
Appendix 7A
Lower River Lee & Tributaries Biological Q-Sampling Report



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Prepared for Ryan Hanley Consulting Engineers

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1. Water Quality Assessment

Introduction

- 1.1 Triturus Environmental Services were contracted by Ryan Hanley Consulting Engineers to conduct a biological Q sampling report on the River Lee and several of its tributaries, Co. Cork. These surveys were commissioned as part of the ecological works prepared to establish baseline biological water quality for the Environmental Impact Statement (EIS) prepared for the Lower Lee (Cork City) Drainage Scheme. A number of discrete proposed works areas are located along the River Lee and selected tributaries, where planned work activities include the installation of flood prevention walls. Water quality survey sites were, where feasible, selected relevant to these proposed works areas.
- 1.2 Baseline water quality was collected specifically from the main channel of the River Lee and on the following selected tributaries; Curragheen, Glasheen, Bride [North] and Glenamought Rivers all of which to varying degrees have flood protection works proposed.
- 1.3 The biological water quality collected would provide baseline readings against which future water quality targets could be gauged. These values should not deteriorate as a result of works associated with the project. According to the Water Framework Directive (2000/60/EEC) target 'good status' i.e. Q4 is required in all Irish Rivers.
- 1.4 The biological water quality data was collected by Ross Macklin of Triturus Environmental Services during base flow water conditions between the 2nd and 5th of April 2015.

Background

- 1.5 The Rivers Lee (EPA code: IE_SW_19_1663), Curragheen (IE_SW_19_1744), Glasheen (IE_SW_19_1744), Bride [North] (IE_SW_19_1451) and Glenamought (IE_SW_19_1520) are located in hydrometric area 19 and within the South Western river basin district (SWRBD).
- 1.6 The Lee, which drains an area of 1253km², is underlain by a mixed geology of Devonian old red sandstones and Dinian mudstones and sandstones, with occasional, highly localised strikes of Tournasian limestone (Geological Survey of Ireland). The Bride (North) and Glenamought tributaries also flow over these geologies. The underlying geologies of the Curragheen and Glasheen Rivers, however, are more dynamic, consisting of intermittent Visean limestone and shale, Waulsortian mudbank limestone with limited Tournasian argillaceous biolclastic limestone (Geological Survey of Ireland).
- 1.7 The River Lee, Bride (North), Curragheen and Glasheen Rivers are considered lowland depositing watercourse (FW2; Fossit, 2000). The Glasheen, Bride and lower Curraheen River tributaries of the River Lee flow through the urban environment of Cork City, and as a consequence have been modified in terms of channel morphology and natural flow regimes. Overall, the Glenamought, with its steeper gradient and higher flow rate, represents a more typical eroding/upland river (FW1) and remains largely unaltered as it does not suffer from urban encroachment and associated point sources of pollution.

Statement of Authority

- 1.8 Ross Macklin BSc. Dip GIS is an environmental scientist who specialises in freshwater and fisheries ecology, in addition to informing engineering solutions for construction works on rivers, including site improvement and rehabilitation. He has ten years professional experience

and has surveyed over 500 different Irish rivers and lakes. Ross's expertise includes aquatic invertebrate and macrophyte studies in addition to fisheries quantification in a variety of surface water habitats. He routinely undertakes physiochemical water quality monitoring and biological quantification of receiving waters based on macro-invertebrate species composition using a number of biotic indices systems, including but not limited to PSYM, BMWP, SSRS and Q-Analysis. Ross has worked on multi-million euro infrastructural projects, undertaken IPPC licensing reports, acted as an ecological clerk (supervisor) of construction works and conducted numerous fisheries and ecological studies in support of a wide range of developments. He has also worked on ecological design for habitat creation projects, construction environmental management plans, method statements and site rehabilitation. Most recently he assessed the projected impacts of the implementation of Food Harvest 2020 on water quality. Ross is also completing a PhD on cyprinid ecology in U.C.C.

