Scottish Sanitary Survey Review

Busta Voe Lee North

SI 327; 410, 409, 755, 753, 754

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	Name	Position	Date
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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 European Union Reference Laboratory publication: “Microbiological Monitoring of Bivalve Mollusc Harvesting Area Guide to Good Practice: Technical Application” (http://www.cefas.defra.gov.uk/nrl/information-centre/eu-good-practice-guide.aspx) 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 2008 for Busta Voe Lee North. The survey was conducted to identify the location, extent and nature of the shellfisheries and the potential

sources of faecal contamination to the shellfisheries, and to recommend boundaries and sampling plans for the production areas. The associated shoreline survey was undertaken in September 2007.

The output of the sanitary survey included a report and recommended sampling plans . 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 2008 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 2008 sanitary survey report.

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Sampling Plan – Busta Voe Lee North

	2008 report	2014 review	Changes from 2008
PRODUCTION AREA	Busta Voe Lee North		No changes
SITE NAMES	Busta Voe Lee, Busta Voe, Hevden Ness, North of Linga, Wetherstaness		
SIN	SI 327-410-08; SI-327-409-08; SI-327-755-08; SI-327-753-08 and SI-327-754-08		
SPECIES	Common mussels		
TYPE OF FISHERY	Long-line		
NGR OF RMP	HU 3570 6616	HU 3577 6615	Changed to include consideration of contaminants coming from land to the east of the fishery
EAST	435700	435770	
NORTH	116160	1166150	
TOLERANCE (M)	20 m	40 m	Increased tolerance to allow for movement of lines
DEPTH (M)	1-3 m	1-3 m	No change
METHOD OF SAMPLING	Hand		No change
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Shetland Island Council		
AUTHORISED SAMPLER (S)	Sean Williamson, George Williamson, Kathryn Winter, Marion Slater	Sean Williamson, Marion Anderson, Gwen Williamson, Vicki Smith	Change in personnel
RECOMMENDED PRODUCTION AREA	Area bounded by lines drawn between HU 3597 6634 to HU 3459 6660 and from HU 3420 6590 to HU 3420 6605 and from HU 3430 6450 to HU 3520 6432 and HU 3568 6428 to HU 3657 6419 to HU 3614 6483 extending to MHWS	Area bounded by lines drawn between HU 3597 6634 to HU 3459 6660 and from HU 3420 6590 to HU 3420 6605 and from HU 3430 6450 to HU 3520 6432 and HU 3568 6428 to HU 3657 6419 to HU 3614 6483 extending to MHWS	No changes

1. Area Description and Fishery

The location of Busta Voe Lee North is shown in Figure 1.1.

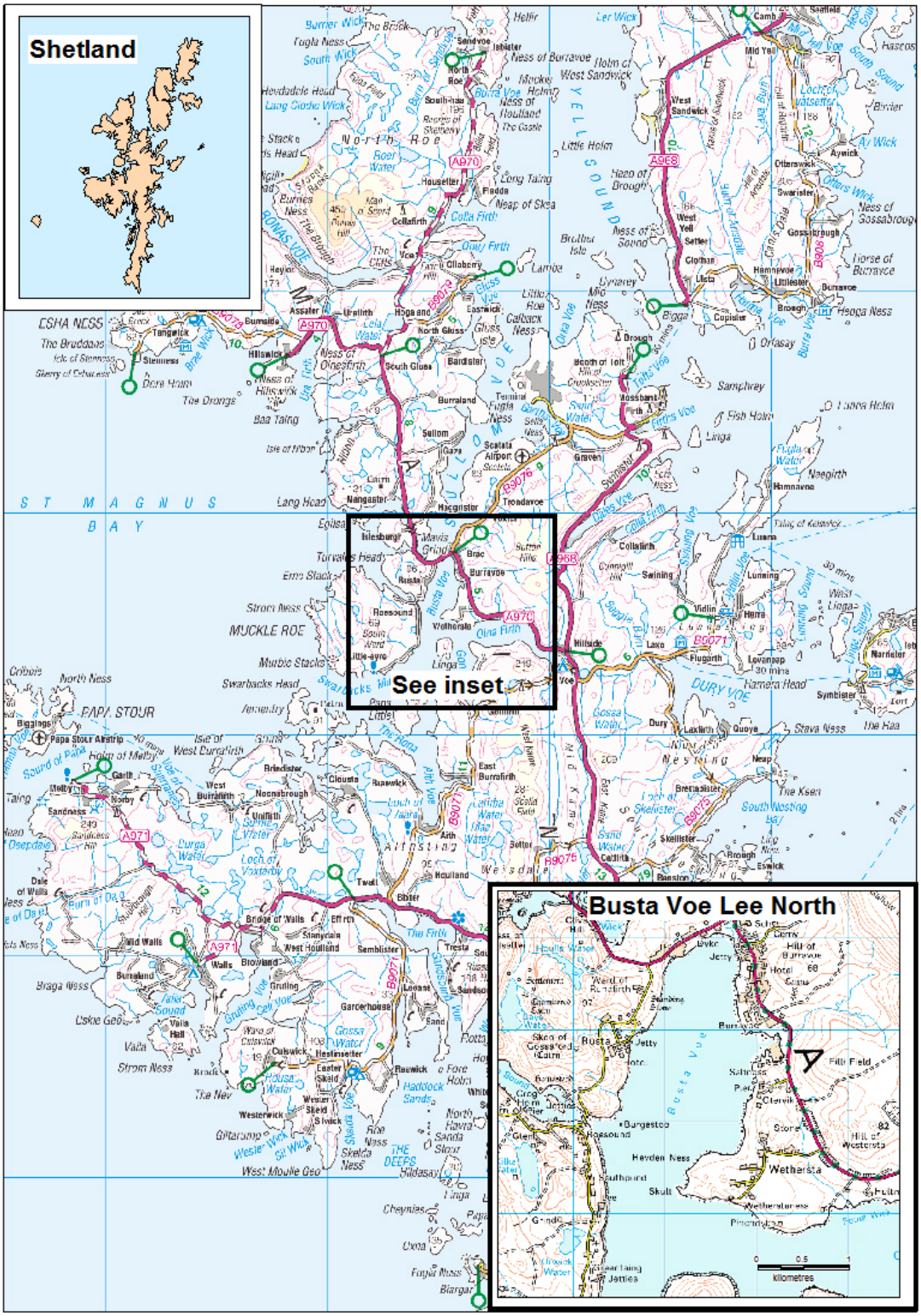

Figure 1.1 Location of Busta Voe Lee North

The five sites classified in the 2008 report remain classified in 2014, with details listed in Table 1.1.

Table 1.1 FSAS 2014 classified sites in Busta Voe Lee North

Production area	Site	SIN	Species	RMP
Busta Voe Lee North	Busta Voe Lee	SI-327-410-08	Common mussels	HU 3570 6616
	Busta Voe	SI-327-409-08		
	Hevden Ness	SI-327-755-08		
	North of Linga	SI-327-753-08		
	Wetherstaness	SI-327-754-08		

The current production area boundaries and RMP stated in the FSAS 2014/15 classification document are the same as those recommended in the 2008 report and are shown in Figure 1.2. Mussel farm boundaries are shown to have varied slightly between the 2007 and 2014 shoreline surveys (see Figure 1.2), though the location of each farm has remained largely constant.

All five sites were identified as still being active during the 2014 shoreline survey and harvesting continued to be rotational. The number of double headed long-lines has remained the same at the following sites: Busta Voe Lee (n=10), Hevden Ness (n=10) and Wetherstaness (n=6). The North of Linga site has increased from four to six lines. The number of lines present at Busta Voe was not given in the 2008 sanitary survey report: in 2014 nine double headed long-lines present. It was noted during the 2014 shoreline survey that the long-lines at each site had 10 m droppers.

The maximum permitted equipment for each site is as follows:

Site	Maximum number of lines	Maximum length (m)
Busta Voe Lee	10	155
Busta Voe	9	200
Hevden Ness	10	220
North of Linga	10	260
Wetherstaness	10	200

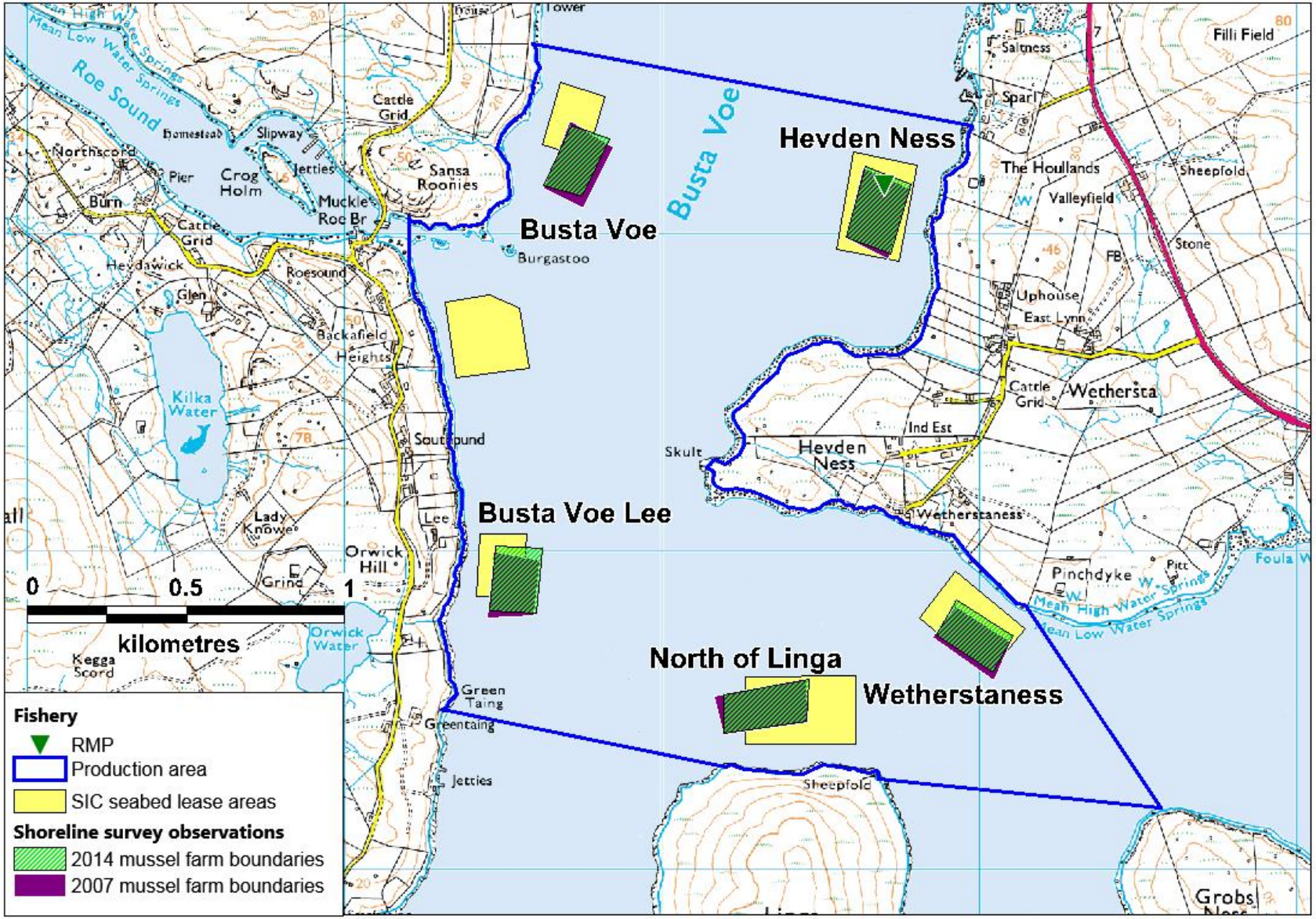

Figure 1.2 Busta Voe Lee North fishery locations in 2008 and 2014, and the current RMP and production area

2. Population and Human Sewage Impacts

2.1 Population

Population data from the General Register Office for Scotland for both the 2001 and 2011 censuses for areas contiguous with Busta Voe Lee North are shown in Table 2.1. The census output areas are shown in Figure 2.1, thematically mapped by population density.

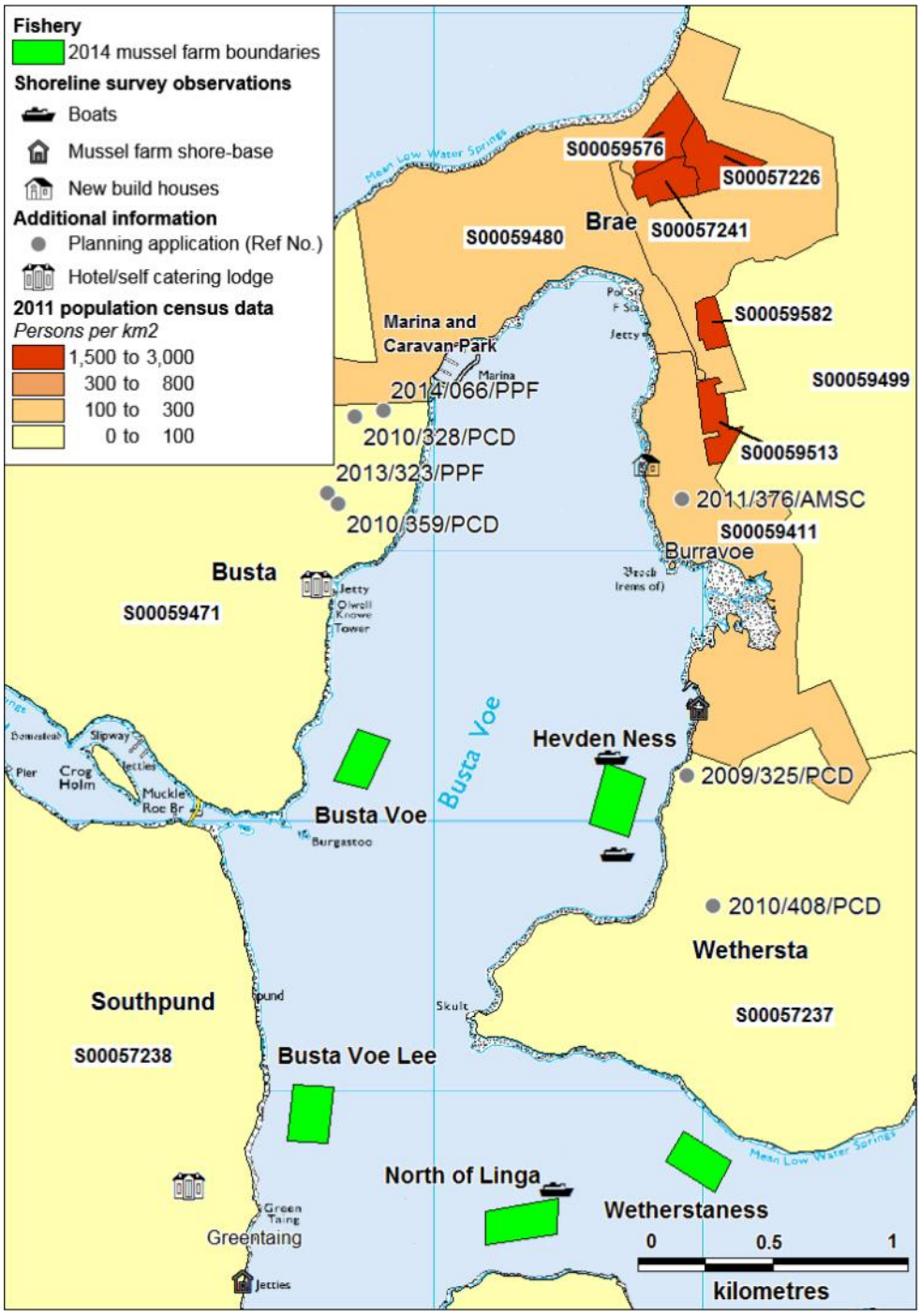

Figure 2.1 Current distribution of human population around Busta Voe Lee North

Table 2.1 Scottish Government Census data for years 2001 and 2011

2001 Census data		2011 Census data	
Census output area	Count	Census output area	Count
60RD000137	50	S00057237	61
60RD000066	65	S00059499	69
60RD000123	102	S00059513	82
60RD000037	104	S00057238	130
60RD000038	160	S00059471	148
60RD000120	183	S00059480	167
60RD000122	207	S00059411	146
TOTAL	871	**TOTAL**	803

Overall, human population around Busta Voe Lee North production area decreased between census years 2001 and 2011, with the largest decrease reported in the output area southeast of Brae. Comparatively, some areas reported notable increases in population e.g. Wethersta (southeast of the voe) and Southpund (southwest of the voe). The highest population density remained in Brae at the northeast head of the voe.

Seven planning applications pertaining to areas around Busta Voe Lee North have been approved since the 2008 sanitary survey report. These applications were downloaded from the Shetland Island Council Planning Portal in July 2014 (Shetland Islands Council, 2014), with full details listed in Appendix 1. Locations of these planning applications are displayed in Figure 2.1. Four applications were made in the northwest of the voe between Brae Marina and Busta jetty. These included the erection of two chalets with a new septic tank (ST) to soakaway, a planning in principal for 17 new residential houses with a connection to the public sewer and two new dwellinghouses, one with a connection to the public sewer and the other connecting to a shared ST to soakaway. The remaining three applications plotted along the east side of the voe. These included the erection of eight dwellinghouses at Brae Camp (near Burravoe) with plans to connect to the public sewer, a new dwellinghouse with ST to soakaway adjacent to Hevden Ness and a dwelling house connecting to an existing ST in Wethersta. No observations were made in the proximity of the planning application locations, though three additional new-build houses were noted to the northeast of the voe.

Holiday accommodation is mostly centred in the town of Brae. There is a caravan park associated with the Delting Boating Club (marked as marina and caravan park on the map) to the northwest of the voe, which has 13 pitches, a chemical toilet disposal point and toilet/shower facilities (Delting Boat Club, 2014). The 2007 planning application for the boating club noted foul drainage goes to the public sewer.

