Water Framework Directive Compliance Report

Physico-chemistry

First Quarter 2024

March 2024

Prepared by: INVAS Biosecurity Ltd.
82 Lakelands Close, Stillorgan, Co Dublin
Tel: +353876468609
Email: joecaffrey@invas.ie
Web: www.invasbiosecurity.ie

Table of Contents

Front Cover: Water sampling on the Shannon-Erne Waterway at Leitrim marina in February 2024.

1. Introduction

Water Framework Directive (WFD) surveillance monitoring of the Royal and Grand Canals, and the Shannon-Erne Waterway, for Q1 2024 was carried out on 14th and 22nd February 2024.

A canal is identified as an Artificial Water Body (AWB) in the WFD and is defined as 'a body of water created by human activity'. In recognition of their navigational role, AWBs must achieve good ecological potential as opposed to good ecological status, the latter which applies to natural water bodies, such as rivers and lakes. Ecological potential is assessed using a combination of biological (native and invasive macroinvertebrate and macrophyte), physico-chemical and hydromorphological quality elements. For classification purposes, the ecological potential of a site or AWB can be Maximum, Good, Moderate, Poor or Bad. Where physico-chemistry alone is being assessed, as in this report, sites and AWBs can achieve either Good or Moderate potential only. In assigning ecological potential, the one-out-all-out rule applies, whereby the lowest value quality element determines the overall classification of the AWB. A system for classifying British and Irish canals based on macroinvertebrate, macrophyte, invasive species, physico-chemical and hydromorphological quality elements is used to assess the ecological potential of AWBs. In the current reporting period (Q1 2024), the canals are classified based on the physico-chemistry of the water during this period.

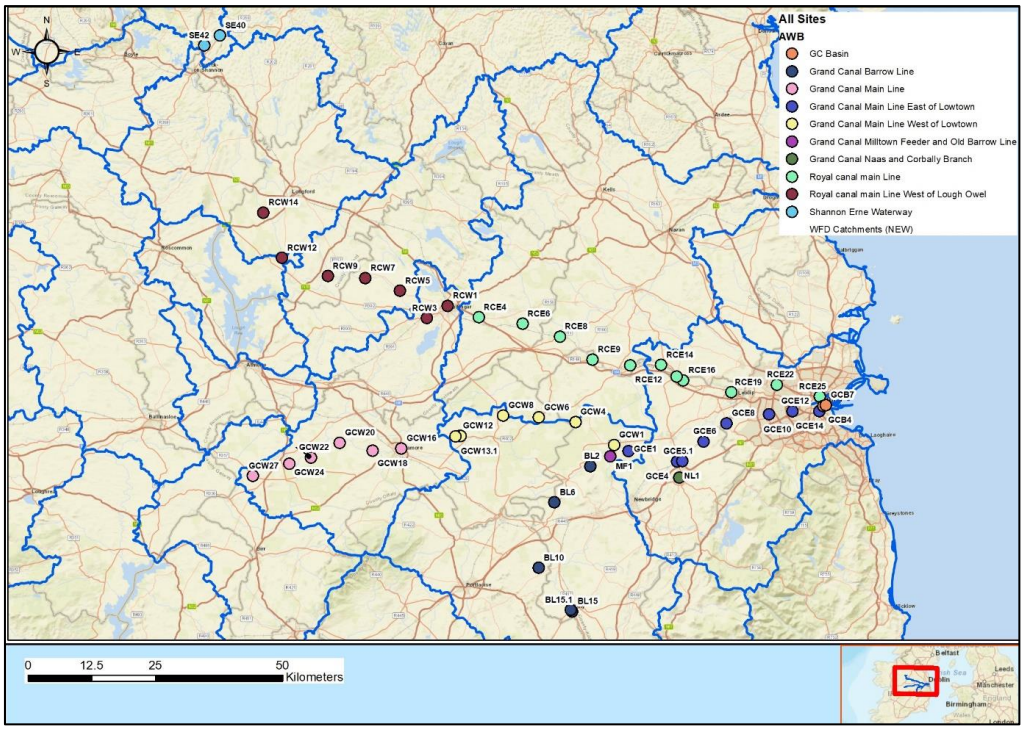

Figure 1. Artificial Water Bodies (AWBs), sites and monitored feeder streams on the Royal and Grand Canals, and the Shannon-Erne Waterway. The AWBs are grouped based on associated river catchments.

The canals are currently divided into 15 AWBs based on their locations within river catchments (Table 1). The Grand Canal supports eight AWBs (this does not include the Grand Canal Basin), the Royal Canal has six AWBs and there is just a single AWB on the Shannon-Erne Waterway. Four of the AWBs have only a single canal sampling site (Table 1), which can be potentially problematic when ecological potential for individual AWBs is being assigned. This reflects the fact that a breach in any biological or abiotic parameter can result in the AWB being changed from Good to Moderate.

For reporting purposes, a simple code has been assigned, whereby AWBs are labelled according to the river catchment in which they occur (Table 1).

Table 1. Artificial Water Bodies (AWBs) included in the WFD Monitoring Programme.

Artificial Water Body (AWB)	Catchment No	New ID Code	New Report Code	Length (km)	No of Sites
GRAND CANAL					
Grand Canal Main Line - Liffey and Dublin Bay	9	IE_09_AWB_GCMLE	GC_09	41.4	6
Grand Canal Main Line East - Barrow	14	IE_14_AWB_GCMLE	GC_14E	15.7	2
Grand Canal Main Line West - Barrow	14	IE_14_AWB_GCMLW	GC_14W	12.9	2
Grand Canal Main Line - Boyne	7	IE_07_AWB_GCMLW	GC_07	14.5	2
Grand Canal Main Line - Lower Shannon	25A	IE_25A_AWB_GCMLW	GC_25A	47.0	6
Grand Canal Naas Line - Liffey and Dublin Bay	9	IE_09_AWB_GCNL	GCNL_09	11.9	1
Grand Canal Milltown Feeder - Barrow	14	IE_14_AWB_GCMF	GCMF_14	10.5	1
Grand Canal Barrow Line - Barrow	14	IE_14_AWB_GCBL	GCBL_14	50.8	4
Grand Canal Basin - Liffey and Dublin Bay	9	IE_09_AWB_GCB	GCB		2
ROYAL CANAL					
Royal Canal Main Line - Boyne Catchment	7	IE_07_AWB_RCMLE	RC_07	42.6	5
Royal Canal Main Line - Liffey and Dublin Bay	9	IE_09_AWB_RCMLE	RC_09	39.4	5
Royal Canal Main Line - Lower Shannon	25A	IE_25A_AWB_RCMLW	RC_25A	13.3	2
Royal Canal Main Line - Upper Shannon	26F	IE_26F_AWB_RCMLW	RC_26F	33.8	3
Royal Canal Main Line - Upper Shannon	26E	IE_26E_AWB_RCMLW	RC_26E	3.7	1
Royal Canal Main Line - Upper Shannon	26C	IE_26C_AWB_RCMLW	RC_26C	14.2	1
SHANNON ERNE WATERWAY					
Shannon Erne Waterway - Upper Shannon	26A	IE_26A_AWB_SEW	SE_26A	25.5	2

Figure 2. Location of the two WFD monitoring sites (SE40 and 42) on the Shannon-Erne Waterway.

