

“Capacity Building and Strengthening Institutional Arrangement”

Analysis and sampling of water and water pollution

Elaboration of guidelines regarding how to respect the national and international law about water, and development of planning systems to assess the water monitoring systems

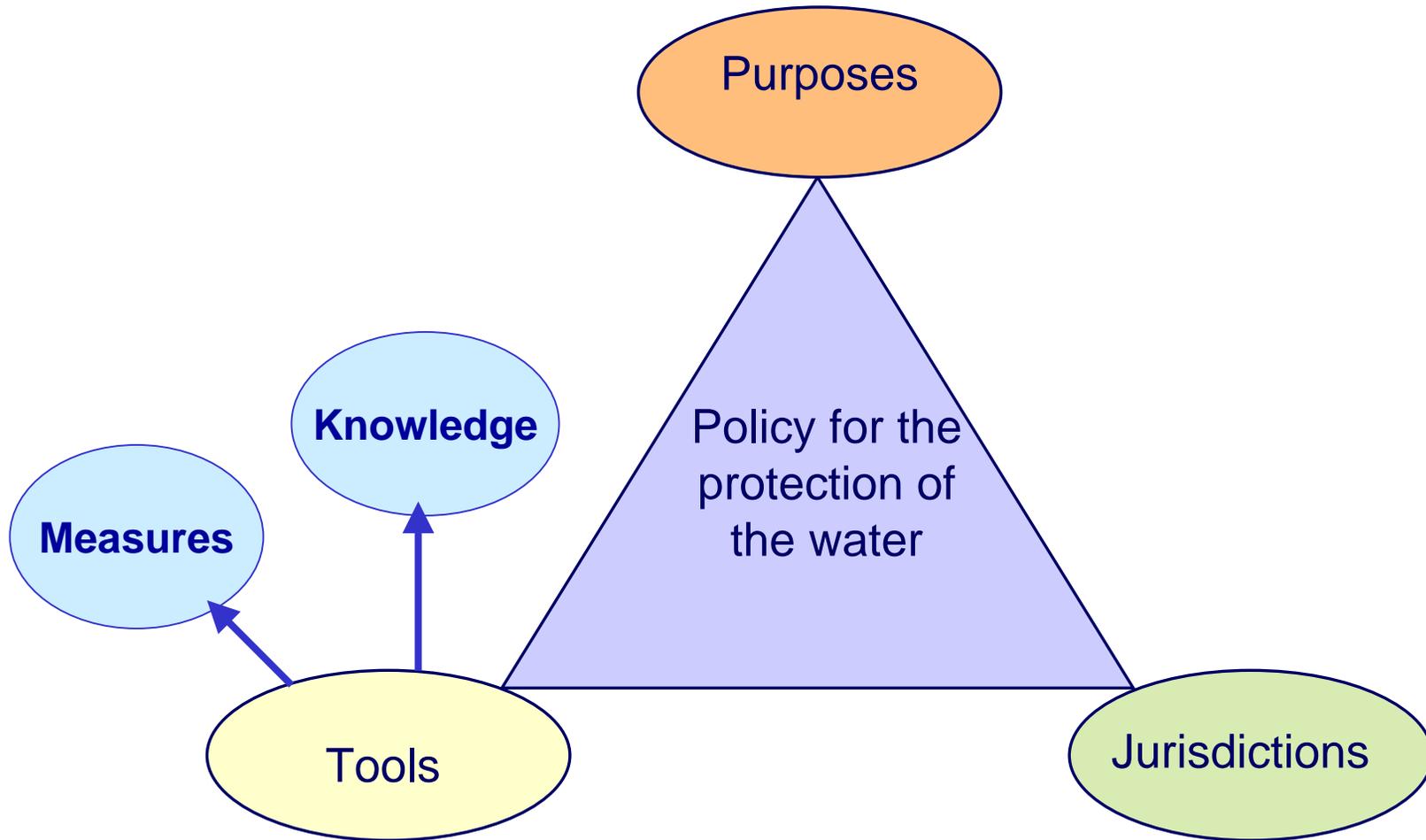
Part 1

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APAT

Agency for Environmental Protection and Technical Services

International and national law on water



Purposes

According to the 2000/60/CE Directive

- Prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
- Promotes sustainable water use based on a long-term protection of available water resources;
- Aims at enhanced protection and improvement of the aquatic environment, *inter alia*, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;
- Ensure the progressive reduction of pollution of groundwater and prevents its further pollution, and

Purposes

- Contributes to mitigating the effects of floods and droughts;
- Contributes to the provision of a sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use;
- Contributes to a significant reduction in pollution in groundwater;
- Contributes to the protection of territorial and marine waters, and
- Achieving the objectives of relevant international agreements, including those which aim to prevent and eliminate pollution of the marine environment, to cease or phase out discharges, emissions and losses of priority hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.

