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IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE 2000/60/EC IN THE TEVERE RIVER BASIN.

M. Ruisi*
* Tevere River Basin Authority, Roma, Italy. E-mail: Manuela.ruisi@abtevere.it

SUMMARY – The Tevere river basin was identified as one of the pilot river basins involved in the testing activity for the implementation of the WFD 2000/60/EC. The experience gained until now allows us to identify characteristic aspects of the WFD in river basins characterized by scarce precipitations during the summer months, such as the Mediterranean river basins. In particular the correct management of groundwater is of vital importance for the achievement of good ecological status, as required by the WFD. This paper illustrates the general approach to water resource planning carried out on a river basin scale, taking into account of hydrogeological river basins.

Keywords: WFD 2000/60/EC, pilot project, water balance, balance unit

1. INTRODUCTION

In occasion of the Water Directors Meeting held in Copenhagen on 21-22 November 2002, the Italian Government identified the Tevere River Basin and the Cecina River Basin as Pilot River Basins for testing of the Water Framework Directive 2000/60/EC (Fig. 1).

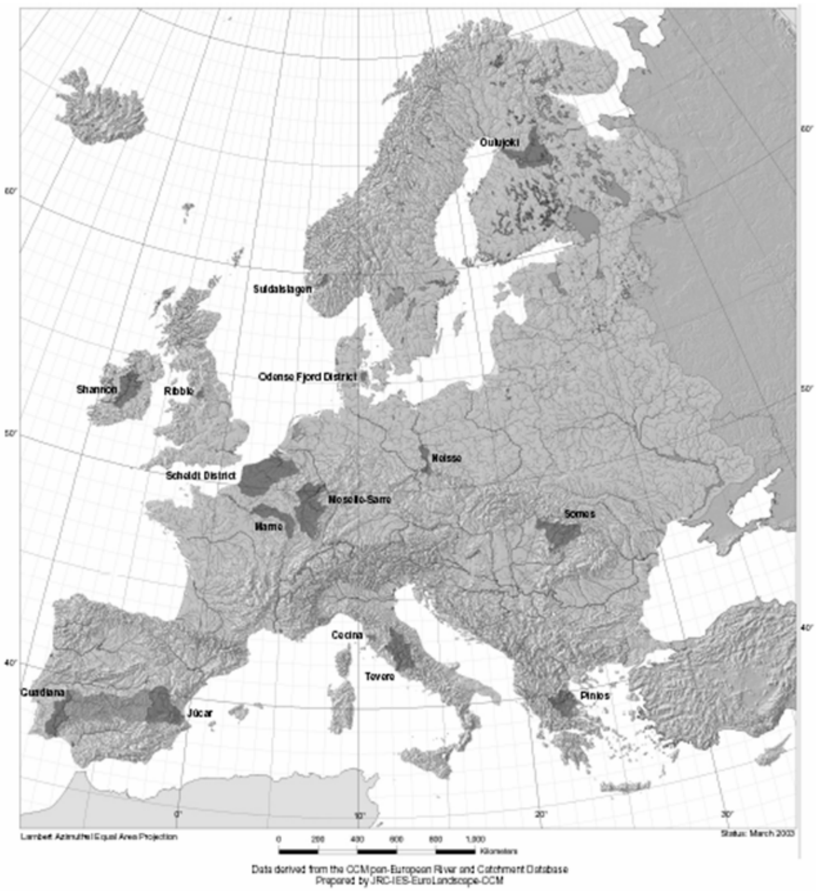

Figure 1. The pilot river Basins

The purpose of the testing activity is to ensure that the European guidance documents, developed by interdisciplinary working groups in the context of the Common Implementation Strategy (CIS), are applicable in practice. Testing activity was previously organized by CIS Working Group 4.1 “Integrated Testing in the Pilot River Basins” and then reorganized through EU Working Group 2B “Integrated River Basin Management”.

2. TESTING ACTIVITY

The Tevere River Basin is responsible for carrying out the testing activity under the supervision of the Ministry of the Environment and of the National Agency for Environmental Protection.

The Tevere Pilot River Basin project is organized around a coordination group made up of members of 18 national, regional, and local bodies and institutions, responsible for different aspects related to water resource management: the Italian Ministry of the Environment, the National Agency for Environmental Protection, the Regions and Regional Agencies for Environmental Protection. Furthermore, three non-governmental organizations and external scientific experts from research institutes and universities are involved in the project.

