Scottish Sanitary Survey Review

Seil Sound

AB-247

April 2015

Cefas

Food Standards Agency
food.gov.uk

Report Title	Seil Sound Sanitary Survey Review
Project Name	Scottish Sanitary Survey
Client/Customer	Food Standards Agency Scotland
Cefas Project Reference	C6316B
Document Number	C6316B_2014_21
Revision	V1.0
Date	10/04/2015

Revision History

Revision number	Date	Pages revised	Reason for revision
0.1	10/02/2015	All	Draft for external consultation
1.0	10/04/2015	iv,v,vi	Amended distribution and list of sampling officers in line with comments received from consultees

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Review Specification and Introduction

Sanitary surveys are used to demonstrate compliance with the requirements stated in Annex II (Chapter II Paragraph 6) of Regulation (EC) 854/2004, whereby if the competent authority decides in principle to classify a production or relay area it must:

- make an inventory of pollution sources of human/animal origin likely to be a contamination source for the production areas;
- examine the quantities of organic pollutants which are released during the different periods of the year, according to the seasonal variations of both human and animal populations in the catchment area, rainfall readings, wastewater treatment, etc.;
- determine the characteristics of the circulation of pollutants by virtue of current patterns, bathymetry and the tidal regime in the production area;
- establish a sampling programme of bivalve molluscs in the production area which is based on the examination of established data, and with a number of samples, a geographical distribution of the sampling points and a sampling frequency which must ensure that the results of the analysis are as representative as possible for the area considered.

The EURL Good Practice Guide (GPG) for the monitoring of bivalve molluscs harvesting areas recommends the re-evaluation of sanitary surveys every six years. Location, extent and nature of fisheries and faecal pollution sources may change over time and the review is conducted to determine whether the sampling plan and/or production area boundaries remain appropriate and protective of public health.

As specified by the Food Standards Agency, this review is comprised of a brief desktop search of publicly available information together with a shoreline survey. No additional data requests are submitted to external bodies. The review is intended to identify significant changes in:

- Historic microbiological data.
- Sewage treatment and sewerage infrastructure.
- Housing and development.
- Harvester operations.

The output of the review is a report identifying any new information that has been obtained and/or whether major elements of the original sanitary survey can be regarded as essentially unchanged. That report includes an overall assessment as to whether the production area/classification zone boundaries and/or RMPs should be modified from those recommended in the original report and if so, a description of the revised boundaries and a revised sampling plan with the boundaries and RMP(s) locations.

A sanitary survey was undertaken in 2009 for Seil Sound. The survey was conducted to identify the location, extent and nature of the shellfishery and the potential sources of faecal contamination to the shellfishery, and to recommend boundaries and sampling plans for the production areas.

The output of the sanitary survey included a report and recommended sampling plans for the four production areas within the sound. These sampling plans are identified on the following pages alongside the recommended changes following findings from this review.

The present report constitutes a review of publicly available information in order to assess changes that have occurred since the 2009 sanitary survey report (see the Review Specification section for further detail). It is not intended to present detailed information relating to pollution sources that were identified in the previous report. This review should be read in conjunction with the 2009 sanitary survey report.

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APPENDICES

1. Planning Applications
2. Scottish Water and SEPA Discharge Information
3. Shoreline Survey Report

Sampling Plan – Seil Sound: North

	2009 Report	2015 Review	Changes
PRODUCTION AREA	Seil Sound: North		No change
SITE NAMES	Ardshellach and Balvicar North		
SIN	AB-247-071-13 and AB-247-735-13		
SPECIES	Pacific oysters		
TYPE OF FISHERY	Trestle based aquaculture		
NGR OF RMP	NM 7760 1726	NM 7760 1726	
EAST	177600	177600	
NORTH	717260	717260	
TOLERANCE (M)	10	20	Increased to allow for slightly greater variation in location of stock available for sampling in the vicinity of the RMP
DEPTH (M)	N/A		No change
METHOD OF SAMPLING	Hand		
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Argyll and Bute Council		
AUTHORISED SAMPLER(S)	Christine McLachlan, William MacQuarrie, Ewan McDougall, Donald Campbell	William MacQuarrie, Ewan McDougall, Heather Harley, Alison Hardie, Christine McLachlan	Change in personnel
RECOMMENDED PRODUCTION AREA	Area bounded by lines drawn between NM 7793 1831 and NM 7812 1831 and between NM 7753 1761 and NM 7754 1716 and between NM 7760 1711 and NM 7804 1711 extending to MHWS		No change

Sampling Plan – Seil Sound: East

	2009 Report	2015 Review	Changes
PRODUCTION AREA	Seil Sound: East		No changes
SITE NAMES	East of Balvicar		
SIN	AB-247-703-08		
SPECIES	Common mussels		
TYPE OF FISHERY	Long-line		
NGR OF RMP	NM 7780 1659	NM 7778 1661	Moved slightly so that it lies on the current location of the fishery
EAST	177800	177780	
NORTH	716590	716610	
TOLERANCE (M)	20	40	Changed to allow for greater movement of mussel lines
DEPTH (M)	1	1	No changes
METHOD OF SAMPLING	Hand		
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Argyll and Bute Council		
AUTHORISED SAMPLER(S)	Christine McLachlan, William MacQuarrie, Ewan McDougall, Donald Campbell	William MacQuarrie, Ewan McDougall, Heather Harley, Alison Hardie, Christine McLachlan	Change in personnel
RECOMMENDED PRODUCTION AREA	Area boundaries are lines drawn between NM 7804 1711 and NM 7769 1710 and between NM 7769 1710 and NM 7770 1652 and between NM 7770 1652 and NM 7790 1653 extending to MHWS	The area bounded by lines drawn between NM 7804 1711 and NM 7770 1711 and between NM 7770 1711 and NM 7770 1652 and between NM 7770 1652 and NM 7790 1653 extending to MHWS	Slight change to boundaries so that the northern boundary directly abuts the southern boundary of Seil Sound: North

Sampling Plan – Seil Sound: Balvicar

	2009 Report	2015 Review	Changes
PRODUCTION AREA	Seil Sound: Balvicar		No change
SITE NAMES	Balvicar and Rubha nan Ron		
SIN	AB-247-072-13 and AB-247-728-13		
SPECIES	Pacific oysters		
TYPE OF FISHERY	Trestle based aquaculture		
NGR OF RMP	NM 7725 1612	NM 7726 1643	Changed to locate on current extent of trestles
EAST	177250	177260	
NORTH	716120	716430	
TOLERANCE (M)	10	20	Increased to allow for slightly greater variation in location of stock available for sampling in the vicinity of the RMP
DEPTH (M)	N/A		No change
METHOD OF SAMPLING	Hand		
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Argyll and Bute Council		
AUTHORISED SAMPLER(S)	Christine McLachlan, William MacQuarrie, Ewan McDougall, Donald Campbell	William MacQuarrie, Ewan McDougall, Heather Harley, Alison Hardie, Christine McLachlan	Change in personnel
RECOMMENDED PRODUCTION AREA	Area boundaries are lines drawn between NM 7716 1680 and NM 7745 1680 and between NM 7745 1680 and NM 7745 1554 and between NM 7745 1554 and NM 7727 1554 extending to MHWS		No change

1. Area Description and Fishery

The location of Seil Sound is shown in Figure 1.1.

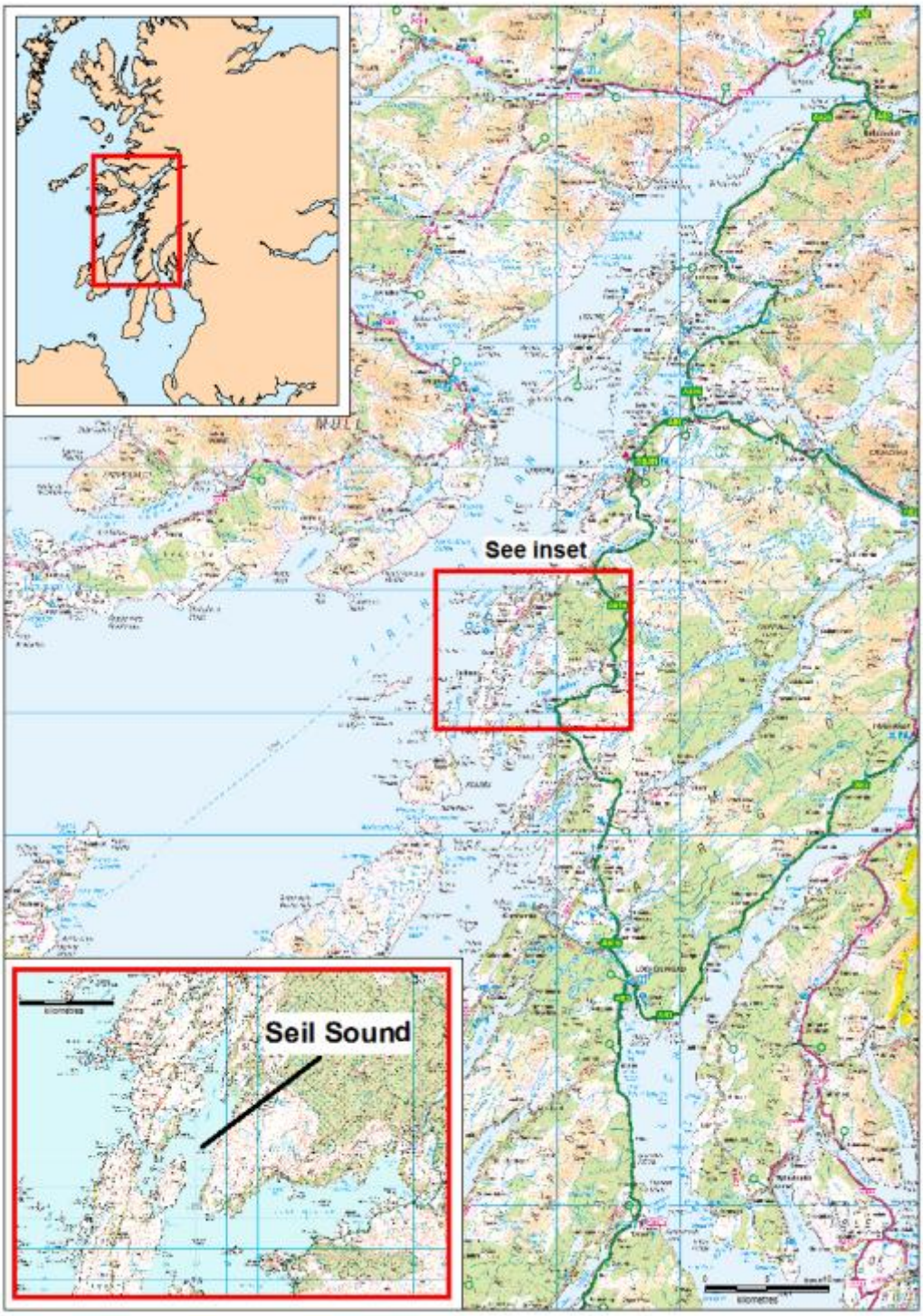

Figure 1.1 Location of Seil Sound

There are currently five classified sites in three production areas within Seil Sound. The 2009 sanitary survey report also included details on fisheries in the Seil Sound: Kilbrandon production area which was declassified in April 2011 and will not be

considered in this review. Details of the five presently classified fisheries are listed in Table 1.1.

Table 1.1 Currently classified fisheries in Seil Sound

Production area	Site	SIN	Species	RMP
Seil Sound: East	East of Balvicar	AB-247-703-08	Common mussels	NM 7780 1659
Seil Sound: North	Ardshellach	AB-247-071-13	Pacific oysters	NM 7760 1726
	Balvicar North	AB-247-735-13		
Seil Sound: Balvicar	Balvicar	AB-247-072-13		NM 7723 1643
	Rubha nan Ron South	AB-247-728-13		

The production area boundaries are defined as follows:

Seil Sound: East - Area bounded by lines drawn between NM 7804 1711 and NM 7769 1710 and between NM 7769 1710 and NM 7770 1652 and between NM 7770 1652 and NM 7790 1653 extending to MHWS.

Seil Sound: North - Area bounded by lines drawn between NM 7793 1831 to NM 7812 1831 and between NM 7753 1761 and NM 7754 1716 and between NM 7760 1711 and NM 7804 1711 extending to MHWS.

Seil Sound: Balvicar - Area bounded by lines drawn between NM 7716 1680 and NM 7745 1680 and between NM 7745 1680 and NM 7745 1554 and between NM 7745 1554 and NM 7727 1554 extending to MHWS.

The production areas for all three areas are as recommended in the 2009 sanitary survey report. The RMPs for Seil Sound: East and Seil Sound: North are also as recommended in the 2009 sanitary survey report. The RMP recommended for the Seil Sound: Balvicar production area in that report was located at NM 7725 1612 (on the Balvicar (Caledonian) site) while the location given in the 2014/15 classification listing is at NM 7723 1643 (on the Rubha nan Ron South site). The RMP location was changed to the Rubha nan Ron South site in May 2012 as FSAS were advised by the local authority that there was no stock on the other site.

The 2014/15 classified production area boundaries and RMPs, along with the 2008 and 2014 shoreline survey fishery observations are displayed in Figure 1.2 and 1.3.

The observations noted at the Seil Sound sites during the 2014 shoreline survey are:

Seil Sound: East

The East of Balvicar common mussel fishery has decreased in size from two long-lines to one and no rafts were present. The RMP position noted during the shoreline survey lies at the southern extent of the current site location and within 30 m of the

RMP location identified by FSAS. The reported dropper length was between 8 and 10 metres. At the time of the shoreline survey visit, no harvestable stock was available and no harvesting was planned.

Seil Sound: North

- The Ardshellach oyster site consisted of one trestle area, with at least fifteen banks of stocked trestles located at the northeastern end of the sound. Part of the array was submerged at the time of the 2014 shoreline survey

- The Eilean Tornal oyster site consisted of two trestle areas, both on the northeast side of the island. The more northerly area consisted of approximately 17 trestles and the more southerly area consisted of 14 lines of trestles. There was little stock at either trestle area.

- The Craig Ulian oyster site consisted of six rows of bare trestles with no stock or bags present.

Harvesting at Seil Sound: North is carried out year-round and there are plans to expand oyster cultivation in this production area in the future.

Seil Sound: Balvicar

- The Rubha nan Ron South oyster site still consisted of two trestle areas; a southern area containing 27 rows of trestles and a northern site which consisted of two trestles to the east of Balvicar boatyard. The harvester (Mr Robertson) noted that there had been poor growth at the Balvicar boatyard site. He reported no plans to further extend either site.

- The Balvicar oyster farm now consists of only one area of empty trestles located in a small embayment north of Rubha na Gaoithe and due east of Balvicar Farm. In the 2008 survey this site was not stocked and was reported to have been inactive for over a year. During the 2014 survey it was noted that the trestles were empty. The shoreline survey team were informed that the site had not been active for a couple of years. No further information on activity at this site was obtained. No evidence was found of the Balvicar (Caledonian) site.

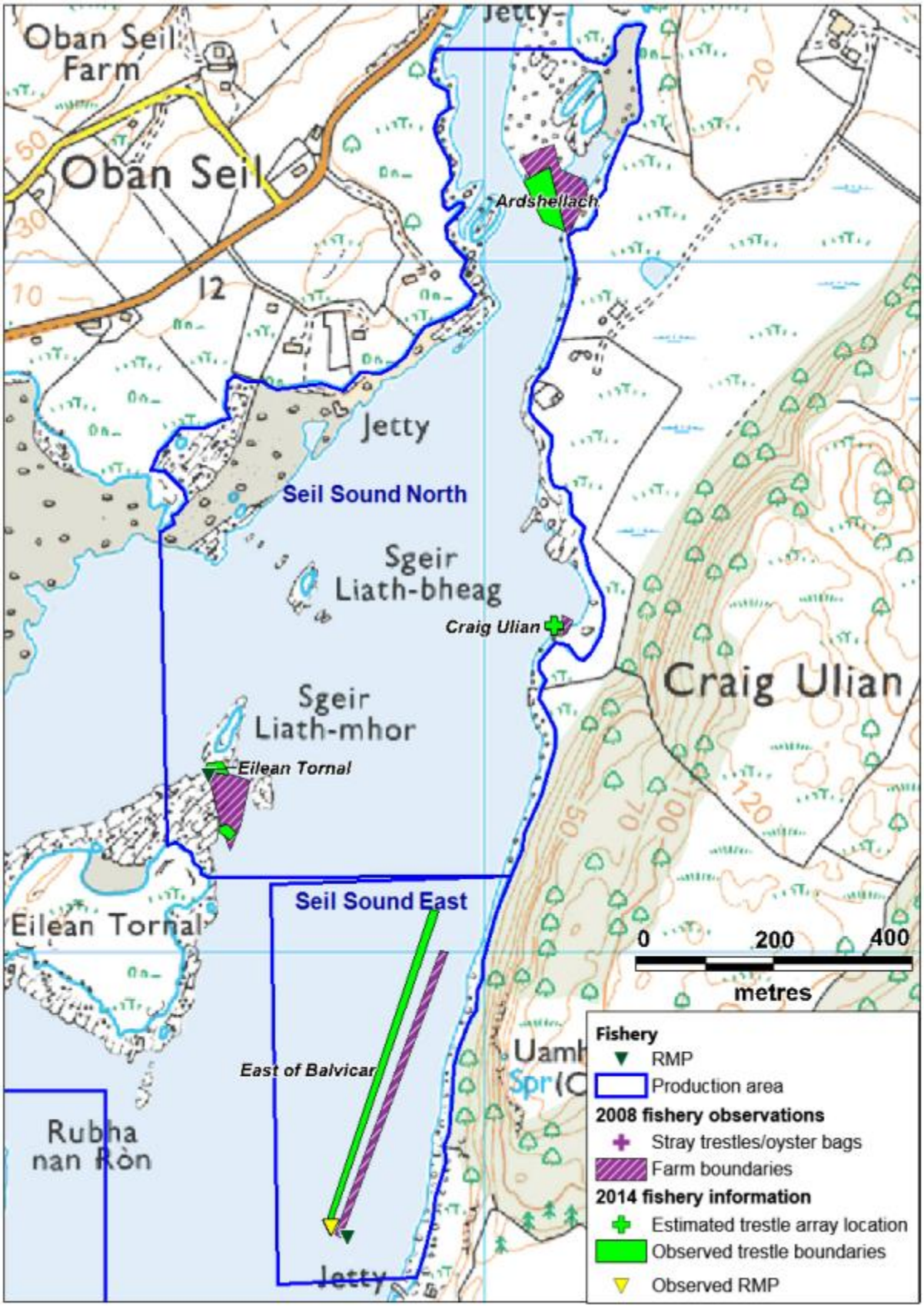

Figure 1.2 Seil Sound North and Seil Sound East fisheries

Figure 1.3 Seil Sound: Balvicar fisheries

2. Population and Human Sewage Impacts

2.1 Population

Figure 2.1 shows the distribution of population and related shoreline survey observations around Seil Sound.

