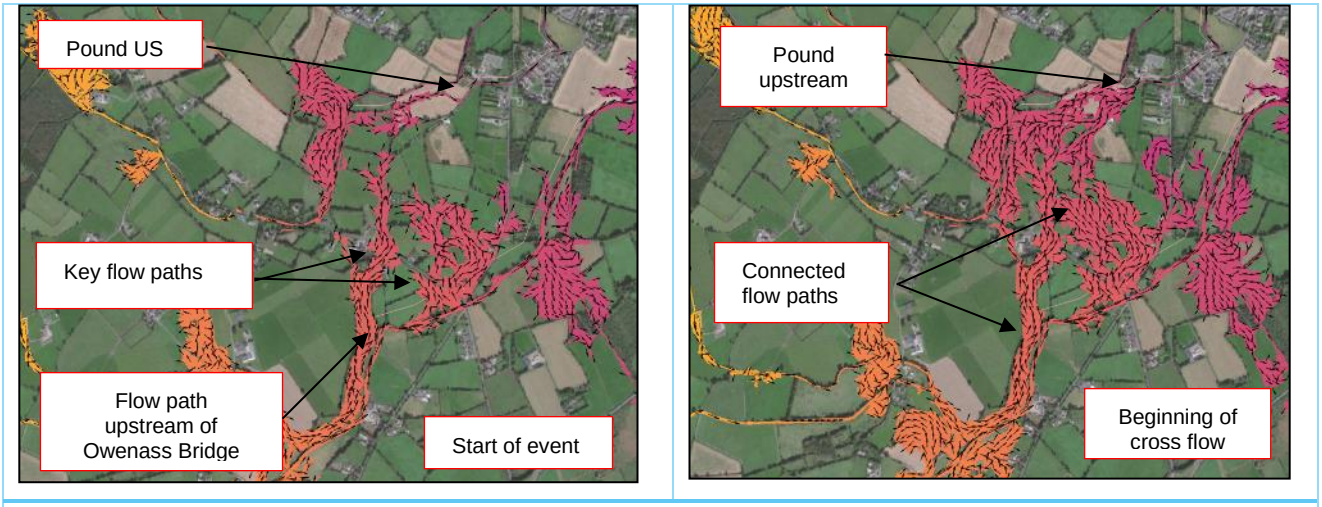
3.4.1.2 Cross catchment flow between the Owenass and Pound Rivers

Cross catchment flow is a key flood mechanism paired with low banks that generates flooding in the area. The interaction of the rivers aggravates the flooding of each watercourse by further overwhelming the systems.

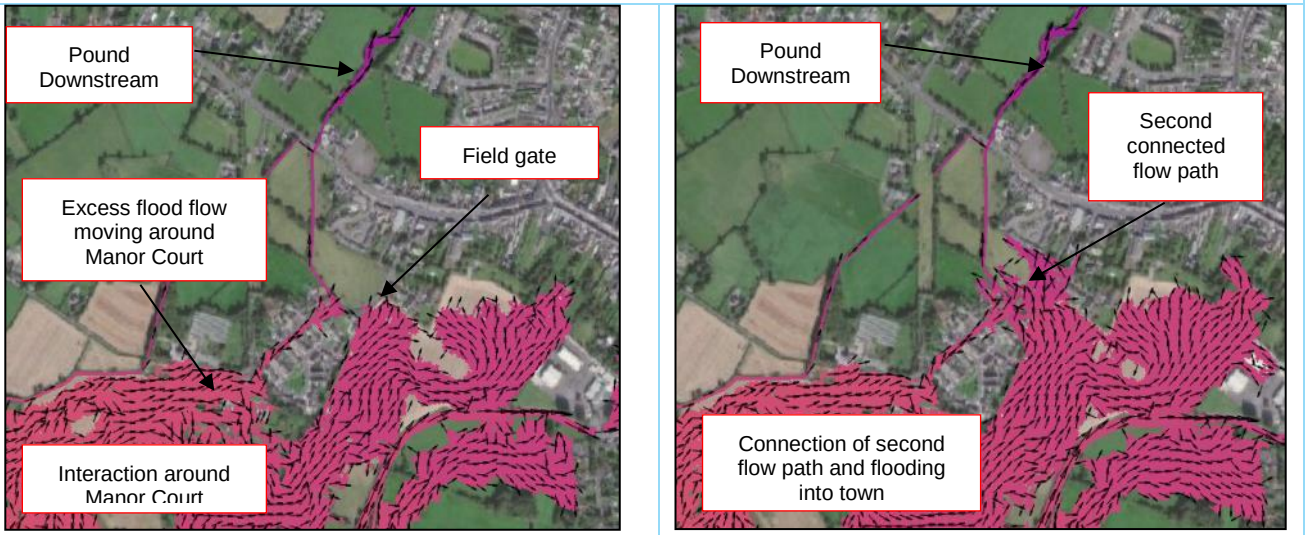
Initially, out of bank flow from the Owenass spills upstream of Mountmellick town around Owenass Bridge. This is caused by increased flows, low bank levels and a constriction caused by Owenass Bridge itself, particularly upstream of the bridge. These flow paths move across the flood plain towards the Pound upstream of Manor Court via topographical low points and pathways within the flood plain (refer to Figure 3-5). The impact of the additional flow from the Owenass in the Pound is shown by the sharp increase in level observed in the hydrographs along the Pound watercourse (Figure 3-5). As mentioned in Section 3.4.1.1 the Pound, an already constricted channel due to the presence of multiple structures, becomes overwhelmed by the flow volume. Increased out of bank spill occurs upstream of Manor Court. This spill, now a combination of flow from the Owenass and Pound, moves across the flood plain in a south-easterly direction around Manor Court towards Mountmellick Town. A large proportion of this flow returns to the Pound watercourse downstream of Manor Court passing through a field gate and across the road while some enters back into the Owenass highlighting the transfer of water back and forth between the two systems.

Directly upstream of Mountmellick Mill bridge another flow transfer pathway from the Owenass to the Pound is activated with a portion of the out of bank flow at this point moving across the field and into the Pound via the same flow path while the rest fills up the flood plain upstream of the main town (Figure 3-5).

This back-and-forth transfer of flow between the watercourses, the limited capacity of the Pound upstream and the activation and filling of the flood plain between the two rivers is the main driver of flooding with the town and wider area.




**Establishment of upstream flow connection between Pound and Owenass**




**Establishment of second downstream flow connection between Pound and Owenass, also note movement of flow back into Owenass towards the south of the images**

Figure 3-5: Cross catchment flow between Owenass and Pound Rivers

3.4.1.3 Downstream of Mountmellick Mill Bridge and the Clontygar River System

The overwhelming of the Owenass River system continues to cause flooding downstream of Mountmellick Mill Bridge. The open greenspace on the right bank is completely inundated by the flood flows (Figure 3-6. This has a knock-on effect on the Clontygar River system. Upstream the Clontygar is already subject to flooding due to constructing structures and low bank levels but the increased levels downstream increase flooding due to the backwater effect resulting in spill along Davitt Road and further downstream near Convent Bridge. Downstream of Convent Bridge the flood waters remain in channel as much of the volume has escaped upstream into the floodplain.

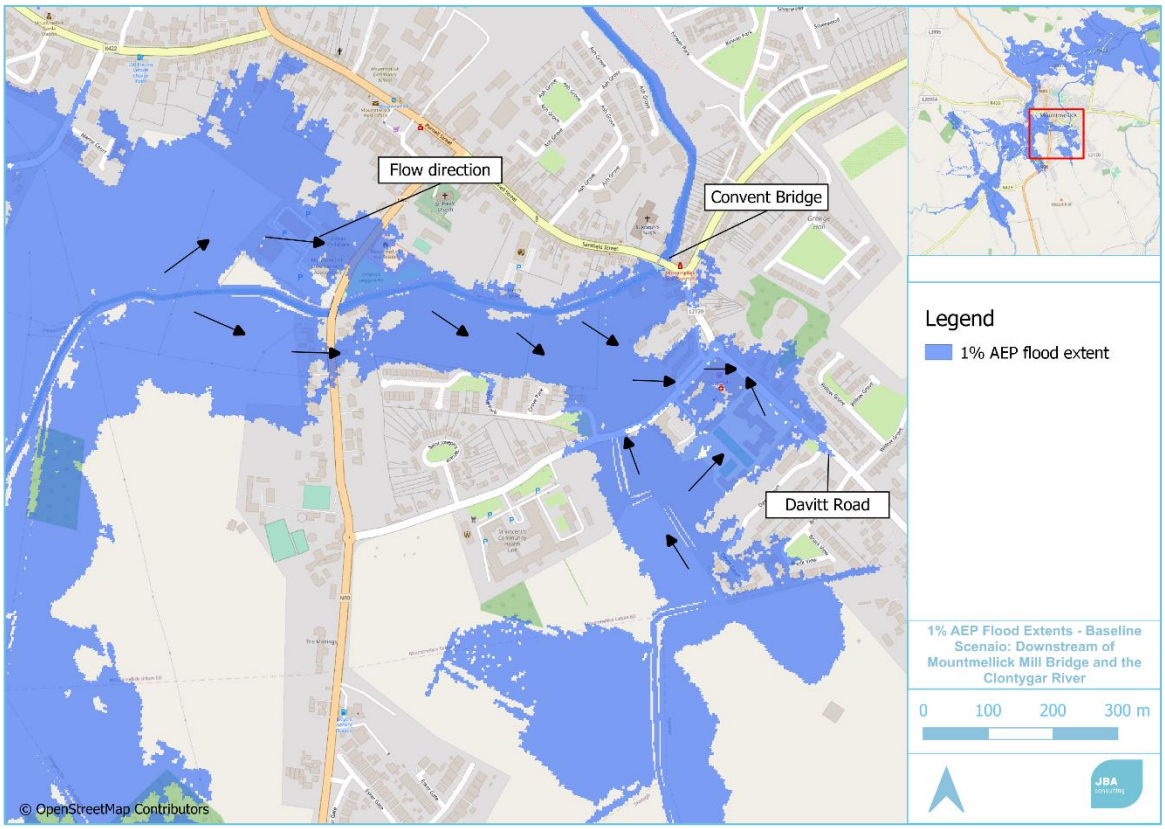



Figure 3-6: 1% AEP Flood Extents - Baseline Scenario: Downstream of Mountmellick Mill Bridge and the Clontygar River

#### 3.4.1.4 Bay Road Business Park

Bay Road Business Park is located north of Mountmellick town closer to the River Barrow (refer to Figure 3-7). During the flood event the area is overwhelmed by out of bank flooding from the River Barrow resulting in increased backwater effects on the Pound River at this location as well. The combination of flood flows from these two watercourses results in overland flow moving across the flood plain and impacting the Midland Steel site. It is noted that due to the steep slopes of the Pound and Owenass Rivers this is the only location within the scheme area where the River Barrow has an impact on a risk receptor. All the flooding upstream and within Mountmellick town is not influenced by the River Barrow.

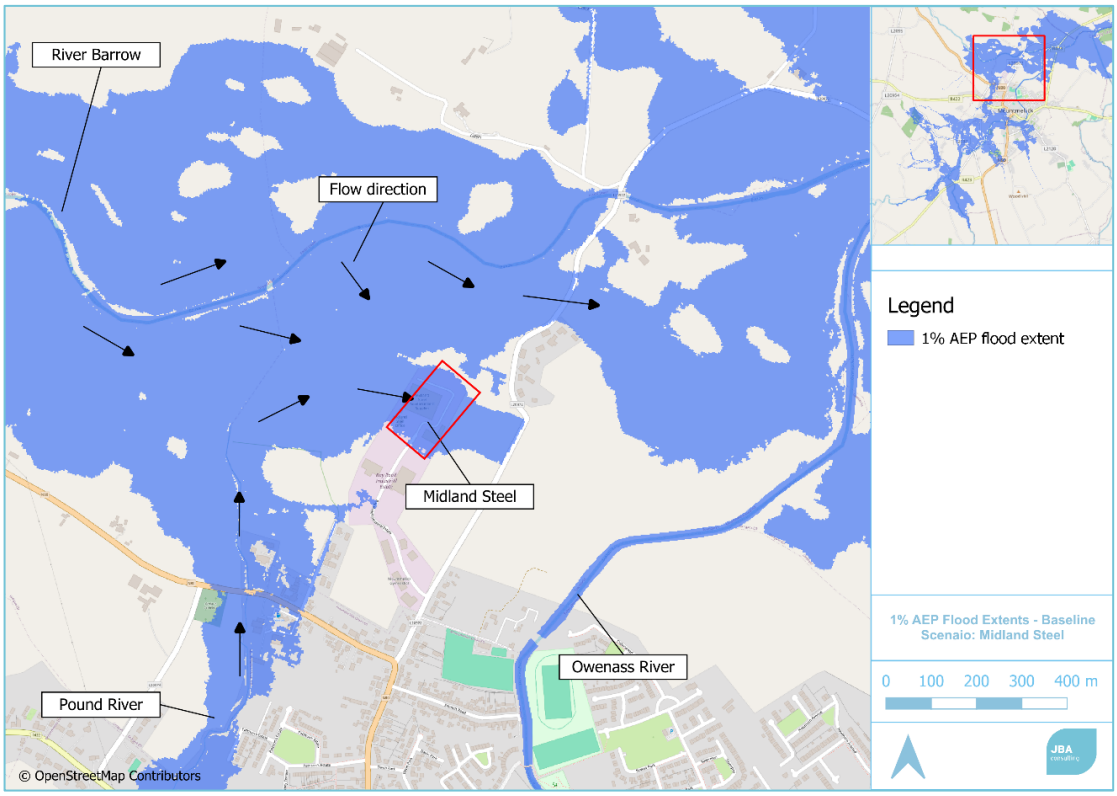



Figure 3-7: 1% AEP Flood Extent - Baseline Scenario: Midland Steel

## 3.5 Baseline flood damages

### 3.5.1 Damages

A damage assessment has been carried out, and previously presented to the progress meetings. Two alternative values for damages have been prepared; the first covers the AFA area only and relates to Option 1. The second covers a wider area upstream of Mountmellick and relates to Option 2A and 2B.

The target standard of protection for the scheme is 1% AEP.

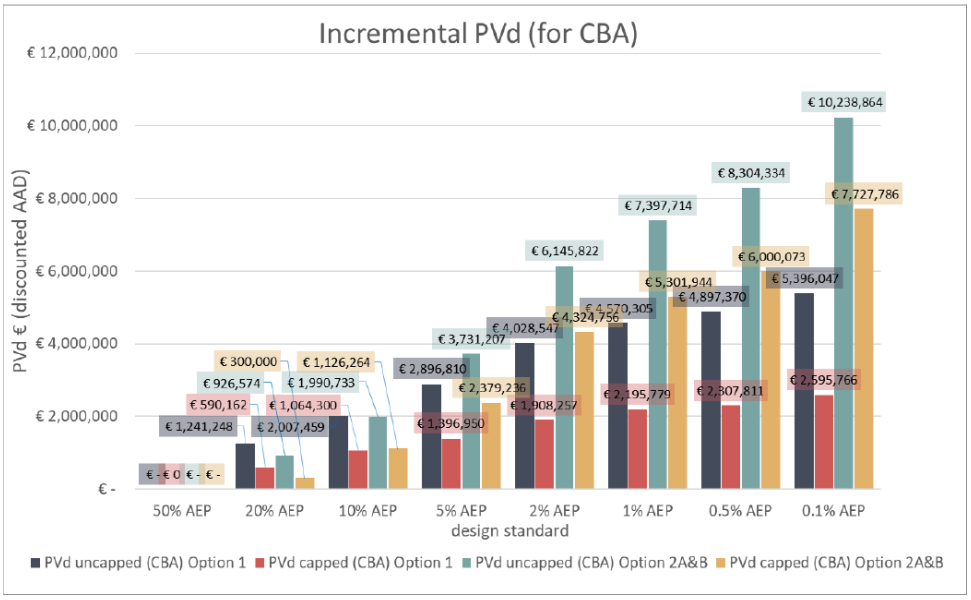



Figure 3-8: Present value of Damages

The table below shows the actual damages incurred as a result of the 2017 flood event which was assessed as being approximately a 1% AEP event, as well as the damages calculated for the 0.1% AEP event.

Table 3-1: 2017 real damages vs calculated damages

| Business | 2017 | Calculated direct damages for 0.1% AEP event | Comment |
|---|---|---|---|
| **Midland Steel** | €550k | € 1,098k | Ground mounted electricity to equipment is vulnerable. Some changes to location of operating panels has been made and plant has been relocated to an alternative site. A temporary berm is also being constructed along part of the perimeter of the site. |
| **HSE building** | €430k | €119.9k | Property type and equipment loss not reflected in MCM. However, HSE have installed racking to reduce losses in future |
| **Standex** | €200k | €80.7k | Covered loss of stock. Building costs included in MDA figure below. |
| **MDA building** | €539.2k | €437k | Includes structural repairs to Standex and HSE buildings, and whole of the MDA building (including café). Note 15% cut on insurance payout was taken for early settlement. |
| **Creche** | €337.6k | €182.3k | Includes combination of buildings and contents. |

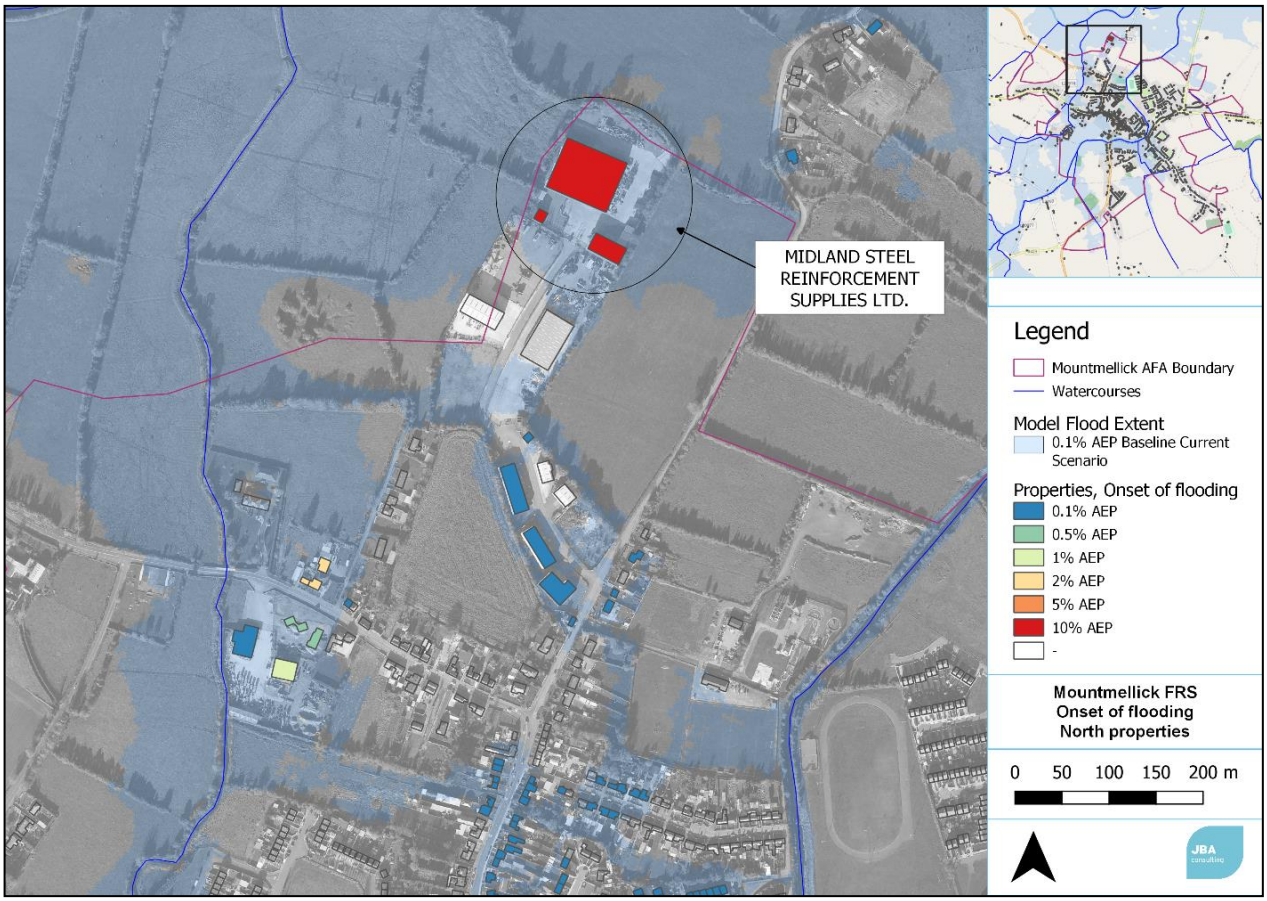



Figure 3-9. Map showing the onset of flood damages to properties. North properties

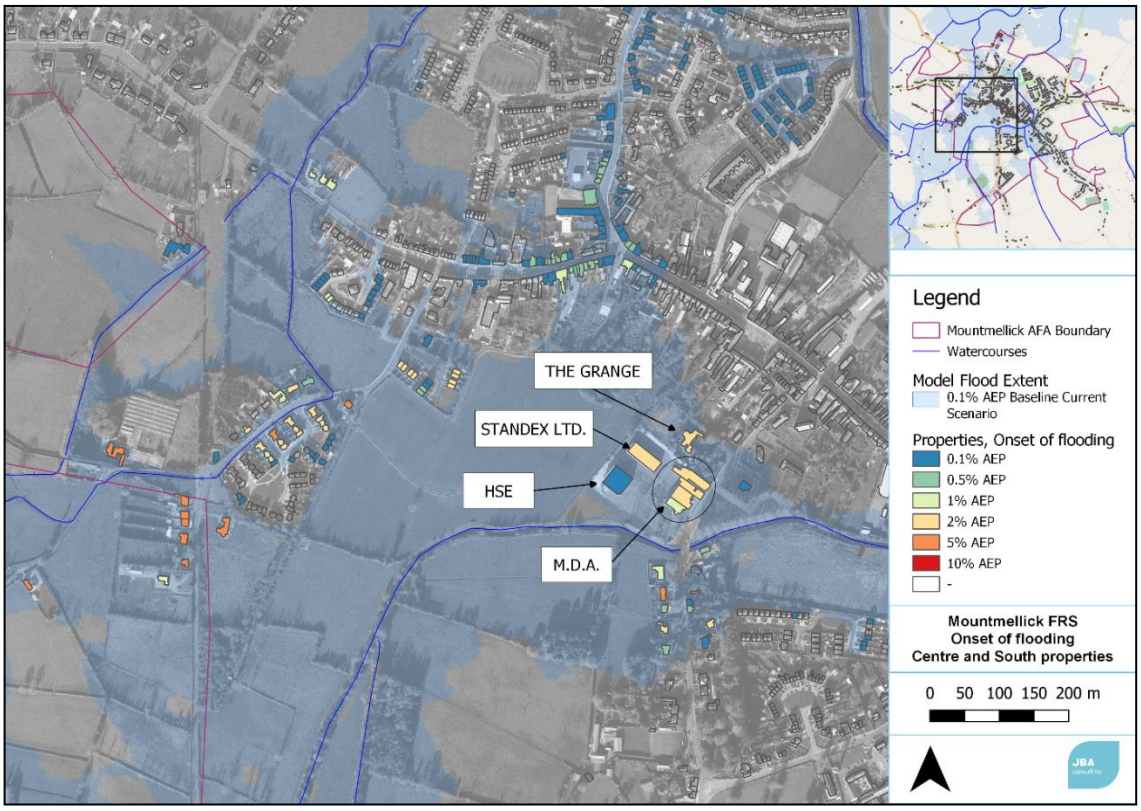


Figure 3-10: Map showing the onset of flood damages to properties. Town centre and south properties

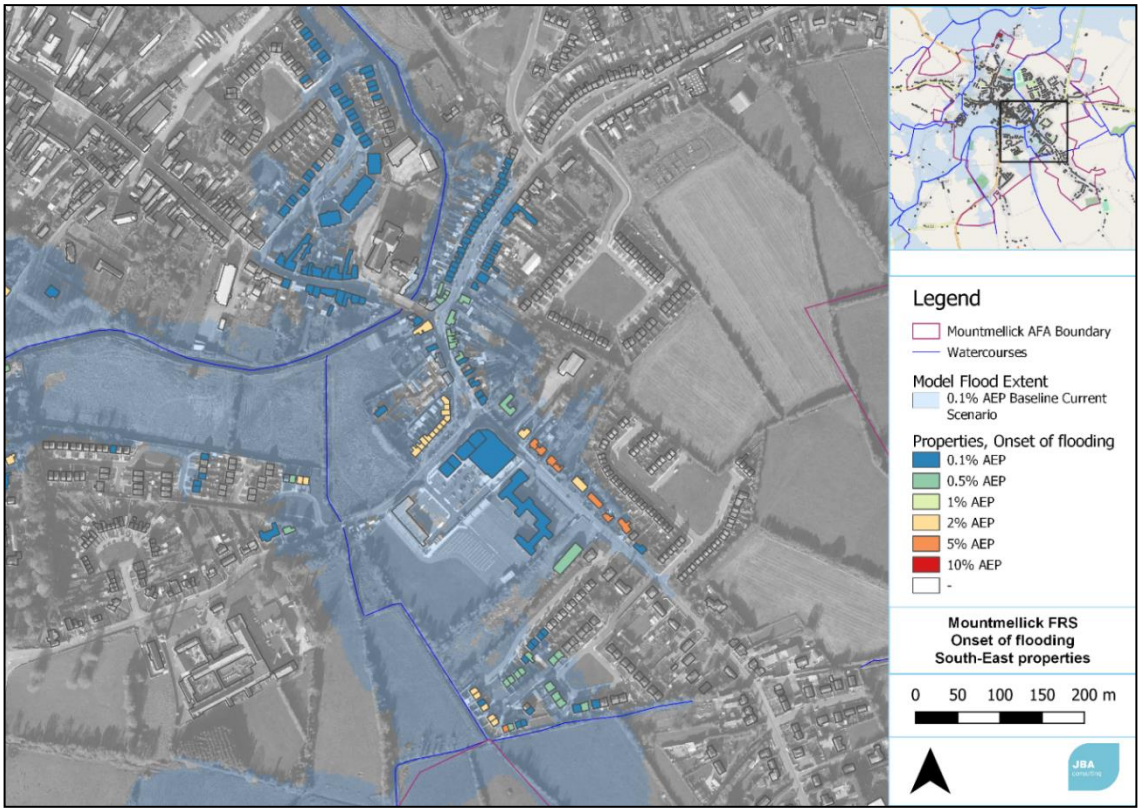



Figure 3-8: Map showing the onset of flood damages to properties. South-East properties

## 3.6 Climate change levels and extent

Climate change has been assessed for the 1% AEP baseline scenario for the Medium Range and High-End Forecast Scenarios (MRFS and HEFS). Figure 3-9 compares the flood extents of the present, MRFS and HEFS 1% AEP extents, as expected there is greater flooding with increased flows in the climate events. The same flood mechanisms identified for the present day are at work in the climate scenarios with increased flow resulting in increased flooding. Depths of flooding also increase in the climate change scenario runs, in Baker's Field for example flood depths increase on average by 0.07m and 0.10m in the MRFS and HEFS events respectively.

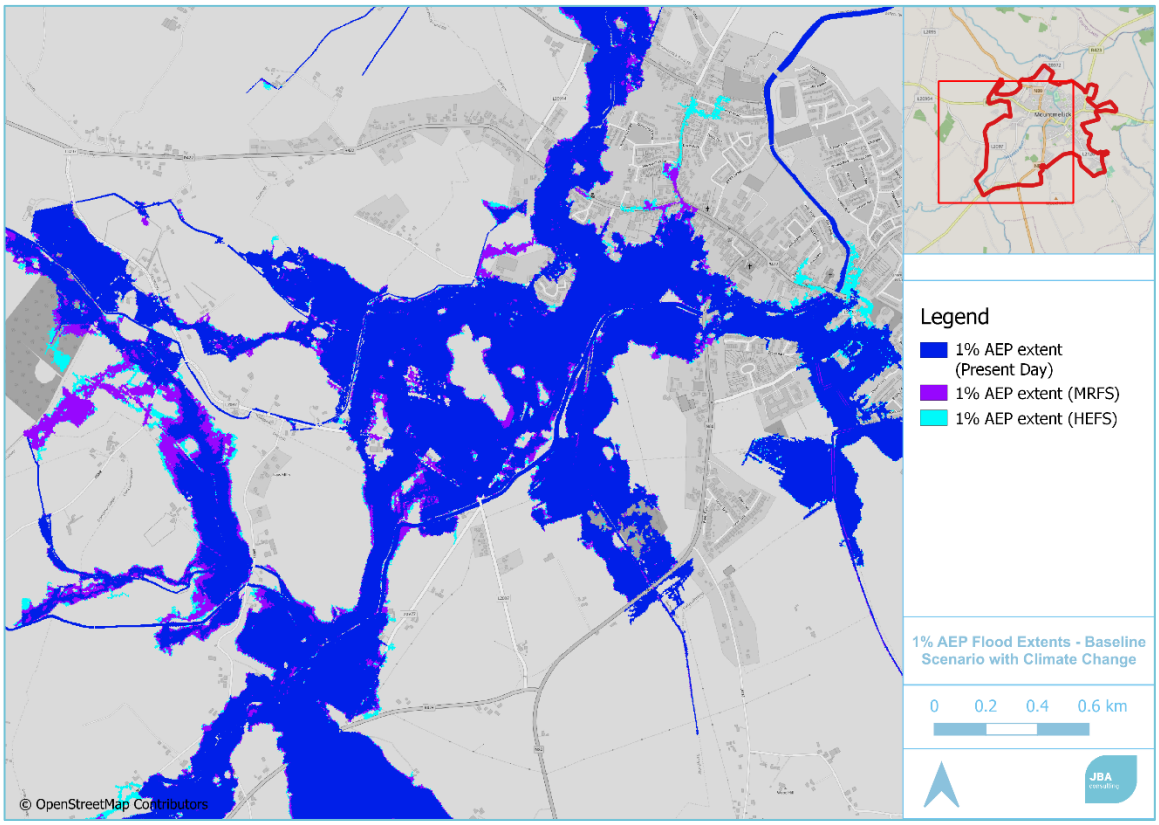



Figure 3-9: 1% AEP Flood Extents - Baseline Scenario with Climate Change

# 4 Initial Screening of Potentially Viable Measures

## 4.1 Introduction

This section details all the flood risk management measures e.g. diversion of flow, containment of flood levels, conveyance of flow etc., considered during the initial screening stage. These measures were assessed with regard to their viability in terms of the following criteria:

- Applicability to the area.
- Technically suitable and effective (can be implemented or constructed in Mountmellick).
- Economic (potential benefits, impacts, likely costs etc.).
- Environmental (potential impacts and benefits).
- Social (impacts on people, society and the likely acceptability of the measure).
- Cultural (potential benefits and impacts upon heritage sites and resources).

Measures are the various methods or processes that could be adopted to reduce the risk of flooding within the area to be protected and are listed in section 4.3. The options are then the adoption of a measure or a combination of measures to provide the required level of protection.

The constraints detailed in Section 2 were also taken into account when screening the possible measures. The potentially viable measures have been compared to the 'Do Nothing' and 'Do Minimum' scenarios.

The ‘Do Nothing’ scenario is defined as the option involving no future expenditure on flood defences or maintenance of existing defences/channels and the abandonment of any existing practices. The implication is that the existing risk of flooding persists in the study area and possibly worsens over time. This is not a sustainable option, so it has not been considered.

The “Do Minimum” measure consists of implementation of additional minimal measures to reduce the flood risk in specific problem areas without introducing a comprehensive strategy. This is in order to maintain the existing standard of protection and would generally involve repairing and reinforcing existing walls now and as repairs are needed in the future. This is not a suitable option due to the flood pathways not overtopping any existing informal defences and river maintenance would not provide any significant reduction in flood level.

As the 'Do Nothing' and 'Do Minimum' Scenarios are not viable options for the scheme various flood risk management measures have been considered and tested to progress the development of a viable scheme option. This measures testing is discussed further in the following sections with reference to different flood risk management approaches.

## 4.2 Flood Risk Reporting Locations

To aid the assessment of various measures, peak water levels have been examined to understand the effectiveness of measures tested. Figure 4-1 shows the location of the comparison points within the measures analysis. A summary table of the water level differences for all measures can be found in Section 4.3.9. All measures were tested using the 1% AEP event to allow a like for like comparison and compared relative to a containment measure configuration 1 levels (refer to Section 4.3.7 for more details).

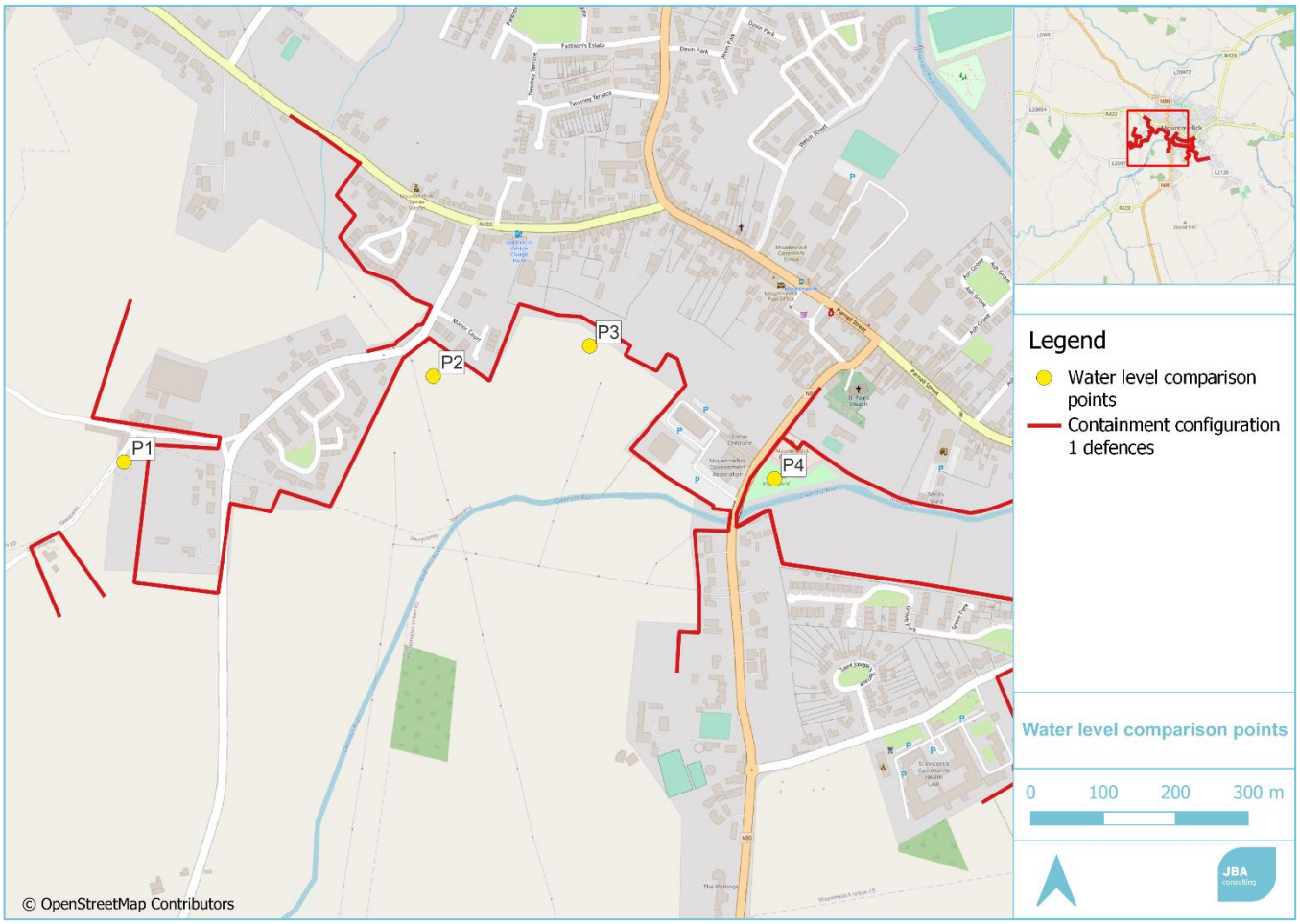



Figure 4-1: Water level comparison points

## 4.3 Screening of Alternative Flood Risk Management Approaches and Measures

A review of alternative Flood Risk Management (FRM) approaches has been undertaken to consider the different FRM methods that could potentially be viable and the spatial scales at which benefits could be realised. A map of the spatial scales for benefits is shown in Figure 4-2. There are eight FRM approaches commonly referred to, they are:

1. Re-purpose of existing non-flood management infrastructure.
2. Catchment scale and disperse actions to reduce flow downstream.
3. Inline storage on main watercourses or tributaries to reduce flow downstream.
4. Diversion of flow around and away from risk areas.
5. Improved conveyance of flow.
6. Refurbish or enhance defences to achieve standard of protection.
7. Containment of flood level.
8. Flood resilience, preparedness, and emergency response.

Table 4-1 shows examples of the different approaches, the scales at which they might be beneficial or relevant to the Mountmellick scheme, and potential measures associated with the approaches.

