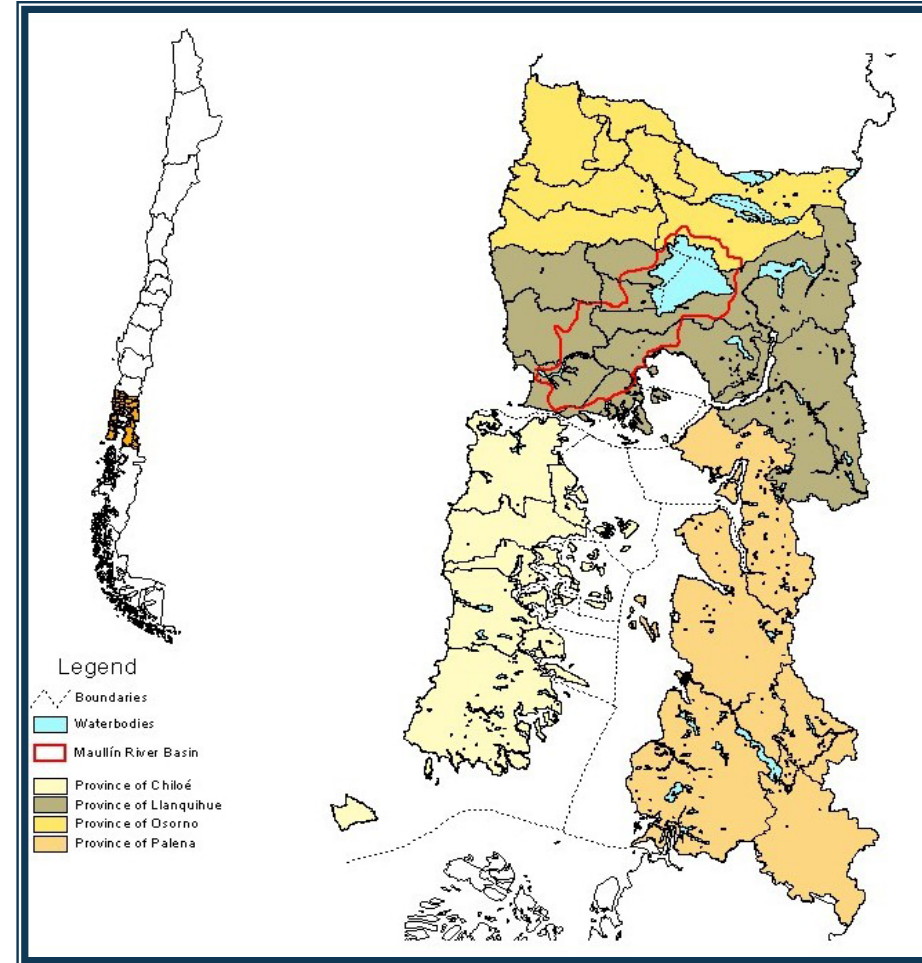


REGULATORY APPROACH FOR WATER QUALITY PROTECTION IN CHILE

**KEY ASPECTS TO BE
CONSIDERED**

MEETING THE LAKE

- Is an oligotrophic lake located in the south of Chile, at the head of the Maullín River Watershed.
- Llanquihue means “submerged place”.
- Has a glacial origin, about 11.000 years ago.
- Its watershed is shared by 4 municipalities.
- Is one of the most important touristic destinations in the country
- Is the first one to be protected by a water quality standard.



