



# Biological Survey for the Ballineen Stretch of the River Bandon

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# 1. Introduction

## 1.1 Statement of Purpose

Acorn water was commissioned by Carbery Food Ingredients Ltd, Ballineen, Co.Cork to perform a biological survey of the River Bandon at five sites, one upstream and 4 downstream of the factory. The purpose of this survey is to determine the current ecological condition of the River Bandon and to assess if the discharge of the factory is having an impact on the ecological status of the Ballineen stretch of the river. This survey was undertaken in order to fulfil the requirements of the EPA license held by Carbery Food Ingredients Ltd.

## 1.2 EPA – Q value system

The EPA – Q value system is used as part of the assessment to determine the ecological status of water bodies. The EU Water Framework Directive mandates the evaluation of waterbodies using among other methods (analysis of morphology, chemistry, fish populations) the Q value, which assesses the communities of macroinvertebrates as an indicator of the ecological condition of the freshwater system. Under the EU Water Framework Directive all waterbodies in Ireland should achieve good status by the end of 2021. Waterbodies not likely to reach good status (represented by a Q value of 4) are considered to be at risk. The Q value system is summarised under the Results section of the Report (EPA 2019).

### 1.3 Explanation of Macroinvertebrates as indicators

Benthic macroinvertebrates are animals without a backbone that can be seen with the naked eye. They have the ability to cling to bottom surfaces such as rocks, leaves or roots. They include arthropods, molluscs and annelids. In many aquatic environments, the macroinvertebrate community is dominated by the larvae of aquatic insects, for example, Ephemeroptera, Plecoptera, Trichoptera and Diptera. These communities are important links in the food web between producers such as algae and debris and higher consumers such as fish. Due to the varying tolerance of these organisms to water pollution, they are key indicators of biological integrity in streams and rivers and can be used as indicators of water quality (Mandaville 2002).

## 2. Methodology

### 2.1 Personnel

The sample collection and assessment were conducted by Stephen Kingston, qualified Wildlife Biologist and Jack France, qualified Environmental Scientist. Both surveyors are employed directly through Acorn water Ltd.

### 2.2 Sample Sites

**Site 1** (Manch Bridge – Sampling Station no. 0400) located at Manch Bridge and 5 km upstream of the discharge from the factory.

**Site 2** (ASW2 – 132790E 053523N) located just below a sharp bend in the river 200m downstream of the discharge from the Factory’s cooling water discharge.

**Site 3** (ASW2a – 133623E 053964N) located 200m downstream of the main effluent treatment plant discharge.

**Site 4** (Ballineen Bridge – Sampling Station no. 0500) located 800m downstream from main effluent treatment plant discharge at a point immediately upstream of Ballineen Bridge.

**Site 5** (Bridge S of Enniskeane – Sampling Station 0550) is situated 6 km downstream from main effluent treatment plant discharge at Murragh Bridge, the second next bridge on the River Bandon downstream of Ballineen.

### 2.3 Map defining the sample locations along the Ballineen stretch of the Bandon river

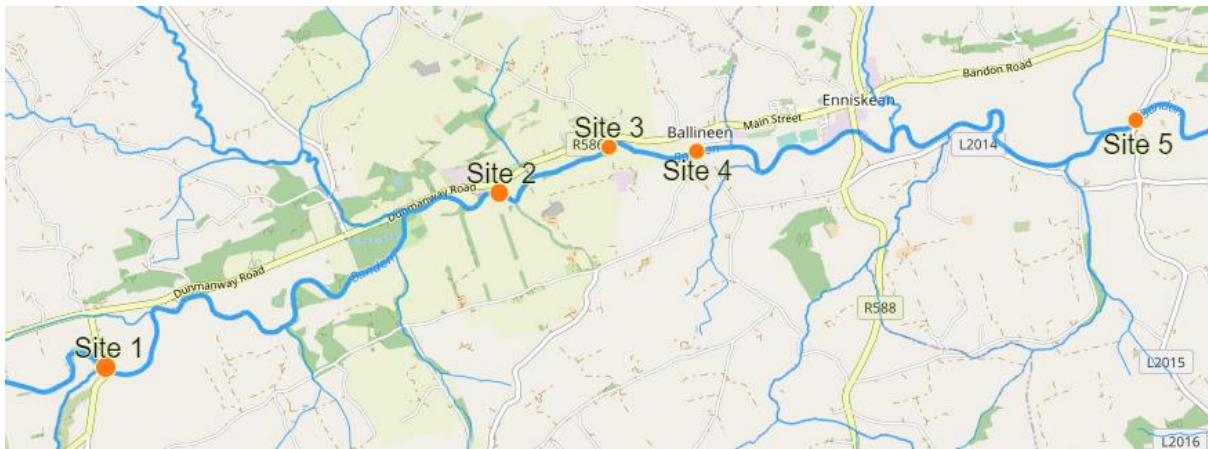


Figure 1. EPA map outlining the course of the Bandon river and the five sampling sites



Figure 2. Satellite Map defining the locations of the 5 sampling sites on the River Bandon

## 2.4 Site arrival Procedure:

On arrival at a sample site, a habitat assessment was carried out, river parameters such as width and average depth were recorded along a transect, while substrate type, flow type, instream vegetation, bankside vegetation and estimated summer cover were all given percentages. A digital camera was used to take three photographs of the river. One perpendicular to the river bank, one upstream and one downstream to the sampling point. A sterile container was used to collect a sample of the river water to be tested later for Orthophosphate. This container was labelled and stored appropriately. One three-minute kick sample (the travelling kick) method was taken at each of the five sites, this ensures all habitats within a riffle area are represented accordingly. These transects were chosen by viewing the river bed from the river bank and selecting representative transects of the river with small to medium sized gravel patches. Once the locations were chosen the participants entered the river from below the most downstream sample section to avoid contamination or disruption of the other sample points.

