National Vegetation Classification Survey of selected areas of the Dee Estuary 2022

Report No: 747

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Cover image: Saltmarshes at Gronant at the outer edge of newly developing marsh

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Cafodd y llystyfiant eu arolygu ym mis Awst a mis Medi 2022 gan dîm o ecolegwyr, gyda llystyfiant yn cael ei neilltuo mewn i is-gymunedau NVC a'i fapio ar luniau o'r awyr wedi'w seilio ar farn o'r maes, ond wedi'w gefnogi gan nodiadau targed a samplau cwadrat.

Roedd mwyafrif o'r ardal arolwg yn cyfateb yn agos i'r cymunedau NVC sy'n bodoli'n barod, gyda ardaoledd eang o forfa heli uchaf a chanol wedi'w gofnodi, yn ogystal a ardaoloedd llai ond arwyddocaol o forfa heli isaf ac arloesol. Roedd hefyd amryw o fathau llystyfiant trosiannol wedi'w cofnodi o amgylch cyrion y morfeydd heli.

Roedd y gymuned morfa heli isaf wedi'w gynrheichioli gan ardaloedd o gymuned morfa heli SM8 *Salicornia Blynyddol* a chymuned morfa heli SM9 *Suaeda maritima*, gyda dim ond ardaloedd bach o gymuned morfa heli SM6 *Spartina anglica* yn bresennol. Roedd rhain i'w canfod mewn ardaoledd o gronni, ac yn brin mewn ardaloedd sy'n draenio'n wael o'r brif forfa heli. Roedd SM10 *Rhywogaethau trosiannol llystyfiant cors isel gyda Puccinellia maritima, rhywogaethau Salicornia blynyddol a Suaeda maritima* hefyd eu canfod yn aml yn yr arolwg yn agos i yml forol y forfa heli.

Roedd y rhan fwyaf o'r forfa heli ganol yn cynnwys cymuned morfa heli SM13 *Puccinellia maritima* a chymuned morfa heli SM14 *Halimione portulacoides*. Roedd ardaloedd llai o gymuned morfa heli SM12 *Aster tripolium*, oedd yn anodd ei wahaniaethu o SM13. Roedd llystyfiant trosiannol rhwng y forfa heli ganol a uchaf eto yn gyffredin, gyda llawer o gymuned morfa heli SM16a *Festuca rubra,* is-gymuned *Puccinellia maritima* wedi'w gofnodi.

Roedd y forfa heli uchaf wedi'w gynrheichioli gan gymunedau morfa heli SM16 *Festuca rubra*, SM24 *Elymus pycnanthus* a SM28 *Elymus repens*. Roedd ardaloedd bach o gymuned morfa heli *Juncus maritimus* hefyd yn bresennol, ond mae *Juncus maritimus* yn brin ym morfeydd heli Aber Dyfrdwy.

Roedd corsydd yn gyffredin yng Ngronant lle roedd corsydd a gwelyau cyrs S4 *Phragmites australis* a cors S21 *Scirpus maritimus* y llystyfiant mwyaf cyffedin mewn corsydd gwlypach rhwng cribau twyni oedd yn cronni. Roedd gan Gronant a'r Parlwr Du ardaloedd trosiannol rhwng morfa heli a thwyni tywod, gyda'r ardaloedd oedd gliriaf yn drosiannol yn dwyni isel gyda cymuned blaendwyn SD4 *Elymus farctus* ssp. *boreali-atlanticus* a chymuned twyn symudol SD5 *Leymus arenarius* gyda cynrheichioliad uchel o rywogaethau morfa heli isaf.

Mae’r arolwg yn amlygu yr ystod amrywiol o lystyfiant sydd yn bresennol ar forfeydd heli Aber Dyfrdwy ac yn diweddaru arolygion cynharach o’r llystyfiant gafodd ei gwblhau ddiwethaf yn 2000.

Executive summary

This report presents the results of a National Vegetation Classification (NVC) survey carried out on selected areas of saltmarsh habitat in the Dee Estuary Special Area of Conservation (SAC). Seven distinct areas of saltmarsh were assessed, from the marshes between accreting dunes at Gronant, southwards through Point of Ayr, Greenfield Flushing Lagoon, Bagillt Marshes, Flint Marshes, and Connah's Quay Marshes to the most southerly areas included in the survey referred to as the Dee River Marshes which extend southwards to the Jubilee Lift Bridge at Queensferry.

The vegetation was surveyed in August and September 2022 by a team of ecologists. Discrete stands of vegetation were identified, assigned to NVC sub-communities and mapped onto aerial images based on a field judgement and supported by target notes and quadrat samples.

Most of the survey area closely matched published NVC communities, with extensive areas of middle and upper saltmarsh recorded, with smaller but still significant areas of lower and pioneer saltmarsh also recorded. There were also various transitional vegetation types recorded around the periphery of the marshes.

The lower saltmarshes were represented by areas of SM8 *Annual Salicornia* salt-marsh community and SM9 *Suaeda maritima* salt-marsh community, with only small areas of SM6 *Spartina anglica* salt-marsh community present. These were found in areas of accretion, and rare in poorly draining parts of the main saltmarshes. The SM10 *Transitional low-marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima* was also commonly encountered in the survey close to the seaward edge of the marsh.

Most of the middle saltmarsh was made up of SM13 *Puccinellia maritima* salt-marsh community and SM14 *Halimione portulacoides* salt-marsh community. There were smaller areas of SM12 *Aster tripolium* salt-marsh community, which was difficult to separate from SM13. Again, transitional vegetation between the middle and upper saltmarsh was common, with much SM16a *Festuca rubra* salt-marsh community*, Puccinellia maritima* sub-community recorded.

The upper saltmarsh was represented by SM16 *Festuca rubra* salt-marsh community, SM24 *Elymus pycnanthus* salt-marsh community and SM28 *Elymus repens* salt-marsh community. Small stands of SM18 *Juncus maritimus* salt-marsh community were present, but *Juncus maritimus* is rare in the Dee Estuary saltmarshes.

Swamps were common at Gronant where S4 *Phragmites australis* swamp and reed-beds and S21 *Scirpus maritimus* swamp were the most extensive vegetation types in wetter marshes between accreting dune ridges. Gronant and Point of Ayr also have areas of saltmarsh to sand dune transition, with the most clearly transitional swards being low dunes with SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community and SD5 *Leymus arenarius* mobile dune community with high representation of lower saltmarsh species.

The survey highlights the diverse range of vegetation present on the saltmarshes of the Dee Estuary and updates previous surveys of the vegetation last completed in 2000.

1 Introduction

1.1 Purpose of this report

JBA Consulting was commissioned by Natural Resources Wales (NRW) to carry out a vegetation survey of selected areas of the Dee Estuary Special Area of Conservation (SAC) using the National Vegetation Classification (NVC). The areas selected for survey are primarily areas of saltmarsh vegetation, a key feature of the SAC.

1.2 The Dee Estuary SAC and survey areas

The Dee Estuary is one of the largest estuaries in the UK, with an area of over 14,000 ha (140 km^2) and is hyper-tidal with a mean spring tidal range of 7.7 m at the mouth (NRW 2018). The SAC covers areas of both Wales and England, and is designated for thirteen features, which includes two Annex 1 saltmarsh vegetation types, 1310 *Salicornia* and other annuals colonizing mud and sand and 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*). The extent and location of the SAC is shown in Figure 1-1.

The survey areas comprise seven separate areas of saltmarsh, and these areas are referred to as sub-sites throughout this report. These are shown in Figure 1-2 in the context of the SAC and running from north to south are Gronant Marshes, Point of Ayr (sometimes also called Talacre), Greenfield Flushing Lagoon, Bagillt Marsh (which includes a flushing lagoon), Flint Marshes (which includes a flushing lagoon and the old harbour), Connah's Quay which is adjacent to the power station of the same name, and the Dee River Marshes. The southern part of Flint Marshes is referred to as Pentre Marsh in previous surveys.

1.3 Previous Surveys of the saltmarsh

A detailed NVC survey of the Dee and Clwyd Estuaries was carried out in 2000 (Dargie, 2001). That survey covered a much larger area than the present survey. This survey references changes in the saltmarsh since a previous survey in 1983 reported by Charman. The original survey is not reviewed here, but reference is made via the descriptions in Dargie (2001).

1.4 Structure of this report

The remainder of this report includes the following sections:

- Section 2 introduces the National Vegetation Classification and some of the naming conventions.
- Section 3 provides the methods used during the survey.
- Sections 4 provide details of the vegetation communities recorded in the survey.
- Sections 5 provide details of the vegetation at each of the sub-sites and discusses the notable species recorded in the survey.
- Section 6 presents a summary of the findings.
- Appendices include a key to interpreting the NVC maps, and details of the areas of habitat in each sub-site.

Figure 1-1. Location of the Dee Estuary SAC.

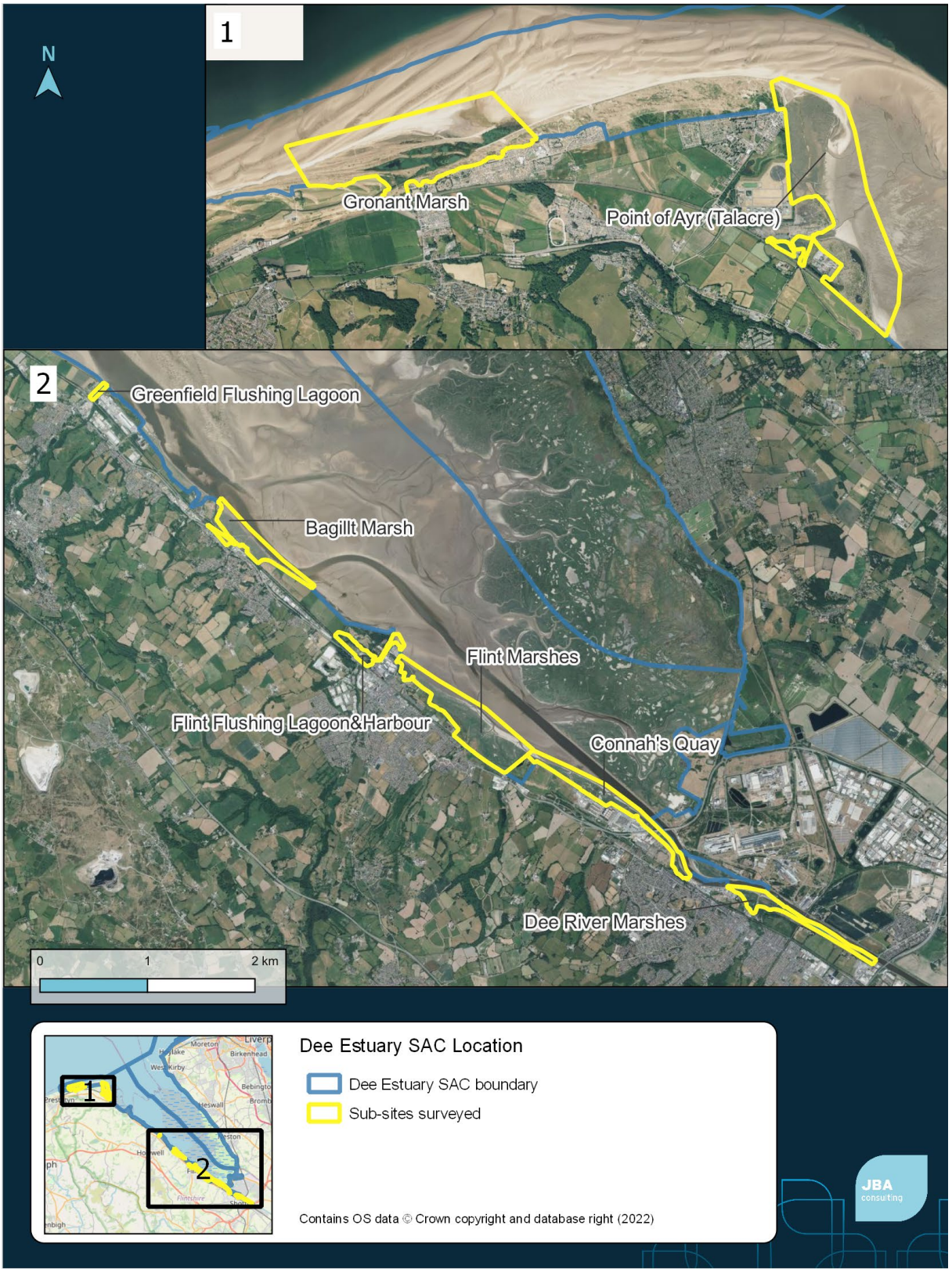


Figure 1-2. Location of sub-sites included in the survey.

2 National Vegetation Classification

The National Vegetation Classification (NVC) is a phytosociological scheme developed to provide a comprehensive system to classify vegetation throughout Wales, Scotland and England. The final scheme was published in the five British Plant Communities volumes (Rodwell 1991a; 1991b; 1992; 1995; 2000). The system has been in widespread use since it was developed in the late 1980s. Since the publication of the original volumes much has been written to develop the classification further, including the Users' Handbook (Rodwell 2006) and a review of proposed additions (Mountford 2011). The survey by Dargie (2001) also added some new communities specifically relevant to the Dee Estuary.

The NVC is not designed as a hierarchical scheme, unlike much European phytosociology. However, the vegetation communities were split into groups based on the broad habitat type, with open vegetation being used as a catch-all for a diverse group of vegetation types at the end. The group codes are shown in Table 2-1.

Table 2-1. NVC categories

NVC Prefix	Category	No. comms	Notes for saltmarsh survey
A	Aquatic	24	Sometimes found in coastal water bodies but generally not mapped in this survey
CG	Calcicolous grassland	14	Not generally found on saltmarsh.
H	Heaths	22	Not generally found on saltmarsh.
M	Mire	38	Includes some of the mires that develop from saltmarsh cut off from tidal inundation but that retain a freshwater supply.
MC	Maritime cliff	12	Coastal grassland influenced by salt, most commonly on coastal cliffs, and includes some vegetation occasionally found on strand lines and shingle.
MG	Mesotrophic grassland	13	Often found on damper or more enriched soils in upper saltmarsh and the transitions beyond the tidal limit.
OV	Open vegetation	42	Includes communities of disturbed ground and tall herb vegetation that are sometimes found on saltmarsh.
S	Swamp and tall-herb fen	28	Includes vegetation that develop from saltmarsh cut off from tidal inundation but that retain a freshwater supply.
SD	Sand dune	19	The main vegetation of sand dunes, and often found in close association with saltmarsh.
SM	Saltmarsh	28	The main group of communities of saltmarsh
U	Calcifugous grassland	21	Not generally found on saltmarsh.
W	Woodland	25	Woodland and scrub communities including many found around the margins of saltmarsh.

2.1 NVC codes and naming conventions

The NVC volumes introduced a specific way of naming each community, a convention which is followed throughout this report. The community is assigned a letter (Table 2-1) with a sequential number, following which are listed one to three prominent species from the community, then a word or two describing the vegetation type for example as follows:

- SM16 *Festuca rubra* salt-marsh community
- S21 *Scirpus maritimus* swamp

Where these communities include sub-communities, these are described in the NVC volumes by a number (typically two) of their characteristic species, or rarely another defining features (e.g., typical sub-community, or species-poor sub-community). Examples for SM16, which includes six sub-communities, are:

- *Puccinellia maritima* sub-community
- *Juncus gerardii* sub-community
- *Festuca rubra-Glaux maritima* sub-community
- *Festuca rubra* sub-community
- *Leontodon autumnalis* sub-community
- *Carex flacca* sub-community

When using shorthand codes these communities are assigned a letter based on the order in which they are described in the volumes (a, b, c…). The same applies where these sub-communities are split further, referred to as 'variants' in the NVC volumes. These are similarly named using prominent species and assigned a roman numeral for the purposes of mapping (i, ii, iii…). The full name of a community (given at least at the first mention in each report would then look something like this: SM16b *Festuca rubra* salt-marsh community*, Juncus gerardii* sub-community. This is subsequently referred to in the text as simply SM16b.

2.2 Frequency, abundance and constant species

Frequency and abundance are the two main variables used to interpret the vegetation data in the NVC volumes, and they are fundamental to the presentation of data in the published volumes. The floristic tables in the NVC combine all data assigned to that community from the whole of the British Isles.

Frequency class is assigned on a scale of 1 to 5, displayed using Roman numerals I-V, and used in the published NVC. It is a measure of the percentage of samples in which each species is recorded. Those that occur in >60% of samples (frequency class IV and V) are considered to be 'constant' in that community (Table 2-2).

Table 2-2. Frequency scale

% samples	Frequency noted in Roman numerals
80-100	V
60-79	IV
40-59	III
20-39	II
0-19	I

The species in frequency classes IV and V are termed ‘constant’ species. This is an important note for interpreting floristic data, with constant species being present in 60% or more of samples e.g., a ‘constant’ species may be absent in 40% of stands nationwide. The abundance values used are simply the range of Domin values recorded for each species in all quadrats, in particular species where the Domin is 8 or over (Table 3-1) can give the impression of overwhelming dominance in a stand.

2.3 Preferential and differential species and the keys

Preferential and differential species are used extensively in the published NVC volumes to help distinguish between different communities and sub-communities. Preferential species are those which tend to have a higher-than-average frequency or constancy within a certain sub-community and differential species have a lower than average frequency. These species form the basis of the dichotomous, or occasionally polytomous keys given in the published volumes to help identify vegetation communities. The keys rely on the overall floristics of stands of vegetation, drawing on both the frequency and abundance of species.

2.4 Philosophy for assigning NVC communities in this survey

The NVC user’s handbook (Rodwell 2006) provides a pragmatic approach to implementing the NVC, accepting the continuous variation in vegetation and the difficulty of defining precise units. The implementation of the NVC on a wide range of field surveys by NRW has led to the development of a specific approach to application and interpretation of the NVC. This approach was specified for these surveys and followed as closely as possible. In particular, the approach is based on assigning vegetation to an NVC community in the field, and not relying on *post hoc* computer assisted analysis. The approach used also favours taking a wider view of the vegetation, using published communities wherever possible, even for stands of vegetation that are some way from the ‘typical’ community description. This approach was dutifully implemented in the field survey, allowing much of the vegetation to be placed into the existing NVC communities, even where the vegetation represents significant local variation. There was also an active decision to avoid mapping transitional stands of vegetation unless there was no clear alternative: vegetation that was intermediate between two communities was assigned to the community to which it had the strongest affinities, with a note added to state its transitional nature. In many cases, such stands were mapped as mosaics, as they typically incorporated small areas of both ends of the transition as well as areas of mixed communities.

3 Methods

3.1 Field survey

3.1.1 Dates and survey team

The field surveys were completed in August and September 2022 by a team of ecologists from JBA Consulting. The survey team was Steven Heathcote, Laura Thomas, Kieran Sheehan, Laura Hodgkinson and Catherine Porter.

Additional data was incorporated from a vegetation survey around Gutter Fawr completed in July 2018 by Steven Heathcote and Anissia Halwyn.

3.1.2 Field mapping

All homogeneous stands of vegetation were identified and described to NVC sub-community level whenever possible. These stands were mapped onto ortho-rectified aerial photographs and OS *Master Map* base maps to a scale of 1:5000. Vegetation was primarily mapped using the set of aerial photographs covering all of Wales, recorded in 2013. However, for the dynamic coastline, particularly foredune vegetation, these images were not possible to use and, in these situations, up-to-date satellite imagery was used, such as Bing Images, and Google Earth, which showed the ortho-rectified satellite images from 2020. Vegetation was assigned to the published communities, and intermediate communities were only used in exceptional circumstances, with the communities mapped using the codes set out in Section 2.1. However, vegetation within the site displayed complex and gradual transitions between communities reflecting subtle variations in environmental parameters and mapping should be viewed as a simplification of this complexity.

In general the survey areas have clear, artificial boundaries that marked the edge of the survey site. Transition zones to terrestrial, and freshwater habitats were mapped as much as possible using the NVC. Transitions below the upper tidal limit into marine habitats were not mapped.

Mosaics of communities were mapped where different communities or sub-communities occurred in intimate association, or within complex, ill-defined boundaries. Vegetation mosaics were mapped as discrete parcels and an estimate of the relative proportions of the component sub-communities of mosaics were included on the map or in a target note.

3.1.3 Quadrat Samples

Quadrat samples were recorded for each sub-community and further samples were collected wherever difficulties with the NVC placement were encountered or for large or variable stands.

A quadrat size of 2m x 2m (or equivalent area on restricted, e.g., narrow, vegetation stands) was used.

Within quadrats the cover of every taxon of vascular plant, bryophyte and lichen were recorded using the Domin scale, with cover assessed by eye as a vertical projection on the ground of the live, above ground parts of the plants in the quadrat.

The Domin scale is the standard measure of cover used in NVC surveys (Rodwell 2006). The cover is based on projected cover, separated by layer where vegetation has a complex structure. The projected cover range and corresponding Domin value are shown in Table 3-1.

Table 3-1. The Domin scale

Cover	Domin
<4%, few individuals	1
<4%, several individuals	2
<4%, many individuals	3
4-10%	4
11-25%	5
26-33%	6
34-50%	7
51-75%	8
76-90%	9
91-100%	10

A record was made of the total cover and mean height excluding flowering stems of the layers together with the cover of any bare sand, soil, litter, rock or open water. A record was also made of grazing level and grazing animal, as well as other obvious management interventions.

3.1.4 Target Notes

Target notes were made by surveyors to supplement the mapping and quadrat data. Target notes were used to describe important features, additional species and other notable characteristics of the vegetation. These sometimes include species lists making use of the Dafor scale (D = dominant; A = abundant; F = frequent; O = occasional; R = rare) to give an indication of a species' abundance.

3.1.5 Notable Species

The location of rare, scarce, uncommon or notable vascular and non-vascular plant species were noted during the survey. Notable species included those listed on the designated site citations, species listed under one of the threatened categories on the Welsh or British Red Lists, species listed on Section 7 of the Environment (Wales) Act 2016, and Nationally Rare and Scarce species. However, no systematic search was made for such species, and the records collected here should be viewed as incidental findings.

3.2 Data Analysis

3.2.1 Mapping

The field maps were digitised in QGIS 3.22 (QGIS.org 2022) and aligned to the Ordnance Survey Master map, with features identified from NRW and Microsoft BING aerial images

3.2.2 Mosaics and Habitat Areas

The area of each habitat presented in the report includes both 'pure' stands and stands which occur in a mosaic. The area of each vegetation type from a mosaic is based on the percentage cover in each mosaic assigned to each vegetation type from the field survey. The total area of the mapped polygon is measured from the GIS and divided into the relative proportion of each component. This figure should be treated with some caution and mosaics were typically complex and assigning proportions to the relevant components is one of the most subjective elements of the survey.

3.2.3 Statistical Analysis of Quadrats

Although not used as the primary method for mapping the NVC communities some *post hoc* analysis of quadrats was completed. This was carried out using Tablefit (Marrs *et al*. 2019) implemented through *JVeg*, JBA's bespoke Microsoft Excel-based wrapper tool for collating and analysing vegetation coverage data. This programme allocates a goodness-of-fit ratio for the quadrat surveyed to the published NVC tables.

3.3 Nomenclature

The vegetation communities follow the names given in the published volumes (Rodwell, 1991a; 1991b; 1992; 1995; 2000), in a few instances supplemented with communities in Mountford (2011). Sub-communities are noted with the letters assigned in the published volume. In Table 4-2 'u' is used as short hand for 'undifferentiated' to note stands that could not be assigned to a specific sub-community, and to clearly mark these as different from the main NVC community as a whole.

Botanical nomenclature follows Stace (2019) except where a species name is part of the NVC title where the original names have been preserved so they are directly traceable to the vegetation types in the published volumes. Where the NVC title should otherwise be updated, the corresponding names are shown in Table 3-2. Vascular plants referred to by their scientific name throughout. Bryophyte nomenclature follows Blockeel *et al*. (2021) and lichens follow the British Lichen Society's Lichen Taxon Dictionary (BLS 2021).

Table 3-2. Synonyms preserved in the NVC community titles used in this report

Names preserved from Rodwell	**Name in Stace (2019)**
Aster tripolium	*Tripolium pannonicum*
Aster tripolium var. *discoideus*	*Tripolium pannonicum var. discoideus*
Desmazeria marina	*Catapodium marinum*
Elymus farctus ssp. *boreali-atlanticus*	*Elymus junceiformis*
Elymus pycnanthus	*Elymus athericus*

Epilobium angustifolium	*Chamaenerion angustifolium*
Glaux maritima	*Lysimachia maritima*
Halimione portulacoides	*Atriplex portulacoides*
Scirpus lacustris ssp. *tabernaemontani*	*Schoenoplectus tabernaemontani*
Scirpus maritimus	*Bolboschoenus maritimus*

4 Results - NVC community descriptions

4.1 Overview

A total of 109 NVC communities and sub-communities (or equivalent) were recorded, along with a range of infrastructure and bare ground areas in 1470 discrete parcels. Most areas of vegetation could be assigned to existing NVC categories, although some show site-specific differences to typical forms of each community. Most vegetation was mapped in discrete parcels, although 21.6ha was recorded as intimate mosaics that couldn't be separated. The NVC communities are described in the following sections in sequence of NVC communities in order of how commonly they were encountered, saltmarsh (SM), swamp (S), mesotrophic grassland (MG), woodland and scrub (W), open vegetation (OV), sand dune (SD), and maritime cliff (MC). The top 15 NVC communities recorded in the survey by area is shown in Table 4-1, with a more detailed breakdown including sub-communities given in Table 4-2, and the same information further separated by sub-site, given in Appendix B. The table excludes the adjacent dune vegetation except where this was partly transitional to saltmarsh. Most of the sand dune was not mapped to NVC community level, but 11.66 ha of SD9, 4.75ha of SD7, 4.44ha SD6, 1.19ha of SD8 and 0.19ha of SD19 were recorded.

Table 4-1. Area of 15 most common NVC communities recorded in this survey.

Community	Area alone (ha)	Area of mosaic (ha)	Total area (ha)
SM13 *Puccinellia maritima* salt-marsh community	52.82	5.49	58.31
SM16 *Festuca rubra* salt-marsh community	48.48	1.91	50.39
SM14 *Halimione portulacoides* salt-marsh community	31.76	7.10	38.86
MG1 *Arrhenatherum elatius* grassland	29.56	0.43	30.00
SM28 *Elymus repens* salt-marsh community	11.08	na	11.08
S21 *Scirpus maritimus* swamp	9.48	na	9.48
S4a *Phragmites australis* swamp and reed-beds	9.29	na	9.29
SM24 *Elymus pycnanthus* salt-marsh community	9.06	0.12	9.18
SM10 *Transitional low-marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima*	6.95	0.09	7.04
SM8 *Annual Salicornia* salt-marsh community	5.41	0.17	5.58
Pans and flashes	3.88	0.10	3.97
S20 *Scirpus lacustris* ssp. *tabernaemontani* swamp	3.84	na	3.84
SM12 *Aster tripolium* saltmarsh	3.28	0.45	3.72
SM9 *Suaeda maritima* salt-marsh community	1.61	0.36	1.97
MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland	1.73	na	1.73

Table 4-2. Area of NVC communities recorded in the survey.

Saltmarsh NVC Communities plus flashes and pans.