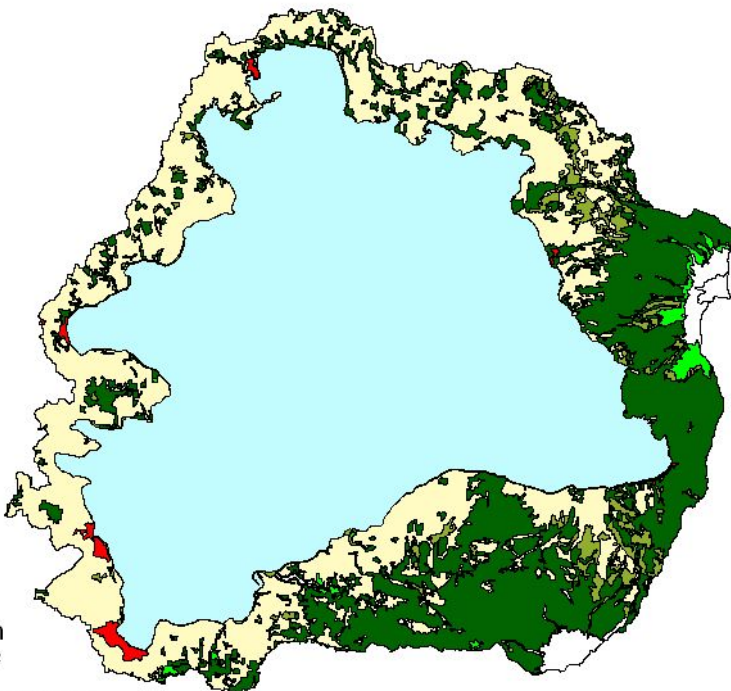
MEETING THE LAKE

- Total Area of the Basin: 1.607 Km²








- 870,5 Km² - lake (53,9%)
- 357 Km² - praries (22,2%)
- 296 Km² - forest (18,4%)
- 28 Km² - srubs (2,8%)
- 10,6 Km² - snow (0,65%)
- 6,02 Km² - cities (0,43%)

Lake's basin

Total area 1607 km²



The map shows the lake basin with various land use categories color-coded: water (light blue), prairies (yellow), forest (dark green), scrublands (light green), snow (white), and cities (red). The lake itself is the largest area, occupying over half of the basin.

	water	867 km ²	53,9 %
	prairies	357 km ²	22,2 %
	forest	296 km ²	18,4 %
	scrublands	46 km ²	2,8 %
	scrublands - prairies	11,7 km ²	0,72 %
	snow	10,6 km ²	0,65 %
	cities	6,02 km ²	0,43 %

MEETING THE LAKE

Lake Llanquihue

Lake Llanquihue's Water Quality

Parameter	Unit	Puerto Octay	Frutillar	Ensenada	Puerto Varas
Conductivity	μS/cm	87	86,7	87,3	85,9
Temperature	C	13,2	13,3	12,8	13,1
PH		7,5	7,6	7,6	7,6
Dissolved Oxygen	mg/l	9,5	9,5	9,4	9,6
Dissolved Oxygen	% Sat	91,9	90,9	89,4	93,3
Turbidity	NTU	1,6	1,7	1,5	1,6
Silica	mg/l	1,4	1,3	1,3	1,3
COD	mg/l	8,2	7	9,3	7,7
Transparency	m	13,5	13,9	16	12,5
Total Nitrogen	μg/l	93,9	101,3	91,4	97,1
Total Phosphorus	μg/l	7,4	7,5	8,5	7,9
Chlorophyl a	μg/l	0,96	0,91	0,94	0,99

Lake Llanquihue

Morphology

Volume	158,6 Km ³
Surface Area	870,5 Km ²
Length and width	42,3 Km - 39,0 Km
Length of shoreline	196,5 Km
Maximum depth	317 m
Mean depth	182 m
Change of Level	0,75 m (average)
Precipitation	2.033 mm/year (average) <1.450>
Inflow (more than 9 small rivers)	(RB) 4,9 m ³ /s; (RBA) 1,8 m ³ /s ; (RT) 2 m ³ /s
Outflow	One outlet: 79 m ³ /s
Retention time	74 years



MEETING THE CHALLENGE

- **At present time lake Llanquihue supports several uses of its waters, including recreation, drinking water supply, aquaculture, industrial water supply and esthetic contemplation.**
- **The deterioration of its water quality will damage the actual uses of the lake and will implicate both economical and ecological consequences.**
- **Since there are no severe problems with water quality, the willingness to implement environmental management is quite low.**
- **Chile's legal framework allows the establishment of environmental quality standards for use in environmental management.**
- **In spite of this favorable legal scenario, setting the standard has required many years and has caused many controversies.**

