Scottish Sanitary Survey Project

Restricted Sanitary Survey Report
Fersness Bay
OI 455
March 2009

Cefas

FOOD STANDARDS AGENCY
SCOTLAND
Buidheann Inbhe-Bìdhe an Alba

Report Distribution – Fersness Bay

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* Distribution of both draft and final reports to relevant agency personnel is undertaken by FSAS.

** Distribution of draft and final reports to harvesters in undertaken by the relevant local authority.

Acknowledgements

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Orkney Islands Council
Robert Hutchinson
SEPA Registry Office Dingwall
Scottish Water
Dr. Alan Lilly, Macaulay Land Research Institute

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1. Area Overview

Fersness Bay is located on the Isle of Eday which is in the group of Orkney Islands off the north coastline of Scotland. Fersness Bay is 2.4 km wide and 1. 3 km long. The depth of Fersness Bay is shallow and varies from 0 – 10m with distance from the shoreline. Given that this was a restricted survey, potential sources of contamination on Faray were not taken into account. A restricted sanitary survey at Fersness Bay was conducted in response to receipt of an application to classify the area for commercial harvest of razor clams and common cockles.

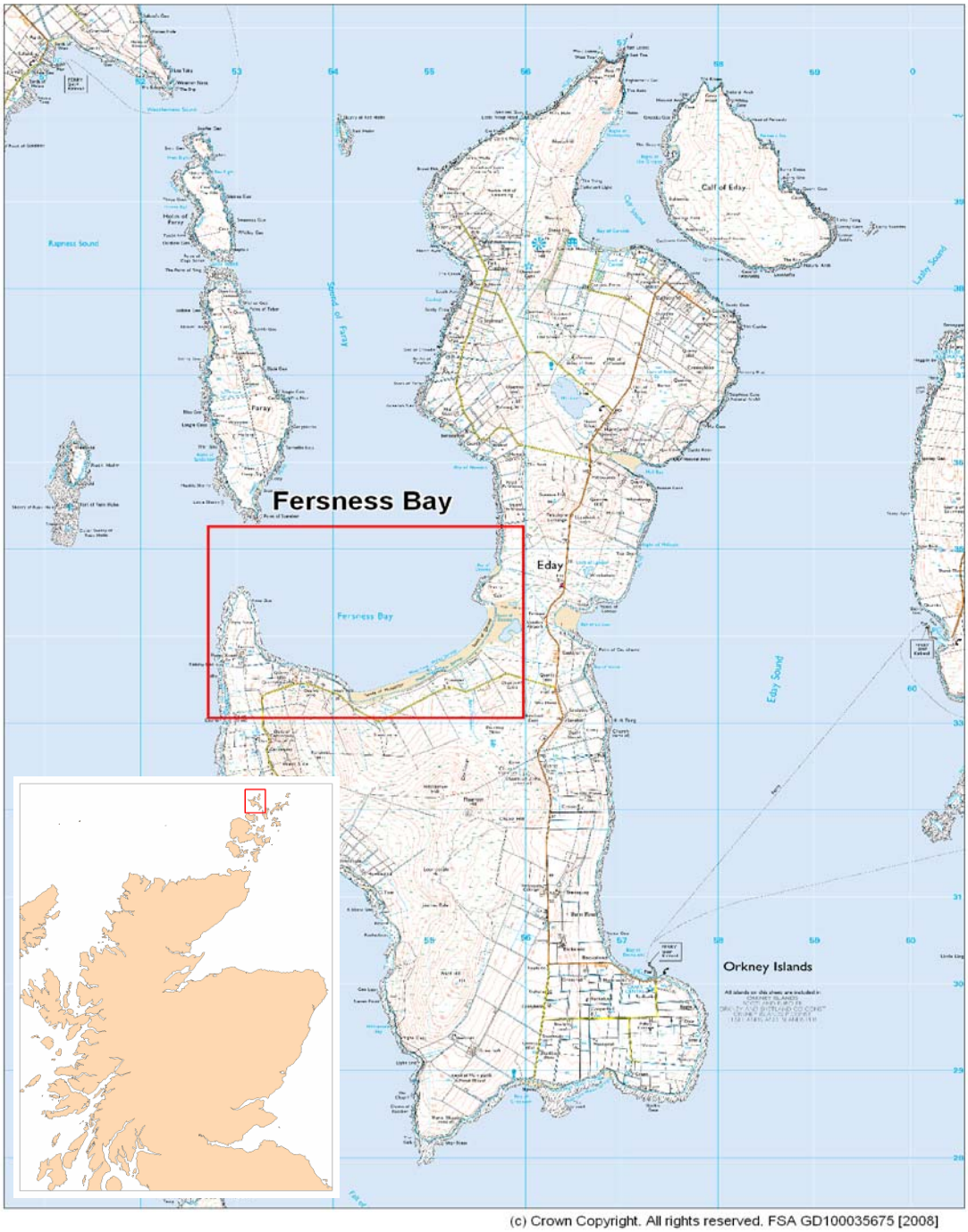


Figure 1.1 Location of Fersness Bay

1.1 Land Cover

The shore of the bay itself is mainly sandy although there are extensive rocky areas. Behind the central section of Fersness Bay between the Sands of Mussetter and the Sands of Doomy is a steep cliff with heath land and grassland behind. The Sands of Doomy and the Sands of Mussetter are both are backed by sand dunes and long grass. Any run off is likely to be concentrated in the numerous small streams around the bay.

1.2 Human Population

Figure 1.2 shows the 2001 census figures for the Island of Eday. A single census output area encompasses the Island of Eday and has a human population of 121. There are no large settlements on Eday and dwellings are scattered throughout the island.

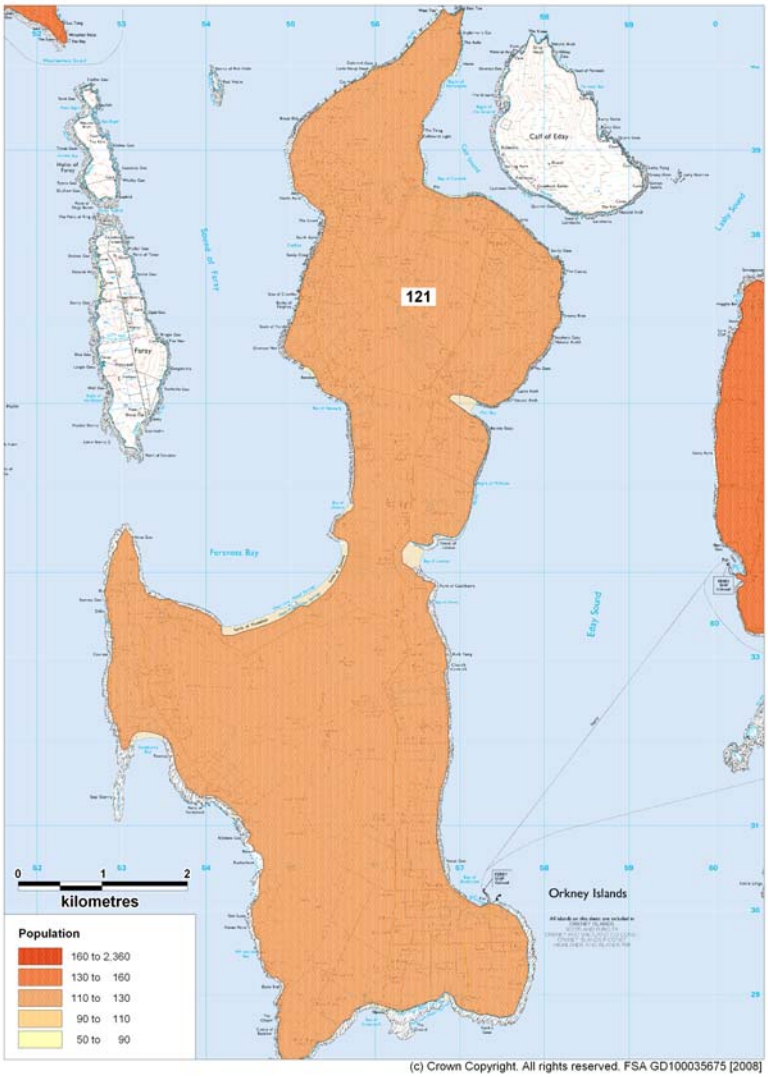


Figure 1.2 Human population surrounding Fersness Bay

Human sewage inputs to the bay will be associated with individual dwellings – see Sections 3 and 9.

2. Fishery

The fishery at Fersness Bay is comprised of the following wild shellfish beds:

Table 2.1 Fersness Bay shellfish

Production Area	Site	SIN	Species
Fersness Bay	Fersness Bay Razors	OI 455 859 16	Razors (*Ensis spp*)
Fersness Bay	Fersness Bay Cockles	OI 455 860 04	Common Cockles (*Cerastoderma edule*)

Prior to the restricted sanitary survey, the production area boundaries and RMP had not been assigned. There is no Crown Estates lease associated with this site. The shellfish beds do not fall within a designated shellfish growing water.

