Irish Cement Ltd.
Platin Works

Integrated Pollution Control Licence Register Number P0030-04

AQUATIC MONITORING REPORT 2023

Version 14th December 2023

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EXECUTIVE SUMMARY

Irish Cement Ltd. operates a limestone quarry and cement facility at Platin Works, near Drogheda, County Louth. Trade effluent is discharged into the River Nanny near Duleek, Co. Meath, under Environmental Protection Area Integrated Pollution Control Licence (IPCL) P0030-05. The current report provides the required information to meet the aquatic monitoring conditions of this licence for 2023.

The current assessment was undertaken during July and September 2023. A total of six sites were monitored on the River Nanny in the vicinity of the effluent discharge point. Three of these sites were located downstream of the discharge point (N1-N3), and three were located upstream (N4-N6). Biological water quality assessments, chemical water quality assessments, and sediment surveys were completed at these sites. The trade effluent was assessed for selected chemical water quality parameters, and *Daphnia* and *Vibrio* aquatic ecotoxicity bioassays were completed.

The River Nanny has a history of water quality issues, primarily caused by agricultural activities. The entire River Nanny was in an unsatisfactory ecological condition when it was last monitored by the EPA in 2020. The EPA ratings for the sites located both upstream and downstream of the outfall are therefore the same, with both rated as 'Q3 - Poor Status'.

The results from the current survey have concluded that there is no difference in biological water quality status between the sites located upstream and downstream of the outfall. The diversity and abundance levels of macroinvertebrates recorded at all sites were typical of an organically polluted lowland Irish river. Biological water quality is rated as poor both upstream and downstream of the discharge. The chemical water quality testing completed indicated no negative impact from the discharge. It was also concluded that there were no differences in the characteristics of the sediments at the sites located downstream and upstream of the discharge location. The aquatic ecotoxicity assessment confirmed that the effluent is non-toxic.

The results indicate that the River Nanny is under considerable ecological pressure; however, the subject discharge is not contributing to this. There is no evidence that the discharge is having any negative impacts on the water quality, macroinvertebrate community, or sediment characteristics of the river. Overall, it is concluded that the discharge is not having a negative impact on the River Nanny and that the discharge is fully compliant with the IPCL. No recommendations are made due to the absence of identified negative impacts from the discharge.

Signed by: -

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TABLE OF CONTENTS

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1. INTRODUCTION

1.1 Background

Irish Cement Ltd. operates a large limestone quarry and cement manufacturing facility at the Platin Works near Drogheda, County Louth. The trade effluent from this site is discharged into the River Nanny near Duleek, Co. Meath. This discharge is licence d by the Environmental Protection Agency (EPA) under Integrated Pollution Control Licence (IPCL) Register Number P0030-05. This licence has several conditions in relation to the monitoring of the receiving water. The current assessment addresses the receiving water monitoring issues in relation to the following conditions as follows:

- Condition 6.14.1: The licensee shall annually evaluate the impact, if any, of the discharge to the River Nanny. The evaluation shall be based on the ambient sampling required under Schedule C.6 Ambient monitoring [receiving water monitoring]. In particular the evaluation shall consider the impact of fine particulate matter in the discharge
- Condition 6.14.2: The licensee shall, if necessary, based on the results of the evaluation incorporate additional mitigation measures for the treatment of surface water prior to discharge.
- Condition 6.14.3: The acute toxicity of the undiluted final effluent to at least four aquatic species from different trophic levels shall be determined by standardized and internationally accepted procedures and be carried out by a competent laboratory. The name of the laboratory and the scope of testing to be undertaken shall be subject to the agreement of the agency. The testing shall be carried out within three months of the date of grant of this licence. Copies of the complete reports shall be submitted to the agency within 6 weeks of completion of the testing.
- Condition 6.14.4: Having identified the most sensitive species outlined in Condition 6.14.3, subsequent compliance toxicity monitoring on the two most sensitive species shall be carried out annually by the laboratory identified in Condition 6.14.3, or an alternative as may be agreed. Copies of the complete reports shall be submitted to the agency within 6 weeks of completion of the testing.

This study provides all the required information and meets these conditions for the 2023 monitoring period. The current study was undertaken by Ecofact Environmental Consultants Ltd. and follows similar assessments completed from 2008 to 2023 as part of the requirements of the relevant discharge licence (Ecofact, 2008 to Ecofact, 2023).

1.2 The River Nanny

The River Nanny (OS Catchment No: 160; EPA code: 08N01) is in County Meath in the Eastern River Basin District (Hydrometric Area 8 - Nanny-Delvin). It rises near Kentstown and flows east through Duleek and Julianstown. It then enters the sea on the southern side of Laytown, 6 km south of Drogheda. Overall, it spans a length of approximately 28km draining a catchment area of 239 km^2 (McGinnity *et al*, 2003).

The closest EPA monitoring station downstream (Station Code: 08N010550) of the Irish cement trade effluent discharge point was rated Q3 in 2020 equivalent to WFD status "Poor". This site is in the same location as survey Site N1. The closest EPA monitoring station upstream is located at survey Site N6. This EPA site (Station Code: 08N010500) was rated Q3 in 2020. Both stations have remained relatively the same status for the last three rounds of sampling by the EPA. Another station (Station Code: 08N010700) was rated Q3 in 2020. This station is located downstream of the survey area at Julianstown, Co. Meath approximately 7km downstream of Site N6.

On the River Nanny the most upstream EPA monitoring station (Station Code: 08N010040) was rated Q3 in 2020. The next site downstream (Station Code: 08N010110) was rated Q3 also in 2020 and is located in Kentstown approximately 6km upstream of Site N6. There is also an EPA monitoring station (Station Code: 08N010280) located 3km upstream of Site N6. This site was rated Q3 in 2020. According to EPA (2018) "*the Nanny River was unsatisfactory along the entire length when surveyed in 2017. Since the 2014 survey, there has been a slight improvement at Station 0280, but a slight decline in quality at Station 0700. The Nanny River still had unsatisfactory ecological conditions at stations 0500, 0550 and 0700 in August 2018*".

The River Nanny at Site N6 is considered to be "Poor" WFD Status 2010-2015 and is an "*at risk*" waterbody. According to the sub-catchment assessment for the Nanny [Meath]_SC_020 the survey area is under pressure from channelisation, urban wastewater and agriculture (EPA, 2018).

The River Nanny is in the Eastern River Basin District and is within the Nanny Water Management Unit (WMU). A WMU is a geographic area primarily defined by similar hydrology and topography. The land use is predominantly agricultural (ERBD, 2009).

Duleek Wastewater Treatment Plant (D0133-01) discharges to the River Nanny c. 2.3rkm upstream of Site N6. The plant carries out Tertiary P removal. The plant is currently compliant with its Emission Limit Values (ELVs) as set out in the plant's licence. However, it is stated in the most recent Annual Environmental Report (AER) that "*the ambient monitoring results do not meet the required EQS at the upstream and the downstream monitoring locations. The EQS relates to the Oxygenation and Nutrient Conditions set out in the Surface Water Regulations 2009*" (Irish Water, 2022).

2. METHODOLOGY

2.1 Site selection and habitats

The locations of the two study sites (Site N1 and N6) are given in Table 1 and Figure 1. The discharge point from the Irish Cement plant is also indicated in Figure 1. The sites surveyed are at the same locations as in previous assessments (2006-2022). The sampling location for the Irish Cement discharge was located at the outfall point to the Nanny River. Any changes in physical habitats at the sites from the previous surveys was recorded.

Table 1 Location of two biological and sediment sampling sites.

