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Survey of sand dune habitats at Portrane, Co. Dublin

Report for RPS Belfast

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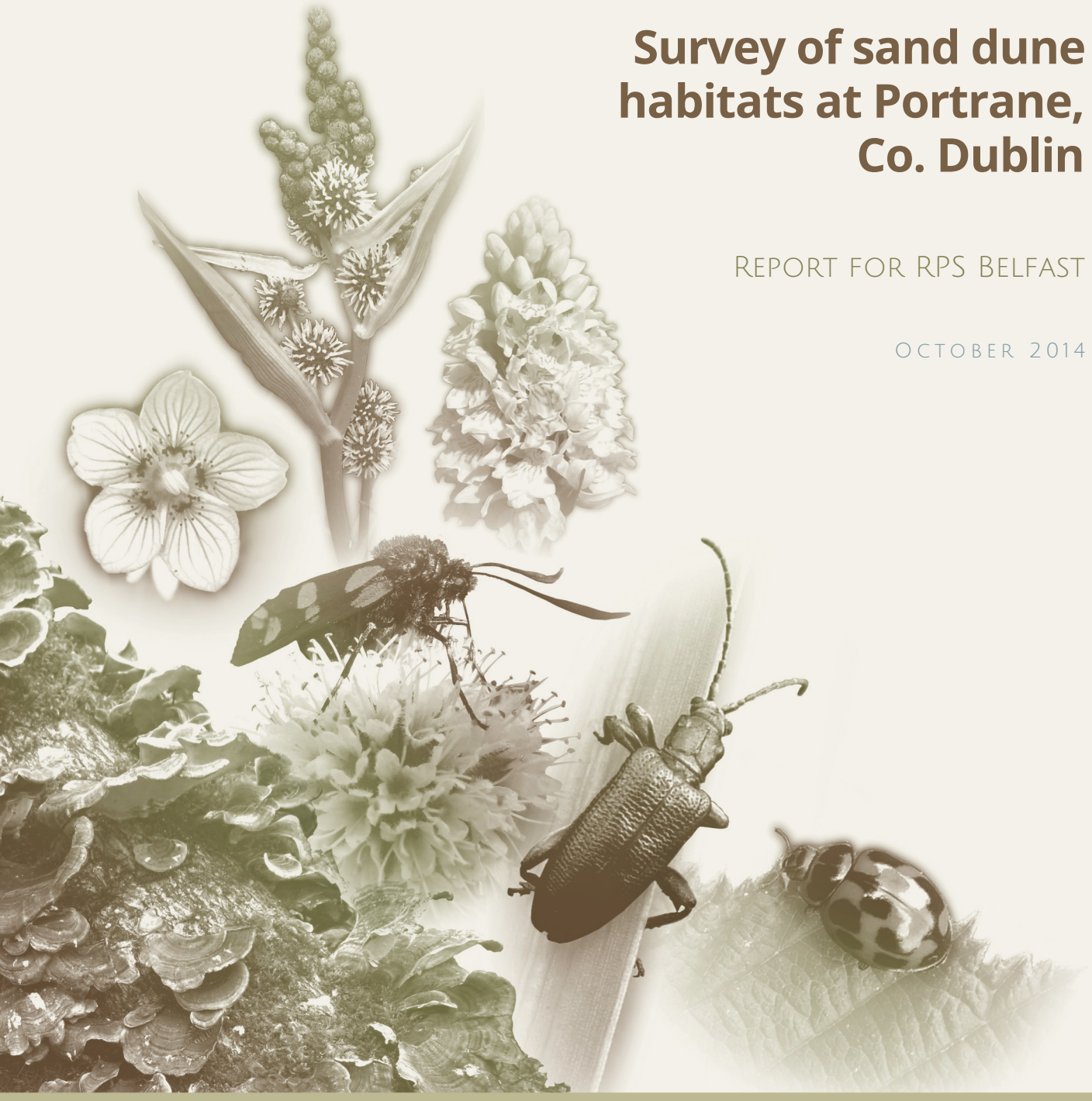

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Report for:

RPS Belfast, Elmwood House, 74 Boucher Road, Belfast

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1 Introduction

1.1 Project Background

BEC Consultants Ltd was contracted by RPS Group to carry out a survey of sand dune habitats at Portrane, Co. Dublin. This is in connection with proposed coastal protection works by Fingal County Council at the Burrow, Portrane, in response to the damage caused by winter storms in early 2014.

This report comprises an overview of sand dune ecology, followed by a description of the habitats and a summary of the proposed works. The methodology section details the field survey approach and the methods used to calculate the area impacted by the proposed works. The results section details the Annex I habitats recorded at the site and compares these areas with those recorded during the Coastal Monitoring Project in 2004 (Ryle *et al.,* 2009). Direct impacts on Annex I sand dune habitats are calculated and the indirect impacts are considered. The dynamic nature of the habitats at the survey site is discussed, together with consideration of the overall impacts of the proposed works. Some mitigation measures are then presented. Throughout this report the standard convention of indicating a priority Annex I habitat with an asterisk (*) is followed. Plant nomenclature follows Stace (2011).

1.2 Sand Dune Habitats

The majority of sand dune systems in Ireland are derived from offshore glacial sediments which have been reworked by tides and wind (Carter and Wilson, 1991; Gaynor, 2008). Due to the hostile environmental conditions associated with sand dune systems (e.g. unstable substrate, and wind and salt spray exposure), they often support specialised plant species and unique vegetation communities (JNCC, 2004). The ecology, extent and geomorphology of sand dunes vary due to a number of environmental factors, including sediment supply, wave conditions and wind direction (Carter and Wilson, 1991), and also due to past and current human activities. Current growth of sand dune systems is restricted to the local reworking of existing sediments (Gaynor, 2008).

Most sand dune systems display the different stages of succession, from strandline through to fixed dunes (Delaney *et al.,* 2013), with each sand dune habitat inextricably linked to the others, forming complex mosaics which change constantly (NPWS, 2013a). As a result of this complex relationship, NPWS (2013a) determine that “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”.

Ten Annex I habitats occur within sand dune systems in Ireland (full names of Annex I habitats are given in Appendix I):

- **1210 Drift line vegetation**
- **1220 Stony bank vegetation**
- **2110 Embryonic dunes**

- **2120 Marram dunes**
- ***2130 Fixed dunes**
- ***2140 Decalcified *Empetrum* dunes**
- ***2150 Decalcified Atlantic dunes**
- **2170 *Salix repens* dunes**
- **2190 Dune slacks**
- ***21A0 Machairs**

1210 Drift line vegetation and **1220 Stony bank vegetation** can be found in the absence of dune systems, but the other eight habitats are exclusively sand dune habitats.

Four of the ten Annex I habitats were mapped as present in Portrane and Rush by Ryle *et al.* (2009): **1210 Drift line vegetation**, **2110 Embryonic dunes**, **2120 Marram dunes** and ***2130 Fixed dunes**. The definitions of each of these four Annex I habitats, based on the descriptions given in the recent National Conservation Assessment report (NPWS, 2013b), are briefly described below.

1.2.1 1210 Drift line vegetation

This is generally a species-poor, fragmented habitat which is predominantly characterised by annual species such as *Atriplex* species, *Cakile maritima* and *Salsola kali*. This habitat can be found on sandy, shingle or stony substrates at the upper part of the strand where flotsam and jetsam are deposited at the high tide mark. The flotsam and jetsam often contain organic matter which provides nutrients and a seed source for vegetation. The habitat tends to be very narrow and does not occupy large areas. It is transient in nature and can be absent in some years due to both natural and anthropogenic causes (NPWS, 2013b).

1.2.2 2110 Embryonic dunes

This habitat of low sand mounds represents the initial phase of dune formation. It typically forms where sand gathers around salt-tolerant species such as *Leymus arenarius* and *Elytrigia juncea* between the high tide mark and **2120 Marram dunes**. Species such as *Cakile maritima, Honckenya peploides* and *Salsola kali* may also occur, however **2110 Embryonic dunes** are largely unvegetated (Fossitt, 2000). It is an unstable habitat which is vulnerable to saltwater intrusion and natural erosion processes, and may be swept away by storms or high tides (NPWS, 2013b).

1.2.3 2120 Marram dunes

This habitat tends to be partly stabilised, forming further inland than the **2110 Embryonic dunes**. They are typically dominated by *Ammophila arenaria*, which traps sand, thereby actively creating these taller dunes. Vegetation cover is incomplete and therefore they have the potential to erode quickly due to the presence of bare sand (NPWS, 2013b). The bare sand between the *Ammophila arenaria* tussocks can be colonised by species such as *Carex arenaria, Euphorbia paralias, Eryngium maritimum* and various yellow-flowered Asteraceae species (Fossitt, 2000).