New information relating to the Busta House Hotel located on the west side of the voe identified a sleeping capacity of 42 persons, catering for functions such as

weddings and also a restaurant that is open to members of the public (Busta House Hotel, 2014). Internet searches also found information relating to a self catering holiday unit; Orwick Lodge which was built in 2012 and has a small sleeping capacity of six (Orwick Lodge, 2014). The lodge is located on a hillside set back from the shoreline southwest of the voe, close to Greentaing and no observations of this lodge were made during the 2014 survey. Holiday accommodation around the voe is noted to be busiest during the summer months. A secondary influx of visitors to Shetland is also noted around the winter fire festivals from mid January to March.

Boat traffic noted during both shoreline surveys was predominantly related to servicing of the mussel and salmon farms in the voe. The 2014 survey also noted four small boats along the shoreline. It should be highlighted that Busta Voe is rated as one of the most popular sailing venues in Shetland, boasting a 54 berth marina facility at the head of the voe, near Brae (Shetland Marinas, 2014). This marina was newly opened and observed to be 50% occupied during the 2007 shoreline survey.

Two mussel farm shore-bases were specifically noted during the 2014 survey, both of which were in use during the previous survey. The Blueshell Mussel Ltd. shore-base was located at Sparl, just north of Wethersta and the second was in Greentaing and is used to serve two Busta Voe Lee South fisheries; Greentaing and Buddascord.

2.2 Sewage Discharges

The 2008 report included information on three community STs and two domestic STs. Only Brae community ST discharged into Busta Voe and was therefore considered to be the main contamination source to the Busta Voe Lee North production area. However, contamination from this ST was noted to stay northwards and would only impact Hevden Ness fishery during northerly winds, when contaminants were transported southwards. Proposed upgrades to Brae ST were also identified for the end of 2008 and included new tanks and a new outfall location a further 40 m offshore.

The 2007 shoreline survey found a number of private STs not identified in the list of consented discharges provided by SEPA. These were predominantly located on the northeast and northwest shorelines, with one ST found to be discharging in Burravoe, southeast of Brae.

Data requests sent to Scottish Water and SEPA for the 2012 Busta Voe Lee South survey report provided updated information on sewage discharges to the Busta Voe Lee North production area. This included the new location of the Brae ST outfall, which had a connected PE of 877 and a design PE of 1000, and a large number of additional private consents identified by SEPA, which are all displayed in Figure 2.2. The large number of private discharges identified by SEPA may at least partly

correspond with the 2009 fee waiver on registering private septic tanks. A list of the consents for which SEPA provided information in 2012 can be found in Appendix 2.

No further information on improvements/changes to STs around Busta Voe was found during the internet search carried out for this review.

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

Table 2.2 Sewage discharge-related observations around Busta Voe Lee North from the 2014 shoreline survey

No.	NGR	Description
1	HU 3418 6578	Concrete septic tank, two houses noted above the road. Wet area below tank with pipe present but no discharge.
2	HU 3581 6755	Brae community septic tank.
3	HU 3574 6754	Area in the sea observed short distance from the shore where water was disturbed creating a circular zone. Possibly end of discharge pipe from the Brae septic tank. No pipe visible on the shore entering the water.
4	HU 3579 6732	Pipe leading to the shore, broken in mid-section with grey discharge, slight smell. Green algal growth in the discharge area. Three new houses built near the shore with a number of houses present just up from the shore.
5	HU 3580 6731	Concrete septic tank below a white house near the shore. Slight smell from the tank.
6	HU 3599 6640	Septic tank thought to be associated with the Blueshell Mussels shore-base found just outside the fenced shore-base area. Small flow of water next to the tank flowing over rocks to the shore.
7	HU 3598 6635	Concrete septic tank within a fenced area below a house up from the shore. Another three houses present in the area.
8	HU 3572 6512	Concrete septic tank of house above the shore. Pipe leading to the shore but no discharge present, assumed to not be in use.

A disturbance in the water was noted a distance offshore from the Brae community ST and was thought to be stemming from the new outfall pipe despite no visible pipe onshore. A seawater sample taken from the shoreline adjacent to the ST returned a low result of 1 *E. coli* cfu/100 ml, suggesting little contamination at that location at the time of the shoreline survey.

Four other functioning STs were observed during the 2014 survey, one of which was noted to be leaking. This leaking ST was thought to be associated with Blueshell Mussels shore-base and was situated approximately 300 m northeast from Hevden Ness fishery. A seawater sample taken in-front of this tank returned a moderately high result (with respect to the range usually seen in Shetland shoreline surveys) of 48 *E. coli* cfu/100 ml. This discharge was also noted close to observation no. 8 and corresponded to a private, primary treated discharge to land soakaway (CAR/R/1070899) identified by SEPA in 2012. The origin of this discharge therefore remains unclear.

A broken pipe with an associated grey discharge was noted close to a ST associated with a white house located on the northeast shore, approximately 200 m south of the Brae ST. No sample was taken at this discharge, which lies approximately 1.1 km north of the Hevden Ness fishery.

Overall, contamination from Brae ST is still expected to remain within the northerly extent of the voe and will only impact the Hevden Ness fishery during northerly wind induced southward transport. It is not known to what extent the upgrades to the Brae ST will have had on levels of contamination crossing Hevden Ness. However, overall it is anticipated upgrades will have reduced levels entering the voe. The newly observed leaking ST noted to the southeast of the voe is expected to impact the northeast extent of the Hevden Ness fishery. It remains unclear whether contamination from the ST with a broken pipe located approximately 1.1 km north of Hevden Ness fishery will remain in the northern extent of the voe or may travel southward and impact the Hevden Ness fishery. New STs associated with new planning applications located in Wethersta and Busta may also act as contamination sources to the eastern and northern extents of Hevden Ness and Busta Voe fisheries respectively.

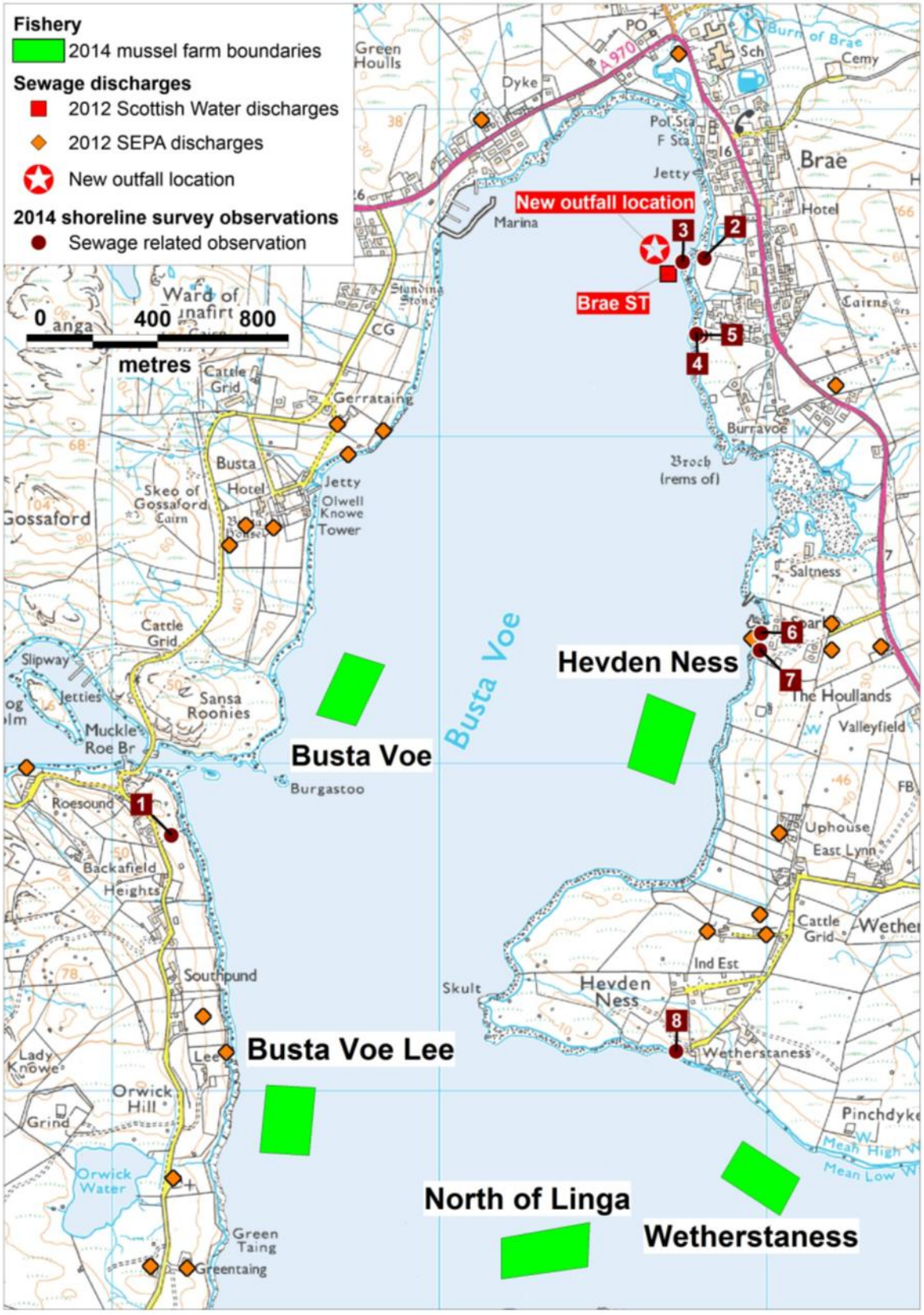

Figure 2.2 Map of public and private sewage discharge information from the 2012 Busta Voe Lee South sanitary survey report and sewage discharge related observations made during the 2014 Busta Voe Lee North shoreline survey

3. Farm Animal Population and Agricultural Impacts

In the 2008 sanitary survey, farm census data on the numbers of farm animals reported for Delting Parish was withheld by Scottish Government due to the small number of reporting farms. Therefore, information presented on farm animals in that report was based on shoreline survey observations made on 5-6th September 2007. Sheep represented the most significant agricultural contamination source to Busta Voe Lee North fisheries although, as high numbers were not observed in any one particular area, all areas were expected to experience similar levels of contamination. The report also indicated sheep abundance was likely to be highest in months May to September.

The 2012 Busta Voe Lee South sanitary survey report included agricultural census data to parish level from the Scottish Government Rural Environment, Research and Analysis Directorate (RERAD) for the Delting parish. The Delting parish covers a total area of 150 km^2 and includes part of mainland Shetland and the islands of Linga and Muckle Roe, encompassing Busta Voe. Overall the data indicated sheep were the main type of livestock kept in the area, with a rough average of 390 per holding. Cattle were also present but less common, with each holding having on average 31 animals. Low numbers of poultry were also kept in the area. Approximately 40 sheep were noted just north of Greentaing during the 2012 Busta Voe Lee South shoreline survey. Sheep droppings and rough grazing land were also noted there.

No additional information on agricultural practices around Busta Voe was found from internet searches undertaken for this review.

Observations of agricultural activity and livestock were made during the 2014 shoreline survey, which was conducted on the 26 and 28th May. These observations are presented in Figure 3.1.

More sheep were seen in 2014 than in 2007, with a greater concentration of animals along the southwest shore of the voe. Cow pats and hoof prints were noted at Burravoe on land adjacent to the Hevden Ness site (on the eastern shore) and also on the southwest shore of the voe, near the Busta Voe Lee site. This distribution slightly varies from that observed during the 2007 survey, when cattle were noted on land to the southwest of the voe near Southpund and and on the southeast shore of the voe, south of Wethersta.

Although no livestock were observed on the shoreline during 2014, it was noted that they had access to the shore near Greentaing and along the entire eastern shoreline. Steep escarpments prevented livestock accessing the shore elsewhere. Eight agricultural sheds were the majority of which were located along the west side of the voe. These were not specifically noted during the 2007 shoreline survey. It was unclear whether these sheds were used to house farm machinery or livestock during poor weather conditions during winter months. If used to house livestock, then

the sheds may represent significant and concentrated sources of faecal contamination, which would be expected to impact all mussel farms except North of Linga, which is not situated close to any of the observed sheds. A silage pit was also noted alongside the largest agricultural shed at Busta. The pit was concrete and seemed in reasonable condition. However, under heavy rainfall conditions there may be some leaching of silage effluent via surface water runoff into the voe, with some level of impact expected at the Busta Voe site.

Overall, sheep continue to represent the main agricultural source of contamination to Busta Voe Lee North. Over the winter months, agricultural sheds located could become concentrated sources of contamination if they are used to house livestock. The silage pit northwest of the voe may also represent a contamination source to northwest extent of the voe during/following heavy rainfall: silage may contain *E. coli* under certain conditions (Chen, et al., 2005).

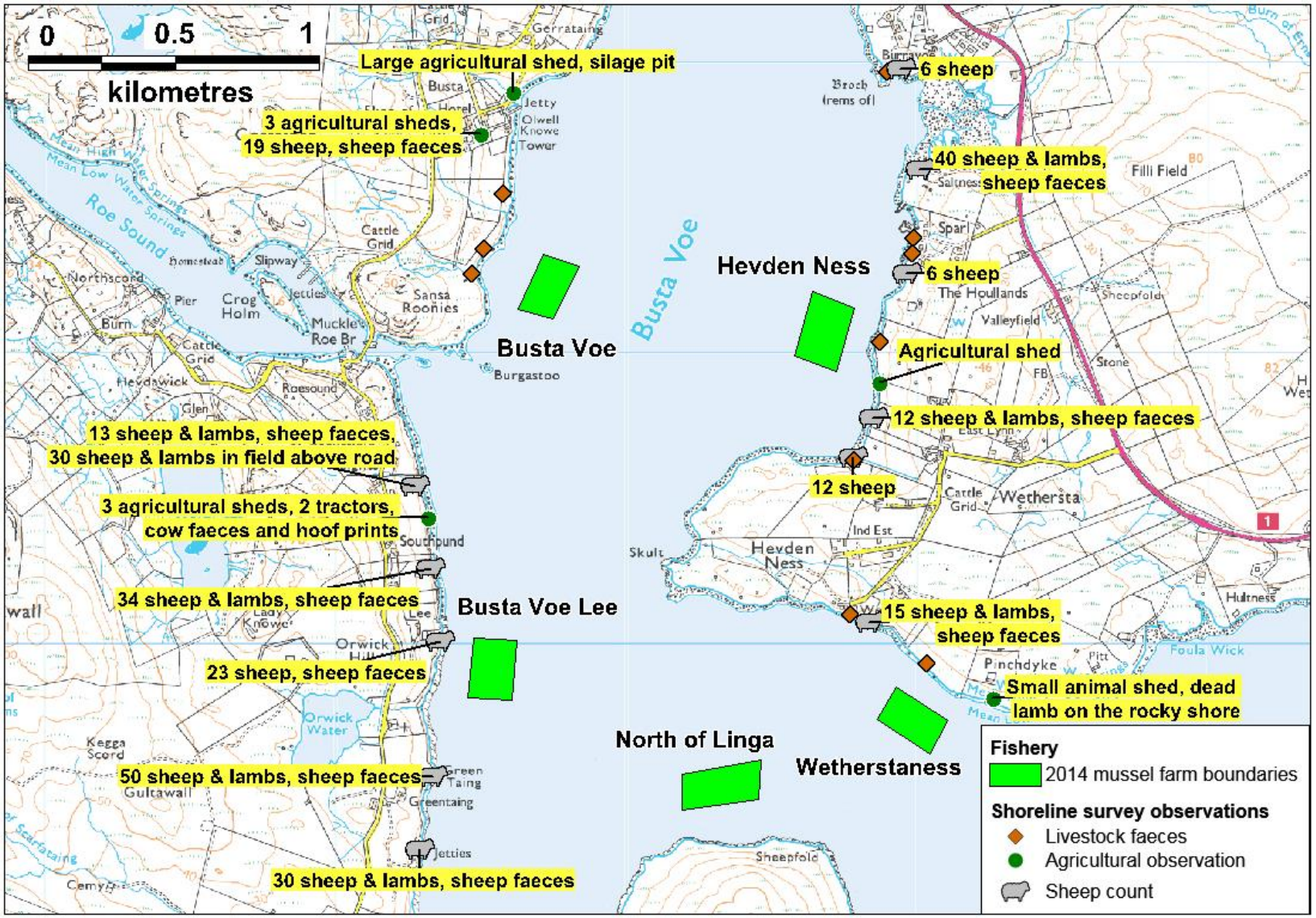

Figure 3.1 Map of farm animals and associated observations made during the 2014 shoreline survey

4. Wildlife

It was concluded in the 2008 sanitary survey report that wildlife contamination impacts were unpredictable both spatially and temporally. Although the most significant impact was expected from birds, this impact would be localised and was not expected to impact one fishery more than another. Seals and cetaceans were also expected to contribute to contamination levels occasionally, with geese also representing a source at times. The wildlife observed during the 2007 shoreline survey (5-6th September) included guillemots, cormorants, greylag geese and a seal.

For this review, information on wildlife has been obtained through a shoreline survey conducted on 26th and 28th May 2014, and through a desk-based internet search. Wildlife observations from the 2014 shoreline survey are displayed in Figure 4.1.

Pinnipeds

New information on harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) in Busta Voe was available from the Special Committee on Seals 2013 report (SCOS, 2013). It stated that in August, between 2007 and 2011, 50-100 harbour seals were reported in Busta Voe, whilst only a few grey seals were reported over the same period. No seals were observed during the 2014 shoreline survey.

Cetaceans

No new information relating to cetaceans in Busta Voe was found during internet searches for this review. No cetaceans were observed during the 2014 survey.

Seabirds

Seabird data was downloaded from the JNCC website (http://jncc.defra.gov.uk/page-4460) in April 2014. Data from a 5 km radius around Busta Voe Lee North production area is listed in Table 4.1 and displayed in Figure 4.1.

