

12. Aquatic Ecology and Hydrology

12.1 Introduction

This chapter provides an assessment of the likely effects/impacts of the proposed road development on both aquatic ecology and hydrology, and has been assessed by both an appropriately qualified ecologist and hydrologist. Where information is presented which is specific to hydrology, this is presented under the hydrology sub-heading.

The proposed road development passes through the catchments of the River Suir, the River Nore and the River Barrow. In doing so, the scheme crosses the River Barrow, the River Nore, and several important tributaries of these rivers.

The aquatic ecology study provides an assessment of the likely effects/impacts of the proposed road development on the aquatic ecology, fisheries and water quality of existing watercourses and associated riparian habitat. It is carried out in accordance with the European Communities (Environmental Impact Assessment) Regulations, 1989-2000⁽¹⁾ and having regard to the Environmental Protection Agency's Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002)⁽²⁾.

The sections regarding hydrology, describe the existing hydrology encountered along the proposed route and the methodology used to develop the preliminary drainage design for the scheme. These sections also assess the potential impacts of the proposed road development on the existing hydrology and flooding environments crossed by the route, and proposes measures to mitigate these potential impacts.

This chapter differentiates between the watercourses crossed by the route, and that are of particular ecological significance (especially those designated as conservation areas, and their associated areas of semi-natural habitat), and those of hydrological interest.

12.2 Methodology

12.2.1 Desk Study

A desk study was carried out to locate and collate the available information on the watercourses along the proposed road development. The National Parks and Wildlife

Services (NPWS) database of the designated conservation areas was checked with regard to their location along the proposed road development. Information on the distribution of protected species locally was sought from the scientific literature and experts.

12.2.2 Field Survey

Field surveys were carried out in June/July 2002 and May/June 2003 to identify, describe, map and evaluate watercourses along the proposed route corridor and to verify the information gathered at the desk study stage. The field survey included an assessment of the fisheries value, riparian habitats and suitable habitat for protected species, at the crossing points of watercourses.

In this report, scientific and common names for plants follow WEBB et al. (1996)⁽³⁾ and Scannell & Synnott (1987)⁽⁴⁾, respectively. Only the common names are given for mammals and birds, and these follow Hayden & Harrington (2000)⁽⁵⁾ and Hutchinson (1989)⁽⁶⁾.

12.2.3 Literature Review and Consultations

Existing records of the distribution of protected species were checked in the following literature: O'Reilly (2002)⁽⁷⁾ for salmonids, Reynolds (1998)⁽⁸⁾ for crayfish, Kurz & Costello (1999)⁽⁹⁾ for lamprey, and Moorkens (1999)⁽¹⁰⁾ for freshwater peal mussel.

The fisheries value of the main watercourses along the route was determined through consultation with the Southern Regional Fisheries Board (SRFB). Information on freshwater species that are listed for protection under Annex II of the EU Habitats Directive was also sought from the SRFB and from the NPWS. Views were sought from NPWS and the SRFB on various aspects of the road development including, the impacts of the proposed crossings on the cSAC watercourse crossings, impacts on the fauna and fisheries and the proposed mitigation measures.

12.2.4 Water Quality Sampling

The quality of water in rivers and streams is one of the main indicators of whether the watercourse is a potential suitable habitat for aquatic species. A number of water samples were collected from the majority of the watercourse crossings where possible, and from some of their feeder streams in June/July 2002 and May/June 2003. The results of these samples are described in Appendix 12.1 in Volume 3 of this EIS.

The water quality of the main watercourses crossed by the road development was assessed using the EPA's standard biological assessment technique (McGarrigle et al., 2002)⁽¹¹⁾. Macro-invertebrates were collected in a 2mm mesh hand-net by kick sampling in a suitable gravel-stone substrate for 2 minutes. Samples were then transferred to plastic buckets and preserved in 70% alcohol.

The identification of invertebrates and evaluation of water quality were undertaken using the five-point 'Q value' system summarised in Table 12.3 and is based on the sensitivity or tolerance of various groups of invertebrates to pollution.

12.2.5 Evaluation and Impact Assessment Criteria

Aquatic sites were evaluated and given an overall significance rating on the basis of the criteria outlined in Table 12.1. The impact levels on aquatic sites were rated as outlined in Table 12.2.

12.2.6 Hydrological Review

A site walkover was undertaken and the watercourses of hydrological interest were visually inspected. During the site walkover, areas of potential flooding were noted. This information was used to inform the Preliminary Design.

A preliminary drainage design for the proposed road development has been carried out to enable suitable outfalls to be identified, to determine land take requirements, and to identify likely environmental impacts.

The Office of Public Works (OPW) was consulted during the Preliminary Design stage to establish their particular requirements relating to the drainage of the new road so that the impact on the existing hydrology may be minimised. The principal requirement of the OPW is that the new road and associated drainage is designed such that it does not cause new nor exacerbate any existing flooding problems.

12.3 Existing Environment

12.3.1 General

The watercourses crossed by the proposed road development lie within the catchments of the Rivers Suir, Nore and Barrow. The proposed route crosses the following rivers and their tributaries; the Blackwater River; the Derrylackey River, the King's River; the Pococke River, the

Nore and the River Barrows. The principal watercourses are described in Table 12.4. Most of the land crossed by the route has been heavily modified by human activity and the predominant land use is agriculture.

12.3.2 Designated Conservation Areas

Designated conservation areas contain habitats or species of national or international conservation importance. The designated areas impacted or in close proximity to the route are either candidate Special Areas of Conservation (cSAC), or proposed Natural Heritage Area (pNHA).

Candidate Special Area of Conservation (cSAC)

This is a statutory designation that has legal basis in the EU Habitats Directive as transposed into Irish law through the European Communities (Natural Habitats) Regulations, 1997 (S.I. 94 of 1997). A candidate SAC is a site that has been transmitted to the EU Commission for designation but still awaits completion of the formal designation process.

Proposed Natural Heritage Area (pNHA)

This is a statutory designation that replaced the previous 'Area of Scientific Interest (ASI)', under the Wildlife (Amendment) Act, 2000. pNHAs are legally protected from damage from the date that they are formally proposed.

Ten designated areas occur within 3km of the proposed road development. These sites, identified and designated by NPWS, are considered to be of national and/or international importance for nature conservation. Table 11.3 in Chapter 11 lists the designated conservation areas that fall within 3km of the scheme. Red Bog, Dungarvan (water-dependent area) occurs within 5km of the proposed route. Some of these designated sites are watercourses and their associated habitats and are listed in Table 12.4.

The King's River, the Pococke River, a first order tributary of the Little Arrigle River, the River Nore, the Madlin River and the River Barrow are all crossed by the road development. All of these watercourses are part of the River Barrow/River Nore candidate Special Area of Conservation (cSAC).

12.3.3 Aquatic Environment

The main watercourses impacted by the route are described and evaluated on the basis of; aquatic and riparian habitats; fisheries value,

water quality and potential for annex species (Table 12.4). Other water features such as ponds and springs were also noted.

Watercourses

The proposed road development will cross 38 watercourses within Hydrometric Areas 14, 15 and 16 (McGarrigle, 2002)⁽¹¹⁾ and numerous smaller streams and drainage ditches. While the smaller streams and ditches were not surveyed in detail, observations were made during the field survey of all crossings.

Future works will be required (due to the need to establish sufficient drainage capacity at the detailed design stage) for (i) the first order tributary of the Smartcastle stream from Ballynamorahan to north of Strangsmill (ii) a first order tributary of the River Nore (KK3) from Lyrath Estate to the confluence with the River Nore (hereafter referred to as the Lyrath stream) and (iii) a field drain at Rathgarvan (from Ballynamona to Rathgarvan). As the limited works proposed will be temporary in nature (refer to section 4.4.8 of this EIS for a description of these proposed off-site drainage works), these watercourses are outside the permanent land acquisition line of the road development. The particular stretches of these watercourses that will be affected have been assessed separately (see Appendix 12.2). The findings of this assessment have been included in the following sections of this Chapter.

Springs

Three springs were found on or in close proximity to the proposed route. 2 occur within site 32, while the third is associated with site 29 (Table 11.4 in Chapter 11). Springs were located at Danganbeg wetland (site 31) and some of these are Annex I Habitat petrifying springs with tufa formation. Springs were also located at Hugginstown Fen (site 22).

Drainage Ditches

Drainage ditches commonly occur along field boundaries and can be dry/wet with stagnant or flowing water or choked with aquatic vegetation. One such example is a field drain at Rathgarvan (see Appendix 12.2) where improvement works may take place due to a drainage outfall from the road (see section 4.4.8 of this EIS for a description of the proposed off-site drainage works).

Artificial lakes and ponds (FL8)

This category is used for artificial or ornamental bodies of standing water. An artificial settlement

pond occurs at site 40 and the watercourse E10 (Table 11.4 in Chapter 11) adjacent to the settlement pond contains a lot of lime sediment.

Water Quality

The water quality of all the main watercourses crossed by the proposed road development was assessed using the EPA Biological Index (Table 12.3). This was taken into consideration when evaluating the overall ecological value of watercourses. Of the 38 watercourses, 32 were suitable for biological sampling. Only 1 (E12) had fair to good water quality, 6 (E1, E2, F2, F3, F10 and F17) had fair water quality, 10 were of doubtful to fair water quality (as was the River Nore based on EPA data from 1998), 14 were of doubtful water quality and 1 watercourse (E10) was of poor to doubtful water quality. The results of the biological analysis (providing baseline data) for all main watercourses crossed by the route are listed in Appendix 12.1. The data provides a baseline against which changes in quality can be determined.

Riparian and Aquatic Habitats

The crossing points of the 38 watercourses along the proposed route were visited during the field survey and described in terms of their riparian and aquatic habitats (Table 12.4). Some of the watercourse channels have been modified to facilitate drainage, which has generally had a damaging effect on the riverbank and riparian habitats. The King's River and the River Nore have a diverse riparian habitat (Table 12.4), as both rivers are located in wooded valleys at the crossing point of the proposed road (see also Table 11.4 in Chapter 11).

Fisheries

Of the 38 watercourses along the proposed route, 6 are designated cSACs due to the presence of salmonids; the King's River, the Pocke River, the tributary of the Little Arrigle River, the River Nore, the Madlin River and the River Barrow, with 21 other watercourses offering strong potential for salmonids (Table 12.4).

Protected Aquatic Fauna (Annex II species)

There are 8 species of fauna typically associated with watercourses that are afforded protection under the EU Habitats Directive⁽¹⁴⁾ and Annex I of the EU Birds Directive⁽¹⁵⁾ (79/209/EEC). However, all watercourses were assessed as to their suitability for protected species of fauna. The determination of presence or absence of species was based on the following:

- NPWS and the SRFB were consulted for records and a literature review was carried out for information on their distribution in the study area;
- Suitable locations at watercourse crossings for otter spraints were examined;
- Examination of otter spraints for the presence of crayfish;
- Observations for presence of dredged channel and if located, were examined for remains of crayfish;
- Observations in pools for salmonids. All areas of riffle were noted for their suitability for spawning of lamprey and salmonids; and
- River banks were examined for the presence of suitable nesting locations for Kingfisher.

The following species were considered in particular:

Atlantic salmon (*Salmo salar*): when in freshwater is an Annex II listed species under the Habitats Directive. The River Nore is a designated salmonid river under the EU 1978 Freshwater Fish Directive in addition to being a cSAC. All other rivers crossed by the road development that are part of the River Barrow/River Nore cSAC have salmon listed as the qualifying interest.

