

Healthy Floodplains Project: Defining ecological assets of the Gwydir Wetlands



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Cover Photograph: Water couch marsh grassland on the Old Dromana Ramsar Site September 2011. (Credit: S. Bowen, OEH).

1 Introduction

The Gwydir Wetlands is an inland floodplain wetland complex 60 km north-west of Moree in northern NSW. The Gwydir Wetlands consist of the major watercourses that make up the Gwydir River delta; the Gingham Watercourse, Lower Gwydir Watercourse and the Mehi River-Mallowa Creek-Moomin Creek System (Figure 1). These wetlands have been recognised as habitat for migratory and endangered waterbirds listed under international migratory bird treaties, and for their unique assemblages of wetland and floodplain plant communities. Parts of these wetlands are listed under the Ramsar Convention (823 ha) and the NSW reserve system (7,069 ha). The entire Gwydir wetlands are listed on the Directory of Important Wetlands in Australia (Environment Australia 2001).

The Gwydir Wetlands contain a number of floristic and structurally diverse flood dependent vegetation communities temporally and spatially dependant on the intermittent inundation from water courses and the availability of groundwater. The floodplain and wetland communities that occur on the Gwydir floodplain have been in severe decline over their range since European settlement and this decline has accelerated in the last 30 years due to land clearing and altered hydrological regimes. These floodplain vegetation communities are highly fragmented and poorly conserved in NSW. All remaining wetland and floodplain vegetation in the Gwydir Wetlands is of high conservation significance and is important for the maintenance and restoration of the ecological health of this unique inland floodplain wetland complex (Bowen and Simpson 2010).

Mapping of all vegetation communities of the Gwydir Wetlands and floodplain was completed in 2008 under the NSW Wetland Recovery Program (Bowen and Simpson 2009). The mapped area covered 450,158 ha and encompassed the two main watercourses of the Gwydir River Delta; the Gingham Watercourse and the Lower Gwydir or Big Leather Watercourse, which combined cover an area of 332,447 ha. The adjoining floodplain area of 117,711 ha to the south of the Lower Gwydir, the Mehi River, Mallowa and Moomin Creek system of floodplains and creeks was also mapped (Bowen and Simpson 2009) (Figure 1, Appendix). This mapping and its associated report (Bowen and Simpson 2010) was used to inform the Gwydir Wetlands Adaptive Environmental Management Plan (AEMP) (DECCW 2010a).

2 Methods

To create an annotated vegetation community map for use in the valley wide floodplain management plan for the Gwydir, a number of additional fields were added to the existing digital map of the vegetation communities of the Gwydir Wetlands and floodplain from 2008 (Bowen and Simpson 2009). These additional fields allow the spatial delineation of flood dependent ecological assets.

2.1 Functional hydro-ecological groups of the semi permanent, floodplain wetlands and flood dependent vegetation communities of the Gwydir Wetlands

Bowen and Simpson (2010) grouped the vegetation communities of the Gwydir Wetlands and floodplain into 'hydro -ecological functional groups' based on the requirements for flooding of the dominant or canopy species of the vegetation community and landscape position, consistent with the definition of a wetland in the NSW Wetlands Policy (DECCW 2010b) (Table 1). These are defined below:

Flood dependent vegetation communities are vegetation communities which occur on floodplains, in which the dominant species depend on (moist conditions) flooding for part or all of their life cycle:

Semi permanent (Non-woody) wetland – (also described as 'Amphibious wetland' (Bowen and Simpson 2010)), are those communities that depend on frequent flooding (less than once per year), to maintain their structural integrity and community condition. Amphibious wetland communities occur on heavy clay soils in channels or depressions subject to frequent inundation and are dominated by species such as; water couch (*Paspalum distichum*), ribbed spike rush (*Eleocharis plana*), marsh club rush (*Bolboschoenus fluvialis*), *Juncus* species, common reed (*Phragmites australis*), cumbungi (*Typha dominensis*) and mixed marsh (McCosker and Duggin 1993; Keyte 1994; McCosker 2007; Bowen and Simpson 2010) (see Figure 2; a and e).

