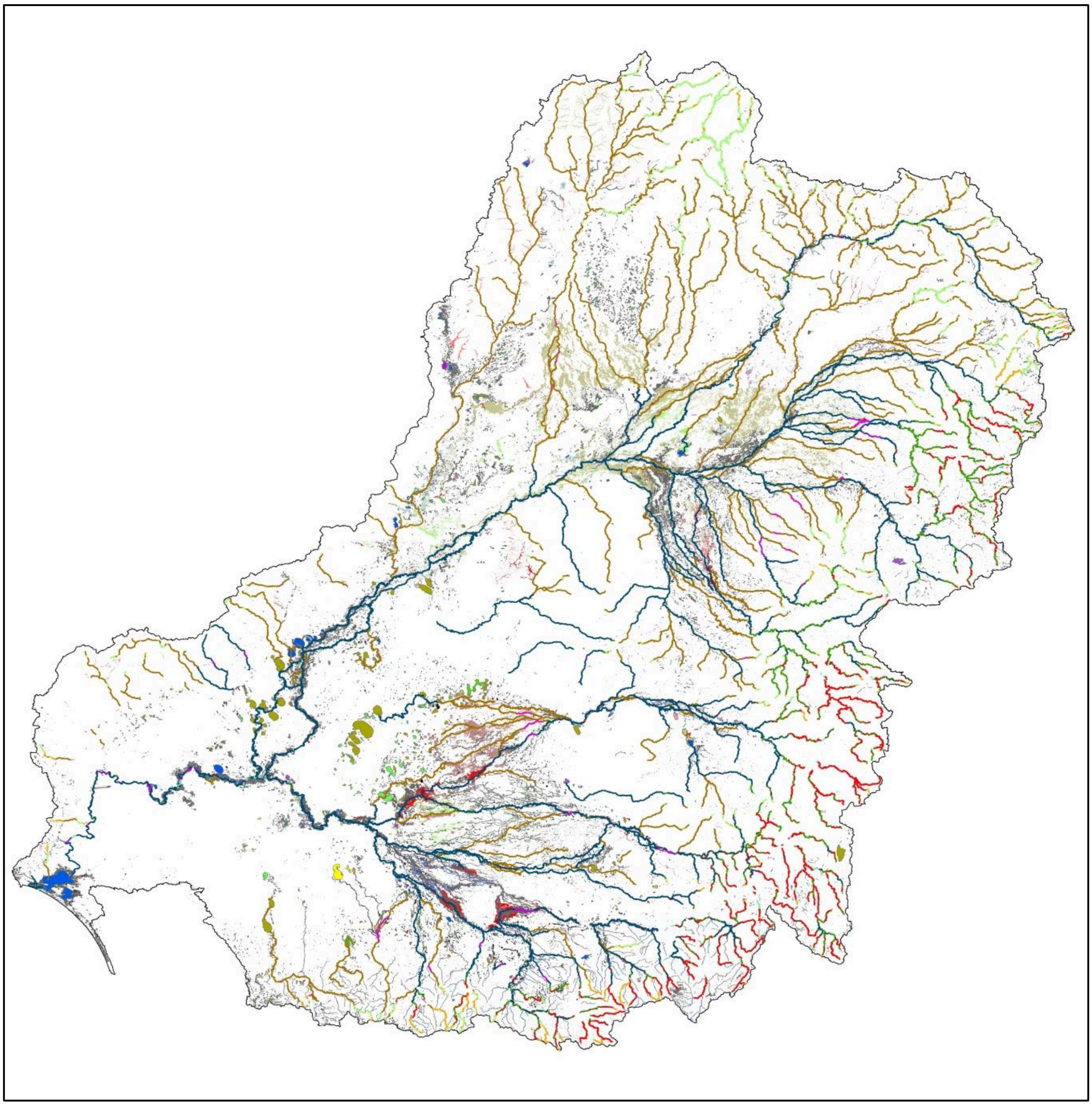
Australian National Aquatic Ecosystem (ANAE) Classification of the Murray-Darling Basin v3.0: User Guide

Commonwealth Environmental Water Office (CEWO)



Australian Government
Commonwealth Environmental Water Office

BROOKS.eco
ECOLOGY & TECHNOLOGY

Citation

Brooks, S. 2021. Australian National Aquatic Ecosystem (ANAE) Classification of the Murray-Darling Basin v3.0: User Guide. Commonwealth Environmental Water Office, Department of Agriculture, Water and the Environment, Australia.

Author Contact

For more information specific to the technical implementation of the ANAE classification of the Murray-Darling Basin data contact the author:

Dr Shane Brooks
Brooks Ecology and Technology
shane@brooks.eco
https:\\brooks.eco

Cover

ANAE mapping of the Murray-Darling Basin

Copyright

Disclaimer

The views and opinions expressed in this publication are those of the author and are presented for the purpose of improving information that can benefit the management of the Murray-Darling Basin's natural resources.

While reasonable efforts have been made to ensure the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication. The Australian National Aquatic Ecosystem (ANAE) Classification Framework is an area of active policy development. Accordingly there may be differences in the type of information contained in this report, to those using future versions of the ANAE.

This information does not create a policy position to be applied in statutory decision making. Further it does not provide assessment of any particular action within the meaning of the Environment Protection and Biodiversity Conservation Act 1999 or Water Act 2007, nor replace the role of the Minister or his delegate in making an informed decision on any action.

Contents

Abbreviations and acronyms

AETG	Aquatic Ecosystems Task Group
ANAE	Australian National Aquatic Ecosystem
AWRC	Australian Water Research Council (Catchment Boundaries)
CEWO	Commonwealth Environmental Water Office
DAWE	Department of Agriculture, Water and the Environment
DES	Department of Environment and Science, QLD
DIWA	Directory of Important Wetlands
DoEE	Australian Government Department of the Environment and Energy (now DAWE)
DELWP	Department of Environment, Land, Water and Planning, Vic.
DEW	Department of Environment and Water, S.A.
DPIE	Department of Planning, Industry and Environment, NSW
Geofabric	Australian Hydrological Geospatial Fabric
GIS	Geographic Information System
LiDAR	Light/Laser Detection and Ranging
LTIM	CEWO Long Term Intervention Monitoring Project
MDBA	Murray-Darling Basin Authority
MDB	Murray-Darling Basin
NCB	National Catchment Boundaries
NVIS	National Vegetation Information System
OEH	Office of Environment and Heritage, NSW (now DPIE)
WOfS	Water Observations from Space (http://www.ga.gov.au/scientific-topics/hazards/flood/wofs)

Introduction

The Australian National Aquatic Ecosystem (ANAE) classification framework was proposed by the Australian Government Aquatic Ecosystems Task Group (AETG) to facilitate consistent cross-jurisdictional adaptive management of aquatic ecosystems (Aquatic Ecosystems Task Group 2012). The framework is published as Module 2 of the Aquatic Ecosystems Toolkit, a set of nationally agreed "good practice" tools for mapping, classifying and assessing the condition of aquatic ecosystems. The framework guides the selection of attributes that are used to discriminate the different aquatic ecosystem types (Figure 1).

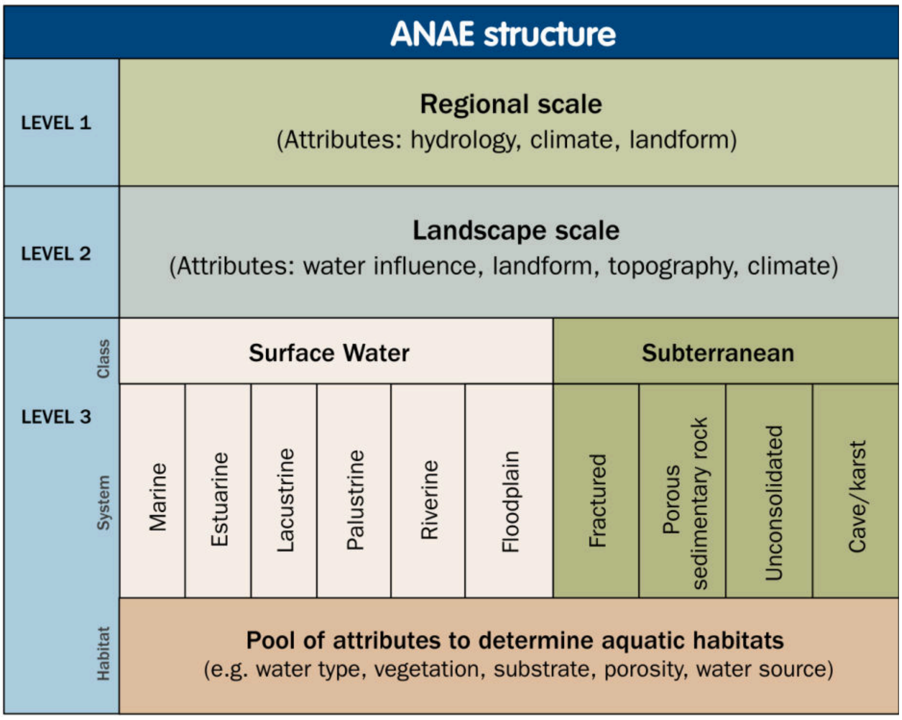


Figure 1. Structure and levels of the Interim Australian National Aquatic Ecosystem Classification Framework (Aquatic Ecosystems Task Group 2012).

The ANAE framework has been used to map and classify all of the aquatic ecosystems of the Murray-Darling Basin (MDB) (Brooks et al. 2014; Brooks 2017). The classification of the MDB integrates the best available mapping for the estuary and all upstream rivers, floodplains, wetlands and lakes sourced from the Basin States, Murray Darling Wetlands Working Group, and Australian Government National maps including the Australian Hydrological Geospatial Fabric (Geofabric, BOM 2020) and Digital Earth Australia. The integration is helped by the fact that jurisdictional wetland mapping and classification systems broadly follow the ANAE framework (QLD Environmental Protection Agency 2005; Jones and Miles 2009; DELWP 2016; Cowood et al. 2017). A full list of data sources is provided in Appendix 3.

Aquatic Ecosystems are grouped into broad ANAE ecosystem types based on the definitions provided in the source mapping layers, or using the framework definitions:

- Riverine ecosystems:
    - The river channel and associated streamside vegetation (riparian vegetation where that can be identified).
- Lacustrine ecosystems:
    - Lakes larger than 8 hectares, with emergent vegetation coverage less than 30%, or
    - Less than 8 hectares depth where the depth exceeds 2m or waver generated shorelines are present.
    - In practice many smaller lakes are included from state mapping.
- Palustrine ecosystems:
    - Wetlands of any size with greater than 30% emergent vegetation.
    - Wetlands less than 8 hectares can lack emergent vegetation, if no wave -formed or bedrock shoreline and depth is less than 2 metres
- Floodplain ecosystems:
    - Land subject to inundation from river channels supporting water dependent vegetation communities
- Estuarine ecosystems:
    - Areas influenced by ocean tides and salinity in the lower reaches of the Murray River mouth and Coorong

Each ecosystem type is then classified using different habitat attributes aligned to Level 3 of the ANAE framework (refer Figure 1). The attributes are populated from the source mapping data or from other state or national data layers such as the National Vegetation Information System (NVIS) and Water Observations from Space (WOfS). The classification is a simple rules based approach using the attributes to group the aquatic ecosystems into different "ANAE types" (e.g. Figure 2 as an example of the ANAE Lake typology).

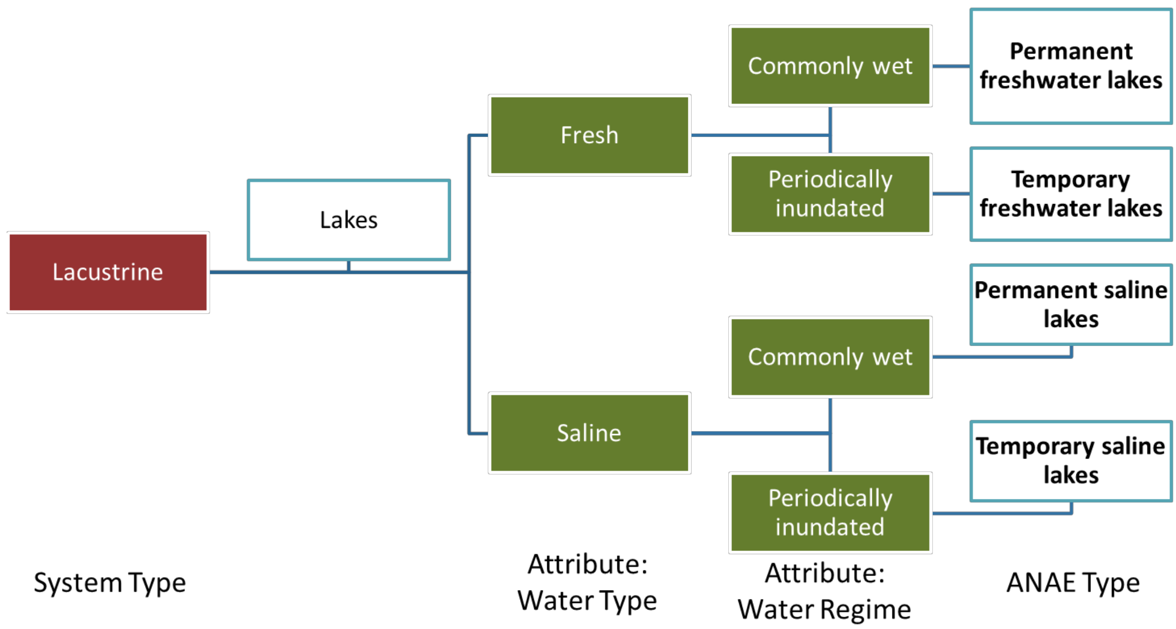


Figure 2. The ANAE classification framework is a simple rules based approach using attribute values to classify ecosystems into ANAE types.

The full typology is included in Appendix 1. For the MDB ANAE the main attributes used to distinguish ecosystem types are:

Water Type (used for Lakes and Wetlands)

- Fresh water (<3000mg/l)
- Saline water(>3000mg/l)
- Salinity of individual wetlands is typically unknown and is assigned by default to fresh unless there is some other evidence to suggest otherwise (e.g. the site is named as a salt lake, or the dominant vegetation is saltmarsh)

Water Regime (used for Lakes, Wetlands, Floodplains, Rivers)

- Commonly wet (water present 80% or more of the time)
- Periodically inundated (water present less than 80% of the time) including intermittently flooded depressions and floodplains.

