Appendix B

Hydrology Assessment Report

B.1 Hydrology Assessment Report

Galway County Council

N6 Galway City Ring Road

Updated NIS – Appendix B
Updated Hydrological Assessment

GCOB-4.04_30.10 (Updated NIS Hydrology Assess)_App B

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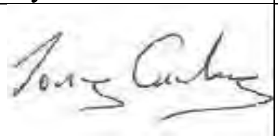
		Signature			
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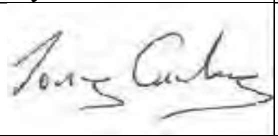
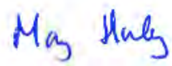
		Signature			
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Contents

1 Introduction

This is an update to NIS Appendix B Hydrology submitted to An Bord Pleanála in October 2018 as part of the application for approval of the proposed N6 GCRR pursuant to Section 51 of the Roads Act 1993 (as amended). It forms part of the response to the request by ABP for further information in December 2023 where they requested GCC to "*Update the appropriate assessment screening document and the Natura Impact Statement including updated site conversation objectives*". Where there have been any changes to the assessment and or any updates since the 2018 NIS, these have been set out in this updated Appendix.

This updated report assesses the potential hydrological construction and operational impacts of the Project, which comprises the proposed N6 Galway City Ring Road (N6 GCRR) and the proposed development at Galway Racecourse to provide replacement stables, on the receiving waters of the Lough Corrib Special Area of Conservation (SAC) (000297), Lough Corrib Special Protection Area (SPA) (004042), Galway Bay Complex SAC (000268) and Inner Galway Bay SPA (004031). The need for these replacement stables, both temporary and permanent stables, arises from the demolition of the existing stables as part of the proposed N6 GCRR. An assessment of the hydrological impact on Ballindooley Lough was also carried out as the Lough is supporting habitat for birds within the Lough Corrib SPA and the Inner Galway Bay SPA.

There are no hydrological impacts predicted upstream of the Project, on the upstream sections of Lough Corrib SAC and the Lough Corrib SPA. The River Corrib and its tributaries flow downstream to the River Corrib Estuary and therefore there is no potential hydraulic pathway for upstream impact from pollutants.

2 Methodology

2.1 Regulations, Legislation and Guidelines

This chapter is prepared having regard to the requirements of Section 50 Subsection (2 and 3) of the Roads Act 1993 as amended, and with the following guidance:

- Environmental Protection Agency (EPA). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022)
- Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (European Commission 2017)
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA 2008b)

- National Road Authority (NRA) Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (referred to as TII Guidelines in this chapter) (NRA, 2008a)
- Surface Water and Drainage Guidance in the Transport Infrastructure Ireland, TII Publications Road Design Standards. DN-DNG-03063 June 2015 and DN-DNG-03065, June 2015
- 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
- Inland Fisheries Ireland (IFI) (2016) Guidelines on protection of fisheries during construction works in and adjacent to waters

Water resource management in Ireland is dealt with in the following key pieces of legislation:

- 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
- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration
- European Union (Drinking Water) Regulations 2023 (S.I. No. 99/2023)
- European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366/2016)
- European Communities Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77/2019)
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293/1988)
- European Union (Water Policy) (Abstractions Registration) Regulations 2018 (SI no. 261/2018)
- European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122/2010) (as amended)
- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks ("the EU Floods Directive")
- Water Services Acts 2007 to 2017 2022
- 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 ("the Water Framework Directive (WFD)")

The methodology principally follows the guidance outlined in Section 5.6 of the NRA Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes pertaining to the treatment of Hydrology which is the same methodology used in the 2018 EIAR. The impact category, duration and nature of impact have been considered in this assessment. The range criteria for assessing the importance of hydrological features within the study area and the criteria for quantifying the magnitude of impacts are assessed in accordance with the guidelines.

2.2 Desk Study

The desk study 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. These features have been investigated on the ground by walkover surveys to assess the significance of any likely environmental impacts on them.

The following list of data sources were reviewed as part of this assessment:

- 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 2016-2021
    - EPA Hydrometric Data System 2017
- 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 website (June 2024)
    - OPW Floodmaps.ie website (June 2024)
    - OPW FSU (Flood Studies Update) Web Portal Site for Flood Flow Estimation
    - OPW Preliminary Flood Risk Assessment Mapping (pFRA) for Galway 2012
    - OPW Western CFRAM Unit of Management 30 – Corrib Final Hydrology Report Feb 2014
    - OPW Western CFRAM Unit of Management 30 and 31 – Corrib and Owengowla final Hydraulics Modelling Report Sept 2015
    - OPW Western CFRAM Unit of Management (30) Final Preliminary Options Report: Vol. 1 Overarching Report July 2017
    - OPW CFRAM Flood Risk Mapping - Final Dec 2017
    - OPW Flood Risk Management Plan for Corrib River Basin (UOM 30) Feb 2018

  - OPW National Indictive Flood Risk Mapping 2021
  - OPW CFRAM channel Surveys *https://www.floodinfo.ie/cross-section-survey-data/. (June 2024)*
- Galway County/City Council
  - Galway County Development Plan (2022 – 2028)
  - Galway City Development Plan (2023 – 2029)
  - Galway Transport Strategy (2016)
  - Planning Register
  - Water Services Section – abstractions, Discharges and Supply Schemes
- National Parks and Wildlife Service (NPWS)
  - Designated Areas Mapping
  - Site Synopsis Reports
  - Conservation Objectives Documents
- Other sources
  - Western River Basin Management Plan (2018 – 2021)
  - Aerial survey photography and Lidar
  - Geological Survey of Ireland (GSI) Web Mapping
  - Specially commissioned bathymetric surveys
  - Topographical survey

Consultation took place with all relevant regulatory bodies including various departments of Galway County Council, Galway City Council, the OPW, GSI, National Parks and Wildlife Service (NPWS) and IFI over the past 10 years on this Project.

Available topographical and hydrometric information (field and desk based) in combination with numerical techniques and mathematical modelling has been used to assist in performing the necessary hydrological impact assessments of watercourses and water bodies within or potentially discharging to European sites in Galway Bay and to Lough Corrib SAC and Lough Corrib Special Protection Area (SPA) and also of Ballindooley Lough that provides supporting habitat for birds within the Lough Corrib and Inner Galway Bay SPAs.

Other neighbouring European sites such as Connemara Bog Complex SAC; East Burren Complex SAC; and Lough Fingall Complex SAC are not hydrologically linked to the study area of the Project. Other European sites such as, Kiltiernan Bay and Island SAC, Black-Head-Pouallagh Complex SAC, Inishmore Island SAC, Inishmaan Island SAC and Inisheer Island SAC which share the West of Ireland coastal waters are considered sufficiently remote that even a worst-case pollution event would have no perceptible impact given the travel time involved and the extensive dilution available within Galway Bay.

2.3 Field Surveys

Field surveys and walkover assessments were carried out to assess the hydrological impacts of the Project. Detailed stream surveys (including topographical surveys where required) were undertaken at areas where hydrological impacts were likely to occur without appropriate mitigation. Specifically, all culvert and bridge crossing locations, proposed road drainage 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/January 2016 winter flood event.

Field surveys and walkover assessments were carried out to assess the hydrological impacts of the Project. In the interim since 2018, site visits were undertaken in April and June 2024 and no significant changes were noted in the baseline from a hydrological perspective.

Surface water quality monitoring was carried out on all main watercourses and potential outfall receptors. Flow estimation in selected outfall streams were also conducted as were targeted bathymetric surveys of Coolagh Lakes, Ballindooley Lough and the River Corrib.

3 Existing Hydrological Environment

3.1 General

The proposed N6 GCRR, commences west of Bearna in An Baile Nua, passes to the north of Galway City and connects with the existing N6 at Coolagh on the east side of the city and lies within hydrometric areas 29, 30 and 31. The only physical discharge to the Lough Corrib SPA is via a proposed road drainage outfall for the proposed N59 Link Road which discharges to a small drainage ditch that eventually discharges to the Lough Corrib SAC and Lough Corrib SPA, post treatment and attenuation.

The proposed N6 GCRR crosses the River Corrib approximately 160m southwest of Menlo Castle and to the north of Coolagh Lakes on the eastern bank and through University of Galway (UoG) Sporting Campus on the western bank. Both the River Corrib and Coolagh Lakes are part of the Lough Corrib SAC.

The proposed N6 GCRR does not encroach into the Galway Bay Complex SAC or Inner Galway Bay SPA as it is located typically 1 to 2km upstream of Galway Bay, and completely outside of the coastal and transitional waters of the Galway Bay.

3.2 Surface Drainage Features

There are five principal surface water drainage catchments and their sub-catchments intercepted/potentially impacted by the Project which are labelled from west to east as follows (refer to Figures 2.1 to 2.15 of this updated NIS):

- Sruthán Na Libeirtí Stream
- Trusky Stream
- Bearna Stream
- Knocknacarra Stream
- Corrib Catchment

1. River Corrib
2. Coolagh Lakes
3. Terryland River
4. Ballindooley Lough System

There are six downstream sub-catchments that also discharge to the Galway Bay Complex SAC and Inner Galway Bay SPA, namely Lough Atalia, Doughiska, Curragreen, Galway City Coastal, Roscam and Glenascaul drainage areas – unchanged since the 2018 EIAR. These small drainage catchments are located on the eastern side of the River Corrib within the karst limestone bedrock formation and do not have surface drainage features. Effective rainfall from these catchments drains to groundwater or is intercepted by the existing urban storm drainage systems. Within these catchments the proposed road drainage is primarily discharging to groundwater and in a number of minor outfalls to the existing urban drainage system. The impact on groundwater and the potential groundwater pathway to the Galway Bay Complex SAC and Inner Galway Bay SPA is dealt with in the Appendix A (Hydrogeology) of the NIS.

The Sruthán Na Libeirtí Stream and the Trusky Stream discharge to Galway Bay coastal waters outside (to the west) of the Galway Bay Complex SAC and Inner Galway Bay SPA, whereas the Bearna Stream, Knocknacarra Stream and River Corrib outfall directly to the Galway Bay Complex SAC and Inner Galway Bay SPA. Coolagh Lakes outfall to the River Corrib, both of which are within the Lough Corrib SAC. Coolagh Lakes are located within the dinantian pure bedded limestone bedrock formation which is highly karstified and may potentially have subterranean groundwater connection with the Galway Bay Complex SAC and Inner Galway Bay SPA. The Terryland River and Ballindooley Lough both drain to groundwater within the karstified limestone bedrock region and consequently may have a groundwater connection with the Galway Bay Complex SAC and Inner Galway Bay SPA, particularly Terryland River which displays a strong tidal signal in its water level, particularly at spring tide periods. Appendix A (Hydrogeology) of the NIS details potential groundwater pathways between the Project and European sites.

The study area for the Project falls within the Western River Basin District (WRBD). The WRBD has classified the transitional coastal waters as moderate status, the coastal waters as good for Inner Galway Bay North and high for Inner Galway Bay South and Outer Galway Bay and classified Lough Corrib as good lake quality. The watercourses and lakes within the study area are assigned as follows Coolagh Lakes (Good), Ballindooley Lough and many of the smaller water courses in the west do not have an assigned status. The Terryland River (Poor), the River Corrib (Good) and the lower reach of Bearna Stream, Trusky and Knocknacarra are assigned moderate. The groundwater quality classification for the entire study area and wider region is good.

3.3 Sruthán na Libeirtí Stream

This is a small stream which rises in a peatland area 2km north of the R336 Coast Road and flows southwards to the coast outfalling to Galway Bay 2km west of Bearna Village at Cora na Libeirtí in An Baile Nua. This stream is unmaintained, narrow (typically 0.5m wide) and shallow < 0.5m. The Sruthán na Libeirtí Stream has a catchment area of 1.5 km^2 and high percentage runoff due to its generally impermeable overburden cover and shallow bedrock.

3.4 Trusky Stream

The Trusky Stream which flows through Bearna is a relatively small stream having a catchment area of 3.3km^2 and outfalls to the Galway Bay at Bearna Harbour. This stream has two main branches one to the east of the harbour road and one to the west. The stream channel has been culverted and modified through Bearna Village and crosses under the R336 Coast Road in two culverts, an original arch culvert near the Twelve Pins Hotel and a concrete piped culvert approximately 170m to the east. This stream represents a flood risk to Bearna Village and the R336 Coast Road at these culvert crossings. This stream rises in peatland to the south of Lough Inch and flows typically southwards 2.5km to the harbour. The channel is not maintained, vegetated and varies in width (0.5 to 1m channel widths) in its middle and upper reaches. The channel through the lower reach has been significantly modified with sections of culverting and new channels to facilitate urban development. Unlike the Sruthán na Libeirtí Stream, the percentage runoff is moderate to low.

3.5 Bearna Stream

The Bearna Stream is the largest of the small watercourses encountered by the Project entering Galway Bay Complex SAC and Inner Galway Bay SPA near Rusheen Bay. Its catchment measures 9.1km^2 at its sea outfall and its main tributaries are the An Sruthán Dubh and the Tonabrocky Streams. This water system rises in the townlands of Pollnaclogha, Drum and Tonabrocky 4km to the north. It is an unmaintained watercourse which in sections is very overgrown particularly in its middle and upper reaches. Flooding is not a significant issue for this stream. The percentage runoff based on overburden and land slope is moderate to low in magnitude.

This stream is within the Galway Bay Complex SAC in its lower downstream fluvial reach at Cappagh Park immediately downstream of the Tonabrocky Stream confluence and within the Galway Bay Complex SAC in its estuarine reach south of the R336 Coast Road. There is a section between Cappagh Park and the R336 Coast Road that is not designated as part of the Galway Bay Complex SAC.

3.6 Knocknacarra Stream

The Knocknacarra stream is a small and highly urbanised stream that discharges to Galway Bay Complex SAC and Inner Galway Bay SPA near Blakes Hill in Salthill. The total catchment area of this stream is 4.4km^2. A large portion of its lower reach is culverted almost to its sea outfall. It rises to the north of Rahoon at Letteragh and flows southwards over a distance of 3km to the sea. It would be considered a highly urbanised watercourse with an urban fraction of almost 50%.

3.7 Corrib Catchment

3.7.1 River Corrib

The River Corrib is essentially a short outflow channel from Lough Corrib to Galway Bay at the Claddagh, Galway. The Corrib Drainage and Navigation Works Scheme (1848-1858) excavated a new wide outlet channel from Lough Corrib known as the Friar's Cut which provides a more direct and deeper channel to service the lake than the meandering old channel (almost 1.5km shorter). Significant excavation of the River Corrib channel has taken place both during the original Corrib Drainage and Navigation Works Scheme and during the OPW Corrib-Clare Arterial Drainage Scheme (in the early 1960's).

The area of the River Corrib catchment is approximately 3,136km^2 to Wolfe Tone Bridge, which is quite large by Irish Standards and is the biggest river system in the Western River Basin District. This includes a total lake surface area of approximately 314km^2 mainly due to Lough Corrib and Lough Mask but also includes Lough Carra, Finny Lakes and the Maam Lakes which attenuate winter flood flows and sustain summer low flows.

The River Corrib channel is a navigation channel and is reasonably wide varying typically from 80 to 130m between the river banks and typically 3 to 4m deep. It is an impounded channel with levels maintained generally close to 6m OD throughout the year by the gated weir at the Salmon Weir.

Table 1 below presents the river water levels and exceedance percentiles derived at the River Corrib Dangan hydrometric recorder. For example, 99-percentile water level represents the water level which is exceeded 99 percent of the time. Very slight changes to the water level duration curve at Dangan can be observed from those published in the 2018 EIAR. These changes are due to the additional years of recorded Corrib levels subject to meteorological conditions.

Table 1: Exceedance Percentile at Dangan Gauge (2003 to 2024)

Levels Equalled or Exceeded for the Given Percentage of Time (mAOD Malin Head OSGM15) (Data derived for the period 2003 to 2024)								
1%	5%	10%	25%	50%	75%	90%	95%	99%
6.592	6.318	6.161	6.011	5.942	5.871	5.806	5.768	5.713

Much of the channel has been excavated with bed levels at the proposed crossing point at 2.75m OD providing a flow area at summer 99-percentile low flow of 300m^2 and a channel velocity of 0.04m/s.

The flow estimation by the OPW for the River Corrib is from the Wolfe Tone Bridge gauge, as this is considered to be a strategic location as it captures the total flow from the River Corrib system including the canals before it enters the bay. This site is tidally backwatered and the flow rating is considered as only fair, requiring extraction of the tidal signal from the data.

In the 2018 EIAR a previous OPW Flow rating relationship was available for flow only up to 2002 and no reliable rating was available post 2002 at Wolfe Tone Bridge Gauge. Since the 2018 EIAR, the OPW have carried out an extensive rating review of this gauge and have made available flow estimates for the period 2009 to 2024 which are considered to be more reliable.

The OPW updated flow duration curve for Wolfe Tone Bridge gauge (2009 to 2024), refer to **Table 2** gives a mean annual flow rate of 107.4cumec, a median flow rate of 90.5cumec, a 95% low flow of 23.7cumec and 98% (dry weather flow) of 16.6cumec. This flow duration curve is used in the updated assessment. This represents an increase of 10% in the median flow over the 2018 EIAR and NIS and has higher flow rates for the Corrib low flow periods. The ramifications for this is, there are higher dilutions for mixing and assimilative capacity over the flows used in the 2018 EIAR and NIS.

Table 2: OPW Flow Duration Relationship for the River Corrib at Wolfe Tone Bridge (30061) (based on reliable record 2009 to 2024)

Flows equalled or exceeded for the given percentage of time (m3/s) (Data derived for the period 2009 to 2024)								
1%	5%	10%	25%	50%	75%	90%	95%	99%
327.5	251.6	210	157	90.5	44.1	28.6	23.7	13.6

As part of this updated EIAR and flood risk assessment for the Project a reasonably consistent flood rating relationship was derived for the Dangan Gauge using the OPW flood flow rating measurements and recorded flood levels when all gates on the Salmon Weir Barrage are opened, which generally applies to maximum floods, each year. This Dangan rating provided a QMED (2year return period) flow of 260.8cumec (available gauged period hydrometric years 1986 to 2022).

The OPW CFRAM (2015) study produced a QMED estimate of 248cumec and the FSU estimate is 244cumec (both based on the Wolfe Tone Bridge gauge data for the record period pre 2002).

The statistical analysis of annual maximum flood flow series for the Dangan gauge of 260.8cumec from 36 years of annual maximum flows is considered more reliable than the FSU and CFRAM estimates as it includes the more recent and wetter period post 2002. In the 2018 EIAR assessment the QMED for Dangan was estimated at 264.4cumec, which is reasonably similar, being only 1.4% higher.

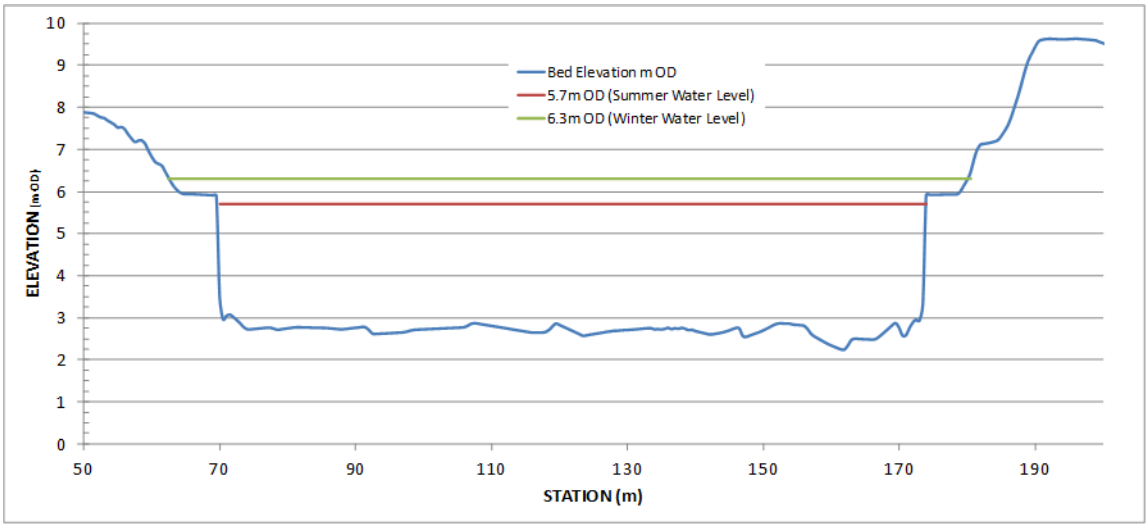
The typical winter-summer water level range in the River Corrib at Dangan is 0.6m (typically 5.7m to 6.3m OD). The River Corrib channel at Dangan is approximately 110m wide and the channel bed invert near the crossing is typically 2.6 to 2.8m OD giving an average flow depth of 3m and a total flow area of 312m^2 at 5.7m OD and 403m^2 at 6.3m OD. At a low flow (95-percentile) of 23.66cumec the average channel flow velocity is small at 0.07m/s and at low 99-percentile flow of 13.6cumec the velocity is 0.04m/s and in typical winter flow (1-percentile) the average velocity is 0.54m/s. These velocities are relatively small in low flow conditions and are not significantly different than the estimated velocities described in the 2018 EIAR.

In **Table 3** below the estimated Corrib floods flows at different Return Periods are presented. These are based on a pooled EV1 growth curve for the River Corrib using hydrologically similar gauges to provide a minimum of 500 Station years of Annual Maxima Flows. This is a much milder growth curve than the one used in the 2018 EIAR and is considered more accurate for such a damped controlled lake catchment. Note in the 2018 EIAR the 100year design Estimate was 519.5cumec (7.4% higher) and the 1000year was 647.9cumec (8.5% higher).

Table 3 Return Period Estimates for the River Corrib at the proposed River Corrib Bridge Crossing

Return Period T years	Flood growth curve XT	QT cumec	Standard Error S.E cumec	Design QT+ S.E. cumec
2	1.0	261.0	9.4	270.4
5	1.189	310.3	16.8	327.1
10	1.313	342.7	21.6	364.3
20	1.433	374.0	26.3	400.4
50	1.588	414.5	32.4	446.9
100	1.704	444.7	36.9	481.7
1000	2.088	545.0	51.9	596.9

Figure 1: Cross-Section of River Corrib in the vicinity of the river crossing at Dangan



3.7.2 Coolagh Lakes

The Coolagh Lakes are part of the River Corrib system and are located within the Lough Corrib SAC. The lake level within Coolagh Lakes is significantly influenced by the River Corrib water levels and the control imposed by the OPW at the Galway City Salmon Weirs Barrage (regulation 5.82 to 6.43m O.D. which is achieved approximately 85% of the time). This is not always achievable particularly during extreme flood events with lake levels exceeding the regulation levels. The periodic closure and opening of gates by the OPW creates inflow and outflow to the lakes in particular to the outer lake which provides additional flushing to the natural local catchment inflows. The water level in the Coolagh Lakes increases until it has positive head to outflow to the River Corrib channel upstream of Jordan's Island via its small narrow outflow channel from the lower lake.

A bathymetric survey of the River Corrib and Coolagh Lakes revealed very deep bed levels within the middle of the two lakes with the deepest part of the lakes at c. -10 and -12m OD Malin respectively. This represents a maximum water depth of 16.5 and 18.5m for the inner and outer lakes respectively. Flow velocities within these lakes are very small with mixing principally by thermal differences and surface wind dynamics. These lakes are likely to represent a permanent sink for sediment if it were to enter such a system.

There are only slight and relatively insignificant changes to the water level duration curve and the associated surface area and volume of these lakes over the 2018 EIAR. The estimated winter 1-percentile water level for Coolagh Lakes is 6.48m OD producing an inundation area of 34ha, whereas the 99% exceedance summer low flow level is 5.71m OD with a lake area of 7ha.

The local catchment area draining to these lakes based on the topography is approximately 2.5km^2. Other deeper groundwater connections to karst areas to the northeast and east cannot be ruled out. Spring flow is evident in the Coolagh Lakes at two spring locations to the east and to the north. The mean annual inflow rate to the lakes is estimated to be approximately 30l/s based on water balance calculations.

The low flow (95%-percentile) contribution is potentially as low as 2 to 3l/s. The bathymetric survey data for the lake is used to estimate the lake storage-stage relationship which for a summer low water level of 5.7m OD is c.630,000m^3 with a combined lake surface area upper and lower lakes) of c. 6.8ha (i.e. the permanent lake volume). Further storage volume and surface area statistics are presented below in **Table 4** below.

Table 4 Percentile Lake Levels, Surface Areas and Storage Volumes in the Coolagh Lakes System

Percentiles	1%	5%	50%	95%	99%
Lake level	6.48mOD	6.24mOD	5.89mOD	5.75mOD	5.71mOD
Area	33.8ha	30.3ha	11.8ha	7.2ha	7.0ha
Volume	753,100m^3	695,900m^3	648,200m^3	639,850m^3	638,850m^3

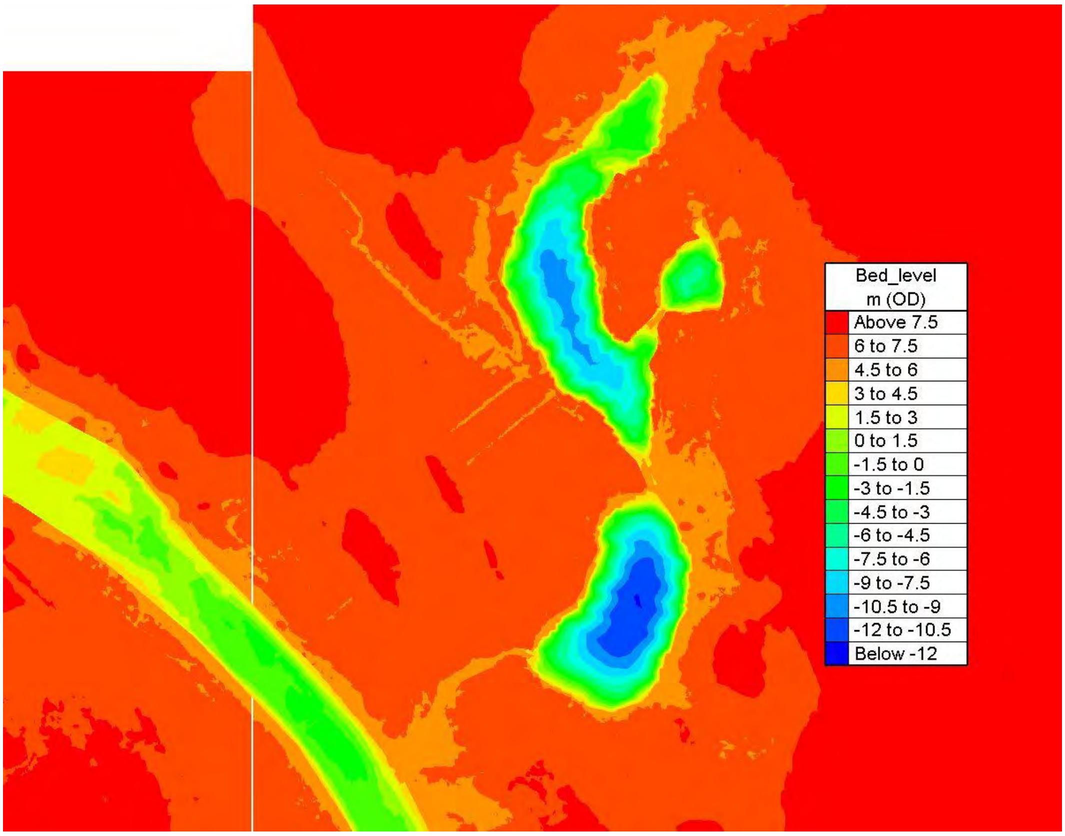
The annual winter-summer difference in storage volume (represented by the difference between the 1 and 99-percentile water levels) is 114,250m^3, therefore the average flushing time and rate of this lake system by the River Corrib summer-winter annual water level variation is estimated to be 5.7years at 3.6l/s. The natural flushing effect of recharge from the local catchment area is significantly higher at 0.7 years (250 days) at a mean annual inflow of 30l/s and the combined effect of the local recharge and the River Corrib is of the order of 34l/s producing an average hydraulic retention period of 223 days. These hydraulic retention times suggest moderate flushing time / exchange rate for a lake system.

The fringes of Coolagh Lakes dry out and only get inundated in winter by the River Corrib water levels. Alkaline fen habitat has been identified surrounding the lakes which are fed by groundwater flow and seepages. The waters within the lakes are quite alkaline with the hardness values recorded in excess of 200 mg/l CaCO3 and the pH at 7.8 to 8.2.

Figure 2 shows the permanent water extent of the Coolagh Lakes and linkage to the River Corrib. A contour map of Coolagh Lakes and adjacent River Corrib channel generated using Lidar and bathymetric survey is presented in **Figure 3**.

Figure 2: Aerial View of Coolagh Lakes and the River Corrib

Figure 3: Bathymetry of Coolagh Lakes and the adjoining River Corrib Channel



3.7.3 Terryland River

The Terryland River, also known as the Sandy River, is a small drainage system that essentially drains the Terryland basin with a total catchment area of 6.75km^2. The river's outlet is to groundwater via two swallow-holes located at Poulavourleen, west of Castlegar Village. Old historic maps of Galway (Grand Jury Map, 1819) show that this river was a spur off the River Corrib channel and the valley floor was almost a lake bed during winter flooding. Arterial drainage works as part of a Public Works Corrib Drainage and Navigation Works Scheme were carried out in the 1850's and as part of these works constructed the Dyke Road embankment to prevent flooding from the River Corrib and allow the reclamation of the Terryland Valley for farm land. Today this embankment and the Salmon Weirs control, protect important commercial, industrial and retail developments that include the Galway Retail Park, Galway Shopping Centre, Terryland Shopping Centre, Terryland Retail Park and Liosbán Industrial Estate.

A water intake from the River Corrib near Jordan's Island provides controlled inflow to feed the Galway City water supply at the Terryland Water Treatment Works, with the excess discharging to the Terryland River. This inflow from the River Corrib to the Terryland River in terms of river flow is relatively small and not significant in respect to flood flow contribution. The watercourse is partially tidal with the tidal signal (0.7 to 0.8m range on spring tides and 0.3 to 0.4m range on neap tides upstream of the swallow-holes) evident and particularly so on spring tides which produces an almost reversal in flow direction coinciding with the flooding and ebbing spring tides (Terryland River Valley Drainage Scheme Report, 1998). These swallow holes are believed to discharge to Galway Bay but the location of the outlet in Galway Bay is of yet unknown. The integrity of these swallow holes is unknown. Ballindooley Lough is considered to be part of the Terryland catchment but the connection is via groundwater flow which has not been proved.

