Chapter 10 Hydrology

10.1 Introduction

This chapter of the EIAR presents the hydrological assessment of the proposed N5 Ballaghaderreen to Scramoge Road Project. The chapter sets out the methodology used in the assessment (Section 10.2), describes the existing hydrological environment (Section 10.3), details the likely significant hydrological impacts associated with the construction and operational phase of the proposed road development, (Section 10.4), describes measures to mitigate identified significant impacts (Section 10.5) and details residual impacts post mitigation (Section 10.6).

The principal potential hydrological impacts to the character of the receiving waters are associated with the proposed road crossing points and the potential for sediment loading and associated road drainage pollutants entering such watercourses during both construction and operational phases. There is also potential for hydrological and hydrogeological impacts to the complex karst drainage system which has been identified across the area of the project. The assessed potential impacts include:

- Surface watercourses crossed by the proposed road involving culvert and bridge structures and associated realignment of the watercourse channel;
- Surface watercourses discharged to via proposed road drainage outfalls and downstream impacts;
- Potential impact to flooding and flood risk, upstream and downstream of proposed channel and floodplain encroachment at proposed crossing points, at material deposit areas and downstream impacts from storm outfall locations;
- Potential morphological changes to watercourses at channel crossings and proposed road outfall discharge locations;
- Potential impacts on sites of ecological importance in proximity to surface watercourses (namely a Turlough at Cregga, Annaghmore Lough (Special Area of Conservation; Site Code: 001626), an Alkaline Fen at Tullyloyd, Clooncullaan Loughs, and Bellanagare Bog;
- Potential impacts on surface water abstraction in proximity to surface water crossings and downstream of storm outfalls (e.g. Lough Gara Abstraction Source).

10.2 Methodology

10.2.1 Data Sources

This chapter has been prepared having due regard to relevant legislation and the following guidance documents:

- EPA Guidelines on the Information to be contained in Environmental Impact Statements, March 2002;
- EPA Advice Notes on Current Practice in the preparation of Environmental Impact Statements, September 2003;
- Surface Water and Drainage Guidance in the National Roads Authority Design Manual for Roads and Bridges;
- TII/NRA Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;

- TII/NRA Environmental Impact Assessment of National Roads Schemes – A Practical Guide, November 2008;
- DoEHLG (Nov 2009) Flood Risk Management and the Planning System Guidance document.

The following Draft Guidance documents have also been consulted:

- Guidelines on the Information to be contained in Environmental Impact Assessment Reports, Draft May 2017; and
- Advice Notes for Preparing Environmental Impact Statements, Draft September 2015.

The Hydrological Impact Assessment Methodology is in general agreement with the guidance outlined in Section 5.6 of the TII/NRA Guidelines pertaining to the treatment of Hydrology. The Impact category, duration and nature of impact have been taken into account in this assessment as per the guidelines. The range criteria for assessing the importance of hydrological features within the study area and the criteria for quantifying the magnitude of impacts follow the TII/NRA guidelines.

The hydrological assessment has been prepared by expanding and updating the desk study work carried out for the Constraints Study and Route Corridor Selection Reports. It includes an assessment of published literature available from various sources including a web based search for relevant material. Site specific topographical information and aerial photography has been reviewed to locate any potential features of hydrological interest, and these have been investigated on the ground by walkover surveys in order to assess the significance of any likely environmental impacts on them.

Available topographical and hydrometric information (field and desk based) has been used to perform hydrological impact assessments of all culvert crossings and proposed outfall locations. All watercourses and water bodies which could be affected directly (i.e. crossed or realigned/ diverted) or indirectly (i.e. generally lie within 250m of the road development boundary or would receive storm runoff from the proposed road development) were assessed through a series of initial walkover visits followed up by a more detailed survey and hydrological assessment. Due to the nature of the hydrological environment it is necessary to consider the larger river catchment environments that the proposed road development traverses.

The following list of data sources were reviewed as part of this assessment of the impacts on hydrology:

Ordnance Survey Ireland (OSi)

- Discovery Series Mapping (1:50,000)
- Six Inch Raster Maps (1:10,560)
- Six inch and 25inch OS Vector mapping
- Orthographic Aerial Mapping

Environmental Protection Agency (EPA)

- Teagasc Subsoil Classification Mapping
- Water Quality Monitoring Database and Reports
- Water Framework Directive Classification

- EPA Hydrometric Data System
- EPA Hydrometric Data System

Office of Public Works (OPW)

- Arterial Drainage scheme land benefitting Mapping for Ireland
- OPW and Drainage District arterial Drainage Channels and maintained channels
- OPW hydrometric Data WEB Site
- Floodmaps Site
- OPW FSU (Flood Studies Update) Web Portal Site for Flood flow Estimation
- OPW Preliminary Flood Risk Assessment Mapping (pFRA).

Roscommon County Council

- Roscommon County Development Plan 2014 – 2020
- Planning Register
- Water Services – Abstractions, Discharges & Supply Schemes

National Parks and Wildlife Service (NPWS)

- Designated Areas Mapping
- Site Synopsis Reports

Other sources

- Shannon River Basin Management Plan (2009 – 2015)
- Aerial survey photography
- Geological Survey of Ireland (GSI) Web Mapping

10.2.2 Consultation with Regulatory and Other Bodies

Consultation took place with all relevant regulatory bodies including various departments of Roscommon County Council, the OPW, GSI and Inland Fisheries Ireland and the Peak Mantua Group Water Supply Group Scheme.

10.2.3 Field Surveys

Field surveys and walkover assessments were carried out to assess the hydrological impacts of the proposed road development. Detailed stream surveys (including topographical surveys where required) were made at areas where hydrological impacts were likely to occur without appropriate mitigation. Specifically all culvert and bridge crossing locations, proposed outfall locations and ecologically sensitive areas were visited and field measurements carried out along with reconnaissance of potential flood risk areas, including site visits during the December 2015 flood event. Flow estimation in selected outfall streams was also conducted.

10.3 Existing Environment

10.3.1 Regional Overview of Hydrology

The rivers and lakes along the proposed road development are located entirely within the Shannon International River Basin District (Shannon IRBD) and have been classified by the Water Framework Directive as Poor to Moderate water quality status

between Ballaghaderreen and Cloonyquin, and Poor to Good between Cloonyquin and Strokestown. The groundwater status for this region is classified as Poor.

The N5 Ballaghaderreen to Scramoge Road proposed road development crosses several watercourses which are part of the Upper Shannon Catchment. The rivers in the Western section of the Study Area which are traversed by the proposed road development flow to the Shannon via the Breedoge River catchment and Lough Gara. Those in the middle section flow via Lough Nablahy and the remaining eastern section flows via the Mountain River Catchment and Kilglass Lough. The proposed road development is in Hydrometric Area No.26 (Upper Shannon Catchment).

The locations of each of the major watercourses along the proposed road development are given in Figure 10.1 in Volume 3 of the EIAR, with each of the outfall locations and their proximity to sensitive ecological receptor locations indicated on Figures 10.2 – 10.6 in Volume 3 of the EIAR. Figure 10.7 in Volume 3 shows the upstream catchment sections and subsections to the various watercourse crossings and outfalls. There are 5 No. major watercourse crossings together with a number of other crossings of minor watercourses and 22 No. surface water outfall discharge locations proposed along the route and these are summarised in Table 10.1 below. A watercourse is defined as a channel that a flowing body of water follows and includes rivers, streams, tributaries and canals. All other culvert crossings proposed as part of this development traverse local or arterial drainage channels or drainage ditches (see Table 10.24).

The proposed road development is divided into four sections heading west to east – see Figure 10.1 in Volume 3 of the EIAR. There are no significant watercourses in section A. In general, watercourses in section B flow in a south-westerly to north-easterly direction. These watercourses ultimately feed the Upper Shannon Catchment first via the Breedoge River and then via Lough Gara which is designated as a Special Protection Area (Site Code: 004048) and is used as a large public water supply source with abstraction from its lower lake. The Carricknabraher is a tributary of the Breedoge, as is the Owennaforeesha River.

Lough Gara lies south west of the Curlew Mountains situated almost 6 kilometres to the North of Frenchpark. Lough Gara is supplied by the Lung River, which enters at the Southwest side, and the Breedoge River, which enters the lake at the Southeast side. From the main upper lake the outflow is through the northeastern corner at Cuppanagh. From that point the river becomes the Boyle River which flows past the town of Boyle into Lough Key and on to the River Shannon.

The Owenur River in section C, flows from West to East crossing the proposed road development at Killeen West and flows to the upper Shannon via Lough Nablahy. Lough Clooncullaan feeds the Owenur River.

The Strokestown and Scramoge Rivers in section D, flow from South to North and join to become the Mountain River and then flow to the Upper River Shannon via Kilglass Lough. The Scramoge River is the largest watercourse crossed by the proposed road development.

The following sections provide a general description of the principal river catchments in the area. Detailed descriptions of the individual watercourses and their sub-catchments which are crossed by, or act as receiving waters from, the proposed road development are also provided.

Table 10.1 Road Section and Associated Catchments

Section No.	Chainage:		Section Length, km	No. of Watercourse Crossings	No. of Outfalls
	From	To			
A	N5 tie in Ch.1+000	5+700	4.7	0	3
B	10+000	24+200	14.2	5	7
C	30+000	40+550	10.5	1	7
D	50+000	54+000	4.0	2	5
Total			**33.4**	**8**	**22**

10.3.2 River Catchments

10.3.2.1 Carricknabrahar River

For the greater part of its length, the Carricknabraher flows eastward crossing the existing N5 east of Frenchpark before continuing east, where it enters the Breedoge River. The Carricknabraher is fed by local streams and has a catchment area of some 20.25km^2 upstream of where it traverses the proposed road development. There are no sources of gauged flood flow information for the River.

Please note there are differences in some of the parameters quoted below between the Flood Studies Report (FSR; 1975) and Flood Studies Update Report (FSU, 2014) due to the differences in the varying mapping techniques used. It is generally considered that the areas calculated in the FSR method are more accurate than those within the FSU as they take into account the drainage network as well as the DTM contours. The FSU only considers the DTM model and has been shown for various catchments to be inconsistent with respect to the watershed.

Table 10.2 FSR Catchment Characteristics of the Carricknabraher River

Catchment Characteristic	
AREA (km^2)	20.25
Annual Rainfall SAAR (mm)	1120
Winter Rainfall Acceptance potential SOIL Index	0.45
Channel Flood Slope S1085 (m/km)	6.4
URBAN – fraction of catchment	0%

Table 10.3 FSU Catchment Descriptors of the Carricknabraher River (Source OPW FSU Web Portal Site)

Catchment Characteristic	
AREA (km^2) (OPW DTM model)	17
Annual Rainfall SAAR (mm)	1110
FARL	1.0
BFISOIL Baseflow Index of Soils	0.454
Drainage Density DRAIND km per km^2	0.815
Channel Flood Slope S1085 (m/km)	7.86
Arterial Drainage Factor ARTDRAIN2	0.3576
URBAN – fraction of catchment	0%

10.3.2.2 Owennaforeesha River

The Owennaforeesha River is also a tributary of the Breedoge River and rises in Brackloon 4.7km south of Bellanagare and flows northwards through Bellanagare village and connects with the Breedoge River in Ballynahowna, 2.8km north of Bellanagare. The river has a catchment area of 26.146km^2 upstream of where it traverses the proposed road development. There are no sources of gauged flood flow information for the River.

Table 10.4 FSR Catchment Characteristics of the Owennaforeesha River

Catchment Characteristic	
AREA (km^2)	26.15
Annual Rainfall SAAR (mm)	1120
Winter Rainfall Acceptance potential SOIL Index	0.36
Channel Flood Slope S1085 (m/km)	3.1
URBAN – fraction of catchment	0%

Table 10.5 FSU Catchment Descriptors of the Owennaforeesha River (Source OPW FSU Web Portal Site)

Catchment Characteristic	
AREA (km^2) (OPW DTM model)	26.1
Annual Rainfall SAAR (mm)	1087
FARL	1.0
BFISOIL Baseflow Index of Soils	0.5047
Drainage Density DRAIND km per km^2	0.691
Channel Flood Slope S1085 (m/km)	4.25
Arterial Drainage Factor ARTDRAIN2	0.6896
URBAN – fraction of catchment	0%

10.3.2.3 Owenur River

The Owenur River is fed from Lough Clooncullaan and takes outflow from Lough Nahincha, Lough O'Moran and several smaller streams before ultimately discharging to the Upper Shannon via Cloonahee Lough.

The Owenur has a catchment area of 31.6km^2 upstream of where the proposed road development traverses the river. This is a gauged river having a hydrometric gauging station (ref 26018) located at Bellavahan Bridge (the river having a catchment at that point of 118km^2). The Bellavahan Bridge gauging station has a good A2 Rating Classification for its flood flow-stage relationship. The record period available for the station is from 1956 to 2013 having a mean annual flood flow of 9.5cumec (Qbar) and a maximum discharge over the 57 year record of 19.6 cumec.

Based on the www.OPW.ie/hydro database the Owenur River has a mean annual flow rate of 2.465m^3/sec and a 95-percentile low flow of 0.13m^3/sec (data derived for the period 1972 to 2002 at Bellavahan Bridge.

Table 10.6 FSR Catchment Characteristics of the Owenur River

Catchment Characteristic	
AREA (km^2)	31.6
Annual Rainfall SAAR (mm)	1120
Winter Rainfall Acceptance potential SOIL Index	0.45
Channel Flood Slope S1085 (m/km)	2.1
URBAN – fraction of catchment	0%

Table 10.7 FSU Catchment Descriptors of the Owenur River (Source OPW FSU Web Portal Site)

Catchment Characteristic	
AREA (km^2) (OPW DTM model)	32.4
Annual Rainfall SAAR (mm)	1062
FARL	0.922
BFISOIL Baseflow Index of Soils	0.5811
Drainage Density DRAIND km per km^2	0.764
Channel Flood Slope S1085 (m/km)	0.1
Arterial Drainage Factor ARTDRAIN2	0.0
URBAN – fraction of catchment	0%

10.3.2.4 Strokestown River

The Strokestown River is a tributary of the Upper Shannon Catchment and rises in Carrowclogher 2.1km south of Strokestown and flows northwards through Strokestown before combining with the Scramoge river to become the Mountain River at Ballymartin, 4.8km north of Strokestown. The river has a catchment area of $5.3km^2$ at the location where the proposed road development crosses it. There are no sources of active gauged flood flow information for the River.

Table 10.8 FSR Catchment Characteristics of the Strokestown River

Catchment Characteristic	
AREA (km^2)	5.3
Annual Rainfall SAAR (mm)	1120
Winter Rainfall Acceptance potential SOIL Index	0.3
Channel Flood Slope S1085 (m/km)	2.2
URBAN – fraction of catchment	10%

Table 10.9 FSU Catchment Descriptors of the Strokestown River (Source OPW FSU Web Portal Site)

Catchment Characteristic	
AREA (km^2) (OPW DTM model)	4.13
Annual Rainfall SAAR (mm)	1016
FARL	1.0
BFISOIL Baseflow Index of Soils	0.527
Drainage Density DRAIND km per km^2	0.757
Channel Flood Slope S1085 (m/km)	1.8015

Catchment Characteristic	
Arterial Drainage Factor ARTDRAIN2	0.0
URBAN – fraction of catchment	0.1008

10.3.2.5 Scramoge River (Mountain River)

The Scramoge River combines with the Strokestown River to become becomes the Mountain River at Ballymartin. The Sramoge River has a catchment area of some 188km^2 upstream of where the proposed road development crosses it. The Mountain River has a catchment area of some 216km^2 at the location of the proposed crossing of same by the road development. This is a gauged river having a hydrometric gauging station (ref 26017) located at Gillstown.

Table 10.10 FSR Catchment Characteristics of the Scramoge River

Catchment Characteristic	
AREA (km^2)	188
Annual Rainfall SAAR (mm)	1120
Winter Rainfall Acceptance potential SOIL Index	0.27
Channel Flood Slope S1085 (m/km)	0.9
URBAN – fraction of catchment	0%

Table 10.11 FSU Catchment Descriptors of the Scramoge River (Source OPW FSU Web Portal Site)

Catchment Characteristic	
AREA (km^2) (OPW DTM model)	195.1
Annual Rainfall SAAR (mm)	1041
FARL	0.913
BFISOIL Baseflow Index of Soils	0.5833
Drainage Density DRAIND km per km^2	0.629
Channel Flood Slope S1085 (m/km)	0.9182
Arterial Drainage Factor ARTDRAIN2	0.0
URBAN – fraction of catchment	0.0

10.3.3 Flood Risk Assessment (FRA)

A flood risk assessment has been undertaken for the proposed road development. The vertical alignment assessment is subdivided in four sections relative to the primary receiving watercourse as set out earlier and listed below:

- Section A: Local Stream outfalling to the Lung River (Lough Gara)
- Section B: Carricknabrahar & Owennaforeesha
- Section C: Owenur River
- Section D: Strokestown River and Scramoge River

All bridge structures will be designed with a capacity to pass the estimated 100 year flood flow with appropriate allowances for statistical error and climate change. A minimum freeboard allowance of greater than 0.3m between its soffit level and the design Flood level will be provided. Consideration of the following flood flows and flood levels were calculated using a number of methods including: FSR, FSR-3,

FSSR-6, IH124/ICP and using the OPW FSU Web Portal and the appropriate design flow adopted.

To inform the Flood Risk Assessment (FRA) the website floodmaps.ie and the pFRA and CFRAM flood mapping were consulted as initial screening. For all of the river crossings, hydraulic flood modelling was carried out to estimate the design flood level and potential impact of the proposed road development, details of which are summarised in Table 10.12.

Table 10.12 Predicted Design Flood Levels and Flood Flows at Each of the Major River Crossings (0.01% Annual Exceedance Probability)

River Name	Chainage (m)	0.01% AEP Flood Level (mOD)	0.01% AEP Flood Flow (m^3/s)
Carricknabrahar River	10+130	79.46	40.3
Owenaforeesha River	14+540	67.46	30.7
Owenur River	30+800	48.30	49.2
Strokestown River	51+250	40.65	5.0
Scramoge River	52+875	40.67	87.8

The flood risk is scored as low, medium or high with no further mitigation measures proposed for low, minor mitigation for medium and re-design recommended for high risk. All of the proposed culvert/ bridge crossings were assessed and found to have a low residual flood risk being generously sized for flood flows and culvert/ bridge soffit freeboard clearance. The findings of the Flood Risk Assessment are summarised in Table 10.13 below. Refer to Section 10.4 for further details.

Table 10.13 Flood Risk Assessment Summary: Road Vertical Alignment

Section	Chainage	Comment on Flood Risk Areas	Overall Flood Risk	Mitigation
A: Local Stream	1+1000 – 5+697	Minimal Flood Risks	Low	None
B: Carricknabrahar River	10+000 – 24+198	Minimal Flood Risks	Low	None
B:Owenaforeesha River		Minimal Flood Risks	Low	None
C: Owenur River	30+000 – 40+511	Minimal Flood Risks	Low	None
D: Strokestown River	50+000 – 54+357	Minimal Flood Risks	Low	None
D: Scramoge River		Minimal Flood Risks	Low	None

This assessment indicates minimal flood risk to the Proposed Road Development.

10.3.4 Surface Water Quality

10.3.4.1 Rivers

EPA Monitoring River Programme

The EPA carries out water quality assessments of rivers as part of a nationwide monitoring programme. Data is collected from physio-chemical and biological surveys, sampling both river water and the benthic substrate (sediment) in contact with the water.

Water sampling is carried out throughout the year and the main parameters t analysed include: conductivity, pH, colour, alkalinity, hardness, dissolved oxygen, biochemical oxygen demand (BOD), ammonia, chloride, ortho-phosphate, oxidised nitrogen and temperature.

Biological surveys are normally carried out between the months of June and October. These examine the relationship between water quality and the relative abundance and composition of the macro-invertebrate communities in the sediment of rivers and streams. The macro-invertebrates include the aquatic stages of insects, shrimps, snails and bivalves, worms and leeches. It is generally found that the greater the diversity of species recorded, the better the water quality is.

The collated information relating the water quality and macro-invertebrate community composition is condensed to a numerical scale of Q-values or Biotic Index. The indices are grouped into four classes based on a river's suitability for beneficial uses such as water abstraction, fishery potential, amenity value, etc. (refer to Table 10.14 below).

Table 10.14 Biological River Water Quality Classification System

Biotic Index (Q value)	Quality Status	Quality Class	Condition
Q5, Q4-5, Q4	Unpolluted	Class A	Satisfactory
Q3-4	Slightly Polluted / Eutrophic	Class B	Transitional
Q3, Q2-3	Moderately Polluted	Class C	Unsatisfactory
Q2, Q1-2, Q1	Seriously Polluted	Class D	Unsatisfactory

The monitored rivers that traverse the proposed road development vary in quality from being slightly polluted (Q3-4) to moderately unpolluted (Q2-3). There are 19 No. monitoring stations that are of relevance to the proposed road development (refer to Table 10.15 for monitoring results).

Table 10.15: EPA Monitored River Water Quality Within or Near Study Area

Biological Quality Ratings (Q Values)													
River Name	**Station No.**	**Year**											
Carricknabraher	**Station Nos.**	**1980**	**1983**	**1987**	**1992**	**1996**	**1999**	**2002**	**2005**	**2008**	**2011**	**2014**	
Cloonshanville Bridge	100	4	4	4-5	4	3-4	4	3-4	3-4	4	4	4	
U/s Owennaforeesha River	200	3	4	-	3	3-4	3-4	3	3	4	3	-	
Owennaforeesha	**Station Nos.**	**1981**	**1984**	**1987**	**1992**	**1996**	**1999**	**2002**	**2005**	**2008**	**2011**	**2014**	
Bellanagare Bridge	100	4	4	3-4	4	4	3-4	3-4	3-4	3-4	4	3-4	
100 m u/s Breedoge confl	200	-	-	-	4-5	4	4	4-5	4	4	3	-	
Owenur	**Station Nos.**	**1980**	**1984**	**1987**	**1992**	**1996**	**1999**	**2002**	**2005**	**2008**	**2011**	**2014**	
Ballyoughter Br	100	4	4	4	4	4	3-4	3	4	4	4	4	
Ballyslish Bridge	300	4	4	4	4	4	4	3-4	4	4	4	4	
Bellanagrange Br	500	4	3-4	4	3-4	3	3	4	4	4	4	4	
Scramoge	**Station Nos.**	**1981**	**1984**	**1986**	**1987**	**1992**	**1996**	**1999**	**2002**	**2005**	**2008**	**2011**	**2014**
Bridge d/s Lough Conny More	50	-	-	-	4	4	4	4	4	4	4	3	3-4
Cloonfree Bridge	200	4-5	4	4	4	4	4	4	4-5	4	4	4	3-4
Cloonconny Bridge	300	3-4	4	4-5	4	3	4	4	4	4	4	4	4
Scramoge Bridge	600	4	4	4-5	4	4	4	4	4-5	4	4	4	4
Strokestown	**Station Nos.**	**1984**	**1987**	**1992**	**1996**	**1999**	**2002**	**2006**	**2008**	**2011**	**2014**		
Br at S. end of Strokestown	50	-	3	2-3	2-3	2-3	3	3-4	2-3	2-3	3		
Br 1.5 km d/s Strokestown	100	3-4	3	2-3	4	2-3	3	3	3	3	3-4		
Br SW Toberpatrick	200	4	4	4	3-4	4	4	3-4	4	4	4		
Breedoge	**Station Nos.**	**1981**	**1983**	**1987**	**1992**	**1996**	**1999**	**2002**	**2005**	**2008**	**2011**	**2014**	
Loughbally Br	100	3-4	4	-	4	3-4	4-5	4	3	-	-	-	
Bella Bridge	200	5	4-5	4-5	4-5	-	-	-	-	-	-	-	
Breedoge Bridge	300	5	4	4	4	4-5	4	4	4	4	4	3-4	
Mountain	**Station Nos.**	**1981**	**1984**	**1987**	**1992**	**1996**	**1999**	**2005**	**2008**	**2011**	**2014**		
1 km u/s Kilglass Lough	100	4	4	4	4	3-4	3-4	4	3-4	3-4	3-4		

The WFD 'Water Matters' website mapping section provides details on the assessments of the 5 water bodies / sub catchments being traversed by the proposed road development at downstream receptors (Table 10.16).

Table 10.16 WFD Classification of River Waters Near the Ballaghaderreen to Scramoge Road Development

Waterbody Name		Code	Status	Objective	Risk
Carricknabrahar River	Tributary of Breedoge	IE_SH_26_3912	Moderate	Restore	1a - At Risk
Owennaforeesha	Tributary of Breedoge	IE_WE_32_3732	Moderate	Restore	1a - At Risk
Owenur	Cloonahee Lough	IE_WE_26_2513	Good	Restore	1a - At Risk
Strokestown	Tributary of Mountain River	IE_WE_34_1421	Poor	Protect	1a - At Risk
Scramoge	Tributary of Mountain River	IE_WE_34_1762	Poor	Restore	1a - At Risk
Breedoge	**Not Traversed by PRD***	IE_SH_26_2898	Poor	Restore	1a - At Risk
Mountain River	**Not Traversed by PRD**	IE_SH_26_3801	Poor	Restore	1a - At Risk

* PRD – Proposed Road Development

The highest quality river is the Strokestown River having a Good status and a Water Framework Objective of 'Protect' as opposed to the 'Restore' which is required for all the other above listed watercourses.

10.3.4.2 Lakes

As part of a national water quality monitoring programme a number of lakes throughout the country are sampled and the trophic status assessed. Lake water quality is most commonly assessed by reference to a scheme proposed by the Organisation for Economic Cooperation and Development (OECD, 1982). This scheme defines the traditional trophic categories by setting boundaries for the annual average values for total phosphorus, chlorophyll A and water transparency, and for the maximum and minimum vales of the latter two parameters.

A modified version of these criteria is used in which annual maximum chlorophyll-a concentration is the only parameter used. This has been further subdivided into six water quality categories by reference to the maximum levels of planktonic algae measured during the period (refer to Table 10.17). Indicators relating to water quality and the probability of pollution are also shown.

Table 10.17 Trophic Classification Scheme for Lake Waters

Classification Scheme		Category Description				
Lake Trophic Category		**Annual Maximum Chlorophyll-a (mg/m^3)**	**Algal Growth**	**Degree of Deoxygenation in Hypolimnion**	**Level of Pollution**	**Impairment of Use of Lake**
Oligotrophic	(O)	<8	Low	Low	Very low	Probably none
Mesotrophic	(M)	8 – 25	Moderate	Moderate	Low	Very little
	Moderately (m-E)	25 – 35	Substantial	May be high	Significant	May be appreciable
Eutrophic	Strongly (s-E)	35 – 55	High	High	Strong	Appreciable
	Highly (h-E)	55 – 75	High	Probably total	High	High
Hypertrophic	(H)	>75	Very high	Probably total	Very high	Very high

The trophic status provides an indication as to what degree the lake is enriched by the presence of nutrients such as phosphorus and to a lesser extent nitrogen in the form of nitrate.

Along the proposed road alignment there are three lake stations currently monitored as part of the EPA water quality reporting. Lough Gara, Annaghmore Lough and Grange Lough are all classified as Oligotrophic/Mesotrophic in terms of water quality indicating that nutrient enrichment is low and eutrophication is not a major concern.

Under the WFD classification for surface water bodies, there are 5 lakes that are listed close to the proposed road development (refer to Table 10.18).

Table 10.18 WFD Classification of Lake Waters Within Study Area

Waterbody Name	Code	Status	Objective	Risk
Lough Gara	IE_SH_26_728	Good	Protect	1b - Probably at Risk
Nablahy Lough	IE_SH_26_682	Good	Protect	2a - Probably Not At Risk
Kilglass Lough	IE_SH_26_748	Moderate	Restore	2a - Probably Not At Risk
Annaghmore Lough	IE_SH_26_669	Moderate	Restore	2a - Probably Not At Risk
Grange Lough	IE_SH_26_706	Good	Protect	2a - Probably Not At Risk

10.3.5 Ecological Receptors

A number of key ecological receptors (KER's) adjacent to the proposed road development have been identified and discussed in detail in Chapter 7. These receptors are summarised in Table 10.19 below.

Table 10.19 Ecological Receptors: Summary

KER No.	Chainage Range	Description	Receptor Importance
KERs 1a(N) & 1b(C)	4+000 – 4+500	Wet Grassland (Molina Meadows) Potential Marsh Fritillary Habitat	National / County Importance

KER No.	Chainage Range	Description	Receptor Importance
KERs 2a(LH) and 2b(N)	5+000-5+500	Raised Bog Cutover Bog Bog Woodland	Local Importance (higher value) National Importance
KER 3(LH)	10+125-10+150	Carricknabraher River – the OPW have indicated this is a Salmonid watercourse	Local Importance (higher value)
KER 4(C)	10+750-10+850	Wet Grassland (Molina Meadows) Potential Marsh Fritillary Habitat	County Importance
KER 5(N)	11+800 – 12+150	Wet Grassland (Molina Meadows) Potential Marsh Fritillary Habitat	National Importance
KERs 6a(N), 6b(N), 6b(C), 6b(LH), 6c(N), 6c(LH), 6c(LL)	10+900 – 12+350	Raised Bog Cutover Bog Wet Heath Bog Woodland	National Importance County Importance Local Importance (lower value)
KERs 7a(N) and 7b(LH)	13+950 – 14+450	Raised Bog Cutover Bog Bog Woodland	National Importance Local Importance (higher value)
KER 8(LH)	14+450 – 14+800	Owennaforeesha River – the OPW have indicated this is a Salmonid watercourse	Local Importance (higher value)
KER 9(LH)	14+500 – 14+650	Bog Woodland	Local Importance (higher value)
KER 10(LH)	15+150 – 15+300	Bog Woodland	Local Importance (higher value)
KER 11(LH)	16+700 – 17+200	Bog Woodland Cutover Bog	Local Importance (higher value)
KER 12(LH)	18+250 – 20+250	Mixed Broadleaved Woodland	Local Importance (higher value)
KER 13(LH)	30+550 – 31+950	Owenur River Marsh and Wet Grassland Wet Grassland Reedswamp & Poor Fen	Local Importance (higher value)
KER 14(LH)	32+900 – 34+450	Mature Tree Lines Wet Grassland	Local Importance (higher value)
KERs 15a(LH) 15b(LL), 15c(N), 15d(C), 15e(C)	33+350 – 35+750	Lough Clooncullaan, Wetland complex Rich Alkaline Fen Reed Swamp Reed Swamp	National Importance Local Importance (higher & lower value) County Importance
KER 16(N)	36+650 – 37+950	Turlough (Cregga)	National Importance
KER 17(LH)	50+850-51+800	Cutover Bog Bog Woodland, Scrub and Grassland	Local Importance (higher value)
KER 18(LH)	52+150 – 52+650	Mixed Woodland & Scrub	Local Importance (higher value)

KER No.	Chainage Range	Description	Receptor Importance
KER 19(LH)	52+850 – 53+250	Scramoge River - the OPW have indicated this is a Salmonid watercourse	Local Importance (higher value)
KER 20(LH)	53+300 – 53+950	Mixed Broadleaved /Conifer Woodland	Local Importance (higher value)

10.3.5.1 SAC's and SPA

Special Areas of Conservation (SAC) and Special Protection Areas (SPA) are afforded legal protection under European Legislation for the conservation of natural habitats and of wild flora and fauna. SAC's and SPA's form part of the NATURA 2000 network of European wide protected sites. A number of priority habitats are also listed which afford special conservation status and attract stricter protection.

