Chapter 17

Water

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17.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) considers and assesses the potential for likely significant impacts of the proposed N2 Slane Bypass and Public Realm Enhancement Scheme (hereafter referred to as the 'Proposed Scheme') on the natural water environment during both the construction and operational phases. This includes impacts on the physicochemical and hydromorphological characteristics of surface waters, drainage and flood risk. Mitigation and monitoring measures to limit potential significant impacts are set out where appropriate.

A full description of the Proposed Scheme is detailed within **Chapter 4 – Description of the Proposed Scheme** and the detailed construction methodology is set out in **Chapter 5 – Description of Construction Phase**.

Other impacts relating to the water environment are discussed in other chapters, namely:

- **Chapter 4 – Scheme Description**: impact on the water environment due to road drainage;
- **Chapter 8 – Population**: impact on recreational users of Water;
- **Chapter 16 – Biodiversity: Aquatic Ecology**: impacts on aquatic ecology; and
- **Chapter 18 – Land, Soils, Geology and Hydrogeology**: hydrogeological and groundwater impacts.

This chapter should be read in conjunction with the Stage 1 – Appropriate Assessment Screening and Stage 2 – Natura Impact Statement for the Proposed Scheme which have been prepared with reference to European sites; these are available under separate cover as part of the overall application for development consent to An Bord Pleanála (ABP).

17.2 Methodology

The water impact assessment has followed the overall methodology and guidance relating to the EIA process and preparation as set out in **Section 1.3.3** of **Chapter 1 – Introduction**.

17.2.1 Legislation, Policy and Guidance

17.2.1.1 Legislation

The following legislative and policy documents were considered during the preparation of this chapter:

- EIA Directive 2011/92/EU as amended by Directive 2014/52/EU;
- Floods Directive 2007/60/EC;
- Water Framework Directive (WFD) 2000/60/EC;
- Urban Waste Water Treatment Directive [UWWTD] 91/271/EEC;
- Local Government (Water Pollution) Acts 1977, as amended;
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations 2011 (S.I. No. 489 of 2011);
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010), as amended;
- European Communities (Assessment and Management of Flood Risks) Regulations, 2010 (S.I. 122 of 2010), as amended;
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010), as amended;

- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009), as amended;
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003), as amended; and
- European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293 of 1988).

17.2.1.2 Policy

Consideration has been given to the following relevant policy documents in the preparation of this chapter:

- Meath County Development Plan 2021-2027;
- The 3rd National Biodiversity Action Plan 2017-2021 (DCHG, 2017) which is a framework for the conservation and protection of biodiversity in Ireland and the 4th draft National Biodiversity Action Plan (NBAP) which will set the national biodiversity agenda for the period 2023-2027; and
- The 2nd cycle River Basin Management Plan (RBMP) and the draft 3rd cycle RBMP which set out the measures necessary to protect and restore water quality in Ireland. The overall aim is to ensure that Ireland's natural waters are sustainably managed and that freshwater resources are protected so as to maintain and improve Ireland's water environment.

17.2.1.3 Guidance

The following guidance was considered during the preparation of this chapter:

- IFI (2016) Guidelines on protection of fisheries during construction works in and adjacent to waters;
- TII (2015) DN-DNG-03065 - Road Drainage and the Water Environment (including Amendment No. 1 dated June 2015);
- DoEHLG (2009) The Planning System and Flood Risk Assessment Guidelines for the Planning Authorities; and
- NRA (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

17.2.2 Zone of Influence

The Zone of Influence (ZoI) consists of a 250m-wide corridor either side of the Proposed Scheme boundary (including the N51 and public realm works) as recommended by the 2008 NRA Guidelines. The full Study Area included in the baseline description extends to potentially hydrologically connected points in the wider WFD subcatchments, shown in **Figure 17.1**. The flood risk impact assessment considers areas within 1km upstream and downstream of the Proposed Scheme on the River Boyne. The ZoI for impacts on aquatic ecology and groundwater are discussed in Chapter 16 and Chapter 18 respectively.

17.2.3 Sources of Information to Inform the Assessment

17.2.3.1 Desktop Study

Information on hydrological receptors within the Study Area was collected in October 2021 through a detailed desktop review of existing studies and datasets as summarised in **Table 17-1** below.

Table 17-1: Summary of relevant desktop reports

Databases	Source
Surface Waters: – Surface watercourses in the Study Area and their respective water quality status – Water Framework Directive data – Drinking water quality	https://gis.epa.ie/EPAMaps/ www.catchments.ie www.water.ie

Databases	Source
Flooding: – Office of Public Works (OPW) Flood Hazard Mapping Website – OPW Preliminary Flood Risk Assessment predicted flood maps – OPW Catchment Flood Risk Assessment Management Study predicted flood maps – Flood Risk Assessment for the N2 Slane Bypass and Public Realm Enhancement Scheme (RPS, 2022), **Appendix 17.2**	www.floodinfo.ie
Teagasc Soil Maps	http://gis.teagasc.ie/soils/map.php
Ordnance Survey Ireland aerial photographs and historical mapping	https://www.osi.ie/
Historic rainfall and evapotranspiration data	www.met.ie
National Parks and Wildlife Services and designated sites	http://webgis.npws.ie/npwsviewer/
Discharge licence reports	www.epa.ie/licensing
Meath County Development Plan (Meath CDP) 2021-2027	www.meath.ie
Meath County Council (MCC) GIS Flood Mapping	Meath County Council *(pers. comms.)*
Gauging station data	www.waterlevel.ie
Catchment characteristics – Flood Studies Update	http://opw.hydronet.com/
Slane N2 Bypass Options Selection Report	http://www.n2slanebypass.ie/

17.2.3.2 Site-Specific Surveys

A number of walkovers were carried out by the drainage design team between 2020 and 2021 to gather information on the existing drainage systems and inform the design of the road drainage for the Proposed Scheme.

Third party surveys were carried out to obtain topographical information to inform the flood risk assessment and drainage design.

Handheld probe readings for dissolved oxygen, temperature, pH, conductivity and total dissolved solids were taken by aquatic ecologists at river sites between 2018 and 2022 as part of aquatic ecology surveys (refer to **Chapter 16**).

A third-party water sampling and monitoring programme was commissioned by MCC in August 2021 to inform the understanding of the baseline water quality in the watercourses within the Study Area. The programme included sampling at eight locations selected for relevance to the EIA. Each location was sampled twice monthly for a period of 12 months; refer to **Figure 17.5** and **Appendix 17.1** for details.

17.2.4 Key Parameters for Assessment

The following key parameters were examined as those having the potential to result in the greatest hydrological impact on an identified receptor or receptor group:

- Surface Water Quality (WQ);
- Drinking Water Resources (DWR);
- Flood Risk (FR); and
- Fluvial Geomorphology (FG).

An overview of potential impacts considered in relation to the above parameters during the construction and operational phases is contained in **Table 17-2**.

Table 17-2: Potential Impacts Considered in Assessment

Parameter	Phase* C	Phase* O	Potential impact
WQ	✓		Construction activities along the Proposed Scheme may increase the risk of sediment discharge to watercourses
WQ		✓	Increased contaminated run-off discharging to surface waters from the Proposed Scheme
WQ	✓	✓	Impact to watercourses due to accidental spillages of chemicals/ fuel
DWR	✓	✓	Increased risk of contaminants entering the surface water abstraction for the Staleen Water Treatment Plant (WTP) or the groundwater abstraction for the Slane PWS.
WQ, FR	✓		Obstruction and contamination of floodwaters during excavation works
FR	✓	✓	Obstruction of drainage by the proposed development
FR	✓	✓	Removal of flood storage as a result of the temporary and permanent works encroaching on the floodplain area
FR		✓	Localised increased flows and flooding in the receiving surface waters
FR		✓	Increased flood risk upstream of Mattock (Mooretown) Stream culverts
FR, FG	✓		Obstruction to river flow within watercourses during excavation works at bridge piers and culvert works including temporary storage of materials
FG	✓	✓	Changes to sediment transport regime – as a result of construction of the bridge and its piers or as a result of drainage outfalls to the channels
FG	✓	✓	Scouring of the riverbed
FG		✓	Hydromorphological changes

**C = Construction, O = Operation*

17.2.4.1 Impacts Scoped out of the Assessment

Based on the baseline environment and the Proposed Scheme description outlined in **Chapter 4**, a number of impacts are proposed to be scoped out of the assessment for Water. These impacts are outlined, together with a justification for scoping them out, in **Table 17-3**.

Table 17-3: Impacts scoped out of the assessment on Water

Potential impact	Justification
Recreational use of water	These impacts are addressed in **Chapter 8**
Impacts on aquatic ecology and biodiversity	These impacts are addressed in **Chapter 16**
Impacts on groundwater and the hydrogeological environment	These impacts are addressed in **Chapter 18**

17.2.5 Assessment Criteria and Significance

The criteria for determining the significance of effects are a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the predicted impacts.

The importance/sensitivity of hydrology attributes (rating criteria) is defined in accordance with the NRA Guidelines (NRA, 2008) which is the most relevant for assessment of river catchments in Ireland. These are listed in **Table 17-4**.

Table 17-4: Rating Criteria for Importance/Sensitivity of Hydrology Attributes

Importance/ Sensitivity	Criteria	Typical Examples
Extremely high	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats

Importance/ Sensitivity	Criteria	Typical Examples
		Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very high	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

The magnitude of impact is defined in accordance with the criteria provided in the NRA Guidelines (NRA, 2008) as outlined in **Table 17-5**. These impacts may be positive, neutral, or negative/adverse. The significance of potential impacts are then described in terms of the descriptions adapted from the EPA Guidelines (EPA, 2022) as outlined in **Table 17-7**.

Table 17-5: Rating Criteria for the Magnitude of Impact on Hydrology Attributes

Magnitude	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat Increase in predicted peak flood level >100 mm Extensive loss of fishery Calculated risk of serious pollution incident >2% annually Extensive reduction in amenity value
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50 mm Partial loss of fishery Calculated risk of serious pollution incident >1% annually Partial reduction in amenity value
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10 mm Minor loss of fishery Calculated risk of serious pollution incident >0.5% annually Slight reduction in amenity value
Negligible	Results in an impact on attribute but not of sufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level Calculated risk of serious pollution incident <0.5% annually

Magnitude	Criteria	Typical Examples
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10 mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50 mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100 mm

Table 17-6: Definition of Terms Relating to the Significance of Impact Levels

Significance of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing or emerging trends
Significant	An impact, which by its character, magnitude, duration, or intensity, alters a sensitive aspect of the environment
Profound	An impact which obliterates all previous sensitive characteristics

The significance of the impacts on hydrology attributes is determined by correlating the importance/ sensitivity of the receptor with the magnitude of the impact. The method employed for this assessment is presented in **Table 17-7**. For the purposes of this assessment, any impacts with a significance level of slight or less have been concluded to be not significant in EIA terms.

Table 17-7: Matrix used for the Rating of the Significance of Environmental Impact

		Magnitude of Impact			
		Negligible	**Small**	**Moderate**	**Large**
Importance/ Sensitivity of Attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
	High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

17.2.6 Data Limitations

This chapter of the EIAR has been prepared based upon the best available information and in accordance with current best practice and relevant guidelines.

There were no technical difficulties or otherwise encountered in the preparation of this chapter of the EIAR.

17.3 Description of Existing Environment (Baseline Scenario)

17.3.1 Current Baseline Environment

The baseline environment described in this section includes hydrological features and connections to the area surrounding the proposed mainline bypass, the N51 route improvements and the Slane village public realm enhancement proposals.

