Sanitary Survey Report
and
Sampling Plan
for Ballylongford Bay

Produced by

AQUAFACT International Services Ltd

In conjunction with

The Sea Fisheries Protection Authority

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Glossary

AFBI	Agri-Food and Biosciences Institute
ANOVA	Analysis Of Variance
APP	Average Physical Product
ASP	Amnesic Shellfish Poisoning
Bathymetry	The measurement of water depth at various places of a water body
Benthic	Of, pertaining to, or occurring at the bottom of a body of water
Biogenic	Produced by living organisms or biological processes
Bioturbation	The stirring or mixing of sediment or soil by organisms
BOD	Biochemical Oxygen Demand
BTO	British Trust for Ornithology
CD	Chart Datum
CEFAS	Centre for Environmental, Fisheries & Aquaculture Science
Corine landuse	is a Pan-European landuse and landcover mapping programme. It supplies spatial data on the state of the European environmental landscape and how it is changing over time. Based on the interpretation of satellite imagery, Corine landuse provides national scale maps of landcover and landcover change on a six year basis for thirty nine countries in Europe.
CSO	Central Statistics Office
CSO	Combined Sewer Overflow
DARD	Department of Agriculture and Rural Development
DED	District Electoral Divisions
Depuration	The process of purification or removal of impurities
Detrital/Detritus	Non-living, particulate, organic fragments which have been separated from the body to which they belonged
DSP	Diarrhetic Shellfish Poisoning
DWF	Dry Weather Flow
EC	European Communities
E. coli	*Escherichia coli*
EMS	Environmental Monitoring Stations
Epifauna	Animals living on the surface of marine or freshwater sediments
Epiflora	Plants living on the surface of marine or freshwater sediments
Fecundity	A measure of fertility or the capability to produce offspring
Fetch	The distance a wave can travel towards land without being blocked

FSA in NI Food Standards Agency of Northern Ireland

Gamete A reproductive cell that fuses with another gamete to produce a zygote, which develops into a new individual

Gametogenesis The formation or production of gametes or reproductive cells

Genotype The genetic makeup of an organism

Geometric Mean The nth root of the product of n numbers (The average of the logarithmic values of a data set, converted back to a base 10 number).

GIS Geographical Information Systems

GPS Global Positioning System

GSM Global System for Mobile Communication

Heterozygosity Having two different alleles of the same gene

Hydrodynamic Forces in or motions of liquids

Hydrography The description and analysis of the physical conditions, boundaries, flows and related characteristics of water bodies

IID Infectious Intestinal Disease

INAB Irish National Accreditation Board

Interspecific Competition Competition for resources between different species

Intraspecific competition Competition for resources between members of the same species

Intervalvular Between valves

I-WeBS Irish Wetland Bird Survey

LAT Lowest Astronomical Tide

Marpol 73/78 International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. Marpol is short for Marine Pollution, 73 for 1973 and 78 for 1978.

Metamorphosis The transformation from the larval to the adult form that occurs in the life cycle of many invertebrates and amphibians

MPN Most Probable Number

MSD Marine Sanitation Device

Multilocus Occurring at more than one position or locus on a chromosome

NAP Nitrates Action Programme

ND Not Detectable

NH_4 Ammonium

NIEA Northern Ireland Environment Agency

NISRA Northern Ireland Statistics and Research Agency

NITB Northern Ireland Tourist Board

Nitrification	The conversion of ammonia to nitrate
NI Water	Northern Ireland Water
NO_2	Nitrite
NO_3	Nitrate
NoV	Norovirus
NRFA	National River Flow Archive
NRL	National Reference Laboratory
OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
P	Phosphorus
PAH	Polycyclic Aromatic Hydrocarbons
Pathogenic	Capable of causing disease
PCB	Polychlorionated Biphenyls
PCP	Pentachlorophenol
p.e.	Population Equivalent
Plankton/Planktonic	Pertaining to small, free-floating organisms of aquatic systems
Pseudofaeces	Material rejected by suspension or deposit feeders as potential food before entering the gut
PSP	Paralytic Shellfish Poisoning
PSU	Practical Salinity Units
RAMSAR	A term adopted following an international conference, held in 1971 in Ramsar in Iran, to identify wetland sites of international importance, especially as waterfowl habitat.
Regulation (EU) 2017/625	of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products
RIB	Rigid Inflatable Boat
RMP	Representative Monitoring Point
RNA	Ribonucleic Acid
SAC	Special Area of Conservation
SFPA	Sea Fisheries Protection Authority
SMILE	Sustainable Mariculture in northern Irish Lough Ecosystems
SOA	Super Output Areas or ward
SPA	Special Protection Area
SPM	Suspended particulate Matter

SPS	Sewage Pumping Station
SS	Suspended Solids
STW	Sewage Treatment Works
Suspension feeders	Animals that feed on small particles suspended in water
TBTO	Tributyl Tin Oxide
Telemetry	The measurement and transmission of data from remote sources to receiving stations for recording and analysis
TPP	Total Physical Product
UKAS	United Kingdom Accreditation Service
UKHO	United Kingdom Hydrographic Office
Vector	A carrier, which transmits a disease from one party to another
WeBS	Wetland Bird Survey
WTP	Water Treatment Plant
WWTW	Waste Water Treatment Works

1. Introduction

Consumption of raw or lightly cooked bivalve molluscs can results in illness due to the presence of micro-organisms, many of which are derived from faecal contamination of the marine environment. Shellfish contaminated with pathogenic microorganisms may cause infectious disease in humans and such outbreaks are more likely to occur close to our coasts where production areas are impacted by sources of human and animal faecal contamination.

The risk of contamination of bivalve molluscs with pathogen microorganisms is assessed through microbiological monitoring programmes. This assessment results in the classification of bivalve mollusc production areas, which in turn governs the level of treatment required before human consumption of the shellfish.

Under EU regulations sanitary surveys of bivalve mollusc production areas and their associated hydrological catchments and coastal waters are required in order to establish the appropriate representative monitoring points 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 219 states:

1. Before classifying a production or relaying area, the competent authorities shall carry out a sanitary survey that includes:

- an inventory of the sources of pollution of human or animal origin likely to be a source of contamination for the production area;
- 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, waste-water treatment, *etc*.;
- 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 1 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.

Currently the Sea Fisheries Protection Authority in conjunction with AQUAFACT International services Ltd are conducting sanitary surveys for new bivalve mollusc production areas and for those existing classified production areas which were previously not surveyed.

This report contains the documents relevant to the sanitary survey of the bivalve mollusc production area at Ballylongford Bay, County Kerry. It identifies the representative monitoring points and supporting sampling plans for pacific oysters in Ballylongford Bay. It also sets out the production area boundaries in the Bay.

2. Overview of the Fishery/Production Area

2.1. Description of the Area

Ballylongford Bay BMCPA is located in the Shannon esturary on the west coast of Ireland. Ballylongford Bay is a 6.9km^2 small shallow bay. The substrate in the outer part of which is mainly composed of stones and mud, while inside of Carrig Island Point mud flats are exposed at low tide. The inner part of the bay is completely intertidal except for two small channels, one from the Ballydine River and the other from behind Carrig Island. Large parts of the outer bay are also intertidal. The subtidal areas range from 0.2 to 6.5m in depth. The area is approximately 7.2km E-W at its widest point and approximately 2.4km N-S. The catchment area of the BMCPA is 95.85km^2. The catchment is mainly drained by the Ballydine River and the Asdee River, along with a series of small streams.

Ballylongford Bay is part of part of the River Shannon and River Fergus SPA (Site Code: IE004077) and is also part of the Lower Shannon SAC (Site Code: IE002165) (Figure 2.1). These site are designated for the presence of a number of important habitats and species (NPWS, 2013).

Lower Shannon SAC is a very large site which stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. The site is designated for a range of species and habitats including: Sandbanks, Estuaries, Tidal Mudflats and Sandflats, Coastal Lagoons, Large Shallow Inlets and Bays, Reefs, Perennial Vegetation of Stony Banks, Vegetated Sea Cliffs, Salicornia Mud, Atlantic Salt Meadows, Mediterranean Salt Meadows, Floating River Vegetation, Molinia Meadows, Alluvial Forests, Freshwater Pearl Mussel (Margaritifera margaritifera), Sea Lamprey (Petromyzon marinus), Brook Lamprey (Lampetra planeri), River Lamprey (Lampetra fluviatilis), Atlantic Salmon (Salmo salar), Bottle-nosed Dolphin (Tursiops truncatus) and Otter (Lutra lutra) (NPWS,2013)

River Shannon and River Fergus SPA is the most important coastal wetland site in the country and regularly supports in excess of 50,000 wintering waterfowl (57,133 - five year mean for the period 1995/96 to 1999/2000), a concentration easily of international importance. Species which occur in the site include: Light-bellied Brent Goose, Dunlin, Black-tailed Godwit, Redshank, Cormorant, Whooper Swan, Shelduck, Wigeon, Teal, Pintail, Shoveler, Scaup, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Bar-tailed Godwit, Curlew, Greenshank, Black-headed Gull, Mute Swan, Mallard, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Oystercatcher, Turnstone and Common Gull (NPWS, 2015).

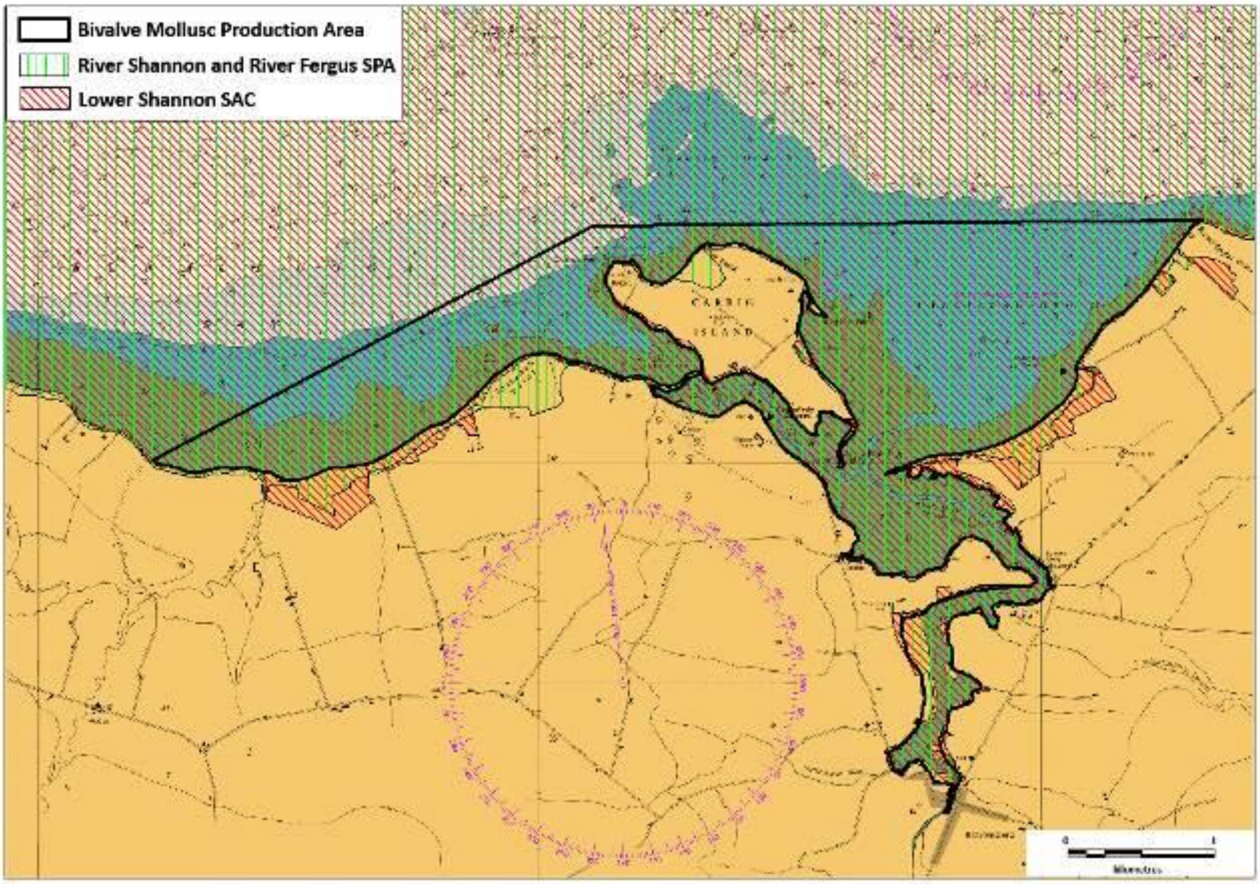


Figure 2.1: Location of Natura 2000 sites overlapping with the Ballylongford Bay BMCPA.

The Ballylongford Bay BMPA supports a diversity of fish species. Species present in the area include dogfish, bull huss, conger, flounder, codling, whiting and a possibility occasional thornback ray (IFI, 2020

Land cover within the Ballylongford Bay catchment is a mixture of pastures, peat bogs, coniferous forest and Land principally occupied by agriculture, with significant areas of natural vegetation

The population of the catchment is approximately 2,505. The main towns/urban centres within the catchment are Tarbert and Ballylongford.

2.2. Ballylongford Fishery

2.2.1. Location/Extent of Growing/Harvesting Area

The shellfish designated waters in Ballylongford Bay cover an area of approximately 8.7km^2 and the Bivalve Mollusc Classified Production Area (BMCPA) covers *c*. 6.9km^2. Both can be seen in Figure 2.2. Pacific oyster cultivation is predominant in Ballylongford Bay.

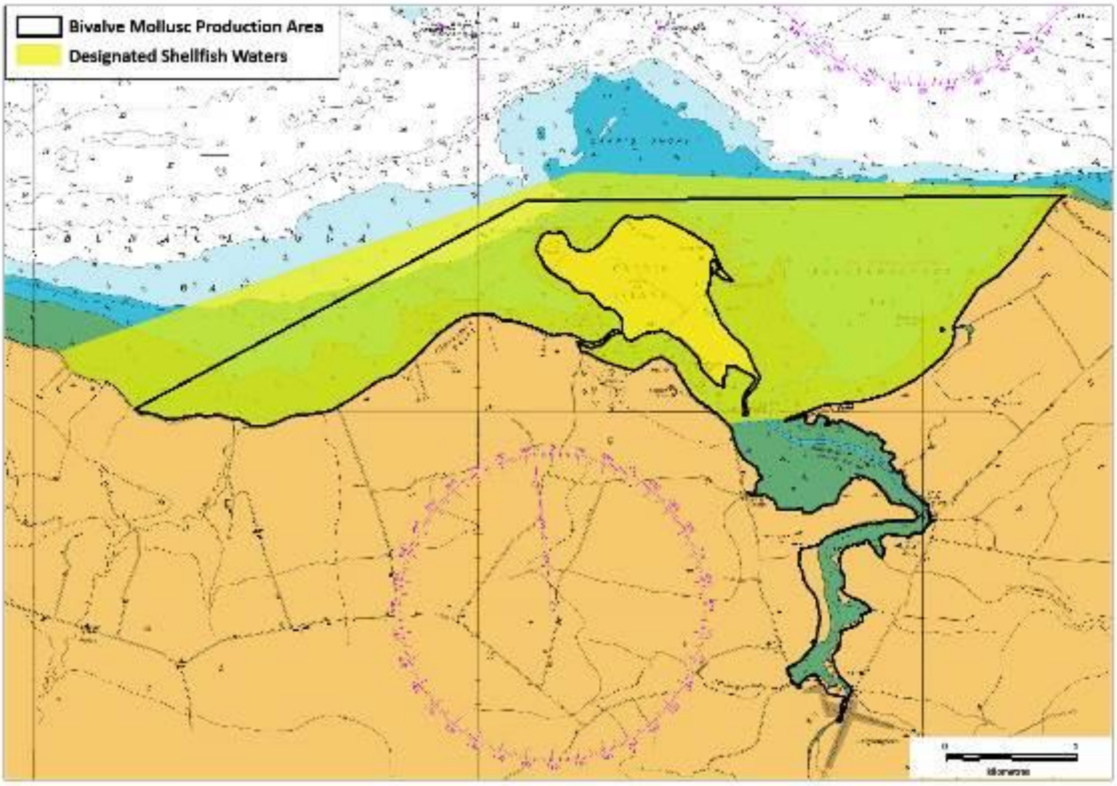


Figure 2.2: Bivalve Mollusc Classified Production Area and Designated Shellfish Waters within Ballylongford Bay.

Figure 2.3 shows the current locations of licenced aquaculture sites within Ballylongford Bay. There are four licenced areas for pacific oysters west of Carrig Island and one to the east. The total licensed area for pacific oysters is 1.15km^2).

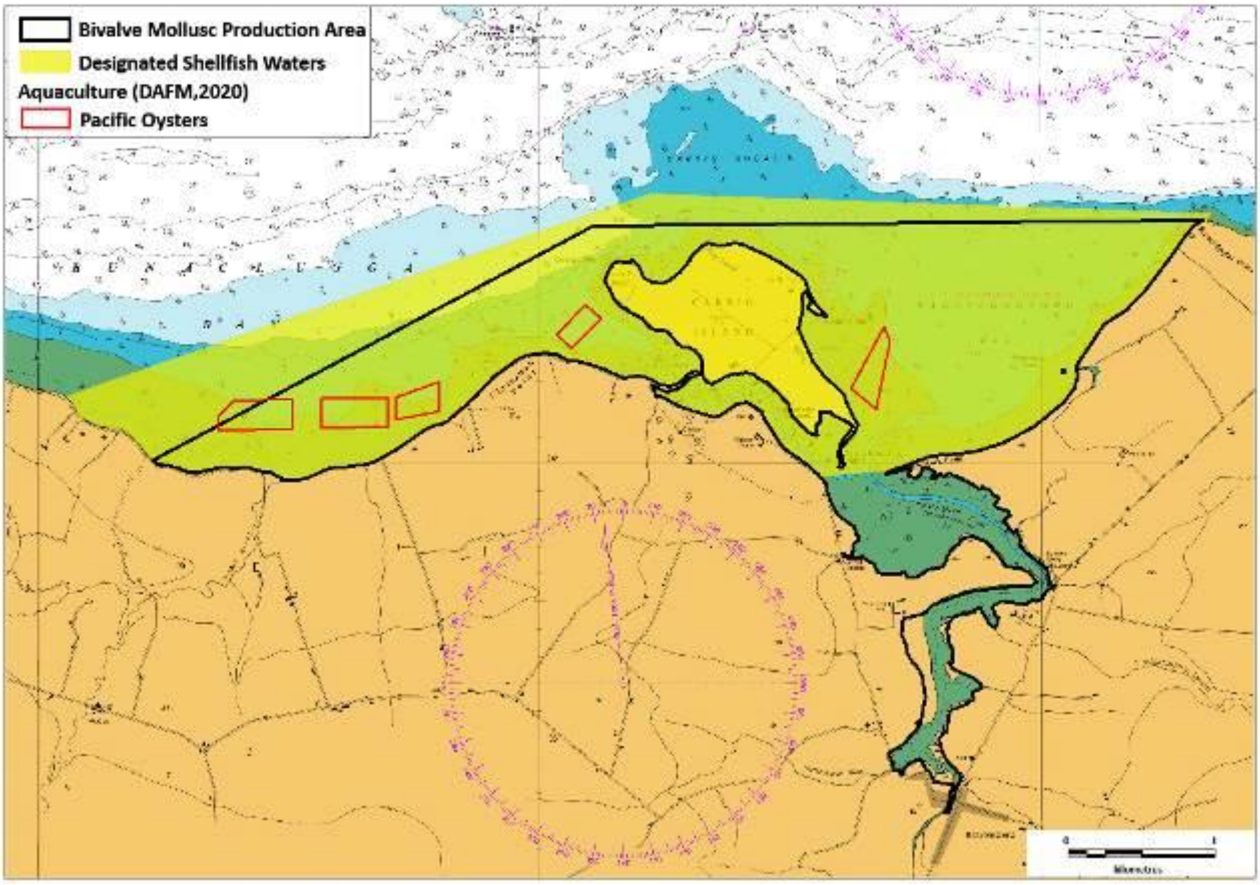


Figure 2.3: Licenced aquaculture sites within Ballylongford Bay (Source: DAFM, 2020).

2.2.2. Description of Species

2.2.2.1. Pacific Oysters (Crassostrea gigas)

Distribution

Figure 2.4 shows the locations of licenced intertidal farmed Pacific oyster sites in Ballylongford Bay. These farmed sites cover an area of 1.15km^2.

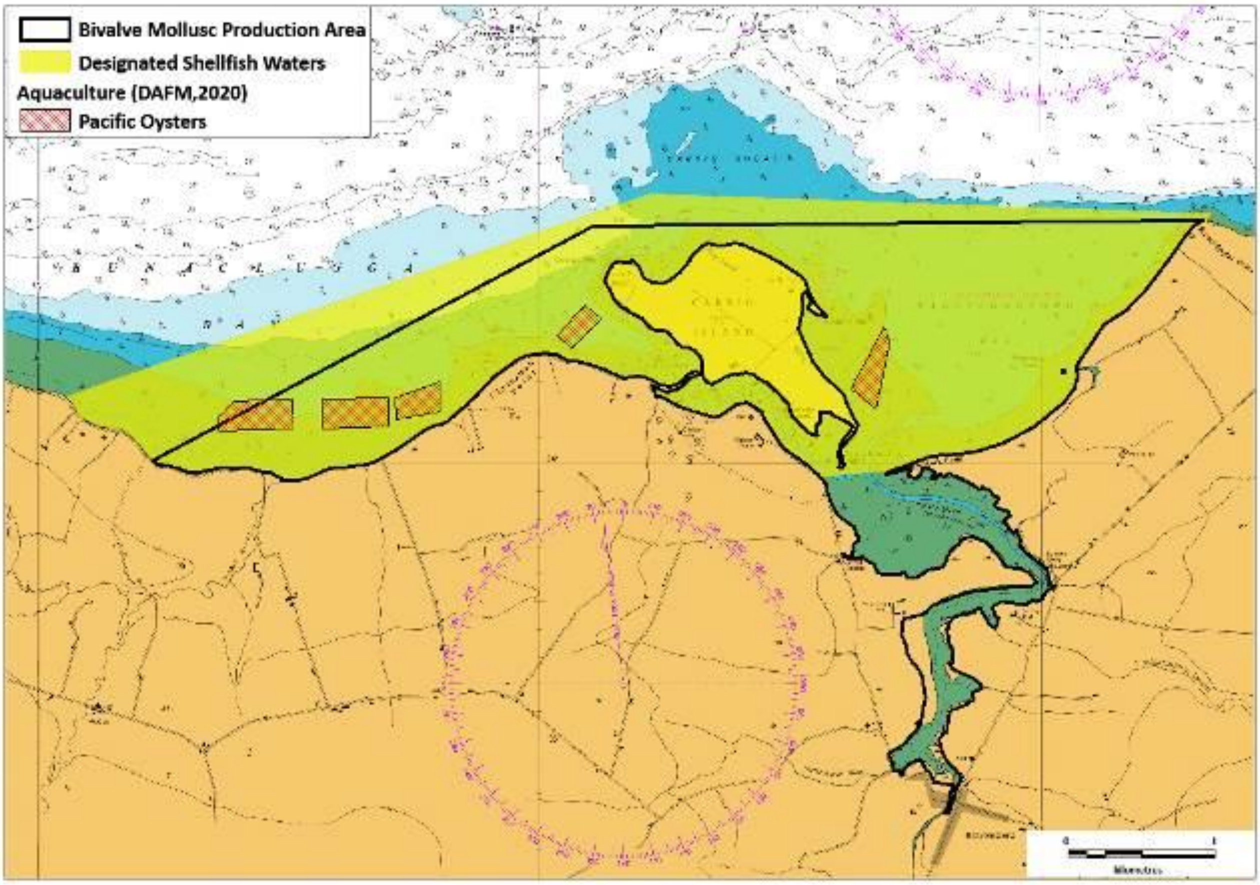


Figure 2.4: Licenced Pacific oyster harvesting sites in Ballylongford Bay (Source: DAFM, 2020).

Fishery

There are five separate areas licensed for pacific oyster growing in the Ballylongford production area. All of these blocks are licensed for the growing of the species using the bag and trestle method whereby oyster are imported as seed and reared to market size in mesh bags fixed upon iron trestle stands. Production in previous years was between five and fifteen tonnes.

Currently only one of the licensed areas is actively being used for the production of pacific oysters. This site, the second most westerly of all the sites, is to the west of Carraig Island upon the shore between Littor and Asdee.

3. Overall Assessment of the Effect of Contamination on Shellfish

3.1. Human sewage/Human population

Ballylongford Bay catchment has a population of 2,505. The population is distributed relatively evenly across the catchment with the highest population occurring in the east. There are only two urbans centres, the largest of which is Tarbert with a population of 540 and Ballylongford with a population of only 391. The population of the Ballylongford catchment is slightly below the average density for rural Ireland with 26.1 people per km2 as opposed to 27 people per km² nationally in rural areas (CSO, 2016).

The 2016 census recorded 1,321 households in the catchment of which 20% are vacant and 3% are holiday homes. The sewage from approximately two thirds of these households is treated by means of septic tanks or other private treatment methods. Although there is a high percentage of households on private treatment systems, it is not considered a major concern due to the low population density and dispersed nature of households in the catchment.

The Ballylongford WWTP is Tertiary N removal facility with a design capacity of 1,000 PE and is operating below capacity with a loading of 738 PE. As the treatment facility is operating well below its designed capacity, the effluent is expected to have a relatively low bacteriological load. However, there are also three storm water overflows associated with the plant. The shoreline survey also identified a pumping station with a storm water over flow (section 5.2.1, Map ID 50). A water sample from this discharge recorded a high *E.* coli level of 24,196 cfu/100ml. During flood events untreated sewage will be discharge from these locations. The impact from these events will be somewhat reduced as the sewage will be highly diluted due to the high volume of water associated with the events. Two discharges were also identified in the shoreline survey as potentially related to septic tanks over flows (section 5.2.1, Map ID 57, 63).

3.2. Agriculture

Agricultural land (pastures 73.6% and land principally occupied by agriculture, with significant areas of natural vegetation 2.5%) accounts for 76.1% of the Ballylongford Bay catchment. Grasses and rough grazing account for almost all of the land used for farming in the catchment with only 1.3% being used for to grow crops.

There are 28,255 cattle in the catchment with the highest no of cattle occurring in Astee (4,058) and Lislaughtin (3,829). The density of cattle in the catchment is relatively high at 1.89 cow/ha, which is slightly higher than the average national stocking density for cattle of 1.45 cow/ha. As stocking densities of cattle are high there is a possibility of bacteriological contamination due to high faecal loads. The number of sheep in the catchment is very low at only 724 sheep. As stocking densities of sheep are low they are unlikely to cause a significant bacteriological impact on the shellfish designated area.

The cattle stocking densities in the catchment are higher than the national average in every electoral division and it is likely that the high faecal load from cattle is impacting on the water quality in the rivers/ streams and drains in the catchment. The shoreline survey tended to confirm this as it noted multiple locations with evidence of nutrient enrichment and water samples taken recorded *E. coli* levels over 1000 cfu/100ml at most stations including those with no obvious point source contamination. .

3.3. Rivers and Streams

Ballylongford Bay drains a catchment of 95.85km^2, the catchment is mainly drained by the Ballydine River and the Asdee River, along with a series of small streams (16) and field drains (43 identified in shoreline survey). The Ballydine River drains 55% of the catchment and the Asdee River drains 26.3%. The dominant land use in the catchment is agriculture with pastures accounting for 73.6% of the catchment. As detailed above in section 3.2 cattle densities are higher than the national average in all electoral divisions. Therefore, runoff from the land is likely to have a high faecal load particularly in periods of heavy rainfall. This runoff will enter the bay via the streams and rivers. As the Ballydine River drains over half of the catchment it will contain the highest faecal load. The primary discharge for Ballylongford WWTP along with three storm water overflows, a pumping station overflow and drains/pipes also discharge to the river. The shellfish quality of the licensed area for pacific oysters to the east of Carrig Island is likely to be impacted by the Ballydine River.

The Asdee River drains over a quarter of the Catchment and so is also likely to receive a high faecal load from runoff. However, there are no sewage related discharges to this river and E. coli results for the river and other streams that discharge west of Carrig Island had much lower *E. coli* levels than in the Ballydine River and estuary. The Asdee River discharge close to three licensed areas, one of which is currently active and so may impact on their shellfish quality.

The current (2010-2015) WFD status of the Ballydine river system upper reaches is categorized as poor status, while the next section of the river is classified as moderate. The remaining stretches of the Ballydine and all other rivers and streams have not been assigned a status. Ballylongford Bay coastal waterbody and transitional waterbody have both been assigned a moderate status.

3.4. Movement of Contaminants

Ballylongford is a small bay with substrate mainly composed of stones and mud. The inner part of the bay is completely intertidal except for two small channels, one from the Ballydine River and the other from behind Carrig Island. Large parts of the outer bay are also intertidal. Velocities in the bay range from 0.05 to 0.5 m/s over the course of the tidal cycle. A model of the currents in the bay found that east of Carrig Island there is a clockwise rotation of water within the bay on all stages of the tide except low water when there is little water movement. West of Carrig Island the currents follow the shoreline moving east on the flooding tide and west on the ebbing tide. As the bay is small and there is constant movement of water through it the residence time is expected to be short. Therefore, most contamination entering the bay from rivers and land will be dispersed out into the Shannon Estuary. Multiple sources of contamination have been highlighted by the desk study and shoreline survey. The combination of these factors means that the bacteriological load for Ballylongford Bay east of Carrig Island is likely to be high particularly after periods of high rainfall. Although there is likely to be a short residence time in the bay this contamination will travel by the licensed pacific oyster area on the east side of Carrig Island. The clockwise rotation of water east of Carrig Island shows that contamination from the Ballydine River will be pushed along the shore of the island and so will pass directly over the oyster bed located there.

The Ballylongford production area west of Carrig Island is separated from Ballylongford Bay proper by the island. It is therefore unlikely for contamination from locations in Ballylongford Bay or river to directly impact on the bacteriological load in this area. As this contamination will be dispersed and diluted into the Shannon Estuary before reaching this area. The sources of bacteriological concern for this area west of Carrig Island is from the rivers/streams and drains that discharge along this section of shoreline. Of these the Asdee River is by far the largest draining approximately one quarter of the entire catchment. This area also has the highest number of cattle in the Ballylongford catchment. A number a streams were noted in the shoreline survey as having signs of nutrient enrichment and cattle were noted next to the Asdee River (Section 5.2.1 below Map code 12). The shoreline in this area west of Carrig Island is a more exposed higher energy site than to the east. Which is made evident by the change in sediment type from mud to sand and cobbles. As such contamination from the Asdee River and other discharges are likely to by quickly dispersed from the area.

Bacteriological contamination enters the marine environment in freshwater from rivers and land runoff. Where contamination occurs the highest concentrations will be in the surface waters as freshwater is less dense than sea water. The movement of this surface water is strongly influenced by wind direction. As the prevailing winds in the area are from the south-west surface water will be mostly frequently blown out of the bay into the Shannon Estuary.

3.5. Wildlife

Ballylongford Bay is part of the River Shannon and River Fergus Estuaries SPA which is an important area for large numbers of a wide variety of species. However, Ballylongford Bay makes up a very small part of this very large area. As such a small proportion of these would be expected to visit the area. Therefore, the bay is unlikely to receive an excessively high faecal load from birds. During the shoreline survey bird numbers were not noted as significant other than approx. 60 ducks upstream of Saleen pier which was quite a distance away from any of the licensed oyster sites.

The Shannon Estuary supports a resident population of bottlenose dolphins (+108). However, there is no information on whether or not they visit Ballylongford bay. Although the resident population tend to frequent the deeper part of the estuary it is likely that they will visit the Ballylongford Bay area from time to time. Both Common (*Phoca vitulina*) and Grey seals (*Haliochoerus grypus*) occur within the lower Shannon estuary but similarly there is no information on whether or not they occur in Ballylongford Bay. It can be presumed that they may visit the area on occasion. Other aquatic mammals that may occur in Ballylonford Bay include Otter (*Lutra lutra*) and Harbour Porpoise (*Phocoena phocoena*).

All aquatic mammals that occur in the BMPA may contribute to background levels of faecal contamination within the area but the impact on the fishery of many of these animals will be unpredictable.

3.6. Seasonality

In 2017, 1.3 million overseas tourists visited Co. Kerry, and 964,000 domestic tourists visited Co. Kerry. The main tourist attractions in the area are Carrigafoyle Castle, Tarbert Bridewell visitor centre, Bromore Cliffs, Nuns Beach, Kerry Writers Museum, Lartigue Monorail and Museum and Listowel Castle. The only attraction located inside the catchment area is Carrigafoyle Castle. The number of holiday homes is also quite small at only 3% of the permanent households in the catchment. For Ireland as a whole, in 2017 most tourists visited between July and September (31%), followed by April to June (27%), October to December (23%) and January to March (18%). There is no reason to expect this trend to be any different in the West region. As tourism numbers in the area are relatively low it is unlikely that there will be a seasonal impact on the shellfish area from tourism.

In terms of agriculture, numbers of livestock would be expected to be higher in Spring/Summer when animals are out grazing on the land. In County Kerry the spreading of slurry or farmyard manure, which would be common place in the catchment, is limited by legislation with a closed period from the 1st of November to the 15th January. From mid-January to the end of October there would be a potential risk of faecal contamination through diffuse run-off from this activity, if it coincides with a period of rainfall then that risk is raised further.

There may be an increase in wading bird numbers during Autumn/winter due to migrating species.

Analysis of rainfall data for the area has shown that August to March are the months with higher rainfall. During this period faecal contamination may enter the bay in run-off from the land. The highest loading from the land would be expected in August and September as faecal load will have been accumulating over the dryer period of April to July.

Analysis of Sea Fishery Protection Authority *E. coli* results for the representative monitoring point found no significant variation between seasons.

3.7. Shoreline survey

The shoreline survey identified 16 rivers/ streams, 43 drains, 4 culverts and 7 storm drains (Identified features can be seen in Figure 6.20 which are cross referenced in Table 6.12). Discharges to the west of Carrig Island are likely to impact on the active oyster areas along this section of shoreline. While discharges to the east and from Ballylongford estuary will impact on the inactive licence area along the eastern shore of Carrig Island.

West of Carrig island seven locations were identified as showing signs of contamination. Two of these were streams showing dirty or discoloured waters (Map ID 12 & 16). While there were five drains which showed signs of enrichment (Map ID 1, 6, 10, 11 and 12). Also, a number of locations were recorded with animals on or near the shoreline. One location had 30+ sheep (Map ID 5), two with cattle one of which had cattle next to a river and the other had 20+ cattle (Map ID 12 & 21). One location was recorded with a flock of wading birds and gulls (Map ID 13). Contamination from all of these sources is likely to impact on the shellfish quality of the licence areas west of Carrig Island.

East of Carrig Island 14 discharges were identified as showing signs of contamination. Four of these were recorded in rivers/ streams with two being dirty or discoloured (Map ID 40 &48) and two showing signs of enrichment (Map ID 76 &84). Six of the identified discharges were from drains with three being dirty or discoloured (Map ID 38, 39 & 68), two showing signs of enrichment (Map ID 78 & 79) and one contained raw sewage (Map ID 60). The drain discharging raw sewage was located in Ballylongford town and came from one of 10 pipes. Two other discharges in Ballylongford showed signs of sewage contamination. One was from a storm drain (Map ID 59) and the other was suspected as being a septic tank overflow (Map ID 57). Also, seven locations were identified with cattle on or near the shoreline (Map ID 38, 67, 70, 72, 80, 81, & 85). Cow numbers ranged from 10 to 30 with over 135 cattle in total. One locations was recorded as having 60+ ducks (Map ID 73). Contamination from these sources will impact on the shellfish quality of oysters at the licensed area east of Carrig Island should production recommence.

