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# **Appendix A8.1**

## **Water Quality Report**

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# DART+ West, Maynooth- Kilcock, Co. Kildare

Water Quality Report

10 November 2021

Project number: 2021s1304

Iarnród Éireann

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## Abbreviations

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
EPA	Environmental Protection Agency
EU	European Union
N	Nitrogen
sp.	Species
spp.	Species (multiple)
SSRS	Small Stream Risk Score
WFD	Water Framework Directive

# 1 Introduction

## 1.1 Background

JBA Consulting Ireland Ltd. has been commissioned by Patrick O'Shea of Roughan & O'Donovan, on behalf of Iarnród Éireann to undertake a baseline Water Quality assessment of the River Lyreen system in the Maynooth-Kilcock area, in relation to the proposed DART+ West project. The DART + West project will serve all existing stations along the railway corridor between Maynooth Station and M3 Parkway Station to Connolly Station and to the proposed Spencer Dock Station, Dublin.

## 1.2 Purpose of Ecological Works

The purpose of surface water and invertebrate-kick sampling surveys was to determine the overall biological health and water quality of the River Lyreen system in the Maynooth-Kilcock area. Such surveys are in line with the monitoring and assessment of water body status that are an integral part of the management strategy for river water quality to meet the EU Water Framework Directive's (WFD) (2000/60/EC) objectives. The EU WFD requires all Member States to protect and improve water quality in all waters so that we achieve good ecological status by 2015 or, at the latest, by 2027. It was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).

## 1.3 Site Location

A total of four surface water and invertebrate kick-sampling sites were located within the main channel of the River Lyreen (adjacent to the R148 and Laraghbryan Cemetery; and east of the L5041) and one of its tributaries (west of the L4051 in the Ballycurraghan area; and south-east of Oughterany Village, Kilcock). Figure 1-1 displays the sampling site locations below.