17.3.1.1 River Catchments

The Proposed Scheme is located within the lower reaches of the Boyne catchment (Hydrometric Area 07) and traverses subcatchments 07_1 (Boyne_SC_110) and 07_15 (Boyne_SC_120) as shown in **Figure 17.1**. It crosses the River Boyne at approximately Chainage (Ch.) 1350, and a tributary of the River Mattock at approximately Ch. 3450. There is one additional subcatchment downstream of the Proposed Scheme, 07_17 (Boyne_SC_130), which discharges to the Irish Sea.

The River Boyne drains a catchment area of approximately 2,694km^2. A network of ditches drains the agricultural lands traversed by the Proposed Scheme towards the River Boyne and River Mattock. The relevant watercourses present within the ZoI and the wider Study Area are shown on **Figure 17.2**.

The Proposed Scheme, which includes the mainline bypass, N51 upgrades and Slane village Public Realm works, are all within the same hydrological catchment and have the same hydrological receptors.

17.3.1.1.1 River Boyne

The River Boyne flows west to east through the Study Area and eventually discharges to the Irish Sea approximately 19 km to the east. It is subject to tidal influence from the Irish Sea within the Study Area. It drains an area of approximately 2,589 km^2 upstream of the proposed bridge crossing. The OPW gauging station at Slane Castle, 1.7 km upstream of the existing Slane Bridge, has recorded a 95%ile flow of 4.4 m^3/s. The nearest downstream gauging station is located at Roughgrange, approximately 4 km downstream of the proposed bridge crossing.

The proposed bridge crossing site is at Ch. 1350 traverses a section of the River Boyne coded by the EPA for the purposes of WFD reporting as the Boyne_170 river water body (EPA code IE_EA_07B042150). This runs from the existing bridge crossing approximately 630 m west of the proposed bridge crossing where it is transitions from the Boyne_160 water body (EPA code IE_EA_07B042100), to Gilltown where it transitions to Boyne_180 water body (EPA code IE_EA_07B042200). The Boyne_180 flows into the Boyne Estuary at the Meath-Louth County border.

Boyne Navigation

The Boyne Navigation is a navigational route comprised of a series of canals and river sections, running for approximately 30 km generally parallel to the River Boyne between Oldbridge (Drogheda) and Navan.[1] The proposed bypass crosses a section of the canal at approximately Ch. 1150, south of the River Boyne between Slane Guard Lock (Lock 8) to the west, and Morgan Lock (Lock 7) to the east. The proposed pedestrian/ cycleway bridge also crosses the canal next to the proposed bypass bridge crossing to link to the towpath.

The canal discharges to the Boyne_170 at Lock 7, approximately 2 km east of the proposed bridge crossings. This section of the canal is currently disused and during site visits, was observed to be heavily vegetated and in poor repair.

Thurstianstown Stream

The Thurstianstown Stream is a tributary to the Boyne_160 in proximity to the scheme but is not directly connected to the scheme by the proposed drainage discharges.

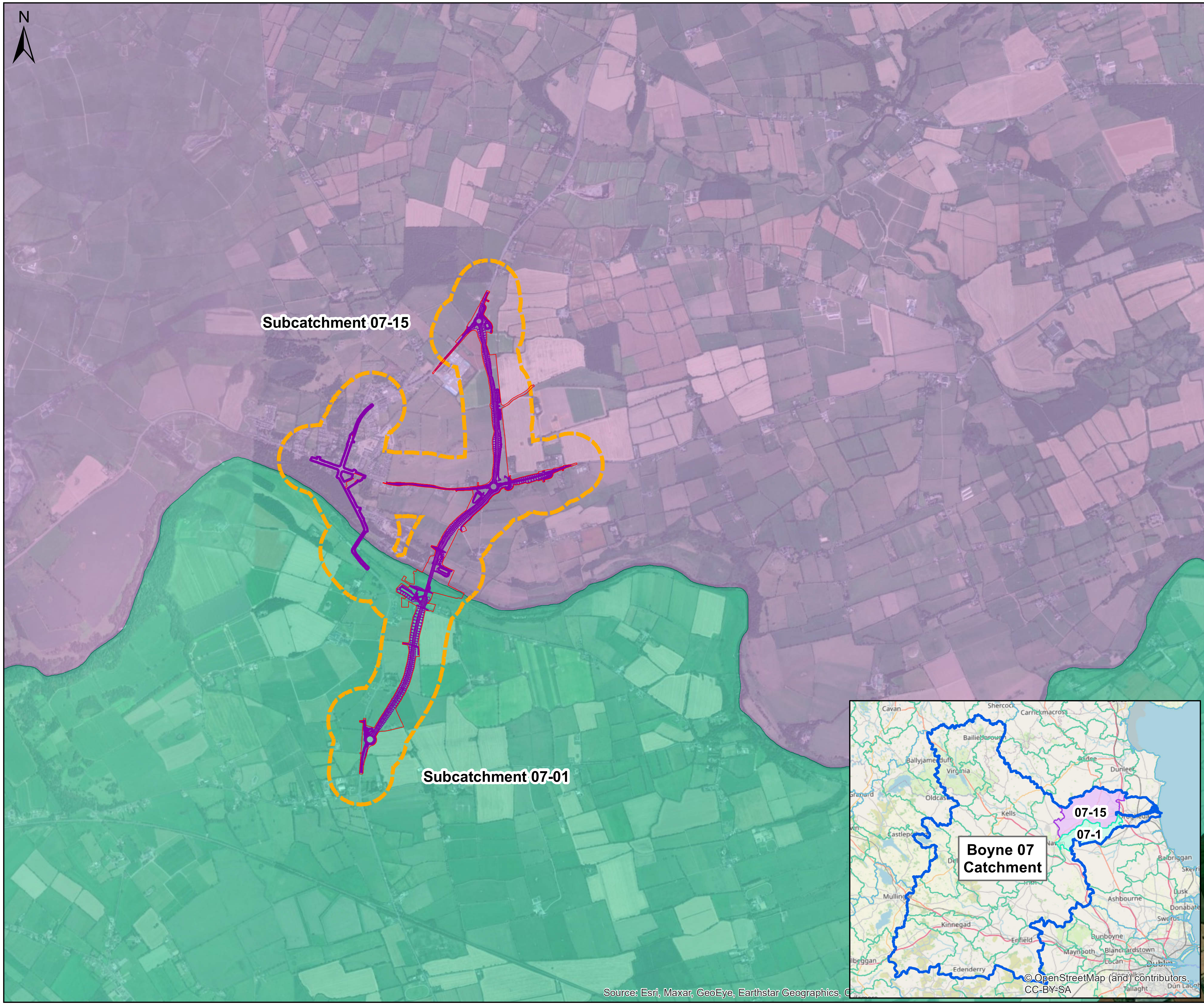
[1] An Taisce – The Boyne Navigation. Available at: https://www.antaisce.org/boyne-navigation

17.3.1.1.2 River Mattock

The River Mattock is a tributary of the River Boyne, flowing roughly west to east through the Study Area and eventually confluences with the River Boyne approximately 6.5 km to the east of the Proposed Scheme, before flowing into the Boyne Estuary. Flow measurements are not available for the River Mattock.

The tributary of the River Mattock crossed by the mainline bypass at approximately Ch. 3450 is part of the Mattock_030 water body (EPA code IE_EA_07M010300). This tributary runs from the west side of Littlewood Forest and is joined by various tributaries before its confluence with the main channel of the Mattock_030, approximately 4 km to the east. The section of the Mattock_030 traversed by the Proposed Scheme is locally known as the 'Mooretown Stream' (hereafter referred to as the 'Mattock (Mooretown) Stream').

One minor field drain is also crossed by the mainline bypass (at approximately Ch. 2860) that leads toward the locally named Slane Stream, which is a small tributary of the Mattock (Mooretown) Stream. The field drain will receive discharge from two attenuation ponds (Ponds 5A and 5B).



Legend

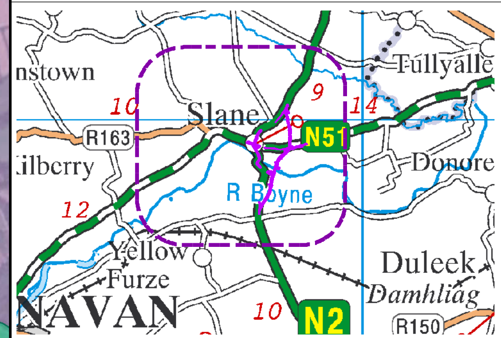
- Proposed Scheme
- Proposed Scheme Boundary
- 500 m ZoI

Subcatchments

- Subcatchment 07-1
- Subcatchment 07-15

Data Source: Environmental Protection Agency (EPA) Catchments Data Package 2021

0 12.5 25 50 Kilometres



Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 17.1

Boyne Catchment and Subcatchments

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Issue Details

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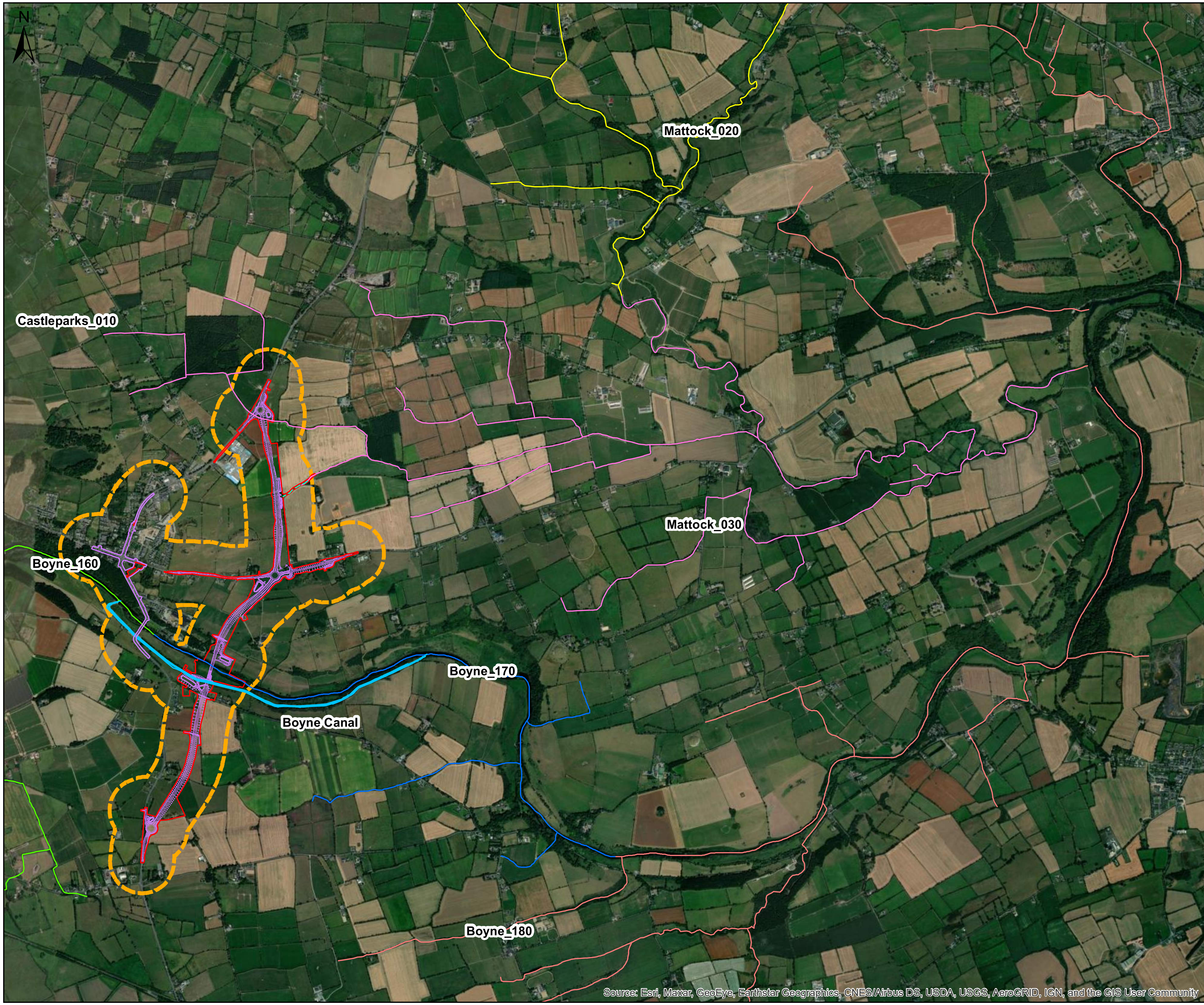
Status:	Rev:	Model File Identifier:
A1	C01	MDT0806-RPS-01-N2-M2-C-XM1001 MDT0806-RPS-01-PR-M2-C-XR9000