Plate 1. Collecting water samples from Kilcock drain (RCE16.1) in mid-February 2024.

2. Materials and Methods

2.1. *Sampling locations*

Physico-chemical sampling is conducted on a quarterly basis at 50 monitoring sites – 41 on the Royal, Grand and Barrow Canals, two on the Grand Canal Basin, two on the Shannon-Erne Waterway, and five on selected canal feeder streams/drains (see Figures 1, 2 and 3). The canal feeders/drains have been a source of elevated nutrient and coliform inputs in the past. They include the Monread drain (GCE5.1) and Ballymullen (GCW12.1) and Ballylennon (GCW13.1) feeder streams on the Grand Canal, the Athy drain (BL15.1) on the Barrow Line, and the Kilcock Harbour drain (RCE16.1) on the Royal Canal.

Since early summer 2023, the water level at the Croke Park (RCE25) monitoring site has been artificially lowered and access to the canal was blocked to facilitate Greenway construction activities. It was, therefore, necessary to take this set of water samples at the nearest accessible upstream site, on this occasion at Cross Guns Bridge. It was also necessary to permanently relocate the Sallins (RCE4) monitoring site some 600 metres west so that water and biological samples could be collected without interference from the permanently moored craft in this area.

During 2023, WI collected occasional water samples for bacteriological analysis (*E. coli* and *Enterococci*) at a number of 'recreational and hotspot' sites on the canals and the Shannon-Erne Waterway, at Leitrim. A small number of these sites roughly corresponded with sites used for the quarterly WFD Canals Surveillance Monitoring Programme, including Leitrim village/marina, GCE8 (Hazelhatch), GCE14 (Baggot Street), GCE5 (Sallins), RCE12 (Castleknock) and RCE16 (Kilcock). A site in Naas Harbour, upstream of NL1, was also sampled by WI during this period. The last set of results received by INVAS from this sampling programme were collected on 26th September 2023.

In addition to the quarterly water samples taken by INVAS at two sites in the Grand Canal Basin as part of the WFD Canals Surveillance Programme, WI and Dublin City Council (DCC) conduct regular water sampling for bacteriological (*E. coli* and *Enterococci*) analysis at up to 11 sites in the Basin (three in the inner, eight in the outer) and two in the adjacent Grand Canal (Figure 4). From early 2022 to late March 2023, just five samples for bacteriology were collected and analysed on a fortnightly basis, these taken from the 1st level of the Grand Canal (1), the inner basin (2 – sites 4 and 5 in Figure 4) and the outer basin (2 – sites 6 and 7 in Figure 4). Between late March and mid-May 2023, when the last set of results was received by INVAS, a sixth sampling site, located in the middle of the outer basis, was included in the sampling programme.

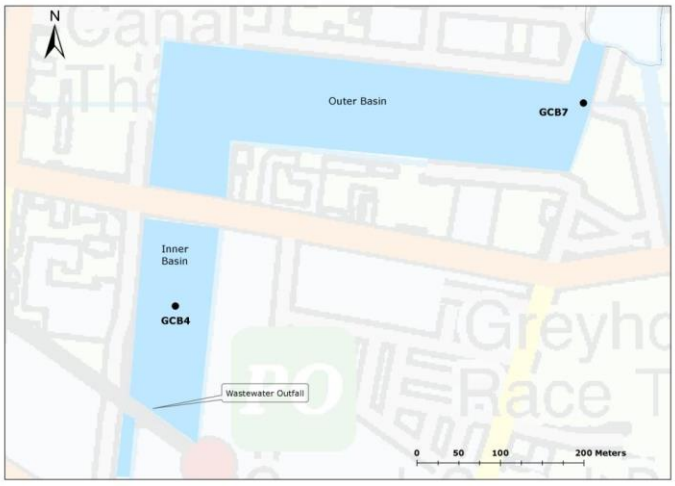

Figure 3. Grand Canal Basin (Dublin) showing the two monitoring sites (GCB4 and GCB7) used by INVAS.

2.2. *Physico-Chemical Monitoring*

Water sampling involves the deployment of a YSI water logger at each monitoring site to measure temperature, conductivity, pH and dissolved oxygen (% and mg/l O_2). Water samples are collected from canal sites and returned to the Independent Analytical Supplies (IAS) laboratory in Bagenalstown for analysis of a range of physico-chemical parameters (Table 2). A subset of these is used to assess indicative ecological potential - Total Phosphorus (TP), Soluble Reactive Phosphorus (SRP), Total Oxidised Nitrogen (TON), Ammonia, Biological Oxygen Demand (BOD) and Faecal Coliforms.

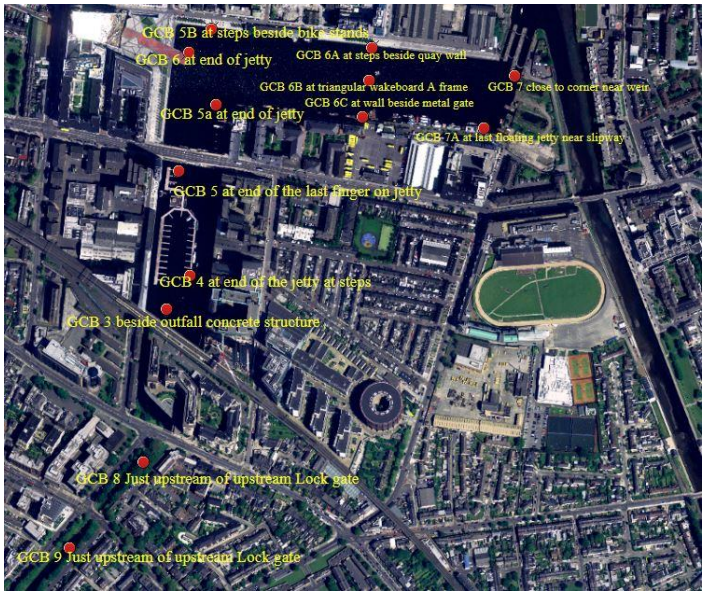

Figure 4. Grand Canal Basin (Dublin) showing the 13 sites that have been sampled in the past by Waterways Ireland and Dublin City Council for bacteriology.

Table 2. Physico-chemical determinands measured as part of WFD monitoring. (Chlorophyll monitoring has been discontinued since 2021.)