Dominant Vegetation (used for Lakes, Wetlands, Floodplains)

- Aquatic grass/sedge/forb
- Black box
- Bogs and fens
- Chenopod
- Coolabah
- Freshwater Grasses / forbs
- Lignum
- Other aquatic tree
- Paperbark
- River cooba
- River red gum
- Saltmarsh
- Seagrass
- Tall emergent aquatic
- Wetland polygons are assigned to the dominant vegetation type by area (i.e. majority rule) without editing the wetland boundaries. Large floodplains are segmented into the different community types.
- Floodplains types distinguish between sparse woodlands and dense forests

Landform (used for the rivers and streams)

- Lowland (channel segment slope < 0.5% and altitude < 300m)
- Transitional (channel segment slope < 6%, altitude < 500m (and not lowland)
- Low Energy Upland (channel segment slope < 0.5% and Altitude > 500m)
- High Energy Upland (channel segment slope >= 6% or (slope > 0.5% and altitude > 500m)
- The estuary adopts attributes from the primary mapping source (Seaman 2003).Water influence (tidal or wave dominated)
- Depth (supratidal, intertidal, subtidal)
- Substrate (silt, sand, rock)
- Structural macrophytes (saltmarsh, trees)

The rationale for selecting these attributes and their thresholds is explained in more detail in Brooks et al. (2014). It is inevitable that limitations, mapping inaccuracies and attribution errors from source data sets will also be transferred into the ANAE data set. Some of the attribution errors are corrected by using multiple data sources to determine the values (for example the water regime is derived from multiple data sets (Geofabric, state mapping and Water Observations from Space with additional on-ground monitoring and mapping contributions from data set users and government monitoring and evaluation programs. The overarching principle is to use the best available data, and the mapping is therefore a mix

Release History

There have been three releases of the ANAE classification of the MDB to date (Figure 3):

1. The Interim classification of the MDB report and GIS data set brought together the state jurisdiction mapping and attributes and developed the classification typology. This initial data set was published as version 1.6 (Cottingham et al. 2012; Brooks et al. 2014).
2. Version 2, completed in 2017, greatly improved the mapping of aquatic ecosystems in eastern NSW and improved the attribution of vegetation on floodplains and riparian systems along rivers throughout the Basin. This was a substantial revision designed to improve the accuracy and currency of aquatic ecosystem mapping and to integrate all ecosystem types into a single aquatic ecosystem map for the Basin (Brooks 2017). Vegetation in Western NSW remained as a data gap in this version because the State mapping was undergoing revision at the time version 2 was released.
3. Version 3 (Brooks 2020) completes the mapping of western NSW and updates the river line mapping to align with the recently released Australian Geofabric v3. The Riverina, Lachlan and Border Rivers areas of NSW were also revised to match current NSW state vegetation maps. Floodplain mapping was cleaned up to remove very small mapping fragments < 1 ha (mostly artefacts of data processing) and to merge adjacent mapping polygons that share the same attributes and ANAE type. The version 3 release completes the Basin-wide coverage of the ANAE data set.

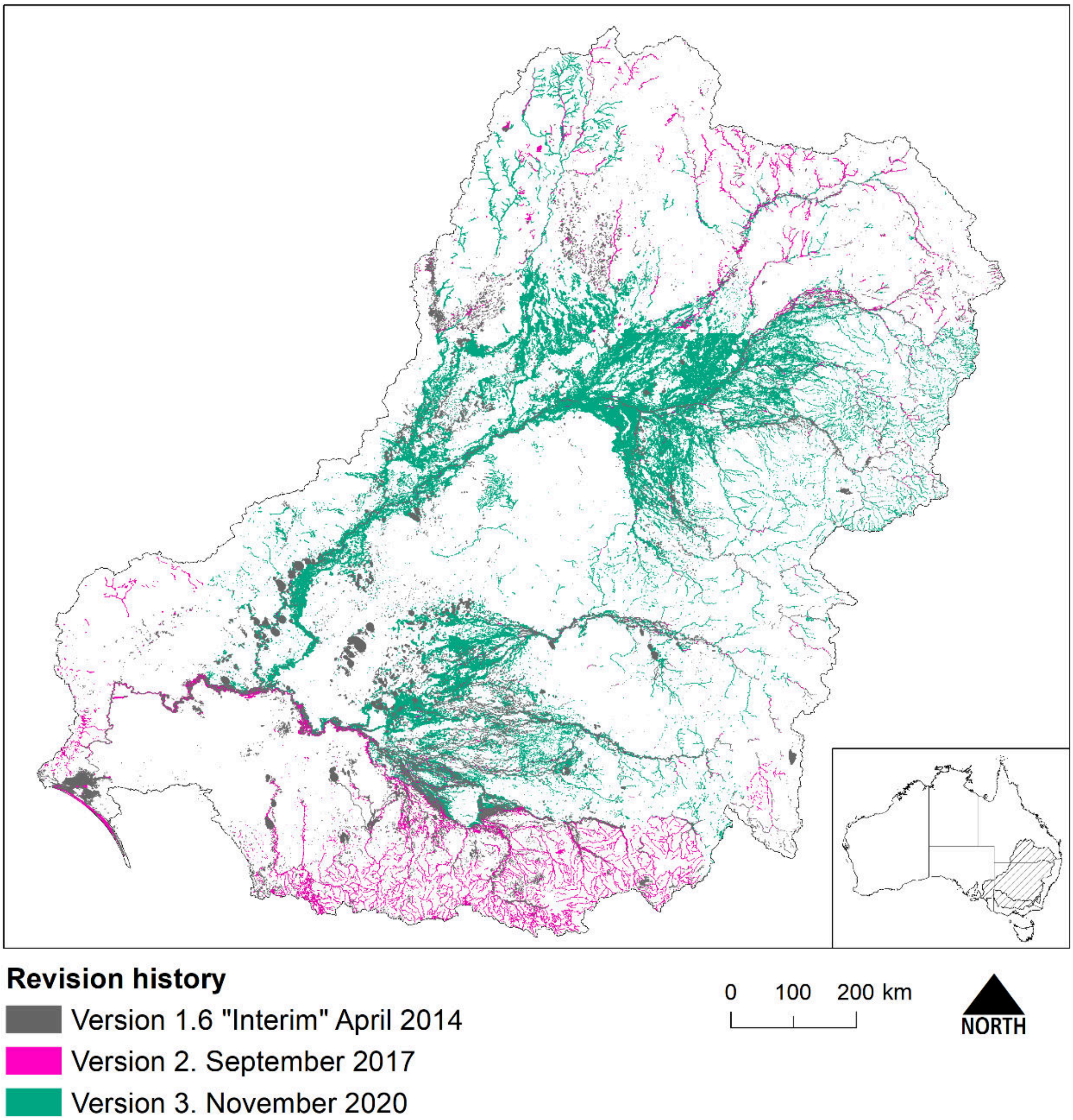


Figure 3. Revision history for the ANAE mapping in the Basin.

The ANAE Murray-Darling Basin data set

The ANAE of the MDB data set is available under a creative-commons license. The mapping layers can be downloaded as GIS shapefiles from https://data.gov.au. These published data sets contain the complete aquatic ecosystem mapping, the ANAE Level 3 attributes (Figure 1) and the classified ANAE ecosystem type.

A larger ESRI file geodatabase is also available. It includes additional base maps, catchment boundaries and MDB subsets of national data sets that represent the ANAE level 1 and 2 attributes.

GIS Shapefiles

Two shapefiles are the primary MDB ANAE spatial data products:

1. Wetlands_ANAE (Figure 4)
   A single map of aquatic ecosystem boundaries (mapped as polygons in GIS) for:
   a. Estuarine ecosystems
   b. Lacustrine ecosystems (lakes)
   c. Palustrine ecosystems (wetlands)
   d. Riverine ecosystems –The polygon mapping includes the large river channels, and smaller waterways where river width has been mapped but does not include every waterway. The complete ANAE river network is mapped using lines (not polygons) and the ANAE uses the Australian Geofabric v3 line mapping (below).
   e. Floodplainss.
2. Waterways_ANAE _Geofabric3 (Figure 5)
   One-dimensional line mapping of river channels (riverine ecosystem type) from the Geofabric v3.2 (BOM 2020) attributed and classified to ANAE type. This data set provides consistent high resolution river line mapping with a nominal positional accuracy of 30m.

Previous versions of the MDB ANAE data set included lower resolution river line mapping from the Geofabric v2.1.1 (BOM 2014). This older ANAE data set "Waterways_ANAE _Geofabric2" is also available and is retained because the river line mapping can be linked to the National Environmental Stream Attributes data set (Stein et al. 2012) providing a wealth of complementary data to describe catchment topography, land use and flow characteristics. These data are not yet available for the Geofabric v3.2.

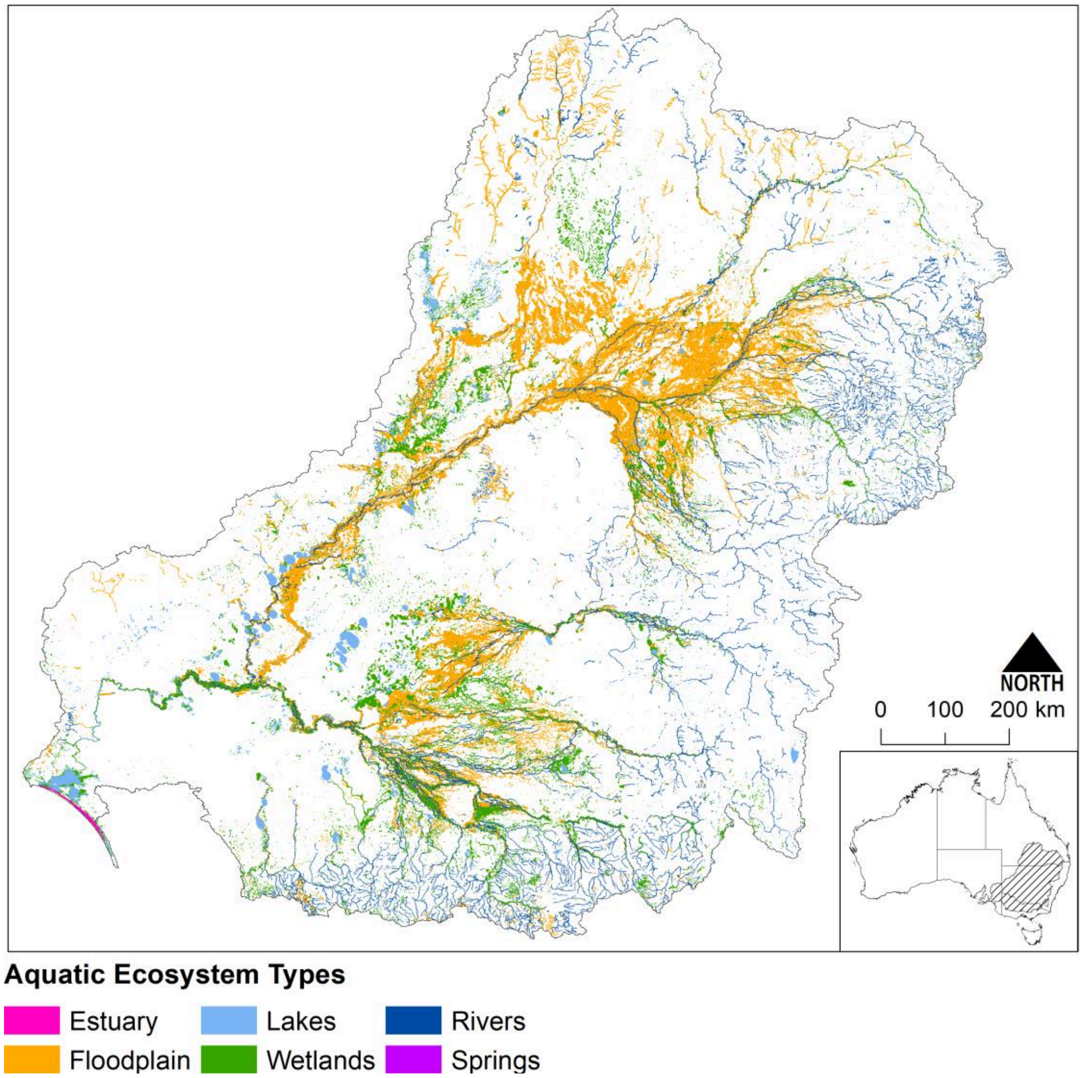


Figure 4. Aquatic ecosystem mapping in the ANAE classification of the Murray–Darling Basin (2020).

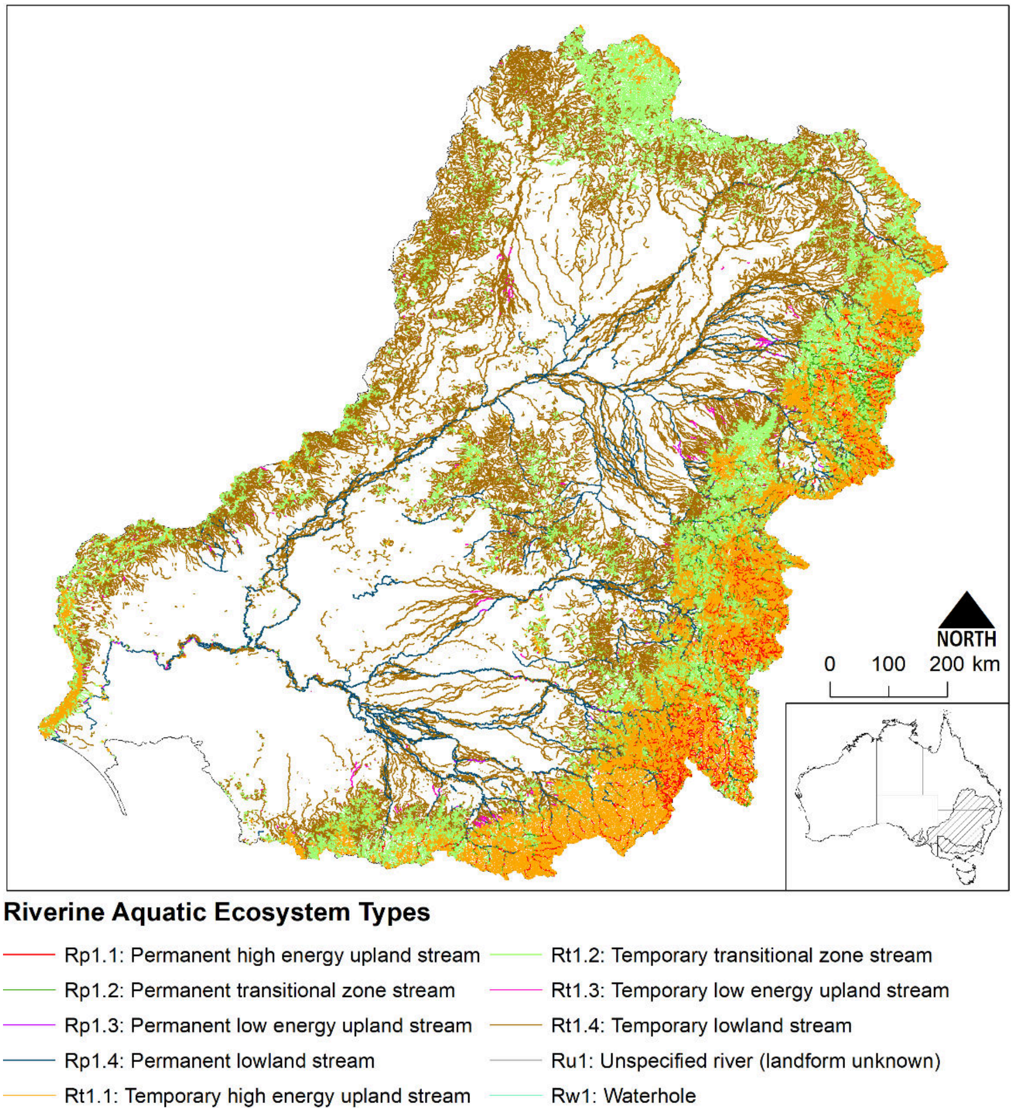


Figure 5. River line mapping in the ANAE classification of the Murray–Darling Basin (2020).

