North Dublin Bay SAC (site code 206)
Conservation objectives supporting document -coastal habitats

NPWS

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Please note that the opinions expressed in the site reports from the Saltmarsh Monitoring Project (SMP), Coastal Monitoring Project (CMP) and Sand Dunes Monitoring Project (SDM) are those of the authors and do not necessarily reflect the opinion or policy of NPWS.

Please note that this document should be read in conjunction with the following report: NPWS (2013). Conservation Objectives: North Dublin Bay SAC 000206. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

1 Introduction

Achieving Favourable Conservation Status (FCS) is the overall objective to be reached for all Annex I habitat types and Annex II species of European Community interest listed in the Habitats Directive 92/43/EEC (Commission of the European Communities, 2007). It is defined in positive terms, such that a habitat type or species must be prospering and have good prospects of continuing to do so.

North Dublin Bay SAC covers the inner part of north Dublin Bay, with the seaward boundary extending from the Bull Wall Lighthouse across to the Martello Tower at Howth Head. The North Bull Island is the focal point of the site. The island is a sandy spit which formed after the building of the South Wall and Bull Wall in the 18th and 19th centuries. It now extends for about 5km in length and is up to 1km wide in places. The island supports a well developed dune system including a large dune slack, and saltmarsh which extends along the length of the landward side of the island. The island is separated from the mainland by intertidal mud and sandflats and is split into two sections by the Bull Island causeway, which also divides the intertidal areas.

Bull Island sand spit is a relatively recent depositional feature. Improvements to Dublin Port during the 18th and 19th centuries (i.e. the construction of the South Wall and North Bull Wall between 1790 and 1825) led directly to the formation of this offshore island. It runs parallel to the coast between Clontarf and Sutton. A causeway was constructed in 1964, 2km north of the Bull Wall. An extensive beach (Dollymount Strand) is found on the seaward side of Bull Island. Much of the interior of Bull Island sand spit is occupied by two golf courses. Despite this modification, the site displays an excellent range of sand dune and saltmarsh habitats. Most of the remainder of the dunes is owned and managed by Dublin City Council for conservation purposes. The dunes consist of a series of parallel ridges interrupted by hollows (slacks). Of particular interest is the presence of a freshwater marsh, referred to as the 'alder marsh'.

The site has been the subject of many studies and has long been recognised as being of international value (Jeffrey 1977a, b; Gaynor, 2008). As well as being a Special Area of Conservation and Special Protection Area, the site is designated as a National Nature Reserve, Wildlife Sanctuary, Ramsar site and UNESCO Biosphere Reserve. The island supports a range of rare plant species including lesser centaury (*Centaurium pulchellum*), red hemp-nettle (*Galeopsis angustifolia*), meadow saxifrage (*Saxifraga granulata*), wild clary (*Salvia verbenaca*) and spring vetch (*Vicia lathyroides*). Dublin Bay is recognised as an Important Bryophyte Area (IBrA) with North Bull Island holding important dune slack byrophytes including *Bryum intermedium, B. marratii, B. uliginosum, B. warneum, Didymodon umbrosus* and *Rhynchostegium megapolitanum* (Lockhart *et al*., 2012). It is also the only site on the east coast to support a population of the rare and protected Annex II species petalwort (*Petalophyllum ralfsii*). Owing the the proximity of Dublin City, the site serves as an important local amenity and is subject to high recreational pressure. A small population of rabbits and some hare graze the site. The site is one of the few actively accreting sites on the east coast of Ireland.

The construction of the causeway to the island in 1965 has had a significant impact on the saltmarsh and intertidal habitats at North Bull Island. This affected tidal currents and led to the deposition of sediment north of the causeway. This area was soon colonised by glassworts (*Salicornia* spp.) as well as common cordgrass (*Spartina anglica*). There have been several attempts with varying success to control *S. anglica* on the mudflats between 1970 and 1995 (McCorry, 2007).

North Dublin Bay SAC (site code: 206) is designated for a range of coastal habitats, including mudflats and salt flats, saltmarsh and sand dunes. The following eight coastal habitats are included in the qualifying interests for the site (* denotes a priority habitat):

- *Salicornia* and other annuals colonising mud and sand (1310)
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (ASM) (1330)
- Mediterranean salt meadows (Juncetaliea maritimi) (MSM) (1410)
- Annual vegetation of drift lines (1210)
- Embryonic shifting dunes (2110)
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)
- Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130)*
- Humid dune slacks (2190)

The first three are saltmarsh habitats and the last five are associated with sand dune systems, although all eight of these habitats are found in close association with each other (McCorry, 2007; Ryle *et al*., 2009; Delaney *et al*., 2013).

The distribution of saltmarsh habitats within North Dublin Bay SAC is presented in Appendix I and sand dune habitats in Appendix II.

This backing document sets out the conservation objectives for the eight coastal habitats listed above in North Dublin Bay SAC, which are defined by a list of parameters, attributes and targets. The main parameters are (a) Range (b) Area and (c) Structure and Functions, the last of which is broken down into a number of attributes, including physical structure, vegetation structure and vegetation composition.

The targets set for the **saltmarsh habitats** are based primarily on the results of the Saltmarsh Monitoring Project (SMP) (McCorry, 2007; McCorry & Ryle, 2009) and this document should be read in conjunction with those reports.

The SMP surveyed, mapped and assessed a total of one sub-site within North Dublin Bay SAC (McCorry, 2007):

1. North Bull Island

As part of the SMP, detailed individual reports and habitat maps were produced for each sub-site and the one for North Bull Island is included in a set of Appendices to this document (Appendix III). The conservation objectives for the saltmarsh habitats in North Dublin Bay SAC are based primarily on the findings of the SMP. It is thought that the one sub-site as surveyed by the SMP represents the total area of saltmarsh within North Dublin Bay SAC.

The targets set for the **sand dune habitats** are based primarily on the results of the Sand Dune Monitoring Project (SDM) (Delaney *et al.*, 2013) and this document should be read in conjunction with that report. It is also recommended that this document be read in conjunction with the final report from the Coastal Monitoring Project (CMP) report (Ryle *et al*., 2009). The CMP was a comprehensive national baseline survey of all known sand dune systems in Ireland. The SDM reviewed and modified the methodology used during the CMP to map and assess the conservation status of dune habitats. A subset of 40 sites (including North Bull and South Bull) were selected as a representative sample of the national dune resource for the SDM survey.

As part of the SDM, detailed individual reports and habitat maps (a revised baseline habitat map and an updated habitat map) were produced for two sub-sites (North Bull Island and South Bull Island) and these are included in a set of Appendices to this document (Appendix IV & V). It should be noted that it was decided to overwrite any saltmarsh habitat areas mapped during the Saltmarsh Monitoring Project (SMP) (McCorry, 2007) with the more recent and accurate SDM polygons when calculating habitat areas.

The conservation objectives for the sand dune habitats in North Dublin Bay are based on the findings of the individual reports for each of these sub-sites from the SDM, combined with the results of Gaynor (2008) and Ryle *et al*. (2009). It is thought that the two sub-sites as surveyed by the SDM represent the total area of sand dunes within North Dublin Bay SAC.

2 Conservation Objectives

The conservation objective aims to define the favourable conservation condition of a habitat or species at a particular site. Implementation of these objectives will help to ensure that the habitat or species achieves favourable conservation status at a national level.

3 Saltmarsh habitats

Saltmarshes are stands of vegetation that occur along sheltered coasts, mainly on mud or sand, and are flooded periodically by the sea. They are restricted to the area between mid neap tide level and high water spring tide level. In Ireland, there are four saltmarsh habitats listed under Annex I of the EU Habitats Directive (92/43/EEC):

- ***Salicornia* and other annuals colonising mud and sand (1310)**
- **Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (ASM) (1330)**
- **Mediterranean salt meadows (*Juncetalia maritimi*) (MSM) (1410)**
- Mediterranean and thermo-Atlantic halophilous scrub (1420)

Three of the above habitats (in bold) are listed as Qualifying Interests for North Dublin Bay SAC. The last habitat is restricted in its distribution to a small number of sites in the south-east of Ireland. Detailed descriptions of each habitat in the sub-site recorded by McCorry (2007) in North Dublin Bay can be found in Appendix III.

The SMP surveyed, mapped and assessed one sub-site within North Dublin Bay SAC (McCorry, 2007). See Appendix I for map:

1. North Bull Island (Appendix III)

Within North Dublin Bay SAC the areas of *Salicornia* habitat are situated in a large area on the mudflats, north of the causeway called the Salicornia bank. This area developed soon after the construction of the causeway in 1964 so this section of habitat is relatively young. This area also contains frequent clumps of common cordgrass (*Spartina anglica*) which can be quite dense in places (McCorry, 2007).

The main area of saltmarsh is dominated by ASM with several areas supporting MSM as indicated by clumps of sea rush (*Juncus maritimus)* at the back of the saltmarsh (McCorry, 2007).

3.1 Overall Objectives

The overall objective for '*Salicornia* and other annuals colonising mud and sand' in North Dublin Bay Complex SAC is to '*restore the favourable conservation condition'*.

The overall objective for 'Atlantic salt meadows' in North Dublin Bay SAC is to '*maintain the favourable conservation condition*'.

The overall objective for 'Mediterranean salt meadows' in North Dublin Bay SAC is to '*maintain the favourable conservation condition*'.

This objective is based on an assessment of the recorded condition of each habitat under a range of attributes and targets. The assessment is divided into three main headings (a) Area (b) Range and (c) Structure and Functions.

3.2 Area

3.2.1 Habitat extent

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. The target is no decrease in extent from the baseline which was established by McCorry (2007) and McCorry and Ryle (2009). Bearing in mind that coastal systems are naturally dynamic and subject to change, this target is assessed subject to natural processes, including erosion and succession.

Baseline habitat maps were produced for the saltmarsh in North Dublin Bay during the SMP. These maps are included with the individual site report in the Appendices at the end of this document.

The total areas of each saltmarsh habitat within the SAC and the total area of the habitat within each sub-site as mapped by the SMP are presented in the following tables.

There are a number of differences in the figures below. The total area for *Salicornia* flats within the SAC is greater than given in the SMP, as the SMP did not always include mosaics when calculating their total areas. In the case of the ASM and MSM small adjustments were made to the figures following the Sand Dunes Monitoring Project (SDM) where polygons were found to overlap. The following general rules were applied when calculating the areas for the site's conservation objectives:

1. Where a polygon was identified as a mosaic of an Annex I habitat and a non-Annex I habitat, then the entire area was counted as the Annex I habitat.
2. Where a polygon was identified as a mosaic of two Annex I habitats, the area was divided 50:50 for each habitat.

Sub-site	**Total area (ha) of *Salicornia* mudflats from SMP**	**Total area (ha) of *Salicornia* mudflats within SAC boundary (including mosaics)**
North Bull Island	28.676	29.10
Total	**28.676**	**29.10**

The target for *Salicornia* flats is that the area should be stable or increasing, subject to natural processes, including erosion and succession.

Sub-site	Total area (ha) of ASM from SMP	Total area (ha) of ASM within SAC boundary (including mosaics)
North Bull Island	82.34	81.84
Total	**82.34**	**81.84**

The target for ASM is that the area should be stable or increasing, subject to natural processes, including erosion and succession.

Sub-site	Total area (ha) of MSM from SMP	Total area (ha) of MSM within SAC boundary (including mosaics)
North Bull Island	8.21	7.98
Total	**8.21**	**7.98**

The target for MSM is that the area should be stable or increasing, subject to natural processes, including erosion and succession.

3.3 Range

3.3.1 Habitat distribution

The saltmarsh within the site mainly occurs along the west side of Bull Island facing the mainland. A small area of saltmarsh extends along the north side of the causeway to the midway point. A small patch of saltmarsh also occurs on the mainland north of the causeway, at the confluence of the Santry River. This saltmarsh was formerly larger in size and was called Watermill Lane saltmarsh (O'Reilly & Pantin, 1957), however, most of it was destroyed by the construction of the causeway in 1964 (McCorry, 2007).

The main area of saltmarsh is dominated by ASM which was the largest single section of saltmarsh surveyed by the SMP in 2006. At the back of the ASM there are frequent patches of MSM (McCorry, 2007).

The target is that there should be no decline or change in the distribution of these saltmarsh habitats, unless it is the result of natural processes, including erosion, accretion and succession.

3.4 Structure and Functions

The location, character and dynamic behaviour of saltmarshes are governed by sediment supply, tidal regime, wind-wave climate and sea level change. The slope of the saltmarsh allows the development of several ecological gradients such as tidal submergence and salinity. This influences the development of distinctive zones of halophytic and salt-tolerant plant communities. Maintaining the favourable conservation condition of the saltmarsh habitats in North Dublin Bay in terms of its structure and functions depends on a range of attributes for which targets have been set as outlined below.

3.4.1 Physical structure: sediment supply

Accretion and erosion are natural elements of saltmarsh systems. Maintaining the sediment supply is vital for the continued development and natural functioning of a saltmarsh system. Interruption to the sediment circulation through physical structures can starve the system and lead to accelerated erosion rates.

The construction of the causeway to the island had a significant impact on the saltmarsh and intertidal habitats at North Bull Island, by affecting tidal currents and leading to the deposition of sediment north of the causeway (McCorry, 2007).

The extent of the *Salicornia* flats was much smaller before the construction of the causeway in 1965-66 (McCorry, 2007).

Within the ASM there is some erosion albeit at a slow rate at the seaward side of the northern tip as seen from comparisons of the 2nd ed. OS map with 2000 aerial photos. The erosion is countered by accretion along the north side of the causeway (McCorry, 2007).

The MSM is mainly situated along the boundary of St Anne's Golf Course and the extent of this habitat is likely to have been greater in the past prior to the development of the golf courses (McCorry, 2007).

The target is to maintain the natural circulation of sediment and organic matter, without any physical obstructions.

3.4.2 Physical structure: creeks and pans

Saltmarshes can contain a distinctive topography with an intricate network of creeks and pans occurring on medium to large-sized sites. Creek density is influenced by vegetation cover, sediment supply and tidal influence. Creeks absorb tidal energy and assist with delivery of sediment into the

saltmarsh. The efficiency of this process depends on creek pattern. Creeks allow pioneer vegetation to become established along their banks higher up into the saltmarsh system. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins.

Within North Bull Island, the ASM topography is well developed and there is a very complex creek and salt pan structure. The creeks are functioning adequately though there has been some disturbance of the drainage of the saltmarsh with several drains crossing the saltmarsh from the golf courses. These drains were dug some time ago. Within the MSM, there are some small saltpans present. Creeks do not generally reach this high up the saltmarsh but some canalised drains from the golf course cross this habitat (McCorry, 2007).

The target is to maintain creek and pan networks where they exist and to restore areas that have been altered.

3.4.3 Physical structure: flooding regime

The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and indeed survival of saltmarshes. Saltmarsh vegetation consists of a limited number of halophytic (salt-tolerant) species that are adapted to regular immersion by the tides. Species in the lowest part of the saltmarsh require regular inundation, while those higher up on the marsh can only tolerate occasional inundation.

The target is to maintain a flooding regime whereby the lowest levels of the saltmarsh are flooded daily, while the upper levels are flooded occasionally (e.g. highest spring tides).

3.4.4 Vegetation structure: zonation

Saltmarshes are naturally dynamic coastal systems. As is the case on the majority of Irish saltmarshes, ASM is the dominant saltmarsh habitat at North Dublin Bay where it occurs in a mosaic with other saltmarsh habitats, including '*Salicornia* and other annuals colonising mud and sand' and 'Mediterranean salt meadows'. There are also natural transitions to fixed dune habitat, with species such as red fescue (*Festuca rubra),* rock sea-lavender *(Limonium binervosum),* long-bracted sedge *(Carex extensa)* and distant sedge (*Carex distans)* are amongst the species present. MSM forms a transition with ASM along part of the golf course boundary (McCorry, 2007). In order to ensure the ecological functioning of all of the saltmarsh habitats it is vital to maintain the zonations and transitions to other habitats, including intertidal, shingle and sand dune habitats.

The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes including erosion and succession.

3.4.5 Vegetation structure: vegetation height

A varied vegetation structure is important for maintaining species diversity and is particularly important for invertebrates and birds. Grazing is often used as a tool for maintaining structural diversity in the sward but stocking levels need to be appropriate. Overgrazing can lead to loss of species and destruction of the vegetation cover, while undergrazing can lead to a loss of plant diversity due to competitive exclusion.

At North Bull Island, there is some light grazing of the ASM by hares and by wildfowl. Wildfowl also graze or forage in the *Salicornia* bank, amongst the *Spartina* clumps. The middle marsh zone of the ASM has a characteristically low sward height. Within the MSM, the sward height is quite diverse and tall (0.2-0.8m). Tha tall rushes may be shielding the other vegetation from natural grazing to some extent (McCorry, 2007).

The target is to maintain structural variation within the sward. A general guideline is that there should be a sward ratio of 30% tall:70% short across the entire saltmarsh.

3.4.6 Vegetation structure: vegetation cover

Vegetation cover can have a major effect on saltmarsh development by reducing the velocity of the tide and thereby enhancing the deposition of sediment. Excessive bare mud, however, is often a sign of overuse by livestock or humans and can lead to destabilisation and accelerated erosion of the system.

The target is to maintain 90% of the area outside of the creeks vegetated.