Determinand	Limit	Determinand	Limit
Total Phosphorus (TP) (mg/l P)*	0.063 mg/l P	Dissolved Oxygen (DO) (mg/l and % saturation)	>5.0 mg/l O_2
Molybdate Reactive Phosphorus (MRP) (mg/l P)	0.025 mg/l P	pH	
Soluble Reactive Phosphorus (SRP) (mg/l P)*	0.025 mg/l P	Conductivity (µS)	
Total Oxidised Nitrogen (TON) (mg/l N)*	4.1 mg/l N	Alkalinity (meq/l)	
Nitrite (mg/l)		Chlorophyll (µg/l)	
Nitrate (mg/l)		Biological Oxygen Demand (BOD) (mg/l O_2)*	<2.5 mg/l O_2
Ammonia (mg/l N)*	0.12 mg/l N	Total Coliforms (TC) (counts/100ml)	5000/100 ml
Temperature (°C)		Faecal Coliforms (counts/100ml)*	1000/100 ml

* Determinands used to assign ecological potential to the Artificial Water Bodies (AWBs)

3. Results

The full set of results from physico-chemical analysis of the water samples taken from the 50 canal, feeder/drain and Grand Canal Basin sites surveyed in Q1 2024 is presented in Appendices I and II.

3.1. *Physico-chemistry at Canal Sites*

Water sampling in Q1 2024 was conducted over two days – 14th and 22nd February 2024. The weather in the days before the first sampling event on 14th February was very changeable, although there was quite an amount of rainfall during this period. There was particularly heavy rainfall on the day and night before sampling on 22nd and this was reflected in a high flow from the feeders sampled on that day (i.e., Ballylennon and Ballymullen – see Plate 3). Water temperature at canal sites over the sampling period varied from 6.0 to 9.2ºC and ranged from 6.0 to 8.8ºC on 14th and from 7.6 to 9.2ºC on 22nd February 2024 (see Appendix I). Water temperatures in both the Monread and Athy drains exceeded those recorded in the canal water on 14th February, at 9.0 and 9.2 ºC, respectively. The highest water temperature recorded in the canal in Q1 of 9.2ºC was recorded on 22nd February at Cornalaur (GCW20).

Plate 2. Live Asian clam (Corbicula fluminea) specimens collected while water sampling in the Grand Canal east of Armstrong Bridge (GCW24) in February 2024.

Water levels at the seven Grand Canal East (GCE) WFD monitoring sites were normal for the time of year and the water was crystal clear at most sites. Results for nutrient parameters were generally low and within acceptable limits at all sampling sites, although slightly elevated values for SRP (0.02mg/l P) were reported at five of the seven sites (see Appendix I). In Q2 and Q3 2023, high Ammonia levels (0.17 and 0.15mg/l N, respectively) were recorded at GCE4 (Sallins), a site that continues to support a large number of

permanently moored craft. Levels for this parameter in Q4 2023 and Q1 2024 were low. High TON and Nitrate readings were recorded at GCE6 (Ponsonby Bridge) and GCE8 (Hazelhatch), respectively, although the readings for all other parameters analysed at these sites were low (Appendix I). Counts for Total coliform and *E. coli* were very low at the seven GCE sites on this sampling occasion and there was no repeat of the elevated bacteriological counts recorded at GCE4 in Q2 and Q4 2023.

As in Q4 2023, water quality conditions at most of the 11 GCW sites in Q1 2024 were generally good (see Appendix I). During sampling, close attention was paid to the site west of Pollagh (GCW22) where a very high TP reading of 0.13mg/l P was reported in Q3 2023. Low levels for all nutrient parameters were recorded here in Q1 2024 (see Appendix I). An unacceptably high TON reading of 4.9mg/l N was recorded on this sampling occasion at GCW16 (Tullamore), although all other parameters examined at this site were well within acceptable limits. On most previous sampling occasions, readings for TON at GCW16 have been low and generally below 2.0mg/l N. The reason for this highly elevated reading is unknown but the site will be examined closely during sampling in Q2 of this year. The one site where high readings for a number of parameters were reported was GCW12 (Daingean), the site that is located between the Ballymullen (GCW12.1) and Ballylennon (GCW13.1) feeders. A very high TP reading of 0.07mg/l P and elevated readings for MRP, BOD and Ammonia were recorded (see Appendix I), probably reflecting the high readings for similar parameters reported for the adjacent Ballylennon feeder (see Section 3.3). This feeder also reported high Phosphorus and Ammonia levels in Q4 2023, a feature that is having an adverse impact on the water quality of the receiving canal. Somewhat elevated BOD readings of 2mg/l O_2 were reported for GCW6 (George's Bridge) and GCW27 (L'Estrange Bridge), although levels for all other parameters examined at these sites were low.

The water in the Naas Line of the Grand Canal (NL1) was very clear, although the water level was down by *c*. 0.2m. Water quality conditions were poor in Q1 2024, with unacceptably high levels recorded for TP, SRP, TON, Nitrate, Total coliform and *E. coli* (see Appendix I). Reasonably high TON and Nitrate levels were reported at this site throughout 2023, although the values recorded on this sampling occasion (5.6 and 5.55mg/l N) far exceeded any values recorded in that year. Bacteriological counts were also very high in Q1 of this year, as they were on the last sampling occasion in Q4 2023. It is clear that contaminated water continues to be discharged to the Naas Canal, probably *via* the drain at Naas Harbour, and it is important that Kildare County Council acts to mitigate this situation before irreparable ecological damage is caused to the receiving Naas and Grand Canals.

The Milltown Feeder (MF1) supported a good flow of crystal-clear water when sampled in Q1 2024. The water quality was excellent and levels for all parameters analysed were low, as has been the case throughout 2023.

The water at the four sites on the Barrow Line was clear and water levels were normal for the time of year at all bar BL6 (Umeras), where levels were artificially low and much of the banksides were exposed. Water

quality conditions were good at most sites, although TON and Nitrate levels were high at BL6, BL10 (Vicarstown) and BL15 (Athy), reporting a maximum value of 3.9mg/l N at BL6. High TON and Nitrate readings had been a feature of some of these sites in the past, although particularly low levels for these parameters were reported in Q2, Q3 and Q4 of 2023. A slightly elevated Ammonia reading of 0.09mg/l N was recorded at BL6, where the water level was artificially low, a factor that may have impacted this reading.

While water levels were normal for February at all ten Royal Canal East (RCE) sites, the water itself was very turbid throughout this section of canal. This contrasted with Royal Canal West (RCW) and the Grand and Barrow Canals, where the water was clear at all sites sampled. Water quality conditions were excellent in this section of canal in Q1 2024 and the highest Ammonia reading recorded was 0.05mg/l N at RCE6 (Thomastown). Likewise, bacteriological counts were low, with 52 counts per 100ml at RCE6 and RCE22 (Clondalkin) being the highest *E. coli* counts recorded. A somewhat elevated BOD reading of 2mg/l O_2 was recorded at RCE9 (Moyvalley), while all other readings were low, at 1mg/l O_2 (see Appendix I).

