Appendix G

Lough Corrib cSAC Habitat Surveys

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N6 Galway City Ring Road

Habitat mapping and assessment of a section of Lough Corrib cSAC and surrounding areas

2017

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1 Introduction

BEC Consultants Ltd were appointed by Scott Cawley to carry out habitat surveys, assess Annex I habitats and collect relevés from sections of Lough Corrib candidate Special Area of Conservation (cSAC) (site code 000297) and additional adjoining areas (Figure 1) which occur within the study area of the N6 Galway City Ring Road (GCRR). This report presents the findings of these surveys carried out during 2014 and incorporates data collected from the area by BEC Consultants during 2013 (Perrin *et al*., 2013).

The aim of the surveys was to provide a baseline dataset for use during consideration of the development of the GCRR and to inform any potential transport solutions which will traverse the scheme study area. The objectives for the survey were to:

- map habitats within the study area recording a number of common and, where appropriate, characteristic, plant species from each mapped polygon;
- record where habitats conform to those listed in Annex I of the EU Habitats Directive, and make a rapid assessment of the habitat value of these areas;
- assess the Annex I habitats using standard assessment criteria developed by the National Parks & Wildlife Service (NPWS);
- record a number of relevés to support the mapping data collected;
- survey areas of potential priority *6210 Calcareous grassland identified by Perrin *et al.* (2013);
- refine mapping of wooded limestone pavement areas which had been mapped as 'Part 8240' by Perrin *et al.* (2013); and
- where possible, relate habitat mapping to vegetation communities developed by NPWS.

Work was conducted by BEC Consultants Ltd, with some of the wetland areas at Coolagh Lakes and Coolanillaun Bog also surveyed and assessed by Wetland Surveys Ireland (WSI) (Crushell & Foss, 2014a, b). All survey work carried out in 2014 was conducted between May and September 2014. The study area for this work was a sub-set of the scheme study area, being mainly concentrated within the cSAC. A number of outlying areas adjacent to the cSAC (west of the River Corrib, west and northwest of Coolagh Lakes, and north of Menlough Road) were also included within the study area.

The convention of indicating priority Annex I habitats by an asterisk (*) is followed in this report.

2 Methods

2.1 Previous surveys

In 2013, habitat mapping and a number of habitat assessments were conducted within the Lough Corrib cSAC at Menlough (northeast of Coolagh Road), at areas adjacent to the River Corrib at Dangan Lower and Menlough, and at areas of limestone pavement at Ballygarraun to the east of the current survey area. The data from Perrin *et al*. (2013) which were collected within the current study area have been incorporated into the current project. Data pertaining to Ballygarraun have been updated and are presented separately in Perrin (2014).

Some habitat mapping data were available from Wilson & Fernández (2013), who carried out a national survey of limestone pavement habitat for NPWS. The limestone pavement northeast of Menlough Road was sampled during this survey, with four monitoring stops (100 m x 100 m) being established. The habitat polygons created for the National Survey of Limestone Pavement (NSLP) were incorporated into the polygons used by Perrin *et al.* (2013) which were subsequently used

during this project. This report also presented results from four assessments for *8240 exposed Limestone pavement and two from 6210 Calcareous grassland.

In preliminary work for the GCRR, a habitat map was created through aerial photograph interpretation by Forest, Environmental Research and Services Ltd. (FERS, 2013), which covered the study area for most of the current project (except Coolanillaun Bog). Polygons generated by FERS were used as the basis for habitat mapping for the areas around Coolagh Lakes and west of the River Corrib.

A report was prepared by Conaghan (2000) which described and assessed habitats along previously proposed routes for the Galway Outer Bypass. This included habitats at Dangan Lower, Coolagh Lakes and the limestone plateau, many of which were considered by Conaghan (2000) as corresponding to Annex I habitats.

2.2 Initial habitat mapping

A GIS model was created to incorporate the mapping from Perrin *et al*. (2013) with polygons created by FERS (FERS 2013). Some re-digitisation of polygon boundaries was carried out prior to habitat mapping in the field. Coolanillaun Bog had not been covered by either of the 2013 studies, so polygon boundaries were created by WSI. All of the areas represented by polygons within the GIS were then viewed in the field and assigned to Heritage Council habitat codes (Fossitt, 2000) and, where relevant, Annex I habitat types. Waypoints were collected on a GPS unit and field maps were annotated to indicate where re-digitisation of polygons was necessary; this was carried out in the office.

Initial habitat mapping was conducted for the area around Coolagh Lakes and the section of the study area west of River Corrib in May 2014. This comprised mapping to level 3 of the Heritage Council habitat codes (Fossitt, 2000) with areas of Annex I habitat also being identified. Initial habitat mapping of Coolanillaun Bog was conducted by WSI during August 2014. Initial habitat mapping of the area northeast of Coolagh Road had been completed by Perrin *et al*. (2013).

2.3 Stage 2 mapping

Stage 2 mapping comprised all polygons being revisited and notes made on the main plant species (three common species and up to three characteristic species) occurring within the polygon. When applicable a short note was also made to describe the habitat and any impacts were noted. For polygons which represented a mosaic of habitats, an approximate percentage cover for each component habitat was recorded.

In addition, polygons which represented Annex I habitats were considered on a rapid quality assessment scale of 1-3, taking general habitat condition and impacts into account, whereby:

1 = the habitat was a poor example of the Annex I habitat;

2 = the habitat was a good example of the Annex I habitat; and

3 = the habitat was an excellent example of the Annex I habitat.

In general, a rating of 1 was assigned to habitats which barely met the criteria to be considered as the Annex I habitat, or Annex I habitats with significant impacts operating on them, such as heavy encroachment by scrub on exposed *8240 Limestone pavement. All wooded limestone pavement was assigned a rating of 1. It should be noted, however, that the impacts should not be so significant that the integrity of the Annex I habitat has been lost; a rating of 1 means that the habitat is in poor condition, but is still Annex I habitat. A rating of 3 was assigned to habitats which exceeded the criteria to be considered as the Annex I habitat, and which were generally free (or almost free) of negative impacts, and/or which were undergoing appropriate management. A rating of 2 was

assigned to any Annex I habitats that fell between these two extremes. Some correspondence was retrospectively applied between this rapid quality assessment scale and assessment stop results, in that a polygon containing a monitoring stop that failed the structure and functions could not receive a rating of 3.

Stage 2 mapping was conducted between July and September 2014. Additional visits to specific polygons were made in January 2015, May 2017 and June 2017. Data recorded from this stage were added to the attributes table within the GIS. Following Smith *et al.* (2011) a DATA_QUAL column was included in the final attributes file to indicate the survey method used for each polygon based on the following codes:

- S= Field data collected from a walkover survey;
- V= Data have been field validated, where the habitat has been viewed in the field in less detail; and
- DD=Habitat information has been derived from aerial photograph interpretation.

Smith *et al.* (2011) notes further codes to describe data of lesser quality but these are not relevant to this project.

A field, NRA_RATING, was included in the attributes table to contain the National Roads Authority (NRA) ecological rating (NRA, 2009) for each of the polygons. Values were assigned as follows:

- All Annex I polygons within the cSAC were assigned the value “International Importance”.
- Annex I polygons outside the cSAC were assigned ratings of International, National and County Importance, based on the Quality rating assigned to them during the survey (3, 2 and 1 respectively).
- Non-Annex polygons outside the cSAC were mainly evaluated on an overall habitat basis, these largely informed by the vegetation communities and/or Fossitt habitats, using the following criteria:
    - All PF, FS, WN, WD, WS, FW, FL habitats assigned to High Local Importance except WS3, WS5 and WD5 assigned to Low Local Importance (see Fossitt 2000 for further details of the codes given).
    - WL1/WL2 assigned to High Local Importance if they add significantly to connectivity or are relatively undisturbed, otherwise assigned to Low Local Importance.
    - HD1 assigned to either High or Low Local Importance on a case-by-case basis, depending on context and other habitats within the polygon (if any).
    - GS communities: All assigned to High Local Importance except communities 3b and 2c, which are assigned to Low Local Importance (more semi-improved community types).
    - ER2: Low Local Importance
    - ED3 assigned to either High or Low Local Importance on a case-by-case basis, depending on species, context and other habitats within the polygon (if any).
    - BL3, GA1, GA2, ED2: No Ecological Importance.
- For non-Annex polygons inside the cSAC, a qualifier “located in SAC” was added. Note that, while all habitats within a cSAC should, according to the NRA guidelines (NRA, 2009), automatically receive a rating of International Importance, the methodology followed here was deemed to be more useful for the overall decision-making process.

Finally, a field, ECO_VALUE, was included in the attributes table to contain a modified version of the NRA ecological rating for each of the polygons. For this field, all Annex I polygons, regardless of whether they were in the cSAC or not, were assigned the value “International Importance”. The values for all non-Annex polygons were the same as the NRA_RATING field.

2.4 Relevés

Representative relevés were collected across the survey area to support the habitat classification given during the mapping exercise and to provide additional data on the conservation value of habitats. Survey time was not spent collecting relevés from habitats within the cSAC which were not of conservation interest (e.g. BL3 Buildings and artificial surfaces), and habitats which are difficult to access (e.g. certain types of WS1 scrub) are under-represented within the relevé data.

Cover of all vascular plants and bryophytes in vertical projection was recorded as a percentage of each plot. Bryophyte samples were collected where necessary and identified later in the lab. Data were entered onto a handheld computer in the field using TurbovegCE.

2.5 Conservation assessment of Annex I habitats

The conservation status of each Annex I habitat was assessed following the guidelines available from NPWS. The purpose of this assessment was to determine the current quality and condition of the Annex I habitats within the study area, highlighting areas which were in particularly good condition and those which might be experiencing management pressures. As the study area did not cover the full extent of the cSAC the results of the assessment can only be considered representative of the study area and not the whole of the cSAC. The results presented here represent baseline data for these habitats and thus (with the exception of the Area assessment) there are no previous data that can be used to draw conclusions on trends in habitat condition (i.e., improvement, stability or decline).

The guidelines, which have been developed specifically for habitats occurring within Ireland, are based on the approach used for the national conservation assessment of Annex I habitats, which is carried out according to guidelines published by the EU (Evans & Arvela, 2011). It utilises four main parameters to assess the habitats at a national level: range, area (extent), structure and functions, and future prospects. This approach has been applied to the conservation assessment of Annex I habitats within individual sites for a number of different national habitat studies such as the Limestone Pavement Monitoring Project (Wilson & Fernández, 2013), Coastal Monitoring Project (Ryle *et al*., 2009), Woodland Monitoring Survey (O'Neill & Barron, 2012) and the Irish Semi-natural Grasslands Survey (ISGS) (O'Neill *et al*., 2013). These assessments adopted a "traffic light" system of assessment for the four criteria, as shown in Table 1.

Table 1. Summary matrix of the parameters and conditions required to assess the conservation status of Annex I habitats. Modified from Ryle *et al*. (2009).

	Favourable	***Unfavourable – Inadequate***	***Unfavourable – Bad***
Range	Stable	>0 - <1% decline per year	≥1% decline per year
Area	Stable	>0 - <1% decline per year	≥1% decline per year
Structure & functions	Stable	1 – 25% of area is unfavourable	> 25% of area is unfavourable
Future prospects	Prospects excellent or good, long-term viability of habitat assured	Intermediate between *Favourable* and *Unfavourable – Bad*	Severe impact from threats, habitat declining rapidly
Overall	*All parameters green*	*Combination of green and amber*	*One or more parameters red*

Range considers the national range (distribution) of a habitat, so it is omitted from assessments carried out on an individual site.

Assessment of area is concerned with detecting changes in the extent of the Annex I habitat over time, particularly habitat losses. The actual parameter measured is percent annual change for the period over which the change is being assessed. Habitat loss or gain at a site can be assessed by reviewing aerial photographs or satellite imagery *in lieu* of baseline habitat mapping though this technique is limited by the availability and quality of historic images and in general only gross habitat changes can be detected with any degree of certainty.

The structure and functions assessment examines a number of criteria that measure the health and overall functioning of the Annex I habitat. These criteria vary, depending on the habitat being assessed. For terrestrial habitats such as those considered for this project, a range of criteria, such as vegetation height, plant species cover and disturbance, are considered to gauge the condition of the habitat and thus to derive their conservation status. The structure and functions of the habitat was assessed by recording monitoring stops which examine the condition of the habitat in addition to providing relevé data for the location. Structure and functions criteria are assessed at each stop based on habitat-specific criteria, with each criterion having a target value which must be reached for it to pass. A failure of one or more criteria to meet a required target causes the stop to fail, except for *8240 Limestone pavement (exposed and wooded types) and *91E0 Alluvial forests, where a single criterion failure may be allowed. The percentage of assessment stops that pass or fail the structure and functions assessment is used as a proxy for the percentage of the area that passes. This assumes that all assessment stops represent and assess a similar area of habitat. It should be noted that failure of an assessment stop, or an assessment result of *Unfavourable*, does not necessarily mean that the habitat is non-Annex or of low conservation value, but rather that it is in need of improved management.

The future prospects parameter assesses how likely the Annex I habitat is to continue to move towards, or remain at, favourable conservation status. According to Evans & Arvela (2011), the future prospects parameter is partly dependent on the area and structure and functions parameters, with impacts, threats and pressures operating on the Annex I habitat also taken into account to determine the likely future trend and status of the habitat. Pressures and threats on Annex I habitats were recorded during fieldwork and adapted to the codes of Ssymank (2011). The nature of each impact (positive, negative or neutral), its intensity (high, medium or low), and the percentage of the Annex I habitat affected were recorded.

Assessment criteria were available from NPWS for the majority of the Annex I habitats recorded (Table 2). The criteria by which habitats were assessed are available in the publications referenced in Table 2 below, together with more complete descriptions of the assessment methodology for each Annex I habitat.

The assessment criteria developed through the National Survey of Upland Habitats (NSUH) have been based primarily on data from upland situations and may not be directly relevant to the lowland examples of these habitats as recorded during the current project. However, as part of this project WSI reviewed the NSUH criteria for 7230 Alkaline fens and 7140 Transition mires and quaking bogs, and considered them appropriate for use on lowland examples of the habitat (Crushell & Foss, 2014a). Criteria for *7120 *Cladium mariscus* fens were developed for this project by WSI (Crushell & Foss, 2014a) as there has been no comprehensive study of the habitat and it has not been described previously in an Irish context. Criteria for 6430 Hydrophilous tall-herb communities were based on data collected during the Irish Semi-natural Grasslands Survey (ISGS) (O'Neill *et al*., 2013) and in general these were considered suitable for assessing unmanaged swamp communities; however, an adjustment was introduced in allowing a higher cover (70%) of the reed species *Phragmites australis*

(common reed) and *Phalaris arundinacea* (reed canary grass) to be present in the relevé before the stop would fail.

Table 2. Annex I habitats recorded, the reference for assessment criteria used, and the size of relevé.

Annex I habitat code	Habitat name†	Reference	Relevé size (metres)
4010	Wet heaths	Perrin *et al.* (2014)	2 x 2
4030	Dry heaths	Wilson & Fernández (2013)	1 x 1 / 2 x 2
4060	Alpine and Boreal heaths	Wilson & Fernández (2013)	1 x 1 / 2 x 2
(*)6210	Calcareous grassland (* important orchid sites)	O'Neill *et al.* (2013)	1 x 1 / 2 x 2
6410	*Molinia* meadows	O'Neill *et al.* (2013)	2 x 2
6430	Hydrophilous tall-herb communities	O'Neill *et al.* (2013)	2 x 2
(*)7130	Blanket bogs (* active)	Perrin *et al*. (2014)	2 x 2
7140	Transition mires and quaking bogs	Perrin *et al.* (2014)	2 x 2
*7210	*Cladium* fens	Crushell & Foss (2014a); criteria developed for GCRR project	2 x 2
7230	Alkaline fens	Perrin *et al.* (2014)	2 x 2
*8240	Limestone pavement	Wilson & Fernández (2013)	5 x 5
*91E0	Alluvial forests	O'Neill & Barron (2013)	10 x 10

† Abbreviated Annex I habitat names are used throughout this report; full Annex I habitat titles are available in CEC (2013)

2.6 Definition of Annex I habitats

Of the 15 Annex I habitats surveyed during this study, the majority are well defined by recent national studies co-ordinated by NPWS (listed in Table 2). Some further definition was required for wooded *8240 Limestone pavement, and this is described below. For *7210 *Cladium mariscus* fens there has been no comprehensive study of the habitat and it has not been described previously in an Irish context. WSI reviewed the available literature and developed assessment criteria for this habitat for use during this project, as there were no existing criteria by which to assess the habitat; these are presented in Appendix 1. Following this review, the species-poor *Cladium mariscus*-dominated swamp community was included within the Annex I habitat type. Some published sources have not included this variant within the Annex I habitat type (Fossitt, 2000; NPWS, 2013) but it equates to the British NVC Community "S2 *Cladium mariscus* swamp and sedge-beds *Cladietum marisci*" (Rodwell *et al*., 1995), which is listed in the Interpretation Manual of EU Habitats (CEC, 2013) as corresponding to the Annex I habitat. The interpretation for this Annex I habitat that is presented in this report is consistent with that used in other countries, e.g. the UK (www.jncc.defra.gov.uk) and Germany (www.bfn.de).

Though the Interpretation Manual does not specifically mention woodland being a component of the Annex I definition for *8240 Limestone pavement, its inclusion appears widely accepted (JNCC, 2009, 2014; Wilson & Fernández, 2013). The Interpretation Manual does include "scrub... (e.g. *Corylo-Fraxinetum*)", and the two corresponding categories from the UK National Vegetation Classification which relate to *8240 Limestone pavement are both woodland types. It is, however, stated by Rodwell *et al.* (2000) that limestone pavement habitats do not fit well in the NVC system, with there being nothing encountered that cannot be described in terms of fragments, or complexes of a variety of vegetation types, already represented elsewhere within the classification.

The National Survey of Limestone Pavement (NSLP) (Wilson & Fernández, 2013) describes two pavement types based on their morphology:

- blocky, characterised by a well-defined structure of clints and grikes; and
- shattered areas of loose rubble which generally lack a well-defined structure of clints and grikes.

Wooded limestone pavement is described in the NSLP as a habitat which "includes low woodland formations dominated by Hazel and/or Ash with typical blocky pavement under the canopy". No justification is provided as to why hazel/ash woodland which has developed over shattered pavement is not included within the Annex I type. The EU Interpretation Manual does include 'shattered pavements' within its definition of the Annex I habitat. Recognising areas of blocky pavement as opposed to shattered pavement under woodland, when the ground is carpeted in a cover of bryophytes, can be difficult. Indeed, both blocky and shattered pavement types frequently occur together, which further complicates the distinction. The species occurring in woodland over blocky pavement and shattered pavement would be similar and can indeed be found in calcareous woodland on deeper soils, so the species do not assist in defining the habitat. As such, it was decided for this project to define wooded *8240 Limestone pavement as having a closed canopy of trees at least 3 m tall with at least 50% of the surface comprising bedrock at the surface (the bedrock was normally covered by mosses) and retaining some evidence of limestone pavement structure. In the wooded limestone pavement habitats encountered during this survey, soil was generally present but was thin (< 2 cm), though could be deeper in places – for example, in old grikes – due to a build-up of humus.

2.7 Vegetation community mapping

Relevés were referred *post hoc* to vegetation communities from the relevant NPWS habitat surveys (Table 2). The limitations of these community descriptions should be recognised, as the vegetation communities have been developed on a project-specific basis rather than as part of an Irish Vegetation Classification, and as such they may have been analysed following different methodologies and at different scales. Some of the communities have been developed based on hundreds of relevés from across the country, while others are based on fewer than 10 representative samples. There is also some overlap between the projects, e.g. both the NSLP and the ISGS have sampled and described calcareous grassland communities. Expert judgment was therefore applied in deciding which vegetation communities to use.

Irish vegetation communities have not been published recently for some of the communities which were recorded, including *Cladium mariscus* fen, reed swamp, scrub and improved grassland. During this study a detailed community definition was developed and applied for *Cladium mariscus* fen and *Cladium mariscus* swamp. For other communities, where recently published vegetation data were not available, either the Fossitt habitat, the Fossitt habitat in combination with the Annex I habitat, or the Fossitt habitat in combination with abundant characteristic species were utilised (Table 3).