Water sampling was carried out at twenty locations along the shore. Particularly high levels were recorded at stations 9, 18 and to a lesser extent 16. Station 9 is located near a Ballylongford WWTP pumping station, while 18 was taken from a storm drain at Saleen pier. Station 16 is located at Ballylongford WWTP's primary discharge. All of these sampling points were located in the Ballylongford estuary and will impact on the shellfish quality of the licence area at the mouth of the estuary along the eastern shore of Carrig Island. As mentioned previously this licence area is currently inactive. To a lesser extent elevated *E. coli* levels were recorded from the majority of the 20 discharges sampled. This is likely connected to the high stocking densities of cattle in the catchment. Due to the high *E. coli* levels from rivers, stream and drains discharging to the production area elevated results have been regularly record in shellfish flesh at the Representative Monitoring point. As such the production area has consistently received a B classification. During flood or high flow periods the *E. coli* levels in the production area are likely to increase.

4. Amendments

The boundary of Ballylongford BMPA has been amended. The northern boundary has been moved north to match up with the designated shellfish waters boundary. The BMPA now stops at Saleen pier, this now allows for a buffer zone between the WWTP discharges and the production area (See Figure 4.1). The production area is now 8.25km^2.

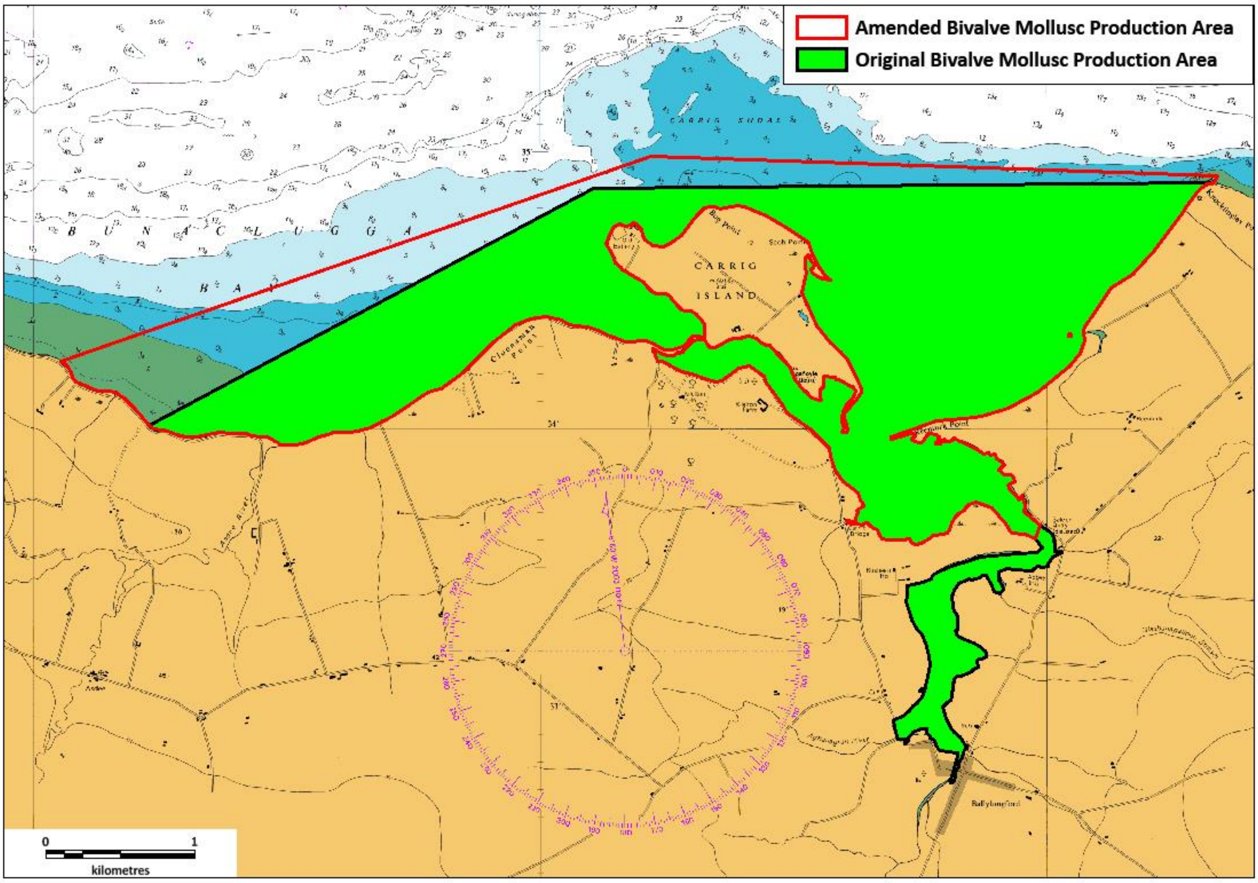


Figure 4.1: Ballylongford amended BMPA.

5. RMPS and Sampling Plan

5.1. Pacific Oysters (*Crassostrea gigas*)

The location of RMP 1 for Pacific oysters is -9.535695 and 52.569955 (95,925.3E, 147,579.3N), and is shown on Figure 5.2 below. RMP 1 is located between the Asdee River and Cloonaman Point in the only licensed area that is currently in production. The RMP is located to the south western corner of this licence area as it is closest to Asdee River which is the most significant likely source of contamination in this area.

A second RMP has been assigned for Pacific oysters. The location of RMP 2 for Pacific oysters is -9.484038 and 52.570807 (99,429.6E, 147,600.8N) and is shown on Figure 5.2 below. RMP 2 is located in the licence area to the east of Carrig Island. The rational for the selection of this RMP is that production in this area is likely to receive a different bacteriological load due to its location at the mouth of the Ballydine River. The Ballydine River drains over half of the catchment and will therefore receive a higher degree of contamination from farmland. Particularly high *E. coli* levels were also recorded at two locations less than two kilometres upstream of this licence area. There is currently no production in this area but should it recommence this RMP should be used.

10 individuals of market size (minimum shell length 8 cms) should be collected for bacteriological analysis. As harvesting can take place throughout the year, sampling needs to be on a monthly basis.

Table 5.1: Coordinates of the Production Area.

Corner	Longitude	Latitude	Easting	Northing
NW	-9.55595	52.56722	94545.6	147304.0
NE	-9.45115	52.58180	101684.2	148778.8
S	-9.47688	52.54585	99858.0	144813.3
S	-9.47664	52.54572	99874.3	144798.7

Table 5.2: Coordinates of each RMP and its relevant species.

RMP	Site Code	Species	Longitude	Latitude	Easting	Northing
RMP 1	KY-BD-BD	Pacific oyster	-9.535695	52.569955	95,925.3	147,579.3
RMP 2	KY-BD-BD	Pacific oyster	-9.484038	52.570807	99,429.6	147,600.8

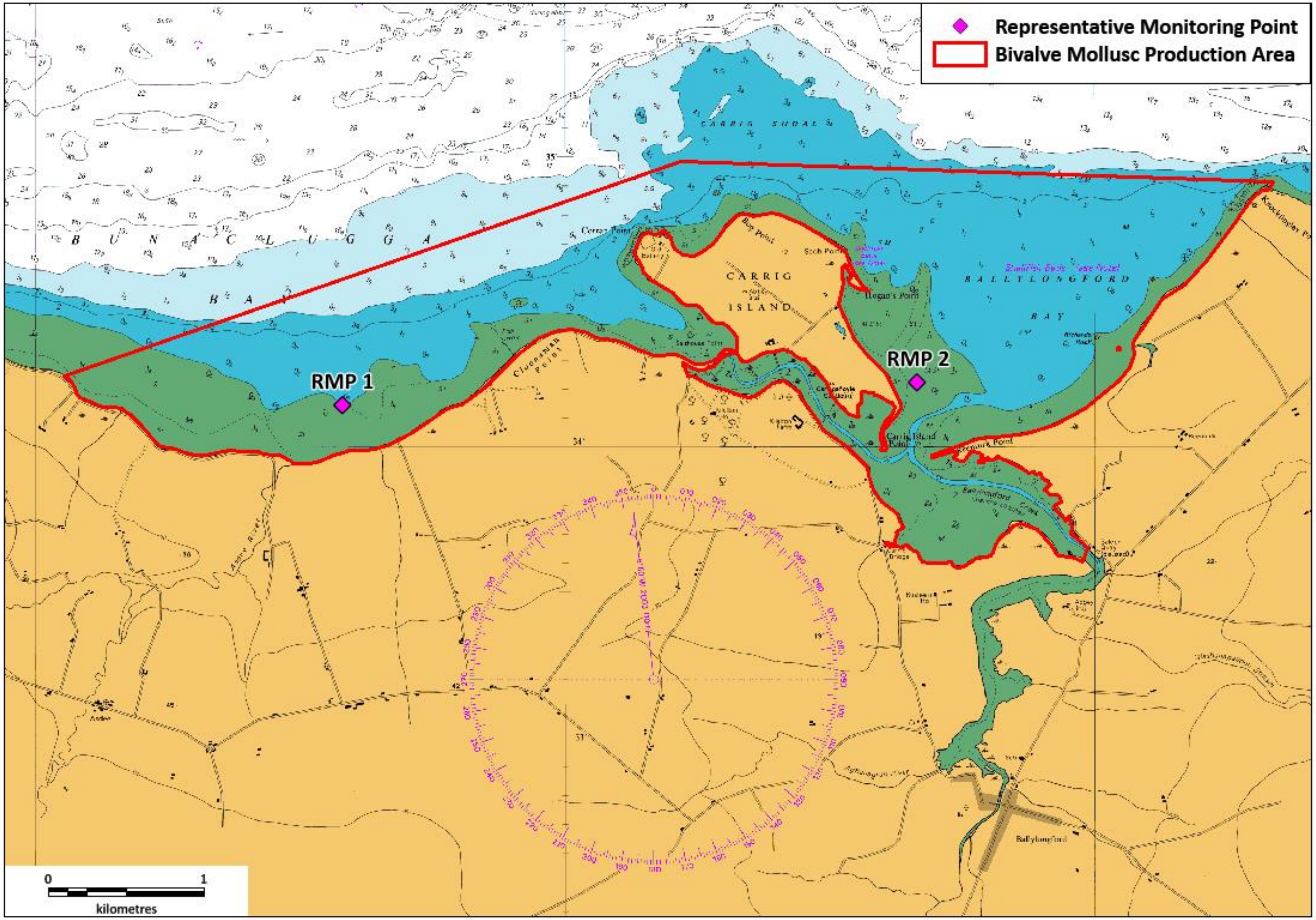


Figure 5.1: Bivalve Mollusc Classified Production Area with RMPs for Ballylongford Bay.

5.2. Species Specific RMP maps

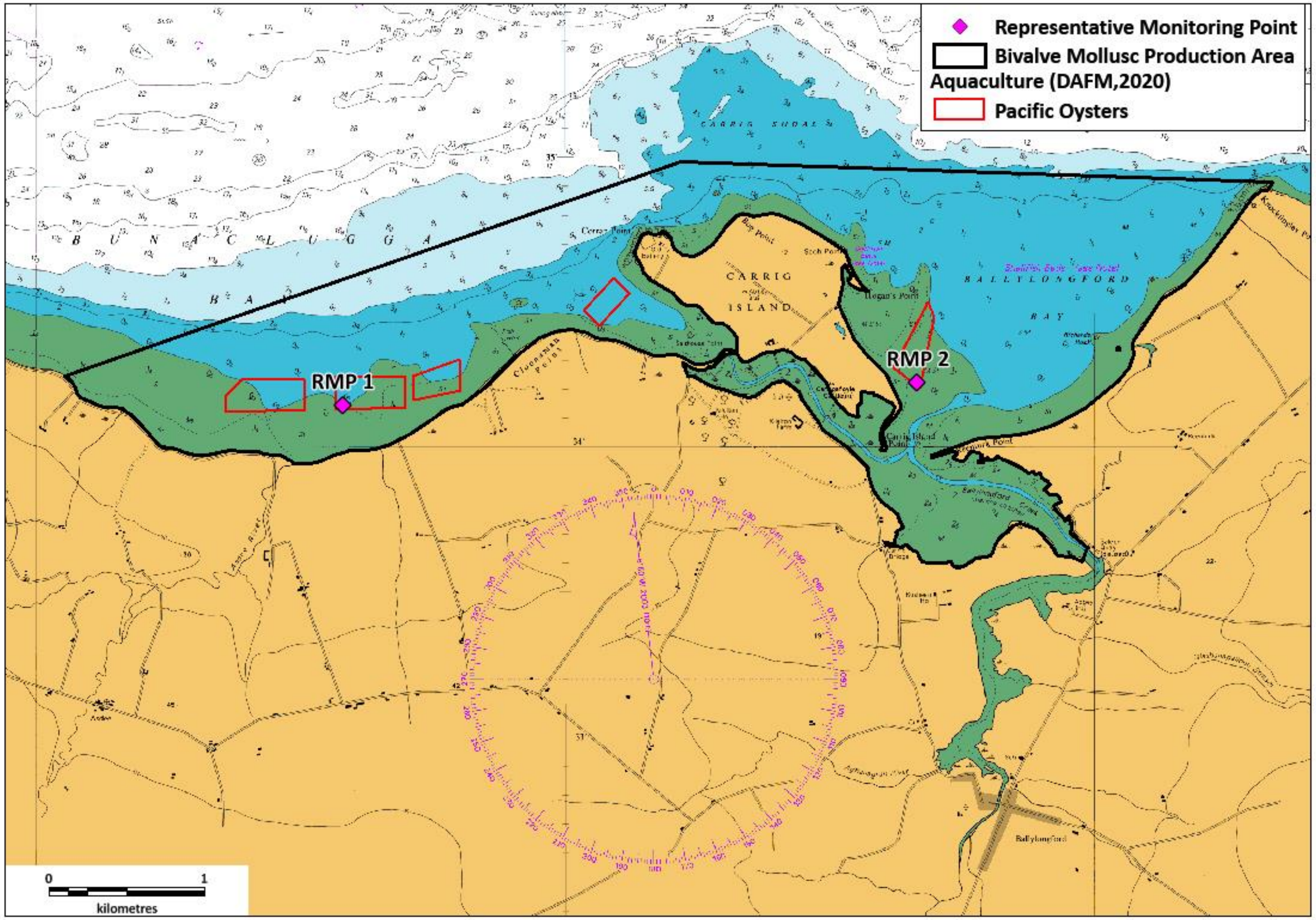


Figure 5.2: Location of the Oyster RMPs within Ballylongford Bay.

5.3. General Sampling Method

All collection and transport of shellfish samples for *E.coli* testing under the Sampling Plan identified as part of the Ballylongford Bay Sanitary Survey should follow the Sea Fisheries Protection Authority's own Code of Practice for the Microbiological Monitoring of Bivalve Mollusc Production Areas (SFPA, 2017). The guidance notes are found at Appendix 9.2 of that document.

6. Appendix 1: Identification of Pollution Sources

This section attempts to document all pollution sources within the Ballylongford Bay catchment area.

6.1. Desktop Survey

Pollution sources were considered within the catchment area of Ballylongford Bay (see Figure 6.1). The catchment area covers an area of 95.85km^2, approximately 17km east west at its widest point and 9km north south at its longest point.

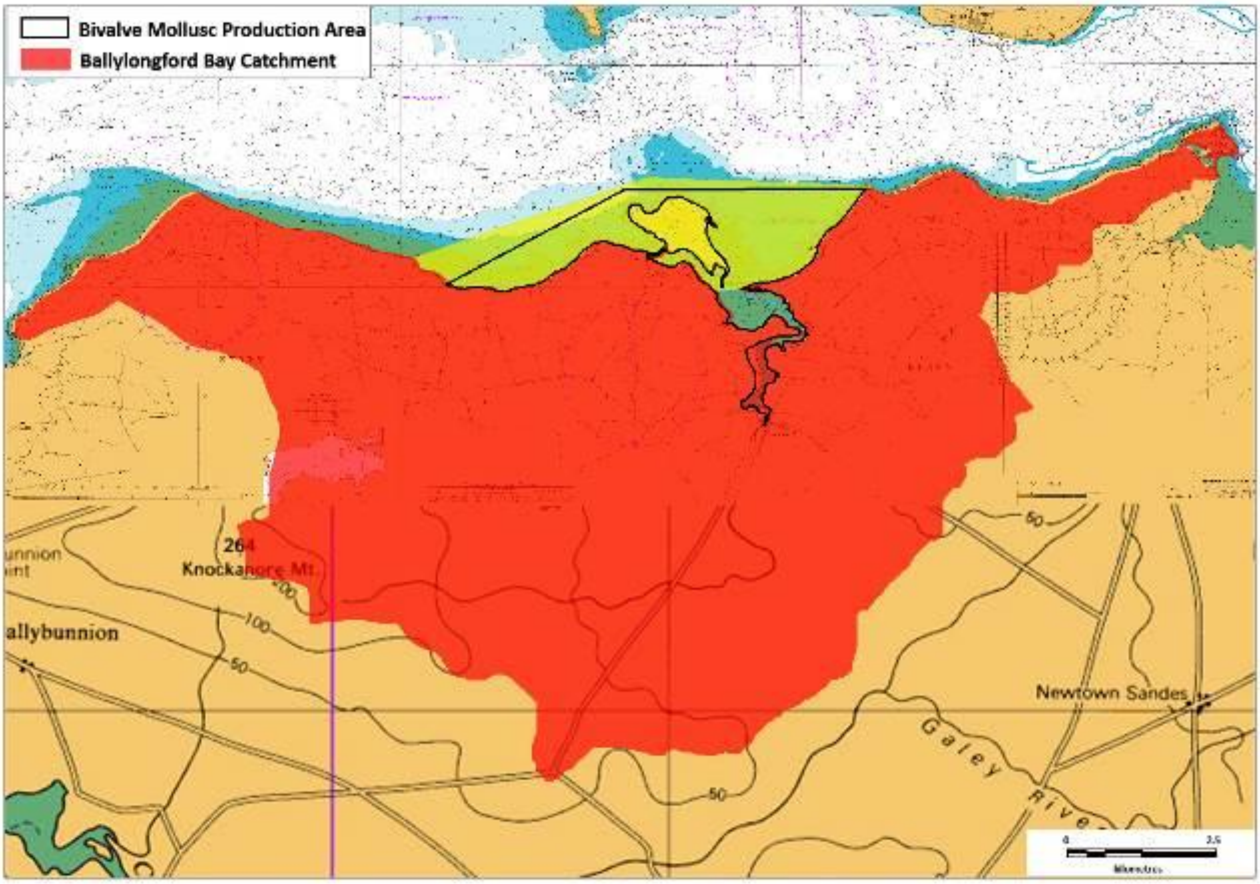


Figure 6.1: Ballylongford Bay catchment area used for assessment of the pollution sources.

6.1.1. Human Population

Population census data used by the Central Statistics Office (CSO) is given in units of Electoral Divisions (ED). Figure 6.2 shows the EDs within the catchment area. The population data were obtained through the Central Statistics Office (CSO) online Small Area Population Statistics (SAPS) (CSO, 2019a) for the year 2016. Town populations were also taken for the 2016 Census. Figure 6.3 shows the human population within

Ballylongford Bay catchment area and Table 6.1 shows these data in tabular form.

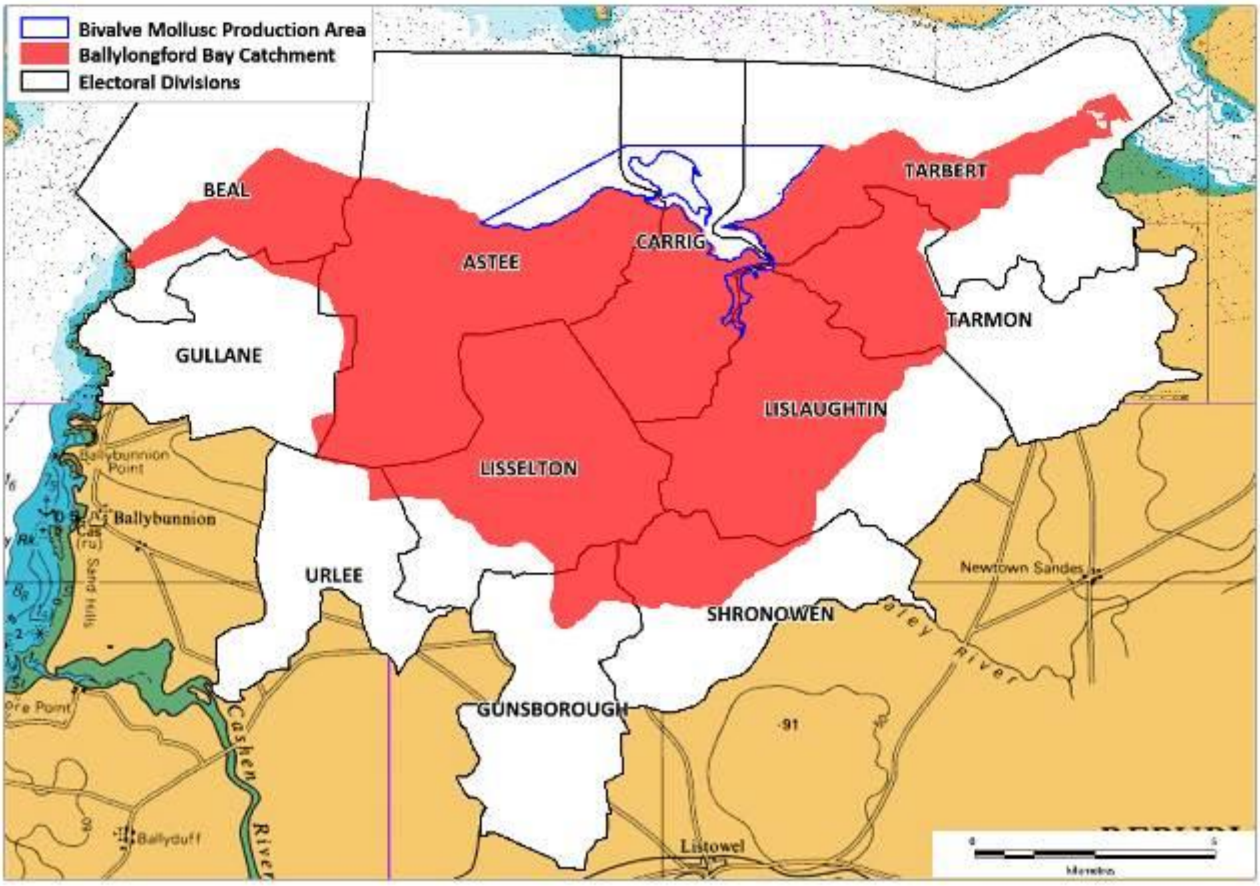


Figure 6.2: Electoral Divisions within the Ballylongford Bay Catchment Area.

The Ballylongford Bay Catchment Area overlaps 11 EDs (11 partially). The EDs that are partially within the catchment are Astee, Beal, Carrig, Gullane, Gunsborough, Lislaughtin, Lisselton, Shronowen, Tarbert, Tarmon and Urlee. Tarbert contains the largest population (761) followed by Lislaughtin (587) and Astee (480).

These 11 EDs accommodate a total population of 4,407. As all of these EDs only partially overlap the catchment area, an attempt was made to estimate the actual population within the catchment. The percentage of the ED lying within the catchment was calculated in GIS and from this value the population size was calculated *e.g*. if 50% of ED lies within catchment area then 50% of the total population was taken to be the population size of the area within the catchment. Using this method, the population of the catchment areas is estimated at 2,505 people. Table 6.1 shows this estimation.

There are two main towns/urban centres within the catchment area Tarbert and Ballylongford. Tarbert (540) has the largest population, while Ballylongford (391) has a smaller population.

There are 2,284 households within the 11 EDs within the catchment area. Of this, 19% are vacant (435) and a further 4% are holiday homes (82). Of the 1,321 houses actually within the catchment (based on the % of the ED within the catchment), 20% are vacant and 3% are holiday homes. Table 6.2 shows the number of households in each ED and the proportion actually within the catchment area.

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 geographic boundaries used. Nonetheless, it is clear that areas with a higher population will have higher levels of sewage and wastewater entering the Ballylongford Bay system. The population in the Ballylongford catchment is relatively low, with population density slightly higher in the east of the catchment. As holiday homes only account for 3% of the dwellings in the catchment they are unlikely to cause a significant increase in the sewage and waste water levels relative to the permanent population.

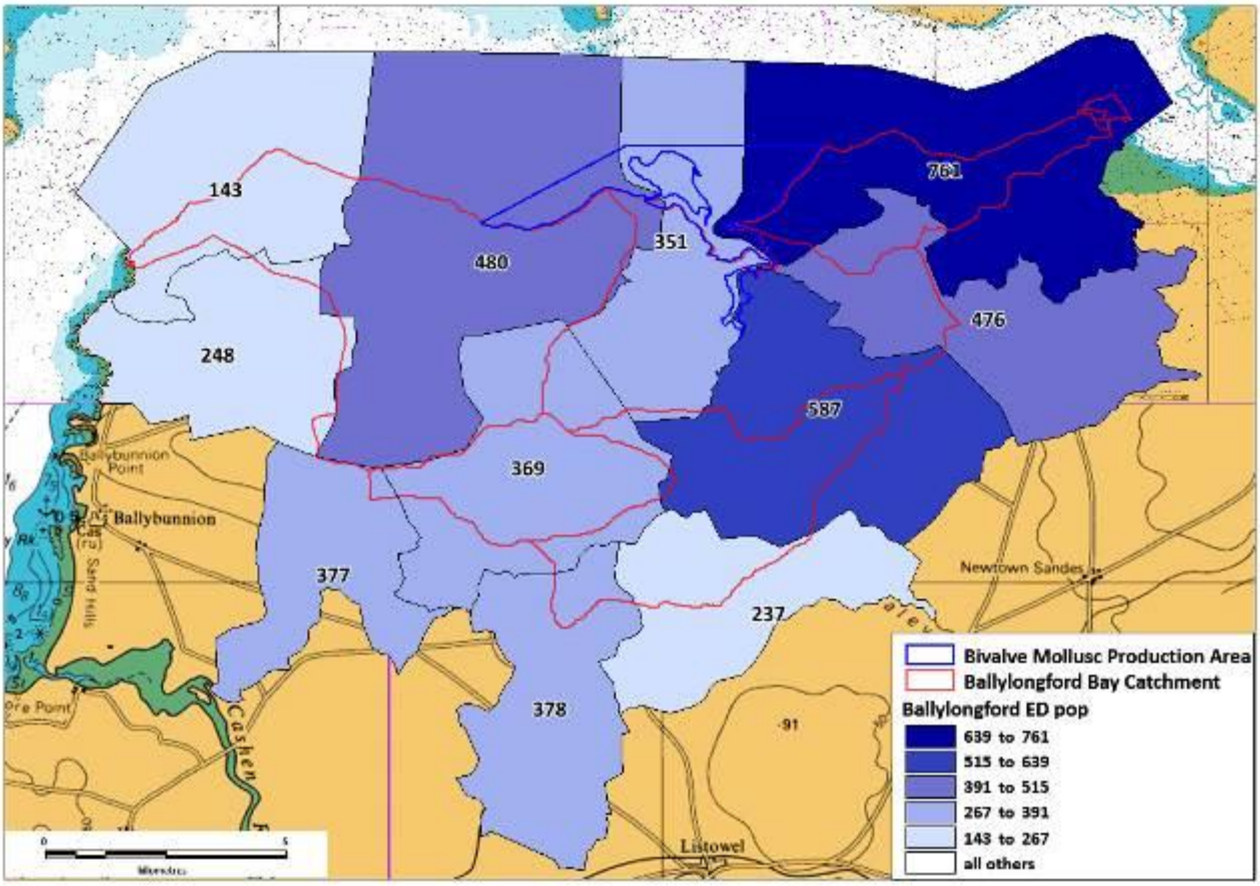


Figure 6.3: Human population within the Ballylongford Bay Catchment Area (Source: CSO, 2019a).

Table 6.1: Human population within the Ballylongford Bay Catchment Area (Source: CSO, 2019a).

Electoral Division	Population (2016)	% ED in Catchment	Estimated Population
Astee	480	99.7	479
Beal	143	91.7	131
Carrig	351	100.0	351
Gullane	248	6.6	16
Gunsborough	378	9.7	37
Lislaughtin	587	66.1	388
Lisselton	369	80.8	298
Shronowen	237	29.7	70
Tarbert	761	74.3	565
Tarmon	476	33.7	160
Urlee	377	2.3	9

Table 6.2: Households within the EDs in the Ballylongford Bay Catchment Areas (Source: CSO, 2019a).

Electoral Division	Total Households	No. Occupied*	Unoccupied holiday homes	Vacant houses	Total Households in Catchment	No. Occupied in Catchment	Unoccupied holiday homes in Catchment	Vacant houses in Catchment
Astee	259	183	15	61	258	182	15	61
Beal	84	55	3	26	77	50	3	24
Carrig	202	156	3	43	202	156	3	43
Gullane	152	105	10	37	10	7	1	2
Gunsborough	172	142	2	28	17	14	0	3
Lislaughtin	307	242	16	49	203	160	11	32
Lisselton	165	134	3	28	133	108	2	23
Shronowen	109	89	3	17	32	26	1	5
Tarbert	411	324	3	84	305	241	2	62
Tarmon	233	186	15	32	78	63	5	11
Urlee	190	151	9	30	4	4	0	1

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

6.1.2. Tourism

In 2017, 4.6 million tourists visited the Southwest Region of Ireland (Failte Ireland, 2018a). This figure was made up of 2,400,000 overseas tourists, 2,100,000 domestic tourists and 69,000 Northern Irish tourists. Of the overseas tourists, 1,277,000 visited Co. Kerry, and of the domestic tourists 964,000 visited Co. Kerry (Failte Ireland, 2018b). The main tourist attractions in the area are Carrigafoyle Castle, Tarbert Bridewell visitor centre, Bromore Cliffs, Nuns Beach, Kerry Writers Museum, Lartigue Monorail and Museum and Listowel Castle.

The only attraction located inside the catchment area is Carrigafoyle Castle. For Ireland as a whole, in 2017 most tourists visited between July and September (31%), followed by April to June (27%), October to December (23%) and January to March (18%). There is no reason to expect this trend to be any different in the Southwest region.

At the time of righting there were no aqua tourism business listed as operating from the Ballylongford area. There are also no Blue flag Beaches in the area, although Littor beach is located to the wester end of the bay and is a Green Coast beach. Saleen quay is located 2km downstream of ballylongford town and has a slipway.

Increases in population in the local area due to tourism may result in an increase in the quantity of sewage discharged within the Ballylongford Bay catchment area. In addition, Papadakis *et al.* (1997) found significant correlations between the number of swimmers present on beaches 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. There are no monitored bathing water areas in the bay. In addition, waste can enter the area from recreational vessels.

6.1.3. 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 sewerage systems (intermittent);

- septic tanks (intermittent);
- crude sewage discharges at some estuarine and coastal locations (continuous).

Treatment of sewage ranges from:

- none at all (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 - N down to 5 mg/l and phosphorus to 2mg/l.
- tertiary (settling, biological treatment and an effluent polishing step which may involve a reed bed (unlikely for a coastal works) or a treatment to reduce the load of micro-organisms in the effluent)., typically removes 100% of BOD, 100% of suspended solids, 33% of nitrogen and 38% of phosphorus from the untreated sewage.

6.1.3.1. Water Treatment Works

There is one waste water or sewage treatment works within the Ballylongford Bay catchment, it is located in Ballylongford Town. Figure 6.4 shows the location of this Treatment Works within the Ballylongford Bay catchment area and Table 6.3 shows the coordinates and facility capacities (EPA, 2019a).

6.1.3.2. Continuous Discharges

Ballylongford WWTP is a Tertiary N removal facility with a design capacity of 1,000 PE (Population Equivalent) and is currently under capacity at 738 PE. The maximum discharge for this facility is 675 m^3/day. The locations of the discharges can be seen in Figure 6.5 and Table 6.4 provides details of the discharge. Strict emissions limits are set out in the discharge Licence for THE facility in terms of BOD (Biological Oxygen Demand), Ortho-Phosphate, Suspended Solids, Nitrogen and Ammonia. These emissions limits comply with the parameters of Shellfish Directive (2006/113/EC) and the Quality of Shellfish Waters Regulations 2006.

There is no geo-referenced database for septic tanks and on-site domestic waste water treatment systems. In order to estimate the numbers of these domestic sewage facilities within the catchment, information on the number of permanent private households and their sewage facilities was sourced from the 2016 census (CSO, 2019a). Of the 1,721 permanent private households in the 11 EDs, 22.6% (389) were connected to a public sewer/treatment system and 75.3% (1,296) had septic tanks or other individual treatment systems. The estimate for the total number of private permanent households actually within the catchment (based on % within the catchment) is 984 and of this 30.4% (300) are on the public system while 67.7% (667) households have their own septic tanks or other individual treatment systems. Table 6.5 shows this information at the ED level and an estimation (based on % within the catchment) of the numbers actually within the catchment.

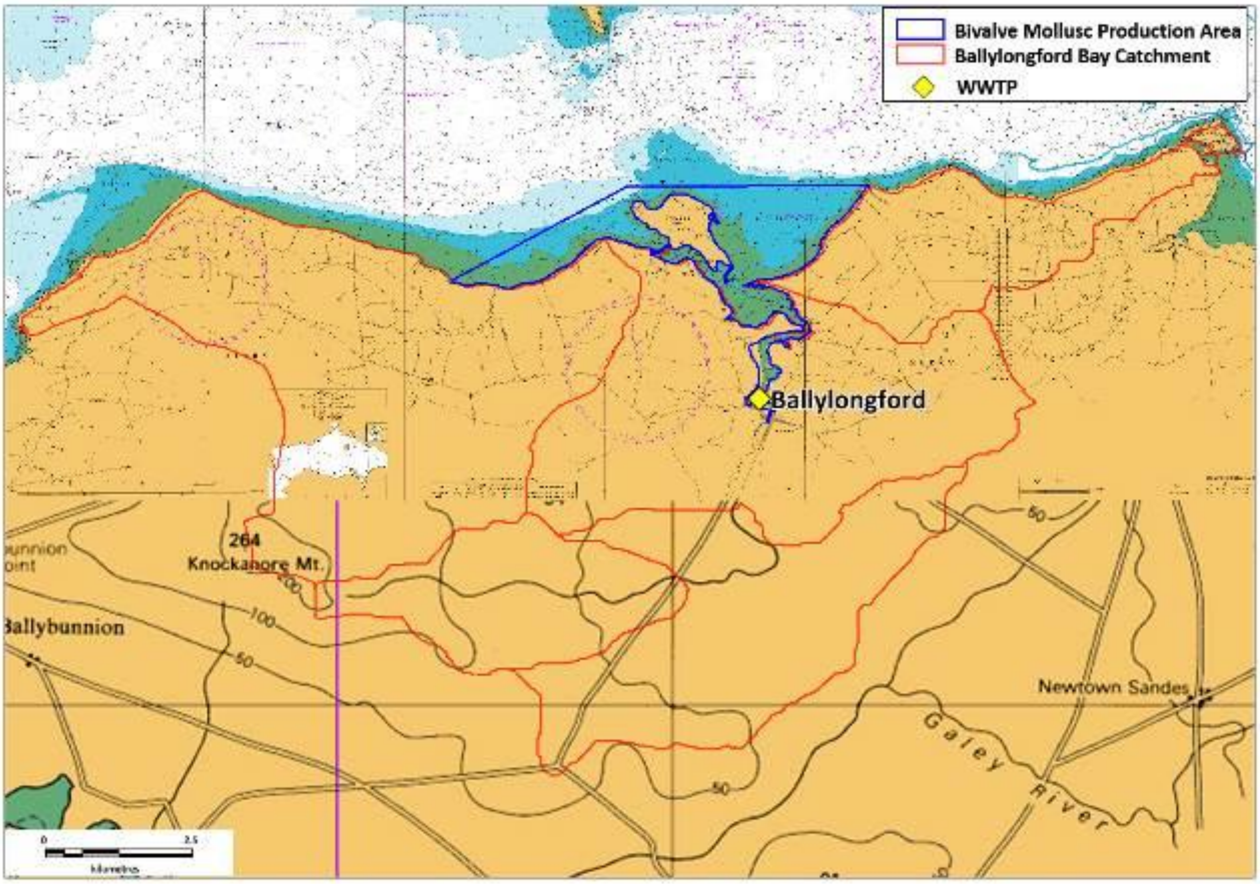


Figure 6.4: Sewage Treatment Works within the Ballylongford Bay Catchment Area (Source: The EPA, 2019a).

Table 6.3: Sewage Treatment Works within the Ballylongford Bay Catchment Area (Source: EPA, 2019a).

