Executive Summary

The objective of this project is the identification, design, and submission of a Flood Relief Scheme, to alleviate the risk of flooding for the communities of Graiguenamanagh and Tinnahinch. The Scheme will be technically, socially, environmentally and economically acceptable to the standards of the EU Directive on the Assessment and Management of Flood Risk (Floods Directive 2007/60/EC) transposed into Irish Law as SI 122 of 2010.

The scheme identified for Graiguenamanagh and Tinnahinch potentially comprises the construction of hard defences and associated works through the urban area of Graiguenamanagh-Tinnahinch along the banks of both the River Duiske and Barrow.

The aim of the project at preliminary design stage is to carry out a detailed evaluation of viable flood relief measures, select the best measure or combination of measures and carry out a preliminary design.

A summary of the key constraints identified for each of the environmental disciplines considered as part of the baseline constraints identification exercise is described below. They include:

- Resources and Materials.
- Population and Human Health.
- Hydrology.
- Soils, Geology and Hydrogeology.
- Ecology and Biodiversity.
- Cultural Heritage and Archaeology.
- Landscape and Visual.
- Air Quality.
- Noise and Vibration.

Constraints have been further designated as follows:

- Programme constraints.
- Engineering/Design constraints.
- Legal constraints.

Resources and Materials
Impacts on services and utilities such as watermains, gas mains, underground powerlines etc. will all need to be considered during the design process. The possible interruption of these services and utilities should be minimised, where possible. Furthermore, impacts on road and rail infrastructure, public rights of way and land ownership will need to be considered.
Additional general and site-specific constraints will need to be considered as the scheme progresses, including: • During planning, development, and construction, the utilities infrastructure must be fully considered to ensure that disruptions to the utilities infrastructure are avoided. • During the construction stage, measures may have to be taken to ensure that construction does not interfere in any of the underground or overground utilities services. • It will be necessary to contact ESB if there is a need for lines to be turned off for a period of time (e.g. for works or relocation of infrastructure) and to determine if the affected residences could be serviced from elsewhere. • It will be necessary to contact Irish Water if there is a need for water utilities to be turned off for a period of time (e.g. for works or relocation of infrastructure) and to determine if the affected residences could be serviced from elsewhere. • During planning, development, and construction, any proposals by the applicant to divert existing water services (watermains, service connections, rising mains, foul and surface water sewers, culverts, etc.) will need to be submitted to Irish Water prior to works commencing. • During the construction stage, measures should be taken in order to ensure the construction does not interfere with underground services. Where work occur in proximity to electrical lines, some areas may have to be cut-off for the remainder of the work. This could cause a constraint to local residents and business. • Underground electrical lines in the study area may be at risk of flooding in extreme weather conditions causing power outages in areas of Graiguenamanagh-Tinnahinch. The location of the underground cable routes in the planning and construction stages of the scheme should be taken into consideration. • Consideration of the designs effect on sewerage capacity in the event of hydrological changes or flooding. • Impacts on road infrastructure and land ownership will need to be considered. • Impacts on public rights of way, footpaths and cycle routes will need to be considered. The proposed scheme design should ensure continuity of the public walkways within its footprint and future plans for same. • Graiguenamanagh Bridge provides a significant crossing of the River Barrow and public right of way and access should be maintained throughout the project construction and operation phases.

Population and Human Health
Constraints on population and human health will depend on the final nature and extent of the scheme, as well as the duration and nature of the construction phase.
Public and tourist amenities and facilities should also be considered key constraints. Impacts on public amenity areas adjacent to and requiring access to the rivers such as riverside walks, parks. playgrounds and tourist features should be considered, with replacement mitigation proposed if necessary. Impacts on tourist facilities, recreation and amenity facilities in the area should be considered constraints, especially those requiring access to the watercourses in the area.