Drawn:	NR	**Date:**	24/05/2023
Checked:	DA	**Scale:**	1:28,000 (A3)
Approved:	NO'N	**Projection:**	ITM

NOTE:



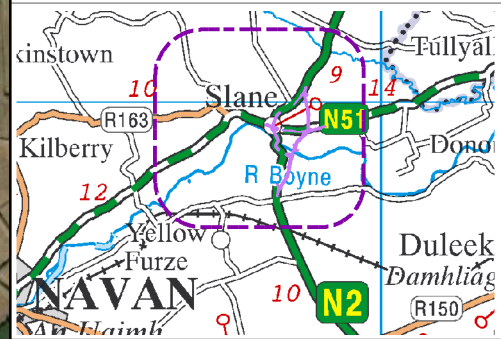
Legend

- Proposed Scheme Boundary
- Proposed Scheme
- 500m Corridor
- Field Drain
- Boyne Canal
- Boyne_160
- Boyne_170
- Boyne_180
- Mattock_020
- Mattock_030

Note: water body colurs on this map are for the purposes of distinguishing between the water bodies and do not indicate WFD status or risk.

Data Source: Environmental Protection Agency (EPA)
River Waterbodies - Cycle 3 2021

0 0.375 0.75 1.5
Kilometres



Client
Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

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Figure 17.2

Watercourses

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Drawn: NR	**Date:** 24/05/2023
Checked: DA	**Scale:** 1:28,000 (A3)
Approved: NO'N	**Projection:** ITM

NOTE:

17.3.1.2 Flood Risk Identification

The Office of Public Works (OPW) carried out an arterial drainage scheme on the River Boyne between the late 1969 and 1986 and continue to provide maintenance upkeep of the channel upstream of the Study Area. The Boyne arterial drainage scheme results in accelerated run-off from the catchment with reduced flood storage. There are several areas of Benefitted Lands[2] within the Study Area.

Stage 1 Flood Risk Identification and Stage 2 Initial Flood Risk Assessment (FRA) were carried out by RPS and records of historical flooding were found in the Study Area. The Eastern Catchment Flood Risk Assessment and Management Study (CFRAMS) predicted flood extent indicated that the area traversed by the mainline bypass element of the Proposed Scheme may be at risk from fluvial and coastal flooding along the banks of the Boyne, and to a lesser extent from pluvial flooding. Flood Mapping (GIS) from MCC also predicts flooding at the Mooretown Stream and MCC engineers documented previous flooding incidents from the River Boyne in the vicinity of the proposed route corridor in February 1990 and in November 2002.

The proposed bridge will traverse the River Boyne and will have piers within the predicted 1 in 100 year event (1% Annual Exceedance Probability (AEP)) and 1 in 1,000 year event (0.1% AEP) floodplains. The proposed bridge will have a freeboard (a safety margin to account for uncertainties in water-level prediction and/or structural performance) above the predicted flood levels in excess of 3 m and hence will not increase the risk of flooding during the 1% AEP and 0.1% AEP events.

A Stage 3 Detailed FRA was also completed by RPS to assess the potential for increased risk to flooding due to the construction of a temporary works platform and bridge piers in the floodplain. This is discussed further in **Section 17.4.1.2**. Figures showing the predicted flood extents are contained in the FRA Report (RPS, 2022) in **Appendix 17.2**.

A review of climate change sensitivity was also undertaken as part of the FRA. The comparison between the predicted CFRAMS 1% and 0.1% fluvial flood levels for the current and midrange future scenario showed an average difference of approximately 0.5 m.

Refer also to **Chapter 4**, **Section 4.4.11.3 (Management of Flood Risk)** for a description of existing sources of flooding and their management in terms of how this has influenced the drainage design for the Proposed Scheme.

17.3.1.3 Water Framework Directive

The EU Water Framework Directive (WFD) is the principal framework for managing the water resources of the entire European Union. The key objectives of the WFD are set out in Article 4 of the Directive. It requires Member States to use their River Basin Management Plans (RBMPs) and Programmes of Measures (PoMs) to protect and, where necessary, restore water bodies in order to reach good status, and to prevent deterioration. Good status means both good chemical and good ecological status.[3]

The Second Cycle River Basin Management Plan for Ireland covers the period 2018-2021; the Third Cycle RBMP is in draft and undergoing consultation and covers the period 2022-2027.

The European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (SI No. 272 of 2009) sets out environmental quality standards (EQS's) which may be used to classify surface water status. These are based on biological quality elements, physicochemical conditions supporting biological elements, priority substances and priority hazardous substances. Surface waters must achieve at least Good ecological status and Good chemical status.

The ecological status falls into either High, Good, Moderate, Poor or Bad. The ecological status is determined by biological factors, supporting water quality conditions and supporting hydrology and morphology.

Hydrology and morphology address the river flow and level and other physical conditions of the water channel such as the width, bed shape and substrate.

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[2] Benefited lands refers to land that was drained as part of the Arterial Drainage Schemes which typically related to improvement of land for agricultural purposes.

[3] https://environment.ec.europa.eu/topics/water/water-framework-directive_en. Accessed March 2023

The chemical status of surface waters is either pass or fail depending on the levels or concentrations of priority substances and chemicals including heavy metals, pesticides, and hydrocarbons compared with European EQS's set to protect aquatic life.

A risk category is also assigned by the EPA based on whether or not a water body is meeting its WFD objectives. A water body is considered to be *Not at Risk* when it is achieving its environmental objectives and there is no evidence indicating a trend towards status decline. A water body *At Risk* is either not achieving its environmental objectives or is trending towards a decline in status; these water bodies are prioritised for the implementation of measures under the RBMP. Where a water body is placed under *Review*, it may show either an improving or a deteriorating trend, but more evidence is needed before it can be considered either *Not at Risk* or *At Risk* respectively. In some cases, there is not yet enough evidence to determine the risk.

17.3.1.4 WFD Status and Risk

WFD status is reported by the EPA to the EC as part of six-year reporting cycles. The overall ecological status of the water bodies in the Study Area are reported by the EPA from the Third Cycle WFD data, which is based on monitoring data for the six-year period 2013-2018. The latest EPA monitoring data has WFD ecological status for the period 2016-2021. **Figure 17.3** and **Figure 17.4** respectively show the WFD ecological status and risk for the water bodies in the Study Area.

Where water bodies have been classed as being *At Risk*, by water quality or survey data, significant pressures and associated impacts have been identified by the EPA. The ecological status and risk category of the water bodies within the Study Area are summarised in **Table 17-8** below. The Second Cycle WFD data, based on monitoring data from 2010-2015, is included for reference.

Note that canals are classed as artificial water bodies (AWBs) under the WFD. The canal section of the Boyne Navigation at Slane is not monitored as part of the EPA's WFD monitoring programme for AWBs.

Table 17-8: Summary of Water Body WFD Ecological Status

Water Body	Second WFD Cycle (2010-2015)		Third WFD Cycle (2013-2018)		Third WFD Cycle (2016-2021)	
	Status	Risk	Status	Risk	Status	Risk
Boyne_160	Moderate	At Risk	Moderate	At Risk	Moderate	At Risk
Boyne_170	Good	Not at Risk	Good	Review	Good	Review
Boyne_180	Good	Not at Risk	Good	Not at Risk	Good	Not at Risk
Mattock_030	Unassigned	At Risk	Moderate*	At Risk	Good[2]	Not at Risk

NOTE 1: WFD status was extrapolated by the EPA for the 2013-2018 status period from a donor river water body, Mattock_010 (EPA code IE_EA_07M010100).

NOTE 2: WFD status was assigned by the EPA for the 2016-2021 status period from monitoring data. Note, risk status has not changed as risk is assessed on a six-yearly basis as part of the characterisation exercise undertaken by the EPA for the purposes of informing the RBMPs.

17.3.1.5 Surface Water Quality

The EPA (2021) reports that the significant pressures in the wider Boyne catchment are:

- Excess nutrients, mainly from phosphates, is the major issue across the entire catchment;
- Changes in hydromorphological conditions leading to channel modification (mainly channelisation due to drainage schemes); and
- Organic pollution associated with farmyard run-off and wastewater discharges.

For the water bodies within the ZoI, the Boyne_170 is at Good Ecological status for the 2013-2018/2016-2021 periods. In the Second WFD Cycle, the EPA reported the Boyne_170 was under pressure due to elevated ammonia, and noted it may also be impacted by pressures in the upstream Boyne_160 which include:

- Anthropogenic (unknown impact);
- Industry (unknown impact);

- Domestic Waste Water (discharges);
- Urban Waste Water (discharges);
- Agriculture (farmyards); and
- Hydromorphology (channelisation).