Methodology

- 1.9 Macro-invertebrate samples were collected on the River Lee and tributaries Curragheen, Glasheen, Glenamought and Bride between the 2nd and 5th May 2015 (see Figure 1.1 below). Where possible the macro-invertebrate sampling stations were situated in the vicinity upstream or downstream of the works areas, given the selection of the sampling sites also depended on the presence of riffle/ glide habitat from which samples could be collected. No samples were collected in the tidal reaches of the river, i.e. north channel of the River Lee (full extent of channel) or downstream of the Gillabey Rock on the south channel as these areas are tidal and are outside the scope of the EPA Q-Value system.
- 1.10 Macro invertebrate samples were collected by 'kick' sampling for approximately 2.5 minutes in the faster flowing areas (riffles) of the river using a standard hand net (250 mm width, mesh size 500 micron). The kick sample was taken moving across the riffle zone and also involved washing large rocks from the riffle zone to ensure a full representation of the species composition from this micro-habitat type. Collected samples were elutriated, refrigerated and identified live within 24 hours of each site visit. The samples were identified using a Nikon SMZ 1000 stereo microscope and numerous Freshwater Biological Association invertebrate keys. Live sorting of invertebrates facilitates improved detection of small cryptic prey items. Identified samples were then fixed in 70% ethanol in the laboratory. Invertebrate taxa were identified to species level where possible. The relative proportions of taxonomic groups were recorded based on the EPA categories (i.e. 8 categories ranging from present to excessive) (Appendix I of Toner *et al.*, 2005¹).

Table 1.1 – Location of macro-invertebrate sampling locations on the River Lee & tributaries

Site No.	River Name	Location	GPS Co-ordinates
Site 1	River Lee	Innishcarra Graveyard	W 56461 70943
Site 2	River Lee	Grotto	W 62992 71957
Site 3	River Lee	Downstream County Hall	W 65373 71319

¹ Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Concannon, C., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCarthaigh, M., Craig, M. & Quinn, R. (2005). Water Quality in Ireland 2001-2003. Environmental Protection Agency, Wexford.

Site 4	Curragheen River	Concrete Works	W 63035 71218
Site 5	Curragheen River	GAA pitches	W 64179 71289
Site 6	Glasheen River	R608	W 65358 70859
Site 7	Glasheen River	Orchard Road	W 65182 71117
Site 8	Glenamought River	Viaduct	W 66461 75061
Site 9	Glenamought River	Ind. Estate	W 66250 74765
Site 10	River Bride	Commons Inn	W 66499 74563
Site 11	River Bride	Orchard Court	W 67371 73426



Plate 1 – Nikon SMZ1000 microscope with LED lighting used in the identification of samples