The inflow from the River Corrib to the Terryland River is via a manmade channel referred to as the Galway Bore which is also the abstraction/intake channel to the Terryland Water Treatment Plant. The excess flow from the bore overspills down into the Terryland River Basin. Historical maps (1819) showed the entire Terryland River Valley as inundated and part of the River Corrib system.

As part of the OPW Flood Relief Scheme, which is underway since 2018, (Coirib go Cósta) a water level station was installed on the Terryland River at the road culvert in the Liosbán Industrial Estate (gauge reference 30117). This confirmed a tidal influence on water levels within this basin with a maximum recorded level in the 3year gauged period of 2.965m OD Malin on the 29 October 2023 for a (gauged period 16 July 2021 to 16 Sept 2024). The recorded tidal signal at this gauge site is 0.2 to 0.4m on spring tides and less than 0.1m on neap tides for this gauged period.

Table 5 Water Level Exceedance Percentile at Terryland Gauge (2021 to 2024)

Levels Equalled or Exceeded for the Given Percentage of Time (mAOD Malin Head OSGM15) (Data derived for the period 2021 to 2024)								
1%	5%	10%	25%	50%	75%	90%	95%	99%

Levels Equalled or Exceeded for the Given Percentage of Time (mAOD Malin Head OSGM15) (Data derived for the period 2021 to 2024)								
2.364	2.248	2.182	2.056	1.964	1.858	1.785	1.738	1.709

3.7.4 Ballindooley Lough System

Ballindooley Lough is an enclosed lough located on the N84 Headford Road at Ballindooley, on the outskirts of Galway City. The lough forms at the floor of a large enclosed depression having a surrounding topographical catchment area of 2.25km^2. The December 2015 event, which peaked on the 2 January 2016, produced possibly the highest flood levels in at least 50 years both within this system and within the Corrib System, with the maximum flood level recorded at 10.29m OD. The typical summer lake low water level is approximately 1.5m lower at c.8.8m OD and in more severe drought conditions it is likely that lake levels fall below 8.5m OD. This suggests that the more extreme annual range in lake level is of the order of 2m but for a typical year it is likely to be between 1 and 1.5m.

During the December 2015 flood event maximum winter flood levels both in the River Corrib and Lough Corrib reached 6.93m OD and 7.27m OD respectively and water levels in the Terryland basin near Castlegar were below 4m OD.

A bathymetric survey of the Ballindooley Lough carried out as part of this study showed that the deepest part of the lake has a bed level of -2.5m OD (i.e. 2.5m below mean sea level) whereas the overbank floodplain area is typically at an elevation of 9.3 to 9.5m OD. This bed level suggests a water depth of some 12m at its deepest location.

At the maximum recorded flood level of 10.29m OD the surface area of the lake expands to 29.7ha and at the summer low water level of 8.5m OD it reduces to c. 4.5ha (4.2ha main lake and 0.3ha smaller pond to the southwest, both connected via a 3m wide and 250m long drain). There is over 2.4km of drainage channel draining the floodplain area of this lough, which feed into the permanent lake. This drainage channel is reasonably maintained and typically the cross-section dimensions are 1.5 to 2m deep and 3m top width. The live storage volume between the winter high of 10.3m OD and the summer low level of 8.5 is 271,500m^3. Approximately 500mm of rainfall (recorded at Met Éireann gauge in Athenry) fell in November and December 2015 and resulted in Ballindooley Lough rising by 1.3m from c.9m OD to 10.3m OD. This represents a change in lake storage volume of almost 250,000m^3, which is 22% of the recorded rainfall depth over the 2.25km^2 catchment area.

The recession characteristics of the recorded lake levels indicate that the water level empties slowly (falls) by typically 0.8 to 1cm per day with almost similar recession characteristics at both high and low lake levels. In the summer period this fall is likely to represent evaporation losses from the lake surface. This slow almost constant like fall in levels suggests an emptying process influenced by the slower more continuous regional groundwater flow with the lake rising and falling with the groundwater table as opposed to a concentrated point (conduit flow via a swallow hole) outflows. The hydrological monitoring indicates that the lake is perched above the surrounding groundwater table in summer dry periods and influenced by the groundwater table in the wetter winter period. The Project in terms of the groundwater table and groundwater flow is located down gradient of Ballindooley Lough. This feature is explained further in the Appendix A (Hydrogeology) of the NIS.

3.8 Baseline Water Quality Sampling of Receiving Waters

Bi-monthly sampling of surface water quality, in the vicinity of the Project, was carried out over a 14-month period commencing November 2015 to December 2016. Repeat monitoring of the surface water quality was carried out in spring 2024. This was carried out to establish baseline water quality conditions in the receiving waters. The sampling locations are as follows noting the additional location in 2024 at the new water intake:

1. Sruthán na Libeirtí at the R336 Coast Road culvert upstream
2. Trusky Stream East at the R336 Coast Road culvert upstream
3. Bearna Stream at Cappagh North
4. Bearna Stream at Cappagh South
5. River Corrib at Dangan Slip
6. River Corrib at Terryland Intake Channel, Jordan’s Island
7. River Corrib New Intake near Quincentenary Bridge
8. Upper Coolagh Lake
9. Lower Coolagh Lake
10. Ballindooley Lough

The water quality sampling results are presented in **Annex 1** of this report with the 2024 results included and showed consistently good quality water at all of the sites with nutrient, Biochemical Oxygen Demand (BOD), sediments and heavy metal concentrations well within acceptable limits based on the surface water regulations. Bacterial faecal contamination was identified at all locations, possibly associated with the presence of agricultural activities and point septic tank and slurry pit sources within the respective catchments.

As was expected the western watercourses (Bearna, Trusky and Sruthán na Libeirtí Streams) associated with the granite bedrock and peatland areas showed slightly lower pH, lower alkalinity and hardness, and elevated iron concentrations over the eastern limestone watercourses. The most alkaline and highest hardness waters were found within Ballindooley Lough followed by the Coolagh Lakes.

3.8.1 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 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 6** below).

Table 6: 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 River Corrib is monitored at Wolfe Tone Bridge and is currently categorised as having good status (Q4) for the period (2004 - 2021) and the Terryland River as having moderate status (Q3) based on the most recent 2021 survey. No other watercourses within the study area are currently monitored by the EPA as part of the EPA Monitoring River Programme. There are no changes to the Corrib Status being consistently classified as "Good" and slight improvement from 2-3 to 3 remaining to moderately polluted for the Terryland River over the classification used in the 2018 EIAR and NIS.

One of the major aims of the Water Framework Directive is that all European waters should achieve a good water quality status by 2027 at the latest.

3.9 Ecological Attribute Status of Surface Waters

Given the European designation and salmonid status of the River Corrib (Lough Corrib SAC) it is considered to have an extremely high attribute value and includes the Coolagh Lakes near Menlo Castle.

The remaining watercourses encountered within the study area are all minor watercourses, with all such streams having catchment areas of well less than 10km^2, the streams are listed below:
- Coastal Streams at Baile Nua (<0.75km^2)
- Sruthán Na Libeirtí (1.5km^2)
- Trusky Stream (3.3km^2)
- Bearna Stream (9.14km^2)
- Knocknacarra Stream (4.4km^2)
- Terryland Stream (6.7km^2)

These watercourses generally have a fisheries value of local high or local low value and the overall ecological valuation of local high:

The Galway Bay Complex SAC is the coastal/transitional waters east of White Strand Beach. The Bearna Village coastal area is outside of the Galway Bay Complex SAC and Inner Galway Bay SPA but given the easterly flooding and westerly ebbing tidal flows these water mix with the SAC/SPA waters within a single tidal excursion.

Sections of the Project will eventually drain into the Galway Bay Complex SAC and Inner Galway Bay SPA via surface water streams, existing urban storm drainage systems and groundwater flows. The Sruthán Na Libeirtí Stream and the Trusky Streams do not directly discharge to the Galway Bay Complex SAC and Inner Galway Bay SPA, outfalling to the sea near Bearna. The remaining streams all outfall into the Galway Bay Complex SAC and Inner Galway Bay SPA. The Terryland River which has a water intake from the River Corrib at Jordan's Island drains the Terryland basin and disappears underground via karst swallow-holes near Castlegar. The outflow from the Castlegar swallow holes is unknown but is likely to discharge to the Galway Bay Complex SAC and Inner Galway Bay SPA via submarine springs or even further out to sea west of the SAC/SPA.

The majority of the above streams have either partially or extensively been urbanised. The fishery resource of these streams is presented in Appendix J of the NIS and is also assessed (as appropriate) in the main report of this NIS and is briefly summarised below:

- The Sruthán na Libeirtí is categorised as of local importance (lower value) for European eel and with no Salmonids present. The lower reaches have some moderate quality salmonid and European eel habitat
- The Trusky Stream is categorised to be of local importance (higher value) for salmonids, European eel and as a nursery for flounder in its lower reaches at Bearna. Some spawning habitat for trout exists in the lower reaches but this is limited

- The Bearna Stream is salmonid and is categorised to be of local importance (higher value) for Brown trout. Upper reaches seasonal but moving downstream the habitat becomes an important salmonid river
- An Sruthán Dubh is a tributary of the Bearna Stream and is considered to be an excellent salmonid habitat throughout its upper reaches and is considered an excellent nursery salmonid stream with good numbers of juvenile brown trout and small numbers of European eel. This is classified to be of local importance higher value for brown trout and European eel
- The Knocknacarra Stream is categorised to be of local importance (higher value) for European eel and as a nursery for estuarine fish. Upper reaches are seasonal and of no fishery value but lower fluvial and estuarine reaches are of importance as a transitional habitat to estuarine fish and eel
- The River Corrib is an important salmonid river system and is considered to have an extremely high attribute value due to its European designation as part of the Lough Corrib SAC and Lough Corrib SPA
- The Terryland River continues to be impacted by urban pollution and is considered to be of limited fisheries value and categorised to be of local importance (lower value) for European eel
- The Coolagh Lakes are categorised to be of local importance (lower value) for coarse fish species and European eel and despite its connection to the River Corrib is of limited or no value to salmonids. The Coolagh Lakes are within the Lough Corrib SAC and therefore classified as of high importance
- Ballindooley Lough is considered an excellent coarse fishery, but not of importance as a salmonid fishery and is categorised to be of local importance (higher value) for coarse fish species

It should be noted that in the hydrological impact assessment all watercourses are treated as highly sensitive waterbodies as they provide the hydraulic pathways to the downstream European Sites of the River Corrib SAC and Inner Galway Bay SAC and SPA.

3.10 Climatological Data in the area of the Project

The mean long term annual rainfall (SAAR) for Project varies slightly with a tendency for increased rainfall from east to west and this is unchanged since 2018. The SAAR value for the Bearna area is typically 1275mm, whereas at the River Corrib crossing point, it is 1250mm and in the Ardaun / Doughiska area it is 1140mm.

The annual potential evapotranspiration rate based on the Athenry Meteorological Station is 505mm and for the Mace Head Station it is 562mm. The Athenry Station is considerably more suitably located to the Project than the Mace Station and therefore considered more applicable. Most recent data up to 2024 is presented in the following tables. Combining this with the annual rainfall, the typical effective rainfall rate for recharge and runoff is calculated as 714mm.

Table 7: Monthly Climatological Data Recorded at Mellows College, Athenry Station (2010-2024)

(a) Total Rainfall (mm) for Athenry Station (Mellows College)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2024	92.4	159.1	130.5	100.7	59	58.9	24.5						625.1
2023	113.9	42	185.9	93.4	63.5	93.8	224.1	129.1	148.2	179.9	113.5	202.9	1590.2
2022	56.9	143.1	39	51.6	78.9	79.4	66	79.6	114.2	199.3	156.2	114.3	1178.5
2021	167.3	113.4	102.1	23.9	95.7	29.8	58.5	84.8	91.1	164	78.9	114.7	1124.2
2020	118.7	248.5	108.2	46.8	49.6	67.9	174.3	109.8	90.3	168	148.1	151.6	1481.8
2019	84.1	73.5	161.4	67.7	46.1	69.7	71	297.3	185.3	115	111.4	144.3	1426.8
2018	173.2	78	81.4	82.2	62.5	25.2	69.7	126.1	98.8	73.8	86.3	125	1082.2
2017	47.4	87.5	142.6	13.5	61.4	119.5	136.8	103.1	118.3	123.3	88.9	157.7	1200.0
2016	145.2	129.8	79.4	49.2	56.7	98.5	85.1	96.3	138.0	58.4	59.1	78.5	1074.2
2015	191.1	68.7	129.9	74.8	138.0	44.9	138.2	114.6	93.3	66.6	216.3	299.4	1575.8
2014	182.5	177.7	103.1	47.6	103.1	38.6	92.4	104.9	10.4	140.9	139.0	124.1	1264.3
2013	132.2	46.5	36.9	102.4	97.2	61.4	101.5	72.8	47.9	120.0	100.0	220.3	1139.1
2012	131.1	62.3	30.5	74.8	48.2	175.6	115.3	114.2	101.4	127.7	131.8	153.2	1266.1
2011	110.8	146.5	44.2	66.9	117.6	135.2	55.3	94.7	138.8	149.2	152.9	160.3	1372.4
2010			73.3	76.8	38.4	28.3	155.5	60.9	155	71.9	130.1	32.3	
Mean	**124.8**	**112.6**	**96.6**	**64.8**	**74.4**	**75.1**	**104.5**	**113.4**	**109.4**	**125.6**	**122.3**	**148.5**	**1272.0**

(b) Potential Evapotranspiration (mm) for Athenry (Mellows College)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2024	11.2	16.3	33.2	53.5	73.4	83.4	47.8						
2022	10.6	18.5	32.6	54	83.8	100.4	74.3	65.7	46.7	23.1	10.7	11.9	532.3
2021	11.2	20	42.4	57.1	77.8	78.9	84.9	81.5	45.1	26.2	13.4	6.2	544.7
2020	7.1	21.7	30.2	63.4	76.7	79.3	N/A	66.7	N/A	25.3	11.8	10.8	393
2019	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
2018	11.1	17	30.9	51.5	25.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
2017	11.7	17.6	36.6	49.2	84.8	76.9	76.1	61.1	42.1	23.5	10.4	8.7	498.7
2016	13.1	17.3	34.5	53.4	80.3	84.2	72.2	61.2	39.9	26.5	9.8	3.4	495.8
2015	13.2	14.6	33.8	60.7	65.2	78.9	71.3	63.4	43.6	23.9	17.6	16.0	502.2
2014	10.8	19.3	32.6	58.5	65.7	87.4	81.8	66.5	47.9	26.3	9.9	10.6	517.3
2013	6.5	14.6	28.7	52.9	68.4	82.4	98.6	65.0	44.1	27.0	12.4	14.8	515.4
LTM Mean	**10.7**	**17.7**	**33.6**	**55.4**	**70.2**	**83.5**	**75.9**	**66.4**	**44.2**	**25.2**	**12.0**	**10.3**	**505.0**

4 Potential Hydrological Impacts

4.1 General

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

4.1.1 Quantitative Impacts

Quantitative hydrological impacts represent changes to the natural flow regime in the aquatic system in terms of changes to the water balance, flow depth, velocities, temperature and density leading to changes in the hydrodynamics of the aquatic system. These changes can be brought about by direct encroachment of the waterbody or by altering the recharge to a waterbody generally by the presence of a road and its associated road drainage system within the catchment area.

Hydraulic structures such as bridges, culverts, channel diversions and outfalls can, if not appropriately designed impact negatively on upstream and downstream water levels and on flow velocities. 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. If in-stream culvert structures and associated channel diversions and transitions are too wide or steep this can significantly affect the mean and low flow regime of the stream in terms of velocity and water depth changes resulting in low velocities and low water depths which can alter the local sedimentology and flow regime resulting in benthic impacts and potential fishery impacts.

Hard paved areas and local changes in the topography created by the road formation can alter the groundwater and surface water recharge regime. The footprint of the proposed N6 GCRR and its associated drainage system can capture surface runoff, unsaturated soil interflow and groundwater flows from up gradient and divert them to point surface and groundwater discharge points. Surface water drainage from the carriageway, grassed margins and embankment slopes can lead to localised increased flows and flooding in the receiving streams. The road formation can act as a large stone drain causing diversion of recharge flows and in deep cuttings into the water table a dewatering effect on the groundwater system which impacts both surface and groundwater systems.

Construction activities such as temporary encroachments of watercourses for construction purposes of a bridge, culvert, outfall, temporary access road and temporary diversion can give rise to changes in the local flow regime which may alter velocities and depths and potentially give rise to changes to the hydrological flow regime and changes to channel morphology (channel deposition and erosion).

4.1.2 Qualitative Hydrological Impacts.

Qualitative hydrological impacts represent changes to the chemistry of the receiving water bodies generally arising from road drainage discharges. 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 (Cd), Lead (Pb), Copper (Cu) and Zinc(Zn). 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. 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.

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.

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, in-stream works can potentially represent a severe disruption to aquatic ecology.

The main contaminants arising from construction runoff include:

- Elevated silt/sediment loading in 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 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.

4.2 Road drainage Surface Water Outfalls

There are 16 proposed mainline surface water outfalls discharging directly to surface watercourses, which is unchanged since the 2018 EIAR, located primarily in the western section of the study area (over the western 10.15km of the mainline for the proposed N6 GCRR). The remaining surface water outfalls from the 7.35km, to the east of the River Corrib will be discharged to groundwater or to existing public storm and foul sewer systems in the absence of surface water drainage features. An additional storm outfall associated with the drainage for the proposed Temporary Car park at the Galway Racecourse discharges to the Ballybrit swallow-hole and associated floodplain area in the adjacent to Ballybrit Castle. The realigned N84 Headford Road and slip roads for the N84 Headford Road Junction will discharge to a small ditch that inflows to Ballindooley Lough. The two short sections of tunnel in the eastern section will discharge to the public foul sewer via pumping. A summary of the proposed outfalls are presented in **Table 8** below.

These road drainage outfalls if not appropriately designed have a potential to adversely impact water quality in the receiving watercourse and groundwater from routine contaminants that are contained in road drainage waters.

The water quality and ecological status of the receiving waters are also potentially threatened by contamination arising from large liquid spillages as a result of an accident on the proposed N6 GCRR.

The surface water storm outfalls also have the potential to impact the general flow and morphological regime of a receiving watercourse by increasing the volume and rate of runoff during storm events. The morphology of the stream is significantly influenced by ambient flow and flooding conditions in the stream. The potential increase in flow volume to the stream arises from an increased impervious area from the proposed road pavement area, the provision of road and embankment drainage with a direct pathway via the road drainage system 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 increases the rate of runoff over the natural greenfield condition.

It is anticipated that the proposed N6 GCRR will remove traffic from the existing road network which will provide some benefit as most of these existing roads do not have sustainable urban drainage systems to protect surface and groundwater bodies from drainage water quality impacts.

As per the 2018 EIAR, most of the surface watercourses being discharged to by the proposed road drainage storm water network are only of high local value, but do eventually discharge to the European sites of the Lough Corrib SAC and the Galway Bay Complex SAC and Inner Galway Bay SPA. The N59 Link Road North outfall S15 eventually discharges to Lough Corrib SAC and the downstream section of Lough Corrib SPA via an existing drainage ditch at Dangan. Such watercourses provide a good buffer for attenuation and provide natural wetland treatment before reaching any of the European sites. Outfalls S18A and S18B discharge directly to the River Corrib channel, which is of high sensitivity being a salmonid river, European designated site (Lough Corrib SAC) and major public water supply source (Terryland Galway City water supply intake). All of the receiving watercourses have local higher attribute value further downstream in their lower reaches and all the outfalls to the Bearna, Knocknacarra and River Corrib Systems eventually discharge into the Galway Bay Complex SAC and Inner Galway Bay SPA. Waters in the Sruthán na Libeirtí and the Trusky Stream at Bearna have the potential after mixing with the coastal waters to reach the tidal waters of the Galway Bay Complex SAC and Inner Galway Bay SPA.

Outfalls S18A and S18B are located on the banks of River Corrib bank edge and represent very limited disturbance with the construction works to be carried out from the dry banks. Therefore water quality risks are significantly reduced. Construction works for outfalls S14A, S14B and S15 located at Dangan / Bushypark on its western bank discharge to the River Corrib via drainage ditches over distances of c. 300 to 800m. These ditches provide an excellent natural wetland and settlement buffer to protect the River Corrib from construction runoff. Notwithstanding this buffer, the construction erosion and Sediment, Erosion and Pollution Control Plan, in the CEMP contained in **Appendix C** of this updated NIS will apply to these watercourses designed to minimise the direct construction runoff to watercourses and minimise disturbance of sediment from in-stream and riverbank works.

Table 8: Proposed Project Drainage Outfalls to Watercourses

Drainage Reference	Approx. Ch. of Outfall	Road Section Ch. Start – Ch. End	Total Impervious Road Area (ha)	Receiving Catchment Area (km^2)	Mean Flow (cumec)	95% Low Flow (cumec)	Catchment	Comment and Fisheries Value
S1	0+000	0+000 – 0+700	1.29	1.47	0.03	0.05	Sruthán na Libeirtí	Local Lower at Site and downstream
S2	0+625	0+700 – 1+000	0.38	0.79	0.02	0.002	Sruthán na Libeirtí	Local Lower at Site and downstream
S3	0+900	1+000 – 1+475	1.28	0.32	0.01	0.0006	Sruthán na Libeirtí	Local Lower at Site and downstream
S4A	1+550	1+475 – 1+900	0.62	0.05	0.001	0.0001	Trusky Tributary	Minor drain Local Higher downstream
S4B	1+560	L-580 – 680	0.07	0.05	0.001	0.0001	Trusky Tributary	Minor drain Local Higher downstream
S5A	2+750	1+900 – 2+850	1.53	0.50	0.011	0.0010	Trusky	Small Stream Local Higher downstream
S5B	2+750	L- 000 – 300	0.14	0.07	0.0012	010001	Trusky Ditch	Minor drain Local Higher downstream
S7A	3+000	2+850 – 3+050	0.24	0.06	0.001	0.0001	Bearna Tributary	Minor drain Local Higher downstream
S7B	3+950	3+050 – 3+900	1.07	5.82	0.129	0.0116	Bearna	Small Stream Local Higher downstream
S8	4+000	3+910 – 4+125	0.26	0.85	0.019	0.0017	Bearna Tributary	Minor drain Local Higher downstream

Drainage Reference	Approx. Ch. of Outfall	Road Section Ch. Start – Ch. End	Total Impervious Road Area (ha)	Receiving Catchment Area (km^2)	Mean Flow (cumec)	95% Low Flow (cumec)	Catchment	Comment and Fisheries Value
S9	4+150	4+125 – 4+900	1.19	4.94	0.110	0.0099	Bearna	Bearna Stream Local Higher downstream
S10	4+850	4+900 – 5+640	1.22	1.90	0.042	0.0038	Bearna Tributary. Tonabrocky	Small Hill side stream Local Higher downstream
S12	6+850	6+325 – 7+300	2.45	1.77	0.039	0.0035	Knocknacarra Tributary	Minor drain Local Higher downstream
S13	7+350	7+300 – 7+525	0.63	0.32	0.007	0.0006	Knocknacarra Tributary	Minor drain Local Higher downstream
S14A	8+300	7+525 – 8+250	2.20	0.14	0.003	0.0003	Corrib Tributary	Minor hillside drain Corrib SAC downstream
S14B	8+550	8+250 – 8+525	0.65	0.26	0.006	0.0005	Corrib Tributary	Minor hillside drain Corrib SAC downstream
S15	East of N59 Link	0 – 625 N59 Link	0.73	0.050	0.001	0.0001	Local Ditch to Corrib	Minor drain Lough Corrib SAC
S18A	9+250	8+525 – 9+250	1.58	3136	107.4	23.7	Corrib River West Bank	Extremely Important Lough Corrib SAC
S18B	9+425	9+250 – 10+150	1.95	3136	107.4	23.7	Corrib River East Bank	Extremely Important Lough Corrib SAC
S21A	12+250	11+850 – 12+450	1.36	< 0.05	< 0.001	< 0.0001	Ballindooley Lough Tributary	Minor drain Local Higher downstream

Drainage Reference	Approx. Ch. of Outfall	Road Section Ch. Start – Ch. End	Total Impervious Road Area (ha)	Receiving Catchment Area (km^2)	Mean Flow (cumec)	95% Low Flow (cumec)	Catchment	Comment and Fisheries Value
S36A	3+380	3+350	0.17	0.10	0.0022	0.0002	Bearna Stream Tributary	Minor drain (Tributary of Bearna stream) Local Higher downstream
S36B	3+380	3+350	0.08	0.14	0.0028	0.0003	Trusky Stream Tributary	Minor drain (Tributary of Trusky stream) Local Higher downstream
S31A	7+230	7+250	0.06	0.26	0.006	0.0005	Knocknacarra Tributary	Minor drain (Tributary of Rahoon stream) Local Higher downstream
S31B	7+230	7+250	0.12	0.27	0.006	0.0005	Knocknacarra Tributary	Minor drain (Tributary of Rahoon stream) Local Higher downstream

Note S44 is removed from this table. S48 and S50 at Galway Racecourse are not subject to HAWRAT and are not included in this table.

4.2.1 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 of the proposed N6 GCRR has been carried out in accordance with the TII Publications DN-DNG-03065 (formerly NRA Design Manual for Roads and Bridges HD45/15) – see **Tables 9** and **10**.

The overall combined probability of a serious HGV spillage entering a watercourse from the proposed N6 GCRR is low at 0.089%. This spillage risk analysis was based on the projected AADT traffic values, which indicate that HGV's figures vary between 2 to 6% of the AADT.

The spillage assessment shows the proposed N6 GCRR will have very low magnitude of risk of impact for individual outfalls or grouped catchment outfalls and of such a low probability that specific pollution control measures for road drainage are not required under the TII DMRB spillage risk assessment analysis. However, given the sensitivity of the sites the road drainage design incorporates pollution reduction measures in the form of spillage containment area, oil and petrol interceptor and wetland /attenuation pond upstream of its outfalls and in the case of the storm drainage discharging to groundwater an engineered infiltration basin. This approach ensures in the event of a serious spillage the risk to receiving waters will be negligible.

Table 9: Serious Spillage Pollution Risk Assessment at proposed outfalls to surface watercourses

Drainage Reference (Refer to Figures 2.1 to 2.15)	Road Chainage	Watercourse	Outfall Risk (%)	Combined Risk (%)
S1	0+000 - 0+700	Sruthán na Libeirtí	0.003	
S2	0+700 - 1+000	Sruthán na Libeirtí	0.0001	
S3	1+000 - 1+475	Sruthán na Libeirtí	0.0004	0.0035
S4A	1+475 - 1+900	Trusky Tributary	0.0001	
S4B	Link Road 0+430 - 0+680	Trusky Tributary	0.0000	
S5A	1+900 - 2+850	Trusky Stream	0.0014	
S5B	Link Road	Ditch Trusky Tributary	0.0000	
S7A	2+850 - 3+050	Ditch Trusky Tributary	0.0001	0.0018
S7B	3+050 - 3+910	Bearna	0.0003	
S8	3+910 - 4+125	Bearna	0.0001	
S9	4+125 - 4+900	Bearna	0.0009	
S10	4+900 - 5+650	Bearna Tributary.	0.0015	0.0028

Drainage Reference (Refer to Figures 2.1 to 2.15)	Road Chainage	Watercourse	Outfall Risk (%)	Combined Risk (%)
S12	6+325 - 7+280	Knocknacarra Tributary	0.0016	
S13	7+300 - 7+525	Knocknacarra Tributary	0.0004	0.0020
S14A	7+525 - 8+250	Corrib Tributary	0.004	
S14B	8+250 - 8+525	Corrib Tributary	0.0012	
S15	0 - 625 N59 link	Existing Ditch to Corrib	0.0032	
S18A	8+525 - 9+250	Corrib River West Bank	0.0030	
S18B	9+250 - 10+150	Corrib River East Bank	0.0045	0.016
S21A	Sliproads and N84 interchange	Ballindooley Lough	0.003	
S36A	Aille Road North	Bearna Stream Tributary	0.0000	
S36B	Aille Road South	Trusky Stream Tributary	0.0000	
S31A	Letteragh Road	Knocknacarra Tributary	0.0000	
S31B	Letteragh Road	Knocknacarra Tributary	0.0000	

Note S44 is removed from this table. S48 and S50 at Galway Racecourse are not trafficked and are not included in this table.

Table 10: Serious Spillage Pollution Risk Assessment at Proposed Outfalls to Groundwater Infiltration

Drainage Reference (Refer to Figures 2.1 to 2.15)	Approx. Chainage	Outfall Risk (%)
S19A	10+150 to 10+730	0.0019
S19B	10+730 to 11+150	0.0014
S20	11+420 to 12+020	0.002
S21B	12+020 to 13+630	0.0051
S22A	13+630 to 14+350	0.0093
S22B	14+350 to 14+950	0.0032
S22C2	Parkmore	0.00053
S22E	Parkmore internal road	0.0001
S40	10+450	0.0000

4.2.2 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 contamination. In terms of the potential impact to receiving watercourses research has found the first flush runoff (10 to 15mm rainfall runoff following an extended dry period) can

produce elevated concentrations locally in the receiving waters. The impact of contaminants within routine road runoff depends on the loading (associated with traffic numbers) and the available dilution in the receiving watercourse.
The high density of outfall discharge points along the mainline of the proposed N6 GCRR, disperses and reduces the potential pollutant point load from the proposed road drainage system. The design traffic volume in conjunction with the relatively small contributing road areas will not give rise to any potential significant hydraulic or pollutant loads on the receiving waters. The potential impact of routine runoff in the absence of storm drainage pollutant removal represents a localised impact on water quality of the receiving environment. The overall loading of heavy metals, sediments, hydrocarbons and other waste products on the receiving waters will be significantly reduced through the provision of various drainage design elements such as, petrol and oils interceptors, filter drains, grassed surface water channels, wetlands, infiltration area and storm attenuation ponds upstream of the outfalls designed to capture and treat the first flush rainfall runoff events.

TII publications document DN-DNG-03065 (HD45) 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 Water Framework Directive (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) numbers.