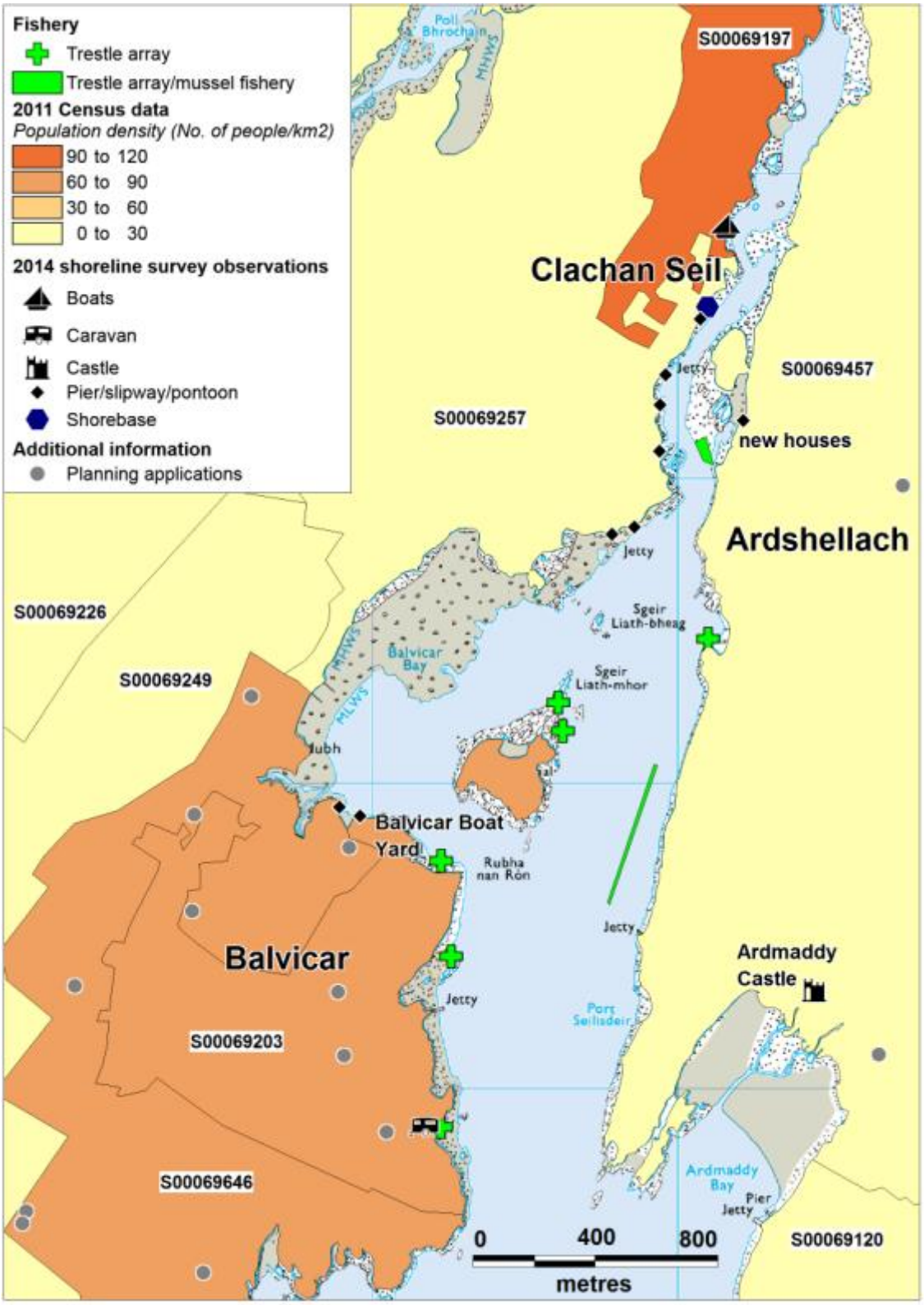

Figure 2.1 Current distribution of human population around Seil Sound

Population data from the General Register Office for Scotland from both the 2001 and 2011 censuses are shown in Table 2.1. It should be noted that the number of output areas and the boundaries of some of the areas changed between the two censuses and it is therefore not valid to directly compare the population values for the output areas for the two censuses.

Table 2.1 Scottish Government Census data for years 2001 and 2011

2001 Census data		**2011 Census data**	
Output area	**Population**	**Output area**	**Population**
60QD000080	98	S00069197	109
60QD000079	105	S00069257	88
60QD000078	112	S00069249	72
60QD000077	144	S00069203	79
		S00069649	109
60QD000081	125	S00069457	117
60QD000070	109	S00069120	57
Total	693	***Total***	631

The population density remains highest around the villages of Clachan Seil and Balvicar and low, or relatively low, in the areas outside these villages.

The area remains a popular tourist destination, with visitor numbers still expected to peak in the summer months. Guest house accommodation is concentrated in the Clachan Seil area, although during the 2014 survey chalets were noted adjacent to the Rubha nan Ron South site. These chalets were reportedly now in constant use suggesting residential use. No caravan or camping sites were observed during the 2014 survey, though a caravan was noted approximately 100 m inshore from the Balvicar site.

Since the 2009 report, 13 planning applications pertaining to new dwelling houses in areas around Seil Sound were submitted to Argyll & Bute Council. These were downloaded from the Argyll and Bute Council Planning Portal in December 2014 (Argyll & Bute Council, 2014). A summary of these applications can be found in Appendix 1. Where the NGRs for the proposed development locations were not specified on the application forms, they have been inferred from the accompanying OS maps. The locations are displayed in Figure 2.1.

The majority of the applications were for developments to be located on the west side of the sound in the Balvicar area. Five of those applications identified the intention to use an existing sewer connection, two to use an existing septic tank (ST) connection and four to install new STs to soakaway. Two of the latter applications were locations on land within 300 m of the Rubha nan Ron South and Balvicar sites. These STs may therefore have the potential to impact these sites if the STs malfunction.

Two applications were for locations on the east side of the sound: one at Ardshellach and one at Ardmaddy Bay. Both applications identified the intention to install new STs to soakaways. Neither was for a location close to any of the shellfish sites.

During the 2014 shoreline survey a small group of new build houses was observed adjacent to the Ardshellach site on the east coast of the sound. The surveyors were unable to determine whether the group comprised four houses or three houses and a garage. No planning applications were returned for this area and these houses were not identified during the 2008 shoreline survey. These houses are anticipated to have private sewage facilities as they are not within the vicinity of the public sewage network. They therefore represent a potentially significant source of contamination for the Ardshellach site with the actual risk dependent on the discharge arrangements.

There are moderate levels of boating activity in the Seil Sound area. The majority of boats continue to be located in the Clachan Seil and Balvicar areas. During the 2014 shoreline survey, 42 moorings were seen at Balvicar boat yard: 30 boats were present on these at the time. A small number of moored boats and some private pontoons at were seen at Clachan Seil on the western shoreline. The Seil Sound East shore-base and Sealife Adventure base with its charter boat were also located in that area. Two private jetties were seen on the eastern side of the sound: one at Ardshellach and the other adjacent a holiday house south of the mussel farm.

2.2 Sewage Discharges

The 2009 report included information on upgrades to Scottish Water community sewage assets in Seil Sound. The upgrades aimed to vastly improve the bacteriological water quality within Seil Sound, which had previously suffered from multiple primary treated sewage inputs. The upgrades included the creation of a single tertiary waste water treatment works (WwTW), located at the northern end of Balvicar Bay. Six pumping stations (PS) with emergency overflow (EO) facilities were also planned: four in Clachan, two in Balvicar. Finally a combined sewage outfall (CSO), with a low predicted spill frequency and spill volume (1.6 per year; 17.2 m^3 per year), would be located at the new WwTW. These upgrades were expected to lead to an overall decrease in contamination levels at most of the shellfish sites. However, the 2009 sanitary survey report concluded that the Eilean Tornal site would be expected to experience localised impacts owing to its proximity (approximately 300 m) to the WwTW outfall and the associated CSO. The upgrades were largely completed when a further site assessment of Seil Sound was undertaken in June 2009. Information on Scottish Water discharges and SEPA discharge consents can be found in Appendix 2.

Additional information on the Balvicar WwTW was obtained from the shellfish growing waters report (SEPA, 2010). The report indicated the WwTW has a population equivalent (PE) of 500 and gave a slightly different discharge location (NM 7742 1748), compared to that given by Scottish Water(NM 7740 1747). An

internet search identified no further information rregarding the performance of the new WwTW or the spill frequency of the associated CSO.

Although a large number of private discharges were observed around Seil Sound during the 2008 shoreline survey, the 2009 sanitary survey report identified that most homes in the area were connected to the upgraded sewage network.

Sewage related observations made during the 2014 shoreline survey are listed in Table 2.2, with their locations displayed in Figure 2.2.

Table 2.2 Sewage discharge-related observations around Seil Sound from the 2014 shoreline survey

No	NGR	Description
1	NM 7813 1884	Brookside pumping station
2	NM 7816 1880	Cast iron outfall pipe about 200 mm diameter, end submerged.
3	NM 7816 1868	Plastic outfall pipe with end blocked by mud. No visible flow evidence.
4	NM 7813 1862	Vent pipes and septic tank in garden ground beyond.
5	NM 7810 1857	Unplanned freshwater (contaminated) sample from 150 mm diameter pipe. The pipe was old and the team considered it was possibly an outfall pipe. Flow 1.5 litre/min measured with jug. SSFW6 result of <1000 *E. coli* cfu/100 ml.
6	NM 7797 1797	Ceramic outfall pipe, broken, freshwater sample taken and marked as contaminated. Appearing to drain from property above. Some smell. Water sample result of 1,000,000 *E. coli* fu/100 ml
7	NM 7779 1782	New pontoon pier. Adjacent outfall pipe encased in concrete with pipe not visible and end submerged. Offshore nearby outfall with yellow marker cross symbol, possibly associated the concrete encased outfall observed.
8	NM 7708 1775	Balvicar Bay Waste Water Treatment Plant (outfall into the middle of the bay).
9	NM 7648 1698	Scottish Water box opposite Balvicar shop.
10	NM 7660 1698	Manhole cover with concrete outfall pipe below with end submerged in pond outflow. No audible flow.
11	NM 7677 1692	Cast iron outfall pipe 150 mm diameter. Probably not in use - barnacles growing on the inside.
12	NM 7676 1683	Scottish Water pumping station across the single track roadway above.
13	NM 7685 1696	Plastic outfall pipe with no flow. Possibly not in use – barnacles growing inside.
14	NM 7718 1617	Outfall pipe of standard 100 mm diameter plastic soil drain. Water sample result of <1000 *E. coli* cfu/100 ml.
15	NM 7789 1652	Plastic outfall pipe from holiday house. Water sample result of 200,000 *E. coli* cfu/100 ml.

The majority of sewage- related observations made during the 2014 shoreline survey were in the Clachan Seil and Balvicar areas and were associated with the sewage network: Brookside PS (waypoint 1&2), Clachan Seil South PS (waypoint 5), Balvicar Post Office PS (waypoint 9), and Balvicar PS (waypoint 11&12). Balvicar WwTW was observed on the shore adjacent to the outfall location given by Scottish Water.

A pipe from a holiday house located on the eastern shoreline of the sound near the southern end of the mussel farm was discharging at the time of the shoreline survey and an effluentsample gave a result of 200,000 *E. coli* cfu/100 ml. A pipe located on the western shore of the sound, approximately 145 m southwest of the Ardshellach oyster site, was discharging at the time of the shoreline survey and a sample of the effluent gave a result of 1,000,000 *E. coli* cfu/100 ml. Both results indicate a high level of faecal contamination: however the low flow rates mean that the *E. coli* loadings will be correspondingly small and any impact on water quality will be very localised.

Subsequent to the shoreline survey site visit, the survey team was informed by a local resident that four houses at NM 7823 1912, on the west shore of the upper sound, were not connected to the Scottish Water system due to a way-leave dispute, and had a sewage outfall to the sound at NM 7832 1908.

Conclusions

Human population and boating activity remains concentrated around the villages of Balvicar and Clachan Seil. Visitors numbers as well as boating activity are still expected to peak in summer. A slight increase in population was noted in the Balvicar area, which was the area identified in the majority of new build housing applications. A small group of new build houses were also observed at Ardshellach: these were not identified in planning application searches.

Significantly fewer private sewage inputs enter Seil Sound since upgrades to the sewage network were completed in June 2009. No additional information has been found on the performance of the sewage network and so it is not known whether the predicted low spill frequency and volume for the WwTW CSO has been achieved. Small, private sewage discharges remain at the upper end of the sound, at Oban Seil and at Balvicar. A contaminated discharge was observed at the shore in the vicinity of the southern end of the mussel lines.

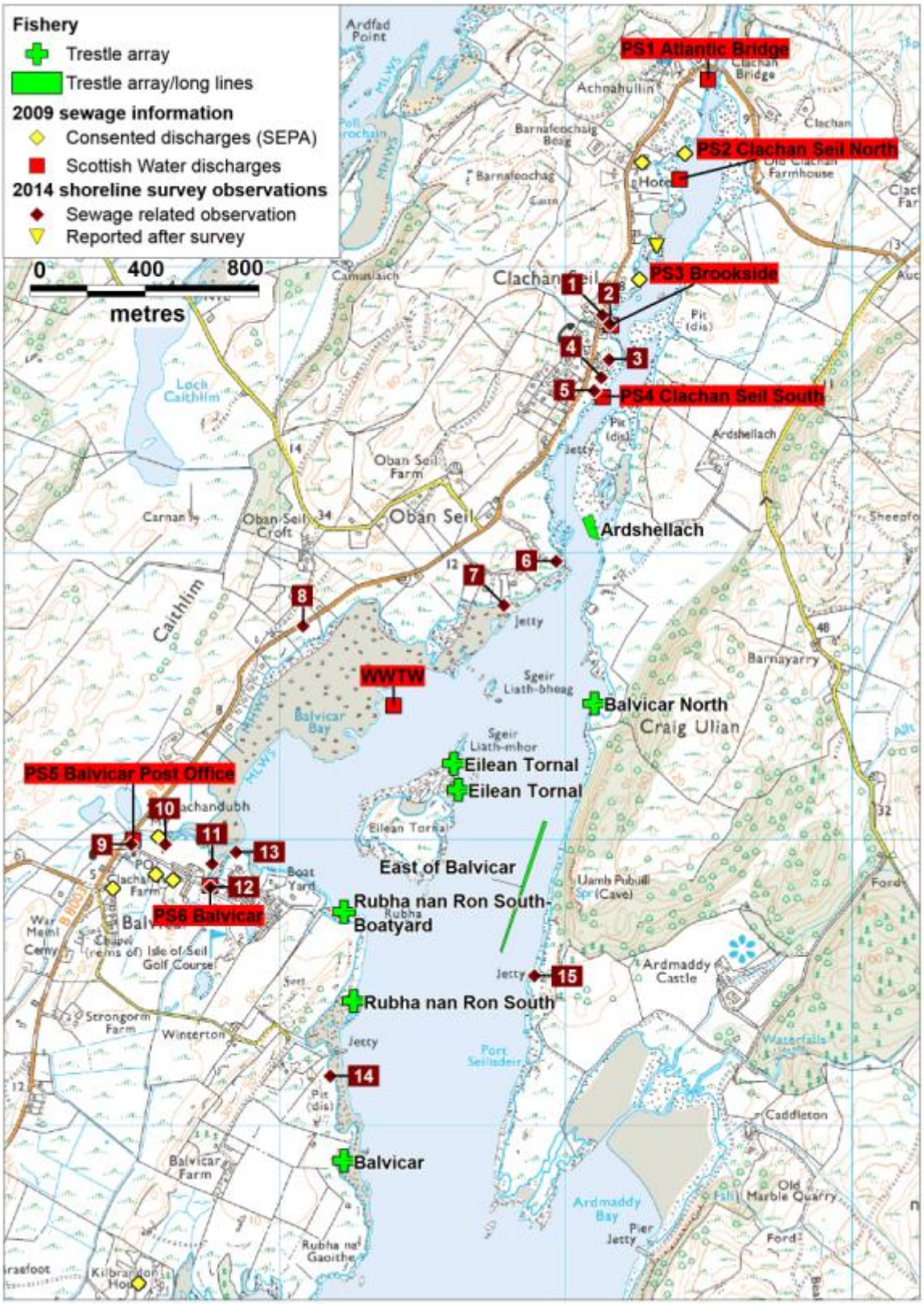

Figure 2.2 Map of sewage discharges in the Seil Sound area

3. Farm Animal Population and Agricultural Impacts

Farm census data was provided by Scottish Government in support of the 2009 sanitary survey report. This indicated that the Kilbrandon & Kilchattan and the Kilninver & Kilmelford parishes were dominated by sheep and cattle farming. This was supported by observations made during the August 2008 shoreline survey, during which large numbers of sheep and cattle were noted on pasture land around the sound. Livestock were particularly concentrated at Balvicar Farm, Craig Ulian and Ardmaddy Bay. It was anticipated that the Balvicar site would experience high levels of inputs from sheep kept on adjacent land and accessing the shoreline around Balvicar Farm, whilst the Craig Ulian site would be impacted from cattle reared on land directly east of there. These animals also had access to the shoreline.

Updated farm census data is not requested for sanitary survey reviews. Additional information for this review has t been obtained through the 2014 shoreline survey and internet searches. Shoreline survey observations only relate to the time of the survey undertaken on the 6th and 8th October 2014: a summary of the observations is displayed in Figure 3.1.

The 2014 shoreline survey noted that livestock (sheep and cattle) were concentrated on the southwestern side of the sound at Balvicar Farm and on the southeastern side around Ardmaddy Bay. Evidence of cattle was also noted on land near the Craig Ulian site. Two small herds of cattle in fields were also observed; one at Oban-Seil and one at Ardshellach. The presence of other working farms was also noted (see Figure 3.1).

Information obtained through an internet search identified that Balvicar Farm is now a free range chicken farm, with small numbers of sheep and cattle also kept on the farm (Argyll Eggs & Balvicar Farm, 2015). Information from the OS map and satellite imagery (Bing, 2014) also indicates a number of other farms in the area. The locations of the farms are displayed in Figure 3.1.

Conclusion

Sheep and cattle remain significant potential sources of faecal contamination to the sound. These are likely to have the greatest impact on the oysters located on the western and eastern shores of the sound. Contamination from livestock kept near Ardmaddy Castle may also impact on the southern end of the mussel lines in Seil Sound: East.

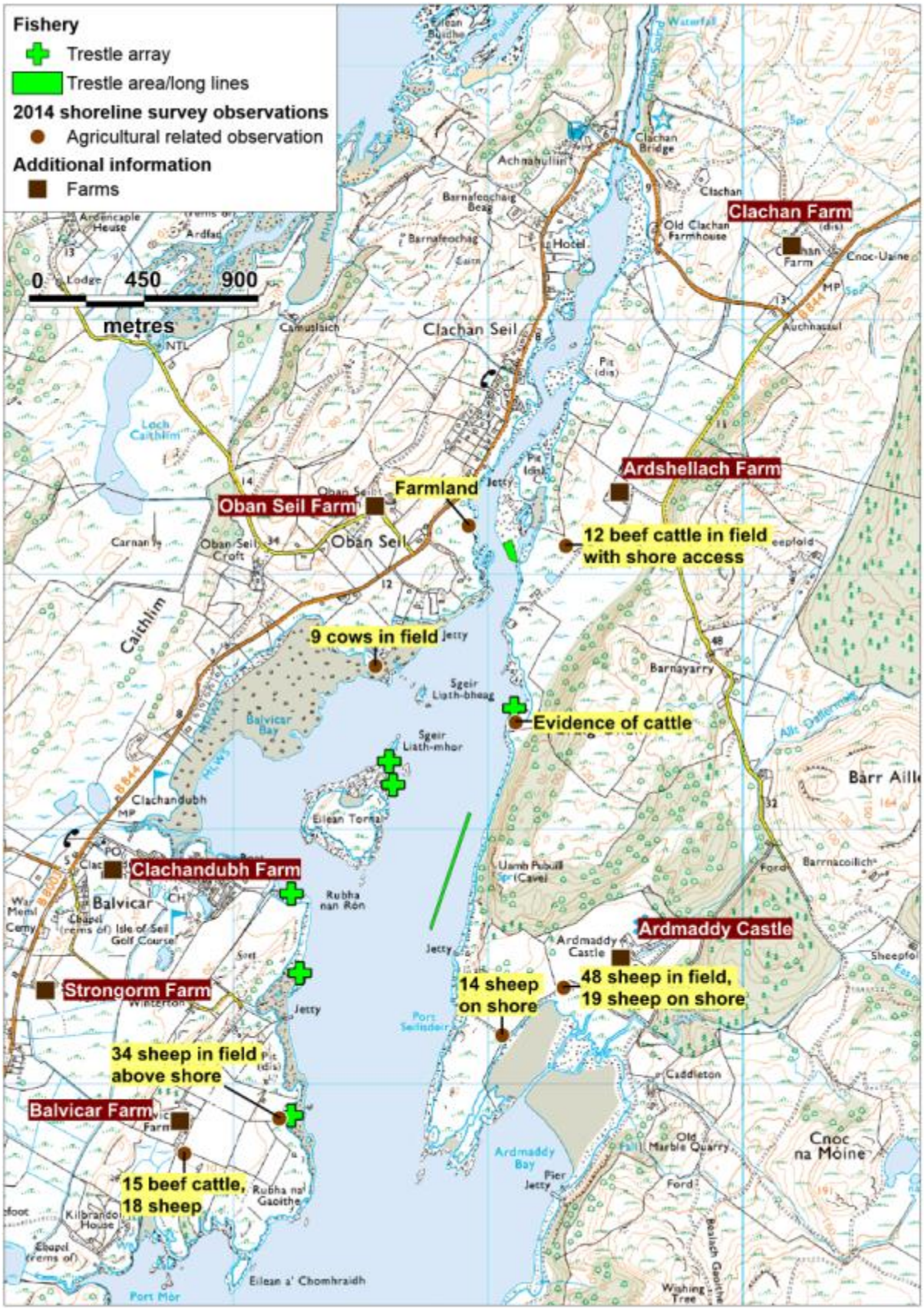

Figure 3.1 Map of farm animal - associated observations made during the 2014 shoreline survey

4. Wildlife

The 2009 report concluded that seals, waterfowl, seabirds, otters and deer may contribute to faecal contamination at the fisheries. Specifically, the seal haul out site to the north was expected to impact Eilean Tornal site, whilst large numbers of geese around Balvicar Farm, Balvicar golf course and Ardshellach were anticipated to impact Balvicar, Rubha nan Ron South and Ardshellach sites.