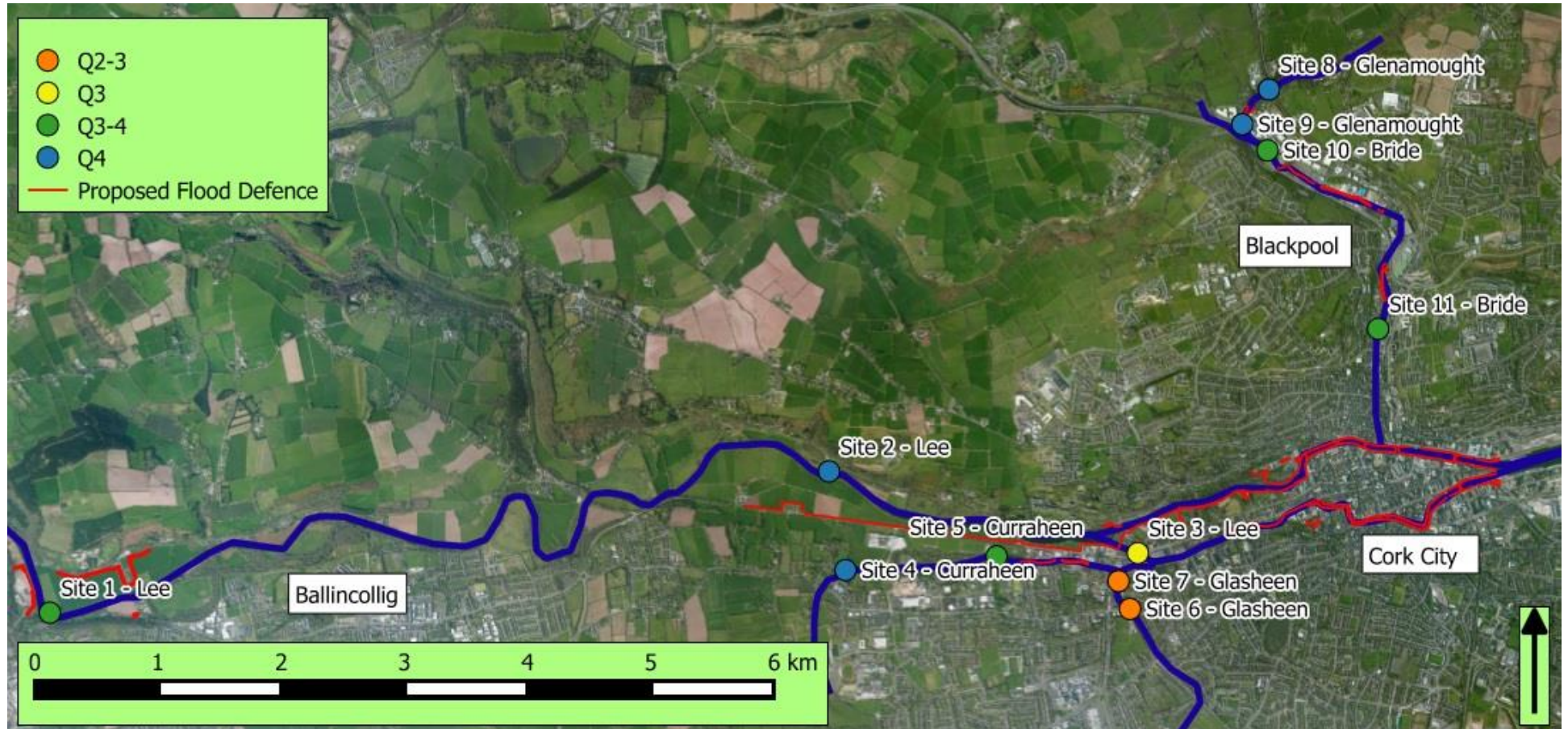


Figure 1.1 - Location of Water Quality Sampling Sites with determined Q Ratings

Results

Existing Water Quality Records

- 1.11 According to the EPA, the biological water quality on the River Lee achieved Q4, 'good status' at Leemount Bridge (Station RS19L030700) during 2011, which indicates it is meeting the requirements of the Water Framework Directive (2000/60/EEC). Biological water quality data for the other tributaries (i.e. Curaheen, Glasheen, Bride and Glenamought) are absent. The water quality of fifteen sites on the Curragheen River was assessed as ranging from Q3-4 according to Kelly et al. (2007). However, under the South West River Basin District Management Plan, the water quality of the Curragheen River is designated as poor and it is an objective to restore this water body to good status by 2015. No other biological water quality data is available for the selected tributaries in the survey.