The exact boundaries of the shellfish bed are unknown. The shellfish are mechanically dredged and the harvester plans to harvest year round apart from June, July and August within the Fersness Bay area. Fersness Bay is shown below in Figure 2.1.

During the shoreline survey, access to a significant portion of the bay was restricted by the presence of creels. Dredging for samples was also not successful at all points when this was attempted. These aspects will restrict both the area that can be practically fished and the location of the recommended RMP.

Figure 2.1 Fersness Bay fishery

3. Sewage Discharges

One discharge consent was provided by SEPA for the area adjacent to Fersness Bay. This is shown in Table 3.1 and mapped in Figure 3.1.

Table 3.1 SEPA discharge consents

Ref No.	NGR of discharge	Discharge type	PE	Discharges to
CAR/R/1020404	HY 5583 3586	Continuous	5	Land via soakaway

No community septic tanks or sewage discharges were identified by Scottish Water for the area surrounding Fersness Bay.

Outfall pipes were also observed during the shoreline survey and these are listed in Table 3.2. Their locations have been included in the mapped discharges in Figure 3.1. Further details can be found in the shoreline survey report in the appendix. No sample was taken at No, 1. The *E. coli* concentration of samples taken at the other three discharges were was very low indicating a low sewage component at the time of sampling.

Table 3.2 Observations of potential sewage discharges

No.	Date	NGR	Description of potential sewage discharge
1	05/04/2009	HY 54998 36547	15cm pipe leading onto shoreline, very small flow. Mulched toilet tissue in pile on floor underneath pipe.
2	05/04/2009	HY 55660 36010	25cm diameter flowing pipe. Fersness fresh water sample 2 (10 *E. coli* cfu/100ml)
3	05/04/2009	HY 53831 33472	6cm diameter pipe flowing into a stream on the shoreline. Fersness fresh water sample 12 (<10 *E. coli* cfu/100ml)
4	05/04/2009	HY 53343 33693	Pipe, flowing into stream on the beach. Fersness fresh water sample 15 (30 *E. coli* cfu/100ml)

Figure 3.1 Sewage discharges at Fersness Bay

4. Animals

4.1 Livestock

The only significant source of information concerning livestock numbers in the area surrounding Fersness Bay was available from the shoreline survey. The observations only relate to the time of the site visits on Monday 2nd and Thursday 5th March 2009.

During the shoreline survey, livestock were present in fields adjacent to the shellfish bed. No livestock were observed along the north-eastern shoreline, however sheep droppings were seen on the shoreline at Bestonhall, indicating that sheep had been present. Approximately 80 sheep and 12 cattle were observed on the headland between the Loch of Doomy and the Sands of Doomy. A further 74 sheep were observed in a field on a cliff towards the centre of Fersness Bay. The majority of livestock (approximately 119 sheep) were concentrated in fields on the western side of Fersness Bay (see Figure 4.1).

Contamination from these may enter the bay during or after heavy rainfall. However, given that sheep were located all around the bay, contamination from this source will be assumed to be evenly distributed.

4.2 Wildlife

While the Isle of Eday does host some colonies of breeding seabirds, the particular stretch of coastline around Fersness Bay does not host significant colonies. Gulls were observed roosting along the stretch of the coastline walked during the shoreline survey, with the majority (44 pairs) scattered throughout the cliffs of Fersness Bay. Seabirds such as gulls will always be present in the bay but their distribution is likely to be even over time and as such would not materially affect placement of an RMP. During the shoreline survey cormorants and geese were also observed (see Figure 4.1). The cormorants were observed only on the north-east side of the bay, though it is likely they will range widely throughout the area.

Rabbits and rabbit droppings were also observed at a number of points along the cliffs above the bay.

Overall, the impact from both seabirds and rabbits will tend to occur around the whole bay and their impact will be assumed to be evenly distributed.

Figure 4.1 Livestock and wildlife present in Fersness Bay

5. Rainfall

The nearest weather station is located in Kirkwall approximately 24.5 km south east of Fersness Bay. Rainfall data was supplied for the period 01/01/03 to 31/12/06 (total daily rainfall in mm). Rainfall data is complete for this period. Although the weather station is some distance from the production area, it is likely that the rainfall experienced in Kirkwall is broadly similar to that experienced at Fersness Bay and so is included in the analysis here.

High rainfall and storm events are commonly associated with increased faecal contamination of coastal waters through surface water run-off from land where livestock or other animals are present, and through sewer and wastewater treatment plant overflows (Mallin et al. 2001, Lee and Morgan 2003).

5.1 Rainfall at Kirkwall

Total annual rainfall and mean monthly rainfall were calculated, and are presented in Figures 5.1 and 5.2.

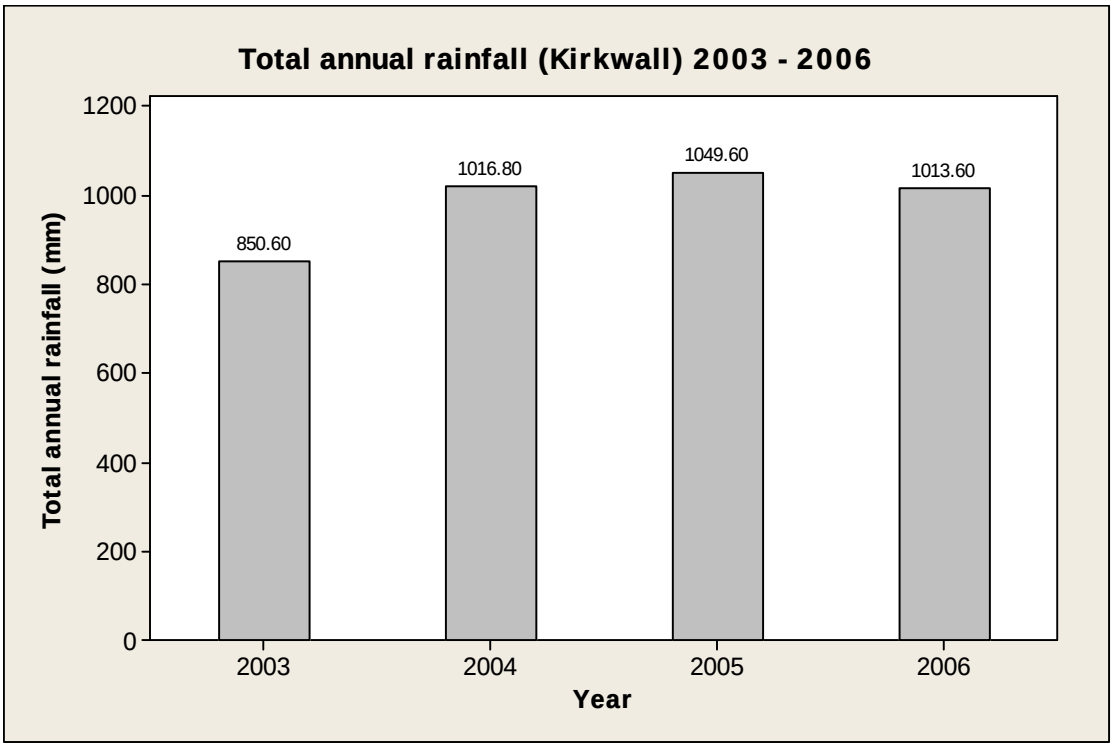


Figure 5.1 Total annual rainfall at Kirkwall 2003 – 2006

Total annual rainfall was considerably lower in 2003 compared to the following three years. The year with the highest amount of rainfall was in 2005. However, the variation between years was much less than the variation within year (see Figure 5.2).