Floodplain wetlands (Woody wetlands) are those communities that depend on moderately frequent flooding (one in five years), to maintain their structural integrity and community condition, e.g., river cooba (*Acacia stenophylla*) shrubland and lignum (*Muehlenbeckia florulenta*) shrubland..

Flood dependent forest and flood dependent woodlands are communities in which the dominant overstorey species require intermittent flooding (one in five to one in 10 years depending on the community) to assist with recruitment and also to recharge groundwater reserves, e.g., River red gum (*Eucalyptus camaldulensis*) forest and coolibah (*E. coolabah*) and blackbox (*E. largiflorens*) woodland (see Figure 2; b and d).

There are also **Non-flood dependent communities** – vegetation communities which occur on floodplains, in which the dominant species do not depend on flooding to complete their life cycle and which occur on higher ground in the floodplain or on old floodplains and are flooded rarely. These are called **Dryland floodplain communities**. Dryland floodplain vegetation communities include very infrequently flooded communities of the western floodplain of the Gwydir such as weeping myall (*Acacia pendula*) woodlands and native grasslands, communities on red solodic ridges or 'prior streams' such as belah (*Casuarina cristata*) woodlands and poplar

box (*E. poplunea*) and white cypress pine (*Callitris glaucophylla*) woodlands and communities occurring on areas of sandy lenses in the clay alluvial soils called 'sand monkeys'. These areas may be important for the recharge of floodplain groundwater (McCosker and Duggin 1993; Keyte 1994; McCosker 2007; Bowen and Simpson 2010) (Figure 2; c and f).

A new field was created within the digital vegetation mapping layer called 'Functional'. Each polygon of the digital vegetation community map was assigned to the appropriate hydro-ecological functional group (after Bowen and Simpson 2010). These functional groups are shown in Table 1. A developed land functional group delineated land used for agricultural purposes.

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A – Non-woody wetlands



B – Flood dependent woodlands



C – Dryland communities



D – Flood dependent woodlands



E – Non-woody (Semi permanent) wetlands



F – Sand monkey communities

Figure 2: Vegetation communities; A) Cumbungi reedland, B) Black box woodland, C) Weeping myall woodland, D) Coolibah-Black box woodland in poor condition, E) Water couch marsh grassland, F) Baradine red gum forest (Bowen and Simpson 2010) (Credit: Sharon Bowen, NSW OEH).

2.2 Defining the ecological importance of plant functional hydro-ecological groups

Each polygon of the digital vegetation community map was assigned a range of ecological importance values (ecological functions and services) based on the hydro–ecological group. These ecological importance values were derived from the outcomes of the NSW Wetland Recovery Program (Bowen and Simpson 2010; Spencer 2010; Spencer et al. 2010) and water requirements of dominant species were sourced from Roberts and Marston (2000).

Bowen and Simpson (2010) identified three Endangered Ecological Communities (EEC) in the Gwydir Wetlands and floodplain:

1. Marsh Club-rush sedgeland in the Darling Riverine Plains Bioregion (NSW OEH 2012a)
2. Coolibah-Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions' (NSW OEH 2011a; 2012b); and
3. Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (NSW OEH 2012c).

Although they were not mapped as communities in 2008 two additional EECs are known to occur within the mapped area:

4. Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions (NSW OEH 2011b; 2012d);
5. Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions NSW OEH (2012e).

All five EECs are listed under Schedule 1 of the NSW *Threatened Species Conservation Act* (TSC Act), and the Weeping Myall EEC and Coolibah-Black Box EEC are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (SEWPaC 2012a; 2012b).

The Coolibah-Black box EEC has been extensively cleared throughout its range. It is estimated that there has been a 61 per cent reduction in the distribution of the community and only 15 per cent of its estimated pre-European extent remains in the Moree plains subregion (Benson et al. 2006; Keith et al. 2009). Land clearing continues to threaten Coolibah – Black Box Woodland (NSW OEH 2011). Bowen and Simpson (2010) reported that only 28 per cent of the estimated 250,000 ha which occurred in the Gingham and Lower Gwydir prior to regulation of the Gwydir River remained in 2008. All remaining Coolibah and Coolibah-Black box open woodland has high conservation value in the Gwydir.

