Applying an Attribute Based Classification Scheme
to understand the seascape-scale intertidal and subtidal ecosystems of the Central Queensland (CQ) coast

Problem: To understand and manage intertidal and subtidal ecosystems, a seamless map is needed to answer the questions
"What is it?" "Where is it?" "How does it work?"
- Currently many disparate datasets exist ie. many different seagrass, corals, mangroves, saltmarsh etc.
- Data needs translating to a common language to allow merging into a seamless layer
- Currently mangrove and saltmarsh is part of terrestrial and aquatic ecosystem mapping.

Solution: A transparent, Attribute-based Classification Scheme to-
- **Classify** datasets based on biophysical attributes in common
- **Typology-** define ecosystem types in terms of these attributes
- **Map the types** in a seamless ecosystem map

The Queensland Intertidal and Subtidal Ecosystem Classification Scheme (scheme) uses the *biological, physical and chemical characteristics* of the water column and sea floor to classify intertidal and subtidal ecosystems, which includes estuarine and marine environments.
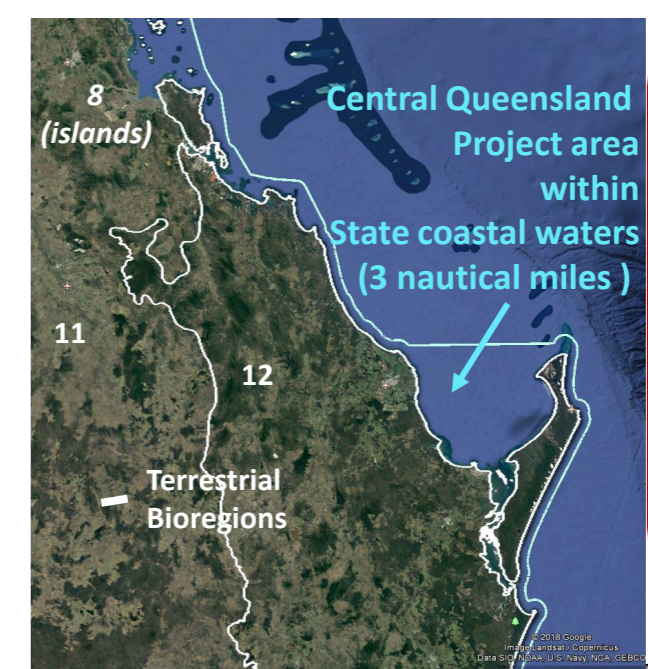
The scheme develops a common understanding and language of classification to improve communication and lead to better management outcomes.

It provides a structured framework and understanding available for mapping. The scheme separates the stages of Attribute classification from Typology.

Features of the scheme are shown in the box below.
Refer to Module 1 on WetlandInfo web page for details

1.1 **A technical collaborative process** in CQ involved multiple stakeholders in participative workshops
The CQ technical expert panel (CQ panel) defined the purpose, scale and outputs, choosing:
- A **benthic** classification scheme.
- **2.1** A **seascape** scale classification typology for general management purposes
- Outputs: **a mapped attribute classification, ecosystem types & descriptions**

Central Queensland Project area within State coastal waters (3 nautical miles)
8 (islands) 11 12 Terrestrial Bioregions

To devise a typology, the CQ panel shortlisted the **Attributes and their categories From the Scheme** (for Example, see grey box left): saltmarsh and mangrove categories from the Scheme needed to map the Structural Macrobiota attribute

ATTRIBUTE CLASSIFICATION for Central Queensland
1.2 The CQ technical panel / project team devised an attribute classification
- **Selected** from the scheme the attributes and their categories relevant to CQ
- **'Cross-walked'** candidate datasets based on attributes in common
- **Compiled** the data into attribute datasets. NB NO HIERARCHY IMPLIED!

B_DEPTH	benthic depth	
CONSOL	consolidation (rockiness for potential attachment of biota)	
INUNDTN	inundation (tidal)	
NRG_MAG	energy magnitude (wave)	
SED_TEX	sediment texture	
SMB_CMP	structural macrobiota – animals and plants creating living structure (Example below)	
SUB_CMP	substrate composition – substrate origin (terrestrial / carbonate)	
T_MORPH	terrain morphology – ups and downs of the terrain	

2.4 The CQ panel **defined the rule-sets** that combined **attributes** and their **categories** to describe **intertidal & subtidal ecosystem types**
e.g. Inundation 'Intertidal', Structural macrobiota 'Grass or herb' for mangrove & saltmarsh examples
See 2.5 Typology extract (below)

2.5

Scheme
Structural Macrobiota categories
- Grass/herb/sedge - undifferentiated
- Grass/herb/sedge - grass or herb
- Grass/herb/sedge - succulent
- Grass/herb/sedge - sedge
- Algae - Encrusting
- Algae - Turf mat
- Algae - Filamentous
- Algae - Blue-green
- Algae - Macroalgae
- Algae - Erect calcareous
- Algae - other or undifferentiated
- Mangrove - Avicennia
- Mangrove - Rhizophora
- Mangrove - Ceriops
- Mangrove - Mixed
- Mangrove -undifferentiated
- Other trees - Melaleuca, Casuarina
- Other or unspecified flora
- Bare – (none)

Apply the Scheme by Cross-walking datasets into composite Attribute layers

Q: Can field values of Candidate Source mapping **CROSS-WALK** to the Categories Of the Scheme?