Name	Easting	Northing	Longitude	Latitude	p.e.	Designed p.e.
Ballylongford	100,181	144,992	-9.47218	52.5475	738	1000

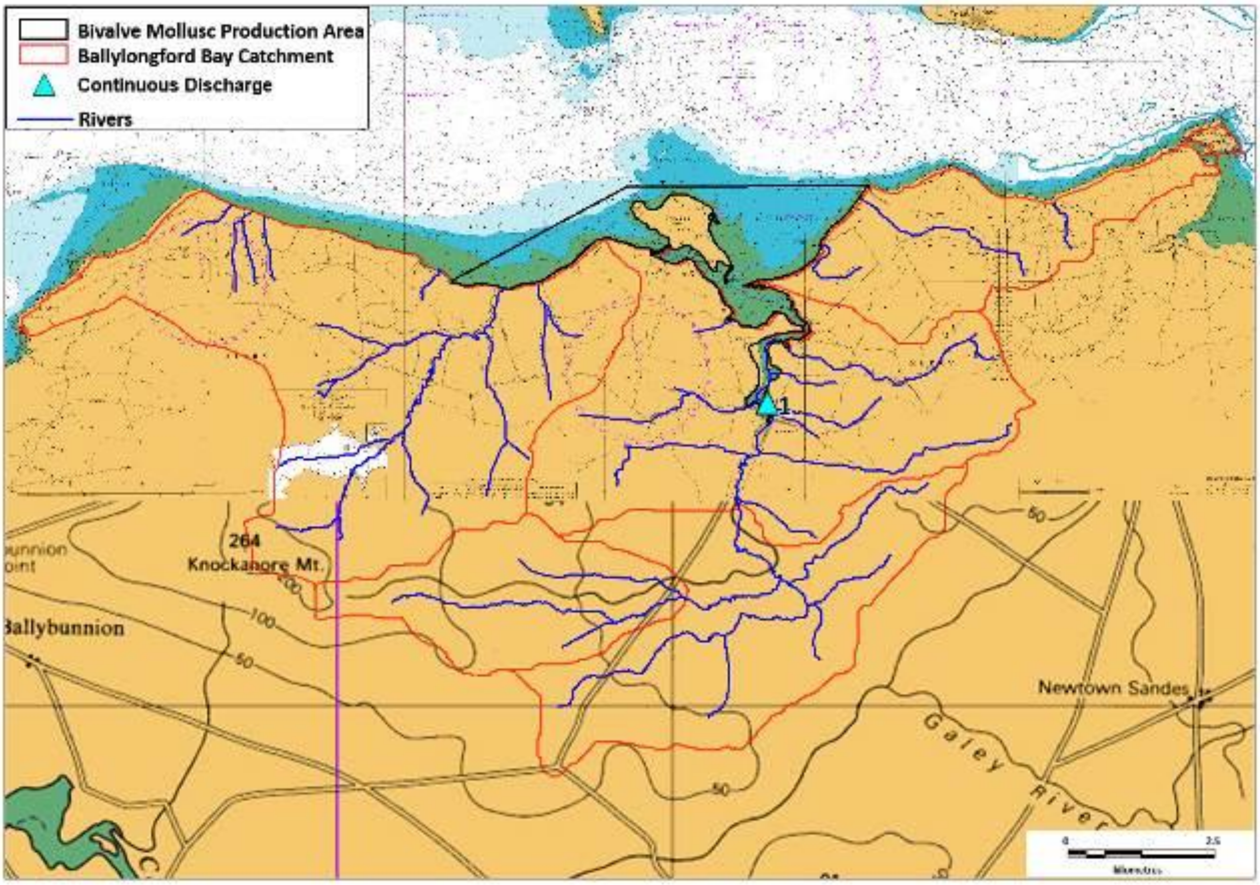


Figure 6.5: Continuous Discharges associated with the Sewage Treatment Works within the Ballylongford Bay Catchment Area (Source: The EPA, 2019a).

Table 6.4: Continuous Discharges within the Ballylongford Bay Catchment area (Source: EPA, 2019a). Map Codes refer to Figure 5.5.

Map Code	Name	Treatment	Easting	Northing	Longitude	Latitude	Receiving Body	Max Discharge/ day (m^3)	DWF/ day (m^3)
1	Ballylongford	Tertiary N removal	99,856	145121	-9.477	52.5486	Ballydine River	675	225

Table 6.5: Sewage facilities at permanent households in the catchment area (CSO, 2019a).

Electoral Division	Entire ED						Catchment %					
	Permanent Private Household	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
Astee	180	3	167	9	1	0	179	3	167	9	1	0
Beal	53	0	52	0	1	0	49	0	48	0	1	0
Carrig	153	78	68	5	1	1	153	78	68	5	1	1
Gullane	102	0	91	8	3	0	7	0	6	1	0	0
Gunsborough	140	3	117	15	5	0	14	0	11	1	0	0
Lislaughtin	234	77	140	11	5	1	155	51	93	7	3	1
Lisselton	130	0	116	9	4	1	105	0	94	7	3	1
Shronowen	88	1	85	1	1	0	26	0	25	0	0	0
Tarbert	315	223	80	5	7	0	234	166	59	4	5	0
Tarmon	177	4	155	18	0	0	60	1	52	6	0	0
Urlee	149	0	135	9	4	1	3	0	3	0	0	0

6.1.3.3. Rainfall Dependent / Emergency Sewage Discharges

In addition to WWTPs having a continuous discharge pipe, they also have intermittent or rainfall dependent discharge pipes in the form of storm water overflows. During storm flows in excess of a predetermined flow rate, the excess will bypass the works and flow directly to the outfall via the storm overflow discharge pipes. The details for the intermittent discharges can be seen in Table 6.6 and their locations can be seen in Figure 6.6.

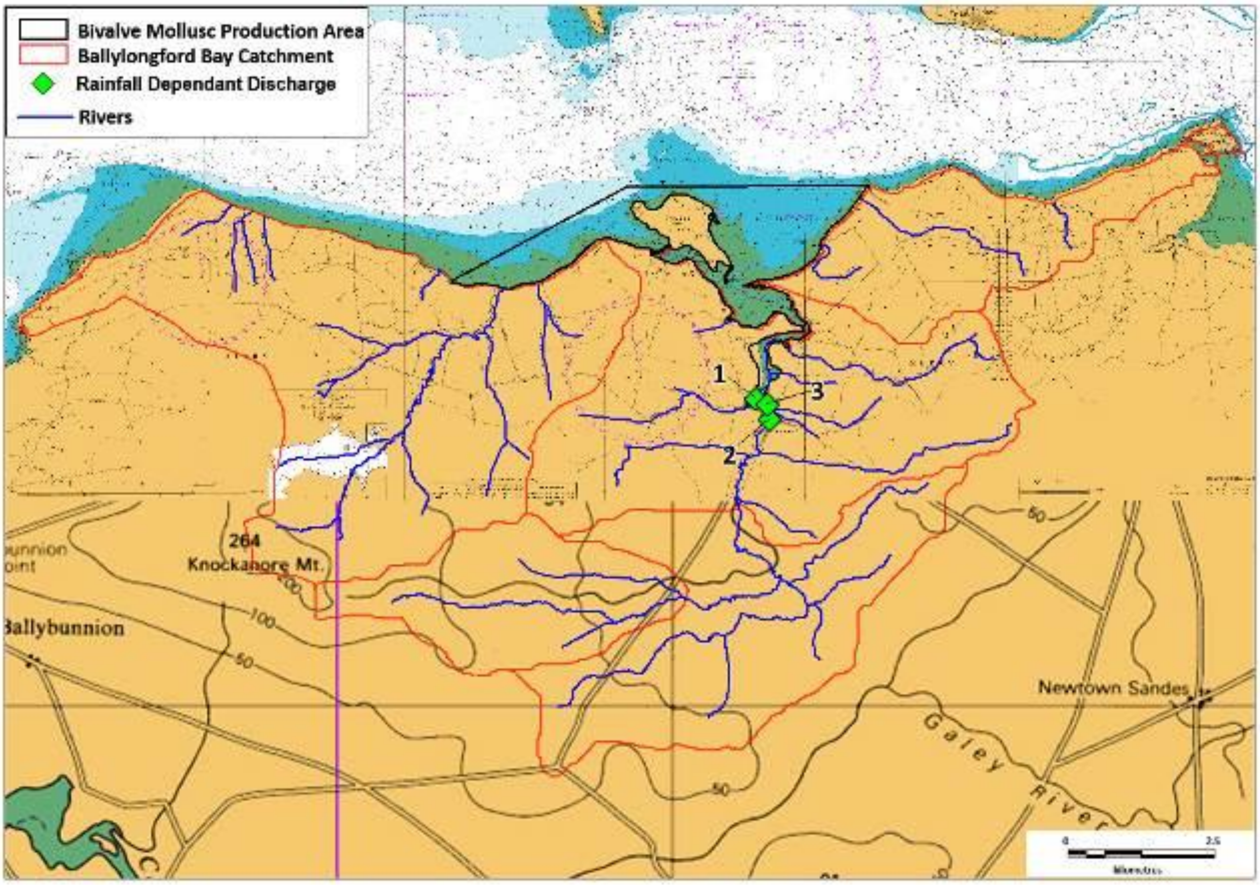


Table 6.6: Rainfall dependent discharges (storm water overflows) within the Ballylongford Bay Catchment area (Source: EPA, 2019a). Map Codes refer to Figure 5.6.

Map Code	Name	Discharge Point Code	Easting	Northing	Longitude	Latitude	Receiving Body
1	Ballylongford	SW2	99,664	145,217	-9.47986	52.5494	Ballydine River
2	Ballylongford	SW3	99,900	144,862	-9.47628	52.5463	Ballydine River
3	Ballylongford	SW4	99,856	145,121	-9.477	52.5486	Ballydine River

Figure 6.6: Rainfall Dependent Discharges associated with the Sewage Treatment Works within the Ballylongford Bay Catchment Area (Source: The EPA, 2019a).

6.1.4. Industrial Discharges

Figure 6.7 shows the industrial discharges to water within the Ballylongford Bay catchment area accounted for during the desk-based assessment (EPA, 2019b; EPA, 2019c). In total, there are eight industrial discharges belonging to one facility. The nature of the facilities is electricity generation using oil fired turbines and the facility is run by SSE. Details on these industrial discharges can be seen in Tables 5.7 and 5.8.

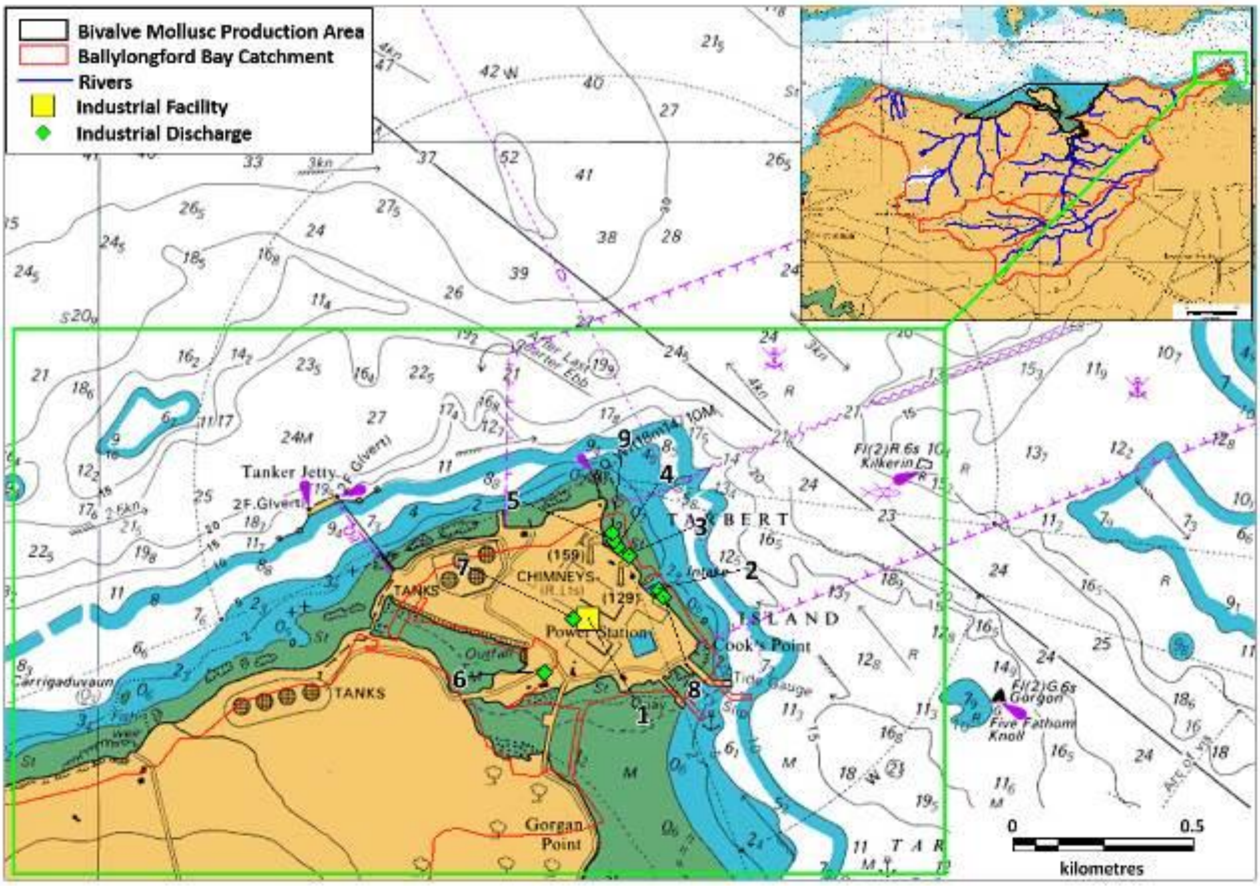


Figure 6.7: All industrial discharges within the Ballylongford Bay Catchment Area (Source: (EPA, 2019b; EPA, 2019c).

Table 6.7: Industrial Facilities with discharges to water within the Ballylongford Bay Catchment Area (Source: EPA, 2019b). Map Codes refer to Figure 5.7.

Map Code	Licence No.	Licence Type	Licence holder	Facility ad	Longitude	Latitude	Easting	Northing
1	P0607-02	IEL	SSE Generation Ireland Limited (Tarbert)	Tarbert Generating station, Tarbert, Listowel, Kerry	-9.36408	52.5886	107,550.39	149,438.94

Table 6.8: Details of Industrial discharges to water within the Ballylongford Bay Catchment Area (Source: EPA, 2019b). Map Codes refer to Figure 5.7.

Map ID	Discharge Code	Licence Type	Licence holder	Longitude	Latitude	Easting	Northing
2	P0607-02_SW34_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.361153	52.589259	107799.7	149489.8
3	P0607-02_SW5_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.362391	52.590108	107717.7	149585.8
4	P0607-02_SW6_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.362853	52.590343	107686.8	149612.6
5	P0607-02_SW7_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.363013	52.590494	107676.3	149629.6
6	P0607-02_SW29_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.365861	52.587203	107476.4	149267.1
7	P0607-02_SW26_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.364672	52.588542	107559.8	149414.5
8	P0607-02_SW33_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.360968	52.589084	107811.9	149470.0
9	P0607-02_SW8_EW	IEL	SSE Generation Ireland Limited (Tarbert)	-9.36311	52.590684	107670.1	149650.9

6.1.5. Landuse Discharges

Figure 6.8 shows the Corine landuse (EPA, 2019d) within the Ballylongford Bay catchment area. Figure 7.7 shows all rivers/streams within the catchment area. Within the catchment area, land use is dominated by pastures (75.9km^2, 73.6%), peat bogs (10.5km^2; 10.2%), coniferous forest (3.1km^2, 3%) and Land principally occupied by agriculture, with significant areas of natural vegetation (2.5km^2; 2.5%) (See Figure 6.9).

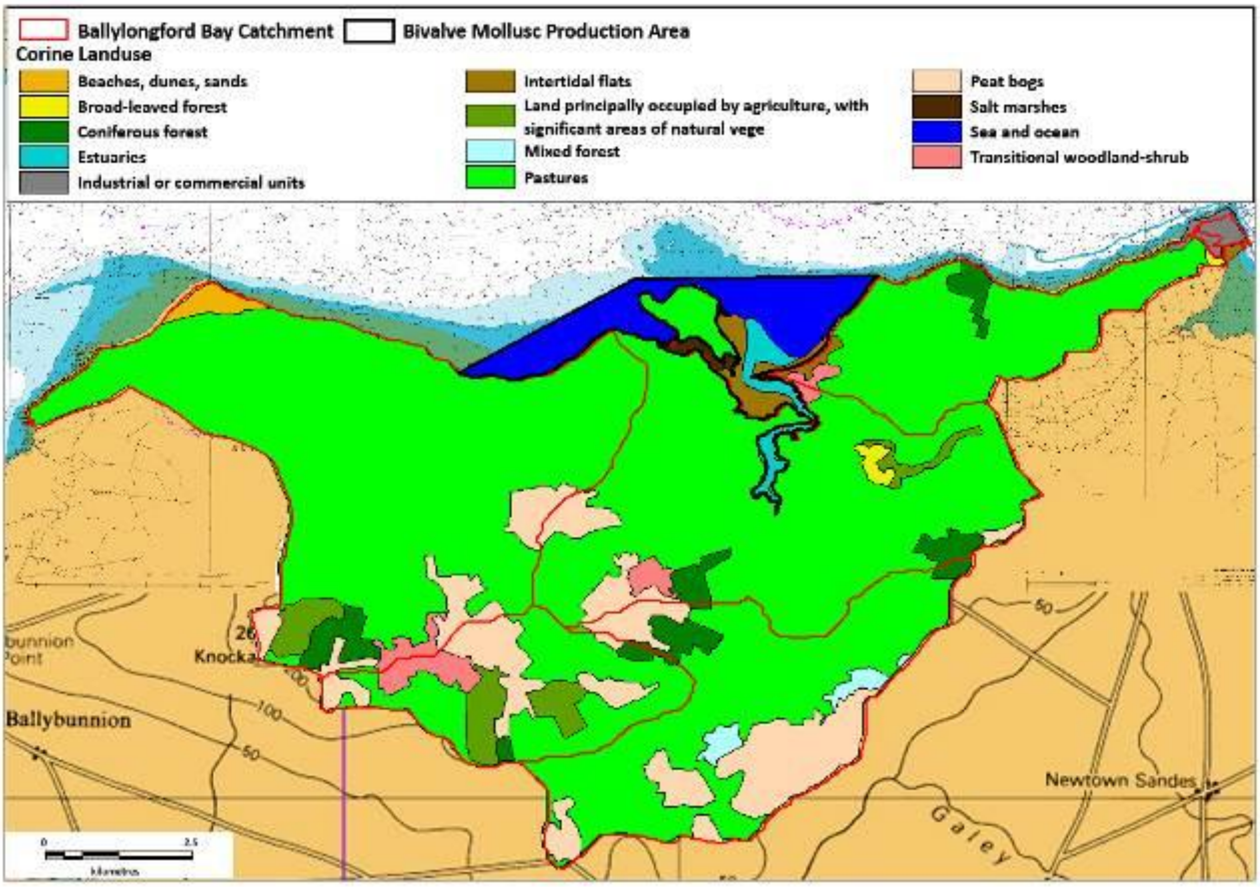


Figure 6.8: Landuse within the Ballylongford Bay Catchment Area (Source: EPA, 2019d).

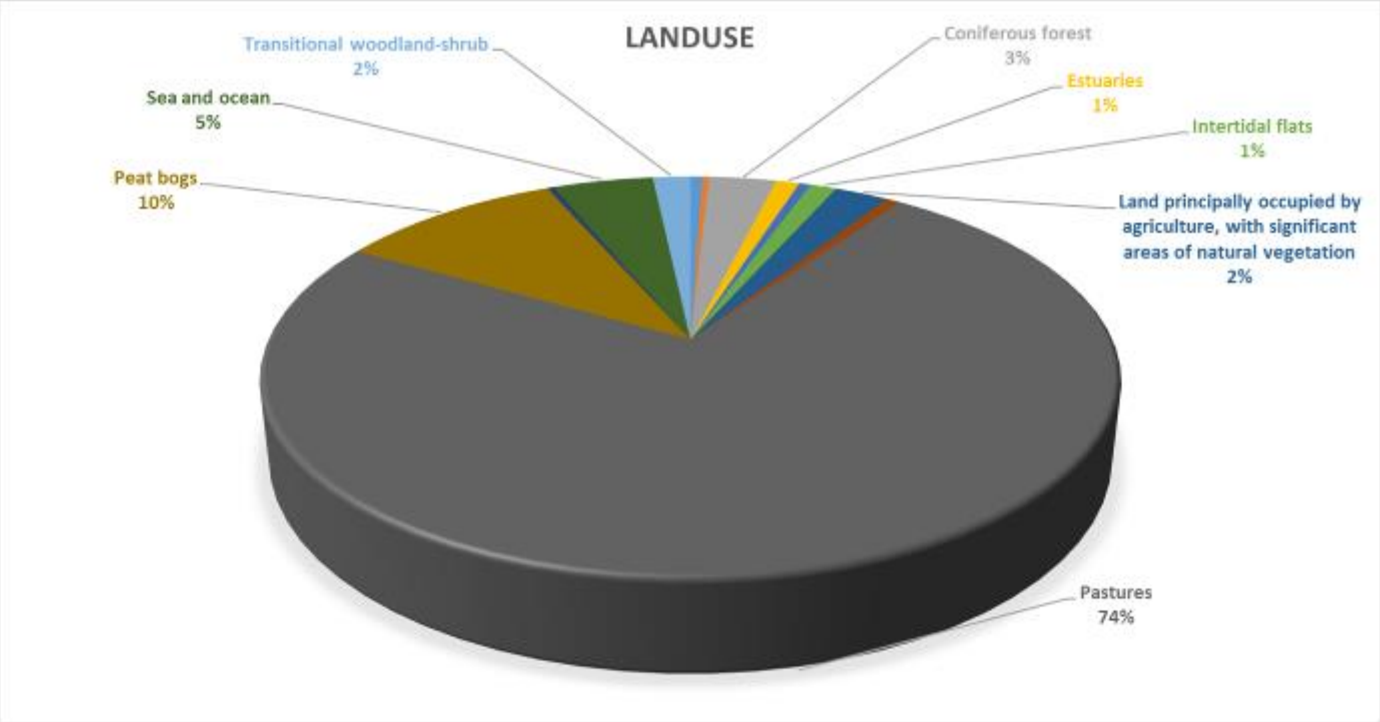


Figure 6.9: Breakdown of landuse within the Ballylongford Bay Catchment Area (only landuse ≥1% is labelled).

Data from the Census of Agriculture 2010 (CSO, 2019b) can be seen in Table 6.9 below. Figure 6.10 to Figure 6.17 show thematic maps for each category in Table 6.9.

Numbers of farms within the catchment range from 27 in Carrig to 64 in Astee. The total area farmed within the catchment varies from 846 ha in Beal to 2,205 ha in Astee. The average farm size ranges from 27.5 ha in Urlee to 40 ha in Carrig.

Total grass and rough grazing (combination of total pasture, total silage, total hay and rough grazing) accounted for almost all of the area farmed, ranging from 845 ha in Beal to 2,194 ha in Astee. Total crops range from 0 ha in Shronowen, Lislaughtin and Tarmon to 58 ha in Gullane.

The total number of cattle within the catchment range from 1,478 in Beal to 4,058 in Astee. The total number of sheep within the catchment range from 0 in Shronowen, Carrig, Tarbert and Astee to 402 in Urlee. The total number of horses within the catchment range from 1 in Gunsborough to 70 in Astee.

The total area farmed in the entire ED's shown in Figure 6.10 to Figure 6.17 amounts to 15,83 ha. However, as most of these ED's only partially overlap the catchment area, an attempt was made to estimate the actual area farmed within the catchment. The percentage of the ED lying within the catchment was calculated in GIS and from this value the area farmed was calculated *e.g.* if 50% of ED lies within catchment area then 50% of the area farmed was taken to be the area farmed within the catchment. Using this method, the area farmed within the catchment is estimated at 8,572 ha. This represents 56.8% of the area.

Table 6.9: Farm census data for all EDs within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

ED Name	County	No. Farms	Area Farmed (ha)	Avg. Farm Size (ha)	Total Crops (ha)	Total Grass & Rough Grazing (ha)*	Cattle	Sheep	Horses
Astee	Kerry	64	2205	34.5	10	2194	4058	0	70
Beal	Kerry	30	846	28.2	1	845	1478	14	24
Carrig	Kerry	27	1081	40.0	32	1051	2204	0	5
Gullane	Kerry	39	1172	30.1	58	1114	1841	190	46
Gunsborough	Kerry	32	1263	39.5	30	1234	2126	12	1
Lislaughtin	Kerry	51	1737	34.1	0	1736	3829	19	30
Lisselton	Kerry	48	1598	33.3	35	1563	2724	49	8
Shronowen	Kerry	30	1007	33.6	0	1008	2041	0	14
Tarbert	Kerry	33	1293	39.2	13	1281	2646	0	15
Tarmon	Kerry	60	1755	29.3	0	1755	3117	38	25
Urlee	Kerry	41	1126	27.5	17	1109	2191	402	26

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

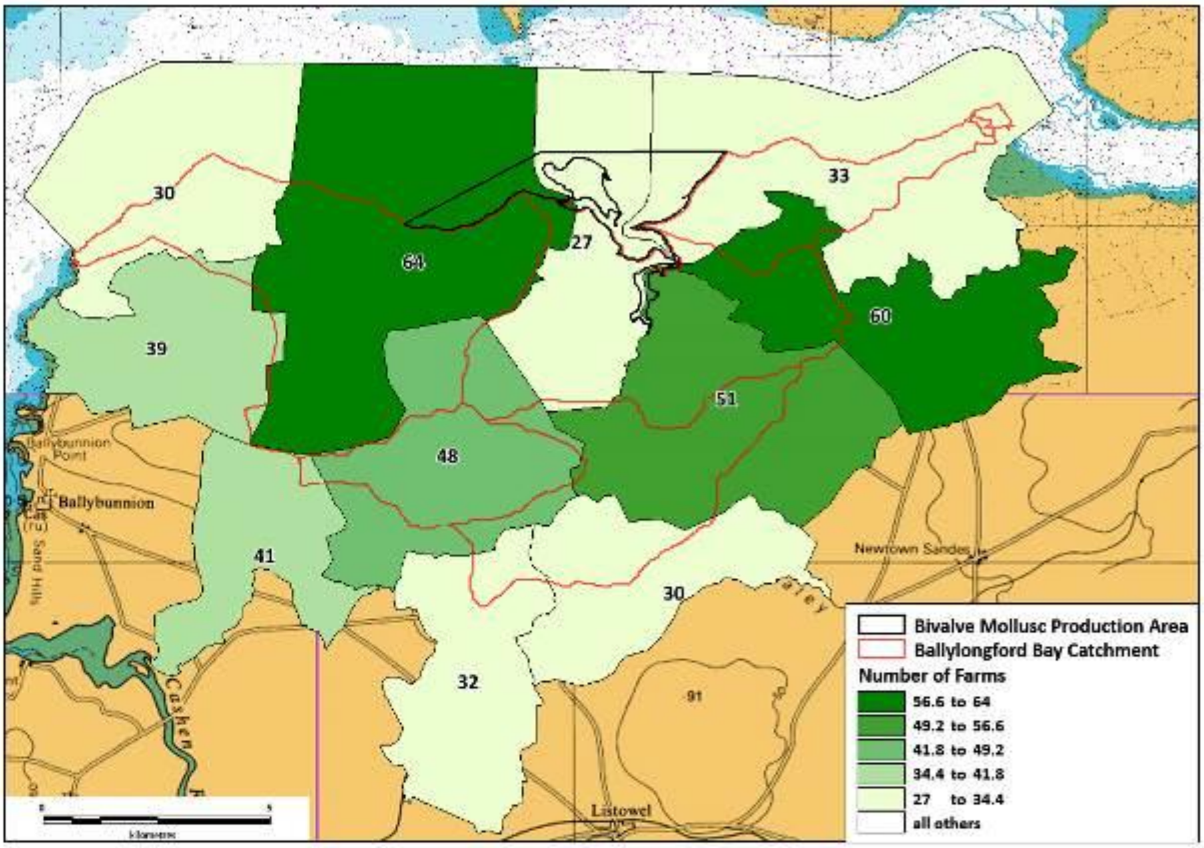


Figure 6.10: Number of farms within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

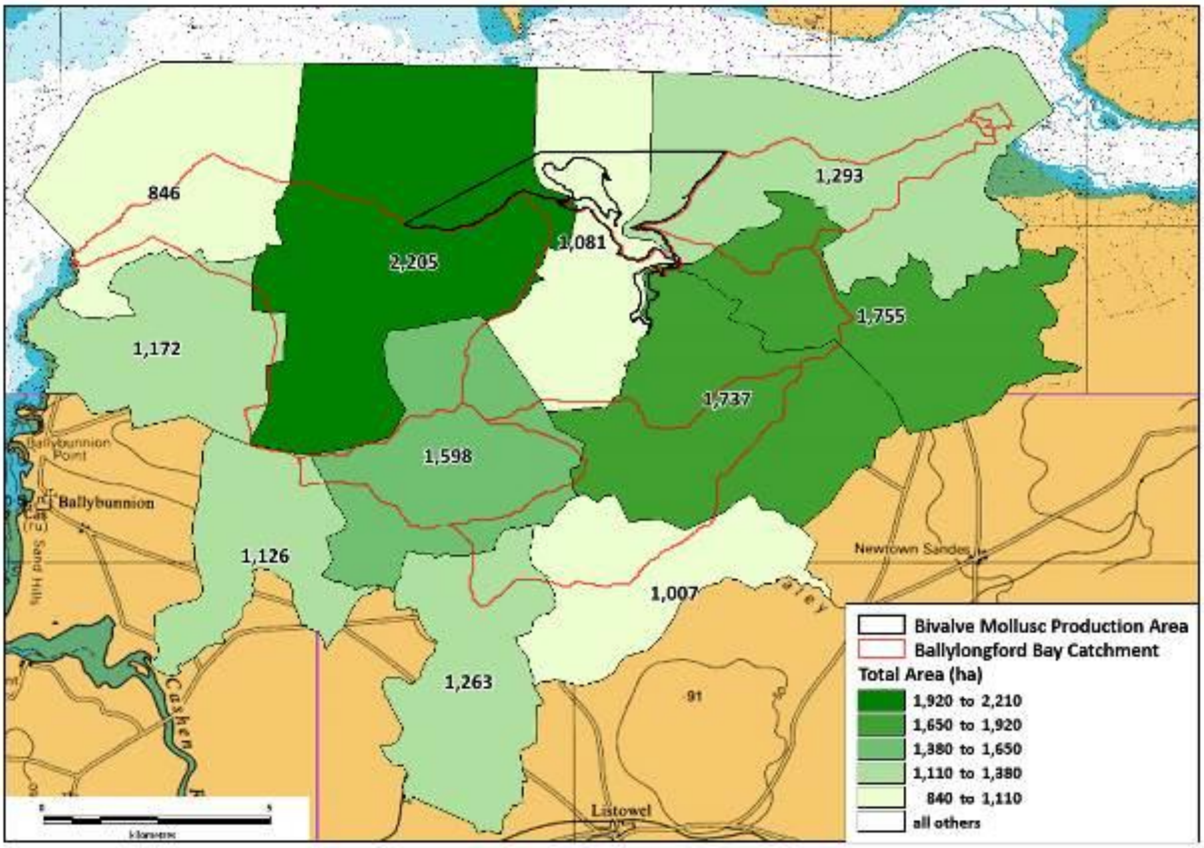


Figure 6.11: Area farmed (ha) within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

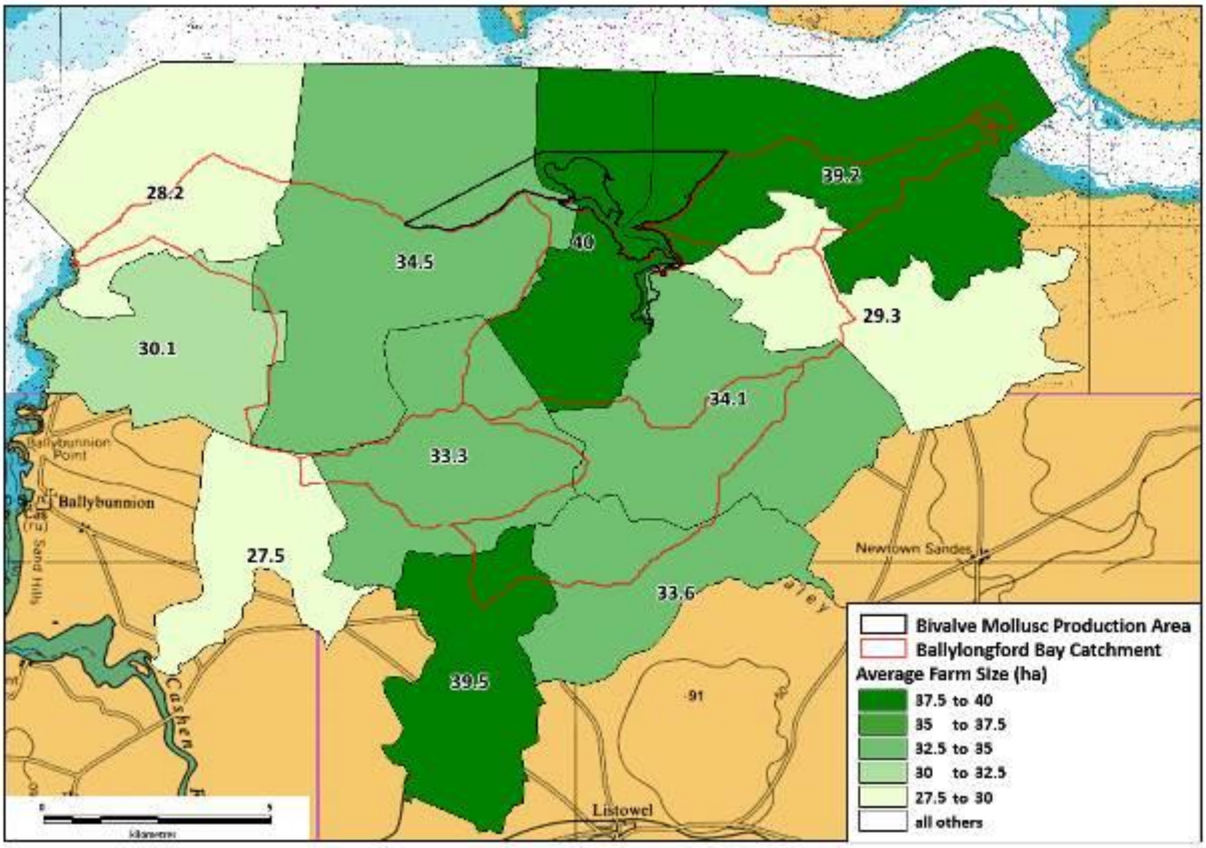


Figure 6.12: Average farm size (ha) within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

