Sanitary Survey Report and Sampling Plan for

Bantry Gearhies, Co. Cork

Produced by

AQUAFACT - APEM Group

In conjunction with

The Sea Fisheries Protection Authority

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Statement of use:

Under EU Regulation 2019/627 which lays down uniform practical arrangements for the performance of official controls on products of animal origin intended for human consumption, a sanitary survey relevant to bivalve mollusc production in Bantry Gearhies was undertaken in 2023/2024. This will provide an appropriate hygiene classification zoning and monitoring plan based on the best available information with detailed supporting evidence. AQUAFACT undertook the desktop component of the work on behalf of the SFPA.

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1	24/11/2023	Interim report for SFPA review
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Document and QA Approval - AQUAFACT

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Glossary

AER	Annual Environmental Report
BMPA	Bivalve Mollusc Production Area
BOD	Biochemical oxygen demand
CAP	Common Agriculture Policy
CFU	Colony forming unit (scientific estimate of microbial cells)
CRS	Coordinated reference system
CSO	Central Statistics Office
DAFM	Department of Agriculture, Food and the Marine
Depuration	The process of purification or removal of impurities
DSW	Designated Shellfish Waters
DWF	Dry weather flow
DWT	Deadweight ton
ED	Electoral Divisions
E. coli	*Escherichia coli*
EPA	Environmental Protection Agency
EU	European Union
EURL	European Union Reference Laboratory
GIS	Geographical Information Systems
GPS	Global Positioning System
Industry	Relates to shellfish producers, BIM, and any relevant shellfish production stakeholders.
ING	Irish National Grid
IPC	Integrated Pollution Control
kn	Knots (kilometres per hour [km/h] is equal to 0.54 knots

LSU	Livestock Unit
MSD	Marine Sanitation Device
MPN	Most Probable Number
NBDC	National Biodiversity Data Centre
NoV	Norovirus
NPWS	National Parks and Wildlife Service
PE	Population Equivalent
Pollution	Encompasses *E. coli* contamination only for the purpose of this sanitary survey report
PPT	Parts Per Thousand
RMP	Representative Monitoring Point
SAC	Special Area of Conservation
SFPA	Sea Fisheries Protection Authority
SI	Statutory Instrument
SPA	Special Protection Area
WFD	Water Framework Directive
WGS84	World Geodetic System 1984 – datum featuring coordinates that change with time.
WWTP	Wastewater Treatment Plan

1. Executive Summary

Under Regulation (EU) 2017/625 and its subsequent Implementing Regulation (EU) 2019/627, there is a requirement for competent authorities intending to classify bivalve mollusc production and relaying areas to undertake a sanitary survey. The purpose of the sanitary survey is to determine the extent to which potential sources of pollution may impact a production area and ultimately inform the sampling plan for the National Microbiological Sampling Programme, as operated by the Sea Fisheries Protection Authority (SFPA); the results of which determine the annual classification for Bivalve Mollusc Production Areas (BMPAs). In the context of this sanitary survey report, pollution encompassed *Escherichia coli* contamination only.

In 2017, shellfish production in Bantry Gearhies became dormant subsequently leading to its declassification. The shellfish industry in Bantry Gearhies has since submitted a request to reopen the production area to harvest mussels (*Mytilus edulis*). In accordance with the European Union Reference Laboratory (EURL) Guide to Good Practice on the microbiological monitoring of bivalve mollusc harvesting areas, a re-evaluation of pollution sources and the sampling plan (primary sanitary survey) should be undertaken if a time trigger (six years or more since the last survey) or a change in the environment has occurred. There is licensed Pacific Oyster (*Magallana gigas*[1]; formerly *Crassostrea gigas*) aquaculture in Bantry Gearhies, however the site has been inactive for several years with no active production at the time of writing this report. Consequently, a sanitary survey must be undertaken to determine species-specific RMPs. This report identifies the sources and types of faecal, *i.e.*, *E. coli*, contamination discharging into Bantry Gearhies and assess whether these sources are likely to affect the microbiological concentration in the production areas.

Bantry Gearhies is approximately 97.03 km^2 in area and is within Bantry Bay, Co. Cork, on the south-western coast of Ireland. It is part of the Southwestern River Basin District and is partially covered by Water Framework Directive (WFD) Designated Shellfish Waters (DSW). Aquaculture of turbot (*Scophthalmus maximus*) and stony sea urchin (*Paracentrotus lividus*) occur between the licensed mussel sites, there are two licensed salmon aquaculture sites, and a seaweed aquaculture site within the Bantry Gearhies area. There is a licensed Pacific oyster (*Magallana gigas*[2]; formerly *Crassostrea gigas*) aquaculture site in Bantry Gearhies, however the site has been inactive for several years with no active production at the time of writing this report.

The SFPA in conjunction with the Castletownbere Port Office has determined that Bantry Gearhies will be divided into two separate bivalve mollusc production areas (BMPAs), namely Bantry Gearhies east BMPA and Bantry Gearhies west BMPA. The boundaries of these two production areas have been drawn so as to exclude an area into which high levels of *E. coli* have been detected during the bacteriological survey, which would, therefore, be an unsuitable location for shellfish production. Upon classification of the two production areas

in Bantry Gearhies, the sampling plan recommends a minimum of 15 individual mussels of market size (minimum length of 4 cm) be collected (CEFAS[3], European Commission[4]) on a monthly basis year-round.

This report endeavours to document and quantify all known sources of pollution entering the Bantry Gearhies east and west BMPAs. The 2016-2021 WFD ecological status was High for river water bodies discharging into these two BMPAs with the exception of Bantry_010 which was of Good status, and the Outer Bantry Bay coastal water body was assigned High status.

The Mealagh River sub-basin drains 61.7% of the contributing catchment and flows through land dominated by pastures and land principally occupied by agriculture. The sub-basin primarily occurs in the Mealagh Electoral Division (ED) which has the third highest calculated population and the highest calculated density of sheep, dairy cows, and other cows. The Mealagh River also flows through and discharges from Bantry Urban ED which has the highest calculated population and contains Bantry town, the only town within the contributing catchment. Therefore, the Mealagh River water body and its tributaries are expected to channel diffuse agricultural pollutants, along with domestic and urban wastewater contamination, into the bay, particularly during periods of high rainfall as many of the streams in this region are spate. However, it should be noted that results from the bacteriological survey did not corroborate this assumption. Within the Fahane_010 and Bantry_010 sub-basins, bacteriological samples returned high levels of pollution from some streams sampled within these sub-basins. While these sub-basins combined drain a lesser proportion (36.2%), these river sub-basins flow over agricultural land and the Fahane_010 water body discharges directly into the DSW and licensed mussel sites at Bantry Gearhies.

Furthermore, there may be seasonal differences in contamination levels. For example, increased numbers of lambs within the contributing catchment are expected during the spring/summer seasons, and the Bantry Gearhies contributing catchment has higher sheep densities compared to the national average for Ireland. Additionally, Met Éireann rainfall data show higher volumes of rainfall from October to January; both of the aforementioned may result in increased *E. coli* levels.

As a result of this sanitary survey, two Representative Monitoring Points (RMPs) have been designated across the Bantry Gearhies production areas, one RMP in the east BMPA (RMP 1 east) and one RMP in the west BMPA (RMP 1 west) (**Figure 6-1**). RMP 1 east is located on the eastern side of licensed site T05/433 in order to capture potential *E. coli* pollution discharging into Bantry Bay from sources upstream of this site. RMP 1 west has been placed on the eastern side of licensed site T05/430A due to the hydrodynamics surrounding the Bantry Gearhies production areas. The cluster of contamination sources to the northeast of this site will be accounted for by RMP 1 west. The RMP locations for monitoring *E. coli* levels in blue mussel have been chosen based on the hydrodynamics of Bantry Gearhies production areas, the freshwater influence, and the results of the

bacteriological and shoreline surveys. Currently, there are no RMPs on the shellfish sites in either Bantry Gearhies east or west BMPA.

2. Introduction

Consumption of raw or lightly cooked bivalve molluscs can result in illness due to the presence of microorganisms, many of which are derived from faecal contamination of the marine environment. Shellfish contaminated with pathogenic microorganisms may cause infectious disease in humans and such outbreaks are more likely to occur close to our coasts where production areas are impacted by sources of human and animal faecal contamination; referred to as pollution for the purposes of this report. The risk of contamination of bivalve molluscs with pathogenic microorganisms is assessed through national microbiological monitoring programmes. This assessment results in the classification of bivalve mollusc production areas (BMPAs), which in turn governs the level of treatment required for the shellfish before human consumption.

Under European Union (EU) regulations, sanitary surveys of bivalve mollusc production areas and their associated hydrological catchments and coastal waters are required to establish the appropriate Representative Monitoring Point(s) (RMPs) for these monitoring programmes. Specifically, under Regulation (EU) 2017/625 and its subsequent Implementing Regulation (EU) 2019/627, there is a requirement to carry out a sanitary survey before classifying any shellfish production or relaying area. Article 56 of Implementing Regulation 627 of 2019 states:

1. before classifying a production or relaying area, the competent authorities shall carry out a sanitary survey that includes:
    a. an inventory of the sources of pollution of human or animal origin likely to be a source of contamination for the production area.
    b. an examination of the quantities of organic pollutants released during the different periods of the year, according to the seasonal variations of human and animal populations in the catchment area, rainfall readings, wastewater treatment, *etc*.
    c. determination of the characteristics of the circulation of pollutants by virtue of current patterns, bathymetry, and the tidal cycle in the production area.
2. the competent authorities shall carry out a sanitary survey fulfilling the requirements set out in paragraph one in all classified production and relaying areas, unless carried out previously.
3. the competent authorities may be assisted by other official bodies or food business operators under conditions established by the competent authorities in relation to the performance of this survey.

In addition, Article 57 of the same regulation requires competent authorities to establish a monitoring programme for live BMPAs that is based on an examination of the sanitary survey described above. Currently, the Sea Fisheries Protection Agency (SFPA) in conjunction with AQUAFACT are conducting sanitary surveys for new BMPAs and for those existing classified production areas which were previously not surveyed. This report

contains the documents relevant to the sanitary survey of the BMPAs at Gearhies, in Bantry Bay, County Cork; herein referred to as Bantry Gearhies east and west. It identifies the RMPs and supporting sampling plan for mussels in Bantry Gearhies east and west production areas. It also sets out the boundaries of the BMPAs in the bay.

3. Overview of the Fishery/Production Area

3.1. Description of the Area

Bantry Gearhies is situated along the south-western coast of Ireland (see **Figure 3-1**) within Bantry Bay. Bantry Bay is a drowned river valley approximately 39 km in length and ranging from 3 km wide at the eastern end to 22 km wide at the mouth of the bay[5]. The bay contains Whiddy, Bere, and Dursey Islands, three of the largest inhabited islands in Ireland[6]. Bantry Bay is sheltered with relatively low current speeds (0.0 – 0.2 ms^{-1}) and low residual currents (**endnote 7**; RPS, 2015; AQUAFACT, 2024 *unpubl.*). The inner bay is gently sloping and is dominated by soft sediment and fine-grained sandy mud, bounded by steep sides of bedrock along the perimeter (Plets *et al*., 2015). Additionally, there are areas of seagrass, kelp beds, and maërl beds[8] (Emblow *et al*., 1994). Bantry Bay is influenced by the gulf stream and has the highest mean temperatures globally at its latitude[9]. Surrounding areas contribute some of the highest recorded rainfall in Ireland, characterised by short spate streams and rivers which rise and fall with the rainfall[9].

Figure 3-1: Location of Bantry Gearhies bivalve mollusc production areas in Bantry Bay, Co. Cork.

The BMPAs for Bantry Gearhies east and west have been defined by the SFPA in conjunction with the Castletownbere Port Office (**Figure 3-2**). Two separate BMPAs, namely Bantry Gearhies east and Bantry Gearhies west, have been determined in order to exclude an area into which there are outfalls with high *E.*

coli levels discharging (see **section 7.2** for details on these outfalls; **Figure 7-35** map ID 20-22); the coordinates for the two BMPAs are detailed in **Table 3.1**.

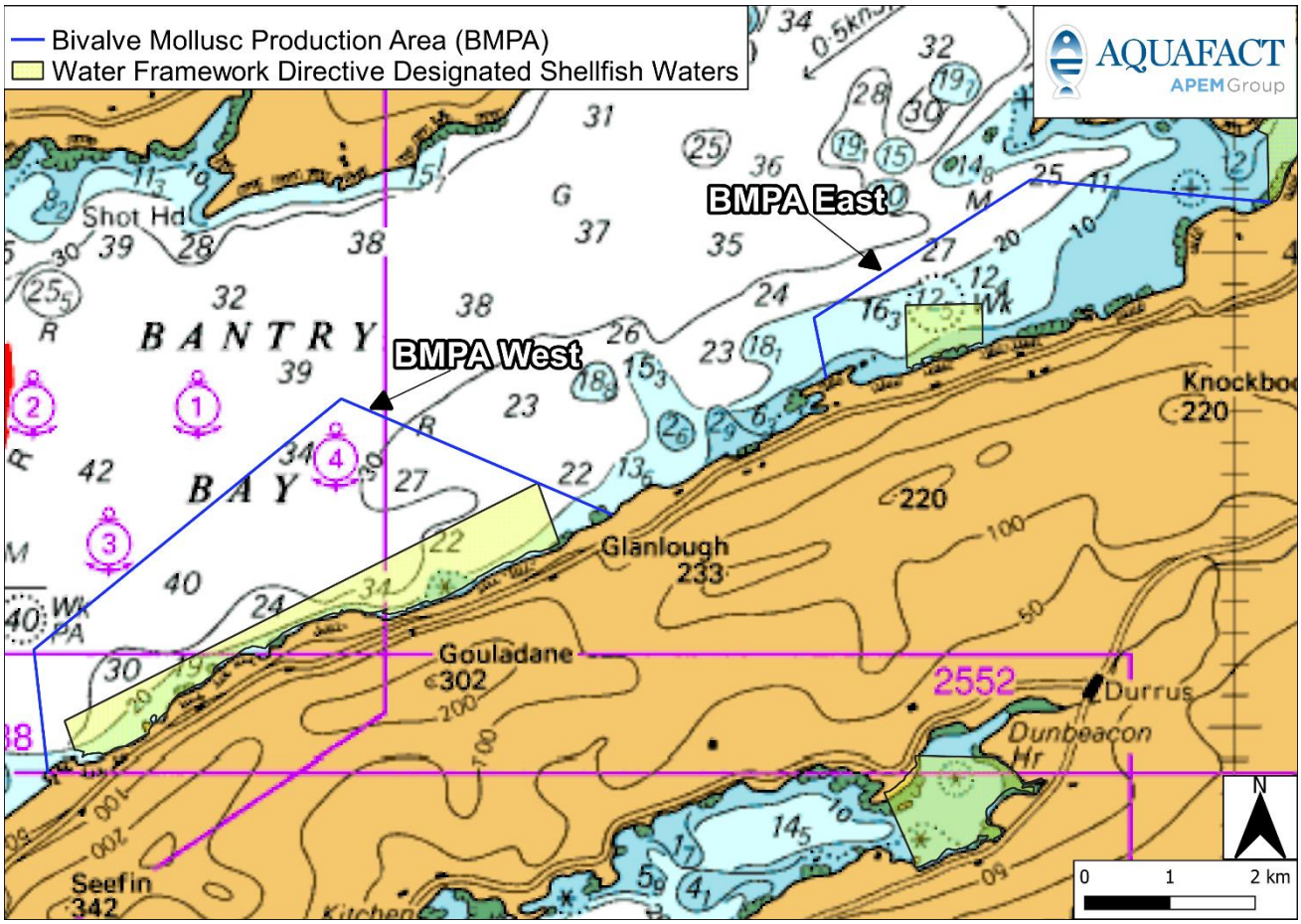


Figure 3-2: Bantry Gearhies bivalve mollusc production areas (BMPAs) east and west in Bantry Bay, Co. Cork.

Table 3.1: Bivalve mollusc production area (BMPA) boundaries for Bantry Gearhies west and east production areas.

	Latitude	Longitude
Bantry Gearhies west BMPA		
1	51.63906	-9.60602
2	51.62467	-9.70300
3	51.65100	-9.65100
4	51.63843	-9.60837
Bantry Gearhies east BMPA		
1	51.65411	-9.56934
2	51.65950	-9.57100
3	51.67400	-9.53433
4	51.67177	-9.49531

Two sub-catchments within the Dunmanus-Bantry Kenmare Water Framework Directive (WFD) catchment contribute to Bantry Gearhies, mainly the Mealagh_SC_010 sub-catchment and partially the Fahane_SC_010 sub-catchment. While other WFD sub-catchments slightly overlap with the contributing catchment boundary, they are not considered here as they provide no hydrological route by which faecal contamination could enter the Bantry Gearhies BMPAs. It is also necessary to note that the WFD catchments and sub-catchments were

established for hydrological purposes and not bacteriological, which is what is required for this sanitary survey. Bantry Gearhies contributing catchment has been determined accordingly by amending the boundaries of the WFD sub-catchments for the purposes of this sanitary survey report only. AQUAFACT has determined a boundary line based on the river water bodies within these sub-catchments that flow into Bantry Bay near Bantry Gearhies BMPAs and simultaneously the Designated Shellfish Waters (DSW) within this bay (see **Figure 3-3** for sub-catchments and boundary line). According to Article 2(10) of Directive 2000/60/EC a "body of surface water means a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water." As rivers are defined under the same directive as mainly being on the surface, a river water body can therefore be described based on the definition of a "body of surface water". The area within this boundary line will be hereafter referred to as Bantry Gearhies contributing catchment/the contributing catchment.

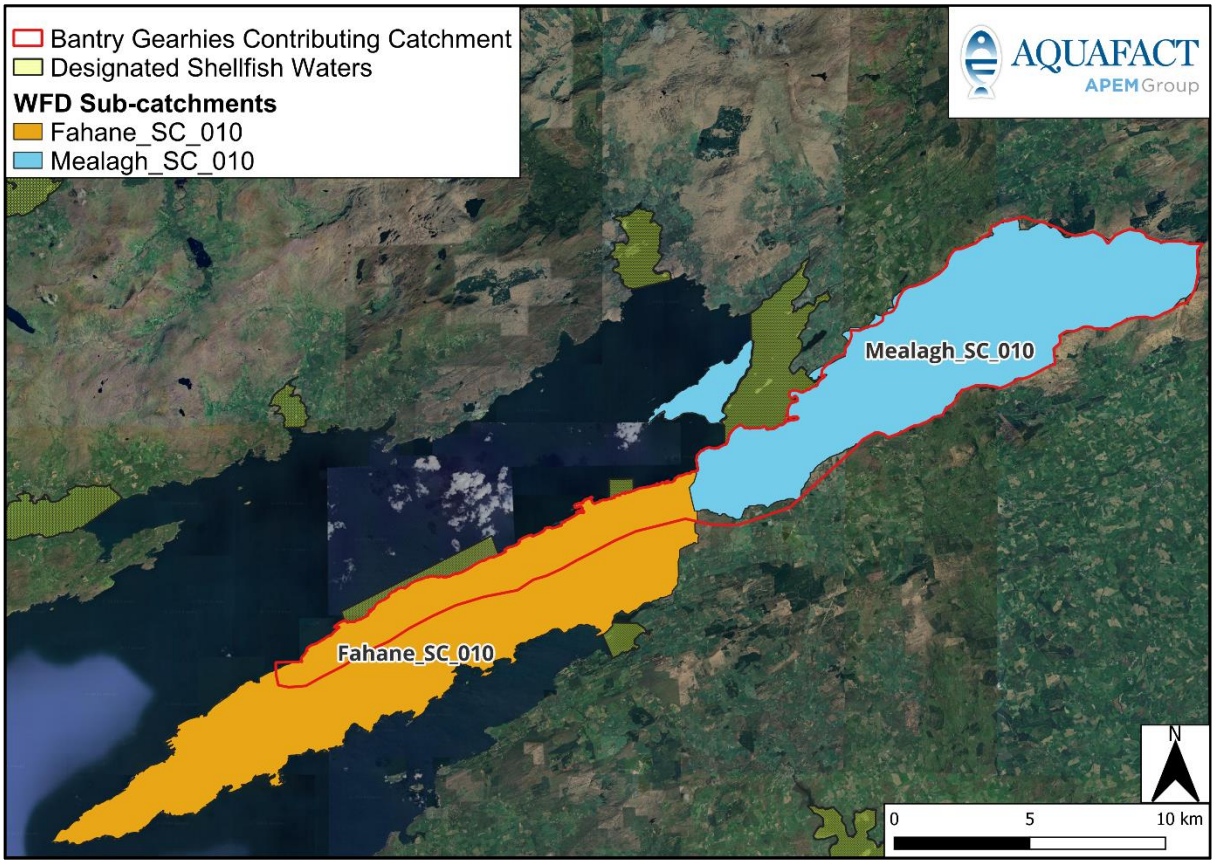


Figure 3-3: Water Framework Directive (WFD) sub-catchments that contribute to the designated shellfish waters and Bantry Gearhies east and west bivalve mollusc production areas; Bantry Gearhies contributing catchment is outlined in red.

The land within Bantry Gearhies contributing catchment features mountainous regions with parallel ridges running through the Sheep's Head Peninsula to the sea (northeast to southwest) dominated by peatlands with blanket bog and heath. The remaining terrain includes valleys, old oak woodlands, alluvial forests, glens, hills, rivers, and peat bogs[6]. Late Devonian and Early Carboniferous sandstone and mudstone compose the bedrock in the area (Pracht & Sleeman, 2002). Sandstone is generally permeable, and formations in the region are

characterised by fine-grained sandstone interbedded with siltstone and mudstone (Pracht & Sleeman, 2002); permeability is reduced in fine-grained sandstones. The Bantry Fault runs across the bay adjacent to the southern coastline. Drumlins are features of the area from the final stages of the last glacial period during the Late Pleistocene, some of which have since been covered by water in the bay (MacCarthy, 2002; Pracht & Sleeman, 2002.

Bantry Gearhies east and west BMPAs do not overlap with any Special Areas of Conservation (SACs) or Special Protection Areas (SPAs). Although, as the Beara Peninsula SPA (004155) and Sheep's Head to Toe Head SPA (004156)[10] are located closely to the Bantry Gearhies BMPAs, they could be a potential source of faecal contamination and will be assessed as such. These sites have been designated for the presence of a number of important bird species under Annex I of the Birds Directive[10].

The Corine land cover within Bantry Gearhies contributing catchment is marginally dominated by pastures (30%), with a mixture of moors and heathlands (23%) and land principally occupied by agriculture, with significant areas of natural vegetation (23%) also covering a similar area. Peat bogs, coniferous forests, and transitional woodland/shrub comprise the land cover to a lesser extent. A small percentage of land cover in the Bantry Gearhies contributing catchment consists of discontinuous urban fabric, broad-leaved forests, mixed forests, sea and ocean, and sports and leisure facilities (**Figure 7-8**).

3.2. Bantry Gearhies Shellfish Fisheries

3.2.1. Location/Extent of Growing/Harvesting Area

Bantry Gearhies does not currently have any classified BMPAs. The licensed shellfish sites at Bantry Gearhies east and west overlap with the Bantry Bay South and League Point DSW (**Figure 3-4**). **Figure 3-4** shows the locations of the current licensed aquaculture sites within Bantry Gearhies BMPAs. Site T05/430A (lilac; **Figure 3-5**) is licensed for blue mussel (*Mytilus edulis*) with a total area of *c*. 0.2419 km^2 (24.19 ha). Site T05/433 (orange; **Figure 3-5**) is licensed for blue mussel with a total area of *c.* 0.1279 km^2 (12.79 ha). Site T05/495A-N (dark green; **Figure 3-5**) is licensed for blue mussel with a total area of *c.* 0.188 km^2 (18.801 ha). Site T05/498A (green; **Figure 3-4**) is licensed for Pacific oyster (*Magallana gigas*[2]; formerly *Crassostrea gigas*) with a total area of *c.* 0.128 km^2 (12.79 ha). Site T05/408 (yellow; **Figure 3-5**) is licensed for blue mussel with a total area of *c.* 0.1747 km^2 (17.47 ha). Site T05/314/2 (purple; see **Figure 3-4** map insert) is licensed for turbot (*Scophthalmus maximus*) and stony sea urchin (*Paracentrotus lividus*) with a total area of *c.* 0.0022 km ^{2}. Site T05-122 is licensed for Atlantic salmon (*Salmo salar*) with a total area of 0.0691 km^2 (6.91 ha). Site T05-122A is licensed for Atlantic salmon with a total area of *c.* 0.0637 km^2 (6.37 ha). Site T05-547A is licensed for seaweed (brown, green, and red seaweed, dulse, North European Kelp (*Laminaria digitata* and *Laminaria hyperborea*) with a total area of *c.* 0.0599 km^2 (5.99 ha).

It is of note that the following licensed shellfish sites fall outside of the DSW: T05-498A, T05-433, and T05-495A-N. While the T05-498A site is licensed for Pacific oyster, there was no active production at this site at the time of writing this report and the site has been inactive for several years. Therefore, only the licensed mussel sites have been considered in this report (**Figure 3-5**).

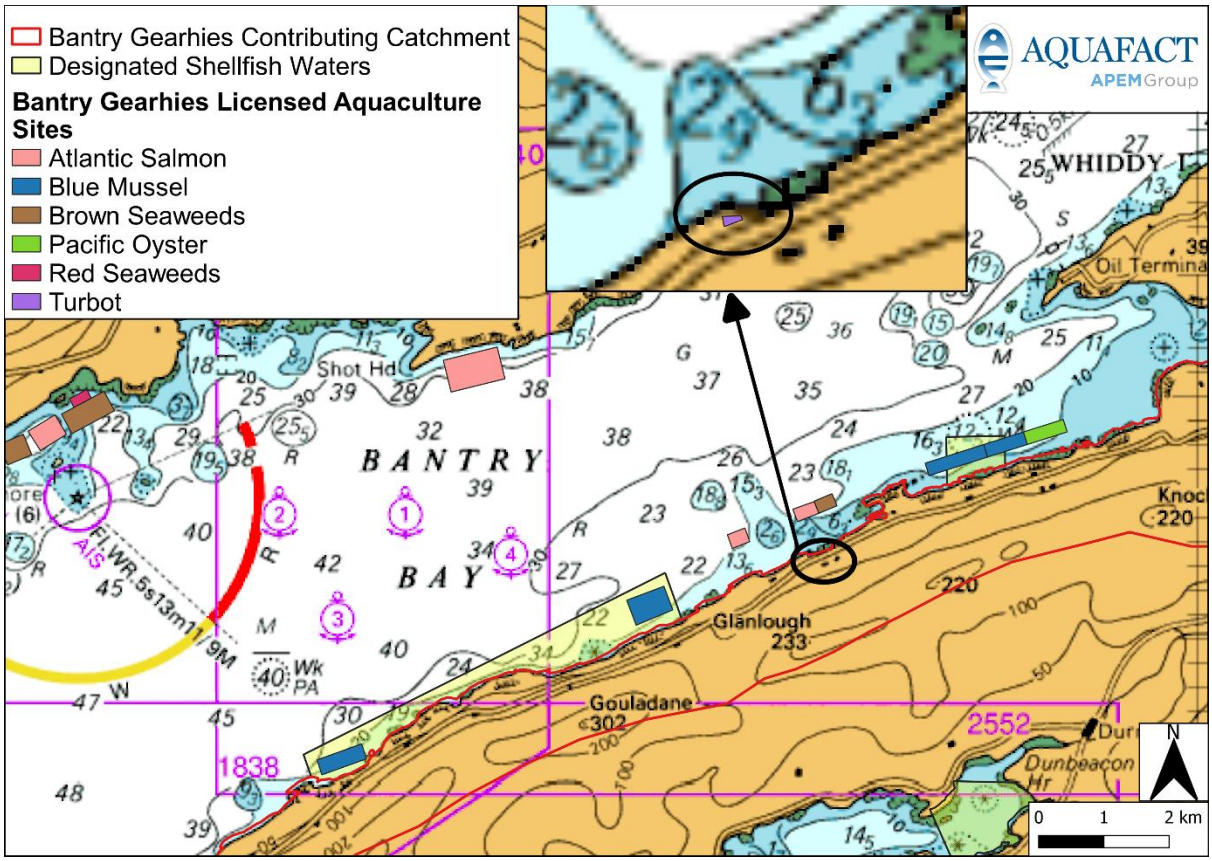


Figure 3-4: Licensed aquaculture sites in the vicinity of the Bantry Gearhies east and west bivalve mollusc production areas (source: Ireland's Marine Atlas[11]).

3.2.2. Description of Bivalve Species

3.2.2.1. Mussels (*Mytilus edulis*)

Distribution

Figure 3-5 shows the locations of licensed mussel sites which occur in Bantry Gearhies east and west production areas which combined cover an area of *c.* 0.7325 km^2.

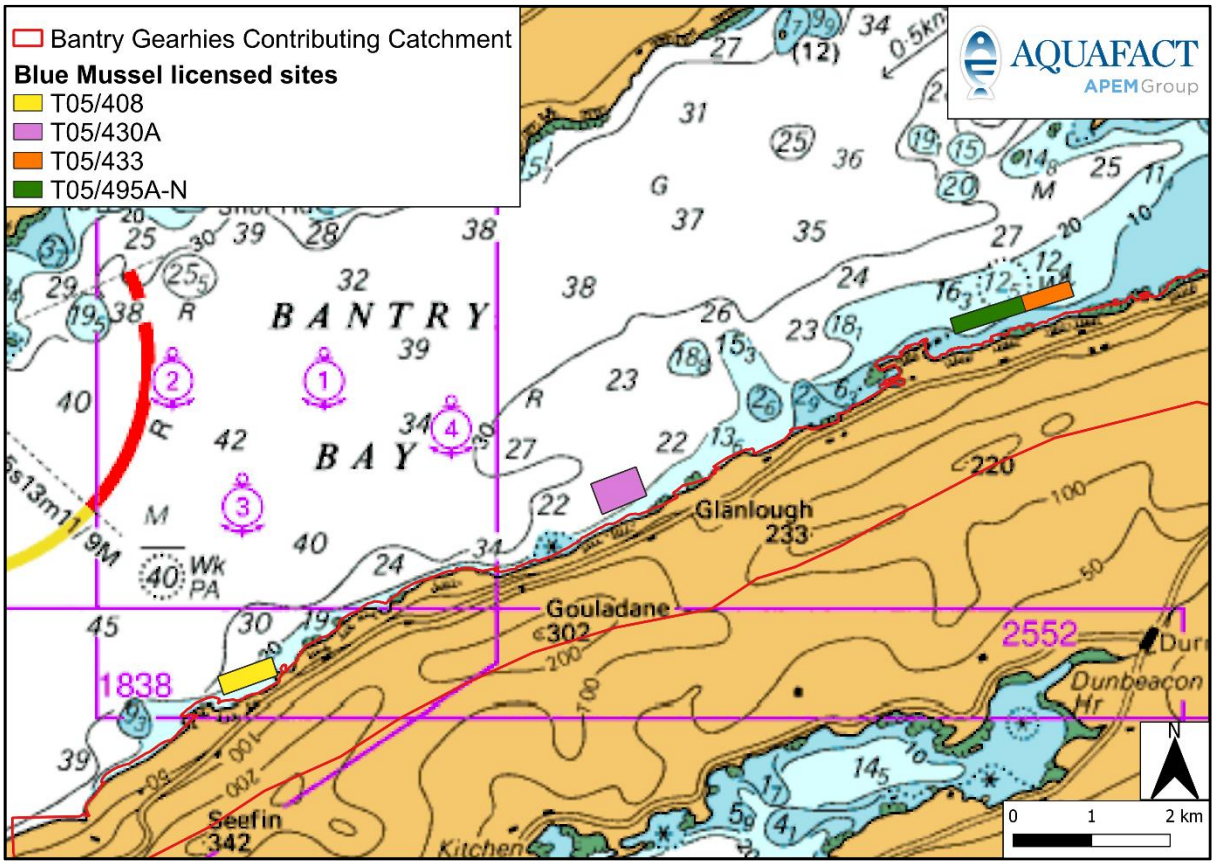


Figure 3-5: Blue mussel (*Mytilus edulis*) licensed sites in the Bantry Gearhies east and west bivalve mollusc production areas (source: Department of Agriculture, Food and the Marine).

Aquaculture and/or Fishery Operations

In Bantry Bay, rope grown blue mussel production is the second most important aquaculture after salmon farming[12]. Bantry Bay was the first substantial attempt at rope-culture mussel farming in Ireland in the late 1970s. The collection of mussel spat is via rope or string suspended on the line. They are placed out during spawning season (April and May) to capture spat settling from the plankton community[12; 5]).

The producers of these mussel sites are intending to commence production in the near future. The harvesting of commercially sized mussels is planned to be seasonal, using longlines.

4. Overall Assessment of Pollution Sources Likely to be a Source of Contamination on Shellfish

This section endeavours to summarise the potential pollution sources impacting Bantry Gearhies production areas and the associated DSW; in the context of this report, pollution refers to *Escherichia coli* contamination only. For that reason, details on the local human population, boating activities, and sewage discharges are provided. Agricultural operations as potential contamination sources, the contributions of rivers and streams, and how contaminants move throughout the DSW and Bantry Gearhies production areas based on currents,

tidal data, and the bathymetry of Bantry Bay are also discussed. Additional potential pollution sources including changes in tourism numbers and activities, yearly variations in agricultural practices, and seasonal precipitation are detailed. Notably, this section incorporates a detailed inventory of pollution sources observed during the shoreline survey, complemented by a discussion on the bacteriological sampling results acquired concurrently. Details of SPAs and SACs in the vicinity of the bay are also provided.

4.1. Human population

Bantry Gearhies contributing catchment has a population of *c.* 5,042 people, which equates to a population density of *c.* 90 people per km^2. Bantry town is the only town/urban area within the contributing catchment and has a population of 2,929[13]**.** The population density of the overall contributing catchment is high in comparison to the population density of the State (73 people per km^2)[13]. Based on the 2022 census, 2,537 households were estimated to be within the contributing catchment, of which 11.4% were vacant and 7.1% were holiday homes.

4.2. Boating

There were three piers, two ports, and eight potential slipways noted during the desktop survey. The shoreline survey validated four of these; two piers (map IDs 54 and 56; **Figure 7-20**), one slip (map ID 64; **Figure 7-20**), and one jetty were confirmed by the shoreline survey (map ID 65; **Figure 7-20**). **Section 4.9** details all of the shoreline survey observations.

4.3. Sewage Discharges

There is one WWTP in Bantry Gearhies contributing catchment. The Bantry WWTP is currently operating under capacity at a Population Equivalent (PE) of 4,053, and, according to the 2022 Annual Environmental Report (AER) for Bantry, is not anticipated to exceed capacity in the coming years. Uisce Éireann (2022) notes Bantry WWTP to be very efficient at removing pollutants, and a monitoring point downstream of the discharge location shows no negative impacts to the water quality of the DSW. Majority (*c.* 60.1%) of the private permanent households within the contributing catchment are on the public system and a further *c.* 37.6% have their own septic tank. Very few (0.5%) households are reported to have no sewage facilities[14].

Of the five storm water overflows noted in the 2022 Bantry AER, three were to be confirmed by Uisce Éireann and only two were noted as being monitored by Uisce Éireann. While these storm water overflows did not meet the criteria of the Department of Housing, Local Government and Heritage (formerly Department of Environment, Housing and Local Government), they were all considered to have a low significance.

One Integrated Pollution Control (IPC) licence, located on Whiddy Island, discharges into the Bantry Gearhies production areas and DSW with storm water, wastewater, and groundwater emissions. However, measures are in place to treat these emissions before they are discharged. Six Section 4 discharges with emissions to water are located within the contributing catchment.

The shoreline survey revealed a number of potential *E. coli* inputs via three outflows, 15 drains, 12 pipes, five run-off points, 28 streams, one culvert/stream, one river, and one brackish lake (*i.e.*, Kilmore Lake) (**Figure 7-35**). Water quality of river water bodies within the contributing catchment was of High status during the 2016-2021 monitoring period, except for the Bantry_010 River water body which was of Good status according to the EPA[15] (**Figure 8-3**). This coincides with the findings of the shoreline survey where all streams/rivers, where noted, were reported as running clear, with the exception of one stream that had foam present (map ID 1; **Figure 7-35**).

4.4. Agricultural Sources

Agricultural land (*i.e.*, pastures; 30%, and land principally occupied by agriculture with significant areas of natural vegetation; 23%) accounts for 53% of Bantry Gearhies contributing catchment. Both of these agricultural land use types dominate the coastline of Bantry Gearhies contributing catchment and are therefore in close proximity to the licensed mussel sites. Observations from the shoreline survey corroborate this categorisation. A mixture of moors and heathlands cover 23% of the contributing catchment.

According to the Census of Agriculture 2022, there are 7,229 cattle in the Electoral Divisions (EDs) that overlap with the contributing catchment, with the highest number of cattle occurring in the Bantry Rural/Whiddy ED (2,159). The density of cattle in the contributing catchment (1.29 cattle/ha) is greater than the minimum set to qualify for the Common Agricultural Policy (CAP) scheme and that is outlined in the EU Regulation No.1166/2008 regarding the 2016 Farm Structure Survey. These values range from 0.4 livestock units/ha (LSU/ha) of farmland to one livestock unit/ha, depending on the age and type of bovine animal (DAFM[16]). There are 7,723 sheep in the contributing catchment, with the highest number of sheep occurring in the Mealagh ED (2,778). The stocking density of sheep in the contributing catchment (*c.* 1.38 sheep/ha farmland) is higher than 1.12 LSU/ha, the average total stocking density for sheep in 2022 (Teagasc, 2023).

4.5. Rivers and Streams

The Mealagh River sub-basins combined drain the majority of the contributing catchment at *c*. 61.7%. Though the Fahane_010 and Glanroon_010 River sub-basins drain the least amount of the contributing catchment, they are not to be overlooked as they discharge directly into the DSW and licensed mussel sites in Bantry Gearhies east and west BMPAs. Additionally, the Fahane_010 and Glanroon_010 River sub-basins overlap with

land principally occupied with agriculture with significant areas of natural vegetation, and the highest concentration of Section 4 discharges are located along the coastline of these river sub-basins.