Water quality conditions at the seven sites on RCW were again excellent in Q1 2024, as they had been in Q4 2023 (see Appendix I). There was no evidence of the high Total coliform and *E. coli* counts that were reported at RCW7 (Kelly's Bridge) and RCW12 (Island Bridge) in Q3 2023, where the latter site also reported a high BOD reading of 3mg/l O_2. In Q1 2024, two sites (RCW7 and RCW14 – west of Ballydrum Bridge) reported BOD levels of 2mg/l O_2, although values for all other parameters were low (see Appendix I).

The water level at the two Shannon-Erne Waterway sites was high and the water was turbid, as expected for a river at this time of year. Water quality conditions at SE40 (east of Leitrim village) were excellent when sampled in Q1 2024 and all parameters were well within acceptable limits (see Appendix I), although a slightly elevated BOD reading of 2mg/l O_2 was recorded at the site. While a TP reading of 0.14mg/l P was recorded here in Q3 2023, values for this determinand parameter were low in Q4 2023 and Q1 2024. Physico-chemical results for SE42 (Leitrim marina) were reasonably good, although elevated readings for TP and MRP were reported (see Appendix I), as was the case in Q4 2023. Bacteriological counts were low at this site in February 2024, as they had been in Q1, Q2 and Q3 of last year, with only moderately elevated counts recorded in Q4 2023.

3.2. *Indicative Ecological Potential of Canal Sites and Artificial Water Bodies*

In Q1 2024, four of the 43 canal and Shannon-Erne Waterway sites breached determinand parameters (Table 3). Three of the sites breached for a single parameter, while NL1 (Naas Line) breached for SRP, TON and *E. coli*. The determinands TP, SRP and *E. coli* were each breached at just one site, while the determinand TON was breached at three sites (Table 3).

Table 3. Classification of the 43 canal sites in the 15 Artificial Water Bodies (AWBs), and the Grand Canal Basin, based on results for the six physico-chemical determinand parameters for Q1 2024.

AWB	Site Code	Year	Total P (mg/L P)	SRP (mg/L P)	TON (mg/L N)	*E. coli* (Count/100ml)	B.O.D. (mg/L O2)	Ammonia (mg/L N)	Indicative Physico-chemical Potential
GCE_09	GCE4	2024	0.030	0.020	1.000	110.000	1.000	0.070	Good
	GCE6	2024	0.030	0.020	5.000	10.000	1.000	0.040	Moderate
	GCE8	2024	0.030	0.020	3.700	31.000	1.000	0.030	Good
	GCE10	2024	0.030	0.020	2.100	10.000	1.000	0.020	Good
	GCE12	2024	0.020	0.010	1.700	10.000	1.000	0.020	Good
	GCE14	2024	0.030	0.020	1.000	122.000	1.000	0.020	Good
GCNL_09	NL1	2024	0.060	0.030	5.600	1,333.000	1.000	0.050	Moderate
GCMF_14	MF1	2024	0.020	0.010	2.500	10.000	1.000	0.020	Good
GCBL_14	BL2	2024	0.020	0.010	1.300	10.000	1.000	0.030	Good
	BL6	2024	0.030	0.010	3.900	10.000	1.000	0.090	Good
	BL10	2024	0.030	0.010	3.800	10.000	1.000	0.020	Good
	BL15	2024	0.020	0.010	3.100	10.000	1.000	0.020	Good
GC_14E	GCE1	2024	0.040	0.010	1.600	10.000	1.000	0.040	Good
	GCW1	2024	0.020	0.010	1.900	10.000	1.000	0.020	Good
GC_14W	GCW8	2024	0.030	0.010	1.000	10.000	1.000	0.020	Good
	GCW12	2024	0.070	0.010	1.000	10.000	2.000	0.110	Moderate
GC_07	GCW4	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
	GCW6	2024	0.010	0.010	2.800	10.000	2.000	0.020	Good
GC_25A	GCW16	2024	0.030	0.010	4.900	10.000	1.000	0.020	Moderate
	GCW18	2024	0.020	0.010	1.000	10.000	1.000	0.020	Good
	GCW20	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
	GCW22	2024	0.010	0.010	1.100	10.000	1.000	0.020	Good
	GCW24	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
	GCW27	2024	0.010	0.010	1.000	10.000	2.000	0.020	Good
GCB*	GCB4	2024	0.040	0.010	2.400	10.000	1.000	0.060	Good
	GCB7	2024	0.040	0.010	1.500	173.000	1.000	0.020	Good
RC_07	RCE4	2024	0.020	0.010	1.000	10.000	1.000	0.040	Good
	RCE6	2024	0.030	0.010	1.200	52.000	1.000	0.050	Good
	RCE8	2024	0.020	0.010	1.200	30.000	1.000	0.030	Good
	RCE9	2024	0.030	0.010	1.300	10.000	2.000	0.020	Good
	RCE12	2024	0.030	0.010	2.800	10.000	1.000	0.020	Good
RC_09	RCE14	2024	0.030	0.010	1.500	10.000	1.000	0.040	Good
	RCE16	2024	0.030	0.010	1.600	10.000	1.000	0.020	Good
	RCE19	2024	0.040	0.010	1.400	10.000	1.000	0.030	Good
	RCE22	2024	0.030	0.010	1.300	52.000	1.000	0.040	Good
	RCE25	2024	0.030	0.010	1.000	10.000	1.000	0.020	Good
RC_25A	RCW1	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
	RCW3	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
RC_26F	RCW5	2024	0.020	0.010	1.400	10.000	1.000	0.020	Good
	RCW7	2024	0.010	0.010	1.100	10.000	2.000	0.020	Good
	RCW9	2024	0.010	0.010	1.000	20.000	1.000	0.020	Good
RC_26E	RCW12	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
RC_26C	RCW14	2024	0.010	0.010	1.000	10.000	2.000	0.020	Good
SE_26A	SE40	2024	0.020	0.010	1.000	10.000	2.000	0.020	Good
	SE42	2024	0.050	0.010	1.000	146.000	1.000	0.050	Good

* The Grand Canal Basin is not a designated AWB.

Fourteen of the 15 AWBs were assigned Good indicative eco-potential based on Q1 results, with GCNL_09 being the only AWB that was at Moderate status (Table 4). This AWB contains only one site, that being NL1 on the Naas Line, and this site breached threshold limits for three of the six determinand parameters (SRP, TON and *E. coli*) in Q1 2024 and was very close to breaching a fourth (TP) (Table 4).

Table 4. Indicative ecological potential for the 15 Artificial Water Bodies (AWBs), and the Grand Canal Basin, based on results for the six physico-chemical determinands in Q1 2024.

