Sanitary Survey Report and Sampling Plan

for Coulagh Bay, Co. Cork

Produced by

AQUAFACT - APEM Group

In conjunction with

The Sea Fisheries Protection Authority

November 2024

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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 Coulagh Bay was undertaken in 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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Revisions

Revision No.	Date	Comment
1	15/07/2024	Interim report for SFPA review
2	18/10/2024	Draft final report for SFPA review
3	29/11/2024	Final report

Document and QA Approval

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	Aisha O'Connor	Senior Consultant Ecologist	18/10/2024
Approved (Final)	Aisha O'Connor	Senior Consultant Ecologist	29/11/2024
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Consultation

Consultee	Date of Consultation	Date of Response
SFPA (Interim)	15/07/2024	03/09/2024
SFPA (Draft final)	18/10/2024	08/11/2024
Approved by SFPA (Final)	02/12/2024	

Table of Contents

Table of Figures

List of Tables

Glossary

BMPA	Bivalve Mollusc Production Area
BOD	Biochemical Oxygen Demand
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFU	Colony forming unit (direct count of visible bacterial colonies)
COA	Certification of Authorisation (relates to WWTP/agglomerations which are not specified under Schedule 2 of the Waste Water Discharge (Authorisation) Regulations 2007, *i.e.*, discharges from agglomerations with a PE of 500).
COD	Chemical Oxygen Demand
CRS	Coordinate Reference System
CSO	Central Statistics Office
Depuration	The process of purification or removal of impurities
DSW	Designated Shellfish Waters
DWF	Dry Weather Flow
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
GSI	Geological Survey of Ireland
kn	Knots (kilometres per hour [km/hr] is equal to 0.54 knots)
LSU	Livestock Unit
MPN	Most Probable Number (statistical method to calculate number of bacterial colonies)
NBDC	National Biodiversity Data Centre
NoV	Norovirus
PE	Population Equivalent
Pollution	Encompasses *E. coli* contamination only for the purpose of this sanitary survey report

pRMP	Provisional Representative Monitoring Point
psu	Practical salinity unit
RMP	Representative Monitoring Point
SAC	Special Area of Conservation
SFPA	Sea Fisheries Protection Authority
S.I.	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 European Union (EU) Regulation 2017/625 and its subsequent Implementing Regulation (EU) 2019/627, there is a requirement for competent authorities intending to classify bivalve 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 this programme determine the annual classification for bivalve mollusc production areas (BMPAs). In the context of this sanitary survey report, pollution refers to *Escherichia coli* (*E. coli*) contamination only.

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 environment has occurred. Site T05-523A is a new site licensed for culturing a variety of bivalve mollusc species with only blue mussel (*Mytilus edulis*) currently growing on site, for sampling purposes only. Consequently, a sanitary survey must be undertaken to determine species-specific representative monitoring points (RMPs) in Coulagh Bay. This report identifies the sources and types of faecal contamination, *i.e., E. coli*, discharging into Coulagh Bay and assesses whether these sources are likely to affect the microbiological concentration in the production area.

Site T05-523A (0.163 km^2) is licensed to produce blue mussels, Pacific oyster (*Magallana gigas*, formerly *Crassostrea gigas*), native oyster (*Ostrea edulis*), stony sea urchin (*Paracentrotus lividus*), red seaweeds (*Rhodophyta*), and brown seaweeds (*Phaeophyceae*). The assessment in this report is primarily for mussel production. At present, there is no BMPA in Coulagh Bay. In conjunction with the SFPA, a boundary has been established to create a BMPA here (**Figure 6-1**).

Coulagh Bay is a semi-enclosed bay located on the south-western coast of Ireland within Kenmare Bay, Co. Cork, and accounts for an area of *c.* 47.63 km^2. Coulagh Bay is predominantly subtidal, and depths range from *c.* 5 m to 45 m; site T05-523A is located in shallow waters (10-20 m). The bay experiences weak current flows so water movement is primarily wind-dominated.

The proposed production of mussels in Coulagh Bay at site T05-523A will be by longlines. It is planned that seed will be grown to adult stock for harvest on a seasonal basis. This licensed site is in its first year of production.

The human population density of the contributing catchment (*c.* 18 people per km^2) is low in comparison to the population density of the State in 2016 (73 people per km^2) and the population density in rural areas in

2016 (27 people per km^2)[1]. However, there are six tourist attractions in the vicinity and approximately one quarter of the houses within the contributing catchment are holiday homes[2] indicating there may be a seasonal increase in *E. coli* levels. The Eyeries wastewater treatment plant (WWTP) is operating under capacity and serves an agglomeration of less than 500[3]. Approximately 32.6% of permanent private households are on the public sewage treatment system, while 64.2% have their own individual treatment system[4]. There are no rainfall dependant or emergency discharges associated with the Eyeries WWTP and there are no industrial emissions or Section 4 discharges licenses within the contributing catchment.

Almost 50% of land cover within Coulagh Bay contributing catchment is agricultural[5] and occurs predominantly along the shoreline of Coulagh Bay, with large areas of moors and heathland occurring further inland. Cattle densities in the contributing catchment were low in comparison to the average stocking rate for cattle in Ireland, however the stocking density of sheep compared to the national stocking rate was above average[6]. Additionally, the bay is within the foraging ranges of some bird species from nearby Special Protection Areas and various marine mammals have been recorded in Coulagh Bay; there are haul-out sites for harbour seals on Illaunameanla and Eyeries Islands.

Site T05-523A occurs adjacent to the Ardacluggin river sub-basin, which predominantly runs over agricultural land as it approaches the shore; moderate to high *E. coli* levels were recorded from this river sub-basin during the bacteriological survey. The shoreline adjacent to site T05-523A was identified as having an aggregation of discharges during the shoreline survey (map IDs 36 to 44; **Figure 7-33**). The Kealincha and Ardacluggin river sub-basins are expected to be the primary routes by which agricultural pollution enters the BMPA as they drain the largest proportions of the contributing catchment.

All data gathered on potential sources of *E. coli* and routes by which contamination may enter the BMPA were combined to make an informed assessment of the RMP location. Based on this, the RMP for blue mussels at site T05-523A has been placed on the south of the site on the shoreward side to capture the highest potential levels of *E. coli* at the shellfish site (**Figure 6-1**). This RMP can also be used as a provisional RMP (pRMP) for Pacific oysters to allow pre-classification sampling of oyster flesh to occur. It is important to highlight that oysters and mussels bioaccumulate *E. coli* at different rates. Although, studies have found that mussels (*M. edulis*) are typically representative indicator species of *E. coli* levels in other shellfish, *M. gigas* being one such species (Younger and Reese, 2013)[7]. Once classified, a review of the Coulagh Bay sanitary survey report will be required to assess that no significant change has occurred regarding the *E. coli* pollution discharging into the BMPA. This is to ensure the pRMP remains representative of *E. coli* levels in Pacific oysters, in which case the pRMP can be upgraded to an RMP. Upon classification of the production area in Coulagh Bay, the sampling plan recommends a minimum of 15 individual blue mussels of market size (minimum length of 4 cm) be

collected (CEFAS[8] (Centre for Environment, Fisheries and Aquaculture Science); European Commission[9]) on a monthly basis year-round.

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 from shellfish produced 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 EU regulations, sanitary surveys of BMPAs 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 Authority (SFPA) in conjunction with AQUAFACT – APEM Group (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 BMPA at

Coulagh Bay, Co. Cork. It identifies the RMP(s) and supporting sampling plan for blue mussels (*Mytilus edulis*), and a preliminary RMP (pRMP) assessment regarding Pacific oysters (*Magallana gigas*, formerly *Crassostrea gigas*) at the multi-culture aquaculture site T05-523A. It also sets out the BMPA boundary in the bay.

3. Overview of the Fishery/Production Area

3.1. Description of the Area

Kenmare Bay is a 55 km long, narrow, southwest facing bay bordered by both Counties Cork and Kerry. It is a deep, drowned, glacial valley, approximately 12 km wide at the mouth of the bay. Coulagh Bay is a semi-enclosed bay, located on the southwestern shores of Kenmare Bay (**Figure 3-1**). It is predominantly subtidal, and experiences weak current flows with poorly defined directional patterns (Bord Iascaigh Mhara, 1990). Depths within Coulagh Bay range from 5 m to approximately 45 m.

Coulagh Bay is bordered by both the Iveragh and Beara Peninsulas. Old red sandstone is prominent throughout Kenmare Bay and reefs are present within the middle regions of the bay, with numerous islets and islands home to a variety of habitats and rare ecological communities[10]. The Caha Mountains on the Beara Peninsula formed from old red sandstone reach peaks of 630 m and host a range of Annex I/II habitats and species under the EU Habitats Directive. Coulagh Bay borders the Beara Peninsula Special Protection Area (SPA) and is close to a number of other SPAs, namely the Bull and the Cow Rocks SPA, Deenish Island and Scariff Island SPA, Iveragh Peninsula SPA, and Sheep's Head to Toe Head SPA. These sites have been designated for the presence of a number of important bird species under Annex I of the Birds Directive[10]. These SPAs are a potential source of faecal contamination and will be assessed as such. Coulagh Bay overlaps the Kenmare River Special Area of Conservation (SAC) designated for the protection harbour porpoise (*Phocoena phocoena*), harbour seal (*Phoca vitulina*), and otter (*Lutra lutra*)[10]. Macroalgae cover the entire intertidal region of Coulagh Bay which is considered a *Laminaria*-dominated community[11].

Figure 3-1: Location of Coulagh Bay in Kenmare Bay, Co. Cork.

The Fanahy and the Ownagappul sub-catchments within the Dunmanus-Bantry-Kenmare Water Framework Directive (WFD) catchment covers the land surrounding Coulagh Bay (**Figure 3-2**). As defined on Environmental Protection Agency (EPA) Catchments[12], regarding water "a catchment is simply defined as an area of land around a river, lake or other body of water". The Ownagappul sub-catchment is made up of six river sub-basins, two of which fully discharge into Coulagh Bay, and the Fanahy sub-catchment is made up of five river sub-basins, one of which entirely discharges into Coulagh Bay. It is necessary to note that WFD river water bodies were established for hydrological purposes and not bacteriological, which is what is required for sanitary surveys. Coulagh Bay contributing catchment has been determined accordingly by aligning to these three sub-basins for the purpose of this sanitary survey report only. AQUAFACT has determined a boundary line based on the river water bodies that flow into Coulagh Bay. 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, 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 waterbody 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 Coulagh Bay contributing catchment/the contributing catchment. The contributing catchment is dominated by the Kealincha River which drains *c*. 44.5% of the contributing catchment.

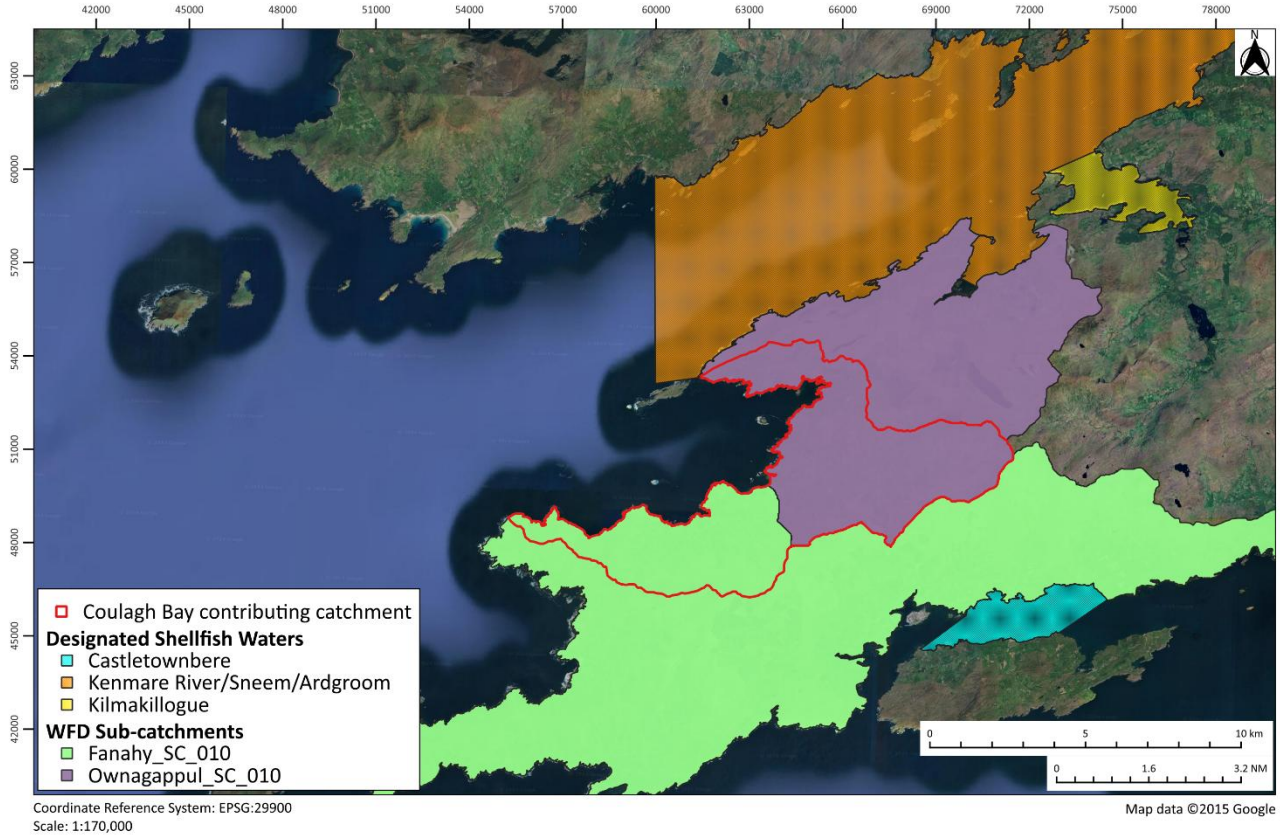


Figure 3-2: Water Framework Directive Ownagappul and Fanahy sub-catchments surrounding Coulagh Bay. The areas of the sub-catchments which contribute to Coulagh Bay are outlined in red and form the contributing catchment. Designated Shellfish Waters around Coulagh Bay are displayed in this map. This figure contains Irish Public Sector Data (Department of Housing, Local Government, and Heritage and EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

The CORINE land cover within Coulagh Bay contributing catchment features agricultural regions with areas of significant natural vegetation, moors and heathland, and areas of sparse vegetation. The remaining terrain includes coniferous forest, pastures, transitional woodland-shrub, bare rocks, and sea and ocean area[5] (**Figure 7-6**).

3.2. Coulagh Bay Shellfish Production Area

3.2.1. Location/Extent of Growing/Harvesting Area

Licensed aquaculture sites within Coulagh Bay can be seen in **Figure 3-3**. Site T05-523A in Coulagh Bay is a new BMPA which requires a sanitary survey to establish a BMPA boundary and species-specific RMPs. Site T05-523A (light blue) is licensed to produce blue mussel, Pacific oysters, native oyster (*Ostrea edulis*), stony sea urchin (*Paracentrotus lividus*), red seaweeds (*Rhodophyta*), and brown seaweeds (*Phaeophyceae*). It has a total area of 0.163 km^2 (16.31 ha). Site T05-233 (pink) is licensed for Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) with a total area of 0.259 km^2 (25.94 ha).

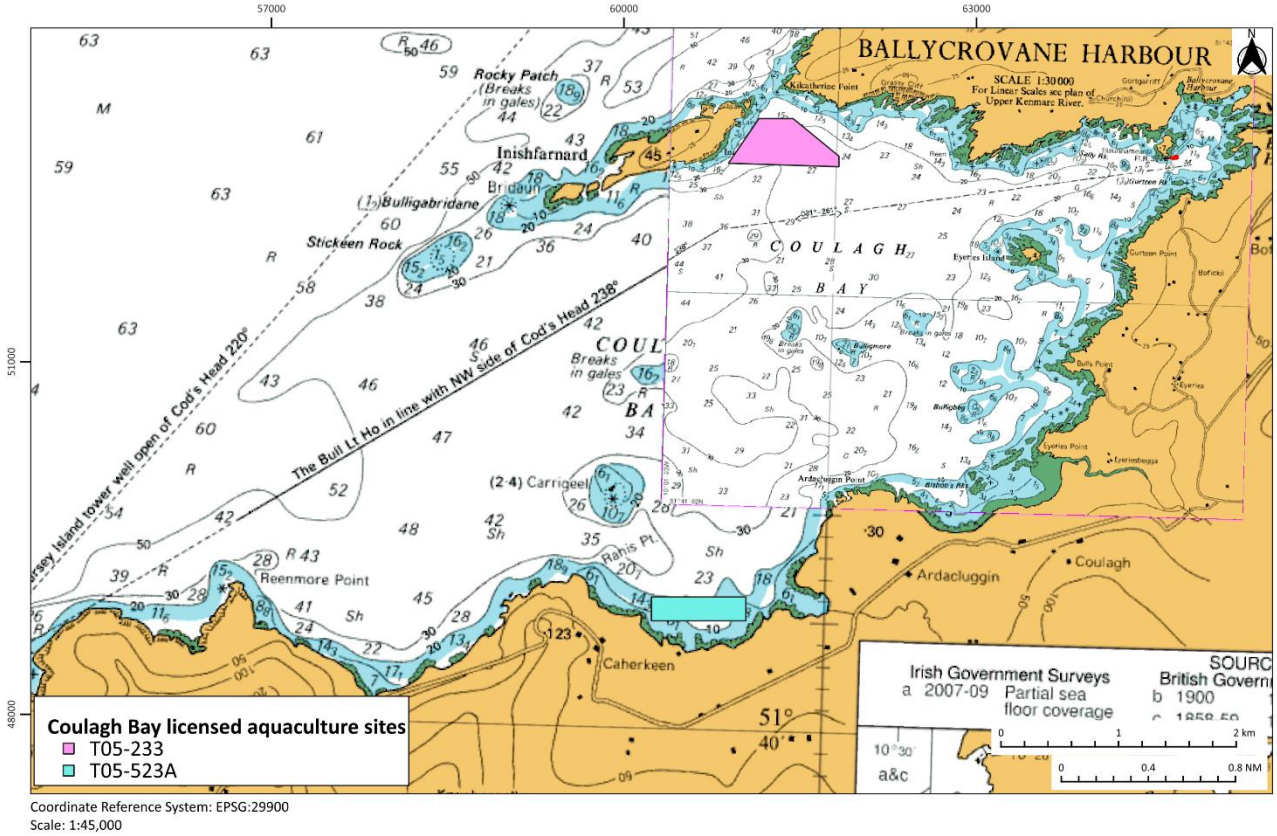


Figure 3-3: Licensed aquaculture sites in Coulagh Bay (source: Ireland's Marine Atlas 2024[13]). This figure contains Irish Public Sector Data (Department of Agriculture, Food and the Marine) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

3.2.2. Description of Bivalve Species

3.2.2.1. Mussels (*Mytilus edulis*)

Aquaculture and/or Fishery Operations

In Coulagh Bay, mussels will be grown from seed to adult stock on longlines. The site is in its first year of production and so is not fully stocked at present. The harvesting of commercially sized mussels is planned to be seasonal, using longlines once classification is established. Under the current licence for T05-523A, floating mussel longlines will be of a maximum 220 m in length, with a maximum of 12 longlines utilised at the site[14].

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 Coulagh Bay BMPA; in the context of this report, pollution refers to *Escherichia coli* (*E. 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 Coulagh Bay BMPA based on currents, tidal data, and the bathymetry of the bay are also discussed. Additional potential pollution sources, including temporally variable sources such as seasonal changes in tourism numbers and activities, yearly variations in agricultural practices, and seasonal precipitation are detailed. This section incorporates a detailed inventory of pollution sources observed during the shoreline surveys, 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

Coulagh Bay has a contributing catchment of 847 people, which equates to a population density of *c.* 18 people per km^2. There are no towns/urban areas within the contributing catchment. The population density of the overall contributing catchment is low in comparison to the population density of the State in 2016 (73 people per km^2); however, this aligns more closely with the average population density in rural areas in 2016 (27 people per km^2)[1]. Based on the 2022 census, there are 583 houses within the contributing catchment, of which 10% were vacant and 25% were holiday homes. Coulagh Bay contributing catchment partially overlaps three electoral divisions (EDs), namely the Coulagh, Kilcatherine, and Killaconenagh. The highest estimated population within the contributing catchment is in Killaconenagh ED.

4.2. Boating

Within the catchment there were eight piers/slips and one beach that were identified during the desktop review were confirmed by the shoreline survey. Of the piers/slips identified, the available data showed that they were predominantly used infrequently or seasonally such as Travara, with the exception of Ballycrovane Pier and slipway (map ID 18; **Figure 7-18**) which was noted as being used by multiple vessels and by the salmon farming company MOWI.

4.3. Sewage Discharges

Eyeries Wastewater Treatment Plant (WWTP) is the only WWTP within the contributing catchment. It has a population equivalent (PE) of less than 500 and is currently operating under capacity at a PE of 200[3]. Eyeries WWTP is regularised by the EPA under a Certificate of Authorisation (COA) which does not require an annual

environmental report to be submitted. Though biannually sampling of biochemical oxygen demand (BOD), suspended solids, and chemical oxygen demand (COD) is undertaken. There were no storm water overflows associated with this WWTP, and no industrial discharges were found within the contributing catchment[15].

Most permanent private households within the contributing catchment had a septic tank or other individual treatment system (*c.* 64.2%), and a further *c.* 32.6% were on the public system[4]. Those with another treatment system or where it was not stated accounted for *c.* 3.1% and very few (*c.* 0.2%) households were reported to have no sewage facilities[4]. Without definitive data on the location of septic tanks and other individual treatment systems, it is challenging to use these data in the selection of specific RMP locations. There was a high proportion of households on private treatment systems, however, the overall population of Coulagh Bay was low compared to the rest of Ireland. The habitation settlement pattern was not well dispersed over the EDs, with a higher population in Killaconenagh, more than double that of Kilcatherine, the next highest population. However, it is of note that the Killaconenagh ED does not border the shoreline of the contributing catchment.

The shoreline surveys undertaken as part of this study revealed a number of potential *E. coli* inputs, these included one drain/runoff, one flow, one storm drain, three drains, three rivers, five freshwater run-off points, seven streams, 15 pipes, and 17 other potential run-off points (**Figure 7-33**). It should be noted that the terminology used for some features is overlapping as it could not be definitively determined what exactly the feature was, *e.g.*, drain versus drain/run-off. However, this distinction has been kept to highlight the variety of potential diffuse inputs found during the shoreline survey. The presence of algal growth and discolouration was noted at some discharges by the shoreline survey. Water quality of the river water bodies within the contributing catchment was assigned Good ecological status during the 2016-2021 WFD monitoring period, including the Outer Kenmare River coastal water body[15] (**Figure 8-5**).

4.4. Agricultural Sources

Land cover[5] is marginally dominated by land principally occupied by agriculture with significant areas of natural vegetation (45%) with moors and heathland (42%) covering a similar area, and to a lesser extent sparsely vegetated areas (10%) and pastures (2%). Bare rocks, coniferous forest, transitional woodland shrub, and sea and ocean represent less than 1% of land cover. As agricultural activities have the potential to be a source of *E. coli* pollution, it is notable that agricultural land accounts for almost half of the contributing catchment. Forest and semi-natural lands (predominantly moors and heathlands) occur inland within the contributing catchment and agricultural lands occur closer to the shore. The three river sub-basins identified in the contributing catchment flow through agricultural lands as they approach Coulagh Bay. The Ardacluggin river sub-basin flows through the land adjacent to site T05-523A; an aggregation of discharges were also identified by the shoreline survey in this area (see maps IDs 26 to 44; **Figure 7-33**). Results from bacteriological analysis

showed that the stations sampled from the Ardacluggin river sub-basin (stations 4-9, **Figure 9-1**) had moderate to high levels of *E. coli* (980-2420 MPN/100 ml). Another aggregation of discharges was identified around Ballycrovane Harbour (within Coulagh Bay) through which the Ballycrovane river sub-basin discharges (map IDs 4 to 14; **Figure 7-33**). While no water samples were taken directly from this sub-basin, a saline sample was taken (station 2, **Figure 9-1**) which may provide an indication into the *E. coli* levels upstream.

According to the Census of Agriculture 2020[16], there were 4,302 cattle in the EDs that overlap with the contributing catchment, with the highest number of total cattle occurring in Coulagh (1,513). Coulagh ED accounts for the largest area of land within the contributing catchment and the estimated number of total cattle within the contributing catchment in Coulagh ED is 677. The density of total cattle in the contributing catchment was low at 0.3 LSU (livestock units)/ha of farmland, compared to 1.31 LSU/ha, the 2022 average stocking rate for Ireland[6]. As Teagasc uses different criteria compared to the Central Statistics Office (CSO) to define cattle and cows, dairy cows are considered separately under both definitions[17].

In 2020 there was a total of 7,422 sheep within the contributing catchment, and the ED with the most sheep was Kilcatherine ED. This is of particular importance to note for livestock abundance and densities as Coulagh and Kilcatherine EDs border the shoreline of Coulagh Bay and the rivers flowing through these EDs could provide a direct route for *E. coli* pollution to discharge into the BMPA. The stocking density for sheep in the contributing catchment (*c.* 1.6 sheep/ha of farmland) was high when compared to 1.12 LSU/ha, the average total stocking density for sheep in 2022[6]. Considering the high number of sheep compared to other livestock in the contributing catchment, sheep may contribute a larger proportion of diffuse agricultural pollution into Coulagh Bay, particularly after periods of elevated rainfall when the surface water runoff may bring more faecal contamination into the bay. Four locations with sheep and one location with cattle were noted during the shoreline survey (map IDs 39, 67, 70, 76, and 60, respectively; **Figure 7-18**). The sheep observed ranged from five to more than 20 across the five sites, and more than 50 cattle were counted.

Water sampling during the shoreline survey showed evidence of bacterial contamination at six out of nine stations sampled (**Table 9-2**). Currently, there are no guideline values for *E. coli* in Designated Shellfish Waters (DSW), however the results from the bacteriological survey can be considered moderate to high. This is particularly notable at the Kealincha River along which the Eyeries WWTP and associated discharges are situated; *E. coli* levels above 2420 MPN (Most Probable Number)/100 ml were reported here[18] (station 3; **Figure 9-1**). Station 4 (**Figure 9-1**) was located within the Ardacluggin river sub-basin which flows over agricultural land, and 2420 *E. coli* MPN/100 ml was also recorded at this station. The other two stations within the Ardacluggin river sub-basin (stations 5 and 6; **Figure 9-1**) and the seawater sample (station 1: **Figure 9-1**) had moderate levels of *E. coli*. Three stations were sampled from a vessel, as close to the freshwater runoffs as logistically possible (stations 7, 8, and 9; **Figure 9-1**); *E. coli* levels at these stations were less than one.

4.5. Rivers and Streams

Coulagh Bay drains a catchment of *c.* 47.63 km^2 and is dominated by the Kealincha and Ardacluggin river sub-basins (44.5% and 37.6%, respectively), and to a lesser extent by the Ballycrovane river sub-basin (**Figure 8-6**). The 2016-2021 WFD status[15] for all water bodies within the contributing catchment was Good, and the adjacent Outer Kenmare River and South Western Atlantic Seaboard were of Good and High status, respectively (**Figure 8-5**). River water bodies are defined by the EPA and are the classification units used in this report to determine how Coulagh Bay contributing catchment is drained rather than considering individual rivers and streams. The Ardacluggin river sub-basin enters Coulagh Bay close to the licensed aquaculture site (T05-523A). Land use overlapping the Ardacluggin water body is dominated by agriculture which may lead to increased levels of contamination (**Figure 7-6**). The Ardacluggin water body drains the largest percentage of the contributing catchment, after the Kealincha water body, and discharges closest to the licensed aquaculture site. The Kealincha water body is likely the main transporter of contamination into the Coulagh Bay BMPA due to the high percentage of the contributing catchment it drains and that it largely drains agricultural land. One bacteriological sample was acquired from the Kealincha river sub-basin (station 3; **Figure 9-1**) and three samples were acquired from the Ardacluggin river sub-basin (stations 4, 5, and 6; **Figure 9-1**). Stations 3 and 4 had *E. coli* levels of ≥ 2420 MPN /100 ml, and stations 5 and 6, which are adjacent to the proposed aquaculture site T05-523A, returned values of 1,203 and 980 MPN/100 ml, respectively; see **Table 9-2**.

4.6. Movement of Contaminants

Coulagh Bay is a sheltered bay within Kenmare Bay, with depths generally less than 30 m. Current flows are weak and there is a small tidal range (**section 8.3**). Water movement in Coulagh Bay is dominated by the wind which prevailed from the south-southwest over the period from 2019-2023 (**section 8.3** and **8.4**). As *E. coli* pollution is generally transported into the bay via freshwater, it is likely that *E. coli* levels will be higher in surface waters which sit on top of the denser seawater. Therefore, the prevailing wind likely plays a large role in the movement of contaminants in Coulagh Bay and across the BMPA, and this movement may be highly varied due to changing wind and environmental conditions.

4.7. Wildlife

Coulagh Bay is within the foraging/breeding range of several bird species and there is the possibility these species will visit the shellfish production area as the habitat type and infrastructure has been known to support these species for a range of activities. The structures present at bivalve mollusc production sites and finfish sites in Coulagh Bay provide suitable areas for birds to perch. Gulls, cormorants, and shags are likely to perch on the floating mussel longlines (Roycraft *et al.*, 2007). The potential use of the longlines by these birds

suggests they may defaecate while present in the area which would add to the *E. coli* levels in the surrounding water.

Coulagh Bay overlaps with Kenmare River SAC which has been designated for a range of species and habitats of which harbour porpoise, harbour seal, and otter are of special conservation interest. Harbour seals are established in the bay utilising rocky islets throughout for resting and moulting activities (**Figure 7-17**) and have been noted to frequent Ballycrovane Harbour which falls within the contributing catchment[10]. Otters have been recorded in Coulagh Bay and harbour porpoise are generally recorded in small pods[40]. Other marine mammals recorded in Coulagh Bay between 2013 and 2021 include bottlenose dolphin (*Tursiops truncatus*), fin whale (*Balaenoptera phyalus*), humpback whale (*Megaptera novaeangliae*), Minke whale (*Balaenoptera acutorostrata*), long-finned pilot whale (*Globicephala melas*), Risso's dolphin (*Grampus griseus*), Sowerby's beaked whale (*Mesoplodon bidens*), striped dolphin (*Stenella coeruleoalba*), and sperm whale (*Physeter macrocephalus*)[19].

The bird and marine mammal populations that visit the site may contribute to background bacteriological levels within the bay, but their impacts will be largely diffuse. Calambokidis and McLaughlin (1987) found that a population of up to 230 harbour seals had the potential to be significant contributors to the high faecal coliform levels reported in Quilcene Bay, Washington, US, which resulted in the cessation of commercial shellfisheries in the area. 419 harbour seals were observed in Kenmare River SAC over the 2017/2018 monitoring period through thermal-imaging surveys, some of which were specifically observed in Ballycrovane Harbour (Morris and Duck, 2019). Based on this, harbour seals in Coulagh Bay will increase bacteriological levels in the BMPA if they occur within the BMPA boundary.

4.8. Seasonality

In 2019, more than 4.6 m tourists visited the southwest region of Ireland (Fáilte Ireland, 2019). This figure was made up of 2,335,000 overseas tourists, 2,316,000 domestic tourists, and 38,000 Northern Irish tourists. Of the domestic tourists in 2022, a total of 1,556,000 trips visited Co Cork, with 4,084,000 overnights and an average length of stay of 2.6 nights; a total of 1,207,000 trips visited Co. Cork, with 3,679,000 overnights and an average length of stay of three nights per trip[20]. There are six tourist attractions within the contributing catchment, and the town of Eyeries itself may be considered a tourist attraction.

The number of holiday homes accounts for 25% of houses within the contributing catchment. The number of domestic trips by Irish residents in 2022 was highest in July to September followed by April to June[21]. This may indicate an increase in the use of holiday homes over these periods. 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 differ from the southwest region due to weather, the number of attractions, and the level of demand for those attractions.

In terms of agriculture, the number of sheep is expected to be highest in spring/summer when lambs are present; also, at that time of the year there may be more extensive grazing on the hills and thus bacterial impacts would be more widely spread. The Fifth Nitrates Action Programme 2022-2025 restricts slurry spreading before October 1st of a given year and prohibits the spreading of soiled water between December 1st and 31st, effective from January 1st, 2024[22]. Guidelines (statutory instrument [S.I.] No. 113/2022) 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[23]. Nearly 50% of the land within the contributing catchment is agricultural, in particular along the coastline of Coulagh Bay, so there is a potential risk associated with contamination resulting from slurry spreading if the 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 of time, faecal contamination may enter the bay via run-off from the land. Though, this largely coincides with the prohibited period for the spreading of soiled water. The highest bacterial loading from the land is expected to occur in August and September as faecal biomass may accumulate over the drier period of April to July. 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 period and winter was the wettest, however the five-year trend from 2019 to 2023 found spring was the driest season and autumn was the wettest.

4.9. Shoreline Survey

Inventory of Pollution Sources

In total 78 features were identified (see **Table 7-10** and **Appendix 4: Shoreline Survey Images**), of which 15 were noted as pipes, seven streams, six fields, five confirmed run-off points, and a further 17 run-off points which were noted as 'potential run-off points' as they could not be definitively confirmed during the survey. There were five locations with sheep (ranging from five to more than 20 individuals) and one location with cows (more than 50). There were four drains, three rivers, three piers and slipways, three piers, two residences, one storm drain, one storage tank, one slipway, one salmon farm site (with 12 pens), one public toilet, one flow, one cave, one beach, one dump site, and one site with evidence of coastal erosion. Most of the discharges flowed directly into Coulagh Bay, except for some discharges that initially discharge into rivers which ultimately flow into Coulagh Bay (**Table 7-12**).

Bacteriological Sampling Results

Water sampling was undertaken as part of the shoreline survey with nine water samples taken from four rivers, from seawater adjacent to a residential property along the shore, from a pier/slipway adjacent to a chemical storage tank, and there were three stations in the bay sampled from a vessel. Station 3 of the bacteriological survey at the Kealincha River had the highest levels of *E. coli* recorded from the survey, exceeding 2420 MPN/100 ml (station 3; **Figure 9-1**). The Kealincha River drains the largest percentage of the contributing catchment (44.5%), flowing predominantly over agricultural land and past the Eyeries WWTP. The Ardacluggin river sub-basin drains a similar percentage of the contributing catchment (37.6%) and *E. coli* levels from the three stations sampled along the Ardacluggin river sub-basin (stations 4, 5, and 6; **Figure 9-1**) reported moderate to high levels of *E. coli*. The Ardacluggin river sub-basin was also predicted to carry diffuse agricultural contamination as it flows over agricultural land. The lowest levels of *E. coli* recorded were from the seawater samples taken from the vessel, where pollution is expected to have diluted compared to the source (stations 7, 8 and 9; **Figure 9-1**).

Of the discharges noted during the shoreline survey, 20 out of 53 were definitively man-made discharges or pipes. During the shoreline survey, it could not be determined if the run-off and potential run-off points were man-made or of natural origin. Therefore, the impact due to human activities cannot be definitively evaluated from the water samples at this time as no water samples were directly taken from these discharge points.

5. Recommended Amendments

There have been no previous RMPs or BMPA boundary established in Coulagh Bay; T05-523A is the first licensed shellfish production site there. As such there are no amendments *per se*. See **section 6** for details on the Coulagh Bay RMP and BMPA, the former has been determined based on the findings of this sanitary survey.

6. Conclusion of the Sanitary Survey

6.1. Bivalve Mollusc Production Area (BMPA)

The BMPA for Coulagh Bay has been established in consultation with the SFPA. The boundary begins at Ardacluggin Point and extends south-westwards to Reenmore Point, encompassing site T05-523A (**Figure 6-1**).