Purposes

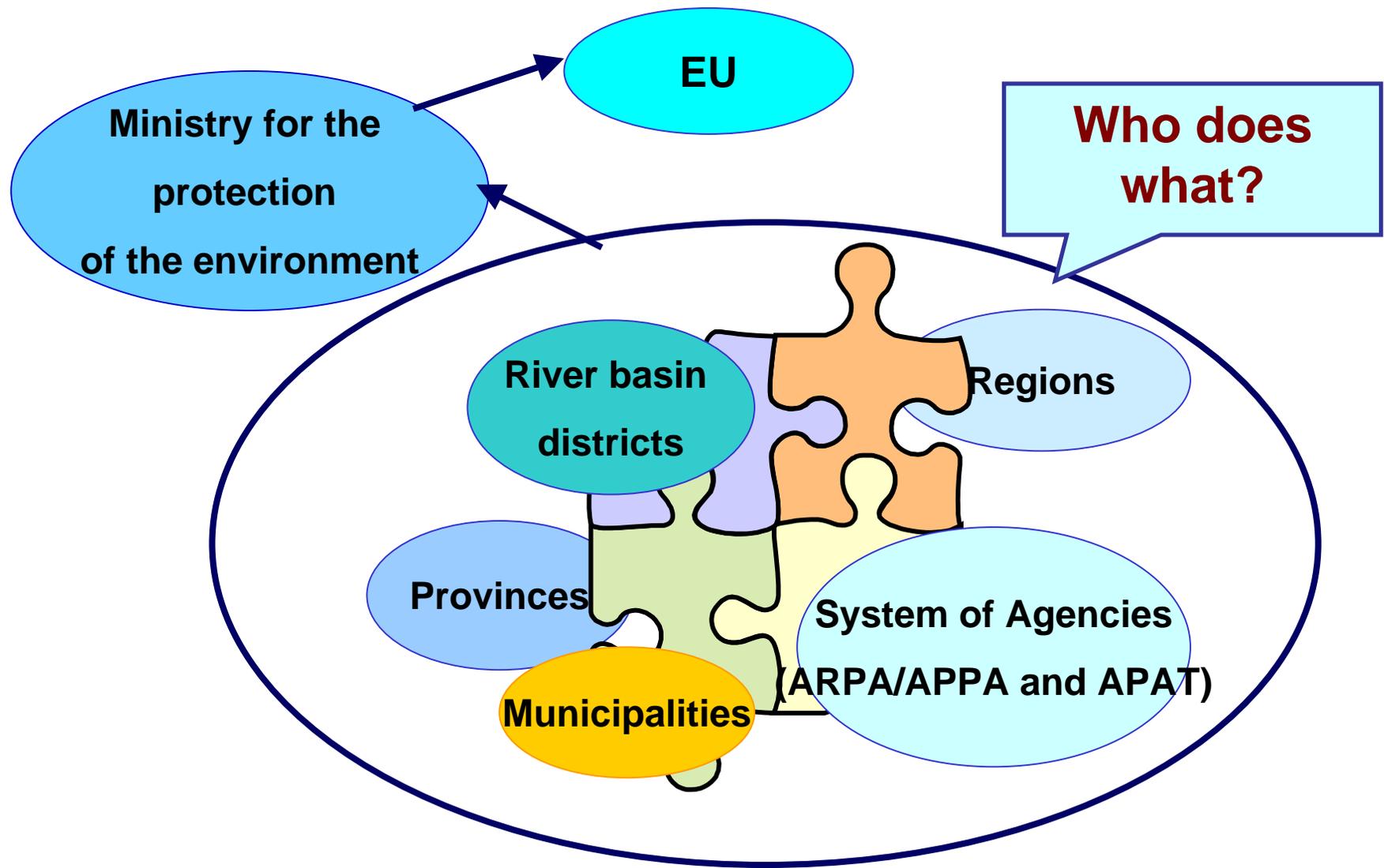
According to the Barcelona Convention

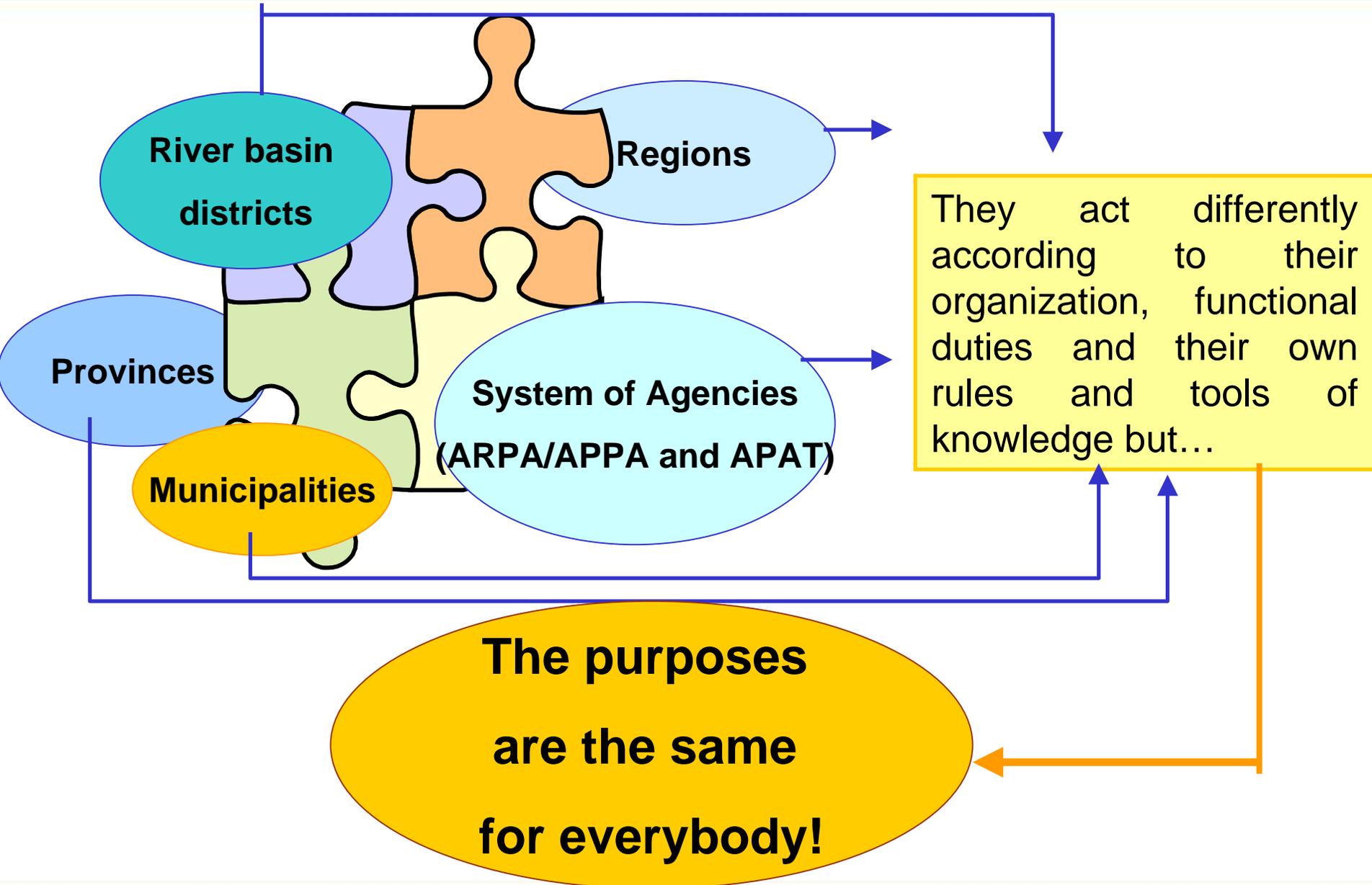
- The Contracting Parties shall....take appropriate measuresto prevent, abate, combat and to the fullest possible extent eliminate pollution of the Mediterranean Sea Area and to protect and enhance the marine environment in that Area so as to contribute towards its sustainable development.

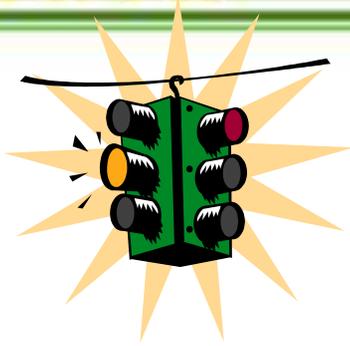
According to the Italian law the purposes are

- To prevent and reduce pollution and make concrete the restoration of the polluted water bodies;
- To achieve the improvement of water status and right protection of the water devoted to specific uses;
- To pursue long term sustainable uses of the water resource, giving priority to water for human consumption;
- To maintain the natural capacity of the water bodies to selfrecovery and the capacity of supporting wide and well structured animal and vegetable communities.

Italian jurisdiction

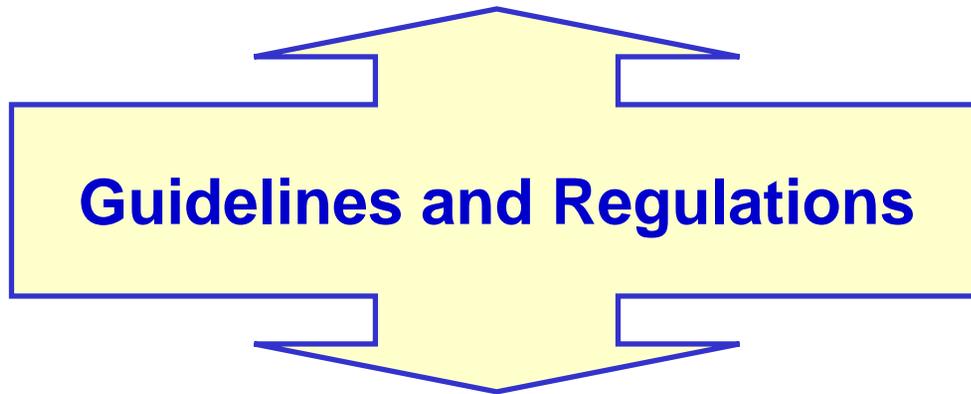






A majority of actors and tools make an ingrated and complex system of application!

