Discussion:
The Coastal Archaeology of West Burra, East Burra & Trondra

The most conspicuous outcome of coastal survey on the Islands of West Burra, East Burra and Trondra has been in the tremendous number of new archaeological sites which have been discovered. In another context it might appear surprising that, after a century or more of archaeological enquiry, so many sites remain unrecorded; but this is not so in Shetland. Every new survey undertaken in Shetland in recent years has demonstrated the enormous and largely untapped archaeological potential of the islands.

The Royal Commission surveys of Shetland, carried out in the 1920's and 1930's and published in 1946 (RCAHMS 1946) came at a time when the nature and diversity of the archaeological remains on the islands was only beginning to be appreciated. At that time, very little excavation had yet been carried out and there was almost no firm information available about local site types and their date and duration of use.

Later, work by Hamilton at Jarlshof (1956) and Clickhimin (1968), together with Calder's excavations and surveys throughout Shetland (1958, 1963) began to redress the balance. The realisation of the wealth of the archaeological resource has been bolstered time and again by each new programme of work. In recent years, Parry's survey of West Burra (Hedges, 1984) the Scatness Environs Project, the Viking Unst Project, and the coastal Zone Assessment surveys (Moore & Wilson, 1995-1998) have each demonstrated that there is still much to be recorded and appreciated.

West Burra, one of the islands in this survey, had already been the subject of detailed work by Parry in 1977 (Hedges, 1984) and it might have been expected that very little new information would be forthcoming. This proved not to be the case, however, and a number of new sites both of prehistoric and later date were discovered. This clearly illustrates the need for ongoing survey and monitoring, especially of the coastal zone where the landscape is liable to change rapidly and where sites may be suddenly revealed and just as quickly destroyed by erosion.

Parry's work established that extensive prehistoric landscapes were preserved on West Burra, comprising houses, burnt mounds, cairns and field systems with clearance heaps and land boundaries. In his analysis of the findings, Hedges (1984) argues that the majority of these remains are likely to be of Bronze Age date. The case for this is, to some extent, backed up by the evidence of a small number of excavations of similar sites. Few excavated burnt mounds have been found to date to any other period, while several excavated oval houses, of the type frequently encountered in the Burras and Trondra, have been dated to this period at Tougs (Hedges, 1986), Scord of Brouster, House 3 (Whittle (Ed), 1986) and Mavis Grind (Cracknell & Smith , 1983).

The findings of this survey show a similar pattern of survival is repeated, and just as substantially, on East Burra and Trondra. While, again, it is thought likely that a large number of the sites may be of Bronze Age date, it is likely that a proportion will be of both earlier and later date. Unless there is clear evidence to suggest otherwise, all prehistoric sites found by this survey have been ascribed to a date range (3rd to 1st millennium BC) which is slightly wider than that usually given for the Bronze Age (2000-500 BC). It is a remarkable occurrence that sites of this period, which are extremely rare elsewhere in Britain, should survive here, and in such profusion.

It is of interest to note that the vast majority of Parry's prehistoric West Burra sites were found on or near the coast. It may be hypothesised, therefore, that the findings of this survey on East Burra and Trondra, although restricted to the coastal zone, provides a representative picture of the nature and type of remains preserved on these islands. There are at least two categories of site which may not be fully represented by this survey, however, Neolithic burial cairns and Norse and medieval settlements. In the case of the former, evidence from other parts of Shetland suggests that they often occur in slightly elevated locations. In the context of these islands, that means they are unlikely to be located close to the coast, which is generally low-lying. Two cairns are noted on rises to the interior of East Burra, for example. These sites lie out with the survey area and were not inspected, but it is probable that they may be of early date and that they may not be the only such sites to exist.

The survey also located a number of sites of later date on all three islands. Of these, some of the most exciting discoveries have been of probable Viking or Norse long houses. Prior to this work, no sites of this period had been reported. Parry's survey appears to have specifically focussed on prehistoric remains and sites of later date seem to have been passed over. The examples found by this survey which was restricted to the coastal zone are unlikely, therefore, to be the only such sites to survive. This was borne out by the discovery of two long houses and associated field systems near Torgur on Trondra,

one of which is reported here (T27). In several cases, these buildings exhibited traits such as bowed walls and rounded gable ends, which are associated with the Viking period. Sites of this period are also especially rare and unusual elsewhere in Britain and even in Shetland.

The failure to identify remains of the 14th to 18th centuries is unlikely to be entirely due to the restricted range of this survey since it is probable that access to the sea was at least as important during this period as it remained until the building of modern roads and bridges. The usual justification for this deficit is that such remains have either been robbed out by more recent developments or that they lie beneath modern settlement . Both explanations may hold true, but it is likely that there is also a problem with site identification deriving from the current lack of knowledge on how remains of this period may be manifested as archaeological features.

Conclusions & General Recommendations

The findings of this survey expand and validate earlier remarks made by Hedges (1984, 1986) regarding the high archaeological potential of West Burra and, as has been illustrated here, East Burra and Trondra. These islands must be regarded as prime areas for archaeological research in view of their remarkable preserved prehistoric landscapes and probable Viking period remains. The natural borders of the island group with the Shetland mainland and their cohesiveness as a unit makes them a suitable candidate for total landscape survey and targeted excavation.