4.2.2.1 HAWRAT Assessment of Road Drainage Outfalls

A HAWRAT assessment has been carried out for all proposed mainline drainage outfalls directly discharging to surface watercourses along the proposed N6 GCRR, including realigned and upgraded link roads and junctions, Table 11 below. The HAWRAT assessment tool uses the AADT category of 10,000 to 50,000 in the assessment process which is appropriate for the Design Year AADT numbers. Further to the west, as ADDT numbers reduce, this category is likely to be precautionary in terms of its water quality predictions as the ADDT numbers are much closer to 10,000 than 50,000. Anticipated traffic volumes on each section of the proposed N6 GCRR are detailed in Chapter 6, Traffic Assessment and Route Cross-Section.

It is also important to note that the HAWRAT assessment presented here is based on direct discharges to watercourses in the absence of proposed drainage design measures, that include petrol interceptors, water quality treatment ponds and wetlands and storm attenuation ponds, and therefore the predictions are worst case not including any treatment performance which have been designed to achieve well in excess of 60% reduction in suspended sediments and associated heavy metal contamination. The HAWRAT analysis was carried out on all of the proposed outfalls in the absence of proposed water quality and attenuation measures and the required level of treatment quantified, refer to **Table 11** below.

In cases where the road drainage outfall discharges to a drainage ditch with very limited drainage catchment, resulting in potentially dry / stagnant conditions during low flows, the local HAWRAT assessment will produce a FAIL result, as there is no dilution available for solutes nor flow velocities to disperse sediment away from the outfall. These failures in the HAWRAT analysis are not considered to represent an impact as such minor ditches are only serving as conduits to the larger stream and river channels. In these cases, the potential impact on watercourses is also assessed further downstream where it joins the larger stream channel, refer to outfall locations on **Figures 2.1** to **2.15**. Note the HAWRAT assessment is carried out in the absence of pollution control measures such as attenuation and water quality improvement pond systems which are designed to achieve in excess of 60% sediment removal performance which significantly reduces local and downstream impacts on water quality.

In general, HAWRAT is considered to provide a very precautionary means to assess those road outfall discharges that will not adversely affect receiving water quality with respect to soluble and sediment-bound pollutants. The screening parameters are sediment and the dissolved heavy metals of zinc and copper concentrations. These represent the primary waste constituents in the road drainage discharges and used as screening parameters for other pollutant substances such as de-icing agents of salt and grit, hydrocarbons, Cadmium, Pyrene, PAHs, nutrients and organics.

Table 11: Results of the HAWRAT Road Outfall Water Quality Assessment of Receiving Surface Waters

Outfall No. (Refer to Figures 2.1 to 2.15)	**Water Hardness (mg/l $CaCO_3$)**	**Dissolved Copper (ug/l)**	**Dissolved Zinc (ug/l)**	**Sediment Deposition Index**	**Comment**
S1	Low < 50	0.31	0.93	174	**Pass** Solubles, **Fail** Sediment (Settlement required 43%)
S2	Low < 50	0.20	0.62	84	**Pass** Solubles, **Pass** Sediment accumulates but not extensive
S3	Low < 50	1.07	3.27	248	**Fail** Solubles, **Fail** Sediment (Required Treatment Solubles 30% reduction Settlement 76%
S4A	Low < 50	2.01	6.27	250	**Fail** Solubles, **Fail** Sediment (Required Treatment 61% settlement and 56% soluble reduction)

Outfall No. (Refer to Figures 2.1 to 2.15)	**Water Hardness (mg/l $CaCO_3$)**	**Dissolved Copper (ug/l)**	**Dissolved Zinc (ug/l)**	**Sediment Deposition Index**	**Comment**
S4B	N/A as traffic levels well below threshold				
S5A	Low < 50	0.87	2.65	299	**Fail** Solubles, **Fail** Sediment (Required Treatment 67% settlement and 25% soluble reduction)
S5B	N/A as traffic levels well below threshold				
S7A	Low < 50	1.39	4.27	122	**Fail** Solubles, **Fail** Sediment (Required Treatment 18% settlement and 44% soluble reduction)
S7B	Low < 50	0.09	0.27	41	**Pass** Solubles, **Pass** Sediment
S8	Low < 50	0.16	0.50	44	**Pass** Solubles, **Pass** Sediment
S9	Low < 50	0.13	0.40	50	**Pass** Solubles, **Pass** Sediment
S10	Low < 50	0.31	0.96	87	**Pass** Solubles, **Pass** Sediment
S12	Low < 50	0.60	1.87	191	**Pass** Solubles, **Fail** Sediment (Required Treatment 48% settlement)
S13	Low < 50	0.82	2.55	178	**Fail** Solubles, **Fail** Sediment (Required Treatment 44% settlement and 3% soluble reduction)
S14A	Med 50 – 200	2.39	7.38	725	**Fail** Solubles, **Fail** Sediment (Required Treatment 87% settlement and 35% solubles reduction)
S14B	Med 50 – 200	1.11	3.46	365	**Fail** Solubles, **Fail** Sediment (Required Treatment 49% settlement and 10% solubles reduction)
S15	Med 50 – 200	2.42	7.49	175	**Fail** Solubles, **Fail** Sediment (Required Treatment 61% settlement and 25% solubles reduction)

Outfall No. (Refer to Figures 2.1 to 2.15)	Water Hardness (mg/l $CaCO_3$)	Dissolved Copper (ug/l)	Dissolved Zinc (ug/l)	Sediment Deposition Index	Comment
S18a	Med 50 – 200	<0.00	<0.00	1	**Pass** Solubles, **Pass** Sediment
S18b	Med 50 – 200	<0. 00	<0.00	2	**Pass** Solubles, **Pass** Sediment
S36A	N/A as traffic levels well below threshold				
S36B	N/A as traffic levels well below threshold				
S31A	N/A as traffic levels well below threshold				
S31B	N/A as traffic levels well below threshold				

Note *S48 and S50 at Galway Racecourse are not trafficked and are not included in this table.*

A HAWRAT water quality toxicity analysis of the proposed N6 GCRR discharges to the River Corrib was also carried out modelling the soluble heavy metal pollutants of copper and zinc from combined outfall sources. In this analysis the 95 percentile low river flow was specified, an AADT Class of >10,000 and < 50,000 and the combined load of all five outfalls having a total road impervious area of 7.08ha and a permeable (Grassed) area of 5.43ha. The annual rainfall catchment was taken as 1250mm, the base flow index as 0.5 the water hardness as medium (50 to 200 CaCO3 mg/l). A cumulated load from all of the outfall discharges (S14A, S14B, S15, S18A and S18B, ref Figures 2.6, 2.7 and 2.12) was also specified in the HAWRAT assessment water quality toxicity analysis so as to include for the combined effects on the Dangan reach section of the River Corrib. This combined load simulation showed no discernible acute or chronic impacts on the water quality of River Corrib due to the high dilutions rates available in the River Corrib. The event statistics for the untreated effluent in the drainage runoff give the following event statistics, refer to **Tables 12** and **13**. These loadings are used as the mean concentration in the two-dimensional modelling of the River Corrib receiving waters presented later in this section.

Table 12: Event Statistics for soluble heavy metal pollutants in untreated Road Drainage Runoff

	Dissolved Copper Cu (µg/l)	**Dissolved Zinc Zn (µg/l)**
Mean	24.00	67.53
90%	45.95	144.85
95%	57.54	191.09
99%	90.93	346.16

Table 13: Event Statistics for soluble heavy metal pollutants in River Corrib at 95% low flow

	Dissolved Copper Cu (µg/l)	**Dissolved Zinc Zn (µg/l)**
Mean	0.00	0.01
90%	0.00	0.01
95%	0.01	0.02
99%	0.03	0.08

The event statistics for this grouped discharge give a mean event concentration in the River Corrib of that is negligible (<0.00 (µg/l)) for copper and (<0.01 (µg/l)) for zinc and 99-percentile event statistics of 0.03 (µg/l) dissolved copper and 0.08 (µg/l) dissolved zinc which are considered to represent only trace concentrations and well below the maximum allowable concentrations of 30 and 100 µg/l as set out in the Surface Water Regulations. In the HAWRAT manual the runoff specific thresholds for short term exposure of organisms gives the following short-term exposure threshold values for dissolved copper and zinc. Refer to **Table 14** below.

Table 14: Maximum Short-term exposure threshold limits for dissolved copper and zinc (WRc 2007)

Exposure Duration	**Copper (µg/l)**	**Zinc (µg/l)**		
		Harness		
		Low (< 50mg/l CaCO3)	Medium (50 to 200 mg/l CaCO3)	High (>200mg/l CaCO3)
24 hour	21	60	92	385
6 hour	42	120	184	770

This assessment clearly shows that the dilution available in the River Corrib even at 99-percentile low flow conditions ensures that the potential toxicity impact from road runoff contaminants on this salmonid river will be negligible and well below allowable levels for dissolved copper and zinc set out in the Salmonid Waters Directive and in the Surface Waters Regulations and also well below the recommended short-term exposure thresholds presented in **Table 14** above.

It should be noted that the above assessment is carried out in the absence of proposed road drainage water quality and attenuation treatment and therefore the potential impact will be considerably lower after the designed treatment.

The provision of first flush treatment in a wetland system and the storage in the attenuation pond provides residence time for the sediment to settle out before being discharged to the watercourse. This storage also reduces the outfall discharge rate with the contaminated first flush event being stored and released gradually.

The updated assessment of the storm water discharge on the River Corrib and downstream receptors represents an improvement over the 2018 EIAR and NIS assessment as the current estimate of the 99-percentile low flow is equivalent to the 95-percentile low flow used in the 2018 EIAR and NIS due to the OPW revised rating relationship for the Corrib flows. This gives a higher dilution available in the Corrib for mixing over the 2018 EIAR and NIS assessment.

This grouped assessment was also carried out on Sruthán na Libeirtí, the Knocknacarra, Bearna and Trusky Streams and were found to satisfy the HAWRAT water quality assessment in the downstream fishery reaches.

For the various individual outfalls discharging to small drains and streams with limited upstream catchment, it is found that the majority of these outfalls fail the HAWRAT assessment (in absence of pollution control measures), simply because there is negligible flow for dilution during 95-percentile low flow design conditions. At these locations, these failures are not considered significant as locally these smaller drains are not fishery sensitive and further downstream in the receiving streams the flow rate and contributing catchment area increases which lessens any potential impact.

The impact on water chemistry downstream in the coastal waters will be negligible due to the significant mixing available in the downstream reaches of the watercourses and within the tidally flushed estuarine reaches.

The proposed storm drainage design for all proposed new surface water outfalls discharging to watercourses includes a spillage containment area (25m^3), a petrol and oil interceptor, a surface flow (SF) wetland with a permanent pond depth of 0.6m (to take first flush volume 15mm) and an attenuation pond (typically having a storage volume of a further 70mm rainfall over the paved area). Such facilities will achieve a long hydraulic residence time for first flush pollutant events ensuring good settlement performance. Flood attenuation will not be provided at the direct outfalls to the River Corrib S18A and S18B as attenuation of the road storm flow is not warranted give immense scale of the River Corrib catchment and capacity of the channel relative to the proposed road drainage direct discharges at S18A and S18B. The other pollution control elements including spillage containment, wetland first flush treatment and petrol and oil interceptors will be provided to achieve storm water treatment and accidental spillage protection for these outfalls.

The expected performance of the designed pollution control measures are expected to achieve in excess of 60% settlement performance of particulate matter but for soluble substances unlikely to achieve above 30% reduction and lower performances during the non-growing season, refer to **Table 15** below. The design ensures no significant water quality impact on receiving designated waters of the

Lough Corrib SAC and Lough Corrib SPA and the downstream Galway Bay SAC and Inner Galway Bay SPA.

Table 15: Expected Pollutant Removal Performance of Vegetated systems extracted from TII DN-DNG-03063

Runoff Constituent	**Stormwater treatment system Performance**					
	Swales	Infiltration Basins	SF Wetlands	SSF ** Wetlands	Detention / Retention Ponds	Sedimentation Ponds
Sus Solids & associated heavy metals	Good	Good	Good	Good	Moderate	Good
Heavy Metals in solution *	Moderate-Good	Moderate-Good	Moderate-Good	Good	Poor	Poor-moderate
Oil and grease	Good	Moderate-Good	Good	Good	Moderate	Moderate
Nutrients	Poor	Poor	Moderate-Good	Good	Poor	Poor-moderate

Notes:

Poor represents < 30% removal efficiencies, Moderate represents 30 to 60% removal efficiency and Good represents > 60% removal efficiency

** applicable to Growing Season*

*** very limited operational life of SSF Wetlands due to clogging of substratum*

In general, the most likely impact of untreated road runoff from the proposed N6 GCRR is the increased total suspended solids loading to receiving waters and associated trace amounts of heavy metals (Cu, Zn) and hydrocarbons. At all proposed surface drainage outfalls, water quality treatment of the sediment load is provided for, which will reduce local impacts from sediment deposition accumulation and potential toxicity levels in the stream/drain channel immediately close to the outfall.

The two tunnel sections of the road do not receive direct surface water runoff, however small volumes of water could potentially be carried into the tunnel on tyres and bodies of wet vehicles. These volumes will be picked up by the internal sealed tunnel drainage and pumped to the foul sewer. This volume for treatment is miniscule (fraction of a percent) in comparison to the overall sewage and combined storm volume treated at the Mutton Island Plant and discharged to the Galway Bay via the Mutton Island marine outfall and therefore will have no perceptible effect of treatment performance of the Mutton Island Treatment Plant and the Galway Bay receiving waters. The Water Quality Impact Assessment is presented in **Table 16** below:

Table 16: Water Quality Impact Assessment

Network Drainage Ref. No.	Outfall Chainage	Dilution Characteristics	Receiving Water Details	Water Quality Impact
S1	0+000	Low summer dilution available	Sruthán na Libeirtí	Slight Permanent Local Slight downstream
S2	0+625	Low summer dilution available	Sruthán na Libeirtí	Slight Permanent Local Slight downstream
S3	0+900	Low summer dilution available	Sruthán na Libeirtí	Moderate Permanent Local Slight downstream
S4A	1+550	Very Low summer dilution available	Trusky Tributary	Moderate Permanent Local Slight downstream
S4B	1+500	Very Low summer dilution available	Trusky Tributary	Slight Permanent Local Slight downstream
S5A	2+750	Low summer dilution available	Trusky Tributary	Slight Permanent Local Slight downstream
S5B	2+800	Very Low summer dilution available	Trusky Tributary	Slight Permanent Local Slight downstream
S7A	3+000	Very Low summer dilution available	Bearna Tributary	Moderate Permanent Local Slight downstream
S7B	3+950	Moderate summer dilution available	Bearna Stream	Slight Permanent Local Slight downstream
S8	4+000	Low summer dilution available	Bearna Tributary	Slight Permanent Local Slight downstream
S9	4+150	Moderate summer dilution available	Bearna Stream	Slight Permanent Local Slight downstream
S10	4+850	Low summer dilution available	Bearna Tributary Tonabrocky	Slight Permanent Local Slight downstream
S12	6+850	Low summer low flow dilution available	Knocknacarra Tributary	Moderate Permanent Local Slight downstream
S13	7+350	Very low summer low flow dilution available	Knocknacarra Tributary	Slight Permanent Local Slight downstream
S14A	8+300	Very low summer low flow dilution available	Minor River Corrib Stream	Moderate Permanent Local and imperceptible in downstream receiving Corrib waters
S14B	8+550	Very low summer low flow dilution	Minor River Corrib Stream	Slight Permanent Local and imperceptible in downstream receiving Corrib waters

Network Drainage Ref. No.	Outfall Chainage	Dilution Characteristics	Receiving Water Details	Water Quality Impact
S15	east of N59 link	Very Low summer dilution	Local drainage Ditch to River Corrib	Moderate Permanent Local and imperceptible in downstream receiving Corrib waters
S18A	9+250	Very High Summer low flow dilution	River Corrib	Slight Permanent Local
S18B	9+425	Very High Summer low flow dilution	River Corrib	Slight Permanent Local
S21A	12+250	Low Summer dilution Eventually drains to groundwater	Ballindooley Lough	Moderate Permanent Local
S36A	3+350	Low summer dilution available	Trusky Tributary	Slight Permanent Local Slight downstream
S36B	3+350	Low summer dilution available	Trusky Tributary	Slight Permanent Local Slight downstream
S31A	7+250	Very low summer low flow dilution available	Knocknacarra Tributary	Slight Permanent Local Slight downstream
S31B	7+250	Very low summer low flow dilution available	Knocknacarra Tributary	Slight Permanent Local Slight downstream

4.2.2.2 Transport Dispersion Modelling of River Corrib Outfalls

Two-dimensional transport and dispersion modelling of the outfall discharges in the River Corrib was carried out so as to assess the local impact effects of the plume near the inflow points and downstream, where full mixing with the receiving flow will not have fully occurred. Simulations were carried out modelling the two principal soluble heavy metal pollutants in the drainage effluent, namely copper and zinc and included the proposed first flush stormwater treatment in the wetland and attenuation ponds, which are designed to capture the first flush event of 15mm rainfall runoff and release slowly back to the River Corrib system so that a high percentage of the sediment is removed through settlement. Low flow conditions were modelled in the River Corrib with the river discharge rate set at the 99-percentile low flow of 13.6cumec (note median river flow is 90.5cumec) and the downstream water level upstream of the Salmon Weir barrage set at 5.7m OD (median 5.9mOD). The estimated median River flow was 82cumec in the 2018 EIAR and is principally due to the rating review by the OPW and the measurement period from hydrometric years 2009 to 2022.

The event mean runoff concentrations from the HAWRAT model was specified as the storm effluent concentration at the outfalls of 24 µg/l Cu and 67.53 µg/l Zn. The simulation was run for combined outfall discharges on the western side of the River Corrib (outfalls 14A, 14B, 15 and 18A), refer to Figures 2.6, 2.7 and 2.12 of the NIS for outfall locations. An independent simulation for outfall S18B on the eastern bank of the River Corrib was also run and results combined with the western outfall simulations to predict the overall impact of the proposed road drainage discharge on the River Corrib.

The drainage discharge plume in the River Corrib migrates with the flowing river downstream towards Galway Bay and therefore exposure duration is limited to hours as opposed to days. The maximum predicted concentrations throughout the model domain are presented below in **Figures 4** to **9** which show that the plume hugs the near bank side of the river for quite a distance downstream before fully mixing across the river channel. The simulations show that during the River Corrib low flow conditions the stormwater plume does not enter via the small channel east of Jordan's Island and therefore has very limited effect on the Terryland Water Supply Intake. It is also noted that the plume does not travel up in the Coolagh Lakes system under these conditions. The large dispersion provided by the River Corrib result in rapid dilution and low trace level pollutant concentrations in the receiving water. The potential impact on water quality in Lough Corrib SAC and Lough Corrib SPA arising from the plume are imperceptible.

The analysis shows that the potential soluble toxicity levels of copper and zinc in the receiving waters are negligible in terms of the threshold levels for 24-hour and 6-hour exposure periods. The available dilution in the River Corrib at low flow conditions is still very large and therefore the combined discharge from the various outfalls to the reach is very well diluted and does not impact the water quality or quantity in the receiving waters.

These simulations predict very low far-field concentrations of heavy metal pollutants under the River Corrib 99-percentile low flow conditions. Simulations predict less than 0.05µg/l dissolved copper and less than 0.1µg/l dissolved zinc in the river channel near Jordan's Island and the Quincentenary Bridge. More elevated concentrations are predicted close to the outfalls of S18A and S18B on both River Corrib banks with predicted concentrations with a maximum local concentration of 1.75µg/l dissolved copper and 4.92µg/l dissolved zinc. These locally elevated concentrations are well below any potential exposure threshold levels for heavy metals and easily satisfy the surface water and Salmonid Waters Regulations. At median river flow the concentration both locally at the outfall and fully mixed downstream are significantly lower at almost six times lower than the River Corrib low-flow scenarios described above.

The potential impact of de-icing agents such as sodium chloride on the receiving water quality of the River Corrib will not result in a water quality impact as the dilution is large and particularly so during winter months, which is the high flow period with river flows generally above the median flow which dilutes and rapidly transports the salt load through the lower reaches of the River Corrib out to sea where they are imperceptible and have no effect.

The water quality impact of the proposed stormwater discharge on the River Corrib, given its high dilution and assimilative capacity, represents only a slight impact immediately local to the outfalls. The high water quality status of the River Corrib and SAC will not be affected by the proposed N6 GCRR and its road drainage discharges.

Figure 4: Maximum Dissolved Copper Concentrations for First Flush Storm Water Event and 99% River Corrib Low Flow for Outfall 18B at Menlough

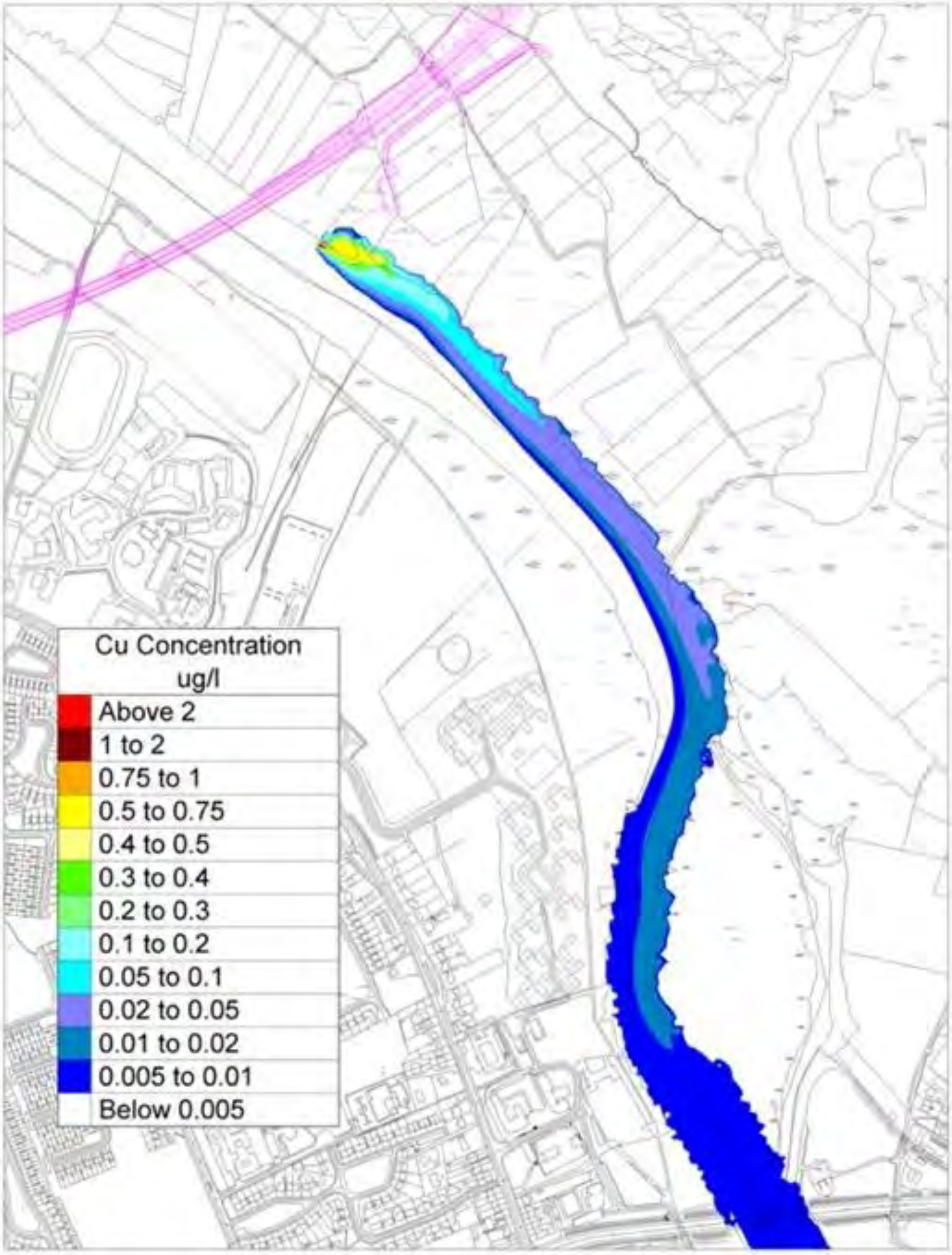


Figure 5: Maximum Dissolved Copper Concentrations for First Flush Storm Water Event and 99% River Corrib Low Flow for Dangan Outfalls (14A,14B 15 and 18A)

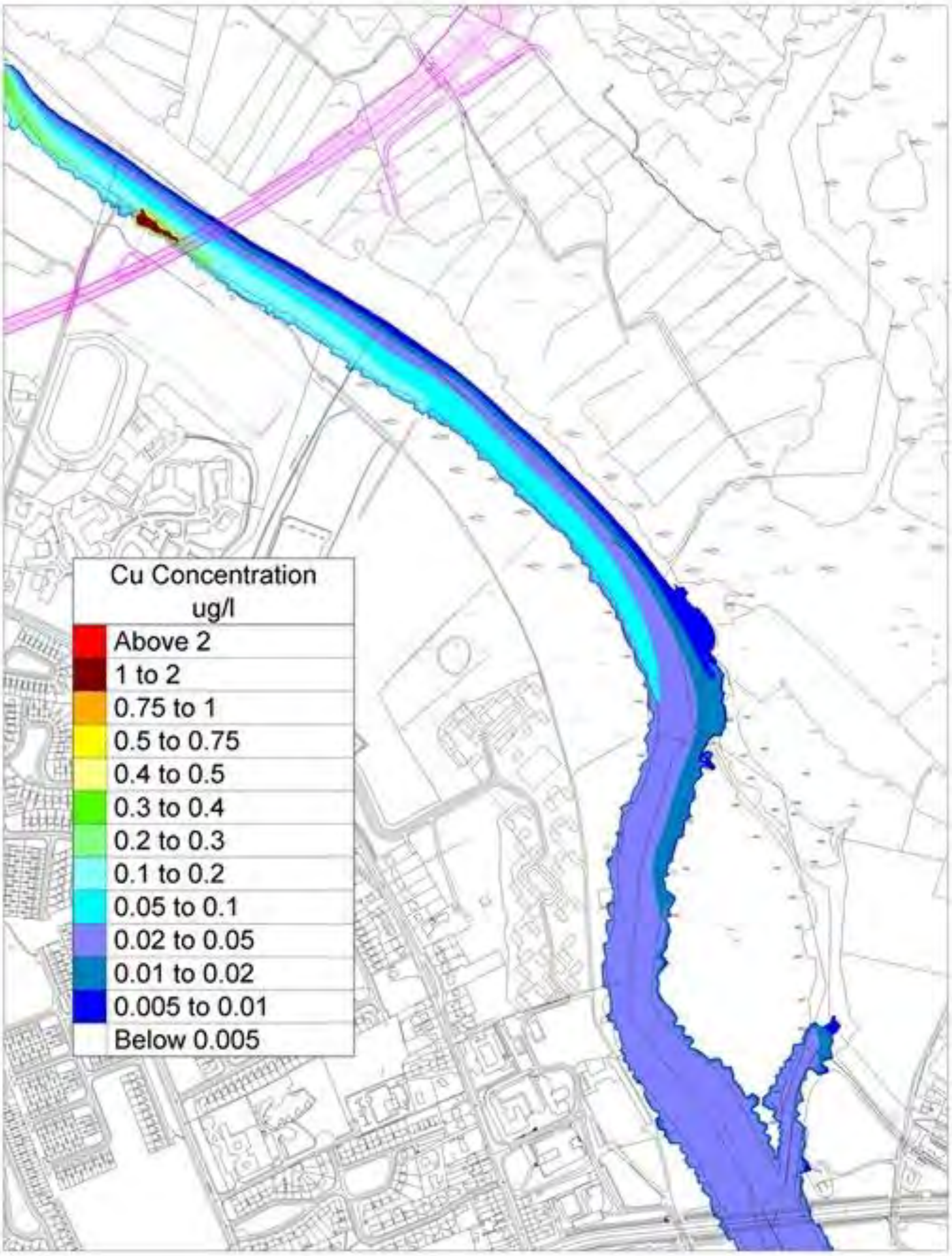


Figure 6: Maximum Dissolved Copper Concentrations for First Flush Storm Water Event and 99% River Corrib Low Flow for all combined Outfalls (14A, 14B, 15, 18A and 18B)

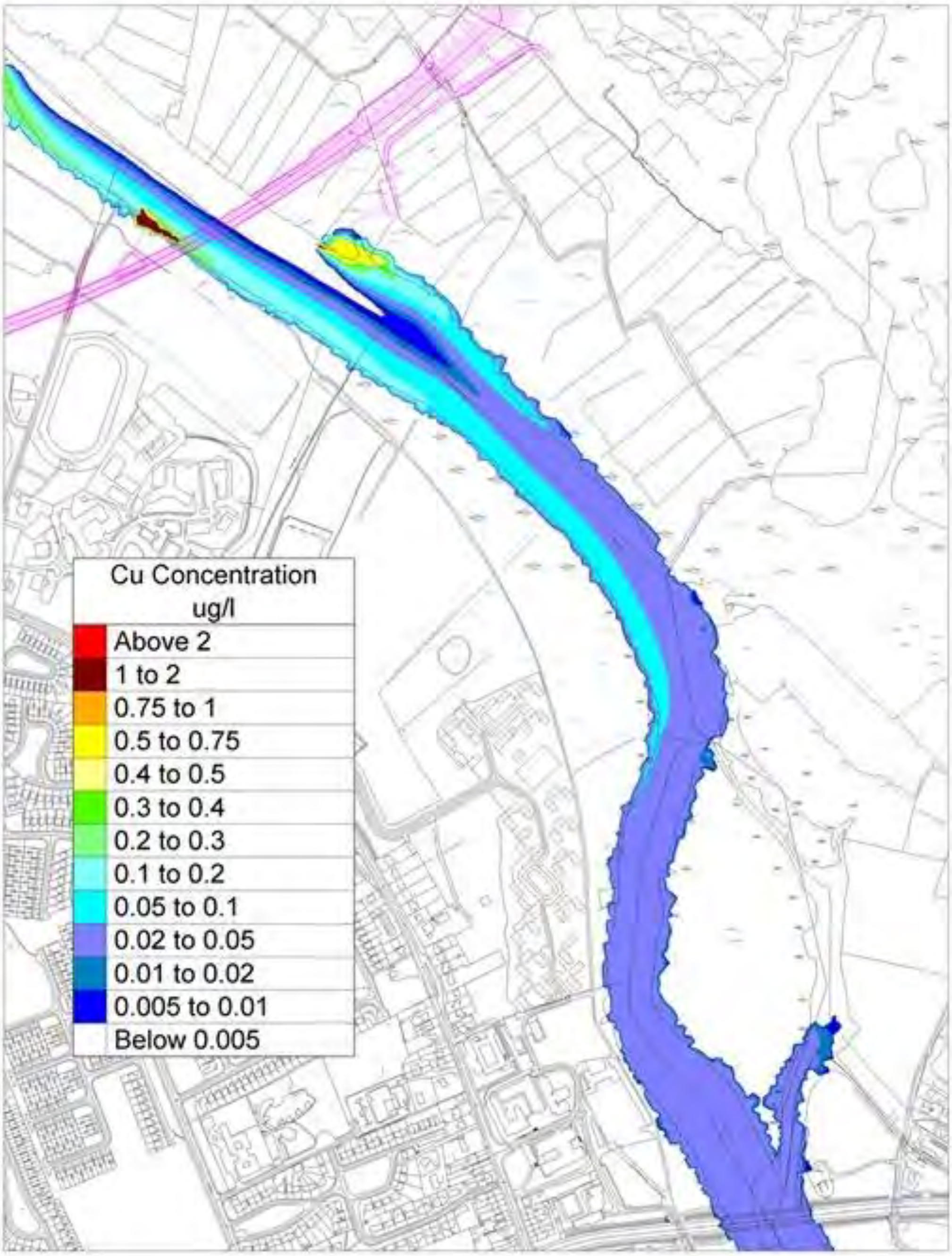


Figure 7: Maximum Dissolved Copper Concentrations for First Flush Rain Storm Event and median River Corrib Flow for all combined Outfalls (14A, 14B, 15, 18A and 18B)

