REFORM

REstoring rivers FOR effective catchment Management

A hydromorphological framework for e-flows

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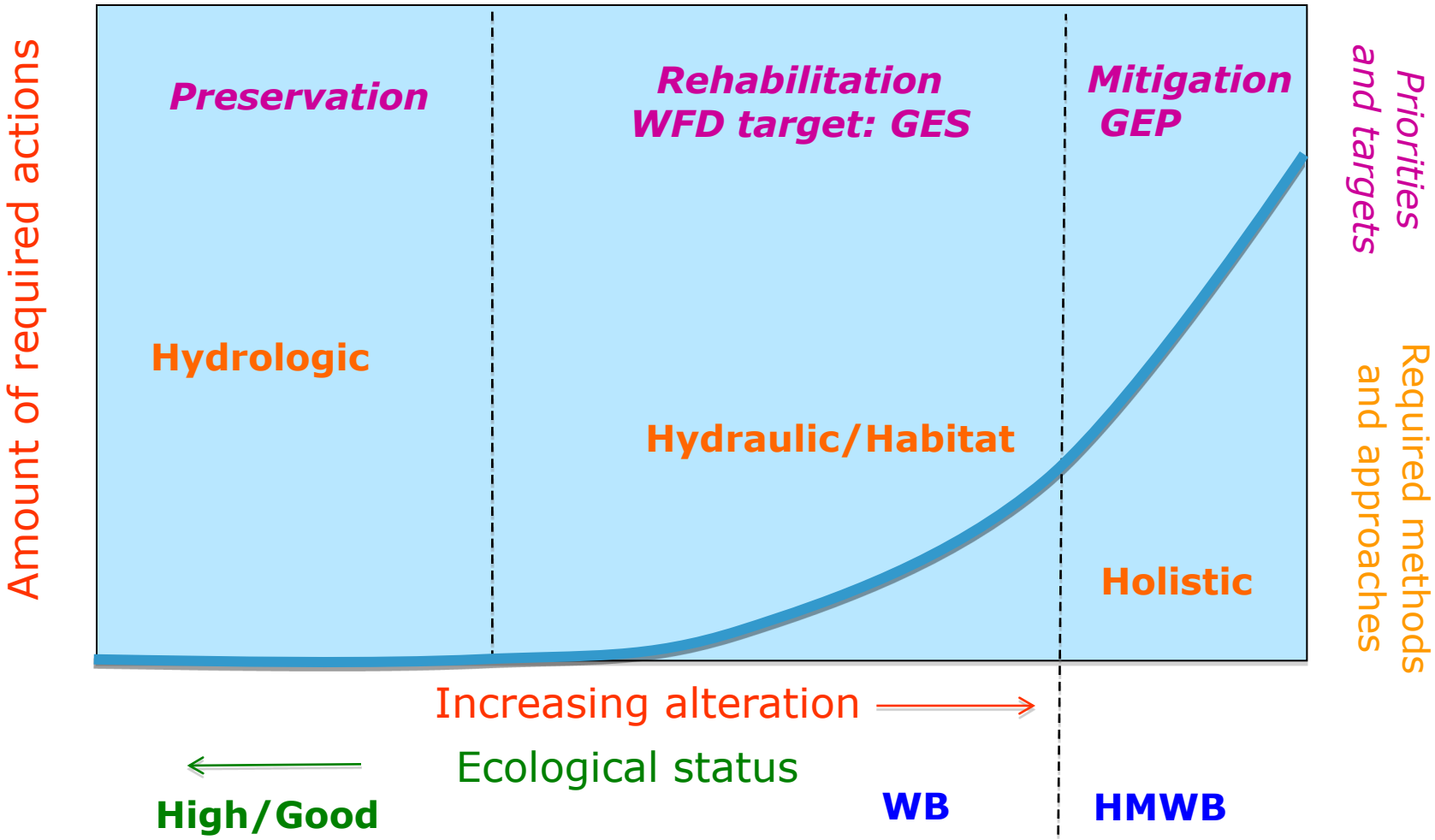
CONTEXT

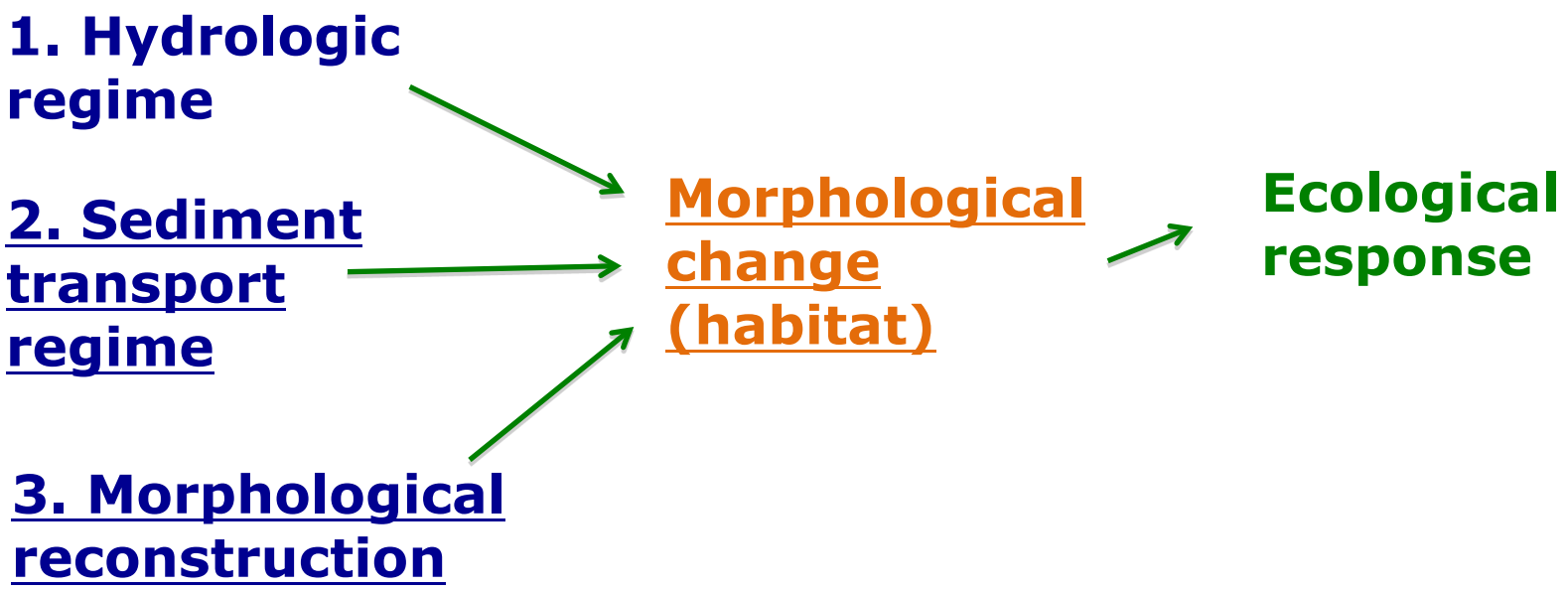
- In the context of the WFD, e-flows represent a possible measure to reach the objectives of good ecological status or potential
- Still little experience in the implementation of e-flows based measures
- The importance of sediment transport and related geomorphic processes as key components of the evaluation has only recently started to be acknowledged