In the determination to list the Carbeen Open Forest in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC, the NSW Scientific Committee noted that this community is '*likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate*'. These factors include; '*small size of existing remnants, the threat of further clearing for grazing and cropping, fire management practises, and land-forming for irrigated crops*' (NSW OEH 2012c).

Information on waterbird feeding and breeding habitat in the Gwydir Wetlands was collated through the NSW Wetland Recovery Program (Spencer et al. 2010; Spencer 2010). At least 75 waterbird species (50 breeding) are known to have used the

Gwydir wetlands. This includes nine threatened waterbird species, such as brolga (*Grus rubicundus*), magpie geese (*Anseranas semipalmata*), black-necked stork (*Ephippiorhynchus asiaticus*) (TSC Act 1995) and Australian painted snipe (*Rostratula australis*) (EPBC Act 1999) (Spencer 2010).

The availability of breeding habitat for colonial-nesting waterbird species has become limited in the Gwydir wetlands due to clearing of areas of *belah*, *lignum*, *cumbungi*, river cooba and river red gum which can provide important nesting habitat for colonial waterbird species, such as ibis, cormorants, egrets and herons. The frequency of large flood events has also declined (Thomas et al. 2010) reducing opportunities for large colonial waterbird breeding events to occur (Spencer 2010). Therefore, protecting floodplain vegetation that is known to support colonial waterbird nesting should be a high conservation priority.

The distribution of feeding habitat is also a key determinant in sustaining waterbird populations in the Gwydir wetlands, with species using a whole suite of habitats including lagoons and waterholes, semi-permanent wetlands and flood dependent vegetation. Some waterbird species will also utilise grasslands and cultivated lands during large-scale flooding (Table 1).

During drier periods waterbird species tend to concentrate around natural water bodies and flooded semi-permanent vegetation on the Gwydir floodplain but breeding activity is generally limited (Spencer et al. 2010). Lagoons and waterholes can also provide important refuge habitats for native fish during periods of low flow (Wilson et al. 2009; Spencer et al. 2010). Ensuring adequate connection between the main watercourses in the Gwydir and natural water bodies and semi-permanent wetlands on the floodplain should be priority for enhancing native fish survival and recruitment.

Although there is limited information available on the distribution of woodland birds in the Gwydir Wetlands and floodplain, they are identified in the Gwydir AEMP as species of special conservation significance (DECCW 2010a) and there are a number of flood dependent and non-flood dependent woodlands that would provide habitat for woodland bird species (Table 1). Some woodland bird species are highly dependent on floodplain woodland communities and many of these species have been declining across inland NSW in recent decades (McGinness et al. 2010).

According to the distribution of the five EECs, threatened species, known waterbird breeding and feeding habitats, and likely woodland birds and native fish habitats a new field was created within the digital vegetation mapping layer called 'Importance'. Each polygon of the digital vegetation community map was assigned to the appropriate ecological importance value(s) (Table 1).

Table 1: Hydro – ecological functional groups for the vegetation communities mapped in the Gwydir Wetlands in 2008 (Bowen and Simpson 2010) and their ecological importance.