4.6. Movement of Contaminants

According to hydrodynamic modelling data, the tidal current flows in an almost linear manner, northeast to southwest, over the Bantry Gearhies east and west production areas (AQUAFACT, 2024 *unpubl.*). Additionally, the prevailing wind direction comes from the southwest (**section 8.4**). Simulated tidal currents were found to be generally low (0.0-0.2 m/s), with mean current speeds on spring tides higher than neaps ([7]; AQUAFACT, 2024 *unpubl.*). Residence time for the whole of Bantry Bay was estimated to be 10.4 days, and 7.7 days for inner Bantry Bay (Dabrowski *et al.*, 2016), both of which give an indication as to the length of time water particles may be present in Bantry Gearhies production areas. While no data on river flow or volume were available at the time of writing, an estimate of area drained by the rivers in the contributing catchment was made at *c*. 90.57 km^2 (**section 8.5**). Applying these available data, discharges into the Bantry Gearhies production areas via the river networks in the contributing catchment will flow directly over the production areas. Since the current speeds and residence times are low, there is potential for contamination remaining in the water system.

4.7. Wildlife

Bantry Gearhies contributing catchment partially overlaps with Sheep's Head SAC, however as none of the species for which the site is designated are expected to occur in the contributing catchment, this SAC is not likely to add to background *E. coli* levels. The Beara Peninsula SPA is less than 10 km away from the nearest licensed aquaculture site (based on Bere Island being the nearest point of the SPA). Sheep's Head to Toe Head SPA is a terrestrial protected area and supports a wide range of breeding seabirds. The Beara Peninsula SPA is a coastal site and is designated for Chough and Fulmar, but also supports other seabird populations. It can be assumed that while there are no specific bird counts for the Bantry Gearhies BMPAs, that a proportion of these birds visit the production areas for foraging, preening, and other activities (Roycraft *et al*., 2007a). The bird species for which these SPAs are designated are listed in **section 7.1.6.2**; see also **endnote 10**. The bird species for which Sheep's Head to Toe Head SPA is designated are unlikely to visit the shellfish production areas as they are terrestrial birds and, as such, the Bantry Gearhies production areas are not likely to provide a conducive habitat. Fulmar is a gull species protected under Annex I of the Birds Directive and is of special conservation interest for the Beara Peninsula SPA. Gulls and shags, which are supported by both SPAs, and cormorants, which have been noted to use the wider Bantry Bay area, are the only bird species likely to perch on floating mussel longlines in the Bantry Gearhies production areas. The potential use of the longlines by these bird species suggest they may defaecate while present in the area which would add to the *E. coli* levels

in the surrounding water. Other seabird species such as terns and oyster catchers use the wider bay area, some of which are seasonal and may contribute to seasonal fluctuations in *E. coli* (Roycroft *et al*., 2004).

Both harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals have been recorded in Bantry Bay. The Bantry Gearhies east and west BMPAs are approximately 8 km[17] away from Glengarriff Harbour and Woodlands SAC which hosts a large permanent colony of harbour seals, a qualifying interest of this SAC. The area within and around the SAC has been associated with haul-out, breeding, resting, and moulting sites, with a maximum count of 151 in 2003 (Cronin *et al.*, 2004) and up to 365 individuals have since been reported[8]. Otters (*Lutra lutra*) are a qualifying interest for Glengarriff Harbour and Woodlands SAC and are active within the harbour. Bottlenose dolphins (*Tursiops 15runcates*), common porpoise (*Phocoena phocoena*), and common dolphins (*Delphinus delphis*) have been sighted in Bantry Bay which has been noted as an important foraging and nursery grounds for common dolphins (Roycraft *et al*., 2007b).

The bird and mammal populations that visit the site may contribute to the background bacteriological levels within the bay, however, there is no way to specifically determine the *E. coli* contribution from birds and marine mammals around the Bantry Gearhies production areas as this parameter is not routinely measured here. Additionally, as the Bantry Gearhies production areas have no physical boundary separating them from the rest of Bantry Bay, there is no apparent barrier that may deter marine mammals from being present in the production areas.

4.8. Seasonality

In 2019, the southwest region of Ireland received 4.7 million tourists, of which 49% were domestic tourists, and holidaying was the purpose of travel for 73% of overseas tourists[18]. In 2019, Cork received 1.5 million tourists[18] and overall, in Ireland, June to August and October to December were the most popular times to visit[19]. There are four documented tourist attractions/activities located within the contributing catchment: Bere Island Heritage Centre (2,815), Bamboo Park (3,187), Garinish Island (63,027), Bryce House (Garinish Island) (6,261), and Bantry House (25,000); numbers in brackets refer to number of recorded visitors in 2022[20]. In 2021, Garinish Island ranked eighth in the top ten most visited tourist attractions in Cork and ranked 11th in 2022[20]. This substantial number of visitors to a small region may impact contamination levels in the area, especially during periods of increased visitors such as June to August and October to December. Holiday homes account for 7.1% of the contributing catchment, and domestic trips by Irish residents were highest in April to June and July to September[21]. This may indicate an increase in the use of holiday homes over these periods. Based on Garinish Island alone, visitor numbers in the area are reasonably high for a small geographic area, therefore it is likely that there will be a seasonal impact on *E. coli* levels in the shellfish area from tourism. Other tourist attractions in the area include Shanvallybeg Beach, several heritage walks (*e.g.*, Bantry Bay Beicín Loop Walk), Bantry Bay Golf Club, and Goats Path Farm and Pod Park. There are several heritage attractions

such as Kilnaruane Pillar Stone, the Whiddy Island Heritage Trail with views of Oileán Chaisleán na Míol which is also part of the long-distance Sheep's Head Way walking route, several standing stones, a holy well, and burial grounds.

In terms of agriculture, the number of sheep would be expected to be higher in spring/summer when lambs are present. Also, at that time of the year there may be more extensive grazing over agricultural land and consequently bacterial impacts would be more widely spread. The spreading of slurry is restricted by Ireland's Fifth Nitrates Action Programme to applications before October 1st of a given year. Statutory Instrument (S.I.) No. 113/202221 sets out guidelines relating to the environmental conditions that should be avoided when spreading slurry or fertiliser. Particular guidelines are also in place for slurry spreading near watercourses, with recommended buffer strip distances provided, *e.g.*, 20 m from lakes and main river channels. The levels of slurry and soiled water spreading were not available for the land bordering the Bantry Gearhies production areas specifically at the time of writing. 53% of the land in the contributing catchment is comprised of pastures (30%) and agricultural land (23%) and much of this land borders the contributing catchment, so there is a potential risk associated with contamination resulting from slurry spreading if guidelines are not adhered to.

Analysis of rainfall data for the contributing catchment has shown that the highest rainfall occurs in October to January. During this period, faecal contamination may enter the contributing catchment in run-off from the land. The highest bacterial loading from the land is expected to occur in August and September as faecal biomass may accumulate over the dryer period of April to June. As significant rainfall events can occur throughout the year it is not just during the winter months that a risk of increased contamination is present. A seasonal trend was observed over the 30-year period in which summer was the driest and winter was the wettest. The five-year trend from 2018 to 2022 found autumn 2022 was the driest season and winter 2020 was the wettest season, however there were data missing from autumn 2022 (October and November) which has likely skewed the results.

4.9. Shoreline Survey

Inventory of Pollution Sources

In total 74 features were identified (see **Appendix 4**: Shoreline Survey Images), of which there were 28 streams, one river, three outflows, 15 drains, one brackish lake (*i.e.*, Kilmore Lake), five run-off points, 12 pipes, one beach, one culvert/stream, one jetty, one slip, two piers, and six salmon pens at three observation locations which correspond to the two licensed salmon aquaculture sites in Bantry Gearhies. All discharges input directly into the DSW.

Bacteriological Sampling Results

Water sampling was undertaken as part of the shoreline survey over two sampling periods, with a total of 28 water samples taken from 26 locations along the shore of the Bantry Gearhies east and west BMPAs. Currently there are no guideline values for *E. coli* levels in DSW. The combined Mealagh sub-basins were anticipated to have the highest *E. coli* levels as the Mealagh River drains 61.7% of the contributing catchment and it is adjacent to two Section 4 licensed discharges (map IDs 1 and 2; **Figure 7-6**), however Stations 11 and 12 were situated on the Mealagh River and both reported low levels of *E. coli* contamination (<1 and 15 cfu/100 ml, respectively). The highest *E. coli* levels measured were at Station 10 at 6,488 cfu/100 ml (map ID 9; **Figure 9-1**) at an outflow pipe. The next highest *E. coli* level of 2,909 cfu/100 ml was recorded at Station 3 on Shanvallybeg beach at the mouth of Hollyhill River (Hollyhill River is the name denoted by the EPA; note the shoreline survey refer to this river as Shanvally River). Hollyhill River is part of the Bantry_010 sub-basin which drains 17.2% of the contributing catchment, this sub-basin is the only water body within the contributing catchment reported of Good water quality status during the EPA's 2016-2021 monitoring period (**Figure 8-3**); all other water bodies were listed as having High status. Three other streams were sampled within the Bantry_010 sub-basin at Stations 24, 25, and 26, and all reported *E. coli* levels of less than 3 cfu/100 ml (map IDs 24, 25, and 26, respectively; **Figure 9-1**). Nine out of the 28 stations that reported <1 cfu/100 ml of *E. coli* were taken from a variety of natural and anthropogenic sources. Station 1 and 2 were the same feature sampled twice for water quality due to human error over the two survey periods and there was a difference of 63 cfu/100 ml *E. coli* for Station 1 and Station 2 samples between the two sampling periods.

Of the discharges noted during the shoreline survey, 30 out of the 66 were anthropogenic discharges or pipes and as such, the impact due to human activities has the potential to be significant. However, water samples were not taken for all discharge points and due to the potential significance of unidentified discharges, a definitive evaluation cannot be made at this time.

5. Recommended Amendments

As no representative monitoring points (RMPs) or BMPA boundaries were previously assigned to the Bantry Gearhies east and west production areas, there have been no amendments or changes as such, only newly proposed BMPA boundaries and RMPs.

6. Conclusion of the Sanitary Survey

One RMP for each of Bantry Gearhies BMPA east and west is recommended for monitoring *E. coli* levels in mussel samples.

6.1. RMP for Mussels (*Mytilus edulis*)

It is recommended that RMP 1 east be situated on the north-eastern side of site T05/433 within the Bantry Gearhies east BMPA (**Figure 6-1** and **Table 6.1**).

As detailed in **Appendix 2: Hydrography/Hydrodynamics**, the tide flows from a northeast to southwest direction on an ebbing tide. RMP 1 east has been placed so as to capture any *E. coli* contamination emanating from potential sources located northeast of the T05/433 site. While both are licensed and therefore controlled, RMP 1 east should account for any potential contamination from the outflows associated with Bantry WWTP and the IPC discharge on Whiddy Island (**Figure 7-5** and **Figure 7-6**, respectively). Bantry Urban ED encapsulates Bantry town, the only town within the contributing catchment, and has the largest population (**Figure 7-2**) and highest number of heritage sites (**Figure 7-4**) out of all the EDs within the contributing catchment. Additionally, the desktop survey noted a concentration of piers, slipways, and ports around Bantry Harbour and town (**Figure 7-18**). The highest number of farms and livestock were recorded in Bantry Rural/Whiddy ED (**Table 7.7**), and this ED borders the coastline adjacent to the T05/433 site (**Figure 7-2**). The Corine land use type pastures dominates the land type along the coastline next to this mussel site (**Figure 7-7**). Regarding likely routes by which these potential contamination sources can enter the BMPA, the desktop and shoreline surveys have corroborated that there are numerous river entry/discharge points along the coastline to the northeast of and directly adjacent to the T05/433 site (**Figure 7-34**). Regarding site T05/433, most of the rivers discharging nearby are from the Mealagh River sub-basin, which drains the majority of the contributing catchment at 61.7% (**Figure 3-3**). Also, the largest proportion of groundwater with extreme vulnerability status occurs along this land mass (**Figure 7-9**). Finally, two of the three highest water sample results from the bacteriological survey were located just upstream of this mussel site (Stations 2 and 3; **Figure 9-1**). Therefore, RMP 1 east has been located to reflect potential *E. coli* contamination from the aforementioned sources and through the described routes.

Within Bantry Gearhies west BMPA, RMP 1 west is being proposed on site T05/430A (**Figure 6-1** and **Table 6.1**). There are numerous piers, slipways, and ports to the northeast of the T05/430A site, as noted from the desktop survey (**Figure 7-18**). The Corine land use type along the coastline adjacent to this mussel site is mainly land principally occupied by agriculture, with significant areas of natural vegetation (**Figure 7-7**). There are many rivers by which contamination from this landscape and these features could enter the Bantry Gearhies west BMPA (**Figure 7-34**). These rivers are part of the Fahane River sub-basin (**Figure 3-3**). Groundwater vulnerability is categorised as being rock at or near surface or karst with intermittent patches of groundwater with extreme vulnerability status (**Figure 7-9**). The water sample with the highest *E. coli* concentration from the bacteriological survey (6,488 *E. Coli* (MPN/100 ml) from Station 9; **Figure 9-1**) is located upstream of the

T05/430A site, so RMP 1 west has been appropriately placed to record any subsequent high levels of contamination.

While the RMPs have been placed based on the ebbing tide, it is of note that on a spring flood tide current speeds are at their highest (0.20 m/s, **section 8.3**), meaning *E. coli* contamination discharging from the Station 9 water sample location is likely to be carried by the current north-eastwards over the mussel sites in Bantry Gearhies east BMPA, reaching site T05/495A-N first and therefore not being immediately detected by RMP 1 east. However, based on the decay rate of *E. coli* (Martin *et al*., 2023), and hydrodynamic properties in the area, concentrations of this contaminant are likely to have reduced by two orders of magnitude by the time the contamination has reached site T05/495A-N, *i.e.*, reduced from > 6,000 CFU/100 ml to approximately 60 CFU/100 ml. At this much lower concentration, *E. coli* contamination emanating from the Station 9 water sample point is unlikely to have a significant effect on the mussels at this site.

As freshwater is the primary source of contamination, and as freshwater sits on top of seawater due to a density difference, it is necessary to take samples from the RMP within the top one metre of water. RMP 1 east and RMP 1 west have been located on the north-eastern side of sites T05/433 and T05/430A, respectively, to capture the highest levels of contamination, therefore representing the worst-case scenario in terms of *E. coli* levels, as sites further downstream should experience lower levels of contamination due to dilution effects.

6.2. Microbiological Sampling Plan

A minimum of 15 individual blue mussels of market size (minimum 4 cm shellfish length) are required to be sampled monthly[4;22]. Flesh samples should be taken within the top one metre of the water column, and as close to the surface as possible, in order to obtain a representative sample of the *E. coli* levels in the production areas. Flesh samples should be taken within a maximum distance of 100 m from the RMPs[22] (**Table 6.1**). Upon establishment of the classified production areas for blue mussels, and considering that harvesting can potentially take place year-round, monthly sampling will be required throughout the entire year. The SFPA is the competent authority responsible for implementing this plan.

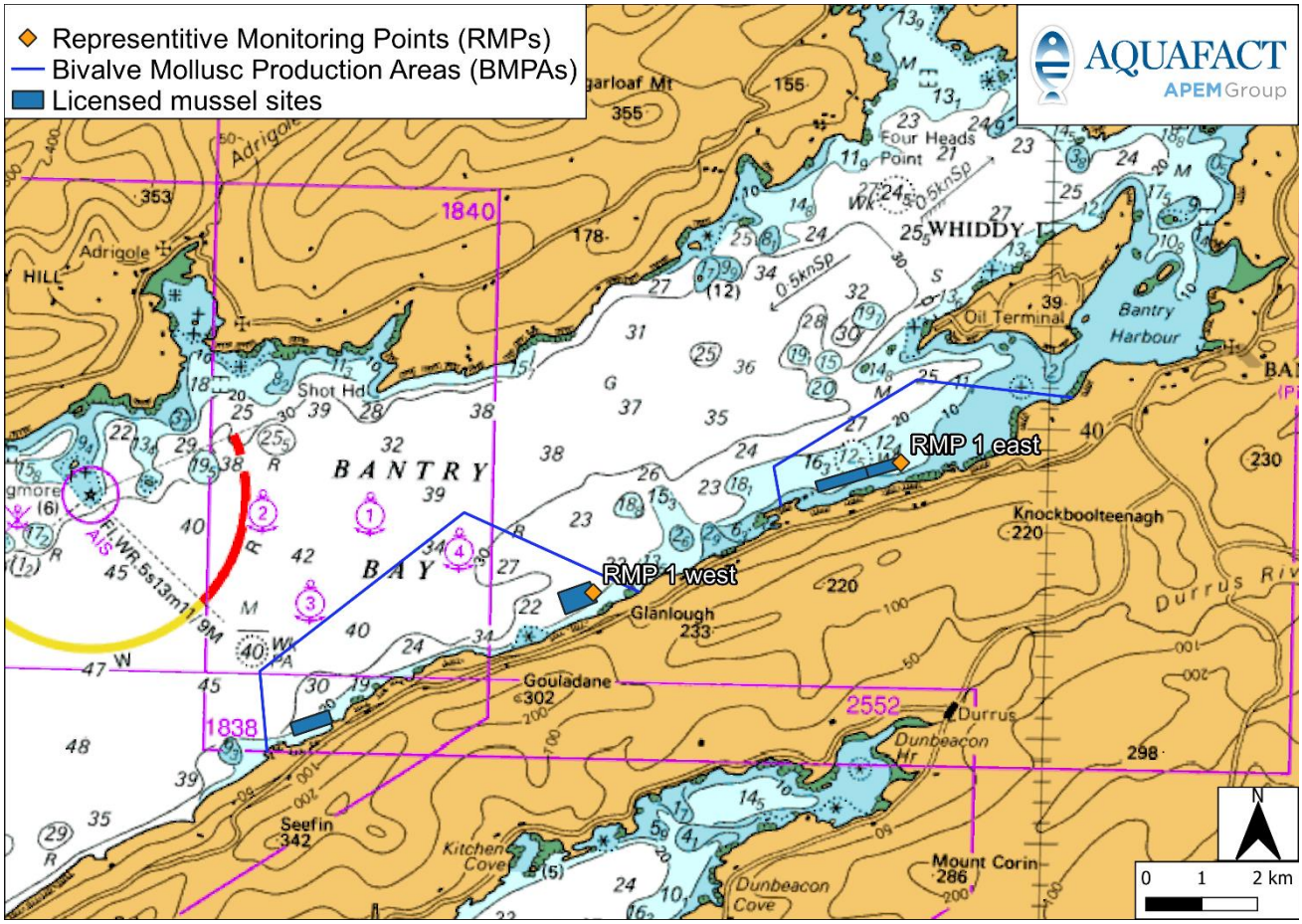


Figure 6-1: Representative Monitoring Points (RMPs) for blue mussel in the Bantry Gearhies bivalve mollusc production areas (BMPAs) east and west.

Table 6.1: Coordinates of the Representative Monitoring Points (RMPs). Note: the coordinate reference system is Irish National Grid (ING).

RMP	Site Code	Species	Latitude	Longitude	Easting	Northing
RMP 1 east	CK-BB-GSE	*Mytilus edulis*	51.6605809	-9.5380699	493570.12	547366.46
RMP 1 west	CK-BB-GSW	*Mytilus edulis*	51.6385763	-9.6170872	488064.93	545192.96

6.3. General Sampling Method

All collection and transport of shellfish samples for *E. coli* testing under the sampling plan identified as part of the Bantry Gearhies Sanitary Survey should adhere to the Code of Practice for the Microbiological Monitoring of BMPAs[22]; the sampling procedure and guidance notes can be found in Appendix 9.2 of that document.

7. Appendix 1: Identification of Pollution Sources

This section documents all pollution sources identified during the desktop and shoreline surveys within Bantry Gearhies contributing catchment; in the context of this report, pollution encompasses *E. coli* contamination only.

7.1. Desktop Survey

Pollution sources were considered within the contributing catchment of Bantry Gearhies (**Figure 7-1**). The contributing catchment covers an area of approximately 56 km^2, *c*. 37.5 km east-west at its longest point and *c*. 5.9 km north-south at its longest point.

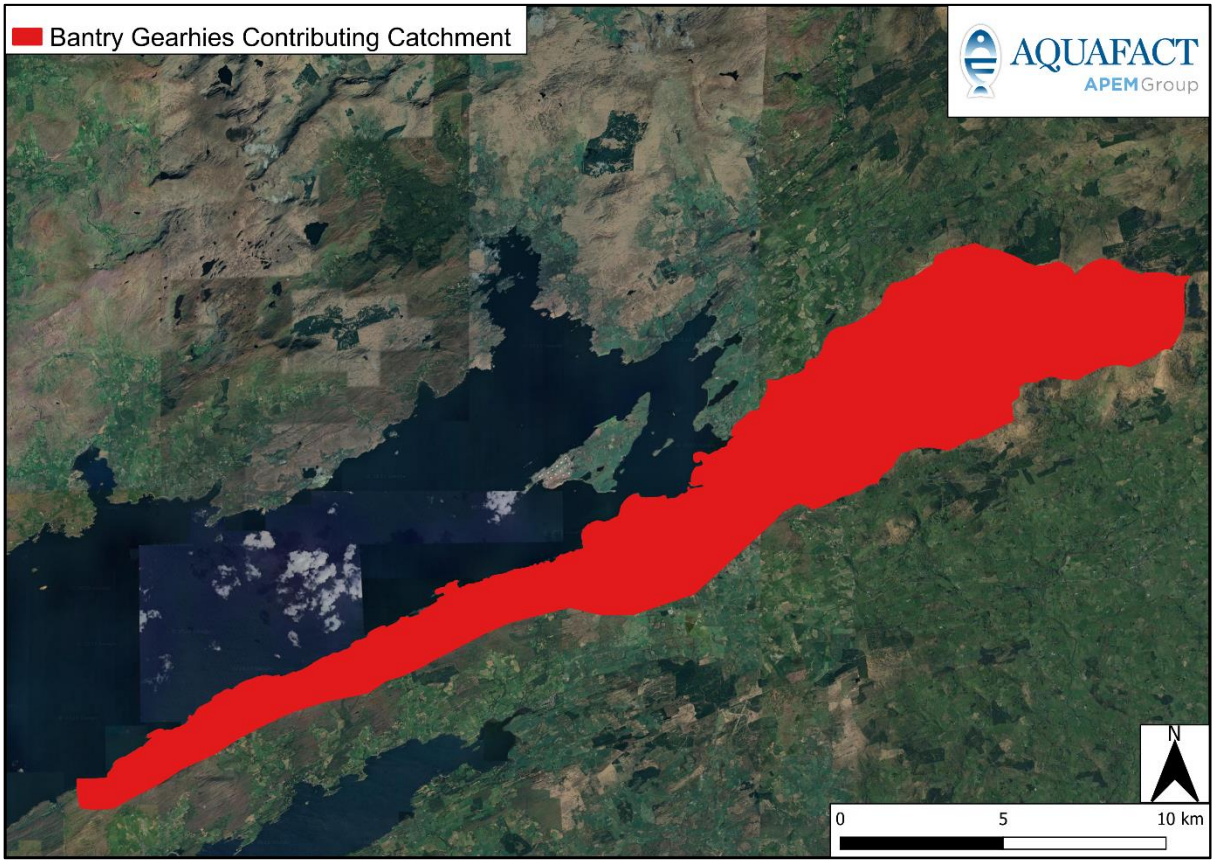


Figure 7-1: Bantry Gearhies contributing catchment established for the assessment of pollution sources into the Bantry Gearhies east and west bivalve mollusc production areas.

7.1.1. Human Population

Population census data used by the Central Statistics Office (CSO) is given in units of EDs; **Figure 7-2** shows the EDs within the contributing catchment. The population data used in this report are from the 2022 census. **Figure 7-3** shows the human population within Bantry Gearhies contributing catchment and **Table 7.1** shows these data in tabular form.

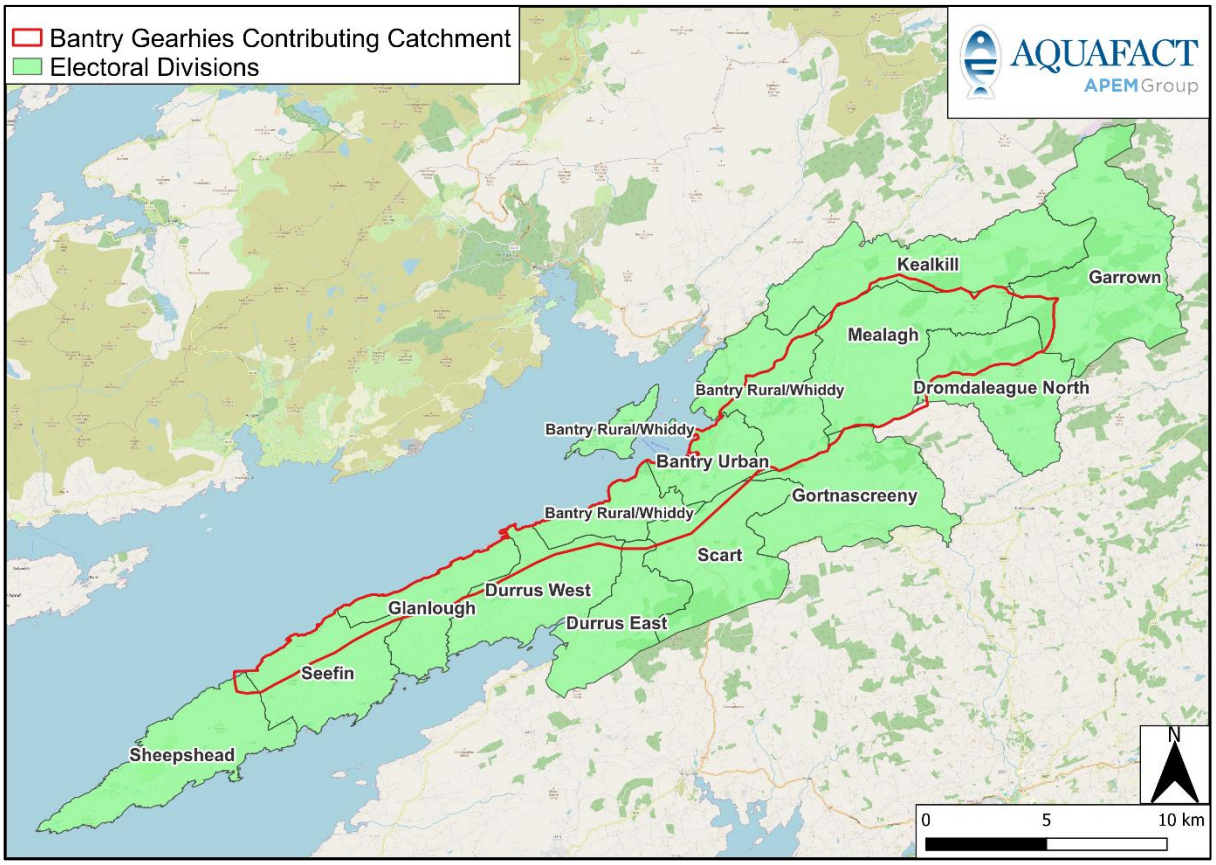


Figure 7-2: Electoral Divisions within Bantry Gearhies contributing catchment.

Bantry Gearhies contributing catchment overlaps 13 EDs (12 partially and Bantry Urban is almost entirely within the contributing catchemnt). The EDs partially within the contributing catchment are Bantry Rural/Whiddy, Dromdaleague North, Durrus East, Durrus West, Garrown, Glanlough, Gortnascreeny, Kealkill, Mealagh, Scart, Sheepshead, and Seefin.

These 13 EDs accommodate a total population of 8,737. As Bantry Urban is the only ED that is completely within the contributing catchment, an effort was made to estimate the actual population within the catchment for the remaining 12 EDs. The geographical area of the 12 EDs overlapping with the contributing catchment was calculated using QGIS software and then converted to a percentage of the overall area (km^2) of the ED using Microsoft Excel. From this value the population size in each ED was calculated, *e.g.*, if 50% of the ED lies within the contributing catchment then 50% of that total population was taken to be the population size of the area within the contributing catchment. Using this method, the population of the contributing catchment is estimated at 5,042 people. Bantry Urban contains the largest population within the contributing catchment (3,349), followed by Bantry Rural/Whiddy (743) and Mealagh (396); **Table 7.1** shows this estimation. There is one town/urban area within the contributing catchment[13]; Bantry town has a population of 2,929[13].

There are 4,486 households in total within the 13 EDs considered here. Of this, 11.4% (510) are vacant and a further 10.7% (478) are holiday homes. Of the 2,537 houses within the contributing catchment (based on % of

the ED within the catchment), 11.4% (288) are vacant and 7.1% (181) are holiday homes. **Table 7.2** shows the number of households in each ED and the proportion within the contributing catchment.

Human population in given areas is obtainable from census data; however, relating this information to the level of microbial contamination in coastal waters is difficult and is constrained by the geographical boundaries used. Nonetheless, it is plausible that areas with a higher population will have higher levels of sewage and wastewater entering the Bantry Gearhies system. Therefore, the highest levels of sewage and waste are expected to enter from the Bantry Urban ED. As holiday homes only account for 7.1% of the dwellings in the contributing catchment they are unlikely to cause a significant increase in the sewage and wastewater levels relative to the permanent population.

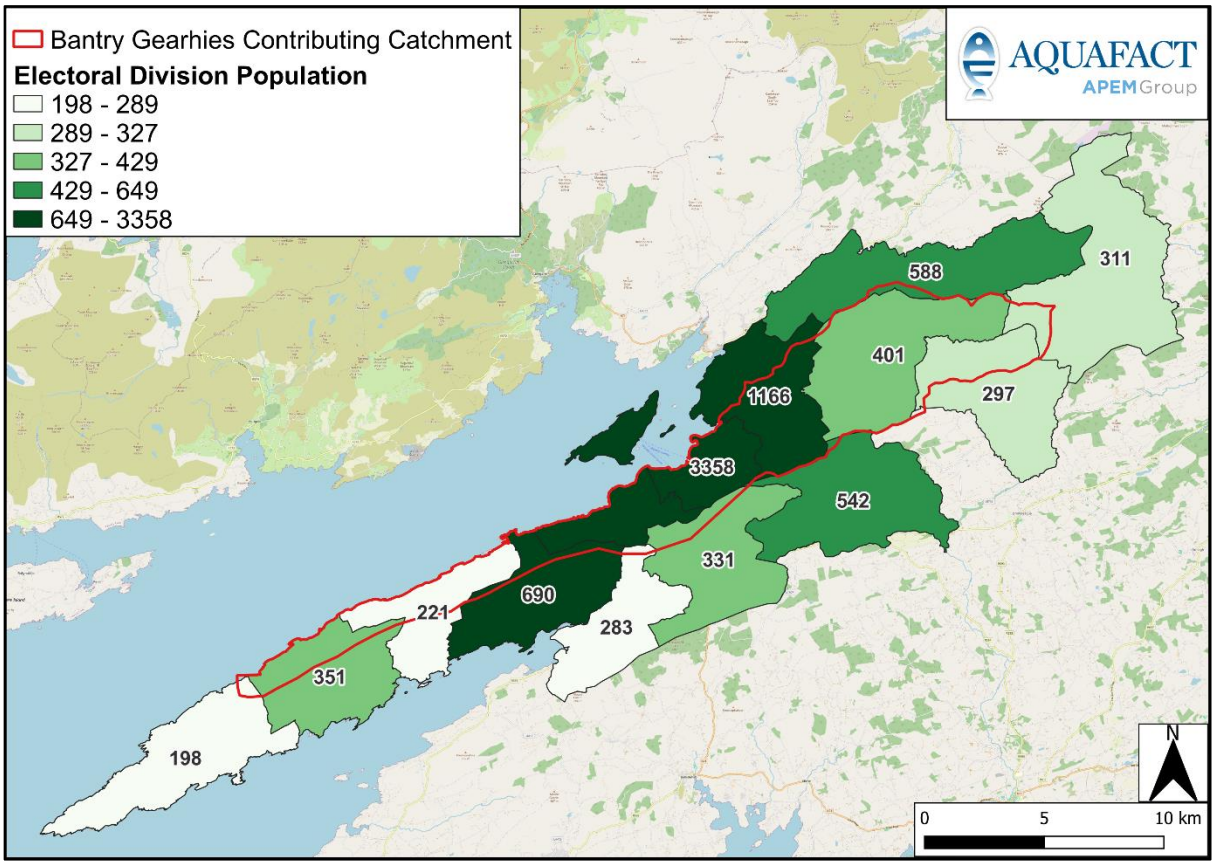


Figure 7-3: Human population per Electoral Division within Bantry Gearhies contributing catchment (source: CSO[13]).

Table 7.1: Human population within Bantry Gearhies contributing catchment (source: CSO[13])

Electoral Division (ED)	Population (2022)	% ED in Catchment	Estimated Population
Bantry Urban	3358	99.72	3349
Durrus East	283	2.49	7
Durrus West	690	16.70	115
Glanlough	221	60.54	134
Mealagh	401	98.77	396
Garrown	311	6.09	19
Scart	331	11.76	39
Seefin	351	31.59	111
Bantry Rural/Whiddy	1166	63.75	743
Kealkill	588	3.12	18
Sheepshead	198	2.14	4
Dromdaleague North	297	34.13	101
Gortnascreeny	542	0.89	5

Table 7.2: Households within the Electoral Divisions in Bantry Gearhies contributing catchment (source: CSO[13]).

Electoral Division	Total Households	No. Occupied*	Unoccupied Holiday homes	Vacant houses	Total Households in Catchment	No. Occupied in Catchment*	Unoccupied holiday homes in	Vacant houses in Catchment
Bantry Urban	1658	1385	70	183	1653	1381	70	182
Durrus East	146	108	28	8	4	3	1	0
Durrus West	420	303	72	43	70	51	12	7
Glanlough	181	96	55	25	110	58	33	15
Mealagh	186	148	12	23	184	146	12	23
Garrown	130	106	9	15	8	6	1	1
Scart	146	114	12	20	17	13	1	2
Seefin	250	144	66	32	79	45	21	10
Bantry Rural/Whiddy	561	446	43	66	358	284	27	42
Kealkill	256	209	17	30	8	7	1	1
Sheepshead	195	88	73	27	4	2	2	1
Dromdaleague North	117	103	1	12	40	35	0	4
Gortnascreeny	240	193	20	26	2	2	0	0

*This figure includes those houses temporarily unoccupied on census night.

7.1.2. Tourism

Data from Fáilte Ireland suggests the southwest region (Cork and Kerry) received 4.7 million tourists in 2019, of which 49% accounted for domestic tourists and of the overseas visitors, 73% were travelling for a holiday[18]. Over the same period, 1.5 million overseas tourists visited County Cork[18]. Of the domestic tourists that visited Cork in 2022, they stayed an average of 2.6 nights[23]. West Cork is a known tourist destination. Attractions include scenic views, adventure routes/trails, angling, Bantry House and Gardens, the Wild Atlantic Way, and leisure sports. North of the bay is the Beara Peninsula and south of the bay is Sheep's Head Peninsula, both of which are popular tourist destinations[6]. Recent years have seen the establishment of kayaking 'Blue Ways' and the rejuvenation of Whiddy Island through the restoration of historic buildings and the opening of a hostel on the island in 2021. Other tourist attractions in the region include several heritage loop walks (*e.g.,* the Bantry Bay Béicín Loop walk, Abbey and Rope Loop, Knocknaveagh and Vaughan's Pass, Donemark Loop, and Lady's Well and Airstrip Loop), Shanvallybeg Beach, Bantry Bay Golf Club, and Goats Path Farm and Pod Park. There are several heritage attractions including Kilnaruane Pillar Stone, standing stones, burial grounds, a holy well, and the Whiddy Island Heritage walk which includes views of Oileán Chaisleán na Míol and is part of the long-distance Sheep's Head Way walking route.

Bere Island Heritage Centre attracted 2,815 visitors, Bamboo Park attracted 3,187 visitors, Garinish Island attracted 63,027 visitors, Bryce House located on Garinish Island attracted 6,261 visitors, and Bantry House attracted 25,000 visitors in 2022 (Fáilte Ireland[20]). For Ireland as a whole in 2019, most tourists visited between June and August (32%), followed by October to December (22%), January to March (19%), and 9% in each of April, May, and September. This trend may vary over the regions of Ireland due to weather conditions, the concentration of attractions in a region, and the popularity of said tourist attractions.

The Bantry Bay Marina opened in 2017 with increased and improved infrastructure, and the ability to house 150 yachts and cruise ships[24]. In 2022, nine cruise ships and 4,563 passengers visited the Port of Bantry[25] which was a decrease from 2019 where 11 cruise ships and 5,429 passengers visited the Port of Bantry[26]. For Ireland as a whole in 2022, the largest number of arrivals by cruise ship and passengers occurred between June to September[25]. Ongoing growth of the cruise sector visiting Cork and the regeneration of Bantry Harbour creates a further prospective market.

No publicly listed beaches were found within the contributing catchment, however a number of potential beaches were noted from the desktop review of the Bantry Gearhies shoreline (**Figure 7-18; Table 7.9**); beaches were listed as being 'potential beaches' where it could not be definitively determined from Google Earth that these areas were in fact beaches.

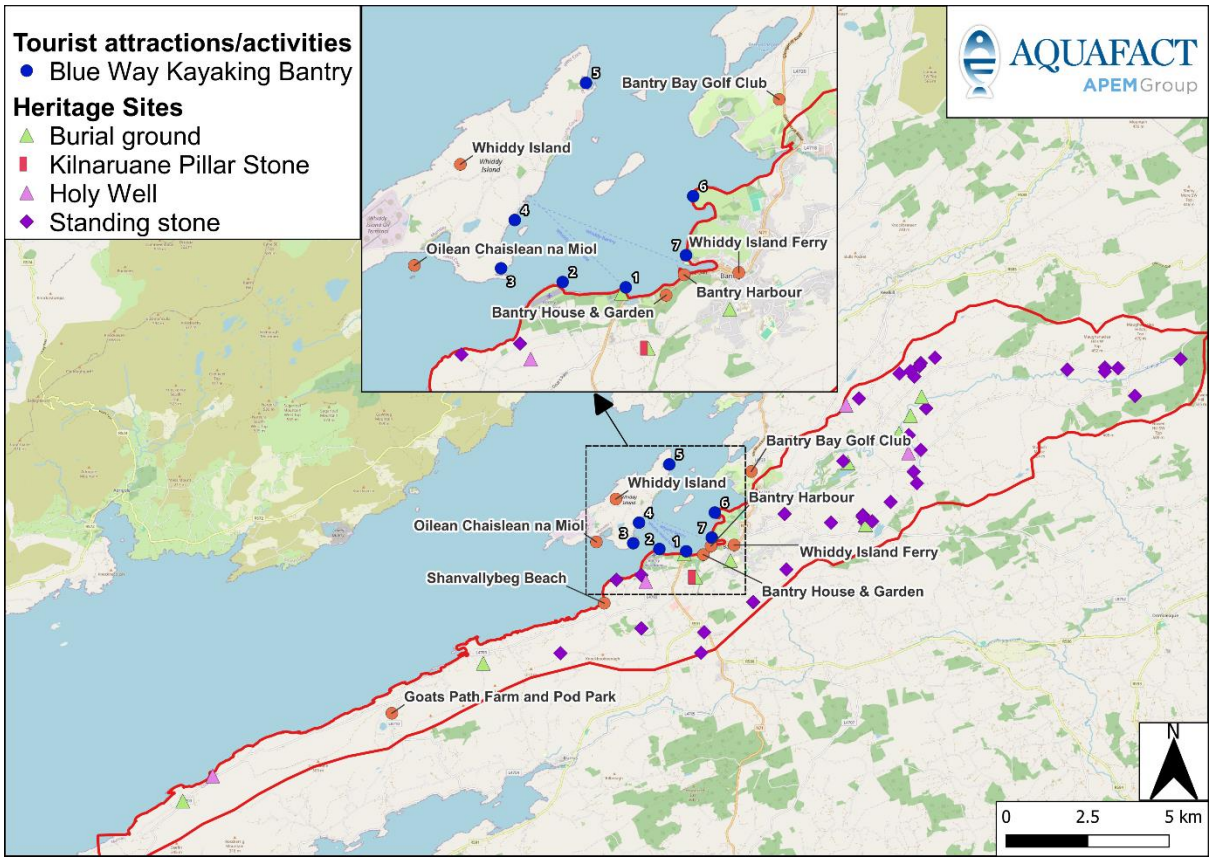


Figure 7-4: Tourist attractions within Bantry Gearhies contributing catchment.