The islands have seen a population influx in recent years and are experiencing renewed development. This is likely to have an impact on the archaeology and it is very desirable that the surveys are extended to include the 'interiors' of each island. The sites discovered by this survey have only been recorded in summary and it is vital that they are mapped, drawn and recorded in more detail.

Further work could be directed towards themes such as the interrelationships between the islands. One areas of study might be an examination of the apparent links between the numerous settlement sites on the east coast of West Burra and the cluster of burnt mounds on the west coast of East Burra in the prehistoric period. Were these site in use at the same time ? If so, were they used by the same groups of people and for what purpose ?

Iron Age studies could be directed towards documentary and field research on the brochs at Burland, its neighbour on the skerry at Ux Ness and the large probable broch mounds at Brough, Grunasound and Duncansclett (Hedges, 1984). Was there a chain of five or more brochs running along the strait between these islands ? If so, what was the social and economic basis which sustained so many high status settlements in this one small area ?

The intriguing remains surrounding the church at Papil lie out with the area of this survey but represent a prime opportunity to discover more about the coming of Christianity to the islands and the nature of one of the most important early religious communities in Shetland. Perhaps the remains found eroding from the coast edge at Duncansclett may date to this period and might be associated with a high status settlement or monastery ?

The recognition of several probable Viking houses could be followed up with a programme of investigation both at the sites recorded here and in the 'interiors' of the islands where further such sites may survive. Several of the houses have already been damaged by erosion and may not survive much longer.

Remains of the more recent past, such as click mills and features associated with crofting and fishing should continue to be recorded as archaeological remains, but it is equally, if not more important, that oral histories are recorded while there are still people who remember the landscape, how life was lived and how things were done in the past. In this respect, initiatives such as the Burland croft on Trondra with its emphasis on traditional crofting practice and preservation of unique Shetland plant and animal species have an important part to play.

Recommendations

Every site recorded within this survey has been assessed to determine if further investigative work is required. The conclusions are given in outline form in the site gazetteers and site descriptions which form the body of this report. In those sections recommendations are given as one of three types: Survey, Monitor or Nil, in accordance with Historic Scotland guidelines.

The term 'Survey' has been used as a general term covering all forms of further archaeological investigation or site protection. This may include topographical survey, section recording, trial trenching and open area excavation.

This section expands upon the specific type of work required where survey or monitoring has been recommended. These sites have been divided into four categories:

- **Category 1:** Urgent action required
- **Category 2:** Assessment required
- **Category 3:** Assessment desirable
- **Category 4:** Monitoring required

The main criteria used to categorise sites were the level of vulnerability to destruction, followed by the degree of archaeological potential.

Category 1 sites are therefore both highly vulnerable and likely to be of high archaeological potential. The sites in this category are listed in order of priority. Within the other categories sites are listed in the order in which they occur on the map sections.
Category 2 sites are vulnerable but either are of lower or unknown archaeological potential.
Category 3 sites may be of low vulnerability/some potential or vulnerable/unknown potential.
The monitoring of **Category 4** sites is recommended either to keep a site of known potential under surveillance or to check for new exposures on sites currently considered to be of low or unknown potential.

Recommendations

Category 1: Urgent Action Required

Site code	Island	Map	Grid reference	Site type	Placename	Date range
WB11	West Burra	3	HU 364 310	Structure, possible house	Bannaminn	10th-14th C
WB14	West Burra	2	HU 3622 3210	Structure, house or fort	Ruff Loch	3rd-1st Mill BC
WB34	West Burra	3	HU 3685 3051	Settlement	Duncansclett	1st Mill BC-1st Mill AD
WB35	West Burra	3	HU 360 319	Possible burial mound	Gossigarth	3rd-1st Mill BC
WB39	West Burra	1	HU 3697 3531	Settlement and enclosed promontory	Lu Ness	3rd-1st Mill BC
EB14	East Burra	5	HU 373 328	Settlement remains	Norbister/Bridge End	3rd-1st Mill BC
EB17	East Burra	5	HU 384 346	Structure, possible longhouse	Whalsies Ayre	10th-14th C
EB18	East Burra	5	HU 3845 3455	House and field system	Whalsies Ayre	3rd-1st Mill BC
EB20	East Burra	5	HU 3855 3475	Structure: possible longhouse	Whalsies Ayre	10th-14th C
EB21	East Burra	5	HU 3865 3480	Structure, possible long house	Whalsies Ayre	10th-14th C
EB28	East Burra	5	HU 3915 3459	Enclosure	Whalsies Ayre	3rd-1st Mill BC
EB45	East Burra	4	HU 3799 3076	Structure	Clettna Taing	Unknown