Population and Human Health
Development of the proposed scheme must take into consideration ways: for areas of commercial or tourist potential maintain their aesthetic and public attractiveness both during construction and operation of the scheme.
Development of the proposed scheme must take into consideration ways to complement and enhance public amenities including green spaces in the proposed scheme footprint. Measures to protect extant recreational areas and green public spaces should be developed within the proposed scheme. The proposed scheme design should ensure continuity of the public walkways within its footprint.
The scheme design should take into account the value (both cultural and economic) of any buildings (residential, retail, etc.) close to the rivers' edges or flood storage areas or likely to be adversely affected by the scheme within the scheme study area.
Regional roads in the project are likely to be congested at peak travel times. Some roads in the scheme area are narrow and may not be suitable for site access. Graiguenamanagh Bridge provides road and pedestrian access between Graiguenamanagh and Tinnahinch as is the only bridge crossing the River Barrow in the vicinity of the scheme and access to the bridge should be maintained throughout scheme construction and development. There is a potential for construction to make traffic more congested in the study area and vicinity. A traffic management plan will be required with the CEMP.
Any design proposals should ensure that any bridges over watercourses are maintained where feasible so that temporary or permanent disruption of local transport links and access to homes and businesses in the study area are minimised. It is also noted that facilities such as schools, medical facilities, and shops are located predominantly in Graiguenamanagh, fewer and less diverse facilities are available in Tinnahinch.
The River Barrow and River Duiske has access and movement limited by urban development in some areas. During construction of the scheme, traffic restrictions could pose problems for deliveries and site access and traffic management measures will need to be considered as part of the environmental impact assessment process.
Construction works will have to be mindful of maintaining access for both pedestrians and cyclists. A traffic management plan will be required during construction works.
The traffic associated with construction works will need to be mindful of the tourist and retail trades.
Sensitive receptors e.g. homes, schools, medical facilities, and outdoor learning/training organisations should be considered key constraints in the design of the flood relief scheme. The scheme design should take into account the value (both cultural and economic) of any buildings (residential, retail, etc.) close to the rivers' edges or likely to be adversely affected by the scheme within the scheme study area. Medical facilities in the scheme study area are sensitive receptors and must be given due consideration. Flooding events can cause devastation to homes, businesses and local facilities, with social and human health impacts. Their specific protection through adequate flood defences should be considered in the design of the scheme.
Other impacts to population that are also concerned with human health, including material assets such as water supply, wastewater treatment, and utilities should also be given due consideration.

Hydrology
Some of the principal surface water bodies in the study area are classed under the Water Framework Directive as 'At risk'. Under WFD requirements, the development of the scheme should incorporate measures not to worsen its status. All possible risks of point source pollution or runoff during construction and operation should be assessed and prevented. Works during the construction of the

Hydrology
scheme could pose a threat to the water quality of water bodies within and downstream of the study area though various mechanism, chiefly: (1) Increasing suspended solids in the water bodies through release or run-off of significant amounts of suspended solids during enabling works and construction; and (2) Unplanned events such as leaks/spills/runoff/accidental release or escape of fuels, oils and lubricants, bulk liquid cement, contaminated leachate, etc. Measures to protect surface water from leaks/spills, contamination, increased turbidity or input of suspended solid, etc, should be considered.
Contamination potentially present on site from historical land use must also be considered. The CEMP for the scheme will include measures to avoid mobilising and/or creating pathways for any contaminants present on site to the surface where surface runoff can introduce contaminants to surface water during enabling and construction works.
Measures to protect active national water monitoring stations and hydrometric gauges and avoid impacting their data collection processes should be considered during design and construction phases.
The scheme design and schedule will need to take into consideration the development of any WWTPs, water abstraction facilities or third party 'WFD' projects in the vicinity of the scheme area, including potential impacts to utilities and infrastructure.

Soils, Geology and Hydrogeology
Made ground Depending on the scheme design and type of works, for areas where made ground is uncompacted and/or highly variable it may be required to excavate and place this material and replace with suitable founding material. This material may also be a possible a source of contamination. As this material will be excavated during construction, it may require contamination testing be undertaken during the detailed site investigation.
Contaminated land The scheme area is located in an area with industrial heritage and commercial properties. If intrusive works are required during construction at locations where known or unknown contaminated land may be present (e.g. from recorded historical land-use), an investigation may be required into determine if land contamination is present and, if present, to determine its nature and extent.
Soils and groundwater Poor draining soils occurring within the scheme footprint are potentially soft and compressible and will likely require a detailed site investigation (SI) in order to design a suitable flood defence scheme. Appropriate environmental controls and management measures will be implemented for any advance SI works, this may include a requirement for AA screening, or an application/notification to NPWS for approval. A CEMP will be developed for construction activities. The CEMP will identify appropriate equipment and construction techniques that should be used in circumstances where there is a potential impact to the environment. Engineering design should minimise the impacts of the flood relief scheme on the sections of river within the study areas and the wide catchment.
Groundwater vulnerability to contamination Depending on the design of the scheme, works may occur adjacent or within areas where groundwater is classified by the GSI as 'extremely vulnerable' to contamination. Appropriate environmental controls and management measures will be implemented for any advance SI works. A CEMP will be developed for construction activities.