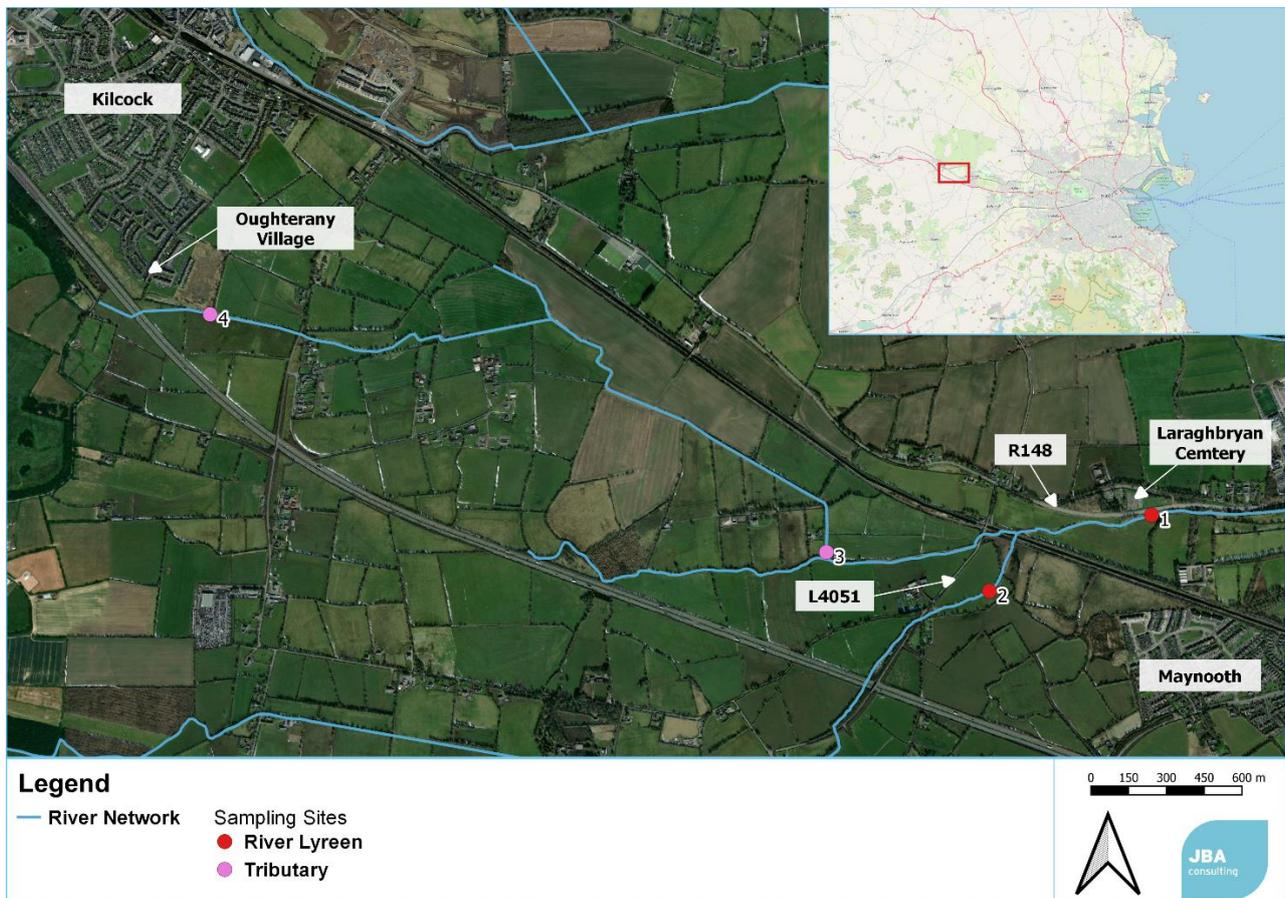


Figure 1-1: Surface water and invertebrate kick-sampling site locations

## 2 Methodology

A total of four sampling points within the River Lyreen and one of its tributaries was deemed a sufficient amount of data to form a baseline on water quality within the Maynooth-Kilcock area. The surveys were conducted on 02/10/2021 by JBA Ecologists, William Mulville and Mark Desmond.

The riverine characteristics of these sampling locations varied from a small river with riffle and pool features, mixed substrate and in-stream vegetation growth (see Figure 2-1), to agricultural ditches, lacking in-stream vegetation, physical variation in substrate and riffle and pool features (see Figure 2-2).



Figure 2-1: River Lyreen main channel sampling site



Figure 2-2: Tributary (agricultural drainage ditch) sampling site

## 2.1 Surface Water Grab Sampling

Water chemistry grab sampling was conducted prior to the invertebrate kick-samples at each sample point to avoid influencing water quality results in regard to suspended solids and sediment bound chemicals. 500ml sample bottles had been provided and sterilised by staff at The Water Lab, Celbridge. As instructed, bottles were initially washed out using the stream water in order to wash out any potential remnant cleaning agents left within them. When sampling, the opening of the bottle was pointed downstream at slight angle in order to prevent any in-stream debris from entering the sample bottle.

Once sampled, the bottles were placed within a cooling box for immediate transport to The Water Lab, Celbridge, Co. Kildare; where analysis was conducted for the following water quality parameters:

- Biological Oxygen Demand (BOD) – Method [SOP-LTM-001]
- Chemical Oxygen Demand (COD) - Method [SOP-LTM-002]
- pH - Method [SOP-LTM-004]
- Total Nitrogen - Method [SOP-LTM-005]
- Nitrate - Method [SOP-LTM-008]
- Nitrite - Method [SOP-LTM-009]
  - Ammonia levels calculated from these above Nitrogen-based parameters
- Total Suspended Solids - Method [SOP-LTM-003]
- Conductivity - Method [SOP-LTM-010]
- Orthophosphate - Method [SOP-LTM-011]

## 2.2 Invertebrate Kick-Sampling & Identification

While many biological assemblages (e.g., bacteria, algae and fish) are used for assessing the ecological conditions of rivers and streams, freshwater benthic macroinvertebrates are the most widely utilised bioindicator; given that they are sensitive to ecological impacts whilst being a relatively simple, efficient and cost-effective faunal group to sample and analyse (Buss et al., 2015).

Following the water grab sampling exercise, invertebrate kick-sampling was carried out at each survey point along the River Lyreen and its tributary. The kick-samples were 2 minutes in length, plus additional stone washing as per the methodology set out in the document - Biological And Physico-Chemical Surveillance And Water Quality Assessment of Rivers, by the Environmental Protection Agency (EPA) in 2005.

Samples were collected from the fast flowing (riffle) areas of the river using a standard hand net (250mm width, mesh size 1mm; adhering to ISO Standard for kick sampling and utilising the EPA protocols). The stone washing procedure ensured that species which cling to stone surfaces – e.g. leeches and gastropods, were effectively collected. Macroinvertebrates collected from each sample were stored in plastic zip-lock bags.