Table 4.1 JNCC seabird data for Busta Voe Lee North

Common name	Species name	Count*	Method
Herring Gull	*Larus argentatus*	62	Occupied nests, territory and individuals on land
Common Gull	*Larus canus*	52	Occupied nests and territory
Great Black-Backed Gull	*Larus marinus*	26	Occupied nests and territory
Black-Headed Gull	*Chroicocephalus ridibundus*	50	Individuals on land
Shag	*Phalacrocorax aristotelis*	182	Occupied nests
Fulmar	*Fulmarus glacialis*	5732	Occupied sites
Arctic Tern	*Sterna paradisaea*	354	Individuals on land
Common Tern	*Sterna hirundo*	2	Individuals on land
Black Guillemot	*Cepphus grylle*	17	Individuals on land
Kittiwake	*Rissa tridactyla*	136	Occupied nests
Great Skua	*Stercorarius skua*	6	Occupied territory
Atlantic Puffin	*Fratercula arctica*	2	Individuals on land

*Counts for occupied nests, sites and territory were doubled. Individuals on land for Atlantic puffin were also doubled for occupied burrows, with total counts given using the adjusted data.

The JNCC dataset indicates that a large number of birds reside on land close to Roe Sound (mid-west) and southwest of the voe. Birds present in significant numbers included fulmar and Arctic terns. Information provided in the NAFC Marine and Spatial Plan for Shetland (2012) similarly identified significant amounts of suitable habitat for Arctic terns in the Roe Sound area, where suitable habitat for black guillemot and common terns was also noted. The Marine and Spatial Plan (2012) also identified suitable habitat areas for herring gulls located along the north side of the Linga, south of the voe and eider duck moult areas east of Linga at Grobs Ness, also to the south of the voe.

The highest abundance, and therefore the greatest contamination impact, of nesting birds is expected during the spring-summer breeding season. Birds were the only wildlife observed during the 2014 shoreline survey. Gulls were the most abundant, with the highest number (n=50) noted flying from the shoreline adjacent to the Wetherstaness fishery. Other species observed included various seabirds and seaducks, geese and wading birds. Bird droppings were also reported on buoys at Busta Voe Lee, North of Linga and at Wetherstaness fisheries.

Otters

The Eurasian otter (*Lutra lutra*) is common in Shetland, which holds approximately 12% of the UK population (Shetland Otters, 2014). Anecdotal accounts state otter spotting hot spots are located south of Busta and to the east at the inlet above Wethersta (Shetland Amenity Trust, 2010). No otters were observed during the 2014 survey.

Rabbits

Four rabbits were observed during the 2014 survey; two on the northwest shore and two on the mid-eastern shoreline. It should be noted that *E. coli* is usually only present inconsistently, and in low concentrations, in weaned healthy rabbits although this changes markedly in colonies suffering from *E. coli* enteritis (Peeters, *et al*., 1984). Therefore, most of the time rabbit will not contribute significant amounts of *E. coli* to the area.

Conclusions

Overall seabirds continue to represent the most significant contamination source from wildlife to the Busta Voe Lee North area. In particular, large nesting colonies for fulmar are located to the southwest, though birds were widely distributed throughout the area during the survey. Eider ducks and geese may also contribute to contamination levels, and may in particular impact the southeast area of the voe around North of Linga and Wetherstaness fisheries. Impacts are also expected from seals, though the timing and locations of these are unpredictable.

Figure 4.1 Map of wildlife around Busta Voe Lee North, including observations made during the 2014 shoreline survey

5. Watercourses

The only significant data on the extent of faecal contamination of watercourses in Busta Voe Lee North came from the two shoreline surveys undertaken in 2007 and 2014. The two surveys were undertaken under slightly different conditions, with scattered showers reported during the 2007 survey and no rain during the 2014 survey but scattered showers occurring within the prior 48 hours.

A comparison of watercourse loadings estimated on the basis of the 2007 and 2014 survey measurements and *E. coli* concentrations is shown in Table 5.1. Sample loadings calculated from the 2014 survey are displayed in Figure 5.1. The Burn of Brae was also sampled and measured during the 2007 shoreline survey, with an estimated loading (8×10^8 *E. coli*/day) indicating moderate contamination levels. The 2014 shoreline survey did not cover that section of shoreline and the Burn of Brae was therefore not sampled or measured.

Table 5.1 Watercourse loadings to Busta Voe Lee North estimated from measurements made during the 2008 and 2014 shoreline surveys

No.*	Description	NGR	2007 Loading (*E. coli* / day)	2014 Loading (*E. coli* / day)
1	Unnamed watercourse	HU 3581 6741	-	1.1×10^8
2	Burn of Erns Moor	HU 3628 6681	9×10^{10}	2.0×10^9
3	Unnamed stream	HU 3626 6664	3×10^9	1.7×10^8
4	Unnamed watercourse	HU 3429 6558	-	4.6×10^8
5	Unnamed watercourse	HU 3434 6509	-	1.4×10^6
6	Unnamed stream	HU 3427 6478	-	2.4×10^8
7	Unnamed stream	HU 3461 6690	1×10^{10}	1.4×10^7
8	Stream from Orwick	HU 3447 6628	6×10^{10}	9.8×10^8
9	Unnamed watercourse	HU 3587 6507	-	8.8×10^7

*Corresponds to the number allocated to watercourses sampled in the 2014 survey, as shown in Figure 5.1.

The loadings calculated from the 2014 survey indicate low to moderate levels of contamination in the nine watercourses sampled and measured. Loadings for the four watercourses from the 2007 survey were higher than those re-sampled in the 2014 survey. This may relate to levels of rainfall experienced during the surveys, with higher rainfall levels reported during the 2007 survey. A stagnant watercourse was also noted in 2014 approximately 300 m south of the Hevden Ness fishery, which is expected to flow during/following heavier rainfall events and may also pose a risk to the Hevden Ness fishery.

The highest estimated freshwater loading continues to come from the Burn of Erns Moor, which enters the voe approximately 900 m northeast of the Hevden Ness fishery. Watercourse loadings are also expected to impact the western side of the Busta Voe fishery and the south and north edges of the Busta Voe Lee fishery.

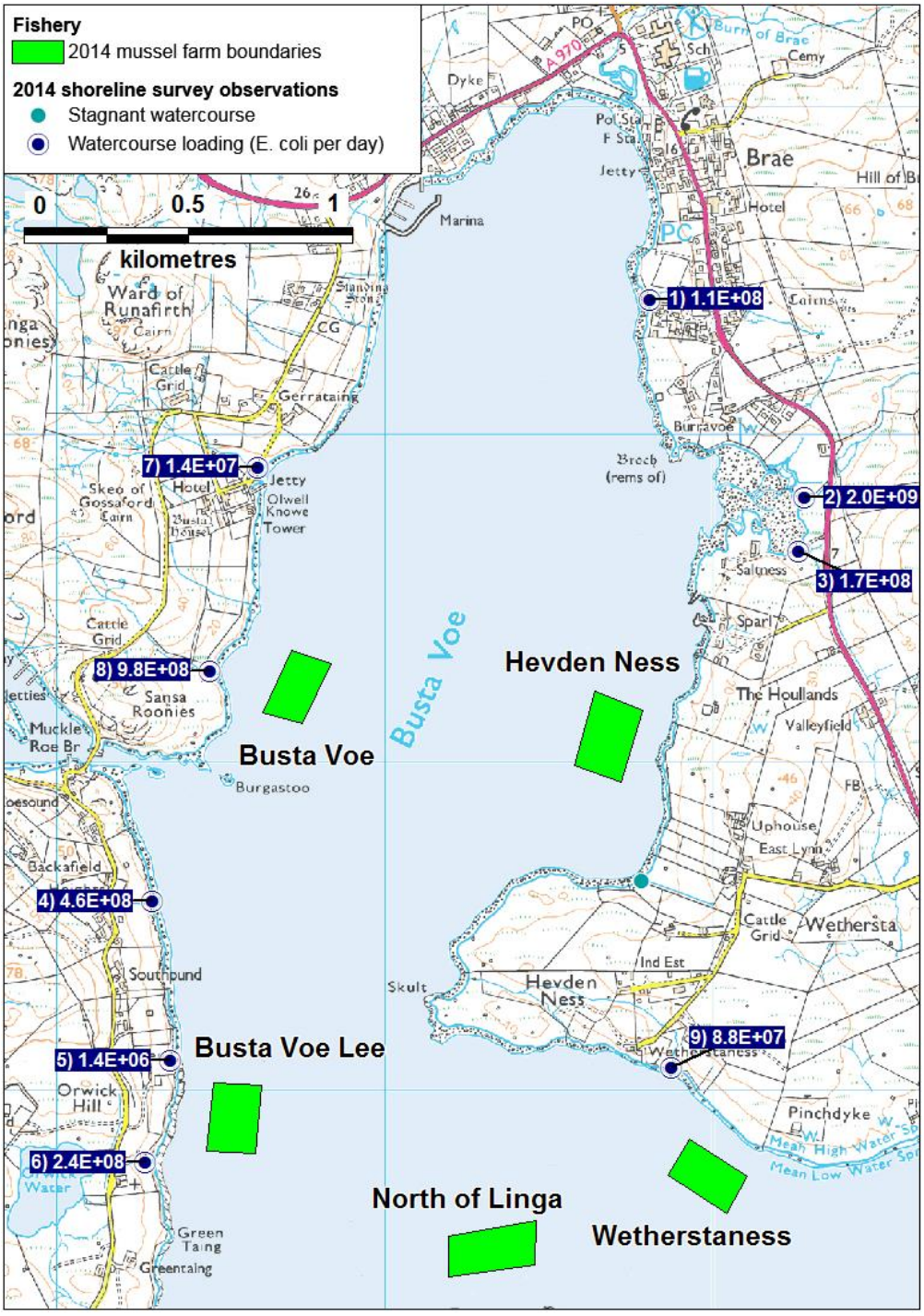

Figure 5.1 Watercourse loadings at Busta Voe Lee North (estimated from the 2014 shoreline survey measurements and results)

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 $1x10^3$, 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 – 31/12/2006 for the analyses undertaken for the 2008 Busta Voe Lee North Sanitary Survey Report: rainfall box-plots and wind roses for 2003-2006 period are presented in that report and have not been reproduced here. Rainfall recorded in total daily rainfall (mm) was taken from the Lerwick weather station, which lies 26 km southeast of the Busta Voe Lee North production area. Wind roses were also taken from the Lerwick weather station.

Meteorological data for this Review was purchased from the Meteorological Office in March 2014 for the period 01/01/2007 - 31/12/2013. Rainfall data from Lerwick was available for all of the survey days.

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 Lerwick weather station rainfall dataset for 2007-2013 is presented by year in Figure 6.1 and by month in Figure 6.2.

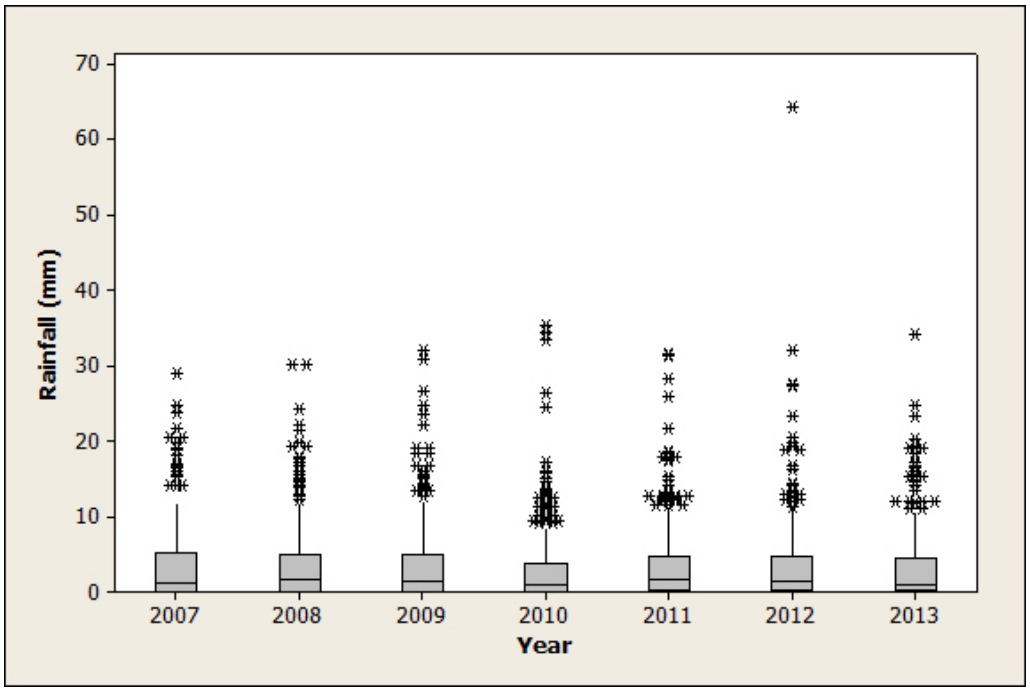

Figure 6.1 Boxplot of daily rainfall at Lerwick by year (2007-2013)

In both data sets, the bulk of the observations were below 10 mm rainfall/day, with the majority of years yielding at least one rainfall event >30 mm. Incidence of a rainfall event >60 mm occurred in both datasets: in 2004 and again in 2012.

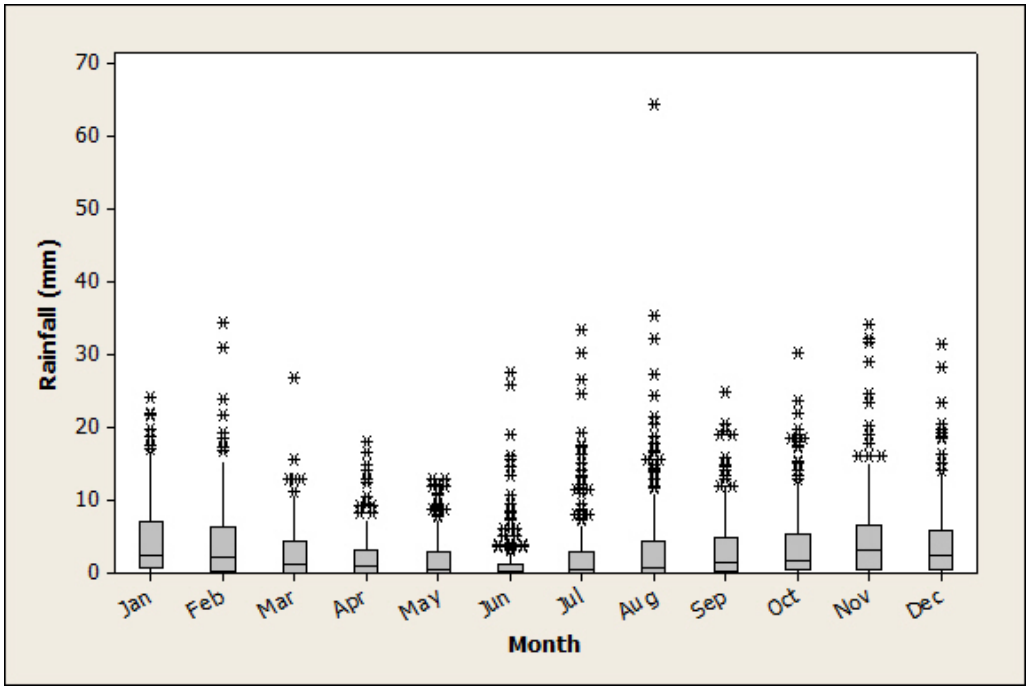

Figure 6.2 Boxplot of daily rainfall at Lerwick by month (2007-2013)

The 2008 report noted that the months September to January were the wettest, with July and August the driest. In the 2007-2013 dataset, daily rainfall values were higher during the autumn and winter. Rainfall peaked in October (1348 mm) and was driest in June (429 mm). Rainfall values exceeding 30 mm/d occurred in February, July, August, October, November and December. There has also been an increase in the number of months where >30 mm rainfall/day is recorded, though this could be affected by the second assessment period covering a greater number of years. Extreme events of >60 mm rainfall/day occurred in August during both periods.

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 Lerwick for the period 2004-2013 while Figure 6.4 shows the annual wind rose for the same period.