Otter (*Lutra lutra*): All watercourses along the proposed route that support fish populations are likely to support otters. The Otter is a legally protected species under the EU Habitats Directive (listed in Annex II) and is found throughout Ireland (Hayden and Harrington, 2000)(5). Otters tend to occupy linear territories along watercourses and are rarely found far away from water.

White-clawed crayfish (*Austropotamobius pallipes*): are generally considered to be widespread in lowland lakes and rivers that are underlain by carboniferous limestone or its derivative glacial drift (Reynolds, 1998)(8). They prefer a firm substrate, moderate productivity levels and hard water with a pH of 7 or above. The River Nore and the River Barrow are known to support crayfish though no signs of this protected species were observed during the watercourse assessment. It is also likely that they occur in some of the tributaries of these rivers.

Irish freshwater pearl mussel (*Margaritifera margaritifera*): is an endemic species protected under the Convention on the Conservation of

European Wildlife and Natural Habitats (Berne Convention) and listed under Annex II and Annex V of the Habitats Directive. It is known to occur in the River Barrow and the River Nore (Moorkens, 1999)⁽¹⁰⁾. The closest record along the River Barrow however, is approximately 25km downstream of the proposed crossing. There are no documented records of pearl mussel in the tributaries of the River Barrow crossed by this route. There are no other records of this species from the area (Moorkens, 1999)⁽¹⁰⁾. No signs of mussel presence were observed during the watercourse assessment.

There are no known records of *Margaritifera durrovensis* along the stretch of the River Nore affected by the road development.

Lamprey Sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*) and river lamprey (*Lampetra flaviatilis*) are known to spawn in the main channel of the River Barrow downstream from Borris (Kurz & Costello 1999)⁽⁹⁾. Brook lamprey is known to occur throughout the Barrow catchment. Sea and brook lamprey are known to be common in the River Nore catchment, however the sea lamprey is usually confined to the lower reaches of the Nore south of Thomastown (Kurz & Costello 1999)⁽⁹⁾. There are records of unspecified species of lamprey from the River Suir catchment. The sea and river lamprey are typically confined to the lower reaches of the rivers and are unlikely to occur in the study area. The brook lamprey however, is common and widespread in Ireland and is likely to occur in most of the watercourses crossed by the proposed route.

Kingfisher (*Akedo atthis*): requires steep to overhanging banks that are at least one metre tall, in which to nest. Habitat conditions do not appear to be suitable for nesting along the stretches of watercourses being crossed. A Kingfisher was noted in flight on the River Barrow during the field survey. They are likely to occur on all watercourses that support fish populations along the proposed route.

12.3.4 Watercourse Ecological Evaluation

All watercourses crossed by the proposed route were evaluated on the basis of their in-stream (aquatic) and riparian habitats, fisheries value, presence of Annex II species and water quality (Table 12.4). Of the 39 watercourses crossed by the route, six are of international importance, two are of national importance, 16 are of high local value and the remaining 15 are of moderate local ecological value. The evaluation of watercourses

for each section of the proposed route are summarised below and specific evaluations are presented in Table 12.4.

The ecological evaluations of the Smartcastle tributary, Lyrath stream and Rathagarvan field ditch have been highlighted in Appendix 12.2, and outlined below.

Waterford to King's River

There are 9 main crossings of watercourses along this section of the route. The first order tributary of the Little Arrigle River is a cSAC on account of its importance for salmonids and hence is of international importance. There are seven watercourses of high local ecological value, while the remaining smaller tributary stream is rated as being of moderate local ecological value as contains some suitable spawning habitat for salmonids.

The lower reaches of the Smartcastle tributary contain some suitable spawning habitat for salmonids and valuable established bank side vegetation.

King's River to Ballyquirke (including the Kilkenny link)

There are 11 main crossings of watercourses along this section of the route. The King's River, the Pockocke River and the River Nore are of internationally important ecological value as they support significant populations of salmon as well as a number of protected species. The Gowran River is of national importance and it is a major trout river. Two watercourses are of high local ecological value while the remaining five are of moderate local ecological value.

The majority of the Lyrath stream contains valuable established bank side vegetation and the lower reaches contain some suitable spawning habitat for salmonids, whereas the Rathagarvan field drain has limited value.

Ballyquirke to Powerstown

Within this section of the road development, the proposed route crosses 19 watercourses, two of which (the Madlin and the Barrow) are designated cSACs (see Section 12.5.3). Of the 19 watercourses impacted by the route, two are of international importance, one is of national importance, seven are of high local value and nine are of moderate value.

12.3.5 Existing Hydrological Setting

The proposed route crosses 52 watercourses of greatly varying size and environmental significance (Table 12.6). This is a different

number as to that referred to in the Aquatic Ecology text as the aquatic ecology text considers watercourses of ecological value, whereas the hydrology text considers watercourses based on flow, rather than ecological importance.

Six of the 52 watercourses lie within Hydrometric Area 16 (River Suir) and include the main channel of the Derrylackey River and several unnamed tributaries of the River Blackwater. A further 14 watercourses, comprising the greater part of the proposed route, lie within Hydrometric Area 15 (River Nore) and include the main channels and both named and unnamed tributaries of the River Nore, King's River and Pockocke River. The final 32 watercourses fall into Hydrometric Area 14 (River Barrow) and include the Monefelim and the Madlin Rivers and many other unnamed tributaries of the River Barrow. The main channel of the River Barrow is also crossed.

For the greater part, the proposed route of both the mainline and Kilkenny link crosses open farmland. To the southern end of the route, farm units tend to be smaller and engaged in stock rearing with much of the farmland put down to grazing pasture. From the King's River northwards, the farm units increase in size and stock farming gives way to more intensive arable tillage as the quality of the farmland improves. The agricultural nature of the land use has led to the gradual local modification of existing drainage patterns over the years through local, and sometimes farm unit specific, land drainage improvement schemes. This is particularly prevalent in the arable farming region around Kilkenny.

There is anecdotal evidence that flooding of farmland occurs in the vicinity of Ballykeaghan/Ballykillaboy and also in the vicinity of the tributary of the Little Arrigle River at Knocktopher.

For the majority of the proposed route crossing open farmland, future urban development pressures are considered to be very low. The only exception to this is the initial section of the Kilkenny link where land at Blanchfieldsland and Hebron House is included in the Kilkenny Area Development Plan and zoned for future commercial development. The only watercourse crossing that is considered to be exposed to potentially greater flows as a consequence of future urban development is the River Nore.

12.4 Predicted Impacts

12.4.1 General Impacts on Aquatic Ecology

Impacts from the route, when operational, would mainly be concerned with runoff of storm water from the road surface (with potential silt and hydrocarbon contamination) and the possibility of accidental spillages on the road that may subsequently enter watercourses and groundwater.

Various activities during the construction of the road development could also impact on water quality. Potential impacts can arise from the civil works necessary to bridge the watercourses, the installation of culverts for the smaller streams and ditches beneath the route, the diversion of existing watercourses, the construction of the earthworks embankments and cuttings, and from site facilities.

The most common and serious impacts arise from:

- interference with fish migration;
- interference with mammal movement;
- loss of aquatic and riparian habitat; and
- harmful discharges during construction and operation.

12.4.2 Predicted Impacts on Designated Conservation Areas

The proposed road development crosses the Pocke River, a first order tributary of the Little Arrigle River, the Madlin River, the King's River, the River Nore and the River Barrow, all of which are part of the River Barrow/River Nore cSAC. The cSAC designation relates to, primarily the river channel and the protection of the aquatic Annex II species that it contains. Impacts on associated riparian habitats have been considered in detail in Chapter 11 of this EIS.

Any impact on a cSAC potentially results in a severe negative impact. However, the bridge designs proposed do not impact on the river channels and provided there are no indirect impacts to the river in relation to surface run-off etc., the integrity of the river cSACs will be maintained (see Table 12.5).

12.4.3 Impacts on Aquatic Fauna

The proposed development will have negative impacts on certain watercourses crossed by the route. The impacts may be permanent depending on the type of crossing used. There

may also be the loss or permanent alteration of aquatic and/or riparian habitat if culverts or bridges are used with the potential result of obstruction to the movement of fish, mammals, invertebrates, birds and bats along these watercourses. Any negative impacts on watercourses and fisheries, as a result of the proposed development, will have knock-on effects for the aquatic fauna.

12.4.4 Specific Impacts on Aquatic Ecology

The operational impacts on each of the rivers/streams of ecological value along the proposed route are outlined in Table 12.5. Of the 39 watercourses, 6 are subject to a severe negative impact, 2 are subject to a major negative impact, 19 are subject to moderate negative impacts and 12 are subject to minor negative impacts.

The impacts of the proposed road development, in terms of its construction and operational phases, on the water quality and aquatic ecology value of the local watercourses are discussed below. Although the existing quality of each main watercourse varies from poor to doubtful in some streams, to fair to good in other streams, it is important that drainage from the proposed route does not cause any further deterioration in quality.

Construction Phase

There will be temporary negative impacts at all crossing points of watercourses at this stage, as culverts are put in place, as new channels are created and as watercourses are directed into re-aligned channels. Impacts include; risk of pollution and siltation and loss and/or disturbance of riparian and in-stream habitat. The risk is greater where spawning areas are within 1km downstream of the crossing. Any impacts will have knock-on effects for local fish and lamprey populations, their spawning habitats and for aquatic invertebrates and plants.

The proposed drainage works to (i) the first order tributary of the Smartcastle stream, (ii) Lyrath stream and (iii) a field drain at Rathgarvan are dealt with in Appendix 12.2 as they are outside the permanent land acquisition line for the road development. As the works will avoid impacting on trees and woody vegetation and will not radically alter the profile of the watercourses, this will constitute a temporary negative residual impact.

The main potential contaminant during the construction phase will be suspended solids. The risk associated with siltation is greater

during the salmonid spawning period – this equates to the annual closed season, when eggs are buried in gravel substrate and are highly susceptible to reduced oxygen levels associated with the deposition of silt.

A variety of construction materials and chemical substances are likely to be used in the works, and these have various polluting potentials if spilled adjacent to or into a watercourse.

Operational Phase

The main impact will be an increase in both the volume and rate of surface water discharge into the local watercourses. This will occur due to the existence of new impermeable surfaces, which are connected to drains discharging to the watercourses.

In temperate climates such as Ireland, the run-off from roads in non-urban areas does not normally cause significant pollution of receiving watercourses. This is due to the frequency of rainfall, which has the effect of frequent cleansing of road surfaces. It is expected that following a prolonged dry period, the first significant run-off from the road surface will contain elevated levels of contaminants, especially particulate matter. This is recognised by the Department of Communications, Marine and Natural Resources in their booklet (1998) entitled *Fishery Guidelines for Local Authority Works*⁽¹²⁾. In such cases, local contamination of the receiving watercourse could occur. Without adequate mitigation and due to the time delay between actual discharge and the increase in flow of the receiving water, the water quality in these circumstances may deteriorate until the flow increases.

The use of grit and salt on roads during icy weather conditions is a long established practice. The grit is of such a high density that it readily settles in grit traps and the particle size is large enough to be effectively removed by filter drains. Filters or traps on the drainage systems will not significantly reduce the salt, as it is a soluble substance. However, the time of year when salt is used generally coincides with good watercourse flows and consequently the concentrations of sodium chloride may be substantially diluted.