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
SM6 *Spartina anglica* salt-marsh community	N/A	N/A	N/A
SM8 *Annual Salicornia* salt-marsh community	N/A	N/A	N/A
SM9 *Suaeda maritima* salt-marsh community	N/A	N/A	N/A
SM10 *Transitional low-marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima*	7.04	N/A	7.04
SM12 Rayed *Aster tripolium* stands	3.72	SM12a, typical sub-community	2.94
SM12 Rayed *Aster tripolium* stands	3.72	SM12b *Puccinellia distans* sub-community	0.78
SM13 *Puccinellia maritima* salt-marsh community	58.31	SM13a *Puccinellia maritima* sub-community	49.50
SM13 *Puccinellia maritima* salt-marsh community	58.31	SM13b *Glaux maritima* sub-community	2.23
SM13 *Puccinellia maritima* salt-marsh community	58.31	SM13c *Limonium vulgare-Armeria maritima* sub-community	0.90
SM13 *Puccinellia maritima* salt-marsh community	58.31	SM13d *Plantago maritima-Armeria maritima* sub-community	1.56
SM13 *Puccinellia maritima* salt-marsh community	58.31	SM13y *Spartina anglica* sub-community	4.12
SM14 *Halimione portulacoides* salt-marsh community	38.86	SM14u undifferentiated stands	1.87
SM14 *Halimione portulacoides* salt-marsh community	38.86	SM14a *Halimione portulacoides* sub-community	24.49
SM14 *Halimione portulacoides* salt-marsh community	38.86	SM14b *Juncus maritimus* sub-community	0.70
SM14 *Halimione portulacoides* salt-marsh community	38.86	SM14c *Puccinellia maritima* sub-community	11.80

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
SM16 *Festuca rubra* salt-marsh community	50.39	SM16u *Festuca rubra* salt-marsh community undifferentiated stands	0.14
SM16 *Festuca rubra* salt-marsh community	50.39	SM16a *Festuca rubra* salt-marsh community *Puccinellia maritima* sub-community	27.97
SM16 *Festuca rubra* salt-marsh community	50.39	SM16c *Festuca rubra* salt-marsh community *Festuca rubra-Glaux maritima* sub-community	14.09
SM16 *Festuca rubra* salt-marsh community	50.39	SM16d *Festuca rubra* salt-marsh community *Festuca rubra* sub-community	7.19
SM16 *Festuca rubra* salt-marsh community	50.39	SM16x *Festuca rubra* salt-marsh community, *Carex extensa* sub-community	1.00
SM18 *Juncus maritimus* salt-marsh community	0.98	SM18u undifferentiated stands	0.00
SM18 *Juncus maritimus* salt-marsh community	0.98	SM18a *Plantago maritima* sub-community	0.77
SM18 *Juncus maritimus* salt-marsh community	0.98	SM18b *Oenanthe lachenalii* sub-community	0.21
SM23 *Spergularia marina-Puccinellia distans* salt-marsh community	0.33	N/A	0.33
SM24 *Elymus pycnanthus* salt-marsh community	9.18	N/A	9.18
SM27 Ephemeral saltmarsh vegetation with *Sagina maritima*	0.36	N/A	0.36
SM28 *Elymus repens* salt-marsh community	11.08	N/A	11.08
Pans and flashes	3.97	N/A	3.97

Grassland NVC Communities

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
MG1 *Arrhenatherum elatius* grassland	30.04	MG1u undifferentiated stands	1.03
MG1 *Arrhenatherum elatius* grassland	30.04	MG1a *Festuca rubra* sub-community	18.61
MG1 *Arrhenatherum elatius* grassland	30.04	MG1b *Urtica dioica* sub-community	10.28
MG1 *Arrhenatherum elatius* grassland	30.04	MG1c *Filipendula ulmaria* sub-community	0.12
MG6 *Lolium perenne-Cynosurus cristatus* grassland	0.72	MG6a typical sub-community	0.72
MG7a *Lolium perenne leys and related* grasslands	0.20	MG7u undifferentiated stands	0.05
MG7a *Lolium perenne leys and related* grasslands	0.20	MG7c *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland	0.15
MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland	1.73	MG11 u undifferentiated stands	0.05
MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland	1.73	MG11a *Lolium perenne* sub-community	0.92
MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland	1.73	MG11b *Atriplex prostrata* sub-community	0.76
MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland	0.46	N/A	N/A
MC5 *Armeria maritima-Cerastium diffusum* ssp. *diffusum* maritime therophyte community	0.58	MC5a *Desmazeria marina* sub-community	0.46
MC5 *Armeria maritima-Cerastium diffusum* ssp. *diffusum* maritime therophyte community	0.58	MC5b *Anthyllis vulneraria* sub-community	0.12
MC6 *Atriplex prostrata-Beta vulgaris* ssp. *maritima* sea-bird cliff community	0.06	N/A	0.06
MC8 *Festuca rubra-Armeria maritima* maritime grassland	0.08	0.08	0.08
U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland	0.39	U4a typical sub-community	0.39

Swamp and Mire NVC Communities

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
S4 *Phragmites australis* swamp and reed-beds	0.87	S4u undifferentiated stands	0.17
S4 *Phragmites australis* swamp and reed-beds	0.87	S4a *Phragmites australis* sub-community	8.68
S4 *Phragmites australis* swamp and reed-beds	0.87	S4b *Galium palustre* sub-community	0.17
S4 *Phragmites australis* swamp and reed-beds	0.87	S4d *Atriplex prostrata* sub-community	0.27
S6 *Carex riparia* swamp	0.01	N/A	0.01
S12 *Typha latifolia* swamp	0.87	S12u undifferentiated stands	0.15
S12 *Typha latifolia* swamp	0.87	S12a *Typha latifolia* sub-community	0.47
S12 *Typha latifolia* swamp	0.87	S12b *Mentha aquatica* sub-community	0.10
S12 *Typha latifolia* swamp	0.87	S12c *Alisma plantago-aquatica* sub-community	0.15
S14 *Sparganium erectum* swamp	0.59	S14a *Sparganium erectum* sub-community	0.25
S14 *Sparganium erectum* swamp	0.59	S14c *Mentha aquatica* sub-community	0.34
S20 *Scirpus lacustris* ssp. *tabernaemontani* swamp	N/A	S20b *Agrostis stolonifera* sub-community	3.84
S21 *Scirpus maritimus* swamp	9.48	S21u undifferentiated stands	0.00
S21 *Scirpus maritimus* swamp	9.48	S21a *Scirpus maritimus* sub-community	6.02
S21 *Scirpus maritimus* swamp	9.48	S21b *Atriplex prostrata* sub-community	0.83
S21 *Scirpus maritimus* swamp	9.48	S21c *Agrostis stolonifera* sub-community	2.62
S26 *Phragmites australis-Urtica dioica* tall-herb fen	1.04	S26a *Filipendula ulmaria* sub-community	0.33
S26 *Phragmites australis-Urtica dioica* tall-herb fen	1.04	S26b *Arrhenatherum elatius* sub-community	0.71
S28 *Phalaris arundinacea* tall-herb fen	0.01	N/A	0.01
M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture	0.24	M23a *Juncus acutiflorus* sub-community	0.24

Sand Dune NVC Communities

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
SD2 *Honkenya peploides-Cakile maritima* strandline community	1.13	N/A	1.13
SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community	1.21	SD4 typical stands	0.65
SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community	1.21	SD4t transitional stands	0.56
SD5 *Leymus arenarius* mobile dune community	1.19	SD5a species-poor sub-community	0.21
SD5 *Leymus arenarius* mobile dune community	1.19	SD5c *Festuca rubra* sub-community	0.42
SD5 *Leymus arenarius* mobile dune community	1.19	SD5t transitional stands	0.56
SD6 *Ammophila arenaria* mobile dune community	4.40	SD6a *Elymus farctus* sub-community	0.12
SD6 *Ammophila arenaria* mobile dune community	4.40	SD6c *Leymus arenarius* sub-community	0.32
SD6 *Ammophila arenaria* mobile dune community	4.40	SD6d *Ammophila arenaria* sub-community	3.03
SD6 *Ammophila arenaria* mobile dune community	4.40	SD6e *Festuca rubra* sub-community	0.94
SD7 *Ammophila arenaria-Festuca rubra* semi-fixed dune community	4.75	SD7a typical sub-community	2.60
SD7 *Ammophila arenaria-Festuca rubra* semi-fixed dune community	4.75	SD7c *Ononis repens* sub-community	1.50
SD7 *Ammophila arenaria-Festuca rubra* semi-fixed dune community	4.75	SD7d *Elymus pycnanthus* sub-community	0.65
SD8 *Festuca rubra-Galium verum* fixed dune grassland	1.19	SD8u undifferentiated stands	0.05
SD8 *Festuca rubra-Galium verum* fixed dune grassland	1.19	SD8a typical sub-community	0.39

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
SD8 *Festuca rubra-Galium verum* fixed dune grassland	1.19	SD8c *Tortula ruralis* ssp. *ruraliformis* sub-community	0.71
SD8 *Festuca rubra-Galium verum* fixed dune grassland	1.19	SD8d *Bellis perennis-Ranunculus acris* sub-community	0.04
SD9 *Ammophila arenaria-Arrhenatherum elatius* dune grassland	11.66	SD9a typical sub-community	11.66
SD16 *Salix repens-Holcus lanatus* dune-slack community	0.36	N/A	0.36
SD17 *Potentilla anserina-Carex nigra* dune-slack community	0.49	SD17u undifferentiated stands	0.39
SD17 *Potentilla anserina-Carex nigra* dune-slack community	0.49	SD17b *Potentilla anserina-Carex nigra* dune-slack community, *Carex flacca* sub-community	0.10
SD19 *Phleum arenarium-Arenaria serpyllifolia* dune *annual* community	0.19	N/A	0.19
SDy *Atriplex glabriuscula-Atriplex prostrata* strandline	0.05	N/A	0.05

Other Open Vegetation NVC Communities plus unclassified single species vegetation stands

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
OV23 *Lolium perenne-Dactylis glomerata* community	0.07	OV23u undifferentiated stands	0.07
OV24 *Urtica dioica-Galium aparine* community	0.05	OV24b *Arrhenatherum elatius-Rubus fruticosus agg.* sub-community	0.05
OV26 *Epilobium hirsutum* community	1.58	OV26u undifferentiated stands	0.05
OV26 *Epilobium hirsutum* community	1.58	OV26b *Phragmites australis-Iris pseudacorus* sub-community	0.08
OV26 *Epilobium hirsutum* community	1.58	OV26c *Filipendula ulmaria-Angelica sylvestris* sub-community	0.32
OV26 *Epilobium hirsutum* community	1.58	OV26d *Arrhenatherum elatius-Heracleum sphondylium* sub-community	1.13
OV27 *Epilobium angustifolium* community	0.08	OV27b *Urtica dioica-Cirsium arvense* sub-community	0.06
OV27 *Epilobium angustifolium* community	0.08	OV27e *Ammophila arenaria* sub-community	0.02
OV28 *Agrostis stolonifera-Ranunculus repens* community	0.27	OV28u undifferentiated stands	0.23
OV28 *Agrostis stolonifera-Ranunculus repens* community	0.27	OV28b *Agrostis stolonifera-Ranunculus repens* community, *Poa annua-Polygonum aviculare* sub-community	0.04
Rosa rugosa	0.2	N/A	0.02
Solidago canadensis	0.05	N/A	0.05

Woodland NVC Communities

Community Type	Total area of community type (ha)	NVC community and sub-community	Area of sub-community type (ha)
W1 *Salix cinerea-Galium palustre* woodland	0.03	N/A	0.03
W2 *Salix cinerea-Betula pubescens-Phragmites australis* woodland	0.78	N/A	0.78
W6 *Alnus glutinosa-Urtica dioica* woodland	0.32	N/A	0.32
W21 *Crataegus monogyna-Hedera helix* scrub	0.78	N/A	0.78
W23 *Ulex europaeus-Rubus fruticosus* scrub	0.06	N/A	0.06
W24 *Rubus fruticosus-Holcus lanatus* underscrub	1.2	W24u undifferentiated stands	0.96
W24 *Rubus fruticosus-Holcus lanatus* underscrub	1.2	W24b *Arrhenatherum elatius-Heracleum sphondylium* sub-community	0.24

4.2 Notes on species identification difficulties

In the accounts of communities that follow, references are made to species or species groups that proved challenging to separate in the field. These are briefly discussed here to give an overview of these and provide context or clarification for the discussion.

Perhaps most widespread was the difficulty separating *Elymus athericus* and *Elymus repens*. Both are common around the Dee Estuary, and they are typically the dominant species in an upper saltmarsh community. Their separation and importance is therefore discussed under the section on SM24 vegetation (Section 4.3.11) and SM28 (Section 4.3.13). Our findings here match those of Dargie (2001) in that both species occur, sometimes together and there are likely to be hybrids present.

Also widespread are annual species of *Atriplex*. Whilst identification of *Atriplex littoralis* and *Atriplex patula* (only in a single location) were relatively straight forwards, separating *Atriplex glabriuscula* and *Atriplex prostrata* proved more difficult. When checked we found most material was referable to *Atriplex prostrata*, representing c. 95% of fruiting material. However, *Atriplex glabriuscula* was also confirmed as present and often mixed with *Atriplex prostrata* but seems to be better represented in strandline communities. There was not time to check all plants of these species, and material was assigned to *Atriplex*

prostrata unless confirmed as *Atriplex glabriuscula*, and so records of *Atriplex prostrata* are best treated in the broad sense of the species.

Parapholis was recorded only at Gronant Dunes and was not found in the other sites listed in Dargie (2001). However, as described in Dargie's report it has the appearance of *Parapholis incurva*, but the anther length falls within the range of *Parapholis strigosa*, and so all material is placed in this species.

Algae was not consistently recorded. No turf-forming algae that are used in the NVC classification were present, but various forms of green and brown algae were present in the most pioneering stands, and where recorded are reported for each quadrat.

4.3 Saltmarsh communities

4.3.1 SM6 *Spartina anglica* salt-marsh community

Constant species: *Spartina anglica.* The survey identified *Puccinellia maritima*, *Suaeda maritima* and *Tripolium pannonicum* as additional constants at low cover.

SM6 *Spartina anglica* salt-marsh community is a species-poor pioneer community where *Spartina anglica* forms stands in the lower saltmarsh and around pools. It often has much bare mud, and common associates are lower marsh species such as *Salicornia, Tripolium pannonicum* and small amounts of *Puccinellia maritima*. Stands recorded in this survey were typical. They occupied only a small extent, c. 1ha overall, sometimes as a mosaic amongst the tidal mud, and sometimes amongst vegetation on the lower saltmarsh.

Table 4-3. Floristic table for SM6 samples

Species	Q052	Q160	Q172	Const.	Ab.
Spartina anglica	9	10	8	V	8-10
Puccinellia maritima	na	2	5	IV	2-5
Tripolium pannonicum	4	na	2	IV	2-4
Suaeda maritima	2	na	3	IV	2-3
Salicornia agg.	na	na	5	II	5
Algae	na	na	3	II	3
Atriplex portulacoides	na	na	2	II	2

4.3.2 SM8 Annual *Salicornia* salt-marsh community

Constant species: *Salicornia* spp.

SM8 Annual *Salicornia* salt-marsh community is an annual vegetation community of the lower saltmarsh, formed by stands of various species of *Salicornia*. They are typically inundated by tides daily and have few associates beyond scattered individuals of lower marsh species. Stands recorded in this survey were typical and appeared largely to comprise of *Salicornia europaea* and lesser amounts of *Salicornia ramosissima*, although the large number of plants and difficulty of checking each to species level means this is indicative only. It was restricted to areas with accreting marsh, as this provides the open ground in the right tidal frame for establishment. The largest stands were recorded at Point

of Ayr where accretion is present along the area from the end of the spit southwards for some distance. It was also present at Flint Marshes. At 5.6ha, it occupies a significantly larger extent than the other pioneer vegetation communities.

Table 4-4. Floristic table for SM6 samples

Species	Q004	Q043	Q053	Q165	Const.	Ab.
Salicornia agg.	8	5	7	6	V	5-8
Suaeda maritima	na	6	5	na	III	5-6
Spartina anglica	4	na	na	2	III	2-4
Puccinellia maritima	na	na	4	-	II	4
Fucoid algae	na	na	na	3	II	3
Tripolium pannonicum	na	na	na	1	II	1

4.3.3 SM9 *Suaeda maritima* salt-marsh community

Constant species: *Suaeda maritima*

SM9 *Suaeda maritima* salt-marsh community is another annual vegetation community of the lower saltmarsh, formed by stands of *Suaeda maritima* in areas of daily tidal inundation. As with SM8, it has few associates beyond scattered individuals of lower marsh species, although they are often slightly more abundant in SM9 compared to SM8. It occupied a smaller total area than SM8 but was more widespread in terms of sub-sites.

Figure 4-1. Extensive SM9 at the southern end of the spit at Point of Ayr.

Table 4-5. Floristic table for samples of SM9

Species	Q042	Q048	Q103	Q129	Q158	Q190	Const	Ab.
Suaeda maritima	7	8	7	6	10	6	V	6-10
Salicornia agg.	7	na	na	5	na	1	III	1-7
Tripolium pannonicum	1	7	na	na	na	na	II	1-7
Cakile maritima	na	na	na	na	na	6	I	6
Elymus junceiformis	na	na	4	na	na	na	I	4
Spartina anglica	na	na	na	4	na	na	I	4
Atriplex prostrata	na	na	na	na	3	na	I	3
Leymus arenarius	na	na	na	na	na	3	I	3
Puccinellia maritima	3	na	na	na	na	na	I	3

4.3.4 SM10 Transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima*

Constant species: *Puccinellia maritima*, annual *Salicornia, Suaeda maritima.* The survey identified *Spartina anglica* and *Tripolium pannonicum* are additional constants.

SM10 Transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima* is a transitional vegetation between the pioneer communities and the grassy *Puccinellia maritima* swards of SM13. Rodwell (2000) describes it as an extreme form of the SM13 community but says there is practical merit in assigning it to its own community. It comprises mixtures of the three named species, with some lower and middle saltmarsh species as associates such as *Spartina anglica* and *Tripolium pannonicum*. There is unsurprisingly some subjectivity around the transition between this vegetation and SM13. In general, where bare ground was present at over 10% cover the vegetation was placed in SM10. The general floristics of stands recorded in this survey match closely to those of the published community.

SM10 was most commonly mapped as a band between the main saltmarsh plain and the seaward edge of the saltmarsh. In most places this was relatively narrow, at most 3m wide, but in places slightly more extensive stands were recorded. At 7ha, it was one of the more common saltmarsh communities recorded in the survey.

Table 4-6. Floristic tables for samples of SM10.

Species	Q021	Q039	Q055	Q132	Q167	Const	Ab.
Salicornia agg.	4	7	8	5	4	V	4-8
Suaeda maritima	8	4	3	7	5	V	3-8
Puccinellia maritima	6	7	5	7	7	V	5-7
Tripolium pannonicum	3	2	2	na	5	IV	2-5
Spartina anglica	2	3	4	na	4	IV	2-4
Atriplex prostrata	3	na	na	na	4	II	3-4
Atriplex portulacoides	na	na	2	na	na	I	2

4.3.5 SM12 *Aster tripolium* salt-marsh community

Constant species: *Puccinellia maritima*, annual *Salicornia, Tripolium pannonicum*. This survey found *Atriplex prostrata* and *Suaeda maritima* as additional constants, but *Salicornia* was present but not constant.

SM12 *Aster tripolium* saltmarsh vegetation represents middle saltmarsh vegetation with prominent *Tripolium pannonicum*. Both SM11 *Aster tripolium var. discoideus* salt-marsh community and SM12 are characterised by the dominance of *Tripolium pannonicum*, in its different forms, with and without ray florets (var. *tripolium* and var. *discoideus* respectively). The status of these forms has been variously debated, but for now they remain distinguished as varieties (Stace 2019). Consistent with Dargie (2001) we found almost all specimens to be of the rayed variety, which indicates SM12 vegetation, although un-rayed individuals were present amongst various vegetation types and showed no ecological separation.

Stands of SM12 were very similar to SM13, a fact noted in Dargie (2001), and consistent with that survey stands were only mapped as SM12 where the cover of *Tripolium pannonicum* was consistently over 10% (Domin 5 or greater). Where the cover varied around this value, stands were more difficult to place, and generally assigned to SM13.

The constant presence of *Puccinellia maritima* meant that most of the stands were placed in the SM12a *Puccinellia maritima* sub-community and the other constants in this survey were *Suaeda maritima* and *Atriplex prostrata*, the latter more typical of SM12b.

Figure 4-2. SM12b at the southern end of Flint Marshes.

Table 4-7. Floristic tables for samples of SM12 vegetation

Quadrat	Q038	Q045	Q159	Q163	Q175	Const.	Ab.
Sub-community	**SM12a**	**SM12a**	**SM12a**	**SM12a**	**SM12b**	na	na
Puccinellia maritima	7	8	9	9	7	V	7-9
Tripolium pannonicum	7	7	7	5	9	V	5-9
Suaeda maritima	3	1	5	6	4	V	1-6
Atriplex prostrata	na	4	1	3	3	IV	1-4
Spartina anglica	na	na	6	5	na	II	5-6
Festuca rubra	na	na	na	na	4	I	4
Plantago maritima	2	na	na	na	na	I	2
Spergularia marina	na	na	na	na	2	I	2
Spergularia media	na	na	na	2	na	I	2
Salicornia agg.	na	1	na	na	na	I	1
Triglochin maritimum	na	na	na	na	1	I	1

4.3.6 SM13 *Puccinellia maritima* salt-marsh community

Constant species: *Puccinellia maritima*. This survey found *Atriplex prostrata* and *Tripolium pannonicum* as additional constants overall, with *Spartina anglica* and *Suaeda maritima* constant in specific sub-communities.

SM13 *Puccinellia maritima* salt-marsh community was the most common vegetation type recorded in the survey. It is a typical middle saltmarsh community, dominated by a low, sprawling cover of *Puccinellia maritima*. The associates can be varied depending on the frequency of tidal inundation, management and history, and this is reflected in the six sub-communities recognised in Rodwell (2000), a relatively high number. The community occupies c. 58ha of the total saltmarsh area.

Most of the SM13 present was easily assigned to the SM13a *Puccinellia maritima* sub-community which is species-poor and characterised by the overwhelming dominant of *Puccinellia maritima* (Figure 4-3). Across the Dee Estuary saltmarshes *Atriplex prostrata* and *Tripolium pannonicum* were also constants of this sub-community, being only occasional associates of it nationally. Two distinct forms were noted during the survey that appear distinctive, although floristically clearly still part of the SM13a vegetation. These are forms where either *Atriplex prostrata* (Figure 4-4) or *Suaeda maritima* are very abundant, the former being fairly widespread, and the latter restricted to Flint Marsh. These species are much taller than the grass, so the stands appear very distinct. The sub-community occupied 49.5ha.

Figure 4-3. Typical SM13a with dominant *Puccinellia maritima* on Flint Marshes.

Figure 4-4. SM13s with abundant *Atriplex prostrata* at Connah's Quay.

Figure 4-5. The pale vegetation on the left of the image is SM13a with constant and abundant *Suaeda maritima*.

The next most common sub-community of SM13 is a new one proposed in Dargie (2001) as the SM13y *Spartina anglica* sub-community. This sub-community matches the floristics of the Dee Estuary SM13a but features *Spartina anglica* as an additional constant. Dargie (2001) comments that it probably reflects the invasion of SM6 by *Puccinellia maritima* as accretion raises the ground level. *Spartina anglica*, a hybrid that arose in southern England in the 19th Century, underwent massive expansion, in part due to deliberate spread (Taylor and Burrows, 1968), in the mid-20th Century (Lacambra et al. 2004). The expansion led to the development of large stands of this species in the lower and pioneer saltmarsh forming SM6 vegetation, but the presence of *Spartina anglica* also increases the rate of accretion. This accretion modifies the inundation enough to allow lower and middle marsh species to colonise, and it was this spread of particularly *Puccinellia maritima* into the extensive stands of SM6 that Dargie suggests accounts for the subsequent development of extensive stands of SM13y. It was most extensive at Point of Ayr and at Gronant Dunes, both accreting systems, and occupied a total of 4.1ha.

Figure 4-6. An area of SM13y at the southern end of Point of Ayr.

Three other sub-communities were also recorded. The SM13b *Glaux maritima* sub-community was recorded in similar situations and with similar composition to SM13a but distinguished by the constant presence of *Lysimachia maritima,* previously known as *Glaux maritima*. It was found more often in the southern end of the survey area at both Dee River Marshes and Connah's Quay, but being very scattered on the other marshes and occupying a total area of 2.2ha. Both the SM13c *Limonium vulgare-Armeria maritima* sub-community and SM13d *Plantago maritima-Armeria maritima* sub-community are characterised by the high abundance of dicot herbs, the latter distinguished by the higher cover of perennial species. They occupy 0.9ha and 1.6ha respectively.

Table 4-8. Floristic table for samples of SM13a.

Species	Q007	Q019	Q023	Q025	Q028	Q030	Q031	Q033	Q034	Q037	Q041	Q044	Q064	Q066	Q067	Q077	Q078	Q080	Q087	Q127	Q140	Q142	Q143	Q155	Q168	Q171	Q179	Q180	Q181	Q182	Q183	Q184	Const.	Ab.
Puccinellia maritima	7	8	9	6	9	8	8	9	7	7	8	10	6	10	8	8	3	8	7	8	10	9	9	9	7	8	9	10	10	9	10	6	V	3-10
Atriplex prostrata	9	5	4	-	6	6	6	5	4	na	na	na	4	3	2	7	na	na	4	7	1	7	4	6	7	2	4	4	2	4	3	1	V	1-9
Tripolium pannonicum	4	6	4	2	4	2	2	3	2	4	4	4	4	4	4	4	1	6	5	5	na	1	4	5	3	5	na	na	na	na	na	na	IV	1-6
Suaeda maritima	na	na	na	na	na	na	na	na	1	7	7	3	na	2	6	na	na	5	4	5	na	1	na	na	6	4	na	na	na	na	na	6	III	1-7
Plantago maritima	na	5	4	8	na	na	1	4	na	na	na	na	na	1	na	na	8	2	4	na	na	na	na	na	na	5	na	na	na	na	na	na	II	1-8
Agrostis stolonifera	na	na	na	na	na	na	na	na	4	na	na	na	8	na	na	na	na	3	na	na	na	na	na	5	na	na	na	na	na	na	na	na	I	3-8
Lysimachia maritima	na	na	na	na	na	na	na	2	7	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	I	2-7
Spergularia media	na	na	na	na	na	na	na	na	6	2	na	na	na	na	na	na	na	1	na	na	na	na	na	na	na	na	na	na	na	na	na	na	I	1-6
Salicornia agg.	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4	5	na	na	na	na	na	2	2	na	na	na	na	na	2	I	2-5
Triglochin maritimum	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4	na	na	na	na	na	na	I	4
Atriplex portulacoides	na	na	na	4	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4	na	2	na	na	na	na	na	na	2	I	2-4
Aster tripolium	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4	1	-	2	2	4	I	1-4
Festuca rubra	na	na	na	3	na	na	na	na	na	na	na	na	na	na	na	na	2	2	na	na	na	na	na	3	na	na	na	na	na	na	na	na	I	2-3
Spartina anglica	na	na	na	na	3	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2	3	na	na	na	na	2	na	na	I	2-3
Elymus athericus	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	I	2
Spergularia marina	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2	na	na	na	na	na	na	I	2

Table 4-9. Floristic table for the sample of SM13b.

Species	Q040
Puccinellia maritima	9
Lysimachia maritima	6
Tripolium pannonicum	3
Atriplex prostrata	1
Plantago maritima	1

Table 4-10. Floristic table for samples of SM13y.

Species	Q006	Q070	Q126	Q174	Const.	Ab.
Puccinellia maritima	8	6	9	7	V	6-9
Atriplex prostrata	2	6	2	7	V	2-7
Spartina anglica	4	6	6	6	V	4-6
Tripolium pannonicum	2	4	2	5	V	2-5
Suaeda maritima	6	5	7	na	IV	5-7
Triglochin maritimum	na	na	na	6	II	6
Salicornia agg.	3	na	na	na	II	3

4.3.7 SM14 *Halimione portulacoides* salt-marsh community

Constant species: : *Atriplex portulacoides*, *Puccinellia maritima*. This survey found *Tripolium pannonicum* as additional constant in specific sub-communities.

SM14 *Halimione portulacoides* salt-marsh community represents saltmarsh in which the low-growing woody perennial *Atriplex portulacoides* is constant and locally abundant with *Puccinellia maritima* the only other constant. It can occupy large areas of middle saltmarsh, but is also often found along creek banks throughout the saltmarsh. It can form a dense and closed canopy community in which relatively few associates persist, often with only bits of *Puccinellia maritima* straggling through the bushes and climbing into the canopy. It can also form more open vegetation, usually with middle saltmarsh species occupying ground between the bushes. Stands were generally easy to delimit, although sometimes an increasingly open canopy where the gaps are occupied by mats of *Puccinellia maritima* can be difficult to separate between the SM14c *Puccinellia maritima* sub-community and SM13, and here the scale of mapping is important and in this study areas of SM13 over 0.25ha amongst *Atriplex portulacoides* were mapped as SM13, rather than part of SM14c. The overall floristics in this survey matched those of the published community, with *Tripolium pannonicum* being the most frequent associate with the two constants. This was the third most extensive community recorded in the survey, occupying 38.9ha and found across all areas, but being more extensive at Connah's Quay and Point of Ayr.

The SM14a *Halimione portulacoides* sub-community is the species-poor form of the community, with a closed canopy of *Atriplex portulacoides* bushes and few associates. It was the most commonly recorded form of SM14, occupying 24ha.

The more open SM14c *Puccinellia maritima* sub-community was also extensive, occupying 11.8ha. It is more open than SM14a, with distinct mats of *Puccinellia maritima* present

between the *Atriplex portulacoides* bushes and a slightly higher average species richness, although the species present are essentially the same.

Figure 4-7. The extensive SM14a at Point of Ayr, with a small stand of *Puccinellia maritima* at the creek edge.

The SM14b *Juncus maritimus* sub-community is very uncommon, reflecting the rarity of the differential species *Juncus maritimus* in the Dee Estuary saltmarshes (Dargie 2001). Only 0.7ha was recorded, although this sub-community was previously absent suggesting some expansion of *Juncus maritimus*.

A total of 1.87ha of undifferentiated stands that could not be assigned to a sub-community were also recorded at Point of Ayr. These were distinctive stands with constant *Spartina anglica* amongst the bushes. It appears to be an analogue of SM13y (Section 4.3.6), with invasion of SM6 by the middle saltmarsh species, *Atriplex portulacoides* and *Puccinellia maritima*, as accretion raises the ground level.

Figure 4-8.Stands of SM14 at Point of Ayr with constant and abundant *Spartina anglica* that represent a distinctive and novel sub-community.

Table 4-11. Floristic table for samples of SM14a

Species	**Q008**	**Q022**	**Q024**	**Q051**	**Q059**	**Q060**	**Q133**	**Q136**	**Q147**	**Q185**	**Q186**	**Q187**	**Const**	**Ab.**
Atriplex portulacoides	10	10	10	10	10	8	3	10	10	10	10	9	V	3-10
Puccinellia maritima	na	3	3	na	na	5	10	na	na	na	1	na	III	1-10
Spartina anglica	na	na	na	na	na	5	na	na	na	1	1	na	II	1-5
Salicornia agg.	na	1	na	na	na	na	na	na	na	na	1	2	II	1-2
Suaeda maritima	na	3	na	na	na	4	na	na	na	na	na	na	I	3-4
Atriplex prostrata	4	1	na	na	na	na	na	na	na	na	na	na	I	1-4
Elymus athericus	3	na	na	na	na	na	na	na	na	na	na	na	I	3
Festuca rubra	na	na	na	na	na	na	2	na	1	na	na	na	I	1-2
Aster tripolium	na	na	na	na	na	na	na	na	na	na	na	2	I	2
Puccinellia distans	na	na	na	na	2	na	na	na	na	na	na	na	I	2
Tripolium pannonicum	na	na	na	na	na	2	na	na	na	na	na	na	I	2

Table 4-12. Floristic table for samples of SM14c

Species	Q020	Q027	Q029	Q057	Q114	Q122	Q130	Q134	Q139	Const	Ab.
Atriplex portulacoides	9	7	7	7	8	7	6	5	5	V	5-9
Puccinellia maritima	5	7	7	7	6	5	8	3	na	V	3-8
Tripolium pannonicum	2	3	4	4	4	3	4	4	2	V	2-4
Suaeda maritima	na	3	5	na	2	na	1	na	na	III	1-5
Festuca rubra	na	na	na	na	na	na	na	3	8	II	3-8
Plantago maritima	na	4	na	2	na	na	na	7	na	II	2-7
Atriplex prostrata	na	na	na	na	na	5	6	na	na	II	5-6
Salicornia agg.	na	na	4	na	na	na	na	na	na	I	4
Spartina anglica	na	3	3	4	na	na	na	na	na	II	3-4
Elymus athericus	3	na	na	na	na	na	na	na	na	I	3
Triglochin maritimum	na	na	na	na	na	na	na	2	na	I	2

4.3.8 SM16 *Festuca rubra* salt-marsh community

Constant species: *Festuca rubra*, *Lysimachia maritima*, *Plantago maritima*. This survey found *Agrostis stolonifera* as an additional constant overall, with *Atriplex prostrata*, *Carex extensa*, *Triglochin maritima* and *Tripolium pannonicum* constant in specific sub-communities.