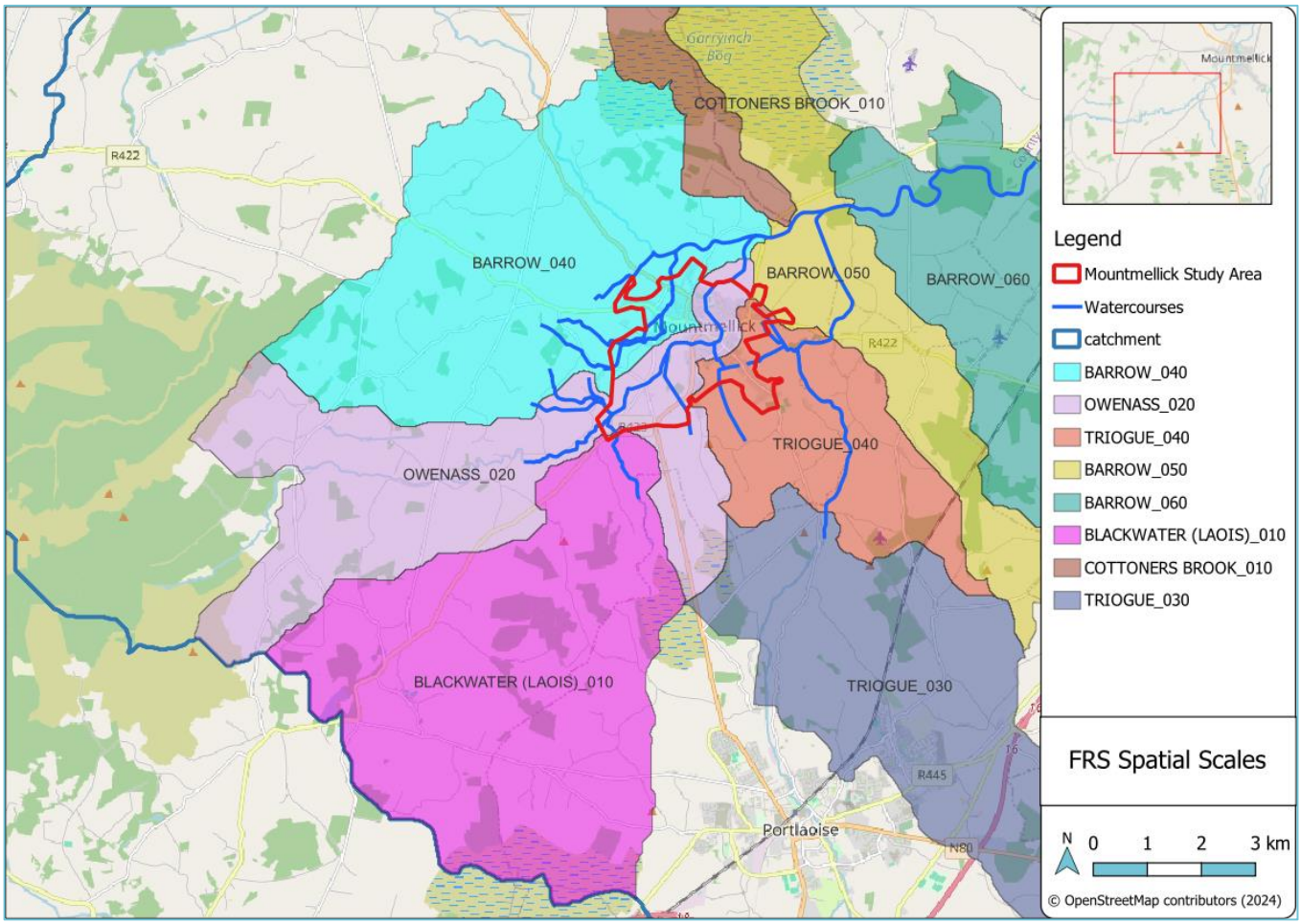



Figure 4-2. Map of Spatial Scales

Table 4-1. Examples of the alternative FRM approaches considered for Mountmellick, grouped by the spatial scale of benefits.

| Spatial Scale of benefits | Spatial Scale for Mountmellick FRS | Flood Risk Management approaches that apply to the spatial scale of benefits | Opportunities for measures associated with the approach, which could be appropriate for this study |
|---|---|---|---|
| **Catchment scale measures.**<br>**Benefits could be realised outside of the scheme area (AFA)** | The full upstream Owenass and Pound catchments that drain into Mountmellick. | 1. Re-purpose of existing non-flood management infrastructure | No suitable infrastructure present within catchment. |
| | | 2. Catchment scale and disperse actions to reduce flow downstream | Increased storage and attenuation across the catchment.<br>Runoff Attenuation Features and Distributed Storage Areas.<br>Land Use Management.<br>Upstream Floodplain Reconnection and Restoration.<br>River Channel Restoration.<br>Catchment, Floodplain and Riparian Woodland.<br>Management of existing Woodlands and Peatlands. |
| | | 3. Inline storage on main watercourses or tributaries to reduce flow downstream | Single storage area, however topography does not present opportunities for sufficient storage.<br>Cascading and combinations of disperse storage areas.<br>Two-stage channels |
| **Measures which are located and provide benefits from within the:**<br>**Flood Cells.** | Mountmellick Flood Cell. | 4. Diversion of flow around and away from risk areas | Relief channel around specific assets, culverts.<br>Longer length diversion channel around risk areas. |
| | | 5. Improved conveyance of flow | Culvert or bridge replacement or enhancement.<br>De-culverting.<br>Maintenance of river corridor.<br>Removal of constraints to flow in the floodplain, river corridor or channel (e.g. two stage channel)<br>Formalise or enhance overland flow routes.<br>Dredging. |
| | | 6. Refurbish or enhance defences to achieve standard of protection | No existing defences. |
| | | 7. Containment of flood level | Flood walls<br>Flood embankments |
| **Measures which apply to all spatial scales.** | All spatial scales. | 8. Flood resilience, preparedness, and emergency response | Flood forecasting and warning.<br>Emergency response plan. Not considered viable for scheme area. |

### 4.3.1 FRM Approach 1: Re-purposing of Existing Flood Management Infrastructure

This approach examines whether existing walls or other infrastructure could be re-purposed into flood management defences. This approach is not viable for the Mountmellick scheme area as there is no infrastructure that can be adequately repurposed to provide flood defence.

### 4.3.2 FRM Approach 2: Catchment Scale and Disperse Actions to Reduce Flow Downstream

FRM approach 2 examines the use of catchment wide measures or measures upstream of the key risk area to reduce flows. This approach is linked to Nature Based Solutions (NBS). NBS features that could be considered include:

- Leaky barriers: Replicating the impact woodland debris partially blocking channels and floodplains creating upstream storage while still allowing a portion of flow down through the system.
- Creation of bunds: Identifying areas of potential for storage of water on the floodplain and creating landscaped storage areas.
- Series of ponds as Runoff Attenuation Features: Creating a sequence of small storage ponds that become activated with increasing flood waters. The retention of water in sequence also allows an opportunity for sediment settling potentially reducing the amount of nutrients entering the wider fluvial system from surface runoff.
- Re naturalising channels: Portions of channels that have been artificially straightened are returned to their natural winding flow paths. This increases the travel time of flood waters through the catchment and activates larger portions of floodplain for storage.
- Increasing buffer zones in fields: Field drains and watercourses travelling along agricultural land barriers are often restricted to close to channel width, increasing the 'buffer zone' between land edges and the channels and rewilding these areas provides greater storage in the channel and enables more sediment trapping via vegetation in flood events potentially improving water quality.
- Land use management: Changes in land use and the management practises for forestry and agriculture can influence the flow response and sediment regime downstream.

Review and testing of various measures that fall under FRM approach 2 were tested for the scheme area within the hydraulic model and are described in the following sections.

Two different benefits were considered as part of the testing - reduction in peak flow by 10% or the delay of flood peak by 3 hours. These modelled scenarios reflect a very ambitions level of catchment management measures. Review of the academic literature shows that flow reductions as a result of NBS are usually within the range of approximately 5% with delays to peak flow achieved in testing also being smaller (e.g. Willis and Klaar, (2021)[2] and Hankin, et.al, (2021)[3]).

The actual benefits are very catchment specific and would vary within a catchment as well as in relation to the location of the measure relative to the benefit. Assessing these ambitious scenarios allows us to test whether upstream catchment measures can deliver anything near the scale of flood risk reduction required to reduce the scale, extent or size of structural measures within Mountmellick.

#### Upland Storage along the Owenass River

An initial test was carried out by applying a 10% reduction in flow to the Owenass River. This model runs tested the concept of whether flood storage in the upper catchment, potentially using some to the NBS features listed above could provide benefit. A 10% reduction was selected for testing as this was considered a reasonable estimation of the maximum decrease in flow upper catchment storage/NBS could achieve. The modelling found that while there was some decrease in peak level within Mountmellick town the decrease was not enough to remove the need for additional measures and hard defences (maximum decrease in levels compared to when containment configuration 1 only is in place: 0.04m).

#### Upland Storage along the Pound River

Similar to the concept measures test described for upland storge on the Owenass the potential impact of upper catchment storage was also tested along the Pound River system. In this test the peaks of the inflow hydrographs into the Pound River were delayed by 3 hours to replicate the delay resulting from storage or NBS features. The aim

2 Willis and Klaar, 2021. NFM Calderdale: Summary Modelling Report 1.0 iCASP(NREC)

3 Hankin, Trevor J. C. PAGE, CHAPPELL, BEVEN, SMITH, KRETZSCHMAR, & LAMB, 2021. Using micro-catchment experiments for multi-local scale modelling of nature-based solutions [Online]. 35 (11). Hydrological Processes

of the test was to establish the principle of storage as beneficial or otherwise. The modelling results found that there was some decrease in peak water levels, but it was minimal (maximum decrease: 0.04m compared to containment configuration 1 only is in place). This is largely because there is already natural storage occurring in the system in the baseline scenario.

### Changes to Owenass River Maintenance Regime

The Owenass river is subject to maintenance and clearing to improve the conveyance of the channel by Laois County Council. A hydraulic model scenario has been run to evaluate the potential effect on flood levels from reducing the channel efficiency upstream of Mountmellick (a proxy to a reduction or cessation of maintenance activity). The measure test was carried out to investigate whether increased storage of flood water in the channel and upstream catchment could reduce the volume or increase the travel time for flood water reaching Mountmellick town. The in-channel Manning's N roughness is adjusted from the baseline hydraulic model between the upstream extent of the model, downstream to the Owenass bridge (refer to Figure 4-3). Roughness was increased by 10-20% depending on the different areas of the channel (e.g., channel bed or sides). The maximum decrease in levels observed within Mountmellick Town were 0.02m compared to when containment configuration 1 only is in place showing that reducing or stopping maintenance is not an effective means of reducing flood levels.

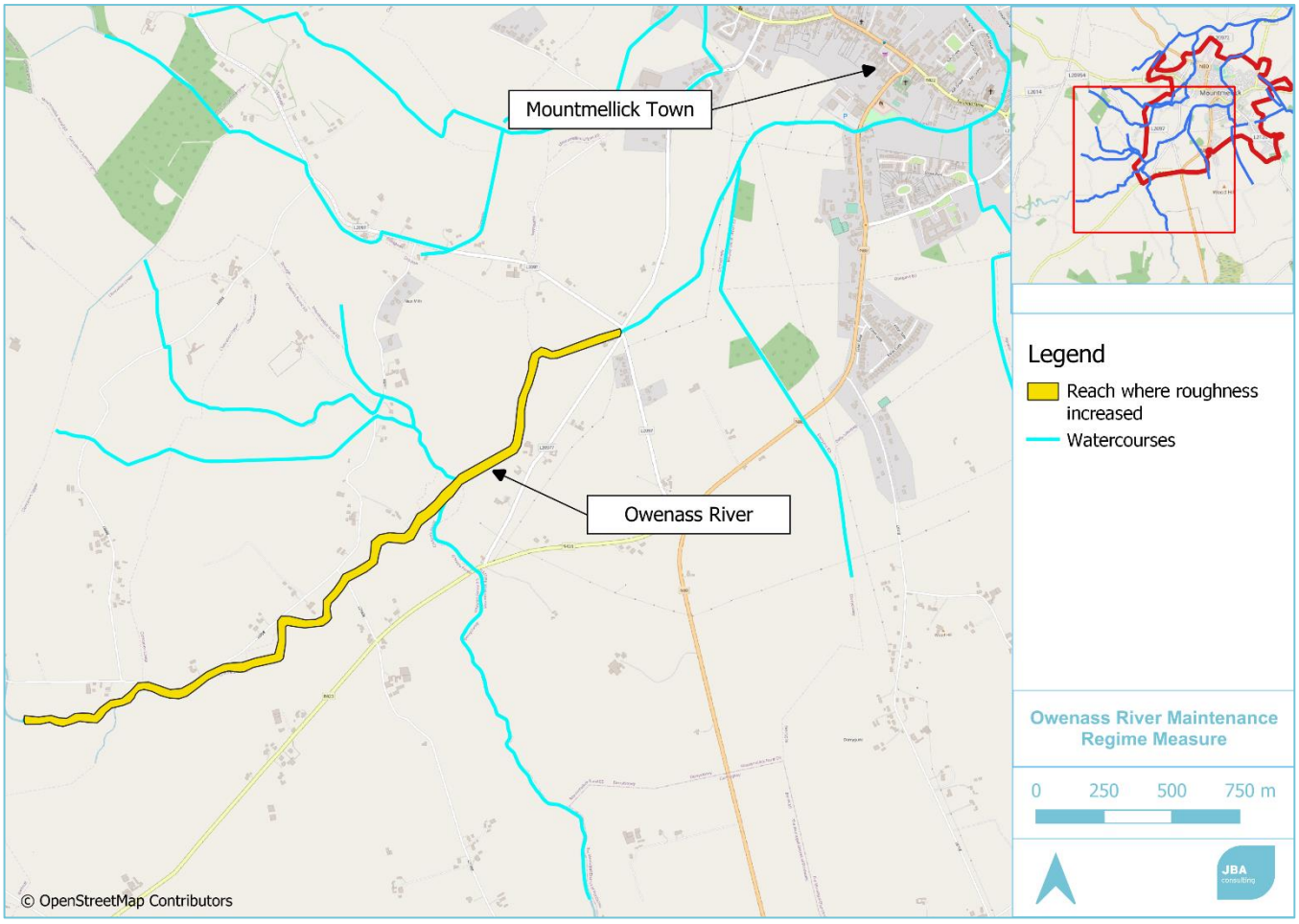



Figure 4-3: Owenass River Maintenance Regime Measure

### Re-meandering of the Blackwater River

The Blackwater River is a tributary of the Owenass River that joins upstream of Mountmellick town. It contributes a significant amount of flow into the Owenass River with the hydrograph peaks of both watercourses occurring at around the same time. A measure test as carried out to examine the potential benefit of any works e.g., NBS storage or meandering of the River on the Blackwater could have on levels downstream. To test the potential benefits these works might have the peak of the Blackwater River was delayed by three hours, the actual potential delay that could be achieves is not known but it was thought that three hours was a reasonable maximum delay. The modelling results in some benefit downstream (maximum decrease in level in Mountmellick town: 0.21m compares to when

containment configuration 1 only is in place) hard defences would still be required and the works required to achieve the delay in the hydrograph along the watercourse would be extensive and costly.

#### FRM Approach 2 Summary

Overall while measures looking at FRM approach two were examined and tested no measure tested was able to provide the necessary reduction in peak level to make be effective and viable for use within the scheme. All measures associated with FRM approach 2 are therefore not viable and have been screed out of the assessment at this stage.

### 4.3.3 FRM Approach 3: Inline Storage on main Watercourses or Tributaries to Reduce Flow Downstream

This approach looks at applying storage along watercourses to reduce flows downstream this approach was tested for the Owenass River by the testing of a two-stage channel. In a two-stage channel the storage area is only activated in a flood with the areas designed such that the flow returns in channel once the event has passed. Figure 4-4 shows the reaches where a 40m wide two-stage channel was tested along the Owenass River within the hydraulic model. Overall, the impact this measure is ineffective in defending or reducing flood risk without the need for hard defences. Peak levels in Mountmellick town actually increase by 0.03m compared to when containment configuration 1 only is in place when this measure is applied. Based on the results of the testing this measure is not considered viable and is screened out of the assessment at this stage

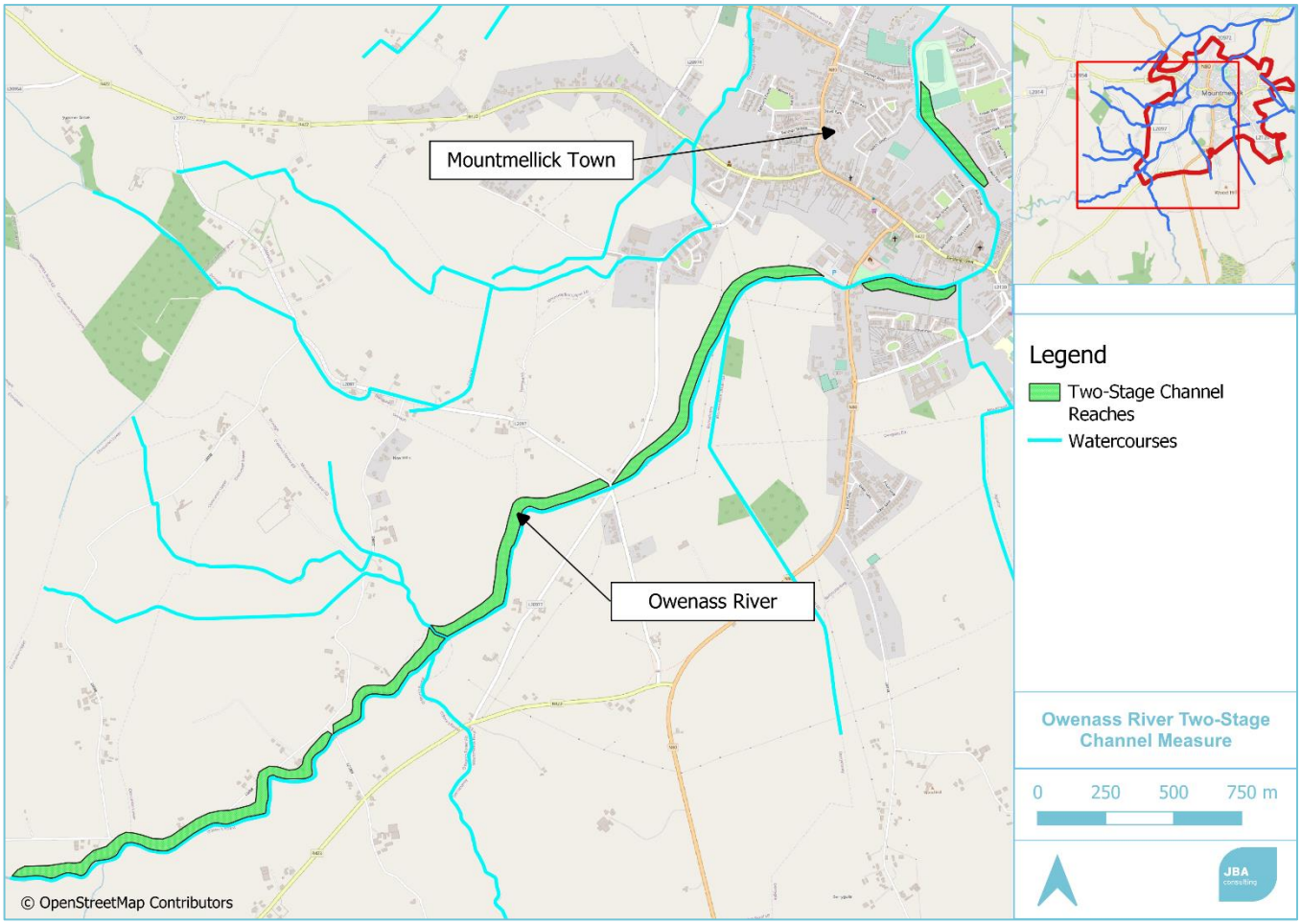



Figure 4-4: Owenass River Two-Stage Channel Measure

### 4.3.4 FRM Approach 4: Diversion of Flow Around and Away from Flood Risk Receptors

This FRM approach looks at the potential to move water away from key risk receptors to reduce flood risk. This approach was considered viable for areas within the scheme area and was tested in the hydraulic model via the testing of a formalised overflow channel through the field within Mountmellick town. As described in Section 3 a large volume of flow travels through the northern access gate of the field across to the Pound system in the baseline scenario. To assess this, a 4m wide shallow channel was created in the modelled 2D floodplain with a flood plain culvert inserted underneath the road (1.2m diameter circular). The bed level and slope of the channel was based on the gradient difference between the bank of the Owenass in Bakers field and the Invert level of the culvert (culvert

soffit required to be 0.30m below road surface) and the bank of the Pound River downstream (refer to Figure 4-5 for channel location). This measure does result in a reduction of water levels along the containment configuration 1 defence line in the field (-0.11m) however there is increased flooding downstream on the Pound watercourse. It is also noted that the required bed level of the channel to allow to the culvert results in an incredibly deep channel which would be unfeasible (2m depth from ground level or greater). This measure is therefore not suitable for consideration in any potential option and is screened out of the assessment at this stage.

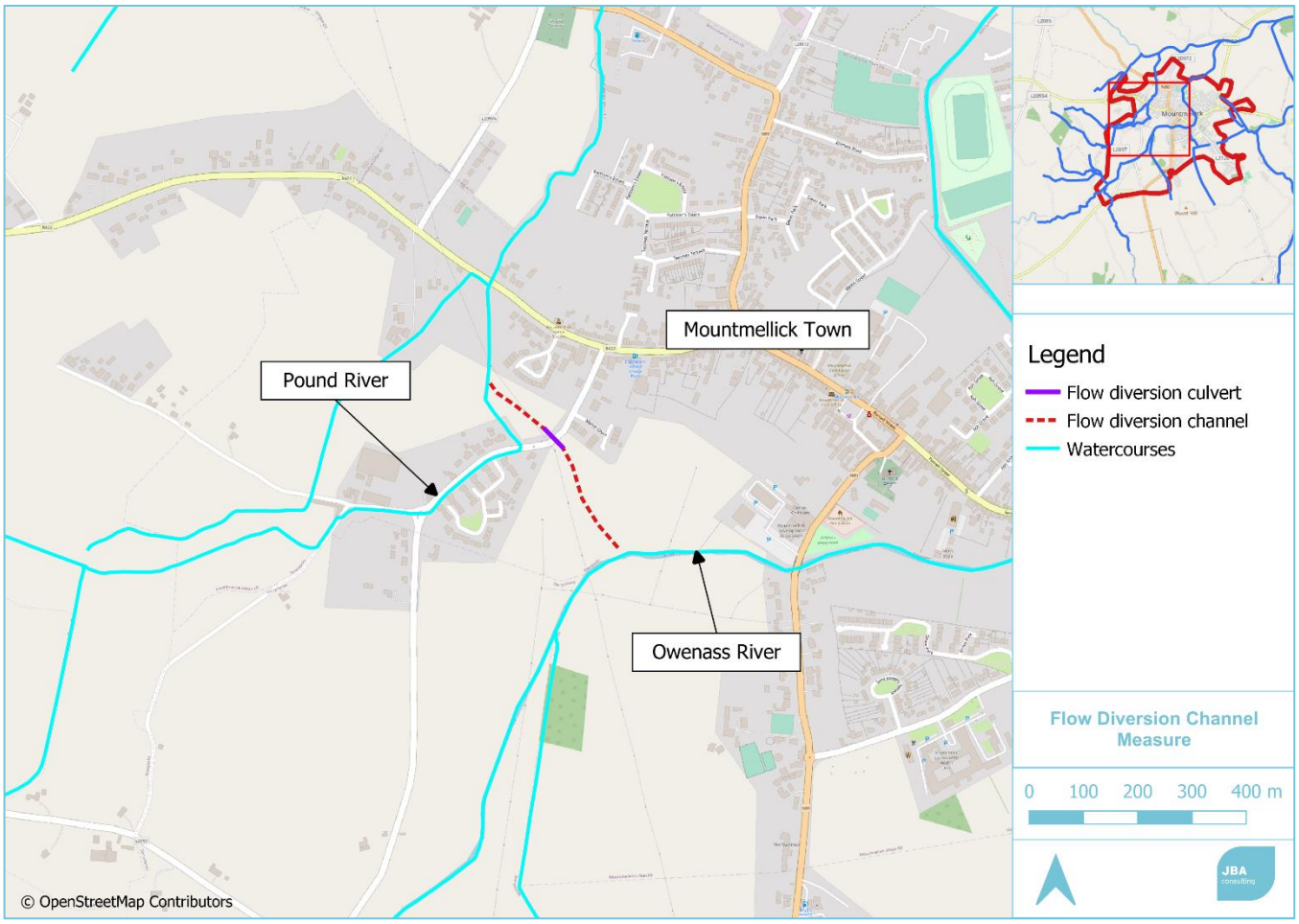



Figure 4-5: Flow Diversion Channel Measure

### 4.3.5 FRM Approach 5: Improved Conveyance of Flow

FRM approach 5, improving conveyance, involves the removal of constrictions on a system or improving the river channel itself. This approach was considered viable for testing as part of the measures testing as there are several critical structures along the Pound and Owenass systems and potential areas where conveyance could be improved. The following sections described the conveyance measures tested.

#### Removal of Structures along the Pound River

As described in Section 3 the Pound River is constricted by multiple structures which reduce the channel capacity and cause backwater effects and aggravate flooding. In this measure all the structures along the Manor Court reach were removed to assess the impact of constriction removal. The maximum decrease in level downstream observed when this measure was tested was 0.08m compared to the containment configuration 1 levels. While there is increased flow moving through the system and total volume is still too great for the channel capacity and so flooding still occurs. The results of the testing highlighted that this measure was not sufficiently beneficial and so is screened out of the assessment at this stage.

#### Increase in capacity at Wolf Tone Bridge

Wolf Tone Bridge along the Pound River (downstream of Manor Court Estate) was identified as a potential structure where the capacity may be limiting flow. A measure test was carried out where the size of the bridge structure was increased to assess whether this would improve peak levels upstream. The modelling found that the change in the

bridge resulted in a decrease in peak level directly upstream by 0.01 – 0.02m with no change in peak levels within the town. The results show the measures is not hydraulically beneficial and so has been screened out of the assessment at this stage.

### Dredging of the Owenass

Aside from removing constrictions regrading a river channel can also improve conveyance of flow and channel capacity. A test was carried out in the hydraulic model to see whether dredging the Owenass River would improve flood risk. Figure 4-6 shows the reach where the dredge test was applied and the change in bed levels tested. The modelling found that there was a maximum decrease of 0.025m upstream of the dredged reach with a slight increase observed further downstream and no change in peak levels within Mountmellick town area. The dredging is noted as being ineffective as the key areas of flooding and spill are upstream of the area where dredging is viable. Given that it produces little hydraulic benefit and would have negative impacts on existing structures (underpinning required) and environment (impact on fish movement and in channel habitat) this measure has been screened out of the assessment at this stage.

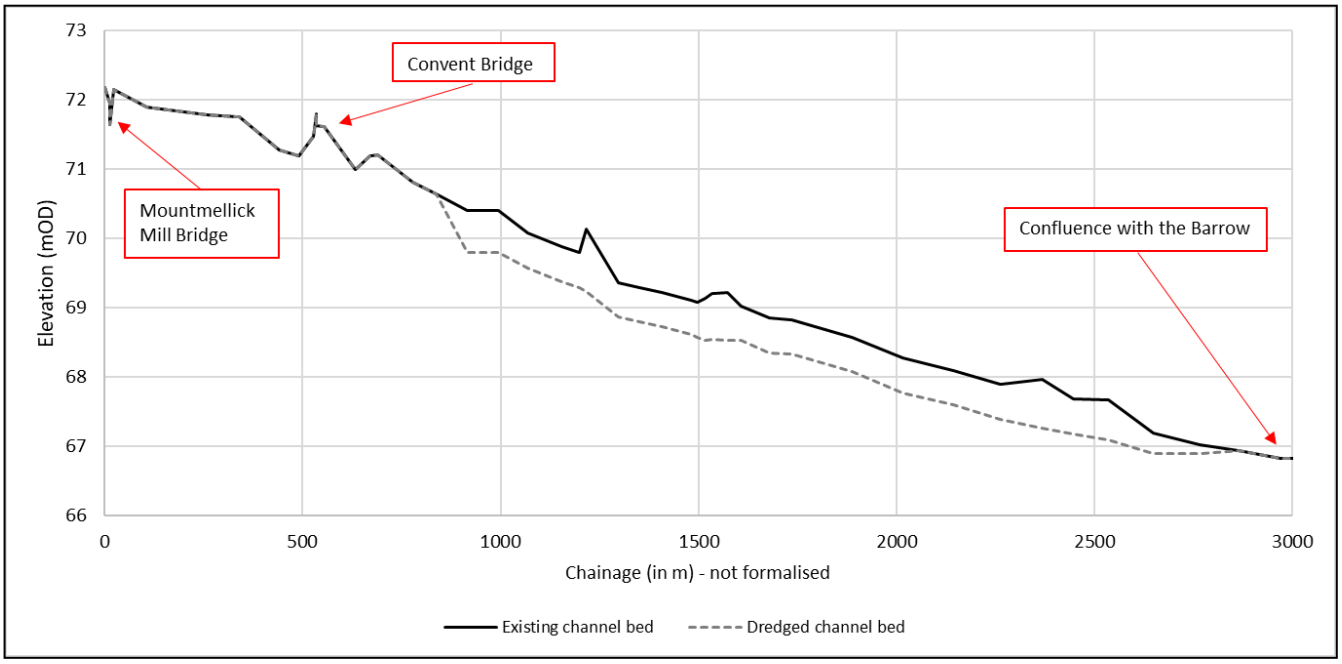



Figure 4-6: Comparison of existing and tested dredged channel beds along the Owenass River

### Removal of Mountmellick Mill Bridge and Right Bank Restrictions

Mountmellick Mill bridge is located at a key location along the Owenass River. Flow must pass through it to continue downstream towards the River Barrow. To examine whether improving the conveyance this section of the watercourse and decrease levels upstream a test was carried out where the bridge and the properties on the right-hand bank were removed from the hydraulic model. The modelling showed a 0.22m reduction in peak level upstream of the bridge location but a 0.16m increase in level downstream of the bridge location compared to the containment configuration 1 only levels. These results highlight that the bridge is a constriction on the system, but this provides benefits downstream. While having some benefit this measure is not considered viable as the removal of the bridge and properties is not cost effective and would have significant negative impact on the town and access.

### FRM Approach 5 Summary

While some benefits were identified when conveyance is improved along the system the hydraulic benefits of the measures tested were shown to be limited and, in many cases, the negative impacts on environmental and social aspects mean that they are not viable. Therefore, all FRM approach 5 measures have been screened out of the assessment at this stage.

## 4.3.6 FRM Approach 6: Refurbish or Enhance Defences to Achieve the Standard of Protection

This FRM approach is not viable for the Mountmellick FRS as there are no existing defences to enhance within the scheme area.

### 4.3.7 FRM Approach 7: Containment of Flood Level

While other FRM approaches were considered potentially viable from the testing carried out they are unable to provide the standard of protection required alone as the impact on peak levels are all minimal and all flooding is not resolved when they are implemented without other approaches. Therefore, containment of flood levels through the use of flood wall and embankments is key to providing protection within Mountmellick. Various configurations of containment defences were tested within the hydraulic model.

This first configuration, containment configuration 1, focuses on defending the main town area only, refer to Figure 4-7. In understanding the flood mechanisms for the Mountmellick area two other configurations of containment were tested which included a barrier between the Pound and Owenass Rivers to prevent cross catchment flow occurring. Two flood plain barrier configurations (containment configuration 2A and 2B) were tested, refer to Figure 4-8 and Figure 4-9. From these two-flood plain barrier containment measures an alternative to the containment proposed in configuration 1 could be examined along the Pound as the volume of flow to manage is reduced once the cross flow is removed (refer to Figure 4-10). For the Pound system flow is contained upstream via defences and a flow control structure which limits the flow moving downstream so it does not exceed the channel capacity and prevents flooding. The flood levels within the town when containment options are in place show increases relative to the baseline which is expected as the flood water is now contained, and receptors are protected.

Downstream at Bay Road Business Park containment of flood levels with hard defences is the only viable approach to protect the property at risk. No other approach or measure tested can achieve the required Standard of Protection (SoP).

These three different approaches to containment were found to be viable solutions for the observed flooding highlighting that FRM approach 7 is the key approach for the scheme moving forward.

