FRANCE – MANAGEMENT PLAN FOR THE ASTIAN AQUIFER CASE #20

This case is concerned with establishing an institutional structure for the management and restoration of groundwater located in the littoral area of the "Languedoc-Roussillon" region, France, where competing uses (agriculture and tourism) threaten the aquifer.

ABSTRACT

Description

Astian groundwater forms part of an aquifer which is confined for much of its length and which plays an essential role in the economic development of the Béziers region (180,000 habitants, which increases to 300,000 in the tourist season). 75% of the groundwater abstracted is used for drinking water. Half of this is consumed between June and August due to the tourist population.

Economic activity in the region is carried out in geographically distinct areas, with tourism in the littoral area and agriculture on the plain. A combination of factors led to the uncontrolled development of the groundwater, namely:

- The groundwater is artesian.
- The quality of the pumped water is good.
- The abstraction rate in many bore holes is more than 100 m³/h.

At one stage, there were more than 600 boreholes in operation. Consequently, the future of this aquifer was endangered, with water quality affected by saline intrusion, a direct result of overabstraction.

In 1990, SMETA (a mixed syndicate of local authorities) was established to organise the management of the aquifer. It involves wide stakeholder representation. The case is an example of an Integrated Water Resource Management approach in a littoral area which involves the public authorities (State and Water Agency), local authorities and users. Through the SMETA structure, the stakeholders defined a harmonised management plan for the aquifer.

Lessons learned

The SMETA organisation proved successful in protecting the aquifer. However, it failed to take into account the effect of small wells, which continue to be sunk and which threaten the quality of the aquifer, and the private property structure, which makes it difficult to control private wells.

Importance for IWRM

- Good example of a groundwater management contract (16 million francs) between the Water Agency and the local authorities, which defined the management rules between the State and the stakeholders.
- The case also illustrates some of the difficulties in developing sustainable programmes for integrated resource management.

Main tools used

C1.2 Water resources assessment
C3.3 Improved efficiency of water supply
C8.1 Information management systems

MAIN TEXT

1 Background and problems

The Astian aquifer

The geographical setting

The Astian sands in Valras-Agde form one of the main deep coastal aquifers of the Languedoc-Rousillon region (see figure 1). The Astian aquifer is essential for the economic development of the Hérault region.

This aquifer has been identified as a "heritage aquifer" by SDAGE (Schéma Directeur d'Aménagement et de Gestion des Eaux du bassin Rhône-Mediterranée-Corse – The Management and Master Development Plan of Water – for the Rhône-Mediterranean-Corsica Basin). A comprehensive management policy has been advocated for this aquifer.