For this review, information on pollution sources from wildlife has been obtained from JNCC dataset, through a shoreline survey conducted in 2014, and through a desk-based internet search undertaken for this review. Shoreline survey observation information only relates to the time of the survey undertaken on the 6th and 8th October 2014 and is displayed in Figure 4.1.

Pinnipeds

The Special Committee on Seals report (Special Committee on Seals, 2013) identified that approximately 100 harbour seals had been recorded within a 10 km grid containing Seil Sound. The data was based on August surveys undertaken between 2007 and 2011. Comparatively only five grey seals were noted within a 10 km radius to the south of Seil Sound. There are also anecdotal accounts of seals in Seil Sound (Atlantic Bay Cottages, 2015), but no further information on haul outs within the sound was found. No seals were observed during the 2014 shoreline survey.

Cetaceans

Since the 2009 sanitary survey report, there have been two recorded sightings of cetaceans at Seil Island: three harbour porpoise in 2014 and two unidentified dolphins in 2013 (Hebridean Whale and Dolphin Trust, 2015). It is unclear whether these sightings were made in Seil Sound or on the west side of the island in the Sound of Insh. Anecdotal accounts state that dolphins have been observed in Seil Sound (Argyll Eggs & Balvicar Farm, 2015). No cetaceans were observed during the 2014 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 to the 5 km area around the fisheries are listed in Table 4.1.

Table 4.1 JNCC seabird data around 5 km of Seil Sound fisheries

Common name	Species name	Count*	Qualifier	Accuracy
Common Gull	*Larus canus*	66	Occupied nests and territory	1 accurate, 1 unknown, 3 estimates
Black-Headed Gull	*Chroicocephalus ridibundus*	16	Occupied nests	Unknown
Lesser Black-Backed Gull	*Larus fuscus*	8	Occupied nests	Unknown
Herring Gull	*Larus argentatus*	56	Occupied nests and territory	4 accurate, 1 unknown, 1 estimate
Great Black-Backed Gull	*Larus marinus*	8	Occupied nests	1 accurate, 3 unknown
Black Guillemot	*Cepphus grylle*	2	Individuals on land	Accurate
Shag	*Phalacrocorax aristotelis*	130	Occupied nests	Accurate
Common Tern	*Sterna hirundo*	4	Occupied territory	Unknown
Arctic Tern	*Sterna paradisaea*	90	Occupied territory and nests	1 unknown, 1 accurate

*Counts for occupied nests, sites and territory were doubled, with total counts given using adjusted data.

The JNCC dataset indicates that there are no seabird colonies within the immediate areas around the Seil Sound fisheries. A moderate sized shag and herring gull breeding colony was located approximately 2.5 km northwest of Seil Sound, close to Sloc nan Scarbh on the Sound of Insh. Birds from that colony are not expected to impact significantly on the shellfish sites within Seil Sound.

Birds were the most common wildlife observed during the 2014 shoreline survey. Species included oystercatcher, gulls, heron, rock pipit, herring gull, shags, greater black backed gulls and ravens. All birds were present in low numbers. Shag and greater black backed gulls were noted at the southern extent of the Seil Sound East mussel site.

Otters

Anecdotal accounts indicate that otters reside within Seil Sound (Argyll Eggs & Balvicar Farm, 2015), though there remains a lack of accurate reports on numbers of otters in the area. Several otter trails were noted just north of the Ardshellach site during the 2014 shoreline survey.

Deer

No new information on deer numbers around Seil Sound was found during internet searches undertaken for this review.

Conclusion

The main wildlife sources of contamination will continue to come from seals, birds and deer. Small levels of contamination from otters are expected at the Ardshellach

site. Contamination inputs from wildlife are expected to remain largely unpredictable and relatively minor compared to other inputs.

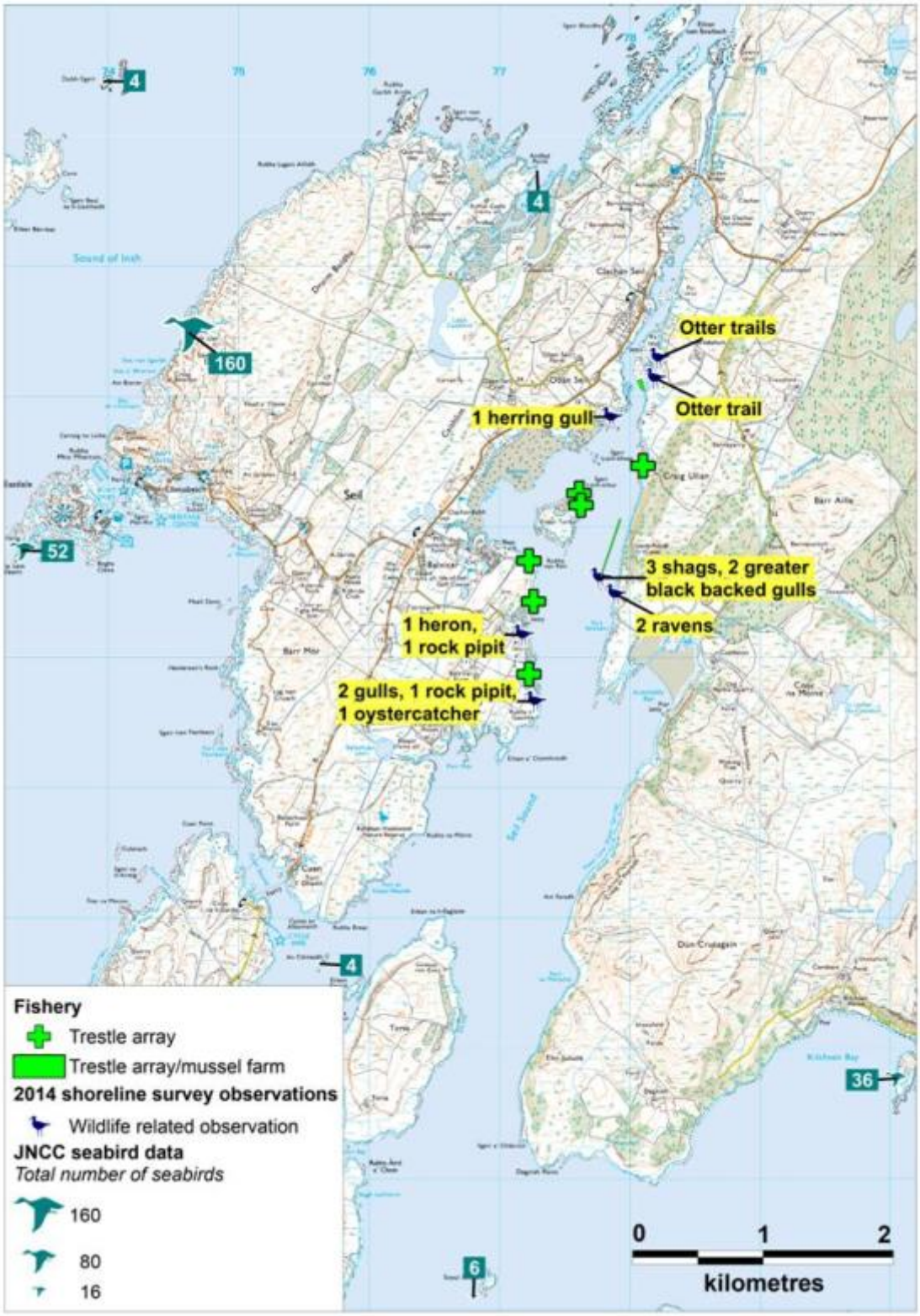

Figure 4.1 Map of wildlife around Seil Sound

5. Watercourses

The 2009 shoreline survey report concluded that loadings from watercourses estimated from shoreline survey measurements were moderate to high and that the watercourse inputs were concentrated around Ardmaddy Bay and Clachan Sound with some inputs to Balvicar Bay and at Kilbrandon.

There are no gauging stations on watercourses that enter into the Seil Sound area. There is a 100 kW hydropower scheme located in Ardmaddy on the Eas nan Ceardach (Adrian Laycock Ltd, 2015). Flow data was requested but was not returned before the drafting of this review.

Weather conditions during the two shoreline surveys were as follows:

2008: overcast, with rain on the second day of sampling.

2014: heavy rain fell in the 48 hours prior to the survey, with rain also reported on the first survey day. The second survey day was dry.

A comparison of watercourse loadings estimated on the basis of the 2008 and 2014 shoreline survey measurements and *E. coli* concentrations are displayed in Table 5.1. In total 15 watercourses were measured and sampled in the 2008 survey, four of which were re-sampled in 2014. Sample loadings from the 2014 survey are displayed in Figure 5.1. A full list of recorded flow measurements and sample results from the 2014 shoreline survey can be found in Appendix 2.

Table 5.1 Watercourse loadings to Seil Sound taken during the 2008 and 2014 shoreline surveys

No.[1]	NGR	Description	2008 Loading (*E. coli* day)	2014 Loading (*E. coli* day)
1	NM 7669 1554	Unnamed watercourse	-	$1.8x10^{13}$
2	NM 7709 1628	Unnamed watercourse	-	$7.3x10^{10}$
3	NM 7676 1683	Unnamed watercourse	-	$1.7x10^{11}$
4	NM 7661 1699	Unnamed watercourse	$1.0x10^{12}$	$1.4x10^{12}$
5	NM 7792 1819	Unnamed watercourse	$4.5x10^{9}$	$1.9x10^{10}$
6	NM 7857 1626	Eas nan Ceardach	$3.0x10^{9}$	$5.1x10^{9}$
7	NM 7845 1632	Allt Dallermaig	$3.0x10^{11}$	$9.6x10^{10}$
N/A	NM 7816 1878	Small watercourse	$1.4x10^{10}$	Not determined
N/A	NM 7858 1597	Small watercourse	$1.3x10^{12}$	Not determined

[1] Numbers reflect numbers used in Figure 5.1 and only apply to Loadings from the 2014 survey, N/A – not applicable as an area of land drainage

Most of the loadings estimated from the 2014 shoreline survey measurements were higher than those estimated from the 2008 shoreline survey measurements. The differences are likely to relate to the higher rainfall that occurred prior to the 2014 shoreline survey.

Conclusion

Watercourses continue to be a significant source of faecal contamination to Seil Sound. Highest impacts are anticipated to remain at the Balvicar, Rubha nan Ron South and Ardshellach sites, with other watercourses in the sound contributing to background levels of contamination.

Figure 5.1 Watercourse loadings at Seil Sound estimated from the 2014 shoreline survey measurements

Where the bacterial loading is labelled on the map, the scientific notation is written in digital format, as this is the only format recognised by the mapping software. So, where normal scientific notation for 1000 is 1x103, in digital format it is written as 1E+03.

6. Meteorological data

Meteorological data had been purchased from the Meteorological Office for the survey period 01/01/2003 - 31/12/2007 for the analyses undertaken for the 2009 Seil Sound Sanitary Survey Report: rainfall box-plots and wind roses for 2003 - 2007 period are presented in that report and have not been reproduced here. Rainfall was recorded in total daily rainfall (mm) were taken from the Kimelford weather station, which lies 5 km east of the Seil Sound production area. Wind roses were also taken from the Glasgow: Bishopton weather station which lies 77 km southeast of the Seil Sound production area.

Meteorological data for this review was purchased from the Meteorological Office in April 2014 for the period 01/01/2008 - 31/11/2013. Rainfall data from Lismore; Frackersaig Farm located 28 km north of the Seil Sound production area has been used in this review. This was due to a large amount of missing data in the Kimelford dataset. However, data for Lismore Frackersaig 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.

Wind roses were provided by the Meteorological Office for the Glasgow: Bishopton weather station for the 2004-2013 period.

6.1 Rainfall

Storm events and high rainfall levels are commonly associated with increased faecal contamination of coastal waters through surface water run-off from land where livestock or wild animals are present and through sewer and waste water treatment plant (WWTP) overflows (Mallin, *et al.*, 2001): (Lee & Morgan, 2003).

The Lismore; Frackersaig Farm weather station rainfall dataset for 2008-2013 is presented by year in Figure 6.1 and by month in Figure 6.2.

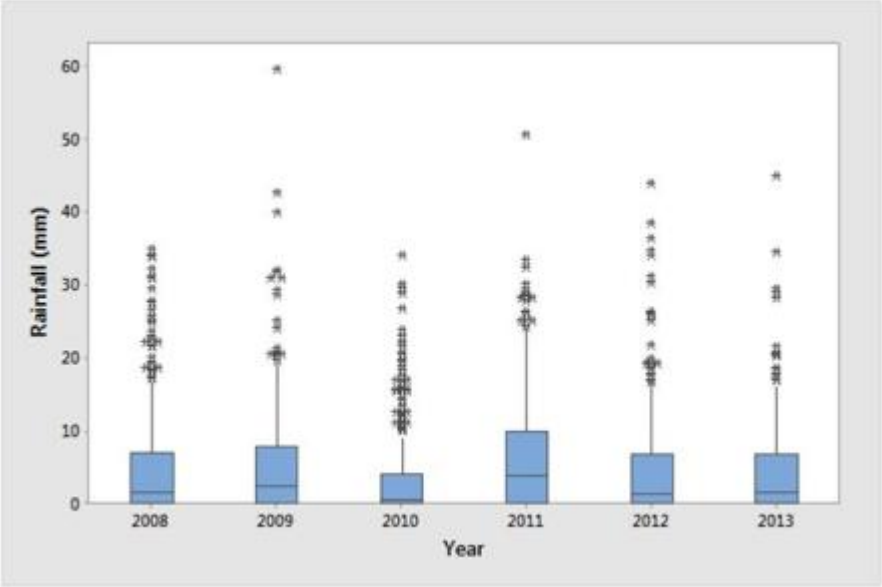

Figure 6.1 Boxplot of daily rainfall at Lismore; Frackersaig Farm (2008-2013)

Daily rainfall totals were mainly <10 mm per day. Rainfall events of >50 mm/day occurred in 2009 and 2011. Total annual rainfall was highest in 2011 (2354 mm) and lowest in 2010 (1199 mm).

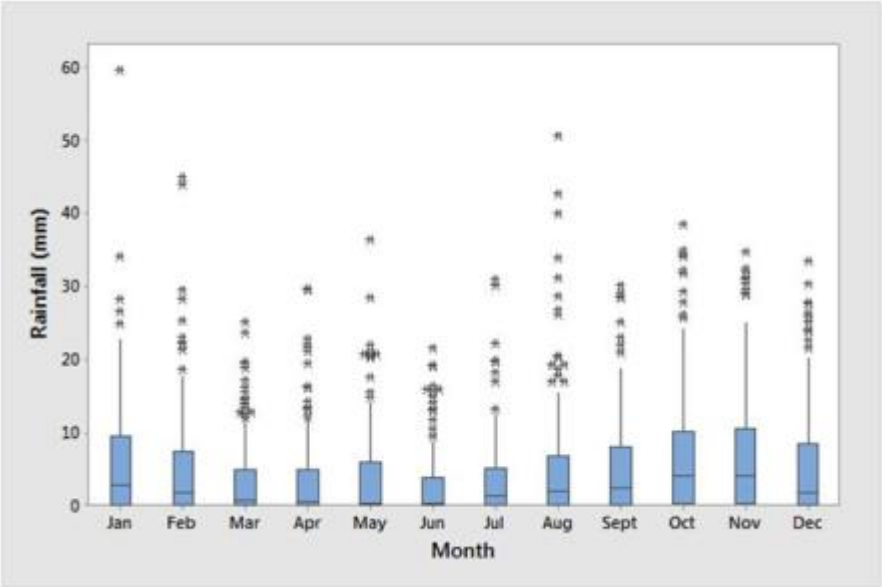

Figure 6.2 Boxplot of daily rainfall by month at Lismore; Frackersaig Farm (2008-2013)

Again the bulk of daily rainfall levels were <10 mm/day. Rainfall events of >50 mm/day were noted in January and August. Highest monthly rainfall totals occurred between from August to February. June was the driest month with a total monthly rainfall of 429 mm.

Care needs to be taken with the assessment of rainfall patterns by both year and month due to the excluded data.

6.2 Wind

Wind speed and direction drive surface water and currents that play an integral part in particulate dispersal. Winds typically drive surface water at ca. 3% of the wind speed (Brown, 1991) so a gale force wind (a minimum of 34 knots/17.2 m/s) would drive a surface water current of about 1 knot or 0.5 m/s.

Figure 6.3 shows seasonal wind roses for Bishopton: Glasgow for the period 2004-2013 while Figure 6.4 shows the annual wind rose for the same period. The local topography of Seil Sound is likely to cause a variation in wind patterns to those shown in the wind roses (Bishopton, Glasgow is located on the west coast and opens to an enclosed bay to the west, compared to Seil Sound which opens to the south and has the island of Seil to the west).

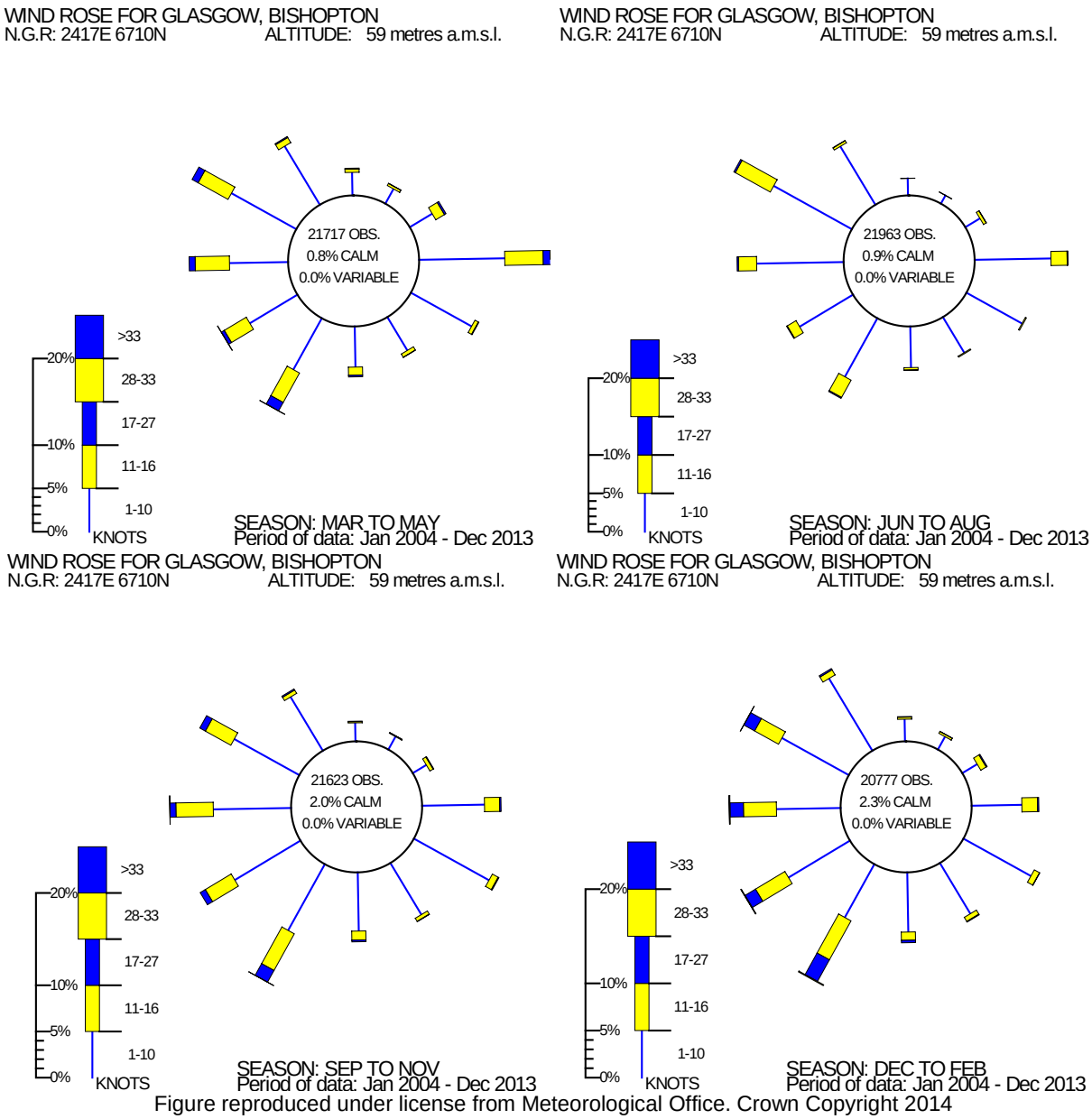

Figure 6.3 Seasonal wind roses for Glasgow: Bishopton (2004-2013)

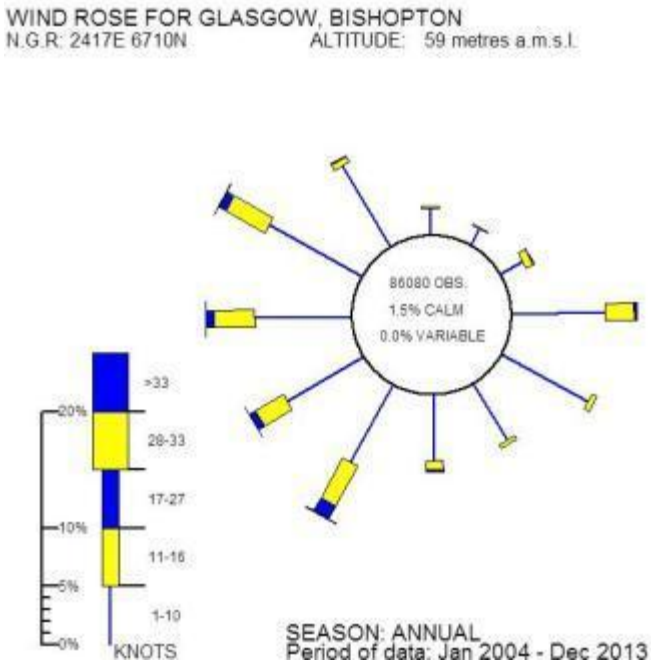

Figure 6.4 Annual wind rose for Glasgow: Bishopton (2004-2013)

Prevailing winds continue to come from the west (between south-southwest and west-northwest). Winds also arise from an easterly direction, mainly during the spring. Winds are strongest during the winter months and weakest during summer. It should be noted that the wind direction at Glasgow: Bishopston will be affected by the orientation of the Firth of Clyde. Seil Sound has a different orientation and is more likely to be impacted by winds from south and south-westerly directions.