Sample invertebrate specimens were identified to the minimum of Family level; and Genus and Species level where possible, using the Guide to Freshwater Invertebrates (Dobson et al., 2012).

### 2.2.1 Calculation of Q-value and Small Stream Risk Score (SSRS)

Q-values were calculated for each invertebrate sample point using the guidance set out in the document – ‘Biological And Physico-Chemical Surveillance And Water Quality Assessment of Rivers’, produced by the Environmental Protection Agency (EPA, 2005).

Additionally, Small Stream Risk Scores were calculated for the three invertebrate samples using the methodology set out in the Small Stream Risk Score Manual (EPA, 2005).

## 2.3 Constraints and Limitations

A number of constraints and limitations are associated with the surface water grab sampling and freshwater invertebrate kick-sampling surveys conducted; these are listed below:

- Surface water grab sampling can only give a snapshot of the water quality at any one point in time within a river system

- The freshwater invertebrates were sampled within a sub-optimal survey period (early October), which may reduce general diversity
- Invertebrate kick-sampling methodology often results in damage to invertebrate samples, which may hinder identification beyond that of family level

## 3 Results

### 3.1 Water Chemistry Sampling

The water chemistry results were compared with the surface water quality ranges and limits set out in the S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (see Table 3-1), with the sample parameters either being graded as 'High', 'Good' or 'Unsatisfactory'.

Table 3-1: The water quality limits and ranges for physico-chemical conditions for supporting the biological elements in freshwater systems

Parameter	Units	High (*)	Good (^)	Unsatisfactory (#)
BOD	mg/l O2	≤ 1.3 (mean)	≤ 1.5 (mean)	> 1.5 (mean)
pH	pH units	Hard Water 6.0 < pH < 9.0	-	Hard Water < 6.0 or > 9.0
Ammonia	mg/l NH3	≤ 0.040 (mean)	≤ 0.065 (mean)	> 0.065 (mean)
Orthophosphate	mg/l P	≤ 0.025 (mean)	≤ 0.035 (mean)	> 0.035 (mean)

The results and grades (symbol coded as per Table 3-1), where applicable, of the water chemistry analysis are displayed for each River Lyreen sample in Table 3-2 displayed below. Notable results from the water chemistry analysis include BOD and Ammonia levels at Unsatisfactory levels; Orthophosphate at High levels in the tributary (Samples 3 and 4) and upstream River Lyreen (Sample 2) and at a Good level at the downstream River Lyreen site (Sample 1); pH levels were graded High across all four samples; and Suspended Solids levels were below the exceedance of limits of < 25mg/l for both salmonid and cyprinid waters as outlined in the guidance from DIRECTIVE 2006/44/EC regarding suspended solids water quality standards for freshwater fish.

Table 3-2: Water chemistry results and grades for River Lyreen and tributary sample points.

Parameter	Units	Sample 1 (R. Lyreen)	Sample 2 (R. Lyreen)	Sample 3 (Tributary)	Sample 4 (Tributary)
BOD	mg/l O2	2.54 #	2.18 #	2.18 #	2.0 #
COD	mg/l O2	42	<15	15	<15
pH	pH units	7.93 *	8.02 *	8.01 *	7.93 *
Ammonia	mg/l NH3	1.084 #	4.68 #	1.573 #	1.974 #
Total Suspended Solids	mg/l	<8	10	15	<8
Conductivity	µS/cm @ 20°C	727	744	723	724
Orthophosphate	mg/l P	0.33 ^	0.22 *	0.23 *	0.13 *

\* = High status

^ = Good status

# = Unsatisfactory status

### 3.2 Invertebrate Kick-Sampling

Freshwater invertebrate specimens were identified to at least the level of Family, and to Species or Genus level where possible. The invertebrates identified during the study are listed along with their respectively presence or absence for each sample, in Table 3-3 in overleaf.