Site	N1	N2	N3	N4	N5	N6
Habitat Category	Riffle	Glide	Pool	Pool	Glide	Riffle
Sample type	Receptor	Receptor	Receptor	Reference	Reference	Reference
Location	Downstream of outfall	Downstream of outfall	Downstream of outfall	Upstream of outfall	Upstream of outfall	Upstream of outfall
NOS Grid Reference	O07976 69254	O07865 69186	O07783 69171	O07589 69186	O07537 69165	O07349 69166

2.2 Chemical Water Quality, TPH and Heavy Metals

During the current survey Conductivity (µs cm^{-1}), water temperature (^{o}C), and Dissolved Oxygen (mgl^{-1} and % saturation) were measured on-site using portable meters. These parameters, along with salinity and pH were also measured in the water sample provided to the appointed laboratory for eco-toxicology testing. Water samples of the effluent, and at Sites N1 and N6, were taken during September 2023. During sampling appropriate measures to prevent contamination from other sources was undertaken and all sampling equipment had been thoroughly cleaned. Samples were labelled and placed in a cooler box and were promptly delivered to the appointed laboratory. The water sample from the effluent was analysed for Total Petroleum Hydrocarbons (TPH) and Heavy Metals. BOD (Biochemical Oxygen Demand) and Total Hardness were analysed in samples taken from Site N1 and N6. On-site measurements of water temperature, dissolved oxygen and pH were also taken using portable meters.

2.3 Sediment Sampling

A sediment sample was obtained for analyses at each of the six sites using a large trowel. This sampling was completed during September 2023. Three sub-samples were taken from undisturbed relatively homogeneous sediment deposits and combined into a composite sample for each site. Each sample was placed into a mixing bowl and objects such as sticks and leaves etc. were removed. The sample was then stirred thoroughly with a mixing spoon to homogenize and placed into a labelled container. The samples were then delivered to the appointed laboratory for Particle Size Distribution Analysis.

2.4 Biological Assessments

2.4.1 Macroinvertebrate sampling

Semi-quantitative sampling of benthic macroinvertebrates was undertaken at the six sites listed using kick sampling (Toner *et al*, 2005). Sampling was undertaken during September 2023. The sites were located in the same established locations as in the previous surveys. These sites are located within a

0.5 km section of river extending upstream of the Irish Cement discharge point (reference sites), and three sites were located over a similar distance downstream (receptor sites). Representative riffle, glide, and pool habitats (EA, 2003) were sampled at both reference and receptor locations.

The biological sampling procedure followed at each site involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the riverbed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute to dislodge invertebrates, which were subsequently caught in the net. This was repeated at three points along/across the watercourse. Stone washings and vegetation sweeps were also undertaken over a further 1-minute period to ensure a representative sample of the fauna present at each site was collected. All three samples of invertebrates from each substation were combined and live sorted on the riverbank for 20 minutes. Identification was undertaken on site.

2.4.2 The Quality Rating (Q) System

2.5 Eco-toxicology testing

2.5.1 Introduction

The species selected for toxicity testing are the freshwater crustacean *Daphnia magna*, and the bioluminescent bacteria *Vibrio fischeri*.

2.5.2 Daphnia magna Bioassay

The Daphnia bioassay was carried out following standard methods based on ISO 6341:2012: 'Water quality – Determination of the inhibition of the mobility of *Daphnia magna* Straus (Cladocera, Crustacea). Young aphids (<24 hours old) are exposed to the effluent at a range of concentrations over 48 hours. Immobilisation is recorded at 24 and 48 hours and compared to the control values. To calculate the equitox number (48hr) the formula is 100 / EC50-48h (%).

2.5.3 Vibrio fischeri bacteria bioassay

Testing was carried out following the ISO 113348-3 Guidelines. This test involves using the marine bacteria *Vibrio fischeri*. Under test conditions, identify the sample concentration that inhibits 50% of luminescence produced by a Vibrio fischeri bacteria suspension in 30, 15, and if needed, 5 minutes (EC50-30min / EC50-15min). The maximum testable concentration is capped at 80%. For opaque or coloured samples, a colour correction is possible during evaluation. In this case, the equitox number (30min) represents the dilution count needed to cause a 50% reduction in luminescence from bacteria introduced into 1m³ of water after 30 minutes.

2.6 Limitations

Water levels were elevated at the time of the survey but it did not affect sampling due to the relatively small size of the river. The summer and autumn of 2023 were one of the wettest on record. The river was sampled during the typical prevailing conditions of this year.

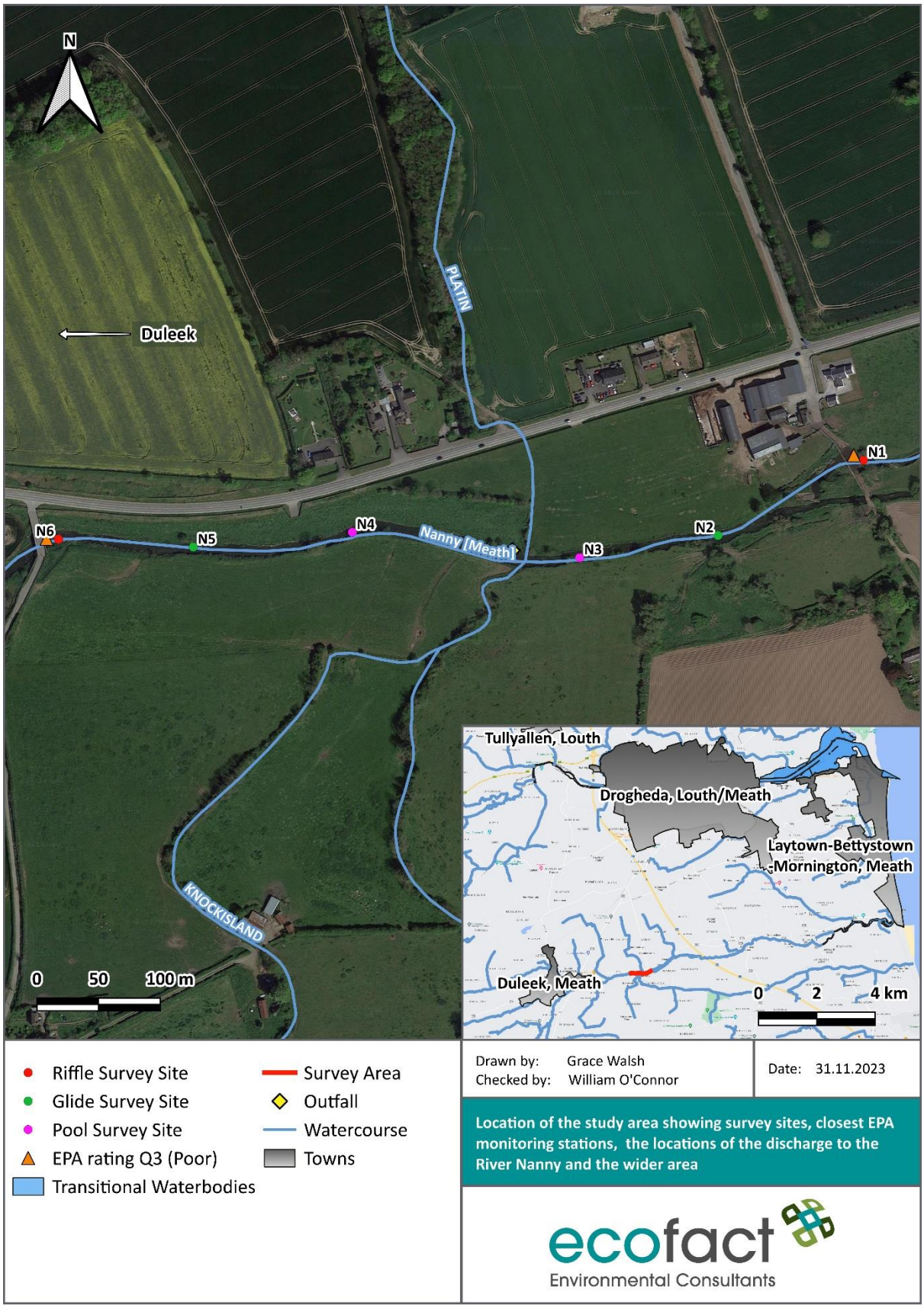

Figure 1 Location of the study area showing the survey sites, closest EPA monitoring stations, the locations of the discharge to the River Nanny and wider area.