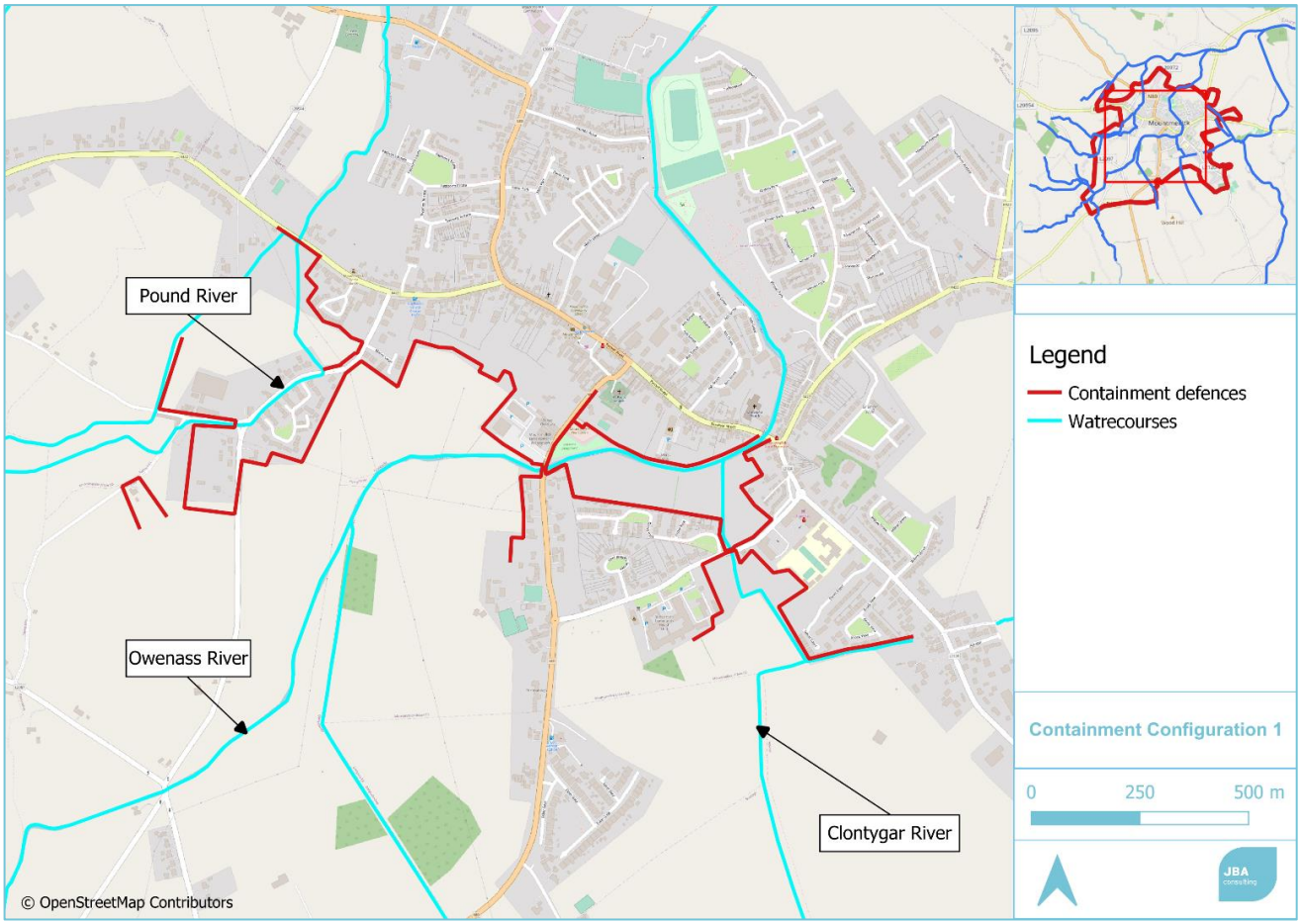



Figure 4-7: Containment Configuration 1

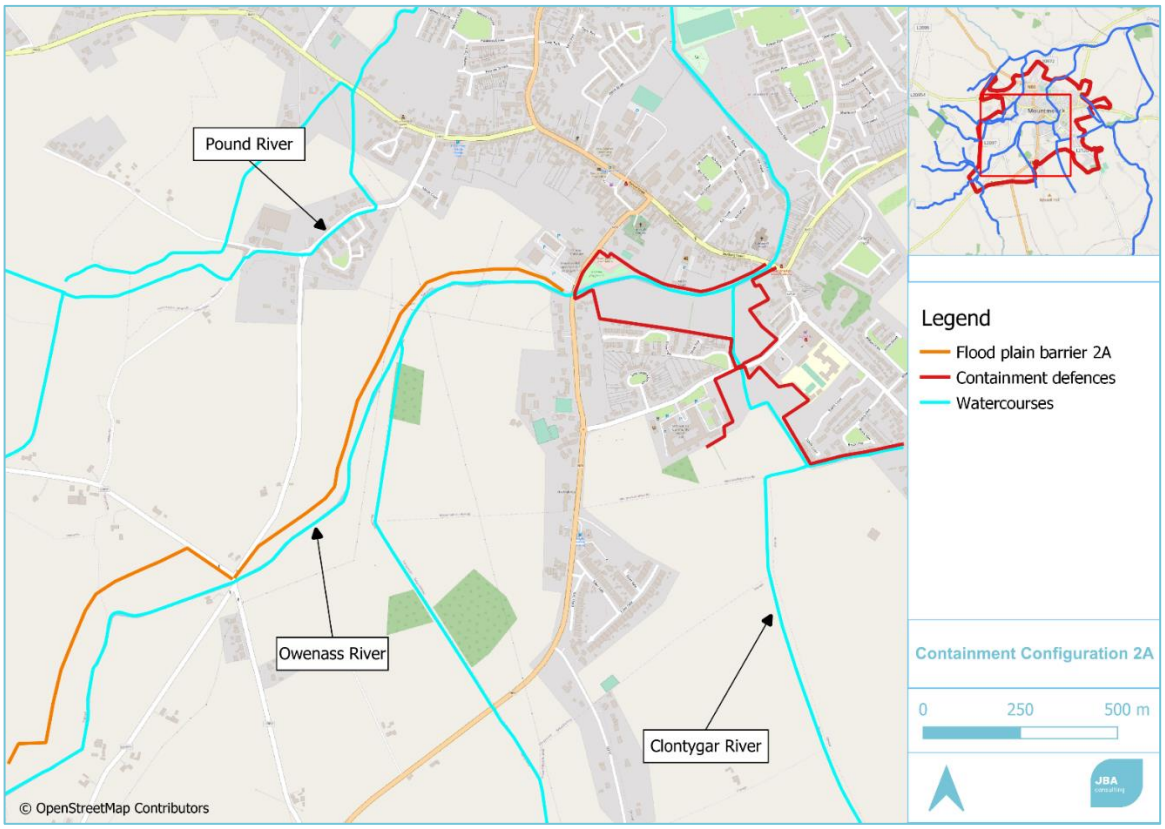



Figure 4-8: Containment Configuration 2A

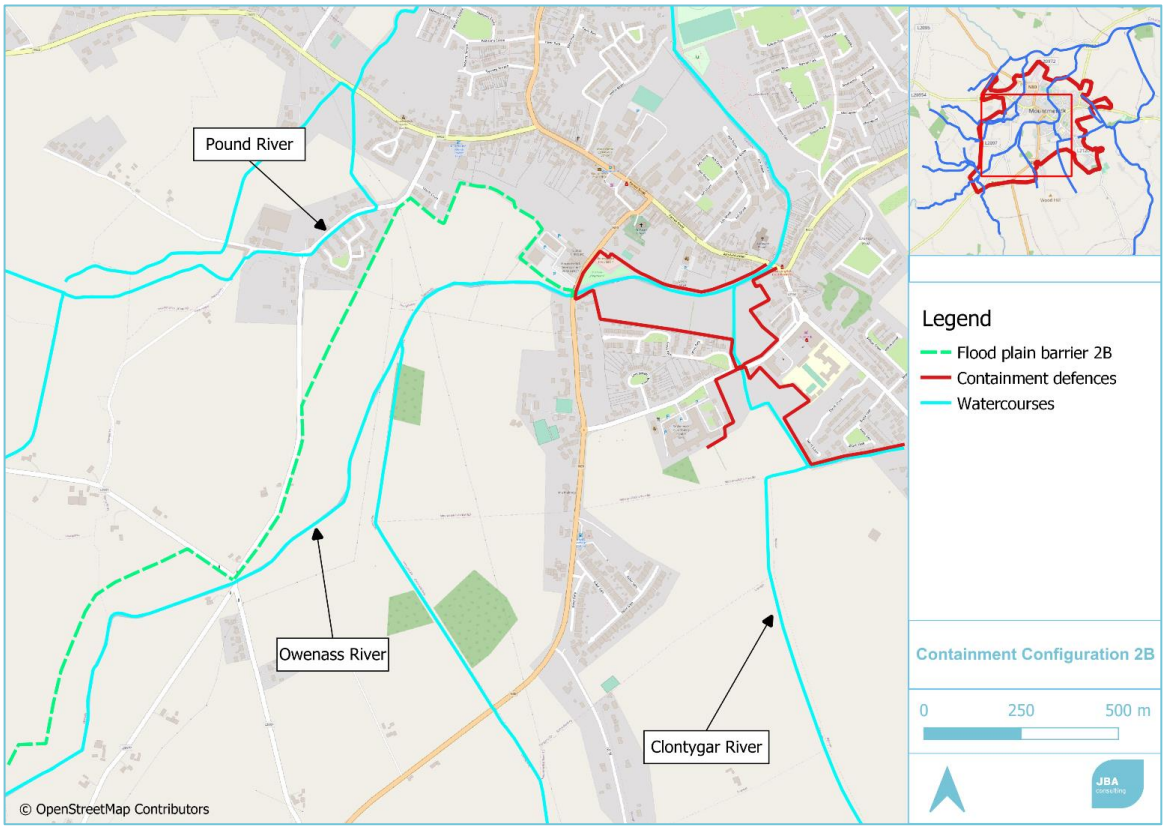



Figure 4-9: Containment Configuration 2B

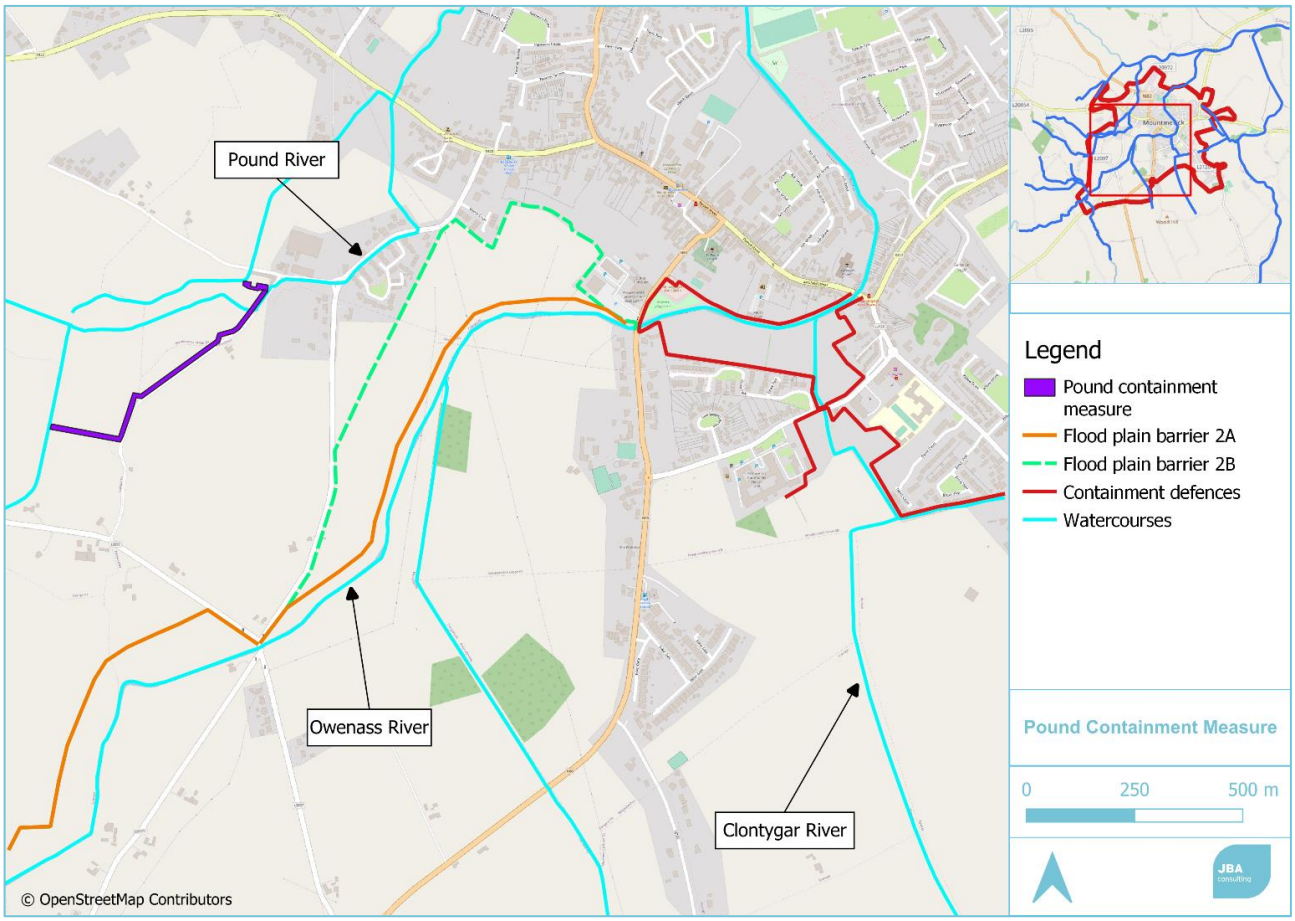



Figure 4-10: Pound Containment Measure

### 4.3.8 FRM Approach 8: Flood Resilience, Preparedness and Emergency Response

This FRM approach focuses on enacting emergency response plans and potential flood forecasting to aid with the protection of risk receptors and enable residents the opportunity to act and evacuate if necessary. Individual property protection (IPP) and potential relocation of receptors and infrastructure are measures associated with this approach. This FRM approach could be applied in Mountmellick. However, at a scheme level it does not remove the need for flood defences and requires flood forecasting/warning along with a co-ordinated response to have all the response measures in place. The purpose of the scheme is to prevent properties and businesses from flooding and not to minimise damages incurred through providing flood warning and evacuation. In addition, the flashy nature of the catchment would only provide limited time to respond to a flood warning. Therefore, this measure is not considered further and is screened out at this stage.

### 4.3.9 Summary of viable FRM approaches and measures tested

From this initial screening FRM approaches 1, 6 and 8 were shown to not be viable for the scheme. Further review of the remaining FRM approaches and the measures tested associated with them highlighted that although some provided some benefit only measures associated with FRM approach 7 (containment) were able to provide the necessary standard of protection. Table 4-2 shows the impact on water levels each measure tested has for the four points shown in Figure 4-1. From the table and as described in the text the non-containment measures tested have minimal hydraulic benefit in reducing water levels. Therefore, from this initial assessment the containment measures tested are to be brought forward for consideration in the scheme option.

Table 4-2: Water level comparisons for measures tested

| FRM Approach | Measure | Water level difference relative to containment configuration 1 | | | | Comments |
|---|---|---|---|---|---|---|
| | | P1 | P2 | P3 | P4 | |
| 7 | Containment configuration 1 (defences around town only) | 75.58mOD | 75.30mOD | 75.30mOD | 74.49mOD | **Risk receptors protected when measure in place - considered viable and brought forward for scheme option consideration.** |
| 2 | Upland Storage along the Owenass River | -0.02m | -0.04m | -0.04m | +0.01m | Minimal decrease in level within town. Not hydraulically beneficial and screened out of assessment at this stage. |
| 2 | Upland Storage along the Pound River | -0.04m | -0.03m | -0.03m | 0.0m | Minimal decrease in level within town. Not hydraulically beneficial and screened out of assessment at this stage. |
| 2 | Changes to Owenass Maintenance Regime | +0.03m | -0.02m | -0.02m | 0.00m | Minimal decrease in level within town. Not hydraulically beneficial and screened out of assessment at this stage. |
| 2 | Re-meandering of the Blackwater River | -0.04m | -0.21m | -0.21m | 0.00m | Significant decrease in peak level at defence line however whether necessary delay is possible is unknown and works required would be extensive. Measure screened out of assessment at this stage. |
| 3 | Two Stage Channel along the Owenass River | -0.03m | +0.03m | +0.03m | +0.01m | Increases in levels along the Owenass observed due to increased conveyance which is not desirable. Measures screened out of assessment at this stage |
| 4 | Formalised Overflow Channel through Field in Mountmellick Town | 0.00m | -0.11m | -0.11m | 0.00m | Minimal decrease in levels within town, involves complex entrenched channels which are not desirable. Measure screened out of assessment at this stage. |
| 5 | Removal of Structures along the Pound River | -0.07m | -0.08m | -0.08m | 0.00m | Increased flow but channel capacity still exceeded, measure not beneficial and screened out at this stage. |
| 5 | Increase in Capacity at Wolf Tone Bridge | 0.00m | 0.00m | 0.00m | 0.00m | No impact on levels at key risk areas. Screened out of assessment at this stage. |
| 5 | Dredging of the Owenass River (with containment configuration 2B) | -0.52m | +0.21m | +0.21m | +0.11m | No impact on levels when containment measures in place. Significant negative environmental and social impacts associated with measures. Screened out of |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | assessment at this stage. |
| **5** | Removal of Mountmellick Mill Bridge and Right Bank Restrictions | 0.00m | -0.21m | -0.22m | +0.16m | Decrease in levels upstream due to additional conveyance but levels increase downstream and bridge/property considered negative social impacts. Measure screened out of assessment at this stage. |
| **7** | Containment configuration 2A (flood plain barrier) | -0.52m | NA | NA | +0.18m | **Increased flooding observed on the right-hand bank of Owenass due to loss of flood plain storage. Levels at defence line increase due to containment. Risk receptors protected - measure considered viable and brought forward for scheme option consideration.** |
| **7** | Containment configuration 2B (flood plain barrier) | -0.52m | +0.21m | +0.21m | +0.10m | **Increased flooding observed on the right-hand bank of Owenass due to loss of flood plain storage. Risk receptors protected - measure considered viable and brought forward for scheme option consideration.** |
| **7** | Containment on Pound River (works with containment configurations 2A and 2B only) | -0.56m | +0.21m | +0.21m | +0.10m | **Reduced flood extents and levels observed along the Pound watercourse (in combination measure). Considered viable and brought forward for scheme option consideration.** |

## 4.4 Nature Based Solution Opportunities and Benefits

Nature based solutions (NBS) were considered as part of measures testing under FRM Approach 2 (refer to Section 4.3.2). Results from the hydraulic modelling and measures tested showed that NBS had minor positive benefit but did not provide full standard of protection to the town on their own and additional measures were still required. Therefore, at this stage NBS measures have been screened out of the assessment as viable flood relief measures.

However, NBS can provide huge amenity potential and environmental benefits to the wider area. Other NBS measures that can complement a flood relief scheme include:

- Retaining floodplain connection – Retaining, as practical as possible, current pathways for river spread, upriver of Mountmellick, will maintain storage capacity during flood events and preserve conveyance and deposition of material through the river system.
- Buffer strips – These can extend habitat zones and allow for the strategic planting of native trees. This can improve bank stability, expand riparian habitats and assist in maintaining water quality.
- Land and ditch management – Large sections of river are adjacent to agricultural land. Effective strategies include, fencing off river access from livestock, managing drain pathways (allow overgrowth to increase flow resistance) and reducing soil compaction from livestock and machinery during winter (promotes filtration/ground water recharge). Land management adjacent to the river source on the Owenass and Pound river can have the benefit of controlling and slowing down runoff and reducing effects of fine sediment transport.
- Woodland creation- Has multiple benefits of habitat creation and shelter, carbon storage and air quality benefits, nutrient attenuation, biodiversity improvement and amenity value.
- Leaky/Debris Dams - In the higher topographical areas such as the Slieve Blooms, leaky dams and tree debris can be used to retard stream flows. This can be especially effective in planted forest zones where felling can potentially cause fine sediment release and cause problem downstream.

Opportunities are presented for the future development of walkways and cycleways adjacent to river corridors. River accessibility measures could include viewing ports and footbridges to engage and reconnect users to the water scape.

Multiple knock-on benefits can arise with the use of NBS. Buffer zones adjacent to the Pound and Owenass Rivers, create new habitats for mammals, insects and birds. Plant roots can assist in bank stabilisation, improve soil quality and promote groundwater recharge.

While not part of the scheme newly created woodland adjacent to the town could have benefits of increasing landscape value and offering green space adjacent to Mountmellick. Climate change benefits can be seen in wider catchment planting through carbon storage and air quality improvement.

Strategic planting of native trees through narrower river reaches provide shelter and food for wildlife. Planting close to riparian zones can absorb large volumes of water. Carbon can be stored and the release of clean oxygen to the area improving people's wellbeing and health.

- Amenity features - picnic areas, nature walks, edible gardens, outdoor gyms, meditation zones, river viewing ports, looped walkways, stepping stones near rivers, river side access areas.
- Bankside rewilding (Habitat creation)
- Riparian improvement (tree planting, increase water uptake, groundwater
- Water quality Improvement benefits

As well as NBS measures green infrastructure such as Sustainable urban Drainage Systems (SuDS) could potentially be implemented in urban areas such as Mountmellick Town. While surface water flooding is outside of the scope of this flood relief scheme SuDS could potentially be implemented in urban areas such as Mountmellick Town to slow the discharge of stormwater into the various watercourses.

In summary while not able to provide flood risk benefit NBS measures should be considered in combination with the final scheme option to enhance and provide greater benefit to the wider area environmentally.

## 4.5 Summary of Screening of Potentially Viable Measures

From the initial review multiple Flood Risk Management (FRM) approaches were identified as having potential benefits for the Mountmellick scheme area. Measures linked to various approaches were tested within the hydraulic model. It was found that the key measures that provided the required Standard of Protection were containment measures associated with FRM approach 7. All other measures considered did provide some hydraulic benefit but not enough to warrant further consideration or had significant negative environmental and social impacts. Three different containment measure configurations were developed and are brought forward for further consideration in the scheme option development.

# 5 Development of flood relief options

## 5.1 Overview

The following options are a combination of the measures that were determined to be the most appropriate for Mountmellick. The images in the following sections are based on a comparison between the current (undefended) scenario and the relevant emerging Options. They are based on the 1% AEP flood event (or event that has a 1% chance of happening in any year, otherwise called the 1 in 100-year flood). The 1% AEP flood is also the level that the defences will be built to protect against. As well as the direct water level, the defences also have an element of freeboard, so are 300mm higher than the water level for walls and 500mm higher for embankments. Freeboard is increased at embankments as the design must consider the fact that earth embankments will be subject to local settlement over time.

The potential environmental effects resulting from each option are recorded on a scale of Slight, Moderate, and High. The likely duration of potential effect is noted i.e., Temporary (during construction only) or Permanent (during operation) and it is assumed that all effects are without mitigation applied. A summary of environmental effects is shown in Figure 5-8 at the end of Chapter 6.

The site was divided in seven areas of assessment for the FRS Options, which are listed below. A map of the extension of each area is also shown below.

- Upstream Owenass Bridge;
- Owenass Bridge to Mountmellick Mill Bridge;
- Clontygar Stream;
- Mannor House, Manor Court, Manor Road;
- Mountmellick Mill Bridge to Convent Bridge;
- Garroon Stream; and
- Bay Road Business Park

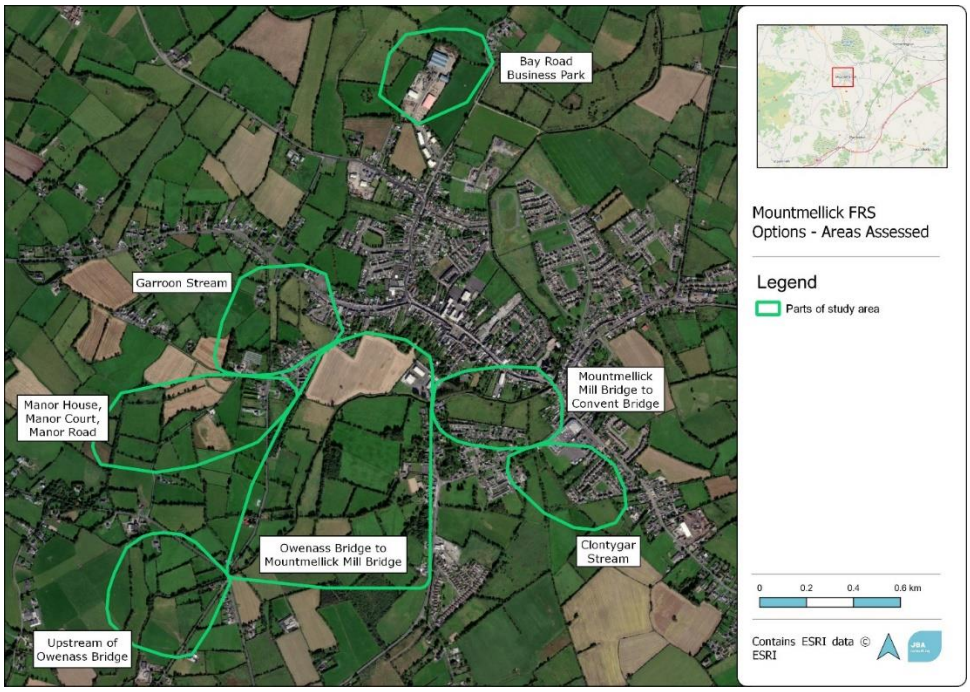



Figure 5-1: Areas of assessment for the FRS options

The three emerging options can be summarised as follows:

- **Option 1** - This option involves embankments around the Mountmellick town area to prevent flood waters from the Owenass, Pound and surrounding watercourses impacting properties. The defence line for Option 1 is similar to the CFRAM scheme alignment and follows existing boundary lines with a large proportion of the existing Owenass floodplain

being retained. The defences will be formed by a combination of earth embankments and concrete walls. A throttle (sluice/flow control structure) is placed at the upstream extent of the Pound watercourse on the first culvert at the Manor Court junction to control flow down the Manor Court area.

- Defences are also in place downstream of Mountmellick Mill Bridge and around the Clontygar as well as around the Midland Steel site.
- **Option 2A** - This option involves an embankment running along the left bank of the Owenass river from upstream of Owenass Bridge to Mountmellick Mill Bridge to prevent floodplain flow from the Owenass moving across to the Pound system. The Owenass embankment in this option generally runs along the line of the left riverbank. The alignment of the Owenass embankment will sever the floodplain connection in this area and presents the risk of impacts to the watercourse and riparian habitats. Option 2A includes the replacement of Owenass Bridge with a similar bridge with a larger span.

  The impact of the proposed embankments on the floodplain means that additional flood protection is required to protect the site of the Irishtown Garden Centre.

  As with Option 1, defences are also in place downstream of Mountmellick Mill Bridge and around the Clontygar. Some defences are also needed upstream of the Pound around the mill pond area as well as around the Midland Steel site.
- **Option 2B** - This option involves an embankment running set back from the riverbank of the Owenass river from upstream of Owenass bridge to Mountmellick Mill bridge to prevent floodplain flow from the Owenass moving across to the Pound system. However, in this option the alignment of the embankment does not run along the riverbank but along existing road edges and field boundaries therefore engaging more of the existing floodplain area compared to option 2A. Option 2B involves the greatest length of defences of the options however having the embankment along existing road and field boundaries reduces impact of defences on workable lands and that there is still connection between the river and a greater portion of floodplain. Option 2B includes the replacement of Owenass Bridge with a similar bridge with a larger span.

  As with Option 2A, the impact of the proposed embankments on the floodplain means that additional flood protection is required to protect the site of the Irishtown Garden Centre

  As with Options 1 and 2A, defences are also in place downstream of Mountmellick Mill bridge and around the Clontygar. Some defences are also needed upstream of the Pound around the mill pond area as well as around the Midland Steel site.

## 5.2 Option 1 - Defences around Mountmellick Town

### 5.2.1 Design Constraints

Although the majority of the works upstream of Mountmellick Mill Bridge are remote from the watercourses, the works between Mountmellick Mill Bridge and Convent Bridge will require access to the River Owenass to complete the works at a number of locations. The design details will minimise the impact on and risk to the river and will allow the works to be constructed in accordance with any ecological programming restrictions or heritage constraints imposed.

The proposed embankments extend along the boundary of existing properties at a number of locations and so the impact on existing structures including houses and their boundary walls will be confirmed and taken into account in the alignment and design of the defence structures.

### 5.2.2 Ongoing maintenance, ownership, and responsibilities

Each of the proposed measures will have their own management and operational plans detailing how the assets will be maintained and how they will be secured during flood risk periods. In Option 1, this will include how the road closures using the flood barriers will be instigated and managed.

Annual inspections of the embankments and the walls will be needed, together with investigations of their performance following each flood event. Monitoring of seepage will be recommended.

Responsibility for the maintenance and storage of the demountable flood barriers and flood gates will remain with Laois County Council (LCC). They are located in publicly accessible areas to ensure clear access for the management of the barriers.

A maintenance plan for the barriers and gates will be developed which will require LCC to inspect and install the flood barriers and gates once a year to examine them for any defects and to ensure staff are trained in and familiar with their installation and operation.

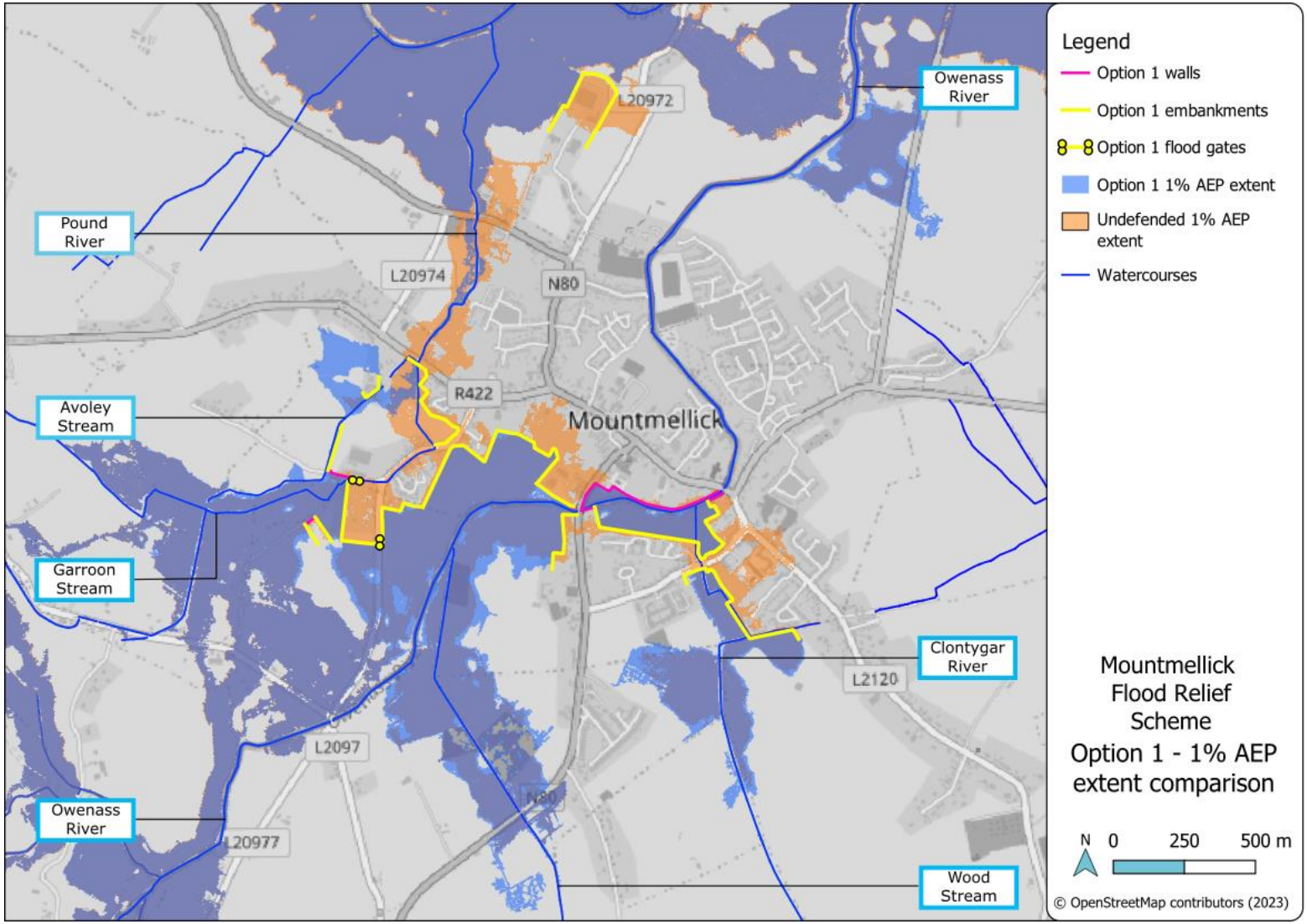



Figure 5-2: Option 1 Overview

### 5.2.3 Mountmellick Mill Bridge to Convent Bridge

#### 5.2.3.1 Description

The playground is flooded in the current scenario and continues to be flooded when Option 1 is in place with the playground in the current scenario, but defences are included along this area as flooding in worsened for the rear of Sarsfield Street when upstream defences are modelled. The defences along the north bank are around 0.6 – 0.9m (2' to 3' high). Flood levels increase by 100mm in the playground defence line to the rear of the playground.

There is only minor spilling on the north bank downstream of and by approximately 250mm in Healion's Field in Option 1 compared to the current scenario.

The left bank (north side of the river) protection is formed by a concrete flood wall. The wall will start at the downstream end of the Mill Bridge and will extend along the boundary of the children's park area. Flood gates will be provided at the access points into the park.

Beyond the children's park area, the wall extends behind the Mountmellick Community Arts Centre and then along the end of a number of private gardens. It will form the boundary at the ends of the gardens. At one garden, the resident has created an access platform onto the riverbank. The proposed wall will ensure access to the river is maintained at this location.

An area of Japanese knotweed is located along this length of the proposed wall. The knotweed has been subjected to a programme of treatment and inspection over the last three years and will be fully eradicated at the time of construction.

The wall then extends and connects into the upstream face of Convent Bridge. There is an existing access ramp down the left bank immediately upstream of Convent Bridge and this access will need to be maintained. To do this, the last 5m length will be formed using a gate or removable section that will remain in place most of the time and will only be removed when access is required to the river.

The right bank (south side of the river) protection is formed by a concrete flood wall that starts at the downstream end of the existing Mill Bridge wing wall and extends along the top of the riverbank along the length of the existing buildings. At the end of the buildings, the wall construction crosses the footpath, including a flood gate to allow access along the existing footpath, and ends. At the end of the wall an earth flood embankment extends long the southern boundary of the open field, along the rear of the gardens of the properties on Grove Park, such that the field provides an area of flood storage.

At the end of the Grove Park properties the embankment extends across the Clontygar stream and then runs along the bank of the stream to meeting Irishtown Road.

The flood embankment then extends adjacent to Irishtown Road and along the outside edge of the field area to maximise the flood storage area provided. This then takes the embankment back to the right bank of the Owenass River. At this point, it re-joins the line of the existing public footpath and so a flood gate is provided in the footpath to provide access along the footpath as well as the required standard of protection during flood events.

Beyond this point, a concrete flood wall extends at the top of the river bank and connects into the upstream face of Convent bridge.

Beyond Convent bridge, the flood wall extends along the right bank (east bank) of the Owenass.

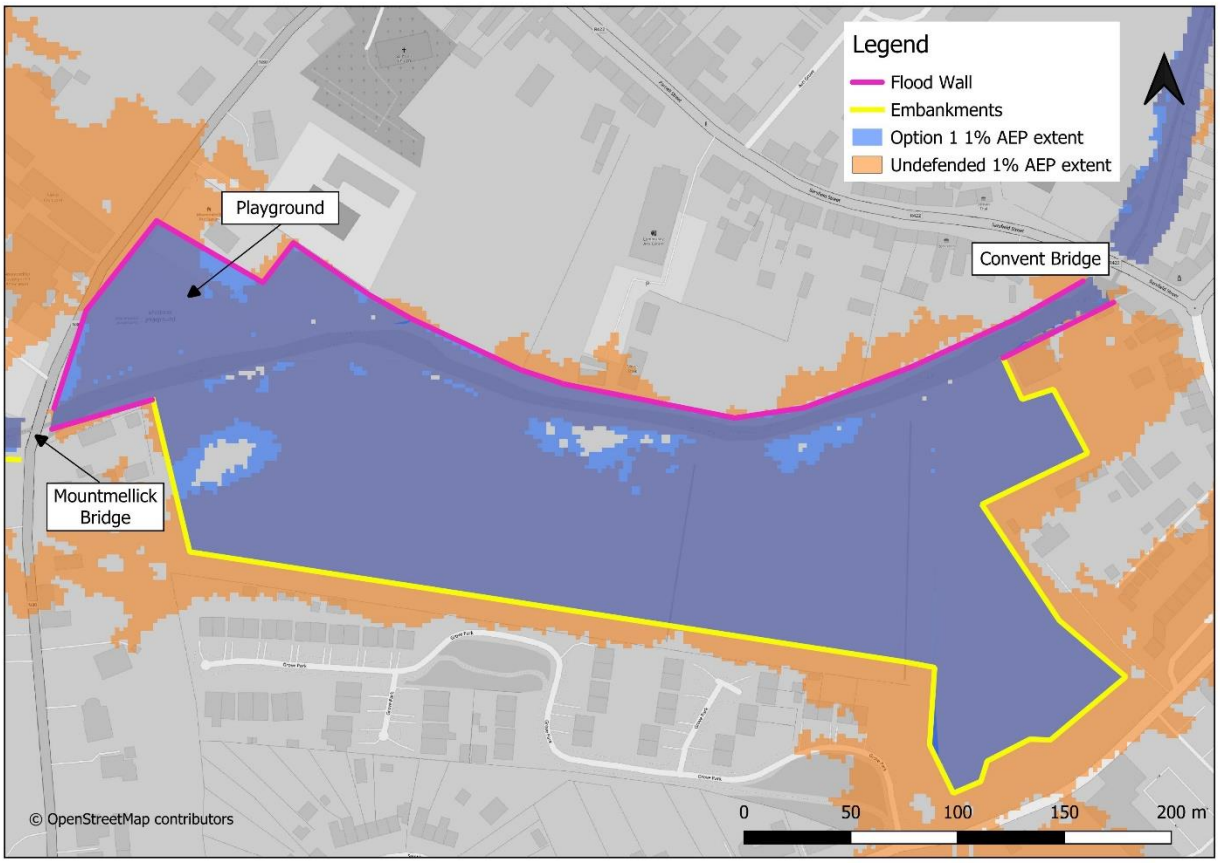



Figure 5-3 Option 1 insert by Mountmellick Bridge

#### 5.2.3.2 Benefits

In Option 1 properties previously flooded in this area are defended. As a result of the additional defences, no additional key risk receptors are impacted.

#### 5.2.3.3 Environmental Assessment

##### Biodiversity

The construction of flood walls and embankments will take place within and adjacent to the River Barrow and River Nore SAC. The defences bisect the boundary of the SAC along the north side of Grove Park and consultation with NPWS will be required (and was completed on 20 December 2023). Monitoring to confirm the presence of otters will be carried out, and may require mitigation to avoid damage to holts and impairing access to feeding sites. Construction within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation. The scheme will undergo Screening for Appropriate Assessment, and move to full Appropriate Assessment as necessary.

There will be the loss of mature trees in the playground; this will lead to a high long-term negative effect. However, it is noted that some of the trees are structurally unsound and may pose a public safety risk in the near future.

Walkover surveys showed that several non-native invasive species are on or near the riverbank, including Giant Butterbur, Snowberry, and Traveller's Joy. There is also a stand of Japanese Knotweed, which has received two seasons of treatment. Care will be needed to ensure no further spread of these species occurs.

Once operational, the proposed defences will not have a direct effect on biodiversity in the area.

Overall, there is a potential long-term high effect on ecology in this area.

##### Hydrology and Hydromorphology

During construction, temporary moderate negative effects are possible on hydrology and hydromorphology. Works along the banks of the River Owenass for the construction of walls and embankments have the potential to increase sedimentation and runoff entering the watercourse. Mitigation measures for managing the risk to water quality are feasible, such as adherence to best

practice guidance, pollution prevention and sediment management measures such as the use of oil booms, spill kits, and silt fences, supervision by an Ecological Clerk of Works (ECoW), and safe concreting measures during wall construction. These will ensure that impacts to hydromorphology and hydrology are reduced to slight negative.

During the operational period, the proposed walls on the left bank may cause localised effects to flow by increasing velocities due to smooth surfaces. Walls can be designed to mitigate the effect on instream and riparian habitat through the creation of rough wall finishes and planting to ensure flow diversity at bank margins. The operational impact will be slight.

The overall impact on hydrology and hydromorphology is moderate negative.

#### Cultural Heritage

The proposed flood walls will be built partially within the Zone of Archaeological Potential of the town of Mountmellick (RMP LA008-021) and will have a slight negative effect on several recorded archaeological features. A moderate effect has been identified for Convent Bridge (RPS 701) as the proposed wall will abut the bridge, while a high effect has been identified for the monument in the playground (RPS 704) as the surrounding wall will significantly alter the setting of this feature. The overall impact on cultural heritage is permanent high negative.

#### Landscape and Visual Amenity

The construction of a defence wall on the left bank may lead to a disruption of views of the River Owenass, particularly for residents whose property backs up to the river.

Views of the river, particularly for residents at the back of their property, are expected to be permanently moderately negatively affected due to the addition of a defence wall.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor, however the extent of works required means that access to the playground is likely to be restricted temporarily.

No other potential permanent effects are anticipated.

### 5.2.4 Clontygar Stream and Davitt Road

#### 5.2.4.1 Description

A new concrete floodwall will extend across the upstream headwall of the existing culvert carrying the Clontygar stream below Irishtown Road. The wall will extent part way along the left bank of the stream, across the headwall and then along the right bank of the stream. It then turns at right angles to the direction of flow in the stream so that it forms the end detail of the new flood embankment.

The new flood embankment then extends along a line just outside the boundary of the school play area and along the rear of the gardens of the properties on Davitt Court. The embankment turns to follow the line of the back of the gardens and extends up to the gardens of the properties on Brook View and then turns 90 degrees to extend across the open field running into the naturally higher ground.

At the 90-degree bend in the embankment - adjacent to Brook View, a culvert has been included to bring the stream that connects into the Clontygar through the embankment. A new alignment of this stream is then constructed so that it runs on the 'wet' side of the embankment.

The existing alignment of the Clontygar stream runs along the boundary of the school playing area and the ends of the gardens on the properties on Davitt Court. This is the same line as the proposed flood embankment and so the alignment of the Clontygar stream is moved slightly to the south until it can connect into the existing alignment on the approach to the Irishtown Road culvert.

A crossing point is to be included in the embankment to allow access from the school play area to the area created between the embankment and the new alignment of the Clontygar stream.

As part of the scheme, the surface water drainage for the Davitt Road area is being assessed to ensure that the proposed FRS does not result in a loss of capacity of the existing drainage network which could increase the flood risk to properties in the Davitt Road area.