In order to build the integrated system up and to keep over the time, all the actors and tools which compone it, must adopt and respect rules, standards, common protocols, by:



Sharing tools and working instructions



Italian law on water management plans a Technical Table (see the art.21 Directive 2000/60/EC – Regulatory Committee), set up by representatives from Ministry of Environment, Ministry of Health, National Environmental Protection Agency and Basin Authorities, Regions and Regional Environmental Protection Agencies.

The aim of the Technical Table is:

- To fix up shared guidelines and regulations for putting into practice the purposes of the law;
- To coordinate activities finalized to collect water data flow.

Guidelines
are necessary in order to:

- Address;
- Guide;
- Coordinate.

making

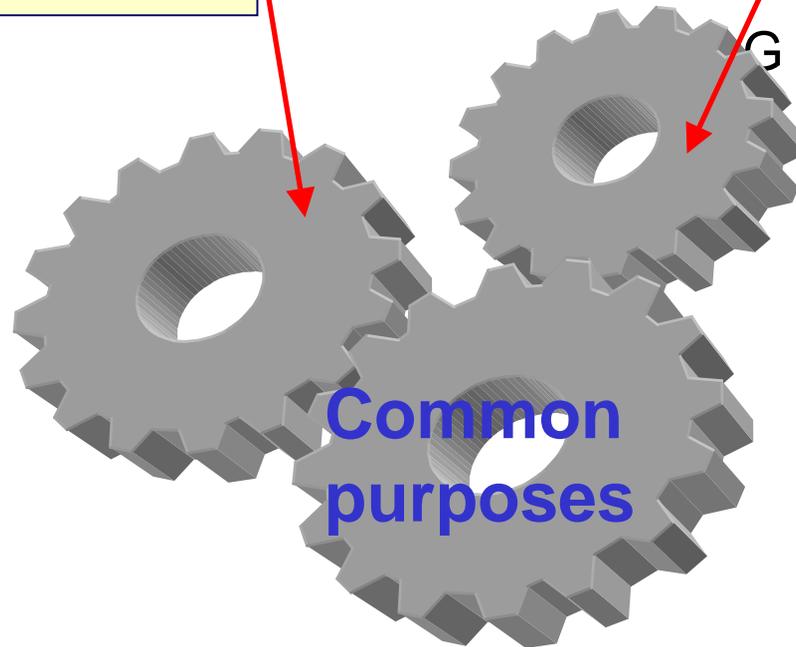


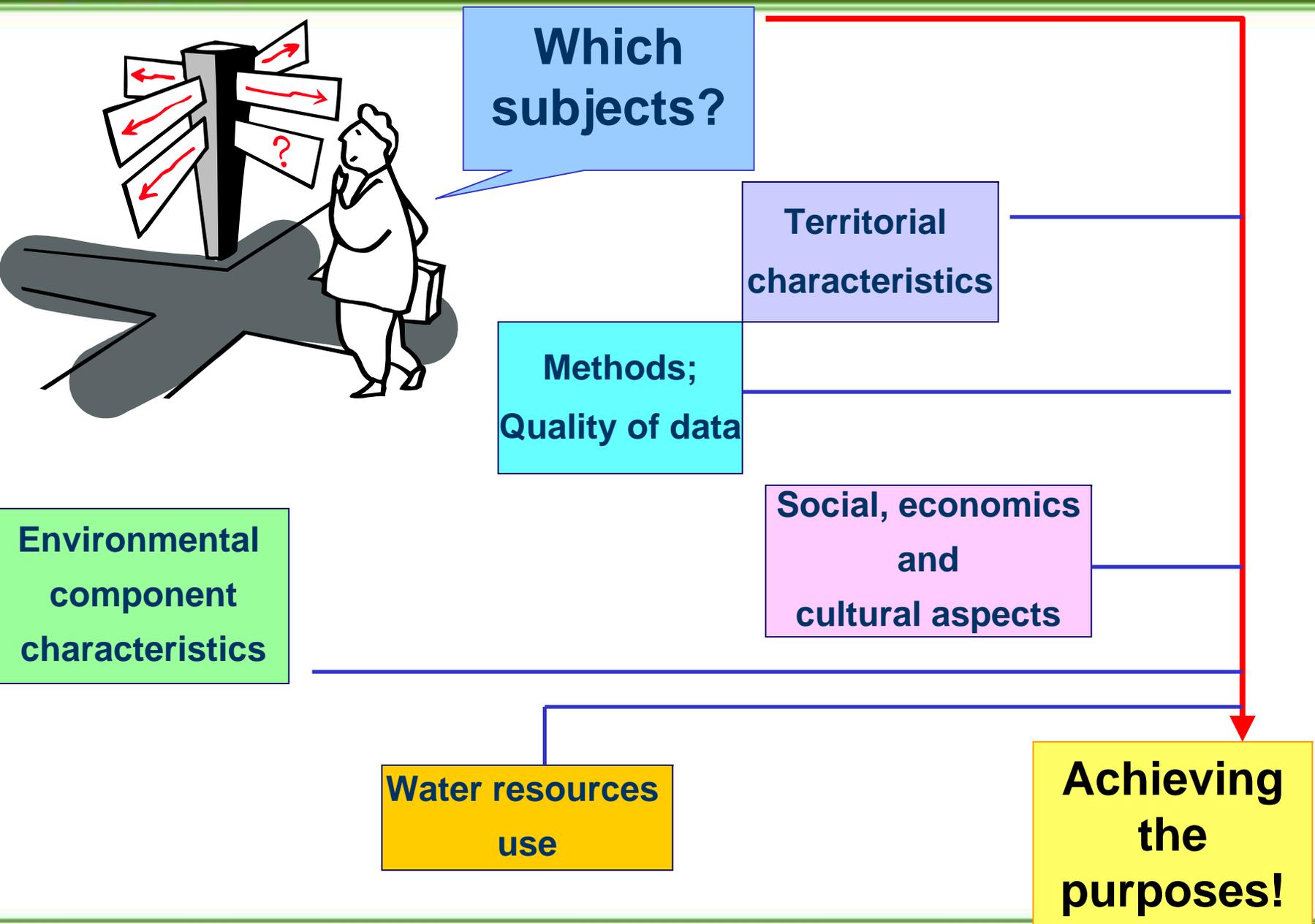
Actions and behaviours similar each others and homogeneous.