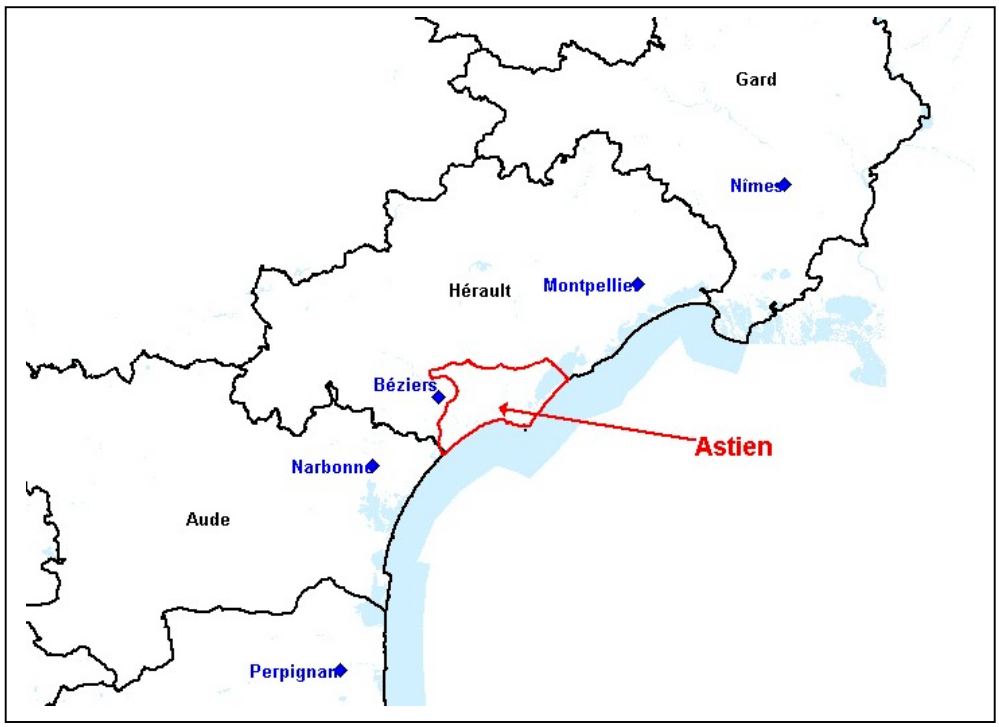

Figure 1: Location of the Astian aquifer

The physical environment

The Astian sands, dating from the maritime Pliocene, form a homogeneous layer of about 20 metres in depth which surfaces in the north and disappears progressively in the south to a depth of 100 to 120 metres beneath the edge of the coast.

The aquifer is confined for most of its length and numerous boreholes are naturally artesian in the southern downstream part. Their hydrodynamic characteristics allow a pumping outflow which can reach about 100 m³/hr. The drainage speeds reach about a few metres per year.

The supply is assured by:

- Direct seepage in the outcrop areas in the extreme north.
- Recharge in the upstream part where the aquifer is shallow.
- The weak productivity of the peripheral aquifers (continental Miocene and Pliocene, karstic basin of Villeveyrac).

- The alluvial aquifer of the most upstream part of the Hérault region.

On the edge of the coast, a clay interface of about 70 metres between the overlying alluvial stretches (Orb, Hérault, Libron) and the Astian aquifer excludes any possibility of recharge.

The quality of the water is generally good, except in the southern periphery (where the chloride content exceeds 250 mg/l), to the north of Thau Lake (where there is a high nitrate content), and to the south of the Vias and Agde communities (where the water contains concentrations of iron greater than 0.2 mg/l).

Socio-economic Context

Activities

There is little urbanisation, except on the periphery (the cities of Béziers and Sète). Tourism is carried out on the coast and agriculture on the plain.

During the summer, coastal tourism nearly doubles the permanent population from 183,000 (including Béziers and Sète) to about 326,000 inhabitants. Vineyards make up 67% of the arable land, but this figure is decreasing slowly.

Water use

The Astian aquifer is used intensively. In 1988 it supplied 4.6 million m³ of water (DIREN – DIrections Regionales de l'ENvironnement estimation). Each year for the last three years, between 3 and 5 million m³ of water was abstracted from the aquifer.

In 1988 the percentage of water abstracted by different sectors was as follows:
- 78% – domestic water supply (AEP of the communes, campsites, private bore holes).
- 12% – agriculture.
- 4% – sports facilities.
- 4% – industry.

The remaining 2% was lost through natural means.

Management Problems

Management of this aquifer reveals the following problems:
- The water abstracted for drinking water comes predominantly from the coastal area (i.e. the tourist zone). More than half the annual volume is abstracted during the months of June, July and August.
- Good quality water near the surface has favoured the development of a large number of bore holes (more than 700 listed, both private and public) (see figure 2).

This has the following consequences for the development of the aquifer:
- The piezometrical level on the edge of the coast collapsed in the eighties. Its previous equilibrium had been disrupted and even seasonal recharge did not improve the situation. There was a major risk of increasing salt concentrations in the water.
- Numerous bore holes of varying standards cause the Astian and aquifers of mediocre quality to mix, because of the decrease in artesian pressure.

As a result of overuse of the aquifer in the coastal area, there has been a decrease in the water table since the beginning of the eighties, with depressions reaching 20 metres below sea level and 1 to 2 metres below sea level in winter.

This situation could lead to irreversible salt pollution of the aquifer, either by the overlying aquifers or by saltwater intrusion. Figure 3 illustrates the mechanism of saltwater intrusion in the Astian aquifer. Due to the contrast in density between freshwater from the continent and saltwater from the sea, a saltwater wedge is formed.