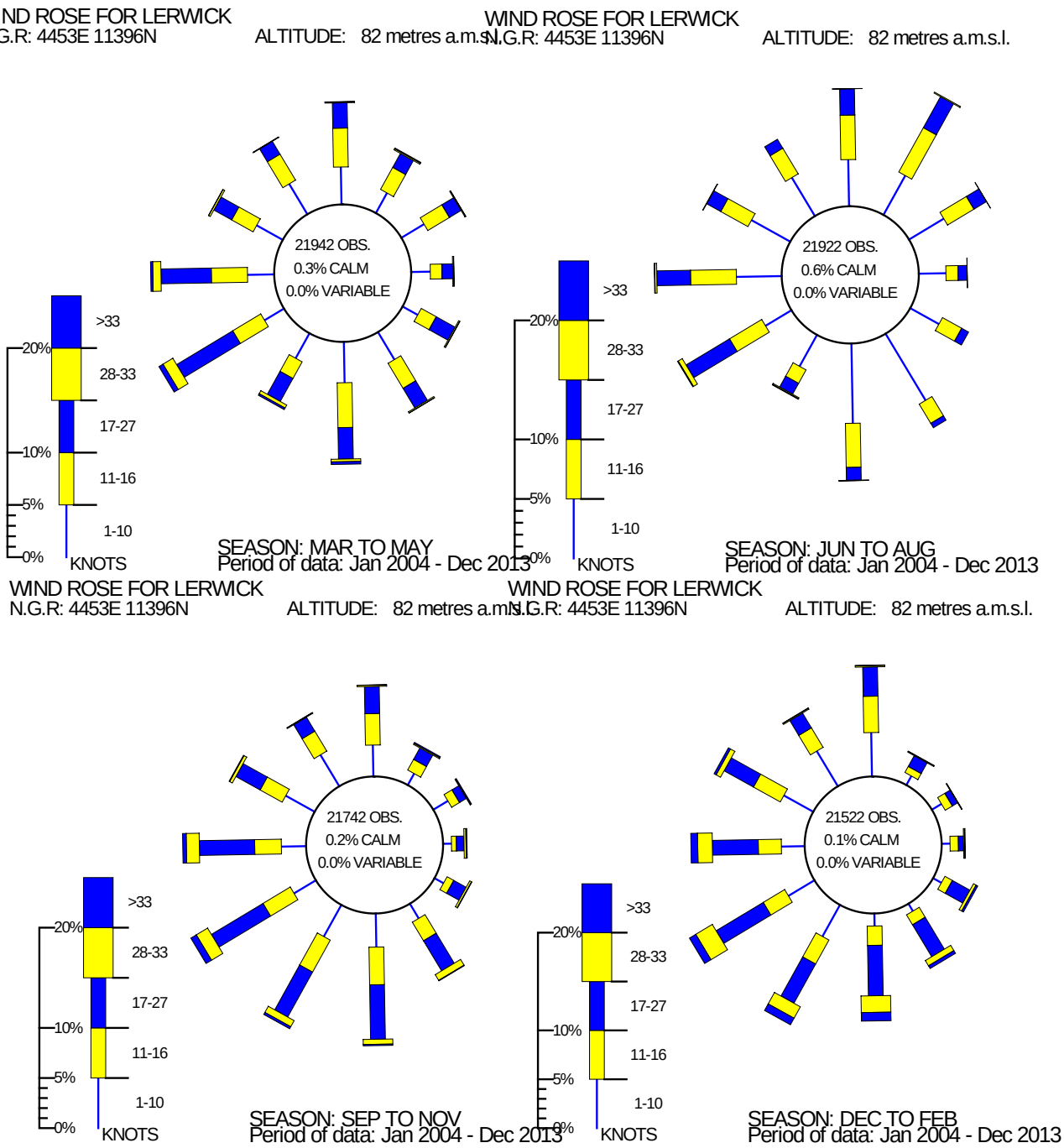

Figure 6.3 Seasonal wind roses for Lerwick (2004-2013)

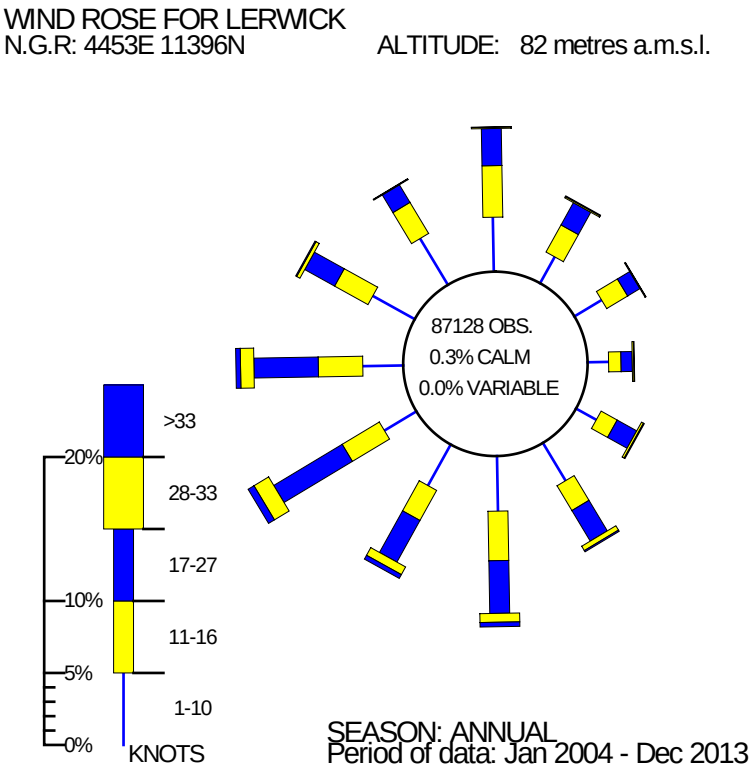

Figure 6.4 Annual wind rose for Lerwick (2004-2013)

Overall the annual wind direction showed that wind was stronger when coming from the west than the east, and winds from the southerly direction were stronger than those from the north. The strongest winds tended to come to from the southwest quarter although winds from the north occurred relatively frequently. During the summer, winds were also often seen from the north-northeast. Winds were strongest during the winter and were weakest during the summer. The local topography and direction of Busta Voe Lee North is likely to cause a variation in wind patterns to those shown in the wind roses (Lerwick is located on the east coast of mainland Shetland, whilst Busta Voe is on the west coast). Busta Voe is relatively sheltered by the surrounding land although westerly winds will have an effect on the wider water body system as Swarbacks Minn, at the southern end of Busta Voe, opens to the west.

7. Historical *E. coli* Data

Results from Busta Voe Lee North production area between 01/01/2007 and 25/06/2014 were extracted from the FSAS database and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data. These related to the sites Hevden Ness, North of Linga, Busta Voe, Busta Voe Lee and Wetherstaness. Data was extracted from the database in June 2014. Historical *E. coli* data assessed for the 2008 sanitary survey report had already been extracted and validated. For the purposes of this report, samples pre-dating 2001 were excluded from the analyses. All *E. coli* results were reported as most probable number per 100 g of shellfish flesh and intravalvular fluid.

E. coli results reported as below the limit of detection (19 or <20) were reassigned a value of 10 *E. coli* MPN/100 g and results above the upper limit of detection (>18000 or 18100) were reassigned a value of 36000 *E. coli* MPN/100 g for the purposes of statistical evaluation and graphical representation.

Three samples were reported as rejected and were omitted from further analysis. Two samples had void results and were also omitted from further analysis. The remaining samples were delivered to the laboratory within 48 hours of collection, had sample locations plotting within the Busta Voe Lee production area and had box temperatures of $<8^{o}C$.

7.1 Summary of microbiological results

Summary results from all five sites within Busta Voe Lee North production area for 2001-2006 and 2007-2014 are displayed in Tables 7.1 to 7.5 respectively. Geometric means and percentiles were calculated only where there were more than 10 sample results.

Table 7.1 Sampling summary results for Hevden Ness 2006-2014

Sampling Summary				
Production area	Busta Voe Lee North			
Site	Hevden Ness			
Species	Common mussels			
SIN	SI-327-755-08			
Location	Various			
Years	2006		2007-2014	
Total no. of samples	8		79	
			2007	8
			2008	9
			2009	9
			2010	12
			2011	11
			2012	12
			2013	12
	2006	8	2014	6
Minimum	<20		<20	
Maximum	>18000		2400	
Median	330		50	
Geometric mean	-		49	
90 Percentile	-		270	
95 Percentile	-		1100	
No. Exceeding 230/100g	4 (50%)		8 (10%)	
No. Exceeding 1000/100g	1 (13%)		4 (5%)	
No. Exceeding 4600/100g	1 (13%)		0	
No. Exceeding 18000/100g	1 (13%)		0	

Table 7.2 Sampling summary results for North of Linga 2006-2010

Sampling Summary				
Production area	Busta Voe Lee North			
Site	North of Linga			
Species	Common mussels			
SIN	SI-327-753-08			
Location	HU 354 645 and HU 351 645			
Years	2006		2007-2010	
Total no. of samples	7		35	
			2007	10
			2008	9
			2009	10
	2006	7	2010	6
Minimum	<20		<20	
Maximum	1100		750	
Median	160		20	
Geometric mean	-		40	
90 Percentile	-		334	
95 Percentile	-		550	
No. Exceeding 230/100g	3 (43%)		4 (11%)	
No. Exceeding 1000/100g	1 (14%)		0	
No. Exceeding 4600/100g	0		0	
No. Exceeding 18000/100g	0		0	

Table 7.3 Sampling summary results for Busta Voe 2001-2007

Sampling Summary				
Production area	Busta Voe Lee North			
Site	Busta Voe			
Species	Common mussels			
SIN	SI-327-409-08			
Location	HU 347 663, HU 347 665 and HU 347 667			
Years	2001-2006		2007	
Total no. of samples	73		6	
	2001	12	2007	6
	2002	12		
	2003	13		
	2004	12		
	2005	12		
	2006	12		
Minimum	<20		<20	
Maximum	5400		310	
Median	50		20	
Geometric mean	52		-	
90 Percentile	286		-	
95 Percentile	575		-	
No. Exceeding 230/100g	8 (10%)		1 (17%)	
No. Exceeding 1000/100g	2 (3%)		0	
No. Exceeding 4600/100g	1 (1%)		0	
No. Exceeding 18000/100g	0		0	

Table 7.4 Sampling summary results for Busta Voe Lee 2001-2007

Sampling Summary				
Production area	Busta Voe Lee North			
Site	Busta Voe Lee			
Species	Common mussels			
SIN	SI-327-410-08			
Location	HU 344 649			
Years	2001-2006		2007	
Total no. of samples	72		4	
	2001	12	2007	4
	2002	12		
	2003	13		
	2004	11		
	2005	12		
	2006	12		
Minimum	<20		<20	
Maximum	2200		160	
Median	20		85	
Geometric mean	40		-	
90 Percentile	473		-	
95 Percentile	700		-	
No. Exceeding 230/100g	9 (12.5%)		0	
No. Exceeding 1000/100g	2 (3%)		0	
No. Exceeding 4600/100g	0		0	
No. Exceeding 18000/100g	0		0	

Table 7.5 Sampling summary results for Wetherstaness 2006-2007

Sampling Summary				
Production area	Busta Voe Lee North			
Site	Wetherstaness			
Species	Common mussels			
SIN	SI-327-754-08			
Location	HU 359 648 and HU 344 643			
Years	2006		2007	
Total no. of samples	7		4	
Years	2006	7	2007	4
Minimum	<20		<20	
Maximum	110		110	
Median	220		60	
Geometric mean	106		-	
90 Percentile	740		-	
95 Percentile	920		-	
No. Exceeding 230/100g	3 (43%)		0	
No. Exceeding 1000/100g	1 (14%)		0	
No. Exceeding 4600/100g	0		0	
No. Exceeding 18000/100g	0		0	

Sampling at Busta Voe, Busta Voe Lee and Wetherstaness ended in 2007. There was therefore insufficient data for these sites post-2006 to undertake a comparison between sampling periods. Regular sampling had taken place at North of Linga between 2006 and mid 2010, with no results >1000 *E. coli* MPN/100 g occurring in samples taken between 2007 and 2010.

Sampling at Hevden Ness started in 2006, with the highest result (>18000 *E. coli* MPN/100 g) occurring in that year.

As sampling was discontinued in 2007 at Busta Voe, Busta Voe Lee and Wetherstaness, no further analysis of sample results from these sites will be carried out in this review.

7.2 Geographical patterns of results

A summary of results taken at Hevden Ness and North of Linga are listed in Table 7.6.

Table 7.6 Comparison of selected summary statistics from Hevden Ness and North of Linga (2007-2014)

Site	Minimum	Maximum	Median	90%ile
Hevden Ness	<20	2400	50	270
North of Linga	<20	750	20	334

A two sample t-test was carried out to test whether $\log_{10}$-transformed results from samples taken at the two sites were significantly different. No statistically significant difference was found (t-test t = 0.71, DF: 68, p = 0.483).

Reported sampling locations at Hevden Ness are displayed in Figure 7.1, with the symbol sizes graduated in proportion to the magnitude of the *E. coli* results.

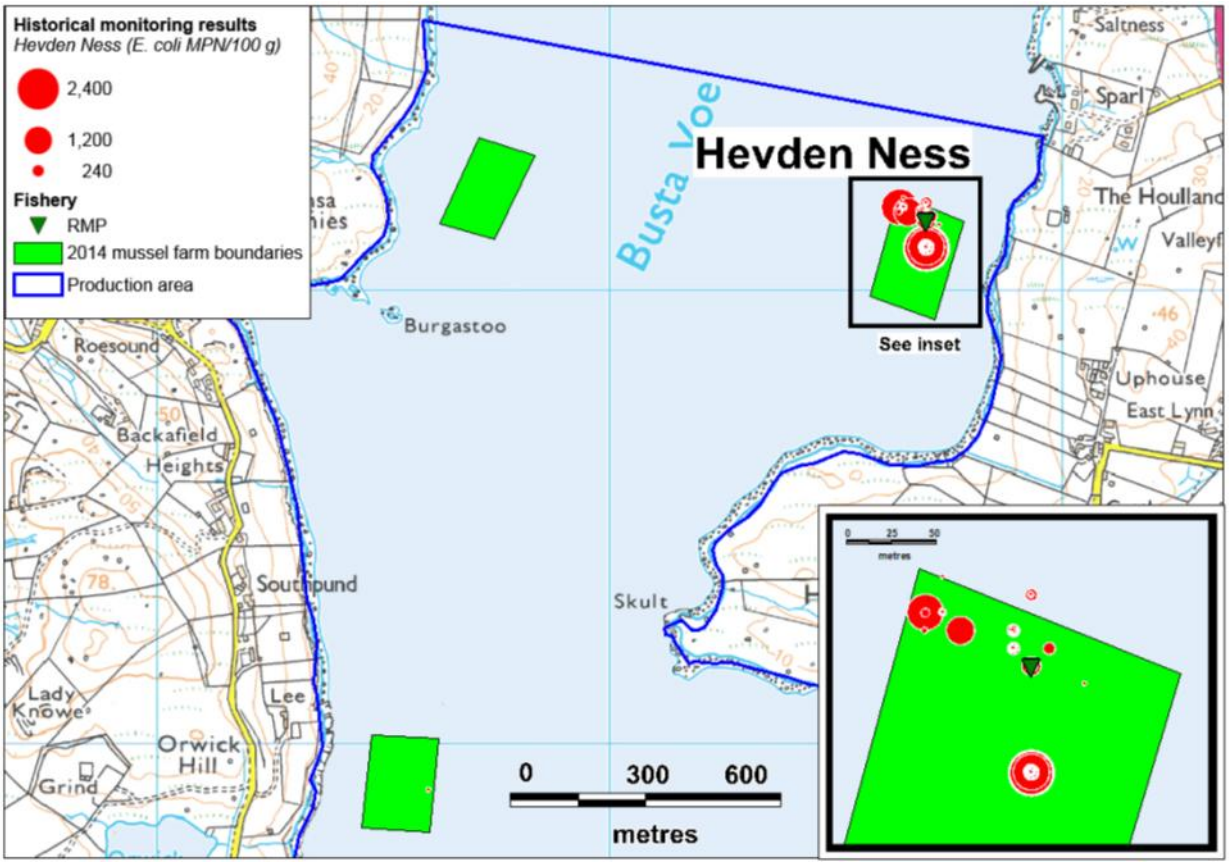

Figure 7.1 Reported sampling locations at Hevden Ness (2007-2014)

Reported sampling locations Hevden Ness were located over the northern half of the extent of the mussel lines apart from one sample that plotted 900 m southwest of the RMP at the Busta Voe Lee farm. The remaining 78 samples were reported to have been taken within 70 m of the RMP (HU 3570 6616). Thirty-one sampling locations plotted 60 m south of the RMP at HU 357 661. The latter location was where two of the samples yielded results >1000 *E. coli* MPN/100 g: However, as these locations were only reported to 100 m accuracy, it is not possible to determine the exact locations for comparison with the results from other samples. The locations of the samples yielding the two other results >1000 *E. coli* MPN/100 g plotted a short distance northwest of the RMP.

Reported sampling locations at North of Linga are displayed in Figure 7.2, with the symbol sizes graduated in proportion to the magnitude of the *E. coli* results.

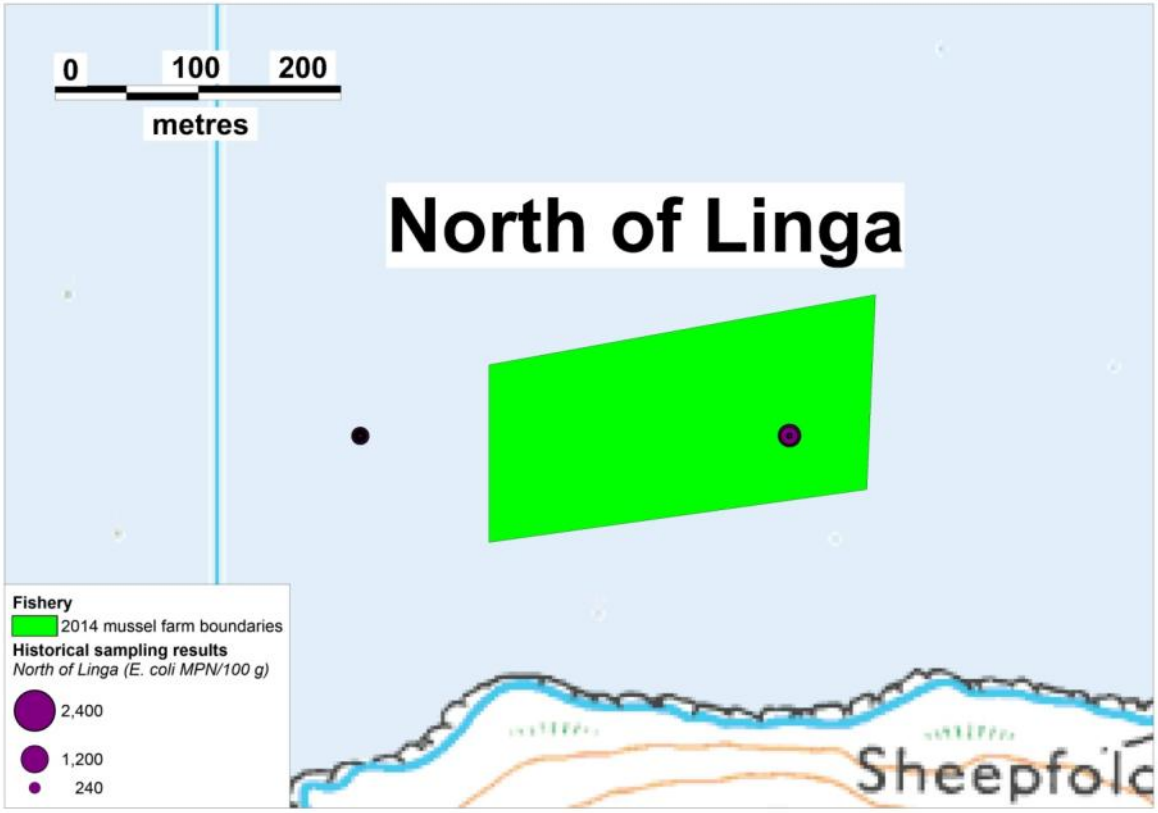

Figure 7.2 Reported sampling locations at North of Linga (2007-2010)

Two sampling locations have been reported at North of Linga. Five samples were reported to have been taken at HU 354 645. The results of these varied between 20 and 750 *E. coli* MPN/100 g. Thirty samples were reported to have been taken at HU 351 645 with results varying between <10 and 460 *E. coli* MPN/100 g.