Table 3-3: Invertebrate identification of Family, Genus and Species levels for each site sample (x = present)

Family	Genus	Species	Site 1	Site 2	Site 3	Site 4
<b>Baetidae</b>	-	-	X	X	X	-
<b>Philopotamidae</b>	-	-	-	X	X	-
<b>Hydropsychidae</b>	<i>Hydropsyche</i>	-	X	X	-	-
<b>Leptoceridae</b>	-	-	X	-	-	-
<b>Sericostomatidae</b>	-	-	X	-	X	-
<b>Limnephilidae</b>	-	-	X	-	-	-
<b>Gammaridae</b>	<i>Gammarus</i>	-	X	X	X	X
<b>Asellidae</b>	<i>Asellus</i>	<i>aquaticus</i>	X	X	X	X
<b>Physidae</b>	-	-	-	-	-	X
<b>Hydrobiidae</b>	-	-	X	-	X	X
<b>Sphaeriidae</b>	-	-	X	X	-	X
<b>Valvatidae</b>	-	-	X	-	-	-
<b>Planorbidae</b>	-	-	X	-	-	X
	<i>Ancylus</i>	-	X	-	-	-
<b>Lumbricidae</b>	-	-	X	X	X	X
<b>Tanypodinae</b>	-	-	-	-	-	X
<b>Orthoclaadiinae</b>	-	-	X	-	X	-
<b>Chironominae</b>	-	-	X	X	X	X
<b>Pediciidae</b>	-	-	-	-	X	-
<b>Dytiscidae</b>	-	-	X	X	X	-
<b>Chysomelidae</b>	-	-	X	-	-	X
<b>Elmidae</b>	<i>Elmis</i>	-	X	-	X	-
<b>Hydrachnidea</b>	-	-	X	X	-	-

### 3.2.1 Q-value and Small Stream Risk Score (SSRS)

Table 3-4 and Table 3-5 overleaf, display the results of the freshwater invertebrate Q-value and Small Stream Risk Score analysis, respectively. The Q-value calculation is based on the relative number of Group A & B invertebrates to Group C, D & E invertebrates, with Group A being most sensitive to pollution and Group E being most tolerant of pollution.

Table 3-4: Invertebrate groups with their relative abundance and their respective Q-value for each stream sample

Site	Group A	Group B	Group C	Group D	Group E	Note	Q-value
1	Absent	Common	Excessive	Small numbers	Absent	Sewage fungus absent	3
2	Absent	Common	Dominant	Numerous	Absent	Sewage fungus absent	3
3	Absent	Common	Dominant	Small numbers	Absent	Sewage fungus absent	3
4	Absent	Absent	Dominant	Common	Absent	Sewage fungus absent	3

The SSRS is based on the diversity and abundance of certain freshwater macroinvertebrate groups; Group 1 consisting of the 3-tailed Ephemeropterans (mayflies); Group 2 the 2-tailed Plecopterans (stoneflies); Group 3 the Trichopterans (caddisflies); Group 4 a combination of Gastropods (snails and bivalves), Oligochaetes (worms) and Dipterans (true flies); and Group 5 the *Asellus* genus (water louse).

Table 3-5: Invertebrate groups with their individual group score, respective mean score (SSRS score) and status for each stream sample

Site	3-tails Score	2-tails Score	Trichopteran Score	GOLD Score	Asellus Score	Mean Score (SSRS)	Status
1	4	0	4	0	2	4.0	<b>At Risk</b>
2	4	0	2	4	2	4.8	<b>At Risk</b>
3	4	0	2	0	2	3.2	<b>At Risk</b>
4	0	0	0	0	0	0	<b>At Risk</b>

## 4 Discussion and Conclusion

The water chemistry results indicated that the water quality of the River Lyreen system was generally Unsatisfactory, as the key parameters of BOD and Ammonia were all notably above their limits. Orthophosphate statuses ranged from Good to High across the sample sites. The remaining chemical parameters were all recorded at passable levels.

The water chemistry results are in concordance with the Q-value and SSRS invertebrate metrics, both which gained less than ideal scores. While each of the four kick-sampling points displayed some minor differences in species assemblages, all samples were dominated by pollution tolerant family/species groups such as Hydrobiidae and *Gammarus* spp.; as well as the notable presence of *Asellus aquaticus*, a species indicative of urban freshwater pollution (O'Callaghan et al., 2019). This ultimately resulted in Q3 values for all sites and SSRS metric indications that the River Lyreen and the tributary examined are 'At Risk'.