E-FLOWS: METHODS, APPROACHES, APPLICATIONS



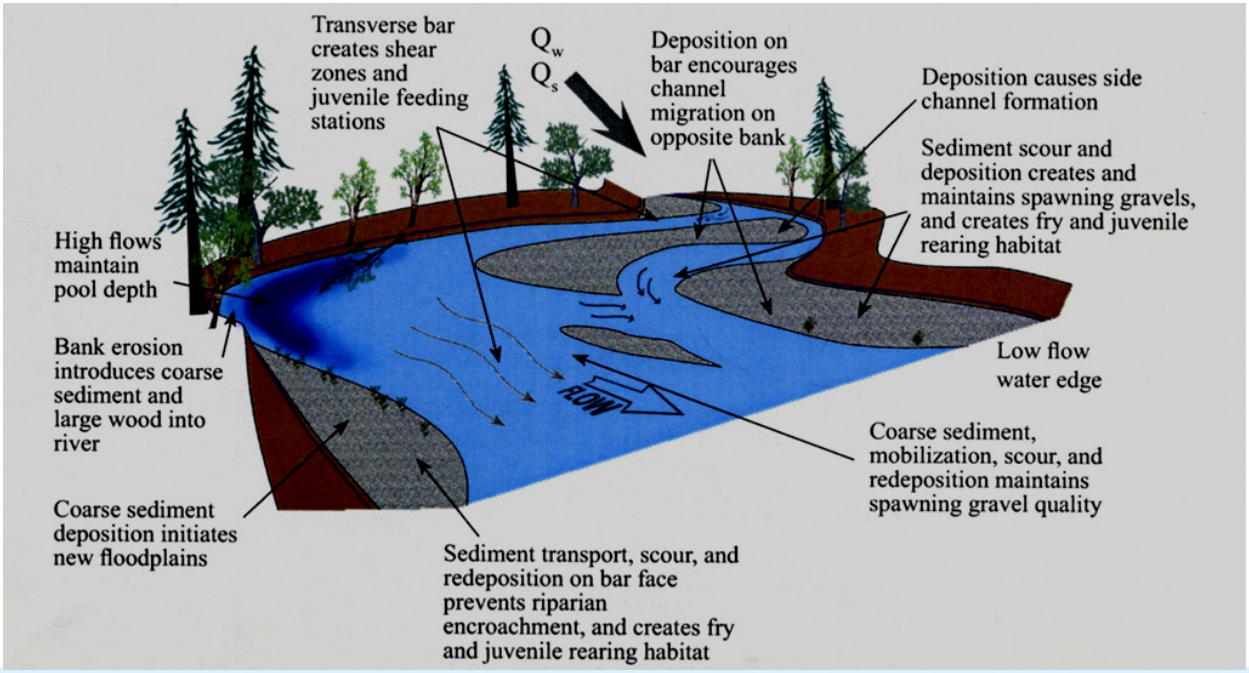
POTENTIAL E-FLOWS ACTIONS

Potential E-Flows actions



PARADIGM

- Enhancing morphological conditions will favour positive ecological response.
- Geomorphic dynamics of a river + functioning of physical processes essential to create and maintain habitats and ensure ecosystem integrity



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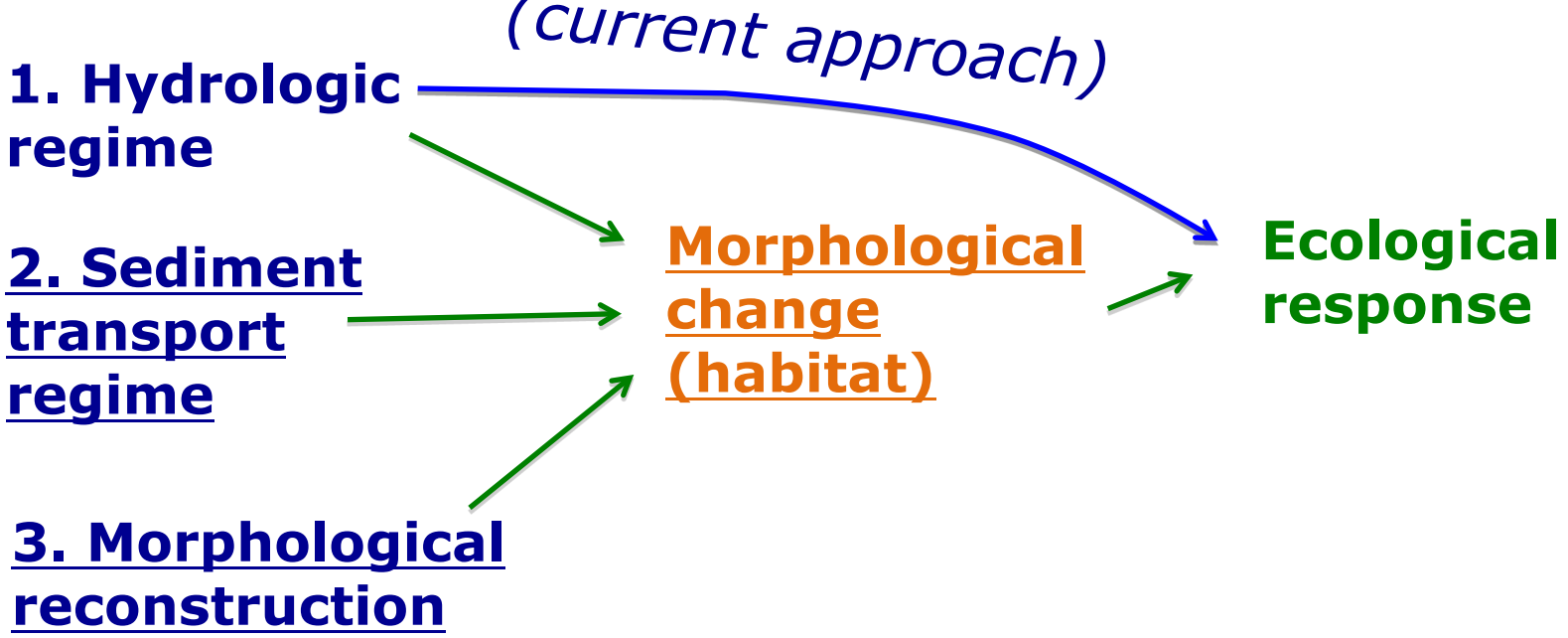