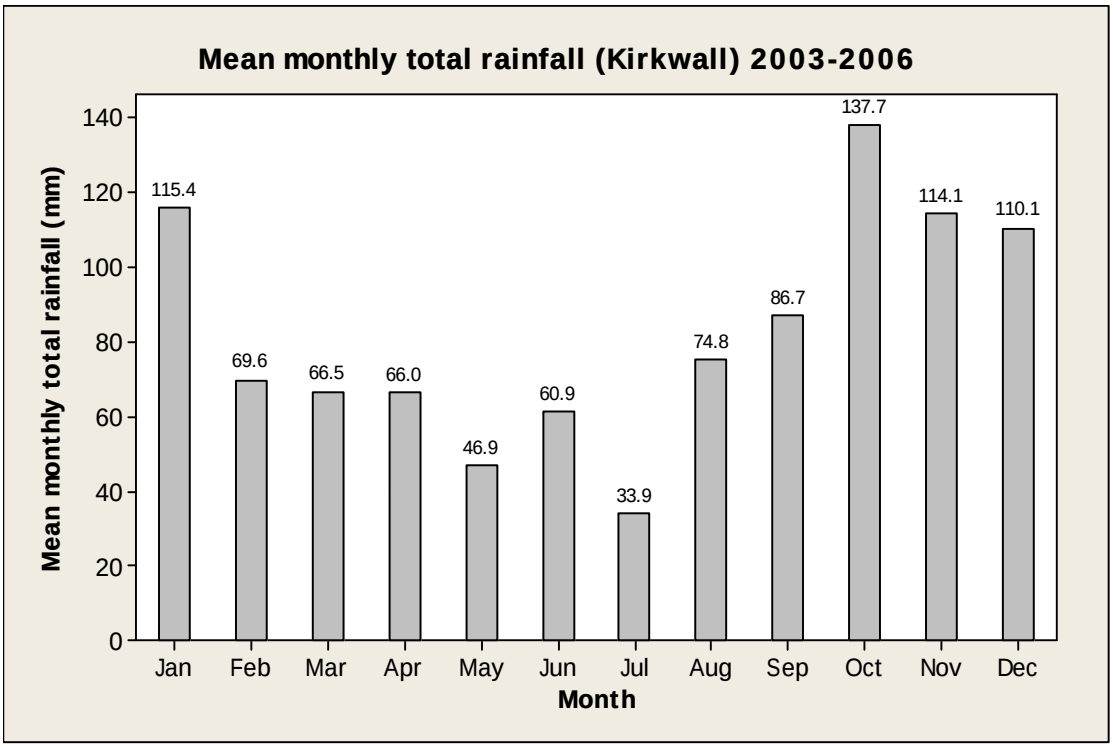


Figure 5.2 Mean total monthly rainfall at Kirkwall 2003 – 2006

The mean rainfall varies markedly between months. The wettest months were January, October, November and December. The largest increases in rainfall over the previous months occurred in August and October. For the period considered here (2003 – 2006), 26.8% of the days experienced no rainfall while 24.6% of days experienced rainfall of 1mm or less.

Periods of increased rainfall are generally associated with higher levels of contaminated surface water runoff. Marked changes in the level of rainfall may also cause significant run off of accumulated faecal matter. This effect would be most likely to occur in August and October, however contamination may occur at any time of the year after a period of heavy rainfall.

Episodes of contamination may occur outside identified periods of higher rainfall, for example when livestock are present on the shoreline.

6. River Flow

There is no river gauging station in the vicinity of Fersness Bay. The streams listed in the table below represented the largest freshwater inputs to the Fersness Bay shellfish bed and are listed in Table 6.1 and mapped in Figure 6.1.

Table 6.1 Stream flow and loadings for Fersness Bay

No	Grid Ref	Description	Width (m)	Depth (m)	Measured Flow (m/s)	Flow in m3/day	*E. coli* (cfu/ 100ml)	Loading (*E. coli* per day)
1	HY 55236 36411	Stream	0.22	0.08	0.463	704.1	10	$5.6x10^5$
2	HY 55744 34775	Stream	0.25	0.1	0.238	514.1	<10	*
3	HY 55527 33901	Stream	0.5	0.09	0.195	758.2	<10	*
4	HY 55274 33653	Burn of Mussetter	0.7	0.05	0.332	1004.0	80	$5.0 x10^5$
5	HY 55217 33609	Stream	0.2	0.06	0.16	165.9	30	$1.0 x10^5$
6	HY 55130 33589	Stream	0.08	0.07	0.057	27.6	<10	*
7	HY 55092 33562	Stream	0.12	0.08	0.01	8.3	<10	*
8	HY 54958 33443	Stream	0.07	0.06	0.39	141.5	<10	*
9	HY 54458 33271	Stream	1	0.06	0.644	3338.5	20	$2.0x10^6$
10	HY 54217 33160	Stream	0.24	0.07	0.059	85.6	<10	*
11	HY 53831 33472	Stream	0.08	0.04	0.108	29.9	<10	*
12	HY 53686 33574	Stream	0.12	0.15	0.004	6.2	<10	*
13	HY 53435 33658	Stream	0.38	0.05	0.188	308.6	20	$1.5x10^5$
14	HY 53343 33693	Stream	0.11	0.1	0.072	68.4	30	$6.8x10^4$

* E. coli loadings per day were not calculated for results of <10 E. coli cfu/100ml

At the time of the survey, the loadings for all the streams were relatively low. The highest contribution was from stream number nine, at the south of the bay. Otherwise, stream borne contamination was generally equally spread around the area.

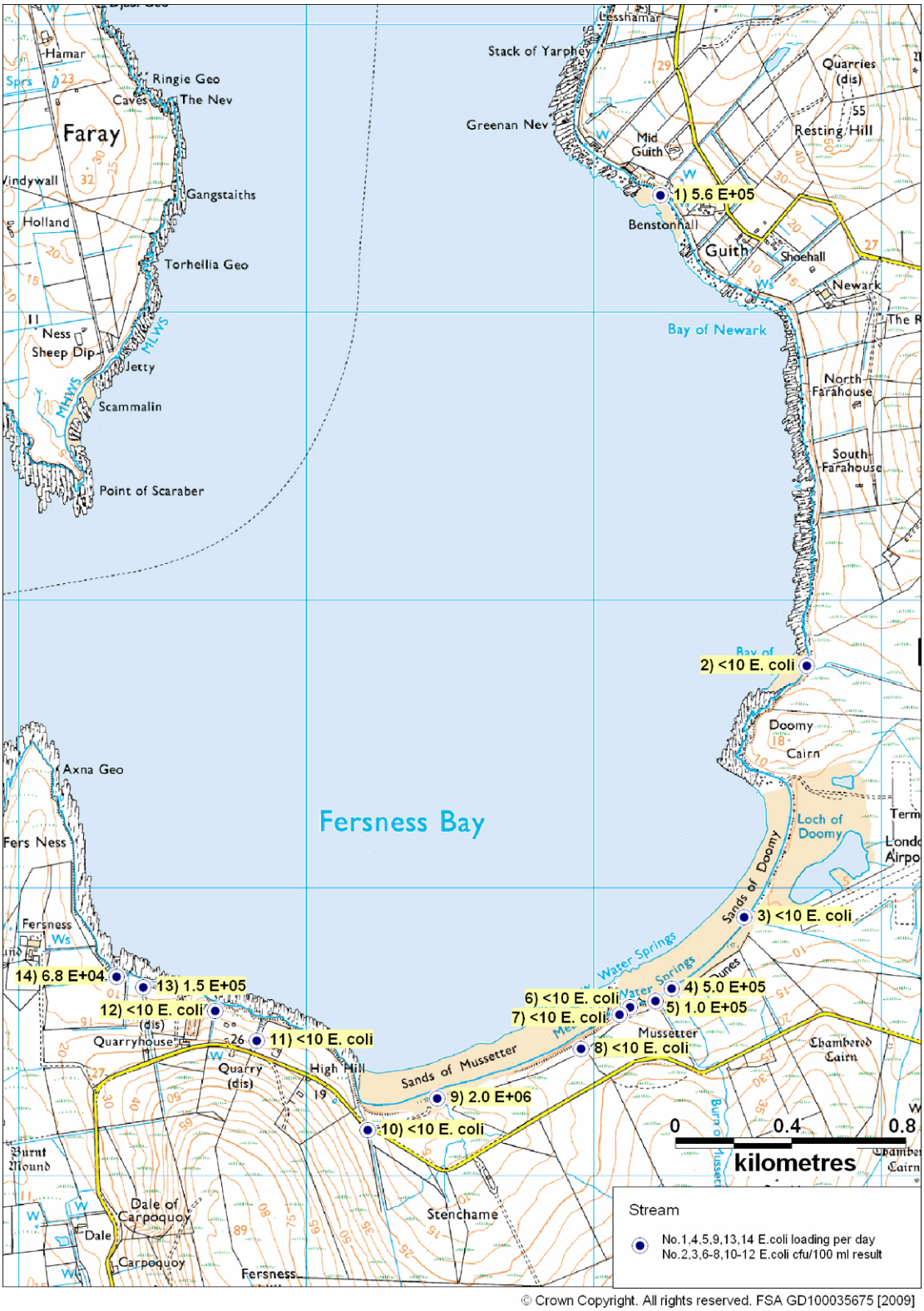


Figure 6.1 Location of stream flows and loadings at Fersness Bay

Where the bacterial loading is labelled as 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 1 x 10^3, in this case it would be written as 1E+3. Calculated loadings are based on the flows and dimensions observed during the shoreline survey only.