No SAC or SPA is traversed by the proposed road development, however there are six designated sites which were screened-in during the Appropriate Assessment screening comprising Bellanagare Bog (SAC and SPA), Annaghmore Lough (SAC), Cloonshanville Bog (SAC), Lough Gara (SPA) and Lough Forbes Complex (SPA).

Bellanagare Bog SAC and SPA

Bellanagare Bog is listed as a SPA (Ref. 004105), a candidate Special Area of Conservation (000592) and also as a proposed National Heritage Area (pNHA) (Ref. 000592). The bog is located some 1.5km south of Frenchpark in the townland of Leggatinty. The proposed road development passes approximately 200m to the north of Bog. The bog shows the characteristics of a blanket bog habitat and is classified as an intermediate raised bog. The site is selected as a SAC for the following habitats and/or species listed on Annex I&II of the E.U. Habitats Directive: Active Raised Bog [7110], Degraded Raised Bog [7120], Rhynchosporion Vegetation [7150], Marsh Fritillary (Euphydryas aurinia) [1065].

Annaghmore Lough SAC

Annaghmore Lough is designated as a candidate Special Area of Conservation (Ref. 001626) and is located approximately 3km south of Elphin. The Lough lies at the centre of a network of small lakes in a rolling, drift-covered landscape. The site was selected as a SAC for the following habitats and/or species listed on Annex I&II of the E.U. Habitats Directive: Alkaline fens [7230] and Vetigo geyeri (Geyer's Whorl Snail) [1013]). In addition the site is important for wintering birds and is listed as a wildfowl sanctuary (WFS-44). This site is relatively intact with minor damage; cattle grazing, burning on the fen and drainage pose the main potential threats to the site. This is a site of considerable conservation importance given the habitats and rare species present. The proposed road development passes approximately 1.8km to the north of this SAC.

Cloonshanville Bog SAC

Cloonshanville Bog is designated as a candidate Special Area of Conservation (Ref. 000614) and is located approximately 1km north of Frenchpark in the townland of Cloonshanville. The site was selected as a SAC for the following habitats and/or species listed on Annex I&II of the E.U. Habitats Directive: Active Raised Bog [7110], Degraded Raised Bog still capable of natural regeneration [7120], Depressions on peat substrates of the Rhynchosporion [7150] and Bog woodland [91D0]. The proposed road development passes within 1.7km to the south of this designated site.

Lough Gara SPA

Lough Gara is a shallow medium-sized lake, situated some 6km north-east of Ballaghaderreen. There are two main sections to the lake, a larger northern basin and a smaller southern basin which are joined by a narrow channel. The main inflowing rivers to the lake system are the River Lung and the Breedoge River while the main outflow from the lake is the River Boyle. The lake is classified as a mesotrophic system, with reduced planktonic algal growth. Callow Bog SAC is situated on the southern shore of the lake. The site was selected as a Special Protection Area due to the presence of the following species: Whooper Swan (Cygnus cygnus) [A038] and Greenland White-fronted Goose (Anser albifrons flavirostris) [A395]. The proposed developed is located c.2.6km south of Lough Gara SPA at its closest point.

Lough Forbes Complex SAC (001818)

This SAC consists of a natural lake system, active raised bogs degraded raised bogs, depressions on peat substrates and alluvial forests. The site is a candidate Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I& II of the E.U. Habitats Directive Natural Eutrophic Lakes [3150], Raised Bog (Active) [7110], Degraded Raised Bog [7120], Rhynchosporion Vegetation [7150], Alluvial Forests [91E0]. This site is located downstream of the proposed road development and is fed by the River Shannon. Based on precautionary principle, the site has been considered to lie within the Zone of Impact of the proposed development in respect of a potential surface water spillage. The proposed developed is located c.10.5 km west of the Lough Forbes Complex SAC at its closest point.

NHA's and pNHA's

This is the national designation for wildlife, and is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. Listed sites that were published on a non-statutory basis in 1995, but have not since been statutorily proposed or designated, are regarded as proposed NHA i.e. pNHA. All NHA's are afforded legal protection from damage from the date they are formally proposed for designation. No NHAs or pNHAs are traversed by the proposed road development (**see Figure 7.1 in EIAR Volume 3**).

Designated Sites in the Zone of Impact of the Proposed Road Development

All European sites located greater than 15km from the Proposed Road Development, with no identifiable connectivity or located in a separate hydrological catchment (Water Framework Directive Catchment Mapping) were deemed to be outside the Zone of Impact of the proposed alignment as no pathways for significant effects were identified.

Additional European sites with hydrological connectivity, located downstream in the Shannon Catchment are considered to be sufficiently remote from the proposed development as results in their exclusion beyond reasonable scientific doubt from being likely to be impacted either by construction activities or operation of the proposed road development. The worst case scenario would be a major pollution incident towards the eastern end of the proposed road development which would have to travel a distance in excess of 70km discharging through a sequence of waterbodies before affecting at any such sites. The buffering and dilution effect of these waterbodies will ensure imperceptible impact on European sites with identifiably hydrological connectivity but located outside the 15km buffer zone.

Table 10.20 summarises the numbers of protected sites occurring within a number of buffer zones from the proposed road development.

Table 10.20 Summary of SAC, SPA, NHA and pNHA Sites Adjacent to the Proposed Road Development

Site	1km Buffer	5km Buffer	10km Buffer	15km Buffer
SAC	2	5	8	17
SPA	1	2	3	4
NHA	0	2	4	9
pNHA	2	7	16	34

10.3.5.2 Water Supply Sources

Regional Water Supply

There are two regional water supply schemes and two Group Water Supply (GWS) schemes in proximity to the proposed road development.

North Roscommon Regional Water Supply

The principal source of the North Roscommon water supply is Lower Lough Gara, located approximately 5km North of Frenchpark. The scheme serves 6,500 people including those in Ballaghaderreen and the surrounding areas. Water is treated by flocculation, clarification, filtration and chlorination. The treatment plant was commissioned in 1982 and upgraded in 1991. The plant produces 7,000m^3 a day.

Water quality is monitored by Roscommon County Council to ensure that the parametric values from the European Communities (Drinking Water) No. 2 Regulations, 2007 are complied with. Both check and audit monitoring is carried out.

Northeast Roscommon & Ballyleague Regional Water Supply Scheme

The North East Roscommon Regional Water Supply extends from Roosky in the east to Tulsk in the west and from Drumsna in the north to Ballyleague in the south. The water supply scheme serves over 5,400 people including residents of Strokestown, Elphin, Tulsk and Scramoge. The supply for this source is taken from Lisheen Lake located approximately 6km north of Strokestown. Roscommon County Council also maintain a number of groundwater supply boreholes located in the vicinity of Strokestown which augment the supply. Boil water notices have frequently been issued for this supply scheme due to continued microbiological contamination from human and agricultural sources. In January 2016 Irish Water, awarded a contract for the design, construction and commissioning of a new water treatment plant for the North East Roscommon & Ballyleague Regional Water Supply Scheme. Construction of the plant commenced in 2016 and is expected to be completed in 2017.

There are three Group Water Scheme supplies within the Study area both of which are spring supplies from the Bedrock Aquifer. The springs are located at Peak, Curracreigh and Lissavilla. A brief description of each scheme is given below. Further more detailed descriptions may be found in **Section 9.3.1**.

Peak Mantua Group Water Supply Scheme

The Peak Mantua Group Water Scheme (GWS) consists of a spring water supply with an abstraction rate of 80m^3/day. The supply source is named Tober Knockageely spring which is located to the east of Bellanagare in the townland of

Peak. This scheme supplies approximately 40 domestic connections and serves up to 90 people.

Curracreigh Group Water Scheme

Curracreigh GWS is an amalgamation of a number of GWS's including; Annaghmore/Corraslira GWS, Clooncullana/Clooncunny GWS, Cloonyquinn GWS and Rathcroaghan/Tulsk GWS. The scheme is supplied by a large spring at Cloonyquinn which is approximately 6km south of Elphin. The spring is located adjacent to the N61 national secondary road in Cloonyquinn. The reported abstraction rate from Curracreigh spring is 300m^3/day and serves over 800 people.

Polecat Group Water Scheme

Polecat Group Water Scheme (GWS) is supplied from a spring (Pollacat spring) located 3km northeast of Elphin. The scheme abstracts approximately 550m^3/d (395 domestic and 588 non domestic/land connections). Polecat GWS is a co-operative and an amalgamation of three GWSs (Aughrim, Creeve and Corbally/Boheroe GWSs). The scheme recently received a significant capital upgrade now providing full treatment (filtration and disinfection) prior to distribution.

10.4 Impact Assessment

10.4.1 Introduction

Road projects given their scale and nature have significant potential for causing impact to the hydrological environment both during their construction and on-going operation and consequently require careful planning and detailed assessment to ensure the best solution is attained.

10.4.2 Methodology

The assessment of hydrological impacts for the proposed road development has been based on the analysis and interpretation of the data acquired during the Constraints Study and Route Corridor Selection phases, as well as site specific investigations undertaken as part of the EIA, including the ecological study, intrusive site investigation, agricultural survey, topographical survey and hydrological walkover and surveys. The procedure follows the guidelines set out in the publication 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes', TII/NRA.

Key hydrological attributes identified along the proposed road development include:

- European Designated Sites including: Bellanagare Bog SAC (000592) SPA (004105), Annaghmore Lough (Roscommon) SAC (001626), Cloonshanville Bog SAC (000614), Lough Forbes Complex SAC (001818), Lough Gara SPA (004048) and Callow Bog SAC.
- Nationally Important Annex 1 habitats such as a Turlough at Cregga, raised bog at Bellanagare and Leggatinty, Alkaline Fen at Tullyloyd, wet grassland at Leggatinty and raised bog at Corskeagh.
- Surface drinking water supply abstraction source at Lough Gara
- Ecologically sensitive surface water features and catchment systems, fishery streams either locally or downstream, Fens, flushes and wetlands etc.;
- Flood Risk Areas; and
- Karstic Areas.

The individual importance of these attributes has been then assessed with respect to their quality, extent / scale and rarity as set out in Table 10.21 below.

Table 10.21 Criteria for Rating Site Attributes

Importance	Criteria
Extremely High	Attribute has a high quality or value on an international scale
Very High	Attribute has a high quality or value on a regional or national scale
High	Attribute has a high quality or value on a local scale
Medium	Attribute has a medium quality or value on a local scale
Low	Attribute has a low quality or value on a local scale

For the purposes of this assessment and particularly with reference to the identified KERs and how their importance was rated from the hydrological perspective (this is in agreement with the approach used for rating ecological sites – see Chapter 7), the following rating criteria were used:

- Local Importance Lower value - Low
- Local Importance Higher value – Medium
- County/ Regionally Important – High
- National Importance – Very high
- European Importance – Extremely Important

Details of the importance rating assigned to each of the key hydrological attributes, and in particular the KERs, is indicated in Table 10.34.

10.4.3 Types of Hydrological Impact

Types of hydrological impact fall into two broad categories of quantitative and qualitative impacts.

10.4.3.1 Quantitative Impacts

Hydraulic structures such as bridges, culverts, channel diversions and outfalls can if not appropriately designed impact negatively on upstream water levels and downstream flows. If a bridge or culvert opening is too narrow or a diversion channel undersized it may impede flow during times of floods thus causing water levels upstream of the structure to be raised above what would occur in the absence of the structure.

In the road development design the adequacy of culvert sizes for local drainage areas and small river catchments is based on providing conveyance for the 100 year return period flood event with recommended climate change allowance. Blockage potential and maintenance requirements are also considered and are often the overriding design factor for small stream crossings. In this respect the design flow used is based on gauged flow data, where available, or the upstream catchment characteristics of the crossing including:

- Catchment area,
- Annual average rainfall for the catchment,
- Mean channel slope (S1085),
- Soil type,
- Flood Studies Report (FSR) 100 year flood growth factor of 1.96.

Each method included the standard factorial error for the related estimation method (Institute of Hydrology Report No. 124 3-variable equation (IH-124) =1.65, Flood Studies Report 6 variable equation (FSR) (Ireland) =1.47). A climate change allowance of 1.2 was included in all estimations. In addition where a channel is maintained under a drainage district or arterial drainage scheme, an arterial drainage factor of 1.6 was also included. The Flood Studies Update (FSU) Research Programme was implemented by the OPW and provides a substantial update of the Flood Studies Report. The FSU is an upgraded method for providing estimates at a network of hydrometric nodes throughout Ireland and has a factorial error of 1.38. The method uses a pooled growth curve of hydraulically similar catchments as the subject catchment which differs from the FSR which uses a single national growth curve.

Surface water drainage from the carriageway, grassed margins and embankment slopes can lead to localised increased flows and flooding in the receiving streams. The proposed mainline road drainage system is a combination of piped drains, concrete surface water channels and filter drains where permitted, which convey storm runoff to one of the various surface outfall locations located along the 33.4km length of mainline road.

10.4.3.2 Qualitative Impacts

Depending on the hydrological and ecological sensitivities of the proposed outfall receiving waters, treatment of the storm water via online or offline detention / water quality improvement ponds are required upstream of the outfall to protect the water quality particularly from spillage and first flush runoff events. The potential contaminant load and accidental spillage risk for a single outfall and sub-catchment area is a function of the Design Traffic Volume and road paved area/length.

10.4.3.3 General Hydrological Impacts

Operational General Impacts:

- Permanent interference with river, streams and floodplains at road bridge / culvert crossing points. These structures can, if not appropriately designed create an obstacle to flow, particularly under flood conditions resulting in increased flood risk and damage as a result of afflux by such structures. Such structures can locally alter bed levels and channel dimension resulting in changes in flow velocity and water depth which can during low flow periods represent a barrier to fish passage. These structures can result in localised bed and bank erosion resulting in long-term changes to the morphology of the stream channel.
- Removal of flood storage as a result of the road footprint encroaching on the floodplain area. This can result in slight to moderate reduction in the flood attenuating function of a floodplain.
- Potential diversion of water between drainage catchments as a result of the road alignment and associated drainage network and outfalls. At some locations, the creation of the proposed road perpendicular to the natural drainage path may lead to the interception of overland flow into the road drainage system (surface drainage or toe drainage / cut off drains) that will convey it to the nearest associated outfall. This may lead in some cases to permanent diversion of flow resulting in an increase in the rate and volume of flow in one watercourse and a corresponding reduction in the other, with potential implications for flood risk and water quality/ dilution.
- Interference with local drainage, relocation, discontinuation and combination of existing land drains as a result of the road footprint and its associated drainage

system including toe drains and attenuation/detention drainage ponds. This can lead to local changes in the hydrological regime and can lead to a concentration of flows where a number of smaller drains are discontinued / diverted. This can lead potentially to a deterioration of the hydraulic capacity and exacerbation of flood risk. In the event of realignment of watercourses this will effectively remove a section of channel reach including its channel and bank-side ecology.

- Increased runoff to watercourses at proposed storm outfalls due to the road pavement (impervious area), reduced transmission time and increased point loading associated with the road and drainage system. This can, particularly in the smaller receiving watercourses/drains, lead to increased flood flow magnitudes and increased frequency of flooding.
- Water quality impact on receiving watercourses at storm outfalls from routine road runoff (generally sediment associated contaminants, heavy metals, hydrocarbons and suspended solids, de-icing agents (salt and grit) and to a lesser extent nutrients, organics, and coliforms). A wide range of heavy metals are known to occur in road drainage waters, the primary metals of concern are cadmium (Cb), Lead (Pb), copper (Cu) and Zinc(ZU). All of these metals are included in the EU substances Directive (76/464/EEC), the EU Directive on Pollution Caused by Certain Dangerous Substances (2006/11/EC), the EU Water Framework Directive (2000/60/EC) and the proposed EU priority Contaminating Substances Directive. In particular Cadmium is a List 1 substance included in the EU Blacklist of dangerous substances; all other compounds are List 2 substances.

The road drainage and associated storm outfalls provide a direct pathway for contaminant from accidental spillages associated with HGV's (agricultural, oil/chemical spillages, bulk liquid, cement, etc.) to gain rapid un-attenuated access to receiving watercourses.

Salt and grit applications to road surfaces to mitigate icy conditions, will result in an increased salinity, pH, conductivity and total dissolved solids concentrations to receiving aquatic system. Increased salinity of watercourses can alter the ecological balance of the aquatic system and increase the bioavailability of chemical contaminants.

Construction General Impacts

Construction activities pose a significant risk to watercourses particularly contaminated surface water runoff from construction activities entering nearby watercourses.

Construction activities within and alongside surface waters associated with bridge and culvert construction, outfalls and channel diversions can contribute to the deterioration of water quality and can physically alter the stream/river bed and bank morphology with the potential to alter erosion and deposition rates locally and downstream. Activities within or close to the watercourse channels can lead to increased turbidity through re-suspension of bed sediments and release of new sediments from earthworks. Consequently instream works can potentially represent a severe disruption to aquatic ecology.

The main contaminants arising from construction runoff include:

- Elevated silt/sediment loading in the construction site runoff. Elevated silt loading can lead to long-term damage to aquatic ecosystems by smothering

spawning grounds and gravel beds and clogging the gills of fish. Increased silt load in receiving watercourses stunts aquatic plant growth, limits dissolved oxygen capacity and overall reduces the ecological quality with the most critical period associated with low stream flow conditions. Chemical contaminants in the watercourse can bind to silt which can lead to increased bioavailability of these contaminants.

- Spillage of concrete, grout and other cement based products. These cement based products are highly alkaline (releasing fine highly alkaline silt) and extremely corrosive and can result in significant impact to watercourses altering the pH, smothering the stream bed and physically damaging fish through burning and clogging by the fine silt of gills.
- Accidental Spillage of hydrocarbons from construction plant and at Storage depots / construction compounds.
- Faecal contamination arising from inadequate treatment of on-site toilets and washing facilities.

10.4.4 Impact of Hydraulic Structures and Interference with Drainage Paths

This sub-section considers the hydraulic impact of the proposed watercourse culvert crossings along the proposed road development. The preliminary drainage design has identified that a large number of minor drains/watercourses are intercepted by the proposed road development. A large number of these smaller field drains can, from a hydraulic and fisheries perspective, be truncated and the upstream portion diverted either to another existing drain close by or connected into the road embankment drainage ditch.

10.4.5 Culvert Crossings

Table 10.22 below presents a summary of the primary culvert crossings including upstream contributing catchment area and Table 10.23 presents the proposed culvert sizes.

Table 10.22: Proposed Road Culvert Crossings

Culvert No.	Location	Ch.	Drainage District Channel	Watercourse Name	WFD River Basin Catchment	Ecological Evaluation	Catchment	
							Area, km^2	Ref. No.
WB10.01	N5	10,130	OPW Boyle Scheme	Carricknabraher	Upper Shannon	4	20.26	1
WB14.01	N5	14,540	OPW Boyle Scheme	Owennaforeesha	Upper Shannon	3-4	26.15	3
WB30.01	N5	30,750	Elphin DD	Owenur River	Upper Shannon	4	31.60	11
WB52.01	N5	52,830	Strokes-town DD	Scramoge River	Upper Shannon	3-4	188.12	15
WC12.01	N5	12,700	OPW Boyle Scheme	Trib. Of Carricknabraher	Upper Shannon	4	3.74	2
WC12.02	LT-56403 North	255	No	-	Upper Shannon	-	3.74	2

Culvert No.	Location	Ch.	Drainage District Channel	Watercourse Name	WFD River Basin Catchment	Ecological Evaluation	Catchment	
							Area, km^2	Ref. No.
WC14.01	N5	14,600	OPW Boyle Scheme	Trib.of Owennaforeesha	Upper Shannon	3-4	5.93	4
WC15.01	N5	15,210	OPW Boyle Scheme	-	Upper Shannon	-	0.09	5
WC21.01	N5	21,325	No	Mantua River	Upper Shannon	-	1.16	6
WC21.02	LS-6023	70	No	Mantua River	Upper Shannon	-	1.53	7
WC23.01	N5	23,200	No	-	Upper Shannon	-	0.17	9
WC24.01	N61 South	235	No	-	Upper Shannon	-	10.24	10
WC24.02	N61 North	800	No	-	Upper Shannon	-	2.16	8
WC33.01	N5	33,200	No	-	Upper Shannon	-	0.16	12
WC33.02	Access	33,200	No	-	Upper Shannon	-	0.16	12
WC33.03	Access	33,345	No	-	Upper Shannon	-	0.16	12
WC51.01	N5	51,110	Strokes-town DD	Strokestown River	Upper Shannon	3-4	5.30	14
WC52.01	LS-6121 East	50	No	-	Upper Shannon	-	0.25	16

As can be seen from above Table 10.22, the majority of the streams intercepted are relatively small in respect to catchment area and the recommended dimensions provided below support the existing stream channel dimensions and will not result in any significant contraction of the streamflow at the crossing point. These sizes ensure that the design flow barrel velocity is of the order of 0.75m/s to 2m/s and thus potential upstream afflux is minimised.

Table 10.23: Minimum Sizing of Water-Crossing Culverts

Culvert No.	Location	Ch.	Length (m)	Size (Pipe Dia) (m)	Size		Mammal Pass Requirement	Fisheries Requirement
					W (m)	H (m)		
WB10.01	N5	10,130	32	N/A	8.00	3.30	Bridge will over span bank to maintain mammal pass	Bridge to be constructed online
WC12.01	N5	12,700	37	N/A	2.70	2.70	Separate 600mm dia pipe for mammal pass next to crossing	Culvert to be constructed offline
WC12.02	LT-56403 North	312	33	N/A	2.70	2.70	Separate 600mm dia pipe for mammal pass next to crossing	Culvert to be constructed online

Culvert No.	Location	Ch.	Length (m)	Size (Pipe Dia) (m)	Size		Mammal Pass Requirement	Fisheries Requirement
					W (m)	H (m)		
WB14.01	N5	14,525	40	N/A	7.00	3.30	Bridge will over span bank to maintain mammal pass	Bridge to be constructed online, with stream diversions not to exceed 60 degrees angle or meandering.
WC14.01	N5	14,600	42	N/A	3.30	2.40		Culvert to be constructed offline, with stream diversions not to exceed 60 degrees angle or meandering.
WC15.01	N5	15,210	44	1.20	N/A	N/A		Culvert to be constructed online
WC21.01	N5	21,325	30	N/A	2.70	1.80		Culvert to be constructed online, with stream diversions not to exceed 60 degrees angle or meandering.
WC21.02	LS-6023	70	25	N/A	3.00	1.80		Culvert to be constructed offline, with stream diversions not to exceed 60 degrees angle or meandering.
WC23.01	N5	23,200	37	1.20	N/A	N/A		Drainage pipe changed to a culvert
WC24.01	N61 South	235	26	N/A	4.20	2.40		Culvert to be constructed offline, with stream diversions not to exceed 60 degrees angle or meandering.
Culvert WC24.02	N61 North	800	20	1.80	N/A	N/A		-
WB30.01	N5	30,750	27	N/A	9.00	3.60	Bridge will over span bank to maintain mammal pass	Bridge to be constructed online
WC33.01	N5	33,200	37	1.20	N/A	N/A		Culvert to be constructed online
WC33.02	Access	33,200	10	1.20	N/A	N/A		Culvert to be constructed online
WC33.03	Access	33,345	10	1.20	N/A	N/A		Culvert to be constructed online
WC51.01	N5	51,110	47	N/A	4.20	2.10	Single mammal ledge.	Culvert to be constructed offline, with stream diversions not to exceed 60 degrees angle or meandering.

Culvert No.	Location	Ch.	Length (m)	Size (Pipe Dia) (m)	Size		Mammal Pass Requirement	Fisheries Requirement
					W (m)	H (m)		
WC52.01	LS-6121 East	50	30	1.50	N/A	N/A		Culvert to be constructed online
WB52.01	N5	52,830	21	N/A	20.00	3.60	Bridge will over span bank to maintain mammal pass	Bridge to be constructed online

Notes:

1) All box culverts are to be constructed to an invert level 500mm below that of the existing channel.

2) All piped culverts are to be constructed to an invert level minimum 300mm below that of the existing channel.

3) The sizes indicated above are full sizes inclusive of any increases required to accommodate depressed inverts or mammal ledges.

The above crossing sizes (Table 10.23) allow for pipe culverts and box section inverts to be buried beneath the existing bed level by depths of 300mm in respect to pipes and 500mm in respect to the box sections.

All other watercourses traversed by the proposed mainline are minor in flow requirements and therefore will be culverted using a standard nominal 1200mm diameter concrete pipe or equivalent.

Under the 1945 Arterial Drainage Act culverting of streams by either new, upgraded or extended culverts/bridges require Section 50 approval from the OPW. This enables the OPW who are responsible for Flood Risk Management and Arterial Drainage to assess the implications of the proposed works. The minimum culvert size to be used in relation to the natural drainage is a 1200mm diameter pipe culvert which facilitates burying of the pipe by 300mm. From a hydraulic capacity, blockage potential and maintenance point of view this minimum culvert size is acceptable and meets the OPW requirement.

Section 50 applications for all culvert and diversion arrangements have been submitted and approved by the OPW as part of the design process. The proposed culverting at each of the watercourse crossings will have a slight to imperceptible local impact on flooding and flood risk.

10.4.6 Stream Diversions Associated with Road Alignment and proposed culverts

Stream diversions/realignments are not proposed on the major Salmonid Rivers; the Carricknabraher, Owenoforeesha and Scramoge Rivers. The construction of watercourse crossings through the proposed road embankment will necessitate in some cases the localised diversion/realignment of the existing non-fishery sensitive watercourse in order to:

a) Allow construction of culverts to be undertaken outside of the watercourses;

b) Facilitate the construction of culverts at different orientations in order to minimise culvert lengths and to tie-in with the road alignment and drainage network;

c) Relocate the watercourses away from the embankment construction footprint.

Where feasible these minor watercourse diversions/realignments will be carried out in the dry and when the channel has established the watercourse will be diverted. The principal impact on a watercourse by a diversion is the change in the watercourse morphology. The general potential impacts are summarised as follows:

- Slacker gradients: Slower flow velocities with resulting increased flow area and deposition, siltation promoting vegetation and weeds to grow in channels during periods of low flow;
- Steeper gradients: Faster flow velocities, increased local bed erosion, shallower low flow depth;
- Sharp bends and change in direction: Erosion and deposition with subsequent changes to the river channel morphology;
- Lack of natural flood plains: Increase in upstream flood levels.

Other potential impacts of watercourse diversions include:

- Change to natural low flow channels: Impact on fisheries and other animals;
- Change to existing foliage and vegetation: Impact on fisheries and other species (otters, badgers etc.).

Watercourse diversions have been identified along the proposed road development involving either diversion in parallel with or at right angles to the existing channels. Table 10.24 summarises the proposed watercourse diversion locations and mitigation – mitigation measures are discussed in more detail in Section 10.5.

Table 10.24: Impact Assessment of Diversions/Realignments of Non-sensitive Watercourses

Chainage From	Chainage To	Ref.	Impact on Flood Flow Magnitude	Impact on Watercourse Morphology	Designed Protection Measures
10130	10330	WD10.01	Minor	Slight	Bank Erosion control at bends
12700	12740	WD12.01	Minor	Slight	Bank Erosion control at bends
14600	14680	WD14.01	Minor	Slight	Bank Erosion control at bends
14590	14600	WD14.02	Minor	Slight	Bank Erosion control at bends
17300	17570	WD17.01	Minor	Slight	Bank Erosion control at bends
21300	21330	WD21.01	Minor	Slight	Bank Erosion control at bends
21740	21760	WD21.02	Minor	Slight	Bank Erosion control at bends
21770	21830	WD21.03	Minor	Slight	Bank Erosion control at bends
30000	30030	WD24.01	Minor	Slight	Bank Erosion control at bends
30600	30720	WD30.01	Minor	Slight	Bank Erosion control at bends
30720	30850	WD30.02	Minor	Slight	Bank Erosion control at bends
33190	33195	WD33.01	Minor	Slight	Bank Erosion control at bends
33200	33350	WD33.02	Minor	Slight	Bank Erosion control at bends
51100	51105	WD51.01	Minor	Slight	Bank Erosion control at bends
51100	51190	WD51.02	Minor	Slight	Bank Erosion control at bends
52850	52900	WD52.01	Minor	Slight	Bank Erosion control at bends
52800	53000	WD52.02	Minor	Slight	Bank Erosion control at bends

10.4.7 Bridge Crossings

Clear span bridges are proposed to avoid constructing piers in-stream at the Carricknabraher, Owennaforeesha, Owenur and Scramoge River crossings. The Strokestown River is also crossed by the proposed road development using a box culvert structure which provides a complete span of the channel given the relatively smaller river channel size.

In order to avoid any potential scour risk associated with the construction of these bridge structures, abutments for bridges will be sufficiently set back from the channel edge with foundations located at depth. This will protect the river channel from changes in morphology, whereby, the channel over time could naturally migrate towards one of the abutments. Each of the proposed major watercourse crossings are discussed in more detail below.

10.4.7.1 Carricknabraher River Bridge Crossing

The span of the proposed bridge is 8m. The estimated design flood level at this crossing point is 79.46m O.D. and therefore the minimum soffit level for the bridge is 79.76m O.D. which provides the required 300mm clearance above the design flood level (100year Flood level with a 20% allowance for the potential effects of Climate Change as per OPW Section 50 requirements).

10.4.7.2 Owennaforeesha River Bridge Crossing

The span of the proposed bridge is 7.0m. The estimated design flood level at this crossing point is 67.46m O.D. and therefore the minimum soffit level for the bridge is 67.76m O.D. which provides the required 300mm clearance above the design flood level (100 year Flood level with a 20% allowance for the potential effects of Climate Change as per OPW Section 50 requirements).

10.4.7.3 Owenur River Bridge Crossing

The span of the proposed bridge is 9.0m. The estimated design flood level at this crossing point is 48.30m O.D. and therefore the minimum soffit level for the bridge is 48.6m O.D. which provides the required 300mm clearance above the design flood level (100 year Flood level with a 20% allowance for the potential effects of Climate Change as per OPW Section 50 requirements).

10.4.7.4 Scramoge River Bridge Crossing

The span of the proposed bridge is 20m. The estimated design flood level at this crossing point is 40.67m O.D. and therefore the minimum soffit level for the bridge is 40.97m O.D. which provides the required 300mm clearance above the design flood level (100 year Flood level with a 20% allowance for the potential effects of Climate Change as per OPW Section 50 requirements).