Table 6-1: Coordinates of the bivalve mollusc production area in Coulagh Bay. Latitude and longitude values are in coordinate reference system (CRS) WGS84, easting and northing values are in CRS Irish Transverse Mercator[24].

Corner	Latitude	Longitude	Easting	Northing
West	51.6769	-10.0715	456742.4	549192.6
East	51.6854	-9.9947	462083.2	549997.8

6.2. RMP for Mussels (*Mytilus edulis*)

One RMP is recommended for shellfish production within the Coulagh Bay BMPA. RMP 1 has been placed on the shoreward side of site T05-523A in order to be most effective at capturing *E. coli* levels, as the majority of potential *E. coli* sources come from the land and shore (**Figure 6-1**, **Table 6-2**). Within the BMPA, the highest density of discharges occurs to the south and southeast of T05-523A. From the water samples taken during the shoreline survey, the two samples with the highest *E. coli* levels (MPN/100 ml) are located close to the shellfish site too (stations 4 and 5, **Figure 9-1**).

The CORINE land type 'Land principally occupied by agriculture' dominates the terrestrial environment along the shoreside of T05-523A. As three rivers overlapping this land type drain a number of tributaries from the Ardacluggin river sub-basin and flow into Coulagh Bay near site T05-523A, there is a clear route for agricultural pollution to enter the waters surrounding the site (**Figure 7-6**, **Figure 7-32**). Water movement in Coulagh Bay is susceptible to wind, which predominantly came from the south-southwest from 2019-2023 (**section 8.4**), meaning T05-523A is generally sheltered from the prevailing wind. Therefore, it is unlikely that pollution from the seawards side of the shellfish site would impact the *E. coli* levels at this site, so placing RMP 1 on the shoreward side of the site is most suitable.

6.3. Microbiological Sampling Plan

Upon classification of Coulagh Bay BMPA, a minimum of 15 individual blue mussels of market size (minimum 4 cm shellfish length) are required to be sampled monthly[9, 25].Shellfish samples for flesh analysis should be taken within the top one metre of the water column and as close to the surface as possible, to obtain a representative sample of the *E. coli* levels within Coulagh Bay BMPA. Flesh samples should be taken within a maximum of 100 m from RMP 1. Once the production area has been classified and considering that harvesting can potentially take place year-round, the minimum sampling frequency for ongoing monitoring should be at

least monthly at the RMP on a year-round basis. The SFPA are the competent authority responsible for implementing this sampling plan.

Table 6-2: Coordinates for the representative monitoring point (RMP) for blue mussels in Coulagh Bay BMPA. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[24] .

RMP	Site Code	Species	Latitude	Longitude	Northing	Easting
RMP 1	KY-CB-CB	*M. edulis*	51.67541	-10.01292	048876	060828

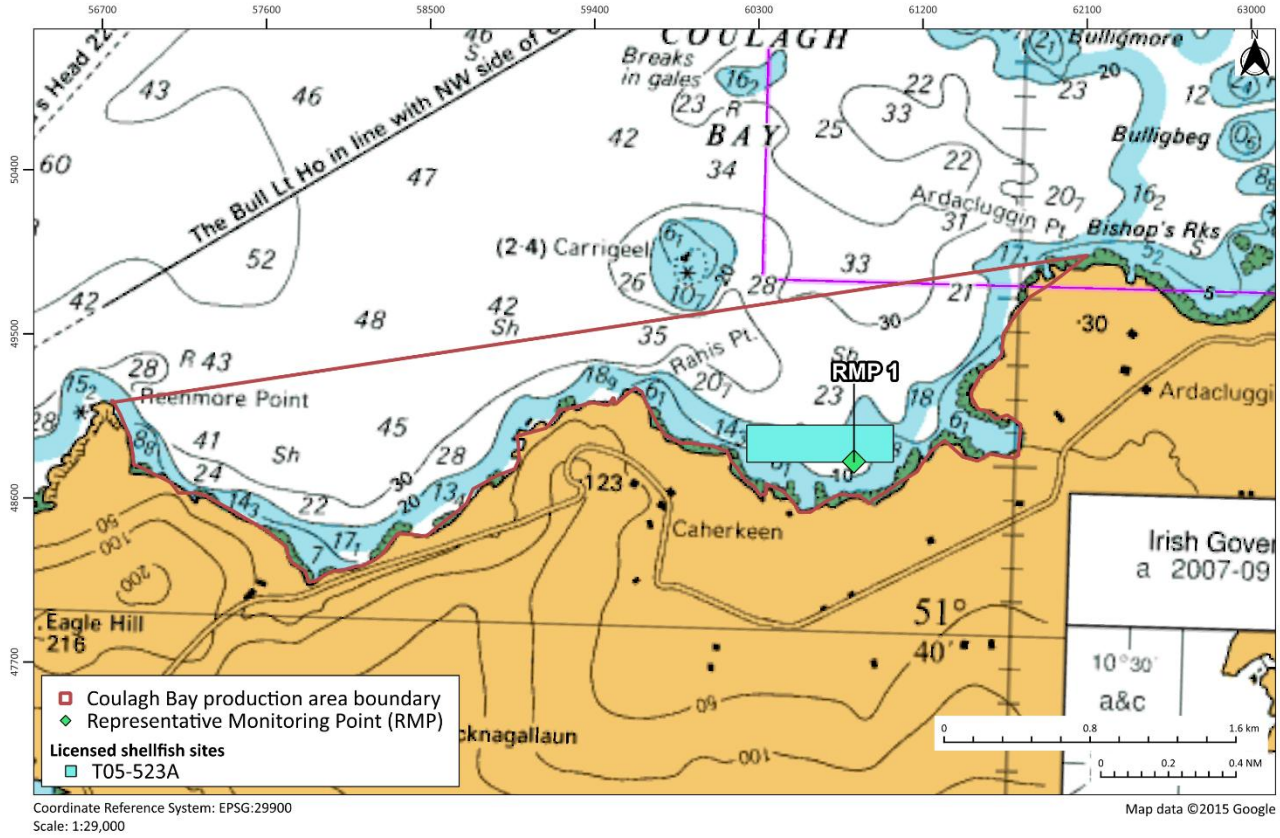


Figure 6-1: Coulagh Bay production area boundary and representative monitoring point (RMP 1) for blue mussels at site T05-523A.

6.4. Preliminary RMP for Pacific Oysters

A preliminary RMP (pRMP) is being allocated for Pacific oysters to allow pre-classification sampling to be carried out. Once this is complete, and Pacific oysters are permanently on site, a definitive RMP will need to be determined depending on the location of the oysters within the BMPA and type of culture used.

Due to the relatively small area of the licensed site and current absence of oyster stock, RMP 1 (*i.e.*, the RMP for mussels) can be preliminarily used as a proxy to monitor *E. coli* in oysters as well. However, it should be noted that there is a difference in bacterial uptake between these bivalve filter feeders. It is recommended that the oyster stock used for pre-classification sampling be placed as close to RMP 1 as practical for representative monitoring.

6.5. General Sampling Method

All collection and transport of shellfish samples for *E. coli* testing under the sampling plan identified as part of the Coulagh Bay Sanitary Survey should adhere to the Code of Practice for the Microbiological Monitoring of Bivalve Mollusc Production Areas, as published on the SFPA website[25].

7. Appendix 1: Identification of Pollution Sources

This section documents all pollution sources identified during the desktop and shoreline surveys within Coulagh Bay 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 Coulagh Bay which covers an area of approximately 47.63 km^2 (**Figure 7-1**).

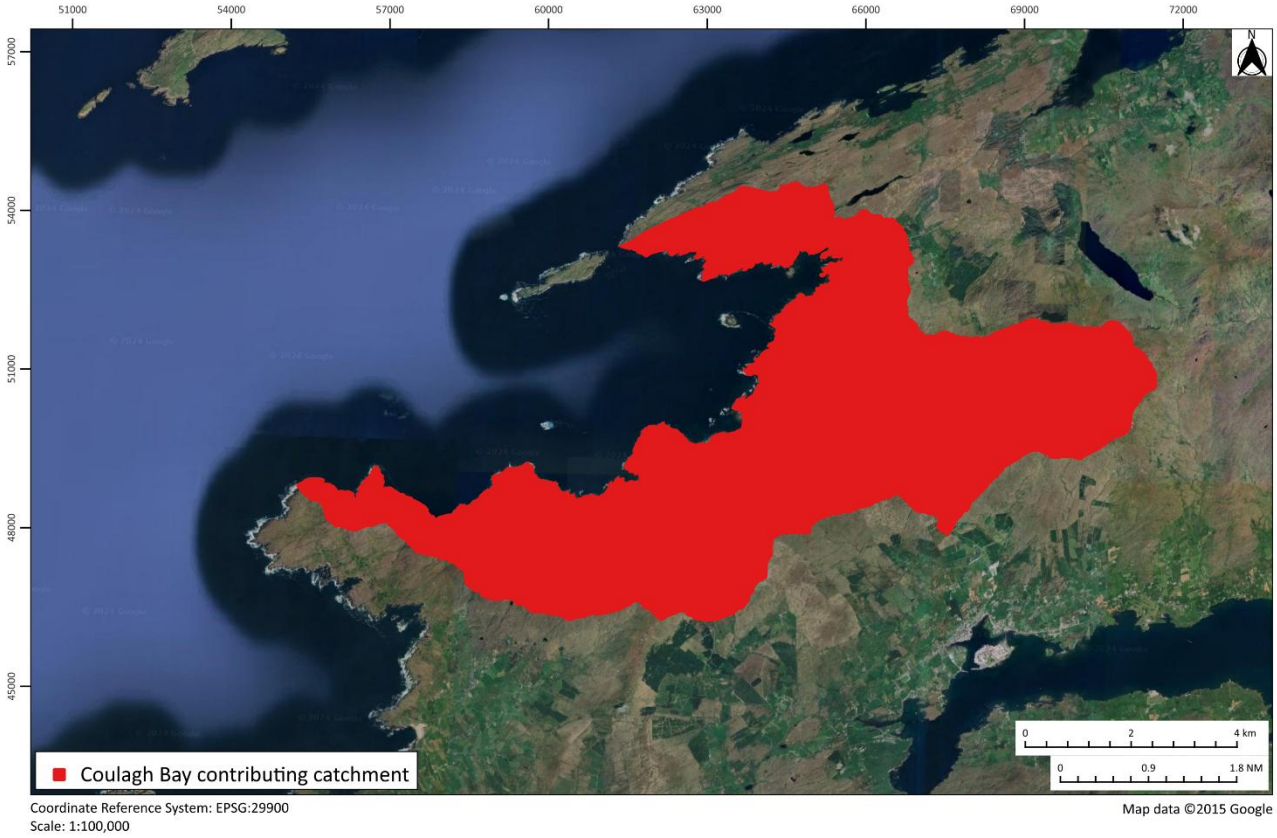


Figure 7-1: Coulagh Bay contributing catchment established for the assessment of pollution sources into the Coulagh Bay bivalve mollusc production area.

7.1.1. Human Population

Population census data used by the 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[16]; the census takes place every five years in Ireland. **Figure 7-3** shows the human population within Coulagh Bay contributing catchment and **Table 7-1** shows these data in tabular form.

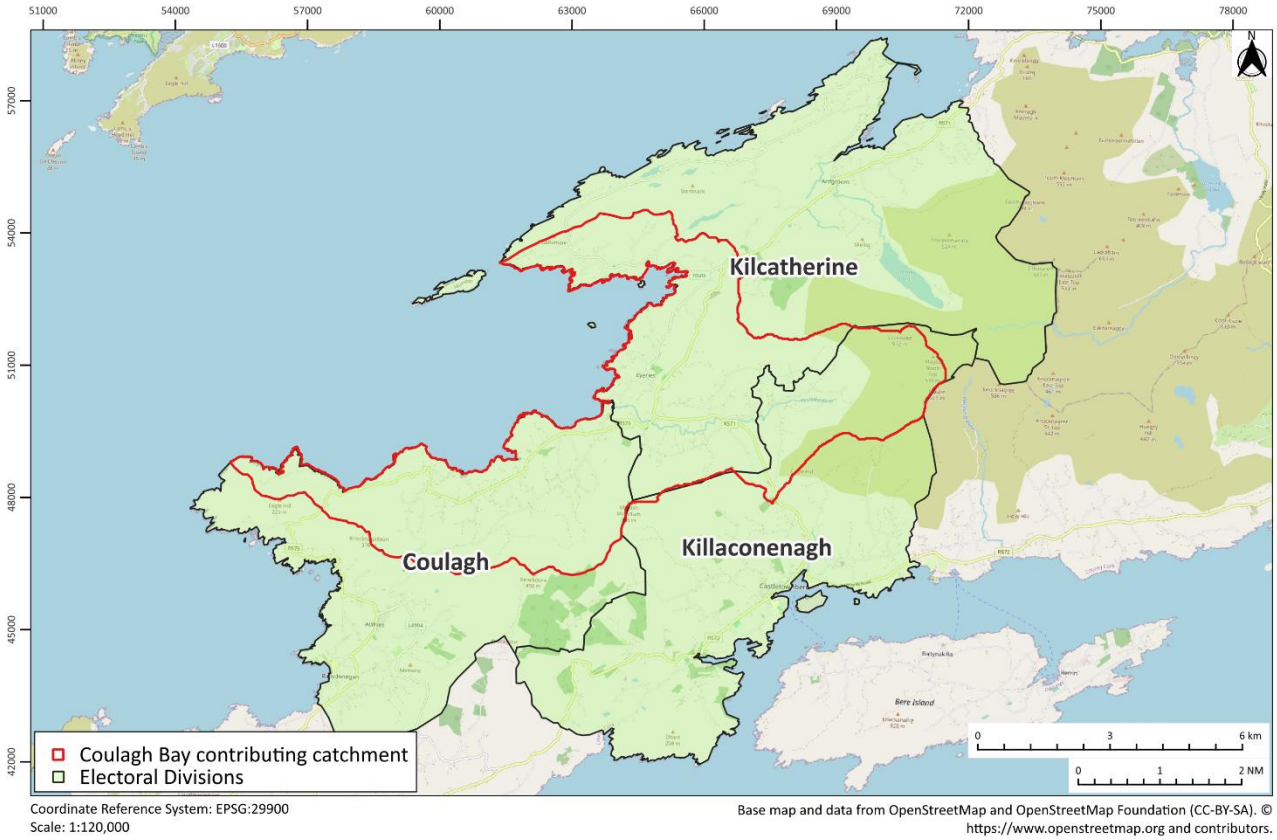


Figure 7-2: Electoral divisions within Coulagh Bay contributing catchment. This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Coulagh Bay contributing catchment partially overlaps three EDs, namely the Coulagh, Kilcatherine, and Killaconenagh EDs. These three EDs accommodate a total population of 2,975 people. As none of the EDs fall completely within the contributing catchment, an effort was made to estimate the actual population within the contributing catchment for the three EDs. The geographical area of the three EDs overlapping with the contributing catchment was calculated using the Geographic Information System (GIS) software QGIS 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 Coulagh Bay contributing catchment is estimated at 847 people. Killaconenagh contains the largest population within the contributing catchment (329), followed by Coulagh (260), and Kilcatherine (258) (see **Table 7-1**). There are no towns or urban areas within the contributing catchment; the nearest town is Castletownbere (*c.* 1.8 km from the nearest point of the contributing catchment[26]).

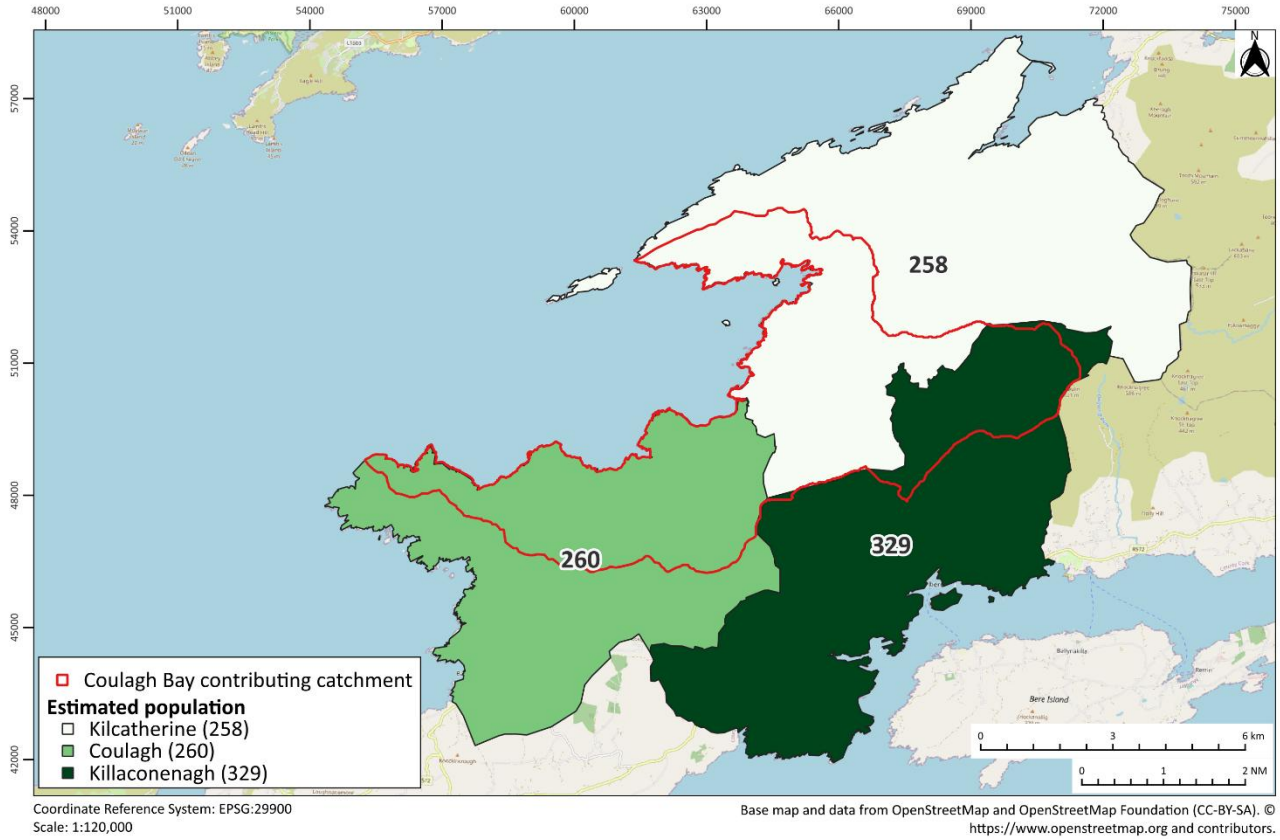


Figure 7-3: Human population per electoral division (ED) within Coulagh Bay contributing catchment (source: CSO[27]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7-1: Human population within Coulagh Bay contributing catchment (source: CSO[16]).

Electoral Division (ED)	Population (2022)	% of Electoral Division in Contributing Catchment	Estimated Population
Coulagh (Co. Cork)	582	44.7	260
Kilcatherine (Co. Cork)	780	33.1	258
Killaconenagh (Co. Cork)	1613	20.4	329
Total	2975	N/A	847

There are 1,971 houses in total within the three EDs considered here[2]. Of this, 65.2% (1,285) are occupied, 11% (218) are vacant and a further 22% (436) are holiday homes. Of the 583 houses within the contributing catchment (based on % of the ED within the contributing catchment), 63% (368) are occupied, 10% (61) are vacant, and a further 25% (147) are holiday homes. **Table 7-2** shows the number of houses 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 Coulagh Bay system. Therefore, the highest levels of sewage and waste are expected to enter from the Killaconenagh ED. Although as the Coulagh and Kilcatherine EDs border the shoreline of the contributing catchment, any anthropogenic discharges from houses in these EDs may have a more notable

impact on the BMPA as the route for pollution to enter the bay is shorter. As holiday homes account for 25% of the dwellings in the contributing catchment, there may be a seasonal increase in the sewage and wastewater levels relative to the permanent population.

Table 7-2: Houses within the electoral divisions in Coulagh Bay contributing catchment (source: CSO[2]).

Electoral Division	Entire Electoral Division				Contributing Catchment %			
	Total Houses	No. Occupied*	Unoccupied Holiday homes	Vacant Houses	Total Houses	No. Occupied*	Unoccupied holiday Homes	Vacant Houses
Coulagh (Co. Cork)	442	251	145	35	199	113	65	16
Kilcatherine (Co. Cork)	580	329	176	63	191	109	58	21
Killaconenagh (Co. Cork)	949	706	115	120	190	141	23	24
Total	1971	1286	436	218	580	363	146	61

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

7.1.2. Tourism

Coulagh Bay contributing catchment is situated in Co. Cork, however the border to Co. Kerry is approximately 3 km away from the contributing catchment. At the time of writing, there were no tourism statistics specifically relating to the Coulagh Bay area, so general statistics from Counties Cork and Kerry are used. It is important to note however that Coulagh Bay is a rural area, so the tourism statistics used are likely to overestimate the actual tourism statistics in the Coulagh Bay region.

In 2023, the southern region (including Cork and Kerry) was comprised of the most domestic overnight trips (42%) compared to Ireland as a whole[28]. In 2022, there were 1,556,000 trips to Cork accounting for 4,084,000 nights with an average length of stay of 2.6 nights, and in Kerry there were 1,207,000 trips made accounting for 3,679,000 nights and an average length of stay of three nights per trip[29]. For Ireland as a whole in 2022, most domestic tourists went on holiday between July and September (40%), followed by April to June (27%), and 16% each in January to March and in October to December[21]. For Ireland as a whole in 2019, most overseas 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[30].

Eyeries village is situated along Coulagh Bay, perched on the Wild Atlantic Way and is part of the Beara Way, making the settlement an attraction in its own right[31]. Attractions within the contributing catchment include the Hag of Beara, Ballycrovane Ogham Stone, Kilcatherine Cemetery, Eyeries Motor Home Park, Eyeries Glamping Pods, and Causkey's Bar (**Figure 7-4**)[32]. The Wild Atlantic Way and the Beara Way pass through the contributing catchment and Eyeries village. The Beara Peninsula is a popular tourist destination and other regions near Coulagh Bay which may attract tourists are Castletownbere, Bere Island, and Dursey Island.

Walking/cycling routes in the region include the Beara Way, Eyeries to Creha Quay Loop, Allihies to Ballydonegan Loop, Bullig Bay Loop, Bere Island to Ardnakinna West Island Loop, Bere Island – Rennin Loop, and Dursey Island Loop[33], however only the Beara Way and the Eyeries to Creha Quay Loop overlap the contributing catchment.

A host of archaeological heritage sites are found in the Beara region, however only Kilcatherine Cemetery and Ballycrovane Ogham stone fall within the contributing catchment. A boat tour company operate out of Ballycrovane Pier from May to October doing approximately four to five tours on the weekend for the purposes of fishing, touring Coulagh Bay, or visiting Bull Rock with a maximum of 12 individuals per tour (*per comms.* Beara Boat Tours). There are no publicly listed beaches within the contributing catchment.

Papadikis *et al*. (1997) found significant correlations between the number of swimmers present on beaches in Greece and the presence of pathogenic bacteria. In 2007, Elmir *et al*. (2007) 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 within the bay, the number of swimmers and subsequently the bacteriological quality of the bay cannot be estimated.

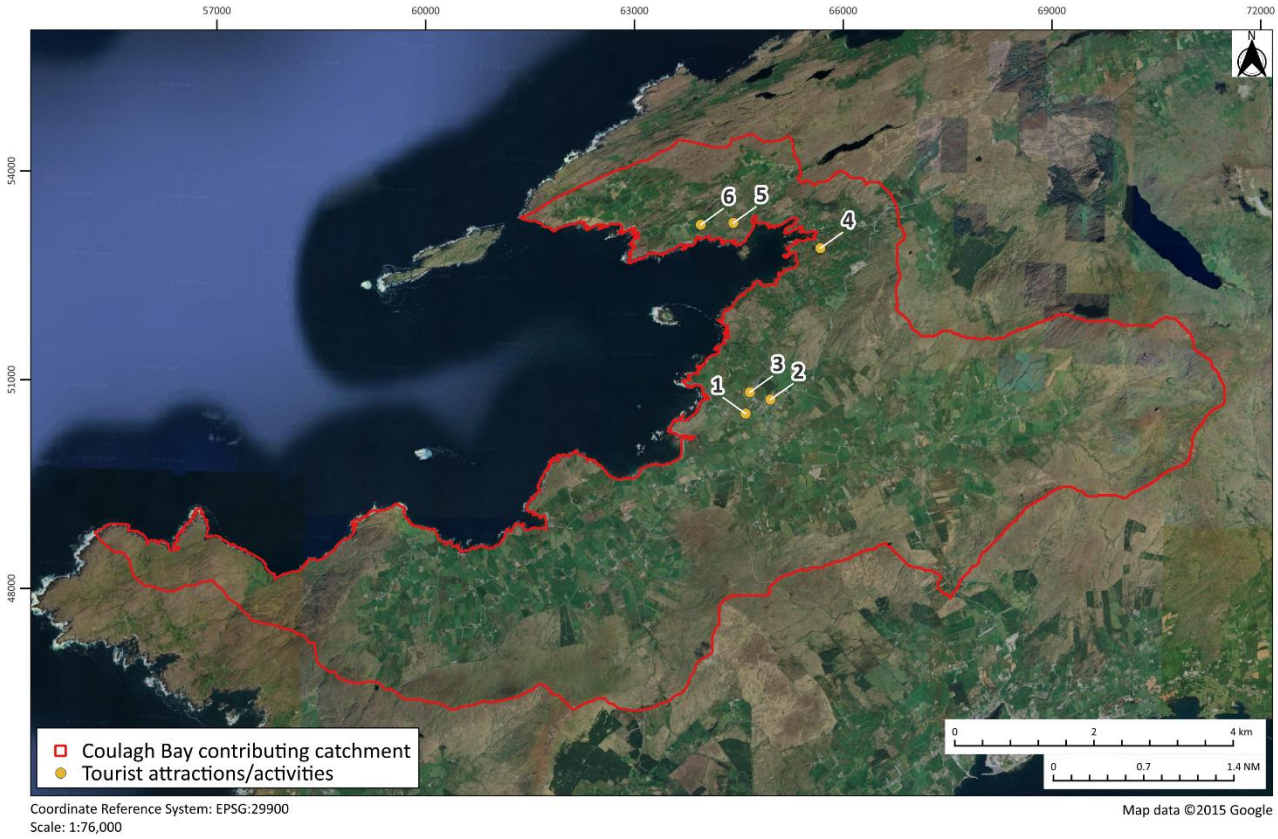


Figure 7-4: Tourist attractions within Coulagh Bay contributing catchment and the Beara Peninsula. Map IDs are cross-referenced to Table 7-3. This figure contains Irish Public Sector Data (Fáilte Ireland) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7-3: Tourist attractions within Coulagh Bay contributing catchment and the Beara Peninsula.

Map ID	Name
1	Eyeries Glamping Pods
2	Eyeries Motor Home Park
3	Causkey's Bar
4	Ballycrovane Ogham Stone
5	The Hag of Beara
6	Kilcatherine Cemetery

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 WWTP within Coulagh Bay contributing catchment with a PE of less than 500, namely the Eyeries WWTP (licence registration A0395-01[34]) (see **Figure 7-5**). Eyeries WWTP is currently operating under capacity[3], and as it has a PE of less than 500, this WWTP is governed by a COA regulated by the EPA. As set out in the COA, BOD, suspended solids, and COD are sampled biannually from the primary discharge point at the Eyeries WWTP. There are no WWTPs serving a PE of more than 500 within the contributing catchment.

7.1.3.2. Continuous Discharges

The Eyeries WWTP has a design capacity of 400 PE[35] but currently operates under capacity at a PE of 200[34]. It is a secondary treatment facility which means that after primary treatment measures, further treatment is conducted to purify the water. There is no tertiary treatment at this WWTP. There have been no updates on this WWTP since the application and Certificate of Authorisation in 2011[34].

There is one primary discharge associated with the Eyeries WWTP and there are no secondary discharges or storm water overflows. The primary discharge point (SW01) releases into a tributary of the Kealincha River and serves an agglomeration of less than 500. The design capacity and flow rates of this WWTP are based on the primary discharge. The maximum volume of waste emitted is 264 m^3/day, typically the emissions are 88 m^3/day under normal conditions with a dry weather flow (DWF) of 0.003 m^3/second. Flow rates of the

receiving water body (tributary of Kealincha River) relative to the primary discharge point are 0.0088 m^3/second during 95% weather flow, however there are currently no flow rate data available during DWF for the receiving water body. The location of discharges associated with Eyeries WWTP can be seen in **Figure 7-5** and map IDs are cross-referenced to **Table 7-4** which provides details of the discharges and sampling points.

Three sampling points are associated with the Eyeries WWTP for monitoring purposes. These include a sampling point at the primary discharge (SW-01 EYER), and one sampling point upstream and downstream of the primary discharge point, respectively.

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[4]. Of the 1,254 permanent private households within the three EDs, 37.6% (472) were connected to a public sewage treatment system and 58.7% (736) had septic tanks or other individual treatment systems. A further 3.4% (43) had another treatment system or the treatment system was not stated, and 0.2% (3) had no sewage facility. The estimated total number of private permanent households within the contributing catchment (based on % within the contributing catchment) is 357 and of this 32.6% (116) are on the public system, while 64.2% (229) have their own septic tank or other individual treatment systems. Households with another treatment system or where the treatment system was not stated account for 3.1% (11) of the households and 0.2% (1) had no sewage facility. **Table 7-5** shows this information at the ED level and the estimations within the contributing catchment.

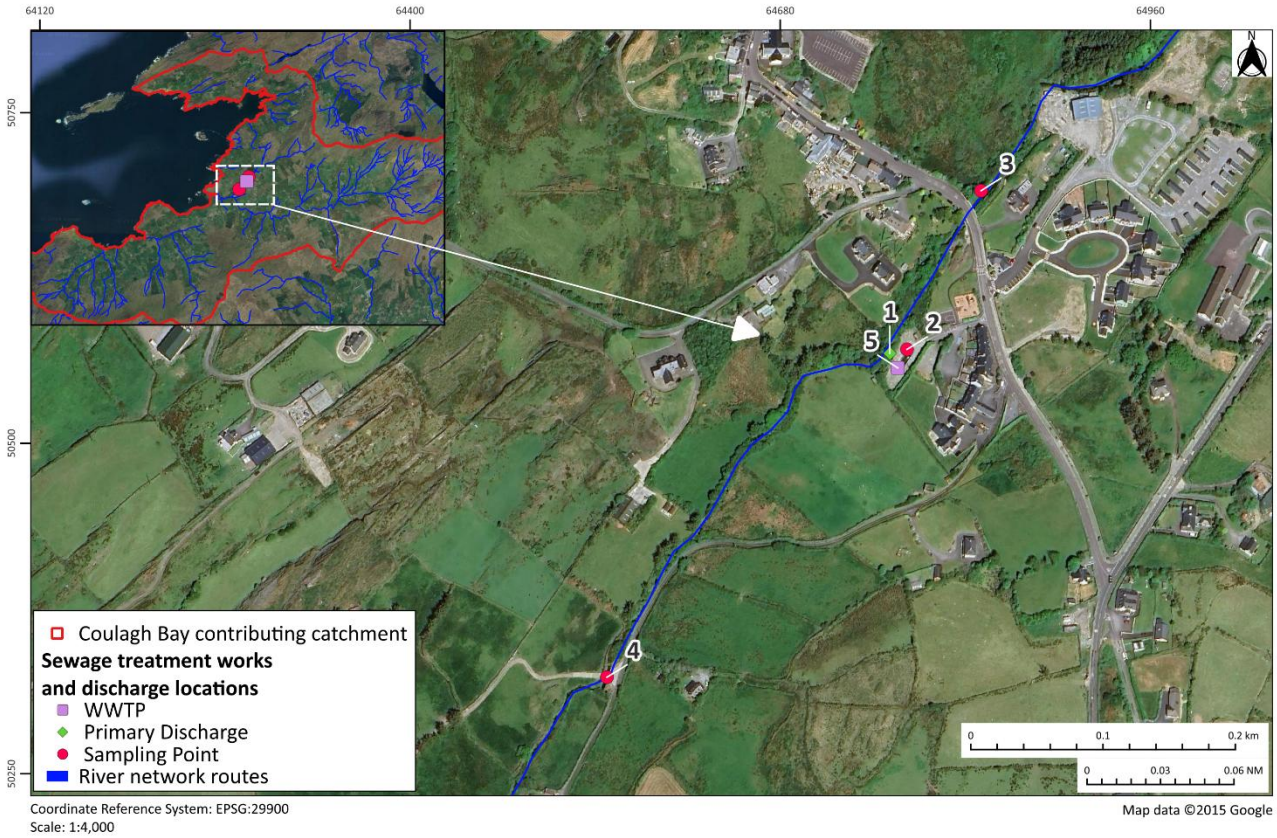


Figure 7-5: Location of Eyeries wastewater treatment plant (WWTP) and discharge locations in Coulagh Bay contributing catchment. Map IDs cross-referenced to Table 7-4. This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Table 7-4: Details of discharges and sampling points related to Eyeries Wastewater Treatment Plant (WWTP)[35]. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[24].

Map ID	Facility	Treatment	Name	Easting	Northing	Latitude	Longitude	Receiving Water Body
1	Primary Discharge	Secondary Treatment	SW-01	64763	50568	51.6918	-9.95648	Tributary of River Kealincha
2	Sampling Point	N/A	SW01 EYER	64776	50571	51.69183	-9.9563	Tributary of River Kealincha
3	Sampling Point	N/A	Upstream sampling point	64832	50691	51.69292	-9.95553	Upstream Tributary of River Kealincha
4	Sampling Point	N/A	Downstream sampling point	64549	50323	51.68955	-9.95948	Downstream Tributary of River Kealincha
5	WWTP	N/A	Eyeries WWTP	64769	50557	51.69171	-9.95639	N/A

Table 7-5: Sewage facilities at permanent households in the contributing catchment (CSO, 2022[4])

	Entire Electoral Division						Contributing Catchment*					
	Permanent Private Households	Public Sewage Scheme	Individual Septic Tank	Other Individual Treatment	Other/ Not Stated	No Sewage Facility	Permanent Private Households	Public Sewage Scheme	Individual Septic Tank	Other Individual Treatment	Other/ Not Stated	No Sewage Facility*
Coulagh	249	52	177	12	7	1	111.4	23.3	79.2	5.4	3.1	0.4
Kilcatherine	322	60	231	26	5	0	106.5	19.8	76.4	8.6	1.7	0.0
Killaconenagh	683	360	260	30	31	2	139.2	73.4	53.0	6.1	6.3	0.4

*Within the contributing catchment section in the above table, numbers are not whole numbers however there cannot be 111.4 permanent private households within Coulagh Bay contributing catchment. Values were rounded to the nearest decimal place to represent facilities within the contributing catchment that were estimated at less than 0.5. Otherwise the number of facilities within the contributing catchment would have been underestimated.

7.1.3.3. Rainfall Dependent/Emergency Sewage Discharges

There were no rainfall dependent or emergency sewage discharges associated with the Eyeries WWTP[35].

7.1.4. Industrial Discharges

There were no industrial licensed facilities within the contributing catchment that have emissions to water (EPA geoportal[15]).

Discharge of trade or sewage effluent to waters is permitted through Section 4 discharge licences. 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 were no Section 4 discharge licences within Coulagh Bay contributing catchment[36].