Each shapefile is packaged with metadata and ESRI ArcGIS "layer files" that define a default symbology to display the relevant ANAE classes in each system type category (Figure 6).

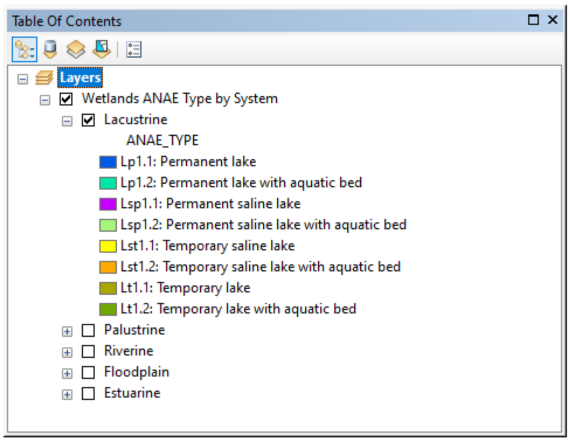


Figure 6. GIS symbology loaded from a Layer definition file categorises the many ANAE ecosystem types by the System Type (Estuarine, Lacustrine, Palustrine, Riverine, Floodplains).

The ANAE Geodatabase

The complete ANAE classification of the Murray-Darling basin data set is an ArcGIS File Geodatabase that is made available under a Creative Commons license on request from (AWE contact point required here). The structure of the geodatabase is mapped out in detail in Appendix 2.

The Geodatabase contains the same feature mapping for wetland polygons and river lines represented in the shapefiles as Geodatabase feature classes:

- Wetlands_ANAE
- Waterways_ANAE _Geofabric3

Additional data layers include:

- Waterways_ANAE _Geofabric2 – the previous version of river line mapping that can be linked to the Geofabric Environmental Stream Attributes data set (not yet available for the Geofabric v2 version).
- National data layers that describe relevant ANAE Level 1 (Regional) and Level 2 (Landscape) attributes (e.g. Figure 7). These are clipped to the Basin but otherwise unmodified from the source data. They are not used in the classification of ecosystem types but are consistent with the ANAE framework structure (Figure 1) defining large scale landscape gradients relevant to aquatic ecosystems.
- Base mapping features (basin boundary, state boundaries, major towns and roads) used for presentation of maps.
- Catchment Boundaries including Geofabric National Catchment Boundaries (NCB), Australian Water Research Council (Catchment Boundaries), and Valley boundaries used in the CEWO Long Term Intervention Monitoring (LTIM) Project (2014-2019) and Flow-MER Project (2019-2021).
- An "Artificial" feature class, mapping more than 780,000 farm dams, ring tanks and municipal water supply reservoirs (Figure 8). This is a collection of jurisdiction data that when viewed together provides a comprehensive view of water storages in the basin.
- ESRI ArcGIS layer files that contain the symbology for displaying the ANAE classes in each system type in ArcGIS.
- ANAE Level 3 Attribute value tables that provide a reference to the source data sets used to obtain attribute values (e.g. water regime, land form, vegetation) for each mapped aquatic ecosystem feature. The attribute tables provide the identifiers to trace back to the source information as well as a simple assignment of "confidence" in how well that source data represents the attribute. They are the means by which multiple lines of evidence can be used to attribute the mapped features. ArcGIS Relationship classes link the attribute tables to the main feature class mapping.

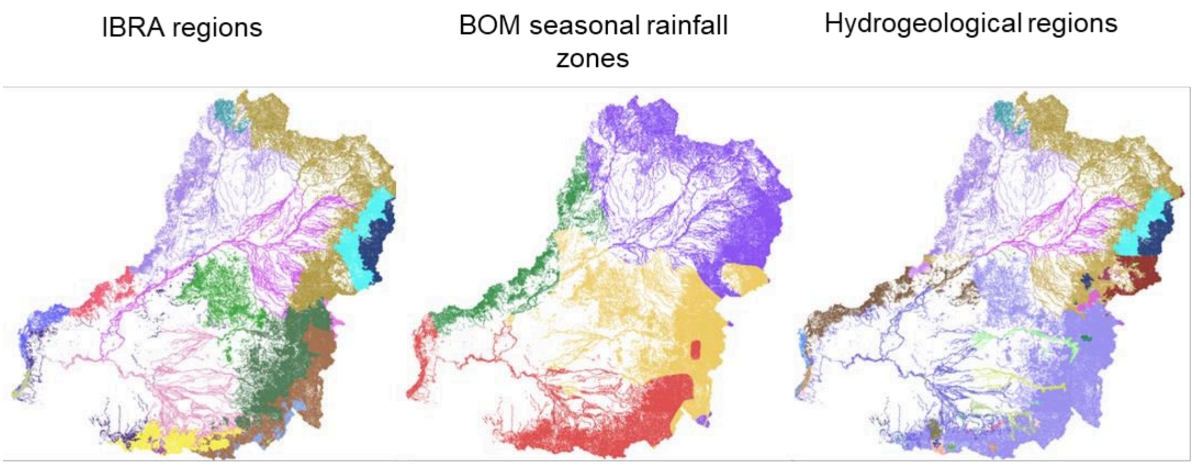


Figure 7. Examples of ANAE Level 1 and Level 2 attributes mapped using national data layers that describe large scale physical and environmental gradients relevant to aquatic ecosystems

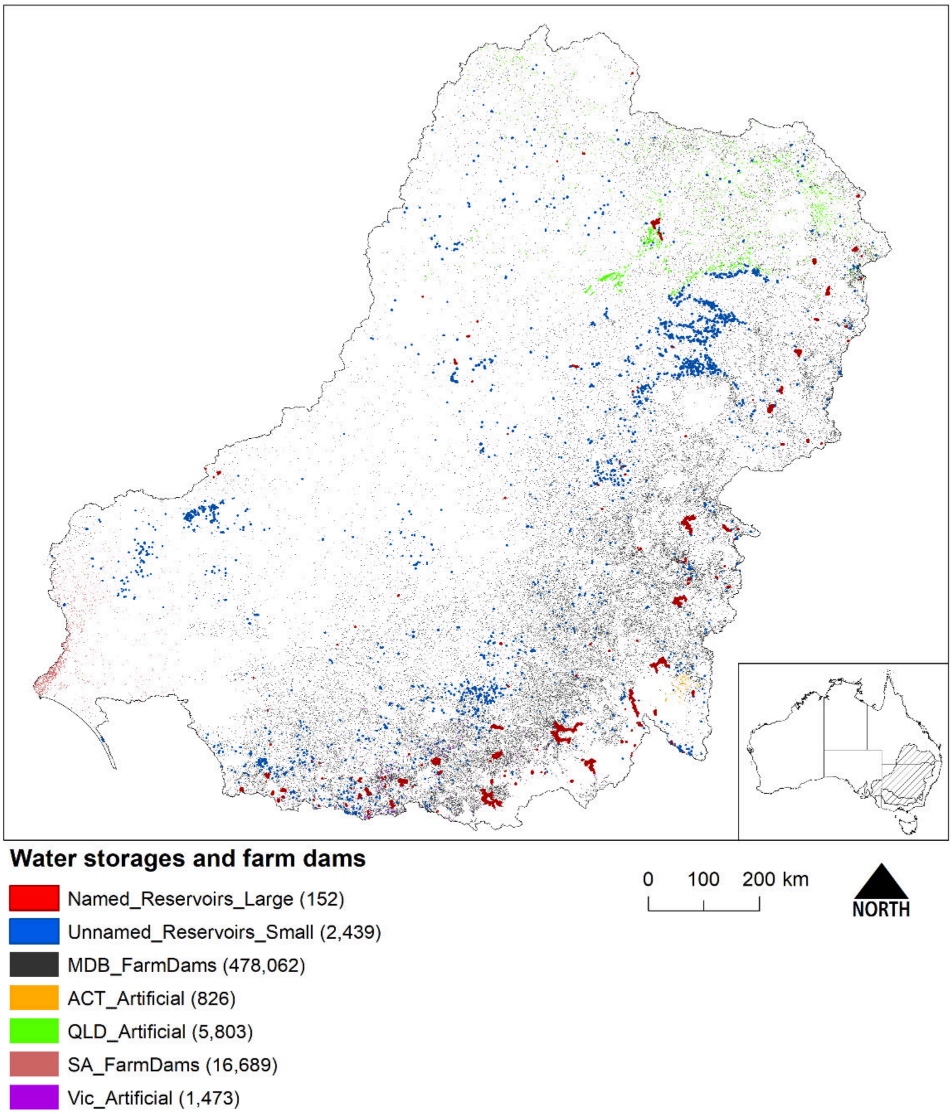


Figure 8. Water storages and farm dams mapped as polygons in the ANAE geodatabase "artificial" feature class (constructed Aquatic Ecosystems). Numbers in parentheses are the count for each data set. An additional 277,000 small dams mapped as point locations were not included in the map.

Concepts and limitations

1. The number of mapped features is a poor representation of the number of aquatic ecosystems

The ANAE data set mapping integrates jurisdiction and national wetlands mapping and the level of detail varies both within and between data sets. Some simple wetlands will be mapped as a single polygon (e.g. lakes with a simple basin bathymetry), while others are mapped as large aggregations of many adjacent polygons with different ANAE types. These aggregations of ANAE types may be many adjacent wetlands in a wetland “complex”, or they may be multiple “habitat patches” within a single wetland. All jurisdiction data sets contain a mix of these two examples. The level of detail in wetland mapping also has changed though time as jurisdiction wetland mapping is updated (e.g. Figure 9).

A third category is very large river features mapped as polygons in the wetlands layer have been artificially divided into smaller sub-units in the ANAE classification. For example the Murray River channel is divided into hundreds of Geofabric “segments” to allow each segment to be classified separately as the river transitions from upland to lowland. The river line mapping represents rivers as the many short sections between tributary junctions.

A count of mapped features is therefore a poor indicator of the number of ecosystems. One approach to quantifying the ANAE types is to aggregate the area of wetland or floodplain, or the river length represented by each ANAE type within an area of interest.

Figure 9. Lake Buloke in Victoria. Example of reduced internal detail in the Victorian *Wetlands_Current* data set compared to earlier mapping used for the interim ANAE classification. The internal line work was removed from wetlands where the spatial arrangement of vegetation was highly variable in response to seasonal water levels (J. Holmes, DELWP pers. comm. 2017).

2. The Wetlands_ANAE polygon mapping contains only a small fraction of riverine ecosystems in the Basin

The Wetlands_ANAE data set attempts to integrate mapping for all aquatic ecosystem types into a single polygon layer for the Basin. The mapping of estuarine areas, lakes and wetlands is as comprehensive as possible integrating state and national data in a single mapping layer. River networks, however, have historically been mapped as one-dimensional lines with only the larger sections mapped in two dimensions as polygons. These larger "watercourse areas" are typically parts of rivers that are wide enough to be mapped from satellite imagery (e.g. wider than a 30 m Landsat satellite pixel). Some higher resolution river mapping is included for Victoria for a subset of rivers across the state that were mapped using high resolution LiDAR, and for channels along the Murray River that were mapped by on-ground surveys by the Murray Darling Wetlands Working Group. Some additional riverine areas are also included where they were mapped as polygons in jurisdiction wetland mapping layers.

To represent the full river network in the Basin, the ANAE data set includes a separate river line data set that attributes and classifies the Australian Geofabric river lines (refer Figure 5). This provides a comprehensive and spatially consistent line map for the Basin that is compatible with the national water information data managed by the BOM.

3. ANAE floodplain ecosystem mapping is limited to the water-dependent ecosystem types

The ANAE classification uses the distribution of long lived water-dependent vegetation (e.g. river red gum forests, black box woodlands, river cooba and coolabah woodlands and lignum scrub) as a proxy to help identify the extent of water-dependent floodplain ecosystems. This is done because floodplain mapping and inundation modelling is not yet sufficient to consistently map the entire floodplain extents for the whole Basin (discussed in detail by Brooks et al. 2014; Brooks 2017) and because representing terrestrial ecosystems is not the objective of the ANAE.

The ANAE classification does <u>not</u> include all the terrestrial ecosystems including urban areas, agricultural land, or native vegetation communities that are not water dependent but are also found on river floodplains. The floodplain areas mapped in the ANAE data set therefore does not represent the total floodplain area. It is the portion of the floodplain that supports remnant water dependent vegetation communities. This is an important consideration when evaluating the impacts and outcomes of overbank flows associated with floods and environmental water management as there may be additional outcomes from inundation of floodplains (e.g. replenishing soil moisture and nutrients) that benefit terrestrial ecosystems that can not be quantified using the ANAE classification data set.

4. Unique identifiers for mapped features

The MDB ANAE data set includes three identifiers that uniquely identify individual mapped ecosystems: SYSID, UID, and SegmentNo.

SYSID A unique integer identifier assigned to each mapped polygon feature. A new SYSID is assigned whenever a feature is added or updated. The allocation of SYSID is arbitrary and new identifiers are assigned by incrementing the current highest value..

UID New in version 3, each mapped polygon is assigned a 9 character UID (UniqueID) that is a 9 character Geohash. The Geohash is an open source algorithm that efficiently encodes the latitude and longitude of the polygon centroid. For example:

Table 1. Example UID geohash locations for four ANAE polygons

UID (geohash)	Coordinates	Location
r1dyq4xpv	-35.448782, 139.140708	Lake Alexandrina
r4m0nb23v	-32.342055, 142.328460	Lake Menindee
r1yegkcd8	-34.470527, 144.285529	Murrumbidgee River at Maude Weir
r1ye3quqh	-34.546831, 144.201586	Eulimbah Swamp Lowbidgee

Geohash has the advantage over the arbitrary SYSID in that it is derived from the geometry of the polygon. If the polygon boundary is edited, the calculated geohash will change. The geohash UID can also be decoded to the latitude and longitude coordinates that precisely locate the position of the feature in the Basin if the data is used outside of GIS. Sites that are close together will have matching prefixes (e.g. Murrumbidgee River and Eulimbah Swamp in Table 1 are 12km apart and the share the r1ye prefix). Libraries for encoding and decoding geohash are freely available for Python, R and other languages and there are website calculators for encoding and decoding geohash. Geohash identifiers are increasingly being used in Australian spatial data sets (e.g. in the Digital Earth Australia DEA_Waterbodies).

The ANAE UID encodes the latitude and longitude of the centroid "inside or touching" the feature to ensure the coordinates are unique to each feature. Note that ArcGIS PolygonGeometry.centroid.X and PolygonGeometry.centroid.Y variables locate the true centroid if that is within or on the feature, or the GIS label point if the true centroid lies outside of the feature. Different software platforms may vary in the definition of the centroid.