Soils, Geology and Hydrogeology
Karst features GSI data indicated that there are no recorded karst features in the study area. However, despite the lack of carbonate lithologies in bedrock in the study area it is prudent to consider that karst features such as caves, swallow holes, weathered rock and dolines may be present and can lead to ground surface and ground instability and are a constraint to be considered in the engineering design of the scheme.
Geoheritage It is good practice to inform the Geological Survey Ireland (GSI) (contact: Beatriz.Mozon@gsi.ie) where: • construction works temporarily or permanently uncover significant outcrop; • were reports detailing any site investigations can be made available to the GSI; • a digital photographic record of any significant new excavation can be produced and provided to the GSI.

Ecology and Biodiversity
Protected Sites The most significant ecological constraints at Graiguenamanagh are the River Barrow and the River Duiske given their status as an SAC. For this reason, any works that are to be carried out to reduce flooding must take this sensitivity into account. Where at all possible, any in-river works should be avoided and every effort must be made to minimise, if not avoid, any run off to it. All work that is to be carried out on the river bank must be carried out in such a way as to minimise the potential for events such as diesel or concrete spillages, run off of water with suspended sediment loadings or any accidental spillages. If it considered necessary to re-build weirs or sluices, the same sort of construction approach should be designed in to minimise resuspension and loss of concrete to the river. Appropriate Assessment under Articles 6(3) and 6(4) of the EU Habitats Directive (Directive 92/43/EEC) will be required for the proposed scheme.
Protected/notable Species In ecological terms, the river corridor (including the river itself) supports a number of protected species including two species of lamprey, salmon, sea and brown trout, otter, bats, badger, and potentially red squirrel, pine martin, white-clawed crayfish and the common frog. Any in-river and bankside works have to be designed to minimise potential impacts on these (and all other) species. All works should be planned wherever possible to be carried out at times of the year that are ecologically least sensitive e.g. outside bird nesting (March – September) and fish migration periods (Spring/Summer, depending on species).
Otter The ecological study area contains suitable commuting, foraging, breeding and resting habitats for otter, although it should be noted that no holts or field signs of otter were recorded during the ecological walkover survey. Desktop study indicates that otters have previously been reported as occurring in the vicinity of the scheme. As a European protected species, the otter is fully protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Any scheme option that may have the potential to disturb otters must be assessed. A full otter survey will be completed once the scheme extents are known. If otters are found to be present and disturbance is likely then KCC must apply for a licence to allow proposed development works that might affect otters to proceed legally. The potential impacts on otter will be assessed and reported in the EIA. Otter mitigation works can potentially be conducted at any time of year but must avoid the breeding season (usually Spring but can be any time of year) if holts are present on site.

Ecology and Biodiversity
Red Squirrel Although red squirrel have been recorded in the study area, no dreys or field signs were recorded during the site visit. Construction work is very unlikely to threaten red squirrel as no drey sites were recorded within the proposed scheme area. Pre-construction surveys would be undertaken for all suitable habitat that will be impacted by the proposed scheme. Should any drey be confirmed as having red squirrel present, works would cease in the vicinity of the drey, and discussion would be held with NPWS to determine the most appropriate course of action including possible erection of artificial nesting sites within suitable retained vegetation. Should a drey be recorded within the scheme extents prior to construction works then appropriate mitigation and a licence for works will be required. Works affecting red squirrel habitat should be timed to avoid the breeding season (1st February – 30th September inclusive); and protection zones of a minimum of 5m or one tree buffer should be employed around active dreys.
Pine Marten Although pine marten have been recorded in the study area, no breeding or resting places or field signs were recorded during the site visit. Construction work is very unlikely to threaten pine marten as no den sites were recorded within the proposed scheme area. Pre-construction surveys would be undertaken for all suitable habitat that will be impacted by the proposed scheme. Should any breeding or resting places be confirmed as having pine marten present, works would cease in the vicinity of the location, and discussion would be held with NPWS to determine the most appropriate course of action including the provision of artificial den boxes in suitable adjacent habitat. Should a den be recorded within the scheme extents prior to construction works then appropriate mitigation and a licence for works will be required. Works affecting pine marten habitat should be timed to avoid the breeding season (March - June inclusive); and protection zones of a minimum of 5m buffer should be employed around active dens.
Badgers Although badgers have been recorded in the study area, no setts or field sign were recorded during the site visit. Construction work is very unlikely to threaten badger as no setts were recorded within the proposed scheme area. Pre-construction update surveys would be carried out to maintain the validity of species data. The results of these would inform the decision as to whether to close a sett through exclusion or to destroy it if it is no longer active. Alternative locations for artificial setts would also be scoped in these updates. Surveys would be carried out in accordance with best practice guidance. Should a badger sett be recorded within the scheme extents prior to construction works then appropriate mitigation and a licence for works will be required. Construction of new setts must be completed in Spring/Summer with blocking and destruction of existing setts completed in Autumn/early winter.
Bat The scattered mature trees, bridges, architecture (churches, masonry) and areas of low water flow provide good foraging, roosting and commuting routes for bat species in the area. Options that require the removal of mature trees or works to bridges or other riverine structures with the potential to support roosting bats shall be assessed for bat potential. Bat surveys shall be conducted on any features with medium or high potential for roosting bats and an initial survey has been undertaken in the scheme area. Once more detail becomes available pertaining to the proposed structural alterations to the site (including the proposed methods of construction), the site should be re-visited for the purpose of: • Surveying key locations (e.g. where it is known that potential roosting habitat will be removed or disturbed); and • Obtaining more detailed information about any potential bat roosts (i.e. whether it is a maternity roost, hibernaculum etc.)