7.1.1. Land Use Discharges

Figure 7-6 shows the CORINE land cover within Coulagh Bay contributing catchment[5] and **Figure 8-6** shows all the river water bodies within the contributing catchment. Land cover within the contributing catchment is marginally dominated by land principally occupied by agriculture with significant areas of natural vegetation (*c.* 21.52 km^2, 45%), with moors and heathland (*c.* 20.02 km^2, 42%) also covering a similar area (**Figure 7-7**). Sparsely vegetated areas (*c.* 4.77 km^2, 10%) and pastures (*c.* 1.04 km^2, 2%) comprise the land cover to a lesser extent. A small percentage of land cover in Coulagh Bay contributing catchment consists of bare rocks (*c.* 0.133 km^2), coniferous forest (*c.* 0.016 km^2), transitional woodland shrub (*c.* 0.06 km^2), and sea and ocean (*c.* 0.083 km^2), and cumulatively they represent 0.61% of cover in the contributing catchment.

CORINE land cover distributes cover types over three hierarchical classes whereby Class 1 is the most broad and is comprised of Classes 2 and 3, whereby Class 3 is the descriptor level used in this report and in **Figure 7-6** to identify and examine land cover within the contributing catchment[5]. When examining land cover at the Class 1 level, 52.48% are forest and semi-natural areas, 47.36% are agricultural areas, and 0.17% are water bodies. This emphasises the significance of agricultural regions in the contributing catchment.

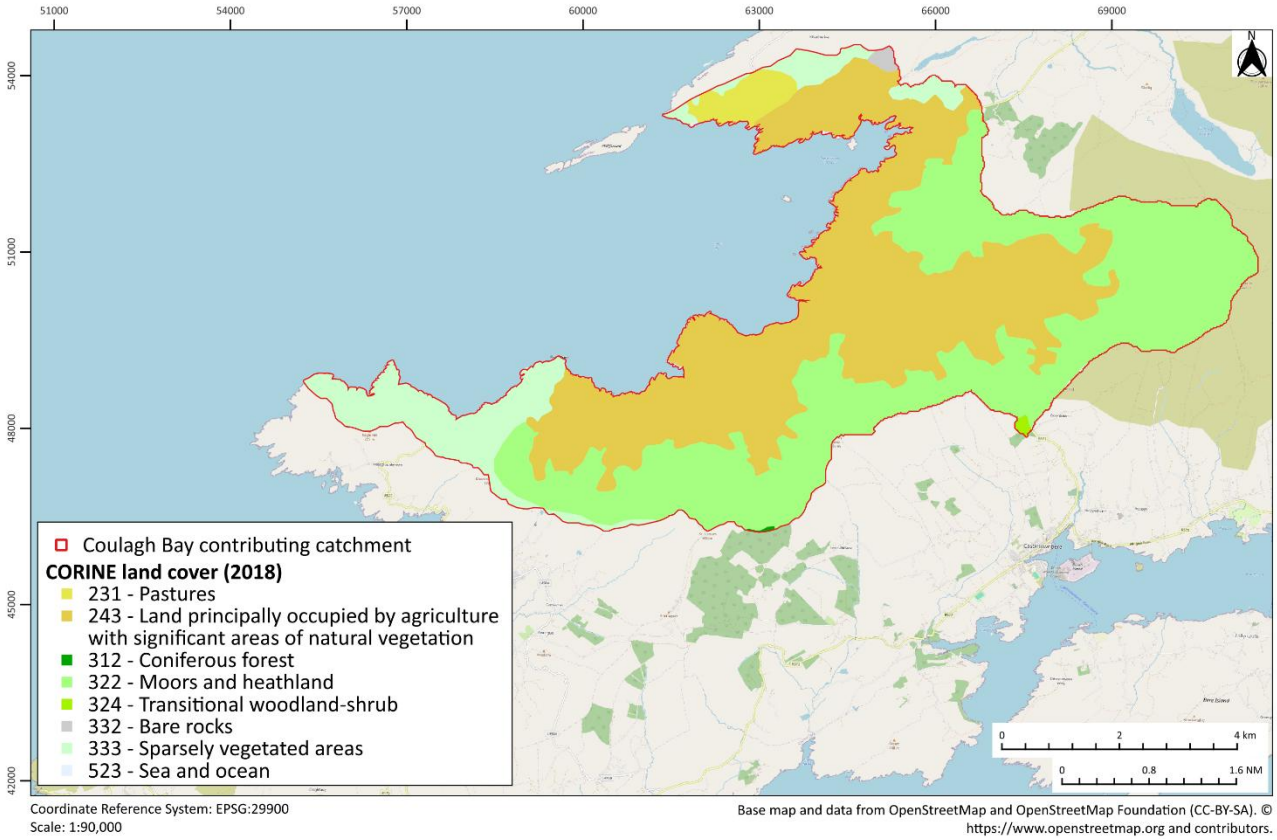


Figure 7-6: CORINE Land Cover (2018) within Coulagh Bay contributing catchment (source: EPA Geoportal[15]). This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

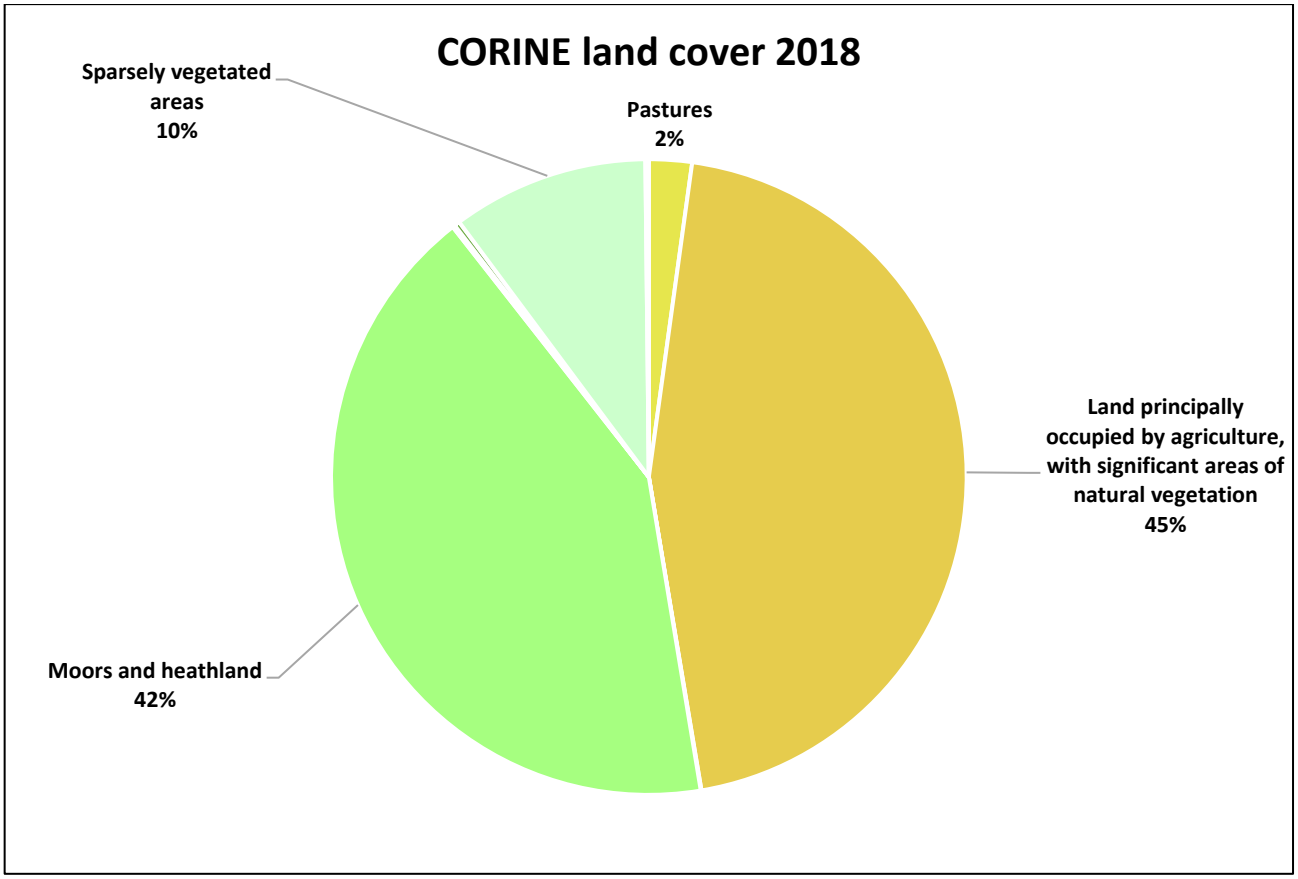


Figure 7-7: Breakdown of CORINE land cover (2018) within Coulagh Bay contributing catchment (percentages have been rounded to the nearest whole number and only land covers ≥1% are labelled). Sea and ocean, bare rocks, transitional woodland-shrub, and coniferous forest are <1% and are not outlined in this figure.

Data from the Census of Agriculture 2020 (CSO[16]) are displayed in **Table 7-6** and **Table 7-7** and are visually represented in **Figure 7-8** to **Figure 7-14**. The number of farms within the EDs in the contributing catchment ranges from 86 in Killaconenagh to 112 in Kilcatherine. The average farm size ranges from 21.6 ha in Coulagh to 28.4 ha in Killaconenagh. The total area farmed varies from 2095.5 ha in Coulagh to 2848.2 ha in Kilcatherine and amounts to 7,384.2 ha across the three EDs. However, as most of these EDs only partially overlap the contributing catchment, an attempt was made to estimate the area farmed (and other relevant agriculture CSO data) within the contributing catchment using the same method as was employed above 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 2,377 ha which represents approximately 50 % 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 (99.5%) in the contributing catchment, ranging from 494 ha in Killaconenagh to 942 ha in Kilcatherine. There were no records of crops growing within any of the EDs.

The total number of cattle within the EDs ranged from 1,332 in Killaconenagh to 1,513 in Coulagh. The total number of sheep within the EDs ranged from 6,298 in Killaconenagh to 9,403 in Kilcatherine. The total number of other cows within the EDs ranged from 522 in Killaconenagh to 604 in Coulagh. Data on dairy cows were supressed for confidentiality purposes and were not available for the three EDs; see **endnote 17** for definitions of other cows and total cattle per the CSO.

Within Coulagh Bay contributing catchment, the total number of cattle ranged from 272 in Killaconenagh to 677 in Coulagh ED. The total number of sheep within the contributing catchment ranged from 1,284 in Killaconenagh to 3,110 in Kilcatherine. The total number of other cows ranged from 106 in Killaconenagh to 270 in Coulagh ED.

Table 7-6: Overall farm census data for the electoral divisions that overlap with Coulagh Bay contributing catchment (source: CSO[16]).

Electoral Division	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Grass & Rough Grazing (ha)*	Total Cattle **	Sheep	Other Cows ***
Coulagh (Co. Cork)	97	2095.5	21.6	2077.5	1513	6771	604
Kilcatherine (Co. Cork)	112	2848.2	25.4	2847	1457	9403	601
Killaconenagh (Co. Cork)	86	2440.5	28.4	2424.9	1332	6298	522

*Total Grass and Rough Grazing taken to be the sum of Total Pasture, Total Silage, Total Hay, and Rough Grazing
**Total cattle is comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.
***Other cows as defined by the CSO are female beef cattle

Table 7-7: Estimated farm census data for the electoral divisions within Coulagh Bay contributing catchment (%) (source: CSO[16]).

Electoral Division	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Grass & Rough Grazing (ha)*	Total Cattle **	Sheep	Other Cows ***
Coulagh (Co. Cork)	43.4	937.2	9.7	929.2	677	3028	270
Kilcatherine (Co. Cork)	37.0	942.1	8.4	941.7	482	3110	199
Killaconenagh (Co. Cork)	17.5	497.6	5.8	494.4	272	1284	106

*Total Grass and Rough Grazing taken to be the sum of Total Pasture, Total Silage, Total Hay, and Rough Grazing
**Total cattle is comprised of all male and female cattle under two years, dairy cows, and non-dairy/other cows.
***Other cows as defined by the CSO are female beef cattle

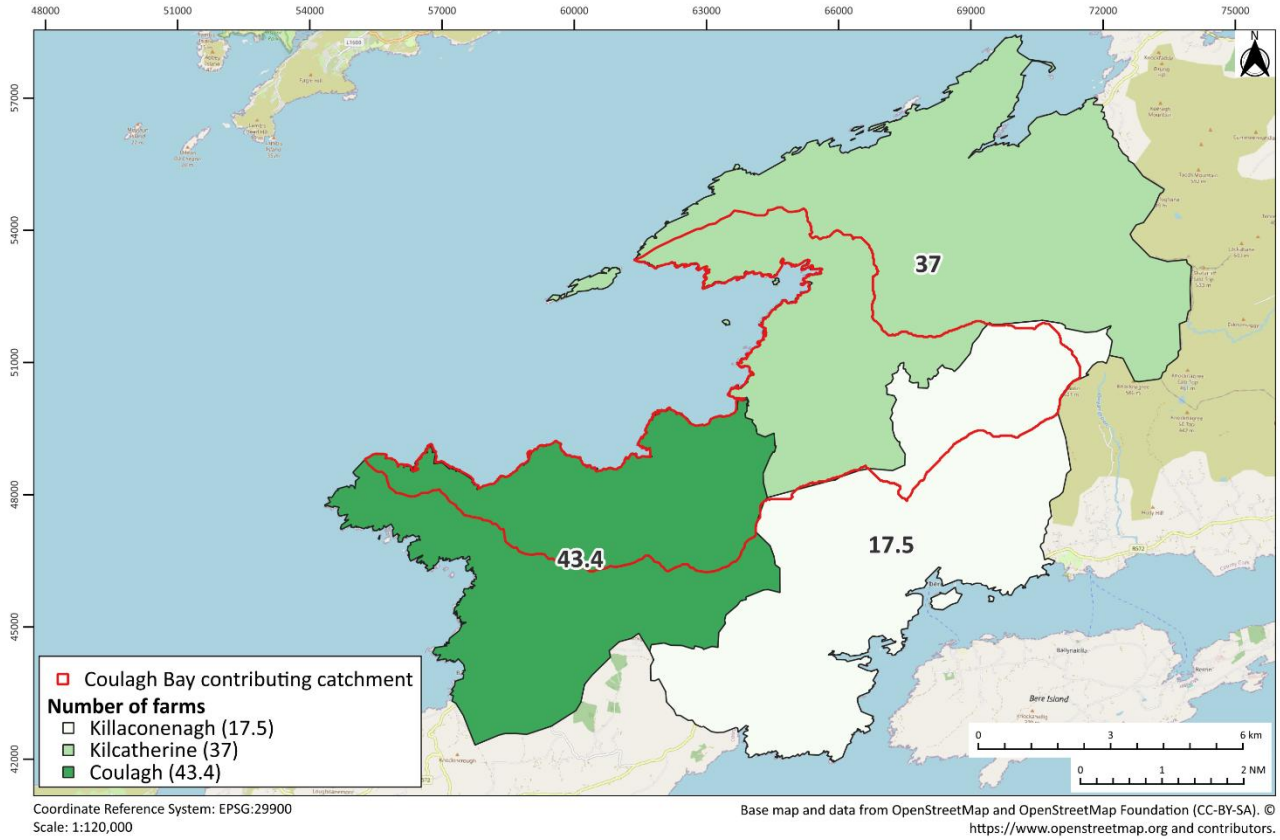


Figure 7-8: Number of farms within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

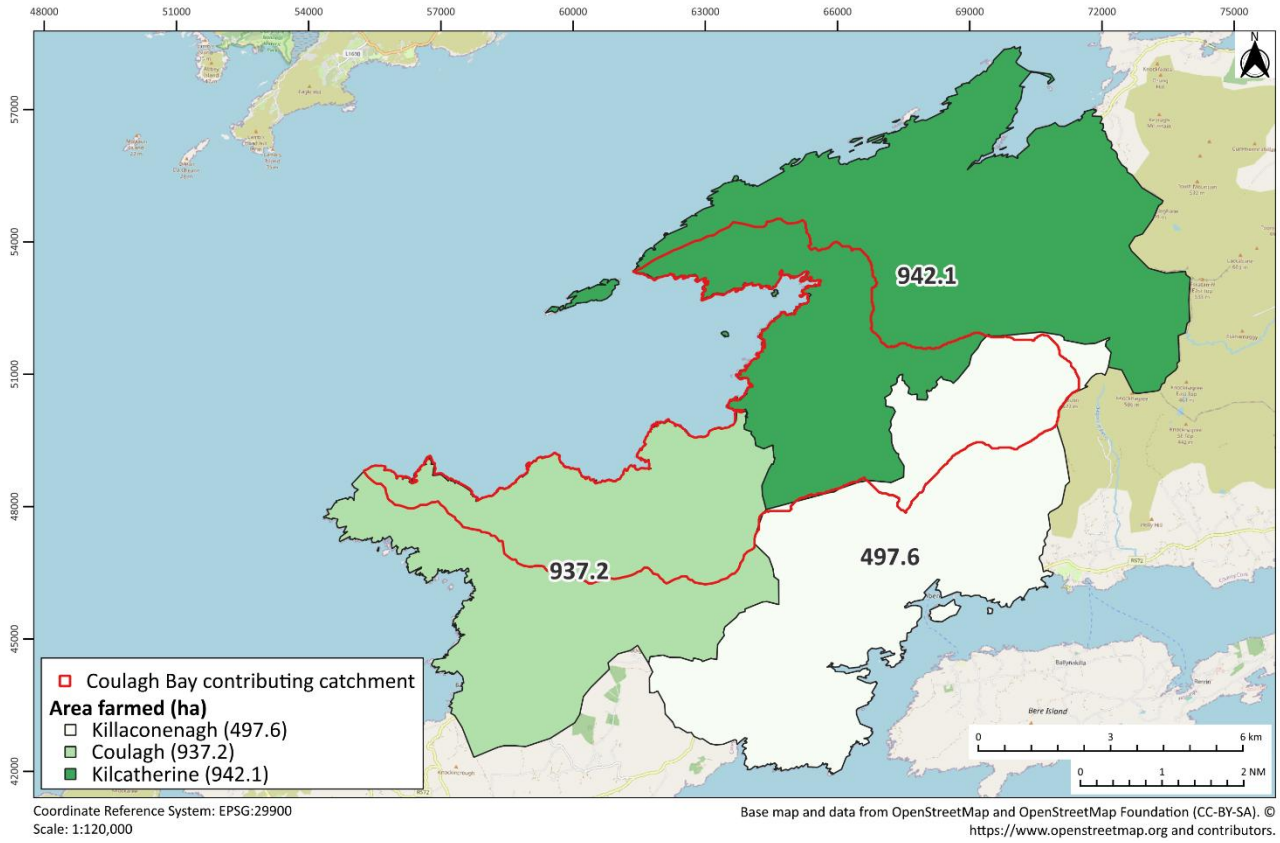


Figure 7-9: Area farmed (ha) within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

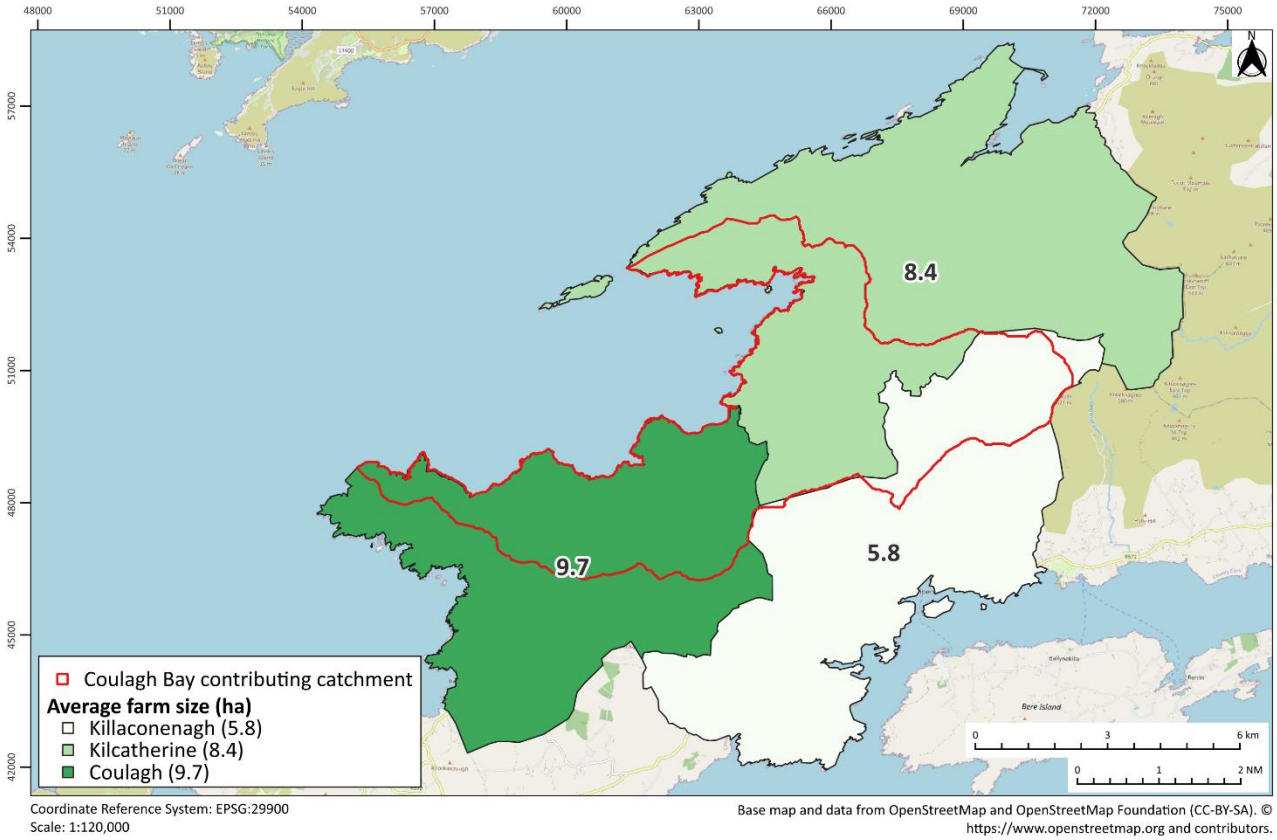


Figure 7-10: Average farm size (ha) within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

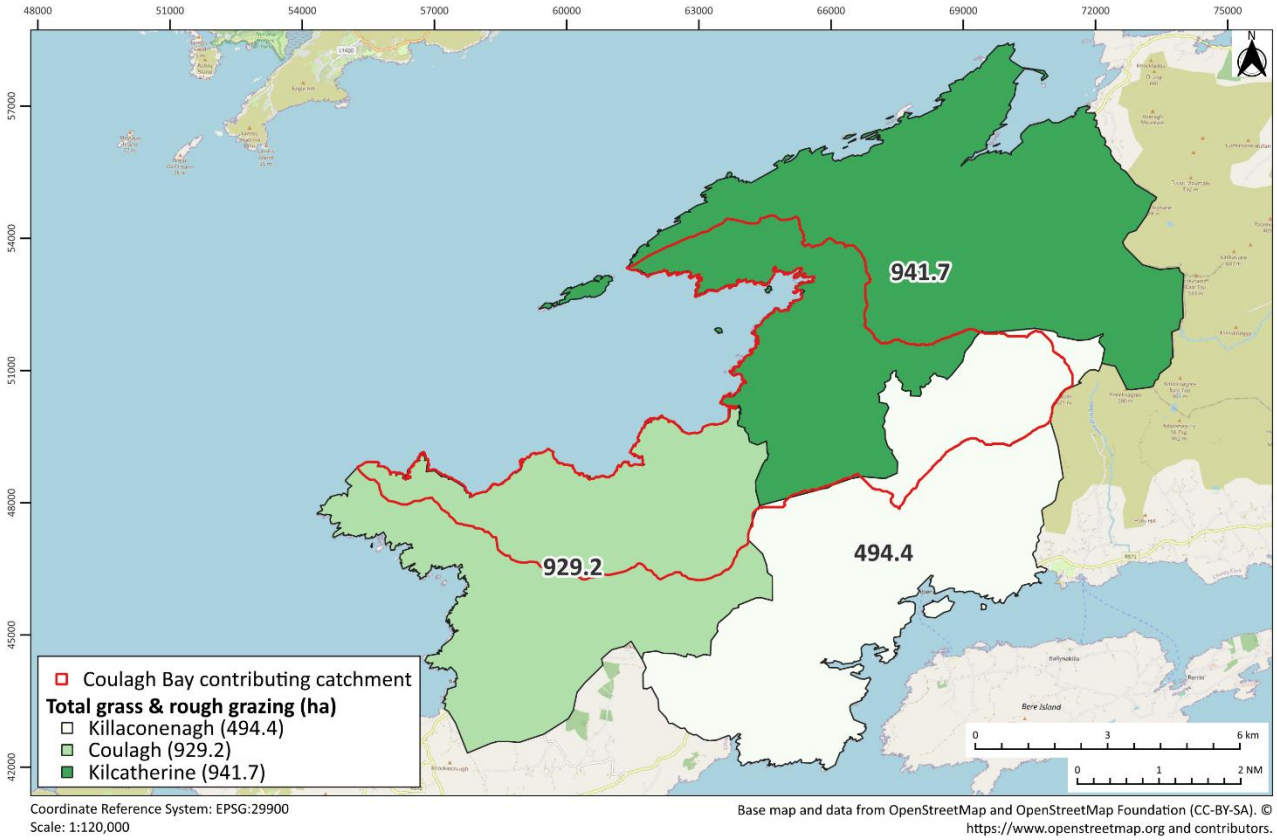


Figure 7-11: Total grass and rough grazing (ha) within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

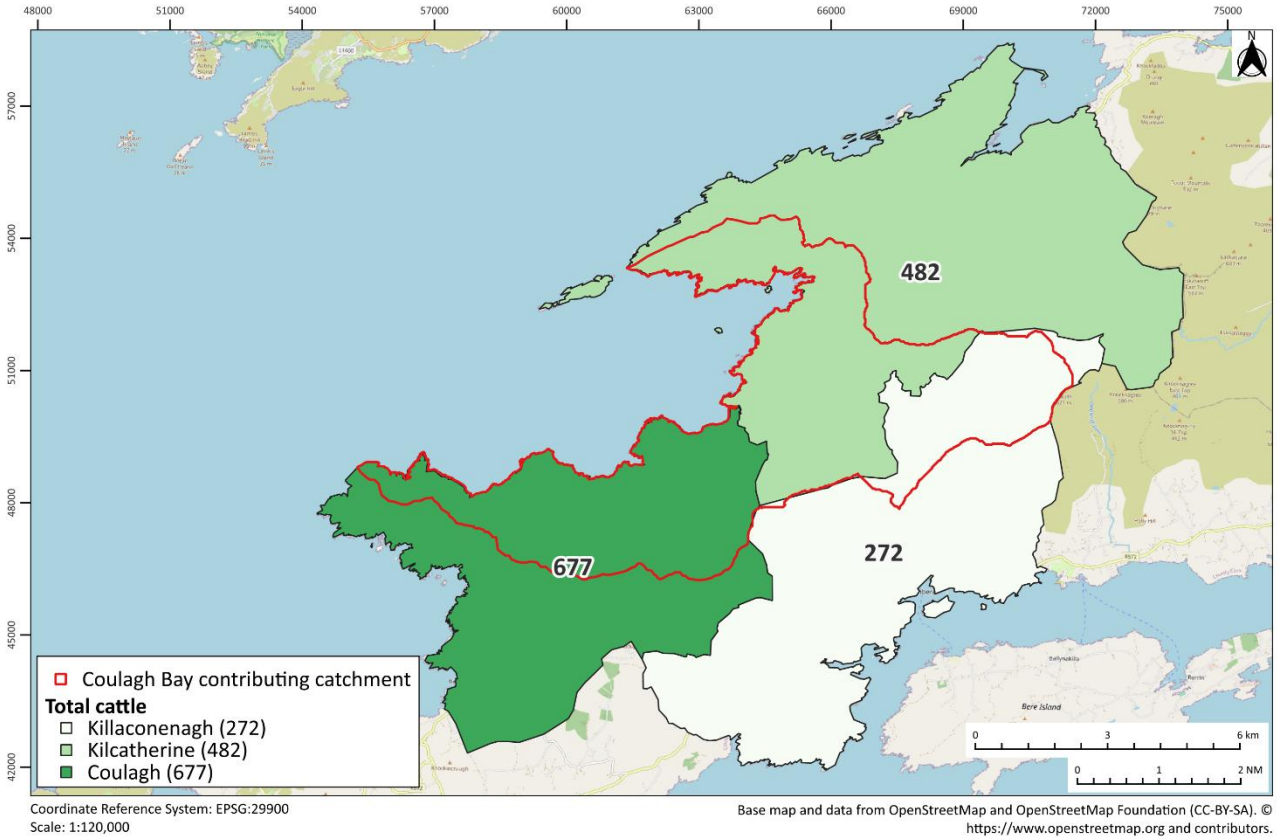


Figure 7-12: Number of cattle within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

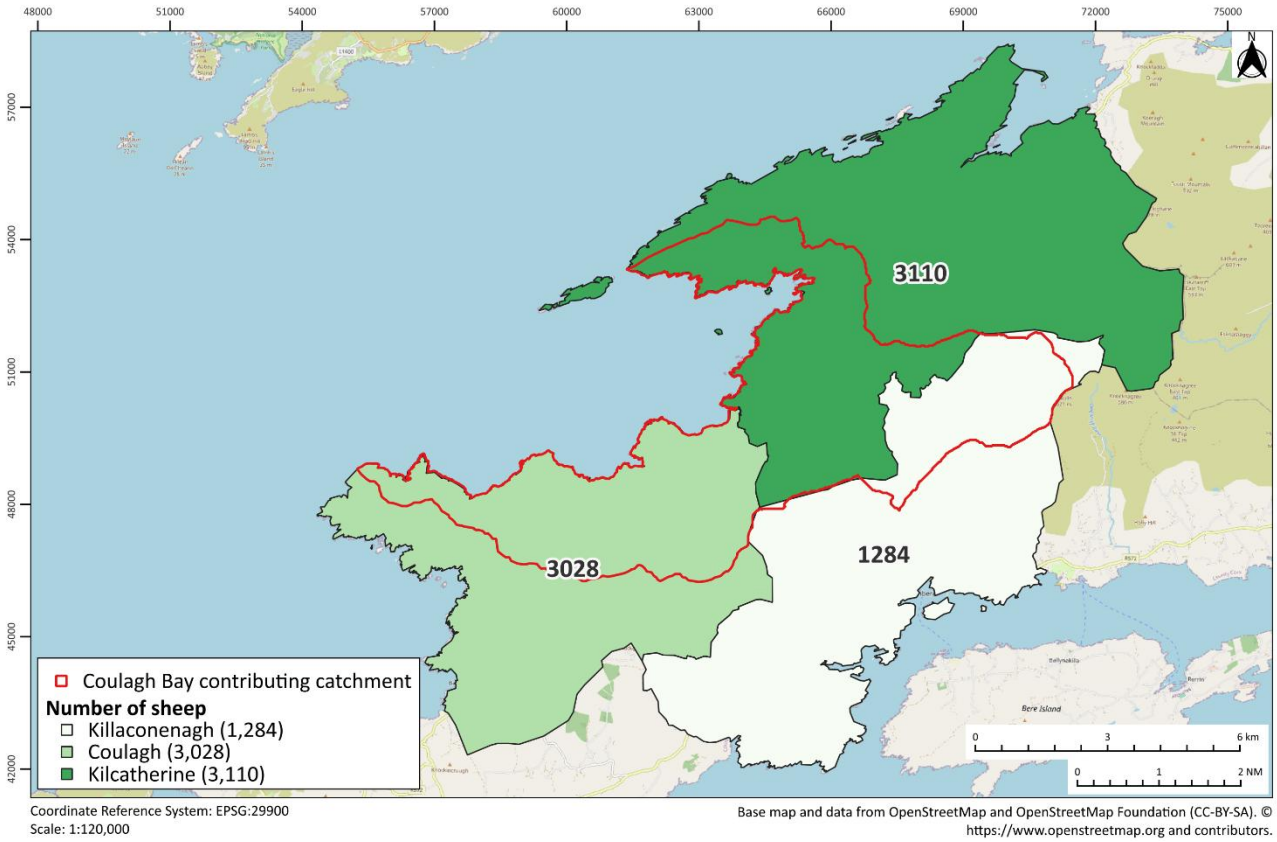


Figure 7-13: Number of sheep within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

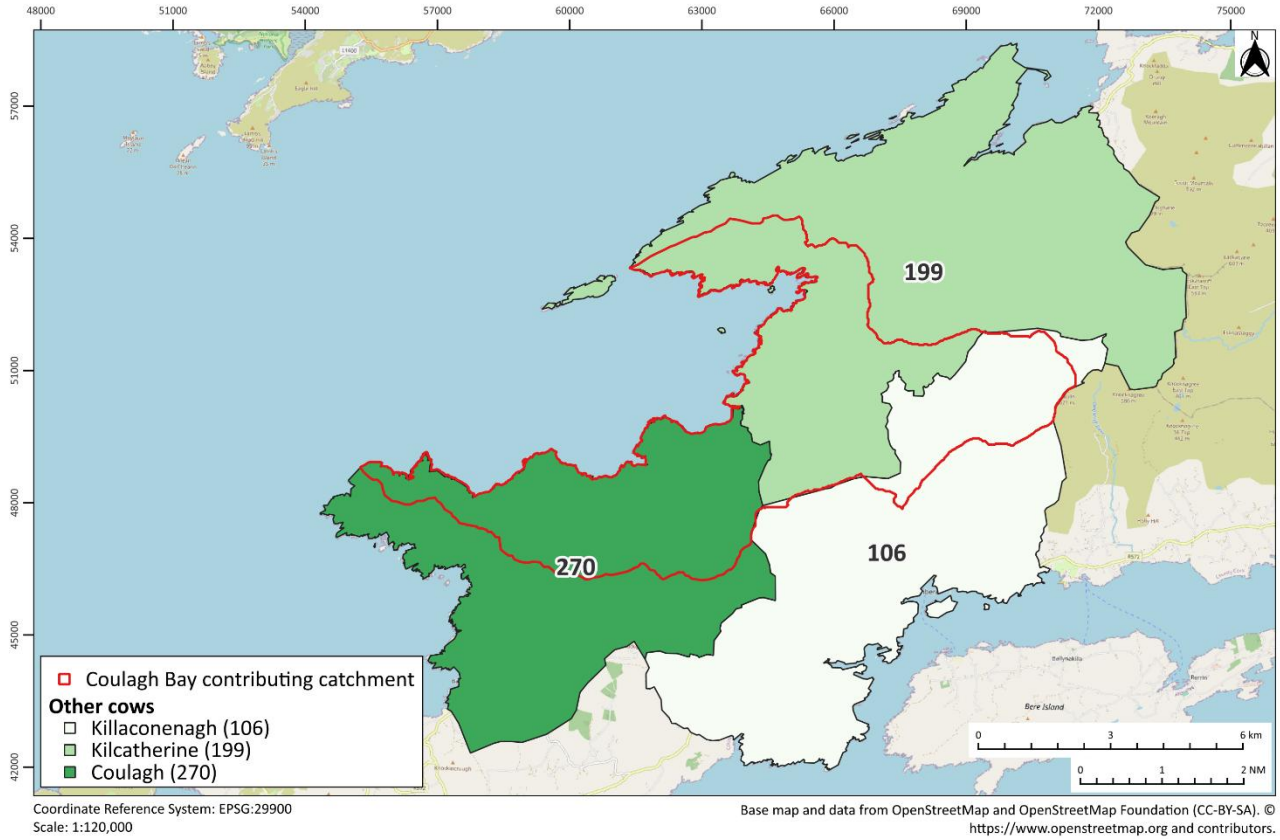


Figure 7-14: Number of other cows within Coulagh Bay contributing catchment (source: CSO[16]). This figure contains Irish Public Sector Data (Tailte Éireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

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 the livestock in the contributing catchment are sheep (7,422), with cattle present in lower numbers (1,431). The agricultural land use in the area is dominated by total grass and rough grazing. Sheep are present in relatively large numbers throughout the EDs. Kilcatherine and Coulagh border the shoreline whereas Killaconenagh is inland and diffuse agricultural pollution must pass subsequently through Coulagh or

Kilcatherine to reach the bay; it is of note that the highest densities of cattle and sheep occur in Coulagh and Kilcatherine, respectively. 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 BMPA until washed into the sea during and/or after periods of rainfall unless deposited directly on the shoreline; this would only apply to Coulagh and Kilcatherine.

