Scottish Sanitary Survey Report

Sanitary Survey Report
Ganavan Bay Cockles
AB-697-1512-04
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Cefas

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The hydrographic assessment and the shoreline survey and its associated report were undertaken by SRSL, Oban.

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Appendices

I. Executive Summary

Under (EC) Regulation 854/2004, which sets forth specific rules for the organisation of official controls on products of animal origin intended for human consumption, sanitary surveys of production areas and their associated hydrological catchments and coastal waters are required in order to establish the appropriate representative monitoring points (RMPs) for the monitoring programme.

The purpose of the sanitary survey is to demonstrate compliance with the requirements stated in Annex II (Chapter II Paragraph 6) of Regulation (EC) 854/2004. The sanitary survey results in recommendations on the location of RMPs, the frequency of sampling for microbiological monitoring, and the boundaries of the production areas deemed to be represented by the RMPs. A sanitary survey was undertaken on the cockle fishery at Ganavan Cockles on the basis recommended in the European Union Reference Laboratory publication: “Microbiological Monitoring of Bivalve Mollusc Harvesting Area Guide to Good Practice: Technical Application” (http://www.cefas.defra.gov.uk/nrl/information-centre/eu-good-practice-guide.aspx). The survey was undertaken because this is a newly classified production area. The original application covered areas on the Isle of Kerrera as well. However, a preliminary assessment identified that potential pollution sources and circulation of pollutants would differ between Kerrera and Ganavan and therefore they have been subject to separate sanitary surveys.

Ganavan Bay is located approximately 2.5 km north of Oban on the west coast of Scotland. It faces to the northwest and contains two beaches, Ganavan Beach and Little Ganavan. These have been identified as areas for commercial harvesting of wild cockles. During the shoreline survey, cockles were found at the northern end of Ganavan Beach and at Little Ganavan. Insufficient cockles for a sample were found at a nearby beach at Camas Bàn.

There are relatively large community discharges, as well as private septic tank discharges, to the northeast of Ganavan Bay at Loch Etive and Ardmuknish Bay, and south of Ganavan Bay in the Sound of Kerrera. There is an emergency overflow for a community sewerage system pumping station at Ganavan Bay and there are also a number of consented private septic tkans in the close vicinity. Several consented private septic tanks were also identified adjacent to Camas Bàn. The latter area is more likely to be affected by discharges located within the Sound of Kerrera (including that from Oban STW) than is Ganavan Bay.

The only evidence of agricultural activity in the immediate area of Ganavan Bay was cattle faeces identified by the shoreline to the north of Ganavan Beach during the shoreline survey. Impacts from wildlife will mainly relate to seabirds, although watercourses may also carry contamination from deer and otters. Seabirds may predominate at the southwestern end of the bay. The area is known to be popular with dog walkers and these may frequent Ganavan Beach more often than Little Ganavan.

Several watercourses were identified during the shoreline survey. Single watercourses entered Ganavan Bay at each of the two beaches and these both had moderate estimated loadings. Another watercourse, with a higher loading, entered the bay between the two beaches. Separate watercourses were identified at Camas Bàn and these could impact that area: however, one had a low estimated loading and the others were too small to be measured or sampled.

The hydrographic assessment determined that currents over the flood tide will generally flow to the northeast at Ganavan on the flood tide and to the southwest on the ebb tide. However, it is likely that an eddy will develop in Ganavan Bay itself. The cumulative transport distance on each phase (flood/ebb) of the tide has been estimated in the region of 1.5 km.

A production area is recommended that includes both of the beaches at Ganavan Bay. An RMP has been recommended in the vicinity of previous reported sampling locations at Little Ganavan.

Camas Bàn has been excluded from the recommended production area. If commercially viable stocks of cockles develop at that location in the future it is recommended that it be subject to a re-assessment with the view to potentially identifying a separate RMP given that it is likely to be affected by different sources of contamination.

II. Sampling Plan

Production Area	Ganavan Cockles
Site Name	Ganavan
SIN	AB-697-1512-04
Species	Common cockle
Type of Fishery	Wild harvest
NGR of RMP	NM 8554 3240
East	185540
North	732400
Tolerance (m)	50
Depth (m)	Not applicable
Method of Sampling	Hand
Frequency of Sampling	Monthly
Local Authority	Argyll & Bute Council
Local Authority Liaison Officer	Ewan McDougall
Authorised Sampler(s)	William MacQuarrie Ewan McDougall Christine McLachlan Allison Hardie Heather Harley
Production area	The recommended production area is: the area bounded by a line drawn between NM 8541 3265 and NM 8632 3320 and extending to MHWS

III. Report

1 General Description

Gananvan Bay is a bay on the western coast of Scotland, part of the Argyll and Bute council area. The bay is approximately 2.5 km north of the town of Oban. The bay is approximately 1 km wide and 300 m from head to mouth. It has a westerly aspect and opens to the Firth of Lorn. There are two main areas of intertidal sand – one at the main Ganavan beach at the northeastern end of the bay, and the other at “Little Ganavan” at the southwestern end. Two smaller intertidal areas are located in inlets between these. A further small area of intertidal sand is located at Camas Bàn to the southwest of Ganavan Bay. A promontory, Rubha na h-Earba, separates Camas Bàn from Ganavan Bay.

The small settlement of Ganavan is located a short distance inland from the shore of the bay. There is a small area of development around the main beach and some housing on the road adjacent to Camas Bàn.

A sanitary survey was undertaken on the classified fishery at on the basis recommended in the European Union Reference Laboratory publication: “Microbiological Monitoring of Bivalve Mollusc Harvesting Area Guide to Good Practice: Technical Application” (https://eurlcefas.org/media/13831/gpg_issue-5_final_all.pdf). This production area was selected for survey on the basis of it being a newly classified area.

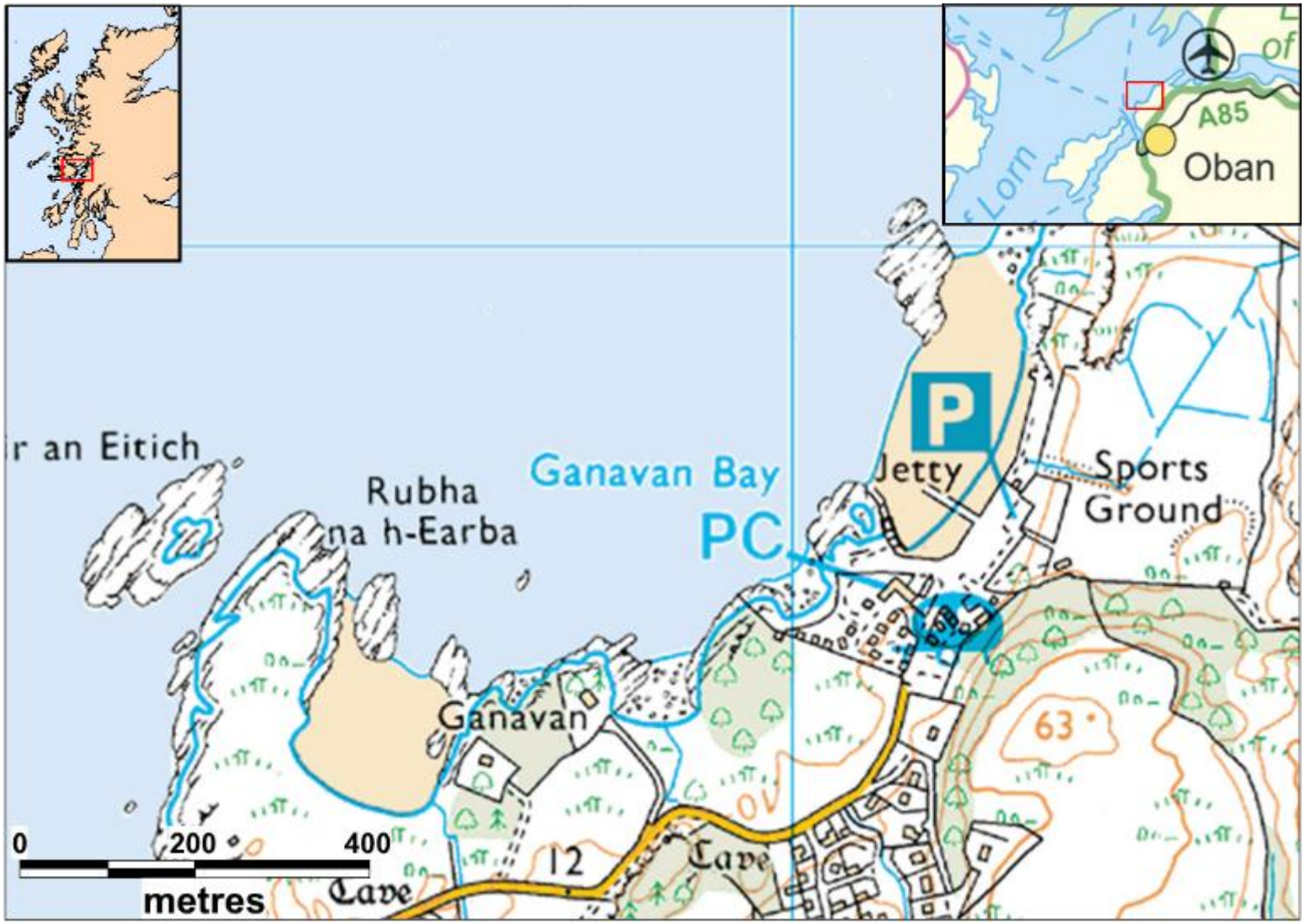

Figure 1.1 Location of Ganavan Bay

2 Fishery

The fishery at Ganavan Bay is a wild common cockle (*Cerastoderma edule*) fishery. Details of the site given in the application form are presented in Table 2.1. The site location is given in Figure 2.1.

Table 2.1 Area shellfish farms

Production area	Site	SIN	Species
Kerrera Cockles	Ganavan Bay	AB-697-1512-04	Common Cockles

The area assessed in this report has been placed in a production area which encompasses the site detailed in Table 2.1 plus an additional three sites at Ardantrive, Sidhean Riabhach and Balliemore, all of which are on the island of Kerrera. These sites have been assessed in a separate report due to anticipation of significant disparities between potential pollution sources and circulation of pollutants between the different sites. The present production area boundaries are defined as: the area bounded by lines drawn between NM 8676 3378, NM 8028 2972, NM 8140 2645, NM 8218 2712, NM 8308 2838, NM 8484 2999, NM 8510 3143 extending to MHWS

There are no cockle stock assessments available for the sites. Cockles can be present throughout the intertidal zone, and sometimes subtidally, but substrate type and particle size will influence whether cockles are present. Cockles were found at both the main Ganavan beach and at Little Ganavan during the shoreline survey although on the main Ganavan Beach they were found towards the northern end but not in the vicinity of the jetty. Cockles were previously reported at a point from approximately midway between those two locations during a biodiversity survey (CSGBI, 2013), indicating that cockle populations were present there in September 2013. This location, and the successful shoreline survey sampling points, are shown in Figure 2.1. Only one cockle was found at Camas Bàn. It is known that cockle populations are usually successful at recovering after harvesting (Tyler-Walters, 2007).

The two small inlets located between the two beaches within Ganavan Bay are shown as being shingle on the OS map. However, on aerial imagery they show as being at least partially sand and therefore cockles may also be present at those locations.

Figure 2.1 Ganavan Bay Fishery

3 Human Population

Information was obtained on the population within the vicinity of the Ganavan Bay fishery from the General Register Office for Scotland. The last census was undertaken in 2011. The census output areas adjacent to the shellfish beds are shown in Figure 3.1 thematically mapped by the 2011 population densities. The population density is low (< 28 people per km^2) in the census output area directly adjacent to the fishery (S00069121). However, the town of Oban (estimated 2011 population – 8,574) is located approximately 2 km south of the bay and Dunbeg (estimated 2011 population – 625) is located less than 1.5 km northeast of the bay.

Scattered dwellings line the coastline surrounding the bay. The beach on the eastern side of the bay is a designated bathing water and has parking facilities for visitors. The research and education facility of the Scottish Association of Marine Science is located in Dunbeg. Dunstaffnage Castle is a tourist attraction located on the northern shoreline of Dunstaffnage Bay. The Isle of Kerrera, located southwest of Ganavan Bay, is very sparsely populated with a resident population of 34 reported in 2011. There is limited tourist accommodation at the southern end of the island. Further tourist accommodation is available in Oban, which also has good rail and road infrastructure, a general hospital and three schools.

There is a jetty on the eastern shore of Ganavan Bay. No fishing or pleasure boats were observed in the area during the shoreline survey. Oban Marina is located on the eastern coastline of Kerrera. A marina is also situated at Dunstaffnage, to the northeast of Ganavan Bay. Ferry services to run from Oban to Lismore, Lochboisdale, Craignure, Castlebay, Coll, Tiree and Colonsay as well as small ferries between Kerrera and Oban. Large cruise ships often dock outside Oban harbour and smaller ferries will run between the cruise ship and harbour for passengers. Several sightseeing and angling boats operate from Oban. There are a number of anchorages in the area (Clyde Cruising Club, 2007): two are located on the eastern shoreline of Kerrera and another is located adjacent to Oban. Mention is also made of the possibility of anchoring in Ganavan Bay although the bay is open to prevailing westerly winds.

Overall, the local population on the coastline directly adjacent to the survey area is low and sparsely distributed in relation to the shellfish beds, however the presence of nearby boating activity in Ardantrive Bay and Oban and the high density of dwellings and tourist accommodation in Oban may impact the fishery.

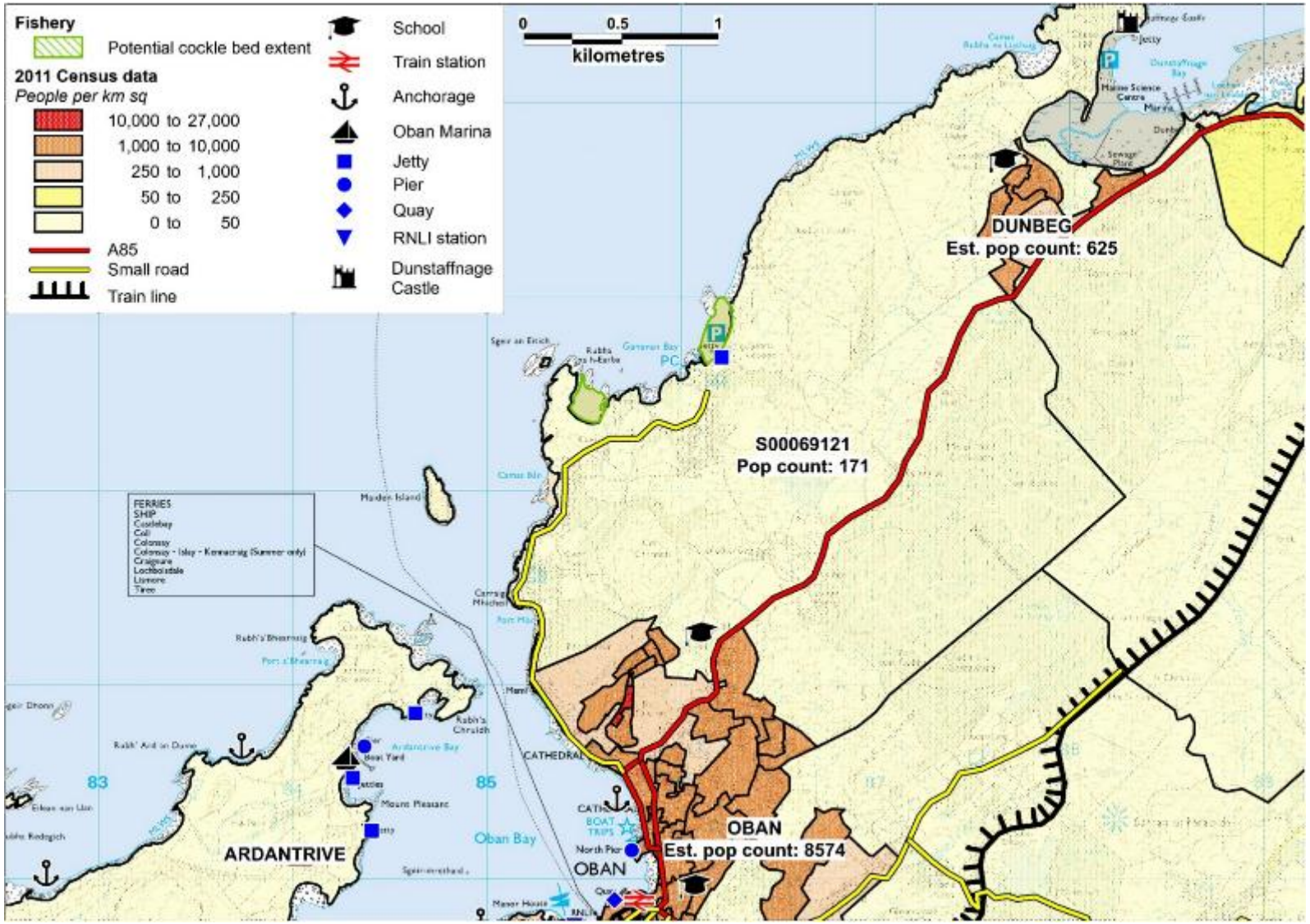

Figure 3.1 Population map for the area around Ganavan Bay

4 Sewage Discharges

Information on sewage discharges within an area 7 km around two points, NM 8850 3380 (a point on the North West of Kerrera) and NM 8300 3000 (Dunstaffnage Marina) was sought from Scottish Water and the Scottish Environment Protection Agency (SEPA). Data requested included the name, location, type, size (in either flow or population equivalent), level of treatment, sanitary or bacteriological data, spill frequency, discharge destination (to land, watercourse or sea), any available dispersion or dilution modelling studies, and whether improvements were in work or planned. Due to three sanitary surveys (Kerrera, Ganavan Bay and Dunstaffnage Bay) being conducted at locations close to each other at similar times, a single data request was used to cover discharges for all three areas. No information was provided on bacteriological quality, sanitary quality, spill frequency or modelling studies.

Information on locations where sewage sludge is applied to land had been requested from SEPA: it was identified that little data was held on this and that the data that was held could not be made available for assessment within the sanitary survey programme.

Discharges which are considered to have an impact on the fisheries (those where the effluent entered the sea within 8 km of the harvesting area) were sub-selected from this data and have been used in the assessment below. The location of those within 3 km of Ganavan Bay are shown on the map in Figure 4.1. Where the locations given by the different data providers are similar, but not identical, the location given by SEPA has been used for the sake of simplicity.

4.1 Community Discharges

Community sewage discharges were reported in the area assessed around Ganavan Bay, covering both Oban to the South and Dunbeg & Connel and Benderloch to the North.

4.1.1 Continuous Community Discharges

Information of nine public continuous outfalls was provided; seven by Scottish Water and eight by SEPA. Details of these discharges are given in Table 4.1.

Table 4.1. Continuous Community Discharges

Scottish Water						SEPA					
Discharge Name	**Licence number**	**Location**	**Treatment Level**	**PE**	**DWF m^3/day**	**Discharge Name**	**Licence number**	**Location**	**Treatment Level**	**PE**	**DWF (m3/day)**
Oban WWTW	CAR/L/1003475	NM 8490 3060	Secondary	-	4958	Oban STW,	CAR/L/1003475	NM 8490 3060	Secondary	13597	4958
Dungallan Terrace SEP	WPC/W/12086 (Formerly CD12219)	NM 8420 2910	Septic Tank	-	-	Dungallan Terrace SEP	WPC/W/12086 (Formerly CD12219)	NM 8420 2910	Septic Tank	-	-
Benderloch WWTW	CAR/L/1000364	NM 9010 3850	Secondary	400	88	Benderloch STW	CAR/L/1000364	NM 90080 38418	Secondary	400	88
Connel SEP	CAR/L/1010872	NM 8960 3450	Septic Tank	-	332.1	Connel & Dunbeg WwTW	CAR/L/1010872	NM 89600 34500	Primary	-	332.1
North Connel STW	CAR/L/1010883	NM 9059 3459	Septic Tank	-	84	North Connel WwTW	CAR/L/1010883	NM 90590 34590	Primary	-	84
Blackcrofts North Connel	-	NM 9237 3465	Septic Tank	Serves 12 houses	-						
Achnacreemore SEP	-	NM930363	-	-	-						
*Reconfigured as South Connel SPS2						Deirdre	CAR/L/1003310	NM 91236 34405	Untreated	-	-
*Reconfigured as North Connel STW						Lora View	CAR/L/1003311	NM 90700 34600	Untreated	-	-

- = Data not provided. DWF=Dry Weather Flow, EO=Emergency Overflow, MDF=Mean Daily Flow, NA=not applicable, PE=Population Equivalent, ST= Septic Tank, WWPS =Waste Water Pumping Station. *Information provided by Scottish Water subsequent to consultation on the draft report.

Two community discharges to the Sound of Kerrera are present south of Ganavan. Oban STW (CAR/L/1003475) serves Ganavan and covers the majority of Oban. This discharge is approximately 2.5 km from Ganavan Bay. Dungellan Terrace septic tank is approximately 4 km from Ganavan Bay. No flow details were given for this discharge.

Seven community discharges were recorded to the north of the fishery. Connel and Dunbeg STW (CAR/L/1010872) discharges at Rubh' Aird nan Leum near the mouth of Loch Etive, approximately 4.5 km from Ganavan Bay. The discharge is consented for a dry weather flow of 332.1 m^3/day. North Connel STW (CAR/L/1010883) discharges to Loch Etive, approximately 5.5 km from Ganavan Bay. It is consented for a dry weather flow of 84 m^3/day. Blackcrofts North Connel, reported only by Scottish Water, discharges to Loch Etive, approximately 7 km from Ganavan Bay. No flow or PE was given. Achnacreemore Septic tank was reported by Scottish Water, but no discharge location is given. A National Grid Reference (NGR) in the name, which may refer to the asset location, is given as NM 930363 (this location lies outwith the area shown in Figure 4.1). No PE or flow value is given for the discharge but it is noted as discharging to soakaway. Deirdre STW (CAR/L/1003310) and Lora View STW (CAR/L/1003311) also discharge to Loch Etive approximately 6 km from Ganavan Bay. These are licensed for the release of untreated effluent. No discharge volume or PE was given. Scottish Water advised that these had been reconfigured and replaced by CAR/L/1010875 and CAR/L/1010883, as shown in Table 4.1. Benderloch STW (CAR/L/1000364) discharges to Ardmuknish Bay approximately 7.1 km from the fishery. The works are licensed for a PE of 400 with a dry weather flow of 88 m^3/day.