3.4.7 Vegetation composition: typical species & sub-communities

Saltmarshes contain several distinct zones that are related to elevation and frequency of flooding. The lowest part along the tidal zone is generally dominated by the most halophytic (salt-tolerant) species including common saltmarsh-grass (*Puccinellia maritima*) and species more usually associated with *Salicornia* muds. The mid-marsh zone is generally characterised by sea thrift (*Armeria maritima*), sea plantain (*Plantago maritima*) and sea aster (*Aster tripolium*). This mid-zone vegetation generally grades into an herbaceous community in the upper marsh, dominated by red fescue (*Festuca rubra*), sea milkwort (*Glaux maritima*) and saltmarsh rush (*Juncus gerardii*).

Within the ASM at North Bull Island, the front of the saltmarsh is dominated by the presence of sea purslane (*Atriplex portulacoides*). Distinct zonations can be seen as the sea purslane (*Atriplex portulacoides*) becomes less frequent and almost disappears and the vegetation is composed of the classic sea pink (*Armeria maritima*)/sea plantain (*Plantago maritima*) sward of the middle marsh.

The target for this attribute is to ensure that a typical flora of saltmarshes is maintained, as are the range of sub-communities within the different zones. Below are lists of typical species for the different saltmarsh zones, although some of these species have a restricted distribution nationally and may not occur in the North Dublin Bay area.

Typical species		
Lower marsh	**Low-mid marsh**	**Mid-upper marsh**
Salicornia spp. *Suaeda maritima* *Puccinellia maritima* *Aster tripolium*	*Puccinellia maritima* *Triglochin maritima* *Plantago maritima* *Atriplex portulacoides* *Aster tripolium* *Spergularia* sp. *Suaeda maritima* *Salicornia* spp. *Glaux maritima*	*Festuca rubra* *Juncus gerardii* *Armeria maritima* *Agrostis stolonifera* *Limonium humile* *Glaux maritima* *Seriphidium maritimum* *Plantago maritima* *Aster tripolium* *Juncus maritimus* *Triglochin maritima* *Blysmus rufus* *Eleocharis uniglumis* *Leontodon autumnalis* *Carex flacca* *Carex extensa*

3.4.8 Vegetation structure: negative indicator species

The only invasive and non-native species recorded on saltmarshes during the SMP was common cordgrass (*Spartina anglica*). This species was recorded throughout North Dublin Bay SAC by the SMP. This species is present on the *Salicornia* flats where it forms a mosaic, however it does not generally dominate in this habitat (McCorry, 2007). Common cordgrass *Spartina* is also widely distributed on ASM, though it is generally found at low cover values (0-5%). The abundance of *Spartina* may increase up to 40% at some locations towards the seawards edge of ASM, though there no indications that it is spreading significantly at this site, although it is likely to increase in extent at the future expense of *Salicornia* flats.

The aim is that negative indicators such as *Spartina* should be absent or under control. The current target for this particular site is no significant expansion and an annual spread of less than 1%.

4 Sand dune habitats

Sand dunes are hills of wind blown sand that have become progressively more stabilised by a cover of vegetation. In general, most sites display a progression through strandline, foredunes, mobile dunes and fixed dunes. Where the sandy substrate is decalcified, fixed dunes may give way to dune heath. Wet hollows, or dune slacks, occur where the dunes have been eroded down to the level of the water-table. Machair is a specialised form of dune system that is only found on the northwest coasts of Ireland and Scotland. Transitional communities can occur between dune habitats and they may also form mosaics with each other. Dune systems are in a constant state of change and maintaining this natural dynamism is essential to ensure that all of the habitats present at a site achieve favourable conservation condition.

In Ireland, there are 9 sand dune habitats (including annual vegetation of drift lines) listed under Annex I of the EU Habitats Directive (92/43/EEC) (* denotes a priority habitat):

- **Annual vegetation of drift lines (1210)**
- **Embryonic shifting dunes (2110)**
- **Shifting dunes along the shoreline with *Ammophila arenaria* (2120)**
- **Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130) ***
- Decalcified dunes with *Empetrum nigrum* (2140) *
- Decalcified dune heath (2150) *
- Dunes with *Salix repens* (2170)
- **Humid dune slacks (2190)**
- Machair (21AO) *

Five dune habitats were recorded by Ryle *et al*. (2009) (indicated in bold above) are listed as Qualifying Interests for North Dublin Bay SAC. These habitats include mobile areas at the front, as well as more stabilised parts of dune systems. Humid dune slacks were also recorded at both sub-sites.

Annual vegetation of drift lines is found on beaches along the high tide mark, where tidal litter accumulates. It is dominated by a small number of annual species (i.e. plants that complete their life-cycle within a single season). Tidal litter contains the remains of marine algal and faunal material, as well as a quantity of seeds. Decaying detritus in the tidal litter releases nutrients into what would otherwise be a nutrient-poor environment. The habitat is often represented as patchy, fragmented stands of vegetation that are short-lived and subject to frequent re-working of the sediment. The vegetation is limited to a small number of highly specialised species that are capable of coping with salinity, wind exposure, an unstable substrate and lack of soil moisture. Typical species include spear-leaved orache (*Atriplex prostrata*), frosted orache (*A. laciniata*), sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*) and prickly saltwort (*Salsola kali*).

Embryonic dunes are low accumulations of sand that form above the strandline. They are sometimes referred to as foredunes, pioneer dunes or embryo dunes, as they can represent the primary stage of dune formation. They are characterised by the presence of the salt-tolerant dune grasses sand couch (*Elytrigia juncea*) and lyme grass (*Leymus arenarius*), which act as an impediment to airborne sand. Strandline species can remain a persistent element of the vegetation.

Where sand accumulation is more rapid, marram grass (*Ammophila arenaria*) invades, initiating the transition to mobile dunes (Shifting dunes along the shoreline with *Ammophila arenaria*). Marram growth is actively stimulated by sand accumulation. These unstable and mobile areas are sometimes referred to as 'yellow dunes' (or white dunes in some European countries), owing to the areas of bare sand visible between the tussocks of marram.

Fixed dunes refers to the more stabilised area of dune systems, generally located in the shelter of the mobile dune ridges, where the wind speed is reduced and the vegetation is removed from the influence of tidal inundation and salt spray. This leads to the development of a more or less closed or 'fixed' carpet of vegetation dominated by a range of sand-binding species (Gaynor, 2008).

Humid dune slacks are wet or moist depressions between dune ridges. They are characterised by the occurrence of a water-table that is maintained by a combination of groundwater (which may or may not be slightly saline), precipitation and an impermeable layer in the soil. In the winter, the water-table normally rises above the soil surface and inundation occurs. In spring and summer, the water-table drops, but the top layer of the soil remains wet. Proximity of the water-table to the surface is evidenced in the vegetation, in which rushes, sedges and moisture-loving herbs such as marsh pennywort (*Hydrocotyle vulgaris*), bog pimpernel (*Anagallis tenella*), grass of Parnassus (*Parnassia palustris*), common marsh-bedstraw (*Galium palustre*) and marsh helleborine (*Epipactis palustris*) are obvious features. The frequency and duration of flooding, as well as the level of salinity, determines the vegetation composition. In addition, nutrient-enrichment can occur as a result of leaching from the surrounding dune ridges. The dune slacks found on Bull Island are extensive and numerous. They mostly run parallel to the axis of the island. The rich flora that the dune slacks support is typical of east coast dune flora and the abundance of orchids is of particular note. Bull Island supports one of the few examples of healthy dune slacks on the east coast of Ireland.

All the dune habitats indicated above occur as a complex mosaic of constantly changing and evolving vegetation communities. They are inextricably linked in terms of their ecological functioning and should be regarded as single geomorphological units. As such, no dune habitat should be considered in isolation from the other dune habitats present at a site, or the adjoining semi-natural habitats with which they often form important transitional communities.

The SDM surveyed two sub-sites within North Dublin Bay SAC. See Appendix II for map:

1. North Bull (Appendix IV)
2. South Bull (Appendix V)

The two subsites lie north and south of the causeway which was built in 1964 and is located towards the centre of Bull Island. Detailed descriptions from the Sand Dune Monitoring Project (SDM) (Delaney *et al.,* 2013) of each sand dune habitat found at North Bull and South Bull are presented in Appendices IV & V.

4.1 Overall objectives

The overall objective for 'Annual vegetation of drift lines' in North Dublin Bay SAC is to 'restore the favourable conservation condition'.

The overall objective for 'Embryonic shifting dunes' in North Dublin Bay SAC is to 'restore the favourable conservation condition'.

The overall objective for 'Shifting dunes along the shoreline with *Ammophila arenaria*' in North Dublin Bay SAC is to 'restore the favourable conservation condition'.

The overall objective for 'Fixed coastal dunes with herbaceous vegetation' in North Dublin Bay SAC is to 'restore the favourable conservation condition'.

The overall objective for 'Humid dune slacks' in North Dublin Bay SAC is to 'restore the favourable conservation condition'.

These objectives are based on an assessment of the recorded condition of each habitat under a range of attributes and targets. The assessment is divided into three main headings (a) Area (b) Range and (c) Structure and Functions.

4.2 Area

4.2.1 Habitat extent

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. A baseline habitat map was produced for the sand dune habitats at each sub-site in North Dublin Bay SAC during the Coastal Monitoring Project (CMP) (Ryle *et al*., 2009). During the SDM, these baseline maps were checked and revised to account for changes in habitat interpretation and ommissions. Updated maps were then produced to reflect the current situation on the ground. The

revised baseline habitat maps and updated habitat maps from the SDM are included with the individual site reports in the Appendices at the end of this document (Appendices IV & V).

The total areas of each sand dune habitat within the SAC as estimated by Delaney *et al*. (2013) are presented in the following table.

Habitat	**Total area (ha) of habitat within SAC boundary following SDM**
Annual vegetation of driftlines	0.11
Embryonic shifting dunes	6.07
Shifting dunes along the shoreline with *Ammophila arenaria*	3.18
Fixed coastal dunes with herbaceous vegetation	104.84
Humid dune slacks	12.11
Total	**126.31**

The extent of 'shifting dunes along the shoreline with *Ammophila arenaria'* and 'fixed coastal dunes with herbaceous vegetation' was assessed as Favourable by both the CMP and the SDM, the target for this attribute for these two habitats is that the area should be stable or increasing. However, as losses have been recorded in the remainder of the habitats listed above, the general target for this attribute for these habitats is that the area should be increasing. Bearing in mind that coastal systems are naturally dynamic and subject to change, this target is always assessed subject to natural processes, including erosion and succession.

4.3 Range

4.3.1 Habitat distribution

Distribution of the more dynamic frontal habitats has changed considerably between the CMP and SDM surveys. For example, during the CMP, driftline vegetation at South Bull consisted only of a single small area of habitat in disturbed grassland beside the Bull Wall. There was no substantial driftline vegetation along the seaward edge of the dunes. At North Bull, driftline vegetation extended over a substantial stretch of the seaward edge of the dunes (Ryle *et al*. 2009). During the SDM significantly less driftline vegetation was recorded than the CMP and while much of this has been attributed to the impacts of mechanical beach cleaning, it may also reflect the timing of the survey. Driftline material can be quickly engulfed by sand and develop into embryo dunes through invasion of sand couch grass (*Elytrigia juncea*).

Embryonic dunes and mobile dunes generally occur as parallel bands along the seaward side of Bull Island. However, the mechanical beach cleaning operations are currently negatively impacting on both of these habitats (Delaney *et al*., 2013).

The fixed dunes occupy the largest area on both North Bull and South Bull.

North Bull supports a single long stretch of dune slack habitat referred to locally as the 'alder marsh', which runs parallel to the shoreline. South Bull possesses a larger number of slacks, which cover a greater area (Ryle *et al*. 2009). Many of these are primary slacks that have formed as the dunes advanced cutting off part of the beach, an unusual feature on Irish dune systems most of which are retreating rather than prograding.

The distribution of sand dune habitats as mapped by Delaney *et* al. (2013) is presented in Appendix II.

There should be no decline or change in the distribution of these sand dune habitats, unless it is the result of natural processes, including erosion, and succession.

4.4 Structure and Functions

The location, character and dynamic behaviour of sand dunes are governed by a combination of geographic, climatic, edaphic and anthropogenic factors. Sand dunes are highly complex, dynamic systems, where the habitats occur in a complex and constantly evolving and changing mosaic. They function as systems in terms of geomorphology and hydrology and maintaining the favourable conservation condition of the habitats present depends on allowing these processes to continue unhindered. Maintaining the favourable conservation condition of all of the sand dune habitats in North Dublin Bay SAC in terms of structure and functions depends on a range of attributes for which targets have been set as outlined below.

4.4.1 Physical structure: functionality and sediment supply

Coastlines naturally undergo a constant cycle of erosion and accretion. There are two main causes of erosion: (a) those resulting from natural causes and (b) those resulting from human interference. Natural causes include the continual tendency towards a state of equilibrium between coasts and environmental forces, climatic change (particularly an increase in the frequency of storms or a shift in storm tracks), relative sea level rise and natural changes in the sediment supply. Human interference is usually associated with changes in the sediment budget, either directly, through the removal of beach or inshore sediment, or indirectly, by impeding or altering sediment movement. It is important to

recognise that the process of coastal erosion is part of a natural tendency towards equilibrium. Natural shorelines attempt to absorb the energy entering the coastal zone by redistributing sediment.

Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Sediment supply is especially important in the embryonic dunes and mobile dunes, as well as the strandline communities where accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. The construction of physical barriers such as sea defences can interrupt longshore drift, leading to beach starvation and increased rates of erosion. Sediment circulation and erosion also has a role to play in the more stabilised dune habitats. Cycles of erosion and stabilisation are part of a naturally functioning dune system, where the creation of new bare areas allows pioneer species and vegetation communities to develop, increasing biodiversity. The construction of physical barriers can interfere with the sediment circulation by cutting the dunes off from the beach resulting in fossilisation or over-stabilisation of dunes.

Unusually for an east coast dune system, Bull island is actively accreting, as indicated by the continued development of parallel ridges on a prograding shore on the east side of the island. There are also areas of erosion throughout the site, caused by overuse and trampling which are exacerbated in places by rabbit grazing (Ryle *et al.* 2009).

At North Bull, movement of sediment towards the recurved, northern tip of the dune has resulted in the formation of a wide swathe of foredune habitat (Ryle *et al*. 2009).

Some coastal protection measures employed at Bull Island over the years include wave barrier fencing, sand trap fencing and marram grass planting. These have met with limited success and there are no indications now of any of these installations or plantings (Ryle *et al.* 2009).

The target for this attribute is to maintain the natural circulation of sediment and organic matter throughout the entire dune system, without any physical obstructions.

4.4.2 Physical structure: hydrological and flooding regime

The conservation of dune slacks is inextricably linked with the local hydrological regime. Dune slacks are characterised by the proximity of a groundwater table that is maintained by the combination of an impermeable layer in the soil, or deeper salt water and precipitation. Dunes with *S. repens* are closely associated with dune slacks but are distinguished from them by a water-table that is at a depth that no longer exerts an influence on the vegetation. Most dune slacks are fed by a range of water sources, including precipitation, surface water or groundwater. The last two sources are usually somewhat calcareous while the first is acid.

The most important influence on the nature and vegetation of a dune slack is the groundwater-table, which can fluctuate considerably throughout the year. The frequency and duration of periods of flooding or inundation determines the vegetation composition. The water-table depth has been identified as the primary determining factor in vegetation variation, followed by weak trends in calcium and sodium availability. Other contributing factors include stage of development, precipitation, distance from the sea, the grazing regime, recreational pressure, nature of the sediment, soil pH and the porosity of the sediment.

Dune slack habitats should never be considered in isolation, but as part of the larger dune system that functions as an eco-hydrological unit. Dune slacks are highly sensitive to human influences on their hydrology, either through water abstraction or drainage works. Generally, the maintenance of a naturally functioning dune slack depends on both the amount of (a) precipitation and (b) groundwater discharge. Water abstraction interferes with the local hydrology, potentially having serious implications for the plant and animal communities of slacks. Abstraction can lower the level of the groundwater-table, causing the slacks to dry out. It can also lead to saline infiltration in slacks formed close to the front of a dune system and particularly where the underlying substrate is highly permeable (e.g. shingle).

Within Bull Island there is some concern that the alder marsh at the North Bull, is becoming increasingly brackish in nature and drying out at an accelerated rate suggesting human involvement. Research on the hydrology of this slack found strong indications that groundwater extraction was occurring from an unidentified source found close to the slack (Devaney, 2008). There is also the potential problem of fertiliser run-off from the adjacent golf course, leading to increased nutrient levels.

The target is to ensure that the hydrological regime continues to function naturally and that there are no increased nutrient inputs in the groundwater.

4.4.3 Vegetation structure: zonation

The range of vegetation zones on a dune system should be maintained. Gaynor (2008) highlights the highly transitional nature of much of the vegetation; therefore, it is important that the transitional communities are also conserved, including those to the saltmarsh communities.

As well as transitions between sand dune habitats, the zonations of vegetation communities and the transitions to saltmarsh communities is notably distinct at Bull Island (Ryle *et al.,* 2009). Many of the rare species associated with this site are either found in transitional communities between dune and saltmarsh habitats or fixed dunes and dune slacks. The latter is particularly the case for a range of rare byrophytes.

The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes, including erosion and succession.

4.4.4 Vegetation structure: bare ground

This target only applies to fixed dunes and dune slacks. It does not apply to the other habitats present where high levels of bare sand are a natural component of the habitat. In the fixed and slack areas some degree of instability is vital. Constant cycles of erosion and stabilisation provide the necessary conditions for the establishment of pioneer species and species that favour open conditions including invertebrates, helping to increase biodiversity.