Ecology and Biodiversity
This information will inform any considerations of mitigation measures that may need to be implemented. The optimal time to conduct map surveys are May and August, when bats are most active. If bats are found, they should not be disturbed during hibernation period (October to March) or maternity period (June to August). If a bat roost requires removal then a licence would be required. Removal of roosts should be carried out during the summer months for hibernation roosts and during the winter months for maternity roosts. As all Irish bats and their roosts are protected under national and EU legislation it is an offence to disturb or interfere with them without a licence. Such a derogation (which must be given by the Minister for the Environment, Heritage and Local Government) can only be sanctioned where there is no satisfactory alternative and where it will not be detrimental to the favourable conservation status of the species concerned. Therefore, any felling of trees or work on bridges which provide suitable roost habitat for bats should be sought in advance of any development that may interfere with such roost sites.
Freshwater Fish Fish present in the river include both brook and river lamprey (*Lampetra planeri* and *L. fluviatilis*), brown trout (*Salmo trutta*), sea trout (*Salmo trutta morpha trutta*), stone loach (*Barbatula barbatula*), three-spined stickleback (*Gasterosteus aculeatus*) and eel (*Anguilla anguilla*). Salmon (*Salmo salar*) have been recorded in the river's lower course. Further surveys are currently being competed on site to establish the presence/absence/abundance of the fish species listed above. This will involve netting and electrofishing surveys. In terms of the construction programme, it should be noted that in salmonid catchments, in-stream works are not permitted between the months of January to April (migration) and October to December (spawning). This corresponds with guidance from Inland Fisheries Ireland (Murphy, 2016). Lamprey (both species) spawning takes place in the spring and early summer period in often the same habitats where salmon and trout spawn (O'Connor, 2017). The spawning season for brown and sea trout is November to February. If spawning grounds are found to be present in the construction zone for the scheme then this period should be avoided. A full impact assessment and management plan for these fish species will be produced as part of the EIA report once full scheme details (including construction methods) are known.
Freshwater pearl mussels *(Margaritifera margaritifera)* Freshwater pearl mussels are present in the river, however, these populations are up stream of Graiguenamanagh. Any impacts that result in a decrease in anadromous salmonid populations (Atlantic salmon and sea trout) could have a significant impact upon the viability of the freshwater pearl mussel population. The lifecycle of freshwater pearl mussel is reliant upon the development of glochidia which that attach to the gills of host fish, usually juvenile salmonids, to continue development (Skinner et al., 2003). Therefore, a decline in the salmonid population within the River, as a result of construction and operational disturbance to migration, could have an impact upon the future viability and population size of freshwater pearl mussel. Works therefore should be carried out outside the period when salmon are migrating either upstream to breed or when fish return to the sea as smolts or adults.
White-clawed Crayfish *(Austropotamobius pallipes)* Any works carried out on the riparian habitat and banks should where possible be restricted to between July and October as this is a period when white-clawed crayfish are less sensitive, with females already having released their young and individuals being more active and not seeking refuge deep in bankside burrows as they do in winter months. Pre-construction surveys may be required, depending on the extent and location of the proposed measures.