Guidelines

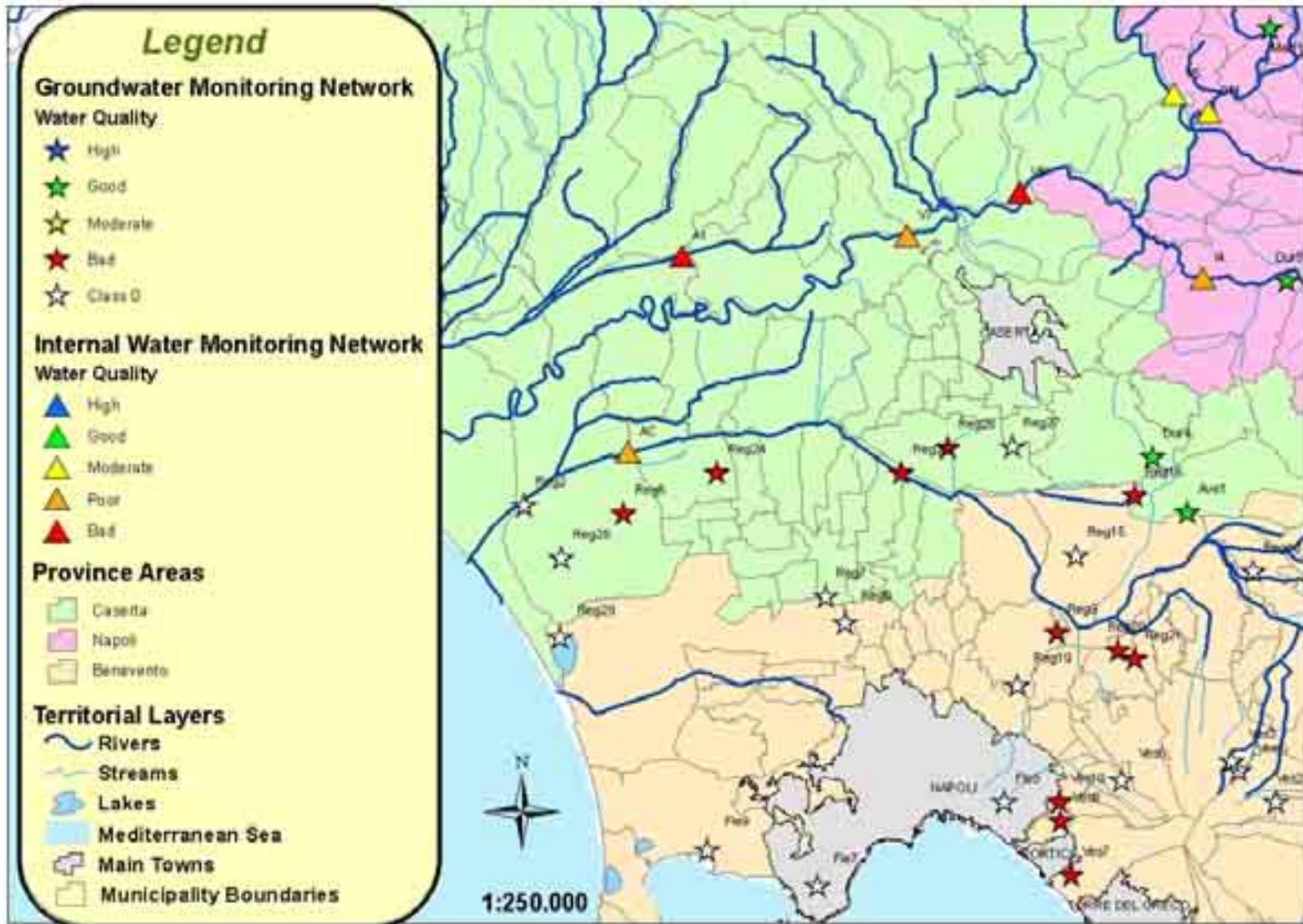
Guidelines reduce non necessary **differences** between different actors!

Guidelines widen the **common components** among different actors!





Territorial characteristics



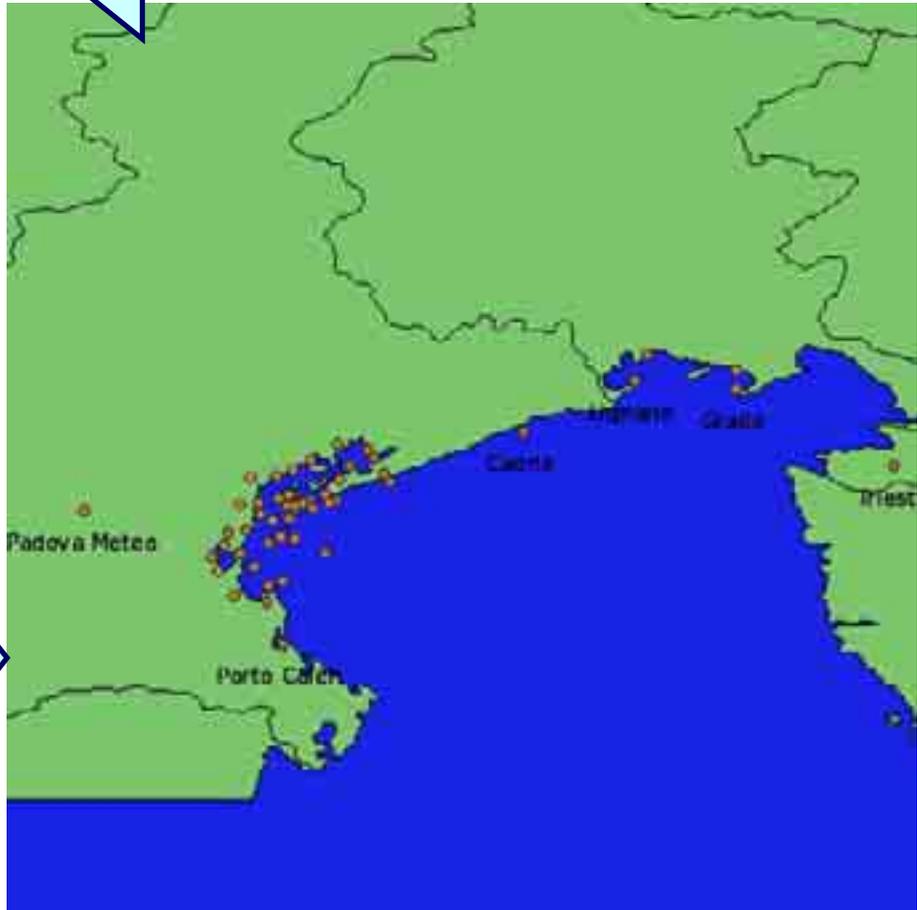
Territorial characteristics





**Lagoon of Venice
APAT
monitoring station**

**APAT monitoring network
of the Lagoon of Venice
basin**



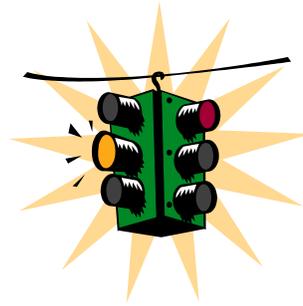
Examples of social, economic, environmental and cultural aspects represented as territorial objects

- Identification and classification of water bodies (status of quality);
- Monitoring network;
- Urban waste water/ domestic waste water/industrial waste water;
- Urban waste water treatment plants;
- Urban waste water treatment plant network;
- Land use;
- Bathing areas;
- Water works (sewage network);
- Protected areas;
- Vulnerable zones;
- Administrative borders (town, province, municipalities, etc.);
- Digital elevation model (D.E.M.).

Represent all of them by GIS!!!!