Recreational use of Bull Island dunes (North and South) is high. Pedestrian tracks, some of which are bare of vegetation, are extensive, although the total cover of bare ground is probably less than 10% of the total fixed dune area (Ryle *et al*. 2009).

Dune slacks are also susceptible to some of the recreational pressures that affect the fixed dunes. Walking tracks traverse the dune slack at North Bull and have led to some erosion and poaching of soil. The slacks at the South Bull are close to the main access points to the island and pedestrian tracks have been created, leading to some erosion of vegetation cover (Ryle *et al*., 2009).

The target is to achieve up to 10% bare sand with the exception of pioneer slacks which can have up to 20% bare sand. This target is assessed subject to natural processes.

4.4.5 Vegetation structure: vegetation height

This attribute applies to the fixed dunes, where a varied vegetation structure is important for maintaining species diversity and is particularly important for invertebrates and birds. The ecological benefits of moderate levels of grazing on dunes have been well documented (Gaynor, 2008). Moderate grazing regimes lead to the development of a species-rich vegetation cover. The animals increase biodiversity by creating micro-habitats through their grazing, dunging and trampling activities. Grazing slows down successional processes and in some cases reverses them, helping to achieve a diverse and dynamic landscape. The effects of trampling assist the internal movement of sand through the development of small-scale blowouts, while dunging can eutrophicate those dune habitats whose nutrient-poor status is crucial for the survival of certain vegetation types. Many species, from plants to invertebrates, benefit immensely from the open and diverse system created by a sustainable grazing regime. Many dune species are small in size and have relatively low competitive ability. Consequently, the maintenance of high species diversity on a dune system is dependent on the existence of some control to limit the growth of rank coarse vegetation (Gaynor, 2008).

Grazing by livestock is absent from both subsites in North Dublin Bay, although rabbits are present on the island in abundance, and are creating localised overgrazing problems in places. In general, however, their activities are probably beneficial in helping to maintain the short-cropped sward that promotes species diversity. Hares are also present but their numbers are probably too low to contribute significantly to any grazing impact (Ryle *et al*., 2009).

The target for this attribute is to maintain structural variation within the sward.

4.4.6 Vegetation composition: plant health of dune grasses

This attribute applies to foredunes and mobile dunes, where blown sand is a natural feature. The health of the dune grasses (particularly *Ammophila arenaria* and *Elytrigia juncea*) is assessed by the plant parts above the ground (they should be green) and the presence of flowering heads. This gives a clear indication of the status of the supply of blown sand, which is required for these species to thrive.

The target for this attribute is that more than 95% of the dune grasses should be healthy.

4.4.7 Vegetation composition: typical species & sub-communities

Species diversity and plant distribution in dunes is strongly controlled by a range of factors, including mobility of the substrate, grazing intensities, moisture gradients, nutrient gradients and human disturbance. In the younger, more mobile dunes, marram (*Ammophila arenaria*) is common, while groundsel (*Senecio vulgaris*), sea rocket (*Cakile maritima*) and dandelion (*Taraxacum* sp.) are also present. The fixed, more stable dune vegetation includes lady's bedstraw (*Galium verum*), common birdsfoot trefoil (*Lotus corniculatus*), wild thyme (*Thymus praecox*), kidney vetch (*Anthyllis vulneraria*), wild pansy (*Viola tricolor*) and biting stonecrop (*Sedum acre*).

There is a diverse flora at North and South Bull Island including some rare and protected species such as adder's tongue (*Ophioglossum vulgatum*), which was recorded in the dune slacks and lesser century (*Centaurium pulchellum*) which was noted by the CMP survey (Ryle *et al*., 2009). Other species present include red hemp nettle (*Galeopsis angustifolia*), meadow saxifrage (*Saxifraga granulata*), wild clary (*Salvia verbenaca*) and spring vetch (*Vicia lathyroides*). The island has also a notable orchid flora including autumn lady's-tresses (*Spiranthes spiralis*), bee orchid (*Ophyrs apifera*), marsh helleborine (*Epipactis palustris*), common twayblade (*Listera ovata*), and several *Dactylorhiza* species.

Petalwort (*Petalophyllum ralfsii*), a rare liverwort and an Annex II species, has its only station away from the western seaboard in Bull Island. A number of rare *Bryum* mosses are also known to occur at the site, including *Bryum bornholmense, B. intermedium, B. marratii, B. uliginosum, B. warneum, Didymodon umbrosus* and *Rhynchostegium megapolitanum* (Lockhart *et al*., 2012)

The target for this attribute is to maintain a typical flora for the particular sand dune habitat.

4.4.8 Vegetation composition: cover of S. repens

The only habitat where this is a specific attribute is humid dune slacks where that target is to maintain less than 40% cover of *S. repens.* This species forms a natural component of many dune slack communities in Ireland. However, high covers of this shrub can lower the level of water-table causing the slacks to dry out. It can also form a dense canopy that shades out slack species leading to a reduction in biodiversity.

The target is therefore to keep the cover of *S. repens* below 40%.

4.4.9 Vegetation composition: negative indicator species

Negative indicators include non-native species (e.g. *Hippophae rhamnoides*), species indicative of changes in nutrient status (e.g. *Urtica dioica*) and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled.

The main invasive species identified in Gaynor (2008) were bracken (*Pteridium aquilinum)* and sea buckthorn (*Hippophae rhamnoides)*. The invasion of non-native species compromises the typical plant community structure. Bracken (*Pteridium aquilinum)* is becoming increasingly dominant, particularly where sites have been abandoned or where grazing levels have been significantly reduced. The vegetation retains many elements of the original vegetation cover, but there is a reduction in biodiversity. As the canopy becomes taller and ranker, many of the low-growing species disappear. In this case, the vegetation is treated as a sub-community of the original community that was invaded. This is always the case unless the original vegetation cover has been completely destroyed, as can happen with *H. rhamnoides*, which can form dense impenetrable thickets.

Occasional patches of sea buckthorn (*Hippophae rhamnoides*) occur particularly near the golf course boundaries. Efforts are on-gong to control the spread of this highly invasive species (Delaney *et al*., 2013).

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The target is that negative indicators (including non-native species) should represent less than 5% of the vegetation cover.

4.4.10 Vegetation composition: scrub/trees

This attribute only applies to the fixed dunes and dune slacks. Scrub encroachment leads to reduction in dune biodiversity and needs to be controlled. The presence of scrub and trees which have deep

roots can also lower the groundwater table which can have significant impacts on the slack communities.

Throughout Bull Island, scattered trees and shrubs such as sycamore (*Acer pseudoplatanus*) and lilax (*Syringia vulgaris*) have been recorded by Ryle *et al*. (2009). However, collectively they do not occupy a significant portion of the dunes.

The target for this attribute therefore is that the cover of scrub and tree species should be under control or represent no more than 5% of the vegetation cover.

5 References

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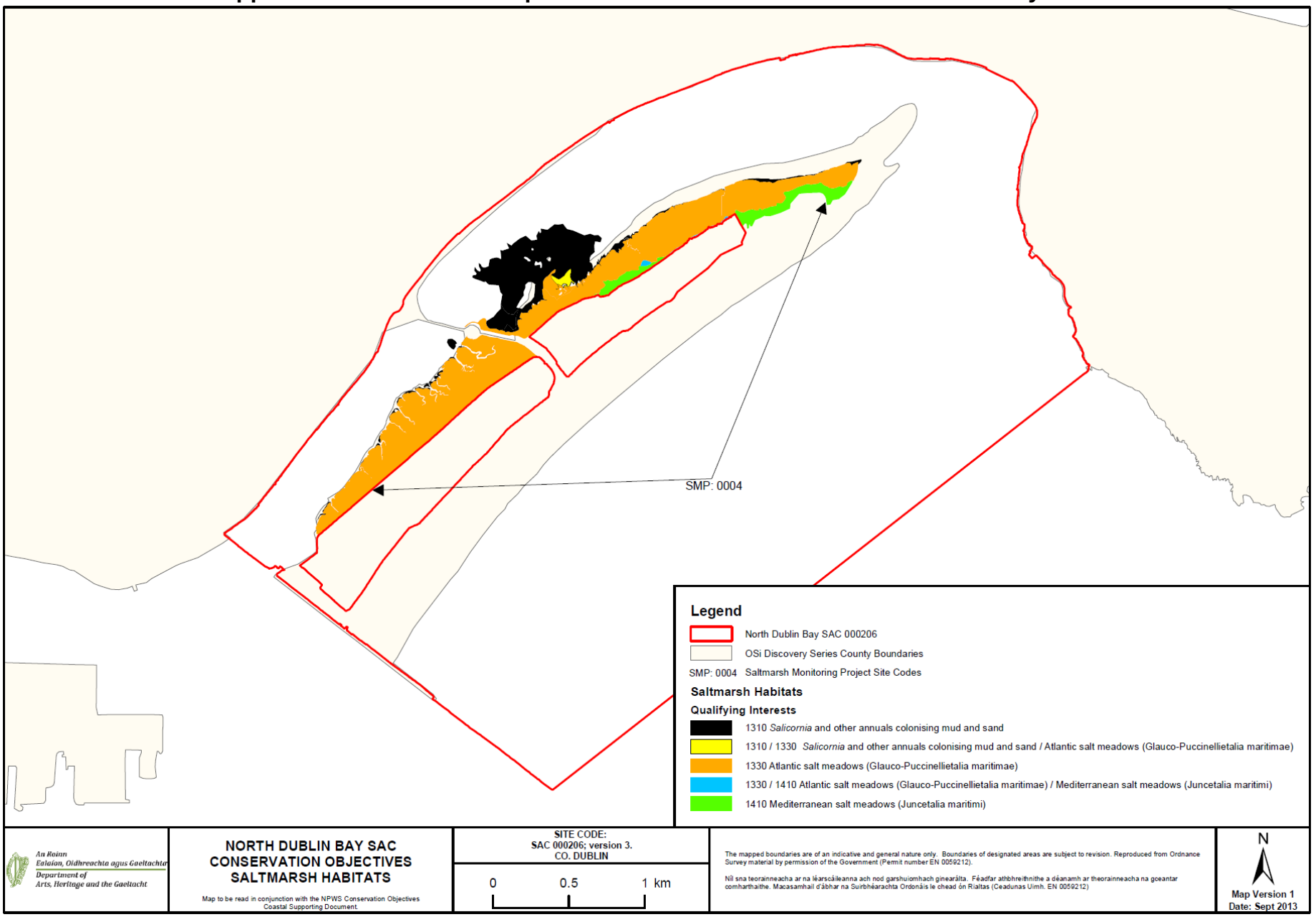
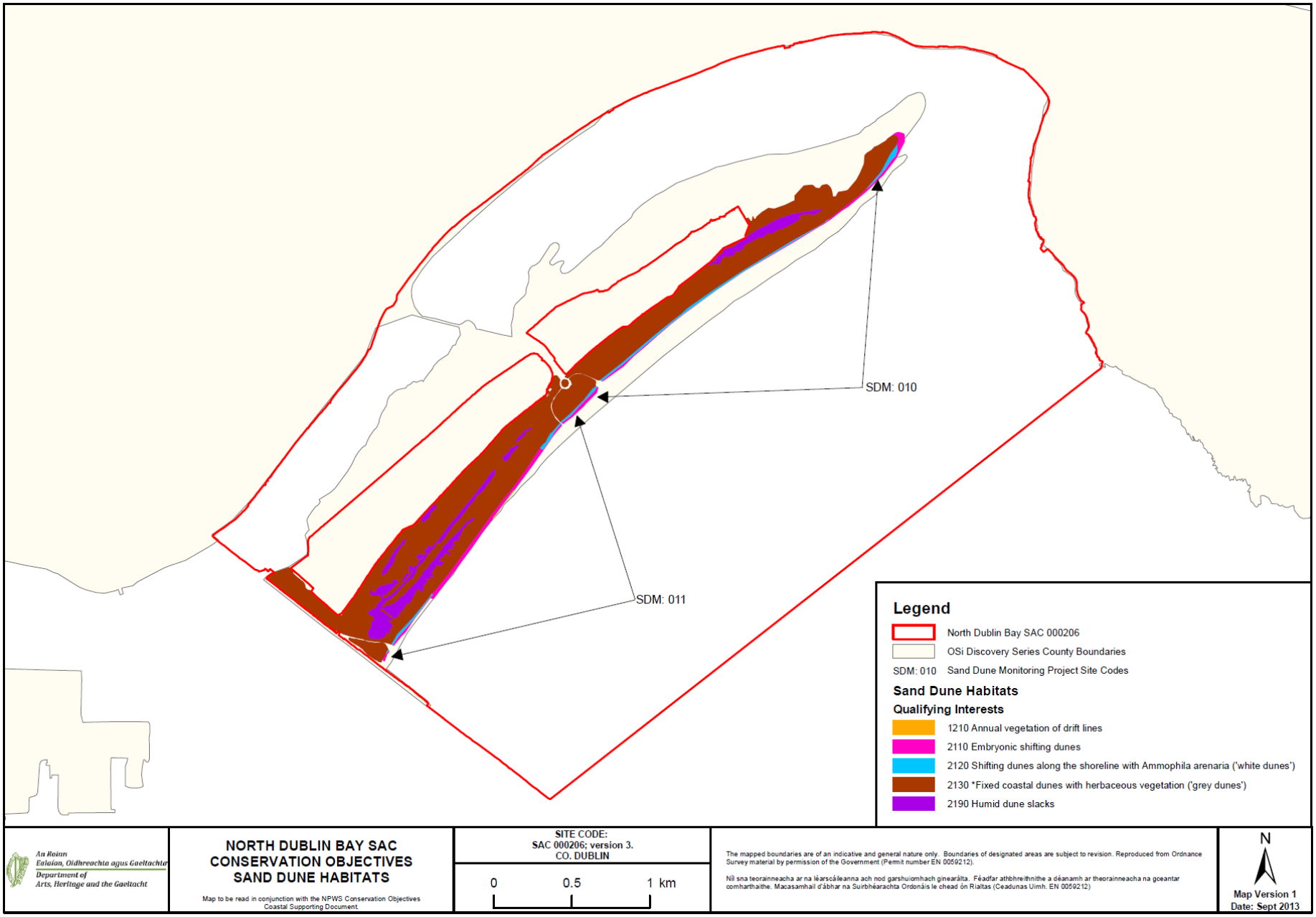
Appendix I –Distribution map of saltmarsh habitats within North Dublin Bay SAC



Appendix II – Distribution map of sand dune habitats within North Dublin Bay SAC



Appendix III – North Bull Island site report and habitat map from the SMP (McCorry, 2007)

1 SITE DETAILS

SMP site name: **North Bull Island**		SMP site code: **SMP0004**	
Site name (Curtis list): **North Bull Island**		CMP site code: **10 + 11**	
		Site No: (Curtis list): **230**	
NPWS Site Name: **North Dublin Bay**		Dates of site visit: **6+7/06/2006**	
NPWS designation	cSAC: **206**	MPSU Plan: **old plan (date)**	
	pNHA: **206**		
	SPA: **North Bull Island SPA4006**		
	Nature Reserve: **North Bull Island (S.I. No 231 of 1988)**		
	Nature Reserve: **North Bull Island (S.I. No 232 of 1988)**		
County: **Dublin**		Discovery Map: **55**	Grid Ref: **323000, 237000**
1st ed 6 inch Map No: **Du15, Du19**		Aerial photos (1995 series): **O3133-D, O3134-C, O3199-A, O3199-B, 31999-C, O3199-D, O3200-A**	
2nd ed 6 inch Map No: **Du15, Du19**		Aerial photos (2000 series): **O3133-D, O3134-C, O3199-A, O3199-B, 31999-C, O3199-D, O3200-A**	
		Aerial photos (2005 series): **not available**	
Annex I habitats currently designated for North Dublin Bay cSAC: ***Salicornia* and other annuals colonizing mud and sand (1310)**; **Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330)**; **Mediterranean salt meadows (Juncetalia maritimi) (1410)**			
Saltmarsh type: **Estuary**		Substrate type: **Mud**	

2 SITE DESCRIPTION

North Bull Island is located in the northern section of Dublin Bay on the east coast of Ireland. The island is a sandy spit about 5 km long and 1 km wide in places. It is dominated by a dune system and the saltmarsh has developed on the landward side of the island facing the mainland. The island is separated from the mainland by intertidal mud and sandflats. It is split into two sections by the Bull Island causeway, which also

divides the intertidal areas. This causeway allows access to the two golf courses on the island and to Dollymount Strand, which is an important amenity area and is a Blue Flag beach (2006). The main land uses on the island are leisure (golf courses), nature conservation (nature reserves) and amenity. The saltmarsh can be accessed from the causeway.

North Bull Island is probably the most famous and studied saltmarsh site in Ireland. It is also one of the most protected sites in Ireland in recognition of its conservation importance, particularly to wintering waders and wildfowl and for the dune/saltmarsh system located on the island. North Bull Island has been designated a Special Protection Area under the EU Birds Directive and it is also a statutory Wildfowl Sanctuary, a Ramsar Convention site, a Biogenetic Reserve, a Biosphere Reserve and a Special Area Amenity Order site. Two separate Statutory Nature Reserves cover much of the island east of the Bull Wall and the surrounding intertidal flats. The first (S.I. 231 of 1988) covers the intertidal and subtidal areas around the island while the second covers the terrestrial dune, beach and saltmarsh habitat (S.I. 232 of 1988). The intertidal areas are owned by the State, while the second nature reserve is owned and managed by Dublin City Council.