7. Historical *E. coli* Data

Results for the Seil Sound sites of Balvicar North (Eilean Tornal), East of Balvicar, Rubha nan Ron South and Balvicar from 01/01/2008 to 09/12/2014 were extracted from the FSAS database and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data. Data were extracted in December 2014. Historical *E. coli* data used in the 2009 report had already been extracted and validated. For the purposes of this report, results from samples pre-dating 2002 were excluded. All *E. coli* results were reported as most probable number per 100 g of shellfish flesh and intravalvular fluid.

Twenty-eight *E. coli* results were recorded as having results below the limit of detection (19,<20, or <18) and were reassigned a value of 10 *E. coli* MPN/100 g, whilst one result was recorded as >18000 and was reassigned a value of 36000 *E. coli* MPN/100 g. These changes were made for the purposes of statistical evaluation and graphical representation.

Seil Sound North (Balvicar North)

All samples were identified as valid. The reported sampling locations for two samples lay more than 100 m outside the production area boundaries and were omitted from further analysis. All remaining samples were received at the laboratory within 48 hours of collection and one sample had a box temperature of 10^{o}C.

Seil Sound East (East of Balvicar)

One sample was identified as rejected and was omitted from further analysis. The reported sampling location for one sample lay more than 100 m outside the production area boundaries and was also omitted from further analysis. All remaining samples were received at the laboratory within 48 hours of collection and one sample had a box temperature of 10^{o}C.

Seil Sound: Balvicar

Balvicar

One sample was identified as rejected and was omitted from further analysis. The remaining samples plotted within 100 m of the production area, were received within 48 hours of collection and had box temperatures of ≤8^{o}C.

Rubha nan Ron South

The reported sampling location for one sample plotted more than 100 m outside the production area boundaries and was omitted from analysis. All remaining samples were identified as valid, were received at the laboratory within 48 hours of collection and had box temperatures of ≤8^{o}C.

7.1 Summary of microbiological results

Summary results for all four sites are given in Tables 7.1 to 7.3.

Table 7.1Sampling and results summary for Seil Sound: North

Sampling Summary				
Production area	Seil Sound: North			
Site	Balvicar North			
Species	Pacific oyster			
SIN	AB-247-735-13			
Location	NM 775 173 & NM 776 171		Various	
Total no. of samples	39		67	
	2002	-	2008	11
	2003	-	2009	9
	2004	10	2010	10
	2005	12	2011	9
	2006	10	2012	8
	2007	7	2013	11
			2014	9
Results Summary				
Minimum	20		<18	
Maximum	5400		9200	
Median	700		170	
Geometric mean	507		141	
90 Percentile	1750		892	
95 Percentile	5400		1960	
No. Exceeding 230/100g	29 (74%)		19 (28%)	
No. Exceeding 1000/100g	15 (39%)		6 (9%)	
No. Exceeding 4600/100g	2 (5%)		1 (2%)	
No. Exceeding 18000/100g	0		0	

Table 7.2 Sampling and results summary for Seil Sound: East

Sampling Summary				
Production area	Seil Sound: East			
Site	East of Balvicar			
Species	Common mussels			
SIN	AB-247-703-08			
Location	NM 779 169 & NM 779 170		Various	
Total no. of samples	27		73	
	2002	-	2008	10
	2003	-	2009	12
	2004	-	2010	9
	2005	9	2011	10
	2006	11	2012	11
	2007	7	2013	10
			2014	11
Results Summary				
Minimum	20		<18	
Maximum	16000		2400	
Median	220		110	
Geometric mean	324		78	
90 Percentile	5400		478	
95 Percentile	11760		883	
No. Exceeding 230/100g	11 (41%)		12 (16%)	
No. Exceeding 1000/100g	7 (26%)		3 (4%)	
No. Exceeding 4600/100g	3 (11%)		0	
No. Exceeding 18000/100g	0		0	

Table 7.3 Sampling and results summary for sites in Seil Sound: Balvicar

Sampling Summary								
Production area	Seil Sound: Balvicar							
Site	Balvicar				Rubha nan Ron South			
Species	Pacific oysters							
SIN	AB-247-072-13				AB-247-728-13			
Location	NM 772 158 & NM 772 158		Various		NM 772 164		Various	
Total no. of samples	64		44		12		34	
	2002	12	2008	11	2002	-	2008	-
	2003	12	2009	12	2003	-	2009	-
	2004	12	2010	10	2004	-	2010	-
	2005	11	2011	11	2005	3	2011	-
	2006	9	2012	-	2006	8	2012	11
	2007	8	2013	-	2007	1	2013	12
			2014	-			2014	11
Results Summary								
Minimum	<20		<20		<20		<18	
Maximum	>18000		>18000		3500		16000	
Median	265		145		265		320	
Geometric mean	279		204		246		269	
90 Percentile	6300		3500		2930		4450	
95 Percentile	16000		13350		3500		16000	
No. Exceeding 230/100g	31 (48%)		18 (41%)		6 (50%)		18 (53%)	
No. Exceeding 1000/100g	14 (22%)		9 (21%)		3 (25%)		8 (24%)	
No. Exceeding 4600/100g	6 (9%)		3 (7%)		0		3 (9%)	
No. Exceeding 18000/100g	2 (3%)		1 (2%)		0		0	

The sampling frequency has been relatively even at all three production areas. In the Seil Sound: Balvicar production area, sampling moved from the Balvicar site to the Rubha nan Ron South site in 2012.

Results >4600 *E. coli* MPN/100 g have been seen at all sites excluding East of Balvicar. Results >18000 *E. coli* MPN/100 g were only seen at the Balvicar site. The summary statistics indicate that the extent of contamination of the shellfish at the Seil Sound: North and Seil Sound: east production areas was lower during the 2008-2014 period than from 2002-2007. No such difference was apparent at Seil Sound: Balvicar.

7.2 Geographical patterns of results

Table 7.4 contains summary statistics for 2008 to 20014 inclusive for *E. coli* results from the three production areas.

Table 7.4 Summary statistics for the *E. coli* results for the Seil Sound production areas 2008-2014

Production area	Species	No. of samples	Geometric mean	90%ile	Minimum	Maximum
Seil Sound: North	Pacific oysters	67	141	892	<18	9200
Seil Sound: East	Common mussels	73	78	478	<18	2400
Seil Sound: Balvicar	Pacific oysters	78	269	4450	<18	>18000

A comparison of the summary statistics for the three production areas indicates that the level of *E. coli* contamination in the Pacific oysters at Seil Sound: Balvicar is higher than those at Seil Sound: North and the mussels at Seil Sound: East. The three production areas had all been sampled on the same date on twenty-eight occasions since January 2008. A two-way Analysis of Variance undertaken on the $\log_{10}$-transformed *E. coli* results for those occasions showed no significant difference in mean (log-transformed) *E. coli* levels between the three production areas. The comparison of results between Seil Sound East and the other two production areas is confounded by the difference in shellfish species.

The geographical locations of samples assigned to Balvicar North and East of Balvicar and are shown in Figure 7.1and those assigned to Balvicar and Rubha nan Ron South are shown in Figure 7.2. The sizes of the symbols are shown proportional to the magnitude of the *E. coli* results.

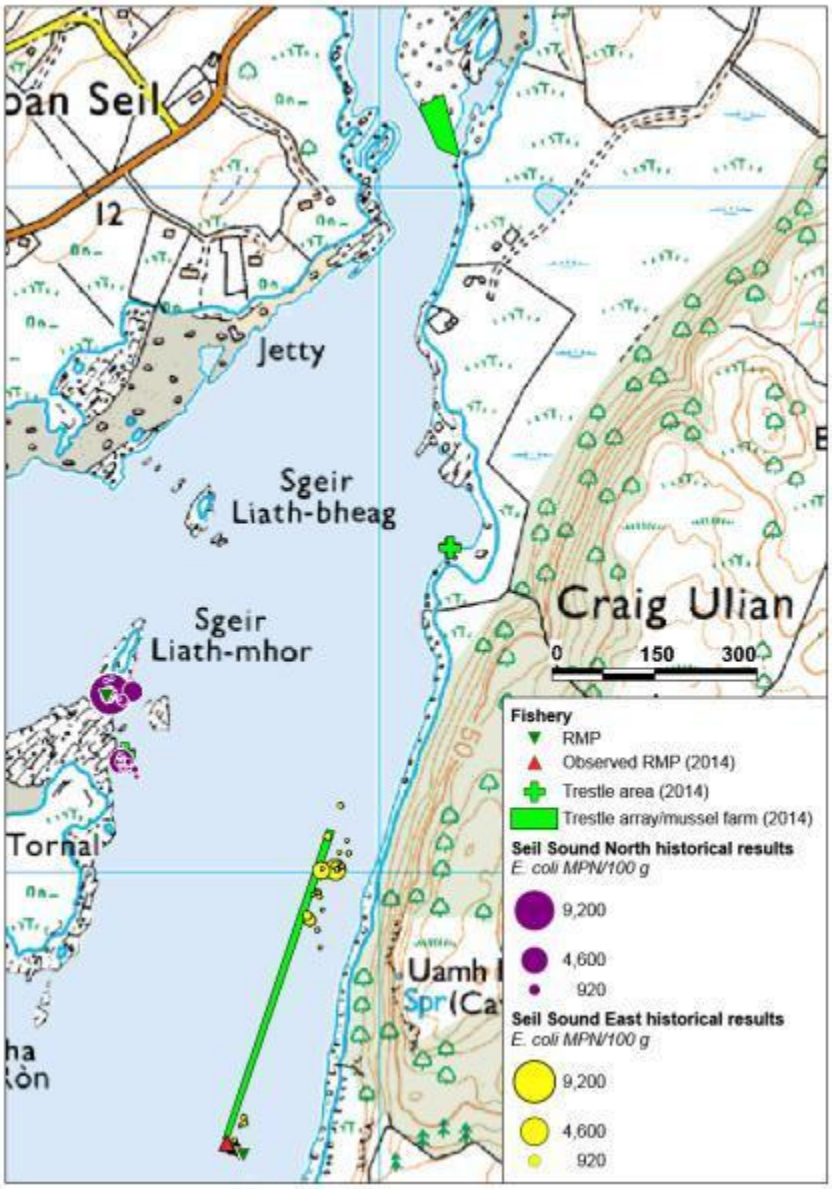

Figure 7.1 Sample results and locations of Seil Sound North and Seil Sound East

Samples assigned to the Seil Sound: North production area have been taken at two distinct areas at the Eilean Tornal site; the northern trestle area where samples taken between 2010 and 2014 plotted within 40 m of the current RMP (NM 7760 1726); and the southern trestle area where samples taken between 2008 and 2009 plotted approximately 100 m southeast of the current RMP. The highest results were seen in samples taken at the more northerly location. As those samples had been taken since the implementation of the sewage improvement scheme, it would appear that the more northerly point will still be subjected to a higher level of contamination.

Samples assigned to the East of Balvicar production area have been taken from two different parts of the mussel farm: an area at the northern extent of the site, approximately 450 m northeast of the current RMP (NM 7780 1659) and sampled predominantly in 2008 and 2009; and an area to the southern extent of the site in the proximity of the current RMP which was sampled from 2010 to 2014. The highest results were from samples taken at the northern extent of the site. However, as a

number of these were taken prior to the implementation of the sewage discharge scheme, it is not apparent whether the difference is due to location or sampling date.

Figure 7.2 Sample results and locations of Seil Sound: Balvicar production area

Sampling within the Balvicar production area has taken place at three separate locations. The Balvicar site was sampled between 2008 and 2009; the Balvicar Caledonian site was sampled between 2010 and 2011; the Rubha nan Ron South site has been sampled since 2012. There was no apparent difference in the extent of contamination between the three sites although the single result of >18000 *E. coli* MPN/100 g from this production area was seen at the Balvicar site.

7.3 Temporal patterns of results

Temporal trends for Balvicar North, East of Balvicar, Balvicar and Rubha nan Ron South are displayed in plots in Figures 7.3-7.7. The figures are fitted with lowess trend lines. These allow for locally weighted regression scatterplot smoothing. At

each point in the dataset an estimated value is fitted to a subset of the data, using weighted least squares. The approach gives more weight to points near to the x-value where the estimate is being made and less weight to points further away. In terms of the monitoring data, this means that any point on the lowess line is influenced more by the data close to it (in time) and less by the data further away. A trend line helps to highlight any apparent underlying trends or cycles.

The trends of *E. coli* sampling results for all four sites that have been sampled in Seil Sound have been analysed for the years between the previous sampling period (2002-2007; where data was available for this period) and the current sampling period (2008-2014). Temporal statistical analyses on sample results from Rubha nan Ron South were not carried out, owing to there being insufficient sample results in the 2002-2007 sampling period.

In order to test for significant differences between results in samples taken over the two periods, the following statistical analyses were carried out:

A two sample t-test (using $\log_{10}$ transformed *E. coli* data) to determine whether there was a statistically significant difference between mean *E. coli* results.

A Chi-squared test or, where applicable, a Fisher's Exact Test to test for a significant difference between the observed and expected *E. coli* results above the levels of 1000 and 4600 *E. coli* MPN/100 g from the two sampling periods. Fisher's Exact Tests were used in place of a Chi-squared test when cells had expected counts at less than five.

Balvicar North – Pacific oysters

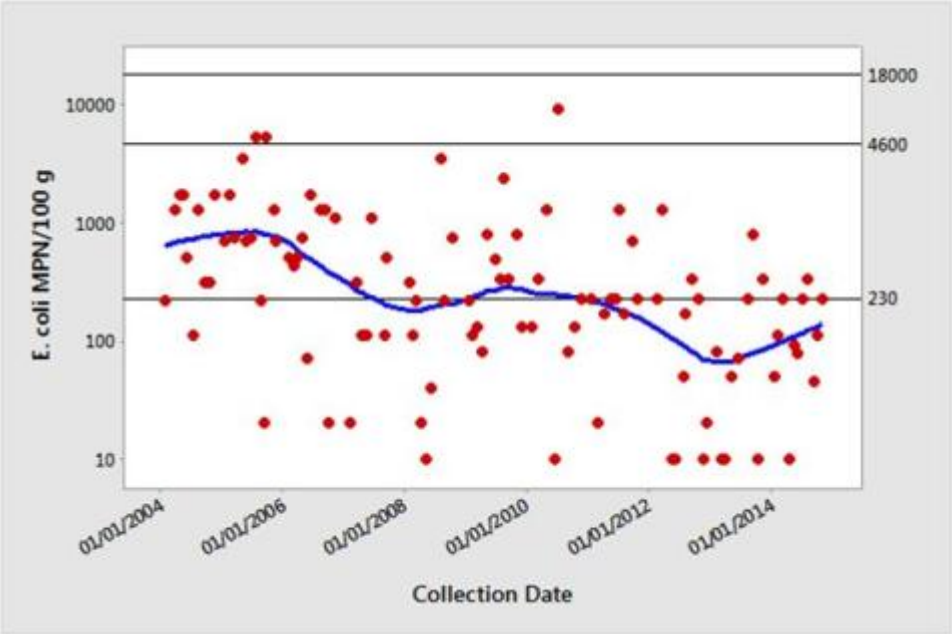

Figure 7.3 Scatterplot of Balvicar North *E. coli* results by date (2004-2014)

Contamination levels at Balvicar North decreased between 2004 and 2014, as shown by the trend-line. A very highly significant difference was found between the

mean log transformed *E. coli* results from the two survey periods (Two sample t-test, t = 4.36, DF = 85, p < 0.001).

Table 7.5 Results above and below 1000 and 4600 *E. coli* MPN/100 g at Balvicar North

		***E. coli* MPN/100g**			***E. coli* MPN/100g**		
		≤1000	>1000	**Total**	≤4600	>4600	**Total**
2001-2007	Observed	24	15	39	37	2	39
2008-2014	Observed	61	6	67	66	1	67
	Total	85	21	106	103	3	106

A very highly significant difference was found between the proportion of results ≤1000 and >1000 *E. coli* MPN/100 g from the two sampling periods (Chi squared Test, p < 0.001).

No significant difference was found between the proportion of results ≤4600 and >4600 *E. coli* MPN/100 g from the two sampling periods (Fisher's Exact Test, p = 0.55).

East of Balvicar – common mussels

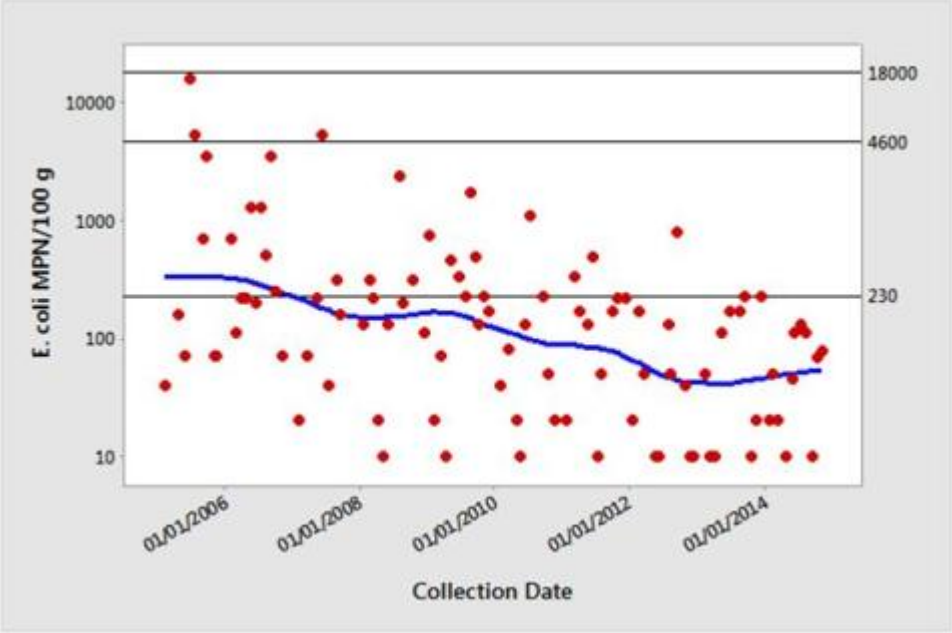

Figure 7.4 Scatterplot of East of Balvicar *E. coli* results by date (2005-2014)

Contamination levels at East of Balvicar have decreased between 2005 and 2014. A highly significant difference was found between the mean transformed *E. coli* results from the two survey periods (Two sample t-test, t = 3.80, DF = 39, p = 0.001).

Table 7.6 Results above and below 1000 and 4600 *E. coli* MPN/100 g at East of Balvicar

		***E. coli* MPN/100g**			***E. coli* MPN/100g**		
		≤1000	>1000	**Total**	≤4600	>4600	**Total**
2002-2007	Observed	20	7	27	24	3	27
2008-2014	Observed	70	3	73	73	0	73
	Total	90	10	100	97	3	100

A highly significant difference was found between the proportion of results ≤1000 and >1000 *E. coli* MPN/100 g from the two sampling periods (Fisher's Exact Test, p = 0.00).

A significant difference was found between the proportion of results ≤4600 and >4600 *E. coli* MPN/100 g from the two sampling periods (Fisher's Exact Test, p = 0.02).