Spillage containment facilities (as outlined in section 4.4 of this EIS) will ensure that accidental spillages on the road surface can be intercepted in advance of receiving watercourses.

Waterford to King's River

The impacts on each watercourse along the proposed route within this section are outlined in Table 12.5. Of the nine watercourses, one is subject to a severe negative impact and eight are subject to a moderate negative impact.

King's River to Ballyquirke

The impacts on each watercourse along the proposed route within this section are outlined in Table 12.5. Of the 11 watercourses, three are subject to a severe negative impact, one is subject to a major negative impact, two are subject to a moderate negative impact and five are subject to a minor negative impact.

Ballyquirke to Powerstown

The impacts on each watercourse along the proposed route within this section are outlined in Table 12.5. Of the 19 watercourses, two are subject to a severe negative impact, one is subject to a major negative impact, nine are subject to a moderate negative impact, seven are subject to a minor negative impact.

12.4.5 Hydrology and Flood Risk Potential

Other potential impacts include downstream flooding due to the increased rate and volume of surface water run-off. The proposed road will generally contribute a relatively small proportion of the flow to the receiving watercourses compared with the contribution from the adjacent land. The principal difference is that flows originating from the proposed road will enter the watercourse more quickly than under the present greenfield run-off conditions. The flood risk potential has been assessed for each of the receiving watercourses and mitigation measures are outlined in Section 12.5 where significant impacts are anticipated.

12.5 Mitigation Measures

12.5.1 General Mitigation Measures (Aquatic Ecology)

The impact of road works on natural watercourses can be minimised by applying sound design principles and by following good work practice. The most common and serious impacts arise from:

- Interference with fish migration;
- Interference with mammal movement;
- Loss of aquatic and riparian habitat; and

- Harmful discharges during construction and operation.

Outlined below are the general remedial or reductive measures that are envisaged and recommended to avoid, reduce and, where possible, remedy the predicted impacts of the proposed road development on aquatic ecology and water quality. These measures compliment the measures recommended in Chapter 11, for the protection of terrestrial ecology.

The following seasonal constraints and remedial measures are aimed at reducing the impact of the road development and construction works on the general ecology of affected watercourses. All works will be conducted in consultation with the SRFB and NPWS.

For watercourses that contain salmonids, no works will be permitted during the annual closed season as defined in section 131 of the Fisheries (Consolidation) Act (1959). The SRFB have outlined the closed season for this region as the period October to June inclusive. However, it will be noted that section 173 of the Act recognises that local circumstance may require protection beyond this period – up to the development of ova and development of the juvenile fish. There may also be a requirement for the protection of seaward passage of smolts. These matters will be agreed in consultation with the SRFB.

Further restrictions may also apply in the case of watercourses containing significant populations of other species including lamprey, coarse fish, freshwater pearl mussel and freshwater crayfish.

If breeding birds are present in the riparian or bankside vegetation, where feasible, no works will be conducted during the months of March to August inclusive (Wildlife Amendment Act 2000).

If necessary, to address the above seasonal constraints, advanced site clearance contracts will be put in place. This will ensure no disturbance will take place at sensitive sites during the restricted periods.

No dumping of soils will be allowed during the construction phase in the following areas:

- Hugginstown Fen cSAC;
- King's River cSAC;
- Pockocke River cSAC;
- Little Arrigle tributary cSAC;
- River Nore cSAC;
- Madlin River cSAC;

- River Barrow cSAC; and
- Danganbeg Wetland.

The extent of each of these areas in the vicinity of the scheme is shown on Figures 11.2 to 11.52 of this EIS.

12.5.2 General Mitigation Measures (Hydrology)

Existing overland flows, which may be impeded by the road development, will be intercepted and conveyed across the road corridor by appropriate cross drainage provision or where necessary, collected and discharged to a suitable outfall.

Where it is not possible to maintain existing drainage flow paths, it will be necessary to provide infiltration basins where the underlying ground conditions permit, or divert these surface water drainage flows into the road drainage system.

Road drainage will be provided for the mainline and some sections of realigned side roads. This drainage will discharge to existing watercourses. At some remote locations, where positive drainage connections for side road drainage are not practicable, surface water flows will discharge 'over-the-edge'.

Where a known flooding problem or risk to residential property currently exists, then mitigation in the form of discharge flow attenuation will be provided. The attenuated discharge to the receiving watercourse will be restricted to the equivalent greenfield run-off rate for the original contributing catchment.

12.5.3 Specific Ecological Mitigation Measures in Designated Areas

The design of the proposed N9/N10 route crossings of each watercourse has aimed to minimise the impacts on a first order tributary of the Little Arrigle River, the King's River, the Pockocke River, the River Nore, the Madlin River and the River Barrow, all of which are part of the River Barrow/River Nore cSAC (Table 12.5 and section 12.5.3 for details of mitigation measures). While an access track will be required between the bank and the abutment at the Madlin River, this track will maintain a sufficient set-back from the river edge and will be constructed with hardcore surface.

Clear span bridges or viaducts, which will avoid direct impact on the river channels, reduce the impact on riparian habitats and fulfil the requirements outlined in mitigation measures for

watercourses, are required (Table 12.5). The bridge design will minimise the impact on these sites. Compensatory planting is proposed in the vicinity of these areas to facilitate the restoration of impacted habitats within the cSAC lands. All lands proposed for compensatory planting at the cSAC watercourse crossings will be permanently acquired. This will allow more control of the restorations of these areas.

A sufficient set-back will be maintained for the extent of the bridge works to ensure the riparian habitat of significant ecological value is maintained. All these watercourses will be fenced off at the outset, prior to construction, to minimise disturbance.

There will be no fording of these designated watercourses.

Measures will be taken within the fenceline to divert construction site run-off waters into siltation ponds, to prevent direct discharge of this run-off into the rivers. Drainage outfalls will be constructed in advance of the main construction works, where possible, in order to facilitate the release of water that goes through settlement ponds during construction.

Any balance ponds proposed within the designated conservation areas at the Madlin River and the first order tributary of the Little Arrigle River will not impact on the qualifying interest of the cSAC and will conform to the highest level of design specifications to replicate a semi-natural water body. The existing field boundaries in close proximity to the proposed balance ponds will be retained. The design of balance ponds will be carried out in consultation with the NPWS.

The design of any drainage outfall in the cSAC, will be such that it does not impact on the integrity of the cSAC and will be dealt with at the detailed design stage. This may involve specialist ecological surveys and design, as appropriate. These works will be designed to promote recolonisation and avoid any downstream impacts, and will be agreed in consultation with the SRFB and NPWS. All pollution prevention measures as outlined in section 12.5.6 will be implemented.

12.5.4 Design Issues (outside Designated Areas)

Bridge and Culvert Design

All bridges and culverts will be designed in consultation with the SRFB and will permit the

passage of fish under all but extreme flow conditions.

Clear spanning bridges or open-bottomed culverts (which are sized to allow the retention of river banks) will be constructed over the two first order tributaries of the River Blackwater (C1 and C2), the Derrylackey River (E1) the Monefelim River (FW2), a first order tributary of the Monefelim River (FW3), the Gowran River (E12), and a first order tributary of the River Barrow (FW15), in addition to the designated watercourses, as listed in Section 12.5.3. The bridge abutments will be set back a sufficient distance to encourage the riparian habitat of significant ecological value to re-establish.

Bank stabilisation, erosion protection and drainage outfalls, if required, for these non-designated watercourse crossings, will be designed in consultation with the SRFB and NPWS at the detailed design stage. All such works will be carried out outside the closed season and depending on the proximity of lamprey spawning, there may be additional seasonal constraints. If ammocete nursery beds are present in the vicinity, salvage may be required. These works will be designed to promote recolonisation of a natural bankside vegetation and avoid any downstream impacts.

If pitching of the bed is essential, it will be laid at the natural grade and level. Raised aprons will be avoided if possible. If one has to be used, a fish-pass will be incorporated. If "hard abutments" are used, they will be of minimum length and will be designed to cater for the passage of mammals.

Where bridging is not an economic option and culverts are required, their length will be kept to a minimum by running them square on to the line of the road wherever possible. This may result in some stream realignment.

Use will be made where required of open-bottomed type culverts, leaving the stream-bed undisturbed and maintaining some natural bank on both sides to allow for the passage of mammals.

Where box culverts are adopted, the design will allow for the maintenance of a minimum depth of water in the culvert. On all watercourses where mammal passage has been identified as a requirement, provision for access will be provided by a mammal ledge, dedicated culvert or similar means.

The following general principles will be adopted for the detailed design of drainage culverts;

- a) The culvert will be set below bed-level.
- b) Culvert width will approximate to that of the natural channels, the use of multiple units of lesser width is not recommended.
- (c) Where possible, the culvert will be laid at a level and grade that allows the upstream invert to remain drowned (by back-watering) under low-flow conditions (e.g. 100mm for trout, 150mm for salmon).
- (d) If the gradient is too steep, the drowning effect will ideally be met by way of a fish pass at the downstream end of the culvert.
- (e) If a culvert has to be laid at a steep gradient, special provision must be made to allow fish to swim upstream without undue effort.
- (f) Pools will be formed at each end of the culvert to provide for transition from the shape of the slope to the shape of the bed. They will be built in masonry or concrete, and designed to provide take-off conditions for upstream migrants entering and leaving the culvert. The downstream pool will be designed to act as a stilling-chamber that will prevent erosion of the banks below and provide quiescent take-off conditions for fish.
- (g) Culvert length will be kept to a minimum, where possible, by running them square-on to the line of the road and by setting the end walls as far as practical into the embankment. This may require localized realignment of stream channels, which should be carried out in accordance with the requirements of the SRFB.
- (h) Concrete will not be used for preventing erosion of stream-beds and banks where a more environmentally friendly option is available e.g. natural bank protection techniques such as willow-fagotting, stone armour, logs, conifer tops or composite protection using products such as coir-matting or geoweb with appropriate planting (reeds, willow, etc). Where concrete is used, it must be sufficiently back-watered at all times to accommodate fish movement.

Mammal Passage

Provision has been made for the passage of mammals across the scheme at specific locations. Table 11.6 (see Chapter 11) provides a list of indicative locations for mammal passes along the proposed route, which have been included in the road development. In addition to the dedicated mammal passage facilities listed in Table 11.6, provision for the passage of mammals will be incorporated into all watercourse crossings of high ecological value (C sites or greater).

Pollution Prevention

Storm run-off from the proposed road to watercourses of fisheries value will be fed through pollution control measures that will be designed with adequate storage capacity and in a manner to facilitate maintenance and cleaning. Sediment traps will also be provided.

Design of balance ponds (flood attenuation areas)

The primary engineering function of a balance pond is to attenuate surface run-off. However, a balance pond can have a number of other potential benefits, such as bio-filtration, sediment traps, spill contaminant facilitation and wetland compensatory habitat.

The design of a balance pond will aim to replicate a natural wetland habitat. Attention will therefore be given at the detailed design stage in relation to size and shape, water depth, supply and quality and general landscaping. The design of balance ponds will be agreed in consultation with the NPWS. Any balance ponds proposed within designated areas will conform to the highest level of design specifications to replicate a semi-natural water body. The existing field boundaries in close proximity to the proposed balance ponds will be retained.

Watercourse Diversions and In-stream Works

Diversions of watercourses will be designed to replicate a natural watercourse system, incorporating meanders, riparian vegetation and other features of a natural watercourse.