7. Historical *E. coli* Monitoring Data

There is no historical E. coli monitoring data available for Fersness Bay

8. Bathymetry and Hydrodynamics

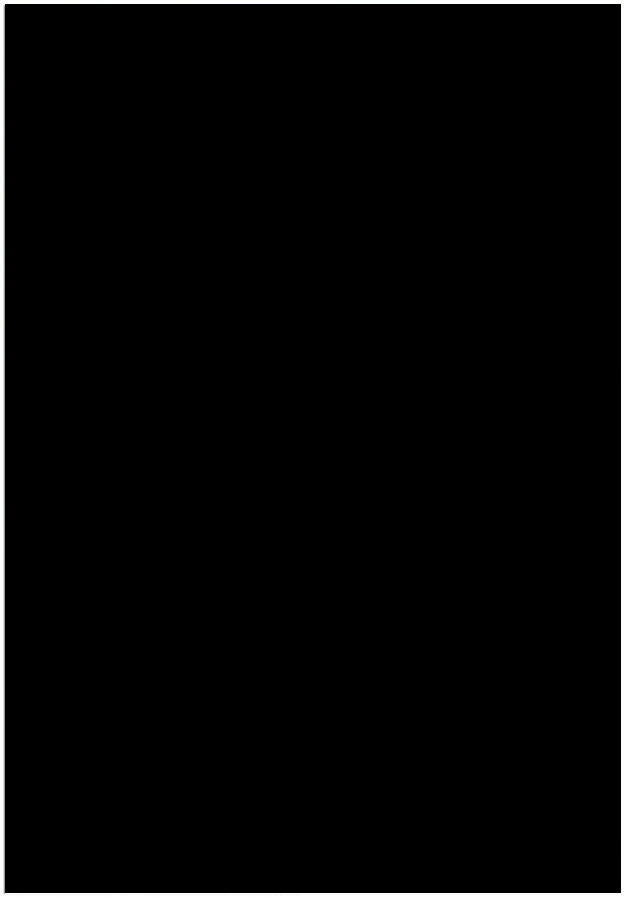


Figure 8.1 Fersness Bay bathymetry

Figure 8.2 Fersness Bay OS

The bathymetry chart above (Figure 8.1) shows that there is a drying area following the length of the coastline along Ferness Bay. North of the bay lies the Sound of Faray, which separates the islands of Faray to the west and Eday to the east. Ferness Bay is sheltered from the southwest by a penisula extending northwards towards Faray, creating a narrow entry at the west end of the bay. Within the bay itself, the bottom slopes away gently toward the 10m depth curve. Within the Sound of Faray and just outside the bay , depths reach 20m or more.

8.1 Tidal curve and description

The two tidal curves below are for the port of Rapness, the nearest secondary port– they have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 21st February 2009. The second is for seven days beginning 00.00 GMT on 28thFebruary 2009. Together they show the predicted tidal heights over high/low water for a full neap/spring tidal cycle.

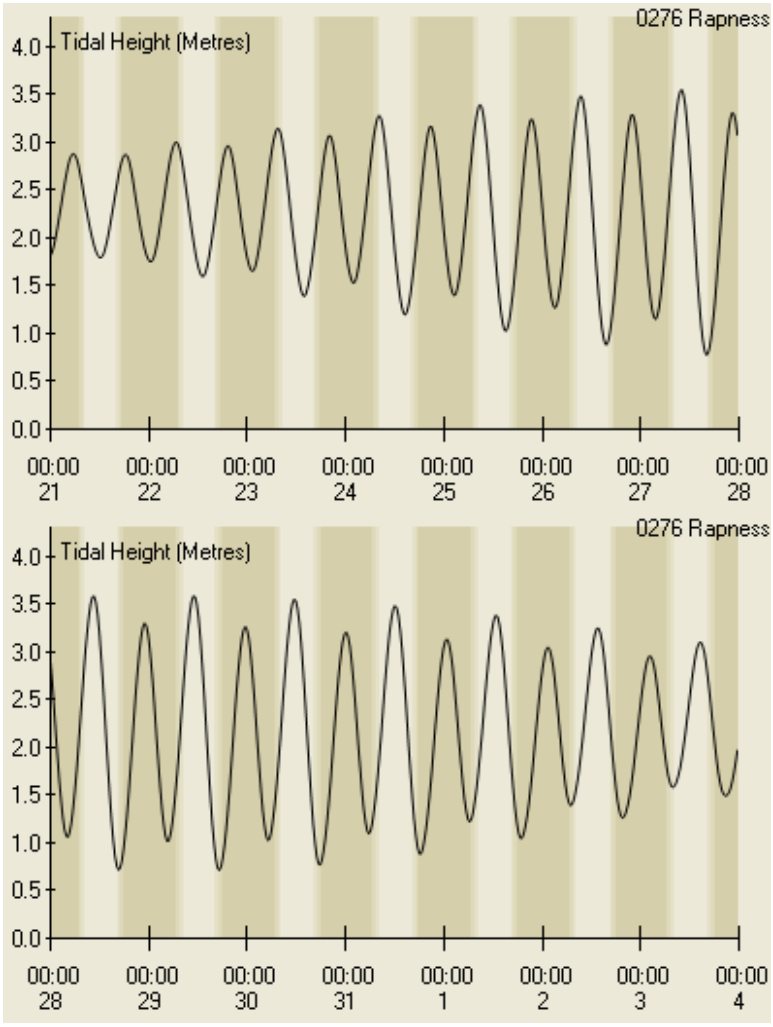


Figure 8.3 Tidal curves for Rapness

The following is the UKHO summary description for Rapness:

The tide type is Semi-Diurnal.

MHWS	3.6 m
MHWN	2.9 m
MLWN	1.6 m
MLWS	0.7 m

Predicted heights are in metres above chart datum. The tidal range at spring tide is therefore approximately 2.9 m and at neap tide 1.3 m.

8.2 Currents

There are no tidal diamonds near Fersness Bay that would give an accurate representation of the currents surrounding the shellfish bed. The Clyde Cruising Club guide covering Orkney indicates that the spring current in the Sound of Faray

is 4 knots (2 m/s). The currents within Fersness Bay are likely to be significantly less than this as the main flow will follow the main channel (see Figure 8.1).

8.3 Conclusions regarding effect on impacting sources

The main flow within Fersness Bay will generally be parallel to the shore, although the currents will be more complex in the vicinity of Fers Ness itself, due to the headland. The relatively shallow nature of the bay will mean that dilution of any large sources of pollution would not be great. However, sufficient dilution should be seen with the relatively minor sources occurring in the area that any impacts on shellfish microbiological quality would be limited to the local area of the source.

9. Shoreline Survey Overview

A restricted shoreline survey of the Fersness Bay was undertaken by staff from Cefas and Orkney Islands Council on Monday 2nd and Thursday 5th March 2009.

Sea water samples were taken at several points along the coastline from the Bay of Doomy to the Fers Ness headland and also from the fishing boat within the shellfish bed area. Results ranged from <1 to 15 *E. coli* cfu/100 ml).

Fresh water samples were taken all along the coastline of the Fersness Bay shellfish bed area at streams and flowing outfall pipes. Results ranged from <10 to 80 *E. coli* (cfu/100 ml). The highest sample was taken from the mouth of the Burn of Mussetter and had a result of 80 *E. coli* (cfu/100 ml).

Sheep and some cattle were present in fields surrounding the shellfish bed. Cattle were located inland near the Bay of Doomy and the sheep were mainly concentrated on inland on the western side of the bay, however some were present towards the centre of the bay at Mussetter. However, fences and raised beaches often restricted direct access to the shoreline.

Seabirds (gulls, cormorants and geese) were seen in very small numbers around the bay. Rabbits and rabbit droppings were seen at a number of points around the cliffs.

Razor samples were collected at one point at the western end of the bay, off the coast of the Doomy headland. The razor samples returned low results of <20 and 20 *E. coli* (MPN/100 g).

A map is provided in Figure 9.1 that shows the relative locations of the most significant findings of the shoreline survey. Where the bacterial concentration is labelled, 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 1×10^3, in this case it would be written as 1E+3.

In summary, identified sources of potentially significant contamination are:

- Freshwater streams in the area
- Outfall pipes in the area
- Livestock grazing in fields adjacent to the shoreline
- Wildlife including seabirds and rabbits around Fersness Bay

Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Fishery

The shellfish bed is located in Fersness Bay, however the exact boundaries of the area are unknown. At the time of the survey, the harvesting area was restricted due to the presence of creels.

Human sewage inputs

The island of Eday has a population of 121 (2001 census). There are no large settlements on Eday and dwellings are scattered all over the island. Adjacent to Fersness Bay there are roughly ten dwellings scattered along the coastline. There is one known SEPA consent for a discharge in the north. Four suspected outfall pipes were observed during the shoreline survey. The three suspected outfalls that were sampled at the time of the survey all yielded very low *E. coli* results.

Agricultural inputs

During the shoreline survey, livestock were present in fields adjacent to the shellfish bed. No livestock were observed along the western shoreline, however sheep droppings were seen on the shoreline at Bestonhall, indicating that sheep had been present. Approximately 80 sheep and 12 cattle were observed on the headland between the Loch of Doomy and the Sands of Doomy. A further 74 sheep were observed in a field on a cliff towards the centre of Fersness Bay. The largest number of livestock (approximately 119 sheep) was located in fields on the western side of Fersness Bay (see Figure 4.1). The concentration of livestock is generally high in all the areas immediately surrounding the bay and no livestock was observed north of the Bay of Doomy.

Wildlife inputs

During the shoreline survey pairs of gulls were spotted nesting all along the Fersness Bay shoreline in the cliffs and raised beaches. Cormorants and geese were also spotted in small numbers. Seabirds including the gulls will always be present along the coastline but their distribution is likely to be even over time and as such would not materially affect placement of an RMP.