Balvicar – Pacific oysters

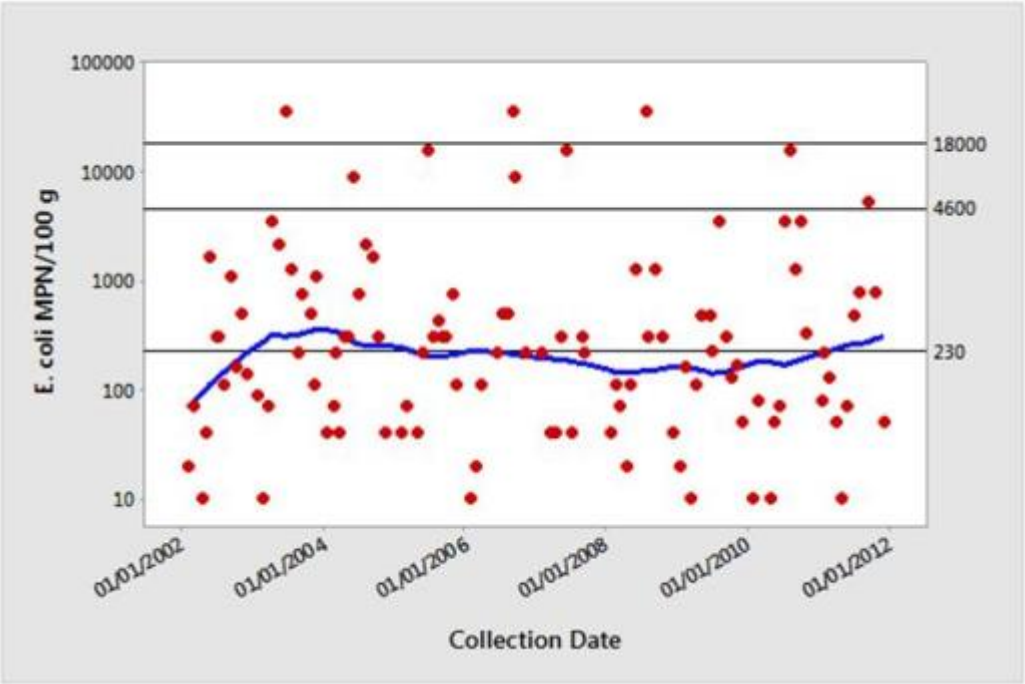

Figure 7.5 Scatterplot of Balvicar *E. coli* results by date (2002-2012)

Contamination levels at Balvicar have shown no marked change from 2002-2011.

No significant difference was found between mean log transformed *E. coli* results from the two sampling periods (Two sample t-test, t = 0.81, DF = 91, p = 0.421).

Table 7.7 Results above and below 1000 and 4600 *E. coli* MPN/100 g at Balvicar

		***E. coli* MPN/100g**			***E. coli* MPN/100g**		
		≤1000	>1000	**Total**	≤4600	>4600	**Total**
2002-2007	Observed	50	14	64	58	6	64
2008-2014	Observed	35	9	44	41	3	44
	Total	85	23	108	99	9	108

No significant difference was found between the proportion of results ≤1000 and >1000 *E. coli* MPN/100 g from the two sampling periods (Chi squared Test, p = 0.859).

No significant difference was found between the proportion of results ≤4600 and >4600 *E. coli* MPN/100 g from the two sampling periods (Fisher's Exact Test, p = 0.735).

Rubha nan Ron South – Pacific oysters

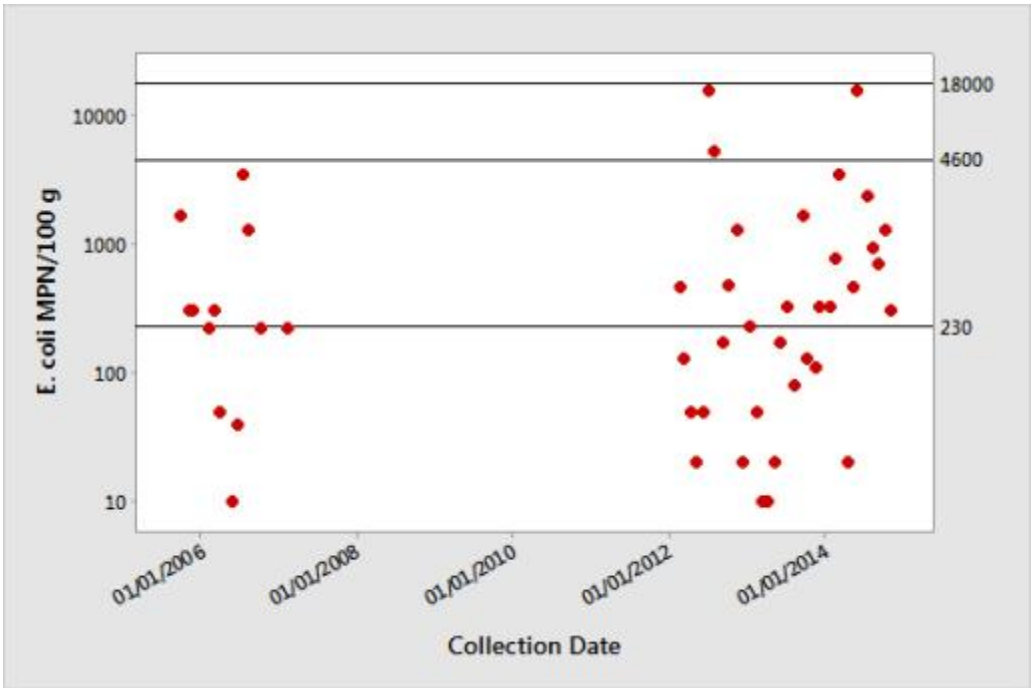

Figure 7.6 Scatterplot of Rubha nan Ron South *E. coli* results by date (2005-2014)

The long gap in sampling at this location makes it difficult to identify any trends in contamination levels. The three highest results were seen in samples taken in the summer.

Conclusions *E. coli* results at Seil Sound: Balvicar have tended to be higher than at the other two production areas, and the highest results (>18000 *E. coli* MPN/100 g) were seen at that site. However, no significant difference was found in average *E. coli* levels at the three production areas. Geographical variation within the three production areas was as follows:

Seil Sound: North – higher results were seen at the northern end of the Eilean Tornal site than at the southern end. The samples were predominantly taken at the northern end since implementation of the sewage improvement scheme and it would therefore seem that the northern part of the site will still be more contaminated.

Seil Sound: East – higher results were seen at the northern end of the mussel farm than at the southern end. However, the samples were predominantly taken at the northern end prior to the implementation of the sewage improvement scheme and it is therefore not clear whether the effect is due to spatial or temporal effects.

Seil Sound: Balvicar – There was no marked difference in the levels of *E. coli* results at the three sites although the highest result of >18,000 *E. coli* MPN/100 g was seen at the Balvicar site towards the southern end of the production area. Samples were mainly taken at the Balvicar site prior to implementation of the sewage improvement scheme

Contamination levels have decreased over time at both the Seil Sound: North and Seil Sound: East production areas. No decrease over time has been seen at the Seil Sound: Balvicar production area.

8. Movement of contaminants

A hydrographic assessment was conducted for Seil Sound in the 2009 report. The findings of that study are as follows:

- Wind direction is the main driver of particulate transport, due to relatively weak tidal currents and the open geometry of the sound.

- Without winds, tidal flows were found to lead to mainly localised transport, particularly around Balvicar North.

- During northerly, easterly or north-easterly winds an anti-clockwise gyre was predicted around Eilean Tor, causing northern particles at Balvicar Bay to impact the Balvicar and Rubha nan Ron Sound sites. There may also be some impact to the Balvicar North site.

- Winds in a southerly, westerly or south-westerly direction were predicted to cause a clockwise circulation around Eilean Tor, leading to transport of particles from sources in Balvicar Bay northwards around Eilean Tor and southwards to East of Balvicar. Under these conditions sources at the southward end of Clachan Sound also showed an impact on Balvicar North and East of Balvicar.

- Inputs at Ardmaddy Bay showed potential northward travel under south, west or south-westerly wind conditions, but did not reach the East of Balvicar site due to the clockwise gyre.

Particle transport distances obtained from modelling undertaken for that assessment were between 1 and 2 km.

Symonds (2011) reported maximum observed and modelled current speeds at Ardmaddy of approximately 0.48 m/s and 0.47 m/s respectively. These would imply a larger maximum particle transport distance over one phase of a tidal cycle (approximately 7 km) than that obtained during the modelling undertaken for the 2009 sanitary survey report.

9. Overall Assessment

This assessment considers the information obtained since the 2009 report and the potential changes in extent and location of faecal contamination.

Human sewage Impacts

Human population remains concentrated in the villages of Clachan Seil and Balvicar with the number of visitors to the area peaking over the summer. Boating activity remains significant and will also peak in summer months.

The number of private sewage discharges in the area have significantly reduced since upgrades to the community sewage system were completed in June 2009. No information was obtained on the performance of the Balvicar WwTW or on the spill frequency and volume of the associated CSO. Some private discharges are still located at the northern end of the sound, at Oban Seil and at Balvicar. In addition, there may be one or more septic tanks associated with some new build houses at Ardshellach and a discharge with a very high *E. coli* concentration was recorded on the shore near the southern end of the mussel lines.

Agricultural impacts

Contamination arising from cattle and sheep may occur at several points around the sound. No information was available on the method of disposal of waste from the chicken-rearing operation at Balvicar Farm. If this goes to land in the locality, this could pose a potential impact on water quality following rainfall.

Wildlife Impacts

Direct faecal contamination to the marine environment from wildlife is still expected to be low in comparison with that from other sources.

Seasonal Variation

There are no changes in the seasonal variation of human population, livestock or wildlife in the area. Highest rainfall levels were recorded between August and February, which would potentially cause higher levels of land runoff over that period although high rainfall events occurring during drier months could wash accumulated faecal material from the land.

Watercourses

Freshwater loading remains a significant potential source of contamination to the Balvicar (Boatyard), Rubha nan Ron South and Ardshellach sites. In addition, loadings associated with watercourses at other locations around the sound will contribute to background levels of *E. coli* within the water body. Salinity profiles taken at the mussel lines showed a small reduction of salinity at the surface of approximately 0.5 psu compared to the values obtained at depth.

Freshwater samples from watercourses had results varying between 20 and 140,000 *E. coli* cfu/100 ml. The highest result was from a sample taken from a watercourse that ran past Balvicar chalets on the southwest coastline. Four freshwater samples marked as contaminated were also taken.

Movement of contaminants

Additional analysis undertaken on the data presented in the 2009 sanitary survey report determined that expected particle transport distances over a single phase of a tidal cycle were between 1 and 2 km. However, extrapolation from data included in a published study indicated that the particle transport distance could be up to approximately 7 km.

Analysis of Results

Historical *E. coli* results

There was no significant difference between the average E. coli levels in the three productions areas although the highest result (>18000 *E. coli* MPN/100 g) was seen in the oysters at Seil Sound: Balvicar. The only marked difference in results between locations within the production areas was seen at Seil Sound: North, where the highest results from the Eilean Tornal site was associated with oyster samples reported to have been taken at the northern end of that site.

Pacific oyster results at Balvicar North and East of Balvicar have reduced over time and a significantly lower proportion of sample results of >1000 *E. coli* MPN/100 g were seen in the 2008-2014 period than prior to this. No such reduction has been seen in the Seil Sound: Balvicar production area which indicates that this may be exposed to different sources of contamination.

Shoreline Survey results

Intertidal oyster samples were taken at the Balvicar site, the northern trestle area at Eilean Tornal and the northwest extent of the Ardshellach site. Sample results were highest at Balvicar (490 *E. coli* MPN/100 g) and lowest at Ardshellach (20 *E. coli* MPN/100 g), with an intermediate result from Eilean Tornal (330 *E. coli* MPN/100 g). Three mussel samples were taken at the East of Balvicar site. Two samples from the top of the lines, taken at the northern and southern extents of the site, both returned

results of 170 *E. coli* MPN/100 g while a low result (20 *E. coli* MPN/100 g) was returned from the sample taken at 3 m depth at the southern extent of the site.

The highest results in seawater samples were from those taken at the Rubha nan Ron South and Balvicar oyster sites (5,400 and 4,200 *E. coli* cfu/100 ml respectively). A seawater sample taken at the northern end of Balvicar Bay, adjacent to a field containing cattle as well as in the vicinity of the Balvicar WwTW outfall, returned a high result of 500 *E. coli* cfu/100 ml. Other seawater samples yielded much lower E. coli results (5 to 23 *E. coli* cfu/100 ml).

Conclusions

The conclusions from the 2009 report indicated that the following were the main potential sources of faecal contamination to the fisheries in Seil Sound:

- Private sewage discharges noted outside the new sewage network to the southwest and southeast are expected to impact Balvicar, Rubha nan Ron South and the southern extent of the East of Balvicar site respectively.

- The Balvicar WwTW and CSO will cause deterioration in contamination levels at the Balvicar North (Eilean Tornal) site, which will also suffer from increases in viral contamination loading.

- High levels of boat traffic around the Balvicar and Clachan Seil areas, though their precise impacts are not known

- Agricultural inputs from the Balvicar Farm area will significantly impact the Balvicar site, with some level of impact also expected at the Craig Ulian site.

- The seal haul-out site at the Eilean Tors was anticipated to impact the wildlife impact at Balvicar North, whilst geese were expected to impact the Balvicar, Rubha nan Ron South, Ardshellach and Balvicar North sites.

- Seasonal increases in livestock will cause their impacts to increase during spring-summer. The number of human visitors to the area will peak in the summer months, whilst geese are reportedly present in highest numbers during winter. Results at Balvicar were statistically higher in summer than spring and winter, though no seasonality in results was found at any other site.

- Freshwater inputs at Ardshellach, Balvicar and Rubha nan Ron South sites.

- Wind direction is important in the movement of contaminants; otherwise weak tidal currents would cause localised contamination impacts. Winds in a west, south and south-westerly direction are expected to increase impacts at Eilean Tornal, Craig Ulian and East of Balvicar sites, whilst winds in a north, west or

north-westerly direction are expected to increase impacts at the Balvicar and Rubha nan Ron South sites, and potentially at the Balvicar North site.

Conclusions from this review are as follows:

- Balvicar WwTW and CSO are likely to contribute to continue to contribute to E. coli levels in the area.

- Private septic tank inputs at the north of the sound, in the vicinity of Oban Seil and Balvicar will cause localised contamination in the vicinity of the outputs. A pipe on the shore in the vicinity of the southern extent of the mussel lines will impact in that area although the loading may be too small to affect water quality at the lines given the depth at that location.

- Boating activity remains centred on Balvicar and Clachan Seil.

- Faecal inputs from farm animals may arise from a number of locations around the sound. The contribution of the chicken rearing operation at Balvicar is unknown as this will depend on whether the waste is disposed of locally, and in what manner.

- Faecal contributions via watercourses remain greatest in the vicinity of the Balvicar, Rubha nan Ron South and Ardshellach sites.

- There are two conflicting estimates of particle transport distance, ranging from approximately 1 to 2 km up to approximately 7 km.

- The results from the shellfish monitoring programme showed no significant difference in average *E. coli* levels between the three production areas. Contamination levels have decreased at the Seil Sound: North and Seil Sound: East production areas but not at the Seil Sound: Balvicar production area.

10. Recommendations

The conclusions of this review indicate that the three production areas are exposed to differing localised sources of contamination. It is therefore appropriate to maintain the three separate areas. The recommendations are shown in Figure 10.1.

Seil Sound: North

The present production area boundaries encompass the three separate sites and exclude major sources of contamination although do include the location of private septic tanks and watercourses. The present RMP is located at the extent of the Eilean Tornal site shown to yield higher results and thus there is no evidence to change the position.

Production area: Area bounded by lines drawn between NM 7793 1831 and NM 7812 1831 and between NM 7753 1761 and NM 7754 1716 and between NM 7760 1711 and NM 7804 1711 extending to MHWS.

RMP: NM 7760 1726.

Tolerance: 20 m to allow for some variation in location of stock available for sampling in the vicinity of the RMP.

Depth: Not applicable.

Seil Sound: East

The production area encompasses the present mussel fishery and excludes any major identified pollution sources. However, it would be appropriate to modify the boundaries slightly at the northern end so that it directly abuts the southern end of the Seil Sound: North production area. The RMP should remain at the southern end of the mussel farm but be relocated by a small distance so that it falls within the present farm boundaries. The sampling depth should be 1 m in order to reflect the higher level of contamination seen in samples taken near the surface.

Production area: The area bounded by lines drawn between NM 7804 1711 and NM 7770 1711 and between NM 7770 1711 and NM 7770 1652 and between NM 7770 1652 and NM 7790 1653 extending to MHWS.

RMP: NM 7778 1661.

Tolerance: 40 m to allow for movement of the mussel lines.

Depth: 1 m.

Seil Sound: Balvicar

The present production area boundaries include all of the current and non-operational sites and exclude major identified pollution sources. The production area

boundaries should therefore be maintained. The Rubha nan Ron South is currently the only significant site harvested within the area and, given that no marked differences in historical monitoring results were noted between sites, the RMP should be maintained at this site but moved to lie on the site.

Production area: Area bounded by lines drawn between NM 7716 1680 and NM 7745 1680 and between NM 7745 1680 and NM 7745 1554 and between NM 7745 1554 and NM 7727 1554 extending to MHWS.

RMP: NM 7726 1643.

Tolerance: 20 m to allow for some variation in location of stock available for sampling in the vicinity of the RMP.

Depth: Not applicable.

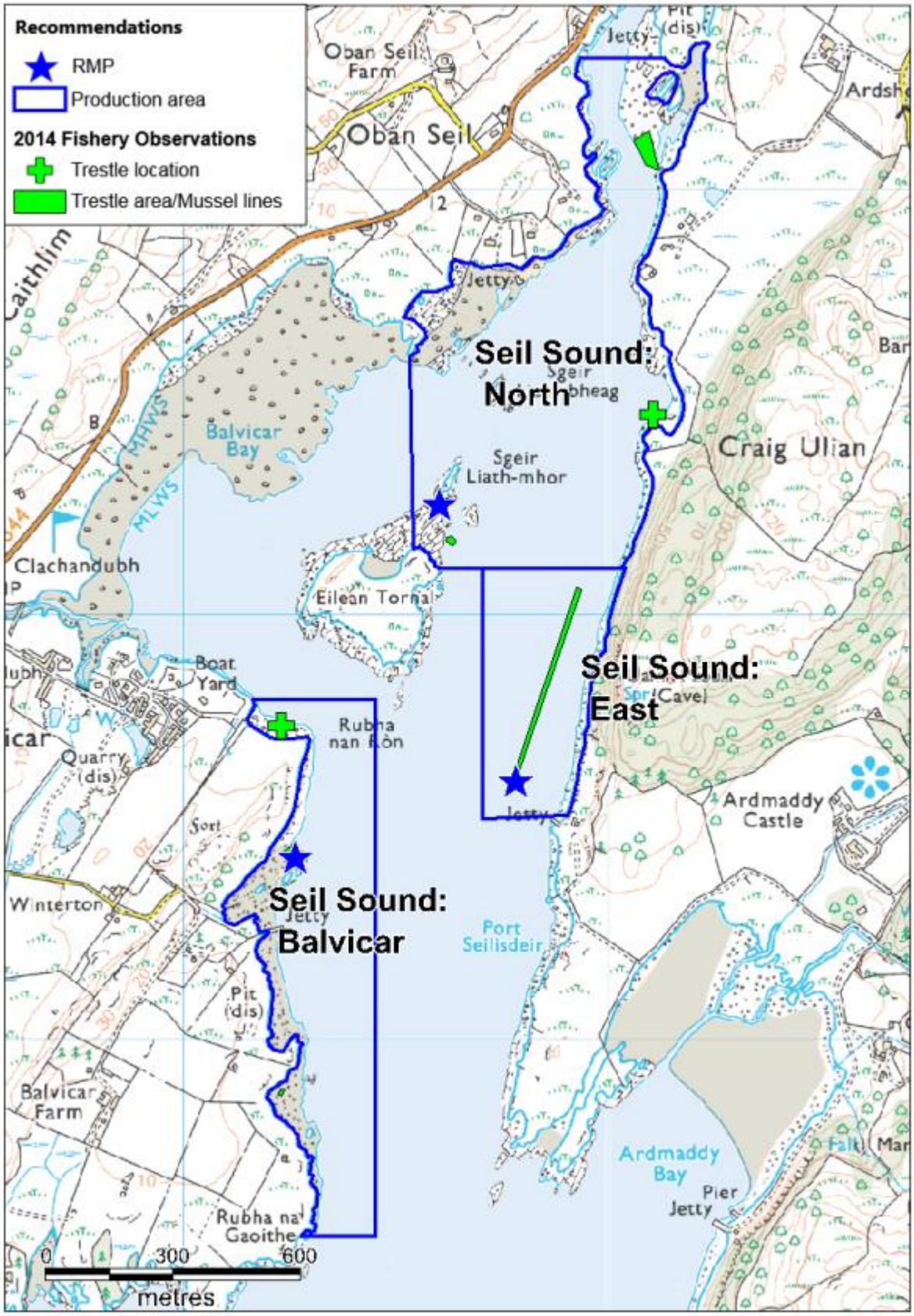

Figure 10.1 Seil Sound recommendations

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12. List of Figures and Tables

Appendices

1. List of planning applications
2. Scottish Water and SEPA discharge information
3. Shoreline Survey Report 2014

Appendix 1

Planning Applications

Planning applications expected to change the human population and overall faecal loading to Seil Sound are listed in Table 1.