SegmentNo A unique integer identifier for each river line segment in the Geofabric surface hydrology network mapping used by the ANAE. The SegmentNo can be used to link the river line mapping to Geofabric catchments. The Geofabric v2 mapping can also use the SegmentNo to link to the National Environmental Stream Attributes data set providing a wealth of metrics for the river channel and catchment (Stein et al. 2012). There is currently no equivalent stream attributes data set for the Geofabric v3.2. Large river features mapped as polygons have been intersected with the Geofabric v2 catchment boundaries to break them into smaller catchment subunits with associated SegmentNo for joining to the Geofabric or National Environmental Stream Attributes.

Using the ANAE data set

1. Extracting a subset for an area of interest.

The ANAE Basin data set maps 278,000 polygon features and over 200,000 river line segments to high spatial resolution. Mapping and spatial analysis using the complete data set requires considerable computing power. Exporting a smaller area of interest is a common first step to reduce the volume of data and improve performance.

The mapping layers in the data set are already in a stand-alone configuration with all ANAE attributes, classified ANAE type and calculated area included in the attribute table structure (refer Appendix 2 : Table Structure).

Geodatabase Users Note: The ANAE Geodatabase uses domain tables to efficiently store repeated information in coded lookup tables (domains). By default, the domain lookup tables are also transferred when exporting data from a geodatabase to geodatabase. They are NOT transferred by default when exporting from geodatabase to shapefile. The resulting shapefile will contain the codes, but not the long form description and this can make the data hard to interpret. To export the coded values in ESRI ARcGIS you change the Environment setting for Fields to "**Transfer field domain descriptions**" prior to exporting the shapefile.

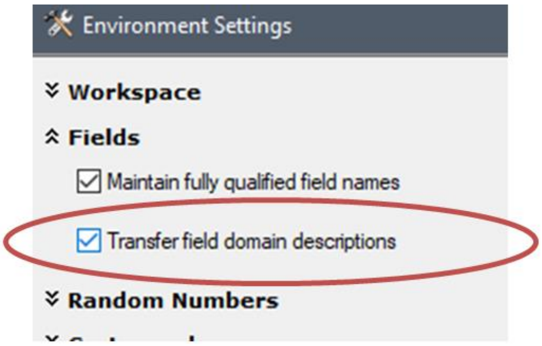


Figure 10. The environment setting to Transfer field domain descriptions should be checked before exporting ANAE data from the Geodatabase to a shapefile to preserve the coded domain values in the shapefile.

Exporting data from the shapefile or geodatabase:

1) The Area of Interest can be selected in GIS a number of ways:
    - Manually
    - By Intersection with another feature. The Geodatabase includes mapping for the National Catchment Boundaries, AWRAC catchment s and LTIM Valleys
    - A select query using attributes values.
2) Export the data to a shapefile or new geodatabase.

2. Summarising the Ecosystem Types in an area of interest.

As discussed above, the number of mapped features is a poor representation of the number of aquatic ecosystems so the different aquatic ecosystem types are often summarised by summing the area of each type within one or more areas of interest such as river catchment or management area.

The default ANAE layer symbology (Wetlands ANAE Type by System) creates 5 separate layers in the Table of Contents of the GIS, one for each system type (using a definition query to isolate each aquatic system type). To statistically summarise across all types you must first add the complete ANAE feature data set as a single layer (Figure 11).

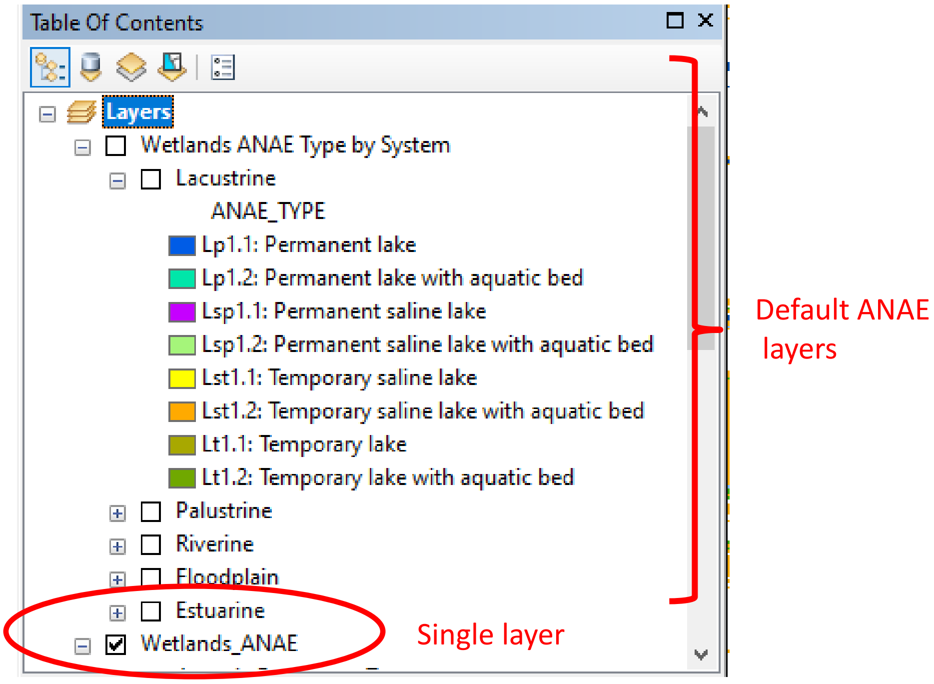


Figure 11. The default symbology from the ANAE layer files separates each system type. Load a single layer to characterise all system types

The ANAE data includes the area in hectares for each ecosystem polygon (Field name = Area_Ha) and length in km for river lines (field name = LengthKm) both calculated using an Albers Equal Area projection.

The data tables also include relevant sorting fields for System Type (estuarine, lacustrine, palustrine, riverine, floodplain).

Summing areas is made simple in GIS (e.g. ESRI ArcGIS Summary Statistics tool Figure 12) but can also be done in other languages that have spatial libraries (e.g. R, Python). Grouping variables can also be used to partition the summary statistics.

A trap for the unwary: It is common practice in GIS to intersect two data layers to analyse the overlapping area or to clip the ANAE layer to another boundary. The area field (AreaHa) will not update automatically and will need to be manually recalculated. This can be done in ArcGIS using the Calculate Geometry tool. The ANAE uses the Albers Equal Area Projection.

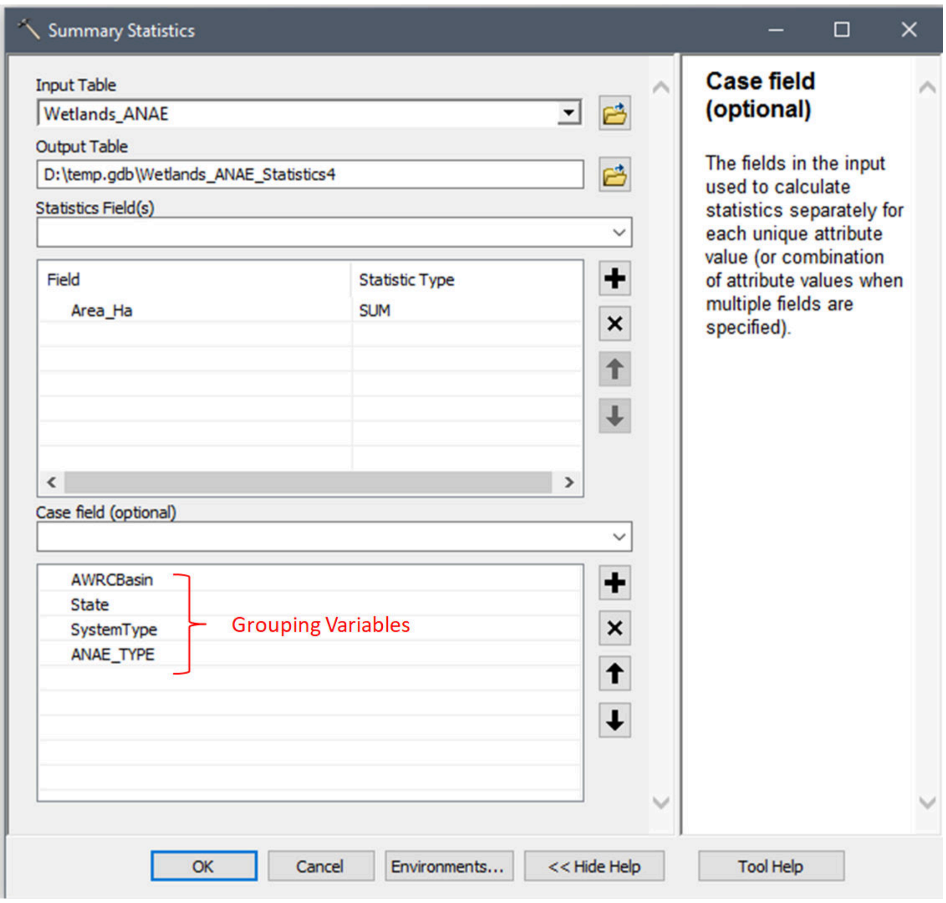


Figure 12. Using the ArcGIS summary statistics tool to calculate the sum area in hectares, grouped by SystemType and ANAE_TYPE

Table

Wetlands_ANAE_Statistics

OBJECTID *	SystemType	ANAE_TYPE	FREQUENCY	SUM_Area_Ha
30	Lacustrine	Lp1.1: Permanent lake	82	1331.247448
31	Lacustrine	Lt1.1: Temporary lake	106	18179.076488
36	Palustrine	Pp2.1.2: Permanent tall emergent marsh	1	17.323252
37	Palustrine	Pp2.3.2: Permanent grass marsh	2	35.707004
38	Palustrine	Pp2.4.2: Permanent forb marsh	3	9.776938
39	Palustrine	Pp3: Peat bog or fen marsh	219	1525.11977
40	Palustrine	Pp3: Permanent wetland	3	1.414327
41	Palustrine	Pp3: Temporary wetland	11	166.627489
42	Palustrine	Pp3: Temporary woodland swamp	8	55.06872
43	Palustrine	Pp4.2: Peat bog or fen marsh	7	5.397495
44	Palustrine	Pp4.2: Permanent sedge/grass/forb marsh	11	17.349966

Figure 13. Resulting summary statistics table

3. Tracing mapped features and attributes back to the source data sets

Mapped Features

The wetlands_ANAE data set contains the fields that link the wetland feature mapping back to the source data set. The source identifier is stored in a text field or a number field enabling a database join to be made between the wetlands_ANAE data set and the source mapping data set using GIS or other database aware software (e.g. MS Access, R).

Field names linking to source are:

Field Name	Purpose
SrcDataID	Name of the source data set. Full citations for all data sources are tabulated in Appendix 3.
SrcField	The name of the data field in the source data set that uniquely identifies the feature
SrcID	The value of the unique identifier for this specific feature stored as text
SrcIDNum	The value of the unique identifier for this specific feature stored as a number (only where the identifier is a number)

For example: The attribute table for the Wetlands_ANAE data set includes a reference to the line mapping for the boundary of Lake Menindee as:

Table

Wetlands_ANAE

OBJECTID *	Shape *	SYSID *	Name	SystemType	SrcID	SrcIDNum	SrcField	SrcDataID
157167	Polygon	7979	LAKE MENINDEE	Lacustrine	505662517	505662517	TOPOID	NSW Topography HydroArea

SrcDataID = The NSW Topography HydroAreas data set (NSW LPI 2013)

SrcField = TOPOID

SrcID = 505662517

Attribute Data

Tracing individual attributes back to source data requires the attribute tables in the Geodatabase.

The full ANAE Geodatabase includes similar fields in the Level3 Attribute tables to identify the source data that was used to determine the various ANAE attribute values.

For example: The row of data in the L3_WaterRegime_Wetlands table that houses the attribute determination for Lake Menindee using two separate data sources to increase confidence in the assignment (two lines of evidence)

t	Src1DataValue	Src1DataField	Src1ID	Src1Field	Src1DataID	Src2DataValu	Src2DataField	Src2ID	Src2Field	Src2DataID	WaterRegime
	1	PERENNIALITY	505662517	TOPOID	NSW Topography Hydro	241	WOfS	<Null>	<Null>	Water Observations from Space 1	Commonly wet

Src1DataID = NSW Topography HydroAreas data set (NSW LPI 2013)
Src1DataField = PERENNIALITY
Src1ID = 505662517
Src1DataValue = 1 (permanent)

And:

Src2DataID = Water Observations from Space 1987-2014
Src2DataField = WOfS
Src2ID = N/A
Src2DataValue = 241 (clear observations wet)

These two lines of evidence resulted in Lake Menindee having the attribute Water Regime = “Commonly wet” with high confidence (discussed below).

4. Mapping and classification quality: Tracking confidence

Simple confidence ratings are assigned to each mapped polygon, and for each attribute following the logic developed for the interim classification:

3 = high confidence,
2 = medium confidence
1 = low confidence

The rating is subjective but attempts to take into account factors such as data gaps, accuracy, resolution, currency, obvious errors and assumptions. The logic rules used to assign confidence are documented to enable the logic of assignment to be changed as required (e.g. to consider additional evidence in making assignments) (Appendix 4). An identifier (ConfID) is coded with each assignment of confidence to identify the defining logic rule set.

In cases where there are no data available to define attribute values, an assignment is assumed to a nominal attribute value and by default the confidence is set to low. For example, in the absence of any hydrological information, the Water Type attribute is assumed to be "Fresh" and the Water Source is assumed to be "Surface water". In each case confidence in the attribute value will be assigned 1 (=low).

Multiple lines of evidence are used wherever possible to elevate confidence. If two or more independent data sets are in agreement this might either add 1 to the existing confidence score or elevate confidence to 3 (=high).

The confidence scores can be displayed as a heat map (Figure 14). The Geodatabase is distributed with ArcGIS layer symbology to display the confidence scores (Wetlands confidence halos.lyr).

