



MINISTERIO
DE MEDIO AMBIENTE

Secretaría General para el Territorio y la Biodiversidad
Dirección General del Agua

**Sicily Joint Workshop
"Drought and water deficiency:
from research to policy making"**

**Water demands and available
resources: balance in long term**

Palermo 8-9 October 2004

Eng. Justo Mora A.-Muñoyerro



WaterStrategyMan Project

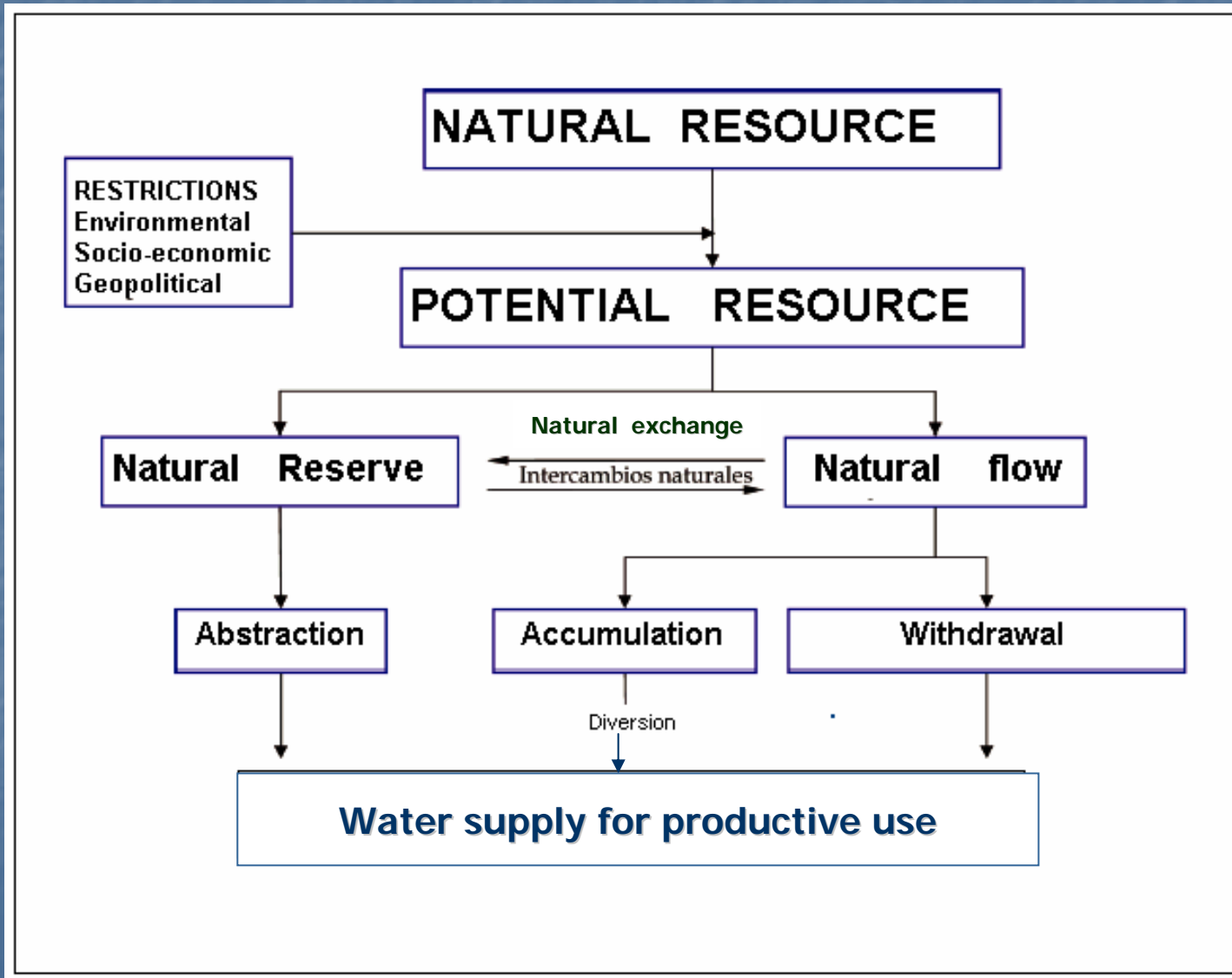
Summary

- Concepts: guarantee and deficit
 - **Water deficiency:**
long term management → planning
 - Spanish case:
 - Hydrological special features
 - **Hydrological planning: how to do it ?:**
 - Policies for transitory periods
 - Conclusions
-



Concepts: guarantee and deficit

Natural resources and transformation into available resource



Resources, availability and water deficiency

Natural Water Resources

Water Resources Management Systems (WRMS)

- Infrastructures
- Restrictions
- Management rules
- **Demands**

Water Supply

Sufficient for demand ?

Failure causes

- Variability of natural resources
- Infrastructures:
 - storage capacity
 - management rules
- Demands excess

Deficit = Demand volume - Water supply

- What margin of deficit produce a failure in the system?
- What frequency of failure is considered permanent failure?

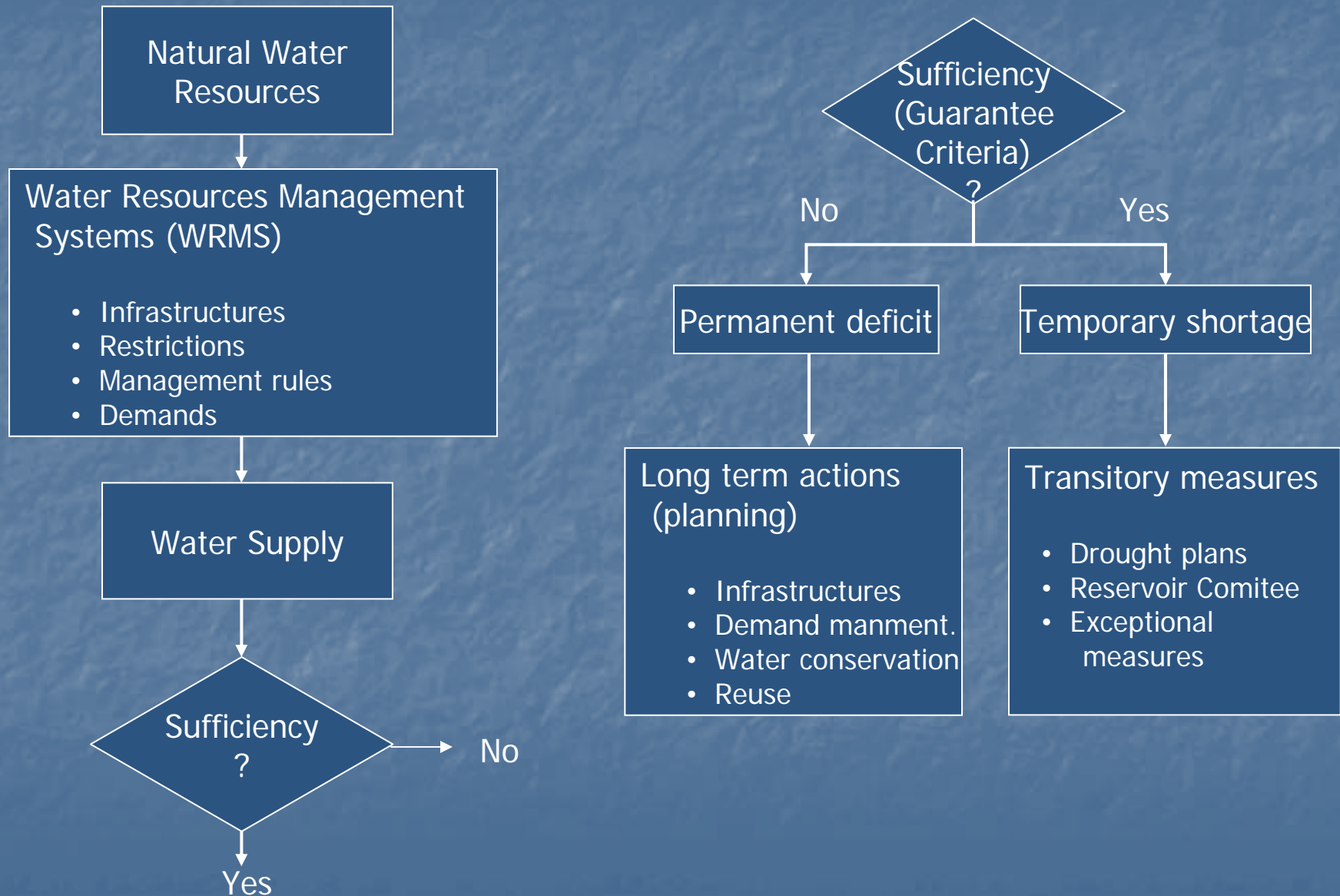
Guarantee of water supply

- Guarantee of water supply is the acceptable level of water supply required for a particular demand of a Water Resource Management System.
- In most countries and systems this value is defined by administrative normative or recommended by voluntary standards (Spain Ministerial Decree 12/09/1992)

Permanent or transitory failure :