4.1.2 Intermittent Community Discharges

Scottish Water provided information relating to eleven CSOs or CSO/EOs and three EOs, while SEPA provided details of fifteen CSOs or CSO/EOs and three EOs.

The information provided by SEPA and Scottish Water differed in both the discharges reported and their discharge locations. The locations given by the different providers are given in Table 4.2. The full data reported by the providers is given in Appendix 6 and 7. Subsequent to the draft consultation on this document, Scottish Water identified that three of the assets reported by SEPA did not discharge or were not CSOs (Greens/Glencruitten Rd PS, Burnbank Terrace CSO, and Nant Drive CSO) and these were removed from the table.

Information provided for one CSO (North Connel, 6 Mosspark CSO) did not include a licence reference or discharge location. It was noted as being associated with Achnacreemore septic tank and therefore the location for the septic tank has therefore been assumed for the CSO.

Table 4.2 Intermittent Community Discharges

Licence number	Discharge Name	Discharge Type	SEPA Location	SW Location	Treatment Level SW
CAR/L/1026157	Gallanach PS,	CSO/EO	NM 84810 29460	NM 8483 2942	6 mm screens
CAR/L/1026157	Corran Esplanade PS	CSO/EO	NM 85623 30556	NM 8581 2998	10 mm screens
CAR/L/1026157	Oban Heritage Centre PS	CSO/EO	NM 85795 29907	NM 8580 2993 (EO only)	-
CAR/L/1026157	Alma Crescent CSO	CSO	NM 85508 29727	-	-
CAR/L/1026157	George Street CSO	CSO	NM 85793 30010	NM 8581 2998	10 mm screens
CAR/L/1026157	Soroba Road CSO	CSO	NM 86044 29338	-	-
CAR/L/1026157	Ganavan	EO	NM 85920 32590	NM 8592 3259	10 mm screens
CAR/L/1026157	Manor House SPS	EO	-	NM 8518 2982	-
CAR/L/1010880	North Connel TPS 2	CSO/EO	NM 90610 34628	NM 9061 3164	6 mm screens
CAR/L/1010886	South Connel TPS 1	CSO/EO	NM 90970 34390	NM 9097 3439	6 mm screens
CAR/L/1010885	South Connel SPS1	CSO/EO	NM 91850 34230	NM 9185 3423	6 mm screens
CAR/L/1010882	North Connel	CSO/EO	NM 92130 34630	NM 9213 3463	6 mm screens
CAR/L/1010872	Connel & Dunbeg WwTW,	CSO/EO	NM 89600 34500	NM 8960 3450	6 mm screens
CAR/L/1010875	Connel SPS2 EO	EO	NM 91260 34430	-	-
CAR/L/1010878	North Connel SPS2 EO	EO	NM 90710 34630	-	-
-	Dunbeg Jane Road CSO	CSO	-	NM 8823 3390	-
-	Dunbeg Jane Road WWPS	EO	-	NM 8801 3347	-
-	Dunbeg Meadow Rd WWPS	CSO/EO	-	NM 8823 3390	-
CAR/L/1000364	Benderloch CSO	CSO	NM 89958 38362	NM 9010 3850	6 mm screens

CSO=Combined Sewer Overflow EO= Emergency Overflow PS=Pumping Station- Data not given SW=Scottish Water

Ganavan EO (CAR/L/10261), discharges within Ganavan Bay, and is the only intermittent discharge within 3 km of the bay.

4.2 Consented Private Discharges – SEPA

SEPA also provided information regarding consented private discharges within the request area identified. Discharges relating to abstraction, impoundment or

engineering works have been excluded from assessment, as they should not contribute any faecal input to the area.

SEPA provided information on 285 sewage discharge consents in the area considered to potentially affect the fishery at Ganavan Bay. The PEs of these discharges range from 5 to 150 but the majority (n=243) have a consented PE of between 5 and 10. As much of the population is served by community sewage network the private discharges are mainly located in peripheral areas outside areas of major settlement. It is not clear whether all of the discharges covered by the consents are still active as there have been significant changes to use of some of the properties over time (e.g. at Ganavan Pavilion) and changes to the coverage by the community sewerage networks.

Only one discharge has a high consented PE for a private discharge (CAR/L/1085662) This is for a discharge to Loch Etive from North Connel and is consented for a PE of 150. This discharge is approximately 6.5 km from the Ganavan cockle beds.

Of the 285 discharges, 199 were consented to go to soakaway or land. The effectiveness of soakaway systems depends on location and maintenance, and SEPA have identified previously that in remote areas, consents originally registered as discharging to land may be diverted to sea or watercourses upon failure of the soakaway fields. Of the remaining 86 consents, 42 were for discharges to watercourses and 46 for discharges directly to sea. Twenty-six of the private discharges are within 100 m of mean high water springs and within 1 km of Ganavan Bay. These are considered most likely to have an impact on the fishery and are given in Table 4.3.

Registration is required for all new properties and upon sale of existing properties. Information provided by SEPA is considered to be correct at the time of writing; however there may be additional discharges that are not yet registered with SEPA.

SEPA also provided information of two marine cage fish farms (MCFF) within the area requested. Working facilities on these may include toilets, but no information was provided regarding these. Information was given of one consent for water treatment filter backwash. This is likely to have a high bacterial content.

Table 4.3 Private discharge consents within 100m of MHWS and 1 km of the fishery

Licence Number	National Grid Reference	Discharge Type	Discharging to	PE
CAR/L/1003316	NM 86052 32694	Sewage (Private) Primary	Ganavan Bay	Not given
CAR/R/1013629	NM 85399 32030	Sewage (Private) Primary	Firth of Lorn	5
CAR/R/1014140	NM 85380 32040	Sewage (Private) Primary	Firth of Lorn	5
CAR/R/1014557	NM 85370 32080	Sewage (Private) Primary	Camas Ban	5
CAR/R/1014806	NM 85335 31871	Sewage (Private) Primary	Firth of Lorn	5
CAR/R/1016245	NM 85412 31935	Sewage (Private) Primary	Soakaway	8
CAR/R/1016811	NM 85340 31760	Sewage (Private) Primary	Land	18
CAR/R/1037465	NM 85370 32060	Sewage (Private) Primary	Firth of Lorn	5
CAR/R/1038157	NM 85740 32540	Sewage (Private) Primary	Firth of Lorn	10
CAR/R/1039308	NM 85340 31870	Sewage (Private) Primary	Camas Ban	6
CAR/R/1039611	NM 85640 32390	Sewage (Private) Primary	Soakaway	5
CAR/R/1113552	NM 85370 32080	Sewage (Private) Primary	Camas Ban	5

PE=Population Equivalent

4.3 Shoreline Survey Discharge Observations

During the shoreline survey, eight observations were noted of sewage discharges and/or sewage-related infrastructure. These are shown in Table 4.4.

Observation 1 reported two 20 cm ceramic pipes in the intertidal zone that may be sewage outfalls but did not relate to any provided discharge consents.

Observation 2 reported an iron outfall pipe with barnacles growing inside, which may indicate reduced or no flow.

Observation 3 reported two outfall pipes, 3a & 3b, running over rocks from the direction of a septic tank. Both were discharging a small trickle of 7.1 ml/s for 3a and 4.8 ml/s for 3b respectively. Samples taken gave a result of 10000 *E.coli* cfu/100ml for 3a and below the detectable limit of 1000 *E.coli* cfu/100ml for 3b. This gives estimated loadings of 6.1×10^7 *E. coli*/day for 3a, and a maximum of 4.2×10^6 *E. coli*/day for 3b.

Observation 4 related to a small, odorous watercourse running from the direction of two houses. A sample returned a value of 670 *E.coli* cfu/100ml, which was consistent with that expected for a watercourse with diffuse inputs and did not reflect marked contamination arising from the dwellings.

Table 4.4 Discharge-associated observations made during the shoreline survey

No.	NGR	Associated Photograph (Appendix 5)	Associated Sample	Description
1	NM 86116 32704	Fig 6 & Fig 7		Two 20 cm ceramic pipes visible at low tide. Housing development at the south end of the beach. Public toilet facility on carpark.
2	NM 86044 32638	Fig 8 & 9		15cm cast iron pipe from direction of houses onto rocky shore, no flow, barnacles growing inside the pipe.
3	NM 85750 32524	Fig 10 & 11		Two pipes running over the rocks from septic tank, One was a 12 cm ceramic pipe discharging a trickle of water from pipe. The second was a 12 cm plastic pipe also discharging a trickle of water.
3a	NM 85750 32522		100000	Flow 7.1 ml/s from ceramic pipe associated with wp 16.
3b	NM 85751 32506		<1000	Flow 4.8 ml/s from plastic pipe associated with wp 18.
4	NM 85353 32086	Fig 12	670	Small watercourse associated with wp 29 running from direction of two houses before joining together on the sand. Strong unpleasant odour.
5	NM 85231 31739	Fig 14		Metal pipe on shore coming from disused urinal building, no flow from pipe.

4.4 Summary

The sewerage needs for the area that includes Ganavan Bay are predominantly served by the Oban sewer network. The treatment works for this network has a PE of 13597 and discharges into Oban Bay. There are also intermittent discharges associated with the network, including one at Ganavan itself. Additionally, there is a small community septic tank outfall and a number of small private discharges to sea. To the northeast of the bay are seven continuous community discharges to Loch Etive and Ardmucknish Bay. The latter discharges are further from Ganavan Bay than are those in the Oban area. There are intermittent community discharges and several private discharges to Loch Etive and Ardmucknish Bay.

Two private discharges to Ganavan Bay (CAR/L/1003316 and CAR/R/1038157) were reported, however no PE was given for the former one and the latter had a PE of 10. An emergency overflow also discharges to the bay. These are likely to give the greatest input of faecal pollution to the cockle beds. The effect of the other discharges to the south and southeast will depend on the effective particle transport distance as well as dilution and dispersion.

Camas Bàn will be directly impacted by the private discharges from the houses in the vicinity. It will be affected to a greater extent than Ganavan Bay by the discharges in the Oban area but less by the discharges at Loch Etive and Ardmuknish Bay.

Figure 4.1 Map of discharges in the vicinity of Ganavan Bay

5 Agriculture

Information on the spatial distribution of animals on land adjacent to or near the shellfishery can provide an indication of the potential amount of organic pollution from livestock entering the shellfish bed areas. Agricultural census data to parish level was requested from the Scottish Government Rural Environment, Research and Analysis Directorate (RERAD) for the Kilmore and Kilbride parish. Reported livestock populations for the parish in 2013 is listed in Table 5.1.

Table 5.1 Livestock numbers in the Kilmore & Kilbride agricultural parish

	Kilmore & Kilbride	
	Area: 120 km^2	
	Holdings	Numbers
Pigs	5	22
Poultry	13	165
Cattle	23	816
Sheep	31	15049
Horses used in Agriculture	0	-
Other horses and ponies	0	-

The livestock census numbers for Kilmore and Kilbride relate to an area of 120 km^2, covering the island of Kerrera and a large area of the adjacent mainland (see inset map in Figure 5.1). It is therefore not possible to determine the spatial distribution of the livestock on the shoreline adjacent to the survey area or to identify how many animals are likely to impact the catchment around the shellfish beds. Although the figures are not useful for assessing the potential impact of livestock contamination to the shellfishery, they do give an idea of the total numbers of livestock over the broader area. Sheep were kept in moderate numbers and cattle, pigs and poultry were kept in small numbers.

A source of spatially relevant information on livestock population in the area was the shoreline survey (see Appendix 5) which only relates to the time of the site visit on the 24th November 2014. Observations made during the survey are dependent upon the viewpoint of the observer some animals may have been obscured by the terrain.

The only agricultural observation made during the shoreline survey was of cattle faeces close to the shoreline north east of the Ganavan Bay shellfish beds. No other livestock were observed during the shoreline survey.

No livestock were visible on publicly available aerial imagery (Bing Maps and Google Maps, accessed 03/03.15).Information on locations where animal slurry is stored and/or applied to land had been requested from SEPA: it was identified that little data was held on this and that the data that was held could not be made available for assessment within the sanitary survey programme.

Any contributions of faecal contamination from livestock are expected to be low, with the greatest impact to areas of the cockle beds closest to the shoreline at the northeastern end of the bay.

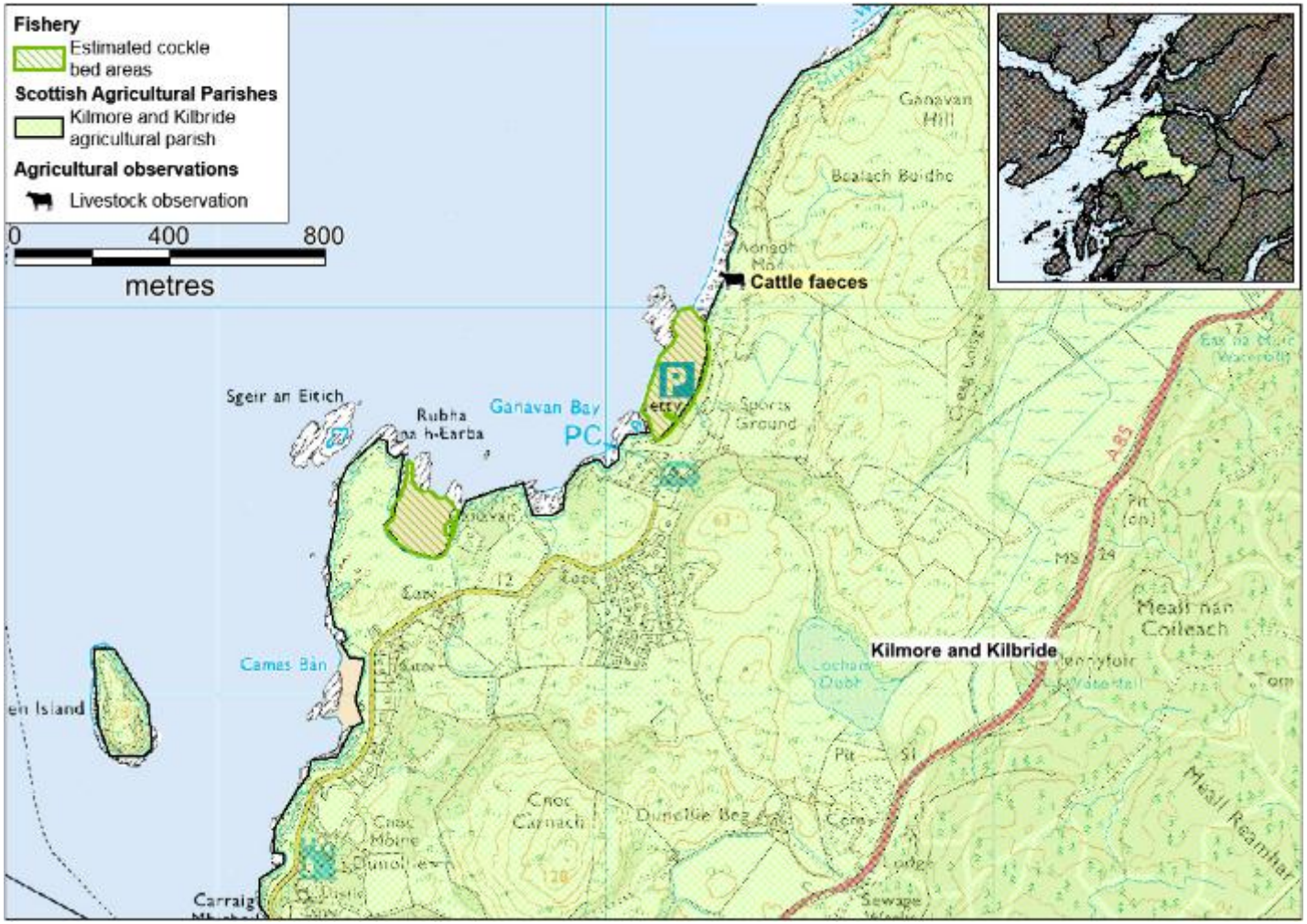

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Figure 5.1 Livestock observations at Ganavan Bay

6 Wildlife and pets

Wildlife species present in and around the production area will contribute to background levels of faecal contamination at the fishery, and large concentrations of animals may constitute significant sources when they are present. Seals (pinnipeds), whales (cetaceans) and some seabirds may deposit faecal wastes directly into the sea, whilst birds and mammals present on land will contribute a proportion of any faecal indicator loading carried in diffuse run-off or watercourses.

The species for which information was potentially available and which could contribute to faecal indicator levels at Ganavan Bay are considered below.

Pinnipeds

The Special Committee on Seals report (SCOS, 2013) indicated that between 100 and 250 common seals were observed within a 10 km radius of Ganavan Bay in August surveys between 2007 and 2011. Comparatively, only 1-5 grey seals were observed in the same area in August surveys over the same period. No seals were observed during the shoreline survey.

Cetaceans

Since 2010, only two sightings of cetaceans have been made in the Ganavan Bay area, and these related to harbour porpoise (Hebridean Whale and Dolphin Trust, 2015). No cetaceans were observed during the shoreline survey.

Seabirds

Seabird data was downloaded from the collated JNCC dataset from the website (JNCC, 2014) in March 2014. The dataset was then manipulated to show the most recent data where repetitions of counts were present. It should be appreciated that the sources of this data are varied, with some recorded as unknown or estimated, whilst some come from reliable detailed surveys such as those carried out for the Seabird 2000 report by Mitchell *et al.*, (2004). Data applicable for the 5 km area around the cockle beds are listed in Table 6.1.

Table 6.1 Seabird counts within 5 km of Ganavan Bay

Common name	Species name	Count*	Qualifier	Accuracy
Herring Gull	*Larus argentatus*	1074	Occupied territory and nests	3 counts accurate, 2 counts unknown, 1 count estimate
Common Gull	*Larus canus*	58	Occupied nests	1 count unknown, 4 counts accurate, 1 count estimate
Lesser Black-Backed Gull	*Larus fuscus*	202	Occupied territory and nests	1 count estimate, 1 count accurate
Great Black-Backed Gull	*Larus marinus*	12	Occupied territory and nests	2 counts of unknown, 2 counts of accurate, 1 count estimate
Arctic Tern	*Sterna paradisaea*	74	Occupied territory and nests	1 count estimate, 2 counts unknown
Common Tern	*Sterna hirundo*	20	Occupied territory and nests	1 count unknown, 2 counts estimates, 2 counts accurate
Shag	*Phalacrocorax aristotelis*	12	Occupied nests	Unknown
Black Guillemot	*Cepphus grylle*	6	Individuals on land	Accurate

*The counts have been adjusted where the method used was occupied nests/sites/territory to reflect the probable number of individual birds (i.e. counts of nests and occupied territory were doubled)

The JNCC seabird dataset indicates that large breeding colonies of herring gulls and lesser black backed gulls are located on the island of Eilean Mòr approximately 3 km northeast of Ganavan Bay. A large herring gull colony was also recorded on the island of Eilean Beag slightly further northeast. Small breeding colonies of Arctic terns, common terns, Greater black-backed gulls, common gulls and individual black guillemots were recorded at Sgeir an Eitich, approximately 200 m from Little Ganavan. Birds in this area are expected to have a more significant impact at the cockle beds, with higher impacts expected during the breeding season which largely falls between May and October.

Birds were the most common wildlife observed during the survey. Species included ringed plovers, gulls, mallard ducks, mute swans, oystercatchers and a kestrel. The majority of birds were noted along the intertidal area where the cockle bed is located, where they are expected to directly contaminate the cockle bed.

Otters

There are three records from the National Biodiversity Network of the Eurasian otter (*Lutra lutra*) within 100 m of Ganavan Bay (https://data.nbn.org.uk/). The dates for the records ranged from the early 1990s to 2011 and so do not necessarily indicate a large population in the area. No otters were observed during the survey.

Deer

The National Biodiversity Network had records of roe deer on land at Lochan Dubh near to Ganavan Bayin 2010 (https://data.nbn.org.uk/). The shoreline survey recorded a roe deer in a field on the southeastern side of Little Ganavan.

Dogs

Five dogs were observed being walked along the shoreline of the northern cockle bed, with bins provided for dog mess located in the adjacent car park. Ganavan Beach is identified by a tourist website as being ideal for dog walking (http://www.tripadvisor.co.uk/). However according to the Marine Conservation Society website, there is a dog ban in force on the beach (Marine Conservation Society, 2013). The Ganavan Beach Management Plan (2012) states that the area is a popular dog walking area and does not mention a ban on dogs on the beach (Argyll and Bute Council, 2012). Dog walkers were observed throughout the day during the shoreline survey.

Conclusions

Cotamination impacts are expected from both wildlife and domestic dogs. Direct and localised impacts are expected from dogs and seabirds depositing droppings directly onto the cockle beds. Additional inputs from wildlife will occur through land runoff or watercourses containing faecal contamination from deer and otters

Contamination from seabirds may be more significant at the southwestern cockle bed due to the birds using Sgeir an Eitich. Contamination from dogs may be more significant at the main beach due to a proportion of people not walking far from the car park. Contamination carried via watercourses will impact both beds approximately equally (see Section 8).