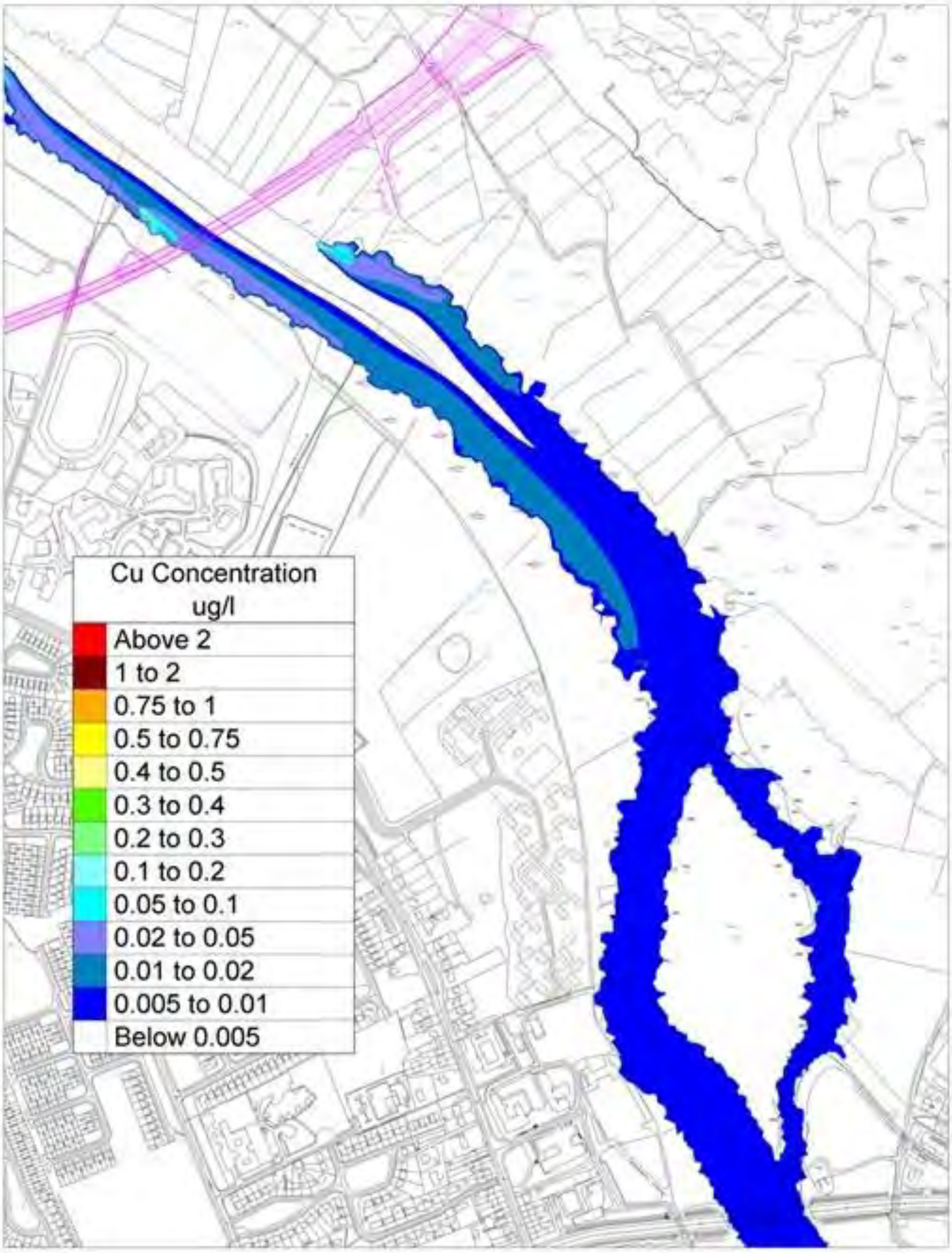


Figure 8: Maximum Dissolved Zinc Concentration for First Flush Rain Storm Event and 99% River Corrib Low Flow for all combined Outfalls (14A, 14B, 15, 18A and 18B)

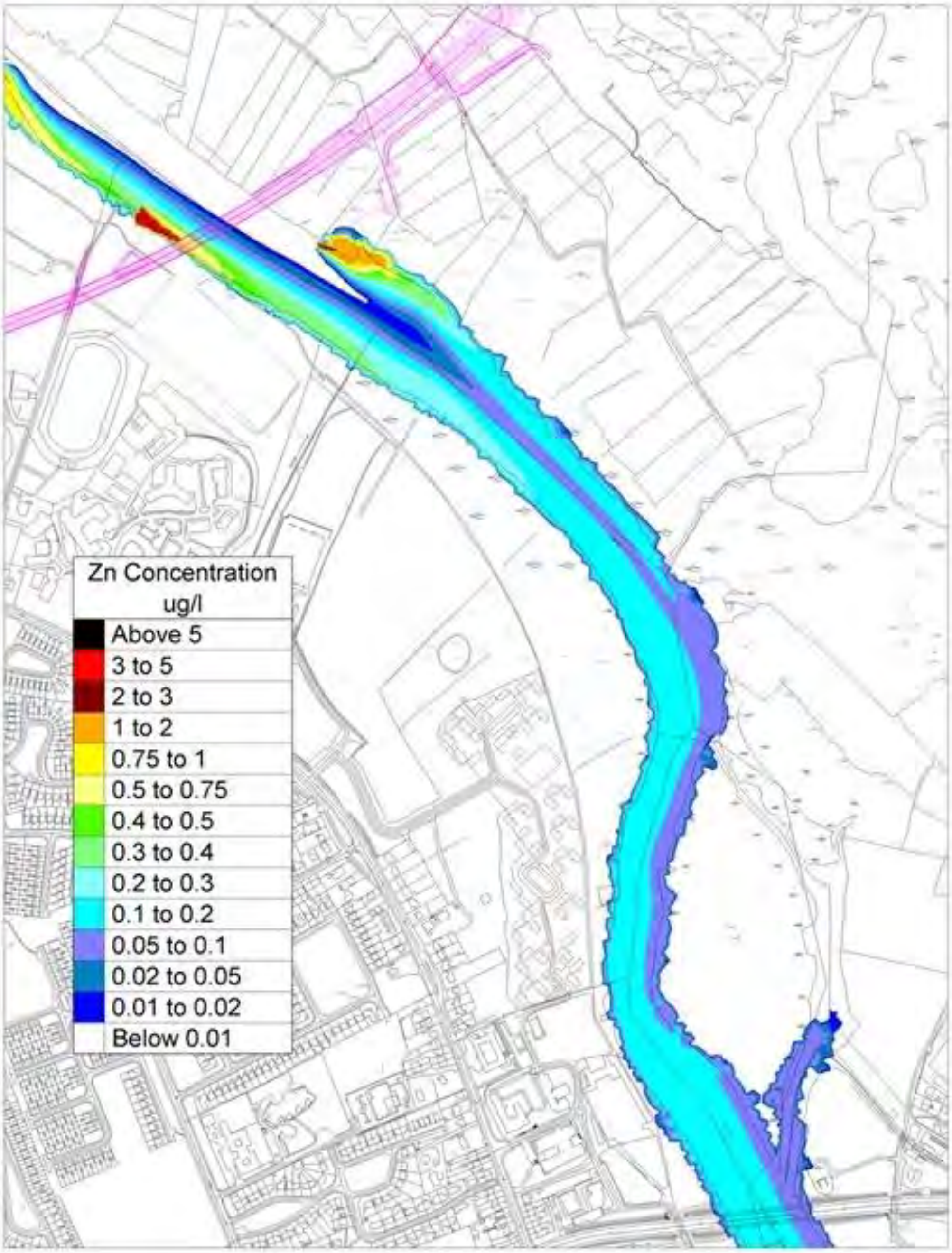
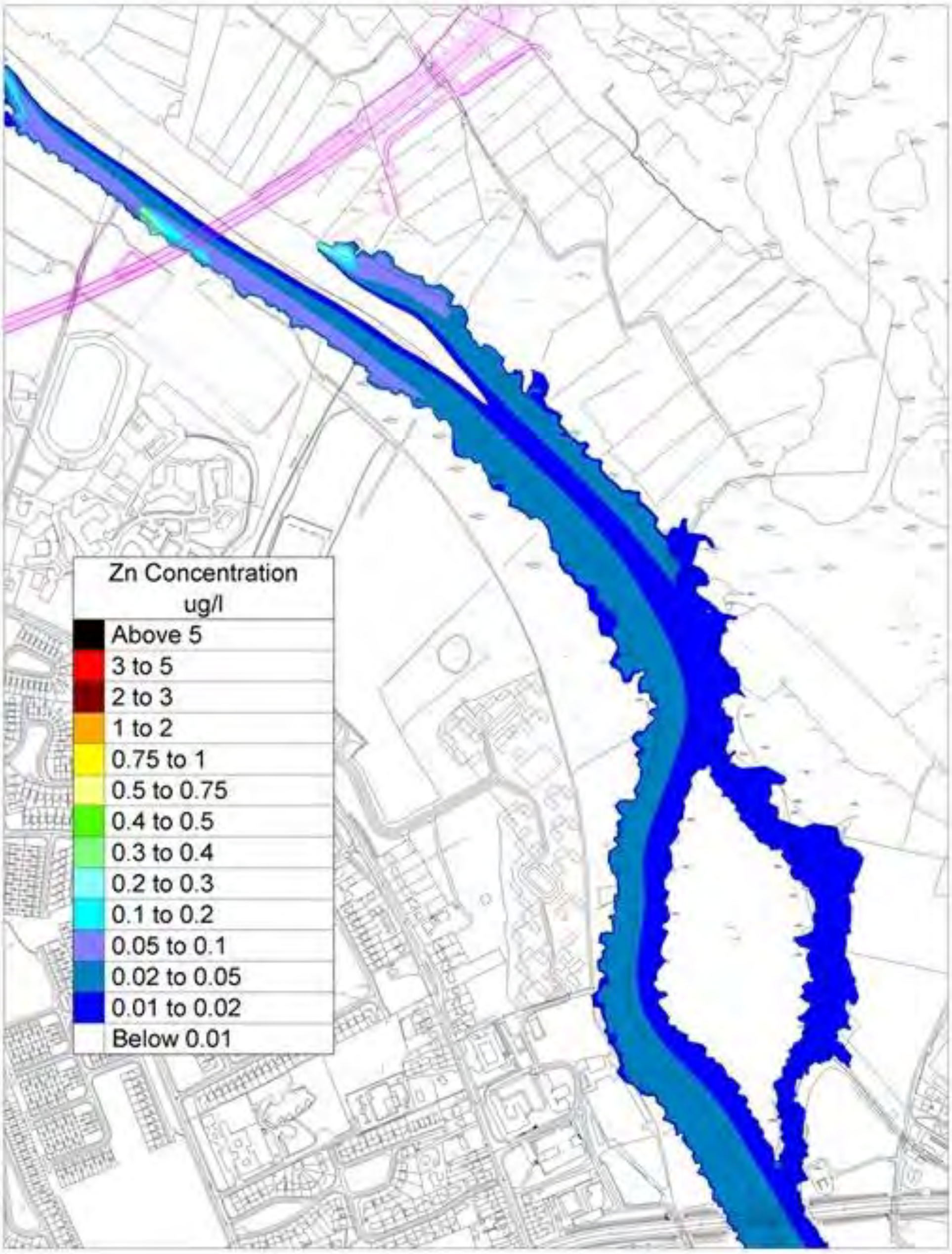


Figure 9: Maximum Dissolved Zinc Concentrations for First Flush Rain Storm Event and median River Corrib Flow for all combined Outfalls (14A, 14B, 15, 18A and 18B)



5 Potential Hydrological Impacts to the Lough Corrib SAC and SPA

5.1 Introduction

The proposed N6 GCRR will discharge either directly or indirectly to the Lough Corrib SAC via a series of proposed road drainage outfalls. A total of five outfalls serving 2.625km of mainline of the proposed N6 GCRR and 0.625km of the N59 Link Road will discharge to surface waters of the River Corrib system. The conservation objective of the various qualifying interest of the Galway Lough Corrib SAC and Lough Corrib SPA require that the natural hydrological regime is maintained in terms of the natural flow regime and water quality.

Four of these outfalls are located on the western side of the River Corrib with one being a direct discharge to the River Corrib (S18A) at (528400, 727742 (18A) ref Figures 2.6, 2.7 and 2.12 of the NIS) and the other three being stormwater outfalls to small tributary streams/drains. A second direct stormwater outfall is located on the eastern bank immediately downstream of the proposed bridge crossing at S18B. The road drainage area associated with these outfalls represents a total paved area of 7.11ha and a total drainage area (paved and grassed areas) of 12.42ha. A summary of the outfall details is provided in **Table 17**.

As discussed in **Section 4.2.2** of this report a cumulated HAWRAT water quality assessment of the proposed N6 GCRR was undertaken. The event statistics for the grouped discharge (S14A, S14B, S18A and S18B) gave a mean event concentration for dissolved Copper and Zinc of < 0.00 (µg/l) and 0.01(µg/l) and 99-percentile event statistics of 0.03 (µg/l) and 0.08 µg/l) dissolved zinc which are considered to represent almost un-detectible, trace concentrations. This analysis was carried out using a 99-percentile low flow estimate for the River Corrib of 14cumec. A first flush runoff rate of 15mm rainfall over a 30minute period gives a potential runoff rate entering the River Corrib of 0.592cumec.

Table 17: Outfall Description

Drainage Reference (Refer to Figures 2.1 to 2.15)	Approx. length of paved road (m)	Total Road Drainage Area (m^2)	Area of Road Surface (m^2)	Proposed Outfall Easting (ITM)	Proposed Outfall Northing (ITM)
S14A	725	56,600	21,990	527703	727162
S14B	275	8,490	6,520	527758	727437
S15	625	18,930	7,270	527640	728261
S18A	725	17,500	15,800	528400	727742
S18B	900	22,680	19,540	528584	727751
Total	3,250	124,200	71,120		

For the purpose of water quality improvement the storm water drainage from the road pavement will be passed through a wetland prior to outfall. These wetlands are designed to provide primary settlement of sediments. All of these stormwater treatment systems are designed with silt traps and fitted with a petrol and oil interceptors and each pond is designed with a spillage containment volume of $25m^3$ to facilitate isolation and containment of storm runoff waters in the event of a serious road spillage. This wetland system will remove the more settleable sediment material with treatment performance to achieve in excess of 60% removal of sediments and associated heavy metal pollutants from the storm water discharge.

5.2 Operational Impacts

5.2.1 Potential Impact of Road Drainage Runoff on River Corrib

A HAWRAT water quality toxicity analysis of the proposed road discharge to the River Corrib was carried out modelling the soluble heavy metal pollutants of copper and zinc. In this analysis the 99percentile low river flow was specified, an AADT Class of >10,000 and <50,000 and the combined load of all five outfalls having a total road impervious area of 7.112ha and a permeable (Grassed) area of 5.31ha. The annual rainfall was taken as 1250mm, the base flow index as 0.5 the water hardness as medium (50 to 200 CaCO3 mg/l).

The impounded nature of the River Corrib flow gives rise to very low flow velocities particularly during summer low flow conditions (average river channel velocities < 0.05m/s) and could potentially give rise to accumulation of sediment deposition in the vicinity of the outfalls at the River Corrib bank for outfalls 18A and 18B (ref Figure 2.7 of the NIS), which could potentially give rise to local impacts on sediment. Such accumulations are predicted not to be very extensive based on the deposition index and easily avoided through primary treatment of the storm water prior to outfalling, which is a proposed design measure with expected settlement removal performance in excess of 60% for suspended solids and particulate matter. This will prevent the potential for local accumulation of sediment at the outfall locations with finer sediment being capable of wider dispersal in the receiving waters and avoiding any local impact.

The analysis shows that the potential soluble toxicity levels of copper and zinc in the receiving waters are negligible in terms of the threshold levels for 24-hour and 6-hour exposure periods. The available dilution in the River Corrib at low flow conditions is still very large and therefore the combined discharge from the various outfalls to the reach is very well diluted and does not impact the water quality or quantity in the receiving waters.

Two-dimensional transport and dispersion modelling of the outfall discharges in the River Corrib was carried out to assess the local impact effects of the plume near the inflow points and downstream, where full mixing with the receiving flow will not have fully occurred. Simulations were carried out modelling the two principal soluble heavy metal pollutants in the drainage effluent, namely copper and zinc and included the proposed first flush stormwater treatment in the wetland and attenuation ponds, which are designed to capture the first flush event of 15mm rainfall runoff and release slowly back to the Corrib system so that a high percentage of the sediment is removed through settlement. The potential impact of de-icing agents such as sodium chloride on the receiving water quality of the River Corrib will not result in water quality impact as the dilution is large and particularly so during winter months, which is the high flow period with river flows generally above the median flow which dilutes and rapidly transports the salt load through the lower reaches of the River Corrib out to sea where they are imperceptible and have no effect.

These simulations predict very low far-field concentrations of heavy metal pollutants under the River Corrib 99-percentile low flows of less than 0.05µg/l dissolved copper and less than 0.1µg/l dissolved zinc in the river channel near Jordan's Island. More elevated concentrations are predicted close to the outfalls of S18A and S18B on both River Corrib banks with predicted concentrations with a maximum local concentration of 1.75µg/l dissolved copper and 4.92µg/l dissolved zinc. These locally elevated concentrations are well below any potential exposure threshold levels for heavy metals (refer to **Table 14** for threshold limits) and easily satisfy the surface water and Salmonid Waters Regulations. At mean river flow the concentration both locally at the outfall and fully mixed downstream are significantly lower at almost six times lower than the River Corrib low-flow scenario. The water quality impact of the proposed stormwater discharge on the River Corrib, given its high dilution and assimilative capacity, represents only a slight impact immediately local to the outfalls. The high water quality status of the River Corrib will not be affected by the Project and its road drainage discharges on the proposed N6 GCRR.

5.2.2 Proposed River Corrib Bridge Crossing

The proposed N6 GCRR crosses the River Corrib approximately 160m to the southeast of Menlo Castle on the eastern side and crosses through UoG Sporting Campus at Dangan on the western side of the river. The proposed structure is a balanced cantilevered structure spanning over the river banks and provides a clear span between support piers of 153m. This clear span is sufficient to allow the support piers to be set back from the channel bank and thereby avoids encroachment of the River Corrib channel and its flood banks and allows for continuous access along the river bank edge on both banks. On the eastern bank the minimum setback distance from the pier face to channel edge is 5m and on the western bank the minimum setback is slightly more than 10m. Such setbacks amply meet IFI requirements for protection of water courses and bank side fishery access.

The bridge deck is to be a post-tensioned in-situ concrete deck which can be built using travelling formwork over river channel and the side spans and therefore constructional impact risks to the Lough Corrib SAC are minimised as it avoids in-stream works, temporary or otherwise (ref Appendix D of this updated NIS).

A detailed hydraulic assessment of the River Corrib and the proposed bridge structure was carried out as part of the Section 50 approvals from OPW for the bridge. This assessment involved development of a detailed 2-dimensional hydraulic model of the River Corrib reach from Menlough to the Salmon Weir Barrage and included the Jordan Island channel and the Coolagh Lakes to predict flood levels and allow testing of various bridge configurations as part of the preliminary design and optioneering studies for the bridge. A summary of the calculated design flood flows and computed flood levels are presented in **Table 18** below.

The modelling of return period flood flows with inclusion for statistical error provided flood levels at the proposed bridge site and these predicted flood levels clearly demonstrate that the proposed bridge structure will have an imperceptible impact on water levels and the flow regime either upstream or downstream nor is there any flood risk issues for the proposed N6 GCRR with the proposed bridge deck and the storm drainage system sufficiently elevated above extreme flood levels.

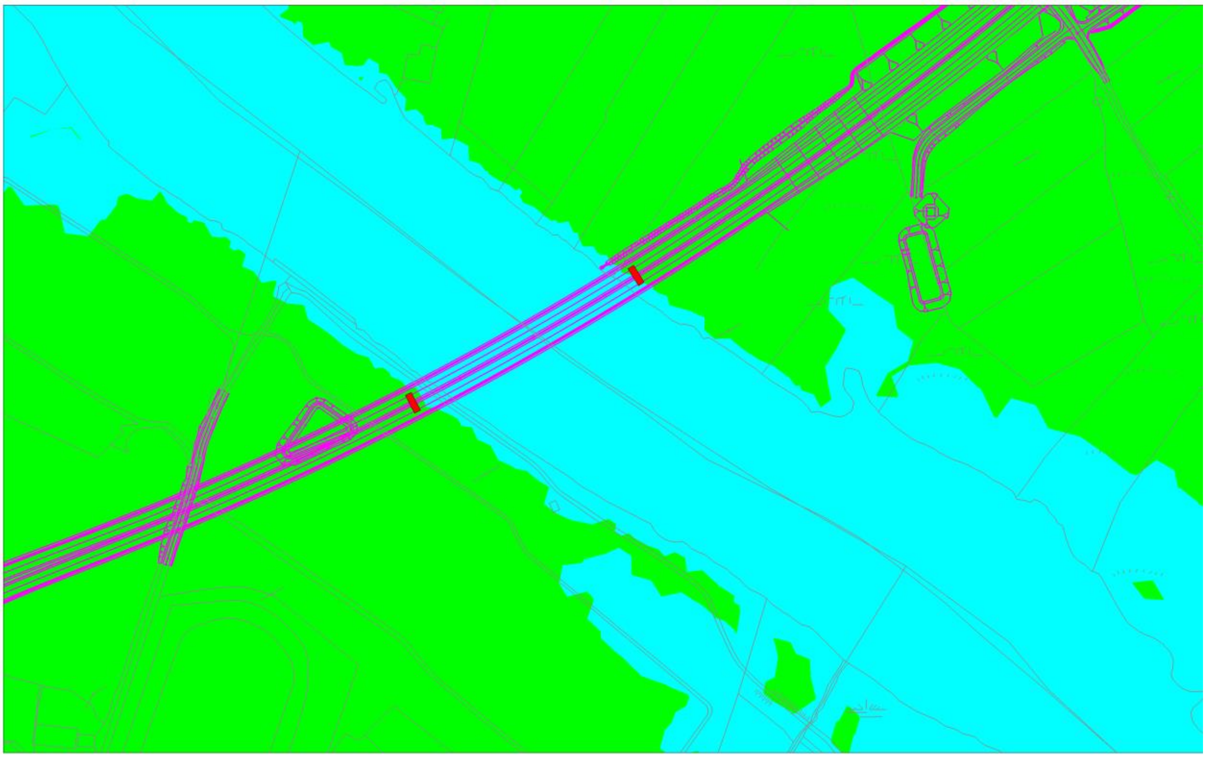
Table 18: Estimated Design Flood Flows and Flood levels at the Proposed River Corrib Bridge Crossing

Return Period years	**QT (1) Flood Flow Cumec**	**Computed Flood Level m OD**
10yr	342.7	6.752
100yr	444.7	7.166
1000yr	545.0	7.524
100yr+CC	578.0	7.630

(1) Note the above flow estimates in Table 18 include the standard statistical sampling error so as to reflect the upper 67-percentile confidence interval.

Hydraulic analysis shows no discernible impact on flood levels at the design flood event which is the 100year with inclusion of the current OPW recommended climate change allowance of 20%. The predicted flood level for this design flood condition (100year + CC) is 7.63m OD. At such a design flood level, both riverbank piers will be located just outside of the flood risk area and well outside the flood conveyance zone. At the estimated 1000year flood level of 7.524m OD associated with a peak flood flow of 545cumec the proposed bridge piers remain just outside the floodplain area in Flood Zone C, refer to **Figure 10** below and therefore no encroachment of the floodplain area will occur at the bridge crossing. The water quality/attenuation ponds are also shown to remain outside the flood risk zones and therefore will not affect the flow regime of the River Corrib.

Figure 10: 1000year flood inundation map of proposed bridge crossing with pier locations shown in red outside of the flood zone



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 bank edge with foundations located at depth. This will protect the river channel from changes in morphology whereby the channel over time would naturally migrate towards one of the abutments.

There is little potential for bank erosion at the proposed River Corrib crossing location as the river channel is straight, regular and cut into bedrock.

5.2.3 Coolagh Lakes

The proposed N6 GCRR traverses the Coolagh Lakes catchment from Ch. 9+700 to Ch. 11+800. There are no proposed direct storm water discharges to the Coolagh Lakes with all road drainage discharges to groundwater via engineered infiltration basins. Outfall S18B (ref Figure 2.7 of the NIS) which discharges directly to River Corrib includes part of the Coolagh Lakes drainage area between Ch. 9+700 to Ch. 10+145 representing a small loss of recharge area of 1.04ha from the Coolagh Lakes system. This represents a very minor loss of recharge water to the lower lake, of 0.44%, which will have no perceptible impact on the flow regime and hydrochemistry of this lake system. Drainage area S19A and S19B (ref Figure 2.7 of the NIS) from Ch. 10+145 to Ch. 11+169 drains a total area of 4.17ha within the Coolagh Lakes catchment area. The S19A and S19B outfall is designed to discharge to groundwater via an engineered infiltration. This runoff water drains into the limestone bedrock aquifer and ultimately potentially recharges the Coolagh Lakes system. The proposed Lackagh Tunnel section (F19 Ch. 11+169 to Ch. 11+414 (refer Figure 2.8 of the NIS)) is to be sealed and located above groundwater table and consequently will not intercept recharge water for the Coolagh Lakes system. The final drainage area in the vicinity of the Lackagh Quarry S20 (servicing Ch. 11+414 to Ch. 12+017 (refer Figure 2.8 of the NIS) is also designed to discharge to ground via engineered infiltration area and consequently will maintain groundwater recharge to the Coolagh Lakes system. The protection of the groundwater quality is dealt with in detail in the hydrogeology assessment, refer to Appendix A of this updated NIS, with the infiltration basin and wetlands systems at each of these outfalls designed to remove pollutants and protect the highly vulnerable, regionally important, groundwater aquifer from adverse impacts by the proposed routine road drainage runoff. These groundwater quality design measures through removal of pollutants via provision of a deep soil filter and generous infiltration areas at the relevant outfalls S19A, S19B and S20 will also prevent impact to the hydrochemistry of the Coolagh Lakes.

A section of proposed N6 GCRR embankment encroaches a small section of the Coolagh Lakes/Corrib flood zone at Ch. 9+850 to Ch. 9+900. The area of encroachment at the 1000year flood level is 0.27ha and at the 100year it is 0.11ha. The proposed encroachment will not have any perceptible impact on flooding or on the hydrological flow regime or hydrochemistry of the lakes as a result of this very minor encroachment.

5.3 Construction Impacts

The proposed construction method for the River Corrib Bridge crossing, as outlined in Appendix D of this updated NIS, will avoid works within the river channel, temporary or otherwise except for the installation of drainage outfalls 18A and 18B. These outfalls are on the riverbank edge and represent very limited disturbance with the construction works to be carried out from the banks and therefore water quality risks are significantly reduced. The main risk will be associated with the construction of the support piers for the bridge adjacent to the channel bank edge which are setback c.10m on the western bank and 5m on the eastern bank. The River Corrib is sensitive as a salmonid river, major water supply source, European site designation and important amenity, both locally and downstream through the city and canals. Potential construction accidental spillages of hydrocarbons from plant and spillage of concrete and associated chemicals associated with constructing the riverside piers, bridge deck and storm outfalls represents a potential temporary impact to the waterbody and places risk to the water supply of Galway City, particularly activities on the eastern bank and therefore is categorised as a potential significant impact in the absence of mitigation.

Construction works for outfalls S14A, S14B and S15 located at Dangan/Bushypark on its western bank discharge to the River Corrib via drainage ditches over distances of c.300 to 800m. These ditches provide an excellent wetland and settlement buffer to protect the River Corrib from construction runoff. Notwithstanding this buffer, the construction erosion and Sediment, Erosion and Pollution Control Plan, in the CEMP contained in Appendix C of this updated NIS will apply to these watercourses designed to minimise the direct construction runoff to watercourses and minimise disturbance of sediment from in-stream and riverbank works.

Construction sediment releases from construction activities associated with the bridge crossing represents a potential temporary impact on the River Corrib water quality both locally and downstream. The potential sediment plume is predicted to hug the riverbank edge for quite a distance downstream (approximately 1 to 2km) before fully mixing across the full channel width. There is generally good dilution in the River Corrib throughout the year to minimise the wider impact of sediment releases on fisheries, benthos and on the public water supply source. The low velocities associated with the River Corrib and particularly along its river edge provides the opportunity for released construction sediment to settle out rapidly along the bank edge, giving rise to the potential for locally smothering of the benthos.