Papadakis *et al.,* (1997) found significant correlations between the number of swimmers present on beaches and the presence of pathogenic bacteria in Greece. In 2007, Elmir *et al.,* showed the role of human skin as an intermediate mechanism of pathogen transmission to the water column. However, as there are no monitored beaches or bathing water locations along the coastline of the Bantry Gearhies east and west production areas, the numbers of swimmers are likely to be low and so will not impact on the bacteriological quality of the bay[27]. Two beaches were identified by the shoreline survey (map IDs 6 and 72; **Figure 7-20**).

7.1.3. Sewage Discharges

Sewage effluent can vary in nature depending on the degree to which the sewage has been treated. Discharges of sewage effluent can arise from a number of different sources and be continuous or intermittent in nature:

- treated effluent from urban sewage treatment plants (continuous).
- storm discharges from urban sewage treatment plants (intermittent).
- effluent from 'package' sewage treatment plants serving small populations (continuous).
- combined sewer and emergency overflows from sewage systems (intermittent).
- septic tanks (intermittent).
- crude sewage discharges at some estuarine and coastal locations (continuous).

Treatment of sewage ranges from:

- none (crude sewage).
- preliminary (screening and/or maceration to remove/disguise solid matter).
- primary (settling to remove suspended solids as sewage sludge). Typically removes 40% of BOD (Biochemical Oxygen Demand), 60% of suspended solids; 17% of nitrogen, and 20% of phosphorus from the untreated sewage.
- secondary (settling and biological treatment to reduce the organic matter content). Typically removes 95% of BOD, 95% of suspended solids, 29% of nitrogen and 35% of phosphorus from the untreated sewage. Nutrient removal steps can be incorporated into secondary treatment which can reduce ammonia – nitrogen down to 5 mg/l and phosphorus to 2 mg/l.
- tertiary (settling, biological treatment, and an effluent polishing step which may involve a reed bed (unlikely for coastal works), or a treatment to reduce the load of microorganisms in the effluent). Typically this treatment removes 100% of BOD, 100% of suspended solids, 33% of nitrogen, and 38% of phosphorus from the untreated sewage.

7.1.3.1. Water Treatment Works

There is one wastewater treatment plant (WWTP) within Bantry Gearhies contributing catchment with a PE of greater than 500, namely the Bantry WWTP (licence registration D0168-01)[28]. **Figure 7-5** shows the location of the Bantry WWTP within the contributing catchment and **Table 7.3** shows the coordinates and capacity of this WWTP. There are no WWTPs serving a PE of less than 500 within the contributing catchment[28].

7.1.3.2. Continuous Discharges

The Bantry WWTP has a design capacity of 6,000 but currently operates under capacity at a PE of 4,053[28]. It is a tertiary treatment facility which means that, after primary and secondary treatment measures, further treatment is conducted to purify the water so that it may be reused (Uisce Éireann, 2022). The Bantry WWTP is designed to have a peak hydraulic (flow) capacity of 4,104 m^3/day and is currently operating at an average hydraulic loading to the WWTP of 2,267 m^3/day (Uisce Éireann, 2022). This WWTP has a dry weather flow (DWF) rate of 1,386 m^3/day (Uisce Éireann, 2022). The capacity of the Bantry WWTP was not anticipated to be exceeded in the following three years after the 2022 AER for Bantry D0168-01 was written. The location of the discharges associated with the Bantry WWTP can be seen in **Figure 7-5**, and **Table 7.3** provides details of the discharges.

According to the 2022 AER for Bantry, the WWTP is compliant with the emission limits set in the wastewater discharge licence (see Uisce Éireann (2022) for details). Though two incidents were reported in 2022, one of which related to an uncontrolled release due to adverse weather; this was not a recurring incident. In

December 2023 another uncontrolled release incident occurred, however it was assessed as having no impact on the environment as the overflow did not discharge into the sea. The Bantry WWTP is reportedly very efficient at removing pollutants since it has a percentage reduction of influent load in excess of 87% (Uisce Éireann, 2022). Additionally, there is a monitoring point associated with the Bantry WWTP downstream of the discharge location which captures that, while the WWTP discharges into DSW, there is no apparent negative impact to the water quality of the DSW.

There are two secondary discharges associated with the Bantry WWTP that fall within the contributing catchment, Bantry Secondary Discharge #1 and #2 as per the Bantry 2022 AER (Uisce Éireann, 2022) (**Figure 7-5**). Secondary Discharge #1 has a combined discharge type and Secondary Discharge #2 has a treated discharge type; both discharges are deemed non-compliant. The constructed peak hydraulic capacity for both secondary discharges is 0 m^3/day, and the DWF rate for both secondary discharges is also 0 m^3/day (Uisce Éireann, 2022). As part of the improvement programme for the Bantry WWTP discharge licence, these two secondary discharges are recommended to be discontinued; the expected completion date of the improvements for Secondary Discharge #1 is after 2024, but Secondary Discharge #2 is not currently funded under the current capital works scheme.

There is no geo-referenced database for septic tanks or on-site domestic wastewater treatment systems available in Ireland. The effectiveness of private treatment systems is unknown. To estimate the numbers of these domestic sewage facilities within the contributing catchment, data on the number of permanent private households and their sewage facilities was sourced from the 2022 census[14]. Of the 3,355 permanent private households in the 13 EDs, 42.2% (1,416) were connected to a public sewerage/treatment system and 55.4% (1,857) had septic tanks or other individual treatment systems. A further 1.9% (65) had another treatment system or the treatment system was not stated, and 0.5% (17) had no sewage facility. The estimated total number of private permanent households within the contributing catchment (based on % within the catchment) is 1,975 and of this 60.1% (1,186) are on the public system, while 37.6% (743) of households have their own septic tank or other individual treatment systems. Regarding households with another treatment system or treatment system not stated, this accounts for 1.8% (36), and 0.5% (10) have no sewage facility. **Table 7.4** shows this information at the ED level and the estimations within the contributing catchment.

Table 7.3: Details of discharges related to Bantry WWTP. Map codes relate to Figure 7-5.

Treatment	Name	Easting	Northing	Latitude	Longitude	Receiving water body
Primary Treatment	SW001	496774.2	548272.5	51.67737498	-9.49264	Inner Bantry Bay
Secondary Treatment	SW003	499704.6	548419.5	51.67922644	-9.45033	Mill River
Secondary Treatment	SW004	499732.5	548499.5	51.67995021	-9.44995	Ally River
Storm Water Overflow	SW007	499732.5	548499.5	51.67995021	-9.44995	Bantry Bay
Storm Water Overflow	SW008*	499603.6	548510.5	51.68002601	-9.45181	Bantry Bay
Ambient Monitoring Point	B1001	497723	549025.4	51.68431383	-9.47915	Inner Bantry Bay
Storm Water Overflow	TBC1	496774.2	548273.5	51.67738396	-9.49264	Coastal
Storm Water Overflow	TBC2	499272.6	548682.5	51.68151213	-9.45665	Coastal
Storm Water Overflow	TBC3	499259.7	548680.5	51.68149183	-9.45683	Coastal

*It should be noted that while SW08 is reported as being a storm water overflow in the 2022 Bantry AER, it was recorded as a primary discharge point, licence code SW001, in a 2021 EPA wastewater discharge licence audit report[29].

Table 7.4: Sewage facilities at permanent households in the contributing catchment (CSO, 2022[14]).

Electoral Divisions (ED)	Entire ED						Contributing Catchment %					
	Permanent Private Household	Public Sewage Schem	Individual Septic Tank	Other individual treatment	Other/Not Stated	No sewage facility	Permanent Private Household	Public Sewage Scheme	Individual Septic Tank	Other individual treatment	Other/Not Stated	No sewage facility
Bantry Urban	1344	1142	162	13	20	7	1340	1139	162	13	20	7
Durrus East	105	1	95	6	3	0	3	0	2	0	0	0
Durrus West	294	117	157	10	7	3	49	20	26	2	1	1
Glanlough	90	0	79	8	3	0	54	0	48	5	2	0
Mealagh	145	1	127	12	4	1	143	1	125	12	4	1
Garrown	106	0	93	7	3	3	6	0	6	0	0	0
Scart	114	0	105	8	1	0	13	0	12	1	0	0
Seefin	140	33	99	6	2	0	44	10	31	2	1	0
Bantry Rural/Whiddy	434	21	367	34	11	1	277	13	234	22	7	1
Kealkill	207	85	106	12	3	1	6	3	3	0	0	0
Sheepshead	82	11	68	2	1	0	2	0	1	0	0	0
Dromdaleague North	102	0	90	7	4	1	35	0	31	2	1	0
Gortnascreeny	192	5	174	10	3	0	2	0	2	0	0	0

7.1.3.3. Rainfall Dependent/Emergency Sewage Discharges

There were five storm water overflows identified in the 2022 AER for Bantry as being part of the Bantry WWTP (Uisce Éireann, 2022); three of these were noted in the AER as needing to be confirmed by Uisce Éireann (**Figure 7-5**; **Table 7.3**). The five storm water overflows were deemed as not meeting the criteria of the Department of Environment, Housing, and Local Government[30], however all five were ranked as having a low significance. Only two of these overflows are monitored, one of which is recorded as having a total discharge volume of 101,926 m^3 in 2022 (Uisce Éireann, 2022).

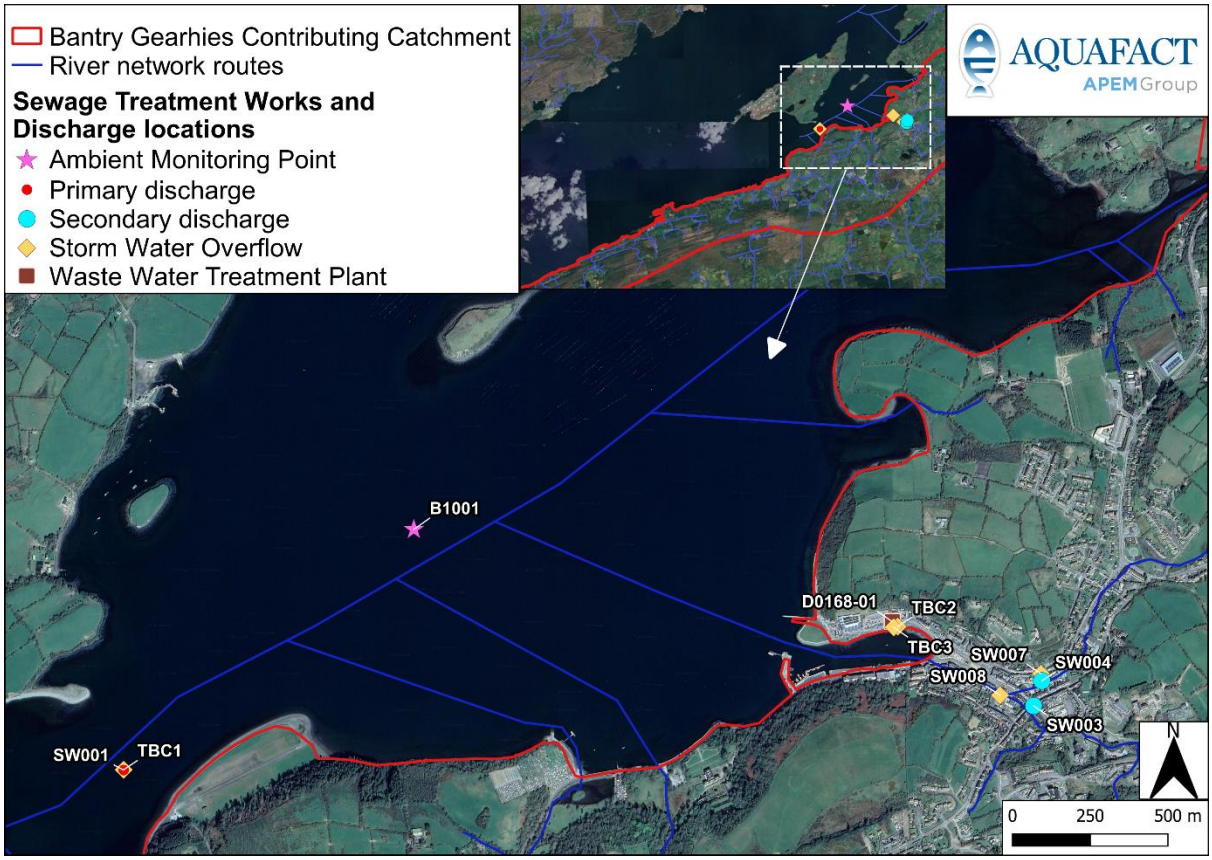


Figure 7-5: Locations of WWTP and discharge locations in Bantry Gearhies contributing catchment. Names cross-referenced to Table 7.3.

7.1.4. Industrial Discharges

There are no Industrial Emissions Licences within the contributing catchment. There is one IPC licence which lies outside of the contributing catchment but is considered here since it discharges into the waters near the Bantry Gearhies east and west production areas and due to the hydrodynamics of the bay (**Figure 7-6**, diamond symbol). This IPC is for Zenith Energy Bantry Bay Terminal Ltd. and is a Class 9 activity, *i.e.*, fossil fuel activity, according to the EPA Act 1992, as amended. There is one discharge point, SWEP-01, associated with this IPC licence. Under the IPC licence these fossil fuel activities are monitored for the various emissions associated

with the activities. Those emissions that are relevant to this sanitary survey are emissions to storm water, wastewater, and groundwater. However, there are measures in place to treat these emission types before they are discharged via the discharge point[29].

A Section 4 discharge licence allows for the discharge of trade or sewage effluent to waters. Under the Local Government (Water Pollution) Acts 1977 and 1990, Cork County Council grants licences for Section 4 discharges within the county of Cork. There are six Section 4 discharge licences within Bantry Gearhies contributing catchment (**Table 7.5**) as identified on EPA Maps[28]; each licence has various stipulations to reduce pollution and monitor discharges. The following information has been extracted from Section 4 discharge licences in Co. Cork[31]; the licences can be accessed from the link at **endnote 31** should further information be sought.

1. Reference number 06/16® (previously 3/09) is licensed to discharge wastewater from the Lahadane Industrial Park to the Mealagh River and will not exceed 10 m^3/day as stipulated in the licence. Surface water runoff from car parks and loading areas are to be discharged using a grit trap and hydrocarbon interceptor.
2. Reference number 7/07 has a licence to discharge treated domestic effluent to a stream at Dunbittern East, Bantry. However, the licence specifies strict criteria under which the licence holder must operate, including a stipulation that wastewater flow should not exceed 10 m^3/day.
3. Reference number 20/81 is licensed to discharge hotel sewage effluent to a stream near the rear of the hotel at Seafield, Bantry.
4. Reference number 16/08® is licensed to discharge effluent from shellfish depuration by UV and domestic sewage from a treatment plant to the sea in Bantry Bay. The wastewater flow should not exceed 7,000 m^3/day.
5. Reference number 9/08® is licensed to discharge water from a shellfish depuration, processing, and packaging facility to the coastal waters at Bantry Gearhies. The wastewater flow is not to exceed 1,100 m^3/day.
6. Reference number 7/91 allows the licensee to discharge wastewater from fish farm activities at the University College Cork Aquaculture Research Centre to the sea at Gearhies, Bantry. The contaminated wastewater is only to comprise that arising from the fish farm activities and the total effluent is not to exceed 600 m^3/day.

Table 7.5: Licensed Section 4 discharges within Bantry Gearhies contributing catchment[28].

Map ID	Reference No.	Licence Holder Name	Facility Address
1	WP(W) 06/16	Murnane & O'Shea	Lahadane, Bantry
2	WP(W) 7/07	Murnane & O'Shea Ltd.	Lahadane, Bantry
3	WP(W) 20/81	Westlodge Hotel	Bantry, Co. Cork
4	WP(W) 16/08®	Keohane Seafoods Ltd	Unit 28, Kinsale Rd. Industrial Estate

5	WP(W) 9/08®	Fastnet Mussels Ltd./ Rockabill Shellfish	Gearhies
6	WP(W) 7/91	David O'Neill	Gearhies, Bantry

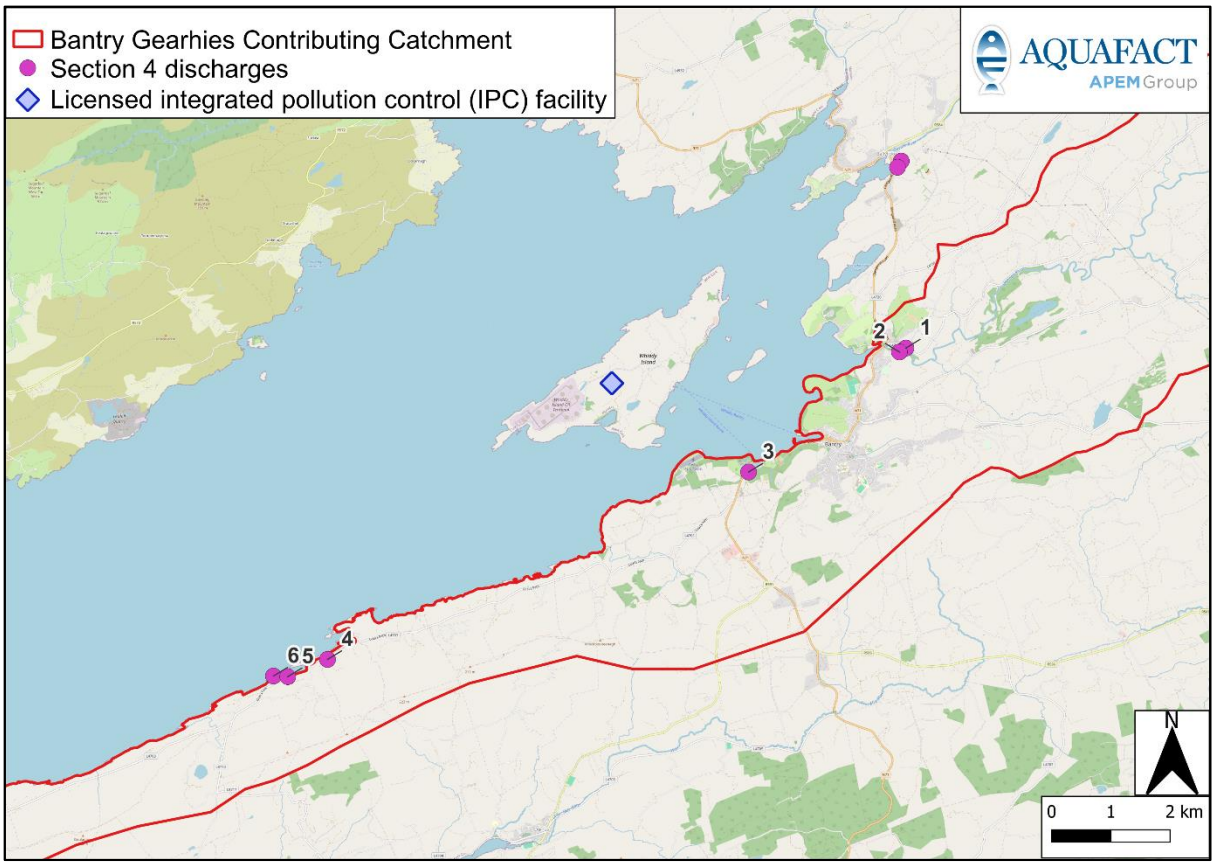


Figure 7-6: Location of industrial discharges within Bantry Gearhies contributing catchment.

7.1.5. Land Use Discharges

Figure 7-7 shows the Corine land use[15] within Bantry Gearhies contributing catchment. **Figure 8-4** shows all the river water bodies within the contributing catchment. The land use within the contributing catchment is marginally dominated by pastures (28.8 km^2, 30%), with a mixture of moors and heathlands (23%) and land principally occupied by agriculture with significant areas of natural vegetation (23%) also covering a similar area. Peat bogs, coniferous forests, and transitional woodland/shrub comprise the land cover to a lesser extent. A small percentage of land cover in Bantry Gearhies contributing catchment consists of discontinuous urban fabric, broad-leaved forests, mixed forests, sea and ocean, and sports and leisure facilities (**Figure 7-8**).

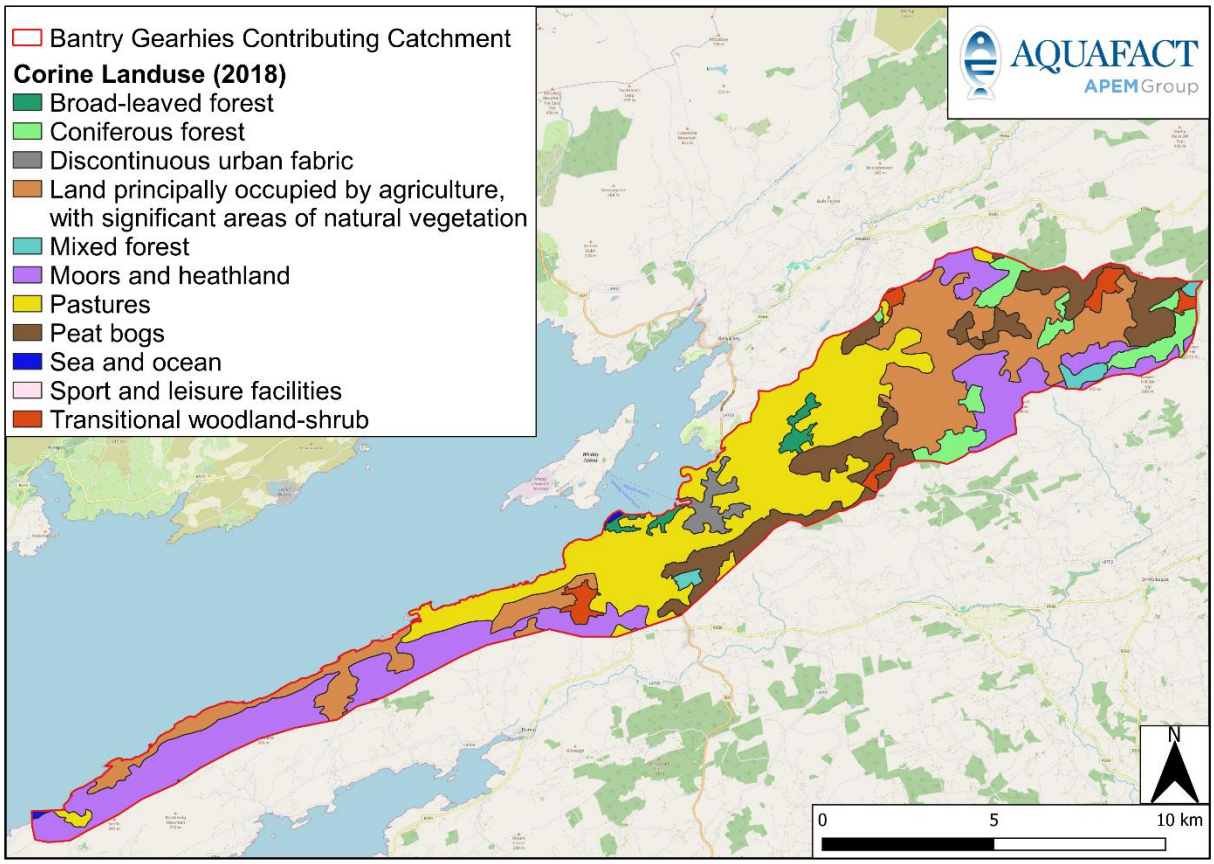


Figure 7-7: Land use within Bantry Gearhies contributing catchment (source: EPA[15]).

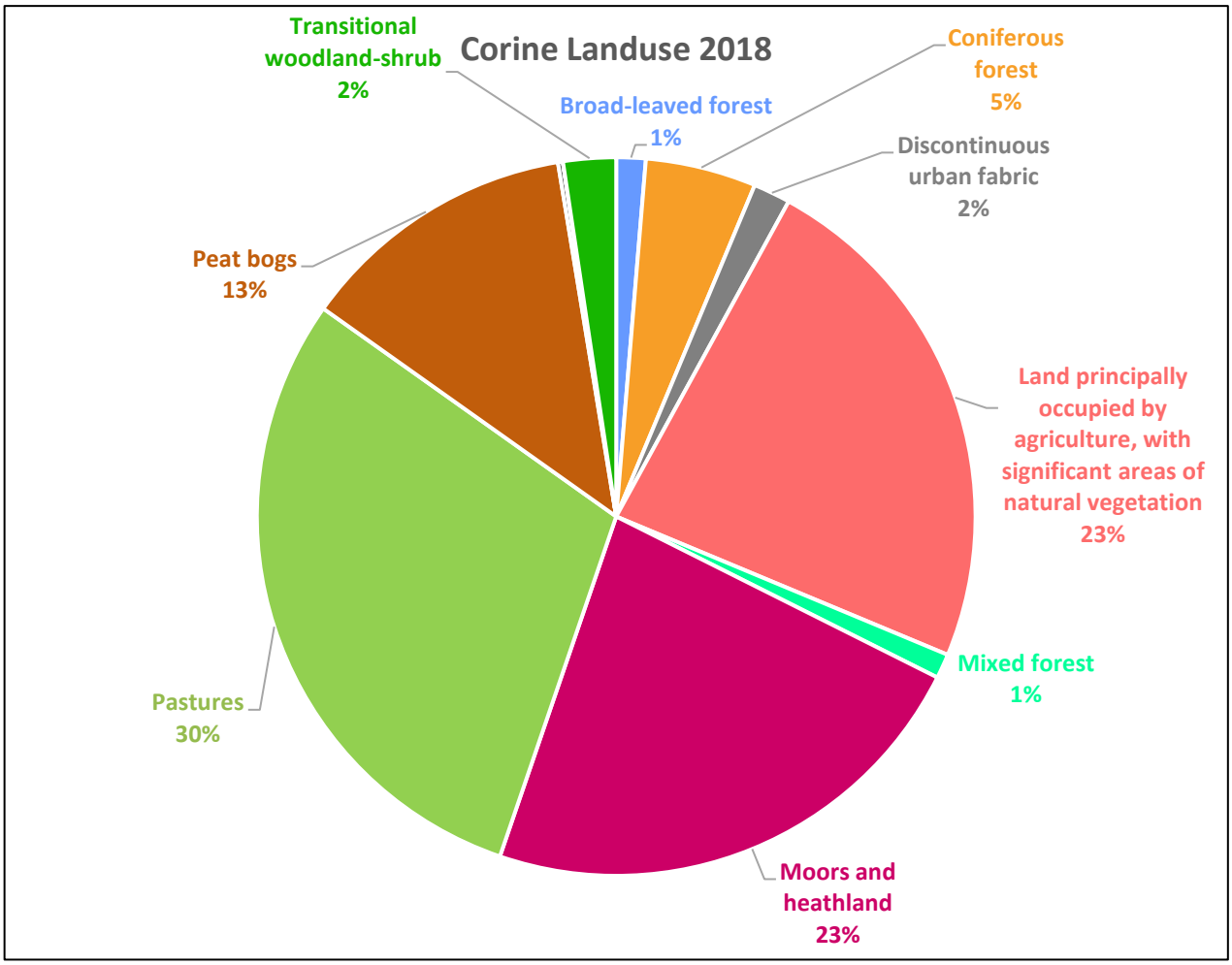


Figure 7-8: Breakdown of Corine land use (2018) within Bantry Gearhies contributing catchment (percentages have been rounded to the nearest whole number and only land uses ≥1% are labelled).

Data from the Census of Agriculture 2022 (CSO[13]) is displayed in **Table 7.6** and **Table 7.7**. The number of farms within the EDs in the contributing catchment ranges from 27 in Bantry Urban to 88 in Bantry Rural/Whiddy. The total area farmed varies from 474.6 ha in Bantry Urban to 2420.6 ha in Bantry Rural/Whiddy. The total area farmed across the entire EDs is shown in **Figure 7-10** to **Figure 7-17** and amounts to 19,605.3 ha. However, as most of these EDs only partially overlap the contributing catchment, an attempt was made to estimate the area farmed within the contributing catchment using the same method as was employed for estimating the human population. The percentage of the ED lying within the contributing catchment was calculated in QGIS, and from this value the area farmed was calculated, *e.g.*, if 50% of the ED lies within the contributing catchment, then 50% of the area farmed was taken to be the area farmed within the contributing catchment. Using this method, the total area farmed within the contributing catchment was estimated at 5,719.8 ha. Which represents 58.9% of the total contributing catchment.

Total grass and rough grazing (combination of total pasture, total silage, total hay, and rough grazing) accounted for almost all the area farmed (*c.* 99%), ranging from 473.2 ha in Bantry Urban to 2411.1 ha in Bantry Rural/Whiddy. There were no records of crops growing within any of the EDs.

The total number of cattle within the EDs ranged from 583 in Bantry Urban to 4,390 in Gortnascreeny. The total number of sheep within the EDs ranged from 403 in Glanlough to 5,717 in Garrown. Dairy cows within the EDs ranged from 299 in Durrus West to 1,723 in Gortnascreeny. The total number of other cows within the EDs ranged from 100 in Bantry Urban to 640 in Bantry Rural/Whiddy; see **endnote 32** for definitions of other cows and total cattle per the CSO.

Within Bantry Gearhies contributing catchment, the total number of cattle ranged from 19 in Sheepshead to 2,159 in Bantry Rural/Whiddy. The total number of sheep within the contributing catchment ranged from seven in Gortnascreeny to 2,778 in Mealagh. There were no dairy cows within Bantry Urban, Durrus East, Glanlough, Seefin, or Sheepshead EDs, but 532 were calculated as being present in Mealagh. The total number of other cows within Bantry Gearhies contributing catchment ranged from four in Gortnascreeny to 421 in Mealagh.

Statutory Instrument (S.I.) No. 113/2022[33] sets out regulations on the application of slurry and organic fertilisers, notably the method by which it is spread, the amount, the environmental conditions, and the required distance from water courses. The Fifth Nitrates Action Programme 2022-2025, given effect by S.I. No. 113 of 2022, restricts slurry spreading to before October 1st of a given year. The programme prohibits the spreading of soiled water between December 1st and 31st, effective from January 1st, 2024 (see publication on overview of the programme for exceptions[34]).

Furthermore, the Geological Survey of Ireland groundwater data viewer shows areas of high to extreme groundwater vulnerability occur within the contributing catchment, and adjacent to the Bantry Gearhies east and west BMPAs there is predominantly rock at or near the surface or karst (**Figure 7-9**). These areas of high vulnerability primarily coincide with pastures but also overlap with peat bogs and agricultural land. In such areas S.I. No. 113/2022 states that “soiled water”[35] cannot be spread on land if the quantity exceeds 25,000 L/ha in a 42-day period or at an irrigation rate greater than three mm/hr on land of thickness less than one metre. While the levels of slurry and soiled water spreading were not readily available for Bantry Gearhies contributing catchment at the time of writing, the fact that 53% of the land is comprised of pastures and agricultural land gives an indication of the potential levels of spreading in the contributing catchment and potential discharge levels to groundwater and, subsequently, the DSW in the bay.

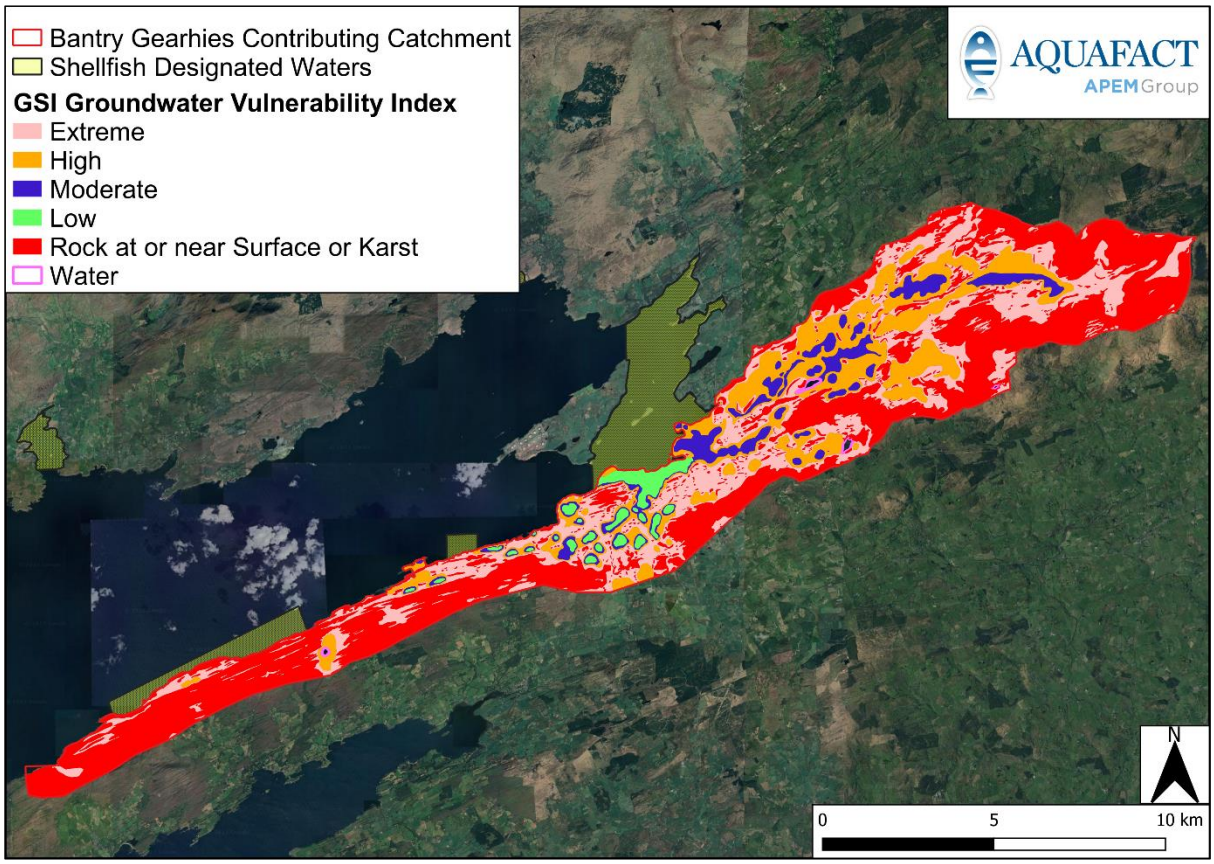


Figure 7-9: Geological Survey of Ireland (GSI) groundwater vulnerability within Bantry Gearhies contributing catchment. Contains Irish Public Sector Data (Geological Survey Ireland) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7.6: Overall farm census data for the Electoral Divisions that overlap with Bantry Gearhies contributing catchment (source: CSO[13]).

Electoral Division (ED)	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Grass & Rough Grazing (ha)*	Total Cattle ***	Sheep	Other cows **	Dairy cows
Bantry Urban	27	474.6	17.6	473.2	583	791	100	0
Durrus East	35	1192.6	34.1	1173.7	1311	1897	379	0
Durrus West	45	1380.4	30.7	1379.4	1778	1943	421	299
Glanlough	29	666	23	665.6	1154	403	254	0
Mealagh	61	1847.1	30.3	1818	2169	2813	426	539
Garrown	46	2289.4	49.8	2287.2	1255	5717	241	343
Scart	51	1498.2	29.4	1494.4	1995	2422	296	672
Seefin	39	855.5	21.9	854.6	1074	1077	282	0
Bantry Rural/Whiddy	88	2420.6	27.5	2411.1	3387	2596	640	668
Kealkill	62	2177.2	35.1	2168.7	2278	4440	387	571
Sheepshead	34	1158.9	34.1	1158.9	906	1395	213	0
Dromdaleague North	38	1517.8	39.9	1516.6	1577	2157	168	464
Gortnascreeny	62	2127	34.3	2123.9	4390	778	424	1723

*Total Grass and Rough Grazing taken to be the sum of Total Pasture, Total Silage, Total Hay, and Rough Grazing.

** Other cows as defined by the CSO are female beef cattle.

*** Total cattle is comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.

Table 7.7: Estimated farm census data for the Electoral Divisions within Bantry Gearhies contributing catchment (%) (source: CSO[13]).

Electoral Division (ED)	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Grass & Rough Grazing (ha)*	Cattle	Sheep	Other cows **	Dairy cows
Bantry Urban	27	473.3	17.6	471.9	581	789	100	0
Durrus East	1	29.7	0.8	29.2	33	47	9	0
Durrus West	8	230.6	5.1	230.4	297	325	70	50
Glanlough	18	403.2	13.9	403.0	699	244	154	0
Mealagh	60	1824.3	29.9	1795.6	2142	2778	421	532
Garrown	3	139.5	3.0	139.4	76	348	15	21
Scart	6	176.2	3.5	175.8	235	285	35	79
Seefin	12	270.2	6.9	269.9	339	340	89	0
Bantry Rural/Whiddy	56	1543.2	17.5	1537.1	2159	1655	408	426
Kealkill	2	67.9	1.1	67.6	71	138	12	18
Sheepshead	1	24.8	0.7	24.8	19	30	5	0
Dromdaleague North	13	518.0	13.6	517.6	538	736	57	158
Gortnascreeny	1	18.9	0.3	18.8	39	7	4	15

* Total Grass and Rough Grazing taken to be the sum of Total Pasture, Total Silage, Total Hay, and Rough Grazing.