Three Annex I habitats, *Salicornia* flats, Atlantic salt meadows (ASM) and Mediterranean salt meadows (MSM), are found at this site. All three habitats are listed as qualifying interests for North Bull Island cSAC. *Spartina* swards are also present at this site. Nearly of the saltmarsh habitat is situated within the cSAC.

North Bull Island and its saltmarsh have a very interesting history as the island is only 200 years old and developed after the construction of the north and south Bull Walls of Dublin Port (Jeffrey 1977, McCorry 2002). The ecology of the island has been examined extensively. Doyle (1934) made the first record of Cordgrass (*Spartina townsendi*) at Bull Island. O'Reilly and Pantin (1957) studied the vegetation of the saltmarsh and there have been several subsequent studies (Boyle, 1976, Boyle 1977, Moore and O'Reilly 1977). Many undergraduate and postgraduate theses have studied various aspects of ecology of the saltmarshes and other intertidal habitats.

The construction of the causeway to the island in 1965 has had a significant impact on the saltmarsh and intertidal habitats at North Bull Island. This affected tidal currents and lead to the deposition of sediment north of the causeway. This area was soon colonised by *Salicornia* spp. Around this time *S. anglica* began to spread in this area. There have been several attempts with varying success to control *S. anglica* on the mudflats from 1970 to 1995. There has been several surveys and reports carried out by An Foras Forbartha (1977, 1980, 1984) and for Dublin City Council by independent consultants (CAAS 1989, ESB International 2002) to examine various aspects of nature conservation and land use on the island and various issues with the construction of the causeway, subsequent sedimentation and the spread of *S. anglica*.

Dublin Corporation commissioned a study in 1996 to examine the impact of reopening the causeway and allowing tidal currents to flow north and south with the aim to reduce or prevent further sedimentation in the intertidal areas. This was in response to continued public concerns about sedimentation in the intertidal areas between North Bull Island and the mainland. The Environmental Impact Assessment (ESB International 2002) came to the conclusion that re-opening the causeway would have a minimal or no impact on sedimentation and that the 'do-nothing approach' was recommended.

The south Bull actually occurs south of the Dublin Port in Dublin Bay and is the name given to the extensive sandflats in this part of the bay (also called Sandymount sandflats or strand).

Three Annex I habitats, *Salicornia* flats, Atlantic salt meadows (ASM) and Mediterranean salt meadows (MSM), are found at this site. All three habitats are listed as qualifying interests for the North Dublin Bay cSAC. *Spartina* swards are also present at this site. Most of the saltmarsh habitat is situated within the cSAC and Nature Reserve. However there is a portion of saltmarsh outside the cSAC and nature reserve boundaries due to the use of the old 3rd edition OS maps to draw the boundaries. These maps are out of date. There are also some rectification errors between the OS map used to the draw the boundaries and the aerial photos. This means there is poor overlap between the actual golf course boundary and the cSAC and nature reserve boundaries.

3 HABITATS

3.1 General description

The general saltmarsh mainly occurs along the west side of Bull Island facing the mainland. A small area of saltmarsh extends along the north side of the causeway to the midway point. A small patch of saltmarsh also occurs on the mainland north of the causeway, at the confluence of the Santry River. This saltmarsh was formerly larger in size and was called Watermill Lane saltmarsh (O'Reilly & Pantin 1957). However most of it was destroyed by the construction of the causeway in 1964.

The main area of saltmarsh is dominated by Atlantic salt meadows (ASM) (Table 3.1). This was the largest single section of saltmarsh surveyed during the project in 2006. There is a gradual slope from the boundary (marked by the golf course boundaries) to the edge, marked by a low salt marsh cliff. At the back of the salt marsh, there are several areas with frequent Sea Rush (*Juncus maritimus*) and these areas are classified as Mediterranean salt meadows (MSM) on the northern side. At the front of the saltmarsh there is a narrow strip in places on bare mud dominated by Glasswort (*Salicornia* spp). This species also dominates a large area in the mudflats to the north of the causeway (called the *Salicornia* bank) where it forms a mosaic with Common Cordgrass (*Spartina anglica*). These areas are classified as (1310) *Salicornia* flats. There are small patches on the *Salicornia* bank that have a Common Cordgrass density greater than 40%. These areas are classified as *Spartina* swards. This habitat is not listed as a qualifying interest for this site.

Table 3.1. Area of EU Annex I habitats listed at North Bull Island.

EU Code	Habitat	Area (ha)
1310	*Salicornia* and other annuals colonizing mud and sand	28.69 [1]
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	82.34 [1]
1410	Mediterranean salt meadows (Juncetalia maritimi)	8.21 [2]
1320	*Spartina* swards (Spartinion maritimae)	0.83 [12]
	Total (not including *Spartina* swards and clumps)	**119.24**

[1] this total includes 33% of the 1310/1330/*Spartina* mosaic
[2] this total includes 50% of the 1330/1410 mosaic..

3.2 *Salicornia* flats (H1310)

This habitat is mainly situated in a large area on the mudflats north of the causeway called the *Salicornia* bank. This area developed soon after the construction of the causeway in 1964 so this section of habitat is relatively young. Glasswort (*Salicornia* sp.) is quite dense in places (20-30%) but becomes sparser at the edges of its distribution. This area contains frequent clumps of Common Cordgrass at various distributions that are scattered over the mudflats. In places the Common Cordgrass is dense enough (> 40%) to be classified as *Spartina* swards. There are few other saltmarsh species found in this area. Common Saltmarsh-grass (*Puccinellia martima*), Lax-flowered Sea Lavender (*Limonium humile*) and Greater Sea-spurrey (*Spergularia media*) are present but in rare amounts. Brown and green algae are frequent to abundant with brown algae associated with the Common Cordgrass clumps and green algae forming large sheets that cover the whole area at times. This area has a complex creek network and there are frequent small depressions on the mud surface. Some of the small creeks and depressions towards the seaward side of the *Salicornia* flats contain Eelgrass (*Zostera angustifolia*).

The habitat is also situated along the edge of the (ASM cliff) on mudflats or on eroding saltmarsh mud. In this situation it usually forms a band or zone between 5-10 m wide. The habitat may be wider at the mouths of creeks and extend further onto the mudflats along the bank of creeks for up to 25 m in places. This zone of Glasswort is discontinuous and disappears in places leaving a boundary between ASM and the mudflats. This is particularly seen along the edge of the southern section where it disappears frequently and reappears at and around the mouths of the creeks. It is dominated by dense Glasswort and also contains frequent Annual Sea-blite (*Suaeda maritima*) and occasional small individual plants of Lax-flowered Sea Lavender, Greater Sea-spurrey (*Spergularia media*) and Common Saltmarsh-grass. Clumps of Common Cordgrass are also found along the edge of the saltmarsh on the mudflats in this habitat. They are rare at the north end of the saltmarsh and become more common towards the causeway (5-10%). They are also quite frequently distributed along the edge of the southern saltmarsh section with an average frequency of between 5-10%. Common Cordgrass may occasionally become more frequent at times (> 25% cover). There is an accretional ramp along the edge of the saltmarsh adjacent to the causeway. In this area there is a natural transition along a gradual slope from mudflats to *Salicornia* flats to ASM.

A small isolated patch of this habitat occurs on the mudflats south of the causeway. It is almost entirely dominated by Glasswort with no other saltmarsh species occurring, apart from Common Cordgrass. This species forms several small clumps and is the only location south of the causeway where Common Cordgrass is found on the mudflats some distance (20 m) from the ASM. Common Cordgrass is also found along the edge of the southern saltmarsh section but is not generally distributed further than 10 m from the edge.

Patches of dense Glasswort may also be found within the ASM in pans. Some pans may be totally filled with Glasswort creating patches 5-10 m in diameter. These areas where not considered when measuring extent.

3.3 *Spartina* swards

This habitat occurs in places on the *Salicornia* bank north of the causeway. Clumps of Common Cordgrass are widely scattered over a much larger area, forming a mosaic with Glasswort. However there are some

smaller patches where is has denser cover (> 40%) and is classified as *Spartina* sward. Generally these are areas where there are aggregations of frequent clumps. Common Cordgrass is still patchy and forms a mosaic with Glasswort and generally does not form the dense swards seen at other sites.

3.4 Atlantic salt meadows (H1330)

This habitat dominates the saltmarsh vegetation. It extends from the saltmarsh cliff (the boundary with the mudflats) back to the golf course boundary or with MSM dominated by Sea Rush. Both O'Reilly and Pantin (1957) and Moore and O'Reilly (1977) have described the vegetation composition and zonation in detail. The front of the saltmarsh is dominated by the presence of Sea Purslane (*Atriplex portulacoides*). Common Saltmarsh-grass, Glasswort, Annual Sea-blite and Lax-flowered Sea Lavender are all frequent to abundant in cover. Other species such as Sea Arrowgrass (*Triglochin maritima*), Greater Sea Spurrey and Sea Pink (*Armeria maritima*) are less frequent. Clumps of Common Cordgrass are also frequent in this zone and occasionally abundant in places. The cover of this species is less frequent towards the tips of the island and most frequent on the saltmarsh in the areas closer to the causeway. Parts of the edge of the saltmarsh show signs of erosion and the Sea Purslane seems to be dying off. These areas are dominated by or have abundant bare mud and there is frequent Lax-flowered Sea Lavender, Common Saltmarsh-grass, Sea Arrowgrass and Greater Sea-spurrey present.

Distinct zonation can be seen as the Sea Purslane becomes less frequent and almost disappears and the vegetation is comprised of the classic Sea Pink-Sea Plantain (*Plantago maritima*) sward of the middle marsh. This zone has a characteristically very low sward height and also contains occasional or frequent Sea Arrowgrass, Lax-flowered Sea Lavender and Common Saltmarsh-grass. Common Cordgrass is less evident in this zone and clumps are generally confined to pans. This zone then transitions into upper saltmarsh. In places this is dominated by Sea Rush and is therefore classified as MSM. There are other sections where this species is less common or absent and the upper saltmarsh vegetation is dominated by Red Fescue (*Festuca rubra*). Other species present include Saltmarsh Rush (*Juncus gerardii*) and Sea Aster (*Aster tripolium*).

The boundary between the ASM and the mudflats or the *Salicornia* flats (1310) is usually quite distinct and marked by the saltmarsh cliff, which is dominated by Sea Purslane. However, a transition between ASM and *Salicornia* flats (1310) is present along the northern side of the causeway adjacent to the saltmarsh and within the crescent-shaped feature seen along the northern saltmarsh.

3.5 Mediterranean salt meadows (H1410)

This habitat is found at the back of the saltmarsh section found north of the causeway. One area is located on upper saltmarsh and its landward boundary is the St Anne's Golf Course embankment. The other main section is found towards the northern tip of the island, north of the golf course. Here there is an excellent natural transition between the ASM to MSM on upper saltmarsh, and then into fixed dunes.

This habitat is distinguished by the presence of Sea Rush. This tall rush forms large clumps in places and though it may not actually dominate the cover (cover varies from 20-50%), it is the most significant part of the vegetation. Many of the clumps have other species colonising within them and this reduces the actual overall cover of Sea Rush. Towards the ASM boundary the habitat is distinguished by isolated large clumps

developing on the Sea Pink-Sea Plantain –dominated sward. Sea Purslane is frequently found colonising only these clumps of Sea Rush. Higher on the marsh, the clumps of Sea Rush become more aggregated and Red Fescue becomes more common. Saltmarsh Rush also appears, growing between the clumps of the larger rush. Other species frequently present at low cover values include Common Scurvygrass (*Cochlearia officinalis*), Lax-flowered Sea Lavender, Sea Plantain, Sea Aster and Sea Milkwort (*Glaux maritima*).

Several other species are present in this habitat situated adjacent to the sand dunes at the northern end of the island. Small grassy areas in the transitional area to the dune slack contain Rock Sea Lavender (*Limonium binervosum*) and Long-bracted Sedge (*Carex extensa*).

The sward height within this habitat is quite diverse and tall (0.2-0.8 m high). The tall rushes may be shielding the other vegetation from natural grazing to some extent. The topography of the saltmarsh becomes somewhat less uniform in this habitat. There is a series of low mounds and shallow hollows and the slope is moderate in places compared to the wide ASM area that has a uniform flat topography over a very gentle slope. There are small salt pans present within this habitat but salt pans are more developed on the ASM. Creeks generally do not reach this high up the saltmarsh but some canalised drains from the golf course crossing this habitat.

Towards the edge of its distribution the clumps of Sea Rush become less frequent. Part of the saltmarsh along the golf course boundary is mapped as a mosaic between ASM/MSM and there is a narrow zone with regular sized clumps scattered along the boundary. There are occasional clumps of Sea Rush located in the southern saltmarsh section but they are isolated and generally do not form any appreciable areas of MSM.

4 IMPACTS

The saltmarsh habitats at North Bull Island are mainly located within the nature reserves so the main activity is nature conservation. This means there are few activities of high intensity affecting the saltmarsh (Table 4.1). Walkers (622) use a track (501) along the landward edge of the saltmarsh (adjacent to the golf courses). These include walking enthusiasts, dog walkers and bird watchers. The grassy embankment at the bank of the saltmarsh prevents the landward migration of the saltmarsh. The golf courses reclaimed the area of saltmarsh transition to dunes in the past. There is some light grazing (146) of the ASM by Hares and by wildfowl (147). Wildfowl also graze or forage amongst of the *Salicornia* bank, amongst the Common Cordgrass clumps. The whole of the saltmarsh and mudflats are subject to water pollution (701) from Dublin Bay and from the Santry River and other minor watercourses. However, there is no visible impact on the flora and fauna and the mudflats support some of the highest densities of waders and wildfowl recorded in Ireland. Litter occurs along the tide lines.

Signs of natural erosion (900) occur along the seaward side of the saltmarsh and the saltmarsh cliff at certain places, particularly to the north of the northern section and the central part of the southern section. The vegetation of the seaward side of the saltmarsh seems to be dying back in places and the layers of mud (distinct from the mudflats) on which the saltmarsh is present is eroding in places. *Salicornia* spp. are colonising the bare mud patches in the eroded areas, so erosion is creating pioneer saltmarsh. The erosion

of the saltmarsh seems to be part of a relatively long cycle, as signs of erosion were noted at these locations in the 1950s (O'Reilly & Pantin 1959).

Common Cordgrass occurs on the *Salicornia* bank in the *Salicornia* flats (1310) and within the Atlantic salt meadows (ASM). This is an invasive species and will generally spread over the mud to exclude the *Salicornia* spp. It is spreading on the *Salicornia* bank and reducing the extent of the *Salicornia* flats. Generally it occurs in densities of between 5-25% within the *Salicornia* flats. Some patches have densities of greater than 40% and are classified as *Spartina* swards.

Common Cordgrass occurs all along the Atlantic saltmarsh on both sides of the causeway. It generally occurs as clumps (between 0.1-5 m in diameter) within pans and in most instances the clumps are confined to the pans. Some old pans have filled and the Common Cordgrass clump is now part of the general saltmarsh vegetation. Some of these clumps have broken up, or other saltmarsh vegetation has invaded them and so there are aggregates of smaller Common Cordgrass clumps. There are no signs that it is spreading extensively on the saltmarsh. Generally it occurs in densities of 1-5% but there are some small areas on both sides of the causeway where it occurs up to 40% cover. Many of the clumps within the pans also contain other saltmarsh species, particularly Common Saltmarsh-grass.

Table 4.1. Intensity of various activities on saltmarsh habitats at North Bull Island.

EU Habitat Code[1]	Activity code[2]	Intensity[3]	Impact[4]	Area affected (ha)	Location of activity[5]
1310	900	C	+1	0.10	Inside
1310	910	C	+1	28.69	Inside
1310	954	A	-1	28.69	Inside
1330	146	C	0	82.34	Inside
1330	147	C	0	82.34	Inside
1330/1410	501	C	-1	< 1	Inside
1330/1410	622	C	-1	< 1	Inside
1330	900	D	0	N/A	Inside
1330	910	D	0	N/A	Inside
1330	954	C	0	82.34	Inside
1410	146	C	0	8.21	Inside
13s	701	C	0	N/A	Outside
13s	601	B	-1	119.24	Outside
13s	620	C	0	119.24	Outside
13s	870	C	0	119.24	Outside

[1] eu codes as per interpretation manual. code 13s is an additional code used to signify the entire saltmarsh habitat.
[2] description of activity codes are found in appendix iii summary report.
[3] intensity of the influence of an activity is rated as a = high, b = medium, c = low influence and d unknown.
[4] impact is rated as –2 = irreparable negative influence, -1 = reparable negative influence, 0 = neutral, +1= natural positive influence and +2 = strongly managed positive influence.
[5] location of activity: inside = activities recorded within and directly impacting the saltmarsh habitat, outside = activities recorded outside but adjacent to sand dune habitat that are impacting the saltmarsh habitat.

Activities occurring outside the site include golf courses (601), amenity use (620) and the causeway (870). Golf courses (601) mark the landward side of both the north and southern saltmarshes, with the boundary marked by an embankment and or a fence. These have an outside impact with disturbance to the wildlife. Some of the creeks on the saltmarsh have been canalised and act as drains from the golf courses.

5 CONSERVATION STATUS

Overall this site has a favourable conservation status (Table 5.1). This site is one of the best examples of saltmarsh habitat in Ireland and is an excellent example of zonation of saltmarsh plant communities. The habitats are located within a Nature Reserve where the primary objective is nature conservation. There are some negative impacts due to disturbance activities relating to the amenity use of the island. However, these activities have a low impact on the saltmarsh structure and functions.