7.3 Temporal patterns of results

As sampling at both Hevden Ness and North of Linga started in 2006, the trends of *E. coli* are presented from that point in time. Due to the low numbers of results being available prior to 2007, no statistical analyses have been undertaken between sampling periods. Scatterplots of *E. coli* results against date for Hevden Ness and North of Linga are shown in Figures 7.3 and 7.4 respectively. Each scatterplot also shows a lowess trend line. Lowess trendlines allow for locally weighted regression scatter plot 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.

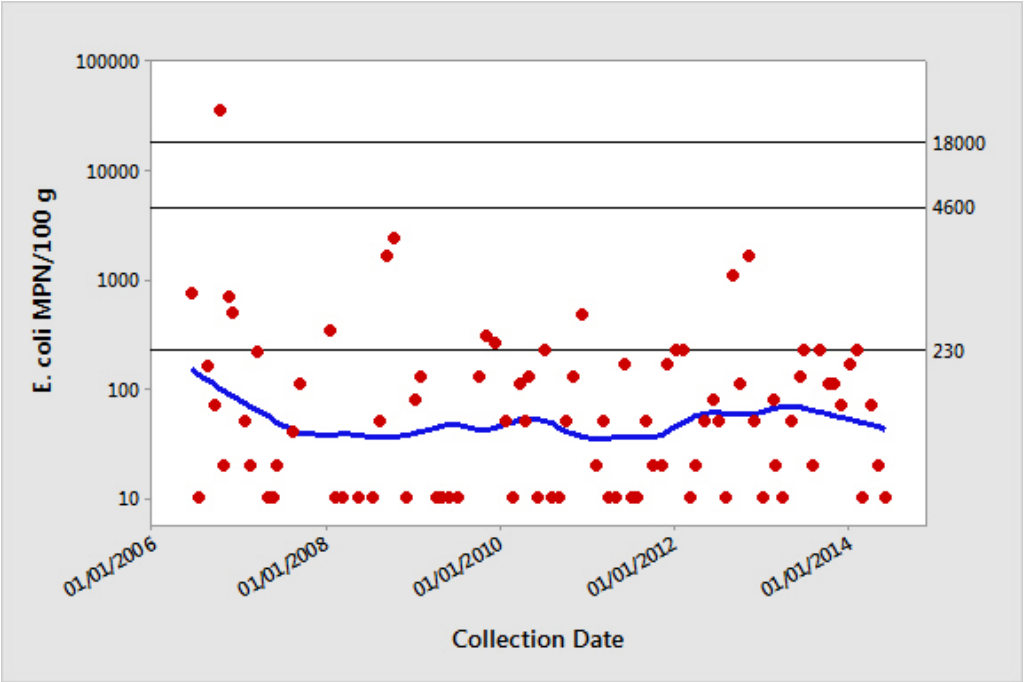

Figure 7.3 Scatterplot of Hevden Ness *E. coli* results by date (2006-2014)

The level of contamination at Hevden Ness appears to have remained stable over the assessment period. Most of the results greater than 230 *E. coli* MPN/100 g occurred during the months of September to December inclusive, with two out of the five results >1000 *E. coli* MPN/100 g taken in September and October, and one taken in November.

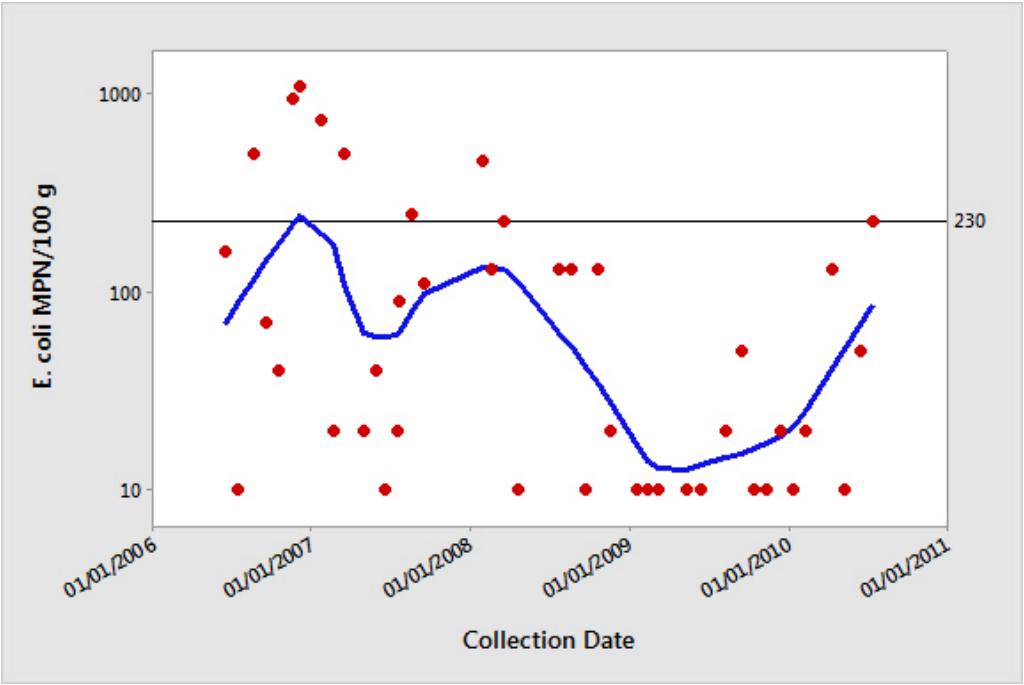

Figure 7.4 Scatterplot of North of Linga *E. coli* results by date (2006-2010)

There has been a decline in the *E. coli* levels at North of Linga with no results greater than 230 *E. coli* MPN/100 g being seen there since early 2008.

Summary

Sampling continued at Hevden Ness and North of Linga after the 2008 report. Although highest results in the present sampling period were reported at Hevden Ness, no statistically significant difference in average *E. coli* results was noted between the two sites. It was not possible to assess whether contamination levels differed spatially within each site. Contamination levels at Hevden Ness appeared to be stable between 2007 and 2014, with highest results between September and November. Sample results from North of Linga declined between 2007 and 2010.

8. Movement of contaminants

Findings from the hydrographic modelling study conducted for the 2008 report were as follows:

Tidal flows were weak, with wind generated currents more influential

Particle transport solely attributed to tides was very small in the order of 250-500 m, leading to particles staying in the vicinity of their release points

Prevailing south-westerly winds confine inputs from sources near Brae to the northeast corner of the voe and generally away from leased areas

Contamination from the Brae area (including the discharge from the Brae community septic tank) is only likely to impact at the Hevden Ness site and this would only be under northerly wind conditions, which occur approximately 20% of the time.

A modelling study was also conducted for the 2012 Busta Voe Lee South sanitary survey report FSAS/Cefas, 2013). The study area covered areas north of a line drawn between HU 3318 6319 (Boat Geo on Muckle Roe) and HU 3392 6224 (Rit Ness on Papa Little island). Information applicable to the Busta Voe Lee North production area is listed below.

A slow flushing time of 13 days, with only 4% of the low water volume exchanged during a tidal cycle. Weather conditions, bathymetric features and the exchange through Roe Sound may affect this, although to what extent is unknown

Wind generated currents and residual tidal flow will be more influential than tide alone

Prolonged northerly winds generate an alongshore current along the western shore of Busta Voe

Prolonged southerly winds generate a counter-clockwise flow between Grobs Ness to the southeast of the voe and Linga

A relationship between strong wind forcing and unidirectional flow in the near-surface waters is evident throughout the area

Uniform salinity with depth (November 2012), though weak tidal stirring may cause thermal stratification during summer months with warmer surface waters sitting above colder and denser bottom water, leading to the formation of density driven currents

Southerly transport of contaminants from the Brae area remains restricted to prevailing northerly winds, and is still considered to only impact the Hevden Ness site. Weak tidal currents will allow for contaminants to remain within an area for a relatively long period of time.

9. Overall Assessment

Human sewage Impacts

Human population continues to be centred northeast of the voe in Brae. Though an overall decrease in population was noted, increases were reported in areas adjacent to fisheries in the southwest and southeast of the voe. Seven new planning applications were made to areas northwest (n=4) and southeast of the voe (n=2), with one application also noted on the mid-east side of the voe. Four of these applications pertained to single dwellinghouses, with two applications for multiple houses noted northwest of Busta and one noted north of Burravoe to the mid-east of the voe. Five of the applications planned to share or use existing ST connections or planned to connect to public sewers, whilst two applications planned to install new STs to soakaways, with one located in Busta and one in Wethersta. No observations were made of these new STs, though they may represent sources of contamination to the north of Busta Voe and east of Hevden Ness fisheries respectively, if malfunctioning.

Tourist accommodation remains concentrated in the northeast and northwest of the voe, although there is a new small self catering lodge on the hillside at Greentaing, southwest of the voe. Visitor numbers peak during summer months, as well as a smaller peak in January to March due to local fire festivals.

Boat activity remains primarily associated with workboats servicing aquaculture farms in the voe, though new evidence suggests the voe is also popular with pleasure boats, particularly during summer months. Pleasure boats are expected to moor at the Delting Boating Club marina and Busta jetty to the northwest of the voe.

Impacts from Brae ST are expected to have declined after the 2008 upgrades. Sewage impacts are expected to have increased at Hevden Ness, owing to an overflowing ST observed approximately 300 m northeast of the fishery, with a broken pipe from a ST located approximately 1.3 km northeast of the fishery expected to contribute to background levels of contamination crossing the fishery during northerly winds.

Agricultural impacts

Agricultural impacts have increased since the 2008 report. Sheep and cattle continue to be reared on land around the voe. Sheep are the more abundant livestock species and are distributed throughout the area. New observational evidence suggests cattle are now reared on land to the mid-east and northeast of the voe, as well as to the southeast and southwest. Agricultural sheds noted around the voe pose concentrated faecal contamination sources during winter months, if they are used to shelter livestock . A silage pit northwest of the voe may also represent a contamination source to the northern extent of Busta Voe fishery during/following heavy rainfall.

Wildlife Impacts

Wildlife impacts are expected to be higher than those deduced in the 2008 report, due to the availability of more detailed data. However, this does not represent a change in actual impact from this source. Significant numbers of birds are now known to reside around land to the southwest of the voe and close to Roe Sound, though birds remained widely distributed throughout the area during the survey. Highest contamination impacts from birds are anticipated during the spring-summer breeding season and may be more significant at the Busta Voe Lee fishery owing to its proximity to the most significantly sized nesting colonies. Waterfowl continue to represent a small contamination source. Seals represent a minor potential source but the location of impact is expected to be variable.

Seasonal Variation

The main visitor season remains in the warmer summer months, though a smaller influx of visitors is also expected from January to March due to the fire festival(s). Pleasure boating activity is similarly expected to be greatest during summer months.

If livestock are kept in the newly observed agricultural sheds over the harsh winter months, then the sheds are expected to represent concentrated and significant contamination sources over this period, at all sites except North of Linga.

Seabirds with nesting colonies on the west coast are expected to represent a higher contamination source during the spring-summer breeding season.

Highest rainfall levels were recorded between November and February, with strongest winds in autumn and winter months in a west south-westerly direction. Northerly winds prevail during summer months, which is also likely to correspond with a westward movement of contaminants and thermal stratification lead density driven currents.

High mussel *E. coli* results at Hevden Ness tended to occur during the months of September to December.

Watercourses

Loadings from watercourses were lower than those presented in the 2008 report, though this may be linked to different times of the year when the surveys were conducted. The highest freshwater input from watercourses continues to enter from Burn of Erns Moor, approximately 900 m northeast of Hevden Ness fishery.

Movement of contaminants

Particle transport solely attributed to tides is still considered to be in the order of 250-500 m. However, additional information reaffirms that wind driven currents will be

more influential than tidal currents in particle transport within Busta Voe. Contaminants arising from the northern end of the voe, e.g. from Brae ST, are likely to be confined to the northern end during prevailing south-westerly winds, but may be transported southward during northerly winds during summer months. Furthermore, weak tidal currents may also lead to stratification and poorly mixed surface waters over summer months.

Analysis of Results

Historical E. coli results

Historical sampling was carried out at Hevden Ness and North of Linga site only since the 2008 report, with sampling ending at North of Linga in 2010. Highest sample results in the present sampling period (2007-onwards) were taken at Hevden Ness, despite no statistically significant difference in average *E. coli* results between the two sites. Contamination levels at Hevden Ness appear to have been stable since 2007, with highest results in September and October in 2008 and September and November 2012.

Shoreline Survey results

Two mussel samples were taken from the northwest extent of both Busta Voe and Hevden Ness fisheries, with one sample from the surface and one from the bottom of the droppers respectively. Results were highest in both samples taken at Busta Voe (surface: 700 *E. coli* MPN/100 g and bottom: 270 *E. coli* MPN/100 g) compared to Hevden Ness (surface: <18 *E. coli* MPN/100 g and bottom: 130 *E. coli* MPN/100 g). Seawater samples taken at all five fisheries yielded low results of <1 or 2 *E. coli* cfu/100 ml. The other seawater sample was taken adjacent to a leaking ST to the northeast of the voe and returned the highest result (48 *E. coli* cfu/100 ml). Freshwater sample results varied between 6 and 1400 *E. coli* cfu/100 ml, with the highest sample associated with the watercourse entering from the west side of the voe, close to the Busta Voe fishery.

Salinity profiles were taken at the same location as mussel and seawater samples at the Busta Voe and depths: 0, 3, 5 and 10 m. Although very small differences were seen between sites and with depth at each site, these differences were within the variability of the instrument.

Conclusions

The main changes from the conclusions of the of the 2008 Busta Voe Lee North sanitary survey are as follows:

Human population along the southwest and southeast shorelines has increased. Planning applications pertaining to areas to northwest, southeast and mid-east sides were noted and included an application for 17 dwelling houses to be built north of Busta suggesting large increases in the population in this area to the northwest of the voe.

Two of these applications: one northwest and one to the southeast had plans for new STs to soakaways, which may impact the northern extent of the Busta Voe fishery and the eastern extent of the Hevden Ness fishery.

New information indicated Busta Voe is popular with visiting yachts, with highest numbers expected during summer months. The majority of boats are expected to moor at the Delting Boat Club marina and Busta jetty, which are respectively located approximately 1.5 km and 600 m north of the Busta Voe fishery.

Impacts from Brae ST are expected to have decreased owing to upgrades made to the infrastructure and the relocation of the main outfall to further offshore.

The leaking ST potentially associated with the Blueshell Mussels shore-base on the mid-east side of the voe is expected to be impacting the northeast extent of the Hevden Ness fishery, which is situated approximately 300 m southwest of the discharge.

New agricultural sheds observed to the northwest, southwest, mid-east and southeast sides of the voe, may represent significant contamination sources during winter months if they are used to house livestock. Inputs of faecal contamination from these sheds are anticipated to impact all fisheries, excluding North of Linga.

Cattle are now known to be reared on land to the mid and northeast of the voe, suggesting an increased contamination impact from livestock on the eastern side of the Hevden Ness fishery.

Overall, there appears to have been an increase in the contamination inputs along the mid-east side of the voe, which are anticipated to have the most significant impact on the Hevden Ness fishery. Although the 2014 shoreline survey reported higher results in both mussel samples taken at the Busta Voe fishery to the west side of the voe, it is anticipated that overall, the contamination levels experienced at Hevden Ness fishery day to day, would be greater than contamination at Busta Voe.

10. Recommendations

Owing to slight changes in contamination sources entering the Busta Voe Lee North production area, there have been some small changes to the recommended sampling plan. The revisions to the sampling plan are as follows:

Production area

This is to remain as the area bounded by lines drawn between HU 3597 6634 to HU 3459 6660 and from HU 3420 6590 to HU 3420 6605 and from HU 3430 6450 to HU 3520 6432 and HU 3568 6428 to HU 3657 6419 to HU 3614 6483 extending to MHWS.

RMP

This should continue to be located on the Hevden Ness site, but relocated to the northeast side of the extent of the farm at HU 3577 6615. This is so it can pick up contamination from existing private discharges, including one that was leaking during the 2014 survey and the new ST to soakaway associated with one of the planning applications, freshwater input from the Burn of Erns Moor, and it is hoped that it will also pick up contamination from the livestock on the adjacent land and the new agricultural shed.

Tolerance

The tolerance should be increased to 40 m to allow for movement of the lines.

Depth

Sampling depth should remain as 1-3 m.

Sampling frequency

Sampling frequency should remain as monthly.