10.4.7.5 Strokestown River Box Culvert Crossing

The span of the proposed box culvert is 4.2m. The estimated design flood level at this crossing point is 40.74m O.D. and the soffit level for the bridge is 41.04m O.D. which provides the required 300mm clearance above the design flood level (100 year Flood level with a 20% allowance for the potential effects of Climate Change as per OPW Section 50 requirements).

The hydrological impact of each of these crossings will have a negligible impact on flooding in terms of flood levels and flow velocities either locally, upstream or downstream of the site as it does not represent a contraction of the river and floodplain flow and retains the natural river channel.

10.4.8 Storm Outfalls

The proposed road development has 22 separate storm outfall discharges along its 33.4km mainline length, which represents on average of one outfall for every 1.5km of road length – see Table 10.25. All of these outfalls discharge to surface watercourses. These outfalls have a potential to adversely impact water quality in the receiving watercourse from routine contaminants that are contained in road drainage waters. The water quality and ecological status of the receiving watercourse is also potentially threatened by contamination arising from large liquid spillages as a result of an accident on the proposed development. These impacts are assessed by using the guidelines provided in the appropriate TII/NRA DMRB document DN-DNG-03065 – "*Road Drainage and the Water Environment*". These storm outfalls also have the potential to impact the flood and morphological regime of a receiving water by increasing the volume and rate of runoff during storm events. The morphology of the stream is significantly influence by ambient flow and flooding conditions in the stream. The potential increase in flow arises from increased impervious area by the road pavement area, the provision of road and embankment drainage with a direct pathway to the receiving watercourse and potential interception of groundwater and diversion of drainage waters that would not otherwise have reached the outfall point. The hard paved areas and the road drainage system reduces the time of concentration for rainwater to arrive at the outfall and thus increase the rate of runoff over the natural Greenfield condition. It is anticipated that the proposed road drainage outfalls will give rise to an overall improvement in water quality of the receiving watercourses as it will generally improve the existing situation of untreated storm drainage from the existing N5 road being discharged. In addition the risk of serious contamination of water courses will be significantly reduced as all proposed outfalls will be fitted with pollution control facilities.

10.4.9 Predicted impact of Storm Discharge on Flooding / Morphology

The 22 outfall discharges and the magnitude of impact to the receiving watercourses have been assessed using flood flow estimation methods, stream channel capacity assessment and evaluation of the importance of the attribute. The potential Impact magnitude is presented in Table 10.32 and all are categorised as 'slight local'. Generally, it is found that the flood impact of the road storm discharge is classified as slight to moderate adverse impact where the receiving watercourse catchment is small i.e. Moderate Impact catchment area <1km^2, Slight to Moderate Impact catchment area <10km^2 and Slight to Negligible Impact where catchment area exceeds 10km^2. The reason for this reduced potential stormwater flood impact in larger catchment sizes is due to the smaller stormwater volume relative to the natural stream and river flood volume. The potential increase in the ambient flood levels arising in larger catchment sizes therefore is reduced.

10.4.10 Water Quality Impact – Accidental Spillage Risk Assessment

The risk of pollution to both surface and groundwater resulting from accidental spillage is an issue considered in the development of proposed road infrastructure projects. Trying to predict the occurrence of a spill with any degree of certainty is difficult. One can conclude that the risk is influenced by the type of roadway, length of road, the traffic volume, and proportion and type of heavy goods vehicles (HGV's). A Spillage risk Assessment for the proposed development has been carried out in accordance with the TII//NRA standard DN-DNG-03065 – see Table 10.25. The spillage assessment shows the proposed road development to have very low magnitude of risk for individual or grouped catchment outfalls and shows the overall spillage risk for the entire development to be < 0.4%. This very low spillage risk (1 in 250 year probability) consequently does not require any specific mitigation measures

to reduce the risk with the overall impact classified as negligible. In fact, the improved road alignment and design, when compared with the existing N5, is anticipated to reduce the number of accidents and will therefore reduce the spillage risk associated with accidents. In addition all storm outfalls will include pollution control facilities in the attenuation ponds. The outflows will be fitted with a penstock or similar restriction at the outfall to the receiving channel. In the event of a serious spill these controls can be put in place to block the outflow of contaminants allowing time for clean up to take place.

Table 10.25 Spillage Risk Assessment at Proposed Outfalls and for Catchments

Outfall	Outfall Chainage	Mainline Length (m)	Outfall Risk (%)	Catchment Combined Risk (%)	River System	Comment
OUT1.01	1+150	1477	0.019	0.019	-	Low Risk
OUT4.01	4+195	2027	0.027	0.027	-	Low Risk
OUT5.01	5+600	1300	0.018	0.046	Carricknabrahar	Low Risk
OUT10.01	10+350	2041	0.028			Low Risk
OUT12.01	12+700	509	0.006	0.006	Trib. Of Carricknabrahar	Low Risk
OUT14.01	14+500	1800	0.016	0.046	Owennaforeesha	Low Risk
OUT14.02	14+500	3300	0.030			Low Risk
OUT21.01	21+050	3525	0.031	0.036	Mantua River	Low Risk
OUT21.02	21+350	527	0.005			Low Risk
OUT22.01	22+900	1073	0.010	0.010	-	Low Risk
OUT30.01	30+500	2000	0.018	0.018	Trib. Of Owenur	Low Risk
OUT30.02	30+900	1763	0.018	0.023	Owenur River	Low Risk
OUT24.01	N61 0+800	-	0.005			Low Risk
OUT33.01	33+250	737	0.008	0.008		Low Risk
OUT33.02	33+750	1750	0.018	0.060	Unnamed	Low Risk
OUT34.01	34+750	3975	0.042			Low Risk
OUT51.01	51+000	3800	0.042	0.042	Ovaun River	Low Risk
OUT51.02	51+422	1019	0.011	0.012	Strokestown	Low Risk
OUT40.01	L1405 0+300	-	0.001			Low Risk
OUT52.01	52+850	661	0.007	0.020	Scramoge	Low Risk
OUT52.02	52+830	420	0.005			Low Risk
OUT53.01	53+250	708	0.008			Low Risk
Total			**0.374**			**Low risk = <1%**

Note: The total is given for indicative purposes only.

10.4.11 Dilution Flow Estimates in receiving Rivers and Streams

The 95-percentile low flow rates in the receiving watercourses (road drainage outfalls) was estimated using the EPA Hydrotool empirical Low Flow formulae for Ireland based on the hydrometric gauge network for Ireland and Catchment Descriptors (see Table 10.29). The EPA Hydrotool was also used for a number of

larger tributaries (Carricknabraher River, Owennaforeesha River, Mantua Stream, Owenur River, Strokestown River and the Scramoge River); see Table 10.26 below.

Table 10.26 Summary of 95th-Percentile Low Flow Rates in the Receiving Watercourses

River/Stream	Area (km^2)	Upper 95% CI (m^3/s)	Lower 95% CI (m^3/s)	95th Percentile Flow (m^3/s)	Median Flow (m^3/s)
Carricknabraher River	19.9	0.042	0.019	0.028	0.298
Owennaforresha River	26.3	0.029	0.013	0.019	0.375
Mantua Stream	5.0	0.005	0.002	0.004	0.071
Owenur River	33.1	0.087	0.038	0.058	0.497
Strokestown Stream	11.9	0.013	0.006	0.009	0.169
Scramoge River	197.1	0.600	0.267	0.4	3.261

It must be noted that the catchment areas shown above are those based on point estimates by the EPA Hydrometric Data System and will therefore slightly differ (<5%) from those which are based on the outfall locations given in Section 10.3.

Based on the above estimates a general equation for the study area based on an area flow relationship can be developed to estimate the 95-percentile and median flows for other streams as follows:

$$q_{95} = 0.0005x^{1.293}$$
$$q_{50} = 0.015x - 0.006$$

where x is the area of the catchment.

The fitted formula (using the EPA data) given is for a catchment area of $1km^2$, a 95th-percentile flow rate of 0.5l/s and a median flow of 9l/s. This is applicable to the study area and is not a nationally derived equation. These low flow estimates were used to determine the available dilution characteristics at each of the outfalls as given in Table 10.29. In addition the median flows were also used in the HAWRAT calculations described above (Table 10.27).

10.4.12 Impact of Routine Road Runoff on Receiving Waters

Research has found that a broad band of potential pollutants are associated with routine runoff from road schemes arising from road traffic and road maintenance. These contaminants are generally associated with the particulate phase and are principally heavy metals, hydrocarbons and suspended solids and de-icing agents (salt and grit) and to a lesser extent nutrients, organics and faecal coliforms. In terms of potential impact to receiving watercourses research has found the first flush runoff (10 to 15mm) can produce elevated concentrations locally in the receiving water. The impact of contaminants within routine road runoff depends on the loading (associated with traffic numbers) and the available dilution in the receiving watercourse.

There are a total of 22 outfall locations over a 33.4km road length. This density of discharge points disperses and reduces the pollutant point load from road drainage waters. The design traffic volume in conjunction with the relatively small contributing road areas will not give rise to significant hydraulic or pollutant loads on the receiving waters. The potential impact of routine runoff represents a slight to moderate local

impact on water quality in the receiving environment. The available dilutions and the evaluated individual outfall water quality impacts are presented in Tables 10.29 and 10.30 respectively. The overall loading of heavy metals, sediment and hydrocarbons on the receiving waters will be significantly reduced through the provision of grassed channels, filter drains where permitted and storm attenuation/water quality improvement ponds.

TII/NRA DMRB DN-DNG-03065 gives guidance and assessment tools for the impact of road projects on the water environment, including the effects of runoff on surface waters. The Highways Agency Water Risk Assessment Tool (HAWRAT) is the tool used to assess the effects of road runoff on surface water quality and uses toxicity thresholds based on UK field research programmes which are consistent with the requirements of the WFD and appropriate for assessment of National Road Schemes in Ireland. The UK research programme has shown that pollution impacts from routine runoff on receiving waters are broadly correlated with Annual Average Daily Traffic (AADT).

A HAWRAT assessment has been carried out for all 22 proposed drainage outfalls along the proposed development see Table 10.27 below. The HAWRAT assessment tool uses a minimum AADT of 10,000 in the assessment process which is well above the projected traffic figures for the N5 Ballaghaderreen to Scramoge road project (almost twice the AADT for some sections), and thus actual pollutant concentrations are expected to be considerably lower than the estimates from the HAWRAT assessment.

Table 10.27 Results of the HAWRAT Assessment

Outfall No.	Water Hardness (mg/l $CaCO_3$)	Average Annual Concentration					
		Without Mitigations (ug/)l			With Mitigations (ug/l)		
		Copper	Zinc	Sediment	Copper	Zinc	Sediment
1.01	High >200	1.82	5.65	Pass	1.09	3.39	Pass
4.01	High >200	0.65	2.03	**FAIL**	0.39	1.22	Pass
5.01 & 10.01	Medium 50 - 200	0.26	0.8	Pass	0.16	0.48	Pass
12.01	Medium 50 - 200	0.19	0.58	Pass	0.11	0.35	Pass
14.01 & 14.02	Medium 50 - 200	0.31	0.97	Pass	0.19	0.58	Pass
21.01 & 21.02	High >200	0.91	3.2	Pass	0.55	1.92	Pass
22.01	High >200	0.98	3.05	Pass	0.59	1.83	Pass
30.01 & 30.02	High >200	0.21	0.76	Pass	0.13	0.46	Pass
30.03	Low < 50	0.45	1.41	Pass	0.27	0.84	Pass
33.01 & 33.02	High >200	0.76	2.35	Pass	0.45	1.41	Pass
34.01	High >200	1.58	4.93	**FAIL**	0.95	2.96	**Pass***
51.01 & 51.02	High >200	0.48	1.73	**FAIL**	0.29	1.04	Pass
40.01	Low < 50	1.26	3.94	**FAIL**	0.76	2.36	Pass
52.01, 52.02 & 53.01	High >200	0.01	0.03	Pass	0	0.02	Pass

**Outfall 34.01 failed the initial assessment with the mitigation of one pond. An additional pond was added downstream of the first pond the HAWRAT assessment was then passed.*

It can be seen that all of the outfalls passed the HAWRAT assessment with the exception of outfall OUT34.01. The failure was based on the sediment load from the associated road drainage. An additional secondary treatment pond was added to the design at this outfall in response to the initial failure of the HAWRAT and the proposed outfall subsequently passed the HAWRAT assessment. This two stage treatment approach will serve to further reduce the sediment load and will ensure no degradation in water quality occurs at this location.

In general, the most likely impact of untreated road runoff from the proposed road development is the increased total suspended solids loading to receiving waters and associated trace amounts of heavy metals (Cu, Zn) and hydrocarbons. Anticipated traffic volumes on each section of the proposed road development are detailed in **Chapter 5.**

10.4.13 Impact on Natural Heritage

10.4.13.1 European Designated Sites (SAC/SPA)

An assessment of the potential impact for European designated sites was carried out and is summarised in Table 10.28 below.

Table 10.28: Rating of Significant Environmental Impacts Caused to European Designated Sites

Impact				
Site Name	**Importance**	**Description**	**Magnitude of Impact**	**Impact Rating**
Bellanagare Bog SAC (000592) SPA (004105)	Extremely Important	Changes to surface hydrology or water balance in the sensitive habitat due to the construction of the proposed road development.	Slight	Imperceptible
Annaghmore Lough (Roscommon) SAC (001626)	Extremely Important		Slight	Imperceptible
Cloonshanville Bog SAC (000614)	Extremely Important		Slight	Imperceptible
Lough Forbes Complex SAC (001818)	Extremely Important		Slight	Imperceptible
Lough Gara SPA (004048)	Extremely Important		Slight	Imperceptible
Callow Bog SAC	Extremely Important		Slight	Imperceptible

The nature of the proposed road development will result in only small localised changes in surface water flow. Each of the hydrologically sensitive areas listed above are located outside the zone of influence and will therefore have an imperceptible impact. In some cases they are not hydraulically linked to the road or are located sufficiently downstream so as to achieve sufficiently large dilution as to have an imperceptible impact. In addition some of these sites are located downstream of the existing N5; the proposed development would therefore result in a net improvement in water quality at these locations due to the provision of treatment prior to outfall. In the event of a worst case scenario (i.e. in the event of a serious surface water contamination spillage) the proposed road development could still have an impact downstream at one of the above listed sites. The spillage risk assessment

has identified this as a very low probability and the inclusion of penstocks in the attenuation pond design will reduce the potential impacts to imperceptible.

10.4.14 Impact on Water Supply Sources

There will be no impact on either the North Roscommon Regional Water supply or the Northeast Roscommon & Ballyleague Regional Water supply as they are both located a significant distance downstream (>2km) from the proposed road development with only one road drainage outfall discharging to each catchment. Impacts on the three local group groundwater supply schemes have been addressed in detail in **Chapter 9 Hydrogeology**.

10.4.15 Impact to Ecological Receptors

A number of ecological receptors adjacent to the proposed road development have been identified and discussed in detail in the **Chapter 7**. A water quality impact assessment was carried out at each outfall location along the proposed road development and the results are given in Table 10.33. Each of the outfalls have been assessed in terms of the predicted impact on the receiving waters in respect to flooding and morphological changes and the outcome of this assessment is given in Table 10.33.

The results of the impacts presented in Tables 10.33 and 10.34 were used to assess potential hydrological impacts to identified ecological receptors. This assessment summary is given in Table 10.35.

Table 10.29 Dilution Characteristics of Receiving Surface Watercourses

Outfall	Outfall Chainage	Road Section	Total Impervious Road Area (ha)	Catchment Area (km^2)	95% DWF l/s	Dilution Characteristics	Receiving Water Details	Comment
OUT1.01	1+150	Ch. 1,000 to Ch. 2,477	3.4	0.135	<0.5	Low summer dilution available	-	Minor stream
OUT4.01	4+195	Ch. 2,477 to Ch. 4,504	2.52	1.41	0.8	Low summer dilution available	-	Outfall downstream of KER1
OUT5.01	5+600	Ch. 4,504 to Ch. 10,150	4.77	20.9	29.4	Good summer dilution	Carricknabraher River	Outfall downstream of KER2 & upstream of KER3
OUT10.01	10+350	Ch. 10,150 to Ch. 12,191				Good summer dilution	Carricknabraher River	Outfall upstream of KER3
OUT12.01	12+700	Ch. 12,191 to Ch. 12,700	0.553	3.74	5.3	Moderate to low dilution available	Trib. of Carricknabraher River	Outfall downstream of KER6
OUT14.01	14+500	Ch. 12,700 to Ch. 14,500	6.3	32.1	23.2	Good summer dilution	Owennaforeesha River	Outfall downstream of KER7 & 8
OUT14.02	14+500	Ch. 14,500 to Ch. 17,800				Good summer dilution	Owennaforeesha River	Outfall downstream of KER7 & 8
OUT21.01	21+050	Ch. 17,800 to Ch. 21,350	5.25	1.16	0.9	Low summer dilution available	Mantua Stream	Outfall upstream of KER12
OUT21.02	21+350	Ch. 21,350 to Ch. 21,877				Low summer dilution available	Mantua Stream	Outfall upstream of KER12
OUT22.01	22+900	Ch. 21,877 to Ch. 22,950	1.44	0.36	1	Low summer dilution available	Trib. of Owenur River	-
OUT30.01	30+500	Ch. 22,950 (section B) to Ch. 30,750 (section C)	5.428	31.6	55.3	Good summer dilution	Owenur River	Outfall upstream of KER15
OUT30.02	30+900	Ch. 30,750 to Ch. 32,513				Good summer dilution	Owenur River	Outfall upstream of KER13

Outfall	Outfall Chainage	Road Section	Total Impervious Road Area (ha)	Catchment Area (km^2)	95% DWF l/s	Dilution Characteristics	Receiving Water Details	Comment
OUT24.01	N61 0+800	Shankhill Roundabout	1.01	2.34	1.5	Low summer dilution available	Trib. of Owenur River	Outfall upstream of KER13
OUT33.01	33+250	Ch. 32,513 to Ch. 33,250	3.1	0.16	<0.5	Low summer dilution available	Ovaun River	Outfall within KER14
OUT33.02	33+750	Ch. 33,250 to Ch. 35,000				Low summer dilution	Ovaun River	Outfall within KER14
OUT34.01	34+750	Ch. 35,000 to Ch. 38,975	5.26	3.33	2.4	Moderate summer dilution	Ovaun River	Outfall within KER14
OUT51.01	51+000	Ch. 38,875 to Ch. 51,150	4.984	5.3	0.4	Low summer dilution	Strokestown River	Outfall downstream of KER17
OUT51.02	51+400	Ch. 51,150 and Ch. 52,169				Low summer dilution	Strokestown River	Outfall located within KER17
OUT40.01	L1405 0+300	Kildalloge Roundabout	1.01	0.236	<0.5	Low summer dilution	-	
OUT52.01	52+850	Ch. 52,169 and Ch. 52,830	2.51	188.12	381.8	Good summer dilution	Scramoge	Outfall upstream of KER19
OUT52.02	52+830	Ch. 52,830 and Ch. 53,250				Good summer dilution	Scramoge	Outfall upstream of KER19
OUT53.01	53+250	Ch. 53,250 and Ch. 53,958				Good summer dilution	Trib. of Scramoge	Outfall upstream of KER19 & downstream of KER20

Table 10.30 Water Quality Impact Assessment

Outfall	Outfall Chainage	Dilution Characteristics	Receiving Water Details	Water Quality Impact	Comment
OUT1.01	1+150	Low summer dilution available	-	Slight Permanent Local	Minor stream
OUT4.01	4+195	Moderate summer dilution	-	Slight Permanent Local	Outfall 1.3km upstream of converge with Carricknabraher River
OUT5.01	5+600	Good summer dilution	Carricknabraher	Slight Permanent Local	Outfall 0.2km upstream of converge with Carricknabraher River
OUT10.01	10+350	Good summer dilution	Carricknabraher	Slight Permanent Local	Outfall direct to Carricknabraher River
OUT12.01	12+700	Moderate to low dilution available	Trib. of Carricknabraher	Slight Permanent Local	Outfall to minor stream
OUT14.01	14+500	Good summer dilution	Owennaforeesha	Slight Permanent Local	Outfall direct to Owennaforeesha River
OUT14.02	14+500	Good summer dilution	Owennaforeesha	Slight Permanent Local	Outfall direct to Owennaforeesha River
OUT21.01	21+050	Low summer dilution available	Mantua River	Slight Permanent Local	Outfall direct to Mantua River
OUT21.02	21+350	Low summer dilution available	Mantua River	Slight Permanent Local	Outfall direct to Mantua River
OUT22.01	22+900	Low summer dilution available	Trib. of Owenur	Slight Permanent Local	Outfall to minor stream
OUT30.01	30+500	Good summer dilution	Owenur River	Slight Permanent Local	Outfall direct to Owenur River
OUT30.02	30+900	Good summer dilution	Owenur River	Slight Permanent Local	Outfall direct to Owenur River
OUT24.01	N61 0+800	Low summer dilution available	Trib. of Owenur	Slight Permanent Local	Outfall 1.5km upstream of converge with Owenur River
OUT33.01	33+250	Low summer dilution available	Unnamed	Slight Permanent Local	Outfall 0.3km upstream of Clooncullaan Lough
OUT33.02	33+750	Low summer dilution	-	Slight Permanent Local	Outfall 0.3km upstream of Clooncullaan Lough
OUT34.01	34+750	Moderate summer dilution	Ovaun River	Slight Permanent Local	Outfall 1.3km upstream of Clooncullaan Lough Swallow hole located 750m downstream.
OUT51.01	51+000	Good summer dilution	Strokestown River	Slight Permanent Local	Outfall direct to Strokestown River

Outfall	Outfall Chainage	Dilution Characteristics	Receiving Water Details	Water Quality Impact	Comment
OUT51.02	51+400	Low summer dilution available	-	Slight Permanent Local	Outfall to minor stream
OUT40.01	L1405 0+300	Low summer dilution available	-	Slight Permanent Local	Outfall to minor stream
OUT52.01	52+850	Good summer dilution	Scramoge River	Slight Permanent Local	Outfall direct to Scramoge River
OUT52.02	52+830	Good summer dilution	Scramoge River	Slight Permanent Local	Outfall direct to Scramoge River
OUT53.01	53+250	Good summer dilution	Trib. of Scramoge River	Slight Permanent Local	Outfall 0.4km from Scramoge River

Table 10.31 Impact Assessment of Storm Drainage on Receiving Waters in Respect to Flooding and Morphological Changes

Outfall	Outfall Chainage	Mainline Road Length (m)	Total Impervious Road Area ha	Receiving Water Catchment Area ha	Channel / lake Capacity	100yr Greenfield Flood Runoff Rate in Receiving Stream (l/s)	Potential Impact
OUT1.01	1+150	1477	3.4	0.135	Narrow vegetated channel moderate capacity	895	Slight Local
OUT4.01	4+195	2027	2.52	1.41	Good capacity channel	2252	Slight Local
OUT5.01	5+600	1300	4.77	20.9	Good capacity wide flat gravelly base	24140	Slight Local
OUT10.01	10+350	2041					Slight Local
OUT12.01	12+700	509	0.553	3.74	Narrow vegetated channel moderate capacity	5367	Slight Local
OUT14.01	14+500	1800	6.3	32.1	Good capacity wide flat gravelly base	18671	Slight Local
OUT14.02	14+500	3200					Slight Local
OUT21.01	21+050	3325	5.25	1.16	Good capacity channel	1893	Slight Local
OUT21.02	21+350	527					Slight Local
OUT22.01	22+900	1073	1.44	0.36	Narrow vegetated channel moderate capacity	895	Slight Local
OUT30.01	30+500	2000	5.428	31.6	Good capacity wide flat base.	35862	Slight Local
OUT30.02	30+900	1763					Slight Local
OUT24.01	N61 0+800	-	1.01	2.34	Moderate Capacity Channel	1058	Slight Local
OUT33.01	33+250	737	3.1	0.16	Sluggish overgrown channel of moderate capacity	895	Slight Local
OUT33.02	33+750	1750					Slight Local
OUT34.01	34+750	3975	5.26	3.33	Sluggish overgrown channel of moderate capacity	4840	Slight Local
OUT51.01	51+000	3800	4.984	5.3	River channel with good capacity wide flat base.	3036	Slight Local
OUT51.02	51+400	1019					Slight Local

Outfall	Outfall Chainage	Mainline Road Length (m)	Total Impervious Road Area ha	Receiving Water Catchment Area ha	Channel / lake Capacity	100yr Greenfield Flood Runoff Rate in Receiving Stream (l/s)	Potential Impact
OUT40.01	L1405 0+300	-	1.01	23.6	Moderate capacity channel	295	Slight Local
OUT52.01	52+850	661	2.51	188.12	River channel with good capacity wide flat base	57909	Slight Local
OUT52.02	52+830	420					Slight Local
OUT53.01	53+250	708					Slight Local

Table 10.32 Rating of Potential Hydrological Impacts to Identified Key Ecological Receptors

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 1a(N) & 1B(C) Ch. 4+000 to Ch. 4+500	Wet Grassland (Molina Meadows) National Importance & County Importance	Construction	Silts and sediments arising from works adjacent to watercourses and construction site runoff.	The wet Grassland type systems are not very sensitive in terms of water quality and soil chemistry to associated construction pollution.	Negligible
			Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	Construction spillages do not represent a significant threat to these wet lands.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands. Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)	There is no proposed direct encroachment into the KER nor are there any temporary works proposed within the KER.	Negligible
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains and a culvert are proposed in the vicinity of the KER which could potentially slightly alter the drainage in the vicinity of the Wet grassland and Molina Meadows both north and south of the road.	Slight to moderate
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands.	At this location the road formation itself is at grade and excavation of unsuitable material beneath the road alignment will be minimal.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 2a(LH) & 2b(N) Ch. 5+000 to Ch. 5+500	Degraded and intact Raised Bog and Cutover bog National Importance & Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This raised bog habitat system is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams, culverts channel diversions, sediment ponds, silt fences etc.).	There is no direct encroachment into the KER but the alignment comes close to the cutover bog section of this KER.	Slight
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges - Accidental fuel spills from road	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible	Negligible
			Road Drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains and a culvert are proposed in the vicinity of the KER which could potentially alter the drainage in the KER.	Slight to moderate
			Changes to watercourse channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on watercourse channel morphology at this section will be negligible with no culverting proposed.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation itself is in embankment and excavation of unacceptable material beneath the road alignment at 2 to 3m excavation depths could give rise to drainage impacts on the adjacent cutover bog and potentially on the Raised Bog Habitat further to the south. In addition a bog access road is proposed adjacent to the proposed alignment which could also change the drainage regime of the bog locally.	Moderate

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 3(LH) Ch. 10+125 to Ch. 10+150	Carrickna-braher River Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This River System which hosts aquatic habitats and species is sensitive to water quality impacts associated from construction activities.	Moderate / Significant
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands	Construction spillages if uncontrolled represent a significant threat to aquatic life both locally and downstream.	Moderate
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	There is a proposed water course crossing of this KER which may involve direct encroachment through in-stream works, floodplain and river bank works.	Moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are two proposed road drainage outfalls discharging to this KER. The water quality impact from the road drainage system based on traffic numbers represents a locally moderate adverse impact.	Slight
			Road Drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Road drainage outfalls will undergo attenuation and effect of road drainage and interceptor drains will have a negligible to small adverse impact on the flow regime and water balance.	Slight
			Changes to watercourse channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on watercourse channel morphology at this section will be minor as the proposed culvert/bridge with be full spanning and river regrading works are not proposed.	Slight
			Changes to watercourse channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition	Impact on watercourse morphology at this section will be negligible with no culverting proposed.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas	Given the scale of the river catchment, such interception by the road and it formation layer will be negligible in terms of the water balance.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 4(C) Ch. 10+750 to Ch. 10+850	Wet Grassland (Molinia Meadows) County Importance	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This raised bog habitat system is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams, culverts channel diversions, sediment ponds, silt fences etc.)	There is no proposed direct encroachment into the KER but alignment comes very close to the cutover bog section of this KER.	Slight
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER.	Slight
			Changes to watercourse channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on watercourse channel morphology at this section will be negligible with no culverting proposed.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation itself is on embankment and excavation of unacceptable material beneath the road alignment will be required to depths of 2 to 2.5m which could give rise to slight drainage impacts on the adjacent Grasssland.	Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 5(N) Ch. 11+480 to Ch. 12+150	Wet Grassland (Molinia Meadows) National Importance	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition)	This raised bog habitat system is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	There is no proposed direct encroachment into the KER but alignment comes very close to the cutover bog section of this KER.	Slight
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains and a culvert are proposed in the vicinity of the KER which could potentially alter the drainage flow towards the KER.	Slight / moderate
			Changes to watercourse channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on watercourse channel morphology at this section will be minor to negligible with only a small low gradient drain being crossed and culverted.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation itself is on embankment and excavation of unacceptable material beneath the road alignment will be required to depths of up to 4m which could give rise to drainage impacts on the adjacent Grasssland by the permeable road formation layer.	Moderate

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 6(a)(N), 6b(N), 6b(C), 6b(LH), 6c(N), 6c(LH), 6c(LL) Ch. 10+900 to Ch. 12+450	Peatland complex of Raised Bog and Cutover Bog with Wet Heath & Bog woodland National Importance, County Importance & Local Importance (Higher & Lower Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition)	This raised bog habitat system is not very sensitive in terms of water quality and soil chemistry impacts associated from road construction activities.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	There is no proposed direct encroachment into National Important Raised Bog area of the KER but alignment encroaches the cutover bog section of this KER.	Slight / moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains and a culvert are proposed in the vicinity of the KER which could potentially alter the drainage in the KER.	Slight to moderate
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section will be negligible with only one pipe culvert crossing proposed and no major diversions proposed	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation is in at grade and embankment and excavation of unacceptable material beneath the road alignment will be significant particularly between 10+900 to 11+700 at up to 4m excavation depth which could give rise to drainage impacts on the adjacent cutover bog and on the Raised Bog Habitat to the south (a portion of which forms part of the Bellanagare Bog SAC/SPA).	Moderate

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 7a(N) & 7b(LH) Ch. 13+950 to Ch. 14+450	Peatland complex of Raised Bog and Cutover Bog with Bog woodland National Importance and Local importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This raised bog habitat system is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)	There is no proposed direct encroachment into National Important Raised Bog area of this KER but alignment encroaches the cutover bog section.	Slight / moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	A number of local drains in the cutover bog will be intercepted and diverted to longitudinal drains Interceptor toe drains and a culvert are proposed in the vicinity of the KER which could potentially alter the drainage in the KER.	Slight to moderate
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section will be negligible with only one pipe culvert crossing proposed and no major diversions proposed.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas	At this location the road formation is in sizeable embankment and excavation of unacceptable material beneath the road alignment will be significant at depths potentially up to 6m excavation which could give rise to drainage impacts on the adjacent cutover bog and on the Raised Bog Habitat to the north.	Moderate