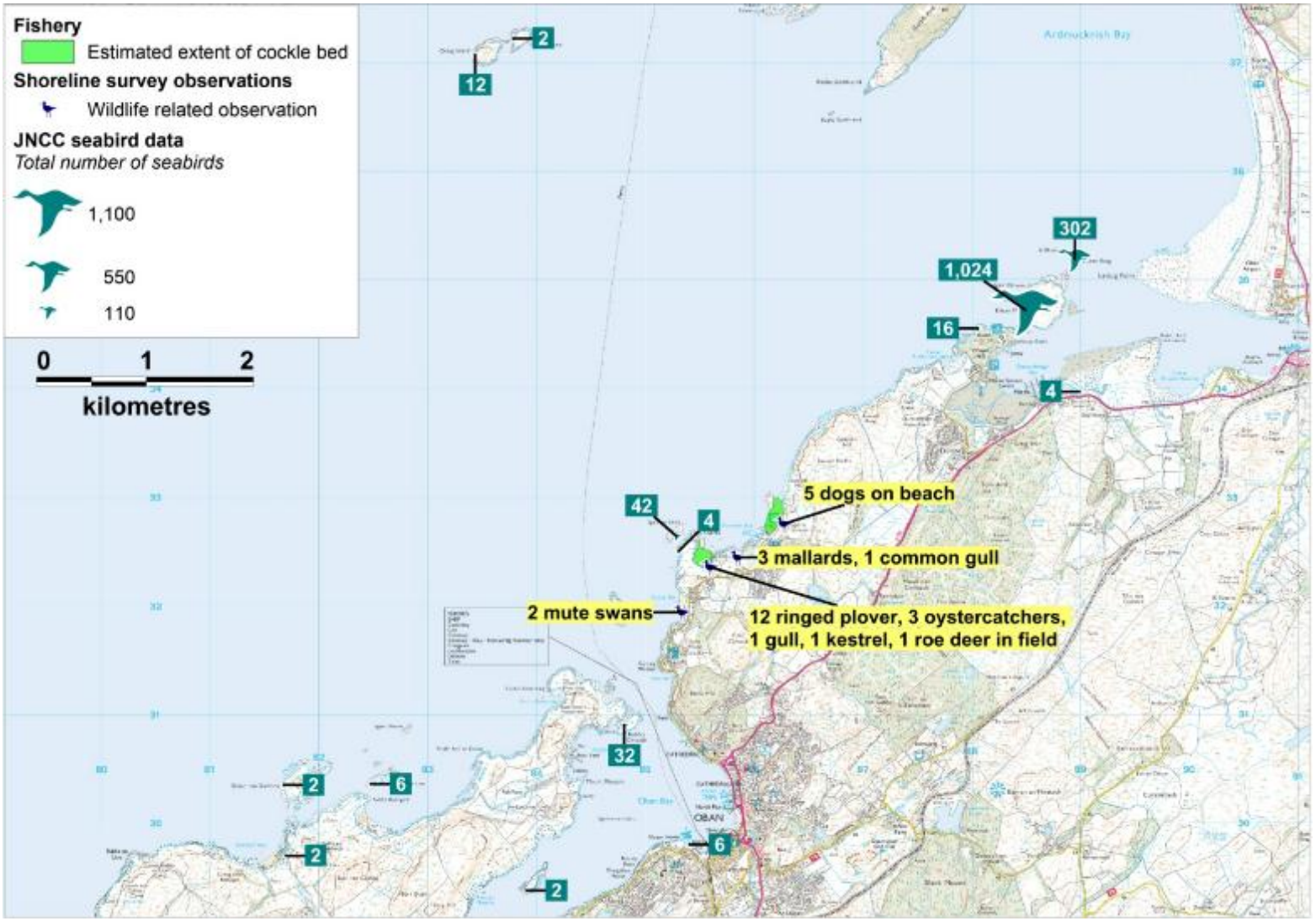

Figure 6.1 Map of wildlife and pet distribution around Ganavan Bay

7 Land Cover

The Land Cover Map 2007 data for the area is shown in Figure 7.1. The predominant land cover type shown adjacent to the shellfish beds is improved grassland with small areas of arable land and broad leaved woodland. In immediately adjacent areas there is dwarf shrub heath and rough grassland. There are also areas of coniferous woodland, bog and arable and horticulture inland. To the south of Ganavan Bay, Oban is represented as a built up/urban areas. It should be noted that the intertidal areas at Ganavan Bay and Camas Bàn are shown as rock rather than sediment; there is an area of littoral/supra-littoral sediment shown inland on Kerrera; there are areas of freshwater shown at the shoreline on Kerrera. Neither of the first two are apparent on aerial imagery and the third seems very unlikely. Therefore, there seems to be some misclassification of land cover types in this area.

Faecal indicator organism export coefficients for faecal coliform bacteria have been found to be approximately 1.2 – 2.8×10^9 cfu km^{-2} hr^{-1} for urban catchment areas, approximately 8.3×10^8 cfu km^{-2} hr^{-1} for areas of improved grassland and approximately 2.5×10^8 cfu km^{-2} hr^{-1} for rough grazing (Kay, *et al*., 2008a). The contributions from all land cover types would be expected to increase significantly after rainfall events, however this effect would be particularly marked from improved grassland areas (roughly 1000-fold) (Kay, *et al*., 2008a).

The highest potential contribution of contaminated run-off to the shellfish beds is from the areas of improved grassland located on the shorelines adjacent to the shellfish beds. Additional input would come from the adjacent areas of rough grassland. These contributions would be expected to increase after rainfall events.

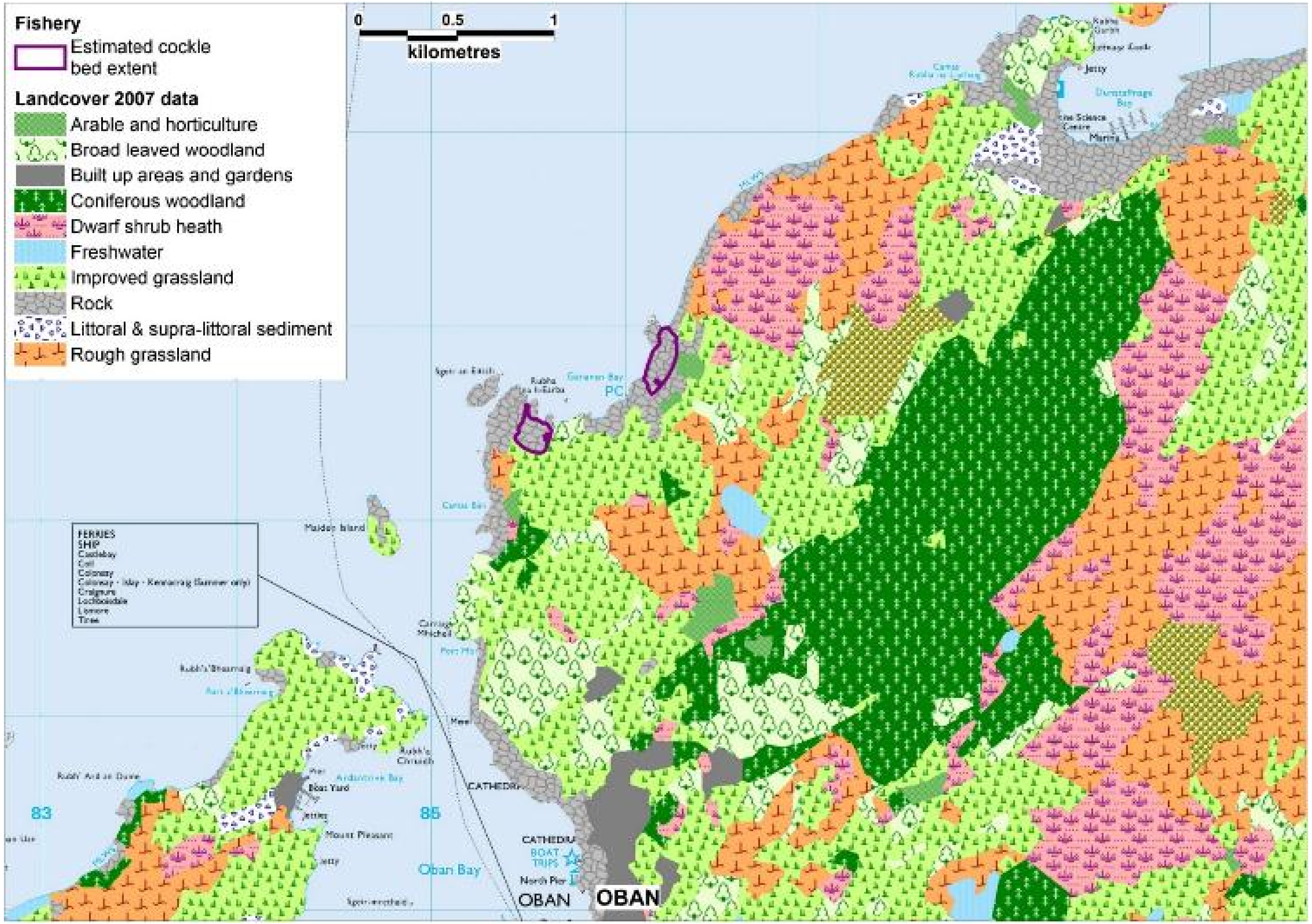

Figure 7.1 LCM2007 land cover data for the area around Ganavan Bay

8 Watercourses

There are no gauging stations on watercourses entering Ganavan Bay.

Spot measurements of flow and microbial content were obtained during the shoreline survey conducted on the 24th November 2014. Rain showers were recorded in the 48 hrs prior to the survey day. The watercourses listed in Table 8.1 are those recorded during the shoreline survey. No areas of land drainage were recorded during the shoreline survey. The locations and loadings of measured watercourses are shown in Figure 8.1.

Table 8.1 Watercourses entering Ganavan Bay

No.	Eastings	Northings	Description	Width (m)	Depth (m)	Flow (m^3/d)	Loading (*E. coli* per day)
1	185350	731843	Unnamed watercourse	0.10	0.015	146	1.5×10^7
2	185353	732087	Unnamed watercourse	NA			Not determined*
3	185346	732145	Unnamed watercourse	NA			Not determined*
4	185592	732353	Unnamed watercourse	0.90	0.06	1920	4.0×10^9
5	185847	732443	Unnamed watercourse	0.50	0.07	877	6.1×10^{11}
6	185994	732570	Unnamed watercourse	NA			Not determined*
7	186269	732752	Unnamed watercourse	0.80	0.03	610	3.0×10^8
8	186324	733067	Unnamed watercourse	0.67	0.02	446	$<4.5 \times 10^7$

*Not measured or sampled, therefore no estimation of *E. coli* loading was possible

In total, 8 watercourses were observed along the coastline of the survey area. Three watercourses were deemed to be too small to be measured or sampled. The watercourse with the highest estimated *E. coli* loading of 6.1 $X10^{11}$ discharged into Ganavan Bay between the two shellfish beds. Watercourse No. 4 discharged directly onto the southwestern cockle bed and had a moderate estimated *E. coli* loading of 4.0×10^9/day. Watercourse No. 7 discharged directly on to the northeastern cockle bed and had a low estimated *E. coli* loading of 3.0×10^8/day. Watercourse No. 1 discharged to the south end of Camas Bàn and had a low estimated *E. coli* loading of 1.5×10^7/day.

Overall, freshwater inputs would be expected to provide moderate levels of contamination to the cockle beds, with the highest impact expected from the watercourses that discharge directly onto the beaches and from watercourse No.5 that discharges between the beaches.

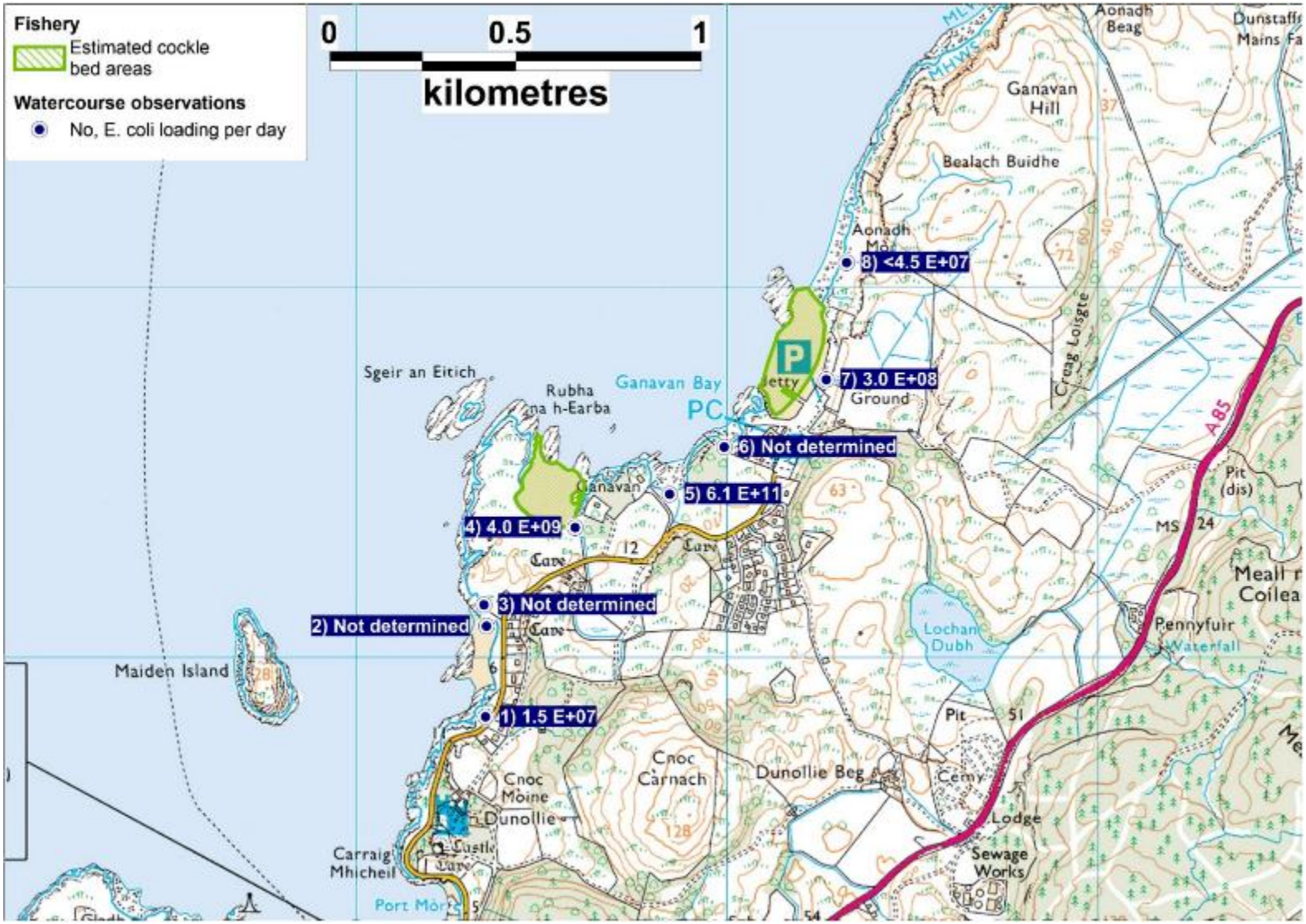

Figure 8.1 Map of watercourse loadings at Ganavan Bay

9 Meteorological Data

The nearest weather station for which a nearly complete rainfall data set was available is located at Lismore; Frackersaig Farm, situated approximately 8 km to the north of the fishery. Rainfall data was available for January 2008 – November 2013 inclusive. Data for the following dates were excluded from the analysis as values were either estimated or accrued across date ranges: 11-14/01/2008, 31/03/2008, 01/04/2008, 04/06/2008, 05/06/2008, 16/06/2008-19/06/2008, 04/05/2009, 05/05/2009, 17/05/2009, 18/05/2009, 10/08/2009, 11/08/2009, 01/12/2010, 02/12/2010, 16/08/2011-20/08/2011, 22/08/2011, 29/10/2011, 30/10/2011, 22/08/2013, 29/10/2011, 30/10/2011, 22/08/2012, 23/08/2012, 04/12/2012 and 05/12/2012. Data for the entire month of December 2013 was unavailable.

The nearest wind station is situated in Tiree, located 87 km west of the production area. Conditions may differ between this station and the fisheries due to the distances between them. However, this data is still shown as it can be useful in identifying seasonal variation in wind patterns.

Data for these stations was purchased from the Meteorological Office. Unless otherwise identified, the content of this section (e.g. graphs) is based on further analysis of this data undertaken by Cefas. This section aims to describe the local rain and wind patterns in the context of the bacterial quality of shellfish at Sound of Kerrera.

9.1 Rainfall

High rainfall and storm events are commonly associated with increased faecal contamination of coastal waters through surface water run-off from land where livestock or other animals are present, and through sewer and waste water treatment plant overflows (Mallin, et al., 2001; Lee & Morgan, 2003). The box and whisker plots in Figures 9.1 and 9.2, present a summary of the distribution of individual daily rainfall values by year and by month. The grey box represents the middle 50% of the observations, with the median at the midline. The whiskers extend to the largest or smallest observations up to 1.5 times the box height above or below the box. Individual observations falling outside the box and whiskers are represented by the symbol *.

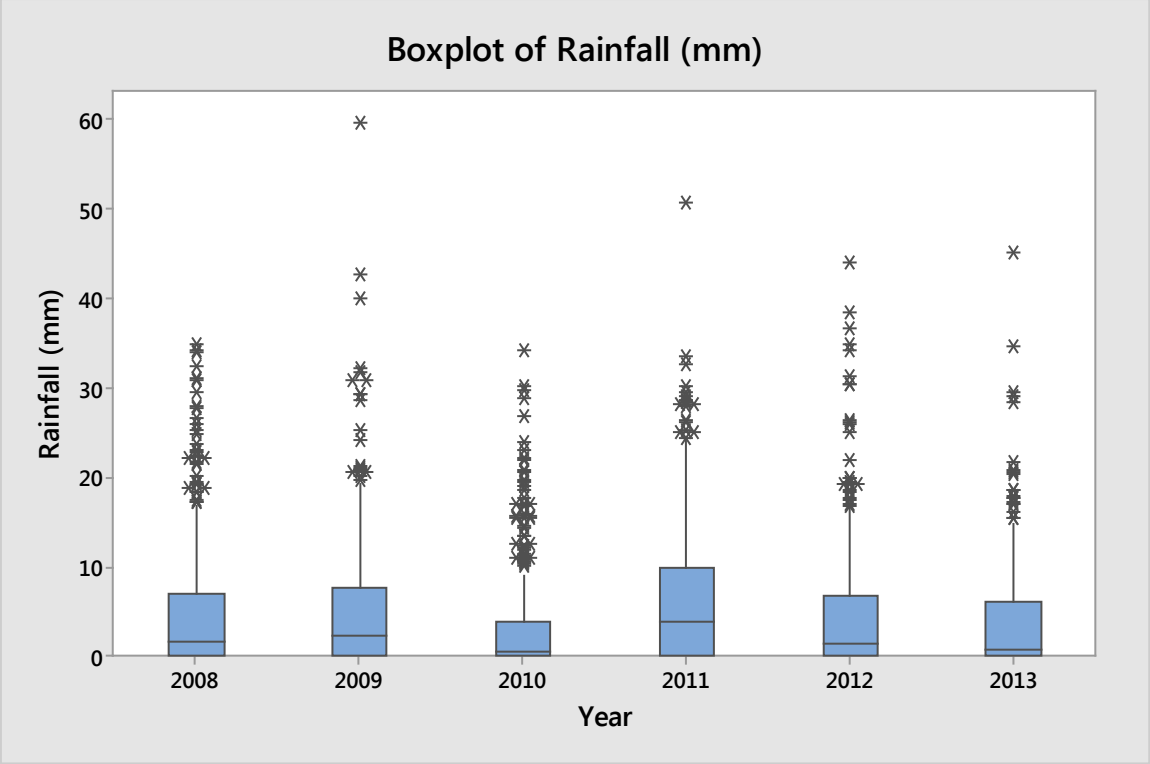

Figure 9.1 Box plot of daily rainfall values by year at Lismore; Frackersaig Farm (2008 – 2013)

Total rainfall values varied from year to year, with 2010 being the driest (1199 mm) and 2011 the wettest (2354 mm). High rainfall values exceeding 40 mm/d occurred in 2009, 2011, 2012 and 2013.

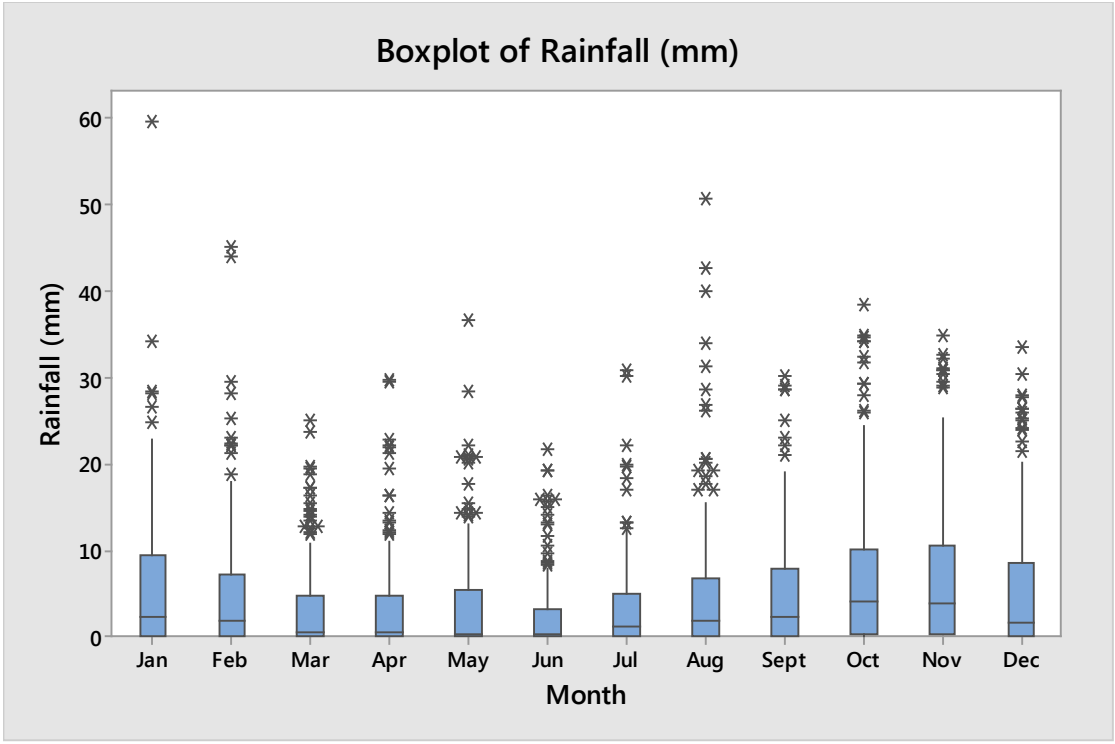

Figure 9.2 Box plot of daily rainfall values by month at Lismore; Frackersaig Farm (2008 – 2013)

Monthly rainfall totals over the period 2008-2013 were higher during the autumn and winter. Rainfall generally increased from August peaking in October while June was the driest month. Rainfall values exceeding 40 mm/d were seen in January, February and August.