Category 2: Assessment Required

Site code	Island	Map	Grid reference	Site type	Placename	Date range
WB1	West Burra	3	HU 363 302	Settlement remains	Minn	3rd-1st Mill BC
WB5	West Burra	3	HU 359 293	Structure, possible cairn	Bight of the Sandy Geos	3rd-1st Mill BC
WB6	West Burra	3	HU 359 294	Burnt Mound	Bight of the Sandy Geos	3rd-1st Mill BC
WB13	West Burra	2	HU 362 321	Structure, house or cairn	Ruff Loch	3rd-1st Mill BC
WB21	West Burra	1	HU 379 369	Settlement and field systems	Setter	3rd-1st Mill BC
WB22	West Burra	1	HU 379 369	Possible burial cairn	Setter	3rd-1st Mill BC
WB24	West Burra	1	HU 3835 3680	Probable burnt Mound and structure	Bruna Ness	3rd-1st Mill BC
WB25	West Burra	1	HU 3835 3680	Burnt Mound	Bruna Ness	3rd-1st Mill BC
WB26	West Burra	1	HU 3835 3680	Burnt Mound	Bruna Ness	3rd-1st Mill BC
WB27	West Burra	1	HU 3810 3485	Possible burial mound	Southerhouse	3rd-1st Mill BC
WB29	West Burra	1	HU 381 347	Indeterminate, structural	Southerhouse	Unknown
WB30	West Burra	2	HU 3795 3455	Possible burial cairn	Southerhouse	3rd-1st Mill BC
WB41	West Burra	1	HU 381 354	Field System	Gardins	3rd-1st Mill BC
WB42	West Burra	1	HU 3811 3542	Structure, possible house	Gardins	3rd-1st Mill BC
EB1	East Burra	4	HU 3765 2985	Enclosure and dyke	Scarfi Taing	Unknown
EB3	East Burra	4	HU 371 287	Enclosed promontory	Point of Stakka	1st Mill BC-1st Mill AD
EB4	East Burra	4	HU 371 288	Enclosed promontory	Scaalie Point/Point of Stakka	Unknown
EB7	East Burra	4	HU 3765 3095	Possible burial mound	Ayre Dyke	3rd-1st Mill BC
EB8	East Burra	5	HU 3750 3180	Mound, possible clearance cairn	Newton	Unknown
EB9	East Burra	5	HU 3755 3230	House	Newton	3rd-1st Mill BC
EB13	East Burra	5	HU 374 325	Possible burial cairn	Midfield Norbister	3rd-1st Mill BC
EB15	East Burra	5	HU 379 338	Possible burial cairn	Grevis Field	3rd-1st Mill BC
EB16	East Burra	5	HU 3795 3395	Mound	Lang Sound	3rd-1st Mill BC
EB24	East Burra	4	HU 383 316	Stony mound	The Taing	Unknown
EB25	East Burra	4	HU 383 316	Enclosure	The Taing	18th-20th C
EB31	East Burra	5	HU 3790 3365	Enclosures and mound	Grevis Field	3rd-1st Mill BC
EB32	East Burra	5	HU 3805 3388	Settlement and field system	Grevis Field	3rd-1st Mill BC
EB34	East Burra	5	HU 382 343	Field boundary	Wester Heog	3rd-1st Mill BC
EB38	East Burra	5	HU 385 323	Boundary bank	east of Loch of Gershon	3rd-1st Mill BC
EB40	East Burra	4	HU 3760 3154	Structure, house or crue	Wick of Blumbister	3rd-1st Mill BC
EB41	East Burra	5	HU 3757 3240	Burnt mound	Houlls	3rd-1st Mill BC
EB42	East Burra	5	HU 3753 3250	Possible burnt mound	Norbister	3rd-1st Mill BC
EB46	East Burra	5	HU 3800 3166	Burnt mound	Voe of North House	3rd-1st Mill BC

Category 2: Assessment Required

Site code	Island	Map	Grid reference	Site type	Placename	Date range
T2	Trondra	6	HU 387 358	Indeterminate, structure	Opposite Ux Ness	Unknown
T3	Trondra	6	HU 3875 3560	Settlement and field system	Kallee Ness	3rd-1st Mill BC
T6	Trondra	7	HU 392 383	Settlement	Torgur	3rd-1st Mill BC
T7	Trondra	7	HU 390 375	House and field system	Burland	3rd-1st Mill BC
T9	Trondra	7	HU 390 375	Burnt Mounds, clearance cairns and enclosure	Burland	3rd-1st Mill BC
T13	Trondra	7	HU 3967 3841	Enclosure	nw of Hardhouse	3rd-1st Mill BC
T18	Trondra	6	HU 3901 3525	Possible house and field system	Kallee Ness	3rd-1st Mill BC
T19	Trondra	6	HU 3963 3589	Structure, possible house	Heugland	3rd-1st Mill BC
T26	Trondra	6	HU 3898 3694	Broch	Burland	1st Mill BC-1st Mill AD