AWB	Year	Total P (mg/L P)	SRP (mg/L P)	TON (mg/L N)	*E. coli* (Count/100ml)	B.O.D. (mg/L O2)	Ammonia (mg/L N)	Indicative Physico-chemical Potential
GCE_09	2024	0.028	0.018	2.417	48.833	1.000	0.033	Good
GCNL_09	2024	0.060	0.030	5.600	1,333.000	1.000	0.050	Moderate
GCMF_14	2024	0.020	0.010	2.500	10.000	1.000	0.020	Good
GCBL_14	2024	0.025	0.010	3.025	10.000	1.000	0.040	Good
GC_14E	2024	0.030	0.010	1.750	10.000	1.000	0.030	Good
GC_14W	2024	0.050	0.010	1.000	10.000	1.500	0.065	Good
GC_07	2024	0.010	0.010	1.900	10.000	1.500	0.020	Good
GC_25A	2024	0.015	0.010	1.667	10.000	1.167	0.020	Good
GCB*	2024	0.040	0.010	1.950	91.500	1.000	0.040	Good
RC_07	2024	0.026	0.010	1.500	22.400	1.200	0.032	Good
RC_09	2024	0.032	0.010	1.360	18.400	1.000	0.030	Good
RC_25A	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
RC_26F	2024	0.013	0.010	1.167	13.333	1.333	0.020	Good
RC_26E	2024	0.010	0.010	1.000	10.000	1.000	0.020	Good
RC_26C	2024	0.010	0.010	1.000	10.000	2.000	0.020	Good
SE_26A	2024	0.035	0.010	1.000	78.000	1.500	0.035	Good

* The Grand Canal Basin is not a designated AWB.

3.3. *Physico-chemistry and Indicative Ecological Potential of Canal Feeders/Drains*

Two of the five feeders/drains were assigned Good indicative eco-potential based on physico-chemical sampling in Q1 2024 (see Appendix II and Figure 5), as was the case for the same feeders/drains in Q1 2023. Only one feeder (Ballymullen) was at Good status on the last sampling occasion, in Q4 2023.

During sampling in February 2024, a fast flow of relatively clear water was being discharged to the Grand Canal *via* the Monread drain (GCE5.1). In Q2, Q3 and Q4 2023, very high bacteriological counts were reported from this drain, well in excess of threshold limits. In Q4 2023, a very high TP reading of 0.09mg/l P was also recorded in the water emerging from the drain and this, in addition to the high bacteriological counts, was a cause for concern for the receiving canal system. In Q1 2024, bacteriological counts were very low and well within acceptable limits, while TP, MRP and SRP levels were relatively low and, again, within threshold limits (Table 5 and Appendix II). TON and Nitrate readings were high, at 3.9 and 3.89mg/l N, respectively, although the Ammonia level was low on this occasion. It is considered that pressure should be maintained on Kildare County Council to identify and eliminate the source(s) of enrichment and pollution to this drain.

A fast flow of turbid water discharged to the Grand Canal from the Ballymullen (GCW12.1) (Plate 3) and Ballylennon (GCW13.1) feeders when sampled in Q1 2024. Results from physico-chemical analysis for most parameters at the former feeder were good on this sampling occasion, although a very high TP reading of 0.08mg/l P, well in breach of the threshold limit (set at 0.063mg/l P) was recorded. This resulted in the

feeder being assigned Moderate rather than Good indicative eco-potential (Table 5 and Appendix II). This is the first quarter since Q1 2023 that this feeder has been at Moderate status.

Plate 3. Brisk flow of coloured water emerging from the Ballymullen Feeder (GCW13.1) in February 2024.

The Ballylennon feeder was at Good indicative eco-potential in Q2 and Q3 2023. In Q1 2023, threshold limits for three determinand parameters (SRP, BOD and Ammonia) were breached while, in Q4 2023, a breach in the threshold for Ammonia resulted in the feeder again being assigned Moderate status. In Q1 2024, elevated readings for MRP and BOD were recorded here and the threshold limits for TP and Ammonia were breached. This resulted in the feeder being assigned Moderate indicative eco-potential on this sampling occasion (Table 5 and Appendix II). It is clear that deleterious matter continues to be discharged to the canal through this feeder and that measures to identify and mitigate the pollution must be made.

Table 5. Indicative ecological potential for the five canal feeders/drains based on results for the six physico-chemical determinands in Q1 2024.

			Total P (mg/L P)	SRP (mg/L P)	TON (mg/L N)	*E. coli* (Count/100ml)	B.O.D. (mg/L O2)	Ammonia (mg/L N)	Indicative Physico-chemical Potential
Monread	GCE5.1	2024	0.040	0.010	3.900	52	1.000	0.050	Good
Ballymullen	GCW12.1	2024	0.080	0.010	1.000	373	1.000	0.050	Moderate
Ballylennon	GCW13.1	2024	0.070	0.010	1.000	75	2.000	0.130	Moderate
Athy	BL15.1	2024	0.020	0.010	5.100	52	1.000	0.070	Moderate
Kilcock Harbour	RCE16.1	2024	0.040	0.010	2.400	185	1.000	0.020	Good

A strong flow of clear water discharged from the Athy drain (BL15.1) when sampled in Q1 2024. This water was significantly warmer (9.2ºC) than the canal water into which it discharged (7.9ºC). The readings recorded for most of the parameters measured in the discharge water were low and well within acceptable limits (Appendix II). The only parameter with an elevated reading was TON, where a high level of 5.1mg/l N, well in breach of the threshold limit of 4.1mg/l N, was recorded. This resulted in the drain being assigned Moderate indicative eco-potential on this occasion. In 2023, this drain was at Moderate status on all four sampling occasions, in Q1 for TON, in Q2 for Ammonia, in Q3 for very significant breaches in TON, Ammonia, BOD and *E. coli*, and in Q4 for *E. coli*. The high bacteriological counts reported in Q3 and Q4 2023 were not repeated in Q1 2024, when very low counts were recorded (see Appendix II and Table 5). However, pressure must be maintained on Kildare County Council to identify the source(s) of pollution to this drain, as water of poor quality continues to be discharged to the Barrow Canal at Athy.

A slow flow of turbid water discharged from the Kilcock drain (RCE16.1) when sampled in Q1 2024. In fact, the water in the harbour and downstream was very turbid. The water quality in the discharge water was good on this sampling occasion and the drain was assigned Good indicative eco-potential based on physico-chemical results (see Appendix II and Table 5). This drain was at Good status in Q1, Q2 and Q3 2023, with relatively low values recorded for most parameters analysed. Results for Q4 2023 were less than satisfactory, however, with readings for TP and *E. coli* in breach of threshold limits. While the water discharging from the drain in Q1 2024 was of good quality, it is important that Kildare County Council continues to be vigilant and to seek out and eliminate any discharges of polluted matter to this drain.

3.4. *Grand Canal Basin*

A Dublin City Council urban wastewater outfall is located in the inner Grand Canal Basin (see Figure 3). This outfall is used to carry storm water overflow but, on occasions, sewage contamination is discharged to the Basin *via* this outfall.