Table 1 Planning applications to areas Balvicar and Ardshellach respectively

Location	ID	Date	Address	Description
Balvicar	09/01256/PP	24/08/2009	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4TF	Demolition of store and erection of 2no. semi-detached dwelling houses
	10/00444/PP	10/03/2010	Balvicar Isle Of Seil Oban	Erection of dwellinghouse and siting of oil storage tank
	10/01069/PPP	22/06/2010	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4TE	Site for the erection of a dwellinghouse
	10/01396/PPP	18/08/2010	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4TE	Site for the erection of a dwellinghouse and associated works.
	10/01433/PPP	23/08/2010	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4TE	Site for the erection of a dwellinghouse
	10/01586/PP	15/09/2010	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4TF	Erection of dwellinghouse and associated works
	11/00034/PPP	07/01/2011	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4RA	Site for the erection of a dwellinghouse
	12/00107/PP	11/01/2012	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4RA	Demolition of existing byre and store and erection of dwellinghouse and detached garage and installation of septic tank and associated drainage.
	13/01978/PP	04/09/2013	Balvicar Isle Of Seil Oban Argyll And Bute	Erection of dwellinghouse and detached garage
	13/02239/PP	02/10/2013	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4TE	Erection of dwellinghouse
	14/00618/PP	12/03/2014	Balvicar Isle Of Seil Oban Argyll And Bute PA34 4RA	Erection of dwellinghouse and formation of vehicular access
Ardshellach	12/02793/PPP	24/12/2012	Ardmaddy Oban Argyll And Bute PA34 4QY	Site for the erection of dwellinghouse and installation of septic tank
	13/02044/PP	05/09/2013	Ardmaddy Oban Argyll And Bute PA34 4QY	Erection of croft house, installation of septic tank and formation of new access.

Appendix 2

Scottish Water and SEPA sewage discharge information

A list of the upgraded community discharges from Scottish Water since April 2009 for the Seil Sound area and the original SEPA discharge information from the 2009 sanitary survey report.

Table 1 Scottish Water upgraded community discharges to Seil Sound

Discharge Name	NGR of discharge	Discharge Type	Level of Treatment	Type of discharge
WWTW	NM 7740 1747	Continuous	Tertiary	FE/CSO
PS1 Atlantic Bridge	NM 7850 1966	Intermittent	Screened	EO
PS No2 Clachan Seil North	NM 7840 1931	Intermittent	Screened	EO
PS No3 Brookside	NM 7816 1880	Intermittent	Screened	EO
PS No4 Clachan Seil South	NM 7813 1855	Intermittent	Screened	EO
PS No5 Balvicar Post Office	NM 7649 1700	Intermittent	Screened	EO
PS No6 Balvicar	NM 7676 1684	Intermittent	Screened	EO

Table 2 SEPA consented discharges (data from the 2009 sanitary survey report)

Ref No.	NGR of discharge	Discharge Type	Level of Treatment	Consented flow (DWF) m^3/d	Consented/ design PE	Discharges to
CAR/R/1015858	NM 7842 1940	Continuous	ST	-	12	Clachan Sound
CAR/R/1020304	NM 7827 1937	Continuous	ST	-	5	Land (via soakaway)
CAR/R/1013702	NM 7826 1896	Continuous	ST	-	7	Seil Sound
CAR/R/1016103	NM 7658 1701	Continuous	ST	-	10	Land
CAR/R/1020115	NM 7642 1683	Continuous	ST	-	7	Land (via soakaway)
CAR/R/1020066	NM 7657 1688	Continuous	ST	-	5	Land (via soakaway)
CAR/R/1019075	NM 7663 1686	Continuous	ST	-	10	Soakaway
CAR/R/1020297	NM 7651 1545	Continuous	ST	-	13	Soakaway

Appendix 3

Shoreline Survey Report

Report Title	Seil Sound Shoreline Survey Report
Project Name	Shellfish Sanitary Surveys
Client/Customer	Cefas
SRSL Project Reference	00561_B0067

Document Number	B0067_Shoreline 0042

Revision History

Revision	Changes	Date
A	Draft issue for internal review	10/11/2014
B	Second draft issue for internal review	14/11/2014
C	Third draft issue for internal review	17/11/2014
01	First formal issue to Cefas	17/11/2014
02	Second issue to Cefas incorporating corrections from Issue 01	08/12/2014
03	Third corrected issue to Cefas	12/12/2014

	Name & Position	Date
Author	Peter Lamont, Lars Brunner	10/11/2014
Checked	Andrea Veszelovszki	12/12/2014
Approved	Andrea Veszelovszki	12/12/2014

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

Production area:	Seil Sound East,
Site name:	East of Balvicar
SIN:	AB-247-703-08
Harvester	Jack MacGregor
Species:	common mussels

Production area:	Seil Sound North,
Site name:	Ardshellach
SIN:	AB-247-071-13
Harvesters	Alan MacFadyen & Jack MacGregor
Species:	Pacific oysters
Site name:	Balvicar North
SIN:	AB-247-735-13
Harvesters	Alan MacFadyen & Jack MacGregor
Species:	Pacific oysters

Production area:	Seil Sound: Balvicar,
Site name:	Balvicar
SIN:	AB-247-072-13
Harvester	James Robertson
Species:	Pacific oysters
Site name:	Rubha nan Ron South
SIN:	AB-247-728-13
Harvester	James Robertson
Species:	Pacific oysters

Local Authority:	Argyll and Bute Council
Status:	Existing area
Date Surveyed:	6th and 8thth October 2014
Surveyed by:	Peter Lamont, Lars Brunner
Existing RMPs:	Seil Sound East (mussels) NM 7780 1659 Seil Sound North (Eilean Tornal, oysters) NM 7760 1726 Seil Sound Balvicar (Rubha nan Ron South, oysters) NM 7723 1643

Area Surveyed:

1. The shellfish sites above

2. Shoreline west side of Seil Sound north from the northeast point of Balvicar Bay to Clachan Seil.

3. Shoreline east side of Seil Sound from Ardmaddy Bay immediately south west of Caddleton to the north boundary of the fishery, west of Ardshellach Farm.

4. Shoreline Seil Sound south, west side, from south of Balvicar farm to roadway B844 west of Balvicar.

Weather

Overnight before the survey there was considerable heavy rain and wind. High winds up to 20 knots and rain were present at the start of the shore survey on Monday 6th, lessening rapidly as the day progressed, and clearing by midday. Thereafter the weather was dry with sunny intervals and on the second survey day, Wednesday, was clear with very light cloud almost no wind and continuous sunshine.

Monday 6th October 2014 – wet with strong SW wind to start with giving way to calm and dry conditions by midday and thereafter.

Wednesday 8th October 2014 – Dry, sunny and no wind, remaining so throughout the day.

Stakeholder engagement during the survey

All stakeholders contacted prior to the survey were very helpful and provided information and free access to site(s). The team were able to meet with the mussel harvester, Mr Jack McGregor, at his shore base on the Monday morning. He was very helpful regarding his mussel operation and informed the team that there were few mussels on the lines (Seil Sound East, East of Balvicar). Mr McGregor shares the Seil Sound North oyster fishery with the second harvester, Mr Alan MacFadyen, who was contacted by the team later by telephone.

Boat work was scheduled for the Wednesday due to the adverse weather on Monday and the team were taken out to the mussel lines and also the oysters at Seil Sound North (north end of Eilean Tornal and Ardshellach) by Mr Malcolm McInnes, an employee of Mr MacGregor & Mr MacFadyen.

The team had met with the third harvester Mr James Robertson previous to the survey (Seil Sound Balvicar, Balvicar and Seil Sound Balvicar, Rubha nan Ron South). The sampling officer for the area had left on maternity leave in the previous two weeks and the replacement was still in training and so was unable to meet the survey team at the time of the visit.

Fishery

Mussels are farmed by Mr Jack McGregor on the east side of Seil Sound. At the time of the survey there were two lines aligned consecutively north to south between waypoints 53/54 and 55 with double dropper lines extending to between 8 and 10 metres depth. At the time of the team visit the mussel stock was at a minimum and with no harvesting planned with no harvestable stock available, as the mussel farm had previously been for sale and only two out of a possible four mussel samples were obtainable.

Elsewhere in the fishery area Pacific oysters are grown on intertidal trestles. The area to the north extends from a line eastwards from the northeast of Eilean Tornal to the beginning of the narrows of Clachan Sound westwards of Ardshellach Farm and contains two actively managed oyster trestle arrays. One of these is located at the north end of Eilean Tornal (Fig 4) and a more extensive array, by Ardshellach, is present on the east side of the channel, at the north end of the fishery area (Fig 3). At the time of the team visit there was much stock at the north array (Ardshellach) and little at Eilean Tornal site.

Eilean Tornal had two trestle groups. One of these was composed of four banks comprising seventeen trestle units (each unit being 3 m in length) and the other of fourteen lines of trestles.

The Ardshellach array comprised at least fifteen banks of trestles, with many full bags of oysters, some of which were underwater at the time of the team visit.

A third, smaller array, below Craig Ulian (waypoint 77) comprised five bare trestle rows with no stock or bags.

The harvester in the north, Mr. Alan MacFadyen informed the team that he and Mr. Jack McGregor plan to expand the oyster cultivation in the future. Harvesting is carried out year round and there is no particular season.

South of Balvicar Bay there are three areas of trestles indicated on the Survey Plan but only two were found by the team and only the Rubha nan Ron South site at Balvicar chalets was currently in use. The southernmost group of trestles are indicated on the Survey Plan as being in a south facing bay east of Kilbrandon House. This site was examined by the team but no sign of trestles were seen. This was possibly because the tide was still high at that time due to strong, south westerly winds overnight. However the team were informed by one of the other harvesters that this site has not been in use for some time and had been managed by someone else in the past.

The second site, due east of Balvicar Farm, was in a small bay and had oyster farm gear stored on shore with piles of empty bags at the top of the shore and a caravan about 100 m inshore (Fig. 5, Waypoint 14). Although there were a small number of bags on the intertidal beach and one or two on the eighteen visible individual trestles there were no live oysters present in bags to provide the planned shellfish sample. However a sample of oysters was obtained by collecting sufficient escaped oysters lying in the intertidal area. The team were informed that this site belonged to a Frenchman and that it hasn’t been in use for a couple of years.

In a bay below Balvicar Chalets, southeast of Balvicar (Seil Sound: Balvicar, Rubha nan Ron South, NM 7723 1643,) was a more extensive trestle array with about twenty seven rows of trestles and containing actively managed oyster stock (Fig. 6, Waypoint 19). At the time of the team visit the tide was not low enough to establish the boundaries of this site but the extent of the array had previously been determined during a visit by SAMS staff in August 2014 at a lower tide and those data and photographs are included in this report, courtesy of Dr. Elizabeth Cook, SAMS (Table 1, Waypoints 106 to 109, and Figs. 23 and 24). The harvester, Mr. James Robertson, also has a site just to the north around the point of Rubha nan Ron, east of Balvicar boatyard but he informed the team that he had found that growth was not as good at that site and that he only had two trestles there (these would have been well covered by the rising tide at the time of the team visit). He had no plans for expansion.

Sewage Sources

Balvicar and Clachan Seil are the two main settlements bordering the fishery area. From both surveyors' local knowledge, many properties near the shore historically either had direct discharge of effluent into the sound or septic tank discharge direct into the sea. However during 2009 to 2010 Scottish Water installed a sewage treatment works alongside, and discharging into, Balvicar Bay (Fig. 16, Waypoint 52). Most properties have been connected to this installation, from the Atlantic Bridge in the north to Balvicar village in the south, with six pumping stations as indicated on Figure 2 of the Survey Plan. These pump to a treatment plant (Fig. 16, Waypoint 52) with a discharge into Balvicar Bay. The harvester for the north area, Mr. Alan MacFadyen, expressed concern about possible emergency discharges from the Balvicar Treatment Plant and said it would be desirable to have notice from Scottish Water of such events either beforehand or as soon as possible afterwards as part of their standard operating procedure so that he and Mr.McGregor could plan their oyster harvesting or monitoring accordingly.

A local resident informed the team that four ex-council houses at NM 78231912 have a direct sewage discharge into the sound in the vicinity of NM 78321908 and were not connected to the Scottish Water system because of a way-leave dispute. The team were unable to confirm this as the information became available after the survey.

On the east side of the sound within the fishery area there are few dwellings. Four new houses are situated at the north end (Fig. 21, Waypoint 104) and one holiday house at the south end, near the south end of the mussel lines (Fig. 18, Waypoint 95). In Ardmaddy Bay the team counted three dwellings at Caddleton. Ardmaddy Castle lies upstream of freshwater sample SSFW10

(Waypoints 91 and 92) and the team were unable to observe how many dwellings were present. No septic tanks were directly observed by the team on the east side, though a discharge from an outfall pipe from the holiday house at the south end was sampled (Fig. 18, Waypoint 96).

The west side of the sound has two main settlements of Balvicar and Clachan Seil both of which contain former council housing together with seventeen scattered dwellings in between, plus Balvicar Farmhouse, Balvicar Chalets and Kilbrandon House to the south. The harvester (Seil Sound: Balvicar), Mr James Robertson, informed the team that there had been problems with high contamination by coliforms preventing harvesting at the Rubha nan Ron South site by Balvicar chalets and that he suspected the cause to be originating from the chalets which have experienced a change of use in the past few years from holiday to permanent accommodation. He had the impression that contamination tended to occur after heavy rain. There had been occasions in the past when his stock were condemned as contaminated while at the same time of sampling, oysters from the Seil Sound north sites belonging to harvester Alan MacFadyen, were clear . Mr. Robertson concluded that this was something particular to his site and speculated on several possible causes including hydrography and visiting yachts but that there seemed to be a lack of investigative action and it was also unclear which authority, if any, was responsible for identifying contamination sources and taking remedial action.

The drainage catchment into the west side of the sound also includes additional properties and farms to the west of the B844 roadway. An unplanned freshwater sample, SSFW8, was taken from the broken outfall pipe shown in Figure 13, while an apparent outfall about 100 metres farther south, could not be sampled, as the end was underwater, at least ten metres offshore at the time of the visit (Fig. 14, Waypoint 50).

Seasonal Population

Tigh na Truish is a small hotel with public house at the Atlantic Bridge. A second hotel, the Willowburn, indicated on the survey plan map near PS2 Clachan Seil North has now reverted to a private house. There are no official campsites but a limited amount of B&B accommodation is available. A collection of seven holiday chalets close to Seil Sound: Balvicar, Rubha nan Ron South oyster array (Waypoint 19) are now sold and occupied as private, permanent dwellings according to the harvester, Mr. Robertson. Balvicar is a former slate mining village with numerous small cottages and many of these are either holiday homes or rented accommodation.

Boats/Shipping

Balvicar Bay has numerous moorings of which the team counted forty two, with thirty occupied by vessels ranging from fishing work boats to yachts and small leisure craft. At Balvicar there is a commercial boatyard with slipway (Fig. 7, Waypoint 21) and a commercial fishing base with shed and pier (Fig. 8, Waypoint 22).

In the channel on the west side leading to the Atlantic Bridge are three private pontoons, one of which is commercial, operating wildlife watching and diving charters (Fig. 9, Waypoint 41, Sealife Adventures). The southernmost pontoon, Waypoint 43, had four leisure boats ashore (Figs. 10 and 11). The channel is narrow and restricted for moorings so there were six moored boats in the channel north to the Atlantic Bridge. which is outwith of the survey area. The team counted an additional two boats in the surveyed area. A slipway with leisure boats stored ashore is incorporated in a new build of four houses on the east side of the channel at the road end, past Ardshellach Farm (Fig. 20, Waypoint 102).

Farming and Livestock

Beef cattle and sheep grazing constitute the main agricultural activity. Balvicar Farm in addition, produces and sells commercially, eggs from free range hens.

On the west side of the sound, south of Balvicar Bay, both cattle and sheep were seen in fields with open access to the shore. North of the bay a small group of nine young Luing cattle were encountered in a field without shore access after the end of the shore survey while exiting to the B844 road between waypoints 50 and 51 (Fig. 15).

On the east side of the sound, sheep were more numerous in the vicinity of Ardmaddy Bay where the team counted a total of eighty one animals. North of the wooded section on the east side twelve beef cattle were observed behind four new build houses in a large field of rough grazing extending with shore access south to waypoint 84 and beyond (Fig. 22, Waypoint 104). On the east side, Ardshellach and Ardmaddy incorporate working farms while on the west side Balvicar Farm occupies the land south of Balvicar. Other farms and livestock occupy the land to the west of the B844 much of which drains into the sound on the west side.

Land Use

The fishery is bordered by land with most types of land use including native woodland, rough pasture, improved pasture, commercial boatyards, fishing bases, aquaculture shore bases, leisure pontoons and associated vehicle access, private domestic dwellings and gardens, communal council and ex-

council dwellings and an ex-industrial (slate mining) village. Easdale Seafoods processing, depuration and packing plant is also situated in Balvicar.

Land Cover

The area is predominantly rural with native woodland limited to the east side of the sound. There is no commercial coniferous forestry in the area. Land, other than in private gardens and the east side native woodland, is either rough or improved grazing.

Watercourses

Two small rivers enter Ardmaddy Bay, the Allt Dallermaig and the Eas nan Ceardach. The latter has been harnessed for small scale hydropower (Fig. 17, Waypoint 88). All other water courses entering the survey area are much smaller. Figure 12 (Waypoint 45) is an example.

Wildlife/Birds

Recent evidence of otters, in the form of regularly used grass track runs, was seen in the Seil Sound North fishery area at the northeast side (Fig. 19, Waypoint 101). Local information from Sealife Adventures is that otters have been seen more often than usual in 2014 implying an increase in the population. Gulls were few in number and only herring and greater black-backed gulls were seen. At the mussel farm lines three shags were perched on the mussel floats with a pair of greater black-backed gulls on the water nearby (Waypoint 55). In the same vicinity two ravens were seen flying near the native woodland on the east side (Waypoint 95). Oystercatcher and rock pipit were observed on the more remote shores south and southeast of Balvicar (Waypoints 7 and 16). The team were informed by locals that small numbers of ducks and sometimes one or two pairs of swans regularly swim in the small lochan known locally as “Teddy’s Pond” the outlet from which was the site of the planned freshwater sample (SSFW5, Waypoint 28). However no wildfowl was observed on the lochan at the time of the team visit.

Specific observations made during the survey are mapped in Figures 1 to 4 and listed in Table 1. Water and shellfish samples were collected at the locations marked on Figures 3 and 4. Bacteriology results are given in Tables 2 and 3. Photographs are presented in Figures 5-24.