Summarizing purposes

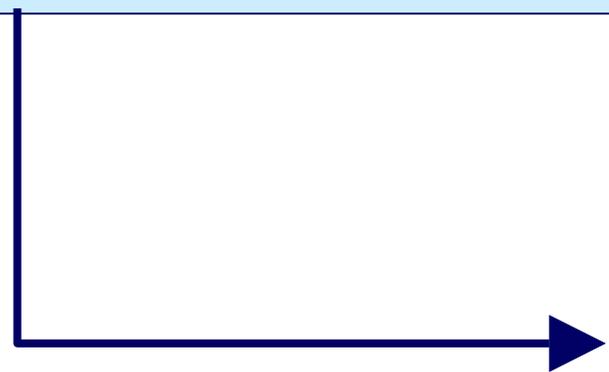
- Protection of the waters and of the aquatic ecosystems;
- Sustainable use of the water resource;
- Prevention from flooding and drought.



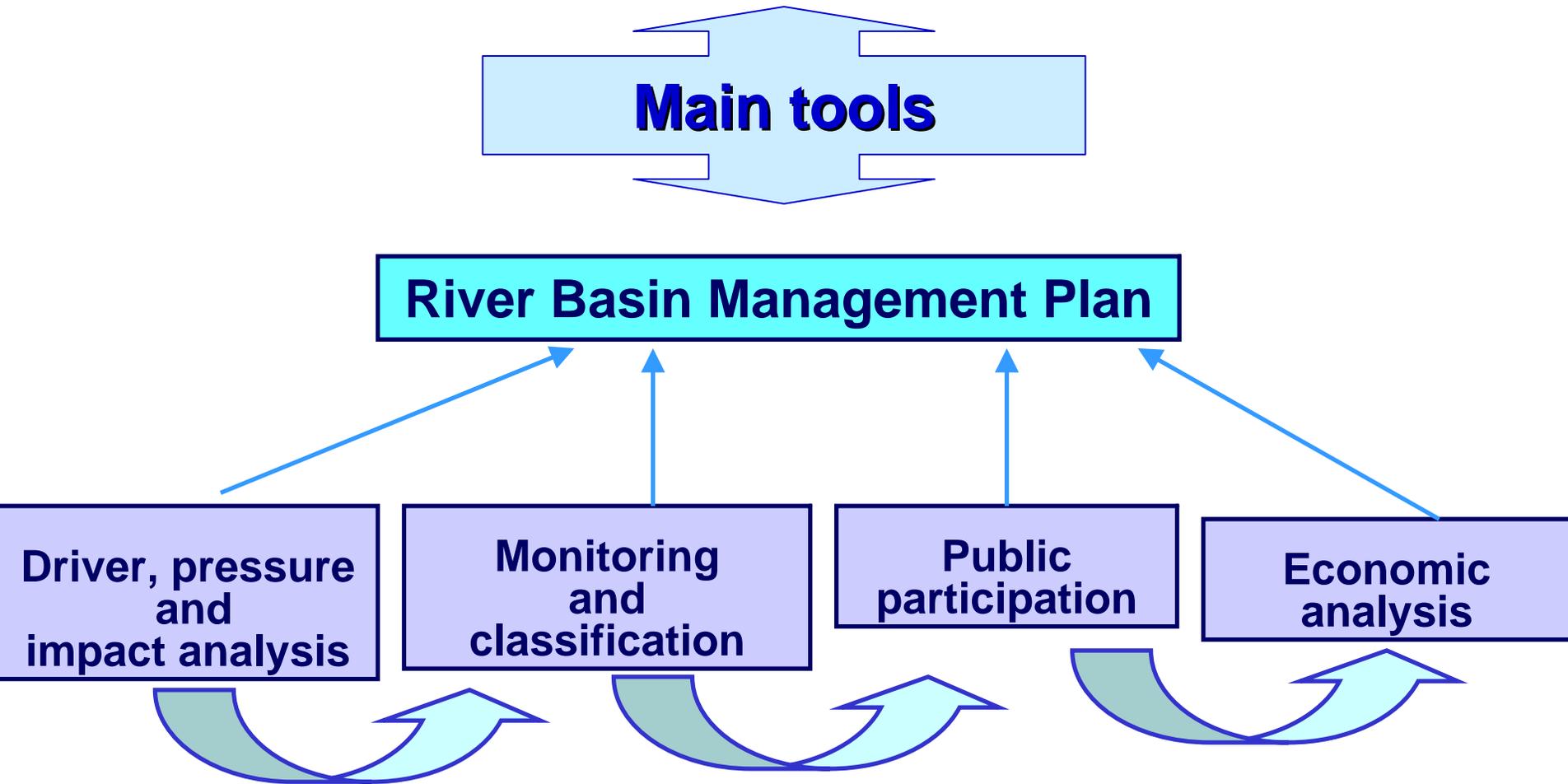
Using as tools

GUIDELINES ON:

- Driver, pressure and impact analysis;
- WB identification, monitoring and classification;
- Economic analysis;
- River basin management planning;
- Public participation.



Environmental Policy Objectives



Drivers and pressures

DIFFUSE SOURCE	urban drainage (including runoff) agriculture diffuse forestry other diffuse
POINT SOURCE	waste water industry mining contaminated land agriculture point waste management aquaculture
ACTIVITIES USING SPECIFIC SUBSTANCES	manufacture, use and emissions from all industrial/agricultural sectors
ABSTRACTION	reduction in flow
ARTIFICIAL RECHARGE	groundwater recharge
MORPHOLOGICAL (Refer also to WFD CIS Guidance Document No 4 on HMWB)	flow regulation river management transitional and coastal management other morphological
OTHER ANTHROPOGENIC	miscellaneous

Diffuse source pressure and impacts examples

Activity or Driving force	Pathway causing Pressure	Possible change in state or impact
Agriculture	Nutrient loss from agriculture by <ul style="list-style-type: none"> • surface runoff • soil erosion • artificial drainage flow • leaching (<i>i.e.</i> interflow, spring water and groundwater) (includes excess fertilisers and manures and mineralization of residues)	Nutrients modify ecosystem
	Pesticide loss by pathways mentioned above	Toxicity, contamination of potable water supplies
	Sediment loss by soil, bank and riverbed erosion	Smothering of bed, alteration of invertebrate assemblage, loss of spawning grounds
Industry discharges to the atmosphere	Deposition of compounds of nitrogen and sulphur.	Acidification of surface and groundwater bodies. Eutrophication
Transportation	Pollutant spillages	Gross pollution of water bodies
	Use of salt as de-icer	Elevated chloride concentration
	Use of herbicides	
	Engine exhausts	Increase in acidifying chemicals in atmosphere and hence deposition

Point source pressure and impact examples

Activity or Driving force	Pressure	Possible change in state or impact
Industrial (IPPC and non-IPPC)	Effluent disposal to surface and groundwaters	Toxic substances have direct effect, increased suspended solids, organic matter alters oxygen regime, nutrients modify ecosystem
Urban activity	Effluent disposal to surface and groundwaters	As above
Landfill	Chemical fluxes in leachate	As above
Animal burial pits (e.g. following epidemic)	Contaminated leachate	As above
Former land use	Contaminated land	Various
Thermal power generation	Return of cooling waters cause alteration to thermal regime	Elevated temperatures, reduced dissolved oxygen, changes in biogeochemical process rates
	Biocides in cooling water	Direct toxic effect on aquatic fauna.
Dredging	Sediment disposal	Smothering of bed, alteration of invertebrate assemblage
	Removal of substrate	Loss of habitat
Fish farming	Feeding, medication, escaping	Nutrients, diseases, veterinary products, artificial fish population, modified food web