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER (LH) Ch. 14+450 to Ch. 14+800	Owennaforeesha River Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This River System which hosts aquatic habitats and species is sensitive to water quality impacts associated from construction activities.	Moderate / Significant
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages if uncontrolled represent a significant threat to aquatic life both locally and downstream.	Moderate
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	There is a proposed water course crossing of this KER which may involve direct encroachment floodplain and river bank works.	Moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are two road drainage outfalls to this river and it adjoining tributary proposed which represents a direct potentially contaminated discharge to the KER. The water quality impact from the road drainage system based on traffic numbers represents a locally small to moderate adverse impact.	Slight / Moderate
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Road drainage outfalls will undergo attenuation and effect of road drainage and interceptor drains will have a negligible to small adverse impact on the flow regime and water balance of the river.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is possible with a new culvert and channel diversion to be constructed. The proposed dimensions will be full spanning at 7m.	Moderate
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	Given the scale of the river catchment such interception by the road and it formation layer will be negligible in terms of the water balance.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 9(LH) Ch. 14+500 to Ch. 14+650	Bog Woodland Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This Bog Woodland is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of woodland is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation is on embankment and excavation of unsuitable material beneath the road alignment will be required to depths of up to 5m which could give rise to slight drainage impacts on the adjacent bog woodland.	Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 10(LH) Ch 15+150 to Ch 15+300	Bog Woodland Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This Bog Woodland is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of woodland is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable as there is no watercourse present.	N/A
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation itself is at embankment and excavation of unsuitable material beneath the road alignment will be required to depths of up to 4m which could give rise to slight drainage impacts on the adjacent bog woodland.	Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 11(LH) Ch 16+700 to Ch 17+200	Cut-over Bog and Bog Woodland Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This Ker comprising forestry on cutover bog is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this peatland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of the KER is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation is at grade but excavation and removal of unsuitable material beneath the road alignment will be required to depths of up to 2m which could give rise to slight drainage impacts on the adjacent peat. The KER is not very sensitive to drainage and such drying effects and therefore the impact will be negligible	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 12(LH) 18+250 – 20+250	Mixed Broadleaved Woodland Local Importance (higher value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This KER comprising forestry is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this forestry system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of the KER is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable.	N/A
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	The KER is not very sensitive to drainage and such drying effects and therefore the impact will be negligible	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 13(LH) Ch 30+550 to Ch 31+950	Upper Owenur River Marsh and Wet Grassland, Wet Grassland Reedswamp & Poor Fen Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This River System which is a highly modified river channel with no natural pattern of riffles, glides and pools. For the purposes of this assessment it is treated as a potential Salmonid river and thus sensitive to pollution from road projects.	Slight to Moderate
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages if uncontrolled represent a threat to aquatic life both locally and downstream.	Slight to Moderate
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	There is a proposed water course crossing of this KER with the bridge crossing to be designed on line which will involve direct encroachment through limited in stream works, floodplain and river bank works.	Moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There is one proposed road drainage outfalls to this river which represents a direct potentially contaminated discharge to the KER. The water quality impact from the road drainage system based on traffic numbers represents a slight adverse impact.	Sligh
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Road drainage outfalls will undergo attenuation and the effect of road drainage and interceptor drains will have a negligible to slight adverse impact on the flow regime and water balance of the river.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is possible with the online bridge construction, however it is not envisaged that instream works are required for this crossing and therefore the impact on channel morphology will be slight to imperceptible. .	Slight
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	Given the scale of the river catchment interception and discharge by the road and it formation layer to this river will be negligible in terms of the water balance and flow regime of the receiving waters.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 14(LH) 32+900 – 34+450	Mature Tree Lines/ Wet Grassland Local Importance (higher value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This KER comprising mainly tree lines is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this tree line and grassland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Impacts relating to this KER are dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable.	N/A
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	The KER is not very sensitive to drainage and such drying effects and therefore the impact will be negligible	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 15a(LH), 15b(LL), Ch. 33+350 to Ch. 34+350	Lough Clooncullaan, and Surrounding Wetland Complex, Local Importance (Higher & lower Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This alkaline Fen System to the north of the Lough is buffered by drainage channels that connect to the Lough and such fen systems would not be very sensitive to water quality impacts arising for road construction works both routine construction runoff or potential spillages during construction.	Slight to moderate
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages if uncontrolled represent a threat to aquatic life both locally and downstream.	Slight to Moderate
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)	The road alignment passes close to the Annex I Alkaline fen and construction works will involve considerable excavation of unacceptable material and embanking of the road which may temporarily impact on drainage to and from the Fen and Lough system.	Slight to Moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will discharge to a local drain that borders alkaline Fen to the north and also to the Ovaun Stream that enters the Lough immediately to the South of the KER. The potential water quality impact of these drains on the KER is likely to be slight given that these drains direct water into the Lough. Given the volume of water available in the Lough and the low volume of road runoff, there will be an imperceptible impact on water quality. The potential for spillage represents a slight to moderate impact.	Slight To Moderate
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Road drainage outfalls will undergo attenuation and the effect of road drainage and interceptor drains will be designed to have a negligible impact.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section will be negligible.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	At this location the road alignment is in significant embankment and removal of unsuitable material beneath the road alignment will be required to depths of anything up to 8m. The proposed road construction could potentially intercept and divert the recharging north to south subsurface flows eastwards with the permeable road formation and thus potentially impact the water balance and hydrochemistry of the KER.	Moderate to Significant

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
15c(N), 15d(C) & 15e(C) Ch. 33+350 to Ch. 34+350	Annex I Transition Mire and Rich Fen Habitat National & County Importance	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition)	These KERs are reasonably buffered from the road construction site and unlikely assuming reasonable construction practices to be impacted by road construction works through direct encroachment of such habitats or by impacts from sediment runoff or potential spillages during construction.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will discharge to the Ovaun Stream downstream of these KERs and therefore road drainage discharges and potential spillages from the Road are unlikely to impact the water quality status of the Transition Mire and Fen and Wetland Habitat.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Road drainage outfalls will undergo attenuation and the road drainage and interceptor drains are designed to have a negligible impact.	Negligible
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section will be negligible as no encroachment outfall or culvert is proposed.	Negligible
			Interception of drainage paths by the permeable Road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	Up gradient of these KERs the alignment is in deep cutting into bedrock which is likely to intercept surface and sub-surface flows off the hillslopes to the northeast. The impact of the cutting and cut-off drains on hydrological regime of the KERs is likely to represent a small adverse impact.	Slight to Moderate

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 16(N) Ch. 36+650 to Ch. 37+950	Turlough (Cregga) National Importance Annex I Priority Habitat	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	The proposed construction works involve significant deep bedrock cutting into the steep hill slopes above the Cregga Turlough Area. Given the terrain and the large excavation works involved, there is a high potential for sediment runoff from the works entering the Turlough area which, in the short term, could impact the water chemistry of the Turlough and result in silt deposition within the Turlough area.	Moderate to Significant
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	The road alignment does not encroach the Turlough area but will intercept its natural recharge waters via overland flow, interflow and deeper percolating flow which temporarily could impact the water balance of the Turlough and its habitat.	Moderate to Significant
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	The road drainage will be a sealed system and will not discharge to the Cregga Turlough. This avoids potential water quality impacts from the routine road runoff waters and accidental road spillages.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	A loss of recharge water arising from direct rainfall on the road pavement area which will be piped to an outfall that discharges to the Ovaun Stream.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition. Interception of drainage paths by the permeable Road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	The deep cutting will intercept hill slope runoff, interflow and groundwater recharge and flow which will potentially impact on the flow regime, the water balance and the water chemistry of the Turlough. Such an impact is considered to represent a potential significant impact to the hydrological function of the Turlough Habitat.	Significant

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 17(LH) Ch. 50+850 to Ch. 51+800	Cut-over Bog Bog Woodland Scrub and Grasslands Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This KER is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this semi-natural habitat system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of cut-over bog and woodland is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	The proposed road will outfall to the Strokestown River. The water quality impact from the road drainage system on this receptor will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section may be associated with the culverting of the Strokestown River. In the context of the overall KER such a local impact is considered small to negligible.	Negligible
			Interception of drainage paths by the permeable Road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	At this location the road formation is embankment and excavation of unacceptable material beneath the road alignment will be required at relatively shallow depths of 1 to 2m which is unlikely to give rise to significant drainage effects on the KER.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 18(LH) Ch. 52+150 – Ch. 52+650	Mixed Woodland & Scrub Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This KER comprising mainly woodland is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this woodland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of the KER is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable.	N/A
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	The KER is not very sensitive to drainage and such drying effects and therefore the impact will be negligible	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 19(LH) Ch. 52+850 to Ch. 53+250	Scramoge River Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This River System which hosts aquatic habitats and species is sensitive to water quality impacts associated from construction activities.	Moderate / Significant
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages if uncontrolled represent a significant threat to aquatic life both locally and downstream.	Moderate
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	There is a proposed bridge construction over the Scramoge River which may involve limited in-stream works, floodplain and river bank works during construction.	Moderate
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	The proposed road development outfalls to this river which represents a direct potentially contaminated discharge. The water quality impact from the road drainage system based on traffic numbers represents a locally slight adverse impact.	Slight
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Road drainage outfalls will undergo attenuation and effect of road drainage and interceptor drains will have a negligible to small adverse impact on the flow regime and water balance of the river.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is possible with existing proposed river bridge to be constructed. The proposed dimensions will be full clear spanning at 20m.	Moderate
			Interception of drainage paths by the permeable Road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	Giver the scale of the Scramoge river catchment such interception by the road and it formation layer will be negligible in terms of the overall water balance.	Negligible

Attribute		Impact			
KER Receptor No.	**Receptor Name and importance**	**Stage**	**Nature of Impact**	**Description of Impact**	**Impact Rating**
KER 20(LH) Ch. 53+300 – Ch. 53+950	Mixed Broadleaved /Conifer Woodland Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	This KER comprising mainly woodland is not very sensitive in terms of water quality and soil chemistry impact associated from construction activities of a road project.	Negligible
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages do not represent a significant threat to this woodland system.	Negligible
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	Direct encroachment into the KER and loss of the KER is proposed which is dealt with in the biodiversity impact assessment.	See Chapter 7 for details.
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	There are no proposed drainage outfalls discharging to this KER. The water quality impact from the road drainage system will be negligible.	Negligible
			Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Interceptor toe drains are proposed in the vicinity of the KER which could potentially alter the drainage in the KER and may potentially give rise to drier conditions.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Impact on stream channel morphology at this section is not applicable.	N/A
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.	The KER is not very sensitive to drainage and such drying effects and therefore the impact will be negligible	Negligible

10.4.16 Impacts of Material Deposition Areas

A total of 17 areas have been identified as deposition areas for the excess soft and unacceptable material along the route. These sites are all within easy haulage distances from the location of large soft ground deposits and are detailed in the Table 10.35 below: These sites provide a storage capacity of 0.978 million m^3 which can accommodate the anticipated 0.96 million $m^3$of potentially excess unacceptable material which may be encountered of along the proposed road development.

Table 10.33 Location of Material Deposition Areas

Area No.	Chainage and Location	Area (Hectares)	Approx. Capacity (m^3)
1	Ch.4+640 – Ch. 4+750, South of proposed N5	0.4	8,000
2	Ch. 4+750 – Ch. 4+80, North of proposed N5	1.1	22,000
3	Ch. 5+400 – Ch. 5+680, South of proposed N5	1.4	28,000
4	Ch.14+700 – Ch. 15+520, South of proposed N5	4.5	90,000
5	Ch.14+950 – Ch. 15+200, North of proposed N5	2.6	52,000
6	Ch.15+320 – Ch. 15+600, North of proposed N5	1.8	36,000
7	Ch.15+550 – Ch. 15+780, South of proposed N5	2.9	58,000
8	Ch.16+075 – Ch. 16+130, South of proposed N5	0.4	8,000
9	Ch.17+000 – Ch. 17+600, South of proposed N5	1.8	36,000
10	Ch. 17+050 – Ch. 17+150, South of proposed N5	0.4	8,000
11	Ch. 17+150 – Ch. 17+600, South of proposed N5	7.3	146,000
12	Ch. 17+640 – Ch. 17+875, South of proposed N5	2.0	40,000
13	Ch. 21+000 – Ch. 21+175, South of proposed N5	2.7	54,000
14	Ch. 20+950 – Ch. 21+450, North of proposed N5	5.4	108,000
15	Ch. 21+350 – Ch. 21+750, North of proposed N5	5.4	108,000
16	Ch. 22+150 – Ch. 22+850, South of proposed N5	8.4	168,000
17	Ch. 22+680 – Ch. 22+840, North of proposed N5	0.4	8,000
Total Storage Volume		**48.9**	**978,000**

These material deposition sites will be bunded sites and will have double erosion control fencing (silt fence) and a sediment settlement pond at the outlet. These facilities will be constructed in advance of their use as deposition areas. In addition wheel wash facilities will be provided at the entrance/exit as outlined in the Construction Erosion and Sediment Control Plan (CESCP) – see Appendix 10.1.

Runoff from the material deposition areas will be contained and treated in temporary settlement ponds upstream of its outfall to the receiving watercourses. These ponds will be maintained until the material deposition areas have stabilised and become adequately vegetated. In addition the specific construction sequence for these areas (described below) will allow for settlement of sediment prior to discharge to the receiving watercourse. The construction sequence of each of the material deposition areas is such that the area allocated for material deposition is compartmentalised to allow a deposition area to be first established in one compartment, while the runoff water from this compartment flows into and is contained within an adjacent compartment. This will allow settlement of sediment to take place. Once settlement of the sediments has occurred, this settlement area is then itself filled with peat and

the adjacent compartment acts as the settlement area for the runoff from this section. This process is repeated as the works advance.

A 2.5m wide permanent maintenance access track will extend around the external perimeter of the peat restoration areas and combined with the foundation to the perimeter berm for access. Materials will initially be delivered to the working area for access road and perimeter berm construction by low ground pressure vehicles such as tracked dumpers and light weight, wide track excavators.

Any local drains within these areas will be either diverted around the site or truncated so as to minimise the volume of water entering such areas to that of direct rainfall and the soil moisture of the material itself.

The construction sequencing and design of the material deposition areas will ensure that there will be negligible impact on adjacent watercourses. In addition a Construction Erosion and Sediment Control Plan has been developed which deals specifically with environmental protection/ mitigation measures for the material deposition areas and this is attached in Appendix 10.1.

10.5 Mitigation Measures

10.5.1 Overview of Mitigation Measures

Mitigation measures follow the principles of avoidance, reduction and remedy. The most effective measure of avoidance is dealt with during the Route Corridor Selection stage and the Design stage, by moving the proposed alignments either laterally or vertically within the route corridor, so as to ensure that it does not traverse or come in close proximity to sensitive hydrological attributes.

Where avoidance of the feature has not been possible, consideration has been given to locally modify the proposed road alignment so as to reduce / minimise the extent of the impact and / or the exposure to human contact e.g. via groundwater supply usage. If any modifications are proposed to reduce hydrological impacts it is necessary to also consider any associated impacts to the hydrological and ecological regimes.

10.5.2 Constructional Mitigation

A Construction Erosion and Sediment Control Plan has been prepared for the proposed road development and is attached in Appendix 10.1. Reference should be made in the first instance to this Plan for specific construction mitigation proposals – a summary of the key mitigation are also given below. As is normal practice with large road infrastructure projects an Environmental Operating Plan (EOP) will be prepared for the proposed road development and the following will be implemented as part this plan:

- EOP will incorporate an Emergency Response Plan detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance incident with any permit of license or other such risks that could lead to a pollution incident, including flood risks.
- All necessary permits and licenses for in stream construction work for provision of culverts and bridges including new and widening of existing structures will be obtained prior to commencement of construction of same. OPW Section 50 consent has been received for all culverts and bridges proposed for this road development.

- Inform and consult with Inland Fisheries Ireland (IFI).
- Refine and finalise Construction Erosion and Sediment Control Plan.

Construction operation will be required to take cognisance of the following guidance documents for construction work on, over or near water.

- Shannon Regional Fisheries Board – Protection and Conservation of Fisheries Habitat with particular Reference to Road Construction.
- Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites (Eastern Regional Fisheries Board)
- Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers.
- CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors.
- CIRIA C648 Control of Water Pollution from Constructional Sites.
- Guidelines for the Crossing of Watercourses during the Construction of National Road schemes (TII/NRA, 2006).
- Guidelines on Protection of Fisheries During Construction Works in and adjacent to Waters (IFI, 2016)

Based on the above guidance documents concerning control of constructional impacts on the water environment, the following outlines the principal mitigation measures that will be prescribed for the construction phase in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts:

- All constructional compound areas will be required to be set back a minimum of 10m from river and stream channels and out of potential floodplain areas.
- Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels and cut-off ditches.
- Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and the diversion of runoff water off these stockpiles to the construction settlement ponds.
- Where constructional works are carried out adjacent to turloughs, fens, stream and river channels and lakes protection of such waterbodies from silt load shall be carried out through use of grassed buffer areas, timber fencing with silt fences or earthen berms to provide adequate treatments of runoff and constructional site runoff waters to the watercourses.
- Use of settlement ponds, silt traps and bunds and minimising construction within watercourses. 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 that will be used for site compound/storage facilities will be fenced off at a minimum distance of 5m. In addition, measures will be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. Compounds shall not be constructed on lands designated as Flood Zone A or B in accordance with the OPW Flood Risk Management Guidelines (November 2009). Compounds will not be permitted in or within 100 metres of a European Site.

- The storage of oils, fuel, chemicals and hydraulic fluids will be in secure areas within the site compounds and will not occur within a minimum of 10m from watercourses. Storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage. Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with *Best Practice Guide BPGCS005 – Oil Storage Guidelines* (Enterprise Ireland).
- Foul drainage from all site offices and construction facilities will be taken off-site and disposed of by a licensed contractor in accordance with legislation to prevent pollution of rivers and local water supply.
- The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.
- Riparian vegetation along the identified sensitive watercourse will be fenced off to provide a buffer zone for its protection to a minimum distance of 5m with the exception of proposed crossing points
- Any surface water abstracted from a river for use during construction shall be through a pump fitted with a filter to prevent intake of fish.
- The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage which as stated earlier has a deleterious effect on water chemistry and aquatic habitats and species. Alternate construction methods are encouraged for example, use of pre-cast or permanent formwork will reduce the amount of in-situ concreting required. Where on-site batching is proposed this activity will be carried out well away from watercourses. Washout from such mixing plant will be carried out only in a designated contained impermeable area.

10.5.3 General Operational Mitigation

10.5.3.1 Water Quality Impact Mitigation

All road pavement runoff water will be collected in a road drainage system and discharged to receiving surface waters. Spillage containment in excess of 50m^3 and pre-treatment in terms of silt traps will be provided upstream of all road drainage outfalls. These treatment and spillage containment facilities are proposed to be provided within the storm attenuation ponds.

The proposed drainage system incorporates a range of pollution control features to limit the water quality impact to receiving waters. These include the use of filter drains, sealed drainage systems and the use of a vegetated lined wetland system upstream of all road drainage outfalls. Each of the attenuation ponds include a wetland system/treatment forebay which has been sized to cater for the first flush volume from the road runoff (this is 10% of the pond area as per the SUDs Manual). Further detention storage (for the 100 year storm event) is available within the overall attenuation storage which includes the pond for settlement of suspended pollutants. The vegetated system will allow for the take up of nutrients in the drainage water. These treatment systems will be provided upstream of all proposed outfalls.

A sealed road drainage system will be used to prevent pollutants infiltrating to groundwater in areas of Regionally Important karst Bedrock Aquifer which have a High or Extreme Vulnerability and where the road cuttings intercepts bedrock or where the cutting reduces the vulnerability to extreme (Overburden Cover < 3m) refer to Chapter 9 Hydrogeology for further details.

To facilitate emergency response to serious spillages all pond and storage systems will be fitted with a manual penstock so as to close off the outfall and contain the spillage water within the pond/storage system for pumping out and appropriate treatment and disposal.

10.5.3.2 Storm Runoff Mitigation

In order to minimise local flooding and associated channel morphological impacts all outfall storm discharges to watercourses will undergo storm attenuation reducing outflow so that there is a negligible increased risk of flooding in the receiving watercourse due to construction of the road up to the 100 year return period and attenuating the 100 year storm event within the pond storage area which will then be released at greenfield runoff rates or lower.

The attenuation pond for each of the outfalls will be sited outside of flood plain areas in order to avoid any residual flood storage loss to the receiving river / stream. These attenuation ponds provide a dual function of attenuation and primary water quality treatment through physical settlement of suspended sediments.

10.5.3.3 Culverts and Bridges

All culverts and bridges are designed to prevent permanent impact to the river morphology. A short term temporary impact may occur whilst on-line bridges and culverts are being put in place. These impacts will be minimised through the incorporation of strict control procedures – refer the outline Construction Erosion and Sediment Control Plan in Appendix 10.1. Permanent impacts on river morphology will be prevented by ensuring the river width is not exceeded or contracted by the proposed culvert or bridge and that reasonable transitions to and from the bridge or culvert is provided where approach and exit channels are skewed to the culvert alignment. In all watercourses the proposed culvert will be embedded into the channel to a depth of 500mm for box sections and a minimum of 300mm for pipe culverts (depending on hydraulic size requirements).

All crossings identified as potential Salmonid rivers/streams and important for mammalian (otter) migration have been designed to maintain the existing migratory routes as far as possible, in accordance with Guidelines for the crossing of Watercourses during the Construction of National Road Schemes, TII/NRA 2008.

10.5.3.4 Watercourse Diversions

The proposed stream and drain diversions have been assessed in Table 10.26. Localised mitigation measures have been identified to prevent bank erosion at sites of bends which were found often to coincide with the proposed road culvert. This protection may be in the form of large boulders or rip-rap along the outer bank with a suitable filter material or geotextile placed inside the armouring to protect the native soil bank. All diversion channels will include fishery friendly requirements where they are identified as having fishery potential. The flood capacity will be enhanced while importantly preserving the low flow channel characteristics. The inclusion of shoals and pools in the channel will assist the rehabilitation of the low flow channel at crossing and diversion sites.

10.5.4 Specific Mitigation Measures

Each of the hydrological features identified that are potentially at risk due to the proposed road development were assessed based on the potential magnitude of the impact in Table 10.34. Where an impact rating was deemed to be slight or negligible it is considered that the adherence to good construction practices can adequately mitigate the level of risk involved and no additional specific mitigation is required.

Each of the features which were found to have an impact rating greater than slight have been considered to require mitigation to reduce the magnitude of risk posed. Table 10.36 gives details of the specific mitigation measures proposed at each hydrological feature. Further details of mitigation measures at the following ecologically important sites are described below.

10.5.4.1 Cregga Turlough

Cregga Turlough is located approximately 3.2km to the north-west of Strokestown in the townlands of Cregga and Cuilrevagh. Cregga Turlough is situated in a depression with a rounded ridge of hills along the eastern side and relatively high land to the west except at the central point where the contours lead to Annaghmore Lough, less than 1km away. The proposed road development runs north and north-east of Cregga Turlough between Ch. 36+600 and Ch. 37+950. Setback distances from the proposed road adjacent to the Turlough are between 100 – 250m with agricultural grassland providing the buffer.

Due to the undulating nature of the landscape at this location, sections of the proposed road development require significant earthworks as it passes the Turlough including large cuttings between Ch. 35+150 to Ch. 36+450 and Ch. 36+900 to Ch. 37+650.

The Turlough receives surface runoff from surrounding areas and discharges directly to groundwater through its base. It is therefore imperative that any silt and sediment laden waters running off the construction works are controlled through interception and settlement in sedimentation ponds prior to discharge.

The water balance in the Turlough during construction must be maintained and therefore cut-off drains shall be provided to direct waters away from the construction site and to the Turlough.

The following specific construction requirements to reduce potential contamination impacts upon the Turlough will be put in place – refer to CESCP in Appendix 10.1 for further details:

- Pre-construction water quality monitoring shall take place in the Turlough to establish baseline conditions – see Figures 10.2 – 10.6 in EIAR Volume 3 for location of same.
- A water quality monitoring programme will be undertaken at suitable locations in the receiving watercourse during the construction phase.
- The storage of oils, fuel, chemicals, hydraulic fluids, shall only take place within site compounds. Storage shall be undertaken in accordance with current best practice for oil storage.
- All machinery operating in the works area adjacent to the Turlough will be cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs.

Detailed and specific construction sequencing together with specific drainage designs are proposed in this area – refer to Appendix 10.1 for details. The construction sequence for cuttings adjacent to Cregga Turlough shall ensure that they are completed in sections so that the base gradient allows conveyance to temporary settlement ponds located within the cutting. A temporary settlement pond may be relocated as the dig advances with the preceding settlement area only filled in once the new settlement area is operational and the road and cutting drainage is constructed. Settlement ponds, temporary or otherwise, will be constructed prior to

the excavation works commencing and will be constructed as detailed in the Construction Erosion and Sediment Control Plan in Appendix 10.1. During construction, impermeable barriers will be placed at 50m intervals in the permeable infiltration galleries shown in Figure 10.5.

Operational

The road construction and cutting into the hillslopes surrounding Cregga Turlough have the potential to intercept and divert necessary and significant recharge waters from the Turlough. Without mitigation a significant volume of recharge water could be intercepted and diverted northwest in the road drainage system to the Ovaun stream that outfalls to Clooncullaan Lough.

The design of this section of the proposed road (Ch. 36+000 to Ch. 38+600) will include suitable drainage design to separate the natural hill slope runoff, interflow and ground waters from the potentially contaminated road pavement waters. Recharge flow from the cuttings will be collected in a separate filter drain and discharged to the Turlough at two separate outfall locations via an infiltration basin so as to maintain the recharge regime of Cregga Turlough.

To capture and separate natural water runoff from up-gradient lands, cut-off ditches will be provided along the up-gradient boundary of the cut section (which is in the natural catchment of the Turlough). The intercepted water will be allowed to discharge to the Turlough through infiltration galleries constructed between Ch. 36+500 to Ch. 36+700, Ch. 37+670 to Ch. 37+870 and Ch. 38+030 to Ch. 38+130 to facilitate the natural recharge of the Turlough. These infiltration galleries are to be utilised during the operational phase of the proposed road development to allow natural recharge water to drain to the Turlough. The inclusion of impermeable barriers at 50m intervals in the permeable infiltration galleries will restrict water flowing laterally along the road formation and will direct water towards the Turlough.

No direct discharge of road pavement runoff waters to the Turlough will be permitted. This will avoid any potential pollution of the Turlough and its groundwater system. This also avoids any potential downstream impacts to Annaghmore Lough SAC as the Cregga Turlough in flood conditions overflows via a surface drain to the Lough. The road pavement waters will be collected in a sealed drainage system and discharged to the Ovaun Stream Outfall at Ch. 34+650.

10.5.4.2 Ovaun Stream

The Ovaun Stream discharges to Clooncullaan Lough some c.2km downstream of the proposed road drainage and cut-off ditch outfall discharges. During the construction phase, this watercourse could, in the absence of mitigation, be at risk as a downstream receptor from potential soiled water runoff and spillages of hydrocarbons from construction vehicles.

A swallow-hole feature connected via a spur channel off the Ovaun Stream drainage district channel that outfalls to the lake has been identified 770m downstream of the Road Outfall. Dye tracer releases carried out of the environmental assessments, show that a proportion of the channel flow discharges to the swallow hole. A larger catchment scale dye tracing study was also carried which identified that this swallow hole discharges to the Owenur River between Ballyslish Bridge and Drummullin northeast of Elphin.

In order to protect both Clooncullaan Lough and the groundwater body from potential contamination from soiled site runoff in the form of suspended sediment, the two

wetland treatment ponds located at Ch. 34+850 will be constructed in advance of the main earthworks to treat this construction runoff. Where necessary additional temporary treatment ponds will be provided within the cutting to ensure the highest level of sediment removal is achieved. These treatment ponds will ensure that all waters entering the watercourse will be afforded treatment prior to discharge and therefore no deterioration in water quality will occur.

Specific construction mitigation measures relating to the overland outfall to the Ovaun River are detailed in the CESCP in Appendix 10.1.

Operational

Surface water runoff from the cutting between Ch. 35+150 and Ch. 36+150, which includes intercepted hill slope runoff and interflow, and the road pavement runoff will be discharged to the Ovaun Stream through a maintained channel and will outfall through a regraded existing minor drain. Hydraulic modelling of the new channel has been undertaken to access the flood risk impacts, particularly at the culverted crossing under the proposed road development. No increased risk of flooding is posed to the surrounding lands. The intercepted hill-slope drainage/runoff water will be kept separate from the road pavement runoff so as to avoid / minimise the potential volume of potentially contaminated road drainage runoff waters and the treatment of such waters by the downstream attenuation pond system

In order to protect both the Lough and the groundwater body from potential contamination, road drainage runoff will be isolated and discharged through a series of two wetland treatment systems comprising of forebay, reed beds and pond systems located at Ch. 34+850 prior to its outfall to the Ovaun Stream (via a local drain). The level of treatment will ensure that the road runoff discharge will not impact on the receiving water quality of the Stream, Lough or groundwater system.

Given that a portion of road runoff will essentially be discharging (770m downstream of the outfall) to groundwater, a groundwater risk assessment has been carried out in line with the EPA document "Guidance on the Authorisation of Discharges to Groundwater (2011)" – refer to Chapter 9 Hydrogeology for details. The outcome of this risk assessment indicated that the discharge will have an imperceptible impact on groundwater quality.

10.5.4.3 Alkaline Fen at Tullyloyd

Constructional

The fen feature will be protected, in particular during the construction phase when it will be most at risk from site traffic, soiled water runoff and spillages of hydrocarbons.

During the construction phase it will be necessary to ensure that the fen area is avoided by all groundworks and is protected from construction runoff. A small berm feature and silt fence along the boundary with the fen area will be constructed so as to intercept and divert any surface water runoff from the working area into the small stream to the north (west of OUT34.01), via suitable measures to remove suspended solids and potential contaminants (i.e. large settlement pond area). Refer to Figures 10.2 – 10.7 for details.

In order to prevent longitudinal drainage in the road formation towards the natural low point of its profile at Ch. 33+850, transverse barriers will be installed in its foundation at 200m intervals between Ch. 33+200 and Ch. 34+500. See Figure 4.39 in EIAR Volume 3 for typical cross-sectional detail at lined sections.

Operational

The road has the potential to intercept recharge to the Fen. Mitigation in the form of permeable construction in the road formation layers will be provided to allow the interflow to transmit southwards under the road to the fen system.

The design of this section of road will include suitable drainage systems to prevent any operational phase surface runoff from the road pavement entering the fen area via overland flow. No direct surface outfall to the fen shall be permitted. Discharge shall be to the existing drainage channel downstream of the fen. A sealed drainage system will be provided along this ecologically sensitive section and the road drainage will pass through a lined wetland treatment system prior to outfall.