Hydro- ecological functional group	Description - NSW Plant Community Type (PCT)	Ecological Importance
Natural water body	Natural water body	Waterbird feeding habitat, refugia for native fish, natural water body
Non-woody wetland (Semi-permanent wetlands)	Marsh Club-Rush very tall sedgeland of inland river systems - PCT ID 205	Marsh club-rush EEC (TSC Act), waterbird feeding habitat,
	Water Couch marsh grassland of frequently flooded inland watercourses - PCT ID 204	Waterbird feeding habitat
	Common Reed – Bushy groundsel aquatic tall grassland of inland river systems - PCT ID 181	Waterbird breeding and feeding habitat
	Cumbungi rushland of shallow semi permanent water bodies of the inland river systems - PCT ID 182	Waterbird breeding and feeding habitat
Woody wetlands (Floodplain wetlands)	River Cooba swamp on the floodplains of the DRP - PCT ID 241 & Lignum shrubland on regularly flooded alluvial clay depressions in the BBS and DRP - PCT ID 247	Woodland bird habitat, waterbird breeding and feeding habitat
Flood dependent forests	River Red Gum open forest of the DRP - PCT ID 36	Woodland bird habitat, waterbird breeding and feeding habitat
Flood dependent woodlands	Coolibah woodland - PCT ID 40, 39	Coolibah-black box EEC (TSC & EPBC Acts), waterbird breeding and feeding habitat, woodland bird habitat
	Black Box woodlands on floodplains of the NSW central and northern wheatbelt including the DRP - PCT ID 37	
Flood dependent woodlands – cultivated	Coolibah woodland - cultivated	Coolibah-black box EEC (TSC & EPBC Acts), woodland bird habitat
	Black Box woodland - cultivated	
Red solodic ridge communities (prior stream communities)	Belah woodland on alluvial plains in the central wheatbelt of NSW - PCT ID 55	Woodland bird habitat, waterbird breeding habitat
	Poplar Box/White Cypress/Budda/Wilga shrubby woodland on sandy loam soils mainly of the NW plains - PCT ID 98	Woodland bird habitat, prior stream, groundwater recharge
Red solodic ridge communities (prior stream communities) – cultivated	Poplar box –cultivated	Woodland bird habitat, prior stream, groundwater recharge
Sand monkey communities	Dirty Gum, White Cypress Pine tall woodland of alluvial sandy lenses (sand monkeys) mainly of the DRP - PCT ID 206	Carbeen woodland EEC (TSC Act), woodland bird habitat, groundwater recharge
Dryland floodplain communities	Weeping Myall open woodland of the DRP and BBS - PCT ID 27	Weeping Myall open woodland EEC (TSC & EPBC Acts), woodland bird habitat
	Native Millet / Cup Grass grassland of the DRP - PCT ID 214	Waterbird feeding habitat, grassland bird habitat
	Windmill grass – copperburr alluvial plains shrubby partly derived - PCT ID 49 & various	
Dryland floodplain communities - cultivated	Weeping Myall woodland – cultivated	Weeping Myall open woodland EEC (TSC & EPBC Acts)
Developed land	Cultivated land, cleared land, land developed for irrigation, irrigation water storage, rural infrastructure	When flooded provides limited feeding habitat for some waterbird species

EEC Endangered Ecological Community, BBS: Brigalow Belt South, DRP: Darling Riverine Plains, TSC Act NSW *Threatened Species Conservation Act 1995*, EPBC Act Australian Government *Environment Protection and Biodiversity Conservation Act 1999*.

2.3 Spatial analysis of environmental assets in relation to historic flooding frequency

The historic flooding frequency of the Gwydir Wetlands and floodplain was mapped by Thomas et al. (2010) as part of the NSW Wetland Recovery Program. The historic flooding frequency is described in terms of Average Return Interval (ARI) or the average time between flooding events (Table 2). For a full description of the historic flood mapping of the Gwydir see Thomas et al. (2010) and Thomas (2012).

Table 2: Historic inundation frequency ARI categories determined by Thomas et al. 2010) (Thomas 2012).

ARI	Description
0.5	flooded more than once per year
1	flooded once per year
3	flooded 1 in 3 years
5	flooded 1 in 5 years
10	flooded 1 in 10 years
15	flooded 1 in 15 years
999*	flooding not detected or outside the mapping area

*Note that the 999 category is assumed in this study to represent very infrequent flooding (more than 1 in 15 years ARI) if within the mapped area unless indicated otherwise.

Using ArcGIS 9.3 the 2008 vegetation map was overlain on the flooding frequency map and using Hawth's Analysis Tools (Zonal Statistics++ Tool) each polygon of the vegetation map was assigned a value for median ARI determined by the median value of the pixels of the (raster) flood frequency map that occurred within the polygon of the (vector) vegetation map. A new field in the digital vegetation community map was created named 'ARI_median'.

To simplify the flooding history information the seven ARI categories were combined into four descriptors for flooding regime (Table 3) and a new field in the digital vegetation community map was created named 'Flooding'.

Table 3: ARI categories grouped into flooding categories.