Quantitative pressure and impact examples

Activity or Driving force	Pressure	Possible change in state or impact
Agriculture and land use change	Modified water use by vegetation. Land sealing	Altered recharge of groundwater body
Abstraction for irrigation, public & private supply	Reduction in flow or aquifer storage	Reduced dilution of chemical fluxes. Reduced storage. Modified flow and ecological regimes. Saline intrusion. Modified dependent terrestrial ecosystem.
Artificial recharge	Increased storage	Increased outflow. Contamination of groundwater.
Water transfer	Increased flow in receiving water	Modified thermal, flow and ecological regimes

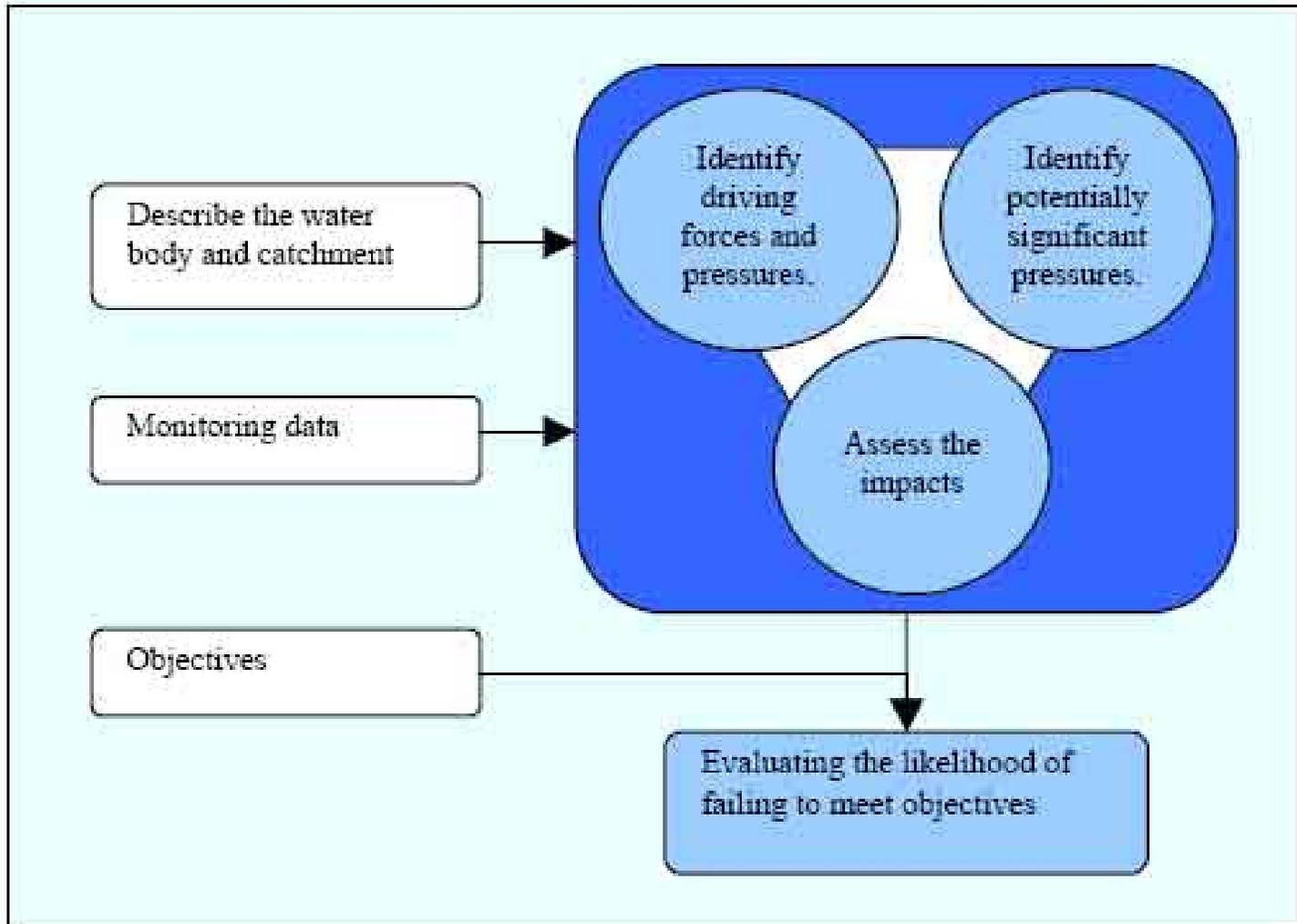
Hydromorphological pressure and impact examples

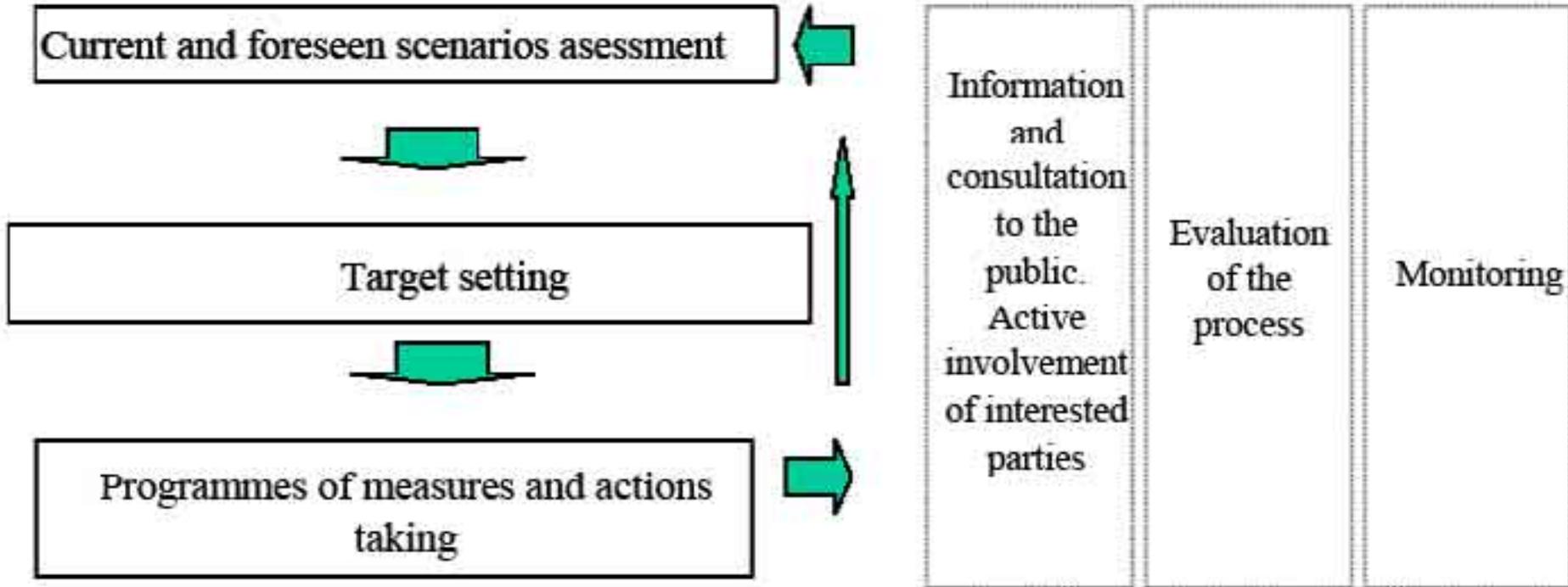
Activity or Driving force	Pressure	Possible change in state or impact
Dredging	Sediment disposal	Smothering of bed, alteration of invertebrate assemblage
	Removal of substrate	Loss of habitat
	Change in water level	Change in water table, loss of wetlands, loss of spawning areas.
Physical barriers (dams, weirs etc.)	Variation in flow characteristics (e.g. volume, velocity, depth) both up and downstream of barrier.	Altered flow regime and habitat.
Channel modification (e.g. straightening)	Variation in flow characteristics (e.g. volume, velocity, depth)	Altered flow regime and habitat.