Category 3: Assessment Desirable

Site code	Island	Map	Grid reference	Site type	Placename	Date range
WB3	West Burra	3	HU 359 294	Burnt Mound	Bight of the Sandy Geos	3rd-1st Mill BC
WB4	West Burra	3	HU 359 294	House	Bight of the Sandy Geos	3rd-1st Mill BC
WB7	West Burra	3	HU 352 295	Click mill	Loch of Annyeruss	18th-20th C
WB12	West Burra	2	HU 361 320	Click Mill	Ruff Loch	18th-20th C
WB15	West Burra	2	HU 363 325	Possible burial cairn	Whinner Hevda	3rd-1st Mill BC
WB17	West Burra	2	HU 3745 3450	Settlement and field system	Southerhouse	3rd-1st Mill BC
WB18	West Burra	1	HU 375 351	Possible burnt mound	Brough	3rd-1st Mill BC
WB23	West Burra	1	HU 3845 3695	Enclosed promontory	Bruna Ness	Unknown
WB31	West Burra	2	HU 3795 3455	Possible burial mound	Southerhouse	3rd-1st Mill BC
WB32	West Burra	2	HU 3710 3210	Indeterminate structure	South Voe, opp Holm of Papil	Unknown
WB36	West Burra	1	HU 3824 3670	Settlement and field system	Bruna Ness	3rd-1st Mill BC
WB37	West Burra	1	HU 3678 3605	House	Atla Ness	3rd-1st Mill BC
WB38	West Burra	1	HU 3692 3535	Burnt Mound	Lu Ness	3rd-1st Mill BC
WB40	West Burra	1	HU 3727 3540	Structure, house or cairn	Sand of Meal	3rd-1st Mill BC
WB43	West Burra	1	HU 3812 3482	Structure, possible house	Southerhouse	3rd-1st Mill BC
WB44	West Burra	1	HU 3812 3481	Structure, probable house	Southerhouse	3rd-1st Mill BC
WB45	West Burra	2	HU 3758 3379	Burnt mound, structures and field system	Tougs	3rd-1st Mill BC
WB46	West Burra	2	HU 3740 3343	Burnt mound	Tougs	3rd-1st Mill BC
WB47	West Burra	2	HU 3742 3342	Mound, possible burial site	Tougs	3rd-1st Mill BC
WB50	West Burra	2	HU 362 321	Enclosure	Ruff Loch	Unknown
WB55	West Burra	1	HU 3668 3558	Enclosed promontory	Fugla Ness	Unknown
WB56	West Burra	1	HU 3805 3477	Structure, possible house	Southerhouse	3rd-1st Mill BC
EB6	East Burra	4	HU 373 302	Possible burial mound	Symbister	3rd-1st Mill BC
EB10	East Burra	5	HU 375 320	Burnt Mounds	Newton	3rd-1st Mill BC
EB33	East Burra	5	HU 3816 3395	Enclosure	Wester Heog	3rd-1st Mill BC
EB35	East Burra	5	HU 3870 3470	Structure, house or cairn	Whalsies Ayre	3rd-1st Mill BC
EB36	East Burra	5	HU 3887 3478	Houses and field system	Whalsies Ayre	3rd-1st Mill BC
EB37	East Burra	5	HU 3905 3454	Settlement and field system	E of Whalsies Ayre	3rd-1st Mill BC
EB39	East Burra	5	HU 3842 3233	Cairn	E of Loch of Gershon	Unknown
EB43	East Burra	4	HU 3696 2948	Cairns	Clivland Bay	3rd-1st Mill BC
EB44	East Burra	4	HU 3755 2981	Structure, possible house or cairn	Scarfi Taing	3rd-1st Mill BC
EB48	East Burra	5	HU 3757 3230	Burnt mound	Houlls	3rd-1st Mill BC
EB49	East Burra	5	HU 3765 3232	Burial mound	Houlls	3rd-1st Mill BC
T4	Trondra	6	HU 389 352	Settlement and field system	Kallee Ness	3rd-1st Mill BC
T11	Trondra	7	HU 4010 3856	Noost	Meadow Ayre	Unknown
T12	Trondra	7	HU 3978 3845	Noosts and enclosure	Scarfataing	18th-20th C
T15	Trondra	7	HU 390 381	Possible house and field system	Torgur	3rd-1st Mill BC
T16	Trondra	7	HU 3902 3783	Enclosures	opp Merry Holm	18th-20th C
T27	Trondra	7	HU 3950 3804	Long house	Cauldhame	10th-14th C

Category 4: Monitoring Required						
Site code	**Island**	**Map**	**Grid reference**	**Site type**	**Placename**	**Date range**
WB8	West Burra	3	HU 3565 2995	Indeterminate mound	Fugla Stack	Unknown
WB10	West Burra	3	HU 3655 3095	Indeterminate structure	Banna Minn	Unknown
WB20	West Burra	1	HU 3690 3590	Shell midden	Hamnavoe	Unknown
WB33	West Burra	2	HU 3710 3210	Indeterminate mound	South Voe, opp Holm of Papil	Unknown
WB51	West Burra	2	HU 3632 3250	Crop mark	Loch of Sandwick	Unknown
WB52	West Burra	3	HU 364 304	Site of possible souterrain & artefacts	Minn	3rd-1st Mill BC
WB54	West Burra	3	HU 3585 3012	Crop mark	Clettnadal, Kettla Ness	Unknown
EB11	East Burra	5	HU 3755 3230	Burnt mound	Houlls	3rd-1st Mill BC
EB12	East Burra	5	HU 375 325	Burnt mound	Norbister	3rd-1st Mill BC
EB19	East Burra	5	HU 385 346	Mound: indeterminate	Whalsies Ayre	Unknown
EB22	East Burra	5	HU 3915 3460	Structure, possible house	Whalsies Ayre	3rd-1st Mill BC
EB26	East Burra	4	HU 381 313	Possible structure	The Taing	Unknown
T5	Trondra	7	HU 399 381	Noost or well	Hudigarth	Unknown
T8	Trondra	7	HU 390 375	Burnt mound	Burland	3rd-1st Mill BC
T10	Trondra	7	HU 4015 3855	Burnt mound	Scarfataing	3rd-1st Mill BC
T17	Trondra	6	HU 3910 3696	Smithy and possible long house	Burland	1st Mill BC-1st Mill AD
T25	Trondra	7	HU 4004 3816	Burnt mound	South Ayre	3rd-1st Mill BC