There is a potential for construction impacts on the Coolagh Lakes and supporting habitat from construction site sediment runoff and construction spillages. The natural wetland habitat in the riparian zones of the lakes provides a good buffer between the construction and the permanent lakes. Notwithstanding this buffer zone, construction phase mitigation measures in the form of sediment and pollution control measures are required to protect this sensitive waterbody.

5.4 Mitigation Measures

Mitigation of potential construction impacts will be achieved through the stringent implementation of good construction practice procedures and environmental controls so as minimise the opportunity for contaminated releases of construction water to the River Corrib. Refer to the Construction Environmental Management Plan (CEMP) in Appendix C of this updated NIS for mitigation measures. As is normal practice the Construction Environmental Management Plan (CEMP) will be finalised by the Contractor in advance of the commencement of construction and the following will be implemented as part this plan:

- An Incident Response Plan detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, logging of non-compliance incidents and any such risks that could lead to a pollution incident, including flood risks (Refer to Section 10 of the CEMP in Appendix C)
- A Sediment Erosion and Pollution Control Plan (Refer to Section 8 of the CEMP in Appendix C). This shall include water quality monitoring and method statements to ensure compliance with environmental quality standards specified in the relevant legislation (i.e. surface water regulations and Salmonid Regulations 1988)
- All necessary permits and licenses for instream construction works associated with the provision of culverts, bridges and outfalls. OPW Section 50 consent has been received for all culverts and bridges proposed in the EIA Report Changes to these structures as part of the detailed design and construction stage will require new Section 50 consent to be obtained
- Inform and consult with OPW Western Arterial Drainage Section who have responsibility for the Corrib-Mask Arterial Drainage scheme and the ongoing control of river and lake levels at the Salmon Weir Barrage in Galway City
- Continue to inform and consult with Inland Fisheries Ireland (IFI)

- Continue to inform and consult with National Parks and Wildlife Service (NPWS)
- All construction works will be carried out in accordance with best practice construction guidance and as such will eliminate the risk of spillage to the River Corrib.
- All works will also be carried out in accordance with Irish Water Standards and Specifications, in line with standard processes and procedures for obtaining connection consent and build over agreements with the utility provider.
- Irish Water (IW) will be consulted in the updating of the CEMP and specifically the and the incident response plan (IRP) for construction and operation stages

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

- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)
- 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 C793 The SuDS Manual
- CIRIA C624 Development and Flood Risk – guidance for the construction industry
- CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors
- CIRIA C648 Control of Water Pollution from Linear Construction Projects, technical guidance
- CIRIA C649 Control of Water Pollution from Linear Construction Projects, site guide
- Guidelines for the Crossing of Watercourses during the Construction of National Road schemes (NRA, 2006)
- Road Drainage and the Water Environment DN-DNG-03065 (TII, June 2015)
- Vegetated Drainage Systems for Road Runoff DN-DNG-03063 (TII, June 2015)

Based on the above guidance documents concerning control of construction 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 located on dry land and set back from river and stream channels and out of floodplain areas. Floodplain areas include the Flood Risk Zones A and B (i.e. outside of the present-day 100year and 1000year flood extents)
- The storage of oils, fuel, chemicals, hydraulic fluids, etc. will not occur within 100m of the River Corrib or within the floodplain area
- Surface water flowing onto the construction area will be minimised through the provision of temporary berms, diversion channels and cut-off ditches, where appropriate
- 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 and avoiding stockpiling of material in vicinity of sensitive watercourses
- Where construction 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 reserved grassed buffer areas, timber fencing with silt fences or earthen berms. These measures will provide adequate treatment of constructional site runoff waters before reaching the watercourses
- Use of settlement ponds, silt traps and bunds and minimising construction activities 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 or sedi-mat
- 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 site 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's The Planning System and Flood Risk Management Guidelines (November 2009). Site compounds will not be permitted in a European Sites (i.e. Lough Corrib SAC)
- 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 with the TII document "Guidelines for the crossing of watercourses during the construction of National Road Schemes". All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 10m from watercourses and floodplain areas
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner to prevent pollution
- 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 watercourses will be fenced off to provide a buffer zone for its protection to a minimum distance of 5m except for proposed crossing points

- The use and management of concrete (which has a deleterious effect on water chemistry and aquatic habitats and species) in or close to watercourses will be carefully controlled to avoid spillage. Where on-site batching is proposed, this activity will be carried out well away from watercourses. Washout from such mixing plants will be carried out only in a designated contained impermeable area
- All Material Deposition Areas must be adequately bunded and compartmentalised such that the rainwater outflow from these facilities is adequately controlled and treated prior to reaching the receiving surface watercourses. The sediment control requirements are set out in the in the Sediment, Erosion and Pollution Control Construction Management Plan section of the CEMP (refer to Appendix C this updated NIS)

Mitigation of potential construction impacts will be achieved through the stringent implementation of good construction practice procedures and environmental controls so as minimise the opportunity for contaminated releases of construction water to the River Corrib. Refer to the Construction Environmental Management Plan (CEMP) in Appendix C of this updated NIS for mitigation measures, relevant items of which are summarised below.

Potential construction impacts in the form of sediment impact and spillages to the Lough Corrib SAC will be mitigated through the use of temporary and the permanent proposed sedimentation ponds and wetland systems with all construction site runoff being passed through such facilities prior to discharge. The provision of continuous double silt fences and temporary settlement ponds in proximity to the River Corrib and its various tributary drains including the Coolagh Lakes will mitigate the potential of construction site runoff pollution during the construction phase. No direct untreated point discharge of construction runoff to the River Corrib, its tributary drains or Coolagh Lakes will be permitted. Construction runoff post settlement treatment shall be discharged to an undisturbed vegetated buffer zone, as opposed to a direct discharge to a watercourse. Such construction discharge zones will be protected from the River Corrib by silt fencing. The regular monitoring of downstream receptor water quality for sediments and hydrocarbons and the inspection of the pollution control facilities will be carried out during construction works. Where a pollution incident is detected, construction works will be stopped until the source of the construction pollution has been identified and remedied. Details of the pollution control facilities and procedures are set out in the Sediment, Erosion and Pollution Control Construction Management Plan section of the CEMP (refer to Appendix C of this updated NIS). The pollution control and treatment facilities will be installed and the monitoring network including instrumentation and procedures established prior to construction activities taking place on the ground in the vicinity of watercourses and sensitive surface and groundwater receptors. The pollution control facilities will be monitored daily to ensure their continued integrity and desired function.

Construction site runoff discharging to the River Corrib and in particular the sediment concentrations will meet the surface water regulations and continuous monitoring of sediment concentrations in the receiving water during construction activities near the River Corrib will be carried out to ensure compliance and respond immediately to pollution events.

Given the proximity of the Project to the Coolagh Lakes, construction impacts represent a potential source of impact on the water quality of the lake from uncontrolled construction site runoff and potential contamination of the groundwater from construction spillages. This potential impact will be mitigated through the implementation of the Sediment, Erosion and Pollution Management Plan which is part of the CEMP in Appendix C of this updated NIS.

5.5 Summary

A summary of the potential impacts of the Project on the Lough Corrib SAC are provided in **Table 19** below. The proposed N6 GCRR via its drainage outfalls will provide a potential pathway for road runoff pollutants to enter the Lough Corrib SAC and Lough Corrib SPA during construction and operational phases. The potential impacts from the operational phase have been reduced in the design process to slight and imperceptible both in respect to flow regime changes and water quality impact. The potential for constructional phase impacts on water quality in the River Corrib has been reduced to slight and imperceptible through the implementation of a robust and site specific Sediment Erosion and Pollution Control Management Plan included in the CEMP in Appendix C of this updated NIS.

The impact of the Project on the surface hydrology of the Coolagh Lakes system will be imperceptible. The proposed N6 GCRR represents a potential pollution hazard and has a residual risk of pollution via contamination of the groundwater at its proposed infiltration basins. Proper management and regular inspection and maintenance of these drainage discharge facilities will significantly reduce the risk of pollution impact on the groundwater and the Coolagh Lakes system.

Table 19: Hydrological Impacts on Lough Corrib SAC (00297)

Attribute	Impact Stage	Nature of Impact	Impact description	Mitigation
Lough Corrib SAC (00297), and Lough Corrib SPA River Corrib	Construction	Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands	A major bridge construction is proposed across the River Corrib and associated with the bridge deck and the bridge piers will be the pouring of concrete and the use of chemical and grouting agents in close proximity to an internationally important waterbody. Due to the major public water abstraction located only 1.7km downstream on the east bank makes it highly sensitive to construction pollution and potential accidental spillages.	A Sediment Erosion and Pollution Control Management Plan has been prepared for the construction phase to protect watercourses by preventing any construction site runoff directly entering watercourse being treated in sedimentation ponds prior to discharge to water courses. Other measures are also drawn up in this plan which include monitoring, reduction of site runoff through cut-off drains and the use of silt fencing near watercourses.
Lough Corrib SAC (000297), Lough Corrib SPA (004042) River Corrib Coolagh Lakes	Construction	Silts and sediments arising from works adjacent to watercourses and construction site runoff	Within the River Corrib Catchment, the various streams/drains encountered provide a pathway for silts and sediment laden runoff water from the construction site to reach the Lough Corrib SAC and cause local increase in suspended solids and turbidity. These activities adjacent to the River Corrib and its floodplain provide a significant source and pathway for sediment laden runoff to enter the River Corrib with little	A Sediment Erosion and Pollution Control Management Plan has been prepared for the construction phase to protect watercourses by preventing any construction site runoff directly entering watercourse being treated in sedimentation ponds prior to discharge to water courses. Other measures are also drawn up in this plan which include monitoring, reduction of site runoff through cut-off drains and the use of silt fencing near watercourses.

Attribute	Impact Stage	Nature of Impact	Impact description	Mitigation
			buffer time available for natural filtering and settlement. The River Corrib Bridge crossing of the Lough Corrib SAC at Menlo/Dangan will not involve any in-stream works but bridge piers are to be located on either bank close to the river edge which can give rise to site runoff entering the river during works. Two bank side drainage outfalls are to be constructed which given their proximity the river flow make it difficult to prevent local disturbance of sediments. Good dilution in the River Corrib significantly lessens the potential impact on the receiving waters There is potential for construction impact in the form sediment runoff and pollution associated with the road construction in the vicinity of the Coolagh/Corrib Floodplain at Ch. 9+850 to Ch. 9+900.	
Lough Corrib SAC (000297), Lough Corrib SPA (004042) River Corrib Coolagh Lakes	Operational	Changes to Flow regime within the River Corrib	The proposed N6 GCRR slightly encroaches the River Corrib floodplain near Menlo/Coolagh Lakes at Ch. 9+850 to Ch. 9+900. The area of encroachment at the 1000year flood level is 0.27ha and at the 100year it is 0.11ha. The proposed encroachment will not	None

Attribute	Impact Stage	Nature of Impact	Impact description	Mitigation
			have any perceptible impact on flooding or on the hydrological flow regime. These encroachments are very small and the potential flood storage loss will be miniscule in relation to the River Corrib flood area and flood volume and there will be no perceptible impact on flooding or flow regime in the River Corrib, the Lough Corrib SAC and Lough Corrib SPA. A number of road outfalls discharge directly and indirectly to the Lough Corrib SAC (outfalls S14A, S14B, S15, S18A, S18B) and Lough Corrib SPA (outfall S15). These outfalls relative to the River Corrib drain a miniscule area and will have no perceptible effect on the flow rate or water depth of the River Corrib.	
Lough Corrib SAC (000297), Lough Corrib SPA (004042) River Corrib Coolagh Lakes	Operational	Impact on Receiving Water Quality of Corrib from Road Drainage at proposed road drainage outfalls	Within the River Corrib Catchment, the various streams/drains encountered provide a permanent pathway for pollutants from the road drainage waters to enter the River Corrib. The potential impact by the road drainage outfalls on the Lough Corrib SAC and SPA have been assessed as having a local	None

Attribute	Impact Stage	Nature of Impact	Impact description	Mitigation
			minor to imperceptible impact and will not affect the "Good" water quality status of the River Corrib. The potential risk of impact to the River Corrib by serious accidental road spillage has been assessed as extremely low risk and is further reduced in the design process through the provision of containment facilities in the form of petrol and oil interceptors and wetland areas upstream of the drainage outfalls	

6 Potential Impacts on Ballindooley Lough

6.1 Introduction

Ballindooley Lough is located within the Clare-Corrib Groundwater Body. The Lough has no surface stream inflows or outflows and is recharged by local overland flow and interflow from the surrounding hill slopes and by groundwater flow from the regionally important Corrib/Clare groundwater body, with groundwater flow from the west, east and north directions. Its groundwater outflow is via groundwater flow southwards in the direction of the Terryland River (based on groundwater table measurements). In summer periods the lake level is perched and outflow is via surface evaporation and some leakage to the groundwater whose level has fallen below the lake level. To ensure continued use of Ballindooley Lough by wintering bird species (some of which are listed as SCI of Inner Galway Bay SPA & Lough Corrib SPA) the natural hydrological regime of Ballindooley Lough is required to be maintained.

The Project traverses to the south of Ballindooley Lough and a section of the road embankment slightly encroaches the 100year flood zone of the lough. The effect of this encroachment on the water balance and flow regime within the lough will be imperceptible given the very minor scale of encroachment and loss of flood storage (fraction of 1 percent).

6.2 Operational Impacts

The section of the mainline of the proposed N6 GCRR from N84 Headford Road Junction to N83 Tuam Road Junction will be serviced by outfall S21B (Refer to Figure 2.9) which is designed to discharge to groundwater in the vicinity of Ballindooley Lough where the groundwater flow gradient is southwards away from the lough. As a consequence there will be no water quality or flow regime impacts on the lough from the mainline carriageway of proposed N6 GCRR during the operational phase.

A single outfall S21A servicing the on-off slip roads and 250m of the existing N84 Headford Road at the N84 Headford Road Junction will discharge via a ditch to Ballindooley Lough. The total drainage area for this section is 3.31ha and the impervious road area is 1.36ha. This represents an average inflow rate of 0.3l/s and the annual average catchment drainage inflow is 20l/s from its 225ha catchment area presenting an average dilution of 67. Ballindooley Lough potentially represents a sink for sediment with the lake rising and falling with the groundwater table and in dry weather periods its water level remains perched above the receding groundwater table.

This proposed outfall is designed with pollution control measures that include a spillage containment volume, a petrol-oil interceptor, a wetland and an attenuation pond. These measures will reduce the potential sediment load on Ballindooley Lough by well over 60%. Circa 1.4km of the existing N84 Headford Road carriageway discharges untreated and uncontrolled into Ballindooley Lough via road side trenches and a storm pipe.

An assessment of the predicted loads and concentrations from road runoff from this outfall are presented in **Table 20** below. The annual mean concentrations of dissolved copper and zinc will rise by 0.399 and 1.417 µg/l respectively based on Event Mean concentrations and loads for significant road drainage pollutants in accordance with Table 3.1 of the TII publications DNS-03065. All other parameters considered below in **Table 20** represent minor increases and will not affect the water quality status of Ballindooley Lough.

Table 20: Predicted mean loads and concentrations of stormwater pollutants to Ballindooley Lough from Outfall S21A

Main Road Drainage Pollutants	Road Runoff Load	Road Runoff Event Mean Concentration	Pollution Control Performance	Lake mean storm Inflow Concentration	Mean Lake Concentration increase
	kg/yr	µg/l	%reduction	µg/l	µg/l
Total Copper	863	91.2	60%	36.48	0.547
Dissolved CU	296	31.3	15%	26.605	0.399
Total Zinc	3336	352.6	60%	141.04	2.116
Dissolved ZN	1051	111.1	15%	94.435	1.417
Total Cadmium	5.96	0.63	60%	0.252	0.004
Total Fluoranthene	9.65	1.02	60%	0.408	0.006
Total Pyrene	9.74	1.03	60%	0.412	0.006
Total PAH	71.1	7.52	60%	3.008	0.045

Please note the predicted lake concentrations in **Table 20** above do not take reducing factors such as filtration and absorption and settlement within the lake, or of plant uptake and natural biodegradation.

6.3 Construction Impacts

During construction there is a potential for uncontrolled site runoff to enter the lake with the potential for carrying construction related pollutants, principally increased sediment into the lake body.

Construction impacts, given the proximity of the Project to the Ballindooley Lough, also represents a potential source of impact on the water quality of the lough from uncontrolled construction site runoff.

6.4 Mitigation Measures

Mitigation of such potential construction impacts will be achieved through the stringent implementation of good construction practice procedures and environmental controls so as minimise the opportunity for contaminated releases of construction water to the Ballindooley Lough. Refer to the Construction Environmental Management Plan (CEMP) in Appendix C of this updated NIS for mitigation measures, relevant items of which are summarised below.

Potential construction impacts in the form of sediment impact and spillages to Ballindooley Lough will be mitigated through the use of temporary and the permanent proposed sedimentation ponds and wetland systems with all construction site runoff being passed through such facilities prior to discharge. The provision of continuous double silt fences and temporary settlement ponds in proximity to the lough and its various tributary drains will mitigate the potential of construction site runoff pollution during the construction phase. No direct untreated point discharge of construction runoff to Ballindooley Lough or its tributary drains will be permitted.

Construction runoff post settlement treatment shall be discharged to an undisturbed vegetated buffer zone, as opposed to a direct discharge to a watercourse. Such construction discharge zones will be protected from the lough by silt fencing. The regular monitoring of receptor water quality for sediments and hydrocarbons and the inspection of the pollution control facilities will be carried out during construction works. Where a pollution incident is detected, construction works will be stopped until the source of the construction pollution has been identified and remedied. Details of the pollution control facilities and procedures are set out in the Sediment, Erosion and Pollution Control Construction Management Plan section of the CEMP (refer to Appendix C of this updated NIS), relevant items of which are summarised below.

- The pollution control and treatment facilities will be installed and the monitoring network including instrumentation and procedures established prior to construction activities taking place on the ground in the vicinity of watercourses and sensitive surface and groundwater receptors. The pollution control facilities will be monitored daily to ensure their continued integrity and desired function
- Construction site runoff discharging to Ballindooley Lough and in particular the sediment concentrations will meet the surface water regulations and that continuous monitoring of sediment concentrations in the receiving water during construction activities near the lough will be carried out to ensure compliance and respond immediately to pollution events

6.5 Summary

The Project and its drainage system both during construction and operation will have imperceptible residual hydrological impact on Ballindooley Lough. This is achieved through design of appropriate pollution control measures at its road drainage outfalls and the implementation at the construction phase of robust sediment, erosion and pollution control mitigation measures.

7 Potential Impacts to the Galway Bay Complex SAC and Inner Galway Bay SPA

7.1 Introduction

The Galway Bay Complex SAC and Inner Galway Bay SPA is a large coastal and transitional zone waterbody that represents the entire inner Galway Bay area and is located typically 1 to 2km down gradient of the Project. The proposed N6 GCRR from Ch. 2+850 to Ch. 17+460 is located within the freshwater catchment (groundwater and surface water) that discharges to the Galway Bay Complex SAC and Inner Galway Bay SPA. The Galway Bay Complex SAC and Inner Galway Bay SPA represents a waterbody having a volume at mean sea level of c.1100million m^3 and a water surface area of c.140km^2. The contributing freshwater catchment area from east of Blackhead near Ballyvaughan, County Clare to Silverstrand to the east of Bearna Village, County Galway is estimated at c.4,200km^2. The Corrib catchment at Galway City is the most significant catchment at 3,136km^2. The proposed surface drainage area of the proposed N6 GCRR is 94.85ha and the hard paved area is 61.2ha. This total surface drainage area represents a very small fraction of the total catchment area of the River Corrib that discharges to the Galway Bay Complex SAC and Inner Galway Bay SPA, at approximately 0.03% of the Corrib catchment.

7.2 Operational Impacts

For the entire length of the Project potential pathways for pollutants to enter the Galway Bay Complex SAC and Inner Galway Bay SPA exist via local surface streams and rivers discharging into Galway Bay and via the groundwater. These potential pathways exist for the current "Do-Nothing" scenario also. Such pathways apply both to the Construction Phase and the Operational Phase of the Project.

The proposed N6 GCRR is designed to TII standards and will provide a safer, less congested road that has significantly improved stormwater treatment over the existing road network. Consequently, it is concluded that the proposed N6 GCRR is likely to have a slight beneficial impact on water quality in the downstream Galway Bay Complex SAC and Inner Galway Bay SPA over the existing "Do-Nothing" scenario as all storm drainage runoff will be appropriately treated using sustainable drainage systems, petrol interceptors, wetland treatment systems and attenuation ponds and infiltration basins prior to discharge to receiving waters.

There is significant buffering between the proposed N6 GCRR and the Galway Bay Complex SAC and Inner Galway Bay SPA which minimises the potential impact of pollution runoff on these sites. The overall scale of the Galway Bay Complex SAC and Inner Galway Bay SPA and the large flushing by tidal waters over spring and neap tides eliminates any potential impact that the Project could have on the water quality of the Galway Bay Complex SAC and Inner Galway Bay SPA. In the eastern section of the proposed Project, drainage discharge is to groundwater, which is a karstified limestone conduit flow aquifer system and likely to have underground preferential flow pathways to the Galway Bay Complex SAC. Refer to Appendix

A (Hydrogeology) of this updated NIS for further details. Similar to the freshwater system the tidal mixing available will ensure that pollutant impacts by the Project during the construction and operation phases will be negligible and particularly so given the proposed storm water treatment for treatment of road runoff waters prior to discharge and the environmental pollution control measures for the construction phase. Refer to CEMP in Appendix C of this updated NIS for further details.

A road accident spillage risk assessment has been carried out for the proposed N6 GCRR using the mid-range traffic growth figures and this shows an overall low risk of a significant spillage. This risk is further reduced through the provision of petrol interceptors and bunded spillage containment areas that can be closed off to contain the contamination.

As a consequence of the small scale of the proposed N6 GCRR surface area relative to the overall freshwater catchment that discharges to the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City, there will be no perceptible impact on the flow regime within this SAC/SPA at either local or regional scale. The conservation objective of the various qualifying interest of the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City require that the natural hydrological regime is maintained in terms of the natural tidal regime, salinities, sediment supply and water quality. The drainage design proposed minimises the potential for local change in runoff and recharge rates having 31 outfalls over the 17.5km mainline length and the provision of storm water treatment and attenuation upstream of these outfalls to throttle discharge rates to greenfield runoff rates, to remove particulate pollutants and provide petrol interceptors. Therefore the Project will have no perceptible hydrological impact on Galway Bay Complex SAC and Inner Galway Bay SPA.

7.3 Construction Impacts

For the entire length of the Project, potential pathways for pollutants to enter the Galway Bay Complex SAC and Inner Galway Bay SPA exist via local surface streams and rivers discharging into Galway Bay and via the groundwater. These potential pathways exist for the current “Do-Nothing” scenario also.

Through these pathways there is potential for silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff to reach the Galway Bay Complex SAC and Inner Galway Bay SPA. Similarly, there is a risk of spillages during construction of contaminants such as hydrocarbons, cement etc. into watercourses and onto wetlands.

There is no direct encroachment of the Galway Bay Complex SAC and Inner Galway Bay SPA by the Project and therefore there is no potential for disturbance due to construction machinery or direct impacts to the flow regime by the Project.

7.4 Mitigation Measures

Potential construction pollution impacts which have a pathway via the surface water courses, and existing storm and combined sewers have an opportunity to enter the Galway Bay Complex SAC and Inner Galway Bay SPA. Mitigation of these impacts will be achieved through the stringent implementation of good construction practice procedures and environmental controls so as minimise the opportunity for contaminated releases of construction water to the River Corrib. Refer to the Construction Environmental Management Plan (CEMP) in Appendix C of this updated NIS relevant items of which are summarised below.

Potential construction impacts in the form of sediment impact and spillages to receiving watercourses and groundwater will be mitigated through the use of temporary and permanent sedimentation ponds and wetland systems with all construction site runoff being passed through such facilities prior to discharge. The provision of continuous double silt fences and temporary settlement ponds in proximity to watercourses will mitigate potential construction pollution risks. No direct untreated point discharge of construction runoff to watercourses will be permitted.

Construction runoff post settlement treatment shall be discharged to an undisturbed vegetated buffer zone, as opposed to a direct discharge to a watercourse. The regular monitoring of receptor water quality for sediments and hydrocarbons and the inspection of the pollution control facilities will be carried out during construction works. Where a pollution incident is detected, construction works will be stopped until the source of the construction pollution has been identified and remedied. Details of the pollution control facilities and procedures are set out in the Sediment, Erosion and Pollution Control Construction Management Plan section of the CEMP (refer to Appendix C of this updated NIS).

The pollution control and treatment facilities will be installed and the monitoring network including instrumentation and procedures established prior to construction activities taking place on the ground in the vicinity of watercourses and sensitive surface and groundwater receptors. The pollution control facilities will be monitored daily to ensure their continued integrity and desired function).

7.5 Summary

The proposed road drainage treatment, the good natural buffering from the receiving watercourses before reaching the Galway Bay Complex SAC and Inner Galway Bay SPA and the natural high dilution within the coastal and transitional waters of these European sites ensures that the residual impact on flow and water quality within the Galway Bay Complex SAC and Inner Galway Bay SPA both locally and regionally will be negligible.

Construction impacts arising from the Project represent a relatively low risk to water quality within the Galway Bay Complex SAC and Inner Galway Bay SPA due to the available buffering by the watercourses and by the high dilution within these European sites. To minimise further this risk of contamination to the Galway Bay Complex SAC a detailed Sediment, Erosion and Pollution Control Management Plan and incident response plan, both of which are detailed in the CEMP (Appendix C of this updated NIS), for the construction phase has been developed for this Project which provides for avoidance, reduction, mitigation and monitoring. Construction hydrological and water quality impacts on the Galway Bay Complex SAC and Inner Galway Bay SPA will be avoided.

The proposed N6 GCRR and its drainage system both during construction and operation will have imperceptible residual hydrological impact on Galway Bay Complex SAC and Inner Galway Bay SPA. This is achieved through design of appropriate pollution control measures at its road drainage outfalls and the implementation at the construction phase of robust sediment, erosion and pollution control mitigation measures.

A summary of the potential impacts on the Galway Bay Complex SAC and Inner Galway Bay SPA is provided in **Table 21** below.

Table 21: Hydrological Impacts on Galway Bay Complex SAC and Inner Galway Bay SPA

Attribute	Phase	Source	Impact description	Mitigation
Galway Bay Complex SAC (00268) Inner Galway Bay SPA (04031)	Construction	Silts and sediments arising from in stream works and works adjacent to watercourses and construction site runoff.	The various streams encountered all along the Project provide a pathway for silts and sediments runoff from the construction site to reach the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City which is typically located 1 to 2km downstream of the Project and therefore at risk of indirect water quality impacts.	A Sediment Erosion and Pollution Control Management Plan has been prepared for the construction phase to protect watercourses by preventing any construction site runoff directly entering watercourse being treated in sedimentation ponds prior to discharge to water courses. Other measures are also drawn up in this plan which include monitoring, reduction of site runoff through cut-off drains and the use of silt fencing near watercourses.
	Construction	Spillages (hydrocarbons, cement etc.) into watercourses and onto wetlands.	Construction spillages similar to silts and sediments can reach the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City via surface runoff and via groundwater.	A Construction Environmental Management Plan (CEMP), refer to Appendix C, for the construction phase has been developed to minimise the risk of serious spillages entering the groundwater and surface watercourses
	Construction	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 of the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City by the Project.	None
	Operational	Road drainage and outfalls impacting on the water quality Regime: - Routine road runoff discharges - Accidental fuel spills from road	There are no direct discharges from road drainage outfalls to the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City but most the road outfalls discharge to watercourses and groundwater aquifer that outfall to this SAC/SPA and therefore provide a pathway for contaminants to reach the SAC/SPA. The probability of	None

Attribute	Phase	Source	Impact description	Mitigation
			accidental road accident spillages is shown to be very low and sufficient dilution available to minimise the impact of routine runoff on the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City.	
	Operational	Changes to watercourse channel morphology because of culverting, diversions, channel regrading works and outfall discharges giving rise to short term erosion and deposition and morphological changes.	The Project will not impact on morphological processes in the Galway Bay Complex SAC and Inner Galway Bay SPA and particularly so as outfall discharges will be attenuated which will limit any local increase in flood runoff rates that could cause increased channel erosion. The sediment yields to the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City will not be perceptibly changed given the proposed works involved and the scale of the overall contributing catchments to the Galway Bay Complex SAC and Inner Galway Bay SPA at Galway City relative to the footprint of the proposed N6 GCRR.	None

8 Conclusion

The Project crosses the Lough Corrib SAC and Lough Corrib SPA and is adjacent to the Galway Bay Complex SAC and Inner Galway Bay SPA. The potential hydrological impacts of the Project on these European sites has been assessed in respect to hydrology and the hydrological impacts on these sites.

In respect to the Galway Bay Complex SAC and Inner Galway Bay SPA there is no direct encroachment within or adjacent to the SAC and SPA boundaries and the potential impacts arise from indirect discharges to Galway Bay Complex SAC and Inner Galway Bay SPA. Pathways via surface watercourses, groundwater flow and via existing urban foul and storm drainage systems exist for both the constructional runoff waters and operational road drainage waters to enter the Galway Bay Complex SAC and Inner Galway Bay SPA.

The assessment concludes that both operationally and during construction there will be no changes to the flow regime discharging to the Galway Bay Complex SAC and Inner Galway Bay SPA and therefore no changes to hydrological regime within these sites in terms of the flow rate, flow depth, velocity or to its physical characteristics of temperature and salinity is predicted.

The routine run-off from the road and first flush events could potentially have raised levels of heavy metals, hydrocarbons, suspended solids and salts which have a potential to impact the water quality at the local scale. The proposed road drainage design will include for spillage containment and storm water treatment facilities upstream of all proposed road drainage outfalls that discharge both to surface and groundwater systems. This water treatment will include treatment ponds and wetlands designed to capture the first flush rainfall event and will be fitted with a petrol and oil interceptor for hydrocarbon removal and a separate spillage containment volume.

The two proposed tunnel sections will have the road drainage water discharged to the public foul sewer where it will ultimately be treated at the Mutton Island Waste Water Treatment Plant before discharging to Galway Bay from Mutton Island. This volume for treatment is miniscule (fraction of a percent) in comparison to the overall sewage and combined storm volume treated at the Mutton Island Plant and discharged to the Galway Bay via the Mutton Island marine outfall and therefore will have no perceptible impact on the flow regime and water quality of the receiving Galway Bay Complex SAC and Inner Galway Bay SPA.