Biological pressure and impact examples

Activity or Driving force	Pressure	Possible change in state or impact
Fisheries	Fishing	Reduced fish fauna, especially on migratory and amphibiotic fish
	Fish stocking	Genetic contamination of wild populations
Introduction of alien species	Competition with indigenous species	Substitution of populations, destruction of habitats, food competition

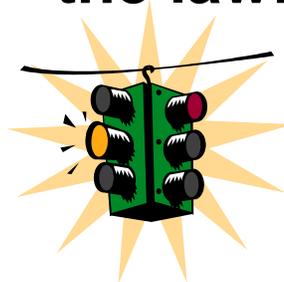
Assessing water bodies at risk of failing environmental objectives



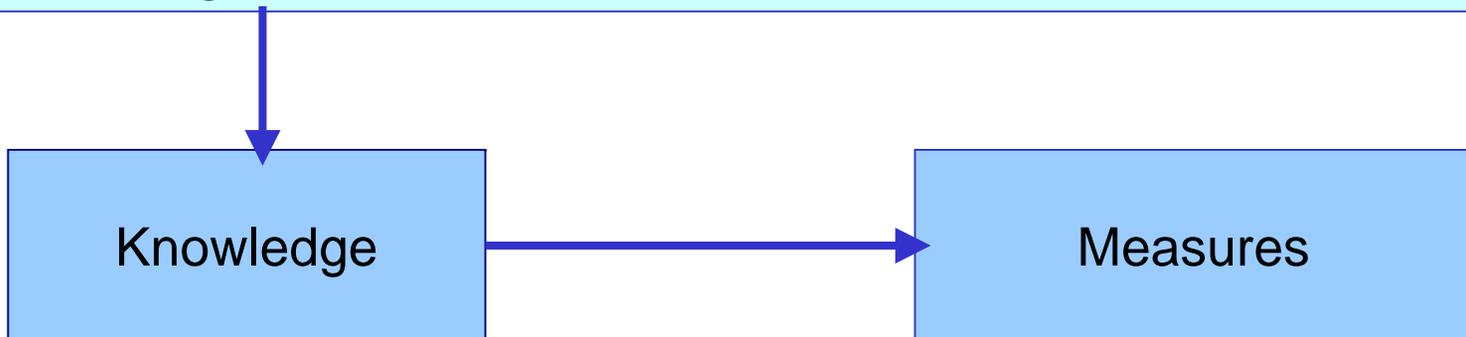


Environmental component characteristics

They represent the environmental objectives of the law!



First of all, **identification** of the territorial characteristics for all water bodies: rivers, lakes, transitional and marine-coastal waters, reservoirs, groundwaters!



Identification of monitoring network

Criteria for selecting number and position of monitoring sites



- Hydro-geomorphological elements;
- Impact elements.



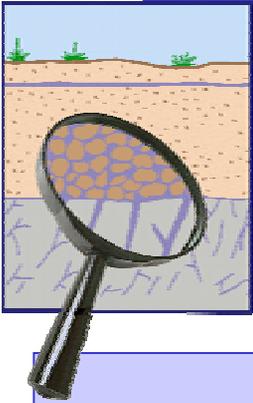
River

- Basin size;
- Right distance from water discharge;
- Protected areas.

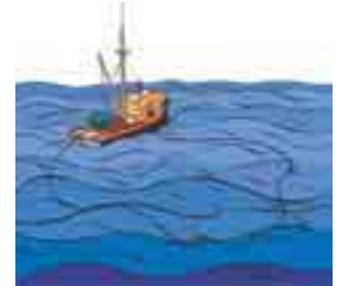
Lakes and reservoirs

- Size;
- Depth;
- Protected areas;
- If supplied by impacted basins.

Criteria for selecting number and position of monitoring sites



- Hydro-geomorphological elements;
- Impact elements.



Groundwaters

- Most representative aquifers;
- Water points (spring, well);
- Different use of waters (drinking water, agriculture, etc.);
- Exchange between groundwater and surface waters;
- Different chemical characterization.

Marine-coastal waters

- Distance from the coast;
- Depth;
- Impacted and control sites.

Criteria for selecting number and position of monitoring sites

- Hydro-geomorphological elements;
- Impact elements.

Transitional waters

- Bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows;
- Protected areas.

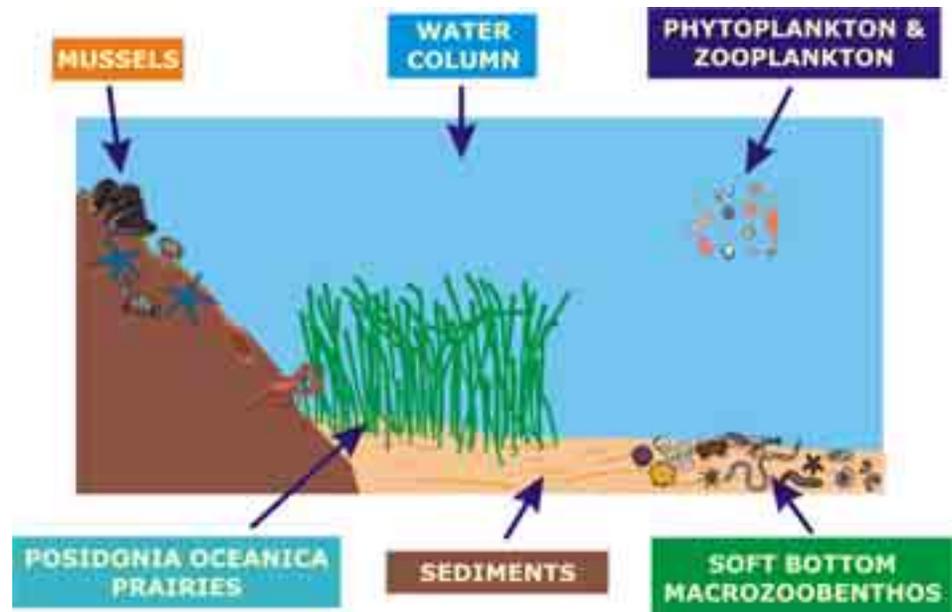


Identification of sampling matrix

According to the purposes of the law, the objective of the monitoring is to establish a coherent and comprehensive overview of water body status as a whole.

The more suitable approach has to be planned in order to evaluate the effectiveness of the measure programmes.

Ecosystemic approach



Identification of monitored parameters and/or monitored indicators (elements of quality)

- Biological;
- Physico-chemical;
- Hydromorphological.



- According to general criteria for selecting environmental indicators:
 - Policy relevance and utility for users*
 - Analytical soundness*
 - Measurability*
- According to official methods (data and technical operational units quality: from sampling to data storage).