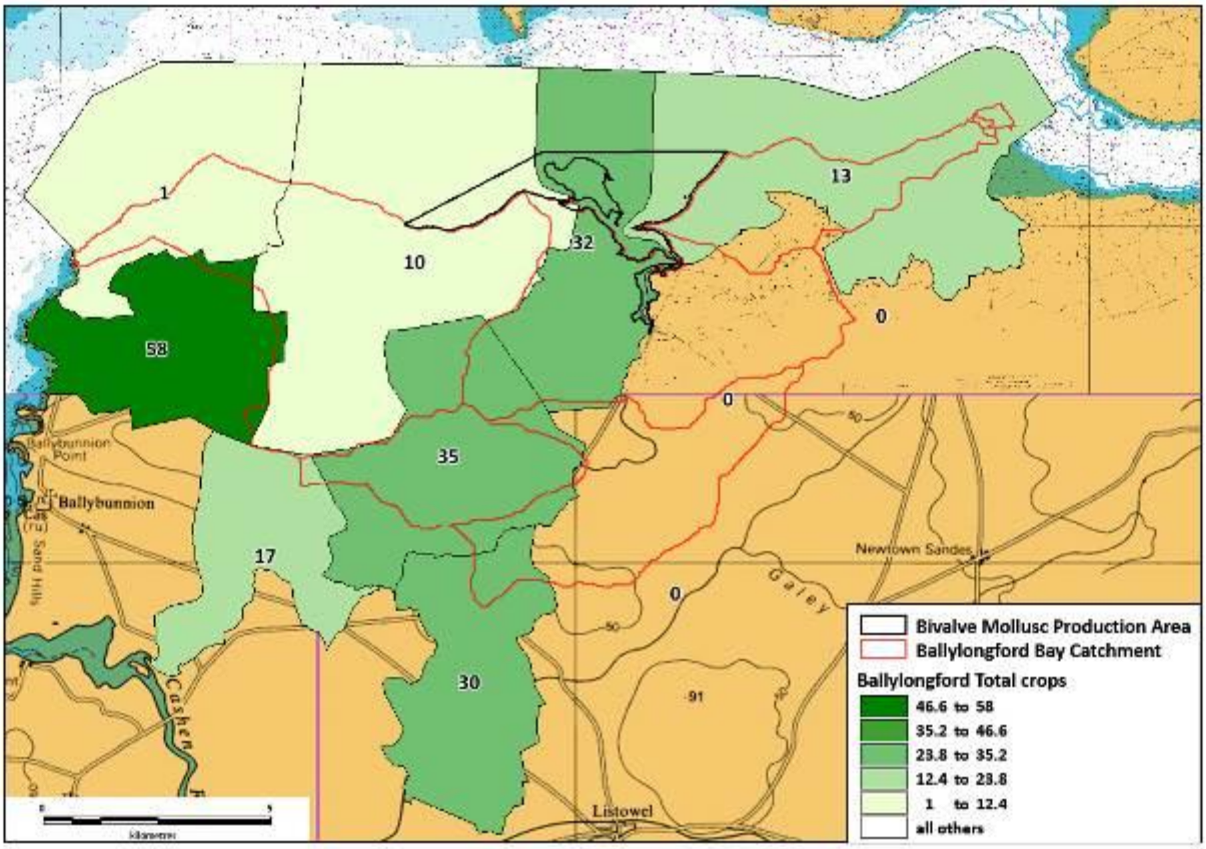


Figure 6.13: Total crops within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

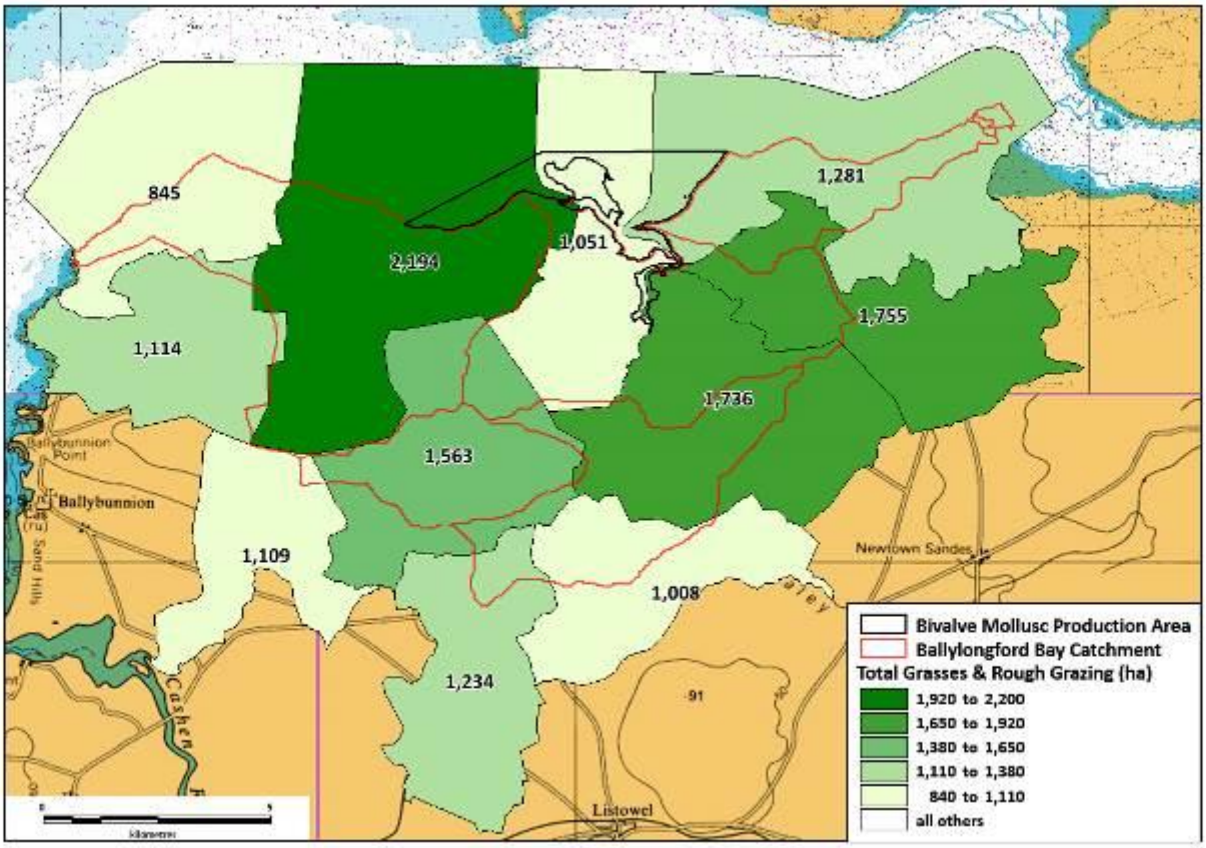


Figure 6.14: Total grass and rough grazing within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

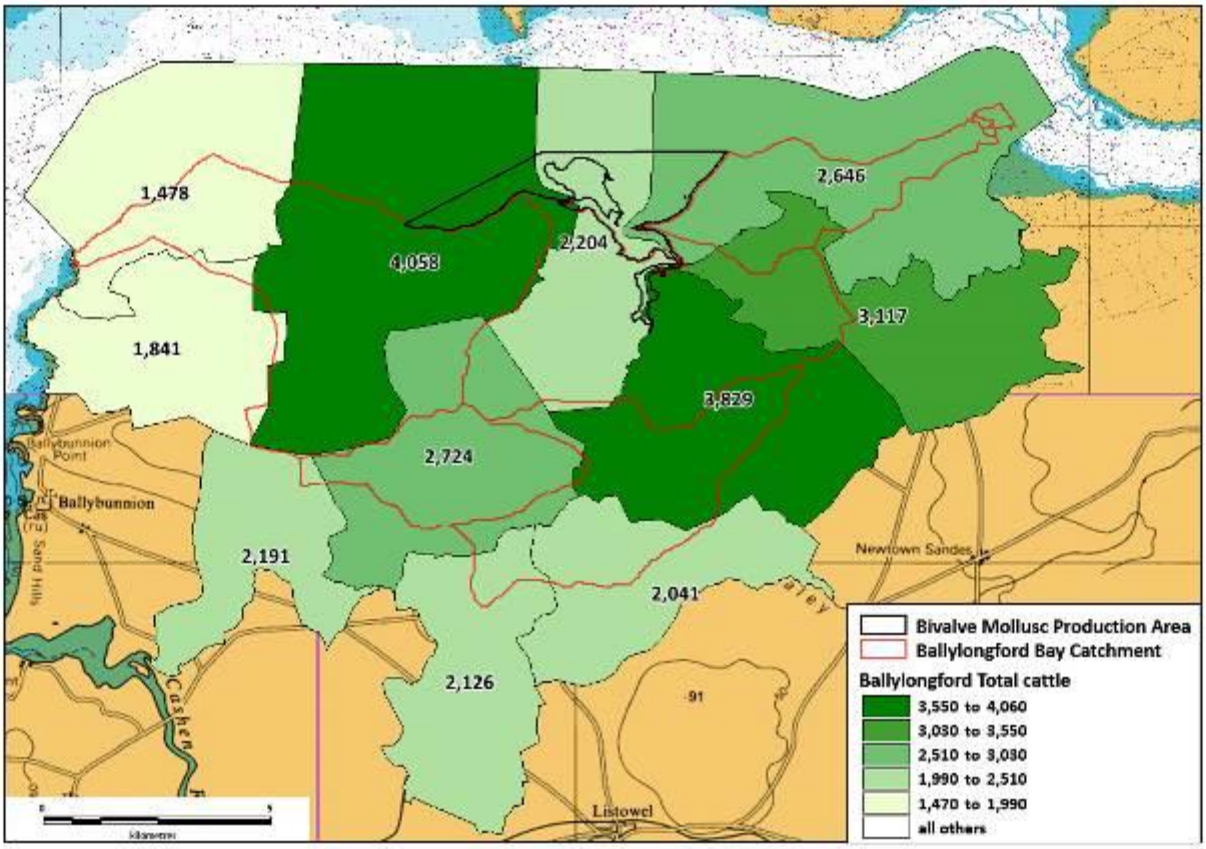


Figure 6.15: Cattle within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

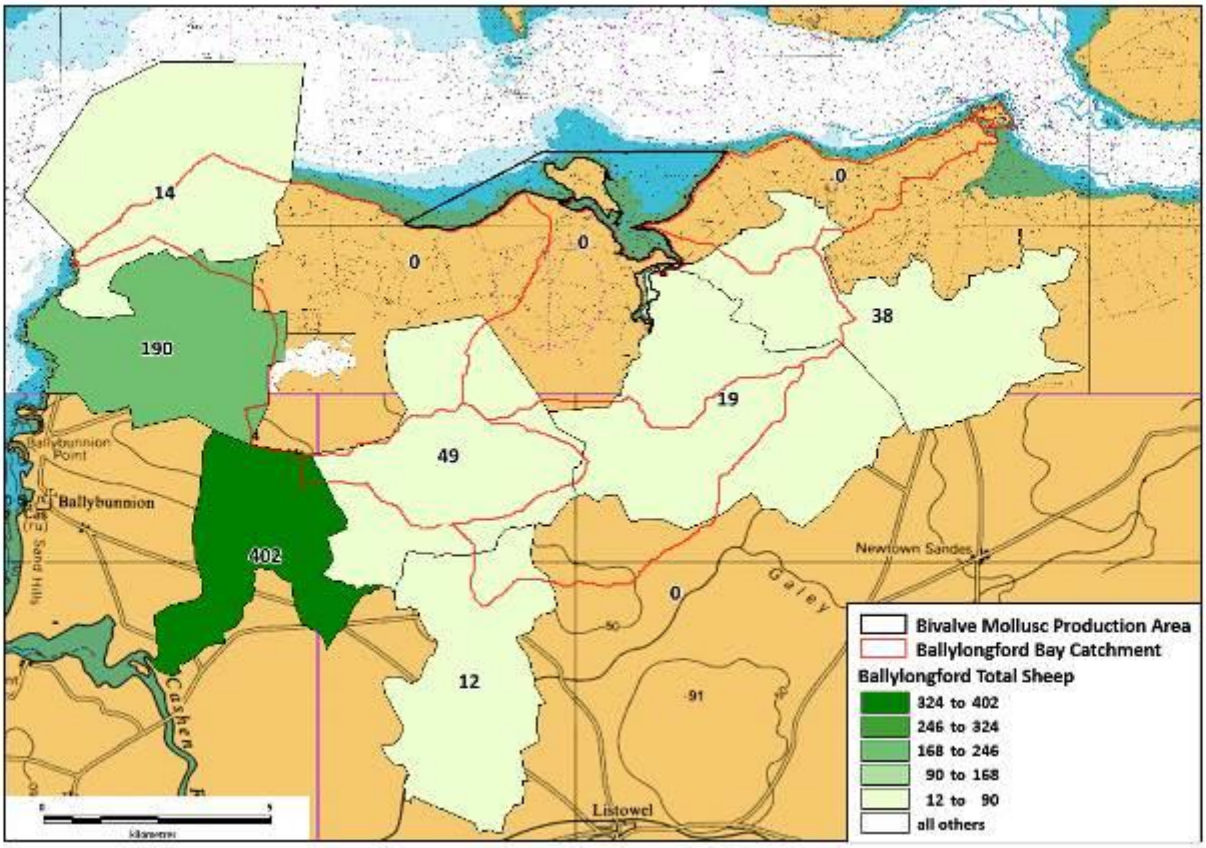


Figure 6.16: Sheep within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

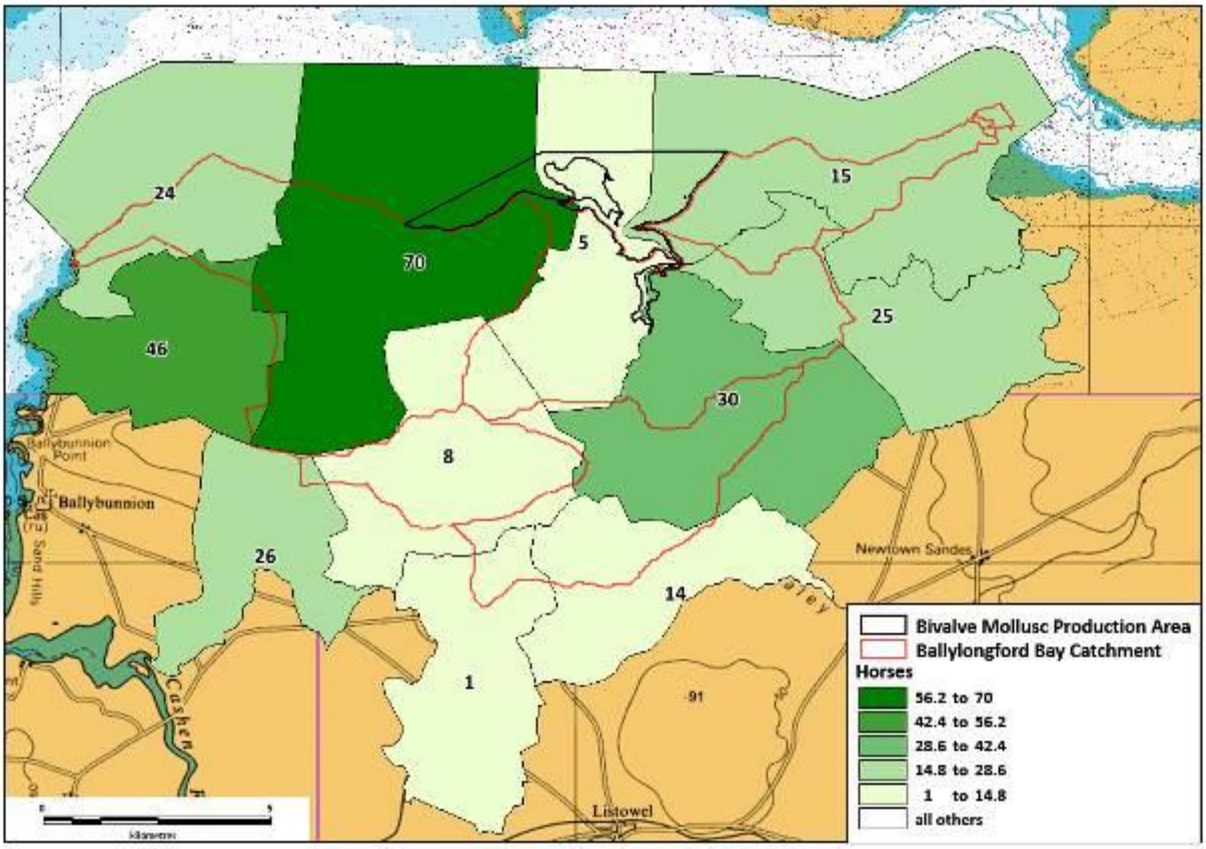


Figure 6.17: Horses within the Ballylongford Bay Catchment Area (Source: CSO, 2019b).

A number of 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 (*e.g.* Crowther *et al.,* 2002). Table 6.10 shows the potential daily loading of *E. coli* from livestock (compared to humans and birds). It can be seen that sheep rank the worst, followed by pigs, cows, birds, humans and poultry.

Table 6.10: 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

The largest majority of livestock in the area are Cattle. Sheep are also present but in relatively low numbers. The majority of agricultural land use in the area is total grass and rough grazing. Cattle are present in relatively large numbers throughout while the highest numbers of sheep are present in the west of the catchment. Livestock droppings along with slurry and farmyard manure may impact the fishery when washed into the sea during and/or after periods of rainfall unless deposited directly on the shoreline.

6.1.6. Other Pollution Sources

6.1.6.1. Shipping

Figure 6.18 shows all boat facilities and activities in Ballylongford Bay.

Table 6.11 details these facilities. There are no commercial ports in Ballylongford Bay. There are no ferries operating in Ballylongford Bay. There is only one several pier or slipway located along the shorelines of Ballylongford Bay. Ballylongford Bay is an inshore pot fishing area for shrimp, lobster and crab (Marine Institute, 2017).

While there is no commercial port in Ballylongford itself traffic for Shannon Foynes, Limerick Harbour and Aughinish Alumina pass by the bay. As these are busy ports there is a relatively high level of traffic therefore the may be a bacteriological impact on the production are although it is not possible to quantify this due to the lack of available information on ship waste.

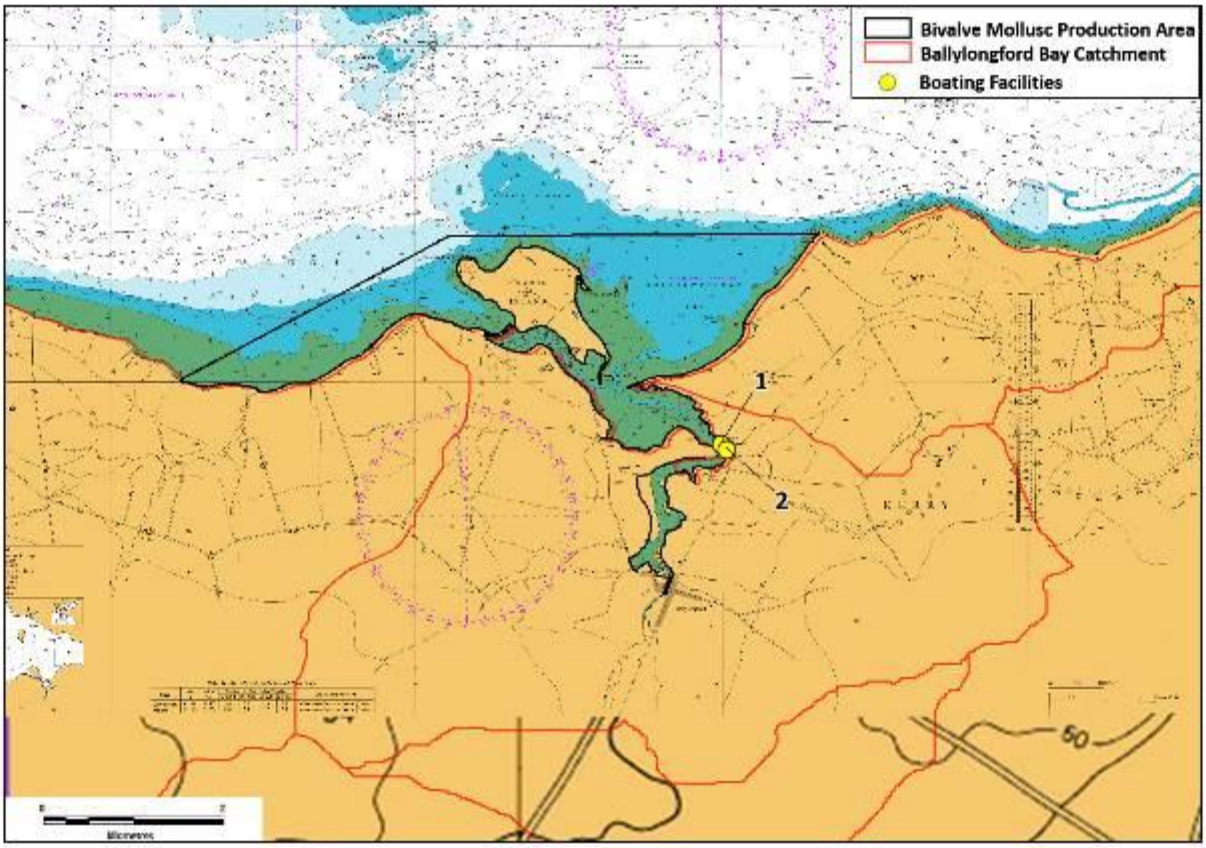


Figure 6.18: Location of all boating facilities and activities in Ballylongford Bay.

Table 6.11: Boating facilities in the Ballylongford Bay. Map Code refers to Figure 6.18.

Map Code	Feature	Use (if known)
1	Pier	Saleen Pier
2	Slip	

6.1.6.2. Wildlife

Birds

It is important to document the bird populations in the Ballylongford 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).

Ballylongford Bay is located within the River Shannon and River Fergus Estuaries SPA (Site Code: 004077). The site is the most important coastal wetland site in the country and regularly supports in excess of 50,000 wintering waterfowl (57,133 - five year mean for the period 1995/96 to 1999/2000), a concentration easily of international importance. The site has internationally important populations of Light-bellied Brent Goose (494), Dunlin (15,131), Black-tailed Godwit (2,035) and Redshank (2,645). A further 17 species have populations of national importance, i.e. Cormorant (245), Whooper Swan (118), Shelduck (1,025), Wigeon (3,761), Teal (2,260), Pintail (62), Shoveler (107), Scaup (102), Ringed Plover (223), Golden Plover (5,664), Grey Plover (558), Lapwing (15,126), Knot (2,015), Bar-tailed Godwit (460), Curlew (2,396), Greenshank (61) and Black-headed Gull (2,681) - figures are five year mean peak counts for the period 1995/96 to 1999/2000. The site is among the most important in the country for several of these species, notably Dunlin (13 % of national total), Lapwing (6% of national total) and Redshank (9% of national total). The site also supports a nationally important breeding population of Cormorant (93 pairs in 2010). Other species that occur include Mute Swan (103), Mallard (441), Red-breasted Merganser (20), Great Crested Grebe (50), Grey Heron (38), Oystercatcher (551), Turnstone (124) and Common Gull (445) - figures are five year mean peak counts for the period 1995/96 to 1999/2000 (NPWS, 2015).

However, Ballylonford makes up only a small part of this very large SPA. As such a reduced number of the aforementioned species will visit the bay regularly. The extent of the SPA can be seen in Figure 2.1.

Aquatic mammals

Common bottlenose dolphins occur in the lower Shannon estuary with a 108+ record in a 12 day survey in 2018 (Rogan et al, 2018). However, there is no information on whether or not they occur in Ballylongford Bay as all records from the survey occurred in the deeper water further out into the Shannon estuary. Both Common (*Phoca vitulina)* and Grey seals (*Haliochoerus grypus*) occur within the lower Shannon estuary but similarly there is no information on whether or not they occur in Ballylongford Bay. It can be presumed that they may visit the area on occasion. Other aquatic mammals that may occur in Ballylonford Bay include Otter (*Lutra lutra)* and Harbour Porpoise (*Phocoena phocoena*).

All aquatic mammals that occur in the BMPA are likely to contribute to background levels of faecal contamination within the area.

6.2. Shoreline Survey

6.2.1. Shoreline Survey Report

A shoreline survey was carried out by the Sea Fisheries Protection Authority between August and September. Figure 3.18 shows the GPS (Global Positioning System) and photography sites accounted for during the four survey days.

The aim of this survey was to identify/confirm and mark all discharges, pollution sources, waterways and marinas along the shoreline. GPS coordinates were recorded for all features and marked on a map. In addition, all features were photographed digitally (where possible). Notes were made on the numbers and types of farm animals obvious from the shoreline and on wild fowl/populations of wild animals with an estimation of their numbers.

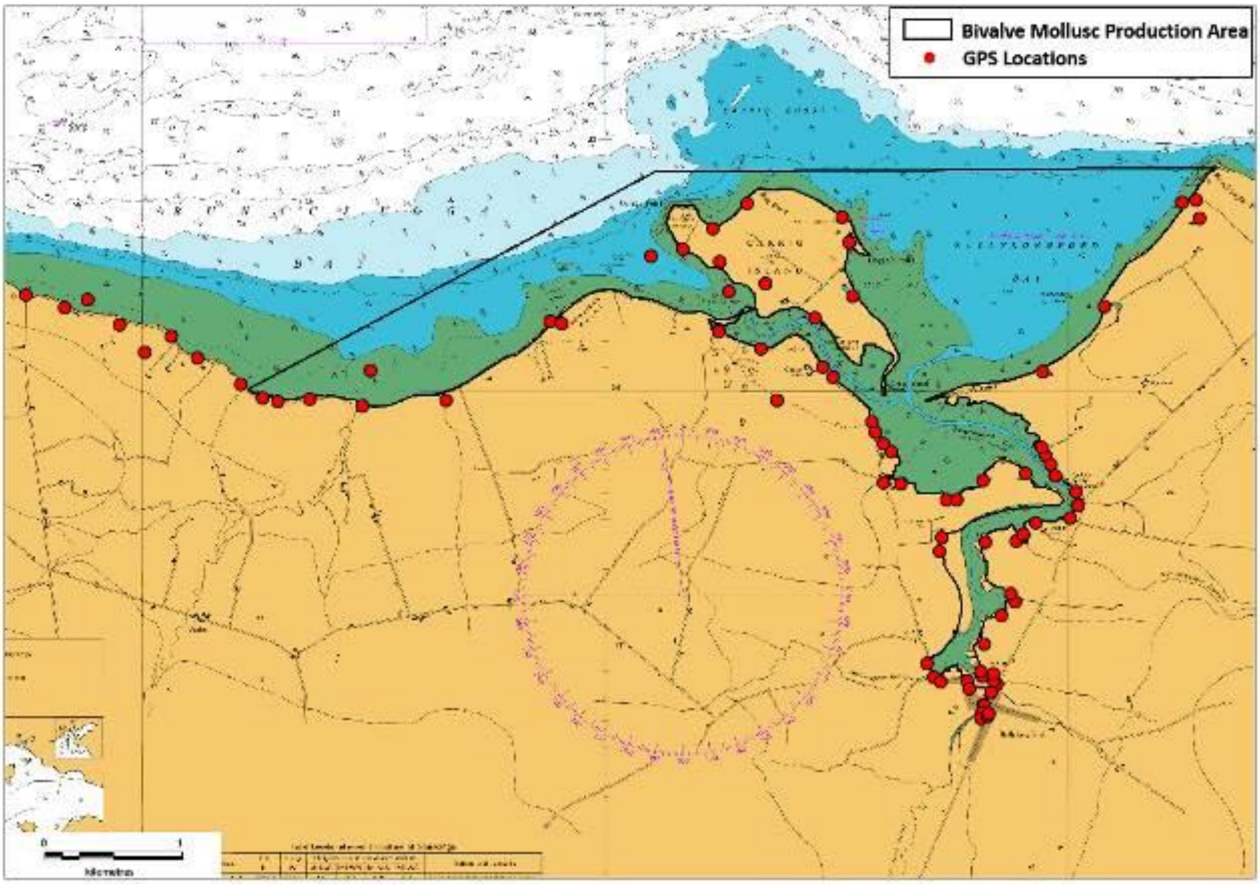


Figure 6.19: Locations of GPS and Photograph Sites.

Figure 6.19 shows the locations of all features observed during the shoreline survey. In total 86 features were identified, of which 16 rivers/streams were identified, 43 drains/ pipes, 1 WWTP pumping stations and outflow, 1 WWTP discharge, 3 location with aquaculture infrastructure, 8 locations with livestock, 4 culverts, 7 storm drains, 2 locations with birds and 2 discharges possibly associated with septic tank overflows. Figure 6.20 to Figure 6.32show aerial imagery of the location of the features and Appendix 6 shows images of most of these features. Table 6.12 details all features identified and the numbering used is cross-referenced to Figure 6.20 to Figure 6.32.

Table 6.12: Features identified during the shoreline survey. Refer to Figure 6.20–Figure 6.32 for locations and Appendix 6 for photographs.

Map Code	Observation	Comments	Longitude	Latitude	Easting	Northing
1	Large piped storm drain	Enrichment from stream	-9.57995	52.57355	92,933.7	148,044.1
2	Field drain	flowing water clear	-9.5758	52.5727	93,212.9	147,943.4
3	Field drain	no much flow water clear	-9.5733	52.5732	93,383.6	147,995.3
4	Field drain	flowing water clear	-9.56985	52.5716	93,613.6	147,812.2
5	30+ sheep in field	sheep grazing up from shore	-9.5671	52.56975	93,795.6	147,602.3
6	piped field drain	good flow, bit of enrichment flowing through marsh	-9.5643	52.57079	93,988.0	147,713.9
7	piped field drain plastic	good flow water clear, flowing through pasture land	-9.5614	52.56939	94,181.2	147,553.9
8	piped field drain concrete	flowing, clear water	-9.55667	52.56767	94,497.8	147,355.5
9	land drain coming through stone	flowing through pasture land, clear	-9.55439	52.56673	94,650.1	147,247.6
10	Concrete pipe blocked, flowing either side	draining good pasture land, a bit of enrichment	-9.55276	52.56651	94,760.1	147,220.7
11	Concrete pipe blocked, flowing either side	draining good pasture land, a bit of enrichment	-9.54929	52.56666	94,995.7	147,232.4
12	small river 7M wide	big farm up stream, cows next to river	-9.54362	52.56623	95,379.1	147,176.3
13	Birds feeding on shore	mixed flock , waders and gulls	-9.54272	52.56859	95,445.8	147,437.6
14	Flowing stream	flowing through pasture land, big farm up stream	-9.53457	52.5666	95,993.7	147,204.4
15	Licenced aquaculture point	Entrance to KY-BD-BD-PO site	-9.52332	52.57176	96,768.6	147,762.4
16	Small stream/field drain	Small stream, low flow from marshy area. Water slightly dirty	-9.52332	52.57176	96,768.6	147,762.4
17	Large stream	Fast flowing into sea from drainage channels	-9.52212	52.57161	96,849.6	147,744.0
18	Inlet Drains	Network of drainage channels	-9.50517	52.57124	97,997.9	147,678.7
19	Large stream	Fast flowing into estuary through 18 inch concrete pipe	-9.50514	52.57113	97,999.7	147,666.4
20	Concrete outflow pipe	Small stream, low flow. Water clear	-9.50051	52.56995	98,310.8	147,528.6
21	Cows	Cows 20+. Pasture and grazing land.	-9.50006	52.5743	98,351.4	148,012.0
22	Concrete outflow pipe	Stone pipe built into wall, medium flow. Some eutrophication evident.	-9.50006	52.5743	98,351.4	148,012.0
23	Concrete outflow pipe	Concrete 18 inch pipe protruding onto shoreline, very little flow	-9.505	52.5757	98,019.8	148,174.7

Map Code	Observation	Comments	Longitude	Latitude	Easting	Northing
24	Oyster trestles	Approx 20-30 abandoned oyster trestles	-9.50402	52.57377	98,081.7	147,958.6
25	Concrete outflow pipe	Concrete 18 inch pipe protruding onto shoreline, very little flow	-9.50899	52.57655	97,751.3	148,274.9
26	Oyster trestles	Approx 40-50 abandoned oyster trestles	-9.51243	52.57611	97,517.0	148,230.9
27	Small stream/field drain	Low land stream, slight discoloration in water, no cattle observed	-9.50577	52.57792	97,972.7	148,422.8
28	Saltwater lake	Flowing into sea.	-9.50205	52.57954	98,228.6	148,597.8
29	30+ cattle in field above shore	cattle feeding from feeder	-9.49178	52.57864	98,922.7	148,483.2
30	small drain, canal	small flow water a bit brown	-9.49105	52.57697	98,968.4	148,296.4
31	Drain from Turlough	good flow clear water	-9.4906	52.5734	98,990.6	147,898.5
32	Cattle in field 20+	cattle in field	-9.49472	52.57197	98,708.0	147,745.2
33	Small stream/field drain	200 meters from castle	-9.49388	52.56878	98,757.6	147,389.0
34	Small stream/field drain	Small drain, water clear and good flow	-9.49269	52.56807	98,836.7	147,308.4
35	Large culvert	18 inch concrete pipe, slight nutrification in water	-9.48855	52.56512	99,110.6	146,974.3
36	Field drain	Medium size drain, water clear and good flow	-9.48819	52.56443	99,133.4	146,897.0
37	Field drain	Medium size drain, water clear with low flow	-9.4873	52.56368	99,192.1	146,812.3
38	Field drain	Water discoloured, round bale feeder in drain,15-20 cows observed in farmyard	-9.48643	52.56319	99,249.9	146,756.6
39	Large culvert	18 inch concrete pipe, long drainage pipe into marshy land	-9.48544	52.56109	99,312.3	146,521.5
40	River	6 m wide river, fast flow, slightly discoloured	-9.48731	52.56118	99,185.7	146,534.2
41	Field drain	Drainage pipe from farm into marshy land	-9.48105	52.5575	99,601.8	146,115.9
42	Small culvert	Drainage pipe from farm into marshy land, water slightly clouded	-9.4812	52.55662	99,589.6	146,018.2
43	field drain	flowing, farm just 300m up from pipe	-9.48057	52.56003	99,640.1	146,396.8
44	land drain	very little flow flowing through agricultural land	-9.47939	52.56002	99,720.1	146,394.0
45	field drain	flowing water clear	-9.47655	52.56129	99,915.6	146,531.4
46	field drain	sluice gate good flow	-9.47195	52.56173	100,228.5	146,574.0
47	Field drain	10 inch concrete pipe flowing under main road from field into estuary, no animals in fields	-9.48269	52.54923	99,471.6	145,198.0

Map Code	Observation	Comments	Longitude	Latitude	Easting	Northing
48	River	2 to 3 meter wide river flowing under main road into estuary, visibly dirty	-9.48188	52.54831	99,524.5	145,094.5
49	Field drain	Drainage pipe, water slightly dirty	-9.481111	52.54799	99,575.9	145,057.8
50	Main outflow pumping station	Main outflow pipe from fenced off structure , 20 m approx. out into channel	-9.49881	52.56659	98,418.3	147,152.3
51	pumping station	Fenced off structure	-9.49881	52.56659	98,418.3	147,152.3
52	Storm drain	12 inch drain with rubber end, outflow clean	-9.47828	52.5481	99,768.2	145,066.1
53	Storm drain	storm drain with sluice cover	-9.478	52.54757	99,786.0	145,006.8
54	Small culvert	Small culvert across from Centra shop in town, cover on end of pipe with low flow	-9.47803	52.54757	99,783.9	145,006.8
55	River	Main river located in the town shed	-9.47661	52.54648	99,877.8	144,883.5
56	surface water drains NO.3	3 storm water drains from street above	-9.47645	52.54644	99,888.5	144,878.9
57	possible septic tank overflow	very dirty water strong odour	-9.47665	52.54601	99,874.0	144,831.3
58	storm drain with sluice cover	100m up from bridge Beale side of river by school	-9.47687	52.5456	99,858.1	144,786.0
59	concrete storm drain	Flowing possible sewage. Tarbert side of river	-9.476354	52.546157	99,907	144,860
60	10 No. drains on concrete wall	Drains with sluice covers, raw sewage coming out of one. Tarbert side	-9.476413	52.546068	99,903	144,850
61	Stream 3 sluice gates 50 m up	a bit of a flow	-9.47577	52.54731	99,936.7	144,974.7
62	Stream	bridge across road	-9.4751	52.54786	99,983.4	145,035.0
63	possible septic tank overflow	non return valve on pipe, just below house	-9.47551	52.54808	99,956.0	145,060.0
64	Field drain and concrete drain	sluice gate on concrete drain, trickle flow	-9.47548	52.54857	99,959.2	145,114.5
65	long concrete square drain	WWTP outflow in middle of the river	-9.47673	52.54843	99,874.1	145,100.7
66	Field drain	very little flow	-9.47688	52.54873	99,864.6	145,134.3
67	Field drain and cows	very little flow 20+ cows	-9.47645	52.55049	99,897.8	145,329.5
68	field drain	brown staining in drain	-9.4746	52.55242	100,027.6	145,541.7
69	stream	a bit of foam in the water	-9.47307	52.55326	100,133.3	145,633.1

Map Code	Observation	Comments	Longitude	Latitude	Easting	Northing
70	land drain	30+ cows in field above water brown	-9.47354	52.5538	100,102.7	145,693.8
71	drain through marsh land	tidal flow through here	-9.47628	52.55724	99,924.7	146,080.4
72	cows in field	15+ cows in field above shore	-9.47294	52.55729	100,151.3	146,081.3
73	Glashanagaloon stream	good flow 60 + duck and waters also here	-9.4722	52.55773	100,202.5	146,129.2
74	field drain	Wavin pipe no flow	-9.4709	52.55846	100,292.3	146,208.7
75	drain	very little flow two tyres on left	-9.46714	52.55879	100,548.0	146,240.2
76	stream flowing	water a little grey	-9.46623	52.55964	100,611.7	146,333.5
77	Saleen Pier storm drain	drain flowing into river at pier	-9.46647	52.56049	100,597.3	146,428.4
78	Land drain	a little trickle of grey water	-9.46881	52.56161	100,441.2	146,556.3
79	land drain	a bit of enrichment	-9.46928	52.56237	100,411.0	146,641.5
80	land drain	very little flow 20+ cows	-9.46969	52.56288	100,384.4	146,698.8
81	Cows above shore	10 cows	-9.47024	52.56346	100,348.4	146,764.1
82	small land drain	flowing through forestry	-9.47005	52.56846	100,372.6	147,320.2
83	Stream	3m wide good flow	-9.46346	52.57273	100,829.1	147,786.3
84	Stream Knockfinglas point	clear water a little enrichment	-9.45353	52.57971	101,517.9	148,549.4
85	cows above shore	20 cows	-9.45312	52.57857	101,543.2	148,422.0
86	Field drain	draining through reed bed	-9.45496	52.57961	101,420.8	148,540.2

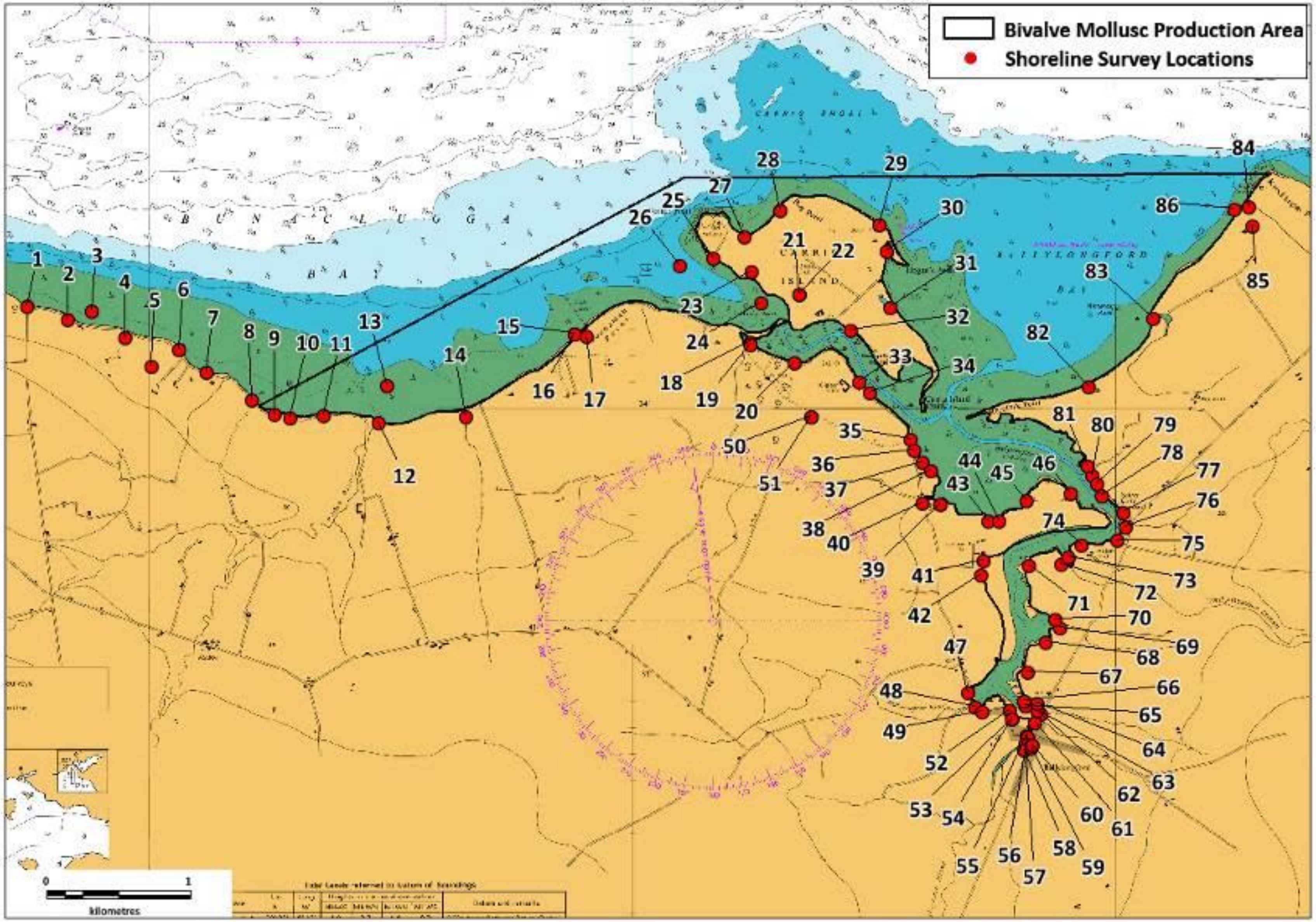


Figure 6.20: All features (numbering cross-reference to Table 6.12) identified during the shoreline survey.