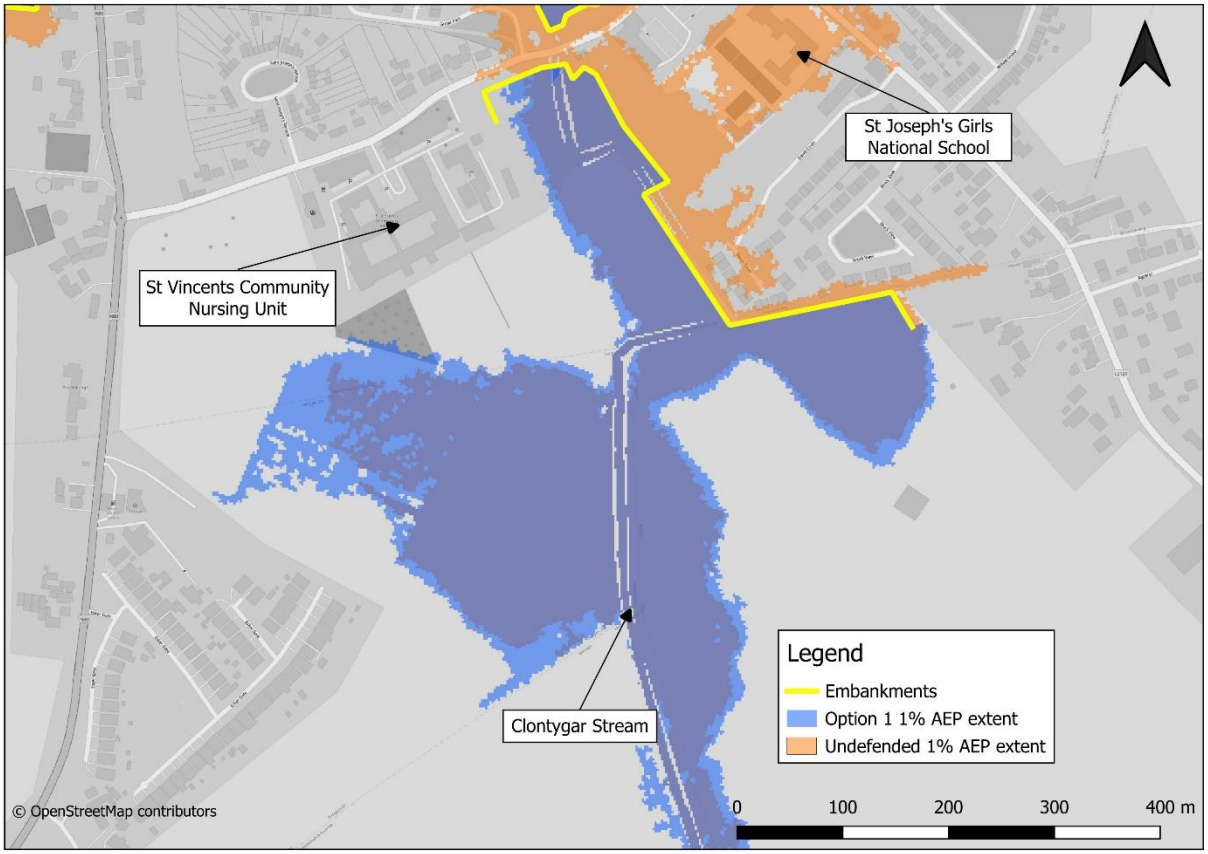



Figure 5-4 Option 1 insert by St Joseph's Girls National School

#### 5.2.4.2 Benefits

The proposed defence line protects many residences and a key access route. The area where flooding is increased is green space which has no key risk receptors. While levels do increase in Option 1 along the Clontygar there is potential for further work and assessment to reduce this by adding a flap valve on the Irishtown Road culvert to prevent backwater from the Owenass river. Levels increase by 5cm in Option 1 when a flap valve is put in place compared to the current level.

#### 5.2.4.3 Environmental Assessment

##### Biodiversity

The construction of flood walls and embankments will take place in an area directly upstream of the River Barrow and River Nore SAC. Construction close to the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

The embankment will require the removal of riparian vegetation along the Clontygar, resulting in moderate negative effects. Disruption to the stream during construction and its realignment to allow for the embankment could lead to moderate negative effects on the stream habitat and aquatic species in the stream.

An ecological survey was undertaken on the Clontygar stream where no species of note or non-native invasive species were recorded.

This option will result in potential permanent moderate effects on ecology in this area.

##### Hydrology and Hydromorphology

The WFD waterbody here (Triogue_040) is at Poor status and is At Risk. Construction of the embankment has the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. However, the stream will require realignment south of the embankment. This will result in direct negative effects on hydromorphology as the existing stream bed and banks will be altered or removed entirely. Long-term moderate negative effects are likely as a result in this area.

#### Cultural Heritage

It is evident from the First Edition 6-inch OS map that the Clontygar Stream was straightened prior to the 1840s. It is therefore possible that the original course of this stream and any potentially related features may be impacted by the proposed embankments which will form part of the flood relief works. Archaeological testing in advance of construction will further assess the nature of archaeological potential in this area.

The EIAR will detail the programme of testing to be completed in advance of the construction works.

The overall potential effect on cultural heritage is permanent, negative and slight.

#### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will not be significant.

No permanent impact on landscape and visual amenity is expected once operational.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.2.5 Owenass Bridge to Mountmellick Mill Bridge

#### 5.2.5.1 Description

The defence line is tight to the line of urban development and follows the northern boundary of the Baker's field and perimeter of the MDA lands. The west bank of the Owenass is flooded in the undefended scenario and continues to be flooded when Option 1 is in place as water levels in the Baker's field increase by 450mm in Option 1 compared to the undefended scenario. The defence varies in height between 1m and 2m.

From the upstream face of Mountmellick bridge, a concrete flood wall will extend from the end of the existing wing wall. In addition, the height of the existing wing wall will be raised. The adoption of a flood wall at this location allows the access to the field from Pearse Street via an existing access gate just to the south side of Mountmellick Mill bridge to be maintained.

Beyond the gardens of the properties on Pearse Street, there is then sufficient room to construct a flood embankment which extends perpendicular to the alignment of the Owenass river and along the rear boundary of the gardens of the properties on Pearse Street.

An area of Japanese knotweed has been found in this area. The knotweed has been subjected to a programme of treatment and inspection over the last three years and will be fully eradicated at the time of construction.

The embankment continues southwards along the boundary with the gardens until it runs into higher ground.

To the north of the Owenass, the embankment extends from Mill Bridge along the boundary of the MDA site and then along the boundary of Baker's field. From there it extends around the Manor Grove properties before crossing the road where a flood barrier will be provided. The embankment then extends northwards towards Manor Road. A flood barrier will be provided crossing Manor Road and a flood wall extends towards the west along the Manor House boundary before an earth embankment extends northwards to higher ground.

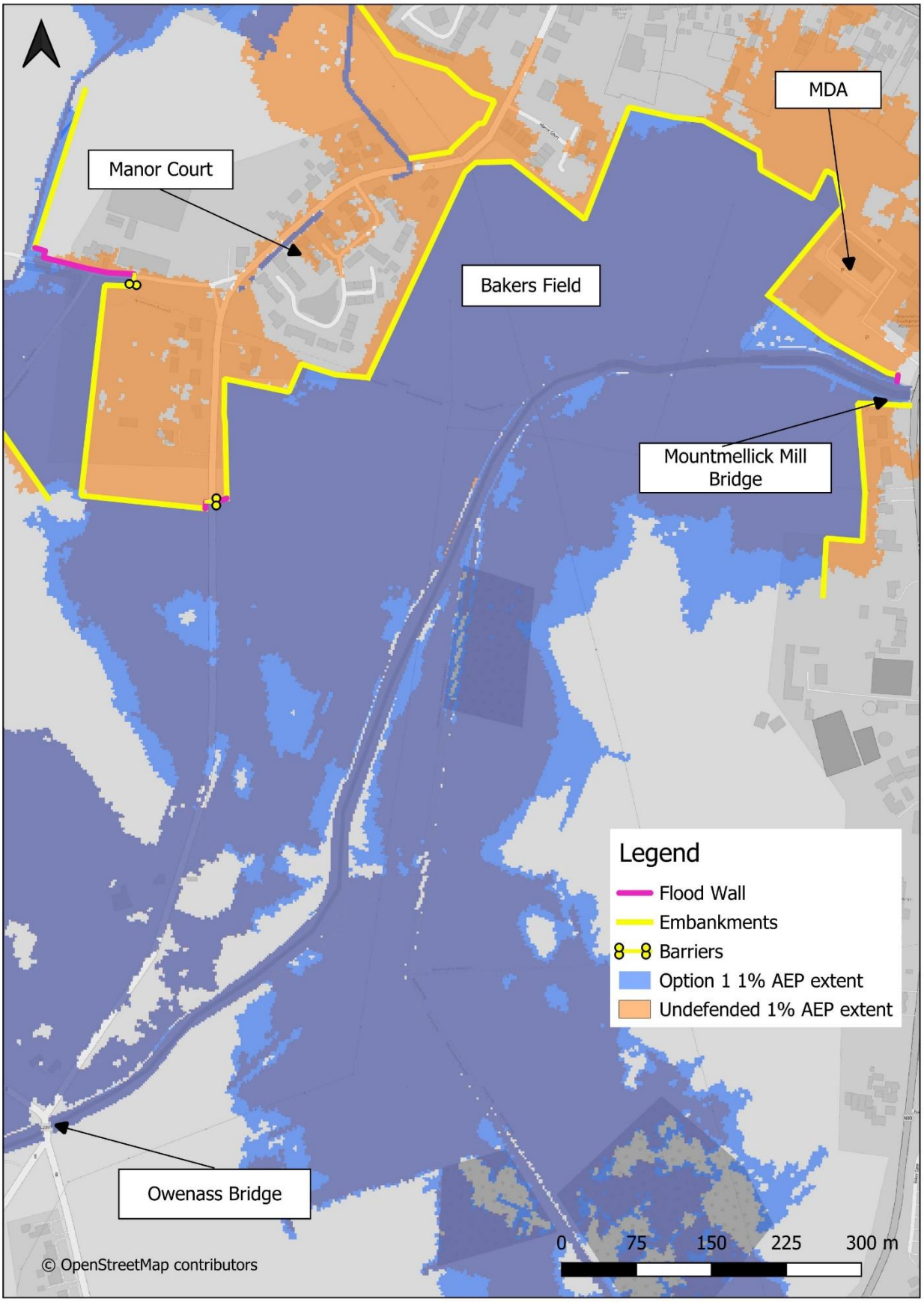



Figure 5-5 Option 1 insert by Bakers Field

5.2.5.2 Benefits

Option 1 protects the properties along Parnell Street, the MDA and Manor Court. Closing off the connection between the Owenass and Pound reduces flood risk on the Pound downstream of Manor Court as there is a reduction of flow passing through that part of the system.

Coupled with works around the pumping station (which could be moved inside the defences), there are opportunities to form a pocket park in this under-utilised corner. Embankment lends itself to an extension to the riverside walkway.

#### 5.2.5.3 Environmental Assessment

##### Biodiversity

The construction of the embankments will take place partially within the River Barrow and River Nore SAC, and will bisect the SAC in two locations. Construction close to or within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

As the embankment is set back from the SAC upstream of the MDA, there is less risk of permanent high ecological effects than in Option 2A.

Non-native invasive species such as Japanese Knotweed, Snowberry, Traveller's Joy, and Montbretia have been identified along the line of the embankment, while Giant Butterbur is present in the river channel.

The set back embankment will allow the area between it and the river to remain in use as an occasional floodplain; benefits to water quality and hydrology due to this have the potential to lead to indirect benefits on the aquatic habitat and species in the operational phase.

This option will result in potential permanent moderate effects on ecology in this area.

##### Hydrology and Hydromorphology

The WFD waterbody here (Owenass_020) is at Moderate status and is At Risk. Construction of the embankment has the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will partially mitigate this risk. The amount of construction required close to the watercourse is low compared to Options 2A and 2B. Due to this, temporary slight negative effects are possible on the WFD waterbody during construction.

The setback embankment will allow for a greater floodplain connection here than in Options 2A and 2B once operational. This could lead to positive long-term impacts.

The overall impact on hydrology and hydromorphology will be slight negative.

##### Cultural Heritage

The embankment will be partially located within the ZAP of the historic town of Mountmellick (RMP LA008-021). In addition to the inherent archaeological potential associated with the riverine / greenfield environment, an embankment is proposed within the former demesne lands of Irishtown House. Archaeological testing will be recommended in advance of construction.

The proposed embankments would be located outside of the proposed ACA to the rear of properties and would not have any effect on the properties or on the streetscape which makes up the character of the ACA.

This option would mean areas along the River Owenass south of the town would continue to be flooded. This would include the locations of a thatched cottage (RPS 857) and a railway bridge (RPS 829) in Derrycloney. While the deck of Owenass Bridge (LAIAR-007-004) would not be flooded, modelling indicates that the north bank of the Owenass River at this location would be flooded, suggesting that the bridge would have to withstand large volumes of water. While the proposed works would not directly impact these features, the continued flooding may ultimately lead to a deterioration to the fabric of these structures, leading to a negative effect.

Embankments around the Mountmellick Development Association (RPS 703) would result in preventing flooding of this protected structure and would facilitate a riverside walkway, resulting in an overall positive effect.

An historic stone wall on Park Street (CH1) will be partly demolished to facilitate an embankment and pedestrian access as part of this option. This would result in a slight negative effect.

The overall potential effect on cultural heritage is permanent, negative and high.

#### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the embankment may lead to a disruption of views for residences in Manor Court and Manor Road. This will lead to a moderate negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is moderate negative.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.2.6 Upstream of Owenass Bridge

#### 5.2.6.1 Description

There are no defences proposed for this area in Option 1. Option 1 focuses on the town of Mountmellick, and no defences are proposed in the upstream floodplain area around Owenass Bridge. Buildings in this area are not flooded in the current scenario and not protected or affected in Option 1.

### 5.2.7 Manor House, Manor Court and Manor Road

#### 5.2.7.1 Description

Embankments will be constructed surrounding the houses of Manor Court and Manor Road, with a small stretch of flood wall in place where there is no space for an embankment.

The property on Sandy Lane will be protected by earth embankments to either side of the property and its grounds and a flood wall along the roadside of the property. The flood wall will incorporate flood gates for access. The defences vary in height between 1m and 2m.

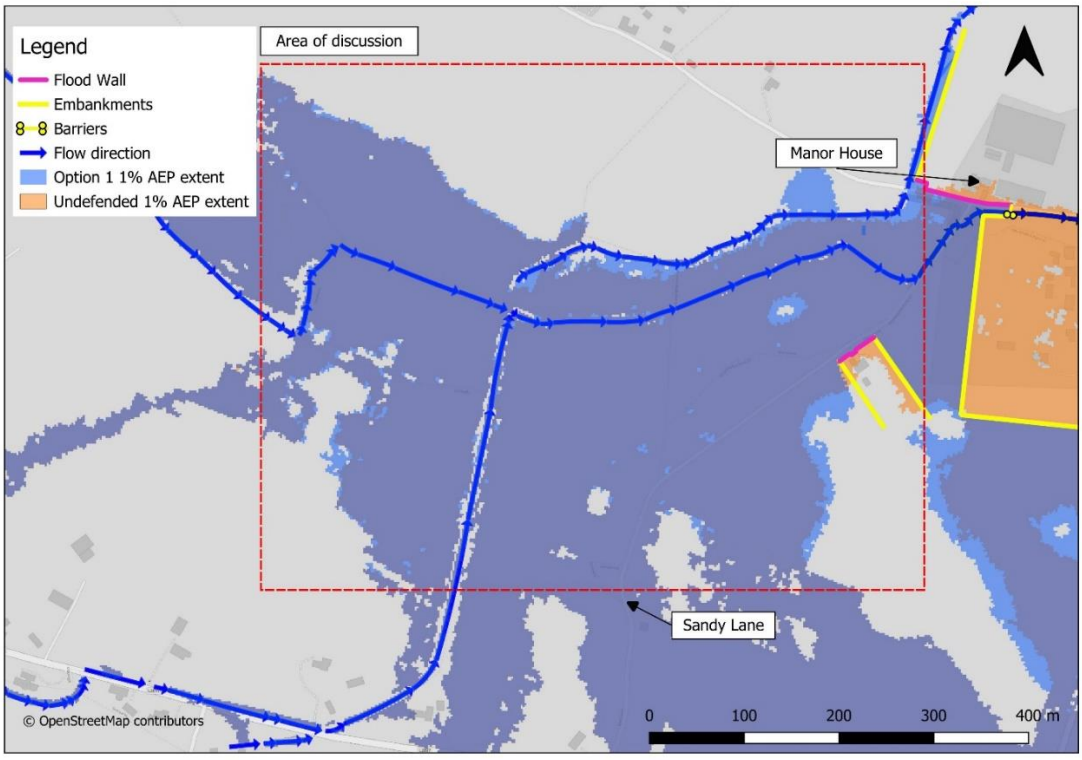



Figure 5-6 Option 1 insert by Manor House

#### 5.2.7.2 Benefits

The storage of the flood waters combined with the throttle reduces flood risk downstream and avoids the need for further work downstream on the Pound. Localised embankments ensure that no key risk receptors are flooded. While water levels do increase, the area flooded is already effected in the current scenario and there is minimal increase in flood extents.

#### 5.2.7.3 Environmental Assessment

##### Biodiversity

The construction of embankments will require the removal of hedgerow, which will lead to moderate negative effects through disturbance or loss of habitat.

The non-native invasive species Montbretia has been identified along the line of the embankment, while Chinese Bramble is present on Manor Road. Construction could lead to accidental disturbance and spread of these non-native invasives, leading to a permanent moderate negative impact.

The overall impact on biodiversity is moderate negative.

##### Hydrology and Hydromorphology

The WFD waterbody here (Barrow_040) is at Moderate status and is At Risk. Construction of the embankment has the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Temporary moderate negative effects are possible on the WFD waterbody during construction.

Once operational, the addition of a throttle here will act as a barrier to longitudinal connectivity, restricting both sediment transport and fish passage. Increased sedimentation is likely under this option.

The overall impact on hydrology and hydromorphology is high negative.

##### Cultural Heritage

In addition to the inherent archaeological potential associated with the riverine / greenfield environment, there is archaeological potential associated with the Garroon Stream, which functioned as the tailrace of the Manor Mills. Archaeological testing will be recommended in advance of construction.

Although the proposed barrier wall on Manor Road would protect Manor House from flooding, this intervention would have an effect on the setting of the house by altering the character of Manor Road which is currently flanked by the stone walls of Manor House and Manor Mills. This would result in an overall slight negative effect on this undesignated architectural heritage feature.

Conversely, these measures would also impact the adjacent Manor Mills, without the benefit of protecting it from flooding. The continuation of flooding of this site will ultimately lead to a moderate negative effect.

The overall potential effect on cultural heritage is permanent, negative and moderate.

##### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the embankments are likely to lead to a disruption of views for residences in Manor Court and Manor Road. This will lead to a moderate negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is moderate negative.

##### Construction and Access Impacts

No other potential  permanent effects are anticipated.

### 5.2.8 Garroon Stream

#### 5.2.8.1 Description

The flood modelling shows that the properties adjacent to Garroon Stream will be inundated as a result of Option 1 and so the properties are to be protected locally through the provision of a flood

wall along the eastern side of the property as there is insufficient room to construct a flood embankment and an earth flood embankment to the south and extending across the field to higher ground to the west of the properties. The defences vary in height between 1m and 2m.

The need to maintain access to the properties means that the length of wall will need to include a number of gated openings.

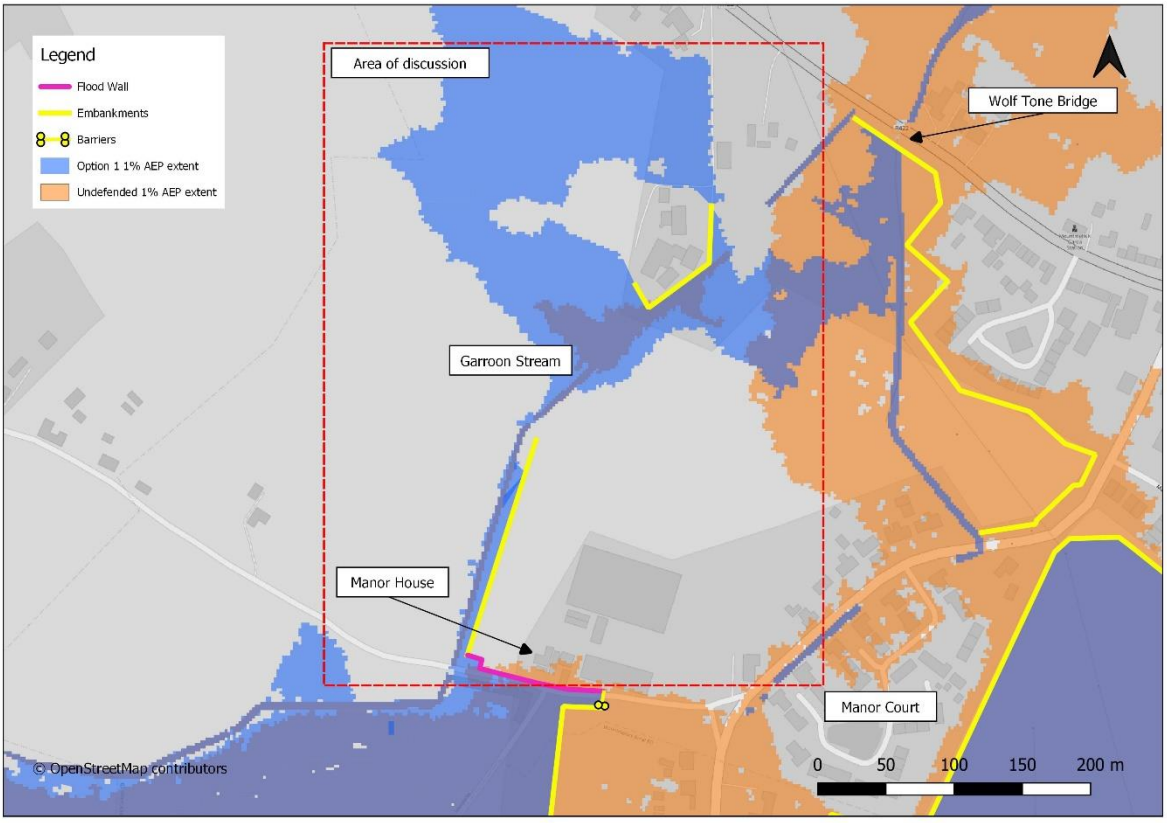



Figure 5-7 Option 1 insert by Garroon Stream

5.2.8.2 Benefits

The Garroon provides a route for flows which have been restricted by the throttle on the Pound, reducing water levels upstream.

5.2.8.3 Environmental Assessment

Biodiversity

The construction of embankments will require the removal of hedgerow, which will lead to temporary moderate negative effects through disturbance or loss of habitat. Construction near the watercourse will also lead to the risk of impacts to riparian and aquatic habitats.

Once operational there will be no significant impacts on biodiversity.

The overall impact on biodiversity is moderate negative.

Hydrology and Hydromorphology

The WFD waterbody here (Barrow_040) is at Moderate status and is At Risk. Construction of the walls and embankment have the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Moderate temporary negative effects are possible on the WFD waterbody during construction. Significant effects during the operational phase are not anticipated.

The Garroon Stream is expected to receive much higher flows in the operational stage, leading to higher bank and bed erosion and deposition of fine sediment on the bed. This would lead to a permanent high negative effect.

The overall impact on hydrology and hydromorphology is high negative.

#### Cultural Heritage

In addition to the inherent archaeological potential associated with the riverine / greenfield environment, there is archaeological potential associated with the Garroon Stream, which functioned as the tailrace of the Manor Mills. It is also evident on historic mapping that a roadway once ran along the north bank of this watercourse. The former Mountmellick Branch of the Great Southern & Western Railway crossed immediately downstream of the proposed defences. It is no longer extant but some related features may remain and evidence of the railway may survive beneath the surface. Some of the former railway would be flooded in this scenario. Archaeological testing will be recommended in advance of construction.

Walls will be to the rear of the railway station and associated structures, with a slight negative effect.

The overall effect of this options would be permanent, negative and slight.

#### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the embankments are likely to lead to a disruption of views for residences in the area. This will lead to a moderate negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is moderate negative.

#### Construction and Access Impacts

No other potential permanent effects are anticipated.

### 5.2.9 Bay Road Business Park

#### 5.2.9.1 Description

The business park is affected by high levels on the River Barrow, which cause the Pound River to back up, rather than being affected by high levels on the Pound alone. A flood embankment is proposed which will surround the northern portion of the Bay Road Business Park on three sides, retaining access from the south. This will protect the Midland Steel site from flooding, but will allow uninterrupted access to the site. The defences vary in height between 1m and 2m.

#### 5.2.9.2 Benefits

The embankment will reduce flood risk to the business park.

#### 5.2.9.3 Environmental Assessment

#### Biodiversity

During construction, a small amount of hedgerow may need to be removed to facilitate access and make way for the embankment. This would lead to a slight negative effect.

Once operational the proposed embankment in this area will not lead to permanent negative effects on biodiversity.

#### Hydrology and Hydromorphology

The Business Park is set back from the nearest WFD waterbody by approx. 250m. Slight temporary negative effects are possible on the local water quality and hydromorphology during construction.

Once operational the proposed embankment in this area will not lead to permanent negative effects on hydrology and hydromorphology.

#### Cultural Heritage

There are no designated cultural heritage features in this area, but there is inherent archaeological potential related to the surrounding watercourses and green fields.

The overall potential effect on cultural heritage is permanent, negative and slight.

#### Landscape and Visual Amenity

There are no specific visual amenity constraints in this area.

#### Construction and Access Impacts

There are no other environmental constraints in this area.

### 5.2.10 Summary of Environmental Assessment

The potential effect of each measure was assessed using the impact classification terminology outlined below:

| Legend | |
|---|---|
| High potential effect |  |
| Moderate potential effect |  |
| Slight/no potential effect |  |

It should be noted that the above classification was used for the comparative assessment of options only and does not reflect the eventual assessment of potential impacts of the proposed development as outlined in the Environmental Impact Assessment (EIA) Screening or other environmental assessments.

| Option 1 - Parts of the study area | | | | | | | |
|---|---|---|---|---|---|---|---|
| Constraints | Mountmellick Mill Bridge to Convent Bridge | Clontygar Stream and Davitt Road | Owenass Bridge to Mountmellick Mill Bridge | Upstream of Owenass Bridge | Manor House, Manor Court, and Manor Road | Garroon Stream | Bay Road Business Park |
| Biodiversity | | | | | | | |
| Hydrology and Hydromorphology | | | | | | | |
| Cultural Heritage | | | | | | | |
| Landscape and Visual Amenity | | | | | | | |
| Construction and Access Impacts | | | | | | | |

Figure 5-8. Summary of Environmental Effects for Option 1.

## 5.3 Option 2A - Embankment along Owenass riverbank

### 5.3.1 Design Constraints

Although the majority of the works upstream of Mountmellick Mill Bridge are remote from the watercourses, the works between Mountmellick Mill Bridge and Convent Bridge will require access to the river Owenass to complete the works at a number of locations. The design details will minimise the impact on and risk to the river and will allow the works to be constructed in accordance with any ecological programming restrictions or heritage constraints imposed.

The proposed embankments extend along the boundary of existing properties at a number of locations and so the impact on existing structures including houses and their boundary walls will be confirmed and taken into account in the alignment and design of the defence structures. The defences vary in height between 1m and 2m.

One of the consequences of preventing the flood flow from the river Owenass from joining the flood flow from the river Pound, is to force more flow through the Owenass Bridge. As a result, this will increase the water level and velocity at the existing structure. Increasing velocity and depth increases the risk of the riverbed adjacent to the bridge abutments being washed away during a flood event as a result of scour. To determine the level of this increase in risk, a Scour Assessment was completed in accordance with Volume 3 Section 4 Part 21 BD 97/12 of the Design Manual for Roads and Bridges - The Assessment of Scour and Other Hydraulic Actions at Highway Structures, May 2012. The assessment confirmed that both Options 2A and 2B resulted in a significant increase in the depth of potential scour at the structure.

Alternatives were investigated to divert some of the additional flow via bypass channels so that the existing structure could remain in place, but their impact on adjacent access and road arrangements was significant and made them inappropriate. As a result, both Options 2A and 2B require the bridge to be replaced with a new structure with a larger opening and engineered to withstand the consequences of the hydraulic loading and scour risk.

### 5.3.2 Ongoing maintenance, ownership, and responsibilities

Each of the proposed measures will have their own management and operational plans detailing how the assets will be maintained and how they will be secured during flood risk periods. In Option 2A, this will include how the footpath closures using the flood gates will be instigated and managed.

Annual inspections of the embankments and the walls will be needed, together with investigations of their performance following each flood event. Monitoring of seepage will be recommended.

Responsibility for the maintenance and testing of the flood gates will remain with Laois County Council (LCC). They are located in publicly accessible areas to ensure clear access for the management of the gates.

A maintenance plan for the gates will be developed which will require LCC to inspect and operate the flood gates at least once a year to examine them for any defects and to ensure staff are trained in and familiar with their installation and operation.

### 5.3.3 Mountmellick Mill Bridge to Convent Bridge

#### 5.3.3.1 Description

The playground is flooded in the current scenario and continues to be flooded when Option 2A is in place with defence line to the rear of the playground.

There is only minor spilling on the north bank downstream of the playground in the current scenario, but defences are included along this area as flooding in worsened for the rear of Sarsfield Street when upstream defences are modelled. The defences along the north bank are around 0.6 – 0.9m (2’ to 3’ high). Flood levels increase by 100mm in the playground and by approximately 250mm in Healion's Field in Option 2A compared to the current scenario.

The left bank (north side of the river) protection is formed by a concrete flood wall. The wall will start at the downstream end of the Mill Bridge and will extend along the boundary of the children's park area. Flood gates will be provided at the access points into the park. The defences vary in height between 1m and 2m.

Beyond the children's park area, the wall extends behind the Mountmellick Community Arts Centre and then along the end of a number of private gardens. It will form the boundary at the ends of the gardens. At one garden, the resident has created an access platform onto the riverbank. The proposed wall will ensure this 'up and over' access to the river is maintained at this location.

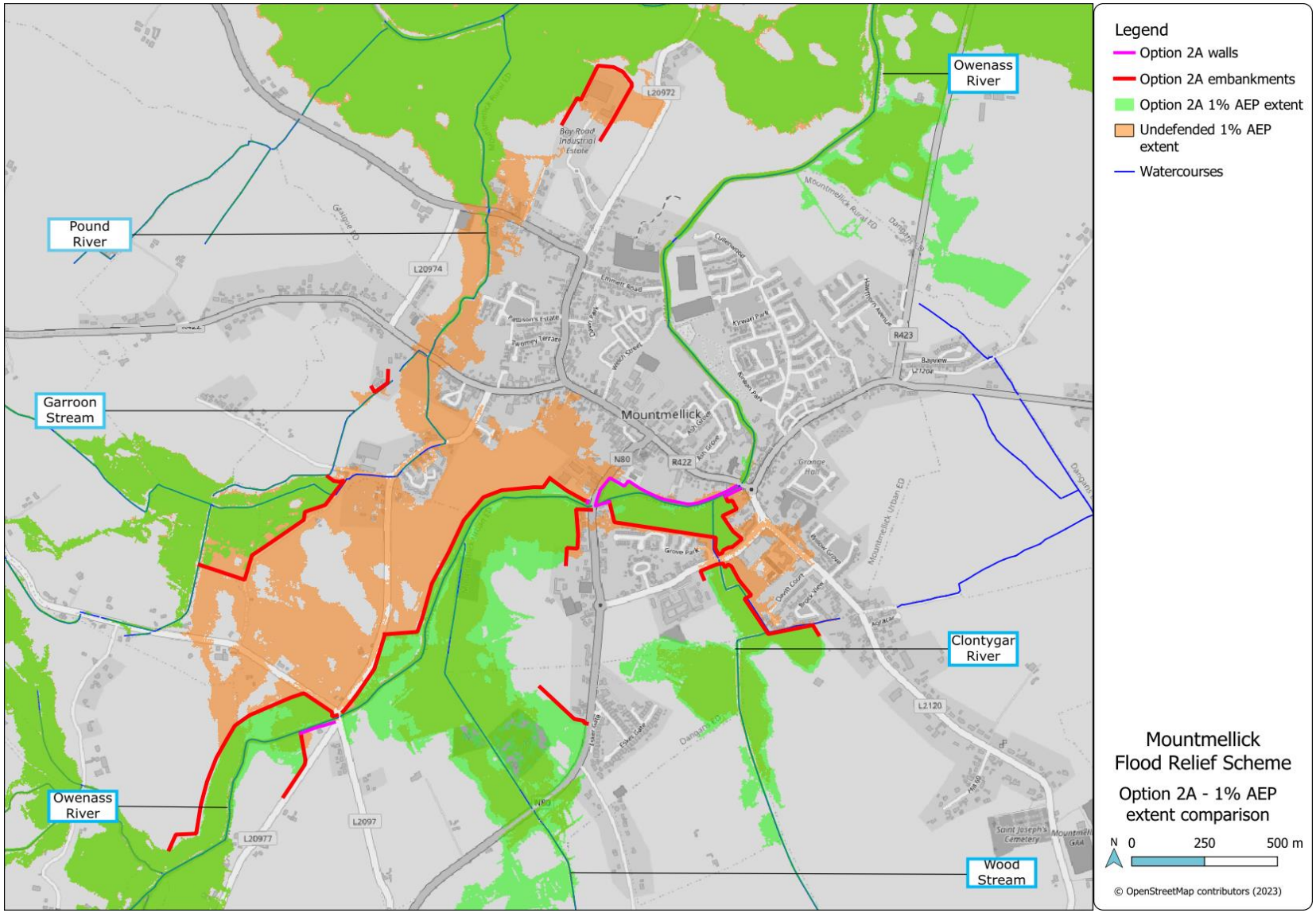



Figure 5-9. Option 2A - Overview

An area of Japanese knotweed is located along this length of the proposed wall. The knotweed has been subjected to a programme of treatment and inspection over the last three years and will be fully eradicated at the time of construction.

The wall then extends and connects into the upstream face of Convent Bridge. There is an existing access ramp down the left bank immediately upstream of Convent Bridge and this access will need to be maintained. To do this, a 5m length of the wall will be formed using a gate or removable section that will remain in place most of the time and will only be removed when access is required to the river.

The right bank (south side of the river) protection is formed by a concrete flood wall that starts at the downstream end of the existing Mill Bridge wing wall and extends along the top of the riverbank along the length of the existing buildings. At the end of the buildings, the wall construction crosses the footpath, including a flood gate to allow access along the existing footpath, and ends. At the end of the wall an earth flood embankment extends long the southern boundary of the open field, along the rear of the gardens of the properties on Grove Park, such that the field provides an area of flood storage.

At the end of the Grove Park properties the embankment extends across the Clontygar stream and then runs along the bank of the stream to meeting Irishtown Road.

The flood embankment then extends adjacent to Irishtown Road and along the outer edge of the field area to maximise the flood storage area provided. This then takes the embankment back to the right bank of the Owenass River. At this point, it re-joins the line of the existing public footpath and so a flood gate is provided in the footpath to provide access along the footpath as well as the required standard of protection during flood events.

Beyond this point, a concrete flood wall extends at the top of the riverbank and connects into the upstream face of Convent bridge.

Beyond Convent bridge, the flood wall extends along the right bank (east bank) of the Owenass at the top of the riverbank and at the ends of the private gardens. There will be areas where the line of the wall will have to locally change to allow for the presence of existing buildings in the garden areas.

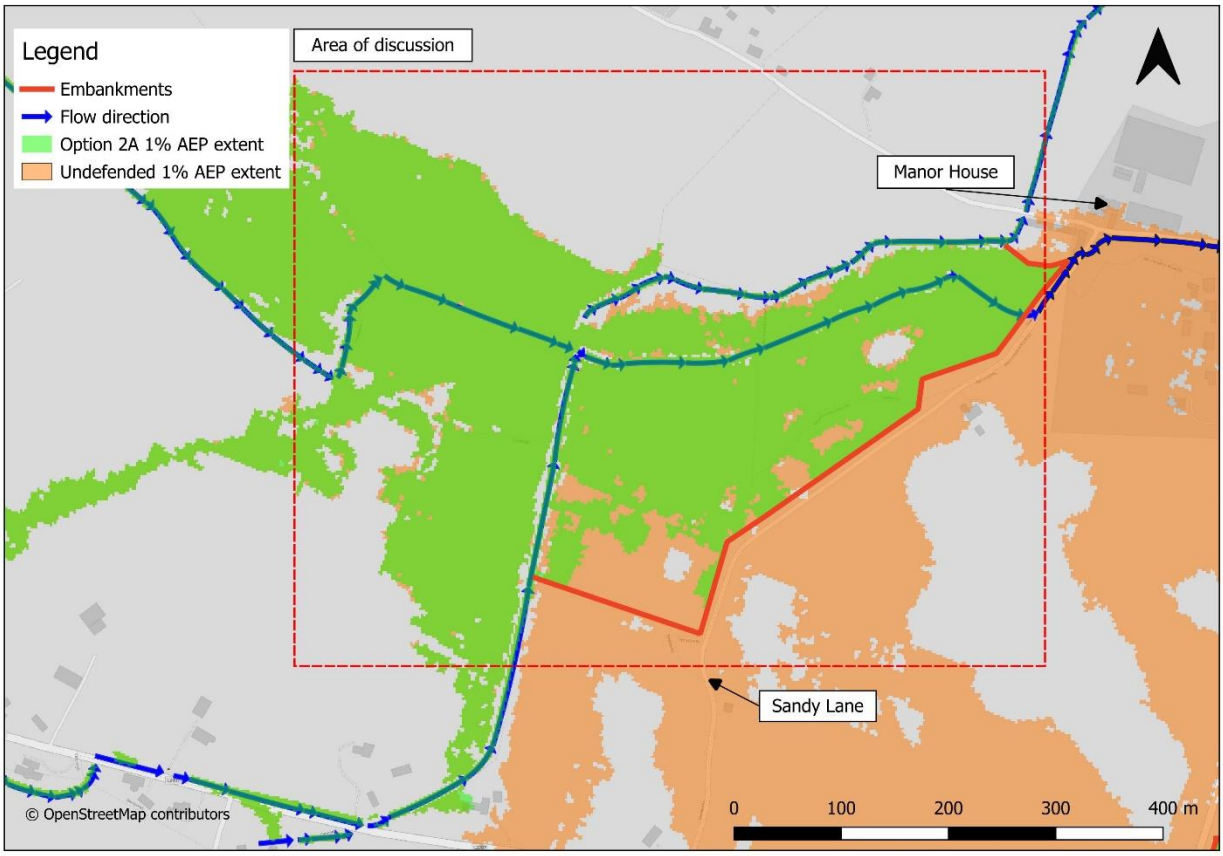



Figure 5-10: Option 2A insert by Mountmellick Bridge

#### 5.3.3.2 Benefits

As with Option 1, in Option 2A properties previously flooded in this area are defended. As a result of the additional defences, no additional key risk receptors are effected.

#### 5.3.3.3 Environmental Assessment

##### Biodiversity

The construction of flood walls and embankments will take place within and adjacent to the River Barrow and River Nore SAC. The defences bisect the boundary of the SAC along the north side of Grove Park and consultation with NPWS will be needed about this. Monitoring to confirm the presence of otters will be carried out and may require mitigation to avoid damage to holts and impairing access to feeding sites. Construction within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

Walkover surveys showed that several non-native invasive species are on or near the riverbank, including Giant Butterbur, Snowberry, and Traveller's Joy. There is also a stand of Japanese Knotweed, which has received two seasons of treatment. Care will be needed to ensure no further spread of these species occurs.