*1.2.4 *2130 Fixed dunes*

Further inland from **2110 Embryonic dunes** and **2120 Marram dunes**, conditions become more sheltered with wind speed reduced, and the influence of tidal inundation and salt spray removed. ***2130 Fixed dunes** are found in this area and tend to more stabilised than the aforementioned habitats. As sand mobility is greatly reduced, a more or less closed or 'fixed' carpet of vegetation develops. Species diversity varies depending on grazing intensities, moisture and nutrient gradients, and human disturbance (NPWS, 2013b), but usually the vegetation of this habitat is typical of species-rich grassland (Delaney *et al.,* 2013). Species such as *Achillea millefolium*, *Agrostis* species, *Anthyllis vulneraria, Euphrasia* species, *Festuca rubra, Galium verum, Lotus corniculatus, Plantago lanceolata* and *Thymus polytrichus* are common (Fossitt, 2000).

1.3 Site Description

Portrane sand dune system is located approximately 3 km northeast of Donabate, County Dublin, on a sand spit known as the Burrow Peninsula. It is one of two sand dune systems within the Rogerstown Estuary SAC (000208); the sand dune system at Rush lies north of the estuary, while Portrane sand dune system lies south of the estuary (Figure 1). Though it is understood that the proposed works will be limited to Portrane, the sand dune habitats at both Rush and Portrane were mapped in this project in order to assess any losses in the context of the resource within the SAC.

Rogerstown Estuary SAC is designated for the following habitats:

- **1130 Estuaries**
- **1140 Mudflats and sandflats**
- **1310 *Salicornia* saltmarshes**
- **1330 Atlantic saltmarshes**
- **1410 Mediterranean saltmarshes**
- **2120 Marram dunes**
- ***2130 Fixed dunes**

Parts of the Portrane and Rush sand dune systems also lie within the Rogerstown Estuary SPA (004015). Brent Goose has a population of international importance at Rogerstown Estuary, and a further 16 species have populations of national importance. Of particular note is the presence of Golden Plover which is listed on Annex I of the EU Birds Directive (NPWS, 2013c).

Two rare plant species have been previously recorded within the Portrane sand dune system, *Viola hirta* and *Anacamptis morio*. Both are Red Data Book species, with *Viola hirta* also listed under the Flora (Protection) Order (1999). *Anacamptis morio* was recorded during the Coastal Monitoring Project (CMP) (Ryle *et al*., 2009), but not *Viola hirta*.

Both Portrane and Rush sand dune systems are noted in Ryle *et al.* (2009) as being under severe recreational pressure and suffer from scrub encroachment, mainly *Hippophae rhamnoides*, and natural erosion which is exacerbated by anthropogenic pressures.

1.3.1 Portrane sand dune system

Four Annex I sand dune habitats were recorded at Portrane during the CMP: **1210 Drift line vegetation, 2110 Embryonic dunes, 2120 Marram dunes** and ***2130 Fixed dunes** (Ryle *et al.,* 2009). The dune habitats were mapped as a narrow band along the eastern and northern edges of the sand spit, with the dune habitats transitioning into saltmarsh at the northern end. Three of the four Annex I sand dune habitats were assessed as Unfavourable-Bad by the CMP (Ryle *et al.,* 2009), while the remaining habitat was assessed as Unfavourable-Inadequate (Table 1).

Table 1. Conservation status of Annex I sand dune habitats at Portrane as assessed by Ryle *et al.* (2009).

Annex I habitat	Extent	Structure & Functions	Future Prospects	Overall Conservation Status
1210 Drift line vegetation	Unfavourable-Inadequate	Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate
2110 Embryonic dunes	Unfavourable-Inadequate	Favourable	Unfavourable-Bad	Unfavourable-Bad
2120 Marram dunes	Unfavourable-Inadequate	Favourable	Unfavourable-Bad	Unfavourable-Bad
***2130 Fixed dunes**	Unfavourable-Inadequate	Unfavourable-Inadequate	Unfavourable-Bad	Unfavourable-Bad

1.3.2 Rush sand dune system

Three Annex I sand dune habitats were recorded at Rush during the CMP: **2110 Embryonic dunes, 2120 Marram dunes** and ***2130 Fixed dunes** (Ryle *et al.,* 2009). The dune habitats were mapped as a narrow band fronting a golf course and residential housing. A large proportion of ***2130 Fixed dunes** was noted to be invaded by *Hippophae rhamnoides*. Two of the three Annex I sand dune habitats were assessed as Unfavourable-Inadequate by the CMP (Ryle *et al.,* 2009), while the remaining habitat was assessed as Unfavourable-Bad (Table 2).

Table 2. Conservation status of Annex I sand dune habitats at Rush as assessed by Ryle *et al.* (2009).

Annex I habitat	Extent	Structure & Functions	Future Prospects	Overall Conservation Status
2110 Embryonic dunes	Unfavourable-Inadequate	Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate
2120 Marram dunes	Unfavourable-Inadequate	Favourable	Unfavourable-Inadequate	Unfavourable-Inadequate
***2130 Fixed dunes**	Unfavourable-Inadequate	Unfavourable-Bad	Unfavourable-Inadequate	Unfavourable-Bad

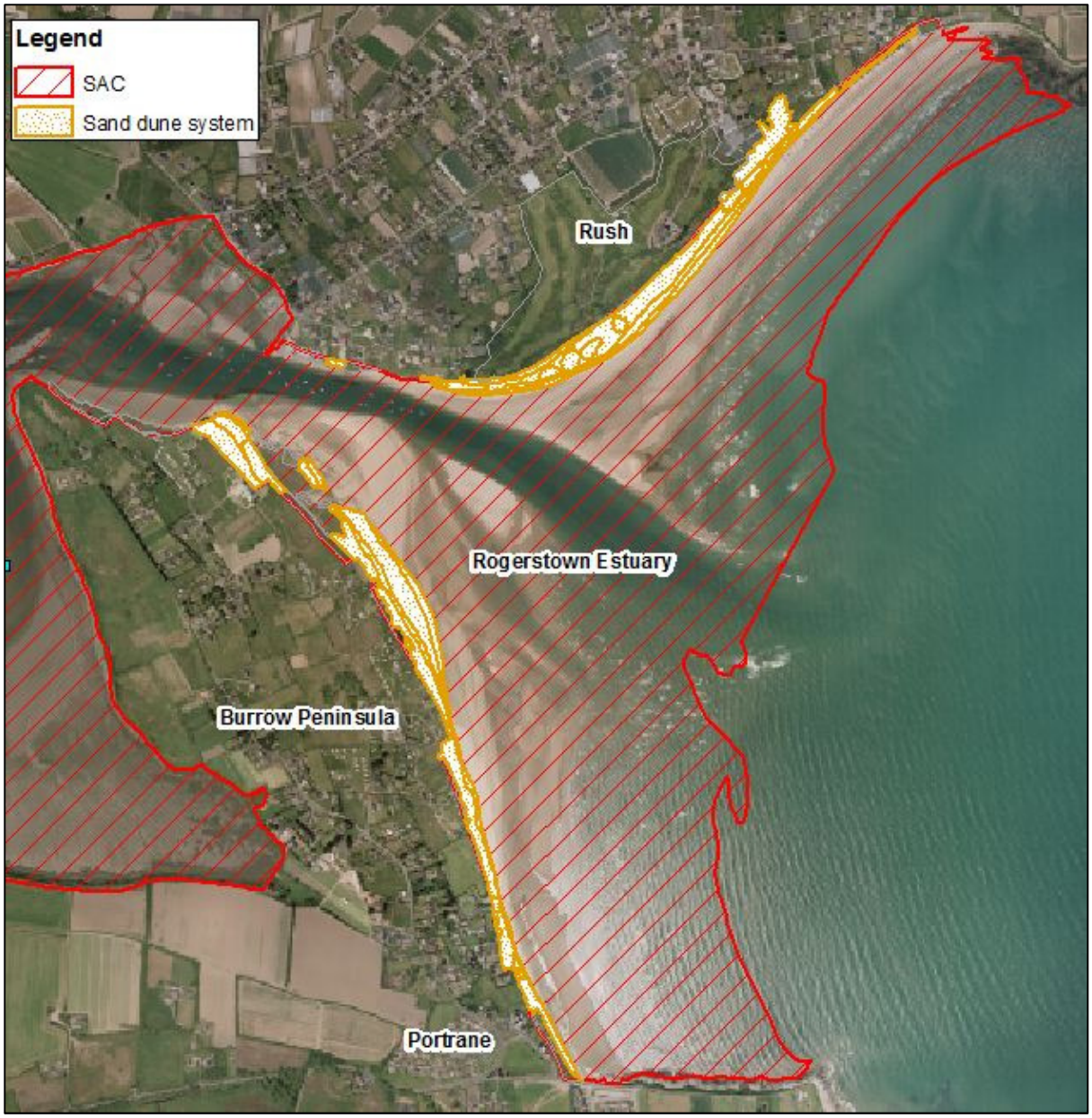

Figure 1. Location of the Portrane and Rush sand dune systems (as mapped during the Coastal Monitoring Project (Ryle *et al.,* 2009)), with Rogerstown Estuary SAC (000208) also identified. (OSI License No. EN 0005014).