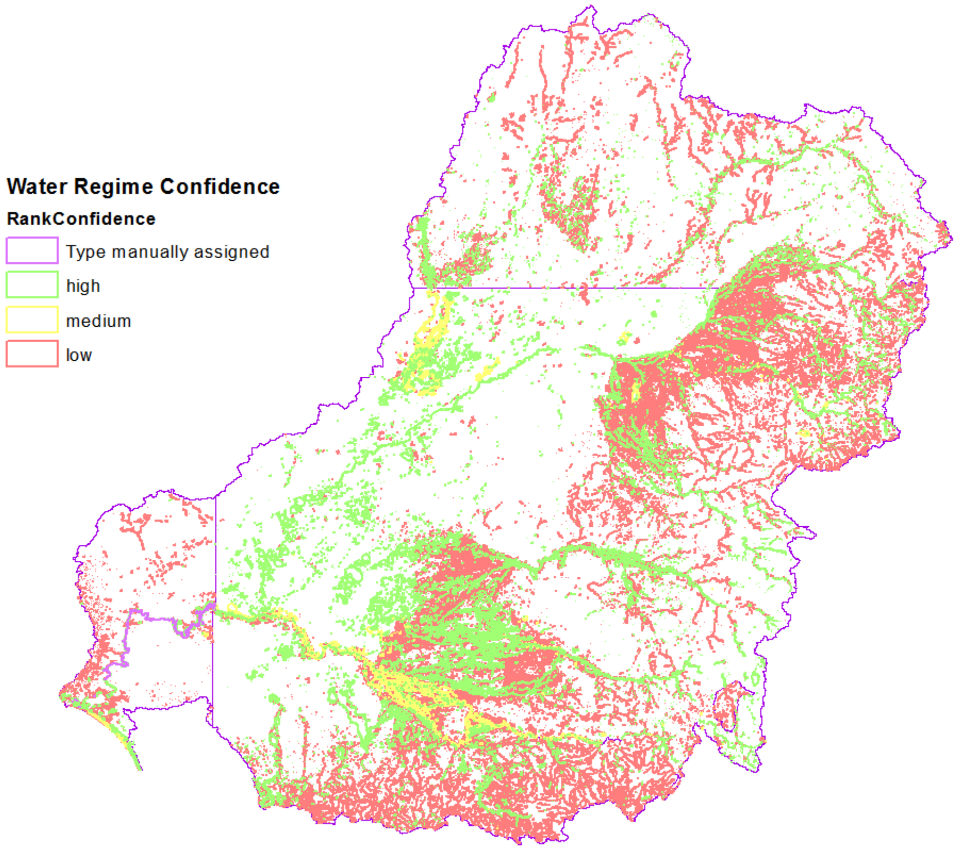


Figure 14. Example of a confidence "heat map" for the ANAE Water Regime attribute.

References

Aquatic Ecosystems Task Group. 2012. Aquatic Ecosystems Toolkit. Module 2 Interim Australian National Aquatic Ecosystems (ANAE) Classification Framework. Department of Sustainability, Environment, Water Population and Communities, Canberra, Australia.

BOM. 2014. Australian Hydrological Geospatial Fabric (Geofabric) v2.1.1. Commonwealth of Australia (Bureau of Meteorology) 2014. Available from http://www.bom.gov.au/water/geofabric/.

BOM. 2020. Australian Hydrological Geospatial Fabric (Geofabric) beta v3.2. Commonwealth of Australia (Bureau of Meteorology). Available from http://www.bom.gov.au/water/geofabric/.

Brooks, S.S. 2017. Classification of aquatic ecosystems in the Murray-Darling Basin: 2017 update. Report to the Murray-Darling Basin Authority and Commonwealth Environmental Water Office, Canberra, Australia.

Brooks, S.S. 2020. (In Prep) Classification of aquatic ecosystems in the Murray-Darling Basin v3: 2020 update. Report to the Commonwealth Environmental Water Office, Canberra, Australia.

Brooks, S.S., Cottingham, P., Butcher, R., and Hale, J. 2014. Interim classification of aquatic ecosystems in the Murray-Darling Basin: Stage 2 report. Canberra, Australia.

Cottingham, P.D., Brooks, S.S., Butcher, R., and Hale, J. 2012. Murray-Darling Basin aquatic ecosystem classification: Stage 1 report. Peter Cottingham & Associates report to the Commonwealth Environmental Water Office, Canberra.

Cowood, A., Nicholson, A., Wooldridge, A., Muller, R., and Moore, L. 2017. Wetland vulnerability to climate change in the ACT. Report for the ACT Environment, Planning and Sustainable Development Directorate.

DELWP. 2016. The Victorian wetland classification framework. Department of Environment, Land, Water and Planning, East Melbourne.

Jones, L., and Miles, M. 2009. River Murray wetland classification project. Report to the Riverine Recovery Project, Department of Water, Land & Biodiversity Conservation.

QLD Environmental Protection Agency. 2005. Wetland Mapping and Classification Methodology – Overall Framework – A Method to Provide Baseline Mapping and Classification for Wetlands in Queensland, Version 1.2. Queensland Government (Environmental Protection Agency), Brisbane.

Roberts, J., and Marston, F. 2011. Water regime for wetland and floodplain plants: a source book for the Murray-Darling Basin. National Water Commission Canberra.

Seaman, R.L. 2003. Coorong and Lower Lakes Ramsar Habitat Mapping Program. Department for Environment and Heritage, South Australia.

Stein, J.L., Mutchinson, M., and Stein, J.A. 2012. National Environmental Stream Attributes v1.1.5. Geoscience Australia. Available from http://pid.geoscience.gov.au/dataset/ga/73045.

Appendix 1. Typology

The ANAE typology was adapted from that of Brooks et al. (2014) to change the application of the "floodplain" attribute and to improve the consistency of type names (e.g. by not mixing terms like "intermittent" and "temporary" and ensuring all type names are singular in the nomenclature of ANAE types.

Water regime, water type and vegetation attributes are the main attributes used throughout the typology. Vegetation structure (not dominant species) is used to help distinguish types for lacustrine and riverine classes. Lacustrine systems are defined as having less than 30 per cent emergent vegetation. Therefore only "water" is considered as a valid attribute category for the dominant vegetation attribute in the typology for lakes.

A1.1 Lacustrine

The typology for lacustrine systems (Table 2) is based on the following Level 3 ANAE attributes:

- Water type;
- Water regime (water permanency);
- Dominant vegetation (water only);
- Finer vegetation (aquatic bed).

The typology for lacustrine systems also captures if the system is located on a floodplain. A number of types can be aggregated (for example permanent lakes with or without submerged macrophytes can be aggregated up to being called just permanent lakes) and this is explained in the descriptions for each combination of attributes in Table 2. As stated above, systems are considered freshwater unless stated otherwise in the naming convention. Also lakes are assumed to have no submergent vegetation unless stated in the name convention.

A1.2 Palustrine

The typology for palustrine systems (Table 3) is based on the following Level 3 ANAE attributes:

- Water type;
- Water regime;
- Dominant vegetation (structure);
- Finer scale vegetation (dominant species).

The typology for palustrine systems also captures if the system is located on a floodplain, and includes a greater number of types as the potential range of vegetation associations/attributes is greater, reflecting the greater range or variability in water regime encountered in this ecosystem class. Springs were assigned to individual features as designated in jurisdictional data sets and were assumed to be commonly wet.

A1.3 Riverine

The typology for riverine systems (Table 4) is based on the following Level 3 ANAE attributes:

- Water source,
- Water regime, and
- Landform.

The riverine confinement attribute was also considered for the typology but was found to be highly correlated with the landform attribute and so provided no additional ecological information.

Waterholes are assumed to have been identified in temporary or periodically inundated streams. However, approaches such as designating permanent palustrine features that intersect steams as 'waterholes' resulted in a vast (unrealistic) number of features being so assigned. The designation of a feature as a 'waterhole' therefore relies on designations from jurisdiction databases.

Including substrate as an attribute in the typology for riverine systems would be informative; however, there is insufficient information available for the MDB to include it at this stage. It may be considered in future iterations of the ANAE framework as it would add useful information on the characteristics of a riverine system (e.g. help define sandy bottom, cobble, boulder or bedrock streams).

A1.4 Estuarine

Estuarine systems (deep water habitats, tidal wetlands, lagoons, coastal salt marshes, mangroves etc.) are the component parts of estuaries i.e. those areas that are semi-enclosed by land with a permanently or intermittently open connection with the ocean, and where ocean water can be diluted by freshwater runoff from the land (AETG 2012).

The single estuary associated with the MDB is that of the Coorong and Murray Mouth. Typically this system is described, and to some extent managed, as three separate areas: the Murray Mouth, North Lagoon and South Lagoon of the Coorong. The hydrology of the system is highly modified and influenced by different inputs of freshwater over the barrages from the Lower Lakes, freshwater from the Upper South East of South Australia (into the South Lagoon), and tidal waters entering via the Murray Mouth. Evaporation in the South Lagoon, in particular, exceeds freshwater inputs and maintains hypersaline conditions; this portion of the Coorong operates predominantly as a reverse estuary (i.e. marine water moving in across the water surface over denser hypersaline water).

Table 2: Lacustrine types using Level 3 attributes. Dominant vegetation and fringing vegetation do not provide any greater separation of types. Codes: Lp = permanent freshwater lacustrine/lakes, Lt = temporary freshwater lacustrine/lakes, Lsp = permanent saline lacustrine/lakes, Lst = temporary saline lacustrine/lakes

Water type	Water regime	Dominant vegetation	Finer scale vegetation	Type			Description
Fresh	Commonly wet	Water	No vegetation	Lake	Lp1: Permanent lake	Lp1.1: Permanent lake	Includes volcanic lakes, dune lakes, crater lakes, alpine lakes and other inland lakes. Typically greater than 2 metres deep with substantial areas of open water – may have fringing vegetation in littoral zone, but are defined as having less than 30 per cent emergent vegetation and no to limited submergent vegetation. Often greater than 8 ha in size, but smaller systems are also included if they are greater than 2m deep and support wave action.
			Aquatic bed			Lp1.2: Permanent lake with aquatic beds	As for Lp1.1 but have substantial areas of submergent macrophytes (e.g. Hattah Lakes). This type of lake is likely to be shallow in areas which support macrophytes.
	Periodic inundation	Water	No vegetation		Lt1: Temporary lake	Lt1.1: Temporary lake	As for Lp1.1 but tend to be shallower and periodically dries (temporary).
			Aquatic bed			Lt1.2: Temporary lake with aquatic bed	As for Lp1.2; but lakes are temporary.
Saline	Commonly wet	Water	No vegetation	Saline lake	Lsp1: Permanent saline lake	Lsp1.1: Permanent saline lake	As for Lp1.1, but saline.
			Aquatic bed			Lsp1.1: Permanent saline lake with aquatic bed	As for Lp1.2, but saline. Examples of typical aquatic vegetation include systems with *Ruppia*.
	Periodic inundation	Water	No vegetation		Lst1: Temporary saline lake	Lst1.1: Temporary saline lake	As for Lt1.1, but saline
			Aquatic bed			Lst1.2: Temporary saline lake with aquatic bed	As for Lt1.2, but saline.

Table 3: Palustrine types using Level 3 attributes. Codes Pp = permanent wetland types, Pt = temporary wetland types, Psp = permanent saline wetland types, Pst = temporary saline wetland types, Pu = unknown type

Water type	Water regime	Dominant vegetation	Finer scale vegetation	Floodplain	Type			Description
Fresh	Commonly wet	Tree	Paperbark	No	Pp1: Permanent swamp forest	Pp1.1: Permanent paperbark swamps	Pp1.1.2: Permanent paperbark swamps	Permanent wetlands; vegetation is emergent and dominated by paperbark.
		Sedge	Tall emergent aquatic	No	Pp2: Permanent marsh	Pp2.1: Permanent tall emergent marsh	Pp2.1.2: Permanent tall emergent marsh	Permanent wetlands; vegetation is dominated by emergent aquatic species, including Typha, Phragmities, Eleocharis, some Juncus species, Includes species ≥1m in height.
		Sedge	Aquatic sedge/grass/forb	No		Pp2.2: Permanent sedge/grass/forb marsh	Pp2.2.2: Permanent sedge/grass/forb marsh	Permanent wetlands; vegetation is emergent, but can also include submergent species as well. Height of emergent species is typically ≤1m – can include species from Carex, Cyperus, Myriophyllum, Triglochin, Eleocharis, Sporobolus, Amphibromus, Pseudoraphis spinescens etc. Includes obligate aquatics as well as amphibious species in littoral zones.
		Grass/forb	Freshwater grasses	Yes		Pp2.3: Permanent grass marsh	Pp2.3.1: Permanent floodplain grass marsh	Permanent wetlands on floodplains; vegetation is emergent grass species.
				No			Pp2.3.2: Permanent grass marsh	As for Pp2.3.1, but not on floodplains.
		Grass/forb	Freshwater forb	Yes		Pp2.4: Permanent forb marsh	Pp2.4.1: Permanent floodplain forb marsh	Permanent wetlands on floodplains; vegetation is emergent forb species.

				No			Pp2.4.2: Permanent forb marsh	As for Pp2.4.1, but not on floodplains.
		Sedge/Grass/ forb	Bogs and fen	No	Pp3: Peat bogs or fen marsh			Permanent wetlands with emergent sedge, grass or forb. Fen marshes are separated from bog by the presence of Sphagnum and groundwater being the dominant water source.
		All remaining	Not specified	Yes	Pp4.1: Floodplain or riparian wetland			Permanent wetlands on floodplains with unspecified vegetation.
				No	Pp4.2: Permanent wetland			As per Pp4.1 but not on floodplains.
			Not specified	All	Pps5: Permanent spring			Permanent freshwater wetlands in groundwater discharge areas.
	Periodic inundation	Tree	River red gum	Yes	Pt1:Temporary swamp	Pt1.1: Temporary river red gum swamp	Pt1.1.2: Temporary river red gum swamp	Intermittently wet river red gum wetlands
				No				
		Tree	Black box	Yes		Pt1.2: Temporary black box swamp		Black box riparian zones or floodplains; have predominantly woodland structure. Occur on infrequently flooded outwash areas and as a string of trees following a palaeo-channel (Roberts and Marston 2011).
				No			Pt1.2.2: Temporary black box swamp	Black box woodland associated with depressional wetland e.g. as a narrow fringe around intermittent lakes or as a woodland across the floor of some deflation basins.
		Tree	Coolibah	Yes		Pt1.3: Temporary Coolibah swamp	Pt1.3.2: Temporary Coolibah swamp	Mainly restricted to the north-west of the Basin. Coolibah is often the dominant tree on infrequently inundated
				No				

								floodplains of northern rivers such as the Darling and Gwydir; forming extensive woodlands. This type may also occur as a riparian fringe beside river channels and around waterholes (Roberts and Marston 2011).
		Tree	River Cooba	Yes No		Pt1.4: Temporary River Cooba swamp	Pt1.4.2: Temporary River Cooba swamp	Intermittent River Cooba wetlands on floodplains. River Cooba is also known as Belalie and Eumong (Roberts and Marston 2011). Common in the northern Basin.
		Tree	Paperbark	Yes No		Pt1.5: Temporary paperbark swamp	Pt1.5.2: Temporary paperbark swamp	Depressional wetlands dominated by Paperbark (Melaleuca sp.)
		Tree	Other aquatic trees	Yes No		Pt1.6: Temporary swamp	Pt1.6.2: Temporary woodland swamp	Wetlands with a range of aquatic dependent trees such as Casuarina, Allocasuarina, Eucalyptus ovata.
		Shrub	Lignum	Yes No		Pt1.7: Temporary Lignum swamps	Pt1.7.2: Temporary Lignum swamp	Temporary Lignum swamps
		Sedge	Tall emergent aquatics	Any	Pt2: Temporary marsh	Pt2.1: Temporary tall emergent marsh	Pt2.1.2: Temporary tall emergent marsh	Temporary wetlands dominated by Phragmites, Juncus Typha, Eleocharis, Baumea, etc. (Pt2.1.1 has been deleted)