Match the Scheme categories with the candidate dataset (Example)
1) Regional Ecosystem mapping (REs)
- None (e.g. bare saltpan with or without microphytobenthos) = 11.1.2a
- Grass/herb/sedge - undifferentiated = RE 12.1.2 the default outer boundary in Bioreg 12
  - Grass/herb/sedge - grass or herb e.g. *Sporobolus* salt couch grassland = 11.1.1, 8.1.3
  - Grass/herb/sedge - succulent e.g. *Sarcocornia* succulents = 11.1.2 , 8.1.2
  - Grass/herb/sedge - sedge e.g. *Eleocharus* sedgeland = 11.1.3, 8.1.4
  - Algae - Encrusting e.g. microphytobenthos - benthic micro-algal mat x no separate BMA
- Mangrove -undifferentiated = RE 12. 1.3 becomes the default outer boundary in Bioreg 12
  - Mangrove – Avicennia = 11.1.4b
  - Mangrove – Rhizophora = 11.1.4a
  - Mangrove – Ceriops = 11.1.4c
  - Mangrove – Mixed =11.1.4d
- Other trees - Melaleuca, Casuarina e.g. 12. 1.1, 8.1.5

1.2

Above: Composite saltmarsh and mangrove mapping of Structural Macrobiota (SMB) categories based on REs

Compile with all other SMB datasets

GIS processing steps
3.3 Benthic Depth / Inundation / Consolidation / Sediment Texture / Substrate Composition / Terrain Morphology / Energy Magnitude → Flatten → Structural macrobiota (overlapping / concatenated)
Apply Typology Rulesets
Ecosystem Types - Dominant Type - Co-Type - Naturalness Qualifier

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Features of the scheme
Aligns with existing attribute-based classifications
- National ANAE and NISB schemes
- Queensland Regional Ecosystems
- Queensland Wetlands classification

- Distinction between **attribute classification** and **typology stages**

Separate **benthic** and **water column** classifications
The water column is **dynamic**, varying a four dimensions -> modelling
The sea floor is more **enduring** -> mapping

Spatial hierarchy of **scales / levels**
Regional level / Subregional level / Seascape level / Habitat level / Community level

Terminology: For a given scale or level, an **attribute has categories**
e.g. Structural macrobiota has categories for the various biota

Attribute classification → Typologies → Mapping/modelling specifications and rules → Released products

Detailed steps to apply the classification. *Numbers in other sections of the poster refer to these steps.*

| Stages | Attribute classification | Typology | Mapping | Product release |

Steps
- Define the purpose, scale and outputs → Define the purpose → Align mapping purpose with classification and typology → Release draft mapping and supporting products for consultation
- Assemble the attributes → Shortlist attributes and categories and collapse/ group categories → Map attributes → Release updated products
- Define the attribute hierarchy → Map types
- Define and run rule-sets → Review and refine mapping
- Review and refine typology (reclassification) → Name types

Outputs
Attribute schema / Field collection schemes / Attribute conceptual models — Conceptual models / Type descriptions / Type field validation — Mapped attributes / Mapped types / Multimedia maps — Web content suite / Conceptual model series / Model inputs

https://wetlandinfo.des.qld.gov.au/wetlands/what-are-wetlands/definitions-classification/classification-systems-background/intertidal-subtidal/

2 **TYPOLOGY** - a key that allocates ecosystems to types
- Uses **attribute & category** combinations
- **Rule-sets** are organized by attribute hierarchy