Common Cordgrass is present at the site and this species is present on the *Salicornia* flats where it forms a mosaic with Glasswort. However, it is generally not dominant in terms of cover and only several small areas were classified as *Spartina* swards. It is also widely distributed on the ASM, though it is generally found at low cover values (0-5%). The abundance of Common Cordgrass may increase up to 40% at some locations towards the seaward edge of the ASM. There are no indications that it is spreading significantly at this site, although it is likely to increase in extent in the future at the expense of *Salicornia* flats.

There are some signs of erosion along the edge of the saltmarsh, particularly at the extremities towards the northern and southern ends of the saltmarsh. However, there are also signs of accretion along the saltmarsh adjacent to north side of the causeway. An accretional ramp is present in this area and there is a gradual transition from mudflats to *Salicornia* flats to ASM with several communities present within the ASM.

Table 5.1. Conservation status of Annex I saltmarsh habitats at North Bull Island.

Habitat	**EU Conservation Status Assessment**			
	Favourable	**Unfavourable - inadequate**	**Unfavourable - Bad**	**Overall EU conservation status assessment**
***Salicornia* flats (1310)**	Extent, Structure and functions	Future prospects		Unfavourable - inadequate
Atlantic salt meadows (1330)	Extent, Structure and functions Future prospects			Favourable
Mediterranean salt meadows (1410)	Extent, Structure and functions Future prospects			Favourable

5.4 *Salicornia* and other annuals colonizing mud and sand (H1310)

5.4.7 Extent

The extent of this habitat is assessed as *favourable*. There are no indications that there has been any loss of habitat due to erosion, sediment redistribution or transformation to *Spartina* sward during the current assessment period. This habitat is mainly distributed in a large area north of the causeway and as a fringe along the edge of the ASM. This was by far the largest area of this habitat recorded during the survey and this is therefore a feature of local distinctiveness.

The area of the *Salicornia* bank was monitored and mapped during the 1970s (Goodwille *et al.* 1971, Jeffrey *et al.* 1977) and 1980's (An Foras Forbartha 1980, 1984) and subsequently by CAAS (1990) and McCorry (2002). The current extent is similar to the extents mapped during these surveys. Its area in 1989 was measured at 25 ha. There are some fluctuations during each period with some losses and gains. These surveys allow much more detailed analysis of the changes in extent and distribution of Glasswort compared to any other site. The current survey shows that Glasswort has extended towards the south and connected to the saltmarsh along the causeway in places. This may indicate that accretion in this area is continuing since the construction of the causeway.

The extent of this habitat was much lower before the construction of the causeway in 1965-6 (O'Reilly & Pantin 1957).

5.4.8 Habitat structure and functions

The structure and functions of this habitat are assessed as *favourable*. Four monitoring stops were recorded in this habitat and all four stops passed. All the attributes reached their targets. Glasswort could not be classified to species level due to the timing of the survey, which took place relatively early in the year. However, Madden (1984) classified the Glasswort colonising on the *Salicornia* bank as *S. dolichostachya*. Glasswort along the edges of the ASM tended to be *S. europaea*. There are no negative impacts on this habitat apart from the presence of Common Cordgrass. This species forms a mosaic with Glasswort on the *Salicornia* Bank and in places along the edge of the saltmarsh. The cover of Common Cordgrass varies and is generally 0-5%, but may increase to 40% in places. Common Cordgrass colonised in this area around the same time as Glasswort.

5.4.9 Future prospects

The future prospects of this habitat are assessed as *unfavourable-inadequate*. This assessment assumes that current management activities and impacts on this habitat continue in the near future. There are few impacts on this site apart from the presence of Common Cordgrass. This species is likely to increase in extent on the *Salicornia* bank and create more patches of *Spartina* sward at the expense of *Salicornia* flats. The rate of increase may be quite slow.

5.5 Atlantic salt meadows (H1330)

5.5.7 Extent

The extent of this habitat is assessed as *favourable*. There are no indications that there has been any significant loss of extent during the assessment period. There are signs of erosion along the saltmarsh cliff boundary at the northern and southern ends of the island. However, these erosion signs have been present for some time (Jeffrey *et al.* 1977) and are present in both aerial photo series (1995 and 2000). There is no indication that there has been any measurable loss of extent due to erosion from a comparison of the two sets of aerial photos. (However, this is complicated by the poor rectification of the 1995 aerial photos in this area and there is up to 15 m error between the two sets of photos.) GPS points along the edge of the saltmarsh generally overlap with the edge of the saltmarsh as indicated from the 2000 aerial photos, indicating that there is no measurable loss of extent during this period.

The actual rate of erosion is quite slow. A comparison of the 2nd edition 6 inch map to the 2000 aerial photos indicates that there has been some shifting of the island at the northern tip seaward during this period. However this movement is only 30-40 m.

5.5.8 Habitat structure and functions

The structure and functions of this habitat are assessed as *favourable*. Sixteen monitoring stops were carried out in this habitat and all sixteen passed. All attributes reached their targets. The ASM at this site is an excellent example of this habitat. Several saltmarsh plant communities are present including pioneer, lower, mid and upper zones depending on elevation. The ASM has a typical species diversity. This site is an excellent example of saltmarsh zonation and different zones can be picked out from the aerial photos. The sward height is quite diverse even though the grazing intensity is moderate from wild birds and animals. The mid zone marsh has a typical very low sward height while the lower and upper zones have a more varied height due the presence of grasses and Sea Purslane.

Common Cordgrass is present in the ASM. It is widely distributed over most of the ASM but is more common towards both sides of the causeway. It also becomes more common towards the seaward edge of the ASM. Common Cordgrass is confined to distinct clumps mainly in salt pans at the back of the ASM. Towards the mid and lower marsh zones Common Cordgrass becomes more frequent with small areas having cover up to 40%. Scattered clumps may be found in salt pans and amongst the ASM vegetation. However the clumps rarely exclude other saltmarsh species and there are frequent amounts of Common Saltmarsh-grass, Lax-flowered Sea Lavender and Sea Purslane.

The saltmarsh topography is well developed and there is a very complex creek and salt pan structure. These creeks are functioning adequately. There has been some disturbance of the drainage of the saltmarsh with several drains crossing the saltmarsh from the golf courses. These drains were dug some time ago and are therefore not assessed.

There are signs of erosion along the saltmarsh cliff (0.3-0.5 m high) mainly at the northern and southern ends of the island. There is a small patch towards the northern end of the island where the surface of the saltmarsh seems to be eroding and is being colonised by Glasswort with occasional relic Sea Purslane

plants. This area is visible on the aerial photos and does not seem to have developed recently. An accretional ramp is present along the edge of the ASM adjacent to the north of the saltmarsh and the pioneer zone is particularly well-developed in this area.

5.5.9 Future prospects

The future prospects of this habitat are assessed as *favourable*. This assessment assumes that current management activities and impacts on this habitat continue in the near future. There are no significant impacts or activities on this habitat apart from disturbance from tracks running though this area and from potential disturbance from the adjacent golf course. Common Cordgrass is present on the saltmarsh though generally at low cover values. This species is not likely to spread significantly over the saltmarsh to transform the ASM to *Spartina* swards. The habitat is found within an area that is primarily managed for nature conservation.

There are signs of erosion along the edge of the ASM. However the rate of erosion is likely to be quite slow. Erosion is also countered by accretion along the north side of the causeway. Saltmarsh is likely to increase in extent in this area as accretion continues.

5.6 Mediterranean salt meadows (H1410)

5.6.7 Extent

The extent of this habitat is assessed as *favourable*. This habitat is mainly situated along the boundary of St Anne's Golf Course. This boundary is not mapped accurately. There has been some landscaping along this boundary recently and there were signs that the golf course may have encroached onto the saltmarsh (MSM habitat). However, there are no indications that this took place between 1995 and 2000 from a comparison of the aerial photos. There are also no indications that any significant encroachment took place between 2000 and 2006 when GPS points taken along the boundary are compared to the 2000 aerial photos. However, small encroachments of several metres can not be distinguished from a comparison of the GPS points and the aerial photos. This habitat is shielded from potential erosion by the ASM.

The extent of this habitat was likely to have been greater in the past before the development of the St Anne's Golf Course and the extension of this golf course.

5.6.8 Habitat structure and functions

The structure and functions of this habitat are assessed as *favourable*. Four monitoring stops were carried out in this habitat and they all passed. All the attributes reached their targets. This habitat has a typical species diversity. It also displays some zonation. The lower seaward side of the MSM has large isolated clumps of Sea Rush with ASM vegetation dominated by Sea Pink and Sea Plantain amongst the clumps. Further landward the clumps become less defined and the vegetation is more heterogeneous. Upper saltmarsh zone species such as Red Fescue, Saltmarsh Rush and Creeping Bentgrass become prominent. One notable feature of this habitat is that Sea Rush cover in this habitat is lower compared to some sites and there are significant amounts of other ASM species within this habitat. There are occasional salt pans present within this habitat. Creeks generally do not reach this high up the saltmarsh but there are several canalised drains from the golf course that pass through this habitat.

This habitat has an artificial boundary along the edge of the golf course. The boundary is a low embankment. Further north there are natural transitions to fixed dune habitat and these natural transitions add significantly to the conservation value of the habitat and the site. This habitat forms a transition with ASM along part of the golf course boundary and it forms a mosaic of scattered clumps of Sea Rush amongst ASM vegetation. Common Cordgrass is generally not found in this habitat as this habitat is mainly situated in the upper zone of the marsh.

5.6.9 Future prospects

The future prospects of this habitat are assessed as *favourable*. This assessment assumes that current management activities and impacts on this habitat continue in the near future. There are no significant impacts or activities on this habitat apart from disturbance from tracks running though this area and from potential disturbance from the adjacent golf course. The habitat is found within an area that is primarily managed for nature conservation.

6 MANAGEMENT RECOMMENDATIONS

No management of saltmarsh habitats is required at this site. Regular monitoring of Common Cordgrass distribution and abundance is required in the future, particularly on the mudflats and on the saltmarsh south of the causeway.

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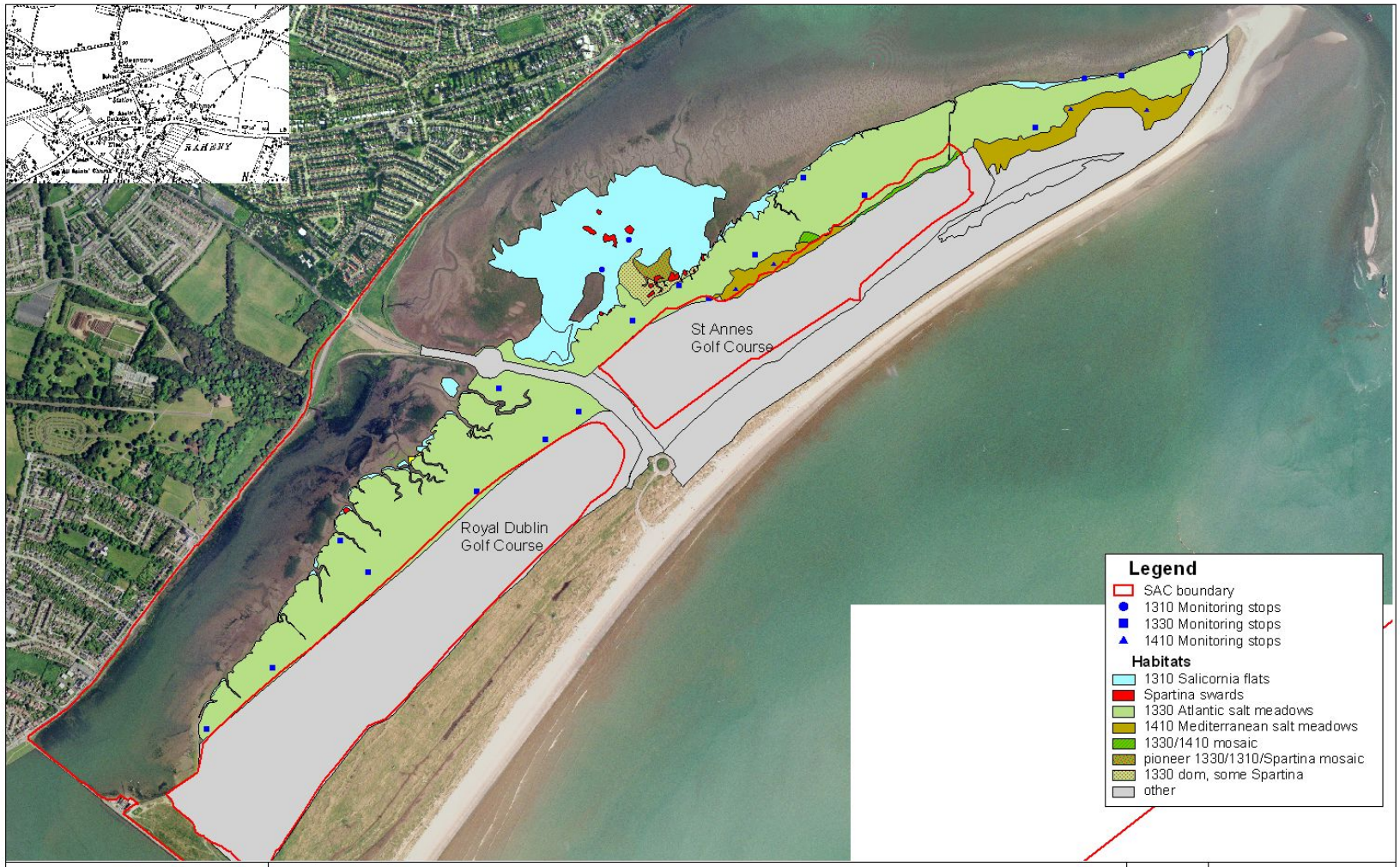

Saltmarsh Monitoring Project

Bull Island

SMP Code: SMP0004

Map produced by: SMP 2006

Map Version: 1

Dublin Bay cSAC (000206)

0 200 400 600 800 1000 1200 1400 1600 Meters N

Scale: 1:12483

APPENDIX IV – SITE REPORT AND HABITAT MAPS FOR NORTH BULL FROM THE SAND DUNES MONITORING PROJECT (DELANEY *ET AL*., 2013).

SITE 010 NORTH BULL

The following individual site report should be read in conjunction with the main report (Delaney *et al*., 2013). Please note that CMP refers to the Coastal Monitoring Project (Ryle *et al*., 2009) and SDM refers to the Sand Dunes Monitoring Project (Delaney *et al*., 2013). Unless otherwise stated, the baseline maps refer to the habitat maps produced during the CMP. These baseline maps were revised, to account for discrepancies in the original survey, before comparisons were made with the habitat maps produced during the SDM (see section 2.3 in SDM main report). These revised maps are referred to as the revised baseline maps in the following text.

1 SITE DESCRIPTION

North Bull, located on the northern part of North Bull Island, is part of a sand spit which stretches from the North Bull Wall into the northern part of Dublin Bay. The following report should be read in conjunction with Site 011 South Bull, which occupies the southern part of North Bull Island. The spit was formed after the North Bull Wall was built and altered the sediment cycling patterns in the bay. The island is still accreting in a seaward direction, with the mobile tip stretching towards Sutton on the mainland. It is one of very few actively accreting sites along the east coast. The south-western most part of what is referred to in this report as North Bull is marked by the causeway access road to the beach, and the site occupies all of the northern sand dunes on the island with the exception of the area occupied by St Anne's Golf Course. The area south of the causeway is referred to as South Bull in this project (site 011 South Bull). North Bull Island (010 North Bull and 011 South Bull) is included in the North Dublin Bay SAC (SAC 000206).

Five Annex I sand dune habitats (* indicates a priority habitat) were recorded on North Bull during the CMP: **1210 Annual vegetation of drift lines**, **2110 Embryonic shifting dunes**, **2120 Marram dunes (white dunes)**, ***2130 Fixed dunes (grey dunes)** and **2190 Humid dune slacks** (Ryle *et al.*, 2009). These habitats are part of a larger system of conservation interest with **1140 Mudflats and sandflats not covered by seawater at low tide**, **1310 *Salicornia* and other annuals colonizing mud and sand**, **1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)** and **1410 Mediterranean salt meadows (*Juncetalia maritimi*) (NPWS, 1999)**. Several rare plants have been recorded at North Bull Island including *Petalophyllum ralfsii*, *Galeopsis angustifolia*, *Saxifraga granulata*, *Salvia verbanaca* and *Vicia lathyroides*, but none of these were seen during the SDM. North Bull Island and the surrounding saltmarsh and intertidal habitats provide excellent habitat for a range of bird species, and it is protected as an SPA (North Bull Island SPA 004006), as well as a statutory Wildfowl Sanctuary. In the past, Little Terns nested on the site. There is a population of Irish Hare which are one of two grazing mammal species on the island, the other being rabbit. Seal use the northern sand flats as a haul-out spot (Ryle *et al.*, 2009).

Golf has been played at St Anne's since the 1920s, and the club comprises an 18 hole golf course and clubhouse. The presence of the golf course means that the transition between the ***2130 Fixed dunes (grey dunes)** and the saltmarsh behind it is interrupted and intact transitions are only present in the north of the site. The site is easily accessible and is a popular amenity for the population of north Dublin. The proximity of North Bull Island to the city is both a challenge and an opportunity. Heavy amenity use can result in impairment of the structural integrity and conservation value of sand dune sites. On the other hand, the presence of an actively accreting sand dune site close to a large urban centre offers huge educational potential.