A total of 333 relevés recorded during this study were classified to a vegetation community, and these communities were then utilised as a reference to assist in the classification of the most frequent vegetation community within each surveyed polygon. *8240 relevés were classified to the more detailed communities listed in Wilson & Fernández (2013), whereas *8240 polygons were classified using the broader vegetation types of limestone pavement exposed (LPE) and limestone pavement wooded (LPW); limestone pavement grassland/heath was never recorded as the most frequent vegetation community within a polygon.

It should be noted that for a few polygons it was not possible to confidently assign a vegetation community based on the available data. On the maps (Figures 6a-d), these instances are indicated as 'Not assigned'. In the GIS shapefile, a number of different descriptors were used, as follows: 'Intermediate' was utilised to indicate the intermediate nature of the community; 'None' was used to denote polygons of built land and other man-made habitats where there was no recognisable

vegetation community; 'Not walked' was used in cases where polygons could not be accessed for a walkover survey; a limited number of habitats were assigned only to Fossitt (2000) category, and were not broken down further into separate communities, with the Fossitt (2000) code serving as the vegetation community in these cases.

Table 3. Novel vegetation communities. All alphanumeric abbreviations, such as FS1, refer to Fossitt (2000).

Vegetation community	Description
FS1_*7210	*Cladium mariscus* swamp as described in Crushell & Foss (2014a)
FS1_6430	FS1 swamp community with indicator species for the 6430 Annex I habitat
FS1_7140	FS1 swamp community with indicator species for the 7140 Annex I habitat
FS1_Phragmites	FS1 swamp community with *Phragmites australis* dominant, often >70% cover
FS1_Scirpus	FS1 swamp community with *Scirpus lacustris* dominant
FS1_Sparganium	FS1 swamp community with *Sparganium erectum* dominant
FS2_*7210	*Cladium mariscus* swamp as described in Crushell & Foss (2014a), with a higher broadleaf herb component and/or lower *Phragmites australis* cover than FS1_*7210
FS2_6430	FS2 swamp community with indicator species for the 6430 Annex I habitat
FS2_Sparganium	FS2 swamp community with *Sparganium erectum* abundant
GM1_6430	GM1 community with indicator species for the 6430 Annex I habitat. This community is a subset of the grassland community 1b (O'Neill *et al.,* 2013)
HH4_4060_Dryas	HH4 heath community with a population of *Dryas octopetala*
PF1_*7210	*Cladium mariscus* fen as described in Crushell & Foss (2014a)
PF1_6430	Tall herb fen community with indicator species for the 6430 Annex I habitat
PF1_Juncus subnodulosus	Fen community with abundant *Juncus subnodulosus* that could not be classified using Perrin *et al.* (2014)
PF1_Molinia	Fen meadow community with abundant *Molinia caerulea* that could not be classified using O'Neill *et al.* (2013) or Perrin *et al.* (2014)
WS1_Myrica	Scrub community with abundant *Myrica gale* that could not be classified using Perrin *et al*. (2008)
WS1_Prunus, WL1_Prunus	Scrub or tree line community with abundant *Prunus spinosa* that could not be classified using Perrin *et al.* (2008)
WS1_Rubus, WL1_Rubus	Scrub or tree line community with abundant *Rubus fruticosus* agg. that could not be classified using Perrin *et al*. (2008)
WS1_Ulex	Scrub community with abundant *Ulex europaeus* that could not be classified using Perrin *et al*. (2008)
WD1_Alnus incana, WD1_Ulmus sp., WS3_Fallopia	Communities with a significant % of non-native trees or shrubs, with the most abundant non-native species noted

2.8 Potential priority habitat *6210 Calcareous grassland

Perrin *et al*. (2013) identified a number of polygons as the Annex I grassland habitat 6210 Semi-natural grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*). At the time of survey in late summer 2013, it was not possible to determine if these corresponded to the priority habitat version of this habitat (*important orchid sites) due to the early flowering period of many orchids. In order to qualify as the orchid-rich priority habitat, *6210 calcareous grassland should

support a population of any orchid species other than the relatively common *Dactylorhiza fuchsii* and *Dactylorhiza maculata* (O'Neill *et al*., 2013).

Each of the polygons identified as having 6210 Calcareous grassland within the area northeast of the Menlough Road were revisited in June 2014 with a view to determining whether they qualified as the priority habitat type, and representative photographs were taken. Where polygons were considered to support suitable orchids, then the habitat map was updated from 6210 Calcareous grassland to *6210 Calcareous grassland (important orchid site), the priority habitat version of this habitat.

3 Results

3.1 Habitat mapping

The extent of the survey area, which covers 478.2 ha, is shown in Figure 1. Excluding the area covered by rivers and lakes, the area surveyed and mapped for this project in 2013 and 2014 is 388.8 ha. The habitat maps presented in Figures 2a-d were created in ArcMap and show the habitats according to the Fossitt (2000) classification scheme. A total of 41 Fossitt (2000) habitats were recorded during the survey. It should be noted that, where a mosaic of habitats was recorded, only the primary habitat (i.e., the one with the highest percentage cover) is represented. A summary of the area of the Fossitt habitats surveyed is presented in Table 4, and further data are available in the associated GIS shapefile.

Table 4. Extent of Fossitt habitats within the survey area.

Fossitt code	Habitat	Area (ha)
BL1	Stone walls and other stonework	0.22
BL3	Buildings and artificial surfaces	6.70
ED1	Exposed sand, gravel or till	<0.01
ED2	Spoil and bare ground	2.33
ED3	Recolonising bare ground	2.92
ED4	Active quarries and mines	0.30
ER2	Exposed calcareous rock	26.95
ER4	Calcareous scree and loose rock	0.01
FL1	Dystrophic lakes	0.13
FL3	Limestone/marl lakes	7.28
FL4	Mesotrophic lakes	0.04
FS1	Reed and large sedge swamps	28.76
FS2	Tall-herb swamps	4.06
FW2	Depositing/lowland rivers	81.99
FW4	Drainage ditches	0.50
GA1	Improved agricultural grassland	4.49
GA2	Amenity grassland (improved)	15.17
GM1	Marsh	3.61
GS1	Dry calcareous and neutral grassland	61.30
GS2	Dry meadows and grassy verges	7.34
GS4	Wet grassland	40.65
HD1	Dense bracken	1.24
HH2	Dry calcareous heath	0.42
HH3	Wet heath	8.00
HH4	Montane heath	0.08
PB3	Lowland blanket bog	6.19
PF1	Rich fen and flush	8.95
PF2	Poor fen and flush	0.10
PF3	Transition mire and quaking bog	4.11

Table 4 (ctd.)

Fossitt code	Habitat	Area (ha)
WD1	(Mixed) broadleaved woodland	12.78
WD2	Mixed broadleaved/conifer woodland	0.07
WD4	Conifer plantation	0.40
WD5	Scattered trees and parkland	1.55
WL1	Hedgerows	1.02
WL2	Treelines	2.31
WN2	Oak-ash-hazel woodland	59.99
WN6	Wet willow-alder-ash woodland	9.64
WS1	Scrub	66.10
WS2	Immature woodland	0.30
WS3	Ornamental / non-native shrubs	0.08
WS5	Recently-felled woodland	0.15
	Total site area	478.22

A total of 16 Annex I habitats, covering 155.2 ha, were recorded during the survey, counting all variants of habitats (i.e., priority, non-priority, wooded, exposed) separately. The aquatic Annex I habitat 3160 Dystrophic lakes was recorded but was not assessed as part of this project, which was focused on terrestrial habitats. The locations of all Annex I habitats are shown in Figures 3a-d. Mosaics of Annex I habitat are represented separately on the map. A summary of the area of the Annex I habitats surveyed is presented in Table 5.

Table 5. Extent of Annex I habitats within the survey area. *denotes priority habitat

Annex I code	Habitat	Area (ha)
3160	Dystrophic lakes	0.13
4010	Wet heaths	7.99
4030	Dry heaths	0.41
4060	Alpine and Boreal heaths	0.08
6210	Calcareous grasslands	6.98
*6210	Orchid-rich calcareous grasslands	12.08
6410	*Molinia* meadows	4.20
6430	Hydrophilous tall-herb communities	5.88
*7120	*Cladium* fens	10.61
7130	Blanket bog (inactive)	3.54
*7130	Blanket bog (active)	2.65
7140	Transition mires and quaking bogs	4.19
7230	Alkaline fens	3.11
*8240	Limestone pavement (exposed)	58.27
*8240	Limestone pavement (wooded)	26.74
*91E0	Alluvial forests	8.89
	Total area of Annex I habitats	**155.74**

The Annex I habitat that covered the greatest area was *8240 Limestone pavement, with both the exposed and wooded variants far exceeding the other Annex I habitats in extent. The two variants of *8240 together covered 85.0 ha, and therefore constituted over half of the Annex I habitat in the survey area.

The distribution of Annex I habitats with respect to the rapid quality assessment carried out during the field survey are represented in Figures 4a-d. Where two Annex I habitats occurring in mosaic within a polygon were ranked differently, the whole polygon was assigned according to the higher score. While taking the form of a rapid assessment of the overall quality of the Annex I habitat within the

polygon, these data complemented the assessment data and permitted some extrapolation in relation to where the best quality examples of the different Annex I habitats are to be found within the study area. Overall, just 32 Annex I polygons were assigned the highest quality rating of 3, covering an area of 7.1 ha. A total of 275 polygons received the middle quality rating covering 74.6 ha, and 378 Annex I polygons covering an area of 75.0 ha were given the lowest quality rating.

A total of 478.2 ha of habitat were surveyed, across both Annex I and non-Annex I habitats. A brief description of each mapped habitat follows below. Habitats which correspond to Annex I habitats are presented first (section 3.2), with non-Annex I habitats described subsequently (section 3.3).

Juniperus communis plants were located within the survey area on the limestone plateau, with up to 35 plants being recorded in one discrete location and a small number of additional isolated plants including some on limestone pavement east of Menlough Village and in one location at Coolanillaun Bog. Cooper *et al.* (2012) define the Annex I habitat 5130 *Juniper communis* formations as being formed from discrete clusters of 50 or more plants. A sufficient number of plants was not recorded to correspond to this Annex I habitat.

3.2 Annex I habitats

***8240 Limestone pavement (exposed)**

Corresponding Fossitt (2000) habitats: ER2 Exposed calcareous rock, WS1 Scrub

Limestone pavement is located on the eastern side of the River Corrib, with the main area occurring as a limestone pavement plateau to the northeast of Coolagh Road. There are additional pockets of *8240 Limestone pavement to the southeast of Coolagh Road between the Coolagh Lakes and Menlough Village, and also in Terryland to the east of Coolagh Lakes. This habitat consists of both the 'block' and 'shattered' variants of limestone pavement, with the shattered type being most frequent. The exposed variant also includes areas of limestone pavement being invaded by scrub (almost invariably *Corylus avellana*) that is not yet forming a continuous canopy and is less than 3 m in height. The main vascular species include scattered low-growing woody species (e.g. *Rubus fruticosus*, *Rosa spinosissima*, *Hedera helix* or immature *Corylus avellana* or *Ilex aquifolium*) and herbaceous species such as *Sesleria caerulea, Teucrium scorodonia, Mycelis muralis, Geranium robertianum, Senecio jacobaea, Carlina vulgaris* and *Carex flacca*. A suite of calcicole ferns is usually found, comprising *Asplenium ruta-muraria, Ceterach officinarum* and, in the deeper clefts (grikes), the shade-loving *Phyllitis scolopendrium*. Characteristic bryophytes are *Ctenidium molluscum*, *Tortella tortuosa* and *Neckera crispa.*

***8240 Limestone pavement (wooded)**

Corresponding Fossitt (2000) habitat: WN2 Oak-ash-hazel woodland

The wooded variant of *8240 Limestone pavement was recorded in areas of hazel woodland with a canopy of at least 3 m and minimal soil depth over at least 50% of the habitat. Soil depth and areas of exposed limestone pavement and boulders differentiate these rocky Annex I variants from non-Annex versions of WN2 Oak-ash-hazel woodland. Typical woody species include *Corylus avellana, Fraxinus excelsior, Crataegus monogyna, Sorbus aria* agg., *Euonymus europaeus, Ilex aquifolium, Prunus spinosa, Rubus fruticosus* agg., *Rosa spinosissima* and *Hedera helix.* The field layer contains species including *Fragaria vesca, Geum urbanum, Potentilla sterilis* and *Sesleria caerulea*. Rocks are sometimes completely covered by bryophytes such as *Eurhynchium striatum, Neckera crispa* and *Thamnobryum alopecurum*, but soil is typically lacking underneath the moss growth. These areas often occur in mosaic with non-Annex I scrub or woodland. Within the study area, wooded *8240 Limestone pavement is confined to the eastern side of the River Corrib and was recorded primarily to

the northeast of the Coolagh Road, but it was also found to occur southeast of Coolagh Road between Coolagh Lakes and Menlough Village, and in Terryland east of Coolagh Lakes.

6210 Calcareous grassland and *6210 Orchid-rich calcareous grassland

Corresponding Fossitt (2000) habitat: GS1 Dry calcareous and neutral grassland

The main areas of species-rich calcareous grassland were found to the northeast of Coolagh Road. Additional examples were recorded between Coolagh Lakes and Menlough Village, at Terryland to the east and south of Coolagh Lakes, on Jordan's Island, and west of the River Corrib to the north of Corrib Village. The thin soils support a highly diverse sward typically containing *Briza media, Carex flacca, Sesleria caerulea, Potentilla erecta, Succisa pratensis, Centaurea nigra, Galium verum* and *Leucanthemum vulgare.* Bryophytes include *Scleropodium purum* and *Ctenidium molluscum.* Some of these habitats are very species-rich, with over 40 species recorded from some 2 m x 2 m relevés. The orchid-rich variant of this habitat was recorded in a number of polygons northeast of Coolagh Road and also in the area west of the River Corrib to the north of the Corrib Village Student Accommodation complex. To be considered the orchid-rich priority habitat (*6210) the 6210 grassland should have a population of any orchid species other than the relatively common species *Dactylorhiza fuchsii* or *Dactylorhiza maculata* (O'Neill *et al*., 2013). It should be noted, however, that orchid populations are ephemeral, and the fact that no orchids were seen in a particular polygon during the survey does not preclude the possibility of them occurring in subsequent years. O'Neill *et al.* (2013) suggest the precautionary approach of considering all 6210 sites as potential priority orchid-rich *6210.

6410 *Molinia* meadows

Corresponding Fossitt (2000) habitats: GS4 Wet grassland, PF1 Rich fen and flush

This Annex I habitat type was quite limited in extent in the area surveyed, being recorded from eleven polygons. These were distributed through the study area, being found at Dangan Lower, Coolanillaun Bog, to the east and south of Coolagh Lakes and with a further single example at Ballindooley in the northeast of the study area. The sward is composed of *Molinia caerulea*, *Cirsium dissectum*, *Anthoxanthum odoratum*, *Carex flacca*, *Cynosurus cristatus* and *Juncus conglomeratus,* with *Centaurea nigra, Succisa pratensis* and *Trifolium pratense* also found. *Calliergonella cuspidata* is the main bryophyte.

4010 Wet heaths

Corresponding Fossitt (2000) habitat: HH3 Wet heath

4010 Wet heaths were recorded at Coolanillaun Bog, with additional small areas towards the north of Coolagh Lakes, at Kentfield in the west of the study area, and with a further area near Dangan Lower. The habitat was primarily classified here on the presence of *Myrica gale* as a dwarf or low shrub together with *Molinia caerulea*. Indicator species such as *Erica tetralix* and *Calluna vulgaris* were sometimes absent.

4030 Dry heaths

Corresponding Fossitt (2000) habitat: HH2 Dry calcareous heath

This habitat was found in mosaic with other calcareous habitats on the limestone plateau to the northeast of Coolagh Road, with an additional area occurring northeast of Coolagh Lakes, again in association with calcareous grassland and limestone pavement. In addition, the habitat was noted as a point feature within other areas on the limestone pavement plateau where it was too small to consider as a mappable area. *Calluna vulgaris* is usually the main species. Where *C. vulgaris* is less

abundant it occurs with species typical of calcareous grassland. Where it is more abundant, diversity is lower and it occurs alongside other woody species such as *Hedera helix* and *Rosa spinosissima*, or *Pteridium aquilinum*.

4060 Alpine and Boreal heaths

Corresponding Fossitt (2000) habitat: HH4 Montane heath

Three adjoining polygons containing this habitat were recorded on the limestone plateau at Ballindooley. The habitat is essentially a diverse calcareous grassland sward in which *Dryas octopetala* is a significant component. *Calluna vulgaris* is also usually present in small amounts. *D. octopetala* was recorded in a number of other polygons but not with sufficient cover to indicate the presence of HH4 Montane heath.

7130 Blanket bog and *7130 Blanket bog (active)

Corresponding Fossitt (2000) habitat: PB3 Lowland blanket bog

PB3 Lowland blanket bog was recorded at Coolanillaun Bog and Dangan Lower. The habitat at Coolanillaun is dominated by *Molinia caerulea,* with typical bog species present throughout including *Calluna vulgaris*, *Erica tetralix* and *Eriophorum angustifolium*, but a notable absence of *Sphagnum* spp. and low overall bryophyte cover. The blanket bog at Coolanillaun is not typical lowland blanket bog, being influenced by flooding from the River Corrib and supporting a range of species more typical of soligenous conditions. This area was considered non-priority 7130 Blanket bog as it was not regarded as 'active' blanket bog. The blanket bog habitat at Dangan Lower occurs in an area of cattle-grazed commonage and is again an atypical example of the habitat. The vegetation is dominated by *Schoenus nigricans* and *Myrica gale*, as in the alkaline fen to the west (see below). Here, however, the bryophyte layer is composed of *Sphagnum* spp. (including *S. denticulatum, S. palustre, S. tenellum* and *S. subnitens*), *Erica tetralix* is much more frequent and *Narthecium ossifragum* is abundant. The peat in the area of the bog is over 1.6 m deep. Due to the presence of peat-forming *Sphagnum* species this habitat was considered *7130 Blanket bog, the priority active version of the habitat.

7230 Alkaline fens

Corresponding Fossitt (2000) habitat: PF1 Rich fen and flush

7230 Alkaline fens were recorded at Coolanillaun Bog, to the east and south of Coolagh Lakes, and at Dangan Lower. A further small area was recorded to the northwest of Menlough Castle near the River Corrib. The presence of brown mosses is key to these areas being considered Annex I habitat. Other species present include the sedges *Carex rostrata,* C. *echinata, C. panicea, C. viridula* and *C. hostiana, Menyanthes trifoliata, Schoenus nigricans*, *Juncus subnodulosus, Mentha aquatica* and *Eriophorum angustifolium.* The Flora (Protection) Order 1999 species *Eriophorum gracile* was found within 7230 Alkaline fens at Coolanillaun Bog.

***91E0 Alluvial forests**

Corresponding Fossitt (2000) habitat: WN6 Wet willow-alder-ash woodland

Examples of this Annex I habitat were found through the wetland areas associated with Coolagh Lakes, Coolanillaun Bog, both sides of the River Corrib, and Jordan's Island. Areas of the habitat are generally small and fragmented within the study area, the largest being just 1.4 ha in size. In the wetter locations the canopy is dominated by *Salix cinerea* with *Phalaris arundinacea, Filipendula*

ulmaria, Calystegia sepium, Iris pseudacorus, Lysimachia vulgaris and *Angelica sylvestris* in the field layer.

7140 Transition mires and quaking bogs

Corresponding Fossitt (2000) habitat: PF3 Transition mire and quaking bog

The largest areas of transition mire were recorded from Coolanillaun Bog and at Terryland to the northeast of Jordan's Island. Additional small examples were recorded from the channel to the east of Jordan's Island, from Dangan Lower, and from a drainage channel northwest of the NUIG Sports Pavilion. The largest complex of this habitat occurs at Coolanillaun Bog in conjunction with a valley depression running north-south through the central part of the bog and around the margin of a small dystrophic lake in the south. In this area there is an abundance of sedges, including *Carex diandra, C. lasiocarpa* and *C. rostrata,* occurring together with herbs such as *Potentilla palustris*, *Epilobium palustre*, *Galium palustre*, *Menyanthes trifoliata*, *Mentha aquatica* and *Valeriana officinalis*. The ground layer is dominated by *Calliergonella cuspidata*. The presence of *Eriophorum gracile*, a species listed on the Flora (Protection) Order 1999, in transition mire at Coolanillaun Bog is notable. Species within the large area of this habitat to the northeast of Jordan's Island include *Carex diandra, C. rostrata* and *C. lasiocarpa,* which were present together with *Equisetum fluviatile*, *Juncus acutiflorus / subnodulosus* and *M. trifoliata*.