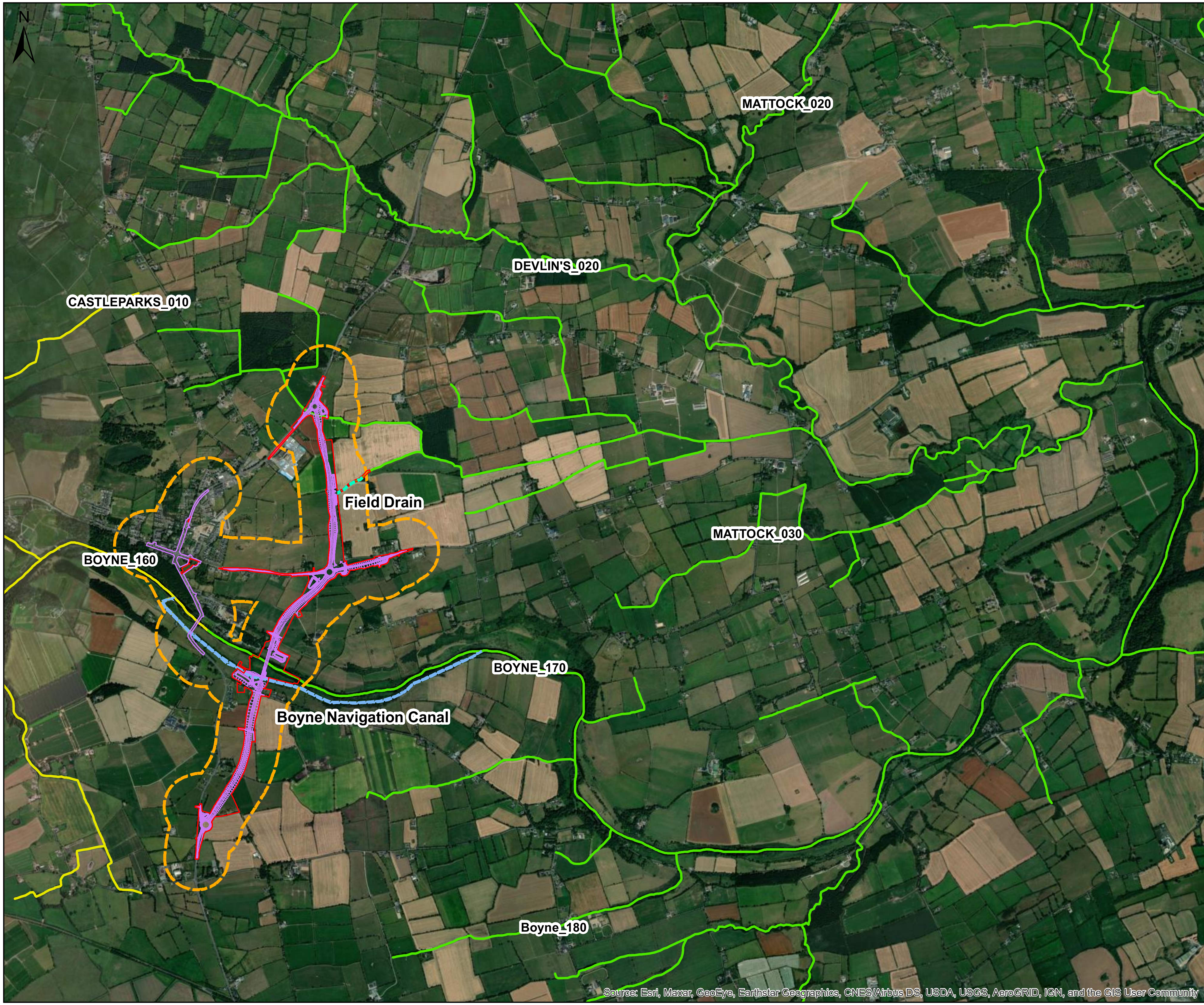
For the Third WFD Cycle, there are four significant pressures recorded by the EPA for the Boyne_160 as follows:

- Domestic Waste Water;
- Urban Waste Water;
- Hydromorphology (channelisation); and
- Agriculture.

For the Third Cycle WFD reporting, the Boyne_170 risk category has dropped from *Not at Risk* to *Review* This is likely due to a changing trend (such as nutrient fluctuations and/or change in biotic index for a given year) or the presence of a potential significant pressure(s). In these cases, the status has not yet deteriorated but warrants further monitoring/data gathering by the EPA.

The Mattock_030 has improved from At Risk over the Second WFD Cycle to Not at Risk under the 2016-2021 monitoring period of the Third WFD Cycle. The EPA previously reported that the significant pressure for the Mattock_030 was agriculture, however its WFD ecological status improved from Moderate in 2013-2018 to Good for 2016-2021.

A number of Boyne water bodies (Boyne_150, Boyne_160, Boyne_170 and Boyne_180) are classed as a Nutrient Sensitive Area (EPA code IERI_EA_2010_0006) in accordance with the UWWTD (91/271/EEC), as they are located downstream of the Navan agglomeration. It is meeting its objective in relation to the UWWTD.



Legend

- Proposed Scheme
- Proposed Scheme Boundary
- 500 m Corridor
- Field Drain
- Boyne Navigation Canal

WFD Ecological Status

- Good
- Moderate

Note: The Boyne Navigation Canal is not part of the EPA's WFD monitoring programme.

Data Source: Environmental Protection Agency (EPA)
WFD River Water bodies - Cycle 3 2021
WFD Ecological Status 2016-2021 (October 2022)

0 0.375 0.75 1.5
Kilometres

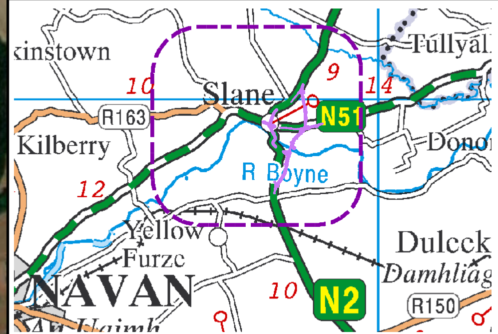


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Figure 17.3

WFD Ecological Status 2016-2021

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Issue Details

File Identifier:
MDT0806-RPS-00-N2-DR-Z-AG-3012

Status:	Rev:	Model File Identifier:
A1	C01	MDT0806-RPS-01-N2-M2-C-XM1001 MDT0806-RPS-01-PR-M2-C-XR9000

Drawn: NR	**Date:** 04/06/2023
Checked: DA	**Scale:** 1:28,000 (A3)
Approved: NO'N	**Projection:** ITM

NOTE:

Legend

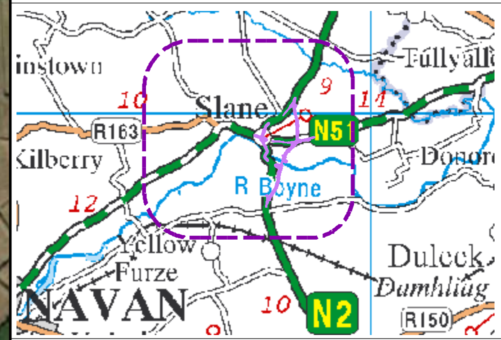
WFD Water Body Risk

- Not at Risk
- Review
- At Risk
- Proposed Scheme
- Proposed Scheme Boundary
- 500 m Corridor
- Boyne Navigation Canal
- Field Drain

Note: The Boyne Navigation Canal is not monitored by the EPA as part of the WFD monitoring programme.

Data Source: Environmental Protection Agency (EPA) River Water Bodies - Cycle 3 2021

0 0.375 0.75 1.5
Kilometres



Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 17.4

WFD Water Body Risk

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Issue Details

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Status:	**Rev:**	**Model File Identifier:**
A1	C01	MDT0806-RPS-01-N2-M2-C-XM1001 MDT0806-RPS-01-PR-M2-C-XR9000

Drawn:	NR	**Date:**	12/06/2023
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17.3.1.5.1 Physicochemical and Biological Status

Physicochemical Status

The EPA carries out water quality assessments of rivers as part of a nationwide monitoring programme. Data is collected from physicochemical and biological surveys, sampling both river water and the benthic substrate (sediment) in contact with the water. Monitoring data was extracted from four EPA monitoring stations on the River Boyne and River Mattock located within the vicinity of the Study Area.

Water sampling was also undertaken as part of this EIAR to supplement and verify the EPA data in establishing the baseline conditions within the ZoI. Samples were collected twice monthly for 12 consecutive months from August 2021 to August 2022 at eight separate locations. A turbidity probe was installed at the existing bridge crossing to provide continuous turbidity readings throughout the monitoring period. However, the data recorded by the probe were considered unfit for use, most likely due to turbulence and biofouling, and are therefore not discussed further in the EIAR.

Figure 17.5 shows the locations of the EPA and EIAR sampling locations. The EIAR sampling parameters included heavy metals and polycyclic aromatic hydrocarbons (PAHs), which were not monitored as part of recent EPA sampling data but were monitored for the EIAR to assess whether the existing road drainage is having a noticeable impact on the watercourses.

The EIAR sampling data and recent EPA data are presented in **Appendix 17.1** with reference to the threshold limits specified by the Surface Water Regulations 2009, as amended, and Salmonid Water Regulations 1988. The EIAR sampling data indicates the presence of nutrient enrichment in the watercourses (elevated ammonia and orthophosphate). Trace concentrations of zinc were found at all sites and the site upstream of the Mattock (Mooretown) Stream crossing had minor concentrations of all heavy metals tested. Total PAHs were consistently below the laboratory limit of detection for all sampling locations. Suspended solids concentrations varied appreciably between the sites and between the sampling events. Sampling was also carried out for the aquatic ecology inputs to the EIAR on various dates between 2018 and 2022 (see **Chapter 16** for details). Additional characterisation of the physicochemical baseline is provided in **Chapter 16**, **Section 16.3.1.1.2**.

Biological Status

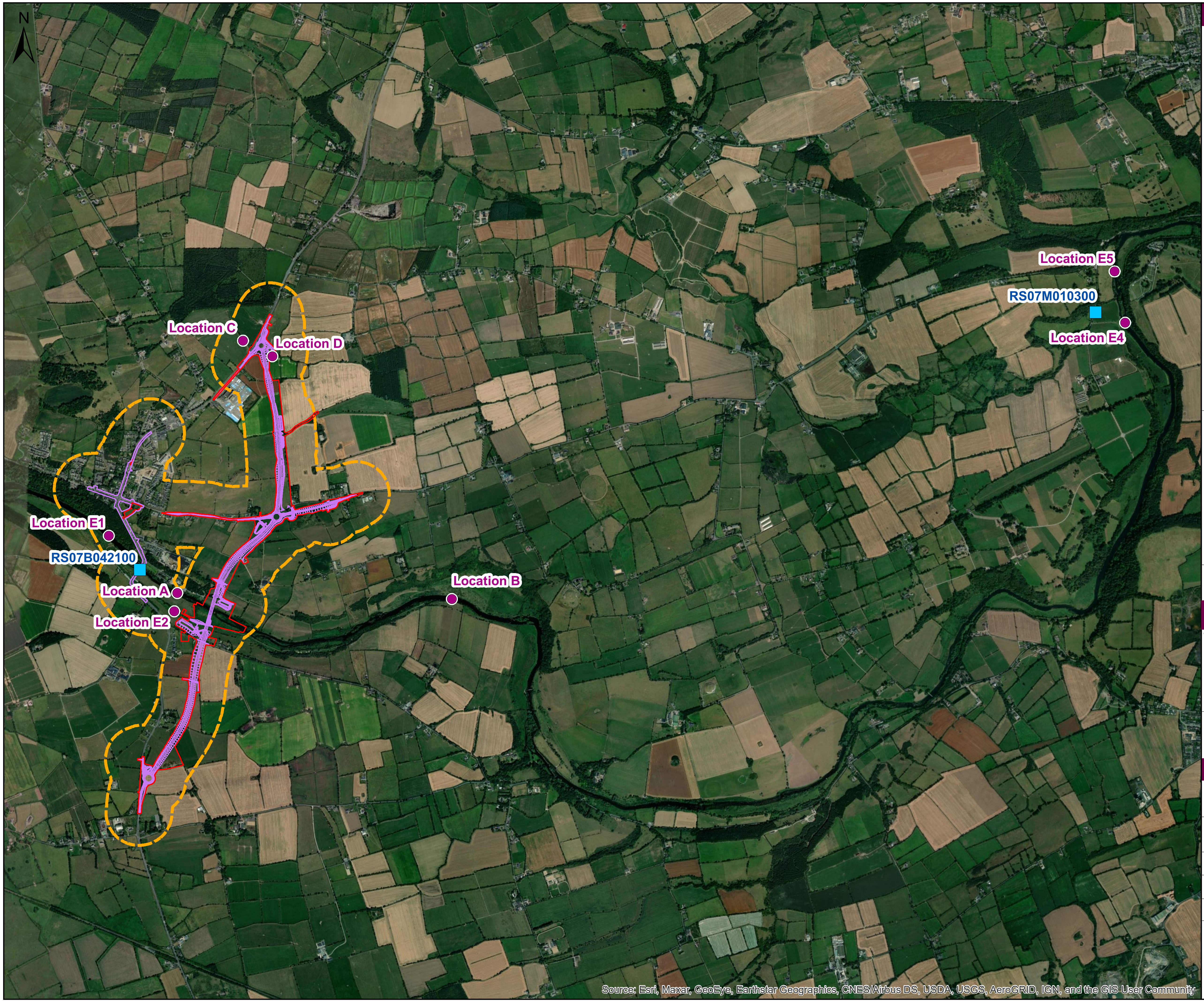
The classification for biological water quality assigns a Q-value based on the macroinvertebrate community composition. The values are grouped into four classes and the classification for each is detailed in **Chapter 16**, **Table 16-3**. The Q-values for the watercourses within the Study Area, along with the most recent year of assessment, are presented in **Table 17-9**. The values presented for Mattock_030 are based on monitoring at stations RS07M010250, located approximately 4.5 km downstream of the Proposed Scheme, and station RS07M010300, located approximately 3.8 km downstream of the Proposed Scheme. The historical EPA results are presented in **Appendix 17.1**.