Heavy abstraction of water on the edge of the coast is thus a major hazard, as the saltwater wedge could go up to the anticlinal line of the aquifer layers. Once the saltwater wedge goes beyond this point, the process is irreversible.

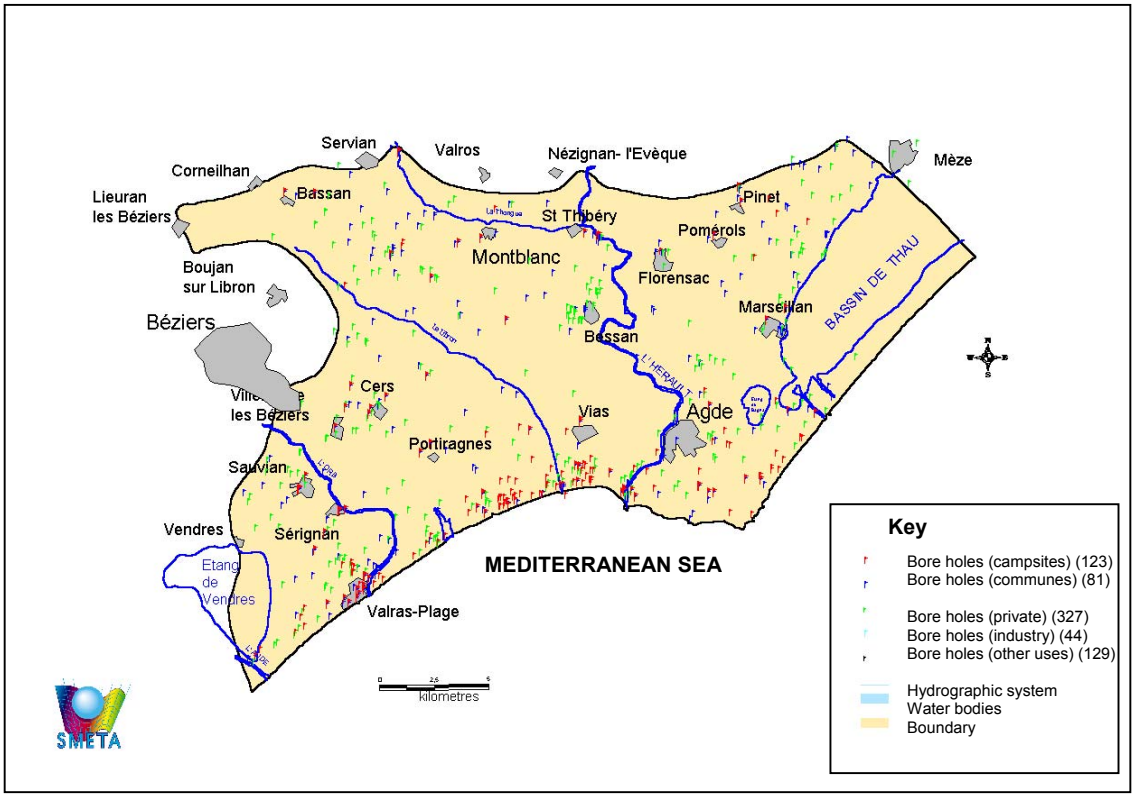

Figure 2: Location and number of bore holes abstracting water from the Astian aquifer