The water level in the Grand Canal Basin was high when sampled in February 2024 and the water was crystal clear. The physico-chemical results from water samples taken at GCB4 (inner basin) were good for all parameters bar MRP, where a level of 0.03mg/l P was recorded. The values for all other nutrient parameters, however, were low and well within acceptable limits (see Appendix I). The water in this inner basin was assigned Good, as it had in all four quarters in 2023.

As with the inner basin, the water quality in GCB7 (outer basin) in Q1 2024 was good and readings for all of the parameters examined were low (see Appendix I). As a consequence, the water in the outer basin was assigned Good indicative eco-potential on this occasion. This was at variance with results recorded here in Q4 2023 where highly elevated readings for TP, MRP, SRP, Total coliform, *E. coli* and Ammonia were reported. These results clearly indicated that contaminated water was continuing to be discharged to the Grand Canal Basin and, while results recorded in Q1 2024 were good, vigilance must be maintained and close monitoring continued to ensure the safety of people using the Basin as a recreational resource.

No results from bacteriological sampling by WI/DCC have been received by INVAS since late May 2023.

4. Issues for Waterways Ireland Resulting from Sampling in Q1 2024

Water quality conditions at NL1 (Naas Canal) were poor in Q1 2024, with unacceptably high levels recorded for TP, SRP, TON, Nitrate, Total coliform and *E. coli*. It is clear that contaminated water continues to be discharged to the Naas Canal, probably *via* the drain at Naas Harbour, and it will be important for Kildare County Council to act to mitigate this situation before irreparable ecological damage is caused to the receiving Naas and Grand Canals.

Unacceptably high TP levels were recorded in both the Ballymullen and Ballylennon feeders on this sampling occasion, with Ammonia also in breach of the threshold limit at the latter feeder. MRP and BOD readings were also elevated at this feeder. The water input from these supplies, and particularly from the Ballylennon supply, resulted in Grand Canal site GCW12 (west of Daingean), located between these feeders, being at Moderate rather than Good on this sampling occasion. It is clear that deleterious matter, probably containing sewage and/or animal waste, continues to be discharged to the canal through these feeders and that measures to identify and mitigate the pollution must urgently be made.

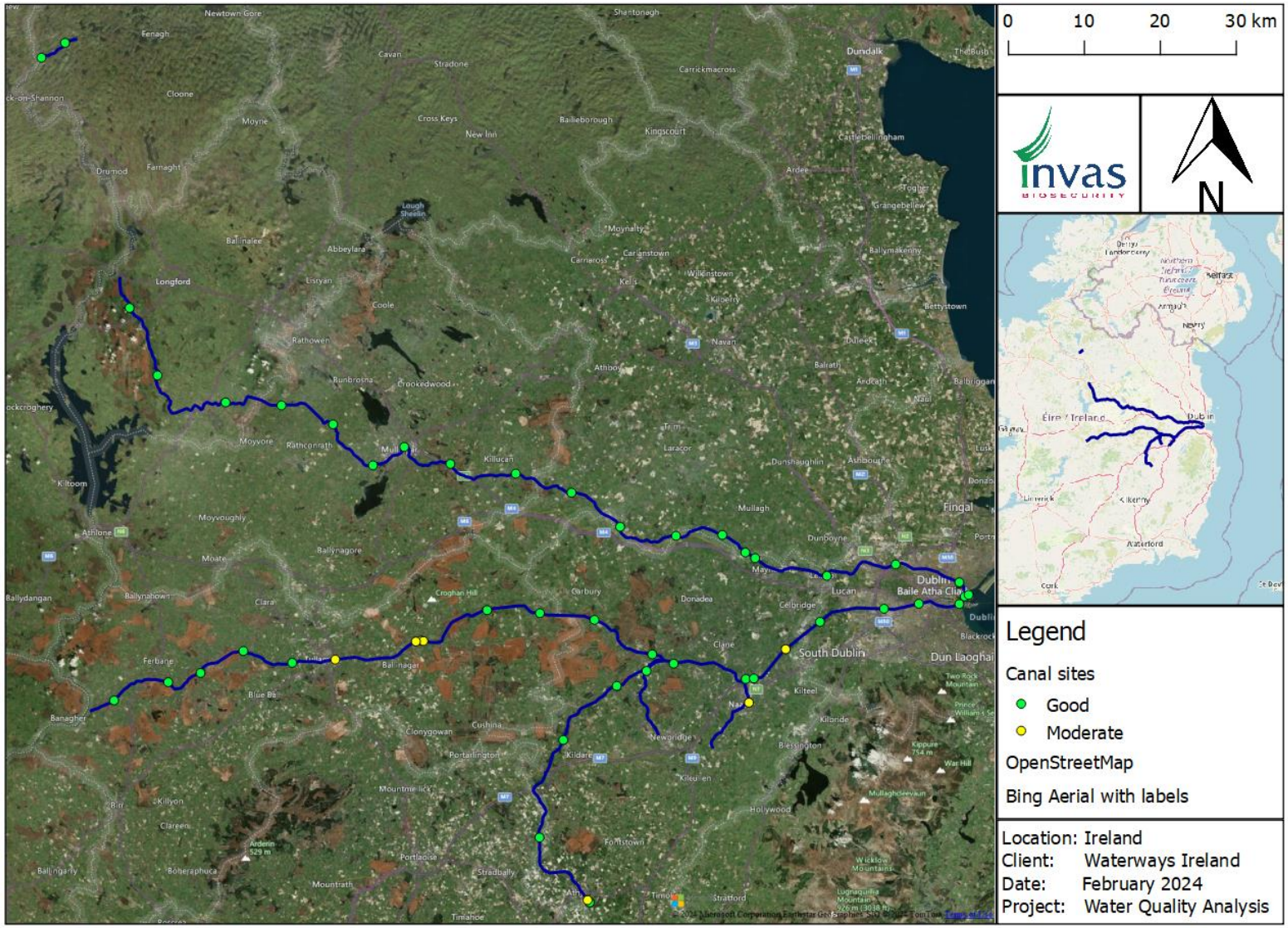

Figure 5. Indicative ecological potential based on physico-chemical data for the 50 canal, Shannon-Erne Waterway and feeder/drain sites monitored in Q1 2024 (Green = Good, Yellow = Moderate).

Appendix I. Physico-chemical results and indicative ecological potential for canal (41), Shannon-Erne Waterway (2) and Grand Canal Basin (2) sites sampled in Q1 2024.