Table 17-9: Q-Values for Watercourses in the Study Area

Watercourse	Station Code	Year	Q-Value	WFD Biological Status
Boyne_160	RS07B042100	2020	4	Good
Boyne_170	RS07B042150	2012	4	Good
Boyne_180	RS07B042200	2020	4	Good
Mattock_030	RS07M010250	1990	3	Poor
Mattock_030	RS07M010300	2020	4	Good

In 2020, the Boyne_160, Boyne_180 and Mattock_030 (RS07M010300 immediately upstream of the confluence with the Boyne) were classed by the EPA as *Unpolluted*. The Mattock_030 (station RS07M010250 at the confluence of the Mattock (Mooretown) Stream reach with the Mattock main channel) was *Moderately polluted* in 1990. The last available EPA pollution rating for Boyne_170 (2012) indicated it was *Unpolluted* (EPA, 2022).

At the crossing point for the proposed culverts on the Mattock_030, the Mattock (Mooretown) Stream was assigned a Q3 (Poor) rating by RPS and consultant aquatic ecologists based on field surveys between 2020-2022; refer to **Chapter 16**, **Section 16.3.1.1.2** (Field Survey Results).



Legend

- Proposed Scheme
- Proposed Scheme Boundary
- 500 m Corridor
- EIAR Sampling Points
- EPA sampling points

Data Source: Environmental Protection Agency (EPA) Biological Quality Stations 2021

0 0.35 0.7 1.4 Kilometres

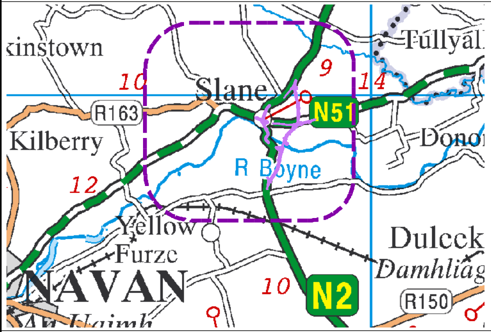


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Figure 17.5

EIAR and EPA Water Quality Sampling Locations

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17.3.1.5.2 Water Supply Sources

There is one known drinking water abstraction from the River Boyne approximately 6km downstream of the proposed crossing site. This serves the Staleen Water Treatment Plant which provides drinking water to approximately 90,000 people in the Drogheda, South Louth and East Meath areas. The source was non-compliant for pesticides in 2015 due to the presence of MCPA (a herbicide) and amyl methyl ether (a fuel additive). The abstraction point is outside the predicted ZoI.

The Slane Public Water Supply (PWS) is adjacent to the scheme, within the predicted ZoI, and abstracts groundwater that is influenced by recharge from the River Boyne; this is discussed further in **Chapter 18**. The PWS has achieved 100% compliance with tested parameters since 2019.[4]

17.3.1.5.3 Wastewater Discharges

There are two known licenced discharges from wastewater treatment plants (WWTPs) within the Study Area. These are summarised in **Table 17-10**. Effluent monitoring is carried out by Irish Water upstream and downstream of the WWTP outfalls and all are compliant, however the Slane WWTP is noted to have exceeded the orthophosphate emission limit value once in 2020.[5]

Table 17-10: Licensed Wastewater Discharges within the Study Area

WWTP	Reg. No.	Plant Population Equivalent (PE)	Treatment Level	Discharge Description
Slane	D0257-01	2,250	Secondary treatment	Primary and storm water overflow discharges to Boyne_160 from the WWTP and a secondary discharge to Boyne_160 from a septic tank (approx. 600 m upstream of the Proposed Scheme).
Donore	D0251-01	1,200	Secondary treatment with phosphorus removal	Primary discharge piped directly to the Boyne_170 (approx. 6.5 km downstream of the Proposed Scheme).

17.3.1.5.4 Section 4 Discharges

There are four known Section 4 discharges to the River Boyne within the study area as follows:

- Slane Whiskey Distillery (No. 14/04) to Boyne_160, approx. 2.1 km u/s of proposed bridge crossing;
- John Doyle, Brendan Jordan & Ken Francis Slane Ind. Estate (No. 07/04) to Boyne_170, approx. 62m to west of bridge crossing;
- Boyne Valley Visitors Centre (No. 12/02) to Boyne_180, approx. 6km d/s of the proposed bridge crossing; and
- Irish Cement Ltd (No. 88/01) to Boyne_180, approx. 7.5km d/s of the proposed bridge crossing.

No Section 4 discharges are recorded in the River Mattock within the study area.

17.3.1.5.5 Storm Sewer Discharges

There are storm sewer outfalls via a petrol interceptor at the existing River Boyne crossing at Slane. These outfalls collect storm water run-off from the existing N2 and the village.

A possible drainage outfall was identified at the existing Mattock (Mooretown) Stream culvert. However, not all drainage outfalls from the existing N2 and N51 have been identified. All storm water drainage discharges may contain pollutants associated with routine road run-off.

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[4] A boil water notice was in effect for the Slane PWS from 03 August 2022 – 08 August 2022 due to the failure of a disinfection system.

[5] Annual Environmental Report for Slane WWTP (Irish Water, 2020). Available at: https://epawebapp.epa.ie/licences/lic_eDMS/090151b2807dc707.pdf

17.3.1.5.6 Other Facilities

There are no licensed waste facilities within the Study Area. The nearest licenced waste facilities are Mullaghcrone Quarry at Donore (Licence No. W0278-01), approximately 2 km south-west of the nearest reach of Boyne_180, and Drogheda Landfill (Licence No. W0033-01), approximately 1 km north of the Boyne Estuary, immediately upstream of Drogheda.

There are two Industrial Emissions Licensed (IEL) facilities located along the Mattock_030 water body. One of these (EPA Licence No. P0431) is located approximately 3 km upstream of the confluence with the River Boyne on the north side of Mattock_030. The other (EPA Licence No. P0951) is located approximately 4 km upstream of the confluence with the River Boyne on the south side of a Mattock_030 tributary.

17.3.1.6 Drainage Systems

Throughout the Study Area there are several ditches, drains and watercourses which drain the surrounding agricultural land and roadways. These outfall to the River Boyne and River Mattock at various locations. There are several benefitting lands from the Boyne Arterial Drainage Scheme along the River Boyne within the Study Area.

Several existing ditches and minor streams are culverted under existing roads. The Mattock (Mooretown) Stream is culverted under the existing N2 at Ch. 3450.

17.3.1.7 Water-dependent Ecological Receptors

The River Boyne in the vicinity of the Proposed Scheme is designated as part of the River Boyne and River Blackwater SAC (Code 002299) and the River Boyne and River Blackwater SPA (Code 004232).

The River Boyne represents a highly significant salmonid system and is designated salmonid water (Protected Area Code IEPA5D0004). Atlantic salmon run the River Boyne in almost every month of the year, with river lamprey known to occur in the lower reaches of the Boyne and otter occurring throughout the SAC.

The Mattock (Mooretown) Stream is not within any designated site; however, it is hydrologically connected to the SAC and SPA at its downstream confluence with the Boyne and is known to support fish populations.

More information on water-dependant ecological receptors can be found in **Chapter 15** and **Chapter 16**.

17.3.2 Evolution of the Environment in the Absence of the Proposed Scheme

In the absence of the Proposed Scheme, the current hydrological regime within the Study Area would not be expected to change significantly. The hydrological baseline may change if the traffic on local roads increases due to future expansion of residential, commercial and industrial developments within the Boyne and local stream catchment areas. Increased traffic on local roads would potentially have a negative impact due to increased pollutants in run-off from roads to watercourses due to existing roads having an inferior drainage network.

The impact on water quality in the absence of the Proposed Scheme is further discussed in **Chapter 16**, **Section 16.3.2**.

17.4 Description of Likely Significant Effects

Sections 17.4.1 and **17.4.3** provide a description of the likely significant effects of the Proposed Scheme on water in cumulation with other <u>existing development</u> in the area. A description of the likely significant effects in cumulation with <u>approved development</u> i.e., development not yet built, is presented in **Section 17.4.4** based on the detailed methodology for CIA included in **Chapter 25**.

The impact interactions between water and other environmental factors are identified and described in **Chapter 26** and assessed throughout **Sections 17.4.1** to **17.4.4**.

17.4.1 Construction Phase

17.4.1.1 Impact on Water Quality

Materials used or generated on construction sites or in construction activities can contaminate surface waters (CIRIA, 2001). During the construction of new or improved roads or maintenance of existing roads, pollution from mobilised suspended solids is generally the prime concern, but spillage of fuels, lubricants, hydraulic fluids and cement from construction plant may lead to incidents, especially where there are inadequate pollution mitigation measures in place (TII, 2015).

Sources of suspended solids include uncontrolled run-off from site enabling works (ground investigations and archaeological testing), earthworks, haulage routes and stockpiles. Dewatering activities, in-stream works and enabling works may also generate sediment-laden run-off. Sources of cementitious particles include the pouring of concrete, run-off from freshly poured concrete and washout of concrete delivery trucks and equipment. Sources of hydrocarbon include run-off or leakage from machinery, accidental spillages during refuelling or storage of petroleum-based products.

Both natural and manmade drainage networks provide direct pathways from the source of pollutants at construction areas to the surrounding receptors (watercourses). Potential impacts may be more pronounced at the River Boyne crossing (which will require temporary working areas and access roads within the floodplain) and the Mattock (Mooretown) Stream crossings (which requires in-stream works), due to the proximity of the sources to the receptors.

The resulting impact on watercourses primarily relates to the watercourse’s ability to support aquatic ecology. Therefore, the impact assessment on water quality has been carried out in **Chapter 16** – refer to **Section 16.4.1**. Impacts relating to the Slane PWS are assessed in **Chapter 18** – refer to **Section 18.4.1**. A comprehensive range of mitigation measures has been incorporated into the proposed construction phasing and methodology to ensure minimal impacts on water quality during the construction phase of the Proposed Scheme; refer to **Chapter 5**.

17.4.1.2 Impact on Flood Risk

The construction of a temporary working platform, cofferdams and an access ramp within the River Boyne 1% AEP and 0.1% AEP floodplains has the potential to increase flooding due to a reduction in floodplain storage and conveyance.

17.4.1.2.1 Magnitude of the Impact

A Stage 3 FRA was carried out (refer to **Appendix 17.2**) to assess the impact on flood risk elsewhere due to the presence of the temporary working platform and cofferdams in the floodplain. A hydraulic model was built and calibrated to estimate water levels, out of bank flow paths and flood outlines around the River Boyne.