Ecosystem types
are combinations of **abiotic and biotic attributes**

POTENTIAL USES:
- Match them in the field
- Information for management

Typology extract mangrove, saltmarsh examples
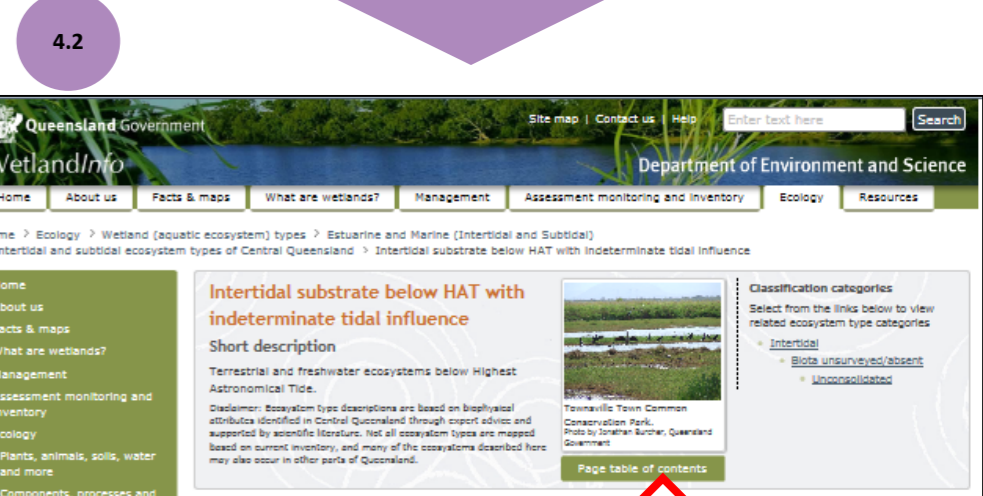Diagnostic attributes: Inundation (intertidal) Structural macrobiota (category)

Intertidal grass-herb-sedge-other succulent	Bare areas above MSL (i.e. Saltpan with or without microphytobenthos)	17
	Grass	2
	Grass-herb-sedge (undifferentiated)	1
	Sedge	4
	Succulent with herb	3
Intertidal mangroves and other trees and shrubs	Avicennia	8
	Ceriops	6
	Mangroves and other trees (undifferentiated)	5
	Mixed mangroves	9
	Other trees and shrubs	10
	Rhizophora	7

Other tidally influenced ecosystem types are not mapped by Land Zone 1 (remnant) REs. Attributes influencing these include:
- Structural macrobiota 'Unknown' or 'None'
- Inundation – e.g. 'Above MSL', 'Indeterminate'
- Sediment texture e.g. 'mud'
- Wave energy e.g. 'low energy'
- Terrain morphology e.g. 'channel'

Intertidal unconsolidated substrate	Above MSL unconsolidated mud (clay pan/saltpan)	27
	Indeterminate inundation - other mapping (e.g. terrestrial (wetlands, quarry, agricultural areas etc.)	119
	Unconsolidated - unknown texture - low energy	41
	Unknown substrate consolidation - channel	43
	Unknown substrate consolidation - outside channel	42

ONLINE - 94 Ecosystem types descriptions in terms of their **attributes**
4.2

Application example - Classify in the field

Grassland is elevated on LiDAR

Danaher 2000 polygons in green differ from the grassland outlines

Subdivide RE polygons using LiDAR and orthophoto

Current visualisation tools (orthophoto, LiDAR and field attributes used to split grass / herb / sedge, mangroves etc.
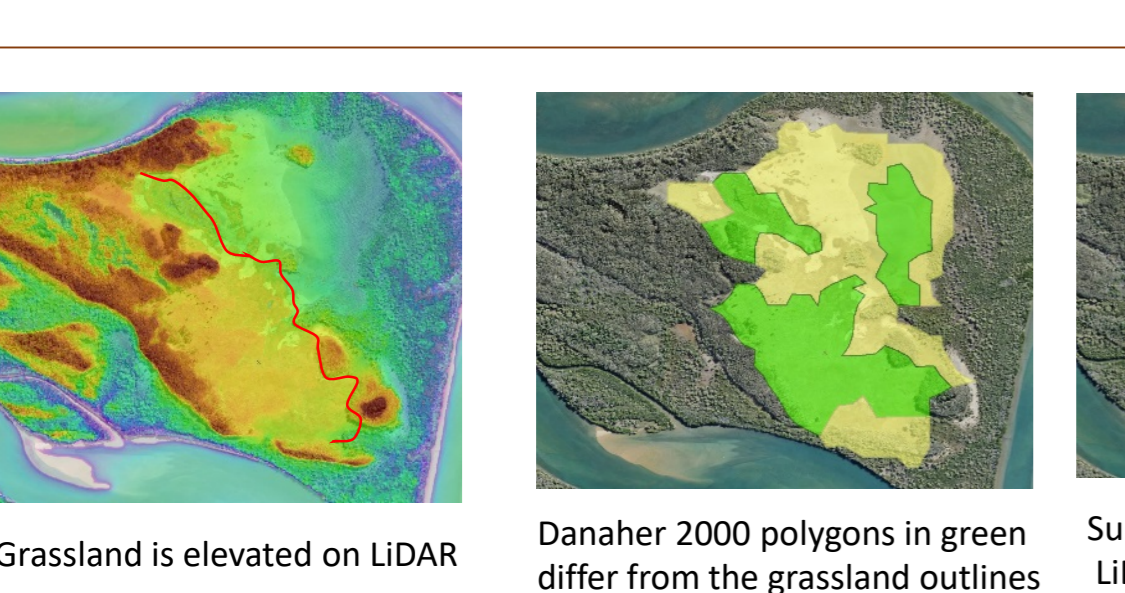
Potential field uses
- **Map the Gaps** e.g. validate existing mapping
- **Monitor**
- **Collect data** to enrich field inventory using the **Attributes and categories** of the scheme such as:
  - Structural macrobiota
  - Sediment texture
  - Inundation
  - Substrate composition
  - Terrain morphology
  - Energy