1.4 Summary Details of Proposed Works

A programme of dune re-profiling, matting and planting in conjunction with sand-trap fencing for areas where significant erosion has occurred at Portrane sand dune system has been recommended (RPS, 2014a), together with the installation of a buried stone revetment in one section. Additional description of these works is given in RPS (2014b) and the main works are summarised below:

- Dune re-profiling of approximately 750 m of dune using sand from the middle or lower beach at Portrane
- Temporary storage and replacement of dune vegetation
- Installation of sand-trap fencing

- Installation of biodegradable matting
- Planting of *Ammophila arenaria* and other dune grasses such as *Leymus arenarius* and *Elytrigia juncea*
- The installation of approximately 40 m of buried stone revetment

Cartesian coordinates indicating the location of the proposed works were provided by RPS and are presented in Table 3.

Table 3. Estimated extents of the proposed works at Portrane sand dune system broken down by sections. Data provided by RPS to BEC Consultants Ltd. (Malcolm Brian, RPS, pers. comm.).

		Cartesian Coordinates (Irish Grid)	
	Approx. width of re-built dune (m)	**Top of Works Area (X, Y)**	**Bottom of Works Area (X, Y)**
	0	325225, 251958	N.A.
Section 1	10	325249, 251872	325258, 251875
Section 2	11.5	325291, 251676	325302, 251679
Section 3	15	325350, 251485	325361, 251488
Section 4	13	325400, 251291	325413, 251295
Section 5	0	325475, 251105	N.A.
Section 6	0	N.A.	N.A.

2 Methodology

The methodology used for the mapping and recording of sand dune habitats for this project was based on Delaney *et al.* (2013), which assessed Annex I sand dune habitats from a representative sample of sites (39 sites) in Ireland between 2011 and 2012.

2.1 Equipment

Surveyors were provided with digital and printed baseline maps of the habitats present at Portrane and Rush recorded during the CMP (Ryle *et al*., 2009). The digital maps, along with shapefiles of the proposed works, were provided as part of a GIS project (using ArcPad software) which was loaded onto mobile mappers. The ArcPad project included a specially designed waypoint shapefile which allowed geographic data to be recorded in the field. A printed recording sheet was also provided to record general information regarding the site and Annex I habitats present. Each ecologist also carried a digital camera, compass, Garmin GPS, first-aid kit, mobile phone and high-visibility vest.

2.2 Field Methodology

In general, the most dynamic habitats occurring on sand dunes are those closest to the sea. **1210 Drift line vegetation, 1220 Stony bank vegetation, 2110 Embryonic dunes** and **2120 Marram dunes** frequently occur in narrow strips on the seaward side of fixed dunes. The boundaries of these linear habitats were mapped using transects perpendicular to the coastline, with transects recorded at regular intervals along the foreshore (between 10 and 50 m apart), running from the beach to the fixed dunes. Waypoints were recorded at each point along the walked transects where there was a

boundary between two habitats. The start and end points of each habitat were also recorded with waypoints. All habitats were drawn on the printed field maps, with particular attention to areas where there was a change in habitat extent. The minimum mapping area for these frontal dune habitats was 10 m long by 2 m wide.

***2130 Fixed dunes** and other non-linear habitats were mapped by walking along their boundaries. Any changes were recorded with waypoints. If there was no change from the boundary as shown on the baseline maps, no waypoints were recorded. All boundaries were marked on the printed field maps once they were checked. With the exception of the narrow linear habitats, the minimum mapping area was 10 m by 10 m and only habitats or changes in habitat larger than this size were mapped. Any other habitat occurring on site below 100 m^2 was noted in the site report and included within the larger adjoining habitat. In some cases it was necessary to map habitat mosaics. For these cases the proportion of each habitat within the mosaic was noted to aid with area calculations.

No attempt was made to enter golf courses, private gardens or other private property if found within the fringes of the SAC. Every attempt was made to determine if Annex I sand dune habitats were present in these areas; however, as land use has changed in the majority of these areas, it was felt that Annex I sand dune habitats could no longer be viable without intervention in current management practices of these areas. In those cases habitats were recorded as non-Annex I habitat by using Fossitt (2000) habitat codes.

Features of interest were recorded using waypoints while mapping the habitat boundaries. Where scrub or bracken were significant features (i.e. occupying an area of ≥ 100 m^2) within an Annex I sand dune habitat, these were mapped as separate polygons and annotated as, for example, *2130/HD1, on the printed maps. Adjoining non-Annex I habitats within the Rogerstown Estuary SAC were mapped according to Fossitt (2000). The SAC boundary was taken as the survey boundary on the landward side, however two areas of ***2130 Fixed dunes** located just outside of the SAC were also mapped as they are located within the vicinity of the footprint of the proposed works. The survey did not extend into the estuary.

2.3 GIS Mapping

A GIS shapefile was produced on return to the office, with the aid of the annotated maps and waypoints taken in the field. The shapefile comprised up-to-date habitat maps of the Annex I sand dune habitats surveyed at Portrane and Rush, as well as non-Annex I habitats also within the site boundaries as described in section 2.2. There were two fields provided for Annex I habitats (N1_Annex; N2_Annex) within the attributes table to account for mosaics, with the percentage cover of each habitat given in the comments field. Features such as scrub and bracken within Annex I sand dune habitats were shown as secondary habitats in the attributes table (N1_Fossitt; N2_Fossitt), and non-Annex I habitats were also recorded using these fields. Other fields within the attributes table – survey date, county, SAC code, SPA code and site name (i.e. Portrane or Rush) – were also populated. The Prim_Hab field identified the primary habitat of the polygon, and was the field used for the habitat symbology for the maps. Following Smith *et al.* (2011), a Data_Qual field was provided

to give information on how each habitat polygon was determined, where S = walkover survey, V = field validated (i.e. habitat viewed in the field but not walked over) and DD = aerial photograph interpretation only. Area (m^2) was calculated on completion of digitisation.

2.4 Calculating Area of Direct Impact

It is difficult to accurately calculate the areas of Annex I sand dune habitats which would be lost as a direct consequence of the proposed coastal works. Not only are the sand dune habitats extremely dynamic in nature and constantly changing in extent and location, but the actual works themselves may also change in extent and location depending on the level of erosion at the site between now and the commencement of the works. The proposed works will cause at best a temporary loss of habitat, or at worst, a permanent loss, depending on a number of factors. Two approaches were taken to calculate the direct area of impact of the proposed works on Annex I sand dune habitats.

The first approach is a more conservative estimate and is based on the assumption that any habitat located seaward of the top of the proposed works line will be directly impacted upon due to dune re-profiling and the other proposed works (Figure 2a). The top of the proposed works line was digitised using the Cartesian coordinates in Table 3.

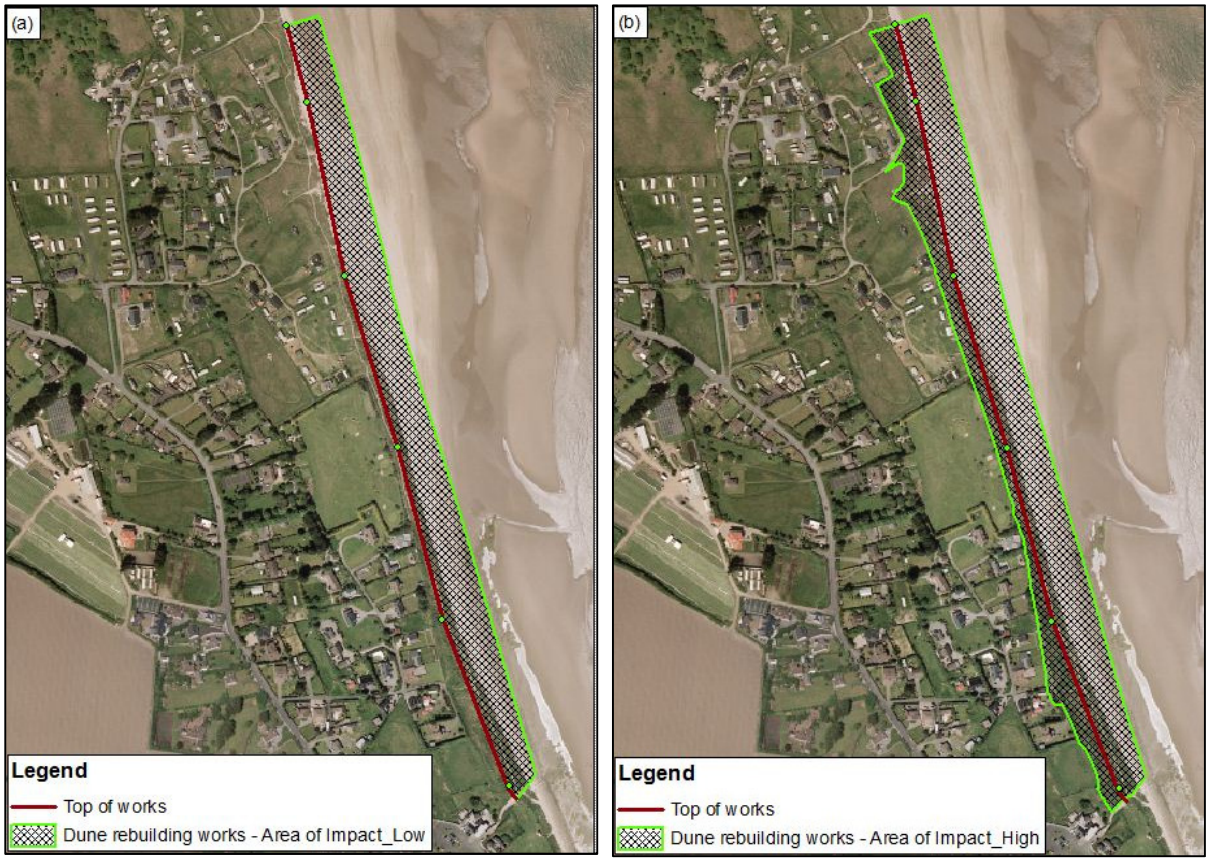

Figure 2. Diagrammatic representation of the two approaches utilised in the calculation of estimated direct loss of Annex I sand dune habitats due to the proposed works: (a) conservative estimate and (b) worse-case scenario estimate. Any Annex I sand dune habitats within the hatched areas are deemed as lost. (OSI License No. EN 0005014).