Ecology and Biodiversity
Biosecurity (Crayfish Plague) Crayfish Plague (a water-mould *Aphanomyces astaci*) has previously been reported in waterways the vicinity of the scheme area with periodical outbreaks occurring within different locations with the catchment. The plague can be spread by moving equipment that has been used in an affected area to an unaffected catchment and strict biosecurity measure will need observed when working in affected catchments. Prior to any in river works during construction the NPWS should be contacted to confirm the status of any outbreaks in the rivers and suitable biosecurity measure should be put in place.
Invasive Species Japanese Knotweed, Himalayan balsam, and Gunnera are listed as invasive plants under the EC (Birds and Natural Habitats) Regulations 2011 (S.1. 477/2011) and have been found within the study area. The regulations prohibit the introduction or dispersal of invasive species and appropriate measures should be undertaken in the proposed scheme development. Therefore, any works occurring in areas where invasive species are present must use appropriate measures. An invasive species treatment and management plan has already been implemented.

Cultural Heritage and Archaeology
Archaeological Heritage There is one national monument within the proposed development area, Duiske Abbey (RMP KK029-01800, National Monument No 620). It is the physical and visual focal point of the town. There are sixteen recorded archaeological monuments (RMP sites) within study area, all relating to the medieval heritage and industrial character of the area: o Castle - tower house, Tinnahinch; o Church Tinnahinch; o Graveyard, Tinnahinch; o Ritual site - holy well, Tinnahinch; o Bridge Tinnahinch, Carlow Brandondale; o Historic town, Graiguenamanagh; o Religious house - Cistercian monks, Graiguenamanagh; o Cross - High cross (present location), Graiguenamanagh; o Tomb – effigial, Graiguenamanagh; o Wall monument, Graiguenamanagh; o Cross, Graiguenamanagh; o Burial, Graiguenamanagh; o Ritual site, holy well Graiguenamanagh; o Clapper bridge, Graiguenamanagh; o Water mill – unclassified, Graiguenamanagh; o Cross - High cross, Graiguenamanagh, Kilkenny. There is a designated Zone of Archaeological Potential (ZAP) in the Record of Monuments and Places around the historic town of Graiguenamanagh (KK029-018). Any development within this zone is considered to be of archaeological potential and is likely to reveal medieval or later archaeological remains, features finds or soils.
Architectural Heritage Graiguenamanagh town is an Architectural Conservation Area (ACA). The boundary encompasses the medieval core of the town, it incorporates the Turf Market, the bridge and the historic quay.

Cultural Heritage and Archaeology
There are thirty-five RPS sites within the constraints study area, of these seven are outside of the ACA. These structures/features should be considered as cultural heritage constraints during the design of the proposed flood relief scheme and avoided where possible. There are twenty-seven NIAH sites in the study area that have not been added to the RPS, however there is a potential that they may be added in the future. Every care should be taken in these locations to avoid direct impacts on protected structures or by means of careful design or by the application of appropriate mitigation measures. This includes development that might adversely affect the setting of the protected structure. Any design proposals in the vicinity of protected structures vicinity should be carried out in a way that will not materially affect the character, integrity, amenity and setting of these sites. An architectural conservation specialist may be required advise on appropriate measures mitigate any potential impact on this.
Archaeological/ Cultural Heritage Potential There is the strong possibility that previously unknown archaeological deposits or features associated with the medieval and later milling in the area or with earlier river crossings may survive subsurface within the study area. For example, there a possibility that evidence of the medieval wooden bridge at Brandondale (KK029-042-) may be unearthed during works (on both sides of the river bank) along the Barrow. Historic accounts of oak piles being recovered at the site during the construction of the Tinnahinch Lock further affirm this risk. There is a general riverine archaeological potential along the Duiske River and the River Barrow to reveal milling activity that could date from the 12th to the post medieval period. There is a significant amount of industrial heritage features recorded in the RMP and RPS in the study area which is associated with a legacy of milling and transport. However, there are several sites and features that have yet to be recorded or identified. The industrial heritage potential is high some unrecorded features include: • A mill race running parallel to the Duiske river which that connected several recorded mills, any development in the vicinity of this has the potential to reveal further milling activity. The proposed storage areas are located in the vicinity of the mill race. • There is also a mill race in Tinnahinch running parallel to the river Barrow and Canal tow path. • There are several former mill/ industrial structures that are not protected these include structures in the Turf Market area and along the mill race and Duiske River. • The canal and its associated protected lock and lock keepers house is considered to be of cultural heritage value and are part of the curtilage of the protected structures. There are several heritage trails within the town that must be maintained/enhanced. Field work will identify unrecorded industrial heritage and cultural heritage features that might be impacted by the scheme.
Historic Character and Setting • Duiske Abbey commands a focal point at the centre of Graiguenamanagh. The narrow and winding medieval streets of the town centre, their interconnection with the Abbey, and the relationship with the River Barrow, and the Duiske River gives Graiguenamanagh its unique visual and aesthetic character. • The River Barrow, with its historic quays, mill buildings, mill races, bridges, canal, canal lock and weirs, is a rich and highly significant cultural, historical industrial and social amenity of Graiguenamanagh- Tinnahinch. It is also a defining character, its visual relationship to the town and the Abbey should be retained. Every effort should be made to retain or enhance this amenity. • While change within the setting of an historic site or landscape may be acceptable, in certain instances development will be considered intrusive and inappropriate (such as large embankments, walls or similar permanent infrastructure). This effect on the setting of