Once operational, the proposed defences will not have a direct effect on biodiversity in the area.

Overall, there is a potential long-term high effect on ecology in this area.

##### Hydrology and Hydromorphology

During construction, temporary moderate negative effects are possible on hydrology and hydromorphology. Works along the banks of the river Owenass for the construction of walls and embankments have the potential to increase sedimentation and runoff entering the watercourse. Mitigation measures for managing the risk to water quality are feasible, such as adherence to best practice guidance, pollution prevention and sediment management measures such as the use of oil booms, spill kits, and silt fences, supervision by an ECoW, and safe concreting measures during wall construction. These will ensure that impacts to hydromorphology and hydrology are reduced to slight negative.

During the operational period, the proposed walls on the left bank may cause localised effects to flow by increasing velocities due to smooth surfaces. Walls can be designed to mitigate the effect on instream and riparian habitat through the creation of rough wall finishes and planting to ensure flow diversity at bank margins. The operational impact will be slight.

The overall impact on hydrology and hydromorphology is moderate negative.

##### Cultural Heritage

The proposed flood walls will be built partially within the Zone of Archaeological Potential of the town of Mountmellick (RMP LA008-021) and will have a slight negative effect on several recorded archaeological features. A moderate effect has been identified for Convent Bridge (RPS 701) as the proposed wall will abut the bridge, while a high effect has been identified for the monument in the playground (RPS 704) as the surrounding wall will significantly alter the setting of this feature. The overall impact on cultural heritage is permanent high negative.

##### Landscape and Visual Amenity

The construction of a defence wall on the left bank may lead to a disruption of views of the river Owenass, particularly for residents whose property backs up to the river.

Views of the river, particularly for residents at the back of their property, are expected to be permanently moderately negatively affected due to the addition of a defence wall.

##### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor, however the extent of works required means that access to the playground is likely to be restricted temporarily.

No other potential permanent effects are anticipated.

### 5.3.4 Clontygar Stream and Davitt Road

#### 5.3.4.1 Description

A new concrete floodwall will extend across the upstream headwall of the existing culvert carrying the Clontygar stream below Irishtown Road. The wall will extent part way along the left bank of the stream, across the headwall and then along the right bank of the stream. It then turns at right angles to the direction of flow in the stream so that it forms the end detail of the new flood embankment.

The new flood embankment then extends along a line just outside the boundary of the school play area and along the rear of the gardens of the properties on Davitt Court. The embankment turns to follow the line of the back of the gardens and extends up to the gardens of the properties on Brook View and then turns 90 degrees to extend across the open field running into the naturally higher ground.

At the 90-degree bend in the embankment - adjacent to Brook View, a culvert has been included to bring the stream that connects into the Clontygar through the embankment. A new alignment of this stream is then constructed so that it runs on the 'wet' side of the embankment.

The existing alignment of the Clontygar stream runs along the boundary of the school playing area and the ends of the gardens on the properties on Davitt Court. This is the same line as the proposed flood embankment and so the alignment of the Clontygar stream is moved slightly to the south until it can connect into the existing alignment on the approach to the Irishtown Road culvert.

A crossing point is to be included in the embankment to allow access from the school play area to the area created between the embankment and the new alignment of the Clontygar stream.

As part of the scheme, the surface water drainage for the Davitt Road area is being assessed to ensure that the proposed FRS does not result in a loss of capacity of the existing drainage network which could increase the flood risk to properties in the Davitt Road area. An option to ensure this is to provide a pumping station at the downstream end of the drainage network to maintain the outfall capacity of the existing system.

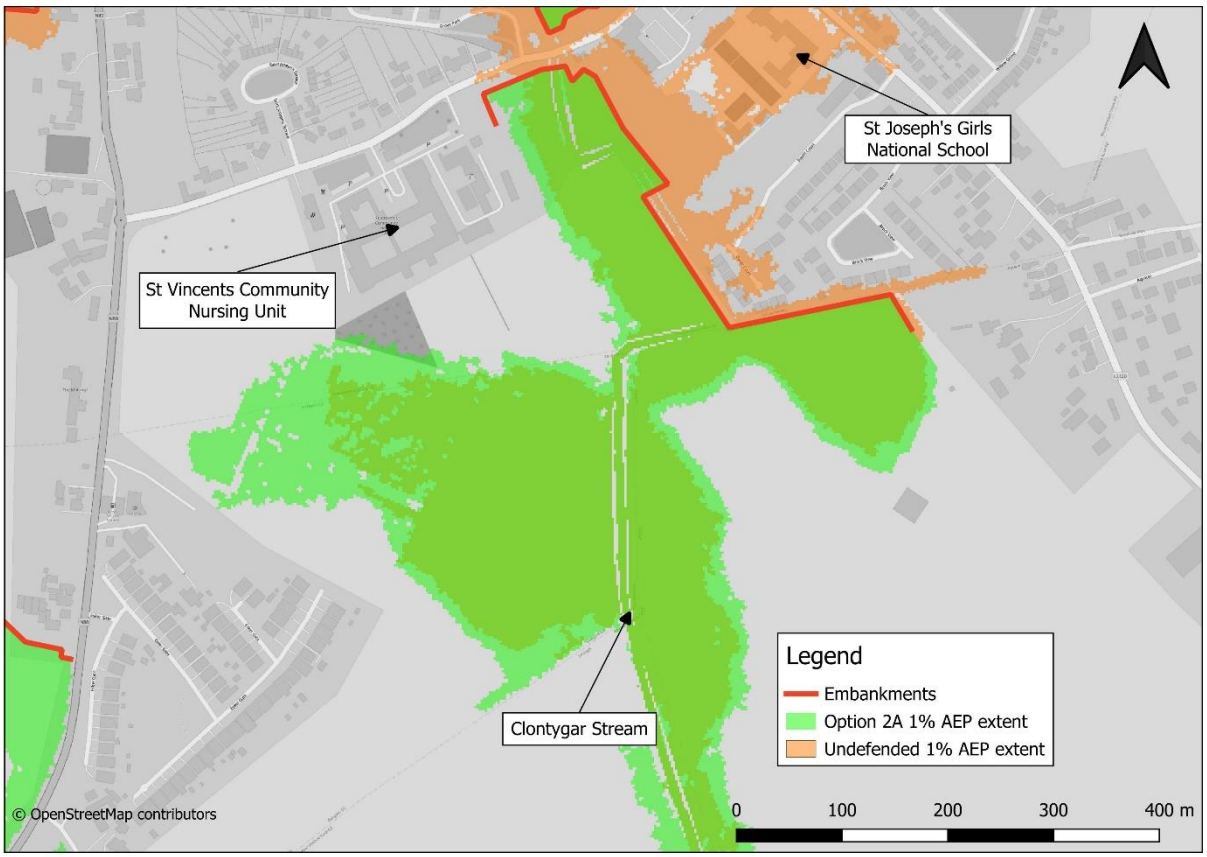



Figure 5-11: Option 2A insert by St Joseph's Girls National School

#### 5.3.4.2 Benefits

The proposed defence line protects many receptors and a key access route. The area where flooding is increased is green space which has no key risk receptors. While levels do increase in

Option 2A along the Clontygar there is potential for further work and assessment to reduce this by adding a flap valve on the Irishtown Road culvert to prevent backwater from the Owenass river. Levels increase by 50mm in Option 2A when a flap valve is put in place compared to the current level.

#### 5.3.4.3 Environmental Assessment

##### Biodiversity

The construction of flood walls and embankments will take place in an area directly upstream of the River Barrow and River Nore SAC. Construction close to the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

The embankment will require the removal of riparian vegetation along the Clontygar, resulting in moderate negative effects. Disruption to the stream during construction and its realignment to allow for the embankment could lead to moderate negative effects on the stream habitat and aquatic species in the stream.

An ecological survey was undertaken on the Clontygar stream where no species of note or non-native invasive species were recorded.

This option will result in potential permanent moderate effects on ecology in this area.

##### Hydrology and Hydromorphology

The WFD waterbody here (Triogue_040) is at Poor status and is At Risk. Construction of the embankment has the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. However, the stream will require realignment south of the embankment. This will result in direct negative effects on hydromorphology as the existing stream bed and banks will be altered or removed entirely. Long-term moderate negative effects are likely as a result in this area.

##### Cultural Heritage

It is evident from the First Edition 6-inch OS map that the Clontygar Stream was straightened prior to the 1840s. It is therefore possible that the original course of this stream and any potentially related features may be impacted by the proposed embankments which will form part of the flood relief works. Archaeological testing in advance of construction will further assess the nature of archaeological potential in this area.

The overall potential effect on cultural heritage is permanent, negative and slight.

##### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will not be significant.

No permanent impact on landscape and visual amenity is expected once operational.

##### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.3.5 Owenass Bridge to Mountmellick Mill Bridge

#### 5.3.5.1 Description

Left bank:

From the downstream wing walls of the new Owenass Bridge, concrete flood walls extend and then turn through 90 degrees to form the end of the new flood embankment. The flood embankment starts as soon as there is enough width in the field to construct it.

As there are access points from Derrycloney Road at this point, the alignment of the embankment extends along the bank of the river. It them moves away from the river to the roadside of the open

fields to maximise flood storage capacity. There is an access bank crossing the embankment at this location to maintain access to both sides of the embankment.

The embankment continues northwards along the side of Derrycloney Road, but then moves away from the road as it follows the boundary of a property. From here the embankment runs along the river Owenass, to be constructed just west of the riparian vegetation along the riverbank.

The embankment turns up from the riverbank to a point at the edge of the Mountmellick Development Association (MDA). At this point, it reverts to a concrete flood wall construction as there is limited room given the extent of the MDA site and the Owenass river. The wall connects into the upstream elevation of Mountmellick Bridge at its wing wall.

There will be a need to raise the level of the wing wall and the upstream parapet of the bridge to prevent flood water spilling onto the highway.

There is a public footpath that extends along the riverbank at this location, and it is anticipated that, rather than including a gated opening in the wall, the route of the footpath will be moved to run within the edge of the MDA site.

Right bank:

From the upstream face of Mountmellick bridge, a concrete flood wall will extend from the end of the existing wing wall. In addition, the height of the existing wing wall will be raised. The adoption of a flood wall at this location allows the access to the field from Pearse Street via an existing access gate just to the south side of Mountmellick Mill bridge to be maintained.

Beyond the gardens of the properties on Pearse Street, there is then sufficient room to construct a flood embankment which extends perpendicular to the alignment of the Owenass river and along the rear boundary of the gardens of the properties on Pearse Street.

An area of Japanese knotweed has been found in this area. The knotweed has been subjected to a programme of treatment and inspection over the last three years and will be fully eradicated at the time of construction.

The embankment continues southwards along the boundary with the gardens until it runs into higher ground.

The flood modelling shows that the area of the Irishtown Garden Centre on Irishtown Road would be inundated as a result of the flood relief scheme. To prevent this, a short length of flood wall will be constructed adjacent to Irishtown Road and an earth embankment will be provided to the west of the garden centre and extending east-west along the edge of the tree line until it runs into higher ground at its western end.

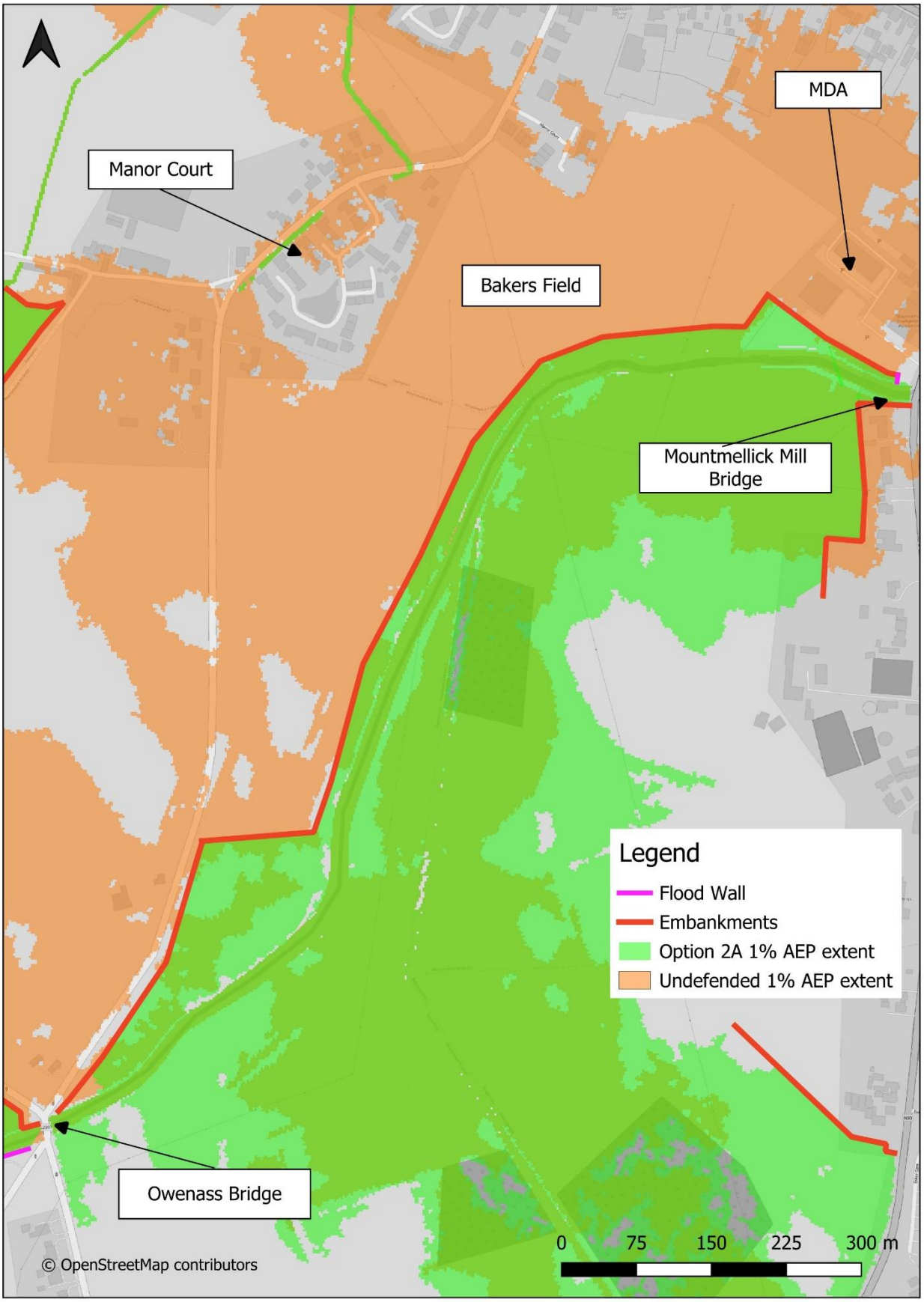



Figure 5-12: Option 2A insert by Bakers Field

5.3.5.2 Benefits

The riverbank defence protects key risk receptors to the north, as in Option 1, and also cuts down flow to the west and therefore removes flooding from lands between the Owenass and Pound Rivers.

The embankment alignment provides a natural continuation of the existing riverside walk and minimises overlooking of residences.

Coupled with works around the pumping station (which could be moved inside the defences), there are opportunities to form a pocket park in this under-utilised corner.

There may be opportunities to re-naturalise the river next to the embankment, including re-meandering the channel.

Embankment lends itself to an extension to the riverside walkway.

#### 5.3.5.3 Environmental Assessment

##### Biodiversity

The construction of the embankments will take place adjacent to the River Barrow and River Nore SAC, and will bisect the SAC in two locations. Construction close to, or within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

As the embankment will extend along the SAC for approx. 1km, there is considerable risk of permanent high ecological effects. The risk of negative effects is higher in Option 2A than 2B, as the embankment is closer to the SAC in 2A.

##### Hydrology and Hydromorphology

The WFD waterbody here (Owenass_020) is at Moderate status and is At Risk. Construction of the embankment has the potential to impact negatively on water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Moderate temporary negative effects are possible on the WFD waterbody during construction, due to the proximity of the embankment to the riverbank.

In the operational phase, the embankment will sever the connection between the river and its floodplain on the left bank. This will alter the hydromorphology of the watercourse, with potential for permanent moderate negative effects.

The overall impact on hydrology and hydromorphology is expected to be moderate negative.

##### Cultural Heritage

Slight negative impacts are also likely on several other features due to the proposed works and remaining flood zones. As the proposed embankment is adjacent to the river Owenass, there is an inherent archaeological potential associated with the riverine environment. However, this option would potentially have a greater impact on the railway, should any features survive. Another embankment is proposed within the former demesne lands of Irishtown House. Archaeological testing will be recommended in advance of construction.

This option would require the replacement of Owenass Bridge (LAIAR-007-004), an 18th / early 19th century masonry bridge of local industrial heritage significance (Hamond 2009), resulting in a moderate negative effect on the undesignated cultural heritage feature.

The overall potential effect on cultural heritage is permanent, negative and moderate.

##### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

The placement of embankments along the riverbank, with the potential for removal of riparian vegetation, means that operational impacts on landscape and visual amenity will be higher in Option 2A than in 2B.

The overall impact on landscape and visual amenity is moderate negative.

##### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.3.6 Upstream of Owenass Bridge

#### 5.3.6.1 Description

Starting at Owenass Bridge and moving upstream.

Left bank:

The wing wall from the upstream face of the new Owenass Bridge extends along the riverbank to a point where there is sufficient room for the earth embankment to be constructed. The embankment extends through the fields and parallel to Rosenallis Road. In order to maintain access to all the areas of the field, three access ramps cross the embankment in this area.

In addition, three small land drainage ditches are crossed by the embankment and so these will be piped through the embankment to maintain flows.

The embankment follows the outer extent of the field and turns southwards until it runs into higher ground where it ends. The defences vary in height between 1m and 2m.

Right bank:

The wing wall from the upstream face of the new Owenass Bridge will extend along the right bank of the river to a position beyond Riverside Lodge and its grounds. This is because the Lodge is very close to the riverbank and there is not sufficient room to construct an embankment.

Beyond the garden on Riverside Lodge, the form of protection changes to an earth embankment that extends southwards until it meets the road. At this point it runs adjacent to the road onto higher ground where it ends. The embankment includes a crossing point to allow access either side of the embankment. The defences vary in height between 1m and 2m.

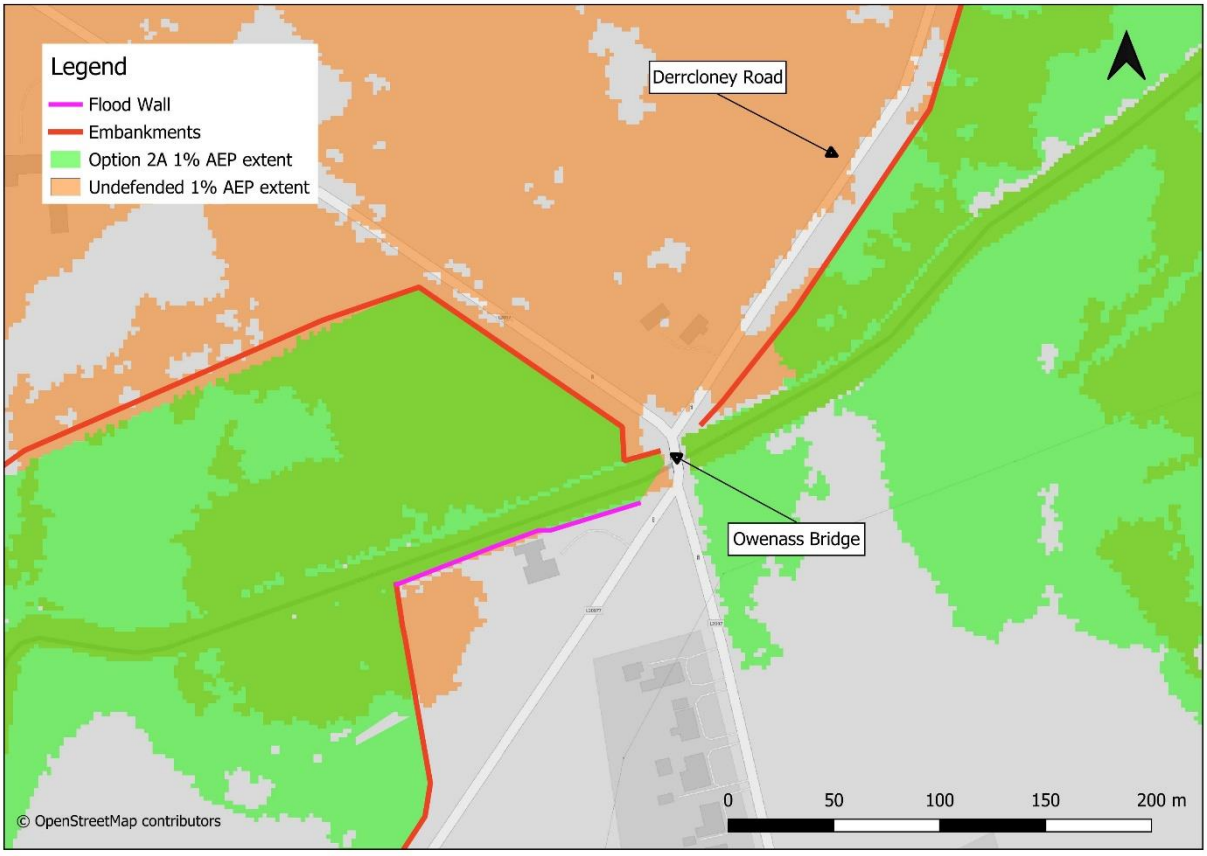



Figure 5-13: Option 2A insert by Owenass Bridge

#### 5.3.6.2 Benefits

The flood plain barrier reduces the need for complex work on the Pound system and removes flood risk from a number of properties in the floodplain.

5.3.6.3 Environmental Assessment

#### Biodiversity

The construction of embankments and retaining wall will take place adjacent to or partially within the River Barrow and River Nore SAC. Construction close to or within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation There is the potential for permanent high ecological effect as the area of works falls within the River Barrow and River SAC boundary along with the noted presence of non-native invasive species. Consultation is required to determine the value of the SAC which can affect the significance of ecological effect.

#### Hydrology and Hydromorphology

The WFD waterbody here (Owenass_020) is at Moderate status and is At Risk. Construction works such as the embankment and retaining wall have the potential to negatively affect the water quality here and downstream, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Temporary slight negative effects are possible on the WFD waterbody during construction.

Once operational, the proposed development is unlikely to have a significant permanent effect on water and hydrology. The connection between the river and floodplain is only slightly restricted in this area, with the left bank in particular still connected.

The overall impact on hydrology and hydromorphology is slight negative.

#### Cultural Heritage

In addition to the inherent archaeological potential associated with the riverine/greenfield environment, historic OS 6 inch maps show that a small dwelling was located along the L20977 in the 19th century. Archaeological testing will be recommended in advance of construction.

One Protected Structure, a thatched house in Derrycloney (RPS No. 857), is within 100m of proposed defences. Surrounding vegetation would screen the embankment from view.

It is proposed to create an embankment on the north bank of the river Owenass abutting the western side of Owenass Bridge (LAIAR-007-004) which cause a potentially negative effect.

The overall potential effect on cultural heritage is permanent, negative and slight.

#### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the defence wall on the right bank may lead to a disruption of views of the river Owenass, particularly for residents whose property backs up to the river. This will lead to a slight negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is slight negative.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.3.7 Manor House, Manor Court, Manor Road

5.3.7.1 Description

The purpose of this embankment is to provide a storage area to hold flow back from the Pound.

Near the junction between Manor Road and Sandy Lane the alignment of the watercourse will be moved from the side of Sandy Lane to an alignment to the west of the proposed embankment. At this location, a control structure will be installed through the embankment to reduce the flow into the Pound and to force water to back up in storage behind the embankment.

The embankment extends along the west side of Sandy Lane and includes raised crossing embankments where access is required across the embankment.

Where the ground level allows, the embankment turns to run perpendicular to Sandy Lane and extends into the higher ground. The defences vary in height between 1m and 2m.

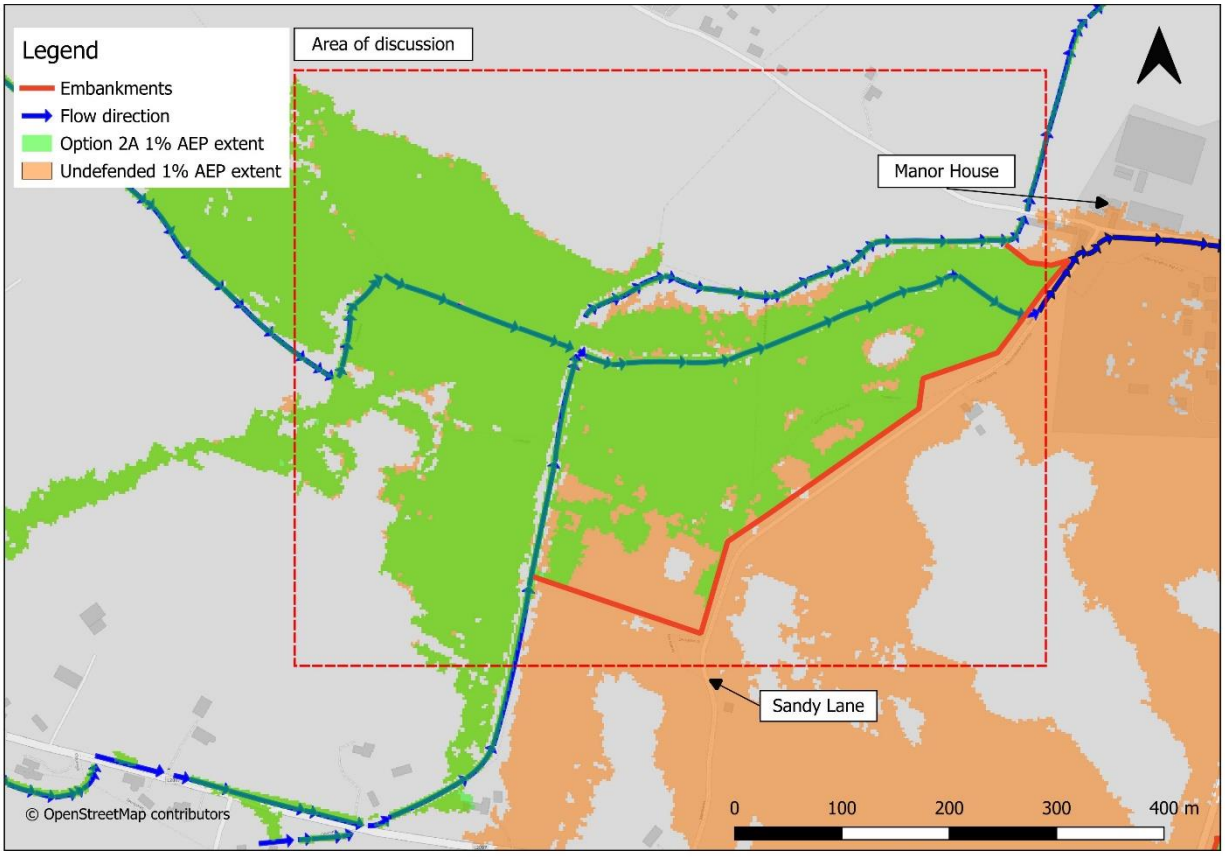



Figure 5-14: Option 2A insert by Manor House

5.3.7.2 Benefits

Significant reduction in flood risk to Derrycloney Road, Manor Road and downstream. There is a reduction of flood depth in currently effected lands and flooding is removed from a large area of land. The historic mill building is defended. Nature-based solutions can be incorporated into the option in this location.

5.3.7.3 Environmental Assessment

Biodiversity

The construction of embankments along the river and through areas of hedgerow and treelines could lead to slight negative effects through disturbance or loss of habitat.

The non-native invasive species Montbretia has been identified along the line of the embankment, while Chinese Bramble is present on Manor Road. Construction could lead to accidental disturbance and spread of these non-native invasives, leading to a permanent moderate negative impact.

Hydrology and Hydromorphology

Construction works close to the stream have the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse.

Slight temporary negative effects are possible on the WFD waterbody during construction.

Once operational, the proposed defences will require the stream to cross through or under the embankment in a culvert. The culvert will lead to permanent slight negative effects on hydrology and hydromorphology, however its length will be short so will not have a significant effect.

The overall effect on hydrology and hydromorphology will be slight negative.

#### Cultural Heritage

This option would protect Manor House and Manor Mills, creating a positive effect on this site. This would offset a slight negative effect of the embankments adjacent to the Manor Mills.

In addition to the inherent archaeological potential associated with the riverine/greenfield environment, the proposed embankment would impact the Townparks/Derrycloney townland boundary which also functions as the Ardea/Rosenallis parish boundary and the Portnahinch/Tinnahinch barony boundary. The embankment would cross the boundary in two locations and follow it for some 118m. Archaeological testing will be recommended in advance of construction.

The overall potential effect on cultural heritage is permanent, positive and slight.

#### Landscape and Visual Amenity

During construction there is potential for temporary negative effects on visual amenity in the area, however due to the location and lack of immediately adjacent residential receptors, this effect will be slight negative only.

No permanent effects on landscape and visual amenity are expected in this area.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.3.8 Garroon Stream

#### 5.3.8.1 Description

The flood modelling shows that the properties adjacent to Garroon Stream will be inundated as a result of Option 2A and so the properties are to be protected locally through the provision of a flood wall along the eastern side of the property as there is insufficient room to construct a flood embankment and an earth flood embankment to the south and extending across the field to higher ground to the west of the properties. The defences vary in height between 1m and 2m.

The need to maintain access to the properties means that the length of wall will need to include a number of gated openings.

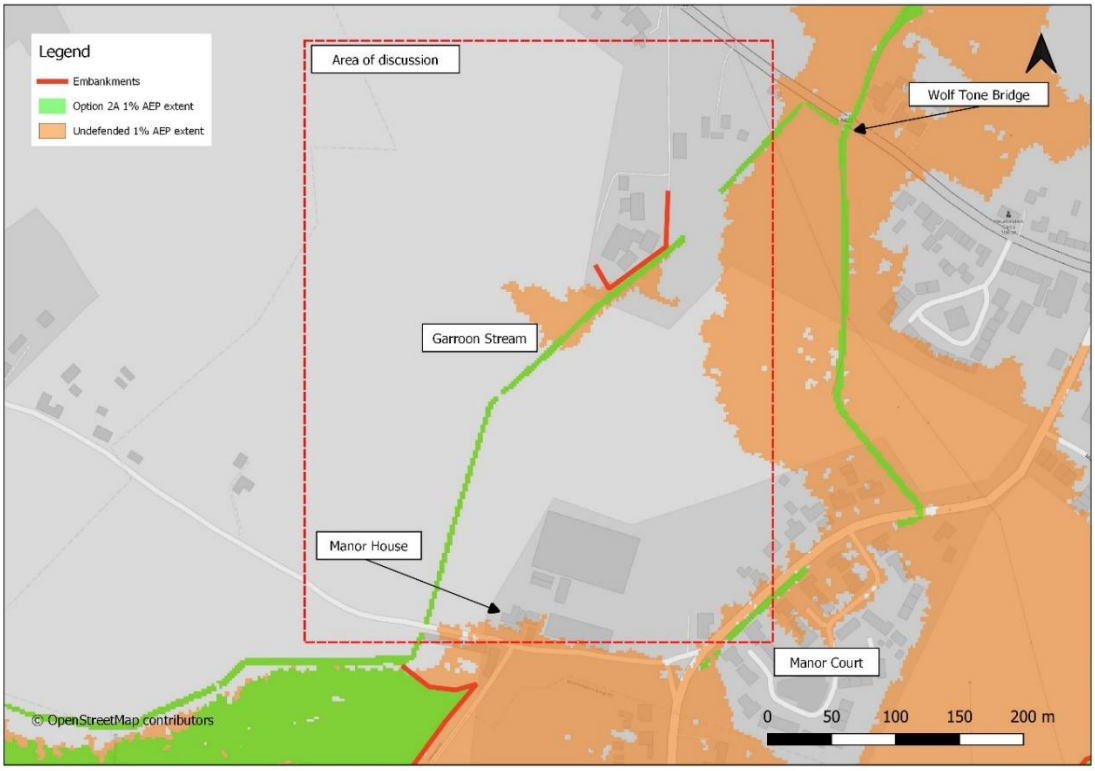



Figure 5-15: Option 2A insert by Garroon Stream

5.3.8.2 Benefits

The Garroon provides a route for flows which have been restricted by the throttle on the Pound, reducing water levels upstream.

5.3.8.3 Environmental Assessment

Biodiversity

A short section of wall will be constructed close to the stream in this area. There is the potential for slight short term negative effects on local biodiversity in this area due to disturbance or loss of habitat.

This option will not result in permanent high effects on ecology in this area.

Hydrology and Hydromorphology

The WFD waterbody here (Barrow_040) is at Moderate status and is At Risk. Construction works adjacent to the stream, in this case a short length of wall, have the potential to lead to temporary negative effects, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Due to the short length of wall required, slight temporary negative effects are possible on the WFD waterbody during construction.

Once operational, the proposal is not likely to cause high permanent effects.

Cultural Heritage

In addition to the inherent archaeological potential associated with the riverine / greenfield environment, there is archaeological potential associated with the Garroon Stream, which functioned as the tailrace of the Manor Mills. It is also evident on historic mapping that a roadway once ran along the north bank of this watercourse. The former Mountmellick Branch of the Great Southern & Western Railway crossed immediately downstream of the proposed defences. It is no longer extant, but some related features may remain, and evidence of the railway may survive beneath the surface. Archaeological testing will be recommended in advance of construction.

Walls will be to the rear of the railway station and associated structures, with a slight negative effect.

The overall effect of this options would be permanent, negative and slight.

#### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the defence wall on the right bank may lead to a disruption from the residences. This will lead to a slight negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is slight negative.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.3.9 Bay Road Business Park

#### 5.3.9.1 Description

The business park is affected by high levels on the River Barrow, which cause the Pound River to back up, rather than being affected by high levels on the Pound alone. A flood embankment is proposed which will surround the northern portion of the Bay Road Business Park on three sides, retaining access from the south. The embankment will be approximately 1m in height.

#### 5.3.9.2 Benefits

The embankment will reduce flood risk to the business park.

#### 5.3.9.3 Environmental Assessment

##### Biodiversity

During construction, a small amount of hedgerow may need to be removed to facilitate access and make way for the embankment. This would lead to a slight negative effect.

Once operational the proposed embankment in this area will not lead to permanent negative effects on biodiversity.

##### Hydrology and Hydromorphology

The Business Park is set back from the nearest WFD waterbody by approx. 250m. Slight temporary negative effects are possible on the local water quality and hydromorphology during construction.

Once operational the proposed embankment in this area will not lead to permanent negative effects on hydrology and hydromorphology.

##### Cultural Heritage

There are no designated cultural heritage features in this area, but there is inherent archaeological potential related to the surrounding watercourses and green fields.

The overall potential effect on cultural heritage is permanent, negative and slight.

##### Landscape and Visual Amenity

There are no specific visual amenity constraints in this area.

##### Construction and Access Impacts

There are no other environmental constraints in this area.

### 5.3.10 Environmental Issues

#### Downstream Geomorphology

Under Option 2A, there is a slight decrease in modelled velocities in the Barrow River by approximately 0.1-0.2m/s in both the Q2 and Q100 events, likely due to the increased floodplain storage offered through the mill pond and dissipation of flows in the wider Garroon and Pound rivers. The changes to the Owenass River include a slight increase of 0.1-0.2m/s under the Q100 scenario

only. These changes are insubstantial in terms of the rivers' abilities to diverge from the existing sediment transport regime.

Changes to the Pound River include a substantial decrease in velocities under the Q100 event between Manor Grove to where the Pound crosses the N80, by up to 0.9m/s. This will benefit the middle reaches of the Pound River by reverting it to a more near-natural flow regime. Sedimentation of the bed will likely continue through the Pound, though this may be offset through the secondary benefits of the upstream flood storage area.

### 5.3.11 Summary of Environmental Assessment

The potential effect of each measure was assessed using the impact classification terminology outlined below:

| Legend | |
|---|---|
| High potential effect |  |
| Moderate potential effect |  |
| Slight/no potential effect |  |

It should be noted that the above classification was used for the comparative assessment of options only and does not reflect the eventual assessment of potential impacts of the proposed development as outlined in the Environmental Impact Assessment (EIA) Screening or other environmental assessments.

| Option 2A - Parts of the study area | | | | | | | |
|---|---|---|---|---|---|---|---|
| Constraints | Mountmellick Mill Bridge to Convent Bridge | Clontygar Stream and Davitt Road | Owenass Bridge to Mountmellick Mill Bridge | Upstream of Owenass Bridge | Manor House, Manor Court, and Manor Road | Garroon Stream | Bay Road Business Park |
| Biodiversity | | | | | | | |
| Hydrology and Hydromorphology | | | | | | | |
| Cultural Heritage | | | | | | | |
| Landscape Visual Amenity | | | | | | | |
| Construction and Access Impacts | | | | | | | |

Figure 5-16. Summary of Environmental Effects for Option 2A.

## 5.4 Option 2B - Embankment on north side of Baker's Field

### 5.4.1 Design Constraints

Although the majority of the works upstream of Mountmellick Mill Bridge are remote from the watercourses, the works between Mountmellick Mill Bridge and Convent Bridge will require access to the river Owenass to complete the works at a number of locations. The design details will minimise the impact on and risk to the river and will allow the works to be constructed in accordance with any ecological programming restrictions or heritage constraints imposed.

The proposed embankments extend along the boundary of existing properties at a number of locations and so the impact on existing structures including houses and their boundary walls will be confirmed and taken into account in the alignment and design of the defence structures.