***7210 *Cladium* swamps**

Corresponding Fossitt (2000) habitats: FS1 Reed and large sedge swamps, FS2 Tall-herb swamps, PF1 Rich fen and flush

The most widespread variant of this habitat to occur within the site is species-poor *Cladium mariscus*-dominated swamp (recorded as FS1 Reed and large sedge swamps or occasionally FS2 Tall-herb swamp). The habitat occurs through the central sections of Coolanillaun Bog, around the margins of the waterbodies at Coolagh Lakes, along the channel to the east of Jordan's Island, and scattered along the western bank of the River Corrib. *Cladium mariscus* is usually dominant, with *Phragmites australis* often occasional. A more open, species-rich variant of the habitat (recorded as PF1 Rich fen and flush) was also recorded with species including *Schoenus nigricans*, *Juncus subnodulosus, Carex lasiocarpa* and *Molinia caerulea*.

6430 Hydrophilous tall-herb communities

Corresponding Fossitt (2000) habitats: FS1 Reed and large sedge swamps, FS2 Tall-herb swamps, GM1 Marsh, PF1 Rich fen and flush

This habitat occurs throughout the wetland sections of the survey area. It was recorded to the north, east and south of Coolagh Lakes, from Coolanillaun Bog, to the east and south of Jordan's Island, and at various locations along the western side of the River Corrib. Frequently recorded species from this habitat include *Filipendula ulmaria*, *Epilobium hirsutum*, *Iris pseudacorus*, *Lysimachia vulgaris*, *Mentha aquatica* and *Phragmites australis*.

3.3 Non-Annex I and freshwater habitats

Non-Annex I Grassland and marsh

GS1 Dry calcareous and neutral grassland was found throughout almost the entire study area except Coolanillaun Bog and Jordan's Island. Significant areas occur between Menlough Castle and Coolagh Lakes, and east of Monument Road in Menlough. Species recorded from this habitat include *Cynosurus cristatus, Centaurea nigra*, *Trifolium repens*, *Plantago lanceolata* and *Ranunculus repens.*

Examples of *GS2 Dry meadows and grassy verges* were recorded throughout the study area, but were generally limited in extent and often represented by rank, unmanaged grassland. Characteristic species recorded include *Dactylis glomerata, Holcus lanatus, Arrhenatherum elatius* and *Plantago lanceolata.*

GS4 Wet grassland was found throughout the wetter sections of the study area: Coolanillaun Bog, west, south and east of Coolagh Lakes, on Jordan's Island, and along the west bank of the River Corrib. *Filipendula ulmaria, Juncus* spp.*, Molinia caerulea, Holcus lanatus* and *Agrostis stolonifera* were all recorded frequently from this habitat.

GM1 Marsh was infrequently found, with small examples from Coolanillaun Bog, north of the National University of Ireland, Galway (NUIG) Sports Pavilion and at Terryland. Species such as *Iris pseudacorus, Valeriana officinalis, Calystegia sepium* and *Filipendula ulmaria* were recorded.

GA1 Improved agricultural grassland is generally confined to the margins of the site e.g. Kiloughter, Terryland and near Quincentennial Bridge. *GA2 Amenity grassland* was recorded at the sports pitches near NUIG Sports Pavilion.

Freshwater

A number of different lake habitats were noted during the survey, but these were not surveyed comprehensively or assigned to Annex I habitat as part of this survey. They were surveyed in a separate Aquatic Habitats survey, the results of which are presented in the Constraints Report. A small area of *FL1 Dystrophic lakes* habitat was found at Coolanillaun Bog, where the acidic surroundings influenced the pH of the waterbody. Coolagh Lakes are classified as *FL3 Limestone / marl lakes.* A small example of *FL4 Mesotrophic lakes* was recorded to the east of one of the Coolagh Lakes.

FW4 Drainage ditches were occasionally recorded within the survey area, with the most extensive draining into the western side of one of the Coolagh Lakes.

The main River Corrib was assigned to the category *FW2 Lowland depositing river*. A small river at Terryland in the southeast of the survey area was also recorded as *FW2 Lowland depositing river*, along with other sections of the River Corrib at Menlough Pier and Glenlo Abbey Hotel.

There are extensive stands of *Phragmites australis* along the banks of the River Corrib on both sides, fringing Jordan's Island, and also Coolagh Lakes classified as non-Annex I *FS1 Reed and large sedge swamps*.

Non-Annex I *FS2 Tall-herb swamps* are less frequent, being recorded around Jordan's Island, and to the north of the island near the outflow of Coolagh Lakes to the River Corrib, northwest of Menlough Castle and on the west bank of the River Corrib near Corrib Village.

Non-Annex I Peatlands

PF1 Rich fen and flush was recorded quite frequently at Dangan Lower and around Coolagh Lakes, with small patches also occurring west of the River Corrib near Corrib Village and north of NUIG Sports Pavilion. Frequently recorded species include *Carex panicea, C. viridula, C. nigra, Juncus subnodulosus* and *Hydrocotyle vulgaris*.

Non-Annex I Heath and dense bracken

Patches of dense bracken, *HD1 Dense bracken,* were recorded frequently across the study area and was often in mosaic with other habitats, particularly WS1 scrub.

Non-Annex I Woodland and scrub

The largest areas of non-Annex I *WN2 Oak-ash-hazel woodland* occur at Menlough to the southwest of Coolagh Road. Additional areas occur though the dry sections of the study area. The habitat is often found in a complex with polygons of wooded *8240 Limestone pavement in areas where the soil was found to be too deep to be considered the Annex I habitat.

WN6 Wet willow-alder-ash woodland generally correlates with the Annex I habitat *91E0 Alluvial forest but a non-Annex I version of the habitat was recorded in a few instances where the ground flora was of particularly poor quality.

Areas of *WD1 (Mixed) broadleaved woodland* were concentrated in the centre of the study area between Menlough Pier and Coolagh Lakes, and on the west bank of the River Corrib around the lands at the NUIG Sports Pavilion. Stands of *Fagus sylvatica* were noted between Menlough Castle and Coolagh Lakes, while otherwise native hazel woodland northeast of Menlough Castle was found to have sufficient abundance of *Acer pseudoplatanus* to classify the habitat as WD1. A small block of *WD4 Conifer plantation*, consisting of *Pinus contorta*, occurs northeast of Jordan's Island adjacent to Annex I 7230 Alkaline fens habitat.

The majority of examples of *WS Scrub/transitional woodland* habitats (WS1-5) were *WS1 Scrub*. The areas of WS1 are dominated by spinose species such as *Rubus fruticosus*, *Prunus spinosa* and *Ulex europaeus.* In addition, areas of low *Corylus avellana* (<3 m) were recorded under this category, as were damp peaty areas dominated by tall *Myrica gale*. *WS2 Immature woodland* was recorded in one location at Terryland, *WS3 Ornamental/non-native shrub* was used to record ornamental planting near Quincentennial Bridge and a *Fallopia japonica* infestation near the NUIG Sports Pavilion. A small area of *WS5 Recently-felled woodland* was recorded southeast of Menlough Castle.

The two *WL Linear woodland/scrub habitats, WL1 Hedgerows and WL2 Treelines,* were recorded only when they formed a significant habitat area and were broad enough (> 4 m) to map as a polygon. They occur throughout the survey area.

Non-Annex I Cultivated and built land

BL3 Buildings and artificial surfaces were recorded at instances through the survey site, corresponding with roads, tracks, car parks and buildings. For ease of mapping, houses, driveways and residential gardens were generally mapped within this category (thus on occasion incorporating *GA2 Amenity grassland* and *BC4 Flower beds and borders* within BL3). Stone walls (*BL1 Stone walls and other stonework*) are a frequent feature of the study area but were not systematically recorded as they were generally less than 4 m wide.

Non-Annex I Exposed rock and disturbed ground

Disturbed ground was recorded as *ED2 Spoil and bare ground* or *ED3 Recolonising bare ground*, depending on the percentage of vegetation cover (habitats with greater than 50% vegetation cover in this context were assigned to ED3). These habitats were found scattered throughout the study area, often in association with path and tracks, and also where recent disturbance of grassland and limestone pavement had occurred, such as on the limestone plateau at Ballindooley, and at Terryland. An active quarry (*ED4 Active quarries and mines*) was recorded for the western strip of Coolagh quarry that lies within the study area.

3.4 Annex I habitat assessments

3.4.1 Area change

Changes in extent of all 15 habitats assessed were recorded for the period 1995 to 2014 through a combination of observations in the field and analysis of historic aerial photographs (www.osi.ie) and online satellite imagery (www.google.ie/maps). The EU Habitats Directive came into force in 1994 and the 1995 aerial photographs provide the baseline imagery closest to this date. Areas of change were viewed and comparisons were made with surrounding Annex I habitat to assess the likelihood of Annex I habitat having occurred previously within the area of change. When it was considered likely that Annex I habitat had occurred, the area was digitised such that area calculations could be determined. This method is relatively subjective and detection of changes is restricted to obvious changes in habitat; subtle changes from one habitat type to another cannot be reliably identified by this process. The results of area change investigations are given in Tables 6-9. Only losses in habitat were found, with no gains in habitat area recorded. Five habitats were found to have suffered area loss: *8240 Limestone pavement (exposed), *8240 Limestone pavement (wooded) (results for these two habitats are presented together in Table 6), 6210 Calcareous grassland (losses of 6210 and *6210 are considered together in Table 7), *91E0 Alluvial forests (Table 8) and 7230 Alkaline fens (Table 9). The overall change in habitat area represented a loss of less than 1% per year for each of these habitats giving them an assessment result of *Unfavourable – Inadequate*. No loss in area was noted for the remaining habitats, which thus received an assessment result of *Favourable* for the area change parameter. The impact codes given in Tables 6-8 are the approved EU impact codes in use for National Conservation Assessment reporting, as given in Ssymank (2011).

Table 6. Impacts causing obvious losses in *8240 Limestone pavement (exposed and wooded), 1995-2014.

Impact code	Impact	Area (ha) 1995-2014
A02.01	Agricultural intensification	0.9
A10.01	Removal of hedges and copses or scrub	0.6
C01	Mining and quarrying	1.5
D01.01	Paths, tracks, cycling tracks	0.6
E01.03	Dispersed habitation	1.1
All impacts		*5.0*
% of *8240 lost	Based on current habitat area (84.47 ha) and area lost (5.0 ha)	5.59%
% loss per year	Period of loss = 19 years	0.29% p.a.

Table 7. Impacts causing obvious losses in *6210/6210 Calcareous grassland, 1995-2014.

Impact code	Impact	Area (ha) 1995-2014
A02.01	Agricultural intensification	1.8
E01.03	Dispersed habitation	0.1
E04.01	Agricultural structures	0.06
All impacts		*2.0*
% of 6210 lost	Based on current habitat area (19.06 ha) and area lost (2.0 ha)	9.5%
% loss per year	Period of loss = 19 years	0.5% p.a.

Table 8. Impacts causing obvious losses in *91E0 Alluvial forests, 1995-2014.

Impact code	Impact	Area (ha) 1995-2014
B02.02	Forestry clearance	0.3
All impacts		*0.3*
% of *91E0 lost	Based on current habitat area (8.89 ha) and area lost (0.3 ha)	3.26%
% loss per year	Period of loss = 19 years	0.17% p.a.

Table 9. Impacts causing obvious losses in 7230 Alkaline fens, 1995-2014.

Impact code	Impact	Area (ha) 1995-2014
B01.02	Artificial planting on open ground (non-native trees)	0.4
All impacts		*0.4*
% of 7230 lost	Based on current habitat area (3.11 ha) and area lost (0.4 ha)	11.40%
% loss per year	Period of loss = 19 years	0.6% p.a.

3.4.2 Structure and functions

A total of 278 relevés were recorded by BEC Consultants in the study area, 232 in 2014 and 46 in 2013. A further 55 relevés were recorded by Wetland Surveys Ireland (WSI) in 2014 in the Coolagh Lakes and Coolanillaun Bog areas. The locations of these 333 relevés are presented in Figures 5a-d, and the species recorded in each relevé are provided as a separate Excel spreadsheet file submitted with this report. In all, 221 of the relevés were recorded in an Annex I habitat, the remaining 112 relevés recorded to characterise the non-Annex I habitats for mapping to community level.

Results of the structure and functions assessment of the Annex I habitats is presented below.

Following Wilson & Fernández (2013), the exposed and wooded variants of *8240 Limestone pavement were assessed under different criteria. For the purposes of this analysis, and following discussion with F. Fernández (pers. comm.) and NPWS (D. Lynn, pers. comm.), scrub-encroached exposed *8240 habitat (*WS1 Scrub*) was distinguished from wooded *8240 habitat (*WN2 Oak-ash-hazel woodland*) partly on canopy characteristics, with the latter having a canopy of 3 m or more. While this canopy height is lower than the 5 m threshold for woodland stipulated in Fossitt (2000), it was considered appropriate for this project to distinguish between the two habitat types. In addition, those areas classified as WN2 woodland invariably had an open canopy which it was possible to walk under, and all the general characteristics of WN2 woodland described in Fossitt (2000). Those areas classified as scrub did not have a differentiated canopy structure, and it was generally not possible to walk easily through the habitat. The assessment results below are presented by Annex I habitat in descending order of their extent within the study area.

Tables 10 and 11 summarise the results by assessment criterion for the two *8240 limestone pavement habitats. The main criteria that failed in exposed *8240 limestone pavement habitats were negative indicator species cover and scrub cover, including *Rubus fruticosus* agg. (brambles), *Prunus spinosa* (blackthorn) and *Corylus avellana* (hazel), with failure due to excessive cover by these species.

Using the methodology of Wilson & Fernández (2013), each *8240 assessment stop is allowed to fail one criterion but still pass overall. Based on the assessment parameters shown in Table 1, failure of 32% of stops equates to a conservation status of *Unfavourable – Bad* for exposed *8240 limestone pavement, while a failure rate of 13% corresponds to a conservation status of *Unfavourable – Inadequate* for wooded *8240 limestone pavement.

Table 10. Summary of Structure and functions assessment results for exposed *8240 Limestone pavement. *n* = 50. U-B = *Unfavourable – Bad*.

Assessment criteria	Target	Failure rate
No. positive indicator species	≥7	10%
% cover negative indicator species	≤1	44%
% cover bracken	≤10	6%
% cover non-native species	≤1	0%
% cover scrub	≤25	44%
Stop failure rate		*32%*
Overall assessment result		*U-B*

Table 11. Structure and functions assessment results for wooded *8240 Limestone pavement. *n* = 32. U-I = *Unfavourable – Inadequate*.

Assessment criteria	Target	Failure rate
No. positive indicator species	≥7	0%
% cover negative indicator species	≤10	0%
% canopy	≥30	0%
% bryophytes	≥50	34%
Grazing pressure [overgrazing]	None	3%
Dead wood	Present	13%
Non-native regeneration	Absent	3%
Stop failure rate		*13%*
Overall assessment result		*U-I*

The Annex I habitat 6210 Calcareous grasslands, and its priority orchid-rich variant, *6210, were assessed according to the criteria outlined in O'Neill *et al.* (2013). Table 12 summarises the results for these two habitats by criterion. The priority habitat *6210 was found to pass more criteria than the non-priority habitat, the latter failing to achieve favourable results for high quality indicator species, negative indicator species and grazing/disturbance at several assessment stops. Overall, 14% of *6210 stops failed their assessments, resulting in a conservation rating of *Unfavourable – Inadequate*, while 67% of 6210 stops failed, a rating of *Unfavourable – Bad*.

Table 12. Structure and functions assessment results for *6210/6210 Calcareous grassland.
*6210 (orchid-rich): *n* = 14. 6210 (non-priority): *n* = 15
U-I = Unfavourable – Inadequate; U-B = Unfavourable – Bad.

Assessment criteria	Target	Failure rate (*6210)	Failure rate (6210)
No. positive indicator species	≥7	7%	20%
No. high quality indicator species	≥2	0%	20%
% cover non-native species	≤1	0%	0%
% cover negative indicator species: maximum individual cover	≤10	0%	20%
% cover negative indicator species: maximum collective cover	≤20	0%	20%
% cover scrub/bracken/heath	≤10	7%	13%
% forb:graminoid	40-90	7%	33%
Median sward height (cm)	5-40	14%	20%
% cover litter	≤25	14%	7%
% disturbed ground	≤10	0%	0%
Grazing/disturbance	No overgrazing/ No disturbance	0%	13%
Stop failure rate		*14%*	*67%*
Overall assessment result		*U-I*	*U-B*

*7210 *Cladium* swamps is a priority habitat which occurs along the River Corrib and Coolagh Lakes. Assessment criteria for this habitat were devised by Crushell & Foss (2014a), and the results of the 34 assessments are presented in Table 13. The main causes of failure for this habitat were excessive cover of woody species such as brambles and *Salix cinerea* (grey willow), as well as negative herbs such as *Epilobium hirsutum* (great willowherb) and *Typha latifolia* (bulrush). Overall, 15% of stops failed, to give a conservation rating of *Unfavourable – Inadequate*.

Table 13. Structure and functions assessment results for *7210 *Cladium* swamps.
n = 34. U-B = *Unfavourable – Bad.*

Assessment criteria	Target	Failure rate
Cladium mariscus present	Yes	0%
No. positive indicator species	≥2	3%
% cover *Cladium* + indicator species	≥75%	0%
% cover negative herbs	<5%	6%
% cover non-native species	<1%	0%
% cover woody species (local vicinity)	<10%	9%
% of live shoots > 1 m	≥50%	0%
% disturbed ground (relevé)	<10%	0%
% disturbed ground (local vicinity)	<10%	0%
Area showing signs of drainage by ditches / heavy trampling / tracking	<10%	0%
Disturbed vegetation (if tufa present)	<1%	n/a
Stop failure rate		*15%*
Overall assessment result		*U-I*

*91E0 Alluvial forests occur scattered throughout the survey area, and are generally fragmented in nature. Using the assessment criteria described in O'Neill & Barron (2013), a minimum of four individual assessment plots are normally recorded for the habitat at a site, with a further assessment

carried out across all four of these plots for functional characteristics such as native tree regeneration, presence of dead wood at the site, and assessment of the age profile of the woodland by means of diameter at breast height (DBH) measurement. The results presented in Table 14 show that the main issues with this habitat in the study area are insufficient height of the canopy, insufficient shrub layer cover and lack of positive indicator species. Across the four plots in which functional parameters were measured, the habitat was found to lack diversity in terms of its age profile (i.e. the stand was even-aged), and large-diameter dead wood was absent. The overall assessment result for *91E0 was therefore *Unfavourable – Bad*.

Table 14: Structure and functions assessment results for *91E0 Alluvial forests. *n* = 7. U-B = *Unfavourable – Bad*.

Assessment criteria	**Target**	**Failure rate**
1-plot assessment criteria		
Positive species (target)	Present	0%
Positive species (non-target)	≥6	14%
Negative species cover	≤10	0%
Negative species regeneration	Absent	0%
Median canopy ht.	≥7m	43%
Total canopy cover	≥30%	0%
Proportion of target species in canopy	≥50%	0%
Native shrub layer cover (10-75%)	10-50%	29%
Native field layer cover	≥20%	0%
Native field layer height	≥20cm	0%
Bryophyte cover	≥4%	29%
Grazing pressure	No overgrazing	0%
Assessment result: 1-plot level	*Passes in ≥8 criteria*	*2 plots failed*

4-plot assessment criteria	*Target*	*Result*
Target species size class distribution	≥1 of each size class present over 4 plots	Fail
Target species regeneration	≥1 sapling ≥2 m tall over all 4 plots	Pass
Other native tree regeneration	≥1 sapling ≥2 m tall in 2 or more plots	Pass
Old trees & dead wood	≥3 from any category (DBH ≥20 cm)	Fail
Assessment result: 4-plot level	*3 of 4 criteria to pass*	*Fail*
Overall assessment result		*U-B*

4010 Wet heaths habitat was assessed according to the criteria in Perrin *et al*. (2014). This habitat failed across the extent of the site on multiple criteria (Table 15), failing comprehensively on cover of indicator mosses and lichens. All stops failed, giving a conservation rating of *Unfavourable – Bad*.