For the period considered here (2008 – 2013) 47 % of days received daily rainfall of less than 1 mm and 17 % of days received daily rainfall of over 10 mm. Care needs to be taken with the assessment of rainfall patterns by both year and month due to the excluded data.

It is therefore expected that run-off due to rainfall will be higher during the autumn and winter months..

9.2 Wind

Wind data was collected from Tiree and summarised in seasonal wind roses in Figure 9.3 and annually in Figure 9.4.

Overall, the winds were predominantly from between south-southeast and west. The strongest wind tended to be from the south. Seasonally, the strongest winds occurred during the autumn and winter. A greater proportion of northerly winds were seen in the spring and summer than in autumn and winter.

Wind is an important factor in the spread of contamination as it has the ability to drive surface water at about (3%) of the wind speed (Brown, 1991) so a gale force wind (34 knots or 17.2 m/s) would drive a surface water current of about 1 knot or 0.5 m/s. Therefore strong winds can significantly alter the pattern of surface currents. Strong winds also have the potential to affect tide height depending on wind direction and local hydrodynamics of the site. A strong wind combined with a spring tide may result in higher than usual tides, which will carry any accumulated faecal matter at and above the normal high water mark into the production area.

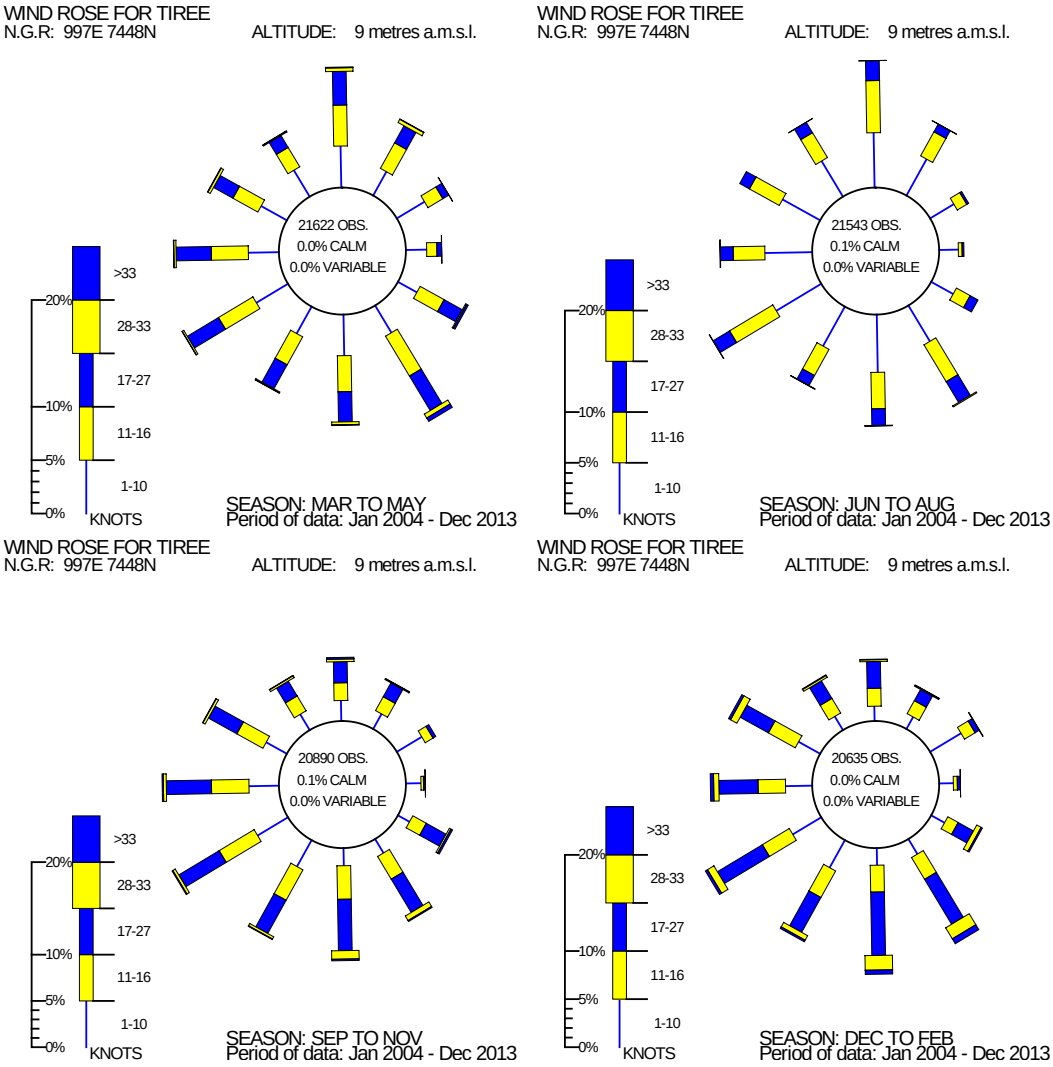

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Figure 9.3 Seasonal wind roses for Tiree

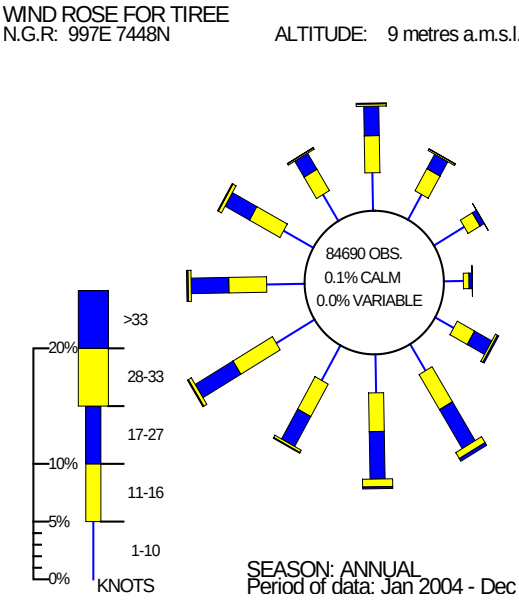

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Figure 9.4 Annual wind rose for Tiree

10 Classification Information

Ganavan Bay is part of Kerrera Cockles production area, a new production area for common cockles (*Cerastoderma edule.*). Kerrera Cockles was classified as B for the months of September 2014 to March 2015 inclusive.

11 Historical *E. coli* Data

11.1 Validation of historical data

Historical sampling results from Ganavan have been used for the classification of the Kerrera Cockles production area. Results for all samples assigned against Ganavan for the period 01/11/2013 to the 04/02/2015 were extracted from the FSAS database and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data. The data was extracted on 04/02/2015. All *E. coli* results were reported as most probable number (MPN) per 100 g of shellfish flesh and intravalvular fluid.

One result reported as <18 was reassigned a value of 10 *E. coli* MPN/100 g and a sample result reported as >18000 was reassigned a value of 36000 *E. coli* MPN/100 g, for the purposes of statistical evaluation and graphical representation.

All samples were reported as valid and were received at the laboratory within 48 hours since collection. All samples had box temperatures ≤8^{o}C, excluding one sample which did not have a box temperature reported. All samples plotted north of the Sound of Kerrera at Ganavan.

11.2 Summary of microbiological results

A summary of samples and results at Ganavan are listed in Table 11.1

Table 11.1 Summary of historical sampling and results

Sampling Summary	
Production area	Kerrera Cockles
Site	Ganavan
Species	Common cockles
SIN	AB-697-1512-04
Location	NM 855 324
Total no of samples	18
No. 2013	4
No. 2014	13
No. 2015	1
Results Summary	
Minimum	<18
Maximum	>18000
Median	330
Geometric mean	283
90 percentile	4311
95 percentile	>18000
No. exceeding 230/100g	12 (67%)
No. exceeding 1000/100g	1 (6%)
No. exceeding 4600/100g	1 (6%)
No. exceeding 18000/100g	1 (6%)

Sampling began in November 2013. Sampling results have varied greatly, from <18 to >18,000 *E. coli*/100 g, with the majority between 100 and 1000 *E. coli* MPN/100 g.

11.3 Overall geographical pattern of results

The reported sampling locations for all samples assigned to Kerrera Cockles are shown in Figure 11.1 with the symbol sizes proportion to the magnitude of the *E. coli* results. All samples had been taken at Ganavan. All samples have been reported to have been taken at Little Ganavan, all but one within 50 m of one another.

Figure 11.1 Map of reported sampling locations for common cockles at Ganavan

11.4 Overall temporal pattern of results

A scatterplot of *E. coli* results against date for Ganavan is presented in Figure 11.2. There is no indication of any trend in the general level of *E. coli* in the cockles over the short period during which sampling has occurred. The highest result was from a sample taken in April 2014. Due to the limited sampling history available, no further analysis of results was undertaken.

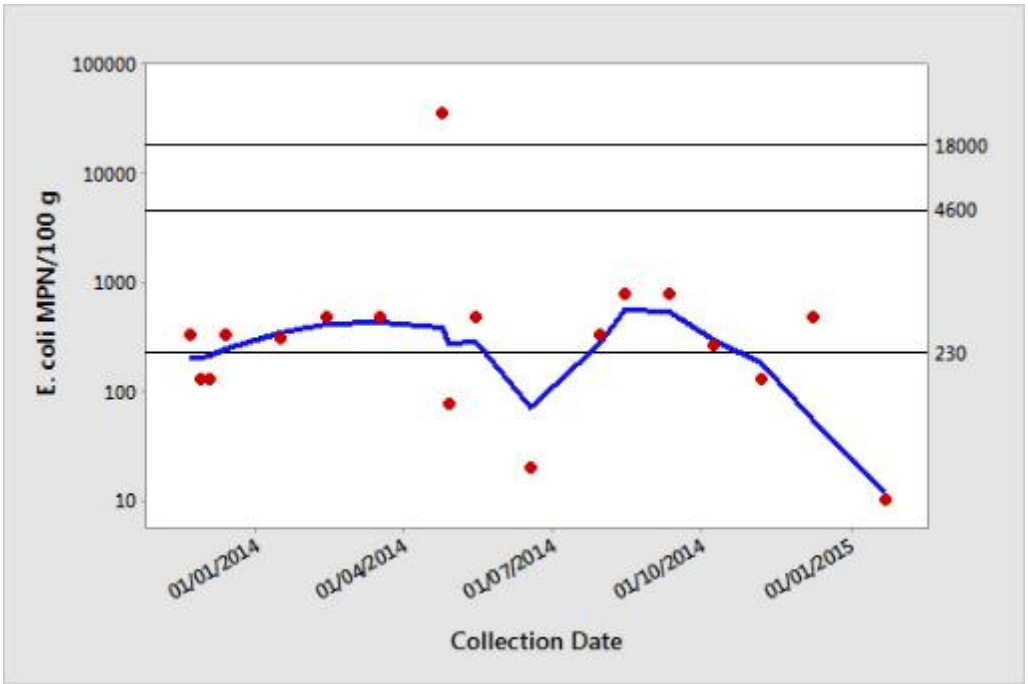


Figure 11.2 Scatterplot of *E. coli* results by collection date at Ganavan, fitted with a lowess line

11.5 Summary and conclusions

Sampling for Kerrera Cockles began in November 2013. All reported sampling locations plot within Ganavan Bay at Little Ganavan. Results have varied markedly with the highest of >18,000 *E. coli* MPN/100 g being from a sample taken in April 2014.

12 Designated Waters Data

Shellfish Growing Waters

The wild cockle beds within Ganavan Bay do not lie within a designated shellfish growing water.

Bathing Waters

The north eastern beach at Ganavan Bay is a designated EU bathing waters. The designated area is approximately 300 metres in length and separated by a jetty. The monitoring point is located in the centre of the bay. The bathing water was designated in 1999. The compliance history since 2007 is shown in Table 12.1. The bathing waters boundary and the location of the monitoring point are shown in Figure 12.1.

Table 12.1. Compliance history at Ganavan Bay designated bathing waters

Bathing Water	Year							
	2007	2008	2009	2010	2011	2012	2013	2014
Ganavan Bay	Pass-M	Pass-G	Pass-G	Pass-G	Pass-G	Pass-G	Pass-G	Pass-G

Notes: Pass-G: Indicates sample meets EC Guideline Standards
Pass-M: Indicates sample meets the EC Mandatory Standards

The Ganavan Bay bathing water profile identified that there were no significant pollution inputs to this designated area under normal conditions (Natural Scotland/SEPA, 2014). It did identify the presence of the Ganavan Pumping Station EO. However, it also stated that: “The principal risks and source of wet weather driven short term pollution at this bathing water arise from intermittent combined sewer overflows. These events are expected to last 1–2 days depending on the duration of the rainfall and may result in elevated bacteria levels compared to dry conditions.” The assets that were considered with regard to those risks were not identified.

Figure 12.1 Designated bathing water – Ganavan Bay

13 Bathymetry and Hydrodynamics

13.1 Introduction

Ganavan Bay is situated in Argyll and Bute on the west coast of Scotland. Approximately 2.5 km to the north of Oban, Ganavan Bay is nearly 1 km across and is bordered by small sandy beaches and rocky outcrops.

To the west, Ganavan Bay is open to the Firth of Lorn, a large body of water bounded by the Isle of Mull to the north and open to the North East Atlantic ocean to the west. Few small streams flow into the assessment area from the Isle of Kerrera itself and the adjacent mainland.

The assessment area encompasses the northern part of the Sound of Kerrera, Oban Bay, and adjacent waters in the Firth of Lorn extending from Rubha na Lice, on the Isle of Kerrera, northwards to Camas Rubha na Liathaig. The assessment area extends 3-4 km offshore in to the Firth of Lorn from the Isle of Kerrera and the mainland. At its widest, the Sound of Kerrera is approximately 2 km in width, while Oban Bay is approximately 1.5 km^2 in area. Ganavan Bay is found at the northern end of the assessment area.

Figure 13.1 Extent of the Ganavan Bay hydrographic study area

Coordinates for Ganavan Bay: 56.437733 N, -5.476805 W

13.2 Bathymetry and Hydrodynamics

13.2.1 Bathymetry

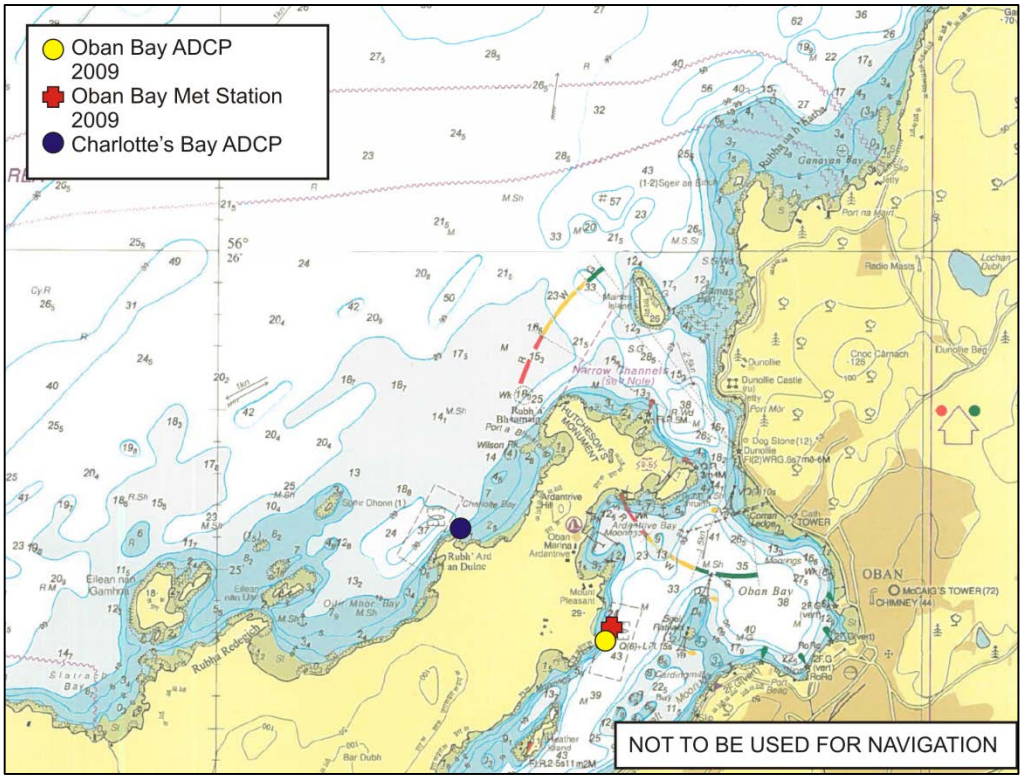


Figure 13.2 Admiralty chart (2387) extract of the Ganavan Bay assessment area with ADCP stations shown. Meteorological (Met) station associated with the Charlotte Bay ADCP deployment is situated outwith the assessment area to the northeast and is not shown on this map.

Figure 13.2 shows the bathymetry of the Ganavan Bay assessment area. Ganavan Bay itself is comprised of both sandy and rocky intertidal shoreline, gently sloping in a north-westerly direction from 1-2 m within the bay to a deep area further offshore, at 56 m in depth. Several small rocky, intertidal outcrops can be found within Ganavan Bay, which is open to the north and bounded to the south by the small island, Sgeir an Eitich.

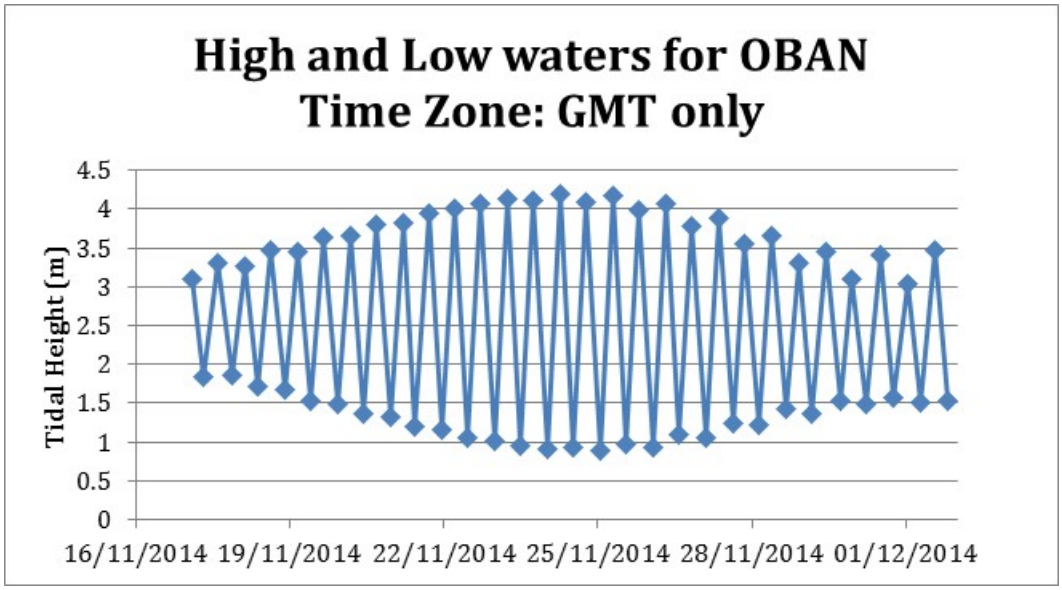
Further south within the assessment area, the north and west of the Isle of Kerrera the bathymetry slopes gently towards the central axis of the Firth of Lorn. A narrow channel of relatively deep water is found at the northern tip of the Isle of Kerrera, with a maximum depth of 38 m. At its narrowest, the channel shallows to a sill of approximately 7 m depth, stretching between the Corran Ledge on the mainland and Rubha Chruidh on the Isle of Kerrera. To the south of this sill, Oban Bay reaches depths of 41 m, shoaling towards the Sound of Kerrera to the south.

The Sound of Kerrera to the south of Oban Bay is a narrow channel punctuated by tidally exposed rocks and small islands. Within the assessment area it reaches a maximum depth of 38 m, and is shallowest around the Ferry Rocks to the southwest of Rubha Tolmach.

13.2.2 Tides

Data on tidal information is provided based on tidal characteristics determined from Oban, within the assessment area.

Standard tidal data for Oban, centred around the survey date of 24th November 2014, are shown in Figure 13.3. Tidal predictions for Oban indicate that in this region the tidal characteristics are semi-diurnal, with a well-developed spring-neap cycle.



Reproduced from Poltips3 [www.pol.ac.uk/appl/poltips3]

Figure 13.3 Two week tidal curve for Oban

Reproduced from Poltips3 [www.pol.ac.uk/appl/poltips3]

Tidal heights in Oban, data from Poltips3 [www.pol.ac.uk/appl/poltips3]:

Mean High Water Springs = 3.96 m
Mean Low Water Springs = 0.84 m
Mean High Water Neaps = 3.02 m
Mean Low Water Neaps = 1.78 m

This gives an approximate tidal volume of water within the assessment area during each tidal cycle of:

Springs: 4.99×10^7 m^3
Neaps: 1.98×10^7 m^3

13.2.3 Tidal Streams and Currents

There are no published tidal diamonds within the assessment area, but charted tidal ebb and flood speeds are available for multiple locations around the Isle of Kerrera. To the north and west of the island, both flood and ebb tides flow at 0.5 m/s, while within the Sound of Kerrera tidal currents reach 0.5 m/s on the flood tide and 0.75 m/s on the ebb.