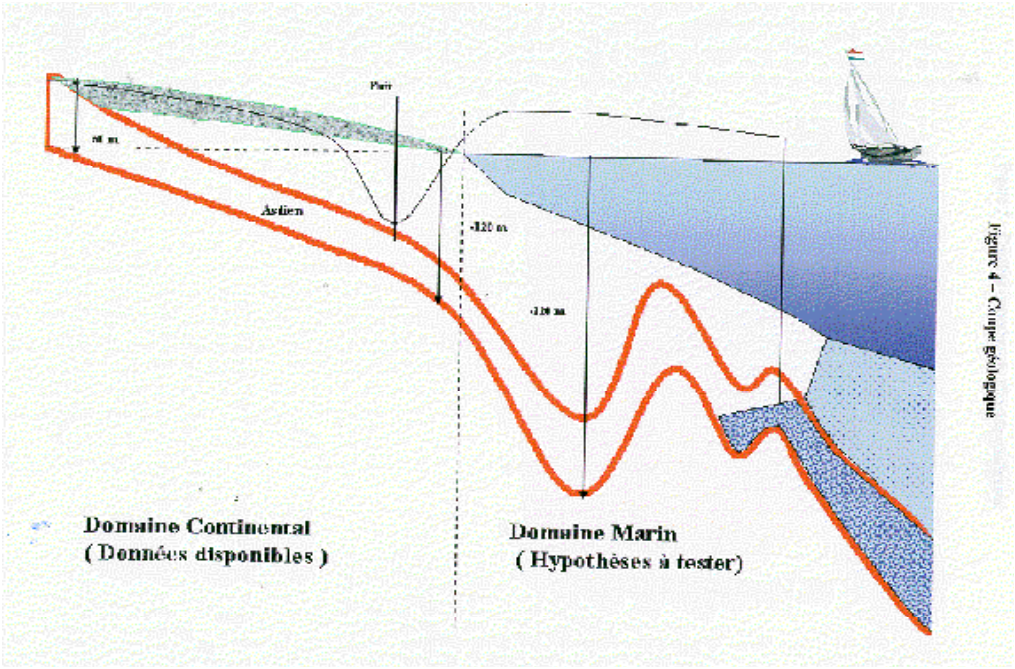

Figure 3: Mechanism of saltwater intrusion in the Astian aquifer

2 *Decisions and actions taken*

At the beginning of the seventies it was recognised that the Astian aquifer was under threat. Since 1970 several initiatives have been undertaken which have led to the establishment of an aid for managing the aquifer. These initiatives comprise:

- 1970: first piezometrical measurement on about 100 private bore holes. First major study of the aquifer.
- 1973: first permanent piezometrical point of observation.
- 1974-1980: establishment of a network of piezometrical observation points along the edge of the coast.
- 1983: first numerical modelling of the aquifer.
- 1986-88: inventory of the bore holes, estimation of water abstracted.
- 1992: modelling saltwater intrusion.
- 1999: study of the relationships between the aquifer, Thau Lake and the sea.
- 2000-01: design of a new numerical model for the aquifer.

Policy for managing the resource

In 1989 a procedure for enforcing a decree – law 1935 – was followed at the State's initiative, but was not implemented because it did not answer the needs of either the local administration or the users.

This led to the integrated management of the aquifer as a "communal asset" which was based on the main principles of the law concerning water (3 January 1992).

In 1990 a local management structure was created, The Combined Union for the Study and Management of the Astian aquifer. This grouped together the various parties wanting to use the water:

- 20 communities situated in the geographical region of the aquifer.
- The Chamber of Agriculture, the Chamber of Commerce and Industry of Hérault.
- The Departmental Council for Hérault.

This Union has assured that it will:

- Take responsibility for further investigations, monitor the environment and the way the resource is used, and establish awareness raising and information campaigns for those concerned with the quality of the environment and its management.
- Promote an institutionalised dialogue between parties concerning the definition and the monitoring of the overall management policies, taking into account the needs and interests of the various networks of users, as well as the necessary preservation of the environment.

In 1996, the Union changed the statutes and its scope. When the Union decided to take on the assessment of the aquifer, certain communities decided to withdraw from it and from then on the Union became The Combined Union for the Study and Working of the Astian (SMETA). The Union aims to be an authority on the aquifer and to guarantee the management goals for the aquifer. The member communities or local administrations regularly consult the Union about various projects (renewing of campsite permits, drilling new, individual bore holes).

The aquifer is managed as part of the natural heritage – this has been achieved through the knowledge acquired about the aquifer, the simulation models available and the existence of a coherent structure for co-ordinating the work. This management approach aims to:

- Balance the water abstracted from the different available resources and guard against increases in the salt content of groundwater at the edge of the coast.
- Continue to use the aquifer in the sectors that are least vulnerable to saltwater intrusion and within the limits of its available capacity.
- Preserve the quality of this resource by reducing the danger of overlap with aquifers near the surface.