		Sedge/grass/ forb	Aquatic sedge/grass/forb	Any		Pt2.2: Temporary sedge/grass/forb marsh	Pt2.2.2: Temporary sedge/grass/forb marsh	Temporary sedge/grass/forb marshes. Marshes tend to be deeper than meadows, ranging anywhere from 20-30 centimetres in depth to up to two metres in depth. Can be vegetated across the whole system or include areas of open water (deeper areas). Includes systems with Eragrostis, Eleocharis, Carex, Cyperus, Paspalum, etc. (Pt2.2.1 has been deleted)
		Grass/forb	Freshwater grasses, Freshwater forbs	Any		Pt2.3: Freshwater meadow	Pt2.3.2: Freshwater meadow	Temporary meadows which tend to be shallow typically ranging between 20 to 40 centimetres in depth. Meadows are typically vegetated across whole system, may have scattered trees, shrubs, and or sedges, but are dominated by grasses and forbs. (Pt2.3.1 has been deleted)
		No vegetation/ Water	n/a	Any	Pt3: Freshwater playas	Pt3.1:Clay pans	Pt3.1.2: Clay pan	Clay pans are typically less than eight hectares and less than two metres deep. Lack wave action characteristic of lacustrine systems (Pt3.1.1: has been deleted)
		All remaining	Not specified	Yes	Pt4.1: Temporary floodplain wetland			Temporary wetlands on the floodplain with unspecified vegetation.
				No	Pt4.2: Temporary wetland			As for Pt4.1, but not associated with floodplains.
Saline	Commonly wet	Tree	Paperbark	All	Psp1: Saline swamps	Psp1.1: Saline paperbark swamp		Permanent saline paperbark swamps, including Melaleuca

							halmaturorum.
		Shrub/sedge/ grass/forb	Saltmarsh	All	Psp2: Salt marsh	Psp2.1: Permanent salt marsh	Permanent inland saltmarsh.
		Grass	Seagrass	All	Psp3: Seagrass marsh	Psp3.1: Permanent seagrass marsh	Permanent saline marshes dominated by seagrass.
		All remaining	Not specified	All	Psp4: Permanent saline wetland		Permanent saline wetlands with unspecified vegetation.
	Periodic inundation	Tree	All trees	All	Pst1: Saline swamp	Pst1.1: Temporary saline swamp	Temporary saline wetlands with tree species.
		Shrub/sedge/ grass/forb	Saltmarsh	All	Pst2: Salt marsh	Pst2.2: Temporary salt marsh	Temporary inland saltmarsh wetlands.
		No vegetation/ water	n/a	All	Pst3: Saline playas	Pst3.2: Salt pans and salt flats	Temporary saltpans and playas typically less than eight hectares and less than two metres deep. Lack wave action characteristic of lacustrine systems.
		All remaining	Not specified	All	Pst4: Temporary saline wetlands		Temporary saline wetlands with unspecified vegetation.
Unknown	Unknown	Unknown	Unknown	All	Pu1: Unspecified wetland		There is no information with which to assign a type.

Table 4: Riverine types using Level 3 attributes. Codes: Rp = riverine – permanent streams, Rt = riverine – temporary streams, Rw = riverine – waterholes, Ru = unspecified streams.

Water source	Water regime	Landform	Type		Description
Surface	Commonly wet	High energy upland	Rp1: Permanent streams	Rp1.1: Permanent high energy upland streams	Fast flowing streams with steep gradient (>6%), and dominated by riffles and runs. Often with coarse substrate. Base flow typically maintained except in extreme droughts.
		Transitional		Rp1.2: Permanent transitional zone streams	Intermediate slope (4-6%) with long runs and riffle zones; pools are infrequent.
		Low energy upland		Rp1.3: Permanent low energy upland streams	Low gradient (<4%), slow flowing systems, often with a narrow channel on relatively flat land. May lack extensive riffle areas.
		Lowland		Rp1.4: Permanent lowland streams	Low gradient (<4%),systems that can include both narrow and relatively shallow flowing systems with pool, riffle, run sequences, and large deeper lowland systems with slow flow and no riffle areas. Base flow is maintained in dry periods, except in extreme drought.
	Periodic inundation	High energy upland	Rt1: Temporary streams	Rt1.1: Temporary high energy upland streams	As for Rp1.1, but may be systems which rise and fall rapidly, wetting and drying for varying lengths of times.
		Transitional		Rt1.2: Temporary transitional zone streams	As for Rp1.2, but are only periodically wet.
		Low energy upland		Rt1.3: Temporary low energy upland streams	As for Rp1.3, but are only periodically wet.
		Lowland		Rt1.4: Temporary lowland streams	As for Rp1.4, but are only periodically wet.
All	Commonly wet	All	Rw1: Waterholes		Commonly wet remnant pools that are located on periodically wet riverine segments.
	Unknown	Unknown	Ru1: Unspecified river		There is no information with which to assign a type.

Table 5: Floodplain types using Level 3 attributes. ***Code: F = floodplain***

Water type	Water regime	Dominant vegetation	Finer scale vegetation	Landform	Type		Description
Fresh	Periodic inundation	Tree	River red gum forest	Upland	F1: Floodplain forest and woodlands	F1.1: Upland river red gum forest floodplain	River red gum forest floodplain located in upland areas. Forests are restricted to frequently flooded sites. Can occur as large (e.g. Barmah Forest) or small patches and strips depending on local topography (Roberts and Marston 2011).
				Lowland		F1.2: River red gum forest floodplain	As for F1.1, but in lowland areas.
			River red gum woodland	Upland		F1.3: Upland river red gum woodland floodplain	River red gum woodland floodplain in upland areas. May have a number of different vegetation understory associations present, including shrubland (lignum) and/or grasslands. Woodland associations are typically inundated less frequently. Cover large areas of the Basin including associated with temporary streams in the west of the Basin (Roberts and Marston 2011).
				Lowland		F1.4: River red gum woodland floodplain	As for F1.3, but in lowland areas
			Black box forest	Upland		F1.5: Upland black box forest floodplain	Black box forest floodplain in upland areas.
				Lowland		F1.6: Black box forest floodplain	As for F1.5, but in lowland areas
			Black box woodland	Upland		F1.7: Upland black box woodland floodplain	Black box woodland floodplain in upland areas.
				Lowland		F1.8: Black box woodland floodplain	As for F1.7, but in lowland areas.
			Coolibah	Upland		F1.9: Upland Coolibah woodland and forest floodplain	Coolibah woodland and forest floodplain in upland areas.

				Lowland		F1.10: Coolibah woodland and forest floodplain	As for F1.9, but in lowland areas.
			River Cooba	Lowland		F1.11: River cooba woodland floodplain	River cooba woodland floodplain. River cooba (or Eumong) is largely a lowland species typically occurring between 50 to 325 m above sea level, but can be found up to 625m ASL.
			Other aquatic tree			F1.12: Woodland floodplain	Woodland floodplain with unspecified dominant tree species.
		Shrub	Lignum	Upland	F2: Floodplain shrubland	F2.1: Upland lignum shrubland floodplain	Lignum shrubland floodplain in upland areas.
				Lowland		F2.2: Lignum shrubland floodplain	As for F2.1, but in lowland areas.
			Other shrub	Upland		F2.3: Upland shrubland floodplain	Shrubland floodplain in upland areas
				Lowland		F2.4: Shrubland floodplain	As for F2.3, but in lowland areas.
		Sedge/grass/forb	Aquatic Sedge/grass/forb	Upland	F3: Floodplain sedge/grassland	F3.1: Upland sedge/forb/grassland floodplain	Sedge/forb/grassland floodplain in upland areas.
				Lowland		F3.2: Sedge/forb/grassland floodplain	As for F3.1, but in lowland areas.
		All other	Not specified	All	F4: Unspecified floodplain	F4: Unspecified vegetation	Floodplain areas with unspecified vegetation. Such areas require further investigation to confirm the associated vegetation and have the feature re-assigned to a more meaningful type.

Table 6: Estuarine types using Level 2 and 3 attributes. Codes: Ewd = estuarine – wave dominated, Etd = estuarine – tide dominated.

Water influence (Level 2)	Water depth	Substrate	Structural macrobiota	Type			Description
Wave dominated	Supratidal	Pebble/gravel	None	Ewd1: Wave dominated	Ewd1.1: Wave dominated supratidal	Ewd1.1.1: Pebble/gravel shorelines	Exposed wave dominated shorelines with coarse substrate.
		Rock	None			Ewd1.1.2: Rocky shoreline	Exposed wave dominated rocky shorelines – can have mud and vegetated areas, typical with saltmarsh species.
	Intertidal	Silt/sand	Seagrass		Ewd1.2: Wave dominated intertidal	Ewd1.2.1:Intertidal seagrass beds	Intertidal seagrass beds exposed at low tide.
		All	Macroalgae			Ewd1.2.2: Intertidal seaweed beds	Intertidal seaweed beds exposed at low tide.
		Silt	Saltmarsh			Ewd1.2.3: Intertidal saltmarsh	Intertidal saltmarsh, as distinct from inland saltmarsh, directly influenced by tidal regime.
		Silt/sand	None			Ewd1.2.4: Intertidal mudflats and sand bars	Fine to medium sands with a relatively high organic content, and areas of microbial mats comprised of cyanobacteria and filamentous algae.
		Rock	None			Ewd1.2.5: Intertidal rocky shorelines	Intertidal rocky shorelines, including exposed rocky shorelines of islands.
		All	Tree			Ewd1.2.6: Wave dominated intertidal forests	Includes Melaleuca halmaturorum swamp paperbark tidally influenced forest/woodland
	Subtidal	Silt/sand	Seagrass		Ewd1.3: Wave dominated	Ewd1.3.1: Wave dominated seagrass beds	Wave dominated seagrass beds, including seagrass beds in the Coorong North Lagoon.

		Sand	None		subtidal	Ewd1.3.2: Coastal lagoon	Wave dominated lagoons that are typically shallow, often elongated bodies of water, often flanked by small areas of intertidal environments.
Tide dominated	Supratidal	Rock	None	Etd1: Tide dominated	Etd1.1: Tide dominated supratidal	Etd1.1.1: Tide dominated rocky shoreline	Tide dominated bare, rocky shoreline.
	Intertidal	Silt	Saltmarsh		Etd1.2: Tide dominated intertidal	Etd1.2.1: Tide dominated saltmarsh	Tidal mudflats.
		Silt/sand	None			Etd1.2.2: Tide dominated mudflats and sandbars	As per Ewd1.2.4, except under tidal influence (may be intermittent).
		All	Tree			Etd1.2.3 Tide dominated forests	Includes Melaleuca halmaturorum swamp paperbark tidally influenced forest/woodland
	Subtidal	Silt/sand	Seagrass		Etd1.3: Tide dominated subtidal	Etd1.3.1: Tide dominated seagrass beds	As per Ewd1.3.3 except tide dominated; rarely exposed except during low tides.
		All	Macroalgae			Etd1.3.2: Tide dominated subtidal seaweed beds	Tide dominated subtidal seaweed beds; rarely exposed except during low tides.
		Sand	None			Etd1.3.3: Tide dominated estuary	Tide dominated estuary with sandy substrate. Murray Mouth and estuary defined by Phillips and Muller (2006) as including the Murray Mouth from the Goolwa Barrage to Pelican Point, including the Goolwa, Coorong and Mundoo channels. Wide tidal channel network flanked by large areas of inter- and sub-tidal environments.

Appendix 2. MDB_ANAE Geodatabase Structure

Schema Table for MDB_ANAE.gdb

Feature Dataset	Feature Class
Features	Watercourses_ANAE
	Wetlands_ANAE
ANAE_Level1	ASRIS Provinces
	BoM Koppen climate classes
	BoM Rainfall Zones Major
	Groundwater provinces
	Hydrogeological Divisions
	Hydrogeology GAB
	IBRA_Regions
ANAE_Level2	ASRIS Atlas of Aust. Soils
	ASRIS Pysiographic Subregions
	BoM Koppen Subregions
	Geofabric 2 Hydrogeological Unit
	IBRA Subregions
Catchments	CEWO_Valleys
	MDB_AWRC_Basins
	MDB_Boundary
	NCB_Basins
	NCB_Catchments
	NCB_Division_Level2
Artificial	Unnamed_Reservoirs_Small
	Named_Reservoirs_Large
	SA_FarmDams
	Vic_Artificial
	MDB_small_dams
	Vic_SmallDams_Extra
	MDB_FarmDams
	QLD_Artificial
	ACT_Artificial
Base layers	Large Storages
	Major Roads
	Major Towns
	MDB_All_States
	SourceMappingCover

Relationships	Relationships that link the attribute tables to the Aquatic Ecosystem feature mapping
Attribute Tables	L3_Landform_Watercourses
	L3_Confinement_Watercourses
	L3_WaterSource_Watercourses
	L3_WaterType_Watercourses
	L3_WaterRegime_Watercourses
	L3_Vegetation_Watercourses
	L3_Landform_Wetlands
	L3_WaterType_Wetlands
	L3_WaterSource_Wetlands
	L3_WaterRegime_Wetlands
	L3_Vegetation_Wetlands
	L3_WaterSource_Wetlands
	L3_Soil_Wetlands
Misc Tables	ANAE_Codes_Lookup
	DataSources
	L3_ANAE_TYPE_Rivers
	L3_BASE
	NCBPfafstetter
	PotentialWaterholes
	Wetlands_Confidence

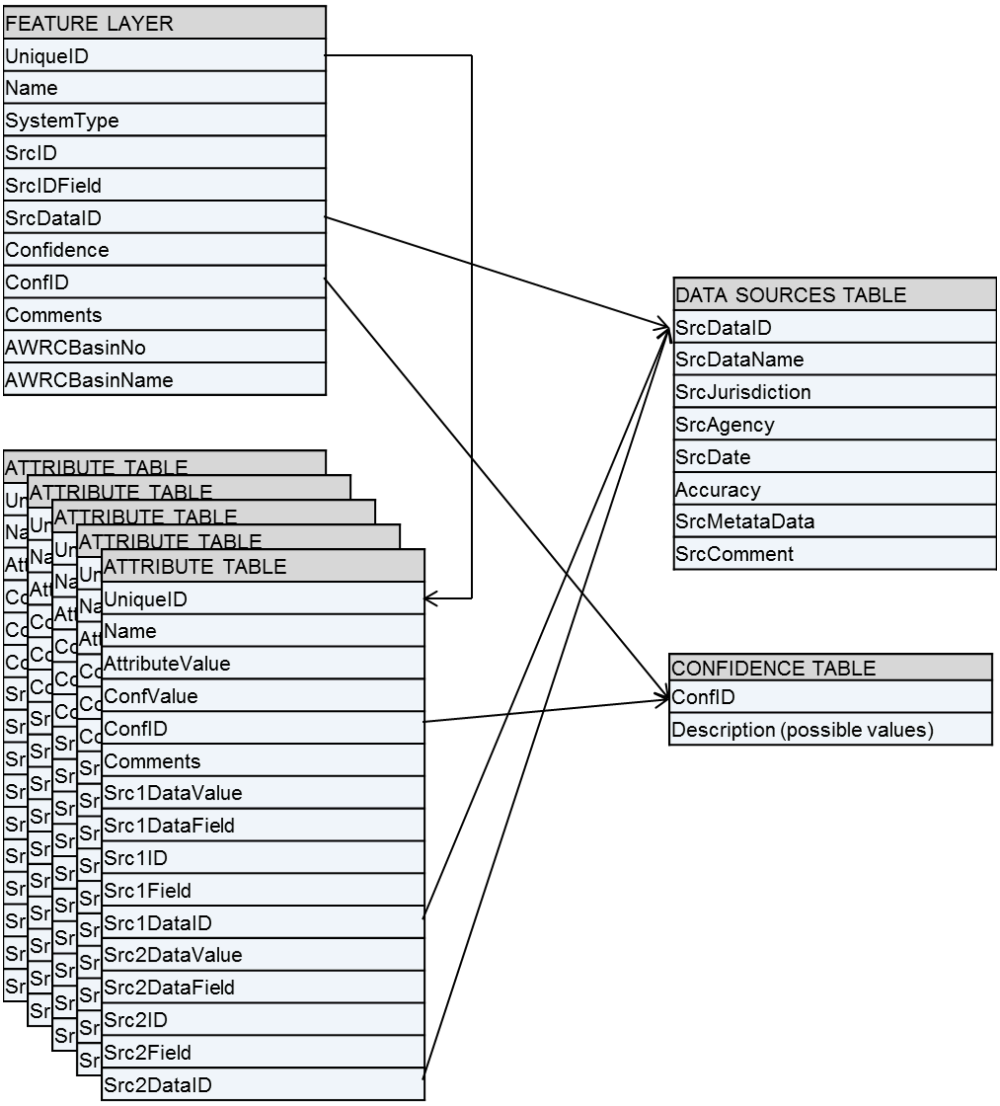
Alphabetic Index of MDB_ANAE Geodatabase components and their role.