Tidal currents reach greater speeds through the narrow channel at the northern entrance to Oban Bay, reaching speeds of 0.75 m/s on the flood tide and 1.25 m/s on the ebb tide. Some enhancement of the speed of the tidal streams caused by shallow areas and tidally exposed rocks will be important within the assessment area.

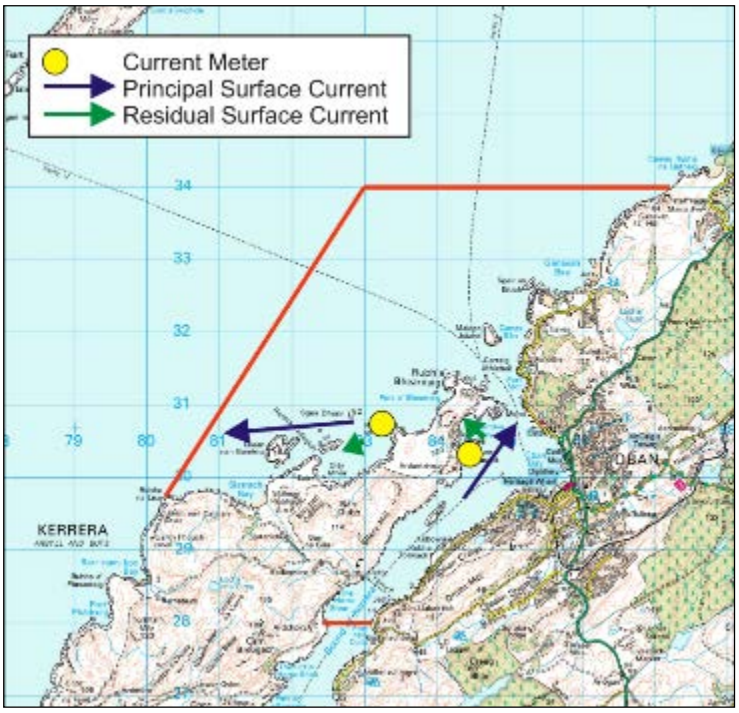


Figure 13.4 Map showing Charlotte Bay and Oban Bay ADCP current meter sample sites within the assessment area

Using the surface principal current amplitude and the assumption of a uniform sinusoidal tide, the cumulative transport distance and residual transport distance, and direction that might be expected during each phase of the tide is shown above. The boundary of the assessment area is indicated by the red line.

Current meter data were available at Charlotte's Bay and Oban Bay, along the western and eastern coastlines of the Isle of Kerrera, respectively. Data were obtained from SEPA for a current meter deployment in Charlotte's Bay in 2005 (SAMS Research Services Ltd., 2006), and in Oban Bay in 2009 (Anderson Marine Surveys Ltd, 2010). A further dataset were available for a current meter deployments carried out in 1995 (Scottish Association for Marine Science 1996), but no current meter data coordinates are supplied. As a result, the findings of the 1995 survey are only used as a general characterisation of Oban Bay in support of the 2009 survey, and are not specifically dealt with in detail. The location of the 2009 Oban Bay current meter data is shown in Figure 13.4.

The 2005 survey at Charlotte's Bay spanned a period of 22 days, and therefore captured a spring-neap cycle. An ADCP was positioned 1 m above the seabed, in a location with a water depth of 31 m (SAMS Research Services Ltd., 2006). Current data from Charlotte's Bay are summarised in Table 13.1.

Mean current speeds at Charlotte's Bay are stronger at the sea surface than at the seabed. Current speeds showed some spring-neap variation at all depths, though this was most

evident near the seabed. Current flows had a more strongly directional nature at mid-water depths than at both the sea surface and the sea bed, and flowed along a north-easterly – south-westerly axis. While currents most frequently flowed in a north-westerly direction at the sea surface, currents flowed in all directions, and may have been influenced by two significant wind events which occurred during the survey. Near-bed currents were strongest in a north to north-westerly direction, but flowed more strongly in the opposite direction (south to south-easterly) two days following a strong wind event on the 24th of November.

Table 13.1 Charlotte's Bay current data measured in 2005

	Near-bed (3 m above seabed)	Mid-water (21 m above seabed)	Surface (29 m above seabed)
Mean Speed (ms^{-1})	0.0627	0.0552	0.0835
Maximum Speed (ms^{-1})	0.2370	0.2490	1.020
Principal Axis Amp & Dir (ms^{-1}) & (^oM)	0.0891 (096)	0.0870 (252)	0.1290 (265)
Residual speed (ms^{-1})	0.0104	0.0119	0.0264
Residual direction (^oM)	340.1	257.8	248.6

The 2009 survey at Oban Bay spanned a period of 15 days, and therefore captured a spring-neap cycle. Three Valeport current meters were deployed at a location with a water depth of 42.6 m, at depths of 2.0 m, 28.0 m, and 36.7 m above the seabed (Anderson Marine Surveys Ltd, 2010). Current data from Oban Bay are summarised in table 13.2.

Mean current speeds at Oban Bay are stronger at the sea surface than at the seabed. Current speeds showed some spring-neap variation at all depths, particularly in the east-west component. This variation was most pronounced near the seabed. Current speeds near the seabed flowed predominantly along an east north-east to west south-west axis, while currents closer to the surface (at 21 m and 29 m above the seabed) had a stronger north-south component, flowing mainly along a north-east to south-west axis. This axis was in parallel to the adjacent coastline, and to the axis of the Sound of Kerrera.

Table 13.2 Oban Bay current data measured in 2009

	Near-bed (2 m above seabed)	Mid-water (28 m above seabed)	Surface (36.7 m above seabed)
Mean Speed (ms^{-1})	0.027	0.057	0.064
Maximum Speed (ms^{-1})	0.148	0.158	0.160
Principal Axis Amp & Dir (ms^{-1}) & (ºM)	0.047 (070)	0.085 (035)	0.093 (035)
Residual speed (ms^{-1})	0.017	0.009	0.009
Residual direction (ºM)	046	348	316

A wind meter was deployed during the Oban Bay 2009 current meter deployment. Strong winds above 10 ms^{-1} were only recorded on two of the 15 survey days, and average wind speeds generally averaged between 1.7 ms^{-1} and 5.5 ms^{-1}. Winds generally came from the south-west, along an axis parallel to that of the Sound of Kerrera.

Current meter data recorded in Oban bay in 1995 is in broad agreement with that of the 2009 survey. In both surveys, surface residual currents tend to flow with a westerly component, and at approximately 0.009 – 0.010 mm^{-11} (Scottish Association for Marine Science, 1996). However, maximum recorded current speeds were substantially greater in 2009, and may have been a result of local topography, though this is difficult to assess as no geographical coordinates were provided for the 1995 survey.

Current meter data from Charlotte's Bay and Oban Bay suggest that the Ganavan Bay assessment area is relatively well flushed. Its open nature and exposure to wave action within the Firth of Lorn suggests that dispersion may be rapid at this location. Sources of wave energy are from both short period waves generated within the Firth of Lorn and longer period swells originating from offshore. However, it is important to note that the nature of the current flows will vary significantly throughout the assessment area, particularly within the more enclosed Sound of Kerrera and Oban Bay. In these areas, flow over sills, around headlands, and around the numerous shallow and/or tidally exposed rocks is likely to enhance dispersion, and these areas may be less exposed to longer period swells.

Using the largest recorded mean surface principal current of 0.129 m s^{-1} and assuming a uniform sinusoidal tide, the cumulative transport that might be expected during each phase of the tide (approximately 6 hours) has been estimated for the assessment area as 1.8 km. No distinction is made here for springs and neaps.

13.2.4 River/Freshwater Inflow

No major rivers flow into the Ganavan Bay assessment area. Several small streams flow into the assessment area from the surrounding hills on the mainland and from the island of Kerrera. There can be significant discharge into Oban Bay from the Black Lyne River. Though outside the assessment area, more substantial freshwater discharges from nearby

sea lochs (e.g. Loch Etive, Loch Linnhe, Loch Creran, Loch Feochan) may influence the waters in and around the assessment area.

Annual precipitation is approximately 1875 mm per year based on data for nearby Loch Feochan (Edwards & Sharples, 1986).

13.2.5 Meteorology

The meteorological station at Frackersaig Farm, Lismore is the nearest weather station and is situated approximately 10 km to the north of the fishery. Rainfall data was available for the period from January 2008 to November 2013 inclusive.

While 2010 generally had the lowest daily rainfall, the highest rainfall for this time period was recorded in 2011 (2354 mm). Very high rainfall events of > 40 mm d^{-1} occurred once in 2009, 2011, 2012 and 2013 while rainfall events of > 30 mm d^{-1} were recorded in all years. These rainfall events (>30 mm d^{-1}) occurred in all months but were much fewer in January, October and November. Daily rainfall values varied seasonally, and were generally lower in late spring and in the summer months (March - July) with the lowest of them being June and higher in winter months (October - December). For the duration of the dataset (2008-2013), daily rainfall below 1 mm occurred on 46% of days, while daily rainfall above 10 mm occurred on 17% of days.

Run-off due to rainfall is expected to be higher in autumn and winter months. However, it must also be noted that substantial rainfall events occurred in summer months also and consequently that high run-off can occur throughout the year.

Wind data were obtained from Tiree, located 86 km to the west of the assessment area. Given the distance between these two locations and varying topography, wind statistics may not be directly transferrable to the specific production area around Ganavan Bay. They are, however, valuable in providing the general pattern of the seasonal wind conditions. Data collected between January 2004 and December 2013 indicate that the predominant wind direction is from the south-southwest and west and the strongest winds tended to be from the south. Seasonally the strongest winds occurred during autumn and winter. Typically the wind came from around the south and west predominantly and in lesser proportion from the north and southeast, throughout the year whilst the summer also saw winds from the north in a slightly higher proportion than in winter. Nevertheless, local wind direction in Ganavan Bay are likely to be somewhat influenced by the surrounding topography.

13.2.6 Model Assessment

Due to the paucity of data in the vicinity of Ganavan and the unconstrained nature of the study area, it was not considered appropriate to set up a box model run for the Ganavan assessment area.

13.3 Hydrographic Assessment

13.3.1 Surface Flow

The site and meteorological data indicate that the discharge of freshwater into the surface will be highly variable around the assessment area and seasonal. Therefore the role of freshwater is likely to be highly localised. In the Ganavan area it is likely to be influenced by freshwater discharging from Loch Etive and local rainfall. A distinct freshwater layer may develop within Oban Bay, but otherwise it will probably be well mixed except under periods of calm and heavy rainfall. However, such a layer would probably be short-lived.

Ganavan itself is a rather simple, open bay though the adjacent waters are relatively complex in terms of bathymetry and flow. Tidal flows are relatively fast in the area and dispersion is likely to be high. From the current meter record in Charlotte Bay and in Oban Bay it is clear that the flow of water is variable in both speed and direction through the water column. The flow of water through the Ganavan area will be different from either of the locations where there are measured currents. In general, the flood tide will transport water to the northeast at Ganavan, whilst the ebb will transport it to the southwest. However, it is very likely that an eddy will develop in Ganavan Bay. The cumulative transport distance on each phase (flood/ebb) of the tide has been estimated at around 1.8 km at the ADCP site in Charlotte Bay and 1.3 km at the ADCP site in Oban Bay.

Surface residual flows would be enhanced by prevailing winds from the southwest. Further residual flow will occur due to the asymmetry of flow through Oban Bay on the flood and ebb tides. Using a value of residual flow speed measured at the surface in Charlotte Bay (0.026 m/s), the net transport over a tidal cycle of approximately 12 hours would be around 1.1 km. in Oban Bay the equivalent residual flow over 12 hours would be around 0.5 km.

13.3.2 Exchange Properties

Tidal flow will dominate the exchange properties of the Ganavan Bay assessment area. Given the open nature it is likely to have a very small flushing time. Even in Oban Bay it is likely that through flow of the tide will result in rather rapid flushing. The prevailing winds from the southwest quadrant will enhance surface flushing rates.

It is expected that the Ganavan assessment area be a well flushed system throughout most of the year with surface contaminants being effectively dispersed in the residual flow.

There are just two data sets available for a rather complex area and these lie some distance to the southwest of Ganavan. The paucity of additional hydrographic data renders the confidence level of this assessment as LOW.

14 Shoreline Survey Overview

The Ganavan Bay shoreline survey was conducted on the 24th November 2014. Rain had fallen in the 48 hours prior to the survey, but the survey day itself was dry.

The fishery consisted of wild common cockle beds. Cockle prevalence was patchy. Large cockles were noted at the north of Ganavan Beach and smaller cockles were noted to the south. Lots of cockles were found in the bay by Rubha na h-Earba (Little Ganavan), but cockles were absent at Camas Bàn. Three cockle samples were taken; a sample from north Ganavan Beach returned a result of <18 *E. coli* MPN/100 g, whilst two samples taken at the Rubha na h-Earba beach returned results of 45 and 78 *E. coli* MPN/100 g.

Human population was sparse, with 15 private dwellings overlooking Camas Bàn Beach and a new housing development noted at the south end of Ganavan Beach. Public toilets were noted at Ganavan Beach car park, with two partially buried ceramic pipes visible at low tide on adjacent Ganavan Beach. A seawater sample taken next to these pipes returned a result of 1 *E. coli* cfu/100 ml. A dry cast iron pipe below houses was noted further to the south. A large private dwelling was noted to the southwest of Ganavan Beach which had a ST at the bottom of the garden with two pipes (one ceramic and one plastic) on the rocks down to the shore. Both pipes had discharges and returned freshwater sample results of 100,000 and <1000 *E. coli* cfu/100 ml respectively. A dry metal pipe coming from a disused urinal in a brick/concrete building was also noted south of Camas Bàn.

No campsites, caravan parks or guest house accommodation was noted. The beaches were, however, identified as being very popular with visitors. A number of ferries were noted during the survey but no other boats were observed.

The surrounding land was mainly farmland and rough pasture, with some deciduous woodland around the Dunollie Castle area. The land was steep in places with rocky sections immediately next to the shore. Dwellings were scattered along the foreshore.

No livestock was seen during the survey, though cattle droppings were noted to the northeast of the surveyed area.

Birds were the most common wildlife observed, including shorebirds, a duck, a gull, and swans. A roe deer was seen in a field adjacent to the beach at Rubha na h-Earba and five dogs were observed being walked along Ganavan Beach.

Six watercourses were measured and sampled, with freshwater results varying between <10 and 70000 *E. coli* cfu/100 ml. The highest result was from a sample taken from a split watercourse that came from the direction of two dwellings at Camas Bàn Beach.

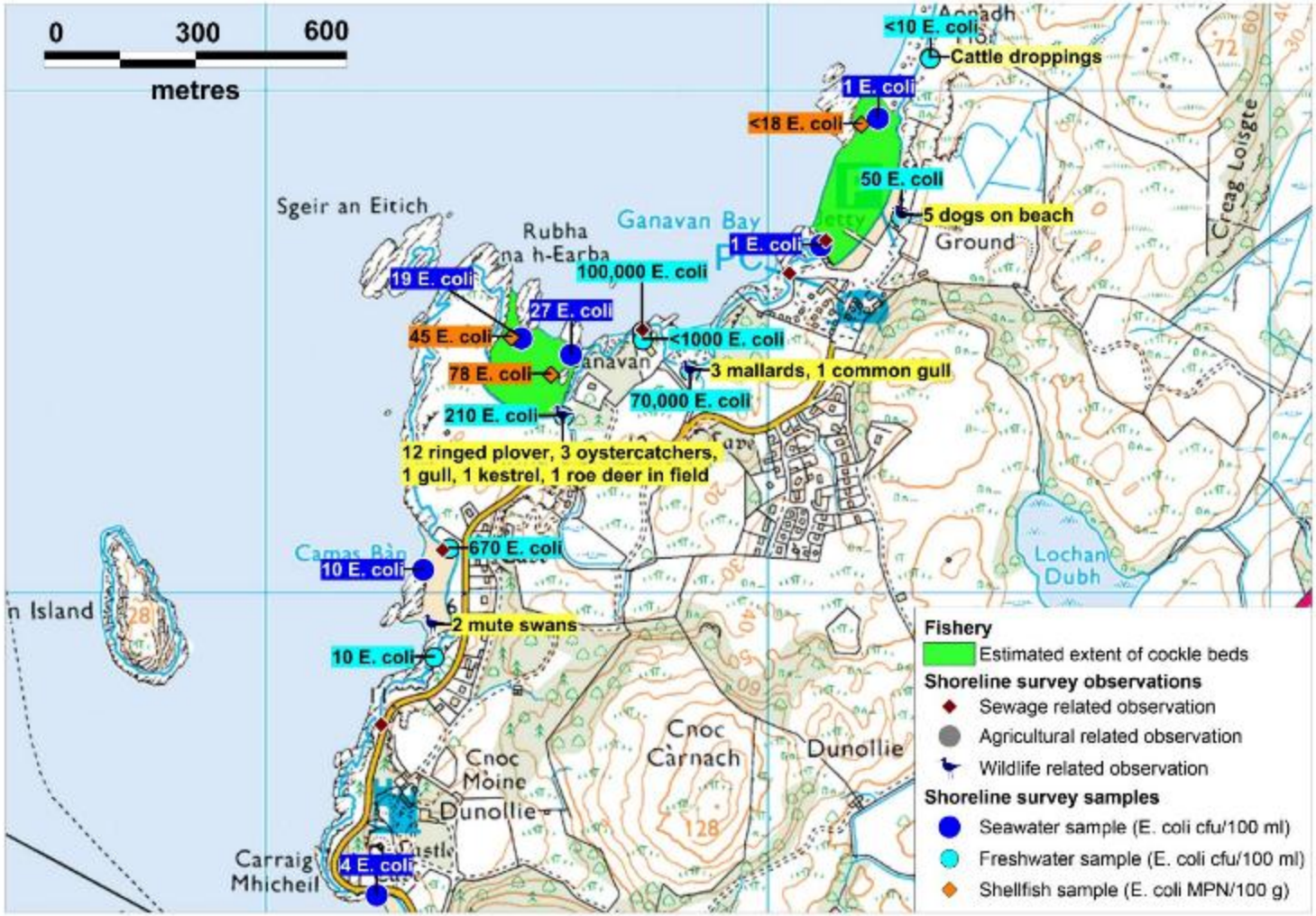


Figure 14.1 Summary of shoreline survey findings for Ganavan Bay

15 Bacteriological Survey

No bacteriological survey was planned for this area due to the uncertainty regarding the location and extent of exploitable cockle stocks.

16 Overall Assessment

Human sewage impacts

The immediate area of Ganavan Bay does not contain any continuous community discharges. There is one emergency overflow associated with a sewage pumping station. There is a consented private septic tank discharge within the bay that has a consented PE of 100, plus a small number of other consented septic tank discharges associated with private dwellings. In addition, there are several consented private dwelling septic tank discharges around Camas Bàn.

Larger community discharges and numbers of consented private septic tank discharges are located within Loch Etive and Ardmuknish Bay to the north and around Oban to the south. The extent that these will impact in the Ganavan Bay area will depend on the particle transport distance as well as the extent of dilution and dispersion. If they do impact, there may be a difference of effect between Ganavan Bay and Camas Bàn, with potentially greater impact from Loch Etive and Ardmuknish Bay discharges at Ganavan and from Oban area discharges at Camas Bàn.

There is the possibility of impact from intermittent overboard discharge from boats anchoring at Ganavan Bay or travelling between the Sound of Kerrera and Dunstaffnage Bay, or further north up the Firth of Lorne and Loch Linnhe.

Agricultural impacts

Little information was obtained on agriculture in the immediate area of Ganavan Bay and the catchments of the watercourses in the locality. The only related observation made during the shoreline survey was of cattle faeces a short distance to the north of the main Ganavan beach. This obviously indicates that cattle are kept in the area, at least intermittently, and that they have access to the shoreline.

Wildlife and pet impacts

Moderate contamination of the intertidal area is expected to arise from seabirds and dogs. Contamination from seabirds may be greater at Little Ganavan due to the birds identified as using Sgeir an Eitich. That from dogs may be greater at the main beach due to more people using that location. Contamination from deer and otters carried via watercourses is expected to impact both beds approximately equally.

Seasonal variation

Although the Oban and surrounding areas attract a large number of tourists, no holiday accommodation was noted at Ganavan during the shoreline survey. This means that while there will be an increased loading to community discharges during the tourist season, there should not be a marked change in the discharges local to the area. Should the public toilets at Ganavan Beach discharge to the bay, an increase in

discharged volume would be expected during the summer. Boat traffic will be greater during the summer months and bird numbers are expected to be higher between May and October.

Watercourses

Contamination associated with watercourses will be significant at both the main Ganavan beach and at Little Ganavan due to the watercourses that enter at those locations and the additional watercourses that enters the bay between the two. Contamination associated with the watercourses would be expected to increase significantly after heavy rainfall.

Movement of contaminants

Currents over the flood tide will generally flow to the northeast at Ganavan on the flood tide and to the southwest on the ebb tide. However, it is likely that an eddy will develop in Ganavan Bay itself. The cumulative transport distance on each phase (flood/ebb) of the tide has been estimated in the region of 1.5 km. Residual flows over a tidal cycle of approximately 12 hours would be approximately 1 km or less.

Temporal and geographical patterns of sampling results

Sampling of cockles at Ganavan Bay began in November 2013. Although results have varied markedly, no generally trend has been apparent in the short time since sampling began. All reported sampling locations plot within Ganavan Bay at Little Ganavan and no evidence is available on which to base an evaluation of spatial effects.