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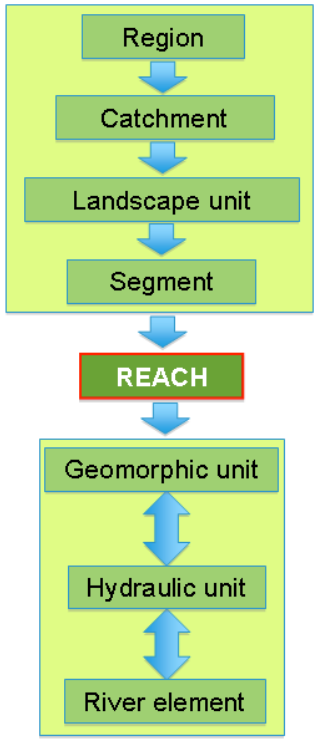
OVERALL HYDROMORPHOLOGICAL REFORM FRAMEWORK



Spatial context

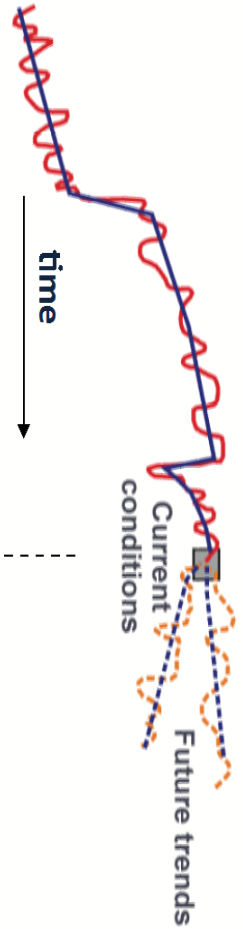
Temporal context

Stage I: Catchment-wide delineation and spatial characterization of the fluvial system

Stage II: Assessment of temporal changes and current conditions

Stage III: Assessment of scenario-based future trends

Stage IV: Management



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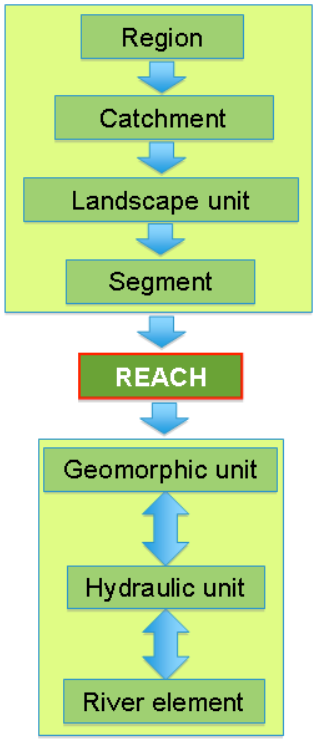
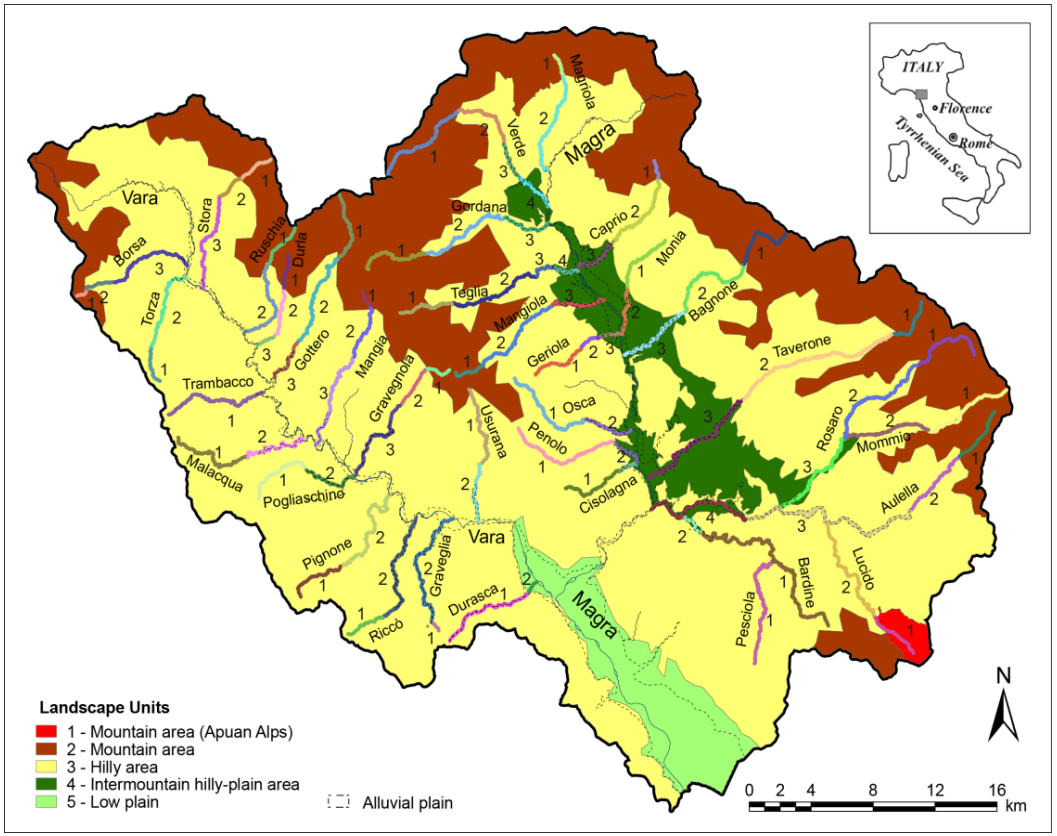
STAGE I: catchment wide spatial delineation and characterization