The results of the simulations show a negligible impact on the predicted flood extents and a maximum increase in peak water levels of 90 mm for the 1% AEP event due to the temporary works. This occurs approximately 200 m upstream of the proposed River Boyne Bridge, adjacent to the Mill House Hotel overflow carpark. The maximum increase in predicted flood depths of 203 mm for the 1% AEP event are confined to the existing greenfield adjacent to the River Boyne right bank immediately upstream of the proposed route corridor.

Given the above, the impact on flood risk due to the temporary works in the floodplain during the construction stage is expected to be **Negligible**.

17.4.1.2.2 Sensitivity of the Receptors

The CFRAMS predicted floodplain within the ZoI protects one commercial property affected by flooding. There are no dwellings affected by flooding in the ZoI. Therefore, the sensitivity of the receptor is considered to be **Low**.

17.4.1.2.3 Significance of the Effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be low. The effect will, therefore, be of **Imperceptible** significance, which is not significant in EIA terms.

17.4.1.3 Impact on Fluvial Geomorphology

Potential impacts on watercourse morphology during the construction phase could arise due to changes in the existing flow and sediment transport regimes, particularly under flood conditions, due to the construction works.

17.4.1.3.1 Magnitude of the Impact

The River Boyne was noted to be under hydromorphological pressures due to channelisation in the Second Cycle WFD assessment. The construction phase will not directly impact on the main channel at the location of the proposed crossing as no in-stream works will take place at that location. However, temporary working platforms will be mounted in the 1% AEP floodplain at this location to facilitate construction of the crossing.

The hydraulic model was analysed to quantify potential changes to the pre-development and construction phase maximum water velocities in the vicinity of the proposed working platforms in the 1% AEP scenario. Within the channel, negligible increases in the velocities immediately upstream of the crossing (3.1m/s increasing to 3.3m/s) and downstream of the crossing (2.9 m/s increasing to 3.2 m/s) were predicted. Within the floodplain, local increases in overland flow velocity are predicted around the proposed access tracks and working platform WP2 on the south side of the river (0.4m/s to 0.8m/s). Slight increases in overland flow velocity are predicted in the immediate vicinity of WP3 on the north side of the river (0.2m/s to 0.4m/s).

The majority of suspended solids will settle out in the attenuation ponds prior to discharge, therefore the proposed drainage outfalls to the River Boyne will not contain appreciable sediment loads, and the discharge rates will be limited to the 1% AEP greenfield run-off rates. Therefore, the potential for changes to the existing flow and sediment transport regimes are minimal and the impact on the River Boyne is predicted to be **Negligible**.

The discharges from the proposed attenuation ponds to the Canal and the Slane Stream, as with the River Boyne, will be limited to the 1% AEP greenfield run-off rate and will not contain appreciable sediment loads. Therefore the magnitude of impact on these watercourses is also predicted to be **Negligible.**

The Mattock (Mooretown) Stream will be realigned, culverted at three locations (Culverts 6A, 6B and 6C) and the existing upstream culvert passing under the existing N2 will be removed. A temporary diversion will allow the culverts to be constructed mostly in the dry, reducing the risk of altering the existing watercourse’s geomorphology during the construction phase. The discharges from the proposed attenuation ponds to the Mattock (Mooretown) Stream will be limited to the 1% AEP greenfield run-off rate and will not contain appreciable sediment loads. Given the above, the impact on local hydromorphology due to the proposed alterations of the Mattock (Mooretown) Stream during construction stage is expected to be **Negligible**.

17.4.1.3.2 Sensitivity of the Receptors

The sensitivity of the River Boyne is considered to be Extremely High given the existing hydromorphological pressures and the ecological importance. The Canal is also assigned Extremely High sensitivity due to its connection with the River Boyne. The Mattock (Mooretown) Stream has the potential to support fish populations and is considered to have Medium sensitivity while Slane Stream which is a tributary of the Mattock (Mooretown) Stream is of low ecological value and has Low sensitivity.

17.4.1.3.3 Significance of the Effect

Overall, the magnitude of the impact is deemed to be negligible and the effect will, therefore, be of **Imperceptible** significance on all receptors, which is not significant in EIA terms.

17.4.2 Operational Phase

17.4.2.1 Impact on Water Quality

Potential impacts on water quality during the operational phase could arise due to routine road run-off, accidental emissions due to spillage, and during maintenance activities.

Routine road run-off is known to contain contaminants such as metals, hydrocarbons and other particles that can adversely affect the chemical and biological quality of watercourses to which they are discharged (TII, 2015). The construction of a new road and associated drainage provides a direct pathway between the source of such pollution and potentially sensitive receptors.

The watercourses within the Study Area currently receive some degree of unattenuated road run-off. However, the EIAR water quality sampling data indicates that this is not having a significant effect on physicochemical or biological status. During the operational phase of the project, run-off from the proposed N2 Slane Bypass will pass through attenuation ponds and therefore receive a degree of treatment before discharging to the environment. The Proposed Scheme includes seven of these attenuation ponds with five associated outfalls to existing watercourses: one to the River Boyne; one to the Boyne Navigation canal; two to the field drain upstream of the Slane Stream, a small tributary to the River Mattock; and one to the Mattock (Mooretown) Stream.

A Highways England Risk Assessment Tool (HEWRAT[6]) assessment was carried out to assess the risk of pollution to watercourses based on the Average Annual Daily Traffic (AADT) predicted over the lifetime of the Proposed Scheme. It was determined that no mitigation measures for the River Boyne (or its tributaries) or the Mattock (Mooretown) Stream would be required if the proposed drainage systems are implemented.

Chapter 4, **Section 4.4.11** provides further information on the drainage proposals and the HEWRAT assessment.

There is an additional risk of unspecified contaminants entering watercourses during the operational/ maintenance phase due to accidental spillages of chemicals, fuels or other hazardous substances on the road, which could run off or drain to watercourses. The severity may depend on the nature and quantity of material spilled.

A spillage risk assessment is contained in **Chapter 4**, **Section 4.4.11.7** which indicates there is no significant risk of such a pollution incident occurring and that no specific spillage prevention measures are required. *I*t is further noted in **Chapter 4**, **Section 4.4.11.12** that prior to opening of the bypass, the appointed operator shall prepare an Environmental Emergency Response Plan

It is expected that the pavement surface course will require replacement every 8 to 10 years. The bridge deck surfacing will need maintenance and replacement after 20 years. Vegetation management will be required annually. Painting of steel work will be required after 20 years. Maintenance of the drainage systems (filter drains, petrol interceptors, grit chambers, attenuation ponds etc) will be ongoing, refer to **Section 4.5**.

An outline Environmental Operating Plan (EOP) (refer to **Chapter 5**, **Appendix 5.6**) will be implemented by the appointed contractor(s). The same mitigation measures included under **Chapter 16**, **Section 16.5.2** shall be included in the Outline EOP. Any potentially hazardous waste arising from maintenance of the drainage systems such as sludge from attenuation ponds, hydrocarbons from petrol interceptors, or materials retained in grit chambers, shall be disposed of at a suitably licensed facility.

The resulting impact on watercourses primarily relates to the watercourse’s ability to support aquatic ecology. Therefore, the impact assessment on water quality has been carried out in **Chapter 16** – refer to **Section 16.4.2**. Impacts relating to the Slane PWS are assessed in **Chapter 18** – refer to **Section 18.4.2**.

17.4.2.2 Impact on Flood Risk

The potential impacts on flood risk due to changes in the hydrological regime in the operational phase of the proposed scheme are discussed below.

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[6] Note this tool was previously referred to as ‘HAWRAT’ (Highways Agency Risk Assessment Tool), reflecting the name change of the UK’s Highways Agency to Highways England.

17.4.2.2.1 Magnitude of the Impact

The additional hard standing over existing greenfield areas due to the construction of the mainline bypass, cycle paths and footpaths has the potential to increase peak run-off rates, which could further exacerbate flood risk in the area. This is mitigated by the proposed drainage design described in **Section 4.4.11.3.2**. The increased risk of rainfall run-off due to the new paved car park at Slane village is also mitigated by design, as described in **Section 4.4.13.7**.

The proposed bridge will be located across the River Boyne and will have its piers within Flood Zone A and B.[7] The lowest soffit level of the bridge is at least 3m above the predicted 0.1% AEP event (1 in 1,000-year water level) hence the proposed mainline bypass will not be at risk of flooding from the River Boyne.

This bridge has been designed with particular reference to the OPW publication 'Arterial Drainage Act 1945 (Section 50) Guide on information to accompany applications for OPW consent for Bridges and Culverts'.

A Stage 3 FRA was carried (RPS, 2022) to assess the permanent impact on flood risk elsewhere due to the presence of the bridge piers in the floodplain. A hydraulic model was built and calibrated to estimate water levels, out of bank flow paths and flood outlines. The results of the simulations show maximum increase in peak water levels of 4 mm and 5 mm for the 1% AEP and 0.1% AEP flow events respectively as a result of the proposed bridge piers located within the predicted floodplain.

The location of the maximum increases in peak water levels are immediately upstream of the proposed River Boyne Bridge adjacent to the Mill House Hotel overflow carpark. The maximum increases in peak water levels were not deemed to be significant and do not to contribute to an overall increase in predicted flood extents.

There are approximately thirteen culverts required to accommodate existing watercourses through the scheme such as streams and land drains. Other minor land drains will be intercepted and rerouted.

The proposed culverts crossing the Mattock (Mooretown) Stream (culverts 6A, 6B and 6C) are more than adequate to accommodate the 1% AEP (1 in 100 year) fluvial flows plus 20% allowance for climate change and provision for a 300 mm freeboard as per the OPW Section 50 design criteria. The results of the Initial FRA concluded that the proposed culvert will not increase flood risk to the proposed mainline bypass or elsewhere. The culverts to be installed as part of the Proposed Scheme are designed in accordance with the OPW requirements and hence, shall not restrict the hydraulic conveyance of the watercourses.

Given the above, the impact on flood risk due to the addition of the proposed bridge and other hydraulic structures during operational stage is expected to be **Negligible**.

17.4.2.2.2 Sensitivity of the Receptors

The CFRAMS predicted floodplain within the ZoI protects one commercial property and no private dwellings affected by flooding. The existing bridge to Slane village has been affected by past flood events, however the proposed bypass will provide alternative access in the event of future flooding. Therefore, the sensitivity of the receptor is considered to be **Low**.

17.4.2.2.3 Significance of the Effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be low. The effect will, therefore, be of **Imperceptible** significance, which is not significant in EIA terms.

17.4.2.3 Impact on Fluvial Geomorphology

Potential impacts on watercourse geomorphology during the operational phase could arise due changes in the existing flow and sediment transport regimes, particularly under flood conditions.

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[7] Flood Zone A is the area where the probability of flooding from the river is highest (greater than 1% AEP).
Flood Zone B is the area where the probability of flooding from the river is moderate (between 0.1% and 1% AEP).

17.4.2.3.1 Magnitude of the Impact

The River Boyne was noted to be under hydromorphological pressures due to channelisation in the Second Cycle WFD assessment. However, the scheme will not directly impact on the main channel at the location of the proposed crossing as it spans the entire width of the river at that location. The bridge piers will be located within the 1% AEP floodplain and therefore will not contribute to long term morphological changes.