Table 15: Structure and functions assessment results for 4010 Wet Heaths. *n* = 8. U-B = *Unfavourable – Bad*.

Assessment criteria	Target	Failure rate
Erica tetralix (20m vicinity)	Present	38%
% cover positive species	≥50%	50%
% cover *Cladonia* and indicator mosses	≥10%	100%
% cover ericoids and *Empetrum nigrum*	≥15%	88%
% cover dwarf shrub species	<75%	0%
% cover negative species	<1%	0%
% cover non-native species (relevé)	<1%	13%
% cover non-native species (local vicinity)	<1%	0%
% cover scattered native trees/scrub	<20%	25%
% cover bracken	<10%	0%
% cover *Juncus effusus*	<10%	0%
Damaged *Sphagnum*	<10%	0%
Signs of browsing on selected dwarf shrub species	*Sphagnum* cover <33% of shoots	14%
Signs of burning (local vicinity)	Absent	0%
Signs of burning inside sensitive areas (local vicinity)	Absent	0%
Cover disturbed bare ground (relevé)	<10%	0%
Cover disturbed bare ground (local vicinity)	<10%	0%
Area showing signs of drainage by ditches / heavy trampling / tracking	<10%	0%
Stop failure rate		*100%*
Overall assessment result		*U-B*

*7130 Blanket bogs (active) and the non-priority 7130 Blanket bogs (inactive) were assessed according to the criteria in Perrin *et al.* (2014). The majority of the habitat in the study area was the priority habitat, where five assessment stops were recorded, with a further small area of non-priority 7130 found at Coolanillaun Bog, in which one assessment stop was recorded. Table 16 shows the results for these two habitats. Failures in three separate criteria were noted in the priority habitat: lack of positive indicator species, damaged sphagnum, and excessive browsing to dwarf shrub species. The individual stop in the non-priority area suffered from burning, as well as excessive cover of negative species, dominance by one or more species, insufficient cover of characteristic bryophytes and lichens, and insufficient positive indicator species. The failure rates of 60% and 100% for the priority and non-priority habitats respectively both result in an assessment result of *Unfavourable – Bad*.

Table 16. Structure and functions assessment results for *7130/7130 Blanket bogs. *7130 (active): *n* = 5. 7130 (inactive): *n* = 1. U-B = *Unfavourable – Bad*.

Assessment criteria	Target	Failure rate (*7130)	Failure rate (7130)
No. of positive indicator species	≥7	20	100
% cover of bryophyte or lichen species, excluding *Sphagnum fallax*	≥10%	0	100
% cover of each of the following species: *Calluna vulgaris, Eleocharis multicaulis, Eriophorum vaginatum, Molinia caerulea, Schoenus nigricans, Trichophorum germanicum*	Individually <75%	0	100
% cover of negative species	Collectively <1%	0	100
% cover of non-native species (relevé)	<1%	0	0
% cover of non-native species (local vicinity)	<1%	0	0
% cover of scattered native trees and scrub	<10%	0	0
% crushed, broken and/or pulled up *Sphagnum* species	<10% of *Sphagnum* cover	20	0
Shoots of ericoids, *Empetrum nigrum* and *Myrica gale* showing signs of browsing	Collectively <33%	20	0
Burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Not evident	0	100
Burning inside boundaries of sensitive areas	Not evident	0	100
Cover of disturbed bare ground (relevé)	< 10%	0	0
Cover of disturbed bare ground (local vicinity)	< 10%	0	0
Area showing signs of drainage resulting from heavy trampling or tracking or ditches or peat cutting	< 10%	0	0
Cover of erosion gullies and eroded areas within the greater bog mosaic	< 5%	0	0
Stop failure rate		*60%*	*100%*
Overall assessment result		*U-B*	*U-B*

6430 Hydrophilous tall-herb communities are found interspersed throughout the wetlands of the study area. A total of 14 relevés were recorded and assessed (Table 17) according to the criteria of O'Neill *et al.* (2013) (criteria were modified to allow a higher cover of common reed in these swamp situations). Scrub invasion by brambles was found to be a problem at two of the stops, while excessive cover (>70%) of common reed was also an issue at one of these. The failure of these two stops means that the habitat receives an overall assessment rating of *Unfavourable – Inadequate*.

Table 17. Structure and functions assessment results for 6430 Hydrophilous tall-herb communities. *n* = 14. U-I = *Unfavourable – Inadequate*.

Assessment criteria	Target	Failure rate
No. of positive indicator species	≥3	0%
% cover non-native species	≤1	0%
% cover negative indicator species	Collectively ≤33%	7%
% cover scrub	≤5%	14%
% cover indicator species	≥40%	0%
Mode herb height	≥50 cm	0%
Cover of bare soil	≤10%	0%
Area showing signs of serious grazing pressure / disturbance	<20m^2	0%
Stop failure rate		*14%*
Overall assessment result		*U-I*

7230 Alkaline fens habitat was assessed according to the criteria of Perrin *et al.* (2014). Table 18 presents the results of the individual criteria. This habitat failed the assessment across a range of criteria, including number and cover of positive indicator species, cover of negative species, and cover of non-native species. The overall assessment was *Unfavourable – Bad*, based on a failure rate of 78% of stops.

Table 18. Structure and functions assessment results for 7230 Alkaline fens. *n* = 9. U-B = *Unfavourable – Bad*.

Assessment criteria	Target	Failure rate
No. of brown moss species	≥1	0%
No. of positive vascular indicator species	≥ 2 (RFLU1a/RFLU2) ≥3 (RFLU4/RFEN1a)	33%
Cover of brown mosses and vascular indicator species	≥ 20% (RFLU1a/RFLU2) ≥75% (Rflu4/RFEN1a)	56%
Total cover of negative species	< 1%	33%
Cover of non-native species	< 1%	0%
Cover of scattered native trees and scrub	< 10%	0%
Total cover of *Juncus effusus* and *Phragmites australis*	< 10%	22%
At least 50% of the live leaves/flowering shoots are more than 5 cm above ground surface	≥50%	0%
Cover of disturbed, bare ground	< 10%	22%
Cover of disturbed, bare ground	< 10%	22%
Area showing signs of drainage resulting from ditches or heavy trampling or tracking	< 10%	33%
Where tufa is present, disturbed proportion of vegetation cover	< 1%	n/a
Stop failure rate		*78%*
Overall assessment result		*U-B*

6410 *Molinia* meadows habitat was assessed according to the criteria detailed in O'Neill *et al.* (2013). The results of the assessment are presented in Table 19. Five of the ten assessments failed, the main reason for failure of the individual assessments being insufficient forbs (broadleaved herbs) in the sward. Expert judgement was exercised in one case where a relevé's failure on 38% forb cover

was considered marginal, so this assessment was allowed to pass overall, as all other criteria were favourable within the stop. The overall failure rate for the habitat was 50%, giving an overall assessment result of *Unfavourable – Bad*.

Table 19. Structure and functions assessment results for 6410 *Molinia* meadows. *n* = 10. U-B = *Unfavourable – Bad.*

Assessment criteria	Target	Failure rate
Total number positives	≥7	0%
Total number HQ	≥1	0%
Cover non-natives	≤1%	0%
Cover negatives individually	≤10%	10%
Cover negatives collectively	≤20%	0%
Cover Polytrichum species	≤25%	0%
Cover scrub/bracken/heath	≤5%	0%
Forb component 40-90%	40-90%	60%
Sward height, proportion 10-80 cm	≥30%	0%
Litter cover	≤25%	40%
Cover bare soil	≤10%	0%
Area showing signs of severe grazing / disturbance	<20m	0%
Stop failure rate		*50%*
Overall assessment result		*U-B*

7140 Transition mires and quaking bogs habitat was assessed according to the criteria in Perrin *et al*. (2014). All assessment relevés were recorded in the RFEN1b community type and assessed according to the criteria relevant for this community (Table 20). Most of the assessments passed, with one stop failing on insufficient species, and another failing on disturbance to the habitat. Overall, these two stop failures (18% of stops) resulted in an overall assessment result of *Unfavourable – Inadequate*.

Table 20. Structure and functions assessment results for 7140 Transition mires and quaking bogs. *n* = 11. U-I = *Unfavourable – Inadequate*.

Assessment criteria	Target	Failure rate (%)
No. of positive indicator species (Groups i or ii)	≥3 (P01a/PFLU5) ≥6 (RFEN1b)	9%
No. of positive indicator species (Group i)	≥1	0%
Collective cover of selected positive indicator species	≥25%	0%
Collective cover of negative species	< 1%	0%
Cover of non-native species	< 1%	0%
PFLU5/RFEN1b: Proportion of the tips of live leaves and/or flowering shoots of vascular plants should be more than 15 cm above the ground surface	≥50%	
Cover of disturbed bare ground (relevé)	< 10%	9%
Cover of disturbed bare ground (local vicinity)	< 10%	0
Area showing signs of drainage resulting from heavy trampling or tracking or ditches (local vicinity)	< 10%	0
Stop failure rate		*18%*
Overall assessment result		*U-I*

4030 Dry heaths habitat was assessed according to the assessment criteria of Wilson & Fernández (2013), as the examples of the habitat surveyed occurred in the context of limestone pavement. Three of the seven stops (43%) failed overall, with failures due to scrub encroachment and insufficient positive indicators (Table 21). The overall conservation result for this habitat is therefore *Unfavourable – Bad*.

Table 21. Structure and functions assessment results for 4030 Dry heaths.
n = 7. U-B = *Unfavourable – Bad.*

Assessment criteria	Target	Failure rate
No. positive indicator species	≥7	29%
% cover negative species	Collectively ≤10%	0%
% cover non-native species	≤1%	0%
% cover trees/shrubs	≤25%	29%
% cover disturbed ground	<10%	0%
Stop failure rate		*43%*
Overall assessment result		*U-B*

One small area of 4060 Alpine and Boreal heaths habitat was found in the limestone plateau at Ballindooley. Although small, this area was found to pass all of the assessment criteria across all three stops (Table 22), and therefore received an overall conservation rating of *Favourable*.

Table 22. Structure and functions assessment results for 4060 Alpine and Boreal heaths.
n = 3. F = *Favourable*.

Assessment criteria	Target	Failure rate
No. positive indicator species	≥7	0%
% cover negative species	Collectively ≤10%	0%
% cover non-native species	≤1%	0%
% cover trees/shrubs	≤25%	0%
% cover disturbed ground	<10%	0%
Stop failure rate		*0%*
Overall assessment result		*F*

The assessment results for the Annex I habitats detailed above are summarised below in Table 23.

Table 23. Summary of structure and functions (S&F) assessment results for all Annex I habitats recorded in the GCRR study area.

Annex I habitat	No. assessments	Failure rate (%)		Assessment result (S&F)
*8240 (Exposed)	50		32%	Unfavourable – Bad
*8240 (Wooded)	33		12%	Unfavourable – Inadequate
*6210	14		14%	Unfavourable – Inadequate
6210	15		67%	Unfavourable – Bad
*7210	34		15%	Unfavourable – Inadequate
*91E0	5	1-stop assessment: 4-stop assessment:	29% 100%	Unfavourable – Bad
4010	8		100%	Unfavourable – Bad
6430	14		14%	Unfavourable – Inadequate
*7130	5		60%	Unfavourable – Bad
7130	1		100%	Unfavourable – Bad
6410	10		50%	Unfavourable – Bad
7140	11		18%	Unfavourable – Inadequate
7230	9		78%	Unfavourable – Bad
4030	7		43%	Unfavourable – Bad
4060	3		0%	Favourable

3.4.3 Future prospects

Fourteen significant impacts were recorded within the study area across the Annex I habitats surveyed, and 11 of these impacts were considered to be having a negative impact on Annex I habitats. Four of the impacts were considered to be having a beneficial effect where they occurred. Impacts such as grazing may be positive, negative or neutral, depending on the intensity at which they occur and the sensitivity of the habitat to damage by grazing.

The main negative impact recorded across the study area as a whole was succession to scrub and woodland, particularly on exposed limestone pavement. A lack of more open *8240 Limestone pavement habitats with exposed rock reduces the niches the habitat can provide which ultimately reduces its structure and functions. Tables 24 to 38 summarise the negative, neutral and positive impacts for each of the Annex I habitats, with the impact codes corresponding to the EU-approved impact codes given by Ssymank (2011).

It should be noted that impacts identified during the area assessment were not included in these tables as it is not evident that these historic impacts pose a continuing threat to the habitat in the future.

Table 24. Impacts recorded within *8240 exposed limestone pavement.

Impact		Description within study area	Intensity	Influence	% habitat
K02.01	Species composition change (succession)	Succession to scrub, woodland, heath or grassland	High	Negative	76-99%
A10.01	Removal of hedges and copses or scrub	Scrub clearance and associated disturbance	High	Negative	1-25%
A02.01	Agricultural intensification	Damage/removal of habitat for agricultural improvements	High	Negative	<1%
C01	Mining and quarrying	Rock displacement/small-scale quarrying	High	Negative	<1%
A04.03	Abandonment/lack of grazing	Lack of management	Medium	Negative	76-99%
D01.01	Paths, tracks, cycling tracks	Tracks created by machinery	Medium	Negative	<1%
I01	Invasive non-native species	e.g. *Centranthus ruber, Cotoneaster* spp.	Low	Negative	<1%
I02	Problematic native species	Bracken encroachment	Low	Negative	<1%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Positive	76-99%
A04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Positive	76-99%

Table 25. Impacts recorded within *8240 wooded limestone pavement.

	Impact	Description within study area	Intensity	Influence	% habitat
A10.01	Removal of hedges and copses or scrub	Disturbance/woodland clearance	High	Negative	1-25%
D01.01	Paths, tracks, cycling tracks	Paths and tracks created by machinery	High	Negative	<1%
B06	Grazing in forests/woodland	Poaching/dung deposition by cattle and horses	Low	Negative	76-99%
I01	Invasive non-native species	Invasive non-natives, e.g. *Acer pseudoplatanus* (sycamore)	Low	Negative	<1%

Table 26. Impacts recorded within *6210 Calcareous grassland (orchid-rich).

	Impact	Description within study area	Intensity	Influence	% habitat
K02.01	Species composition change (succession)	Scrub encroachment	Medium	Negative	51-75%
A04.03	Abandonment/lack of grazing	Lack of management	Low	Negative	1-25%
I02	Problematic native species	Bracken encroachment	Low	Negative	<1%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Positive	76-99%
A.04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Positive	76-99%

Table 27. Impacts recorded within 6210 Calcareous grassland (non-priority).

	Impact	Description within study area	Intensity	Influence	% habitat
A10.01	Removal of hedges and copses or scrub	Disturbance/scrub clearance	High	Negative	<1%
K02.01	Species composition change (succession)	Succession to scrub (mainly) and some dry heath	Medium	Negative	1-25%
C01	Mining and quarrying	Small-scale quarrying	Medium	Negative	<1%
A04.03	Abandonment/lack of grazing	Lack of management	Low	Negative	26-50%
I02	Problematic native species	Bracken encroachment	Low	Negative	<1%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Positive	76-99%
A.04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Positive	76-99%

Table 28. Impacts recorded within *7210 *Cladium* swamps.

	Impact	Description within study area	Intensity	Influence	% habitat
J2.07.01	Groundwater abstractions for agriculture	Drainage	Medium	Negative	<1%
K02.01	Species composition change (succession)	Scrub encroachment	Low	Negative	1-25%
A.04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Neutral	<1%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Neutral	<1%

Table 29. Impacts recorded within *91E0 Alluvial forests.

	Impact	Description within study area	Intensity	Influence	% habitat
B02.02	Forestry clearance	Woodland clearance	High	Negative	<1%
G01.02	Walking, horse-riding and non-motorised vehicles	Trampled paths through woodland causing fragmentation	Medium	Negative	<1%
I01	Invasive non-native species	*Cornus sericea*	Low	Negative	<1%
J02.07.01	Groundwater abstractions for agriculture	Ditch clearance/drainage	Low	Neutral	<1%
B06	Grazing in forests/woodland	Horse grazing	Low	Positive	<1%

Table 30. Impacts recorded within 4010 Wet heaths.

	Impact	Description within study area	Intensity	Influence	% habitat
A04.03	Abandonment/lack of grazing	Lack of management	Medium	Negative	51-75%
K02.01	Species composition change (succession)	Bramble encroachment	Medium	Negative	1-25%
C01.03	Peat extraction	Past peat cutting	Low	Negative	<1%
A04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Positive	1-25%

Table 31. Impacts recorded within *7130 Blanket bogs (active).

	Impact	Description within study area	Intensity	Influence	% habitat
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Neutral	100%

Table 32. Impacts recorded within 7130 Blanket bogs (inactive).

	Impact	Description within study area	Intensity	Influence	% habitat
C01.03	Peat extraction	Past peat cutting	High	Negative	76-99%

Table 33. Impacts recorded within 6430 Hydrophilous tall-herb communities.

	Impact	Description within study area	Intensity	Influence	% habitat
K02.01	Species composition change (succession)	Scrub encroachment	Low	Negative	26-50%

Table 34. Impacts recorded within 7230 Alkaline fens.

	Impact	Description within study area	Intensity	Influence	% habitat
B01.02	Artificial planting on open ground (non-native trees)	Planting of conifer stand and associated continuing habitat impacts	High	Negative	1-25%
J2.07.01	Groundwater abstractions for agriculture	Drainage	Medium	Negative	1-25%
K02.01	Species composition change (succession)	Scrub encroachment	Low	Negative	<1%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Neutral	1-25%
A04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Neutral	1-25%

Table 35. Impacts recorded within 6410 *Molinia* meadows.

	Impact	Description within study area	Intensity	Influence	% habitat
A04.03	Abandonment/lack of grazing	Lack of management	Medium	Negative	26-50%
K02.01	Species composition change (succession)	Scrub encroachment	Low	Negative	1-25%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Positive	1-25%
A04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Positive	1-25%

Table 36. Impacts recorded within 7140 Transition mires and quaking bogs.

	Impact	Description within study area	Intensity	Influence	% habitat
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Neutral	<1%
A04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Neutral	<1%

Table 37. Impacts recorded within 4030 Dry heaths.

Impact		Description within study area	Intensity	Influence	% habitat
K02.01	Species composition change (succession)	Succession to scrub	Low	Negative	26-50%
I02	Problematic native species	Bracken encroachment	Low	Neutral	<1%
A04.02.03	Non-intensive horse grazing	Grazing (horse)	Low	Neutral	<1%

Table 38. Impacts recorded within 4060 Alpine and Boreal heaths.

Impact		Description within study area	Intensity	Influence	% habitat
K02.01	Species composition change (succession)	Scrub encroachment	Low	Neutral	<1%
A04.02.01	Non-intensive cattle grazing	Grazing (cattle)	Low	Positive	100%

Table 39 summarises the future prospects assessment results for each of the Annex I habitats. Details of quantifying impacts in a scoring system are given in O'Neill *et al.* (2013). Three Annex I habitats – *7130 Blanket bogs (active), 7140 Transition mires and quaking bogs, and 4060 Alpine and Boreal heaths – are seen to have *Favourable* future prospects, having no negative impacts operating on them. Three habitats – the two *8240 habitats and 7130 Blanket bogs (inactive) – have *Unfavourable – Bad* future prospects. For the limestone pavement habitats, this is due to negative impacts such as scrub and woodland encroachment operating over a large area of the habitat. For the blanket bog, it is due to the negative effects of past peat cutting which continue to affect the quality of the habitat after cessation of the activity. All other habitats were scored as *Unfavourable – Inadequate* for future prospects, due to a range of impacts operating at a lower level or over a smaller proportion of the habitat.

Table 39. Summary of Future Prospects (FP) scores for Annex I habitats. Scores calculated according to O'Neill *et al*. (2013).