- It means that a WRMS is available to attend a group of demands , according to determinate reliability criteria, we are accepting certain margin of failure to satisfy fully the total water supply theoretically required
- The margin of **accepted failure** is limited by guarantee criteria. When it happens is necessary to carry out **transitory measures**
- In other cases, the WRMS couldn't be considered enough and show a **permanent deficit**. It's necessary to balance the offer of available resources and water demands on a **medium/long term basis**

Deficit/shortage and guarantee



Water deficiency: long term management

Performances on the offer

LONG TERM SOLUTIONS

- New investment water resources development
 - Localization problems
 - Operation costs and effectiveness
 - Terms of execution and of operation
- Increase of surface water regulation and groundwater withdrawal
- Reuse
- Desalination plants

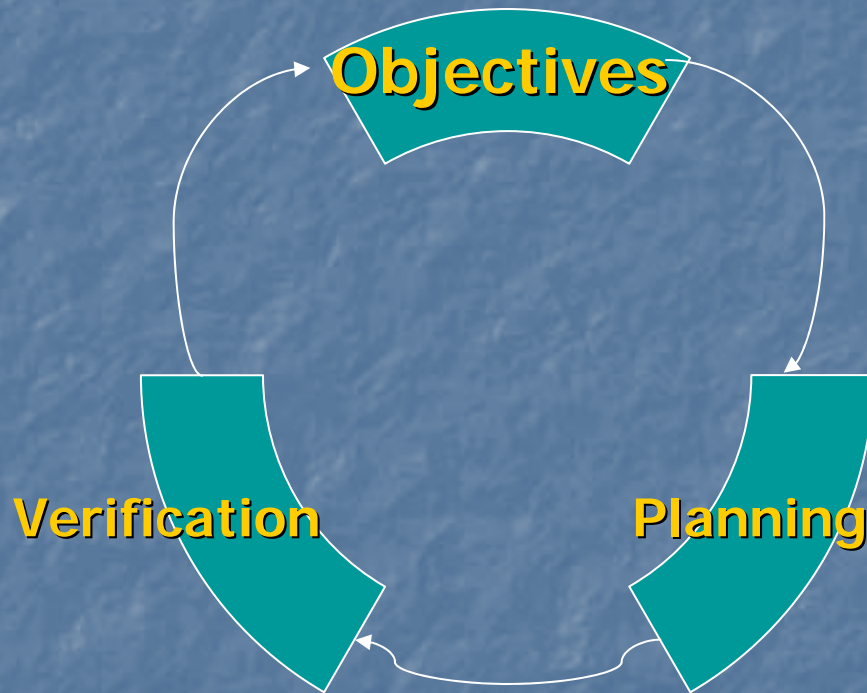
Performances on the demand

- Long term demand management: water conservation
 - Pricing and measurements
 - Efficiency measures
 - Conjunctive use
- Short term:
 - Preferential uses
 - Basic human needs
 - Environmental needs
 - Woody crops irrigation needs
 - Other uses
 - Industrial uses
 - Hidropower uses
 - Water supply interruptions
 - Public awareness campaigns

Performances on water quality

- Difficulties in short term measures
- Improvements in wastewater systems (sewage, tertiary treatment and reuse)
- Joint responsibility in application
- Atypical contamination sources control

Long term actions:planning

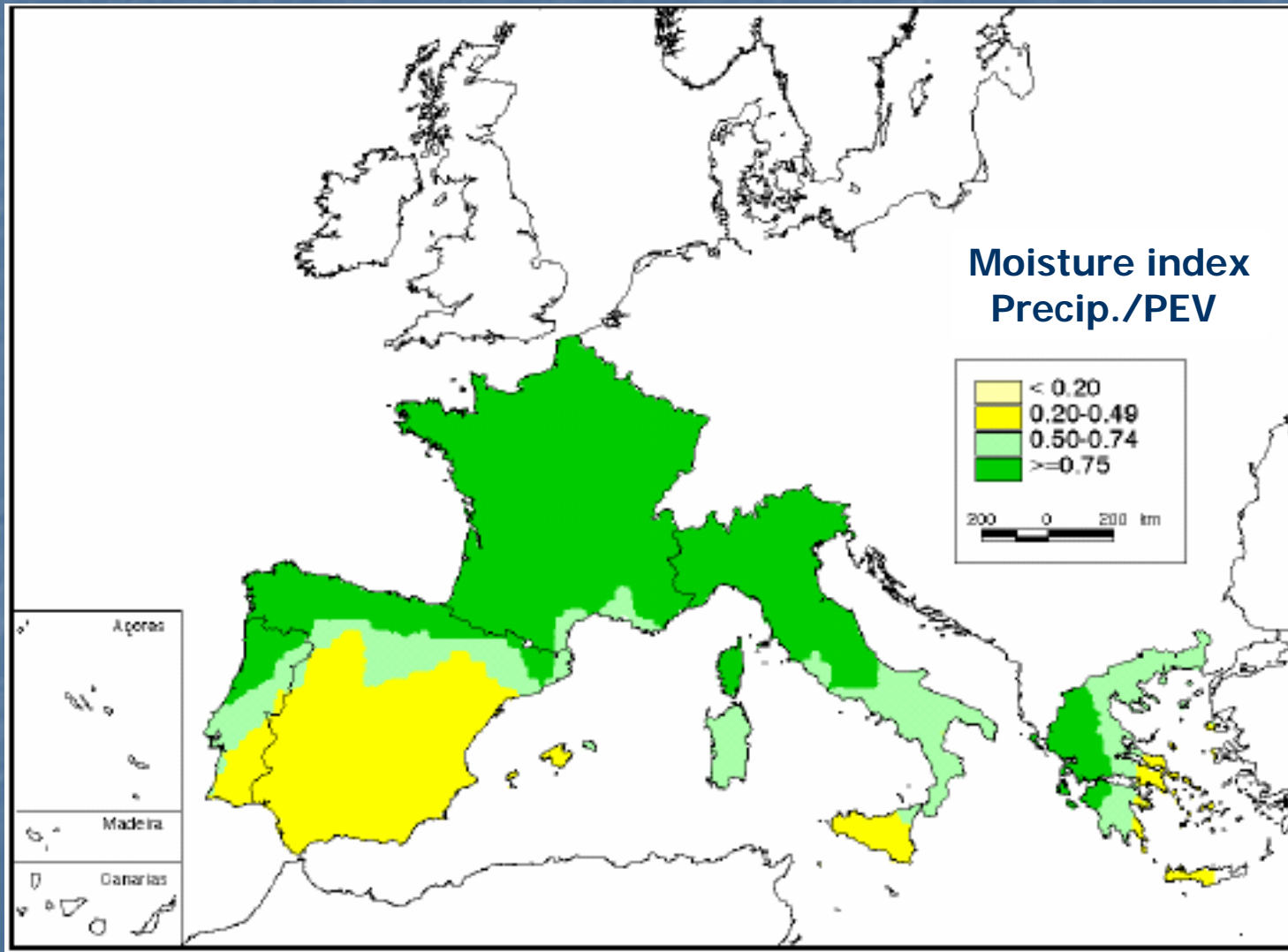


River Basin Plans process developed in Spain

- Spanish special features
- Long term management: Hydrological Plans
 - Institutional organization
 - Contents
 - Demands/available resources balance: procedure
 - Permanent deficit
 - Ground water over abstraction
- Temporal shortage and transitory measures
 - Links among drought threshold and guarantee criteria

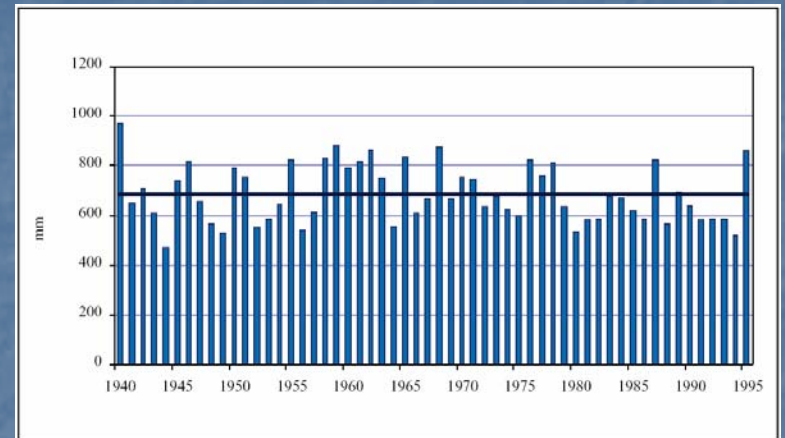
**Spanish case:
hydrological special features**