Statutory instrument (S.I.) No 113/2022[23] sets out regulations per the application of slurry and organic fertilisers, notably the method by which is it 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 before October 1st of a given year. The programme prohibits the spreading of soiled water between December 1st and 31st, and came into effect as of January 1st, 2024 (see publication on the overview of the programme for exceptions[22]).

Within the Ownagappul sub-catchment, over Cycle 3 of the WFD, the river bodies within this sub-catchment were at risk of not meeting their WFD objectives, and all associated coastal water bodies were also at risk; those at risk were of Good status over the 2016-2021 monitoring period[37]. The main pressures affecting the rivers within Ownagappul_SC-010 are anthropogenic, hydromorphological, and extractive industry causing sediment and habitat morphological impacts[37]. Within the Fanahy sub-catchment, some of the river and coastal water bodies were at risk of not meeting their WFD objectives, and those water bodies were of Good status over the 2016-2021 monitoring period. The main pressures affecting coastal water bodies within this sub-catchment are anthropogenic pressures[37]. All of the river water bodies within the contributing catchment were of Good status.

The Geological Survey of Ireland (GSI) groundwater data viewer[38] shows areas of moderate to extreme groundwater vulnerability occur within the contributing catchment with significant areas of rock at or near surface or karst (*c.* 20.6 km^2, 43.5%). The area of each index level was calculated in QGIS and used to calculate the percentage ratios within the contributing catchment. Areas of extreme (*c.* 14.9 km^2, 31.3%) and high (*c.* 11 km^2. 23.2%) groundwater vulnerability also comprised the contributing catchment. Moderate groundwater vulnerability equated to 2% (*c.* 0.9 km^2) and there were no areas of low groundwater vulnerability within the contributing catchment. The coastline of Coulagh Bay contributing catchment is bordered by rock at or near surface or karst, with areas of extreme or high groundwater vulnerability adjacent and these areas primarily coincide with regions of land principally occupied by agriculture with significant areas of vegetation.

In areas of extreme vulnerability, S.I. No. 133/2022 states that “soiled water” cannot be spread on land if the quantity exceeds 25,000 litres/ha in a 42-day period or at an irrigation rate greater than three mm/hr on land of thickness less than one metre[23]. While the levels of slurry and soiled water spreading were not readily

available for Coulagh Bay contributing catchment at the time of writing this report, 47.4% (*c.* 22.6 km^2) of land is comprised of pastures and agricultural land overlapping primarily extreme to high groundwater vulnerability (including rock at or near surface or karst). This provides an indication to the potential levels of spreading in the contributing catchment and potential discharge levels to groundwater, and subsequently, the BMPA in the bay.

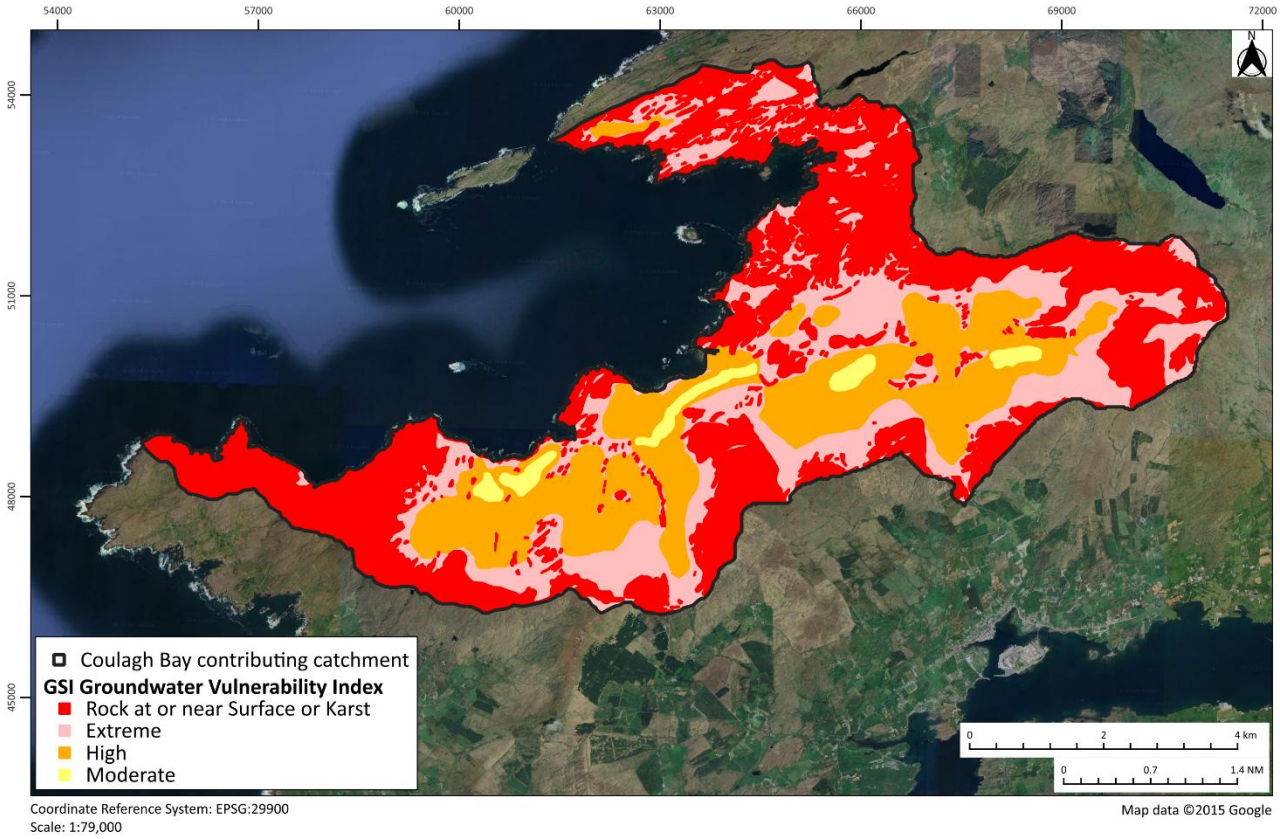


Figure 7-15: Geological Survey of Ireland (GSI) groundwater vulnerability within Coulagh Bay contributing catchment[38]. This figure contains Irish Public Sector Data (GSI) licensed under a Creative Commons Attribution 4.0 International (CC by 4.0) licence.

7.1.2. Other Pollution Sources

7.1.2.1. 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 and c) waste 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"[39]. Although adopted in 1973, the Annex did not come into effect internationally 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 3 miles of shore, Annex IV requires that sewage discharges be treated by a certified Marine Sanitation Device prior to discharge into the ocean. Sewage discharges made between 3 and 12 miles offshore must be treated by no less than maceration and chlorination, and sewage discharged greater than 12 miles from shore is unrestricted. Annex IV also established certain sewage reception facility standards and responsibilities for ports and contracting parties[39].

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 [Joint Group of Experts on the Scientific Aspects of Marine environmental Pollution], 1990).

Figure 7-16 shows all potential boat facilities and activities, namely slipways, piers, ports, and beaches within Coulagh Bay contributing catchment; **Table 7-9** details these facilities. There were 26 boat facilities/activities noted from the desktop survey to be confirmed/discounted by the shoreline survey. A tourist vessel operates out of Ballycrovane Pier seasonally (*per comms.* Beara Boat Tours).

While data on sewage discharge levels from boating activities in the area were not available at the time of writing, it is unlikely that pollution occurs; disposal of sewage at sea governed by S.I. No. 492/2012 prevents this. Therefore, it is highly unlikely that any vessels in the area would have any negative impacts on *E. coli* contamination levels in the production area.

Figure 7-16: Potential beaches, ports, piers, marinas, and slips identified during the desktop review that were to be confirmed by the shoreline survey. Map IDs cross-referenced to Table 7-9.

Table 7-9: Potential beaches, ports, piers, marinas, slips, and jetties identified using Google Satellite imagery during the desktop review that were to be confirmed by the shoreline survey. Those features confirmed by the shoreline survey are in bold below. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[24].

Map ID	Feature	Feature Name	Easting	Northing	Latitude	Longitude
1	**Slip**	N/A	460501.1	548657.5	51.67296	-10.017
2	Beach	Travaud Beach	460498.1	548546.2	51.67228	-10.0167
3	Beach	N/A	461409.3	548966.4	51.67558	-10.0039
4	Beach	N/A	461755.1	548956.9	51.67604	-9.99932
5	Beach	Travara Beach	461689	549070	51.67707	-9.99963
6	**Slip**	N/A	461689	549070	51.67737	-9.99999
7	**Pier/Harbour**	N/A	461619.8	549071.9	51.6772	-10.0008
8	Beach	N/A	461619.8	549071.9	51.67745	-10.001
9	Beach	Coulagh Beach	462948.8	549592.2	51.68238	-9.98155
10	**Beach**	N/A	463655.2	550129.6	51.6865	-9.97161
11	**Pier**	Drinagh Pier	464175.1	551451.3	51.69902	-9.96472
12	Beach	N/A	464325.3	551892.5	51.70268	-9.96317
13	Beach	N/A	464400.4	552113.1	51.70514	-9.96216
14	**Slip**	N/A	464754.8	552437.5	51.7083	-9.9566
15	Beach	Boffickil Bay Beach	465031.3	552430.1	51.70827	-9.95335
16	Beach	N/A	465034.2	552541.3	51.70921	-9.95267
17	Beach	Eyeries Rocks	465181.4	552871.3	51.71171	-9.95109
18	Slip	N/A	465187.3	553093.7	51.71356	-9.95083
19	**Slip**	N/A	465325.5	553090	51.71381	-9.94947
20	**Pier/Harbour**	Ballycrovane Pier	465325.5	553090	51.7138	-9.94934
21	Beach	N/A	464986	553321.7	51.71562	-9.95384
22	Beach	N/A	464986	553321.7	51.71576	-9.95423
23	**Slip/Pier/Harbour**	N/A	464709.6	553329.1	51.7159	-9.95823
24	Beach	N/A	463045.4	553151.4	51.71387	-9.98211
25	Beach	N/A	462979.3	553264.5	51.71496	-9.98282
26	Beach	Dreenamalack Bay Beach	462772.1	553270.2	51.71516	-9.98584
27	Beach	N/A	462288.4	553283.4	51.71543	-9.99349
28	Beach	N/A	462222.4	553396.5	51.71559	-9.99435

7.1.2.2. Wildlife

Birds

It is important to document the bird population in the Coulagh Bay 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 are a range of bird species which have been recorded in the region and may forage or utilise the intertidal and subtidal habitats of Coulagh Bay. Roycraft *et al.*, (2004) found abundances of *Laridae* (gulls),

Phalacrocoracidae (cormorants), and *Alcidae* (auks) significantly higher in areas of mussel longline aquaculture compared to control sites. The shag (*Phalacrocorax aristotelis*) and the cormorant (*Phalacrocorax carbo*) are waterbirds within the family *Phalacrocoracidae* and they utilise mussel aquaculture sites primarily for preening, standing, and drying (Roycraft, 2007). Gull species were attracted to mussel aquaculture areas for swimming and foraging, and 64% of activities were associated with suspension buoys (Roycraft *et al*., 2007). *Laridae* have been observed using the floats for resting, preening, loafing, and overnighting activities (Branco *et al*., 2001). *Laridae* found in the nearby areas which may utilise Coulagh Bay include herring gull (*Larus argentatus*), lesser black-backed gull (*Larus fuscus*), great black-backed gull (*Larus marinus*), kittiwake (*Rissa tridactyla*), and arctic tern (*Sterna paradisaea*). Auk species may be found in Coulagh Bay, particularly during breeding seasons with several breeding colonies identified in nearby habitats, however they are typically deep diving seabirds that have large foraging ranges. They utilise rocky cliff and island habitats for the breeding season. Manx shearwater (*Puffinus puffinus*) and storm petrel (*Hydrobates pelagicus*) may utilise the intertidal and subtidal habitats in the bay during breeding season. Many of these species use high cliff areas during breeding season, which are present in Coulagh Bay and in the adjacent SPAs for which the relevant bird species are protected.

Aquatic Animals

Coulagh Bay overlaps with Kenmare River SAC which has been designated for a range of species and habitats of which harbour porpoise, harbour seal, and otter are of special conservation interest. Harbour seals are established in the bay utilising rocky islets throughout for resting and moulting activities (**Figure 7-17**) and have been noted to frequent Ballycrovane Harbour which falls within the contributing catchment. During a 2012 aerial thermal imaging survey 38 seals were observed hauled out during moulting on Eyeries Island within Coulagh Bay[40]. Harbour seals have been recorded within Coulagh Bay, in Ballycrovane Harbour on the islands of Illaunameanla and Eyeries. Between 2001-2013, a maximum of seven individuals were recorded on the National Biodiversity Data Centre (NBDC)[40].

Otters have been recorded in Kenmare Bay, and in Coulagh Bay have been confirmed in the Atlas of Mammals in Ireland 2010-2015 surveys through spraint observations around Allihies beach[40]. Harbour porpoises occur in Kenmare and Coulagh Bays, and are generally recorded in small pods. The largest recordings on NBDC were 12 near Scariff and 25 to the north of Dursey Island; the most recent record was four individuals in 2017[40].

No estimates on 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 (colony forming units) *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 Coulagh Bay contributing catchment are likely to add to background levels of faecal contamination within the area, particularly during haul-out periods for seals.

Various other marine mammals are known to occur in the bay. Bottlenose dolphins (*Tursiops truncatus*) have been recorded within Coulagh Bay and in the surrounding area; the largest recorded pod in Coulagh Bay was 12 individuals[40]. The Porcupine Bank Canyon SAC and the South-West Porcupine Bank SAC are offshore SACs approximately 330 km away from the nearest boundary of the contributing catchment and have recently been designated to include bottlenose dolphin. Bottlenose dolphins occur both coastally and offshore. A study in 2007 using three tagged offshore dolphins (Klatsky *et al*. 2007) found they travel a mean distance of 28.3 km/day, however there was variability between individuals and a maximum distance of 98.4 km travelled by a female within one day.

Between 2013 to 2021, common dolphin, fin whale, humpback whale, minke whale, long-finned pilot whale, Risso's dolphin, Sowerby's beaked whale, striped dolphin, and sperm whale, have all been documented in or around Coulagh Bay and may utilise the bay on occasion[40].

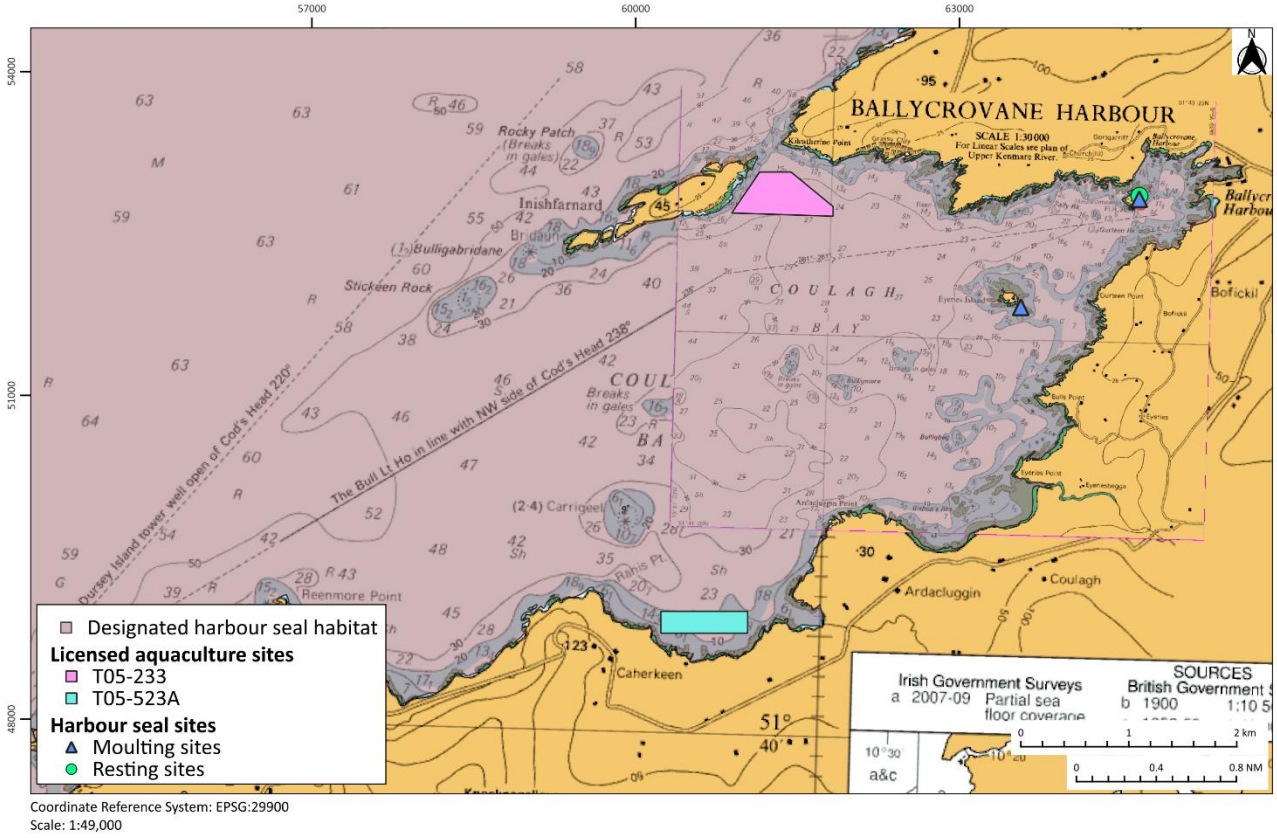


Figure 7-17: Harbour seal habitat and site use in reference to Coulagh Bay and the licensed aquaculture sites within the bay. This figure contains Irish Public Sector Data (Department of Housing, Local Government, and Heritage) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

7.2. Shoreline Survey

7.2.1. Shoreline Survey Report

The objective 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 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. Due to the nature of the shoreline, some features were recorded from sea (*i.e.* using a vessel) and were recorded as potential features (*e.g.,* map ID 4: Potential runoff; **Figure 7-18**), as the features could not be definitively confirmed due to the distance of the vessel from the shoreline.

Two shoreline surveys were conducted in accordance with the SFPA's standard operating procedure[25] over eight survey days to cover the extent of the contributing catchment shoreline. The first survey was over six days from the 23rd of July to the 11th of August 2024, from map IDs 1 to 66 (**Figure 7-18**). The second survey was over two days from the 20th to the 29th of August, from map IDs 67 to 78 (**Figure 7-18**). Six water samples from the first survey were taken on the 13th August 2024 after a night of moderate rainfall, and three water samples were taken during the second survey on the 29th of August 2024. Map IDs 1 to 21 and 67 to 78 were surveyed using a rib or chartered vessel.

Figure 7-18 shows the GPS locations of 78 sites; the shoreline survey transects can be determined from the data points in this figure. See **Appendix 4: Shoreline Survey Images** for the associated photographs.

Figure 7-18: Location of GPS and photograph sites combined from the first and second shoreline surveys (numbering cross-referenced to Table 7-10).

Figure 7-18 shows the locations of all features observed during the shoreline survey. Of the 78 features identified, there was one beach, one cave, one dump site, one site with evidence of erosion processes occurring, one flow, one public toilet, one salmon farm site (with 12 pens), one slipway, one storage tank, one storm drain, two residencies, three piers, three piers and slipways, three rivers, four drains, five run-off points, five locations with livestock (four locations with sheep, one location with cattle), six fields, seven streams, 15 pipes, and 17 potential run-off points. **Figure 7-19** to **Figure 7-31** show the locations of these features. **Table 7-10** details all the features identified, and the numbering used is cross-referenced to **Figure 7-18** to **Figure 7-31**.

Table 7-10: Features identified during the shoreline survey. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[24]. Refer to Figure 7-18 to Figure 7-31 for locations and Appendix 4: Shoreline Survey Images for photographs.

Map ID	Observation	Comment	Photo ID	Latitude	Longitude	Easting	Northing
1	Salmon farm at Inishfarnard	12 pens operated by MOWI for finfish aquaculture. Coordinates correspond to the closest pen structures to the mainland shore.	N/A	51.71198	-10.0061	461375.6	552972.1
2	Land runoff	Freshwater runoff with observed algal growth. Potential gully.	1	51.7151	-10.0019	461677.1	553310.8
3	Stream	Small stream. Low flow. Discolouration observed.	2	51.71509	-9.99738	461985.9	553301.9
4	Potential runoff	Eroded cliff. Potential freshwater runoff. No flow.	3	51.7156	-9.99451	462185.9	553352.8
5	Cliff face erosion	Large area of cliff face erosion at interface between the land and sea.	4	51.71548	-9.99339	462263	553337.7
6	Carrignaportan Pier	Cork County Council concrete pier. Infrequently used due to exposed conditions.	N/A	51.71493	-9.98317	462967.7	553256.5
7	Field	Field in Gortgarriff. Potential natural watercourse.	5	51.71394	-9.96528	464200.5	553113.1
8	Residential property	Permanent residence in Tragalee bordering shore/bay.	6	51.7163	-9.95872	464660.6	553363.8
9	Tragalee pier and slipway	Tragalee pier. Seasonal use by 2-3 small U10 vessels.	N/A	51.7159	-9.95817	464697.6	553317.8
10	Concrete pipe	Concrete pipe under road to Kilcatherine. No flow. Potential function as surface water drain.	7	51.71599	-9.95513	464908.1	553322.6
11	Potential runoff	Potential water drainage below stone dwelling. No flow.	8	51.7167	-9.95016	465253.6	553392.8
12	Potential runoff	Potential freshwater land runoff. No flow.	9	51.71639	-9.94978	465278.4	553357
13	Small black pipe	Small bore black alkathene pipe adjacent to dump site.	10	51.71567	-9.94842	465370.8	553274.1
14	Three pipes	Three black small to medium bore alkathene pipes leading to/from land/sea. No flow.	11a and 11 b	51.71543	-9.94817	465386.9	553247.2
15	Pipes	Pipes near old house. Presumed function as surface water drain. No flow.	12	51.715	-9.94516	465594.1	553194.1
16	Two concrete pipes	Two large bore concrete pipes under road to Ballycrovane Pier. Presumed function as water drain. No flow.	13	51.7141	-9.94511	465594.8	553094.2
17	Concrete pipe	Concrete pipe under road at eastern end of Ballycrovane Pier. No flow.	14	51.71362	-9.94816	465382.2	553045.7
18	Ballycrovane Pier and slipway	Cork County Council pier. Used by multiple vessels and MOWI.	N/A	51.7138	-9.94943	465295.4	553068.1
19	Salmon farm chemical storage tank	Various pipes extruding from and connected to a large chemical container.	15	51.71364	-9.94988	465263.4	553051.4
20	Pipes associated with salmon farm aquaculture	Large black pipe running from shore to vessel docking station relating to the salmon farm aquaculture site. Unknown contents/purpose. No flow.	16	51.7137	-9.95127	465168.1	553060.5
21	Potential runoff	Potential freshwater runoff. No flow.	17	51.70963	-9.95177	465121	552608.9

22	Old coastguard station slipway	Old coastguard slipway - not in use.	N/A	51.7083	-9.95662	464782.3	552470.3
23	Potential runoff	Potential freshwater runoff onto pebble strand adjacent to old coastguard station. No flow.	18	51.7079	-9.95589	464831.5	552423.7
24	Potential runoff	Potential freshwater runoff near old coastguard station. No flow.	19	51.7074	-9.95864	464639.5	552374.2
25	Drinagh Pier	Cork County Council concrete pier. No boats observed on day of survey. Small pebble strand adjacent.	20	51.69917	-9.96472	464194.8	551469.2
26	Potential runoff	Potential freshwater runoff. No flow.	21	51.69472	-9.96861	463912.7	550982.2
27	Field with land drain	Large land drain. Algal growth present and no flow.	22	51.6925	-9.96667	464040.4	550731.4
28	Kealincha River	Large river. The Kealincha river sub-basin includes the tributaries into which the Eyeries WWTP discharges.	23	51.68778	-9.9725	463623	550217.1
29	Eyeries Strand	Redundant pumping station for concrete fish farm land base.	24	51.68528	-9.97167	463673	549937.5
30	Concrete drain	Concrete drain below redundant fish farm land base. Very little flow. Discolouration observed.	25	51.68472	-9.9725	463613.8	549877.2
31	Pipe	Plastic 9-inch drainage pipe. No flow.	26	51.68417	-9.97528	463420	549820.6
32	Potential runoff	Origin unknown of potential land runoff. No flow. Discolouration observed.	27	51.68417	-9.97556	463400.9	549821
33	Potential runoff	Potential land drain runoff on Coulagh Strand. Little flow. Discolouration observed with oily tinge.	28	51.68421	-9.97604	463367.3	549826.6
34	Land drain	Land drain and runoff. No flow. Stones discoloured. Cattle present.	29a and 29b	51.68222	-9.98139	462991.7	549615.8
35	Field	Field in Ardacluggin. Possible runoff/underground land drain. Discolouration and potential leaching observed.	30	51.68222	-9.98472	462761.2	549622
36	Field	Field in Ardacluggin. Possible runoff/underground land drain. Discolouration and potential leaching observed.	31	51.68222	-9.985	462742	549622.5
37	Stream	Small clear running stream.	32	51.68121	-10.0013	461613.3	549540.7
38	Stream	Small clear running stream.	33	51.68093	-10.0014	461604.1	549509.8
39	Livestock	Approximately 20+ sheep observed on field that borders sea/bay.	34	51.67833	-10.0031	461481.7	549224.1
40	Pipe	Small bore black alkathene U-PVC pipe extruding from shed at Travara.	35	51.67728	-10.001	461618.1	549102.8
41	Travara Pier and slipway	Popular swimming location. Several small U10 vessels use pier and slipway.	N/A	51.67736	-10.0004	461664.6	549110.5
42	Public toilets	Septic tank adjacent to public toilets. The percolation area not observed.	36	51.67761	-10.0001	461686.6	549137.5
43	Storm drain	Storm drain at Travara adjacent to slipway. No flow.	37	51.6775	-10	461687.3	549126.2
44	Four Properties	Four houses at Travara. No outfalls.	38	51.67687	-9.99931	461736.2	549054.7
45	Travara River	River.	N/A	51.67584	-9.99828	461804.7	548938.1
46	Pipes	One large bore metal and one small bore alkathene pipe in Travara River.	39	51.67584	-9.99828	461804.7	548938.1
47	Drain pipe	Black 9-inch drain pipe discharging into a tributary of Travara River.	40	51.67583	-9.99639	461935.1	548933.4
48	Mains metal pipe	Mains metal pipe with stop valve.	41	51.67598	-9.99545	462000.5	548947.5

49	Pipe	Pipe discharging into river.	42	51.67598	-9.99545	462000.5	548947.5
50	Runoff	Low flow. Discolouration and potential leaching observed.	43	51.67583	-9.99694	461896.7	548934.4
51	Rusty metal pipe	Rusty pipe on shore. No flow.	44	51.67582	-9.99794	461828.2	548935.1
52	Potential runoff	Potential stream or runoff. No flow.	45	51.67579	-9.99795	461826.8	548931.5
53	Stream	Stream or land runoff. Low flow.	46	51.67556	-10.0075	461165.9	548923.6
54	Potential runoff	Potential runoff from land. No flow.	47	51.67333	-10.0089	461063.1	548679
55	Field	Field for pasture/grazing. Possibility for runoff to occur. No flow.	48	51.67341	-10.009	461056.3	548687.8
56	Field	Field for pasture/grazing. Possibility for runoff to occur. No flow.	49	51.67329	-10.0092	461043.5	548674.8
57	Field and runoff	Field for pasture/grazing. Runoff with small flow.	50	51.67298	-10.0107	460935.4	548643.4
58	Stream	Moderate stream flowing through pasture and grazing fields. Stream is adjacent to proposed aquaculture site T05-523A.	51	51.67285	-10.0116	460876.9	548630.4
59	Field and runoff	Field for pasture/grazing with runoff.	52	51.6728	-10.0141	460701.1	548629.7
60	Livestock and runoff	Runoff observed from livestock field. 50+ cattle observed. Low flow. Discolouration observed.	53	51.6728	-10.015	460638.8	548631.4
61	Concrete pipe	Concrete pipe from under livestock fields. Low flow, clear running, some algal overgrowth.	54	51.67223	-10.0156	460598.4	548569.1
62	Dump site	Dump site on strand. Old plastic silage bale wraps and metal engine block present.	55	51.67206	-10.0161	460563.3	548551.1
63	River	Medium river with bridge at Travaud.	56	51.67167	-10.0173	460473.5	548510.2
64	Travaud Pier	Pier seldom used due to exposed nature.	57	51.67222	-10.0175	460464.2	548571.9
65	Drain	Drain at Travaud Pier. No flow. Cattle present in field behind pier.	58	51.67194	-10.0172	460482.6	548540.4
66	Cave	Cave opening.	59	51.67306	-10.02	460293.9	548669.4
67	Livestock	10 sheep observed in field in Caherkeen.	60	51.67593	-10.0282	459733	549005.3
68	Potential runoff	Potential freshwater runoff. No flow.	61	51.67743	-10.0294	459654.5	549174.5
69	Potential runoff	Potential freshwater runoff. No flow. Algal growth on rocks.	62	51.67632	-10.0369	459132.7	549064.9
70	Livestock	Five sheep.	63	51.67359	-10.0405	458878.6	548767.9
71	Potential runoff	Potential freshwater runoff. No flow.	64	51.67201	-10.0428	458714.3	548597.3
72	Potential runoff	Potential freshwater runoff. No flow.	65	51.66935	-10.0506	458167.9	548315.8
73	Stream	Small stream crossing under road. No odour and clear.	66	51.66894	-10.0503	458186.3	548270
74	Potential runoff	Potential freshwater runoff. No flow.	67	51.66795	-10.0564	457762.6	548171.6
75	Stream	Large stream crossing under road. No odour and clear.	68	51.66757	-10.0572	457707.6	548131
76	Livestock	Approximately 12 sheep observed on field that borders sea/bay.	69	51.66992	-10.0775	456307.6	548432.4
77	Potential runoff	Potential freshwater runoff. No flow.	70	51.67205	-10.0775	456314.4	548669
78	Flow	Small flow, clear running, no odour.	71	51.67111	-10.0781	456272.9	548565.8

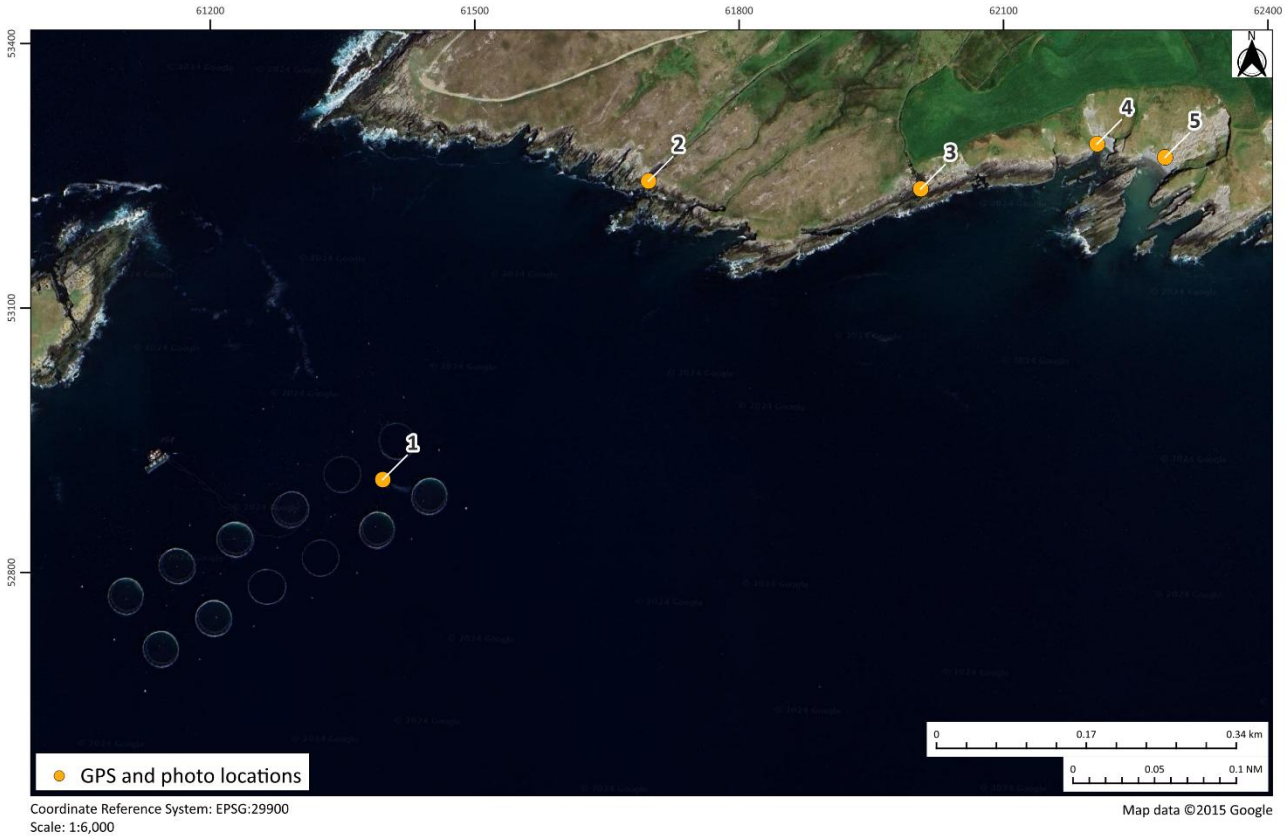


Figure 7-19: Features 1–5 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-20: Features 6 and 7 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-21: Features 8-20 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-22: Features 21-24 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