The road embankment adjacent to the fen will be constructed on a granular layer so as to maintain existing pathways for overland and interflow from the west and southwest to continue discharging to the fen. It may be necessary to strip back overburden layer to shallow bedrock so as to ensure that the drainage layer functions appropriately. This granular layer will be wrapped in a geotextile to avoid infiltrating fines reducing its porosity over time. Importantly this granular layer shall be isolated from any existing or constructed surface drains so that it does not have the potential to drain the wetland as opposed to supply it.

Leggatinty Bog

In order to prevent drainage of adjacent blanket bog by the road formation, a longitudinal impermeable sub-surface barrier will be installed running parallel to the road alignment between Ch. 10+500 and Ch. 10+650 on the west side of the alignment, between Ch.11+600 and Ch. 12+000 on the north side of the alignment and between Ch. 11+750 and Ch. 12+250 on the south side of the alignment. Refer to Figure 4.39 in EIAR Volume 3 for typical cross-sectional detail at lined sections.

10.5.4.4 Additional Mitigation Measures

A number of precautionary measures are also proposed in some locations even when the level of impact was categorised as slight or negligible. Shallow toe drains with check dams will be incorporated to maintain water levels in the wetlands adjacent to KER's 1, 4, 5, 6, 9, 10,11,13,17 & 18. At KER 13 transverse barriers at every 200 – 300m in the road formation will also be incorporated as a precaution to prevent any draining of the wetland area – refer to Figures 9.5 – 9.10 for locations.

At KER 1, transverse barriers to prevent longitudinal drainage in the road formation will be provided at 100m intervals between: Ch.4+050 and Ch. 4+500 to prevent dewatering. At KER 4, a longitudinal impermeable barrier will be provided along the eastern boundary of the alignment to prevent potential dewatering. To prevent longitudinal drainage from the road formation layer impacting KER 5, transverse impermeable barriers will be provided between Ch. 10+900 and Ch. 11+600 at 100m intervals – refer to Figures 9.5 – 9.10 for locations.

The extent of longitudinal barriers or transverse barriers proposed is dictated by the natural contours of the surrounding lands and whether it is blanket bog or wet grassland habitat (Refer to Figure 4.39 in EIAR Volume 3 for typical cross-sectional detail at lined sections).

All other mitigation measures proposed at each hydrological feature are summarised in Table 10.36. General mitigation measures described above will apply at all KER locations including maintaining existing watercourses in place.

Table 10.34 Proposed Mitigation Measures for Hydrological Features with the Corresponding Residual Impact Rating

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 1a(N) & 1B(C) Ch. 4+000 to Ch. 4+500	Wet Grassland (Molina Meadows) National Importance & County Importance	Operational	Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	No Improvements to drains in the area surrounding the wetland area. Transverse barrier at 100m intervals. Additional culvert beneath the road to ensure overland flow connectivity to wetlands. Check dams to be incorporated in toe drains to maintain water levels in the wetlands.	Negligible
KER 2a(LH) & 2b(N) Ch. 5+000 to Ch. 5+500	Degraded and intact Raised Bog and Cutover Bog National Importance & Local Importance (Higher Value)	Operational	Road Drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Longitudinal barrier in the road formation returned to competent bedrock/overburden to prevent the migration of water into road formation. The proposed bog access road shall be of floating road construction with existing drainage channels maintained and thus drainage of the bog will be negligible.	Negligible
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.		Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 3(LH) Ch. 10+125 to Ch. 10+150	Carricknabraher River Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	A Construction Erosion and Sediment Control Plan (CSECP) has been developed – see Appendix 10.1The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will be treated in an attenuation pond with a treatment forebay provided prior to outfalling to receiving watercourse. The attenuation pond will be fitted with a penstock or similar restriction at the outfall to the receiving channel.	Slight
KER 4(C) Ch. 10+750 to Ch. 10+850	Wet Grassland (Molinia Meadows) County Importance	Operational	Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	All existing watercourses and local drainage channels will be maintained to ensure increased drainage of lands does not occur. Transverse barriers at 100m intervals. Check dams to be incorporated on toe drains to maintain wet conditions.	Slight
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas		
KER 5(N) Ch. 11+480 to Ch. 12+150	Wet Grassland (Molinia Meadows) National Importance	Operational	Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	All existing watercourses and local drainage channels will be maintained to ensure increased drainage of lands does not occur. Transverse barriers at 100m intervals. Check dams to be incorporated on toe drains to maintain wet conditions.	Slight
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.		

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 6(a)(N), 6b(N), 6b(C), 6b(LH), 6c(N), 6c(LH), 6c(LL) Ch. 10+900 to Ch. 12+450	Peatland complex of Raised Bog and Cutover Bog with Wet Heath & Bog Woodland National Importance, County Importance & Local Importance (Higher & Lower Value)	Construction	Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
		Operational	Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Longitudinal barrier running along the edge of the road formation. Maintain transverse flow paths/ditches through culverting/piping. Use of shallow toe drains with check dams as appropriate.	Slight
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.		Slight
KER 7a(N) & 7b(LH) Ch. 13+950 to Ch. 14+450	Peatland complex of Raised Bog and Cutover Bog with Bog Woodland National Importance and Local importance (Higher Value)	Construction	Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
		Operational	Road drainage system – outfalls, culverts, interceptor drains, diversions and truncations affecting the water flow regime.	Longitudinal & transverse drains. Check dams on toe drains to maintain wet conditions.	Slight
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effects on adjacent soils and wetlands areas.		

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 8 (LH) Ch. 14+450 to Ch. 14+800	Owennaforeesha River Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will be treated in an attenuation pond with a treatment forebay provided prior to outfalling to receiving watercourse. The attenuation pond will be fitted with a penstock or similar restriction at the outfall to the receiving channel.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	All existing watercourses and local drainage channels will be maintained to ensure drainage of lands does not occur.	Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 13(LH) Ch 30+550 to Ch 31+950	Upper Owenur River Marsh and Wet Grassland, Wet Grassland Reedswamp & Poor Fen Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will be treated in an attenuation pond with a treatment forebay provided prior to outfalling to receiving watercourse. The attenuation pond will be fitted with a penstock or similar restriction at the outfall to the receiving channel.	Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 15a(LH), 15b(LL), Ch. 33+350 to Ch. 34+350	Lough Clooncullaan, and Surrounding Wetland Complex Local Importance (Higher & lower Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will be treated in an attenuation pond with a treatment forebay provided prior to outfalling to receiving watercourse. The attenuation pond will be fitted with a penstock or similar restriction at the outfall to the receiving channel.	Slight
			Interception of drainage paths by the permeable road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	Transverse barriers every 100m in the road formation. Maintain transverse flow paths/ditches. Shallow toe drain with check dams if required.	Slight
15c(N), 15d(C) & 15e(C) Ch. 33+350 to Ch. 34+350	Annex I Transition Mire and Rich Fen Habitat National & County Importance	Operational	Interception of drainage paths by the permeable Road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.	Transverse barriers every 100m in the road formation. Maintain transverse flow paths/ditches. Shallow toe drain with check dams if required.	Slight

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 16(N) Ch. 36+650 to Ch. 37+950	Turlough (Cregga) National Importance Annex I priority Habitat	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.)		
		Operational	Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	Interceptor ditches and filter drains will collect existing overland and interflow which discharge to the Turlough in three distribution galleries between Ch.36+500 to Ch.36+700, between Ch.37+670 to Ch. 37+870 and between Ch.38+030 to Ch.38+130,. The existing ground will be excavated to bedrock and filled with free draining material to existing ground level to facilitate the dispersal/infiltration of overland drainage intercepted by the proposed road development. The provision of transverse impermeable bunds at 50m intervals to prevent longitudinal flow of sub-surface water will be incorporated within the free draining material. This will ensure that the existing water balance of the Turlough is maintained.	Slight
			Interception of drainage paths by the permeable Road formation resulting in diversion of waters and in a dewatering effect on adjacent soils and wetland areas.		

Attribute		Impact			
KER Receptor No.	**Receptor Name and Importance**	**Stage**	**Description of Impact**	**Mitigation Measures Proposed**	**Residual Impact**
KER 19(LH) Ch. 52+850 to Ch. 53+250	Scramoge River Local Importance (Higher Value)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff. Silts and sediments and nutrient pollution arising from handling of peat (excavation, removal, deposition).	A Construction Sediment Erosion and Control Plan (CSECP) has been developed – see Appendix 10.1. The measures outlined in the CSECP will ensure no adverse impacts on water quality occur.	Slight
			Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.		
			Disturbance due to construction machinery and carrying out of temporary works (cofferdams culverts channel diversions, sediment ponds, silt fences etc.).		
		Operational	Road drainage and outfalls impacting on water quality: - Routine road runoff discharges. - Accidental fuel spills from road.	Road drainage will be treated in an attenuation pond with a grease trap provided prior to outfalling to receiving watercourse. The attenuation pond will be fitted with a penstock or similar restriction at the outfall to the receiving channel.	Slight
			Changes to stream channel morphology as a result of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition.	All existing watercourses and local drainage channels will be maintained to ensure drainage of lands does not occur.	Slight

10.6 Residual Impacts

The residual hydrological impacts associated with the proposed road development can be grouped as follows:

- Flood Risk;
- Water Quality;
- Channel Morphology; and
- Impacts on Key Ecologically sensitive areas (KERs).

10.6.1 Flood Risk

10.6.1.1 Road Runoff

There is a potential to increase peak flow rates and runoff volumes due to the increased impermeable area associated with the proposed road development and the collecting drainage system which discharges at outfall points. The implementation of sustainable drainage systems (SUDs) through the incorporation of engineered attenuation ponds and controlled discharges at all outfalls will control storm runoff rates to Greenfield flood runoff rates so as not to exacerbate flooding and flood risk in the receiving watercourses.

This will mitigate negative impacts on flood risk in the receiving streams from road runoff. Attenuation storage has been sized to accommodate the 100 year storm event which represents a higher design standard to 50 year recommended in the TII/NRA Guidelines. There will be an imperceptible residual impact from the proposed road development.

10.6.1.2 Diversion of Runoff Between Catchments and Sub-catchments

At some locations the creation of the proposed road development and its associated road drainage system will lead to the interception of overland flow into the road drainage system and its subsequent discharge to nearby watercourses. Without mitigation, this may lead in some cases to a diversion and concentrating of overland flow that would otherwise have discharged to a different watercourse.

There is a deep cutting at Cregga and there will be a substantial diversion of hillslope runoff, interflow and groundwater flow which currently enters the Ovaun Stream and Clooncullaan Lough system. This has been mitigated through the provision of interceptor drains that will convey this intercepted runoff back into the system maintaining existing conditions.

At the deep cutting section in the Cregga area, the substantial diversion of hillslope runoff, interflow and groundwater flow which currently enters the Turlough system has been mitigated through the provision of interceptor drains that will convey intercepted runoff water beneath the road through an infiltration gallery to its original location discharging to Cregga Turlough.

At all other locations along the proposed road development, intercepted runoff water continues to discharge to watercourses and drains within its original catchment and sub-catchment. There will therefore be an slight to imperceptible residual impact from the proposed road development due to the diversion of runoff.

10.6.1.3 Flood Conveyance

No negative residual impacts on flood risk due to loss of conveyance are anticipated at river and stream crossings. All culvert design flows provided for include large

factors for uncertainty associated with flood estimation in small ungauged catchments and thus the proposed culvert sizes are considered to be conservatively large and in all cases substantially exceed the existing culvert sizes on such streams and therefore avoid any conveyance capacity issues. There will be a slight to imperceptible residual impact from the proposed road development.

10.6.1.4 Floodplain Storage

This loss of floodplain storage where the proposed road development crosses such areas is minor relative to the catchment flood flows and will result in no perceptible impact on flood levels either locally upstream or downstream and therefore will have negligible impact on flood risk at these locations. There will be a slight to imperceptible residual impact from the proposed road development.

10.6.2 Water Quality

The proposed road drainage will be collected and discharged to watercourses resulting in localised water quality impact at the outfall sites. This impact will be minimised through the use of filter drains where permitted, sealed drainage systems and the use of a vegetated lined wetland system upstream of all road drainage outfalls with further detention storage provided within the attenuation pond system for settlement of suspended pollutants.

It is anticipated that the proposed road drainage outfalls will give rise to an overall slight positive impact on water quality of the receiving watercourses as it will generally improve the existing situation of untreated storm drainage from the existing N5 road. On the catchment scale such mitigation meets the objectives of the River Basin Management Plan of protecting and improving the water quality status.

10.6.2.1 Accidental Spillage

All pollution control facilities and attenuation areas will be fitted with a penstock or similar restriction at the outfall to the receiving channel. The overall risk assessment to quantify the likelihood of a serious accidental spillage indicates a cumulative risk for the entire road length to be very small at 1 in 250 year risk and with individual outfalls having a considerably lower risk (DMRB Volume II Section 3 Part 10).

The impact from accidental spillages on stream outfalls will be reduced by the use of treatment forebays incorporated within the attenuation pond upstream of the outfall and the provision of a penstock on the pond outflow which can be closed off in the event of a serious pollution incident arising. There will be a positive residual impact from the proposed road development due to these measures.

10.6.2.2 Water Abstraction

No negative impacts to Regional Supplies surface water abstraction sources area are anticipated (Lough Gara lake abstraction source) during the construction and operation phases. There will be no residual impact from the proposed road development.

10.6.3 Morphology

No negative residual impacts to surface water feature morphology are anticipated, as all practicable mitigation measures for drainage, bridges and culverts and channel realignments as stated in the mitigation section are to be implemented. There will be no residual impact from the proposed road development.

10.6.4 Impacts on Key Ecological Receptors

The residual impact of the proposed road development on key ecologically sensitive areas (also known as Key Ecological Receptors or KERs) has been assessed and the results are shown in Table 10.35. Only a slight residual impact from the proposed road development is anticipated at key ecologically sensitive areas.

In addition, and as outlined above, the proposed development will result in a positive impact on water quality of the receiving watercourses as it will generally improve the existing situation of untreated storm drainage from the existing N5 road. The risk of serious pollution to these watercourse will also be reduced with the inclusion of pollution control measures which can be closed off in the event of a serious pollution incident arising.

APPENDIX 10.1
Construction Erosion and Sediment Control Plan (CESCP)

1. INTRODUCTION

1.1. General

This document outlines the procedures and technical practices for implementing effective erosion and sediment control through a variety of delivery methods. The report provides an effective tool for reducing potential environmental effects by:

- Identifying erosion and sediment control objectives before construction;
- Encouraging planning to manage water, control erosion and control sediment by identifying potential impacts and mitigation measures;
- Providing a mechanism for clear communication to workers;
- Defining a performance expectation; and
- Assuring owners and regulators that due diligence has been exercised.

The purpose of a Construction Erosion and Sediment Control Plan (CESCP) is to:

- Minimise erosion potential by effective planning, procedures and water management;
- Apply erosion control measures to prevent the movement of sediment; and
- Apply sediment control measures to prevent off-site sediment release in the event of sediment movement.

This plan is intended to be a live working document and therefore the measures proposed herein may be added to or amended as the project progresses. This plan will form an integral part of the Environmental Operating Plan (EOP) for the proposed road development. In particular, the mitigation, control, monitoring and emergency measures for the proposed road development in relation to Erosion and Sediment Control are described in this document.

1.2. Description of the Proposed Road Development

Key Elements

The description of the proposed development has been divided into the sections outlined in Table 1.1 below.

Table 1.1 Proposed Development Sections

Section	Segment	Chainage
A	Section A of the proposed road development begins outside of Ballaghaderreen in the townland of Glebe East and terminates south of Frenchpark with a roundabout with the R361.	1,000 – 5,697
B	Section B of the proposed road development starts south of Frenchpark at the roundabout intersection with the R361 and continues east. Section B ends with roundabout intersection with the N61 in the townland of Gortnacrannagh.	10,000 – 24,200
C	Section C of the proposed road development starts with a roundabout intersection with the N61 and continues east towards the townland of Lavally where it ends in a roundabout intersection on the LP-1405 (link to the R368).	30,000 - 40,542

Section	Segment	Chainage
D	Section D of the proposed N5 alignment starts with a roundabout intersection of the LP-1405 (link to the R368), just north of Strokestown. The alignment finishes at a tie-in to the existing N5 in the townland of Scramoge.	50,000 – 53,970

The total length of the mainline is 33.4km of type 1 single carriageway.

1.3. Contract Procurement

The Contract Procurement is expected to be that of a Design/Build Contract. This type of contract places a responsibility on the appointed contractor to carry out the detailed design and to build the project and includes the requirement to comply with the obligations of the Environmental Impacts Assessment Report (EIAR), the Natura Impact Statement (NIS) and with the development consent for the proposed road development.

This CESCP sets out the minimum requirements that must be adhered to in terms of avoidance measures, minimisation measures, and protective measures for the water environment. Any alternative measures that may be incorporated at the construction stage will be required to provide at least the same, or, a better standard of protection.

1.4. Consultations

Consultation has taken place with the National Parks and Wildlife Services (NPWS) and the Inland Fisheries Ireland (IFI) and their comments/observations with regard to measures and controls for water quality protection have been adopted within the plan.

1.5. Scope and Methodology

The protection of lakes, watercourses, karst features and groundwater from pollution arising from construction works is achieved by avoidance in the first instance. Where potential impacts on lakes and watercourses cannot be avoided, the methodology seeks to implement appropriate mitigation during the construction phase to avoid adverse impacts and provide appropriate protection. This plan was completed and should be read with reference to the following documents:

- The European Water Framework Water Framework Directive (WFD) 2000/60/EC – European Communities (Water Policy) Regulations 2003 (SI 722 of 2003) (as amended).
- The Fisheries (Consolidation) Act 1959 (as amended).
- The Fisheries (Amendment) Act 1999 (No. 35 of 1999).
- E.C. (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293 of 1988).
- The Local Government (Planning and Development) Act 2000 (No. 30 of 2000).
- The Local Government (Water Pollution) Act 1977 (as amended), The Surface Water Regulations (S.I. No. 272 of 2009).
- The Wildlife Act (1976), as amended.
- Control of water pollution from construction sites. Guidance for consultants and contractors (C532) developed by the Construction Industry Research and Information Association (CIRIA, 2001).
- Control of Water Pollution from Linear Construction Projects. Technical Guidance (C648), (CIRIA, 2006).

- Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. (Eastern Regional Fisheries Board, 2003).
- Maintenance and protection of the Inland Fisheries resource during road construction and improvement works. (Southern Regional Fisheries Board, 2007).
- Guidelines for the crossing of watercourses during the construction of National Road Schemes. (National Roads Authority, 2008).
- Working at construction and demolition sites: PPG6 Pollution Prevention Guidelines (UK Environment Agency).

1.6. Principles of Erosion and Sediment Control

The principles of erosion and sediment control during the construction stage of a road project as outlined in CIRIA C648 include:

- Erosion control (preventing runoff) is more effective than sediment control in preventing water pollution. Erosion control is less subject to failure from high rainfall, requires less maintenance and is also less costly.
- Plan erosion and sediment controls early in the project lifecycle and incorporate into the design and construction programme.
- Install drainage and runoff controls before starting site clearance and earthworks.
- Minimise the area of exposed ground.
- Prevent runoff entering the site from adjacent ground, as this creates additional polluted water.
- Provide appropriate control and containment measures on site.
- Monitor and maintain erosion and sediment controls throughout the project.
- Establish vegetation as soon as practical on all areas where soil has been exposed.

This CESCP sets out the minimum requirements that must be adhered to. Any alternative measures that may be incorporated at the construction stage will be required to provide at least the same, or, a better standard of protection to surface and groundwater bodies.

1.7. Contents of Plan

This plan contains the following information:

(i) An identification of existing land use, surface water features, low-lying areas and natural drainage pathways;

(ii) An outline of the main construction activities likely to be relevant in relation to erosion and sediment generation;

(iii) Identification of the areas most likely to have the potential for runoff;

(iv) Collection of information on soil types, rainfall data, etc;

(v) Selection of the best controls to avoid and minimise runoff and erosion;

(vi) Ensure that control measures are correctly installed and sized - initial runoff controls to be in place before site works begin;

(vii) A description of the inspection and maintenance programme throughout construction to ensure the necessary controls are in place and operational.

(viii) Emergency Procedures.

2. SITE CHARACTERISTICS

2.1 General

The following gives a general overview of the landscape character and the main natural drainage pathways which are relevant in terms of erosion and sediment control.

2.2 Landscape Character

Section A

The landscape of Section A is typical of rural Ireland comprising of low lying agricultural farmland with sparsely located residential properties. Section A is notably low-lying and flat to gently-undulating; the proposed road closely follows the contours of the existing landscape with no major areas of cut or fill needed. In section A the proposed road development crosses through large areas of forestry particularly in the areas of Dungar and Turlaghnamaddy.

Section B

The landscape of section B includes a varied mix of rolling hills, large areas of agriculture farmland, forestry, bog and scrubland. Large sections of the proposed road development in Section B will require areas of cut and fill due to the undulating nature of the landscape. The alignment in Section B crosses the Carricknabraher River and the Owennaforeesha River. In addition the proposed road development also crosses an area of karst bedrock with surface karst features in the townland of Mantua.

Section C

The landscape in Section C is similar to that of Section B, as both are a varied mix of rolling hills, large areas of agriculture farmland, forestry and scrubland. The proposed road development within Section C will require large sections of cut and fill embankments due to the rolling hills in the area, most notably in the townlands of Cregga, Killeen East, Cuilrevagh and Lettreen. Section C crosses the Owenur River.

Section D

The proposed road development ties into the existing N5 in the townland of Scramoge. The landscape in Section D is a varied mix of rolling hills, areas of agriculture farmland and forestry. In Section D the proposed road development crosses the Strokestown River and the Scramoge River.

2.1 Natural Drainage Ways

The proposed road development crosses the following rivers and several small watercourses which are tributaries of these:

- The Carricknabraher River;
- The Owennaforeesha River;
- The Owenur River;
- The Strokestown River; and,
- The Scramoge River.

Each of the watercourses listed above are within the EPA Hydrometric Area No. 26 (upper River Shannon section). Section A of the proposed road development does not cross any major rivers or watercourses.

Section B contains the Carricknabraher River, the Owennaforeesha River and the Mantua Stream all of which join the Breedoge River before outfalling into Lough Gara SPA on the Roscommon – Sligo border.

Section C of the proposed road development crosses the Owenur River.

Section D of the proposed road development crosses both the Strokestown and Scramoge Rivers. These rivers then merge north-east of Strokestown to form the Mountain River which then outflows into Kilglass Lough.

A map showing the locations of the catchments is given in Figure 10.13 contained within Volume 3 of the EIAR.

Following consultation with Inland Fisheries Ireland (IFI), the following major watercourses listed below have been identified as being considered Salmonoid or to have potential to be Salmonoid and consequently are treated as sensitive to pollution. In addition there is a requirement for angler access at these locations:

- Carricknabraher River;
- Owenaforeesha River; and
- Scramoge River

The ecological significance of these watercourses have been categorised as being of Local Importance Higher Value – refer to Chapter 7 – Biodiversity contained within Volume 2 of the EIAR for details.

3. POTENTIAL SOURCES OF RUNOFF

The following paragraph outlines what are considered to be the main potential sources of sediment and other water pollutants arising from the Construction Stage of the proposed road development.

3.1 Earthworks

The most significant area of concern regarding erosion and sediment control on any road construction project is the process where topsoil, subsoil and peat surfaces are exposed.

Typically these surfaces are exposed during:

- The initial site clearance works/topsoil strip;
- Excavation of cuttings;
- Construction of fill slopes;
- Excavation and backfilling of soft spots underneath proposed embankments;
- The construction of borrow pits and material deposition areas;
- Transportation of soils, particularly saturated peat, within the bounds of the development either to material deposition areas or stockpile locations.
- The construction of spoil repositories;
- Construction of haul roads for earthworks operations;
- Stockpiling of acceptable and unacceptable earthworks material for reuse or removal offsite; and
- Stockpiling of road construction material (rockfill, capping and subbase etc.).

These sources of pollution have been identified through a detailed review of the project design.

3.2 Structures & Concrete

Concrete, grout and other cement-based products which would typically be used in the construction of structures are highly alkaline and corrosive and can have a devastating effect on water quality. Cement-based products generate very fine, highly alkaline silt (11.5pH) that can physically damage fish by burning their skin and blocking their gills. This alkaline silt can also smother vegetation and the bed strata of watercourses and can indirectly mobilise pollutants such as heavy metals by changing the water's pH. Concrete and grout pollution is often highly visible.

Particular risks are posed to water quality when construction is taking place over or near surface water bodies (e.g. bridges or headwalls), through the potential for spillage of cement based compounds or hydrocarbons and physical disturbance giving rise to sediment release.

Cement and lime may also be used in soil improvement techniques and in soil stabilisation. These practices also have the potential for release to watercourses particularly through surface runoff of sediment laden waters.

3.3 Watercourse Crossings and In-stream Works

There are numerous minor watercourse crossings and stream diversions associated with this proposed road development. Diversion or maintenance of these channels has the potential to generate sediment through disturbance.

3.4 Construction Compounds & Machinery Re-fuelling/Lubrication

A number of temporary construction compound sites will be required along and / or in the vicinity of the proposed road development. These compounds will include (but will not be limited to): material stockpiles, loading and unloading areas, fuel stores, machinery stores, canteens and site offices and toilets. The location, size and suitability of the sites selected will be at the discretion of the contractor and will be subject to compliance with all relevant legislation. The following potential compound sites have been identified within the proposed development boundary (refer to Figures 2.1 – 2.26 in Volume 3 of the EIAR for details):

- Adjacent to the Frenchpark Roundabout at Ch. 5+600;
- Adjacent to the R369 between Ch. 17+200 and Ch. 17+600;
- Adjacent to the R368 between Ch. 34+750 and Ch. 35+000.

Particular considerations in relation to the location of such facilities and their generation of pollution during the construction stage include:

- Sanitary Wastewater treatment;
- Hard-standing surface water runoff;
- Potential for hydrocarbon pollution to groundwater and surface water;
- Avoidance of flood risk areas;
- Set back distances from sensitive watercourses and ecological receptors.

In addition to the construction compound sites discussed above, the construction of the proposed development will require rock processing areas with crushing facilities and material stockpiles at various locations along the proposed alignment. The location of these facilities will vary as the construction works progress. Rock

processing areas will be located in areas of deep cuttings typically at the base of the cutting or in a specified area within the cutting itself. Cuttings through overburden may also require soil processing facilities. Material (soil) improvement areas may be required in order enhance poor strength or non-cohesive material allowing reuse within the works. These material improvement areas would likely be located in a designated area either, within or adjacent to, the cutting location. The significant cuttings included with the proposed development are summarised in Table 3.1 below.

Table 3.1 Significant Cuttings Proposed Along the Road Alignment

Chainage (m)	Location	Max Depth of Cut (m BGL)	Soil Type / Stratum
13+000 – 13+800	Ballaghcullia	10.9	Glacial Till / Sandstone
18+800 – 20+600	Kilvoy & Corry East	6.6	Glacial Till / Limestone
22+000 - 22+600	Cartronagor	4.2	Glacial Till
23+250 – 30+450	Gortnacrannagh	8.6	Glacial Till / Limestone
30+000 - 30+500	Gortnacrannagh	7.8	Glacial Till / Limestone
32+100 – 33+100	Killen East	13.0	Glacial Till
35+600 – 36+450	Cregga	27.0	Glacial Till / Limestone
36+850 – 37+600	Cuilrevagh	14.5	Glacial Till / Limestone
39+650 – 40+050	Lettreen & Corskeagh	4.7	Glacial Till
50+000 – 50+650	Lavally	7	Glacial Till
52+450 – 52+700	Scramoge	5	Glacial Till

Both rock and overburden cuttings/processing areas will generally include a material stockpile where either rock or overburden material is stored before being hauled to areas of fill along the scheme. These stockpiles and material/rock processing areas both have the potential to produce sediment which could be mobilised during periods of heavy rainfall.

In addition, it is envisaged that topsoil and/or acceptable material will be stockpiled during the course of the proposed road development. Stockpiles of granular material containing a high proportion of fines presents a risk for mobilisation of sediment laden water during periods of heavy rainfall.

4. WATERBODIES & GROUNDWATER RECEPTORS

The main waterbodies which could potentially be impacted by sediment are generally considered to be those relating to aquatic ecology (including adjacent wetlands) and fisheries. Other smaller local watercourses have the capacity to function as a conduit to more sensitive areas/watercourses further downstream. A summary of each of the main watercourse along the proposed road development is given in Table 4.1 below.

Table 4.1 Summary of Watercourses Adjacent to the Proposed Development

Waterbody	Description
Unnamed minor watercourse located in the townland of Rathkerry at Ch.1+200. (Local Importance Lower Value)	– Local minor watercourse – This watercourse has limited fishery potential with the downstream receptor being the River Lung.

Waterbody	Description
Carricknabraher River (Local Importance Higher Vlaue)	– The Carricknabraher River has been assigned a value of Local Importance (Higher Value) by the Project Ecologist – This river has the capacity to function as a conduit to more sensitive areas downstream. – The river is not designated as being Salmonid at the proposed crossing but has been identified as having Salmonid potential. – No significant habitat for Otter, Kingfisher, Lamprey, Crayfish or Salmon was recorded during ecological surveys at the crossing points but the potential for these species to use the watercourses was acknowledged with suitable habitat located in the wider area.
Unnammed stream -located in the townland of Mullen at Ch.12+705. (Local Importance Lower Value)	– Local minor watercourse – This watercourse has limited fishery potential with the downstream receptor being the Carricknabraher River.
Owennaforeesha River (Local Importance Higher Vlaue)	– The Owennaforeesha River has been assigned a value of Local Importance (Higher Value) by the Project Ecologist – This river has the capacity to function as a conduit to more sensitive areas downstream. – The river is not designated as being Salmonid at the proposed crossing but has been identified as having Salmonid potential. – No significant habitat for Otter, Kingfisher, Lamprey, Crayfish or Salmon was recorded during ecological surveys at the crossing points but the potential for these species to use the watercourses was acknowledged with suitable habitat located in the wider area.
Unnammed minor stream in the townland of Drummin at Ch.14+632. (Local Importance Lower Value)	– Local minor watercourse – This watercourse has limited fishery potential with the downstream receptor being the Owennaforeesha River.
Mantua Stream at Ch.21+325. (Local Importance Lower Value)	– Local minor watercourse – This watercourse has limited fishery potential with the downstream receptor being the Breedoge River.
Unnammed minor watercourse in the townland of Mantua at Ch.23+200. (Local Importance Lower Value)	– Local minor watercourse – This watercourse has limited fishery potential and discharges to the Mantua stream with the downstream receptor being the Breedoge River.
Owenur River (Local Importance Higher Value)	– The Upper Owenur River is a modified channel which has been subject to significant drainage works. – The River is classified as Local Importance (higher value) on the basis of supporting semi natural habitat types
Clooncullan Lough (Local Importance Higher Value)	– Lough Clooncullaan, is surrounded by wetland habitats including Rich Fen and Reed Swamp (refer to ecological habitat mapping Figures 7.27 – 7.51 – EIAR Volume 3). – The Lough itself has been classified as Local Importance (higher value) – The Ovaun stream discharges to Clooncullan Lough. – Clooncullan Lough discharges to the Owenur River downstream.
Ovaun Stream at Ch.34+750. (Local Importance Lower Value)	– The Ovaun stream is a modified channel which has been subject to significant drainage works. – This watercourse has limited fishery potential. It discharges to Clooncullan Lough which in-turn discharges to the Owenur River.