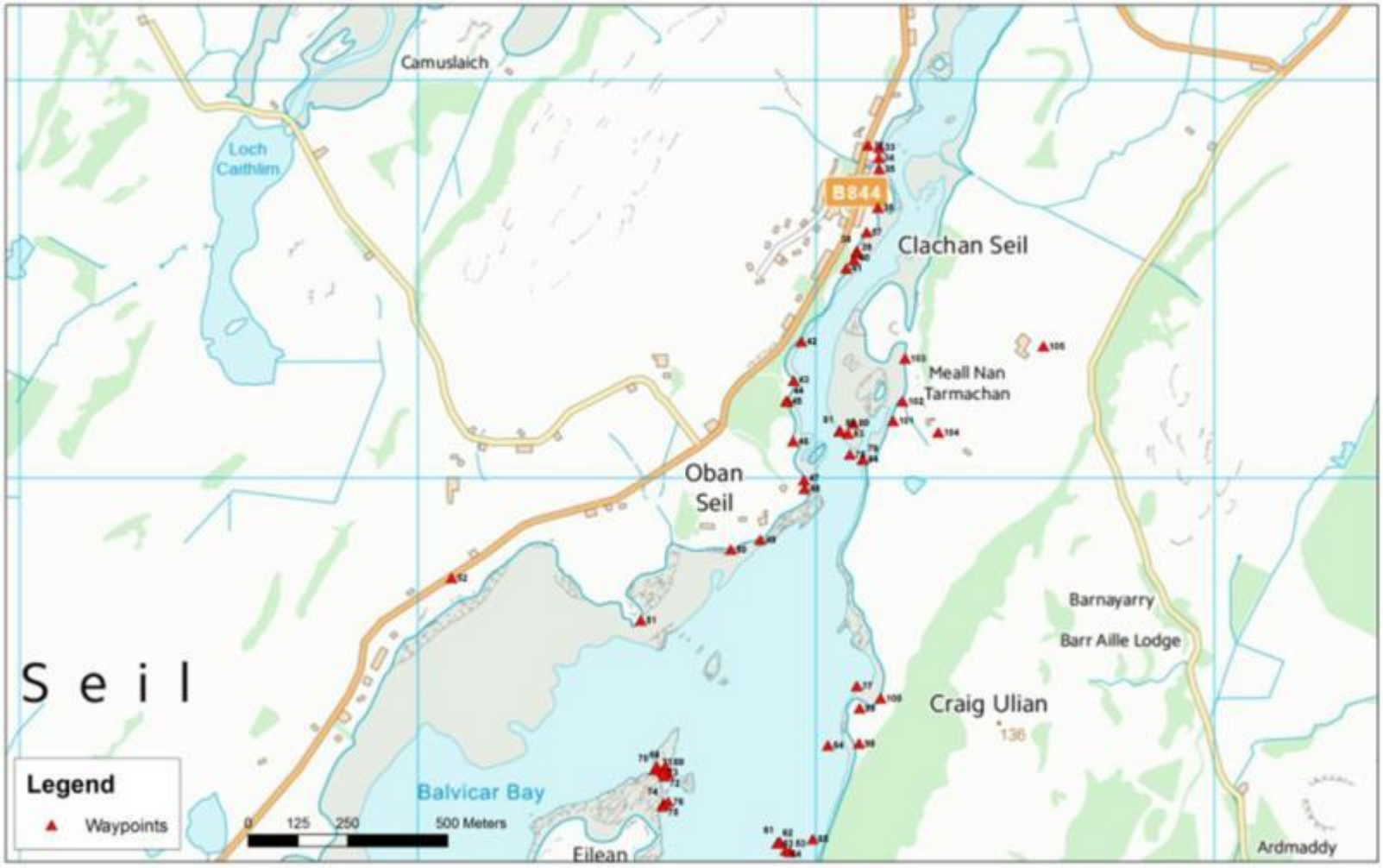

Figure 2. Seil Sound north waypoints

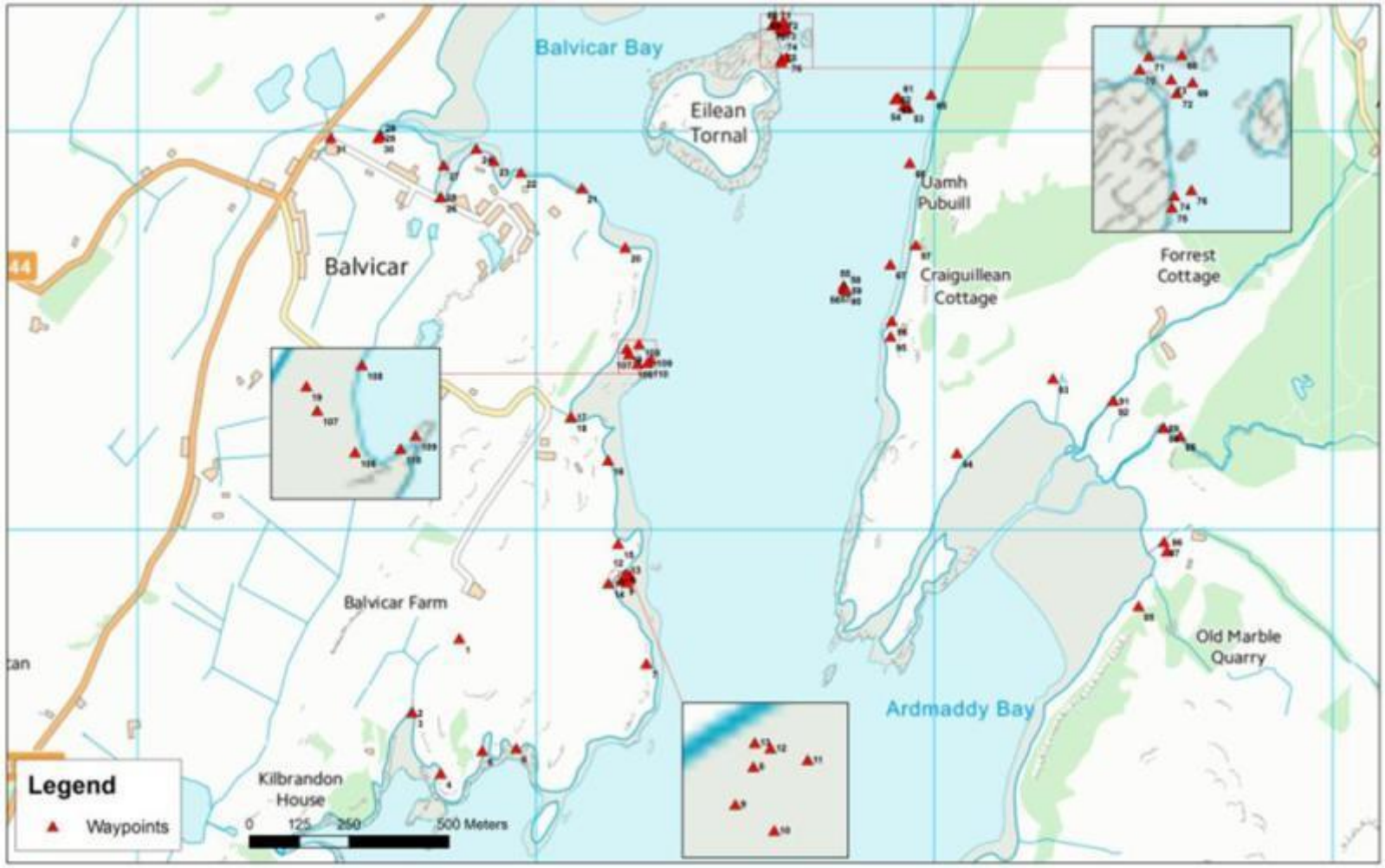

Figure 2. Seil Sound south waypoints

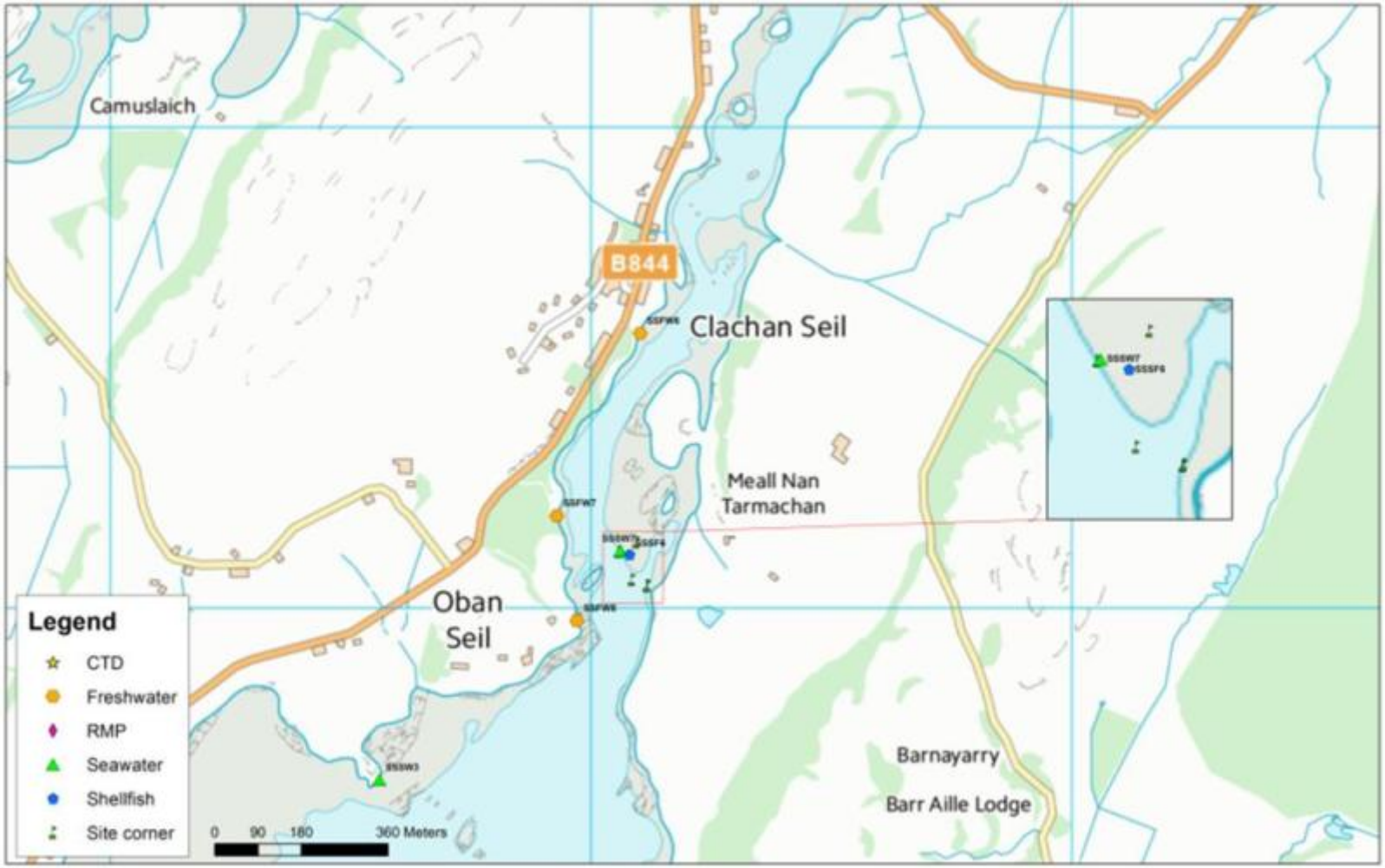

Figure 3. Seil Sound north samples

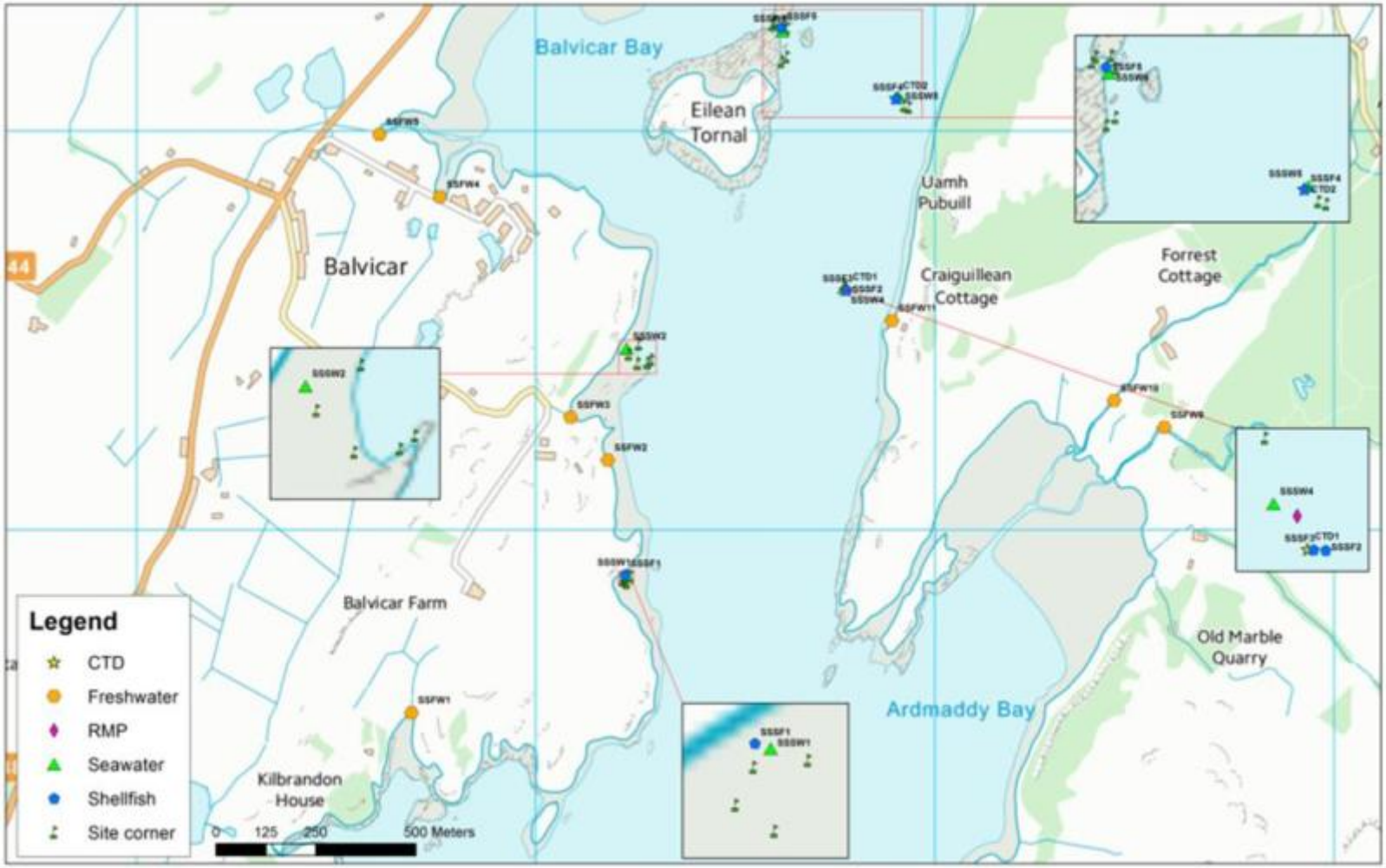

Figure 4. Seil Sound south samples

Table 1 Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
1	06/10/2014	9:50	NM 76807 15727	176808	715727			Start of shore survey in field above shore. Livestock: 15 beef cattle, 18 sheep.
2	06/10/2014	9:59	NM 76688 15541	176689	715542		SSFW1	Planned freshwater sample Balvicar Farm stream. Sample associated with waypoint 3.
3	06/10/2014	9:59	NM 76688 15541	176689	715542			Freshwater sample observations: Width 1.09 m, depth 12 cm, Flow 0.054 m/sec, SD 0.014. Kilbrandon House in view, no outfall pipe observed along shore.
4	06/10/2014	10:07	NM 76760 15388	176761	715388			Small burn, not sampled, from local land drainage immediately above shore.
5	06/10/2014	10:12	NM 76864 15445	176865	715445			Small burn not sampled from bog.
6	06/10/2014	10:14	NM 76950 15451	176950	715452			Bay indicated as having oyster trestles. No sign of trestles as tide still high having been pushed in by strong winds overnight.
7	06/10/2014	10:24	NM 77277 15664	177277	715665			Wildlife: 2 gulls, 1 oystercatcher, 1 rock pipit.
8	06/10/2014	10:31	NM 77223 15882	177224	715883			NW corner oyster trestle array. No bags with oysters present.
9	06/10/2014	10:31	NM 77219 15873	177219	715874			SW corner.
10	06/10/2014	10:31	NM 77228 15867	177228	715868			SE corner.
11	06/10/2014	10:31	NM 77236 15884	177236	715884			NE corner.
12	06/10/2014	10:32	NM 77227 15886	177227	715887		SSSW1	Planned seawater sample.
13	06/10/2014	10:49	NM 77223 15888	177224	715888		SSSF1	Planned shellfish sample taken from escaped Pacific oysters found on shore. No live animals present in the few bags lying onshore or on the trestles. Site appears unused.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
14	06/10/2014	10:50	NM 77181 15865	177182	715866	Fig. 5		Empty oyster bags stored on shore with caravan 200 m inland from shore. Tide rising. Livestock: 34 sheep in field above shore.
15	06/10/2014	10:54	NM 77206 15964	177206	715965			Out of commission work boat onshore with empty oyster bags inside.
16	06/10/2014	10:58	NM 77180 16174	177181	716175		SSFW2	Unplanned freshwater sample from outfall (contaminated). Freshwater sample observations: pipe of standard 100 mm diameter plastic soil drain. Flow 0.015 L/min estimated using jug. Dwelling above shore. Wildlife nearby; 1 heron, 1 rock pipit.
17	06/10/2014	11:04	NM 77087 16282	177088	716282		SSFW3	Planned freshwater sample from Balvicar Chalets burn. Sample associated with waypoint 18.
18	06/10/2014	11:04	NM 77087 16283	177088	716283			Freshwater sample observations: Width 0.4 m, depth 6 cm, flow 0.025 m/s, SD 0.008. Chalets formerly holiday accommodation but now sold and owner occupied according to harvester Mr. James Robertson.
19	06/10/2014	11:13	NM 77227 16454	177227	716455	Fig. 6	SSSW2	Planned seawater sample at oyster trestle array. Tide too high at time of visit to determine extent of trestle array. For corner co-ordinates taken on a previous survey on 10th of August 2014 see Waypoints 106 to 110.
20	06/10/2014	11:22	NM 77223 16709	177224	716709			Small watercourse, bog drainage.
21	06/10/2014	11:27	NM 77115 16857	177115	716858	Fig. 7		Balvicar boatyard: 30 boats on 42 moorings with about 4 working boats. Dinghies and other boats on hard standing. Two piers with a slipway in between.
22	06/10/2014	11:33	NM 76962 16896	176962	716897	Fig. 8		Fishing base pier with metal shed.
23	06/10/2014	11:38	NM 76893 16926	176894	716926			Concrete slipway at edge of garden ground. Date in cement "1996" and "Crown Estate lease no. 3433054401" inscribed in the cement also.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
24	06/10/2014	11:41	NM 76849 16957	176850	716957			Plastic outfall pipe with no flow. Possibly not in use – barnacles growing inside.
25	06/10/2014	11:45	NM 76760 16834	176760	716835		SSFW4	Planned freshwater sample. Sample associated with waypoint 26.
26	06/10/2014	11:46	NM 76761 16834	176761	716835			Freshwater sample observations: Flow outwelling in three places through the slate quarry spoil. Width (1) 0.35 m, depth 6 cm, flow 0.186 m/s SD 0.004; Width (2) 1.10 m, depth 6 cm, flow 0.251 m/s SD 0.008. Scottish Water pumping station across the single track roadway above.
27	06/10/2014	11:55	NM 76768 16915	176768	716916			Cast iron outfall pipe 150 mm diameter. Probably not in use - barnacles growing on the inside.
28	06/10/2014	12:00	NM 76608 16991	176609	716991		SSFW5	Planned freshwater sample from outflow from low level lochan to the west of the road, locally known as "Teddy's pond". Sample associated with waypoint 29.
29	06/10/2014	12:00	NM 76607 16991	176607	716991			Freshwater sample observations: Width 1.15 m, depth 70 cm, flow 0.929 m/s SD 0.021.
30	06/10/2014	12:04	NM 76603 16983	176604	716984			Manhole cover with concrete outfall pipe below with end submerged in pond outflow. No audible flow.
31	06/10/2014	12:10	NM 76484 16984	176485	716984			Scottish Water box opposite Balvicar shop. End of Balvicar South shore survey.
32	06/10/2014	13:05	NM 78130 18836	178130	718836			Start of Balvicar Bay North shore walk. Scottish Water pumping station "Brookside".
33	06/10/2014	13:07	NM 78158 18830	178159	718830			Six leisure craft with two moored in the channel. Six more moored boats in the channel up to the Atlantic Bridge.
34	06/10/2014	13:08	NM 78157 18804	178157	718805			Outfall pipe of cast iron of about 200 mm diameter. End submerged.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
35	06/10/2014	13:09	NM 78158 18777	178158	718777			Small watercourse.
36	06/10/2014	13:12	NM 78155 18680	178155	718680			Plastic outfall pipe with end blocked by mud and no visible flow evidence.
37	06/10/2014	13:15	NM 78126 18618	178126	718618			Vent pipes and septic tank in garden ground beyond. Small watercourse present.
38	06/10/2014	13:17	NM 78102 18571	178102	718571		SSFW6	Unplanned freshwater sample from 150 mm diameter possible field drain. Marked as contaminated. The pipe was old and the team considered it was possibly an outfall pipe Freshwater sample observations: Flow 1.5 Litre/min measured with jug.
39	06/10/2014	13:20	NM 78100 18564	178100	718565			Small shore base for Seil Sound East mussel operation. Small pontoon.
40	06/10/2014	13:21	NM 78094 18548	178095	718548			Pipe for hill burn, 150 mm diameter.
41	06/10/2014	13:23	NM 78075 18527	178076	718527	Fig.9		Pontoon with car park above shore. Sealife Adventure base. Diesel tank (about 600 litre capacity) onshore at start of pontoon.
42	06/10/2014	13:28	NM 77962 18343	177962	718343			Pontoon with small yacht tied up. Three moorings in sight (no moored craft).
43	06/10/2014	13:31	NM 77943 18245	177943	718245	Figs. 10, 11		Pontoon with four leisure boats ashore and small woodland beyond.
44	06/10/2014	13:33	NM 77929 18192	177929	718192		SSFW7	Unplanned freshwater sample associated with waypoint 45.
45	06/10/2014	13:34	NM 77924 18193	177925	718194	Fig. 12		Freshwater sample observations: Watercourse draining through farmland above past Oban Seil Farm, beside Ardencaple road. Width 0.85 m, depth 4 cm, flow 0.243 m/s, SD 0.006.
46	06/10/2014	13:38	NM 77941 18092	177942	718092			Leisure cruiser tied to small pontoon.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
47	06/10/2014	13:41	NM 77969 17995	177969	717995		SSFW8	Unplanned freshwater sample associated with waypoint 48.
48	06/10/2014	13:44	NM 77970 17973	177970	717974	Fig. 13		Freshwater sample observations: Ceramic outfall pipe, broken, marked as contaminated. Appearing to drain from property above. Some smell. Width (in pipe) 8 cm, depth 1 cm, flow 0.254 m/s, SD 0.001.
49	06/10/2014	13:54	NM 77859 17844	177860	717845			Slipway. Wildlife; herring gull in water.
50	06/10/2014	13:58	NM 77785 17820	177786	717821	Fig. 14		New pontoon pier. Adjacent outfall pipe encased in concrete with pipe not visible. End submerged at time of visit. Offshore nearby outfall with yellow marker cross symbol, possibly associated the concrete encased outfall observed at waypoint 49.
51	06/10/2014	14:07	NM 77559 17642	177559	717643	Fig. 15	SSSW3	Planned seawater sample. End of Balvicar Bay North shore survey. Livestock: 9 Luing cattle at roadside field.
52	06/10/2014	14:21	NM 77084 17749	177084	717749	Fig. 16		Scottish Water Balvicar Bay Waste Water Treatment Plant (outfall into the middle of the bay).
53	08/10/2014	9:36	NM 77934 17060	177934	717060			Seil Sound East mussel array NE corner.
54	08/10/2014	9:37	NM 77922 17063	177923	717064			NW corner.
55	08/10/2014	9:40	NM 77772 16613	177772	716613			South end of mussel array, single line. Wildlife; 3 shags perched on mussel floats, 2 greater black-backed gulls nearby on water.
56	08/10/2014	9:41	NM 77775 16605	177776	716605			RMP position, Seil Sound East mussels.
57	08/10/2014	9:42	NM 77773 16606	177773	716607		SSSW4	Planned seawater sample at south end of mussel array.
58	08/10/2014	9:45	NM 77776 16602	177777	716602		CTD1	Planned CTD sample south end Seil Sound East mussels.
59	08/10/2014	9:57	NM 77778 16601	177778	716602		SSSF2	Planned surface shellfish sample.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
60	08/10/2014	10:02	NM 77777 16602	177777	716602		SSSF3	Planned shellfish sample from depth. Mussels from 3 m depth. No more available.
61	08/10/2014	10:17	NM 77908 17085	177909	717086		SSSW5	Planned seawater sample from north end of Seil Sound mussels.
62	08/10/2014	10:18	NM 77902 17081	177902	717082		CTD2	Planned CTD sample from north end of Seil Sound mussels.
63	08/10/2014	10:19	NM 77903 17081	177903	717082		SSSF4	Planned surface shellfish sample from north end of Seil Sound mussels. No mussels at depth.
64	08/10/2014	10:30	NM 78029 17328	178030	717328			Photograph from boat of shore at old Luing ferry boat remains.
65	08/10/2014	10:31	NM 77991 17092	177991	717093			Photograph from boat of shore to the south below wooded hillside.
66	08/10/2014	10:32	NM 77938 16921	177938	716922			Photograph from boat of shore to the south.
67	08/10/2014	10:34	NM 77889 16666	177890	716666			Photograph from boat of shore to the north with house.
68	08/10/2014	10:45	NM 77621 17276	177621	717276			North corner Eilean Tornal Pacific oyster trestle array comprising 4 banks of trestles with about 17 trestle units.
69	08/10/2014	10:45	NM 77628 17257	177629	717258			NE corner.
70	08/10/2014	10:46	NM 77593 17266	177594	717266			SW corner.
71	08/10/2014	10:47	NM 77599 17274	177600	717275			NW corner.
72	08/10/2014	10:49	NM 77618 17250	177618	717251		SSSW6	Planned seawater sample.
73	08/10/2014	10:54	NM 77614 17259	177614	717260		SSSF5	Planned shellfish sample, Elean Tornal Pacific oyster array.
74	08/10/2014	10:58	NM 77616 17182	177617	717183			Second trestle array, Eilean Tornal. Eastern limit not possible to waymark because of tide level. Trestles extend approximately 30 m SE from waypoint 74. Array consisting of approximately 14 lines of trestles most without bags.
75	08/10/2014	10:59	NM 77614 17174	177615	717175			SW corner.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
76	08/10/2014	11:03	NM 77627 17186	177628	717186			NW corner.
77	08/10/2014	11:14	NM 78102 17477	178102	717477			Small oyster trestle array with no bags or oysters, 6 rows running at 90 degrees to the shore below Craig Ulian.
78	08/10/2014	11:18	NM 78084 18059	178085	718059			SW limit of Ardshellach oyster trestles, Seil Sound north. Waypoint taken from boat as trestles were underwater.
79	08/10/2014	11:21	NM 78116 18046	178116	718046			SE corner.
80	08/10/2014	11:23	NM 78093 18137	178094	718138			NE corner.
81	08/10/2014	11:25	NM 78057 18117	178058	718118			NW corner.
82	08/10/2014	11:26	NM 78060 18118	178060	718119		SSSW7	Planned seawater sample, Ardshellach oyster trestle array, Seil Sound north.
83	08/10/2014	11:28	NM 78079 18111	178080	718112		SSSF6	Planned shellfish sample, pacific oysters, Ardshellach site, Seil Sound north.
84	08/10/2014	11:36	NM 78116 18047	178117	718048			SE limit of Ardshellach trestle array.
85	08/10/2014	12:06	NM 78512 15808	178512	715809			Start of Seil Sound shore walk east side south end Ardmaddy Bay.
86	08/10/2014	12:08	NM 78583 15946	178584	715947			Extra waypoint taken in error.
87	08/10/2014	12:09	NM 78576 15970	178577	715970			Small watercourse, not sampled. Observed as hill drain by the team.
88	08/10/2014	12:11	NM 78617 16235	178617	716236	Fig.17		Hydroelectric scheme comprising two separate buildings of different ages with the newer, westernmost building, being larger. Both buildings containing generating plant in use.
89	08/10/2014	12:14	NM 78574 16257	178575	716257		SSFW9	Planned freshwater sample.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