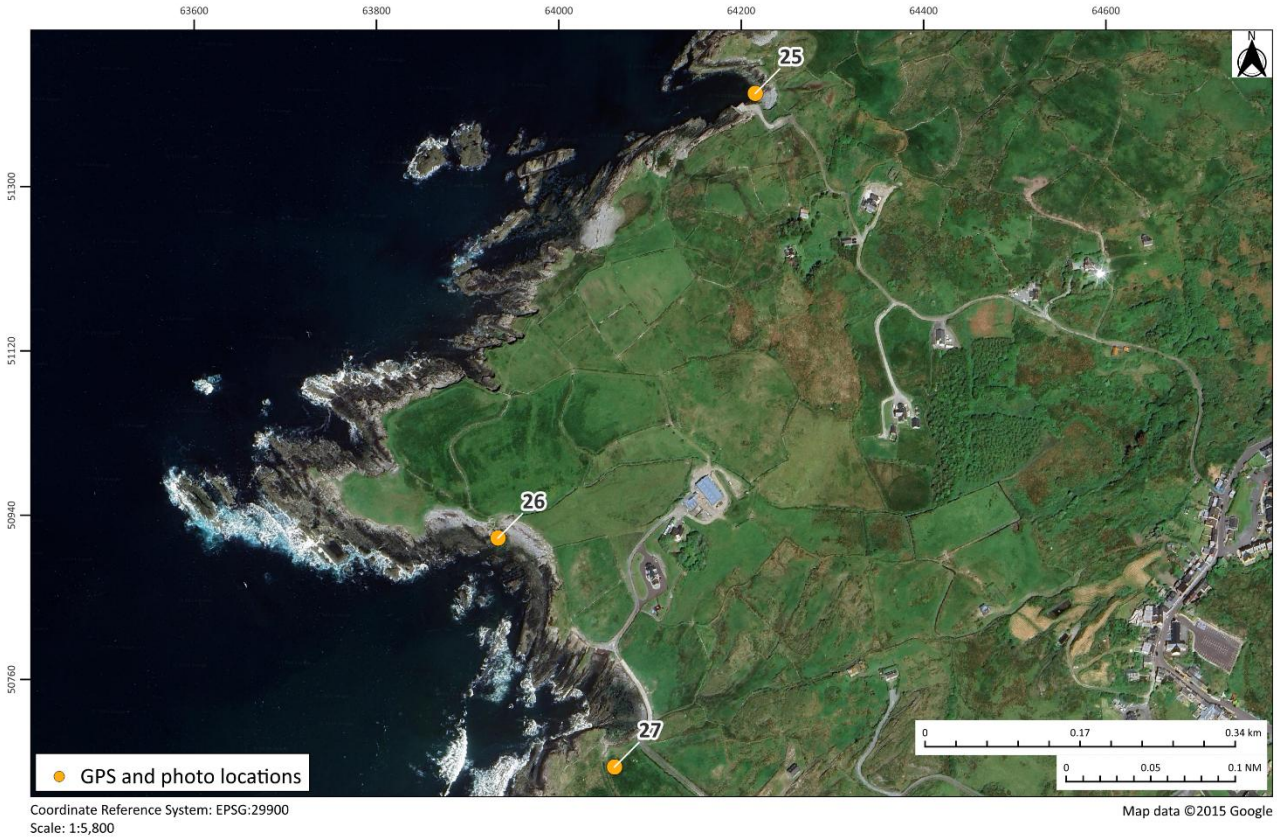


Figure 7-23: Features 25-27 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-24: Features 28-36 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

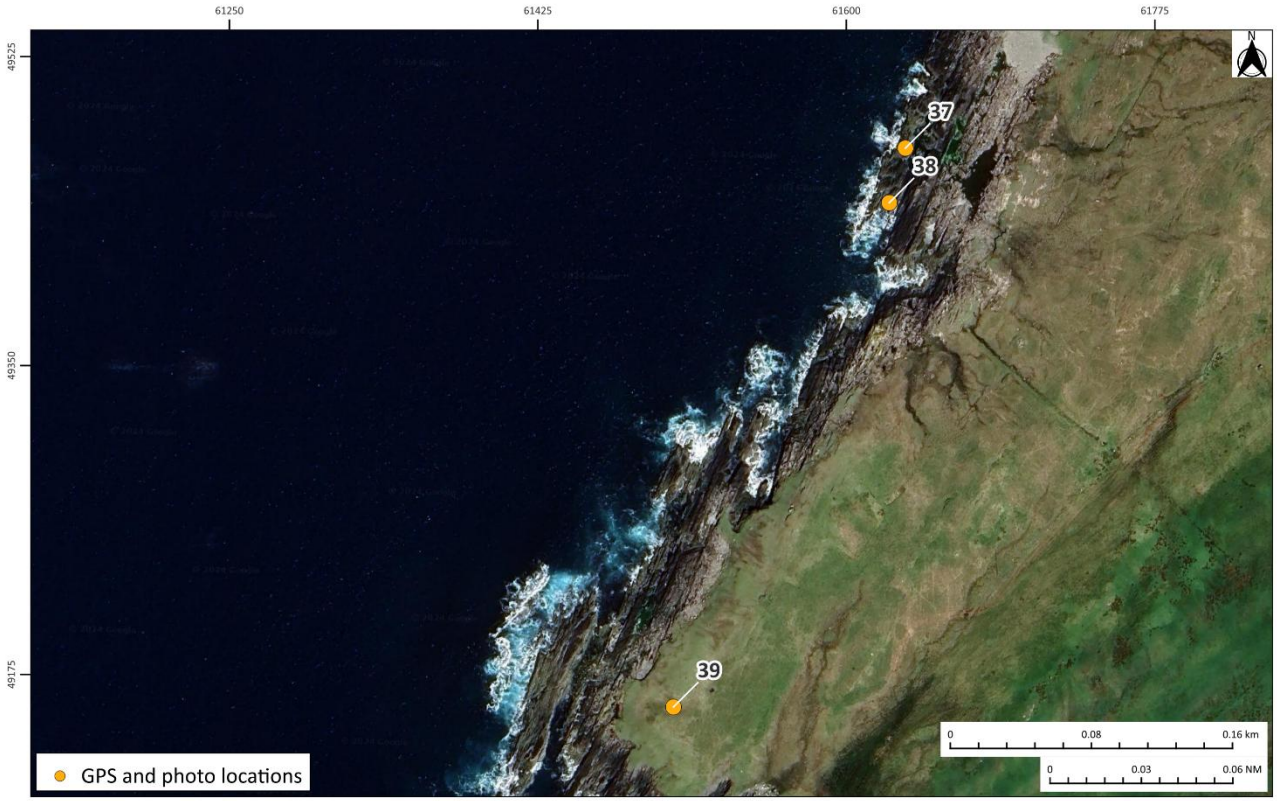


Figure 7-25: Features 37-39 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-26: Features 40-52 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-27: Features 53-58 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

Figure 7-28: Features 59-66 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

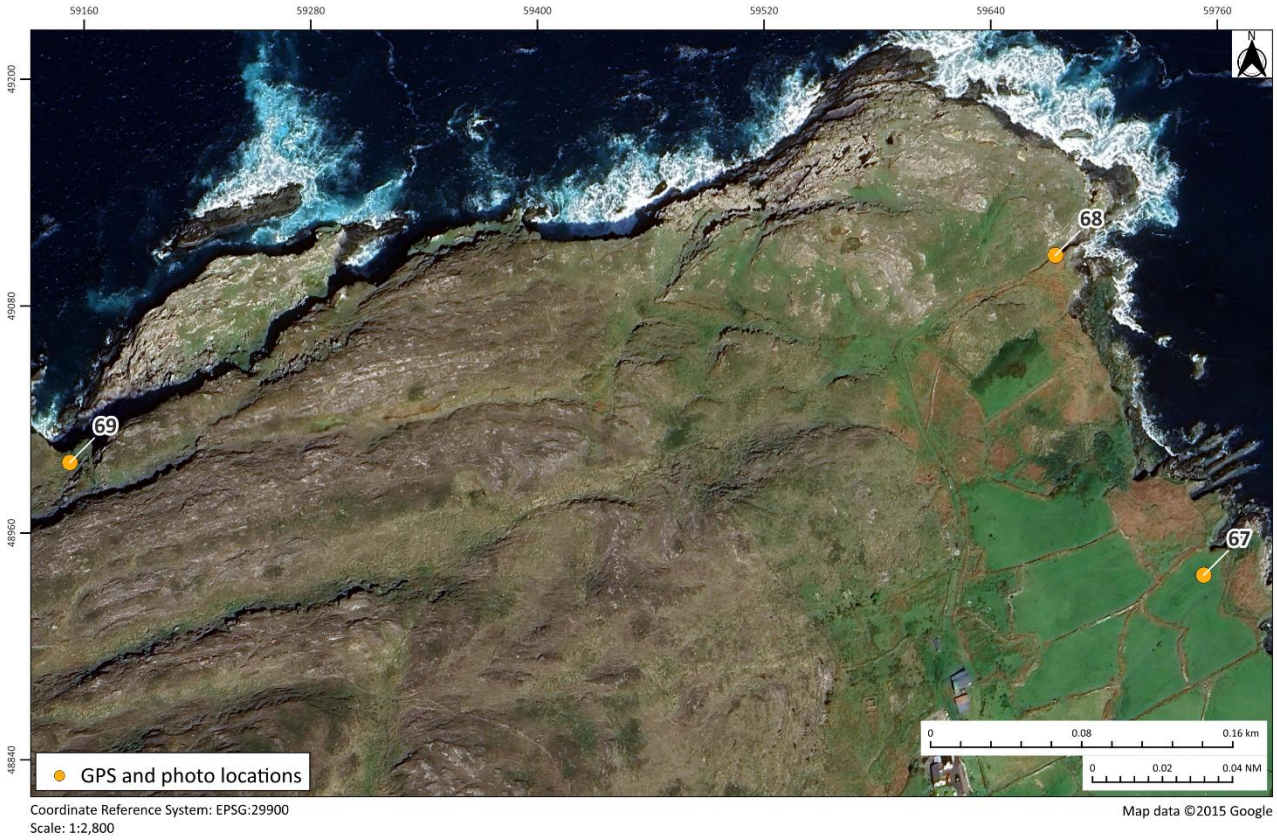


Figure 7-29: Features 67-69 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

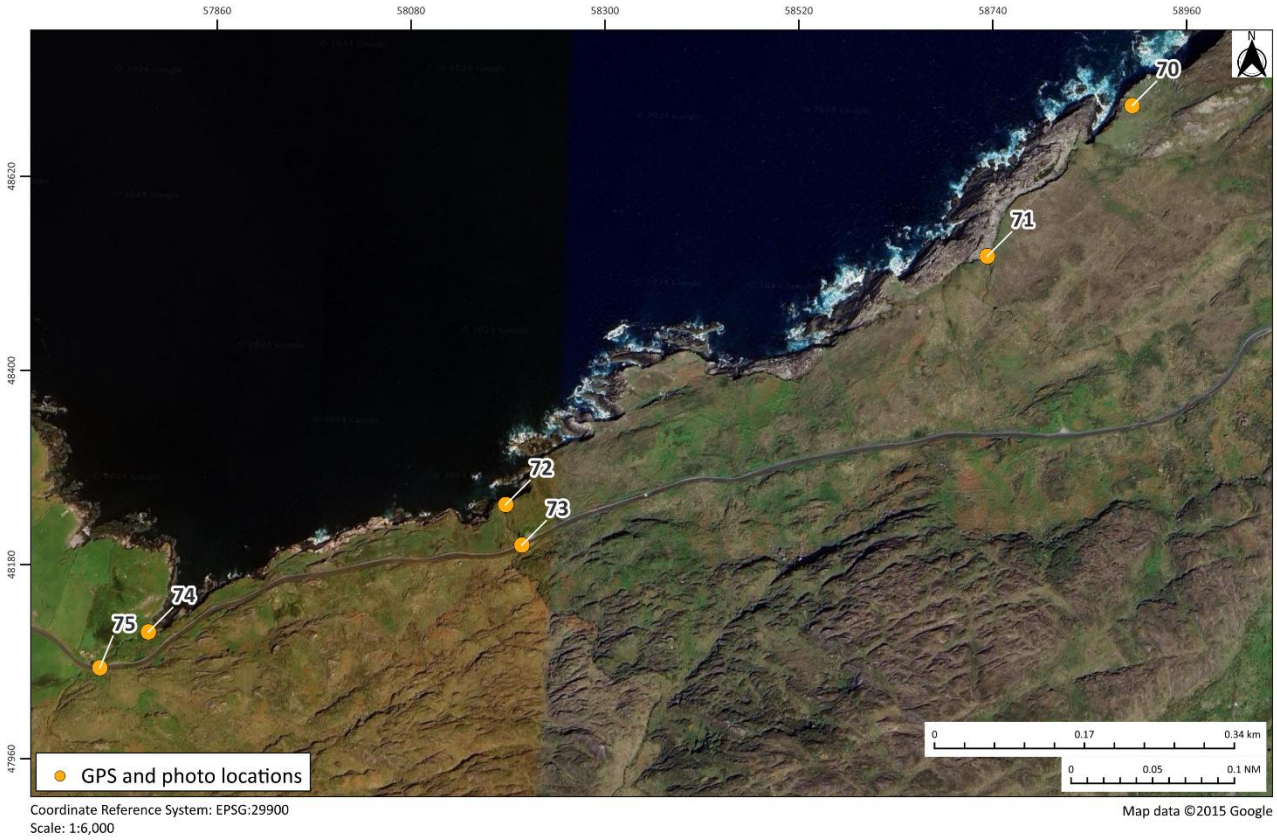


Figure 7-30: Features 70-75 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

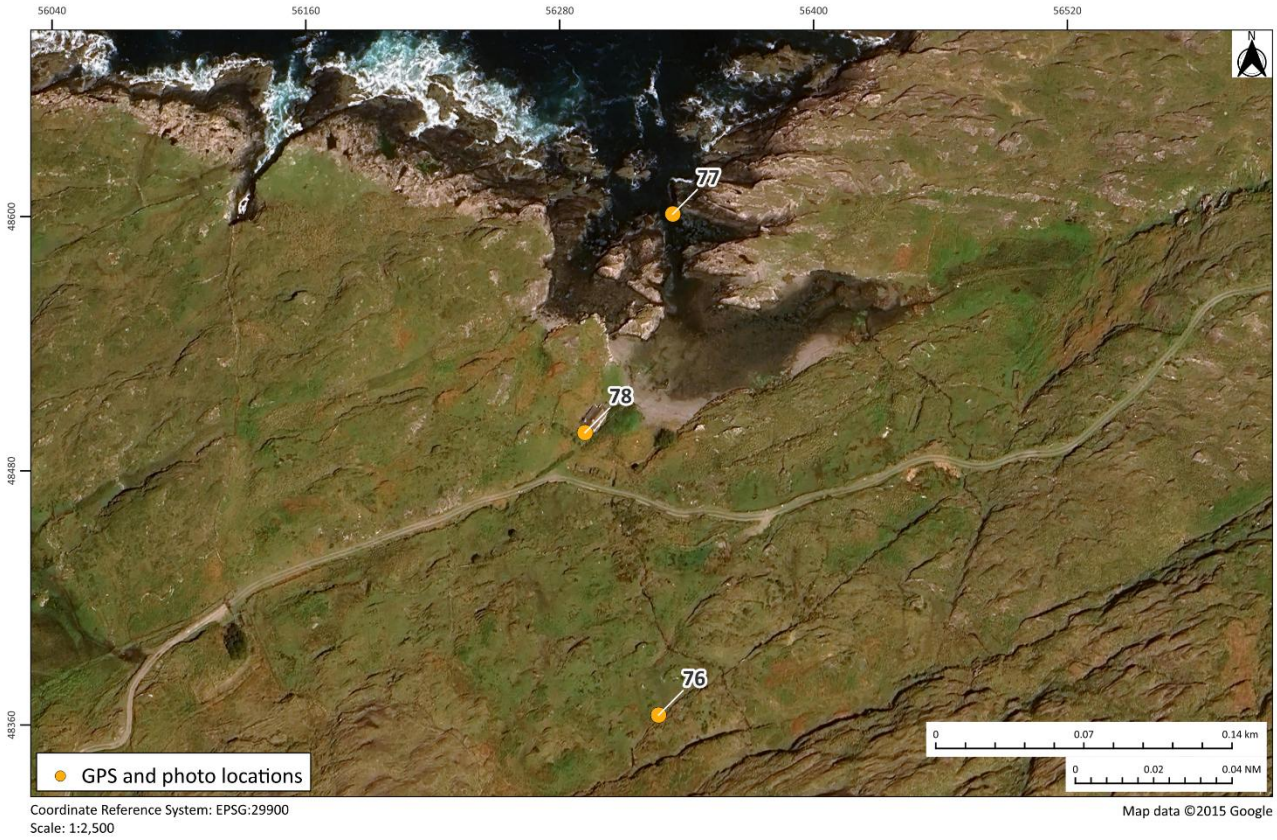


Figure 7-31: Features 76-78 identified during the shoreline survey (numbering cross-referenced to Table 7-10).

7.2.2. Locations of Sources

Figure 7-32 shows all rivers/streams that discharge in Coulagh Bay and **Table 7-11** provides cross-referenced details for this map. **Figure 7-33** shows all discharges into Coulagh Bay contributing catchment and **Table 7-12** provides cross-referenced details for industrial discharges, drains, pipes, rivers, and stream discharges.

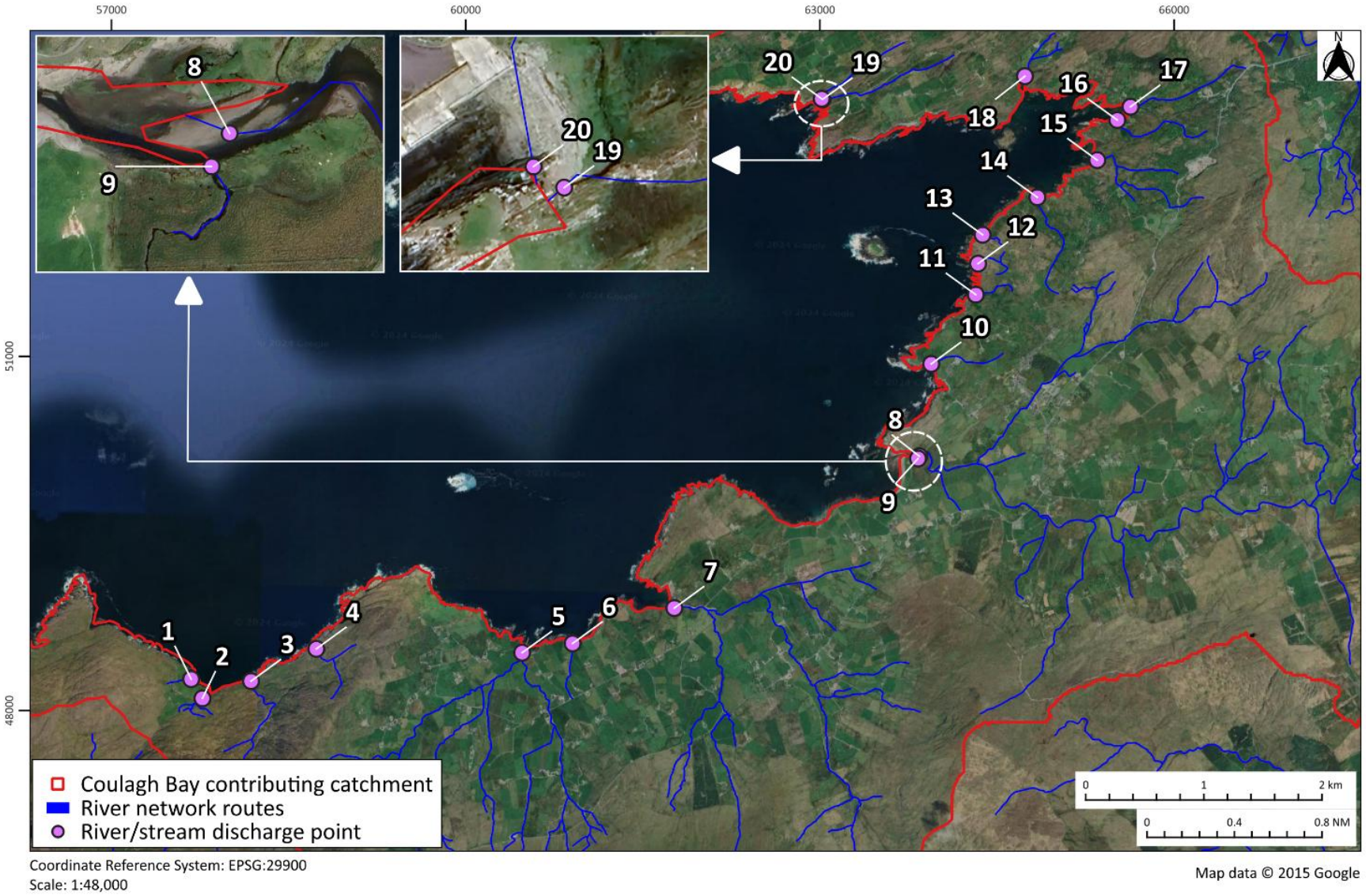


Figure 7-32: Location of all river/stream discharge points into Coulagh Bay according to EPA (source: EPA Geoportal[15]). Map IDs cross-referenced to Table 7-11.

Table 7-11: River/stream discharge points that discharge from the contributing catchment into Coulagh Bay. Map IDs are cross-referenced to Figure 7-32. River names are those identified by the EPA (source: EPA Geoportal[15]).

Map ID	EPA River Name
1	Null
2	Null
3	Null
4	Null
5	Null
6	Null
7	Ardacluggin
8	Kealincha
9	Null
10	Null
11	Eyeries
12	Null
13	Null
14	Null
15	Base of Rocks
16	Faunkill
17	Ballycrovane
18	Null
19	Gortgarriff
20	Null

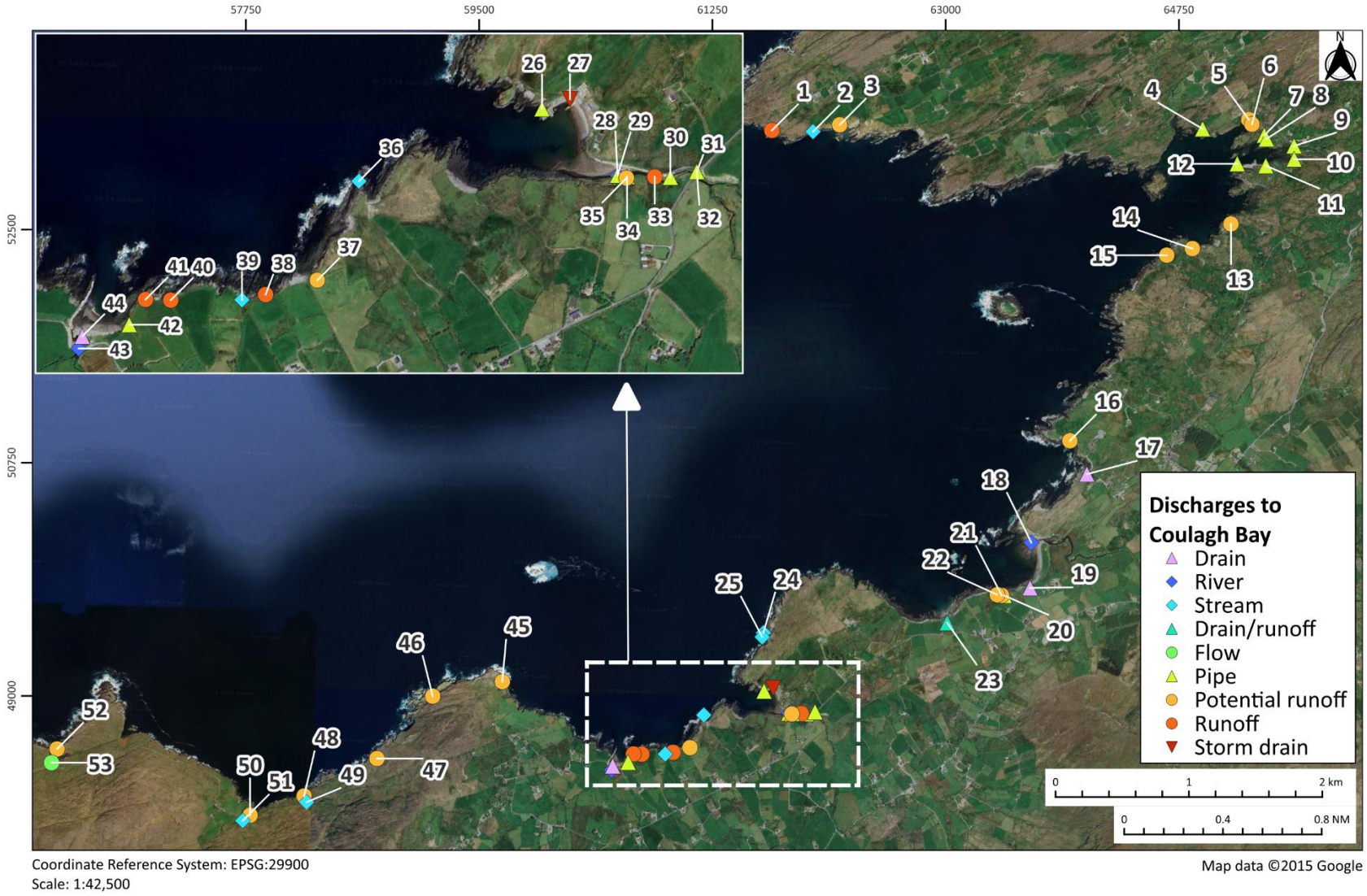


Figure 7-33: Locations of discharges, as observed during the shoreline surveys, into Coulagh Bay. Main map shows map IDs 1-25 and 45-53 and insert map shows map IDs 26-44. Map IDs cross-referenced to Table 7-12. Potential runoff indicates that the feature could not be conclusively determined during the shoreline survey however these potential features have not been discounted.

Table 7-12: Location of discharges, as observed during the shoreline surveys, that discharge into Coulagh Bay. Map IDs are cross-referenced to Figure 7-33. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[24].

Map ID	Observation	Comment	Picture Number	Latitude	Longitude	Easting	Northing
1	Land runoff	Freshwater runoff with observed algal growth. Potential gully.	1	51.7151	-10.0019	461677.1	553310.8
2	Stream	Small stream. Low flow. Discolouration observed.	2	51.71509	-9.99738	461985.9	553301.9
3	Potential runoff	Eroded cliff. Potential freshwater runoff. No flow.	3	51.7156	-9.99451	462185.9	553352.8
4	Concrete pipe	Concrete pipe under road to Kilcatherine. No flow. Potential function as surface water drain.	7	51.71599	-9.95513	464908.1	553322.6
5	Potential runoff	Potential water drainage below stone dwelling. No flow.	8	51.7167	-9.95016	465253.6	553392.8
6	Potential runoff	Potential freshwater land runoff. No flow.	9	51.71639	-9.94978	465278.4	553357
7	Small black pipe	Small bore black alkathene pipe adjacent to dump site.	10	51.71567	-9.94842	465370.8	553274.1
8	Three pipes	Three black small to medium bore alkathene pipes leading to/from land/sea. No flow.	11a and 11b	51.71543	-9.94817	465386.9	553247.2
9	Pipes	Pipes near old house. Presumed function as surface water drain. No flow.	12	51.715	-9.94516	465594.1	553194.1
10	Two concrete pipes	Two large bore concrete pipes under road to Ballycrovane Pier. Presumed function as water drain. No flow.	13	51.7141	-9.94511	465594.8	553094.2
11	Concrete pipe	Concrete pipe under road at eastern end of Ballycrovane Pier. No flow.	14	51.71362	-9.94816	465382.2	553045.7
12	Pipes associated with salmon farm aquaculture site	Large black pipe running from shore to vessel docking station. Unknown contents/purpose. No flow.	16	51.7137	-9.95127	465168.1	553060.5
13	Potential runoff	Potential freshwater runoff. No flow.	17	51.70963	-9.95177	465121	552608.9
14	Potential runoff	Potential freshwater runoff onto pebble strand adjacent to old coastguard station. No flow.	18	51.7079	-9.95589	464831.5	552423.7
15	Potential runoff	Potential freshwater runoff near old coastguard station. No flow.	19	51.7074	-9.95864	464639.5	552374.2
16	Potential runoff	Potential freshwater runoff. No flow.	21	51.69472	-9.96861	463912.7	550982.2
17	Field with land drain	Large land drain. Algal growth present and no flow.	22	51.6925	-9.96667	464040.4	550731.4
18	Kealincha River	Large river. Kealincha river sub-basin includes the tributaries into which the Eyeries WWTP discharges.	23	51.68778	-9.9725	463623	550217.1
19	Concrete drain	Concrete drain below redundant fish farm land base. Very little flow. Discolouration observed.	25	51.68472	-9.9725	463613.8	549877.2
20	Pipe	Plastic 9-inch drainage pipe. No flow.	26	51.68417	-9.97528	463420	549820.6

21	Potential runoff	Origin unknown of potential land runoff. No flow. Discolouration observed.	27	51.68417	-9.97556	463400.9	549821
22	Potential runoff	Potential land drain runoff on Coulagh Strand. Little flow. Discolouration observed with oily tinge.	28	51.68421	-9.97604	463367.3	549826.6
23	Land drain	Land drain and runoff. No flow. Stones discoloured. Cattle present.	29a and 29b	51.68222	-9.98139	462991.7	549615.8
24	Stream	Small clear running stream.	32	51.68121	-10.0013	461613.3	549540.7
25	Stream	Small clear running stream.	33	51.68093	-10.0014	461604.1	549509.8
26	Pipe	Small bore black alkathene U-PVC pipe extruding from shed at Travara.	35	51.67728	-10.001	461618.1	549102.8
27	Storm drain	Storm drain at Travara adjacent to slipway. No flow.	37	51.6775	-10	461687.3	549126.2
28	Travara River	River.	N/A	51.67584	-9.99828	461804.7	548938.1
29	Pipes	One large bore metal and one small bore alkathene pipe in Travara River.	39	51.67584	-9.99828	461804.7	548938.1
30	Drain pipe	Black 9-inch drain pipe discharging into a tributary of Travara River.	40	51.67583	-9.99639	461935.1	548933.4
31	Mains metal pipe	Mains metal pipe with stop valve.	41	51.67598	-9.99545	462000.5	548947.5
32	Pipe	Pipe discharging into river.	42	51.67598	-9.99545	462000.5	548947.5
33	Runoff	Low flow. Discolouration and potential leaching observed.	43	51.67583	-9.99694	461896.7	548934.4
34	Rusty metal pipe	Rusty pipe on shore. No flow.	44	51.67582	-9.99794	461828.2	548935.1
35	Potential runoff	Potential stream or runoff. No flow.	45	51.67579	-9.99795	461826.8	548931.5
36	Stream	Stream or land runoff. Low flow.	46	51.67556	-10.0075	461165.9	548923.6
37	Potential runoff	Potential runoff from land. No flow.	47	51.67333	-10.0089	461063.1	548679
38	Field and runoff	Field for pasture/grazing. Runoff with small flow.	50	51.67298	-10.0107	460935.4	548643.4
39	Stream	Moderate stream flowing through pasture and grazing fields. Stream is adjacent to proposed aquaculture site T05-523A.	51	51.67285	-10.0116	460876.9	548630.4
40	Field and runoff	Field for pasture/grazing with runoff.	52	51.6728	-10.0141	460701.1	548629.7
41	Livestock and runoff	Runoff observed from livestock field. 50+ cattle observed. Low flow. Discolouration observed.	53	51.6728	-10.015	460638.8	548631.4
42	Concrete pipe	Concrete pipe from under livestock fields. Low flow, clear running, some algal overgrowth.	54	51.67223	-10.0156	460598.4	548569.1
43	River	Medium river with bridge at Travaud.	56	51.67167	-10.0173	460473.5	548510.2
44	Drain	Drain at Travaud Pier. No flow. Cattle present in field behind pier.	58	51.67194	-10.0172	460482.6	548540.4
45	Potential runoff	Potential freshwater runoff. No flow.	61	51.67743	-10.0294	459654.5	549174.5
46	Potential runoff	Potential freshwater runoff. No flow. Algal growth on rocks.	62	51.67632	-10.0369	459132.7	549064.9
47	Potential runoff	Potential freshwater runoff. No flow.	64	51.67201	-10.0428	458714.3	548597.3

48	Potential runoff	Potential freshwater runoff. No flow.	65	51.66935	-10.0506	458167.9	548315.8
49	Stream	Small stream crossing under road. No odour and clear.	66	51.66894	-10.0503	458186.3	548270
50	Potential runoff	Potential freshwater runoff. No flow.	67	51.66795	-10.0564	457762.6	548171.6
51	Stream	Large stream crossing under road. No odour and clear.	68	51.66757	-10.0572	457707.6	548131
52	Potential runoff	Potential freshwater runoff. No flow.	70	51.67205	-10.0775	456314.4	548669
53	Flow	Small flow, clear running, no odour.	71	51.67111	-10.0781	456272.9	548565.8

8. Appendix 2: Hydrography/Hydrodynamics

8.1. Simple/Complex Models

The hydrodynamic conditions in outer Kenmare Bay are described in a three-dimensional hydrodynamic model that was recently run by AQUAFACT (AQUAFACT, 2024 *unpublished*). While the model wasn't specifically focused on Coulagh Bay, the data has been used here to describe the hydrodynamic conditions likely to occur in Coulagh Bay considering the proximity to the modelled area.

8.2. Depth

Coulagh Bay is predominantly subtidal, and depths are generally less than 30 m, with a gradual increase in depth from the shore seawards until a steep drop in bathymetry results in a pronounced increase in depth. The seaward side of Coulagh Bay reaches depths of 45 m (**Figure 8-1**). The site T05-523A is located in shallow waters between *c.* 10-20 m.

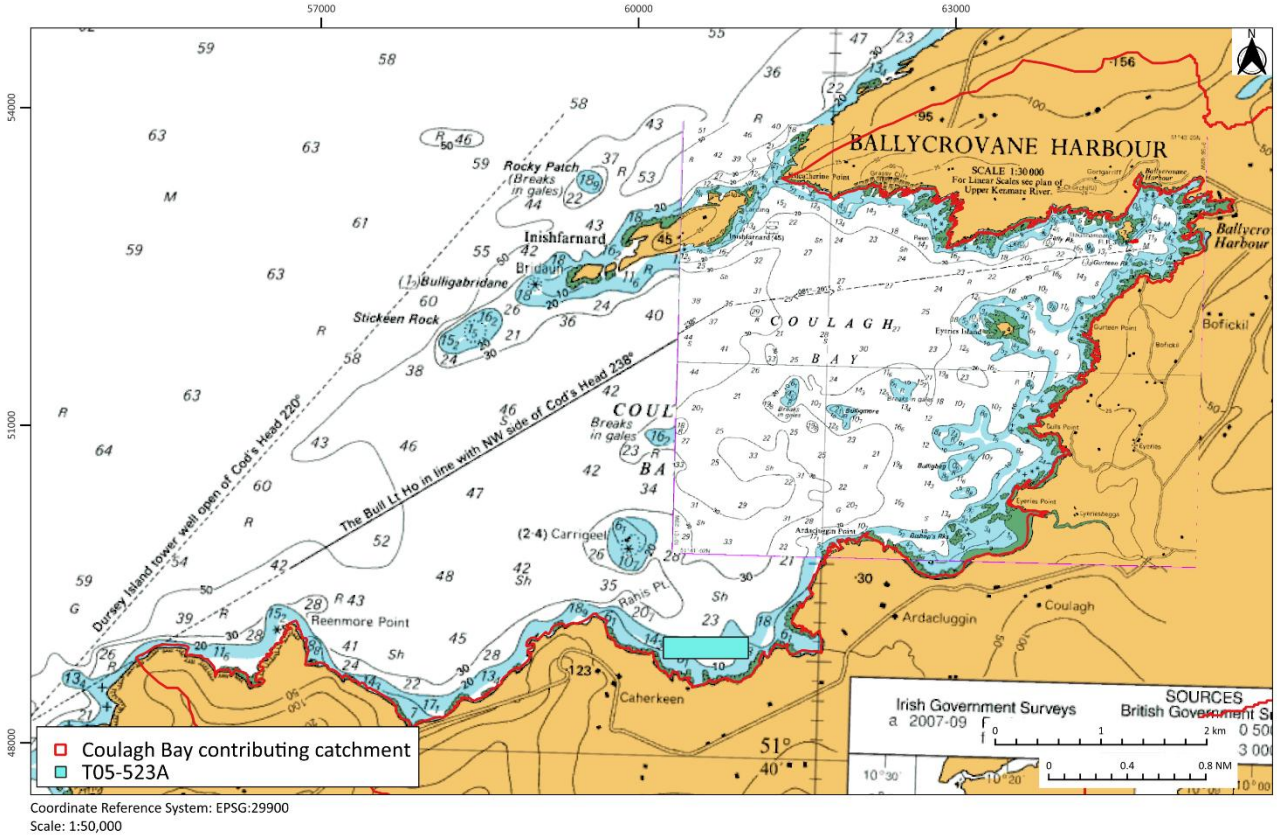


Figure 8-1: Coulagh Bay bathymetry. This figure contains Irish Public Sector Data (Department of Agriculture, Food and the Marine) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

8.3. Tides and Currents

Throughout Kenmare and Coulagh Bays, current flows are weak with poorly defined directional patterns due to the propagation of a small tidal range in and out of an enclosed basin with a small surface area and large sea boundary (Bord Iascaigh Mhara, 1990). Tidal flow direction in Kenmare Bay is rectilinear parallel to the shoreline in a southwest to northeast direction on the respective ebbing and flooding tides (AQUAFACT, 2024).