ARI	Flooding category
0.5	Flooded once a year or more
1	
3	Flooded every >1<10 years
5	
10	Flooded every 10 years
15	Flooded every 10+ years
999	

To identify the spatial distribution of the ecological assets in relation to water requirements the flooding categories and hydro-ecological functional groups were

combined to produce an asset code (Table 4). A new field in the digital vegetation community map was created named 'Asset_code'. Each vegetation polygon was assigned a score for the asset code (1 to 13) in this field.

This approach allowed vegetation polygons to be grouped by asset codes based on median ARI (flooding needs) and hydro-ecological functional group (the water requirements of the dominant species').

These asset codes were aligned to the criteria for ecological assets (Semi-permanent and floodplain wetlands, and Flood-dependent vegetation) identified in Chapter 4 of the draft Gwydir Scoping Study (Table 4).

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Table 4: Vegetation hydro-ecological functional groups (Bowen and Simpson 2009) grouped by flooding history (Thomas et al. 2010).

Functional Group	ARI	Asset Code	HFP Ecological Asset Type
Non-woody wetland vegetation	0.5 or 1	1	Semi permanent wetlands – very frequently flooded
Woody wetland vegetation	0.5 or 1	1	Floodplain wetlands – very frequently flooded
Developed land	0.5 or 1	1	Developed land in very frequently flooded areas
Flood dependent forest	0.5 or 1	1	Flood dependent vegetation – very frequently flooded
Flood dependent woodland	0.5 or 1	1	Flood dependent vegetation – very frequently flooded
Non-woody wetland vegetation	3	2	Semi permanent wetlands – frequently flooded
Woody wetland vegetation	3	2	Floodplain wetlands – frequently flooded
Flood dependent forest	3	2	Flood dependent vegetation – frequently flooded
Flood dependent woodland	3	2	Flood dependent vegetation – frequently flooded
Red solodic ridge communities (prior stream communities)	3	2	Floodplain vegetation – frequently flooded
Sand monkey communities	3	2	
Dryland floodplain communities	3	2	
Developed land	3	2	
Non-woody wetland vegetation	5	3	Semi permanent wetlands – frequently flooded
Woody wetland vegetation	5	3	Floodplain wetlands – frequently flooded
Flood dependent forests	5	3	Flood dependent vegetation – frequently flooded
Flood dependent woodland	5	3	Flood dependent vegetation – frequently flooded
Flood dependent woodland – cultivated	5	3	Floodplain vegetation – frequently flooded
Red solodic ridge vegetation (prior stream communities)	5	3	
Sand monkey vegetation	5	3	
Developed land	5	3	
Woody wetland vegetation	10	4	Floodplain wetlands – moderately frequently flooded
Flood dependent woodland	10	5	Flood dependent vegetation - moderately frequently flooded
Flood dependent woodland – cultivated	10	5	
Red solodic ridge communities (prior stream communities)	10	6	Floodplain vegetation - moderately frequently flooded
Red solodic ridge communities (prior stream communities) – cultivated	10	6	
Sand monkey communities	10	6	
Dryland floodplain communities	10	7	
Developed land	10	8	Developed land - moderately frequently flooded
Woody wetland vegetation	15	9	Floodplain wetlands – infrequently flooded
Flood dependent woodland	15	10	Flood dependent vegetation – infrequently flooded
Flood dependent woodland – cultivated	15	10	
Red solodic ridge communities (prior stream communities)	15	11	Floodplain vegetation – infrequently flooded
Red solodic ridge communities (prior stream communities) –cultivated	15	11	
Sand monkey communities	15	11	
Dryland floodplain communities	15	12	
Developed land	15	13	Developed land – infrequently flooded