New channels will be sinuous and meandering rather than uniformly straight. The constant erosion and deposition within a sinuous channel results in the formation of riffle, glide and pool conditions. The degree of sinuosity within the channel depends on the space available and will be designed according to the prevailing conditions. Incorporating stone deflectors, v-notch weirs and other appropriate features can

develop riffle, glide and pool conditions, within straight channel cuttings.

Temporary stream diversions will be made on geotextile surfaces with a surface layer of coarse aggregate to hold it in place. The outline approach for permanent watercourse diversions will be agreed in consultation with the SRFB and the NPWS, in addition to the detailed design and construction methodology.

12.5.5 Construction Phase (Aquatic Ecology)

General

Bunds, siltation ponds, hydrocarbon and grit interceptors will be put in place, as appropriate, to control pollution and run-off.

Pollution Prevention

A wide variety of specialty chemical substances are used in modern construction. Generally these are used in small quantities and the materials are normally stored in secured site huts or sheds. It is also normal to store diesel fuel for construction equipment on site. Oil storage tank(s) and the associated filling area and distribution pipe work should be at least 10 m distant from surface water courses (rivers, streams, field drains) and 50m from wells or boreholes. Storage tanks should have secondary containment (110% capacity) provided by means of an above ground bund to capture any oil leakage irrespective of whether it arises from leakage of the tank itself or from associated equipment such as filling and off-take points, sighting gauges etc., all of which should be located within the bund. Bund specification should conform to the current best practice for oil storage.

Adequate protection measures will be put in place to ensure that all hydrocarbons and other chemicals used during the construction phase are appropriately handled, stored (no storage of hydrocarbons or any toxic chemicals will occur within 50m of a watercourse) and disposed of in accordance with recognised standards. Re-fuelling of plant will not occur within 50m of any watercourse.

Concrete (including waste and wash-down water) will be contained and managed appropriately to prevent pollution of all watercourses. Pouring of concrete for aprons, sills, and other works will be carried out in the dry and allowed to cure for 48 hours before re-flooding. Pumped or tremied concrete will be monitored carefully to ensure no accidental

discharge. Mixer washings and excess concrete will not be discharged to water.

The contractors' site compounds will be equipped with temporary toilet facilities, and the contractor will be responsible for their servicing and maintenance. Foul drainage from the offices and other construction facilities will be contained and disposed of in an appropriate manner to prevent pollution of all watercourses. There will be no discharge from these facilities to the local environment.

During the construction phase periodic monitoring of water quality in the vicinity of works will be carried out to ensure that there are no unauthorised discharges and to ensure the effectiveness of procedures designed to prevent pollution.

Siltation and Suspended Solids

Techniques for the control of suspended solids are well established (e.g., interceptors and traps) and the management of this forms part of the overall project management for the development. The contract documents will specify the necessity for the contractor to take all reasonable precautions to prevent silt laden water from discharging directly to watercourses.

Siltation of water bodies will be minimised by the appropriate use of settlement ponds, silt traps and bunds and by avoiding operating within water bodies where feasible. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.

All watercourses that occur in areas of land to be used for accommodation works or storage depots will be fenced off at a distance of at least 10m to avoid any direct impacts.

Bankside vegetation will be left intact where feasible by erecting fencing prior to the commencement of any site works. Where possible the fence will be set at a minimum distance of 2m from the bank of the watercourse or at the edge of the woody canopy (whichever is greater).

If temporary or permanent diversion of the watercourse is required, this will be carried out prior to the removal of bankside vegetation.

Watercourse Diversions and In-stream Works

Typical measures for control at river bank-sides include installation of cofferdams so that the river flows around the outside leaving the interior, that is, the works area, dry. As an alternative, the channel will be diverted around the works area

leaving the latter dry. Such works will preferentially be done during the dry period of the year when flows are low and the risk of suspended solids release is minimal.

A number of the smaller streams may be slightly realigned to pass under the road through culverts. In most cases the culvert will be made in pre-cast sections that can be lowered into the existing channel with minimal disturbance. However, in some cases it may be necessary to construct the culvert beside the existing channel and then connect the upstream end to the channel, while in other cases it might be more appropriate to divert the existing channel slightly 'off-line' and construct the culvert in the dry channel bed.

In-stream works will not be carried out in watercourses frequented by salmon or trout during the Annual Close Season, duration of the season varies regionally, but the SRFB have been consulted on the timing and have indicated that October to June inclusive is the closed season in this region. Further restrictions may also apply in the case of watercourses containing significant populations of other species including lamprey, coarse fish, freshwater pearl mussel and freshwater crayfish.

In-stream containment and dewatering operations may facilitate operation within closed periods. All dewatering flow will be passed through settlement ponds or tanks to remove sediments and will be preceded by a fish salvage operation carried out by, or on behalf of the SRFB.

Where suitable spawning gravels occur within a watercourse at the site of a proposed crossing, these gravels will be removed and stored for reinstatement on completion of the works, in accordance with the requirements of the SRFB.

Watercourse diversions will be carried out in the dry and in isolation from the existing watercourse. The compensatory diversion channel will be designed in detail and to the satisfaction of the statutory bodies. This will involve the grading of the riverbanks to an acceptable slope, the construction of a sinuous channel and the incorporation of suitable substrates.

Where natural bankside vegetation is to be removed, machinery will operate from the bank and pull the vegetation back from the edge of the watercourse. If temporary or permanent diversion of the watercourse is required, this will be carried out prior to the removal of bankside vegetation. Where permanent diversion is taking

place, existing vegetation will be removed in sods for replanting on the new river banks.

Replanting or rehabilitation of banksides will be undertaken following sensitive grading of the banks to replicate a natural topography (slopes will not be greater than 1:2). Planting will be conducted using native species and will follow a natural zonation that is appropriate to the river profile. Temporary deer proof fencing will be erected to protect newly planted areas if required.

Transplanting of bankside vegetation will be conducted in the dormant season, but where restrictions are in place due to the presence of salmonids, transplanting will be carried out during the period August to November.

Once the construction is completed and establishment of vegetation has commenced, the connection to the existing watercourse can be made. This will only occur within the approved operational window for in-stream works. The salvage of fish from the section of watercourse to be abandoned will be undertaken by or on behalf of the SRFB. These watercourses will be surveyed for the presence of protected species and salvaged under licence from the NPWS.

Operation of machinery in-stream will be kept to an absolute minimum. All construction machinery operating in-stream will be mechanically sound to avoid leaks of oils, hydraulic fluid, etc. Machinery will be steam-cleaned and checked prior to commencement of in-stream works.

Fording of watercourses to gain access to the opposite bank will only be considered where no alternative option exists and under approval of the SRFB. Where required, access will be restricted to one crossing point and traffic limited. In-stream and bankside preparation and rehabilitation will be required.

Specific measures in addition to those outlined in this section apply to the proposed drainage works on (i) the first order tributary of the Smartcastle stream, (ii) Lyrath stream and (iii) a field drain at Rathgarvan, and these are dealt with in Appendix 12.2.

12.5.6 Operation Phase (Aquatic Ecology)

The main consequence of the proposed route on the watercourses will be additional volumes of water from the storm water drainage. The road drainage design has assessed the discharge flows from the road drainage against the flows in the natural streams. At drainage outfalls where it

has been identified that there would be a potentially increased risk of flooding in the receiving water, attenuation measures have been included in the design to reduce the discharge to approximately that of the natural catchment, i.e. the greenfield run-off rate.

Pollution Prevention

All surface water run-off from the new road to watercourses of fisheries value will be directed through pollution control measures. The pollution control measures will be designed with adequate storage capacity and in a manner to facilitate maintenance and cleaning.

The proposed drainage systems will ensure that the release of particulate matter (mainly grit, dust and grass clippings where grass is planted) to watercourses will be minimal and consequently there will be no significant adverse impact on surface and groundwater chemical quality. This is particularly important in the case of drainage from the road surfaces following a dry spell. As noted above, the levels of particulate matter in the run-off are likely to be elevated at such times when compared with levels during average rainfall periods. Consequently a drainage system incorporating a means of reducing the level of particulate matter discharged is essential.

Accidental spill containment will be included in the pollution control measures.

The outfall for each drainage discharge pipe will be specifically designed to ensure that scouring of either the bottom or the banks of the receiving watercourse will be minimal.

Waterford to King's River - Remedial or Reductive Measures

While the general remedial or reductive measures for watercourses outlined above apply to the watercourses in this section, the more specific, remedial or reductive measures are outlined in Table 12.5.

The realignment of the second order tributary at Knocktopher junction (E5) is a short-term impact as this stretch of river will be re-established as a watercourse with natural features. The current condition along this stretch is of low ecological value due to siltation and the absence of a variable flow regime. The realignment will improve the flow regime of this stretch of watercourse by incorporating the measures outlined above for stream diversions.

King's River to Ballyquirke – Remedial or Reductive Measure

While the general remedial or reductive measures for watercourses outlined above apply to the watercourses in this section, the more specific remedial or reductive measures are outlined in Table 12.5.

Ballyquirke to Powerstown – Remedial or Reductive Measures

While the general remedial or reductive measures for watercourses outlined above apply to the watercourses in this section, the more specific remedial or reductive measures are outlined in Table 12.5.

12.6 Residual Impacts

12.6.1 Aquatic Ecology

As part of the construction contract, the contractor will be required to put in place sound environmental protection procedure prior to the commencement of work on site, including all the mitigation measures outlined in Section 12.5. Provided good working practices are adopted during the construction of the works, there will be no significant residual impact on water quality.

All works in the vicinity of rivers and streams will be designed in consultation with SRFB and the NPWS.

Storm water run-off from the proposed road to watercourses of fisheries value will be fed through pollution control measures that will be designed with adequate storage capacity and in a manner to facilitate maintenance and cleaning. The installation of these measures will largely mitigate any impacts on water quality.

The proposed drainage system will delay the release of surface drainage water and prevent any associated contaminants from entering the adjacent watercourse following any chemical or related spillages resulting from traffic accidents and/or accidental spillages. This will afford an opportunity for the road maintenance authority and the emergency services to assess the nature of the hazard and to determine the most appropriate response. The standard procedure where possible will be to contain the material and collect it. In the case of solid materials this is usually feasible. For a liquid chemical spillage that has entered the drainage system it could be decided that the best response would be to remove all material including soil from the affected part of the drain and transport it to a

specialist remediation facility for decontamination.

The impacts on each of the rivers/streams of ecological value post remedial or reductive measures are outlined in Table 12.5. Of the 39 watercourse crossings, 15 are subject to moderate negative residual impact, 13 are subject to minor negative residual impact and the 11 remaining have no significant impacts.

Designated Conservation Areas

The residual impact assessment assumes that there will be no direct or indirect impact on the designated watercourses and that every possible mitigation measure will be employed to minimise the risk. This will require the implementation of all measures as stated in Section 12.5 and the specific mitigation measures as outlined in Table 12.5. However, there will be some direct impacts on the associated riparian habitat. This is dealt with in Chapter 11.

When a roadway crosses a cSAC, whose qualifying interest is the watercourse, there is an inherent risk associated with it which, despite all the proposed mitigation, still exists. These risks are minimised through the design and standards with which the roadway is constructed, but it cannot be ruled out entirely. Any permanent negative impact on a watercourse that is a designated cSAC, is severe. Any temporary or short-term localised impact on a designated watercourse constitutes a major negative impact.