Cultural Heritage and Archaeology
archaeological and architectural heritage sites requires an assessment to be made on a case-by-case basis according to the type of development, its location and landscape setting by means of objective analysis based on a set of predefined criteria and professional judgement, supported by appropriate descriptive material. • Specific mitigation requirements can only be identified as issues for development once the design options are defined. Further assessments such as archaeological testing, underwater archaeological assessments, structural architectural heritage appraisals or structural surveys etc. may be required in the next phases of the assessment or as mitigation measures for the scheme. • It should be noted, however, if flood relief measures impact any areas in proximity to an RMP, or in the ZAP of the town, the judicious use of archaeological assessment techniques may be required in these areas in order to understand the implications for the proposed scheme. • In accordance with the Architectural Heritage Guidelines any work to or in the vicinity of a Protected Structure, NIAH site or the ACA require a conservation heritage impact assessment by a conservation architect. • All recommendations made in this report are subject to approval of the relevant Local Authorities and the National Monuments Service, Department of Culture, Heritage and the Gaeltacht.

Landscape and Visual
Existing Trees and Hedgerows The study area contains outdoor amenity areas, matures stand of trees and small woodlands and tree lined recreational pathways along both sides of the River Barrow and sections of the River Duiske. The retention and protection of trees and woodlands within Graiguenamanagh -Tinnahinch and surrounding areas in the valley is emphasised with the Kilkenny CDP (2014 -2020). There are areas of woodland, trees and hedgerows also contained with the River Barrow and River Nore Special Area of Conservation (SAC Site Code: 002162). The existing trees and planting within the study area provides both visual and recreational amenity for the residential and amenity areas within the study area and the wider districts. Additionally, the 'green' character of the landscape is considered by KCC and CCC to be a key component of local tourism development for Graiguenamanagh-Tinnahinch and the wider area. Additionally, such areas also provide a network of habitats, ecological 'corridors' and 'stepping stones' essential for wildlife.
Landscape Character The proposed development of the subject site will result in a change to the landscape character which will be most noticeable locally, such as from the adjacent residential and tourist areas (including along the river banks and bridges). It may also result in a change to the landscape character within the wider vicinity of the Barrow Valley. The potential magnitude of this change will be assessed when the details, scale and extent of the proposed interventions have been finalised.
Historical landscape character and cultural heritage Within the study area there are several designations and structures of national interest that need to be considered such as: • A number of Protected Structures and Recorded Monuments within or in close proximity of the study area (refer to section 8 of this report for more details). • Conservation Area. • Zone of Archaeological Interest. • Sites of Archaeological Interest.

Landscape and Visual
Recreational amenity value There are several recreational amenities within the study area that need to be considered in relation to possible impacts on their accessibility, recreational and visual values: • Walking/ cycling pathways along much of the length of the river, including national Waymarked Ways. • An outdoor activities hub located in Graiguenamanagh on the bank of the River Barrow. • Land use zoning objectives in county development plans – areas zoned as Amenity and Open Space/ Biodiversity. • Swimming area and diving board area in the River Barrow.