3.2 Review and refine **4.2**

Products - interactive web-mapping & ecosystem types

Layer List
Naturalness CQ
- ☑ Subtidal CQ
  - Subtidal coral
  - Subtidal seagrass
  - Subtidal algae
  - Subtidal boulders
  - Subtidal other biota
  - Subtidal consolidated substrate
  - Subtidal unconsolidated substrate
- ☑ Intertidal CQ
  - Intertidal grass-herb-sedge-other succulent
  - Intertidal mangroves and other trees & shrubs
  - Intertidal coral
  - Intertidal seagrass
  - Intertidal algae
  - Intertidal boulders
  - Intertidal other biota
  - Intertidal consolidated substrate
  - Intertidal unconsolidated substrate

Intertidal CQ: Below HAT - tidal influence indeterminate - natural (other mapping) or modified (e.g. agricultural)
Attributes and qualifiers
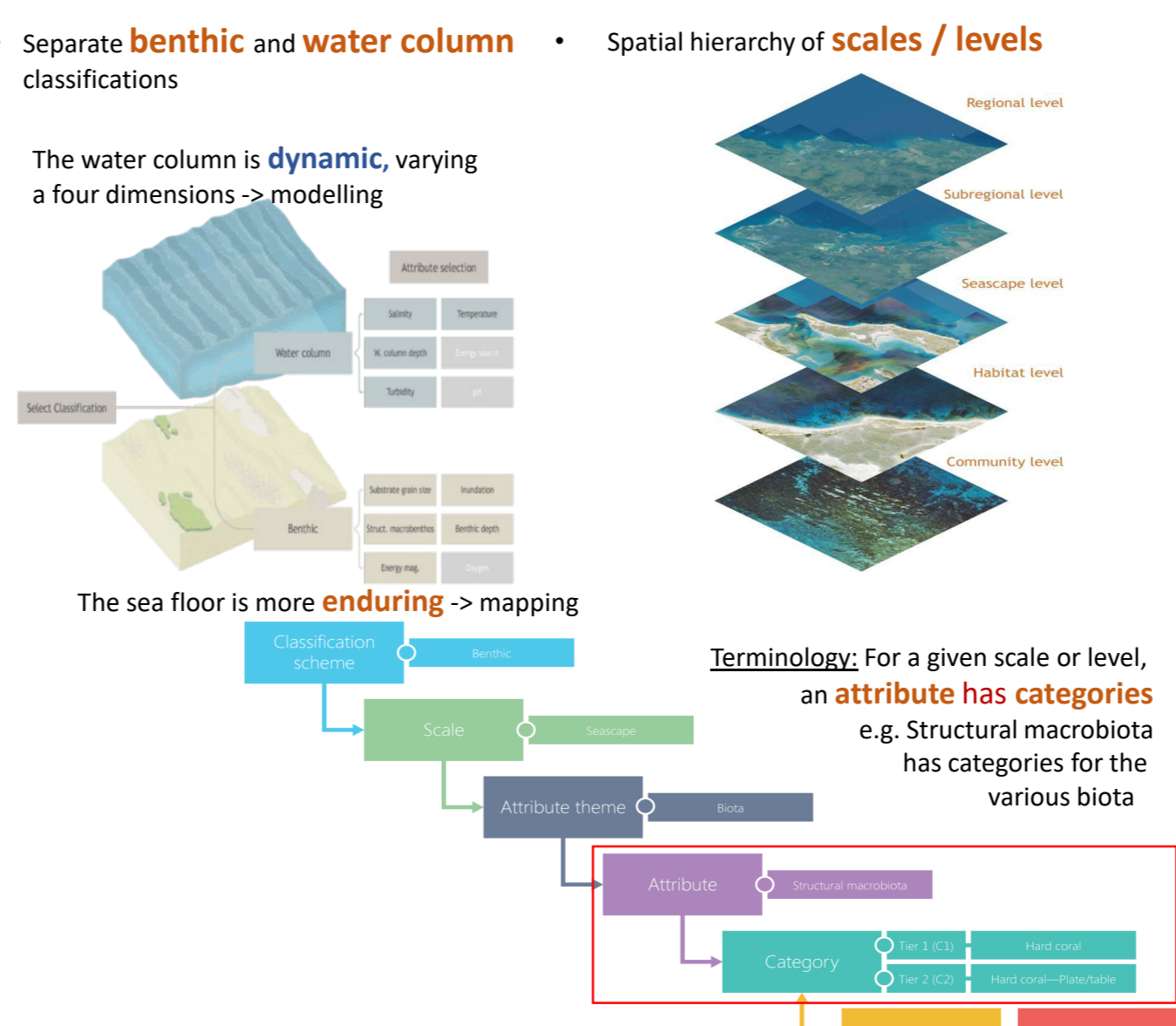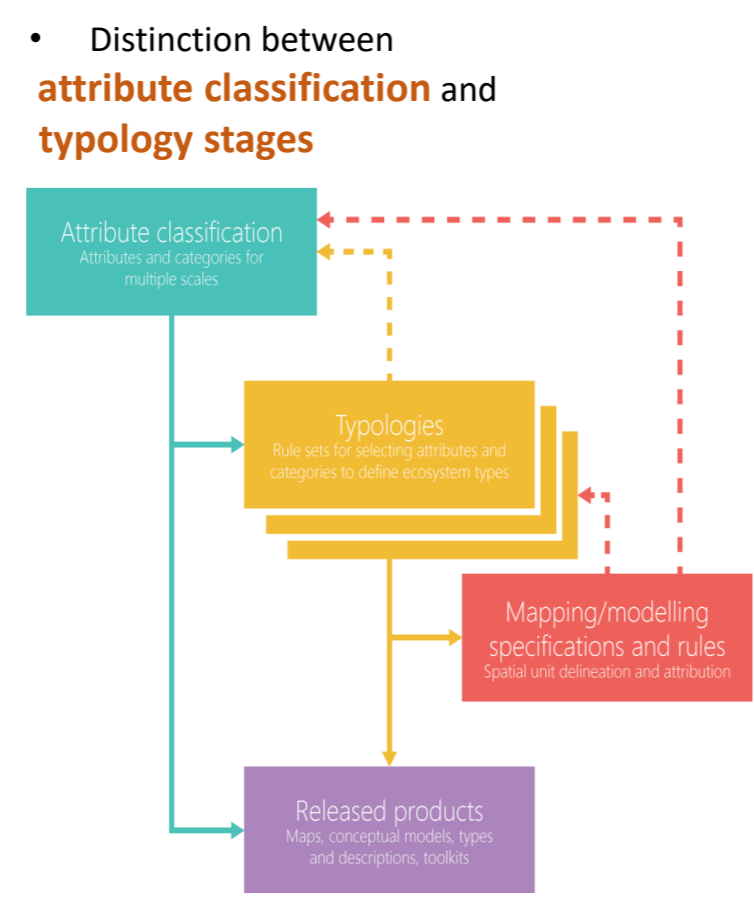**Metadata**