3. RESULTS

The results of the Particle Size Distribution Analysis of fine sediments sampled at the six survey sites are given in Table 2. The classifications of each sediment sample from the Particle Size Distribution Analysis is given in Table 3. Table 4 presents the results of the BOD (Biochemical Oxygen Demand), Total Hardness, Alkalinity and Conductivity for Sites N1 and N6. The results of the on-site water quality assessments undertaken during September 2023 are presented in Table 5. Table 6 gives the results of the on-site macroinvertebrate survey at the six survey sites on the River Nanny during September 2023. Table 7 and 8 gives the hydrocarbons and heavy metal results from the discharge sampled in September 2023.

3.1 River sampling

3.1.1 Site N1 (Receptor site)

This site is located at Beaumont Bridge downstream of a weir. Site N1 is a receptor site and is located downstream of the discharge point. This site does not receive the full flow of the River Nanny, as some of the water is diverted into an old headrace. There is riffle habitat present at this site. The site is also located at cattle crossing ford. This site was silted (with cattle using it as a crossing point) and had excessive macrophyte and filamentous algae growths.

The results of the surveys at this site are as follows: -

- At this site, the sediment consisted of 0.5% clay, 5.76% silt, 36.32% sand and 57.87% gravel. This is relatively coarse substrate with a low proportion of fine sediment.
- The dominant species present in the kick sample was *Gammarus duebeni*. There was a small number of Class B pollutant sensitive species present however, most taxa were the pollutant tolerant Class C and D species indicating moderately polluted conditions.
- Biochemical Oxygen Demand (BOD) was 1.1 mg/l. The Surface Water Regulations EQS for BOD to achieve "Good status" is <1.5 mg O_2 /l. Total Hardness was 354 mg/L $CaCO_3$. Temperature, Conductivity, and Dissolved Oxygen levels were normal.

The water quality status at this site was rated ‘Q3 – Poor Status’. This is based on the macroinvertebrate assemblages recorded. The BOD recorded was normal. The site is impacted locally by agricultural activities and background siltation and eutrophication was apparent at the site.

3.1.2 Site N2 (Receptor site)

Site N2 is located downstream of the discharge location and is a glide habitat. The site is located approximately 110m upstream of Beaumont Bridge. The river at this site has a low flow due to the presence of the downstream weir which impounds water. The substrate was mostly composed of clay, silt, and underlying gravel.

The results of the surveys at this site are as follows: -

- At this site, the sediment consisted of 1.35% clay, 75.27% silt, 22.73% sand and 0.65% gravel. This is relatively silty substrate.
- The pollutant tolerant *Gammarus duebeni* was the most abundant taxa. There was a small number of Class B pollutant sensitive species present however, most taxa were the pollutant tolerant Class C and D species.
- Temperature, Conductivity, and Dissolved Oxygen levels were normal.

The water quality status at this site was rated 'Q3 – Poor Status'. A high amount of instream vegetation, filamentous algae, and silt was also present.

3.1.3 Site N3 (Receptor site)

This site is a receptor site located downstream of the outfall. This site is located approximately 260m upstream of Beaumont Bridge. The substrate was a mixture of cobble and fine particles with some gravel and rock also present.

The results of the surveys at this site are as follows: -

- At this site, the sediment consisted of 1.64% clay, 75.29% silt, 22.65% sand and 0.42% gravel. This is silty substrate.
- Macroinvertebrate diversity at this site was similar to Site 2 and dominated by Group C and D species.
- Temperature, Conductivity, and Dissolved Oxygen levels were normal.

The water quality status at this site was rated 'Q3 – Poor Status'. There was also a high amount of instream vegetation - and an excessive number of filamentous algae were present. There were also very high levels of silt present here.

3.1.4 Site N4 (Reference site)

Site N4 was the reference pool site. This site again had high levels of siltation. The level of instream vegetation present at this site was very high and an excessive amount of filamentous algae was present.

The results of the surveys at this site are as follows: -

- The sediment consisted of 1.21% clay, 74.66% silt, 23.93% sand and 0.19% gravel. This is relatively silty substrate.
- The macroinvertebrate assemblage at this site was again dominated by Class C and D species resulting in a classification of Q3 and WFD status "Poor".
- Temperature, Conductivity, and Dissolved Oxygen levels were normal.

This site is located upstream of the outfall and the results were almost identical to Sites 2 and 3 located downstream of the outfall.

3.1.5 Site N5 (Reference site)

Site N5 was the reference glide site. It is located approximately 100m downstream of Site N6. he level of instream vegetation present at this site was very high and an excessive amount of filamentous algae was present.

The results of the surveys at this site are as follows: -

- The sediment consisted of 1.09% clay, 74.64% silt, 22.42% sand and 1.86% gravel. This is silty substrate.
- The macroinvertebrate assemblage at this site was again dominated by Class C and D species resulting in this site being assessed as being 'Moderately Polluted' (Q3).

- Temperature, Conductivity, and Dissolved Oxygen levels were normal.

Again, this site is located upstream of the outfall and the results were very similar to Sites 2 and 3 located downstream of the outfall. The macroinvertebrate assemblages present at all the sites were similar.

3.1.6 Site N6 (Reference site)

Site N6 was the reference riffle site. Excessive siltation and filamentous algae growths were recorded. There was some instream vegetation confined to the banks. This substrate at this site consisted of high proportions of cobble / boulder. In 2021 directly upstream of the bridge, during the final site visit in September it was noted that significant agricultural activities in the form of vegetation clearance and field ploughing had taken place upstream. A lot of silt is now present at this site, especially under the bridge.

The results of the surveys at this site are as follows: -

- The sediment consisted of 0.21% clay, 13.12% silt, 60.81% sand and 28.86% gravel. This is course substrate which can be linked to this being a riffle site with less deposition. It is very similar to Site 1 which is also a riffle site.
- The macroinvertebrate assemblage at this site was again dominated by Class C and D species.
- BOD was 0.9 mg/l. The Surface Water Regulations EQS for BOD to achieve "Good status" is <1.5 mg O_2 /l. Total Hardness was 359 $CaCO_3$. Temperature, Conductivity, and Dissolved Oxygen levels were normal.

The water quality status at this site was rated ‘Q3 – Poor Status’. The BOD recorded was normal. The site is impacted locally by agricultural activities and background siltation and eutrophication was apparent at the site.

3.2 Outfall sampling

3.2.1 Chemical water quality

A sample of the effluent was tested for Total Petroleum Hydrocarbons (TPH) and a suite of Heavy Metals, and all parameters were in compliance with the limit’s values in the discharge licence. In addition, Heavy Metals were all complaint with the relevant Environmental quality standards (EQSs). Total Petroleum Hydrocarbons and Heavy Metal levels in the effluent sample were all below the detection levels.

3.2.2 Aquatic ecotoxicity

The toxicity results indicate that the discharge from the Irish Cement Plant is non-toxic. The *Daphnia magna* bioassay and the *Vibrio fischeri* bacteria bioassay results are presented in Appendix 2.