Figure 6.21: Features 1-7 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

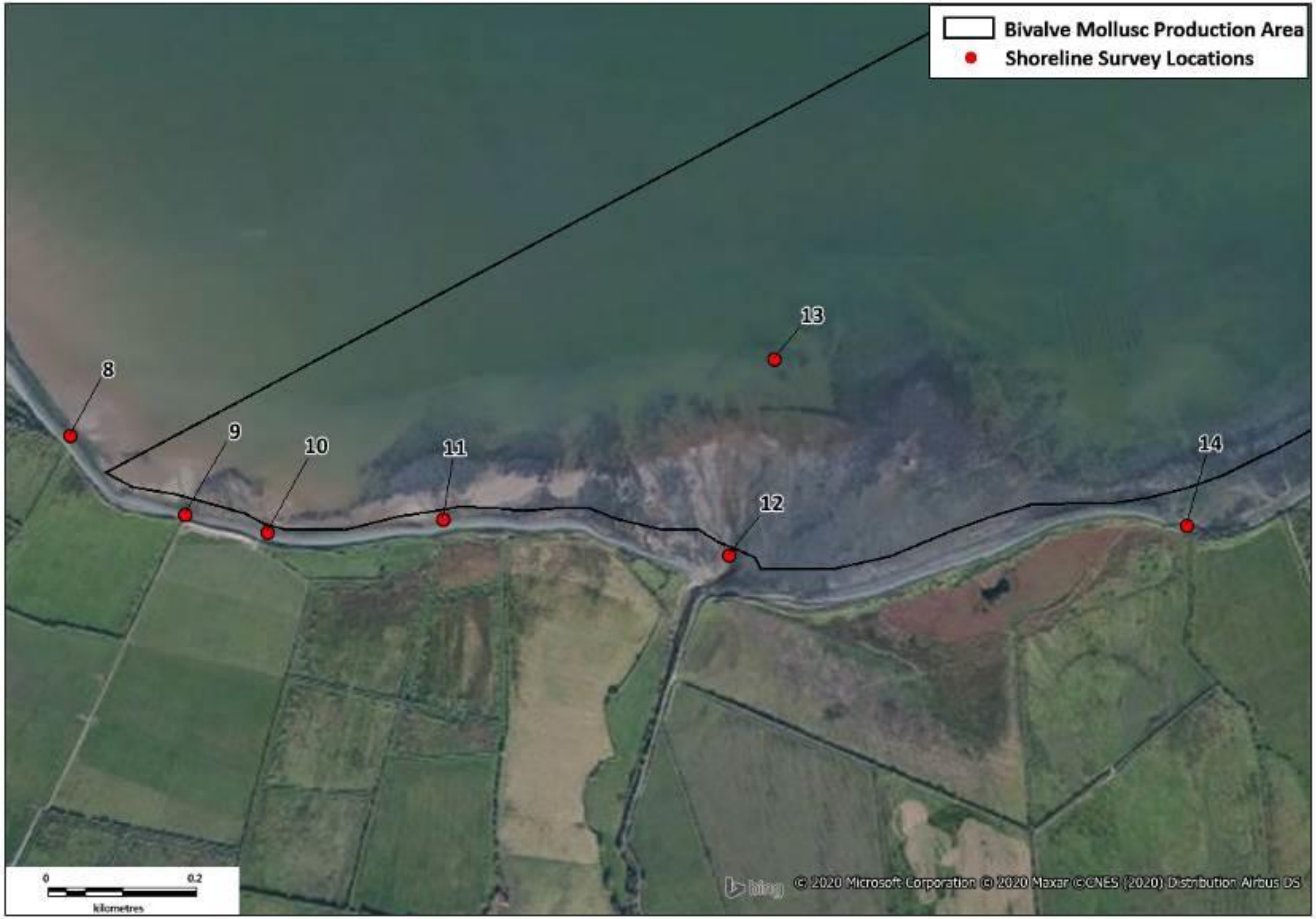


Figure 6.22: Features 8-14 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

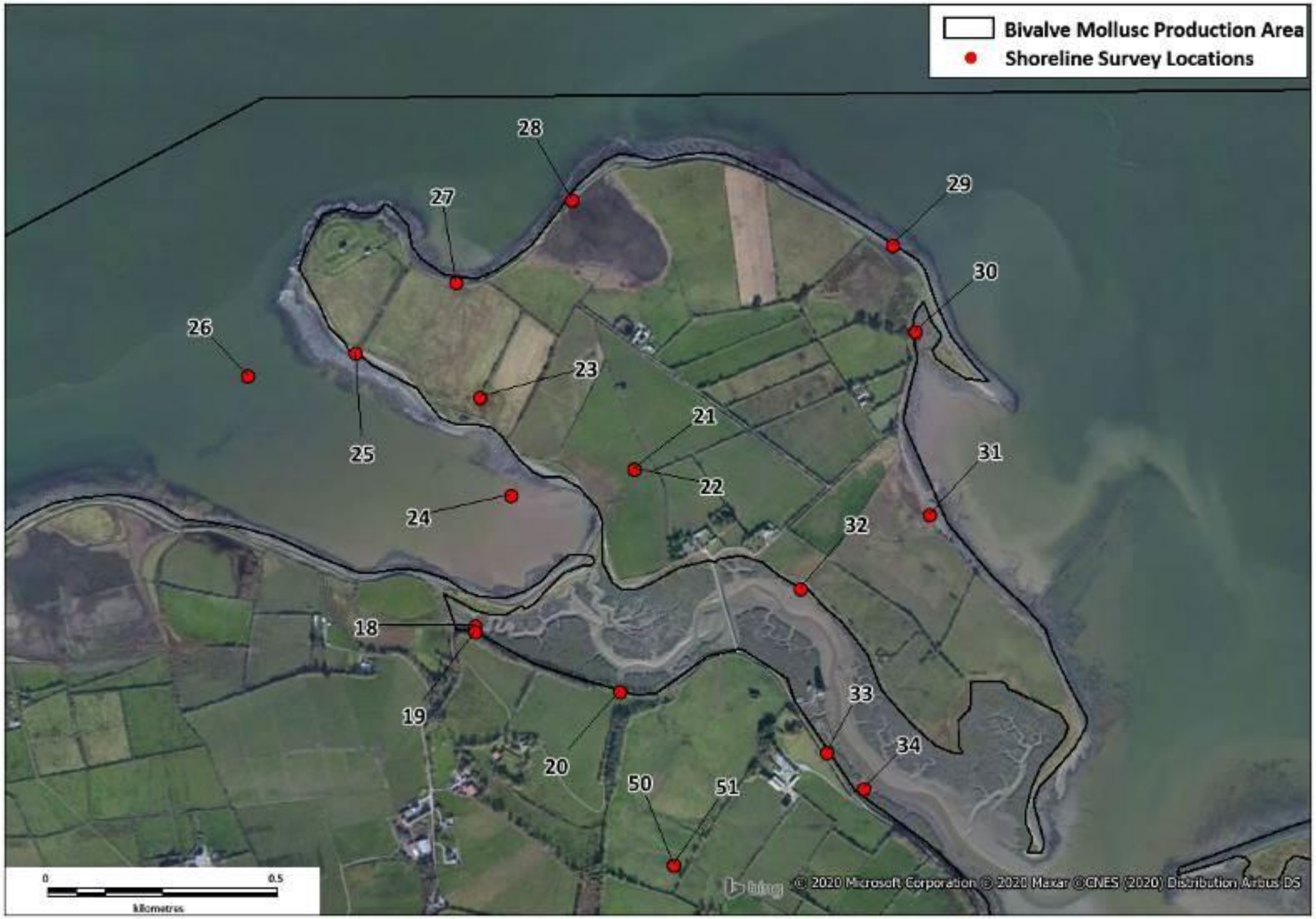


Figure 6.23: Features 18-34, 50-51 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

Figure 6.24: Features 35-40, 43-45 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

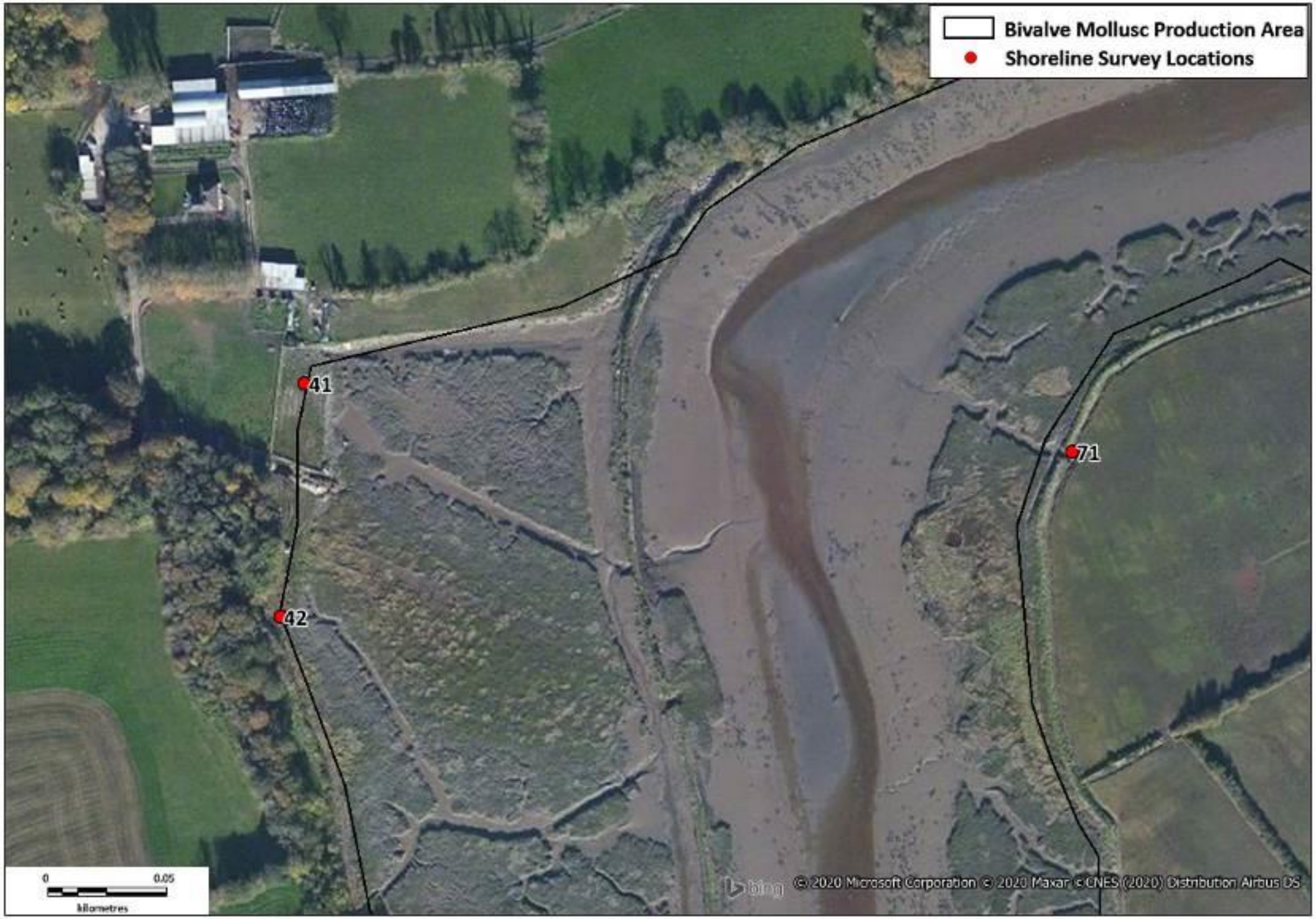


Figure 6.25: Features 41-42, 71 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

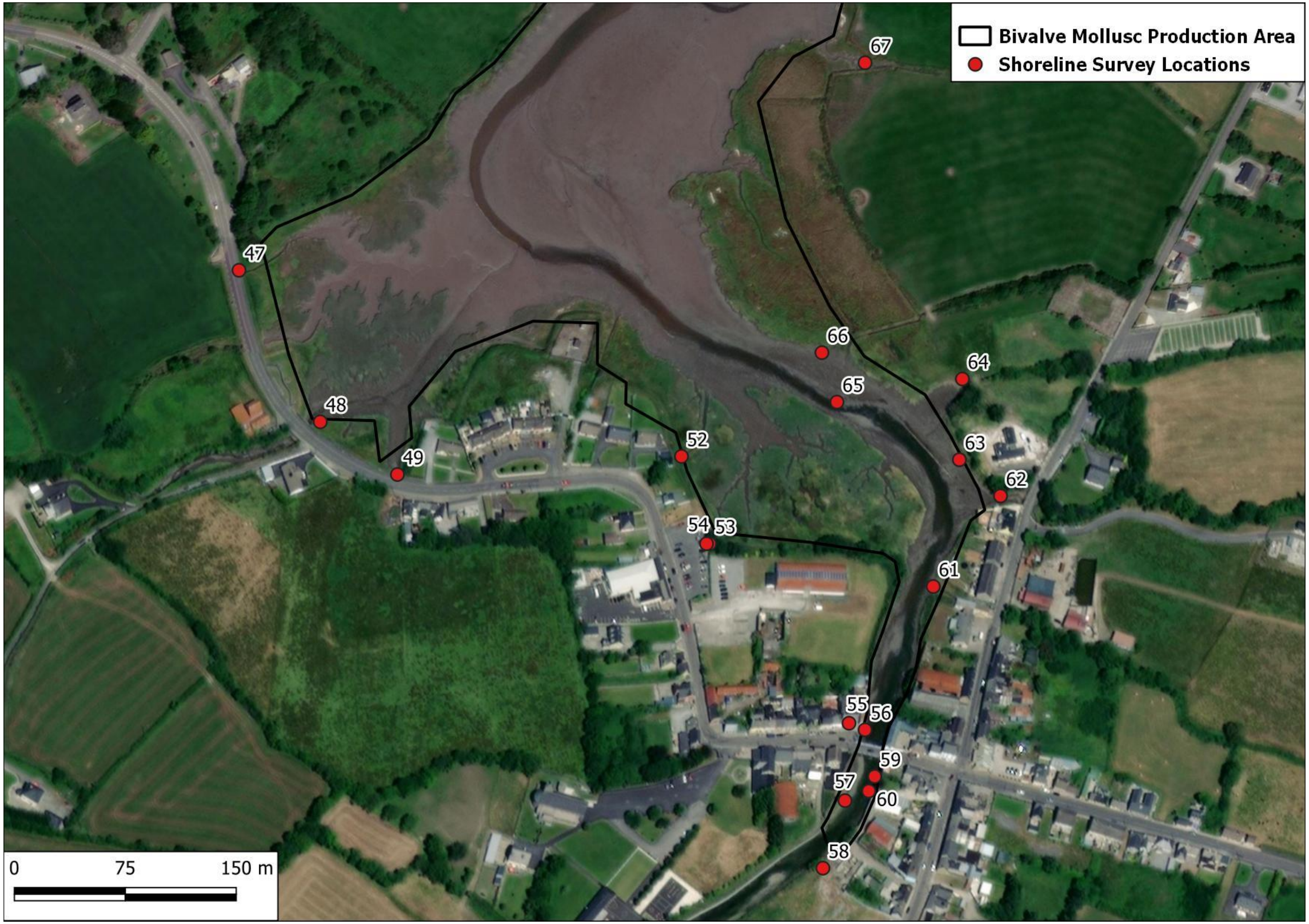


Figure 6.26: Features 47-49, 52-67 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

Figure 6.27: Features 68-70 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

Figure 6.28: Features 72-74 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

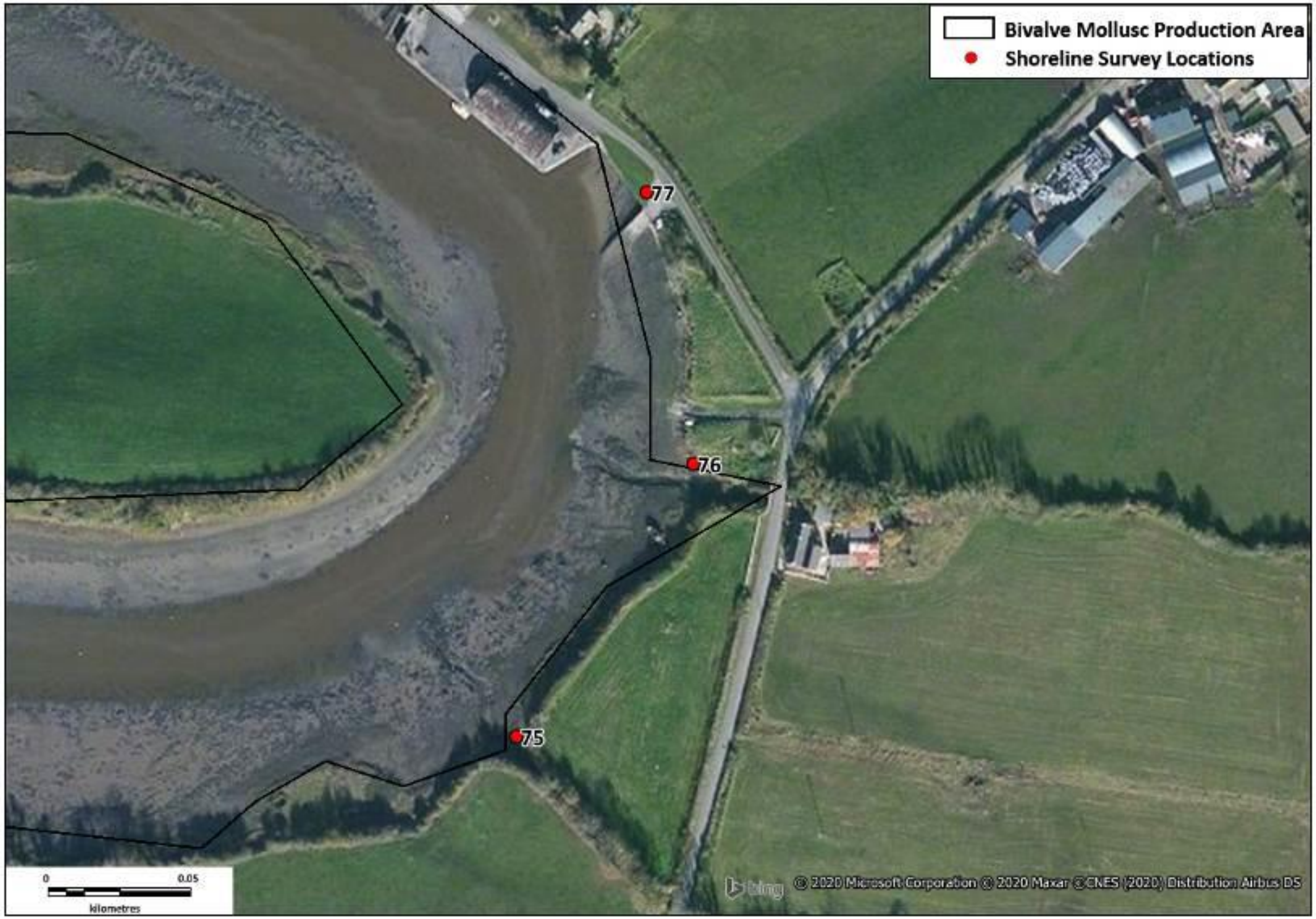


Figure 6.29: Features 75-77 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

Figure 6.30: Features 78-81, 46 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

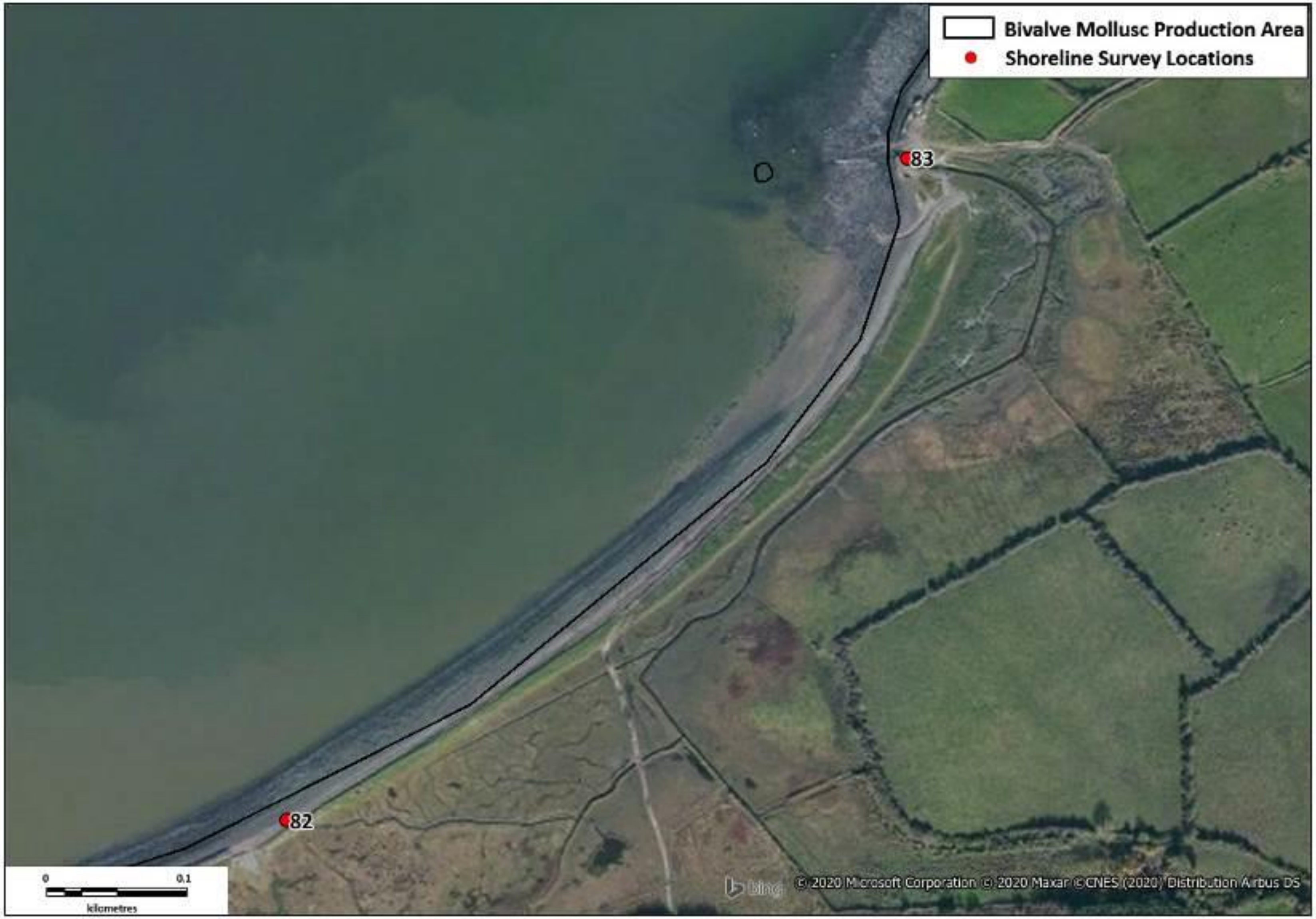


Figure 6.31: Features 82-83 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

Figure 6.32: Features 84-86 (numbering cross-reference to Table 6.12) identified during the shoreline survey.

6.2.2. Locations of Sources

Figure 6.33 shows all watercourses discharging into Ballylongford Bay and Table 6.13 provides cross-referenced details for this map. Figure 6.34 shows all discharges in the Ballylongford Bay catchment area and Table 6.14 provides cross-referenced details for all of these discharges.

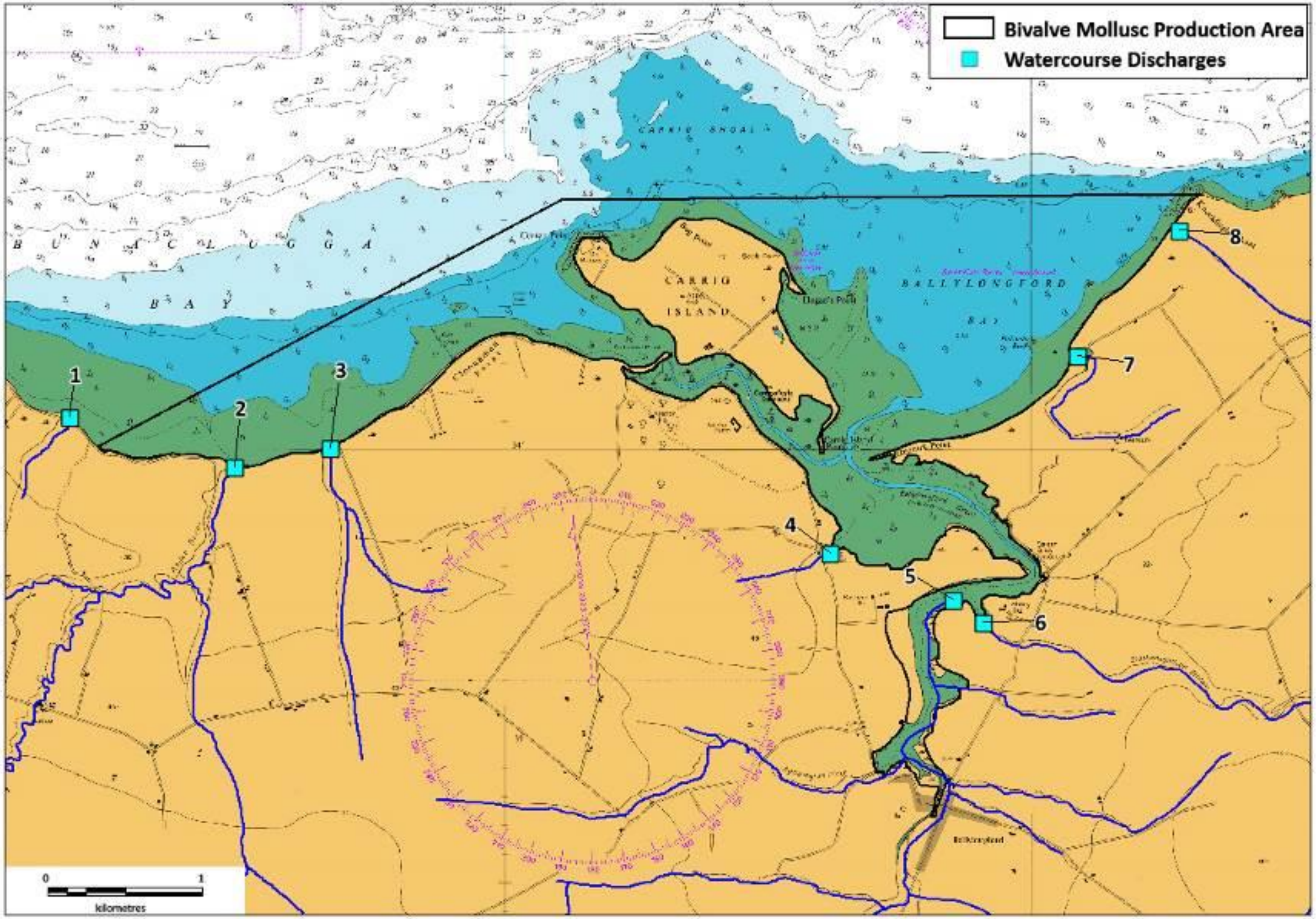


Figure 6.33: Location of all watercourses discharging into Ballylongford Bay.

Table 6.13: Cross-referenced table for Figure 6.33 Watercourses.

Map ID	Watercourse
1	Unnamed
2	Asdee River
3	Unnamed
4	Unnamed
5	Ballylongford
6	Unnamed
7	Unnamed
8	Unnamed

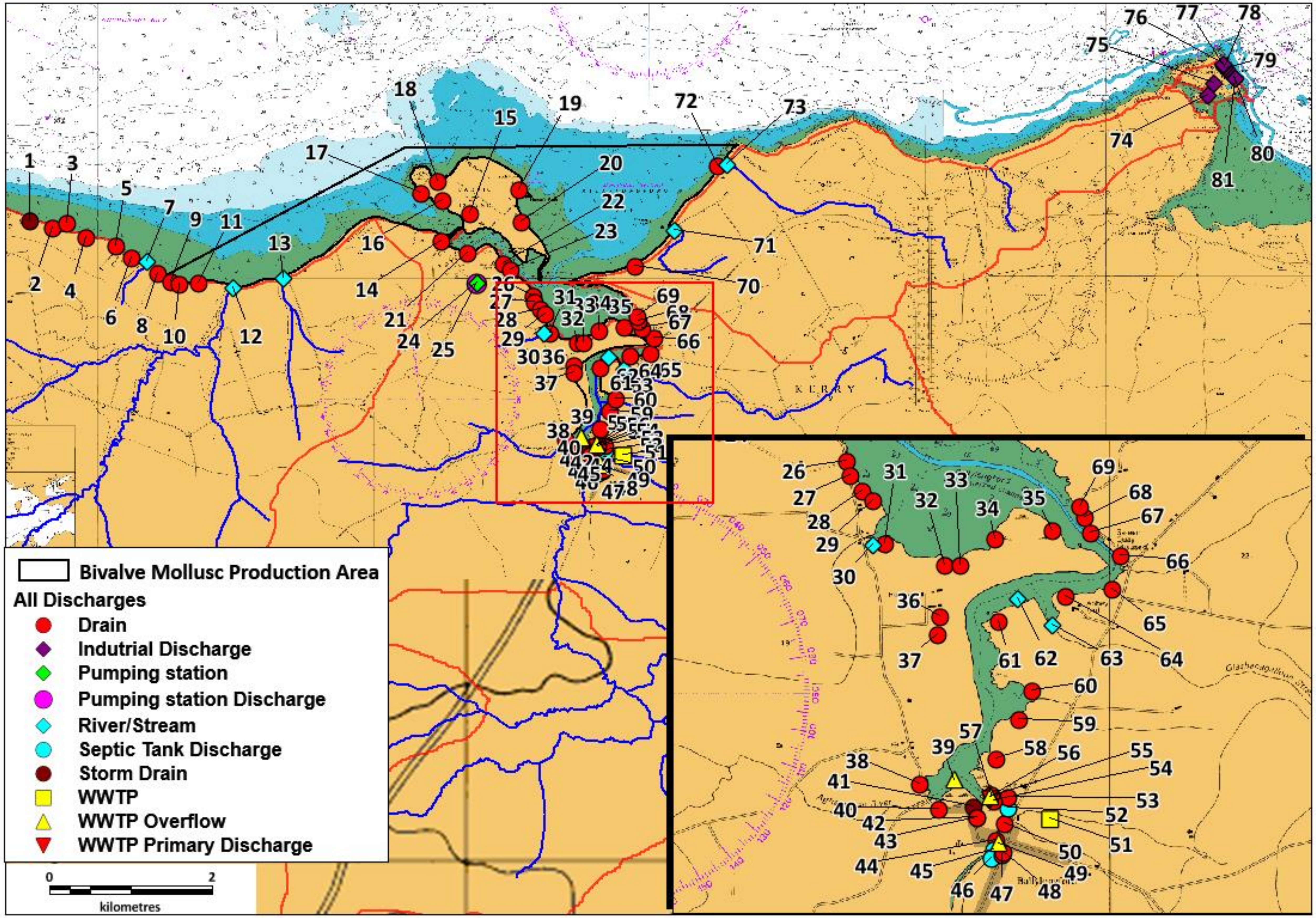


Figure 6.34: Locations of all discharges within Ballylongford Bay Catchment Area.