One of the consequences of preventing the flood flow from the river Owenass from joining the flood flow from the river Pound, is to force more flow through the Owenass Bridge. As a result, this will increase the water level and velocity at the existing structure. Increasing velocity and depth increases the risk of the riverbed adjacent to the bridge abutments being washed away during a flood event as a result of scour. To determine the level of this increase in risk, a Scour Assessment was completed in accordance with Volume 3 Section 4 Part 21 BD 97/12 of the Design Manual for Roads and Bridges - The Assessment of Scour and Other Hydraulic Actions at Highway Structures, May 2012. The assessment confirmed that both Options 2A and 2B resulted in a significant increase in the depth of potential scour at the structure.

Alternatives were investigated to divert some of the additional flow via bypass channels so that the existing structure could remain in place, but their impact on adjacent access and road arrangements was significant and made them inappropriate. As a result, both Options 2A and 2B require the bridge to be replaced with a new structure with a larger opening and engineered to withstand the consequences of the hydraulic loading and scour risk as agreed with the Heritage Engineer.

### 5.4.2 Ongoing maintenance, ownership, and responsibilities

Each of the proposed measures will have their own management and operational plans detailing how the assets will be maintained and how they will be secured during flood risk periods. In Option 2B, this will include how the footpath closures using the flood gates will be instigated and managed.

Annual inspections of the embankments and the walls will be needed, together with investigations of their performance following each flood event. Monitoring of seepage will be recommended.

Responsibility for the maintenance and testing of the flood gates will remain with Laois County Council (LCC). They are located in publicly accessible areas to ensure clear access for the management of the gates.

A maintenance plan for the gates will be developed which will require LCC to inspect and operate the flood gates at least once a year to examine them for any defects and to ensure staff are trained in and familiar with their installation and operation.

### 5.4.3 Mountmellick Mill Bridge to Convent Bridge

#### 5.4.3.1 Description

The playground is flooded in the current scenario and continues to be flooded when Option 2B is in place with defence line to the rear of the playground.

There is only minor spill on the north bank downstream of the playground in the current scenario, but defences are included along this area as flooding in worsened for the rear of Sarsfield Street when upstream defences are modelled. The defences along the north bank are around 0.6 – 0.9m (2’ to 3’ high). Flood levels increase by 100mm in the playground and by approximately 250mm in Healion's Field in Option 2B compared to the current scenario.

The left bank (north side of the river) protection is formed by a concrete flood wall. The wall will start at the downstream end of the Mill Bridge and will extend along the boundary of the children's park area. Flood gates will be provided at the access points into the park.

Beyond the children's park area, the wall extends behind the Mountmellick Community Arts Centre and then along the end of a number of private gardens. It will form the boundary at the ends of the gardens. At one garden, the resident has created an access platform onto the riverbank. The proposed wall will ensure this 'up and over' access to the river is maintained at this location.

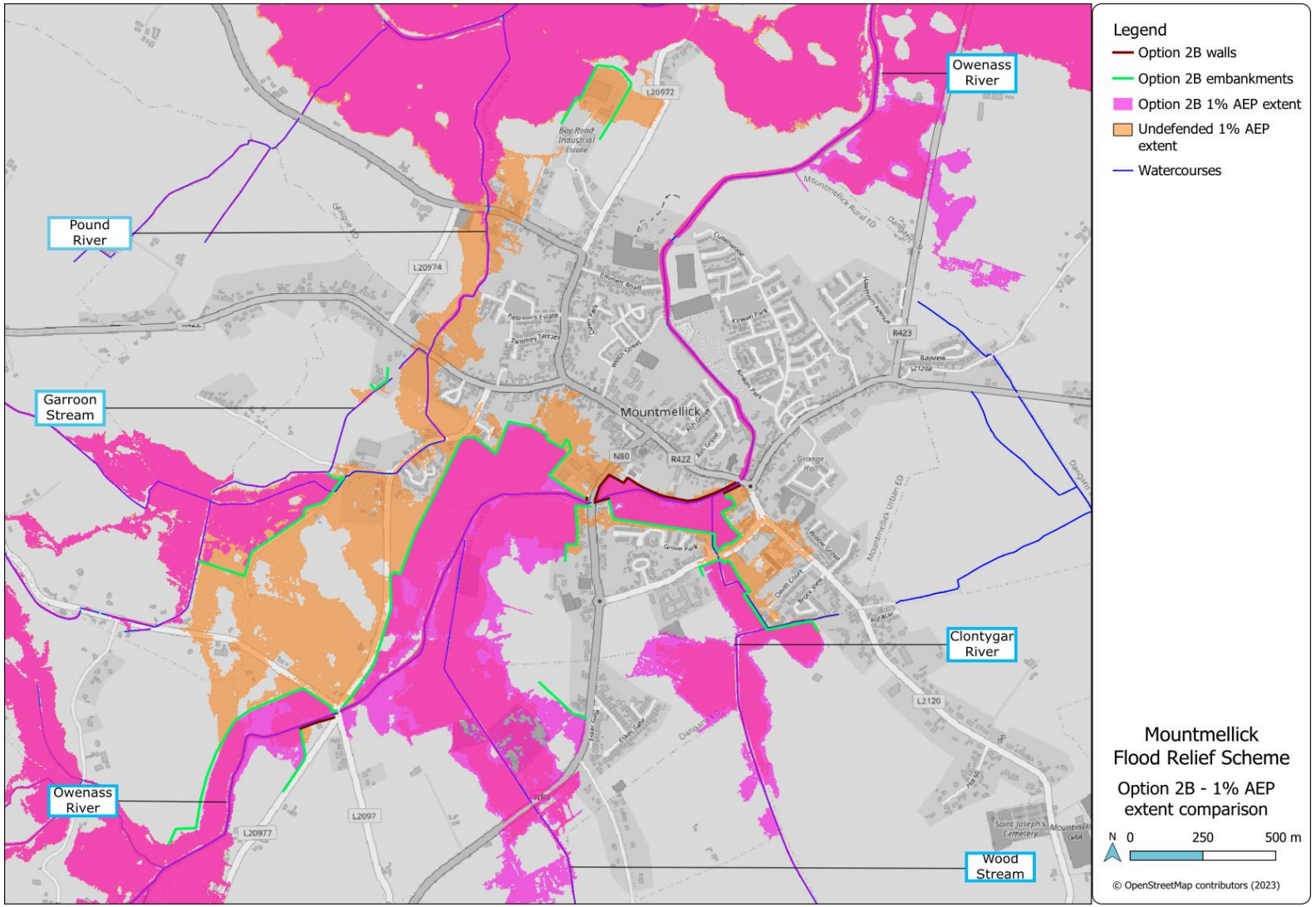



Figure 5-17. Option 2B - Overview

An area of Japanese knotweed is located along this length of the proposed wall. The knotweed has been subjected to a programme of treatment and inspection over the last three years and will be fully eradicated at the time of construction.

The wall then extends and connects into the upstream face of Convent Bridge. There is an existing access ramp down the left bank immediately upstream of Convent Bridge and this access will need to be maintained. To do this, a 5m length of the wall will be formed using a gate or removable section that will remain in place most of the time and will only be removed when access is required to the river.

The right bank (south side of the river) protection is formed by a concrete flood wall that starts at the downstream end of the existing Mill Bridge wing wall and extends along the top of the riverbank along the length of the existing buildings. At the end of the buildings, the wall construction crosses the footpath, including a flood gate to allow access along the existing footpath, and ends. At the end of the wall an earth flood embankment extends long the southern boundary of the open field, along the rear of the gardens of the properties on Grove Park, such that the field provides an area of flood storage.

At the end of the Grove Park properties the embankment extends across the Clontygar stream and then runs along the bank of the stream to meeting Irishtown Road.

The flood embankment then extends adjacent to Irishtown Road and along the outside edge of the field area to maximise the flood storage area provided. This then takes the embankment back to the right bank of the Owenass River. At this point, it re-joins the line of the existing public footpath and so a flood gate is provided in the footpath to provide access along the footpath as well as the required standard of protection during flood events.

Beyond this point, a concrete flood wall extends at the top of the riverbank and connects into the upstream face of Convent bridge.

Beyond Convent bridge, the flood wall extends along the right bank (east bank) of the Owenass at the top of the riverbank and at the ends of the private gardens. There will be areas where the line of the wall will have to locally change to allow for the presence of existing buildings in the garden areas.

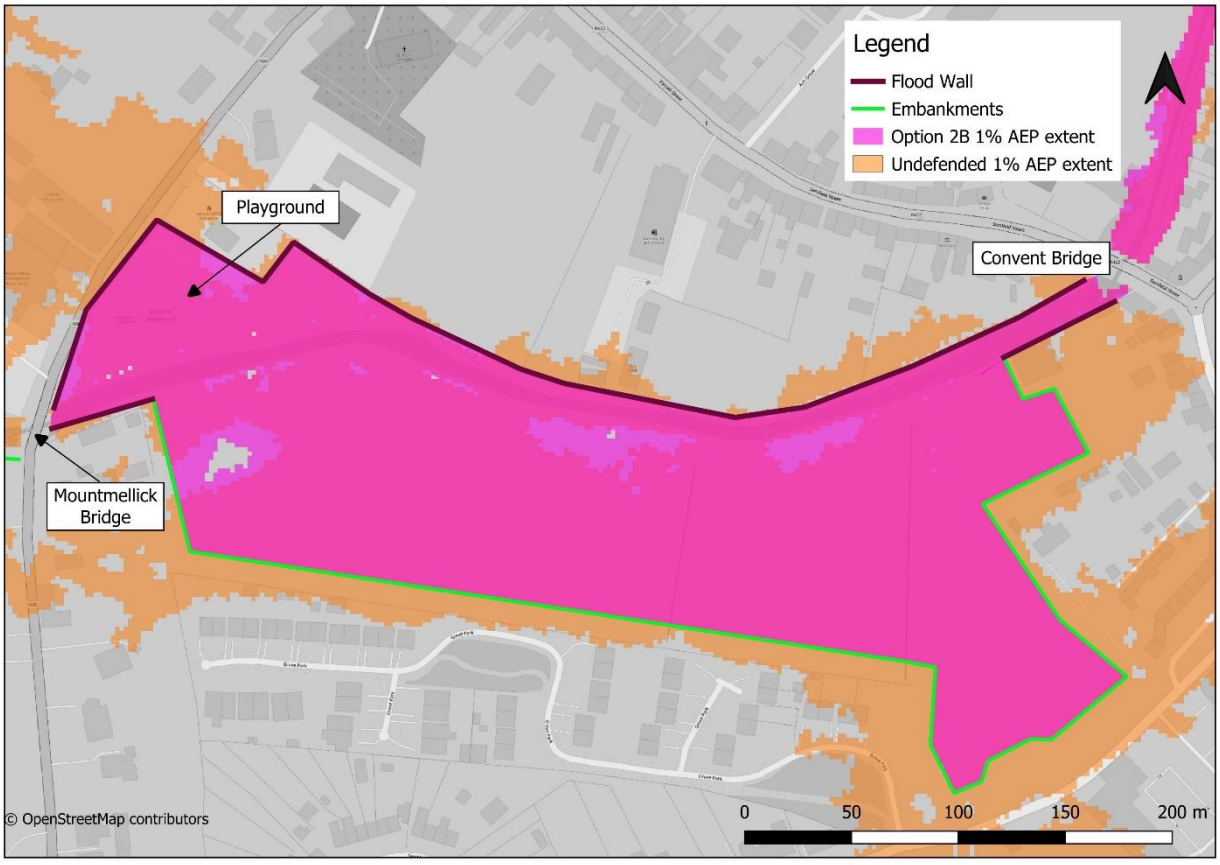



Figure 5-18. Option 2B insert by Mountmellick Bridge

#### 5.4.3.2 Benefits

As with Option 1 and 2A, in Option 2B properties previously flooded in this area are defended. As a result of the additional defences, no additional key risk receptors are effected.

#### 5.4.3.3 Environmental Assessment

##### Biodiversity

The construction of flood walls and embankments will take place within and adjacent to the River Barrow and River Nore SAC. The defences bisect the boundary of the SAC along the north side of Grove Park and consultation with NPWS will be needed about this. Monitoring to confirm the presence of otters will be carried out and may require mitigation to avoid damage to holts and impairing access to feeding sites. Construction within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

Walkover surveys showed that several non-native invasive species are on or near the riverbank, including Giant Butterbur, Snowberry, and Traveller's Joy. There is also a stand of Japanese Knotweed, which has received two seasons of treatment. Care will be needed to ensure no further spread of these species occurs.

Once operational, the proposed defences will not have a direct effect on biodiversity in the area.

Overall, there is a potential long-term high effect on ecology in this area.

##### Hydrology and Hydromorphology

During construction, temporary moderate negative effects are possible on hydrology and hydromorphology. Works along the banks of the river Owenass for the construction of walls and embankments have the potential to increase sedimentation and runoff entering the watercourse. Mitigation measures for managing the risk to water quality are feasible, such as adherence to best practice guidance, pollution prevention and sediment management measures such as the use of oil booms, spill kits, and silt fences, supervision by an ECoW, and safe concreting measures during wall construction. These will ensure that impacts to hydromorphology and hydrology are reduced to slight negative.

During the operational period, the proposed walls on the left bank may cause localised effects to flow by increasing velocities due to smooth surfaces. Walls can be designed to mitigate the effect on instream and riparian habitat through the creation of rough wall finishes and planting to ensure flow diversity at bank margins. The operational impact will be slight.

The overall impact on hydrology and hydromorphology is moderate negative.

##### Cultural Heritage

The proposed flood walls will be built partially within the Zone of Archaeological Potential of the town of Mountmellick (RMP LA008-021) and will have a slight negative effect on several recorded archaeological features. A moderate effect has been identified for Convent Bridge (RPS 701) as the proposed wall will abut the bridge, while a high effect has been identified for the monument in the playground (RPS 704) as the surrounding wall will significantly alter the setting of this feature. The overall impact on cultural heritage is permanent high negative.

##### Landscape and Visual Amenity

The construction of a defence wall on the left bank may lead to a disruption of views of the river Owenass, particularly for residents whose property backs up to the river.

Views of the river, particularly for residents at the back of their property, are expected to be permanently moderately negatively affected due to the addition of a defence wall.

##### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor, however the extent of works required means that access to the playground is likely to be restricted temporarily.

No other potential permanent effects are anticipated.

### 5.4.4 Clontygar Stream and Davitt Road

#### 5.4.4.1 Description

A new concrete floodwall will extend across the upstream headwall of the existing culvert carrying the Clontygar stream below Irishtown Road. The wall will extent part way along the left bank of the stream, across the headwall and then along the right bank of the stream. It then turns at right angles to the direction of flow in the stream so that it forms the end detail of the new flood embankment.

The new flood embankment then extends along a line just outside the boundary of the school play area and along the rear of the gardens of the properties on Davitt Court. The embankment turns to follow the line of the back of the gardens and extends up to the gardens of the properties on Brook View and then turns 90 degrees to extend across the open field running into the naturally higher ground. The defences vary in height between 1m and 2m.

At the 90-degree bend in the embankment - adjacent to Brook View, a culvert has been included to bring the stream that connects into the Clontygar through the embankment. A new alignment of this stream is then constructed so that it runs on the 'wet' side of the embankment.

The existing alignment of the Clontygar stream runs along the boundary of the school playing area and the ends of the gardens on the properties on Davitt Court. This is the same line as the proposed flood wall and so the alignment of the Clontygar stream is moved slightly to the south until it can connect into the existing alignment on the approach to the Irishtown Road culvert.

A crossing point is to be included in the embankment to allow access from the school play area to the area created between the embankment and the new alignment of the Clontygar stream.

As part of the scheme, the surface water drainage for the Davitt Road area is being assessed to ensure that the proposed FRS does not result in a loss of capacity of the existing drainage network which could increase the flood risk to properties in the Davitt Road area. An option to ensure this is to provide a pumping station at the downstream end of the drainage network to maintain the outfall capacity of the existing system.

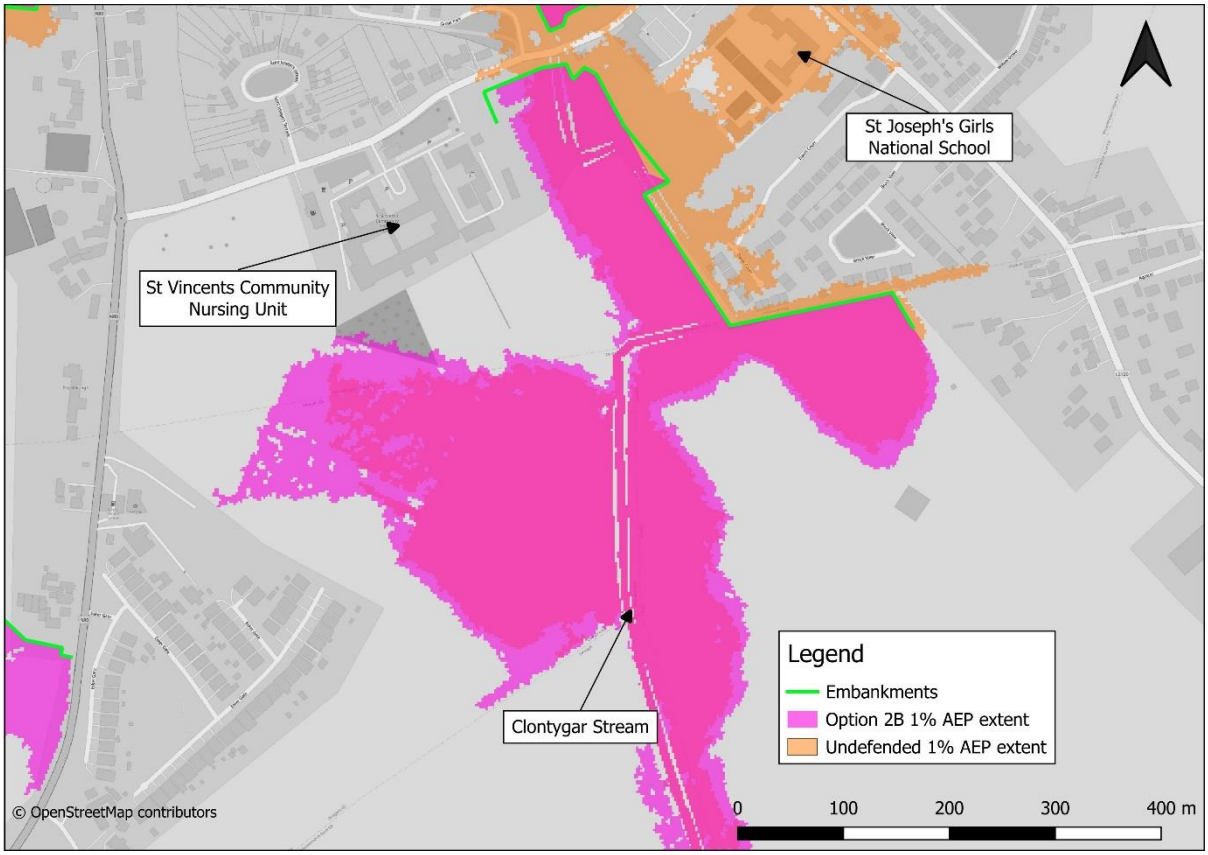



Figure 5-19. Option 2B insert by St. Joseph's Girls National School

#### 5.4.4.2 Benefits

The proposed defence line protects many residences and a key access route. The area where flooding is increased is green space which has no key risk receptors. While levels do increase in

Option 2B along the Clontygar there is potential for further work and assessment to reduce this by adding a flap valve on the Irishtown Road culvert to prevent backwater from the Owenass river. Levels increase by 50mm in Option 2B when a flap valve is put in place compared to the current level.

#### 5.4.4.3 Environmental Assessment

##### Biodiversity

The construction of flood walls and embankments will take place in an area directly upstream of the River Barrow and River Nore SAC. Construction close to the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

The embankment will require the removal of riparian vegetation along the Clontygar, resulting in moderate negative effects. Disruption to the stream during construction and its realignment to allow for the embankment could lead to moderate negative effects on the stream habitat and aquatic species in the stream.

An ecological survey was undertaken on the Clontygar stream where no species of note or non-native invasive species were recorded.

This option will result in potential permanent moderate effects on ecology in this area.

##### Hydrology and Hydromorphology

The WFD waterbody here (Triogue_040) is at Poor status and is At Risk. Construction of the embankment has the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. However, the stream will require realignment south of the embankment. This will result in direct negative effects on hydromorphology as the existing stream bed and banks will be altered or removed entirely. Long-term moderate negative effects are likely as a result in this area.

##### Cultural Heritage

It is evident from the First Edition 6-inch OS map that the Clontygar Stream was straightened prior to the 1840s. It is therefore possible that the original course of this stream and any potentially related features may be impacted by the proposed embankments which will form part of the flood relief works. Archaeological testing in advance of construction will further assess the nature of archaeological potential in this area.

The overall potential effect on cultural heritage is permanent, negative and slight.

##### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will not be significant.

No permanent impact on landscape and visual amenity is expected once operational.

##### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.4.5 Owenass Bridge to Mountmellick Mill Bridge

#### 5.4.5.1 Description

Left bank:

From the downstream wing walls of the new Owenass Bridge, concrete flood walls extend and then turn through 90 degrees to form the end of the new flood embankment. The flood embankment starts as soon as there is enough width in the field to construct it.

As there are access points from Derrycloney Road at this point, the alignment of the embankment extends along the bank of the river. It them moves away from the river to the roadside of the open

fields to maximise flood storage capacity. There is an access bank crossing the embankment at this location to maintain access to both sides of the embankment.

The embankment continues northwards along the side of Derrycloney Road, but then moves away from the road as it follows the boundary of a property and its grounds before returning to run along Derrycloney Road to maximise flood storage capacity.

The embankment then follows a line across the open land moving away from Derrycloney Road so that it can enter Baker's Field to the rear of the gardens at Manor Grove. Within this length, there is a crossing point to allow access either side of the embankment.

Within Baker's Field, the embankment takes a line across the northern boundary of the field to a point at the edge of the Mountmellick Development Association (MDA). At this point, it reverts to a concrete flood wall construction as there is limited room given the extent of the MDA site and the Owenass river. The wall connects into the upstream elevation of Mountmellick Bridge at its wing wall.

There will be a need to raise the level of the wing wall and the upstream parapet of the bridge to prevent flood water spilling onto the highway.

There is a public footpath that extends along the riverbank at this location, and it is anticipated that, rather than including a gated opening in the wall, the route of the footpath will be moved to run within the edge of the MDA site.

Right bank:

From the upstream face of Mountmellick Mill Bridge, a concrete flood wall will extend from the end of the existing wing wall. In addition, the height of the existing wing wall will be raised. The adoption of a flood wall at this location allows the access to the field from Pearse Street via an existing access gate just to the south side of Mountmellick Mill Bridge to be maintained.

Beyond the gardens of the properties on Pearse Street, there is then sufficient room to construct a flood embankment which extends perpendicular to the alignment of the Owenass river and along the rear boundary of the gardens of the properties on Pearse Street.

An area of Japanese knotweed has been found in this area. The knotweed has been subjected to a programme of treatment and inspection over the last three years and will be fully eradicated at the time of construction.

The embankment continues southwards along the boundary with the gardens until it runs into higher ground.

The flood modelling shows that the area of the Irishtown Garden Centre on Irishtown Road would be inundated as a result of the flood relief scheme. To prevent this, a short length of flood wall will be constructed adjacent to Irishtown Road and an earth embankment will be provided to the west of the garden centre and extending east-west along the edge of the tree line until it runs into higher ground at its western end.

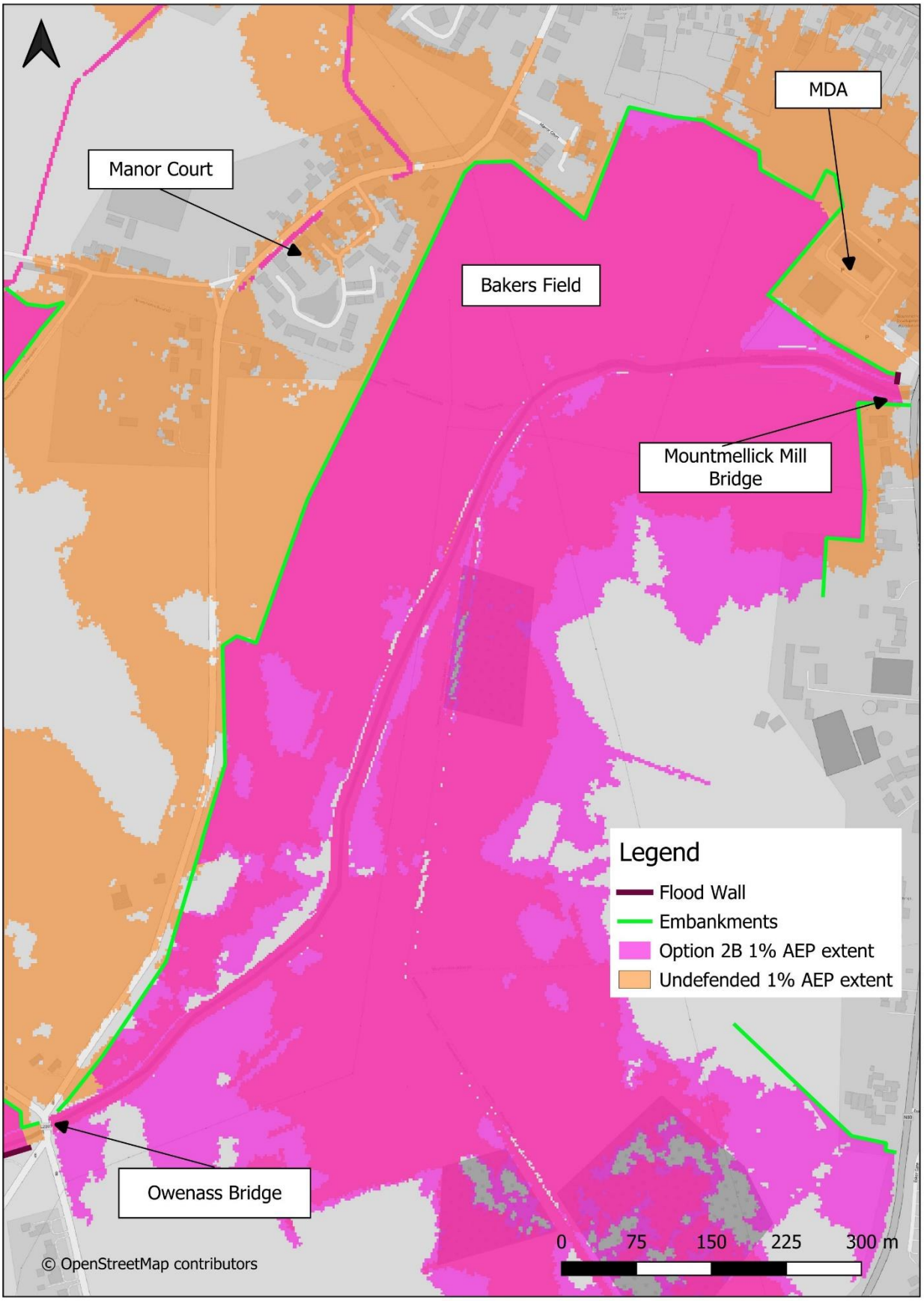



Figure 5-20. Option 2B insert by Bakers Field

5.4.5.2 Benefits

Option 2B protects the properties along Parnell Street, the MDA and Manor Court. Closing off the connection between the Owenass and Pound reduces flood risk on the Pound downstream of Manor Court and also cuts down flow to the west and therefore removes flooding from lands between the Owenass and Pound Rivers.

Coupled with works around the pumping station (which could be moved inside the defences), there are opportunities to form a pocket park in this under-utilised corner.

Embankment lends itself to an extension to the riverside walkway.

#### 5.4.5.3 Environmental Assessment

##### Biodiversity

The construction of embankments will take place close to the River Barrow and River Nore SAC, and will bisect the SAC in two locations. Construction close to, or within the SAC could lead to negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

Option 2B in this area is preferable to Option 2A as the proposed embankment is set further back from the river Owenass. This will result in fewer direct effects and less potential for indirect effects.

The set back embankment will allow the area between it and the river to remain in use as an occasional floodplain; benefits to water quality and hydrology due to this have the potential to lead to indirect benefits on the aquatic habitat and species in the operational phase.

This option will result in potential permanent moderate effects on ecology in this area.

##### Hydrology and Hydromorphology

The WFD waterbody here (Owenass_020) is at Moderate status and is At Risk. Construction of the embankment has the potential to impact negatively on water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Slight temporary negative effects are possible on the WFD waterbody during construction.

In the operational phase, increased floodplain connectivity will have benefits for water quality and sediment transport, if the floodplain is vegetated and will not exacerbate fine sediment release.

The overall impact on hydrology and hydromorphology is expected to be slight negative to neutral.

##### Cultural Heritage

Slight negative impacts are also likely on other cultural heritage features due to the proposed works and remaining flood zones. As the proposed embankment is set back from the river Owenass compared to Option 2A, there is less risk of impact on the inherent archaeological potential associated with the riverine/greenfield environment. However, this option would potentially have a greater impact on the railway, should any features survive. Another embankment is proposed within the former demesne lands of Irishtown House (a former structure, with no designation). Archaeological testing will be recommended in advance of construction.

This option would require the replacement of Owenass Bridge (LAIAR-007-004), an 18th / early 19th century masonry bridge of local industrial heritage significance (Hamond 2009), resulting in a moderate negative effect on the undesignated cultural heritage feature.

The overall potential effect on cultural heritage is permanent, negative and moderate.

##### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

The placement of embankments set back from the river's edge and along the rear of properties along Manor Court and Manor Road means that operational impacts on landscape and visual amenity are the same as Option 1 but greater than Option 2A.

The overall impact on landscape and visual amenity is slight negative.

##### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.4.6 Upstream of Owenass Bridge

#### 5.4.6.1 Description

Left bank:

The wing wall from the upstream face of the new Owenass Bridge extends along the riverbank to a point where there is sufficient room for the earth embankment to be constructed. The embankment extends through the fields and parallel to Rosenallis Road. In order to maintain access to all the areas of the field, three access ramps cross the embankment in this area.

In addition, three small land drainage ditches are crossed by the embankment and so these will be piped through the embankment to maintain flows.

The embankment follows the outer extent of the field and turns southwards until it runs into higher ground where it ends. The defences vary in height between 1m and 2m.

Right bank:

The wing wall from the upstream face of the new Owenass Bridge will extend along the right bank of the river to a position beyond Riverside Lodge and its grounds. This is because the Lodge is very close to the riverbank and there is not sufficient room to construct an embankment.

Beyond the garden on Riverside Lodge, the form of protection changes to an earth embankment that extends southwards until it meets the road. At this point it runs adjacent to the road onto higher ground where it ends. The embankment includes a crossing point to allow access either side of the embankment. The defences vary in height between 1m and 2m.

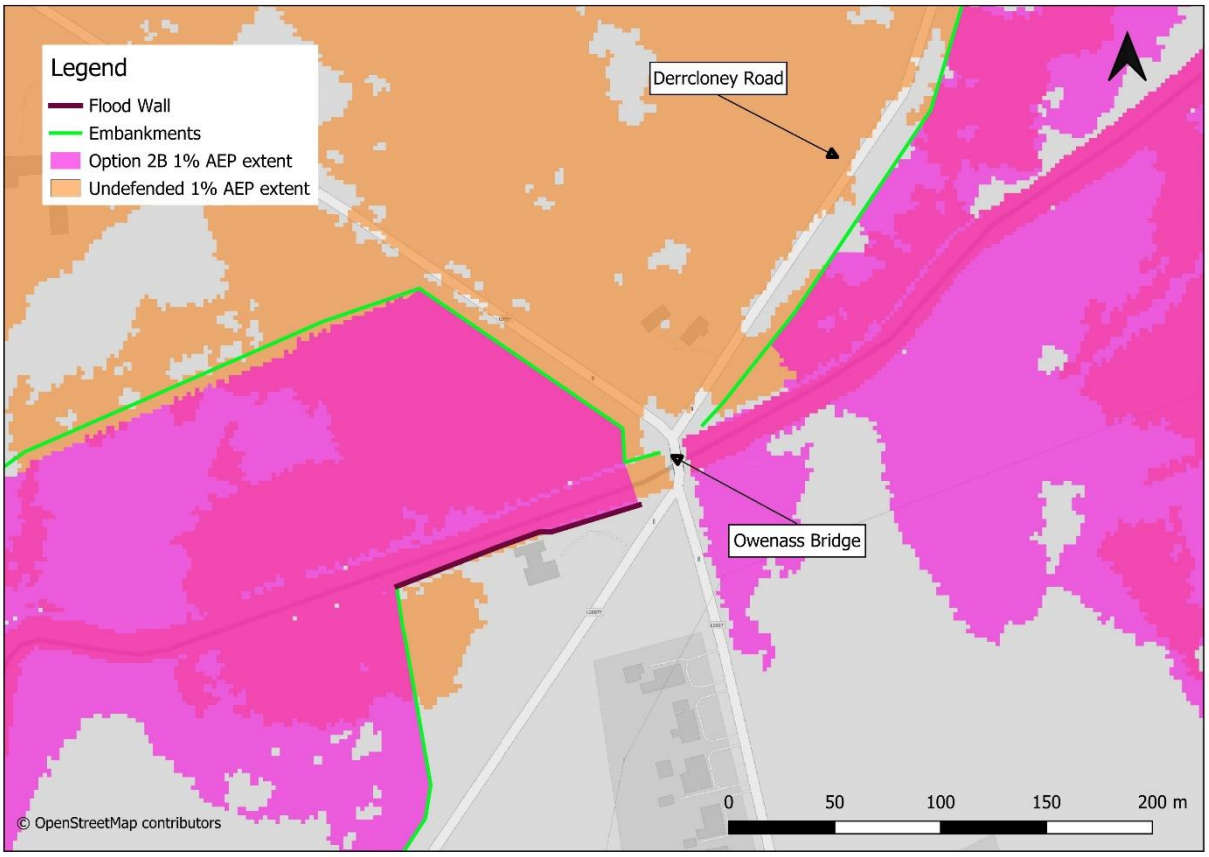



Figure 5-21. Option 2B insert by Owenass Bridge

#### 5.4.6.2 Benefits

The flood plain barrier reduces the need for complex work on the Pound system and removes flood risk from a number of properties in the floodplain.

#### 5.4.6.3 Environmental Assessment

##### Biodiversity

The construction of embankments and retaining wall will take place adjacent to or partially within the River Barrow and River Nore SAC. Construction close to or within the SAC could lead to

negative effects due to disturbance, loss of habitat, and pollution or increased sedimentation travelling downstream. The scheme will undergo Screening for Appropriate Assessment and move to full Appropriate Assessment as necessary.

There is the potential for permanent high ecological effect as the area of works falls within the River Barrow and River SAC boundary along with the noted presence of non-native invasive species. Consultation is required to determine the value of the SAC which can affect the significance of ecological effect.

#### Hydrology and Hydromorphology

The WFD waterbody here (Owenass_020) is at Moderate status and is At Risk. Construction works such as the embankment and retaining wall have the potential to affect negatively the water quality here and downstream, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Temporary slight negative effects are possible on the WFD waterbody during construction.

Once operational, the proposed development is unlikely to have a significant permanent effect on water and hydrology. The connection between the river and floodplain is only slightly restricted in this area, with the left bank in particular still connected.

The overall impact on hydrology and hydromorphology is slight negative.

#### Cultural Heritage

In addition to the inherent archaeological potential associated with the riverine/greenfield environment, historic Ordnance Survey (OS) 6 inch maps show that a small dwelling was located along the L20977 in the 19th century. Archaeological testing will be recommended in advance of construction.

One Protected Structure, a thatched house in Derrycloney (RPS No. 857), is within 100m of proposed defences. Surrounding vegetation would screen the embankment from view.

The overall potential effect on cultural heritage is permanent, negative and slight.

#### Landscape and Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the defence wall on the right bank may lead to a disruption of views of the River Owenass, particularly for residents whose property backs up to the river. This will lead to a slight negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is slight negative.

#### Construction and access

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.4.7 Manor House, Manor Court, Manor Road (same in 2A and 2B)

#### 5.4.7.1 Description

The purpose of this embankment is to provide a storage area to hold flow back from the Pound.

Near the junction between Manor Road and Sandy Lane the alignment of the watercourse will be moved from the side of Sandy Lane to an alignment to the west of the proposed embankment. At this location, a control structure will be installed through the embankment to reduce the flow into the Pound and to force water to back up in storage behind the embankment.

The embankment extends along the west side of Sandy Land and includes raised crossing embankments where access is required across the embankment.

Where the ground level allows, the embankment turns to run perpendicular to Sandy Lane and extends into the higher ground. The defences vary in height between 1m and 2m.