	Canal	Site Code	AWB	Quarter	Date	Total P (mg/L P)	MRP (mg/L P)	SRP (mg/L P)	TON (mg/L N)	Temperature	Conductivity (µS)	pH	DO %	DO (mg/L O_2)	Total Coliform (Count/100ml)	*E-Coli* (Count/100ml)	B.O.D. (mg/L O2)	Ammonia (mg/L N)	Nitrite (mg/L N)	Nitrate (mg/L N)	Alkalinity (meq/L)	Alkalinity (mg/L $CaCO_3$)	Indicative Physico-chemical Potential
GCE1_Q1	Grand Canal	GCE1	GC_14E	Q1	14/02/2024	0.040	0.010	0.010	1.600	6.8	492	8.25	83.7	10.20	10	10	1.00	0.040	0.030	1.590	4.394	219.90	Good
GCE4_Q1	Grand Canal	GCE4	GC_09	Q1	14/02/2024	0.030	0.010	0.020	1.000	7.9	455	8.43	93.5	11.20	767	110	1.00	0.070	0.030	1.000	4.380	219.20	Good
GCE6_Q1	Grand Canal	GCE6	GC_09	Q1	14/02/2024	0.030	0.010	0.020	**5.000**	7.2	451	8.39	89.6	10.50	181	10	1.00	0.040	0.030	4.970	4.166	208.50	Moderate
GCE8_Q1	Grand Canal	GCE8	GC_09	Q1	14/02/2024	0.030	0.010	0.020	3.700	6.8	434	8.51	91.0	11.00	435	31	1.00	0.030	0.030	3.690	4.278	214.10	Good
GCE10_Q1	Grand Canal	GCE10	GC_09	Q1	14/02/2024	0.030	0.010	0.020	2.100	6.0	399	8.59	98.0	12.10	31	10	1.00	0.020	0.030	2.100	3.544	177.40	Good
GCE12_Q1	Grand Canal	GCE12	GC_09	Q1	14/02/2024	0.020	0.010	0.010	1.700	6.0	395	8.62	97.0	12.00	10	10	1.00	0.020	0.030	1.700	3.628	181.60	Good
GCE14_Q1	Grand Canal	GCE14	GC_09	Q1	14/02/2024	0.030	0.010	0.020	1.000	6.7	396	8.59	94.0	11.60	218	122	1.00	0.020	0.030	1.000	3.459	173.10	Good
GCW1_Q1	Grand Canal	GCW1	GC_14E	Q1	14/02/2024	0.020	0.010	0.010	1.900	6.7	447	8.44	95.0	11.40	712	10	1.00	0.020	0.030	1.900	4.334	216.90	Good
GCW4_Q1	Grand Canal	GCW4	GC_07	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.8	456	8.30	92.6	10.80	10	10	1.00	0.020	0.030	1.000	2.869	143.60	Good
GCW6_Q1	Grand Canal	GCW6	GC_07	Q1	22/02/2024	0.010	0.010	0.010	2.800	8.9	444	8.46	96.0	10.80	51	10	2.00	0.020	0.030	2.800	3.153	157.80	Good
GCW8_Q1	Grand Canal	GCW8	GC_14W	Q1	22/02/2024	0.030	0.010	0.010	1.000	8.7	400	8.19	78.1	9.20	10	10	1.00	0.020	0.030	1.000	3.113	155.80	Good
GCW12_Q1	Grand Canal	GCW12	GC_14W	Q1	22/02/2024	**0.070**	0.020	0.010	1.000	8.8	427	8.04	67.9	7.60	226	10	2.00	0.110	0.030	1.000	3.213	160.80	Moderate
GCW16_Q1	Grand Canal	GCW16	GC_25A	Q1	22/02/2024	0.030	0.010	0.010	**4.900**	8.8	408	8.42	89.1	10.10	10	10	1.00	0.020	0.030	4.900	3.954	197.90	Moderate
GCW18_Q1	Grand Canal	GCW18	GC_25A	Q1	22/02/2024	0.020	0.010	0.010	1.000	8.6	421	8.39	90.5	10.50	85	10	1.00	0.020	0.030	1.000	2.625	131.40	Good
GCW20_Q1	Grand Canal	GCW20	GC_25A	Q1	22/02/2024	0.010	0.010	0.010	1.000	9.2	441	8.51	94.4	10.80	10	10	1.00	0.020	0.030	1.000	3.127	156.50	Good
GCW22_Q1	Grand Canal	GCW22	GC_25A	Q1	22/02/2024	0.010	0.010	0.010	1.100	8.9	389	8.45	76.8	8.80	10	10	1.00	0.020	0.030	1.100	3.485	174.40	Good
GCW24_Q1	Grand Canal	GCW24	GC_25A	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.7	365	8.50	83.0	9.40	10	10	1.00	0.020	0.030	1.000	2.737	137.00	Good
GCW27_Q1	Grand Canal	GCW27	GC_25A	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.3	330	8.35	83.2	9.50	20	10	2.00	0.020	0.030	1.000	3.566	178.50	Good
NL1_Q1	Grand Canal	NL1	GCNL_09	Q1	14/02/2024	0.060	0.010	**0.030**	**5.600**	8.4	471	8.25	78.1	9.00	17,329	**1,333**	1.00	0.050	0.050	5.550	4.723	236.40	Moderate
MF1_Q1	Grand Canal	MF1	GCMF_14	Q1	14/02/2024	0.020	0.010	0.010	2.500	7.6	460	8.35	85.0	9.80	20	10	1.00	0.020	0.030	2.500	5.031	251.80	Good
BL2_Q1	Grand Canal	BL2	GCBL_14	Q1	14/02/2024	0.020	0.010	0.010	1.300	6.8	354	8.51	94.0	11.50	10	10	1.00	0.030	0.030	1.300	2.496	124.90	Good
BL6_Q1	Grand Canal	BL6	GCBL_14	Q1	14/02/2024	0.030	0.010	0.010	3.900	8.8	494	8.49	106.0	12.30	10	10	1.00	0.090	0.030	3.880	4.212	210.80	Good
BL10_Q1	Grand Canal	BL10	GCBL_14	Q1	14/02/2024	0.030	0.010	0.010	3.800	7.6	461	8.32	83.1	10.00	52	10	1.00	0.020	0.030	3.790	4.482	224.30	Good
BL15_Q1	Grand Canal	BL15	GCBL_14	Q1	14/02/2024	0.020	0.010	0.010	3.100	7.9	441	8.54	96.0	11.20	153	10	1.00	0.020	0.030	3.090	4.048	202.60	Good
GCB4_Q1	Grand Canal	GCB4	GCB*	Q1	14/02/2024	0.040	0.030	0.010	2.400	7.3	469	8.51	78.0	9.50	512	10	1.00	0.060	0.030	2.380	3.958	198.10	Good
GCB7_Q1	Grand Canal	GCB7	GCB*	Q1	14/02/2024	0.040	0.010	0.010	1.500	7.0	389	8.41	93.0	11.00	2,603	173	1.00	0.020	0.030	1.500	3.506	175.50	Good
RCE4_Q1	Royal Canal	RCE4	RC_07	Q1	22/02/2024	0.020	0.010	0.010	1.000	8.0	437	8.31	77.0	8.80	20	10	1.00	0.040	0.030	1.000	3.417	171.00	Good
RCE6_Q1	Royal Canal	RCE6	RC_07	Q1	22/02/2024	0.030	0.010	0.010	1.200	8.4	449	8.26	73.1	8.40	1,153	52	1.00	0.050	0.030	1.200	4.032	201.80	Good
RCE8_Q1	Royal Canal	RCE8	RC_07	Q1	22/02/2024	0.020	0.010	0.010	1.200	8.9	433	8.35	76.5	8.20	183	30	1.00	0.030	0.030	1.190	3.195	159.90	Good
RCE9_Q1	Royal Canal	RCE9	RC_07	Q1	14/02/2024	0.030	0.010	0.010	1.300	6.0	392	8.43	88.1	10.80	10	10	2.00	0.020	0.030	1.290	5.197	260.10	Good
RCE12_Q1	Royal Canal	RCE12	RC_07	Q1	14/02/2024	0.030	0.010	0.010	2.800	6.3	446	8.27	74.2	9.10	31	10	1.00	0.020	0.030	2.800	4.503	225.40	Good
RCE14_Q1	Royal Canal	RCE14	RC_09	Q1	14/02/2024	0.030	0.010	0.010	1.500	6.1	438	8.25	81.0	10.00	10	10	1.00	0.040	0.030	1.490	4.903	245.40	Good
RCE16_Q1	Royal Canal	RCE16	RC_09	Q1	14/02/2024	0.030	0.010	0.010	1.600	6.4	439	8.47	92.0	10.80	63	10	1.00	0.020	0.030	1.600	4.408	220.60	Good
RCE19_Q1	Royal Canal	RCE19	RC_09	Q1	14/02/2024	0.040	0.010	0.010	1.400	6.5	454	8.40	83.0	10.20	10	10	1.00	0.030	0.030	1.400	4.689	234.70	Good
RCE22_Q1	Royal Canal	RCE22	RC_09	Q1	14/02/2024	0.030	0.010	0.010	1.300	6.7	469	8.22	78.0	9.50	135	52	1.00	0.040	0.030	1.300	4.246	212.50	Good
RCE25_Q1	Royal Canal	RCE25	RC_09	Q1	14/02/2024	0.030	0.010	0.010	1.000	6.4	406	8.48	104.0	12.14	31	10	1.00	0.020	0.030	1.000	3.658	183.10	Good
RCW1_Q1	Royal Canal	RCW1	RC_25A	Q1	22/02/2024	0.010	0.010	0.010	1.000	7.8	408	8.27	80.0	9.50	52	10	1.00	0.020	0.030	1.000	2.282	114.20	Good
RCW3_Q1	Royal Canal	RCW3	RC_25A	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.1	400	7.64	80.0	9.10	10	10	1.00	0.020	0.030	1.000	2.689	134.60	Good
RCW5_Q1	Royal Canal	RCW5	RC_26F	Q1	22/02/2024	0.020	0.010	0.010	1.400	8.9	414	8.22	84.1	9.50	20	10	1.00	0.020	0.030	1.400	3.045	152.40	Good
RCW7_Q1	Royal Canal	RCW7	RC_26F	Q1	22/02/2024	0.010	0.010	0.010	1.100	8.6	427	8.38	89.5	10.20	20	10	2.00	0.020	0.030	1.000	3.792	189.80	Good
RCW9_Q1	Royal Canal	RCW9	RC_26F	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.6	419	8.36	81.4	9.40	41	20	1.00	0.020	0.030	1.000	3.493	174.80	Good
RCW12_Q1	Royal Canal	RCW12	RC_26E	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.5	355	8.28	72.0	8.30	10	10	1.00	0.020	0.030	1.000	3.389	169.60	Good
RCW14_Q1	Royal Canal	RCW14	RC_26C	Q1	22/02/2024	0.010	0.010	0.010	1.000	8.4	340	8.43	84.1	10.10	10	10	2.00	0.020	0.030	1.000	3.229	161.60	Good
SE40_Q1	Shannon Erne	SE40	SE_26A	Q1	22/02/2024	0.020	0.010	0.010	1.000	8.3	199	8.29	84.3	10.10	10	10	2.00	0.020	0.030	1.000	2.284	114.30	Good
SE42_Q1	Shannon Erne	SE42	SE_26A	Q1	22/02/2024	0.050	0.020	0.010	1.000	7.8	205	8.28	81.6	9.70	602	146	1.00	0.050	0.030	1.000	2.771	138.70	Good