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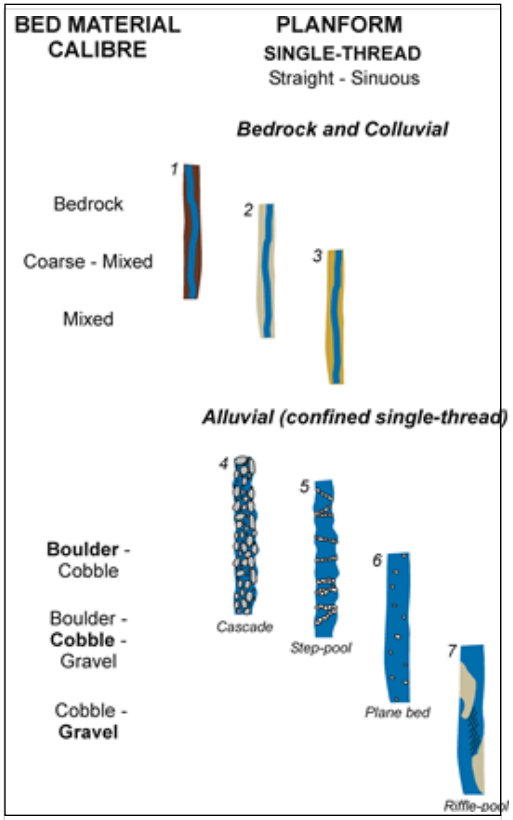
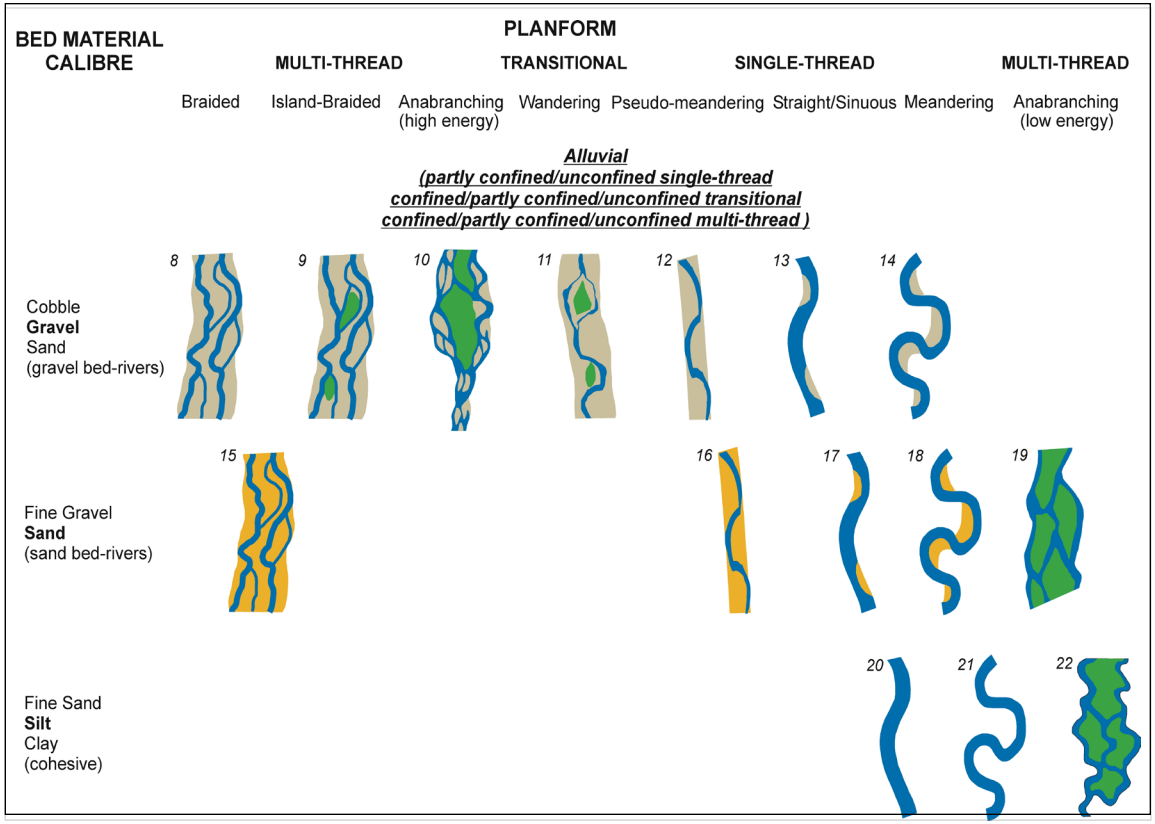
STAGE I

Classification of **River typologies** as part of the characterization process





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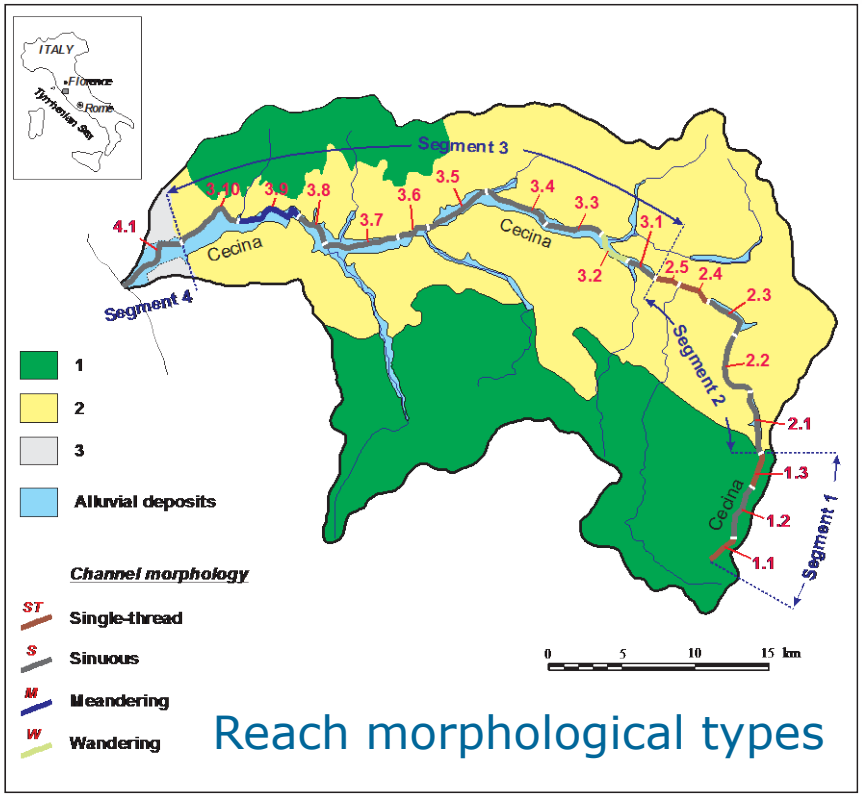
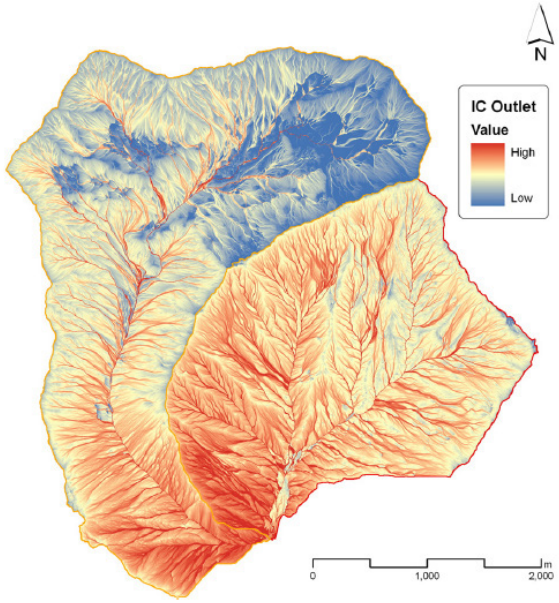
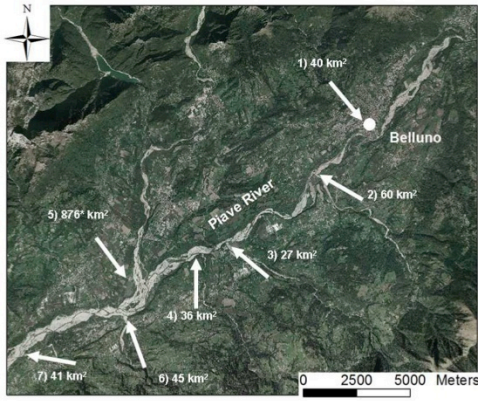
STAGE I: relevant aspects for e-flows



Reach morphological types





Sediment production and connectivity

STAGE I: relevant aspects for e-flows

1.identification of main sediment sources, delivery processes, and sediment transport along the river network to set existing alterations (i.e. dams) within the catchment context;

2. evaluation of effective discharge and of minimum flow needed to initiate sediment transport;

3. evaluation of impacts of existing alterations on the sediment budget.