MANAGEMENT SYSTEM BASED ON ENVIRONMENTAL QUALITY STANDARDS

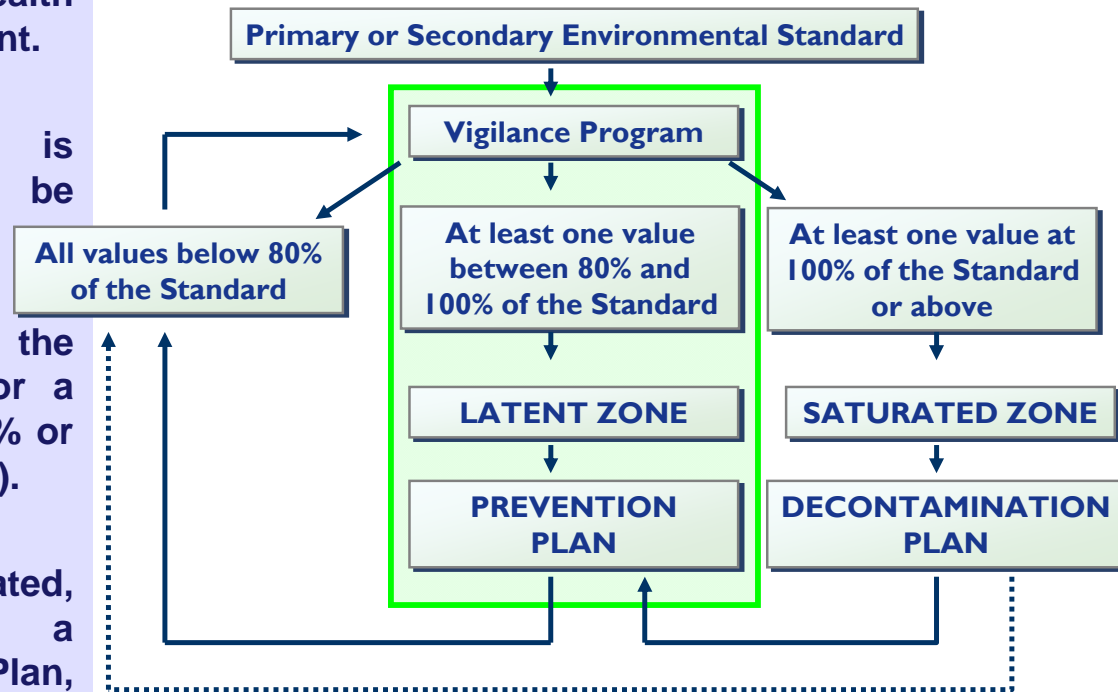
There are two kinds of environmental standards: Primary to protect human health and Secondary to protect the environment.

Once an environmental standard is established, the compliance must be evaluated through monitoring.

According to the monitoring results, the government MUST dictate a Latent or a Saturated zone (if values are above 80% or 100% of the standard value, respectively).

If a zone is classified as Latent or Saturated, the government MUST elaborate a Prevention or Decontamination Plan, respectively.