Geodatabase Object	Type	Role
ANAE_Floodplain_Types_Frequency	Data Table	Summary counts of ANAE types by system type and state
ANAE_Watercourses_Types_Frequency	Data Table	Summary counts of ANAE types by system type and state
ANAE_Wetland_Types_Frequency	Data Table	Summary counts of ANAE types by system type and state
ASRIS_Atlas_of_Australian_Soils	Polygon	ANAE Level 2 attribute spatial layer
ASRIS_Physigraphic_Provinces_Subregions	Polygon	ANAE Level 2 attribute spatial layer
ASRIS_Provinces	Polygon	ANAE Level 1 attribute spatial layer
BoM_Koppen_climate_classes	Polygon	ANAE Level 1 attribute spatial layer
BoM_Koppen_subregions	Polygon	ANAE Level 2 attribute spatial layer
BoM_Rainfall_Zones_Major	Polygon	ANAE Level 1 attribute spatial layer
DataSources	Data Table	Table of mapping and attribute data sources
Estuarine_ANAE	Polygon	Aquatic ecosystem mapping layer classified by ANAE
Floodplain_ANAE	Polygon	Aquatic ecosystem mapping layer classified by ANAE
Hydrogeological_Divisions	Polygon	ANAE Level 1 attribute spatial layer
IBRA_Regions	Polygon	ANAE Level 1 attribute spatial layer
IBRA_Subregions	Polygon	ANAE Level 2 attribute spatial layer
L3_ANAE_TYPE_Rivers	Data Table	Table of classification output (linked to watercourses)
L3_BASE	Data Table	Blank table for ANAE recording attribute data
L3_Confinement_Watercourses	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Floodplain_Soils	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Floodplain_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Landform_Floodplain	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Landform_Watercourses	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Landform_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Soil_Floodplain	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Soil_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Vegetation_Floodplain	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_Vegetation_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_WaterRegime_Watercourses	Data Table	ANAE Attribute data per aquatic ecosystem feature

L3_WaterRegime_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_WaterSource_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
L3_WaterType_Wetlands	Data Table	ANAE Attribute data per aquatic ecosystem feature
LargeStorages	Polygon	Large reservoirs (not classified to type)
MappedStreams_10mBuffer	Polygon	Geofabric v2.0 stream lines as 20m wide polygon
MappedStreams_SegmentNo	Line	Geofabric v2.0 stream lines
MDB_All_States	Polygon	Jurisdiction borders
MDB_AWRC_Basins	Polygon	Aust. Water Resources Council catchment boundaries
MDB_Boundary	Polygon	Murray Darling Basin outline
MDB_GDE_Surface	Polygon	National GDE Atlas surface expression of groundwater
MDB_NVIS41	Raster Catalog	Attribute Source: NVIS41 values for NVISDSC1 as approx. 500 raster tiles stored in raster catalog
MDB_NVIS41_ref	Mosaic	Attribute Source: Raster Mosaic to reference NVIS tiles as single layer
MDB_NVIS41_LOOKUP	Data Table	Attribute Source: Lookup table of veg data by NVIS_ID (=NVISDSC1=value of MDB_NVIS41_ref mosaic
mrRTF	Raster	Attribute Source: Multi-resolution ridge top flatness raster from CSIRO
mrVBF	Raster	Attribute Source: Multi-resolution valley bottom flatness raster from CSIRO
MWWG_Wetlands	Polygon	Source map: Murray Wetlands Working Group wetlands
NCB_Basins	Polygon	Sub basin outlines
NCB_Division_Level2	Polygon	Murray Darling Basin outline
NCBPfafstetter	Table	Geofabric Pfafstetter numbers per catchment SegmentNo
NSW_Gwydir_RERP	Polygon	Source mapping layer
NSW_Lowbidgee_RERP	Polygon	Source mapping layer
NSW_MacMarsh_RERP	Polygon	Source mapping layer
NSW_MCMA_Wetlands	Polygon	Source mapping layer
NSW_Namoi_wetlands	Polygon	Source mapping layer
NSW_Watercourses	Line	Source mapping layer
NSW_Wetlands	Polygon	Source mapping layer
PotentialWaterholes	Polygon	Permanent riverine wetlands on temporary watercourses
QLD_Watercourses	line	Source mapping layer
QLD_Wetlands	Polygon	Source mapping layer
RERP_ANAE	Data Table	Aquatic ecosystem mapping layer classified by ANAE
SA_LLakes_Habitats_2003	Polygon	SA Lower Lakes Habitat Mapping Program 2003
SA_SAWID_Wetlands	Polygon	Source mapping layer
SA_Watercourses	Line	Source mapping layer

SA_Wetlands	Polygon	Source mapping layer
SA_Wetlands_SAAE_2010	Data Table	SA Aquatic Ecosystems classification 2010
Vic_Watercourses	Line	Source mapping layer
Vic_Wetlands	Polygon	Source mapping layer
Watercourses_50mPoly	Polygon	ANAE stream layer as blocky polygons
Watercourses_ANAE	Line	Aquatic ecosystem mapping layer classified by ANAE
Wetlands_ANAE	Polygon	Aquatic ecosystem mapping layer classified by ANAE
Wetlands_Confidence	Data Table	Table summarising confidence in ANAE attributes

Data Table Relationships



Wetlands and Floodplain

UniqueID = "**SYSID**" for linking Wetlands_ANAE to ANAE Level 3 attribute tables

Watercourses and MappedStreams

UniqueID = "**SegmentNo**" for linking Watercourses_ANAE and MappedStreams_ANAE to:

- ANAE Level 3 attribute tables
- Geofabric v2.0 (available from the Bureau of Meteorology http://www.bom.gov.au/water/geofabric/)
- National Environmental Stream Attributes (available from http://www.ga.gov.au/topographic-mapping/national-surface-water-information.html)

Table Structure

Feature Layers (wetlands, watercourses)

Field Heading	Data Type	Description
OBJECTID	Long Integer	Auto-generated GIS unique identifier
SYSID	Long Integer	Unique Feature ID code. Used to join to ANAE attribute tables to feature mapping
SrcID	Text	Text
SystemType	Text	Text
SrcID	Text	UniqueID in source data set. Used to join to source data.
SrcIDNo	Long Integer	UniqueID in source data set. Used to join to source data.
SrcField	Text	Field name in source data set. Used to join to source data.
SrcDataID	Integer	Unique identifier in DataSources table for source data set
Confidence	Integer	Confidence rating (1-4)
ConfID	Integer	Unique lookup identifier in Confidence table
Comment	Text	Comment
State	Text	Jurisdiction state name
AWRCBNum	Text	Australian Water Resources Council Basin NUMBER (MBD is divided into 27 basins)
AWRCBName	Text	Australian Water Resources Council Basin NAME (MBD is divided into 27 basins)
SegmentNo	Long Integer	National Catchment Boundary SegmentNo - Identifies catchments in Geofabric v2.0. Used to link to catchments, mapped streams, and national environmental stream attributes.
AltSrcID	Text	Alternative source ID for polygon (used in Vic and QLD to assign jurisdiction wetland id numbers used to groups adjacent polygons into a single wetlands)
AltSrcFiel	Text	Name of field for Alternative source ID in source data
MeanLandform	Text	ANAE Level 3 Landform attribute assigned to each feature
WaterType	Text	ANAE Level 3Water Type attribute assigned to each feature
WaterRegime	Text	ANAE Level 3Water Regime attribute assigned to each feature
Floodplain	Text	ANAE Level 3Floodplain attribute assigned to each feature. Indicates that feature touches the MDBA wetlands v2 “Kingsford” maximum extent flood mapping.
WaterSource	Text	ANAE Level 3 Water Source attribute assigned to each feature
Vegetation	Text	ANAE Level 3 Vegetation - NVIS 4.1 NVISDSC1 code (numbers below 1000 are used for custom additions to NVIS to include new 2008 RERP vegetation.)
Veg_Riverine	Text	ANAE Level 3 Vegetation - Grouped vegetation types used in riverine typology
Veg_Palustrine	Text	ANAE Level 3 Vegetation - Grouped vegetation types used in palustrine typology
Veg_Lacustrine	Text	ANAE Level 3 Vegetation - Grouped vegetation types used in lacustrine typology
ANAE_TYPE	Text	ANAE Classification Type code + description in single field

ANAE_CODE	Text	ANAE Classification Type code
ANAE_DESC	Text	ANAE Classification Type description
TypeMethod	Text	Method used to assign types (using attributes or manually assigned as an override if attributes are not correct)
TypedBy	Text	Person or agency updating the type
Shape_Length	Float	Auto-generated GIS feature length
Shape_Area	Float	Auto-generated GIS feature area

Attribute tables

Naming convention: L3<attribute>_<feature>

Common Field Headings	Data Type	Description
SYSID	Long Integer	Unique Feature ID code. Used to join to ANAE attribute tables to feature mapping
Confidence	Integer	Confidence rating (1-4)
ConfID	Integer	Unique lookup identifier in Confidence table
Comment	Text	Comment
Src1DataValue	Text	Attribute value from first attribute dataset
Src1DataField	Text	Name of field containing attribute value from first attribute dataset
Src1ID	Text	Corresponding feature identifier (row) in first attribute data set
Src1Field	Text	Name of field containing feature identifier in first attribute data set
Src1DataID	Integer	Unique identifier in DataSources table for first attribute data set
Src2DataValue	Text	Attribute value from a second attribute dataset
Src2DataField	Text	Name of field containing attribute value from a second attribute dataset
Src2ID	Text	Corresponding feature identifier (row) in a second attribute data set
Src2Field	Text	Name of field containing feature identifier in a second attribute data set
Src2DataID	Integer	Unique identifier in DataSources table for a second attribute data set
Landform only	**Data Type**	**Description**
Landform	Text	Landform assignment using majority mrVBF and mrRTF
mrVBFMean	Double	**Mean mrVBF value per feature - not majority**
mrRTFMean	Double	**Mean mrRTF value per feature - not majority**
MeanLandform	Text	Landform assignment using mean mrVBF and mrRTF
mrVBF	Integer	mrVBF stored as integer (Src1DataValue is text)
mrRTF	Integer	mrRTF stored as integer (Src2DataValue is text)
L3_Confinement only	**Data Type**	**Description**
CountTotal	Long Integer	Total pixel count per feature
CountValley	Long integer	Pixel count as valley floor (mrVBF >3)
ConfineRatio	Double	Proportion of feature that is valley floor
Confinement	Text	L3 ANAE attribute assignment
L3_WaterType only	**Data Type**	**Description**
WaterType	Text	L3 ANAE attribute assignment
L3_WaterSource only	**Data Type**	**Description**
WaterSource	Text	L3 ANAE attribute assignment
L3_WaterRegime only	**Data Type**	**Description**
WaterRegime	Text	L3 ANAE attribute assignment
VicConfidence	Integer	Victoria source data confidence value

L3_Soil only	Data Type	Description
Soil_type		L3 ANAE attribute assignment
L3_Floodplain only	**Data Type**	**Description**
floodplain		L3 ANAE attribute assignment
L3_Vegetation only	**Data Type**	**Description**
NVIS_ID	Long Integer	NVISDSC1 value as integer to link to lookup table
Riverine	Text	L3 ANAE attribute assignment
Floodplain	Text	L3 ANAE attribute assignment
Palustrine	Text	L3 ANAE attribute assignment
MVG_NUMBER	Text	NVIS vegetation group number
MVG_NAME	Text	NVIS vegetation group name
MVS_NUMBER	Text	NVIS vegetation sub-group number
MVS_NAME	Text	NVIS vegetation sub-group name
conf_basic	Integer	Confidence in assigning NVIS data to simple ANAE vegetation groupings
conf_fine	Integer	Confidence in assigning NVIS data to more detailed ANAE vegetation groupings

Appendix 3. Data Sources

Table 7. Data sources contributing to the ANAE classification of the Murray-Darling Basin. This table is included in the classification ArcGIS database under the name DataSources and the SrcDataID is used to attribute the source data for all mapped features and attribute values.