Table 2 Results of the Particle Size Distribution Analysis of fine sediments sampled at the six survey sites.

Particle size (mm)	% Passing in each sample					
	N1	N2	N3	N4	N5	N6
	Riffle Receptor	Glide Receptor	Pool Receptor	Pool Reference	Glide Reference	Riffle Reference
< 63	100	100	100	100	100	100
< 31.5	100	100	100	100	100	100
< 16	95.49	100	100	100	100	100
< 8	70.49	100	100	100	100	99.76
< 4	55.67	99.58	99.86	99.92	98.45	93.13
< 2	42.13	99.34	99.58	99.81	98.14	74.14
< 1	30.27	98.75	99.4	99.45	97.58	43.34
< 0.5	20.74	97.69	98.93	98.6	96.9	22.00
< 0.25	12.99	96.15	97.91	97.02	95.79	18.67
< 0.125	7.95	91.03	91.68	89.72	89.79	16.91
< 0.063	5.81	76.61	76.94	75.88	75.72	13.34
< 0.032	4.35	61.09	61.78	60.49	60.16	9.93
< 0.016	2.52	40.54	42.05	40.35	38.89	5.91
< 0.008	1.1	22.04	23.78	21.9	20.23	2.94
< 0.004	0.33	8.19	9.25	7.93	7.1	1.09
< 0,002	0.05	1.35	1.64	1.21	1.09	0.21

Table 3 Classifications of each sediment sample from the Particle Size Distribution Analysis of fine sediments sampled at the six survey sites and sample descriptions.

Classification	% of each					
	N1	N2	N3	N4	N5	N6
	Riffle Receptor	Glide Receptor	Pool Receptor	Pool Reference	Glide Reference	Riffle Reference
Clay	0.05	1.35	1.64	1.21	1.09	0.21
Silt (dust)	5.76	75.27	75.29	74.66	74.64	13.12
Sand	36.32	22.73	22.65	23.93	22.42	60.81
Gravel	57.87	0.65	0.42	0.19	1.86	25.86

Table 4 BOD (Biochemical Oxygen Demand), Total Hardness, Alkalinity and Conductivity at Sites N1 and N6 in September 2023 (ISO17025 Accredited).

Parameter	N1	N6	Analytical Technique	Units
Alkalinity (Surface Water)	287	297	Colorimetry	mg/L CaCO3
BOD (Surface Water)	1.1	0.9	Electrometry	mg/L
Conductivity (Surface Water at 20C)	615.0	613.0	Electrometry	µscm -1@20C
Hardness Total (Surface Water)	354	359	Colorimetry	

Table 5 On-site water quality assessments undertaken during September 2023 on the River Nanny.

Parameter	N1	N2	N3	N4	N5	N6
Conductivity (µS cm-1)	610	580	599	611	601	620
Temperature (oC)	14.2	14.3	15.1	13.7	14.5	14.3
Dissolved Oxygen (%)	110	120	111	125	90	98

Table 6 Results of the on-site macroinvertebrate survey at the six survey sites on the River Nanny during September 2023.

	Pollution sensitivity group	Site N1	Site N2	Site N3	Site N4	Site N5	Site N6
Habitat Category		Riffle	Glide	Pool	Pool	Glide	Riffle
Sample type		receptor	receptor	receptor	reference	reference	reference
MAYFLIES (Uniramia, (Ephemeroptera)							
Baetidae	C	***	**	**	***	**	***
Empherellidae	C	***	**		*	**	**
CASELESS CADDIS FLIES (Trichoptera)							
Hydropsychidae)	C	**	*		**		**
Polycentropodidae	C		*			*	**
Rhyacophilidae	C	**		*			**
CASED CADDIS FLIES (Tricoptera)							
Sericostomatidae		***				*	**
Limnephilidae		*	*	**		*	***
DAMSELFLIES (Odonata, Zygoptera)							
Calopterygidae	B		***	*		*	
CRUSTACEANS (Crustacea)							
Gammaridae	C	*****	*****	*****	*****	*****	****
Asellidae	D		**	*		**	
SNAILS (Mollusca, Gastropoda)							
Planorbiidae	C	*		**	*		*
Hydrobiidae	C	**	***	***	***	*	**
MUSSELS (Mollucsa, Lamellibranchiata)							
Orb/ Pea Mussels (Sphaeridae)	D	**			**	*	
BEETLES (Coleoptera)							
Elmidae)							*
Dytiscidae	C		**	*	**	**	
Haliplidae	C		**	*			**
TRUE FLIES (Diptera)							
Blackfly larvae (Simulidae)	C	**	**		*		*
Chironomidae							
Green chironomid	C	**	*				*
Chironomous sp.	E	*	*			**	
BUGS (Hemiptera)							
Corixidae	C	*	*	***	*		
Gerridae	C	**		***	*	*	***
SEGMENTED WORMS (Annelida, Clitellata)							
Lumbricidae	D	*	*				*
LEECHES (Hirudinea)							
Erpobdellidae	E	**			*		
Family Diversity		**17**	**16**	**12**	**12**	**13**	**16**
Q rating		**Q3**	**Q3**	**Q3**	**Q3**	**Q3**	**Q3**
Status		**Poor**	**Poor**	**Poor**	**Poor**	**Poor**	**Poor**

* Present = 1 individual, ** Scarce/Few = <1%, *** Small numbers = <5%, **** Fair numbers = 5-10%, **** Common = 10-20%, ***** Numerous = 25-50%, ****** Dominant = 50-75%, ******* Excessive = >75%

Table 7 Hydrocarbons results from the discharge sampled in September 2023. (ISO17025 Accredited).

Hydrocarbon	LOD/Units	Results	Analytical Technique
Mineral Oil by Calculation	ug/L	<2.5	GC-FID
TPH (>C10-12)	ug/L	<1	GC-FID
TPH (>C10-40)	ug/L	<1	GC-FID
TPH (>C12-14)	ug/L	<1	GC-FID
TPH (>C14-16)	ug/L	<1	GC-FID
TPH (>C16-18)	ug/L	<1	GC-FID
TPH (>C18-20)	ug/L	<1	GC-FID
TPH (>C20-22)	ug/L	<1	GC-FID
TPH (>C22-24)	ug/L	<1	GC-FID
TPH (>C24-26)	ug/L	<1	GC-FID
TPH (>26-28)	ug/L	<1	GC-FID
TPH (>C28-30)	ug/L	<1	GC-FID
TPH (<C30-32)	ug/L	<1	GC-FID
TPH (>C32-34)	ug/L	<1	GC-FID
TPH (C>34-36)	ug/L	<1	GC-FID
TPH (C>36-38)	ug/L	<1	GC-FID
TPH (C>38-40)	ug/L	<1	GC-FID

Table 8 Heavy Metal results from the sample taken of the Irish Cement discharge during September 2023. (ISO17025 Accredited).

Heavy Metal	Units	Results	E.Q.S S.I. No.272 of 2009	Analytical Technique
Arsenic	µg/l	1	<25µg/l	ICPMS
Cadmium	µg/l	<1	0.2 µg/l	ICPMS
Chromium	µg/l	2	4.7, 3.4 µg/l	ICPMS
Cobalt	µg/l	<1		ICPMS
Copper	µg/l	<3	5µg/l	ICPMS
Lead	µg/l	<1	7.2µg/l	ICPMS
Nickel	µg/l	<2	20µg/l	ICPMS
Manganese	µg/l	<18		ICPMS
Mercury	µg/l	<0.06	0.05 µg/l	ICPMS
Zinc	µg/l	<9	8 or 50 or 100 µg/l	ICPMS

4. CONCLUSIONS

This report addresses Integrated Pollution Control (IPC) Licence Register Number P0030-04 (Conditions 6.14.1-5) for 2023. Macroinvertebrate diversity and abundance levels indicate typical characteristics of an organically polluted lowland Irish river. Pollution-tolerant organisms dominate, and toxicity tests confirm the effluent's non-toxic nature to aquatic ecology in the River Nanny. Results show no significant differences in sediment or macroinvertebrate assemblages upstream and downstream of the Irish Cement discharge.