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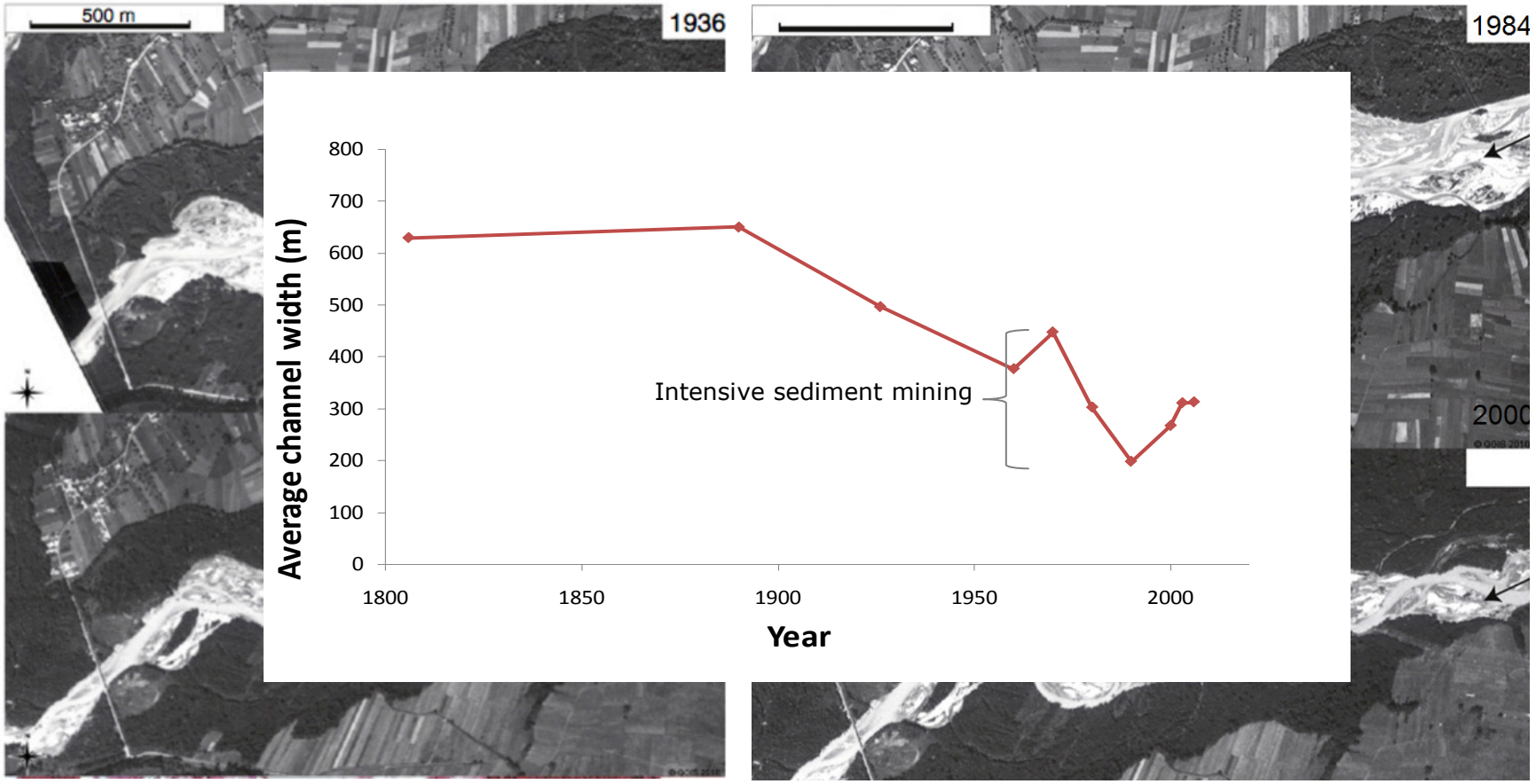
STAGE II: assessment of temporal changes and current conditions



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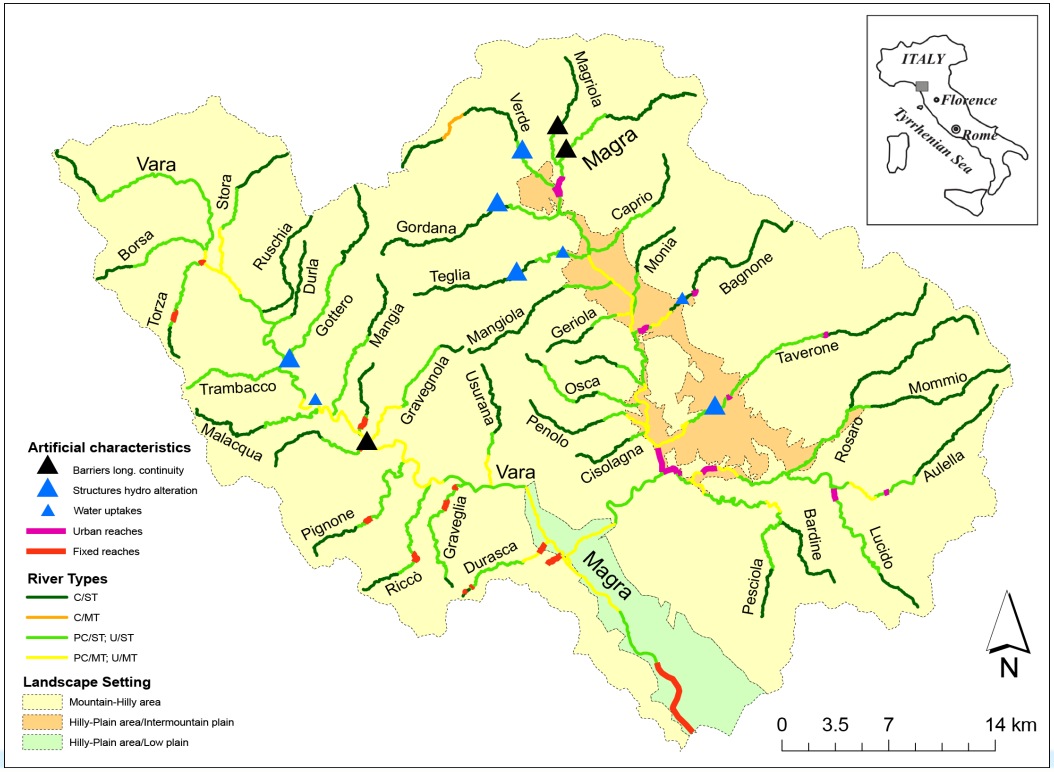
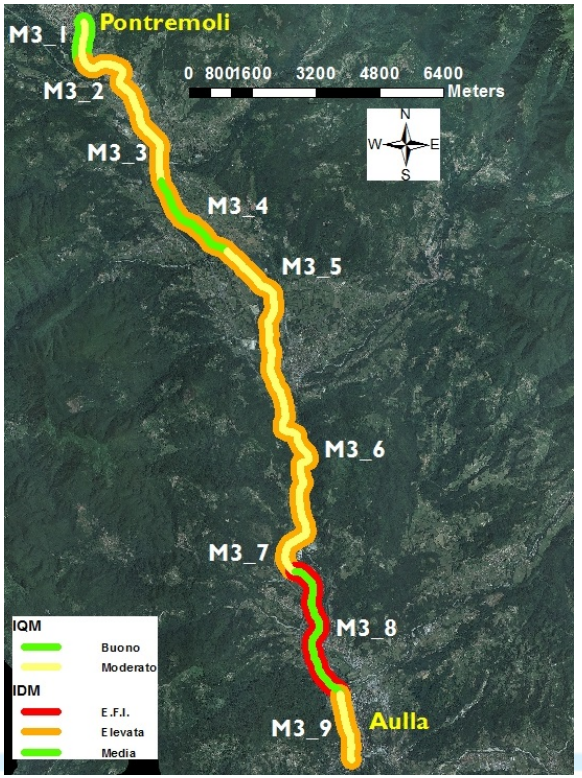
STAGE II

