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Título del Trabajo Fin de Máster:

INTEGRATED WATER RESOURCES MANAGEMENT FOR ECOSYSTEM SERVICES ASSESSMENT

Intensificación:

RECURSOS HÍDRICOS

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Resumen:

Las tendencias actuales a nivel internacional, y específicamente a nivel europeo, avanzan hacia la gestión sostenible y eficiente de los recursos naturales. Esta corriente se plasma en la "Directiva Europea Marco del Agua", en las estrategias "Europa 2020" y "Estrategia de la UE sobre la Biodiversidad hasta 2020", y en el "Plan para salvaguardar los recursos hídricos de Europa", entre otros documentos oficiales. La evaluación de los Servicios de los Ecosistemas puede ayudar a preservar ecosistemas sanos, impulsando decisiones efectivas sobre los recursos naturales. Además, la Gestión Integrada de Recursos Hídricos, apoyada por Sistemas Soporte a la Decisión, permite considerar múltiples variables de un sistema de recursos hídricos dentro del objetivo más amplio del desarrollo sostenible.

En este trabajo se propone una metodología para la Gestión Integrada de Recursos Hídricos, y se aplica al Sistema de Recursos Hídricos del Río Tormes, en España. Esta consta de cinco modelos encadenados para la evaluación de los recursos hídricos y la contaminación difusa, la gestión del agua, la modelación de la calidad del agua y la evaluación del hábitat; todos ellos integrados en el Sistema Soporte a la Decisión AQUATOOL. Se propone un análisis de compensación para presentar la evolución de la calidad del agua, la satisfacción de las demandas y la disponibilidad de hábitat frente a la variación de caudales ecológicos en diversos puntos del sistema. Los resultados se analizan mediante gráficos que pueden ser fácilmente entendidos por los decisores y los actores interesados, apoyando decisiones consensuadas e informadas.

Se propone una metodología para integrar la evaluación de los Servicios de los Ecosistemas y la Gestión Integrada de Recursos Hídricos, que se desarrollará en futuros trabajos. Esta unión conlleva el enriquecimiento de la metodología para la Gestión Integrada de Recursos Hídricos, añadiendo al análisis multiobjetivo tradicional del suministro a las demandas y caudales ecológicos, otras variables interesantes para la toma de decisiones como la producción de agua, el almacenamiento en acuíferos, la autodepuración del agua y la biodiversidad.

Current trends at international level, and specifically at European level, advance towards sustainable and efficient management of natural resources. This current is expressed in the "European Water Framework Directive", the strategies "Europe 2020" and "EU biodiversity strategy to 2020", and in "A Blueprint to safeguard Europe's Water Resources", among other official documents. The Ecosystem Services Assessment can help preserving healthy ecosystems, underpinning effective natural resource decisions. Besides, Integrated Water Resources Management, supported by Decision Support Systems, allows considering multiple variables of a water resources system, inside the broader objective of sustainable development.

In this work, a methodology for Integrated Water Resources Management is proposed and applied to the Tormes Water Resources System, in Spain. It consists of five chained models that stand for water resources evaluation, diffuse pollution evaluation, water management, water quality modelling and habitat evaluation; all they integrated in the Decision Support System AQUATOOL. A tradeoff analysis is proposed to present the evolution of water quality, satisfaction of demands and habitat availability, as environmental flows change in several points of the water resources system. The results are analysed through graphics that can be easily understood by decision makers and stakeholders, supporting sound and informed decisions.

A methodology to integrate Ecosystem Services Assessment and Integrated Water Resources Management is proposed here, and will be developed in further research. This union entails the enrichment of the methodology for Integrated Water Resources Management, adding to the traditional analysis of supply to demands and environmental flows, other interesting variables to take decisions like freshwater production, water storage in aquifers, water purification and biodiversity to the multipurpose analysis.