The purpose of the project is to test all the guidance documents developed by the CIS Working Groups (Tab. 1).

Table 1. Guidelines under testing

Horizontal guidance document on the application of term water body
Analysis of pressures and impact
Identification and designation of heavily modified water bodies
Reference conditions for inland surface waters
Typology and classification of transitional and coastal waters
Inter-calibration
Economic analysis
Monitoring
Tools for assessment and classification of groundwater
Best practices in river basin planning
Geographic Information Systems
General list concerning the integrated testing in pilot river basins
Wetlands

The first phase of the testing activity concerns the implementation of Art. 5 of the WFD. The second phase consists in the development of a River Basin Management Plan, which has to be completed by the end of 2006.

In 1989 river basin plans were introduced into the Italian national legislation by means of Law n. 183. The Tevere River Basin Authority is in charge of defining the river basin plan’s objectives and water balance (quantitative aspects of water resource). The Regions are responsible for defining the river basin plan’s actions for the protection of water bodies (qualitative aspects) (Fig. 2).

In 1999 many aspects of the Water Framework Directive were implemented into the Italian national legislation by means of legislative decree 152/99.

The goals of the WFD testing activity in the Tevere River Basin are:

- to verify the gap between the content and the objectives of the river basin plans set out in accordance with the national legislation and the river basin management plan set out in conformity with the WFD and the European guidance documents;
- to identify issues related to river basin planning which are not contained in the WFD and issues regarding hydrogeological risk (floods, gravitational movements, etc.);
- to test the level of coordination between neighboring River Basin Authorities in order to include the hydrogeological structures and groundwater that do not fall within the borders of the river basin and to form one single river basin, in accordance with the definition of river basin district of Article 3 of the WFD;

- to test operational models for the implementation of the river basin plan measures in conformity with the WFD, coordinating the bodies and institutions responsible for the water cycle, in accordance with the national legislation.

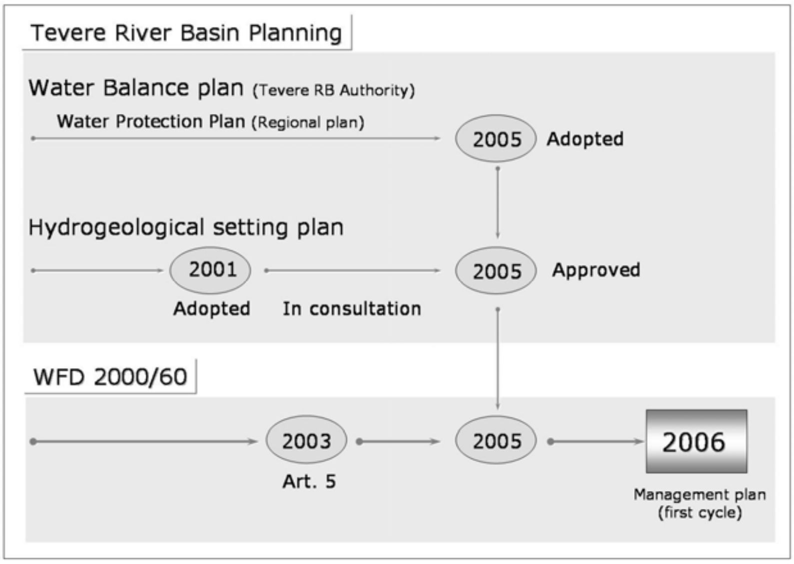

Figure 2. Tevere river basin planning and WFD 2000/60

The characterization and analysis phase was carried out in pursuance of the provisions of Article 5 of the WFD, and contains:

- Analysis of the Tevere River Basin's characteristics, extended to the neighboring river basins in order to include volcanic hydrogeological structures that do not fall entirely within the Tevere River Basin.
- Identification of the drivers and pressures.
- Identification of the impacts caused by human activity on the status of surface and groundwater bodies.
- An economic analysis of water use.
- A register of the Protected Areas in conformity with Article 6 of the Directive.

The analysis allowed us to identify surface and groundwater bodies for further HMWB designation tests.

A first assessment of the risk of failing to meet the Directive's objectives by 2015 was carried out on the basis of available data on the hydrological, chemico-physical and biological status.

The further assessment of the risk of failing to meet the directive's objectives was postponed to 2006, after the application of the river basin plan measures.