2 CONSERVATION ASSESSMENTS

2.1 Overview

Survey work was carried out at North Bull on the 18th and 19th of July and on the 5th of August 2011. Conservation assessments were carried out on four of the five habitats recorded during the CMP, and the results of these assessments are presented in Table 1. **1210 Annual vegetation of drift lines** was not assessed as it was no longer present on the site in 2011. None of the habitats assessed on North Bull have a Favourable conservation status. Three habitats, **2110 Embryonic shifting dunes**, **2120 Marram dunes (white dunes)** and **2190 Humid dune slacks** were assessed as Unfavourable-Inadequate and the remaining habitat, ***2130 Fixed dunes (grey dunes)**, was assessed as Unfavourable-Bad.

Table 1. Conservation assessment results for all Annex I dune habitats surveyed at North Bull, Co. Dublin.

Habitat	Area	Structure & Functions	Future Prospects	Overall result
2110 Embryonic shifting dunes	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (stable)
2120 Marram dunes (white dunes)	Favourable (stable)	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (stable)
*2130 Fixed dunes (grey dunes)	Favourable (stable)	Unfavourable-Bad (stable)	Unfavourable-Inadequate (stable)	Unfavourable-Bad (stable)
2190 Humid dune slacks	Unfavourable-Inadequate (deteriorating)	Unfavourable-Inadequate (deteriorating)	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (deteriorating)

2.1.1 Area

The areas of Annex I sand dune habitats at North Bull are presented in Table 2. There were some small revisions made to the areas of each habitat mapped during the baseline survey. These are the result of more detailed mapping techniques as well as a change in the interpretation of the saltmarsh/sand dune boundary. The total sand dune area has increased by 0.74 ha (1.6%) since the baseline survey due to accretion. The habitat with the biggest change in area is ***2130 Fixed dunes (grey dunes)** which has

grown by 6.67 ha (19.8%). **1210 Annual vegetation of drift lines** has been entirely lost since the baseline survey. This is an ephemeral habitat and the loss may be part of the natural processes affecting coastal habitats. However, the practice of mechanical beach cleaning south of the site may have reduced the availability of drift line material for the formation of the habitat.

Table 2. Areas of Annex I habitats originally mapped at North Bull during the Coastal Monitoring Project (baseline survey), the revised baseline areas and areas mapped during the Sand Dune Monitoring Project in 2011.

Habitat	Baseline survey (ha)	Revised baseline (ha)	Sand Dunes Monitoring
1210 Annual vegetation of drift lines	1.30	1.30	0.00
2110 Embryonic shifting dunes	2.48	2.45	2.64
2120 Marram dunes (white dunes)	7.00	6.94	2.20
*2130 Fixed dunes (grey dunes)	34.18	33.69	40.36
2190 Humid dune slacks	2.84	3.04	2.96
Total	47.80	47.42	48.16

2.1.2 Structure and Functions

Table 3 shows the results of the Structure and Functions assessment. Structure and Functions for **2110 Embryonic shifting dunes** and **2120 Marram dunes (white dunes)** were assessed as Unfavourable-Inadequate due to interference with the sediment dynamics (beach cleaning). ***2130 Fixed dunes (grey dunes)** were assessed as Unfavourable-Bad because of a combination of damage, undergrazing and invasive species. **2190 Humid dune slacks** were assessed as Unfavourable-Inadequate because of the encroachment of invasive, non-native species.

Table 3. Annex I sand dune habitats at North Bull for which Structure and Functions were assessed, with the number of monitoring stops and assessment criteria and the number of criteria that failed presented.

Habitat	No. monitoring stops	Total no. assessment criteria	No. failed criteria
2110 Embryonic shifting dunes	4	7	1
2120 Marram dunes (white dunes)	4	7	1
*2130 Fixed dunes (grey dunes)	8	11	3
2190 Humid dune slacks	4	11	1

2.1.3 Future Prospects

Table 4 shows the impacts and activities which were recorded at North Bull in 2011. Impact codes are assigned according to Ssymanck (2010). Most of the negative impacts recorded are related either directly or indirectly to amenity use of the dunes, and these include beach cleaning, fire, trampling, walking, use of motorised vehicles and littering. Other negative impacts include undergrazing and invasive species (*Hippophae rhamnoides*). Pollution and discharges were recorded during the CMP but were not considered to be problematic during the SDM. Discharges were not observed and EPA data suggest that water quality in Dublin Bay was good in 2011 (EPA, 2012).

Table 4. Impacts recorded in Annex I sand dune habitats at North Bull in 2011. Source refers to whether the impact being scored originates inside or outside the Annex I habitat being assessed.

Habitat code	Impact code	Impact description	Intensity	Effect	Percent of habitat	Source
2110	G01.02	Walking	Low	Negative	100	Inside
2110	G01.03.02	Driving on beach	Medium	Negative	5	Outside
2110	G05.01	Trampling	Medium	Negative	10	Outside
2110	G05.05	Beach cleaning	Medium	Negative	100	Outside
2120	G01.02	Walking	Low	Negative	100	Inside
2120	G01.03.02	Driving on beach	Medium	Negative	5	Outside
2120	G05.01	Trampling	Medium	Negative	10	Outside
2120	G05.05	Beach cleaning	Medium	Negative	100	Outside
*2130	A04.03	Lack of grazing	Medium	Negative	50	Inside
*2130	A10.01	Removal of sea buckthorn	Medium	Positive	5	Inside
*2130	D01.01	Paths and tracks	High	Negative	5	Inside
*2130	G01.02	Walking	Low	Negative	70	Inside
*2130	G01.03.02	Quad-bikes	Low	Negative	15	Inside
*2130	G02.01	Golf course	Low	Neutral	50	Outside
*2130	G05.01	Trampling	High	Negative	10	Inside
*2130	H05.01	Littering	Low	Negative	1	Inside
*2130	I01	Invasive non-native species (Sea buckthorn)	Medium	Negative	5	Inside
*2130	J01.01	Fire	High	Negative	5	Inside
*2130	K04.05	Rabbit grazing	Medium	Positive	30	Inside
2190	A10.01	Removal of sea buckthorn	High	Positive	15	Inside
2190	G01.02	Walking	Medium	Neutral	5	Inside
2190	G02.01	Golf course	Low	Neutral	100	Outside
2190	I01	Invasive non-native species (Sea buckthorn)	Medium	Negative	5	Inside
2190	K01.03	Drying out	Medium	Negative	80	Inside
2190	K02.01	Scrub encroachment	Low	Negative	10	Inside

2.2 Annex I habitat assessments

The conservation status of the Annex I habitats at North Bull is discussed below. The present conservation status in 2011 is compared with the baseline status and if a habitat is not in Favourable status, the main reasons for the Unfavourable assessment are given. Areas recorded in 2011 are compared with the revised baseline areas. It should be borne in mind that natural processes such as erosion, deposition and succession are primary drivers of change on coastal habitats.

2.2.1 1210 Annual vegetation of drift lines

This habitat was not present at North Bull when it was surveyed in 2011, so no assessment was carried out.

2.2.2 2110 Embryonic shifting dunes

A thin strip **of 2110 Embryonic shifting dunes** is present on the southeast facing front of North Bull and, after a short break at the beach access point, it runs all the way to the northern tip of the island, where it is at its widest.

Area

Area of **2110 Embryonic shifting dunes** increased from 2.45 during the CMP to 2.64 ha during the SDM. The main increase has been in the north east of the site, where accretion has occurred at the tip. There has been some erosion in the central part of the site. Beach cleaning activities occur in the south of the island (South Bull), and these have an impact on the sediment dynamics of the whole island as the sand removed in the southern part of the beach is unavailable for dune building by wind action. There is also a gap where the habitat has not developed at the main access point to the beach. Because of the dynamic character of foredune communities, the Area assessment must include areas of habitat which have been lost due to anthropogenic activities and areas where the habitat would have established in the absence of anthropogenic activities. It is not possible to give an exact figure for the area of **2110 Embryonic shifting dunes** habitat which has failed to develop at North Bull because of anthropogenic activities. During the CMP, Area was assessed as Unfavourable-Inadequate. The impacts limiting the extent of **2110 Embryonic shifting dunes** in parts of the site have remained the same since the baseline survey and Area was assessed as Unfavourable-Inadequate (stable) during the SDM.

Structure and Functions

All of the criteria passed in the Structure and Functions assessment, with the exception of the criterion assessing interference with sediment dynamics. Beach cleaning occurring farther south on the strand has an impact on fresh sediment availability which is necessary for this habitat to persist. During the CMP, Structure and Functions were assessed as Favourable. Beach cleaning was reported in the CMP individual site report for North Bull, so the change in status is considered to relate to the interpretation of the criteria rather than to suggest that there has been a genuine deterioration in the quality of the habitat. Structure and Functions were assessed as Unfavourable-Inadequate (stable) during the SDM.

Future Prospects

Beach cleaning, trampling, driving, parking and walking in the habitat were recorded as impacts during the SDM. Beach cleaning and walking have a negative effect on 100% of the habitat, with beach cleaning having a medium intensity and walking a low-intensity. Driving and trampling occur in an area which does not currently support vegetation and the impacts prevent further colonisation. It is difficult to quantify the exact area affected by these impacts. Future prospects were assessed as Unfavourable-Inadequate during the CMP due to trampling, walking, driving and other large scale impacts such as water pollution and discharges. Water pollution and discharges were not observed in 2011, but the degree of impacts and the effects of the impacts do not appear to have altered since the baseline survey, so Future Prospects were assessed as Unfavourable-Inadequate (stable).

Conservation assessment

All of the parameters were assessed as Unfavourable-Inadequate (stable). During the CMP, the habitat was assessed as Unfavourable-Inadequate. The conservation status of **2110 Embryonic shifting dunes** was assessed as Unfavourable-Inadequate (stable) during the SDM.

2.2.3 2120 Marram dunes (white dunes)

The **2120 Marram dunes (white dunes)** habitat is now restricted to a very narrow band between the **2110 Embryonic shifting dunes** and the ***2130 Fixed dunes (grey dunes)** at North Bull, and this is the result of a combination of erosion and succession.

Area

The area of **2120 Marram dunes (white dunes)** decreased from 6.94 ha during the CMP to 2.20 ha during the SDM and this is almost entirely due to succession to ***2130 Fixed dunes (grey dunes).** There has also been some erosion at the north-eastern tip of the spit. There has been no clear anthropogenic loss of habitat. Area was assessed as Favourable during the CMP. During the SDM, area was assessed as Favourable (stable).

Structure and Functions

The criterion assessing interference with sediment dynamics failed during the Structure and Functions assessment because of the beach cleaning taking place in the southern part of the island. A reduction in blown sand can affect the health of *Ammophila arenaria* and causes it to spread less vigorously. Structure and Functions were assessed as Favourable during the CMP. During the SDM, Structure and Functions were assessed as Unfavourable-Inadequate (stable) because beach cleaning was being carried out during the CMP, but was not considered in the Structure and Functions assessment at that time.

Future Prospects

Beach cleaning, trampling, driving and walking in the habitat were recorded as impacts during the SDM. Beach cleaning and walking have a negative impact on 100% of the habitat, while trampling and driving on the beach have a negative impact on approximately 10% and 5% of the habitat respectively. Driving and trampling occur in an area which does not currently support vegetation and the impacts prevent further colonisation. During the CMP, Future Prospects were assessed as Unfavourable-Inadequate because of discharges, walking, driving on the dunes and trampling. Water pollution was also included, but the area affected was not known. There was no evidence of a negative effect related to discharges or water pollution in 2011. According to the EPA website, water quality in the bay has consistently met EU guide values since 2006 (EPA, 2012). Future Prospects were assessed as Unfavourable-Inadequate (stable) during the SDM as the main impacts have remained the same.

Conservation assessment

Area was assessed as Favourable and the other two parameters were assessed as Unfavourable-Inadequate (stable). Conservation status was assessed as Unfavourable-Inadequate during the CMP. During the SDM, the conservation status of **2120 Marram dunes (white dunes)** was assessed as Unfavourable-Inadequate (stable).

*2.2.4 *2130 Fixed dunes (grey dunes)*

This is by far the most extensive habitat at North Bull, and it supports several unusual plant and invertebrate species (McCorry & Ryle, 2009). The most frequent species include *Galium verum, Festuca rubra, Hypochaeris radicata, Lotus corniculatus* and *Viola tricolor*.

Area

The area of ***2130 Fixed dunes (grey dunes)** increased from 33.69 ha during the baseline survey to 40.36 ha during the SDM. The increase in area is due to succession of the **2120 Marram dunes (white dunes)** to ***2130 Fixed dunes (grey dunes)** along the south-east facing foredunes and at the north-eastern tip of the island. Area was assessed as Favourable during the CMP. During the SDM, Area was assessed as Favourable (stable).

Structure and Functions

Three of the criteria assessed as part of the Structure and Functions assessment failed: frequency of non-native species, height of the vegetation and damage due to disturbance. Non-native species were present near two of the eight monitoring stops, and included *Acer pseudoplatanus* and *Hippophae rhamnoides. Hippophae rhamnoides* is a particularly worrying feature of the dunes as it can spread very quickly and some young shoots were observed. Tall, rank vegetation is common on the site, and this can lead to a reduction in species diversity over time. A network of beaten tracks is present in the ***2130 Fixed Dunes (grey dunes)** exposing the underlying sand and maintaining blowouts so that they do not recolonise with vegetation. The most severe damage is closest to the access points at the southern end of the site, but there are paths and tracks running all the way to the north-eastern tip of the island. During the CMP, the habitat was assessed as Unfavourable-Inadequate due to lack of species diversity and lack of short turf. There was no indication that damage or non-native species were recorded at monitoring stops during the CMP. However, aerial photographs and management plans (McCorry & Ryle, 2009) confirm that disturbance and *Hippophae rhamnoides* have been present for over a decade and were present during the CMP. In the individual site report on North Bull, the habitat description for ***2130 Fixed dunes (grey dunes)** for the CMP mentions extensive pedestrian tracks and the introduced species *Acer pseudoplatanus* and *Syringa vulgaris*. The factors affecting the Structure and Functions appear to have remained stable since the CMP was carried out. During the SDM, Structure and Functions were assessed as Unfavourable-Bad (stable) because of the damage associated with heavy recreational pressure, the presence of non-native species and insufficient short turf which appear to have affected the site since prior to the baseline assessment.

Future Prospects

Eight negative impacts were recorded at North Bull in 2011. Trampling, paths and tracks, littering, fire, walking and motorised driving are all negative impacts associated with recreational use of the site. Much of the site suffers from undergrazing and invasive non-native species also represent a threat. St Anne's Golf course is located in an area at least partially occupied by ***2130 Fixed dunes (grey dunes)** in the past and its presence was recorded as a neutral influence. It was initially the source of some invasive species, but there appear to have been efforts

within the course to manage these. There has been some attempt to control the spread of *Hippophae rhamnoides* on the site, and this represents a positive impact. Rabbits are present, although rabbit numbers are said to have been reduced due to disease and uncontrolled dogs (McCorry & Ryle, 2009). In the absence of other grazing animals, rabbits represent a positive impact. Currently, the Irish Hare population is very small. During the CMP, Future Prospects were assessed as Unfavourable-Inadequate and impacts such as grazing, discharges, the golf course, walking and horse-riding, motorised vehicles, other leisure activities, pollution, invasive species and other natural processes were recorded. Many of the impacts have remained the same, but water quality has improved (http://www.bathingwater.ie/epa/history.htm) and there is evidence that the spread of *Hippophae rhamnoides* is being tackled. During the SDM, Future Prospects were assessed as Unfavourable-Inadequate (stable) as the impacts relating to disturbance, recreational use and lack of grazing have not been tackled, but the control of *Hippophae rhamnoides* which has been ongoing for some time is likely to improve the habitat condition if continued, bringing Structure and Functions to Unfavourable-Inadequate status.

Conservation assessment

During the CMP, Area was assessed as Favourable and Structure and Functions and Future Prospects were assessed as Unfavourable-Inadequate. However, under the current methodology, the assessment would probably have been Unfavourable-Bad due to impairment of the Structure and Functions of the habitat. During the SDM, the conservation status of ***2130 Fixed dunes (grey dunes)** were assessed as Unfavourable-Bad (stable).

2.2.5 2190 Humid dune slacks

One large slack (known locally as the 'alder marsh') is present at North Bull. As well as the typical indicator species, *Epipactis palustris*, *Succisa pratensis* and *Filipendula ulmaria* were recorded from the **2190 Humid dune slacks** habitat.

Area

The area of **2190 Humid dune slacks** has decreased slightly from 3.04 ha during the baseline survey to 2.96 ha during the SDM. The loss of Area is due to drying out of the habitat leading to succession in a small area which is dominated by *Hippophae rhamnoides*. Drying out is a natural process for **2190 Humid dune slacks**; however this process can be accelerated due to anthropogenic activities which upset the hydrological functioning of the habitat. The presence of *Hippophae rhamnoides* in this area has most likely helped to accelerate desiccation, and as it was planted deliberately on North Bull Island, loss of Area cannot be seen to be solely due to natural succession. Area was assessed as Favourable during the CMP. Area was assessed as Unfavourable-Inadequate (deteriorating) during the SDM.