** Other cows as defined by the CSO are female beef cattle.

*** Total cattle is comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.

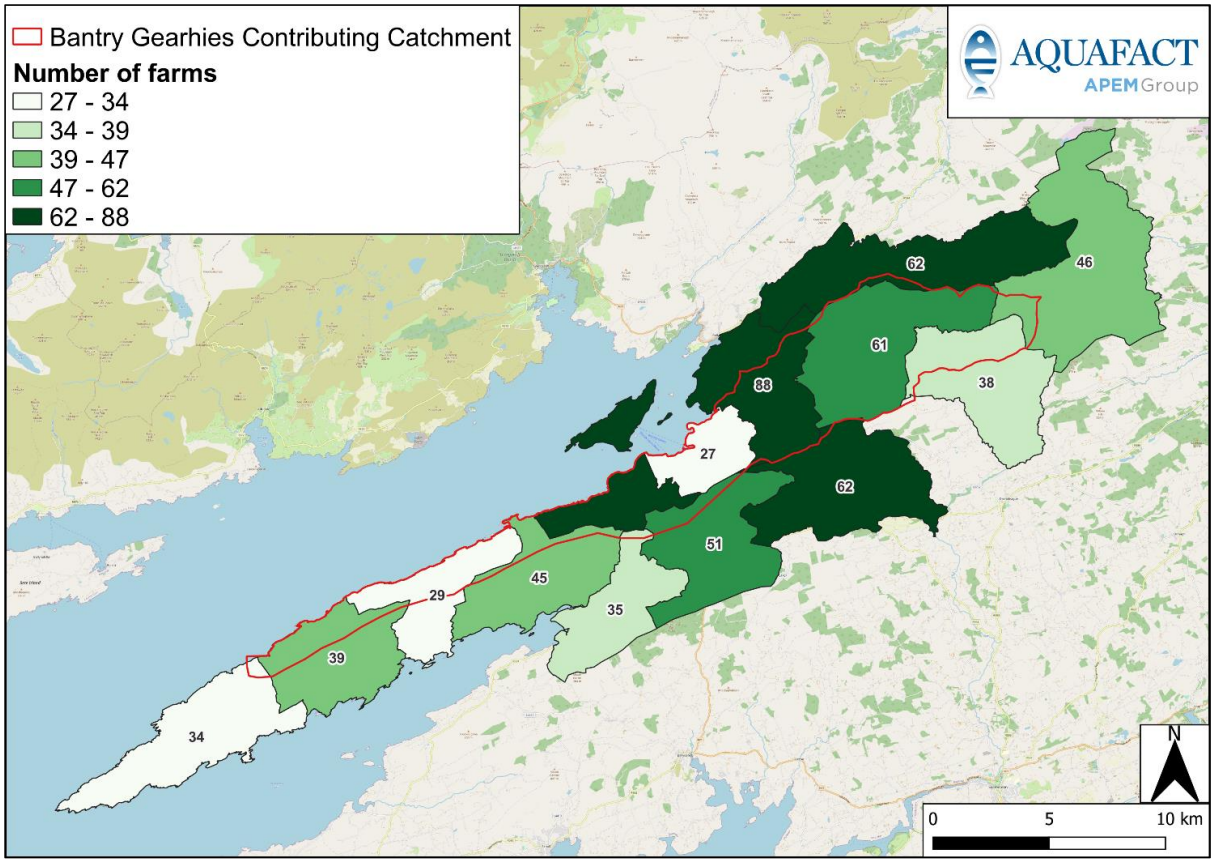


Figure 7-10: Number of farms within Bantry Gearhies contributing catchment (source: CSO[13]).

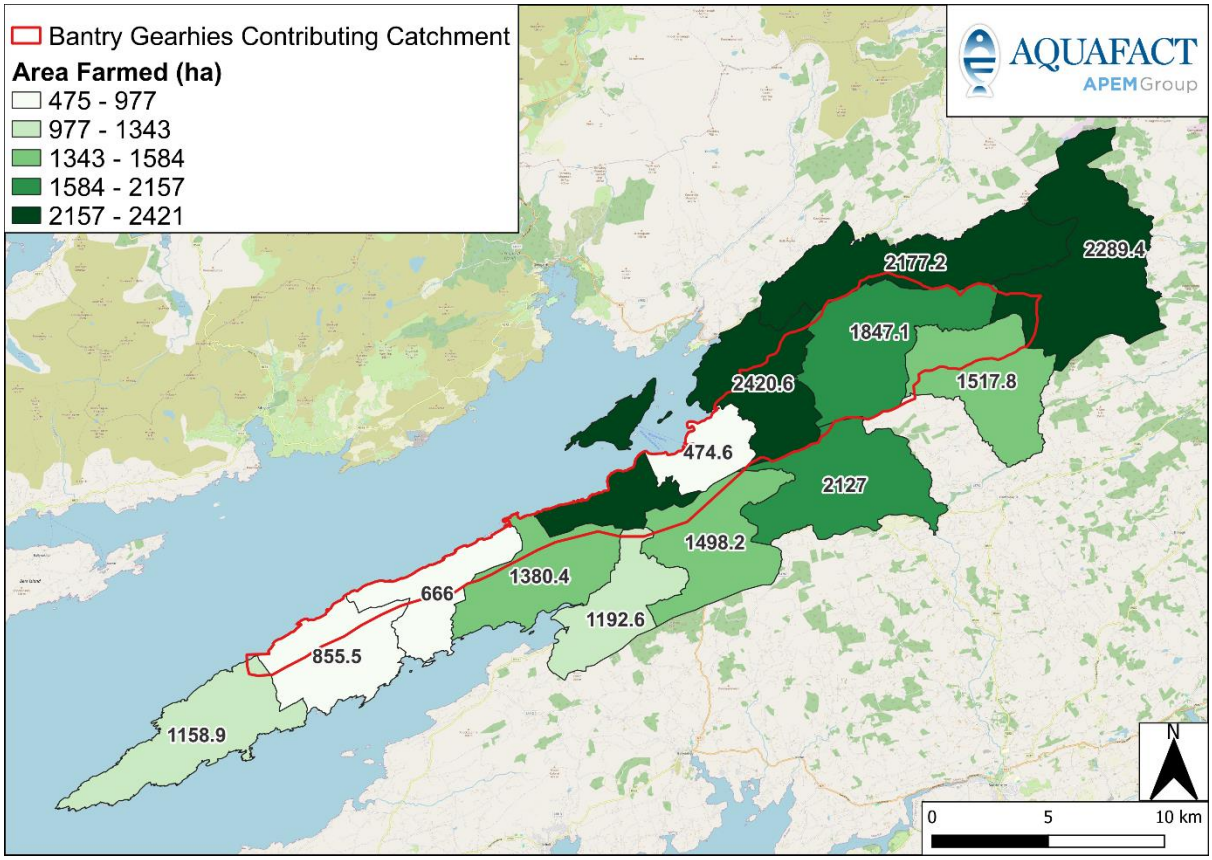


Figure 7-11: Area farmed (ha) within Bantry Gearhies contributing catchment (source: CSO[13]).

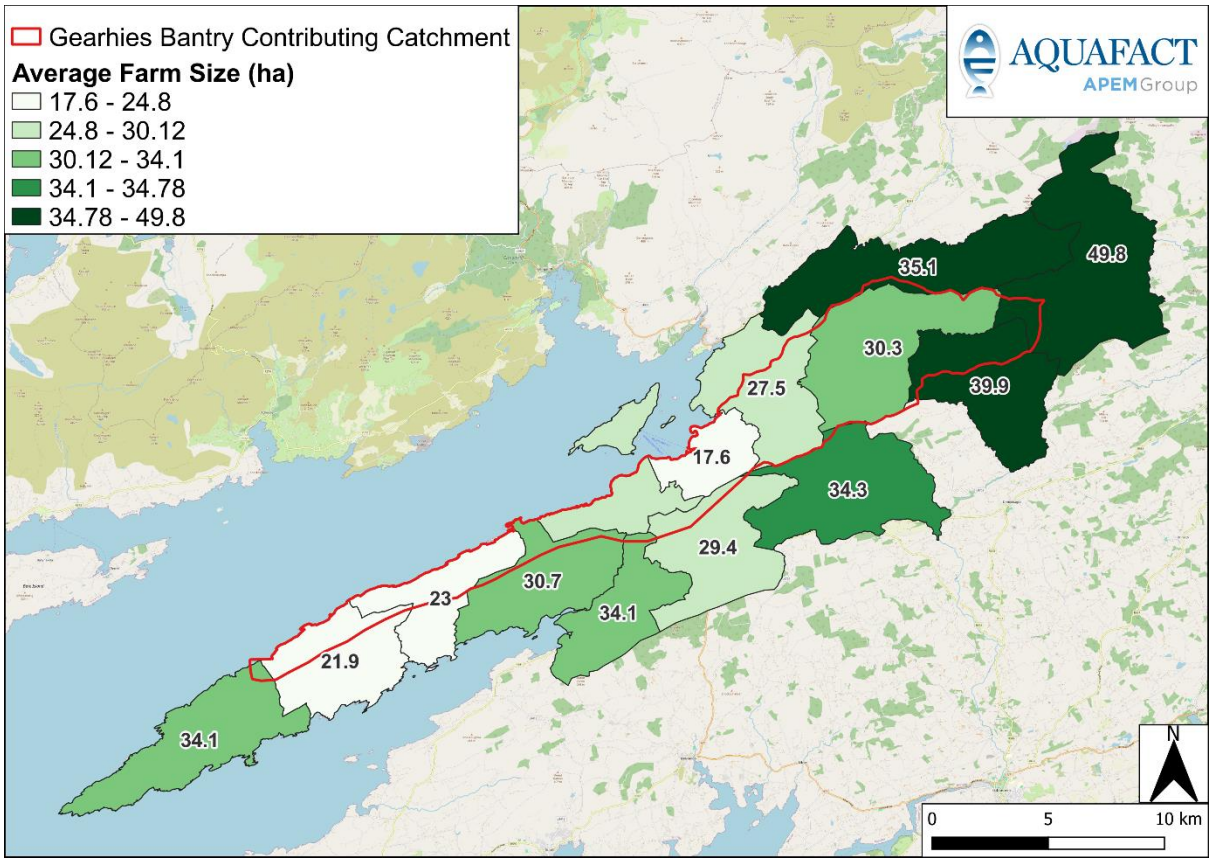


Figure 7-12: Average farm size (ha) within Bantry Gearhies contributing catchment (CSO[13]).

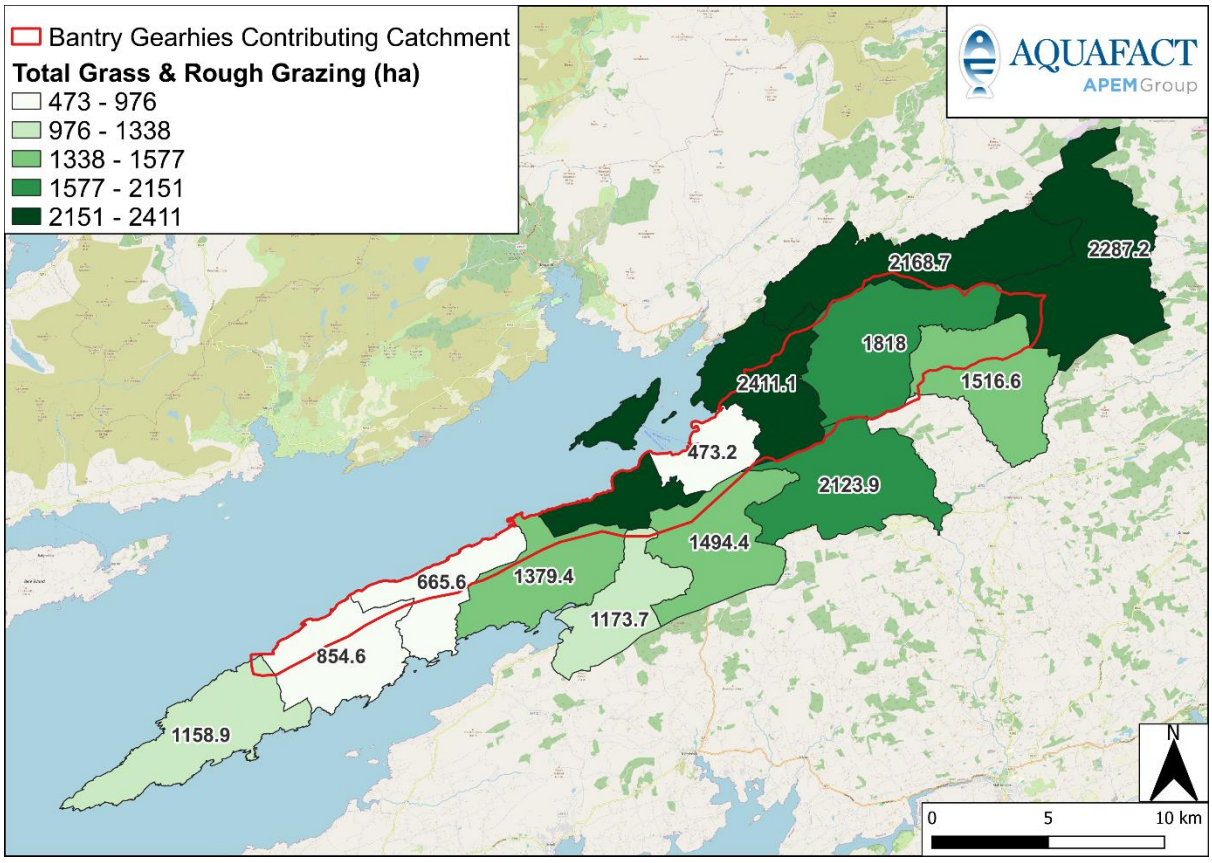


Figure 7-13: Total grass and rough grazing (ha) within Bantry Gearhies contributing catchment (source: CSO[13]).

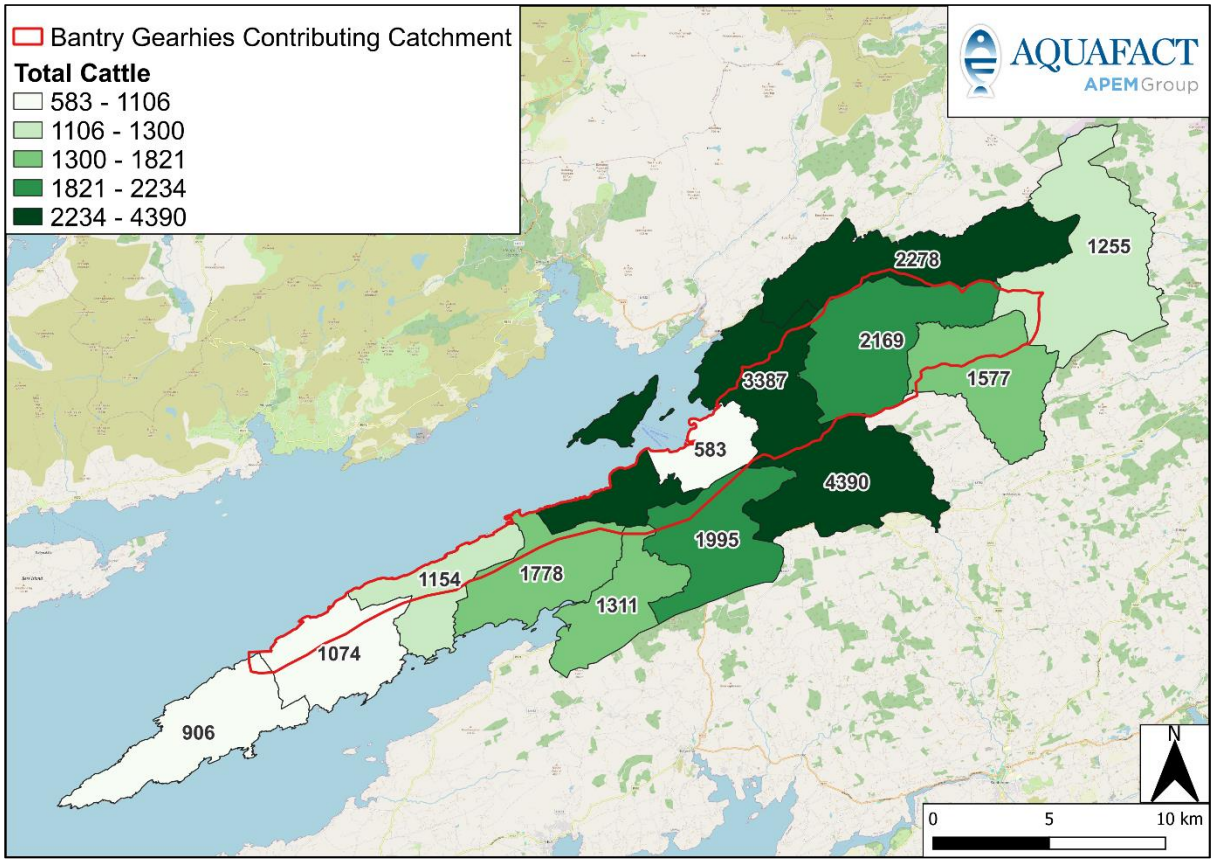


Figure 7-14: Number of cattle within Bantry Gearhies contributing catchment (source: CSO[13]).

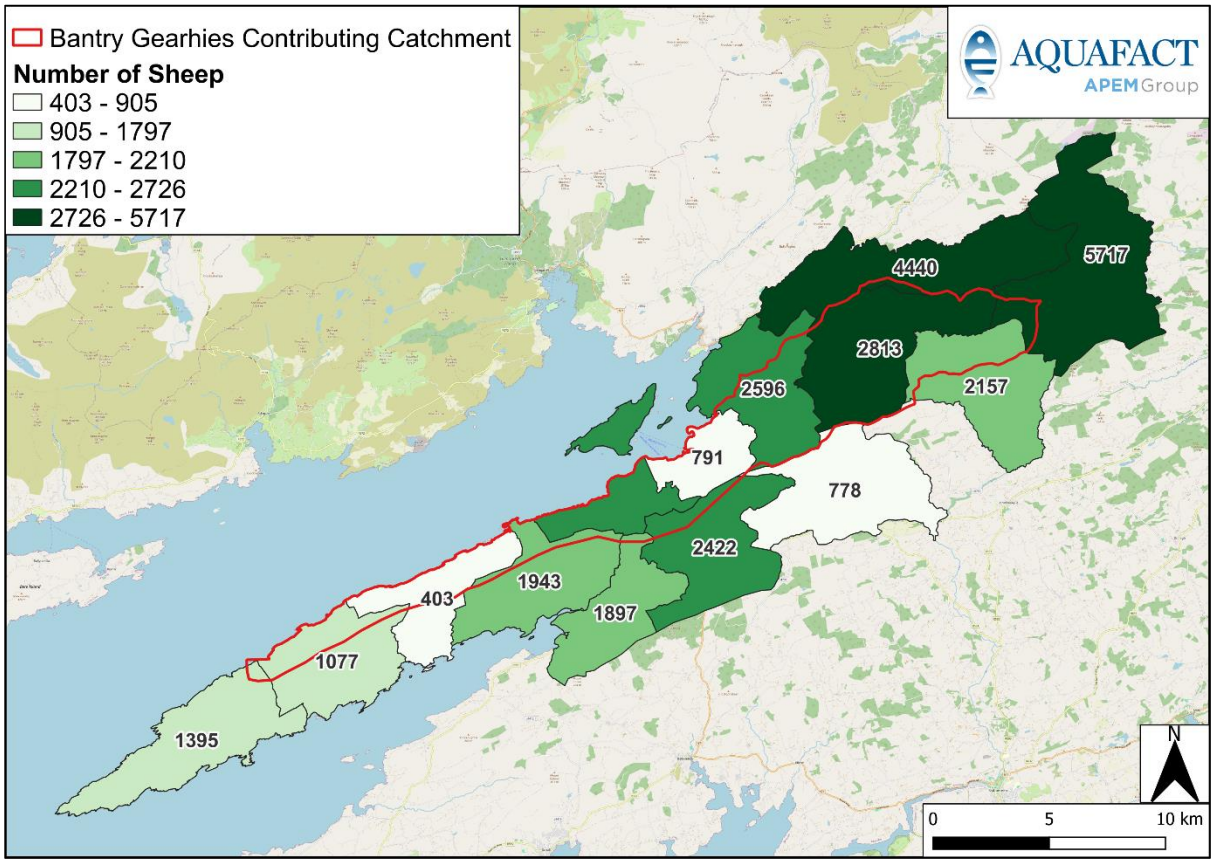


Figure 7-15: Number of sheep within Bantry Gearhies contributing catchment (source: CSO [13]).

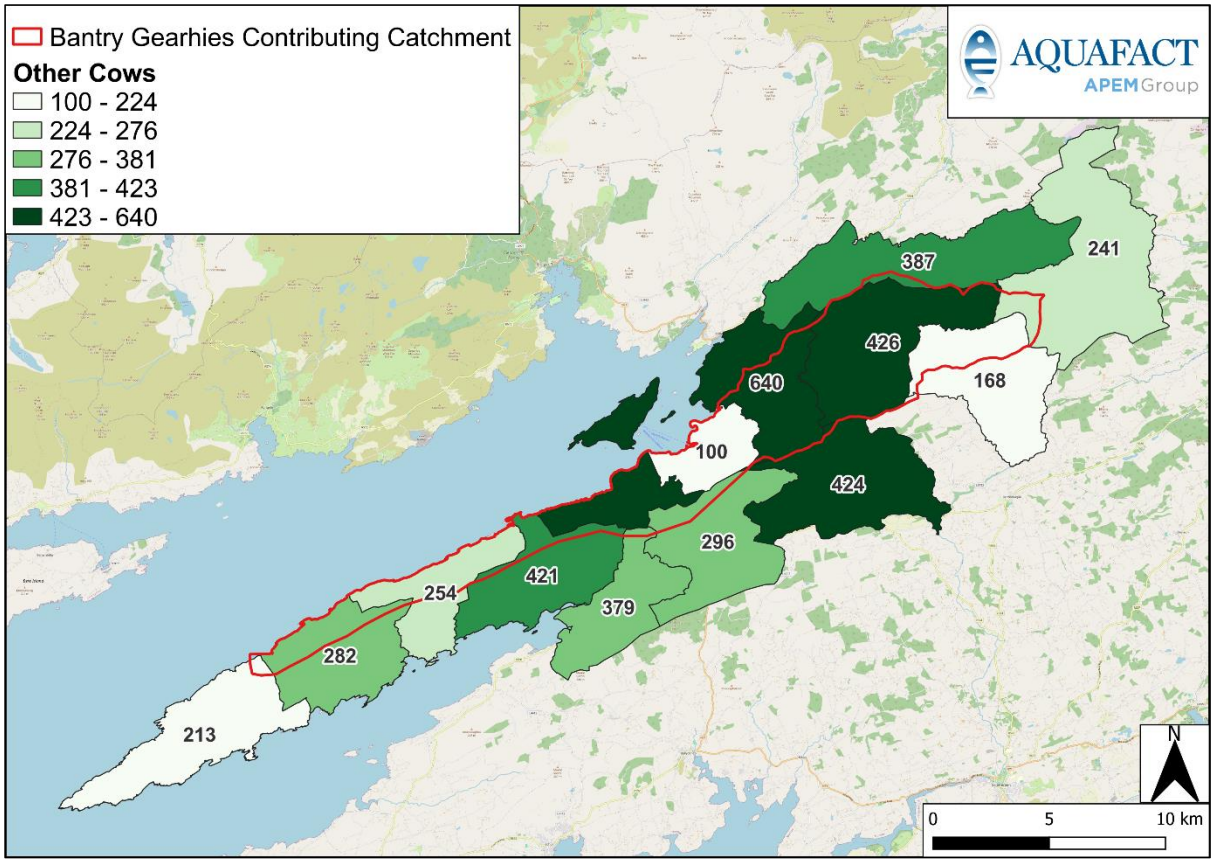


Figure 7-16: Number of other cows within Bantry Gearhies contributing catchment (source: CSO[13]).

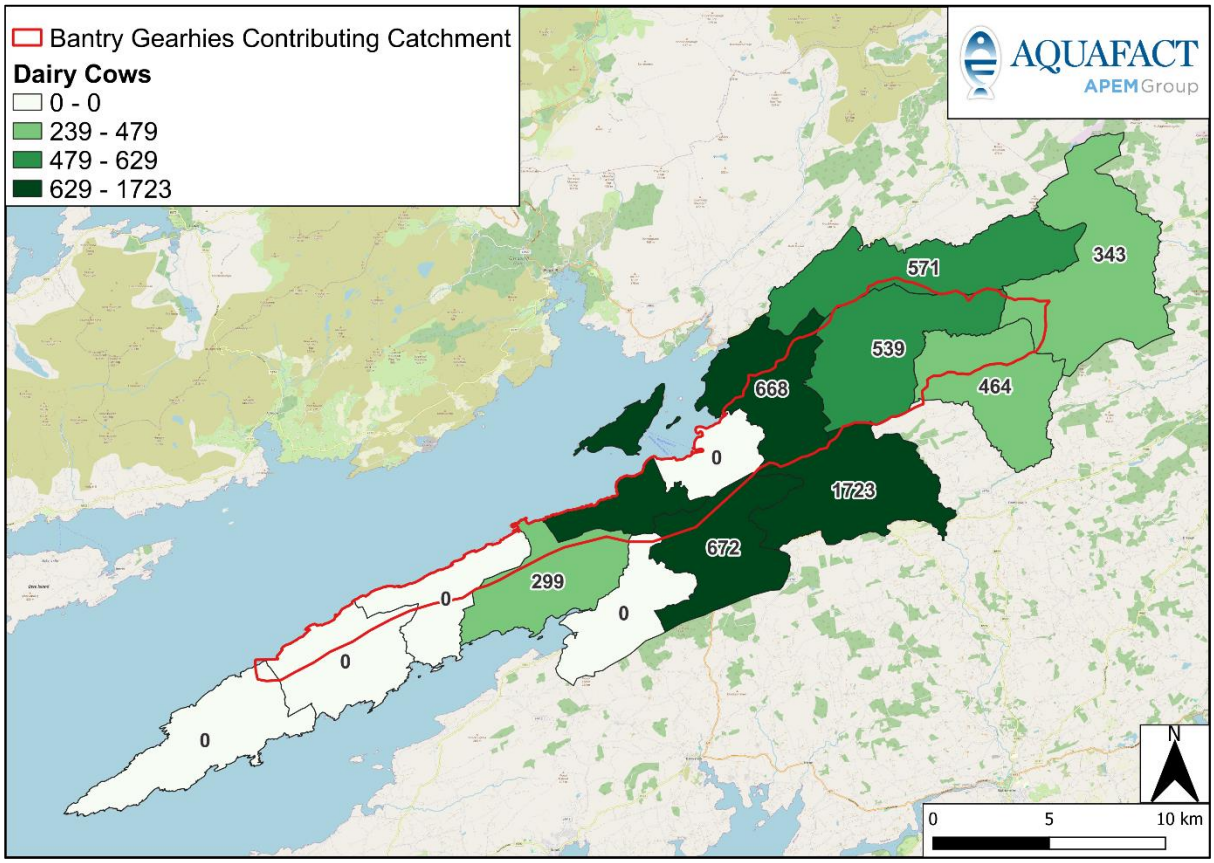


Figure 7-17: Number of dairy cows within Bantry Gearhies contributing catchment (source: CSO[13]).

Several studies have reported a strong association between intensive livestock farming areas and faecal indicator concentrations of microorganisms in streams and coastal waters due to run-off from manure, especially during high flow conditions, both from point and non-point sources of contamination (Crowther *et al.,* 2002). **Table 7.8** shows the potential daily loading of *E. coli* from livestock compared to humans and birds. It can be seen that sheep rank the worst based on the average number of *E.coli* per gram of faecal production, followed by pigs, cows, birds, humans, and poultry.

Table 7.8: Potential daily loading of *E. coli* (Jones & White, 1984).

Source	Faecal Production (g/day)	Average Number (*E. coli*/g)	Daily Load (*E. coli*)	Rank
Man	150	13×10^6	1.9×10^9	5
Cow	23600	0.23×10^6	5.4×10^9	3
Sheep	1130	16×10^6	18.1×10^9	1
Chicken	182	1.3×10^6	0.24×10^9	6
Pig	2700	3.3×10^6	8.9×10^9	2
Gull	15.3	131.2×10^6	2×10^9	4

Most of livestock in the contributing catchment are sheep (7,722), however cattle are also present in similar densities (7,228). Most of agricultural land use in the area is total grass and rough grazing. Sheep are present in relatively large numbers throughout the EDs with the highest numbers recorded in the northeast in Garrown, Mealagh, and Kealkill. The highest numbers of cattle are located predominantly in the centre of the contributing catchment in Gortnascreeny, Bantry Rural/Whiddy, and Kealkill. Sheep numbers would be expected to increase in spring following the birth of lambs and decrease in the autumn as they are sent to market. Therefore, larger quantities of livestock droppings will be deposited during this period, though it may not impact the DSW until washed into the sea during and/or after periods of rainfall unless deposited directly on the shoreline.

7.1.6. Other Pollution Sources

7.1.6.1. Shipping

Operational waste from vessels, if not properly managed, can end up in the sea where the potential for contamination or pollution occurs. Wastes generated or landed in ports and harbours can be broadly divided into

a) operational and domestic waste from ships and boats.
b) waste from commercial cargo activities.
c) wastes generated from maintenance activities and associated maritime industry activities.

Marpol Annex IV defines sewage as “drainage from medical premises, toilets, urinals, spaces containing live animals, and other waste waters when mixed with sewage waste streams”. Although adopted in 1973, the Annex did not come into effect until September 2003, with subsequent amendments entered into force in

August 2005. Annex IV requires ships to be equipped with either a sewage treatment plant, a sewage comminuting and disinfecting system, or a sewage holding tank. Within three miles of shore, Annex IV requires that sewage discharges be treated by a certified Marine Sanitation Device (MSD) prior to discharge into the ocean. Sewage discharges made between three and 12 miles offshore must be treated by no less than maceration and chlorination, and sewage discharged greater than 12 miles from shore are unrestricted. Annex IV also established certain sewage reception facility standards and responsibilities for ports and contracting parties.

Ship sewage originates from water-borne human waste, wastewaters generated in preparing food, washing dishes, laundries, showers, toilets, and medical facilities. However, as waste enters the marine environment from many sources, it makes the identification of specific impacts from ship/boat waste very difficult. It is widely recognised that the majority of pollution entering the marine environment comes from land-based sources and atmospheric inputs from land based industrial activities, with only an estimated 12% originating from shipping activities (GESAMP, 1990).

Figure 7-18 shows all boat facilities and activities, namely slipways, piers, and ports within Bantry Gearhies contributing catchment and **Table 7.9** lists these features and coordinates. There is one commercial port within the contributing catchment, Port of Bantry, which facilitates commercial operations including oil transhipment on Whiddy Island. The majority of ships calling to the port are large oil tankers, bulk cargo, and small to medium cruise line vessels from large ports in Europe and America[36]. In 2016, seven vessels used the oil terminal facility and two cruise ships anchored in Bantry port[36]. In 2022, the Port of Bantry traded 106 tonnes of goods with other EU countries and 176 tonnes with non-EU countries[25].

There are three marinas and four harbours in Bantry Bay, outside of the Bantry Gearhies east and west production areas. There is a national ferry route in operation to/from Whiddy Island. Vessel navigation within Bantry Bay is associated with commercial fishing, aquaculture service vessels, vessel maintenance, naval service operations, ferry traffic, tanker traffic, tourism, and leisure (MERC, 2015). Cruise liners anchor off Bantry Inner Harbour.

The largest proportion of vessel movement is associated with the commercial fishing harbour of Castletownbere, which is outside of Bantry Gearhies contributing catchment. The Bantry Bay fishing port is situated on the southern shore of inner Bantry Bay *c*. 10 km from the Bantry Gearhies east BMPA[37]. Approximately five in-shore fishing boats operate for shrimp and prawns[12]. In 2015, an estimated 20 boats were fishing in the bay over a 12-month period[24]. The vessel limit for Whiddy Island oil terminal is < 100,000 deadweight tonne (DWT) and is predominantly within the range of 20,000 to 50,000 DWT[38]. It is one of Ireland's largest oil storage facilities where crude oil and oil products are shipped via a single mooring with a

nominal storage capacity of approximately 1.2 million tonnes[39]. Cargo ships, naval vessels, and large trawlers use the terminal for refuelling.

Bantry Bay has an established sailing club and is popular for marine recreational activities including kayaking, diving, and angling[38]. The Irish Marine Federation found visiting boats to remain three nights on average[40]. The development of a new marina in 2017 was expected to increase vessel density due to increased and improved infrastructure.

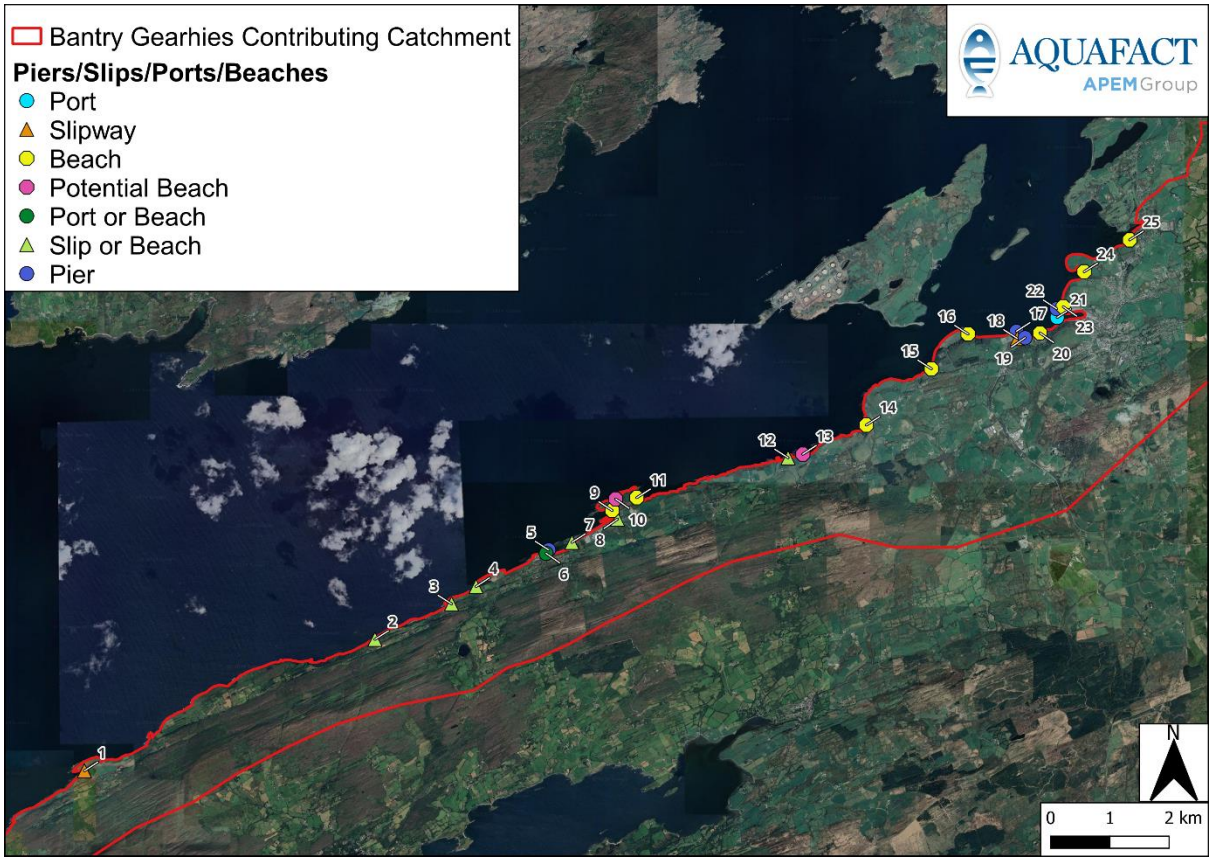


Figure 7-18: Potential access points/routes to the Bantry Gearhies east and west bivalve mollusc production areas as observed during the desktop survey. Potential beach indicates the appearance of a beach using google satellite imagery; were not confirmed during the shoreline survey. Map IDs refer to Table 7.9.

Table 7.9: Potential access points/routes to the Bantry Gearhies east and west bivalve mollusc production areas as observed during the desktop survey. Potential beach indicates the appearance of a beach using google satellite imagery; were not confirmed during the shoreline survey. Map IDs refer to Figure 7-18.

Map ID	Feature ID	Latitude	Longitude	Easting	Northing
1	Slipway	51.612	-9.699	482335.1	541312.8
2	Slip/Beach	51.632	-9.628	487301.5	543425.5
3	Slip/Beach	51.637	-9.609	488628.9	543952.5
4	Slip/Beach	51.64	-9.603	489051.5	544277.1
5	Pier	51.645	-9.586	490240.2	544807.5
6	Port/Beach	51.645	-9.586	490240.2	544807.5
7	Slip/Beach	51.647	-9.58	490660.2	545021
8	Slip/Beach	51.65	-9.569	491428.5	545338.3
9	Beach	51.651	-9.57	491361.7	545451
10	Potential Beach	51.653	-9.569	491435.7	545672
11	Beach	51.653	-9.564	491781.6	545664.6
12	Slip/Beach	51.659	-9.527	494355.6	546277.8
13	Potential Beach	51.66	-9.524	494565.5	546384.7
14	Beach	51.664	-9.508	495681.5	546806.6
15	Beach	51.673	-9.492	496808.7	547785
16	Beach	51.678	-9.484	497373.3	548329.9
17	Pier	51.678	-9.472	498203.1	548313.1
18	Slipway	51.677	-9.472	498200.9	548201.9
19	Pier	51.677	-9.47	498339.2	548199.1
20	Beach	51.678	-9.466	498618.1	548304.7
21	Port	51.681	-9.462	498901.3	548632.9
22	Pier	51.682	-9.462	498903.6	548744.1
23	Beach	51.682	-9.46	499041.9	548741.4
24	Beach	51.687	-9.455	499398.7	549290.6
25	Beach	51.692	-9.444	500170.2	549831.7

7.1.6.2. Wildlife

Birds

It is important to document the bird populations in the Bantry Gearhies area as bird faeces are rich in faecal bacteria (Oshira & Fujioka, 1995) and have been shown to be a source of faecal contamination in the marine environment (Jones *et al*., 1978; Standridge *et al*., 1979; Levesque *et al.*, 1993; Alderisio & DeLuca, 1999; Levesque *et al*., 2000; Ishii *et al.*, 2007).