Important issues, which were not dealt with in the guidance documents, emerged from the testing exercise in the Tevere river basin:

- The identification of the main interactions between surface and groundwater (Fig.3) and the characterization of the exchange interfaces. This aspect is relevant because in presence of interactions it is necessary to define coordinated objectives for surface and groundwater in order to meet the WFD objectives in both hydrological systems.
- The definition of the river basin's water balance by means of compatible dissipative water uses in the single management units.
- The characterization of the impact on water bodies deriving from hydrogeological risk mitigation measures (floods and landslides). This aspect was considered because there is an apparent contradiction between the WFD objective of minimizing water body modifications and the growing demand for safety of the populations exposed to hydrogeological risk.

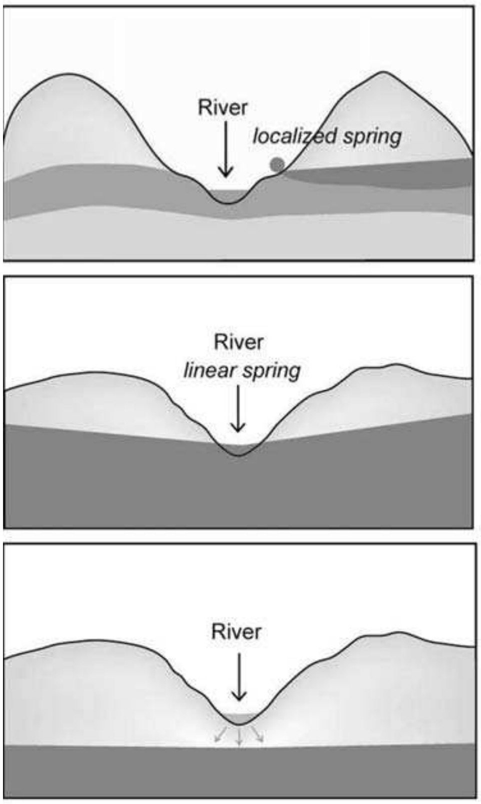

Figure 3. Surface/groundwater interactions

3. WATER BALANCE IN THE TEVERE RIVER BASIN

This important issue derives from our national legislation and was developed into the testing activity, because the Water Framework Directive does not specifically refer to water balance. Therefore we divided the river basin into water balance management units, by subdividing the entire hydrographic basin in groups of geographic sub-basins and aquifers (Fig. 4).

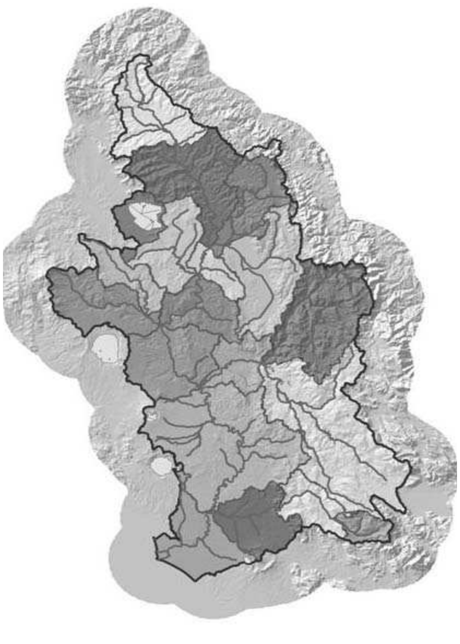

Figure 4. Balance Unit in the Tevere river basin

In each of the balance units we identified the drivers and pressures, and where possible their qualitative and quantitative impact on the water body.

Finally we identified water bodies that have been heavily modified (HMWB) as a result of human activity. Some modifications, such as flood barriers, can be introduced for defensive purposes.

Within each balance unit we are carrying out an economic analysis considering conflictual water uses and the next step is the involvement of public participation. We believe that this has first to be done locally, identifying the conflicts regarding water use in each of the balance units. Then we have to do this globally to allow all stakeholders to have a general view of all balance units, and to see if the objectives that are reached or that fail to be reached in one balance unit affect other units, since the balance units are hydraulically interrelated and affect one another.

An example of the application of the water balance can be seen at the mouth of the Tevere river, where the natural base flow 100 years ago, before the extensive settlement in the river basin, was about 130 m^3/s. Today the base flow of the Tevere river amounts to about 80-90 m^3/s (Fig. 5).