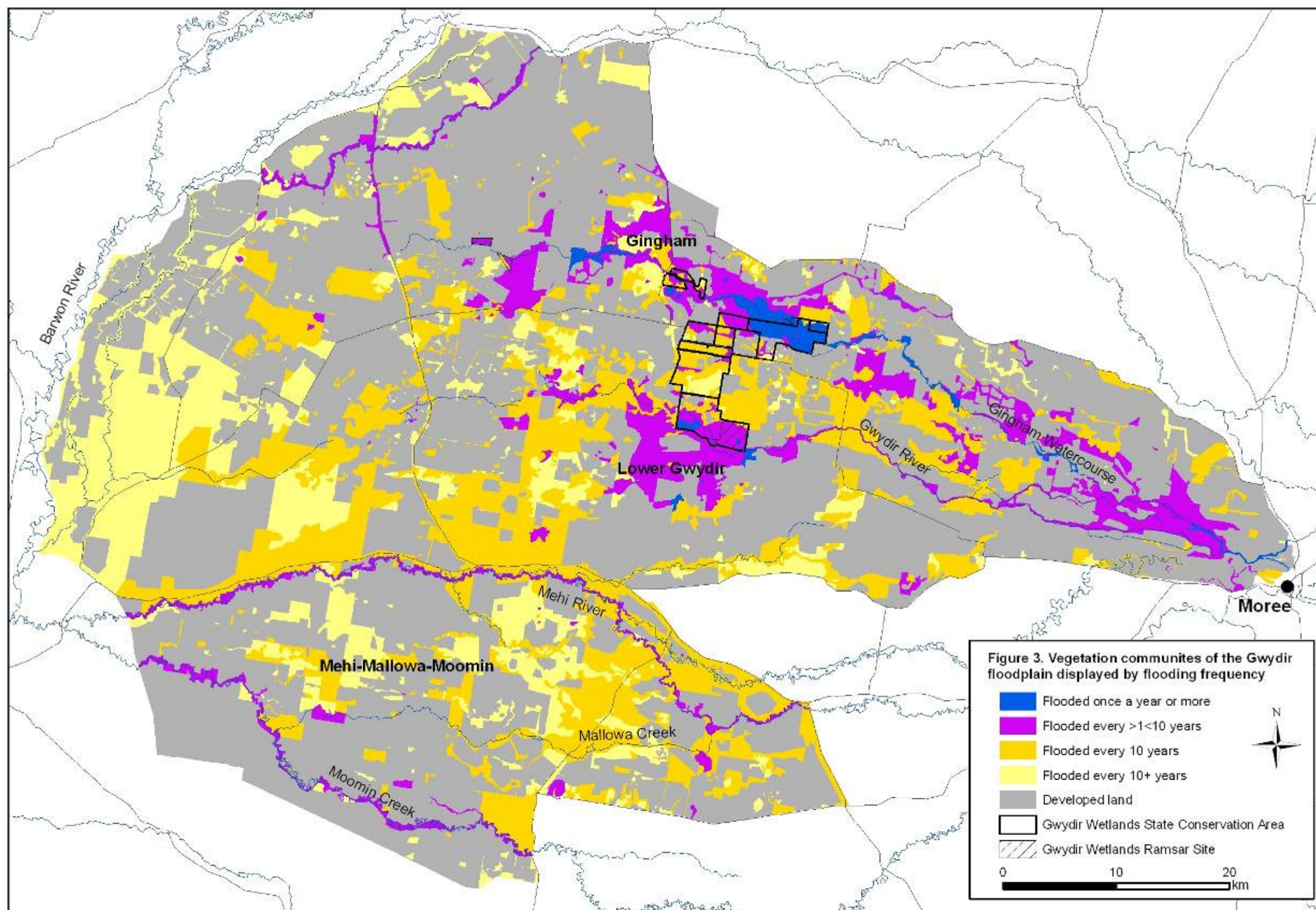
3 Results

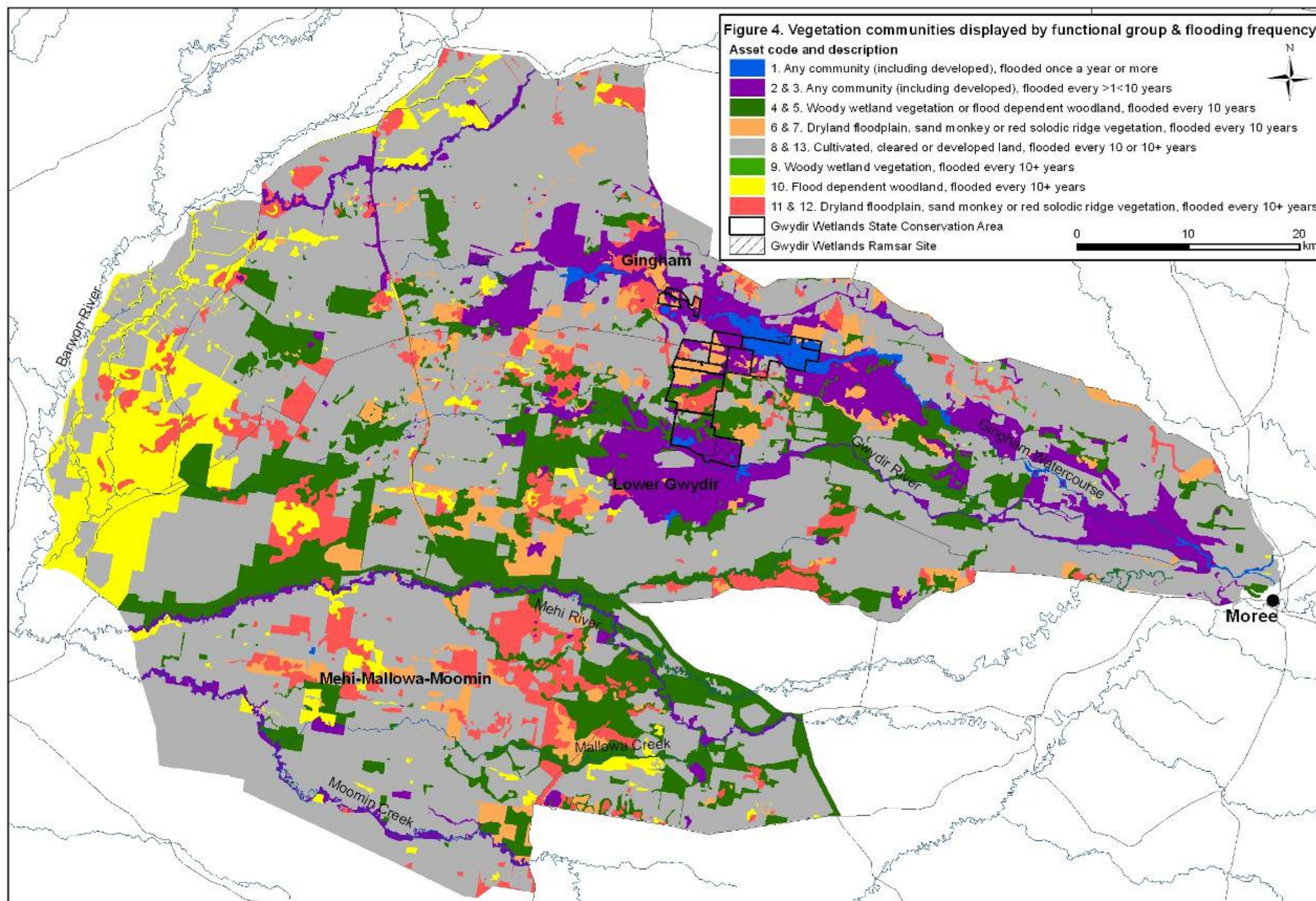
An annotated map using the polygons of the 2008 vegetation map of the Gwydir wetlands and floodplain has been produced by analysing the spatial delineation of vegetation community types from Bowen and Simpson (2009) with historical flood frequency mapped by Thomas et al. (2010) and using the average return intervals of flooding as defined by Thomas (2012).

The new fields added to the 2008 map (as described in the previous section) allow the map to be displayed in various ways. Figure 3 shows the areas of floodplain vegetation that are flooded at different frequencies and highlights areas of disconnected wetlands. Figure 4 displays the spatial distribution of the Healthy Floodplain Project ecological assets defined by asset codes based on the vegetation community type (hydro-ecological group) and the median frequency of flooding (ARI).

4 Conclusion

The annotated digital vegetation map represents a spatial delineation of ecological assets of the Gwydir Wetlands and floodplain to inform the Valley Wide Floodplain Management Plan for the Gwydir. The map relates to the lower Gwydir catchment specifically to semi-permanent, floodplain wetlands and flood dependent vegetation defined in the draft Gwydir Scoping Study.





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Appendix: Gwydir Wetlands and Floodplain 2008 Vegetation Map