The SM16 *Festuca rubra* salt-marsh community was the second most common vegetation type recorded in the survey, occupying 50.1ha. It is a middle to upper saltmarsh vegetation type, characterised by the constant presence of *Festuca rubra*, *Plantago maritima* and *Lysimachia maritima*, although the latter was not found to be a constant in all sub-communities, both in this study and Dargie (2001). In some forms of SM16, *Agrostis stolonifera* can be as abundant as *Festuca rubra*, or even replace it. The overall floristics of the Dee Estuary stands were similar to the published communities, but the community covers some very different stands at sub-community level.

Three sub-communities were widespread. The SM16a *Puccinellia maritima* sub-community is the most common, occupying 49.5ha. It represents a transitional form, between SM13 and the other SM16 sub-communities with *Puccinellia maritima* constant and the differential species being those typical of the SM13 community. About half of the stands recorded in this survey were not typical in that, along with constant *Puccinellia maritima*, *Agrostis stolonifera* was constant and often abundant, but *Festuca rubra* was absent. Despite the absence of *Festuca rubra* these stands clearly represent SM16a, and were mapped as this, despite statistically fitting better to SM13a in Tablefit. These stands had constant *Atriplex prostrata* and *Tripolium pannonicum* along with *Plantago maritima*, but *Lysimachia maritima* was only rare, consistent with floristics for this vegetation type recorded by Dargie (2001).

Figure 4-9. A stand of SM16a at Flint Marshes with a mixed mat of *Agrostis stolonifera* and *Puccinellia maritima* and a few emergent middle marsh forbs.

The SM16c *Festuca rubra-Glaux maritima* sub-community was also widespread, occupying 14.1ha. It is distinguished by the presence of typical middle saltmarsh herb species and is a low, relatively species-rich habitat type. It was separated from SM16a by the lack of constant *Puccinellia maritima*, and from other SM16 communities by the constant presence of *Lysimachia maritima*, *Triglochin maritima*, and *Tripolium pannonicum*. It also included all stands of SM16 with *Juncus gerardii*. No SM16b *Juncus gerardii* sub-community was recorded, reflecting the absence of stands where this species was the principal graminoid species.

The species-poor SM16d *Festuca rubra* sub-community is dominated by dense, often springy, mats of *Festuca rubra* with relatively few associates. It was the third most common community, occupying 6.9ha. It has a range of uncommon associates, with *Elymus athericus* and *Plantago maritima* the most constant associates, but neither were constant. In one stand, *Festuca rubra* was completely replaced by *Agrostis stolonifera*.

The proposed new SM16x *Carex extensa* sub-community from Dargie (2001) remains present at Gronant, where it occupies c. 1ha on the transition between saltmarsh and sand dune. This vegetation was the same as that described in Dargie (2001) with similarities to SM16c and SM16d but with constant and abundant *Carex extensa*.

Figure 4-10. *Carex extensa* dominant in a strip of SM16x between the saltmarsh (right) and sand dune (left) at Gronant.

Table 4-13. Floristic table for samples of SM16a

Species	**Q009**	**Q063**	**Q068**	**Q069**	**Q072**	**Q079**	**Q083**	**Q088**	**Q146**	**Q164**	**Q166**	**Q188**	**Const**	**Ab.**
Plantago maritima	4	2	4	1	2	1	4	6	6	na	6	2	V	1-6
Puccinellia maritima	9	7	8	6	4	7	8	7	na	8	4	5	V	4-9
Agrostis stolonifera	na	7	6	8	na	6	5	6	na	7	na	1	IV	1-8
Atriplex prostrata	4	4	4	5	na	na	na	5	na	1	4	3	IV	1-5
Tripolium pannonicum	4	5	5	5	na	5	5	4	4	na	4	na	IV	4-5
Festuca rubra	4	na	na	na	9	4	na	na	5	na	9	7	III	4-9
Atriplex portulacoides	na	na	na	na	4	4	na	na	na	na	na	2	II	2-4
Lysimachia maritima	na	na	3	3	na	na	6	na	na	na	na	na	II	3-6
Triglochin maritimum	na	na	na	na	na	na	na	na	8	na	na	na	I	8
Aster tripolium	na	na	na	na	na	na	na	na	na	na	na	2	I	2
Atriplex glabriuscula	na	na	na	na	na	4	na	na	na	na	na	na	I	4
Beta vulgaris var. maritima	na	na	na	na	na	na	na	na	na	na	na	4	I	4
Suaeda maritima	na	na	na	na	na	na	3	na	na	na	na	1	I	1-3
Spergularia marina	na	na	na	na	2	na	na	na	na	na	na	na	I	2
Cochlearia officinalis	na	na	na	na	na	na	na	na	na	na	na	1	I	1
Elymus junceiformis	na	na	na	na	1	na	na	na	na	na	na	na	I	1
Plantago coronopus	na	na	na	na	na	na	na	na	na	na	na	1	I	1

Species	Q009	Q063	Q068	Q069	Q072	Q079	Q083	Q088	Q146	Q164	Q166	Q188	Const	Ab.
Salicornia agg.	na	na	na	na	na	na	na	na	na	na	na	1	I	1
Spergularia media	na	na	na	na	na	na	1	na	na	na	na	1	I	1

Table 4-14. Floristic data from samples of SM16c.

Species	Q128	Q154	Q157	Const.	Ab.
Festuca rubra	8	3	8	V	3-8
Lysimachia maritima	7	3	5	V	3-7
Agrostis stolonifera	na	10	8	IV	8-10
Tripolium pannonicum	6	1	na	IV	1-6
Atriplex prostrata	na	2	1	IV	1-2
Plantago maritima	4	na	na	II	4
Elymus athericus	na	na	2	II	2

Table 4-15. Floristic table for samples of SM16d.

Species	Q010	Q011	Q026	Q032	Q047	Q049	Q058	Q112	Q153	Q169	Q178	Const.	Ab.
Festuca rubra	8	4	7	8	9	8	9	9	na	10	9	V	4-10
Agrostis stolonifera	6	8	7	6	na	5	na	na	10	na	6	IV	5-10
Plantago maritima	na	3	5	na	na	4	4	1	na	3	na	III	1-5
Elymus athericus	2	4	2	na	na	na	3	3	na	na	4	III	2-4
Suaeda maritima	na	na	na	na	5	1	na	na	na	4	na	II	1-5
Atriplex portulacoides	na	na	na	na	na	1	na	6	na	na	na	I	1-6
Lysimachia maritima	na	na	na	2	na	na	na	na	na	na	3	I	2-3
Carex extensa	na	na	5	na	na	na	na	na	na	na	-	I	5
Apium graveolens	na	4	na	na	na	na	na	na	na	na	na	I	4
Armeria maritima	na	na	na	4	na	na	na	na	na	na	na	I	4
Beta vulgaris var. maritima	na	na	na	na	na	na	4	na	na	na	na	I	4
Lotus corniculatus	na	na	na	4	na	na	na	na	na	na	na	I	4
Plantago lanceolata	4	na	na	na	na	na	na	na	na	na	na	I	4
Tripolium pannonicum	na	na	na	na	4	na	na	na	na	na	na	I	4
Atriplex prostrata	na	na	na	na	na	na	na	na	2	na	na	I	2
Medicago lupulina	2	na	na	na	na	na	na	na	na	na	na	I	2
Sonchus arvensis	na	na	na	na	na	na	na	2	na	na	na	I	2
Spergularia media	na	na	na	na	na	na	na	2	na	na	na	I	2
Triglochin maritimum	na	na	na	na	na	na	na	na	na	na	2	I	2

Table 4-16. Floristic data for the SM16e sample.

Species	Q082
Festuca rubra	7
Agrostis stolonifera	5
Trifolium repens	5
Plantago maritima	4
Elymus repens	3
Lolium perenne	3
Lysimachia maritima	3
Poa humilis	3
Scorzoneroides autumnalis	2
Chaerophyllum temulum	1

Table 4-17. Floristic data for samples of SM16x.

Species	Q100	Q118	Q120	Const.	Ab.
Festuca rubra	8	6	7	V	6-8
Carex extensa	5	8	8	V	5-8
Plantago maritima	4	4	5	V	4-5
Agrostis stolonifera	2	7	na	IV	2-7
Triglochin maritimum	2	na	4	IV	2-4
Atriplex portulacoides	na	na	3	II	3
Centaurium erythraea	na	3	na	II	3
Lysimachia maritima	3	na	na	II	3
Limonium binervosum agg.	na	2	na	II	2
Plantago coronopus	na	2	na	II	2
Suaeda maritima	na	na	2	II	2
Tripolium pannonicum	na	na	2	II	2
Eryngium maritimum	na	1	na	II	1
Leymus arenarius	na	1	na	II	1
Ononis repens	na	1	na	II	1
Scorzoneroides autumnalis	na	1	na	II	1

A small amount of vegetation with constant *Limonium binervosum* agg. was recorded at Gronant, occupying the transitional zone between the saltmarsh and a low shingle ridge, with a total area of only 0.26ha. The vegetation is not easy to place and is characterised by the constant presence of *Festuca rubra* at low cover with *Limonium binervosum* agg. *Catapodium marinum*, and *Plantago coronopus* in a very open sward. The species composition is close to SM16d, although it is not the dense springy mats of *Festuca rubra* that typically characterise this vegetation. The *Limonium* was not identified to species within the aggregate, but *Limonium britannicum* is the only member of the aggregate known from Gronant and the plants recorded here are likely to be this species.

Figure 4-11. The very open sward with *Limonium binervosum* agg. and *Plantago coronopus* amongst scattered *Festuca rubra*, at Gronant.

Table 4-18. Floristic table for a sample from SM16 with *Limonium binervosum*.

Species	**Q117**
Limonium binervosum agg.	6
Plantago coronopus	6
Festuca rubra	5
Atriplex portulacoides	4
Plantago maritima	4

4.3.9 SM18 *Juncus maritimus* salt-marsh community

Constant species: *Agrostis stolonifera*, *Festuca rubra*, *Juncus gerardii*, *Juncus maritimus*, *Lysimachia maritima.*

The SM18 *Juncus maritimus* salt-marsh community is defined by the constant and abundant presence of *Juncus maritimus*, which forms tall dense clumps. It is rare in the Dee Estuary, a fact noted in Dargie (2001), and which remains true from this survey, occupying 0.98ha. The small number of samples confirm the floristics to be similar to the published community, with the *Juncus* joined by a grassy layer of *Agrostis stolonifera* and *Festuca rubra but* stands on the Dee Estuary were lacking in the supposed constants *Juncus gerardii* and *Lysimachia maritima*. Typical associates are upper saltmarsh species including *Atriplex prostrata*, *Carex extensa*, *Elymus athericus* and *Oenanthe lachenalii*. However, where there is freshwater influence, stands included *Apium graveolens*, and *Eupatorium cannabinum* and these stands are transitional to freshwater fens.

Two sub-communities were recorded. The SM18a *Plantago maritima* sub-community was most commonly recorded, distinguished by the constant present of *Plantago maritima* and *Triglochin maritima*. The SM18b *Oenanthe lachenalii* sub-community, distinguished by the constant presence of *Oenanthe lachenalii*, was recorded only in a small quantity.

Figure 4-12. SM18 at Flint Marshes.

Table 4-19. Floristic table for samples of SM18.

Species	**Q177**	**Q194**
Sub-community	**SM18a**	**SM18b**
Agrostis stolonifera	6	9
Apium graveolens	na	4
Atriplex prostrata	2	na
Bolboschoenus maritimus	na	3
Carex extensa	na	1
Elymus athericus	4	na
Epilobium hirsutum	1	na
Eupatorium cannabinum	na	2
Festuca rubra	6	4
Holcus lanatus	na	1
Juncus maritimus	8	6
Oenanthe lachenalii	na	1
Rumex crispus	2	na

4.3.10 SM23 Spergularia marina-Puccinellia distans salt marsh community

Constant species: *Puccinellia distans*, *Puccinellia maritima*, *Spergularia marina*. This survey found *Agrostis stolonifera* as an additional constant, with *Spergularia media* replacing *Spergularia marina*.

Stands of SM23 *Spergularia marina-Puccinellia distans* salt-marsh community are characterised as open stands of vegetation in which *Spergularia marina* is abundant along with one or other, or both, of *Puccinellia maritima* and *Puccinellia distans*. These stands usually arise in the upper saltmarsh following disturbance and are a secondary pioneer community. As is typical of vegetation of disturbed ground, there can be quite a variety of species present, and each can lend a distinct appearance to the vegetation. In the case of this survey, *Puccinellia distans* was rarely encountered and *Spergularia media* was more common than *Spergularia marina*. In total only 0.33ha were recorded, and of this around half were very atypical stands. The more typical stands feature *Spergularia media* with *Plantago maritima* and *Puccinellia maritima*. However, some stands were assigned here which had a high abundance of *Oxybasis rubra* with lesser amounts of *Spergularia marina* and *Puccinellia maritima*. These were found in the flushing lagoons at Flint Marshes, where the lower-lying and presumably poorly draining ground is kept open by winter flooding, allowing the annual vegetation to develop over the drier summer.

Figure 4-13. *Oxybasis rubra* in the Flint Marshes flushing lagoon forming atypical SM23.

Table 4-20. Floristic data for SM23 samples.

Species	Q050	Q085	Q150	Const.	Ab.
Puccinellia maritima	3	3	5	V	3-5
Agrostis stolonifera	na	2	6	IV	2-6
Plantago maritima	1	na	3	IV	1-3
Spergularia media	5	na	5	IV	5
Atriplex prostrata	na	6	na	II	6
Oxybasis rubra	na	5	na	II	5
Festuca rubra	4	na	na	II	4
Elymus junceiformis	3	na	na	II	3
Spergularia marina	na	2	na	II	2
Atriplex portulacoides	1	na	na	II	1
Suaeda maritima	1	na	na	II	1

4.3.11 SM24 *Elymus pycnanthus* salt-marsh community

Constant species: *Elymus athericus*. This survey found *Atriplex prostrata* as an additional constant.

The SM24 *Elymus pycnanthus* salt-marsh community is an upper saltmarsh community found primarily towards the upper limits of saltmarsh as well as on raised banks and along creeks. The community is characterised by constant and abundant *Elymus athericus*, a coarse grass able to create dense swards and develop a thick leaf litter. Associates are uncommon and few in number, most often species associated with the drift line such as *Atriplex prostrata*, as the dense grassy sward is very effective at trapping the drift line. *Atriplex prostrata* was constant in the samples from the Dee Estuary. SM24 has similarities to SM28 (Section 4.3.13), the key differential being the dominance of either *Elymus athericus* (SM24) or *Elymus repens* (SM28). Our findings match that of Dargie (2001) in that both species are present and there is much material that is difficult to assign to either. Further distinguishing characteristics for stands assigned to SM24 were that it was also more species poor and associates more typical halophytes suggesting a stronger saline influence. They occupied 9.18ha in total.

Dargie (2001) noted the presence of bands of SM24 along the edges of major creeks, noting how the presence of *Elymus athericus* encouraged deposition, creating raised ground along the creek edges that separated the creeks from the marsh behind, altering drainage patterns and significantly influencing the development of the marsh. This process has continued, and good examples of the raised creek banks were present on Flint Marshes and Connah’s Quay. In some places, including the southern end of Flint Marshes and at Connah's Quay, raised bunds of SM24 are present alongside linear creeks, and here this may represent historic excavation of channels, most likely to maintain drainage of the railway that forms the inland bound of the saltmarsh.

Figure 4-14. A typical area of the large saltmarsh plain at Flint Marshes with SM13a in the foreground and SM24 along the creek behind.

Table 4-21. Floristic data for samples of SM24.

Species	Q005	Q046	Q065	Q076	Q131	Q149	Q170	Const.	Ab.
Elymus athericus	10	10	7	9	10	10	10	V	7-10
Atriplex prostrata	3	4	2	4	na	na	5	IV	2-5
Tripolium pannonicum	1	na	4	1	na	na	na	III	1-4
Puccinellia maritima	na	na	8	5	na	na	na	II	5-8
Festuca rubra	na	na	na	na	na	na	5	I	5
Agrostis stolonifera	na	na	na	na	na	na	4	I	4
Atriplex glabriuscula	na	na	na	na	4	-	na	I	4
Beta vulgaris var. *maritima*	na	na	na	na	na	2	na	I	2
Plantago maritima	na	na	2	na	na	na	na	I	2

4.3.12 SM27 Ephemeral saltmarsh vegetation with *Sagina maritima*

Constant species: Not listed in Rodwell (2000). *Festuca rubra*, *Plantago coronopus* and *Sagina maritima* were used as key indicators in this survey.

Stands of SM27 Ephemeral saltmarsh vegetation with *Sagina maritima* were uncommon, occupying only 0.36ha, mostly in the old harbour at Flint and around the edges of the

saltmarsh at Gutter Fawr. It is characterised as very open swards of annual and ephemeral species, with scattered perennials of small size. Floristic data was not given in Rodwell (2000), but a range of halophytes were listed as associates, depending on where the vegetation occurred relative to the tidal frame. Here the stands were towards the upper limit of tidal inundation, and the constant *Sagina maritima* is associated with upper saltmarsh species including *Agrostis stolonifera*, *Festuca rubra*, *Plantago coronopus*. Stands at Flint harbour are very similar to MC5 and become increasingly so away from the edge of the saltmarsh.

Figure 4-15. A stand of SM27 along the edge of the old harbour at Flint, with similarities to MC5.

Figure 4-16. SM27 at the edge of the Gutter Fawr saltmarsh.

Table 4-22. Floristic data from the samples of SM27

Row Labels	Q189	Q036
Festuca rubra	5	4
Agrostis stolonifera	4	na
Sagina maritima	4	3
Aster tripolium	2	na
Plantago coronopus	2	8
Spergularia media	2	na
Atriplex prostrata	1	na
Holcus lanatus	1	na

4.3.13 SM28 *Elymus repens* salt-marsh community

Constant species: *Agrostis stolonifera*, *Atriplex prostrata*, *Elymus repens*, *Festuca rubra*. This survey found *Festuca rubra* was not amongst the constant species.

The SM28 *Elymus repens* salt-marsh community is primarily an upper saltmarsh community. It is characterised by the constant and abundant presence of *Elymus repens* with *Agrostis stolonifera*, *Festuca rubra* and *Atriplex prostrata* and a long list of known associates. The vegetation on the Dee Estuary matches the published description well, albeit with *Festuca rubra* only occasional. The presence of *Lolium perenne* and *Rumex crispus* in some stands show they are rarely inundated in saline water. The distribution is interesting, to the north being recorded only in the flushing lagoons and not on the main saltmarsh but becoming a significant component of the main saltmarsh in the southern part

of Connah's Quay and the Dee River Marshes, perhaps indicating the dilution of the saline water by freshwater from the river during high tides. They occupied a total area of 11.1ha.

Table 4-23. Floristic data for samples of SM28.

Species	Q015	Q016	Q086	Q148	Const.	Ab.
Elymus repens	8	10	9	4	V	4-10
Atriplex prostrata	1	4	4	8	V	1-8
Agrostis stolonifera	6	3	5	4	V	3-6
Sonchus arvensis	3	na	1	na	III	1-3
Arrhenatherum elatius	2	na	na	na	II	2
Lolium perenne	na	2	na	na	II	2
Tripolium pannonicum	na	na	na	2	II	2
Rumex crispus	na	1	na	na	II	1

Figure 4-17. Extensive SM28 in the flushing lagoon at Flint Marshes.

4.4 Swamp and Mire vegetation

4.4.1 S4 *Phragmites australis* swamp and reed-beds

Constant species: *Phragmites australis*

Stands of S4 *Phragmites australis* swamp and reed-beds are typical of upper saltmarsh and characterised by dense stands of *Phragmites australis*, often with a deep layer of wet leaf litter underneath and a few scattered associates that can persist amongst the tall vegetation. They occupied 9.3ha, primarily in the large and more fixed areas of marsh at Gronant where saline influence is much reduced. Smaller stands were associated with ponded areas and freshwater drain margins in the other sub-sites. Stands were under sampled owing to the difficulty of safe access in most places, but as a species-poor vegetation type there was little difficulty in assigning them to sub-communities. The main distinction was between S4a *Phragmites australis* sub-community which is the most species-poor sub-community and more common in freshwater situations such as at Gronant where it occupied 8.7ha, and S4d *Atriplex prostrata* sub-community where there is still salinity and a supply of drift material that allows the persistence of halophytic associates, and which occupied 0.27ha. A small area of S4b *Galium palustre* sub-community was also recorded landward of the sea wall at Point of Ayr where it occupied old ponds and a small wetland area. It is characterised by the presence of associates that are typical of freshwater fen and swamp including *Galium palustre*, *Mentha aquatica*, *Iris pseudacorus*, and *Eupatorium cannabinum*.

Table 4-24. Floristic table for the single sample of S4a.

Species	**Q156**
Phragmites australis	10
Elymus athericus	3

Figure 4-18. Stands of S4a along the edge of Gutter Fawr inland of the Gutter Fawr sluice in 2018.

4.4.2 S6 Carex riparia swamp

Constant species: *Carex riparia*

A single stand of S6 *Carex riparia* swamp was present at Gronant Dunes adjacent to the Prestatyn Gutter and characterised by the dominance of *Carex riparia* in a species-poor stand occupying 0.02ha.

4.4.3 S12 Typha latifolia swamp

Constant species: *Typha latifolia*

Stands of S12 *Typha latifolia* swamp were recorded only at Gronant Dunes where they were relatively common along the margins of Prestatyn Gutter, sometimes forming extensive stands where there was low-lying ground adjacent to the river. They are characterised by the dominance *Typha latifolia*, which forms tall dense stands, but a range of fen and swamp associates are able to persist amongst it. All of the three sub-communities were recorded with the most common being the species-poor S12a *Typha latifolia* sub-community (0.47ha), and roughly equal amounts of the more species-rich S12b *Mentha aquatica* sub-community (0.10ha), and the richest S12c *Alisma plantago-aquatica* sub-community (0.15ha).

Figure 4-19. Stands of *Typha latifolia* (S12) and *Sparganium erectum* (S14) are present along Prestatyn Gutter between the pumping station and the outfall.

4.4.4 S14 Sparganium erectum swamp

Constant species: *Sparganium erectum*

Similar to S12, stands of S14 *Sparganium erectum* swamp were recorded along the Prestatyn Gutter at Gronant. Stands were placed in one of two sub-communities in roughly equal amounts, the species-poor S14a *Sparganium erectum* sub-community (0.25ha) and the richer S14c *Mentha aquatica* sub-community (0.34ha).

4.4.5 S20 Scirpus lacustris ssp. tabernaemontani swamp

Constant species: *Schoenoplectus tabernaemontani.* This survey found *Bolboschoenus maritimus*, *Puccinellia maritima*, *Agrostis stolonifera* and *Tripolium pannonicum* as additional constants.

Stands of S20 *Scirpus lacustris* ssp. *tabernaemontani* swamp were recorded only at Gronant, and here they formed an interesting and atypical vegetation type at the accreting edge of the saltmarsh. Stands are typically characterised by the constant and dominant presence of *Schoenoplectus tabernaemontani* with a few brackish associates, but at Gronant, they formed a mixed canopy with *Bolboschoenus maritimus*. There was a varied understory, with more pioneering stands associated with lower saltmarsh species, closer in nature to S20a *Scirpus lacustris* ssp. *tabernaemontani* sub-community, but much richer than the form described in Rodwell (2000). The more inland stands were taller and denser, and the silt was mixed with sand such that associates varied from middle and upper saltmarsh species to those of more open dune vegetation. These stands perhaps come closer to S20b *Agrostis stolonifera* sub-community, but it is not a very good fit to the

vegetation. In the end, the constant presence of *Bolboschoenus maritimus* suggests these stands could also fit with S21, but the presence of *Schoenoplectus tabernaemontani* clearly differentiates them from other stands of S21 that are common and widespread at Gronant, and it was felt these stands should be mapped as a distinct vegetation type, and they were mapped as S20b, but the variation is such that they deserve to be recognised as at least a distinctive local variant, if not a distinct sub-community. The vegetation occupies 3.8ha.

Figure 4-20. The inland and better developed stands of S20 at Gronant.

Figure 4-21. The more open pioneering stands of S20 with a high sand content in the substrate.

Figure 4-22. Stands of S20 (right) forming the pioneering vegetation at Gronant and separated from dune vegetation (left) by an area open sandy shingle.

Table 4-25. Floristic table for samples of S20.

Species	Q001	Q002	Q003	Q197	Const.	Ab.
Bolboschoenus maritimus	6	6	8	6	V	6-8
Schoenoplectus tabernaemontani	5	4	6	4	V	4-6
Puccinellia maritima	na	7	6	5	IV	5-7
Agrostis stolonifera	7	4	2	na	IV	2-7
Tripolium pannonicum	2	4	5	na	IV	2-5
Festuca rubra	5	3	na	na	III	3-5
Phragmites australis	4	1	na	na	III	1-4
Lysimachia maritima	3	3	na	na	III	3
Cochlearia anglica	2	3	na	na	III	2-3
Spartina anglica	na	na	3	1	III	1-3
Juncus maritimus	na	4	na	na	II	4
Suaeda maritima	na	na	na	4	II	4
Atriplex prostrata	3	na	na	na	II	3
Oenanthe lachenalii	3	na	na	na	II	3
Salicornia agg.	-	na	na	3	II	3
Carex extensa	2	na	na	na	II	2
Plantago maritima	2	na	na	na	II	2
Tripleurospermum maritimum	na	2	na	na	II	2
Spergularia media	na	1	na	na	II	1

4.4.6 S21 Scirpus maritimus swamp

Constant species: *Bolboschoenus maritimus*.

Stands of S21 *Scirpus maritimus* swamp were the most extensive wetland vegetation type at Gronant Dunes in the marshes enclosed by accreting ridges, but present in small stands in other sub-sites. They are characterised by the dominance of the tall *Bolboschoenus maritimus*, and even where grazed form dense stands with few associates, although the associates that are present are important for distinguishing sub-communities. The total area of this vegetation was 9.48ha. The largest area was occupied by the species-poor and wettest S21a *Scirpus maritimus* sub-community. These stands had relatively few associates, although *Eupatorium cannabinum* and *Mentha aquatica* were frequent. Some stands were wet enough to have a floating mat of *Lemna gibba*, *Lemna minor* or *Lemna trisulca*. Many of the extensive stands of S21a had a fringe of S21c *Agrostis stolonifera* sub-community where they transitioned to other vegetation, most commonly to the dune vegetation at Gronant. Around these margins *Agrostis stolonifera* was a constant presence forming a low mat under the *Bolboschoenus maritimus*. Small amounts of the more brackish S21b *Atriplex prostrata* sub-community were recorded too, characterised by the presence of saltmarsh species amongst the *Bolboschoenus*.

Figure 4-23. Dense stands of S21a at Gronant.

There is an area of S21 at the eastern end of the survey area at Gronant which is grazed by ponies. This area was sampled in more detail which showed that S21 is largely unaffected by the grazing, with dense stands still present and despite some flattening of the vegetation, were no different from S21 elsewhere at Gronant.

Figure 4-24. Pony-grazed S21a at Gronant.

Table 4-26. Floristic table for samples of S21a.

Species	**Q071**	**Q090**	**Q091**	**Q092**	**Q099**	**Q107**	**Q192**	**Q196**	**Const**	**Ab.**
Bolboschoenus maritimus	10	8	9	9	10	10	10	8	V	8-10
Angelica sylvestris	3	6	1	4	na	na	na	na	III	1-6
Lycopus europaeus	1	3	na	4	1	na	na	na	III	1-4
Mentha aquatica	1	7	na	na	4	na	na	na	II	1-7
Epilobium hirsutum	3	na	6	6	na	na	na	na	II	3-6
Lemna gibba	5	na	na	na	na	3	na	na	II	3-5
Cirsium arvense	na	na	3	2	na	na	na	na	II	2-3
Eupatorium cannabinum	1	1	-	na	na	na	na	na	II	1
Hedera helix	na	v	8	na	na	na	na	na	I	8
Lemna minor	na	-	na	na	na	na	8	na	I	8
Agrostis stolonifera	na	5	na	na	na	na	na	na	I	5
Green algae	na	-	na	na	na	na	na	5	I	5
Kindbergia praelonga	na	4	na	na	na	na	na	na	I	4
Lemna trisulca	na	na	na	na	na	4	na	na	I	4
Rubus fruticosus agg.	na	na	4	na	na	na	na	na	I	4
Festuca rubra	na	2	-	na	na	na	na	na	I	2
Potentilla reptans	na	na	2	na	na	na	na	na	I	2
Ranunculus repens	2	na	na	na	na	na	na	na	I	2
Equisetum palustre	1	na	na	na	na	na	na	na	I	1

Species	Q071	Q090	Q091	Q092	Q099	Q107	Q192	Q196	Const	Ab.
Holcus lanatus	na	na	na	1	na	na	na	na	I	1
Oenanthe lachenalii	na	na	na	1	na	na	na	na	I	1
Ranunculus acris	na	na	na	1	na	na	na	na	I	1
Salicornia agg.	na	na	na	na	na	na	na	1	I	1
Spartina anglica	na	na	na	na	na	na	na	1	I	1

Table 4-27. Floristic table for samples of S21b.