The hydraulic model was analysed to quantify potential changes to the pre- and post-development maximum water velocities in the vicinity of the proposed Boyne crossing in the 1% AEP scenario. Within the channel, there is no change to the velocities immediately upstream of the crossing, while a negligible increase (2.9 m/s increasing to 3.1 m/s) is predicted immediately downstream of the crossing. Within the floodplain, local reductions in overland flow velocity are predicted around the proposed maintenance access tracks on the south side of the river, and around the proposed bridge piers. Slight increases in overland flow velocity are predicted in the immediate vicinity of the proposed central pier (0.4 m/s to 0.8 m/s) and northern pier (0.2 m/s to 0.6 m/s).

A scour assessment was completed by RPS in line with Part 21 of BD 97/12 for the 0.1% AEP event. The assessment concluded that the risk of scour at the bridge piers is low, and that no measures to counteract scour are required as part of the design (refer to **Chapter 4**, **Section 4.4.9.8.5** for further details).

The majority of suspended solids will settle out in the attenuation ponds prior to discharge, therefore the proposed drainage outfalls to the River Boyne will not contain appreciable sediment loads, and the discharge rates will be limited to the 1% AEP greenfield run-off rates. Therefore, the impact on the River Boyne is deemed to be **Negligible**.

No permanent structures will be added to the Canal or the Slane Stream. The discharges from the proposed attenuation ponds to the Canal and the Slane Stream, as with the River Boyne, will be limited to the 1% AEP greenfield run-off rate and will not contain appreciable sediment loads. Therefore, the magnitude of impact on these watercourses is also predicted to be **Negligible.**

The Mattock (Mooretown) Stream will be realigned, culverted at three locations (Culverts 6A, 6B and 6C) and the existing upstream culvert passing under the existing N2 will be removed. The culverts have been designed in accordance with OPW Section 50 requirements and therefore are predicted to have minimal hydraulic impact on the watercourse. Reinstatement of instream habitats in realigned sections of the stream will be carried out to mimic existing morphology. Energy dissipators will be installed upstream and downstream of the proposed culverts to reduce potential for bank and riverbed erosion.

Given the above, the impact on local geomorphology due to the proposed alterations of the Mattock (Mooretown) Stream during operational stage is expected to be **Negligible**. Impacts on hydromorphology are discussed further in **Section 16.4.2**.

17.4.2.3.2 Sensitivity of the Receptors

The sensitivities of the receptors are as described in **Section 17.4.1.3.2**.

17.4.2.3.3 Significance of the Effect

Overall, the magnitude of the impact is deemed to be negligible and the effect will, therefore, be of **Imperceptible** significance on all receptors, which is not significant in EIA terms.

17.4.2.4 Impacts on Designated Sites

During the operational phase there is potential for significant impacts on hydrologically connected designated sites. The impacts on water quality for watercourses that are hydrologically connected to designated sites are discussed in the above section, while the impacts on aquatic ecological receptors at these sites are discussed in detail in **Section 16.4.2**.

17.4.3 WFD Considerations

This section evaluates the impact of the Proposed Scheme on the overall ecological status of relevant river water bodies (RWBs) in terms of the objectives set out in Article 4(1) of the WFD. Article 4(1)(a) requires that, within specified time frames, Member States shall:

- Prevent deterioration of the status of all bodies of surface water; and
- Protect, enhance and restore all surface water bodies, with the aim of achieving good status.

17.4.3.1 Background

A 2015 decision by the European Court of Justice (CJEU) in the so-called *Weser* case[8] established that Article 4(1)(a)(i) to (iii) of Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy must be interpreted as meaning that the Member States are required — unless a derogation is granted — to refuse authorisation for an individual project where it may cause a deterioration of the status of a body of surface water or where it jeopardises the attainment of good surface water status or of good ecological potential and good surface water chemical status by the date laid down by the directive.

This decision effectively established two key tests of WFD compliance which, by definition, must be established in advance of the project occurring. These key tests for WFD compliance are examined in this section in relation to whether, as a result of the Proposed Scheme:

1. Deterioration of water body status may occur; or
2. Attainment of good surface water status could be jeopardised.

The concept of 'deterioration of status of a body of surface water' is not defined in the WFD. The decision in *Weser* provided the following clarifications on the way in which WFD compliance should be interpreted:

- "Deterioration of the status" of the water body includes a fall by one class of any element of the quality elements within the meaning of Annex V of the WFD, even if the fall does not result in a fall of the classification of the body of surface water as a whole.
- If the quality element is already in the lowest class, any deterioration of that element represents a deterioration of the status within the meaning of WFD Article 4(1)(a)(i).

The decision in *Weser* also placed emphasis on the interpretation of the word "enhancement" in Article 4(1) of Directive 2000/60/EC. The objectives carry not only the obligation to prevent deterioration, but also the obligation to "enhance" status (Art. 4 (1)(a)). That is, any deterioration, even within a status class band, challenges the precise Article 4 obligation of "enhancement". Hence any degree of further deterioration of a quality element is considered a contradiction, as it drives the water body further away from achieving WFD objectives. Other case law[9] has since emerged on the subject of compliance with WFD and this has been considered.

17.4.3.2 Effects on Water Body Status

Three river water bodies (RWBs) are potentially affected by the Proposed Scheme. **Table 17-11** sets out the current EPA assigned water body status. Included are the biological quality and supporting elements used by the EPA to classify status within these RWBs.

[8] Case C-461/13 Bund für Umwelt und Naturschutz Deutschland ECLI:EU:C:2015:433.

[9] Including but not limited to Case C559/19 and Case C525/20

Table 17-11: EPA River Water Body Status Summary

EPA River	RWB Name	RWB Code	Q-value status	*GPC status	Overall EPA RWB WFD Status 2016-2021	EPA Assessment Technique
Thurstianstown Stream Boyne	Boyne_160	IE_EA_07B042100	Good (Q4)	Pass	Moderate	Monitored
Boyne	Boyne_170	IE_EA_07B042150	Good (Q4)	Pass	Good	Monitored
Mattock (Mooretown) Stream	Mattock_030	IE_EA_07M010300	Good (Q4)	Pass	Good	Monitored

Source: EPA Geoportal – data download section in October 2022.

** GPC = General Physicochemical*

Examples of how to carry out the assessment are in Section 3.4.1 of the Common Implementation Strategy (CIS) Guidance No. 36 (CIS, 2017), published with cognisance of case law on what constitutes 'deterioration'. The following **Table 17-12** to **Table 17-14** are based on CIS (2017), examining how the Proposed Scheme will affect the WFD environmental objectives of the affected river water bodies: Boyne_170, Mattock_030 and Boyne 160.[10]

Boyne_170

The EPA monitor macroinvertebrate Q-value (at RS 07B042150) and general physicochemical conditions in this water body, resulting in OOAO[11] status of 'good' for the current WFD reporting period (2016-2021). The River Boyne will be crossed, but with no direct impingement on the channel or the Navigation Canal and no change to flood or scour risk on the Boyne floodplain. Road drainage will flow via Attenuation Ponds 2 and 3 which can be expected to improve run-off quality compared to the existing situation where there is no drainage treatment from the existing N2. The Proposed Scheme will result in a significant reduction in HGV and stop-start traffic over the existing Slane N2 bridge crossing of the Boyne, which will reduce the level of unattenuated and untreated road drainage from the old infrastructure, hence a net improvement in drainage water quality can be expected during the operational phase.

Table 17-12 shows that the Proposed Scheme, therefore:

1. Does not cause deterioration of good water body status; and
2. By definition, does not jeopardise attainment of good status.

[10] Note there are no direct physical impacts in Boyne_160, this sub-basin is only a receiving RWB for (distant) drainage from the proposal via Thurstianstown Stream.

[11] OOAO = one out, all out

Table 17-12: Boyne_170 – Water Body Status Considerations

Quality elements	EPA Biological quality elements (BQEs)	Hydromorphological quality elements supporting the BQEs			General physicochem. elements supporting the BQEs	Overall ecological status
Starting point: EPA assigned status is 'good', on the basis of monitoring of biological (macroinvertebrate Q-value) & physicochemical quality element.						
Modification proposed: New clear span crossing of River Boyne main channel and adjoined Navigation Canal. Drainage to the channel is via attenuation ponds with pre-treatment (hydrocarbon interceptors, vortex grit separator). Ponds designed to accommodate 1% AEP flood event (+20% climate change allowance). No direct footprint within channel. Bridge piers with 10m set-back from banks. Reduction of traffic flows over existing Slane Bridge and introduction of road run-off treatment (via attenuation ponds) on new road.						
Effect of modification (proposed scheme): Overall ecological status is maintained at 'good'. There are no changes to overall RWB status and no deterioration in hydromorphological elements supporting the biological quality elements. Physicochemical elements and Q-value are not affected by the scheme and will continue to be driven primarily by catchment pressures upstream of Slane.						
	Macroinverts (Q-value)	Hydrology	Morphology	Continuity		
Starting point	2 (Q4)	≤2*	≤2*	≤2*	2	2
Effect of modification	2 (Q4)	≤2*	≤2*	≤2*	2	2
Ecological Status Classes - 1: High; 2: Good; 3: Moderate; 4: Poor; 5: Bad						
* *"supporting conditions" are by definition equal to, or poorer than, highest BQE value*						

Mattock_030

This waterbody is monitored by the EPA at the Mattock River Station 07M010300 (New bridge upstream River Boyne confluence) recording Q-value (macroinvertebrates) and general physicochemical conditions that derive OOAO status of 'good' for the current WFD reporting period (2016-2021). **Table 17-13** shows that the Proposed Scheme:

1. Does not cause deterioration of good water body status; and
2. Does not jeopardise the maintenance of good status.

The biological quality element (macroinvertebrate Q-value) is limited by agricultural drainage activity and poor physicochemical conditions, as evidenced by site-specific water sampling conducted for the aquatic impact assessment. There is no contribution from the Proposed Scheme that would jeopardise good water quality supporting the biological quality elements and hence good ecological status. There will be a net improvement in the hydromorphological quality elements of continuity and hydrology given the removal of an existing fish barrier. In addition, road drainage will flow via Attenuation Pond 6 which can be expected to improve run-off quality compared to the existing situation where there is no road drainage treatment.