The second approach is based on a worst-case scenario where all Annex I sand dune habitats, both seaward and landward of the top of the proposed works line, will be directly impacted upon (Figure 2b). The true area of direct impact would be expected to lie somewhere between the two approaches. As the site may suffer from continued erosion between now and the commencement of works, it was important to calculate the worst-case scenario in addition to the more conservative estimate, particularly as the extents provided in Table 3 may change (Malcolm Brian, RPS, pers. comm.). With regards to the worst-case scenario approach, two areas of ***2130 Fixed dunes** found outside, but directly adjacent to, the SAC were brought in for the area calculations as both areas would be impacted upon in this scenario. Areas for this approach were therefore calculated on an SAC-only basis and on an SAC and surrounding environs basis.

3 Results

3.1 General Site Description

All four of the previously mapped Annex I sand dune habitats (Ryle *et al.,* 2009) were mapped at Portrane and Rush during this survey: **1210 Drift line vegetation**, **2110 Embryonic dunes**, **2120 Marram dunes** and ***2130 Fixed dunes**. **1220 Stony bank vegetation** was also mapped at Rush during this survey. For maps of both the Portrane and Rush sand dune systems refer to Appendix II.

Previous erosion events were evident in both sand dune systems, with the ***2130 Fixed dunes** often ending in a steep cliff-edge with the vegetation slumping. The **1210 Drift line vegetation** and **2110 Embryonic dunes** were typically found developing at the base of the "dune cliffs", showing that there is some active natural growth of the sand dune systems since the last erosion event. Parts of the foredune habitats are quite disturbed, with dumping of beach detritus common within these habitats. Sand bags in front of the ***2130 Fixed dunes** at Portrane were also evident during the site visit.

The Annex I sand dune habitats at the northern tip of Portrane sand dune system form discrete boundaries with both CM1 Lower saltmarsh and CM2 Upper saltmarsh, with Annex I habitats **1310 *Salicornia* saltmarshes** and **1330 Atlantic saltmarshes** present in this area. **1310 *Salicornia* saltmarshes** is characterised by an abundance of *Salicornia* species. **1330 Atlantic saltmarshes** has an abundance of *Atriplex portulacoides* and *Limonium* sp., with *Puccinellia maritima*, *Plantago maritima* and occasional *Spartina anglica* also present.

3.2 Annex I sand dune habitats at Portrane and Rush

3.2.1 1210 Drift line vegetation

1210 Drift line vegetation (Figure 3) was mapped at both the Portrane and Rush sand dune systems. It forms an almost continuous fringe in front of the ***2130 Fixed dunes** found at Rush, but is more fragmented at Portrane, with narrow strips found at the southern end of Portrane sand dune system, and another strip at the northern end. This habitat also forms a mosaic with **2110 Embryonic dunes** at the southern end of Portrane. The habitat is showing signs of disturbance, with dumping of beach detritus common within this habitat. It is also showing signs of succession towards **2110 Embryonic dunes** in a number of areas.

This habitat is characterised by frequent *Cakile maritima* and *Salsola kali*, with occasional *Beta vulgaris* ssp. *maritima*. Where **1210 Drift line vegetation** is found to be transitioning into **2110 Embryonic dunes**, or where it forms a mosaic with this habitat, *Leymus arenarius* and *Ammophila arenaria* are occasional to frequent. *Atriplex* species and *Matricaria discoidea* are also present within the mosaic.

Figure 3. 1210 Drift line vegetation at Rush

3.2.2 1220 Stony bank vegetation

1220 Stony bank vegetation (Figure 4) was mapped in one area at Rush, near the main entrance to the beach at the northern end. The habitat is very disturbed, exhibiting signs of localised enrichment, possibly from the dumping of beach detritus within this habitat. It is moving away from the Annex I habitat definition. It is characterised by frequent *Beta vulgaris* ssp. *maritima* and *Potentilla anserina*, and occasional *Tripleurospermum maritimum*. The substrate varies from fine shingle to pebbles, with sand intermixed.

Figure 4. 1220 Stony bank vegetation at Rush

3.2.3 2110 Embryonic dunes

2110 Embryonic dunes (Figure 5) were only mapped at Portrane, with the majority found running in a narrow strip from halfway up the Burrow Peninsula to the northern tip. This habitat is found seaward of the ***2130 Fixed dunes** and forms a mosaic with and transitions into **2120 Marram dunes** at the northern tip, and with **1210 Drift line vegetation** at the southern end of Portrane.

2110 Embryonic dunes at Portrane are characterised by frequent *Leymus arenarius*, *Elytrigia juncea* and *Ammophila arenaria*, with *Honckenya peploides* and *Cakile maritima*. The presence of *Ammophila arenaria* within this habitat suggests the potential for swift succession to **2120 Marram dunes**.

Figure 5. 2110 Embryonic dunes at Portrane

3.2.4 2120 Marram dunes

As with **2110 Embryonic dunes, 2120 Marram dunes** (Figure 6) are only present at Portrane. This habitat is currently restricted to the northern tip of the Burrow Peninsula, with a large area forming a mosaic with the **2110 Embryonic dunes**. **2120 Marram dunes** at Portrane are characterised by frequent *Leymus arenarius* and *Ammophila arenaria*, with occasional *Raphanus raphanistrum* ssp. *maritimus*.

Figure 6. 2120 Marram dunes at Portrane

*3.2.5 *2130 Fixed dunes*

***2130 Fixed dunes** (Figure 7) are found at both Portrane and Rush and form the major habitat within both sand dune systems. For the most part, this habitat is fringed by **1210 Drift line vegetation** at Rush or by either **1210 Drift line vegetation** or **2110 Embryonic dunes** at Portrane in a seaward direction. Landward of the ***2130 Fixed dunes** are residential properties, caravan parks, golf courses and other amenity grassland types, with coastal squeeze a major threat for this habitat at both Portrane and Rush.

Figure 7. *2130 Fixed dunes at Portrane

***2130 Fixed dunes** at the southern end of Portrane are quite rank, with *Ammophila arenaria*, *Dactylis glomerata* and *Daucus carota* the most common species. Further north, this habitat becomes more herb-rich, with *Anthyllis vulneraria*, *Lotus corniculatus*, *Trifolium arvense*, various yellow composites and *Euphorbia paralias* becoming more frequent. The grass *Festuca rubra* is also frequent at the northern end. At Rush the ***2130 Fixed dunes** are quite rank and are characterised by *Dactylis glomerata*, *Arrhenatherum elatius*, *Urtica dioica* and *Equisetum arvense*.

Scrub encroachment is negatively impacting on this habitat, both at Portrane and Rush. *Hippophae rhamnoides* has formed some rather dense thickets on the ***2130 Fixed dunes** at Rush, with evidence of some clearance of this species in the recent past. It is also present on the ***2130 Fixed dunes** at Portrane, but has not formed dense thickets. Other occasional scrub species found within this habitat at Portrane include *Crataegus monogyna* and *Prunus spinosa*. *Pteridium aquilinum* is also negatively impacting on the ***2130 Fixed dunes** at Portrane.

3.3 Area change of Annex I sand dune habitats

Ryle *et al.* (2009) surveyed the sand dune systems at Portrane and Rush in July 2004. By comparing the area of each Annex I sand dune habitat mapped by Ryle *et al.* (2009) with those mapped for this current survey, an indication of how dynamic these systems are can be gained. All four of the Annex I

sand dune habitats mapped at Portrane by Ryle *et al.* (2009) were mapped during this survey (Table 4a). At Rush however, neither **2110 Embryonic dunes** nor **2120 Marram dunes** were present during the current survey, while **1210 Drift line vegetation** and **1220 Stony bank vegetation**, which were recorded during the current survey, were not recorded by Ryle *et al.* (2009) (Table 4b).

Table 4. Areas of Annex I sand dune habitats located at (a) Portrane and (b) Rush. Areas mapped as part of this project are presented beside areas mapped during the Coastal Monitoring Project[1] (CMP) (Ryle *et al.,* 2009).