In the sheltered Coulagh Bay, currents are even less well defined compared to outer Kenmare Bay. The circulation and water movement in Coulagh are dominated by wind and almost no tidal oscillation occurs otherwise (Bord Iascaigh Mhara, 1990). Wind from any direction can influence the circulation in the bay. The estimated wind velocity required to initiate flow is approximately 5 m/s, occurring 50% of the time (Bord Iascaigh Mhara, 1990). Prevailing wind conditions generally increase surface velocities and dispersion, dominating the tidal flows (AQUAFACT, 2024).

Spring tidal range in Kenmare Bay is *c.* 3.5 m and the neap tidal range is *c.* 1.6-1.8 m[41], which approximately aligns with the 1990 study (Bord Iascaigh Mhara) which found that in Ballycrovane the spring tidal range was 3 m and the neap tidal range was 1.6 m. Depth in the entrance to Kenmare is < 75 m and this, coupled with the orientation of the bay, diffracts Atlantic swell waves around the approach to the bay[41]. A hydrographic survey in Kenmare Bay undertaken in 1990 indicated weak tidal stream velocities throughout the outer bay region and 0.06-0.1 m/s in the main channel[41].

Tidal currents in Coulagh Bay were found to be *c.* 0.02–0.04 m/s and tidal flow direction data showed near equal distribution in every direction, both indicative of slack tidal conditions; these conditions are exaggerated under neap tides in Coulagh Bay with very slack flows less than 0.04 m/s throughout the neap tidal cycle[41]. Velocities increased by *c.* 50% during the spring tidal cycle however were typically less than 0.08 m/s in the inner bay and are still considered slack[41].

The site of interest (T05-523A) is situated in the southern corner of Coulagh Bay and in this region throughout the neap and spring tidal cycles, velocity remains at <0.025 m/s, based on the computed mid-depth tidal velocities observed in 1990 [41]. Within Coulagh Bay, Bord Iascaigh Mhara (1990) found there were no regions of substantial speed which is consistent with a semi-enclosed coastal basin and both modelled and measured flow data were similar at 0.02 m/s.

8.4. Wind and Waves

Wind data from 2019 to 2023 from Valentia Observatory Met Éireann station[42] (see **Figure 8-7** for location), Co. Kerry are displayed in **Table 8-1** and **Table 8-2** below and wind roses for each corresponding year can be seen in **Figure 8-4**.

In 2019, *c*. 13% of the wind came from the south, with *c*. 11% coming from the west and *c*. 8% coming from the northwest; the strongest wind came from the west-northwest. In 2020, *c*. 13% of the wind came from the west, *c*. 12% came from the south and *c*. 7% came from the southwest and north, respectively; the strongest wind came from the west-southwest. In 2021, *c*. 16% of the wind came from the south and *c*. 14% came from the west; the strongest wind came from the west. In 2022, *c*. 14% of the wind came from the south, *c*. 10% came from the west and *c*. 9% came from the southwest and northeast; the strongest wind came from the west-southwest. In 2023, *c.* 10% of the wind came from the southwest, 15% came from the east and northeast, and 18% came from the north; the strongest wind came from the north.

In 2019, 2020, and 2022 wind directions were more variable than in 2021 and 2023. The prevailing wind over the 2019 to 2023 time period came from a south-southwest direction. **Table 8-2** shows the seasonal average wind from 2019 to 2023. 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 indicated that winds are typically strongest in the winter months (11.4 kn), followed by autumn (9.55 kn), spring (9.1 kn), and then summer (8.2 kn).

Table 8-1: Wind speed (knots) and direction (degree) from Valentia Observatory, Co. Kerry from 2019-2023 (source: Met Éireann[42]).

	2019		2020		2021		2022		2023	
Month	**Mean Speed (knots)**	**Max 10-min Mean Direction (°)**	**Mean Speed (knots)**	**Max 10-min Mean Direction (°)**	**Mean Speed (knots)**	**Max 10-min Mean Direction (°)**	**Mean Speed (knots)**	**Max 10-min Mean Direction (°)**	**Mean Speed (knots)**	**Max 10-min Mean Direction (°)**
January	9.2	240	11.1	190	8.3	180	9	169	10.3	189
February	12.9	197	17.2	243	12.5	178	14.4	248	9.5	167
March	11.4	227	11.3	185	10.2	208	8.4	155	1.7	170
April	10.3	186	6.4	191	7.6	185	8.5	194	9.4	175
May	8.2	213	8.8	184	9.2	221	9.2	226	7.2	185
June	8.6	194	9	230	7.6	182	9.2	216	7.2	183
July	7.8	244	9.3	246	6.3	243	7	248	9.9	229
August	10.1	225	8	209	7.1	229	6.3	214	8.8	230
September	9.2	216	8.1	216	6.9	213	7.7	178	8.8	177
October	9.7	177	11.6	200	9.2	210	10.8	198	8.1	159
November	10	153	10.3	194	8.6	189	13	209	11.3	211
December	12	208	11.9	200	11	193	9.2	148	13.1	213

Table 8-2: Seasonal average wind speed (knots) from Valentia Observatory, Co. Kerry wind data (source: Met Éireann[42]).

Season	2019	2020	2021	2022	2023	5-Year Average
Winter	10.7	12.9	9.8	12.1	11.3	11.4
Spring	10	8.8	9	8.7	9.1	9.1
Summer	8.8	8.8	7	7.5	8.7	8.2
Autumn	9.6	10	8.2	10.5	9.4	9.5

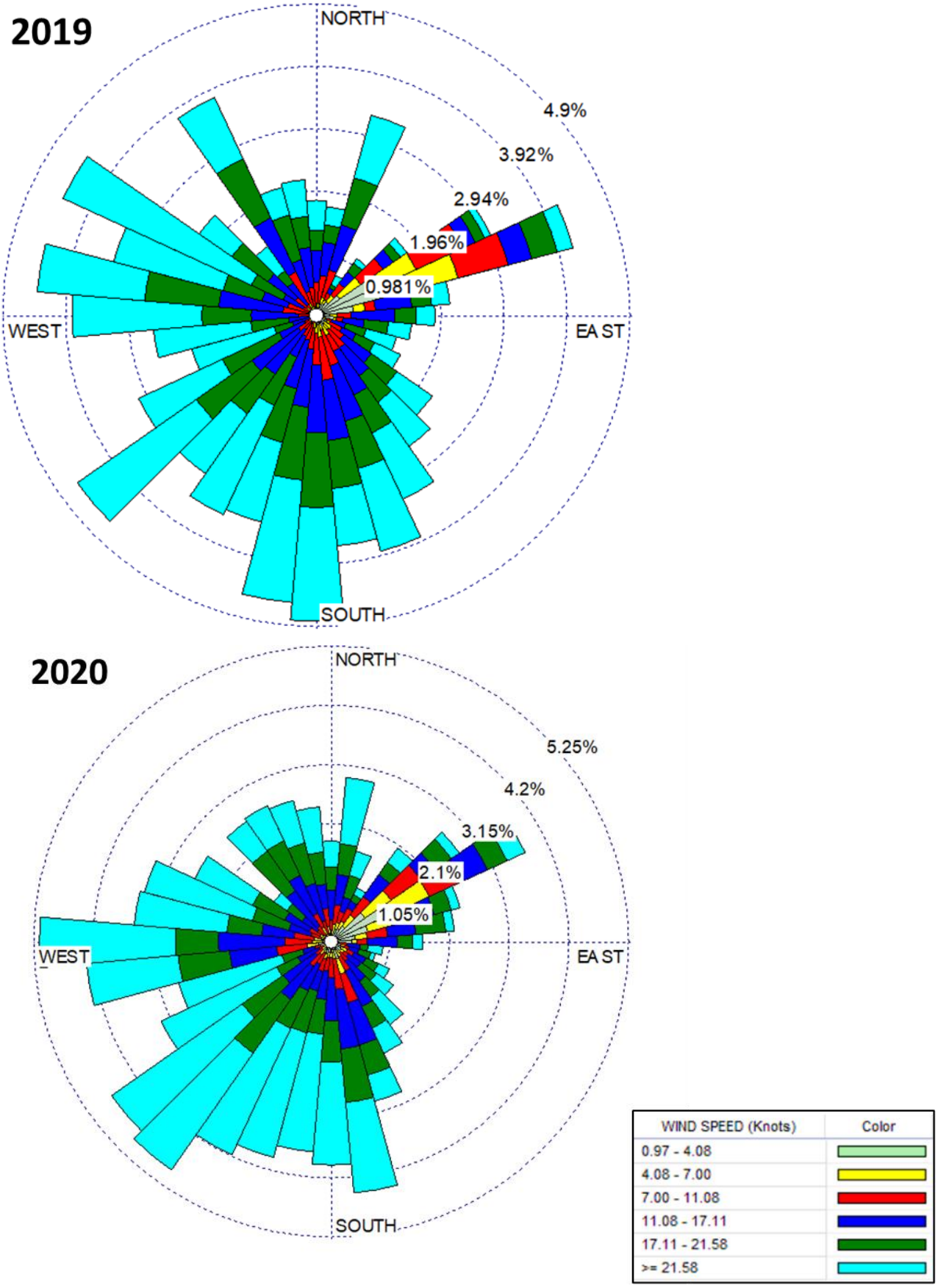


Figure 8-2: Wind roses for Valentia Observatory Met Éireann station, Co. Kerry from 2019 and 2020 (source: Met Éireann[42]).

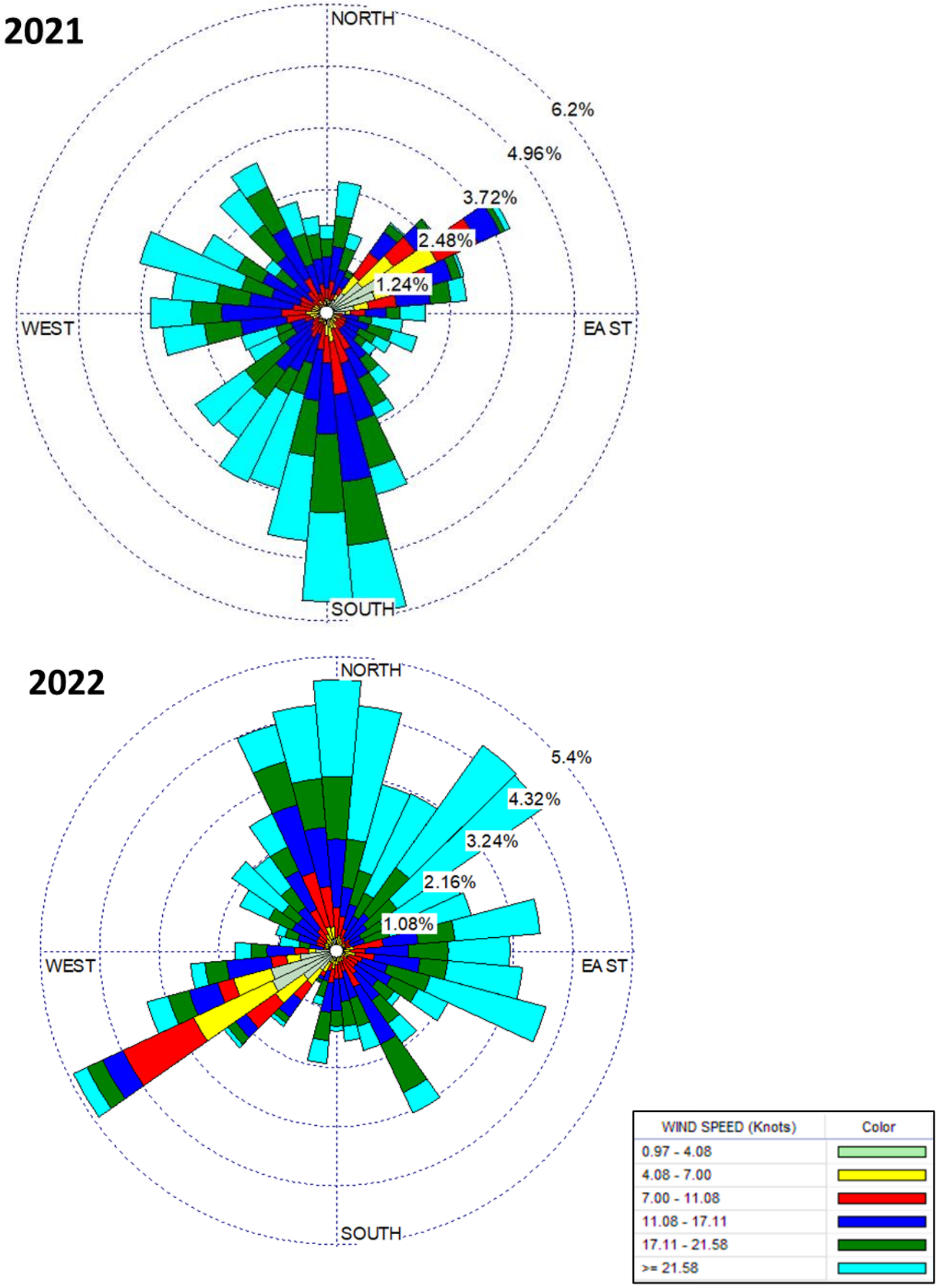


Figure 8-3: Wind roses for Valentia Observatory Met Éireann station, Co. Kerry from 2021 and 2022 (source: Met Éireann[42])

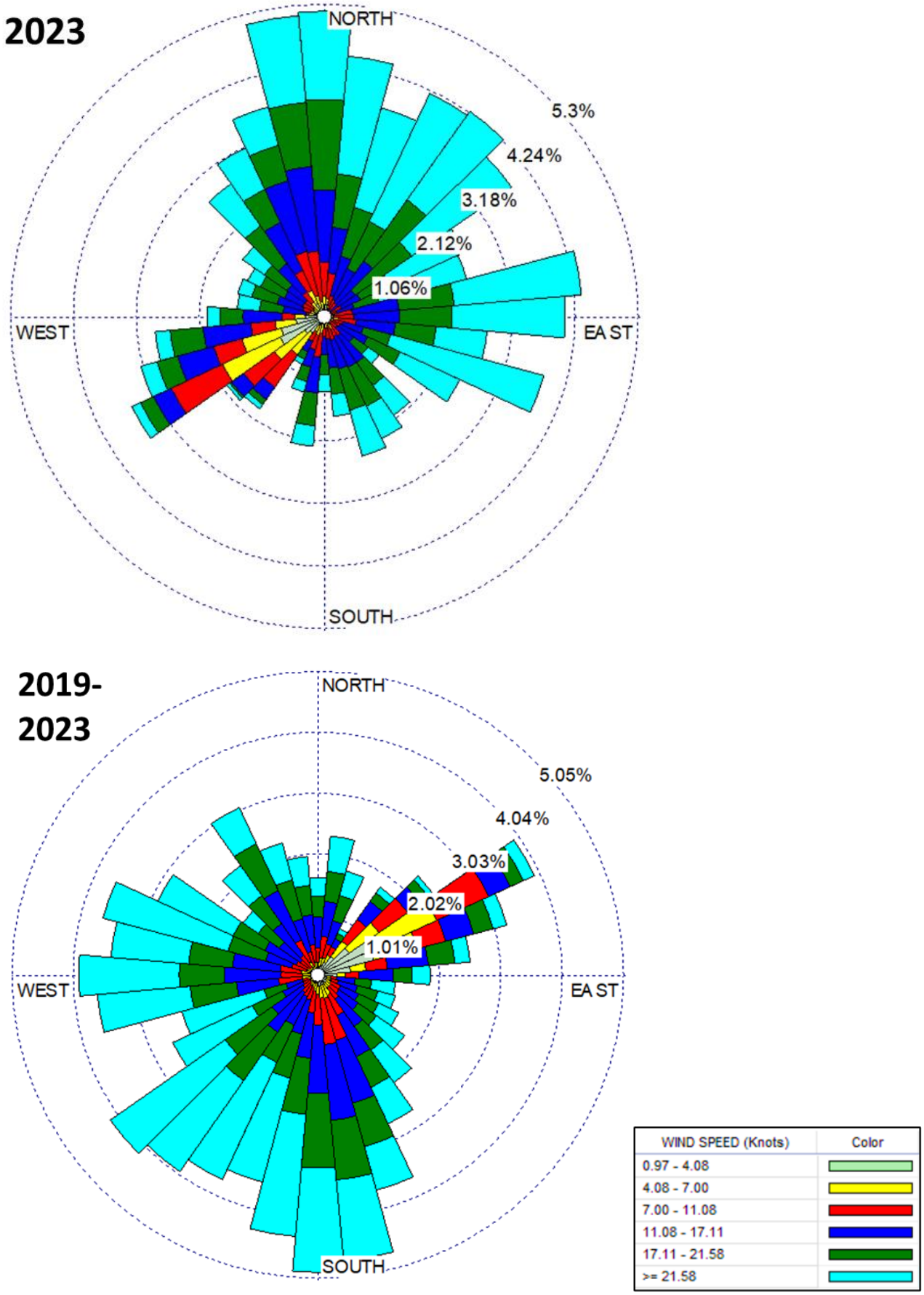


Figure 8-4: Wind roses for Valentia Observatory Met Éireann station, Co. Kerry from 2023 and the average wind spped and direction is displayed over the 2019 to 2023 period (source: Met Éireann[42]).

Wind conditions affect the hydrodynamic conditions in Coulagh Bay by generating wind-induced currents and waves. Of these phenomena, wind-induced waves are an important factor in the process of sediment resuspension and transport. Wind waves are produced by the local prevailing wind. They travel in the direction of the prevailing wind, *i.e.*, a south-westerly wind will produce north-easterly moving waves. The height of wind waves depends on:

- the strength of the wind,
- the time the wind has been blowing and
- the fetch.

TOMAWAC wave modelling software was used by AQUAFACT in 2019 (AQUAFACT, 2023) to investigate the wave climate around Inishfarnard Island in Coulagh Bay. Over the 17-year study period, the maximum recorded significant wave height was 13.8 m with a wave period of 12 seconds in 2007. There were 22 storm events which exceeded a 10 m significant wave height, and seven events exceeded a 12 m significant wave height[41]. The study indicated that outer Coulagh Bay is a moderately exposed site with the most critical storm waves produced from a westerly direction[41]. A local wind wave simulation found maximum significant wave heights of 1.8 to 2.3 m for southwest and westerly storm winds, which are less significant than the Atlantic swell waves which under severe storm conditions produce waves of 4.6 to 5.2 m[41]. Wave-induced mixing is predicted to ensure vertical mixing and subsequently stratification is expected in deeper waters away from T05-523A which is located within more shallow regions of the bay (Bord Iascaigh Mhara, 1990).

8.5. River Discharges

Three WFD river sub-basins within the contributing catchment drain entirely into Coulagh Bay: Ardacluggin_010, Ballycrovane_010, and Kealincha_010, covering a total area of *c.* 47.64 km^2. Within these river sub-basins there are three corresponding river water bodies (see **Figure 8-5** for coastal water bodies and river sub-basins, and **Figure 8-6** for river water bodies). The contributing catchment is dominated by the Kealincha_010 river sub-basin (drains *c.* 44.5%) and the Ardacluggin_010 river sub-basin (drains *c.* 37.6%), and to a lesser extent by the Ballycrovane_010 river sub-basin (drains *c.* 17.9%).

The 2016-2021 WFD status[15] of Coulagh Bay and its associated freshwater and coastal sources can be seen in **Figure 8-5**. Of the riverine systems flowing directly into Coulagh Bay contributing catchment, all water bodies were of Good WFD status. The Outer Kenmare River coastal water body was of Good status for the same monitoring period, and the South Western Atlantic Seaboard (HAs 21;22) which the Outer Kenmare River and associated river water bodies ultimately feed into, was of High status. Real-time flow and water level measurements were not available for the relevant river water bodies at the time of writing this report. The River Flow Estimates – Hydrotool was developed by the EPA[43] to estimate representative flows expected in rivers under natural conditions without the incorporation of artificial influences or discharges[44]. Within the Ardacluggin_010 river sub-basin there were two Hydrotool estimates, both of which were estimated from where the river network route discharges into the bay. In the Kealincha river sub-basin, along the Kealincha River there were several reference points however only the point at the mouth of the Kealincha River was used to provide consistency between the two sub-basins (**Figure 8-6**). The Ardacluggin sub-basin river flow estimates were 0.211 m^3/s and 0.272 m^3/s (map IDs 1 and 2, respectively; **Figure 8-6**), however estimated river flows at Kealincha were higher at 0.859 m^3/s (map ID 3; **Figure 8-6**).

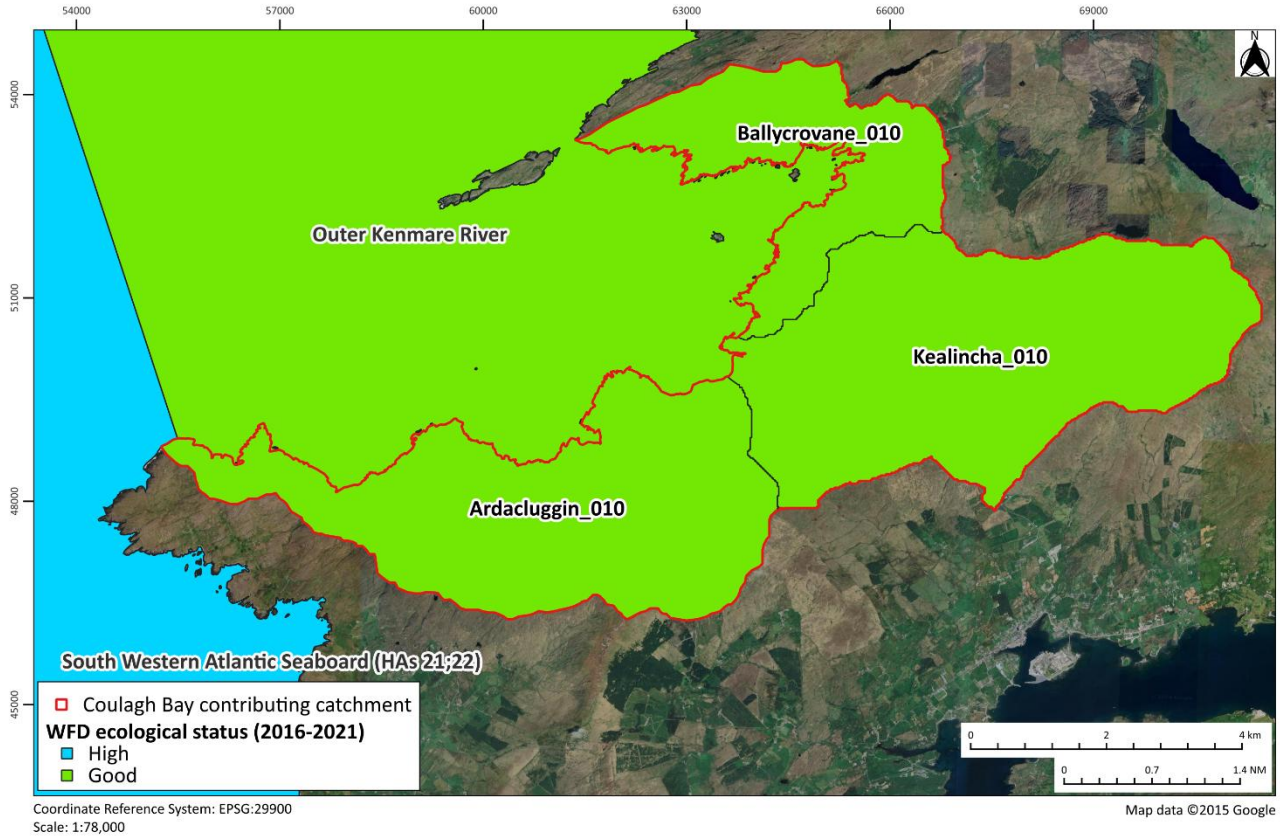


Figure 8-5: Water Framework Directive (WFD) 2016-2021 ecological status of river sub-basins and coastal water bodies within Coulagh Bay contributing catchment (source: EPA[15]). This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

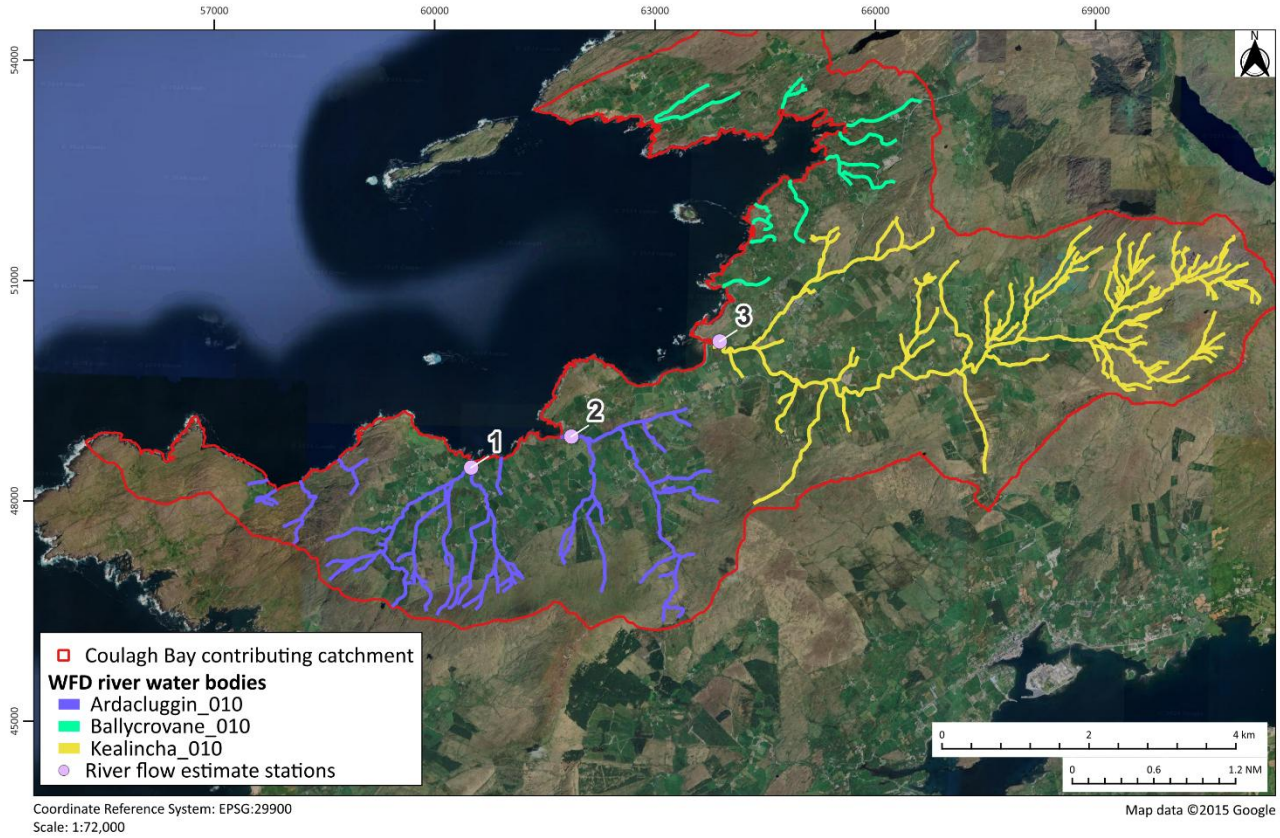


Figure 8-6: Water Framework Directive (WFD) river water bodies within Coulagh Bay contributing catchment (source: EPA[15]). River flow estimates (EPA Hydrotool[43]). This figure contains Irish Public Sector Data (EPA) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

8.6. Rainfall Data

8.6.1. Amount and Time of Year

In this section, data from the Kenmare (Derreen) Met Éireann station (**Figure 8-7**), situated c. 18 km northeast of Coulagh Bay, was used to investigate long term rainfall patterns, *i.e.*, 30-year period, and rainfall patterns over a recent 5-year period *i.e.*, 2019-2023. **Figure 8-8** shows the average monthly rainfall data for Ireland (Met Éireann42) from 1991 to 2021. The wettest months overall during this period were October-January. The wettest months in the Kenmare Bay region from 1993 to 2023 were also October to January and the driest months were May to August (**Figure 8-9**). **Table 8-3** shows the 30-year monthly average rainfall at the Kenmare (Derreen) Met Éireann station. During the period 1993 to 2023, average rainfall at Kenmare (Derreen) was lowest in June (120.7 mm) and highest in December (268.8 mm). The greatest daily total ranged from a low of 60.9 mm in May to a high of 119.9 mm in October. **Table 8-4** shows the seasonal averages at Kenmare (Derreen) Met Éireann station from 1993 to 2023. Lowest average rainfall over the 30-year period was in summer (128.4 mm) with the highest average rainfall experienced in winter (240.5 mm).

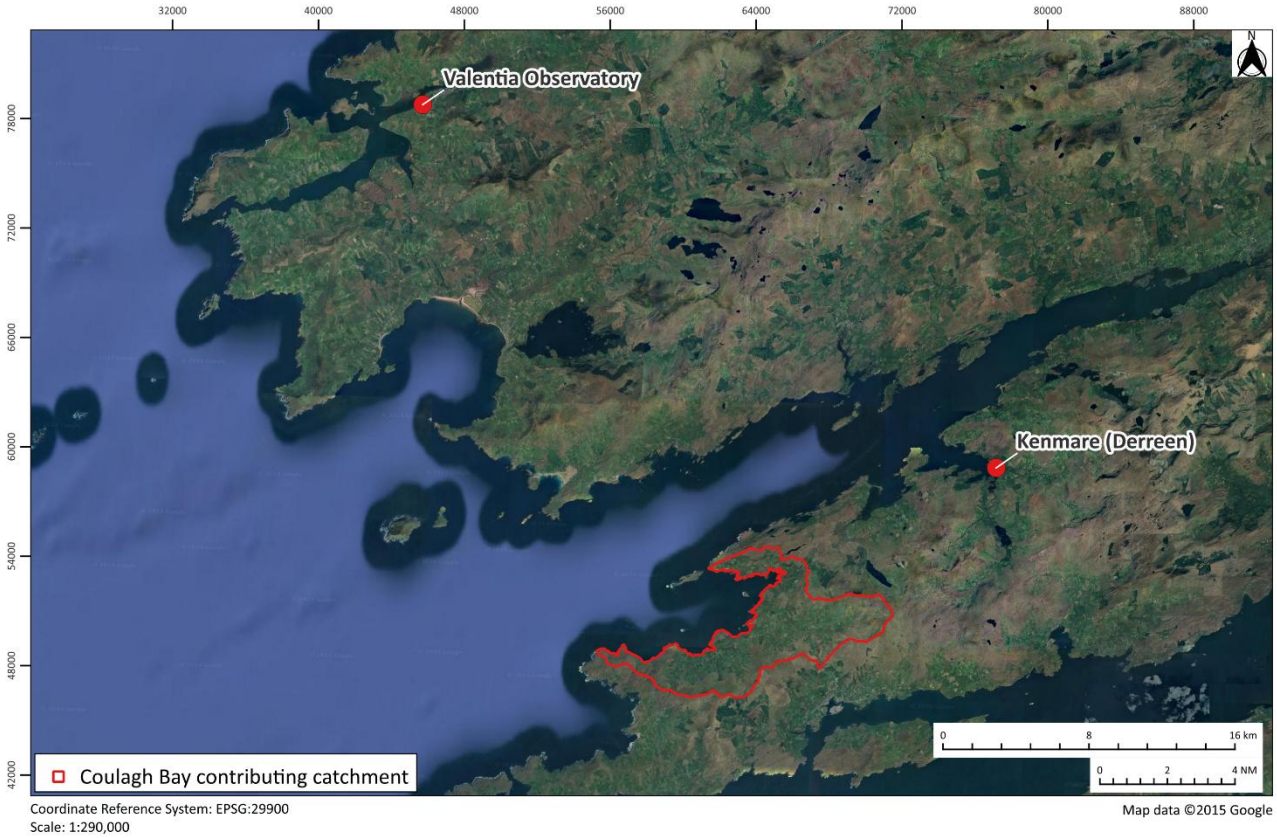


Figure 8-7: Location of Kenmare (Derreen) Met Éireann station and Valentia Observatory Met Éireann station in relation to Coulagh Bay contributing catchment (source: Met Éireann42).

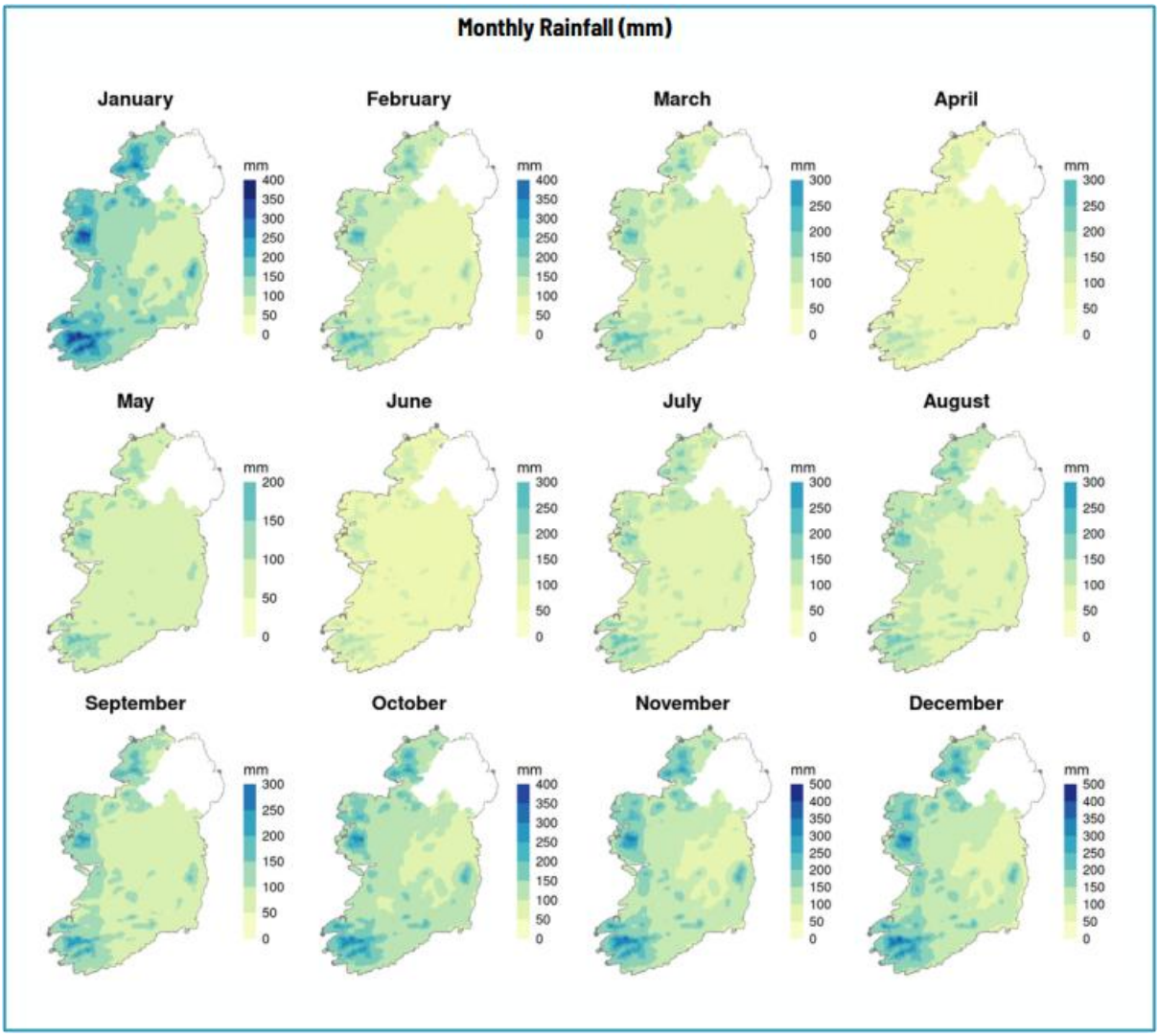


Figure 8-8: Average monthly rainfall (mm) data from 1991 to 2020 for Ireland (source: Curley *et al.*, 2023).