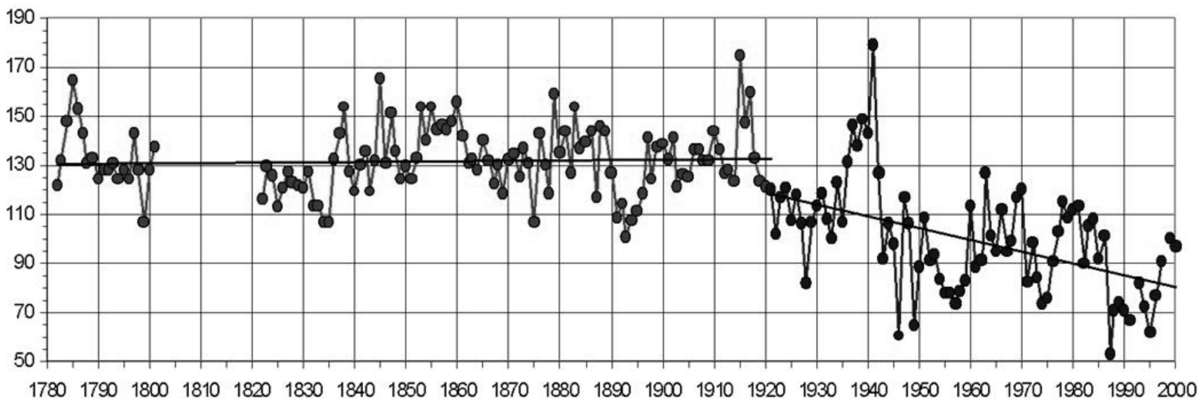

Figure 5. Minimum flow measured at the mouth of the Tevere river from 1780 to 2000

This means that during the last 100 years, the development of human activities led to a dissipative use of water resources accounting for about 40 m^3/s during the dry seasons. Dissipative water uses are represented by agriculture, drinking water and industry. To give an idea of the population growth in the river basin, it is enough to know that the number of inhabitants in the city of Rome has grown from 300000 in 1870 to 3.5 million today.

This means that dissipative water uses reduce surface water and groundwater availability of the natural systems. The structure of the ecosystems is changing and water bodies are more vulnerable to pollution because dilution is reduced.

Consequently the aims of the river basin plan are to restore water into the natural systems, to impose limits on dissipative water uses, and to restore water at the river mouth.

Therefore once we know the natural base flow at the river mouth, we have to identify a sustainable base flow, on the basis of which we can define sustainable dissipative uses. On the contrary, the minimum flow supplying water to depending ecosystems becomes a local obligation to respect within the water balance management unit.

In practice, we define a sustainable base flow value at the mouth of the Tevere river basin. The next step is to identify water balance units. Then, for each balance unit, we define the base flow rates we want to reach through river basin plans.

4. CASE STUDY "COLLI ALBANI"

This case study shows the importance of the plan measures to be adopted in an area where water resources are intensely exploited and consequently there is a risk of failing to reach good ecological status in surface and groundwater bodies.

The "Colli Albani" volcano's hydrogeological structure is situated in the southern part of the Tevere River Basin, near the city of Rome (Fig. 6). In the last 50 years this area has been subject to growing pressures due to the expansion of urban settlements, scattered houses, industrial activity and agriculture (crops with elevated water needs). The water demand has mainly been satisfied by wells that pump groundwater. In the last years, consequently also to scarce rainfall, there has been a strong decrease of the base flow in surface watercourses associated to groundwater circulation. In particular, lake Albano's level, associated to the aquifer, has been dropping at a rate of about 30 cm per year and the surface base flow has decreased by 50% from 1970 and it is mainly sustained by waste water discharge.

These studies have been carried out for the the Tevere River Basin Authority by the Geological Science Department of the University "Roma Tre" of Rome, coordinator Prof. Capelli. The methodology used consists in defining the water balance of the volcanic structure's four groundwater basins. A complex procedure based on field surveys, monitoring of the piezometric levels, and the assessment of the water needs has been used in order to calculate the water balance. The following are the main steps for the definition of the water balance:

1) Physical features (Digital Terrain Model for distributed altimetry and slope analysis; geological map on a scale of 1: 25 000; Available Water Capacity (AWC) map; water needs land use map; monthly evapotranspiration coefficient map related to land uses)
2) Hydrogeological balance areas (piezometric elevation map based on about 3000 field measures carried out in the last 5 years; riverbed base flow measure map, represents the locations of the measures carried out in 2002 along the drainage stems of the river, fed by the aquifer's base flow; hydrogeological basin map defined by the watershed of the groundwater table; prevolcanic bed rock formation map; hydrogeological balance map with the optimal balance areas on which actions aimed at the protection and safeguard of water resources are based)
3) Climatic features (precipitation, thermometric and hydrometric station distribution map; monthly precipitation distribution map; monthly maximum temperature distribution map; monthly mean temperature distribution map; monthly minimum temperature distribution map)
4) Water consumption and withdrawals (well inventory map; Industrial area map, contains information for the assessment of water needs and withdrawal authorizations for industrial use; urban and residential area map, contains information for the assessment of water needs and withdrawal authorizations for drinking water supply; agricultural map, water shortage is based on the distributed flow and soil water balance considered on a daily or monthly scale, and associated to the minimum water needs for crop irrigation)