2015 Water Quality Data (this report)

- 1.12 Biological water quality data as prescribed by the Environmental Protection Agency (EPA; Toner et al. 2005), group invertebrates into classes whereby very pollution intolerant species are denoted class A, and species with greater pollution tolerance fall into successive classes (B through E respectively). As such the presence or absence of these groups and their relative abundances facilitates an assessment of biological river health. Our results are discussed in this context in order to interpret potential changes in the river community composition. See Figure 1.1 above for locations and Figure 1.2 below for a summary of the findings for each of the sites surveyed (i.e. sites 1-11). Tables 1.1 and 1.2 list all of the species recorded and show by colour separation the EPA taxonomic classes as prescribed above.
- 1.13 Sites 1-3 were located on the main channel of the River Lee. The furthest upstream sample (i.e. site 1) was located downstream of Innishcarra Dam near Innishcarra Graveyard. The composition of the sample had low numbers of pollution intolerant class A invertebrates, an absence of class B invertebrates (also pollution intolerant), and a dominance of class C invertebrates (more pollution tolerant).
- 1.14 The class A invertebrates included two stonefly species, a single specimen of *Isoperla grammatica* and 2 no. *Amphinemura sulcicollis*. The very pollution tolerant class D was also found in high numbers for two invertebrate species, the freshwater hoglouse, *Asellus aquaticus* and the bivalve *Pisidium amnicum*. The presence of small numbers of class A invertebrates and the dominance of class C, coupled with high numbers of two pollution tolerant invertebrates in class D indicated that the sample was representative of a Q3-4 slightly polluted site.
- 1.15 Site 2 on the River Lee was located adjacent to the Grotto on the back Lee Road. The site had high numbers of the flattened mayfly species *Heptagenia sulphurea* (class A very clean water species), with lesser numbers of the very clean water (class A) stonefly species *Isoperla grammatica* and *Chloroperla torrentium*. However the pollution tolerant invertebrate species *Asellus aquaticus* (class D) was also present in good numbers and indicative of some level of pollution. Nonetheless, the presence of a high diversity of species in the sample (N=15) coupled with the presence of clean water mayfly and stonefly species indicates the sample is representative of unpolluted Q4 (good status) water quality.
- 1.16 Site 3 on the River Lee was located downstream of the County Hall Weir adjacent to a small footbridge on the suburbs of Cork City. The absence of very clean water (Class A) and clean water (Class B) invertebrates indicated lower quality water. The sample was dominated by class C (moderately pollution tolerant) invertebrate species including caseless caddis species

Hydropsyche augustipennis and *Oecetis ochracea*. Other class C invertebrate species included the gastropod snails *Planorbis planorbis* and *Valvata piscinalis*. The presence of the class D pollution tolerant invertebrate forms representing the leech species *Helobdella stagnalis* and the bivalve snail *Sphaerium corneum*, further indicated that the sample was representative of a Q3 moderately polluted watercourse.