Species	Q017	Q081	Q144	Q145	Q162	Q195	Const.	Ab.
Bolboschoenus maritimus	8	10	10	9	9	8	V	8-10
Atriplex prostrata	6	5	4	5	5	na	V	4-6
Tripolium pannonicum	na	na	1	7	1	na	III	1-7
Agrostis stolonifera	3	3	na	na	3	na	III	3
Puccinellia maritima	na	na	na	na	na	5	I	5
Phragmites australis	na	na	na	na	na	3	I	3
Elymus repens	na	na	na	2	na	na	I	2
Tripleurospermum maritimum	na	na	na	na	2	na	I	2
Apium graveolens	na	na	1	na	na	na	I	1
Salicornia agg.	na	na	na	na	na	1	I	1
Spartina anglica	na	na	na	na	na	1	I	1

Table 4-28. Floristic data for samples of S21c.

Species	Q014	Q095	Q102	Q105	Q176	Q193	Const	Ab.
Bolboschoenus maritimus	7	7	10	7	9	9	V	7-10
Agrostis stolonifera	8	8	4	na	6	9	V	4-9
Mentha aquatica	na	4	2	5	na	na	III	2-5
Epilobium hirsutum	na	3	na	1	na	5	III	1-5
Atriplex prostrata	6	na	na	na	5	na	II	5-6
Typha latifolia	na	5	na	3	na	na	II	3-5
Lycopus europaeus	na	3	na	2	na	na	II	2-3
Lemna minuta	na	na	5	na	na	na	I	5
Iris pseudacorus	na	na	na	4	na	na	I	4
Leptodictyum riparium	na	na	4	na	na	na	I	4
Sonchus arvensis	4	na	na	na	na	na	I	4
Apium graveolens	na	na	na	na	na	3	I	3

Species	Q014	Q095	Q102	Q105	Q176	Q193	Const	Ab.
Lysimachia maritima	na	3	na	na	na	na	I	3
Oenanthe lachenalii	na	3	na	na	na	na	I	3
Agrimonia eupatoria	na	na	na	2	na	na	I	2
Alisma plantago-aquatica	na	na	na	2	na	na	I	2
Cochlearia officinalis	na	na	na	na	2	na	I	2
Festuca rubra	na	na	na	na	2	na	I	2
Helosciadium nodiflorum	na	na	na	2	na	na	I	2
Angelica sylvestris	na	na	na	1	na	na	I	1
Lythrum salicaria	1	na	na	na	na	na	I	1
Rumex crispus	na	1	na	na	na	na	I	1
Rumex obtusifolius	na	na	na	na	na	1	I	1
Salix cinerea	na	na	na	1	na	na	I	1
Triglochin maritimum	na	na	na	na	1	na	I	1
Veronica beccabunga	na	na	na	1	na	na	I	1

4.4.7 S26 Phragmites australis-Urtica dioica tall-herb fen

Constant species: *Phragmites australis*, *Urtica dioica*.

Stands of S26 *Phragmites australis-Urtica dioica* tall-herb fen were typically found at the edge of S4 reedbeds where the *Phragmites australis* is able to invade drier ground, as at Gutter Fawr inland of the sluice, but are also present at the Flint flushing lagoon which is perhaps a former reedbed that has dried out. They were characterised by the dominance of *Phragmites australis* but with the presence of species of drier ground, notably *Urtica dioica* and *Arrhenatherum elatius*. Two sub-communities were recorded, S26a *Filipendula ulmaria* sub-community was found in wetter situations and S26b *Arrhenatherum elatius* sub-community in drier situations.

Table 4-29. Floristic data for samples of S26.

Species	Q121	Q108
Sub-community	**S26a**	**S26b**
Achillea millefolium	na	2
Agrostis stolonifera	7	na
Amblystegium serpens	na	5
Angelica sylvestris	7	na
Arrhenatherum elatius	na	7
Brachythecium rutabulum	na	5
Cerastium fontanum	2	na
Chamaenerion angustifolium	na	4
Cirsium arvense	3	4
Cirsium palustre	2	na

Species	Q121	Q108
Sub-community	**S26a**	**S26b**
Cirsium vulgare	2	na
Epilobium hirsutum	3	na
Epilobium species	5	na
Eupatorium cannabinum	3	na
Heracleum sphondylium	na	2
Jacobaea vulgaris	2	na
Linaria purpurea	1	na
Mentha aquatica	4	na
Phragmites australis	7	7
Potentilla anserina	na	6
Ranunculus repens	1	na
Sonchus arvensis	na	2
Sonchus oleraceus	2	na
Urtica dioica	6	na

4.4.8 M23 Juncus effusus/acutiflorus-Galium palustre rush-pasture

Constant species: *Galium palustre*, *Holcus lanatus*, *Juncus acutiflorus* or *Juncus effusus*, *Lotus pedunculatus*.

Small amounts of M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture (0.2ha) were present at Point of Ayr, in an area of relict saltmarsh isolated from tidal inundation by an embankment. There is still some brackish influence, with *Bolboschoenus maritimus* present in low amounts, but *Juncus acutiflorus* and *Phragmites australis* are both constantly present in a very diverse sward with elements of dune slack and mesotrophic grassland. The prominent of *Juncus acutiflorus* means the vegetation to south of the marsh is separated from that assigned to SD17 (Section 4.7.6) despite there being significant floristic similarities between these vegetation types. This is another vegetation type that is a poor fit to any NVC community and placement in M23 perhaps fails to convey the species-rich nature of this vegetation. It sits in a mosaic with ponds (presumably dug to encourage Natterjack Toads) and *Phragmites australis* dominated swamp as well as the SD17.

4.5 Mesotrophic grassland, acid grassland, maritime cliff and open vegetation communities

4.5.1 MG1 Arrhenatherum elatius grassland

Constant species: *Arrhenatherum elatius*, *Dactylis glomerata*. This survey found *Cirsium arvense* and *Festuca rubra* as additional constants.

Stands of MG1 *Arrhenatherum elatius* grassland are coarse grasslands distinguished by the constant and abundant present of *Arrhenatherum elatius*. They were the most common

vegetation on high ground adjacent to the saltmarsh, including on areas of made ground that extend out into the saltmarsh. It is not a true saltmarsh vegetation type, but it was mapped to illustrate the transitions that occur at the salt marsh margins. Most stands were assigned to MG1a *Festuca rubra* sub-community (18.6ha) where *Festuca rubra* is present in a grassy sward, or MG1b *Urtica dioica* sub-community (10.2ha) due to the constant and locally abundant presence of tall ruderal species in the sward. A small amount (0.15ha) of the damper MG1c *Filipendula ulmaria* sub-community was also recorded.

Figure 4-25. MG1b on the made ground that extends into to west side of Flint Marsh towards the southern end.

Table 4-30. Floristic table for samples of MG1.

Species	**Q012**	**Q018**	**Q138**	**Q141**	**Q152**	**Const**	**Ab.**
Sub-community	**MG1**	**MG1a**	**MG1a**	**MG1a**	**MG1b**	na	na
Arrhenatherum elatius	4	9	2	2	8	V	2-9
Festuca rubra	3	na	7	4	3	IV	3-7
Cirsium arvense	4	4	na	4	3	IV	3-4
Agrostis stolonifera	4	3	na	na	4	III	3-4
Achillea millefolium	na	4	4	1	na	III	1-4
Elymus repens	na	1	4	na	3	III	1-4
Holcus lanatus	8	na	na	4	na	II	4-8
Dactylis glomerata	na	1	na	7	na	II	1-7
Urtica dioica	1	na	na	na	5	II	1-5
Lolium perenne	na	3	na	4	na	II	3-4
Lotus corniculatus	na	na	4	2	na	II	2-4
Sonchus arvensis	4	na	na	na	2	II	2-4

Species	Q012	Q018	Q138	Q141	Q152	Const	Ab.
Sub-community	**MG1**	**MG1a**	**MG1a**	**MG1a**	**MG1b**	na	na
Trifolium repens	na	1	2	na	na	II	1-2
Plantago lanceolata	na	1	1	na	na	II	1
Lepidium draba	na	na	na	6	na	I	6
Ononis spinosa	na	na	na	5	na	I	5
Rubus fruticosus agg.	5	na	na	na	na	I	5
Chaerophyllum temulum	na	na	na	na	4	I	4
Cirsium vulgare	4	na	na	na	na	I	4
Epilobium hirsutum	na	na	na	na	4	I	4
Heracleum sphondylium	na	na	na	na	4	I	4
Jacobaea vulgaris	4	na	na	na	na	I	4
Taraxacum agg.	na	na	4	na	na	I	4
Torilis japonica	na	4	na	na	na	I	4
Eupatorium cannabinum	na	na	na	na	3	I	3
Mentha aquatica	3	na	na	na	na	I	3
Poa pratensis	na	na	na	3	na	I	3
Ranunculus acris	na	na	3	na	na	I	3
Veronica chamaedrys	na	na	na	na	3	I	3
Elymus junceiformis	na	na	2	na	na	I	2
Rumex crispus	na	na	na	na	2	I	2
Centaurea nigra	na	1	na	na	na	I	1
Lathyrus pratensis	na	na	1	na	na	I	1
Rumex obtusifolius	na	na	na	na	1	I	1
Tragopogon pratensis	na	1	na	na	na	I	1

4.5.2 MG6 *Lolium perenne-Cynosurus cristatus* grassland and MG7 *Lolium perenne* leys and related grasslands

Constant species: *Cerastium fontanum*, *Cynosurus cristatus*, *Festuca rubra*, *Holcus lanatus*, *Lolium perenne*, *Trifolium repens*

Small areas of MG6 *Lolium perenne-Cynosurus cristatus* grassland and MG7d *Lolium perenne leys and related* grasslands*, Lolium perenne-Alopecurus pratensis* grassland were recorded on raised ground behind the artificial sea banks, but adjacent to saltmarshes in the Dee Estuary and Connah's Quay sub-sites. They are present only above the limits of tidal inundation.

Table 4-31. Floristic data for the MG7d sample.

Species	Q151
Agrostis stolonifera	7
Lolium perenne	5
Taraxacum agg.	5
Dactylis glomerata	4
Holcus lanatus	4
Avenula pubescens	3

4.5.3 MG11 Festuca rubra-Agrostis stolonifera-Potentilla anserina grassland

Constant species: *Agrostis stolonifera*, *Festuca rubra*, *Potentilla anserina*.

Stands of MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland are grassy vegetation associated with the upper saltmarsh, often around transitions to non-saltmarsh vegetation and separated from SM16 swards by the constant presence of *Potentilla anserina* with *Festuca rubra* and *Agrostis stolonifera*. Only 1.7ha were recorded, reflecting to some extent the limited upper saltmarsh present. Both MG11a *Lolium perenne* sub-community and MG11b *Atriplex prostrata* sub-community were recorded, with the named species being key differentials separating these stands.

Table 4-32. Floristic sample from a very species-poor stand of MG11.

Species	Q173
Agrostis stolonifera	10
Potentilla anserina	4

4.5.4 MG13 Agrostis stolonifera-Alopecurus geniculatus grassland

Constant species: *Agrostis stolonifera*, *Alopecurus geniculatus*

A small amount of MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland was recorded in two places. It was present in the most inland marsh to dune transitions at Gronant, and in a few shallow depressions in the upper saltmarsh at Flint Marshes. In all situations the swards were species-poor and dominated by *Agrostis stolonifera*, with only small amounts of *Alopecurus geniculatus* present. The stands generally had few associates, with the grasses forming a thick mat. Overall 0.46ha were recorded.

4.5.5 U4 Festuca ovina-Agrostis capillaris-Galium saxatile grassland

Constant species: *Agrostis capillaris*, *Anthoxanthum odoratum*, *Festuca rubra*, *Galium saxatile*, *Potentilla erecta*

Whilst most of the made ground on piles of dumped spoil has turned into MG1 grassland, one such spoil heap on Bagillt Marshes has retained a strongly acid character, and as such U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community has developed. This is characterised by the absence of *Arrhenatherum elatius* and the dominance of *Agrostis capillaris* and *Festuca ovina*.

Table 4-33. Floristic data for the sample of U4.

Row Labels	Q137
Agrostis capillaris	8
Festuca ovina	7
Peltigera canina	6
Rhytidiadelphus squarrosus	6
Bryum capillare	4
Geranium molle	4
Holcus mollis	1
Hypnum cupressiforme	1

4.5.6 MC5 *Armeria maritima-Cerastium diffusum* ssp. *diffusum* maritime therophyte community

Constant species: *Armeria maritima*, *Plantago coronopus*, *Festuca rubra*, *Cerastium diffusum*, *Sedum* spp.. Stands recorded here were not typical.

The stands of MC5 *Armeria maritima-Cerastium diffusum* ssp. *diffusum* maritime therophyte community recorded in the survey are all at the upper limit of tidal inundation and represent open swards of small, low-growing rosette species, with *Plantago coronopus* constant and typically the most abundant. They are present in two situations, occupying 0.58ha. At Gronant these swards occur on a low sandy single ridge that separates areas of marsh. Here the typical associates are a range of both dune and saltmarsh species.

Two other stands of vegetation were, tentatively, assigned in MC5a *Desmazeria marina* sub-community and were present at the south end of Point of Ayr and alongside the old harbour at Flint (Figure 4-15). The latter being present in close association with, and transitional to, SM27. In both of these situations very open vegetation is present resulting from an artificial substrate with little organic soil development and occasional inundation. The associates are those of upper saltmarsh, and they could be considered to represent extreme forms of SM16, or possibly a form of SM27, and their placement in MC5 is made on the constant presence of *Plantago coronopus* and *Festuca rubra*, the latter only at low abundance, as well as *Catapodium marinum* and *Plantago maritima*.

Figure 4-26. The open sward of MC5 vegetation at the southern end of Point of Ayr.

The vegetation at Flint harbour was associated with a distinctive soil crust, formed with acrocarpous bryophytes, and likely a significant algae component. This soil crust was used to separate the vegetation mapped as MC5, being a slightly more permanent vegetation type, from that of the ephemeral SM27.

Figure 4-27. The MC5 at Flint harbour, with a soil crust of acrocarpous mosses and the rosettes of *Plantago coronopus*.

Table 4-34. Floristic table for samples of MC5.

Species	Q113	Q115	Q116	Const.	Ab.
Sub-community	**MC5b**	**MC5a**	**MC5a**	na	na
Plantago coronopus	5	6	5	V	5-6
Festuca rubra	5	4	5	V	4-5
Catapodium marinum	3	4	2	V	2-4
Syntrichia ruraliformis	6	na	5	IV	5-6
Sedum acre	4	na	5	IV	4-5
Eryngium maritimum	3	na	4	IV	3-4
Trifolium arvense	1	na	3	IV	1-3
Honckenya peploides	3	3	na	IV	3
Plantago maritima	1	1	na	IV	1
Atriplex portulacoides	na	4	na	II	4
Brachythecium albicans	na	na	4	II	4
Elymus junceiformis	na	na	4	II	4
Ononis repens	na	na	4	II	4
Ammophila arenaria	na	na	3	II	3
Lotus corniculatus	3	na	na	II	3
Limonium binervosum agg.	na	2	na	II	2
Limonium vulgare	2	na	na	II	2
Sagina maritima	na	2	na	II	2

4.5.7 MC6 Atriplex prostrata-Beta vulgaris ssp. maritima sea-bird cliff community and SDy Atriplex glabriuscula-Atriplex prostrata strandline

Constant species: *Atriplex prostrata*, *Beta vulgaris* var. *maritima*, *Festuca rubra*, *Tripleurospermum maritimum*

Only a few small areas of MC6 *Atriplex prostrata-Beta vulgaris* ssp. *maritima* sea-bird cliff community were mapped (0.06ha) along the rock armour at the upper edge of Flint Marshes and Greenfield Flushing Lagoon. The vegetation is formed on the strandline which collects amongst the rock armour. The free-draining but nutrient-rich substrate means that tall perennials such as *Atriplex prostrata*, *Beta vulgaris* var. *maritima*, *Rumex crispus* and *Tripleurospermum maritimum* are able to persist.

Included here are also strandline stands dominated by *Atriplex glabriuscula* and *Atriplex prostrata* with few or no other associates. These were recognised by Dargie (2001) who mapped them as 'SDy *Atriplex glabriuscula* – *Atriplex prostrata* strandline' and the community was also identified in Ferry et al. (1990) as their 'B' community on the shingle of Dungeness. It is found in similar situations to MC6 and is clearly related but much more species-poor, occupying 0.05ha.

4.5.8 MC8 Festuca rubra-Armeria maritima maritime grassland

Constant species: *Festuca rubra*, *Armeria maritima*

A single stand of *Festuca rubra* dominated grassland was assigned to MC8 *Festuca rubra-Armeria maritima* maritime grassland. It is present landward of the public footpath on the north side of Flint docks. It is a fixed grassland sward and has a range of associates typical of both saltmarsh and sand dune vegetation including *Beta vulgaris* var. *maritima*, *Eryngium maritimum*, *Euphorbia paralias*, *Plantago maritima* and *Puccinellia maritima*. This makes is very difficult to place in the NVC, but MC8a typical sub-community was chosen on the basis of the dominance of *Festuca rubra* and the varied range of associates, but the placement is at best a loose fit.

Figure 4-28. *Festuca* grassland landward of the public footpath at Flint docks.

Table 4-35. Floristic tables for vegetation samples assigned to MC8.

Species	**Q035**	**Q135**
Sub-community	**MC8e/SM27**	**MC8a**
Agrostis stolonifera	4	na
Armeria maritima	2	na
Beta vulgaris var. *maritima*	na	1
Bryum dichotomum	5	na
Centaurium erythraea	2	na
Ceratodon purpureus	6	na

Eryngium maritimum	na	5
Euphorbia paralias	na	3
Festuca rubra	5	8
Honckenya peploides	na	2
Leymus arenarius	na	2
Lotus corniculatus	3	na
Lysimachia maritima	2	na
Plantago coronopus	4	na
Plantago maritima	na	3
Puccinellia maritima	na	2
Sagina maritima	3	na
Streblotrichum convolutum	3	na
Trifolium arvense	na	2

4.5.9 OV23 Lolium perenne-Dactylis glomerata community

Constant species: *Dactylis glomerata*, *Lolium perenne*, *Plantago lanceolata*, *Taraxacum* agg.

A small amount (0.07ha) of trampled and disturbed vegetation is present on the raised bank that extends out into Flint Marshes just south of the castle. It was placed in OV23 *Lolium perenne-Dactylis glomerata* community and the open sward includes much *Lolium perenne* and *Trifolium repens* with some *Festuca rubra* and *Poa annua*.

4.5.10 OV24 Urtica dioica-Galium aparine community

Constant species: *Galium aparine*, *Urtica dioica*

The OV24 *Urtica dioica-Galium aparine* community was recorded at the flushing lagoon at Flint, occupying 0.05ha of ground on the inland side of the stream that runs through it. It is dominated by tall herbs, most prominently *Urtica dioica*. There is frequent *Rubus fruticosus* agg. and *Epilobium hirsutum* and it is similar to W24 and OV26 recorded nearby, but the dominance of *Urtica dioica* and the constant *Galium aparine* make OV24b *Urtica dioica-Galium aparine* community*, Arrhenatherum elatius-Rubus fruticosus agg.* sub-community the most appropriate place for this stand.

Table 4-36. Floristic data for the sample of OV24b.

Row Labels	**Q084**
Urtica dioica	6
Brachythecium rutabulum	5
Cirsium arvense	5
Galium aparine	5
Chamaenerion angustifolium	3
Epilobium hirsutum	3
Cirsium vulgare	2
Rubus fruticosus agg.	2

4.5.11 OV26 Epilobium hirsutum community

Constant species: *Epilobium hirsutum*, *Urtica dioica.* This survey found *Agrostis stolonifera*, *Rumex crispus*, *Pulicaria dysenterica*, *Rubus fruticosus* agg., *Cirsium arvense*, *Mentha aquatica*, and *Sonchus asper* as additional constants.

Stands of OV26 *Epilobium hirsutum* community were recorded in several places and occupy 1.58ha. They are a tall herb vegetation community with constant *Epilobium hirsutum* and *Urtica dioica*. The stands were present in locations away from tidal inundation, found at the margins of wetlands in the Flint flushing lagoon and at Gronant. The small number of samples from this vegetation show that additional constants include *Agrostis stolonifera*, and *Rumex crispus* with *Agrimonia eupatoria*, *Pulicaria dysenterica* and *Rubus fruticosus* agg. each locally abundant in particular stands.

Figure 4-29. OV26 vegetation in the northern part of the flushing lagoon at Flint Marshes.

Table 4-37. Floristic data for samples of OV26.

Species	**Q125**	**Q124**	**Q161**	**Const.**	**Ab.**
Sub-community	**OV26c**	**OV26d**	**OV26d**	na	na
Epilobium hirsutum	6	5	8	V	5-8
Agrostis stolonifera	7	4	5	V	4-7
Rumex crispus	2	7	1	V	1-7
Pulicaria dysenterica	8	4	na	IV	4-8
Rubus fruticosus agg.	na	1	6	IV	1-6

Species	Q125	Q124	Q161	Const.	Ab.
Sub-community	**OV26c**	**OV26d**	**OV26d**	na	na
Cirsium arvense	2	3	na	IV	2-3
Mentha aquatica	3	3	na	IV	3
Sonchus asper	3	3	na	IV	3
Urtica dioica	1	1	na	IV	1
Agrimonia eupatoria	na	na	8	II	8
Arrhenatherum elatius	na	na	6	II	6
Elymus repens	na	na	5	II	5
Myosotis scorpioides	5	na	na	II	5
Potentilla reptans	na	5	na	II	5
Vicia cracca	4	na	na	II	4
Angelica sylvestris	3	na	na	II	3
Heracleum sphondylium	na	na	3	II	3
Ervum tetraspermum	2	na	na	II	2
Helminthotheca echioides	na	2	na	II	2
Jacobaea vulgaris	na	2	na	II	2
Oxybasis rubra	na	2	na	II	2
Phragmites australis	2	na	na	II	2
Plantago major	na	2	na	II	2
Sonchus oleraceus	2	na	na	II	2
Cerastium fontanum	na	1	na	II	1
Cirsium vulgare	1	na	na	II	1
Epilobium montanum	na	1	na	II	1
Eupatorium cannabinum	1	na	na	II	1
Lotus corniculatus	na	1	na	II	1
Ranunculus sceleratus	na	1	na	II	1

4.5.12 OV27 Epilobium angustifolium community

Constant species: *Chamaenerion angustifolium*

A small stand of OV27e *Epilobium angustifolium* community*, Ammophila arenaria* sub-community was associated with the margins of the wetlands where they transition to dunes at Gronant.

4.5.13 OV28 Agrostis stolonifera-Ranunculus repens community

Constant species: *Agrostis stolonifera*, *Ranunculus repens*

In the northern end of the flushing lagoons at Flint, some pools had recently been scraped and these were dry at the time of survey and being colonised by a few inundation-tolerant species. Only *Agrostis stolonifera* was constant, but *Ranunculus repens* was present, along with *Ranunculus sceleratus* and *Oxybasis rubra*. This vegetation is difficult to place, and OV28 *Agrostis stolonifera-Ranunculus repens* community is best approximation.

Table 4-38. Floristic data for samples of OV28.

Species	Q103	Q123
Agrostis stolonifera	10	2
Atriplex prostrata	2	na
Cirsium arvense	1	1
Lysimachia maritima	4	na
Oxybasis rubra	na	7
Ranunculus repens	1	1
Ranunculus sceleratus	na	1
Sonchus arvensis	2	na

4.6 Woodland and scrub communities

Two types of wet woodland were noted. A small stand of W1 *Salix cinerea-Galium palustre* woodland was recorded at Gronant where a small number of *Salix cinerea* were present at the edge of the swamp. Stands of W2 *Salix cinerea-Betula pubescens-Phragmites australis* woodland and W6 *Alnus glutinosa-Urtica dioica* woodland were present in the northern part of the Flint flushing lagoon. The W6 is mature woodland but the W2 is very open cover of developing woodland.

Figure 4-30. The W6 woodland at the back of the flushing lagoon at Flint Marshes.

Other woodland and scrub communities were recorded forming the immediate surrounding vegetation to the saltmarsh. Most common are patches of *Rubus fruticosus* agg. scrub, generally referable to W24 *Rubus fruticosus-Holcus lanatus* underscrub. Mature woodland has developed on raised ground around the north end of Flint Marshes, with much *Betula pubescens* probably representing a secondary form of W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland but were not surveyed in detail. Fringing areas of

W21 *Crataegus monogyna-Hedera helix* scrub and W23 *Ulex europaeus-Rubus fruticosus* scrub were recorded elsewhere.

4.7 Sand dune and shingle communities

Sand dune and shingle communities were present at both Gronant and Point of Ayr and although they were not mapped in detail, where they occurred within or adjacent to saltmarsh they were recorded. The dune communities that occur in close association with the saltmarsh are discussed below.

4.7.1 SD2 Honckenya peploides-Cakile maritima strandline community

Constant species: *Cakile maritima*, *Honckenya peploides*

Stands of SD2 *Honckenya peploides-Cakile maritima* strandline community are present around the outmost edges of the spits at Gronant and Point of Ayr. They are separate from the saltmarsh, developing on pure sand and in this part of the Dee Estuary characterised by *Cakile maritima*, with *Honckenya peploides* scattered and more often found in open sandy vegetation further inland.

Table 4-39. Floristic data for samples of SD2

Species	Q075	Q191
Atriplex prostrata	na	2
Cakile maritima	6	2
Elymus junceiformis	4	1
Eryngium maritimum	na	1
Festuca rubra	3	na
Honckenya peploides	na	4
Leymus arenarius	3	na
Polygonum oxyspermum	na	2
Sonchus arvensis	1	na

4.7.2 SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community

Constant species: *Elymus junceiformis*. This survey found *Eryngium maritimum* and *Euphorbia paralias* as additional constants.

The SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community is most typically found on embryo dune ridges, and some pure stands on sand are present around the accreting species. However, there are stands of *Elymus junceiformis* that are more closely associated with saltmarsh, and these were mapped as SD4t to denote a transitional variant of the community. These are typically present on the landward side of the spits where the edge of the partly enclosed marsh transitions to the dunes, and often closely associated with SD5 too. In these situations, and most abundantly at Point of Ayr, there

are open stands of *Elymus junceiformis* mixed with species of the adjacent upper saltmarsh, typically SM14 and SM16. Samples from this vegetation show that the only other constant species in these transitional swards was *Atriplex portulacoides*, but frequent associates include *Puccinellia maritima*, *Salicornia* agg., *Suaeda maritima*, and *Tripolium pannonicum*.

Table 4-40. Floristic table for samples of typical SD4

Species	Q104	Q110	Q111	Q198	Const.	Ab.
Elymus junceiformis	5	5	4	8	V	4-8
Eryngium maritimum	1	5	4	1	V	1-5
Euphorbia paralias	na	1	3	4	IV	1-4
Tripleurospermum maritimum	5	na	na	3	III	3-5
Honckenya peploides	na	2	1	na	III	1-2
Festuca rubra	4	na	na	na	II	4
Oenothera species	4	na	na	na	II	4
Carex arenaria	na	na	na	3	II	3
Cirsium arvense	3	na	na	na	II	3
Lotus corniculatus	3	na	na	na	II	3
Parapholis strigosa	3	na	na	na	II	3
Sonchus arvensis	3	na	na	na	II	3
Leymus arenarius	na	2	na	na	II	2
Sedum acre	2	na	na	na	II	2
Plantago maritima	1	na	na	na	II	1
Rumex crispus	na	na	1	na	II	1

Figure 4-31. Transitional SD4 in the transition from low dunes with SD5 in the background to SM14 saltmarsh below the picture.

Table 4-41. Floristic table for samples of transitional SD4.

Species	Q054	Q073	Q093	Q101	Q119	Const	Ab.
Elymus junceiformis	7	8	8	5	6	V	5-8
Atriplex portulacoides	4	3	1	3	4	V	1-4
Puccinellia maritima	3	na	na	5	6	III	3-6
Suaeda maritima	3	na	na	4	5	III	3-5
Salicornia agg.	1	na	2	5	na	III	1-5
Tripolium pannonicum	1	na	4	2	na	III	1-4
Festuca rubra	2	5	na	na	na	II	2-5
Leymus arenarius	na	na	na	2	3	II	2-3
Plantago maritima	1	na	1	na	na	II	1
Lysimachia maritima	na	na	5	na	na	I	5
Beta vulgaris var. maritima	na	4	na	na	na	I	4
Bolboschoenus maritimus	na	-	4	na	na	I	4
Atriplex littoralis	na	3	na	na	na	I	3
Sonchus oleraceus	na	na	2	na	na	I	2
Spergularia media	na	2	na	na	na	I	2
Atriplex prostrata	na	na	na	na	1	I	1
Cakile maritima	na	na	na	na	1	I	1
Sonchus arvensis	na	1	na	na	na	I	1
Spergularia marina	1	na	na	na	na	I	1

4.7.3 SD5 *Leymus arenarius* mobile dune community

Constant species: *Leymus arenarius*

Stands of SD5 *Leymus arenarius* mobile dune community are present on the low dunes and developing spits at both Gronant and Talacre. On the embryo dunes around the spits, it is more commonly found on the deeper sand, with SD4 occupying the transition zone, but on more mature dunes, such as those north of the spit at Point of Ayr, SD5 occupies the transition zone between the dune and saltmarsh, and here stands are mapped as SD5t to note this transitional variant. The transitional stands have constant *Leymus arenarius* with saltmarsh species such as *Spergularia media*, *Suaeda maritima* and *Tripolium pannonicum*. These contrast with more typical forms of SD5 including SD5a species-poor sub-community which is present on embryo dunes and SD5c *Festuca rubra* sub-community which is present on slightly more mature small dunes and has a wider range of sand dune associates including constant *Festuca rubra*.