(a) Portrane

Annex I Habitat	Total area (ha) of habitat from CMP	Total area (ha) of habitat currently present	Net change in area (ha) (% change in area)
1210 Drift line vegetation	0.76	0.39	-0.37 (-48.7%)
2110 Embryonic dunes	2.16	1.93	-0.23 (-10.6%)
2120 Marram dunes	1.25	0.38	-0.87 (-69.6%)
***2130 Fixed dunes**	5.70	6.62	+0.92 (+16.1%)

(b) Rush

Annex I Habitat	Total area (ha) of habitat from CMP	Total area (ha) of habitat currently present	Net change in area (ha) (% change in area)
1210 Drift line vegetation	0.00	0.86	+0.86 (not defined)
1220 Stony bank vegetation	0.00	0.30	+0.30 (not defined)
2110 Embryonic dunes	1.13	0.00	-1.13 (-100%)
2120 Marram dunes	1.34	0.00	-1.34 (-100%)
***2130 Fixed dunes**	6.28	4.74	-1.54 (-24.5%)

At Portrane, the foredune habitats **1210 Drift line vegetation**, **2110 Embryonic dunes** and **2120 Marram dunes** have all decreased in area since Ryle *et al.* (2009) (Table 4a). The largest loss of habitat occurred for **2120 Marram dunes** (0.87 ha). ***2130 Fixed dunes** increased in area since Ryle *et al.* (2009). At Rush, **2110 Embryonic dunes, 2120 Marram dunes** and ***2130 Fixed dunes** have all decreased in area since being mapped by Ryle *et al.* (2009) (Table 4b). The largest loss of habitat occurred for ***2130 Fixed dunes** (1.54 ha). Although there has been a loss of habitat in the foredune area at Rush, this has been somewhat offset by the development of **1210 Drift line vegetation** and **1220 Stony bank vegetation**, with collectively over one hectare of these habitats mapped during the current survey.

3.4 Area of Direct Impact

The estimated area loss of Annex I sand dune habitats at Portrane using the two approaches as described in Section 2.4 can be seen in Table 5. Three Annex I sand dune habitats are within the footprint of the proposed works; **1210 Drift line vegetation**, **2110 Embryonic dunes** and ***2130 Fixed dunes**. The figures presented in Table 5 are based on the survey carried out in September

[1]Areas presented for the CMP were calculated from the shapefile available from NPWS, with some minor adjustments made. Scrub polygons mapped during the CMP were examined in the context of the habitats where they were mapped. Subsequently, they were brought in to the areas presented in Table 4 if they were on dune habitats. This was to ensure consistency between the areas of each sand dune habitat present in Table 4. Three polygons of ***2130 Fixed dunes (grey dunes)** at Rush which were mapped during the CMP were excluded from Table 4b as they were outside the Rogerstown Estuary SAC (000208).

2014. It should be noted that, in the intervening time period between this survey and the commencement of the proposed works, there is the potential for **2120 Marram dunes** to develop, and that the other foredune habitat extents may also change.

Table 5. Estimated area of impact on Annex I sand dune habitats at Portrane due to the proposed works based on a conservative approach and a worse-case scenario.

Annex I Habitat	Conservative approach	Worst-case scenario approach	
	Area (ha) and % of SAC resource impacted upon	Area (ha) and % of SAC resource impacted upon	Area (ha) and % of SAC & environs resource impacted upon
1210 Drift line vegetation	0.28 ha (22.0%)	0.29 ha (23.4%)	0.29 ha (23.4%)
2110 Embryonic dunes	0.17 ha (9.0%)	0.28 ha (14.4%)	0.28 ha (14.4%)
***2130 Fixed dunes**	0.21 ha (1.8%)	1.44 ha (15.3%)	1.79 ha (12.7%)

In both scenarios, the proposed works will have the most significant impact on **1210 Drift line vegetation** – between 22.0% and 23.4% of the SAC resource. Impacts on **2110 Embryonic dunes** are estimated to be between 9.0% and 14.4%, while impacts on ***2130 Fixed dunes** are estimated to be between 1.8% and 15.3% of the SAC resource.

3.5 Indirect Impacts on Habitats

It is recommended in SNH (2000) that coastal processes, particularly the relationship between beach and dune system, be monitored for several years before making an informed decision on managing dune erosion. Without the insight gained by such monitoring it is difficult to accurately predict indirect impacts.

All dune habitats, particularly **1210 Drift line vegetation**, **1220 Stony bank vegetation**, **2110 Embryonic dunes** and **2120 Marram dunes**, require a continuous supply and circulation of sand (NPWS, 2013a). By removing sand from the beach for dune re-profiling, the natural sedimentation and deposition processes within the SAC are impacted upon, and the sand dune habitats may suffer from sediment starvation. It is expected that the proposed works, particularly the dune re-profiling and rock revetment, will need ongoing maintenance following significant storm events (RPS, 2014b). This would involve further removal of sand from the middle or lower beach. Continued sediment depletion will impact on the newly planted dune grasses, especially *Ammophila arenaria,* as all foredune grasses require blown sand to thrive (JNCC, 2004). This will also have consequences for the sand dune habitats outside the proposed works area; if the foredune grasses begin to die off or lack in vigour, **2110 Embryonic dunes** and **2120 Marram dunes** will become even more susceptible to erosion.

Sediment depletion will also impact on the sand-trap fencing, with its success dependent on the availability of wind-blown sand. If too much sand is taken from the middle or lower beach for maintenance, the presence of the sand-trap fencing may become redundant. The use of heavy machinery on the beach will also lead to sand compaction, which is likely to contribute to sediment

starvation for both the newly re-profiled dunes and the sand dune habitats outside the proposed works area.

The removal of existing ***2130 Fixed dunes** vegetation while dune re-profiling occurs could have the potential to create blowouts within these source areas if too much of the surface area is denuded. Alternatively, if the dune grasses to be planted are not sourced from within the local vicinity, there is the potential for the introduction of non-native species and other species not currently found within the Portrane sand dune system. The machinery and equipment used for the proposed works could also be a potential source for invasive or introduced species. The machinery may also cause localised erosion of any sand dune habitats located either side of the main entrance on to the beach and also as they turn into the holding compound.

Rock revetments should be placed high on the beach, away from the active foreshore zone; otherwise they will not remain successfully buried (SNH, 2000). It is evident that erosion is quite severe in the location of the proposed rock revetment (Figure 8) with active development of **1210 Drift line vegetation** at the base of the erosion cliff. **1210 Drift line vegetation** forms around the high tide mark (Delaney *et al.*, 2013), and its presence so close to the property to be protected suggests that the rock revetment will be uncovered following significant storm events. If this rock revetment is not actively monitored and maintained, erosion may continue along the adjacent sand dune habitats, eventually leaving the revetment seaward of the general line of the sand dune system (SNH, 2000).

Lastly, the removal of sediment from the middle or lower beach may contribute to erosion of a new area of shoreline. The presence of the accumulated sand on the middle and lower beach, which is to be used for re-profiling of the dunes, is likely to currently assist with beach protection as it causes waves to break or refract before they reach the sand dune system. By removing this sand bar, erosion may become more intensive due to increased wave energy further up the shore and this potential impact should be considered. The response to the removal of sediment is particularly difficult to predict when it occurs within an estuary, with the potential for erosion problems to appear at some distance away (SNH, 2000).

Figure 8. Location of the proposed buried rock revetment. Covered sand bags are visible in the foreground, with a narrow strip of **1210 Drift line vegetation** found landward of these.

4 Discussion

4.1 Area change of Annex I sand dune habitats

The changes in area of the Annex I sand dune habitats, particularly of the foredune habitats, emphasise the dynamic nature of the sand dune systems found within the Rogerstown Estuary SAC (000208). Although there have been overall net losses of some habitats within the SAC since the CMP (Ryle *et al.*, 2009), there was active development of foredune habitats noted at both Portrane and Rush during the current survey.

The loss of foredune habitats is not unusual as these habitats are unstable and transient in nature, with natural processes such as erosion, deposition and succession primary drivers of change (Delaney *et al.*, 2013). As such, only losses or gains in habitat area due to anthropogenic activities are taken into account when carrying out Conservation Assessments of Annex I habitats. The majority of loss of **2110 Embryonic dunes** and **2120 Marram dunes** in Portrane and Rush, and of **1210 Drift line vegetation** at Portrane can be ascribed to the natural processes of erosion and succession. It is important to note, however, that some area loss may be due to beach cleaning, evidence of which was noted both by Ryle *et al.* (2009) and by surveyors during the current survey. Beach cleaning impacts on sediment supply as it typically involves the removal of the upper layer of sand and algae from the beach, which in turn is often deposited in mounds in the foredunes.