Structure and Functions

All but one of the criteria in the Structure and Functions assessment passed. The only criterion to fail assessed the presence of non-native species. The highly invasive scrub species *Hippophae rhamnoides* has started to spread into the slack, and this presents a double threat to the habitat as it shades out other species in its immediate vicinity and it causes increased water loss to the dune system through transpiration. Structure and Functions were assessed as Favourable during the CMP, and no

mention is made in that report to *Hippophae rhamnoides* encroachment. The spread of *Hippophae rhamnoides* is a negative development for the dune slacks. During the SDM, Structure and Functions were assessed as Unfavourable-Inadequate (deteriorating).

Future Prospects

No impacts specific to the **2190 Humid dune slacks** habitat were recorded during the CMP, but discharges, nautical sports, motorised vehicles, water pollution and other natural processes are noted as affecting all habitats at the site, and Future Prospects were assessed as Unfavourable-Inadequate due to recreational pressure. None of these impacts were recorded in 2011 during the SDM. Negative impacts recorded in 2011 included drying out of the habitat, the presence of *Hippophae rhamnoides* and general scrub encroachment. The presence of *Hippophae rhamnoides* is a particular threat, because of its ability to form large species-poor thickets in a short time. The drying out of the slack appears to be occurring at an accelerated rate in North Bull. This acceleration, first noted by DCC staff in the 1990s, has led to the belief that the drying out cannot be entirely explained by natural succession. Research studying the hydrology, vegetation and restoration prospects of the dune slack was carried out, the results of which showed a strong indication that water extraction was occurring and was having a detrimental effect on the hydrological functioning of the slack and vegetation (Devaney, 2008). Walking in the slacks and the adjacent golf course were noted as neutral impacts. Although the damage due to disturbance can no longer be detected in the ***2190 Humid dune slacks** habitat, that threat has been replaced with the threat of scrub encroachment and drying out. Future Prospects were assessed as Unfavourable-Inadequate (stable) during the SDM.

Conservation assessment

Area and Structure and Functions were assessed as Unfavourable-Inadequate (deteriorating) and Future Prospects were assessed as Unfavourable-Inadequate (stable) during the SDM. Conservation status was assessed as Unfavourable-Inadequate during the CMP. Due to the negative effects of *Hippophae rhamnoides* on the habitat, the conservation assessment of **2190 Humid dune slacks** during the SDM was Unfavourable-Inadequate (deteriorating).

3 DISCUSSION

3.1 Beach cleaning

Unusually on the east coast of Ireland, the dunes at North Bull Island are part of an accreting system with the dunes extending to the north and east of the site since the island began to form after the creation of the North Bull Wall (McCorry & Ryle, 2009). The establishment of foredune habitats is a necessary step in dune building, and the development of drift line vegetation is frequently the first step in this process. The importance of drift line vegetation is acknowledged in its inclusion on Annex I of the Habitats Directive as **1210 Annual vegetation of drift lines**.

Beach cleaning is carried out on the southern strand of the island. Litter and other jetsam is removed by hand, and a layer of sand and decomposing algal material is removed from the upper intertidal zone by mechanical means and deposited in large

mounds in the foredune zone, including the northern part of the dunes (McCorry & Ryle, 2009). The motivation for beach cleaning is two-fold. It prevents the strong smell of decomposing algae from discouraging amenity use of the island and material removed is deposited in the foredunes to reduce the effects of erosion.

The process of beach cleaning and deposition of beach materials has a negative effect on the dunes at North Bull for two reasons. The shape of the spit and the fact that it is building towards the north-eastern tip suggests that material is moved from south-west to north-east by a process of longshore drift. The removal of sand and other beach material in the south means that there is less sand available to be moved into the northern section by longshore drift and wind. This can have a detrimental effect on dune building, and the reduction in sediment availability could cause scouring and erosion of the foredunes. Dumping the material at the foot of eroded dune faces interferes with the natural development of foredunes by depositing nutrient rich, dense material in a location where mobile sands would generally accumulate. Reduction of sediment availability and dumping on the fore-dunes and drift line could be responsible for the loss of **1210 Annual vegetation of drift lines**. The use of vehicles to carry dredged material up the beach can help to spread weedy species, as can the presence of nutrient-rich deposits in the foredunes. In the absence of materials on the beach that are toxic to coastal organisms, beach cleaning is not a recommended conservation tool (Vanhooren et al., 2011). Mechanical beach cleaning should be undertaken as infrequently as practical. Dublin City Biodiversity Action Plan recognises the need to find an alternative to mechanical beach cleaning as part of the development of best practice in beach management (Dublin City Council, 2008).

3.2 Amenity use

North Bull Island is a popular amenity site with easy access via two bridges and ample parking on the beach and on the causeway. Many of the activities that occur on the site are focussed on the beach and water, and so do not directly affect the sand dune habitats. Amenity use of the dunes includes walking, running, dog-walking and antisocial behaviour. As a result, campfires, trampling and erosion of the vegetation have caused a network of tracks and some small blowouts in the dune system. Disturbance prevents revegetation and blow outs present in 2011 can be seen clearly in aerial photography published in 1995. The presence of tracks and blowouts reduces the stability of the dunes and can result in an exacerbation of occasional storm damage.

Dogs are frequently allowed to run off the lead in the sand dunes, and this has an effect on rabbits and hares, the only grazing animals present on the site. Although allowing dogs off the lead is prohibited, the size and topography of the site make it difficult to enforce the regulation. Currently, access to dogs on a lead is not restricted in any part of North Bull Island other than the golf courses.

The northern most part of the site, from the golf course boundary to the accreting tip of the island, experiences the smallest degree of amenity use. The beach is used by seals and was formerly used as a breeding site for Little Tern. Because of its distance from the main access routes, this part of the island has the best potential for conservation management and measures promoting sensitive use of the habitats.

3.3 Invasive species

Several invasive species have been recorded from North Bull, and of these the most serious threat comes from *Hippophae rhamnoides*. This was initially planted as shelter in the golf course, and later spread into the Annex I sand dune habitats (McCorry & Ryle, 2009). There are efforts to restrict the spread of the species, and the remains of cut plants were seen during surveying in 2011. The success of the control measures will form a core part of monitoring in the future. The removal of the plant from the site would represent an improvement in the conservation status of both ***2130 Fixed dunes (grey dunes)** and **2190 Humid dune slacks**.

3.4 Hydrology

North Bull Island is fed by a fresh groundwater lens which floats on top of the seawater below the island. **2190 Humid dune slacks** are typically the lowest lying habitats within a dune system and are therefore closest to the groundwater table. The daily, seasonal and annual fluctuations in the groundwater levels help to determine and maintain dune slack vegetation and succession. Changes to groundwater levels ultimately affect the Area, Structure and Functions and Future Prospects of **2190 Humid dune slacks**, with a lowering of groundwater levels leading to drying out and a shift to older phases in succession, such as scrub development. Apart from natural succession, typical causes of drying out in slacks include groundwater extraction and drainage of adjacent land. The **2190 Humid dune slack** on North Bull is drying out at an accelerated rate, suggesting human involvement. Research on the hydrology of this slack found strong indications that groundwater extraction was occurring from an unidentified source found close to the slack (Devaney, 2008). In the North Bull Management Plan (McCorry and Ryle, 2009), the authors recommended that hydrological monitoring on the island continue and that consultation with the two golf courses should be initiated in relation to water management issues, since these properties dominate the terrestrial part of North Bull Island.

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Key
1210 Strandline
2110 Embryonic Dunes
2120 White Dunes
2130 Fixed Dunes
2190 Dune Slacks
BL Built Land
GM Saltmarshes
WS Scrub, transitional woodland
SAC boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Monitoring survey of Annex I sand dune habitats in Ireland 2011-2012
North Bull, Co. Dublin
- Revised Baseline Habitat Map -
SDM code: 010
Date of map production: 25-10-2013
0 0.1 0.2 Km
N


Key
2110 Embryonic Dunes
2120 White Dunes
2130 Fixed Dunes
2130 Fixed Dunes / CM Saltmarshes
2130 Fixed Dunes / ED Disturbed Ground
2130 Fixed Dunes / WS Scrub, transitional woodland
2190 Dune Slacks
2190 Dune Slacks / WS Scrub, Transitional Woodland
BL Built Land
SAC boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Monitoring survey of Annex I sand dune habitats in Ireland 2011-2012
North Bull, Co. Dublin
- Updated SDM Map -
SDM code: 010
Date of map production: 25-10-2013
0 0.1 0.2 Km
N

APPENDIX V – SITE REPORT AND HABITAT MAPS FOR SOUTH BULL FROM THE SAND DUNES MONITORING PROJECT (DELANEY *ET AL.*, 2013)

SITE 011 SOUTH BULL

The following individual site report should be read in conjunction with the main report (Delaney *et al.*, 2013). Please note that CMP refers to the Coastal Monitoring Project (Ryle *et al.*, 2009) and SDM refers to the Sand Dunes Monitoring Project (Delaney *et al.*, 2013). Unless otherwise stated, the baseline maps refer to the habitat maps produced during the CMP. These baseline maps were revised, to account for discrepancies in the original survey, before comparisons were made with the habitat maps produced during the SDM (see section 2.3 in SDM main report). These revised maps are referred to as the revised baseline maps in the following text.

1 SITE DESCRIPTION

South Bull comprises the sand dunes on North Bull Island, Dublin, between the North Bull wall and North Bull Island causeway. This report should be read in conjunction with site 010 North Bull, which comprises the sand dunes on North Bull Island north of the causeway. North Bull Island is a sand spit which developed after the building of the North Bull Wall altered the sediment cycling patterns in the bay. Almost all of the west-facing part of the dunes is occupied by the Royal Dublin Golf Course, and is excluded from the site. North Bull Island (including 010 North Bull and 011 South Bull) is included in the North Dublin Bay SAC (SAC 000206). Five Annex I sand dune habitats (* indicates a priority habitat) were recorded on South Bull during the CMP: **1210 Annual vegetation of drift lines**, **2110 Embryonic shifting dunes**, **2120 Marram dunes (white dunes)**, ***2130 Fixed dunes (grey dunes)** and **2190 Humid dune slacks** (Ryle *et al.*, 2009). The wider landscape surrounding the sand dunes is also of conservation interest with **1140 Mudflats and sandflats not covered by seawater at low tide**, **1310 *Salicornia* and other annuals colonizing mud and sand**, **1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)** and **1410 Mediterranean salt meadows (*Juncetalia maritimi*)** present (NPWS, 1999). Rare plants which have been recorded at North Bull Island include *Petalophyllum ralfsii*, *Galeopsis angustifolia*, *Saxifraga granulata*, *Centaurium pulchellum*, *Salvia verbanaca* and *Vicia lathyroides.* The only rare plant found during survey in 2011 was *Salvia verbenaca*. North Bull Island and the surrounding saltmarsh and intertidal habitats provide excellent habitat for a wide range of bird species and it is protected as an SPA (North Bull Island SPA 004006), as well as a statutory Wildfowl Sanctuary. Rabbits and Irish Hare are the only grazing mammals at the site.

The Royal Dublin Golf Course has operated on the island since 1889, but was altered considerably between 2000 and 2007 (Royal Dublin Golf Course, 2013). The presence of the golf club has interrupted the transitions between saltmarsh habitats and the Annex I sand dune habitats on the island. Proximity to Dublin and good access roads have caused North Bull Island to be the focus of considerable amenity use. There are several activities which take place on the water or the beach, and

walking, dog-walking and antisocial behaviour take place in the dunes. Although the accessibility of the dunes at North Bull Island has resulted in some damage due to recreational use, it also means that North Bull Island is a useful educational resource.

2 CONSERVATION ASSESSMENTS

2.1 Overview

South Bull was surveyed between the 18th and 20th of July 2011. All of the habitats which were recorded during the CMP were present during the SDM, and assessments were carried out in all of them. The results of the conservation assessments are shown in Table 1. No trend could be established for **1210 Annual vegetation of drift lines** because it was not assessed during the CMP. None of the five habitats at South Bull were in Favourable conservation status and four of them were assessed as Unfavourable-Bad. Overall, there has been a deteriorating trend at the site since the CMP.

Table 1. Conservation assessment results for all Annex I dune habitats surveyed at South Bull, Co. Dublin.

Habitat	Area	Structure & Functions	Future Prospects	Overall result
1210 Annual vegetation of drift lines	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Bad	Unfavourable-Bad
2110 Embryonic shifting dunes	Unfavourable-Bad (deteriorating)	Unfavourable-Bad (deteriorating)	Unfavourable-Bad (deteriorating)	Unfavourable-Bad (deteriorating)
2120 Marram dunes (white dunes)	Favourable (stable)	Unfavourable-Bad (deteriorating)	Unfavourable-Bad (deteriorating)	Unfavourable-Bad (deteriorating)
*2130 Fixed dunes (grey dunes)	Favourable (stable)	Unfavourable-Bad (stable)	Unfavourable-Bad (deteriorating)	Unfavourable-Bad (deteriorating)
2190 Humid dune slacks	Favourable (stable)	Unfavourable-Inadequate (deteriorating)	Unfavourable-Inadequate (stable)	Unfavourable-Inadequate (deteriorating)

2.1.1 Area

Table 2 shows the areas of each habitat mapped at South Bull Island in 2011, during the baseline survey and the revised baseline areas. A larger area was included in the survey in 2011 than in the baseline survey, and the CMP areas were revised to cover the total sand dune area surveyed in 2011. The biggest changes were the addition of a field adjacent to the Bull Road which is composed of somewhat altered but still recognisable ***2130 Fixed dunes (grey dunes)** and two polygons of **2190 Humid dune slacks** which were previously mapped as saltmarsh. Small changes in the baseline area of the other habitats are the result of more detailed mapping.

Table 2. Areas of Annex I dune habitats originally mapped at South Bull during the baseline survey (CMP), the revised baseline areas and areas mapped during the Sand Dune Monitoring Project in 2011.

Habitat	Baseline survey (ha)	Revised baseline (ha)	Sand Dunes Monitoring
1210 Annual vegetation of drift lines	0.08	0.08	0.11
2110 Embryonic shifting dunes	0.45	0.44	3.43
2120 Marram dunes (white dunes)	5.15	5.13	0.97
*2130 Fixed dunes (grey dunes)	54.16	56.70	65.38
2190 Humid dune slacks	3.21	8.40	9.15
Total	63.05	70.75	79.04

2.1.2 Structure and Functions

Table 3 shows the results of the Structure and Functions assessment. None of the Annex I dune habitats present were assessed as having Favourable Structure and Functions. The Structure and Functions for **1210 Annual vegetation of drift lines** were assessed as Unfavourable-Inadequate due to beach cleaning and disturbance, while **2190 Humid dune slacks** were assessed as Unfavourable-Inadequate due to scrub encroachment. **2110 Embryonic shifting dunes** and **2120 Marram dunes (white dunes)** were assessed as Unfavourable-Bad due to trampling or disturbance, beach cleaning and invasive species (*Senecio squalidus*). ***2130 Fixed dunes (grey dunes)** were assessed as Unfavourable-Bad due to a lack of grazing resulting in a rank, tall sward with low diversity of indicator species, and also due to disturbance.

Table 3. Annex I sand dune habitats at South Bull for which Structure and Functions were assessed, with the number of monitoring stops, assessment criteria and the number of criteria that failed.

Habitat	No. monitoring stops	Total no. assessment criteria	No. failed criteria
1210 Annual vegetation of drift lines	2	6	2
2110 Embryonic shifting dunes	4	7	3
2120 Marram dunes (white dunes)	4	7	3
*2130 Fixed dunes (grey dunes)	10	11	3
2190 Humid dune slacks	10	11	1

2.1.3 Future Prospects

Impacts recorded in sand dune habitats at South Bull Island are presented in Table 4. The most frequent negative impacts recorded were associated directly or indirectly with amenity use and these included driving motorised vehicles, trampling, beach cleaning and dumping of beach materials, vandalism and fire. Amenity use affects all of the habitats on the site. The site also suffers from a lack of grazing, scrub encroachment and non-native species. Saltwater intrusion was a problem in the past, but appears to have become less severe in recent years.

Table 4. Impacts recorded in Annex I sand dune habitats at South Bull in 2011. Source refers to whether the impact being scored originates inside or outside the Annex I habitat being assessed.

Habitat code	Impact code	Impact description	Intensity	Effect	Percent of habitat	Source
1210	G01.03.02	Driving on beach	Low	Negative	20	Outside
1210	G05.01	Trampling	Medium	Negative	5	Inside
1210	G05.05	Beach cleaning	High	Negative	100	Outside

2110	G05.01	Trampling	Medium	Negative	50	Inside
2110	G05.05	Beach cleaning	Medium	Negative	100	Outside
2110	I01	*Senecio squalidus*	Low	Negative	20	Inside
2110	J03	Dumping of beach material	High	Negative	5	Inside
2120	G05.01	Trampling	Medium	Negative	20	Inside
2120	G05.05	Beach cleaning	Low	Negative	100	Outside
2120	I01	*Senecio squalidus*	Low	Negative	40	Inside
2120	J03	Dumping of beach material	Medium	Negative	5	Inside
*2130	A04.03	Lack of grazing	Medium	Negative	80	Inside
*2130	D01.01	Paths, Tracks	High	Negative	5	Outside
*2130	D01.02	Roads	Low	Neutral	1	Outside
*2130	G01.02	Walking	Medium	Neutral	75	Inside
*2130	G02.01	Golf course	Low	Neutral	5	Outside
*2130	G05	Fire	High	Negative	1	Inside
*2130	G05.01	Trampling	High	Negative	10	Inside
*2130	G05.04	Vandalism	Medium	Negative	1	Inside
*2130	I01	Invasive non-native species	Medium	Negative	1	Inside
2190	G01.02	Walking	Medium	Negative	10	Inside
2190	G01.03.02	Motorised driving	Medium	Negative	5	Inside
2190	J02.09.01	Saltwater Intrusion	High	Negative	10	Outside
2190	K02.01	Scrub encroachment	Medium	Negative	20	Inside

2.2 Annex I habitat assessments

The conservation status of the Annex I habitats at South Bull is discussed below. The present conservation status in 2011 is compared with the baseline status and if a habitat is not in Favourable status, the main reasons for the Unfavourable assessment are given. Areas recorded in 2011 are compared with the revised baseline areas. It should be borne in mind that natural processes such as erosion, deposition and succession are primary drivers of change on coastal habitats. Where human intervention can be shown to have prevented the natural accretion of a habitat, this is considered to equate to a loss of Area.