The effluent is non-toxic and no harmful levels of organic compounds and heavy metals were detected in the effluent sample.

The River Nanny, previously deemed ecologically unsatisfactory by the EPA in 2020, remains so, mainly due to diffuse agricultural and septic tank pollution. Elevated nutrient levels in the catchment are also a concern. However, the discharge has a neutral impact on local River Nanny aquatic ecology, sediments, and measured water quality parameters.

PLATES

Plate 1 The River Nanny at Site N1 during September 2023.

Plate 2 The River Nanny at Site N4 during September 2023.

Plate 3 Kick sampling at Site N6 during September 2023.

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APPENDIX 1 LABORATORY CERTIFICATES (PSD)

Attachment no. 1 to the certificate of analysis for work order PR23B1045

Method: S-GRAINSIZ
Issue Date: 23.10.2023

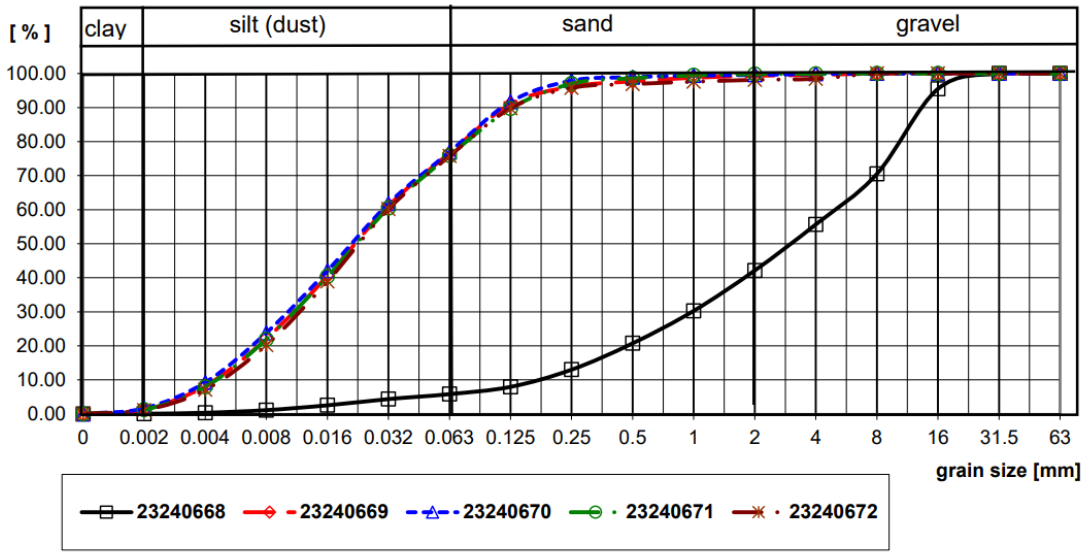
Sample label:				23240668	23240669	23240670	23240671	23240672
Lab. ID:				4070/007/01	4070/007/02	4070/007/03	4070/007/04	4070/007/05
Total weight of sample:			[g]	166.41	85.37	50.23	72.36	54.18
q	< 0.002	mm	[%]	0.05	1.35	1.64	1.21	1.09
q	0.002-0.004	mm	[%]	0.28	6.84	7.60	6.72	6.01
q	0.004-0.008	mm	[%]	0.77	13.85	14.54	13.96	13.14
q	0.008-0.016	mm	[%]	1.42	18.50	18.27	18.46	18.66
q	0.016-0.032	mm	[%]	1.83	20.55	19.73	20.14	21.27
q	0.032-0.063	mm	[%]	1.46	15.53	15.15	15.38	15.56
q	< 0.063	mm	[%]	5.81	76.61	76.94	75.88	75.72
q	0.063-0.125	mm	[%]	2.14	14.41	14.74	13.84	14.07
q	0.125-0.250	mm	[%]	5.04	5.12	6.23	7.30	6.01
q	0.250-0.500	mm	[%]	7.75	1.55	1.02	1.59	1.11
q	0.500-1.000	mm	[%]	9.53	1.05	0.48	0.84	0.68
q	1.000-2.000	mm	[%]	11.86	0.60	0.18	0.36	0.55
q	2.000-4.000	mm	[%]	13.54	0.23	0.28	0.11	0.31
q	4.000-8.000	mm	[%]	14.82	0.42	0.14	0.08	1.55
q	8.000-16.000	mm	[%]	25.00	0.00	0.00	0.00	0.00
q	16.00-31.50	mm	[%]	4.51	0.00	0.00	0.00	0.00
q	31.50-63.00	mm	[%]	0.00	0.00	0.00	0.00	0.00
q	> 63.00	mm	[%]	0.00	0.00	0.00	0.00	0.00
Q	< 0,002	mm	[%]	0.05	1.35	1.64	1.21	1.09
Q	< 0.004	mm	[%]	0.33	8.19	9.25	7.93	7.10
Q	< 0.008	mm	[%]	1.10	22.04	23.78	21.90	20.23
Q	< 0.016	mm	[%]	2.52	40.54	42.05	40.35	38.89
Q	< 0.032	mm	[%]	4.35	61.09	61.78	60.49	60.16
Q	< 0.063	mm	[%]	5.81	76.61	76.94	75.88	75.72
Q	< 0.125	mm	[%]	7.95	91.03	91.68	89.72	89.79
Q	< 0.250	mm	[%]	12.99	96.15	97.91	97.02	95.79
Q	< 0.500	mm	[%]	20.74	97.69	98.93	98.60	96.90
Q	< 1.000	mm	[%]	30.27	98.75	99.40	99.45	97.58
Q	< 2.000	mm	[%]	42.13	99.34	99.58	99.81	98.14
Q	< 4.000	mm	[%]	55.67	99.58	99.86	99.92	98.45
Q	< 8.000	mm	[%]	70.49	100.00	100.00	100.00	100.00
Q	< 16.00	mm	[%]	95.49	100.00	100.00	100.00	100.00
Q	< 31.50	mm	[%]	100.00	100.00	100.00	100.00	100.00
Q	< 63.000	mm	[%]	100.00	100.00	100.00	100.00	100.00

q -fraction percentage part, **Q** - fraction cumulative part.