## 2.5 Fieldwork

Fieldwork was conducted on the 8<sup>th</sup> of June 2020. On arrival at a sample site, a habitat assessment was carried out, river parameters such as width and average depth were recorded along a transect, while substrate type, flow type, instream vegetation, bankside vegetation and estimated summer cover were all given percentages along with other relevant information noted. A digital camera was used to take three photographs of the river. One perpendicular to the river bank, one upstream and one downstream to the sampling point. A sterile, labelled 250ml plastic bottle was used to collect a sample of the river water to be tested later for Orthophosphate. One three-minute kick sample (the travelling kick) method was taken at each of the five sites, this ensures all habitats within a riffle area are represented accordingly. These transects were chosen by viewing the river bed from the river bank and selecting representative transects of the river with small to medium sized gravel patches. Once the locations were chosen the participants entered the river from below the most downstream sample section to avoid contamination or disruption of the other sample points. One participant placed the D-Frame net fitted with 500-micron mesh netting in the river firmly on top of the substrate while standing behind it and the stopwatch was set to three minutes. The other participant began

kicking the river bed at right angles to the river flow one metre upstream of the net for the allocated three minutes. Once the three minutes had passed the net was quickly removed from the river and the sample was transferred to a large white container to inspect the contents. Care was taken to ensure all macroinvertebrates were removed from the mesh and included in the sample. Once all the sample material had been transferred into the large container, any large debris (e.g. stones or large twigs) were rubbed clean of all macroinvertebrates and discarded afterwards. The contents were transferred from the large basin into the sample container with some river water, 50ml of Ethanol were added to the container to neutralise the Invertebrates and ensure no predation could occur within the sample. The sample was labelled appropriately. This process was repeated for each of the samples in each of the five sites. Upon arrival in the lab, both the samples and orthophosphate samples were placed in the fridge for preservation.

## 2.6 Analysis

### 2.7 Chemical analysis

The water samples to be tested for Orthophosphate were submitted to the Acorn Water laboratory for chemical analysis. The results were then returned to be included in this report.

### 2.8 Biological analysis

The contents of a random sample were poured into a wide shallow white container, additional water was added to aid with ease of separation of macro-invertebrates from remaining debris. Using a self-illuminating table-top mounted magnifying glass the sample was scanned for the largest specimens first (Leeches, Caddis-flies, Stone-flies, Worms etc.), these were removed with a needle tipped forceps and placed in open petri-dishes for later identification. Afterwards the smaller specimens were removed and placed in petri-dishes for later identification. Finally, once there appeared to be no specimens left in the sample tray, a five-minute scan of the whole remaining sample was performed to discover and remove any invertebrates that were missed or obscured by debris in previous scans. The sample water was then discarded and the identification of the collected specimens was conducted using the relevant keys and freshwater ecology books. The numbers of all individual species were recorded. This process was repeated for all samples collected over the five sites.

### 3. Analysis and Scoring

#### 3.1 The EPA Q-Value system

The data was entered into an excel table. The data collected at each site from all samples were combined to give a total of all individuals of each species present in any one site. 3 indices were used to assess the ecological quality of the tested sites. The most relevant is the EPA Q value system.

The quality ratings are outlined below.

*Table1: 'Q' Community Water Value Diversity Quality Condition*

<b>Q Value</b>	<b>WFD Status</b>	<b>Pollution Status</b>	<b>Condition</b>
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Very Low	Seriously polluted	Unsatisfactory

##### 3.1.1 Relative abundance was assigned as outlined below.

- Present (1/2 individuals)
- Scarce/Few (<1%)
- Small Numbers (<5%)
- Fair Numbers (5-10%)
- Common (10-20%)
- Numerous (25-50%)
- Dominant (50-75%)
- Excessive (>75%)

The Table of Qualifying criteria used to assess the Q value for each site can be viewed on page 196 of (Toner *et al.* 1986)

The other two systems calculated in this report are systems used in Britain. They are the BMWP (Biological Monitoring Working Party) score and the ASPT (Average Score Per Taxon) score.

The **BMWP score** is a system where a tolerance value from 1-12.5 is allocated to the genus of each relevant macro-invertebrate family. The most pollution sensitive families are allocated a score of 12.5 while the most pollution tolerant families are allocated a score of 1.

The **ASPT score** is a derivative of the BMWP score where the BMWP score is divided by the number of families used to calculate the BMWP.

Table 2. BMWP and ASPT.

<b>BMWP score</b>	<b>ASPT score</b>	<b>Rating</b>	<b>Water Quality</b>
151+	6.0+	7	Excellent
121-150	5.5-5.9	6	Excellent
91-120	5.1-5.4	5	Excellent
61-90	4.6-5.0	4	Good
31-60	3.6-4.5	3	Moderate
15-30	2.6-3.5	2	Poor
0-14	0-2.5	1	Very Poor

## 4. Results:

### 4.1 Raw Data:

Table 3. Habitat assessment for site 1

<b>Location: Site 1</b>	Manch Bridge				
<b>Time:</b>	16:00				
<b>Width (M)</b> =20.3	<b>Avg Depth (cm)</b> =8.84				
<b>Substrate type%</b>	<b>L. Rocks</b>	<b>Cobbles =25</b>	<b>Gravels =60</b>	<b>Sand =15</b>	<b>Mud</b>
<b>Flow type %</b>	<b>Riffle =75</b>	<b>Glide =20</b>	<b>Pools =5</b>		
<b>Instream Vegetation %</b>	<b>Macro Algae =10</b>	<b>Micro Algae</b>	<b>Macrophytes =10</b>		
<b>Bankside Vegetation %</b>	75				
<b>Estimated Summer Cover %</b>	5-10				

Table 4. Habitat assessment for site 2

<b>Location: Site 2</b>	Carbery cooling				
<b>Time:</b>	14:50				
<b>Width (M)</b> =13.0	<b>Avg Depth (cm)</b> =12.44				
<b>Substrate type%</b>	<b>L. Rocks =5</b>	<b>Cobbles =70</b>	<b>Gravels =20</b>	<b>Sand =5</b>	<b>Mud</b>
<b>Flow type %</b>	<b>Riffle =85</b>	<b>Glide =15</b>	<b>Pools</b>		
<b>Instream Vegetation %</b>	<b>Macro Algae =15</b>	<b>Micro Algae</b>	<b>Macrophytes =40</b>		
<b>Bankside Vegetation %</b>	60				
<b>Estimated Summer Cover %</b>	25				

Table 5. Habitat assessment for site 3

<b>Location: Site 3</b>	Carbery Farm				
<b>Time:</b>	13.25				
<b>Width (M) =</b> 15.1	<b>Avg Depth (cm) =</b> 18:54				
<b>Substrate type%</b>	<b>L. Rocks =5</b>	<b>Cobbles = 75</b>	<b>Gravels =15</b>	<b>Sand =3</b>	<b>Mud =2</b>
<b>Flow type %</b>	<b>Riffle</b>	<b>Glide =90</b>	<b>Pools =10</b>		
<b>Instream Vegetation %</b>	<b>Macro Algae =70</b>	<b>Micro Algae</b>	<b>Macrophytes =80</b>		
<b>Bankside Vegetation %</b>	95				
<b>Estimated Summer Cover %</b>	25				