The proposed road drainage treatment, the good natural buffering from the receiving watercourses before reaching the Galway Bay Complex SAC and Inner Galway Bay SPA and the natural high dilution within the coastal and transitional waters of these European sites ensures that the residual impact on flow and water quality within the Galway Bay Complex SAC and Inner Galway Bay SPA both locally and regionally will be negligible.

Construction impacts arising from the Project represent a relatively low risk to water quality within the Galway Bay Complex SAC and Inner Galway Bay SPA due to the available buffering by the watercourses and by the high dilution within these European sites. To minimise further this risk of contamination to the Galway Bay Complex SAC a detailed Sediment, Erosion and Pollution Control Management Plan for the construction phase has been developed for this project which provides for avoidance, reduction, mitigation and monitoring. Construction hydrological and water quality impacts on the Galway Bay Complex SAC and Inner Galway Bay SPA will be avoided.

The proposed N6 GCRR will discharge directly and indirectly to the Lough Corrib SAC via a series of proposed road drainage outfalls. Run-off waters from four such outfalls will enter the River Corrib on its western bank at Dangan and a fifth outfall will discharge to its eastern bank south of Menlo Castle. Two further outfalls to the east of Menlo Castle will discharge to groundwater and are within the catchment of Coolagh Lakes which are also part of the Lough Corrib SAC. All road drainage outfall discharges will undergo first flush water quality treatment in a wetland and pond system and will be fitted with an oil and petrol interceptor to capture hydrocarbons. Assessment of the potential impact both at individual outfalls and the cumulative load from the five surface outfalls on the water quality of the River Corrib was assessed using two-dimensional hydrodynamic and transport dispersion modelling and using the TII HAWRAT package. The findings from this assessment clearly show that the proposed routine discharge and first flush events will be sufficiently diluted by the River Corrib flow, even during low flow conditions, as not to have any perceptible impact on the water quality status of the Lough Corrib SAC either upstream, locally or downstream. The assessment shows that water quality treatment of the first flush event through detention and wetland filtering is an important pollution control measure to reduce any potential localised impacts near the outfall point such that predicted heavy metal and suspended sediment concentrations do not exceed environmental threshold levels and easily satisfy the surface water regulations. The residual impact of the road drainage discharge on water quality in the River Corrib is assessed as imperceptible.

The proposed N6 GCRR traverses close to the Coolagh Lakes located just to the north of its winter flood extent area. There is no direct discharge of road drainage runoff proposed to the Coolagh Lakes with the proposed road drainage discharge at two outfalls directed to groundwater via a two large engineered infiltration basins within the Coolagh Lake Catchment area. These engineered infiltration fields are designed to protect groundwater quality through soil filtering in a 2m minimum deep infiltration zone of suitably permeable soil filter class. It is expected that this treated road drainage water may eventually contribute as groundwater baseflow to the Coolagh Lakes or the River Corrib further downstream. The design of the infiltration basins, coupled with the inclusion of a hydrocarbon interceptor and containment area, will provide an appropriate level of protection to prevent contamination of groundwater from the infiltration basins. Refer to the Appendix A (Hydrogeology) of this updated NIS for further details.

The proposed N6 GCRR traverses close to Ballindooley Lough with a potential slight encroachment of its extreme 100year flood zone by the road embankment.

This will have no measurable impact of the flow and flooding regime within the lake.

A single outfall S21A servicing the on-off slip roads and 250m of the existing N84 Headford Road at the N84 Headford Road Junction will discharge via a ditch to the Ballindooley Lough system. This proposed outfall is designed with pollution control measures that include a spillage containment volume, a petrol-oil interceptor, a wetland and an attenuation pond. These measures will reduce the potential sediment loading on Ballindooley Lough by well over 60%. The existing N84 Headford Road carriageway for c.1.4km currently discharges untreated and uncontrolled into Ballindooley Lough via road side trenches and a storm pipe. An assessment of the impact of the proposed road storm discharge on water quality in Ballindooley Lough shows very minor increases in pollutant concentrations within the lough and such increases will not affect the water quality status of the lough.

The construction phase of the Project in the absence of construction pollution control measures has the potential to impact water quality within the lough from uncontrolled site runoff. This will be mitigated by ensuring no direct uncontrolled site runoff to the lough is permitted with all site runoff collected and suitably treated in sedimentation ponds prior to discharge.

Flow regime change in the River Corrib either from the proposed bridge crossing or from the proposed outfalls will not occur with the outfall discharge rates being minor in respect to the River Corrib flows and the proposed bridge structure avoiding, through its very large 153m bridge span, the effective conveying floodplain of the River Corrib with no in-stream piers proposed.

Construction impacts in the form of sediment releases and spillages on the Lough Corrib SAC that includes its tributaries, the River Corrib and the Coolagh Lakes represents a potential temporary impact to water quality of these surface waters. Given their protection status construction mitigation is proposed in the form of implementing, robust and targeted pollution control measures.

A Construction Erosion Management Plan, refer to Appendix C of this updated NIS, has been prepared to mitigate all potential construction impacts on the water quality of the Lough Corrib SAC including the River Corrib and the Coolagh Lakes. Within the CEMP various avoidance, reduction, mitigation and monitoring measures are presented. The measures are specifically designed to prevent any untreated construction runoff water entering directly the River Corrib or the Coolagh Lakes systems. Construction site run-off water discharging to the River Corrib will be treated using construction settlement ponds, silt fencing and vegetated buffer areas prior to entering the River Corrib or its tributaries and the construction discharges will satisfy the surface water regulations.

The residual impact of the Project during the construction phase on the Lough Corrib SAC under the proposed mitigation will be imperceptible.

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Annex 1

Water Quality Monitoring Results

Annex 1

Water Quality Monitoring

A.1 Water Quality Monitoring

A.1.A 2015 to 2016 Data

A.1.B 2024 Data

A.1.A 2015 to 2016 Data

Annex 1A 2015 & 2016
Water Quality Monitoring of Selected Surface Waters for the N6 Galway City Ring Road

The Surface Water Sampling Locations are presented in Figure 1 as follows:
The Laboratory Water Quality Testing was carried out by Henesey Glan Uisce Teo, Na Forbartha, Co. Galway.

1.	Liberty	Sruthán na Libertí
2.	Bearna Village	Trusky Stream
3.	Cappagh South	Bearna Stream d/s of the Tonabrooky confluence
4.	Cappagh North	Bearna Stream d/s of the Tonabrooky confluence
5.	Dangan Slip	Corrib River
6.	Terryland	TerryLand intak Channel at Jordan's Island
7.	Inner Coolagh	Coolagh Lake Inner
8.	Outer Coolagh	Coolagh Lake Outer
9.	Ballindooley	Ballindooley Lough

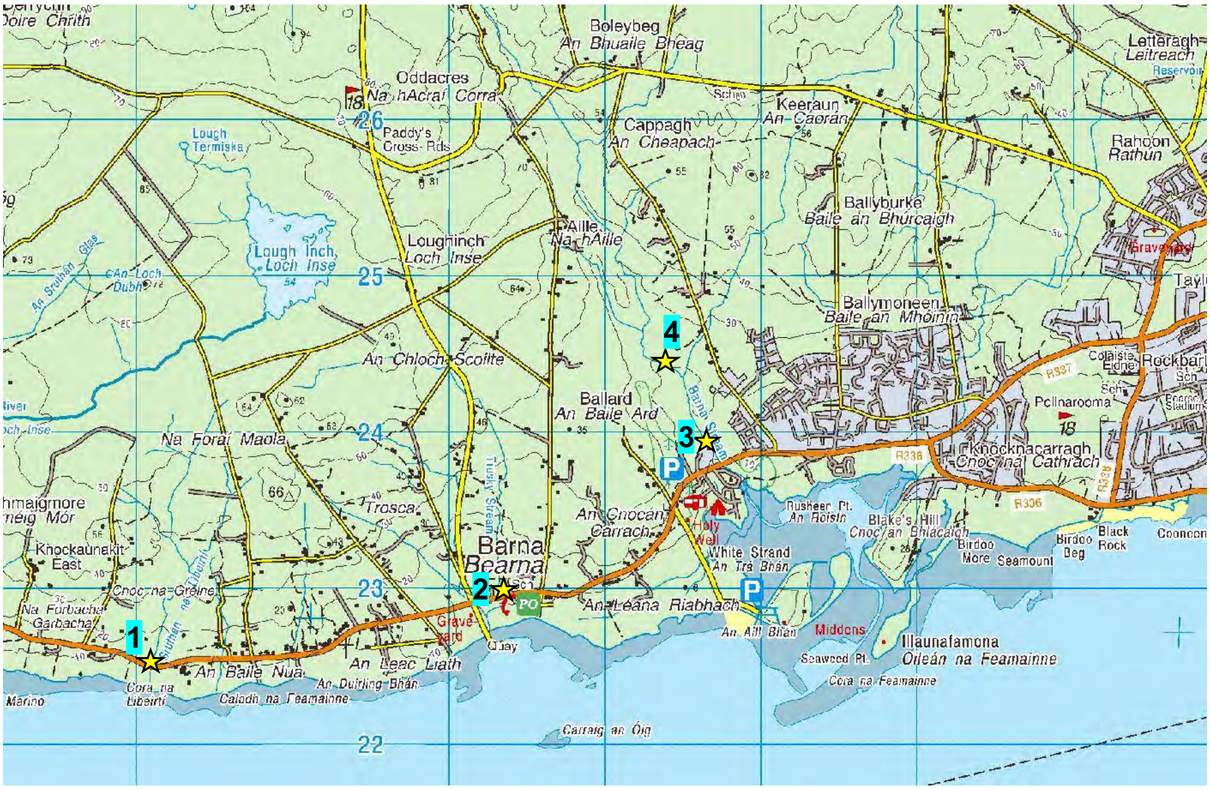

Figure 1a Location of Surface Water Quality Monitoring Sites

Figure 1b Location of Surface Water Quality Monitoring Sites (Continued)

Date	Sample Location	pH	suspended solids mg/l	COD mg/l	BOD mg/l	conductivity µS @20º	calcium mg/l	Alkalinity mg/l CaCO3	total hardness mg/l CaCO3
30.11.15	Liberty Stream	7.83	2.6	32	<2.0	227	8.06		57.3
30.11.15	Barna village	7.56	4.7	37	2.1	230	19.3		63.2
30.11.15	Cappagh south	7.46	3.9	27	<2.0	193	15.8		52.4
30.11.15	Cappagh north	7.43	2.2	26	<2.0	175	14.8		43.9
02.12.15	Waterworks	7.77	2.4	24	<2.0	417	44.5		266
30.11.15	Daingean	8.10	8.2	14	<2.0	306	55.6		149
30.11.15	Ballindooley	7.32	1.5	<10	<2.0	592	69.8		302
02.12.15	Inner Coolough	7.72	1.0	12	<2.0	510	41.4		229
04.02.16	Liberty Stream	7.90	1.2	35	<2.0			60	
04.02.16	Barna village	7.76	1.8	38	<2.0			78	
04.02.16	Cappagh south	7.67	2.0	27	<2.0			58	
04.02.16	Cappagh north	7.46	1.6	24	<2.0			50	
03.02.16	Waterworks	8.13	2.2	16	2.1			138	
03.02.16	Daingean	8.24	4.8	18	2.1			164	
03.02.16	Ballindooley	8.19	2.2	15	2.7			206	
03.02.16	Inner Coolough	8.16	<1.0	10	2.1			198	
03.02.16	Outer Coolough	8.20	1.4	10	3.2			202	
19.04.16	Liberty Stream	8.16	<1.0	90	<2.0			66	
19.04.16	Barna village	7.90	<1.0	47	<2.0			102	
19.04.16	Cappagh south	8.01	1.3	33	<2.0			86	
19.04.16	Cappagh north	7.94	1.5	36	2.2			78	
19.04.16	Waterworks	8.40	1.6	31	2.3			108	
19.04.16	Daingean	8.35	1.0	29	<2.0			118	
19.04.16	Ballindooley	7.50	8.0	49	5.8			150	
19.04.16	Inner Coolough	8.17	5.8	28	3.4			200	
19.04.16	Outer Coolough	8.24	3.8	30	3.2			204	

Date	Sample Location	pH	suspended solids mg/l	COD mg/l	BOD mg/l	conductivity µS @20º	calcium mg/l	Alkalinity mg/l CaCO3	total hardness mg/l CaCO3
08.06.16	Liberty Stream	8.02	3.0	42	<2.0			94	
08.06.16	Barna village	7.97	2.4	35	<2.0			92	
08.06.16	Cappagh south	8.02	1.0	37	<2.0			104	
08.06.16	Cappagh north	8.01	1.2	39	<2.0			100	
08.06.16	Waterworks	8.18	3.4	37	<2.0			92	
08.06.16	Daingean	8.50	2.8	37	<2.0			92	
08.06.16	Ballindooley	8.20	1.4	33	<2.0			148	
08.06.16	Inner Coolough	8.18	2.8	32	2.7			182	
08.06.16	Outer Coolough	8.26	1.8	32	<2.0			164	
24.08.16	Liberty Stream	7.88	2.1	59	<2.0			70	
24.08.16	Barna village	7.68	1.9	58	2.0			98	
24.08.16	Cappagh south	7.89	2.7	40	<2.0			80	
24.08.16	Cappagh north	7.83	3.4	51	<2.0			68	
25.08.16	Waterworks	8.33	1.0	15	<2.0			90	
25.08.16	Daingean	8.38	1.4	15	<2.0			100	
25.08.16	Ballindooley	8.42	5.3	29	<2.0			138	
25.08.16	Inner Coolough	8.11	4.4	7	<2.0			218	
25.08.16	Outer Coolough	8.32	<1.0	12	<2.0			168	

Date	Sample Location	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Total N mg/l N	Phosphate mg/l P	Total P mg/l P	faecal coliforms cfu/100ml	total coliforms cfu/100ml
30.11.15	Liberty Stream	0.025	0.505	0.005	0.901	0.01	0.017	2400	3200
30.11.15	Barna village	0.027	0.717	0.005	1.139	0.038	0.075	2700	4800
30.11.15	Cappagh south	0.026	0.502	0.003	0.84	0.009	0.017	2600	3700
30.11.15	Cappagh north	0.026	0.406	0.003	0.758	0.011	0.023	6500	8800
02.12.15	Waterworks	0.01	0.521	0.006	0.897	0.003	0.023	<1	0
30.11.15	Daingean	0.08	0.583	0.006	0.882	0.003	0.013	700	2100
30.11.15	Ballindooley	0.042	1.848	0.001	1.919	0.058	0.06	500	1600
02.12.15	Inner Coolough	0.014	0.142	0.001	0.41	<0.003	0.021	<1	0
04.02.16	Liberty Stream	0.018	0.37	0.004		0.008		70	70
04.02.16	Barna village	0.023	0.59	0.006		0.031		114	114
04.02.16	Cappagh south	0.014	0.427	0.003		0.003		64	64
04.02.16	Cappagh north	0.018	0.319	0.004		0.003		146	146
03.02.16	Waterworks	0.018	0.425	0.003		0.004		68	68
03.02.16	Daingean	0.017	0.49	0.005		0.006		63	63
03.02.16	Ballindooley	0.017	0.151	0.003		0.028		6	6
03.02.16	Inner Coolough	0.037	0.479	0.003		0.026		29	29
03.02.16	Outer Coolough	0.039	0.499	0.004		0.022		27	27
19.04.16	Liberty Stream	0.011	0.207	0.003		0.008		42	42
19.04.16	Barna village	0.019	0.59	0.003		0.026		68	68
19.04.16	Cappagh south	0.014	0.333	0.003		0.003		46	46
19.04.16	Cappagh north	0.013	0.295	0.003		0.005		35	35
19.04.16	Waterworks	0.085	0.296	0.002		<0.003		2	2
19.04.16	Daingean	0.061	0.25	0.002		<0.003		0	0
19.04.16	Ballindooley	0.184	0.016	0.001		0.03		0	0
19.04.16	Inner Coolough	0.037	0.302	0.003		<0.003		12	12
19.04.16	Outer Coolough	0.057	0.292	0.003		<0.003		0	0

Date	Sample Location	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Total N mg/l N	Phosphate mg/l P	Total P mg/l P	faecal coliforms cfu/100ml	total coliforms cfu/100ml
08.06.16	Liberty Stream	0.016	0.115	0.003		0.013		42	42
08.06.16	Barna village	0.068	1.42	0.01		0.092		136est	136est
08.06.16	Cappagh south	0.019	0.396	0.002		0.004		590	590
08.06.16	Cappagh north	0.018	0.465	0.002		0.006		630	630
08.06.16	Waterworks	0.037	0.024	0.002		0.003		99	99
08.06.16	Daingean	0.026	0.014	0.001		<0.003		87	87
08.06.16	Ballindooley	0.01	0.01	0.001		<0.003		48	48
08.06.16	Inner Coolough	0.014	0.025	<0.001		0.003		64	64
08.06.16	Outer Coolough	0.014	0.009	0.003		<0.003		0	0
24.08.16	Liberty Stream	0.014	0.213	0.006		0.011		69	69
24.08.16	Barna village	0.011	0.4	0.005		0.052		158est	158est
24.08.16	Cappagh south	0.014	0.223	0.005		0.005		98	98
24.08.16	Cappagh north	0.014	0.208	0.007		0.006		98	98
25.08.16	Waterworks	0.018	0.009	0.002		<0.003		0	0
25.08.16	Daingean	0.027	0.015	0.002		<0.003		30	30
25.08.16	Ballindooley	0.078	0.008	0.002		<0.003		21	21
25.08.16	Inner Coolough	0.014	0.676	0.002		<0.003		100	100
25.08.16	Outer Coolough	0.039	0.018	0.002		<0.003		90	90

Date	Sample Location	sulphate mg/l	chloride mg/l	sodium mg/l	potassium mg/l	magnesium mg/l	zinc mg/l	lead mg/l	copper mg/l
30.11.15	Liberty Stream	<7.0		9		1.4	<0.005		0.005
30.11.15	Barna village	<7.0		12		2.8	<0.005		<0.001
30.11.15	Cappagh south	<7.0		12		2.3	<0.005		<0.001
30.11.15	Cappagh north	<7.0		12		2.3	<0.005		<0.001
02.12.15	Waterworks	<7.0		18		1.6	<0.005		0.004
30.11.15	Daingean	<7.0		12		3.2	<0.005		<0.001
30.11.15	Ballindooley	<7.0		12		3.7	<0.005		0.004
02.12.15	Inner Coolough	18.7		12		1.8	<0.005		0.004
04.02.16	Liberty Stream	<7.0	45.2	26.3	1.72	2.5	<0.005	<0.006	0.004
04.02.16	Barna village	9.87	43.3	24.1	2.48	2.6	<0.005	<0.006	0.017
04.02.16	Cappagh south	9.24	43.3	21.2	1.72	2.1	<0.005	<0.006	0.002
04.02.16	Cappagh north	<7.0	43.3	23.1	1.44	2.1	<0.005	<0.006	<0.001
03.02.16	Waterworks	<7.0	23.5	14.3	<5	2.3	<0.005	<0.006	<0.001
03.02.16	Daingean	<7.0	21.7	13.7	<5	2.4	<0.005	<0.006	<0.001
03.02.16	Ballindooley	<7.0	34.3	23.5	4.17	3.1	<0.005	<0.006	<0.001
03.02.16	Inner Coolough	20.8	34.3	20.7	1.96	2.4	<0.005	<0.006	0.001
03.02.16	Outer Coolough	22.2	32.5	19.5	1.89	2.5	<0.005	<0.006	<0.001
19.04.16	Liberty Stream	<7.0	37.9	30.2	0.96	3.28	<0.005	<0.004	0.003
19.04.16	Barna village	22	41.5	31.9	1.95	3.98	<0.005	<0.004	0.022
19.04.16	Cappagh south	14.3	36.1	27.1	1.61	3.27	<0.005	<0.004	0.002
19.04.16	Cappagh north	<7.0	32.5	26.2	1.12	3.18	<0.005	<0.004	0.001
19.04.16	Waterworks	<7.0	27.1	16.9	0.97	3.79	<0.005	<0.004	0.001
19.04.16	Daingean	<7.0	28.9	17.9	0.98	2.93	<0.005	<0.004	0.001
19.04.16	Ballindooley	<7.0	39.7	26.9	3.91	3.56	<0.005	<0.004	0.001
19.04.16	Inner Coolough	13.5	43.3	23.9	1.6	2.95	<0.005	<0.004	0.001
19.04.16	Outer Coolough	26.7	27.1	27.5	1.79	3.4	<0.005	<0.004	0.001

Date	Sample Location	sulphate mg/l	chloride mg/l	sodium mg/l	potassium mg/l	magnesium mg/l	zinc mg/l	lead mg/l	copper mg/l
08.06.16	Liberty Stream	28.9	63	33	1	4	<0.005	<0.0005	<0.001
08.06.16	Barna village	40.5	43.2	32	4	4	<0.005	<0.0005	0.025
08.06.16	Cappagh south	18.5	32.4	26	2	4	<0.005	<0.0005	<0.001
08.06.16	Cappagh north	16.1	39.6	25	2	4	<0.005	<0.0005	<0.001
08.06.16	Waterworks	<7.0	23.4	19	1	3	<0.005	<0.0005	<0.001
08.06.16	Daingean	<7.0	25.2	18	1	3	<0.005	<0.0005	<0.001
08.06.16	Ballindooley	<7.0	36.9	26	3	3	<0.005	<0.0005	<0.001
08.06.16	Inner Coolough	24	35.1	25	2	3	<0.005	<0.0005	<0.001
08.06.16	Outer Coolough	14.2	34.2	23	2	3	<0.005	<0.0005	<0.001
24.08.16	Liberty Stream	<7.0	36.1	26	1	3	<0.005	<0.0005	<0.001
24.08.16	Barna village	46.1	34.3	25	3	4	<0.005	<0.0005	0.01
24.08.16	Cappagh south	<7.0	36.1	22	2	3	<0.005	<0.0005	<0.001
24.08.16	Cappagh north	<7.0	25.3	21	2	3	<0.005	<0.0005	<0.001
25.08.16	Waterworks	<7.0	19.9	14	1	3	<0.005	<0.0005	<0.001
25.08.16	Daingean	<7.0	30.7	14	1	3	<0.005	<0.0005	<0.001
25.08.16	Ballindooley	<7.0	36.1	19	2	3	<0.005	<0.0005	<0.001
25.08.16	Inner Coolough	18.6	30.7	17	2	3	<0.005	<0.0005	<0.001
25.08.16	Outer Coolough	25.9	37.9	17	2	3	<0.005	<0.0005	<0.001

Date	Sample Location	iron mg/l	manganese mg/l	chromium µg/l	cadmium µg/l	Extractable hydrocarbons mg/l	TDS mg/l	PAH total ng/l	turbidity NTU
30.11.15	Liberty Stream	0.027	<0.005			62			2.13
30.11.15	Barna village	0.098	<0.005			44			3.01
30.11.15	Cappagh south	0.082	<0.005			57			2.1
30.11.15	Cappagh north	0.088	<0.005			78			1.8
02.12.15	Waterworks	0.053	0.032			37			0.3
30.11.15	Daingean	0.031	<0.005			55			6.58
30.11.15	Ballindooley	0.026	<0.005			21			1.08
02.12.15	Inner Coolough	0.011	0.005			63			0.25
04.02.16	Liberty Stream	0.202	<0.005	<0.5			202		
04.02.16	Barna village	0.333	<0.005	0.6			196		
04.02.16	Cappagh south	0.198	<0.005	<0.5			160		
04.02.16	Cappagh north	0.201	0.006	<0.5			160		
03.02.16	Waterworks	0.148	<0.005	<0.5			166		
03.02.16	Daingean	0.178	<0.005	<0.5			200		
03.02.16	Ballindooley	0.178	<0.005	<0.5			264		
03.02.16	Inner Coolough	0.163	<0.005	<0.5			294		
03.02.16	Outer Coolough	0.188	<0.005	<0.5			306		
19.04.16	Liberty Stream	0.17	0.009	<0.9	<0.09		182		
19.04.16	Barna village	0.267	0.022	<0.9	<0.09		216		
19.04.16	Cappagh south	0.316	0.044	<0.9	<0.09		178		
19.04.16	Cappagh north	0.457	0.045	<0.9	<0.09		154		
19.04.16	Waterworks	0.058	0.008	<0.9	<0.09		158		
19.04.16	Daingean	0.053	0.006	<0.9	<0.09		158		
19.04.16	Ballindooley	0.035	0.009	<0.9	<0.09		254		
19.04.16	Inner Coolough	0.022	0.006	<0.9	<0.09		310		
19.04.16	Outer Coolough	0.011	0.004	<0.9	<0.09		318		

Date	Sample Location	iron mg/l	manganese mg/l	chromium µg/l	cadmium µg/l	Extractable hydrocarbons mg/l	TDS mg/l	PAH total ng/l	turbidity NTU
08.06.16	Liberty Stream	0.026	<0.005	<0.5	<0.5		202		
08.06.16	Barna village	0.015	<0.005	<0.5	<0.5		208		
08.06.16	Cappagh south	0.05	0.015	<0.5	<0.5		196		
08.06.16	Cappagh north	0.046	0.007	<0.5	<0.5		266		
08.06.16	Waterworks	0.078	0.013	<0.5	<0.5		198		
08.06.16	Daingean	0.059	0.008	<0.5	<0.5		196		
08.06.16	Ballindooley	<0.010	<0.005	<0.5	<0.5		248		
08.06.16	Inner Coolough	<0.010	<0.005	<0.5	<0.5		296		
08.06.16	Outer Coolough	0.013	0.007	<0.5	<0.5		270		
24.08.16	Liberty Stream	0.336	0.019	<0.5	<0.5		164		
24.08.16	Barna village	0.367	0.013	<0.5	<0.5		220		
24.08.16	Cappagh south	0.537	0.035	<0.5	<0.5		158		
24.08.16	Cappagh north	0.712	0.033	<0.5	<0.5		156		
25.08.16	Waterworks	0.039	0.008	<0.5	<0.5	53	144	5	
25.08.16	Daingean	0.029	0.01	<0.5	<0.5	106	146	4	
25.08.16	Ballindooley	<0.010	<0.005	<0.5	<0.5	197	224	8	
25.08.16	Inner Coolough	<0.010	<0.005	<0.5	<0.5	70	280	8	
25.08.16	Outer Coolough	<0.010	<0.005	<0.5	<0.5	134	250	17	

HENSEY GLAN-UISCE TEO.
Coismeigmore, Furbo, Co. Galway.

ENVIRONMENTAL MONITORING REPORT

Hydro Environmental Ltd.,
4, Caisel Riada,
Clarinbridge,
Co. Galway

N6 sampling sites: November 2015

Table 1.

Date	Sample	pH	conductivity	Turbidity*	suspended solids	COD	BOD	Sulphate
			µS @20°	NTU	mg/l	mg/l	mg/l	mg/l
30.11.15	1	7.83	227	2.1	2.6	32	<2.0	<7.0
30.11.15	2	7.56	230	3.0	4.7	37	2.1	<7.0
30.11.15	3	7.46	193	2.1	3.9	27	<2.0	<7.0
30.11.15	4	7.43	175	1.8	2.2	26	<2.0	<7.0
30.11.15	5	8.10	306	6.6	8.2	14	<2.0	<7.0
02.12.15	6	7.72	510	0.25	1.0	12	<2.0	18.7
02.12.15	7	7.77	417	0.30	2.4	24	<2.0	<7.0
30.11.15	8	7.32	592	1.1	1.5	<10	<2.0	<7.0

Table 2.