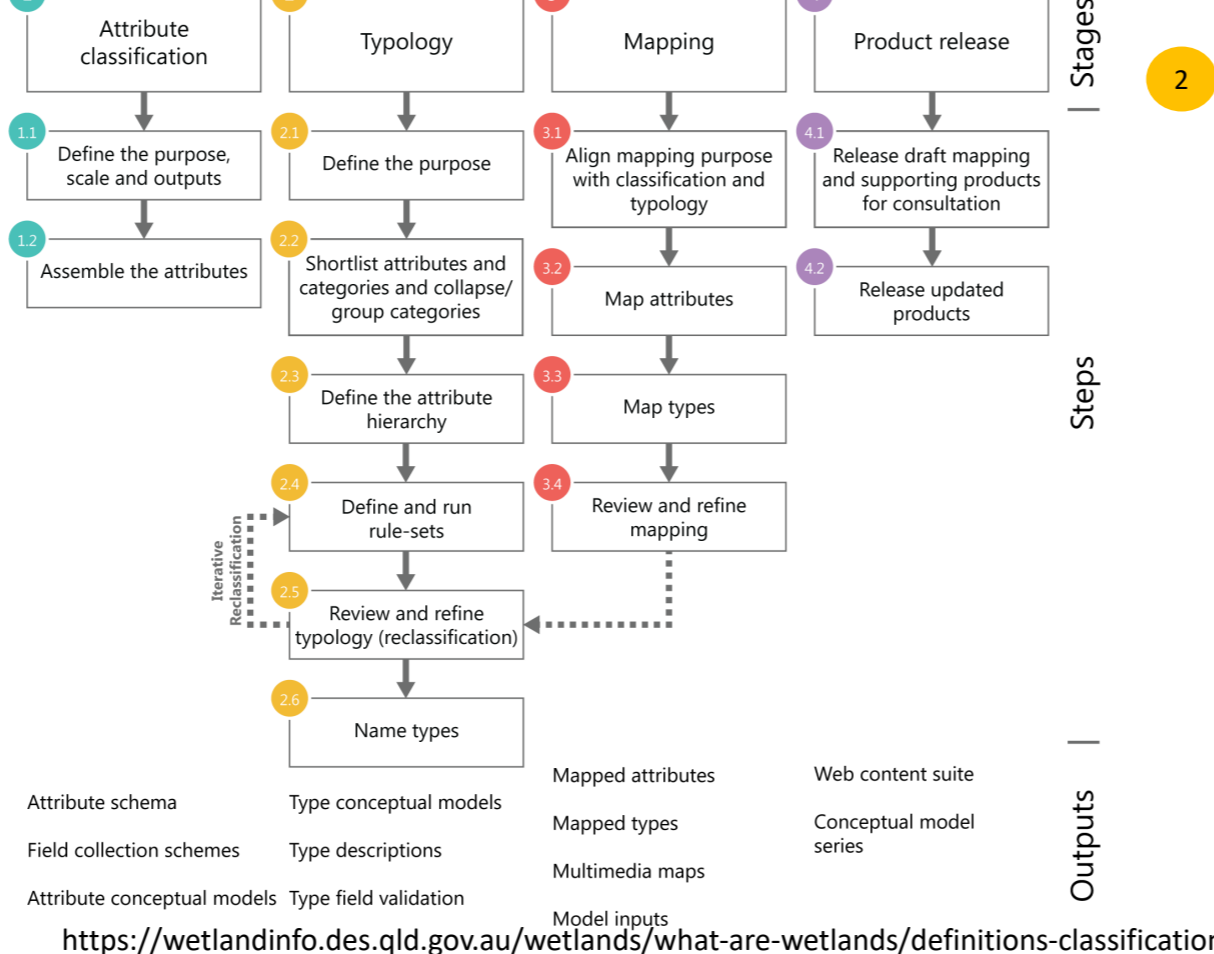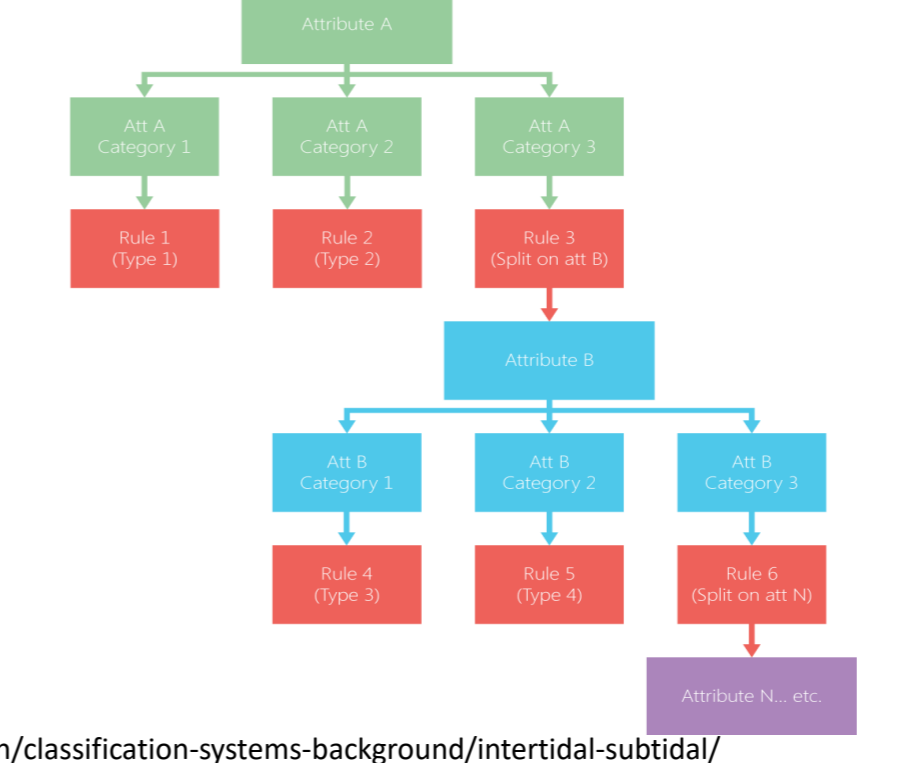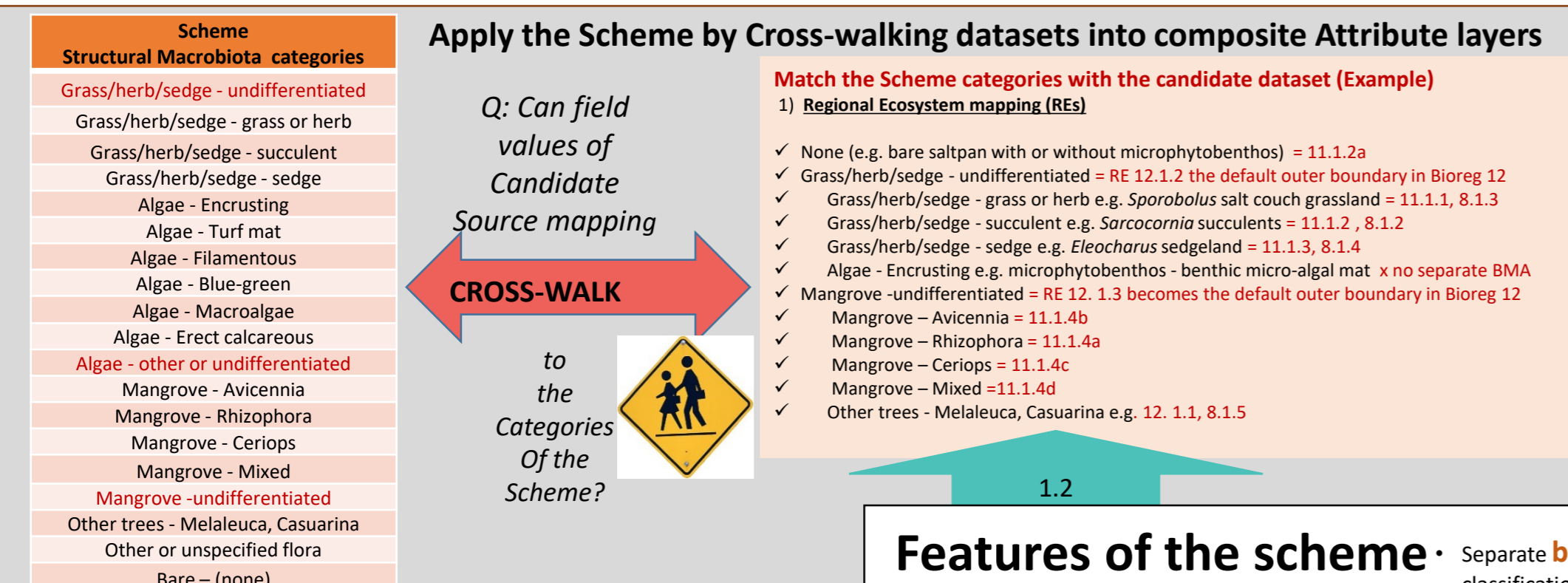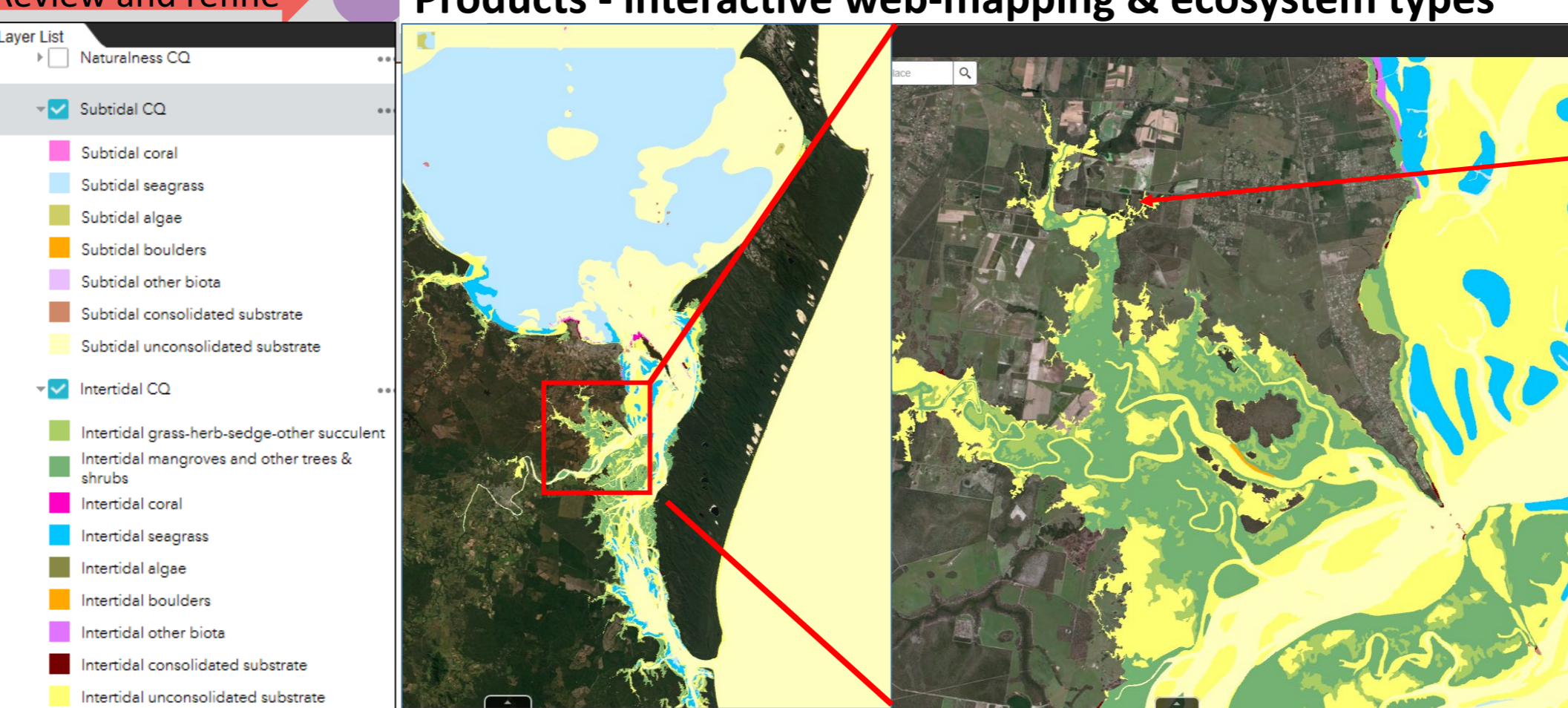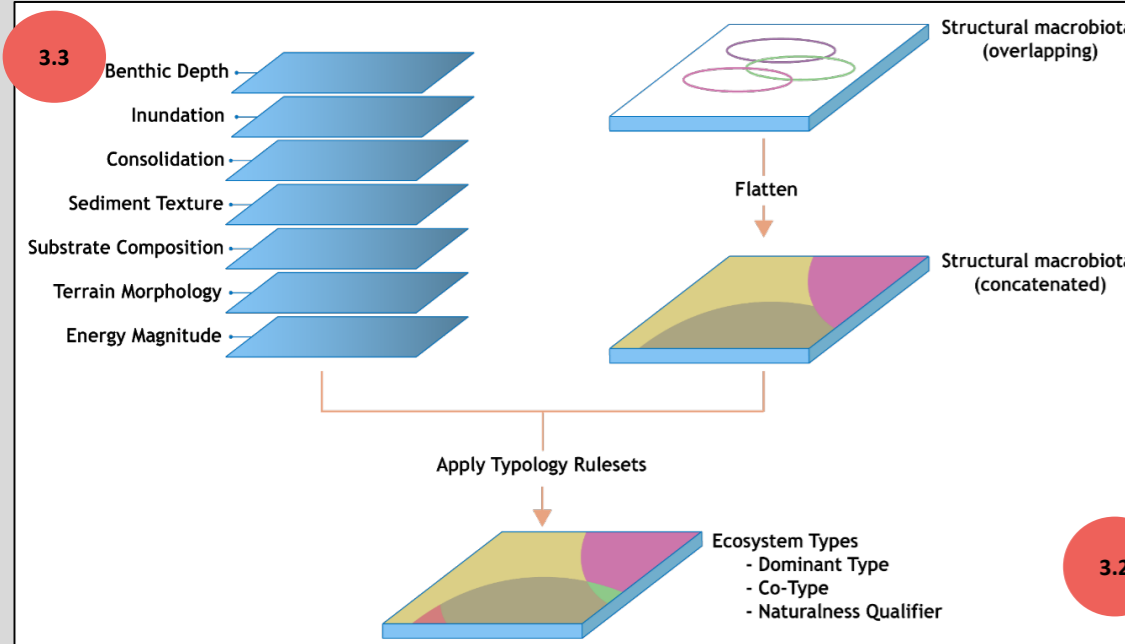| Dominant ecosystem type label: | Below HAT - tidal influence indeterminate - natural (other mapping) or modified (e.g. agricultural) |
Benthic depth:	>0m
Energy magnitude:	Very low
Sediment texture:	Sandy MUD
Structural macrobiota composition:	Unknown
Substrate composition:	Terrigenous (e.g. muds, sands and gravels derived from rock)
Terrain morphology:	Plane
Consolidation:	Unconsolidated

Interactive web-mapping links to **ecosystem type descriptions** & underpinning **attributes**