90	08/10/2014	12:14	NM 78574 16255	178575	716256			Freshwater sample observations: Sample taken immediately downstream of two hydroscheme buildings. Width 3 m, depth (1) 20 cm, flow 0.288 m/s SD 0.027; depth (2) 18 cm, flow 0.755 m/s, SD 0.042
91	08/10/2014	12:23	NM 78449 16323	178449	716324		SSFW10	Planned freshwater sample.
92	08/10/2014	12:23	NM 78448 16323	178448	716324			Freshwater sample observations: Second (westernmost) Ardmaddy Bay watercourse running past Ardmaddy Castle upstream. Width 2.85 m, depth (1) 22 cm, flow 0.332 SD 0.027; depth (2) 26 cm, flow 0.499, SD 0.021.
93	08/10/2014	12:30	NM 78297 16379	178298	716380			Livestock in field upshore from track, 48 sheep. Onshore 19 sheep.
94	08/10/2014	12:31	NM 78056 16192	178057	716193			Livestock, 14 more sheep onshore.
95	08/10/2014	12:34	NM 77890 16485	177890	716486	Fig.18		Holiday house by jetty. Seil Sound mussel lines offshore. Wildlife: 2 ravens overhead.
96	08/10/2014	12:37	NM 77892 16524	177893	716525		SSFW11	Unplanned freshwater sample from outfall pipe marked as contaminated. Freshwater sample observations: Plastic outfall pipe from holiday house, flow rate about 0.06 L/min (estimated measurement).
97	08/10/2014	12:43	NM 77953 16715	177953	716716			South end of woodland fringed shore surveyed from boat.
98	08/10/2014	13:13	NM 78108 17333	178108	717333			North end of woodland fringed shore surveyed by boat.
99	08/10/2014	13:17	NM 78109 17421	178109	717421			Evidence of recent presence of cattle observed.
100	08/10/2014	13:19	NM 78161 17446	178162	717446			Unnamed burn from hillside.
101	08/10/2014	13:31	NM 78193 18143	178193	718144	Fig. 19		Otter trail in deep grass. New build house behind (one of four).

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
102	08/10/2014	13:34	NM 78216 18192	178217	718193	Fig. 20		Slipway for private house. Small watercourse running against east side.
103	08/10/2014	13:37	NM 78223 18300	178223	718301			End of shorewalk at north end of production area. More otter trails in grass also present.
104	08/10/2014	13:44	NM 78306 18114	178306	718115	Figs. 21 and 22		New housing comprising 3 or possibly 4 houses (one resembles a large garage adjoining the nearby main house). Livestock: 12 beef cattle in field beyond with sea shore access to the south.
105	08/10/2014	13:49	NM 78570 18331	178571	718332			Ardshellach Farm. End of Seil Sound survey.
106	10/08/2014	11:42	NM 77254 16417	177255	716417	Figs. 23 and 24		S corner of trestles (trestle array oriented as a diamond in plan view with the deep water side oriented NW to SE). Few loose *C. gigas* under trestles.
107	10/08/2014	11:46	NM 77233 16440	177234	716441			W corner of trestles.
108	10/08/2014	11:47	NM 77258 16466	177258	716466			N corner in line with E corner (water at N corner too deep to access).
109	10/08/2014	11:50	NM 77288 16426	177289	716427			A waypoint inside the diamond shaped array.
110	10/08/2014	11:51	NM 77280 16419	177280	716419			Easternmost corner of trestles.

Photographs referenced in the table can be found attached as Figures 5 - 24.

Sampling

Seawater and freshwater samples were collected at the sites marked in Figures 3 and 4. Freshwater samples 2, 6, were from outfall pipes and 8 and 11 were marked as contaminated because the origin was uncertain.

Only three of four planned mussel samples from the lines in the east of the sound were obtained as there was almost no stock on the lines at the time of the visit. The southernmost planned oyster sample at the site east of Balvicar Farm was taken from escaped oysters found on the shore as there were no live animals in any of the few bags the team found at the site.

All the samples were transferred to Biotherm boxes with ice packs and posted to Glasgow Scientific Services (GSS) for *E. coli* analysis from Oban Post Office and processed at the laboratory the following day. On Monday the 6th October one Pacific oyster, eight freshwater and three seawater samples were posted, the temperature on arrival at the laboratory was recorded as 3.8°C. On Wednesday 8th October two Biotherm boxes were used to send collected samples. Four Pacific oyster and three freshwater samples were sent in a large box with an arrival temperature recorded at 3.7°C and one Pacific oyster and four seawater samples in a smaller box arriving at a recorded temperature of 3.3°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/100 ml)	Salinity (ppt)
1	06/10/2014	SSFW1	NM 76688 15541	Freshwater	30,000	
2	06/10/2014	SSFW2	NM 77180 16174	Freshwater (cont.)	<1000	
3	06/10/2014	SSFW3	NM 77087 16282	Freshwater	140,000	
4	06/10/2014	SSFW4	NM 76760 16834	Freshwater	20,000	
5	06/10/2014	SSFW5	NM 76608 16991	Freshwater	2,120	
6	06/10/2014	SSFW6	NM 78102 18571	Freshwater (cont.)	<1000	
7	06/10/2014	SSFW7	NM 77929 18192	Freshwater	2,720	
8	06/10/2014	SSFW8	NM 77970 17973	Freshwater (cont.)	1,000,000	
9	08/10/2014	SSFW9	NM 78574 16257	Freshwater	20	
10	08/10/2014	SSFW10	NM 78449 16323	Freshwater	390	
11	08/10/2014	SSFW11	NM 77892 16524	Freshwater (cont.)	200,000	
12	06/10/2014	SSSW1	NM 77227 15886	Seawater	4,200	27.82
13	06/10/2014	SSSW2	NM 77227 16454	Seawater	5,400	30.17

14	06/10/2014	SSSW3	NM 77559 17642	Seawater	500	32.16
15	08/10/2014	SSSW4	NM 77773 16606	Seawater	23	33.96
16	08/10/2014	SSSW5	NM 77908 17085	Seawater	15	33.78
17	08/10/2014	SSSW6	NM 77618 17250	Seawater	7	33.6
18	08/10/2014	SSSW7	NM 78060 18118	Seawater	5	33.78

Table 3. Shellfish Sample Results

No.	Date	Sample	Grid Ref	Type	Sample depth (m)	*E. coli* (MPN/100g)
1	06/10/2014	SSSF1	NM 77223 15888	Oysters	intertidal	490
2	08/10/2014	SSSF2	NM 77778 16601	Mussels	<1	170
3	08/10/2014	SSSF3	NM 77777 16602	Mussels	3	20
4	08/10/2014	SSSF4	NM 77903 17081	Mussels	<1	170
5	08/10/2014	SSSF5	NM 77614 17259	Oysters	intertidal	330
6	08/10/2014	SSSF6	NM 78079 18111	Oysters	intertidal	20

Salinity Profiles

CTD profiles were taken at the north and south end of the mussel production area from the harvester's boat as plotted in Fig. 4. The gathered data will be sent to client as a separate document. A “Castaway” S/N 10G100653 instrument was used to collect the data.

Photographs

Figure 5. Seil Sound South, oyster array east of Balvicar Farm. Empty oyster bags stored on shore above apparently unused oyster trestles. Site of planned seawater and shellfish samples SSSW1 and SSSF1 respectively. Waypoint 14.

Figure 6. Seil Sound South, Rubha nan Ron south, oyster trestles by Balvicar Chalets. The tide level is just at the top of some of the bags seen beyond the standing figure on the shore. Site of planned seawater sample SSSW2. Waypoint 19.

Figure 7. Balvicar boatyard, Balvicar village. Seil Sound south. Waypoint 21.

Figure 8. Fishing base pier and slipway at Balvicar village. Waypoint 22.

Figure 9. Sealife Adventures pontoon with charter vessel. Diesel tank on the right and car park (out of frame) above. Waypoint 41.

Figure 10. Pontoon, Seil Sound North, west side. New build houses (4 of) in the distant background on the east side of the sound. Waypoint 43.

Figure 11. One of four leisure craft ashore by pontoon with small, newly established woodland beyond. Waypoint 43.

Figure 12. Watercourse Seil Sound North, west side, flowing past Oban Seil Farm. Site of unplanned freshwater sample SSFW7. Waypoint 45.

Figure 13. Broken ceramic pipe with flow. Site of unplanned freshwater sample SSFW8. Waypoint 48.

Figure 14. Concrete encased pipe near new pontoon pier. End underwater. Waypoint 50.

Figure 15. Luing beef cattle in B844 roadside field with no direct shore access. Between waypoints 50 and 51.

Figure 16. Scottish Water Balvicar Bay Waste Water Treatment Plant looking southeast from the B844. Balvicar village right distant and Eilean Tornal in the mouth of the bay left distance. Outfall pipe covered by tide. Waypoint 52.

Figure 17. Housing for old (small) and new (larger) small scale hydroelectric plant at Ardmaddy Bay on the Eas nan Ceardach watercourse Waypoint 88. Site of planned freshwater sample SSFW10, Waypoint 89, is three metres downstream of the second (larger) building.

Figure 18. Holiday house by jetty near Seil Sound East mussel farm lines. Outfall pipe source of unplanned freshwater sample SSFW11. Waypoint 95.

Figure 19. Otter trail (arrowed) in deep grass above Seil Sound North, north east shore. One of four new houses in background. Waypoint 101.

Figure 20. View south from the north of Seil Sound looking south, showing slipway and associated boats for one of four new houses at the north east of Seil Sound. Waypoint 102.

Figure21. Three of four new houses at the north east of Seil Sound. View west towards the sound. Waypoint 104.

Figure 22. Three of twelve cattle in field by new housing at the north east of Seil Sound . Near Ardshellach Farm shore side road end. Waypoint 104.

Figure 23. Seil Sound Balvicar (south), Rubha nan Ron south, oyster trestles photographed on 12th August 2014. Waypoints 106 to 109.

Figure 24. Seil Sound Balvicar (south), Rubha nan Ron south, oyster trestles by Balvicar Chalets photographed on 12th August 2014. Chalets with modern bungalow on the left (south) at the head of the bay in the background. Waypoints 106 to 109.

Appendix 4 - Seil Sound CTD data

Data obtained during the shoreline survey. The locations of the casts are shown in Figure A4.1.

Figure A4.1 Location of CTD cast

CAST 1

Data Header

% Device	10G100653
% File name	10G100653_20141008_085635
% Cast time (local)	08/10/2014 09:56
% Sample type	Cast
% Cast data	Processed
% Location source	GPS
% Start latitude	56.289639
% Start longitude	-5.5922954
% Start GPS horizontal error(Meter)	2.130000114
% Start GPS vertical error(Meter)	5.349999905
% Start GPS number of satellites	5
% Cast duration (Seconds)	61.4
% Samples per second	5
Calibration Date	March 2013
Calibration offset for Temperature	-0.033
Calibration offset for Salinity	0.029

CTD data (calibration offsets applied)

Depth (Meter)	Temperature (Celsius)	Salinity (Practical Salinity Scale)
0.149056153	13.31536937	33.57176628
0.447151254	13.31647358	33.56939
0.745251329	13.31515416	33.57563026
1.043350716	13.31564844	33.57233482
1.341449516	13.31692998	33.57833404
1.639548123	13.31850436	33.57184009
1.93764629	13.32218704	33.58064366
2.235744175	13.327019	33.5735959
2.533842869	13.33312545	33.57334091
2.83194072	13.34270197	33.58220926
3.130036892	13.35398122	33.59074307
3.428132149	13.36197667	33.59241238
3.726227797	13.36977799	33.58842932
4.024323369	13.38238352	33.59544831
4.322415947	13.39870006	33.61964702
4.620503724	13.41603892	33.64398895
4.91858779	13.44310189	33.66131299
5.216669373	13.47832833	33.67946241
5.514743558	13.53287016	33.7477662
5.812805993	13.6125408	33.81646405
6.11084807	13.69189057	33.96811127
6.408871596	13.74770112	34.01459071
6.70689155	13.77969147	34.02038804
7.004912083	13.79334814	34.01869102
7.302932059	13.79697831	34.02700685
7.600951535	13.80282606	34.02272684
7.898971182	13.80756806	34.02536171
8.196990013	13.81284504	34.02971935
8.495007201	13.81103978	34.03796926
8.793023023	13.81028347	34.03822042
9.091037685	13.81162824	34.04550945
9.267899596	13.81683601	34.0390622

CAST 2

Data Header

% Device	10G100653
% File name	10G100653_20141008_092028
% Cast time (local)	08/10/2014 10:20:28
% Sample type	Cast
% Cast data	Processed
% Location source	GPS
% Start latitude	56.2939907
% Start longitude	-5.5907491
% Start GPS horizontal error(Meter)	1.580000043
% Start GPS vertical error(Meter)	2.420000076
% Start GPS number of satellites	7
% Cast duration (Seconds)	72.5
% Samples per second	5
Calibration Date	March 2013
Calibration offset for Temperature	-0.033
Calibration offset for Salinity	0.029

CTD data (calibration offsets applied)

Depth (Meter)	Temperature (Celsius)	Salinity (Practical Salinity Scale)
0.149060518	13.23588795	33.51292375
0.447162233	13.23765497	33.52291534
0.745268102	13.23621669	33.52642077
1.043373707	13.23786814	33.5223576
1.34147887	13.24059419	33.52851288
1.639583478	13.24036943	33.52497717
1.937688709	13.24055486	33.51999392
2.235794023	13.23894962	33.52089873
2.533899009	13.24424322	33.5209061
2.832004345	13.25642482	33.51935202
3.130110005	13.28203214	33.52487315
3.42820996	13.34442755	33.59001117
3.726300572	13.41449094	33.63952413
4.024388699	13.45899071	33.6391345
4.322476405	13.49016617	33.66016307
4.620552167	13.54626129	33.7653933
4.918614085	13.60392282	33.81037774
5.216672269	13.63185745	33.8183063
5.514728936	13.65992594	33.83576112
5.812777919	13.70204058	33.90239155
6.110813972	13.74874216	33.97154016
6.408841045	13.78362442	34.00116228
6.706865638	13.80233754	34.00498409
7.004890223	13.810861	34.00557512
7.302914593	13.81429112	34.00714029
7.600938413	13.8171436	34.00920092
7.898960613	13.81843224	34.01971212
8.196980946	13.82108251	34.0239158
8.494999876	13.82450999	34.03088419
8.79301815	13.82918005	34.02896551
9.091036098	13.82845812	34.03188733
9.390807216	13.82715065	34.02705282