Water Quality Standard Application in Chile



STAGES AND PROCEDURES FOR THE ESTABLISHMENT OF A WATER QUALITY STANDARD

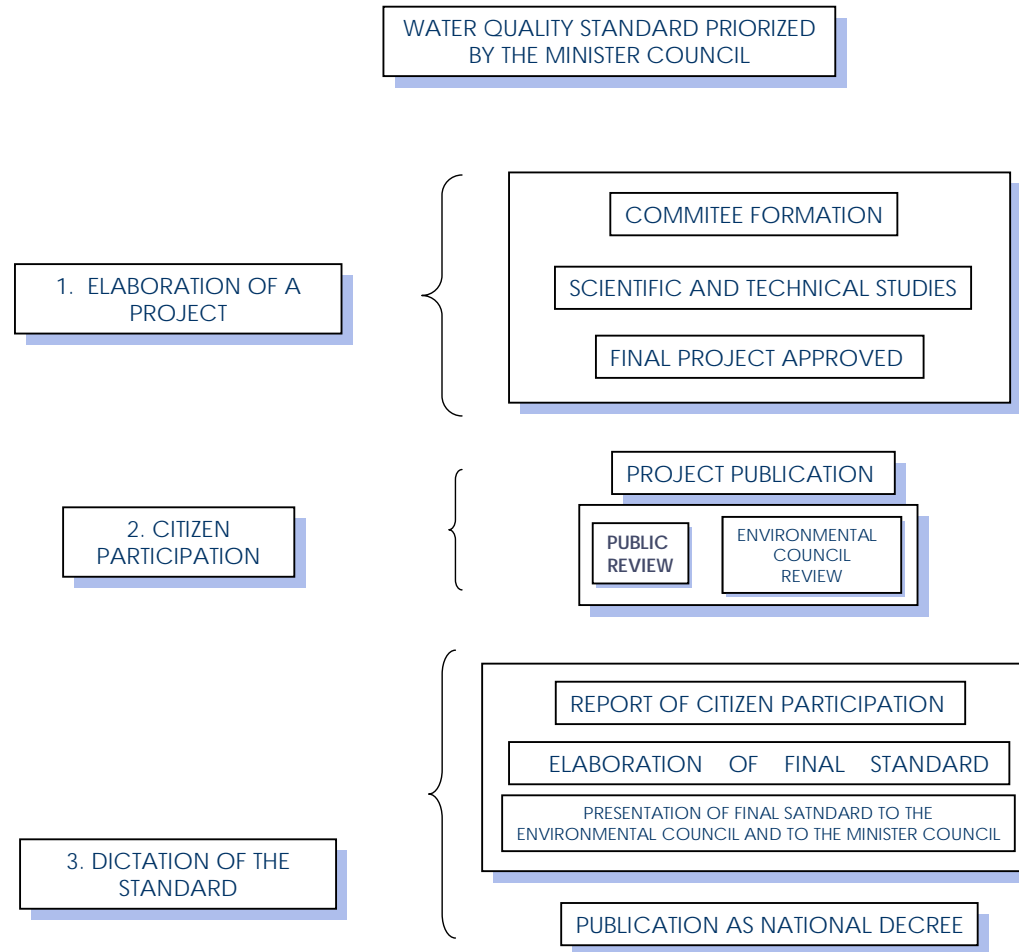
Water quality standards must satisfy a regulated procedure before its formal establishment.

The adequate completion of every stage helps to build a more effective regulation.

The realization of studies to collect data and conduct its further interpretation will help to foster “lake experts” and build strong technical arguments to support the initiative.

The formation of public-private committees and the citizen participation helps to build governance for the further application of the standard.