Annex I habitat	Score	Assessment result (FP)
*8240 (Exposed)	-7.75	Unfavourable – Bad
*8240 (Wooded)	-3.75	Unfavourable – Bad
*6210	-1.25	Unfavourable – Inadequate
6210	-2.75	Unfavourable – Inadequate
*7210	-1	Unfavourable – Inadequate
*91E0	-1.25	Unfavourable – Inadequate
4010	-2.75	Unfavourable – Inadequate
6430	-0.75	Unfavourable – Inadequate
*7130	0	Favourable
7130	-3.75	Unfavourable – Bad
6410	-1	Unfavourable – Inadequate
7140	0	Favourable
7230	-2.75	Unfavourable – Inadequate
4030	-0.75	Unfavourable – Inadequate
4060	1.5	Favourable

Table 40 summarises the overall condition assessment for each of the Annex I habitats assessed. Due to combinations of *Unfavourable* assessments for most of the habitats, only 4060 Alpine and

Boreal heaths was given an assessment of *Favourable* overall, most of the habitats (10 of the 15) being assessed as *Unfavourable – Bad*, and the remaining four as *Unfavourable – Inadequate*.

Table 40. Summary of all assessment data for Annex I habitats.
F = *Favourable*, U-I = *Unfavourable – Inadequate*, U-B = *Unfavourable – Bad*.

Annex I habitat	Area change	Structure & Functions	Future Prospects	Overall condition assessment
*8240 (Exposed)	U-I	U-B	U-B	U-B
*8240 (Wooded)	U-I	U-I	U-B	U-B
*6210	U-I	U-I	U-I	U-I
6210	U-I	U-B	U-I	U-B
*7210	F	U-I	U-I	U-I
*91E0	U-I	U-B	U-I	U-B
4010	F	U-B	U-I	U-B
6430	F	U-I	U-I	U-I
*7130	F	U-B	F	U-B
7130	F	U-B	U-B	U-B
6410	F	U-B	U-I	U-B
7140	F	U-I	F	U-I
7230	U-I	U-B	U-I	U-B
4030	F	U-B	U-I	U-B
4060	F	F	F	F

3.5 Annex I rapid quality assessment ratings

Annex I polygons surveyed and mapped were each assigned a quality assessment rating of 1 (poor) to 3 (excellent) in the field. The only Annex I habitats to receive a quality rating of 3 were exposed *8240 Limestone pavement (3.14 ha), *6210 Orchid-rich calcareous grasslands (2.02 ha), 7140 Transition mires and quaking bogs (0.55 ha), 6430 Hydrophilous tall-herb communities (0.16 ha), 6210 Calcareous grasslands (0.05 ha) and *7210 *Cladium* swamps (0.03 ha). Some areas of mosaic of *8240 and *6210 habitats covering 1.2 ha were also assigned the highest quality rating.

3.6 Vegetation community mapping

Frequencies of the vegetation communities mapped in the study area are shown in Table 41, and the distribution of the communities is shown in Figures 6a-d. The exposed *8240 Limestone pavement (LPE) Annex I habitat was the most frequent vegetation community recorded at the site, followed by the calcareous grassland community 3a, which was often present as either the Annex I habitat *6210 or 6210. The vegetation communities add additional definition to the vegetation recorded during the study and will assist in future monitoring and habitat mapping at the site.

Table 41. Most frequent vegetation communities recorded

Vegetation community	Frequency	Associated Annex I habitat
LPE	247	*8240
GS1_3a	149	*6210/6210
WS1_Prunus	86	None
LPW	71	*8240
WN2_2e	71	None
WS1_Rubus	66	None
FS1_Phragmites	62	None
FS1_*7210	59	*7210
WS1_2e	39	None
WN2_2a	37	None
GA2	36	None
GS2_3c	36	None
GS4_1b	35	None
GS1_3b	33	None
WN6_3c	31	*91E0
GS1_3c	30	None
FS2_6430	28	6430
GS4_1c	28	6410
GS1_3d	26	None
GA1	22	None
PF3_RFEN1b	22	7140
WD1_2f	21	None
PF1_RFLU1b	16	None
WN6_3e	16	*91E0
WS1_Myrica	15	None
GS4_2d	11	None
WN6_3b	11	*91E0
GM1_6430	10	6430
GS1_2c	10	None

4 Discussion

Most of the survey detailed in this report took place within Lough Corrib cSAC. A total of 478.2 ha of habitat were mapped, with almost 90 ha of this area mapped as rivers or lakes. The remaining 388.8 ha of habitat were comprehensively surveyed and assessed. Of this, 155.74 ha were classified as Annex I habitat. This represents 40% of the surveyed area.

A small proportion of this Annex I habitat was rated by field surveyors as being in excellent condition, with the remainder equally split between good and poor condition. Annex I habitat assessment results, following examination of recent area changes, current structure and functions, and future prospects, indicate that many of the habitats are in *Unfavourable* condition. However, poor quality ratings and unfavourable condition assessments probably indicate that these habitats are suffering from impacts that may be linked to poor or lack of management, but they do not diminish the overall importance of the habitats in a regional or national context. Many deficiencies could be rectified with

the application of suitable management, restoring the habitat to a more favourable conservation status, and rigorous monitoring of Annex I habitats to identify habitat deterioration before it becomes irremediable. In addition, it should be noted that conservation assessment criteria have been developed with assessment of the national Annex I habitat resource in mind; regional variants (e.g. naturally species-poor examples) may fail when assessed against these national criteria, when in fact they represent excellent examples of the habitat in the regional context.

*8240 Limestone pavement, including both exposed and wooded variants, is the Annex I habitat that covers the greatest extent within the area surveyed. Significant areas of (*)6210 (Orchid-rich) Calcareous grasslands also occur, both in association with the limestone pavement and separately from it, the calcareous soil and underlying bedrock of the area being conducive to the formation of this particular Annex I habitat.

Many of the Annex I habitats exist in mosaic with non-Annex I habitats. In particular, the wetland areas around the River Corrib floodplain, Coolagh Lakes and Coolanillaun Bog are a complex of interconnected habitats that form a continuous hydrological system. Therefore, even those areas of habitat that do not correspond to an Annex I habitat contribute to the conservation objectives of the whole of the cSAC. For hydrologically linked systems in particular, impacts that occur in non-Annex I habitats, even at some distance from Annex I habitats, may have repercussions for the Annex I habitats. The Annex I habitats do not exist in isolation and non-Annex I habitats such as *Phragmites australis* swamp are integral to the functioning of the local ecosystem and to ensuring that the structure and functions of associated Annex I habitats are maintained.

It should be noted that all activities taking place within the cSAC that have the potential to affect the Annex I habitats found within the cSAC can only be carried out in accordance with the Conservation Objectives for cSACs developed by NPWS. It should also be noted that the species *Eriophorum gracile* (slender cottongrass) was recorded in two of the Annex I habitats at Coolanillaun Bog. In addition to the protection afforded by the cSAC designation, this species is further protected under Irish law by the Flora (Protection) Order 1999.

In summary, the majority of the surveyed area was found to be comprised of Annex I habitats, or non-Annex I habitats functionally linked with Annex I habitats. Any impacts or activities with the potential to affect the Annex I habitats within Lough Corrib cSAC must take cognisance of the Conservation Objectives for the cSAC.

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Figure 1. Survey area

Figure 2a. Primary Fossitt habitats within the survey area

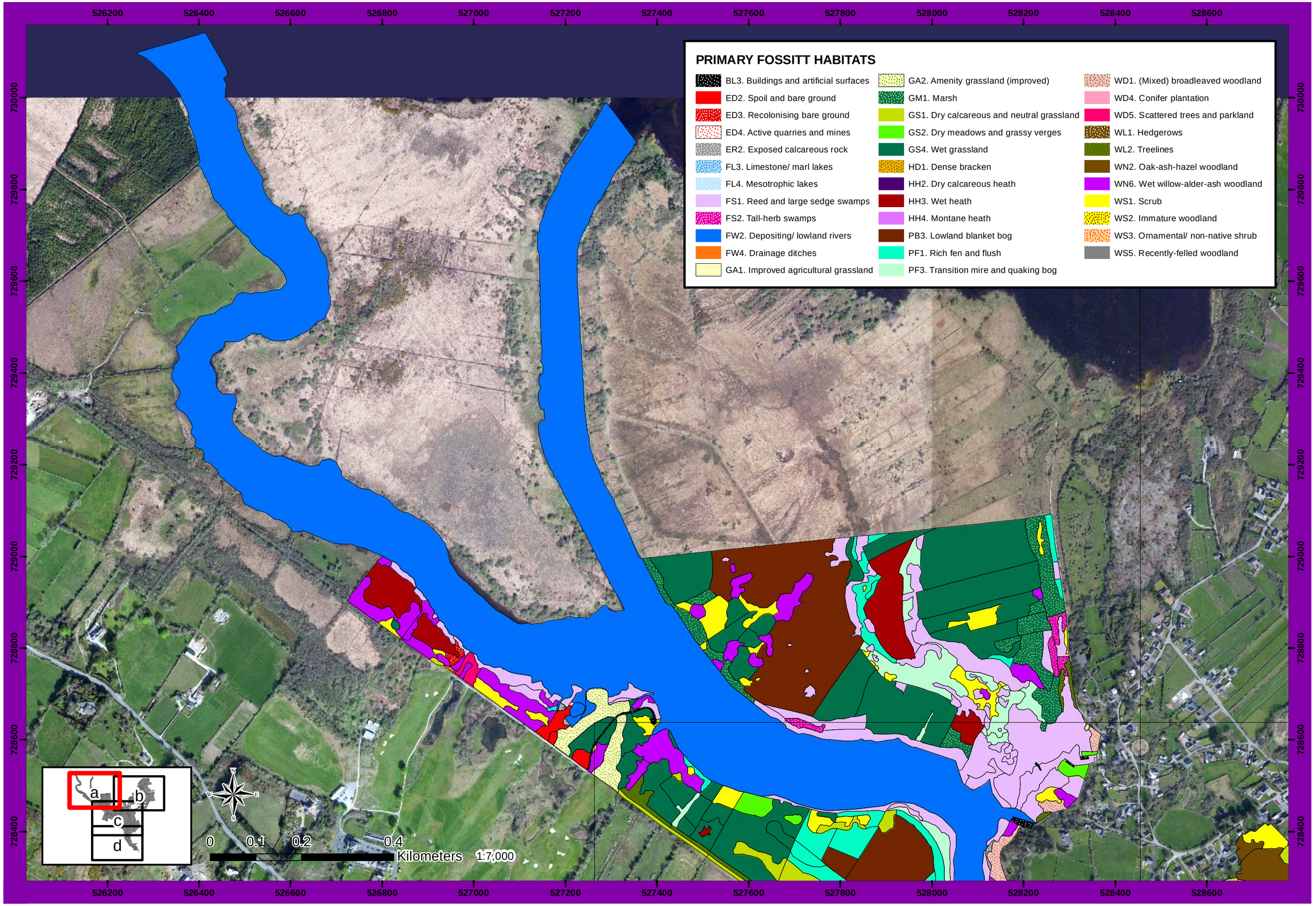

Figure 2b. Primary Fossitt habitats within the survey area

PRIMARY FOSSITT HABITATS

- BL3. Buildings and artificial surfaces
- ED2. Spoil and bare ground
- ED3. Recolonising bare ground
- ED4. Active quarries and mines
- ER2. Exposed calcareous rock
- FL3. Limestone/ marl lakes
- FL4. Mesotrophic lakes
- FS1. Reed and large sedge swamps
- FS2. Tall-herb swamps
- FW2. Depositing/ lowland rivers
- FW4. Drainage ditches
- GA1. Improved agricultural grassland
- GA2. Amenity grassland (improved)
- GM1. Marsh
- GS1. Dry calcareous and neutral grassland
- GS2. Dry meadows and grassy verges
- GS4. Wet grassland
- HD1. Dense bracken
- HH2. Dry calcareous heath
- HH3. Wet heath
- HH4. Montane heath
- PB3. Lowland blanket bog
- PF1. Rich fen and flush
- PF3. Transition mire and quaking bog
- WD1. (Mixed) broadleaved woodland
- WD4. Conifer plantation
- WD5. Scattered trees and parkland
- WL1. Hedgerows
- WL2. Treelines
- WN2. Oak-ash-hazel woodland
- WN6. Wet willow-alder-ash woodland
- WS1. Scrub
- WS2. Immature woodland
- WS3. Ornamental/ non-native shrub
- WS5. Recently-felled woodland

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Figure 2c. Primary Fossitt habitats within the survey area