There was evidence of rabbits around the cliffs but these were not restricted to any one part of the bay. Wildlife such as dolphins, porpoises, whales and water birds may be present at times in the area, however numbers and seasonality are unknown.

Seasonal variation

There were no historical monitoring results available to establish a pattern of seasonal variation.

Livestock numbers in the area as a whole are likely to be at their highest during the summer months when calves and lambs are present. During the

warmer months livestock may access streams to drink and cool off more frequently, leading to higher levels of faecal contamination in freshwater streams and the shellfish bed itself.

Rivers and streams

A total of fourteen streams were discharging into the Fersness Bay shellfish bed area at the time of the shoreline survey. The water samples taken from these streams gave results between <10 and 80 *E. coli* (cfu/100 ml) indicating low levels of contamination. Twelve out of fourteen of these streams discharge directly into the area of the shellfish bed.

Rainfall

Rainfall patterns at Kirkwall (the nearest rainfall station) show rainfall levels are higher between October and January than during the remainder of the year. An increase in rainfall, especially early in this period and after the dry summer months, may be expected to wash a flush of bacteria from the surrounding land into the production area. The impact of this is likely to be most acute nearest where the streams enter the sea.

Analysis of results

There are no historical monitoring results available for Fersness Bay.

Fresh water samples were taken all along the coastline of the Fersness Bay shellfish bed area from flowing suspected outfall pipes. However, the highest result taken was only 30 *E. coli* (cfu/100 ml).

The level of contamination and calculated bacterial loading for the streams discharging into Fersness Bay were relatively low at the time of survey.

Seawater samples were taken at several points along the coastline. Results were low ranged from <1 to 15 *E. coli* (cfu/100 ml).

Razor fish samples were collected at one point at the eastern end of the shellfish bed, off the coast of the Doomy headland. The razor samples returned low results of <20 and 20 *E. coli* (MPN/100 g).

Movement of contaminants

The dilution of contaminants within the bay will be relatively minor due to the shallow depth. Contamination from any individual source will be likely to be take parallel to the shore by tidal currents.

Overall conclusions

There are several potential sources of faecal contamination around the bay. However, none of these predominated at the time of the shoreline survey and it is expected that the spatial distribution will be relatively even, although impacts will be greatest closer to the shore.

11. Recommendations

The recommended production area is the area bounded by a line drawn between HY 5304 3451 and HY 5552 3465 extending to MHWS (see Figure 11.1). This covers the area of the potential fishery as identified to Cefas at the time of the shoreline survey and also the location of the dredges (successful and unsuccessful) undertaken at the time of the survey.

The recommended RMP for both species is HY 5449 3358 with a tolerance of 150m (see Figure 11.1). This location is immediately off shore of the stream containing the largest *E. coli* loading and the seawater sampling location that yielded the highest *E. coli* result. The tolerance should allow for variation in density of the two species. If initial dredges are unsuccessful with the specified tolerance, the recommendation can be reviewed.

Sampling frequency should initially be monthly and reviewed when sufficient data has been obtained.

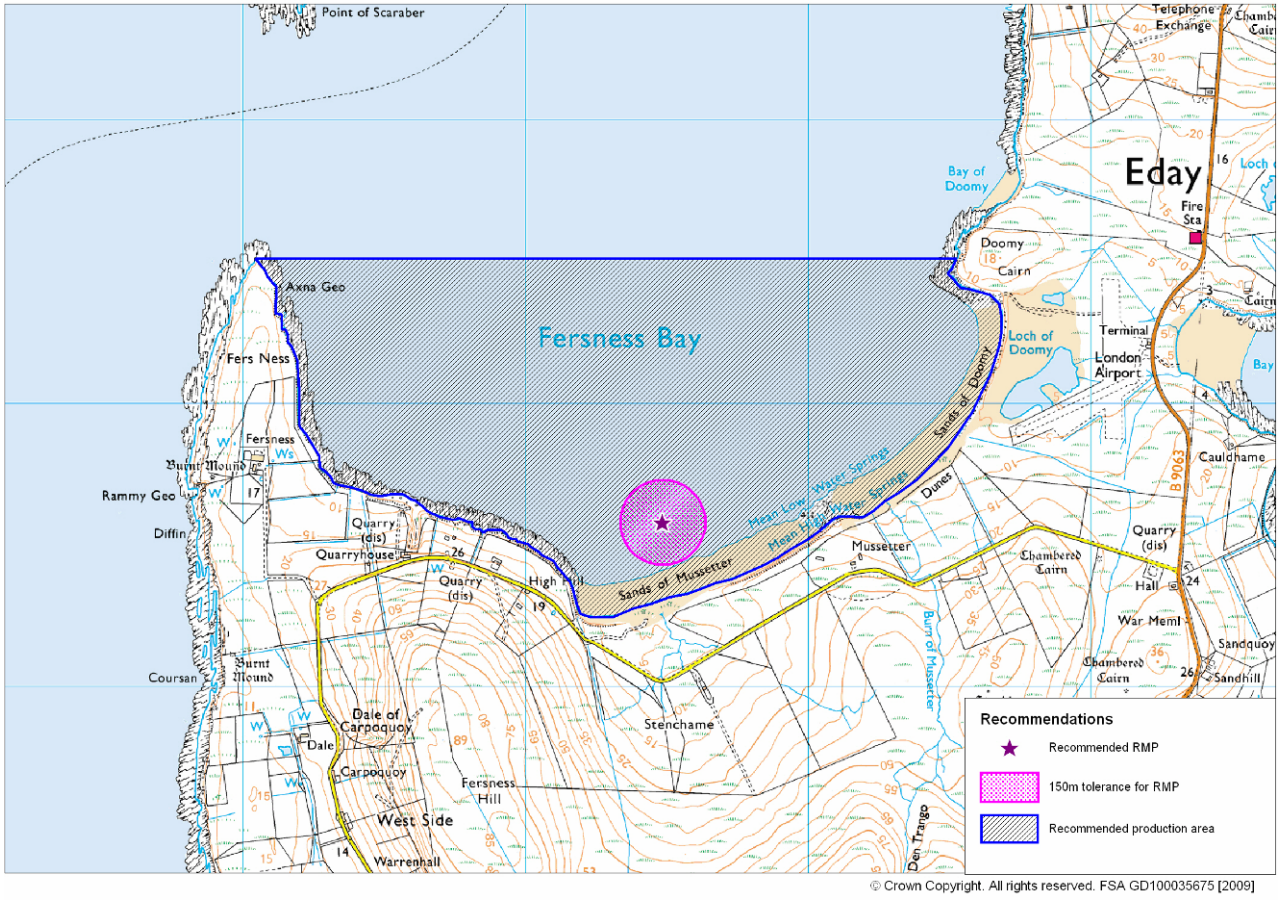


Figure 11.1 Recommendations for Fersness Bay

12. References

Lisle, J.T., Smith, J.J., Edwards, D.D., and McFeters, G.A. (2004). Occurrence of microbial indicators and *Clostridium perfringens* in wastewater, water column samples, sediments, drinking water, and Weddell Seal faeces collected at McMurdo Station, Antarctica. *Applied Environmental Microbiology*, 70:7269-7276.

Lee, R.J., Morgan, O.C. (2003). Environmental factors influencing the microbial contamination of commercially harvested shellfish. *Water Science and Technology* 47, 65-70.

Mallin, M.A., Ensign, S.H., McIver, M.R., Shank, G.C., Fowler, P.K. (2001). Demographic, landscape, and meteorological factors controlling the microbial pollution of coastal waters. *Hydrobiologia* 460, 185-193.

13. List of Figures and Tables

Figures

Tables

Appendices

1. Summary Sampling Plan
2. Shoreline Survey Report

Sampling Plan for Fersness Bay

PRODUC-TION AREA	SITE NAME	SIN	SPECIES	TYPE OF FISH-ERY	NGR OF RMP	EAST	NORTH	TOLER-ANCE (M)	DEPTH (M)	METHOD OF SAMPLING	FREQ OF SAMPLING	LOCAL AUTHORITY	AUTHORISED SAMPLER(S)	LOCAL AUTHORITY LIAISON OFFICER
Fersness Bay	Fersness Bay	OI 455	Razor clams, Common cockles	Wild harvest	HY 5449 3358	354490	1033580	150	NA	Dredging	Monthly	Orkney Islands Council	Julie Murphy	Julie Murphy

Shoreline Survey Report

Fersness Bay
Orkney
OI 455

Restricted Scottish Sanitary Survey

Shoreline Survey Report

Production area:	Fersness Bay	
Site name:	Fersness Bay	
Species:	Razors	
	Cockles	
Harvester:	Robert Hutchinson	
Local Authority:	Orkney Islands Council	
Status:	New application	
Date Surveyed:	Monday 2nd March 2009 & Thursday 5th March 2009	
Surveyed by:	Jessica Larkham	Cefas
	Dr Ron Lee	Cefas
	Julie Murphy	Orkney Islands Council
Existing RMP:	N/A	
Area Surveyed:	See Figure 1.	