The Management Plan for the aquifer

The structure of SMETA offers the possibility of dialogue between all the water users. This dialogue prevails in the objectives of managing the aquifer as a communal asset and has led to a Plan for the management of the aquifer.

This Plan was unanimously approved at the Union meeting of December 6th 1996 and signed on June 23rd 1997 by the State (Minister for the Development of the Environment), the Water Agency Rhône-Mediterranean-Corsica, the Departmental Council for Hérault, SMETA, and the member communities of the Union. It covers the period 1997-2002 and defines the actions to be carried out over these five years. It also identifies the parties involved and guarantees financing plans adapted to each operation.

The Plan was drawn up around five themes with specific objectives:

1. **Quantitative management of the aquifer** – with the objective of limiting the risks of saltwater intrusion in the coastal areas, improving the quality of water supplied to various sectors and conserving the water supply in the region.
2. **Preservation of water quality** – which aims to reduce the risks of polluting the aquifer by dealing with any defective installations and ensuring that bore holes are drilled correctly.
3. **Water saving** – the goal of which is to limit water losses mainly due to leaks in certain community networks of drinking water and from artesian wells.
4. **Leadership and information** – the objective being to ensure the Management Plan for the aquifer is honoured by all participants, and to explain and diffuse the knowledge acquired about the aquifer, its functioning and development.
5. **Monitoring the resource and additional studies** – which should produce an improvement in the knowledge of how the aquifer functions, use environmental monitoring, and have evaluations of the Plan and the integrated management of the resource readily available.

3 Outcomes

The First Assessment

Initiatives linked to the Plan

After defining the priorities, the first initiatives were carried out at the beginning of 1998 by bringing the first inventory of the boreholes up to date. A year later the first assessments of the dilapidated state of private boreholes were carried out by analysing the water. Equipment was also installed which would register the piezometrical levels on a continuous basis onto the surveillance network of the aquifer.

The first assessment of the initiatives undertaken within the framework of the Plan includes the following:

1. Quantitative management of the aquifer

- Public water supply network provides a golf course, a big water user on the coast, with a provisional supply of water.
- Linking three communities to an alternative resource (to reduce the pressure on the Astian aquifer).

2. Preservation of water quality

- On-site assessment and filling-in works for abandoned public bore holes.
- Public survey to declare the drilling operations as being in the interest of the public (filling-in or rehabilitation of private bore holes).

3. Water saving

- Diagnostic studies of the potable water network with search for leaks.
- Rehabilitation works for the network.
- A communal scheme for potable water supply.

4. Leadership and information

- Recruiting a part-time hydrogeologist and a groundwater technician.
- Printing and distribution of documents for the general public (signposts, drilling guides, etc.).

- Encouraging users to install water meters.

5. Monitoring the resource and additional studies

- Monitoring the resource (piezometrical level, water quality), distribution of leaflets.
- Modernisation of the piezometrical network.
- Study of the extension of the Astian aquifer into the sea.
- Updating the inventory of bore holes and the uses of the aquifer.
- Designing a new hydrodynamic simulation model for the aquifer.

Besides this, additional initiatives concerning the Plan have been carried out:

For theme 1:

- Improvement of conditions for abstracting water (in some communities).

For theme 2:

- Indication of the state of the network through water analyses (170 private and public bore holes).

Assessment of the management of the aquifer

About 700 boreholes were documented in 1999. This inventory, however, is not an exhaustive one, as many private family boreholes have not been registered, especially in the north where the aquifer is easily accessible.

In 2001, the biggest users (i.e. those abstracting a volume greater than 2000m³/yr) were:

- 9 communities with 15 bore holes used for potable water.
- 19 campsites (out of 63 using the aquifer).
- 2 bore holes used for irrigation.

Between 1989 and 1999 there was a 25% reduction in the **known** water abstracted (see figure 4), from 4.4 to 3.25 million m³. However, in 2000, there was a significant increase in water abstraction, reaching 3.75 million m³ (i.e. increasing by 13% in one year). The increase in 2000 can be attributed to an increase in water abstracted by communities.