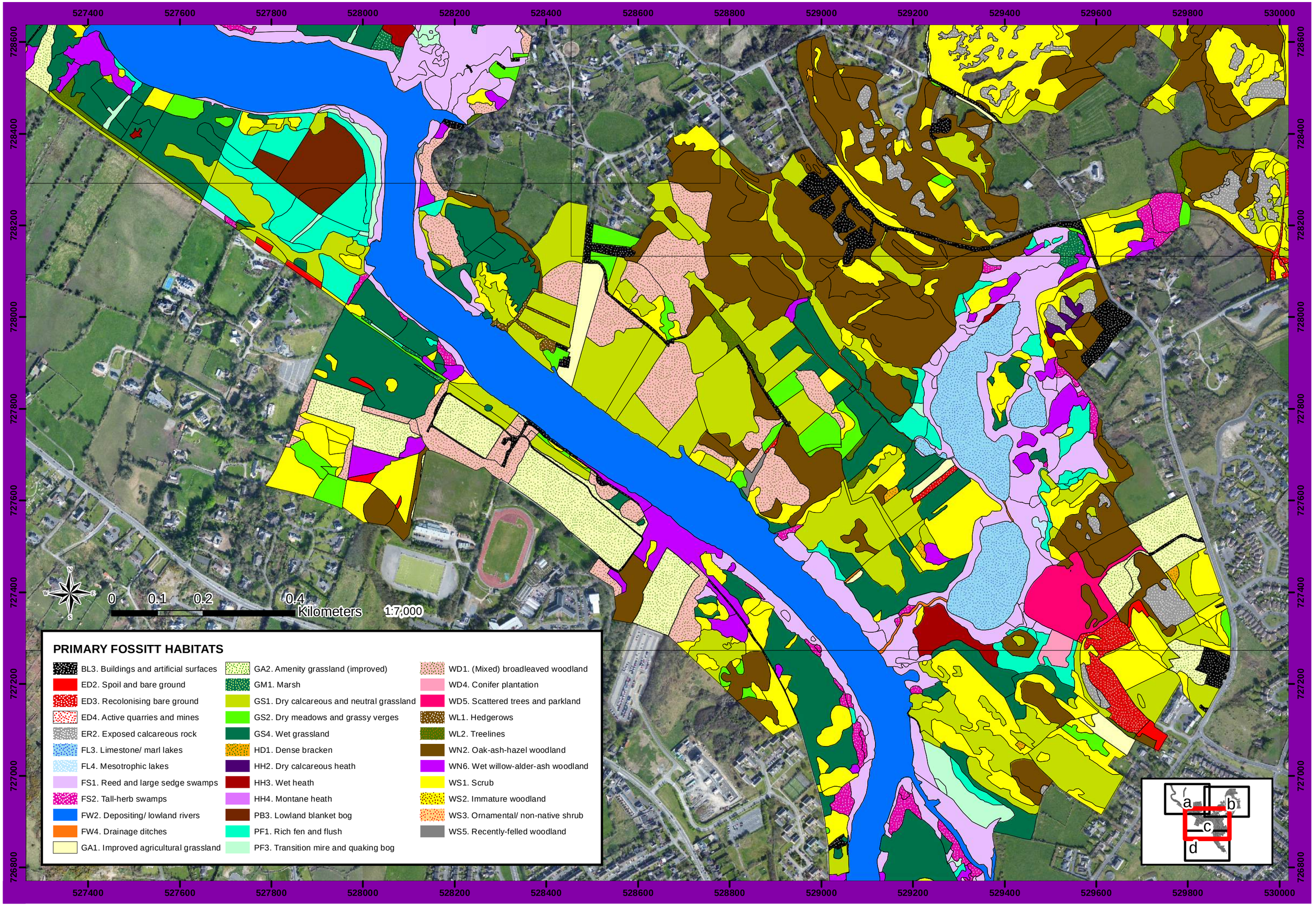


Figure 2d. Primary Fossitt habitats within the survey area

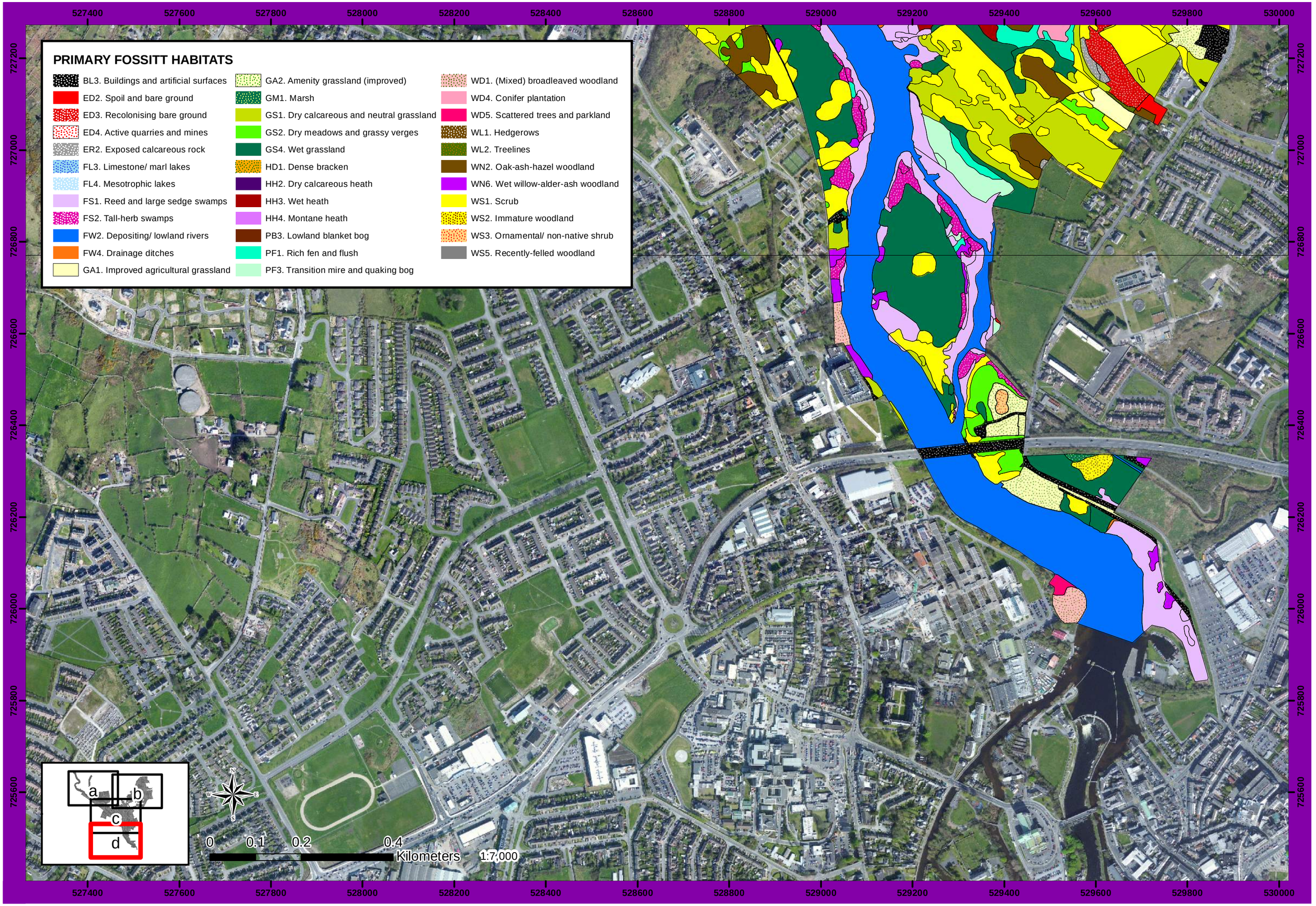


Figure 3a. Primary Annex I habitats within the survey area

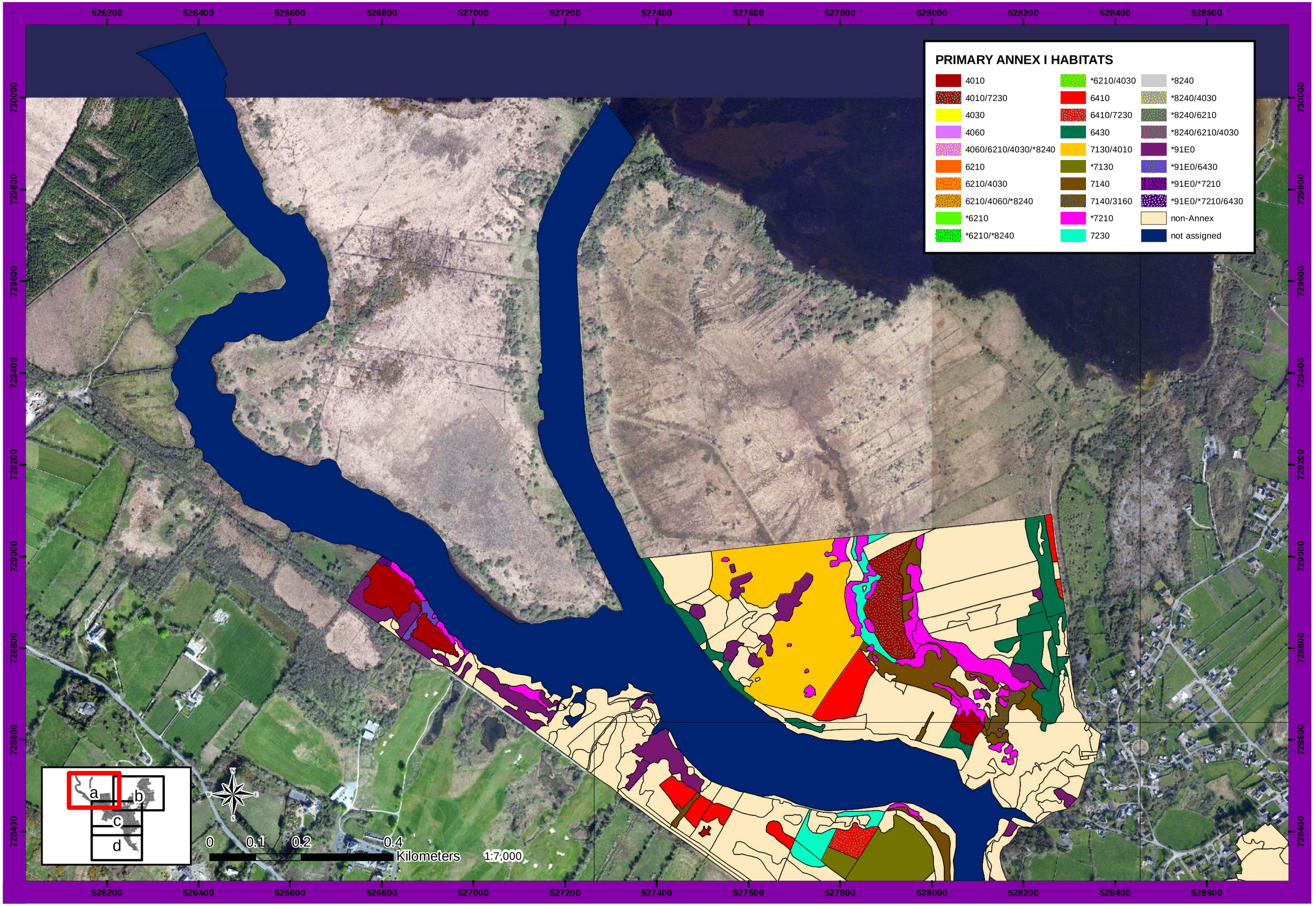


Figure 3b. Primary Annex I habitats within the survey area

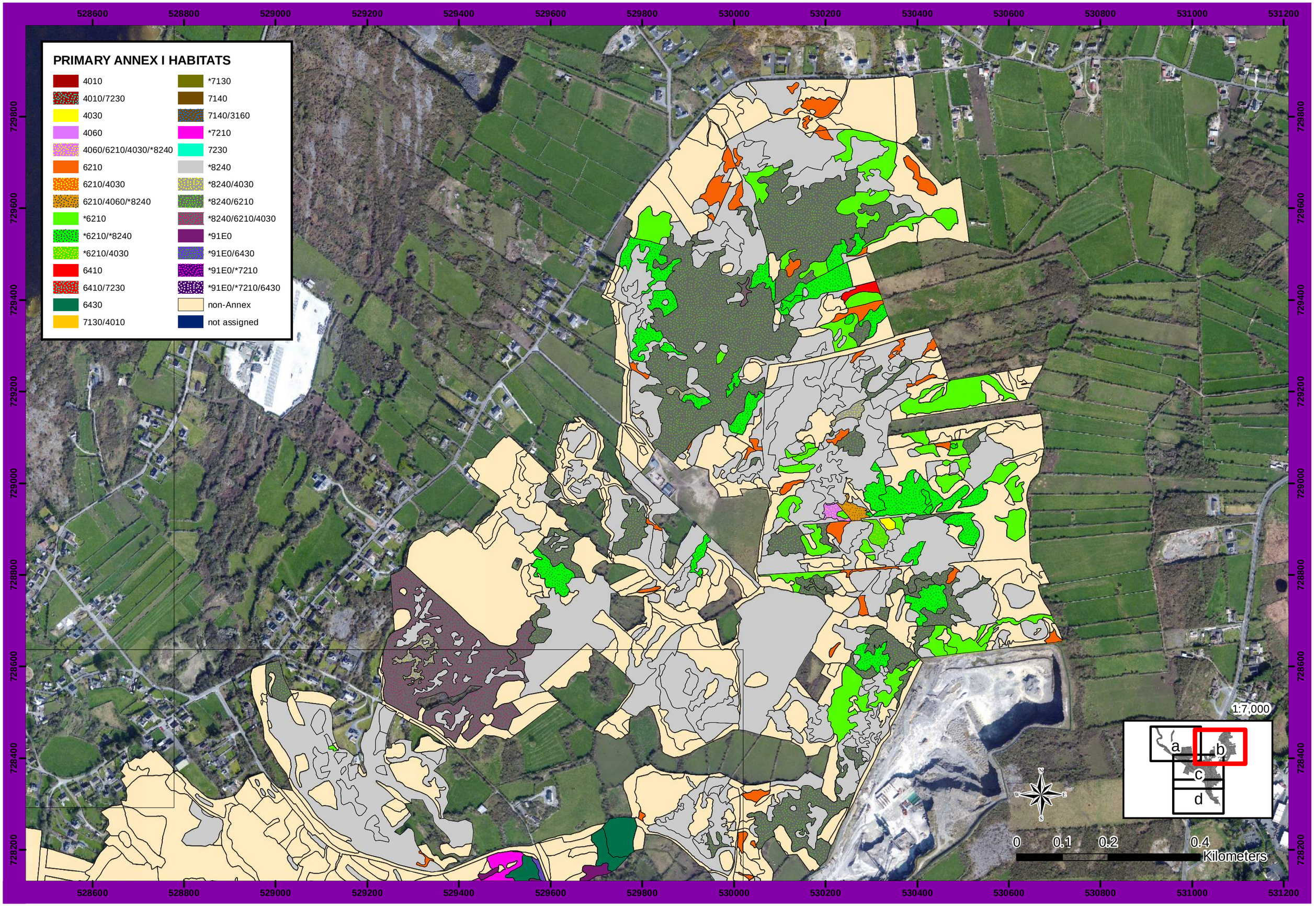


Figure 3c. Primary Annex I habitats within the survey area

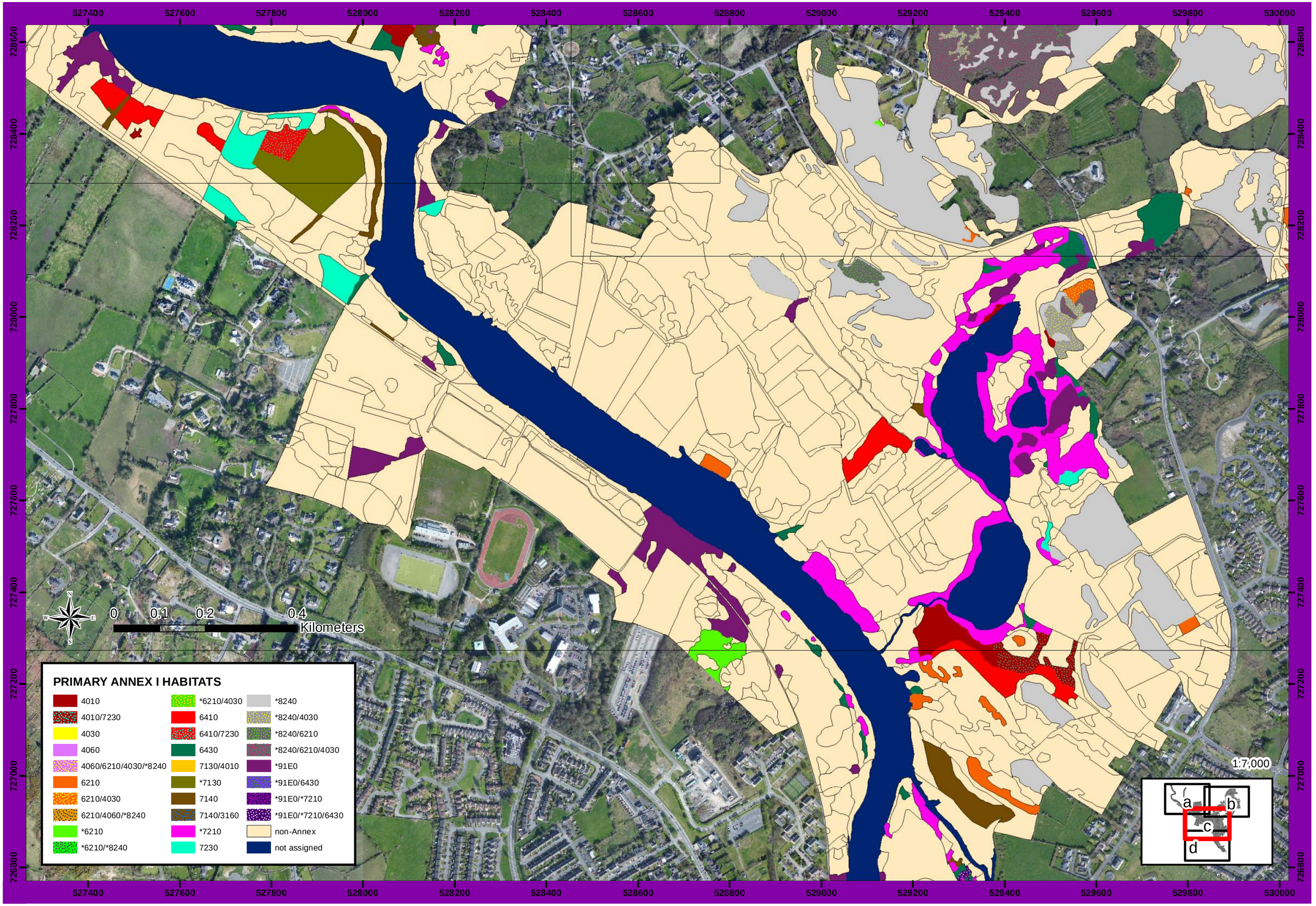


Figure 3d. Primary Annex I habitats within the survey area

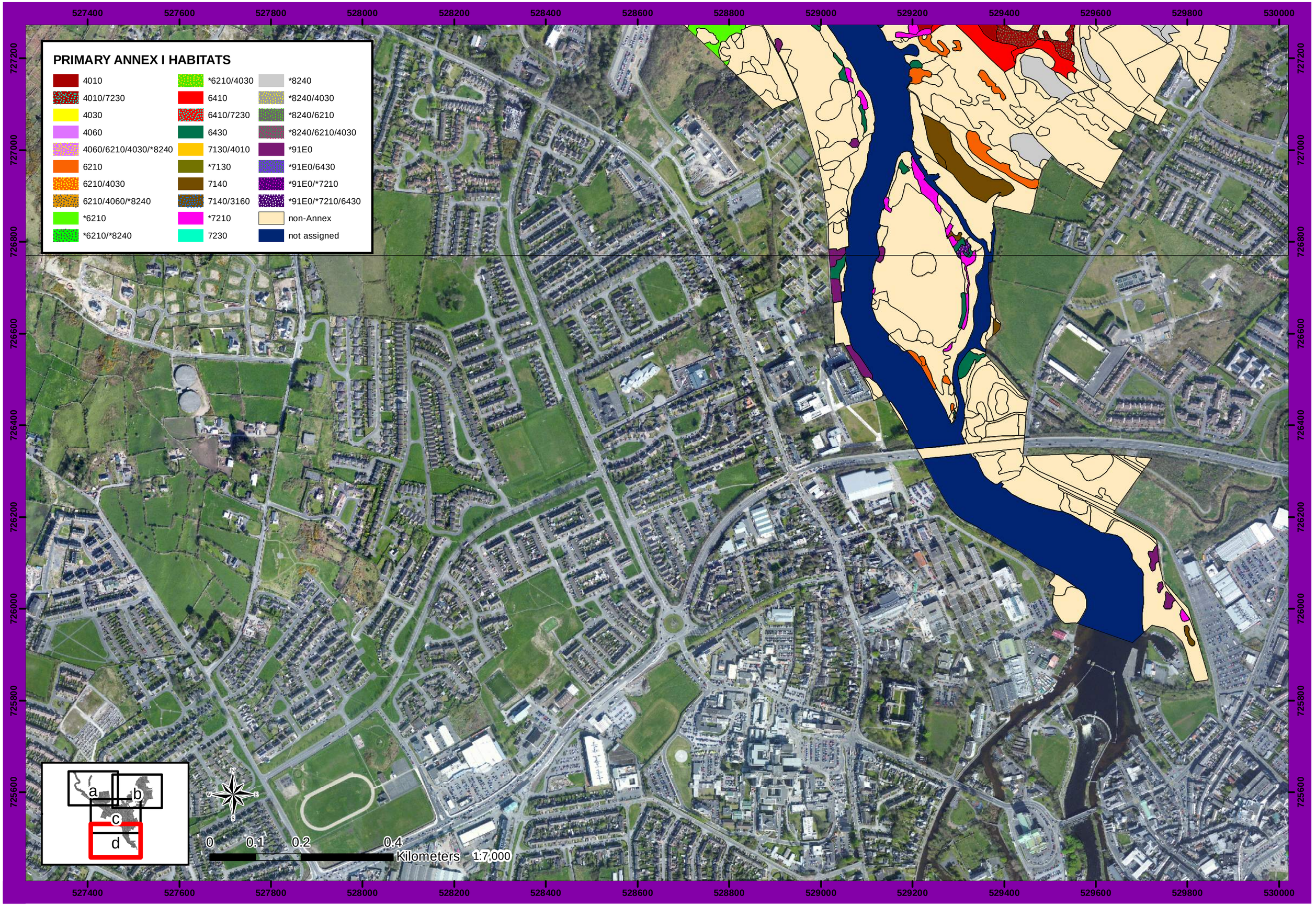


Figure 4a. Rapid assessment of Annex I habitat quality within the survey area

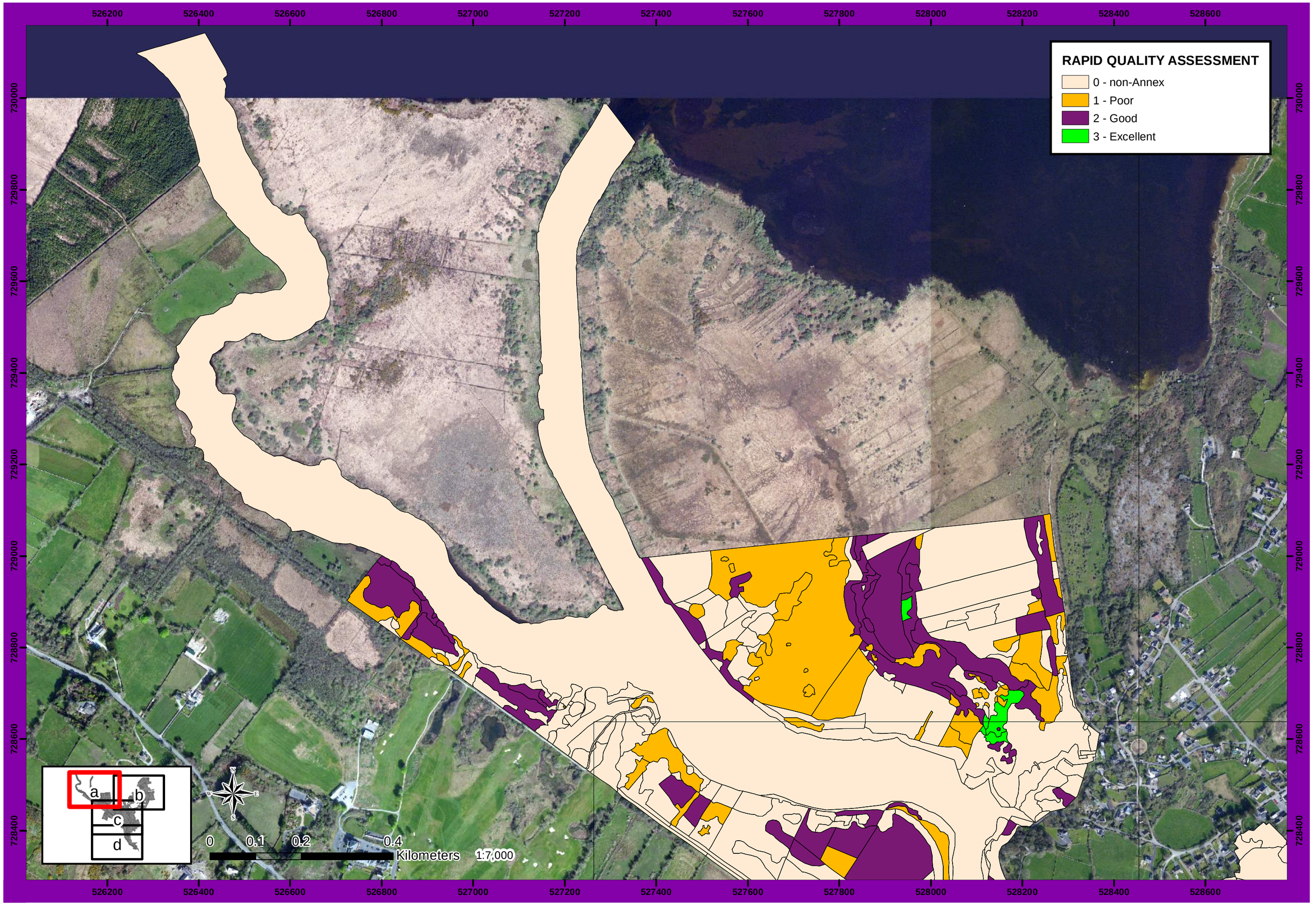


Figure 4b. Rapid assessment of Annex I habitat quality within the survey area

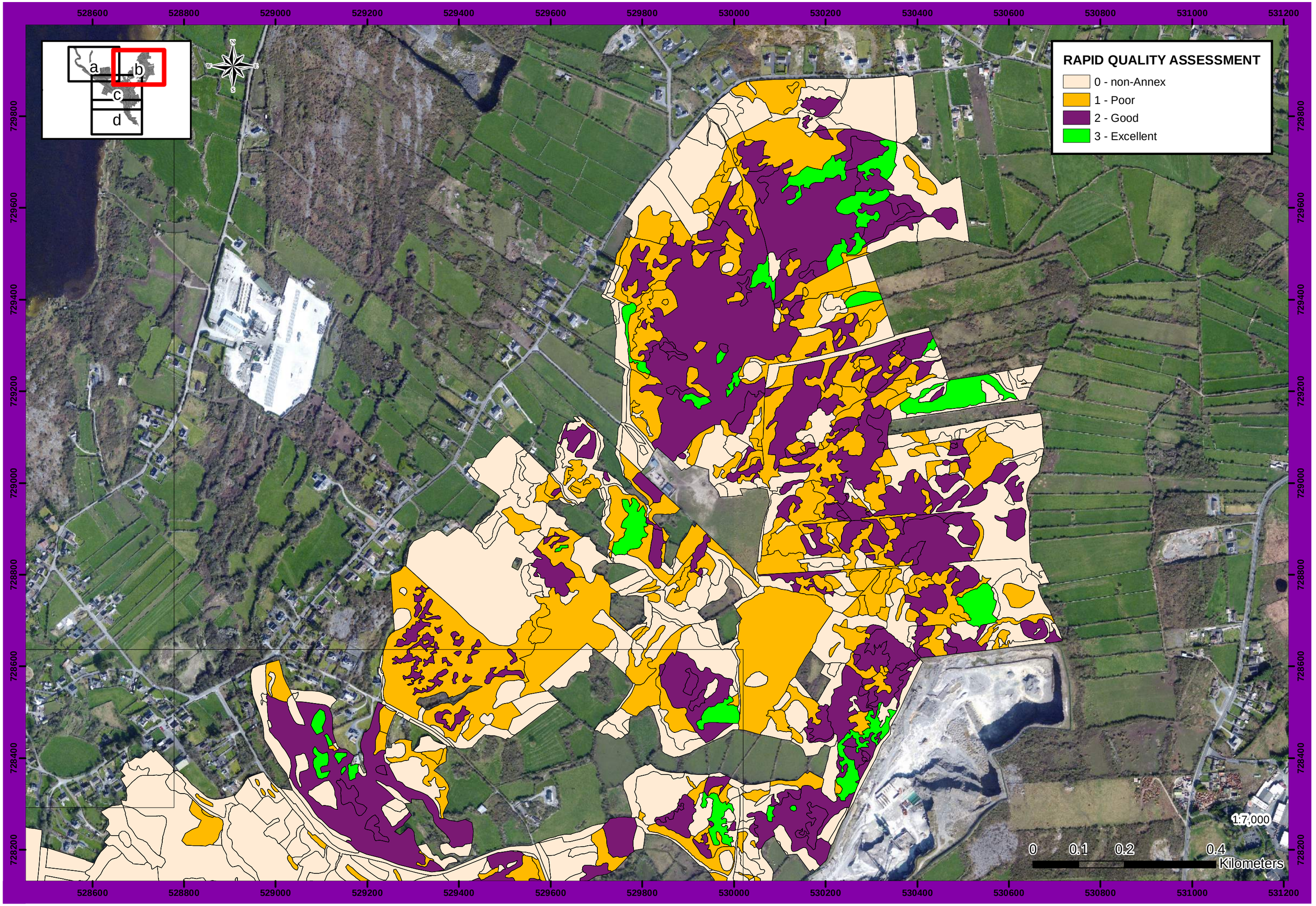