WATER QUALITY STANDARD PRIORIZED BY THE MINISTER COUNCIL



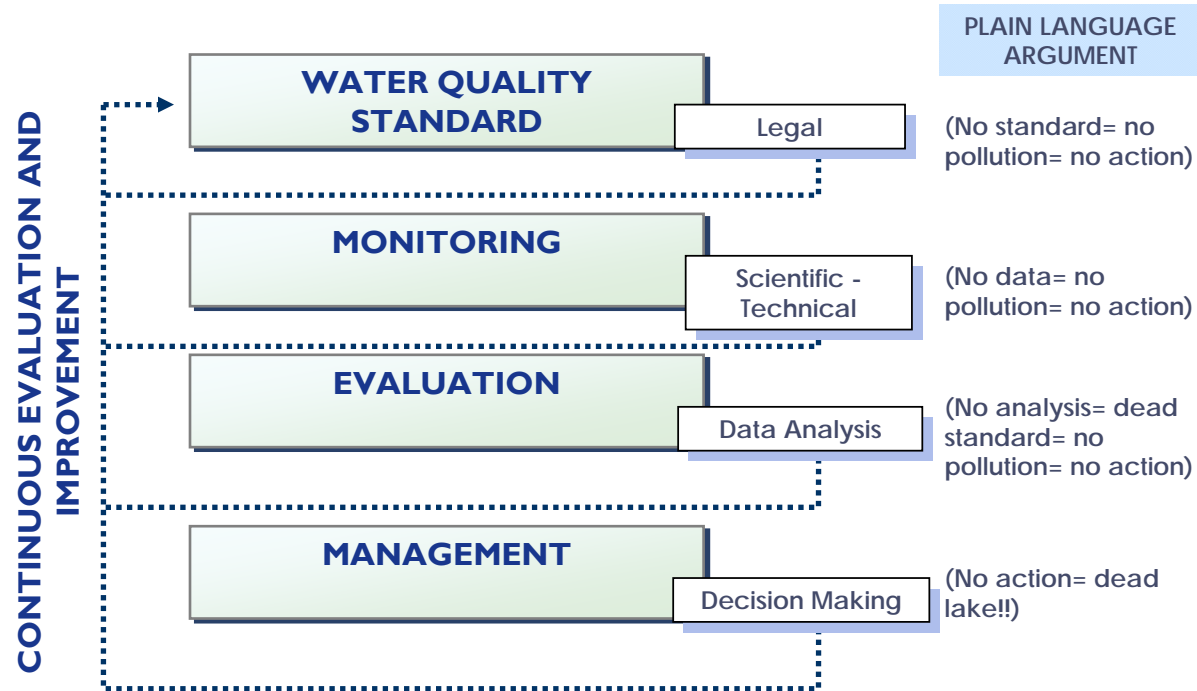
GENERATING A COMPREHENSIVE CONCEPTUAL MODEL TO BUILD CONSENSUS

When working with groups or committees, it is important to rise agreement on basic objectives.

This simple model helped not only to understand the importance of working on a water quality standard, but also to actively involve several actors from different disciplines.

It is important to dedicate time to manage a common language and to listen and understand all involved actors.

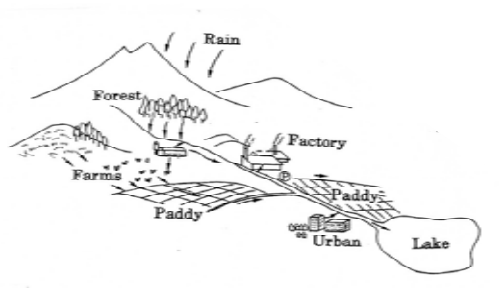
BASIC MODEL FOR REGULATORY APPROACH



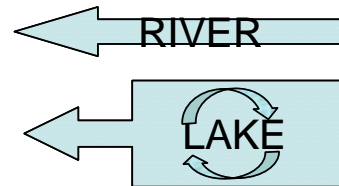
UNDERSTANDING A LAKE'S ESSENTIAL CHARACTERISTICS CAN HELP TO IMPROVE MANAGEMENT

Lakes have.....

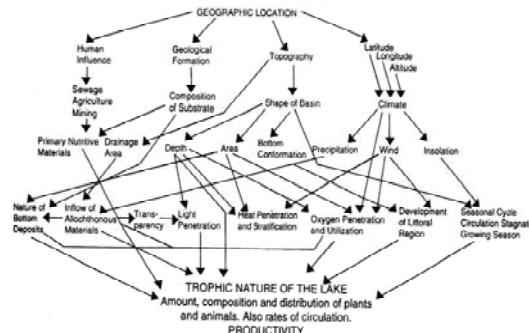
Integrating Nature:



Long Retention Time:



Complex Dynamics:



So, mangement must.....

- Go beyond administrative boundaries
- Seek for coherence and coordination of different actors and their capacities.
- Build local awareness and long term commitment.
- Establish long term monitoring
- Ensure long term financing.
- Build strong relation with Science and Investigation
- Encourage Cause-Effect research.