Table 6. Habitat assessment for site 4

<b>Location: Site 4</b>	Ballineen Bridge				
<b>Time:</b>	11:10				
<b>Width (M) =</b> 30.4	<b>Avg Depth (cm)=10.68</b>				
<b>Substrate type%</b>	<b>L. Rocks = 5</b>	<b>Cobbles = 55</b>	<b>Gravels = 30</b>	<b>Sand = 5</b>	<b>Mud = 5</b>
<b>Flow type %</b>	<b>Riffle = 5</b>	<b>Glide = 95</b>	<b>Pools</b>		
<b>Instream Vegetation %</b>	<b>Macro Algae = 25</b>	<b>Micro Algae</b>	<b>Macrophytes = 75</b>		
<b>Bankside Vegetation %</b>	95				
<b>Estimated Summer Cover %</b>	5				

Table7. Habitat assessment for site 5

<b>Location: Site 5</b>	Murragh Bridge				
<b>Time:</b>	09:20				
<b>Width (M) =</b> 29.1	<b>Avg Depth (cm) =</b> 11.88				
<b>Substrate type%</b>	<b>L. Rocks = 5</b>	<b>Cobbles = 40</b>	<b>Gravels = 50</b>	<b>Sand = 3</b>	<b>Mud = 2</b>
<b>Flow type %</b>	<b>Riffle = 20</b>	<b>Glide = 80</b>	<b>Pools</b>		
<b>Instream Vegetation %</b>	<b>Macro Algae =5-10</b>	<b>Micro Algae = &lt;5</b>	<b>Macrophytes = 70</b>		
<b>Bankside Vegetation %</b>	95				
<b>Estimated Summer Cover %</b>	5				

## Macroinvertebrate survey Q-Values

Table 8. Q-value rating for site 1

<b>Site 1 (Manch):</b>			
A: 0.6%	Few	Q3-4	
B: 47.4%	Numerous	Q5, Q4, Q3-4	
C: 44.0%	Numerous	Q3-4	
D: 5.7%	Fair numbers	Q3-4	
E: 1.6%	Small numbers	Q2	<b>Site 1 rating: Q3-4</b>

Table 9. Q-value for site 2

<b>Site 2 (Carbery Cooling):</b>			
A: 3.5%	Small numbers	Q3-4	
B: 61.6%	Dominant	Q5, Q4	
C: 28.5%	Numerous	Q4, Q3-4	
D: 4.7%	Small numbers	Q3-4	
E: 0.5%	Few	Q5, Q4, Q3-4	<b>Site 2 rating: Q3-4</b>

Table 10. Q-value for site 3

<b>Site 3 (Carbery Farm):</b>			
A: 1.7%	Small numbers	Q3-4	
B: 31.8%	Numerous	Q5, Q4, Q3-4	
C: 9.6%	Fair numbers	Q4	
D: 51.7%	Dominant	Q2	
E: 4.0%	Small numbers	Q2	<b>Site 3 rating: Q3-4</b>

Table 11. Q-value for site 4

<b>Site 4 (Balineen Bridge):</b>			
A: 3.7%	Small numbers	Q3-4	
B: 37.2%	Numerous	Q5, Q4, Q3-4	
C: 33.7%	Numerous	Q4, Q3-4	
D: 24.2%	Common/Numerous	Q3-4, Q3	
E: 0.2%	Few	Q5, Q4, Q3-4, Q3	<b>Site 4 rating: Q3-4</b>

Table 12. Q-value for site 5

<b>Site 5 (Murragh Bridge):</b>			
A: 3.4%	Small numbers	Q3-4	
B: 35.0%	Numerous	Q5, Q4, Q3-4	
C: 20.0%	Common	Q3-4, Q4	
D: 36.4%	Numerous	Q3	
E: 0.1%	Few	Q5, Q4, Q3-4, Q3	<b>Site 5 rating: Q3-4</b>

Table 13. Numbers of Marco-invertebrates collected at all sites.

Common Name	Family	Revised BMWP Score	EPA Q-Value	SITES				
				Site 1	Site 2	Site 3	Site 4	Site 5
<b>STONEFLIES</b> (Plecoptera)	Leuctridae	9.9	B	31	158	102	159	123
	Perlidae	12.5	A		20	12	12	13
<b>MAYFLIES</b> (Ephemeroptera)	Baetidae	5.3	B	261	627	470	417	355
	Heptageniidae	9.8	A	5	43	27	60	55
	Ephemerellidae	7.7	B	132	338	142	149	223
<b>CADDIS FLIES</b> (Trichoptera)	Rhyacophilidae	8.3	C		37	4	4	7
	Polycentropidae	8.6	C	12	14	4	4	4
	Hydropsychidae	6.6	C	3	43	3	7	18
	Phryganeidae	7.0	C		2	3	1	2
	Brachycentridae	9.4	B	7	13	23	8	97
<b>TRUE FLIES</b> (Diptera)	Tipulidae	5.5	C					
	Chironomidae	3.7	D	29	62	752	238	108
	Simuliidae	5.8	C	281	273	38	325	14
<b>BETTERLES</b> (Coleoptera)	Gyrinidae	7.8	C	6	3	9	5	10
	Elmidae	6.4	C	89	140	144	291	291
<b>CRUSTATIANS</b>	Asellidae	2.1	D	1			2	7
	Gammaridae	4.5	C	1	7	6	7	20
<b>SNAILS</b> (Mollusca)	Hydrobiidae	3.9	D	20	24	407	232	613
	Planorbidae	2.9	D					1
<b>LIMPETS &amp; MUSSELS</b> (Mollusca)	Ancylidae	5.6	C	2	2	7	14	37
<b>WORMS</b> (Annelida)	Oligochaeta	3.5	E	14	9	89	4	2
<b>LEECHES</b>	Glossiphoniidae	3.1	D	1				1
	Erpobdellidae	2.8	D		9	1	9	3