Figure 4-32. SD5 forming the vegetation at the transition between sand dune and saltmarsh at Point of Ayr.

Figure 4-33. Stands of SD4 and SD5 of the youngest dune ridge at Gronant.

Table 4-42. Floristic data for samples of SD5.

Species	Q056	Q074
Sub-community	**SD5c**	**SD5t**
Ammophila arenaria	na	2
Atriplex littoralis	1	na
Atriplex prostrata	na	2
Beta vulgaris var. *maritima*	5	5
Elymus athericus	4	na
Elymus junceiformis	na	3
Festuca rubra	8	6
Leymus arenarius	4	5
Rumex crispus	1	na
Spergularia media	na	1
Suaeda maritima	na	4
Tripleurospermum maritimum	1	na
Tripolium pannonicum	na	2

4.7.4 SD7 *Ammophila arenaria-Festuca rubra* semi-fixed dune community

Constant species: *Ammophila arenaria*, *Festuca rubra*, *Poa pratensis*, *Hypochaeris radicata*. This survey found *Ononis repens*, *Elymus repens* and *Eryngium maritimum* as additional constants.

Stands of SD7 *Ammophila arenaria-Festuca rubra* semi-fixed dune community represent typical semi-fixed dune swards and are a part of the dune vegetation at Gronant. The SD7d *Ammophila arenaria-Festuca rubra* semi-fixed dune community*, Elymus pycnanthus* sub-community includes the upper saltmarsh grass *Elymus athericus*, which can occur away from saltmarshes in dune vegetation, but here is typical of dune swards close to the edge of the saltmarsh, perhaps on former saltmarsh where sand has accreted over the marsh to a sufficient depth to exclude the other saltmarsh species. In the samples here *Elymus repens* locally replaced *Elymus athericus*.

Table 4-43. Floristic data for samples of SD7

Species	Q098	Q097	Q109	Const	Ab.
Sub-community	**SD7a**	**SD7d**	**SD7d**	na	na
Festuca rubra	5	9	8	V	5-9
Ammophila arenaria	9	na	3	IV	3-9
Ononis repens	3	5	na	IV	3-5
Elymus repens	na	2	3	IV	2-3
Eryngium maritimum	1	na	1	IV	1
Plantago maritima	na	na	6	II	6
Arrhenatherum elatius	na	4	na	II	4
Brachythecium rutabulum	4	na	na	II	4
Erigeron bonariensis	4	na	na	II	4

Leymus arenarius	na	na	4	II	4
Rubus caesius	na	4	na	II	4
Sedum acre	na	na	4	II	4
Sonchus arvensis	na	na	4	II	4
Sonchus oleraceus	na	4	na	II	4
Syntrichia ruraliformis	na	na	4	II	4
Homalothecium lutescens	3	na	na	II	3
Lotus corniculatus	na	3	na	II	3
Plantago coronopus	na	na	3	II	3
Agrostis capillaris	2	na	na	II	2
Clematis tangutica	2	na	na	II	2
Hypochaeris radicata	na	na	2	II	2
Poa humilis	na	2	na	II	2
Cirsium vulgare	na	1	na	II	1
Inula conyzae	1	na	na	II	1
Senecio squalidus	1	na	na	II	1
Sonchus asper	1	na	na	II	1
Taraxacum agg.	1	na	na	II	1
Tripleurospermum maritimum	1	na	na	II	1

4.7.5 SD8 *Festuca rubra-Galium verum* fixed dune grassland

At Gronant this community forms part of transitional zones, particularly with SM16 as the vegetation becomes increasingly dry. The swards here are characterised by species-poor *Festuca rubra*, forming SM16d where the water table is higher, but slowly losing and indication of wetness and picking up more dune species to become closer to SD8. The boundary of these vegetation types is very difficult to delimit, and possibly varies depending on the climate.

4.7.6 SD16 *Salix repens-Holcus lanatus* dune-slack community and SD17 *Potentilla anserina-Carex nigra* dune-slack community

Another set of difficult vegetation types that occupy the transition zones between saltmarsh and sand dune were assigned to the dune slack communities SD16 *Salix repens-Holcus lanatus* dune-slack community and SD17 *Potentilla anserina-Carex nigra* dune-slack community. These communities were only recorded at Gronant. In the pony-grazed area of marsh (Figure 4-24) there is an open, grassy vegetation on slightly higher ground than the S21 vegetation. It is very diverse, and is characterised by mesotrophic grasses including *Agrostis stolonifera*, *Festuca rubra*, *Holcus lanatus* and *Poa* sp. but includes a range of associates including saltmarsh species such as *Juncus gerardii*, *Oenanthe lachenalii* and fen species including *Angelica sylvestris, Epilobium hirsutum* and *Myosotis scorpioides*, and dune slack species such as *Dactylorhiza* sp. and *Rhinanthus minor*. This combination is not typical of any NVC community, and despite the lack of *Salix repens* is placed in SD16.

There is a similar situation for the ungrazed vegetation that runs along the southern edge of the marsh to the north of the pony field at Gronant. Here the transitional vegetation is a similar mix of mesotrophic grassland, dune slack and saltmarsh species. This is also very variable in composition and is placed in SD17 *Potentilla anserina-Carex nigra* dune-slack community.

Figure 4-34. Vegetation in the relict marsh at Point of Ayr, now with dune slack vegetation referred to SD17b.

Table 4-44. Floristic data for marshes assigned to dune slack communities.

Species	**Q106**	**Q061**	**Q062**	**Q089**
Community	**SD17a**	**SD17b**	**SD17b**	**SD16**
Rhinanthus minor	2	4	4	3
Calliergonella cuspidata	5	7	5	na
Agrostis stolonifera	6	3	na	7
Festuca rubra	6	na	6	5
Juncus gerardii	na	4	4	2
Angelica sylvestris	4	1	na	2
Juncus acutiflorus	1	4	na	4
Phragmites australis	4	4	4	na
Holcus lanatus	na	na	3	7
Epilobium hirsutum	4	na	na	3
Trifolium repens	na	4	na	3
Ranunculus acris	na	na	4	2
Carex otrubae	na	3	2	na
Oenanthe lachenalii	2	na	na	3
Carex flacca	na	1	3	na

Species	Q106	Q061	Q062	Q089
Community	**SD17a**	**SD17b**	**SD17b**	**SD16**
Cerastium fontanum	3	na	na	1
Odontites vernus	na	na	3	1
Dactylorhiza species	na	na	1	2
Brachythecium rutabulum	na	4	4	na
Plantago lanceolata	4	na	4	na
Solidago canadensis	na	4	4	na
Poa humilis	3	na	na	3
Ranunculus repens	na	3	3	na
Cardamine pratensis	1	1	na	na
Amblystegium serpens	na	na	na	7
Hydrocotyle vulgaris	na	na	5	na
Lysimachia vulgaris	na	5	na	na
Vicia cracca	na	5	na	na
Carex distans	4	na	na	na
Equisetum palustre	na	na	na	4
Lathyrus pratensis	na	na	na	4
Lotus pedunculatus	na	4	na	na
Plagiomnium affine	na	na	4	na
Trifolium pratense	4	na	na	na
Arrhenatherum elatius	3	na	na	na
Chamaenerion angustifolium	na	na	3	na
Equisetum arvense	na	3	na	na
Equisetum variegatum	na	na	3	na
Euphrasia species	na	na	3	na
Iris pseudacorus	na	3	na	na
Juncus conglomeratus	na	na	3	na
Lotus corniculatus	3	na	na	na
Poa trivialis	na	na	na	3
Potentilla reptans	na	na	na	3
Eupatorium cannabinum	na	na	2	na
Leucanthemum vulgare	na	2	na	na
Sonchus oleraceus	2	na	na	na
Agrimonia eupatoria	na	na	na	1
Carex arenaria	na	na	1	na
Cirsium arvense	na	na	1	na
Jacobaea vulgaris	1	na	na	na
Juncus bufonius	na	na	na	1
Myosotis scorpioides	na	na	na	1
Oenothera species	na	na	na	1
Rumex crispus	1	na	na	na
Vicia sativa	1	na	na	na
Vicia sepium	na	na	1	na

4.7.7 Other sand dune vegetation

Areas of sand dune adjacent to, or in a few instances surrounded by, saltmarsh include SD6 *Ammophila arenaria* mobile dune community, SD9 *Ammophila arenaria-Arrhenatherum elatius* dune grassland, and SD19 *Phleum arenarium-Arenaria serpyllifolia* dune *annual* community. These all occur on pure sand, and although a few samples were taken, are clearly separate from the saltmarsh vegetation and the influence of saline water.

Table 4-45. Floristic data for sample of SD9a.

Species	Q096
Ammophila arenaria	8
Arrhenatherum elatius	6
Festuca rubra	6
Polypodium interjectum	5
Lotus corniculatus	4
Ononis repens	4
Poa humilis	4
Rubus caesius	4
Agrostis capillaris	3
Jacobaea vulgaris	3
Dactylis glomerata	2
Sonchus oleraceus	2
Taraxacum agg.	2
Anacamptis pyramidalis	1
Centaurium erythraea	1
Scorzoneroides autumnalis	1

Table 4-46. Floristic data for sample of SD19.

Species	Q094
Syntrichia ruraliformis	7
Lotus corniculatus	6
Ceratodon purpureus	5
Ammophila arenaria	4
Brachythecium albicans	4
Bryum capillare	4
Elymus junceiformis	4
Ononis repens	4
Sedum acre	4
Arenaria serpyllifolia	3
Festuca rubra	3
Hypochaeris radicata	3
Phleum arenarium	3
Eryngium maritimum	2
Honckenya peploides	2
Leontodon saxatilis	2
Anacamptis pyramidalis	1
Erigeron acris	1

4.8 Miscellaneous vegetation and other

A few stands of vegetation that didn't fit within the NVC were mapped, along with various forms of non-vegetation. Unvegetated habitats included tracks, paths, roads, sea defence structures, sluices and tidal flaps.

There were a few single species stands of vegetation present. These included a 0.05ha stand of *Solidago canadensis* present in the relict saltmarsh at the Point of Ayr. *Solidago canadensis* is able to spread vegetatively, and in the damp sand has managed to colonise a large area forming a colourful display but displacing the very rich dune slack flora that would otherwise be present. Similarly, *Rosa rugosa* is present at Gronant, although primarily in dune vegetation and not in the saltmarsh, where it forms dense, species-poor stands. It was mapped as this species, but it occurs more widely in the sand dune vegetation, along with another striking non-native, *Clematis tangutica*.

Figure 4-35. Stands of *Solidago canadensis* invading the rich dune slack flora in the marsh at Talacre.

Areas of bare ground were mapped as ‘PF’ for pans and flashes, as done by Dargie (2001). These are most common as apparently natural features on most of the marshes, but some pools have been excavated to provide habitat variation for birds. This is most obvious at Connah’s Quay where circular pools with islands have been created. Some areas in and around the margin of such pools were colonised by annual saltmarsh vegetation (typically SM9) and were mapped as this vegetation such that the 3.97ha of PF is probably an underestimate of the area of pools of water on the saltmarshes.

Figure 4-36. The artificial pools created at Connah's Quay

Figure 4-37. Natural saltmarsh pans on Flint Marshes.

4.9 Notable Species

A systematic survey for notable species was not carried out, but notable species were recorded where encountered and are discussed below.

4.9.1 Rare and protected species

Of the rare and notable species recorded in Dargie (2001) only *Parapholis strigosa* was found. This was present in the dunes at Gronant, often in the transitional vegetation where sandy shingle is present between the dune and saltmarsh.

4.9.2 Invasive species

Invasive species were much more commonly encountered. Stands of *Solidago canadensis* and *Rosa rugosa* are discussed in the preceding section, although neither represents a threat to saltmarsh. The dunes at Gronant included other non-natives such as *Clematis tangutica*, *Erigeron bonariensis*, and *Erigeron glaucus*, but these appear to be persisting in the vegetation at low levels rather than invading. *Hippophae rhamnoides* was also present in the dunes on low shingle ridges between the areas of saltmarsh. It appears to have been controlled by cutting and stump treatment and the bushes present are regrowth from the stumps.

A small number of invasive non-native species listed on Schedule 9 of the Wildlife and Countryside Act were also associated with upper limit of saltmarsh, some commonly found around buildings and landscaped areas and on hard sea defences at the edge of the saltmarsh. Species recorded include *Cotoneaster simonsii* (Flint Marshes, Dee River Marshes), *Crocosmia* x *crocosmiiflora* (Point of Ayr) and the former as well as *Parthenocissus quinquefolia,* and *Cotoneaster horizontalis* (both Dee River Marshes).

Other non-native species recorded in or around the transition to the saltmarsh include *Buddleja davidii*, *Prunus laurocerasus* and *Symphoricarpos albus* (all three Dee River Marshes), and *Symphyotrichum* sp. (sandy vegetation at Gronant), as well as floating *Lemna minuta* recorded floating in the water under a canopy of *Bolboschoenus maritimus* in S21c vegetation at Gronant.

5 Results - NVC description for each sub-site

5.1 Gronant Marshes

The saltmarshes at Gronant are formed in an open coast back barrier system formed by the accreting dunes that have developed from the ridge that runs east from Prestatyn. The system is slightly complicated where these dunes meet those that form the Talacre system, creating something of an open embayment at the head of the barrier system. Successive marshes have become enclosed by new accreting dune ridges, creating a series of marshes between tall sand dunes, and the process is ongoing with area. The largest and most landward set of marshes is around the Prestatyn Gutter, between a tidal sluice and its outfall at the sea. There are then a series of smaller marshes becoming increasingly more saline moving northwards.

Although Prestatyn Gutter has been modified and there has been land reclamation of the dunes, and presumably marshes to the west, much of what remains at Gronant is very natural and makes a clear display of the way successive marshes form behind accreting dune ridges. This ongoing process of accretion and succession is also apparent when comparing the present survey to that of Dargie (2001).

Inland there are three areas of marshes with a strong freshwater influence from Prestatyn Gutter (Figure 5-1 Areas A, B, and C including A/B) and are dominated by tall monocots, with stands of S4a *Phragmites australis* swamp and reed-beds*, Phragmites australis* sub-community and S21 *Scirpus maritimus* swamp the most common swamp vegetation types. There are stands of S12 *Typha latifolia* swamp and S14 *Sparganium erectum* swamp along the edges of Prestatyn Gutter. Further north, the next marsh (Area D) supports vegetation with a more distinctive saline influence, with SM14 *Halimione portulacoides* salt-marsh community and SM16 *Festuca rubra* salt-marsh community both extensive and including the most extensive stands of the proposed novel sub-community SM16x *Festuca rubra* salt-marsh community, *Carex extensa* sub-community. There are smaller amounts of SM10 *Transitional low-marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima* and SM13 *Puccinellia maritima* salt-marsh community present around the creeks and in lower-lying areas. The most pioneering vegetation (Area E and the pioneer saltmarsh) is referable to SM9 *Suaeda maritima* salt-marsh community and unusually stands of S20 *Scirpus lacustris* ssp. *tabernaemontani* swamp.

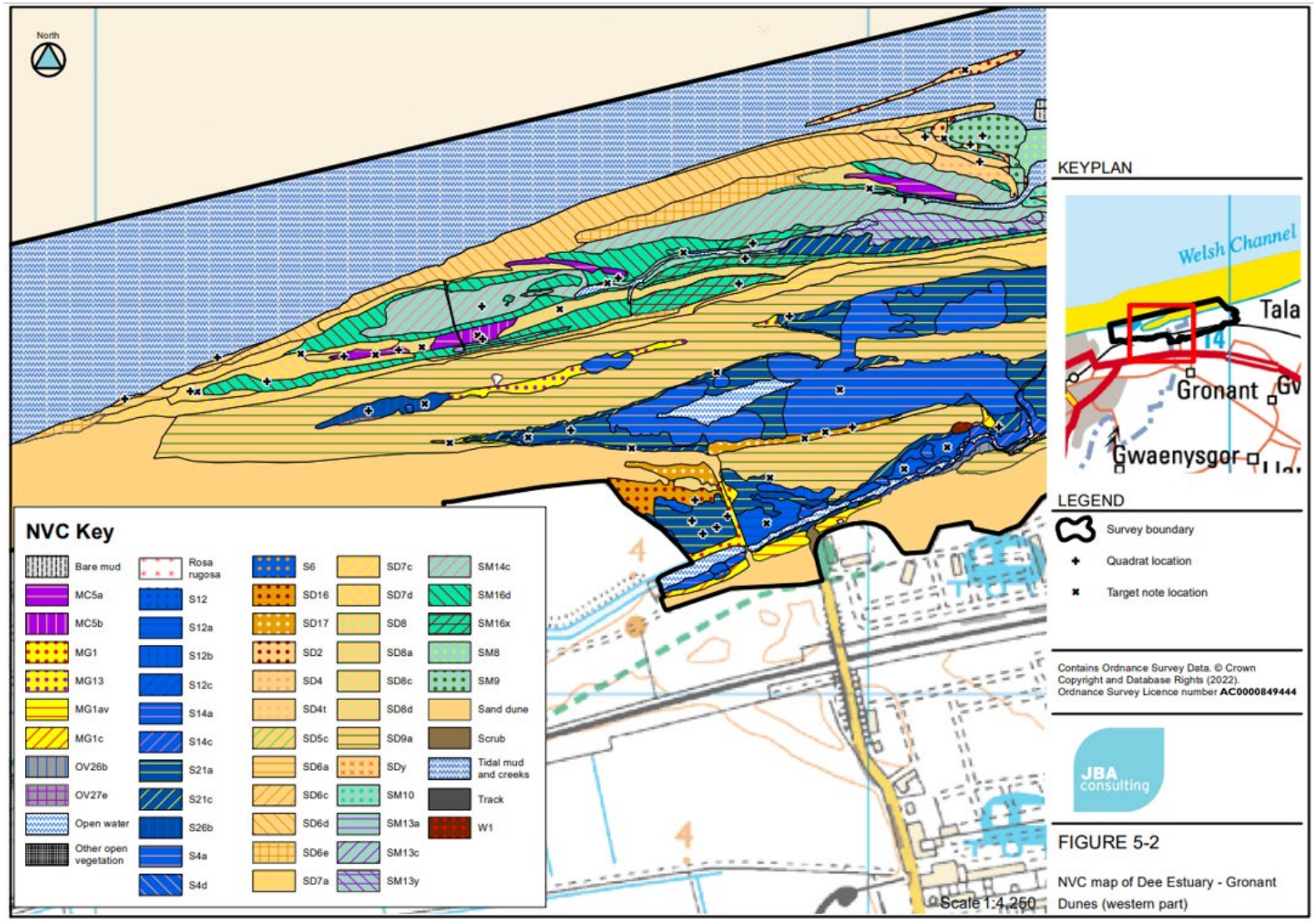
There are extensive transitions to sand dune vegetation, most difficult to classify, but towards the eastern end of the site where there are newly accreting ridges these include areas of SD2 *Honckenya peploides-Cakile maritima* strandline community, SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community that include species of lower saltmarsh amongst the dune flora.

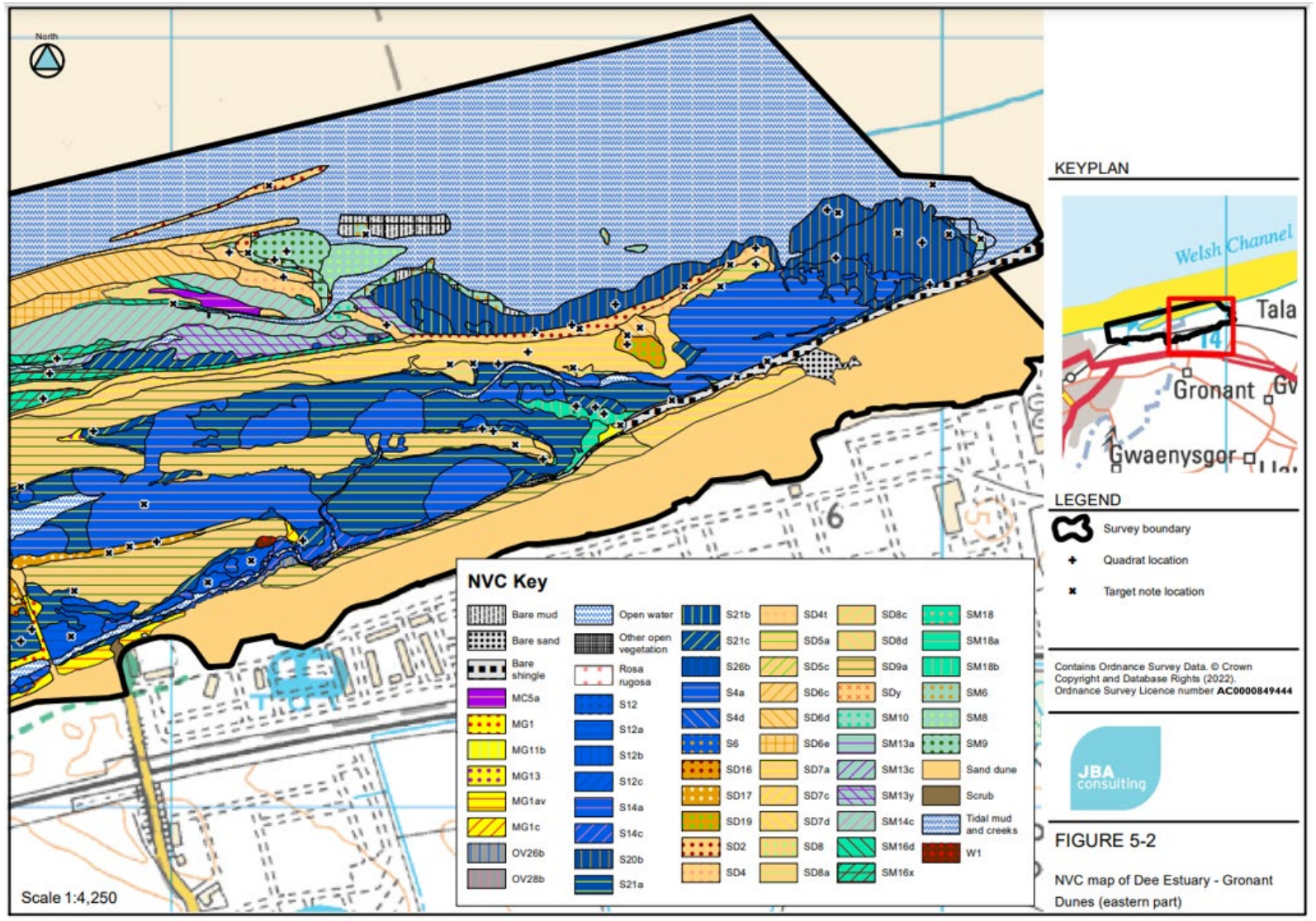
Figure 5-1. Features of the saltmarsh at Gronant. Areas A-E are referred to in the text.

Whilst most of the marshes are separated by mature dune ridges with fixed dune vegetation, there is a small shingle ridge that runs east to west through Area D, and this has a mix of sandy vegetation and shingly saltmarsh with *Limonium binervosum* agg. and are assigned to SM16d but are a very poor fit to this.

At the western end of the survey is an area of marsh fenced off and grazed by ponies. This area has a wetter southern part with species-poor S21 *Scirpus maritimus* swamp, and a damp northern section, with a rather mixed vegetation that is best approximated by dune slack vegetation. The grazing acts to keep the dune slack area open and species-rich, but the *Bolboschoenus maritimus* vegetation is apparently unpalatable and has developed a tall, dense sward.

Figure 5-2. NVC maps for Gronant Dunes.




North
Scale 1:4,250
NVC Key
Bare mud
Bare sand
Bare shingle
MC5a
MG1
MG11b
MG13
MG1av
MG1c
OV26b
OV28b
Open water
Other open vegetation
Rosa rugosa
S12
S12a
S12b
S12c
S14a
S14c
S20b
S21a
S21b
S21c
S26b
S4a
S4d
S6
SD16
SD17
SD19
SD2
SD4
SD4t
SD5a
SD5c
SD6c
SD6d
SD6e
SD7a
SD7c
SD7d
SD8
SD8a
SD8c
SD8d
SD9a
SDy
SM10
SM13a
SM13c
SM13y
SM14c
SM16d
SM16x
SM18
SM18a
SM18b
SM6
SM8
SM9
Sand dune
Scrub
Tidal mud and creeks
W1
KEYPLAN
Welsh Channel
Tala
Gronant
Gwaenysgor
LEGEND
Survey boundary
Quadrat location
Target note location
Contains Ordnance Survey Data. © Crown Copyright and Database Rights (2022). Ordnance Survey Licence number AC0000849444
JBA consulting
FIGURE 5-2
NVC map of Dee Estuary - Gronant Dunes (eastern part)

5.2 Point of Ayr

The saltmarsh at Point of Ayr is formed in an open coast back barrier system. The landward extent of the saltmarsh is defined by a sea bank, which is shown as present in the 1871 Ordnance Survey map. The bank has allowed extensive conversion of previously marshy land into drier ground, principally used as pasture, but a few areas of relict marsh persist. Anecdotally historic attempts were made to reclaim further land from the saltmarsh, but these failed. The outer limits in the northern section are defined by a tall dune ridge which extends in a spit around the marsh enclosing the top half. The spit has a fairly high shingle component, and in more open areas supports a breeding colony of Little Terns, a fact that affords it protection from disturbance over summer, despite high visitor numbers to the area. South of the spit the marsh appears to be accreting with extensive pioneer saltmarsh extending from the spit south to the site of the old colliery. A low sandy ridge runs north-south through the middle of the saltmarsh, but this is not tall enough to support dune grassland except in a few high spots.

The northern extent of the saltmarsh is used as a public car park and is unsurfaced and inundated on the highest tides. The use is sufficient to compact and disturb the ground enough to prevent vegetation developing and leads to significant trampling of the adjacent vegetation. This impact is being reduced by Natural Resources Wales, who are reducing visitor impacts by fencing off areas and maintaining the fencing and pathways, allowing saltmarsh to expand back into some areas from which it had previously been lost.

The southern part, referred to as the separate sub-site of Point of Ayr Colliery in Dargie (2001) is south-west of the Talacre Gas Terminal and defined by two large areas of made ground, presumably overburden from the old Point of Ayr Colliery, and which are separated by the outfall of Gutter Fawr. Gutter Fawr itself is tidal in a small embayment, but a tidal sluice under a minor road (a 19th century tramway serving the Point of Ayr Colliery) separates a brackish reedbed from the full tidal cycle.

The vegetation in the main areas of saltmarsh at Point of Ayr is typical of that of much of the Dee Estuary, with large areas of SM14 *Halimione portulacoides* salt-marsh community forming the area of enclosed saltmarsh to the north, with SM16 *Festuca rubra* salt-marsh community becoming more common to the south and on the lower parts of the sandy ridge that runs through the marsh. The pioneer vegetation includes SM13 *Puccinellia maritima* salt-marsh community, with significant areas of the SM13y *Puccinellia maritima* salt-marsh community, *Spartina anglica* sub-community present reflecting the accreting nature of the saltmarsh. The most tidal areas around Gutter Fawr support similar vegetation, with much species-poor SM13a *Puccinellia maritima* salt-marsh community*, Puccinellia maritima* sub-community. The accreting pioneer vegetation is comprised of distinct areas of both SM8 *Annual Salicornia* salt-marsh community and SM9 *Suaeda maritima* salt-marsh community.