- 1.17 Sites 4 and 5 were located on the Curragheen River tributary of the River Lee. Site 4 was located in the vicinity of the old concrete works downstream of Carrigrohane Bridge, while site 5 was located adjacent to the GAA pitches further downstream. Site 4 had good numbers of class A invertebrate species present including the flattened mayfly species *Rhithrogena semicolorata* and the stonefly species *Brachyptera risi* and *Chloroperla torrentium*. Site 4 also has the large cased caddis species *Anabola nervosa* and the smaller stone cased species *Goera pilosa* present (both clean water class B invertebrates). The presence of a very high species diversity (N=19), good numbers of class A invertebrates and low numbers of pollution tolerant invertebrates accounted for a Q rating of 4 (i.e. unpolluted water; i.e. good status) at site 4 on the Curragheen River. Site 5 further downstream on the Curragheen River had only one class A species present (i.e. *Heptagenia sulphurea*) in low relative abundance. Site 5 on the Curragheen River also had higher numbers of the water pollution tolerant crustacean *Asellus aquaticus* which together accounted for a lower Q rating of Q3-4 (i.e. moderate status) than that recorded at site 4.
- 1.18 Sites 6 and 7 were located on the Glasheen River. The river was heavily encroached by the urban surrounds of Cork City and suffered from numerous point sources of pollution including storm drains. No EPA class A or B clean water invertebrates were found present in the samples collected. The samples were dominated by class C, D and E invertebrates indicating a clear shift in the invertebrate community towards more pollution tolerant forms. These included the (class D) crustacean *Asellus aquaticus* in very high numbers, and class E *Tubificid* sp. worms and the non-biting midge species *Chironomus riparius*. The dominance in the sample of pollution tolerant invertebrates accounted for a Q rating of 2-3 (i.e. poor status).
- 1.19 Sites 8 and 9 were located on the Glenamought River, a more high gradient and natural river on the outskirts of Cork City, between the townlands of Kilnap and Glenamought. Both sites had a good diversity of clean water stoneflies and mayflies present including the mayfly species *Rhithrogena semicolorata*, *Heptagenia sulphurea* and *Ecdyonurus torrentis*. The stonefly species recorded between the two sites included *Brachyptera risi*, *Isoperla grammatica* and *Chloroperla torrentium*. Together the good diversity of stoneflies and mayflies indicates good quality water. Pollution tolerant invertebrate forms were virtually absent apart from the leech species *Haemoptis sanguisuga* (class D) at site 9. In summary the invertebrate composition encountered at sites 8 and 9 were representative of Q4 unpolluted, good status water quality.
- 1.20 Sites 10 and 11 were located on the River Bride (of which the Glenamought is a tributary). The River Bride was located on a more modified section of the river where urban encroachment and point sources of pollution were evident. Some localised realignment of the channel was also evident. Only small numbers of very clean water (class A) invertebrates were present at sites 10 and 11, while only one species from class B was present (also indicative of clean water). Sites 10 and 11 were dominated by class C (moderately pollution tolerant) invertebrate species that included good numbers of the mayfly species *Baetis rhodani*, a mayfly species characteristic of slightly polluted waters. In summary the water quality at sites 10 and 11 on the River Bride were indicative of Q3-4 moderate status, slightly polluted water.
- 1.21 Water quality in the River Lee and tributaries Curragheen, Glasheen, Glenamought & Bride can be summarized as follows (see Figure 1.1 above for locations);