Table 14. EPA Q-Values compared between Surveys from 2008 to present

Scores	Survey	Site 1	Site 2	Site 3	Site 4	Site 5
EPA Q-Value	2003 June	Q3-4	Q4	-	Q4	Q4
EPA Q-Value	2003 Sept	Q3-4	Q4(Q3-4)	-	Q4	Q4
EPA Q-Value	2004 June	Q4	Q4(Q3-4)	-	Q4	Q4
EPA Q-Value	2004 Sept	Q3-4	Q4	Q4(Q3-4)	Q4(Q3-4)	Q4(Q3-4)
EPA Q-Value	2005 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2005 Sept	Q3-4	Q3-4	Q3-4	Q3-4	Q3-4
EPA Q-Value	2006 June	Q4	Q4	Q3-4	Q4	Q4
EPA Q-Value	2006 Sept	Q4	Q4	Q3-4	Q3-4	Q4(Q3-4)
EPA Q-Value	2007 June	Q4	Q4	Q4	Q4(Q3-4)	Q4(Q3-4)
EPA Q-Value	2007 Sept	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2008 May	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2008 Sept	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2009 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2009 Aug	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2010 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2010 Aug	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2011 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2011 Sept	Q3-4	Q3-4	Q4	Q4	Q4
EPA Q-Value	2012 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2012 Sept	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2013 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2013 Aug	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2014 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2014 Sept	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2015 June	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2015 Sept	Q4	Q4	Q4	Q4	Q4
EPA Q-Value	2016 June	Q3-4	Q4	Q4	Q4	Q4

EPA Q-Value	2016 Sept	Q3-4	Q4	Q4	Q4	Q4
EPA Q-Value	2017 June	Q3-4	Q4	Q4	Q4	Q4
EPA Q-Value	2017 Sept	Q3-4	Q4	Q4	Q4	Q4
EPA Q-Value	2018 June	Q3-4	Q3-4	Q4	Q4	Q4
EPA Q-Value	2018 Sept	Q3-4	Q3-4	Q3-4	Q3-4	Q3-4
EPA Q-Value	2019 June	Q3-4	Q3-4	Q3-4	Q3-4	Q3-4
EPA Q-Value	2019 Sept	Q3-4 approaching Q3!	Q3-4 approaching Q3!	Q3-4 approaching Q3!	Q3-4 approaching Q3!	Q3-4 approaching Q3!
EPA Q-Value	2020 June	Q3-4	Q3-4	Q3-4	Q3-4	Q3-4

Table 15. Total BMWP Scores compared between Surveys from 2008 to present

Scores	Survey	Site 1	Site 2	Site 3	Site 4	Site 5
Total BMWP	2003 June	78	113	-	145	109
Total BMWP	2003 Sept	85	61	-	112	107
Total BMWP	2004 June	87	87	-	106	128
Total BMWP	2004 Sept	45	96	104	133	82
Total BMWP	2005 June	86	124	122	128	115
Total BMWP	2005 Sept	68	98	126	102	100
Total BMWP	2006 June	91	114	99	121	130
Total BMWP	2006 Sept	115	106	119	119	115
Total BMWP	2007 June	78	100	102	112	121
Total BMWP	2007 Sept	110	96	109	103	104
Total BMWP	2008 May	112	98	114	114	104
Total BMWP	2008 Sept	115	106	106	118	109
Total BMWP	2009 Aug	107	96	92	100	102
Total BMWP	2009 Sept	103	105	100	113	110
Total BMWP	2010 Aug	98	96	93	104	92
Total BMWP	2010 Sept	86	101	102	93	95
Total BMWP	2011 June	106	112	101	109	115
Total BMWP	2011 Sept	85	81	111	106	100
Total BMWP	2012 June	112	108	118	106	112

Total BMWP	2012 Sept	103	112	118	121	112
Total BMWP	2013 Aug	103	103	109	112	115
Total BMWP	2013 Sept	98	103	115	115	117
Total BMWP	2014 June	99	103	115	105	109
Total BMWP	2014 Sept	109	112	112	118	115
Total BMWP	2015 June	106	114	105	99	108
Total BMWP	2015 Sept	102	115	111	115	112
Total BMWP	2016 June	72	85	85	98	102
Total BMWP	2016 Sept	65	64	96	84	109
Total BMWP	2017 June	73	87	74	68	54
Total BMWP	2017 Sept	70	72	98	82	100
Total BMWP	2018 June	87	95	82	82	92
Total BMWP	2018 Sept	107	113	96	93	86
Total BMWP	2019 June	91	102.6	103.1	110.9	110.9
Total BMWP	2019 Sept	94.9	115.9	123.4	124.2	131.2
Total BMWP	2020 June	108.7	129.1	129.1	131.2	137.2

Table 16. Total ASPT Scores compared between Surveys from 2008 to present

Scores	Survey	Site 1	Site 2	Site 3	Site 4	Site 5
ASPT	2003 June	5.6	6.3	-	6.9	6.8
ASPT	2003 Sept	5.3	5.6	-	5.9	5.9
ASPT	2004 June	6.2	5.8	-	5.9	6.1
ASPT	2004 Sept	4.5	5.6	5.0	5.5	5.1
ASPT	2005 June	6.1	6.5	5.8	5.8	5.5
ASPT	2005 Sept	4.9	5.2	5.3	5.4	5.3
ASPT	2006 June	6.1	6.3	5.0	6.1	6.5
ASPT	2006 Sept	5.8	5.6	5.2	5.2	5.8
ASPT	2007 June	6.0	6.3	5.6	6.2	6.1
ASPT	2007 Sept	5.8	5.6	5.6	5.7	6.1
ASPT	2008 May	5.6	6.1	6.0	6.0	6.1
ASPT	2008 Sept	5.8	5.9	5.9	5.6	6.1
ASPT	2009 June	5.9	6.4	6.1	6.3	6.4
ASPT	2009 Aug	5.7	5.8	5.9	5.7	6.1
ASPT	2010 June	6.1	6.0	6.2	5.8	6.1
ASPT	2010 Aug	5.7	5.9	5.4	5.8	5.3
ASPT	2011 June	5.9	5.9	6.3	6.1	5.8