The proposed clear span crossings over the watercourses within the River Barrow/River Nore cSAC have been selected to avoid any direct impacts on the river channel thus protecting the qualifying interest of the cSAC. Where all reasonable mitigation measures are taken to prevent any indirect impacts on the qualifying interests of the cSAC, the proposed project will not adversely affect the integrity of the site and hence the resultant residual impact is not significant (Table 12.2).

Waterford to King's River - Residual Impacts

The residual impacts on each watercourse along the proposed route within this section are outlined in Table 12.5. Of the nine watercourses impacted, six are subject to a moderate negative residual impact, one is subject to a minor negative residual impact and two will have no significant residual impact.

King's River to Ballyquirke – Residual Impacts

The residual impacts on each watercourse along the proposed route within this section are outlined in Table 12.5. Of the 11 watercourses impacted, two are subject to a moderate negative residual impact, five are subject to a minor negative residual impact and the impacts on the four remaining are not significant.

Ballyquirke to Powerstown – Residual Impacts

The residual impacts on each watercourse along the proposed route within this section are outlined in Table 12.5. Of the 19 watercourses impacted, seven are subject to a moderate negative residual impact, seven are subject to a minor negative residual impact and the impacts on the five remaining are not significant.

12.6.2 Hydrology

Through the provision of a hydraulically adequate road surface water drainage network, appropriate cross drainage and attenuation at appropriate points of discharge points, no adverse residual impacts are anticipated on the existing hydrological setting.

12.7 Limitations, Assumptions and Difficulties Encountered

No additional limitations, assumptions or difficulties were encountered, further to those outlined in Section 12.2.

12.8 References

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- (15) European Union 'Birds Directive' (1979) Council Directive 79/209/EEC of 2 April 1979 on the conservation of wild birds.
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Table 12.1 Natura Evaluation of Watercourses

Watercourses are evaluated on the basis of a number of characteristics and features as outlined below. The characteristics are defined as follows:

- Riparian habitat on a watercourse refers to the associated vegetation or habitats that are generally particular to rivers, such as fringing wet woodland, floodplain and oxbow lakes.
- Aquatic habitat refers to the in-water conditions of any watercourse, including substratum, that are typically associated with un-modified river and stream channels, including riffles, glides and pools.
- The fisheries value of a watercourse refers to its suitability for fish, primarily salmonids (salmon, sea-trout and brown trout), and to the associated value for recreational angling purposes.
- Annex II species are those that are listed for, or legally protected under the Habitats Directive (92/43/EEC).
- Annex I habitats are those that are listed for, or legally protected under the Habitats Directive, including Priority Habitats.
- The evaluation of water quality uses a five-point system (Q value) based on the presence and relative abundance of various invertebrates using the Environmental Protection Agency's (EPA) standard technique (Lucey et al., 1999). Q5 equates to pristine conditions while Q1 equates to gross pollution.

Rating	Riparian habitat	Aquatic habitat	Fisheries value	Annex II species Annex I habitat	Water quality
A	Designated SAC/SPA	Designated SAC/SPA	Designated Salmonid Water		
B	Designated NHA. Containing species listed under Flora Order. Annex I habitats.	Designated NHA. Containing species listed under Flora Order. Annex I habitats.	Significant populations of breeding salmonids.	Significant spawning or resident populations. Significant area of Annex I habitat.	
C	Poor examples of Annex I habitats Semi-natural habitats	Poor examples of Annex I habitats Semi-natural habitats	Containing some resident salmonids or good stocks coarse species	Limited spawning or resident populations. Limited area of Annex I habitat.	Q5 or Q4/5
D	Some semi-natural habitat limited in size	Some semi-natural habitat limited in size	Contains some fish species	Headwater or tributary of watercourse with Annex II species.	Q4
E	Artificial or highly modified	Artificial or highly modified	No significant populations any species fish		Q3 or less
F	Sites that have not been adequately assessed but may contain habitat or species of note.				

*Note: * If one characteristic of a site meets the criteria for a particular rating, then that rating is applied.*

Table 12.2 Criteria for Assessing Impact Significance**Aquatic Sites
Site Category *****A Sites****

	Temporary	Short-term	Medium-term	Long-term
Extensive	Major	Severe	Severe	Severe
Localised	Major	Major	Severe	Severe

B Sites**

	Temporary	Short-term	Medium-term	Long-term
Extensive	Major	Major	Severe	Severe
Localised	Moderate	Moderate	Major	Major

C Sites**

	Temporary	Short-term	Medium-term	Long-term
Extensive	Moderate	Moderate	Major	Major
Localised	Minor	Moderate	Moderate	Moderate

D Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	Minor	Minor	Moderate	Moderate
Localised	Not significant	Minor	Minor	Minor

E Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	Not significant	Not significant	Minor	Minor
Localised	Not significant	Not significant	Not significant	Not significant

In line with the EPA guidelines (EPA 2002), the following terms are defined when quantifying duration:

- Temporary: up to 1 year.
- Short-term: from 1-7 years.
- Medium-term: 7-15 years.
- Long-term: 15-60 years.
- Permanent: over 60 years.

Localised impacts on rivers are loosely defined as impacts measurable no more than 250m from the impact source. Extensive impacts on rivers are defined as impacts measurable more than 250m from the impact source. Any impact on salmonid spawning habitat, or nursery habitat where it is in short supply, would be regarded as an extensive impact as it is likely to have an impact on the salmonid population beyond the immediate vicinity of the impact source.

* Site categories A to E are defined in Table 12.1.

** The use of a clear span bridge on all watercourses of international (provided the integrity of the cSAC is not affected), national or high local ecological value will not constitute a significant adverse impact on the aquatic habitat or associated biota, provided the remedial and reductive measures outlined within the EIS are adhered to.

Table 12.3 The Biological River Quality Classification System (Q Value) (After Lucey et al., 1999)⁽¹³⁾

Q Value	Community Diversity	Water Quality	Condition	Quality Status
Q5	High	Good	Satisfactory	Unpolluted
Q4	Reduced	Fair	Satisfactory	Unpolluted
Q3	Much reduced	Doubtful	Unsatisfactory	Moderately polluted
Q2	Low	Poor	Unsatisfactory	Seriously polluted
Q1	Very low	Bad	Unsatisfactory	Seriously polluted

Table 12.4 Summary Description and Evaluation of Watercourses Along the Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation	Riparian Habitat and Evaluation	Fisheries Value and Evaluation	Presence of Annex Species	Q val.*	Overall Eval.
Waterford to King's River (31+300)						
Suir River Catchment						
1 st order trib. of River Blackwater 9+150 Sample C1	Channel width = 1.5-2m; Depth = 15-25cm. Uniform riffle flow. Water quality Q3.	C Shaded by treelines of overhanging ash on both banks.	C Potential salmonid habitat (River Blackwater holds substantial salmonid population) ⁴	C Potential for lamprey spp (records for River Suir catchment) ⁵ , otter and kingfisher ¹	C 3	C
1 st order trib. of River Blackwater 10+020 Sample C2	Channel width = 6.5m; Depth = 30-60cm. Uniform riffle flow. Water quality Q3.	C Shaded by treeline of overhanging ash and sycamore.	C Potential salmonid habitat (River Blackwater holds substantial salmonid population) ⁴	C Potential for lamprey spp (records for River Suir catchment) ⁵ otter and kingfisher ¹	C 3	C
Derrylackey River (1 st order trib. of River Blackwater) 13+800 Sample E1	Channel width = 2.5=3m; Depth = 10-20cm. Riffle, glide, pool sequence. Substrate of cobbles and pebbles. No aquatic vegetation.	C Western bank grass-dominated (GA1/GS4). Treeline of semi-mature ash (WL2) with willow-scrub (WS4) and ruderal species on eastern bank.	C Brown trout present. ⁴	C Potential for lamprey spp (records for River Suir catchment) ⁵ otter and kingfisher ¹	C 4	C
1 st order trib. of Derrylackey River 14+400 Sample E2	Channel width = 2-3m; Depth = 10-25cm. Riffle, glide, pool sequence. Substrate of cobbles and boulders with a little silt and gravel. Occasional watercress, some green algae.	C Western bank with rosebay willowherb, soft rush, nettles and fool's water cress (GS4). Stonewall with ruderal species, occasional hawthorn, some sycamore, yellow iris and lesser celandine on eastern bank.	D Potential salmonid habitat ⁴	C Potential for lamprey spp (records for River Suir catchment) ⁵ otter and kingfisher ¹	C 4	C
Possible 2 nd order trib. of River Blackwater 19+600 Sample E3	Channel width = <1m; Depth = 20cm. Fast flow, with riffle, glide, pool sequence. Substrate of cobbles with a little silt along bank edges where cattle poaching has occurred. Occasional watercress and floating sweet grass along banks.	D Northern bank with gorse, rushes (GA1/GS4). GA1/GS4 with narrow strip of gorse and ruderal species, and stonewall with occasional willow on southern bank.	D Potential salmonid habitat ¹	C No evidence of protected spp, but trib. of watercourse with Annex II spp. ¹	D 3	C

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation	Riparian Habitat and Evaluation	Fisheries Value and Evaluation	Presence of Annex Species	Q val.*	Overall Eval.
River Nore Catchment						
cSAC 1 st order trib. of Little Arrigle River, which is 1 st order trib. of the River Nore 24+500 Sample E4	Channel width = 2-3m; Depth = 20cm. Fast flow, with riffle, glide, pool sequence. Substrate of cobbles with some silt and gravel. Rare watercress.	A Northern bank grass-dominated (GA1) with occasional alder, dogrose, ivy, holly, nettles, cleavers, willow and meadow sweet. Hedgerow of hawthorn and ash with ivy (WL1) on southern bank.	A cSAC; salmonid habitat ⁴	A Potential for lamprey spp (common in River Nore catchment) ⁵ otter and kingfisher ¹	B	3/4 A
1 st order trib. of Little Arrigle River 25+020 to 25+280 Sample E5	Channel width = 1m; Depth = 20cm. Moderate flow, glide-dominated. Silt substrate with few cobbles. No aquatic vegetation.	D Hedgerow of hawthorn with ruderal spp and abundant bryophytes on western bank. Southern bank dominated by nettles with thistles, cleavers and <i>Arum</i> sp.	D Little potential for salmonids ¹	D No evidence of protected spp, but trib. of watercourse with Annex II spp. ¹	D	3/4 D
1 st order trib. of King's River 29+980 Sample E6	Channel width = 1m; Depth = 10cm. Moderate flow, with riffle, glide, pool sequence. Substrate of cobbles with some pebbles, gravel and silt. No aquatic vegetation.	C Hedgerow of hawthorn with spp-rich ground flora on eastern bank. Western bank with ruderal species grading into improved grassland.	D Potential salmonid habitat (King's River is a designated Salmonid River) ²	C Potential for lamprey spp (common in River Nore catchment) ⁵ otter and kingfisher ¹	C	3 C
2 nd order trib. of King's River 30+200 Sample E7	Channel width = 1.5-2m; Depth = 15-20cm. Moderate flow, glide-dominated. Substrate of cobbles, pebbles and silt. Frequent algae.	D Hedgerow of hawthorn, blackthorn, dogrose, bramble and occasional alder on western bank. Hedgerow of bramble, alder, willow and hawthorn on eastern bank.	C Potential salmonid habitat (King's River is a designated Salmonid River) ² .	C Potential for lamprey spp (common in River Nore catchment) ⁵ otter and kingfisher ¹	C	3 C
King's River (31+300) TO Ballyquirke, including Kilkenny Link						
King's River (cSAC) 1 st order trib. of River Nore 31+540 to 31+565 Sample E8	Channel width = 12m; Depth = 30-40cm. Very fast flow, with riffle, glide, pool sequence. Substrate of boulders, cobbles and gravel. Sparse fool's watercress, water crowfoot and reed.	A Southern bank grass-dominated with meadow sweet, cow parsley cleavers and reed canary-grass, and mature woodland sloping steeply away from the river. Northern bank with similar vegetation, in addition to willow and ash.	A cSAC; and designated Salmonid River ²	A Lamprey spp (common in River Nore catchment) ⁵ , crayfish, ⁴ otter and kingfisher ¹	B	3 A