Table 8-3: Average monthly rainfall at Kenmare (Derreen) Met Éireann station, Co. Kerry from 1993 to 2023 (source: Met Éireann[42]).

Monthly Average	Month	Greatest Daily Total
256.9	**January**	88.9
195.9	**February**	106.2
159.1	**March**	83.1
136.0	**April**	80.3
123.6	**May**	60.9
120.7	**June**	66
132.1	**July**	70.9
132.4	**August**	77.5
169.0	**September**	149.4
232.0	**October**	119.9
242.4	**November**	112.3
268.8	**December**	91.4

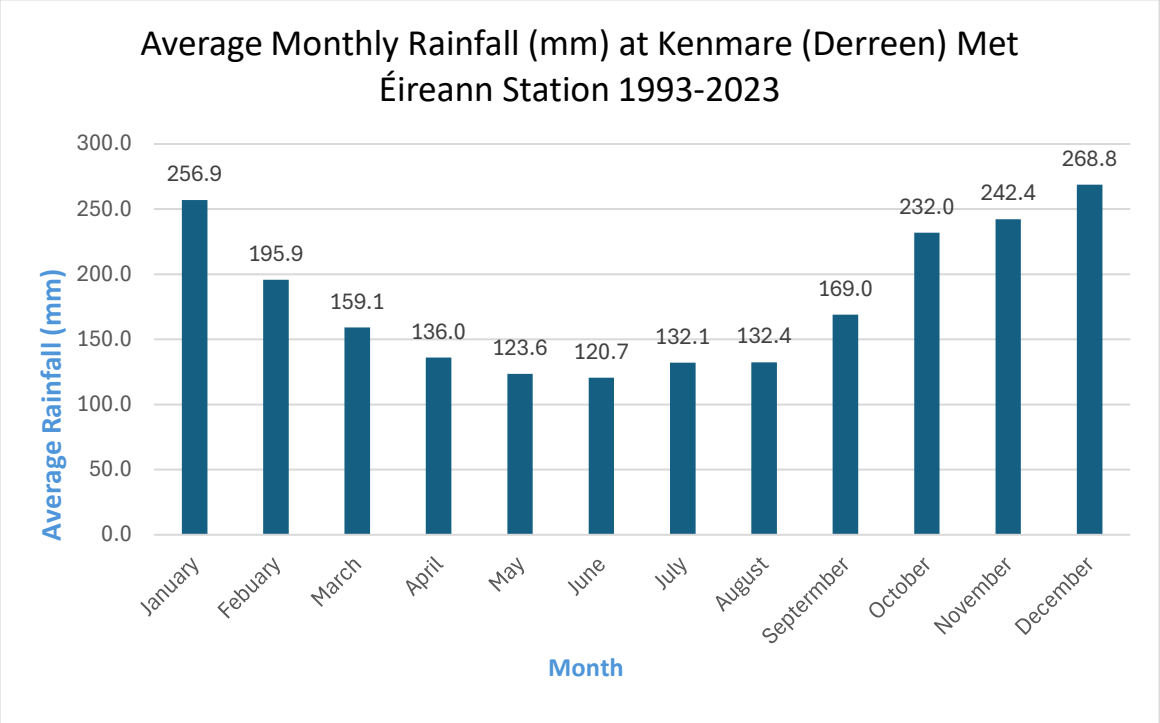


Figure 8-9: Average monthly rainfall (mm) at Kenmare (Derreen) Met Éireann station from 1993-2023 (source Met Éireann[42]).

Table 8-4: Average seasonal rainfall values (mm) from 1993 to 2023 at Kenmare (Derreen) Met Éireann station, Co. Kerry (source: Met Éireann[42]).

Season	Average Rainfall (mm)
Autumn	214.4
Spring	139.6
Summer	128.4
Winter	240.5

Table 8-5 shows the total monthly rainfall at the Kenmare (Derreen) Met Éireann station (see **Figure 8-10** from 2019 to 2023)[42]. Maximum monthly rainfall on record was in November 2022 (447 mm) and the lowest monthly rainfall was in April 2021 (30 mm). The five-year average monthly rainfall ranged from a low of 103.7 mm in May to a high of 301.1 mm in October. Annual average ranged from 160.1 mm in 2021 to 204.9 mm in 2023.

Table 8-6 shows the total seasonal rainfall at Kenmare (Derreen) Met Éireann station from 2019-2023[42]. The following seasonal fluctuations were observed: in 2019, summer was the driest season and autumn was the wettest; in 2020, spring was the driest season and winter was the wettest; in 2021, summer was the driest season and winter was the wettest; in 2022, summer was the driest season and autumn was the wettest; in 2023, summer was the driest season and winter was the wettest. Over the five years, summer 2021 was the driest season and autumn 2022 was the wettest season.

Table 8-5: Total monthly rainfall data (mm) at Kenmare (Derreen) Met Éireann station, Co. Kerry from 2019 to 2023 (source: Met Éireann[42]).

Year	2019	2020	2021	2022	2023	Monthly 5-Year Average
January	128.7	179.4	190.2	84.1	262.8	169
February	216.9	301	393.3	206.7	60.2	235.44
March	179.6	118.4	96.6	132.8	369.9	179.5
April	203	81.7	30	136.5	88	107.8
May	61.6	71.7	233.2	84.3	67.7	103.7
June	104.8	149	44.4	160.5	137.5	119.2
July	83.7	237.3	69.8	47.5	203.9	128.5
August	188.4	325.7	39.9	47.8	152.7	150.9
September	199.7	117	133.2	183.7	236.1	173.9
October	226.5	283.6	332.9	337.7	324.8	301.1
November	210.6	278.3	88.4	447	192.2	243.3
December	284	281.4	269.6	207.4	362.7	281
Annual Average	**174**	**202**	**160.1**	**173**	**204.9**	

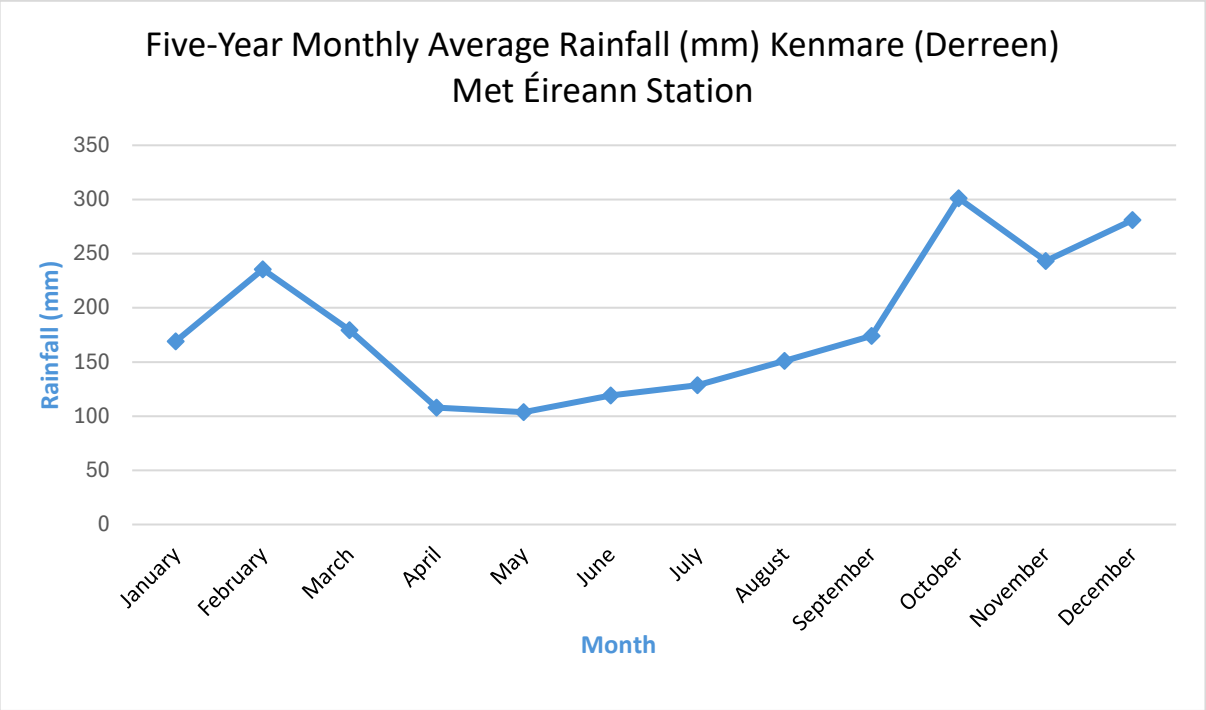


Figure 8-10: Five-year monthly average rainfall (mm) at Kenmare (Derreen) Met Éireann station from 2019 to 2023 (source Met Éireann[42]).

Table 8-6: Total seasonal rainfall (mm) at Kenmare (Derreen) Met Éireann station from 2019 to 2023 (source: Met Éireann[42]).

Season/Year	2019	2020	2021	2022	2023
Autumn	636.8	678.9	554.5	968.4	753.1
Spring	444.2	271.8	359.8	353.6	525.6
Summer	376.9	712	154.1	255.8	494.1
Winter	629.6	761.8	853.1	498.2	685.7

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[45]). For a one in 100-year return period, 30.6 mm of rain would be expected over a one-hour period and 120.1 mm over 24 hours. While these would be extremely uncommon events, the model predicts that once a year 13.1 mm of rain would fall in one hour and 51.5 mm over a 24-hour period. Data from Kenmare (Derreen) Met Éireann station show there have been 85 24-hour periods within which more than 51.5 mm of rain fell over the 30-year period from 1993-2023. For this same period, September had the greatest daily rainfall with 149.4 mm. Over the 5-year period 2019-2023, data from Kenmare (Derreen) Met Éireann station show there have been 14 24-hour periods within which more than 51.5 mm of rain fell[42]. 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 51.5 mm within a 24-hour period over 30 years, recorded at the Kenmare (Derreen) Met Éireann station[42].

Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
18-Sep-93	149.4	17-Oct-00	68.6	10-Apr-16	57.7
03-Oct-16	119.9	05-Jan-13	68.6	10-Jun-13	57.1
18-Nov-09	112.3	16-Nov-11	67.8	20-Aug-01	56.9
11-Oct-96	109.2	30-Dec-00	67.6	02-Oct-16	56.6
18-Feb-07	106.2	05-Apr-18	67.6	06-Jul-23	56.6
01-Nov-11	96	27-Nov-99	66.6	09-Feb-01	56.4
26-Dec-10	91.4	20-Nov-02	66.6	05-Oct-14	56.4
26-Dec-23	91.4	09-Jun-03	66	18-Nov-93	56.1
12-Jan-18	88.9	27-Apr-05	66	30-Aug-98	54.6
22-Dec-02	87.6	12-Jan-06	66	02-Jan-16	54.6
22-Feb-21	86.4	08-Jun-96	65.5	02-Nov-94	54.4
11-Sep-15	86.1	20-Dec-99	64.8	06-Jan-16	54.1
10-Mar-04	83.1	20-Jun-20	64.5	22-Jan-02	53.9
26-Sep-17	81.8	10-Nov-20	64.3	13-Jan-09	53.3
10-Nov-03	81.3	20-Oct-17	63.5	20-Oct-98	52.8
13-Apr-03	80.3	07-Oct-21	63.5	21-Dec-99	52.6
10-Sep-02	79.5	05-Oct-95	61.5	21-Apr-98	52.3
12-Mar-96	79.2	20-May-08	60.9	20-Oct-02	52.3
29-Dec-15	77.5	05-Sep-10	60.9	09-Feb-03	52.3
24-Aug-20	77.5	02-Sep-17	60.5	30-Jun-10	52.3
11-Jan-10	75.7	11-Jan-11	59.7	14-Jun-13	52.3
17-Nov-11	75.4	13-Apr-19	59.7	29-Oct-09	52.1
18-Feb-21	74.2	16-Apr-18	59.4	25-Nov-22	52.1
13-Nov-18	72.6	16-Oct-95	58.7	26-Jan-95	51.8
17-Jan-16	71.6	27-Oct-04	58.4	05-Apr-10	51.8
12-Feb-21	71.4	12-Dec-18	58.4	14-Aug-20	51.6
29-Jul-94	70.9	29-Jul-20	58.4	19-May-21	51.6
08-Feb-96	70.1	06-Sep-93	57.7		
28-Nov-11	70.1	17-Sep-99	57.7		

8.7. Salinity

Salinity can affect current patterns and the interaction between water bodies of different masses as the salt content of seawater effects the relationship between temperature and density; salinity even effects the flow of deep ocean currents. At the time of writing, no salinity data were available for Coulagh Bay specifically. There are stations monitored by the EPA in Kenmare Bay, namely KN165 and KN170. Between 2010 and 2021, salinity ranged from 31.2-35.4 psu[46] at these stations; samples were taken in summer and winter.

Figure 8-11: Environmental Protection Agency (EPA) coastal monitoring stations[46].

8.8. Turbidity

Turbidity can affect water clarity as high concentrations of particulate matter can impact light penetration and habitat quality, and particles provide attachment surfaces for pollutants such as bacteria[47]. 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. Bord Iascaigh Mhara (1990) established a simple tidal prism model in Coulagh Bay to assess flushing times whereby water entering the basin on a flood tide was assumed to be fully mixed with the water mass inside. It was assumed that the volume of sea water plus freshwater inputs equals the volume of water in the tidal prism, and on the ebb tide the same volume is removed. The estimated flushing times over spring tides were six days and over neap tides were 12 days (Bord Iascaigh Mhara, 1990).

8.10. Discussion

Coulagh Bay is located in Co. Cork, on the southwestern bank of Kenmare Bay, forming part of the northern shore of the Beara Peninsula. Coulagh Bay is predominantly subtidal with a depth range of *c.* 5–45 m, however around site T05-523A depths range from *c.* 10–20 m. In Kenmare Bay, spring tidal range is *c.* 3.5 m and neap tidal range is *c.* 1.6-1.8 m[41]. Current flow in the bay is weak with poorly defined directional patterns; this is due to the fact that it is a semi-enclosed bay with a small tidal range, small surface area, and large sea boundary (Bord Iascaigh Mhara, 1990). Due to the sheltered conditions of the bay, water movement and circulation is dominated by wind conditions, whereby a wind from any direction can influence circulation patterns in the bay (Bord Iascaigh Mhara, 1990). Tidal currents range from 0.02-0.04 m/s and evidence of slack tidal conditions has been noted which are emphasised during neap conditions, with unidirectional distribution of tidal flow data observed[41]. Currents around T05-523A were < 0.025 m/s[41]. The estimated flushing time of the bay was six days over a spring tide and 12 days over a neap tide (Bord Iascaigh Mhara, 1990). Outer Coulagh Bay experiences a moderate wave climate[41], however conditions in the inner bay become more sheltered.

There are three river water bodies within Coulagh Bay contributing catchment; the Kealincha water body drains the largest proportion of the contributing catchment (*c.* 44.5%), followed by the Ardacluggin (*c.* 37.6%) and the Ballycrovane (*c.* 17.9%), all of which were of Good ecological status during the 2016-2021 WFD monitoring period[15]. These water bodies flow from moors and heathland dominated land cover to agricultural land as they approach the bay.

Wind direction data from 2019, 2020, and 2022 were more variable than in 2021 and 2023. The prevailing wind between 2019-2023 came from a south-southwest direction, and seasonal averages over the same period indicated winds are typically strongest in the winter months (11.4 kn), followed by autumn (9.55 kn), spring (9.1 kn), and summer (8.2 kn). Rainfall data suggests that the wettest months around Coulagh Bay are October to January and the driest months are May to August. It is expected that run-off due to rainfall will be higher during the October to January period, however heavy rainfall events can occur in most months of the year, and it is not just the winter months that are at risk of increased faecal contamination.

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 BMPAs and to fix the boundaries thereof. The process involves regular sampling of shellfish from each area to be classified 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[25]. There are no historical microbiological data for Coulagh Bay as it is a new shellfish production site, and the BMPA will be designated resulting from this report.

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.

9.1.2. Norovirus (NoV)

The licensed site within Coulagh Bay is a new site and has to date not been subjected to any norovirus sampling programme or baseline studies of norovirus levels. Therefore, no data on norovirus is available for Coulagh Bay.

9.2. Current Data

9.2.1. Sampling Sites and Methodology

Nine water samples were taken within Coulagh Bay. The locations of these sites can be seen in **Figure 9-1** and **Table 9-2** shows the station coordinates. All water samples were collected in sterile plastic water bottles. The water samples were delivered to the laboratory for analysis on the same day that they were collected and were stored in a cool box during transportation.

Table 9-2: Water sample results and coordinates from the Coulagh Bay bacteriological survey. Numbering cross-referenced to Figure 9-1. Latitude and longitude values are in CRS WGS84, easting and northing values are in CRS Irish Transverse Mercator[24].

Station ID	Observation	Freshwater (FW) or Seawater (SW)	*E. coli* MPN/ 100 ml	Latitude	Longitude	Easting	Northing
1	Residential property	SW	1106	51.7163	-9.95872	553363.8	464660.6
2	Salmon farm chemical storage tank	SW	259	51.71364	-9.94988	553051.4	465263.4
3	Kealincha River	FW	>2420	51.68778	-9.9725	550217.1	463623
4	Pipes	FW	2420	51.67584	-9.99828	548938.1	461804.7
5	Stream	FW	1203	51.67285	-10.0116	548630.4	460876.9
6	River	FW	980	51.67167	-10.0173	548510.2	460473.5
7	Potential runoff	SW from vessel	<10	51.67322	-10.0447	058624	048693
8	Potential runoff	SW from vessel	<10	51.67067	-10.0519	058118	048424
9	Potential runoff	SW from vessel	<10	51.66978	-10.0564	057804	048333

Figure 9-1: Location and magnitude of *E. coli* (MPN/100 ml) results from the water samples taken during the shoreline survey (numbering cross-referenced to Table 9-2).

9.2.2. Bacteriological Analysis Results

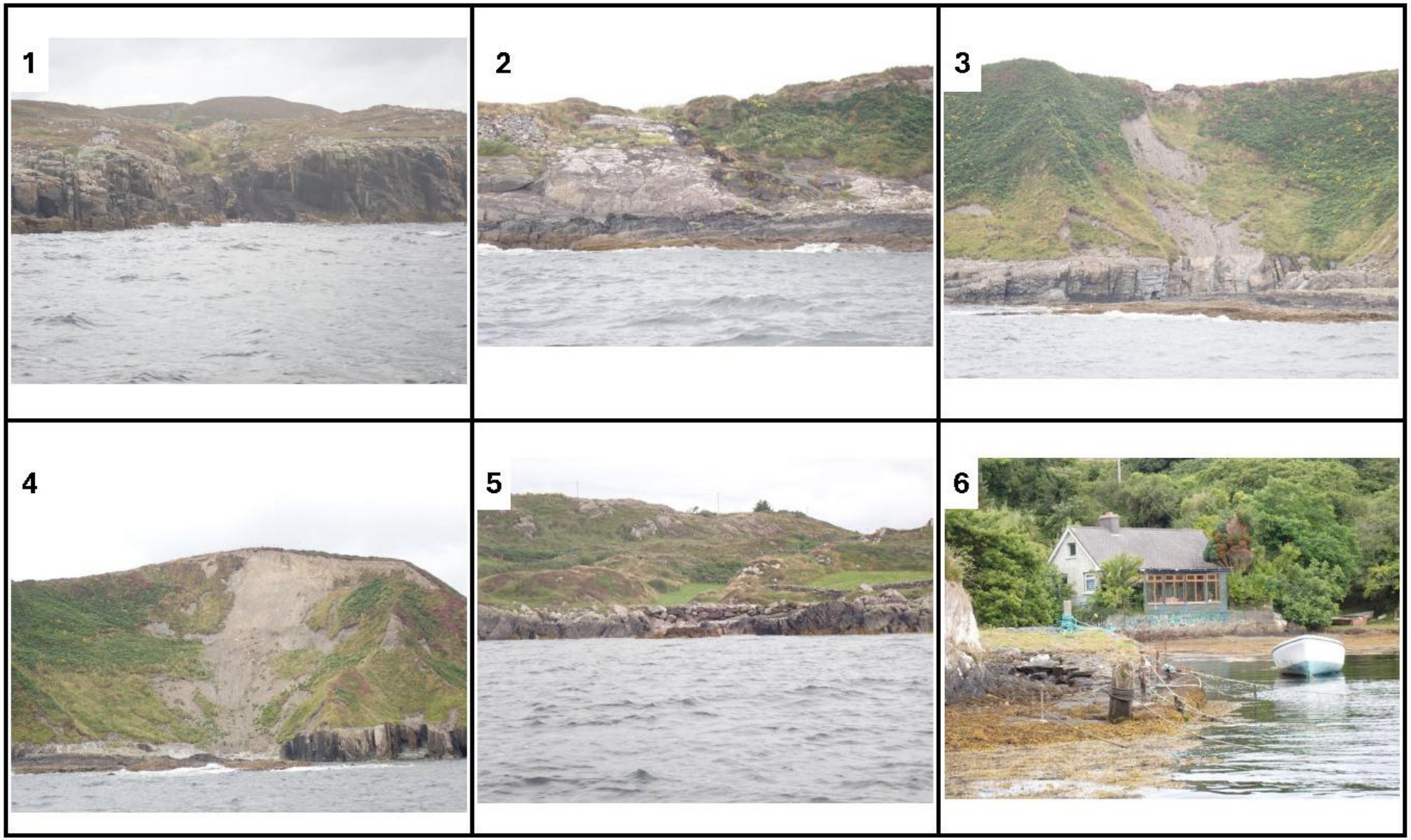
The water sample results listed in **Table 9-2** and **Figure 9-1** show the magnitude of *E. coli* in the water samples, measured as the most probable number per 100 ml (MPN/100 ml). Stations 1-6 were sampled during the first shoreline survey and stations 7-9 were sampled during the second shoreline survey. Stations 7-9 were associated with potential runoffs from land; however, seawater was sampled from a vessel near these runoff points and as such may not accurately reflect *E. coli* levels from these sources due to the dilution factor. Water samples for stations 1, 2, and 7-9 were taken from seawater, while water samples for stations 3-6 were collected from freshwater sources.

Station 1 was located at a residential property on the shore of Coulagh Bay (map ID 8; **Figure 7-18**). Station 2 was acquired from seawater located off a pier/slipway adjacent to a chemical storage tank associated with a salmon finfish farm (map ID 19; **Figure 7-18**). Stations 3, 5, and 6 were located on a large river, a moderate stream, and a medium river, respectively (map IDs 28, 58, and 63, respectively; **Figure 7-18**). Station 3 was situated within the Kealincha river sub-basin. Station 5 was situated within the Ardacluggin river sub-basin and was noted as running through pasture and grazing fields. Station 6 was also situated within the Ardacluggin river sub-basin. Station 4 was taken from the Travara River (colloquial name) located along the Ardacluggin river sub-basin adjacent to two pipes discharging into a river (map ID 46; **Figure 7-18**). Stations 7, 8, and 9 are associated with map IDs 71, 72, and 73 (**Figure 7-18**). It is of note, that the sources of Stations 7-9 overlapped agricultural and pastural lands, indicating that sampling at source may have reflected higher levels of *E. coli* than what was recorded at sea.

9.2.3. Shellfish Flesh Quality Sampling

Currently there is no shellfish flesh sampling in Coulagh Bay as site T05-523A is new. Once production becomes established at this site, the SFPA will conduct regular shellfish flesh sampling as required.