Diagnostic phase, producing identification of problems and critical reaches: (1) Initial screening; (2) Assessment of alterations of hydrological regime; (3) Assessment of morphological status (MQI)



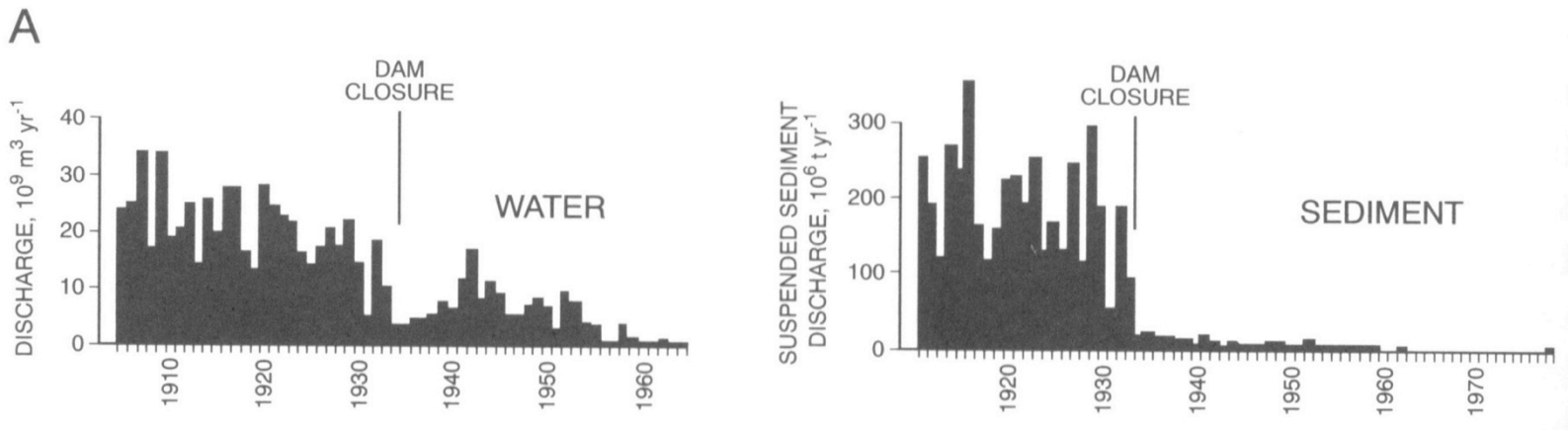


STAGE II: relevant aspects for e-flows

1. understanding how hydromorphological alterations (e.g., dams, weirs, water abstraction, etc.) have impacted channel morphology, identifying the spatial and temporal extent of such alterations;

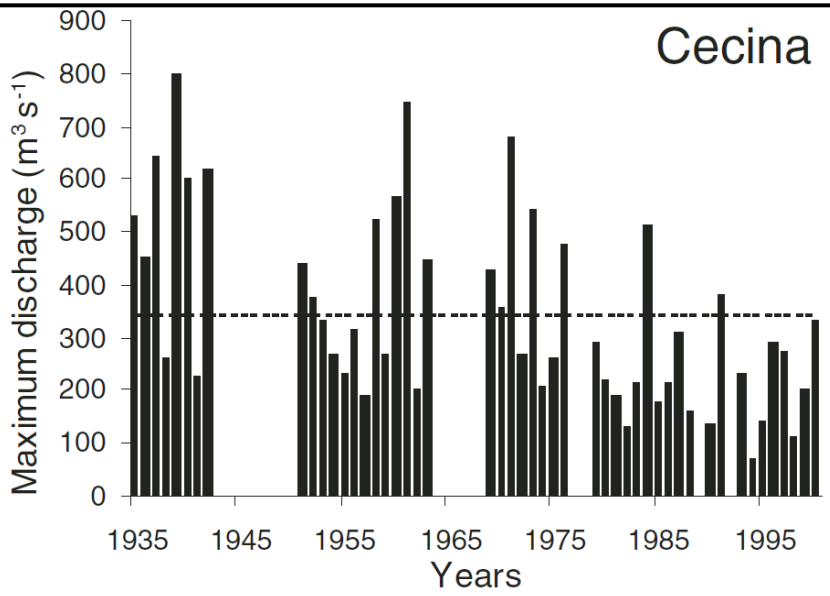
2. assessment of modifications of channel forming discharge, possible hydropeaking, and other hydrologic alterations;

3. impacts on sediment budget and channel morphology downstream of barriers.