The freshwater invertebrate results are generally in line with 'Poor' Invertebrate Status / Potential given to this section (LYREEN\_010) of the River Lyreen sub-catchment (LYREEN\_SC\_010) detailed in the WFD 2013-2018 Surface Water Monitoring programme (Catchments, 2021). Furthermore, the WFD Cycle 2 Catchment Liffey and Dublin Bay Sub-catchment Lyreen\_SC\_010 (2020) report states that Lyreen system suffers from both agricultural and urban (domestic and industrial) inputs/pressures, which would largely be in line with the water chemistry results recorded, with the exception of the Ammonia levels which appear well above the monitoring averages. Given this outlier, one must note the constraints of surface water grab sampling given their limitation to only give a snapshot of the water quality at any one point in time within a river system. These increased Ammonia levels may be result of a flush from an agricultural source, which releases sporadically into the Lyreen sub-catchment.

Given the results of the water chemistry samples; the Q-value (=3) and SSRS (At Risk) invertebrate metrics; and the previous monitoring data for the sub-catchment, it is clear that the River Lyreen and the examined tributary suffer from moderate levels of agricultural and urban pollution, which is characteristic of small-scale river networks in the area.

## Appendices

### A Water Chemistry Analysis Results

<b>Contact Name:</b>	william mulville	<b>Date Sampled:</b>	08/10/2021
<b>Customer Name:</b>	JBA Consulting	<b>Date Received:</b>	08/10/2021
<b>Address:</b>	Unit 8, Block 660	<b>Sample Location:</b>	lyreen river S1
	Greenogue Business Plaza		
	Rathcoole	<b>Date Analysis Started:</b>	08/10/2021
	Dublin	<b>Date Analysis Completed:</b>	25/10/2021
	Ireland	<b>Sample Type:</b>	Surface Water
<b>Sample Condition:</b>	Satisfactory	<b>Sample Description:</b>	Surface Water
<b>Sample ID:</b>	N6375	<b>Grab/Composite:</b>	Grab

### TEST REPORT

Parameter	Result	Units	Method	Accreditation Status
COD	42	mg/l O2	SOP-LTM-002	***
pH	7.93	pH units	SOP-LTM-004	***
cBOD	2.54	mg/l O2	SOP-LTM-001	***
Total Suspended Solids	<8	mg/l	SOP-LTM-003	***
Total Nitrogen	2.4	mg/l N	SOP-LTM-005	***
Nitrate	1.3	mg/l NO3-N	SOP-LTM-008	***
Nitrite	0.016	mg/l NO2-N	SOP-LTM-009	***
Conductivity	727	µS/cm @ 20°C	SOP-LTM-010	***
Orthophosphate	0.33	mg/l P	SOP-LTM-011	***

<b>Comments:</b>	
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Signed:

I. macukaite

Date:

26/10/2021

Ms Inga Macukaite - Laboratory Analyst

The above results relate to the sample(s) tested.

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<b>Contact Name:</b>	W MULVILLE	<b>Date Sampled:</b>	08/10/2021
<b>Customer Name:</b>	JBA Consulting	<b>Date Received:</b>	08/10/2021
<b>Address:</b>	Unit 8, Block 660	<b>Sample Location:</b>	LYREEN RIVER S2
	Greenogue Business Plaza		
	Rathcoole	<b>Date Analysis Started:</b>	08/10/2021
	Dublin	<b>Date Analysis Completed:</b>	25/10/2021
	Ireland	<b>Sample Type:</b>	Surface Water
<b>Sample Condition:</b>	Satisfactory	<b>Sample Description:</b>	Surface Water
<b>Sample ID:</b>	N6376	<b>Grab/Composite:</b>	Grab

### TEST REPORT

Parameter	Result	Units	Method	Accreditation Status
COD	<15	mg/l O2	SOP-LTM-002	***
pH	8.02	pH units	SOP-LTM-004	***
cBOD	2.18	mg/l O2	SOP-LTM-001	***
Total Suspended Solids	10	mg/l	SOP-LTM-003	***
Total Nitrogen	5.7	mg/l N	SOP-LTM-005	***
Nitrate	1.0	mg/l NO3-N	SOP-LTM-008	***
Nitrite	0.020	mg/l NO2-N	SOP-LTM-009	***
Conductivity	744	µS/cm @ 20°C	SOP-LTM-010	***
Orthophosphate	0.22	mg/l P	SOP-LTM-011	***

<b>Comments:</b>	
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Signed:

I. macukaite

Date:

26/10/2021

Ms Inga Macukaite - Laboratory Analyst

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\*\* Accredited by Sub-con lab  
\*\*\* Non-accredited