Figure 4c. Rapid assessment of Annex I habitat quality within the survey area

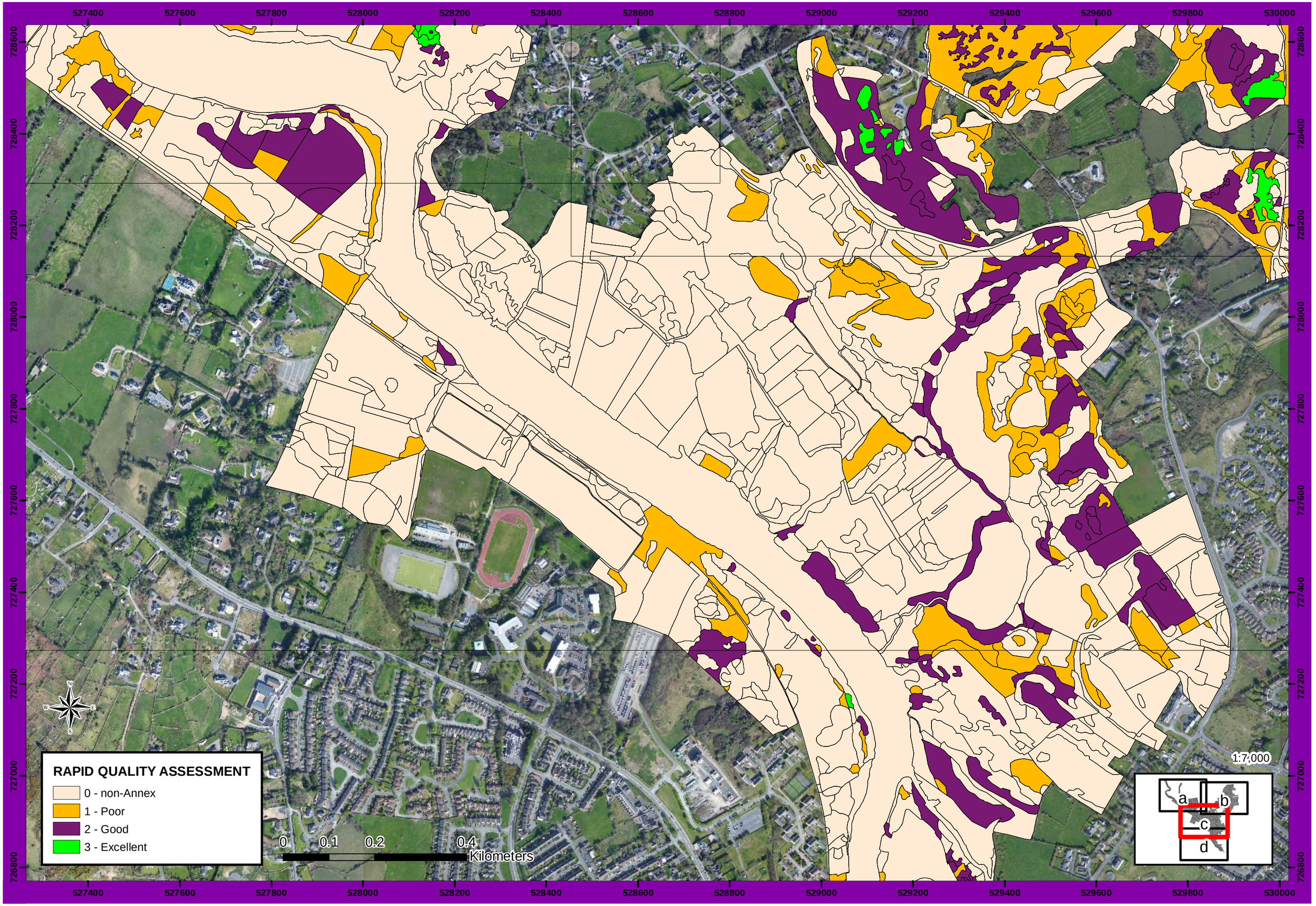


Figure 4d. Rapid assessment of Annex I habitat quality within the survey area

Figure 5a. Location of relevés and results of conservation assessment monitoring stops within the survey area

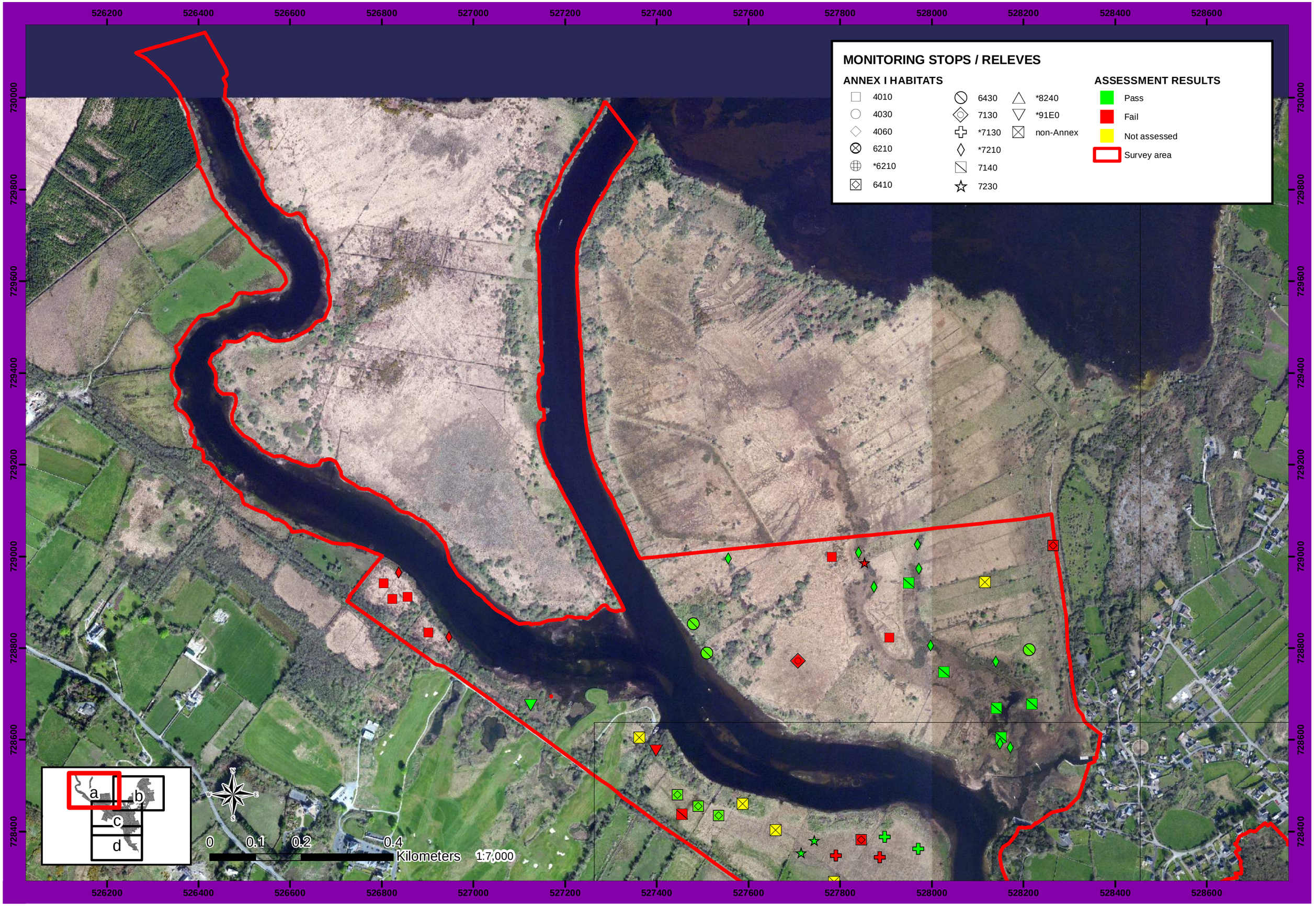


Figure 5b. Location of relevés and results of conservation assessment monitoring stops within the survey area

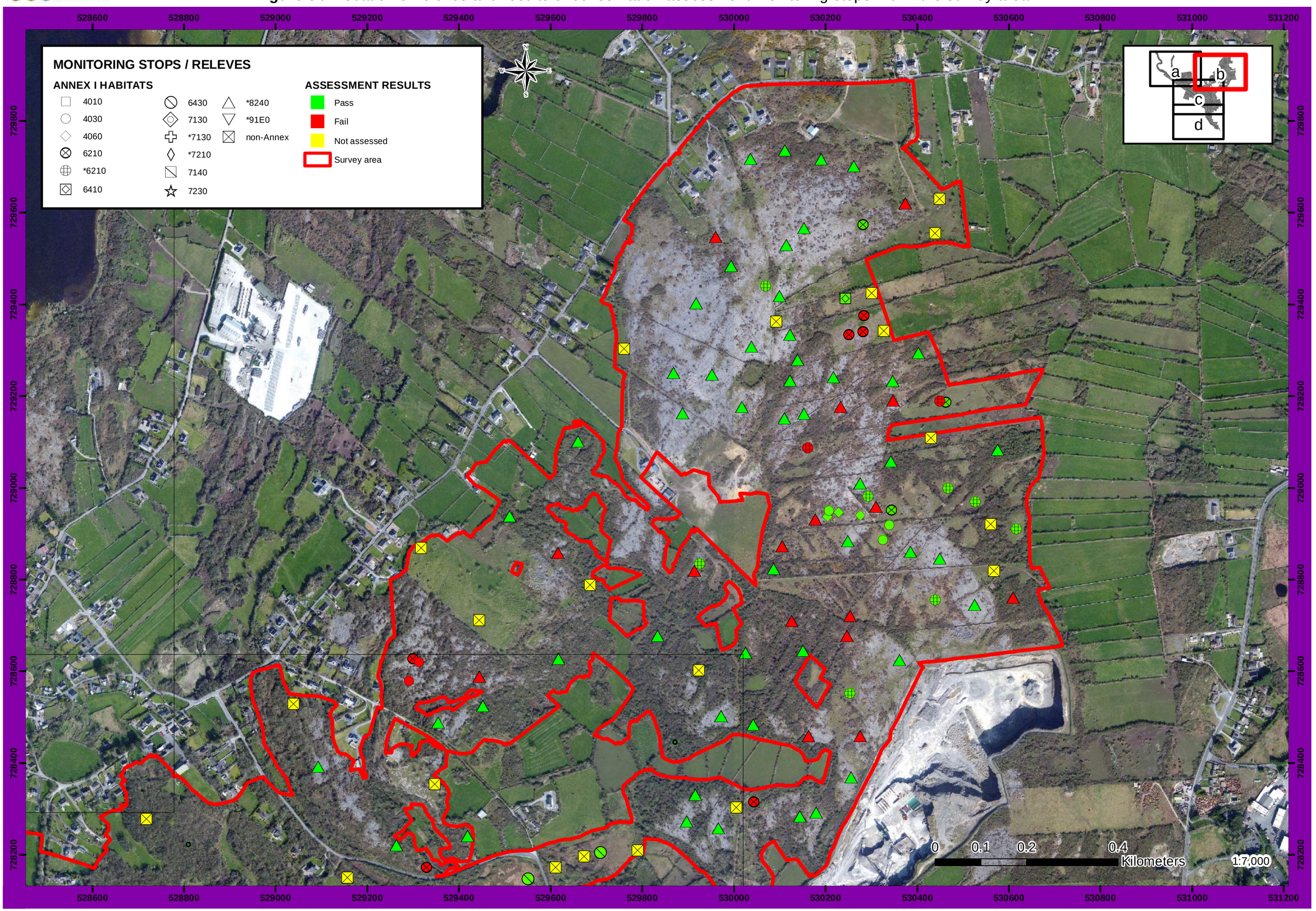


Figure 5c. Location of relevés and results of conservation assessment monitoring stops within the survey area

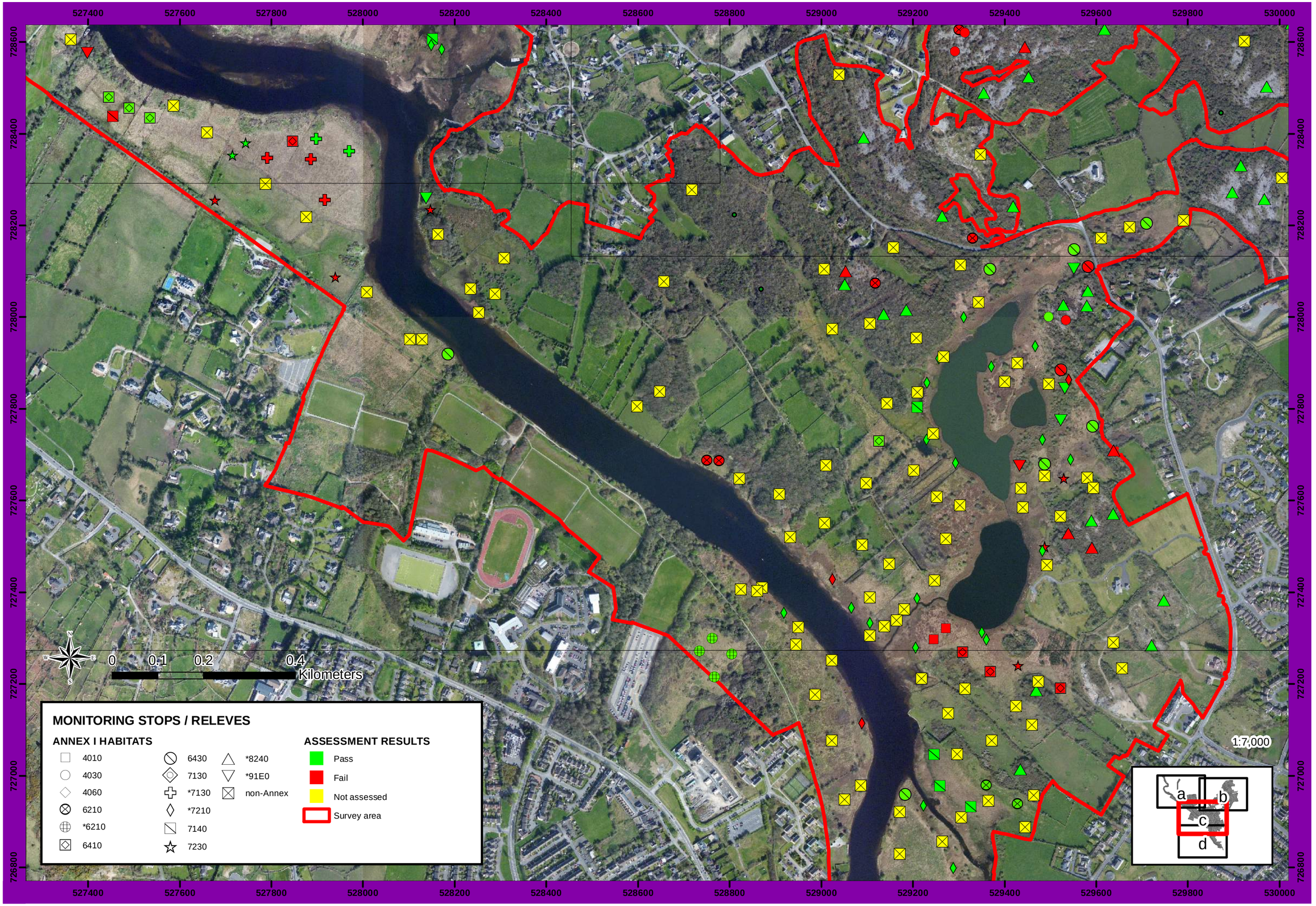


Figure 5d. Location of relevés and results of conservation assessment monitoring stops within the survey area