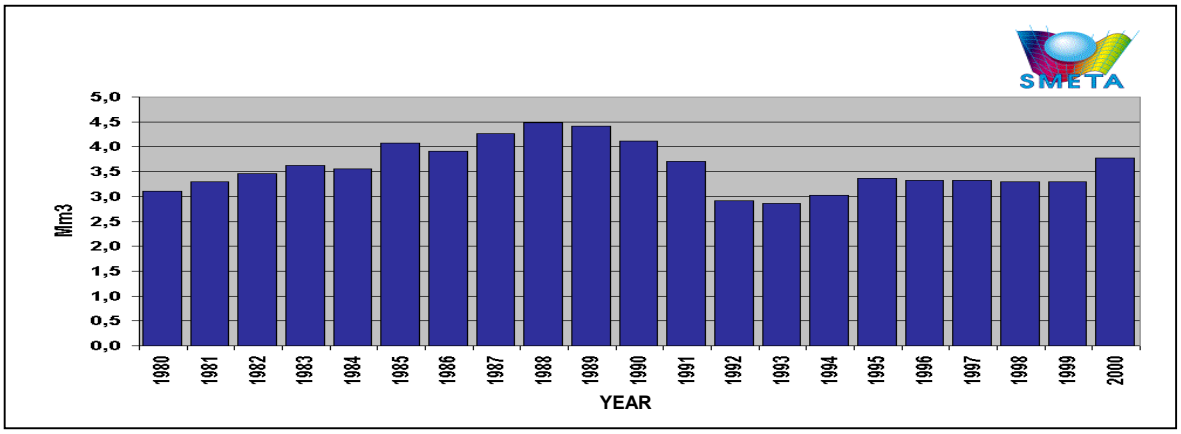

Figure 4: Annual amount of (known) water abstracted from the Astian aquifer (1980 to 2000) (SMETA)

Before the Plan was developed, several initiatives had been undertaken to reduce the pressure on the aquifer in the overused coastal sectors. In the eastern areas, in Valras, an alternative resource has been used since 1990 and in the west, Agde was partially linked to the public network to supply the golf course. This led to an increase in and some stabilising of the piezometrical level, although the aquifer is still overused in the Valras area.

In the remaining geographical area affected by the aquifer, it is still difficult to balance the annual climatic changes (and how these affect the aquifer in terms of recharge) and the increase in the amount abstracted.

In the last few years, however, the water abstracted has increased substantially in the central coastal area (Vias, Portiragne) bringing about a large local decrease in the piezometrical level.

The amount of water abstracted by the private sector, and in particular by campsites, is still not clear for the institutes concerned or for the Union, as demonstrated in figure 5.