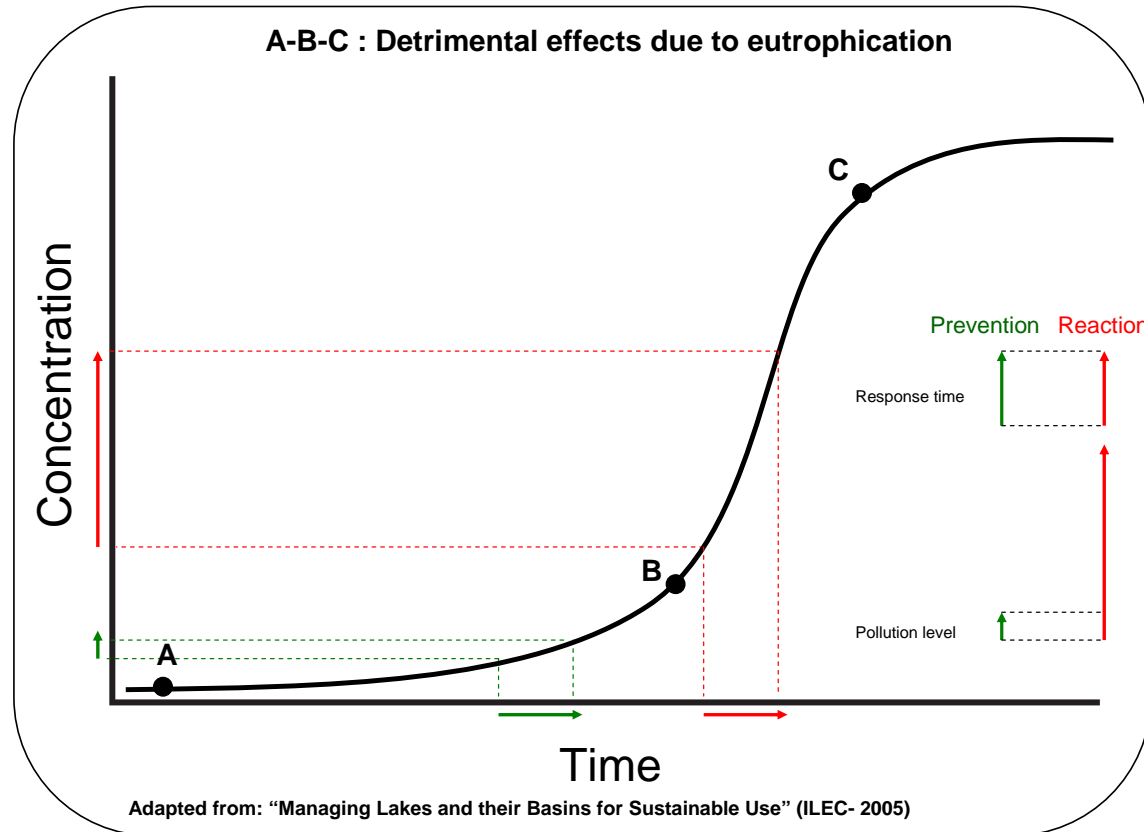
ADVANTAGES OF WATER QUALITY STANDARD CONTROL AS A PREVENTIVE INSTRUMENT

In big, clean lakes such as lake Llanquihue, nutrients concentration starts to increase at a very slow rate, in a beginning (A-B).

When symptoms of eutrophication can be observed (B), concentrations of nutrients have increased significantly.

Preventive monitoring can detect small changes in water quality that can be more easily reverted.

Reactive monitoring will reveal quick and significant changes in water quality, more complex to manage.