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation		Riparian Habitat and Evaluation		Fisheries Value and Evaluation		Presence of Annex Species		Q val.*	Overall Eval.
Ennisnag Stream 1 st order trib. of King's River 34+080 Sample E9	Channel width = 2.5-3m; Depth = 20-30cm. Moderate to fast flow with riffle, pool, riffle, glide sequence. Gravel substrate with cobbles and silt near the edge of watercourse. Watercourse fenced on both sides, no cattle access.	C	Southern bank grass-dominated with willow and an area of gorse and bramble. Northern bank grass-dominated with semi-mature willow treeline. Bankside vegetation includes willowherb, meadow sweet and cuckooflower.	C	Potential salmonid habitat (King's River is a designated Salmonid River) ²	C	Potential for lamprey spp (common in River Nore catchment) ⁵ otter and kingfisher ¹	C	3	C
1 st order trib. of River Nore 39+120 to 39+200 Sample E10	Channel width = 1-1.5m; Depth = 20-35cm. Fast flow, riffle-dominated with some glide. Substrate of cobbles. Fool's watercress and watercress, some algae. Water volume altered due to discharge of groundwater from settlement lagoons; discharge of lime sediment from settlement lagoons.	D	Eastern bank dominated by ruderal species, grading into improved grassland. Hedgerow with occasional mature sycamore and ash, and ruderal species on western bank.	D	No fisheries value at present due to discharge of lime sediment from settlement lagoons ¹	E	Little potential for protected spp. ¹	E	2/3	D
River Nore (cSAC) 39+950 to 39+990 (unsuitable for sampling) **	Channel width = approx. 20m; Depth = .1m. Fast flow, silty substrate at edges. No aquatic vegetation.	A	Southern bank with reed canary-grass and occasional elder, willow, hawthorn and sycamore, grading into wet grassland. Dense scrub with hawthorn, gorse, semi-mature ash and occasional alder or northern bank.	A	Designated Salmonid River ⁴	A	Potential for sea/river lamprey, Brook lamprey present. ⁵ Freshwater pearl mussel. ⁷ Crayfish ⁶ Otter and kingfisher ¹	B	N/A	A
1 st order trib. of River Nore 42+640 Sample E11	Channel width = 1m; Depth = 10-30cm. Fast flow, with riffle, pool, riffle, glide sequence. Substrate of cobbles with silt along edges. Continuous cover of fool's watercress along northern bank.	C	Southern bank grass-dominated with ruderal species, grading into arable crop. Hedgerow with frequent alder and willow, occasional ash and bramble, blackthorn, rosebay willow herb, cleavers and sycamore saplings on northern bank.	C	Potential salmonid habitat (River Nore is a designated Salmonid River) ⁴	C	Potential for lamprey sp (common in River Nore catchment) ⁵ otter	C	3	C

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation		Riparian Habitat and Evaluation		Fisheries Value and Evaluation		Presence of Annex Species		Q val.*	Overall Eval.
1 st order trib. of River Nore 45+760	Channel width = 1-15m; Depth = 20-30cm. No flow. Silty substrate. Fool's watercress.	E	Hedgerow of hazel on western bank. Eastern bank dominated by ruderal species grading into improved grassland.	D	Little potential for salmonids ¹	D	No evidence of protected spp, but trib. of watercourse with Annex II spp. ¹	D	N/A	D
River Barrow Catchment										
Gowran River (1 st order trib. of River Barrow) 48+240 Sample E12	Channel width = 2-3m; Depth = 15-20cm. Moderate flow, with riffle, glide sequence. Substrate of cobbles and gravel. No aquatic vegetation.	C	Western bank with ruderal species, and frequent alder and sycamore. Eastern bank with ruderal species and frequent hazel and hawthorn.	C	Good salmonid habitat (River Barrow holds substantial salmonid population) ⁴	B	Potential for lamprey spp. ⁵ otter and kingfisher ¹	C	4-5	B
Kilkenny Link										
Pococke River (cSAC) (1 st order trib. of River Nore) 1+120 Sample KK1	Channel width = 2.5m; Depth = 20cm. Riffle-glide sequence with moderate flow. Substrate with cobbles and pebbles, some silt in glide areas. Frequent crowfoot.	A	Grass-dominated with water mint, ragwort, nettles, dock, marsh marigold, and creeping buttercup. Relatively high species diversity on western bank.	A	Potential salmonid habitat (River Nore is a designated Salmonid River) ²	A	Potential for lamprey spp. ⁵ otter and kingfisher ¹	B	3-4	A
2 nd order trib. of River Nore 2+320 Sample KK3	Channel width = 1-1.5m; Depth = 10cm. Slow flow, glide-dominated. Substrate of cobbles and silt. Sparse fool's watercress.	D	Grass-dominated with dandelion, thistles, creeping buttercup, cowslip, rushes, meadow sweet, creeping cinquefoil.	D	Little potential of salmonids ¹	D	No evidence of protected spp, but trib. of watercourse with Annex II spp. ¹	D	3	D
1 st order trib. of River Nore 3+260 Sample Kk3	Channel width = 1.5m; Depth = 15cm. Slow flow, glide-dominated. Silt substrate. Frequent crowfoot and fool's watercress. River banks poached by cattle.	D	Ruderal species grading into improved grassland: dock, nettles, dandelion, fox's tail, ragwort, rosebay willowherb. Occasional willow.	D	Little potential for salmonids ¹	D	No evidence of Annex II spp, but trib. of watercourse with Annex II spp. ¹	D	3	D
1 st order trib. of River Nore 5+300 Sample KK4	Channel width = 1-2m; Depth = 20cm. Slow flow, pool-dominated. Substrate of cobbles and silt. Abundant fool's watercress and iris.	E	Western bank grass-dominated with nettles, rosebay willowherb, vetch, bramble, meadow sweet. Hedgerow of willow on eastern bank.	D	Little potential for salmonids ¹	D	No evidence of protected spp, but trib. of watercourse with Annex II spp. ¹	D	3	D

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation		Riparian Habitat and Evaluation		Fisheries Value and Evaluation	Presence of Annex Species		Q val.*	Overall Eval.	
Ballyquirke to Powerstown										
1 st order trib. of Monefelim River 62+200 FW1 (unsuitable for sampling)	Channel 0.5 – 1m wide, 5 – 15cm deep. Silty substrate, with cobbles in places. Slow flow, frequent stagnant pools. Very silty with high turbidity.	E	Both banks (approximately 1m high) have agricultural grassland and ruderal species. Lots of bare ground due to poaching. Hawthorn, hazel, ash and alder on south-west bank.	D	Not of great fisheries importance ⁴	D	None recorded. Little potential for protected species. ¹	E	-	D
Monefelim River (1 st order trib. of River Barrow) 62+870 FW2	Channel 5m wide, 10-15cm deep. Cobble substrate, with some gravel. Fast flow, with some riffle areas. Aquatic vegetation limited to greater watermoss on rocks.	C	Both banks have bare patches as stock have access. Many ruderal species, with occasional overhanging hawthorn, alder, ash, gorse and dog rose.	C	Important salmon and trout spawning ground ⁴	B	Salmon. Potential for river/brook lamprey, otter, kingfisher and crayfish (occurs in River Barrow) ^{3, 5}	B	4	B
1 st order trib. of Monefelim River 63+200 FW3	Channel 5 m wide, 5 - 10 cm deep. Cobble substrate, with some silt. Steady flow – with riffle and glide. Aquatic vegetation limited to some green algae.	D	Both banks have hedgerows with cherry, willow, ash, hawthorn and a varied ground flora. Remains of an ancient stone wall lines the north-eastern bank and bank stabilising structures are also present.	C	Potential spawning nursery ⁴	C	Potential for salmon, river/brook lamprey and crayfish (occurs in River Barrow) ^{3, 5} otter and kingfisher ¹	C	4	C
3 rd order trib. of River Barrow 65+380 FW4 (unsuitable for sampling)	Channel 50 – 100 cm wide, 5 cm deep. Substrate silty, with occasional gravel. Moderate to slow flow. Turbidity high (white – grey), no visibility.	E	Western bank is agricultural grassland, and eastern bank consists of a hedgerow of oak, willow, hawthorn, blackthorn, gorse and an assemblage of wetland plants, including sedges, rushes and willowherbs.	D	Unlikely to support salmonids ¹	E	None recorded. Little potential for protected species. ¹	E	-	D
3 rd order trib. of River Barrow 66+105 FW5	Channel 1 m wide, 5 - 10 cm deep. Gravel and silt substrate, with occasional cobble. Slow flow, with some glide.	D	Treeline of ash, oak, alder, hawthorn, holly and elm on 2m high southern bank. Stone wall with ruderal species on northern bank adjacent to roadway (very shaded).	D	Some suitable conditions for salmonids but not of great fisheries importance ¹	D	No evidence of protected spp, but trib. of watercourse with Annex II spp. ¹	D	3-4	D

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation	Riparian Habitat and Evaluation	Fisheries Value and Evaluation	Presence of Annex Species	Q val.*	Overall Eval.
2 nd order trib. of River Barrow 66+440 FW6	Channel 50 – 100 cm wide, 5-10 cm deep. Gravel substrate, with some silt. Moderate to slow flow – glide and light riffle. Aquatic vegetation comprised of fool's watercress, watercress and occasional common reed.	D Agricultural grassland on northern bank, with a number of ruderal species. Hedgerow of young alder and ash, cherry, gorse, and dog rose on southern bank.	D Some suitable conditions for salmonids but not of great fisheries importance ¹	D No evidence of protected spp, but trib. of watercourse with Annex II spp. ^{1,5}	3-4	D
1st order trib. of River Barrow 67+465 FW7	Channel 1m wide, 5 - 10 cm deep. Cobbles and gravel substrate. Steady flow, with small, occasional riffle areas.	D Agricultural grassland with ruderal species and ferns and woodrush on northern bank. Treeline of ash and oak with varied ground flora on southern bank.	D May support salmonids, but not of great fisheries importance ⁴	D None recorded. Potential for salmon and brook lamprey ¹ (occurs in River Barrow) ^{3,5}	3-4	D
2nd order trib. of River Barrow 68+070 FW8	Channel 50 - 100 cm wide, 5-10 cm deep. Cobble substrate. Steady flow, with occasional riffle areas.	D Agricultural grassland on 1m high northern bank. Treeline of young and semi-mature ash, willow, hawthorn and dog rose on 1.5 m southern bank.	D Some suitable conditions for salmonids but not of great fisheries importance ¹	D No evidence of protected spp, but trib. of watercourse with Annex II spp. ^{1,5}	3-4	D
2nd order trib. of River Barrow 69+110 FW9	Channel 30-50 cm wide, 5 cm deep. Mud substrate, with occasional gravel patches. Moderate flow, with occasional riffle. Aquatic vegetation comprised of patches of fool's watercress and some algae.	E Agricultural grassland on northern bank, and hawthorn hedgerow on southern bank.	E Some suitable conditions for salmonids but not of great fisheries importance ¹	D None recorded. Little potential for protected species ¹ .	3-4	E
Madlin River (cSAC) (1 st order trib. of River Barrow) 70+900 FW10	Channel 2-3 m wide, 5 - 15 cm deep. Cobble substrate, with some gravel. Fast flow, with riffle areas.	A South bank (1 m) with agricultural grassland. Occasional young to semi-mature ash, alder, elder and gorse on north bank (1 – 1.5 m high).	A Very important spawning ground ⁴	A Salmon present ³ Potential for river/brook lamprey and crayfish (occurs in River Barrow) ^{3,5} otter and kingfisher ¹	B 4	A
1 st order trib. of Madlin River 71+220 FW11	Channel 1.5 m wide, 5-10 cm deep. Substrate silty in places, gravel and cobbles downstream. Predominantly glide and pool, rare riffle. Occasional watercress.	D Western bank with agricultural grassland and occasional ruderal species. Treeline of young ash, horse chestnut, willow and occasional alder, with ruderal species, on eastern bank	D Potential for salmonids (Trib. of salmonid nursery Madlin River) ¹	C Potential for brook lamprey (occurs in River Barrow) ^{3,5} otter and kingfisher ¹	C 3	C