Waterbody	Description
Strokestown River (Local Importance Higher Vlaue)	– The Strokestown River is a highly modified channel which has been the subject to extensive drainage works. – The River is classified as Local Importance (higher value) on the basis of supporting semi natural habitat types – This watercourse has limited fishery potential with the downstream receptor being the Mountain River.
Scramoge River (Local Importance Higher Vlaue)	– The Scramoge River, its tributary and surrounding lands were assigned Local Importance (higher value) on the basis of supporting semi natural habitat types with high biodiversity and high degree of naturalness and habitat connectivity throughout the wider area. – The river is not designated as being Salmonid at the proposed crossing but has been identified as having Salmonid potential. – No significant habitat for Otter, Kingfisher, Lamprey, Crayfish or Salmon was recorded during ecological surveys at the crossing points but the potential for these species to use the watercourses was acknowledged with suitable habitat located in the wider area.

The route of the proposed development alignment passes through areas of karstified bedrock with surface features present such as swallow holes, springs, a turlough and numerous enclosed depressions. Exposed bedrock is also present in a number of locations. Given that these features provide a direct connection to groundwater and that the underlying aquifer is classified as a Regionally Important Groundwater Resource, protection from construction sediment and other water pollutants is required. The main features which require protection during the construction stage are summarised in Table 4.2 below.

Table 4.2 Summary of Groundwater Receptors Adjacent to the Proposed Development

Groundwater Feature	Description
Leggatinty Swallow Hole & Cave	– There are 2 No. swallow hole features and a cave located at Leggatinity. – A local stream enters the cave at Legatinity and reappears at Cloonshanville Spring to the north. – A number of enclosed depressions are also located at this location. – The proposed alignment passes within c.200m of these features.
Polloweneen (Mantua) Swallow Hole Features	– There are 4 No. swallow hole features located immediately adjacent to the proposed alignment. – A number of enclosed depressions are also located at this location. – Polloweneen swallow hole has been shown to be connected underground to the Polecat Groundwater Supply Scheme springs. – Swallow holes also shown to be connected to Tobernacuilly spring. – One of these swallow hole feature will be excavated and filled with drainage stone during the construction stage.
Polecat Springs Groundwater Supply	– The Polecat Springs groundwater supply is a spring which is located in the townland of Lissavilla c.3km north-east of Elphin. – The proposed development is inside the Zone of Contribution (ZOC) for this supply between Ch. 17+500 and 34+000 – see Figure 9.7 EIAR Volume 3. The ZOC boundary has been recently redelineated due to tracer studies carried out as part of this scheme. The area of the ZOC through which the proposed development passes is mapped as being connected to the supply based solely on karst underground connections.

Groundwater Feature	Description
Peak-Mantua Groundwater Supply	– The Peak-Mantua groundwater supply scheme is a spring which is located in the townland of Peak c.2.5km east of Bellanagare. – The northern boundary of the ZOC) for this supply extends directly along the perimeter of the proposed alignment over a length of c.1.5km between Ch. 15+500 and 17+000 – see Figure 9.7 EIAR Volume 3.
Lugboy Swallow Hole	– This swallow hole feature is located c.250m south of the proposed alignment. – The Ovaun stream discharges into this swallow hole c.770m downstream of a proposed road drainage outfall. This outfall will be constructed in advance of the main construction works to facilitate the disposal of storm water runoff. – This swallow hole feature is connected to a spring(s) which feeds the Owenur River in the vicinity of Drummullin east of Elphin.
Cregga Turlough	– A Turlough is located at Cregga and a number of karst features are also recorded in the area. – The Turlough is surrounded by steep hillslopes to the east and therefore receives a large portion of overland runoff. – Bedrock is at or close to the ground surface across the area enclosed by the Turlough and in the surrounding hillslopes.

5. EARTHWORKS

5.1 Earthworks

Existing Environment

Solid Geology

There are three main rock units identified along the proposed road development:

- Visean Limestone Formation;
- Ballymore Limestone Formation; and
- Fearnaght/Boyle Sandstones.

The majority of the proposed road development is underlain by limestone noted to be karstified. This karstification has impacts on surface and groundwater quality due to the presence of preferential flowpaths to sensitive water bodies which allow rapid conveyance within the aquifer system.

Subsoils

Fine grained glacial till is the predominant soil type present along the proposed road development. Isolated pockets of made ground and lacustrine deposits (Marl) were also encountered. A number of areas of alluvium and peat deposits were encountered along the length of the proposed road development. Areas of soft, highly compressible or organic soil will not be suitable as road foundations. Along many areas of the proposed road development, the subsoils encountered generally have a high silt content with low permeability and therefore are potentially easily mobilised by rain/runoff waters when exposed.

Unacceptable Material

Areas of soft and/or compressible or organic soil will require an engineered solution to provide suitable footing for road foundations. In these areas ground improvement measures will be required in line with the design criteria to be stated in the Works

Requirements. The method of ground improvement will be dependent on the work programme of the appointed contractor and his preferred method of work. The final solution will be specific to the construction programme, and the available time for completion or phasing of the works.

Typical methods adopted may consist of one of more of the following solutions:

- Excavate and Replacement;
- Surcharging;
- Vertical Drainage Measures;
- Basal Reinforced Earthworks;
- Staged Construction Techniques;
- Limiting Rates of Construction; and
- Pile Supported Embankment.

The total volume of peat, alluvium and lacustrine deposits to be excavated would be approximately 940,000m^3 (full excavate and replace). This material will be deposited in material deposition areas whereby the material will be placed in specially designed areas which will allow settlement and drainage to occur and with natural re-vegetation taking place over time. The excavation and removal to material deposition areas presents risks to adjacent waterbodies from potential sedimentation and nutrient enrichment from potential organic material within the peat sediment.

Imported Material

There will be a requirement to import construction materials and concrete. There are a number of quarries in the vicinity of the proposed road development which may be utilised in the sourcing of this material. Only those quarries that are authorised will be used in the construction phase. The assessment of the earthworks quantities including the reusability of the materials indicate that there will be a deficit of acceptable material over the entire project if the option of full excavation and replacement is adopted.

Soil Improvements

A soil improvement programme may be adopted by the contractor in order to reduce the volume of unacceptable material and allow reuse of marginal material along the proposed road development. Soil improvement (the process of improvement) involves the treatment of soils with various binder applications to improve their properties and allow their reuse for various applications of the construction. An example of soil improvement would involve waterlogged clay being treated to fulfil roles on site such as bulkfill or use within embankments or landscaping measures. The advantage of soil improvement is that material which would otherwise be disposed of can now be reused lessening the need for material deposit areas and/or export of material from the proposed road development.

A typical form of soil improvement involves the use of plant to apply binders such as lime or cement to the poor quality soil material with mixers then utilised to incorporate these products into the parent material and a crusher to process the material ready for treatment. Typically a spreader applies the binding agent (lime/cement) to the material in-situ. The material can also be excavated and moved to a more appropriate location before the binder is applied. A mixing drum or mechanical cultivator is then used to pulverise the binding agent into the material. The material is then allowed to cure before being transported to its required location on the proposed

development where it is placed and compacted in accordance with the TII Specification for Road Works.

The use of lime/cement binders during soil improvement presents risks to adjacent waterbodies and/or karst features. Specific construction management measures for soil improvement processes (should they be utilised) are described in Section 7 of this plan.

Quarrying and Rock Processing

The processing of rock from cuttings for reuse within the proposed road development will require rock crushing and processing facilities. The exact locations of rock processing facilities will be determined by the appointed contractor; however it is likely that this activity will occur within the road cutting footprint itself. These activities have the potential to create high quantities of sediment laden runoff given the hardstanding nature of the rock cut face. The main watercourses at risk are therefore those adjacent to the likely location of these rock processing facilities which are:

- The Ovaun Stream located some 250m south of a deep cutting at Lugboy – this watercourse then flows into Clooncullaan Lough and the Owenur River.
- Cregga Turlough which is located adjacent to the deep cutting at Cregga.

Specific construction management mitigation for these areas is outlined in Section 7 of this plan.

Haul Routes

The main construction activities will consist predominantly of earthworks operations and subsequent road pavement construction. The earthworks will involve the excavation and placement of materials (with possibility for blasting in rock cuttings) for the construction of cuttings and embankments as well as the hauling of materials and importation of materials to complete the road formation and sub-formation. The main materials that will be hauled to, from and within the site in bulk are:

- Earthworks, including topsoil, general cut and fill material, rock and capping materials;
- Pavement Materials, including granular sub-base material and bituminous pavement materials;
- Concrete, both in-situ and precast units such as concrete bridge beams, pipes, culverts and headwalls;
- Other materials will be required including fencing material, plants, ducting etc.

To construct the earthworks, materials will need to be hauled between different sections of the development. In general, materials will be hauled along the route of the proposed road, thus limiting the need to use the public road network. The use of this haul route along the alignment will also present potential for sediment and/or organic material (within the peat) to enter watercourses at crossing points.

6. EROSION AND SEDIMENT CONTROLS

6.1 General

The principal objectives in relation to erosion and sediment control during the earthworks operation will be:

- To keep the exposed surface area to an absolute minimum;
- To minimise the amount of runoff from the site;
- To organise the work so that it progresses from the low point towards the high point within each outfall catchment;
- To have an efficient earthworks operation to ensure that fill is placed as material is removed; and
- To ensure that the unacceptable material is removed and placed in controlled material deposition areas in an efficient manner.

6.2 Principal Avoidance Measures

The protection of watercourses from pollution by construction works is achieved through avoidance in the first instance. In this regard, the following measures will be implemented during the construction phase:

(i) Site clearance involving topsoil stripping will progress along with the earthworks and will not be carried out over large areas in advance of the earthworks;

(ii) It is estimated that a maximum of 940,000m^3 of peat, silt and alluvium will be excavated as part of the proposed road development. The excavated peat, silt and alluvium soil will be deposited in material deposition areas. These material deposition areas have been specifically designed to avoid sediment entering adjacent watercourses and minimise water quality impacts on waterbodies

(iii) Bridge and watercourse crossing construction will involve clear span bridge structures over the Carricknabraher, Owennaforeesha, Owenur and Scramoge Rivers and a box culvert over the Strokestown River in order to avoid significant and lengthy works adjacent to major watercourses.

6.3 Principal Control Measures

6.3.1 General

This section outlines the principal mitigation and protection measures that will be prescribed for the construction phase in order to protect all the catchments, watercourses and ecologically designated areas. Specific measures are described in Section 7. General control measures will include:

- There will be maintenance of good site management at all times and all site personnel will be made aware of the importance of the freshwater environment and the requirement to avoid pollution of all types, throughout all stages of the construction phase.
- Surface water flowing onto the construction area will be minimised through the advance construction of cut-off ditches – see Plate 6.1 below.
- All soiled construction runoff water will be passed through sedimentation ponds prior to outfall to the receiving watercourse. These sedimentation ponds may be a combination of temporary settlement ponds and permanent attenuation ponds for the road drainage during the construction phase – see Section 7.1 for details on runoff calculations and sizing of temporary sedimentation ponds.
- The storage of oils, fuel, chemicals and hydraulic fluids will be in secure areas within the site compounds and will not occur within a minimum of 10m from watercourses.
- Storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage. Storage tanks and associated provision, including bunds, will conform to the current best practice for oil

storage and will be undertaken in accordance with *Best Practice Guide BPGCS005 – Oil Storage Guidelines* (Enterprise Ireland).

- Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance to the TII/NRA document "Guidelines for the crossing of watercourses during the construction of National Road Schemes". All chemical and fuel filling locations will be protected from potential spillages through the provision of appropriate protection measures including bunded areas and double skinned bowser units with spill kits.
- Compounds/storage facilities will be located at least 10m away from sensitive watercourses. In addition, measures will be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. Compounds shall not be constructed in lands at risk of flooding.
- Foul drainage from all site offices and construction facilities will be taken off-site and disposed of by a licensed contractor, in accordance with legislation to prevent pollution of rivers and local water supply.
- Management of construction material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This will involve the construction of collector ditches surrounding material stockpiles to contain runoff and direct it to the settlement ponds (either operational or temporary depending on the construction sequence) before discharge to an adjacent watercourse. In addition the establishment of vegetation on the exposed soil adjacent to material stockpiles may also be used to slow down and treat (through settlement) runoff waters. Typical examples of where silt fences would be employed adjacent to stockpiled materials is indicated in Plate 6.1 below.
- Where construction works are carried out alongside stream and river channels, protection of such rivers from silt load will be carried out. This will be through the use of retaining a grassed buffer zone, the provision of silt fences or compacted earthen berms so as to prevent direct runoff of waters from the construction site to watercourses.
- Where road drainage outfalls are to be located, the vegetation at these sites will be stripped immediately prior to the construction of the outfall and a Hessian or equivalent material pinned over all exposed soil following completion. This will be re-seeded using native species of grass only.
- Where required, the pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc for outfalls, bridges and culverts will be completed in the dry and allowed cure for 48 hours before re-flooding in order to avoid pollution of watercourses.

Plate 6.1 Typical Silt Fence Usage

- Use of settlement ponds, silt traps and bunds and minimising construction within watercourses. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap. An example of a typical temporary settlement pond/lagoon is presented in Plate 6.2 below.
- Riparian vegetation will be fenced off to provide a 5m buffer zone for its protection. Construction works at crossings will result in the loss of riparian vegetation, however these works will be minimised so as to result in the least amount of disturbance and loss being incurred.

- Any surface water abstracted from a river for use during construction (e.g. overpumping of a drain) shall be through a pump fitted with a filter to prevent intake of fish.

Plate 6.2 Typical Temporary Settlement Pond/Lagoon

- The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage which as stated earlier has a deleterious

effect on water chemistry and aquatic habitats and species. Alternate construction methods are encouraged for example, use of pre-cast concrete or permanent formwork will reduce the amount of in-situ concreting required. Where on-site batching is proposed by the contractor, this activity will be carried away from watercourses (minimum 10m). Washout from such mixing plant and also from concrete delivery trucks will be carried out only in a designated contained impermeable area. A typical washout facility is indicated in Plate 6.3 below.

Plate 6.3 Typical Washout Facility

- Material deposition areas will be initially enclosed within double silt fences, as shown in Plate 6.4, and settlement ponds will be initially constructed at the drainage outfalls of these sites. Where required, an access road will then be constructed within the deposition area.
- Wheel wash facilities will be installed at the exit from each material deposition area. All construction vehicles leaving the material deposition areas will be required to pass through these facilities.
- Temporary sedimentation ponds will be provided within these areas at appropriate locations which will be influenced by the compartmentalisation sequencing. These ponds will provide treatment for sediment runoff prior to discharge to adjacent watercourses.

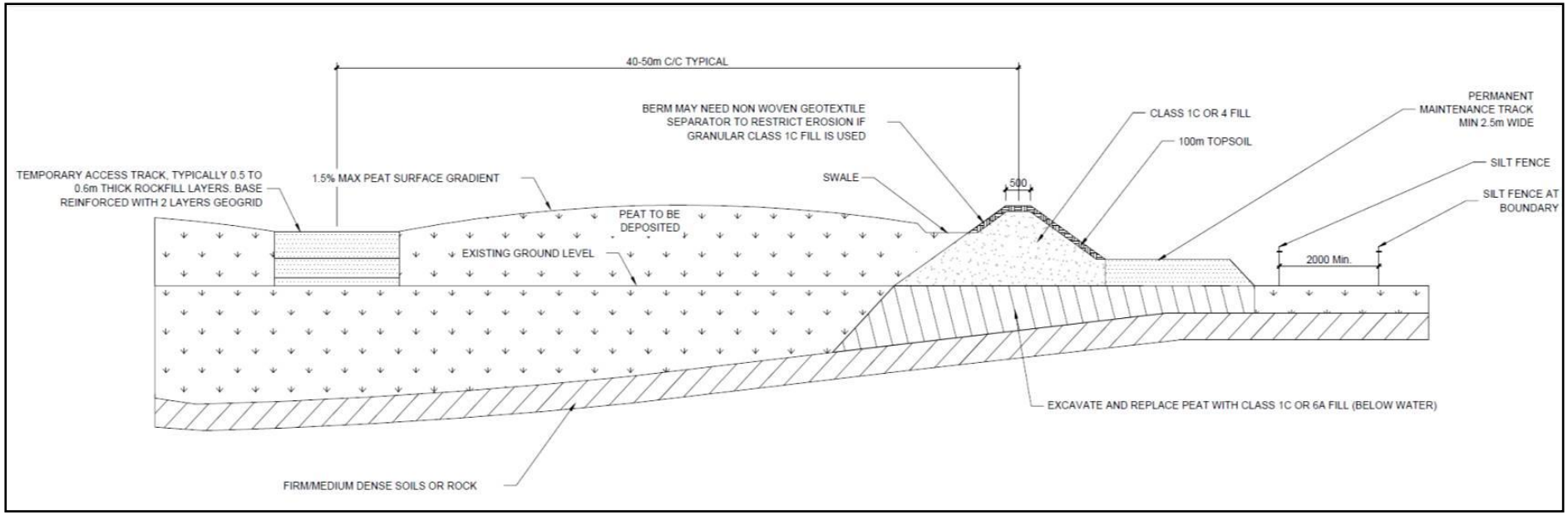

Plate 6.4 Typical Detail for Material Deposition Area

7. SPECIFIC MITIGATION MEASURES

7.1 Watercourse Crossings and Attenuation Ponds

A summary of each watercourse that is either crossed by or in close proximity to the proposed road development is given in Table 7.1 below. Specific mitigation measures proposed for each of these locations to mitigate risks to water quality have been summarised under a number of headings below. In addition, Figures 1 – 15 in Appendix A10.2 outline specific mitigation measures at each location. A list of construction requirements at each of the major river crossings is also provided below.

Table 7.1 Summary of Watercourses Potentially Impacted by the Proposed Road Development

Waterbody Name	Townland	Chainage	Summary of Adjacent Works
Unnamed Stream	Rathkerry	1+200	Watercourse Crossing Attenuation Pond
Carricknabraher River	Mullen	10+135	Watercourse Crossing Attenuation Pond Material Deposition Area
Unnammed Stream - Tributary of the Carricknabraher River	Mullen	12+705	Watercourse Crossing Attenuation Pond
Owennaforeesha River	Drummin	14+522	Watercourse Crossing Attenuation Pond
Unnammed Stream - Tributary of the Owennaforeesha River	Drummin	14+632	Watercourse Crossing Attenuation Pond
Mantua Stream	Mantua	21+325	Watercourse Crossing Material Deposition Area
Unnammed - Tributary of the Mantua Stream	Mantua	23+200	Watercourse Crossing Attenuation Pond Material Deposition Area
Owenur River	Tullycarton	30+720	Watercourse Crossing Attenuation Pond
Clooncullan Lough	Clooncullan	33+000 – 35+000	Located c.210m south of the road scheme. Attenuation Pond
Ovaun Stream	Clooncullan	34+750	Located c.215m south of the road scheme. Attenuation Pond
Strokestown River	Vesnoy	51+150	Watercourse Crossing Attenuation Pond
Scramoge River	Scramoge	52+825	Watercourse Crossing Attenuation Pond

Watercourse Crossing Locations

In order to provide protection during construction to each of the watercourses listed in Table 7.1 above, specific construction sequencing and drainage requirements are proposed.

The work area in the vicinity of each watercourse will be cordoned off prior to any construction activities commencing on site. The provision of double silt fences along the cordoned work areas will be employed to contain any potential silt or sediment runoff. Where multiple crossings are proposed due to parallel access tracks adjacent to the mainline, a double silt fence will be provided between the two crossing points to protect from potential sediment runoff at each location.

Stockpiling, temporary or otherwise, of construction material or topsoil will be prohibited within 10m of watercourses in order to minimise sources of sediment runoff. In addition site compounds shall not be located within 5m of any watercourse. Fuel storage, temporary or otherwise, shall be permitted only within site compound areas and not within 10m of a watercourse at these locations.

To avoid any risk of impacting on sensitive fishery watercourses during construction, all instream works to the mainline channel of the following major watercourses will only be permitted between the period of the 1st May and the 31st September: the Carricknabraher, Owennaforeesha and Scramoge Rivers.

Temporary Sedimentation Basins

In order to limit the potential for pollution due to runoff from construction, runoff waters will be directed through a sedimentation pond prior to discharge. In this regard, save as set out below, the operational (permanent) road drainage attenuation ponds together with the associated outfalls to the receiving watercourse, will be constructed in advance of the main construction works.

The purpose of a temporary sedimentation basin is to provide an area where sediment laden runoff is allowed to pond, so that the suspended sediment will settle out.

At specific locations (e.g. during the advancement of deep rock cuttings at Lugboy and Cregga), it may be necessary to first establish temporary sedimentation basins in areas where it is not possible to construct the operational attenuation ponds in advance of the construction works, or where it will not be possible to outfall to an attenuation pond due to the nature of the works or topology. These temporary ponds will be contained within an earthen bund and will be lined to prevent infiltration in areas of high or extreme vulnerability.

In order to ensure that temporary sedimentation ponds are sized correctly, the design parameters to be followed for these ponds is detailed below. Runoff from the exposed surfaces has shall be calculated using the Modified Rational Method and applying extreme rainfall information obtained from Met Eireann and specific to the area. The ponds shall be designed to accommodate a depth of rainfall constituting to a 1 in 10 year (14 hour) flood event at 1m depth. Contingency measures should be in place to release water via a spillway or similar in the event of a more serious rainfall event.

Modified Rational Formula: $Q = C \times i \times A$

Where:

Q = the peak discharge (m^3/hour);

C = Coefficient of permeability (conservatively assume 0.6 for a stripped construction site)

i = rainfall intensity (m/hour); *The depth of rainfall constituting to a 1 in 10 year (14 hour) flood event at 1m depth*

A = the contributing area (m^2);

The design of temporary sedimentation ponds shall be carried out as in accordance with Ciria Document C532 "*Control of Water Pollution from Construction Sites"* (Ciria, 2001) and Ciria Document C648 "*Control of water pollution from linear construction projects*" (Ciria C648, 2006).

Each temporary pond shall be subject to detailed design by the contractor. Permanent attenuation ponds which are constructed in advance of the main earth works to be utilised during the construction stage shall be sized in accordance with the detailed drainage design to cater for the 1 in 100 year flood event. During the construction stage accumulated sediment will be removed on a periodic basis.

On completion of the road construction works, permanent ponds utilised during the construction stage shall be cleaned of any remaining silt and debris and all necessary works undertaken to establish the required vegetation for the long term operation of the pond.

Construction Sequencing

The construction sequencing will take place in a manner which will mitigate potential impacts upon the receiving waters. A double layer of silt fences along identified work areas adjacent to watercourses (as shown in Figures 1 – 15 in Appendix A10.2) will be provided in advance of works commencing on site to contain silt and sediment runoff. Pre-earthwork ditches will then be provided in order to collect surface runoff during the start of construction. On completion of the earthworks the drainage along this section will be established as soon as is practicable.

Once the permanent road drainage has been installed, it will outfall to one of the proposed attenuation pond locations. During the construction stage temporary drainage measures will be employed to connect this drainage to the attenuation ponds where required, or in certain instances to a temporary settlement pond. This will prevent surface water runoff outfalling untreated to existing watercourses.

Construction Requirements at Sensitive Watercourses

The following are specific construction requirements to reduce potential contamination impacts on the Carricknabraher, Owennaforeesha and Scramoge Rivers.

- Instream works will only be permitted between the period of the 1st May and the 31st September.
- Pre-construction water quality monitoring shall take place in the receiving watercourses to establish baseline conditions at the locations indicated on Figures 10.2 – 10.6 in Volume 3 of this EIAR.
- A water quality monitoring programme (see Section 8.2 for details) will be undertaken at suitable locations in the receiving watercourse during the construction phase.
- A 10m offset adjacent to the watercourses listed above, will be demarcated at the outset of works with double silt fences put in place. Site drainage will be directed through a settlement facility prior to discharge. Temporary facilities to trap and contain any accidental spillage shall also be provided.
- Topsoil stripping in proximity to each of the above named rivers will be undertaken as much as feasible in dry weather conditions and all stockpiles will be located as far away as practicable from the river but in any event no closer than 10m.

- The storage of oils, fuel, chemicals, hydraulic fluids, shall only take place within site compounds and will be located at a minimum distance of 10m from any watercourse. Storage shall be undertaken in accordance with current best practice for oil storage (See Section 6 for details).
- All machinery operating in these locations will cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs. All fuelling of machinery will be undertaken at a minimum set-back of 10m from each river.

Soil Improvements

Soil improvement activities, if utilised by the contractor, would involve lime/cement binder being spread over the ground surface and mechanically mixed with curing then taking place leading to a subsequent improvement in the quality of the material. The spreading of the binding agent (lime/cement) has the potential to impact on water quality in adjacent watercourses either though direct runoff during periods of rainfall or from airborne propagation of the binder. In addition to the measures outlined in this document, the contractor shall implement environmental measures as outlined in UK DMRB HA 74/07 "Section 6 – Environmental Considerations" The following are specific construction requirements to reduce potential contamination impacts from soil improvement activities:

- Soil improvement works shall only be carried out in calm, clear and dry metrological conditions. Lime/cement application shall not be exposed to wind and where any risk occurs will be misted/sprayed down immediately. Other handling systems shall be carried out with regard to the mitigation measures set out in Chapter 13 (Air Quality and Climate) in Volume 2 of this EIAR;
- Soil improvement works shall not take place within 25m of any of the minor watercourses as listed in Table 4.1;
- Soil improvement works shall not take place within 100m of any of the major watercourses as listed in Table 4.1 or within 100mm of Clooncullaan Lough;
- Soil improvement works shall not take place within 100m of the Polloweneen Swallow Hole features or within 100m of the boundary of Cregga Turlough. The boundary of Cregga Turlough KER is identified in the ecological habitat mapping – Figures 7.27 – 7.51 in EIAR Volume 3. The Polloweneern Swallow Hole features are indentified in Figure 10 in Appendix A10.2 of this document.

7.2 Polloweneen (Mantua) Swallow Hole Features

In the townland of Mantua between Ch. 18+300 and Ch. 19+500 there are multiple swallow holes both north and south of the proposed road development. Such features provide direct access for pollution to enter the groundwater system, therefore it will be necessary to protect such features from untreated construction surface water runoff. In addition, at least one of these swallow holes is connected directly to the Polecat Groundwater Supply Scheme which serves Elphin and its surrounds.

A double silt fence will be constructed along the site boundary so as to intercept and minimise the potential direct runoff from the works area to the adjacent swallow holes and watercourses. Cut-off ditches will be provided to collect construction runoff; which will then pass through a temporary settlement pond before out-falling into the nearest watercourse – refer to Plate A1.8 for details.

The swallow hole at Ch. 19+045 is located in the centre of the proposed road alignment. During the construction phase this swallow hole will be excavated to bedrock and backfilled with a permeable coarse grained stone (Class 6A or 6C

material or similar) placed and wrapped in a geotextile membrane. Prior to this treatment the area around the swallow hole will be fenced off with a double silt fence in order to provide protection and minimise potential construction runoff.

Due to the presence of swallow holes in this area, management of construction material stockpiles is of the highest importance. Soiled runoff from stockpiles shall be managed by controlling and diverting such runoff to a sedimentation pond prior to discharge. No direct discharge from the works will be permitted to the swallow holes at this location.

Topsoil stripping in proximity to the swallow hole features at this location will be undertaken as much as feasible in dry weather conditions. All stockpiles will be located no closer than 10m to any of these swallow hole features.

7.3 Cregga Turlough

Cregga Turlough is located approximately 3.2km to the north-west of Strokestown in the townland of Cuilrevagh. Cregga Turlough is situated in a depression with a rounded ridge of hills along the eastern side and relatively high land to the west except at the central point where the contours lead to Annaghmore Lough, less than 1km away. The proposed road development runs north and north-east of Cregga Turlough between Ch. 36+600 and Ch. 37+950. The land acquisition boundary ranges between 116m and 291m from the boundary of the turlough and is 116m from the turlough at its closes point at Chainage Ch.36+725. Due to the undulating nature of the landscape at this location, sections of the proposed road development require significant earthworks as it passes in the vicinity of the Turlough including large cuttings between Ch. 35+150 to Ch. 36+450 (Cut 1) and Ch. 36+900 to Ch. 37+650 (Cut 2).

The Turlough receives surface runoff from surrounding areas and discharges directly to groundwater through its base. It is therefore imperative that silt and sediment laden waters running off the construction works are controlled through interception and settlement prior to discharge.

The water balance to the Turlough during construction must be maintained and therefore cut-off drains shall be provided to direct waters away from the construction site and to the Turlough – see Plates 7.1 & 7.2 below.

The following specific construction requirements to reduce potential contamination impacts upon the Turlough are required:

- Pre-construction water quality monitoring shall take place in the Turlough to establish baseline conditions – see Figures 10.2 – 10.6 in EIAR Volume 3 for location of same.
- A water quality monitoring programme (see Section 8.2 for details) will be undertaken at suitable locations in the receiving watercourse during the construction phase. .
- The storage of oils, fuel, chemicals, hydraulic fluids, shall only take place within site compounds. Storage shall be undertaken in accordance with current best practice for oil storage (See Section 6 for details).
- All machinery operating in the works area adjacent to the Turlough will be cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs.

Detailed and specific construction sequencing together with specific drainage designs are proposed in these areas as detailed below.

Construction Sequencing

Cut 1 – Ch. 35+150 to 36+450 (Lugboy)

A road drainage attenuation pond is proposed at Ch. 34+850. This pond will be constructed prior to the commencement of the main earthworks to facilitate treatment of discharge from construction runoff.

The construction sequence for the cuttings shall ensure that the cutting is completed in sections so that the base gradient allows conveyance to temporary settlement ponds located within the cutting. It is envisaged that the construction sequence would involve starting the cutting at Ch. 35+150 and advancing the works towards Ch. 36+450. A temporary settlement pond could be located at Ch 35+050 approx. The temporary settlement pond may be relocated as the dig advances with the preceding settlement area only filled in once the new settlement area is operational and the road and cutting drainage is constructed. Settlement ponds, temporary or otherwise, will be constructed prior to the excavation works commencing and will be constructed as detailed in Section 6.1 of this CESCP. In addition, filter drains will be constructed along each of the berms in the cutting to convey natural clean surface and groundwater to the watercourse directly.