Although there was a net gain of ***2130 Fixed dunes** at Portrane, there were recorded losses of this habitat too. One area of habitat previously mapped ***2130 Fixed dunes** by Ryle *et al.* (2009) at the northern tip was no longer determined to be this habitat during the current survey. This area (0.89 ha) appears to be currently managed as a hay meadow, with evidence of nutrient enrichment. It no longer retains the characteristics of ***2130 Fixed dunes**. As this was private property, however, this area was only viewed externally and could not be verified by a walkover survey. ***2130 Fixed dunes** at Portrane and Rush also suffered area loss due to erosion as evidenced by steep erosion cliffs on the seaward side of this habitat. Although erosion is a natural process, there are a number of well-worn tracks throughout this habitat, which suggests that anthropogenic factors, such as trampling and recreational activities, may be exacerbating the natural erosion.

Approximately 0.55 ha of the 0.92 ha of ***2130 Fixed dunes** gained at Portrane is due to three areas previously mapped as "Amenity Grassland" or "Other Undefined" by Ryle *et al.* (2009) being mapped as ***2130 Fixed dunes** during this survey. These areas were probably previously managed as amenity grassland but have since reverted back to ***2130 Fixed dunes** due to a cessation of management. By examining the location of **2120 Marram dunes** as mapped by Ryle *et al.* (2009), it can be concluded that a sizeable area of this habitat at the northern tip has since succeeded to ***2130 Fixed dunes**, helping to explain the loss of one habitat and gain in the other. A similar situation also occurs in Rush, where again by examining the location of **2120 Marram dunes** as mapped by Ryle *et al.* (2009), it can be concluded that some of this habitat has since succeeded to ***2130 Fixed dunes**.

4.2 Impact of the Proposed Works on the sand dune habitats

Table 5 presents both conservative and worse-case scenario estimates of the percentage area of Annex I sand dune habitats within the SAC that will be impacted upon through the proposed works. The expected direct area of impact will lie somewhere between the two estimates. The nature of the impact will be at best a temporary loss of Annex I sand dune habitat, and at worst, a permanent loss of some habitat. The scale of these impacts will depend on a number of factors.

In the short term there will be a loss of **1210 Drift line vegetation**, **2110 Embryonic dunes** and ***2130 Fixed dunes**, as areas of these habitats (as mapped in September 2014) lie directly within the footprint of the proposed works. If the proposed works are successful, this loss of habitat would be expected to be temporary for ***2130 Fixed dunes**. The newly created dunes, presumably similar in character to marram dunes due to the planting of *Ammophila arenaria* on bare sand and with a profile similar to this habitat, would become more stable over time and would be expected to succeed to ***2130 Fixed dunes**. The loss of the foredune habitats **1210 Drift line vegetation** and **2110 Embryonic dunes** would be expected to be permanent, however, due to the proximity of the high tide line to the foot of the re-profiled dunes.

In another scenario, if the re-profiled dunes need continued maintenance following storm events by the deposition of more sand on top of these newly eroding dunes, they will not be able to succeed naturally to ***2130 Fixed dunes** due to the level of instability and on-going disturbance. The short-

term loss of ***2130 Fixed dunes** due to the proposed works would be expected to become a permanent loss of habitat in this instance.

In the final scenario, the proposed works fail entirely. Here the short-term loss of area of ***2130 Fixed dunes** would be expected to become a permanent loss, however there would be potential for **1210 Drift line vegetation** and **2110 Embryonic dunes** to develop in the old footprint of the proposed works assuming that the natural sedimentation processes currently in operation at Portrane would not have been altered by the proposed works and subsequent failure.

4.3 Mitigation Measures and Recommendations

RPS (2014b) give detailed mitigation measures for the protection of the Annex I sand dune habitats and other habitats within the Rogerstown Estuary SAC (000208) and Rogerstown Estuary SPA (004015). Below is a list of mitigation measures and recommendations specifically related to the Annex I sand dune habitats present at Portrane, some of which are also mentioned by RPS (2014b).

- The natural dune profile should be retained wherever possible to minimise impacts on ***2130 Fixed dunes**. This includes stable dunes which are greater than 4 m AOD.
- Any sediment taken from the middle or lower beach should be checked for pollutants, debris and non-indigenous plant material prior to its transportation to the proposed works area.
- Dune grasses required for planting should be locally sourced; care should be taken not to denude the surface area of the source habitats to the extent that blowouts occur.
- Dune grasses required for planting should only include species which are indigenous to the site.
- The transplanted dune grasses should be monitored to ensure that vigorous growth of the plants has been established.
- Construction personnel must be made aware of the sensitivity of the habitats adjacent to the proposed works, with the need for careful working practices to avoid damage to these habitats highlighted.
- Access and transit routes to and from the sand source and proposed works must be planned in advance, and vehicles, equipped with floatation tyres to minimise compaction damage, should strictly follow these routes. Transit routes should be restricted to two vehicle widths.
- Routes to the proposed works area for personnel should also be carefully planned to minimise trampling damage to adjacent sand dune habitats.
- A walkover survey by an ecologist before the commencement of the proposed works is of vital importance. The sand dune system at Portrane is a highly dynamic system; with many of the Annex I sand dune habitats in transition from one to the other at the time of the current survey. Before vehicle and construction personnel routes can be finalised, the footprints of

these routes need to be rechecked, as an area previously free of an Annex I sand dune habitat may develop one in the intervening time period.

- Similarly, a walkover survey by an ecologist should be carried out before the proposed works commence to check for the presence of **2120 Marram dunes** within the footprint of the works. Based on current mapping the proposed works will directly impact on **1210 Drift line vegetation**, **2110 Embryonic dunes** and ***2130 Fixed dunes**. It is possible given the dynamic nature of the Portrane sand dune system that **2120 Marram dunes** could develop within the footprint of the proposed works in the intervening time period. Both ***2130 Fixed dunes** and **2120 Marram dunes** are qualifying interests for the Rogerstown Estuary SAC.
- Consideration should be given to the potential for the removal of the sand bar from the middle/lower beach contributing to wave action further up the beach, thus exacerbating erosion.
- An ecological clerk of works should be appointed to monitor progress and to ensure that unnecessary impacts on Annex I habitats and other ecological features of the SAC are avoided.
- Monitoring should be conducted to assess the post-work development of Annex I habitats within the footprint of the works and, where possible, to quantify any indirect impacts within the SAC.
- On completion of works, to reduce the impacts of soil compaction from construction traffic, the transit routes should be harrowed to a depth below which compaction is expected.

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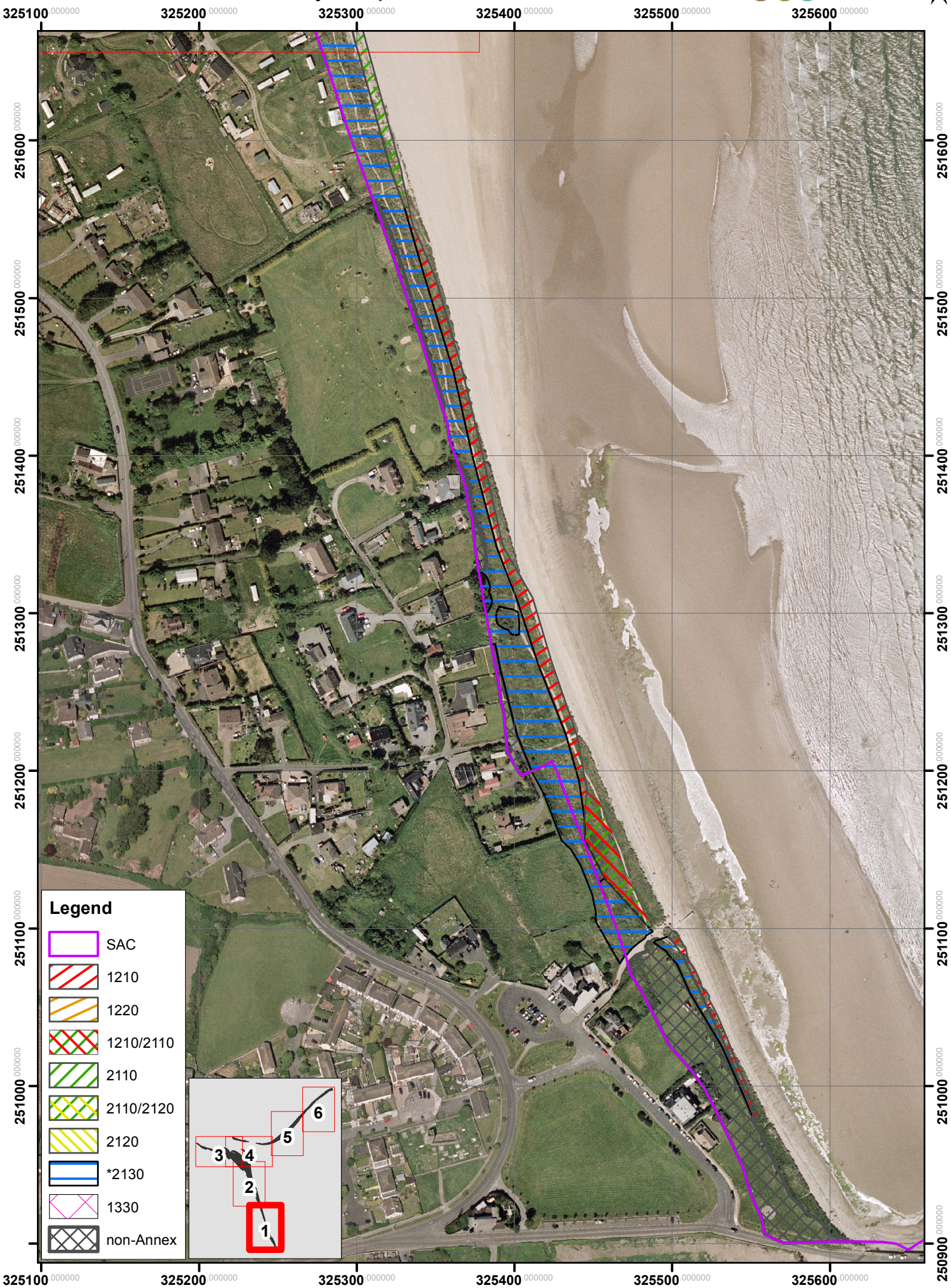
Appendix I – Full names of Annex I habitats

The following standard abbreviations are used throughout this report for Annex I habitats.