Spanish hydrology special features

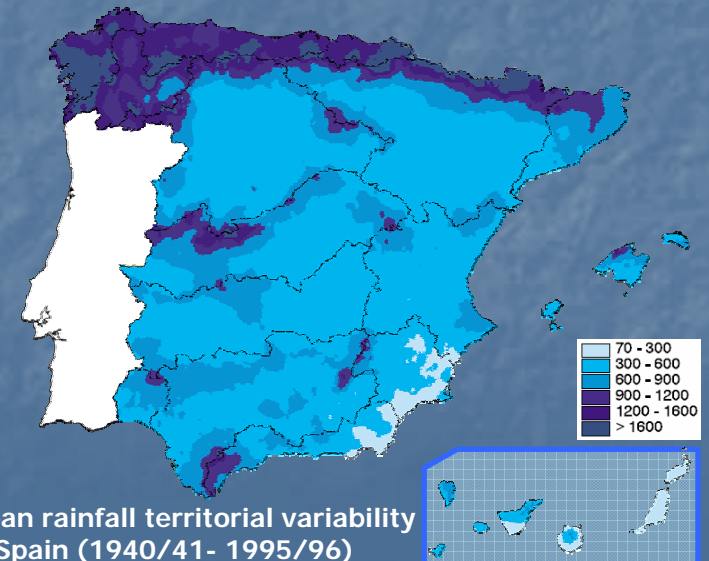


Efficient water management needed

- The irregular spanish hydrologic regime makes water a special scarce resource, with restricted availability and strong regional and time contrasts, situation not comparable to the rest of EU
- In Spain the mean relationship between natural global resources and water demands for consuntive uses is 3 times minor rest of EU, while natural available resources represente 8 % of total resources (40-50 % in central EU countries)
- Spanish water resources occur with high irregularity in time (interannual and anual) and in space (humid north regions versus arid mediterranean regions)

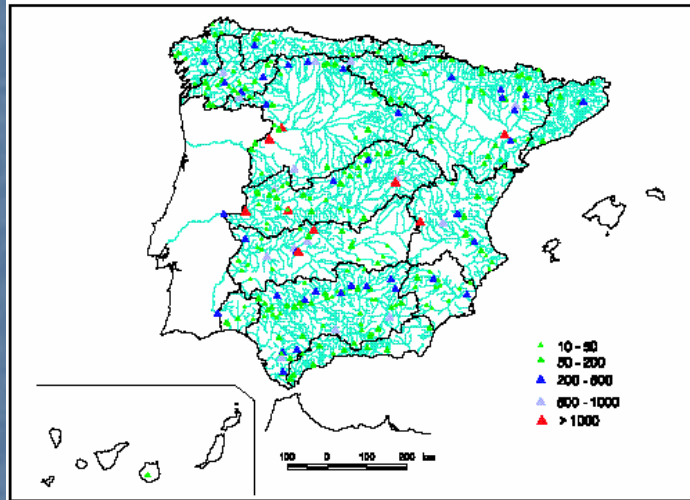


Mean rainfall time series variability in Spain (1940/41- 1995/96)



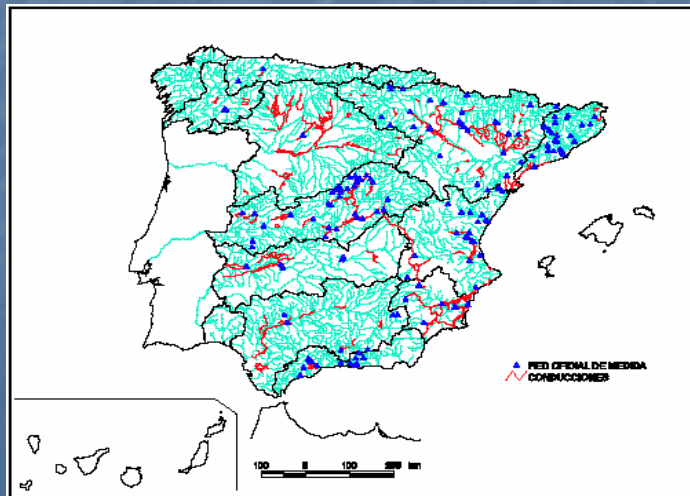
Mean rainfall territorial variability in Spain (1940/41- 1995/96)

HIDRAULIC INFRASTRUCTURES MANAGEMENT



Reservoirs with storage capacity >10 hm³

Plan	Número de embalses en explotación	Capacidad de los embalses en explotación (hm ³)	Superficie inundada (ha)	Capacidad de los embalses en ejecución (hm ³)	Capacidad total (explotación y ejecución) (hm ³)
Norte I	53	3.040	11.771	0	3.040
Norte II	27	559	2.913	0	559
Norte III	32	122	712	0	122
Duero	67	7.654	35.417	13	7.667
Tajo	198	11.131	58.806	4	11.135
Guadiana I	90	8.508	48.039	335	8.843
Guadiana II	36	684	4.654	92	776
Guadalquivir	107	8.208	43.293	659	8.867
Sur	37	1.160	5.212	159	1.319
Segura	27	1.144	6.580	79	1.223
Júcar	47	3.343	17.263	6	3.349
Ebro	151	6.761	40.294	941	7.702
C. I. Cataluña	14	692	2.450	80	772
Galicia Costa	22	688	4.446	0	688
Total península	908	53.694	281.850	2.368	56.062
Baleares	2	11	119	0	11
Canarias	114	101	477	0	101
Total España	1.024	53.806	282.445	2.368	56.174



Data of the operating reservoir and in construction (Septembdr 1996)

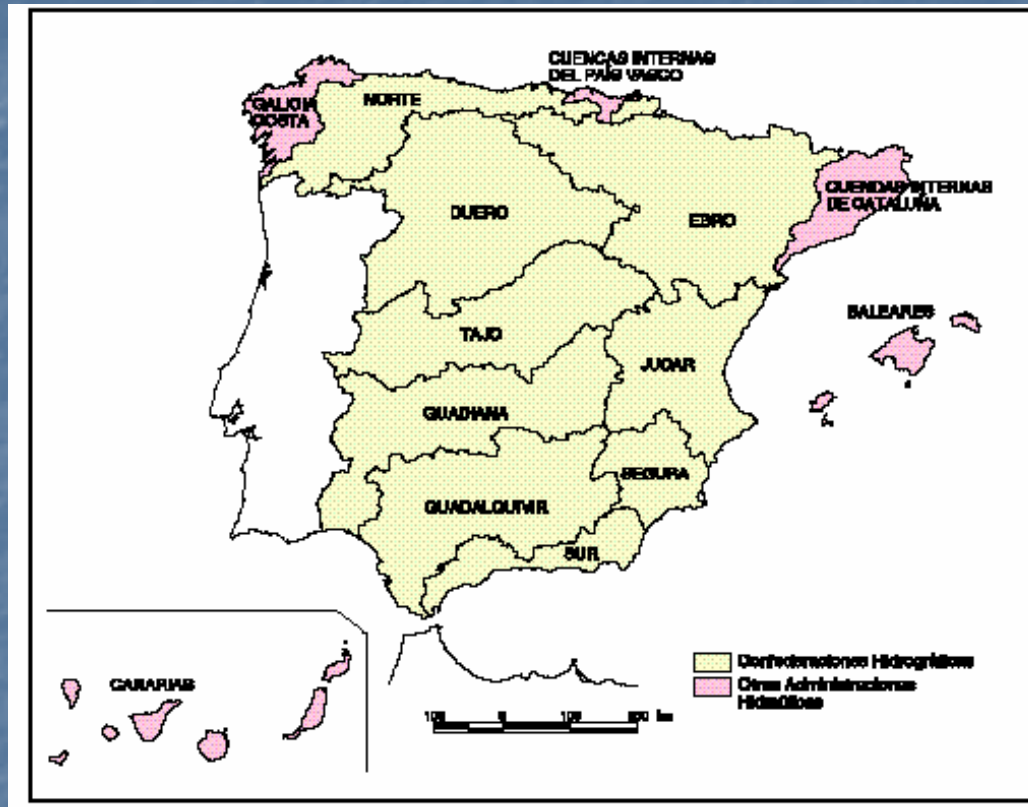
Map of the most important conductions for water supply and irrigation, and main control point

Long term management:
Hydrological Planning

How to do it ?