There is no overlap between Bantry Gearhies contributing catchment and the adjacent SPAs. Sheep's Head to Toe Head SPA borders the contributing catchment and Beara Peninsula SPA is *c.* 10 km[41] away from the nearest licensed aquaculture site in the Bantry Gearhies west production area (T05/408) based on Bere Island being the nearest point of the SPA.

Sheep's Head to Toe Head SPA is a terrestrial site encompassing vast areas of high coast, sea cliffs, the land adjacent to the cliffs edge, and sand dunes extending from Sheep's Head to Mizen Head, Brow Head, and Toe

Head peninsulas in the east. The site is designated as an SPA under Annex I of the E.U. Birds Directive and is of special conservation interest for the following species: peregrine (14) and chough (146). Choughs are also a Red Data Book species, and the Mizen Head cliffs hold some of the highest concentrations of breeding pairs in Ireland, making it a population of national importance. Studies show that Chough forage mainly within 300 m inland of their breeding sites. This SPA also supports a range of breeding seabirds including Fulmar (114), Herring Gull (60), Shag (34), Kittiwake (40), Black Guillemot (174), and Great Black-backed Gull (2). Note that these data are from surveys from 1991, 2001, 2002, 2002/2003, and winter studies 2003/2004[42].

The Beara Peninsula SPA is a coastal site including high coast, sea cliffs, and upland areas from Reenmore Point/Cod's Head to its southern border of Bere Island. It contains cliffs, wet/dry heath, blanket bogs, freshwater marsh, grasslands, bedrock shores, and islets. This site is an SPA under Annex I of the E.U. Birds Directive and is of special conservation interest for the following species: chough (108) and fulmar (1150). Other seabird populations that occur within this SPA include shag (24), herring gull (40), lesser black-backed gull (8), razorbill (10), black guillemot (174), and peregrine (8). Note that these data are from studies in 1992, 2000, and 2002/2003[43].

Other species that use the wider Bantry Bay area include arctic terns (greater than 200) that breed near Whiddy Island, cormorants (greater than 100), and common terns (less than 100) that breed in small numbers in the neighbouring Kenmare Bay SAC (Roycroft *et al*., 2007b). Foraging by adjacent colonies occurs in the bay, in particular gannets, Manx shearwaters, and storm petrels (Roycroft *et al*. 2007b). It has been observed that seabird densities appear higher in the outer bay in the summer months and in lower numbers in winter, but in winter they are in higher concentrations in the inner bay (MERC, 2015). Other species of birds include mute swans (34), curlew (19), oystercatchers (175), mallard (48), and little egret (6)[44].

Aquatic Animals

Harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) have been recorded in Bantry Bay. Bantry Gearhies is adjacent to Glengarriff Harbour and Woodlands SAC (000090) within which harbour seals are designated as a Qualifying Interest. The area within and around the SAC have been associated with haul-out, breeding, resting, and moulting sites[8]. Harbour seals breed within the bay and may occur in large numbers in summer and autumn (Roycroft *et al*. 2004). The largest colony of harbour seals in southwest Ireland occur on the islands in Glengarriff Harbour, with a maximum count of 151 individuals recorded in 2003 (Cronin *et al.*, 2004). Subsequent counts recorded 340 individuals in 2012 and 365 individuals in 2013 and in 2021 25 seals were recorded[8]. It is worth noting that the harbour seal surveys up to and including 2013 were dedicated monitoring surveys, while the 2021 records are based on citizen science observations. Therefore these 2021 data do not represent a decline in the harbour seal population in Bantry Bay as they are single point observations. Bantry Bay was important during the 2003 moult period, however compared to the rest of the

bay, the sites in Glengarriff Harbour are used year-round (Cronin *et al.*,2004). A high number of pups have also been recorded (Cronin *et al*., 2004). **Figure 7-19** illustrates the habitat and sites used by harbour seals.

Otters (*Lutra lutra*) are a Qualifying Interest for the Glengarriff Harbour and Woodlands SAC (000090). A survey in 2019 found evidence of feeding, resting, and spraint sites (Malachy Walsh and Partners, 2021). There have been reports of individuals in and adjacent to the Bantry Gearhies east and west BMPAs, with the most recent sighting in 2019, and sightings in inner Bantry Harbour in 2016[8]. Common porpoise and bottlenose dolphins have been recorded in the bay (Roycraft *et al*., 2007a; **endnote 8**). Bottlenose dolphins are a wide-ranging coastal species and have been sighted in the bay[8], including the inner areas ([10]; Roycroft *et al*., 2007a). Between 2003 to 2005, common dolphins were reported using Bantry Bay as an important habitat for foraging and nursery grounds (Roycraft *et al*., 2007b). Records of up to 125 individuals within Bantry Bay have been reported on the Irish Whale and Dolphin Group sightings database[10]. The aforementioned aquatic mammals have a national distribution on all Irish coastlines.

No estimates of the volumes of seal faeces are available, although it is reasonable to assume that what is ingested and not assimilated in the gut must pass. The concentration of *E. coli* and other faecal indicator bacteria contained in seal faeces has been reported as being similar to that found in raw sewage, with counts showing up to 1.21 x 104 CFU *E. coli* per gram dry weight of faeces (Lisle *et al*., 2004). *Salmonella* and *Campylobacter* spp. have also been found in wild seals (Stoddard *et al*., 2005). All aquatic mammals that occur within Bantry Gearhies contributing catchment are likely to add to background levels of faecal contamination within the area, particularly during haul-out periods for seals.

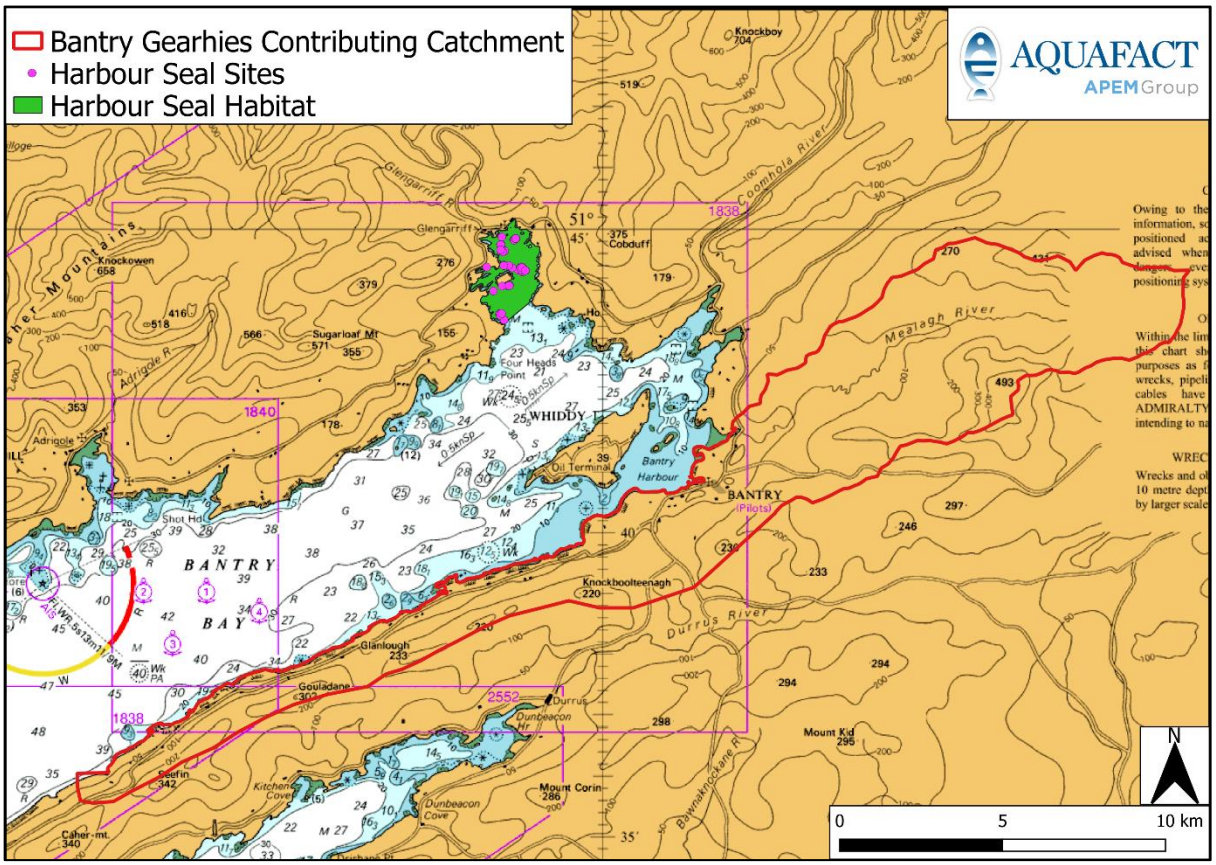


Figure 7-19: Harbour seal habitat and sites (source: NPWS[45]).

7.2. Shoreline Survey

7.2.1. Shoreline Survey Report

The aim of the shoreline survey is to confirm all observations from the desktop survey and to identify all additional discharges, pollution sources, waterways, and marinas along the shoreline. As part of the survey GPS (Global Positioning System) coordinates were recorded for all features and marked on a map. In addition, all features were photographed digitally (where possible). Notes were made of most of the features regarding the observation being made.

Two shoreline surveys were carried out by the SFPA to cover the extent of the contributing catchment shoreline. The first survey was over three survey days in November 2023 and the second survey took place on the 24th of January 2024. **Figure 7-20** shows the GPS locations of 74 sites which were photographed (see **Appendix 4: Shoreline Survey Images**), and the shoreline survey transects can be determined from the data points in this figure. The shoreline was walked where practical; a boat was used on one survey day and identified 20 features (map IDs 23 to 42; **Figure 7-20**). The area after map ID 23 (**Figure 7-20**) was not surveyed. Of the features observed, there were 28 streams, one river, three outflows, 15 drains, one brackish lake (*i.e.*, Kilmore Lake), five run-off points, 12 pipes, one beach, one culvert/stream, one jetty, one slip, two piers, and six salmon pens at three locations which correspond to the two licensed salmon aquaculture sites in Bantry

Gearhies. **Figure 7-21** to **Figure 7-33** show the locations of these features. **Table 7.10** details all features identified, and the numbering used is cross-referenced to **Figure 7-21** to **Figure 7-33**.

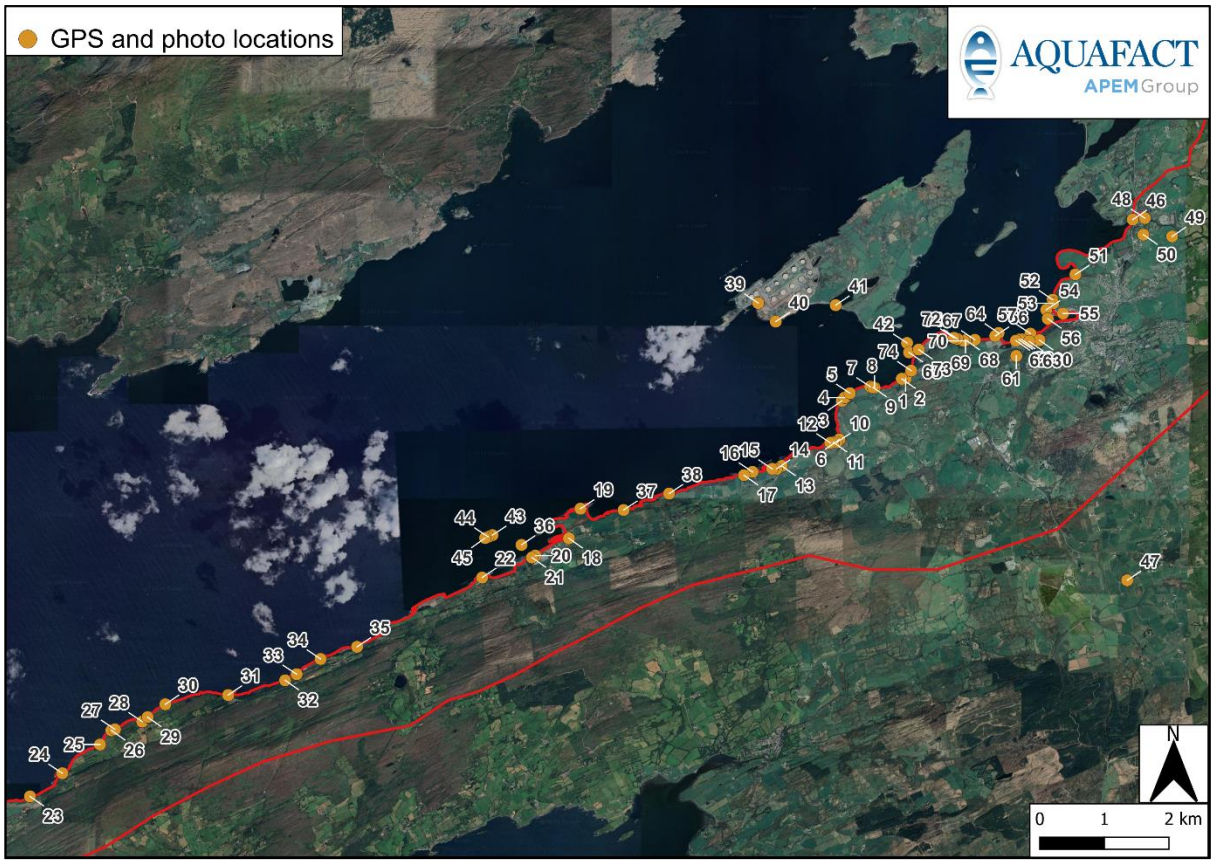


Figure 7-20: Locations of GPS and photograph sites from the shoreline survey (numbering cross-referenced to Table 7.10).

Table 7.10: Features identified during the shoreline survey. Latitude and longitude values are in coordinate reference system (CRS) WGS84, easting and northing values are in CRS Irish Transverse Mercator[46]. Refer to Figure 7-21 to Figure 7-33 for locations and Appendix 4: Shoreline Survey Images for photographs. * marks an error in the observation coordinates, this observation should be discounted.

No.	Observations	Comments	Photo IDs	Latitude	Longitude	Easting	Northing
1	Small stream	Airstrip, water mostly clear, slight foam, agricultural grazing land surrounds. Second shoreline survey noted stream through marsh grounds feeding the bay.	1	51.67226	-9.49344	496707.5	547704.9
2	Land drain	Grazing grassland surrounds.	2	51.67224	-9.4943	496648.2	547703.1
3	Land drain	Running clear.	3	51.66918	-9.50769	495714.9	547382.2
4	Concrete pipe drain	Running clear.	4	51.66964	-9.50705	495760.4	547432.3
5	Land drain	Running clear.	5	51.67024	-9.50587	495842.9	547497.6
6	Medium size river	Shanvally beach main river sampling point.	6	51.66384	-9.50823	495665.2	546788.8
7	Land drain	Running mostly clear, slight foam, agricultural land surrounds.	7	51.67114	-9.50133	496159.2	547591.3
8	Land drain	Running clear, agricultural land surrounds.	8	51.67102	-9.50038	496224.5	547576.1
9	Land drain	Running clear, two drains merging.	9	51.67105	-9.50073	496200.4	547580.7
10	Land drain	Running clear onto strand west of Shanvally River, beech woodland surrounds.	10	51.66342	-9.50886	495620.9	546743.8
11	Land drain	Beech woodland surrounds.	11	51.66342	-9.50958	495570.9	546744.4
12	Land drain	Mud slide from cliff face.	12	51.66337	-9.51027	495523.2	546739.7
13	Stream	Sampling point.	13	51.66016	-9.5211	494766.4	546398.1
14	Land drain	Running clear.	14	51.65973	-9.52231	494682	546352.7
15	Stream	Running clear.	15	51.65976	-9.52324	494617.2	546356.6
16	Land drain	Curraghavaddra beach drain.	16	51.65934	-9.52764	494312.5	546316
17	Stream	Sampling point.	17	51.65887	-9.52956	494178.3	546267.4
18	Stream	Sampling point.	18	51.65012	-9.56866	491452.3	545351
19	Cliff face run-off	Cliff face water run-off point.	19	51.65423	-9.56609	491639.8	545804.8
20	Outflow pipe	Outflow pipe.	20	51.64773	-9.57617	490926.9	545096.5
21	Outflow pipe	Outflow pipe.	21	51.64746	-9.57693	490873.7	545067.6
22	Outflow pipe	Outflow pipe.	22	51.64468	-9.58806	490096.9	544775.2
23	Stream	Stream to shore run-off.	23	51.61432	-9.68908	483028.2	541555.3

No.	Observations	Comments	Photo IDs	Latitude	Longitude	Easting	Northing
24	Stream	Stream to shore run-off.	24	51.61754	-9.68186	483536	541901.7
25	Stream	Stream to shore run-off.	25	51.62152	-9.67344	484129.7	542331.1
26	Stream	Stream to shore run-off.	26	51.62349	-9.67089	484311	542545.6
27	Stream	Stream to shore run-off.	27	51.62363	-9.6701	484366.1	542560.5
28	Stream	Stream to shore run-off.	28	51.62471	-9.664	484790.8	542670.4
29	Stream	Stream to shore run-off.	29	51.62532	-9.66281	484874.9	542736.8
30	Stream	Stream to shore run-off.	30	51.62711	-9.65884	485154.3	542929.4
31	Stream	Stream to shore run-off.	31	51.62839	-9.6448	486129.5	543050
32	Stream	Stream to shore run-off.	32	51.63043	-9.63207	487015.8	543257.5
33	Stream	Stream to shore run-off.	33	51.63128	-9.6295	487195.7	543348.2
34	Stream	Stream to shore run-off, upland agricultural grazing.	34	51.63339	-9.62415	487571.3	543574.4
35	Stream	Stream to shore run-off.	No photo	51.63508	-9.61601	488139.4	543749.4
36	Outflow pipe	Outflow pipe - water sample taken.	No photo	51.64922	-9.57926	490716.6	545266.3
37	Stream	Stream to shore run-off.	35	51.65405	-9.55645	492306.5	545770.4
38	Stream	Stream to shore run-off.	36	51.65633	-9.54626	493016.7	546008.9
39	Whiddy Island outflow	Whiddy Island outflow pipe running to shore.	37	51.68274	-9.52637	494454.4	548917
40	Land run off	Land run-off water brown in colour.	38	51.68017	-9.52244	494720	548626.3
41	Kilmore Lake	Béal Tonnta strand adjacent to Kilmore Lake outflow to sea.	39	51.68244	-9.50906	495650.8	548859.7
42	Bantry Water Treatment outflow (Sea)	Wastewater treatment plant outflow at Bantry airstrip.	No photo	51.6772	-9.49312	496741	548253.4
43	Salmon pens X2	Salmon pens 1-2, 470 m from adjacent land.	No photo	51.65056	-9.58577	490269.8	545426
44	Salmon pens X2	Salmon pens 3-4, 470 m from adjacent land.	No photo	51.65033	-9.58672	490203.1	545401.2
45	Salmon pens X2	Salmon pens 4-6, 470 m from adjacent land.	No photo	51.65017	-9.5874	490156	545384.3
46	Stream	Stream 1 (sample 1) fed by stream 2 via culvert in photo.	40	51.6943	-9.44269	500265.8	550085.7
47*	Stream	Stream 3 entering stream 1.	No photo	51.6443	-9.44393	500070.1	544525.8
48	Culvert/stream	Stream 2 entering via culvert into stream 1.	41, 42	51.6945	-9.43999	500452.9	550104.3
49	Drain	Drain from residential houses feeding into the bay.	43	51.69196	-9.4339	500868.3	549813.5
50	Stream	Stream running through agricultural land via a marsh into the bay.	44	51.6922	-9.4403	500426.4	549848.9

No.	Observations	Comments	Photo IDs	Latitude	Longitude	Easting	Northing
51	Drain	Beach drain.	45	51.6867	-9.4555	499363.4	549257.9
52	Run-off	Hill run-off.	46	51.6832	-9.46059	499003.7	548875.7
53	Run-off	Hill run-off	47	51.6827	-9.46043	499013.7	548819.8
54	Pier	End of pier.	48	51.6818	-9.46201	498902.4	548721.9
55	Drain	Drain near supermarket and campsite.	49	51.68129	-9.45825	499161.3	548660
56	Pier	Main pier.	No photo	51.68056	-9.46168	498922.5	548583.5
57	Pipe	Pipe.	50	51.6785	-9.46556	498649.6	548359.7
58	Drain	Outfall opposite Bantry House gate.	51	51.67772	-9.4676	498506.8	548275.8
59	Pipe	Pipe, no sample as no evidence of pollution.	52	51.67767	-9.46815	498468.6	548271
60	Pipe	Pipe, no sample as no evidence of pollution.	53	51.67759	-9.46353	498788	548255.7
61	Pipe	Pipe, no sample as no evidence of pollution.	54	51.6754	-9.46871	498424.8	548019.3
62	Pipe	Pipe, sample taken due to algal growth.	55	51.67752	-9.4688	498423.4	548255.2
63	Stream	Outflow stream.	56	51.67743	-9.46582	498629.2	548241.1
64	Slip	Slipway opposite graveyard, no evidence of pollution.	57	51.67859	-9.47267	498158.1	548379.6
65	Jetty	Jetty to east (50 m) restricted access.	58	51.67589	-9.49267	496769	548107.4
66	Pipes	6 x pipes. No water active or evidence of pollution.	59	51.67817	-9.47341	498106	548334
67	Stream	Stream, no evidence of contamination.	60	51.67764	-9.47797	497789.5	548281.4
68	Stream	Stream, algal growth.	61	51.67759	-9.47994	497653.2	548278.6
69	Pipe	Pipe- no sample as no evidence of contamination.	62	51.67759	-9.48006	497644.9	548278.7
70	Stream	Stream, good flow and algal growth.	63	51.67749	-9.48046	497617	548268.2
71	Stream	Stream, no evidence of contamination.	No photo	51.67777	-9.4819	497518	548301.3
72	Beach	Beach, no evidence of contamination.	64	51.67791	-9.48263	497467.9	548317.9
73	Pipe	No sample as no water or evidence of contamination.	65	51.67628	-9.49051	496919.2	548147.7
74	Run-off	Discharge from cliff, evidence of algae on cliff nearest waste treatment facility.	66	51.67336	-9.49219	496796.4	547825.3

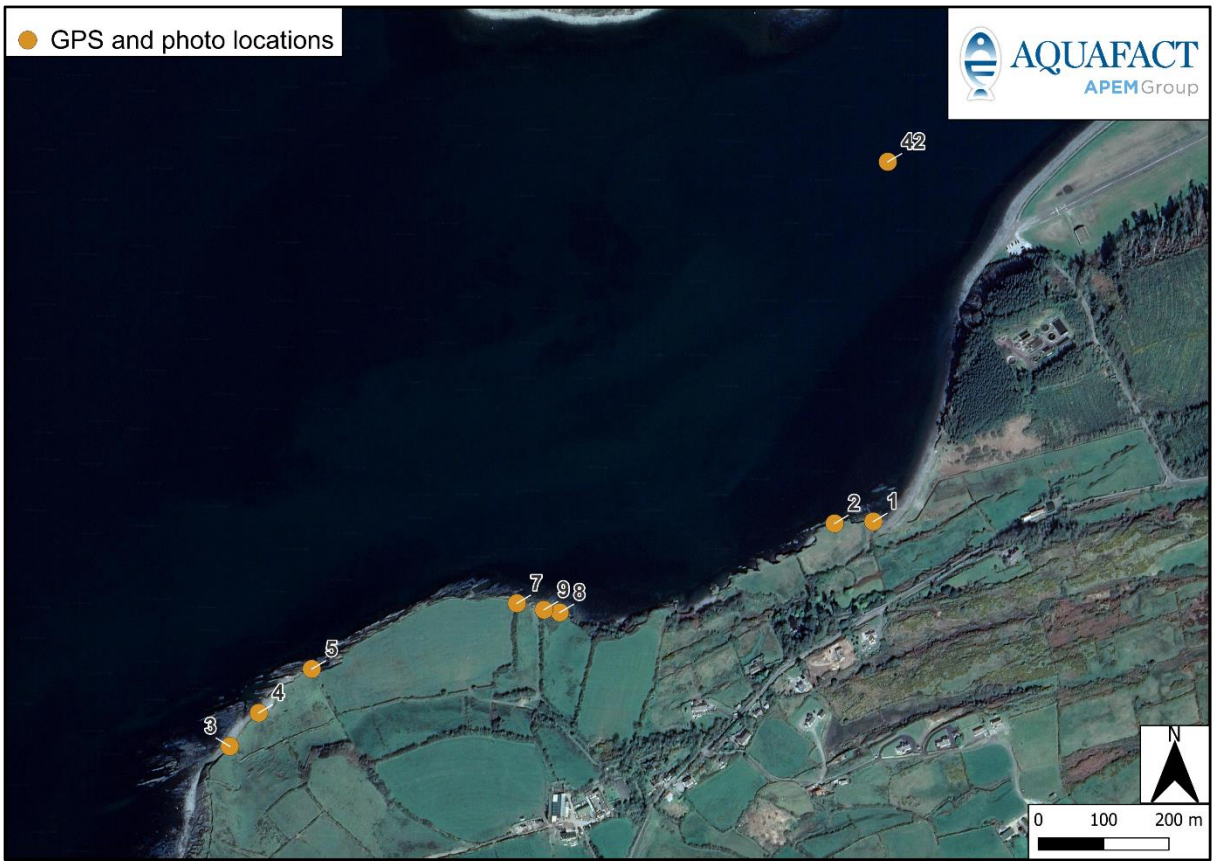


Figure 7-21: Features 1-5, 7-9, and 42 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

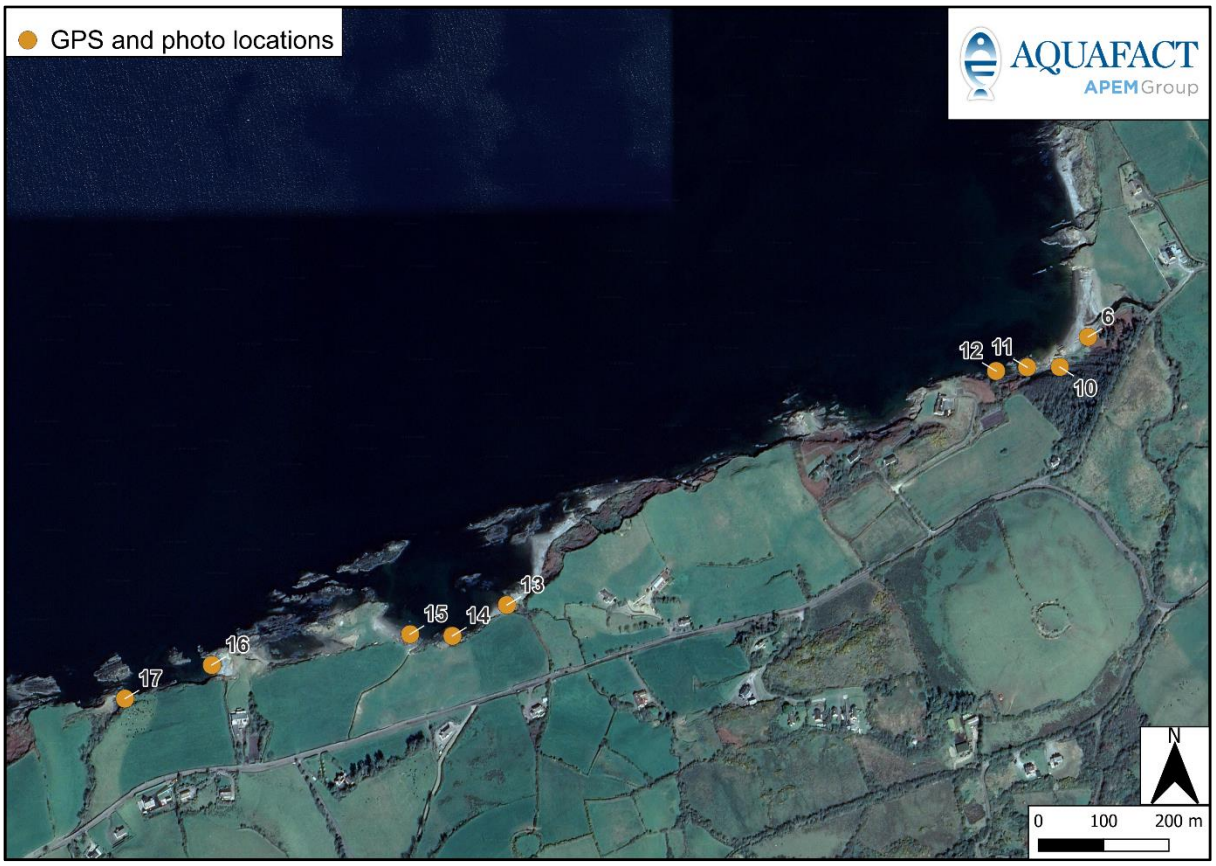


Figure 7-22: Features 6 and 10-17 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-23: Features 18, 19, 37, and 38 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

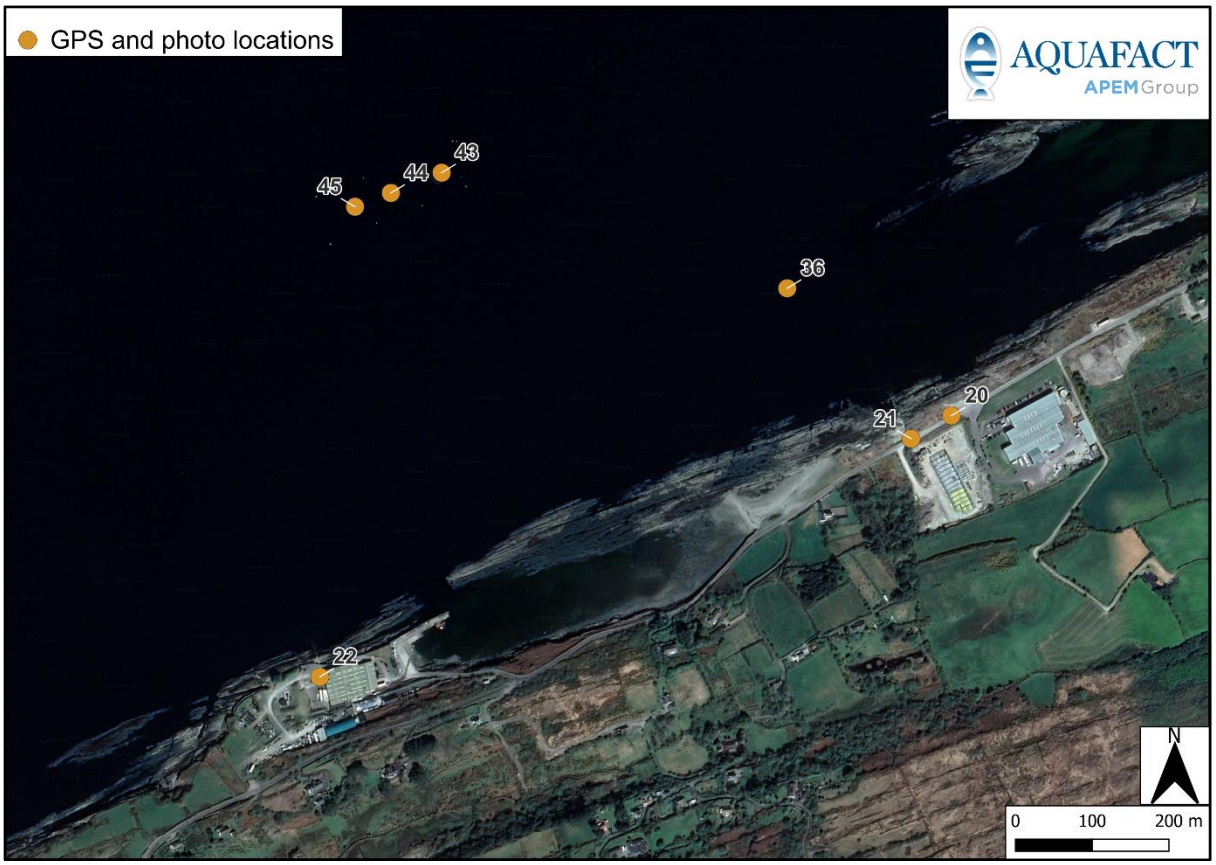


Figure 7-24: Features 20-22, 36, and 43-45 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-25: Features 31-35 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-26: Features 25-30 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-27: Features 23-24 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

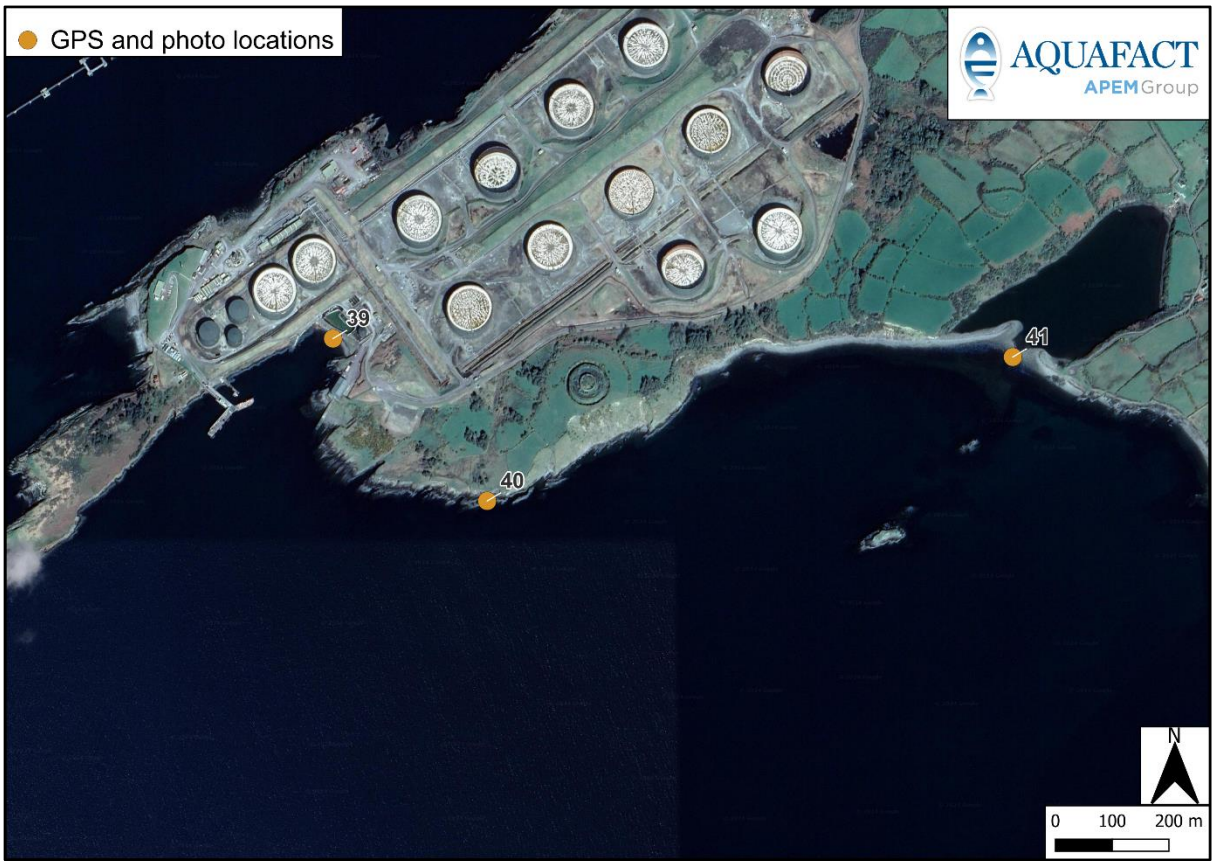


Figure 7-28: Features 39-41 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

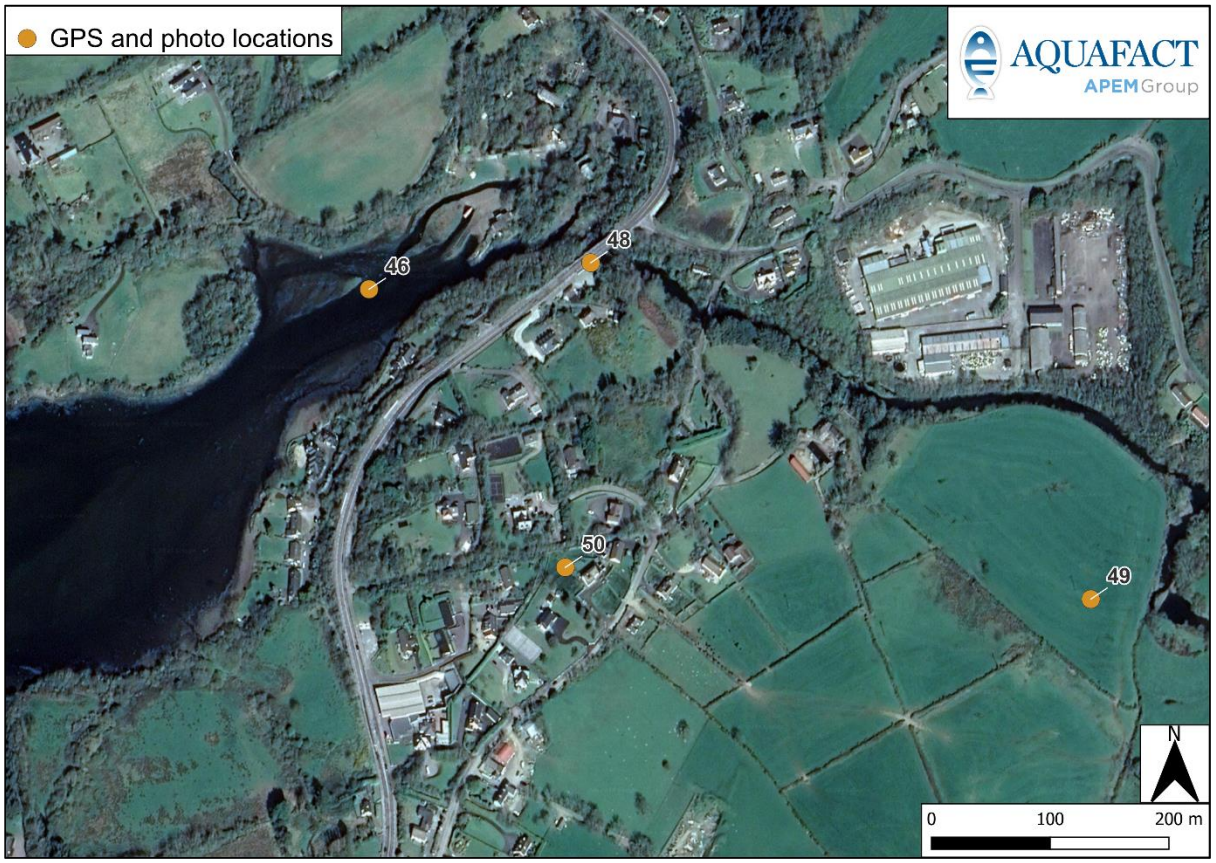


Figure 7-29: Features 46, and 48-50 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

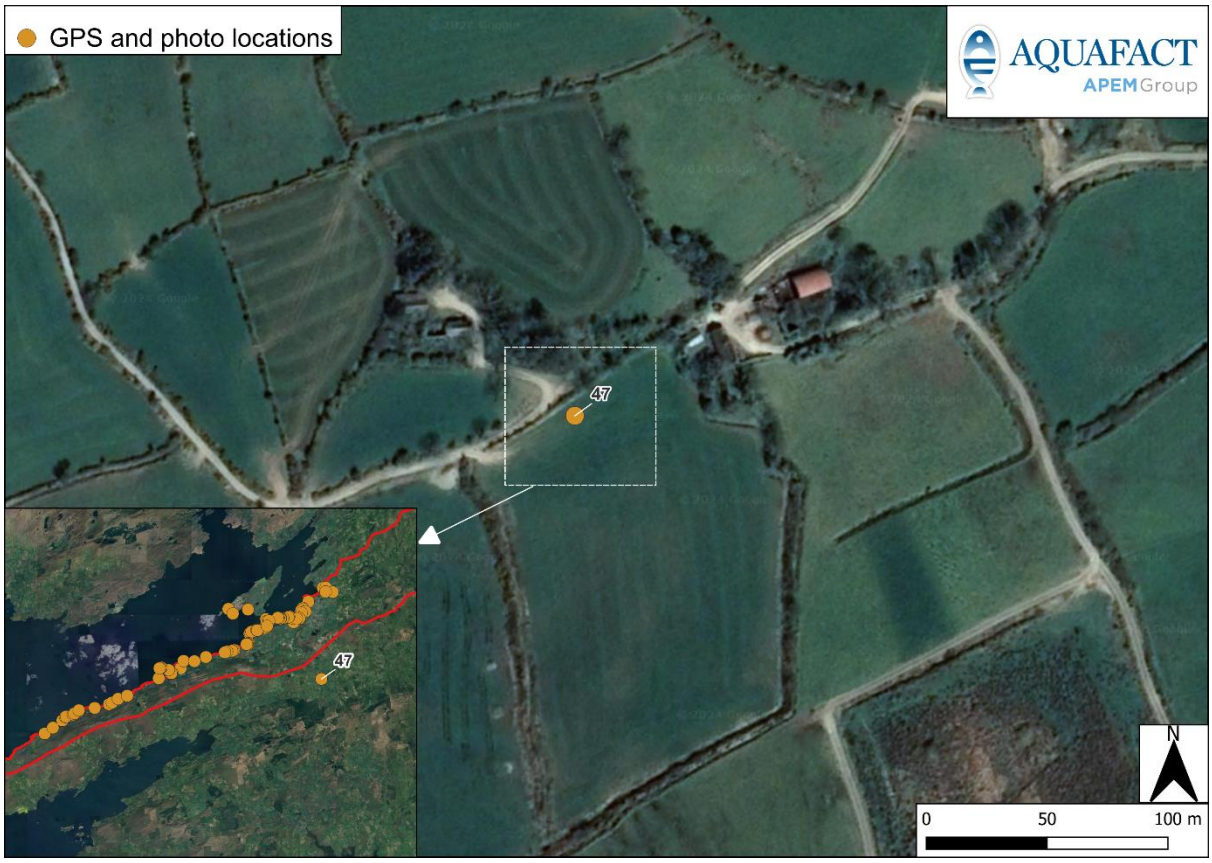


Figure 7-30: Feature 47 identified during the shoreline survey (numbering cross-referenced to Table 7.10). Note that feature 47 was described in the shoreline observations as being adjacent to features 46 and 48, however the GPS coordinates for feature 47 place it outside of the contributing catchment. Therefore, an error was made in recording the coordinates of this feature, consequently it can be discounted.