Annex I code	Full name of Annex I habitat	Standard Abbreviation
1130	Estuaries	Estuaries
1140	Mudflats and sandflats not covered by seawater at low tide	Mudflats and sandflats
1210	Annual vegetation of drift lines	Drift line vegetation
1220	Perennial vegetation of stony banks	Stony bank vegetation
1310	*Salicornia* and other annuals colonising mud and sand	*Salicornia* saltmarshes
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Atlantic saltmarshes
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	Mediterranean saltmarshes
2110	Embryonic shifting dunes	Embryonic dunes
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Marram dunes
***2130**	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Fixed dunes
***2140**	Decalcified fixed dunes with *Empetrum nigrum*	Decalcified *Empetrum* dunes
***2150**	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)	Decalcified Atlantic dunes
2170	Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)	*Salix repens* dunes
2190	Humid dune slacks	Dune slacks
***21A0**	Machairs	Machairs

Appendix II - Habitat Maps for Portrane and Rush

Portrane Sand Dune Survey: Map 1 of 6



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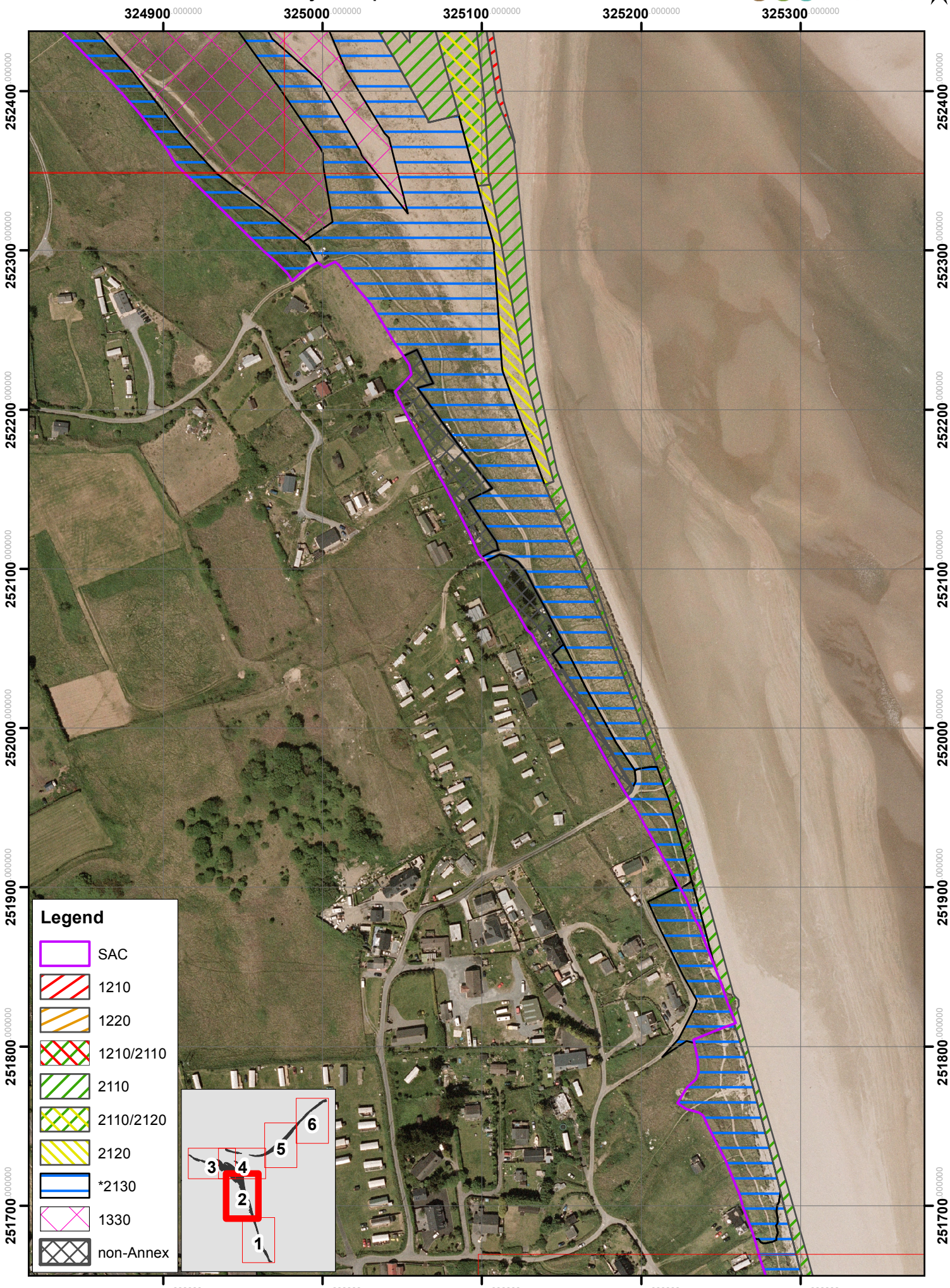
Portrane Sand Dune Survey: Map 2 of 6



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0 30 60 90 120 150 Meters

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Portrane Sand Dune Survey: Map 3 of 6

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0 37.5 75 150 Meters

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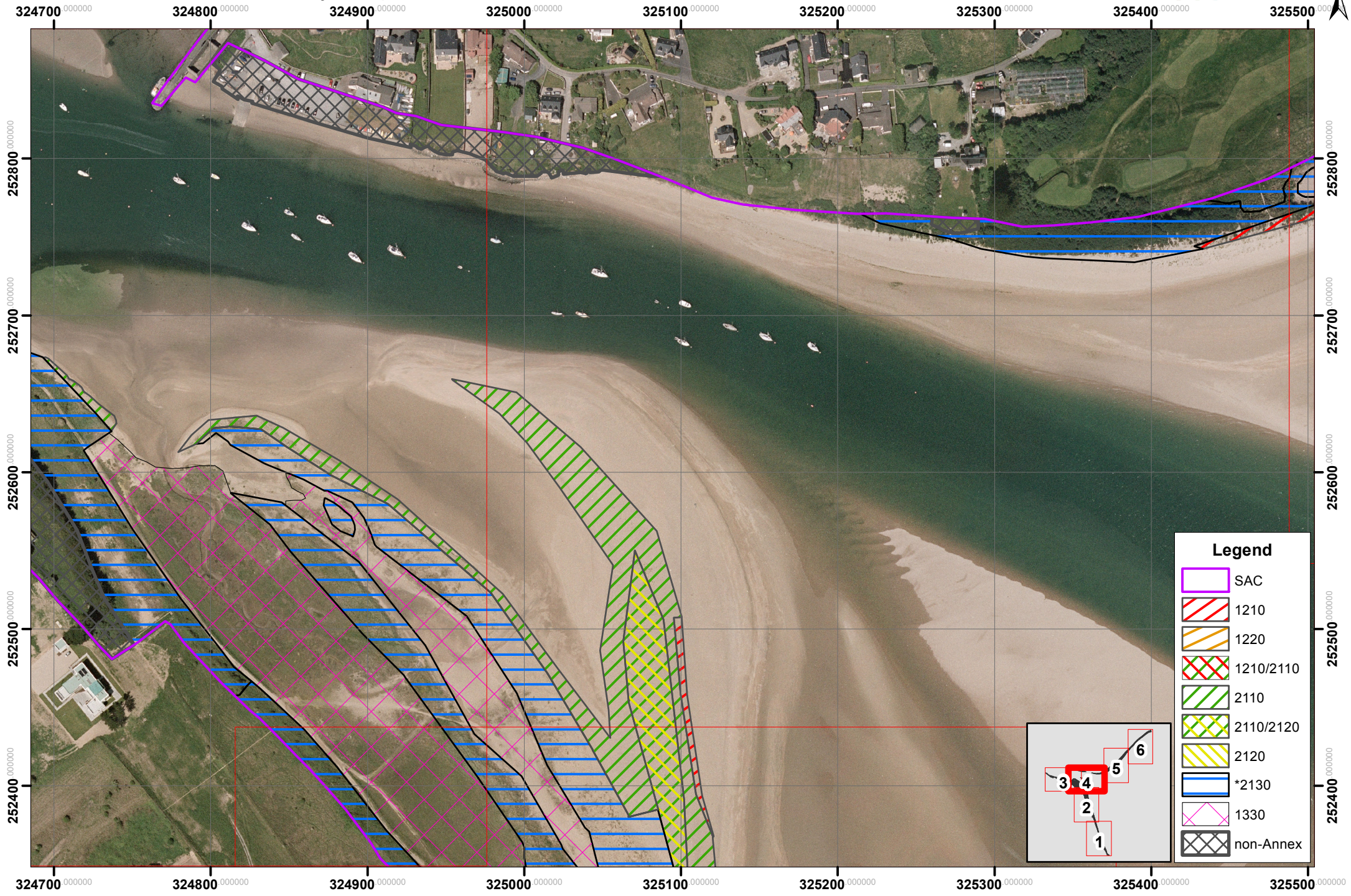
Portrane Sand Dune Survey: Map 4 of 6