Weather observations
Monday 2nd March: Cloudy, strong winds, 3-4m swell, some showers, 5.8°C.
Thursday 5th March: Light cloud cover, slight breeze, dry with little rainfall in previous 24hrs.

Site Observations

Fishery

The Fersness Bay site is harvested for Razors (*Ensis spp*) and Common cockles (*Cerastoderma edule*). The razors are mechanically dredged within the vicinity of Fersness Bay. There are restrictions on the area due to the presence of creels. The harvester plans to harvest every month apart from June to August.

Sewage/Faecal Sources

The area surveyed is sparsely populated with individual dwellings and farms along the stretch of the coastline from Greenan Nev in the north to Fersness on the western side of the bay. There is only one private septic tank registered with SEPA, located towards the northern end of survey area, towards the Bay of Newark. During the shoreline survey three outfall pipes were discovered. The first was located at the beginning of the walk on the northern shoreline near Greenan Nev, the second was located mid way down the eastern coastline near Newark and the final one was located on the western shoreline close to the disused quarry.

Seasonal Population

There are no campsites/caravan parks or B&Bs/hotels in the vicinity of Fersness Bay.

Boats/Shipping

There is little shipping activity in the water surrounding the island of Eday. The ferry route from Kirkwall to North Ronaldsay runs along the western coastline of Eday and therefore Fersness Bay. Fishing boats are expected to be present in the area although only one creel boat was observed (300m off the shoreline) on the day of the survey.

Land Use

Surrounding Fersness Bay beach are sand dunes, with heath land on the cliffs and grassland and arable farmland in the surrounding fields.

Wildlife/Birds

During the shoreline survey gulls and cormorants were observed all the along the coastline of Fersness Bay. In total, approximately 106 gulls, 18 cormorants and 2 geese were observed.

Shoreline observations can be found in Table 1 and the locations are shown in Figure 1.

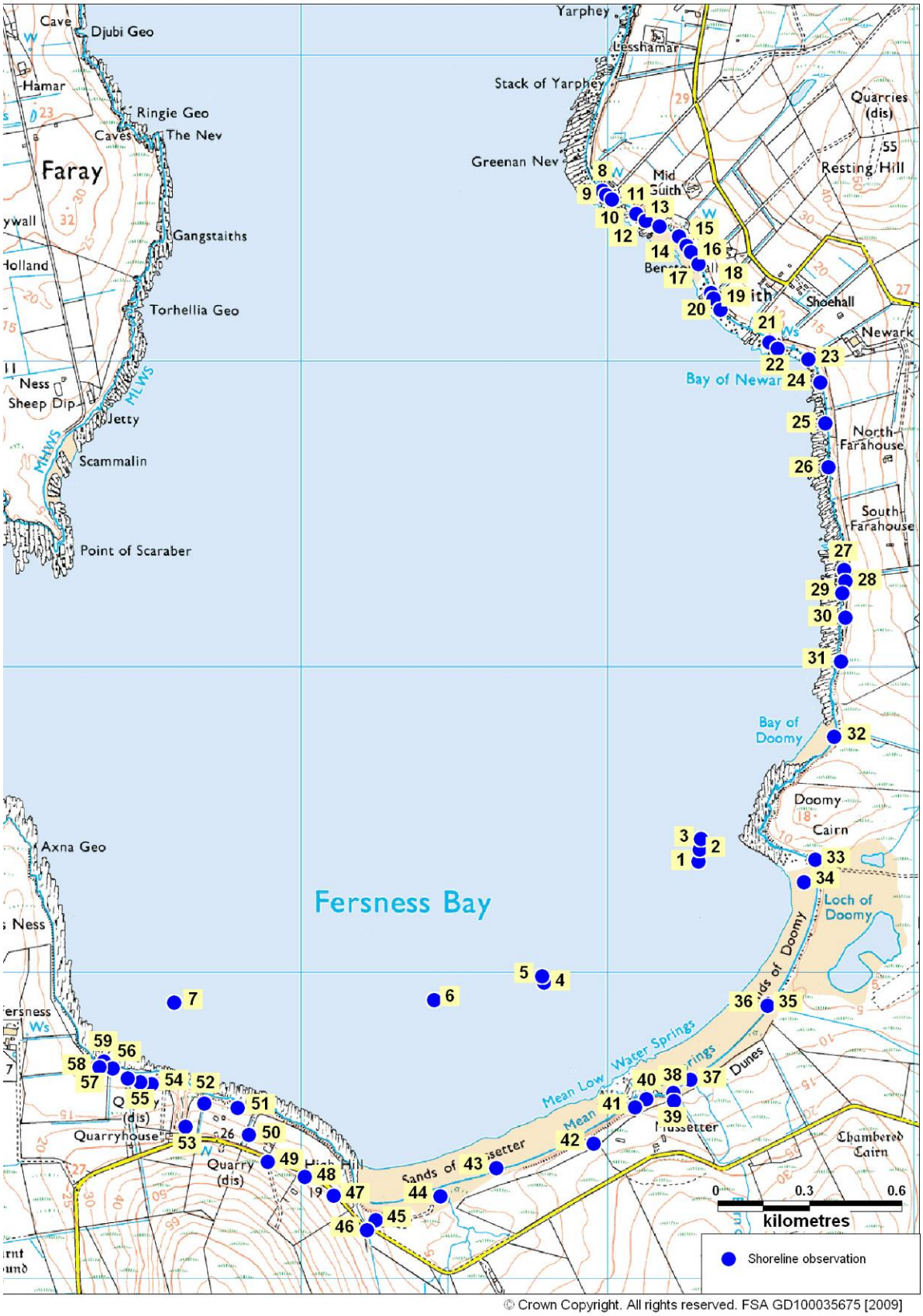


Figure 1. Shoreline observations

Table 1. Shoreline observations

No.	Date	Time	NGR	East	North	Associated photograph	Description
1	02/03/2009	12:37 PM	HY 55300 34366	355300	1034366		Approx. 80 sheep, 12 cattle on shoreline. Start of 1st dredge. 4 houses on shoreline.
2	02/03/2009	12:45 PM	HY 55304 34405	355304	1034405		Salinity = 34.5ppt.
3	02/03/2009	12:49 PM	HY 55309 34441	355309	1034441		Fersness shellfish samples 1 & 2 (both razors). Fersness seawater sample 1.
4	02/03/2009	1:03 PM	HY 54795 33970	354795	1033970		Start of 2nd dredge (unsuccessful). Salinity = 34.5.
5	02/03/2009	1:10 PM	HY 54789 33991	354789	1033991		Fersness sea water sample 2.
6	02/03/2009	1:18 PM	HY 54436 33913	354436	1033913		Fersness sea water sample 3.
7	02/03/2009	1:25 PM	HY 53588 33905	353588	1033905		Fersness sea water sample 4. Salinity 34.5, air temperature 7.1^{0}C. Approx 100 sheep, 1 farm & 7 houses on the shoreline. 6 gulls on the water.
8	05/03/2009	9:22 AM	HY 54986 36561	354986	1036561		Small croft with dwelling.
9	05/03/2009	9:24 AM	HY 54998 36547	354998	1036547	Figure 4	15cm pipe flowing off cliff onto shoreline, very small flow. Mulched toilet tissue in pile on floor underneath pipe.
10	05/03/2009	9:26 AM	HY 55016 36532	355016	1036532	Figure 5	Land seepage.
11	05/03/2009	9:30 AM	HY 55098 36485	355098	1036485		Land seepage.
12	05/03/2009	9:31 AM	HY 55127 36464	355127	1036464		Land seepage.
13	05/03/2009	9:34 AM	HY 55173 36445	355173	1036445		New cottage 200m inland.
14	05/03/2009	9:38 AM	HY 55236 36411	355236	1036411	Figure 6	Small stream W 0.22, D 0.08, Flow 0.463. Frothing in places. Fersness fresh water sample 1.
15	05/03/2009	9:43 AM	HY 55261 36382	355261	1036382	Figure 7	Small concrete hut up some steps with a well beside it, contains pipe work and old rusty pump inside. Sheep droppings nearby. Overflow pipe would discharge onto shore but no flow.
16	05/03/2009	9:48 AM	HY 55276 36361	355276	1036361		Surface water flowing onto shoreline from field.
17	05/03/2009	9:50 AM	HY 55301 36322	355301	1036322		Very small stream.
18	05/03/2009	9:54 AM	HY 55341 36227	355341	1036227		Surface water flowing onto shoreline from field.
19	05/03/2009	9:56 AM	HY 55349 36208	355349	1036208		Surface water flowing onto shoreline from field.
20	05/03/2009	9:59 AM	HY 55372 36171	355372	1036171		New cottage 200m inland to NNE and old cottage 200m inland to E.
21	05/03/2009	10:07 AM	HY 55532 36065	355532	1036065		Concrete structure at top of shore. Cottage 150m inland.
22	05/03/2009	10:09 AM	HY 55558 36045	355558	1036045		Field run off.