Appendix II. Physico-chemical results and indicative ecological potential for canal feeder/drain sites sampled in Q1 2024.

Canal	Site	Location	AWB_Code	Quarter	Date	Total P (mg/L P)	MRP (mg/L P)	SRP (mg/L P)	TON (mg/L N)	Temperature (degree C)	Conductivity (µS)	pH	DO %	DO (mg/L O_2)	Total Coliform (Count/100ml)	*E-Coli* (Count/100ml)	B.O.D. (mg/L O2)	Ammonia (mg/L N)	Nitrite (mg/L N)	Nitrate (mg/L N)	Alkalinity (meq/L)	Alkalinity (mg/L $CaCO_3$)	Indicative Physico-chemical Potential
Grand Canal	GCE5.1	Monread Feeder	GC_09	Q1	14/02/2024	0.040	0.020	0.010	3.900	9.00	483	8.30	86.3	10.00	733	52	1.00	0.050	0.030	3.890	3.357	168.00	Good
Grand Canal	GCW12.1	Ballymullen Feeder	GC_14	Q1	22/02/2024	0.080	0.010	0.010	1.000	7.90	511	8.19	80.4	9.50	758	373	1.00	0.050	0.030	1.000	3.193	159.80	Moderate
Grand Canal	GCW13.1	Ballylennon Feeder	GC_14	Q1	22/02/2024	0.070	0.020	0.010	1.000	7.60	346	7.56	71.3	8.50	683	75	2.00	0.130	0.030	1.000	2.897	145.00	Moderate
Grand Canal Barrow Line	BL15.1	Athy Drain	GCBL_14	Q1	14/02/2024	0.020	0.010	0.010	5.100	9.20	604	8.45	79.0	8.80	495	52	1.00	0.070	0.030	5.080	4.096	205.00	Moderate
Royal Canal	RCE16.1	Kilcock Harbour Drain	RC_09	Q1	14/02/2024	0.040	0.010	0.010	2.400	8.10	484	8.43	86.9	9.90	6,867	185	1.00	0.020	0.030	2.400	4.022	201.30	Good

INVAS Biosecurity Ltd.
82 Lakelands Close, Stillorgan, Co Dublin.
Tel: +353876468609
Email: joecaffrey@invas.ie
Web: www.invasbiosecurity.ie

Company Registration Number: 509929
VAT Number: Ie 98205960