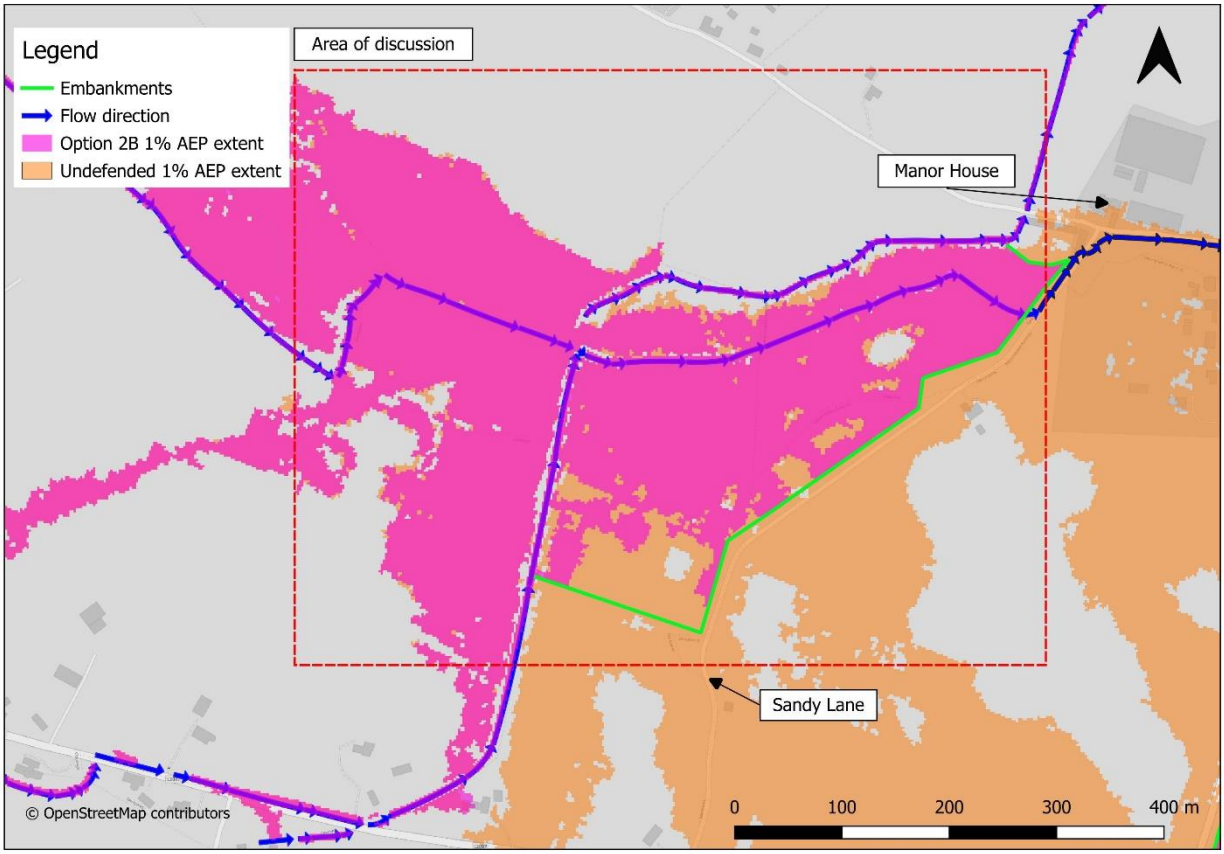



Figure 5-22. Option 2B insert by Manor House

5.4.7.2 Benefits

Significant reduction in flood risk to Derrycloney Road, Manor Road and downstream. There is a reduction of flood depth in currently impacted lands and flooding is removed from a large area of land. The historic mill building is defended. Nature based solutions can be incorporated into the option in this location.

5.4.7.3 Environmental Assessment

Biodiversity

The construction of embankments along the river and through areas of hedgerow and treelines could lead to slight negative effects through disturbance or loss of habitat.

The non-native invasive species Montbretia has been identified along the line of the embankment, while Chinese Bramble is present on Manor Road. Construction could lead to accidental disturbance and spread of these non-native invasives, leading to a permanent moderate negative impact.

Hydrology and Hydromorphology

Construction works close to the stream have the potential to negatively affect water quality, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse.

Slight temporary negative effects are possible on the WFD waterbody during construction.

Once operational, the proposed defences will require the stream to cross through or under the embankment in a culvert. The culvert will lead to permanent slight negative effects on hydrology and hydromorphology, however its length will be short so will not have a significant effect.

The overall effect on hydrology and hydromorphology will be slight negative.

#### Cultural Heritage

This option would protect Manor House and Manor Mills (Laois Indiustrial Archeological Record Number - LAIAR Ref: 007-002), creating a positive effect on this site. This would offset a slight negative effect of the embankments adjacent to the Manor Mills.

In addition to the inherent archaeological potential associated with the riverine/greenfield environment, the proposed embankment would impact the Townparks/Derrycloney townland boundary which also functions as the Ardea/Rosenallis parish boundary and the Portnahinch/Tinnahinch barony boundary. The embankment would cross the boundary in two locations and follow it for some 118m. Archaeological testing will be recommended in advance of construction.

The overall potential effect on cultural heritage is permanent, positive and slight.

#### Landscape and Visual Amenity

During construction there is potential for temporary negative effects on visual amenity in the area, however due to the location and lack of immediately adjacent residential receptors, this effect will be slight negative only.

No permanent effects on landscape and visual amenity are expected in this area.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.4.8 Garroon Stream

#### 5.4.8.1 Description

The flood modelling shows that the properties adjacent to Garroon Stream will be inundated as a result of Option 2B and so the properties are to be protected locally through the provision of a flood wall along the eastern side of the properties as there is insufficient room to construct a flood embankment and an earth flood embankment to the south and extending across the field to higher ground to the west of the properties.

The need to maintain access to the properties means that the length of wall will need to include a number of gated openings. The defences vary in height between 1m and 2m.

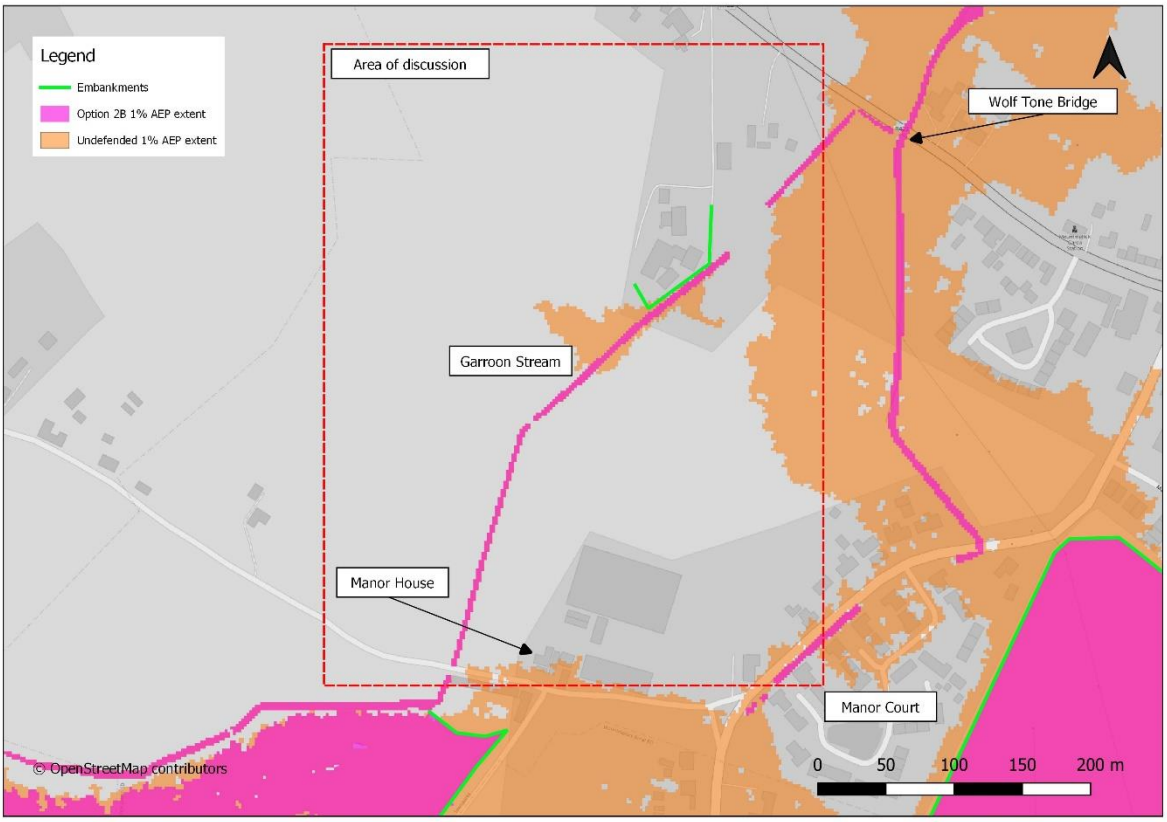



Figure 5-23. Option 2B insert by Garroon Stream

5.4.8.2 Benefits

The Garroon provides a route for flows which have been restricted by the throttle on the Pound, reducing water levels upstream.

5.4.8.3 Environmental Assessment

Biodiversity

A short section of wall will be constructed close to the stream in this area. There is the potential for slight short term negative effects on local biodiversity in this area due to disturbance or loss of habitat.

This option will not result in permanent high effects on ecology in this area.

Hydrology and Hydromorphology

The WFD waterbody here (Barrow_040) is at Moderate status and is At Risk. Construction works adjacent to the stream, in this case a short length of wall, have the potential to lead to temporary negative effects, by the mobilisation of sediments or release of contaminants from construction vehicles or compounds. Construction work will be done following best practice guidance including the protection of watercourses, which will mitigate this risk. The FRS must not result in a deterioration of the WFD status of the watercourse. Due to the short length of wall required, slight temporary negative effects are possible on the WFD waterbody during construction.

Once operational, the proposal is not likely to cause high permanent effects.

Cultural Heritage

In addition to the inherent archaeological potential associated with the riverine / greenfield environment, there is archaeological potential associated with the Garroon Stream, which functioned as the tailrace of the Manor Mills (Laois Indiustrial Archeological Record Number - LAIAR Ref: 007-002). It is also evident on historic mapping that a roadway once ran along the north bank of this watercourse. The former Mountmellick Branch of the Great Southern & Western Railway crossed immediately downstream of the proposed defences. It is no longer extant, but some related features may remain and evidence of the railway may survive beneath the surface. Archaeological testing will be recommended in advance of construction.

Walls will be to the rear of the railway station and associated structures, with a slight negative effect.

The overall effect of this option would be permanent, negative and slight.

#### Landscape Visual Amenity

During construction, temporary slight negative impacts on visual amenity are likely due to the use of machinery and construction works. These impacts will be temporary slight negative.

Once operational, the defence wall on the right bank may lead to a disruption from the residences. This will lead to a slight negative impact on visual amenity for these residents.

The overall impact on landscape and visual amenity is slight negative.

#### Construction and Access Impacts

There is the potential for temporary slight negative effects for residents, pedestrians and road users through disturbance associated with construction works in this area. Measures to mitigate impact on access and residential amenity will be outlined in the operating plans to be devised by the contractor.

No other potential permanent effects are anticipated.

### 5.4.9 Bay Road Business Park

#### 5.4.9.1 Description

The business park is affected by high levels on the River Barrow, which cause the Pound River to back up, rather than being affected by high levels on the Pound alone. A flood embankment is proposed which will surround the northern portion of the Bay Road Business Park on three sides, retaining access from the south. The embankment will be approximately 1m in height.

#### 5.4.9.2 Benefits

The embankment will reduce flood risk to the business park.

#### 5.4.9.3 Environmental Assessment

#### Biodiversity

During construction, a small amount of hedgerow may need to be removed to facilitate access and make way for the embankment. This would lead to a slight negative effect.

Once operational the proposed embankment in this area will not lead to permanent negative effects on biodiversity.

#### Hydrology and Hydromorphology

The Business Park is set back from the nearest WFD waterbody by approx. 250m. Slight temporary negative effects are possible on the local water quality and hydromorphology during construction.

Once operational the proposed embankment in this area will not lead to permanent negative effects on hydrology and hydromorphology.

#### Cultural Heritage

There are no designated cultural heritage features in this area, but there is inherent archaeological potential related to the surrounding watercourses and green fields.

The overall potential effect on cultural heritage is permanent, negative and slight.

#### Visual Amenity

There are no specific visual amenity constraints in this area.

#### Construction and access impacts

There are no other environmental constraints in this area.

### 5.4.10 Environmental Issues

#### Downstream Geomorphology

Under Option 2B, there is a slight decrease in modelled velocities in the Barrow River by approximately 0.1-0.2m/s in both the Q2 and Q100 events, likely due to the increased floodplain

storage offered through the mill pond and dissipation of flows in the wider Garroon and Pound rivers. The changes to the Owenass River include a slight increase of 0.1-0.2m/s under the Q100 scenario only. These changes are insubstantial in terms of the rivers' abilities to diverge from the existing sediment transport regime.

Changes to the Pound River include a substantial decrease in velocities under the Q100 event between Manor Grove to where the Pound crosses the N80, by up to 0.9m/s. This will benefit the middle reaches of the Pound River by reverting it to a more near-natural flow regime. Sedimentation of the bed will likely continue through the Pound, though this may be offset through the secondary benefits of the upstream flood storage area.

### 5.4.11 Summary of Environmental Assessment

The potential effect of each measure was assessed using the impact classification terminology outlined below:

| Legend | |
|---|---|
| High potential effect |  |
| Moderate potential effect |  |
| Slight/no potential effect |  |

It should be noted that the above classification was used for the comparative assessment of options only and does not reflect the eventual assessment of potential impacts of the proposed development as outlined in the Environmental Impact Assessment (EIA) Screening or other environmental assessments.

| Option 2B - Parts of the study area | | | | | | | |
|---|---|---|---|---|---|---|---|
| Constraints | Mountmellick Mill Bridge to Convent Bridge | Clontygar Stream and Davitt Road | Owenass Bridge to Mountmellick Mill Bridge | Upstream of Owenass Bridge | Manor House, Manor Court, and Manor Road | Garroon Stream | Bay Road Business Park |
| Biodiversity | | | | | | | |
| Hydrology and Hydromorphology | | | | | | | |
| Cultural Heritage | | | | | | | |
| Landscape Visual Amenity | | | | | | | |
| Construction and Access Impacts | | | | | | | |

Figure 5-24. Summary of Environmental Effects for Option 2B.

## 5.5 Summary of Environmental Assessment of Options

| Parts of the study area | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mountmellick Mill Bridge to Convent Bridge | | | Clontygar Stream and Davitt Road | | | Owenass Bridge to Mountmellick Mill Bridge | | | Upstream of Owenass Bridge | | | Manor House, Manor Court, and Manor Road | | | Garroon Stream | | | Bay Road Business Park | | |
| Options | 1 | 2a | 2b | 1 | 2a | 2b | 1 | 2a | 2b | 1 | 2a | 2b | 1 | 2a | 2b | 1 | 2a | 2b | 1 | 2a | 2b |
| Biodiversity | | | | | | | | | | | | | | | | | | | | | |
| Hydrology and Hydromorphology | | | | | | | | | | | | | | | | | | | | | |
| Cultural Heritage | | | | | | | | | | | | | | | | | | | | | |
| Landscape and Visual Amenity | | | | | | | | | | | | | | | | | | | | | |
| Construction and Access Impacts | | | | | | | | | | | | | | | | | | | | | |

Figure 5-25. Summary of Environmental Effects for all Options.

The three options have been discussed and their likely environmental impacts assessed in the sections above. The proposed defences between Mountmellick Mill Bridge to Convent Bridge, at Bay Road Business Park, and on the Clontygar Stream are common across all three options. These will therefore have the same impact in each option and will be discussed briefly here before the other measures are discussed in greater detail.

The proposed defences between Mountmellick Mill Bridge and Convent Bridge are a combination of flood wall and embankment. The defences are close to the riverbank, and are adjacent to or cross through the SAC at several points. This is expected to have a high negative impact on the riparian habitats in the area during construction, and could lead to impacts on the SAC. There is also potential for a high negative impact on cultural heritage, as the proposed flood wall is within a Zone of Archaeological Potential. Moderate impacts on hydrology, hydromorphology and visual amenity are also likely. The impacts here are common across all three options.

The proposed embankment at Bay Road Business Park is likely to have slight negative impacts during construction, with no significant impacts once operational. The proposed defences along the Clontygar Stream, comprising an embankment and partial realignment of the stream to accommodate this, are likely to have moderate negative effects during construction on biodiversity and hydrology and hydromorphology, and permanent moderate negative effects on visual amenity, due to the construction of an embankment close to residential areas, and on hydromorphology due to the realignment of the stream. These impacts are also common across all three options.

Option 1 performs worse than Options 2A and 2B at the Garroon Stream and Manor House/Manor Court/Manor Road. There are potential high negative effects due to changes in hydromorphology in these areas, and moderate effects on biodiversity, visual amenity, and cultural heritage (Manor House/Manor Court/Manor Road only). Between Owenass Bridge and Mountmellick Mill Bridge, Option 1 performs worse than Option 2B due to its embankment running along the edge of Mountmellick town, a Zone of Archaeological Potential. However, it performs slightly better than Option 2A in this area due to its embankment being set back from the riverbank.

Option 1 has greater potential negative effects overall than Options 2A and 2B, so Option 1 is the least preferred option for environment.

Options 2A and 2B resulted in very similar potential effects, being identical in all areas except Owenass Bridge to Mountmellick Mill Bridge. Option 2B in this area has an embankment set back from the riverbank. This allows it to avoid the highest impacts on biodiversity and hydrology and hydromorphology. Option 2A will see the embankment run directly adjacent to the riverbank, with high potential impacts on the SAC, riparian and aquatic habitats, and water quality during construction. Once operational, the embankment would also prevent the river having connectivity with its floodplain. This connection is retained in Option 2B, with resulting positive effects on hydromorphology and biodiversity.

Option 2B is therefore the preferred option from an environmental point of view.

## 5.6 Summary of Measures and Potential Flood Relief Options

Following the screening stage, a number of potentially viable measures have been identified to protect against flooding in the 1% AEP fluvial event. This section further develops the potentially viable measures into options. Multi Criteria Assessment (MCA) for each option will be carried out to aid in the selection of the preferred option. The table below provides a summary of potential options.

Table 5-1: Potential Flood Relief Options

| Location | Option 1 | Option 2A | Option 2B |
|---|---|---|---|
| Mountmellick Mill Bridge to Convent Bridge | Flood wall to the north side of the park and along the northern bank of the Owenass until it meets Convent Bridge.<br><br>A flood wall immediately downstream of Mountmellick Mill Bridge to the south side of the river, and then flood embankment along the northern boundary of Grove Park, Irishtown Road and returning to the Owenass where a flood wall extends to Convent Bridge.<br><br>From Convent Bridge, the flood wall extends along the eastern bank. | | |
| Clontygar Stream to Davitt Road | A new concrete floodwall will extend across the upstream headwall of the existing culvert carrying the Clontygar stream below Irishtown Road.<br><br>A new flood embankment then extends along a line just outside the boundary of the school play area and along the rear of the gardens of the properties on Davitt Court and up to the area next to Brook View and then extends to the naturally higher ground.<br><br>A pumping station will be incorporated to maintain the capacity of the Davitt Road drainage network. | | |
| Owenass Bridge to Mountmellick Mill Bridge | A flood wall and flood bank to the northern boundary of Baker's Field including flood barriers crossing the highway.<br><br>Flood embankment extending behind the gardens of properties on Pearse Street. | A flood bank will extend along the western and then northern bank of the Owenass until it reached the MDA site where a wall will connect to Mountmellick Mill Bridge.<br><br>A flood wall and then flood embankment will extend from Mountmellick Mill Bridge and behind the properties along Pearse Street.<br><br>An embankment will extend to the south of the Irishtown Garden Centre. | A flood bank will extend along the western and then northern boundary of the fields to the side of the Owenass until it reached the MDA site where a wall will connect to Mountmellick Mill Bridge.<br><br>A flood wall and then flood embankment will extend from Mountmellick Mill Bridge and behind the properties along Pearse Street.<br><br>An embankment will extend to the south of the Irishtown Garden Centre. |
| Upstream of Owenass Bridge | No defence | On the left bank of the Owenass, the wing wall from the upstream face of the new Owenass Bridge extends along the riverbank. The embankment then extends through the fields.<br><br>The embankment follows the outer extent of the field and turns southwards until it runs into higher ground where it ends.<br><br>On the right bank, the wall from the upstream face of the new Owenass Bridge will extend along the right bank of the river to a position beyond Riverside Lodge and its grounds.<br><br>Beyond the garden on Riverside Lodge, an earth embankment extends southwards until it meets the road. At this point it runs adjacent to the road onto higher ground where it ends. | |
| Manor House, Court and Road | Embankments surrounding the houses of Manor Court and Manor Road, and a small length of flood wall. | Near the junction between Manor Road and Sandy Lane the alignment of the watercourse will be moved from the side of Sandy Lane to an alignment to the west of the proposed embankment. At this location, a control structure will be installed through the | |

| | | |
|---|---|---|
| | Property on Sandy Lane to be protected by embankments to either side of the property and a flood wall along the roadside of the property. The flood wall will incorporate flood gates for access. | embankment to reduce the flow into the Pound and to force water to back up in storage behind the embankment. |
| Garroon Stream | Area protected locally through the provision of a flood wall along the southern and eastern sides of the properties.<br>The wall will include a number of gated openings. | |
| Bay Road Business Park | A flood embankment is proposed which will surround the northern portion of the Bay Road Business Park on three sides, retaining access from the south. | |

# 6 Climate change adaptation

## 6.1 Introduction to Climate Change Adaptation

Climate change is an important consideration in any scheme to ensure it remains operational into the future. Predicted increases in rainfall and flows will put pressure on the scheme conventperformance. Climate change analysis has been carried out on the proposed scheme Option 2 to examine the necessary changes required to ensure it remains operational into the future when considering the Mid-Range Future Scenario (MRFS).

To carry out this work the baseline model was run for the MRFS and the overall impacts assessed. Following this the present-day scheme option was run with the climate change (MRFS) flows to establish any changes or additional areas at risk in the future event with the scheme in place.

Following the establishment of the key mechanisms at risk areas, testing of potential adaptations was carried out. From the performance of the proposed scheme in climate change scenarios, a climate change adaptability plan was created. This was based on adaptation pathway decision tree analysis and is documented in the following sections to ensure an adaptable scheme into a range of potential futures.

## 6.2 Adaptation Pathways

For Mountmellick, there is one main avenue that can be considered – extending and raising defences. The increase in flood level from the present day to the MRFS is approximately 0.15m and the increase in flood level from MRFS to High End Future Scenario (HEFS) is approximately a further 0.08m.

### 6.2.1 Design Constraints

The key design constraint for the MRFS scheme is the ability to adapt the current scheme defences to allow for raising and increased storage. These aspects have therefore been considered as resilience measures that are to be built into the scheme in the form of foundations and groundwork designs such that future changes can be made with limited cost and difficulty. Alignments of the proposed defences have also taken this into consideration to prevent the need to further realign defences in the future.

### 6.2.2 Scale of Defences

Defence heights and lengths will increase in the MRFS due to the increased levels simulated in the model. The extent by which defences will have to be raised will vary depending on location. Landscaping and ecological impacts of raised defences will have to be considered in the future to ensure the defences not only provide the necessary protection but also do not result in any conflicts with environmental and landscape aspects.

The life expectancy of a typical flood gate or demountable barrier is approx. 25 years. A review of flood levels should take place ahead of replacement of the flood gates to determine if taller gates are required.

All the walls will be designed to allow for the top of wall levels to be increased in the future without the need to re-design and bolster the foundation details. In a similar way, the earth embankments will be designed and constructed with a foundation depth and width sufficient to allow the crest level to be increased in the future to provide protection for the MRFS and still maintain the minimum required crest width for safe access and maintenance. To do this, the crest width will be wider than necessary to start with to allow the width to be reduced as the crest width is increased.

Access will be very challenging in places e.g. the location of the proposed wall immediately downstream of Convent Bridge. In this case, the proposed scheme will construct the wall already taking into account the impact of climate change. The difference in top of wall level is typically between 150mm and 220mm and so to remove the need to have a considerable impact on the river and public in the future, it is more effective to build the wall slightly higher now.

## 6.3 Climate Change Adaption Summary

The potential adaptations for the climate change scenario look to enhance the current scheme design to protect into the future. The need for larger foundations and adaptable construction details (e.g. embankment widths) are the key measures needed to allow adaptation of the scheme in the future. The construction costs associated with construction of defences to the MRFS level for the

present-day scheme are not cost beneficial at present day and so are proposed as future adaptation works instead when they are required.

### 6.3.1 Carbon emissions from the Options

Results show just under 1,000 ($tCO_2e$) difference between the highest and lowest WLC (Whole Life Carbon), between all three options. Option 1, which consists of walls and embankments around Mountmellick town, was the lowest carbon output at 7,187 ($tCO_2e$). Option 2A and 2B, were similar with 8,169 and 7,924 ($tCO_2e$) respectively. These options had large sections of embankments along the Owenass river with the main difference in embankment placement. Total operational and demolition carbon output were similar for all the three options with option 2A the highest carbon emitter.

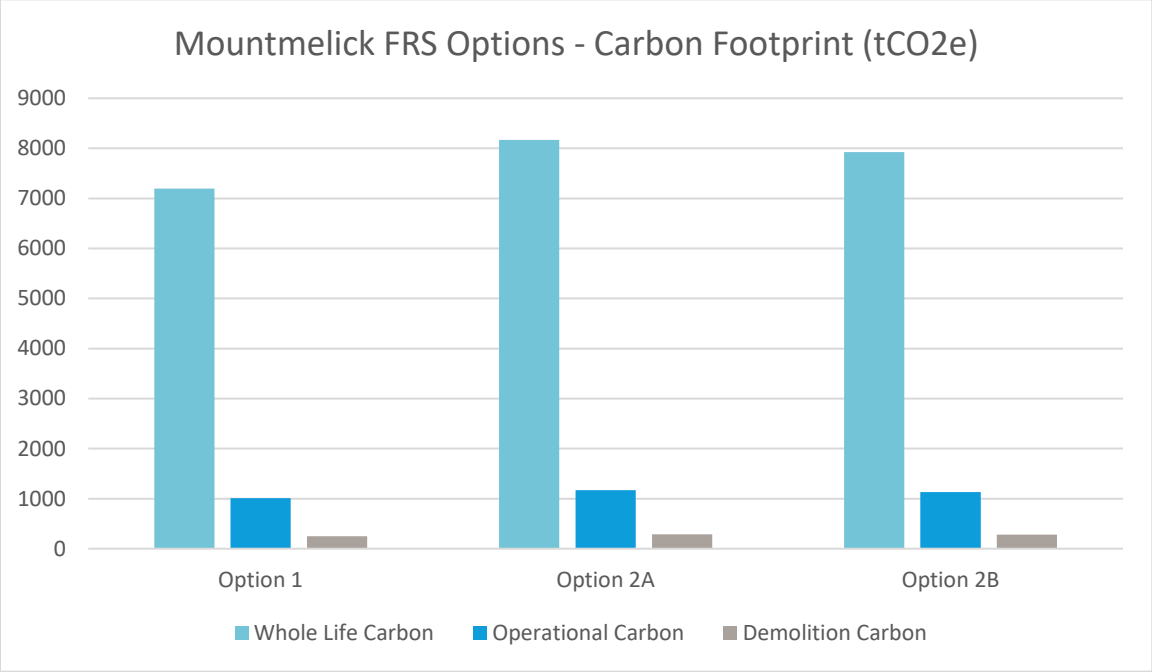



Chart 6-1: Mountmellick FRS Carbon Footprint Outputs for Whole life, Operational and Demolition Carbon ($tCO_2e$).

# 7 Economic Appraisal of Shortlisted Options

## 7.1 Introduction

The scope of this assessment is to derive flood damages for the scheme. The economic flood damages of the scheme have been calculated in the form of Annual Average Damages (AAD), based on a range of probabilities and a resulting expected Net Present Value (NPV) of damages. This section provides the results and supporting data for the assessment. An initial assessment of benefits using the OPW approach (September 2018) found the scheme to be non-cost beneficial, risking the need to curtail the scheme to a smaller area or preventing the scheme from progressing any further. As some of the proposed defences would provide a greater standard of protection (e.g. walls constructed to guarding height), an alternative methodology was used to assess the benefits. This methodology seeks to fully value the future damages to examine whether this is a means of justifying the scheme economically.

The following methodology follows the Technical Methodology Note – Cost Benefit Analysis (CBA) from CFRAM (Sept 2018). The latest OPW guidance (2022) has not been applied.

## 7.2 Options Benefits

Benefits of a scheme can be divided into either tangible or intangible benefits.

Tangible benefits are those to which it is possible to assign monetary values. In general, the benefit assigned is a calculation equivalent of the monetary loss that would occur if the scheme was not in place. These include a reduction in:

- Direct damage to buildings and contents.
- Indirect property, community and business.
- Disruption of road traffic.

Intangible benefits are those to which it is not possible to assign a monetary value from recognised economic principles. Monetary values placed on these benefits are therefore subjective. Intangible benefits include:

- Avoidance of anxiety, inconvenience and ill health.
- Avoidance of the inconvenience of post flood recovery.

For this appraisal, the range of benefits comprise the following:

- Tangible benefit – Residential properties avoided flooding.
- Tangible benefit – Non-residential properties avoided flooding.
- Infrastructure utility cost damages avoided.
- Emergency services costs damages avoided.
- Intangible benefits for residential properties and some locally owned commercial properties.

### 7.2.1 Baseline and Climate Scenarios Damage Data

Flood damages are a potential tangible benefit of the scheme that have been calculated using the baseline design scenario. To carry out this assessment flood damage data is used.

The land use in a flood prone area (often referred to as the Benefit Area) influences the likely damage characteristics and costs. Houses are affected differently from offices and warehouses, which in turn suffer different kinds of costs of damage from those experienced in industrial premises. Various land use sectors have been chosen to assess the impact of different depths of flooding on each. Flood damage data for the residential, retail, distribution, office and manufacturing sectors are provided in the Multi Coloured Manual (MCM) 2019. Detailed descriptions of these data sets are provided in Chapters 4 and 5 of the Manual. Additional costs for emergency services in dealing with flooding are also given in Chapter 6 of the Manual. All cost data in the MCM are in sterling and converted to € equivalent using the appropriate Purchasing Power Parity (PPP). Inflation is also accounted for by using the current Consumer Price Index (CPI).

In the MCM, for a particular property, the damage due to flooding is a function of both flooding depth and its duration. Depths considered in the residential dwellings sector range from -0.3m to +3.0m in relation to the ground floor of the buildings. Information is tabulated for flood durations less than 12 hours.

The MCM provides a set of databases for retail, commercial and industrial flood damage. The Flood Hazard Research Centre (FHRC) derived the depth/damage data sets based on data collections and discussions with representatives from a range of non-residential properties.

### 7.2.2 Property Categorisation Assumptions

The geodirectory database (property point attributes) from An Post Geodatabase was used in GIS shapefile format. Each point was assigned a building polygon derived from the OSI vector mapping. Some outbuildings have been retained in the receptor database where they could incur damages.

Threshold levels for each property were assigned from the survey contract. For the un-surveyed buildings, the MEAN DTM value within perimeter was calculated in GIS and used as threshold.

To link these data to the property descriptions and hence damage curves outlined in the Multi-Coloured Manual the following assumptions were made:

- Residential damages would be based on the sector average for each type of property with the sector average applied where no category was available. No age or social class data was included in the assessment.
- Commercial property damages have been based on a conversion of the An Post GeoDirectory data to MCM codes using conversion tables provided by the OPW. Site visits and Google street view were used to aid the identification of property types to ensure the correct MCM code has been applied.
- Unknown properties were verified by using Google Street view and Google Maps.

FRISM©JBA (JBAs bespoke GIS based flood damage estimation tool) was used to estimate direct damages per property per event. The following parameters have been applied:

- The depth of flooding at each receptor is the maximum flood level within the perimeter of the property boundary.
- MCM2019 curves have been used. Residential properties have been split by type. Using floor area from building footprint obtained from OSI vector mapping to factor depth-damage curve per m2. Floor area has been calculated using GIS analysis.
- Residential curves from 2019 applied.
- Damage curve conversion factor: CPI for inflation from 2019 to 2023, Purchasing Price Parity for conversion of £ to €.

### 7.2.3 Property Capping Assumptions

The present value damages for any given property should not exceed its current valuation. This is to prevent justification for a flood mitigation scheme being based on the repeated flooding of a property over the project life when it would be more cost beneficial to simply purchase the property. The capping values have been assigned to each property based on:

- Commercial rates as supplied for a nearby flood relief scheme and where not available the values were scaled from other FRSs.
- Residential property values were chosen as most reasonable value from daft.ie and property tax valuation.

### 7.2.4 Infrastructure Utility Assets and Emergency Sector

For the area, economic damages to infrastructural utility assets (e.g. electrical sub-stations, gas installations and pipe-work, and telecommunications assets, etc.) was calculated as 20% of total direct property costs. Costs to emergency services have been included in the economic damages and have been calculated as 8.1% of the total direct property costs for the town.

### 7.2.5 Intangible and Indirect Damages

Flood events can cause significant stress, anxiety and ill health to potentially affected people, during and then after a flood. Individuals generally also incur some costs due to their properties flooding that are not directly related to damage, such as evaluation, temporary accommodation, loss of earnings, increased travel and shopping costs, etc.

For residential properties, the intangible and indirect flood damages were set equal to the total (direct) property damage.

### 7.2.6 Discounting and Present Value Damages (PVd)

Given a choice between receiving a specific sum now and the same amount sometime later, most people will express a preference for the present sum. The tangible benefits accruing from a flood alleviation scheme will not provide cash sums to the beneficiaries; however, they will prevent a negative cash flow (avoidance of associated flooding costs) from the individuals.

The avoidance of fixed negative cash flow now is also preferable to avoidance sometime in the future. The “social time preference” (STP) can be measured by an appropriate Discount Rate (STPDR) and is taken as the compound rate of interest ‘r’ (% per annum) by which ‘y’ Euros in ‘x’ years' time is equal to one euro now.

The benefits arising from a flood relief scheme commence on the completion of the scheme and exist for the life of the works. To obtain a method of the overall benefit in present day monetary values, it is necessary to:

- Estimate the average damage arising each year of the project life, termed the Average Annual Damages (AAD)
- Discount the AAD to present values using the appropriate discount rate.
- Total the present values to obtain the overall damages.

The Department of Finance's discount rate for public investment is 4% up to 30 years and then 3.5% from 31-50 years. The lifetime over which the damages are discounted is taken as 50 years. For computation purposes, it is assumed that the residual value of the scheme at the end of the period is nil. This may be regarded as somewhat conservative, since works typically have a design life of 100 years.

### 7.2.7 Calculation of Annual Average Damage (AAD) and Present Value of Damages (PVd)

The Annual Average Damage (AAD) was calculated as the sum of the damage values of each probability, up to and including the 1% AEP event as the upper bounding event.

The Average Annual Damage, discounted at a rate of 4% per annum, is then calculated over a time-horizon of 50 years to produce a Net Present Value of the potential flood damage. This represents the Net Present Value of the benefit of the Scheme.

### 7.2.8 Modelling Scenarios

The present-day baseline scenario was the 1% AEP baseline design event.

For the climate change scenarios, the flows upstream were increased by 20% for the MRFS and 30% for the HEFS.

The Present Value Benefit (PVb) of each option scenario, in the present day only and the increase from present day to future climate change conditions is the difference between the baseline damages and option scenario residual damages.

### 7.2.9 Present-day and Climate Scenario Baseline Damages

Climate change uplifts in flow have assumed a lower bound value of 20%, that would be fully realised in 50-years’ time. The foundations of the scheme elements are designed to a 30% uplift flow i.e. the HEFS.

The damages for each option are the same as the same receptors are provided a consistent SoP and do not change between options.

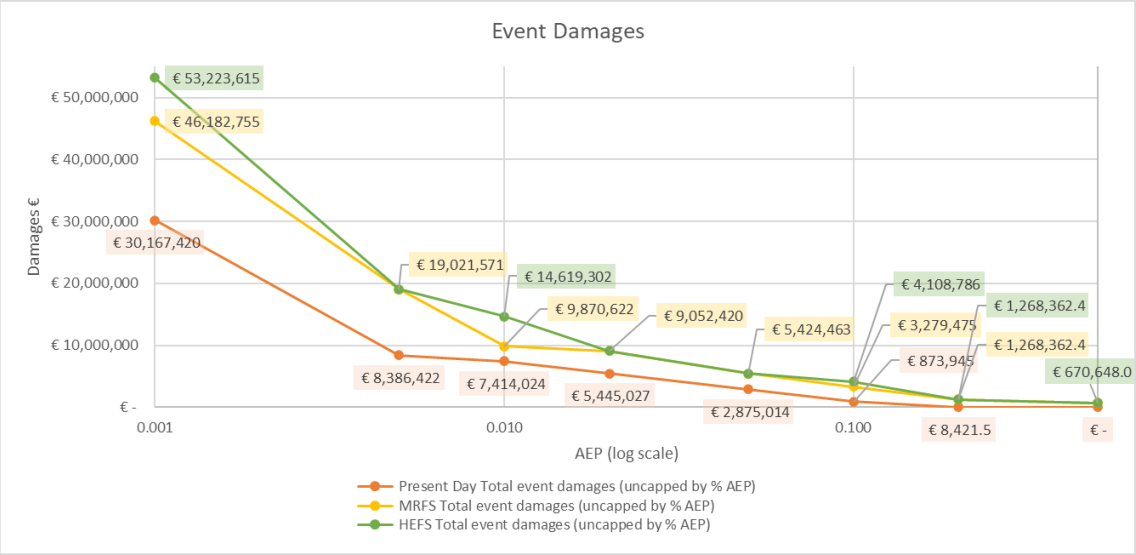



Figure 7-1: Damage curve for baseline event showing the present day, MRFS and HEFS climate change scenarios.

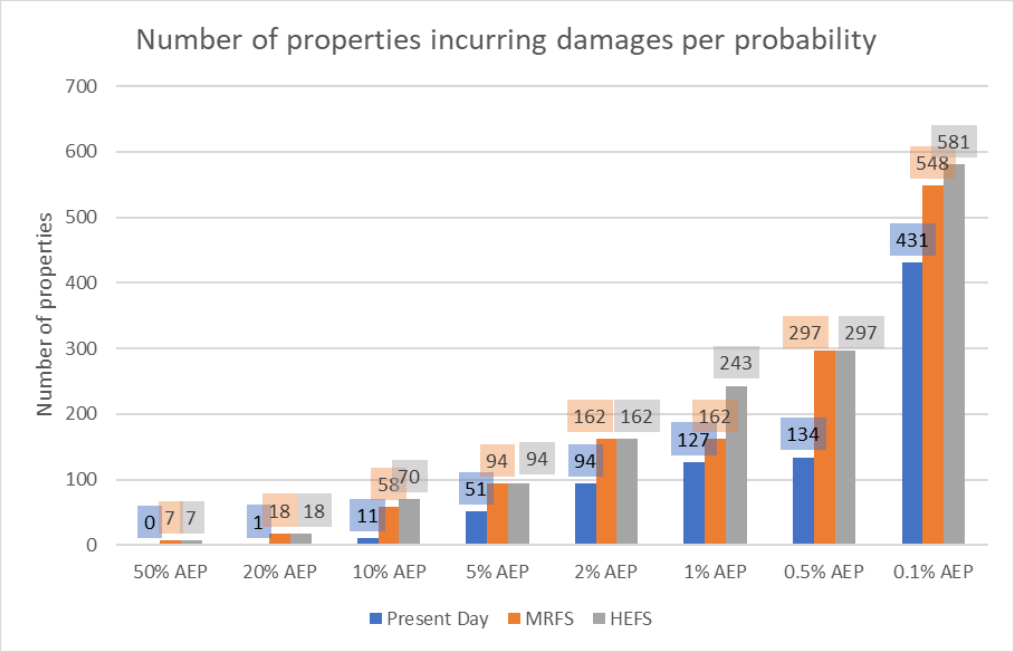



Figure 7-2: Number of properties at risk per probability in the baseline, for the present day, MRFS and HEFS climate change scenarios.