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation		Riparian Habitat and Evaluation		Fisheries Value and Evaluation		Presence of Annex Species		Q val.*	Overall Eval.
1 st order trib. of Madlin River 71+800 FW12	Channel 2.5 m wide, 10 cm deep. Substrate of cobbles and gravel. Slow riffle, glide, pool sequence. Abundant algae (sign of enrichment).	C	Southern bank with 0.3 m-wide strip of ruderal species and arable crop beyond. Ruderal species with hawthorn, mature ash and alder on northern bank.	E	Good trout stream ⁴	C	Potential for brook lamprey (occurs in River Barrow) ^{3,5} otter and kingfisher ¹	C	3-4	C
2 nd order trib. of River Barrow 72+470 FW13	Channel 0.5 m wide, 5 cm deep. Substrate of gravel. Riffle, glide, pool sequence. No aquatic vegetation.	C	Overhanging hedgerow of hawthorn, blackthorn, ash saplings and dogrose on southern bank Ruderal species along wall on northern bank.	D	Potential for salmonids (Trib. of salmonid nursery Madlin River) ¹	C	Potential for brook lamprey (occurs in River Barrow) ^{3,5} otter and kingfisher ¹	C	3	C
1 st order trib. of River Barrow 72+990 FW14	Channel 1.5-2 m wide, 5-10 cm deep. Silty as a result of cattle poaching; some cobble and gravel downstream with silt along edges. Little to no flow; riffle, glide further downstream. Occasional fool's watercress.	E	Hedgerow of hazel and mature hawthorn with ruderal species on northern bank. Improved grassland with occasional gorse and nettles on southern bank.	D	Trout occasionally present. ⁴	D	No evidence of protected spp, but trib. of watercourse with Annex II spp. ^{1,5}	D	3	D
1 st order trib. of River Barrow 73+630 FW15	Channel 2.5-3 m wide, 10-15 cm deep. Substrate of cobbles and gravel. Riffle and pool. No aquatic vegetation.	C	Hedgerow of hawthorn with ruderal species on northern bank Hedgerow of willow, hawthorn, mature ash and gorse with ruderal species on southern bank.	D	High quality stream for salmonids ⁴	C	Potential for brook lamprey (occurs in River Barrow) ^{3,5} otter and kingfisher ¹	C	3-4	C
2 nd order trib. of River Barrow 73+785 FW16 (unsuitable for sampling)	Channel 0.5 m wide, 10-15 cm deep. Silty substrate. Little to no flow, pool-dominated. Fool's watercress present in-stream; ruderal species along edges.	E	Hedgerow of mature willow, hawthorn, hazel and rare oak with blackthorn, bramble and nettle understorey on northern bank. Southern bank dominated by grasses and ruderal species, grading into arable crop.	D	Not of great fisheries importance ⁴	E	Little potential for protected species ¹ .	E	-	D
2 nd order trib. of River Barrow 74+540 FW17	Channel 2.5 m wide, 10-20 cm deep. Substrate of cobble with some gravel and silt. Meandering stream; riffle, glide, and pool sequence. No aquatic vegetation.	C	Arable crop with frequent clusters of alder and willow and ruderal species on northern and southern banks.	E	Important for salmonids ⁴	C	Potential for brook lamprey (occurs in River Barrow) ^{3,5} otter and kingfisher ¹	C	4	C

Table 12.4 (Cont'd) Summary Description And Evaluation Of Watercourses Along The Proposed Route

Name Chainage Sample No.	Aquatic Habitat and Evaluation		Riparian Habitat and Evaluation		Fisheries Value and Evaluation		Presence of Annex Species		Q val.*	Overall Eval.
River Barrow cSAC 75+560-75+610 FW18 (unsuitable for sampling)	Channel 25 m wide, >1 m deep. Slow, uniform flow. Reed canary-grass along edges. River bank along track artificially graded.	A	New road track, with drainage ditch and hazel-dominated scrub with occasional ash, beech, hawthorn and oak beyond, on western bank; little ground flora. Improved grassland on eastern bank.	A	Large stocks of salmonids ²	B	Brook lamprey present. Potential for river and sea lamprey. ⁴ Crayfish, freshwater pearl mussel, otter, kingfisher ³	B	-	A
1 st order tributary of River Barrow Ch. 0+530 on N9 South Link at Junction 5 FW 19	Channel width = 1m, Depth = 15-25cm. Mud/silt substrate to east of crossing with slow flow, sand and gravel substrate to west of crossing with riffle and glide. There is no aquatic vegetation at this crossing point.	C	Hedgerow on north bank with ruderal species on southern bank.	D	Trout present in the lower reaches ¹	D	Potential for brook lamprey (occurs in River Barrow) ^{3, 5} otter and kingfisher ¹	C	3	C

Natura assessment¹; References: O'Reilly (2002)²; NPWS (2003)³; SRFB (2002)⁴; Kurz & Costello (1999)⁵; Reynolds (1998)⁶; Moorkens (1999)⁷; Ecoserve (2002)⁸.

*See Appendix 12.1 for water quality rating

** Q value for River Nore is based on EPA data from Ballylinch Bridge in 1998 (6km downstream of proposed crossing) as this stretch is unsuitable for sampling.

Table 12.5 Watercourse Evaluation, Impacts, Mitigation and Residual Impacts

Name/Townland Chainage Sample No.	Overall Evaluation	Length of River Impacted	Predicted Impacts	Mitigation	Residual Impacts*
Waterford to King's River					
1 st order trib. of River Blackwater 9+150 Sample C1	C	90m	Moderate negative	Clear span bridge with no in-stream works. No tracking across the river without the use of a temporary bridge. Retention of rivers banks. Bridge design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Not significant
Ballygreek River 1 st order trib. of River Blackwater 10+020 Sample C2	C	160m	Moderate negative	Realignment of channel and installation of arch type culvert incorporating the SRFB recommendations and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly straight. Arch culvert will include at least 1m of bank to allow for mammal passage.	Moderate negative
Derrylacky River (1 st order trib. of River Blackwater) 13+800 Sample E1	C	190m	Moderate negative	Realignment of channel and installation of arch type culvert incorporating the SRFB recommendations and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly. Arch culvert will include at least 1m of bank to allow for mammal passage.	Moderate negative
1 st order trib. of Derrylacky River 14+400 Sample E2	C	140m	Moderate negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Moderate negative
Possibly 2nd order trib. of River Blackwater 19+600 Sample E3	C	100m	Moderate negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. Realignment of channel incorporating the SRFB recommendations and incorporating principles detailed in Section 12.5.	Moderate negative
1 st order trib. of Little Arrigle River (cSAC) 24+500 Sample E4	A	60m	Severe negative	Clear span bridge. No in-stream works. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and NPWS and incorporating principles as outlined in Section 12.7.2 and 12.7.3. Attenuation areas will be constructed to the highest specification using reed bed design that provides for habitat creation (see Section 12.5 – Design Issues).	Not significant

Table 12.5 (Cont'd) Watercourse Evaluation, Impacts, Mitigation and Residual Impacts

Name/Townland Chainage Sample No.	Overall Evaluation	Length of River Impacted	Predicted Impacts	Mitigation	Residual Impacts*
1 st order trib. of Little Arrigle River 25+020 to 25+280 Sample E5	D	310m	Moderate negative	Realignment of 290m of channel including culverts to cross the mainline and Link Roads at a perpendicular angle would be preferable. Cascade required due to levels of ground in this area – Drop of 1.5m over 5m distance is preferable. Final realignment of channel and cascade will incorporate the SRFB recommendations and incorporate principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly straight. Any works to this watercourse should be from the eastern bank to ensure the retention of a treeline of oak and ash on the western bank.	Minor negative
1 st order trib. of King's River 29+980 Sample E6	C	150m	Moderate negative	Realignment of 80m of channel incorporating the SRFB recommendations and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly.	Moderate negative
2 nd order trib. of King's River 30+200 Sample E7	C	80m	Moderate negative	Minor diversion to allow for a culvert of 60m at a perpendicular to mainline is preferable. Realignment of channel incorporating the SRFB recommendations and incorporating principles detailed in Section 12.5.	Moderate negative
King's River to Ballyquirke					
King's River cSAC 31+540 to 31+565 Sample E8	A	110m	Severe negative	Clear span bridge to clear the valley, retaining banks with no in stream works. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and NPWS and incorporating principles detailed in Section 12.7.2 and 12.7.3. Sensitive location of construction access track adjacent to proposed mainline.	Not significant
Ennisnag River 34+080 Sample E9	C	100m	Moderate negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. Construction of access track outside crown spread of trees or 2m away from river bank, whichever is the greater distance.	Moderate negative
1 st order trib. of River Nore 39+120 and 39+200 Sample E10	D	210m	Minor negative	Diversion of 110m and a culvert of 30m would be preferable to allow for a perpendicular crossing, thereby reducing culvert length. Culvert and diversion design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly straight.	Minor negative
River Nore (c SAC) 39+950 to 39+990 (unsuitable for sampling)	A	160m	Severe negative	Clear span bridge retaining existing banks with no in stream works. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and NPWS and incorporating principles as outlined in Section 12.7.2 and 12.7.3.	Not significant

Table 12.5 (Cont'd) Watercourse Evaluation, Impacts, Mitigation and Residual Impacts

Name/Townland Chainage Sample No.	Overall Evaluation	Length of River Impacted	Predicted Impacts	Mitigation	Residual Impacts*
1 st order trib. of River Nore 42+640 Sample E11	C	80m	Moderate negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. Attenuation areas will be constructed to the highest specification using reed bed design that provides for habitat creation (see Section 12.5 – Design Issues).	Moderate negative
1 st order trib. of River Nore 45+760 to (unsuitable for sampling)	D	75m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative
Gowran River (1 st order trib. of River Barrow) 48+240 Sample E12	B	80m	Major negative	Arch-type structure retaining existing banks with no in stream works. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Not significant
King's River to Ballyquirke – Kilkenny Link Road					
Pococke River (cSAC) 1 st order trib. of River Nore 1+120 Sample KK1	A	40m	Severe negative	Clear span bridge with no in-stream works. Retention of river banks. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and NPWS and incorporating principles detailed in Section 12.5.	Not significant
2 nd order trib. of River Nore 2+320 Sample KK2	D	60m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative
1 st order trib. of River Nore 3+260 Sample KK3	D	70m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative
1 st order trib. of River Nore 5+300 Sample KK4	D	80m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative

Table 12.5 (Cont'd) Watercourse Evaluation, Impacts, Mitigation and Residual Impacts

Name/Townland Chainage Sample No.	Overall Evaluation	Length of River Impacted	Predicted Impacts	Mitigation	Residual Impacts*
Ballyquirke to Powerstown					
1st order trib. of Monefelim River 62+200 FW1 (unsuitable for sampling)	D	300m	Moderate negative	Culvert (70m culvert) and diversion (240m) design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly straight.	Moderate negative
Monefelim River (1 st order trib. of River Barrow) 62+865 FW2	B	70m	Major negative	Clear span bridge retaining existing banks with no in stream works. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Not significant
1 st order trib. of Monefelim River 63+195 FW3	C	70m	Moderate negative	Clear span bridge retaining existing banks with no in stream works. Bridge design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. No tracking across the river without the use of a temporary bridge. Ensure access track to pollution control area crosses the watercourse using the existing culverted section and retain hedgerow adjacent to track. Construction of track will be a minimum of 2m from the northern bank.	Not significant
3 rd order trib. of River Barrow 65+380 FW4 (unsuitable for sampling)	D	65m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative
3 rd order trib. of River Barrow 66+105 FW5	D	100m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles as outlined in Section 12.5.	Minor negative
2 nd order trib. of River Barrow 66+440 FW6	D	70m	Minor negative	Increased landtake to allow realignment of stream to north of realigned local road (L6673). Realignment and culvert design (at mainline crossing) to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative
1st order trib. of River Barrow 67+465 FW7	D	90m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative

Table 12.5 (Cont'd) Watercourse Evaluation, Impacts, Mitigation and Residual Impacts

Name/Townland Chainage Sample No.	Overall Evaluation	Length of River Impacted	Predicted Impacts	Mitigation	Residual Impacts*
2nd order trib. of River Barrow 68+070 FW8	D	50m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5	Minor negative
2nd order trib. of River Barrow 69+110 FW9	D	500m	Moderate negative	Culvert (50m) design and stream diversion (500m) to satisfaction of SRFB and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly. Ensure embankments do not unnecessarily impact the watercourse.	Moderate negative
Madlin River cSAC (1 st order trib. of River Barrow) 70+900 FW10	A	50m	Severe negative	Clear span bridge with no in-stream works. Retention of river banks. No tracking across the river without the use of a temporary bridge. Construction of access track between the bank and the abutment at the Madlin River using hardcore surface. Maintain 2 metres of ground between the track and riverbank edge. Provide a bund between the proposed track and river bank to act as a buffer against machinery spills. Bridge design to satisfaction of SRFB and NPWS and incorporating principles detailed in Section 12.5. Attenuation areas will be constructed to the highest specification re: reed bed design that provides for habitat creation (see Section 12.5 – Design Issues).	Not significant
1 st order trib. of Madlin River 71+220 FW11	C	200m	Moderate negative	Culvert (40m and 40m culvert) design and stream diversion (80m) to satisfaction of SRFB and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly.	Moderate negative
1 st order trib. of Madlin River 71+810 FW12	C	50m	Moderate negative	Culvert design to satisfaction of SRFB and incorporating principles detailed above – Bridge and culvert design. Ensure best practice during construction as outlined in Section 12.5 – Pollution Prevention.	Moderate negative
2 nd order trib. of River Barrow 72+470 FW13	C	200m	Moderate negative	Culvert (50m, 18m x2) design and stream diversion (approx 110m) to satisfaction of SRFB and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly. Ensure bund/landscape areas do not unnecessarily impact the watercourse.	Moderate negative
1 st order trib. of River Barrow 72+980 FW14	D	50m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Minor negative

Table 12.5 (Cont'd) Watercourse Evaluation, Impacts, Mitigation and Residual Impacts

Name/Townland Chainage Sample No.	Overall Evaluation	Length of River Impacted	Predicted Impacts	Mitigation	Residual Impacts*
1 st order trib. of River Barrow 73+630 FW15	C	70m	Moderate negative	Clear span bridge with no in-stream works. Retention of river banks. No tracking across the river without the use of a temporary bridge. Bridge design to satisfaction of SRFB and incorporating principles detailed in Section 12.5.	Not significant
2 nd order trib. of River Barrow 73+785 FW16 (unsuitable for sampling)	D	64m	Minor negative	Culvert design to satisfaction of SRFB and incorporating principles detailed above – Bridge and culvert design. Ensure best practice during construction as outlined in Section 12.5 – Pollution Prevention.	Minor negative
2 nd order trib. of River Barrow 74+540 FW17	C	145m	Moderate negative	Culvert (45m) and diversion (100m) design to satisfaction of SRFB and incorporating principles detailed in Section 12.5. New channels will be sinuous and meandering rather than uniformly.	Moderate negative
River Barrow cSAC 75+560-75+610 FW18 (unsuitable for sampling)	A	30m	Sever negative	Clear span bridge with no in-stream works. Retention of river banks. Bridge design to satisfaction of SRFB and NPWS and incorporating principles detailed in Section 12.5.	Not significant
1st order tributary of River Barrow Ch. 0+530 on N9 South Link at Junction 5 FW 19	C	70m	Moderate negative	Culvert design to satisfaction of SRFB and incorporating principles detailed above – Bridge and culvert design. Ensure best practice during construction as outlined in Section 12.5 – Pollution Prevention.	Moderate negative

* This residual impact evaluation for watercourses with clear-span bridges assumes (i) best practice during construction incorporating all the mitigation proposals outlines in the general mitigation contained in Section 12.5 in association with specific mitigation outlined in the table and (ii) bioengineering practices are taken on board rather than gabion baskets for regarding banks.

Table 12.6 Watercourse Crossing Locations of Hydrological Significance

Watercourse	Hydrometric Area	Cross Drainage Structure
MAINLINE		
R. BLACKWATER: tributary at Deerpark (ch. 9+110 – 9+120).	16	ST 105
R. BLACKWATER: tributary at Glendonnell (ch. 10+020 – 10+050).	16	ST 107
R. BLACKWATER: tributary at Ballylusky (ch. 11+900).	16	C12a
R. BLACKWATER: tributary at Earlsrath (ch. 12+180).	16	C13
R. BLACKWATER: tributary – Derrylacky River at Lukeswell (ch. 13+810 – 13+890).	16	ST 203
R. BLACKWATER: tributary at Lukeswell (ch. 14+390).	16	ST 205
RIVER NORE: tributary at Kilkeasy (ch. 19+660).	15	C17
RIVER NORE: tributary at Sheepstown (ch. 24+500 – 24+510).	15	S 242
RIVER NORE: tributary at Sheepstown (ch. 25+120).	15	C23
RIVER NORE: tributary at Rathduff (ch. 30+170).	15	C25
RIVER NORE: tributary – Main channel of King's River at Stoneyford (ch. 31+540 – 31+630).	15	ST 220
RIVER NORE: tributary at Ennisnag (ch. 34+080).	15	C27
RIVER NORE: Main channel north of Bennettsbridge (ch. 39+800 – 40+040).	15	ST228
RIVER NORE: tributary at Holdenstown (ch. 42+640).	15	C31
RIVER NORE: tributary at Rathcash (ch. 45+750).	15	C34
RIVER BARROW: tributary at Baunboy (ch. 47+010)	14	C36
RIVER BARROW: tributary at Blanchevillespark (ch. 48+230 – 48+240)	14	C38
RIVER BARROW: tributary at Ballyquirke (ch. 61+100)	14	PB-C2
RIVER BARROW: tributary at Ballyquirk - Sraghgaddy (ch. 61+190)	14	PB-C3
RIVER BARROW: tributary at Ballinvally (ch. 62+190 - 62+340)	14	PB-C4
RIVER BARROW: tributary at Ballinvally - Garryduff (ch. 62+550)	14	PB-C5
RIVER BARROW: tributary - Main Channel of Monefelim River at Ballinvally/Garryduff (ch. 62+865)	14	ST 6
RIVER BARROW: tributary Main Channel of Ballyvalden River at Garryduff/Kilmacahill (ch. 63+195)	14	ST 8

Table 12.6 (Cont'd) Watercourse Crossing Locations

Watercourse	Hydrometric Area	Cross Drainage Structure
RIVER BARROW: tributary at Jordanstown (ch. 63+960)	14	PB-C7
RIVER BARROW: tributary at Kellymount / Shankill (ch. 65+360)	14	PB-C8
RIVER BARROW: tributary at Shankill (ch. 66+105)	14	PB-C9
RIVER BARROW: tributary at Shankill (ch. 66+260)	14	PB-C11
RIVER BARROW: tributary at Shankill (ch. 66+440)	14	PB-C12
RIVER BARROW: tributary at Shankill -Moanmore (ch. 67+465)	14	PB-C13
RIVER BARROW: tributary at Moanmore (ch. 68+070)	14	PB-C13a
RIVER BARROW: tributary at Moanmore (ch. 68+775)	14	PB-C14
RIVER BARROW: tributary at Closutton (ch. 69+160)	14	PB-C14a
RIVER BARROW: tributary at Closutton (ch. 69+705)	14	PB-C15
RIVER BARROW: tributary at Moanduff (ch. 70+285)	14	PB-C16
RIVER BARROW: Tributary. Main Channel of Madlin River at Moanduff (ch. 70+900)	14	ST 17
RIVER BARROW: tributary at Moanduff (ch. 71+245)	14	PB-C17 & PB-C18
RIVER BARROW: tributary at Ballynolan - Demesne (ch. 71+500)	14	PB-C19
RIVER BARROW: tributary at Demesne (ch. 71+810)	14	PB-C20
RIVER BARROW: tributary at Seskin Lower (ch. 72+475)	14	PB-C21
RIVER BARROW: tributary at Coolnakisha (ch. 72+980)	14	PB-C22
RIVER BARROW: tributary at Coolnakisha (ch. 73+260)	14	PB-C23
RIVER BARROW: tributary at Coolnakisha (ch. 73+625)	14	PB-C24
RIVER BARROW: tributary at Cranavonane (ch. 73+785)	14	PB-C25
RIVER BARROW: tributary at Cranavonane (ch. 74+540)	14	PB-C26
RIVER BARROW: tributary at Tomard Lower (ch. 75+560)	14	PB-C27
RIVER BARROW: Main Channel at Tomard Lower - Cloghrystick (ch. 75+590)	14	ST 23
RIVER BARROW: tributary at Cloghrystick on Realigned National Road N9 (South) at Junction 5	14	PB-C29

Table 12.6 (Cont'd) Watercourse Crossing Locations

Watercourse	Hydrometric Area	Cross Drainage Structure
<u>KILKENNY LINK</u>		
RIVER NORE: tributary – Poccocke River at Blanchfieldsland (ch. 1+160 – 1+170)	15	S 304
RIVER NORE: tributary – Poccocke Stream at Archersrath (ch. 2+320)	15	C50
RIVER NORE: tributary at Lyrath (ch. 3+280)	15	C51
RIVER NORE: tributary at Scart (ch. 5+300)	15	C52
RIVER NORE: tributary at Clifden (ch. 6+390)	15	C53