Hinterland Geology, Coastal Geomorphology and Erosion Class (Alan Stapf)

Aims and Methods

The aim of the survey was to identify and categorise sections of the coastline into erosion and geological/geomorphological classes as defined by Historic Scotland, (Ashmore 1996). The survey also indicates the coastal areas more susceptible and at risk to erosion in the near future. Survey was conducted by one person during November 1998. No areas were left un-surveyed within the given remit. All survey was carried out from the hinterland and/or foreshore as conditions allowed.

The survey includes additional notes referring to drift type, soils, drainage and land-use. This is because marine erosion, although the most important, is not the sole eroding agent. Sub-aerial erosion by water and wind also play key roles, especially within areas of softer drift deposits which contain the majority of archaeological information. Present land use is also of importance, in that erosion of drift deposits can be instigated or aggravated by land use, eg. over stocking on steeply sloping land or sand extraction from foreshore or hinterland.

Background: Geology

Geologically the Shetland Islands as a whole consist of igneous and metamorphic rock in the north and west with sandstones along the south western fringes. The general trend of faults and folds is NNE to SSW and the underlying geology is generally reflected in the overall topography, even though there are substantial hills within the sandstone areas the hills are subdued and rolling as compared with the higher and more craggy ranges of the metamorphic and igneous areas. This general trend is reflected in the survey area. West Burra, East Burra and Trondra predominantly consist of metamorphic rocks, mainly schists and gneiss which is part of the Colla Firth group. Within this group, the majority of East Burra is made up of the East Burra Pelite which is a migmatised gneiss, that is, a gneiss which has itself been metamorphosed to a higher degree.

Background: Geomorphology

The islands in the survey area tend to be exposed to the elements from the west, and the west coasts are consequently more rugged with craggy outcrops of rock more commonly found on the exposed sites. Much of the west coast of East Burra is sheltered from the full force of the sea and weather by West Burra and therefore has a much more hospitable geomorphology which includes cultivable fields. To some degree this is also the case for south west Trondra which also gains some protection from West Burra. The summits of the hills tend to be much more rounded on the eastern side than those on the western side.

Both West and East Burra have small peninsulas to the south which are joined to their respective islands by small bars or isthmus'; Kettla Ness to West Burra and Houss Ness to East Burra. Both lie at a similar location to each other and may constitute a similar fault area or localised geomorphological element. There are a large number of bars, tombolas and ayres within Shetland and these two isthmus' may constitute one of these elements. The majority appear to be quite stable with some accretion taking place on many. Steers (1973) indicates that the bars may be accreting at a pace which is equal to the submergence of the islands.

The topography has been softened in many places by the deposition of till, predominantly during and towards the end of the last ice age. During this last glaciation there was probably only one main local glacier to the north of Mainland with flows running to the north west and north east. The latter flows would abut the regional major glaciation, dominated by the westerly flowing Scandinavian ice sheet. The Scandinavian ice sheet ran in a westerly direction across the south of Mainland and there is no evidence that Shetland supported a glacier in the south, which would hinder the flow of ice. Many of the voes in and around the survey area may have been deepened slightly by ice movements.

Further gelifluction or colluvial deposits have also accumulated down slope since the last glacial retreat with much accumulation of peat within some areas. Most of the places where deep layers of till are evident in section lie on the east sides of Trondra and East Burra.

The islands have been submerging since the last ice age due to an isostatic uplift of mainland Scotland, due to loss of ice, and a consequent down warping of peripheral land masses such as Orkney and especially Shetland. Added to this there have been eustatic changes in sea level ie. sea level rises. A post glacial shoreline of -9m, approximately 5,500 BP has been estimated by Hoppe, (1965) who analysed

submerged peat around south Shetland, and a massive 30m rise in mean sea level change since 7,000 BP has been approximated by Lambeck (1995), using a mathematical model.

If the submergence was consistent over time, which is unlikely, this would equate to approximately 1.64mm and 4.29mm/year change in sea level for the respective researchers. However the sea level changes have lessened since the initial upsurge following the last glaciation.

Within the survey area possible evidence of submergence can be seen where talards of soil and peat are found at high water mark at localised points. These areas lie to the north of East Burra and to a lesser extent to the south of East Burra. No peat sediments were found to lie below HWM within these areas. No raised beaches were seen in the survey area nor have they been documented. The absence of raised beaches is perhaps verification that the islands are submerging

Apart from till there are minor drift deposits of blown sand and peat. Within the hinterland of the survey area peat is more commonly found to the north of East Burra with only sporadic deposits in other areas. Sand deposits underlie much of the isthmus areas on West Burra where, for example, a large area of sand lies close to Hamnavoe. These drift deposits probably underlie an area running from the Sand of Meal towards the coast directly to the north. Sands also make up the isthmus between West Burra and the peninsula of Kettla Ness. Houss Ness, the southern peninsula of East Burra is attached to the island by a cobble and shingle bar.