To capture and separate natural clean water runoff from up-gradient lands, cut-off ditches will be provided along the up-gradient boundary of the cut section (east of Ch. 36+100, which is in the natural catchment of the Turlough). The intercepted clean water will be allowed to discharge to the Turlough through infiltration galleries that are to be constructed between Ch. 36+500 to Ch. 36+700 to facilitate the natural recharge of the Turlough. To facilitate this outfall arrangement infiltration galleries will be constructed in advance of the main works programme.

A typical cross-section through the cutting is given in Figures 4.37 and 4.38 in Volume 3 of the EIAR. In addition a plan of the area is also given in Plate 7.1 illustrating the possible sequencing of the works.

As the excavation progresses, the soiled construction runoff will be conveyed westward with the profile of the road to the Ovaun Stream passing through temporary and permanent settlement ponds. Between Ch. 36+100 and Ch. 36+750, construction runoff will be treated in a temporary settlement pond and discharged to the Turlough at Ch36+500 to Ch36+700 through the infiltration galleries described above.

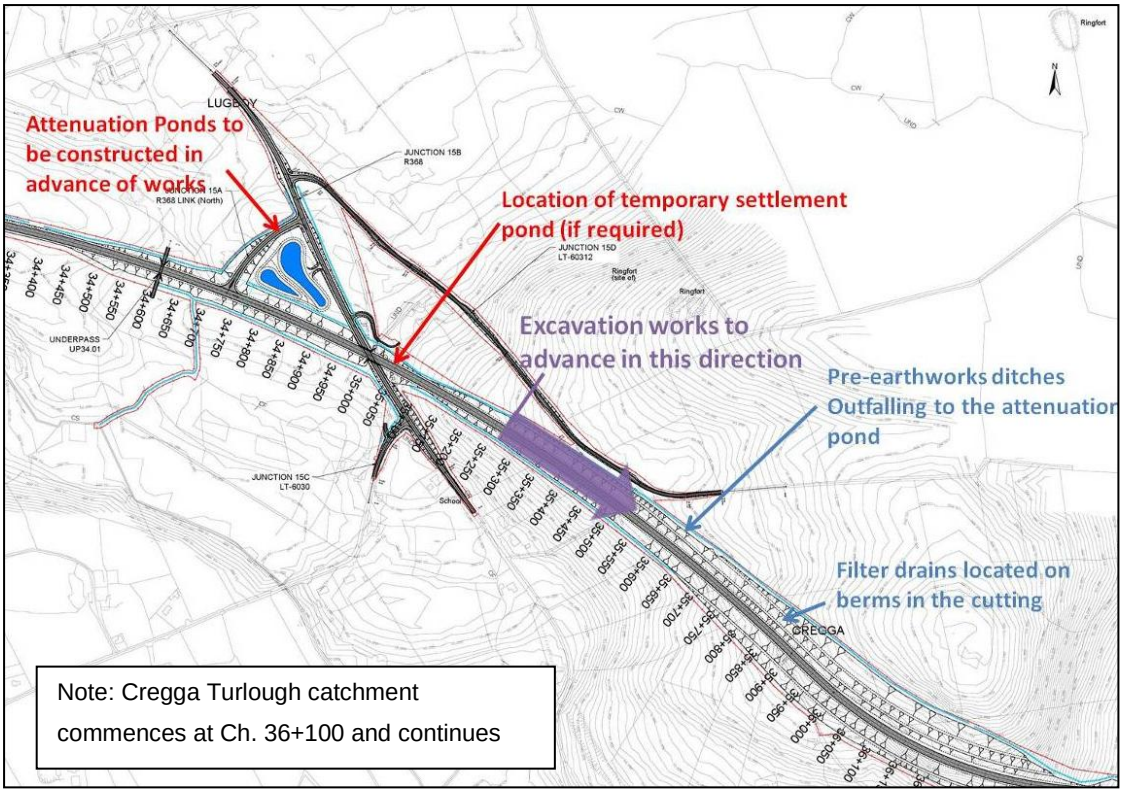

Plate 7.1 Construction Sequencing Between Ch. 35+150 and 36+450

Cut 2 – Ch. 36+900 to Ch. 37+650

Similarly for Cut Section 1 the sequence of excavation may commence at Ch. 36+900 and progress to Ch. 37+650.

A temporary settlement pond located between Ch. 36+500 and Ch. 36+900 will be constructed prior to the commencement of the earthworks. This will facilitate the treatment of soiled construction runoff from the cut section.

Additional temporary settlement ponds may be located along the cut section where required which will then discharge to this final pond before discharging to the Turlough. All discharges to the Turlough will first pass through a sedimentation pond and will discharge through the infiltration galleries.

A shallow cut-off ditch will be provided along the up-gradient boundary of the cut section to capture overland runoff and interflow and discharge this greenfield runoff to the Turlough through the proposed infiltration galleries. These galleries are located between Ch. 37+670 to Ch. 37+870 and Ch. 38+030 to Ch. 38+130. These infiltration galleries are to be utilised during the operational phase of the proposed road development to allow natural recharge water to drain to the Turlough.

As the excavation progresses, the soiled construction runoff will be conveyed to a construction phase outfall to the Turlough at Ch. 38+030 to Ch. 38+130 and will be serviced by a temporary settlement pond/ponds as required.

The construction sequence for the cuttings shall ensure that the cutting is completed in sections so that the base gradient allows conveyance to temporary settlement ponds. This may be achieved by starting the cutting at Ch. 36+900 and advancing the works towards Ch. 37+650.

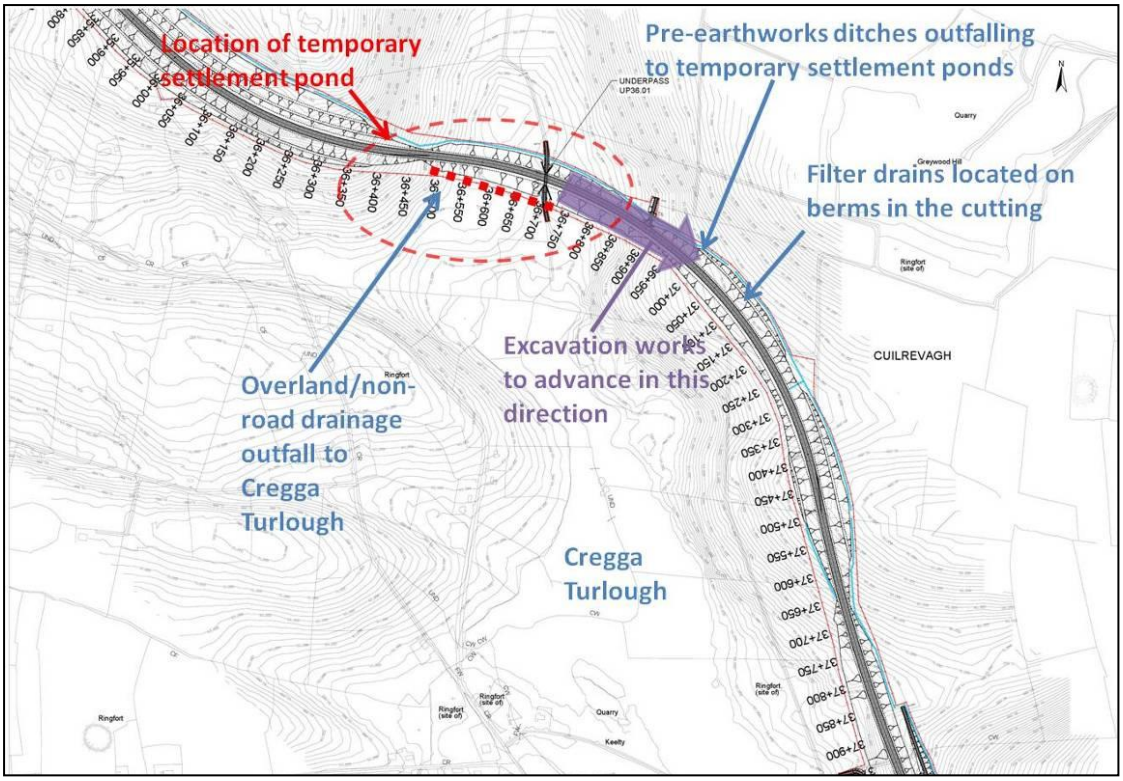

Plate 7.2 Construction Sequencing Between Ch. 36+900 to Ch. 37+650

7.4 Material Deposition Areas

Material Deposition areas are proposed at various locations along the proposed road development, none of which are located in ecologically sensitive areas. In all cases a minimum setback of 5m from watercourses is provided– please refer to Table 7.1 for details.

Double silt fences will be provided outside the proposed footprint of the material deposition areas in advance of commencement of construction works. In order to contain the deposited material, engineered bunds (see Plate 6.4) will be provided around the perimeter of the material deposition areas. Runoff from the material deposition areas will be directed to sedimentation ponds which will be provided upstream of the outfall to the receiving watercourse. These ponds will be maintained until the material deposition areas have stabilised and become adequately vegetated. In addition the specific construction sequence for these areas (described below) will allow for settlement of sediment prior to discharge to the receiving watercourse through the provision of additional temporary sedimentation ponds.

Table 7.1 Location of Material Deposition Areas

Area No.	Location and Chainage	Area (Hectares)	Approx Capacity (m^3)
1	Ch.4+640 – Ch 4+750, South of proposed N5	0.4	8,000
2	Ch 4+750 – Ch 4+80, North of proposed N5	1.1	22,000
3	Ch 5+400 – Ch 5+680, South of proposed N5	1.4	28,000
4	Ch.14+700 – Ch 15+520, South of proposed N5	4.5	90,000
5	Ch.14+950 – Ch 15+200, North of proposed N5	2.6	52,000
6	Ch.15+320 – Ch 15+600, North of proposed N5	1.8	36,000

Area No.	Location and Chainage	Area (Hectares)	Approx Capacity (m^3)
7	Ch.15+550 – Ch 15+780, South of proposed N5	2.9	58,000
8	Ch.16+075 – Ch 16+130, South of proposed N5	0.4	8,000
9	Ch.17+000 – Ch 17+600, South of proposed N5	1.8	36,000
10	Ch 17+050 – Ch 17+150, South of proposed N5	0.4	8,000
11	Ch 17+150 – Ch 17+600, South of proposed N5	7.3	146,000
12	Ch 17+640 – Ch 17+875, South of proposed N5	2.0	40,000
13	Ch 21+000 – Ch 21+175, South of proposed N5	2.7	54,000
14	Ch 20+950 – Ch 21+450, North of proposed N5	5.4	108,000
15	Ch 21+350 – Ch 21+750, North of proposed N5	5.4	108,000
16	Ch 22+150 – Ch 22+850, South of proposed N5	8.4	168,000
17	Ch 22+680 – 22+840, North of proposed N5	0.4	8,000
Total Storage Volume		**48.9**	**978,000**

Construction Sequencing

The construction sequence of each of the material deposition areas is such that the area allocated for material deposition is compartmentalised to allow a material deposition area to be first established in one compartment, while the runoff water from this compartment flows into and is contained within an adjacent compartment. This will allow settlement of sediment to take place prior to runoff water discharging to a receiving watercourse. Once a compartment has been filled, the adjacent compartment, which was used temporarily as a sedimentation pond, is then itself filled with material and the next compartment acts as the settlement area for the runoff from this section. This process is repeated as the works advance until all compartments are filled. A final treatment pond will retained upstream of the outfall until the areas have stabilised and vegetation has established. A typical cross-section of the material deposition areas is given in Plate 6.4.

8. MONITORING AND AUDIT

8.1 Introduction

The Construction Erosion and Sediment Control Plan (CESCP) will form part of the Environmental Operating Plan (EOP). The EOP shall be prepared in accordance with the NRA's *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan*.

The minimum requirements for the control of sediment shall include all of the controls, measures, mitigations and monitoring described in this plan. The monitoring of all aspects of the EOP, including the CESCP, will be carried out by the contractor. The responsibilities of the Employer will be discharged by the Employer's Site Representative Staff. The contractor will be required to undertake continuous monitoring of the works to ensure compliance with the EOP, including the CESCP. In addition, the Employers Site Representative Staff will oversee the works to ensure that the contractor is complying with their responsibilities.

8.2 Monitoring and Audit

8.2.1 General

The avoidance, control and mitigation measures outlined in this document will ensure that erosion and sedimentation arising from the works is controlled. They have been developed in accordance with best practice, in consultation with environmental organisations including NPWS and IFI, and have been shown to work on other projects. As with all systems, there is a requirement to have monitoring, audit and feedback loops to demonstrate the operation of the system. The following describes the framework of the pre-construction monitoring and construction monitoring regime;

8.2.2 Pre-Construction

Pre-construction water quality monitoring in the receiving watercourses shall be undertaken at the following watercourses: the Carricknabraher River, the Owennaforeesha River, the Owenur River, the Strokestown River and the Scramoge River; with a minimum of six monthly samples being taken to establish baseline conditions. This testing shall include (but will not be limited to): Suspended Solids (SS), Turbidity, Dissolved Oxygen (DO), Nitrate, Nitrite, Total Nitrogen, Phosphate, Total Phosphorus, Temperature, Ammonia, Biological Oxygen Demand (BOD) and Total Hydrocarbons. The locations of these sampling points are shown on Figure 10.8 contained within EIAR Volume 3.

8.2.3 Construction Stage

Similarly monthly surface water quality sampling shall be undertaken at the above locations and for the sample quality parameters throughout the construction phase. This monitoring will be reviewed on an ongoing basis during construction. Where the surface water regulations are exceeded in these watercourses, an investigation shall be undertaken to identify the source of non-compliance and corrective action implemented where the non-compliance is deemed to be associated with the proposed road development. To support the reactive element of this monitoring all watercourses to which there is a discharge from the works shall be monitored on a daily basis for turbidity. Readings will be taken from the watercourses immediately upstream and downstream of the works and where the difference between these readings exceeds 30ntu, this will trigger investigatory procedures.

The investigation will establish whether or not the elevated turbidity readings are as a result of the construction works. Where this is the case, immediate corrective actions which may include stopping of these sediment generating works will be enforced until such time that such polluting activities can be controlled.

8.2.4 Contractor

The procedures and monitoring and audit regime outlined in this section shall be used by the contractor to ensure and demonstrate the effective operation of the avoidance, control and mitigation measures for Erosion and Sediment control. It will facilitate use as a feedback loop to target any issues that may arise.

8.2.5 Site Environmental Manager (SEM)

In order to ensure the successful development, implementation and maintenance of the EOP, the Client will be required to appoint an independent Site Environmental Manager (SEM) to provide independently verifiable audit reports.

The Site Environmental Manager must possess sufficient training, experience and knowledge appropriate to the nature of the task to be undertaken, a Level Eight qualification recognised by the Higher Education and Training Awards Council

(HETAC), or a University equivalent, or other qualification acceptable to the Employer, in Environmental Science or Environmental Management, Environmental Hydrology, Engineering or other relevant qualification acceptable to the Employer.

Separate from the on-going and detailed monitoring carried out by the contractor as part of the EOP; the SEM shall carry out the inspection/ monitoring regime described below on behalf of the employer. The results will be stored in the SEM's Monitoring file and will be available for inspection/ audit by the Client, NPWS or IFI staff. All inspections/ monitoring/ results will be recorded on standard forms.

Inspection / Monitoring Regime:

(i) Inspect the Principal Control Measures outlined in this plan on a weekly basis. Report findings to the Contractor;

(ii) Inspect surface water treatment measures (ponds, tanks, mini-dams, sandbags, etc.) on a daily basis and obtain turbidity readings;

(iii) Inspect all outfalls to watercourses on a daily basis and obtain turbidity readings. Where excavation, deposition, pumping out or concreting works are on-going in the vicinity obtain turbidity readings three times per day;

(iv) Daily visual inspection of watercourses to which there is a discharge from the works and those in the vicinity of construction works;

(v) Wheel wash facilities shall be inspected on a weekly basis;

(vi) Borrow Pits shall be inspected on a daily basis while in operation and on a weekly basis thereafter;

(vii) Material Deposition Areas shall be inspected on a daily basis while in operation and on a weekly basis thereafter;

(viii) Stockpiles shall be monitored on a daily basis while being filled or emptied and otherwise on a weekly basis;

(ix) Control measures for works at or near water bodies shall be inspected on a daily basis;

(x) Concrete operations at or near watercourses shall be supervised and designated chute washing out facilities shall be inspected on a daily basis;

(xi) Site Compounds shall be inspected on a weekly basis;

(xii) The Contractor's EOP monitoring results shall be audited by the SEM on a frequent basis (6 times per quarter at a minimum);

(xiii) Any and all exceedance of the investigatory level for turbidity shall be reported the Employer and shall be investigated thoroughly by the SEM and the Contractor. Where the works are identified as the source causing the exceedance, the procedure outlined in Item "(xiv) (a)- (d)" below shall be followed;

(xiv) Any direct release of sediment to a watercourse causing plumes or exceedance of the turbidity investigatory levels shall result in:

  (a) the Employer shall be notified immediately;

  (b) the contractor will be required to take immediate action and to implement measures to ensure that such discharges do not re-occur;

  (c) Works if stopped, shall not recommence until appropriate corrective measures to avoid any repetition are put in place. Such measures shall be agreed with the SEM following consultation with the Employer;

  (d) Works and/ or discharges from the works shall not recommence until written consent is received from the SEM.

(xv) Where the SEM considers that the risk of a sediment release is high, he/she shall inform the contractor and request protective action to be taken. The SEM shall report all such notifications and requests to the Contract Manager and the Client.

9. EMERGENCY PROCEDURES

9.1 Introduction

Prior to commencing works, the Contractor shall prepare an Emergency Response Plan based on a thorough risk assessment. The plan shall detail the procedures to be undertaken in the event of the release of any sediment into a watercourse, serious spillage of chemical, fuel or other hazardous wastes (e.g. concrete), non-compliance incident with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.

9.2 Resources

Relevant staff, including cover staff, shall be trained in the implementation of the Emergency Response Plan and the use of any spill kit/ control equipment as necessary. The contractor shall provide a list of all such staff to the Employer's Site Representative detailing the name, contact number, and training received, and the date of that training.

The Contractor shall provide a full list, including the exact locations, of all pollution control plant and equipment to the Employer's Site Representative. All such plant and equipment shall be maintained in place and in working order for the duration of the works.

9.3 Spill Response

The Emergency Response Plan shall include a simplified Spill Response with the following as a minimum:

(i) Instruction to stop work;

(ii) Instruction to contain the spill;

(iii) Details of spill clean-up material location;

(iv) Name and contact details of responsible staff;

(v) Measures particular to the location and the activity;

(vi) Instruction to contact the SEM (including Name and Contact Details).

This Spill Response shall be displayed at several locations throughout the site and at all sensitive locations.

10. REFERENCES

Control of Water Pollution from Construction Sites: CIRIA (C532) 2001;

Control of water pollution from linear road projects: CIRIA (C648) 2006;

Guidelines for the Crossing of Watercourses during the Construction of Road Projects: National Roads Authority (TII) (2006);

NRA (TII) Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan: National Roads Authority (2007).