Date	Sample	Ammonia	Nitrate	Nitrite	Total N*	Phosphate	Total P*
		mg/l N	mg/l N	mg/l N	mg/l N	mg/l P	mg/l P
30.11.15	1	0.025	0.505	0.005	0.901	0.010	0.017
30.11.15	2	0.027	0.717	0.005	1.139	0.038	0.075
30.11.15	3	0.026	0.502	0.003	0.840	0.009	0.017
30.11.15	4	0.026	0.406	0.003	0.758	0.011	0.023
30.11.15	5	0.080	0.583	0.006	0.882	0.003	0.013
02.12.15	6	0.014	0.142	0.001	0.410	<0.003	0.021
02.12.15	7	0.010	0.521	0.006	0.897	0.003	0.023
30.11.15	8	0.042	1.848	0.001	1.919	0.058	0.060

Test methods. The following methods were used for sample analysis:

pH: Method No. 12 Revision No. 3
Conductivity: Method No. 19 Revision No. 0
Phosphate : Method No. 5 Revision No. 9
Ammonia : Method No. 2 Rev No. 012
Nitrite : Method No. 10 Rev No. 004
Nitrate : Method No. 11 Rev No. 003
BOD: Method No. 4 Revision No. 12
Suspended Solids: Method No. 7 Revision No. 4
COD: Method No. 13 Revision No. 4
Sulphate (as SO_4) : Method No. 14 Revision No. 2

*not accredited

SIGNED..Mary Hensey.............. DATE..3-2-16....
Mary Hensey M.Sc.

ilac-MRA

INAB ISO 17025 ACCREDITED TESTING DETAILED IN SCOPE REG NO.047T

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CERTIFICATE OF ANALYSIS

Client	:	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway

Report No.	:	280070
Date of Receipt	:	01/12/2015
Start Date of Analysis	:	01/12/2015
Date of Report	:	28/01/2016
Order Number	:	
Sample taken by	:	Client

Lab No	Sample Description	Test	*	Result	Units
638929	TLN 1	Total Coliforms (Filtration)	R	3,200	cfu/100ml
		Copper, total	R	5	ug/l
		Sodium, total	R	9	mg/l
		Iron, total	R	27	ug/l
		Total Hardness (Kone)	R	57.3	mg/l CaCO3
		Calcium, total	S	8.06	mg/l
		Faecal Coliforms (Filtration)	R	2,400	cfu/100ml
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	62 ** Unknown Pattern	ug/l
		Magnesium, total (in water)	S	1.4	mg/l

** Note: The comment expressed here is an interpretation and is not INAB accredited

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
Hensey Glan Uisce Teo.
Coismeigmore
Furbo
Co. Galway

Report No. : 280071
Date of Receipt : 01/12/2015
Start Date of Analysis : 01/12/2015
Date of Report : 28/01/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
638930	TLN 2	Copper, total	R	<1	ug/l
		Sodium, total	R	12	mg/l
		Iron, total	R	98	ug/l
		Total Hardness (Kone)	R	63.2	mg/l CaCO3
		Calcium, total	S	19.3	mg/l
		Faecal Coliforms (Filtration)	R	2,700	cfu/100ml
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	4,800	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	44 ** Unknown Pattern	ug/l
		Magnesium, total (in water)	S	2.8	mg/l

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Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client	:	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway		

Report No.	:	280073
Date of Receipt	:	01/12/2015
Start Date of Analysis	:	01/12/2015
Date of Report	:	28/01/2016
Order Number	:	
Sample taken by	:	Client

Lab No	Sample Description	Test	*	Result	Units
638932	TLN 3	Copper, total	R	<1	ug/l
		Sodium, total	R	12	mg/l
		Iron, total	R	82	ug/l
		Total Hardness (Kone)	R	52.4	mg/l CaCO3
		Calcium, total	S	15.8	mg/l
		Faecal Coliforms (Filtration)	R	2,600	cfu/100ml
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	3,700	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	57 ** Unknown Pattern	ug/l
		Magnesium, total (in water)	S	2.3	mg/l

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Client :	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway	Report No.	: 280074
		Date of Receipt	: 01/12/2015
		Start Date of Analysis	: 01/12/2015
		Date of Report	: 28/01/2016
		Order Number	:
		Sample taken by	: Client

Lab No	Sample Description	Test	*	Result	Units
638933	TLN 4	Copper, total	R	<1	ug/l
		Sodium, total	R	12	mg/l
		Iron, total	R	88	ug/l
		Total Hardness (Kone)	R	43.9	mg/l CaCO3
		Calcium, total	S	14.8	mg/l
		Faecal Coliforms (Filtration)	R	6,500	cfu/100ml
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	8,800	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	78 ** Unknown Pattern	ug/l
		Magnesium, total (in water)	S	2.3	mg/l

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Furbo
Co. Galway

Report No. : 280076
Date of Receipt : 01/12/2015
Start Date of Analysis : 01/12/2015
Date of Report : 28/01/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
638935	TLN 5	Copper, total	R	<1	ug/l
		Sodium, total	R	12	mg/l
		Iron, total	R	31	ug/l
		Total Hardness (Kone)	R	149	mg/l CaCO3
		Faecal Coliforms (Filtration)	R	700	cfu/100ml
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	2,100	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	55 ** Unknown Pattern	ug/l
		Calcium, total (in water)	S	55.6	mg/l
		Magnesium, total (in water)	S	3.2	mg/l

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Barbara Lee
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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Coismeigmore
Furbo
Co. Galway

Report No. : 280247
Date of Receipt : 02/12/2015
Start Date of Analysis : 02/12/2015
Date of Report : 28/01/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
639230	TLN 6	Copper, total	R	4	ug/l
		Sodium, total	R	12	mg/l
		Iron, total	R	11	ug/l
		Total Hardness (Kone)	R	229	mg/l CaCO3
		Faecal Coliforms (Filtration)	R	< 1	cfu/100ml
		Manganese, total	R	5	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	0	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	63 ** Unknown Pattern	ug/l
		Calcium, total (in water)	S	41.4	mg/l
		Magnesium, total (in water)	S	1.8	mg/l

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Barbara Lee
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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Co. Galway

Report No. : 280248
Date of Receipt : 02/12/2015
Start Date of Analysis : 02/12/2015
Date of Report : 28/01/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
639231	TLN 7	Copper, total	R	4	ug/l
		Sodium, total	R	18	mg/l
		Iron, total	R	53	ug/l
		Total Hardness (Kone)	R	266	mg/l CaCO3
		Faecal Coliforms (Filtration)	R	< 1	cfu/100ml
		Manganese, total	R	32	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	0	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	37 ** Unknown Pattern	ug/l
		Calcium, total (in water)	S	44.5	mg/l
		Magnesium, total (in water)	S	1.6	mg/l

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Report No. : 280077
Date of Receipt : 01/12/2015
Start Date of Analysis : 01/12/2015
Date of Report : 28/01/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
638936	TLN 8	Copper, total	R	4	ug/l
		Sodium, total	R	12	mg/l
		Iron, total	R	26	ug/l
		Total Hardness (Kone)	R	302	mg/l CaCO3
		Faecal Coliforms (Filtration)	R	500	cfu/100ml
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Total Coliforms (Filtration) (Environmental Waters)	R	1,600	cfu/100ml
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	21 ** Unknown Pattern	ug/l
		Calcium, total (in water)	S	69.8	mg/l
		Magnesium, total (in water)	S	3.7	mg/l

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

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Barbara Lee
Environmental Scientist

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HENSEY GLAN-UISCE TEO.
Coismeigmore, Furbo, Co. Galway.

ENVIRONMENTAL MONITORING REPORT

Hydro Environmental Ltd.,
4, Caisel Riada,
Clarinbridge,
Co. Galway

N6 sampling sites: February 2016

Table 1.

Date	Sample	Temperature	pH	suspended solids	TDS*	COD	BOD	Alkalinity*
		°C		mg/l	mg/l	mg/l	mg/l	mg/l $CaCO_3$
04.02.16	Liberty Stream	8.1	7.90	1.2	202	35	<2.0	60
04.02.16	Barna village	8.5	7.76	1.8	196	38	<2.0	78
04.02.16	Cappagh south	8.5	7.67	2.0	160	27	<2.0	58
04.02.16	Cappagh north	8.6	7.46	1.6	160	24	<2.0	50
03.02.16	Waterworks		8.13	2.2	166	16	2.1	138
03.02.16	Daingean		8.24	4.8	200	18	2.1	164
03.02.16	Ballindooley		8.19	2.2	264	15	2.7	206
03.02.16	Inner Coolough		8.16	<1.0	294	10	2.1	198
03.02.16	Outer Coolough		8.20	1.4	306	10	3.2	202

Table 2.

Date	Sample	Ammonia	Nitrate	Nitrite	Phosphate	sulphate	chloride
		mg/l N	mg/l N	mg/l N	mg/l P	mg/l	mg/l
04.02.16	Liberty Stream	0.018	0.370	0.004	0.008	<7.0	45.2
04.02.16	Barna village	0.023	0.590	0.006	0.031	9.87	43.3
04.02.16	Cappagh south	0.014	0.427	0.003	0.003	9.24	43.3
04.02.16	Cappagh north	0.018	0.319	0.004	0.003	<7.0	43.3
03.02.16	Waterworks	0.018	0.425	0.003	0.004	<7.0	23.5
03.02.16	Daingean	0.017	0.490	0.005	0.006	<7.0	21.7
03.02.16	Ballindooley	0.017	0.151	0.003	0.028	<7.0	34.3
03.02.16	Inner Coolough	0.037	0.479	0.003	0.026	20.8	34.3
03.02.16	Outer Coolough	0.039	0.499	0.004	0.022	22.2	32.5

Test methods. The following methods were used for sample analysis:

pH: Method No. 12 Revision No. 3
Phosphate : Method No. 5 Revision No. 9
Ammonia : Method No. 2 Rev No. 012
Nitrite : Method No. 10 Rev No. 004
Nitrate : Method No. 11 Rev No. 003
BOD: Method No. 4 Revision No. 12
Suspended Solids: Method No. 7 Revision No. 4
COD: Method No. 13 Revision No. 4
Chloride : Method No. 9 Revision No. 3
Sulphate (as SO_4) : Method No. 14 Revision No. 2

*not accredited

SIGNED..Mary Hensey.................. DATE..16-3-16...
Mary Hensey M.Sc.

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Coismeigmore
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Co. Galway

Report No. : 285762
Date of Receipt : 05/02/2016
Start Date of Analysis : 05/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651927	TLN 1	Copper, total	R	4	ug/l
		Iron, total	R	202	ug/l
		Potassium, total (in water)	S	1.72	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	70	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	70	cfu/100ml
		Sodium, total (potable water)	S	26.3	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.5	mg/l

INAB ISO 17025 ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
Hensey Glan Uisce Teo.
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Furbo
Co. Galway

Report No. : 285763
Date of Receipt : 05/02/2016
Start Date of Analysis : 05/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651928	TLN 2	Copper, total	R	17	ug/l
		Iron, total	R	333	ug/l
		Potassium, total (in water)	S	2.48	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	0.6	ug/l
		E coli (Filtration) (Environmental Waters)	R	114	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	114	cfu/100ml
		Sodium, total (potable water)	S	24.1	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.6	mg/l

INAB ISO 17025 ACCREDITED TESTING DETAILED IN SCOPE REG NO. 106T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Co. Galway

Report No. : 285764
Date of Receipt : 05/02/2016
Start Date of Analysis : 05/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651929	TLN 3	Copper, total	R	2	ug/l
		Iron, total	R	198	ug/l
		Potassium, total (in water)	S	1.72	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	64	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	64	cfu/100ml
		Sodium, total (potable water)	S	21.2	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.1	mg/l

INAB ISO 17025 ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
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Scientist

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CERTIFICATE OF ANALYSIS

Client	:	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway	Report No. Date of Receipt Start Date of Analysis Date of Report Order Number Sample taken by	: 285765 : 05/02/2016 : 05/02/2016 : 23/02/2016 : : Client

Lab No	Sample Description	Test	*	Result	Units
651930	TLN 4	Copper, total	R	<1	ug/l
		Iron, total	R	201	ug/l
		Potassium, total (in water)	S	1.44	mg/l
		Manganese, total	R	6	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	146	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	146	cfu/100ml
		Sodium, total (potable water)	S	23.1	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.1	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Co. Galway

Report No. : 285647
Date of Receipt : 04/02/2016
Start Date of Analysis : 04/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651559	TC 1	Copper, total	R	<1	ug/l
		Iron, total	R	148	ug/l
		Potassium, total (in water)	S	1.19	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	68	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	68	cfu/100ml
		Sodium, total (potable water)	S	14.3	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.3	mg/l

INAB ISO 17025 ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
Hensey Glan Uisce Teo.
Coismeigmore
Furbo
Co. Galway

Report No. : 285648
Date of Receipt : 04/02/2016
Start Date of Analysis : 04/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651560	TC 2	Copper, total	R	<1	ug/l
		Iron, total	R	178	ug/l
		Potassium, total (in water)	S	1.37	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	63	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	63	cfu/100ml
		Sodium, total (potable water)	S	13.7	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.4	mg/l

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CERTIFICATE OF ANALYSIS

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Report No. : 285649
Date of Receipt : 04/02/2016
Start Date of Analysis : 04/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651561	TC 3	Copper, total	R	<1	ug/l
		Iron, total	R	178	ug/l
		Potassium, total (in water)	S	4.17	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	6	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	6	cfu/100ml
		Sodium, total (potable water)	S	23.5	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	3.1	mg/l

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Report No. : 285650
Date of Receipt : 04/02/2016
Start Date of Analysis : 04/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651562	TC 4	Copper, total	R	1	ug/l
		Iron, total	R	163	ug/l
		Potassium, total (in water)	S	1.96	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	29	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	29	cfu/100ml
		Sodium, total (potable water)	S	20.7	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.4	mg/l

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Report No. : 285651
Date of Receipt : 04/02/2016
Start Date of Analysis : 04/02/2016
Date of Report : 23/02/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
651563	TC 5	Copper, total	R	<1	ug/l
		Iron, total	R	188	ug/l
		Potassium, total (in water)	S	1.89	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		E coli (Filtration) (Environmental Waters)	R	27	cfu/100ml
		Total Coliforms (Filtration) (Environmental Waters)	R	27	cfu/100ml
		Sodium, total (potable water)	S	19.5	mg/l
		Lead, total (in water)	S	<0.006	mg/l
		Magnesium, total (in water)	S	2.5	mg/l

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HENSEY GLAN-UISCE TEO.
Coismeigmore, Furbo, Co. Galway.

ENVIRONMENTAL MONITORING REPORT

Hydro Environmental Ltd.,
4, Caisel Riada,
Clarinbridge,
Co. Galway

N6 sampling sites: April 2016

Table 1.

Date	Sample	Temperature	pH	suspended solids	TDS*	COD	BOD	Alkalinity*
		°C		mg/l	mg/l	mg/l	mg/l	mg/l $CaCO_3$
19.04.16	Liberty Stream	9.0	8.16	<1.0	182	90	<2.0	66
19.04.16	Barna village	9.1	7.90	<1.0	216	47	<2.0	102
19.04.16	Cappagh south	9.5	8.01	1.3	178	33	<2.0	86
19.04.16	Cappagh north	10.0	7.94	1.5	154	36	2.2	78
19.04.16	Waterworks		8.40	1.6	158	31	2.3	108
19.04.16	Daingean		8.35	1.0	158	29	<2.0	118
19.04.16	Ballindooley		7.50	8.0	25~~5~~4 254	49	5.8	150
19.04.16	Inner Coolough		8.17	5.8	310	28	3.4	200
19.04.16	Outer Coolough		8.24	3.8	318	30	3.2	204

Table 2.

Date	Sample	Ammonia	Nitrate	Nitrite	Phosphate	sulphate	chloride
		mg/l N	mg/l N	mg/l N	mg/l P	mg/l	mg/l
19.04.16	Liberty Stream	0.011	0.207	0.003	0.008	<7.0	37.9
19.04.16	Barna village	0.019	0.590	0.003	0.026	22	41.5
19.04.16	Cappagh south	0.014	0.333	0.003	0.003	14.3	36.1
19.04.16	Cappagh north	0.013	0.295	0.003	0.005	<7.0	32.5
19.04.16	Waterworks	0.085	0.296	0.002	<0.003	<7.0	27.1
19.04.16	Daingean	0.061	0.250	0.002	<0.003	<7.0	28.9
19.04.16	Ballindooley	0.184	0.016	0.001	0.030	<7.0	39.7
19.04.16	Inner Coolough	0.037	0.302	0.003	<0.003	13.5	43.3
19.04.16	Outer Coolough	0.057	0.292	0.003	<0.003	26.7	27.1

Test methods. The following methods were used for sample analysis:

pH: Method No. 12 Revision No. 3
Phosphate : Method No. 5 Revision No. 9
Ammonia : Method No. 2 Rev No. 012
Nitrite : Method No. 10 Rev No. 004
Nitrate : Method No. 11 Rev No. 003
BOD: Method No. 4 Revision No. 12
Suspended Solids: Method No. 7 Revision No. 4
COD: Method No. 13 Revision No. 4
Chloride : Method No. 9 Revision No. 3
Sulphate (as SO_4) : Method No. 14 Revision No. 2

*not accredited

SIGNED... Mary Hensey ...
Mary Hensey M.Sc.

DATE..31 - 5 - 16..

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ilac-MRA

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 047T

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Co. Galway

Report No. : 292906
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668678	TCN 1 19/04/16	E coli (Filtration)	R	42	cfu/100ml
		Total Coliforms (Filtration)	R	42	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	170	ug/l
		Manganese Total 10 days TAT	S	9.39	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	3.28	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	0.96	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	30.2	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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Report No. : 292914
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668686	TCN 2 19/04/16	E coli (Filtration)	R	68	cfu/100ml
		Total Coliforms (Filtration)	R	68	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	267	ug/l
		Manganese Total 10 days TAT	S	22	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	22.3	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	1.95	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	31.9	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

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CERTIFICATE OF ANALYSIS

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Report No. : 292912
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668687	TCN 3 19/04/16	E coli (Filtration)	R	46	cfu/100ml
		Total Coliforms (Filtration)	R	46	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	316	ug/l
		Manganese Total 10 days TAT	S	43.7	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	1.45	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	1.61	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	27.1	mg/l

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Client	:	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway	Report No. Date of Receipt Start Date of Analysis Date of Report Order Number Sample taken by	: : : : : :	292913 19/04/2016 19/04/2016 18/05/2016 Client

Lab No	Sample Description	Test	*	Result	Units
668688	TCN 4 19/04/16	E coli (Filtration)	R	35	cfu/100ml
		Total Coliforms (Filtration)	R	35	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	457	ug/l
		Manganese Total 10 days TAT	S	45	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	1.09	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	1.12	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	26.2	mg/l

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CERTIFICATE OF ANALYSIS

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Report No. : 292915
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668689	TCN 5 19/04/16	E coli (Filtration)	R	2	cfu/100ml
		Total Coliforms (Filtration)	R	2	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	57.9	ug/l
		Manganese Total 10 days TAT	S	8.18	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	0.78	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	0.97	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	16.9	mg/l

INAB ISO 17025 ACCREDITED TESTING
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CERTIFICATE OF ANALYSIS

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Report No. : 292916
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668690	TCN 6 19/04/16	E coli (Filtration)	R	0	cfu/100ml
		Total Coliforms (Filtration)	R	0	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	52.8	ug/l
		Manganese Total 10 days TAT	S	6.08	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	0.69	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	0.98	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	17.9	mg/l

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Report No. : 292917
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668691	TCN 7 19/04/16	E coli (Filtration)	R	0	cfu/100ml
		Total Coliforms (Filtration)	R	0	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	34.9	ug/l
		Manganese Total 10 days TAT	S	8.54	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	0.52	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	3.91	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	26.9	mg/l

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Report No. : 292918
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
668693	TCN 8 19/04/16	E coli (Filtration)	R	12	cfu/100ml
		Total Coliforms (Filtration)	R	12	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	21.9	ug/l
		Manganese Total 10 days TAT	S	6.18	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	0.87	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	1.6	mg/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	23.9	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
Hensey Glan Uisce Teo.
Coismeigmore
Furbo
Co. Galway

Report No. : 292919
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 18/05/2016
Order Number :
Sample taken by : CLS

Lab No	Sample Description	Test	*	Result	Units
668695	TCN 9 19/04/16	E coli (Filtration)	R	0	cfu/100ml
		Total Coliforms (Filtration)	R	0	cfu/100ml
		Lead Total	S	<0.38	ug/l
		Iron Total 10 days TAT10	S	10.6	ug/l
		Manganese Total 10 days TAT	S	3.63	ug/l
		Chromium Total 10 days	S	<0.93	ug/l
		Copper Total 10 days	S	0.74	ug/l
		Zinc Total 10 days	S	<4.6	ug/l
		Potassium Total 10 days	S	1.79	ug/l
		Cadmium Total 10 days	S	<0.09	ug/l
		Sodium Total 10 days	S	27.5	mg/l

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 108T

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Co. Galway

Report No. : 295865
Date of Receipt : 19/04/2016
Start Date of Analysis : 19/04/2016
Date of Report : 31/05/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
676220	TCN 1 19/04/16	Magnesium Total 10 days	S	3.28	mg/l
676221	TCN 2 19/04/16	Magnesium Total 10 days	S	3.98	mg/l
676222	TCN 3 19/04/16	Magnesium Total 10 days	S	3.27	mg/l
676223	TCN 4 19/04/16	Magnesium Total 10 days	S	3.18	mg/l
676224	TCN 5 19/04/16	Magnesium Total 10 days	S	3.79	mg/l
676225	TCN 6 19/04/16	Magnesium Total 10 days	S	2.93	mg/l
676226	TCN 7 19/04/16	Magnesium Total 10 days	S	3.56	mg/l
676227	TCN 8 19/04/16	Magnesium Total 10 days	S	2.95	mg/l
676228	TCN 9 19/04/16	Magnesium Total 10 days	S	3.4	mg/l

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HENSEY GLAN-UISCE TEO.
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ENVIRONMENTAL MONITORING REPORT

Hydro Environmental Ltd.,
4, Caisel Riada,
Clarinbridge,
Co. Galway

N6 sampling sites: June 2016

Table 1.

Date	Sample	Temperature	pH	suspended solids	TDS*	COD	BOD	Alkalinity*
		°C		mg/l	mg/l	mg/l	mg/l	mg/l $CaCO_3$
08.06.16	Liberty Stream	16.3	8.02	3.0	202	42	<2.0	94
08.06.16	Barna village	14.6	7.97	2.4	208	35	<2.0	92
08.06.16	Cappagh south	17.0	8.02	1.0	196	37	<2.0	104
08.06.16	Cappagh north	18.2	8.01	1.2	266	39	<2.0	100
08.06.16	Waterworks		8.18	3.4	198	37	<2.0	92
08.06.16	Daingean		8.50	2.8	196	37	<2.0	92
08.06.16	Ballindooley		8.20	1.4	248	33	<2.0	148
08.06.16	Inner Coolough		8.18	2.8	296	32	2.7	182
08.06.16	Outer Coolough		8.26	1.8	270	32	<2.0	164

Table 2.

Date	Sample	Ammonia	Nitrate	Nitrite	Phosphate	sulphate	chloride
		mg/l N	mg/l N	mg/l N	mg/l P	mg/l	mg/l
08.06.16	Liberty Stream	0.016	0.115	0.003	0.013	28.9	63.0
08.06.16	Barna village	0.068	1.420	0.010	0.092	40.5	43.2
08.06.16	Cappagh south	0.019	0.396	0.002	0.004	18.5	32.4
08.06.16	Cappagh north	0.018	0.465	0.002	0.006	16.1	39.6
08.06.16	Waterworks	0.037	0.024	0.002	0.003	<7.0	23.4
08.06.16	Daingean	0.026	0.014	0.001	<0.003	<7.0	25.2
08.06.16	Ballindooley	0.010	0.010	0.001	<0.003	<7.0	36.9
08.06.16	Inner Coolough	0.014	0.025	<0.001	0.003	24.0	35.1
08.06.16	Outer Coolough	0.014	0.009	0.003	<0.003	14.2	34.2

Test methods. The following methods were used for sample analysis:

pH: Method No. 12 Revision No. 4
Phosphate : Method No. 5 Revision No. 9
Ammonia : Method No. 2 Rev No. 012
Nitrite : Method No. 10 Rev No. 004
Nitrate : Method No. 11 Rev No. 003
BOD: Method No. 4 Revision No. 12
Suspended Solids: Method No. 7 Revision No. 4
COD: Method No. 13 Revision No. 4
Chloride : Method No. 9 Revision No. 3
Sulphate (as SO_4) : Method No. 14 Revision No. 2

*not accredited

SIGNED......Mary Hensey............ DATE..18-7-16...
Mary Hensey M.Sc.

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Coismeigmore
Furbo
Co. Galway

Report No. : 297872
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 07/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680446	TCN 1 08/06/16	E coli (Filtration)	R	42	cfu/100ml
		Total Coliforms (Filtration)	R	42	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	33	mg/l
		Iron, total	R	26	ug/l
		Potassium, total	R	1	mg/l
		Magnesium, total	R	4	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Furbo
Co. Galway

Report No. : 301235
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 07/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680447	TCN 2 08/06/16	E coli (Filtration)	R	136est	cfu/100ml
		Total Coliforms (Filtration)	R	136est	cfu/100ml
		Copper, total	R	25	ug/l
		Sodium, total	R	32	mg/l
		Iron, total	R	15	ug/l
		Potassium, total	R	4	mg/l
		Magnesium, total	R	4	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

**Note: est means that results obtained were calculated from plates containing greater than 100 colonies

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Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Report No. : 297873
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 07/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680448	TCN 3 08/06/16	E coli (Filtration)	R	590	cfu/100ml
		Total Coliforms (Filtration)	R	590	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	26	mg/l
		Iron, total	R	50	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	4	mg/l
		Manganese, total	R	15	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

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Barbara Lee
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CERTIFICATE OF ANALYSIS

Client	:	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway	Report No. Date of Receipt Start Date of Analysis Date of Report Order Number Sample taken by	: 297874 : 09/06/2016 : 09/06/2016 : 07/07/2016 : : Client

Lab No	Sample Description	Test	*	Result	Units
680450	TCN 4 08/06/16	E coli (Filtration)	R	630	cfu/100ml
		Total Coliforms (Filtration)	R	630	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	25	mg/l
		Iron, total	R	46	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	4	mg/l
		Manganese, total	R	7	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

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Client	:	Mary Hensey Hensey Glan Uisce Teo. Coismeigmore Furbo Co. Galway	Report No. Date of Receipt Start Date of Analysis Date of Report Order Number Sample taken by	: 297875 : 09/06/2016 : 09/06/2016 : 15/07/2016 : : Client

Lab No	Sample Description	Test	*	Result	Units
680452	TCN 5 08/06/16	E coli (Filtration)	R	99	cfu/100ml
		Total Coliforms (Filtration)	R	99	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	19	mg/l
		Iron, total	R	78	ug/l
		Potassium, total	R	1	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	13	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

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Barbara Lee
Environmental Scientist

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Report No. : 297876
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 15/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680454	TCN 6 08/06/16	E coli (Filtration)	R	87	cfu/100ml
		Total Coliforms (Filtration)	R	87	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	18	mg/l
		Iron, total	R	59	ug/l
		Potassium, total	R	1	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	8	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

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CERTIFICATE OF ANALYSIS

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Report No. : 297877
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 15/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680456	TCN 7 08/06/16	E coli (Filtration)	R	48	cfu/100ml
		Total Coliforms (Filtration)	R	48	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	26	mg/l
		Iron, total	R	<10	ug/l
		Potassium, total	R	3	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

ISO 17025 INAB ACCREDITED TESTING
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CERTIFICATE OF ANALYSIS

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Report No. : 297878
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 15/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680457	TCN 8 08/06/16	E coli (Filtration)	R	64	cfu/100ml
		Total Coliforms (Filtration)	R	64	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	25	mg/l
		Iron, total	R	<10	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 108T

Approved by: Barbara Lee

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Report No. : 297879
Date of Receipt : 09/06/2016
Start Date of Analysis : 09/06/2016
Date of Report : 15/07/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
680459	TCN 9 08/06/16	E coli (Filtration)	R	0	cfu/100ml
		Total Coliforms (Filtration)	R	0	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	23	mg/l
		Iron, total	R	13	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	7	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

ISO 17025 INAB ACCREDITED TESTING
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HENSEY GLAN-UISCE TEO.
Coismeigmore, Furbo, Co. Galway.

ENVIRONMENTAL MONITORING REPORT

Hydro Environmental Ltd.,
4, Caisel Riada,
Clarinbridge,
Co. Galway

N6 sampling sites: August 2016

Table 1.

Date	Sample	pH	suspended solids	TDS*	COD	BOD	Alkalinity*
			mg/l	mg/l	mg/l	mg/l	mg/l $CaCO_3$
24.08.16	Liberty Stream	7.88	2.1	164	59	<2.0	70
24.08.16	Barna village	7.68	1.9	220	58	2.0	98
24.08.16	Cappagh south	7.89	2.7	158	40	<2.0	80
24.08.16	Cappagh north	7.83	3.4	156	51	<2.0	68
25.08.16	Waterworks	8.33	1.0	144	15	<2.0	90
25.08.16	Daingean	8.38	1.4	146	15	<2.0	100
25.08.16	Ballindooley	8.42	5.3	224	29	<2.0	138
25.08.16	Inner Coolough	8.11	4.4	280	<10	<2.0	218
25.08.16	Outer Coolough	8.32	<1.0	250	12	<2.0	168

Table 2.

Date	Sample	Ammonia	Nitrate	Nitrite	Phosphate	sulphate	chloride
		mg/l N	mg/l N	mg/l N	mg/l P	mg/l	mg/l
24.08.16	Liberty Stream	0.014	0.213	0.006	0.011	<7.0	36.1
24.08.16	Barna village	0.011	0.400	0.005	0.052	46.1	34.3
24.08.16	Cappagh south	0.014	0.223	0.005	0.005	<7.0	36.1
24.08.16	Cappagh north	0.014	0.208	0.007	0.006	<7.0	25.3
25.08.16	Waterworks	0.018	0.009	0.002	<0.003	<7.0	19.9
25.08.16	Daingean	0.027	0.015	0.002	<0.003	<7.0	30.7
25.08.16	Ballindooley	0.078	0.008	0.002	<0.003	<7.0	36.1
25.08.16	Inner Coolough	0.014	0.676	0.002	<0.003	18.6	30.7
25.08.16	Outer Coolough	0.039	0.018	0.002	<0.003	25.9	37.9

Test methods. The following methods were used for sample analysis:

pH: Method No. 12 Revision No. 5
Phosphate : Method No. 5 Revision No. 9
Ammonia : Method No. 2 Rev No. 012
Nitrite : Method No. 10 Rev No. 004
Nitrate : Method No. 11 Rev No. 003
BOD: Method No. 4 Revision No. 12
Suspended Solids: Method No. 7 Revision No. 4
COD: Method No. 13 Revision No. 4
Chloride : Method No. 9 Revision No. 3
Sulphate (as SO_4) : Method No. 14 Revision No. 2

*not accredited

SIGNED........Mary Hensey........ DATE..14-9-16..
Mary Hensey M.Sc.

ilac-MRA
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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Coismeigmore
Furbo
Co. Galway

Report No. : 306063
Date of Receipt : 25/08/2016
Start Date of Analysis : 25/08/2016
Date of Report : 07/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
700595	TCN 1 24/08/16	E coli (Filtration)	R	69	cfu/100ml
		Total Coliforms (Filtration)	R	69	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	26	mg/l
		Iron, total	R	336	ug/l
		Potassium, total	R	1	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	19	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

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Approved by: Barbara Lee

Barbara Lee
Environmental Scientist

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Client : Mary Hensey
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Co. Galway

Report No. : 306065
Date of Receipt : 25/08/2016
Start Date of Analysis : 25/08/2016
Date of Report : 07/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
700598	TCN 2 24/08/16	E coli (Filtration)	R	158est	cfu/100ml
		Total Coliforms (Filtration)	R	158est	cfu/100ml
		Copper, total	R	10	ug/l
		Sodium, total	R	25	mg/l
		Iron, total	R	367	ug/l
		Potassium, total	R	3	mg/l
		Magnesium, total	R	4	mg/l
		Manganese, total	R	13	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

*Note: est means that results obtained were calculated from plates containing greater than 100 colonies

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Report No. : 306066
Date of Receipt : 25/08/2016
Start Date of Analysis : 25/08/2016
Date of Report : 13/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
700601	TCN 3 24/08/16	E coli (Filtration)	R	98	cfu/100ml
		Total Coliforms (Filtration)	R	98	cfu/100ml
		Copper, total	R	<2	ug/l
		Sodium, total	R	22	mg/l
		Iron, total	R	537	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	35	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<1	ug/l

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CERTIFICATE OF ANALYSIS

Client : Mary Hensey
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Furbo
Co. Galway

Report No. : 306067
Date of Receipt : 25/08/2016
Start Date of Analysis : 25/08/2016
Date of Report : 07/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
700603	TCN 4 24/08/16	E coli (Filtration)	R	98	cfu/100ml
		Total Coliforms (Filtration)	R	98	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	21	mg/l
		Iron, total	R	712	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	33	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l

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Co. Galway

Report No. : 306138
Date of Receipt : 26/08/2016
Start Date of Analysis : 26/08/2016
Date of Report : 06/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
700994	TCN 5 25/08/16	E coli (Filtration)	R	0	cfu/100ml
		Total Coliforms (Filtration)	R	0	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	14	mg/l
		Iron, total	R	39	ug/l
		Potassium, total	R	1	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	8	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l
		PAH total	R	5	ng/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	53 **Unknown Pattern	ug/l

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Approved by: Barbara Lee

Barbara Lee
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Report No. : 306139
Date of Receipt : 26/08/2016
Start Date of Analysis : 26/08/2016
Date of Report : 12/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
701000	TCN 6 25/08/16	E coli (Filtration)	R	30	cfu/100ml
		Total Coliforms (Filtration)	R	30	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	14	mg/l
		Iron, total	R	29	ug/l
		Potassium, total	R	1	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	10	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l
		PAH total	R	4	ng/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	106 **Unknown Pattern	ug/l

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Report No. : 306140
Date of Receipt : 26/08/2016
Start Date of Analysis : 26/08/2016
Date of Report : 12/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
701005	TCN 7 25/08/16	E coli (Filtration)	R	21	cfu/100ml
		Total Coliforms (Filtration)	R	21	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	19	mg/l
		Iron, total	R	<10	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l
		PAH total	R	8	ng/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	197 **Unknown Pattern	ug/l

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Report No. : 306141
Date of Receipt : 26/08/2016
Start Date of Analysis : 26/08/2016
Date of Report : 12/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
701008	TCN 8 25/08/16	E coli (Filtration)	R	100	cfu/100ml
		Total Coliforms (Filtration)	R	100	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	17	mg/l
		Iron, total	R	<10	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l
		PAH total	R	8	ng/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and Lube Oil) by GC-FID	R	70 **Unknown Pattern	ug/l

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Report No. : 306142
Date of Receipt : 26/08/2016
Start Date of Analysis : 26/08/2016
Date of Report : 12/09/2016
Order Number :
Sample taken by : Client

Lab No	Sample Description	Test	*	Result	Units
701011	TCN 9 25/08/16	E coli (Filtration)	R	90	cfu/100ml
		Total Coliforms (Filtration)	R	90	cfu/100ml
		Copper, total	R	<1	ug/l
		Sodium, total	R	17	mg/l
		Iron, total	R	<10	ug/l
		Potassium, total	R	2	mg/l
		Magnesium, total	R	3	mg/l
		Manganese, total	R	<5	ug/l
		Zinc, total	R	<5	ug/l
		Chromium, total	R	<0.5	ug/l
		Lead, total	R	<0.5	ug/l
		Cadmium, total	R	<0.5	ug/l
		PAH total	R	17	ng/l
		Extractable Hydrocarbons Water (C8-C40, Diesel Range and *Lube Oil) by GC-FID*	R	134 **Unknown *Pattern*	ug/l

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A.1.B 2024 Data

Annex 1.2 2024 Updated Data
Water Quality Monitoring of Selected Surface Waters for the N6 Galway City Ring Road Project

The Surface Water Sampling Locations are presented in Figure 1 as follows:
The Laboratory Water Quality Testing was carried out by Henesey Glan Uisce Teo, Na Forbartha, Co. Galway and CLS Laboratories Galway City.