Background: Soils and Land Use

The natural soils within the survey area tend to be peaty podzols or peaty gleys for the most part, with rankers more prevalent over rocky exposed areas. There are also some areas where there are podzol soils. In particular, the north west peninsula of Trondra not only has buried podzols but there are also some good brown earths which probably indicates a slightly differing soil evolution to other soils in the survey area. There are also some signs of cultivation horizons within this area. Another area where cultivation horizons are evident lies south of Duncansclett to the south of West Burra.

There is very little true peat build up along the coast edge, only to the north of East Burra and to a lesser extent the south of Trondra was there significant amounts of peat. Although many of the sheltered fields are cultivable there is little evidence of present cultivation taking place. The more freely draining and

improved soils tend to lie over thick drift deposits. Consequently most cultivable soils lie on the east of each island, along much of the west coast of East Burra and within a few isolated sheltered coves and shallow dips. The majority of coastline and hinterland on the north west and south of Trondra, the west of West Burra, the north of East Burra and the two southern peninsulas is unfenced and left open for rough grazing.

One of the more unusual environments within Shetland is the small area of hinterland on the south west coast of Kettla Ness opposite Rod Skerries where there is a large covering of thrift (*Armeria maritima*).

In those areas which are sensitive to coastal erosion, where drift deposits are more abundant, there is evidence that fence lines have been relocated further back from the coast line as erosion has advanced.

Background: Susceptibillty to Erosion

Those parts of the coast line which are most susceptible to erosion are the sections with a low edge (less than 5m) and composed of soft drift materials, such as tills and sands, lying close to or below the high water mark.

Most of the coastal rock platforms of Shetland are either steeply shelving or are almost non- existent. Consequently there is little moderation of high energy waves where the intertidal rock platforms tend to be steep and so form a narrow foreshore beach which is not capable of dissipating the wave's energy as does a long shallow platform. High energy storm beaches lie around the forked peninsulas to the north west of West Burra whereas a few low energy storm beaches lie to the south east of West Burra and south west of East Burra.

Another main factor affecting the erodibility of the coast edge is the exposure of the coast to the long reaches of storm waves. There is little long-term information on wind speed and direction, the two main affecters of wave size. Wright, (1976), reviewed meteorological data and found that between 1920 - 1974 there was an increase in north westerly and northerly winds at the expense of westerly and south westerly winds. Winds are however still predominantly westerly or southerly (Borne 1997) with wave height exceeding 1.5 m for 10% of the year and 0.5 m for 75% of the year on the south and western facing coasts (Draper 1991). Sea currents are also likely to affect erosion by removing eroded material from the base of the coast edge. In this respect there is little build up of talus material below cliff lines

around Shetland. The currents may also be a major factor in the erosion of the soft sediments found along the sheltered eastern sides of Trondra and East Burra.

Background: Types of Erosion

The sea is the main agent of erosion within the survey area and leads to landslip after mechanical undercutting of the cliff face or scouring of the coast edge. If the wave height, speed and direction are constant along the coast then the rate of erosion is also moderated by the rock platform gradient and the depth of the cove. A more shallow rock platform tends to dissipate the waves energy before hitting the coastal edge and a forward breaking wave is the dominant wave form, however if the cove is deep and narrow there is a funnelling affect of the waves which concentrates the energy. A point which is worthy of note concerns offshore currents and their role in removing talus and other foreshore deposits. It must also be borne in mind that there is very little talus lying below cliffs although there is evidence of recent localised rock falls.

Marine erosion also takes place within a storm beach which gradually migrates landwards. This type of erosion is not always obvious and a cursory look or a snap-shot in time may lead one to assume an accretion of shingle as one cannot see the gradual landward migration of the coast. There is evidence of this type of localised erosion along part of the storm beach close to Fugla Ness on West Burra.

If a storm beach lies on a steeply rising foreshore then the waves are more likely to throw the cobbles against the base of the cliff or coast edge so increasing the erosive power of the waves. Within this survey there is only one storm beach which lies next to a soft sediment coast edge, south of Symbister on Houss Ness, East Burra. Most of the easily eroded drift deposits lie on the east sides of East Burra and Trondra where there is also only moderate cobble cover along the upper foreshores.

Marine erosion also takes place along the hinterland of exposed coast edges and headlands where wave throw and splash together with following water run-off account for some denudation of the soil and drift deposits. This is especially evident along parts of the west coast of West Burra, notably The Alter. Chemical erosion by salt spray is a rather more protracted process and has not been alluded to in this survey other than in combination with observable weathering processes of rocks and the denudation of stabilising vegetation. Erosion by slow sea inundation is difficult to observe although the talards to the north of East Burra and South of Trondra may be due to this type of slow, insidious, erosion.