SrcDataID	Data Name	Jurisdiction	Agency	Date	Comment
1	Geofabric v2.0 Cartography AHGFMappedStream	Australia	BoM	2012	Geofabric Surface Cartography - V2.0 © Commonwealth of Australia (Bureau of Meteorology) 2011
2	Geofabric v2.0 Cartography AHGFHydroArea	Australia	BoM	2012	Geofabric Surface Cartography - V2.0 © Commonwealth of Australia (Bureau of Meteorology) 2011
3	Geofabric v2.0 Cartography AHGFWaterbody	Australia	BoM	2012	Geofabric Surface Cartography - V2.0 © Commonwealth of Australia (Bureau of Meteorology) 2011
4	SA Topo Watercourses	SA	DEW	2011	<Null>
5	SA Topo - Statewide Wetlands	SA	DEW	2011	<Null>
6	Vic ISC HydroLine	Vic	DELWP	2011	<Null>
7	Vic Wetlands 2013	Vic	DELWP	2015	<Null>
8	QLD Wetland Mapping - HydroLine	QLD	DES	2013	<Null>
9	QLD Wetland Mapping v4 - Regional Ecosystems	QLD	DES	2015	<Null>
10	NSW Topography HydroLine	NSW	LPI	2013	<Null>
11	NSW Topography HydroArea	NSW	LPI	2013	<Null>
12	River Murray Wetland Database	NSW	Murray Wetlands Working Group	2003	<Null>
13	Namoi Floodplain	NSW	Namoi CMA	2009	<Null>
14	Namoi Wetland Assessment Mapping	NSW	Namoi CMA	2009	<Null>
15	Murrumbidgee Wetlands Resource Book spatial data	NSW	Murrumbidgee CMA	2011	Murray, P.A., 2008, Murrumbidgee Wetlands Resource Book, Murrumbidgee Catchment Management Authority
20	Wetlands GIS of the Murray-Darling Basin Series 2.0	MDB	MDBA	2004	Kingsford et al. 2004. Classifying landform at broad spatial scales: the distribution and conservation of wetlands in New South Wales, Australia. Marine and Freshwater Research

					55:17-31
21	South Australia Wetlands Inventory Database	SA	DEW	2013	SE_ANAE table and base mapping layer
22	ANAE Quasi-Fabric	All	CEWO	2013	constructed from jurisdiction and Geofabric for application of ANAE
23	GDE Atlas	Australia	BoM	2012	<Null>
31	NSW River Styles	NSW	NoW	2012	<Null>
32	NVIS4.2	MDB	DAWE	2016	<Null>
33	3 sec Multi-Resolution Valley Bottom Floor mrVBF	Australia	CSIRO	2012	<Null>
34	3 sec Multi-Resolution Ridge Top Flattness mrRTF	Australia	CSIRO	2013	<Null>
35	Digital Atlas Of Australian Soils	Australia	Geosciences Aust	2000	ABARES 1991, Digital Atlas of Australian Soils–Soil landscapes map, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra
36	SA Ramsar habitat mapping	SA	DEW	2003	<Null>
37	SA Murray River Floodplain Information Pack	SA	DEW	2012	<Null>
38	Land systems of Victoria 250	Vic	DELWP	2007	<Null>
39	Floodplains_SA_ANAE	SA	DEW	2014	Constructed ANAE floodplain layer for SA. Includes SAAE floodplain and some areas subject to inundation from DEW state mapping.
40	Vic Hydro_water_area_polygon	Vic	DELWP	2016	<Null>
41	NSW State Vegetation Type Map: Riverina Regional Native Vegetation PCT Map Version v1.0 - VIS_ID 4469	NSW	DEPIE	2017	<Null>
42	NSW State Vegetation Type Map: Central West/Lachlan Regional Native Vegetation PCT Map Version v1.0 - VIS_ID 4469	NSW	DEPIE	2017	<Null>
43	NSW State Vegetation Type Map: Border Rivers Gwydir / Namoi Regional Native Vegetation PCT Map Version v1.0 - VIS_ID 4469	NSW	DEPIE	2017	<Null>
44	Vic ISC2010 Streambed Width	Vic	DELWP	2017	<Null>
45	ACT ANAE Classification	ACT	ACT	2017	Cowood A., Nicholson A., Wooldridge A., Muller R. and Moore L 2017 Wetland vulnerability to climate change in the ACT. Report to ACT

					Environment, Planning and Sustainable Development Directorate
46	Seaman 2003 Coorong habitat mapping	SA	DEW	2003	Attributes updated by Dickson, C., Billows, C., Whiterod, N., and Bachmann, M. 2015. Coorong, Lower Lakes and Murray Mouth (CLLMM) Wetland Condition Assessments – Coorong sites
47	Water Observations from Space 1987-2014	Australia	Geosciences Aust	2015	<Null>
48	LTIM Murrumbidgee Wetlands	NSW	CSU	2015	From Skye Wassens - CEWO LTIM Project
49	Geofabric v3.2 AHGFNetworkStream	Australia	BOM	2020	Derived from 1sec DEM
50	Digital Earth Australia Waterbodies (smoothed)	Australia	Geosciences Aust	2020	Derived from Landsat - source polygons smoothed
51	NSW State Vegetation Type Map: Western Region v1.0. VIS_ID 4492	NSW	DEPIE	2020	<Null>
52	NSW State Vegetation Type Map: Central Tablelands Region Version 1.0. VIS_ID 4778	NSW	DEPIE	2020	<Null>

Appendix 4. Confidence rules

ConfID	Description
1	Rivers Feature Mapping Confidence = 2. Geofabric Mapped Streams. Used only as infill where state layers not represented. Confidence =2 because courser scale of data. Not as accurate as state layers. Includes connector segments that don't exist in real world.
2	Rivers Feature Mapping Confidence = 3 for all Victorian data stream segments. High confidence (3). Fine scale data with complete coverage.
3	Rivers Feature Mapping Confidence = 2. SA Selection of stream segments. Confidence down rated due to large number of incomplete, disconnected stream segments.
4	Rivers Feature Mapping Confidence = 3. NSW Selection of stream segments. High confidence (3). Fine scale complete coverage.
5	Rivers Feature Mapping Confidence =3 QLD Selection of stream segments. High confidence (3). Fine scale complete coverage.
6	Rivers Feature Mapping Confidence = 3 Average of state and Geofabric confidence values per Geofabric SegmentID.
7	Landform Confidence = 3 Lowland determination with mrVBF. High confidence - upper limit of data set is unambiguous.
8	Landform Confidence = 3 Upland determination with mrVBF, mrRTF High confidence - lower limit of data set is unambiguous.
9	Landform Confidence = 2 Transitional - confidence down-rated because threshold somewhat arbitrary despite calibration with River Styles. Feedback from NSW suggests results might over-represent upland areas.
10	Landform Confidence = 2 Low energy upland - confidence down-rated because threshold is somewhat arbitrary and discussion with John Gallant CSIRO indicated mrRTF has undergone less testing.
11	Confinement (river mapping) Confidence = 3 if confinement ratio = 0 or 1 (absolute) Confidence = 2 for ratios in between as thresholds are arbitrary despite being informed by River Styles.
12	Water Regime to river mapping All states: Confidence = 1: Assume periodically inundated if no data or unknown Confidence = 3: provided in state layer Confidence = 2: down rate to 2 if Geofabric doesn't agree with state layer Confidence = 2: no data in state layer and regime derived from Geofabric only Confidence = 4: State Layer Agrees with Geofabric (2 sources of evidence).
13	Water Source to river mapping Confidence = 1: Assumed surface water fed in absence of any data if listed as unknown in state layers.
14	Wetland polygon mapping General confidence in Jurisdiction wetland layers.

	Confidence = 3: QLD, VIC, SA, Confidence = 2: NSW (mapping is surface water area not wetlands) Confidence = 2: Feature in Geofabric but not in state layers.
15	Assigning system type to wetland polygons. All states: Confidence = 1: If type is unknown assumed value is Palustrine. Confidence = 2: Riverine defined by intersection of polygons with Geofabric major rivers. Confidence = 3: Jurisdiction mapping defines the system type for this feature. NSW: Confidence = 2: SystemType assigned to Lacustrine based on part of the Name NSW_Wetlands.HYDRONAMETYPE = 'LAKE' OR NSW_Wetlands.HYDRONAMETYPE = 'LAKES' OR NSW_Wetlands.HYDRONAMETYPE = 'POND' OR NSW_Wetlands.HYDRONAMETYPE = 'PONDS'. SA: 158 systems with "Dam" in the name. Confidence lowered to 2 perhaps should be deleted because artificial. Confidence = 4: Murray River main channel in SA (certain).
16	Assigning water type (salinity) to wetland polygons. All states: Confidence = 1: Assume Freshwater if no data or unknown. VIC: Confidence = 3: Fresh, and all saline categories apart from "Fresh-Hyposaline" obvious mappings. Confidence = 2: "Fresh-Hyposaline" mapped to saline (lower confidence). QLD: Confidence = 3: Fresh and Saline are straightforward mappings Confidence = 2: Hyposaline (3000 -30000 ppt). - mapped to saline but low end of range overlap fresh. SA: Confidence = 3: Fresh and Saline are straightforward mappings Confidence = 2: Brackish mapped to Saline. NSW: Confidence = 1: NO DATA.
17	Water Regime to wetland polygons Confidence = 1: Assume Periodic (no data or unknown) SA. two data sources Confidence = 3, "Src2DataValue" is null and ("Src1DataValue" = 'TEMPORARY' OR "Src1DataValue" = 'SEASONAL' OR "Src1DataValue" = 'RUNOFF/TEMPORARY COMBINATION' OR "Src1DataValue" = 'RUNOFF OR SEEPAGE' OR "Src1DataValue" = 'CONTROLLED IRRIGATION') Confidence = 3, WET "Src2DataValue" = 'Permanent'. Confidence = 3, PERIODIC "Src2DataValue" = 'Ephemeral' OR "Src2DataValue" = 'Seasonal' OR "Src2DataValue" = 'Years (> 1yr)' Confidence = 2, data sources different: "Src2DataValue" = 'Permanent' and ("Src1DataValue" = 'SEASONAL' OR "Src1DataValue" = 'TEMPORARY') Geofabric Confidence = 3 = permanent, temporary. Rest are no data (1) QLD Confidence = 3: PI: "Src1DataValue" = 'Intermediately (40-60% of images)' OR "Src1DataValue" = 'Rarely (20% of images)' Confidence = 3: CW: "Src1DataValue" = 'Commonly (80-100% of images)' NSW Confidence = 3: CW: "Src1DataValue" = '1' Confidence = 3: PI: "Src1DataValue" = '2' OR "Src1DataValue" = '3' VIC Confidence = 3: CW: "Src1DataValue" = 'Permanent' Confidence = 3: PI: "Src1DataValue" = 'Seasonal' OR "Src1DataValue" = 'Intermittent' OR "Src1DataValue" = 'Episodic'.

18	Floodplain Confidence = 1: All low confidence. Allocated as spatial join with Kingsford floodplain. Low confidence in Kingsford layer being definitive for floodplain boundary.
19	Landform using mrVBF and mrRTF Confidence = 3: Low Engery Lowland = VBF > 3, "mrVBFMean" > '3' Confidence = 3: Low Energy Upland = VBF <2.5 and RTF >2.5, "mrVBFMean" <2.5 and "mrRTFMean">2.5 Confidence = 3: High Energy Upland = mrVBF < 2.5 and mrRTF <= 2.5, "mrVBFMean" <2.5 and "mrRTFMean"<=2.5 Transitional VBF Confidence = 3: "mrVBFMean" >=2.5 and "mrVBFMean"<=3.
20	Springs Feature Confidence = 2: Larger wetland polygons (supplied to GDE mapping by NSW) - spring identifies the whole polygon not spring outlet Confidence = 3: Points Taken from GDE mapping
21	RERP Feature Mapping Confidence =2. Not really mapping wetlands. Mapping is management units for environmental watering that contain wetlands and floodplain assets
22	WaterSource-Wetlands Confidence = 1 Assume Surface Confidence = 3 SAWID SE_ANAE water source Confidence = 3 SPRINGS = GROUNDWATER Confidence = 3 MWWG GROUNDWATER= underground water.
23	2008 RERP veg mapping Confidence = 3: certain at even the fine (Palustrine) level that the ANAE vegetation class assigned matches the vegetation description provided. Confidence = 2: some assumptions made e.g. "River Cooba-Lignum Association" is River cooba and not lignum, based on description of how things were assigned in the metadata. Confidence =1: Bigger assumption made mostly in the absence of clear direction in the metadata e.g. "Baradine Red Gum Association" has been assigned as "tree" because it is actually the species Eucalyptus chloroclada (sometimes called Baradine, but sometimes called Baradine red gum) - but Baradine also grows with E. camaldulensis, so maybe the association name meant a combination of the two species and should have been assigned "Red gum" under the ANAE.
24	Namoi feature mapping Confidence = 3: fine scale mapping. System Type defined in the source data for all features.
25	MCMA Wetlands feature mapping Confidence = 3: system type defined in the source Confidence = 1: no type defined so assume palustrine
26	SAWID mapping Confidence = 3: system type defined Confidence = 2: SAWID lists feature as “EST - Estuary” but 2003 habitat mapping says “palustrine”. Define as palustrine with lower confidence (ie believe 2003 habitat mapping) Confidence = 1: no system type defined. Assume palustrine.
27	MWWG Features Confidence =2: system Type defined using NAME of system Lacustrine: upper (Name) like '%LAKE%' Riverine: upper (Wetlands_All_NEW.Name) like '%CREEK%' or upper(Wetlands_All_NEW.Name) like '%RIVER%' or upper(Wetlands_All_NEW.Name) like '%ANABRANCH%') Palustrine: upper(Wetlands_All_NEW.Name) like '%SWAMP%' or upper(Wetlands_All_NEW.Name) like '%LAGOON%')
28	Confidence = 2:Method to define riverine if NOT defined already in source data sets: riv_perc_overlap >0.3 Confidence =1: buffer ANAE quasi-fabric to 50m buffer. Intersect with wetland polygons. Overlap greater than 30% = riverine
29	Confidence =3: Water Source in Namoi. Specified groundwater or surface water in data set

30	NVIS vegetation assignment Use confidence attribution from the NVIS lookup table.
31	MWWG Salinity Confidence = 3: SALINE="YES" Confidence = 2: SALINE="YES?" (note the question mark) Confidence = 1: SALINE= blank therefore assume fresh.
32	MWWG water regime(set using intersect with NSW hydroarea) Confidence = 2: NSW topo hydroarea pereniallity = 1 or 3. Confidence = 1: no data. Assume periodic inundation Confidence = 3: perenniality = "NO" (explicit definition) Confidence = 1: NSW topo data = "mainly dry" but MWWG = permanent. MWWG preferred as mapping was from ground surveys. Lower confidence.
33	SPRINGS Confidence = 3:permanent defined using two fields in the dataset - L3_WaterRegime_Wetlands.Src1DataValue = 'Permanent, near permanent (static)' OR L3_WaterRegime_Wetlands.Src2DataValue = 'Permanent, Near Permanent' Confidence = 1: no data therefore default to assumption that springs are "Commonly wet".
34	ASRIS Soils Confidence =1: all confidence; source data very coarse.
40	**System Type** NSW Regional Vegetation Mapping (Riverina, Central West and Border Rivers) Confidence = 1 (assumed Palustrine) Confidence = 2 Typha, emergent marshes (Palustrine by definition) Coorong Habitat Mapping Confidence = 2: System type defined in data set but determined from a distance with binoculars ACT ANAE mapping Confidence = 3: (2017 project - deemed high quality) Victorian ISC Rivers Confidence = 3: (mapped by LiDAR) SA and VIC state veg mapping Confidence = 2 boundaries used to define floodplains QLD Regional Ecosystems Confidence = 3
41	Use of WOfS to boost Hydrological regime (whole basin) Confidence = 3: Median WOfS >=200
42	Vegetation Attribute NSW Regional Vegetation Mapping (Riverina, Central West and Border Rivers) Confidence = 2 : Mapped from PCTID Confidence = 3 : PCTID and NVIS Vegetation agree same value Confidence = 4 : PCTID, NVIS and MDBA modelled vegetation agree on same value
43	Water Source, Water Type, Water Regime Riparian and Floodplain Mapping NSW Regional Vegetation PCTID, SA and VIC state mapping in NVIS Confidence = 1 : Assumed defaults. Surface water, Fresh water, Periodic inundation (Water regime also checked against WOfS - see ConfID 41)
99	Typology or system type over ridden manually Confidence = 3 (or can be set lower by user)