Test method specification: CZ_SOP_D06_07_120 (CSN EN ISO 17892-4; CSN EN 933-1; CSN EN 933-2; BS ISO 11277; pokyn TOM 23/1) Determination of graininess by the combined method of the suspension density, sieve analyses and calculation of permeability from measured values according to USBSC; CZ_SOP_D06_07_123 (ISO 13320) Determination of particle size and distribution using laser diffraction

Page 1 from 2

Attachment no. 1 to the certificate of analysis for work order PR23B1045



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Attachment no. 2 to the certificate of analysis for work order PR23B1045

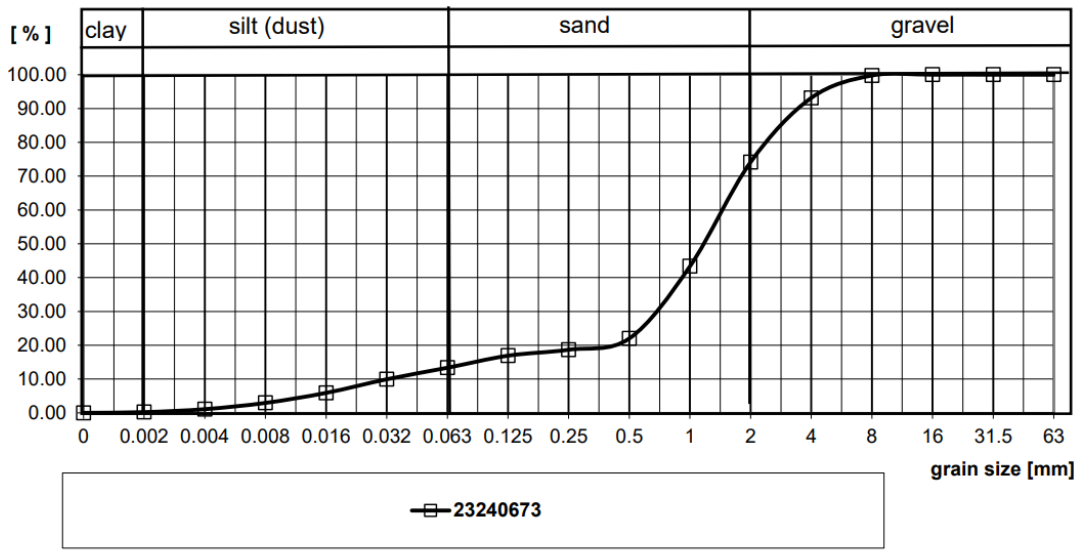
Method: S-GRAINSIZ
Issue Date: 23.10.2023

Sample label:				**23240673 - Fitz ID 4070/007/06**
Lab. ID:				006
Total weight of sample:			[g]	100.70
q	**< 0.002**	mm	[%]	0.21
q	**0.002-0.004**	mm	[%]	0.88
q	**0.004-0.008**	mm	[%]	1.85
q	**0.008-0.016**	mm	[%]	2.97
q	**0.016-0.032**	mm	[%]	4.02
q	**0.032-0.063**	mm	[%]	3.40
q	**< 0.063**	mm	[%]	13.34
q	**0.063-0.125**	mm	[%]	3.57
q	**0.125-0.250**	mm	[%]	1.76
q	**0.250-0.500**	mm	[%]	3.34
q	**0.500-1.000**	mm	[%]	21.34
q	**1.000-2.000**	mm	[%]	30.80
q	**2.000-4.000**	mm	[%]	18.99
q	**4.000-8.000**	mm	[%]	6.63
q	**8.000-16.000**	mm	[%]	0.24
q	**16.00-31.50**	mm	[%]	0.00
q	**31.50-63.00**	mm	[%]	0.00
q	**> 63.00**	mm	[%]	0.00
Q	**< 0,002**	mm	[%]	0.21
Q	**< 0.004**	mm	[%]	1.09
Q	**< 0.008**	mm	[%]	2.94
Q	**< 0.016**	mm	[%]	5.91
Q	**< 0.032**	mm	[%]	9.93
Q	**< 0.063**	mm	[%]	13.34
Q	**< 0.125**	mm	[%]	16.91
Q	**< 0.250**	mm	[%]	18.67
Q	**< 0.500**	mm	[%]	22.00
Q	**< 1.000**	mm	[%]	43.34
Q	**< 2.000**	mm	[%]	74.14
Q	**< 4.000**	mm	[%]	93.13
Q	**< 8.000**	mm	[%]	99.76
Q	**< 16.00**	mm	[%]	100.00
Q	**< 31.50**	mm	[%]	100.00
Q	**< 63.000**	mm	[%]	100.00

q -fraction percentage part, **Q** - fraction cumulative part.

Test method specification: CZ_SOP_D06_07_120 (CSN EN ISO 17892-4; CSN EN 933-1; CSN EN 933-2; BS ISO 11277; pokyn TOM 23/1) Determination of graininess by the combined method of the suspension density, sieve analyses and calculation of permeability from measured values according to USBSC; CZ_SOP_D06_07_123 (ISO 13320) Determination of particle size and distribution using laser diffraction

Attachment no. 2 to the certificate of analysis for work order PR23B1045



The end of result part of the attachment the certificate of analysis

APPENDIX 2 LABORATORY CERTIFICATES (WATER QUALITY)

FITZ SCIENTIFIC
MONITORING & TESTING

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Boyne Business Park,
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Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.fitzsci.ie
Email: info@fitzsci.ie

A copy of this certificate is available on www.fitzsci.ie. Customer supplied information appear in italics.

Customer	*William O Connor*	Lab Report Ref. No.	4040/007/07
	Ecofact Environmental Consultants Ltd	Date of Receipt	22/09/2023
	Unit 48	*Sampled On*	*22/09/2023*
	Tait Business Centre	Date Testing Commenced	22/09/2023
	Domnic St	Received or Collected	Delivered by Customer
	Limerick City	Condition on Receipt	Acceptable
Customer PO		Date of Report	10/10/2023
Customer Ref	*N1*	*Sample Type*	*Surface Water*
Ref 2			
Ref 3			

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Alkalinity (Surface Water)	102	Colorimetry	287	mg/L CaCO3	INAB
BOD (Surface Water)	113	Electrometry	1.1	mg/L	INAB
Conductivity (Surface Water at 20C)	112	Electrometry	615.0	µscm -1@20C	INAB
Hardness Total (Surface Water)	111	Colorimetry	354	mg/L CaCO3	INAB

Signed: A Harmon Date: 10/10/2023

Aoife Harmon - Laboratory Supervisor

Acc. : Accredited Parameters by ISO/IEC 17025:2017

For bacterial analysis a result of 0 means none detected in volume examined
All organic results are analysed as received and all results are corrected for dry weight at 104 C
Results shall not be reproduced, except in full, without the approval of Fitz Scientific
Results contained in this report relate only to the samples tested (P) : Presumptive Results

** : The test result for this parameter may be invalid as it has exceeded the recommended holding time (BS EN ISO 5667-3:2018)

Final results will be issued without any estimated uncertainty of measurement being applied. This can be supplied on request.
Fitz Scientific maintain all customer information in the strictest confidence which is legally enforceable.

Page 1/1

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Customer	*William O Connor*	Lab Report Ref. No.	4040/007/08
	Ecofact Environmental Consultants Ltd	Date of Receipt	22/09/2023
	Unit 48	*Sampled On*	*22/09/2023*
	Tait Business Centre	Date Testing Commenced	22/09/2023
	Domnic St	Received or Collected	Delivered by Customer
	Limerick City	Condition on Receipt	Acceptable
Customer PO		Date of Report	10/10/2023
Customer Ref	*N6*	*Sample Type*	*Surface Water*
Ref 2			
Ref 3			

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Alkalinity (Surface Water)	102	Colorimetry	297	mg/L CaCO3	INAB
BOD (Surface Water)	113	Electrometry	0.9	mg/L	INAB
Conductivity (Surface Water at 20C)	112	Electrometry	613.0	µscm -1@20C	INAB
Hardness Total (Surface Water)	111	Colorimetry	359	mg/L CaCO3	INAB

Signed: A Harmon **Date: 10/10/2023**

Aoife Harmon - Laboratory Supervisor

Acc. : Accredited Parameters by ISO/IEC 17025:2017

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	Ecofact Environmental Consultants Ltd	Date of Receipt	22/09/2023
	Unit 48	*Sampled On*	22/09/2023
	Tait Business Centre	Date Testing Commenced	22/09/2023
	Domnic St	Received or Collected	Delivered by Customer
	Limerick City	Condition on Receipt	Acceptable
Customer PO		Date of Report	10/10/2023
Customer Ref	*NO*	*Sample Type*	*Effluent*
Ref 2			
Ref 3			