Impacts on water and sediment flow downstream of Hoover dam, Colorado River, USA (Meade & Parker, 1985)

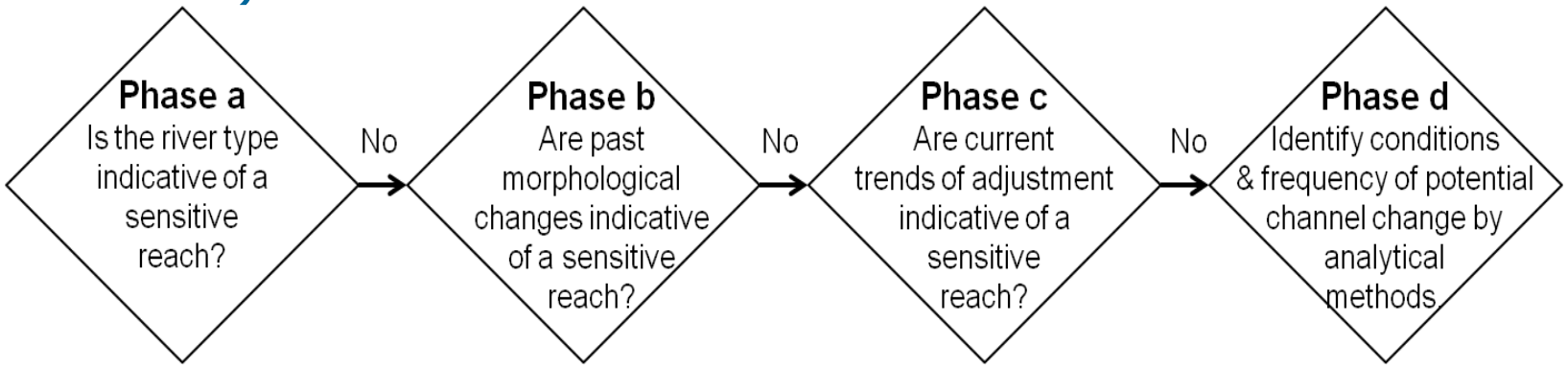
Reforestation in the drainage basin	Construction of levees and other bank protection structures	Dates of intense sediment mining
Since 1920s-1930s	Locally, since 1920s-1930s	1970s



River discharge alteration

STAGE III: assessment of scenario-based future changes

- Assessment of potential morphological changes occurring under different scenarios to select the best management options.
- Assessment of **sensitivity** and **morphological potential** at a catchment scale because the aim is to set priorities (i.e. reaches with higher probability of success).



Flow chart summarising the sequence of 4 phases developed in D6.2 and used to identify sensitive reaches

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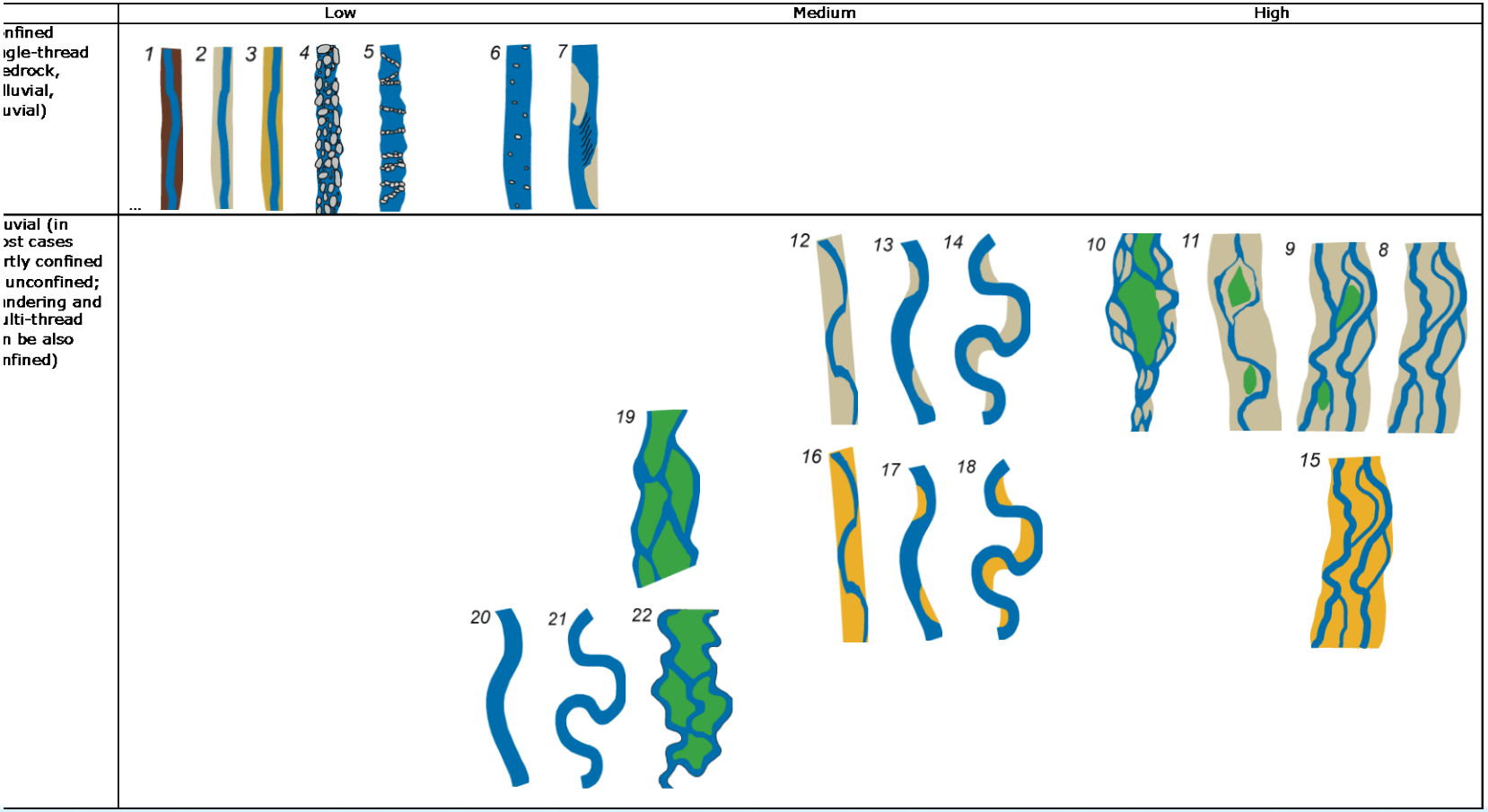
STAGE III: assessment of scenario-based future changes

Phase a: Simple classification of sensitivity based on river typology



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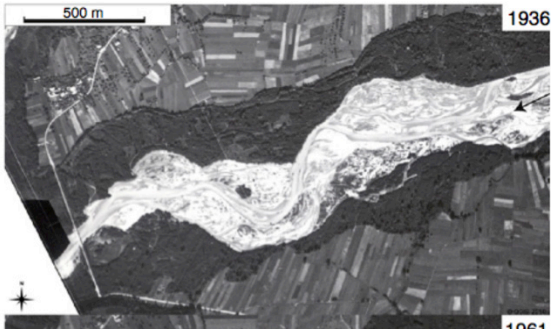
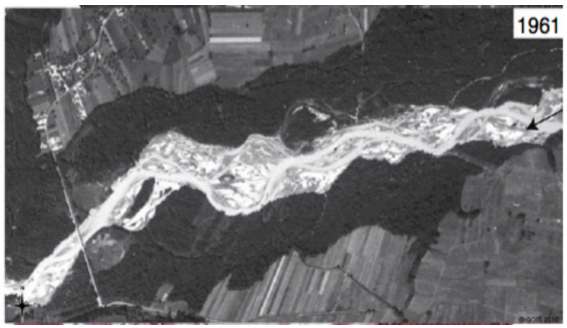
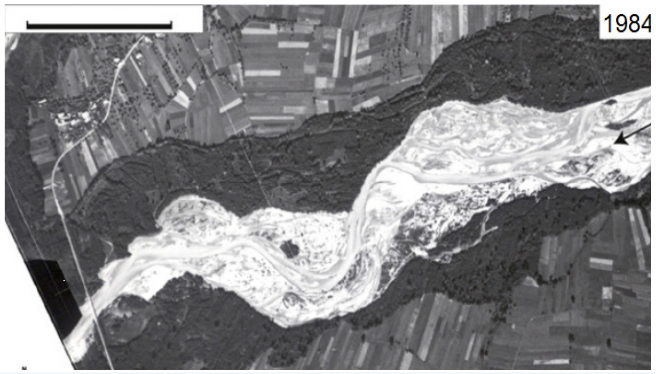
STAGE III: assessment of scenario-based future changes