Les tendències actuals a nivell internacional, i específicament a nivell europeu, avancen cap a la gestió sostenible i eficient dels recursos naturals. Aquesta corrent es plasma en la "Directiva Europea Marco del Agua", en les estratègies "Europa 2020" y "Estrategia de la UE sobre la Biodiversidad hasta 2020", i al "Plan para salvaguardar los recursos hídricos de Europa", entre altres documents oficials. L'avaluació dels Serveis dels Ecosistemes pot ajudar a preservar ecosistemes sans, impulsant decisions efectives sobre els recursos naturals. A més, la Gestió Integrada de Recursos Hídrics, recolzada per Sistemes Suport a la Decisió, permet considerar múltiples variables d'un sistema de recursos hídrics dins de l'objectiu més ampli del desenvolupament sostenible.

En aquest treball es proposa una metodologia per a la Gestió Integrada de Recursos Hídrics, i s'aplica al Sistema de Recursos Hídrics del Riu Tormes, en Espanya. Aquesta consta de cinc models encadenats per a l'avaluació dels recursos hídrics i la contaminació difusa, la gestió de l'aigua, la modelació de la qualitat de l'aigua i l'avaluació de l'hàbitat; tots ells integrats en el Sistema Suport a la Decisió AQUATOOL. Es proposa una anàlisi de compensació per a presentar l'evolució de la qualitat de l'aigua, la satisfacció de les demandes i la disponibilitat d'hàbitat front a la variació de caudals ecològics en diversos punts del sistema. Els resultats s'analitzen mitjançant gràfiques que poden ser fàcilment compreses pels decisors i els actors interessats, donant suport a decisions consensuades i informades.

Es proposa una metodologia per a integrar l'avaluació dels Serveis dels Ecosistemes i la Gestió Integrada de Recursos Hídrics, que es desenvoluparà en futurs treballs. Aquesta unió comporta l'enriquiment de la metodologia per a la Gestió Integrada de Recursos Hídrics, afegint a l'anàlisi multiobjectiu tradicional del subministrament a les demandes i caudals ecològics, altres variables interessants per a la presa de decisions com la producció d'aigua, l'emmagatzematge en aqüífers, l'autodepuració de l'aigua i la biodiversitat.

Palabras clave:

Integrated Water Resources Management / Ecosystem Services Assessment / Tradeoff analysis / Decision Support Systems / AQUATOOL

GENERAL INDEX

1. Introduction

1.1. Research framework

Europe 2020 (EC, 2010) is the growth strategy established in the European Union (EU) for the coming decade. It involves objectives on employment, research and innovation, climate and energy, education, and combating poverty. To achieve these goals, the defined economic and social growth has to be smart, sustainable and inclusive. After the launch of this strategy, the EU has developed numerous complementary documents focused on the different target aspects.

In 2011, the European Commission published the "EU biodiversity strategy to 2020" (EC, 2011). It aims to struggle against biodiversity loss and to enhance an efficient and green economy. It considers the Ecosystem Services (ES) assessment as a powerful tool to assign an economic value to nature and the services it provides. This can help decision makers to determine the best use of scarce ecological resources by providing information about benefits and maintaining costs, creating a common language, revealing the opportunities to work with nature, emphasizing the urgency of action, and generating information for designing policy incentives for environmental protection (TEEB, 2010). Currently, the "Mapping and Assessment of Ecosystems and their Services in Europe", one of the key actions of the EU Biodiversity Strategy to 2020, is being developed. The initial methodological work on biophysical mapping and assessment is expected to be delivered by 2014.

Also fitting into the overall resource-efficiency objective of Europe 2020, the European Commission published "A Blueprint to safeguard Europe's Water Resources" (EC, 2012) in response to the diverse problems that should be addressed for water resources management in the different member states. Differently from the European Water Framework Directive (EP, 2000), it admits that common criterion and policies for water planning and management cannot be applied to so unalike climatic contexts, like those existent in the EU. The Blueprint stresses key aspects like efficiency and governance improvements in water resources management. Besides, it states that there are information gaps and errors in the dissemination and integration of the information for decision making.