- Site 1 (River Lee, Iniscarra Graveyard) **Q3-4 Slightly Polluted (Moderate Status)**
- Site 2 (River Lee, Grotto, Back Lee Road)) **Q4 Moderately Polluted (Poor Status)**
- Site 3 (River Lee, downstream County Hall) **Q3 Moderately Polluted (Poor Status)**
- Site 4 (Curragheen River, Concrete Works) **Q4 Unpolluted (Good Status)**
- Site 5 (Curragheen River, GAA Pitches) **Q3-4 Slightly Polluted (Moderate Status)**
- Site 6 (Glasheen River, R608) **Q2-3 Seriously-Moderately Polluted (Poor Status)**
- Site 7 (Glasheen River, Orchard Road) **Q2-3 Seriously-Moderately Polluted (Poor Status)**
- Site 8 (Glenamought River, Viaduct) **Q4 Unpolluted (Good Status)**
- Site 9 (Glenamought River, Ind. Park) **Q4 Unpolluted (Good Status)**
- Site 10 (River Bride, Commons Inn) **Q3-4 Slightly Polluted (Moderate Status)**
- Site 11 (River Bride, Orchard Court) **Q3-4 Slightly Polluted (Moderate Status)**

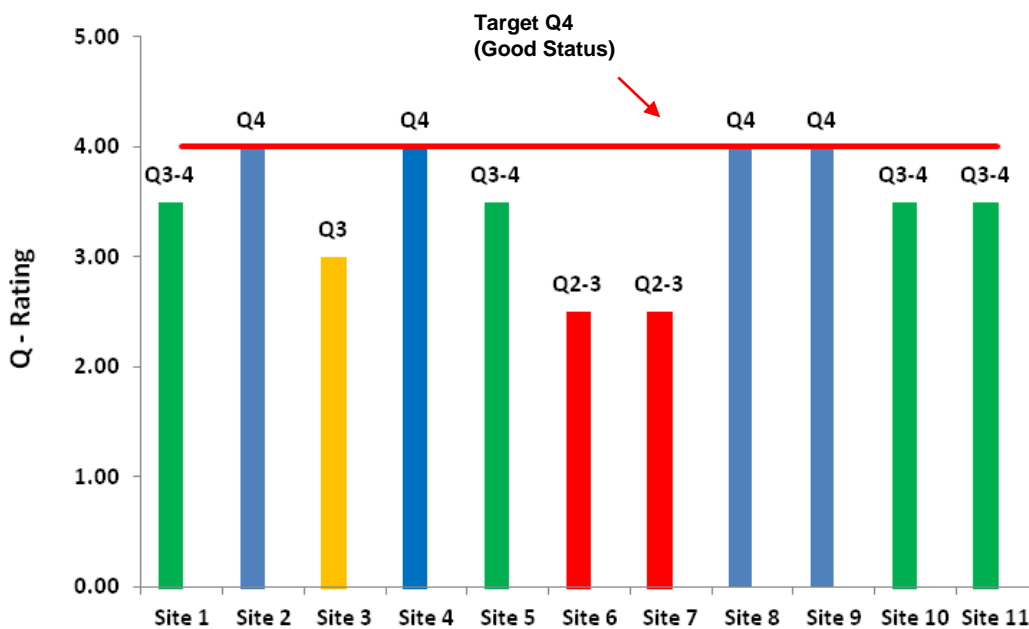


Figure 1.2 – Biological Q-Ratings on the River Lee & tributaries April 2015

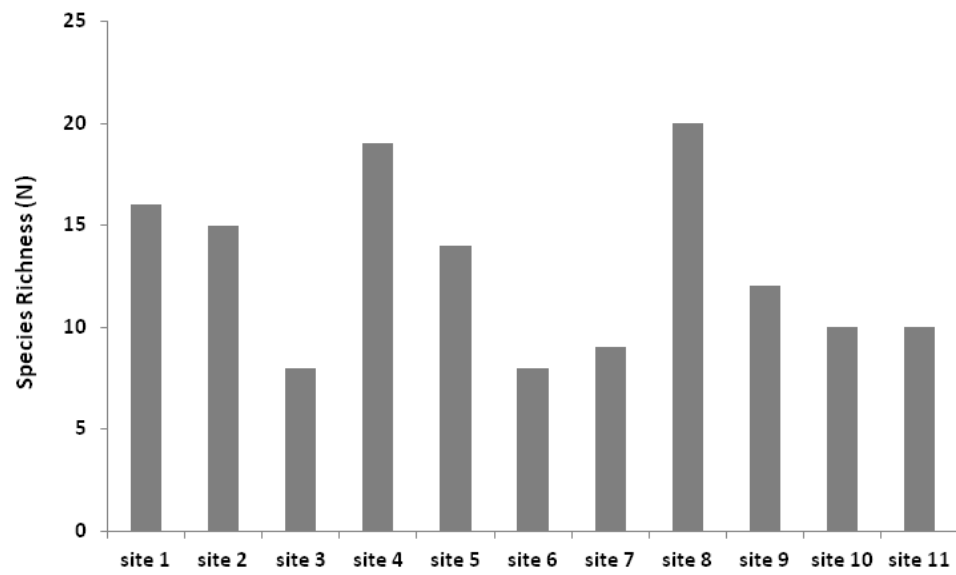


Figure 1.3 – Macro-invertebrate Species Richness (N) present in the River Lee & tributaries April 2015