Table 6.14: Cross-referenced table for Figure 6.34 Discharges.

Map_ID	Observation	Comments	Longitude	Latitude	Easting	Northing
1	Large piped storm drain	Enrichment from stream	-9.57995	52.57355	92933.7	148044.1
2	Field drain	flowing water clear	-9.5758	52.5727	93212.9	147943.4
3	Field drain	no much flow water clear	-9.5733	52.5732	93383.6	147995.3
4	Field drain	flowing water clear	-9.56985	52.5716	93613.6	147812.2
5	piped field drain	good flow, bit of enrichment flowing through marsh	-9.5643	52.57079	93988.0	147713.9
6	piped field drain plastic	good flow water clear, flowing through pasture land	-9.5614	52.56939	94181.2	147553.9
7	River/Stream	Unnamed River	-9.558581	52.56897	94371.3	147503.0
8	piped field drain concrete	flowing, clear water	-9.55667	52.56767	94497.8	147355.5
9	land drain coming through stone	flowing through pasture land, clear	-9.55439	52.56673	94650.1	147247.6
10	Concrete pipe blocked,flowing either side	draining good pasture land, a bit of enrichment	-9.55276	52.56651	94760.1	147220.7
11	Concrete pipe blocked,flowing either side	draining good pasture land, a bit of enrichment	-9.54929	52.56666	94995.7	147232.4
12	River/Stream	Asdee River	-9.542997	52.566046	95421.0	147154.9
13	River/Stream	Unnamed River	-9.533839	52.567182	96044.6	147268.1
14	Inlet Drains	Network of drainage channels	-9.50517	52.57124	97997.9	147678.7
15	Conc outflow pipe	Stone pipe built into wall, medium flow. Some eutrophication evident.	-9.50006	52.5743	98351.4	148012.0
16	Conc outflow pipe	Conc 18 inch pipe protruding onto shoreline, very little flow	-9.505	52.5757	98019.8	148174.7
17	Conc outflow pipe	Conc 18 inch pipe protruding onto shoreline,very little flow	-9.50899	52.57655	97751.3	148274.9
18	Small stream/field drain	Low land stream,slight discoloration in water,no cattle observed	-9.50577	52.57792	97972.7	148422.8

Map_ID	Observation	Comments	Longitude	Latitude	Easting	Northing
19	small drain, canal	small flow water a bit brown	-9.49105	52.57697	98968.4	148296.4
20	Drain from Turlough	good flow clear water	-9.4906	52.5734	98990.6	147898.5
21	Conc outflow pipe	Small stream, lowflow. Water clear	-9.50051	52.56995	98310.8	147528.6
22	Small stream/field drain	200 meters from castle	-9.49388	52.56878	98757.6	147389.0
23	Small stream/field drain	Small drain,water clear and good flow	-9.49269	52.56807	98836.7	147308.4
24	Main ouflow pumping station	Main ouflow pipe from fenced off structure , 20 mts approx out into channel	-9.49881	52.56659	98418.3	147152.3
25	pumping station	Fenced off structure	-9.49881	52.56659	98418.3	147152.3
26	Large culvert	18 inch conc pipe,slight nutrification in water	-9.48855	52.56512	99110.6	146974.3
27	Field drain	Medium size drain,water clear and good flow	-9.48819	52.56443	99133.4	146897.0
28	Field drain	Medium size drain,water clear with low flow	-9.4873	52.56368	99192.1	146812.3
29	Field drain	Water discoloured,round bale feeder in drain,15-20 cows observed in farmyard	-9.48643	52.56319	99249.9	146756.6
30	River/Stream	Unnamed River	-9.486454	52.561033	99243.4	146516.6
31	Large culvert	18 inch conc pipe,long drainage pipe into marshy land	-9.48544	52.56109	99312.3	146521.5
32	field drain	flowing, farm just 300m up from pipe	-9.48057	52.56003	99640.1	146396.8
33	land drain	very little flow flowing through agricultural land	-9.47939	52.56002	99720.1	146394.0
34	field drain	flowing water clear	-9.47655	52.56129	99915.6	146531.4
35	field drain	sluice gate good flow	-9.47195	52.56173	100228.5	146574.0
36	Field drain	Drainage pipe from farm into marshy land	-9.48105	52.5575	99601.8	146115.9
37	Small culvert	Drainage pipe from farm into marshy land,water slightly clouded	-9.4812	52.55662	99589.6	146018.2
38	Field drain	10 inch conc pipe flowing under main road from fild into estuary,no animals in fields	-9.48269	52.54923	99471.6	145198.0
39	WWTP Overflow	SW2	-9.479861	52.549436	99664.0	145217.0
40	Field drain	Drainage pipe,water slightly dirty	-9.481111	52.54799	99575.9	145057.8

Map_ID	Observation	Comments	Longitude	Latitude	Easting	Northing
41	Storm drain	12 inch drain with rubber end, outflow clean	-9.47828	52.5481	99768.2	145066.1
42	Small culvert	Small culvert across from Centra shop in town,cover on end of pipe with low flow	-9.47803	52.54757	99783.9	145006.8
43	Storm drain	storm drain with sluice cover	-9.478	52.54757	99786.0	145006.8
44	surface water drains NO.3	3 storm water drains from street above	-9.47645	52.54644	99888.5	144878.9
45	possible septic tank overflow	very dirty water strong odour	-9.47665	52.54601	99874.0	144831.3
46	storm drain with sluice cover	100m up from bridge Beale side of river by school	-9.47687	52.5456	99858.1	144786.0
47	concrete storm drain	Flowing possible sewage. Tarbert side of river	-9.476354	52.546157	99,907	144,860
48	10 No. drains on concrete wall	Drains with sluice covers, raw sewage coming out of one. Tarbert side	-9.476413	52.546068	99,903	144,850
49	WWTP Overflow	SW3	-9.476276	52.546291	99900.0	144862.0
50	Stream 3 sluice gates 50 m up	a bit of a flow	-9.47577	52.54731	99936.7	144974.7
51	WWTP		-9.472175	52.54751	100181.0	144992.0
52	possible septic tank overflow	non return valve on pipe, just below house	-9.47551	52.54808	99956.0	145060.0
53	Field drain and concrete drain	sluice gate on concrete drain, trickle flow	-9.47548	52.54857	99959.2	145114.5
54	long concrete square drain	WWTP outflow in middle of the river	-9.47673	52.54843	99874.1	145100.7
55	WWTP Overflow	SW4	-9.477003	52.548609	99856.0	145121.0
56	WWTP Primary Discharge	SW1	-9.477003	52.548609	99856.0	145121.0
57	Field drain	very little flow	-9.47688	52.54873	99864.6	145134.3
58	Field drain and cows	verry little flow 20+ cows	-9.47645	52.55049	99897.8	145329.5
59	field drain	brown staining in drain	-9.4746	52.55242	100027.6	145541.7
60	land drain	30+ cows in field above water brown	-9.47354	52.5538	100102.7	145693.8
61	drain through marsh land	tidal flow through here	-9.47628	52.55724	99924.7	146080.4
62	River/Stream	Ballylongford River	-9.474765	52.558322	100029.9	146198.7
63	River/Stream	Unnamed River	-9.471897	52.557044	100221.5	146052.5
64	field drain	wavin pipe no flow	-9.4709	52.55846	100292.3	146208.7

Map_ID	Observation	Comments	Longitude	Latitude	Easting	Northing
65	drain	very little flow two tyres on left	-9.46714	52.55879	100548.0	146240.2
66	Saleen Pier storm drain	drain flowing into river at pier	-9.46647	52.56049	100597.3	146428.4
67	Land drain	a little trickle of grey water	-9.46881	52.56161	100441.2	146556.3
68	land drain	a bit of enrichment	-9.46928	52.56237	100411.0	146641.5
69	land drain	very little flow 20+ cows	-9.46969	52.56288	100384.4	146698.8
70	small land drain	flowing through forestry	-9.47005	52.56846	100372.6	147320.2
71	River/Stream	Unnamed River	-9.462906	52.572449	100866.0	147754.3
72	Field drain	draining through reed bed	-9.45496	52.57961	101420.8	148540.2
73	River/Stream	Unnamed River	-9.453166	52.579681	101542.5	148545.6
74	Indutrial Discharge	SW29	-9.365861	52.587203	107476.4	149267.0
75	Indutrial Discharge	SW26	-9.364672	52.588542	107559.8	149414.5
76	Indutrial Discharge	SW8	-9.36311	52.590684	107670.1	149650.8
77	Indutrial Discharge	SW7	-9.363013	52.590494	107676.3	149629.6
78	Indutrial Discharge	SW6	-9.362853	52.590343	107686.8	149612.6
79	Indutrial Discharge	SW5	-9.362391	52.590108	107717.6	149585.8
80	Indutrial Discharge	SW34	-9.361153	52.589259	107799.8	149489.8
81	Indutrial Discharge	SW33	-9.360968	52.589084	107811.9	149470.1

7. Appendix 2: Hydrography/Hydrodynamics

7.1. Simple/Complex Models

A model of the lower Shannon Estuary by Hydro Environmental Ltd (2020) along with admiralty charts, wind and rainfall patterns and physio-chemical data will be used to describe the system.

7.2. Depth

Ballylongford is a small bay at the edge of the lower Shannon estuary. The substrate in the outer part of which is mainly composed of stones and mud, while inside of Carrig Island Point mud flats are exposed at low tide. The inner part of the bay is completely intertidal except for two small channels, one from the Ballydine River and the other from behind Carrig Island. Large parts of the outer bay are also intertidal. The subtidal areas range from 0.2 to 6.5m in depth. (Admiralty Chart 1547). Figure 7.1 shows water depth in the area.

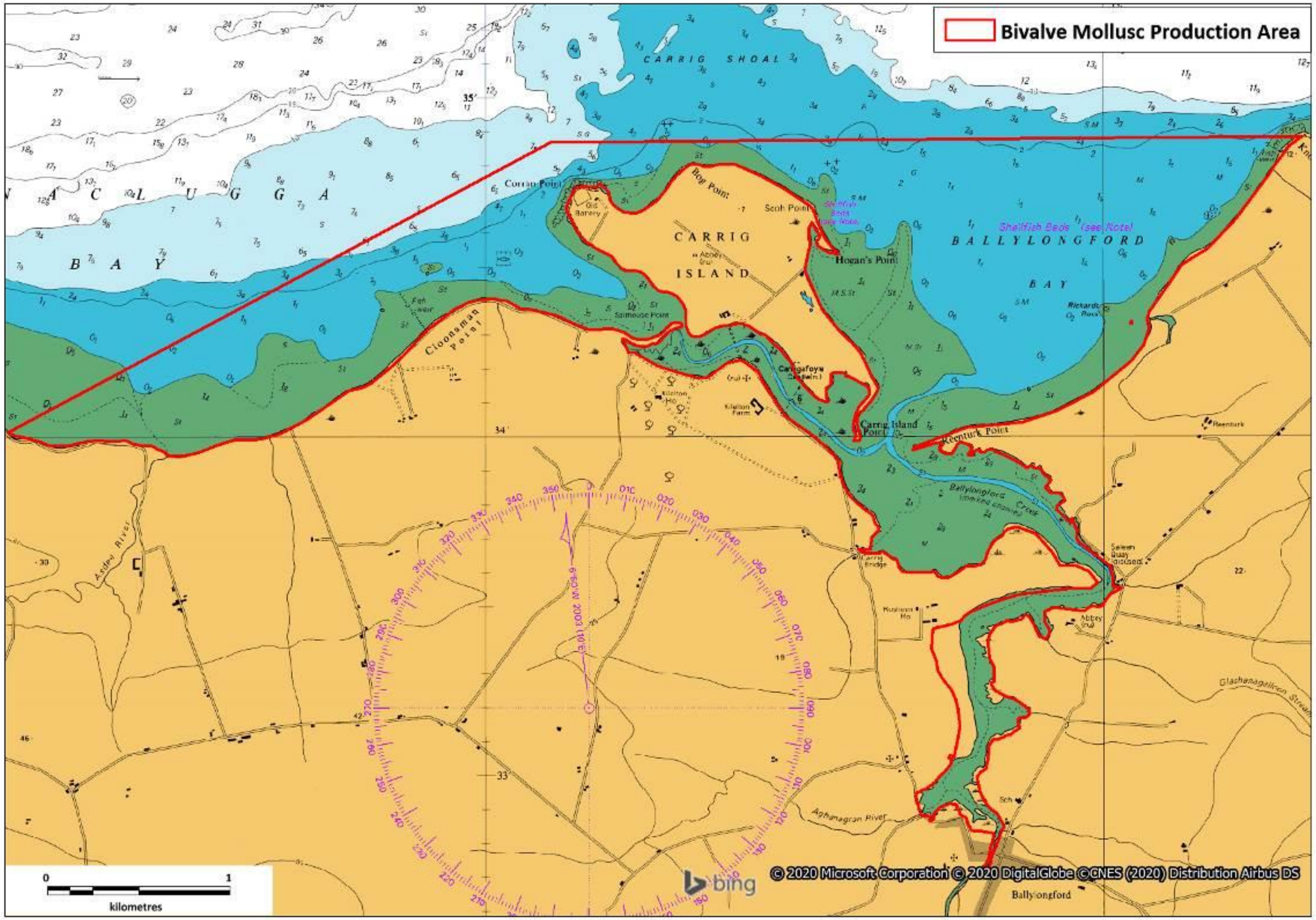


Figure 7.1: Depths in Ballylongford Bay (Source: Admiralty Chart 1547).

7.3. Tides & Currents

Predicted spring and neap tidal ranges in Ballylongford Bay are in the region of 4.5 and 2.0m respectively (Admiralty Chart 1547). A model of the lower Shannon estuary shows the current patterns on the different stages of the tide during a spring tide (See Figure 7.2 to Figure 7.5). East of carrig Island at low water there is little water movement with currents less than 0.05 m/s. On the mid-flood water flowing up the Shannon Estuary turns south into Ballylongford and flows along the eastern shore before circling around and flowing along Carrig Island and back into the main body of the estuary. At high water the currents move in a similar pattern to mid flood but at lower velocities. During mid-ebb water in the estuary is flowing west as it reaches Ballylongford it flows into the bay towards Carrig Island when it reaches the island it is forced north by the shoreline and back out into the estuary. West of Carrig Island the water flows east following the shoreline at low water, mid-flood and High water. During mid-ebb it does the opposite flowing along the shoreline westwards. Current velocities range from less than 0.05 to 0.5 m/s with these highest velocities occurring during mid-flood and mid-ebb tides (Hydro environmental Ltd., 2020).

Table 7.1: Ballylongford Bay tidal characteristics (Source: Admiralty Chart No. 1547).

Admiralty Chart 1547 Levels (m CD)	MHWS	MHWN	MLWN	MLWS
Kilrush	5.0	3.7	1.7	0.5

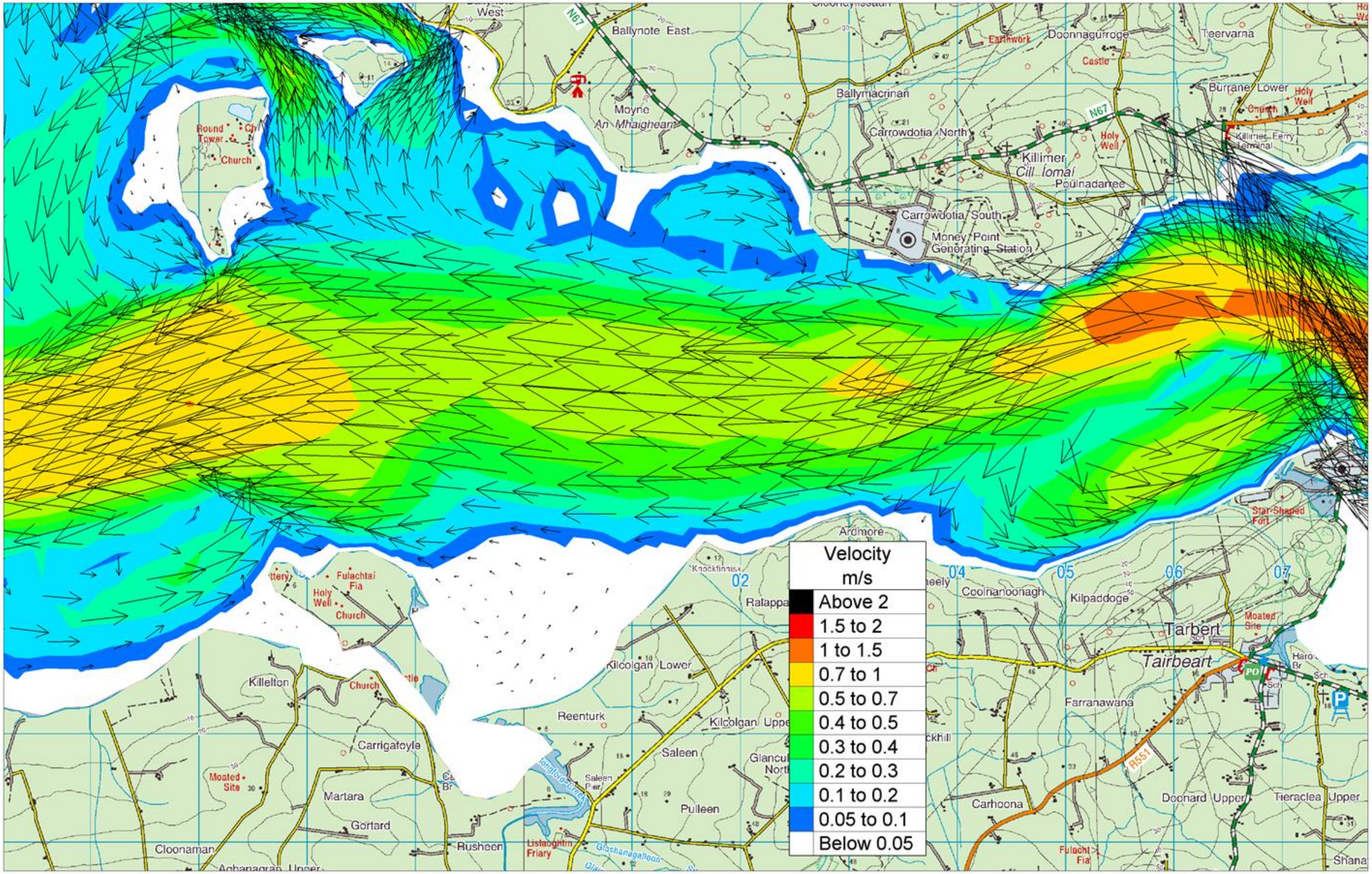


Figure 7.2: Lower Shannon Estuary current patterns at low water on a spring tide.

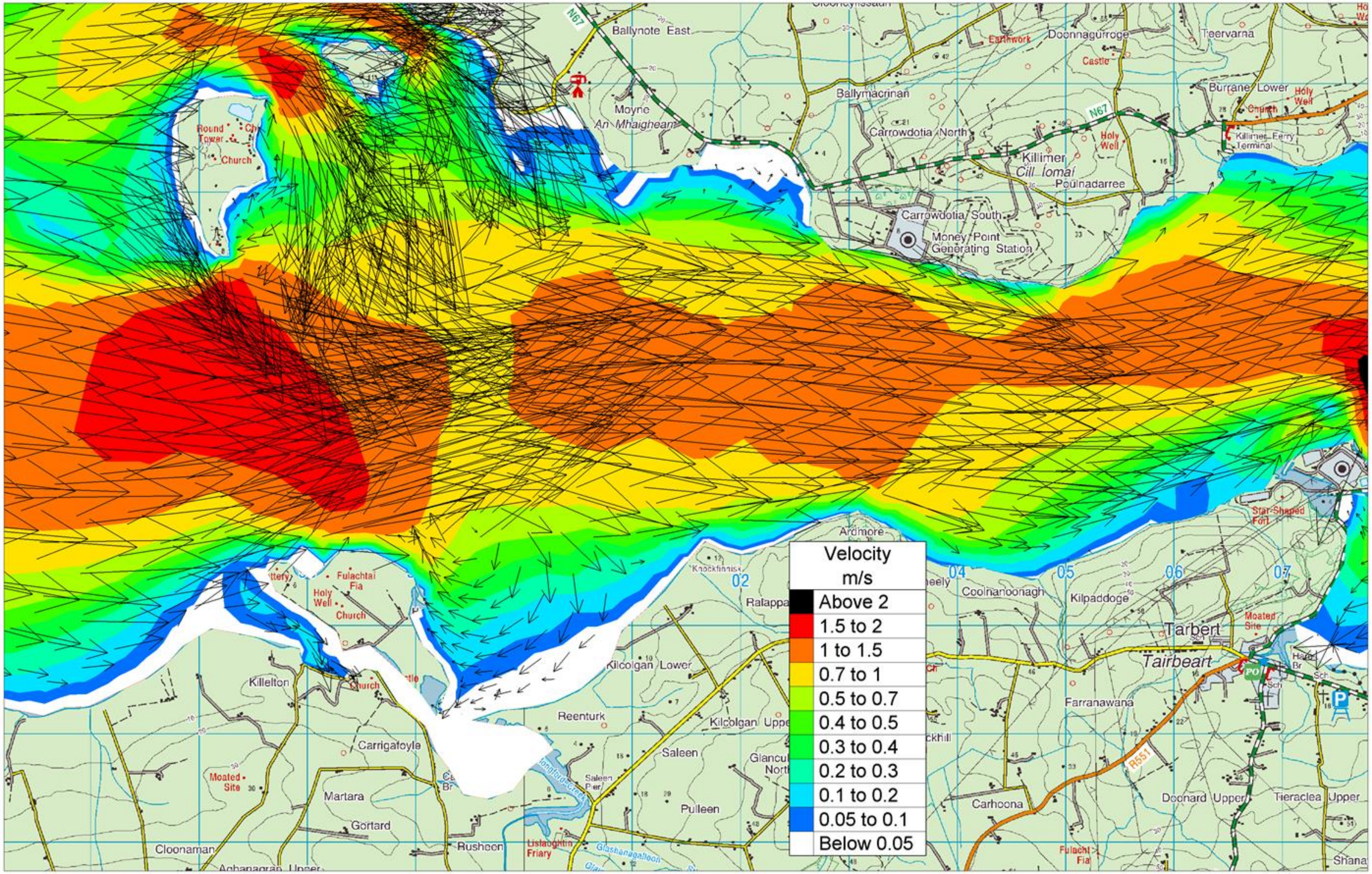


Figure 7.3: Lower Shannon Estuary current patterns at mid-flood on a spring tide.

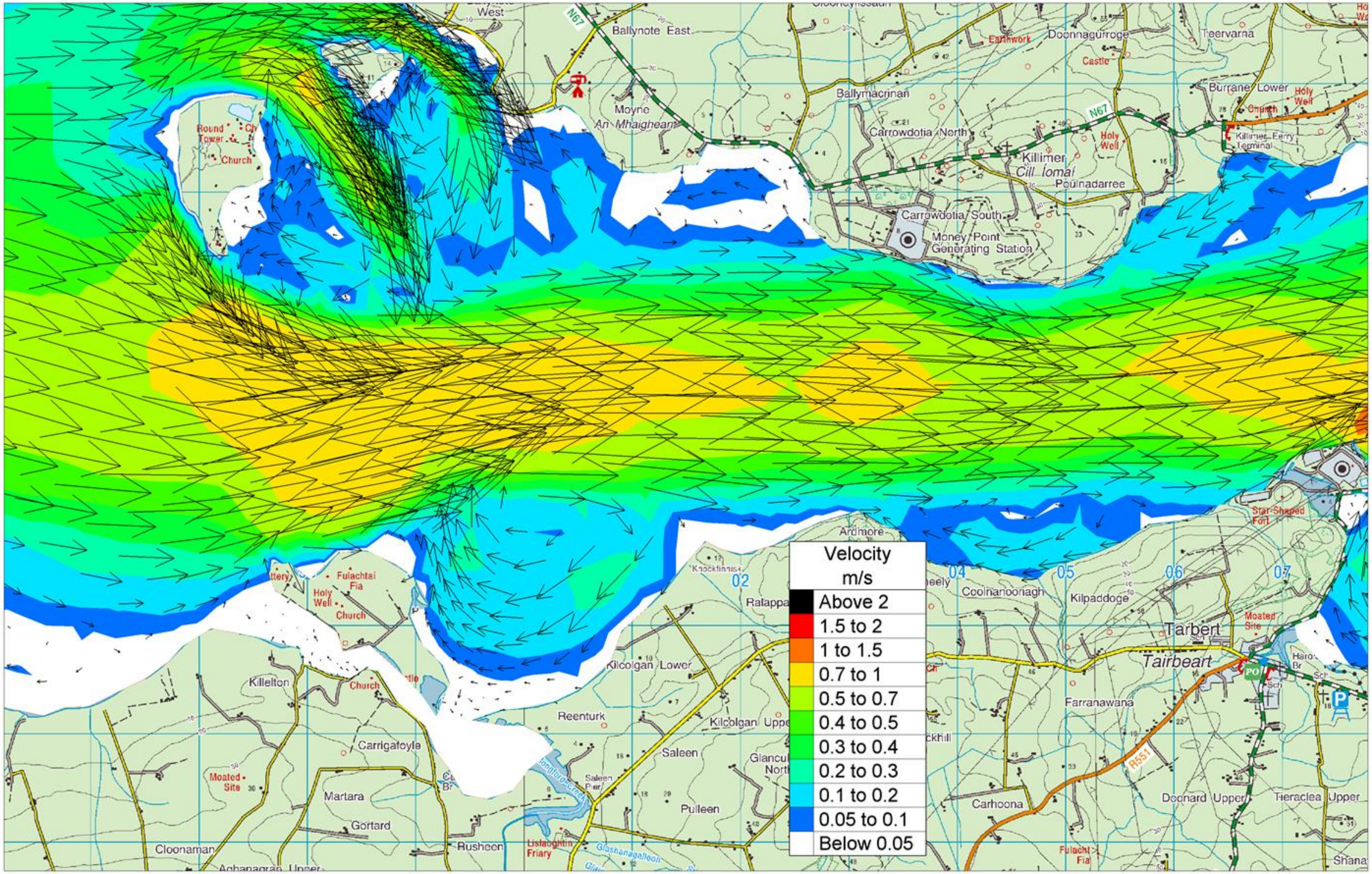


Figure 7.4: Lower Shannon Estuary current patterns at high water on a spring tide.

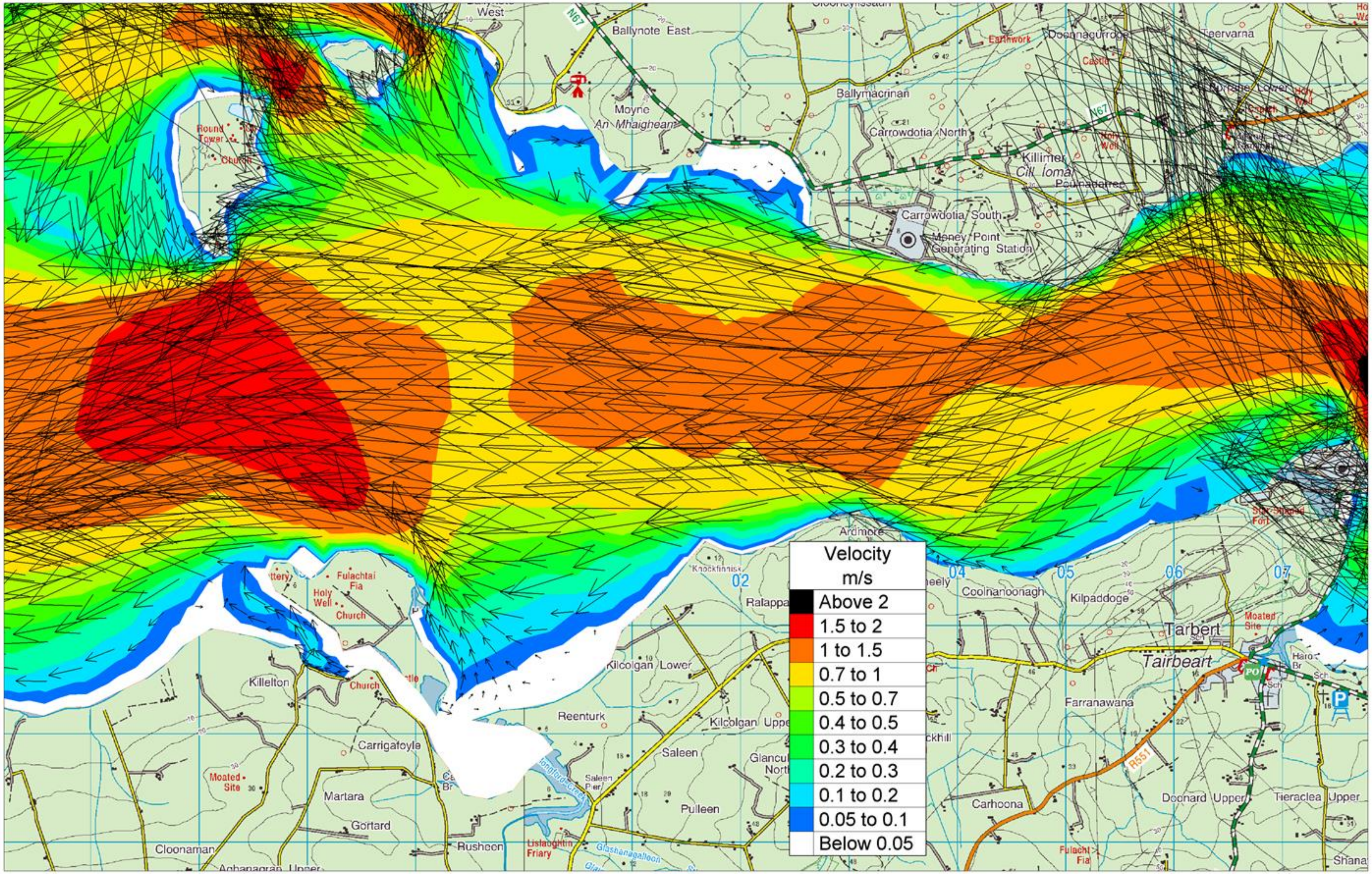


Figure 7.5: Lower Shannon Estuary current patterns at mid-ebb on a spring tide.

7.4. Wind and Waves

Wind data from 2015 to 2019 from the Shannon Airport station (Met Eireann, 2019a) are displayed in Table 7.2 below and wind roses for each year can be seen in Figure 7.6.

In 2015, 22.2% of the wind came from the west, while 18% came from the southwest and 16% from the south. The strongest winds came from the west southwest (69kn). In 2016, 19.3% of the wind came from the west, 16.8% from the southwest and 15% from the southeast. The strongest winds (63kn) came from the west. In 2017, 25.4% of the wind came from the west, 18.2% came from the southwest and 16% came from the southeast. The strongest winds (66kn) came from the southeast. In 2018, 18.4% of the winds came from the west, with 17.8% coming from the southeast and 16.1% coming from the southwest. The strongest winds (63kn) came from the west. In 2019, 21.9% of the wind came from the west, 18.5% came from the southeast and 15.2% came from the southwest. The strongest winds (66kn) came from the west. It can be seen from the 2015-2019 wind rose diagram that the prevailing wind direction is southwest.

Table 7.3 shows the seasonal averages from 2015 to 2019. 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 5 years indicate that winds are typically strongest in the winter months (10.3kn), followed by spring (9.1kn), while autumn and summer are the calmest (8.8kn).

Table 7.2: Wind speed and direction data for Shannon Airport from 2015-2019 (Source: Met Eireann, 2019a).

	2015		2016		2017		2018		2019	
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	11.8	239.0	11.2	201.0	8.3	181.3	12.5	210.3	7.8	252.9
February	8.9	202.9	11.0	192.8	11.2	187.5	9.7	206.4	11.5	189.6
March	10.6	205.8	8.8	205.8	10.4	205.2	9.1	151.9	10.5	233.9
April	7.8	196.7	8.8	203.7	7.6	229.3	10.0	168.0	10.5	156.0
May	11.0	216.5	7.6	186.5	7.6	183.9	7.8	195.5	8.1	221.6
June	9.3	215.0	8.4	238.7	9.8	229.7	7.0	221.0	8.9	204.7
July	10.3	210.6	8.4	228.7	8.5	230.3	7.4	259.0	7.7	218.4
August	8.6	221.9	9.9	213.9	8.2	234.2	9.0	239.4	10.0	209.0
September	7.8	225.7	9.2	218.0	9.4	214.7	8.6	229.0	8.9	201.0
October	7.3	161.0	7.9	157.1	9.8	216.5	8.5	224.2	9.1	163.2
November	11.9	229.7	6.6	223.0	7.6	256.0	10.7	144.0	8.2	194.3
December	12.8	182.3	8.4	169.4	8.5	230.0	10.5	183.9	10.5	204.5

Degrees Direction Key: 0°/360° = N; 23° = NNE; 45° = NE; 68° = ENE; 90° = N; 113° = ESE; 135° = SE; 158° = SSE; 180° = S; 203° = SSW; 225° = SW; 248° = WSW; 270° = W; 293° = WNW; 315° = NW; 338° = NNW

Table 7.3: Seasonal averages (knots) for Shannon Airport wind data (Source: Met Eireann, 2019a).

Season	2015	2016	2017	2018	2019	5 Year Average
Winter	11.2	10.2	9.3	10.9	10.0	10.3
Spring	9.8	8.4	8.5	8.9	9.7	9.1
Summer	9.4	8.9	8.8	7.8	8.9	8.8
Autumn	9.0	7.9	8.9	9.3	8.8	8.8

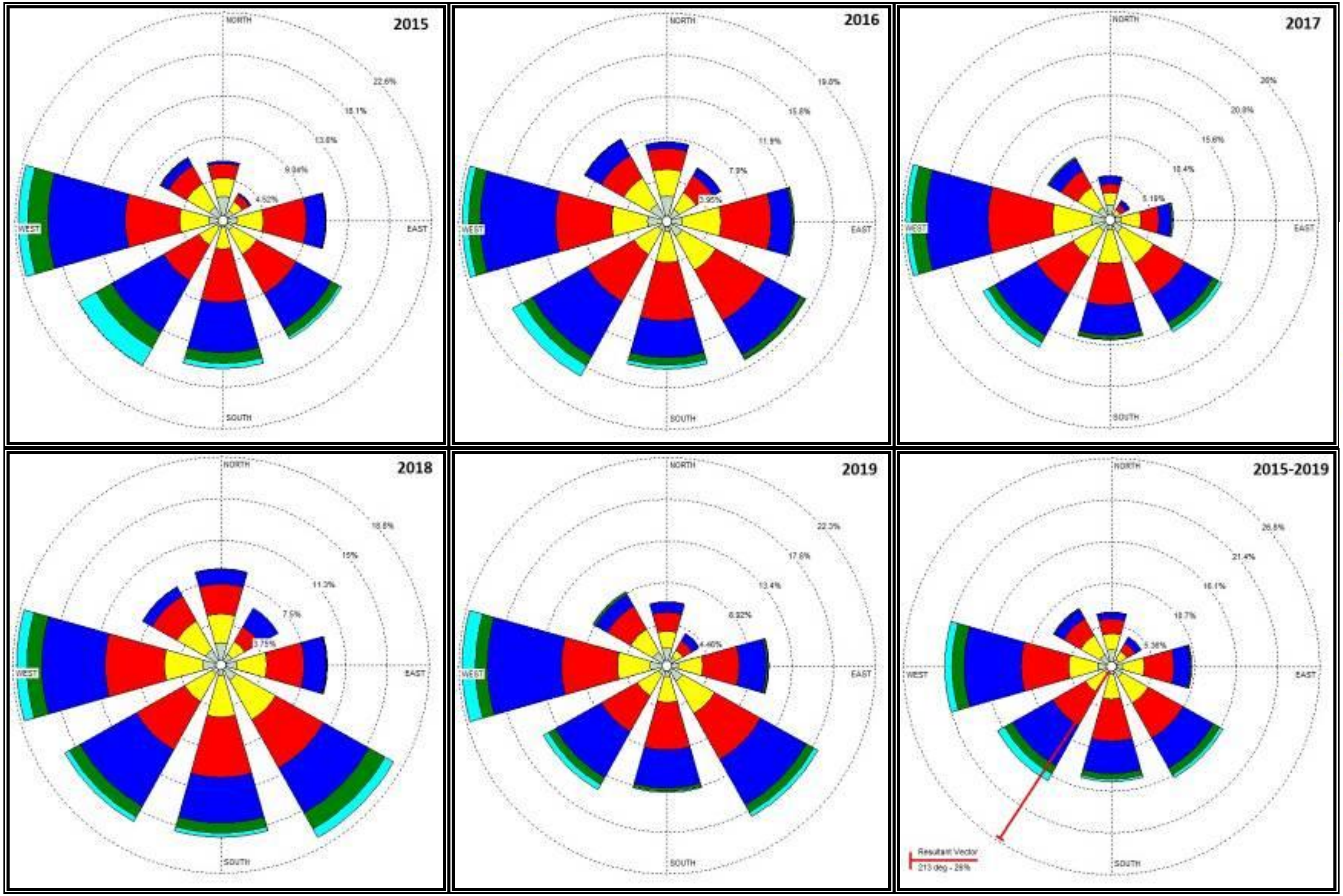


Figure 7.6: Wind roses for Shannon Airport from 2015 to 2019 (Source: Met Eireann, 2019a).