Sub-aerial erosion is the second main eroding agent and is mainly due to rain water and wind. With rain water the affects are seen as soil creep, peat flow, land slip and water erosion, i.e. rill and gully formation or stream erosion caused by run-off. No active gully erosion was seen in the survey. It is primarily surface water run-off which is most erosive. If infiltration of water into the soil or drainage is impeded then the surface run-off increases. Cattle poaching and smearing of the soil decreases infiltration whereas vegetation increases infiltration and also slows down the water run-off velocity. Sub-aerial erosion tends to be locally confined yet aids or instigates localised sea erosion. In some areas this is the primary cause of soil and drift erosion, most notably the erosion of topsoil north west of Hamnavoe.

Wind erosion is usually manifested in soft drift deposits, mainly sand in this case, where wind blow can lead to deflation troughs and scouring of sand dunes. There were few areas where sand drift was evident and of these there was only minor erosion at Sand of Meal, West Burra. Other eroding agents are biological. In this survey the agents are limited to animal, (mainly sheep and cattle) and human disturbance all of which can be controlled by management policies. Land use practices and management tend to aggravate or alleviate sub-aerial erosion but appear to have little effect on sea erosion without large resource input.

Background: Accretion

The only area of accretion within the survey which is worthy of note lies on the north eastern side of the isthmus between West Burra and Kettla Ness. Sand is usually the major accreting material due to strong variable winds and the size of erodible particle. If sands are deposited on the foreshore by the sea they can be easily blown onto the hinterland and subsequently stabilised by vegetation. Although coast edge erosion may contribute to some sandy sediments the major proportion of source material comes from deeper sea bottom sediments. In rainy temperate to rainy marine climatic zones sand makes up almost a half to two thirds of bottom sediments respectively (Hanson, 1988). Cobble and shingle storm beaches may or may not be accreting, in nearly all cases there appears to be erosion co-existing with the accretion. Generally it is suggested that the storm beaches are eroding the shoreline by migrating landwards. In most cases there is evidence to support this view, e.g. dying or decaying vegetation beneath an advancing front of cobbles and lack of lichen on newly deposited stone.

Overall, ayres and bars are probably stable or accreting at a very slow rate and as Steers (1973) indicates, they may be indicative of a slowly submerging landscape.

The Report

Hinterland Geology and Coastal Geomorphology Gazetteer Entries

The gazetteer entries comprise a set of characteristics for each coastal unit. The categories are as follows:

Category	Example
Label - Place name	2. Sand of Meal
Grid Reference (to centre of area)	HU 374 355
Length of Unit	0.6km
Foreshore Type	Sandy foreshore, some rock platform to NW
Coast Edge Type	<5m
Hinterland Type	Drift/rock interface is intermittently visible
Description	A sandy foreshore runs into the cove.....

Erosion Class: Gazetteer Entries

The gazetteer entries comprise a set of characteristics for each coastal unit. The categories are as follows

Category	Example
Label - Place name	7. Bruna Ness
Grid Reference (to centre of area)	HU 383 371
Length of Unit	0.6km
Erosion Class at time of visit	Eroding and stable
Description	Most erosion lies to each side.....

Erosion Classes

The following definitions have been used:

▪Eroding: Where more than 70% of the coastline is actively eroding.

▪Eroding to Stable: Where there is both active erosion and stable areas, with 30-70% of either one.

▪Stable: A section which is more than 70% stable. Usually any erosion is limited and local; any variation is specified in the accompanying text.

▪Accreting to Stable: Where there are both accreting and stable areas, with 30-70% of either one

▪Accreting: A section with accretion over more than 70% of its length.

▪Accreting/Eroding: There are both accreting and eroding processes taking place and may vary from 20% to 80% of each process. The erosion and accretion may not be arranged in a linear fashion along the coastline; there may be erosion of the coastal edge and deposition of sands along the foreshore.

Survey Results

The majority of the coasts surveyed have a foreshore made up of rock platform with a distinct coastal edge. The main high energy storm beaches lie around the forked peninsula of Hamnavoe on West Burra.

There are two localised large sandy beaches within the survey area at Banna Minn and the Sand of Meal, West Burra both have small areas of hinterland with a sandy nature. Other sandy beaches such as that within Voe of North Houss on East Burra are extremely limited, and tend to be located on the sheltered

east coasts or within sheltered coves. Cobbles were fairly widespread around the more sheltered coves and generally absent from the majority of exposed coastline. Where cobbles are found they tend to lie along the upper foreshore.

In the following tables it will be noted that there are no *Accreting* or *Accreting to Stable* erosion classes as there is no area large enough to warrant their inclusion.

Overall, the major erosion class is *stable* with *eroding to stable* the next most common followed by *eroding*. The survey shows that while there are local points of erosion the majority of the coast line is stable. East Burra has the least area, just under 3%, of coast edge which is definitely eroding even though there is approximately one third of coastline which has some localised erosion. Most erosion occurs on Trondra, which has both the longest distance and highest proportion of eroding coastline. Consequently, as each island has about one third of its' coast edge in the *eroding to stable* class, Trondra has the lowest proportion of coastline which is stable, less than 50%. There is only one area where accretion was on a scale large enough to note. This lies in Banna Minn on West Burra and is within the *Accreting and Eroding* class.