Conclusions

The assessment of the movement of contaminants suggests that little impact will arise at Ganavan Bay from discharges located at Loch Etive/ Ardmuknish Bay or the Oban area. Therefore, the predominant sources will be local to the area. These sources consist of private septic tank discharges, watercourses, seabirds and dogs. There may also be some impact from cattle. The community network EO will cause significant contamination within the bay if it operates.

Camas Bàn, however, is within 1.5 km of the Oban STW outfall and therefore this could impact at this location. In addition, the primary local sources will be private septic tank discharges, watercourses and seabirds.

Overboard discharges from boats may impact both areas on occasion.

17 Recommendations

The following recommendations relate to Ganavan Bay from where cockle samples have been consistently reported and where cockle samples were obtained during the shoreline survey. Only a single cockle was found at Camas Bàn and thus it has been assumed that there are insufficient stocks at the moment for commercial exploitation. Although close geographically, Ganavan Bay and Cams Bàn are also subject to different sources of faecal contamination. Therefore, if stocks of cockles are found at Camas Bàn in the future, a re-assessment should be undertaken in order to identify a suitable RMP.

A summary of the recommendations is presented in map form in Figure 17.1.

Production area

The recommended production area is: the area bounded by a line drawn between NM 8541 3265 and NM 8632 3320 and extending to MHWS. This encompasses the extent of both identified cockle beds.

RMP

It is recommended that the RMP be located at NM 8554 3240. There is not expected to be a marked difference in the level of contamination between the two identified cockle beds and the recommended RMP location is in the vicinity where sampling has been successfully reported on an ongoing basis.

Tolerance

It is recommended that a tolerance of 50 m be applied. This will allow for some variability in density of stocks in the area.

Depth of sampling

Not applicable.

Frequency

It is recommended that monthly sampling be continued.

Figure 17.1 Map of recommendations at Ganavan Cockles

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19 List of Figures and Tables

Appendices

1. General Information on Wildlife Impacts
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4. Shoreline Survey Report
5. Table of Consented Discharges (Source: SEPA)

1. General Information on Wildlife Impacts

Pinnipeds

Two species of pinniped (seals, sea lions, walruses) are commonly found around the coasts of Scotland: These are the European harbour, or common, seal (*Phoca vitulina vitulina*) and the grey seal (*Halichoerus grypus*). Both species can be found along the west coast of Scotland.

Common seal surveys are conducted every 5 years and an estimate of minimum numbers is available through Scottish Natural Heritage.

According to the Scottish Executive, in 2001 there were approximately 119,000 grey seals in Scottish waters, the majority of which were found in breeding colonies in Orkney and the Outer Hebrides.

Adult Grey seals weigh 150-220 kg and adult common seals 50-170 kg. They are estimated to consume between 4 and 8% of their body weight per day in fish, squid, molluscs and crustaceans. No estimates of the volume of seal faeces passed per day were available, though it is reasonable to assume that what is ingested and not assimilated in the gut must also pass. Assuming 6% of a median body weight for harbour seals of 110kg, that would equate to 6.6kg consumed per day and probably very nearly that defecated.

The concentration of *E. coli* and other faecal indicator bacteria contained in seal faeces has been reported as being similar to that found in raw sewage, with counts showing up to 1.21×10^4 CFU (colony forming units) *E. coli* per gram dry weight of faeces (Lisle *et al* 2004).

Both bacterial and viral pathogens affecting humans and livestock have been found in wild and captive seals. *Salmonella* and *Campylobacter* spp., some of which were antibiotic-resistant, were isolated from juvenile Northern elephant seals (*Mirounga angustirostris*) with *Salmonella* found in 36.9% of animals stranded on the California coast (Stoddard, et al., 2005) *Salmonella* and *Campylobacter* are both enteric pathogens that can cause acute illness in humans and it is postulated that the elephant seals were picking up resistant bacteria from exposure to human sewage waste.

One of the *Salmonella* species isolated from the elephant seals, *Salmonella typhimurium*, is carried by a number of animal species and has been isolated from cattle, pigs, sheep, poultry, ducks, geese and game birds in England and Wales. Serovar DT104, also associated with a wide variety of animal species, can cause severe disease in humans and is multi-drug resistant (Poppe, et al., 1998)

Cetaceans

As mammals, whales and dolphins would be expected to have resident populations of *E. coli* and other faecal indicator bacteria in the gut. Little is known about the concentration of indicator bacteria in whale or dolphin faeces, in large part because the animals are widely dispersed and sample collection difficult.

A variety of cetacean species are routinely observed around the west coast of Scotland. Where possible, information regarding recent sightings or surveys is gathered for the production area. As whales and dolphins are broadly free ranging, this is not usually possible to such fine detail. Most survey data is supplied by the Hebridean Whale and Dolphin Trust or the Shetland Sea Mammal Group and applies to very broad areas of the coastal seas.

It is reasonable to expect that whales would not routinely affect shellfisheries located in shallow coastal areas. It is more likely that dolphins and harbour porpoises would be found in or near fisheries due to their smaller physical size and the larger numbers of sightings near the coast.

Birds

Seabird populations were surveyed all over Britain as part of the SeaBird 2000 census. These counts are investigated using GIS to give the numbers observed within a 5 km radius of the production area. This gives a rough idea of how many birds may be present either on nests or feeding near the shellfish farm or bed.

Further information is gathered where available related to shorebird surveys at local bird reserves when present. Surveys of overwintering geese are queried to see whether significant populations may be resident in the area for part of the year. In many areas, at least some geese may be present year round. The most common species of goose observed during shoreline surveys has been the Greylag goose. Geese can be found grazing on grassy areas adjacent to the shoreline during the day and leave substantial faecal deposits. Geese and ducks can deposit large amounts of faeces in the water, on docks and on the shoreline.

A study conducted on both gulls and geese in the northeast United States found that Canada geese (*Branta canadiensis*) contributed approximately 1.28×10^5 faecal coliforms (FC) per faecal deposit and ring-billed gulls (*Larus delawarensis*) approximately 1.77×10^8 FC per faecal deposit to a local reservoir (Alderisio & DeLuca, 1999). An earlier study found that geese averaged from 5.23 to 18.79 defecations per hour while feeding, though it did not specify how many hours per day they typically (Gauthier & Bedard, 1986)

Waterfowl can be a significant source of pathogens as well as indicator organisms. Gulls frequently feed in human waste bins and it is likely that they carry some human pathogens.

Deer

Deer are present throughout much of Scotland in significant numbers. The Deer Commission of Scotland (DCS) conducts counts and undertakes culls of deer in areas that have large deer populations.

Four species of deer are routinely recorded in Scotland, with Red deer (*Cervus elaphus*) being the most numerous, followed by Roe deer (*Capreolus capreolus*), Sika deer (*Cervus nippon*) and Fallow deer (*Dama dama*).

Accurate counts of populations are not available, though estimates of the total populations are >200,000 Roe deer, >350,000 Red deer, < 8,000 Fallow deer and an unknown number of Sika deer. Where Sika deer and Red deer populations overlap, the two species interbreed further complicating counts.

Deer will be present particularly in wooded areas where the habitat is best suited for them. Deer, like cattle and other ruminants, shed *E. coli*, *Salmonella* and other potentially pathogenic bacteria via their faeces.

Otters

The European otter (*Lutra lutra*) is present around Scotland with some areas hosting populations of international significance. Coastal otters tend to be more active during the day, feeding on bottom-dwelling fish and crustaceans among the seaweed found on rocky inshore areas. An otter will occupy a home range extending along 4-5km of coastline, though these ranges may sometimes overlap (Scottish National Heritage, n.d.). Otters primarily forage within the 10 m depth contour and feed on a variety of fish, crustaceans and shellfish (Paul Harvey, Shetland Sea Mammal Group, personal communication).

Otters leave faeces (also known as spraint) along the shoreline or along streams, which may be washed into the water during periods of rain.

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2. Tables of Typical Faecal Bacteria Concentrations

Summary of faecal coliform concentrations (cfu $100ml^{-1}$) for different treatment levels and individual types of sewage-related effluents under different flow conditions: geometric means (GMs), 95% confidence intervals (CIs), and results of t-tests

Indicator organism	**Base-flow conditions**				**High-flow conditions**			
Treatment levels and specific types: Faecal coliforms	*n*[c]	Geometric mean	Lower 95% CI	Upper 95% CI	*n*[c]	Geometric mean	Lower 95% CI	Upper 95% CI
Untreated	252	1.7×10^{7} * (+)	1.4×10^{7}	2.0×10^{7}	282	2.8×10^{6} * (-)	2.3×10^{6}	3.2×10^{6}
Crude sewage discharges	252	1.7×10^{7} * (+)	1.4×10^{7}	2.0×10^{7}	79	3.5×10^{6} * (-)	2.6×10^{6}	4.7×10^{6}
Storm sewage overflows					203	2.5×10^{6}	2.0×10^{6}	2.9×10^{6}
Primary	127	1.0×10^{7} * (+)	8.4×10^{6}	1.3×10^{7}	14	4.6×10^{6} (-)	2.1×10^{6}	1.0×10^{7}
Primary settled sewage	60	1.8×10^{7}	1.4×10^{7}	2.1×10^{7}	8	5.7×10^{6}		
Stored settled sewage	25	5.6×10^{6}	3.2×10^{6}	9.7×10^{6}	1	8.0×10^{5}		
Settled septic tank	42	7.2×10^{6}	4.4×10^{6}	1.1×10^{7}	5	4.8×10^{6}		
Secondary	864	3.3×10^{5} * (-)	2.9×10^{5}	3.7×10^{5}	184	5.0×10^{5} * (+)	3.7×10^{5}	6.8×10^{5}
Trickling filter	477	4.3×10^{5}	3.6×10^{5}	5.0×10^{5}	76	5.5×10^{5}	3.8×10^{5}	8.0×10^{5}
Activated sludge	261	2.8×10^{5} * (-)	2.2×10^{5}	3.5×10^{5}	93	5.1×10^{5} * (+)	3.1×10^{5}	8.5×10^{5}
Oxidation ditch	35	2.0×10^{5}	1.1×10^{5}	3.7×10^{5}	5	5.6×10^{5}		
Trickling/sand filter	11	2.1×10^{5}	9.0×10^{4}	6.0×10^{5}	8	1.3×10^{5}		
Rotating biological contactor	80	1.6×10^{5}	1.1×10^{5}	2.3×10^{5}	2	6.7×10^{5}		
Tertiary	179	1.3×10^{3}	7.5×10^{2}	2.2×10^{3}	8	9.1×10^{2}		
Reed bed/grass plot	71	1.3×10^{4}	5.4×10^{3}	3.4×10^{4}	2	1.5×10^{4}		
Ultraviolet disinfection	108	2.8×10^{2}	1.7×10^{2}	4.4×10^{2}	6	3.6×10^{2}		

comparing base- and high-flow GMs for each group and type.

Source: (Kay, et al., 2008b)

Table 3 – Geometric mean (GM) and 95% confidence intervals (CIs) of the GM faecal indicator organism (FIO) concentrations (cfu/100ml) under base- and high-flow conditions at the 205 sampling points and for various subsets, and results of paired t-tests to establish whether there are significant elevations at high flow compared with base flow

FIO	*n*	**Base Flow**			**High Flow**		
Subcatchment land use		Geometric mean	Lower 95% CI	Upper 95% CI	Geometric mean[a]	Lower 95% CI	Upper 95% CI
Total coliforms							
All subcatchments	205	5.8×10^3	4.5×10^3	7.4×10^3	7.3×10^{4}**	5.9×10^4	9.1×10^4
Degree of urbanisation							
Urban	20	3.0×10^4	1.4×10^4	6.4×10^4	3.2×10^{5}**	1.7×10^5	5.9×10^5
Semi-urban	60	1.6×10^4	1.1×10^4	2.2×10^4	1.4×10^{5}**	1.0×10^5	2.0×10^5
Rural	125	2.8×10^3	2.1×10^3	3.7×10^3	4.2×10^{4}**	3.2×10^4	5.4×10^4
Rural subcatchments with different dominant land uses							
≥75% Imp pasture	15	6.6×10^3	3.7×10^3	1.2×10^4	1.3×10^{5}**	1.0×10^5	1.7×10^5
≥75% Rough Grazing	13	1.0×10^3	4.8×10^2	2.1×10^3	1.8×10^{4}**	1.1×10^4	3.1×10^4
≥75% Woodland	6	5.8×10^2	2.2×10^2	1.5×10^3	6.3×10^{3}*	4.0×10^3	9.9×10^3
Faecal coliform							
All subcatchments	205	1.8×10^3	1.4×10^3	2.3×10^3	2.8×10^{4}**	2.2×10^4	3.4×10^4
Degree of urbanisation							
Urban	20	9.7×10^3	4.6×10^3	2.0×10^4	1.0×10^{5}**	5.3×10^4	2.0×10^5
Semi-urban	60	4.4×10^3	3.2×10^3	6.1×10^3	4.5×10^{4}**	3.2×10^4	6.3×10^4
Rural	125	8.7×10^2	6.3×10^2	1.2×10^3	1.8×10^{4}**	1.3×10^4	2.3×10^4
Rural subcatchments with different dominant land uses							
≥75% Imp pasture	15	1.9×10^3	1.1×10^3	3.2×10^3	5.7×10^{4}**	4.1×10^4	7.9×10^4
≥75% Rough Grazing	13	3.6×10^2	1.6×10^2	7.8×10^2	8.6×10^{3}**	5.0×10^3	1.5×10^4
≥75% Woodland	6	3.7×10	1.2×10	1.2×10^2	1.5×10^{3}**	6.3×10^2	3.4×10^3
Enterococci							
All subcatchments	205	2.7×10^2	2.2×10^2	3.3×10^2	5.5×10^{3}**	4.4×10^3	6.8×10^3
Degree of urbanisation							
Urban	20	1.4×10^3	9.1×10^2	2.1×10^3	2.1×10^{4}**	1.3×10^4	3.3×10^4
Semi-urban	60	5.5×10^2	4.1×10^2	7.3×10^2	1.0×10^{4}**	7.6×10^3	1.4×10^4
Rural	125	1.5×10^2	1.1×10^2	1.9×10^2	3.3×10^{3}**	2.4×10^3	4.3×10^3
Rural subcatchments with different dominant land uses							
≥75% Imp. pasture	15	2.2×10^2	1.4×10^2	3.5×10^2	1.0×10^{4}**	7.9×10^3	1.4×10^4
≥75% Rough Grazing	13	4.7×10	1.7×10	1.3×10^2	1.2×10^{3}**	5.8×10^2	2.7×10^3
≥75% Woodland	6	1.6×10	7.4	3.5×10	1.7×10^{2}**	5.5×10	5.2×10^2
[a] Significant elevations in concentrations at high flow are indicated: **po0.001, *po0.05.							
[b] Degree of urbanisation categorised according to percentage built-up land: 'Urban' (X10.0%), 'Semi-urban' (2.5–9.9%) and 'Rural' (o2.5%).							

Source: (Kay, et al., 2008a)

Table 4 - Comparison of faecal indicator concentrations (average numbers/g wet weight) excreted in the faeces of warm-blooded animals

Animal	Faecal coliforms (FC) number	Excretion (g/day)	FC Load (numbers/day)
Chicken	1,300,000	182	2.3×10^8
Cow	230,000	23,600	5.4×10^9
Duck	33,000,000	336	1.1×10^{10}
Horse	12,600	20,000	2.5×10^8
Pig	3,300,000	2,700	8.9×10^8
Sheep	16,000,000	1,130	1.8×10^{10}
Turkey	290,000	448	1.3×10^8
Human	13,000,000	150	1.9×10^9

Source: (Gauthier & Bedard, 1986)

References

Gauthier, G. & Bedard, J., 1986. Assessment of faecal output in geese. *Journal of Applied Ecology,* 23(1), pp. 77-90.

Kay, D. et al., 2008a. Faecal indicator organism concentrations and catchment export coefficients in the UK. *Water Research,* 42(10/11), pp. 2649-2661.

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3. Hydrographic Assessment Glossary

The following technical terms may appear in the hydrographic assessment.

Bathymetry. The underwater topography given as depths relative to some fixed reference level e.g. mean sea level.

Hydrography. Study of the movement of water in navigable waters e.g. along coasts, rivers, lochs, estuaries.

MHW. Mean High Water, The highest level that tides reach on average.

MHWN. Mean High Water Neap, The highest level that tides reach on average during neap tides.

MHWS. Mean High Water Spring, The highest level that tides reach on average during spring tides

MLW. Mean Low Water, The lowest level that tides reach on average.

MLWN. Mean Low Water Neap, The lowest level that tides reach on average during neap tides.

MLWS. Mean Low Water Spring, The lowest level that tides reach on average during spring tides.

Tidal period. The dominant tide around the UK is the twice daily one generated by the moon. It has a period of 12.42 hours. For near shore so-called rectilinear tidal currents then roughly speaking water will flow one way for 6.2 hours then back the other way for 6.2 hours.

Tidal range. The difference in height between low and high water. Will change over a month.

Tidal excursion. The distance travelled by a particle over one half of a tidal cycle (roughly~6.2 hours). Over the other half of the tidal cycle the particle will move in the opposite direction leading to a small net movement related to the tidal residual. The excursion will be largest at Spring tides.

Tidal residual. For the purposes of these documents it is taken to be the tidal current averaged over a complete tidal cycle. Very roughly it gives an idea of the general speed and direction of travel due to tides for a particle over a period of several days.

Tidal prism. The volume of water brought into an estuary or sea loch during half a tidal cycle. Equal to the difference in estuary/sea loch volume at high and low water.

Spring/Neap Tides. Spring tides occur during or just after new moon and full moon when the tide-generating force of the sun acts in the same direction as that of the moon, reinforcing it. The tidal range is greatest and tidal currents strongest during spring tides.

Neap tides occur during the first or last quarter of the moon when the tide-generating forces of the sun and moon oppose each other. The tidal range is smallest and tidal currents are weakest during neap tides.

Tidal diamonds. The tidal velocities measured and printed on admiralty charts at specific locations are called tidal diamonds.

Wind driven shear/surface layer. The top metre or so of the surface that generally moves in the rough direction of the wind typically at a speed that is a few percent (~3%) of the wind speed.

Return flow. A surface flow at the surface may be accompanied by a compensating flow in the opposite direction at the bed.

Stratification. The splitting of the water into two layers of different density with the less dense layer on top of the denser one. Due to either temperature or salinity differences or a combination of both.

4. Shoreline Survey Report

Report Title	Kerrera cockles Ganavan Bay Shoreline Survey Report
Project Name	Shellfish Sanitary Surveys
Client/Customer	Cefas
SRSL Project Reference	00561_B0067

Document Number	B0067_Shoreline 0046

Revision History

Revision	Changes	Date
A	Issue for internal review	04/12/2014
B	Issue for internal review	16/12/2014
01	First issue to Cefas	18/12/2014
02	Second issue to client incorporating corrections from Issue01	11/02/2015

	Name & Position	Date
Author	Debra Brennan & Peter Lamont	02/12/2014
Checked	Andrea Veszelovszki	11/02/2015
Approved	Andrea Veszelovszki	11/02/2015

SRSL, Scottish Marine Institute, Oban, Argyll, PA37 1QA, tel 01631 559 470, www.samsrsl.co.uk

Production area:	Kerrera cockles
Site name:	Ganavan Bay
SIN:	AB-697-1512-04
Species:	Common cockles
Existing RMP:	No RMP associated
Harvester:	Mr Douglas MacArthur
Local Authority:	Argyll and Bute Council
Status:	Awaiting Classification
Date Surveyed:	24/11/2014
Surveyed by:	Debra Brennan & Peter Lamont

Area Surveyed

Approximately 2 km of the shoreline was surveyed starting just north of Ganavan Bay moving west along the shoreline towards Rubha na h- Earba and then in a southerly direction along the shore at Camas Bàn ending the survey at Port Mòr south of Dunollie Castle.

Weather

There had been a few rain showers in the 48 hour period prior to the survey.

On the day of the survey there was no rain. Cloud cover at the start of the day was 100% which cleared slightly to approximately 80% by the afternoon giving some patches of sunshine. Temperature was an average of 6°C, there was no wind and the sea state was calm.

Stakeholder engagement during the survey

Prior to the survey the harvester Mr Douglas MacArthur spoke with the surveyor Eilidh Cole and was helpful informing where or where not we might locate cockle samples within the production area. The survey team did not have any contact with any stakeholders during the survey. There was also contact made with the Sampling Officer Mr Ewan McDougall for the area and useful information was gathered from him too.

Fishery

A wild fishery of common cockles is found within the survey area. Cockles were present in some areas but not found in all of the surveyed area. Because of this some but not all of the samples required were obtained. At Ganavan beach large cockles were easily found at the north end, north of the planned position

(GBSF1). At the south end, in the vicinity of the jetty, cockles were smaller and more difficult to locate and not enough were found for a sample. In the bay south of Rubha na h-erba (southwest side of Ganavan Bay) cockles were readily found at both locations suggested in the survey plan, however no cockles were found to sample in Camas Bàn.

Sewage Sources

There was a public toilet facility on the car park at Ganavan Beach. No obvious sewage discharge was observed from this facility. There was a development of new houses at the south end of Ganavan Beach, the map of the survey plan suggests, that these were serviced by two community discharge facilities although on the day of the survey these were not observed. Two pipes were visible at low tide at waypoint (wp) 10, Fig 10, however it was not obvious where these two pipes originated, as they were partially buried in the sand. There was a large private dwelling to the southwest of Ganavan Bay which had a septic tank at the bottom of the garden with two pipes on the rocks down to the shore. Both pipes had discharges and unplanned samples were taken (wps 16 & 18). There was a second large property on the same peninsula but no sewage pipe or septic tank was observed.

Camas Bàn Beach has fifteen private dwellings overlooking the bay. Two watercourses coming from the direction of two of the dwellings joined together and ran over the sand, there was an unpleasant odour and an unplanned sample was taken (wp 30).