Table 17-13: Mattock_030 – Water Body Status Considerations

<table>
<tr><td colspan="7">Starting point: EPA assigned status is 'good', on the basis of monitoring of Q-value (biological quality element) near the tributary confluence with River Boyne. Note that site-specific surveys indicate that biological quality status is 'poor' (Q3) in the affected RWB segment at Mooretown.</td></tr>
<tr><td colspan="7">Modification proposed: Series of 3No. culverts on a small, upper headwater tributary of the RWB that is extensively modified by drainage. Culverts designed to facilitate fish passage with reinstatement of realigned channel. Removal of existing fish barrier at upstream end of an existing culvert. Hydromorphological quality therefore improved. Drainage to the channel is via attenuation ponds with pre-treatment (hydrocarbon interceptors, vortex grit separator). Ponds designed to accommodate 1% AEP flood event (+20% climate change allowance).</td></tr>
<tr><td colspan="7">Effect of modification (proposed scheme): Overall ecological status is maintained at 'good'. There are no changes to overall RWB status and a net improvement in hydromorphological elements supporting the biological quality elements. Physicochemical elements and Q-value are not affected by the scheme and will continue to be driven primarily by catchment pressures upstream of the proposed scheme.</td></tr>
<tr><th rowspan="2">Quality elements</th><th>EPA Biological quality elements (BQEs)</th><th colspan="3">Hydromorphological quality elements supporting the BQEs</th><th rowspan="2">General physicochem. elements supporting the BQEs</th><th rowspan="2">Overall ecological status</th></tr>
<tr><td>Macroinverts (Q-value)</td><td>Hydrology</td><td>Morphology</td><td>Continuity</td></tr>
<tr><td>Starting point</td><td>2 (Q4)</td><td>≤2*</td><td>≤2*</td><td>≤2*</td><td>2</td><td>2</td></tr>
<tr><td>Effect of modification</td><td>2 (Q4)</td><td>≤2*↑</td><td>≤2*</td><td>≤2*↑</td><td>2</td><td>2</td></tr>
<tr><td colspan="7">Ecological Status Classes - 1: High; 2: Good; 3: Moderate; 4: Poor; 5: Bad</td></tr>
<tr><td colspan="7">* "supporting conditions" are by definition equal to, or poorer than, highest BQE value</td></tr>
</table>

Boyne_160

The EPA monitor two biological quality elements in this water body: macroinvertebrate Q-value and phytobenthos (diatoms). General physicochemical conditions are also monitored, resulting in OOAO status of 'moderate' for the current WFD reporting period (2016-2021). **Table 17-14** shows that the Proposed Scheme:

1. Does not cause deterioration of water body status; and
2. Does not jeopardise attainment of good status.

Phytobenthos (diatom/ microalgae) and surface water chemical status limits overall water body status to 'moderate'. Physicochemical conditions are clearly not meeting 'good' status criteria, as evidenced by site-specific water sampling conducted for this impact assessment (refer to **Appendix 17.1**). Impaired water quality is primarily driven by catchment pressures upstream of Slane, leading to failure to achieve good status currently. There are no physical (hydromorphological) changes to the water body or emissions to surface water in this RWB, either temporary or long term, associated with the Proposed Scheme that could preclude achievement of water quality conditions conducive to achievement of good ecological status.

Table 17-14: Boyne_160 – Water Body Status Considerations

Starting point: EPA assigned status is 'moderate', on the basis of monitoring of biological elements & physicochemical quality element in worst condition (in this case 'moderate').

Modification proposed: No instream modifications at any point in this RWB. A small proportion of surface drainage at the southern end of the proposed scheme naturally flows to an upper drain of the Thurstianstown Stream and this will continue. The majority of the proposed new road surface drainage from this area will be directed northwards via Attenuation Ponds 1 and 2 towards the Boyne_170. The Thurstianstown portion flows to the Boyne_160 main channel segment. The border of RWB occurs at Slane Bridge where a reduction in average daily traffic flow will result from the proposal, hence a reduction of potential road runoff pollutants.

Effect of modification (proposed scheme): Overall ecological status is maintained at, at least, 'moderate'. There are no changes to overall RWB status and no deterioration in hydromorphological elements supporting the biological quality elements. Physicochemical elements and biological elements (Q-value, phytobenthos) are not affected by the scheme and will continue to be driven primarily by catchment pressures upstream of the proposed scheme.

Quality elements	Biological quality elements (BQEs)		Hydromorphological quality elements supporting the BQEs			General physicochem. elements supporting the BQEs	Overall ecological status
	Macroinverts (Q-value)	Phytobenthos	Hydrology	Morphology	Continuity		
Starting point	2 (Q4)	3	≤3*	≤3*	≤3*	≤2	3
Effect owing to modification	2 (Q4)	3	≤3*	≤3*	≤3*	≤2	3

Ecological Status Classes - 1: High; 2: Good; 3: Moderate; 4: Poor; 5: Bad

** "supporting conditions" are by definition equal to, or poorer than, highest BQE value*

17.4.4 Cumulative Impact

A cumulative impact assessment (CIA) has been undertaken to consider potential for cumulative impact of the Proposed Scheme with other approved development. The detailed methodology for the CIA is described in **Chapter 25 – Cumulative Effects**. The assessment has considered cumulative sources and impact pathways which could impact on water.

The projects listed in **Appendix 25.2** have been assessed. Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved. No approved projects were screened-in for having a potential cumulative impact on fluvial geomorphology or drinking water resources.

Projects were screened-in for Water if there is potential for significant cumulative effects on flood risk, drinking water resources or fluvial geomorphology, outlined in **Table 17-15**. Screening for cumulative effects on water quality due to emissions to watercourses has been carried out for **Biodiversity: Aquatic Ecology**, as described in Chapter 16, **Section 16.4.3** (Cumulative Impact).

Table 17-15: Projects Screened-in for Potential Cumulative Effects on Water

Project Code	Project Location	Project Type	Potential for Cumulative Effect
PR 2	Millhouse, Slane, Co. Meath	Restaurant	Possible – Pathway via floodplain

The application for PR 2 seeks permission for a single-storey extension to the existing structure measuring approximately 79 m^2 in floor area. The new structure will be within the modelled 1% AEP floodplain and could therefore cause reduced flood conveyance and storage capacity.

A site-specific flood risk assessment was submitted in response to a request for further information by the planning authority. This found that the proposal would not adversely impact the hydrological regime of the area or to increase flood risk elsewhere and was considered appropriate from a flood risk perspective. The flood levels reported in the Flood Risk Assessment (FRA) carried out by RPS (refer to **Appendix 17.2**) lead to the conclusion that the proposed extension would be outside the post-development 0.1% annual exceedance probability (AEP) floodplain, and therefore would not cause a cumulative impact on flood risk.

However, with the proposed mitigation outlined for the Proposed Scheme, no significant cumulative impacts are anticipated during the construction or operational phases.

17.5 Mitigation Measures

17.5.1 Construction Phase

As outlined in **Chapter 5**, a wide range of sediment and erosion controls will be put in place such as the use of attenuation, check dams and silt barriers. Stockpile locations have been chosen to minimise potential impacts of run-off on the water environment. The sequencing of the works, described in **Section 5.12**, has been developed with the sensitivity of the receiving environment in mind.

Works within the River Boyne floodplain are necessary to construct the bridge crossing. Access tracks from the upper bank will be constructed down to temporary working platforms (TWPs) in the floodplain. The following measures will be implemented to minimise potential impacts on the river and canal:

- Construction of attenuation ponds prior to construction of bridge crossing;
- Construction of interceptor ditches to capture run-off;
- Works confined to TWPs to avoid working directly on the floodplain surface;
- Silt and hydrocarbon barrier fences installed at the edges of the TWPs;
- Platforms constructed on reno mattress to facilitate the passage of water in the event of flooding;
- Cofferdams to be constructed around foundation excavations to prevent water and sediment from entering or escaping; and
- Staged removal of TWPs in sections to reduce erosion potential.

The sequencing and methodology of the earthworks elements, described in **Section 5.13**, has also been developed to minimise potential impacts on watercourses. This includes:

- Construction and vegetation of pre-earthworks ditches in the first phase of works to allow for effective interception of surface water run-off;
- Construction of the permanent attenuation ponds in the first phase of works so that they will be used during the remaining construction period to control and improve the quality of run-off entering watercourses;
- Extent of exposed earthworks at any one time will be minimised by covering and seeding completed sections;
- Earthworks plugs will be maintained at low point of cut areas until slopes have been vegetated, initial road construction layers have been placed and all road drainage pipes and chambers, and groundwater filter drains and chambers have been installed;
- Vehicle wheel washing will occur in controlled zones prior to leaving the site;
- Early vegetation establishment on stockpiles to prevent erosion of topsoil;
- Protection of stockpile locations with ditches and silt fences to prevent run-off towards the stockpile and the run-off of sediment from the stockpile; and
- Weather monitoring to avoid exposing earthworks slopes and the temporary protection of earthworks slopes prior to forecasted large rainfall events.

Further information on construction phase mitigation measures in relation to the aquatic environment will be found in **Chapter 5**, **Section 5.2 Pre-Main Construction Works (Enabling Works)**, **Section 5.4 Construction Works**, **Section 5.11 Environmental Emergency Procedures/Contingency**, and **Section 5.12 Detailed Construction Methodology and Sequencing** and **Chapter 16**, **Section 16.5.1 Construction Phase**.

17.5.2 Operational Phase

In the event that an accidental release of potential pollutants occurs during the operational phase, an emergency response plan will be followed to minimise potential contamination of watercourses/groundwater; refer to **Section 4.4.11.12 Environmental Emergency Procedures**. This shall include at a minimum a set of criteria for identifying emergencies, lines of communication, training, procedures to be followed for spill containment and remediation including information on location of spill kits.

If, during maintenance activity, scouring is observed around the bridge piers in the River Boyne floodplain, a scour assessment will be undertaken and scour protection measures will be put in place to alleviate further scouring.

The energy dissipators installed at the Mattock (Mooretown) Stream culverts will be maintained to reduce the likelihood of morphological changes.

Further information on operational phase mitigation measures in relation to the aquatic environment will be found in **Section 16.5.2 Operational Phase**.

17.6 Residual Impacts

The drainage outfalls are predicted to have a negligible residual impact on water quality and quantity in the watercourses within the Study Area. This is based on the design adopted, and the physicochemical data assessed from the EPA monitoring data and EIAR sampling data.

Compared to the existing scenario, the will likely bypass to have a beneficial effect on the water environment as its drainage systems are designed to a higher standard than the existing road drainage. Potential pollution due to routine run-off on the existing N2 will therefore be reduced as traffic migrates to the new bypass.

Residual impacts on ecological receptors are discussed in **Chapters 15** and **16**. Residual impacts on groundwater and the Slane PWS drinking water supply are addressed in **Chapter 18**.

There is no significant increase in flood risk predicted during the operational phase of the development, therefore the residual impact is negligible.

Impacts on the existing hydrological environment will be minimised by the adherence to SuDS principles and appropriately sized culverts and interceptor drains specified in the drainage design.

Hydromorphological pressures on watercourses during the operational phase have been assessed and are considered negligible in the River Boyne and the Boyne Navigation Canal. In the Mattock (Mooretown) Stream, the culverts have been designed according to OPW guidance to minimise hydraulic impacts and measures such as energy dissipation will be adopted to ensure natural recovery of the realigned stream to minimise hydromorphological impacts, therefore the residual impact is considered negligible (refer also to **Chapter 16**, **Section 16.5.2** for further detail on the measures referenced).

17.7 Monitoring

17.7.1 Construction Phase

Refer to **Chapter 16**, **Section 16.7.1** for details of monitoring during the construction phase.

17.7.2 Operational Phase

It is expected that the OPW will continue to monitor flows in the River Boyne at the Slane Castle gauging station upstream of the ZoI. Any unforeseen changes in extreme flow volumes or increased frequency can be risk assessed in the context of the scheme design. It is expected that the EPA will continue to sample at the existing Slane Bridge. EPA monitoring downstream at the WWTP discharges is also expected to continue. This will continue to provide a robust water quality baseline for the River Boyne upstream of the proposed bridge crossing.

Water quality monitoring will be undertaken monthly by the appointed operator in the River Boyne and Mattock until at least 24 months post-completion. Additional sampling points if required can be determined by the appointed operator The results of the water quality monitoring programme will be reviewed by MCC on an ongoing basis. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken were the this is deemed to be associated with the Proposed Scheme.

The realigned reach of the Mattock (Mooretown) Stream shall be monitored annually by the operator to ensure the energy dissipators are still in place. If they have been washed away, they shall be replaced. The culverts must be maintained free of blockages.

The drainage systems serving the Proposed Scheme will be monitored to ensure that same continue to function as designed to ensure adequate treatment of run-off before discharge to watercourses. Maintenance of each component is set out in TII standards and manufacturer recommendations. Maintenance requirements related to these systems are discussed in detail in **Chapter 4**, **Section 4.5**.

17.8 Chapter References

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