The total length of the surveyed coastline is almost 63 km. Of this 37 km (58%) is definitely stable with 21 km (33%) in the *eroding to stable* class. It has to be borne in mind that the *eroding to stable* class consists of localised erosion with a combination of both stable and eroding areas, between 30-70% (average 50%), of either one. Also, much of the coast edge erosion is of a low grade and low rate, especially where the coastal landmass volume is greater, i.e. high cliffs. Therefore one can estimate that probably almost 50 km (85%) of the surveyed coast edge is at present stable. Given that the coastal zone erosion survey of Northmavine (Moore and Wilson 1998) demonstrated that almost 24% of the coast edge was definitely eroding, with perhaps 40% eroding in some way, it may appear surprising that in this survey only 8% of coast edge is definitely eroding with less than 30% in some state of erosion. There are two good reasons for there being less erosion within this survey area: firstly, much of the coastline is sheltered from south westerly storms and secondly, there are less drift deposits close to the coast edge than was found in the Northmavine survey.

Analysis of The Survey Results

Erosion Class Distances (km)

	E	E/S	S	A/E	Totals
West Burra	1.85	11.1	20.85	0.25	34.05
East Burra	0.5	6.5	11.1	0	18.1
Trondra	2.65	3.35	4.8	0	10.8
Total	5	20.95	36.75	0.25	62.95

Erosion Class Proportions (%)

	E	E/S	S	A/E
West Burra	5.43	32.60	61.23	0.73
East Burra	2.76	35.91	61.33	0.00
Trondra	24.54	31.02	44.44	0.00
All Islands	7.94	33.28	58.38	0.40

Individual Section Erosion Class Distances (km)

		E	E/S	S	A/S	Total
West Burra	Map 1	0.55	2.2	9.1	'0.00	
	Map 2	0.5	3.4	6.4	'0.00	
	Map 3	0.8	5.5	5.35	0.25	
East Burra	Map 4	0.25	3.05	6.05	0.00	
	Map 5	0.25	3.45	5.05	0.00	
Trondra	Map 6	1.70	1.80	2.30	0.00	
	Map 7	0.95	1.55	2.50	0.00	
Total (km)		5	20.95	36.75	0.25	62.95
Total (%)		7.94	33.28	58.38	0.40	

E = Eroding, E/S = Eroding to Stable, S = Stable, A/E Accreting and Eroding)

Conclusions and Recommendations

Overall, the geomorphological features observed within the survey area, concur with a mass of evidence that the sea level has been and is still rising due to the relative down-warping of the islands and global increases in sea level since the last glaciation. Even though no submerged peat was found to lie below the HWM in this survey, it should be noted that peat at a depth of 8.6m to 8.9m below HWM was located within Symbister harbour on Whalsay (Mykura 1976). A complete absence of raised beaches may also be interpreted as evidence of a drowned landscape.

As regards erosion, the predominant geology of metamorphic and igneous rock is more resistant to erosion than the sandstones to the south west of Mainland where the bedding in the majority of cases is, or is close to, horizontal, leading to straight edged cliffs where marine erosion is greater than sub-aerial erosion.

The most easily erodible units are the soft drift deposits which are mainly made up of tills or sand deposits capped by some soil type. Deep tills, occasionally together with underlying saprolite, are generally found in low lying areas as a result of past glacial erosion of higher ground and consequent deposition within low troughs or basins. Therefore the deeper tills tend to be located along the lower lying sections of coastline. The topography of these areas has gentle slopes since this type of medium is also susceptible to sub-aerial erosion. In the case of this survey, most of the deeper tills lie on the east side of the islands.

Where the coast edge is made up of rock which is at least over 2m above the high water mark there is very limited erosion. Where the coast edge is low, and soft sediments lie within reach of high water, there is more erosion.

Almost all the *eroding* class is due to marine action whereas perhaps two thirds of the erosion within the *eroding to stable* class is due to marine action with the rest due to sub-aerial erosion. Given this information it can be calculated that perhaps less than 15% of the erosion encountered is due to sub-aerial agents.

It is likely that land management practices account for a very small proportion, or instigation, of sub-aerial erosion. Various practical remedies could be implemented, e.g. decreasing stocking levels in particularly wet conditions until vegetation can stabilise bare soil and drift. This is particularly relevant to the erosion of hinterland just north of Hamnavoe on West Burra where bare soil and sand is eroding into the sea. Erosion may have been instigated by sheep and is certainly aggravated by stocking levels. All erosion precautions are based on good management and husbandry techniques and therefore it is recommended that these practices be promoted in any coastal management policy.

There is little that can be done to completely negate marine erosion of the coast edge unless huge resources are committed to local problems. However, where boulders and rocks have been laid e.g. on the isthmus of Kettla Ness, erosion has been slowed down considerably if not momentarily halted.

It is recommended that it would be advisable to monitor the survey areas every few years in order to discern changes in erosion patterns and to increase the information on rates of erosion, for which there is very little data.

An overall recommendation is that some form of coastal management policy be established and invoked. At present conflicts may arise between the interests of agriculture, nature and archaeological conservation, leisure and amenities.