There is more unusual vegetation around the developing spit where embryo dunes support SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community and SD5 *Leymus arenarius* mobile dune community swards that are occasionally inundated with tidal water, or are just accreting on the tidal sediment. Sandy areas on top of saltmarsh are also created when the sea breaches the line of dunes, creating an overwash zone of sand on top of the saltmarsh behind. This process is expected to increase in frequency as a result of sea level rise. The resulting sandy swards have many lower and middle saltmarsh

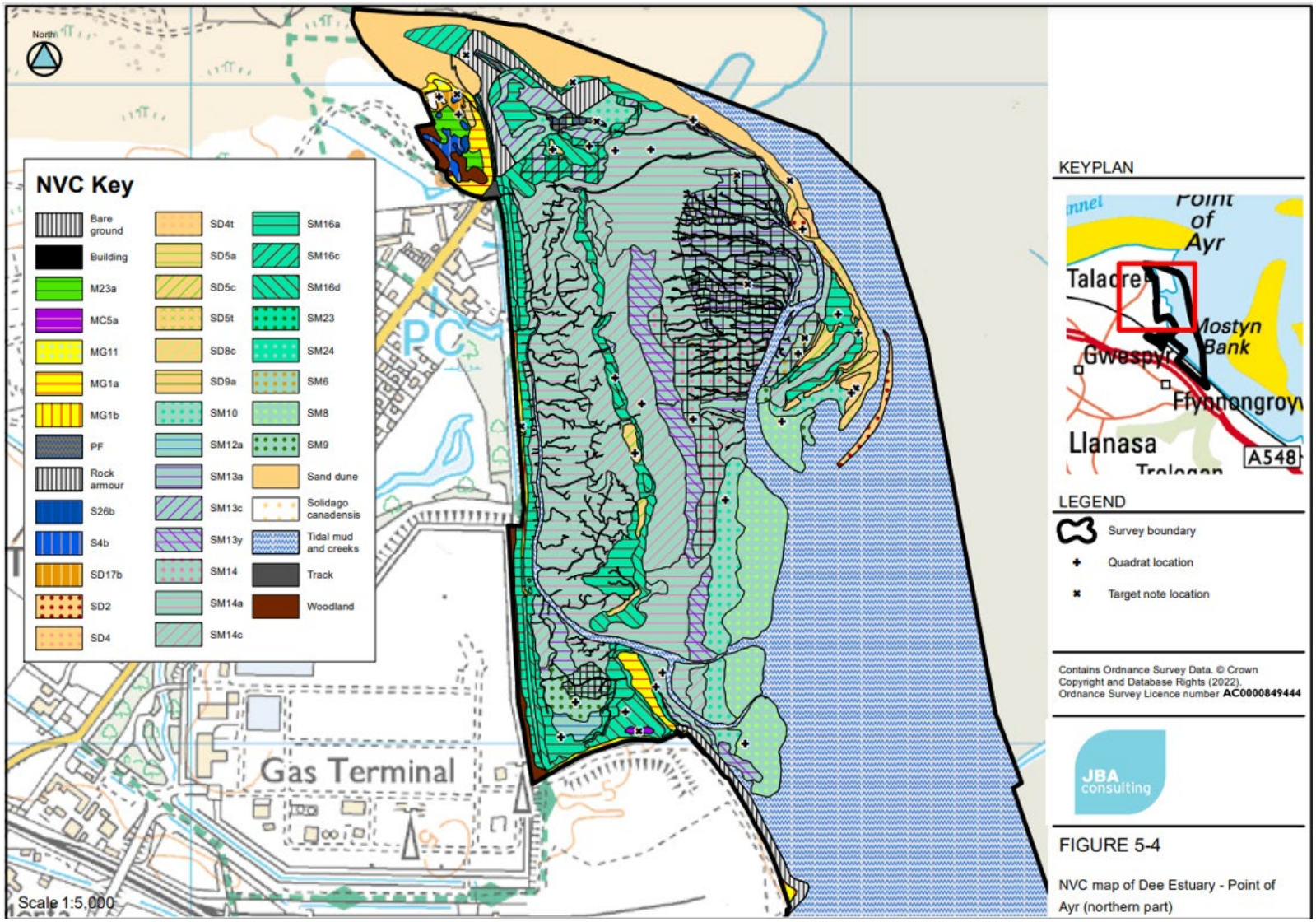
species, giving rise to transitional vegetation. These are characterised by having dune graminoids (*Elymus junceiformis* and *Leymus arenarius*) with the typical associates comprising saltmarsh herbs such as *Atriplex prostrata*, *Suaeda maritima*, *Tripolium pannonicum* and a few dune pioneer species such as *Cakile maritima*, *Euphorbia paralias,* and *Honckenya peploides*. On the lower ground, there are also stands of SM14 *Halimione portulacoides* salt-marsh community with constant and locally abundant *Spartina anglica*, which appear to be homologous to SM13y in terms of formation by invasion of SM6 from the middle saltmarsh species.

Figure 5-3. Important features at Point of Ayr.

There is a small area of marsh landward of the sea bank at the north end of the Point of Ayr, which has a distinctive sandy component, but large areas of S4 *Phragmites australis* swamp and reed-beds and some species-rich vegetation with a dune slack character, referred to SD17 *Potentilla anserina-Carex nigra* dune-slack community and M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture*, Juncus acutiflorus* sub-community.

The southern projection of raised ground was mapped as saltmarsh by Dargie (2001) because dredgings were dumped here, creating a saline environment. However, this practice seems to have ceased and the area now supports a rank sward of MG1 *Arrhenatherum elatius* grassland.

Figure 5-4. NVC maps for Point of Ayr.



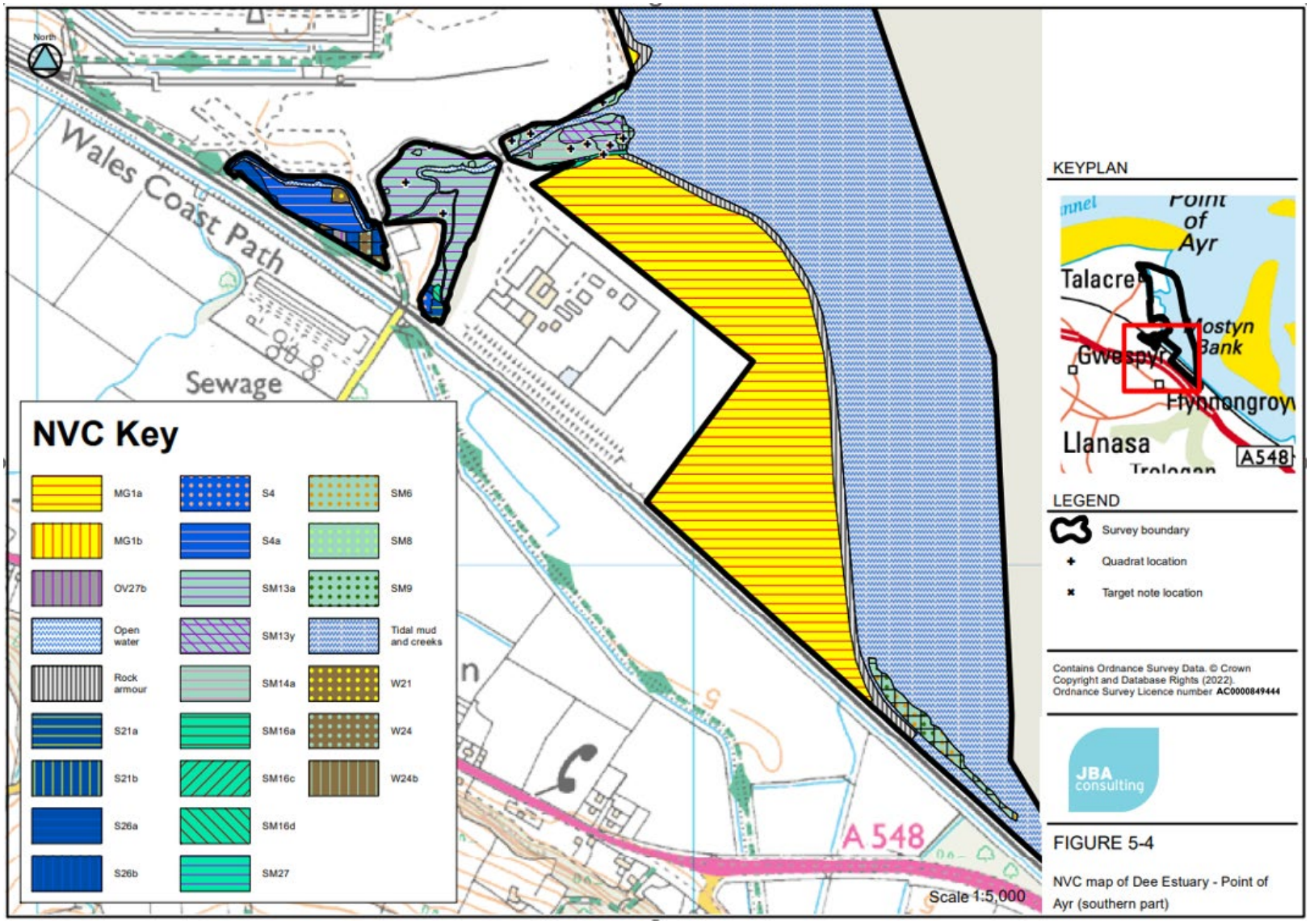


FIGURE 5-4

NVC map of Dee Estuary - Point of Ayr (southern part)

5.3 Greenfield Flushing Lagoon

A small area of saltmarsh persists at Greenfield Dock where an unnamed stream reaches the sea, and a small gap allows it out between the rock armour and sea bank. The dock was built in the 18th Century and the 1871 and 1910 OS maps show a wharf extending out beyond the sea bank and a high concentration of industrial sites, plus the adjacent Holywell railway station showing it would have been a busy and important place. The outer area is still used as a harbour for small fishing boats and is separated from the main inner area of saltmarsh by a minor road bridge.

There is very little vegetation downstream of road bridge, predominantly bare mud and the tidal channel with small patches of *Atriplex portulacoides* (SM14a *Halimione portulacoides* salt-marsh community*, Halimione portulacoides* sub-community) and small area of the SM13a *Puccinellia maritima* saltmarsh community, *Puccinellia maritima* sub-community, where *Puccinellia* overwhelmingly dominated the sward.

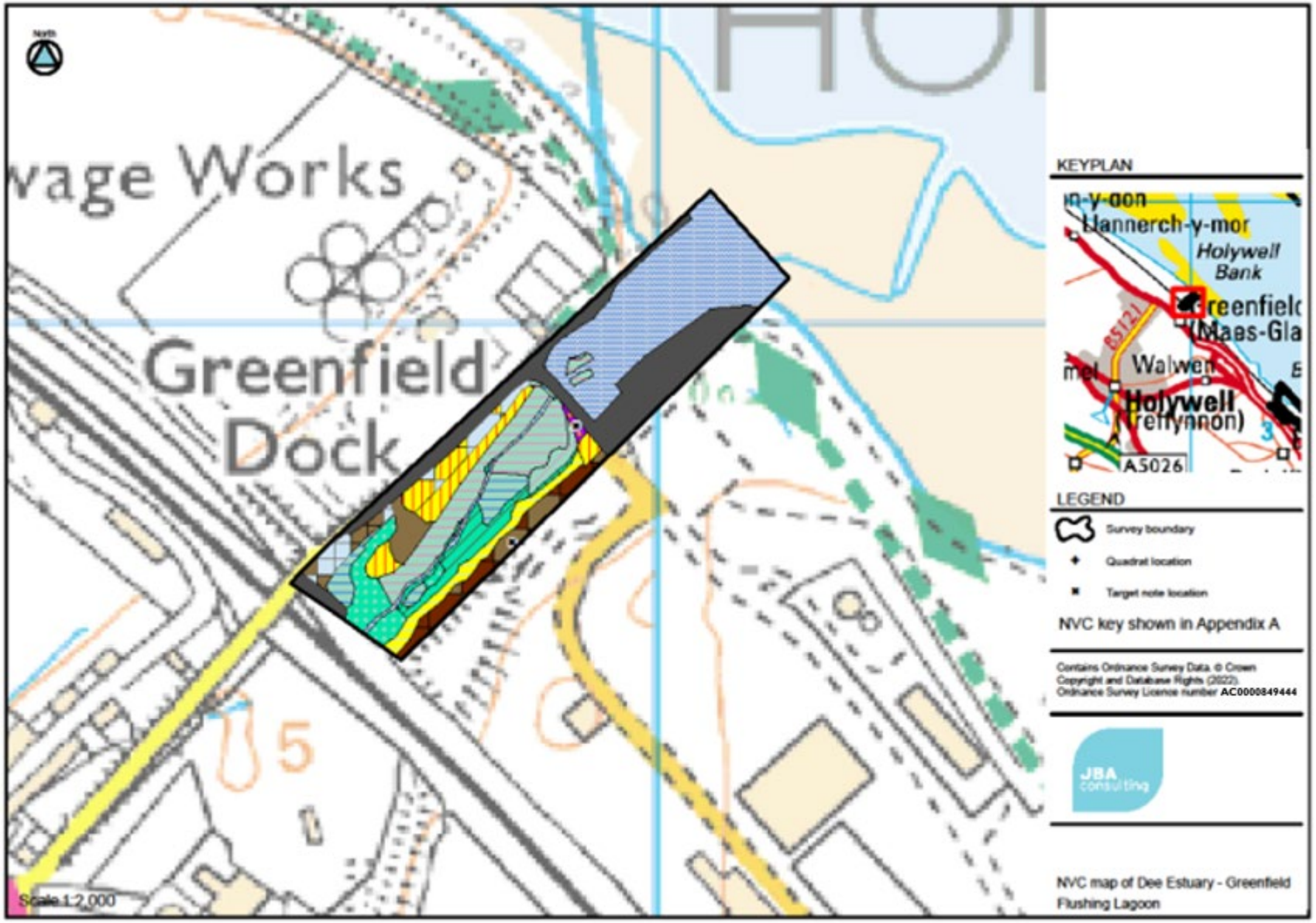
Upstream of the road bridge, saltmarsh vegetation was much more developed with large areas of almost pure *Atriplex portulacoides* (SM14a), particularly alongside the channel. Further away from the channel, a greater variety of communities were recorded, including SM14c *Halimione portulacoides* salt-marsh community, *Puccinellia maritima* sub-community with *Puccinellia* becoming more prevalent with the *Atriplex portulacoides,* SM16c *Festuca rubra* salt-marsh community, *Festuca rubra-Glaux maritima* sub-community where *Festuca rubra* became co-dominant with *Puccinellia* and the SM16d *Festuca rubra* sub-community with almost pure *Festuca rubra.* There were also small areas of Couch (SM24/28). There was also a relatively species-rich community assigned to SM12a *Aster tripolium* saltmarsh, *Puccinellia maritima* sub-community in many areas with *Tripolium pannonicum* and *Puccinellia maritima* co-dominant, along with a range of other herbs.

Along a ridge on the left bank MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community is present, with pockets of scrub. Where the ground raises on the right bank MG11a *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland, *Lolium perenne* sub-community is present with *Agrostis stolonifera* dominant, along with pockets of MG1b.

Figure 5-5. Greenfield Flushing lagoon looking northeast towards the road bridge from the southern end of the inland section.

Figure 5-6. Greenfield Flushing Lagoon features.

Figure 5-7. NVC maps for Greenfield Flushing Lagoon.



5.4 Bagillt Marshes

Originally formed as open coast saltmarsh, land reclamation to the south and dumping of material to the north have made the main part of Bagillt Marshes into a form of open embayment. The railway separates out from the main marsh an area of saltmarsh which is referred to as Bagillt Flushing Lagoon. This still receives regular inundation from tidal water, although the flow is regulated by the culvert under the railway.

The northern limit is defined by an artificial low hill created presumably with overburden from the Bettisfield Colliery and the 1871 map shows very little saltmarsh in this area of the coast. The southern limits of the saltmarsh are largely defined by the sea bank that has enclosed an area of saltmarsh, and this was present in 1871, with no saltmarsh seaward of the bank. In subsequent times a saltmarsh has accumulated, being shown on the 1910 OS map, in the embayment and in front of the sea bank to the south, but is currently undergoing active erosion, as it was in 2000 (Dargie, 2001). The low track that runs across the middle of the saltmarsh to the edge of the main creek is present in the 1910 map and was used as a boat landing stage.

Figure 5-8. Eroding edge of the saltmarsh at Bagillt.

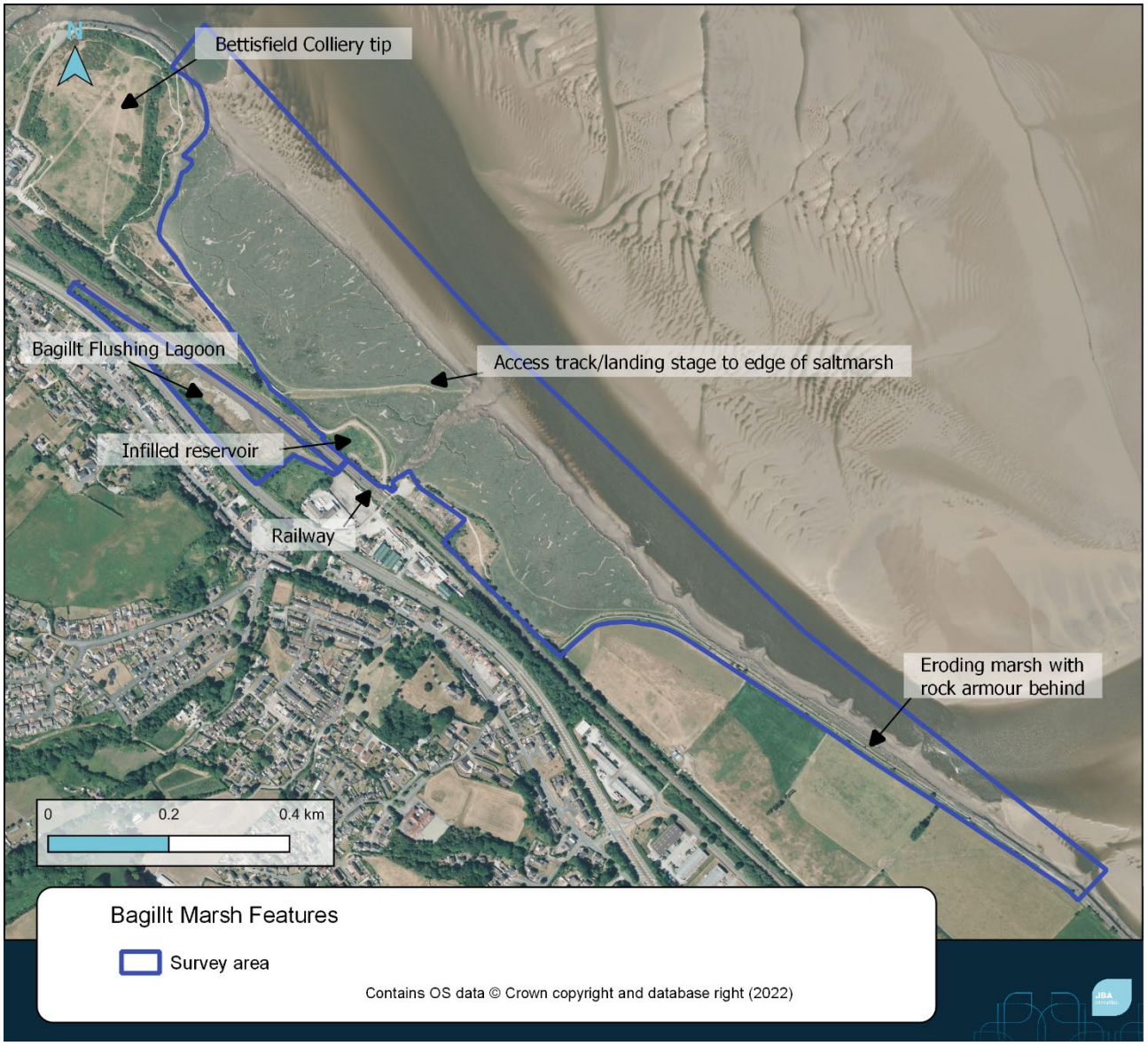


Figure 5-9. Bagillt Marsh features.

The main saltmarsh at Bagillt is a relatively homogenous area of *Atriplex portulacoides* (SM14a *Halimione portulacoides* salt-marsh community*, Halimione portulacoides* sub-community) with small open lawns of *Puccinellia maritima* within it. It is generally mono-specific but there is a distinct divide moving landward where the pure *Atriplex portulacoides* stand is replaced with an understorey of *Puccinellia maritima* (SM14c *Halimione portulacoides* salt-marsh community, *Puccinellia maritima* sub-community*)*. The precise location of the divide is not always easy to locate within the ecotone, but on the ground the differentiation between the two communities outside of the transitional area is clear. The frontage is eroding along the entire marsh and there is virtually no colonising vegetation (Figure 5-8); this is replaced by increasingly moribund and eventually dead *Atriplex portulacoides* bushes at the immediate soft cliff face fronting the marsh. Landward, the situation is complicated by the presence of the track which brings an anthropogenic influence with *Festuca rubra* and, where it is a little wetter in depressions and ruts, *Puccinellia maritima* dominating the sward (SM16 *Festuca rubra* salt-marsh community, SM16c *Festuca rubra-Glaux maritima* sub-community). Finally, this is backed by tall

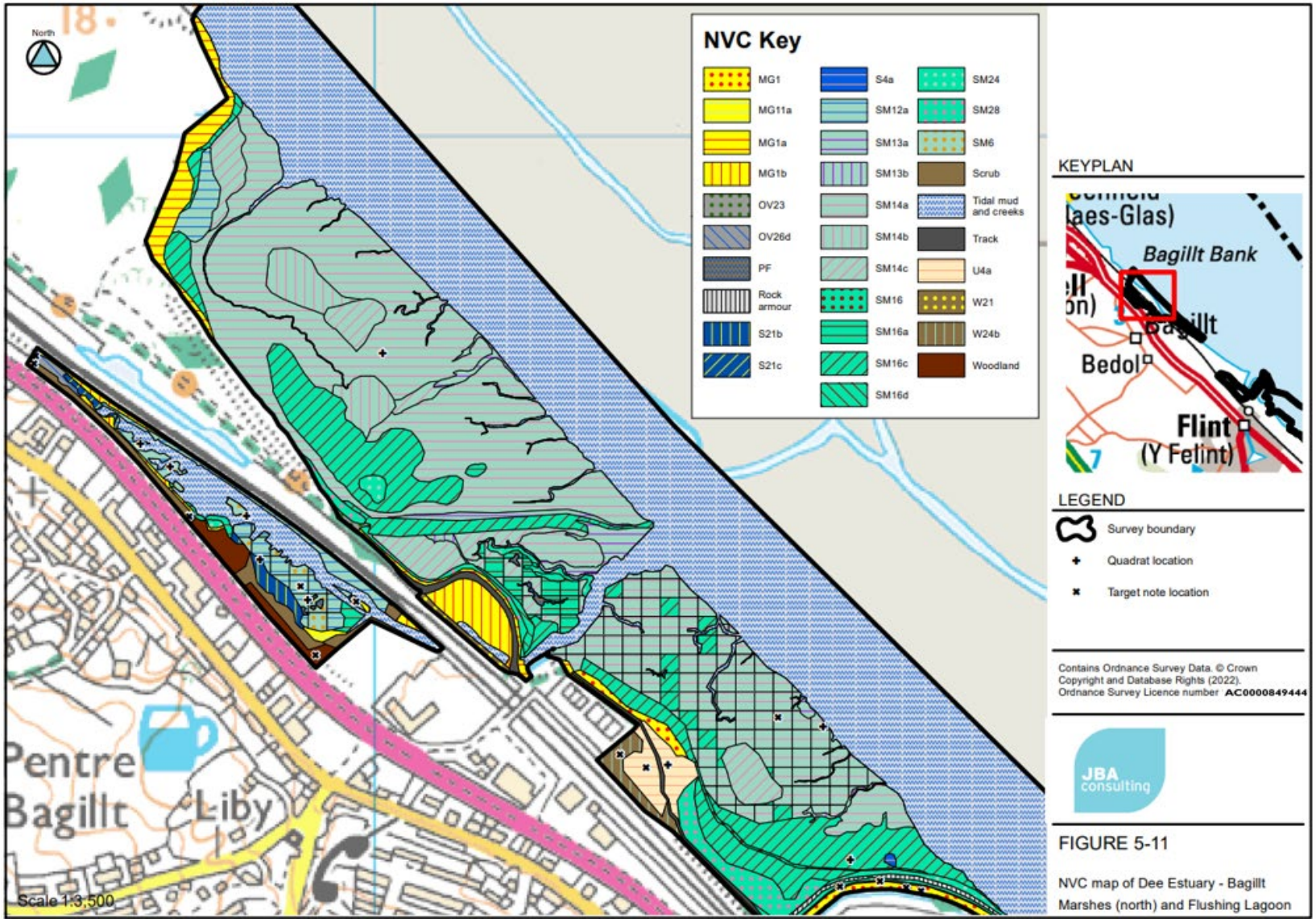
ungrazed grassland dominated by *Elymus repens* (SM28 *Elymus repens* salt-marsh community) marking the rear of the saltmarsh.

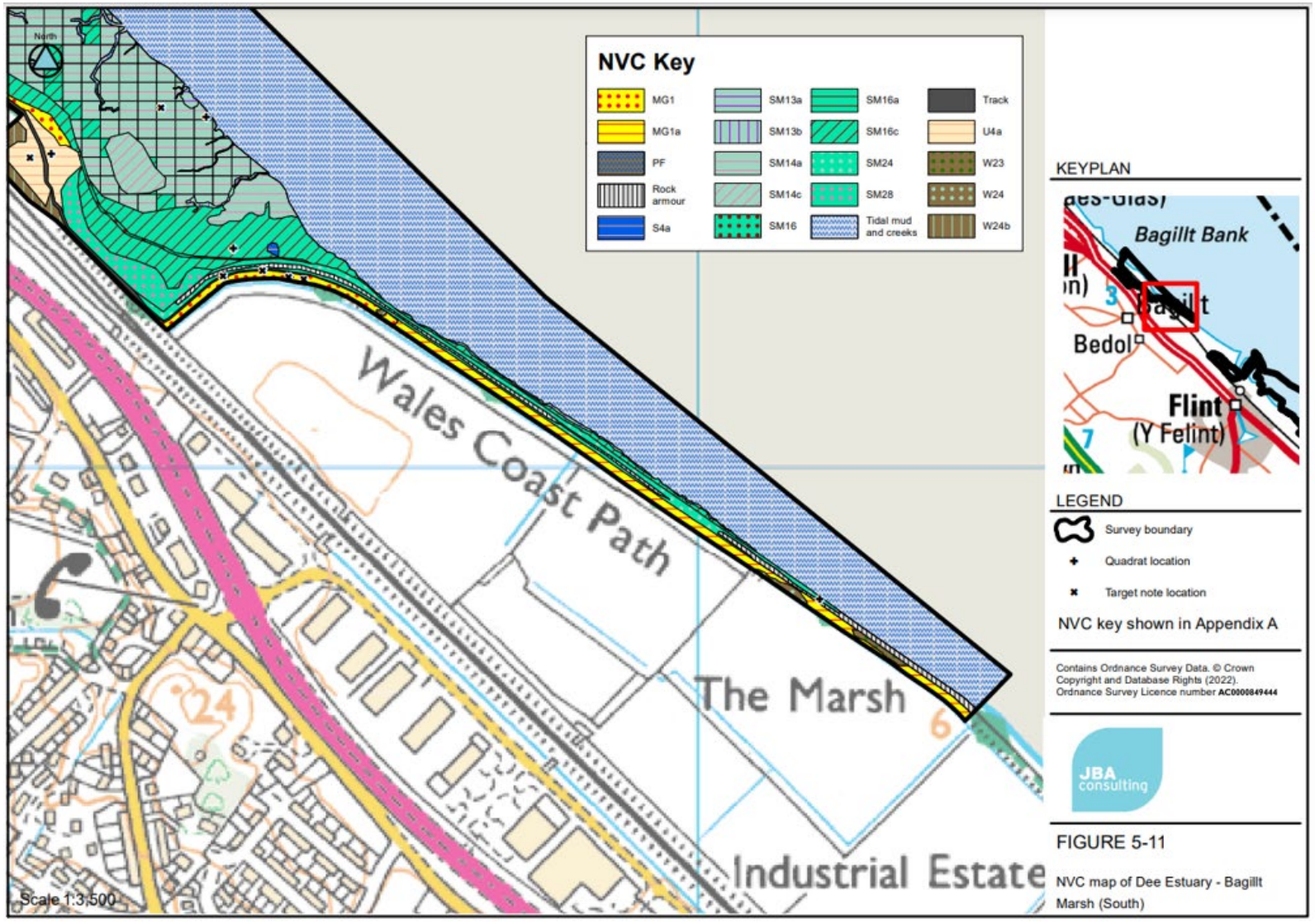
The linear strip south-east of the main marsh is a sea wall behind which there are sheep-grazed semi-improved grassland fields; these were very dry at the time of the survey. The sea wall (flood bank) is fronted with stone, behind which there is a species-rich grassy bank (MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community), although in places this is replaced by scrub vegetation (W24 *Rubus fruticosus - Holcus lanatus* underscrub community and W23 *Ulex europaeus - Rubus fruticosus* scrub). The grassy bank is notable for its Yellow Meadow-ant *Lasius flavus* anthills. On the base of the seaward side, there is (as you move south-east) a continuous strip of *Elymus athericus* (SM24 *Elymus pycnanthus* salt-marsh community) grassland fronted by a varied strip of the SM16c *Festuca rubra* salt-marsh community, *Festuca rubra-Glaux maritima* subcommunity that rapidly peters out. This merges into a narrow strip of saltmarsh (SM13 *Puccinellia maritima* saltmarsh community, SM13a *Puccinellia maritima* sub-community) that decreases in extent and eventually disappears completely, breaking up into a few tussocks (often around a specimen of *Triglochin maritimum*) before giving way to open mud at low tide. Erosion is occurring and it is clear that saltmarsh has been lost as the main channel of the river has migrated to this side of the estuary, likely in response to structures on the North bank. There is little sign of this erosion decreasing in the medium term and it is likely that, in response, this sliver of saltmarsh will be lost to be replaced with accreting saltmarsh on the North bank of the estuary.

Bagillt Flushing Lagoon is a small, but very complex and interesting area of saltmarsh, bound on both margins by ridges of higher ground where saltmarsh vegetation gave way to scrub and stands of the OV26 *Epilobium hirsutum* community. Within the flushing lagoon itself the channel consisted of bare mud, and the saltmarsh along the southern boundary of the channel was extremely varied, with small patches of quite distinct communities noted. A species-rich community was most prevalent which was recorded as SM12a *Aster tripolium* saltmarsh, *Puccinellia maritima* sub-community, with *Tripolium pannonicum*, *Puccinellia maritima*, *Spartina anglica*, *Suaeda maritima* and *Atriplex prostrata*. However, it seemed to be a poor-fit to this community and could have been late successional SM10 *Transitional low-marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima* or SM13d *Puccinellia maritima* salt-marsh community*, Plantago maritima-Armeria maritima* sub-community, but neither of these communities really seemed to reflect this community and so it was recorded as SM12a. There were also small pockets of almost pure SM6 *Spartina anglica* salt-marsh community, particularly along the channel banks. There was a relatively large bed of *Bolboschoenus maritimus*, with an understory of *Puccinellia maritima* and *Atriplex prostrata*, recorded as S21b *Scirpus maritimus* swamp*, Atriplex prostrata* sub-community and S21c *Scirpus maritimus* swamp*, Agrostis stolonifera* sub-community with more abundant *Agrostis stolonifera* was also recorded in pockets at the northern end.