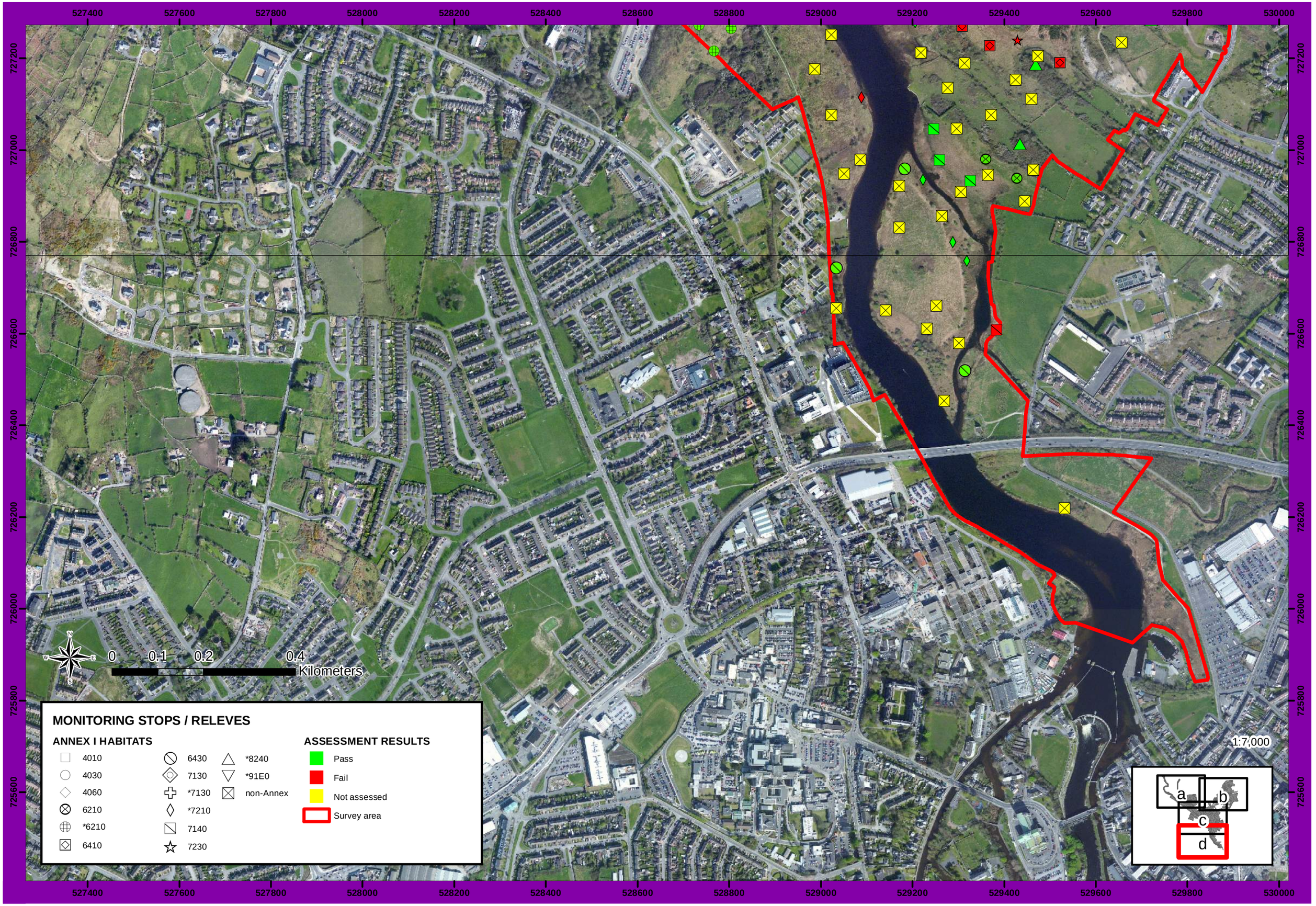


Figure 6a. Vegetation communities within the survey area

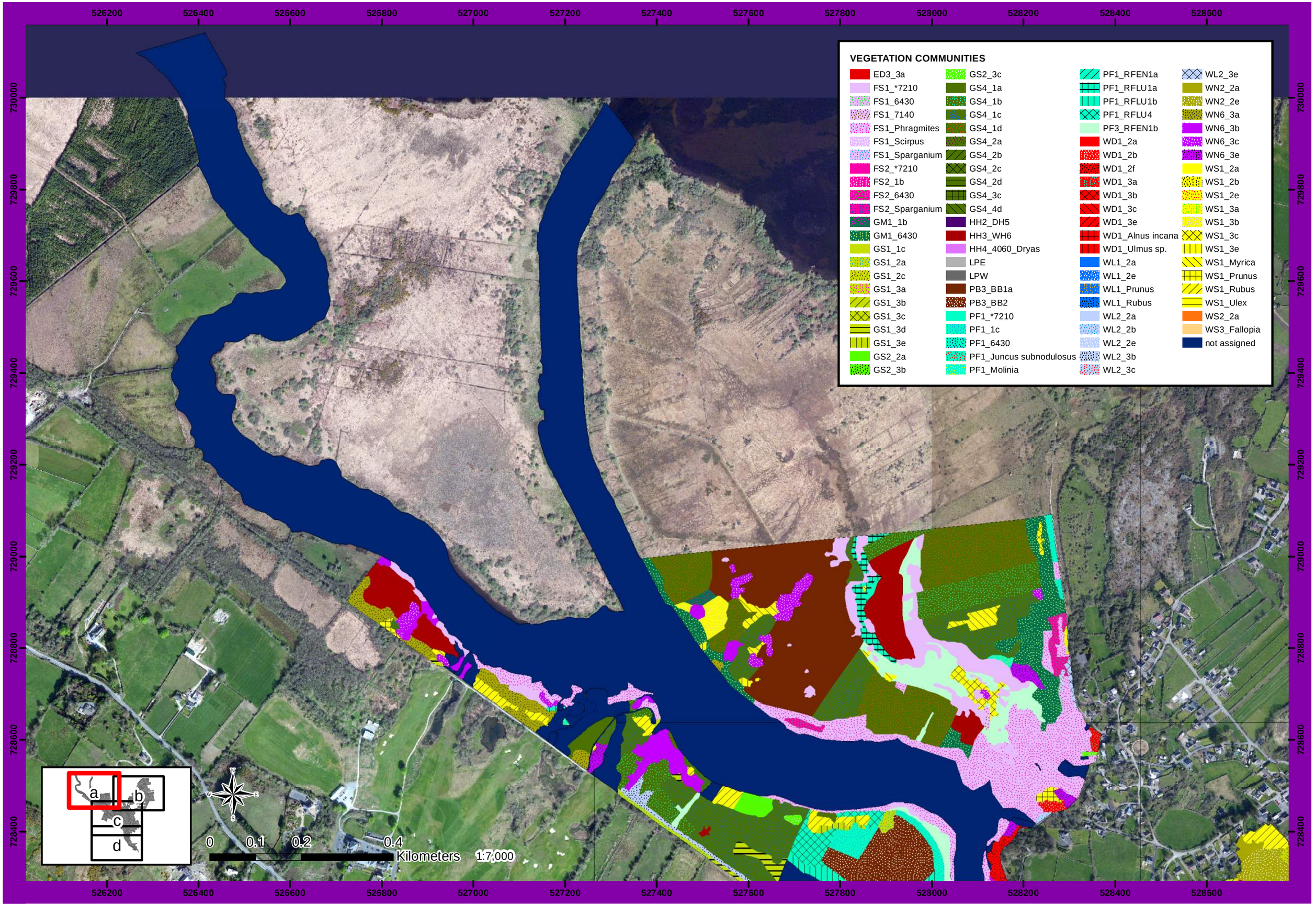


Figure 6b. Vegetation communities within the survey area

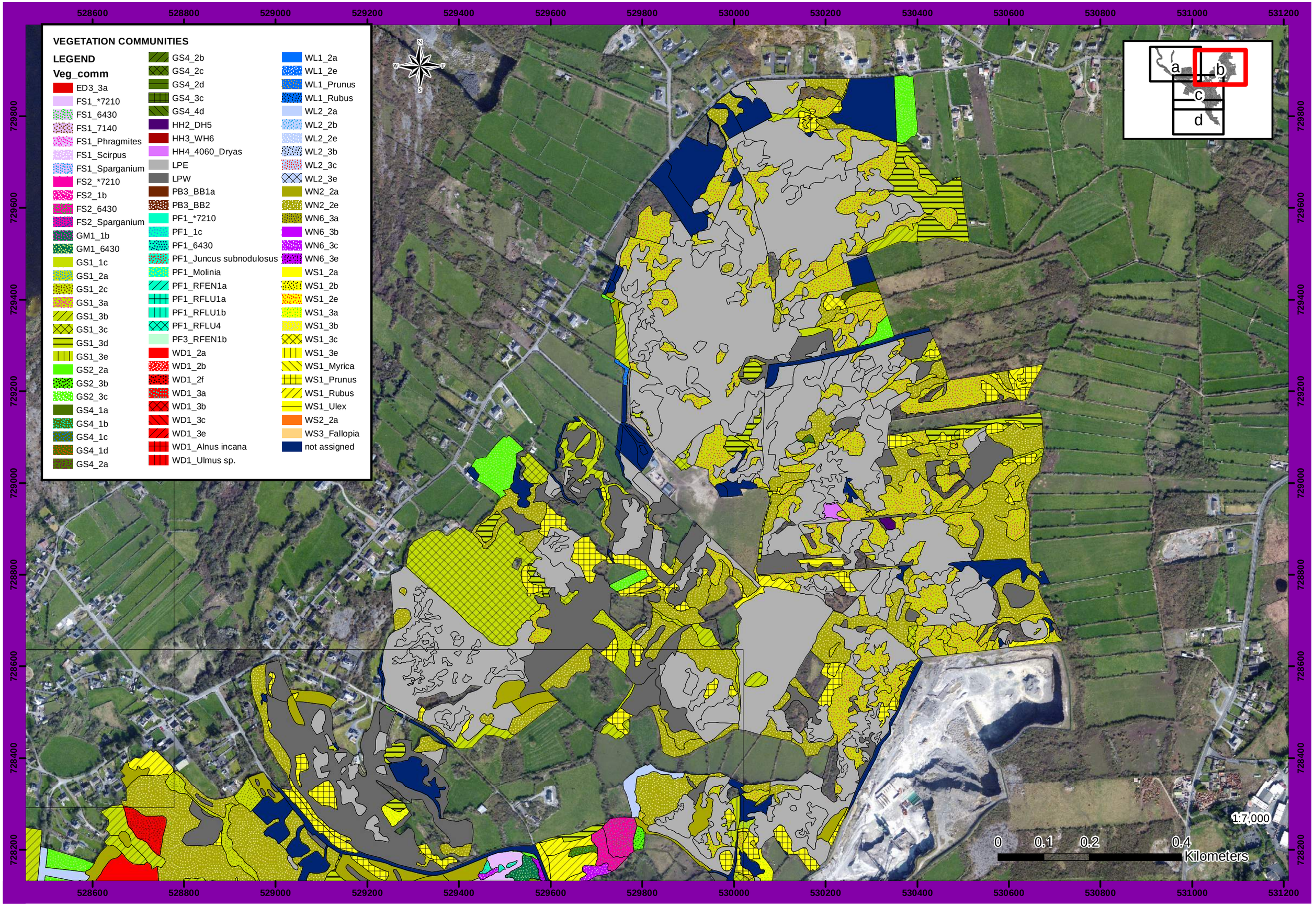


Figure 6c. Vegetation communities within the survey area

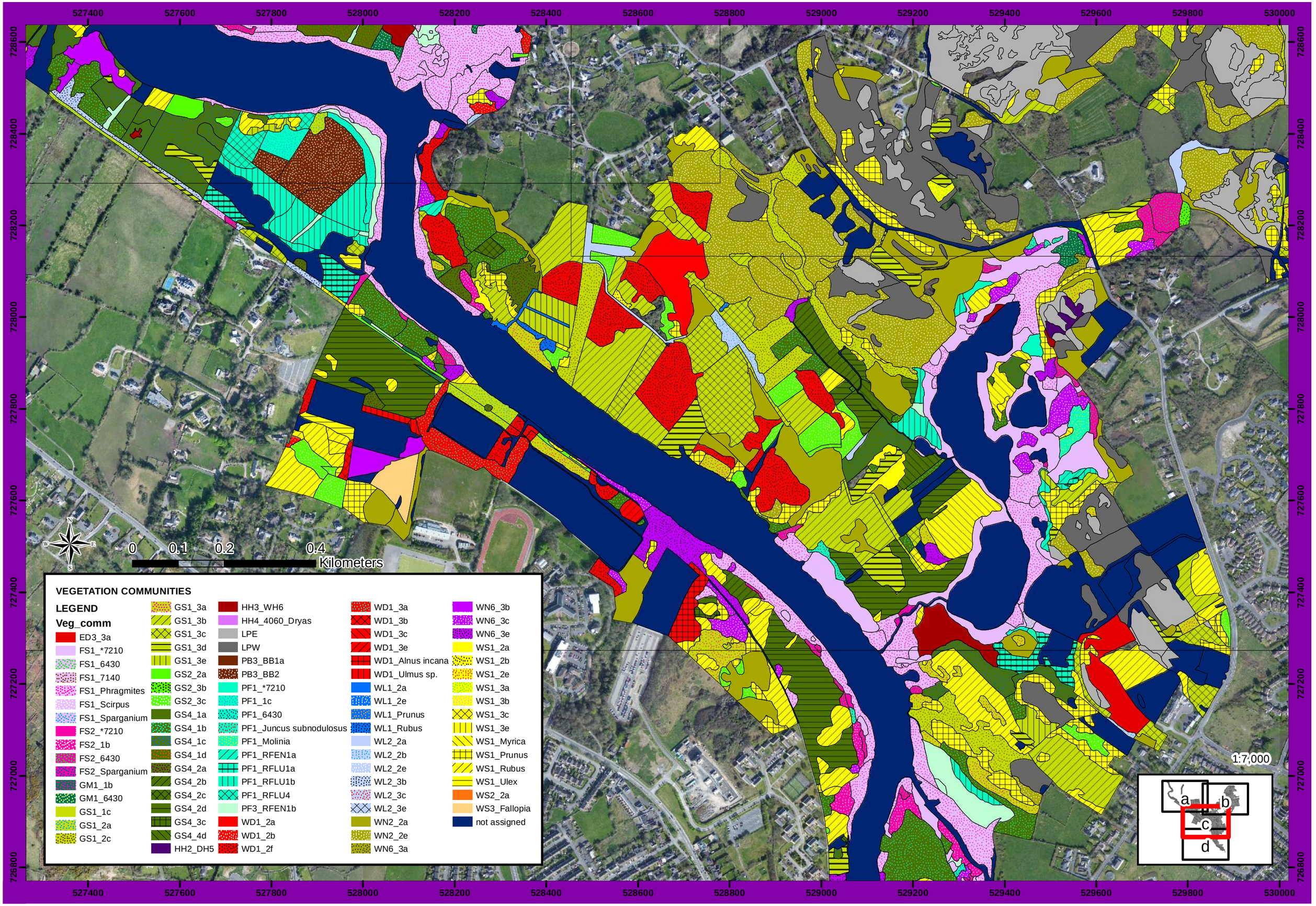
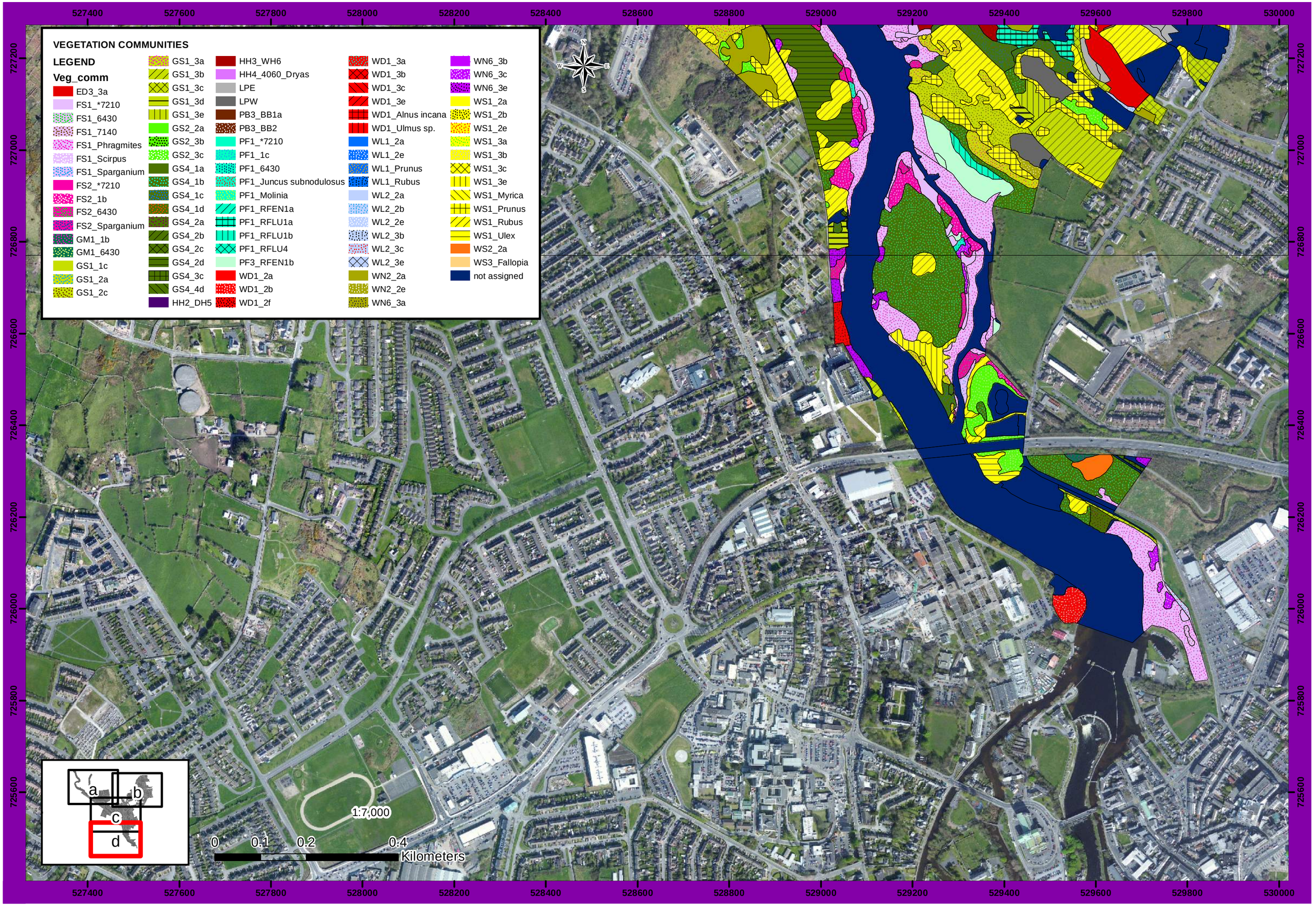


Figure 6d. Vegetation communities within the survey area



Appendix 1: Assessment criteria for *Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae [7210]

The assessment scheme presented below was developed by Crushell & Foss (2014a, b)

Assessment varies between the *Cladium* swamp (FS1) and *Cladium* fen (PF1) variants of the habitat, both of which are considered to correspond with the EU Annex I habitat *7210 Calcareous fens with *Cladium mariscus* as defined in the EU Habitats Interpretation manual.

Criteria for Condition Assessment of *Cladium* swamp

Criteria		Scale of assessment
Vegetation composition		
1	*Cladium mariscus* present	Relevé
2	Number of positive vascular indicator species present ≥ 2	Relevé
3	Vegetation cover of *Cladium* and vascular indicator species ≥ 75%	Relevé
4	Total cover of the following species < 5%: *Epilobium hirsutum, Typha latifolia*	Relevé
5	Cover of non-native species < 1%	Relevé
6	Cover of scattered native trees and scrub (woody species) < 10%	Local vicinity†
Vegetation structure		
7	At least 50% of the live leaves/flowering shoots are more than 100 cm above ground surface	Relevé
Physical structure		
8	Cover of disturbed, bare ground < 10%	Relevé
9	Cover of disturbed, bare ground < 10%	Local vicinity
10	Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	Local vicinity
11	Where tufa is present, disturbed proportion of vegetation cover < 1%	Local vicinity

Criteria for Condition Assessment of open *Cladium* fen

Criteria		Scale of assessment
***Cladium* fen Vegetation composition**		
1	*Cladium mariscus* present	Relevé
2	At least one brown moss species present	Relevé
3	Number of positive vascular indicator species present ≥ 3	Relevé
4	Vegetation cover of brown mosses and vascular indicator species ≥ 75%	Relevé
5	Total cover of the following species: *Anthoxanthum odoratum, Epilobium hirsutum, Holcus lanatus, Ranunculus repens* < 1%	Relevé
6	Cover of non-native species < 1%	Relevé
7	Cover of scattered native trees and scrub < 10%	Local vicinity
8	Total cover of *Juncus effusus* and *Phragmites australis* < 10%	Local vicinity
Vegetation structure		
9	At least 50% of the live leaves/flowering shoots are more than 5 cm above ground surface	Relevé
Physical structure		
10	Cover of disturbed, bare ground < 10%	Relevé
11	Cover of disturbed, bare ground < 10%	Local vicinity
12	Area showing signs of drainage resulting from ditches or heavy trampling or tracking < 10%	Local vicinity
13	Where tufa is present, disturbed proportion of vegetation cover < 1%	Local vicinity

† Within approximately 20 m^2 radius of relevé

Positive indicator species for EU Annex I habitat *Cladium mariscus* fen (7210)*

***Cladium* Swamp Variant**
Carex lasiocarpa
Phragmites australis
Equisetum fluviatile
Lemna trisulca
Potentilla palustris
Menyanthes trifoliata
***Cladium* Fen Variant**
Brown mosses
Bryum pseudotriquetrum
Calliergon sarmentosum
Campylium stellatum
Ctenidium molluscum
Drepanocladus revolvens
Drepanocladus cossonii
Fissidens adianthoides
Palustriella commutata
Palustriella falcata
Scorpidium scorpioides
Vascular Plants
Carex panicea
Carex viridula
Eleocharis quinqueflora
Juncus bulbosus
Pinguicula vulgaris
Anagallis tenella
Carex dioica
Carex lasiocarpa
Carex panicea
Carex viridula
Carex rostrata
Cirsium dissectum
Molinia caerulea
Pinguicula vulgaris
Schoenus nigricans
Selaginella selaginoides

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