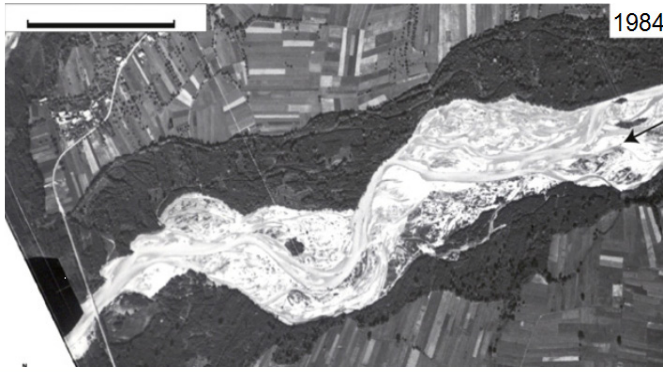
Phase b: Assessment of sensitivity based on past changes (last 100-200 years)





Phase c: Assessment of sensitivity based on current trends of adjustments (last 10-20 years)





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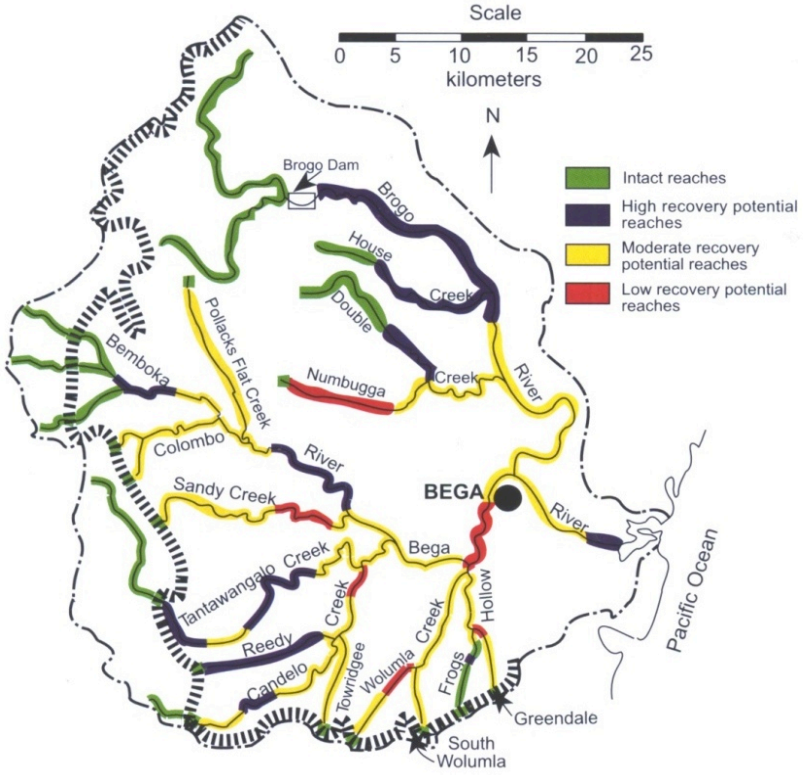
STAGE III: assessment of scenario-based future changes

Morphological potential: integration of **sensitivity** with other factors

- **Evolutionary trajectory** of change that determines current morphological conditions
- **Connectivity and position within catchment**: takes account of off-site impacts and limiting factors



STAGE IV: management

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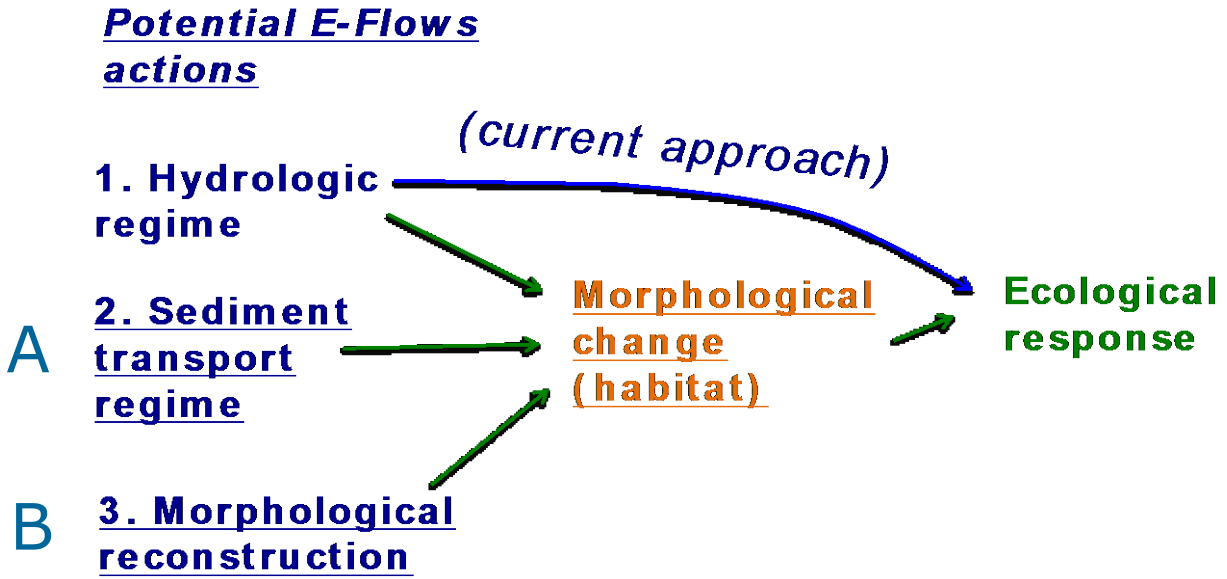
Selection of **possible e-flows actions** and assessment of **reach-scale sensitivity**



A. High sensitive reaches: supporting morphological changes

B. Low sensitive reaches: morphological reconstruction

STAGE IV: relevant aspects for e-flows

1. Identification of flows needed to initiate transport, determining and maintaining channel morphology and related habitats;

2. Strategy to release sediments downstream of barriers;

3. Geomorphic effects of possible removal of barriers.

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Let’s talk about it!