Views & Visual Amenity Value
Key viewpoints will be selected when the details, scale and extent of the proposed interventions have been defined, these shall include views into and out of the study area and those that demonstrate the visual amenity value within the locality.
There is a need to protect:
• Residential views towards the rivers and Graiguenamanagh Bridge.
• Views towards the rivers and Graiguenamanagh Bridge from businesses serving the tourism and recreational sector (e.g. cafes, etc).
• Recreational views – towards to and from the river (e.g. public pathways and parks).
• Views for entering the town from the surrounding areas in the valley by road (e.g. for drivers, cyclists, walkers, etc).
• Views from the national waymarked trails.
Views to be preserved and protected in the vicinity of Graiguenamanagh, as identified in the Kilkenny development Plan 2014 – 2020 and the Graiguenamanagh Local Area Plan 2009 are:
• V1 View east and south over the Barrow valley on the Thomastown / Graiguenamanagh Road, R703 from Coppenagh Hill between the junctions with road numbers LP 4203 and LT 82152.
• V2 View East over the Barrow Valley on the Graiguenamanagh / New Ross Road and in particular the views overlooking St. Mullins, between the junctions with road numbers LP 4209 and LT 82463.
• V3 View east over the Barrow Valley on the Graiguenamanagh / Ullard Road just North of Graiguenamanagh, Road No. LS 8221 between the junctions with road numbers 438 and LS 8222.
There is a need to protect and minimise any negative impact on the following views in particular:
• Protected views as identified in the KCDP 2014 – 2020 and the GLAP 2009.
  ○ particularly the protected views along the R703 which forms the boundary of the study area to the west.
• Public, recreational and residential views to and from the rivers and bridges, with emphasis on area that may be visually impacted by the suggested hard defence proposals in CFRAM:
  ○ Towards and from The River Barrow and River Nore Special Area of Conservation SAC (including the Duiske River)
  ○ Towards and from Recorded Monuments and Protected Structures e.g. bridge, Tinnahinch Castle
  ○ Public pathways, amenity areas and national 'Waymarked Ways' such as The South Leinster Way and The Barrow Way which pass through the study area.
  ○ Other tourist amenities e.g. guesthouses, cafes, restaurants, seating areas.

Landscape and Visual
Construction Phase and Operational Phase During the construction phase, the following elements of the proposed development have the potential to cause visual impacts, they will however be short to medium term in duration: • Temporary site works – hoarding, lighting, cranes, car parking, storage areas. • Construction traffic – dust and emissions. • Tree and vegetation clearance. • Groundworks – cut and fill excavations. • Laying of foundations. The principal elements which are likely to give rise to landscape and visual impact visual impact in the long term/operational phase are: • Removal of some existing trees. • Height of proposed structures/ interventions. • New structures/ interventions. • Change of character – dependent on proposed interventions type and scale. • Proposed tree and shrub planting. Appropriate design, siting and mitigation measures are required to integrate the proposed scheme within the landscape.

Air Quality
The key constraints in relation to air quality and climate are any sensitive receptors in proximity to the location of construction works. The scheme design should take into consideration any sensitive receptors such as residences, schools, businesses, and medical facilities located in proximity to works associated with the flood relief scheme. The CEMP for the construction phase of the scheme should include mechanisms to reduce air quality impacts during construction and a traffic management plan should be developed.

Noise and Vibration
Noise and vibration effects are expected to occur during the construction phase only and would be expected to include: • Construction traffic. • Earthmoving plant and equipment. • Sheet piling. • Power tools and generators. The CEMP for the construction phase of the scheme should include mechanisms to reduce noise generated during construction and a traffic management plan should be developed.
Construction noise is temporary in nature, and therefore the normal way of minimising the impact is to limit the working hours. For larger infrastructure projects the Local Authority may place noise limits on the construction works.
A number of structures potentially vulnerable to vibrations associated with construction works have been identified in the vicinity of the proposed locations for hard defences (in the preferred option of the CFRAM): • Graiguenamanagh Tinnahinch Bridge; • Ruins on the waterfront adjacent to the Graiguenamanagh Tinnahinch Bridge; • A stone building on the waterfront at Graiguenamanagh;

- A derelict building at the waterfront, may be sensitive to vibration;
- Waterfront shops/residential property;
- Tinnahinch Castle;
- Graiguenamanagh Mill;
- Barrow tributary bridge and adjacent building;
- A brick chimney located adjacent to the Aldi supermarket entrance,
- Graiguenamanagh Abbey, and
- Clapper Bridge

The scheme design and methods for works during construction should consider potential impacts to such structures and consider if there is a requirement for ongoing noise and vibration monitoring during construction.

The following tables provide a summary of the above constraints summarised according to programme, engineering/design and legal constraints.