2.2.1 1210 Annual vegetation of drift lines

A small, narrow strip of **1210 Annual vegetation of drift lines** was recorded during the SDM in a location where it was not formerly recorded. The area of **1210 Annual vegetation of drift lines** mapped during the CMP has since succeeded to ***2130 Fixed dunes (grey dunes)**. It was found in an unusual spot, in that it was surrounded by fixed dune vegetation in an area that was highly disturbed (Ryle *et al.*, 2009). The habitat was not assessed during the CMP due to its limited total area, and therefore no trends can be ascribed to this habitat.

Area

Although the area of **1210 Annual vegetation of drift lines** has increased since the baseline survey, the mechanical beach cleaning which is part of the management strategy in this part of North Bull Island is an impediment to the development of **1210 Annual vegetation of drift line** because it removes the organic material which give

rise to the habitat. It is not possible to quantify the area of **1210 Annual vegetation of drift lines** which would develop at South Bull in the absence of beach cleaning. On the basis of expert judgement, Area was assessed as Unfavourable-Inadequate during the SDM.

Structure and Functions

The criteria examining damage due to disturbance and interference with the sediment dynamics failed in the Structure and Functions assessment. As a result, Structure and Functions were assessed as Unfavourable-Inadequate during the SDM.

Future Prospects

Three negative impacts were recorded affecting **1210 Annual vegetation of drift lines** in 2011. Trampling and driving on the beach had a medium-and low intensity effects respectively, while beach cleaning had a high-intensity negative effect on 100% of the habitat. These impacts will continue to affect the Area and Structure and Functions of the habitat, and could result in either of these criteria being assessed as Unfavourable-Bad in the near Future (within the next 12 years). Future Prospects were assessed as Unfavourable-Bad.

Conservation assessment

The conservation status was assessed as Unfavourable-Bad during the SDM due to the combination of Unfavourable-Inadequate assessments for Area and Structure and Functions and the Unfavourable-Bad assessment for Future Prospects.

2.2.2 *2110 Embryonic shifting dunes*

A band of **2110 Embryonic shifting dunes** runs along the entire length of South Bull and, for most of its length, it is the most seaward habitat at the site. Its development in the far southwest has been disrupted by the deposition of beach detritus.

Area

During the CMP, Area was assessed as Favourable. The area of **2110 Embryonic shifting dunes** has increased from 0.44 ha to 3.43 ha since the baseline survey, and this is due to natural accretion. However, an area of 0.81 ha was identified in 2011 as having been lost due to dumping of drift line material. This is equal to 23% of the area of **2110 Embryonic shifting dunes** present in 2011 and Area was assessed as Unfavourable-Bad (deteriorating).

Structure and Functions

Three of the assessment criteria failed during the Structure and Functions assessment, those assessing the presence of non-native species, interference with the sediment dynamics and damage due to disturbance. *Senecio squalidus* has become established in the foredunes at North Bull Island, particularly in the southern end. The removal of sand from the beach as part of beach cleaning affects sediment availability for dune building, while trampling has caused damage to the remaining **2110 Embryonic shifting dunes** habitat. During the CMP, Structure and Functions were assessed as Favourable. Structure and Functions were assessed as Unfavourable-Bad (deteriorating) during the SDM.

Future Prospects

During the CMP, walking and trampling were recorded as negative impacts. Two positive impacts were recorded, other natural processes and other leisure and tourist activities. Other natural processes probably refer to active accretion and it is not entirely clear what the positive leisure and tourist activities might have been. Future Prospects were assessed as Unfavourable-Inadequate during the CMP because of trampling close to the access points. Dumping of beach materials, beach cleaning, trampling, and non-native species were recorded as negative impacts at South Bull in 2011. There were no apparent positive management measures in place which will address the loss of area, and the factors which caused the loss of area and have impaired the Structure and Functions of the habitat remain in place. As a result, Future Prospects were assessed as Unfavourable-Bad (deteriorating) during the SDM.

Conservation assessment

All three of the assessment parameters were assessed as Unfavourable-Bad during the SDM. This represents deterioration in comparison with the Unfavourable-Inadequate assessment given during the CMP. The conservation status of **2110 Embryonic shifting dunes** was assessed as Unfavourable-Bad (deteriorating) during the SDM.

2.2.3 2120 Marram dunes (white dunes)

The **2120 Marram dunes (white dunes)** are located in the northern and southern parts of the site, close to the access points. They are absent from the middle of the site. Their position close to the access points makes them vulnerable to disturbance due to human activity.

Area

2120 Marram dunes (white dunes) decreased in size from 5.13 ha during the CMP to 0.97 ha during the SDM. This is due to succession to ***2130 Fixed dunes (grey dunes)**, and does not represent an anthropogenic loss of habitat. Area was assessed as Favourable during the CMP. During the SDM, Area was assessed as Favourable (stable).

Structure and Functions

The criteria assessing the presence of non-native species, interference with the sediment dynamics and damage due to disturbance all failed in the Structure and Functions assessment. *Senecio squalidus* has become naturalised in the foredunes at South Bull. Beach cleaning threatens the accretion of dunes and could impede development of **2120 Marram dunes (white dunes)**. Trampling has led to small tracks and blowouts throughout the habitat. The dumping of dredged deposits can also be considered a disturbance of the Structure and Functions of the habitat as it results in a higher nutrient input than is normal for the habitat. During the CMP, Structure and Functions were assessed as Favourable. The failure of three assessment criteria caused the habitat to be assessed as Unfavourable-Bad (deteriorating) during the SDM.

Future Prospects

Beach cleaning, dumping of deposited materials, trampling and the presence of a non-native species (*Senecio squalidus*) are negative impacts at South Bull. During the CMP, Future Prospects were assessed as Unfavourable-Inadequate due to recreational

pressures (walking and trampling were recorded). Because the impacts recorded in 2011 will continue to have a negative effect on the Structure and Functions of the habitat, with no positive impacts recorded to help alleviate these pressures in the foreseeable future, Future Prospects were assessed as Unfavourable-Bad (deteriorating) in 2011.

Conservation assessment

Although area was assessed as Favourable (stable), Structure and Functions and Future Prospects were assessed as Unfavourable-Bad (deteriorating). During the CMP, the conservation status of the habitat was assessed as Unfavourable-Inadequate. During the SDM, conservation status of **2120 Marram dunes (white dunes)** was assessed as Unfavourable-Bad (deteriorating).

*2.2.4 *2130 Fixed dunes (grey dunes)*

***2130 Fixed dunes (grey dunes)** is the most extensive habitat at South Bull. It is located between the Royal Dublin Golf course and the foredune habitats, and also includes a small polygon of land southwest of the golf course. The ***2130 Fixed dunes (grey dunes)** are quite low, without tall dune ridges, and they continue to build eastwards by a process of succession. The habitat is notable as it supports a healthy population of *Salvia verbenaca*, which should be considered a feature of interest at the site.

Area

The area of ***2130 Fixed dunes (grey dunes)** increased from 56.70 during the CMP to 65.38 during the SDM as a result of natural succession. Area was assessed as Favourable during the CMP. During the SDM, Area was assessed as Favourable (stable).

Structure and Functions

Three criteria failed in the Structure and Functions assessment: those assessing the presence of target species, the height of the vegetation and damage due to disturbance. During the CMP, Structure and Functions were assessed as Unfavourable-Bad because of a lack of target species and rank conditions at two stops. Recreational pressure was also mentioned as a pressure on the habitat. During the SDM, Structure and Functions were assessed as Unfavourable-Bad (stable).

Future Prospects

Lack of grazing and trampling are the most important negative impacts on ***2130 Fixed dunes (grey dunes)** at South Bull. Other negative impacts include vandalism, invasive non-native species and paths and tracks and campfires. During the CMP, burning, trampling, walking, the golf course, interpretive centres and invasion by a species were recorded as negative impacts, but the habitat was assessed as Unfavourable-Inadequate due to recreational pressure and rank vegetation. Activity by rabbits, which were said to be abundant, was recorded as a neutral impact. During the SDM, evidence of rabbit activity was occasional and was not sufficient to maintain a structurally diverse, species rich-sward. Future Prospects were assessed as Unfavourable-Bad (deteriorating).

Conservation assessment

During the CMP the conservation status was assessed as Unfavourable-Bad due to the Structure and Functions assessment. For the SDM, Area was assessed as Favourable (stable), but Structure and Functions and Future Prospects were assessed as Unfavourable-Bad (stable) and Unfavourable-Bad (deteriorating) respectively. Because Future Prospects are found to be deteriorating, the conservation status of ***2130 Fixed dunes (grey dunes)** was assessed as Unfavourable-Bad (deteriorating) during the SDM.

2.2.5 2190 Humid dune slacks

2190 Humid dunes slacks are most extensive in the south-western part of South Bull, although there are slacks which stretch almost to the north-eastern end of the site. Most of the slacks are elongated features running parallel to the building coast of the spit, and these are primary slacks which developed when part of the beach was separated form the sea during dune building. There is evidence of human intervention in the south-west where a man-made berm bisects a long dune slack.

Area

The area of **2190 Humid dune slacks** at South Bull increased from 8.40 ha during the CMP to 9.15 ha during the SDM. The vegetation composition in the new areas of slack indicates that it is unlikely that they are the result of recent blow outs, and the increase in area is more likely to relate to fluctuations in the water table. During the CMP, Area was assessed as Favourable. During the SDM, Area was assessed as Favourable (Stable).

Structure and Functions

One of the criteria failed during the Structure and Functions assessment: cover of scrub. Scrub was recorded at six of the ten monitoring stops. There were beaten paths and vehicle tracks running through some of the slacks, but disturbance from this was not felt to be significant enough to warrant a fail for this criterion. During the CMP, Structure and Functions were assessed as Favourable. **2190 Humid dune slacks** were assessed as Unfavourable-Inadequate (deteriorating) during the SDM.

Future Prospects

Walking, motorised driving, scrub encroachment and saltwater intrusion are recorded as negative impacts affecting **2190 Humid dune slacks** at South Bull. During the CMP, Future Prospects were assessed as Unfavourable-Inadequate because of erosion associated with paths and tracks through the dune slacks. Motorised vehicles were also recorded as a negative impact. As much of the scrub is well developed, it was almost certainly present when the site was surveyed for the CMP, but it may have spread in the intervening period. Saltwater intrusion should not be taken as a new negative impact as it refers to an area which was formerly mapped as saltmarsh. The impacts affecting **2190 Humid dune slack** do not appear to have changed dramatically since the baseline survey. Although scrub encroachment appears to have become more serious, saltwater intrusion seems to be less intense in the area formerly mapped as saltmarsh than it was during the CMP. Future Prospects were assessed as Unfavourable-Inadequate (stable) during the SDM.

Conservation assessment

Area was assessed as Favourable (stable), Structure and Functions were assessed as Unfavourable-Inadequate (deteriorating) and Future Prospects were assessed as Unfavourable-Inadequate (stable) during the SDM. During the CMP, the conservation status was assessed as Unfavourable-Inadequate because the Future Prospects were assessed as Unfavourable-Inadequate while the other two parameters were assessed as Favourable. Because two parameters were assessed as Unfavourable-Inadequate during the SDM, the conservation status of **2190 Humid dune slacks** was assessed as Unfavourable-Inadequate (deteriorating).

3 DISCUSSION

3.1 Beach cleaning

Beach cleaning and dumping of beach materials had a direct negative impact on **2110 Embryonic shifting dunes** and **2120 Marram dunes (white dunes)** and an indirect impact on **1210 Annual vegetation of drift lines** at South Bull in 2011. The deposits were dumped in an area of **2110 Embryonic shifting dunes,** degrading it to the point where it could no longer be described as an Annex I habitat. Where the deposits were covered by sand and **2120 Marram dunes (white dunes)** developed on top of them, the habitat contained non-typical, weedy species because of the nutrient-rich matter and the seeds present in the dumped deposits which underlay the sand. The removal of drift line material diminishes the substrate for **1210 Annual vegetation of drift lines** and the removal of the upper layer of sand during mechanical beach cleaning reduces the quantity of sand available for dune building. Using heavy machinery on the shore also causes sand compaction which affects invertebrate habitat on the beach (Madden, 2006).

Beach cleaning is carried out in order to prevent rotting algae from causing an off-putting odour for beach users (McCorry & Ryle, 2009). While the importance of North Bull Island as a public amenity is acknowledged, mechanical beach cleaning is not recognised as best practice in the conservation of sand dunes (Vanhooren et al., 2011). Driving vehicles collecting debris between the dunes and the tide line can destroy the initial stages of sand dune formation, and **1210 Annual vegetation of drift lines** is particularly vulnerable to the removal of drift line material. Ensuring that any mechanical beach cleaning occurs below the tide line can avoid direct impacts. Finding alternative methods for cleaning the beach may be the most sensitive solution. In the meantime, using vehicles to clean the beach as infrequently as possible and restricting mechanised beach cleaning to areas which are most problematic and well used would be of benefit to the conservation status of the foredune habitats (Madden, 2006).

Dumping of beach sediments and debris in the dunes is carried out to reduce erosion in the foredunes. Erosion on the southern foredunes is caused by damage due to disturbance associated with the access points and car parks. The most appropriate way to resolve the damage to the dunes may be to tackle damaging activities. Sand dunes are dynamic systems, and can recover quickly when damaging activities cease to affect them.

3.2 Amenity use

North Bull Island is located just off the coast of Dublin. It is linked to the city by two roads which terminate at either end of South Bull. Car parking and other public facilities further accommodate beach-users. Trampling and littering are most evident close to the access points, but there is a network of eroded paths and blow outs running through the fixed dune ridge behind the beach. Campfires have resulted in burning of habitat and this was recorded both during the baseline survey and in 2011. Given the proximity to a large urban centre and the number of visitors to North Bull Island, damage to the site is relatively low in comparison with, for example, site 046 Tramore, or site 133 Strandhill. The relatively sensitive use visitors make of the dunes may be due to awareness of the conservation value of the site. There have also been successful measures to prevent cars from accessing the sand dunes. Further measures to protect the dunes from intensive use may help to reduce damage, particularly close to the access points.

3.3 Saltwater intrusion

Two areas of saltmarsh were mapped within the ***2130 Fixed dunes (grey dunes)** during the baseline survey. They were located in the south-western end of the site, separated from each other by a man-made berm. During 2011 they were reclassified as dune slack. Although there were some indicators of saline conditions present during the SDM, the areas are isolated from the sea by sand dunes. Dune slacks are fed by fresh groundwater, but they can retain a saline character due to occasional flooding during storms (Grootjans *et al*., 1998). Aerial photographs indicate that there was a breach close to the saline dune slacks through which saltwater may have entered occasionally in the past. The breach was used as an access road, but is now only used by walkers and has become vegetated. The saline influence appears to have diminished since the site was surveyed as part of the CMP.

3.4 Grazing

Two grazing mammals occur at North Bull Island: rabbits and hares. The populations of both species tend to fluctuate (McCorry & Ryle, 2009) and the numbers of both species appeared to be small in 2011. Rabbits can successfully graze sand dunes to maintain structural diversity and a species-rich short sward, but they are not present in sufficient numbers to maintain the sward at South Bull at present. There are several possible reasons for the small rabbit population, but disease and disturbance may be factors. Myxomatosis has been found in rabbits on the island and although efforts are made to ensure that dogs are kept on a lead, the topography and size of the site make this hard to enforce.

When rabbit populations are small on the island, mowing could be employed to increase the structural diversity of the ***2130 Fixed dunes (grey dunes)** habitat. This should be undertaken in a sensitive manner as motorised vehicles can have a damaging effect on dune vegetation.

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Key
1210 Strandline
2110 Embryonic Dunes
2120 White Dunes
2130 Fixed Dunes
2150 Dune Slacks
BL Built Land
ED Disturbed Ground
SAC 000208
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Monitoring survey of Annex I sand dune habitats in Ireland 2011-2012
South Bull, Co. Dublin
- Revised Baseline Habitat Map -
SDM code: 011
Date of map production: 25-10-2013
0 0.1 0.2 Km
N


Key
1210 Strandline
2110 Embryonic Dunes
2120 White Dunes
2130 Fixed Dunes
2130 Fixed Dunes / ED Disturbed Ground
2130 Fixed Dunes / WS Scrub, Transitional Woodland
2190 Dune Slacks
BL Built Land
ED Disturbed Ground
SAC boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Monitoring survey of Annex I sand dune habitats in Ireland 2011-2012
South Bull, Co. Dublin
- Updated SDM Map -
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0 0.1 0.2 Km
N