PUBLIC ADMINISTRATION of the WATER in SPAIN

Basin Authority



Basins territories – CCHH

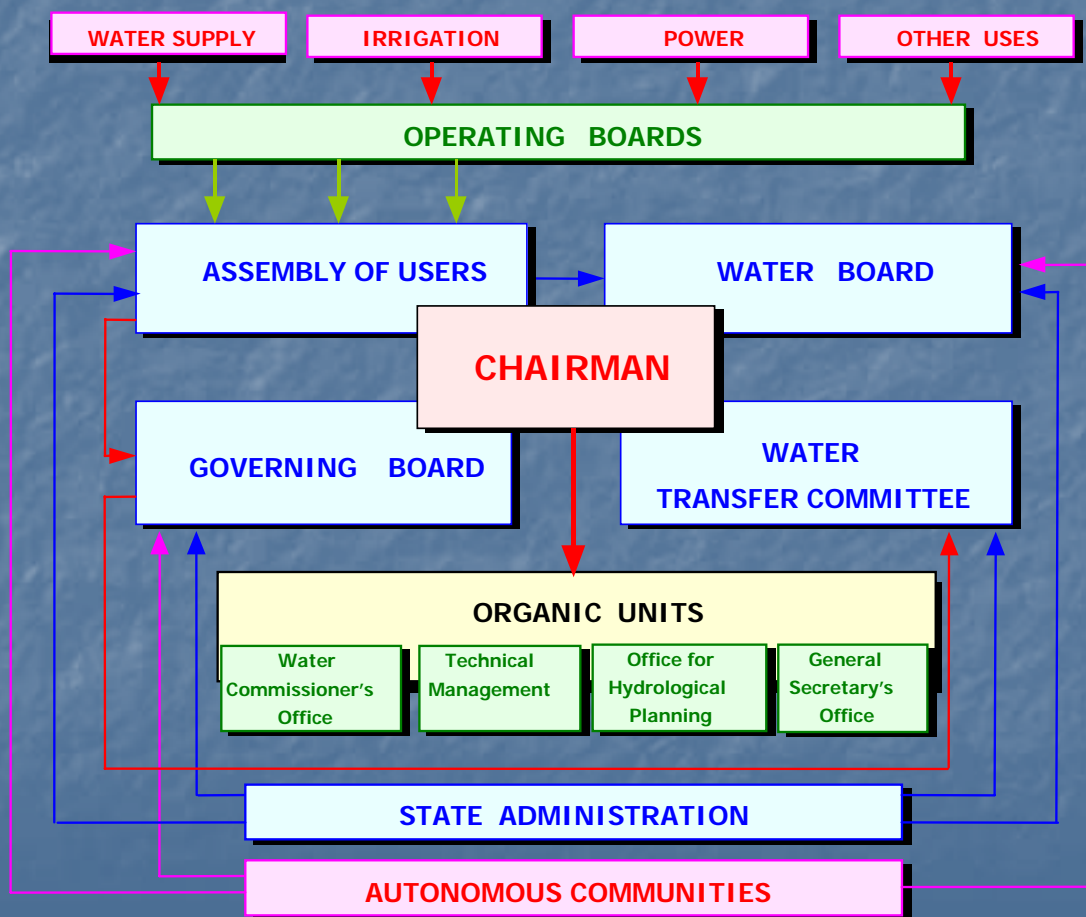
- 1. Attached to Ministry Of Environment
CONFEDERACIONES HIDROGRÁFICAS de:
Northern Basin
Duero
Tajo
Guadiana
Guadalquivir
Southern Basin
Segura
Júcar
Ebro

- 2. Attached to Autonomous Regions
Cuencas Internas de Cataluña
Galicia Costa
Cuencas Internas del País Vasco
Balears Islands
Canary Islands

Tajo Basin Authority



Ministerio de Medio Ambiente
Confederación Hidrográfica
del Tajo



Administrative structure



Ministerio de Medio Ambiente
Confederación Hidrográfica
del Tajo

Governing Bodies

CHAIRMAN

GOVERNING BOARD

Management Bodies

USERS ASSEMBLY

COMMITTEE FOR WATER
TRANSFER

OPERATING BOARDS

WORKS BOARDS

Planning Bodies

WATER BOARD FOR THE BASIN

Article 22 of the Water Act describes the powers and duties of the Water Authorities for performing their functions

Content of Hydrological Plans I

- Inventory of water resources
- Current and foreseeable uses and demands
- Assignment of priorities and compatibility of uses
- Allocation/reservation of resources for uses and requirements for conservation/recovery of the natural environment
- Water quality characteristics, sewage planning
- Basic rules improvements to irrigated land which ensure best exploitation of water resources

Content of Hydrological Plans II

- Protection perimeters and measures to preserve affected resources and environment
- Forest hydrological restoration and land protection plans
- Aquifer artificial recharge and protection guidelines
- Basic infrastructures required
- Operating limitations for hydropower
- Criteria for studies , procedures and efforts guided to prevent flood and drought damages

Water deficiency

Water Act regulations

- Inventory of water resources
- Current and foreseeable uses and demands
- Assignment of priorities and compatibility of uses
- Allocation/reservation of resources for uses and natural environment
- Basic rules improvements to irrigated land optimizing water use
- Basic infrastructures required

Technical procedure

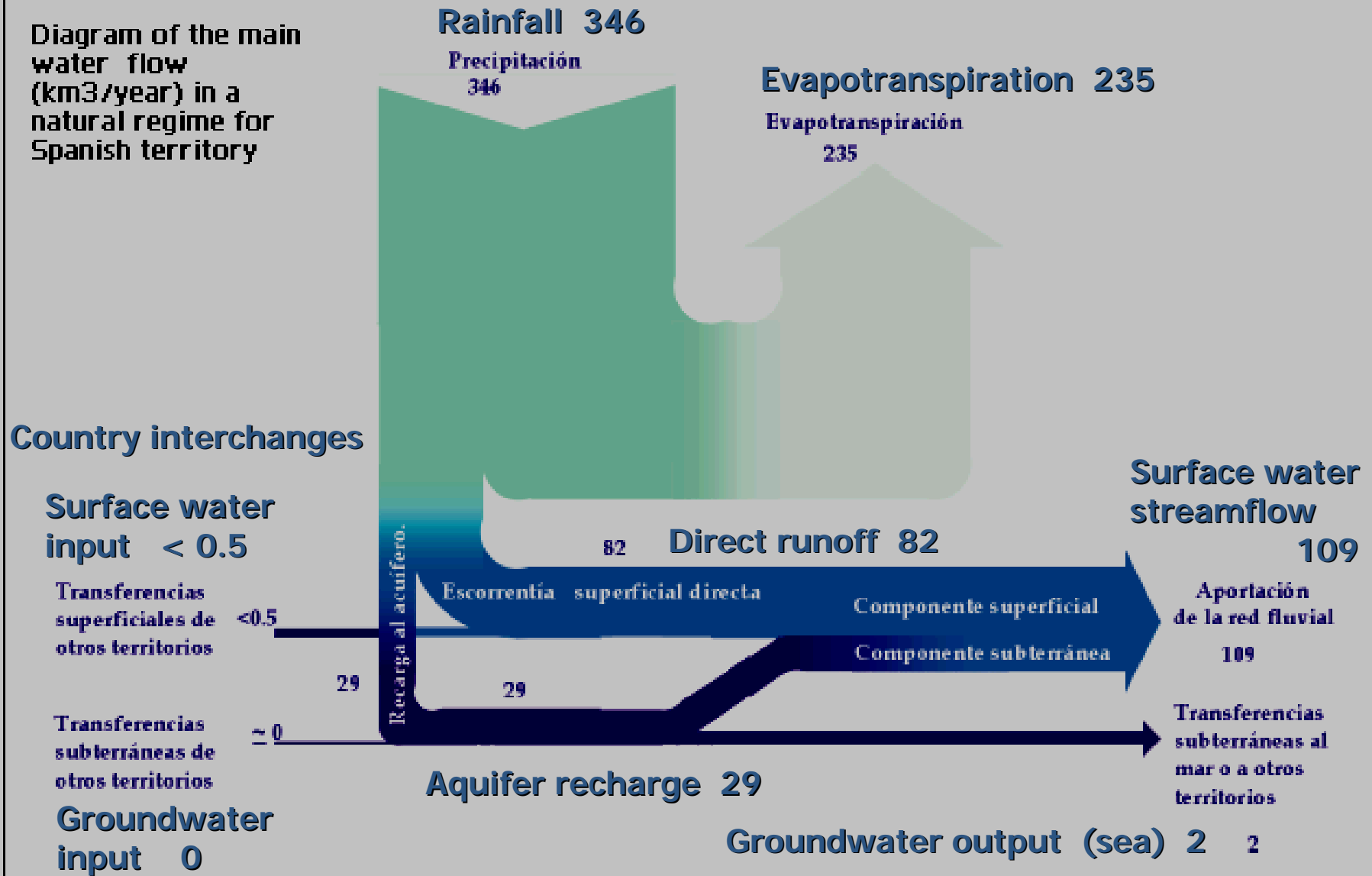
- Basin resources assessment
- Demands evaluation
- Definition of Water Resources Management Systems (WRMS)
- Study of environmental requirements
- Analysis of water supplies and demands satisfied in WRMS (modelling simulation)
- Demands-Water availability balance → Deficit->Measures