In line with proposed future actions to address these problems, the Blueprint for Europe's water resources recognises that water accounting provides basic information to support decision making and action in water resources management. Consequently, a proposed action consists of the development of the "CIS Guidance on water accounts (and ecological flow)" during 2014.

According to the abovementioned communications, the European Environment Agency developed the Common International Classification of Ecosystem Services. It contributes to the revision of the System of Environmental-Economic Accounting (UN, EC, IMF, OECD, WB, 2003), an accounting methodology which links physical and economic data. This framework was particularised to water resources into the System of Environmental-Economic Accounting for Water (UNSD, 2007), with the aim of improving water control and governance. Other concepts like the Water Footprint (WF) are also interesting to work towards sustainable development. The WF, accounts for the total volume of water needed to produce goods and services consumed by a person, state or industry (Hoekstra, 2012). Therefore, it includes both the real water and the virtual water (Allan, 1993) required to produce the consumed products.

However, as stated by Andreu et al. (2012), the water accounting can be a useful tool to improve transparency in water management, but other tools and methodologies are needed to manage scarce water resources in semi-arid and arid regions. This requires Decision Support Systems (DSS), like AQUATOOL DSS Shell (Andreu et al. 1996), to analyse in an integrated and dynamic way the distribution of water resources, the influence of management rules, or the assessment of the effects of infrastructures and other measures.

1.2. Need for Ecosystem Services analysis

The ES are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life (Daily, 1997). A simpler definition given by the Millennium Ecosystem Assessment, MEA (2005), states the ES as the benefits people obtain from ecosystems. Noteworthy examples of ES are: purification of air and water, attenuation of droughts and floods, cycling and movement of nutrients, generation and preservation of soils, pollination of crops, etc. (Holdren and Ehrlich, 1974; Ehrlich and Ehrlich, 1981, Daily et al., 1997).

The possibility of substituting these natural services with artificial processes is too remote and unlikely, and the related costs would be unaffordable (Costanza et al., 1997; Brauman et al., 2007). Thinking in an extreme example, if all the vegetation in a river basin was replaced for other uses it would be necessary to substitute its function for floods mitigation by building protection structures. The costs of construction, maintaining and operation of these structures could be much higher than the economic benefits obtained with the change in the land use. On the other hand, if a river loses its auto-depuration capacity due to ecosystems degradation, the costs of water treatments would increase. In this sense, the ES assessment can help analysing the tradeoffs between preserving healthy ecosystems and affecting them to the cause of economic growth (changes in water allocation, agricultural expansion, etc.), underpinning effective natural resource decisions (Wallace, 2007).

Monetary valuation can be a powerful tool for assessment and policy making because it provides a common metric with which to make comparisons (Brauman et al., 2007). An accurate management of ecosystems would imply considering the utilitarian links between people and ecosystems, but also the intrinsic value of nature as integral factors of decision making (MEA, 2003). That is, not only the use value has to be considered when valuing the ES; also the non-use value (option value, bequest value and existence value) that people give to ES should be included in the total value. However, some authors (Daily et al., 2000; Farber et al., 2002; Spangenberg and Settele, 2010) claim that calculated value of ecosystems and their services is not a robust figure, because it varies with the valuation method applied, or with people's preferences.

Despite the importance of ES to conduct sustainable growth when making decisions about natural ecosystems, they are poorly valued by society and frequently the current trends of development do not take them into proper account. Then, an explicit accounting of ES and the effects of different interventions on them is a first step to make more informed decisions (Daily, 2000). In this sense, integrative science can help providing tools such as scenario analysis (Brauman et al., 2007). Actually, there are several tools for ES modelling (Vigerstol and Aukema, 2011), although some consider that current models fall short of the needs and expectations of decision makers (Keeler et al., 2012). More specifically, referring to water issues, Cook and Spray (2012) noted that there is an implementation gap between theoretical and practical application of ES and other related concepts like IWRM.