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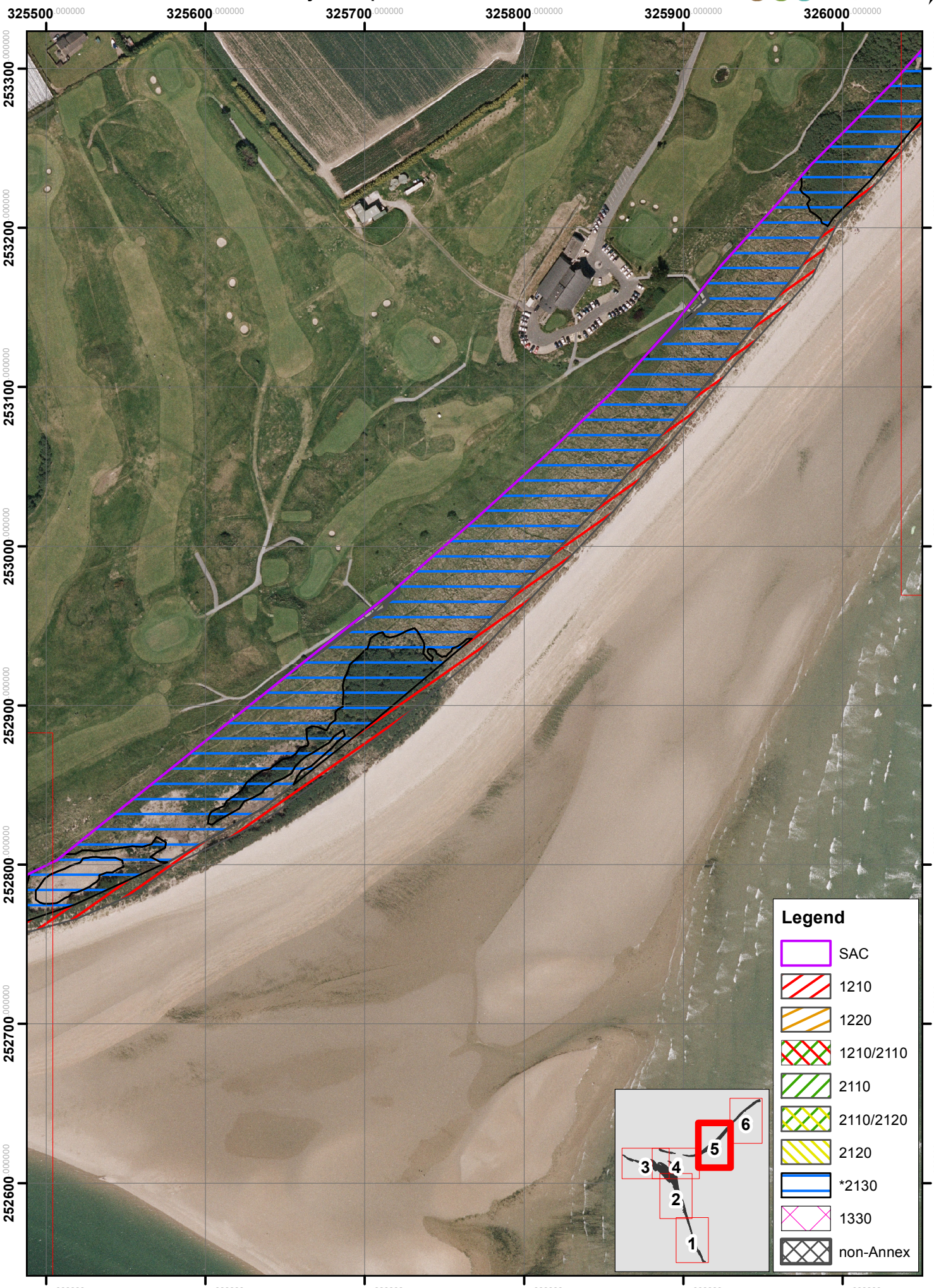
Portrane Sand Dune Survey: Map 5 of 6



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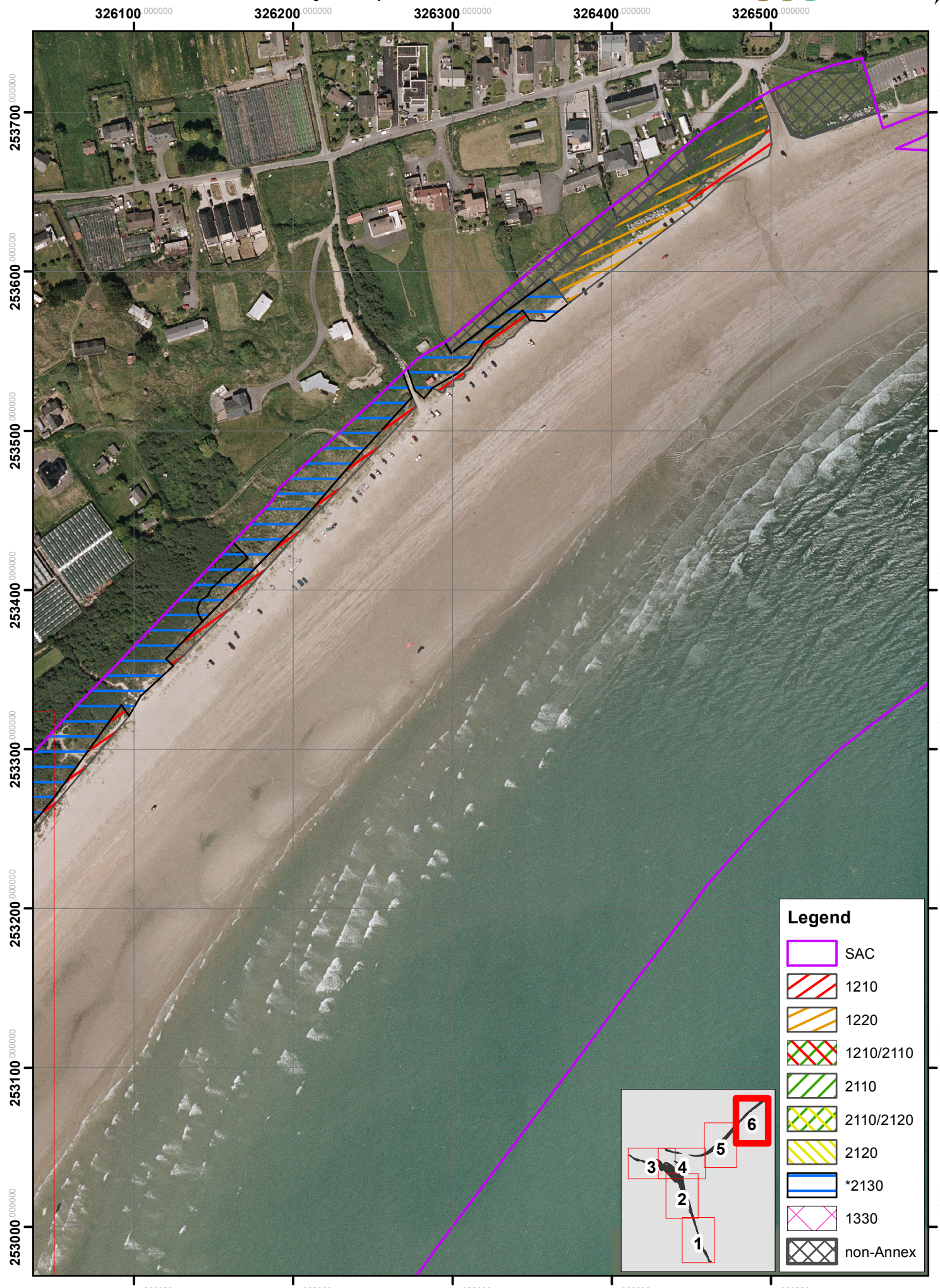
Portrane Sand Dune Survey: Map 6 of 6



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