APPENDIX A10.2
Figures with Specific Mitigation Measures Proposed

Plate A1.1 – Rathkerry Watercourse Crossing

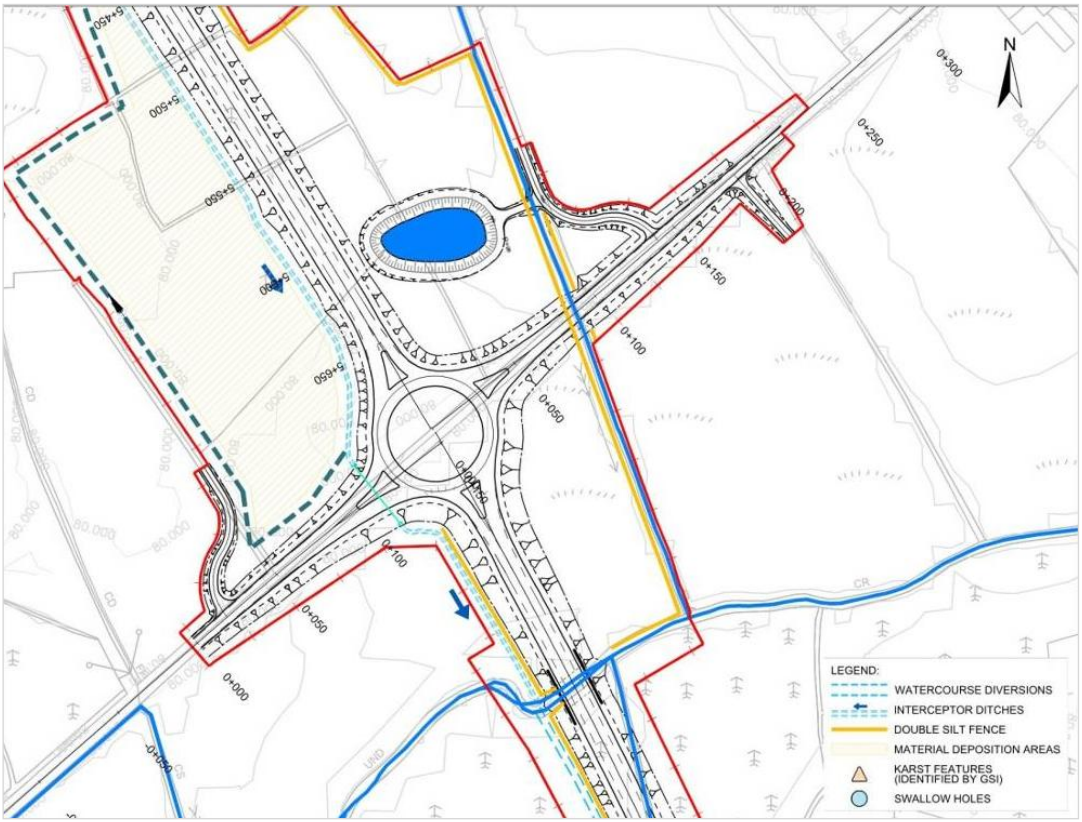

Plate A1.2 – The Carricknabraher River Crossing at Ch.10+135

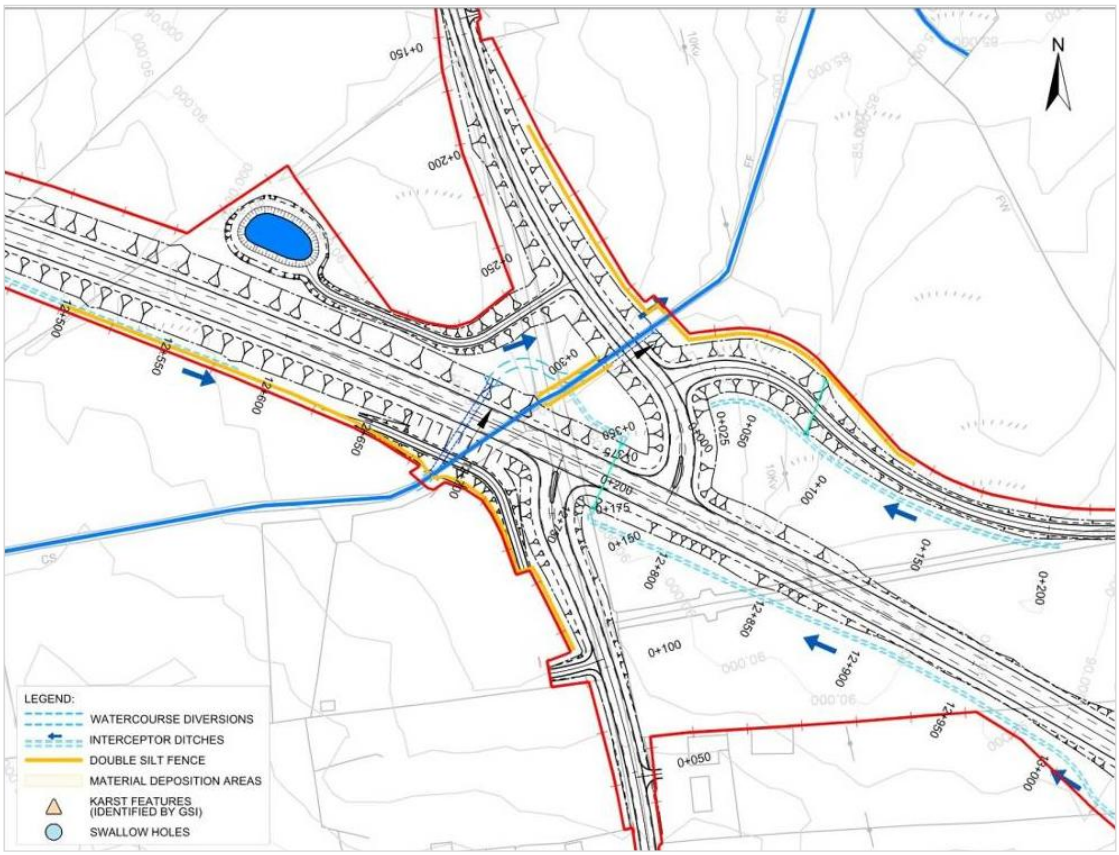

Plate A1.3 – Tributary Stream of the Carricknabraher River at Ch.12+705

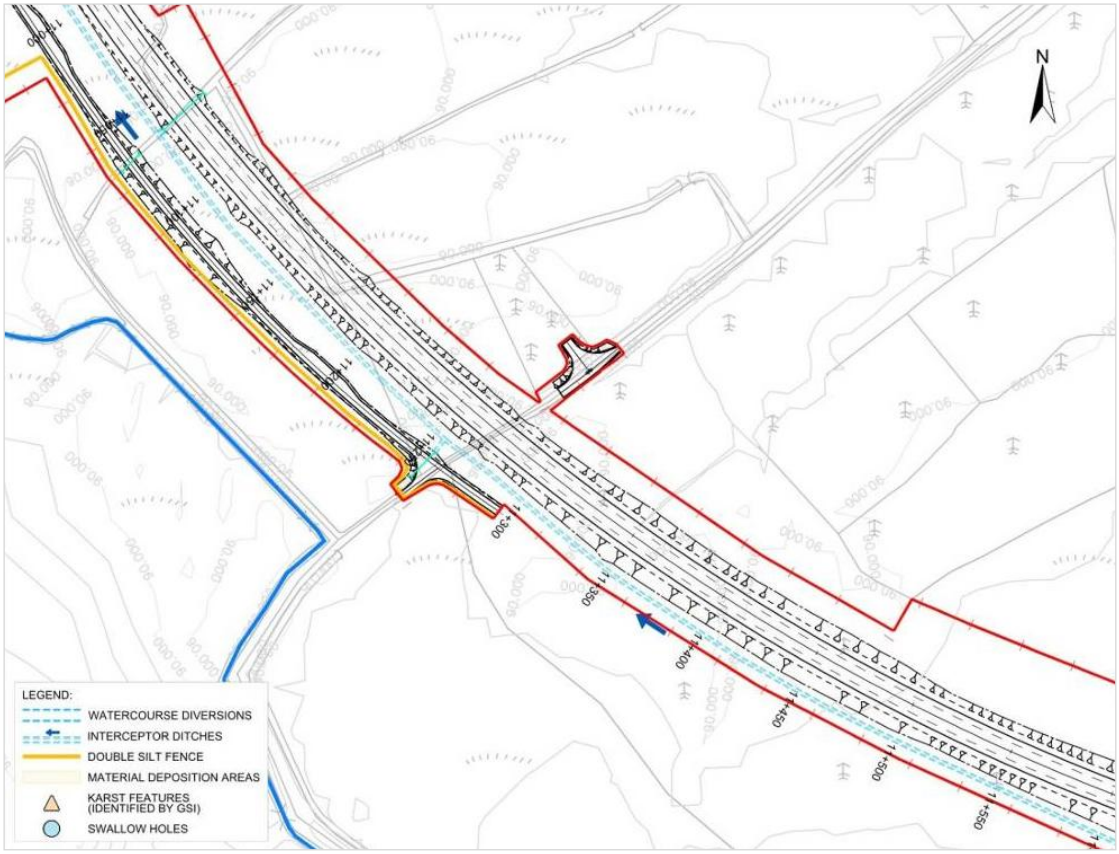

Plate A1.4 – Leggatinty Bog

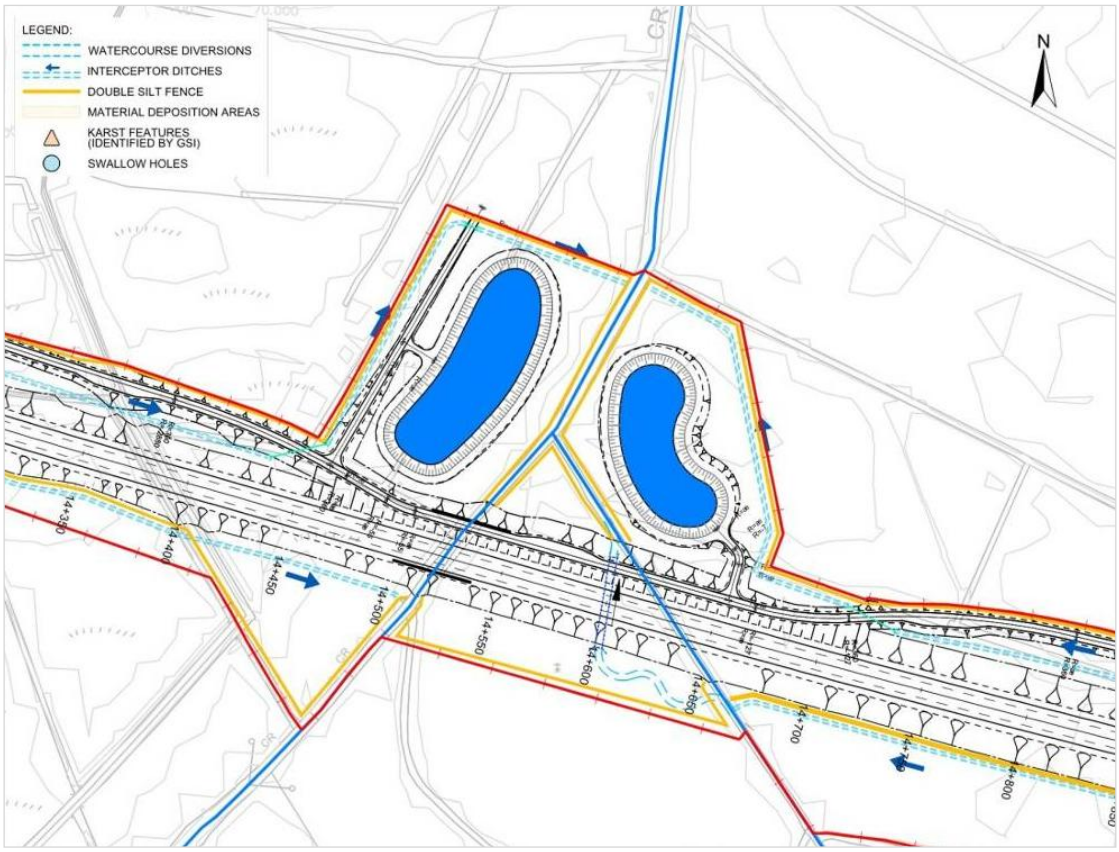

Plate A1.5 – Attenuation Ponds at the Owennaforeesha River Frossing

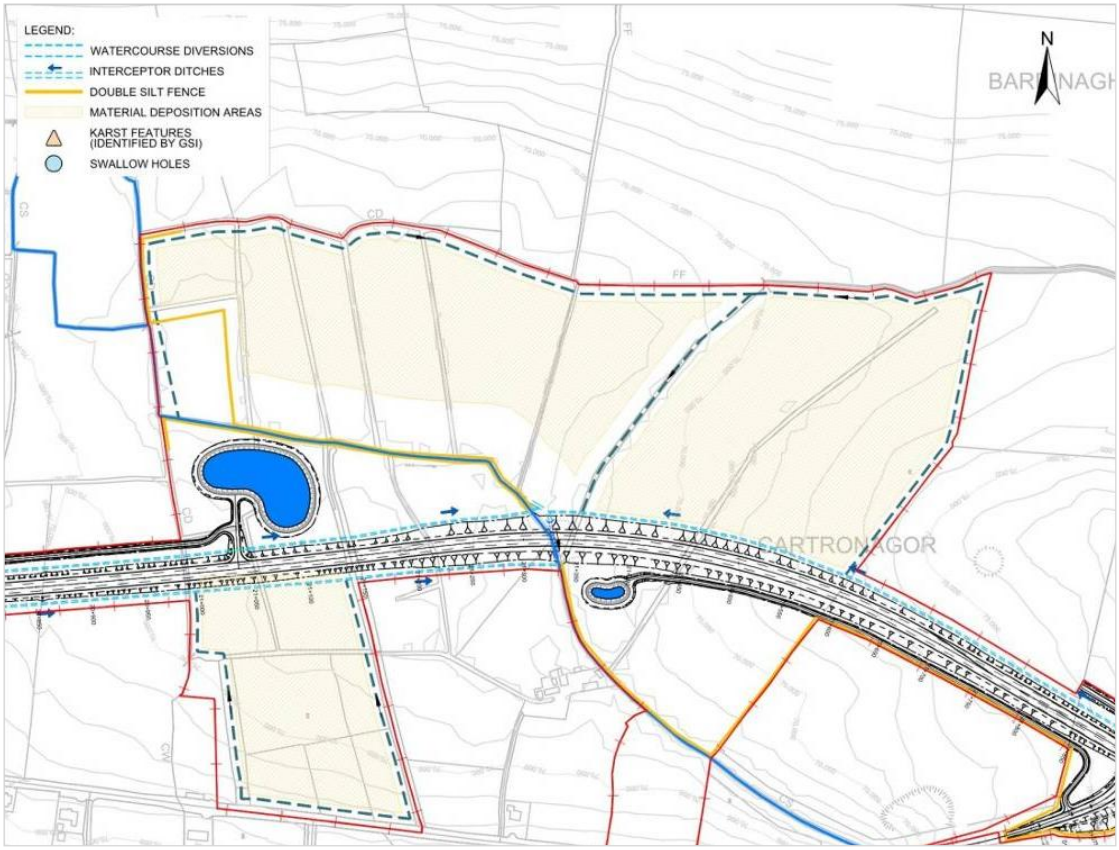

Plate A1.6 – Mantua Stream Crossing at Ch.21+325

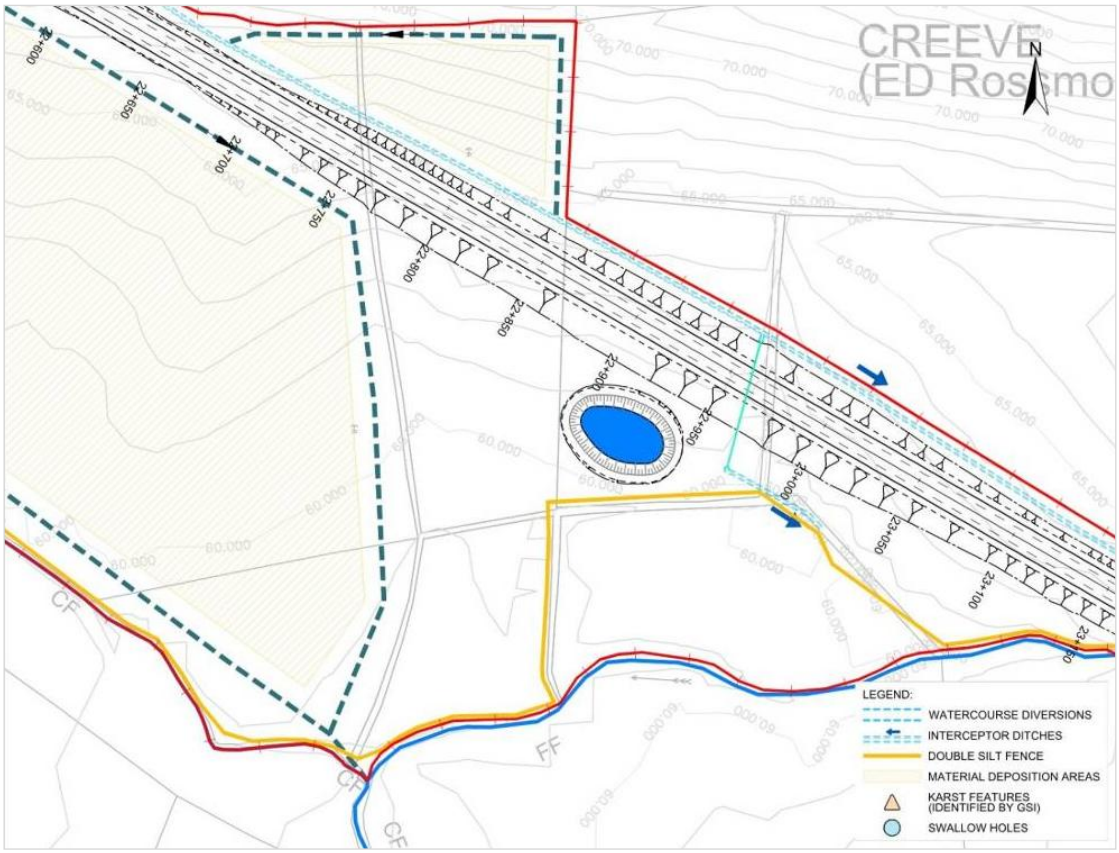

Plate A1.7 – Attenuation Pond Located at Ch.23+200

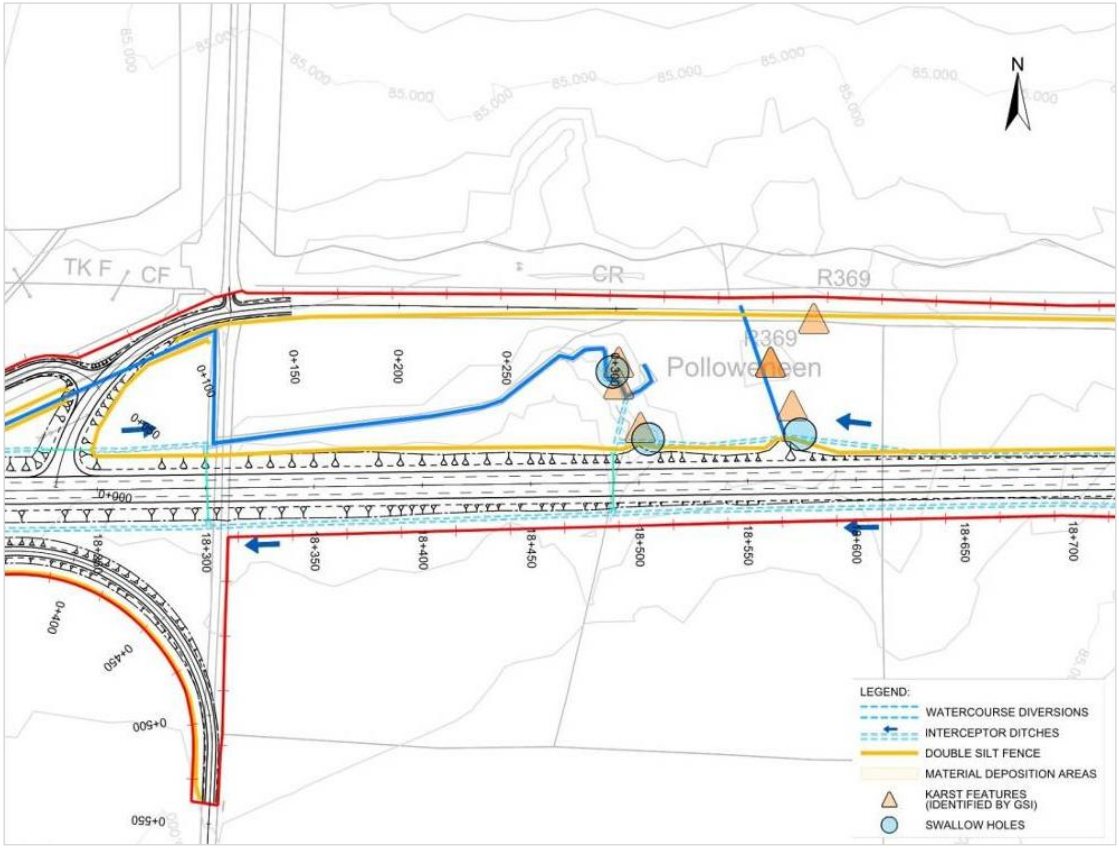

Plate A1.8 – Mantua Swallow Holes

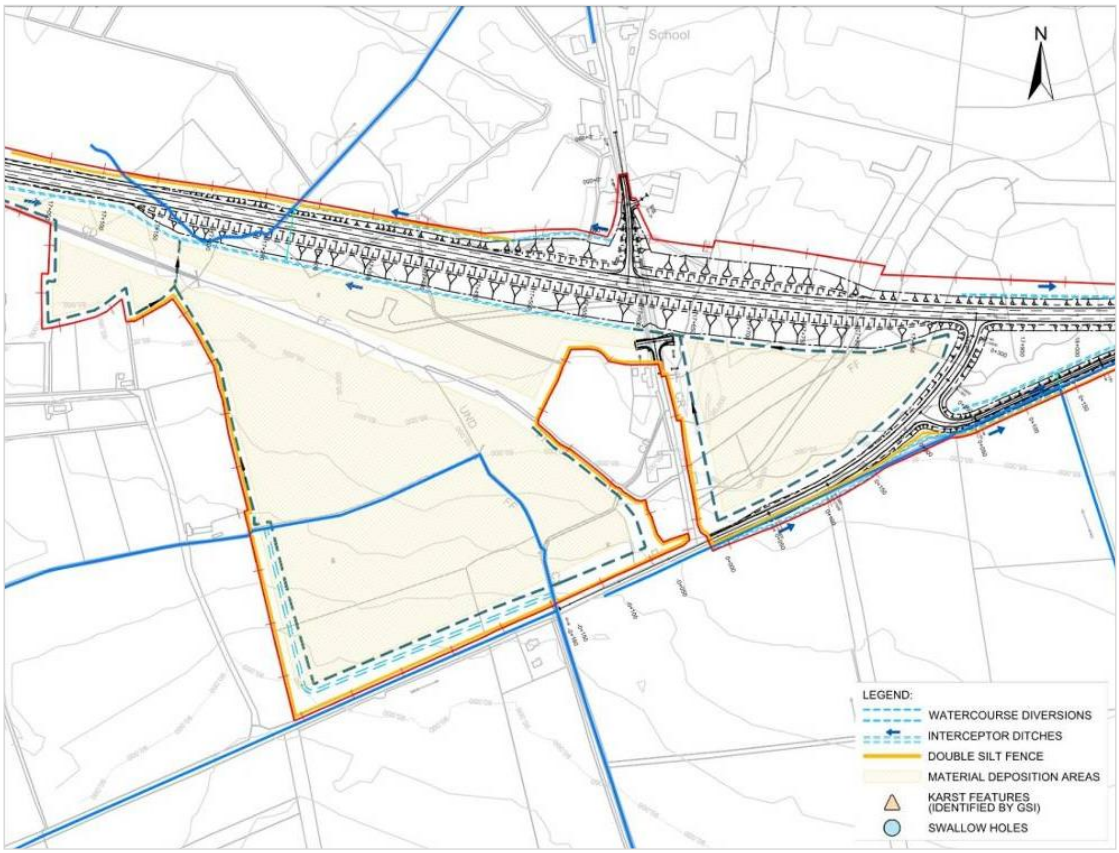

Plate A1.9 – Peat Recovery Areas Between Ch.17+000 and Ch.17+875

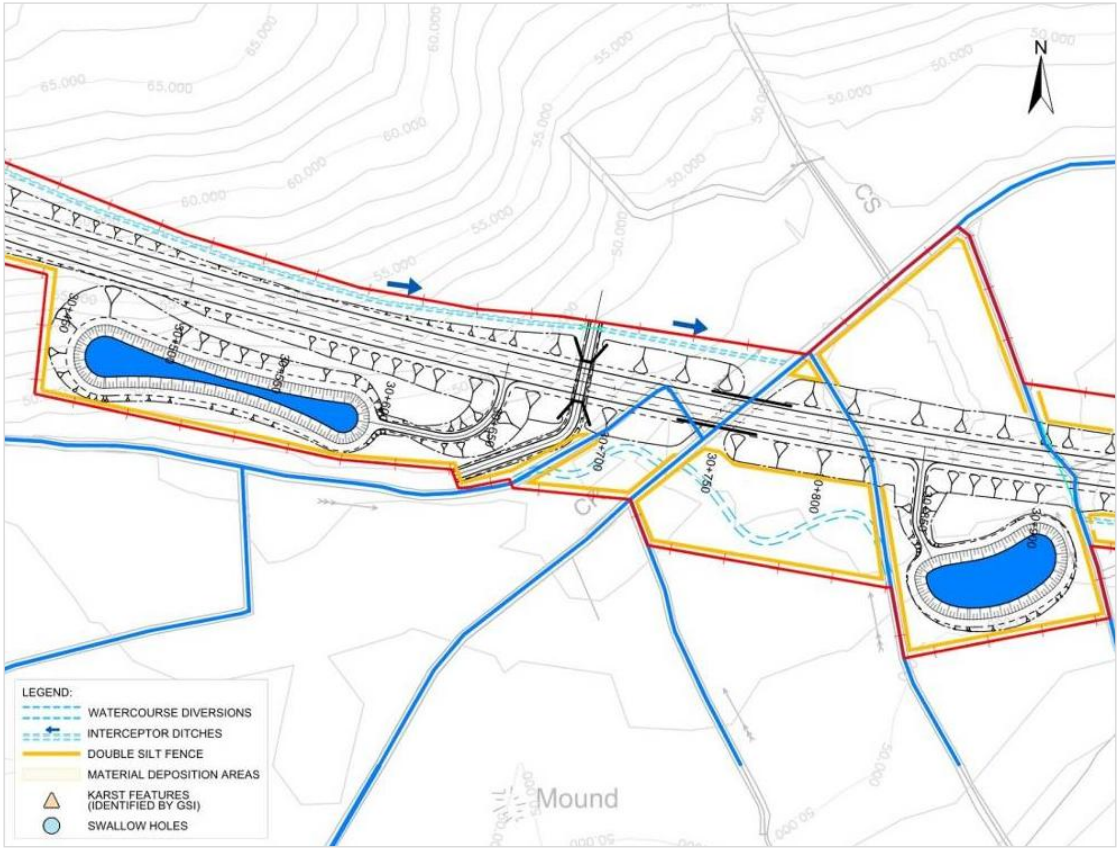

Plate A1.10 – The Owenur River Crossings and Attenuation Ponds

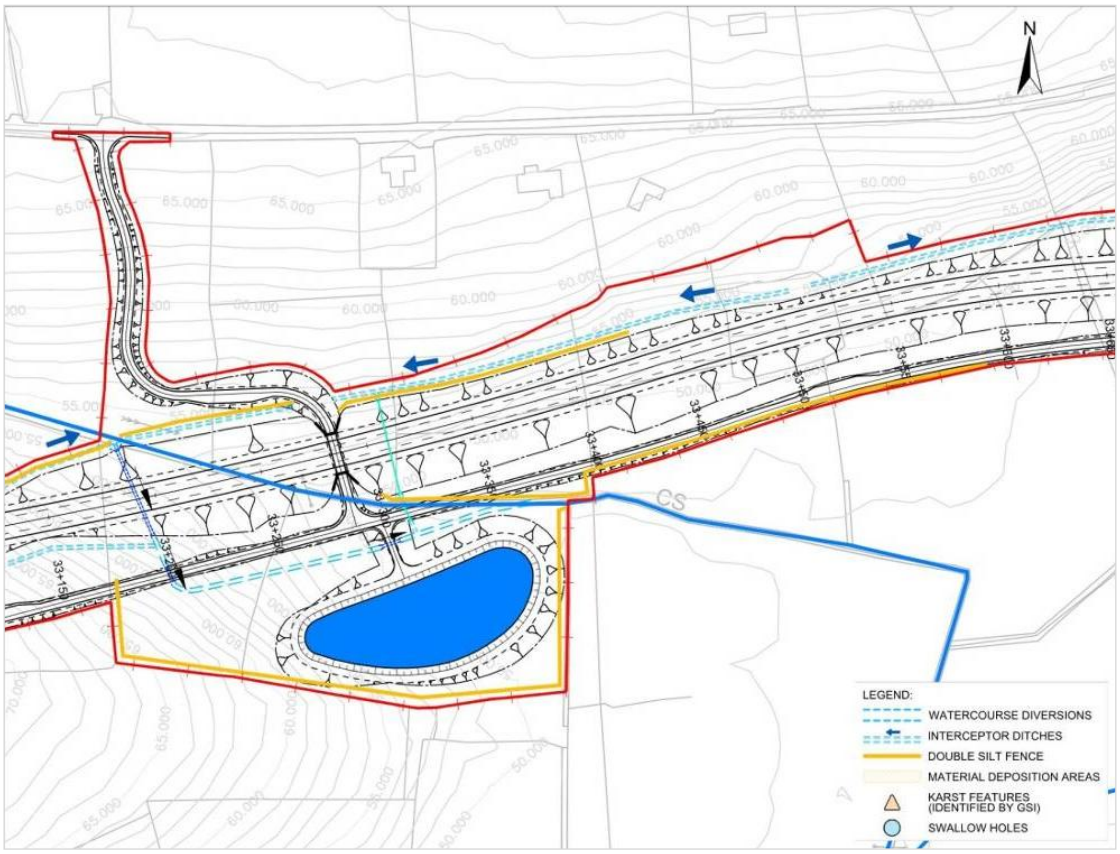

Plate A1.11 – Clooncullan Lough

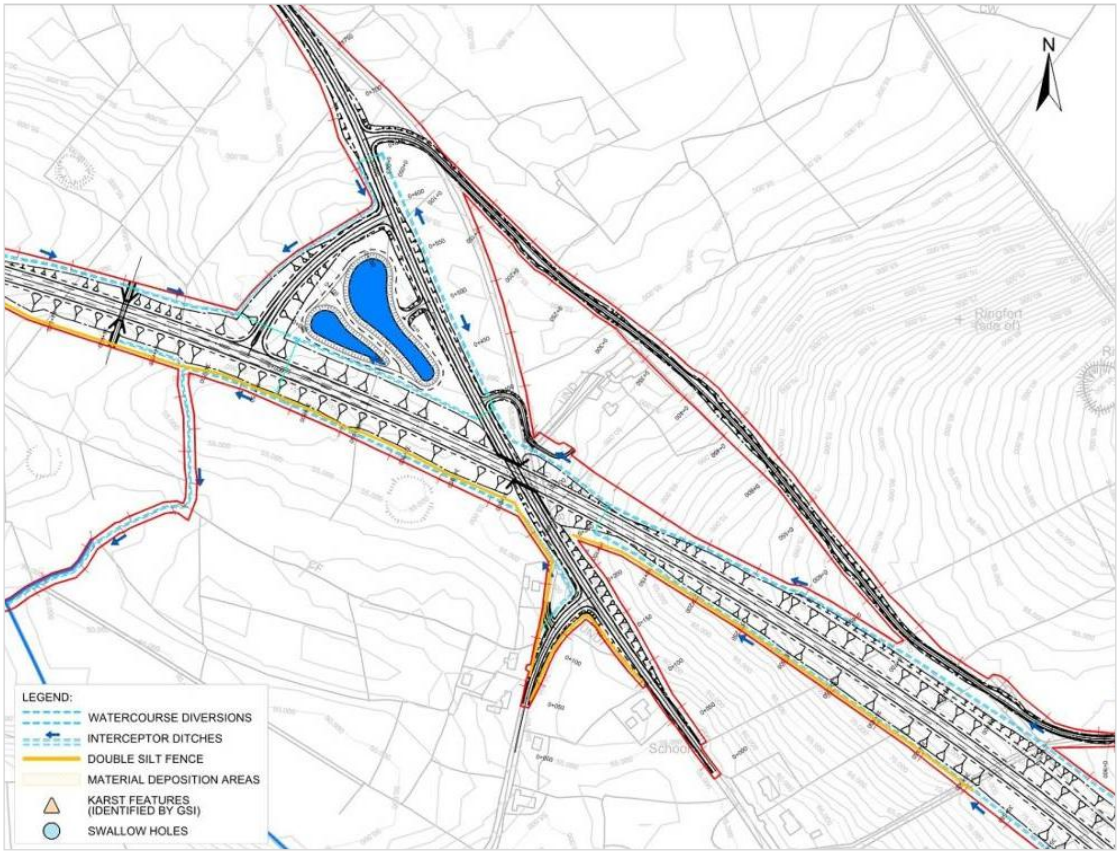

Plate A1.12 – Ovaun River Adjacent to the Scheme

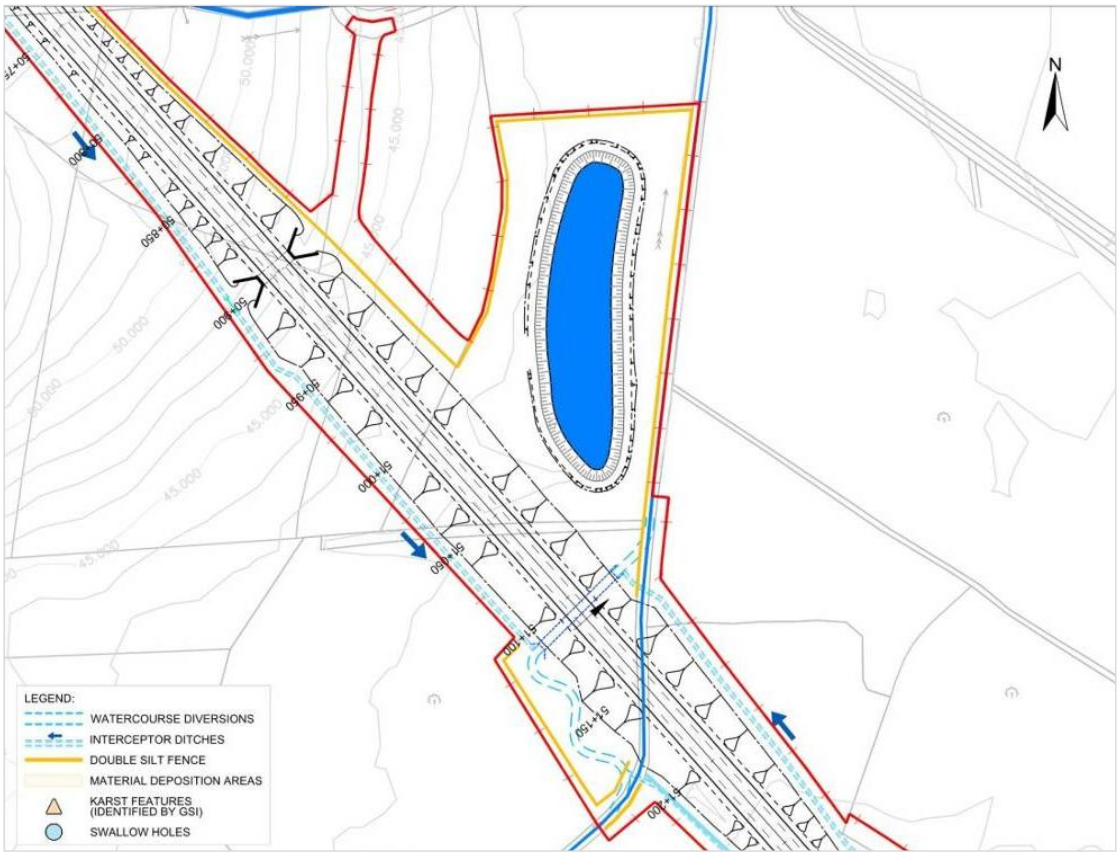

Plate A1.13 – The Strokestown River Crossing at Ch.51+150

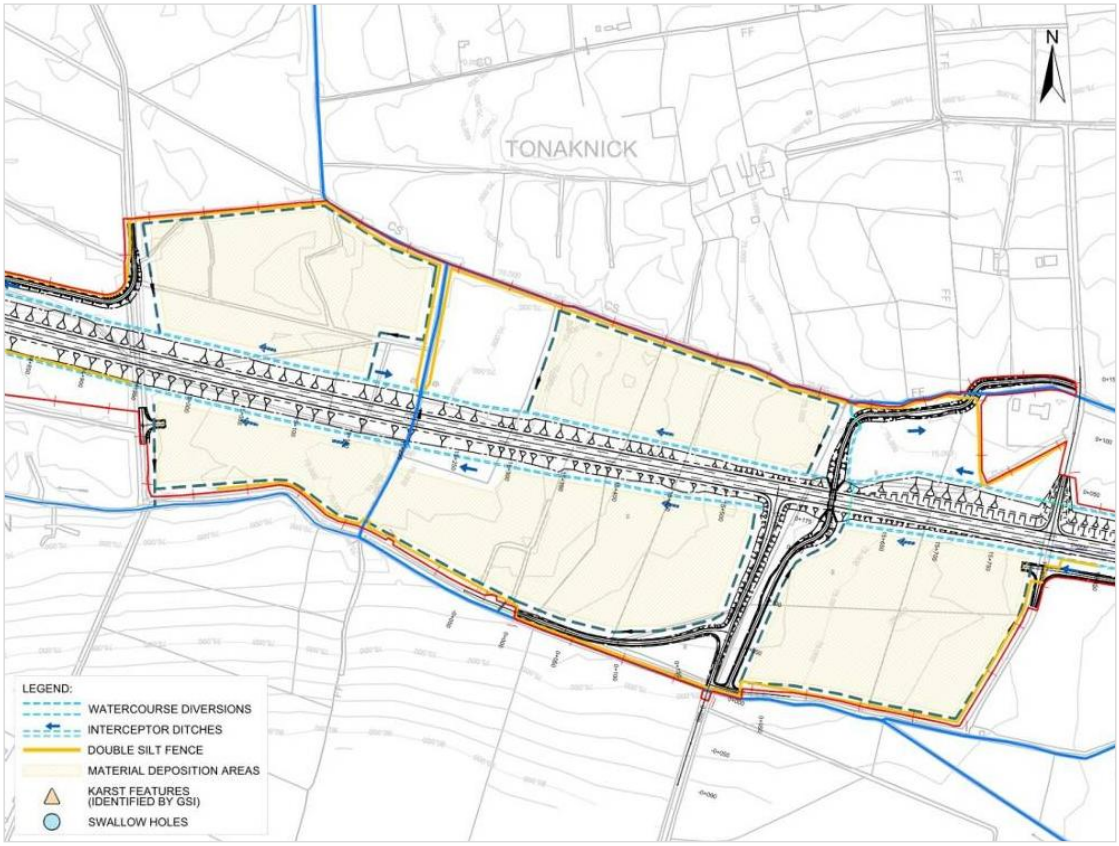

Plate A1.14 – Example of Peat Recovery Areas

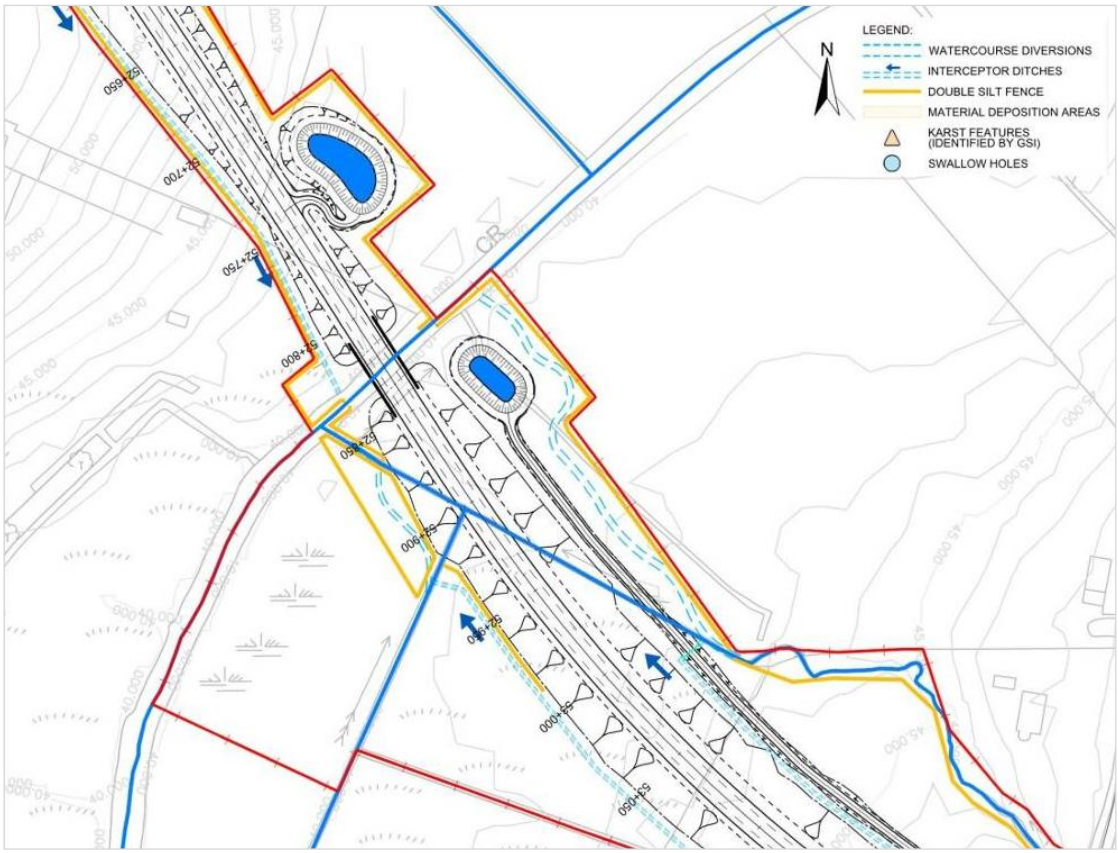

Plate A1.15 – The Scramoge River Crossing and Ponds