ASPT	2011 Sept	5.0	5.1	5.3	5.9	5.6
ASPT	2012 June	5.6	5.7	5.6	5.9	5.9
ASPT	2012 Sept	6.1	5.9	5.6	5.5	5.9
ASPT	2013 June	6.1	6.1	6.1	5.9	5.8
ASPT	2013 Aug	6.1	6.1	5.8	5.8	5.9
ASPT	2014 June	5.8	6.1	5.8	5.8	6.1
ASPT	2014 Sept	5.7	5.9	5.6	5.6	5.8
ASPT	2015 June	6.2	6.0	6.2	5.8	5.7
ASPT	2015 Sept	5.7	5.8	5.6	5.8	5.9
ASPT	2016 June	6.0	6.1	6.1	6.5	6.0
ASPT	2016 Sept	5.0	5.3	5.3	6.0	5.5
ASPT	2017 June	6.6	5.8	6.2	6.8	6.0
ASPT	2017 Sept	6.6	6.3	5.7	6.1	6.3
ASPT	2018 June	6.2	5.9	6.3	6.3	6.1
ASPT	2018 Sept	5.6	5.7	5.1	5.5	5.1
ASPT	2019 June	6.5	6.4	6.4	6.5	6.5
ASPT	2019 Sept	6.3	6.4	6.5	6.5	6.6
ASPT	2020 June	6.0	6.8	6.8	6.6	6.2

Table 17. Orthophosphate results for all five sampling sites June 8<sup>th</sup> 2020.

Sites	Reference number	Orthophosphate (mg/L, P)
1	E8287	0.08
2	E8286	0.10
3	E8285	0.10
4	E8284	0.09
5	E8283	0.05

## Habitat Assessment Results

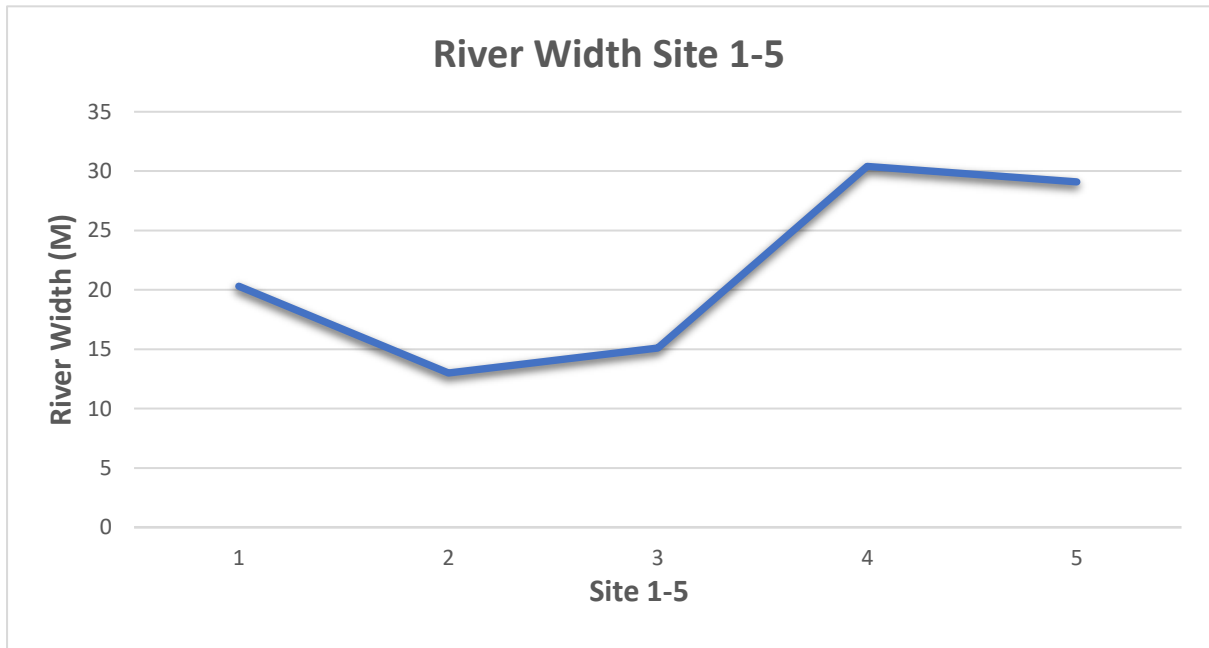


Figure 3. a line graph of the river width of the five sampling points

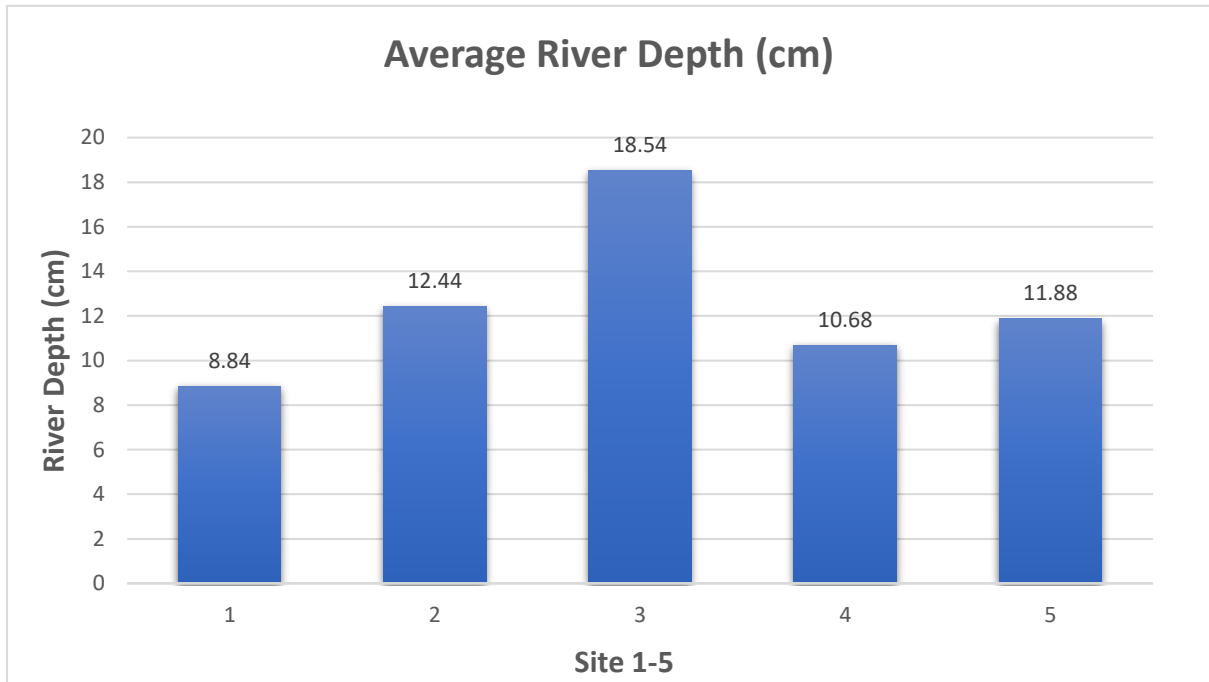


Figure 4. A bar chart of the average depth of the river for the five sampling sites.