Quality elements for rivers and lakes

RIVERS	LAKES
<i>Biological elements</i>	
Composition and abundance of aquatic flora	Composition, abundance and biomass of phytoplankton
Composition and abundance of benthic invertebrate fauna	Composition and abundance of other aquatic flora
Composition, abundance and age structure of fish fauna	Composition and abundance of benthic invertebrate fauna
	Composition, abundance and age structure of fish fauna
<i>Hydromorphological elements supporting the biological elements</i>	
Quantity and dynamics of water flow	Quantity and dynamics of water flow
Connection to groundwater bodies	Residence time
River continuity	Connection to the groundwater body
River depth and width variation	Lake depth variation
Structure and substrate of the river bed	Quantity, structure and substrate of the lake bed
Structure of the riparian zone	Structure of the lake shore
<i>Chemical and physical elements supporting the biological elements</i>	
Thermal conditions	Transparency
Oxygenation conditions	Thermal conditions
Salinity	Oxygenation conditions
Acidification status	Salinity
Nutrient conditions	Nutrient conditions
Specific pollutants	Specific pollutants

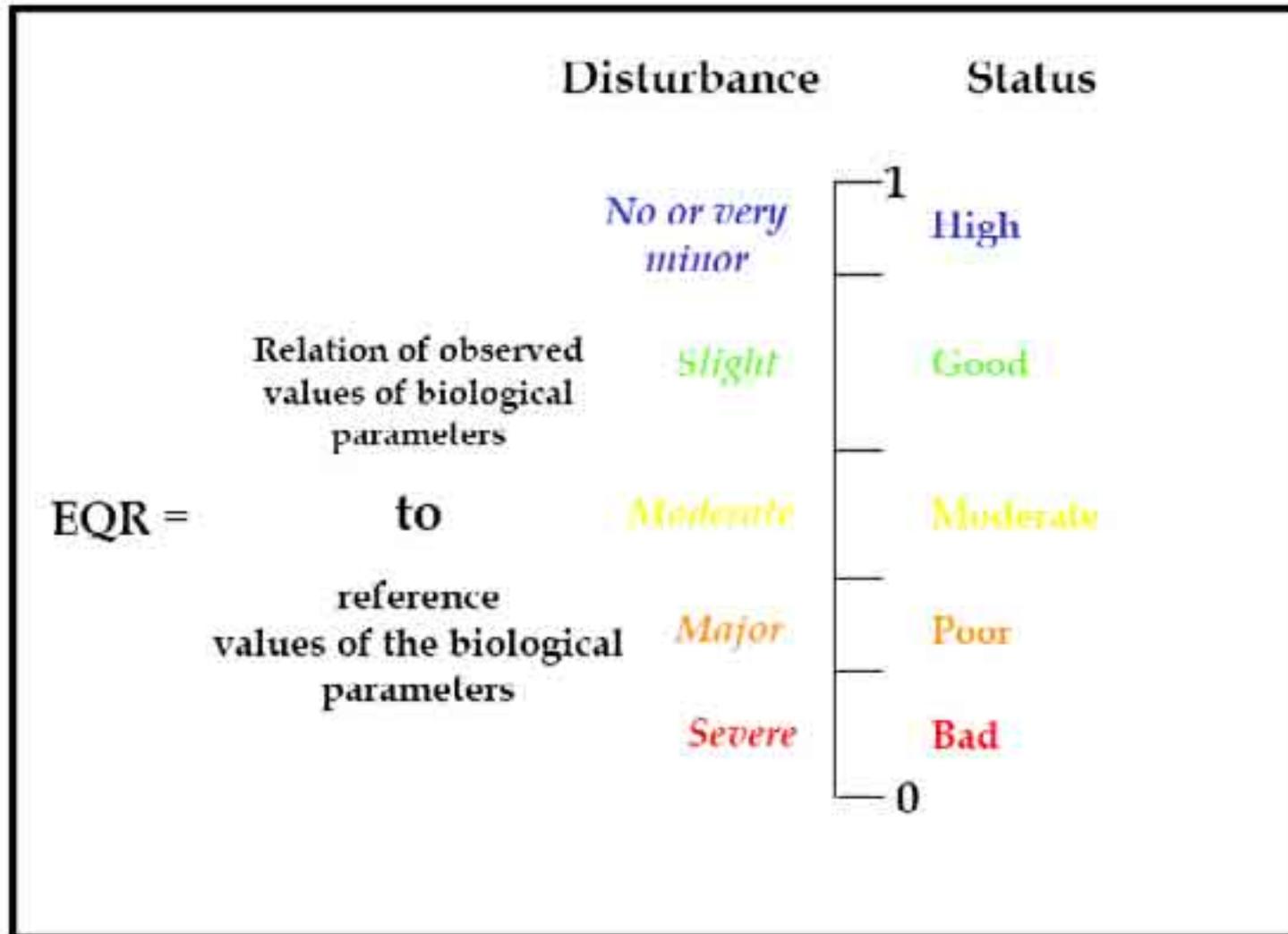
Quality elements for transitional an coastal waters

TRANSITIONAL WATERS	COASTAL WATERS
<i>Biological elements</i>	
Composition, abundance and biomass of phytoplankton	Composition, abundance and biomass of phytoplankton
Composition and abundance of other aquatic flora	Composition and abundance of other aquatic flora
Composition and abundance of benthic invertebrate fauna	Composition and abundance of benthic invertebrate fauna
Composition and abundance of fish fauna	
<i>Hydromorphological elements supporting the biological elements</i>	
Morphological conditions: <ul style="list-style-type: none"> ○ Depth variation; ○ Quantity, structure and substrate of the bed; ○ Structure of the inter-tidal zone 	Morphological conditions: <ul style="list-style-type: none"> ○ Depth variation; ○ Structure and substrate of the coastal bed; ○ Structure of the inter-tidal zone
Tidal regime: <ul style="list-style-type: none"> ○ Freshwater flow; ○ Wave exposure 	Tidal regime: <ul style="list-style-type: none"> ○ Direction of dominant currents; ○ Wave exposure
<i>Chemical and physical elements supporting the biological elements</i>	
Transparency	Transparency
Thermal conditions	Thermal conditions
Salinity	Salinity
Oxygenation conditions	Oxygenation conditions
Nutrient conditions	Nutrient conditions
Specific pollutants	Specific pollutants

Quality and quantitative elements for groundwater

GROUNDWATER
<i>Chemical elements</i>
Oxygen content
pH value
Conductivity
Nitrate
Ammonium
Specific pollutants
<i>Quantitative status</i>
Groundwater level regime

Classification scheme



Reference conditions

Without any specific ranking of the methods the main options for establishing reference conditions are:

- Spatially based reference conditions using data from monitoring sites;
- Reference conditions based on predictive modelling;
- Temporally based reference conditions using either historical data or paleoreconstruction or a combination of both;
- A combination of the above approaches.

EQR = ecological quality ratio

Ratio representing the relationship between the values of the biological parameters observed for a given body of surface water and values for these parameters in the reference conditions applicable to that body. The ratio shall be represented as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero.

Normative definitions of ecological status classifications

- High status

There are no, or only very minor, anthropogenic alterations to the value of the physico-chemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions.

The value of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only minor, evidence distortion.

There are the type specific condition and communities.

Normative definitions of ecological status classifications

- **Good status**

The value of the biological quality elements for the surface body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface body type under undisturbed conditions.

- **Moderate status**

The value of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body under undisturbed conditions. The value show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.

Classification: conceptual pathway