Figure 5-10. Bagillt Flushing Lagoon at low water looking to the north.

Figure 5-11. NVC maps for Bagillt Marshes.




North
NVC Key
MG1
MG1a
PF
Rock armour
S4a
SM13a
SM13b
SM14a
SM14c
SM16
SM16a
SM16c
SM24
SM28
Tidal mud and creeks
Track
U4a
W23
W24
W24b
Wales Coast Path
The Marsh
Industrial Estate
Scale 1:3,500
KEYPLAN
Bagillt Bank
Bedol
Flint
(Y Felint)
LEGEND
Survey boundary
Quadrat location
Target note location
NVC key shown in Appendix A
Contains Ordnance Survey Data. © Crown Copyright and Database Rights (2022). Ordnance Survey Licence number AC0000849444
JBA consulting
FIGURE 5-11
NVC map of Dee Estuary - Bagillt Marsh (South)

5.5 Flint Marshes

Flint Marshes is comprised of several distinct components. The northern end includes a flushing lagoon which is an area formerly used to wash down boats. It is isolated from the wider saltmarsh by a sluice and a large area of made ground. The stream that flows through the flushing lagoon outfalls at the top end of Flint Docks, now disused but formerly a major industrial hub. The docks are separated from the wider area of the saltmarsh to the south by another, probably artificial, outcrop of raised ground. On the top end of the main marsh there is the 13th Century Flint Castle, just north of a section of reclaimed and defended land seaward of the railway. Further south the marsh is part of the RSPB Dee Estuary nature reserve and was referred to as Pentre Marsh in Dargie (2001) and this extends south and is contiguous with the Connah's Quay saltmarsh, although a sea bank means there is an abrupt contraction of saltmarsh at the southern end of Flint Marshes. A low cliff runs through the middle of the main saltmarsh, clearly indicating the extent of former erosion, but the marsh has re-formed seaward of this cliff for several hundred metres, although a low cliff is also now present at the seaward edge in places, showing that another cycle of erosion is underway.

Figure 5-12. Flint Marsh features.

The main area of Flint Marshes supports extensive stands of SM13a *Puccinellia maritima* salt-marsh community*, Puccinellia maritima* sub-community, SM14a *Halimione portulacoides* salt-marsh community*, Halimione portulacoides* sub-community and SM16a *Festuca rubra* salt-marsh community*, Puccinellia maritima* sub-community. Locally there are stands of SM12 *Aster tripolium* saltmarsh. The transition seaward is a little varied and marked by the presence of a low cliff as a remnant of a previous phase of erosion. Now most of the marsh is showing signs of accretion, albeit limited in extent, and in these areas SM10 Transitional low-marsh vegetation with *Puccinellia maritima,* annual *Salicornia species* and *Suaeda maritima* is the most common vegetation at the pioneering edge, and there are, very locally, patches or stretches of SM8 Annual *Salicornia* salt-marsh community and SM9 *Suaeda maritima* salt-marsh community.

Figure 5-13. Flint Castle with SM13 saltmarsh up to the base and SM16a slightly further from the castle.

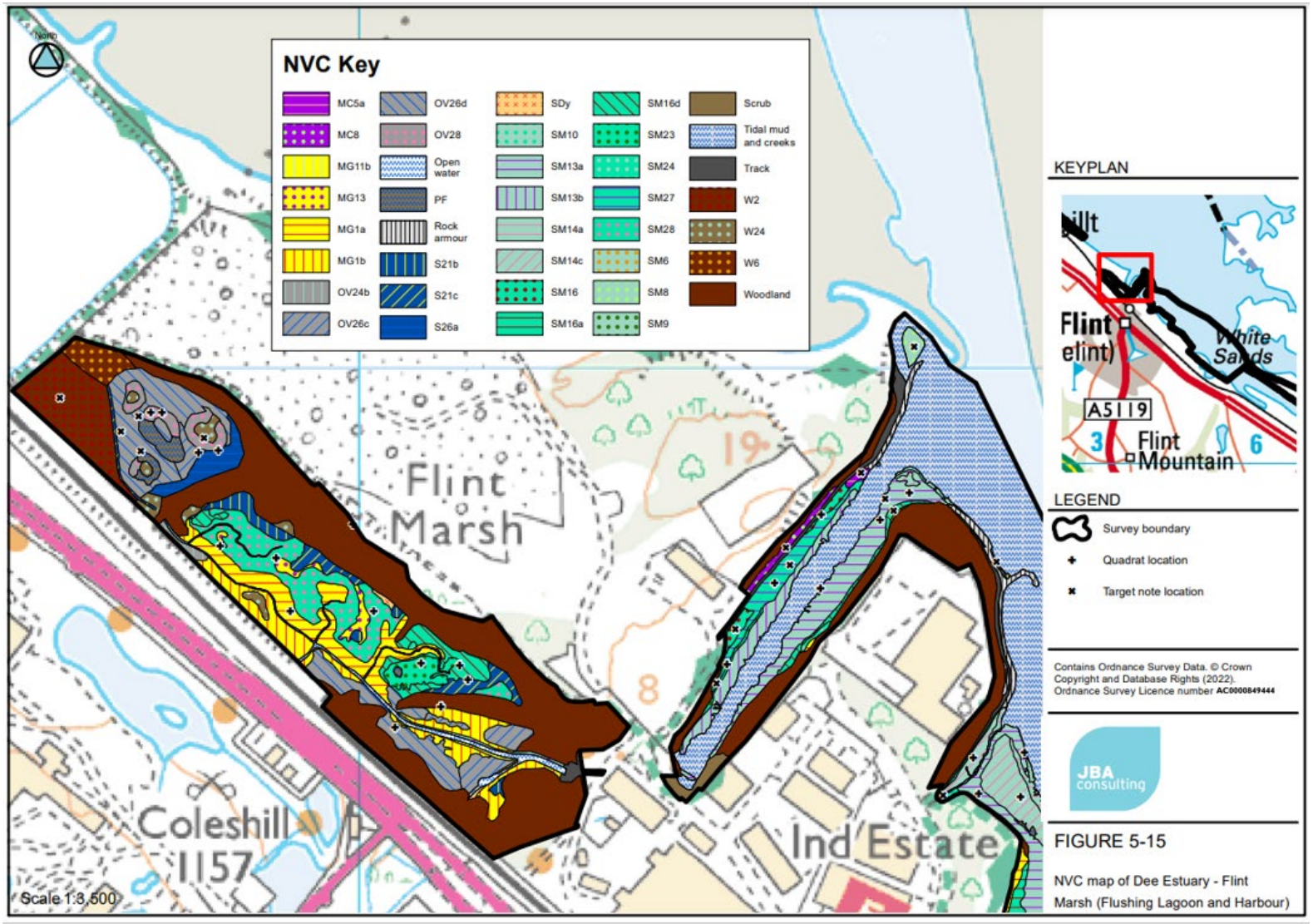
The main area of the flushing lagoon is brackish, receiving only limited saline inundation which is quickly diluted by the freshwater flows. Here the saltmarsh includes areas of S21 *Scirpus maritimus* swamp and SM16 *Festuca rubra* salt-marsh community with pools supporting an interesting variety of annual species including *Oxybasis rubra*, with better developed areas assigned to SM23 *Spergularia marina-Puccinellia distans* salt-marsh community. Slightly higher ground supports an extensive SM28 *Elymus repens* salt-marsh community and a raised bank along the main channel is high enough to have MG1 *Arrhenatherum elatius* grassland. The top end of the flushing lagoon at Flint had very unusual vegetation present, unlike a saltmarsh, and had seemingly been subject to considerable disturbance. In the central part of the northern area, it appeared earthworks had been relatively recently undertaken to create a horseshoe-shaped depression (dry at the time of survey), with a raised island in the middle. The depression appeared to have held water in the past but was currently dry and covered with *Oxybasis rubra*. The island consisted of highly ruderal vegetation. Marginal areas similarly were ruderal, but with some evidence of freshwater influence with *Epilobium hirsutum*, *Pulicaria dysenterica*, *Agrimonia eupatoria* and *Lysimachia vulgaris*, along with *Heracleum sphondylium*, *Urtica dioica* and *Calystegia sepium* in a community described as OV26 *Epilobium hirsutum* community. There were also dense patches of scrub. Small areas of *Phragmites australis* (S26 *Phragmites australis-Urtica dioica* tall-herb fen) and *Bolboschoenus maritimus* (S21 *Scirpus maritimus* swamp) were also present and there were clear vehicle tracks through the vegetation.

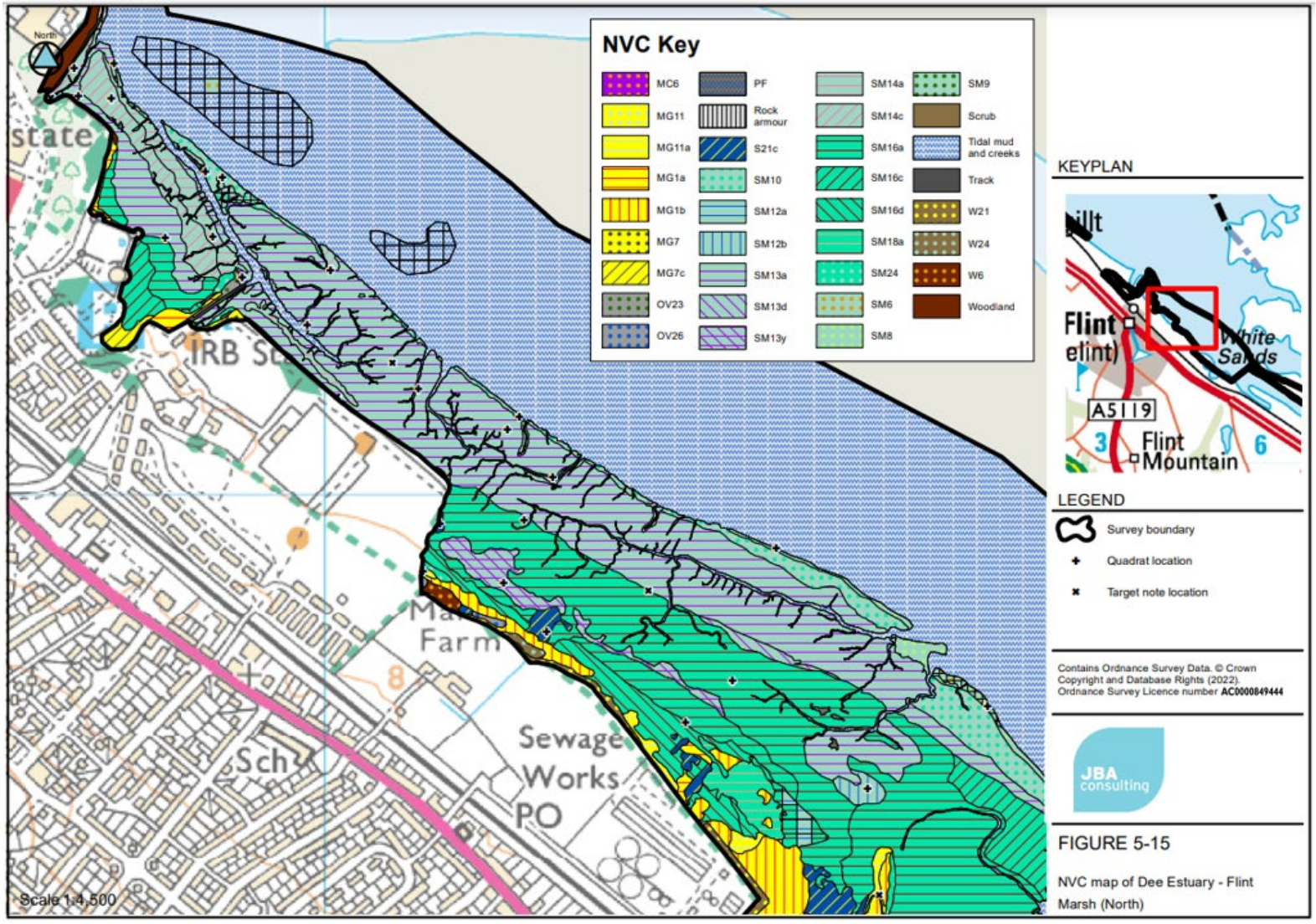
The old docks still have a large, deep central channel. Either side is a narrow ledge of SM13a *Puccinellia maritima* salt-marsh community*, Puccinellia maritima* sub-community vegetation, which becomes fragmented or lost due to scouring from the sluices and culverts at the most inland extent. Further up the bank, the south side of the docks have a typical SM16 *Festuca rubra* salt-marsh community sward, but the north side supports a

very open vegetation with a distinctive shallow crust, referred in places to both SM27 ephemeral saltmarsh with *Sagina maritima* and MC5 *Armeria maritima-Cerastium diffusum* ssp. *diffusum* maritime therophyte community (Sections 4.3.12 and 4.5.5). This possibly relates to made ground and soil contamination, which limits the type of vegetation that can develop.

Figure 5-14. The Flint docks at highish tide.

Figure 5-15. NVC maps for Flint Marshes.




NVC Key
MC6
MG11
MG11a
MG1a
MG1b
MG7
MG7c
OV23
OV26
PF
Rock armour
S21c
SM10
SM12a
SM12b
SM13a
SM13d
SM13y
SM14a
SM14c
SM16a
SM16c
SM16d
SM18a
SM24
SM6
SM8
SM9
Scrub
Tidal mud and creeks
Track
W21
W24
W6
Woodland
KEYPLAN
Flint
A5119
Flint Mountain
LEGEND
Survey boundary
Quadrat location
Target note location
Contains Ordnance Survey Data. © Crown Copyright and Database Rights (2022). Ordnance Survey Licence number AC0000849444
JBA consulting
FIGURE 5-15
NVC map of Dee Estuary - Flint Marsh (North)
Scale 1:4,500
Sewage Works
PO
Farm

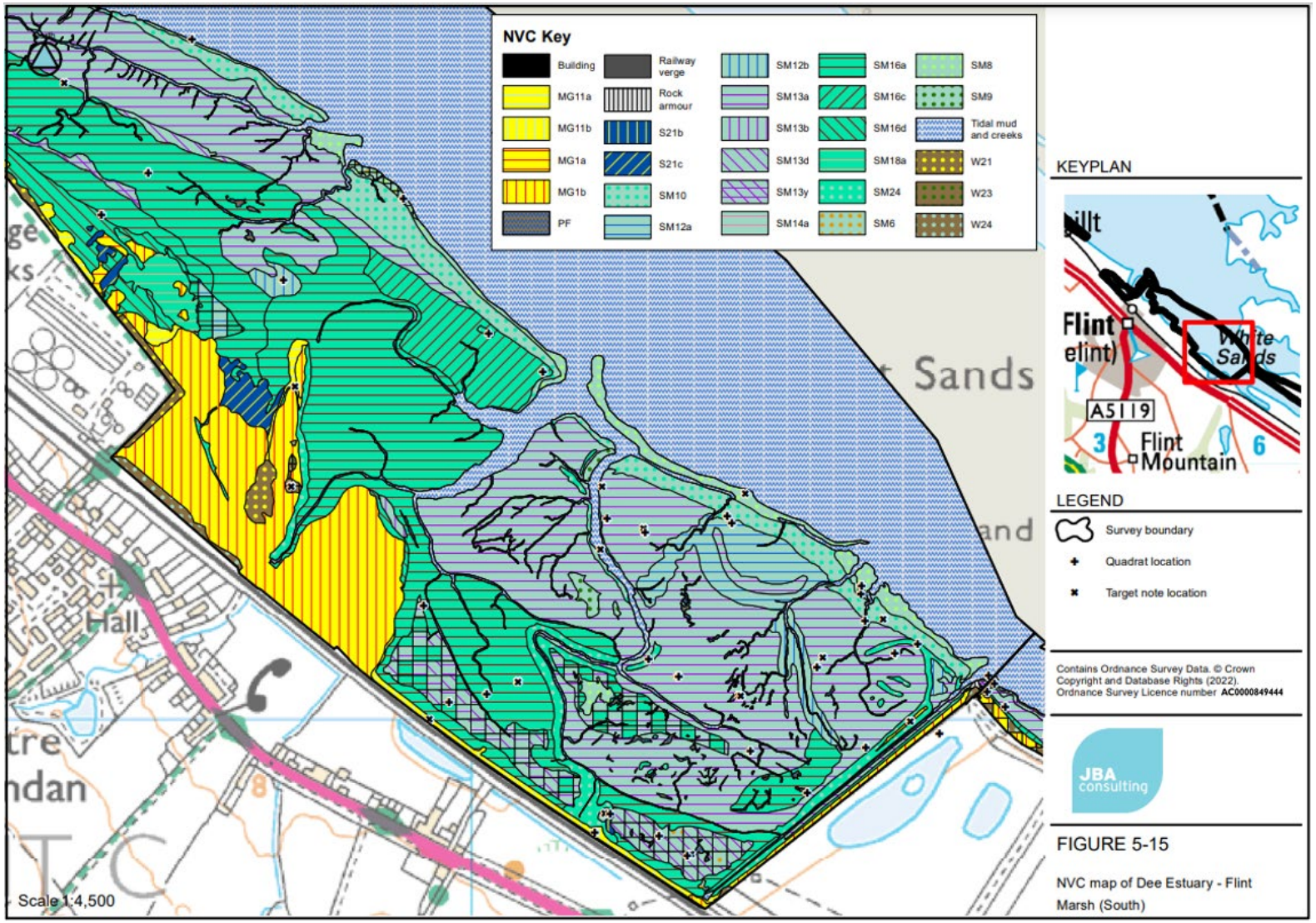


FIGURE 5-15

NVC map of Dee Estuary - Flint Marsh (South)

5.6 Connah’s Quay Power Station Marsh

The northern part of the marshes at Connah’s Quay are restricted in extent by the river and a sea bank which means they are around a fifth of the depth of Flint Marshes that are immediately adjacent to the north. They widen slightly as they head south, although still constrained by a sea bank that defends (although the bank also pre-dates) the Connah’s Quay power station, and here the Dee Naturalists have created a nature reserve for birds by creating artificial pools in the saltmarsh, defended from the full impact of the tidal river by a low bank. The marsh narrows to the south, and large pylons are present in the marsh, until the meander of the river means that there is no space for saltmarsh southwards until the start of the Dee River Marshes. The southern part of the marsh is crossed by A548 suspension bridge which has bridge pillars in the marsh and casts a significant shadow (Figure 5-17).

Figure 5-16. Connah’s Quay marsh features.

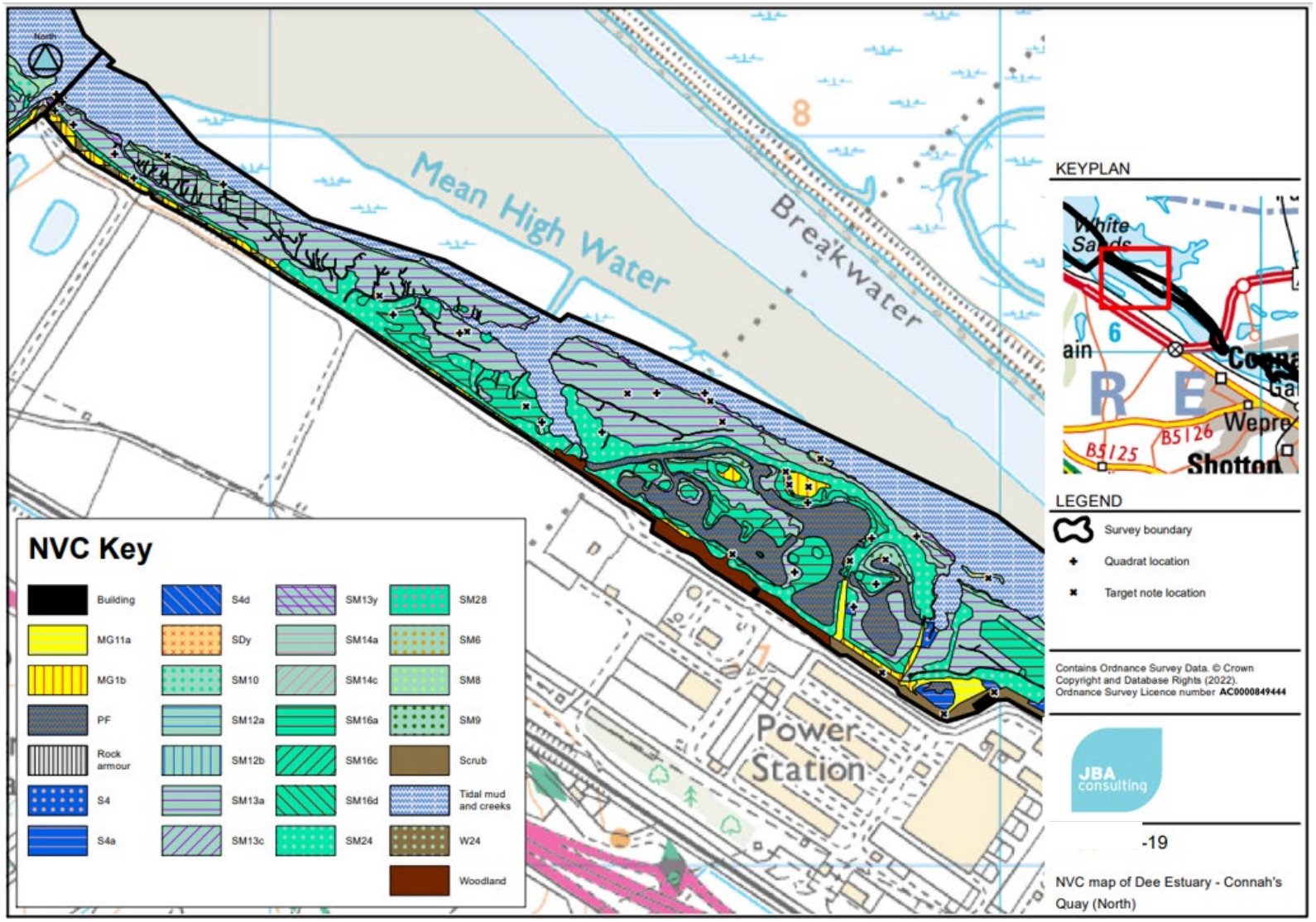
Figure 5-17. SM9 saltmarsh under the Flintshire road bridge.

In the Dee Naturalists the area around the open lagoons (Figure 5-18) and bare mud areas were quite complex with SM13a *Puccinellia maritima* salt-marsh community*, Puccinellia maritima* sub-community around the margins of the bare mud, grading back as the ground levels elevated to SM24 *Elymus pycnanthus* salt-marsh community, with then the MG11a *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland*, Lolium perenne* sub-community even higher back. There were also pockets of S4 *Phragmites australis* swamp and reed-beds and the SM16d *Festuca rubra* salt-marsh community*, Festuca rubra* sub-community. The narrow strip of saltmarsh running in front of the power station was fairly uniform in character across its length from the bird hide to the cable suspension bridge. Along the River Dee bank was a very narrow scattered strip of SM10 *Transitional low-marsh vegetation with Puccinellia maritima, annual Salicornia species and Suaeda maritima*, which typically appeared directly adjacent to bare mud, with no intermediate pioneer communities (except a mosaic of this was recorded in a small area). This SM10 band was typically very narrow, only 2-3m wide in places and quickly graded back into SM13a *Puccinellia maritima* salt-marsh community*, Puccinellia maritima* sub-community with a much higher component of *Puccinellia maritima*. A raised bank along the saltmarsh between the pylons consisted of SM24, which then graded into SM16a *Festuca rubra* salt-marsh community*, Puccinellia maritima* sub-community behind with *Festuca rubra* and *Puccinellia maritima* co-dominant. Where the channels passed through the saltmarsh, SM13a tended to be present closer to them, grading back into SM16a. On the landward side of the saltmarsh, where disturbance levels were seemingly high, including rabbit grazing, but not significant to create patches of bare mud, SM16c *Festuca rubra* salt-marsh community, *Festuca rubra-Glaux maritima* subcommunity with a high proportion of *Lysimachia maritima* was present typified by a very short sward. Directly underneath the bridge, possibly influenced by shading, an almost pure stand of SM9 *Suaeda maritima* salt-marsh community was present. Eastwards of the bridge, a similar transitional pattern of saltmarsh communities had also developed, although without the narrow band of SM10

along the front of the saltmarsh edge, with SM13a marsh dropping off a shelf directly onto bare mud.

Figure 5-18. The landscapes lagoons at Connah's Quay.

Figure 5-19. NVC maps for Connah’s Quay.



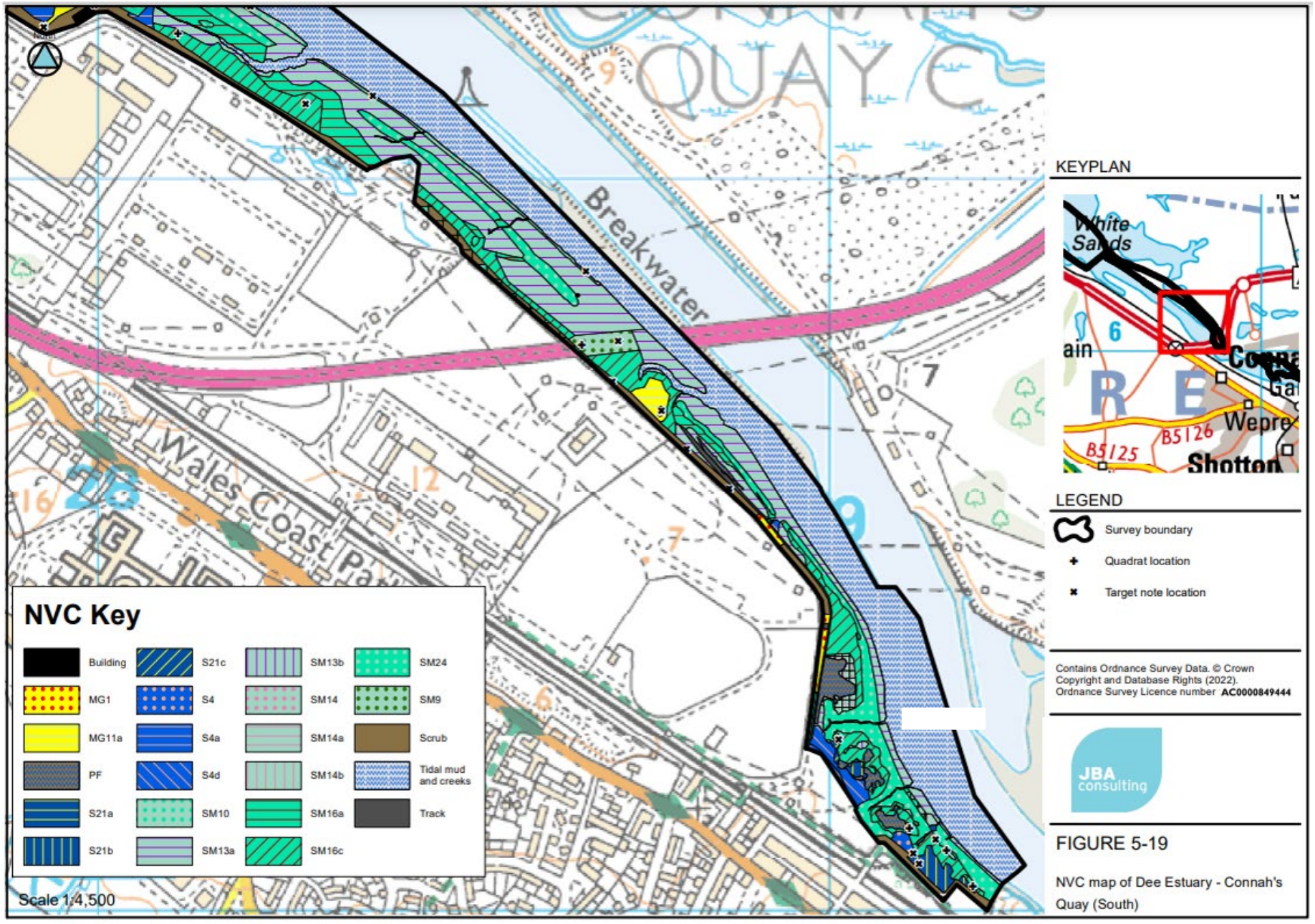


FIGURE 5-19

NVC map of Dee Estuary - Connah's Quay (South)

5.7 Dee River Marshes

The Dee River Marshes are a 2.6km long narrow strip along the left bank of the Dee River. The widest area of marsh is that around the outfall of the Wepre Gutter where the marsh is in a wide embayment, although this is constrained at the eastern side of the gutter by a sewage works and other past land-raising works. The marsh continues upriver where the watercourse has been straightened and it is attempting to re-meander itself by cutting behind the training walls causing erosion of the marsh, especially upstream of the Wepre Gutter. The marshes are crossed by three bridges, the railway to the north, then further south the B5441 and A494. Given the straightness of the river here, and the presence of bridges, piers and jetties (on the North shore) there is a degree of instability in the channel course with erosion and deposition of saltmarsh taking place on both banks. This, overall, will lead to a dynamic equilibrium between the amount of marsh being lost and gained and both banks, however, the root cause of the instability itself is anthropogenic in nature. This section of marsh is the only known location of the notable species *Bupleurum tenuissimum*, although it was not recorded in the current survey, it was noted by Dargie (2001) and was recorded again here in 2021.

Figure 5-20. Dee River Marshes looking north towards the railway bridge, the erosion of marsh inside an old training wall can clearly be seen.