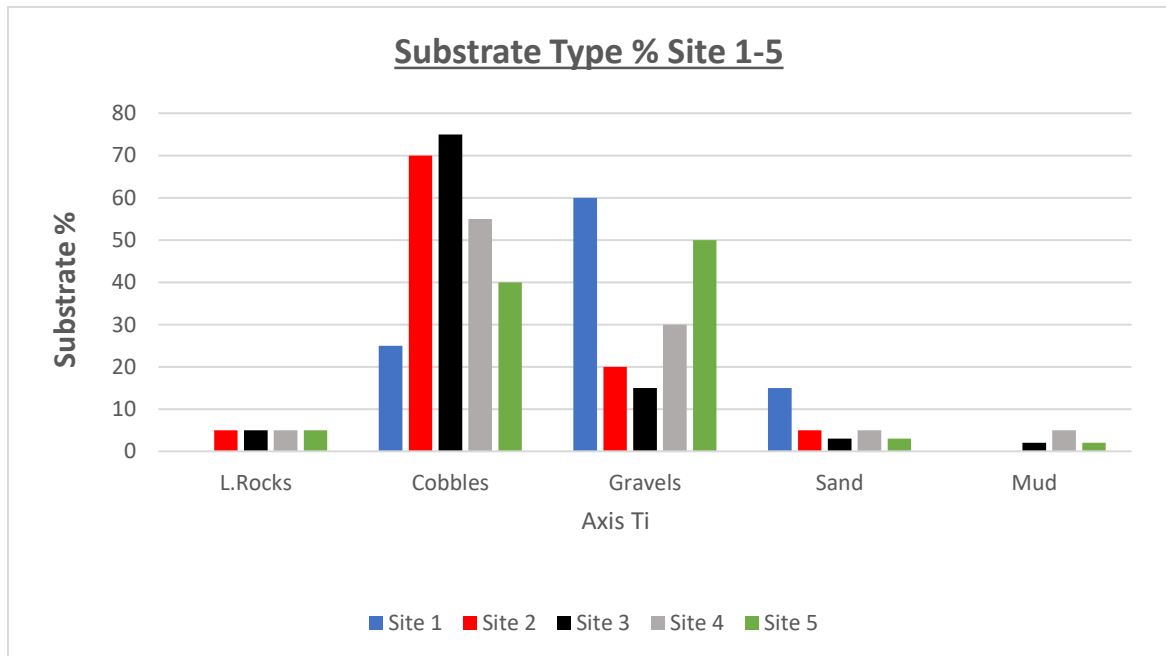


Figure 5. A bar chart of the substrate type percentage for the five sampling sites