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<b>Contact Name:</b>	W MULVILLE	<b>Date Sampled:</b>	08/10/2021
<b>Customer Name:</b>	JBA Consulting	<b>Date Received:</b>	08/10/2021
<b>Address:</b>	Unit 8, Block 660	<b>Sample Location:</b>	LYREEN RIVER S3
	Greenogue Business Plaza		
	Rathcoole	<b>Date Analysis Started:</b>	08/10/2021
	Dublin	<b>Date Analysis Completed:</b>	25/10/2021
	Ireland	<b>Sample Type:</b>	Surface Water
<b>Sample Condition:</b>	Satisfactory	<b>Sample Description:</b>	Surface Water
<b>Sample ID:</b>	N6377	<b>Grab/Composite:</b>	Grab

### TEST REPORT

Parameter	Result	Units	Method	Accreditation Status
COD	15	mg/l O2	SOP-LTM-002	***
pH	8.01	pH units	SOP-LTM-004	***
cBOD	2.18	mg/l O2	SOP-LTM-001	***
Total Suspended Solids	15	mg/l	SOP-LTM-003	***
Total Nitrogen	2.8	mg/l N	SOP-LTM-005	***
Nitrate	1.2	mg/l NO3-N	SOP-LTM-008	***
Nitrite	0.027	mg/l NO2-N	SOP-LTM-009	***
Conductivity	723	µS/cm @ 20°C	SOP-LTM-010	***
Orthophosphate	0.23	mg/l P	SOP-LTM-011	***

<b>Comments:</b>	
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Signed:

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<b>Contact Name:</b>	W MULVILLE	<b>Date Sampled:</b>	08/10/2021
<b>Customer Name:</b>	JBA Consulting	<b>Date Received:</b>	08/10/2021
<b>Address:</b>	Unit 8, Block 660	<b>Sample Location:</b>	LYREEN RIVER S4
	Greenogue Business Plaza		
	Rathcoole	<b>Date Analysis Started:</b>	08/10/2021
	Dublin	<b>Date Analysis Completed:</b>	25/10/2021
	Ireland	<b>Sample Type:</b>	Surface Water
<b>Sample Condition:</b>	Satisfactory	<b>Sample Description:</b>	Surface Water
<b>Sample ID:</b>	N6378	<b>Grab/Composite:</b>	Grab

### TEST REPORT

Parameter	Result	Units	Method	Accreditation Status
COD	<15	mg/l O2	SOP-LTM-002	***
pH	7.93	pH units	SOP-LTM-004	***
cBOD	<2	mg/l O2	SOP-LTM-001	***
Total Suspended Solids	<8	mg/l	SOP-LTM-003	***
Total Nitrogen	4.2	mg/l N	SOP-LTM-005	***
Nitrate	2.2	mg/l NO3-N	SOP-LTM-008	***
Nitrite	0.026	mg/l NO2-N	SOP-LTM-009	***
Conductivity	724	µS/cm @ 20°C	SOP-LTM-010	***
Orthophosphate	0.13	mg/l P	SOP-LTM-011	***

<b>Comments:</b>	
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Signed:

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26/10/2021

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## **Report Notes**

### **Accreditation Status**

Accreditation Status is denoted as follows:

- \* INAB accredited to ISO 17025
- \*\* Accredited by Sub-con Lab to ISO 17025
- \*\*\* Non-accredited

Sub-contracted accreditation is provided by the sub-con lab's own accreditation provider.

### **Microbiological Analysis**

The results obtained from microbiological testing in cfu/100ml should be interpreted as follows:

- 0 cfu/100ml - Not detected in the volume of sample analysed
- 1 - 3 cfu/100ml - Less than 4 cfu/100ml detected
- 4 - 9cfu/100ml - Estimated result

Sample results for Micro analysis tested outside 24 hours from the time of sampling may have impacted the validity of results.

This will be noted in the report comments section of the report if it applies to this sample.

### **Sampling**

Samples taken by staff of The Water Lab follow SOP-LGM-001-Sampling. Specific sampling requirements for individual tests are described on those test SOPs.

### **Testing**

All results of Laboratory testing apply to the sample as received, except where indicated otherwise.

All in-house testing is performed at The Water Lab's premises at the M4 Business Park in Celbridge, Co. Kildare. Subcontracted testing is performed at the premises of the subcontractor used, and these tests are noted as 'Sub-C' in the method section of the report. Testing performed at the site of sampling is noted as '(on-site)' in the parameter section of the report.

## References

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