A pipe was observed from the road, coming from a disused urinal in a brick and concrete building (wp 34, Fig 14), there was no flow from the pipe.

The private discharge depicted on the survey plan map at Port Mòr (wp 35) was not observed by the team.

Seasonal Population

No official campsites or caravan parks were seen in the area surrounding the survey area. There are no B&B’s or hotels in the area. The beach at Ganavan was very popular with visitors and dog walkers were observed throughout the day of the survey (Fig 3).

Boats/Shipping

No fishing or pleasure boats were observed during the survey. The Caledonian MacBrayne ferry routes to Mull, Coll, Tiree, Barra and Lismore pass close to Camas Bàn and Port Mòr at the southern end of the survey area. A number of ferries were observed throughout the day of the survey.

Farming and Livestock

No cattle, sheep or other livestock were observed at any point during the shoreline survey although cattle droppings were observed at wp 3.

Land Use

The land surrounding the shoreline of the production area was mainly farmland, although no livestock was observed. There were three main residential developments close to the production area.

Land Cover

The predominant land cover surrounding Ganavan Bay is farmland and rough pasture. There is some deciduous woodland around the Dunollie Castle area. The land is steep in places with rocky sections immediately next to the shore.

Watercourses

There were five unnamed watercourses noted on the survey plan, all of which were located, recorded and sampled. Unplanned samples were taken at the following waypoints: 16, 18 and 29; these samples were labelled GBFW4, GBFW5 and GBFW7, respectively.

Wildlife/Birds

Three drake mallard (*Anas platyrhynchos*) and one common gull (*Larus canus*) were observed at wp 14. One common gull, three oystercatchers (*Haematopus ostralegus*) and twelve ringed plover (*Charadrius hiaticula*) were observed on the beach at Rubha na h-Earba along with one kestrel (*Falco tinnunculus*) above the field and one roe deer (*Capreolus capreolus*) close to the beach (wp 23).

Specific observations made during the survey are mapped in Figure 1 and listed in Table 1. Water and shellfish samples were collected at the locations marked

on Figure 2. Bacteriology results are given in Tables 2 and 3. Photographs are presented in Figures 3-14

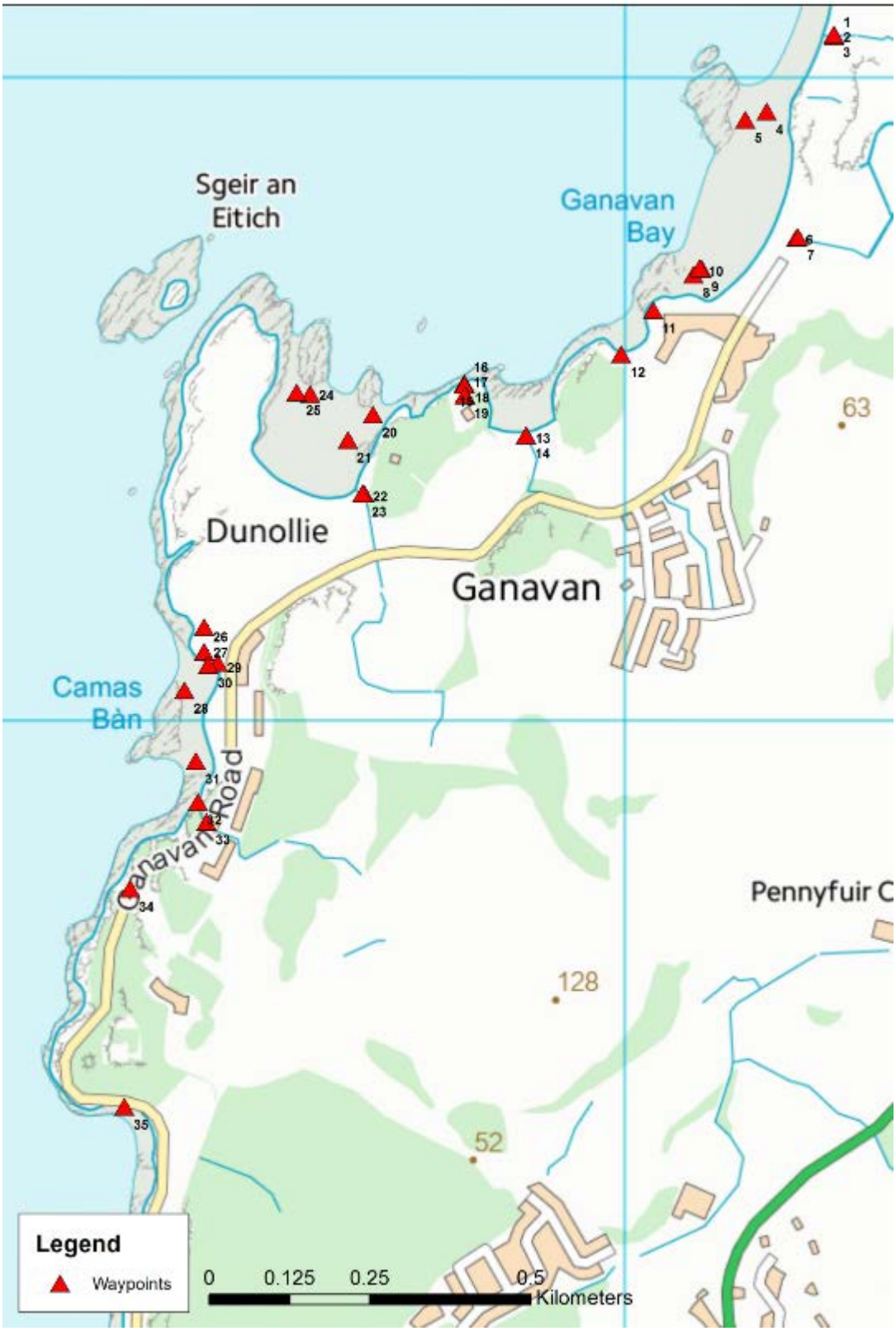

Figure 1. Kerrera cockels Ganavan Bay waypoints

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Figure 2. Kerrera cockels Ganavan Bay samples

Table 1 Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
1	24/11/2014	10:49	NM 86325 33064	186325	733065			Start of survey.
2	24/11/2014	10:50	NM 86324 33066	186325	733067		GBFW1	Planned freshwater sample.
3	24/11/2014	10:50	NM 86324 33067	186324	733067			Watercourse associated with waypoint (wp) 2, running from hillside down onto pebble shore. Width: 67 cm, Depth 2 cm, Flow 0.385 m/s, SD 0.031. Cow droppings observed in field above shore.
4	24/11/2014	10:59	NM 86220 32947	186220	732947		GBSW1	Planned seawater sample.
5	24/11/2014	11:17	NM 86187 32934	186187	732935	Fig 4	GBSF1	Planned shellfish sample.
6	24/11/2014	11:28	NM 86266 32750	186266	732751		GBFW2	Planned freshwater sample.
7	24/11/2014	11:30	NM 86268 32752	186269	732752	Fig 3 & Fig 5		Watercourse associated with wp 6, running through field, piped under shore, flow observed from broken pipe onto sandy beach. Width 80 cm, Depth 3 cm Flow 0.294 m/s, SD 0.006. Dog walkers and visitors on beach. Five dogs were observed at this waypoint.
8	24/11/2014	11:49	NM 86106 32693	186107	732694		GBSW2	Planned seawater sample.
9	24/11/2014	11:50	NM 86119 32702	186120	732703			Planned shellfish sample location, only one cockle found- no sample taken.
10	24/11/2014	11:51	NM 86116 32704	186116	732704	Fig 6 & Fig 7		Two 20 cm ceramic pipes visible at low tide. Housing development at the south end of the beach. Public toilet facility on carpark.
11	24/11/2014	12:05	NM 86044 32638	186044	732638	Fig 8 & 9		15cm cast iron pipe from direction of houses onto rocky shore, no flow, barnacles growing inside the pipe.
12	24/11/2014	12:09	NM 85994 32570	185994	732570			Watercourse running alongside housing development onto shore. Less than 1 m wide, no sample taken.
13	24/11/2014	12:17	NM 85846 32443	185847	732444		GBFW3	Planned freshwater sample.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
14	24/11/2014	12:19	NM 85846 32443	185847	732443			Watercourse associated with wp 13 running from field over sandy bay. Width 50 cm, Depth 7 cm, Flow 0.290 m/s, SD 0.003. One large private dwelling on shore. Housing development approximately 300 m from shore. Three drake mallard and one common gull in the sea.
15	24/11/2014	12:28	NM 85750 32524	185751	732525	Fig 10 & 11		Two pipes running over the rocks from septic tank, One was a 12 cm ceramic pipe discharging a trickle of water from pipe. The second was a 12 cm plastic pipe also discharging a trickle of water.
16	24/11/2014	12:33	NM 85750 32522	185751	732522		GBFW4	Unplanned freshwater sample from the ceramic pipe associated with wp 15.
17	24/11/2014	12:34	NM 85750 32522	185751	732522			Flow 7.1 ml/s from ceramic pipe associated with wp 16.
18	24/11/2014	12:37	NM 85752 32505	185752	732506		GBFW5	Unplanned freshwater sample from the plastic pipe associated with wp 15.
19	24/11/2014	12:38	NM 85751 32506	185751	732506			Flow 4.8 ml/s from plastic pipe associated with wp 18.
20	24/11/2014	12:58	NM 85609 32476	185609	732476		GBSW3	Planned seawater sample.
21	24/11/2014	13:15	NM 85569 32436	185570	732437		GBSF2	Planned shellfish sample.
22	24/11/2014	13:20	NM 85594 32353	185594	732354		GBFW6	Planned freshwater sample.
23	24/11/2014	13:21	NM 85592 32353	185592	732353			Watercourse associated with wp 22 running onto shore from field. Width 90 cm, Depth 6 cm, Flow 0.411 m/s SD 0.007. One house near to shore. Twelve ringed plover, three oystercatchers, one gull on beach. One kestrel hovering above the beach, one roe deer in field.
24	24/11/2014	13:32	NM 85510 32508	185511	732508		GBSW4	Planned seawater sample.
25	24/11/2014	13:35	NM 85490 32510	185490	732511		GBSF3	Planned shellfish sample.
26	24/11/2014	14:05	NM 85346 32145	185346	732145			Watercourse running onto shore < 1 m width - not sampled.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
27	24/11/2014	14:07	NM 85346 32107	185347	732107			Small sandy bay. Calmac ferry route to Mull and surrounding islands with a ferry observed passing close by. Fifteen houses overlooking the bay.
28	24/11/2014	14:11	NM 85315 32047	185316	732047		GBSW5	Planned seawater sample.
29	24/11/2014	14:23	NM 85367 32090	185368	732090		GBFW7	Unplanned freshwater sample.
30	24/11/2014	14:28	NM 85353 32086	185353	732087	Fig 12		Small watercourse associated with wp 29 running from direction of two houses before joining together on the sand. Strong unpleasant odour. Flow not possible to measure (running over and sinking in sand). Width 54cm, depth ,<1cm.
31	24/11/2014	14:34	NM 85333 31937	185334	731937			Two mute swans in the sea.
32	24/11/2014	14:37	NM 85336 31873	185337	731874		GBFW8	Planned freshwater sample.
33	24/11/2014	14:42	NM 85350 31842	185350	731843	Fig 13		Watercourse associated with wp 32 piped under road onto beach via a 30 cm diameter plastic pipe. Width of flow 10 cm, depth 1.5 cm, Flow 1.126 m/s, SD 0.040.
34	24/11/2014	15:00	NM 85231 31739	185231	731739	Fig 14		Metal pipe on shore coming from disused urinal building, no flow from pipe.
35	24/11/2014	15:11	NM 85222 31399	185223	731400		GBSW6	Planned seawater sample. End of survey.

Photographs referenced in the table can be found attached as Figures 3-14

Sampling

Seawater and freshwater samples were collected at sites marked in Figure 2. All planned freshwater and seawater samples were obtained. Three extra freshwater samples were also taken; two from pipes and one from a watercourse. The extra freshwater samples were named GBFW4, GBFW5 and GBFW7 and were taken at waypoints 16, 18 and 29 respectively. Only three out of the five shellfish samples were obtained, these were named GBSF1, GBSF2 and GBSF3 and were taken at waypoints 5, 25 & 21 respectively. Planned shellfish samples from north of Ganavan Pavilion outfall and north end of Camas Bàn beach were not obtained.

All the samples were transferred to a Biotherm 30 box with ice packs and posted to Glasgow Scientific Services (GSS) for *E. coli* analysis. All freshwater, seawater and shellfish samples were received by GSS within 24 hours of collection. The sample temperature on arrival at GSS was 4.3°C.

Seawater samples were tested for salinity by GSS and the results were reported in mg Chloride per litre. These results have been converted to parts per thousand (ppt) using the following formula:

$$\text{Salinity (ppt)} = 0.0018066 \times Cl^{-} \text{ (mg/L)}$$

Table 2. Water Sample Results

No.	Date	Sample	Grid Ref	Type	E. coli (cfu/100ml)	Salinity (ppt)
1	24/11/2014	GBFW1	NM 86324 33066	Freshwater	<10	
2	24/11/2014	GBFW2	NM 86266 32750	Freshwater	50	
3	24/11/2014	GBFW3	NM 85846 32443	Freshwater	70000	
4	24/11/2014	GBFW4	NM 85750 32522	Freshwater	100000	
5	24/11/2014	GBFW5	NM 85752 32505	Freshwater	<1000	
6	24/11/2014	GBFW6	NM 85594 32353	Freshwater	210	
7	24/11/2014	GBFW7	NM 85367 32090	Freshwater	670	
8	24/11/2014	GBFW8	NM 85336 31873	Freshwater	10	
9	24/11/2014	GBSW1	NM 86220 32947	Seawater	1	32.52
10	24/11/2014	GBSW2	NM 86106 32693	Seawater	1	32.70
11	24/11/2014	GBSW3	NM 85609 32476	Seawater	27	33.96
12	24/11/2014	GBSW4	NM 85510 32508	Seawater	19	33.06
13	24/11/2014	GBSW5	NM 85315 32047	Seawater	10	33.60
14	24/11/2014	GBSW6	NM 85222 31399	Seawater	4	33.96

Table 3. Shellfish Sample Results

No.	Date	Sample	Grid Ref	Type	E. coli (MPN/100g)
1	24/11/2014	GBSF1	NM 86187 32934	shellfish	<18
2	24/11/2014	GBSF2	NM 85569 32436	shellfish	78
3	24/11/2014	GBSF3	NM 85490 32510	shellfish	45

Salinity Profiles

No CTD profiles were taken on this survey.

Photographs

Figure 3. Dog walkers on Ganavan Beach associated with wp 7.

Figure 4. Site of shellfish sample GBSF1 associated with wp 5.

Figure 5. Watercourse associated with wp 7.

Figure 6. Two pipes visible at low tide associated with wp 10.

Figure 7. Car park and toilet block at Ganavan Beach associated with wp10.

Figures 8 and 9 (insert). Pipe from housing development with barnacles growing inside associated with wp 11.

Figures 10 & 11 (insert). Two pipes from septic tank- samples taken from end of ceramic pipe and from plastic pipe associated with wp 15.

Figure 12. Watercourse running over sand with unpleasant odour, associated with wp 30.

Figure 13. Watercourse diverted under road via pipe associated with wp 33.

Figure 14. Disused urinal with metal outflow pipe associated with wp 34.

5. SEPA Discharge Consents

Licence No.	NGR	Discharge Type	Discharges to	Op	PE
CAR/L/1003316	NM 86052 32694	Sewage (Private) Primary	Ganavan Bay	=	100
CAR/L/1009842	NM 88623 33872	Sewage (Private) Secondary	Dunstaffnage Bay	>	15
CAR/L/1085662	NM 91500 34800	Sewage (Private) Primary	Loch Etive	=	150
CAR/R/1009285	NM 84511 30847	Sewage (Private) Primary	Ardantrive Bay	=	6
CAR/R/1009869	NM 90690 35583	Sewage (Private) Secondary	Soakaway	=	10
CAR/R/1010988	NM 87540 29880	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1012082	NM 90440 34190	Sewage (Private) Primary	Firth of Lorn	=	5
CAR/R/1013629	NM 85399 32030	Sewage (Private) Primary	Firth of Lorn	=	5
CAR/R/1013701	NM 89876 39797	Sewage (Private) Primary	Allt an Duine Mhoir	=	5
CAR/R/1014140	NM 85380 32040	Sewage (Private) Primary	Firth of Lorn	=	5
CAR/R/1014557	NM 85370 32080	Sewage (Private) Primary	Camas Ban	=	5
CAR/R/1014806	NM 85335 31871	Sewage (Private) Primary	Firth of Lorn	=	5
CAR/R/1015011	NM 88140 29580	Sewage (Private) Primary	Land	=	12
CAR/R/1015462	NM 85840 28304	Sewage (Private) Primary	U/T of Scroba Burn	=	5
CAR/R/1015834	NM 92240 34790	Sewage (Private) Primary	Land	=	5
CAR/R/1015925	NM 93056 36112	Sewage (Private) Primary	Land	=	6
CAR/R/1016022	NM 92028 34856	Sewage (Private) Primary	Land	=	5
CAR/R/1016245	NM 85412 31935	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1016438	NM 91360 34090	Sewage (Private) Primary	Land	=	5
CAR/R/1016444	NM 91096 34304	Sewage (Private) Primary	Land	=	5
CAR/R/1016602	NM 91014 33105	Sewage (Private) Primary	Lusragan Burn	=	6
CAR/R/1016811	NM 85340 31760	Sewage (Private) Primary	Land	=	18
CAR/R/1017171	NM 90469 31399	Sewage (Private) Secondary	Lusragan Burn	=	6
CAR/R/1017596	NM 89210 40720	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1018319	NM 89670 39464	Sewage (Private) Primary	Land	=	5
CAR/R/1018409	NM 90987 35596	Sewage (Private) Primary	UN/WC	=	10
CAR/R/1018768	NM 91420 34061	Sewage (Private) Secondary	Lusragan Burn	=	6
CAR/R/1019181	NM 93530 36010	Sewage (Private) Primary	Land	=	6
CAR/R/1019519	NM 89790 39370	Sewage (Private) Primary	Land	=	6
CAR/R/1019543	NM 92710 35380	Sewage (Private) Primary	Land	=	5
CAR/R/1020567	NM 89970 39900	Sewage (Private) Primary	Land	=	5
CAR/R/1020698	NM 84326 28053	Sewage (Private) Secondary	Soakaway	=	14
CAR/R/1020769	NM 93440 35980	Sewage (Private) Primary	Loch Etive	=	6
CAR/R/1020884	NM 89883 39830	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1021159	NM 91460 34060	Sewage (Private) Secondary	Soakaway	=	6
CAR/R/1021257	NM 93060 36200	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1021347	NM 93030 36260	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1021717	NM 90600 37330	Sewage (Private) Primary	Land	=	6
CAR/R/1021730	NM 92630 34840	Sewage (Private) Primary	Land	=	8
CAR/R/1022555	NM 88690 29790	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1022604	NM 84666 29214	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1022606	NM 87532 29912	Sewage (Private) Primary	Soakaway	=	6

CAR/R/1022607	NM 84750 29250	Sewage (Private) Primary	U/T of Sound of Kerrera	=	5
CAR/R/1024633	NM 87487 30028	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1024658	NM 92047 33950	Sewage (Private) Primary	Soakaway	=	15
CAR/R/1024775	NM 91420 34061	Sewage (Private) Primary	Lusragan Burn	=	20
CAR/R/1025910	NM 92770 35870	Sewage (Private) Primary	Land	=	5
CAR/R/1026572	NM 91300 34100	Sewage (Private) Secondary	Land	=	6
CAR/R/1026580	NM 91300 34150	Sewage (Private) Secondary	Land	=	6
CAR/R/1027839	NM 94031 36114	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1028139	NM 86220 32270	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1028813	NM 87480 29930	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1029131	NM 89080 39290	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1029589	NM 91340 34890	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1029857	NM 91540 34940	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1030773	NM 87940 30721	Sewage (Private) Primary	Alltan Tartach	=	5
CAR/R/1034046	NM 90740 31770	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1034129	NM 84540 30890	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1034580	NM 89572 30353	Sewage (Private) Secondary	U/T of Dig Bharrain	=	5
CAR/R/1034611	NM 90600 33970	Sewage (Private) Secondary	U/T of Ardmucknish	=	5
CAR/R/1035111	NM 88987 29975	Sewage (Private) Secondary	U/T of Dig Bharrain	=	6
CAR/R/1036100	NM 89837 40107	Sewage (Private) Secondary	Allt an Duine Mhoir	=	6
CAR/R/1037061	NM 84680 29110	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037153	NM 92685 35587	Sewage (Private) Primary	Soakaway		5
CAR/R/1037166	NM 90258 38061	Sewage (Private) Primary	Soakaway	=	14
CAR/R/1037168	NM 90307 38054	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037178	NM 91480 34940	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037182	NM 88090 29500	Sewage (Private) Primary	Soakaway	=	16
CAR/R/1037183	NM 86099 32313	Sewage (Private) Primary	U/T of Firth of Lorn	=	5
CAR/R/1037184	NM 88126 29559	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037247	NM 90542 37315	Sewage (Private) Primary	UN/WC	=	5
CAR/R/1037276	NM 87381 30073	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1037291	NM 92930 35838	Sewage (Private) Primary	Loch Etive	=	5
CAR/R/1037304	NM 90539 32130	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037309	NM 90518 37479	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037312	NM 91660 34930	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1037362	NM 92800 35370	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1037392	NM 92606 34823	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1037395	NM 87397 30055	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037422	NM 92759 35409	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037459	NM 92320 36440	Sewage (Private) Primary	Land	=	5
CAR/R/1037465	NM 85370 32060	Sewage (Private) Primary	Firth of Lorn	=	5
CAR/R/1037471	NM 89892 39761	Sewage (Private) Primary	Alt an Duine Mhoir	=	5
CAR/R/1037480	NM 93064 36194	Sewage (Private) Primary	Soakaway	=	6