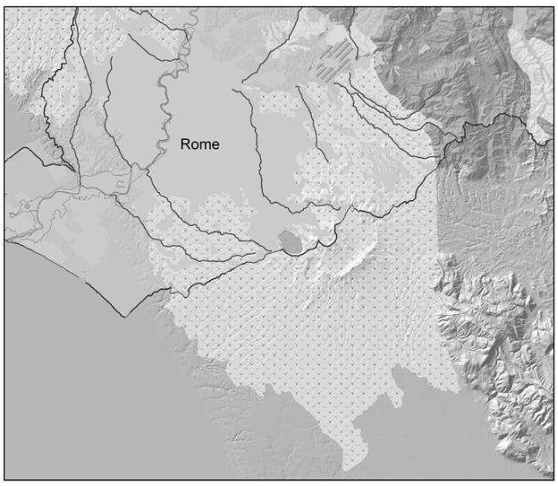

Figure 6. Hydrogeological structure of Colli Albani

The results show that water resources are intensely exploited in this area. The exploitation rate ranges from 45% to 111%, which means that the overall abstraction rate exceeds the groundwater recharge rate (Fig. 7).

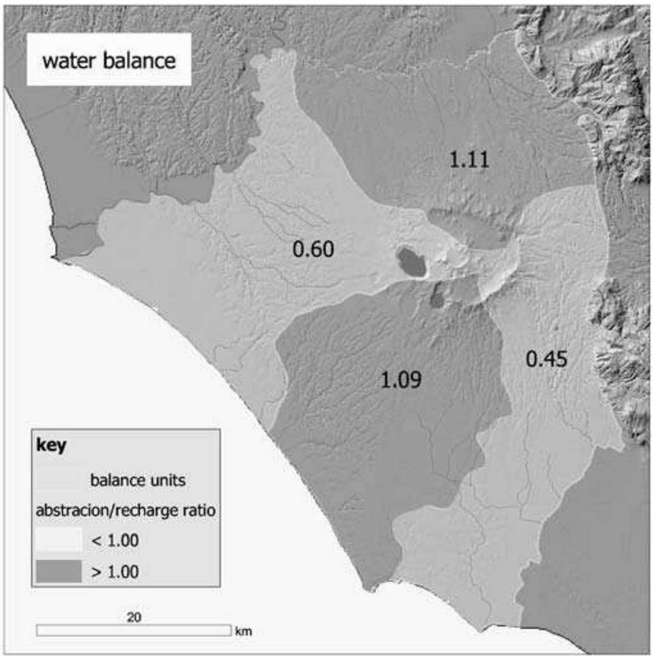

Figure 7. Balance unit and abstraction/recharge ratio of Colli Albani

The River Basin Management Plan defines two thresholds regarding groundwater exploitation:

- A threshold for the safeguard and protection of water, to reach in the short term through administrative actions. This threshold envisages a 15% reduction of withdrawals.
- An optimal threshold (total withdrawals about 25% of recharge), to reach by 2015,_through the application of measures to save water, the enhancement of water distribution systems and the transfer of water from other parts of the river basin.

5. CONCLUSIONS

The application of the guidelines drafted by CIS in the Tevere river basin was a positive experience. The recommended procedures are in line with most of the procedures already adopted in river basin planning. However, there are some aspects that need to be integrated and/or considered further in depth.

These aspects regard:

- Classification of groundwater typologies and analysis of interactions between surface water and groundwater.
- Water balance on a local and on a river basin scale, as an element for the assessment of the risk of failing to reach the Directive’s objectives.

The second aspect is relevant to the Mediterranean river basins where peak water demand for human activities coincides with the dry season. Under these conditions the main water resources are represented by groundwater stored in aquifers or flowing on the surface as base flow.

Testing activity demonstrated that alterations to the water balance constitute the main risk factor of failing to reach the Directive’s objectives.