Family	Species	Site 1 - Lee	Site 2 - Lee	Site 3 - Lee	Site 4 - Curraheen	Site 5 - Curraheen	Site 6 - Glasheen	EPA Class
Heptageniidae	<i>Heptagenia sulphurea</i>		12			2		A
	<i>Rhithrogena semicolorata</i>				22			A
Nemouridae	<i>Amphinemura sulcicollis</i>	2						A
Taeniopteridae	<i>Brachyptera risi</i>				3			A
Perlodidae	<i>Isoperla grammatica</i>	1	1					A
Chloroperlidae	<i>Chloroperla torrentium</i>		2		5			A
Limnephilidae	<i>Anabola nervosa</i>				3	2		B
Goeridae	<i>Silo palipes</i>				1			B
Seracostomatidae	<i>Seracosoma personatum</i>					1		B
Caenidae	<i>Caenis lactuosa</i>		1					C
Baetidae	<i>Baetis rhodani</i>	3	3		16	26		C
Ephemerellidae	<i>Ephemerella ignita</i>	3						C
Ryacophilidae	<i>Ryacophila dorsalis</i>	1	1					C
Hydropsychidae	<i>Hydropsyche siltalai</i>		12		3			C
	<i>Hydropsyche augustipennis</i>	9		8		16		C
Polycentropodidae	<i>Holocentropus picicornis</i>	11	7					C
	<i>Polycentropus kingi</i>				1			C
	<i>Oecetis ochracea</i>			1				C
Gammaridae	<i>Gammarus duebenii</i>	7	29		14	4	6	C
Elmidae	<i>Elmis aenea</i>				2	1		C
	<i>Limnius volkmari</i>	2			1			C
Simuliidae	<i>Simulium sp.</i>			6	4	2	2	C
Chironomidae	<i>Chironominae</i>	14						C
	<i>Spaniotoma sp.</i>		2			1		C
Tipulidae	<i>Dicranota sp.</i>				2			C
Lumbricinae	<i>Eiseniella sp.</i>			1				C
Lymnaeidae	<i>Lymnaea stagnalis</i>		3			2	3	C
Valvatidae	<i>Valvata piscinalis</i>		1	4				C
Ancylidae	<i>Ancylus fluviatilis</i>		23		6			C
Hydrobiidae	<i>Hydrobia ventrosa</i>	1						C
Planorbidae	<i>Planorbis planorbis</i>	1		1				C
Piscolidae	<i>Piscola geometrica</i>				1			C
Flatworm	<i>Polycelis nigra</i>	3			2	4	6	C
Hydracarina	<i>n/a</i>				1			C
Lymnaeidae	<i>Lymnaea peregra</i>	1						D
Sphaeriidae	<i>Pisidium amnicum</i>	15						D
	<i>Spharium sp.</i>						3	D
	<i>Spharium corneum</i>			8				D
Glossiphoniidae	<i>Helobdella stagnalis</i>		1	2				D
Erpobdellidae	<i>Erpobdella octoculata</i>				1	1		D
Asellidae	<i>Asellus aquaticus</i>	13	15		2	11	42	D
Chironomidae	<i>Chironomus riparius</i>					1	5	E
Tubificidae	<i>Tubificid sp.</i>						14	E
	Taxon Richness N	16	15	8	19	14	8	
	Q Rating	Q3-4	Q4	Q3	Q4	Q3-4	Q2-3	

Table 1.1 – Macro-invertebrate composition at sites 1-6 on the River Lee, Curragheen & Glasheen

Family	Species	Site 7 - Glasheen	Site 8 - Glenamought	Site 9 - Glenamought	Site 10 - Bride	Site 11 - Bride	EPA Class
Heptageniidae	<i>Heptagenia sulphurea</i>		1				A
	<i>Rhithrogena semicolorata</i>		18	7		2	A
	<i>Ecdyonurus torrentis</i>			1			A
Nemouridae	<i>Amphinemura sulcicollis</i>		2	4		2	A
Taeniopterigidae	<i>Brachyptera risi</i>			3			A
Perlodidae	<i>Isoperla grammatica</i>		2		1		A
Chloroperlidae	<i>Chloroperla torrentium</i>			1		1	A
Limnephilidae	<i>Halesus radiatus</i>		3				B
	<i>Limnephilus sp.</i>			1			B
Goeridae	<i>Silo palipes</i>		1				B
Seracostomatidae	<i>Seracosoma personatum</i>		1		1		B
Baetidae	<i>Baetis rhodani</i>	2	31	11	8	32	C
Ephemerellidae	<i>Ephemerella ignita</i>		5	2	2		C
Ryacophilidae	<i>Ryacophila dorsalis</i>		2		1		C
Hydropsychidae	<i>Hydropsyche siltalai</i>		6	6	2	5	C
Polycentropodidae	<i>Holocentropus picicornis</i>		1		2		C
Gammaridae	<i>Gammarus duebenii</i>	7	11	7	22	2	C
	<i>Limnius volkmari</i>		2				C
Gyrinidae	<i>Gyrinus sp.</i>		1				C
Simuliidae	<i>Simulium sp.</i>		3			3	C
Chironomidae	<i>Chironominae</i>		1			27	C
	<i>Spaniotoma sp.</i>		24				C
Lumbricinae	<i>Eiseniella sp.</i>				1	1	C
Lymnaeidae	<i>Lymnaea stagnalis</i>	1					C
Ancylidae	<i>Ancylus fluviatilis</i>		2	1		2	C
Hydrobiidae	<i>Hydrobia ventrosa</i>	1					C
	<i>Potamopyrgus antipodarum</i>		1				C
Flatworm	<i>Polycelis nigra</i>	2					C
	<i>Spharium sp.</i>	11					D
Hirudinea	<i>Haemoptis sanguisuga</i>			1			D
Asellidae	<i>Asellus aquaticus</i>	55					D
Chironomidae	<i>Chironomus riparius</i>	4			16		E
Tubificidae	<i>Tubificid sp.</i>	7					E
	Taxon Richness N	9	20	12	10	10	
	Q Rating	Q2-3	Q4	Q4	Q3-4	Q3-4	