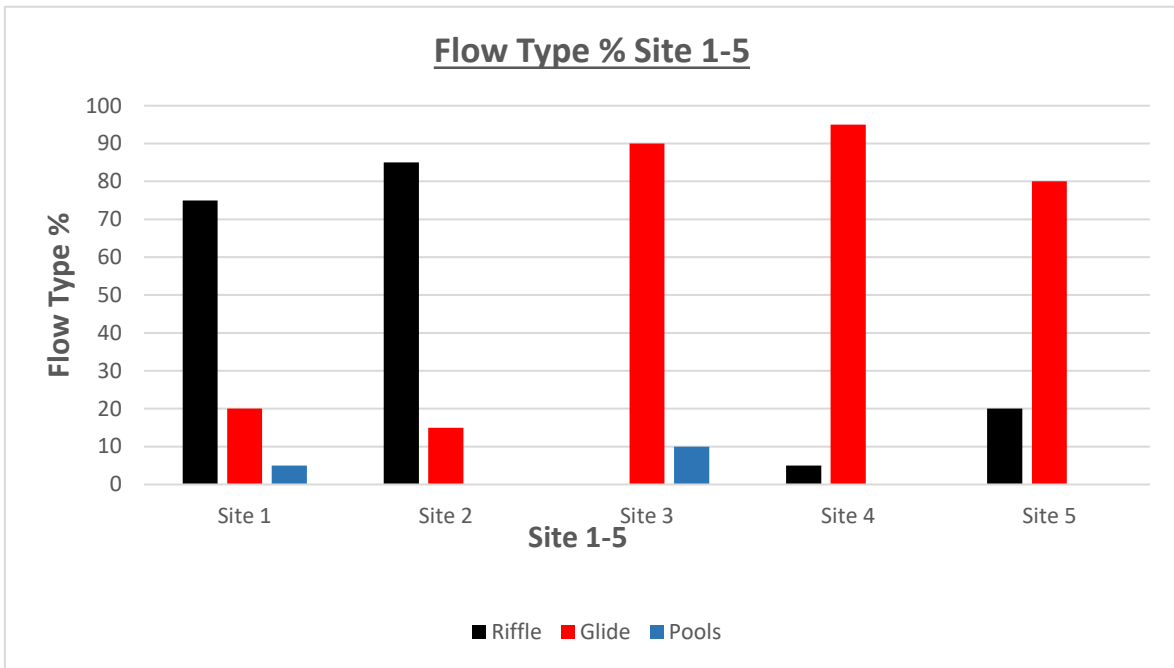


Figure 6. A bar chart of the flow type percentage for the five sample sites

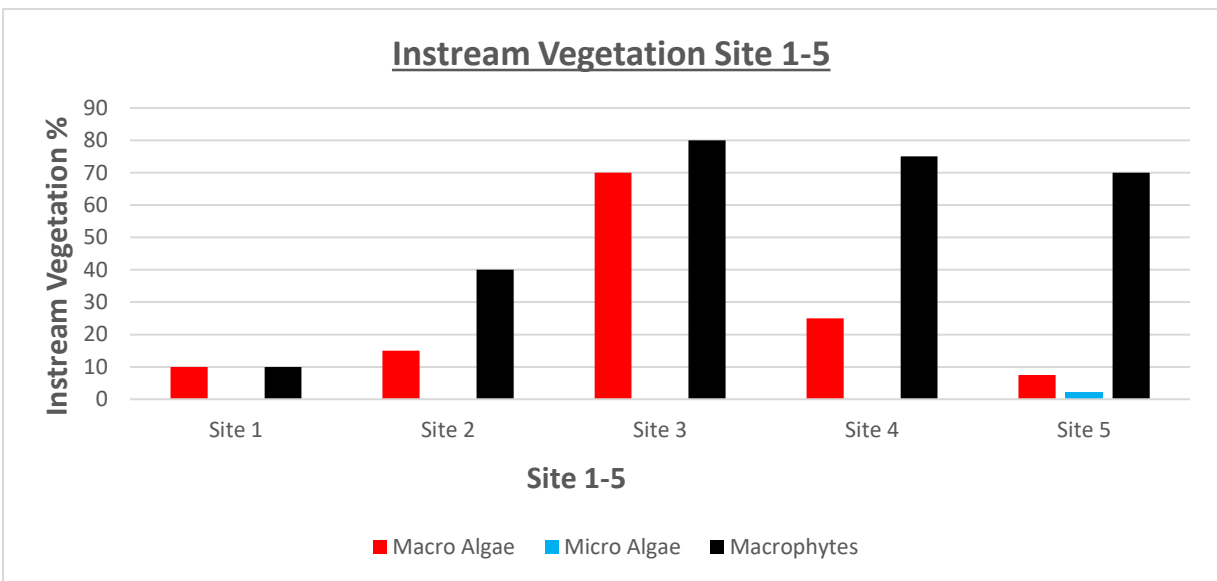


Figure 7. A bar chart of the in-stream vegetation percentage for the five sites

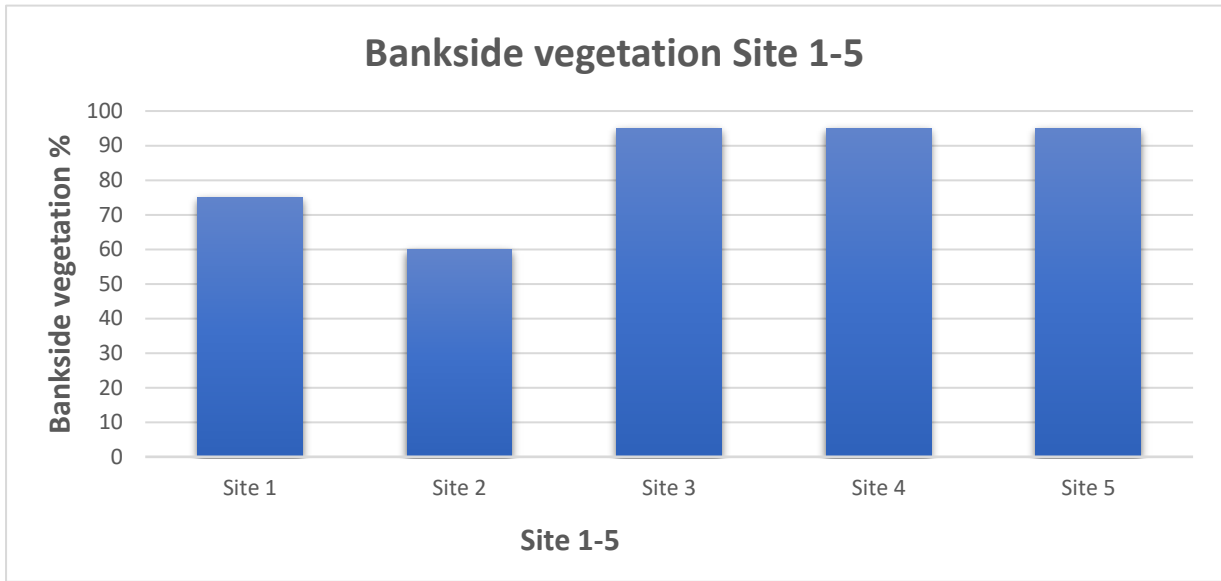


Figure 8. A bar chart of the bankside vegetation percentage for the five sites

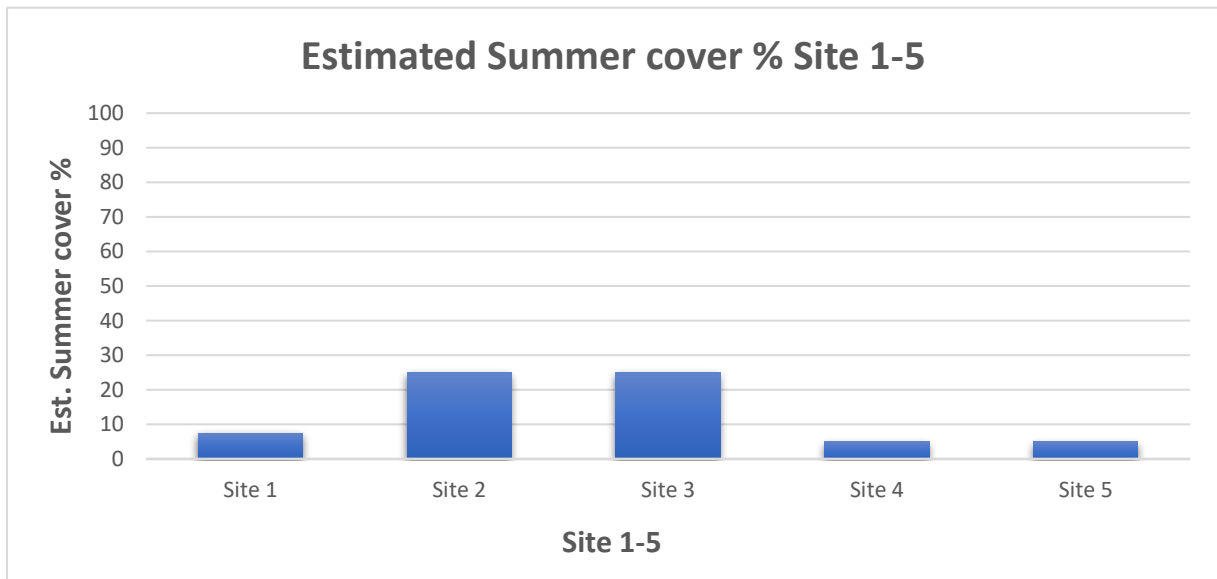


Figure 9. A bar chart of the estimated summer cover percentage for the five sites