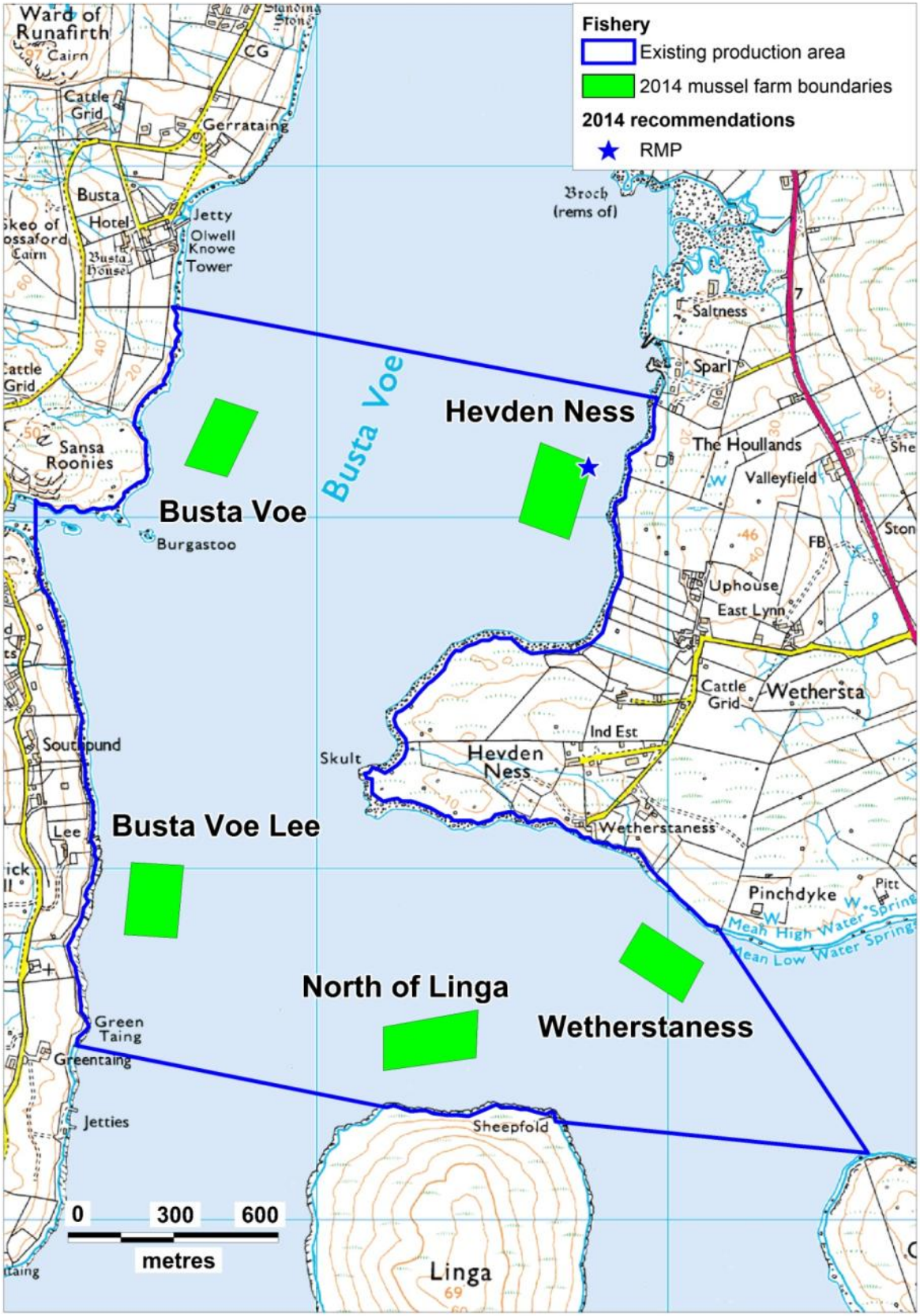

Figure 10.1 Recommended production area boundaries and RMP for Busta Voe Lee North

11. References

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12. List of Figures and Tables

Appendices

1. List of planning applications
2. List of SEPA discharge consents from the 2012 Busta Voe Lee South report
3. Shoreline Survey Report 2014

Appendix 1

Planning Applications

Planning applications expected to change the human population and overall faecal loading to Busta Voe Lee North are listed in Table 1.

Table 1 Planning applications to areas around Busta Voe Lee North

Location	Ref No.	Date	Address	Description
Busta	2010/359/PCD	24/9/10	North of Livorna Busta Brae ZE2 9QN	To erect 2 chalets, new ST to soakaway
	2010/328/PCD	25/8/10	Busta Brae ZE2 9QN	To construct an access road, service connections and surface water drainage system to serve a 17 house residential development, sewage to public sewer
Wethersta	2010/408/PCD	9/11/10	Lower House Wethersta Brae ZE2 9QL	Erect storey and a half dwellinghouse, sewage to existing ST
Brae	2009/325/PCD	13/8/13	Whitehaas Sparl Brae Shetland ZE2 9QJ	Renewal of Planning Permission 2009/325/PCD: Erect dwellinghouse with associated access, parking, amenity space and a new ST to soakaway
	2011/376/AMSC	9/12/11	Camp Brae Shetland ZE2 9QJ	Erect 8 dwellinghouses (approval of matters specified in conditions), with sewage to public sewer
	2013/323/PPF	13/9/13	Busta Brae Shetland ZE2 9QN	Erect dwellinghouse and integral garage and detached shed, shared ST to soakaway
	2014/066/PPF	28/2/14	Busta Busta Brae Shetland ZE2 9QN	Erect dwellinghouse

Appendix 2

SEPA consents for Busta Voe

The SEPA consents identified in the Busta Voe Lee South survey report in 2012 are listed in Table 2.

Table 2 SEPA consents for the Busta Voe area identified in 2012

Licence	NGR	Site Name	Discharge Type	Discharges to	PE	Mean Daily Flow m^3/d
CAR/L/1001837	HU 3570 6750	Sunnyside Playing Field STE to Busta Voe	Public Primary	Seawater	0	0
CAR/L/1002320	HU 3573 6817	North Mainland Pool, Brae	Other Effluent	FW	-	1
CAR/R/1018415	HU 3435 6512	N/A	Private Secondary	Seawater	5	0
CAR/R/1019138	HU 3513 6797	N/A	Private Primary	Land soakaway	10	0
CAR/R/1019472	HU 3423 6446	N/A	Private Primary	Land soakaway	5	0
CAR/R/1019797	HU 3472 6695	N/A	Private Primary	Seawater	6	0
CAR/R/1028195	HU 3419 6474	N/A	Private Primary	Land soakaway	5	0
CAR/R/1032546	HU 3428 6523	N/A	Private Primary	Land soakaway	8	0
CAR/R/1033256	HU 3621 6716	N/A	Private Primary	Land soakaway	11	0
CAR/R/1036850	HU 3483 6702	N/A	Private Primary	Seawater	5	0
CAR/R/1036919	HU 3374 6599	N/A	Private Primary	Seawater	6	0
CAR/R/1037468	HU 3604 6579	N/A	Private Primary	Land soakaway	5	0
CAR/R/1038738	HU 3600 6548	N/A	Private Primary	Land soakaway	5	0
CAR/R/1039454	HU 3635 6636	N/A	Private Primary	Land soakaway	5	0
CAR/R/1039754	HU 3582 6549	N/A	Private Primary	Land soakaway	5	0
CAR/R/1039901	HU 3469 6704	N/A	Private Primary	Land soakaway	6	0
CAR/R/1039921	HU 3436 6667	N/A	Private Primary	Land soakaway	7	0
CAR/R/1040119	HU 3620 6643	N/A	Private Primary	Land soakaway	5	0
CAR/R/1045105	HU 3412 6447	N/A	Private Primary	Land soakaway	5	0
CAR/R/1045113	HU 3598 6554	N/A	Private Primary	Land soakaway	5	0

Licence	NGR	Site Name	Discharge Type	Discharges to	PE	Mean Daily Flow m^3/d
CAR/R/1070899	HU 3596 6639	N/A	Private Primary	Land soakaway	12	0
CAR/R/1075104	HU 3441 6673	N/A	Private Primary	Land soakaway	6	0
CAR/R/1077302	HU 3620 6635	N/A	Private Primary	Land soakaway	12	0
CAR/R/1078002	HU 3450 6672	N/A	Private Primary	Land soakaway	7	0

N/A not applicable due to privacy surrounding information on house names and address, - no information provided

Appendix 2

Shoreline Survey Report

Production Areas:	Busta Voe Lee North	
Site Names:	Busta Voe Lee	
	Busta Voe	
	Hevden Ness	
	North of Linga	
	Wetherstaness	
SIN:	Busta Voe Lee:	SI-327-410-08
	Busta Voe:	SI-327-409-08
	Hevden Ness:	SI-327-755-08
	North of Linga:	SI-327-753-08
	Wetherstaness:	SI-327-754-08
Harvesters:	**Blueshell Mussels**: Michael Laurenson	
Local Authority:	Shetland Islands Council	
Status:	Existing area	
Date surveyed:	26 & 28 May 2014	
Surveyed by:	Sean Williamson (Hall Mark Meat Hygiene Ltd.)	
	Vicki Smith (SSQC Ltd.)	
	We are grateful to Blueshell Mussels for providing assistance during the marine survey work.	
Existing RMP:	Hevden Ness:	HU 3570 6616 *(E. coli)*

Area Surveyed: See Figure 1

Specific observations made on site are mapped in Figure 1 and listed in Table 1. Water and shellfish samples were collected at the locations marked on Figures 2 and 3. Bacteriology results are given in Tables 2 and 3. Salinity profiles are presented in Table 4 with profile locations marked on Figure 2. Photographs are presented in Figures 4-23.

Weather

Monday 26 May 2014

Overcast conditions in the early morning cleared to cloudy conditions for the shoreline survey. F3-F4 easterly winds persisted for the majority of the day, moving east-south east and increased to a F6 strong breeze in the late evening.

Wednesday 28 May 2014

Overcast and foggy conditions in the morning cleared to sunshine for the shoreline walk. The easterly F2-F3 winds in the morning moved northerly into the afternoon.

Preceding the shoreline survey, Saturday 24 May was an overcast day with light rain showers present in the early hours of the morning and again in the afternoon. A F3-F4 easterly gently breeze remained throughout the morning before moving east-north east and increased to a F5 strong breeze in the afternoon. Sunday 25 May again was an overcast-cloudy day however rain was less frequent with only a brief period of light rain present late morning. The wind remained a north easterly F3-F4 throughout the day changing to east-north easterly moving into the evening.

Fishery

The location of the mussel lines for all five fisheries are mapped in Figure 1. All fisheries had stocked mussel lines on site. Harvesting was conducted on a rotational basis with different lines set out at fisheries in different years to allow harvesting of stock annually.

The Busta Voe Lee fishery consisted of ten mussel lines running parallel to the eastern shoreline of Muckle Roe (Figure 4). All lines were double headed longlines with 10 metre droppers. The site is licensed for ten 155 metre twin-headline longlines.

The Busta Voe fishery consisted of nine mussel lines running parallel to the western shoreline of Busta Voe (Figure 5). All lines were double headed longlines with 10 metre droppers. Two mussel samples were collected at the north end of the site. The site is licensed for nine 200 metre twin-headline longlines.

The Hevden Ness fishery consisted of ten mussel lines running parallel to the eastern shoreline of Busta Voe (Figure 6). All lines were double headed longlines with 10 metre droppers. Two mussel samples were collected from the north end of the site. The site is licensed for ten 220 metre twin-headline longlines.

The North of Linga fishery consisted of six mussel lines running parallel to the northern shoreline of the island of Linga (Figure 7). All lines were double headed longlines with 10 metre droppers. The site is licensed for ten 260 metre twin-headline longlines.

The Wetherstaness fishery consisted of six mussel lines running parallel to the southern shoreline at Wetherstaness (Figure 8). All lines were double headed longlines with 10 metre droppers. The site is licensed for ten 200 metre twin-headline longlines.

Sewage/Faecal Sources

The largest settlement in the area is the village of Brae. A circular area of disturbed water a short distance from the shore adjacent to the community septic tank (Figure 9) was observed, this was assumed to be the location of the end of the discharge pipe (Figure 10). As you move further south on the eastern shore the houses become sparser with approximately 20 houses located south of Burravoe. On the survey route from Brae to Wethersta three additional septic tanks were observed. One was below a house north of the Burravoe area which had an associated pipe leading to the shore. The pipe had a broken section in the middle which had a small grey discharge with a slight smell (Figure 11). The second tank was next to the Blueshell Mussels shorebase at Sparl and had a small flow of water down from the tank to the sea (Figure 12). The third tank was just south of Sparl in a fenced area below a house (Figure 13). At Wetherstaness three houses are present however only two were visible from the shore. The house nearest the shore at the west end of the route had an associated septic tank (Figure 14). There was a pipe leading to the shore however it did not look to be in use as there was no discharge. On the north western shore there are approximately 15 houses in the Busta area, seven located above the road some distance from the shore. Two houses were located at the shore below the Busta House Hotel and four houses were located behind the Busta House Hotel. No septic tanks were identified in this area. On the Muckle Roe section of the shoreline survey there are approximately 16 houses evenly spaced along the shoreline. Ten of the houses are located

above the road with six below. One septic tank was identified near the shore with two houses observed above the road (Figure 15). There was a pipe leading to the shore but no discharge was present so it was assumed it was not connected to the septic tank. Two pipes were noted at the shore below a house north of the Greentaing jetty, a small discharge was present from both but it was assumed to be land drainage as there was no smell or colouration to the water.

Sample analysis

Ten freshwater samples were obtained from watercourses around Busta Voe, five on the western shore and five from the eastern shore. Nine of the ten samples obtained were outlined in the sampling plan, with one additional sample being obtained from the east shore in the Brae area. A freshwater sample which was outlined in the sample plan near the north end of the Busta Voe fishery was not obtained as no watercourse could be identified in the area. Eight of the ten watercourses sampled were found to have *E. coli* levels between 6-100 cfu/100ml. The two samples with the highest *E. coli* counts were from a small watercourse south of the Muckle Roe bridge (180 cfu/100ml) (Figure 16) and a sample from a watercourse discharging near the Busta Voe fishery (1400 cfu/100ml) (Figure 17).

Seawater samples were obtained from all five fisheries from the north ends of the sites with the exception of the North of Linga fishery with the sample collected from the east end of the site. The seawater samples obtained had *E. coli* levels between <1-2 cfu/100ml.

Another two seawater samples were obtained on the eastern shoreline walk between Brae and Wethersta, both of which were outlined in the survey plan. The samples were obtained near the water's edge where the Brae community septic tank was discharging and from the sea below where a septic tank was discharging at Sparl which may be associated with the Blueshell Mussels shorebase. The *E. coli* levels for these samples were 1 and 48 cfu/100ml respectively.

Mussel samples were obtained from two fisheries in the Busta Voe Lee North production area. Samples were obtained from the north end of the Busta Voe fishery, three lines in from the furthest west line. Two samples were obtained, one from the top of a mussel dropper and one from the bottom of the dropper. The sample obtained from the surface was found to have a count of 700 *E. coli* MPN/100g with the bottom sample returning levels of 270 *E. coli* MPN/100g. Two samples were obtained from the north end of the Hevden Ness fishery, five lines in from the furthest west line. The surface sample was taken from the top of a mussel dropper and the bottom sample was collected from the *E. coli* RMP sampling basket located 8 metres from the surface. The sample obtained from the top recorded a count of <18 *E. coli* MPN/100g with the bottom sample returning levels of 130 *E. coli* MPN/100g.

Salinity profiles were obtained from the north ends of the two fisheries sampled for mussels. Both profiles showed decreases in salinity from 10 metres to the surface which were within the accuracy of the probe used (± 0.35 ppt). Surface salinity was 34.92 ppt at the Busta Voe fishery and 35.03 ppt at the Hevden Ness fishery.

Temperature profiles were also obtained from the north ends of the two fisheries sampled for mussels. Both profiles showed a slight increase in temperature from 10 metres to the surface (0.1°C difference). Temperature ranged from 9.2°C to 9.3°C.

Salinities of the seawater samples analysed at the laboratory showed salinities ranging from 33.95 PSU present at the Busta Voe Lee fishery to 35.39 PSU present at the Hevden Ness fishery.

Seasonal population

Brae has a number of local amenities to serve both the community and visitors, including shops, a health centre, a school, a leisure centre, a community hall, garages, a care home, cafes and restaurants. Currently the Sullom Voe Oil Terminal is undergoing an upgrade and a new Gas Plant is being built near the Terminal just north of the Brae area. This has seen a large influx of workers from the British mainland requiring accommodation. With Brae being the closest village to the Oil Terminal accommodation in the area such as hotels, B&B's and self-catering properties are fully booked out long term. Due to the high demand for accommodation a new 100 room hotel, The Moorfield Hotel, was constructed recently just north of the village at the head of Busta Voe. Located on the east coast of Busta Voe is the Brae Hotel, with 35 rooms, Drumquin Guest House, with 10 rooms and the Valleyfield Guest House, with 12 rooms and also three, two bedroom chalets to rent. On the west coast of Busta Voe is the Busta House Hotel, with 22 rooms. On Muckle Roe there are three B&B properties one located at the south end of the island out with the production area, one in the Roe Sound area and Orwick Lodge located at the south end of the production area which can accommodate four people. At the north end of Busta Voe is a caravan park at the Delting Boating Club which can hold thirteen vehicles.

Boats/Shipping

Boat traffic in Busta Voe is largely associated with mussel farming and leisure boats. Blueshell Mussels which own all the mussel fisheries in the Busta Voe Lee North production area have a large shorebase located on the east shore of the voe at Sparl (Figure 18). A number of large and small workboats operate out of this shorebase, with one large workboat and one small workboat being present at the pier at the time of the survey. Large workboats were working at the Hevden Ness and North of Linga fisheries during the shoreline walks with another large workboat moored just south of the Hevden Ness fishery. On the south west shoreline just outside the production area there is a jetty adjacent to the Greentaing fishery which is owned by Northmaven Marine. The jetty is used by the company as a shorebase for servicing their sites (Greentaing and Buddascord). A small workboat was present at the jetty at the time of the survey. Just below the Busta House Hotel a small harbour area was noted with a working boat present (Figure 19). Creels and boxes associated with fishing were present on the pier beside the boat. A boat on a trailer was also present in this area. Two small leisure boats were noted on a beach and outside a house on a trailer on the Brae to Wethersta walk. At the head of Busta Voe there is a marina associated with the Delting Boating Club. Shetland Marine Charters a boat hire business operates out of the Brae marina, with a vessel being available for fishing trips or sightseeing tours. Shetland Windsurfing Club and Sullom Voe Sub Aqua Club are based at the Brae marina. Also dinghy sailing courses and yacht races take place during the summer months.