Balance between demands and available resources: procedure

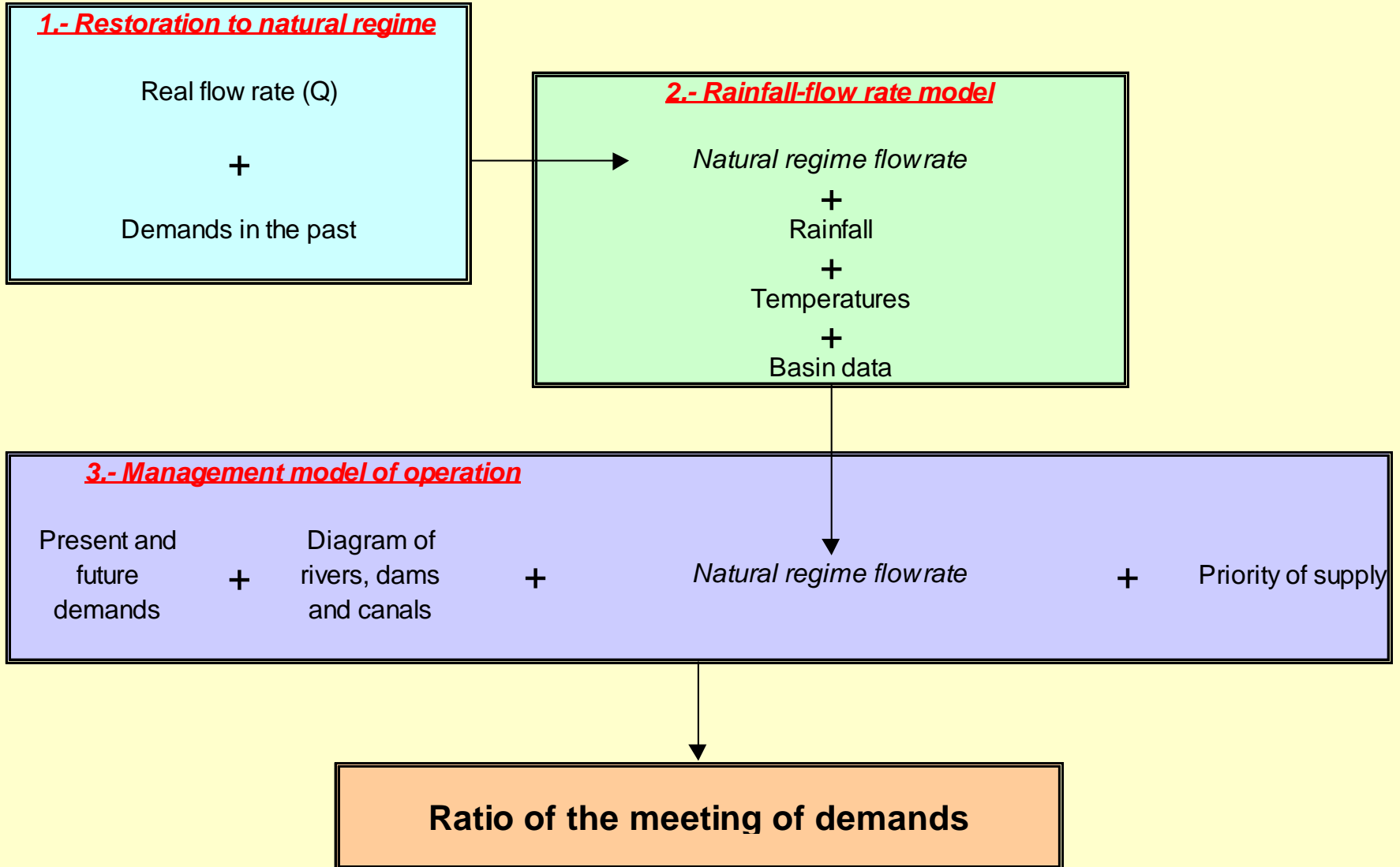
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- Definition of Water Resources Management Systems (WRMS)
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- Demands-Water availability balance → Deficit

Spanish resources assessment

Diagram of the main water flow (km³/year) in a natural regime for Spanish territory



WATER RESOURCES ASSESSMENT IN EBRO BASIN PLANNING

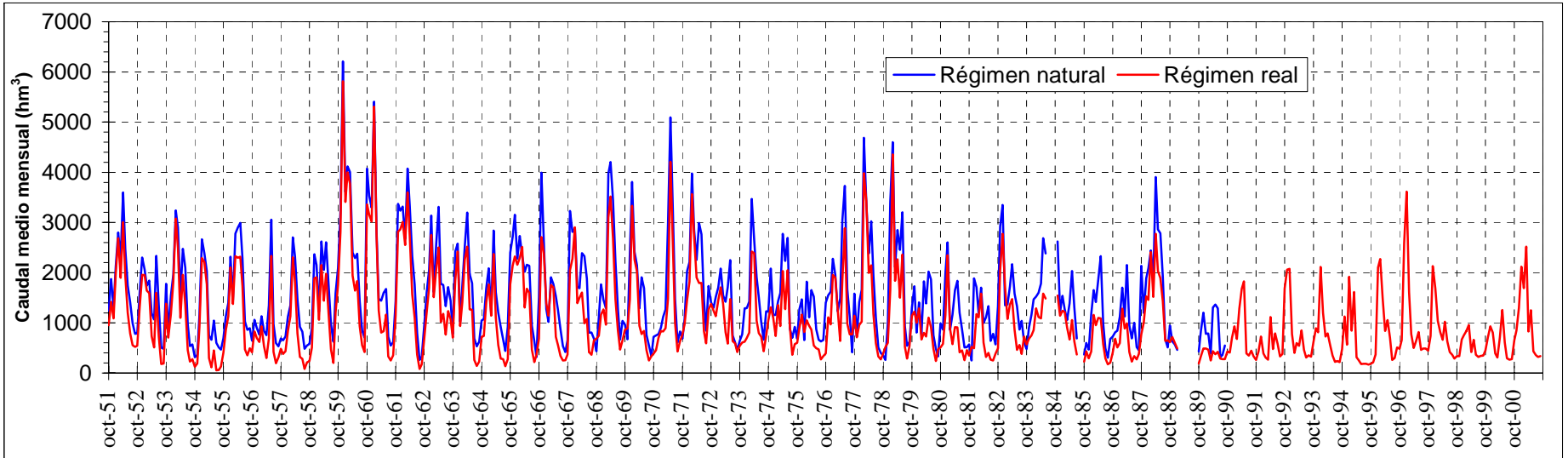
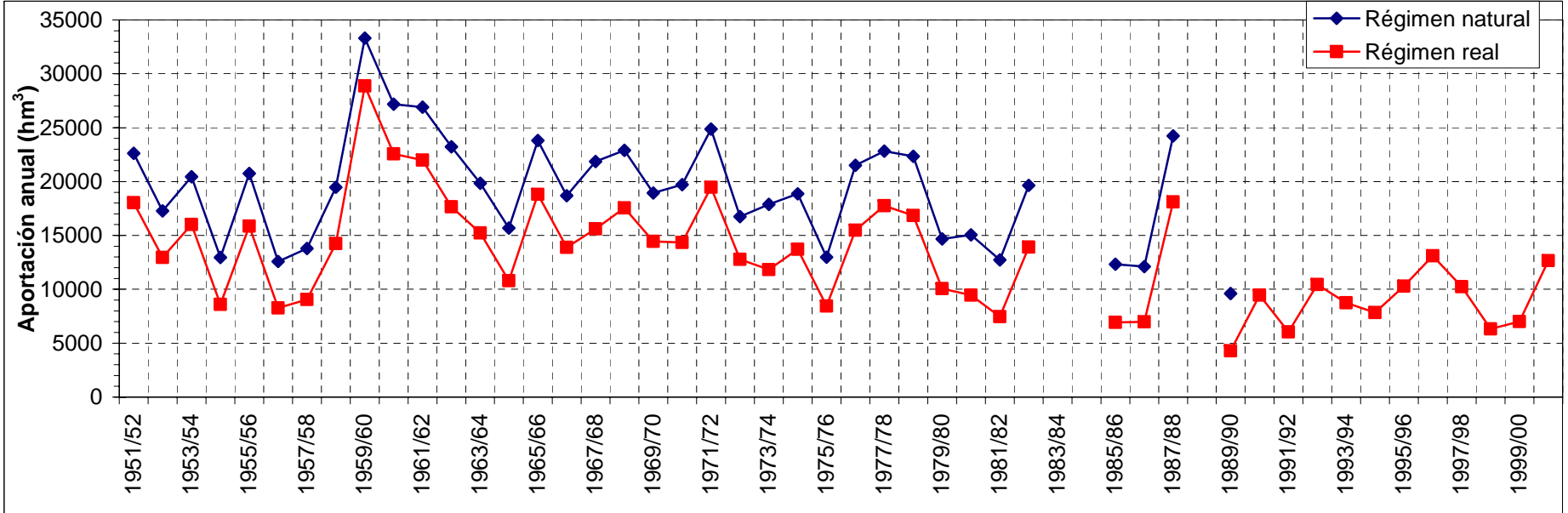


Código estación:

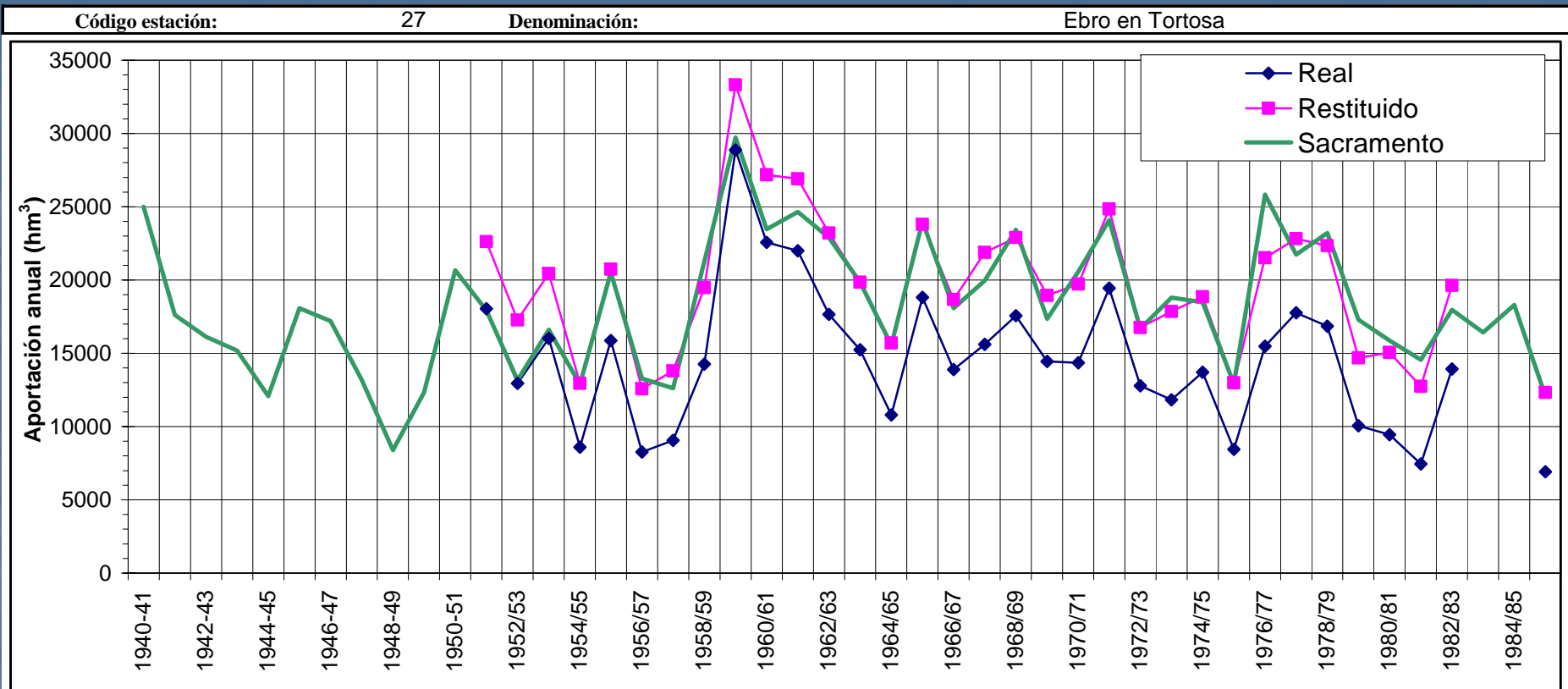
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Denominación:

Ebro en Tortosa

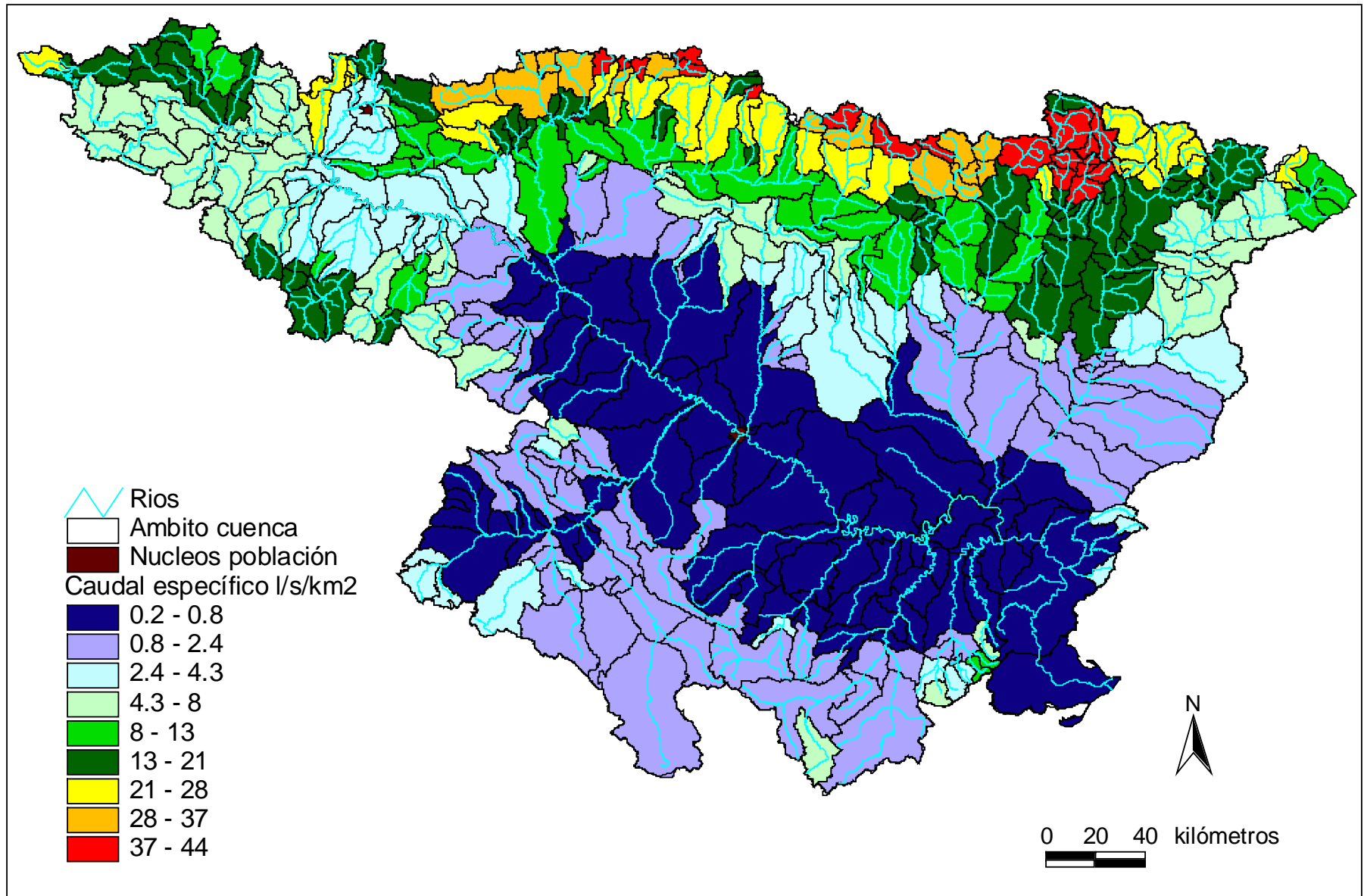


- Ejemplo de serie obtenida con el Sacramento para el Ebro en Tortosa:



El caudal medio para los 46 años hidrológicos del periodo 1940/41-1985/86 es 18.217 hm³/año

Specific discharge 442 (Sacramento modelling results) Basin of river Ebro. Monthly value 1940/1985



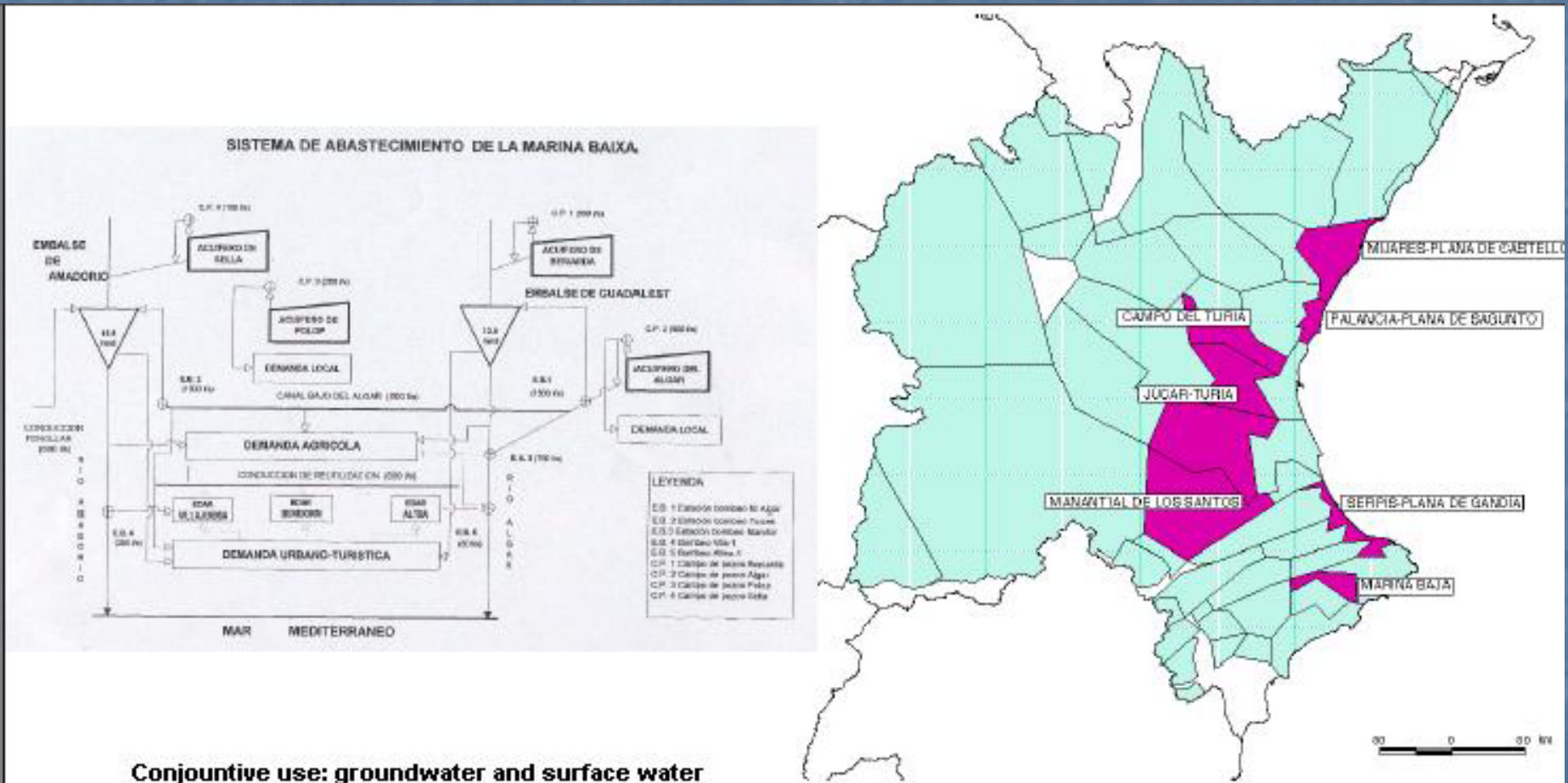
Water Resources Management Systems (WRMS)