1.	Liberty	Sruthán na Libertí
2.	Bearna Village	Trusky Stream
3.	Cappagh South	Bearna Stream d/s of the Tonabrooky confluence
4.	Cappagh North	Bearna Stream d/s of the Tonabrooky confluence
5.	Dangan Slip	Corrib River
6.	Terryland	TerryLand water intake Jordan's Island
6'.	New Intake	New water Intake Corrib Dyke Road Terryland
7.	Inner Coolagh	Coolagh Lake Inner
8.	Outer Coolagh	Coolagh Lake Outer
9.	Ballindooley	Ballindooley Lough

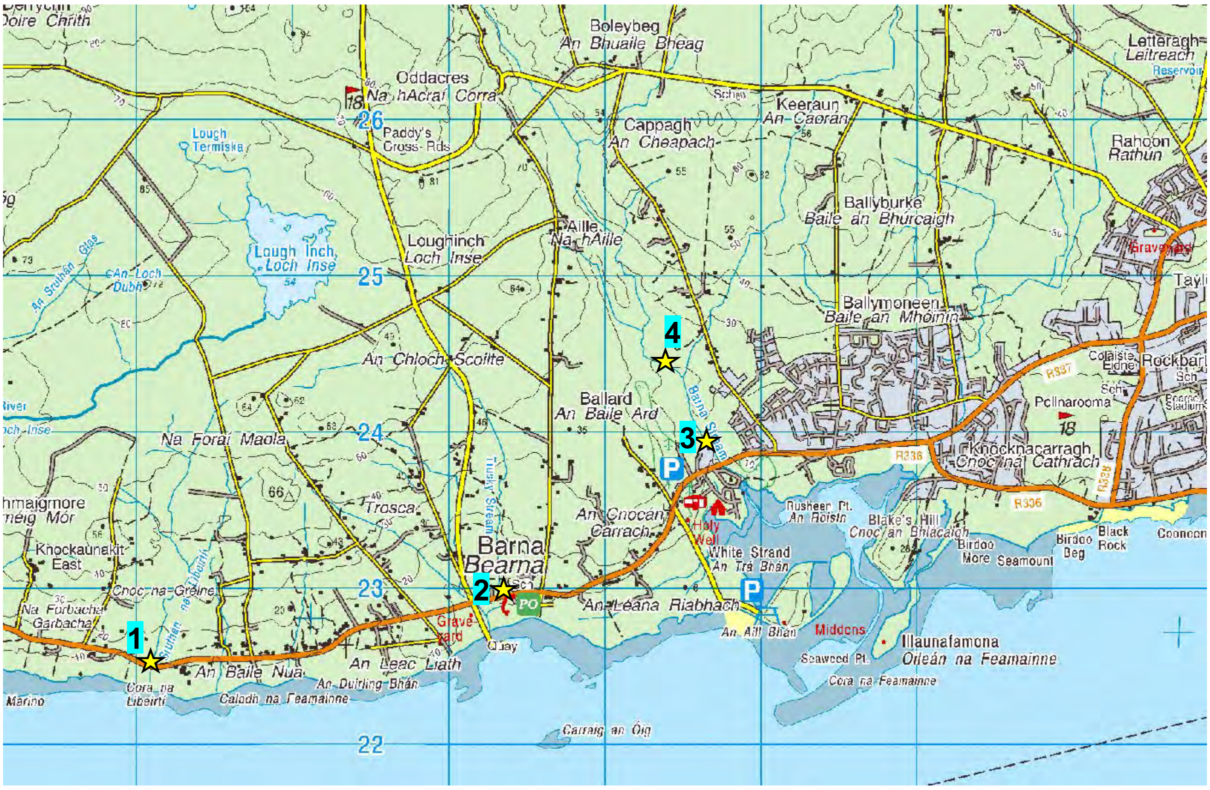

Figure 1a Location of Surface Water Quality Monitoring Sites

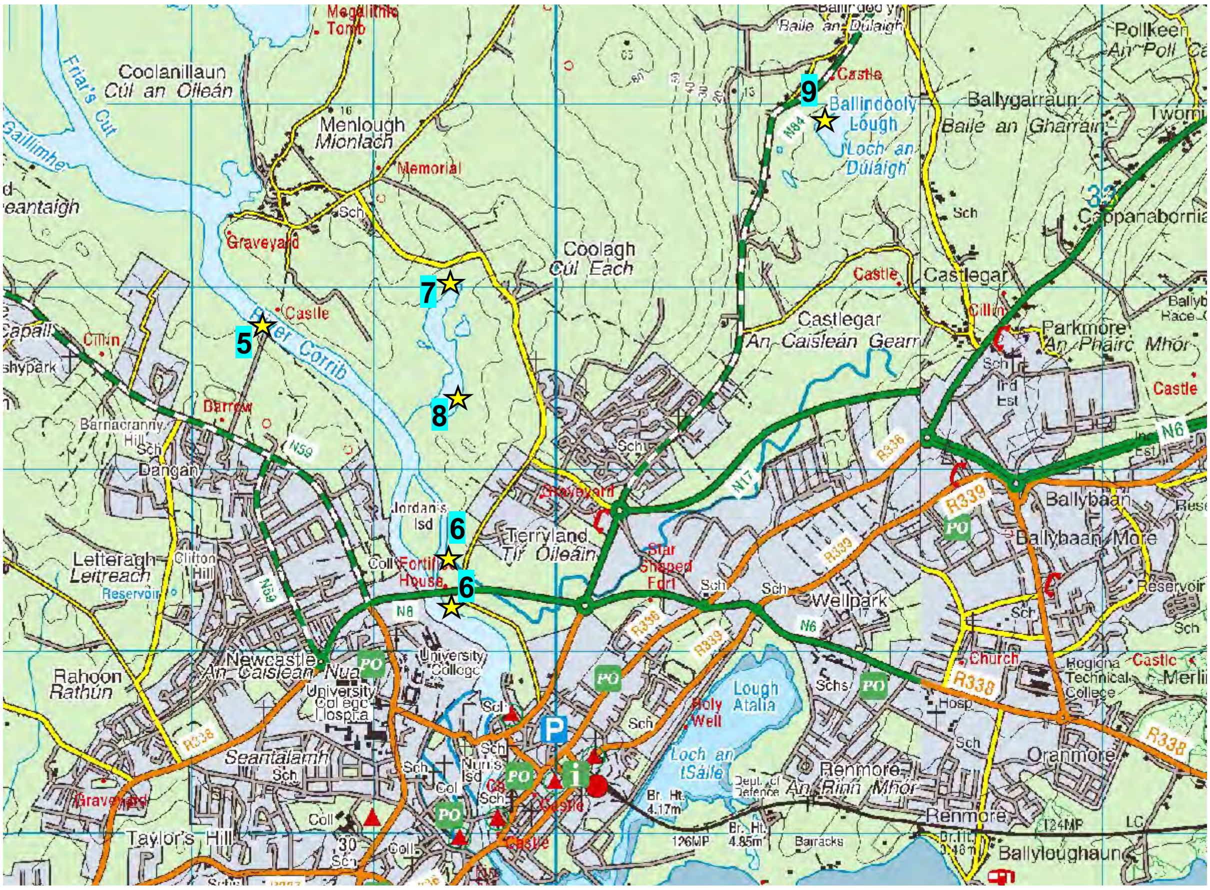

Figure 1b Location of Surface Water Quality Monitoring Sites (Continued)

Date	Sample Location	pH	suspended solids mg/l	COD mg/l	BOD mg/l	conductivity µS @20º	calcium mg/l	Alkalinity mg/l CaCO3	total hardness mg/l CaCO3
30.11.15	Liberty Stream	7.83	2.6	32	<2.0	227	8.06		57.3
30.11.15	Barna village	7.56	4.7	37	2.1	230	19.3		63.2
30.11.15	Cappagh south	7.46	3.9	27	<2.0	193	15.8		52.4
30.11.15	Cappagh north	7.43	2.2	26	<2.0	175	14.8		43.9
02.12.15	Waterworks	7.77	2.4	24	<2.0	417	44.5		266
30.11.15	Daingean	8.10	8.2	14	<2.0	306	55.6		149
30.11.15	Ballindooley	7.32	1.5	<10	<2.0	592	69.8		302
02.12.15	Inner Coolough	7.72	1.0	12	<2.0	510	41.4		229
04.02.16	Liberty Stream	7.90	1.2	35	<2.0			60	
04.02.16	Barna village	7.76	1.8	38	<2.0			78	
04.02.16	Cappagh south	7.67	2.0	27	<2.0			58	
04.02.16	Cappagh north	7.46	1.6	24	<2.0			50	
03.02.16	Waterworks	8.13	2.2	16	2.1			138	
03.02.16	Daingean	8.24	4.8	18	2.1			164	
03.02.16	Ballindooley	8.19	2.2	15	2.7			206	
03.02.16	Inner Coolough	8.16	<1.0	10	2.1			198	
03.02.16	Outer Coolough	8.20	1.4	10	3.2			202	
19.04.16	Liberty Stream	8.16	<1.0	90	<2.0			66	
19.04.16	Barna village	7.90	<1.0	47	<2.0			102	
19.04.16	Cappagh south	8.01	1.3	33	<2.0			86	
19.04.16	Cappagh north	7.94	1.5	36	2.2			78	
19.04.16	Waterworks	8.40	1.6	31	2.3			108	
19.04.16	Daingean	8.35	1.0	29	<2.0			118	
19.04.16	Ballindooley	7.50	8.0	49	5.8			150	
19.04.16	Inner Coolough	8.17	5.8	28	3.4			200	
19.04.16	Outer Coolough	8.24	3.8	30	3.2			204	

Date	Sample Location	pH	suspended solids mg/l	COD mg/l	BOD mg/l	conductivity µS @20º	calcium mg/l	Alkalinity mg/l CaCO3	total hardness mg/l CaCO3
08.06.16	Liberty Stream	8.02	3.0	42	<2.0			94	
08.06.16	Barna village	7.97	2.4	35	<2.0			92	
08.06.16	Cappagh south	8.02	1.0	37	<2.0			104	
08.06.16	Cappagh north	8.01	1.2	39	<2.0			100	
08.06.16	Waterworks	8.18	3.4	37	<2.0			92	
08.06.16	Daingean	8.50	2.8	37	<2.0			92	
08.06.16	Ballindooley	8.20	1.4	33	<2.0			148	
08.06.16	Inner Coolough	8.18	2.8	32	2.7			182	
08.06.16	Outer Coolough	8.26	1.8	32	<2.0			164	
24.08.16	Liberty Stream	7.88	2.1	59	<2.0			70	
24.08.16	Barna village	7.68	1.9	58	2.0			98	
24.08.16	Cappagh south	7.89	2.7	40	<2.0			80	
24.08.16	Cappagh north	7.83	3.4	51	<2.0			68	
25.08.16	Waterworks	8.33	1.0	15	<2.0			90	
25.08.16	Daingean	8.38	1.4	15	<2.0			100	
25.08.16	Ballindooley	8.42	5.3	29	<2.0			138	
25.08.16	Inner Coolough	8.11	4.4	7	<2.0			218	
25.08.16	Outer Coolough	8.32	<1.0	12	<2.0			168	
13.03.24	Liberty Stream	7.70	2.0	41	3	163	19	43.2	54.7
12.03.24	Barna village	7.60	2.0	37	1.0	215	30	76.6	81.5
12.03.24	Barna Stream Cappagh N	7.50	<2	36	1	149	19	47.6	54.1
13.03.24	Barna Stream Cappagh S	7.70	<2	27	<1	171	23	57.6	62.4
13.03.24	Corrib New Intake (ref 6')	8.40	5.0	14	<1	245	46	118	114
12.03.24	Daingean	8.20	<2	<10	<1	264	48	127	123
12.03.24	Ballindooley	8.00	<2	14	2	392	70	186	176
12.03.24	Inner Coolough	7.90	87.0	107	<4	390	79	208	190

Date	Sample Location	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Total N mg/l N	Phosphate mg/l P	Total P mg/l P	faecal coliforms cfu/100ml	total coliforms cfu/100ml
30.11.15	Liberty Stream	0.025	0.505	0.005	0.901	0.01	0.017	2400	3200
30.11.15	Barna village	0.027	0.717	0.005	1.139	0.038	0.075	2700	4800
30.11.15	Cappagh south	0.026	0.502	0.003	0.84	0.009	0.017	2600	3700
30.11.15	Cappagh north	0.026	0.406	0.003	0.758	0.011	0.023	6500	8800
02.12.15	Waterworks	0.01	0.521	0.006	0.897	0.003	0.023	<1	0
30.11.15	Daingean	0.08	0.583	0.006	0.882	0.003	0.013	700	2100
30.11.15	Ballindooley	0.042	1.848	0.001	1.919	0.058	0.06	500	1600
02.12.15	Inner Coolough	0.014	0.142	0.001	0.41	<0.003	0.021	<1	0
04.02.16	Liberty Stream	0.018	0.37	0.004		0.008		70	70
04.02.16	Barna village	0.023	0.59	0.006		0.031		114	114
04.02.16	Cappagh south	0.014	0.427	0.003		0.003		64	64
04.02.16	Cappagh north	0.018	0.319	0.004		0.003		146	146
03.02.16	Waterworks	0.018	0.425	0.003		0.004		68	68
03.02.16	Daingean	0.017	0.49	0.005		0.006		63	63
03.02.16	Ballindooley	0.017	0.151	0.003		0.028		6	6
03.02.16	Inner Coolough	0.037	0.479	0.003		0.026		29	29
03.02.16	Outer Coolough	0.039	0.499	0.004		0.022		27	27
19.04.16	Liberty Stream	0.011	0.207	0.003		0.008		42	42
19.04.16	Barna village	0.019	0.59	0.003		0.026		68	68
19.04.16	Cappagh south	0.014	0.333	0.003		0.003		46	46
19.04.16	Cappagh north	0.013	0.295	0.003		0.005		35	35
19.04.16	Waterworks	0.085	0.296	0.002		<0.003		2	2
19.04.16	Daingean	0.061	0.25	0.002		<0.003		0	0
19.04.16	Ballindooley	0.184	0.016	0.001		0.03		0	0
19.04.16	Inner Coolough	0.037	0.302	0.003		<0.003		12	12
19.04.16	Outer Coolough	0.057	0.292	0.003		<0.003		0	0

Date	Sample Location	Ammonia mg/l N	Nitrate mg/l N	Nitrite mg/l N	Total N mg/l N	Phosphate mg/l P	Total P mg/l P	faecal coliforms cfu/100ml	total coliforms cfu/100ml
08.06.16	Liberty Stream	0.016	0.115	0.003		0.013		42	42
08.06.16	Barna village	0.068	1.42	0.01		0.092		136est	136est
08.06.16	Cappagh south	0.019	0.396	0.002		0.004		590	590
08.06.16	Cappagh north	0.018	0.465	0.002		0.006		630	630
08.06.16	Waterworks	0.037	0.024	0.002		0.003		99	99
08.06.16	Daingean	0.026	0.014	0.001		<0.003		87	87
08.06.16	Ballindooley	0.01	0.01	0.001		<0.003		48	48
08.06.16	Inner Coolough	0.014	0.025	<0.001		0.003		64	64
08.06.16	Outer Coolough	0.014	0.009	0.003		<0.003		0	0
24.08.16	Liberty Stream	0.014	0.213	0.006		0.011		69	69
24.08.16	Barna village	0.011	0.4	0.005		0.052		158est	158est
24.08.16	Cappagh south	0.014	0.223	0.005		0.005		98	98
24.08.16	Cappagh north	0.014	0.208	0.007		0.006		98	98
25.08.16	Waterworks	0.018	0.009	0.002		<0.003		0	0
25.08.16	Daingean	0.027	0.015	0.002		<0.003		30	30
25.08.16	Ballindooley	0.078	0.008	0.002		<0.003		21	21
25.08.16	Inner Coolough	0.014	0.676	0.002		<0.003		100	100
25.08.16	Outer Coolough	0.039	0.018	0.002		<0.003		90	90
13.03.24	Liberty Stream	0.019	0.19	<0.005	1.28	0.043	<0.05	330	>1,000
12.03.24	Barna village	0.01	0.467	<0.005	1.06	0.068	0.06	>100	>100
12.03.24	Barna Stream Cappagh N	0.013	0.191	<0.005	0.561	<0.03	<0.05	>100	>100
13.03.24	Barna Stream Cappagh S	0.013	0.229	<0.005	0.641	<0.03	<0.05	480	60
13.03.24	Corrib New Intake (ref 6’	0.01	0.345	<0.005	0.525	<0.03	<0.05	15	>100
12.03.24	Daingean	0.01	0.418	<0.005	0.778	<0.03	<0.05	32	>100
12.03.24	Ballindooley	0.01	<0.1	<0.005	<0.5	0.042	0.06	21	17
12.03.24	Inner Coolough	0.006	0.548	<0.005	0.876	0.04	0.17	30	860

Date	Sample Location	sulphate mg/l	chloride mg/l	sodium mg/l	potassium mg/l	magnesium mg/l	zinc mg/l	lead mg/l	copper mg/l
30.11.15	Liberty Stream	<7.0		9		1.4	<0.005		0.005
30.11.15	Barna village	<7.0		12		2.8	<0.005		<0.001
30.11.15	Cappagh south	<7.0		12		2.3	<0.005		<0.001
30.11.15	Cappagh north	<7.0		12		2.3	<0.005		<0.001
02.12.15	Waterworks	<7.0		18		1.6	<0.005		0.004
30.11.15	Daingean	<7.0		12		3.2	<0.005		<0.001
30.11.15	Ballindooley	<7.0		12		3.7	<0.005		0.004
02.12.15	Inner Coolough	18.7		12		1.8	<0.005		0.004
04.02.16	Liberty Stream	<7.0	45.2	26.3	1.72	2.5	<0.005	<0.006	0.004
04.02.16	Barna village	9.87	43.3	24.1	2.48	2.6	<0.005	<0.006	0.017
04.02.16	Cappagh south	9.24	43.3	21.2	1.72	2.1	<0.005	<0.006	0.002
04.02.16	Cappagh north	<7.0	43.3	23.1	1.44	2.1	<0.005	<0.006	<0.001
03.02.16	Waterworks	<7.0	23.5	14.3	<5	2.3	<0.005	<0.006	<0.001
03.02.16	Daingean	<7.0	21.7	13.7	<5	2.4	<0.005	<0.006	<0.001
03.02.16	Ballindooley	<7.0	34.3	23.5	4.17	3.1	<0.005	<0.006	<0.001
03.02.16	Inner Coolough	20.8	34.3	20.7	1.96	2.4	<0.005	<0.006	0.001
03.02.16	Outer Coolough	22.2	32.5	19.5	1.89	2.5	<0.005	<0.006	<0.001
19.04.16	Liberty Stream	<7.0	37.9	30.2	0.96	3.28	<0.005	<0.004	0.003
19.04.16	Barna village	22	41.5	31.9	1.95	3.98	<0.005	<0.004	0.022
19.04.16	Cappagh south	14.3	36.1	27.1	1.61	3.27	<0.005	<0.004	0.002
19.04.16	Cappagh north	<7.0	32.5	26.2	1.12	3.18	<0.005	<0.004	0.001
19.04.16	Waterworks	<7.0	27.1	16.9	0.97	3.79	<0.005	<0.004	0.001
19.04.16	Daingean	<7.0	28.9	17.9	0.98	2.93	<0.005	<0.004	0.001
19.04.16	Ballindooley	<7.0	39.7	26.9	3.91	3.56	<0.005	<0.004	0.001
19.04.16	Inner Coolough	13.5	43.3	23.9	1.6	2.95	<0.005	<0.004	0.001
19.04.16	Outer Coolough	26.7	27.1	27.5	1.79	3.4	<0.005	<0.004	0.001

Date	Sample Location	sulphate mg/l	chloride mg/l	sodium mg/l	potassium mg/l	magnesium mg/l	zinc mg/l	lead mg/l	copper mg/l
08.06.16	Liberty Stream	28.9	63	33	1	4	<0.005	<0.0005	<0.001
08.06.16	Barna village	40.5	43.2	32	4	4	<0.005	<0.0005	0.025
08.06.16	Cappagh south	18.5	32.4	26	2	4	<0.005	<0.0005	<0.001
08.06.16	Cappagh north	16.1	39.6	25	2	4	<0.005	<0.0005	<0.001
08.06.16	Waterworks	<7.0	23.4	19	1	3	<0.005	<0.0005	<0.001
08.06.16	Daingean	<7.0	25.2	18	1	3	<0.005	<0.0005	<0.001
08.06.16	Ballindooley	<7.0	36.9	26	3	3	<0.005	<0.0005	<0.001
08.06.16	Inner Coolough	24	35.1	25	2	3	<0.005	<0.0005	<0.001
08.06.16	Outer Coolough	14.2	34.2	23	2	3	<0.005	<0.0005	<0.001
24.08.16	Liberty Stream	<7.0	36.1	26	1	3	<0.005	<0.0005	<0.001
24.08.16	Barna village	46.1	34.3	25	3	4	<0.005	<0.0005	0.01
24.08.16	Cappagh south	<7.0	36.1	22	2	3	<0.005	<0.0005	<0.001
24.08.16	Cappagh north	<7.0	25.3	21	2	3	<0.005	<0.0005	<0.001
25.08.16	Waterworks	<7.0	19.9	14	1	3	<0.005	<0.0005	<0.001
25.08.16	Daingean	<7.0	30.7	14	1	3	<0.005	<0.0005	<0.001
25.08.16	Ballindooley	<7.0	36.1	19	2	3	<0.005	<0.0005	<0.001
25.08.16	Inner Coolough	18.6	30.7	17	2	3	<0.005	<0.0005	<0.001
25.08.16	Outer Coolough	25.9	37.9	17	2	3	<0.005	<0.0005	<0.001
13.03.24	Liberty Stream	<5	26	14	1	2	<0.006	<0.0006	0.003
12.03.24	Barna village	8.93	22.2	13	2	3	0.007	<0.0006	0.011
12.03.24	Barna Stream Cappagh N	5.88	17.5	10	1	2	<0.006	<0.0006	<0.0012
13.03.24	Barna Stream Cappagh S	6.84	19.9	11	1	2	<0.006	<0.0006	<0.0012
13.03.24	Corrib New Intake (ref 6’	5.51	14.2	8	1	3	<0.006	<0.0006	<0.0012
12.03.24	Daingean	5.85	14.2	8	1	3	0.03	<0.0006	0.004
12.03.24	Ballindooley	6.79	24.3	14	4	3	<0.006	<0.0006	<0.0012
12.03.24	Inner Coolough	12.4	15.7	10	2	2	0.005	<0.0005	0.003

Date	Sample Location	iron mg/l	manganese mg/l	chromium µg/l	cadmium µg/l	Extractable hydrocarbons mg/l	TDS mg/l	PAH total ng/l	turbidity NTU
30.11.15	Liberty Stream	0.027	<0.005			62			2.13
30.11.15	Barna village	0.098	<0.005			44			3.01
30.11.15	Cappagh south	0.082	<0.005			57			2.1
30.11.15	Cappagh north	0.088	<0.005			78			1.8
02.12.15	Waterworks	0.053	0.032			37			0.3
30.11.15	Daingean	0.031	<0.005			55			6.58
30.11.15	Ballindooley	0.026	<0.005			21			1.08
02.12.15	Inner Coolough	0.011	0.005			63			0.25
04.02.16	Liberty Stream	0.202	<0.005	<0.5			202		
04.02.16	Barna village	0.333	<0.005	0.6			196		
04.02.16	Cappagh south	0.198	<0.005	<0.5			160		
04.02.16	Cappagh north	0.201	0.006	<0.5			160		
03.02.16	Waterworks	0.148	<0.005	<0.5			166		
03.02.16	Daingean	0.178	<0.005	<0.5			200		
03.02.16	Ballindooley	0.178	<0.005	<0.5			264		
03.02.16	Inner Coolough	0.163	<0.005	<0.5			294		
03.02.16	Outer Coolough	0.188	<0.005	<0.5			306		
19.04.16	Liberty Stream	0.17	0.009	<0.9	<0.09		182		
19.04.16	Barna village	0.267	0.022	<0.9	<0.09		216		
19.04.16	Cappagh south	0.316	0.044	<0.9	<0.09		178		
19.04.16	Cappagh north	0.457	0.045	<0.9	<0.09		154		
19.04.16	Waterworks	0.058	0.008	<0.9	<0.09		158		
19.04.16	Daingean	0.053	0.006	<0.9	<0.09		158		
19.04.16	Ballindooley	0.035	0.009	<0.9	<0.09		254		
19.04.16	Inner Coolough	0.022	0.006	<0.9	<0.09		310		
19.04.16	Outer Coolough	0.011	0.004	<0.9	<0.09		318		

Date	Sample Location	iron mg/l	manganese mg/l	chromium µg/l	cadmium µg/l	Extractable hydrocarbons mg/l	TDS mg/l	PAH total ng/l	turbidity NTU
08.06.16	Liberty Stream	0.026	<0.005	<0.5	<0.5		202		
08.06.16	Barna village	0.015	<0.005	<0.5	<0.5		208		
08.06.16	Cappagh south	0.05	0.015	<0.5	<0.5		196		
08.06.16	Cappagh north	0.046	0.007	<0.5	<0.5		266		
08.06.16	Waterworks	0.078	0.013	<0.5	<0.5		198		
08.06.16	Daingean	0.059	0.008	<0.5	<0.5		196		
08.06.16	Ballindooley	<0.010	<0.005	<0.5	<0.5		248		
08.06.16	Inner Coolough	<0.010	<0.005	<0.5	<0.5		296		
08.06.16	Outer Coolough	0.013	0.007	<0.5	<0.5		270		
24.08.16	Liberty Stream	0.336	0.019	<0.5	<0.5		164		
24.08.16	Barna village	0.367	0.013	<0.5	<0.5		220		
24.08.16	Cappagh south	0.537	0.035	<0.5	<0.5		158		
24.08.16	Cappagh north	0.712	0.033	<0.5	<0.5		156		
25.08.16	Waterworks	0.039	0.008	<0.5	<0.5	53	144	5	
25.08.16	Daingean	0.029	0.01	<0.5	<0.5	106	146	4	
25.08.16	Ballindooley	<0.010	<0.005	<0.5	<0.5	197	224	8	
25.08.16	Inner Coolough	<0.010	<0.005	<0.5	<0.5	70	280	8	
25.08.16	Outer Coolough	<0.010	<0.005	<0.5	<0.5	134	250	17	
13.03.24	Liberty Stream	0.341	0.041	<0.6	<0.6	66	85	0	2.0
12.03.24	Barna village	0.333	0.032	<0.6	<0.6	33	109	0	2.6
12.03.24	Barna Stream Cappagh N	0.485	0.045	<0.6	<0.6	52	75	0	1.9
13.03.24	Barna Stream Cappagh S	0.302	0.024	<0.6	<0.6	50	88	0	1.9
13.03.24	Corrib New Intake (ref 6’	0.144	0.014	<0.6	<0.6	91	126	0	7.1
12.03.24	Daingean	0.053	<0.006	<0.6	<0.6	44	134	0	0.5
12.03.24	Ballindooley	0.044	<0.006	<0.6	<0.6	57	197	1	2.2
12.03.24	Inner Coolough	0.204	0.175	1	<0.5	44	195	0	22.4