Wind conditions affect the hydrodynamic conditions in Ballylongford 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 southwesterly wind will produce northeasterly moving waves. The height of wind waves depends on:

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

7.5. River Discharges

Ballylongford Bay drains a catchment of 95.85km^2, the catchment is mainly drained by the Ballydine River and the Asdee River, along with a series of small streams (Figure 7.7). The Ballydine River drains 55% (52.78km^2) of the catchment and the Asdee River drains 26.3% (25.23 km^2).

The current (2010-2015) WFD status of Ballylongford Bay and its associated freshwater sources can be seen in Figure 7.8. Of the river systems Ballydine upper reaches is categorized as poor status, while the next section of the river is classified as moderate. The remaining stretches of the Ballydine and all other rivers and streams have not been assigned a status. Ballylongford Bay coastal waterbody and transitional waterbody have both been assigned a moderate status.

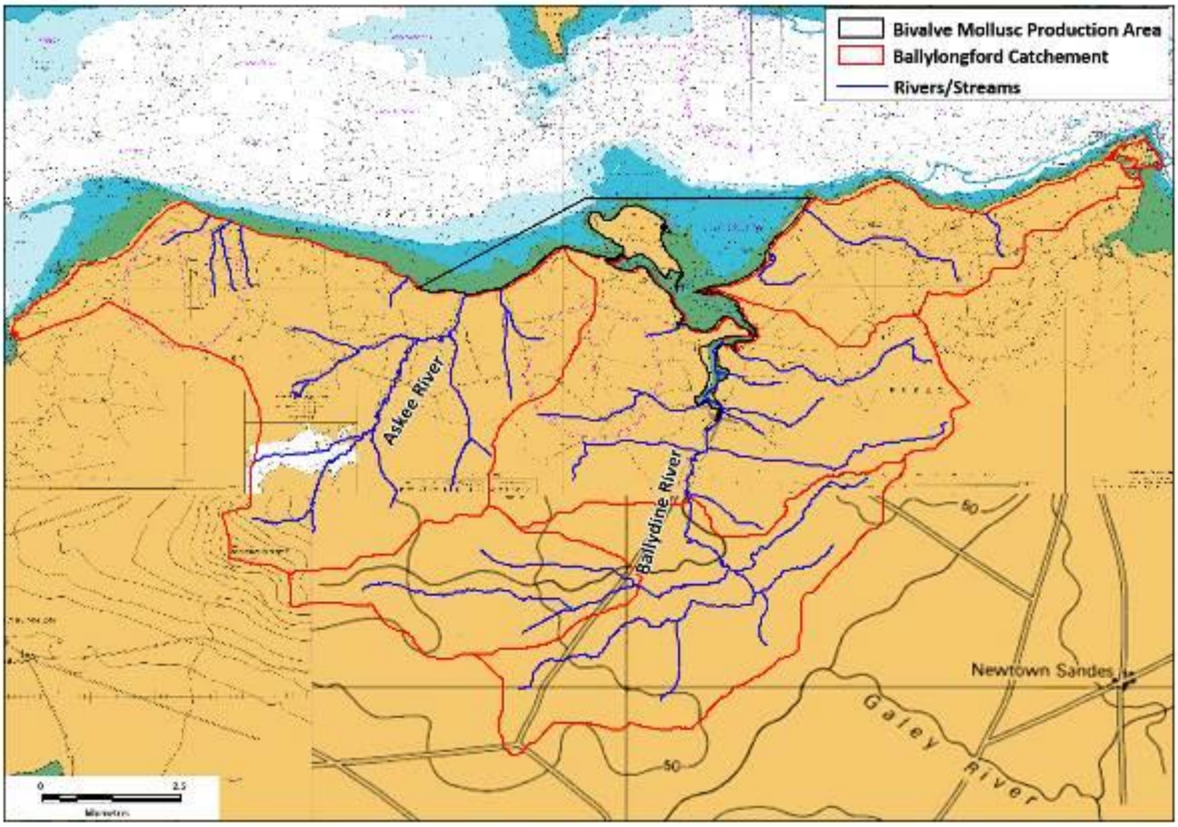


Figure 7.7: Rivers in the Ballylongford Bay catchment area (Source: EPA, 2019).

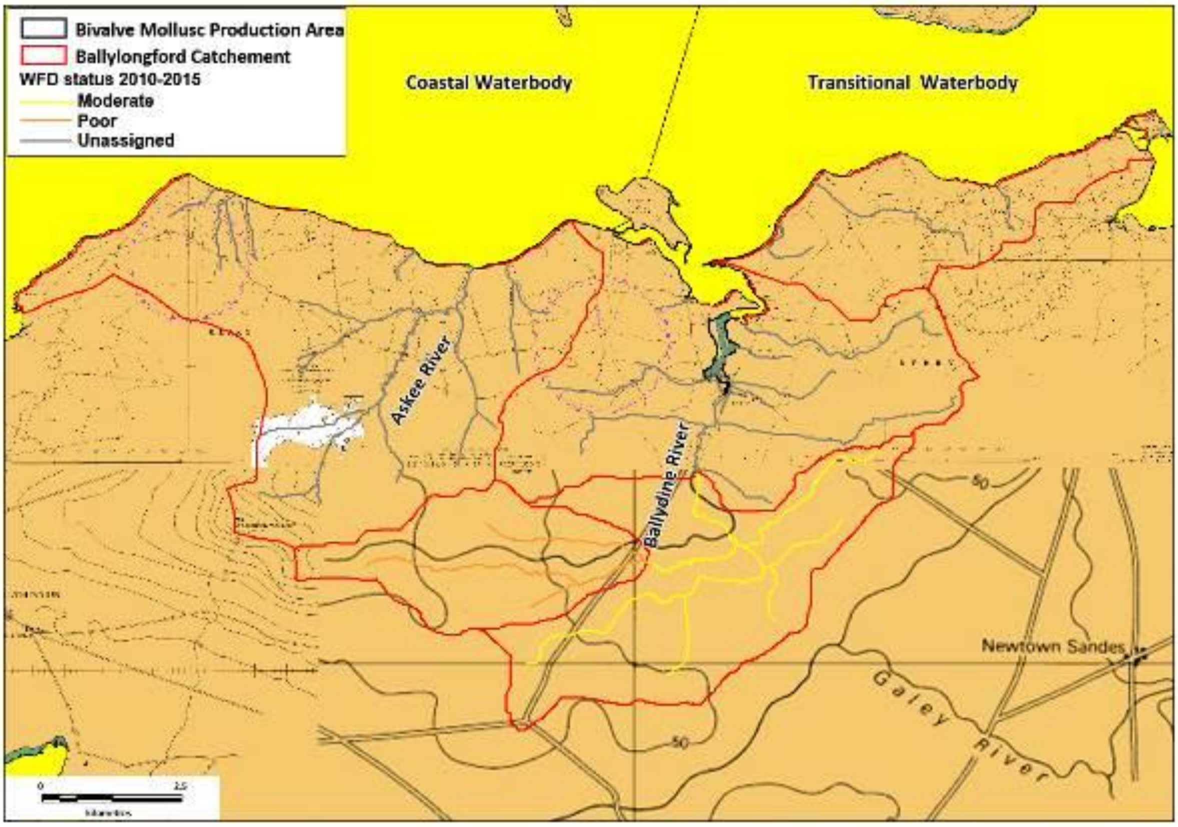


Figure 7.8: WFD Status of the coastal and river waterbodies in the catchment area (Source EPA, 2019).

7.6. Rainfall Data

7.6.1. Amount & Time of Year

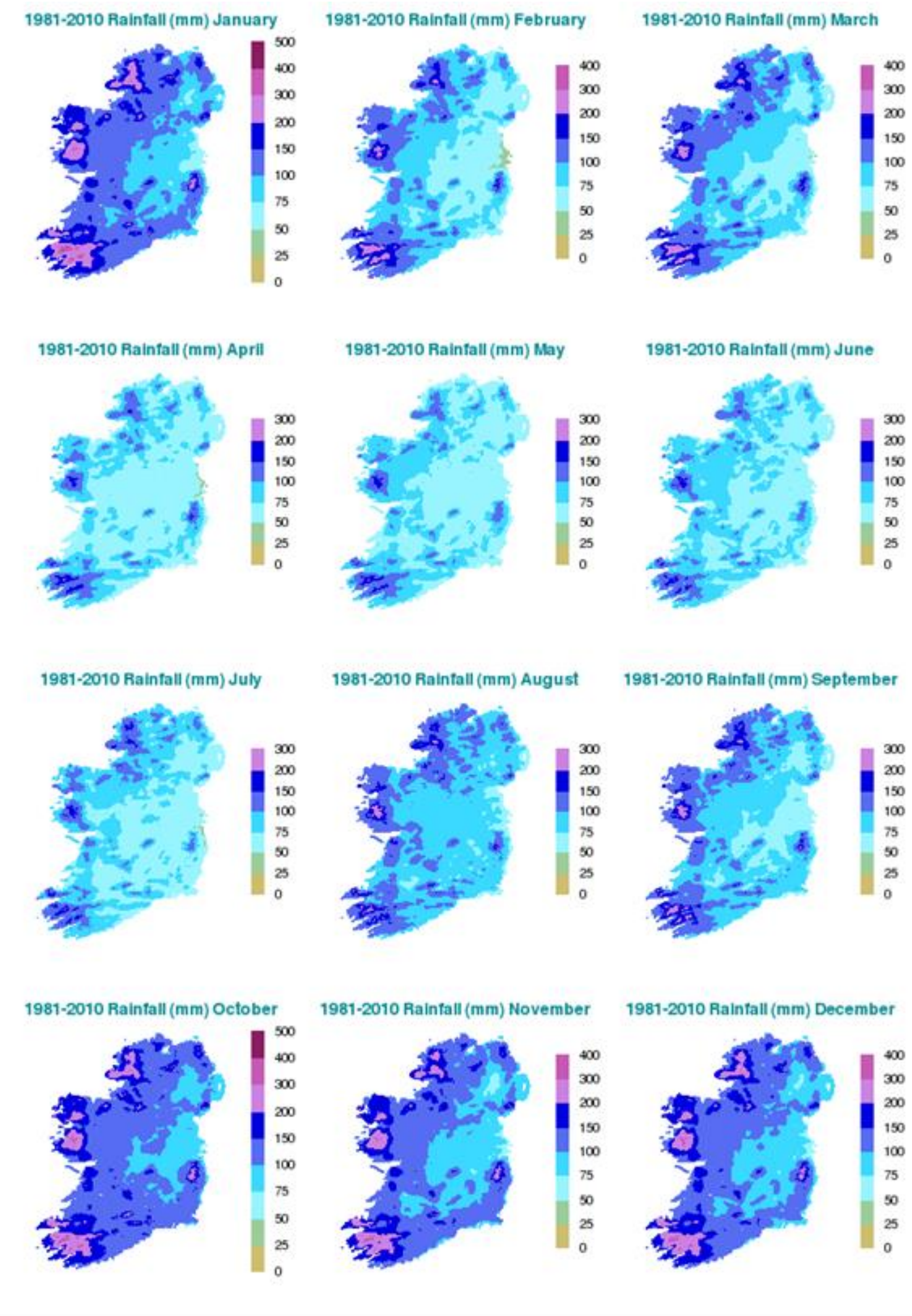
Figure 7.9 shows the average monthly rainfall data for Ireland (Met Eireann, 2019b) from 1981 to 2010. The wettest months in the Ballylongford Bay region over this 30-year period were October to January with the driest months from April to July. Table 7.4 shows the 30-year average monthly rainfall at the Shannon Airport station which is located c. 37km northeast of Ballylongford Bay BMCPA (Figure 7.10 shows the location of the Shannon Airport station). During the period 1981 to 2010, average rainfall at Shannon Airport was lowest in April (59.2mm) and highest in October (104.9mm). The greatest daily total ranged from a low of 25mm in May to a high of 52.3mm in September. Table 7.5 shows the seasonal averages at Shannon Airport from 1981 to 2010. Lowest average rainfall over the 30 year period was in summer (70.6mm) with the highest average rainfall experienced in winter (94.1mm).

Table 7.4: Monthly average rainfall at Shannon Airport from 1981 to 2010 (Source: Met Eireann, 2019c).

Month	Average Rainfall (mm)	Greatest Daily Total (mm)
January	102.3	38.2
February	76.2	29.4
March	78.7	28.1
April	59.2	40.2
May	64.8	25
June	69.8	40.6
July	65.9	39.5
August	82	51
September	75.6	52.3
October	104.9	36.9
November	94.1	26.9
December	104	41.2
Year	977.6	52.3

Table 7.5: Average seasonal rainfall values (mm) from 1981-2010 at Shannon Airport (Source: Met Eireann, 2019c).

Season	Average
Spring	71.4
Summer	70.6
Autumn	91.5
Winter	94.1


1981-2010 Rainfall (mm) January
1981-2010 Rainfall (mm) February
1981-2010 Rainfall (mm) March
1981-2010 Rainfall (mm) April
1981-2010 Rainfall (mm) May
1981-2010 Rainfall (mm) June
1981-2010 Rainfall (mm) July
1981-2010 Rainfall (mm) August
1981-2010 Rainfall (mm) September
1981-2010 Rainfall (mm) October
1981-2010 Rainfall (mm) November
1981-2010 Rainfall (mm) December

9b).

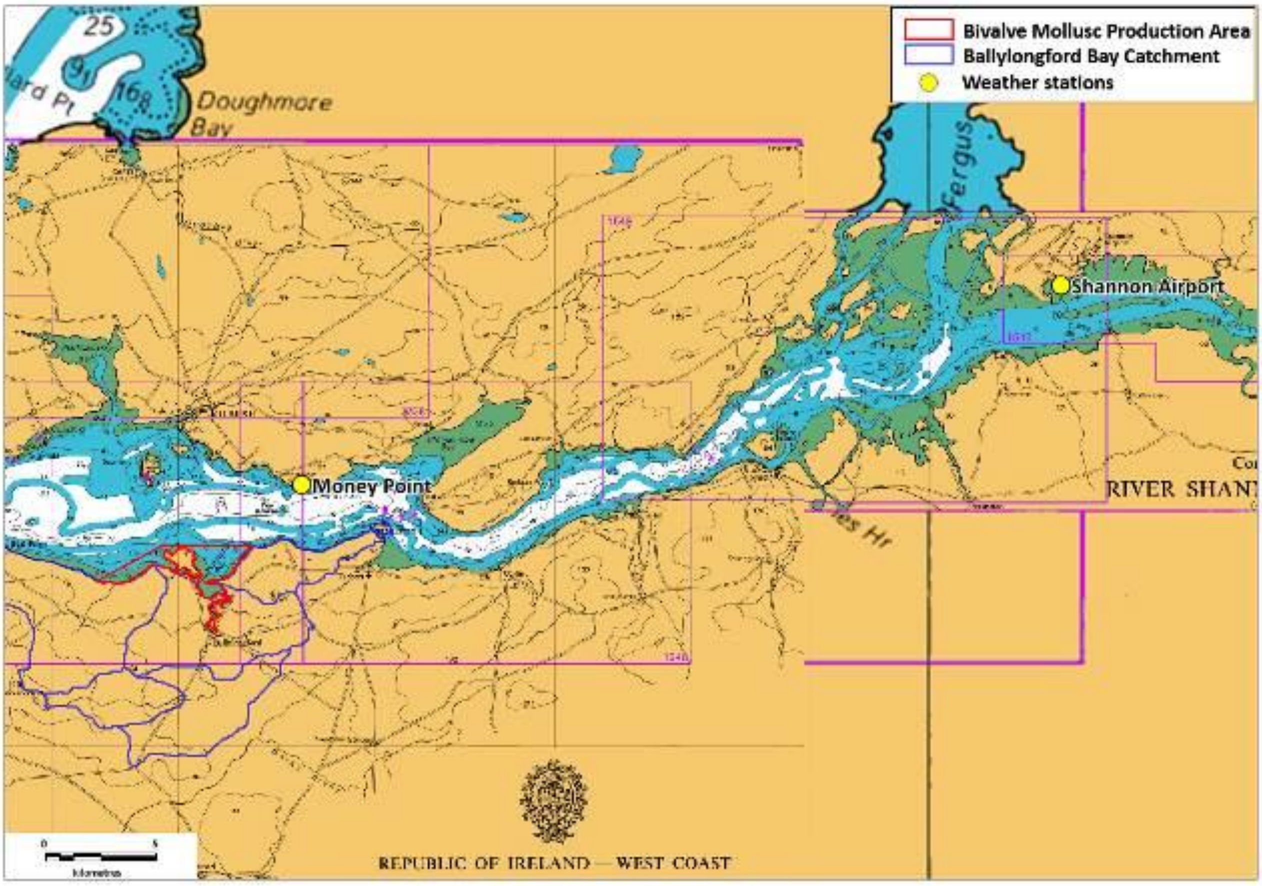


Figure 7.10: Location of Met Eireann weather stations in relation to the Ballylongford Bay production area.

Table 7.6 shows total monthly rainfall at the Money Point Met Eireann station (see Figure 7.10), located c. 3km northeast of Ballylongford Bay production area from 2015 to 2019 (Met Eireann, 2019d).

Money Point weather station is located at the ESB Money Point power station. Maximum monthly rainfall was in December 2015 (328.3mm) and the lowest monthly rainfall was June 2018 (8.8mm). The 5-year average monthly rainfall ranged from a low of 56.1mm in June to a high of 169.3mm in December. Annual averages ranged from 78.5mm in 2018 to 122.6mm in 2015.

Table 7.7 shows the total seasonal rainfall at Money Point from 2015-2019 (Met Eireann, 2019d). The following seasonal fluctuations were observed from 2015-2019: In 2015, summer was the driest season and winter was the wettest, in 2016 spring was the driest and winter was the wettest. In 2017, spring was the driest and winter was the wettest. In 2018, summer was the driest and winter was the wettest. In 2019, there was no data available for June, therefore, it is not possible to ascertain the driest or wettest seasons for this year. Over the five years summer 2018 was the driest season and winter 2015 was the wettest season.

Table 7.6: Total monthly rainfall (mm) data at Money Point, Co. Clare, from 2015 to 2019 (Source: Met Eireann, 2019d).

Year	2015	2016	2017	2018	2019	Monthly 5 yr. Average
Jan	143.6	158.4	87.2	156.4	83.5	125.82
Feb	88.8	149.5	100.4	78.8	80.5	99.6
Mar	99.2	87.4	112.3	56.5	159.2	102.92
Apr	67.8	64.2	20.4	77.4	56.2	57.2
May	129.5	46.4	44.1	50.3	37.7	61.6
Jun	41.7	81.4	92.5	8.8	N/A	56.1
Jul	103.2	88.2	135.1	56.8	45.2	85.7
Aug	68.5	112.9	86.3	74.5	135.1	95.46
Sep	156.4	107.2	109.8	70.5	87.1	106.2
Oct	60.3	45.3	94.3	51.8	89.2	68.18
Nov	184.1	74	113.6	99.6	127.5	119.76
Dec	328.3	86.3	148.2	160.9	122.8	169.3
Annual Average	122.6	91.8	95.4	78.5	93.1	-

Table 7.7: Total seasonal rainfall (mm) at Mouney Point from 2015-2019 (Source: Met Eireann, 2019d).

Station	Season/Year	2015	2016	2017	2018	2019
Money Point	**Spring**	296.5	198	176.8	184.2	253.1
	Summer	213.4	282.5	313.9	140.1	N/A
	Autumn	400.8	226.5	317.7	221.9	303.8
	Winter	560.7	394.2	335.8	396.1	286.8

7.6.2. Frequency of Significant Rainfalls

Figure 7.11 shows the average monthly rainfall at Shannon Airport from 1981-2010 and Figure 7.12 shows the 5 year monthly average rainfall at Money Point weather station from 2015-2019. Over the 30-year period from 1981 to 2010, October was the wettest month followed closely by December and January. Over this period, September followed by December had the greatest daily rainfall. Over the past 5 years at Money Point, December has been the wettest month followed by January and November. June was the driest month followed by April and May.

For the 5-year 2015-2019 period, average greatest daily rainfall at Money Point was 18.7mm, with a maximum of 63.6mm. Over the same period, the number of wet days (rainfall >1mm) a month averaged at 16.7 with the maximum number of 29 days/month.

Met Eireann has developed a depth duration frequency model for the estimation of point rainfall frequencies (Fitzgerald, 2007; Met Eireann, 2019e). For a 1 in 100 year return period, 33.9mm of rain would be expected over 1 hour and 79.8mm over 24 hours. Whiles these would be extreme uncommon events, the model predicts that once a year 11.0mm would fall in 1 hour and 37.6mm over a 24 hour period.

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 waste water 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 November to February period. However, as can be seen in Table 7.4 above, extreme rainfall events leading to episodes of high run-off can occur in most months of the year and it is therefore not just the winter months that are at risk of increased contamination. When these 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.

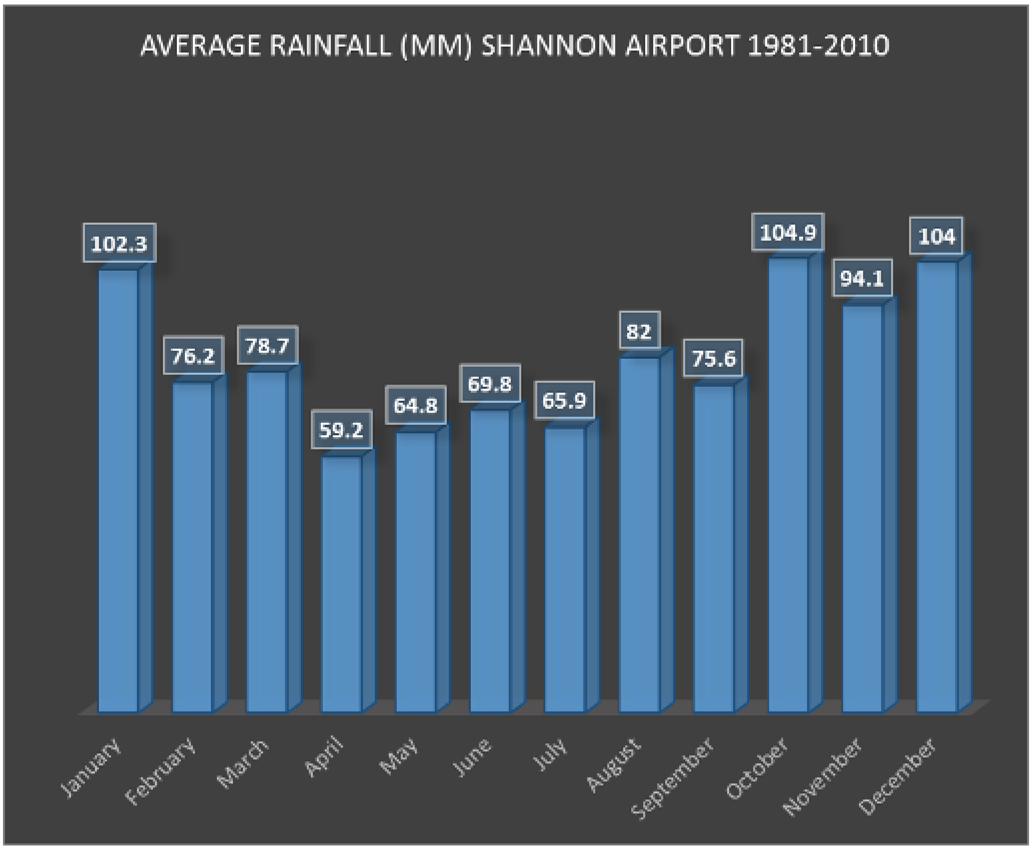
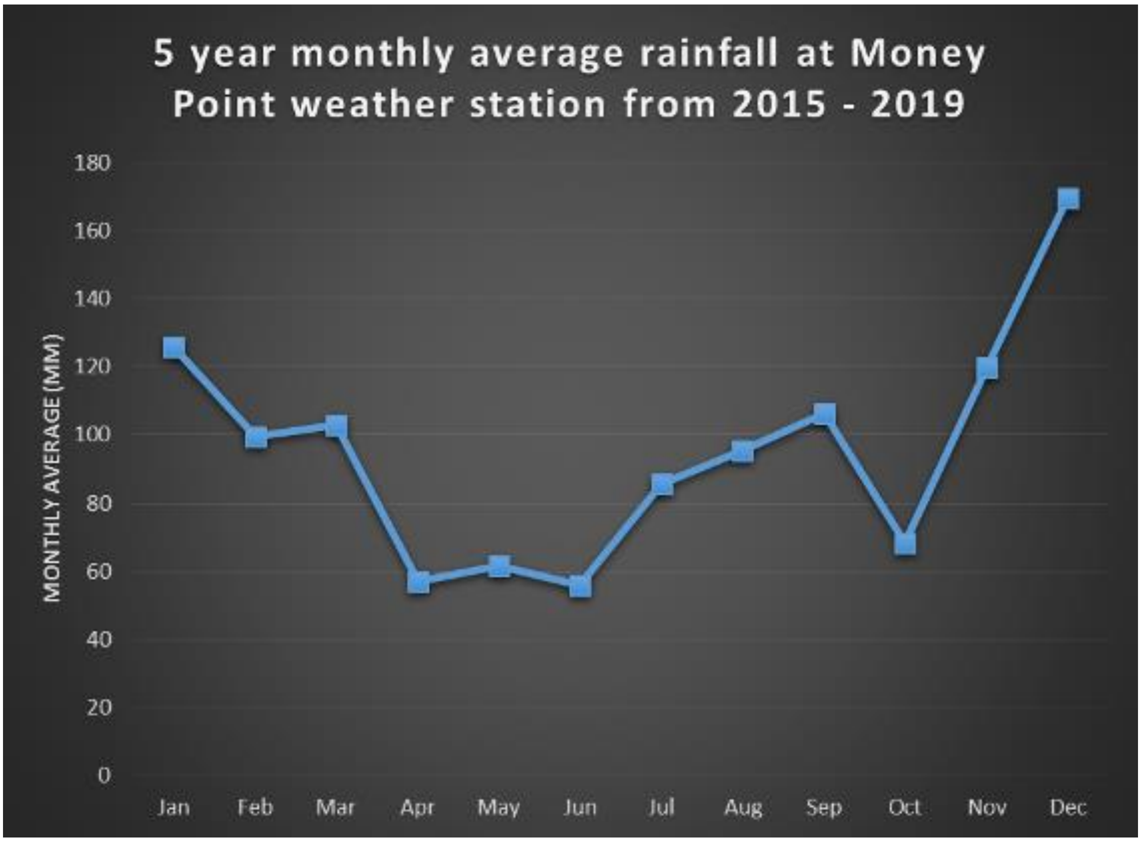


Figure 7.11: Average monthly rainfall (mm) at Shannon Airport from 1981-2010 (Source: Met Eireann, 2019c).



(Source: Met Eireann, 2019d).

7.7. Salinity

The Ballylongford Bay production area has a variable salinity due to its location in the Shannon estuary. The salinity is effected by the stage of the tide and the level of freshwater influence from the Ballylongford Bay catchment and the Shannon basin. The salinity in Ballylongford Bay is monitored as part of the Shellfish Water Directive. The monitoring point is located to the east of Carrig Island and salinity has been recorded from 27.35 to 29.78 PSU (Source: Marine Institute).

7.8. Turbidity

The turbidity of Ballylongford Bay can vary significantly depending on the tide, levels of freshwater input and weather conditions. Turbidity in Ballylongford Bay can range from 1.4 to 80.6 NTU (Source: Marine Institute).

7.9. Residence Time

Residence time can be defined as the average amount of time that a molecule of water of a particle spends in a particular system. Residence times are important because of the way they govern productivity rates as well as the vulnerability to water quality degradation. No data on the residence time of Ballylongford Bay was available at the time of writing. However, due to the highly tidal nature of the inner bay and the openness of the outer bay with the Shannon estuary the residence time is likely to be short.

7.10. Discussion

Ballylongford is a small bay at the edge of the lower Shannon estuary. The substrate in the outer part of which is mainly composed of stones and mud, while inside of Carrig Island Point mud flats are exposed at low tide. The rising tides flows northward along the West coast, on the flooding tide the tidal signal will swing into the Shannon from the West and flow eastwards. When it passes Carrig Island, part of it will flow southwards and spill into Ballylongford Bay while the rest will head on eastwards up the river. The ebb tide is essentially the reverse of this in Ballylongford. The strongest winds come from the west (up to 66Kn), while the prevailing wind is from the southwest. The Ballydine River is the largest river that feeds into the bay and drains 55% of the catchment. The driest period in the Ballylongford area is between April and July, while the wettest period is between October and January. Salinity is generally high 27.35 to 29.78 PSU and turbidity varies significantly with values of 1.4 to 80.6 NTU being recorded.

8. Appendix 3: Shellfish and Water Sampling

8.1. Historical Data

8.1.1. Shellfish Water Quality

The Marine Institute carries out quarterly water quality monitoring as part of the Shellfish Waters Directive in Ballylongford Bay. Sampling is confined to the oyster aquaculture area. The EPA carries out monitoring under the Water Framework Directive. However, *E. coli* is not routinely measured under these programmes.

8.1.2. Shellfish Flesh Quality

In accordance with Regulation (EU) 2017/625 and the subsequent implementing regulation (EU) 2017/627 the Sea Fishery Protection Authority is required to classify bivalve mollusc production areas and to fix the boundaries thereof. The process involves regular sampling of shellfish from each area to be classified in order to establish levels of microbiological contamination which subsequently determines which classification should be awarded for that particular area. The SFPA currently sample shellfish flesh at one location in the Ballylongford Bay production area for classification purposes. Figure 8.1 shows this location of this sampling site Table 8.1 shows the coordinates.

Table 8.1: Coordinates of sampling sites within the Ballylongford Bay Production Area.

Sample Code	Species	Latitude	Longitude
KY-BD-BD	Pacific Oysters	52.5747	-9.3686

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.

Table 8.2 summarises this system. Table 8.3 shows the current and historical (back to 2014) classifications within Ballylongford Bay. For 2019 Ballylongford Bay is classified as B for Oysters.

Table 8.2: Classification system for shellfish harvesting areas.

Classification			Permitted Levels	Outcome
	A	<230	Not exceeding 230 *E. coli* per 100 g flesh and intravalvular liquid in 80% of the samples in the review period	May go direct for human consumption if end product standard met.
	B	<4600	not exceeding 4600 *E. coli* per 100 g flesh and intravalvular liquid in 90% of the 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* per 100 g of flesh and intravalvular liquid	Must be subject to relaying for a period of at least 2 months or cooked by an approved method.
	Above 46,000 *E.coli*/100g flesh			Prohibited. Harvesting not permitted

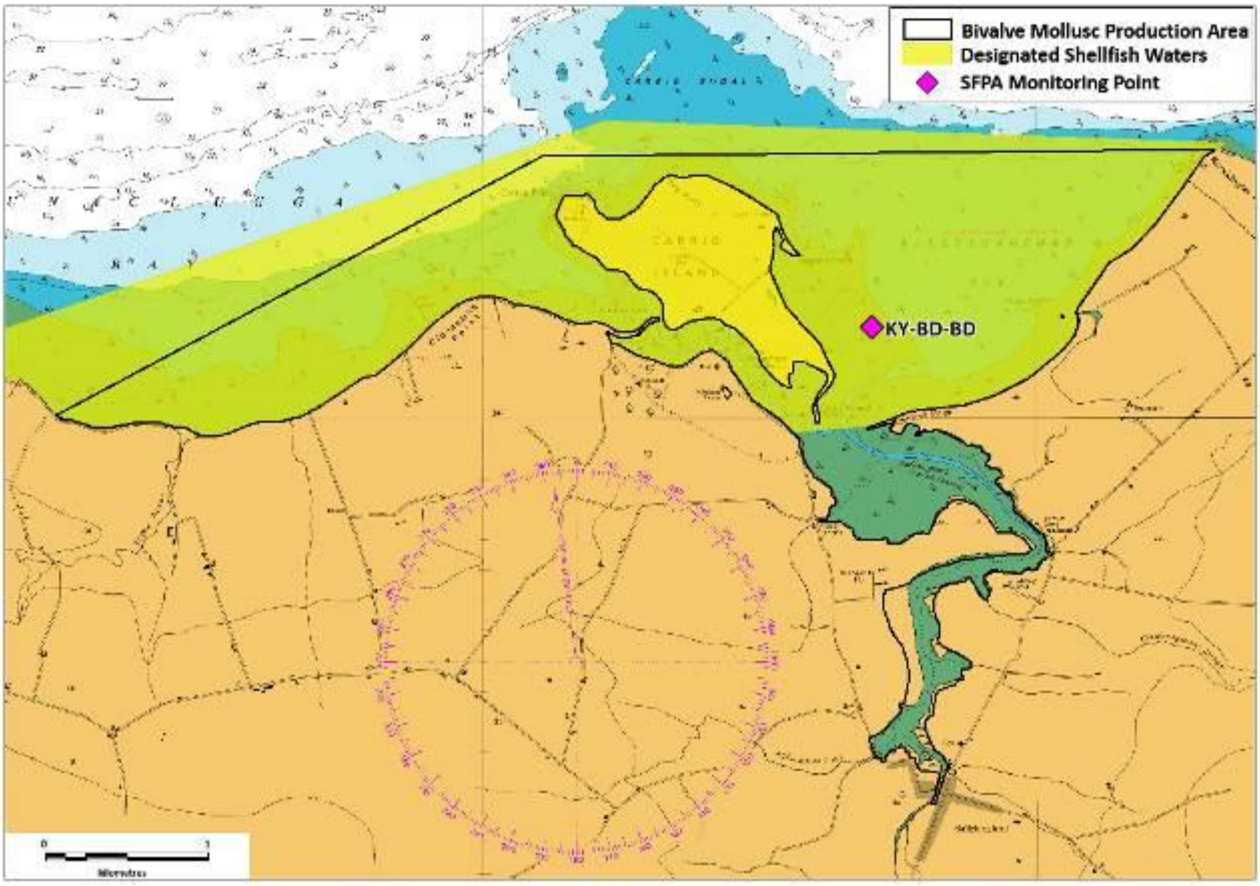


Figure 8.1: Locations of SFPA shellfish monitoring points for classification purposes.

Table 8.3: Current and historical classification of shellfish beds in Ballylongford Bay (2014 – 2020).

Boundaries	Bed Name	Species	Classification					
			2014	2015	2016	2017	2018	2019
Beal Point to Knockfinglas Point	All Beds	Oysters	B	B	B	B	B	B

Table 8.4 list the *E. coli* results for pacific oysters in Ballylongford Bay from January 2014 to June 2020. Figure 8.2 shows these data in graphical form.

As shown in Table 8.3 above, Ballylongford Bay has had a **B** classification for pacific oysters from 2014 to 2019. The monthly classification trends for pacific oysters can be seen in Table 8.4 and Figure 8.2.