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Arsenic (Industrial Eff.)	177	ICPMS	1	ug/L	INAB
Cadmium (Industrial Eff.)	177	ICPMS	<1	ug/L	INAB
Chromium (Industrial Eff.)	177	ICPMS	2	ug/L	INAB
Cobalt (Industrial Eff.)	177	ICPMS	<1	ug/L	INAB
Copper (Industrial Eff.)	177	ICPMS	<3	ug/L	INAB
Lead (Industrial Eff.)	177	ICPMS	<1	ug/L	INAB
Manganese (Industrial Eff.)	177	ICPMS	<18	ug/L	INAB
Mercury (Industrial Eff)	178	ICPMS	<0.06	ug/L	INAB
Mineral Oil by Calculation	188	GC-FID	<2.5	ug/L	
Nickel (Industrial Eff.)	177	ICPMS	<2	ug/L	INAB
TPH (>C10-12)	188	GC-FID	<1	ug/L	
TPH (>C10-40)	188	GC-FID	<1	ug/L	
TPH (>C12-14)	188	GC-FID	<1	ug/L	
TPH (>C14-16)	188	GC-FID	<1	ug/L	
TPH (>C16-18)	188	GC-FID	<1	ug/L	
TPH (>C18-20)	188	GC-FID	<1	ug/L	
TPH (>C20-22)	188	GC-FID	<1	ug/L	
TPH (>C22-24)	188	GC-FID	<1	ug/L	
TPH (>C24-26)	188	GC-FID	<1	ug/L	
TPH (>C26-28)	188	GC-FID	<1	ug/L	

Signed: A Harmon **Date: 10/10/2023**

Aoife Harmon - Laboratory Supervisor

Acc. : Accredited Parameters by ISO/IEC 17025:2017

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	Ecofact Environmental Consultants Ltd	Date of Receipt	22/09/2023
	Unit 48	*Sampled On*	*22/09/2023*
	Tait Business Centre	Date Testing Commenced	22/09/2023
	Domnic St	Received or Collected	Delivered by Customer
	Limerick City	Condition on Receipt	Acceptable
Customer PO		Date of Report	10/10/2023
Customer Ref	*NO*	*Sample Type*	*Effluent*
Ref 2			
Ref 3			

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
TPH (>C28-30)	188	GC-FID	<1	ug/L	
TPH (>C30-32)	188	GC-FID	<1	ug/L	
TPH (>C32-34)	188	GC-FID	<1	ug/L	
TPH (>C34-36)	188	GC-FID	<1	ug/L	
TPH (>C36-38)	188	GC-FID	<1	ug/L	
TPH (>C38-40)	188	GC-FID	<1	ug/L	
Zinc (Industrial Eff.)	177	ICPMS	<9	ug/L	INAB

Signed: A Haverman **Date: 10/10/2023**

Aoife Harmon - Laboratory Supervisor

Acc. : Accredited Parameters by ISO/IEC 17025:2017

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Results contained in this report relate only to the samples tested (P) : Presumptive Results

** : The test result for this parameter may be invalid as it has exceeded the recommended holding time (BS EN ISO 5667-3:2018)

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Page 2/2

APPENDIX 3 LABORATORY CERTIFICATES (ECOTOXICOLOGY)

SGS

cofrac ESSAIS
Accreditation No.1-6464 scope available on www.cofrac.fr

REFERENCES

Order: 2023-GAS-001
Estimate: DR23-03278
Received Rouen: 27/07/2023
Requested by: M. NOURELDIN Ahmed,
SGS GAS ANALYSIS SERVICES, IRELAND
Client ID: N1
Description: WATER
Nature: WATER
Comments:
Subject of the revision: Report address adjustment

ECOFACT Environmental Consultants Ltd.
TAIT BUSINESS CENTRE
DOMINIC STREET
LIMERICK
V94NW81
IRELAND

Rouen, 09/08/2023

REPORT
RN23-08271.001 Page 1 / 7
Revision 1

This document cancels the document of same number previously issued which to be destroyed or returned to the laboratory.

SUMMARY OF RESULTS

Sample	Ecotoxicity parameter	Standard	Result (endpoint)
RN23-08271.001	*Daphnia* sp., Acute Immobilisation Test	ISO 6341	**EC50-48h > 100%**
	Vibrio fischeri, Light emission Inhibition Test	ISO 11348-3	**EC50-30min > 80%**

Conclusion:

No significant toxicity of the sample was demonstrated during the aquatic ecotoxicity tests implemented.

This document cancels the document of same number previously issued which to be destroyed or returned to the laboratory.

Parameter:

I- DETERMINATION OF DAPHNIDS MOBILITY INHIBITION – ACUTE TOXICITY TEST –

NF EN ISO 6341 - T 90 301

Principle: Young daphnids, aged less than 24 hours at the start of the test, are exposed to the test sample at a range of concentrations for a period of 48 hours. Immobilization is recorded at 24 hours and 48 hours and compared with control values. The results are analysed in order to calculate the EC50 at 48h.

Calculation of equitox number (48h):

The equitox number (48h) corresponds to the number of dilutions necessary to induce the immobilization, after 48 hours, of 50% of the daphnia introduced into $1m^3$ of water.

It can therefore be calculated: Equitox number (48h) = $\frac{100}{EC50\text{-}48h\ (\%)}$

Test Organism: *Daphnia magna* Straus (*Cladocera, Crustacea*) between 6 and 24 hours old and produced from parthenogenically reproducing brood female population.

Sample:

Sampled by the client on [a]	20/07/2023		
Frozen by the client on [a]	20/07/2023		NA ☐
Conservation during transport (report upon receipt)	Ambient t° ☐	Refrigerated ☐	Frozen ☒
Method of preservation in the laboratory	Ambient t° ☐	Refrigerated ☐	Frozen ☒
Thawing mode	Ambient t° ☒	Bath 30°C ☐	NA ☐
Preparation of the sample after stirring and before dilutions	Settling 2h ☒	Filtration ☐	Centrifugation ☐
pH of the raw sample	7.1	Adjustment: no ☒	yes ☐
Conductivity of the raw sample	488 µS/cm		
Dissolved oxygen in the raw sample	76%	≥ 40% ☒	<40% [b] ☐

(a) Information provided by the client
(b) In this case, an aeration of less than 20 minutes and without supersaturation was carried out before testing so as to obtain a rate of> 40%.

Reminder of the storage and transport requirements of the test standard NF EN ISO 6341: the sample must be analyzed within 12 hours of sampling or within 72 hours kept refrigerated or within 2 months frozen.

Test medium (dilution water) - prepared every week:

➢ *Composition:*

Product	Concentration in the test medium (mg/L)
Calcium Chloride dihydrated ($CaCl_2$, $2H_2O$)	294
Magnesium Sulphate heptahydrated ($MgSO_4$, $7H_2O$)	123.25
Sodium Hydrogenocarbonate ($NaHCO_3$)	64.75
Potassium chloride (KCl)	5.75

The dilutions are prepared in demineralised water.

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➢ *Characteristics required by the standard:*

Compliance (pH and O_2) is controlled with each medium preparation

pH = 7,8 ± 0,5 Compliance ☒ (Adjustment : no ☒ NaOH ☐ HCl ☐)
O_2 > 7 mg/L after an aeration of 20 minutes maximum Compliance ☒
Hardness = 225 ± 50 mg/L Compliance according to NF EN ISO 6341

Reference substance:

The reference substance is Potassium Dichromate ($K_2Cr_2O_7$) tested with the conditions set by the NF EN ISO 6341 standard in 24h.