Farming and Livestock

The majority of the land observed during the survey around Busta Voe was rough grazing. 196 sheep were observed on the western shore and 91 sheep were observed on the eastern shore of Busta Voe. Of these animals 196 had access to the shore, the majority of the sheep on the eastern shore were able to access the shore with more fenced areas present on the western shore (Figure 20). Sheep faeces were noted on nine occasions where animals were not present, animals in these areas with the exception of one would have been able to access the shore. Steeper escarpments on the western shore however may have restricted access to the shore by the animals.

Evidence of cows grazing was observed with faecal matter and hoof prints noted on three occasions, twice on the eastern shore and once on the western shore, however no animals were present at the time of the survey. The animals that had been grazing on the eastern shore would have been able to access the shore however the animals on the western shore had no access to the shore.

Agricultural buildings were noted on five occasions during the shoreline survey. A shed was noted on the Brae to Wethersta walk and a small animal shed was present on the Wetherstaness walk. Larger buildings were noted on the western shore with three sheds observed beside a house in Muckle Roe with associated farm vehicles. In the Busta area a large agricultural shed and silage pit (Figure 21) were noted a short distance up the hill from the shore and three sheds were observed behind the Busta House Hotel.

Land Use and Land Cover

Rough grassland dominated the shorelines around the Busta Voe Lee North production area. The eastern shoreline was characterised by rocky shores and lowland areas further north near the more populated areas and steeper escarpments further south near the Wethersta and Wetherstaness areas. A large sandy area which was submerged at high tides and accessible on foot during low tide was present between the populated area of Brae and the shorebase at Sparl. The western shore was dominated by steeper escarpments and rocky shores with only two lowland areas observed near Busta House Hotel and at the Greentaing jetties at the south end of the walk. Wet boggy areas were noted on two occasions in the Wetherstaness area with marsh marigolds present. A wet area below a septic tank on the western shore was surrounded by wild iris and marsh marigolds, with a small patch of trees present further up the field.

There was some rainfall in the days preceding the shoreline survey however wet boggy areas were not common.

Watercourses

Ten watercourses were sampled during the shoreline survey, nine of which were outlined on the sample plan. The additional sample not outlined in the plan was obtained from a small watercourse on the east shore below houses in the village of Brae (Figure 22).The sampling plan detailed a freshwater sampling location on the west shore at the north end of the Busta Voe fishery however on approaching the location no freshwater water discharge could be observed. Flow rate was recorded at nine of the ten watercourses sampled. Flow rate was

not recorded at one of the watercourses as there was insufficient water flow due to the stagnant nature of the watercourse.

Wildlife/Birds

Birds were observed in all areas surveyed. Most commonly observed were gulls (86 in total) which were observed at all five fisheries visited. Large numbers of gulls were observed during the walk at Wetherstaness where 40 gulls were seen taking flight from the shore and 10 gulls were observed on buoys at the Wetherstaness fishery. Eider ducks were also common (31 in total) with the highest numbers noted around the Busta Voe and Wetherstaness fishery. Shags, artic terns and guillemots were also seen on buoys, in the water or in flight around the fisheries. A large variety of birds were observed on the Brae to Wethersta walk including oystercatchers, geese, curlews, blackbirds, plovers, a collared dove and a heron however the birds were usually not observed in high numbers. Birds were observed feeding on a large sandy area south of Burravoe where the sea ebbs and flows out of (Figure 23). Bird faeces were observed on buoys at most of the fisheries visited. Goose faeces were observed twice, south of the populated area in Brae and in the Busta area. Shell debris was observed on three occasions which could indicate areas where birds may have been feeding. These areas were near Brae on the sand bank, on the shore near the Busta Voe fishery and at Wetherstaness on the shore adjacent to the fishery.

Rabbits were observed in the Busta area on the western shore and Wethersta area on the eastern shore.

General observations

Recorded observations apply to the date of survey only. Animal numbers were recorded on the day from the observer's point of view. This does not necessarily equate to total numbers present as natural features may obscure individuals and small groups of animals from view.

Dimensions and flows of watercourses are estimated at the most convenient point of access and not necessarily at the point at which the watercourse enters the sound.

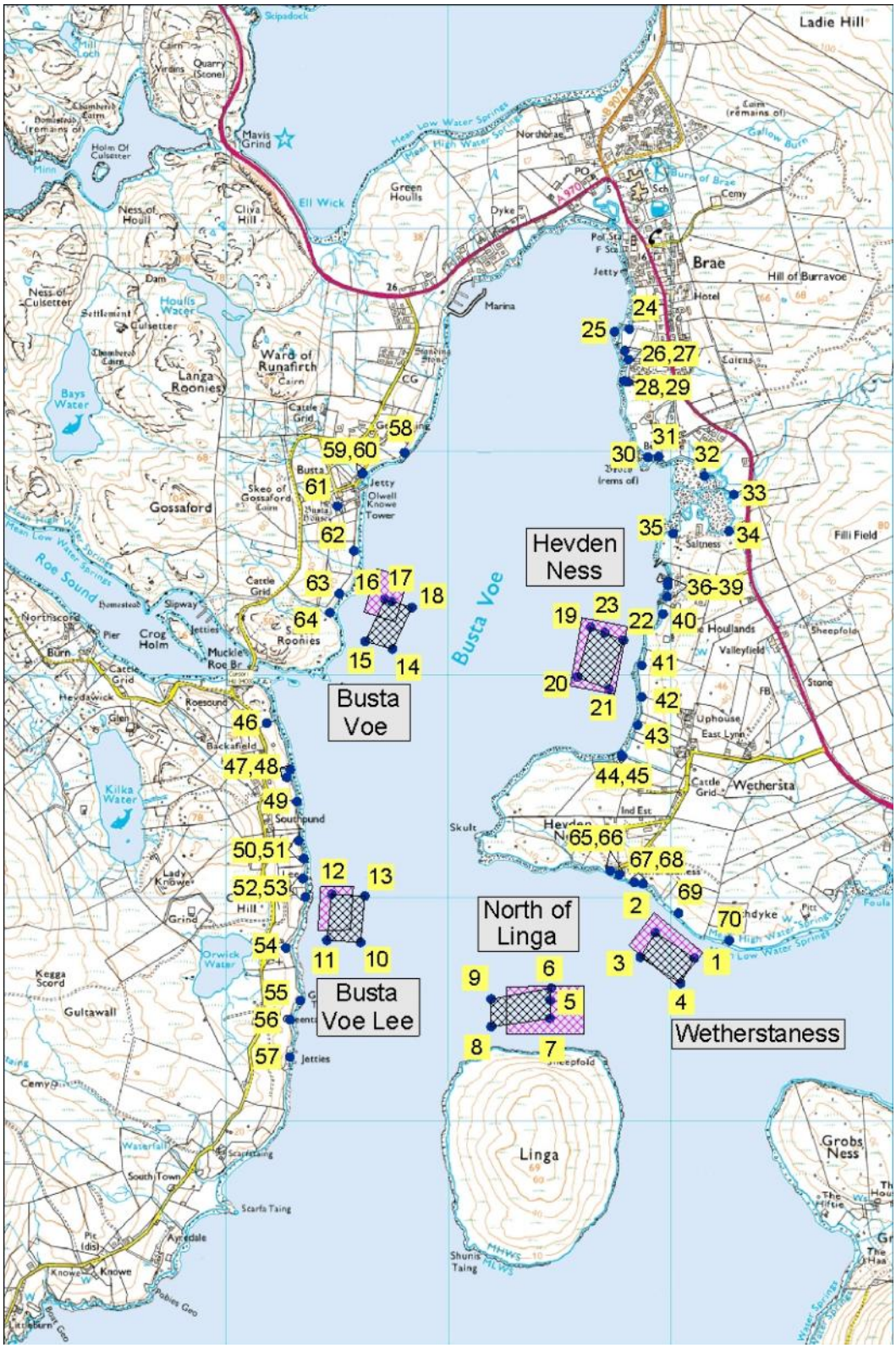

Figure 1 Map of shoreline observations Busta Voe Lee North.

Table 1 Shoreline Observations

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
1	26/05/2014 08:21	HU 36102 64733	436102	1164733			Busta Voe Lee North shoreline survey - boat work. Weather: Cloudy, gentle breeze. Sea state: large wavelets, no white caps. Harvesting is operational on a rotational basis with different lines set out in different years to allow harvesting of some stock annually. SE corner of the Wetherstaness fishery. 6x double headed longlines, 10m droppers.
2	26/05/2014 08:23	HU 35927 64847	435927	1164847		BVLN-SW01	NE corner of the Wetherstaness fishery. Seawater sample collected.
3	26/05/2014 08:27	HU 35861 64736	435861	1164736			NW corner of the Wetherstaness fishery. Two gulls on buoys at the fishery and one gull in flight.
4	26/05/2014 08:29	HU 36041 64619	436041	1164619			SW corner of the Wetherstaness fishery. Some bird faeces on buoys at the fishery.
5	26/05/2014 08:32	HU 35454 64544	435454	1164544		BVLN-SW02	North of Linga fishery. 6x double headed longlines, 10m droppers. Seawater sample collected from the east end of the third line down from the north. Two shags and one gull on buoys at the fishery.
6	26/05/2014 08:37	HU 35460 64598	435460	1164598			NE corner of the North of Linga fishery. Six shags on buoys at the fishery and one shag in flight.
7	26/05/2014 08:39	HU 35454 64462	435454	1164462			SE corner of the North of Linga fishery.
8	26/05/2014 08:41	HU 35190 64425	435190	1164425			SW corner of the North of Linga fishery.
9	26/05/2014 08:42	HU 35190 64549	435190	1164549			NW corner of the North of Linga fishery. Some bird faeces on the buoys at the fishery. Four guillemots in the water and one artic tern in flight.
10	26/05/2014 08:45	HU 34603 64803	434603	1164803			SE corner of the Busta Voe Lee fishery. 10x double headed longlines, 10m droppers.
11	26/05/2014 08:46	HU 34452 64812	434452	1164812			SW corner of the Busta Voe Lee fishery. One artic tern and one shag on buoys at the fishery.
12	26/05/2014 08:49	HU 34473 65018	434473	1165018		BVLN-SW03	NW corner of the Busta Voe Lee fishery. Seawater sample collected. One eider duck and one shag on buoys at the fishery and one gull in flight. Some bird faeces on the buoys at the fishery.
13	26/05/2014 09:02	HU 34622 65010	434622	1165010			NE corner of the Busta Voe Lee fishery.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
14	26/05/2014 09:06	HU 34746 66116	434746	1166116			SE corner of the Busta Voe fishery. 9x double headed longlines, 10m droppers. One artic tern on a buoy at the fishery.
15	26/05/2014 09:08	HU 34624 66150	434624	1166150			SW corner of the Busta Voe fishery. Two artic terns, two gulls and two shags on buoys at the fishery. Two guillemots in the water.
16	26/05/2014 09:11	HU 34712 66340	434712	1166340			NW corner of the Busta Voe fishery. Eleven eider ducks in flight.
17	26/05/2014 09:15	HU 34743 66328	434743	1166328		BVLN-MUSS01 (Top), BVLN-MUSS02 (Bottom) & BVLN-SW04	Two mussel samples collected from the north end of the Busta Voe fishery, three lines in from the furthest west line, nearest the shore. Surface sample collected from the top of a mussel dropper, bottom sample collected from bottom of a mussel dropper. Salinity Profile 1 collected (ppt/°C): 10m 35.17/9.2, 5m 34.98/9.3, 3m 34.95/9.2, surface 34.92/9.3. Seawater sample collected.
18	26/05/2014 09:34	HU 34834 66301	434834	1166301			NE corner of the Busta Voe fishery.
19	26/05/2014 09:37	HU 35637 66214	435637	1166214			NW corner of the Hevden Ness fishery. 10x double headed longlines, 10m droppers. Two artic terns in flight.
20	26/05/2014 09:39	HU 35576 65989	435576	1165989			SW corner of the Hevden Ness fishery. One gull and one guillemot in the water.
21	26/05/2014 09:40	HU 35719 65937	435719	1165937			SE corner of the Hevden Ness fishery. Two artic terns on buoys at the site.
22	26/05/2014 09:41	HU 35784 66155	435784	1166155			NE corner of the Hevden Ness fishery.
23	26/05/2014 09:45	HU 35701 66189	435701	1166189		BVLN-MUSS03 (Top), BVLN-MUSS04 (Bottom) & BVLN-SW05	Two mussel samples collected from the north end of the Hevden Ness fishery, five lines in from the furthest west line. Surface sample collected from the top of a mussel dropper, bottom sample collected from the RMP E-coli sample basket at a depth of 8m. Salinity Profile 2 collected (ppt/°C): 10m 35.19/9.2, 5m 35.13/9.3, 3m 35.11/9.3, surface 35.03/9.3. Seawater sample collected.
24	26/05/2014 12:11	HU 35811 67548	435811	1167548	Figure 9		Start of the shoreline walk; Brae to Wethersta. Cloudy with moderate breeze. Lowland areas, rough grazing with rocky shores. Brae community septic tank. Two blackbirds on the

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							rocks near the shore. Hotels, public houses, community hall, shops, fish and chip shop, garage, leisure centre, school and large number houses in the area.
25	26/05/2014 12:18	HU 35744 67537	435744	1167537	Figure 10	BVLN-SW06	Seawater sample collected at the shore. Area in the sea observed short distance from the shore where water was disturbed creating a circular zone. Possibly end of discharge pipe from the septic tank. No pipe visible on the shore entering the water.
26	26/05/2014 12:26	HU 35790 67451	435790	1167451			Old disused concrete septic tank.
27	26/05/2014 12:32	HU 35807 67412	435807	1167412	Figure 22	BVLN-FW01	Small watercourse flowing through a field to the stony beach, over a small step below a fence. Three houses, shed and a church near the shore. Wild iris present beside the watercourse. Some green algae present on the steps and rocks around the watercourse. Freshwater sample obtained (not on the survey plan) and flow rate measured; width 25 cm, depth 4 cm, flow 0.311 m/s, st. dev. 0.002 m/s. One oystercatcher in flight.
28	26/05/2014 12:42	HU 35801 67311	435801	1167311			Concrete septic tank below a white house near the shore. Slight smell from the tank.
29	26/05/2014 12:45	HU 35787 67316	435787	1167316	Figure 11		Pipe leading to the shore, broken in mid-section with grey discharge, slight smell. Green algal growth in the discharge area. Three new houses built near the shore with a number of houses present just up from the shore. Rocky shore with grass verges. Two curlews in flight.
30	26/05/2014 12:55	HU 35895 66975	435895	1166975			Cow, goose and sheep faeces present outside the fenced areas so animals would have had access to the shore. Three oystercatchers, one collared dove and one gull in flight.
31	26/05/2014 13:00	HU 35943 66978	435943	1166978			Six sheep present in a field above the shore, not fenced so animals could access the shore. Houses noted at the top of the field.
32	26/05/2014 13:05	HU 36147 66890	436147	1166890			Eight gulls, two artic terns and a heron in flight.
33	26/05/2014 13:15	HU 36280 66808	436280	1166808		BVLN-FW02	Lowland area, large watercourse originating from up the hill splits into a number of smaller streams leading to the shore.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							Sea ebbs and flows into and out of this sand bank area. Freshwater sample obtained from largest watercourse (on the survey plan) and flow rate measured; width 200 cm, depth 20 cm, flow 0.104 m/s, st. dev. 0.008 m/s. One oystercatcher in flight.
34	26/05/2014 13:25	HU 36259 66644	436259	1166644	Figure 23	BVLN-FW03	Small watercourse to the south of the lowland area, discharge from a large pipe coming under a small side road. Lots of birds present in this area. Four gulls feeding and one gull in flight. Lots of empty shells in lowland area where birds have been feeding. One house near the shore, west of the watercourse. Small boat outside the house on a trailer. Seven houses noted on the north shore of the lowland area. Freshwater sample obtained (on the survey plan) and flow rate measured; width 60 cm, depth 5 cm, flow 0.089 m/s, st. dev. 0.004 m/s.
35	26/05/2014 13:43	HU 36007 66632	436007	1166632			Forty sheep and lambs in fields, not fenced so animals had access to the shore. Sheep faeces present. Two oystercatchers in flight. Mussel shells present where birds may have been feeding.
36	26/05/2014 13:54	HU 35983 66418	435983	1166418	Figure 18		Blueshell Mussels Ltd. shorebase at Sparl. Office units, workshops and factory present. Buoys, ropes, nets, pegs and large storage units present around the shorebase. Large lorry on site at the time of the survey. One large workboat at the pier and one small workboat on the pier. More boats known to work from this shorebase but were not present during the survey.
37	26/05/2014 14:01	HU 35982 66408	435982	1166408		BVLN-SW07	Seawater sample obtained from the shore below a concrete septic tank.
38	26/05/2014 14:03	HU 35985 66402	435985	1166402	Figure 12		Septic tank mentioned above thought to be associated with the Blueshell Mussels shorebase found just outside the fenced shorebase area. Small flow of water next to the tank flowing over rocks to the shore. Sheep faeces present outside the fenced area so animals would have had access to the shore.
39	26/05/2014 14:07	HU 35980 66350	435980	1166350	Figure 13		Concrete septic tank within a fenced area below a house up from the shore. Another three houses present in the area.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							Sheep faeces noted within the fenced area.
40	26/05/2014 14:10	HU 35962 66273	435962	1166273	Figure 6		Hevden Ness fishery. Large workboat on site. Six sheep present in an unfenced area with access to the shore.
41	26/05/2014 14:16	HU 35867 66043	435867	1166043			Four geese in flight. Cow and sheep faeces noted but no animals present, however these animals would have had access to the shore.
42	26/05/2014 14:19	HU 35867 65901	435867	1165901			Agricultural shed at the top of the field up from the shore. House present next to the shed. Large workboat not in use moored south of the Hevden Ness fishery.
43	26/05/2014 14:23	HU 35848 65775	435848	1165775			Twelve sheep and lambs noted in a fenced area with sheep faeces also present. Two rabbits present in the field.
44	26/05/2014 14:27	HU 35776 65641	435776	1165641			Twelve sheep observed with access to the shore. Six houses noted in the fields above the shore.
45	26/05/2014 14:33	HU 35779 65636	435779	1165636		BVLN-FW04	Very small stagnant watercourse, originating from a field leading to the stony beach at the shore. Wild iris present around the watercourse. Freshwater sample obtained (on the survey plan) but insufficient water flow to record flow rate. Sheep faeces observed near the shore and two rabbits noted in the field above the shore. Small boat observed on the beach. End of shoreline walk.
46	28/05/2014 08:39	HU 34182 65784	434182	1165784	Figure 15		Shoreline walk; Muckle Roe bridge to Greentaing jetty. Fog clearing to sunshine and light breeze. Rough grazing, steep escarpments and rocky shores. Concrete septic tank, two houses noted above the road. Wet area below tank with marsh marigolds and wild iris present. Pipe present at the shore but no discharge. One gull in flight.
47	28/05/2014 08:48	HU 34287 65576	434287	1165576	Figure 16	BVLN-FW05	Small watercourse, very little water flowing over rocks and through vegetation. Wild iris present around the watercourse. Freshwater sample obtained (on the survey plan) and flow rate measured; width 40 cm, depth 10 cm, flow 0.074 m/s, st. dev. 0.005 m/s.
48	28/05/2014 08:54	HU 34272 65541	434272	1165541			Four houses noted above the shore. Thirteen sheep and lambs in field above the shore, sheep faeces present. Small