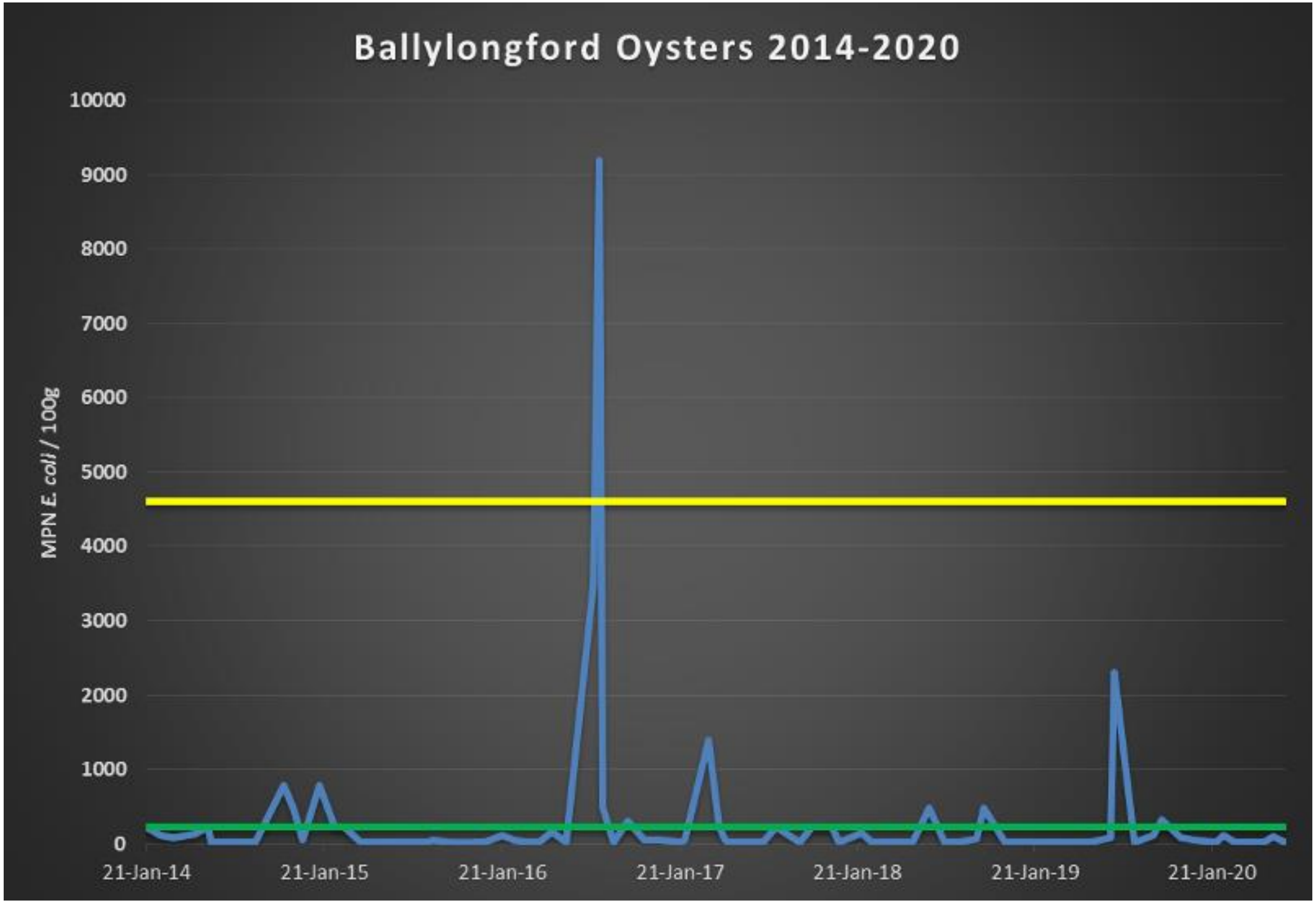
Table 8.5 shows the summary statistics for the *E. coli* historical data from the pacific oyster monitoring site from 2014 to 2019. Table 8.6 shows the variations of the annual geometric means of *E. coli* for the pacific oyster beds from the year 2014 to 2019. Figure 8.3 shows the trend in geometric mean from 2014 to 2019 for pacific oysters in Ballylongford Bay. The geometric mean ranged from 41.4 MPN/100ml in 2015 to 120.1 MPN/100ml in 2016.

There was no statistical difference between the oyster *E. coli* results between season or between years (one-way ANOVA, p = 0.67517 (seasons), one-way ANOVA, p = 0.54021 (years), Appendix 4).

Table 8.4: *E. coli* results from Ballylongford Bay Pacific Oysters from January 2014 to June 2020 (Source: SFPA).

Date	MPN *E. coli* /100g	Category	Date	MPN *E. coli* /100g	Category
21-Jan-14	230	A	12-Apr-17	230	A
18-Feb-14	110	A	25-Apr-17	45	A
18-Mar-14	80	A	3-May-17	18	A
29-Apr-14	130	A	7-Jun-17	18	A
27-May-14	230	A	11-Jul-17	20	A
4-Jun-14	20	A	7-Aug-17	230	A
10-Jul-14	20	A	25-Sep-17	18	A
27-Aug-14	18	A	19-Oct-17	230	A
2-Sep-14	18	A	29-Nov-17	230	A
30-Oct-14	790	B	14-Dec-17	20	A
18-Nov-14	490	B	29-Jan-18	140	A
9-Dec-14	45	A	20-Feb-18	20	A
12-Jan-15	790	B	20-Mar-18	18	A
11-Feb-15	230	A	24-Apr-18	20	A
4-Mar-15	230	A	15-May-18	20	A
6-Apr-15	18	A	18-Jun-18	490	B

Date	MPN *E. coli* /100g	Category	Date	MPN *E. coli* /100g	Category
25-May-15	18	A	19-Jul-18	18	A
15-Jun-15	18	A	15-Aug-18	18	A
15-Jul-15	18	A	24-Sep-18	68	A
24-Aug-15	18	A	9-Oct-18	490	B
1-Sep-15	45	A	22-Nov-18	20	A
7-Oct-15	18	A	7-Jan-19	18	A
24-Nov-15	20	A	06-Feb-19	20	A
16-Dec-15	20	A	28-Mar-19	20	A
21-Jan-16	110	A	08-Apr-19	18	A
15-Feb-16	45	A	14-May-19	18	A
14-Mar-16	18	A	27-Jun-19	78	A
6-Apr-16	20	A	03-Jul-19	2300	B
3-May-16	170	A	13-Aug-19	20	A
1-Jun-16	18	A	23-Sep-19	110	A
27-Jul-16	3500	B	10-Oct-19	330	B
10-Aug-16	9200	C	17-Nov-19	78	A
17-Aug-16	490	B	17-Dec-19	45	A
6-Sep-16	20	A	29-Jan-20	18	A
6-Oct-16	310	B	12-Feb-20	110	A
9-Nov-16	45	A	09-Mar-20	20	A
14-Dec-16	45	A	06-May-20	18	A
25-Jan-17	18	A	26-May-20	92	A
1-Feb-17	45	A	19-Jun-20	18	A
21-Mar-17	1400	B			


Ballylongford Oysters 2014-2020
MPN E. coli / 100g
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
21-Jan-14
21-Jan-15
21-Jan-16
21-Jan-17
21-Jan-18
21-Jan-19
21-Jan-20

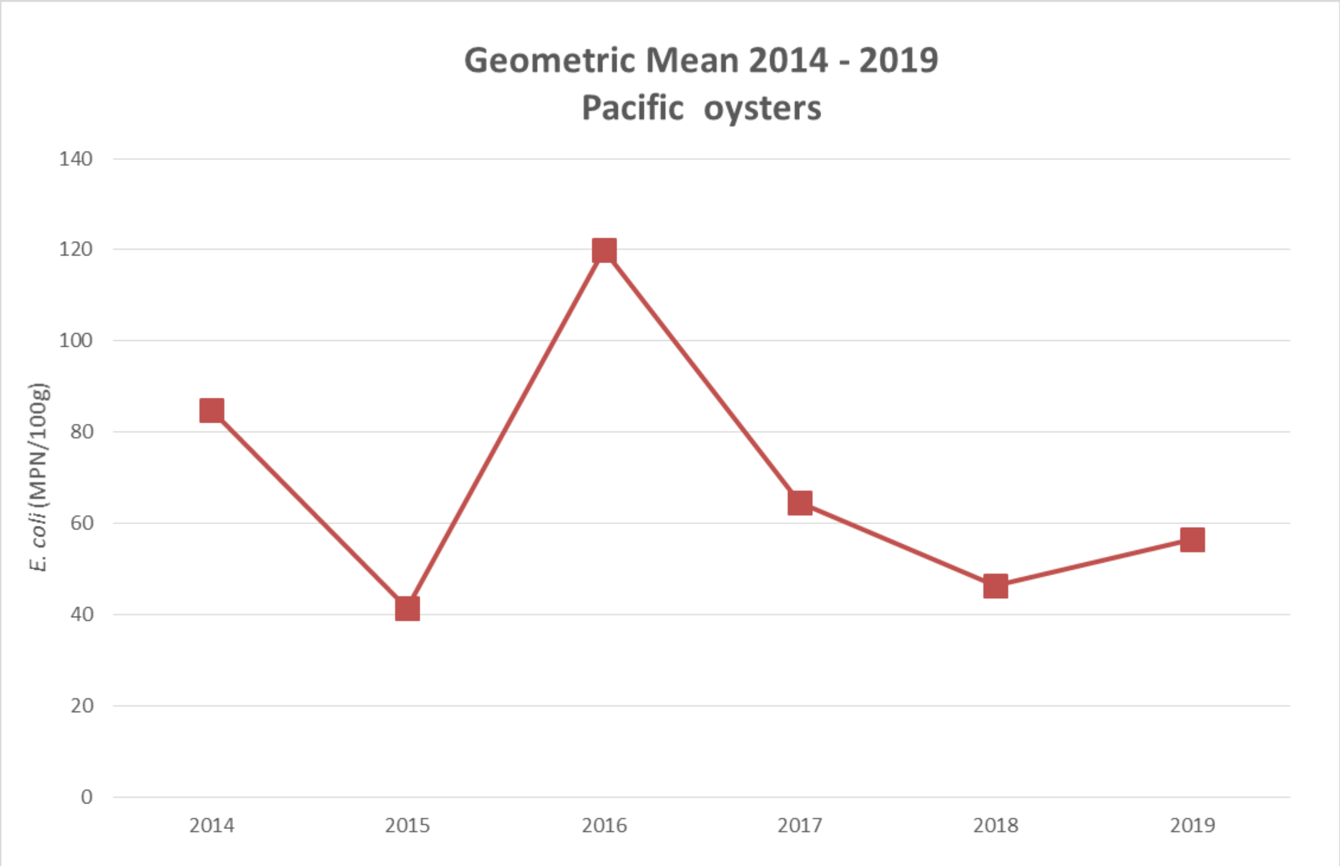

Geometric Mean 2014 - 2019
Pacific oysters
E. coli (MPN/100g)
140
120
100
80
60
40
20
0
2014
2015
2016
2017
2018
2019

Table 8.5: Summary statistics of historical *E. coli* data monitored from shellfish beds in Ballylongford Bay.

Code	Species	Date of 1st Sample	Date last Sample	Minimum *E. coli* (MPN/100g)	Maximum *E. coli* (MPN/100g)	Median *E. coli* (MPN/100g)	Geometric Mean *E. coli* (MPN/100g)
KY-BD-BD	Pacific Oyster	21/01/2014	19/06/2020	18	9200	45	62

Table 8.6: Variation of annual geometric means of *E. coli* (MPN/100g) from shellfish beds monitored in Ballylongford Bay.

Code	Species	2014	2015	2016	2017	2018	2019
KY-BD-BD	Pacific Oyster	84.7	41.4	120.1	64.5	46.4	56.5

In addition to *E. coli* monitoring carried out by SFPA, the Marine Institute (MI) conducts monthly monitoring for the presence of toxin producing phytoplankton in shellfish waters, including *Alexandrium spp* and *Dinophysis spp.* and for marine biotoxins (including DSP, PSP and ASP) in shellfish flesh. The MI also monitors shellfish flesh for chemical contaminants *e.g.* heavy metals, organochlorides, polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), pentachlorophenol (PCP) and Tributyl Tin Oxide (TBTO).

Over the period 2014 to 2018, there have been 13 biotoxin related closures.

8.1.3. Norovirus (NoV)

Monthly oyster samples collected during the EU baseline survey for norovirus demonstrated a generally low prevalence of norovirus with the exception of some of the winter months. Raised norovirus levels were noted in January 2018 and March 2017 and to a lesser extent in February 2018 indicating that the production area is at periodic risk of faecal contamination from human sources.

Table 8.7: Ballylongford Norovirus result from EU baseline survey 2016-2018

Month-Year	NoV GI Copies/g	NoV GII Copies/g
November 2016	<LOQ	<LOQ
Decmeber 2016	<LOQ	<LOQ
January 2017	<LOQ	<LOQ
February 2017	<LOQ	<LOQ
March 2017	1550	319
April 2017	Not detected	Not detected
May 2017	<LOQ	<LOQ
June 2017	Not detected	Not detected
July 2017	Not detected	Not detected
August 2017	Not detected	Not detected
September 2017	105	119
October 2017	<LOQ	113
November 2017	Not detected	314
December 2017	Not sampled	Not sampled
January 2018	1168	148
February 2018	259	507
March 2018	<LOQ	<LOQ
April 2018	Not detected	<LOQ
May 2018	Not detected	<LOQ
June 2018	Not detected	Not detected
July 2018	Not detected	Not detected
August 2018	109	Not detected
September 2018	<LOQ	<LOQ

8.2. Current Data

8.2.1. Sampling Sites & Methodology

Twenty water sampling sites were sampled within the Ballylongford Bay BMCPA in October 2020. The locations of these sites can be seen in Figure 8.4 and Table 8.8 shows the station coordinates.

Ten stations were sampled on the 21st October 2020 (Stations 1–8, 10, 13), there was 4-5 mm of rain over the previous 48 hours. Ten stations were sampled on the 26st November 2018 (Stations 9, 11, 12, and 14-20), there was 5-6 mm of rain over the previous 48 hours.

Table 8.8: Water sample coordinates with date of sampling.

Station	Feature	Latitude	Longitude	Easting	Northing	Sampling Date
1	Large piped storm drain	52.57355	-9.57995	92933.7	148044.1	21/10/2020
2	piped field drain	52.57079	-9.56430	93988.0	147713.9	21/10/2020
3	small river 7M wide	52.56623	-9.54362	95379.1	147176.3	21/10/2020
4	Large stream	52.57161	-9.52212	96849.6	147744.0	21/10/2020
5	Large stream	52.57113	-9.50514	97999.7	147666.4	21/10/2020
6	Concrete outflow pipe	52.57430	-9.50006	98351.4	148012.0	21/10/2020
7	Small stream/field drain	52.57792	-9.50577	97972.7	148422.8	21/10/2020
8	Drain from Turlough	52.57340	-9.49060	98990.6	147898.5	21/10/2020
9	pumping station	52.56659	-9.49881	98418.3	147152.3	26/10/2020
10	River	52.56118	-9.48731	99185.7	146534.2	21/10/2020
11	field drain	52.56003	-9.48057	99640.1	146396.8	26/10/2020
12	field drain	52.56173	-9.47195	100228.5	146574.0	26/10/2020
13	River	52.54831	-9.48188	99524.5	145094.5	21/10/2020
14	Storm drain	52.54810	-9.47828	99768.2	145066.1	26/10/2020
15	River	52.54648	-9.47661	99877.8	144883.5	26/10/2020
16	long concrete square drain	52.54843	-9.47673	99874.1	145100.7	26/10/2020
17	stream	52.55326	-9.47307	100133.3	145633.1	26/10/2020
18	Saleen Pier storm drain	52.56049	-9.46647	100597.3	146428.4	26/10/2020
19	Stream	52.56846	-9.46312	100842.5	147310.7	26/10/2020
20	Stream Knockfinglas point	52.57968	-9.45317	101542.5	148545.6	26/10/2020

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

8.2.2. Microbial Analysis Results

Table 8.9 shows the water sample analysis results and Figure 7.4 shows the magnitude of the *E. coli* results. The two highest *E. coli* results were record at stations 9 and 18. These results were an order of magnitude higher than any other station. Station 9 was located beside a discharge from a pumping station belonging to Ballylongford WWTP and station 18 was taken from a storm drain at Saleen pier. The lowest result was recorded at station 14 which is a storm drain at Ballylongford town.

Table 8.9: Water *E. coli* results for Ballylongford Bay.

Station No.	*E. coli* (cfu/ 100ml)
1	1725
2	1607
3	933
4	1259
5	2909
6	2359
7	2282
8	233
9	24196
10	1723
11	1396
12	602
13	1210
14	52
15	2247
16	7701
17	1354
18	24196
19	331
20	3255

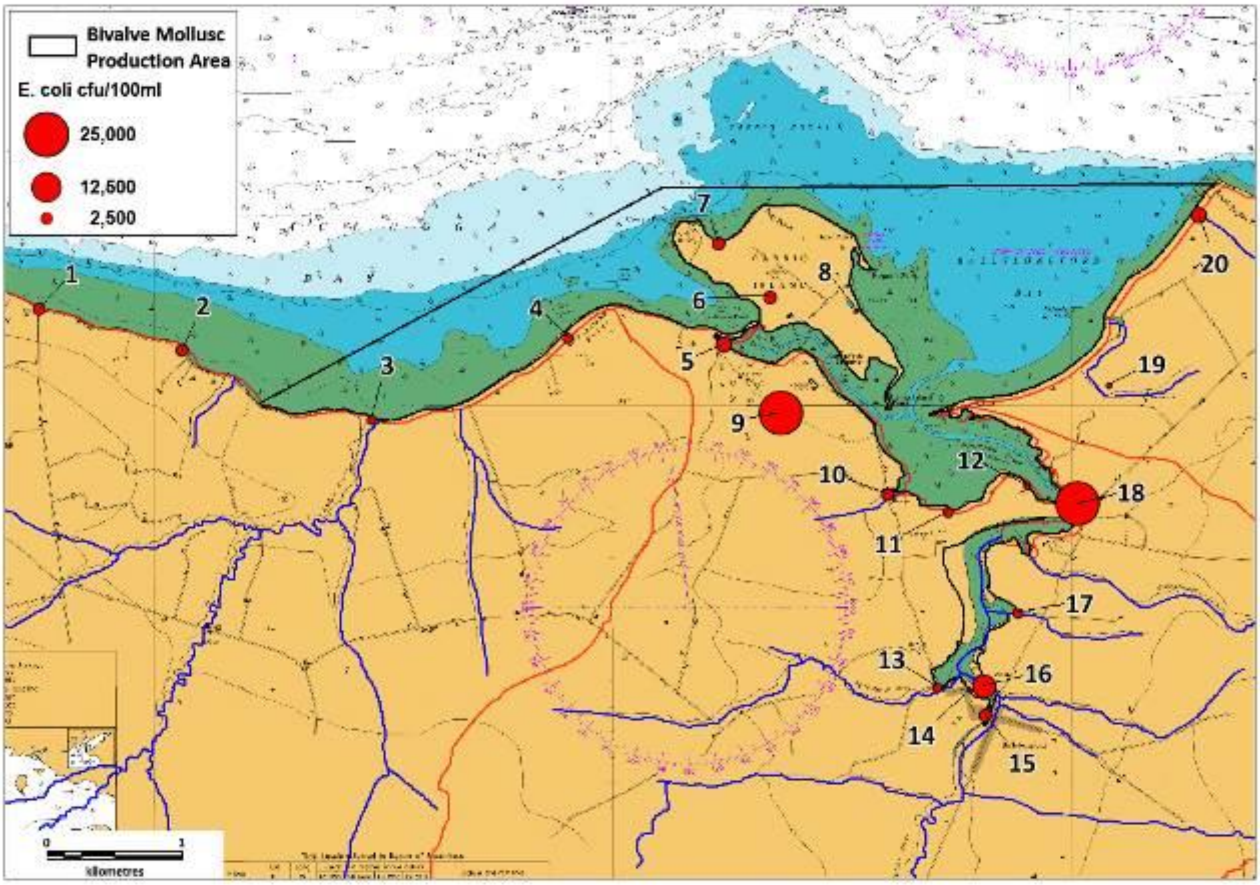


Figure 8.4: Location and magnitude of *E. coli* results from the shoreline survey.

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Appendix 4

Statistical Analysis

Pacific oysters v Season

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Spring	19	32.39894	1.705207	0.318271
Summer	19	36.03225	1.896434	0.832733
Winter	17	30.02544	1.766202	0.22593
Autumn	18	34.93039	1.940577	0.334149

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.668467	3	0.222822	0.512261	0.675169	2.737492
Within Groups	30.01349	69	0.434978			
Total	30.68195	72				

Pacific oysters v Year

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
2014	12	23.25226	1.937689	0.327203
2015	12	19.60512	1.63376	0.328659
2016	13	27.16041	2.089262	0.767892
2017	13	23.68585	1.821989	0.388188
2018	11	18.49537	1.681397	0.328497
2019	12	21.188	1.765667	0.412872

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.76795	5	0.35359	0.819344	0.540213	2.351658
Within Groups	28.914	67	0.431552			
Total	30.68195	72				

Appendix 5

Shoreline Survey Images

The pictures here were taken during the shoreline survey and relate to Section 6.2 of the main document, pages 49 to 67. Please see table 6.12 for the descriptions and co-ordinates and also figure 6.20 for the overall mapped locations. Also see figures 6.21 to 6.32 for specific picture locations.


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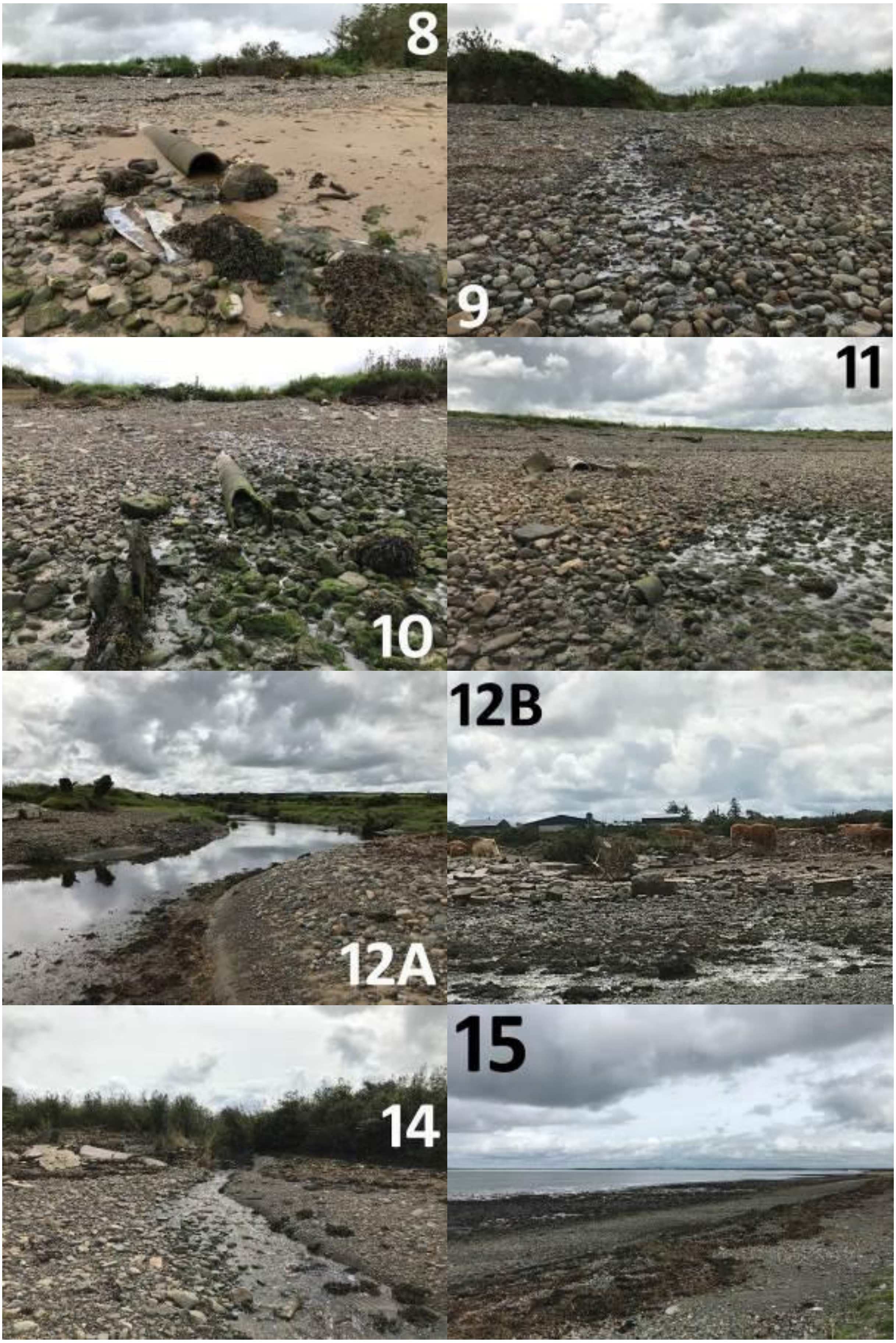
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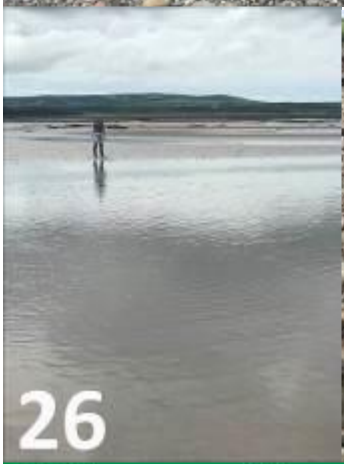
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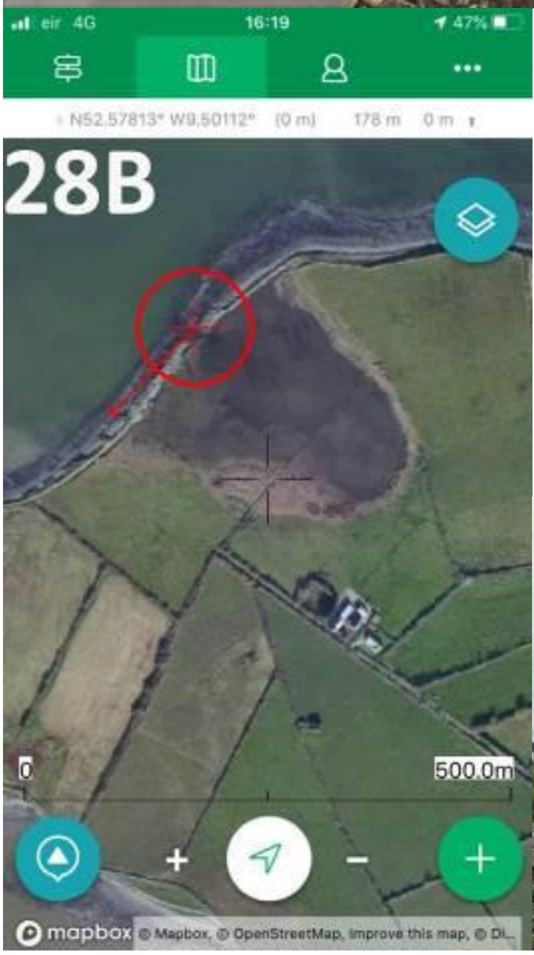
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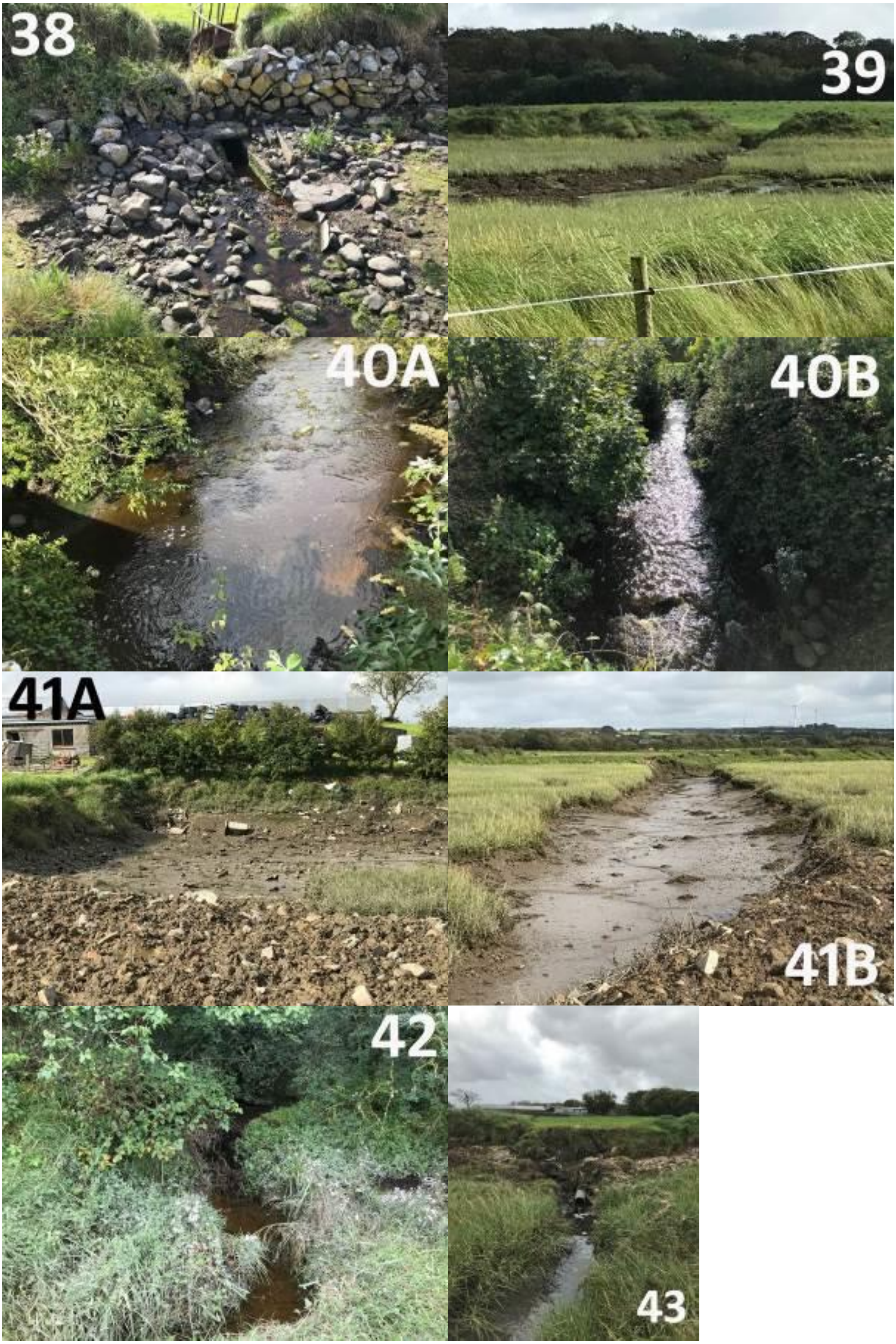
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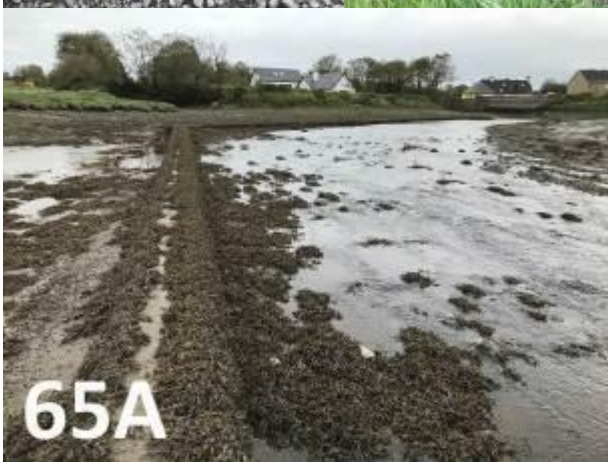
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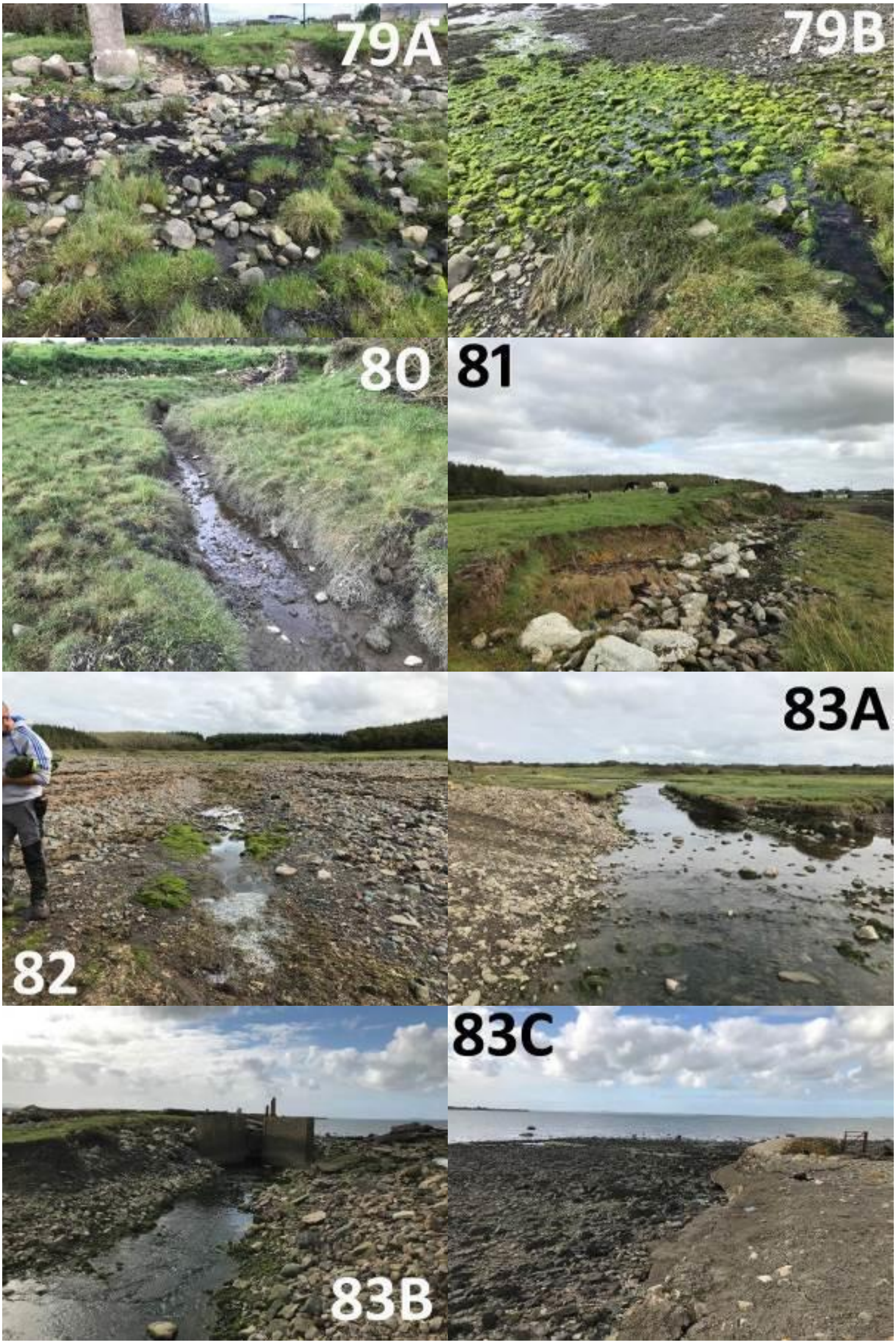
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Appendix 6

Species Specifc RMPs

Ballylongford Bay

Bivalve Mollusc Classified Production Area

Pacific Oyster Monitoring Information

Site Name: Ballylongford Bay

Site Identifier: KY-BD-BD

Monitoring Point Coordinates

RMP 1

Latitude: 52.569955 **Longitude:** -9.535695

RMP 2 (Only to be used if production starts at this site)

Latitude: 52.570807 **Longitude:** -9.484038

Species: *Crassostrea gigas*

Sample Depth: Surface

Sample Frequency: Monthly

Responsible Authority: Sea Fisheries Protection Authority

Authorised Samplers: SFPA Port Office Dingle

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

Sampling Size: Minimum 10 market sized animals

Sampling Method: Taken from trestles at point