Figure 7-31: Features 51-56 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-32: Features 57-63 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

Figure 7-33: Features 64-74 identified during the shoreline survey (numbering cross-referenced to Table 7.10).

7.2.2. Locations of Sources

Figure 7-34 shows all rivers/streams that discharge into Bantry Gearhies and **Table 7.11** provides cross-referenced details. **Figure 7-35** shows all discharges into Bantry Gearhies contributing catchment and **Table 7.12** provides cross-referenced details for industrial discharges, drains, pipes, rivers, and stream discharges.

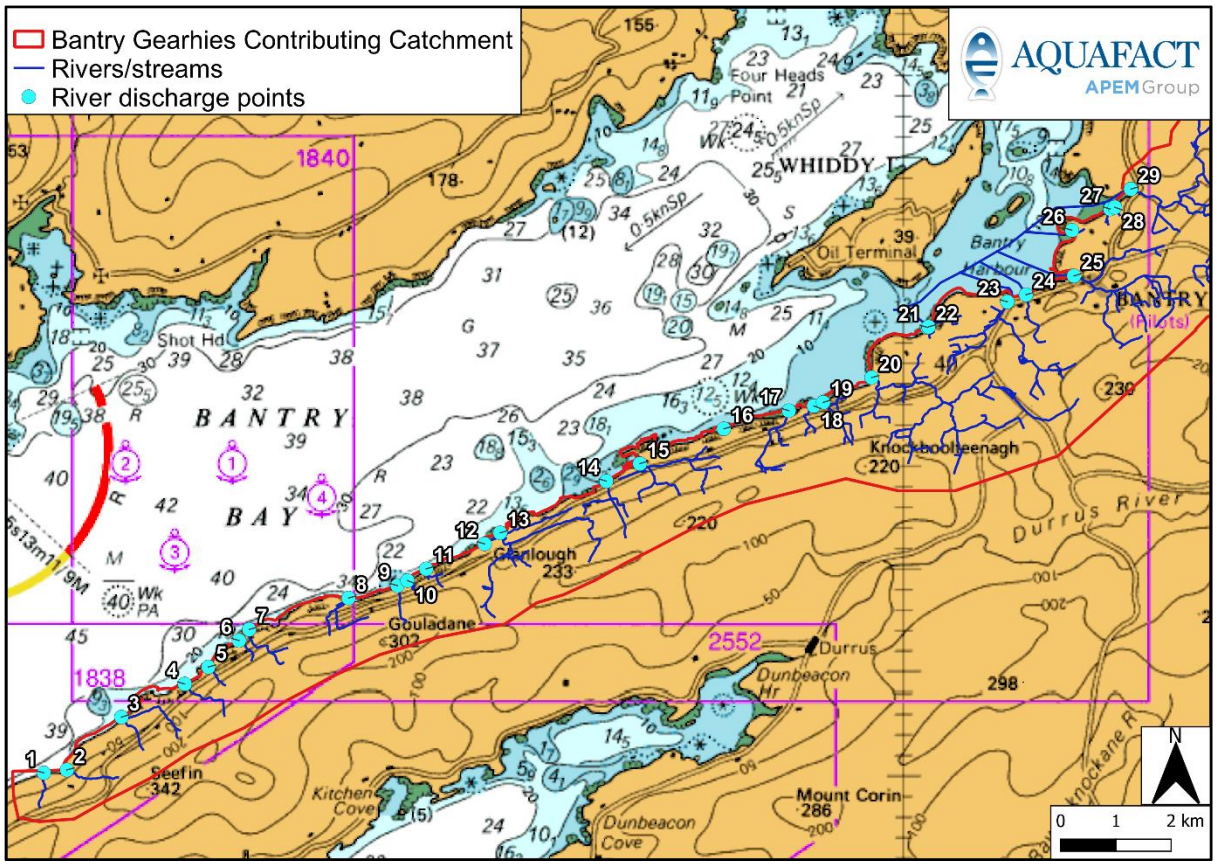


Figure 7-34: Locations of all river/stream discharge points into Bantry Gearhies.

Table 7.11: River/stream discharge points that discharge from the contributing catchment into the Bantry Gearhies east and west production areas. Map IDs are cross-referenced to Figure 7-34.

Map ID	River/stream	Map ID	River/stream
1	Glanalin	**16**	Unnamed
2	Killeen North	**17**	Unnamed
3	Unnamed	**18**	Rooska East
4	Unnamed	**19**	Unnamed
5	Gouladoo	**20**	Hollyhill 21
6	Unnamed	**21**	Unnamed
7	Unnamed	**22**	Unnamed
8	Foilakilly	**23**	Dromleigh North
9	Unnamed	**24**	Seafield 21
10	Unnamed	**25**	Bantry
11	Unnamed	**26**	Reenrour East
12	Unnamed	**27**	Unnamed
13	Fahane 21	**28**	Lahadane 21
14	Unnamed	**29**	Mealagh
15	Unnamed		

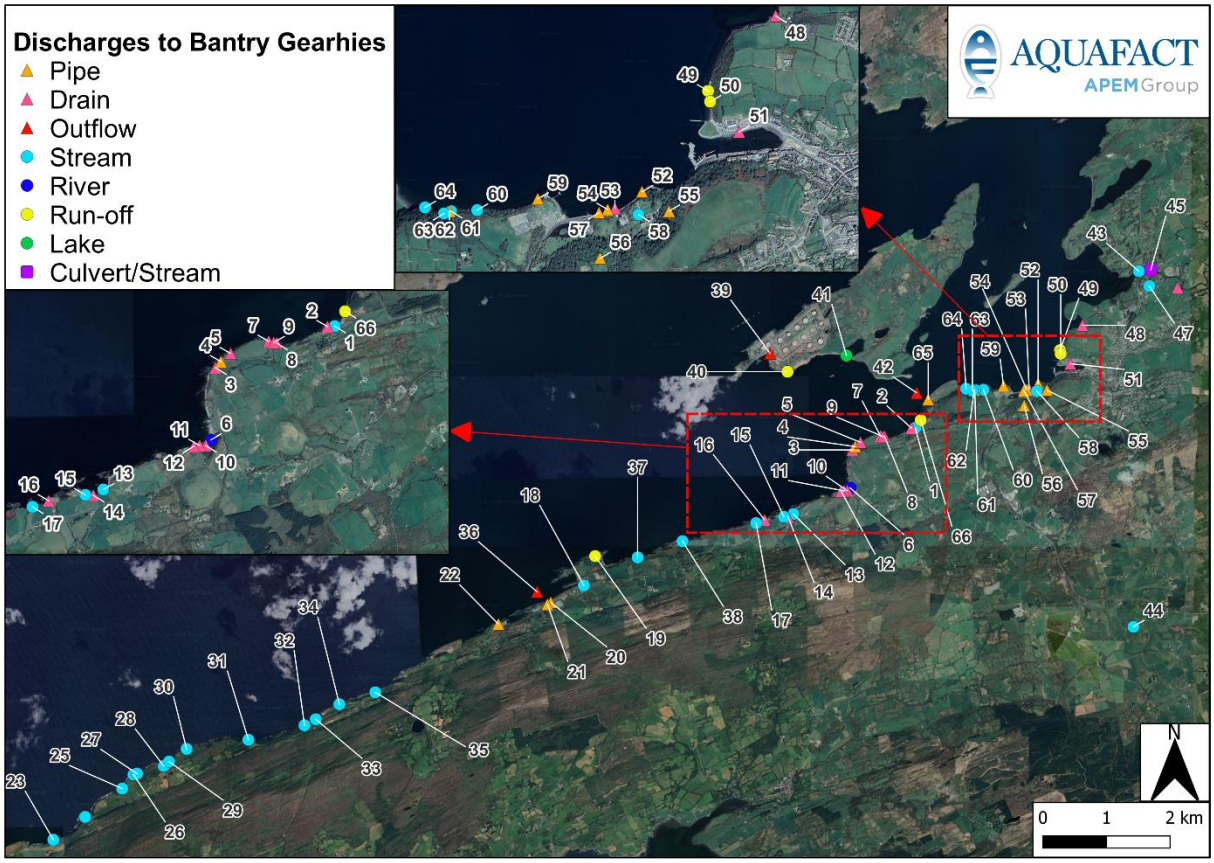


Figure 7-35: Locations of discharges, as observed during the shoreline surveys, into the Bantry Gearhies east and west bivalve mollusc production areas. Note observation 44 can be discounted as an error was made in recording the GPS coordinates for this point.

Table 7.12: Locations of discharges, as observed during the shoreline surveys, that discharge into the Bantry Gearhies east and west bivalve mollusc production areas. Cross-referenced to Figure 7-35. Latitude and longitude values are in coordinate reference system (CRS) WGS84, easting and northing values are in CRS Irish Transverse Mercator[46]. * marks an error in the observation coordinates, this observation should be discounted.

No.	Observations	Comments	Latitude	Longitude	Easting	Northing
1	Small stream	Airstrip, water mostly clear, slight foam, agricultural grazing land surrounds. Second shoreline survey noted stream through marsh grounds feeding into the bay.	51.67226	-9.49344	496707.5	547704.9
2	Land drain	Grazing grassland surrounds.	51.67224	-9.4943	496648.2	547703.1
3	Land drain	Running clear.	51.66918	-9.50769	495714.9	547382.2
4	Concrete pipe drain	Running clear.	51.66964	-9.50705	495760.4	547432.3
5	Land drain	Running clear.	51.67024	-9.50587	495842.9	547497.6
6	Medium sized river	Shanvally beach main river sampling point.	51.66384	-9.50823	495665.2	546788.8
7	Land drain	Running mostly clear, slight foam, agricultural land surrounds.	51.67114	-9.50133	496159.2	547591.3
8	Land drain	Running clear, agricultural land surrounds.	51.67102	-9.50038	496224.5	547576.1
9	Land drain	Running clear, two drains merging.	51.67105	-9.50073	496200.4	547580.7
10	Land drain	Running clear onto strand west of Shanvally River, beech woodland surrounds.	51.66342	-9.50886	495620.9	546743.8
11	Land drain	Beech woodland surrounds.	51.66342	-9.50958	495570.9	546744.4
12	Land drain	Mud slide from cliff face.	51.66337	-9.51027	495523.2	546739.7
13	Stream	Sampling point.	51.66016	-9.5211	494766.4	546398.1
14	Land drain	Running clear.	51.65973	-9.52231	494682	546352.7
15	Stream	Running clear.	51.65976	-9.52324	494617.2	546356.6
16	Land drain	Curraghavaddra beach drain.	51.65934	-9.52764	494312.5	546316
17	Stream	Sampling point.	51.65887	-9.52956	494178.3	546267.4
18	Stream	Sampling point.	51.65012	-9.56866	491452.3	545351
19	Cliff face run-off	Cliff face water run-off point.	51.65423	-9.56609	491639.8	545804.8
20	Outflow pipe	Keohanes Seafood outflow pipe 1 sampling point.	51.64773	-9.57617	490926.9	545096.5
21	Outflow pipe	Keohanes Seafood outflow pipe 2.	51.64746	-9.57693	490873.7	545067.6
22	Outflow pipe	Outflow pipe.	51.64468	-9.58806	490096.9	544775.2
23	Stream	Stream to shore run-off.	51.61432	-9.68908	483028.2	541555.3

No.	Observations	Comments	Latitude	Longitude	Easting	Northing
24	Stream	Stream to shore run-off.	51.61754	-9.68186	483536	541901.7
25	Stream	Stream to shore run-off.	51.62152	-9.67344	484129.7	542331.1
26	Stream	Stream to shore run-off.	51.62349	-9.67089	484311	542545.6
27	Stream	Stream to shore run-off.	51.62363	-9.6701	484366.1	542560.5
28	Stream	Stream to shore run-off.	51.62471	-9.664	484790.8	542670.4
29	Stream	Stream to shore run-off.	51.62532	-9.66281	484874.9	542736.8
30	Stream	Stream to shore run-off.	51.62711	-9.65884	485154.3	542929.4
31	Stream	Stream to shore run-off.	51.62839	-9.6448	486129.5	543050
32	Stream	Stream to shore run-off.	51.63043	-9.63207	487015.8	543257.5
33	Stream	Stream to shore run-off.	51.63128	-9.6295	487195.7	543348.2
34	Stream	Stream to shore run-off, upland agricultural grazing.	51.63339	-9.62415	487571.3	543574.4
35	Stream	Stream to shore run-off.	51.63508	-9.61601	488139.4	543749.4
36	Outflow pipe	Outflow pipe - water sample taken.	51.64922	-9.57926	490716.6	545266.3
37	Stream	Stream to shore run-off.	51.65405	-9.55645	492306.5	545770.4
38	Stream	Stream to shore run-off.	51.65633	-9.54626	493016.7	546008.9
39	Whiddy Island outflow	Whiddy Island outflow pipe running to shore.	51.68274	-9.52637	494454.4	548917
40	Land run off	Land run-off water brown in colour.	51.68017	-9.52244	494720	548626.3
41	Kilmore Lake	Béal Tonnta strand adjacent to Kilmore Lake outflow to sea.	51.68244	-9.50906	495650.8	548859.7
42	Bantry Water Treatment outflow (Sea)	Wastewater treatment plant outflow at Bantry airstrip.	51.6772	-9.49312	496741	548253.4
43	Stream	Stream 1 (sample 1) fed by stream 2 via culvert in photo.	51.6943	-9.44269	500265.8	550085.7
44*	Stream	Stream 3 entering stream 1.	51.6443	-9.44393	500070.1	544525.8
45	Culvert/Stream	Stream 2 entering via culvert into stream 1.	51.6945	-9.43999	500452.9	550104.3
46	Drain	Drain from residential houses feeding into the bay.	51.69196	-9.4339	500868.3	549813.5
47	Stream	Stream running through agricultural land via a marsh into the bay.	51.6922	-9.4403	500426.4	549848.9
48	Drain	Beach drain.	51.6867	-9.4555	499363.4	549257.9
49	Run-off	Hill run-off.	51.6832	-9.46059	499003.7	548875.7
50	Run-off	Hill run-off.	51.6827	-9.46043	499013.7	548819.8

No.	Observations	Comments	Latitude	Longitude	Easting	Northing
51	Drain	Drain near supermarket and campsite.	51.68129	-9.45825	499161.3	548660
52	Pipe	Pipe.	51.6785	-9.46556	498649.6	548359.7
53	Drain	Outfall opposite Bantry House gate.	51.67772	-9.4676	498506.8	548275.8
54	Pipe	Pipe, no sample taken as no evidence of pollution.	51.67767	-9.46815	498468.6	548271
55	Pipe	Pipe, no sample taken as no evidence of pollution.	51.67759	-9.46353	498788	548255.7
56	Pipe	Pipe, no sample taken as no evidence of pollution.	51.6754	-9.46871	498424.8	548019.3
57	Pipe	Pipe, sample taken due to algal growth.	51.67752	-9.4688	498423.4	548255.2
58	Stream	Outflow stream.	51.67743	-9.46582	498629.2	548241.1
59	Pipes	6 x pipes. No water active or evidence of pollution.	51.67817	-9.47341	498106	548334
60	Stream	Stream, no evidence of contamination.	51.67764	-9.47797	497789.5	548281.4
61	Stream	Stream, algal growth.	51.67759	-9.47994	497653.2	548278.6
62	Pipe	Pipe, no sample no evidence of contamination.	51.67759	-9.48006	497644.9	548278.7
63	Stream	Stream; good flow and algae growth.	51.67749	-9.48046	497617	548268.2
64	Stream	Stream, no evidence of contamination.	51.67777	-9.4819	497518	548301.3
65	Pipe	No sample taken, no water or evidence of contamination.	51.67628	-9.49051	496919.2	548147.7
66	Run-off	Discharge from cliff, evidence of algae on cliff nearest waste treatment facility.	51.67336	-9.49219	496796.4	547825.3

8. Appendix 2: Hydrography/Hydrodynamics

8.1. Simple/Complex Models

The environmental conditions of Bantry Bay are described in a Water Quality Modelling Report by RPS (2015) and in the 2012 Bantry Harbour Development Environmental Impact Statement by RPS[7] which include hydrodynamic modelling of the bay. Additionally, AQUAFACT recently ran a three-dimensional hydrodynamic model of Bantry Bay (AQUAFACT, 2024 *unpubl.*). These reports have been used to describe the hydrodynamics of Bantry Bay in relation to Bantry Gearhies east and west production areas in the following sections.

8.2. Depth

Bantry Bay is predominantly subtidal and deepens gradually from 30 m near Whiddy Island to greater than 70 m at the mouth of the bay (Raine *et al.*, 1993). **Figure 8-1** illustrates the bathymetry of Bantry Bay.

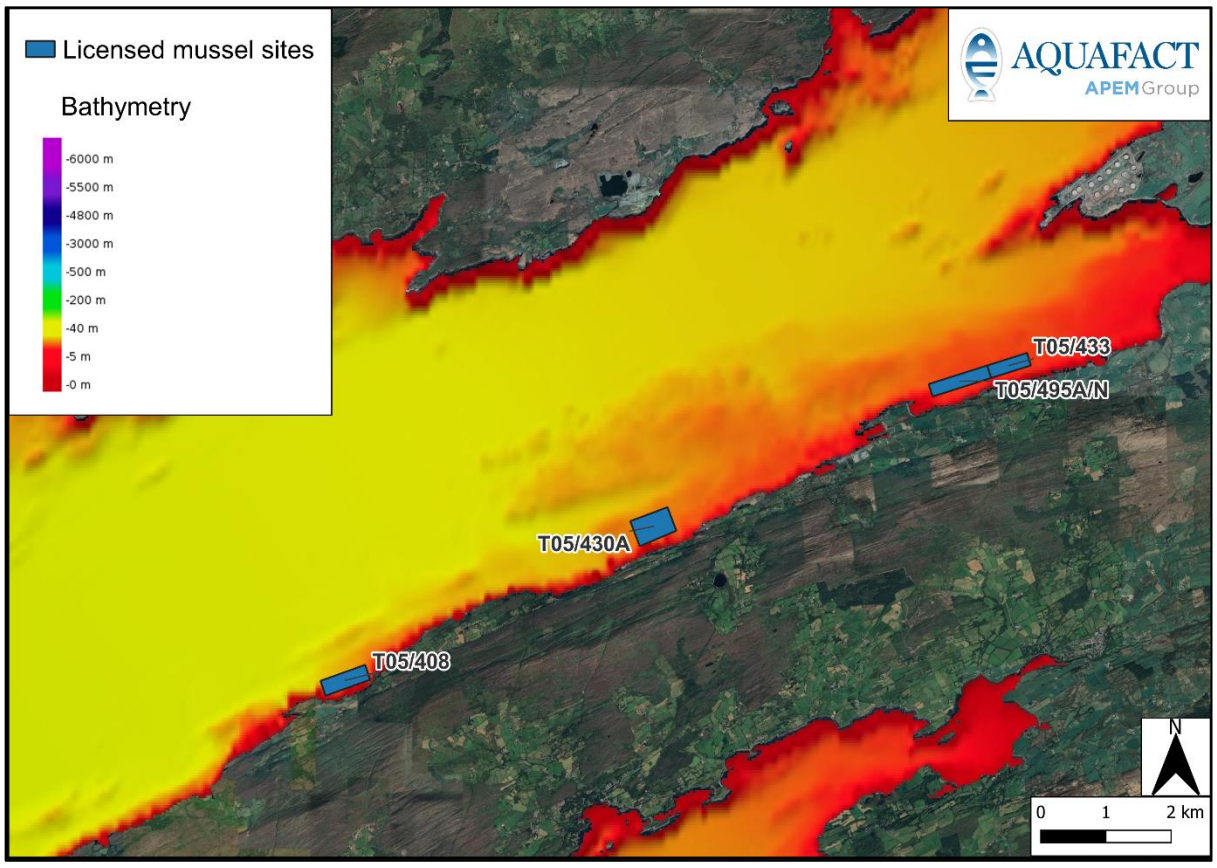


Figure 8-1: Bantry Bay bathymetry (source: EMODnet; licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence).

8.3. Tides and Currents

The mean spring tidal range within Bantry Bay is 2.9 m and the mean neap tidal range is 1.5 m [7]. Tidal currents are generally low at 0.0–0.2 m/s^2 [7]. Large areas of the bay are characterised by weak residual currents

(Dabrowski *et al*., 2016). Significant eddying is incurred due to the domination of flow patterns by meteorological and wave induced conditions (RSP, 2012). Residual currents may be used to assess flow characteristics and dispersion potential (RPS, 2015). RPS (2015) found that Bantry Bay has relatively low residual currents in the main body and around the Bantry Gearhies production areas (RSP, 2015). Overall, Bantry Bay has a weak current regime. The model simulations run by AQUAFACT (2024, *unpubl.*) align with these findings. The simulations from this model showed that around the Bantry Gearhies production areas on an ebbing tide, water flow is in an almost linear, northeast to southwest direction, and the opposite is apparent on a flooding tide. Mean current speeds on neap tides were in the region of 0.08-0.12 m/s and on spring tides this increased to a mean of 0.12-0.20 m/s.

8.4. Wind and Waves

Wind data from 2018 to 2022 from Sherkin Island Met Éireann station (**Figure 8-6**), Co. Cork[47] are displayed in **Table 8.1** and **Table 8.2** below, and wind roses for each corresponding year can be seen in **Figure 8-2**.

In 2018, *c*. 15% of the wind came from the southwest, *c*. 12% came from the west-southwest, and *c.* 9% came from the south-southwest. The strongest winds came from the west-southwest. In 2019, *c*. 14% came from the southwest, *c*. 12% came from the west-southwest, and *c*. 11% came from the west-northwest. The strongest winds came from the west-southwest. In 2020, *c*. 18% of the wind came from the southwest, *c*. 13% came from the west-southwest, and *c*. 9% came from the west-northwest. The strongest winds came from the west-southwest. In 2021, *c.* 12% came from the west-southwest, *c.* 11% of the wind came from the southwest, and *c*. 10% of the wind came from the west-northwest. The strongest winds came from the south-southwest. In 2022, *c*. 17% of wind came from the west-southwest, *c*. 10% came from the southwest, and *c*. 9% from west-northwest. The strongest winds came from the west-southwest. It can be seen from the wind roses for 2018-2022 (**Figure 8-2**) that the prevailing wind direction comes from the southwest.

Table 8.2 shows the seasonal wind averages from 2018 to 2022. Seasons were selected by grouping the results from the following periods: spring (March-May), summer (June-August), autumn (September-November), and winter (December-February). Seasonal averages over the past five years indicate that winds are typically strongest in the winter months (15.4 kn), followed by autumn (13 kn), spring (12 kn), and summer (10.1 kn).

Table 8.1: Wind speed (knots) and mean wind direction for Sherkin Island Met Éireann station, Co. Cork from 2018-2022 (source: Met Éireann[47]).

	2018		2019		2020		2021		2022	
Month	**Average of wind speed**	**Average of Wind Direction**	**Average of wind speed**	**Average of Wind Direction**	**Average of wind speed**	**Average of Wind Direction**	**Average of wind speed**	**Average of Wind Direction**	**Average of wind speed**	**Average of Wind Direction**
January	17.6	217	11.6	232	14.8	201	12.0	196	11.7	181
February	14.3	205	16.6	195	21.5	235	17.2	174	18.8	247
March	12.4	161	14.4	219	14.8	171	12.9	188	11.7	141
April	12.2	164	13.0	151	10.0	130	11.0	149	11.5	172
May	9.5	171	10.1	192	12.2	142	12.5	211	11.3	210
June	8.7	160	10.7	202	11.7	215	9.8	193	11.2	202
July	8.5	200	9.1	205	11.7	227	9.1	202	9.0	208
August	10.5	231	12.3	218	10.4	201	9.8	182	9.2	187
September	11.3	208	12.1	206	10.9	196	10.3	186	10.4	195
October	11.0	193	13.5	192	15.3	219	12.1	208	14.7	198
November	16.6	161	14.1	222	14.5	189	10.5	236	17.4	216
December	15.5	206	15.7	195	15.2	238	14.9	196	13.9	153

Table 8.2: Five-year seasonal average wind speed (knots) for Sherkin Island Met Éireann station, Co. Cork (source: Met Éireann[47]).

Season	2018	2019	2020	2021	2022	5-Year Average
Autumn	12.9	13.2	13.6	11.0	14.2	13.0
Spring	11.4	12.5	12.4	12.1	11.5	12.0
Summer	9.2	10.7	11.3	9.6	9.8	10.1
Winter	15.9	14.6	17.1	14.6	14.7	15.4

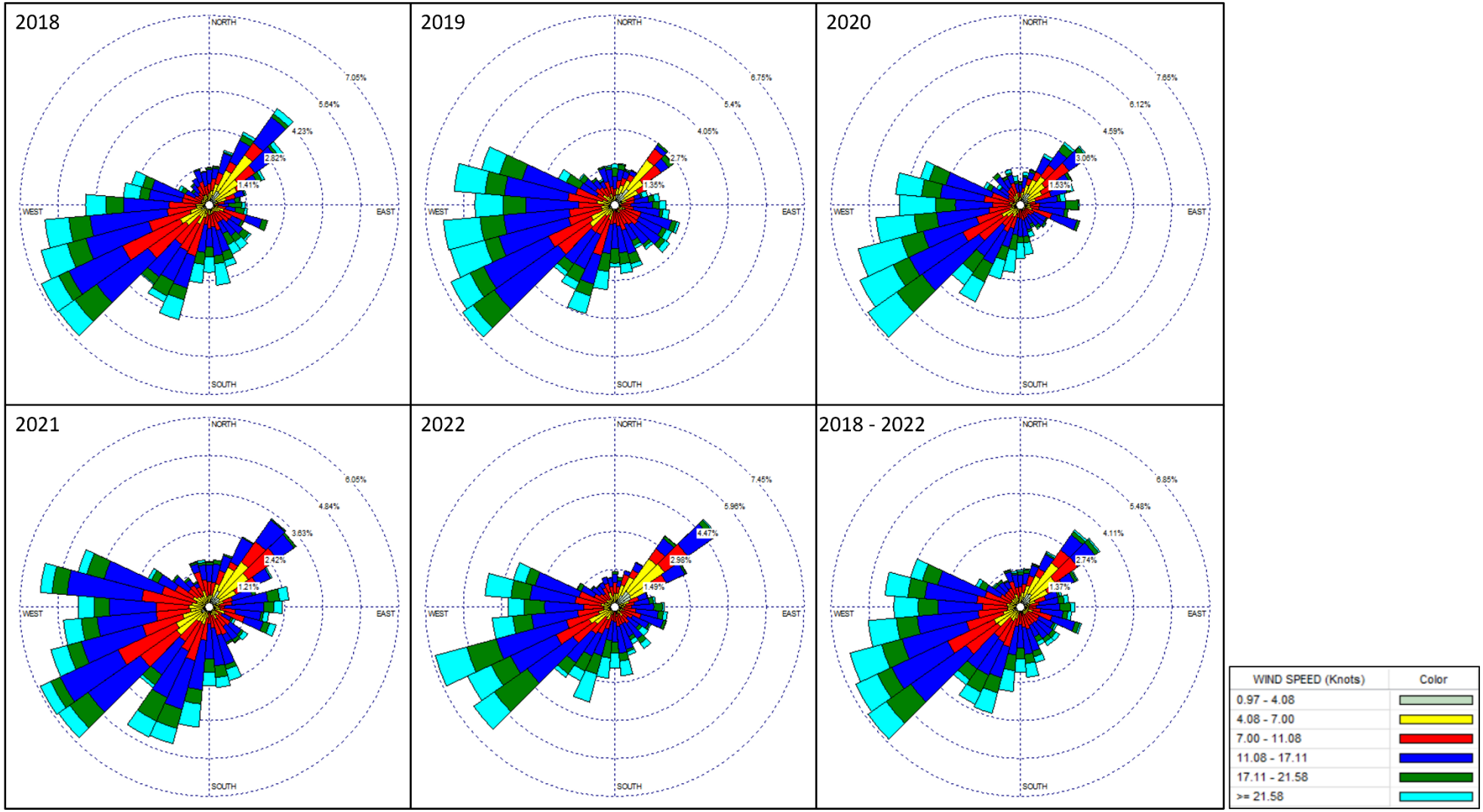


Figure 8-2: Wind roses for Sherkin Island Met Éireann station, Co. Cork from 2018 to 2022 (source: Met Éireann[47]).

8.5. River Discharges

There is one WFD river sub-basin which drains into Bantry Gearhies production areas and four river sub-basins which partially drain into the east and west production areas, covering an area of 105.46 km^2; within these river sub-basins there are five corresponding river water bodies (see **Figure 8-3** for coastal water bodies and river sub-basins, and **Figure 8-4** for river water bodies). There are some additional river sub-basins that slightly overlap with the Bantry Gearhies contributing catchment boundary, but, as they do not drain into the Bantry Gearhies production areas, they have not been considered in this report. As the drainage area calculated incorporates these river sub-basins which discharge outside of Bantry Gearhies, an approximation of the area which drains into Bantry Gearhies only was made using QGIS to avoid an over-estimation of the area, returning a value of *c.* 90.57 km^2.

The contributing catchment is dominated by the Mealagh_010 and _020 WFD River sub-basins which combined drain *c.* 61.7% of the contributing catchment. Bantry_010 River sub-basin drains *c.* 17.2% of the contributing catchment, and Fahane_010 and Glanroon_010 River sub-basins combined drain *c.* 21.1% of the contributing catchment.

The 2016-2021 WFD status of Bantry Gearhies and its associated freshwater and coastal sources can be seen in **Figure 8-3**. Of the river systems flowing directly into Bantry Gearhies, all water bodies were of High status, except for Bantry which was of Good status. Bantry Gearhies coastal water body (CWB) was of High status for the same monitoring period. The Mill River, part of the Bantry_010 sub-basin, was the only riverine water body with water level measurements. Over the period December 2022 to November 2023, the daily mean water level was 8.24 m. October and November had the highest daily mean water levels, and the maximum daily level was recorded in August at 8.68 m. Flow measurements were not available for the other relevant water bodies at the time of writing this report.

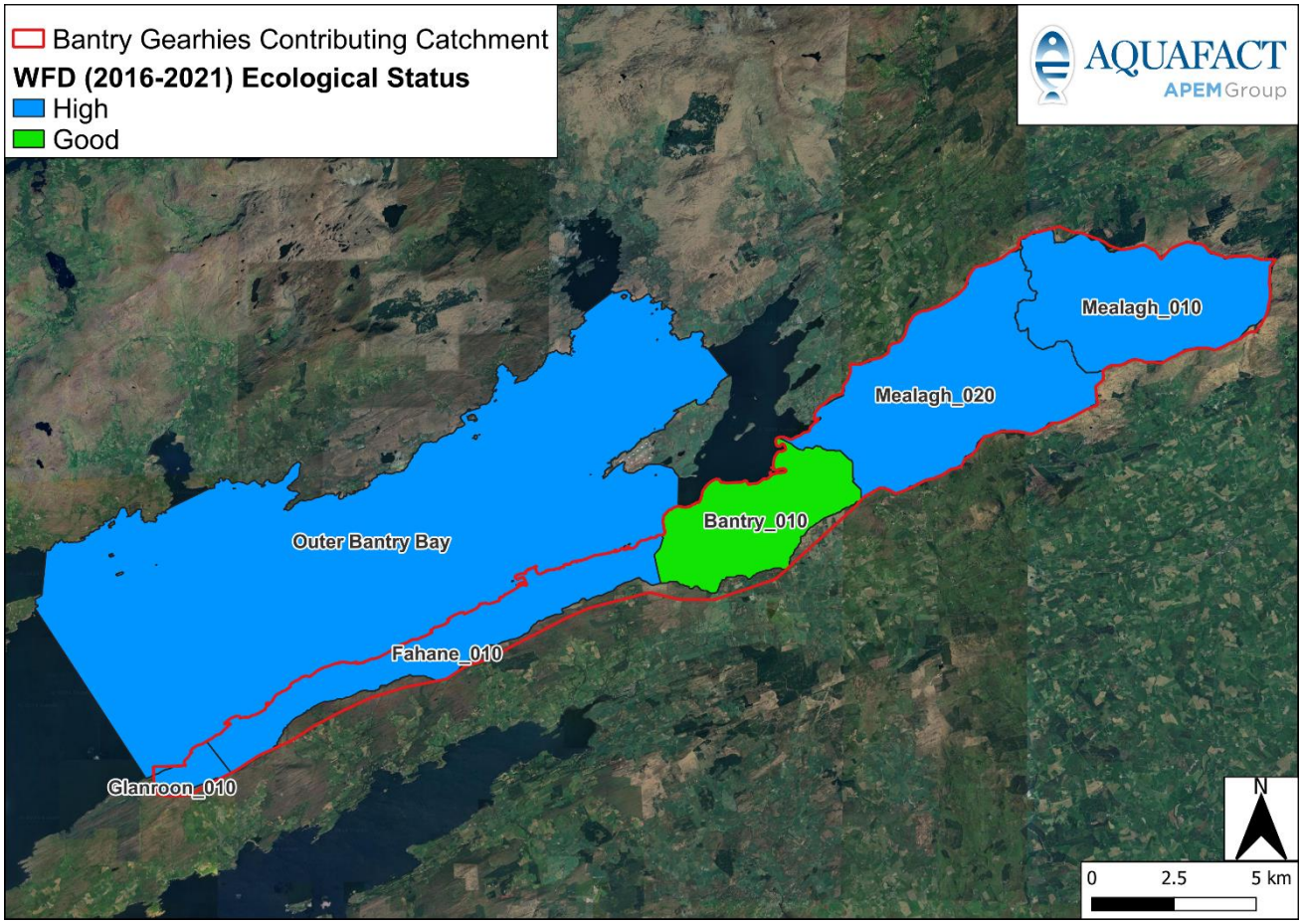


Figure 8-3: Water Framework Directive (WFD) 2016-2021 ecological status of river sub-basins within Bantry Gearhies contributing catchment (source: EPA[15]).