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							area of trees and patches of wild iris present in the field. Thirty sheep and lambs noted above the road in a field behind a house. Three artic terns and two gulls in flight.
49	28/05/2014 08:57	HU 34316 65433	434316	1165433			Three agricultural sheds and two tractors next to a house at the top of the field below the road. Cow faeces and hoof prints present in a fenced area above the shore but no animals grazing. Eleven gulls in flight.
50	28/05/2014 09:04	HU 34325 65258	434325	1165258			Thirty three sheep and lambs in a fenced area and one sheep outside the fenced area. Sheep faeces present inside and outside fenced area. Two houses present above the road.
51	28/05/2014 09:08	HU 34347 65178	434347	1165178	Figure 4		Busta Voe Lee fishery.
52	28/05/2014 09:12	HU 34344 65089	434344	1165089		BVLN-FW06	Small watercourse with little water flowing discharging to the shore at the north end of the Busta Voe Lee fishery. Wild iris present around the watercourse. Freshwater sample obtained (on the survey plan) and flow rate measured; width 10 cm, depth 2 cm, flow 0.135 m/s, st. dev. 0.009 m/s. Two artic terns, two plovers and one gull in flight.
53	28/05/2014 09:21	HU 34356 65006	434356	1165006			Twenty three sheep and sheep faeces in an unfenced area up from the shore however access to the shore would be difficult due to the high escarpments.
54	28/05/2014 09:28	HU 34267 64778	434267	1164778		BVLN-FW07	Large watercourse discharging to the shore at the south end of the Busta Voe Lee fishery. Two houses noted below the road up the field from the watercourse. One artic tern observed in flight. Freshwater sample obtained (on the survey plan) and flow rate measured; width 15 cm, depth 5 cm, flow 0.403 m/s, st. dev. 0.007 m/s.
55	28/05/2014 09:39	HU 34331 64542	434331	1164542	Figure 20		Fifty sheep and lambs in fenced area above the shore however animals were able to get through gaps in the fence. Sheep faeces were present inside and outside the fenced area. Would have been difficult for animals to access the shore due to steep escarpments.
56	28/05/2014 09:41	HU 34287 64457	434287	1164457			Black plastic pipe with small discharge at the top of high escarpment near the edge of the shore. House noted above the pipe, below the road. Small white plastic corrugated pipe

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							with a very small discharge near the black pipe. Brown algae present on the inside of both pipes. Assumed that the pipes must be used for land drainage. One gull in flight.
57	28/05/2014 09:49	HU 34286 64290	434286	1164290			Lowland area where jetty/shorebase is located used to service Greentaing and Buddascord fisheries. Small workboat present. Equipment associated with mussel fisheries stored around the jetty such as ropes, pegs and buoys. Thirty sheep and lambs in fenced area above the jetty however gate for a small road used to access the jetty was open so animals were able to access the shore. Sheep faeces were present inside and outside the fenced area. One artic tern in flight. End of shoreline walk.
58	28/05/2014 10:27	HU 34801 66995	434801	1166995			Shoreline walk; Busta to Muckle Roe bridge. Sunshine and very little wind. Rough grazing with steep escarpments and rocky shores below. Three houses noted below the road however no discharge to seawater was observed as outlined in the survey plan. One rabbit observed.
59	28/05/2014 10:34	HU 34610 66900	434610	1166900	Figure 21	BVLN-FW08	Lowland area, small stony/gravel beach, watercourse originating from the hill leading to the shore discharging through a large black plastic pipe coming under a small road. Wild iris present around the watercourse above the small road. House present next to the watercourse at the shore with Busta House Hotel to the south. Freshwater sample obtained (on the survey plan) and flow rate measured; width 30 cm, depth 2 cm, flow 0.383 m/s, st. dev. 0.002 m/s. Large agricultural shed and silage pit above the main road up the hill.
60	28/05/2014 10:40	HU 34613 66903	434613	1166903	Figure 19		Small harbour area with a small boat present in the water. Boat on a trailer on the grass above the harbour area. Three sheds above the side road. Equipment associated with creel fishing present such as creels and boxes.
61	28/05/2014 10:48	HU 34499 66755	434499	1166755			Three houses present near the shore to the south of the hotel. Three agricultural sheds present behind the hotel. Nineteen sheep in a fenced field above the shore, with sheep faeces noted inside and outside the fenced area. Escarpments

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							increasing in height. One rabbit noted.
62	28/05/2014 10:54	HU 34573 66555	434573	1166555	Figure 5		Sheep and goose faeces noted inside and outside a fenced area. Freshwater sample to be collected in regards to the survey plan however no watercourse was identified. Two rabbits noted. Busta Voe fishery.
63	28/05/2014 11:00	HU 34507 66364	434507	1166364			Two eider ducks in the water and two eider ducks and one oystercatcher in flight. Mussel and cockle shells present on the grass near the shore, areas where birds may have been feeding. Sheep faeces present outside a fenced area.
64	28/05/2014 11:05	HU 34465 66279	434465	1166279	Figure 17	BVLN-FW09	Large watercourse leading to a stony beach near the Busta Voe fishery. Flowing through rocks and vegetation, marsh marigolds present. Sheep faeces present next to the watercourse. Freshwater sample obtained (on the survey plan) and flow rate measured; width 15 cm, depth 15 cm, flow 0.036m/s, st. dev. 0.005 m/s. End of shoreline walk.
65	28/05/2014 12:11	HU 35766 65106	435766	1165106	Figure 7 & 8		Shoreline walk; Wetherstaness. Sunshine and very little wind. Rough grazing with steep escarpments and rocky shores below. Wetherstaness and North of Linga fisheries, boat on site at the North of Linga fishery. Sheep faeces present in an unfenced areas above the shore. Twelve eider ducks in flight.
66	28/05/2014 12:12	HU 35724 65124	435724	1165124	Figure 14		Concrete septic tank of house above the shore. Pipe leading to the shore but no discharge present, assumed to not be in use.
67	28/05/2014 12:16	HU 35834 65072	435834	1165072			Fifteen sheep and lambs in unfenced area with access to the shore. Sheep faeces present.
68	28/05/2014 12:19	HU 35872 65066	435872	1165066		BVLN-FW10	Small watercourse leading to the shore through rocks, west of the Wetherstaness fishery. House up the hill near the watercourse. Freshwater sample obtained (on the survey plan) and flow rate measured; width 20 cm, depth 8 cm, flow 0.064m/s, st. dev. 0.012 m/s.
69	28/05/2014 12:27	HU 36031 64934	436031	1164934			Ten gulls on buoys at the Wetherstaness fishery and forty gulls in flight from the shore. Three eider ducks in the water. Mussel shells on the shore possibly where birds have been feeding. Wet boggy area near the shore, sheep faeces

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
							present.
70	28/05/2014 12:34	HU 36259 64811	436259	1164811			Small animal shed at the top of the field. Boggy area with marigolds present. Dead lamb on the rocky shore. Escarpments have lessened in height. Wetherstaness and North of Linga fisheries. End of shoreline walk.

Sampling

Water and shellfish samples were collected at the locations indicated in Figures 2 and 3. Nine of the ten freshwater samples detailed in the survey plan were obtained from watercourses, as well as one additional freshwater sample which was collected from a small watercourse on the eastern shore below houses in Brae at the north end of the shoreline walk. All samples were transported initially by a cool backpack and then in a cool box to SSQC Ltd. for analysis within 24 hours of sample collection.

Bacteriology results are present in Table 2 and 3 and mapped in Figures 2 and 3.

Seawater samples were also tested for salinity at SSQC Ltd. In the field salinity profiles were collected using a YSI Professional Plus handheld meter and CT probe which had an accuracy of (± 0.35 ppt). Results are presented in Table 4 and locations of the profiles are mapped in Figure 2.

Table 2 Water sample *E. coli* results

No.	Sample Ref.	Date/Time (UT)	Position	Type	*E. coli* (cfu/100ml)	Salinity*
1	BVLN-SW01	26/05/2014 08:23	HU 35927 64847	Sea Water	<1	34.12
2	BVLN-SW02	26/05/2014 08:32	HU 35454 64544	Sea Water	<1	34.15
3	BVLN-SW03	26/05/2014 08:49	HU 34473 65018	Sea Water	2	33.95
4	BVLN-SW04	26/05/2014 09:15	HU 34743 66328	Sea Water	2	35.37
5	BVLN-SW05	26/05/2014 09:45	HU 35701 66189	Sea Water	<1	35.39
6	BVLN-SW06	26/05/2014 12:18	HU 35744 67537	Sea Water	1	34.87
7	BVLN-FW01	26/05/2014 12:32	HU 35807 67412	Fresh Water	40	-
8	BVLN-FW02	26/05/2014 13:15	HU 36280 66808	Fresh Water	57	-
9	BVLN-FW03	26/05/2014 13:25	HU 36259 66644	Fresh Water	73	-
10	BVLN-SW07	26/05/2014 14:01	HU 35982 66408	Sea Water	48	10.2
11	BVLN-FW04	26/05/2014 14:33	HU 35779 65636	Fresh Water	11	-
12	BVLN-FW05	28/05/2014 08:48	HU 34287 65576	Fresh Water	180	-
13	BVLN-FW06	28/05/2014 09:12	HU 34344 65089	Fresh Water	6	-
14	BVLN-FW07	28/05/2014 09:28	HU 34267 64778	Fresh Water	90	-
15	BVLN-FW08	28/05/2014 10:34	HU 34610 66900	Fresh Water	7	-
16	BVLN-FW09	28/05/2014 11:05	HU 34465 66279	Fresh Water	1400	-
17	BVLN-FW10	28/05/2014 12:19	HU 35872 65066	Fresh Water	100	-

*Practical Salinity Scale 1978 (PSS-78)

Table 3 Shellfish sample *E. coli* results

No.	Sample Ref.	Date/Time (UT)	Position	Type	Depth	*E. coli* (MPN/100g)
1	BVLN-MUSS01	26/05/2014 09:15	HU 34743 66328	Common Mussel	Top	700
2	BVLN-MUSS02	26/05/2014 09:15	HU 34743 66328	Common Mussel	Bottom	270
3	BVLN-MUSS03	26/05/2014 09:45	HU 35701 66189	Common Mussel	Top	<18
4	BVLN-MUSS04	26/05/2014 09:45	HU 35701 66189	Common Mussel	Bottom	130

Table 4 Salinity profiles

Profile	Date/Time (UT)	Position	Depth (m)	Salinity (ppt) (± 0.35 ppt)	Temperature (°C)
1	26/05/2014 09:15	HU 34743 66328	surface	34.92	9.3
			3	34.95	9.2
			5	34.98	9.3
			10	35.17	9.2
2	26/05/2014 09:45	HU 35701 66189	surface	35.03	9.3
			3	35.11	9.3
			5	35.13	9.3
			10	35.19	9.2

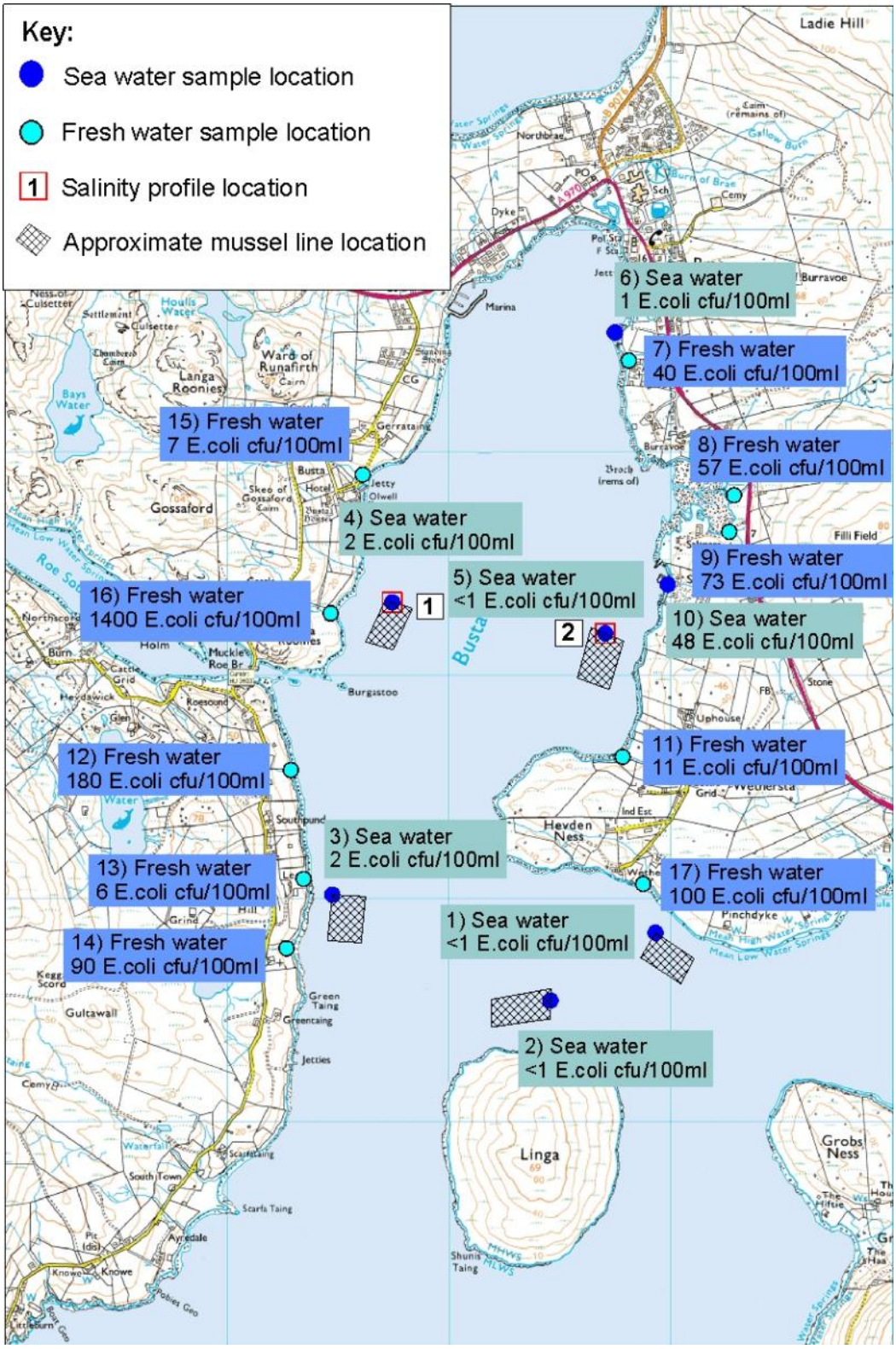

Figure 2 Map of water sample results and salinity profile locations Busta Voe Lee North.

Figure 3 Map of shellfish sample results Busta Voe Lee North.

Photographs

Figure 4 – Mussel lines at the Busta Voe Lee fishery looking east.

Figure 5 – Mussel lines at the Busta Voe fishery looking south east.

Figure 6 – Mussel lines at the Hevden Ness fishery looking south west with a large workboat on site.

Figure 7 – Mussel lines at the North of Linga fishery looking south west with a large workboat on site.

Figure 8 – Mussel lines at the Wetherstaness fishery looking south.

Figure 9 – Brae community septic tank.

Figure 10 – Disturbed area short distance from the shore adjacent to the Brae community septic tank, possibly the end of the discharge pipe.

Figure 11 – Broken pipe with a grey discharge associated with a septic tank below a house in Brae.

Figure 12 – Septic tank beside the Blueshell Mussels shorebase.

Figure 13 – Septic tank associated with houses at Sparl.

Figure 14 – Septic tank servicing a house at Wetherstaness.

Figure 15 – Septic tank south of the Muckle Roe bridge.

Figure 16 – Small watercourse south of the Muckle Roe bridge.

Figure 17 – Watercourse adjacent to the Busta Voe fishery.

Figure 18 – Blueshell Mussels shorebase at Sparl.

Figure 19 – Small harbour area at Busta.

Figure 20 – Sheep grazing in a fenced area at Greentaing.

Figure 21 – Large agricultural building and silage pit at Busta.

Figure 22 – Additional freshwater sample obtained from a watercourse below houses in Brae.

Figure 23 – Sand bank area south of Burravoe, accessible at low tide where birds were feeding.