No.	Date	Time	NGR	East	North	Associated photograph	Description
23	05/03/2009	10:13 AM	HY 55660 36010	355660	1036010	Figure 8	25cm diameter pipe, flow (jug) 700ml/1 second. Fersness fresh water sample 2.
24	05/03/2009	10:19 AM	HY 55698 35933	355698	1035933	Figure 9	6 gulls on shoreline.
25	05/03/2009	10:23 AM	HY 55714 35800	355714	1035800		Surface water flowing onto shoreline from field. Croft 200m inland. Lots of bird droppings in the area.
26	05/03/2009	10:33 AM	HY 55725 35656	355725	1035656	Figure 10	8 cormorants on small rocks, 10m off shoreline.
27	05/03/2009	11:02 AM	HY 55775 35320	355775	1035320		Field run off.
28	05/03/2009	11:05 AM	HY 55780 35283	355780	1035283		Rabbit droppings, lots of it concentrated in a small area. Also some sheep droppings.
29	05/03/2009	11:08 AM	HY 55769 35245	355769	1035245		Field run off.
30	05/03/2009	11:10 AM	HY 55780 35165	355780	1035165		Bungalow 500m inland.
31	05/03/2009	11:13 AM	HY 55765 35022	355765	1035022		10 cormorants in sea and approx. 12 gulls on cliff edge.
32	05/03/2009	11:19 AM	HY 55744 34775	355744	1034775	Figure 11	Stream down centre of sandy part of beach from sand dunes. W 0.25, D 0.10, Flow 0.238. Fersness fresh water sample 3. Fersness seawater sample 5.
33	05/03/2009	11:49 AM	HY 55681 34372	355681	1034372	Figure 12	Passage between sand dunes from Loch of Doomy to Fersness Bay. Stagnant water all they way along, looks like there might be a flow on occasions.
34	05/03/2009	11:52 AM	HY 55644 34299	355644	1034299		Fersness seawater sample 6. 1 razor shall observed on beach, roughly every 10m.
35	05/03/2009	12:01 PM	HY 55527 33901	355527	1033901	Figure 13	Stream from dunes splits into two streams on beach. Fersness fresh water sample 4, taken at stream prior to it dividing. 1st part of stream W 0.50, D 0.09, Flow 0.195.
36	05/03/2009	12:02 PM	HY 55526 33895	355526	1033895		2nd part of stream (mentioned above) W 0.28, D 0.11, Flow 0.202.
37	05/03/2009	12:11 PM	HY 55274 33653	355274	1033653	Figure 14	Stream from dunes, W 0.70, D 0.05, Flow 0.332. Fersness fresh water sample 5.
38	05/03/2009	12:14 PM	HY 55217 33609	355217	1033609	Figure 15	Stream from dunes, W 0.20, D 0.06, Flow 0.160. Fersness fresh water sample 6. 4 gulls on bank.
39	05/03/2009	12:18 PM	HY 55220 33584	355220	1033584	Figure 16	New house and concrete shed inland. Approx. 74 sheep in field next to house.
40	05/03/2009	12:21 PM	HY 55130 33589	355130	1033589	Figure 17	Water flowing onto shore, just below new house mentioned above. W 0.08, D 0.07, Flow 0.057. Fersness fresh water sample 7. Rabbit burrows in sand

No.	Date	Time	NGR	East	North	Associated photograph	Description
							on cliff and in heather.
41	05/03/2009	12:24 PM	HY 55092 33562	355092	1033562		Water flowing onto shore, W 0.12, D 0.08, Flow 0.010. Fersness fresh water sample 8. 6 pairs of gulls.
42	05/03/2009	12:32 PM	HY 54958 33443	354958	1033443		Water flowing from cliff onto shoreline. Sampled and measured on the cliff. W 0.07, D 0.06, Flow 0.390. Fersness fresh water sample 9.
43	05/03/2009	12:44 PM	HY 54640 33364	354640	1033364		Fersness seawater sample 7.
44	05/03/2009	12:48 PM	HY 54458 33271	354458	1033271	Figure 18	Stream from dunes onto beach, W 1.0, D 0.06, Flow 0.644. Fersness fresh water sample 10.
45	05/03/2009	1:09 PM	HY 54246 33193	354246	1033193	Figure 19	16 gulls at south end of bay.
46	05/03/2009	1:12 PM	HY 54217 33160	354217	1033160	Figure 20	Stream (goes under road and travels down to sea). W 0.24, D 0.07, Flow 0.059. Fersness fresh water sample 11.
47	05/03/2009	1:17 PM	HY 54108 33273	354108	1033273	Figure 21	9 sheep in field next to road.
48	05/03/2009	1:19 PM	HY 54014 33335	354014	1033335	Figure 22	Cottage next to road. 2 geese in field. Approx. 8 sheep on wrong side of fence, on the shoreline.
49	05/03/2009	1:21 PM	HY 53892 33385	353892	1033385		Derelict extensive croft buildings.
50	05/03/2009	1:25 PM	HY 53831 33472	353831	1033472	Figure 23	6cm diameter pipe flowing into a stream on the shoreline. W 0.08, D 0.04, Flow 0.108. Fersness fresh water sample 12.
51	05/03/2009	1:30 PM	HY 53795 33561	353795	1033561		Ground water seepage.
52	05/03/2009	1:33 PM	HY 53686 33574	353686	1033574	Figure 24	Ditch along side of field from road to shoreline. W 0.12, D 0.15, Flow 0.004. Fersness fresh water sample 13.
53	05/03/2009	1:40 PM	HY 53625 33500	353625	1033500	Figure 25	Disused quarry with lots of gulls, est. 50.
54	05/03/2009	1:48 PM	HY 53514 33639	353514	1033639		Small house 300m inland from shore. 2 sheep in field. 1 creel boat offshore about 300m away.
55	05/03/2009	1:50 PM	HY 53476 33644	353476	1033644		Field drainage.
56	05/03/2009	1:51 PM	HY 53435 33658	353435	1033658	Figure 26	Ditch from direction of small house, flowing onto shore. W 0.38, D 0.05, Flow 0.188. Fersness fresh water sample 14.
57	05/03/2009	1:57 PM	HY 53387 33689	353387	1033689		Field run off.
58	05/03/2009	1:59 PM	HY 53343 33693	353343	1033693	Figure 27	Pipe, Fersness fresh water sample 15. Flowing into stream on beach, W 0.11, D 0.10, Flow 0.072.
59	05/03/2009	2:04 PM	HY 53357 33712	353357	1033712		Fersness seawater sample 8.

Photos referenced in the table can be found attached as Figures 4 - 27.

Sampling

Water samples were collected at sites marked on the map in Figure 2. Seawater samples were collected on both the 2nd and 5th March, whilst fresh water samples were only collected on the 5th March. Shellfish samples were collected on 2nd March, two days before the shoreline survey due to the availability of the harvester. Bacteriology results follow in Tables 2 and 3.

Seawater samples were tested for salinity using a hand held refractometer. These readings are recorded in Table 1 as salinity in parts per thousand (ppt).

Water and shellfish samples were collected at sites marked on the map.