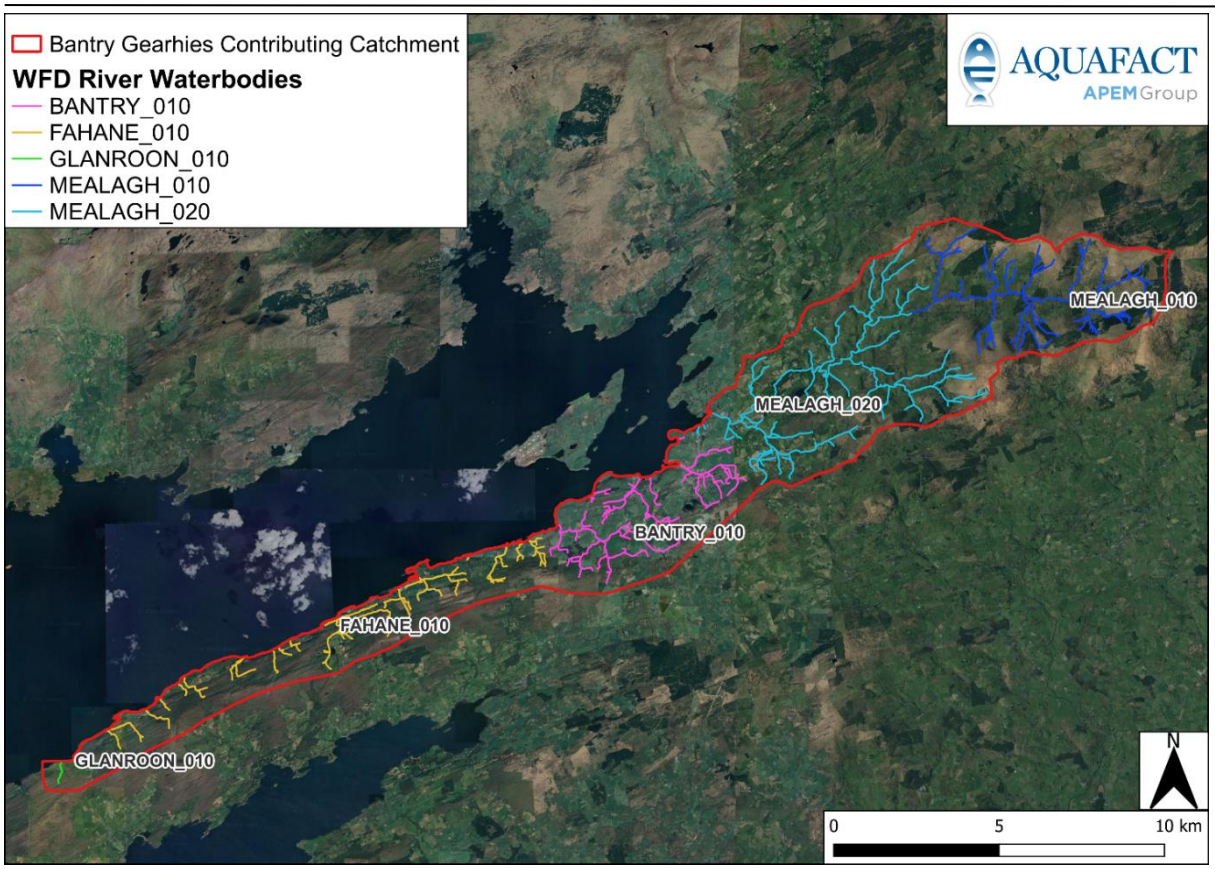


Figure 8-4: Water Framework Directive (WFD) river water bodies within Bantry Gearhies contributing catchment (source: EPA[15]).

8.6. Rainfall Data

8.6.1. Amount and Time of Year

In this section, data from the Glengarriff (Ilnacullin) Met Éireann station, situated in Bantry Bay (**Figure 8-6**), was used to investigate long term rainfall patterns, *i.e.,* over a 30-year period, and rainfall patterns over a recent 5-year period, *i.e.,* 2018-2022. Glengarriff (Ilnacullin) Met Éireann station is located in Glengarriff Bay, *c.* 10.44 km from Bantry Gearhies[41]. **Figure 8-5** shows the average monthly rainfall data for Ireland from 1991 to 2020 (Met Éireann[47]). The wettest months overall during this period were October-January. The wettest months in the Bantry Gearhies region over the same 30-year period were October to January (> 200 mm) with the driest months from April to June (< 121 mm).

Table 8.3 and **Figure 8-7** show the 30-year average monthly rainfall at the Glengarriff (Ilnacullin) Met Éireann station. During the period of 1992 to 2022, average rainfall at Glengarriff (Ilnacullin) Met Éireann station was lowest in May (117.2 mm) and highest in December (260.2 mm). The greatest daily total ranged from a low of 45.2 mm in May to a high of 100.1 mm in October; note that the data on greatest daily total rainfall (mm) was missing for some years/months within the year. **Table 8.4** shows the seasonal average rainfall data at

Glengarriff (Ilnacullin) Met Éireann station from 1992 to 2022. Lowest average rainfall over the 30-year period was in summer (127.7 mm) with the highest average rainfall experienced in winter (232.2 mm).

1991 – 2020 Averages

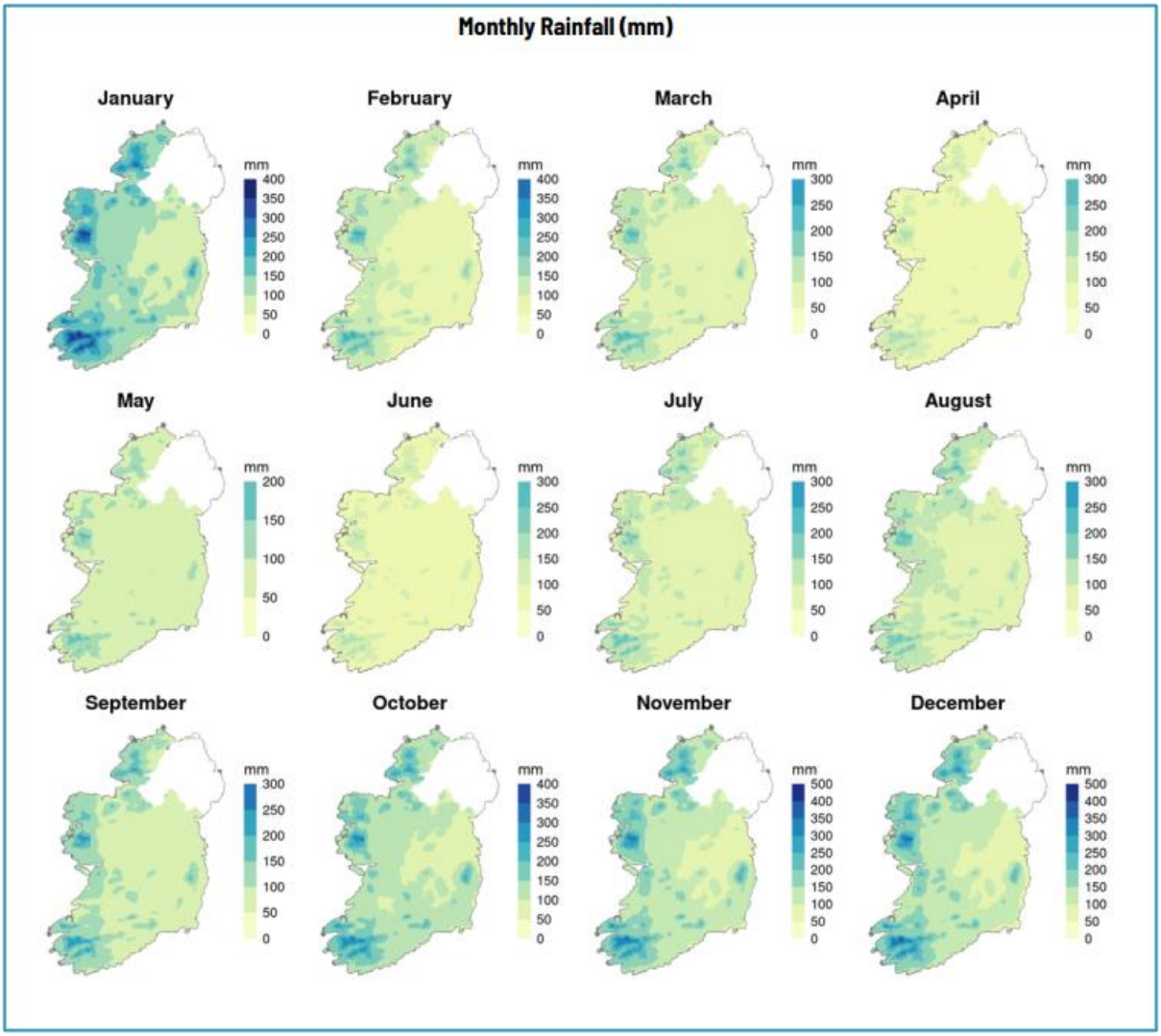


Figure 8-5: Average monthly rainfall (mm) data from 1991-2020 for Ireland (source: Curley *et al.,* 2023).

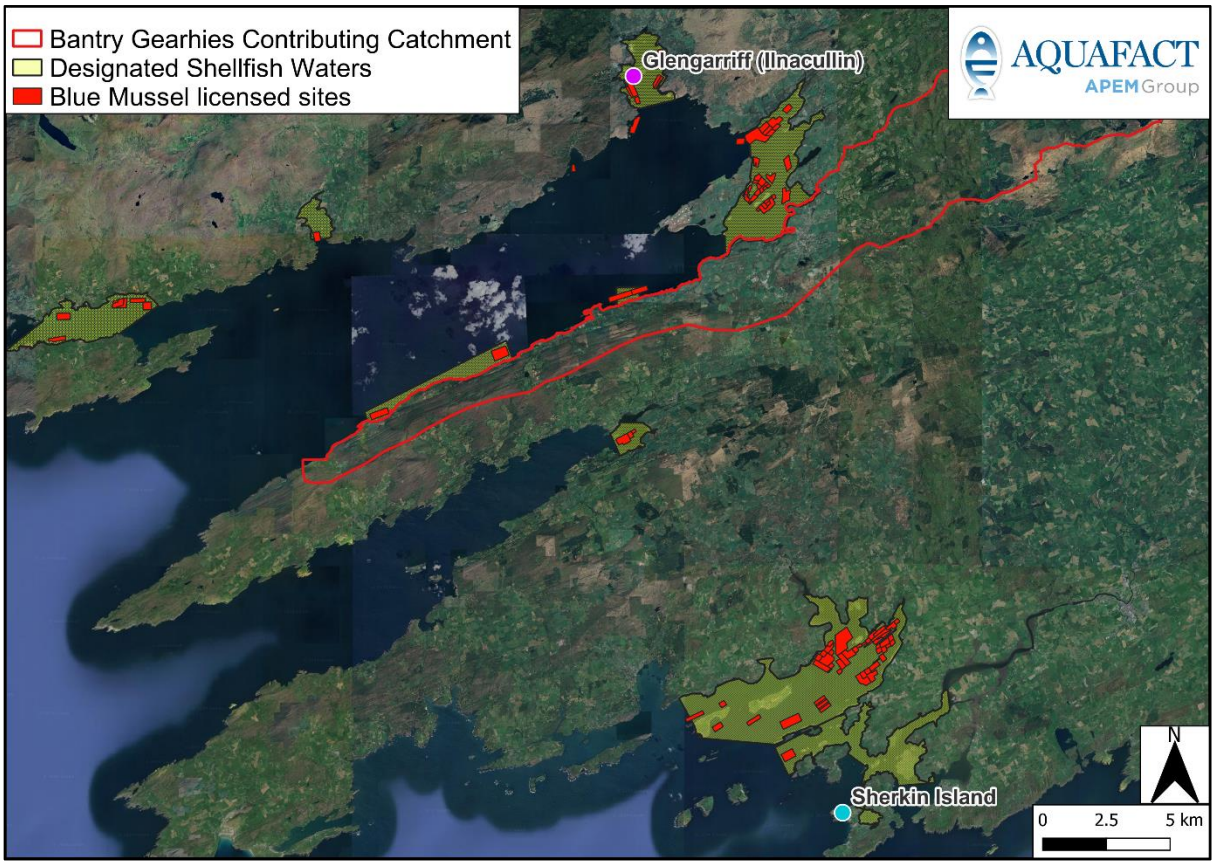


Figure 8-6: Location of Glengarriff (Ilnacullin) Met Éireann station and Sherkin Island Met Éireann station in relation to the Bantry Gearhies east and west bivalve mollusc production areas.

Table 8.3: Monthly average rainfall at Glengarriff (Ilnacullin) Met Éireann station, Co. Cork from 1992 to 2022 (source: Met Éireann[47]).

Average Rainfall (mm)	Month	Greatest Daily Total (mm)
248.2	**January**	79.0
190.1	**February**	55.5
149	**March**	51.0
118.7	**April**	47.0
117.2*	**May**	45.2*
120.1	**June**	64.0
131.8	**July**	81.2
131.1	**August**	52.7
150.8	**September**	86.0
206.1*	**October**	100.1*
220.4*	**November**	68.6*
260.1*	**December**	87.8*

*Data was missing for some months.

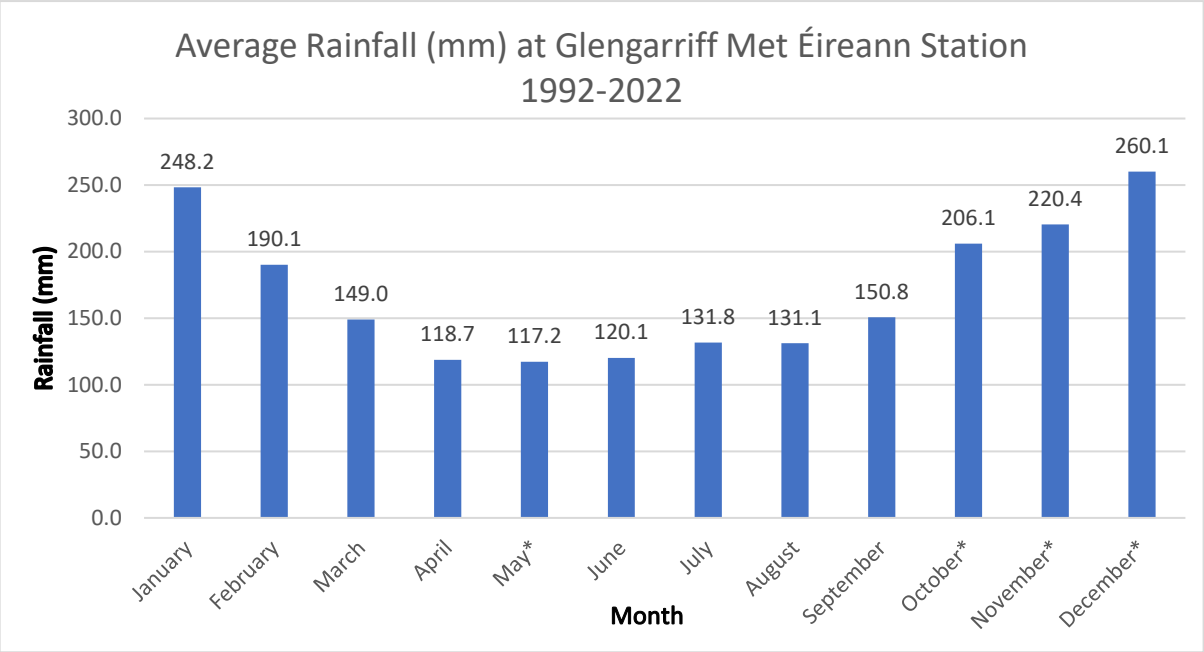


Figure 8-7: Average monthly rainfall (mm) at Glengarriff (Ilnacullin) Met Éireann station from 1992 to 2022 (source: Met Éireann[47]).

Table 8.4: Average seasonal rainfall values (mm) from 1992-2022 at Glengarriff (Ilnacullin) Met Éireann station, Co. Cork (source: Met Éireann[47]).

Season	Average (mm)
Autumn*	192
Spring*	128.4
Summer	127.7
Winter*	232.2

*Data was missing for some months.

Table 8.5 shows the total monthly rainfall at the Glengarriff (Ilnacullin) Met Éireann station (see **Figure 8-8** from 2018 to 2022)[47]. Maximum monthly rainfall on record was in February 2020 (466.2 mm) and the lowest monthly rainfall was in April 2021 (20.5 mm). The 5-year average monthly rainfall ranged from a low of 99.3 mm in April to a high of 301.3 mm in December. Annual average ranged from 117.0 mm in 2022 to 215.4 in in 2020. The 5-year monthly average was 172.13 mm.

Table 8.6 shows the total seasonal rainfall at Glengarriff (Ilnacullin) Met Éireann station from 2018-2022[47]. The following seasonal fluctuations were observed: in 2018, summer was the driest season and winter was the wettest. In 2019, summer was the driest and autumn was the wettest. In 2020, spring was the driest and winter was the wettest. In 2021, summer was the driest and winter was the wettest. In 2022, autumn was the driest and winter was the wettest. Over the five years, autumn 2022 was the driest season and winter 2020 was the wettest season. However there were data missing for some months in autumn 2022 which has likely influenced the results. The second highest rainfall was recorded in summer 2021.

Table 8.5: Total monthly rainfall (mm) data at Glengarriff (Ilnacullin) Met Éireann station, Co. Cork, from 2018 to 2022 (source: Met Éireann[47]).

Year	2018	2019	2020	2021	2022	Monthly 5-year average
January	383.2	109.6	180.4	280.3	106.4	212.0
February	116.9	237.3	466.2	253.6	245.5	263.9
March	164.7	254.1	167.4	147.9	90.6	165.0
April	189.8	130.6	54.7	20.5	100.8	99.3
May	108.6	52.3	63.9	232.6	70.1	105.5
June	80.1	82.7	131.8	90.4	150.4	107.1
July	93.1	84.9	230.2	73.9	84.1	113.2
August	91.7	218.1	280.7	91.9	29.9	142.5
September	129.9	179.4	123.2	129	175	147.3
October	108.8	227.3	257.9	372.7		241.7*
November	305.9	213.1	261.1	81.4		215.4*
December	317.6	272.7	367.1	247.6		301.3*
Annual Average	174.2	171.8	215.4	168.5	117.0**	

*Calculated as monthly 4-year average as data points for October, November, and December 2022 were missing.

**Average calculated across 9 months as data points for October, November, and December were missing.

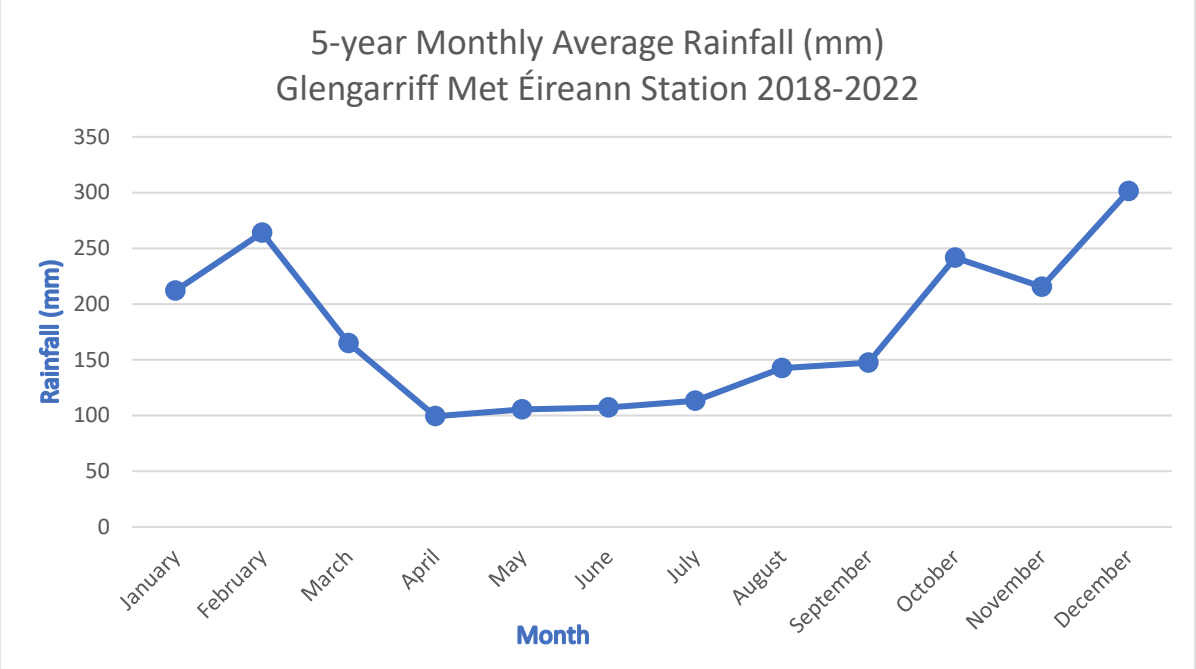


Figure 8-8: 5-year monthly average rainfall (mm) at Glengarriff (Ilnacullin) Met Éireann station from 2018 to 2022 (source: Met Éireann[47]).

Table 8.6: Total seasonal rainfall (mm) at Glengarriff (Ilnacullin) Met Éireann station, Co. Cork, from 2018 to 2022 (source: Met Éireann[47]).

Season/Year	2018	2019	2020	2021	2022
Autumn	544.6	619.8	642.2	583.1	175.0*
Spring	463.1	437.0	286.0	401.0	261.5
Summer	264.9	385.7	642.7	256.2	264.4
Winter	817.7	619.6	1013.7	781.5	351.9*

*Data missing from October (autumn), November (autumn), and December (winter) 2022.

8.6.2. Frequency of Significant Rainfalls

Met Éireann has developed a depth duration frequency model to estimate point rainfall frequencies (Fitzgerald, 2007; Met Éireann[47]). For a one in 100-year return period, 32.8 mm of rain would be expected over a one-hour period and 128.5 mm over 24 hours. While these would be extremely uncommon events, the model predicts that once a year 13.5 mm of rain would fall in one hour and 52.9 mm over a 24-hour period. Data from Glengarriff (Ilnacullin) Met Éireann station show there have been 33 24-hour periods within which more than 52.9 mm of rain fell over the 30-year period from 1992-2022. For this same period, October had the greatest daily rainfall with 100.1 mm. Over the 5-year period 2018-2022, data from Glengarriff (Ilnacullin) Met Éireann station show there have been five 24-hour periods within which more than 52.9 mm of rain fell[47]. A significant rainfall is considered to be ≥ 120 mm of rain within a 24-hour time period (Tony Cawley, pers. comm).

Increased faecal contamination of coastal waters is typically associated with high rainfall and storm events through surface water run-off from livestock or other animals present, and through sewer and wastewater treatment plant overflows (Mallin *et al*., 2001; Lee & Morgan, 2003). It is therefore expected that run-off due to rainfall will be higher during the October to January period. However, as can be seen in the rainfall data in **Table 8.7**, heavy rainfall events leading to episodes of high run-off can occur in most months of the year and, therefore, it is not just the winter months that are at risk of increased faecal contamination. When these out of season heavy rainfall events occur during generally drier periods in spring and summer months, they are likely to carry higher loadings of faecal material which has accumulated on pastures where greater numbers of livestock are present.

Table 8.7: Rainfall events greater than 52.9 mm within a 24-hour period over 30 years, recorded at the Glengarriff (Ilnacullin) Met Éireann station.

Date	Rainfall (mm)	Date	Rainfall (mm)
09-Oct-08	100.1	09-Jul-94	60.3
04-Dec-15	87.8	11-Oct-96	60
28-Sep-96	86	05-Dec-15	59.2
29-Jul-20	81.2	12-Jan-18	58
06-Jan-13	79	07-Oct-21	57.3
26-Oct-00	76.7	21-Jul-96	57.2
26-Dec-94	75	18-Dec-93	56.4
13-Nov-03	68.6	12-Jan-08	56.3
15-Jan-21	67.2	02-Sep-17	55.9
11-Sep-15	66.7	07-Sep-09	55.6
17-Jan-07	66.1	19-Feb-19	55.5
16-Jun-09	64	21-Nov-92	55
11-Dec-93	62.5	26-Dec-10	54.6
02-Jan-12	61.8	03-Oct-16	54.5
22-Oct-08	61.4	11-Dec-15	54.4
23-Jul-05	60.7	17-Jul-10	53.5

20-Oct-17	60.4		

8.7. Salinity

Bantry Bay has limited estuarine characteristics with surface salinities in summer typically in excess of 33 ppt in the inner bay regions (Raine *et al*., 1993).

8.8. Turbidity

Turbidity can affect water clarity as high concentrations of particulate matter can have effects on light penetration and habitat quality and particles provide attachment for pollutants such as bacteria[48]. At the time of writing, no turbidity data were available.

8.9. Flushing time

Flushing time can be defined as the time it takes to replace a certain water mass in a coastal system. Flushing times are important because of how they explain water exchange and how this governs productivity rates as well as the vulnerability to water quality degradation. In Bantry Bay, flushing is generally in an anticlockwise direction (Dabrowski *et al*., 2016). Residence times were estimated by Dabrowski *et al*. (2016) at 10.4 days for the whole of Bantry Bay and 7.7 days for the inner bay. The authors acknowledged that these values are likely underestimating the actual residence times. However, these values can act as a guide to water exchange in the Bantry Gearhies east and west production areas for the purposes of this report.

8.10. Discussion

The Bantry Gearhies east and west production areas lie along the south-eastern coastline of Bantry Bay, covering an area of approximately 7.75 km^2 and 11.43 km^2, respectively. Bantry Gearhies is completely subtidal with depths ranging from approximately 10 m at licensed sites T05/495A-N and T05/433, to approximately 25 m at licensed site T05/430A, and 20 m at licensed site T05/408.

Bantry Bay's mean spring tidal range is 2.9 m and the mean neap tidal range is 1.5 m [7]. Low current speeds of 0.0-0.2 m/s^2 were measured ([7]; AQUAFACT, 2014 *unpubl.*) and anticlockwise flushing was evident in the upper and lower layers (Dabrowski *et al.*, 2016). Based on data from 2018-2022 from Sherkin Island Met Éireann station, the prevailing wind direction comes from the southwest. Seasonal trends show that winds are strongest in the winter months and reduce in the summer.

Using data from Glengarriff (Ilnacullin) Met Éireann station, the wettest months appear to be October to January when looking over a five-year (2018-2022) and a 30-year (1992-2022) period. Over the same five-year period, the lowest average monthly rainfall occurred in April (99.3 mm) while the highest average monthly

rainfall was recorded in December (301.3 mm), and the 5-year monthly average was 172.13 mm. Autumn 2022 was the driest season and winter 2020 the wettest. However due to data missing from autumn 2022 these results may be skewed and summer 2021 is likely the driest season.

The Mealagh River sub-basins drain the majority of the contributing catchment (*c.* 61.7%). While the Fahane_010 and Glanroon_010 River sub-basins drain this area to a lesser degree (21.1% combined), these river water bodies drain directly into the DSW and licensed mussel sites in the Bantry Gearhies production areas.

Surface salinity in inner Bantry Bay is in excess of 33 ppt in the summer (Raine *et al*., 1993). No turbidity data were available at the time of writing. Residence times of 10.4 days for the entirety of Bantry Bay and 7.7 days for the inner bay were estimated by dividing water volume by average inflows, although Dabrowski *et al*. (2016) stress that this is an underestimation of residence times.

9. Appendix 3: Shellfish and Water Sampling

9.1. Historical Data

9.1.1. Shellfish Flesh Quality

In accordance with Regulation (EU) 2017/625 and the subsequent implementing regulation (EU) 2019/627, the SFPA is required to classify bivalve mollusc production areas and to fix the boundaries thereof. The process involves regular sampling of shellfish from each area to be classified in order to establish levels of microbiological contamination which subsequently determines the classification that should be awarded for that particular area.

The regulations stipulate that the competent authority must monitor the levels of *E. coli* within the harvesting area and that according to the sample results, must classify the area as being one of three categories: **A**, **B** or **C**. An **A** classification allows for the product to be placed directly on the market, whereas a **B** or **C** classification requires the product to go through a process of depuration, heat treatment, or relaying before it can be placed on the market. **Table 9.1** summarises this system. **Table 9.2** states the likely classification that would be assigned for shellfish beds in Bantry Gearhies, based on the historical microbiological results.

Table 9.1: Classification system for shellfish harvesting areas.

Classification			Permitted Levels	Outcome
	A	<230	Not exceeding 230 *E. coli*/100 g flesh/liquid in 80% of samples. Not exceeding 700 *E. coli* 100 g in remaining 20% of samples.	May go directly for human consumption if end product standards met.
	B	<4600	Not exceeding 4,600 *E. coli*/100 g flesh/liquid in 90% of samples. Not exceeding 46,000 *E. coli* 100 g in remaining 10% of samples.	Must be subject to purification, relaying in Class A area (to meet Category A requirements), or cooked by an approved method.
	C	<46000	Not exceeding 46,000 *E. coli*/100 g flesh in all samples.	Must be subject to relaying for a period of at least 2 months or cooked by an approved method.
	Above 46,000 *E. coli* per 100 g flesh/liquid.			Prohibited. Harvesting not permitted.

Table 9.2 lists the *E. coli* results for mussels in the Bantry Gearhies east and west production areas from January 2011 to November 2015 and May 2022 to October 2022. The Bantry Gearhies east and west BMPAs have not been classified, but based on these results, the BMPAs would have achieved an **A** class for mussels during these active periods. The production areas became dormant in 2017 until April 2022 so no data are available for this time period.

Table 9.2: Historical *E. coli* results from Bantry Gearhies mussels from January 2011 to October 2022 (source: SFPA). Note: the Bantry Gearhies east and west production areas have never been classified, however the likely classification is provided based on the historical results; colour coded per Table 9.1.

Sampling Date	*E. coli* MPN/100 g	Likely Classification	Sampling Date	*E. coli* MPN/100 g	Likely Classification
18-Jan-11	20	A	29-Jan-14	40	A
28-Feb-11	130	A	17-Feb-14	70	A
28-Mar-11	20	A	31-Mar-14	20	A
11-Apr-11	20	A	28-Apr-14	310	B
26-Apr-11	20	A	01-May-14	20	A
27-Apr-11	20	A	28-May-14	20	A
27-Jun-11	330	B	24-Jun-14	20	A
27-Jul-11	50	A	14-Jul-14	20	A
24-Aug-11	20	A	13-Aug-14	20	A
02-Nov-11	330	B	11-Sep-14	18	A
05-Dec-11	50	A	01-Oct-14	9200	C
06-Dec-11	20	A	28-Oct-14	18	A
25-Jan-12	20	A	25-Nov-14	45	A
06-Feb-12	20	A	08-Dec-14	20	A
13-Mar-12	20	A	26-Feb-15	18	A
02-Apr-12	20	A	18-Mar-15	18	A
09-May-12	20	A	28-Apr-15	18	A
14-Jun-12	20	A	24-May-15	18	A
03-Jul-12	310	B	25-Jun-15	18	A
21-Aug-12	80	A	23-Jul-15	20	A
10-Sep-12	3500	B	16-Sep-15	93	A
08-Oct-12	20	A	06-Oct-15	18	A
13-Nov-12	20	A	04-Nov-15	18	A
11-Dec-12	5400	C	09-May-22	45	A
14-Jan-13	20	A	24-May-22	18	A
14-Feb-13	20	A	07-Jun-22	18	A
05-Mar-13	20	A	20-Jun-22	18	A
02-Apr-13	20	A	04-Jul-22	18	A
14-May-13	20	A	18-Jul-22	20	A
10-Jun-13	20	A	04-Aug-22	16000	C
01-Aug-13	220	A	17-Aug-22	18	A
21-Aug-13	170	A	30-Aug-22	2800	B
10-Sep-13	20	A	12-Sep-22	270	B
27-Nov-13	20	A	26-Sep-22	18	A
12-Dec-13	20	A	10-Oct-22	220	A

9.1.2. Norovirus (NoV)

The licensed shellfish sites within the Bantry Gearhies east and west production areas have to date not been subject to any norovirus sampling programme or baseline studies of norovirus levels. Therefore, no data on norovirus are available for Bantry Gearhies.

9.2. Current Data

9.2.1. Sampling Sites and Methodology

28 water samples were taken along the coastline of Bantry Gearhies contributing catchment from 26 locations during the bacteriological survey; Station 12 is to be discounted due to an error in recording the GPS coordinates. The locations of the sites can be seen in **Figure 9-1** and **Table 9.3** shows the sample station coordinates. Duplicate samples were taken from two different locations over the two survey periods (Station 1 and 2; **Table 9.3**) and Station 27 and 28 (**Table 9.3**), which was due to human error but are included here for more information.

Table 9.3: Water sample results and coordinates from the Bantry Gearhies bacteriological survey. * marks an error in the sample coordinates, this sample should be discounted.

Station	Feature	*E. coli* (MPN/100 ml)	Latitude	Longitude	Easting	Northing
1	Small stream.	63	51.67226	-9.49344	496707.5	547704.9
2	Small stream.	1	51.67222	-9.49341	496709.5	547700.2
3	Medium size river.	2909	51.66384	-9.50823	495665.2	546788.8
4	Stream	602	51.66016	-9.5211	494766.4	546398.1
5	Stream	98	51.65887	-9.52956	494178.3	546267.4
6	Stream	52	51.65012	-9.56866	491452.3	545351
7	Outflow	31	51.64922	-9.57926	490716.6	545266.3
8	Bantry Water Treatment outflow.	169	51.6772	-9.49312	496741	548253.4
9	Outflow (shore).	10	51.64773	-9.57617	490926.9	545096.5
10	Outflow	6488	51.64468	-9.58806	490096.9	544775.2
11	Stream	1	51.6943	9.44269	500265.8	550085.7
12*	Stream	15	51.6443	9.44393	500070.1	544525.8
13	Drain	1	51.69196	9.4334	500902.9	549812.8
14	Stream	110	54.6922	9.4403	500426.4	549848.9
15	Drain	1	51.6867	9.4555	499363.4	549257.9
16	Run-off	1	51.6832	9.46059	499003.7	548875.7
17	Run-off	1	51.6827	9.46043	499013.7	548819.8
18	Pier	1	51.6818	9.46201	498902.4	548721.9
19	Drain	1	51.68129	9.45825	499161.3	548660
20	Pier	9	51.68056	9.46168	498922.5	548583.5
21	Pipe	1	51.6785	9.46556	498649.6	548359.7
22	Drain	1	51.67772	9.4676	498506.8	548275.8
23	Pipe	1	51.67752	9.4688	498423.4	548255.2
24	Stream	2	51.67743	9.46582	498629.2	548241.1
25	Stream	1	51.67759	9.47994	497653.2	548278.6
26	Stream	3	51.67749	9.48046	497617	548268.2
27	Run-off	1	51.67336	9.49219	496796.4	547825.3
28	Run-off	3	51.67336	9.49219	496796.4	547825.3

All water samples were collected in sterile plastic water bottles. These samples were stored in a cool box until delivered to the laboratory for analysis (within 24 hours of collection).

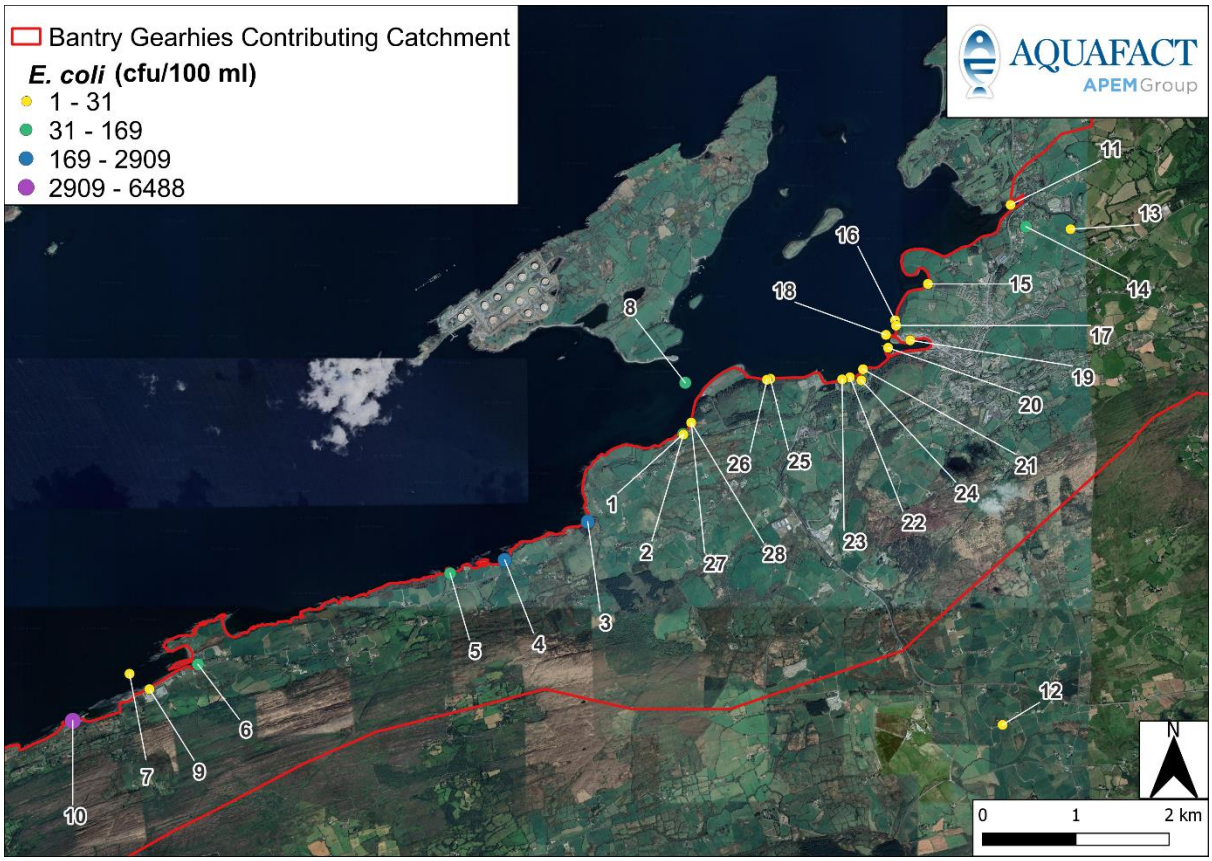


Figure 9-1: Location and magnitude of *E. coli* results from the water samples taken during the shoreline survey (numbering cross-referenced to Table 9.3). Due to an error in recording the GPS coordinates, Station 12 can be discounted.