The vegetation here is relatively uniform comprising mostly SM13a *Puccinellia maritima* salt-marsh community*, Puccinellia maritima* sub-community and SM16a *Festuca rubra* salt-marsh community*, Puccinellia maritima* sub-community. These are often in linear strips along the river front and relate to artificial banks and depressions (excavated to create the banks) that lie riverward of the main flood bank. These have dammed former creeks leading to these silting-up and becoming isolated pools within the saltmarsh. The margins of these can mirror the vegetation bands fronting the marsh, with SM13b *Puccinellia maritima* salt-marsh community, *Glaux maritima* sub-community and SM16c *Festuca rubra* salt-marsh community, *Festuca rubra-Glaux maritima* sub-community with the raised banks being composed of MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community and SM28 *Elymus repens* salt-marsh community representing the drier conditions. Behind a former flood bank, large pools have developed which, in one

location near Hawarden Bridge, have been poached by horses to rough mud and were flooded at the time of the survey following a spring tide (Figure 5-23). In other locations these have formed large, semi-permanent freshwater pools that fluctuate in area leaving wide muddy margins at drawdown which are excellent habitats for invertebrates and, as a result, wading birds and passerines. However, the majority of these drain into a small tributary 280m upstream of the Wepre Gutter which, due to the erosion of the saltmarsh here, is undergoing rapid headward cutting which has now reached the location of the former flood bank that impounds these waterbodies. This nick-point migration is causing the banks of the tributary to slump dramatically and, if not addressed, will result in the draining of the large pools behind the flood bank, further increasing the erosion within the tributary and the loss of these water bodies.

Figure 5-21. Nick point migration up a small creek about to drain a large pool on the Dee River marshes.

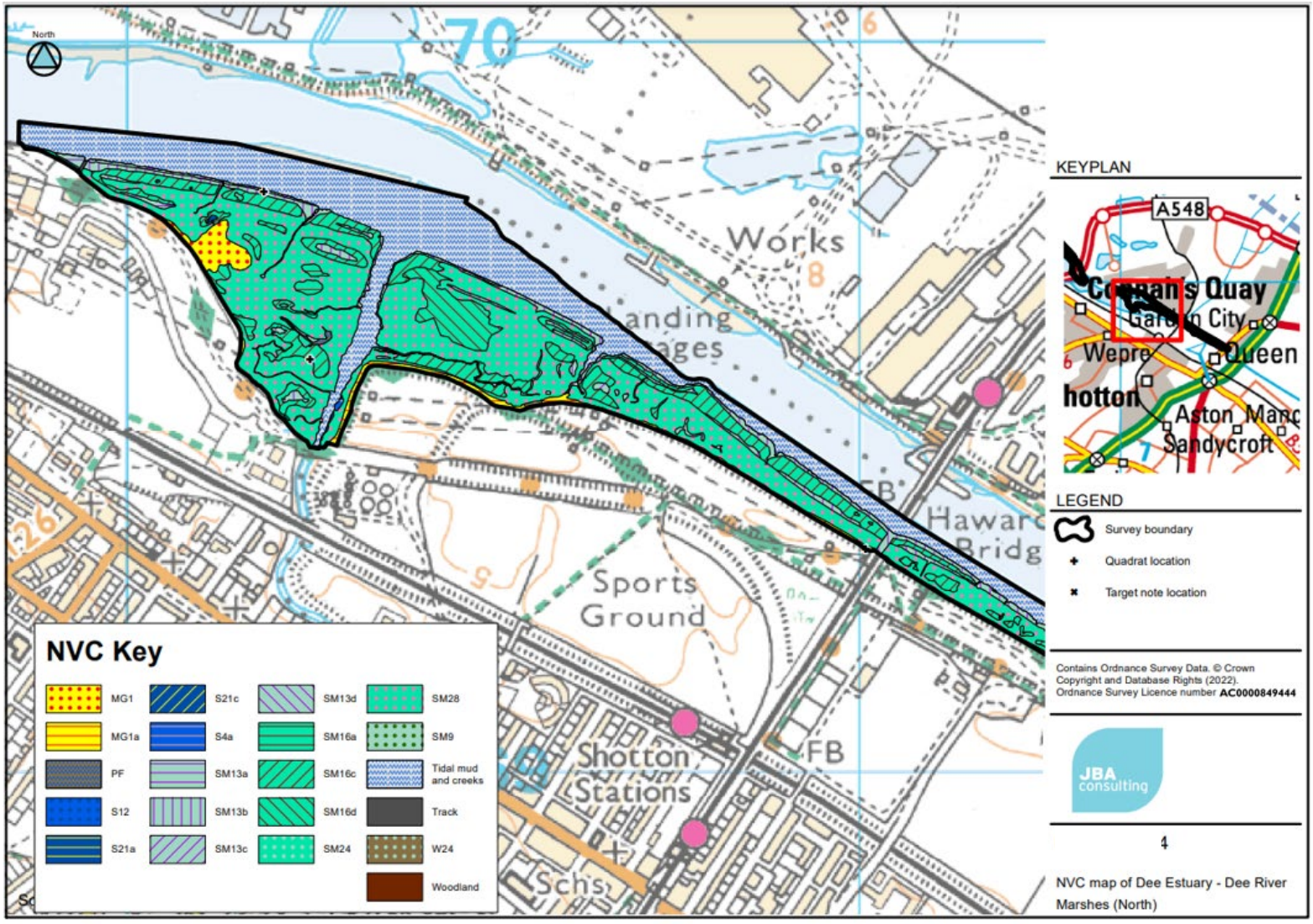
Along the right bank of the Wepre Gutter there is a small area of *Phragmites australis* reedbed (S4a *Phragmites australis* swamp and reed-beds, *Phragmites australis* sub-community) adjacent to another linear community dominated by *Bolboschoenus maritimus* (S21c *Scirpus maritimus* swamp, *Agrostis stolonifera* sub-community); both communities are not represented as contiguous blocks on the left bank, just isolated stands of individual plants.

West of the gutter, the same mix of habitats as seen elsewhere within the linear banks and depressions is seen, along with the blocked creeks and the isolated ponds and the same hydrosere around these as that on the marsh frontage. In one location there has been some land-raising and here ruderal grassland vegetation has established which was dominated by *Holcus lanatus* and *Arrhenatherum elatius* and was attributed to MG1 *Arrhenatherum elatius* grassland.

Figure 5-22. Features of the Dee River Marshes.

Figure 5-23. A small area of saltmarsh heavily grazed and poached by horses, then flooded on a spring tide on the Dee River Marshes.

Figure 5-24. NVC maps for Dee River Marshes.



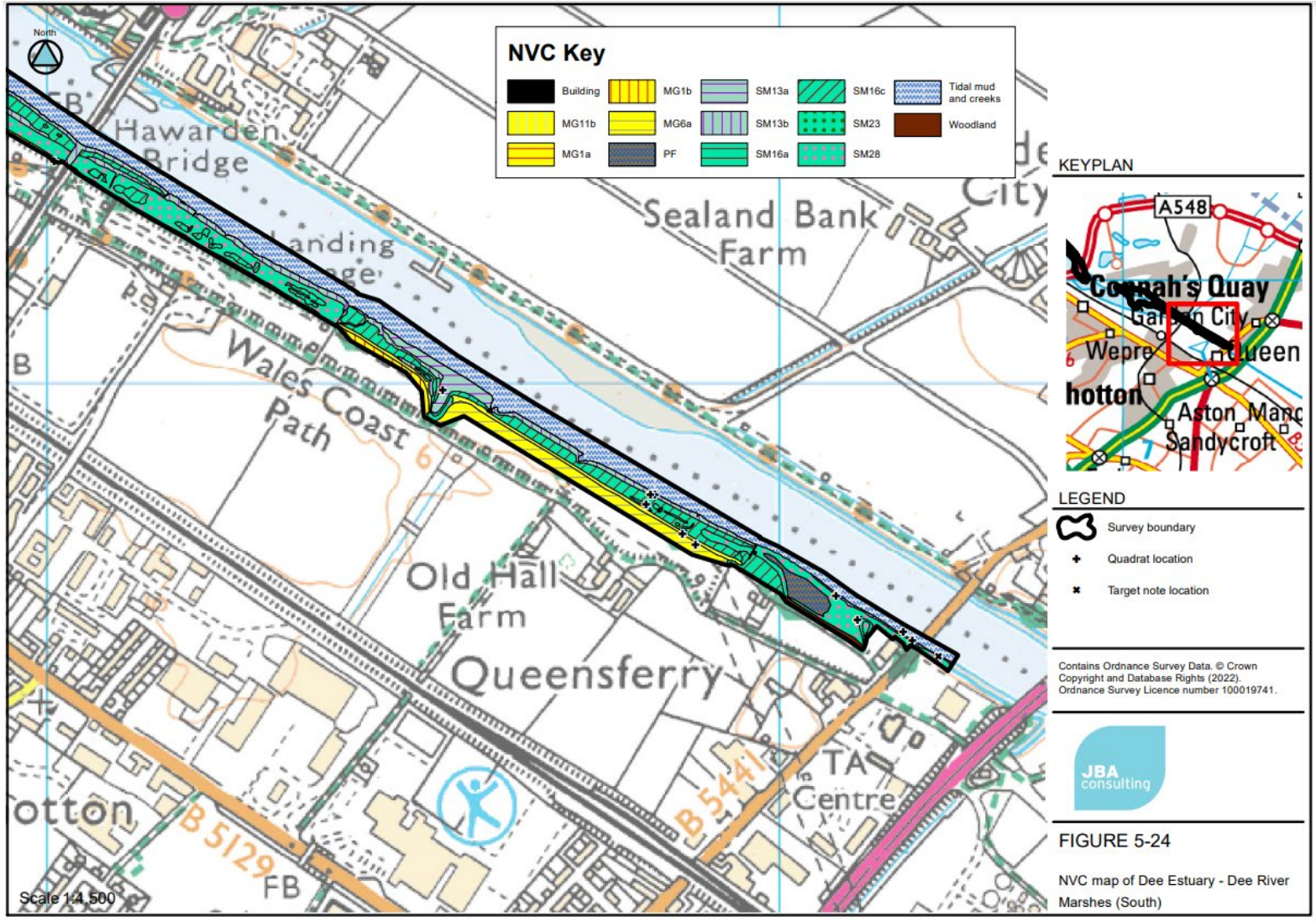


FIGURE 5-24

NVC map of Dee Estuary - Dee River Marshes (South)

6 Evaluation

6.1 General saltmarsh characteristics

The saltmarshes of the Dee Estuary form an important component of the designated site, both in their own right and as an important habitat that provides both ecosystem services and supporting other biodiversity. The greatest extent of marshes are middle saltmarsh, with smaller amounts of lower saltmarsh. Upper saltmarsh is much more limited, restricted by historic land reclamation and hard boundaries to the landward side of the saltmarsh reflecting in a large part the important historic industrial exploitation of the coast. Where upper saltmarsh is present, it is often subject to altered tidal inundation, either where the tidal flows are controlled by sluices or culverts, as in the flushing lagoons, or where artificial defences constrain inland flow, backing up the water to a higher depth than would otherwise occur.

There is a general trend of erosion in the inner estuary, with compensatory accretion occurring on the right bank, with significant accretion at Gronant and Point of Ayr. The marshes are generally not grazed by livestock, and this is reflected in the typically thick, grassy swards and the abundance of species-poor forms of most of the NVC communities recorded here. Rabbits and Geese are locally significant grazers of the saltmarsh.

There is a high level of public access to the saltmarshes. This is most notable at Point of Ayr and Gronant, with infrastructure in place to support parking and access into or across the marshes, with the adjacent dunes or sea the main focal point for visits. There is also a high level of access onto the Dee River Marshes where footpaths are clearly visible on the saltmarsh. There is easy access to the northern parts of Flint Marsh around the castle, but the southern RSPB managed section, and Connah's Quay marshes are not open to the public.

6.2 Interesting and unique features

A number of interesting and unique features are present in the Dee Estuary saltmarsh. These are discussed above but a few key points are highlighted below:

- Sequence of marshes between dune ridges at Gronant with a varied range of brackish swamp communities through to pioneer saltmarsh with areas of transitional sandy and shingly saltmarsh.
- Areas of *Carex extensa* dominated upper saltmarsh at Gronant form a distinct new sub-community of SM16 and have persisted as a stable vegetation since the previous survey in 2000.
- Sandy saltmarshes forming around the accreting spit at Point of Ayr have atypical transitional sand dune and saltmarsh vegetation.
- Flushing lagoons support transitional brackish vegetation with species-rich swards.

6.3 Conservation Assessment

Although it is difficult to make an assessment from a single visit, the extent of saltmarsh is clearly of high conservation importance. The occurrence of a large extent of saltmarsh forms an important part of the mosaic of coastal habitats that together make up the Dee Estuary SAC and Ramsar site of international importance. A brief site-level conservation assessment of the saltmarsh in their own right is given here based on the well-established criteria set out by Ratcliffe (1977, 1986). These criteria are typicalness, fragility, size, diversity, naturalness, rarity, ecological coherence and potential value.

6.3.1 Typicalness

The saltmarshes of the Dee Estuary within the survey area are primarily comprised of typical vegetation of ungrazed saltmarsh, with some smaller grazed areas, and is formed in a location in which saltmarsh would be expected to form. Most of the vegetation is easily placed within an existing NVC category with only minor local variation or transitions to non-saltmarsh vegetation, and in this case can be considered typical of saltmarsh.

6.3.2 Fragility

The fragility of saltmarsh is emphasised by the clear evidence of erosion that has occurred historically and is ongoing. With predicted sea level increases, coastal squeeze is likely to result in more erosion of the saltmarsh, with hard sea defences preventing any landward migration. However, saltmarsh is less fragile in the sense that it is resistant to extreme weather events, and through accretion is able to resist some of the impacts of sea level rise.

6.3.3 Size

Although the individual saltmarsh areas are separated by hard-engineered sections of coastline, the saltmarsh make up a considerable area that is of significance nationally, particularly when the areas surveyed here are combined with other areas of saltmarsh on the Dee Estuary.

6.3.4 Diversity

The diversity at both the species level is generally low on saltmarshes, there being relatively few specialist species adapted to the saline environment, which are generally found only on saltmarsh. The absence of grazing or management in the areas surveyed here means that the saltmarshes recorded here are particularly species-poor. The diversity at the community level is also relatively low, with the most diversity found around the accreting systems at Gronant and Point of Ayr. For both species and vegetation diversity, the transition zones to terrestrial and freshwater habitats contribute significantly to overall diversity in all locations surveyed.

6.3.5 Naturalness

The Dee Estuary saltmarshes surveyed here, with the exception of Gronant, are all eco-cultural habitats, a natural ecosystem that has developed on a coast heavily modified and

exploited for over three centuries. The result is that the upper saltmarsh is much curtailed and natural transitions from saltmarsh to another habitat are almost completely absent. The modification of middle and lower saltmarsh is relatively uncommon, with creation of bird pools at Connah's Quay one of the few significant alterations. The remaining marsh has largely developed naturally, and 'natural' middle and lower saltmarsh vegetation is present on all the marshes. The marshes at Gronant appear very natural and excepting some alterations on the inland areas of Prestatyn Gutter, display a natural and extensive pattern of successive marshes being partly enclosed by accreting dune ridges.

6.3.6 Rarity

The saltmarsh vegetation recorded in this survey is not particularly rare either in Wales or the UK as a whole. The accreting systems at Gronant and to a lesser extent at Point of Ayr are very rare, and possibly unique.

6.3.7 Ecological Coherence

Much of the ecological coherence of the marshes has been lost through fragmentation as sections of coast have been protected from inundation by the construction of sea banks and sea walls so that the sub-sites recorded here are isolated from each other by sections of coast without semi-natural vegetation. There is also loss of coherence with within individual marshes in the upper saltmarsh where there is much disruption from artificial banks and tipping of material, with the flushing lagoons each separated from the main marshes. The is good ecological coherence to the seaward side, with the marshes forming the natural transition from the tidal mud and sand flats.

6.3.8 Potential Value

The marshes are already of very high conservation value. They have a significant role in ecosystem services including flood protection by reduction of tidal energy, carbon sequestration and supporting wider biodiversity. There is the potential to increase the value through managed realignment to create new upper saltmarsh and more closely link the saltmarsh to semi-natural vegetation above the tidal limit.

6.3.9 Summary

The saltmarshes on the Dee Estuary support a large area of important vegetation of high conservation value. The geomorphology has created a series of varying marshes closely tied to the human history of the coastline which has left them reduced and fragmented. Despite this, extensive areas of saltmarsh vegetation are present, and these are clearly important habitat in their own right, as well as part of the wider Dee Estuary.

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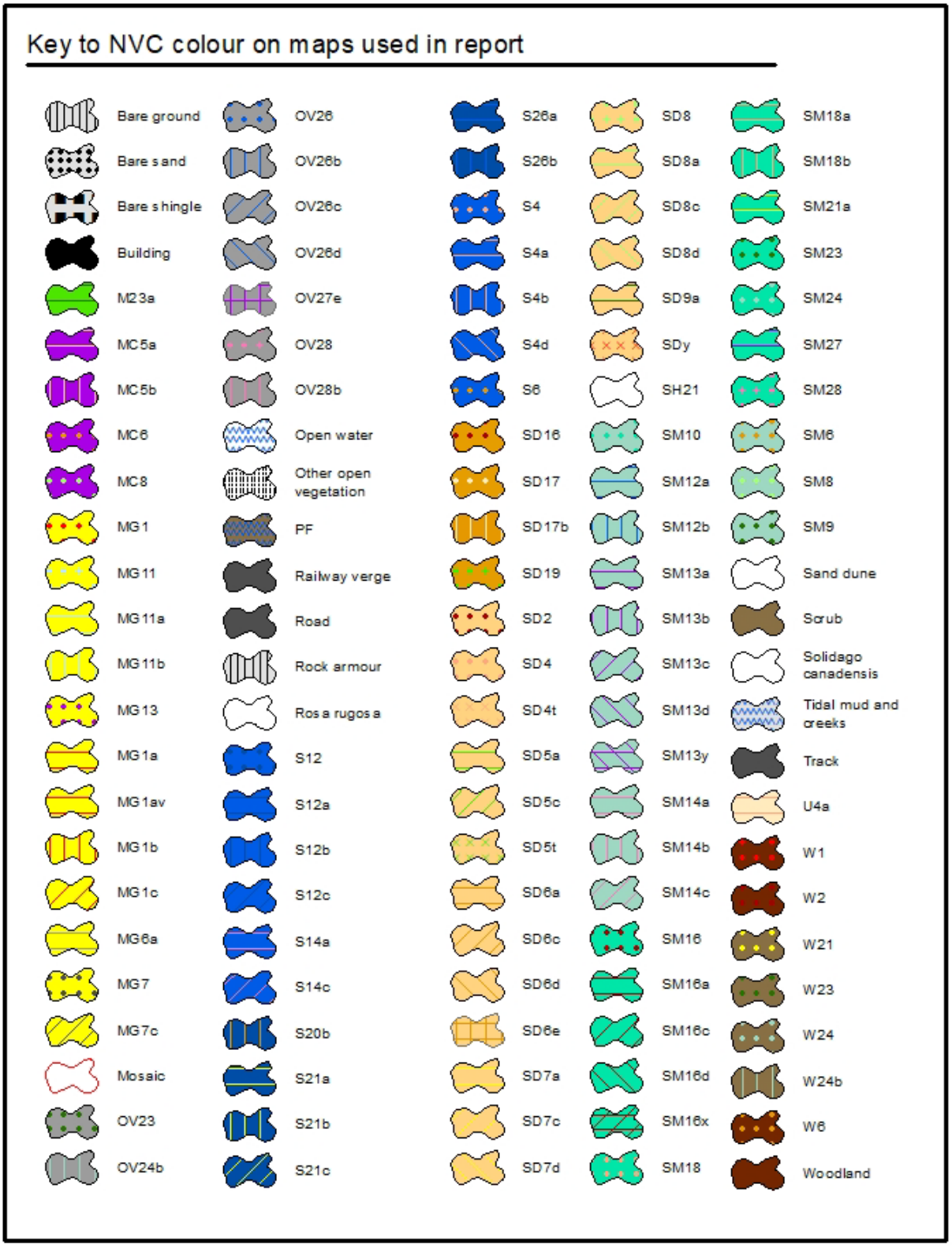
Appendices

A. Key to the NVC maps



B. Areas of habitat by sub-site

Table 7-1 presents a detailed breakdown of each NVC sub-community, and other mapping categories, by sub-site.

Table 7-1. Area (ha) of vegetation types found in each sub-site in 2022.

Vegetation	Bagillt Marshes	Connah's Quay	Dee River Marshes	Flint Marshes	Greenfield Flushing Lagoon	Gronant Dunes	Point of Ayr	Total
SM6	0.16	0.07	na	0.18	na	0.13	0.48	1.02
SM8	na	0.08	na	1.80	na	0.36	3.35	5.58
SM9	na	0.46	0.01	0.26	na	0.61	0.62	1.97
SM10	na	0.65	na	3.85	0.00	0.25	2.29	7.04
SM12a	0.79	0.13	na	1.70	0.11	na	0.21	2.94
SM12b	na	0.03	na	0.75	na	na	na	0.78
SM13a	0.49	11.12	0.61	31.68	0.00	0.08	5.52	49.50
SM13b	0.06	0.03	1.73	0.42	na	na	na	2.23
SM13c	na	0.02	0.02	na	na	0.11	0.75	0.90
SM13d	na	na	0.01	1.55	na	na	na	1.56
SM13y	na	0.23	na	0.89	na	0.87	2.13	4.12
SM14	na	0.01	na	na	na	na	1.86	1.87
SM14a	10.52	0.45	na	0.95	0.29	na	12.28	24.49
SM14b	0.61	0.09	na	na	na	na	na	0.70
SM14c	1.43	0.31	na	1.05	0.04	3.10	5.87	11.80
SM16	0.06	na	na	0.08	na	na	na	0.14
SM16a	0.40	3.24	0.15	20.38	na	na	3.80	27.97
SM16c	4.02	2.37	4.01	2.60	0.09	na	0.99	14.09
SM16d	0.10	0.32	0.70	2.00	0.01	2.35	1.70	7.19
SM16x	na	na	na	na	na	1.00	na	1.00
SM18	na	na	na	na	na	0.00	na	0.00
SM18a	na	na	na	0.66	na	0.11	na	0.77
SM18b	na	na	na	na	na	0.21	na	0.21
SM23	na	na	0.05	0.21	na	na	0.08	0.33
SM24	0.70	5.78	0.01	2.15	0.14	na	0.40	9.18
SM27	na	na	na	0.28	na	na	0.08	0.36
SM28	0.61	na	9.54	0.93	na	na		11.08
M23a	na	na	na	na	na	na	0.24	0.24
MC5a	na	na	na	0.02	na	0.40	0.03	0.46
MC5b	na	na	na	na	na	0.12	na	0.12
MC6	na	na	na	0.05	0.01	na	na	0.06

Vegetation	Bagillt Marshes	Connah's Quay	Dee River Marshes	Flint Marshes	Greenfield Flushing Lagoon	Gronant Dunes	Point of Ayr	Total
MC8	na	na	na	0.08	na	na	na	0.08
MG1	0.37	0.12	0.39	na	na	0.16	na	1.03
MG1a	1.26		0.54	0.96	na	0.21	15.64	18.61
MG1b	0.57	0.67	0.15	8.49	0.21	na	0.19	10.28
MG1c	na	na	na	na	na	0.12	na	0.12
MG6a	na	na	0.72	na	na	na	na	0.72
MG7	na	na	na	0.05	na	na	na	0.05
MG7c	na	na	na	0.15	na	na	na	0.15
MG11	na	na	na	0.02	na	na	0.03	0.05
MG11a	0.04	0.42	na	0.36	0.11	na	na	0.92
MG11b	na	na	0.29	0.44	na	0.04	na	0.76
MG13	na	na	na	0.11	na	0.35	na	0.46
OV23	0.02	na	na	0.05	na	na	na	0.07
OV24b	na	na	na	0.05	na	na	na	0.05
OV26	na	na	na	0.05	na	na	na	0.05
OV26b	na	na	na	na	na	0.08	na	0.08
OV26c	na	na	na	0.32	na	na	na	0.32
OV26d	0.05	na	na	1.08	na	na	na	1.13
OV27b	na	na	na	na	na	na	0.06	0.06
OV27e	na	na	na	na	na	0.02	na	0.02
OV28	na	na	na	0.23	na	na	na	0.23
OV28b	na	na	na	na	na	0.04	na	0.04
Other open vegetation	na	na	na	na	na	0.15	na	0.15
S4	na	0.12	na	na	na	na	0.05	0.17
S4a	0.01	0.18	0.01	na	na	7.84	0.64	8.68
S4b	na	na	na	na	na	na	0.17	0.17
S4d	na	0.26	na	na	na	0.01	na	0.27
S6	na	na	na	na	na	0.01	na	0.01
S12	na	na	0.00	na	na	0.15	na	0.15
S12a	na	na	na	na	na	0.47	na	0.47
S12b	na	na	na	na	na	0.10	na	0.10
S12c	na	na	na	na	na	0.15	na	0.15
S14a	na	na	na	na	na	0.25	na	0.25
S14c	na	na	na	na	na	0.34	na	0.34
S20b	na	na	na	na	na	3.84	na	3.84
S21	na	0.00	na	na	na	na	na	0.00
S21a	na	na	0.01	na	na	5.94	0.07	6.02
S21b	0.12	0.25	na	0.20	na	0.25	0.01	0.83
S21c	0.04	0.02	0.01	1.03	na	1.53	na	2.62

Vegetation	Bagillt Marshes	Connah's Quay	Dee River Marshes	Flint Marshes	Greenfield Flushing Lagoon	Gronant Dunes	Point of Ayr	Total
S26a	na	na	na	0.22	na	na	0.12	0.33
S26b	na	na	na	na	na	0.29	0.41	0.71
S28	na	0.00	na	na	na	na	na	0.00
SD2	na	na	na	na	na	0.84	0.29	1.13
SD4	na	na	na	na	na	0.56	0.09	0.65
SD4t	na	na	na	na	na	0.29	0.27	0.56
SD5a	na	na	na	na	na	0.18	0.03	0.21
SD5c	na	na	na	na	na	0.03	0.39	0.42
SD5t	na	na	na	na	na	na	0.56	0.56
SD6a	na	na	na	na	na	0.12	na	0.12
SD6c	na	na	na	na	na	0.32	na	0.32
SD6d	na	na	na	na	na	3.03	na	3.03
SD6e	na	na	na	na	na	0.94	na	0.94
SD7a	na	na	na	na	na	2.60	na	2.60
SD7c	na	na	na	na	na	1.50	na	1.50
SD7d	na	na	na	na	na	0.65	na	0.65
SD8	na	na	na	na	na	0.05	na	0.05
SD8a	na	na	na	na	na	0.39	na	0.39
SD8c	na	na	na	na	na	0.68	0.03	0.71
SD8d	na	na	na	na	na	0.04	na	0.04
SD9a	na	na	na	na	na	11.61	0.05	11.66
SD16	na	na	na	na	na	0.36	na	0.36
SD17	na	na	na	na	na	0.39	na	0.39
SD17b	na	na	na	na	na	na	0.10	0.10
SD19	na	na	na	na	na	0.19	na	0.19
SDy	na	0.02	na	0.03	na	na	na	0.05
Solidago canadensis	na	na	na	na	na	na	0.05	0.05
Rosa rugosa	na	na	na	na	na	0.02	na	0.02
U4a	0.39	na	na	na	na	na	na	0.39
W1	na	na	na	na	na	0.03	na	0.03
W2	na	na	na	0.78	na	na	na	0.78
W21	0.07	na	na	0.65	na	na	0.05	0.78
W23	0.03	na	na	0.03	na	na	na	0.06
W24	0.04	0.25	0.01	0.57	na	na	0.08	0.96
W24b	0.20	na	na	na	na	na	0.04	0.24
W6	na	na	na	0.32	na	na	na	0.32
Bare ground	na	na	na	na	na	na	0.89	0.89
Bare mud	na	na	na	na	na	0.44	na	0.44
Bare sand	na	na	na	na	na	0.19	na	0.19

Vegetation	Bagillt Marshes	Connah's Quay	Dee River Marshes	Flint Marshes	Greenfield Flushing Lagoon	Gronant Dunes	Point of Ayr	Total
Bare shingle	na	na	na	na	na	0.70	na	0.70
Building	na	0.04	0.00	0.00	na	na	0.00	0.05
Open water	na	na	na	0.22	0.04	1.18	0.33	1.77
PF	0.04	3.05	0.26	0.48	na	na	0.14	3.97
Railway verge	na	na	na	0.08	na	na	na	0.08
Road	na	na	na	na	0.52	na	na	0.52
Rock armour	0.37	na	na	0.23	na	na	1.76	2.36
Sand dune	na	na	na	na	na	23.96	3.22	27.19
Scrub	0.38	1.46	na	0.11	0.17	0.06	na	2.19
Tidal mud and creeks	20.85	na	9.13	84.53	0.73	49.80	59.6	224.64
Tidal mud	na	na	na	2.06	na	0.16	na	2.22
Track	0.28	0.16	0.01	0.35	0.03	0.02	0.12	0.97
Woodland	0.27	0.67	0.10	5.98	0.10	na	0.56	7.69
Grand Total	**45.37**	**33.09**	**28.47**	**184.74**	**2.61**	**133.42**	**128.74**	**556.43**

C. Data Archive Appendix

Data outputs associated with this project are archived in NRW's X Drive on server–based storage at Natural Resources Wales.

The data archive contains:

The final report in Microsoft Word and Adobe PDF formats.

A series of GIS layers on which the maps in the report are based.

A set of raster files in ESRI and ASCII grid formats.

A full set of images produced in jpg format.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue https://libcat.naturalresources.wales (English Version) and https://catllyfr.cyfoethnaturiol.cymru (Welsh Version) by searching 'Dataset Titles'. The metadata is held as record no NRW_DS125736

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