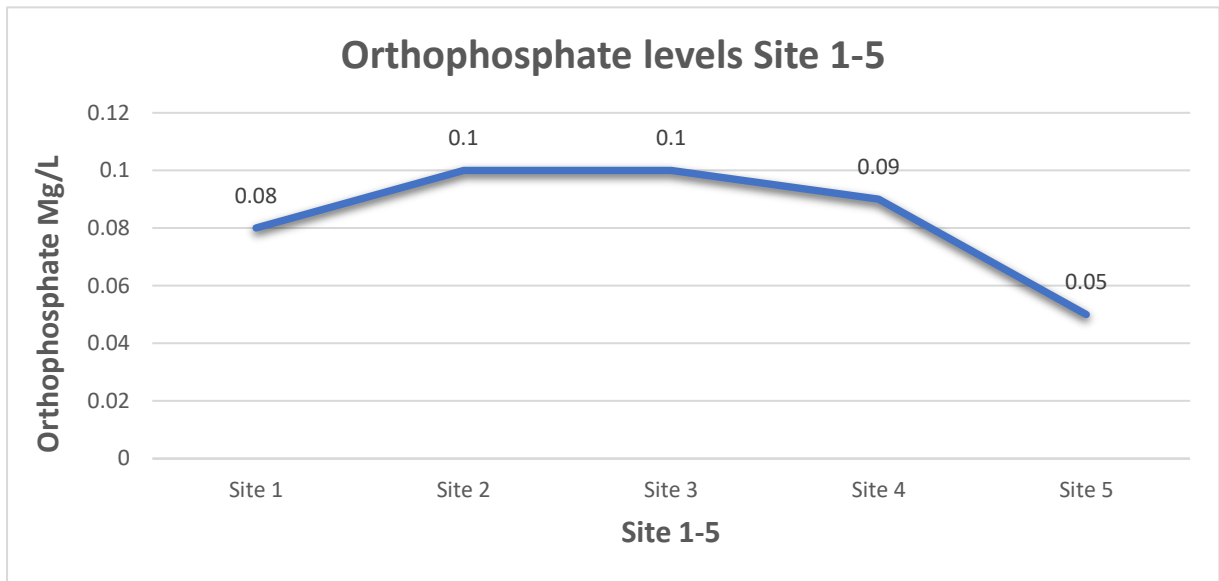


Figure 10. A line graph of the orthophosphate levels for the five sites

## 5. Conclusion and Recommendations

The EPA Q-Value at all sites lie at Q 3-4 with site 3 being the lowest quality of all five sites bordering on a Q3 rating with more than 50% category D and 4% category E organisms present. This result shows signs that some pollution may be present. Only few category A organisms represented by Stonefly larvae of the genus *Perla bipunctata* and Mayfly larvae of the genus *Ecdyonurus* were present at all sites. The highest category A organisms was represented in site 4 at 3.7% while the lowest was recorded at site 1 with 0.6%.

The scoring systems for BMWP and ASPT were updated and continue to fall into the excellent Quality categories at all sites. Orthophosphate levels measured at all sites were above the 0.035 Mg/L limit as referred to by the EPA. This is likely to have a significant impact on the river conditions and evidence of nutrient pollution can be seen from the instream vegetation habitat assessment results. All sites both upstream and downstream are substantially greater than the EPA recommendations for orthophosphate levels. Concentrations of phosphate consistently greater than 0.035 mg/L are likely to lead to nutrient pollution. Orthophosphate (OP) or 'soluble reactive phosphorus' is bioavailable to freshwater organisms and the exceedance of the OP standard has been identified as the single largest cause of water bodies not achieving 'good ecological status' in the UK and Ireland, under the European Union Water Framework Directive. High OP concentrations lead to reduced sensitive invertebrate populations in freshwater river catchments (Everall *et al*, 2018).

When rating the communities using the EPA Q-system as well as the BMWP- and ASPT scores, water quality upstream of the factory did not seem to be significantly higher than downstream. This suggests that the effluent from the water cooling and main factory discharge are not likely to have a significant impact upon the invertebrate communities.

When visiting the sites and performing a habitat assessment it was noted that farmers had created access to the water for their cattle at several spots along the river. These cattle access spots also allowed poaching by the animals to occur thus causing erosion of the river banks (notably near site 1, site 2 and site 5) which causes pollution and siltation decreasing water quality and capable of affecting the composition of benthic macroinvertebrate communities

(Conroy *et al.* 2016). Nutrient pollution was evident at all sites with higher orthophosphate levels and an increase in macrophyte growth. Macrophyte species such as *Ranunculus aquatilis* known as white water-crow foot was present in all sites and excessive in sites 3, site 4 and site 5.

The decrease in water quality is therefore likely traced back to intensified agriculture thus increasing the likeliness of eutrophication along with the notable shallow depth of this stretch of river. This observation makes this section of the river more susceptible to nutrient pollution with a lower volume of water allowing an increase of light penetration for photosynthesis. This increase of light penetration and the low average depth of the river allows algal and macrophyte growth to flourish.

It would be recommended to liaise with farmers with land adjacent to the river and to advise them to observe buffer strips and to not let their cattle access the river. Further monitoring of orthophosphate levels is recommended along this section of the river and at the discharge point of Carbery Waste Water Treatment Plant to ensure stable conditions in respect to the EPA guidelines. These range of factors on the river Bandon influence its moderate and unsatisfactory status as described by the WFD, until these pressures are identified and eliminated it is unlikely that the status of the river Bandon will improve.

## 6. References

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## 7. Appendices: Photographs

Site 1 = Manch Bridge



Site 2 = Carbery Cooling plant



Site 3 = Downstream of Carbery Waste Water Treatment Plant

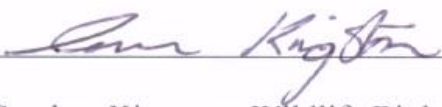


Site 4 = Balineen Bridge

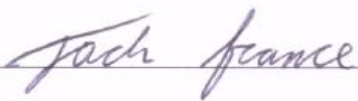


Site 5 = Murragh Bridge



Signed:   
Stephen Kingston, Wildlife Biologist

Date: 22/06/20

Signed:   
Jack France, Environmental Scientist

Date: 22/06/20