9.2.2. Bacteriological Analysis Results

The water sample results listed in **Table 9.3** and **Figure 9-1** show the magnitude of *E. coli* in the water samples, measured as most probable number per 100 ml (MPN/100 ml). Stations 1 and 3-10 were collected during the first shoreline survey in November and Stations 2 and 11-28 were collected during the second shoreline survey in January. Stations 1 and 2 were located at an unnamed small stream within the Bantry_010 sub-basin (map ID 1; **Figure 7-20**). Two samples were taken from the station location due to the survey area overlapping during the two shoreline surveys. The water quality was reported by the first shoreline survey as mostly clear with a slight foam thought to be from agricultural grazing lands surrounding the stream, and the second shoreline survey noted the stream was running through marsh ground into the bay. Station 3 was taken from Hollyhill River and was reported as running clear (Hollyhill is the EPA designated name; note the shoreline survey refers to this river as Shanvally) (map ID 6; **Figure 7-20**). Stations 4, 5, and 6 were located at unnamed streams within the Fahane_010 River sub-basin (map ID 13, 17, and 18, respectively; **Figure 7-20**). Station 7 was located offshore at a discharge near a Section 4 licensed discharge, which is permitted to discharge wastewater arising

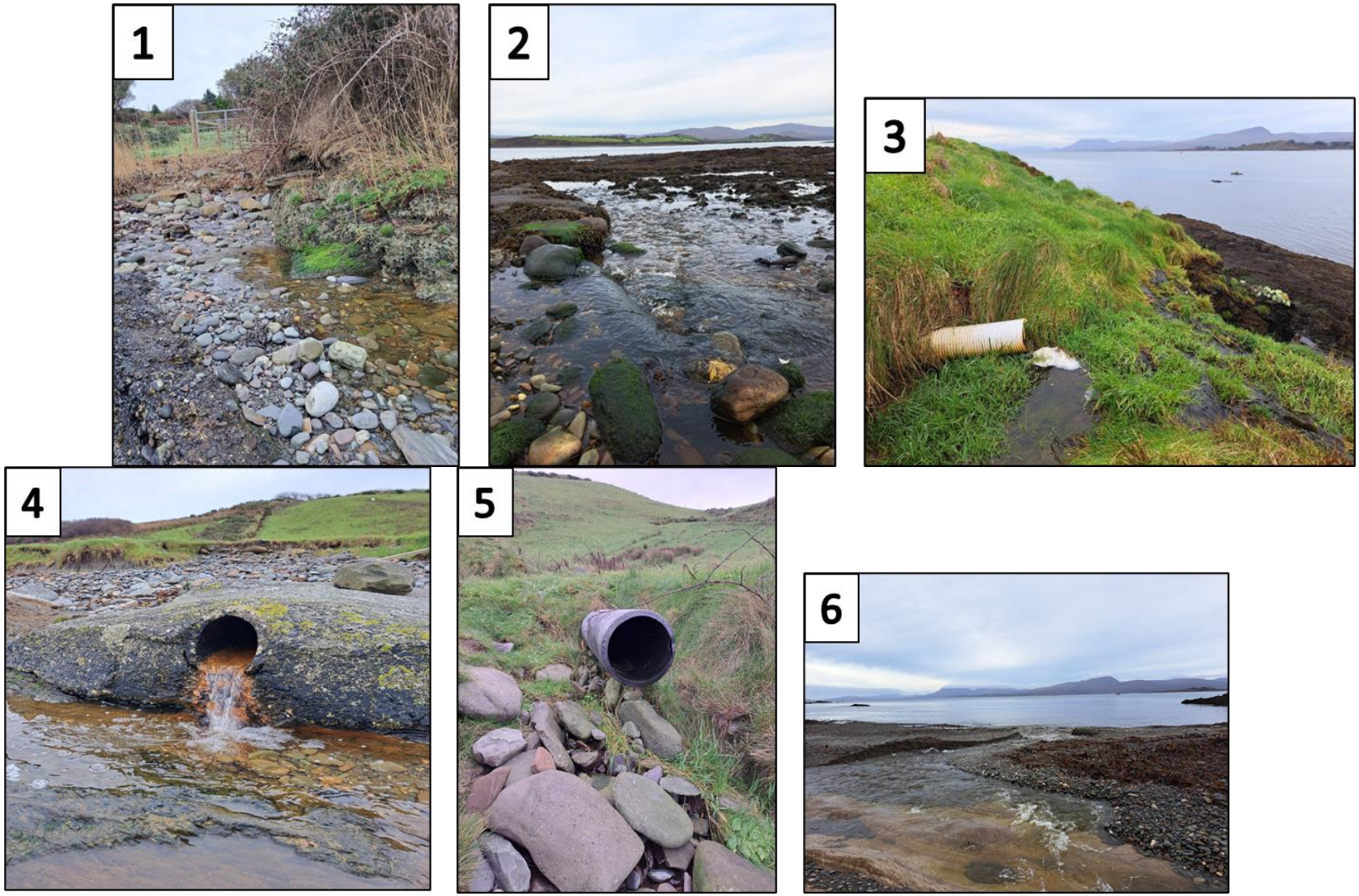
from shellfish depuration/processing activities and treated domestic wastewaters (map ID 36; **Figure 7-20**). Station 8 was located offshore at the Bantry WWTP outflow adjacent to Bantry airstrip (map ID 42; **Figure 7-20**). Stations 9 and 10 were located onshore at two outflow pipes (map IDs 20 and 22, respectively; **Figure 7-20**).

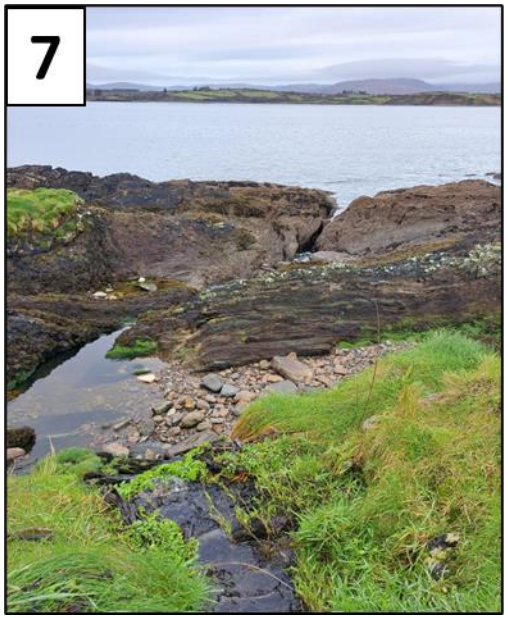
Stations 11 was located on a stream associated with the Mealagh River (map IDs 46; **Figure 7-20**) Station 11 was situated at the mouth of the Mealagh River where it discharges into the bay. Note that the location of Station 12 is not an accurate representation of the GPS coordinates of this feature as it has been attributed to being adjacent to Station 11, therefore this sample can be discounted. Station 13 was sampled from a drain associated with discharges from residential housing (map ID 49; **Figure 7-35**). Station 14 was sampled from a stream running through agricultural and marsh lands into the bay (map ID 50; **Figure 7-20**). Station 15 was located at a beach drain (map ID 51; **Figure 7-20**). Stations 16 and 17 were sampled from run-off discharging from hills (map IDs 52 and 53, respectively; **Figure 7-20**). Station 18 was located at the end of a pier (map ID 54; **Figure 7-20**). Station 19 was located in inner Bantry Harbour in a built-up area with amenities such as a campsite and supermarkets (map ID 55; **Figure 7-20**). Station 20 was located on the main pier in Bantry Bay (map ID 56; **Figure 7-20**). Station 21 was sampled from a pipe (map ID 57; **Figure 7-20**). Station 22 was located at a drain opposite the gate to Bantry House; (map ID 58; **Figure 7-20**). Station 23 was sampled from a pipe and algal growth was noted during the shoreline survey (map ID 62; **Figure 7-20**). Station 24 was sampled from a stream within the Bantry_010 River sub-basin (map ID 63; **Figure 7-20**). Stations 25 and 26 were taken from streams within the Bantry_010 River sub-basin (map IDs 68 and 70, respectively; **Figure 7-20**). Both streams were noted as having algal growth, and the stream at Station 26 was also noted as having 'good flow' indicating there was a large volume of water flowing from this stream at the time of survey. Stations 27 and 28 were located at run-off discharging from a cliff that was near to a wastewater treatment facility and algal growth was noted at this run-off (map ID 74; **Figure 7-20**). Two samples were taken at this location due to human error (map IDs 27 and 28; **Figure 9-1**).

9.2.3. Shellfish Flesh Quality Sampling

The SFPA does not currently sample shellfish flesh in Bantry Gearhies and no BMPAs exist here.

10. Appendix 4: Shoreline Survey Images

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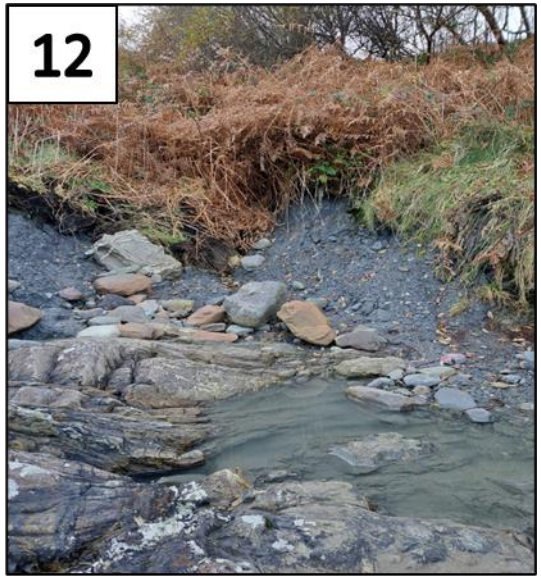
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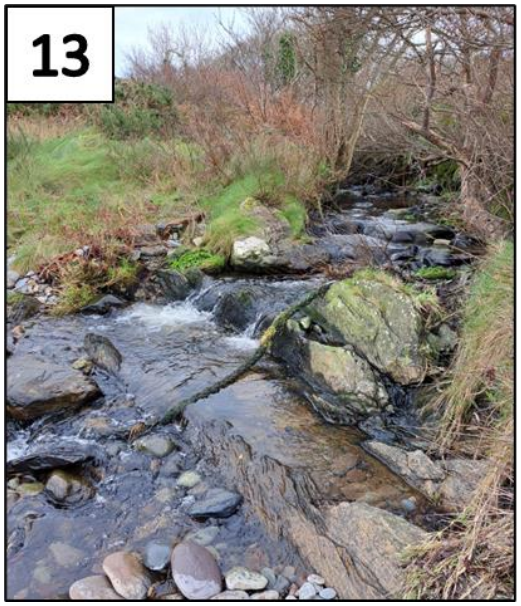
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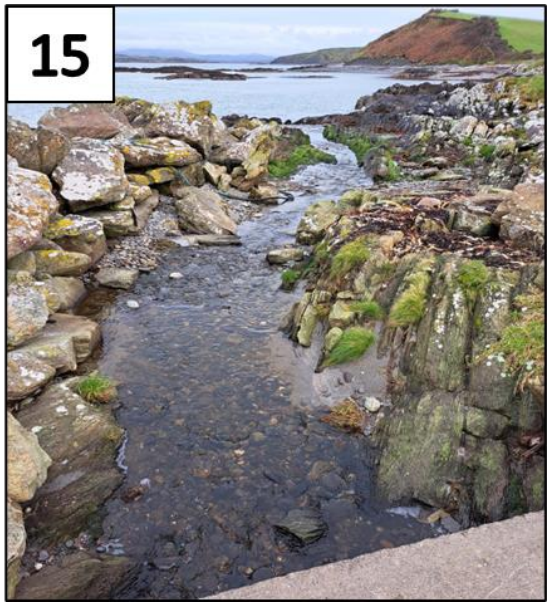
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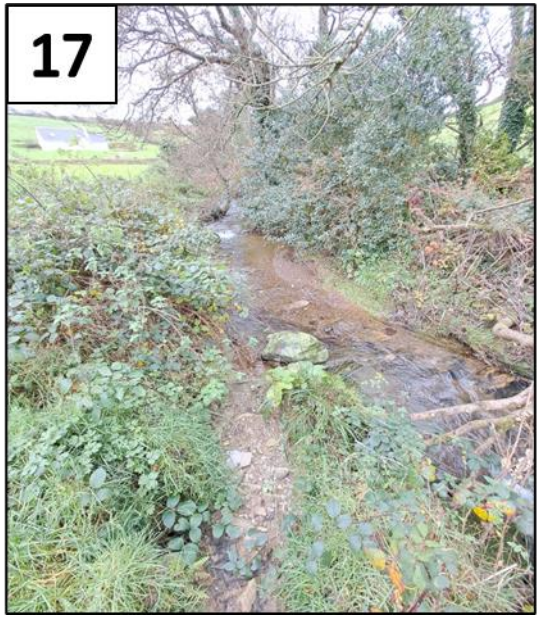
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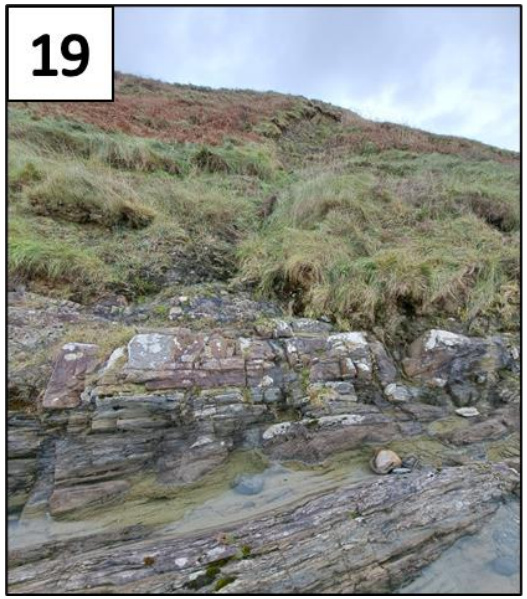
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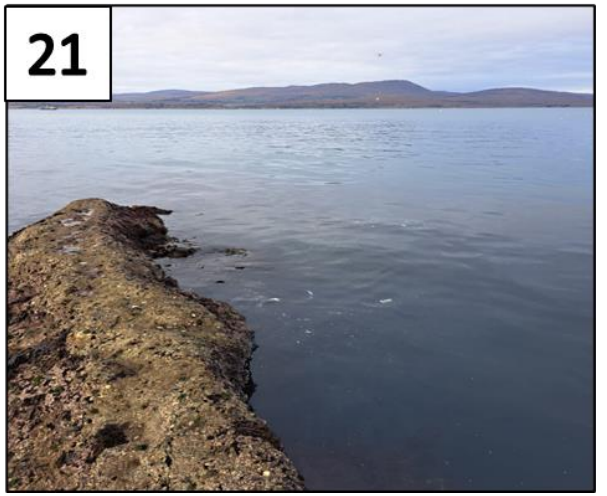
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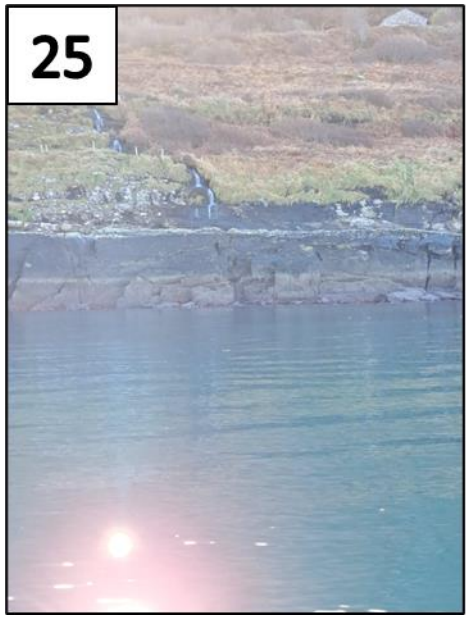
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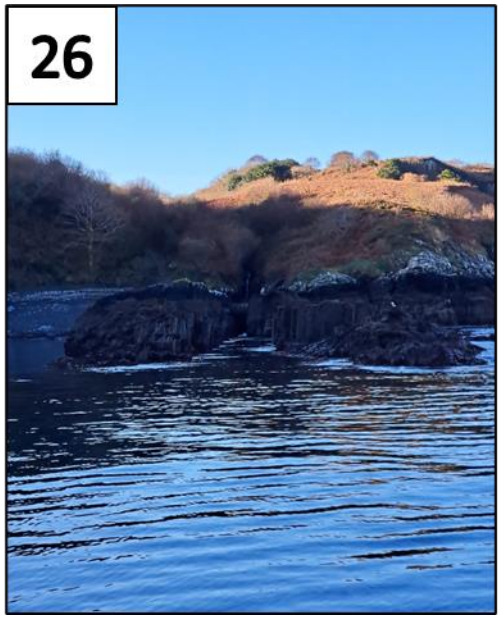
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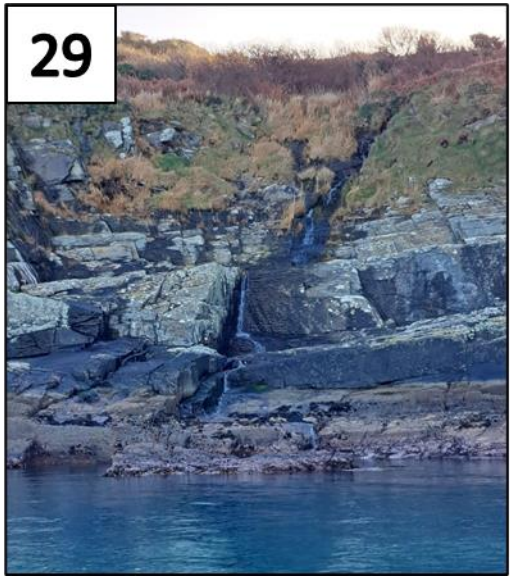
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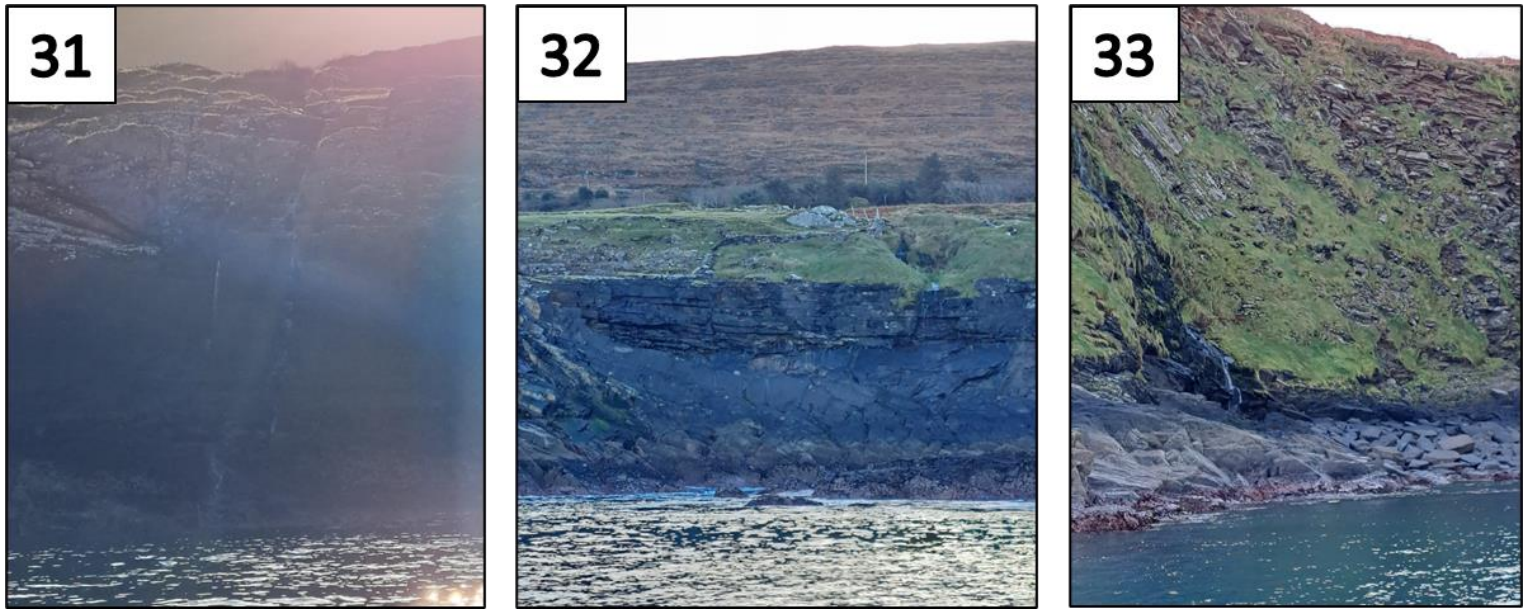
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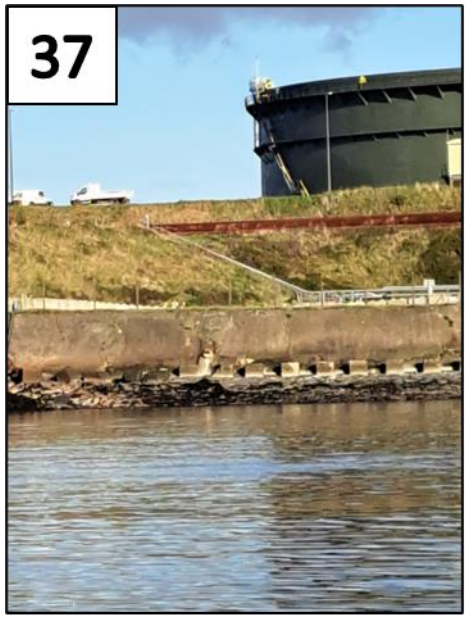
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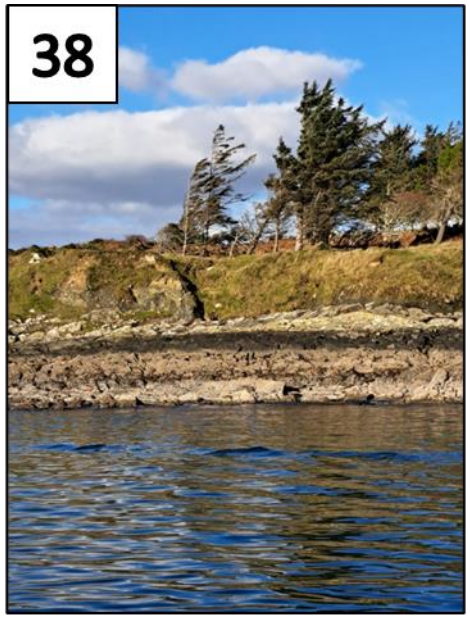
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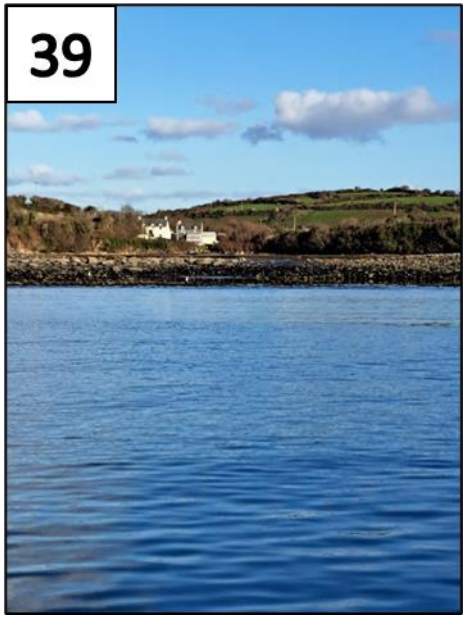
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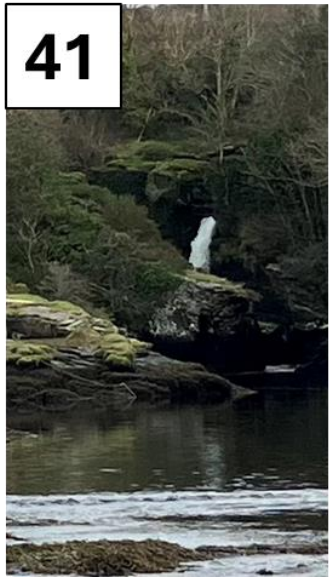
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11. Appendix 5: Blue Mussel Monitoring Information

Bantry Gearhies East Production Area

Site Name: Bantry Gearhies east

Site Identifier: CK-BB-GSE

Monitoring Point Coordinates:

RMP 1 east **Latitude:** 51.6605809 **Longitude:** -9.5380699

Species: *Mytilus edulis*

Sample Depth: Samples should be taken within the first one metre of surface water.

Sample Frequency: Monthly

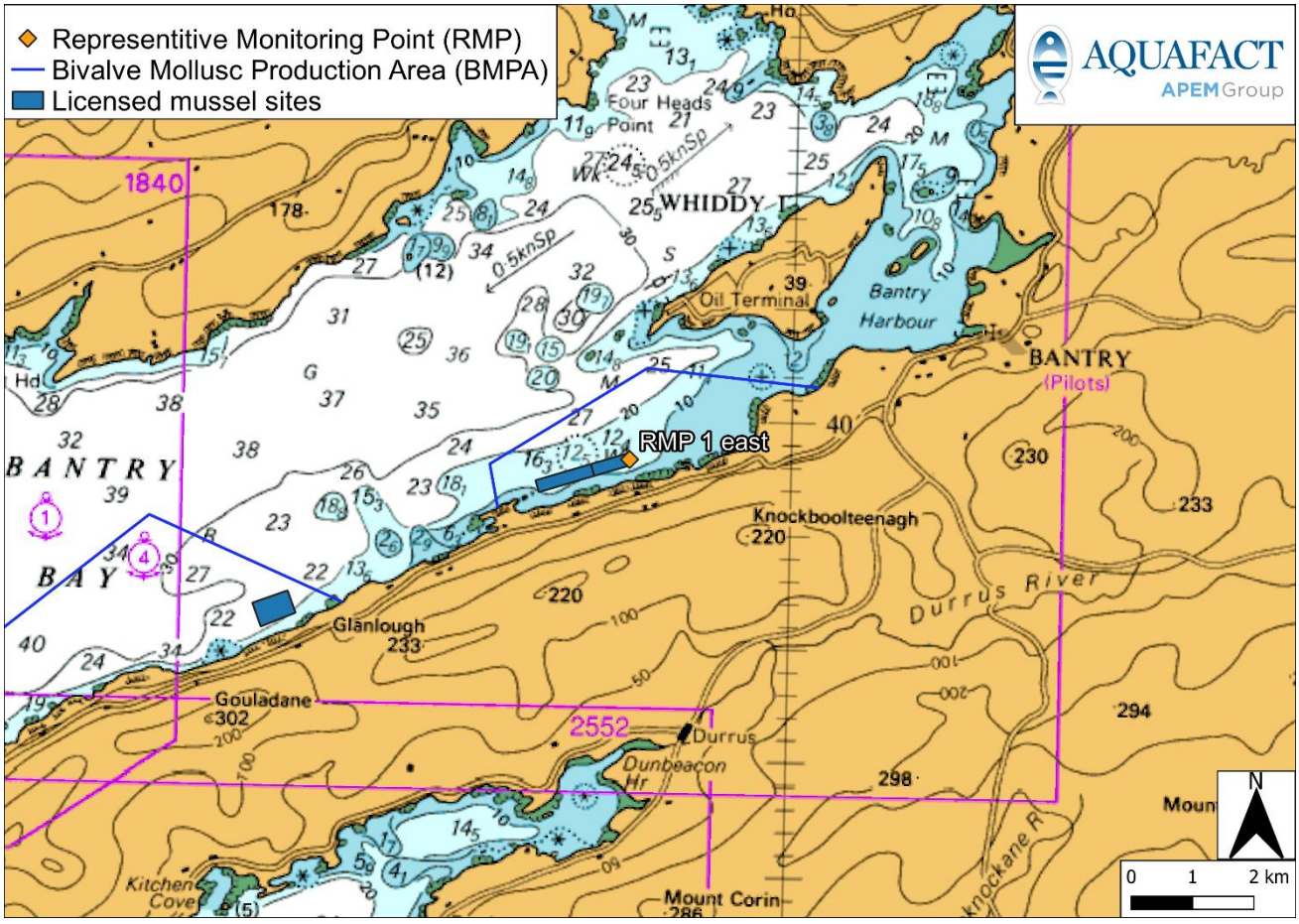
Responsible Authority: Sea Fisheries Protection Authority

Authorised Samples: SFPA Castletownbere Port Office

Maximum Allowed Distance from Sampling Point: The sample must be taken from within 100 m of the sampling point.

Sampling Size: Minimum 15 market sized shellfish

Sampling Method: Taken from rope at point.



Bantry Gearhies West Production Area

Site Name: Bantry Gearhies west

Site Identifier: CK-BB-GSW

Monitoring Point Coordinates:

RMP 1 west **Latitude:** 51.6385763 **Longitude:** -9.6170872

Species: *Mytilus edulis*

Sample Depth: Samples should be taken within the first one metre of surface water.

Sample Frequency: Monthly

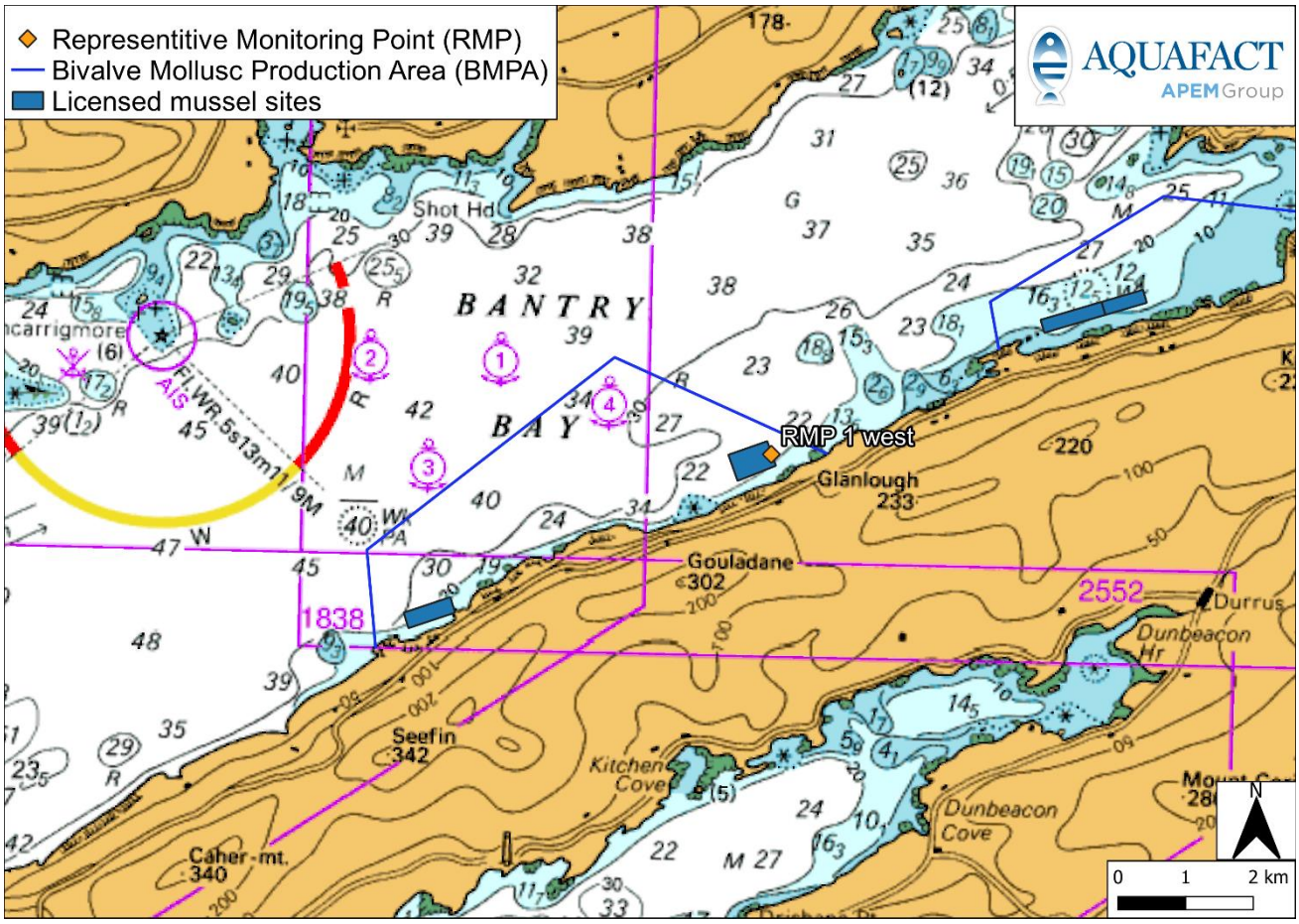
Responsible Authority: Sea Fisheries Protection Authority

Authorised Samples: SFPA Castletownbere Port Office

Maximum Allowed Distance from Sampling Point: The sample must be taken from within 100 m of the sampling point.

Sampling Size: Minimum 15 market sized shellfish

Sampling Method: Taken from rope at point.



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13. List of Endnotes

[1] See WoRMS database for reason for change in naming of Pacific oyster, *i.e.*, is based on molecular analysis: https://www.marinespecies.org/aphia.php?p=taxdetails&id=1545897#sources
[2] See WoRMS database for reason for change in naming of Pacific oyster, *i.e.*, is based on molecular analysis: https://www.marinespecies.org/aphia.php?p=taxdetails&id=1545897#sources
[3] http://www.marinemonitoring.org/wp-content/uploads/2019/02/20181231gpg_issue-7-final.pdf
[4] European Commission 2017: https://food.ec.europa.eu/system/files/2018-12/biosafety_fh_guidance_community_guide_bivalve_mollusc_monitoring_en.pdf
[5] The link for Screening Matrix for Aquaculture activities in Outer Bantry Bay Aug 2020 is available at: https://assets.gov.ie/153300/6839bb19-e34a-4d75-bd43-288cd55ad01c.pdf
[6] untitled (globalislands.net)
[7] https://assets.gov.ie/88986/09c2b44e-7fe7-4b39-8bf5-c8fe95b00b24.pdf
[8] National Biodiversity Data Centre: https://maps.biodiversityireland.ie/Species
[9] http://streamscapes.ie/wp-content/uploads/2019/05/StreamScapes-Cuan-Baoi-The-Catchments-of-Bantry-Bay.pdf
[10] All conservation objectives and site synopses for the abovementioned SACs and SPAs can be found on the NPWS protected sites website https://www.npws.ie/protected-sites
[11] Ireland's Marine Atlas: Ireland's Marine Atlas | Marine Institute
[12] https://assets.gov.ie/88992/a61074ac-7e0b-40f3-a0ce-f833e5cb83f1.pdf
[13] See statistics tab on CSO website for census of population 2016 & 2022; see census interactive map for small area population statistics & agricultural data: https://www.cso.ie/en/
[14] See type of sewerage for permanent private households 2022: https://data.cso.ie/
[15] EPA Geoportal: Environmental Protection Agency, Ireland (EPA) Geoportal
[16] DAFM Press Release: https://www.gov.ie/en/press-release/9cec1-farmers-individual-stocking-rates-for-new-cap-schemes-now-available-on-agfoodie/
[17] Distance relates to shortest linear distance, *i.e.*, 'as the crow flies'.
[18] See Fáilte Ireland website for West Cork Coast – Destination and Experience Development Plan: west-cork-coast-destination-and-experience-development-plan.pdf (failteireland.ie)
[19] Key Tourism Facts 2019: Failte Ireland - Tourism Research & Statistics | Irish Tourism Statistics | Tourism Reports
[20] Failte Ireland - Visitor Numbers to Attractions Dashboard | Activities and Attractions | Tourism Research & Statistics
[21] See Travel by Irish Residents: HTQ01 - Travel by Irish Residents (cso.ie)
[22] See publications tab for SFPA code of practice: https://www.sfpa.ie/
[23] Irish resident travel by county 2022: Failte Ireland - Tourism Research & Statistics | Irish Tourism Statistics | Tourism Reports
[24] AP2115SAVEBANTRYBAYAPPEAL090817.pdf (alab.ie)
[25] Statistics of port traffic 2022: https://www.cso.ie/en/releasesandpublications/ep/p-spt/statisticsofporttrafficq4andyear2022/
[26] See CSO Maritime Transport Omnibus 2019: https://www.cso.ie/en/statistics/
[27] Map-of-identified-bathing-waters-with-classification-2021.pdf (beaches.ie)
[28] https://gis.epa.ie/EPAMaps/
[29] See EPA Licence and Enforcement Access Portal for 2022 AER for Zenith Energy Bantry Bay Terminal Ltd – P0419; see 2021 Waste Water Discharge Licence Audit Report for licence register number D0168-01: https://leap.epa.ie/
[30] Department of Environment, Housing and Local Government 1995 – Procedures and criteria in relation to storm water overflows: https://www.epa.ie/publications/licensing--permitting/waste-water/
[31] See Section 4 Discharges, Cork for licence information: Section 4 Discharges – Useful Data for Irish River Conservation / Water Quality (irishriverproject.com)
[32] As defined by the CSO, other cows are female beef cattle. Total cattle are comprised of all male and female cattle under two years, dairy cow, and non-dairy/other cows.
[33] https://www.irishstatutebook.ie/eli/statutory.html
[34] See 'Publications' tab on gov.ie website for Fifth Nitrates Action Programme Overview document: https://www.gov.ie/en/publication/f1d01-fifth-nitrates-action-programme-2022-2025/
[35] See S.I. No. 113/2022 Part 1 Interpretation 4. (2) for definition of "soiled water"
[36] Port of Bantry. Port Waste Management Plan 2017: INTRODUCTION (bantrybayport.com)

[37] Bantry Bay Inner Shellfish Pollution Reduction Programme Characterisation Report Number III: https://www.gov.ie/en/publication/7faa4-designated-shellfish-waters-in-cork/
[38] Aquaculture Licences Appeals Board (Appeal Ref No. AP2/2015). Technical Advisor's Final Report: 1 (alab.ie)
[39] Department of Housing, Local Government, and Heritage 2021 – Bantry Bay South Shellfish Area – Country Cork Shellfish Pollution Reduction Programme (Report 44): https://assets.gov.ie/129195/a7605741-70eb-4088-a951-73ff1313cdf8.pdf
[40] https://assets.gov.ie/89007/fdf9832b-59b0-4410-80d1-ded9b075a3b3.pdf
[41] Distance relates to the shortest linear distance, *i.e.*, 'as the crow flies'.
[42] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004156.pdf
[43] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004155.pdf
[44] https://assets.gov.ie/124372/31bcf2a2-0d33-41a7-b62f-3d7423965000.pdf
[45] See Site-specific Conservation Objectives shapefile for associated habitat and species data shapefiles: https://www.npws.ie/maps-and-data/habitat-and-species-data
[46] Tailte Eireann co-ordinate converter GridInQuestII: https://gnss.osi.ie/new-converter/
[47] See climate tab for current and historical data: https://www.met.ie/
[48] Turbidity and water: Turbidity and Water | U.S. Geological Survey (usgs.gov)