10. Appendix 4: Shoreline Survey Images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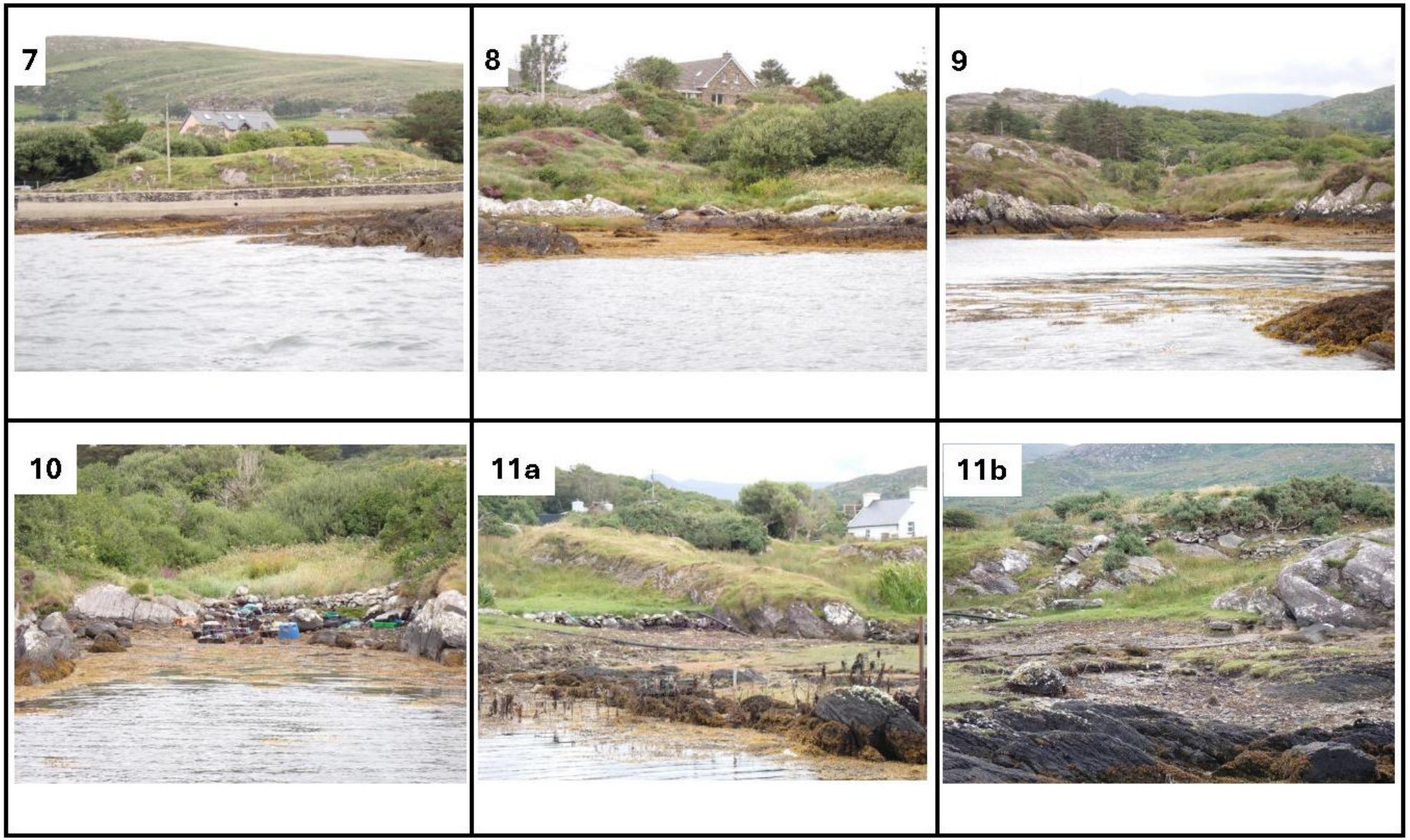
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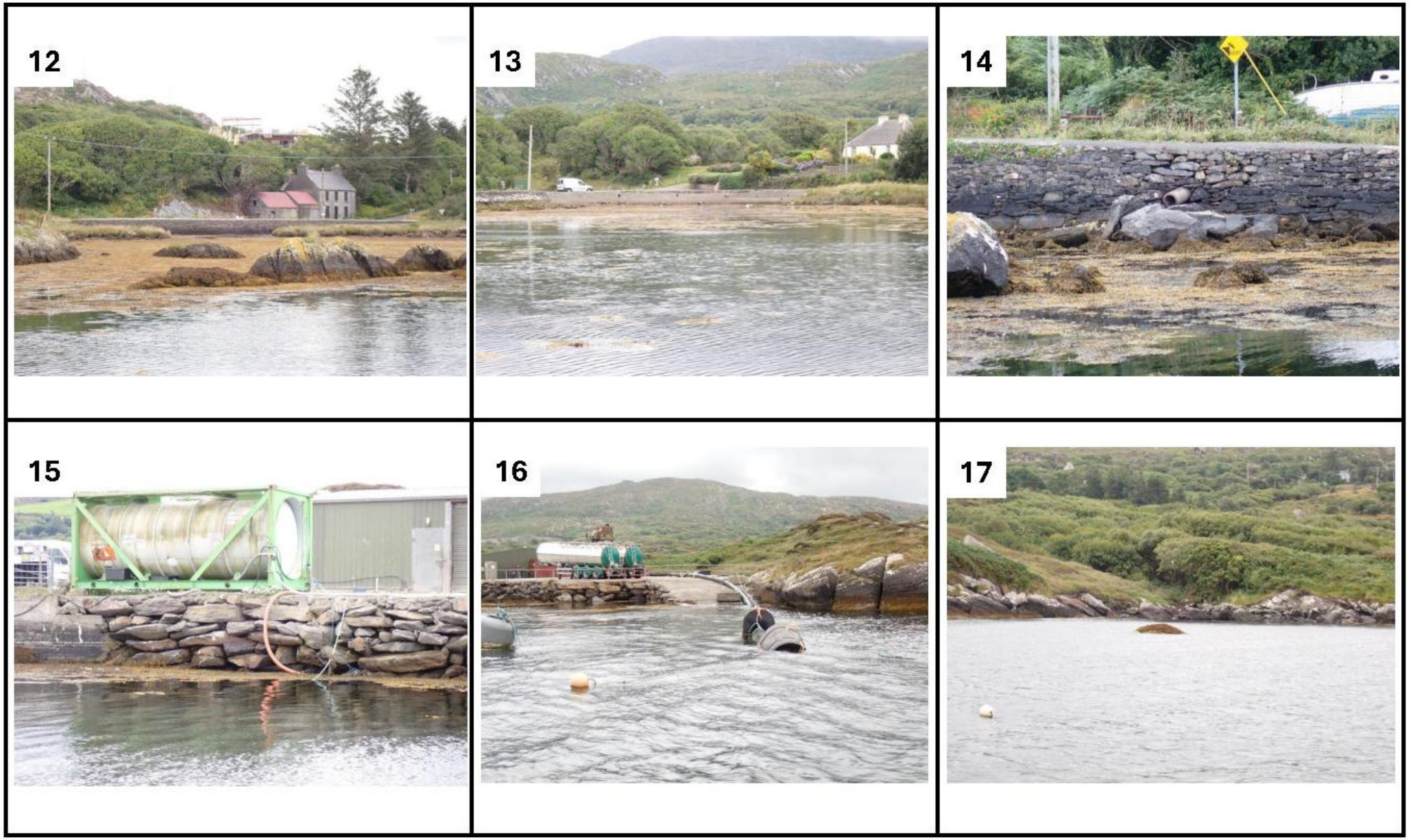
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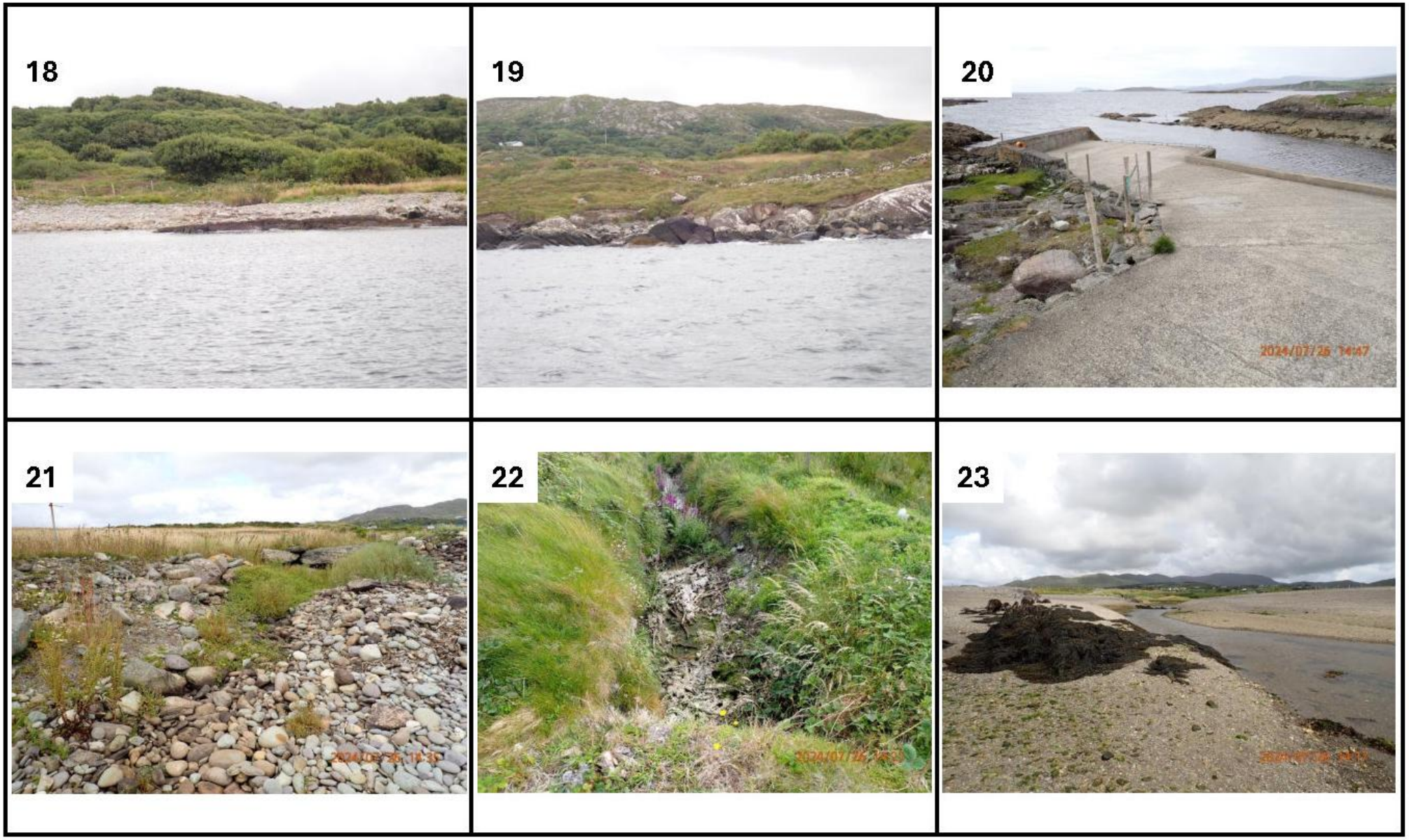
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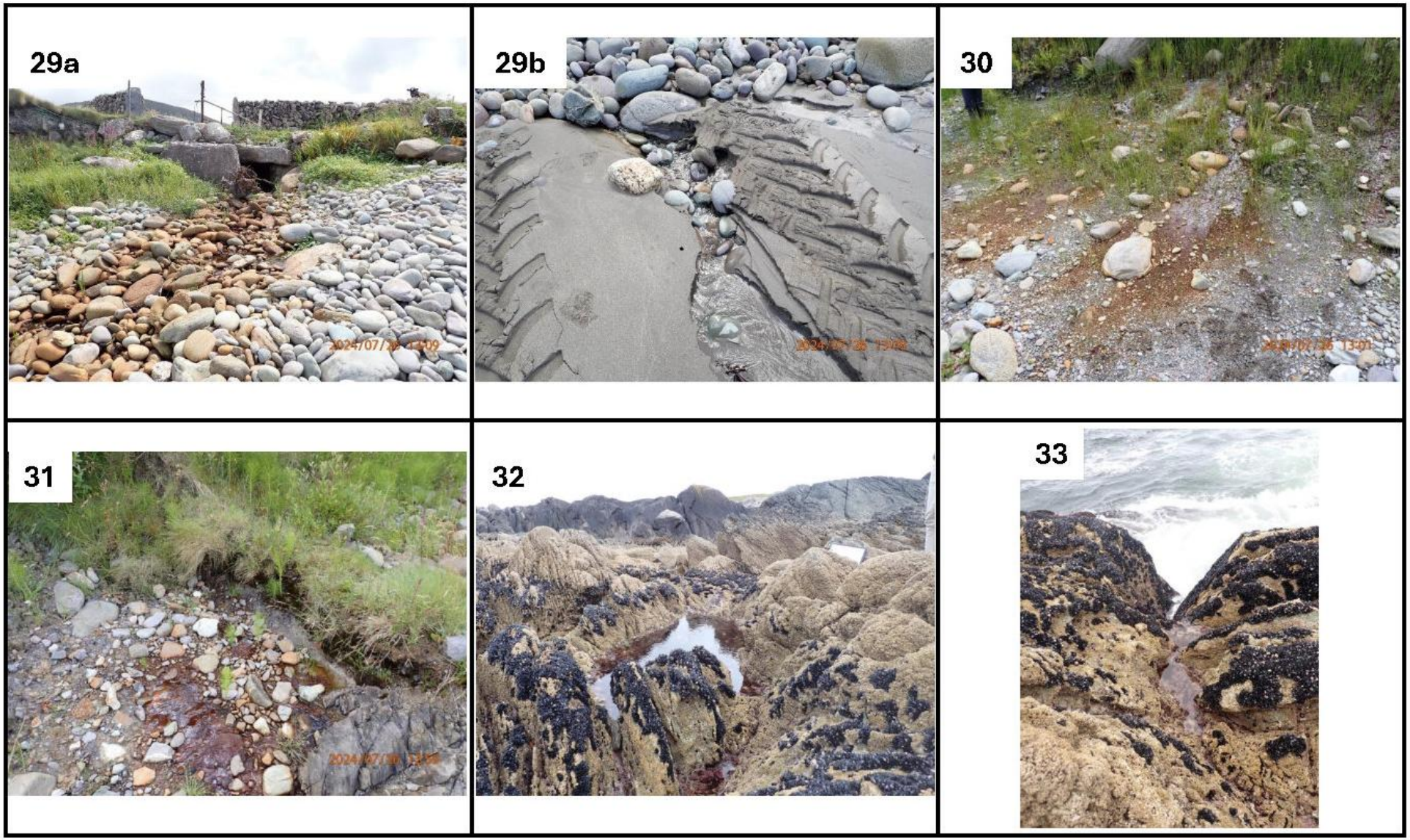
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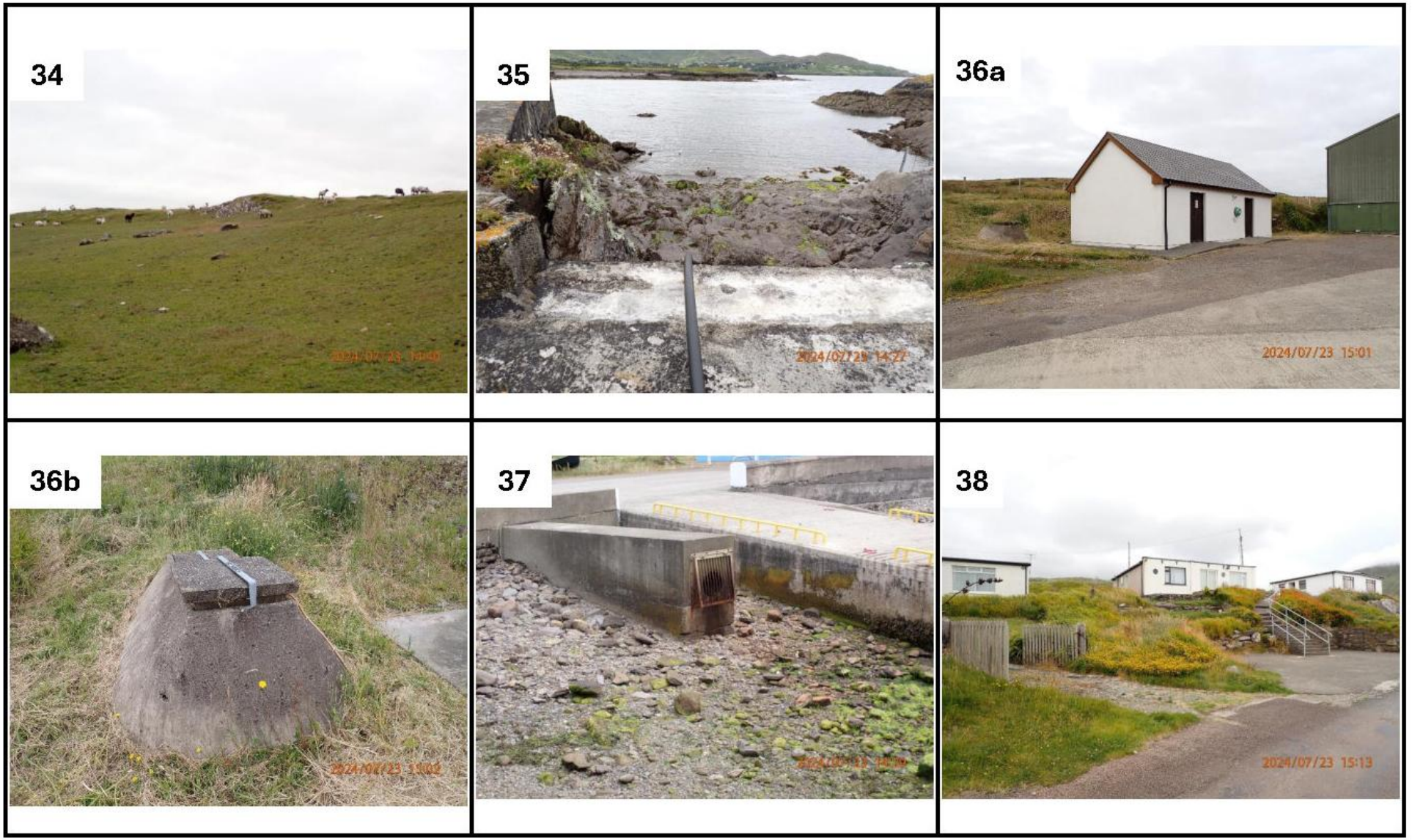
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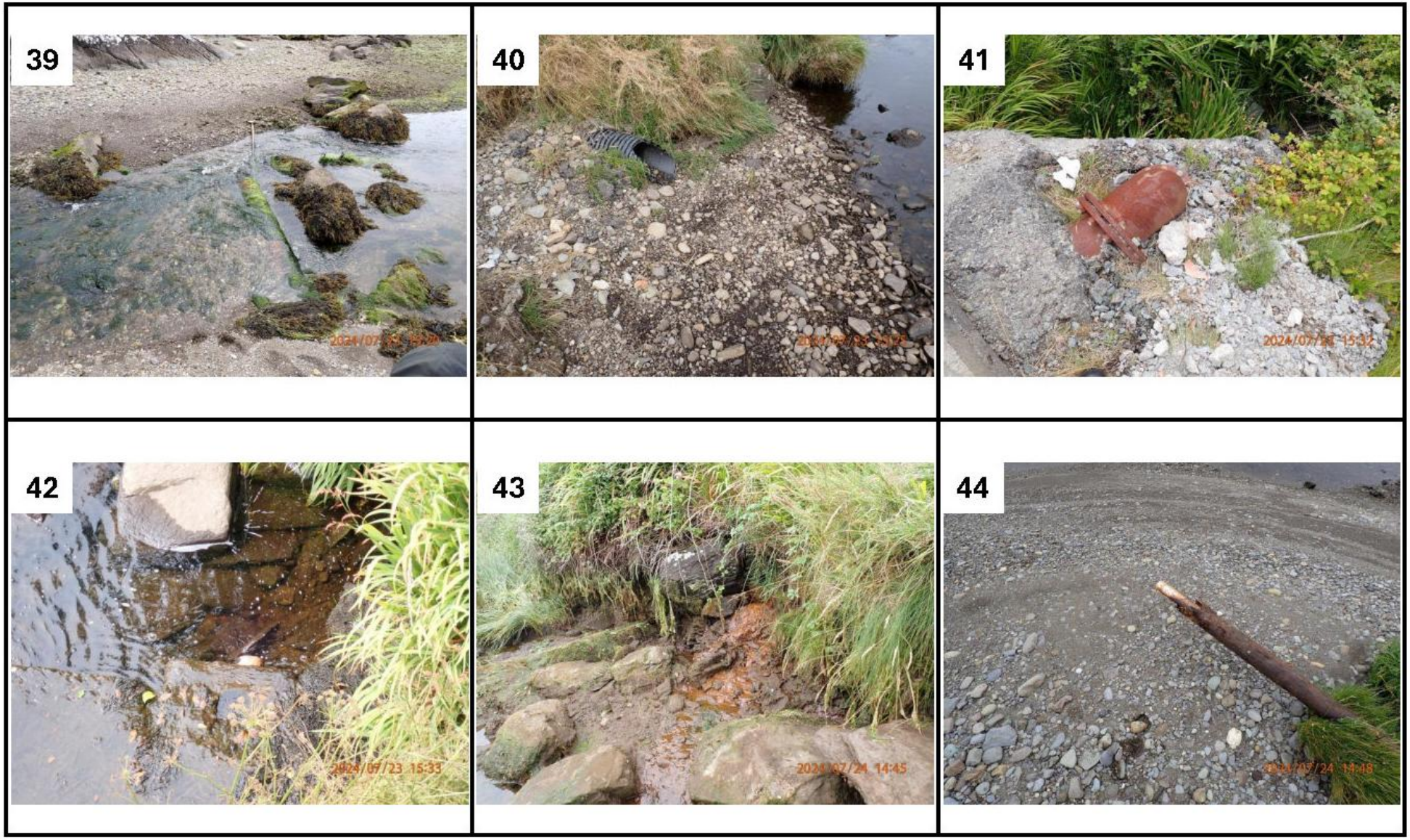
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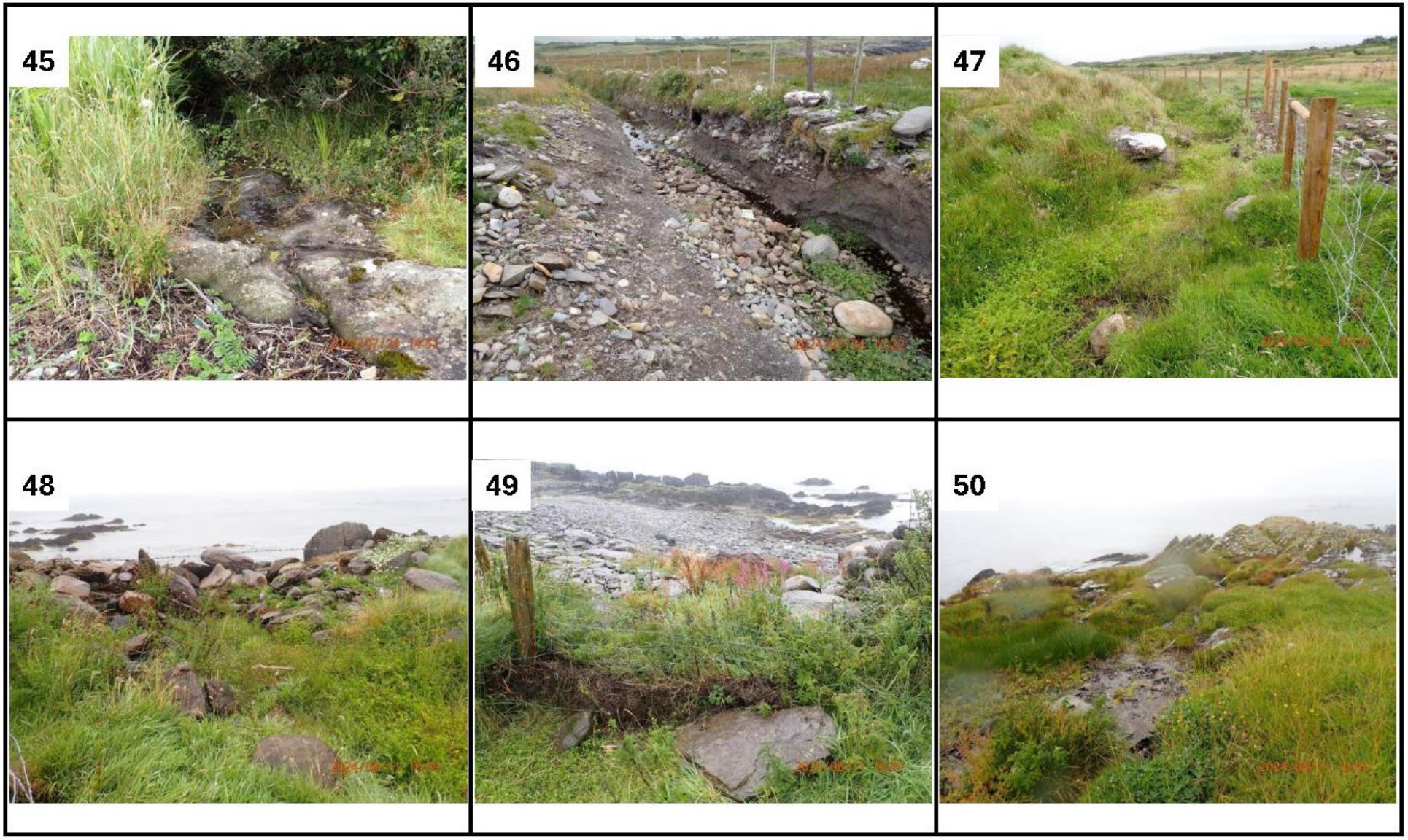
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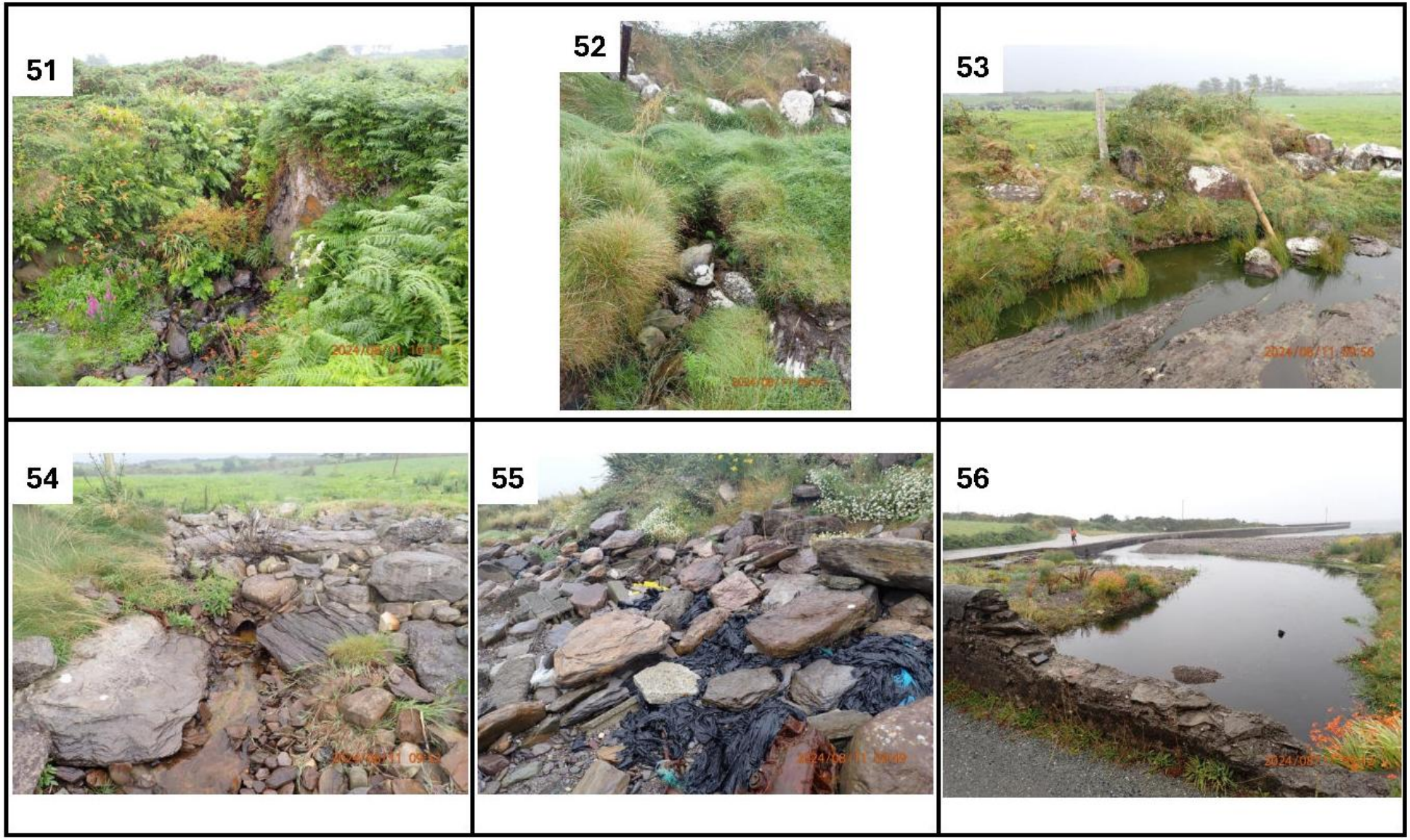
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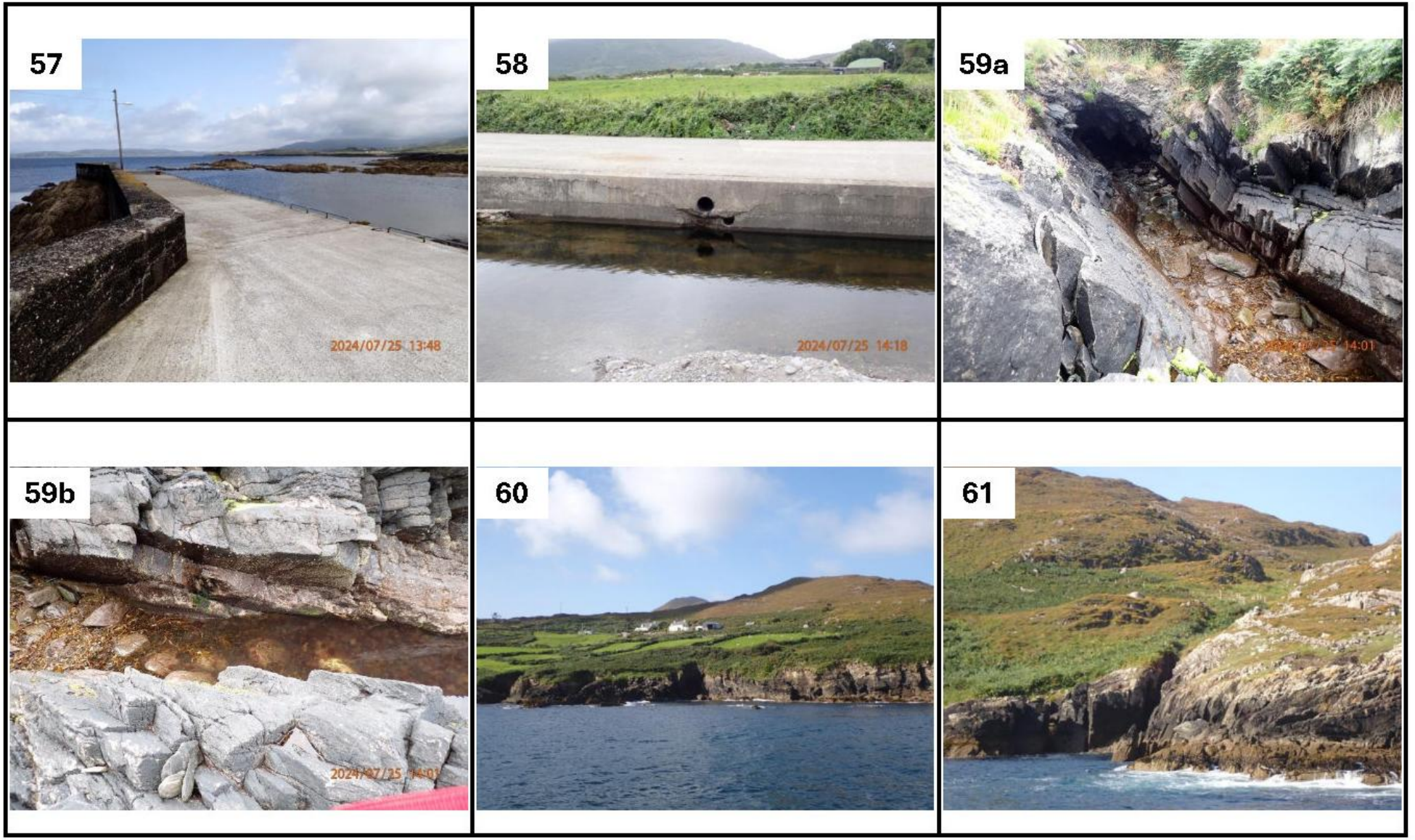
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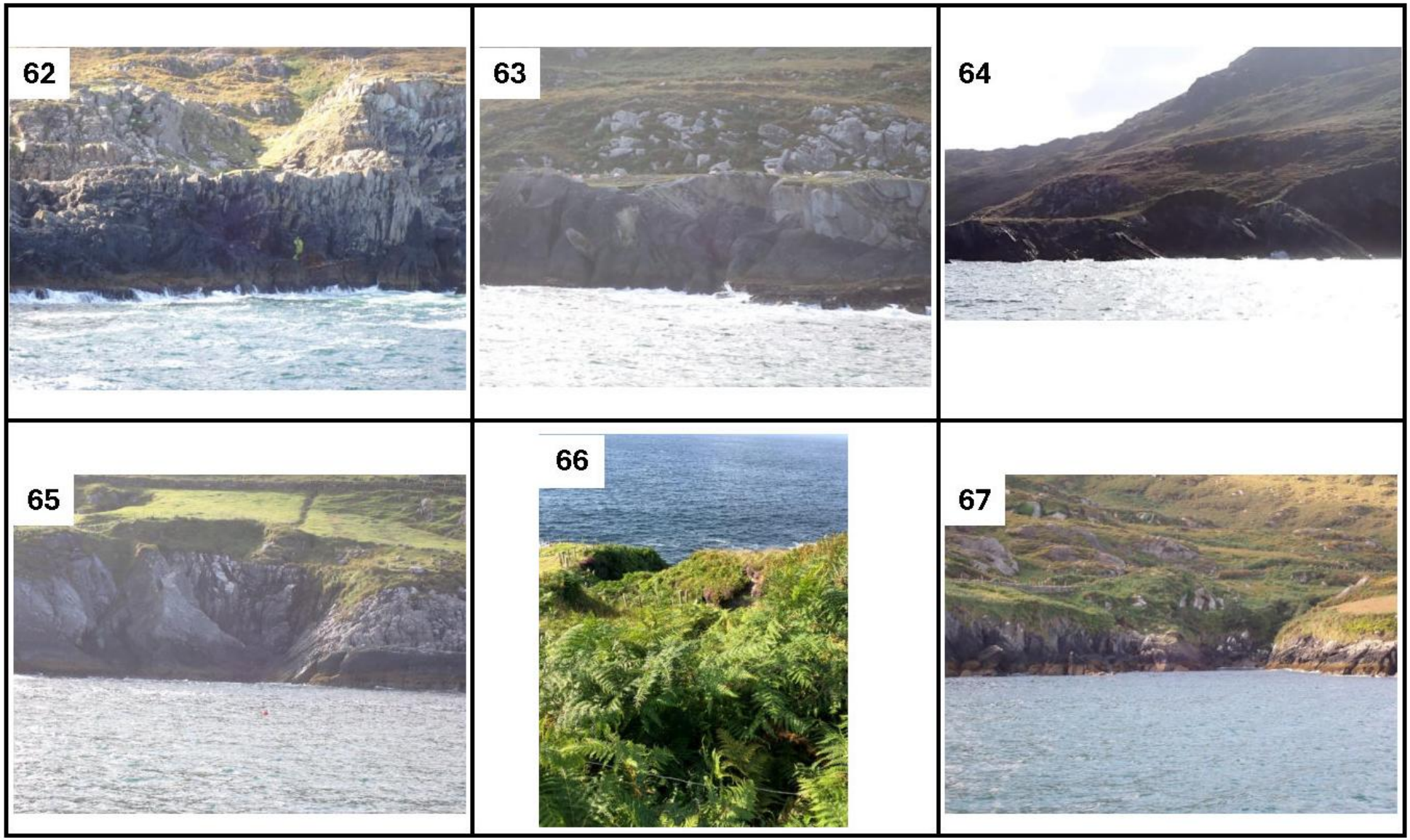
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11. Appendix 5: Blue Mussel Monitoring Information

Coulagh Bay Production Area

Site Name: Coulagh Bay

Site Identifier: KY-CB-CB

Monitoring Point Coordinates:

RMP 1 **Latitude:** 51.67541 **Longitude:** -10.01292

Species: *Mytilus edulis*

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

Sample Frequency: Monthly

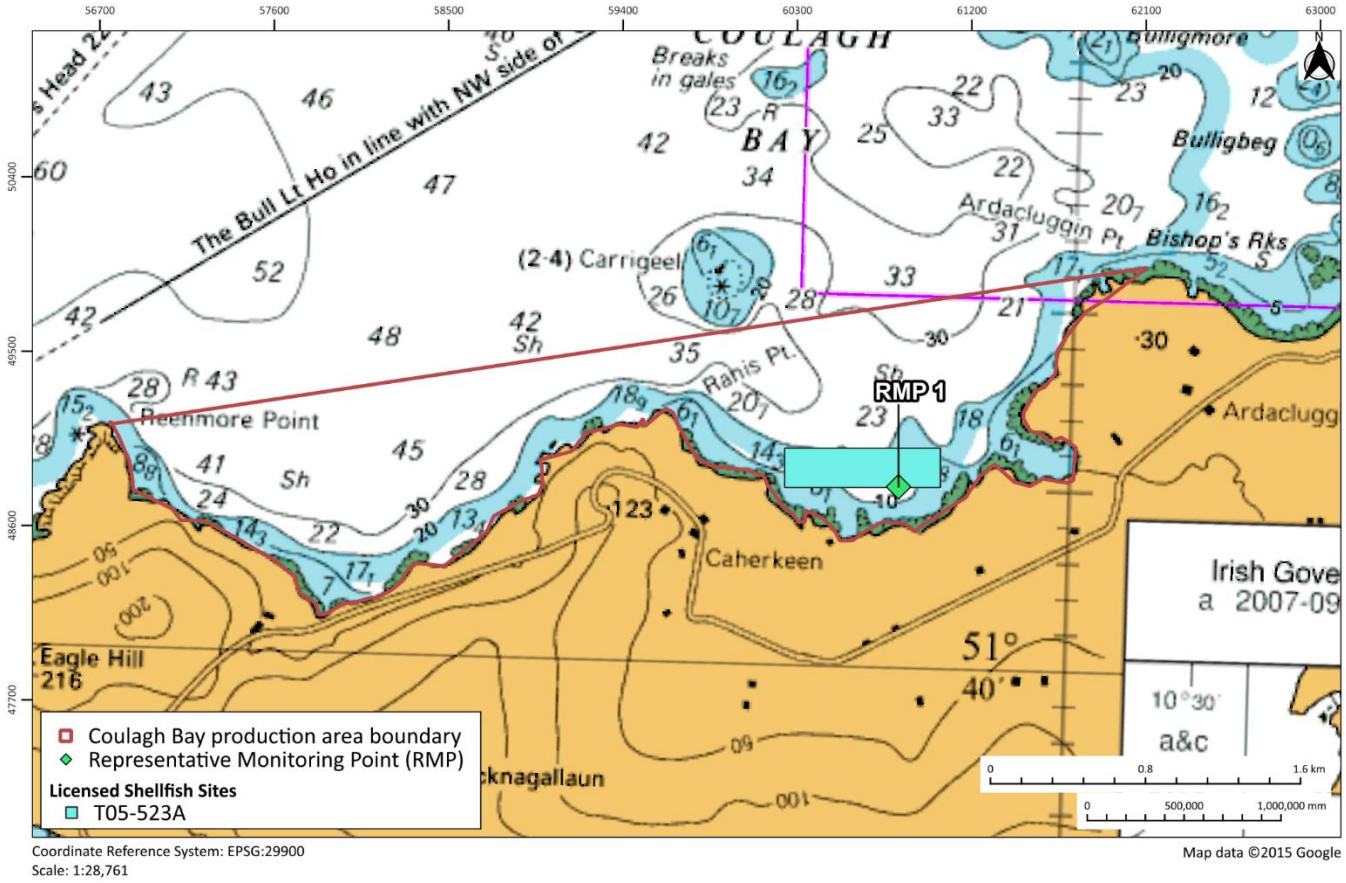
Responsible Authority: Sea Fisheries Protection Authority

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 Census of Population 2016 – Profile 2 Population Distribution and Movements on the CSO: https://www.cso.ie/en/

[2] See 'Housing Stock and Vacancy Rate': https://data.cso.ie/

[3] See wastewater treatment capacity register for Cork provided by Uisce Éireann: https://www.water.ie/connections/developer-services/capacity-registers/wastewater-treatment-capacity-register/cork

[4] See type of sewerage for permanent private households 2022: https://data.cso.ie/

[5] See CORINE Land Cover, a standardised land cover, biotope, and air quality dataset for Europe initially produced in the 1990s; 2018 are the most recent data: https://gis.epa.ie/GetData/Download

[6] Teagasc National Farm Survey 2022: https://www.teagasc.ie/publications/2023/teagasc-national-farm-survey-2022.php

[7] Food Standards Agency: Critical review of the current evidence for the potential use of indicator shellfish species to classify UK shellfish production areas and CEFAS: https://www.food.gov.uk/sites/default/files/media/document/865-1-1607_FS512006_VMcFarlane_0.pdf

[8] Microbiological Monitoring of Bivalve Mollusc Harvesting Areas – Guide to Good Practice: Technical Application: European Reference Laboratory for Monitoring of Marine Biotoxins (aesan.gob.es)

[9] European Commission 2017: Microbiological monitoring of bivalve mollusc harvesting areas: review of current practices (europa.eu)

[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] See Macroalgal canopy cover (Essential Ocean Variable) in Europe – polygons (2023): https://emodnet.ec.europa.eu/geoviewer/

[12] Catchments.ie - Water, from source to sea.

[13] Ireland's Marine Atlas: https://www.marine.ie/site-area/data-services/interactive-maps/irelands-marine-atlas

[14] See licence details for T05-523A in Co. Galway at: https://www.gov.ie/en/collection/ae2ab-shellfish-licences/

[15] See EPA Geoportal at https://gis.epa.ie/GetData/Download

[16] See statistics tab on CSO website for census of population 2016 &2022; see census interactive map for small area population statistics and agricultural data https://www.cso.ie/en/

[17] 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 cows, and non-dairy/other cows.

[18] See Eurofins explanation of MPN vs. CFU

[19] National Biodiversity Data Centre: https://maps.biodiversityireland.ie/Species

[20] See Irish Resident Travel by County 2022 at https://www.failteireland.ie/Research-and-Insights.aspx

[21] See 'Fáilte Ireland Tourism Facts 2022': https://www.failteireland.ie/Research-Insights/Current-Tourism-Performance.aspx

[22] See 'Publications' tab on gov.ie website for Fifth Nitrates Action Programme Overview document: gov - Fifth Nitrates Action Programme 2022-2025 (www.gov.ie)

[23] https://www.irishstatutebook.ie/eli/2022/si

[24] Tailte Éireann co-ordinate converter GridInQuestII: Ordnance Survey Ireland :: Geodetic services :: Co-ordinate converter (osi.ie)

[25] See publications tab for SFPA code of practice: https://www.sfpa.ie/

[26]Distance related to the shortest linear distance, *i.e.,* 'as the crow flies'.

[27] https://data.gov.ie/dataset/electoral-division/resource/607cf6d7-789a-4eea-ac14-6849498827ce

[28] Household Travel Survey Quarter 4 and Year 2023: https://www.cso.ie/en/releasesandpublications/ep/p-hts/householdtravelsurveyquarter4andyear2023/

[29] See Irish Resident Travel by County 2022 at https://www.failteireland.ie/Research-and-Insights.aspx

[30] See 'Key Tourism Facts 2019': https://www.failteireland.ie/Research-Insights/Current-Tourism-Performance.aspx

[31] Welcome to Eyeries; a colourful gem on the Wild Atlantic Way: https://eyeries.ie/

[32] Failte Ireland tourism activities and attractions: https://data.gov.ie/dataset/tourism-activities-and-attractions

[33] See Things to do at Eyeries County Cork, Ireland at https://www.discoverireland.ie/whats-nearby

[34] See Application Form within View Applicant documents and Final Determination within View EPA documents: https://leap.epa.ie/licence-profile/A0395

[35] https://epawebapp.epa.ie/licences/lic_eDMS/090151b2803ca7fb.pdf

[36] See WFD Section 4 discharges at https://gis.epa.ie/GetData/Download

[37] See the WFD Pressure dashboard for 21_16 Ownagappul_SC_010 and Fanahy_SC_010 water bodies: https://www.catchments.ie/wfd-data-dashboards/

[38] See Groundwater Vulnerability at https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef

[39] See 'Final Act of the International Conference on Marine Pollution, 1973 (MARPOL, 1973) and Convention: https://www.imo.org/en/KnowledgeCentre/ConferencesMeetings/Pages/Marpol.aspx

[40] National Biodiversity Data Centre: https://maps.biodiversityireland.ie/Species

[41] See EIA Volumes 1, 2, and 3 for more details: https://www.gov.ie/en/aquaculture-licence/b361b-t05-233-comhlucht-iascaireachta-fanad-teoranta-aquacultureforeshore-licence-application-off-inishfarnard-island-co-cork/?referrer=https://www.gov.ie/en/publication/775a8-t05-233-comhlucht-iascaireachta-fanad-teoranta-aquacultureforeshore-licence-application-off-inishfarnard-island-co-cork/

[42] See climate tab for current and historical data: https://www.met.ie/

[43] Estimated naturalised river flows: https://gis.epa.ie/geonetwork/srv/api/records/bac8d094-70fa-4c70-98d7-b3e0d91fef9f

[44]EPA water level and flow data on HydroNet: https://www.epa.ie/our-services/monitoring--assessment/freshwater--marine/rivers/water-level-and-flow-data/

[45] Rainfall Return Period: https://www.met.ie/climate/services/rainfall-return-periods

[46] See KN165 and KN170 in Outer Kenmare Bay:
https://www.geohive.ie/maps/35f833f89f68431c9a64ecddfdd07c70/explore

[47] Turbidity and water: https://www.usgs.gov/special-topics/water-science-school/science/turbidity-and-water