	Test date	EC50-24h	CI (95%)	Validity criterion	Validity
$K_2Cr_2O_7$	From 25/07 to 26/07/2023	1.53 mg/L	[1.41 - 1.66] mg/L	[0.6 - 2.1] mg/L	yes ☒ no ☐

Test dates: From 02/08/2023 to 04/08/2023

Results:

➢ *Raw data:*

Tested concentrations %	Daphnids immobilized per well at 48h (**)				Daphnids behavior (***)	Percentage of immobilized	pH at t=0h	pH at t=48h	Dissolved O_2 in mg/L at t=48h	Conclusions	Value LID
	Replicate A	Replicate B	Replicate C	Replicate D							
Control	0	0	0	0	N	0	8.0	8.1	8.2	valid	
1	0	0	0	0	N	0	8.0	8.1	-		
10	0	0	0	0	N	0	7.9	8.1	-		
100	0	0	0	0	N	0	7.1	7.8	8.0	Cmax 0%	1

(**) 5 daphnids per well (***) N = Normal L = Lethargy F = Surface flotation R = Rotation or abnormal circular movement D = Discoloration

➢ *Table of results - Daphnia magna:*

	RN23-08271.001	*CI (95%)*
EC50-48h (*)	**> 100%**	**NA**
Percentage of inhibition in 48 hours for 100% of sample	< 10%	-
Equitox number / m^3	< 1	NA

The calculations are performed with the statistical test of Probits, if required. Technician: L. Lepeule

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Abbreviations:

NA = Not Applicable.
NaOH = Sodium hydroxide.
HCl = Hydrochloric acid.
O_2 = Dissolved oxygen.
EC50-48h = Effective Concentration corresponding to 50% of immobilization in 48 hours.
CI (95%) = Confidence Interval at 95%.
LID = Lowest Ineffective Dilution (at least 90% of the daphnids are mobile).
Cmax 0% = Maximum tested concentration corresponding to 0% of immobilization.
Cmin 100% = Minimum tested concentration corresponding to 100% of immobilization.
EC50-48h > 100%: No toxicity detected

Type of report:

1) report without reserve: the requirements were met and communicated to the laboratory	☒
2) report with reserves: all the information was not communicated to the laboratory	☐
3) report with reserves: the conditions do not comply with the requirements	☐

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Parameter:

II- DETERMINATION OF THE INHIBITORY EFFECT ON THE LIGHT EMISSION OF *Vibrio fischeri*

NF EN ISO 11348-3

Principle: Determination, under the test conditions, of the sample concentration which, in 30, 15 and if necessary 5 minutes, inhibits 50% of the luminescence produced by a suspension of bacteria *Vibrio fischeri* (EC50-30min / EC50-15min). Maximum testable concentration = 80%.
A color correction can be made in the case of the evaluation of an opaque or colored sample.

Calculation of equitox number (30min):

The equitox number (30min) corresponds to the number of dilutions necessary to induce, after 30 minutes, 50% luminescence inhibition of bacteria introduced into $1m^3$ of water.

It can therefore be calculated: Equitox number (30min) $\frac{100}{EC50\text{-}30min\ (\%)}$

Test organism: *Vibrio fischeri* (new nomenclature = *Aliivibrio fischeri*) bacterial suspension reconstituted on the day of the test. Freeze dried bacteria stored at t°<-18°C. Batch No.22EY00501 (supplier: Modern Water).

Test medium: Salty water NaCl 20g/L according to the recommendations of the standard NF EN ISO 11348-3.

Sample:

- Water that is not colored or opaque
- Collected by the customer and transported frozen to the laboratory
- Salinity: 0.2 ‰
- pH of the raw sample = 7.1
- Storage: frozen
- Thawing mode: ambient temperature
- Pre-treatment: filtration
- Method of preparation of test solutions: salinity adjustment and direct dilution in mineral medium

Test conditions:

- Test temperature: 15°C ± 1°C
- Used test media: pH = 7.0
- Without color correction

Test date: 03/08/2023

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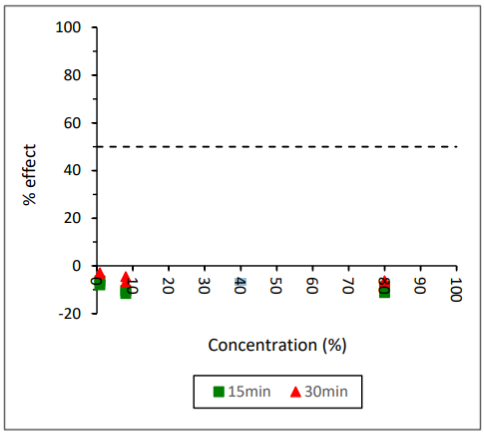
Results:

➢ *Raw data:*

Time	Sample	Conc (%)	I0	It	Gamma	%Effect
15 minutes						
	Control	0.00	98	76	0.7813	
	Control	0.00	97	75	0.7745	
	1	0.80	93	77	-0.0589	-6.26%
	2	0.80	91	76	-0.0734	-7.92%
	3	8.00	91	78	-0.0937	-10.34%
	4	8.00	91	79	-0.1041	-11.62%
	5	80.00	91	77	-0.0800	-8.70%
	6	80.00	88	76	-0.1008	-11.20%
30 minutes						
	Control	0.00	98	72	0.7381	
	Control	0.00	97	71	0.7274	
	1	0.80	93	71	-0.0412	-4.30%
	2	0.80	91	68	-0.0281	-2.89%
	3	8.00	91	71	-0.0635	-6.78%
	4	8.00	91	69	-0.0435	-4.55%
	5	80.00	91	71	-0.0660	-7.06%
	6	80.00	88	68	-0.0586	-6.22%

➢ *Dose-response:* for 15 and 30 minutes of exposure



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➢ *Validity table:*

- Sensitivity of bacteria to reference toxicants:

Reference substance	Date	Tested concentration	Inhibition in 30 min (%)	Reference value	Compliance
3,5-dichlorophenol	03/08/2023	3.4 mg/L	51%	20 to 80% of inhibition	C
Zinc sulfate heptahydrate	03/05/2023	9.7 mg/L	54%		C
Potassium dichromate	03/05/2023	52.9 mg/L	55%		C

- Other criteria:

		Calculated value		Reference value	Compliance
		15 min	30 min		
Value of the correction factor		0.7744	0.7333	0.6 à 1.3	C
Parallel determinations	Control	0.15%	0.19%	≤ 3%	C
	0.8%	0.83 points	0.71 points	≤ 3 points*	C
	8%	0.64 points	1.12 points	≤ 3 points*	C
	80%	1.25 points	0.42 points	≤ 3 points*	C

* validity criterion to be taken into account only for the determination of the NEMD (No Effect Maximum Dose)

➢ *Table of results - Vibrio fischeri:*

	RN23-08271.001	***CI (95%)***
EC50-15min	> 80%	NA
EC50-30min	**> 80%**	**NA**
Percentage of inhibition in 15 minutes for 80% of sample	< 10%	-
Percentage of inhibition in 30 minutes for 80% of sample	< 10%	-
Equitox number / m^3	< 1.25	NA

The calculations are performed with the Microtox® software, if required. Technician: M. Lemoing

Abbreviations:

NA = Not Applicable.
EC50-Xmin = Concentration causing 50% of inhibition of light emission in X minutes on the bacteria *Vibrio fischeri*
CI (95%) = Confidence Interval at 95%.
EC50-30min > 80%: No toxicity detected (or toxicity < 50% at 80% of sample)

Results validated electronically by **Aline JOURDAN** Phone No: +33 6 23 73 30 86
Project Manager

This validation is an electronical signature realized in conformity with requirements of ISO 17025

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