- Group of water engineering structures and related water bodies serving one or more purposes and managed as a unified whole system
- Water Act Regulations (Reglamento Planificación Hidrológica y APA), WRMS include:
 - Natural elements (water, territory...)
 - Infrastructures, facilities,...
 - Demands and water rights conditions
 - Management rules of hydraulic infrastructures (maximum/minimum outflows, dam safety levels...)

Tagus Basin shared in WRMS

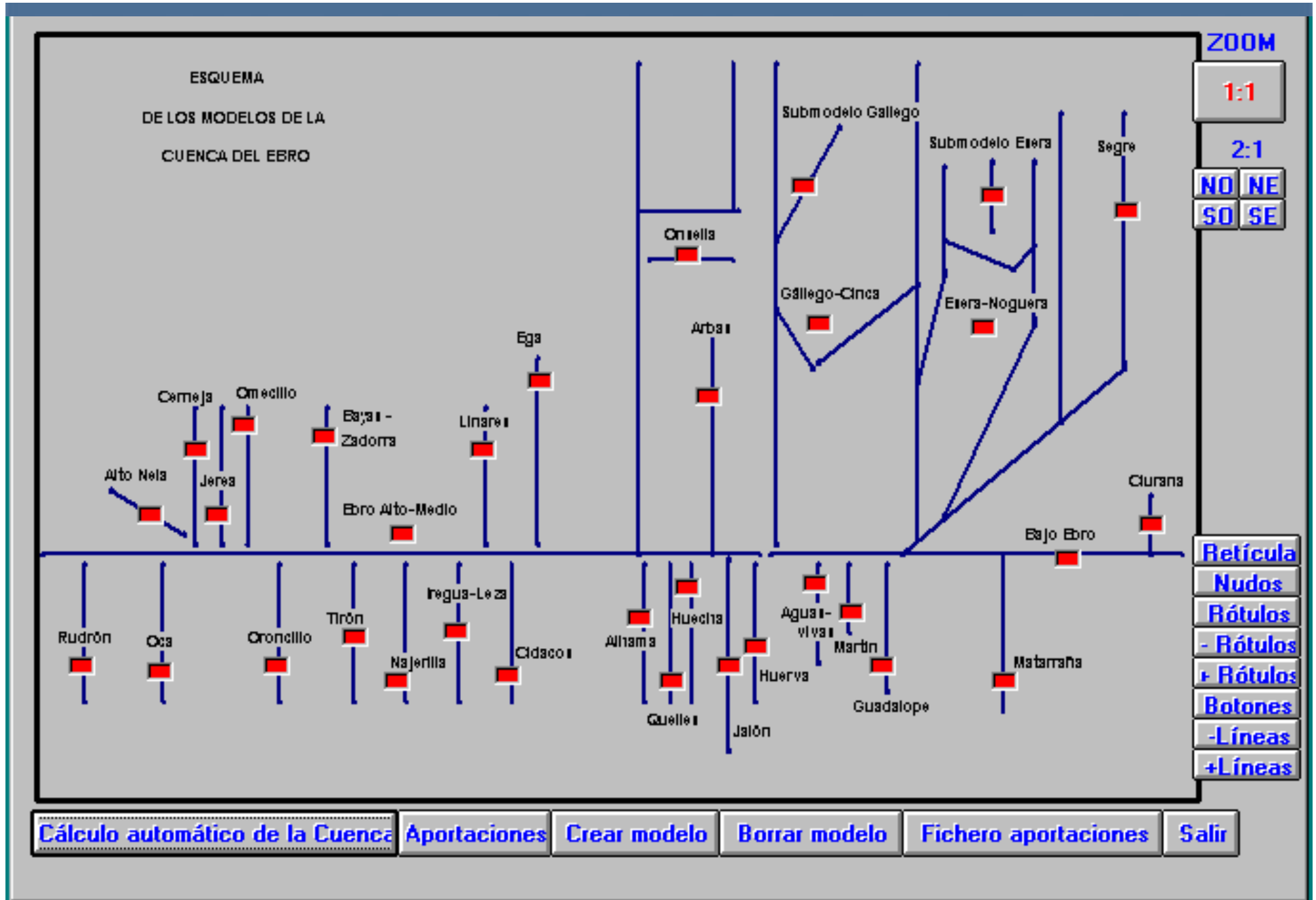


WRMS in JÚCAR BASIN

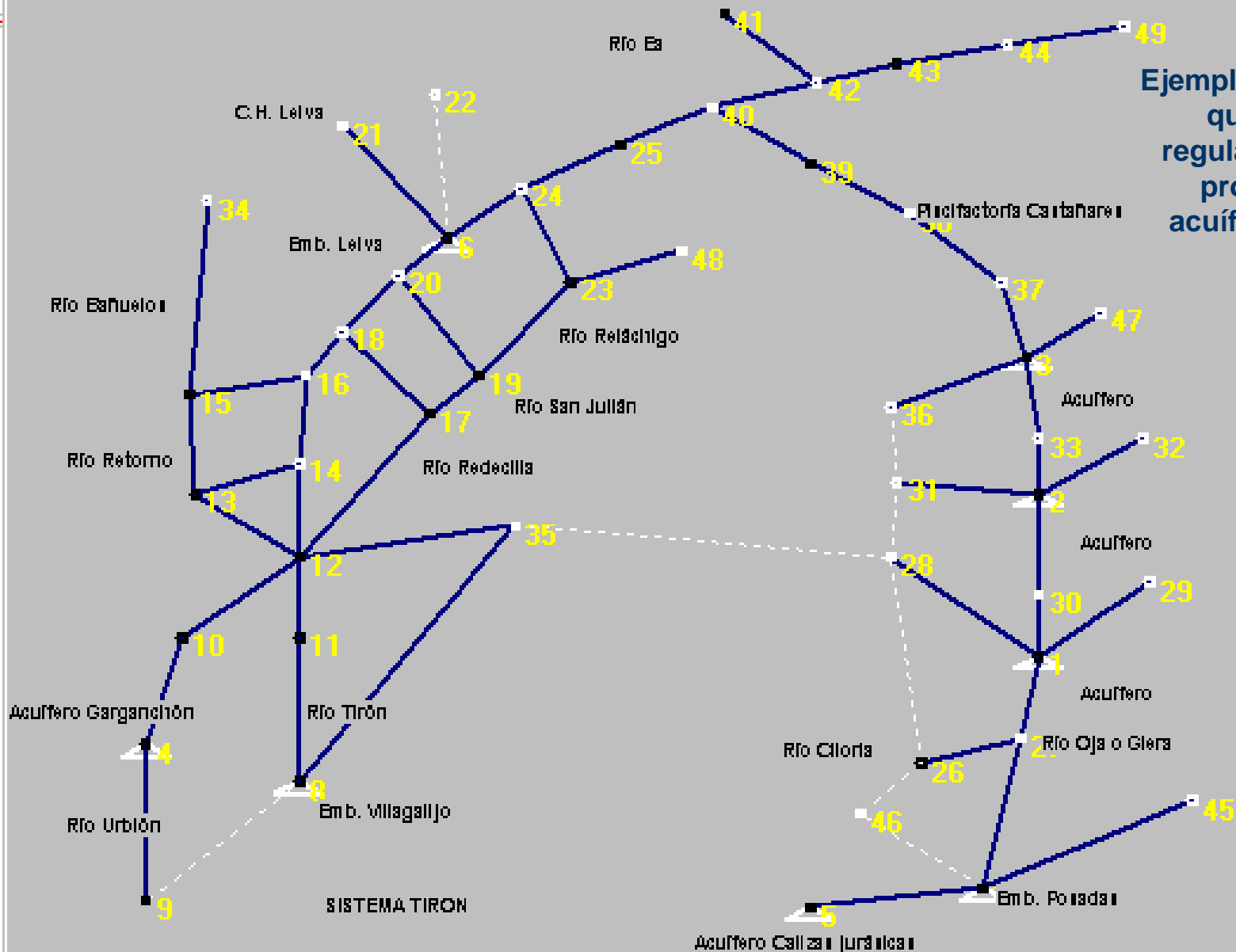


Conjunctive use: groundwater and surface water

SHARING the whole BASIN in WRMS :Sketch of 33 Resource Management Systems in Ebro basin