## 7.3 Option Costs

### 7.3.1 Methodology

When building up cost estimates for a scheme of this scale, it is important that the expected whole life costs of the works and its management are developed and not just the scheme capital costs. The following are the elements that were considered when developing cost estimates for the project:

- Construction costs (including environmental mitigation measures)
- Design and site supervision costs
- Site investigation and survey costs
- Land purchase and compensation costs
- Maintenance costs
- Allowance for optimism bias
- Allowance for art
- Optimism bias

- Allowance for unknowns
- Preliminaries
- Archaeology
- Site Investigation

The following costs were excluded:

- Value Added Tax

### 7.3.2 Construction Costing Method

Base costs for construction elements of the scheme were obtained from the following sources:

- Estimates and tendered rates from similar civil engineering contracts.
- Published cost databases, including the NRA unit cost database and the draft OPW unit cost database.

The following assumptions have been made when compiling the construction cost estimates:

- Normal working week for construction personnel and plant
- No exceptional adverse weather.
- Construction contracts with values of between €15m and €20m and durations of 18 to
- 24 months.
- Significant costs of traffic management within space restrictions.
- Allowance of 10% for known unmeasured items such as local drainage, services etc.

Environmental and archaeological monitoring will be required during the construction of the works. It is also likely that some environmental mitigation and improvement works will be necessary.

An allowance of has been made for design and site supervision costs, reflecting the current best estimate of the likely duration of the construction contracts and required size of site supervision teams for the construction phase only.

### 7.3.3 Specialist Survey Costs incurred to the end of Stage 1

Specialist surveys, including site investigation, topographic survey and various environmental surveys (bat surveys, bird surveys, aquatic surveys etc.) and monitoring assessments have been carried out for the scheme. These are included under design and supervision costs, discussed below.

### 7.3.4 Design and Supervision Costs

Design and Supervision includes all design fees and all third-party survey and assessment costs incurred to date. An allowance for expected future surveys and estimated design and site supervision costs for Stages 3-5, reflecting the current best estimate of the likely duration of the construction contracts and required size of site supervision teams for the construction phase only, has also been included.

### 7.3.5 Maintenance Works

Laois County Council organise and mount a significant response operation when extreme flows are forecast in Mountmellick. Such an operation was implemented for the floods in 2017 and 2020. Based on past events, it is expected that this operation would be required every 5 years (reducing to every 4 years after year 20).

### 7.3.6 Project Contingency/Optimism Bias

There can be a tendency for budget cost estimates for flood defence schemes to be overly optimistic i.e. underestimating the cost of the works. In a project of this nature where access for labour, plant and materials will be difficult, including a robust contingency in the cost estimate is essential. A contingency/optimism bias of 35% of the construction cost has been included in the whole project cost.

### 7.3.7 Allowance for Art

The “per cent for art” scheme is compulsory for all major public works contracts. For this size of project (investment band €5,000,000 to €20,000,000), the required allowance for art is 1% of the

capital cost up to a maximum of €125,000. Details of capital cost estimates are in Table 7-1.

### 7.3.8 Scheme Costs

Table 7-1 summarises the total cost of all three scheme options and the works included.

Table 7-1: Summary of Option Costs

| Item | % | Option 1 | Option 2A | Option 2B |
|---|---|---|---|---|
| Capital Costs | | €3,685,294 | €4,384,990 | €4,089,247 |
| Construction | | €2,361,949 | €2,848,277 | €2,658,604 |
| Measured | | €1,917,166 | €2,311,914 | €2,157,958 |
| Unmeasured | 10% | €191,717 | €231,191 | €215,796 |
| Preliminaries | 12% | €253,066 | €305,173 | €284,850 |
| Land Purchase | | €369,096 | €492,492 | €421,512 |
| Art | 1% | €23,619 | €28,483 | €26,586 |
| Enabling Costs | | €930,630 | €1,015,738 | €982,545 |
| Design and Construction Supervision | | €632,363 | €698,017 | €672,412 |
| Investigations and Surveys | | €203,789 | €203,789 | €203,789 |
| Environmental & Arch. Monitoring | | €94,478 | €133,931 | €106,344 |
| Operation and Maintenance (50 year) (PV) | | €416,703 | €427,975 | €466,298 |
| Optimism Bias | 35% | €1,101,712 | €1,146,688 | €1,093,716 |
| Whole Life Cost (PV Costs) | | €5,203,708 | €5,959,653 | €5,649,261 |

## 7.4 Benefit Cost Analysis

Benefit cost analysis examines the ratio between the total damages and the total scheme cost for the 1% AEP design event (the SoP event). A benefit cost ratio (BCR) of one, indicates that the scheme's costs and damages are equal, values above one indicates a cost beneficial scheme and less than one a non-cost beneficial scheme.

The total benefits resulting from the implementation of the works to defend Mountmellick for the 1% AEP event and associated costs are given in the table below to allow the calculation of the BCR. It should be noted that uncapped values have been used.

Table 7-2: Cost Benefit Ratios

| | PV Costs | PVd (uncapped) | BCR |
|---|---|---|---|
| Option 1 | €5,203,708 | €4,570,305* | 0.88 |
| Option 2A | €5,959,653 | €7,397,714 | 1.24 |
| Option 2B | €5,649,261 | €7,397,714 | 1.31 |

* The PVd for Option 1 is lower as the option does not provide protection to the same number of at risk properties as Options 2A and 2B.

If capped values are used, the BCR for each of the options is 0.42, 0.77 and 0.81 respectively.

As all BCRs are below 1.0 it means that the proposed scheme will cost more to build than the total damages incurred during the SoP event.

# 8 Multi-Criteria Analysis of Shortlisted Options

## 8.1 Introduction

Multi-Criteria Analysis (MCA) is a tool to compare proposed scheme options against one another using a set of flood risk management objectives. The following objectives are considered in the MCA:

- Technical
- Economic
- Social
- Environmental

Each of these objectives include subcategories for further assessment. Each objective has also been weighted both globally and locally to reflect the importance of each. These weightings are in accordance with the OPW Technical Methodology Note (TMN) – Option Appraisal and the Multi-Criteria Analysis (MCA) Framework.

## 8.2 Technical Objectives

The technical objective of the MCA relates to the overall success of the scheme in protecting receptors from flood risk. There are three sub-objectives under the technical objective listed in

Table 8-1 highlights the weightings applied to each objective.

Table 8-1: Technical Weightings

| Technical Sub-objective | | Local Weighting | Comments |
|---|---|---|---|
| 1A | Ensure flood risk management options are operationally robust. | 5 | Constant (no change permitted) |
| 1B | Minimise health and safety risks associated with the construction and maintenance of flood risk management options. | 5 | |
| 1C | Ensure flood risk management options are adaptable to future flood risk and the potential impacts of climate change. | 5 | |

Table 8-2: Technical Scores

| Technical Sub-objective | Score Option 1 | Score Option 2A | Score Option 2B | Comments |
|---|---|---|---|---|
| 1A | 300 | 500 | 500 | The proposed scheme relies on fixed elements such as raised defences which will be designed to a sufficient standard such that they do not fail during an SoP event.<br>Flood barriers crossing the highway are included in option 1, but not in options 2A or 2B. |
| 1B | 200 | 200 | 200 | Construction of the scheme will be carried out by competent, qualified contractors with full detailed design and construction details to be considered.<br>Particular risks, as defined under the Safety, Health and Welfare at Work (Construction) Regulations, associated with all three options include:<br>Falling from a height/burial within excavations under earthfalls.<br>Work exposing persons to the risk of drowning – both during construction and maintenance as all |

| | | | | |
|---|---|---|---|---|
| | | | | options include the need for works adjacent to the watercourse. |
| 1C | 300 | 300 | 300 | All options score the same as all defences will be constructed to permit an extension in height without the need to reconstruct the proposed defences. The embankments will be constructed wide enough such that the crest level can be raised in the future and still maintain the minimum crest width required. The foundations for the flood walls will be designed to allow the wall heights to be raised to allow for the MRFS. |

## 8.3 Economic Objective

The economic objective of the MCA considers the total benefits the scheme provides to the area. There are four sub-objectives.

Table 8-3: Economic Weightings

| Economic Sub-objective | | Local Weighting | Comments |
|---|---|---|---|
| 2A | Minimise economic risk | 2.739 | AAD for the scheme = €205,428 |
| 2B | Minimise risk to transport infrastructure | 5 | Based on calculated assessment of the probability of flooding to different road classifications. |
| 2C | Minimise risk to utility infrastructure | 2.75 | Three Pumping Stations (Irishtown, Emmet Terrace, Connolly Street) protected by scheme |
| 2D | Minimise risk to agriculture | 1 | Agricultural land is present within the scheme area. |

Table 8-4: Economic Scores

| Economic Sub-objective | Score Option 1 | Score Option 2a | Score Option 2b | Comments |
|---|---|---|---|---|
| 2A | 15.75 | 32.87 | 32.87 | AAD for damages in place (Excludes infrastructure, indirect and intangible damages which are included in the CBA):<br>O1 = €106,997<br>O2A = 0<br>O2B = 0<br>No flood warning available for flood forecasting system. |
| 2B | 122.1 | 172.3 | 198.1 | Option 2A and 2B scores higher than Options 1 as both provides higher level of protection. |
| 2C | 192.5 | 192.5 | 192.5 | The scheme will protect the three pumping stations at flood risk. |
| 2D | 12 | 12 | 12 | The scheme does not propose any protection to agricultural zoned lands. |

## 8.4 Social Objectives

The social objective of the MCA examines the impact the scheme has in relation to the local community and the visual changes to the area that the scheme will have. There are four sub-objectives under this heading.

Table 8-5: Social Weightings

| Social Sub-objective | Local | Comments |
|---|---|---|

| Weighting | | | |
|---|---|---|---|
| 3A (i) | Minimise risk to human health and life of residents | 0.7294 | Based on calculated assessment of the probability of flooding to all properties in the scheme area. |
| 3A (ii) | Minimise risk to high vulnerability properties | 5 | Based on calculated assessment of the probability of flooding of high vulnerability properties (Scoil Iosaif Naofa, Scoil Padraig Naofa, HSE Primary Care Centre, Childcare Centre and a traveller's caravans) |
| 3B (i) | Minimise risk to infrastructure and amenity | 0.525 | Based on calculated assessment of the probability of flooding of infrastructure and amenity (Scoil Iosaif Naofa, Scoil Padraig Naofa, Veterinary Centre, Fire Station, HSE centre in M.D.A., Playground) |
| 3B (ii) | Minimise risk to local employment | 0.1968 | Based on calculated assessment of the probability of flooding of buildings that provide employment (56 businesses) |

Table 8-6: Social Scores

| Social Sub-objective | Score Option 1 | Score Option 2A | Score Option 2B | Comments |
|---|---|---|---|---|
| 3A (i) | 53.41 | 93.85 | 94.87 | Options 2A and 2B score the same as the same level of protection is provided to all properties. |
| 3A (ii) | 425 | 425 | 425 | |
| 3B (i) | 1.125 | 1.125 | 1.125 | |
| 3B (ii) | 4.37 | 6.85 | 6.8 | |

## 8.5 Environmental Objectives

The environmental objective includes the most sub-objectives. The scheme should be as environmentally neutral or beneficial as possible given the works undertaken and the final configuration.

Table 8-7: Environmental Weightings

| Environmental Sub-objective | | Local Weighting | Comments |
|---|---|---|---|
| 4A | Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives | 5 | Constant (no change permitted) |
| 4B | Avoid detrimental effects to, and where possible enhance Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and steppingstones. | 5 | Maximum weighting based on the presence of Natura 2000 site - River Barrow and River Nore SAC |
| 4C | Avoid damage to or loss of, and where possible enhance nature conservation sites and protected species or other known species of conservation concern. | 2 | Weighting of 2 due to impacts being local in scale. |
| | | | |
| 4D | Maintain existing and where possible create new fisheries habitats including the maintenance or | 2 | Atlantic Salmon recorded in the River Barrow and River Owenass. |

| | | | |
|---|---|---|---|
| | improvement of conditions that allow upstream migration for fish species. | | |
| 4E | Protect, and where possible enhance visual amenity, landscape protection zones and views into/from designated scenic areas within the river corridor. | 1 | No designated views or specified landscape sensitivity or value in the area, but landscape features and views in the town are important locally. |
| 4F (i) | Avoid damage to or loss of features of architectural value and their setting. | 4 | MCA Guidance is to use the PRFA Methodology (OPW, 2011). Mountmellick Courthouse (NIAH 12900329) is found in the town centre. Courthouses are listed as Extreme vulnerability in the OPW PRFA Guidance, however 'Extreme' is not listed on the local weighting guidance for the MCA. As 'High' to 'Moderate vulnerability is given a local weighting of 3 in the MCA Guidance, a score of 4 has been given here to reflect the presence of the Courthouse. |
| 4F (ii) | Avoid damages to or loss of features of archaeological value and their setting. | 3 | PRFA Methodology (OPW, 2011) lists the historic town of Mountmellick (LA008-032) as high vulnerability, which equates to a local weighting of 3. |

Table 8-8: Environmental Scores

| Env. Sub-objective | Score Option 1 | Score Option 2a | Score Option 2b | Comments |
|---|---|---|---|---|
| 4A | -160 | -80 | 0 | Option 1 would require a throttle at Manor House, which would negatively affect hydromorphology, sedimentation and fish passage.<br><br>Option 2A and 2B similar, but 2A requires construction along the banks of the Owenass for the embankment, whereas 2B's embankment is set back from the river's edge, reducing potential for construction-phase impacts. |
| 4B | 0 | 0 | 50 | Works set back from river in Option 2B. |
| 4C | -30 | -30 | -30 | Construction in all three options is likely to lead to short-term impacts due to loss of vegetation. |
| 4D | -195 | -78 | -39 | Option 1 scores lower due to the proposed throttle or flow control device at Manor House/Manor Court/Manor Road, which introduces a new barrier to migration.<br><br>Option 2A and 2B score similarly, however Option 2A has more construction along the riverbank, with more potential for construction phase impacts as a result. |
| 4E | -16 | -8 | 0 | Physical defences will be designed with minimal visual and landscape impact in mind.<br><br>Option 1 scores the lowest due to the visual impact of the flood wall and embankments along the back of residential properties at Garroon Stream |

| | | | | |
|---|---|---|---|---|
| | | | | and Manor House.<br><br>Option 2A and 2B are similar, with 2B slightly preferable as the setback embankment along the River Owenass has less potential impact on the river corridor landscape than 2A. |
| 4F (i) | 0 | 32 | 32 | Option 1 scores lower due to it not providing flood protection to a number of protected structures, which would be protected by Options 2A and 2B. |
| 4F (ii) | 0 | 12 | 12 | Works requiring excavations will require archaeological assessment prior to commencement. Mitigation measures will likely be proposed as a result of this assessment, such as an archaeological watching brief while works are carried out. In all three options, a large area of the historic town of Mountmellick which was previously at flood risk will now be protected. In Option 1, the embankment is partially within the historic town. |

## 8.6 MCA Outcomes and Conclusions

The MCA is a useful tool to guide the decision-making process and to review the performance of the scheme with regard to each of the sub-categories discussed above.

**Criteria Scores:** The MCA produces a weighted score for each objective and the sum of these within each of the criteria classifications is the Criteria Score, as summarised in Table 8-9 below.

- **MCA Benefit Score:** The sum of the scores for the economic, social and environmental criteria. It excludes the technical criteria score. This score represents the net benefits of the option.
- **Option Selection MCA Score:** The sum of the scores for all four of the criteria. This score compliments the MCA Benefit Score with the Technical Criteria Score, and hence includes all of the aspects that should be taken into account in considering the preferred option for a given location.

Table 8-9: Summary of MCA Scores

| Criteria | Option 1 | Option 2A | Option 2B |
|---|---|---|---|
| Technical | 800 | 1000 | 1000 |
| Economic | 342 | 410 | 436 |
| Social | 483 | 526 | 527 |
| Environmental | -401 | -152 | 25 |
| MCA Benefit Score | 425 | 784 | 988 |
| Options Selection Score | 1255 | 1784 | 1988 |

When the MCA Benefit Score and Options Selection Score are considered, the highest scoring option is Option 2B. For this reason, Option 2B has been identified as the preferred option. This is discussed further in Section 9.

# 9 Selection of preferred option

## 9.1 Introduction

Three options have been considered as viable to provide appropriate flood relief to Mountmellick considering the local constraints and how the various watercourses operate and interact. In particular how, the Owenass and the Pound interact when they are in flood.

The options vary in detail and in extent, but Option 1 varies greatly from Options 2A and 2B as it only extends within the area of the town and incorporates flood gates on public highways to secure the required level of protection. However, downstream of Mountmellick Mill Bridge, all three options are the same.

Options 2A and 2B are very similar. They both extend to upstream of Owenass Bridge and contain the Pound with the same alignment of embankments and walls. The only difference between the two options is the alignment of the proposed earth flood embankment extending from Owenass Bridge to Mountmellick Mill Bridge. In Option 2A, the proposed embankment follows the line of the right (west) bank of the river Owenass and in Option 2B, the proposed embankment follows the western and northern boundary of Baker's Field.

When considering the cost benefits, Option 2B is the most cost beneficial followed by Option 2A and then Option 1. However, the decision should not only be based on financial aspects alone and in this case a multi criteria analysis (MCA) has also been completed which has assessed the options considering technical, economic, social, and environmental criteria. The result of the analysis gives the highest MCA benefit score to Option 2B, with Option 2A receiving the second highest score and Option 1 receiving the lowest score.

## 9.2 Emerging Preferred Option

Option 2B was established as the emerging preferred option as it has a number of clear advantages when compared to Options 1 and 2A. These include:

- It protects significantly more properties than Option 1 - which is one of the reasons the cost benefit is much larger compared with that of Option 1.
- It does not require the use of flood barriers crossing the highway to ensure the standard of protection is achieved.
- As with Option 2A, it prevents the connectivity between the floodplains of the Owenass and the Pound.
- It has the advantage over Option 2A that it provides greater floodplain storage for the river Owenass which means that the resulting water levels are slightly lower than those resulting from Option 2A.
- Much more of the proposed work is remote from the river environment/SAC and so there is less risk of the works having a detrimental effect on ecology and potential cultural heritage in the river environment.
- It has the highest MCA Benefit Score, clearly in excess of that for Option 1 and 2A.

# 10 Refinement of preferred option

## 10.1 Introduction

The emerging options (1, 2A and 2B) were published and formed the basis of the Emerging Options Engagement Event held in April 2021. Option 2B was then developed further as the preferred option and published at the Public Information Day (PID) held on 12 September 2023

The PID gave the public the opportunity to review the option and to discuss it with the design team and were invited to comment on the proposal. These comments were reviewed and enabled the option to be developed further.

## 10.2 Developments in the period between the Emerging Options Event and the PID

During the period from April 2021 to September 2023, Option 2B was developed further and amended in areas. These amendments/improvements include:

- Rather than extending the earth embankment along the western and northern boundary of Baker's field, it was changed to extend through the middle of the field. This had the following advantages:
    - It moved the embankment away from the rear of the gardens of the properties on Manor Grove and Manor Court. This removed the risk of any invasion of privacy issues resulting from the gaining access to the crest of the embankment and looking into gardens and properties.
    - It enables an area of the field to be utilised as an asset for the town rather than lost to flood storage.
    - It reduces the total length of embankment required and so reduces the environmental impact in terms of materials needed and vehicle movements required.
- It had initially been proposed that flood protection would be provided by earth flood embankments where the available area allowed and flood walls where it did not. As the design of the preferred option was developed and in particular the climate change adaptation measures required, this approach was reconsidered. The proposed embankment base widths were increased to allow for the height of the embankments to be raised in the future and still maintain at least a 3m crest width. In addition, a review of the ground investigation information completed, confirmed that the depth of foundation of the embankments had to be significant in places. To counter both of these, the gradient of the side slopes was increased, but this still resulted in a significant volume of material and traffic movements being required. In addition, the size of the embankments resulted in a significant visual impact being imposed in the town centre.

  As a result, it was decided to replace the proposed embankments in the centre of Mountmellick with flood walls. This change was made at the following locations:
    - At the rear of the properties on Pearse Street just upstream of Mill Bridge.
    - Within the field to the rear of Grove Park and Irishtown Road.
    - At the diversion of the Clontygar stream adjacent to Davitt Court and Brock View.
- Initially, it had been proposed to construct a flood wall around the children's park on Pearse Street. This had the advantage of keeping the proposed works away from the river environment but would mean the children's park would still be at an increased risk of flooding. It was therefore decided to amend the line of the wall to extend it along the top of the riverbank through the park. This would ensure the park would remain protected as part of the scheme. Because the wall would extend close to the line of existing poplar trees, it was anticipated that the trees would have to be removed as part of the scheme.
- There is an existing public footpath extending along the right (southern) bank of the Owenass between Mill Bridge and Convent Bridge. The path is narrow because of the barrier formed by a stone wall that extends along the side of the path. The wall is of solid construction and would hinder the efficient use of the proposed flood storage area in the adjacent field. To enhance the hydraulic connection between the Owenass and the field, it is proposed to remove the stone wall and replace it with an open fence. This will allow the flood flows to both enter the flood storage area more readily and re-enter the Owenass as flood levels fall.

Although not offering additional flood relief benefit, this alteration also provided the opportunity to set the new fence back from the line of the existing wall and widening the footpath, so increasing the amenity value of this route across the town.

- At the same public footpath, the original Option 2B included flood gates at two locations - one at either end of the footpath. The gates allowed access to be maintained during normal conditions but were required to be closed to secure the flood defence during flood events. In an aim to make the scheme operationally as passive as possible, both gates were replaced by locally raising the wider footpath to ensure the path level provided the required level of protection.

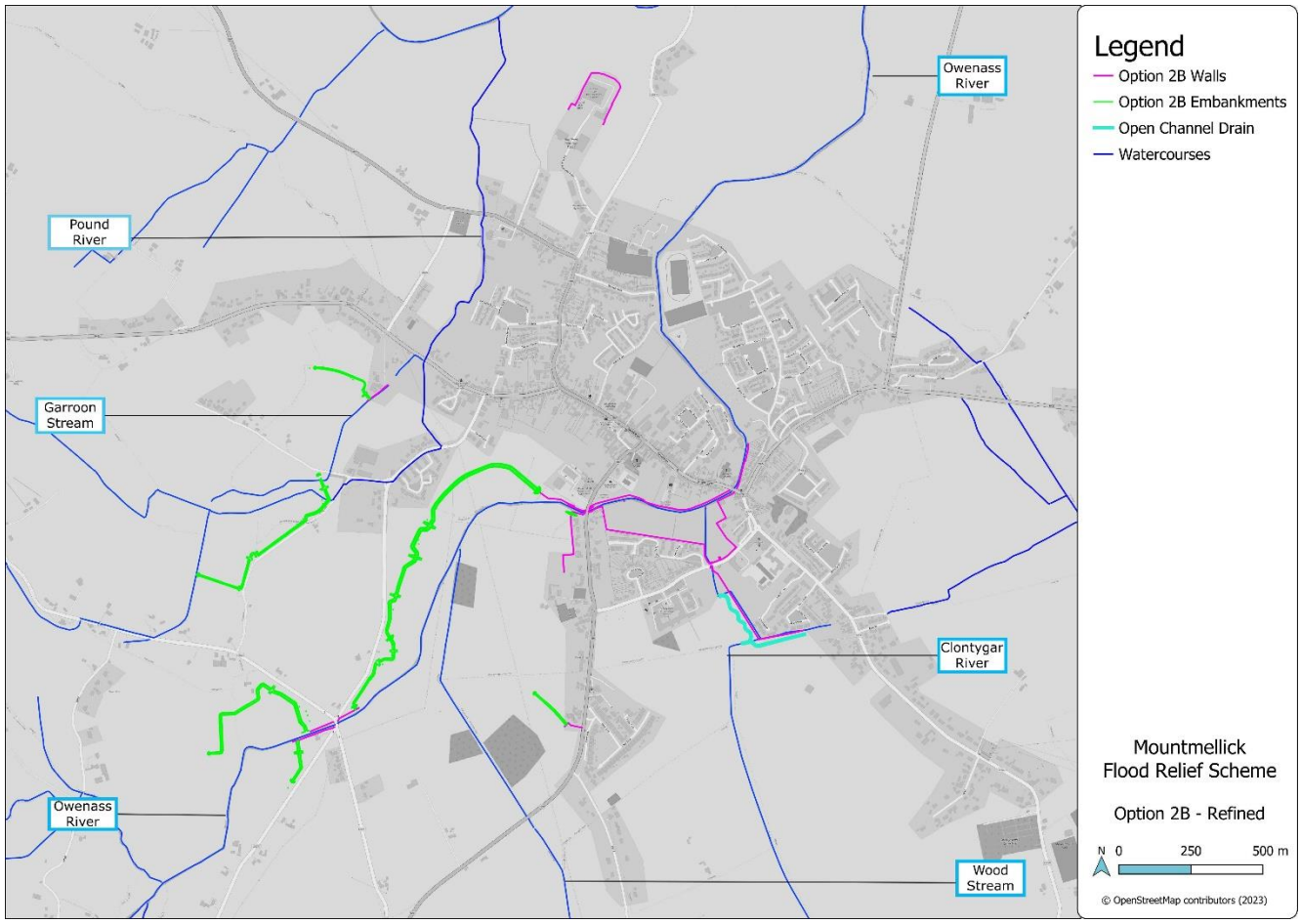



Figure 10-1 Preferred Option/Refined Option 2B

## 10.3 Developments following the PID

The amendments to the preferred option outlined above were issued to the public at the PID held on the 12 September 2023 at the MDA. The discussion held at that meeting and communications that followed afterwards resulted in further amendments to the preferred option. These included:

- The alignment of the proposed flood wall to the south side of the MDA car park was amended to extend into the area of land between the car park and the river. This ensured a greater area remained accessible, but ensured the proposed works stepped away from the river environment.
- To ease construction and minimise the impact of the works on the riverbank along the edge of the children's park, it was decided to align the wall offset from the line of trees. This will mean that the trees can remain in position although it is envisaged that it would be beneficial to pollard the trees to maximise their stability and lifespan. It also means that no work would be required in the river environment and the stability that the trees offer to the riverbank will be maintained or even enhanced.

## 10.4 Cost Benefit Analysis of Eligible Preferred Option

As a result of the development of the preferred option and the addition of various elements, the cost estimate was recalculated taking into account the changes. It should be noted that the impact of inflation over the last two years was also applied. The revised costs are given below:

Table 10-1: Summary of Costs

| Item | % | Option 2B |
|---|---|---|
| Capital Costs | | €13,939,491 |
| Construction | | €10,981,420 |
| Measured | | €8,913,490 |
| Unmeasured | 10% | €891,349 |
| Preliminaries | 12% | €1,176,581 |
| Land Purchase | | €1,328,000 |
| Art | 1% | €125,000 |
| Enabling Costs | | €1,505,072 |
| Design and Construction Supervision | | €1,207,957 |
| Investigations and Surveys | | €242,208 |
| Environmental & Arch. Monitoring | | €54,907 |
| Operation and Maintenance (50 year) (PV) | | €446,830 |
| Optimism Bias | 30% | €3,428,475 |
| Whole Life Cost (PV Costs) | | €17,814,796 |

The Present Value Benefits only considering the present day (without the impact of climate change) are €9,673,294.

To consider the impact of climate change, we have included an incremental increase in AAD each year in line with the slower trajectory climate scenario. When this is done, the scheme as proposed provides €15,895,090 of benefits over the next 50 years.

The resulting Benefit Cost Ratios for the developed Option 2B are detailed below:

Table 10-2: Benefit Cost Ratios

| | PV Costs | PVd (uncapped) | BCR |
|---|---|---|---|
| Without the impact of Climate Change | €17,814,796 | €9,673,294 | 0.54 |
| With the impact of Climate Change Option 2B | €17,814,796 | €15,895,090 | 0.89 |

Although the BCRs detailed above remain less than 1, the calculation used to establish them has not included the provision of any write-off values. For Mountmellick, it has been established that the Midland Steel site is inundated as a result of the MRFS 50% AEP event. If it were a residential site, the OPW guidance would allow the flood risk-free value of the property to be considered as a benefit. Despite the OPW guidance only recommending this for residential properties we have undertaken a sensitivity test to understand how the economic appraisal is impacted if this were taken into account. For this sensitivity test a value of €1,000/m2 has been used as the write-off value of the site. This has been based on published construction cost data which for Industrial units include 'Warehouse/factory (10% office space). Including the write-off value for Midland Steel the

PVd taking climate change into account increases from €15,895,090 to €20,504,822. This would result in a BCR of 1.15. It should be noted that this is only for information and that it is not possible under the OPW guidance to consider write-off in this way for non-residential property. The BCR therefore remains at 0.89 when taking climate change into account.

## 10.5 Freeboard Analysis

Freeboard analysis and sensitivity testing has been carried out for the preferred option.

Soft defences such as earthwork embankments are vulnerable to long term consolidation of the earthworks (settlement), so are normally assigned a higher freeboard than hard defences, such as walls.

Review of the modelled results shows no additional factors that need to be accounted for in the freeboard of the defences, therefore the freeboard allowance adopted for scheme design is as follows:

- 0.30m for hard defences
- 0.50m for soft defences

The actual freeboard achieved in some areas is greater than those above, due to the minimum guarding height of 1.1m required for health and safety reasons. There is no requirement to provide additional freeboard for wave action and/or wind setup given the inland location of the proposed scheme.

# 11 Conclusions

The extent and severity of the flood risk in the study area was established and defined through a detailed hydrology study, hydraulic modelling, flood mapping, largely undertaken through the South East CFRAM Study, but reviewed and updated under this project.

The aim of the Mountmellick FRS is to produce a scheme that will protect at risk properties up to the 1% AEP event.

The Options Report follows on from the establishment of the baseline and existing scenario work to establish flood risk in the area and examines what could be put in place to provide the protection required. It considers all the constraints in the area, key flood risk mechanisms and receptors.

An initial high-level consideration of flood risk management methods was first carried out with viable methods used to develop measures that could be built within the existing system. The flood risk management methods identified as potentially being appropriate were containment and conveyance.

Several measures were then tested and their impact on the overall flood risk to see which were viable. The overall benefit, buildability, environmental impact and complexity of each measure was taken into consideration when screened. From these measures, three scheme options were developed and Option 2B was identified as the preferred option. Climate change adaptability was also considered when developing the final option and the incorporation of climate change adaptability features into the present-day scheme was determined.

The outcome of this optioneering work is the development of Option 2B, which is discussed in detail in Section 5.4 and then refined and developed as detailed in Section 10.

This combination of measures was found to be the one with the greatest local support. Adaptations to the scheme to combat the impacts of climate change were also identified and a MRFS scheme was developed to demonstrate that the proposed scheme will continue to provide the SoP into the future.

The scheme option was then assessed from an environmental, cost and buildability perspective. Environmental considerations influenced the alignment and construction methodology for some defences, particularly in Options 2A and 2B. Option 1 scored the poorest environmentally.

The estimated whole life project cost of the preferred scheme for the current scenario is €17,814,796 with a benefit cost ratio of 0.89.

# Appendices

# A Appendix - Understanding Flood Risk

Flood Risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood Risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

## A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period years, a 1% AEP flood 1 in 100 chance of occurring in any given year. In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table A-1: Conversion between return periods and annual exceedance probabilities

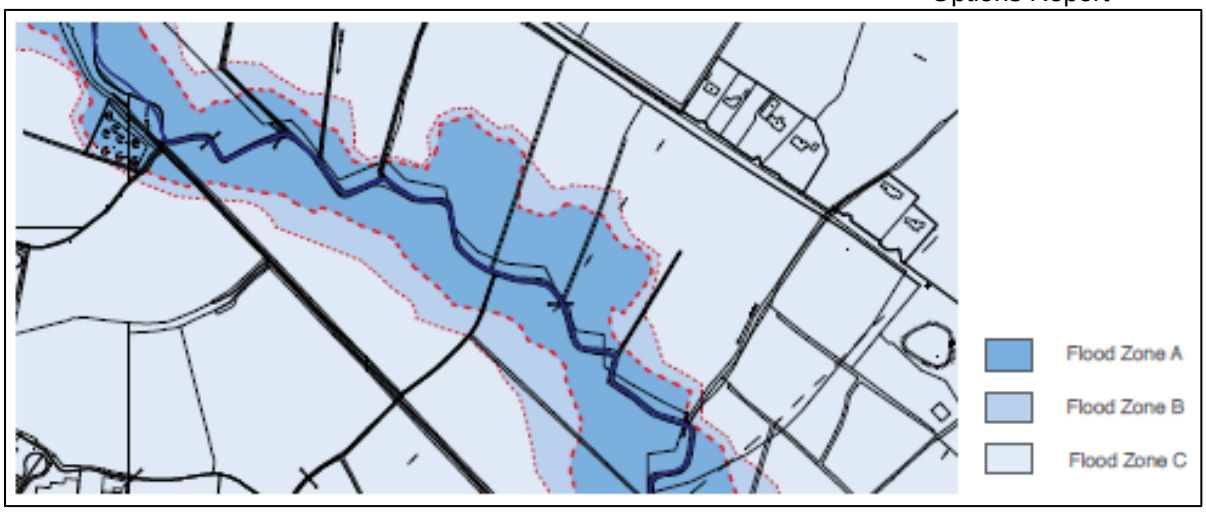
| • **Return period (years)** | • **Annual exceedance probability (%)** |
|---|---|
| 2 | 50 |
| 10 | 10 |
| 50 | 2 |
| 100 | 1 |
| 200 | 0.5 |
| 1000 | 0.1 |

## A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purpose of the Planning Guidelines, there are 3 types of levels of flood zones, A, B and C.

| Zone | Description |
|---|---|
| **Flood Zone A** | Where the probability of flooding is highest, greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/ tidal Flooding |
| **Flood Zone B** | Moderate probability of flooding, between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/ tidal. |
| **Flood Zone C** | Lowest probability of flooding, less than 0.1% from both rivers and coastal/ tidal. |

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences will be maintained in perpetuity.




## A.3 Consequences of Flooding

Consequences of flooding depend on the Hazards caused by flooding (depth of water, speed of flow. Rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure of the population, presence and reliability of mitigation measures etc.)

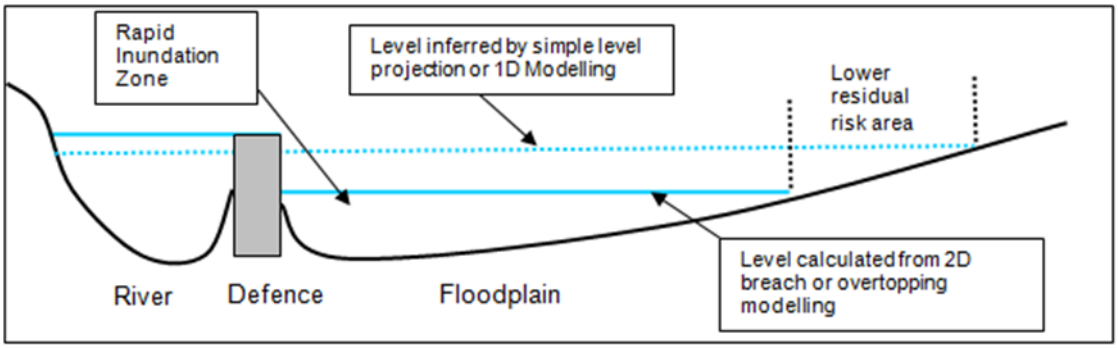
The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on type of development, nature, which are detailed in Table X of the Guidelines, and are summarised as:

- **Highly vulnerable**, including residential properties, essential infrastructure and emergency service facilities
- **Less vulnerable**, such as retail and commercial and local transport infrastructure, such as changing rooms.

**Water compatible**, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

## A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level or a breach occurs. This known as residual risk:



# B Carbon Calculation

Table B-1 Carbon Outputs for the three options for Mountmellick FRS

| Stage (tCO2e) | Option 1 | Option 2A | Option 2B |
|---|---|---|---|
| **Capital Carbon** | 2,890 | 3,313 | 3,203 |
| **Operational Carbon** | 1,010 | 1,173 | 1,134 |
| **Replacement Carbon** | 3,037 | 3,393 | 3,308 |
| **Refurbishment Carbon** | 0 | 0 | 0 |
| **Demolition Carbon** | 250 | 290 | 279 |
| **Residual Carbon** | 0 | 0 | 0 |
| **Whole Life Carbon** | **7,187** | **8,169** | **7,924** |

The Carbon Modelling Tool (CMT) is a UK Environment Agency produced high level whole life carbon assessment and optioneering tool. It has been created for use during project optioneering to enable quick and simple carbon assessment to inform the solution selection process. The main aim of the carbon tool during the appraisal phase is to look at the asset built in carbon output. Carbon is now a large part of the decision-making process. A focus on a low carbon option, can lead to reduced costs and improved efficiency during the delivery stage. A more accurate assessment, closer to the delivery stage may be needed when material type and dimensions are more closely finalised. This will lead to more accurate emission rates of the various options.

Consultation with the design team gave early volumes and area values associated with the flood mitigation features. This was used in the modelling tool as the main input data to calculate the carbon footprint. From table B-1, results show higher emission outputs from option 2A compared to the other two options with approximately 1,000 (tCO2e) between option 2A and option 1 (lowest emissions). This trend was reflected through the operational, replacement and demolitions carbon outputs for all the three outputs.

**Capital carbon** refers to emissions associated with the creation of an asset. Also referred to as “embodied carbon”.
**Operational carbon** describes emissions associated with the operation and maintenance of an asset.
**Whole life carbon**, combines both capital and operational carbon and is analogous to whole life cost.

Offices at
Dublin
Limerick

Registered Office
24 Grove Island
Corbally
Limerick
Ireland

t: +353 (0) 61 345463
e:info@jbaconsulting.ie

JBA Consulting Engineers and Scientists Limited
Registration number 444752

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