1.3. Objectives and scope of the research

The main objective of this thesis is to propose a methodology for the combination of ES assessment and IWRM that will be developed in further research (PhD). The aim is to advance towards the integration of the diverse requirements of the existing legislation about water resources management (MARM, 2008; EC, 2012) and, in a broader sense, about basins management (EP, 2000).

There are many ES to value, but lots of them are referred to science fields very far from water resources management; e.g. crop pollination, carbon sequestration, terrestrial biodiversity, wave and wind energy models, or aesthetic quality. Thus, the focus of this thesis will be on analysing the ES related with freshwater, even though some of them are produced by terrestrial ecosystems (Brauman et al., 2007), e.g. nutrients retention by vegetation, freshwater production, etc. This is reasonable considering that the water availability in river systems (in quantity and quality) deeply relies on the state of the surrounding territory. In fact, Le Maitre et al. (2007) support that soils are a key factor in ecosystem productivity, like water flow regulation and water quality. This group of ecosystem services has been named as hydrologic ES (Brauman et al., 2007) or freshwater ES (Wilson, 1999; Vigerstol and Aukema, 2011) among others. But from now on, in this thesis it will be referred to as ES, for simplicity.

Along this thesis, first, a methodology for coupling models dedicated to river basins and water resources management, based on IWRM, will be designed and applied to the Tormes Water Resources System (TWRS) in the Duero River Basin District, in Spain. The period of analysis will be from October 1996 to September 2007, which includes a critical period related to a drought event. The potential of jointly analysing different aspects of a water resources system will be exemplified. Some indicators and graphics will be proposed to synthesise all the relevant information for decision making, which explicitly show the gains and losses of each objective in diverse scenarios.

Second, the potential ES that can be obtained from the results of the chained models will be analysed. With this information, a preliminary set of ES and other indicators will be suggested according to their usefulness for decision making. Finally, all these indicators will be gathered in the proposal of a new tool for ES anlysis (to be developed in the PhD) backed on the IWRM methodology. This final tool will allow the integration of classical aspects of water management, like the satisfaction of water demands and environmental flows, with the sustainable management of the territory of the basins, adding new variables related with ES to the multipurpose analysis.

1.4. Structure and content of the Master's Thesis

This document is structured in the likeness of a scientific paper. First, the introduction sets the basis for the research and its added value with respect to the current state of the art. Second, the material and methods are presented; that is, methodologies, software and data. Third, the case of application to de TWRS is developed to exemplify the proposed method. After that, the results are analysed to extract conclusions about the potential of the method for decision making. Then, the future research lines are drafted and backed on the current research. And finally, the conclusions state the deductions and reasoning of the research.

2. Material and methods

2.1. Methodology for Integrated Water Resources Management

As population grows and other water demanding sectors develop, the issue of water allocation has become more complex (Andreu et al., 2012). This is why, simulation models need to be adapted to consider the sustainable management of water resources (UNESCO, 1999; Loucks, 2000; Ito et al., 2001), inside the broader objective of sustainable development (UN, 1987). This has brought about simulation models to evolve towards new approaches like DSS, experts systems, collaborative planning and management, and dynamic decision systems, among others (Solera, 2003).

In line with the abovementioned concepts, the IWRM is a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems, as defined by the Global Water Partnership (2000). From these definitions, it is clear that in order to cover so many water and ecosystems related aspects the use of integrative models is increasingly necessary.

In this thesis, a methodology comprised of five coordinated modules is used to integrate aspects of water resources evaluation, diffuse pollution evaluation, water allocation, water quality, and habitat suitability for aquatic species. These five modules are part of the AQUATOOL DSS Shell for integrated water planning and management. AQUATOOL allows analysing the effect of multiple management alternatives and scenarios on the relevant variables in a river basin. Thus, it is easier to conduct tradeoff analysis, risk evaluations, and other useful processes which provide data for informed decision making. Technically, AQUATOOL is a geo-referenced database system which provides a common interface, data and results management tools for different modules directed to analyse the key aspects of river basins and water resources management. These modules have been designed for more than 20 years following well established methodologies for water resources systems analysis.