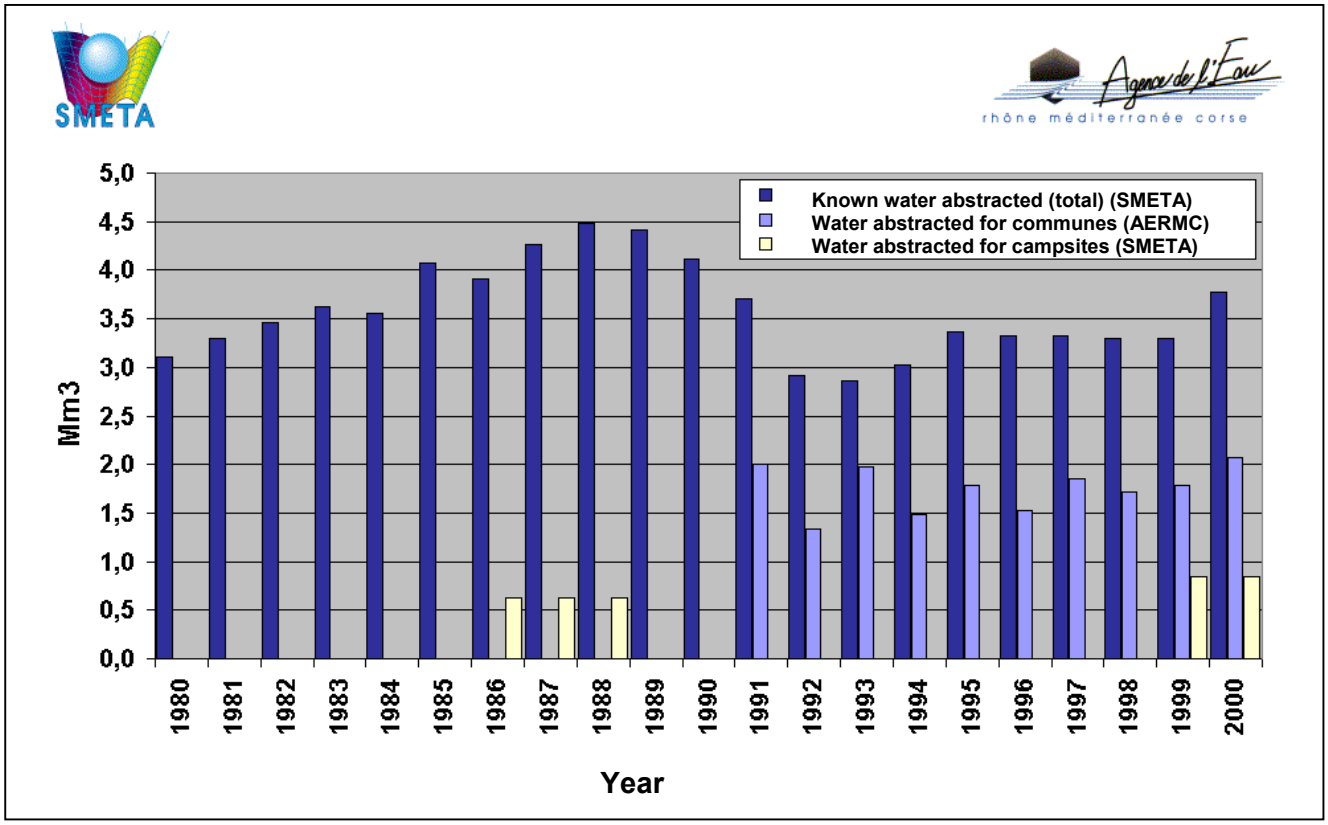

Figure 5: Known water abstracted from the Astian aquifer by different sectors (communes and campsites) (1980 to 2000)

Future Prospects

The first five years of the Plan have allowed the creation of a technical and political structure to manage the aquifer by undertaking action in all the areas of work defined at the signing of the Plan. Nevertheless, technical, legal, and administrative difficulties have been encountered.

Despite considerable results that have reduced the degradation of the resource on the coast, the threat of irreversible damage is still present because of a lack of management planning for all the alternative resources in the area and because of poor economic management of the aquifer.

The poor control of existing and potential private bore holes makes it difficult to implement perennial protection of the aquifer against pollution by the overlying aquifers.

This is due to:

- The absence of regulatory provisions for small bore holes (less than 8m³/h).
- The inalienable right of private property which poses a problem because of French law. (It slows down the initiatives for improving the quality of the bore holes.)

In addition to this, the financial management of the aquifer is not yet satisfactory.

Considering these factors, and with the objective of continuing the work achieved so far, prospects for the evolution of integrated management will have to be re-examined in consultation with all the users (collective users, the Departmental Council for Hérault, the State, water boards, etc.).

This consultation will be undertaken by:
1) The Union and others concerned, who will:

- Continue to reorient the Union's initiatives in the framework of a second Management Plan for the aquifer (with continuation of the themes from the first Plan).

2) The Ministry for the Development of the Environment via its public services and bodies, who will:

- Update knowledge of the true state of groundwater abstraction via regulations and taxes.
- Make full use of existing aids:
    - Planning aids – implementing a scheme for organising and managing water (SAGE).
    - Reinforcing regulatory management aids (allotment areas, etc.).
    - Financial incentives via taxes on the abstraction of water (identification and control of the permits) and also via financial aids to fund the more significant initiatives in terms of environmental aspects which conform to the five management themes.

4 Lessons learned

The SMETA organisation proved successful in protecting the aquifer. However, it failed to take into account the effect of small wells, which continue to be sunk and which threaten the quality of the aquifer, and the private property structure, which makes it difficult to control private wells.

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