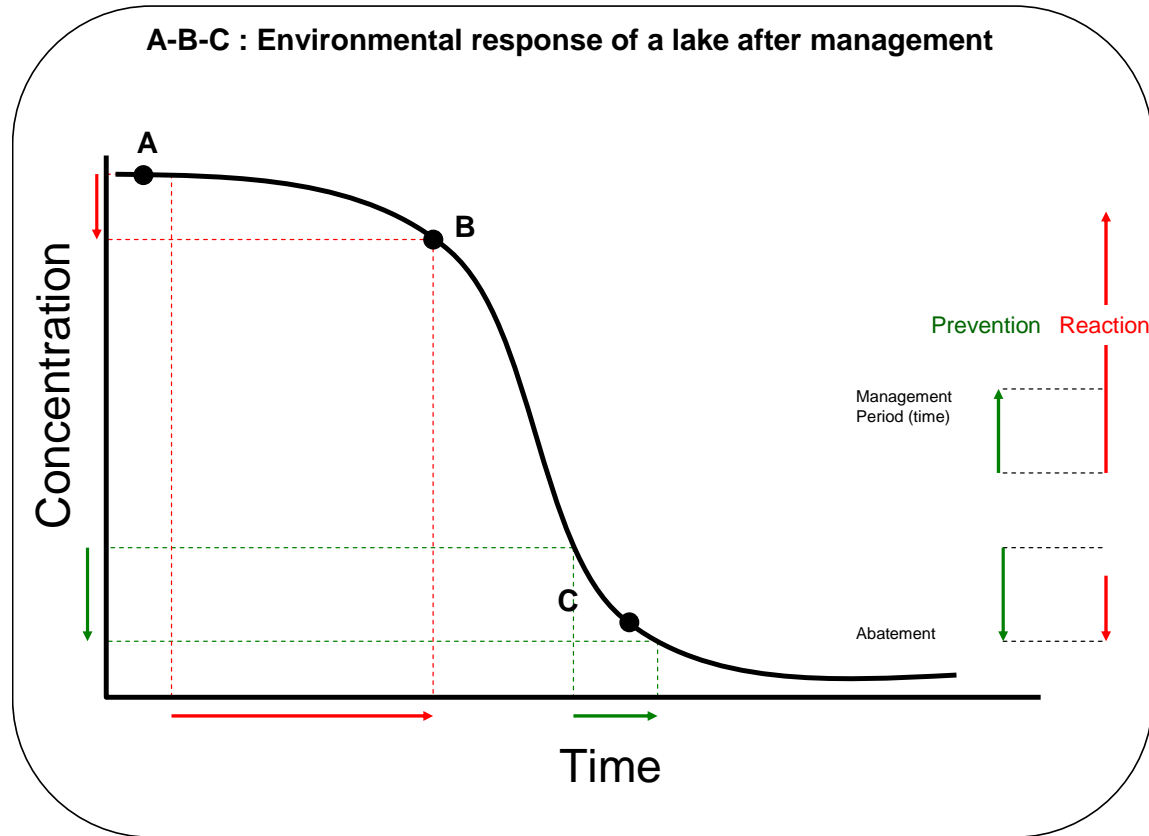
ADVANTAGES OF WATER QUALITY STANDARD CONTROL AS A PREVENTIVE INSTRUMENT

If monitoring accuses water quality changes, a management plan can be implemented.

In a preventive approach, it can be seen that for a significant reduction of nutrients concentration it will take shorter time and resources if compared with a reactive approach.

Waiting for a lake to become a problem can become “the” biggest problem to be solved.

Prevention of a lake becoming a problem can help to save time and resources for its management.



ADVANTAGES OF WATER QUALITY STANDARD CONTROL AS A PREVENTIVE INSTRUMENT

ECONOMIC BENEFITS OF REGULATION

- Stability or increase of properties value.
- Stability or increase of abatement costs for drinking water supply
- Long time viability for turistic and recreational activities (bathing, fishing, navigation)
- Major development of turistic investments.
- Conservation of biodiversity and environmental services related to the lake's water quality.

ECONOMIC RISKS OF NO ACTION

- Management of uncomforted lake's users.
- Decrease of properties value.
- Decrease of touristic activities and investments.
- Viability risk for aquaculture and sport fishing.
- Loss of biodiversity and environmental services.

LESSONS OF THE PROCESS:

- **1: Know and understand if the legislative system supports (or not) a project for water quality management and build powerful and simple statements based on that.**
- **2: “Watchening” (watch + listen) every opinion and make a more complex classification of them instead of “agree or disagree” will help a more constructive coordination.**
- **3: Ensuring good quality data will ensure good quality decisions.**
- **4: Starting with a simple management tool such as a water quality standard can lead to the establishment of a more complex and integrated tool.**
- **5: Interacting and working closely with the community can significantly help to improve and ensure management effectiveness.**