Table 2. Water sample results

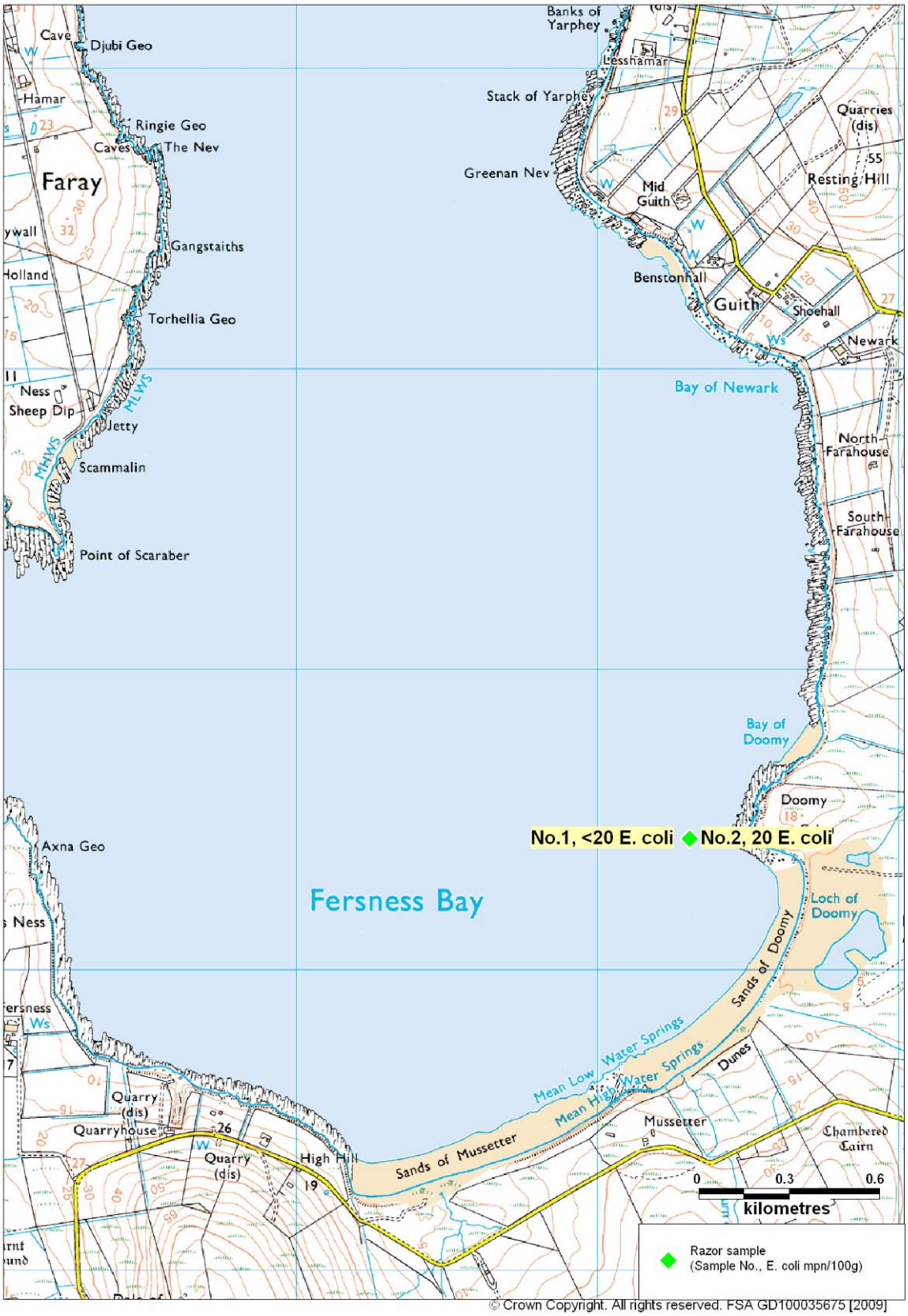
No.	Date	Sample	Grid Ref	Type	E. coli (cfu/ 100ml)	Salinity (ppt.)
1	02/03/2009	Fersness SW1	HY 55309 34441	Seawater	<1	34.5
2	02/03/2009	Fersness SW2	HY 54789 33991	Seawater	<1	34.5
3	02/03/2009	Fersness SW3	HY 54436 33913	Seawater	<1	34
4	02/03/2009	Fersness SW4	HY 53588 33905	Seawater	<1	34.5
5	02/03/2009	Fersness SW5	HY 55744 34775	Seawater	<1	34
6	02/03/2009	Fersness SW6	HY 55644 34299	Seawater	<1	35
7	02/03/2009	Fersness SW7	HY 54640 33364	Seawater	15	33
8	02/03/2009	Fersness SW8	HY 53357 33712	Seawater	3	32
9	05/03/2009	Fersness FW1	HY 55236 36411	Freshwater	10	-
10	05/03/2009	Fersness FW2	HY 55660 36010	Freshwater	10	-
11	05/03/2009	Fersness FW3	HY 55744 34775	Freshwater	<10	-
12	05/03/2009	Fersness FW4	HY 55527 33901	Freshwater	<10	-
13	05/03/2009	Fersness FW5	HY 55274 33653	Freshwater	80	-
14	05/03/2009	Fersness FW6	HY 55217 33609	Freshwater	30	-
15	05/03/2009	Fersness FW7	HY 55130 33589	Freshwater	<10	-
16	05/03/2009	Fersness FW8	HY 55092 33562	Freshwater	<10	-
17	05/03/2009	Fersness FW9	HY 54958 33443	Freshwater	<10	-
18	05/03/2009	Fersness FW10	HY 54458 33271	Freshwater	20	-
19	05/03/2009	Fersness FW11	HY 54217 33160	Freshwater	<10	-
20	05/03/2009	Fersness FW12	HY 53831 33472	Freshwater	<10	-
21	05/03/2009	Fersness FW13	HY 53686 33574	Freshwater	<10	-
22	05/03/2009	Fersness FW14	HY 53435 33658	Freshwater	20	-
23	05/03/2009	Fersness FW15	HY 53343 33693	Freshwater	30	-

Table 3. Shellfish sample results

No.	Date	Sample	Grid Ref	Type	E. coli (cfu/100g)
1	03/03/09	Fersness 1	HY 55309 34441	Razor	<20
2	03/03/09	Fersness 2	HY 55309 34441	Razor	20

Figure 3. Water sample results

Figure 4. Shellfish sample results



Photographs

Figure 4 15cm pipe flowing from cliff onto shoreline. Mulched toilet tissue in pile underneath pipe.

Figure 5 Land seepage

Figure 6 Small stream with froth, location of fresh water sample 1.

Figure 7 Concrete hut containing pipe work and rusty water pump.

Figure 8. 25cm diameter pipe flowing onto shoreline, fresh water sample 2.

Figure 9. Gulls nesting on cliff next to shoreline.

Figure 10. Cormorants on small rocks 10m off shore.

Figure 11. Stream running down centre of beach at Bay of Doomy. Location of fresh water sample 3.

Figure 12. Passage between sand dunes from Loch of Doomy to Fersness Bay.

Figure 13. Stream running across Fersness Bay, location of fresh water sample 4.

Figure 14. Stream running across Fersness Bay, location of fresh water sample 5.

Figure 15. Stream running across Fersness Bay, location of fresh water sample 6.

Figure 16. New house with approx. 74 sheep in field next to it.

Figure 17. Water flowing onto shoreline, new house behind. Location of fresh water sample 7.

Figure 18. Stream running across Fersness Bay, location of fresh water sample 10.

Figure 19. Gulls nesting on cliffs at south end of Fersness Bay.

Figure 20. Stream running under road down to Fersness Bay, location of fresh water sample 11.

Figure 21. Sheep in field next to shoreline and road.

Figure 22. Cottage next to road.

Figure 23. 6cm pipe flowing onto shoreline, location of fresh water sample 12.

Figure 24. Ditch running along side road and down to shoreline, location of fresh water sample 13.

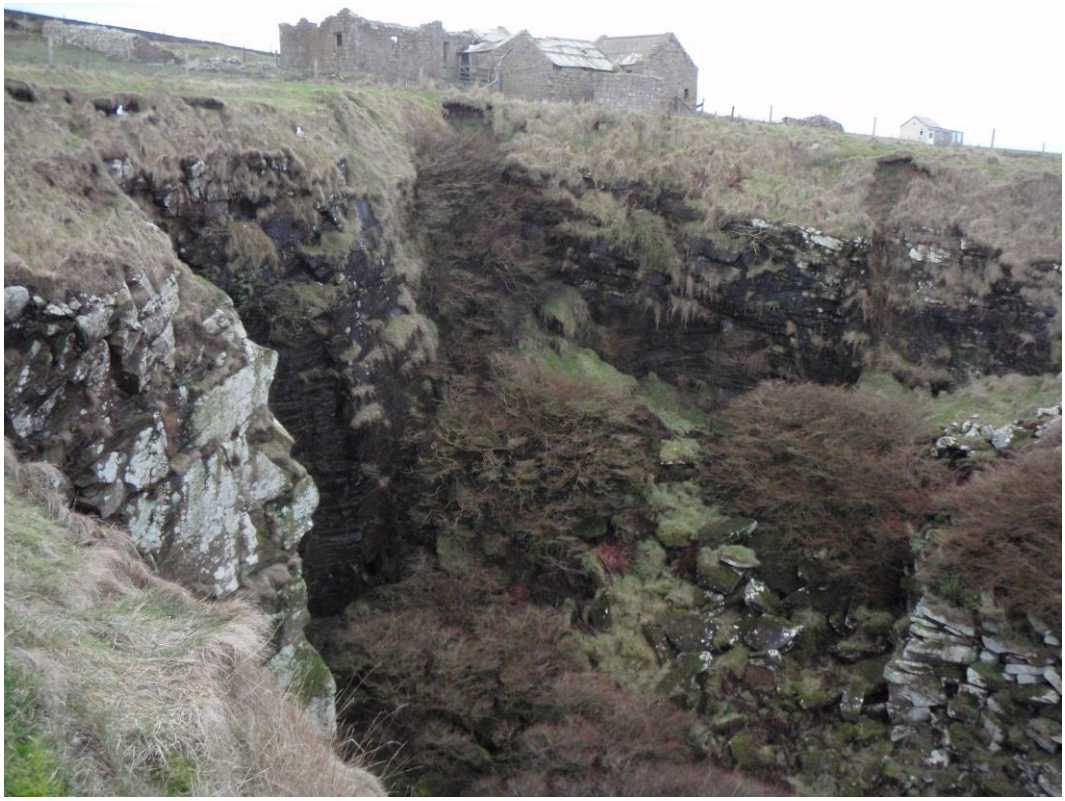


Figure 25. Disused quarry with gulls nesting.

Figure 26. Ditch flowing down to shoreline next to small house. Location of fresh water sample 14.

Figure 27. Pipe flowing into stream down to beach. Location of fresh water sample 15.