CAR/R/1037491	NM 92678 35220	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037492	NM 92234 34775	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037493	NM 92925 35349	Sewage (Private) Primary	Loch Etive	=	5
CAR/R/1037529	NM 92090 34780	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037561	NM 86109 31095	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1037578	NM 89420 30320	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1037592	NM 93829 36019	Sewage (Private) Primary	Loch Etive	=	7
CAR/R/1037699	NM 93070 36140	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037707	NM 90202 40173	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037716	NM 87910 29920	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037722	NM 89860 39670	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1037726	NM 85380 28990	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037812	NM 90600 37260	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037919	NM 89890 39450	Sewage (Private) Primary	Soakaway	=	21
CAR/R/1037979	NM 86133 32261	Sewage (Private) Primary	Soakaway		5
CAR/R/1037980	NM 86111 32296	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1037981	NM 86067 32305	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038076	NM 90130 31300	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038089	NM 89140 40660	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1038116	NM 91450 34910	Sewage (Private) Primary	Soakaway	=	20
CAR/R/1038123	NM 90260 39400	Sewage (Private) Primary	Soakaway	=	15
CAR/R/1038129	NM 90573 37294	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038157	NM 85740 32540	Sewage (Private) Primary	Firth of Lorn	=	10
CAR/R/1038170	NM 90261 39381	Sewage (Private) Primary	Soakaway	=	15
CAR/R/1038198	NM 86133 32261	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1038203	NM 82433 28789	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038218	NM 86100 32340	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1038222	NM 92315 34771	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038224	NM 86126 32389	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1038246	NM 79581 27030	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038293	NM 84043 29958	Sewage (Private) Primary	Sound of Kerrera	=	10
CAR/R/1038294	NM 84060 30070	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038302	NM 87650 30280	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038417	NM 86150 32460	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038486	NM 89810 39390	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1038576	NM 92790 35907	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1038577	NM 90890 36930	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038598	NM 91172 33649	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1038991	NM 91212 34900	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039117	NM 93520 36070	Sewage (Private) Primary	Land	=	5
CAR/R/1039167	NM 91628 34931	Sewage (Private) Primary	Soakaway	<=	15
CAR/R/1039174	NM 90388 38838	Sewage (Private) Primary	Soakaway	<=	15
CAR/R/1039187	NM 92770 34980	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039211	NM 92851 35673	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1039235	NM 92991 35993	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1039308	NM 85340 31870	Sewage (Private) Primary	Camas Ban	=	6
CAR/R/1039338	NM 90651 34070	Sewage (Private) Primary	Loch Etive	=	5
CAR/R/1039346	NM 91496 34219	Sewage (Private) Primary	Lusragan Burn	=	5

CAR/R/1039448	NM 86596 29768	Sewage (Private) Primary	U/T of Alltan Tartach	=	5
CAR/R/1039477	NM 87599 30607	Sewage (Private) Primary	Land	=	5
CAR/R/1039480	NM 92862 35777	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1039511	NM 89765 39355	Sewage (Private) Primary	Soakaway	<=	15
CAR/R/1039553	NM 89960 39850	Sewage (Private) Primary	Land	=	6
CAR/R/1039544	NM 92350 34810	Sewage (Private) Primary	Land	=	6
CAR/R/1039551	NM 92250 34180	Sewage (Private) Primary	Land	=	5
CAR/R/1039572	NM 90921 32672	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039581	NM 89749 39757	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039591	NM 90390 38330	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039611	NM 85640 32390	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039613	NM 82782 28664	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039615	NM 92740 35395	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039616	NM 82890 28670	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039618	NM 86430 31640	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1039620	NM 85300 31610	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039624	NM 85300 31620	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039627	NM 85475 32067	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039630	NM 85590 32190	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039635	NM 81060 26868	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039637	NM 80885 26348	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039639	NM 81704 27322	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1039640	NM 93104 36171	Sewage (Private) Primary	Land	<=	50
CAR/R/1039647	NM 90880 34850	Sewage (Private) Primary	Land	<=	50
CAR/R/1039650	NM 93140 36210	Sewage (Private) Primary	Land	=	6
CAR/R/1039677	NM 82360 28740	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039678	NM 82290 28680	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039679	NM 80170 28340	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039680	NM 81890 29170	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1039686	NM 80650 27060	Sewage (Private) Primary	Soakaway	=	20
CAR/R/1039749	NM 89817 39561	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039751	NM 90420 33960	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1039764	NM 89970 39309	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1039787	NM 93025 36188	Sewage (Private) Secondary	Soakaway	=	6
CAR/R/1039831	NM 89832 39356	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1039844	NM 89810 39540	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1039847	NM 92220 34130	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1039906	NM 90980 34360	Sewage (Private) Primary	Falls of Lora	=	5
CAR/R/1039917	NM 90748 36968	Sewage (Private) Primary	Ledaig Burn	=	5
CAR/R/1039920	NM 91025 34758	Sewage (Private) Primary	Loch Etive	=	6
CAR/R/1039959	NM 92175 34641	Sewage (Private) Primary	Loch Etive	=	25
CAR/R/1039984	NM 86619 29730	Sewage (Private) Primary	Alltan Tartach	=	6
CAR/R/1039990	NM 92790 35804	Sewage (Private) Primary	Land	=	6
CAR/R/1040010	NM 90600 37370	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1040018	NM 90640 37280	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1040066	NM 92671 35195	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1040074	NM 91510 35084	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1040110	NM 89767 39187	Sewage (Private) Primary	Land	=	6

CAR/R/1040386	NM 90555 38347	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1040504	NM 87610 29890	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1040753	NM 89050 29710	Sewage (Private) Primary	Soakaway	<=	20
CAR/R/1040770	NM 93475 36146	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1040773	NM 94530 36480	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1040775	NM 94619 36411	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1040782	NM 89190 40680	Sewage (Private) Primary	Soakaway	=	7
CAR/R/1040796	NM 91180 34902	Sewage (Private) Primary	UN/WC	=	6
CAR/R/1041106	NM 90310 38910	Sewage (Private) Primary	Soakaway	=	30
CAR/R/1041534	NM 91360 34350	Sewage (Private) Secondary	Falls of Lora	=	12
CAR/R/1041588	NM 87948 30262	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1042339	NM 93390 36036	Sewage (Private) Primary	Loch Etive	=	7
CAR/R/1042668	NM 90840 35480	Sewage (Private) Primary	Soakaway	=	30
CAR/R/1042807	NM 92455 34800	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1044188	NM 92380 34793	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1045223	NM 92043 36597	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1046285	NM 85880 28445	Sewage (Private) Primary	Soroba Burn	=	5
CAR/R/1046508	NM 92220 34680	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1048201	NM 93852 36024	Sewage (Private) Primary	Loch Etive	=	7
CAR/R/1049653	NM 91256 34128	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1049654	NM 89850 39800	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1057525	NM 85901 28444	Sewage (Private) Primary	Soroba Burn	=	5
CAR/R/1062989	NM 91490 34130	Sewage (Private) Primary	Soakaway	=	30
CAR/R/1068593	NM 90770 34100	Sewage (Private) Untreated	Coastal Waters	=	6
CAR/R/1074694	NM 90947 32678	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1076356	NM 85820 28460	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1076615	NM 85832 28372	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1079227	NM 88960 30120	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1079832	NM 88790 33900	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1079862	NM 91487 34731	Sewage (Private) Primary	Loch Etive	=	5
CAR/R/1081644	NM 84860 30860	Sewage (Private) Primary	Sound of Kerrera	=	6
CAR/R/1081769	NM 88821 33938	Sewage (Private) Secondary	Soakaway	=	15
CAR/R/1082500	NM 93962 36109	Sewage (Private) Secondary	Allt Tigh Dhonnchaidh	=	5
CAR/R/1082582	NM 88680 29981	Sewage (Private) Secondary	Soakaway	=	15
CAR/R/1083550	NM 92020 34850	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1083790	NM 87309 30112	Sewage (Private) Secondary	Alltan Tartach	=	5
CAR/R/1085372	NM 86402 31330	Sewage (Private) Primary	UN/WC	=	5
CAR/R/1085417	NM 90080 39640	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1085700	NM 93130 36129	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1086857	NM 84464 27951	Sewage (Private) Primary	UN/WC	=	13
CAR/R/1086894	NM 82810 27430	Sewage (Private) Untreated	Sound of Kerrera	=	5
CAR/R/1088158	NM 92520 34840	Sewage (Private) Primary	Soakaway	=	11
CAR/R/1089002	NM 89883 39809	Sewage (Private) Primary	Allt an Duine Mhoir	=	5
CAR/R/1089060	NM 89205 30161	Sewage (Private) Secondary	U/T of Dig Bharrain	=	5

CAR/R/1090026	NM 89230 40700	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1092283	NM 93083 35981	Sewage (Private) Primary	Loch Etive	=	5
CAR/R/1093903	NM 82734 28666	Sewage (Private) Primary	U/T of Sound of Kerrera	=	8
CAR/R/1094227	NM 89910 39380	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1094250	NM 93430 35980	Sewage (Private) Primary	Coastal Waters	=	5
CAR/R/1094673	NM 88674 29715	Sewage (Private) Secondary	U/T of Dig Bharrain	=	8
CAR/R/1095399	NM 85225 31364	Sewage (Private) Primary	Oban Bay	=	13
CAR/R/1095459	NM 90720 38500	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1095619	NM 92954 35881	Sewage (Private) Primary	Loch Etive	=	6
CAR/R/1095759	NM 88675 39126	Sewage (Private) Primary	UN/WC	=	5
CAR/R/1095791	NM 81731 27368	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1095871	NM 81130 26940	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1096209	NM 89640 39510	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1097470	NM 84822 29382	Sewage (Private) Primary	UN/WC	=	5
CAR/R/1099103	NM 87310 30430	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1100341	NM 89991 33384	Sewage (Private) Primary	UN/WC	=	5
CAR/R/1100983	NM 92770 35640	Sewage (Private) Primary	Land	=	6
CAR/R/1100984	NM 92790 35600	Sewage (Private) Primary	Land	=	6
CAR/R/1102723	NM 90993 35607	Sewage (Private) Primary	Ledaig Burn	=	6
CAR/R/1102753	NM 88916 29933	Sewage (Private) Secondary	U/T of Dig Bharrain	=	5
CAR/R/1103746	NM 90080 39720	Sewage (Private) Primary	Soakaway	=	9
CAR/R/1104560	NM 91586 34999	Sewage (Private) Primary	Soakaway	=	15
CAR/R/1104804	NM 93310 36000	Sewage (Private) Untreated	Loch Etive	=	6
CAR/R/1105346	NM 90680 32140	Sewage (Private) Primary	Land	=	8
CAR/R/1106230	NM 90080 39730	Sewage (Private) Secondary	U/T of Allt an Duine Mhoir	=	8
CAR/R/1106852	NM 88900 29620	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1107994	NM 92760 35850	Sewage (Private) Primary	Land	=	7
CAR/R/1108005	NM 88130 29490	Sewage (Private) Secondary	UN/WC	=	5
CAR/R/1111342	NM 92340 34310	Sewage (Private) Secondary	Loch Etive	=	5
CAR/R/1111711	NM 94020 36110	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1111795	NM 91508 34179	Sewage (Private) Primary	Lustagan Burn/Black Lochs	=	15
CAR/R/1113552	NM 85370 32080	Sewage (Private) Primary	Camas Ban	=	5
CAR/R/1113758	NM 88360 29450	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1114293	NM 86644 29742	Sewage (Private) Secondary	Allt Tartach	=	15
CAR/R/1114386	NM 91400 34350	Sewage (Private) Untreated	Loch Etive	=	7
CAR/R/1115018	NM 90640 34980	Sewage (Private) Primary	Land	=	5
CAR/R/1115182	NM 93310 36000	Sewage (Private) Primary	Loch Etive	=	7
CAR/R/1117296	NM 90820 34640	Sewage (Private) Untreated	Loch Etive	=	6
CAR/R/1117804	NM 83190 27590	Sewage (Private) Secondary	Soakaway	=	10
CAR/R/1120787	NM 93090 36040	Sewage (Private) Primary	Soakaway	=	10
CAR/R/1120937	NM 90490 37510	Sewage (Private) Primary	Land	=	5
CAR/R/1121197	NM 92400 34370	Sewage (Private) Untreated	Loch Etive	=	8
CAR/R/1121758	NM 90610 33950	Sewage (Private) Primary	UN/WC	=	5

CAR/R/1122063	NM 92900 35550	Sewage (Private) Primary	Soakaway	=	8
CAR/R/1122389	NM 89810 39990	Sewage (Private) Primary	Soakaway	=	5
CAR/R/1122956	NM 90059 33010	Sewage (Private) Secondary	Soakaway	=	5
CAR/R/1123477	NM 91360 34340	Sewage (Private) Untreated	Loch Etive	=	15
CAR/R/1123643	NM 90822 32277	Sewage (Private) Primary	Soakaway	=	6
CAR/R/1124152	NM 91269 34902	Sewage (Private) Primary	Soakaway	=	6
CAR/S/1011729	NM 90330 33975	Sewage (Private) Secondary	Soakaway	=	20
CAR/S/1015890	NM 86540 27070	Sewage (Private) Tertiary	Allt Criche	=	33
CAR/S/1021079	NM 91390 34900	Sewage (Private) Secondary	Soakaway	<=	50
CAR/S/1079282	NM 87970 34180	Sewage (Private) Secondary	Soakaway	=	45
CAR/S/1085444	NM 89900 39600	Sewage (Private) Secondary	Soakaway	=	24
CAR/S/1107891	NM 83080 27560	Sewage (Private) Tertiary	Soakaway	<=	25
CAR/R/1122261	NM 89810 30570	Sewage (Public) Primary	Soakaway	=	5
CAR/R/1014205	NM 90486 34047	Sewage (Public) Primary	Land	=	8
CAR/R/1024422	NM 90660 34000	Sewage (Public) Primary	Coastal Waters	=	6
CAR/R/1109422	NM 91650 34310	Sewage (Public) Primary	Loch Etive	=	50
CAR/R/1037642	NM 91220 34380	Sewage (Public) Untreated	Loch Etive	=	5
CAR/L/1000364	NM 90080 38418	Sewage (Public) Secondary	Ardmucknish Bay	=	400
CAR/L/1003310	NM 91236 34405	Sewage (Public) Untreated	Loch Etive	=	0
CAR/L/1003311	NM 90700 34600	Sewage (Public) Untreated	Loch Etive	=	0
CAR/L/1010872	NM 89600 34500	Sewage (Public) Primary	Firth of Lorn	=	0
CAR/L/1003475	NM 85185 30824	Sewage (Public) Secondary	Oban Bay	=	13597
CAR/L/1010883	NM 90590 34590	Sewage (Public) Primary	Loch Etive	=	0
CAR/L/1026157	NM 85508 29727	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 85508 29727	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 85793 30010	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 85793 30010	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 85871 30609	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 85871 30609	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 86044 29338	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 86044 29338	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 86413 28473	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1026157	NM 86413 28473	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1000364	NM 89958 38362	Sewage (Public) Combined Sewer Overflow (CSO)		NA	NA
CAR/L/1000889	NM 85920 32590	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1010875	NM 91260 34430	Sewage (Public) Emergency Overflow (EO)		NA	NA

CAR/L/1010878	NM 90710 34630	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1026157	NM 85920 32590	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1026157	NM 85920 32590	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1026157	NM 85623 30556	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1026157	NM 85795 29907	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1026157	NM 86818 29881	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1026157	NM 84810 29460	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1010880	NM 90610 34628	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1010886	NM 90970 34390	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1010885	NM 91850 34230	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1010882	NM 92130 34630	Sewage (Public) Emergency Overflow (EO)		NA	NA
CAR/L/1010872	NM 89600 34500	Sewage (Public) Emergency Overflow (EO)		NA	NA

LS=Land/Soakaway, SW= Seawater Body, FW= Freshwater Body, PE= Population Equivalent, - = Not applicable

6. Scottish Water Discharges

Name	Licence	Dicharge Location	Type	Treatment	Consented Flow	Overflow	Storage
ACHNACREEMORE SEP NM930363		NM930363					
DUNGALLAN TERRACE SEP NM842291	CD12219	NM 8420 2910	FE	septic tank			0
OBAN GALLANACH SPS 1998 NM848294	CAR/L/1026157	NM 8481 2946	EO	6 mm screens	storage 6m3	n/a	0
GALLANACH PUMPING STATION	CAR/L/1026157	NM 8483 2942	CSO	6 mm screens	105 m3	12	0
Gallanach SPS CSO	CAR/L/1026157	NM 8483 2942	CSO	6 mm screens	105 m3	12 l/s	0
Gallanach SPS EO	CAR/L/1026157	NM 8483 2942	EO	6 mmscreens		n/a	0
CORRAN ESPLANADE PS	CAR/L/1026157	NM 849 306	CSO	6 mm screens	4998	160 l/s	0
OBAN WWTW 2000 NM867314	CAR/L/1003475	NM 8490 3060	FE	secondary	4958		26600
OBAN MANOR HOUSE WWPS	CAR/L/1026157	NM 8518 2982	EO	6 mm screens	storage 6m3	n/a	0
Manor House SPS EO	CAR/L/1026157	NM 8518 2982	EO	6 mm screens		n/a	0
OBAN, ALMA CRESCENT CSO	CAR/L/1026157	NM 8555 2972	CSO	15mm screen	2 m3	23 l/s	0
OBAN HERITAGE CENTRE SPS 1992 NM858299	CAR/L/1026157	NM 8580 2993	EO				0
Heritage Centre SPS EO	CAR/L/1026157	NM 8580 2993	EO				
OBAN, CORRAN PARK WWPS 1997 NM857306	CAR/L/1026157	NM 8581 2998	EO	15 mm screens	4998	n/a	0
OBAN GEORGE ST CSO NM859299	CAR/L/1026157	NM 8581 2998	CSO	10 mm screens	4998	900	0
CORRAN ESPLANADE PS	CAR/L/1026157	NM 8581 2998	CSO	10 mm screens	4998	160 l/s	0
George Street CSO	CAR/L/1026157	NM 8581 2998	CSO	10 mm screens	4998	900 l/s	0
Corran Parks SPS EO	CAR/L/1026157	NM 8581 2998	EO	15 mm screens			n/a
OBAN GANAVAN WWPS 2003 NM859323	CAR/L/1026157	NM 8592 3259	EO	10 mm screens	storage 7 m3	n/a	0
Ganavan SPS EO	CAR/L/1026157	NM 8592 3259	EO	10 mm screens			n/a
DUNBEG MEADOW RD WWPS CSO NM881336		NM 881336	CSO				
KILMORE WWTW NM883257	CAR/L/1000611	NM 882 258	FE	secondary	25 m3		120
KILMORE, KILMORE STW CSO	CAR/L/1000611	NM 8820 2580	CSO	6 mm screens		25 m3	1 l/s
CONNEL SEP WWPS CSO NM890339	CAR/L/1010872	NM 8960 3450	CSO	6 mm screens	332.1	2 l/s	0
CONNEL SEP NM890339	CAR/L/1010872	NM 8960 3450	FE	septic tank	332.1		0
CONNEL SEP WWPS NM890339	CAR/L/1010872	NM 8960 3450	EO	6 mm screens	332.1		0

Name	Licence	Dicharge Location	Type	Treatment	Consented Flow	Overflow	Storage
BENDERLOCH WWTW 1976 NM903384	CAR/L/1000364	NM 9010 3850	FE	secondary	88		400
BENDERLOCH, BENDERLOCH CSO		NM 9010 3850	CSO				0
BENDERLOCH, BENDERLOCH STW CSO	CAR/L/1000364	NM 9010 3850	CSO	6 mm screens	88	6 l/s	0
NORTH CONNEL SEP WWTW	CAR/L/1010883	NM 9059 3459	FE	sepic tank	84		0
CONNEL NORTH SPS NO1 NM906347	CAR/L/1010880	NM 9061 3464	EO	6 mm screens	84		0
CONNEL NORTH SPS NO1 NM906347 CSO	CAR/L/1010880	NM 9061 3464	CSO	6 mm screens	84	8 l/s	0
CONNEL NORTH SPS NO2 NM907347	CAR/L/1010878	NM 9071 3463	EO	6 mm screens	1.5		0
CONNEL SOUTH SPS NO1 NM909343	CAR/L/1010886	NM 9097 3439	EO	6 mm screens	89.7		0
CONNEL STH SPS1 CSO NM909343	CAR/L/1010886	NM 9097 3439	CSO	6 mm screens	89.7	23 l/s	0
CONNEL SOUTH SPS NO2 NM913344	CAR/L/1010875	NM 9126 3443	EO	6 mm screens	2		0
CONNEL SOUTH ACHALEVEN SPS NM919342	CAR/L/1010885	NM 9185 3423	EO	6 mm screens	40		0
CONNEL, ACHALEVEN CSO	CAR/L/1010885	NM 9185 3423	CSO	6 mm screens	40	7 l/s	0
CONNEL NORTH SPS NO3 NM920348	CAR/L/1010882	NM 9213 3463	EO	6mm screens	23.6		0
CONNEL NORTH SPS NO3 NM920348 CSO	CAR/L/1010882	NM 9213 3463	CSO	6mm screens	23.6	7 l/s	0
BLACKCROFTS NORTH CONNEL SEP NM923348		NM 9237 3465	FE	septic tank	12 houses		0
(associated with Achnacreemore ST		soakaway	CSO				0
NORTH CONNEL, 6 MOSSPARK CSO							
DUNBEG JANE ROAD CSO 2013 NM880334			CSO				0
DUNBEG JANE ROAD WWPS NM880335			EO				0
DUNBEG MEADOW RD WWPS CSO NM881336			CSO				0
DUNBEG MEADOW RD WWPS NM882336			EO				0