Table 1.2 – Macro-invertebrate composition at sites 7-11 on the Rivers Glasheen, Glenamought & Bride.

Discussion

- 1.22 Currently the overall water quality on the River Lee main channel is achieving target Q4 good status as required under the Water Framework Directive, at only one of the three sites surveyed on the River Lee (i.e. site 2). The remaining 2 sites surveyed (i.e. sites 1 and 3) are achieving slightly polluted (Q3-4) and moderately polluted (Q3) water respectively. As such both sites have moderate status and are not achieving the target Q4 good status water quality required under the Water Framework Directive. It is likely that diffuse agricultural enrichment in addition to waste water point sources are contributing to the localised declines in water quality of the River Lee. Future improvement in water quality may push longer longitudinal reaches of the river channel into the good status (Q4) category.
- 1.23 The Curragheen River was achieving good status Q4 water quality at site 4 (concrete works) but deteriorated slightly downstream at site 5 (GAA pitches) where slightly polluted water (Q3-4) was recorded. The Curragheen River historically has suffered from pollution from waste water outfalls upriver and the recorded Q measurements appear to indicate an improvement in water quality. Very healthy salmonid and lamprey stocks were also recorded during surveys in 2014 indicating a healthy river overall. Should the trends continue to improve the water quality may achieve good status over a longer reaches of the channel.
- 1.24 The Glasheen River tributary of the River Lee had the poorest water quality of all of the river sites surveyed on the lower River Lee and tributaries. There was evident abundant blanket *Cladophora* weed and some localised patches of sewage fungus present on the Glasheen River along much of the channel. The River was heavily encroached by the suburbia of Cork City and had numerous storm drains and other point sources of pollution. It was evident from the discoloration in the water and smell from these outfalls that they were contributing to the recorded poor water quality at sites 6 and 7 (i.e. Q2-3 poor status water).
- 1.25 The Glenamought River was among the cleanest of the river sites surveyed with Q4, good status water quality recorded at both sites 8 and 9 surveyed on the river channel. The Glenamought River was located in a non urbanised environment and rises in a wooded river valley with limited human interference. The river retained a very natural profile with riffle, glide and pool habitat. While some localised realignments have occurred in its lower reaches the water quality appears to be unaffected. The Glenamought River between the Viaduct and the Industrial Estate downstream near its confluence with the River Bride had very high densities of salmonids as observed during electro-fishing surveys in 2014. The river had clean swift flowing water and clean substrata which evidently have helped maintain the rivers unpolluted status (i.e. good status Q4 water quality at sites 7 & 8).
- 1.26 Further downstream on the River Bride (sites 10 and 11) the water quality deteriorated. This was likely as a result of urban encroachment and associated storm drain point sources of pollution (pers. obs.) that are entering the river. As such the water quality was recorded as Q3-4 slightly polluted (moderate status). Fortunately the strong flow volumes and the remaining pockets of semi-natural channel are helping to maintain the river in a category that has the capacity to improve to target Q4 (i.e. from moderate status to good status). Further improvements in water quality by means of the detection and control of point sources may help the river achieve good status in the future.
- 1.27 It is recommended that future biological water quality surveys are undertaken on the River Lee and tributaries during the construction and operational phases of the proposed flood relief works to ensure that the status quo of the baseline water quality is maintained before and after construction.

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