MODELO DEL TIRON



Ejemplo del río Tirón en el que se incluye la regulación subterránea producida por los acuíferos del río Glera

Diseño de esquemas

Modificación de datos

Simulación

Análisis de resultados

Utilidades

Salir

Demands evaluation

- According to regulations of Water Act Rule (Reglamento Administración Pública del Agua y Planificación Hidrológica): Water necessities for different uses, defined for the following data:
 - Total yearly volume and monthly distribution
 - Quality requirements for every use
 - Supply reliability for every use (guarantee criteria)
 - Returns of water used : amount, temporal distribution and quality

Environmental requirements

- Water requirements -in quantity and quality- to support ecological capability of ecosystems including their processes and biodiversity (MEDROPLAN)
- (WFD purpose)...protects and enhances status aquatic ecosystems and,with regard to their water needs, terrestrial ecosystem and wetlands...
- According with Spanish Water Act, the environmental requirements have priority over water demands, except human consumption. This requirements must be established for each water body or aquifer

Demands: guarantee criteria

- Show the endurance to the failure of water supply
- Each use (urban, irrigation, industrial,...) has different capacity
- It's technical and economical impossible to satisfy fully demands at every time and everywhere
- The guarantee criteria is a conventional rule establishing the quantitative conditions under a demand could be considered sufficiently satisfied

Different types of guarantee criteria

- System behaviour facing a crisis
- Failure occurrence probability
- Severity of failure
- Failure duration
- Economic impact

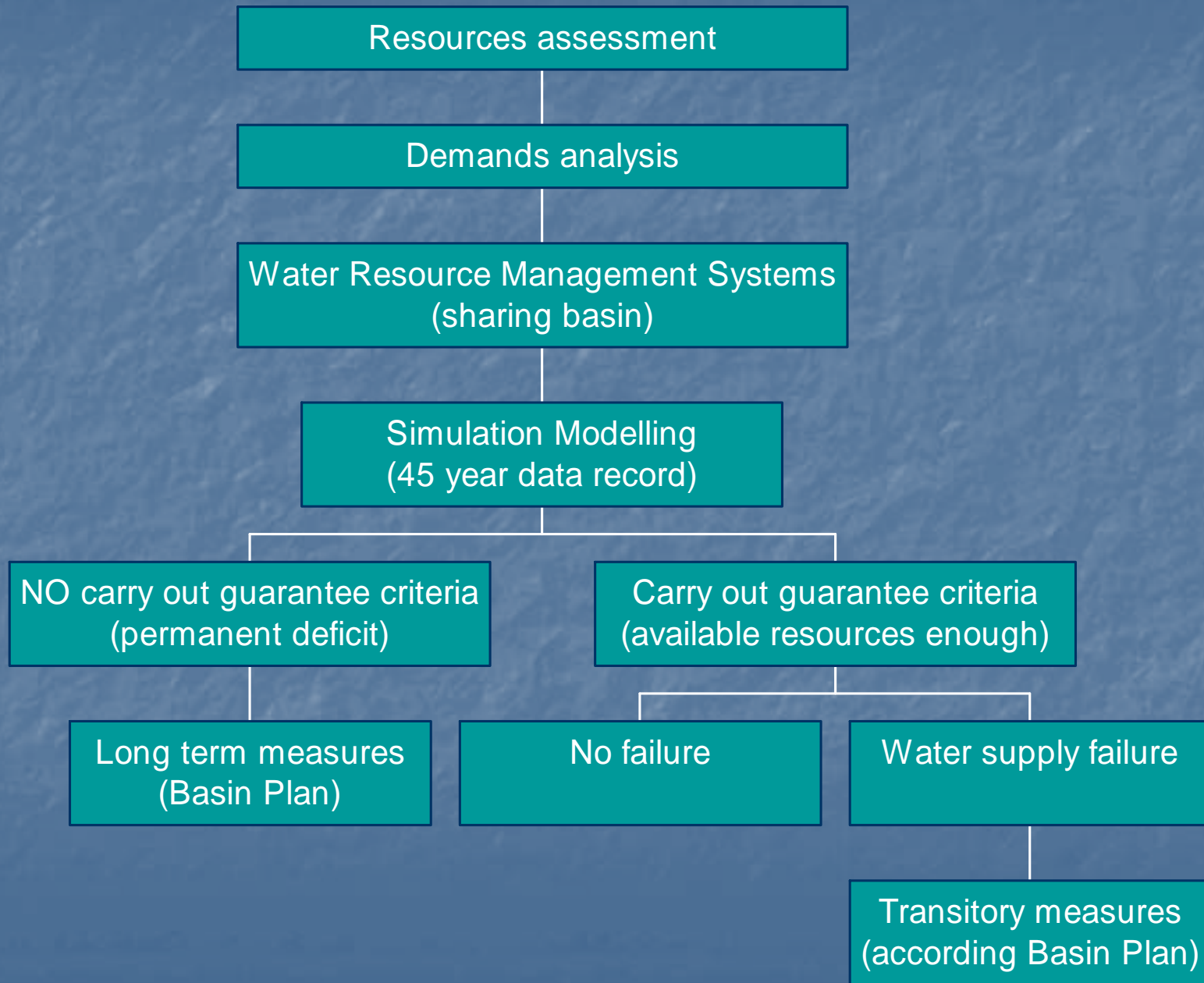
Technical Instructions for Hydrological Plans (O.M. 24 Sept 92)

- A demand is considered satisfied during a certain period of time (45 years) if:

- The deficit in a year is $< A$ % of yearly demand
- The deficit in two consecutive years is $< B$ % of yearly demand
- The deficit in ten consecutive years is $< C$ % of yearly demand

■	URBAN	IRRIGATION	INDUSTRIAL
■ A	5-10	20-40	$< 5-10$
■ B	10-16	30-60	$< 10-16$
■ C	16-30	40-80	$< 16-30$

WRMS Simulation Modelling



Permanent or transitory failure : measures to be taken

- It means that a WRMS is available to attend a group of demands , according to determinate reliability criteria, we are accepting certain magnitude of failure to satisfy fully the total water supply theoretically required
- The magnitude of **accepted failure** is limited by guarantee criteria. When it happens is necessary to carry out the Emergency Plans or similar **transitory measures**
- In other cases, the WRMS couldn't be considered enough and show a **permanent deficit**. It's necessary to balance the offer of available resources and water demands on a **medium/long term basis**

Deficiency and long term measures

- Demand management and water conservation
- Reuse
- Performances on water quality

New investment water resources development

- Localization problems
- Operation costs and effectiveness
- Terms of execution and of operation
- Increase of surface water regulation and groundwater withdrawal
- Desalination plants

Transitory periods: to be prepared

We don't know when but it's sure it will occur
→ it's necessary to be prepared and foresee the actions and measures : planning, legal and institutional

■ Hydrological Plans

- Include criteria about studies and measures in order to get ready for drought and avoid or mitigate damages

■ General Regulations

- Law 10/2001 of National Hydrological Plan (Plan Hidrológico Nacional), Section 27 "Droughts management". Emergency Plans
- Different Sections of current Water Act (Texto Refundido Real Decreto-Legislativo 1/2001). Exceptional measures

■ Institutional Tools

- Reservoir Committee of River Basin Authorities

■ International bodies

International bodies: Albufeira Agreement

- Cooperation Agreement for protection and sustainable use of international basins between Spain and Portugal (**Albufeira 11/30/98**). Rivers included:
 - Miño y Limia
 - Duero
 - Tajo
 - Guadiana
- Section 19 of Albufeira Agreement deals with drought and scarcity, encouraging both countries to establish a joint indicator system that allows to fix border flows in exceptional cases



Conclusions

It's technically and economically impossible to satisfy **fully** demands at all times and everywhere.

- We accept certain margin of failure to satisfy fully the total water supply theoretically required. The magnitude of **accepted failure** is limited by guarantee criteria.
- If these conditions are not met, the availability of water can not be considered sufficient and Water Resource Management System shows a **permanent deficit**. It's necessary to balance available resources and water demands in the **medium/long term** → Basin Management Plan. It involves technical, economic, legal and institutional aspects.
- In the case of this sort of accepted failure it is necessary to implement Emergency Plans or similar **transitory measures**.
- Special case of international bodies → agreements for cooperation