Programme Constraints
Protected/notable Species. All works should be planned wherever possible to be carried out at times of the year that are ecologically least sensitive e.g. outside bird nesting (March – September) and fish migration periods (Spring/Summer, depending on species (see below)).
Otter. If otters are found to be present and disturbance is likely then KCC must apply for a licence to allow proposed development works that might affect otters to proceed legally. The potential impacts on otter will be assessed and reported in the EIA. Otter mitigation works can potentially be conducted at any time of year but must avoid the breeding season (usually Spring but can be any time of year) if holts are present on site.
Red Squirrel. Construction work is very unlikely to threaten red squirrel as no drey sites were recorded within the proposed scheme area. The potential impacts on this species will be assessed and reported in the EIA. Works affecting red squirrel habitat should be timed to avoid the breeding season (1st February – 30th September inclusive).
Pine Marten. Construction work is very unlikely to threaten pine marten as no den sites were recorded within the proposed scheme area. The potential impacts on this species will be assessed and reported in the EIA. Works affecting pine marten habitat should be timed to avoid the breeding season (March - June inclusive).
Badger. Although badgers have been recorded in the study area, no setts or field sign were recorded during the site visit. Construction work is very unlikely to threaten badger as no setts were recorded within the proposed scheme area. Should a badger sett be recorded within the scheme extents prior to construction works then appropriate mitigation and a licence for works will be required. Construction of new setts must be completed in Spring/Summer with blocking and destruction of existing setts completed in Autumn/early winter.
Bats. The scattered mature trees, bridges, architecture (churches, masonry) and areas of low water flow provide good foraging, roosting and commuting routes for bat species in the area. Options that require the removal of mature trees or works to bridges or other riverine structures with the potential to support roosting bats shall be assessed for bat potential. Bat surveys shall be conducted on any features with medium or high potential for roosting bats. The optimal time to conduct map surveys are May and August, when bats are most active. If bats are found, they should not be disturbed during hibernation period (October to March) or maternity period (June to August). If a bat roost requires removal, then a licence would be required. Removal of roosts should be carried out during the summer months for hibernation roosts and during the winter months for maternity roosts.

Programme Constraints
Freshwater Fish. Fish present in the river include both brook and river lamprey *(Lampetra planeri* and *L. fluviatilis*) (O'Connor, 2017), brown trout *(Salmo trutta)*, sea trout *(Salmo trutta morpha trutta)*, stone loach *(Barbatula barbatula)*, three-spined stickleback *(Gasterosteus aculeatus)* and eel *(Anguilla anguilla)*. Salmon *(Salmo salar)* have been recorded in the river's lower course. In terms of the construction programme, it should be noted that in salmonid catchments, in-stream works are not permitted between the months of January to April (migration) and October to December (spawning). This corresponds with guidance from Inland Fisheries Ireland. Lamprey (both species) spawning takes place in the spring and early summer period in often the same habitats where salmon and trout spawn. The spawning season for brown and sea trout is November to February. If spawning grounds are found to be present in the construction zone for the scheme then this period should be avoided.
White-clawed Crayfish *(Austropotamobius pallipes) Any* works carried out on the riparian habitat and banks should where possible be restricted to between July and October as this is a period when white-clawed crayfish are less sensitive, with females already having released their young and individuals being more active and not seeking refuge deep in bankside burrows as they do in winter months.
Japanese Knotweed, Himalayan balsam, and Gunnera are listed as invasive plants under the EC (Birds and Natural Habitats) Regulations 2011 (S.1. 477/2011). These regulations prohibit the introduction or dispersal of invasive species and appropriate measures should be undertaken in the proposed scheme development. Therefore, any works occurring in areas where invasive species are present must use appropriate measures.
Any in-river works will need to ensure compliance with the WFD. Co-ordination of any in-river works with the IFI and adherence to any IFI requirements.
The presence of previously un-recorded underwater archaeological artefacts may significantly slow down the construction programme.
The application for derogation licences should be applied for in advance of any works which may disrupt any protected species.
Replies to requests for further information/clarification from An Bord Pleanála.

Engineering/Design Constraints
The design of the final scheme will be subject to a number of site investigations and may change depending on the findings of these investigations.
The made ground is uncompacted and highly variable may require excavation and replacement with suitable founding material.

Legal Constraints
A 3rd party challenge to the application to An Bord Pleanála and a request for an oral hearing.
All works must comply with all national and international laws and treaties as mentioned in the relevant sections of this report as well as the environmental reports provided as appendices. Compliance with relevant European Directives (EIA Directive, Birds Directive, Habitats Directive, Water Framework Directive, etc) and the instruments transposing these into Irish Law will be required.

Screening for EIA and AA will be undertaken in line with national and international laws, and using:

- appropriate specialist topic-specific guidance.
- national and EU guidance for environmental assessment.

The outcome of these assessments will inform the requirement for further environmental assessment. It is understood on the basis of information available at the time of writing that AA/NIS and EIA will be required. An EIA Scoping Report will be prepared and submitted in Spring 2021.