Before presenting the IWRM methodology, it is necessary to describe the modules which will be coupled.

2.1.1. Water resources evaluation

The water resources evaluation models or continuous hydrological models reproduce, to a certain extent, the hydrological cycle in a river basin. Their main aim is to assess the available water resources to feed water management models. Hence, the relevant processes in these models are different from the ones considered in the hydrological models for rainfall events. In the continuous hydrological models the basic data is precipitation and the main result is total runoff in the river basin, broken down in surface runoff at the drainage points and underground runoff into river stretches. Apart from that, these models usually reproduce evapotranspiration, infiltration, soil water storage, and percolation, although the detail of the results basically depends on the equations and the spatial discretisation used. The temporal step is often monthly or daily at the most.

In general, there are several classifications with different selection criterion for both types of rainfall-runoff models. According to the kind of equations used, they can be classified as deterministic (physically based, conceptual and empirical) or probabilistic models. Depending on the way they take into account spatial variability of parameters and variables they can be considered aggregated, distributed or semi-distributed models. With respect to the vertical performance of the hydrological cycle there is a huge range of models; from the simplest annual-scale model of Budyko (1958) which considers that the runoff is an exponential function of the evapotranspiration and precipitation, to the hourly-scale model SAC-SMA (Burnash et al., 1973) that tries to represent the details of the hydrological cycle through the division of the soil in 5 different tanks and 16 parameters. But in the end, the success of a hydrological model in a specific basin deeply depends on the data availability and quality. It is very important to count on adequate data which cover a long period to successfully calibrate and validate the models.

EVALHID (Paredes-Arquiola et al., 2013a) is a module integrated in the DSS AQUATOOL which allows the development of three types of continuous rainfall-runoff models to assess the available water resources in complex river basins. These models are:

- Témez (1977): It is a conceptual model with four parameters that divides the soil in two zones: non-saturated and saturated. For each time step, the water from precipitation is stored in the upper part of the soil. The portion not evapotranspirated, the surplus, is distributed as surface runoff and recharge. Aquifers are represented with unicellular models, where the discharge is proportional to the stored volume. The parameters are the maximum storage capacity in the soil, the coefficient for surplus generation, the maximum infiltration and the discharge rate of the aquifer.

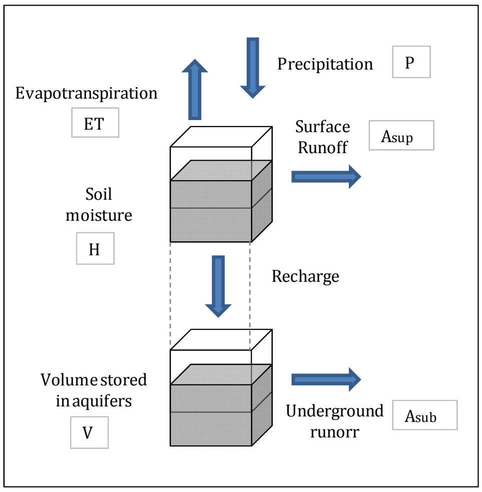


Figure 1. Diagram of the Témez model.

- Hydrologiska Byråns Vattenbalansavdelning model, HBV (Bergström, 1995): It is a conceptual model developed by the Swedish Meteorological and Hydrological Institute. Nevertheless, the variation made by the Hydraulic Engineering Institute of the University of Stuttgart (Lindström et al., 1997) is the most used. The model has 8 parameters and divides the phases of the hydrological cycle in four modules: snow, soil moisture and effective rainfall, evapotranspiration, and runoff. These modules are related with two tanks. The upper tank generates the surface runoff and the interflow, while the lower tank generates the base flow.

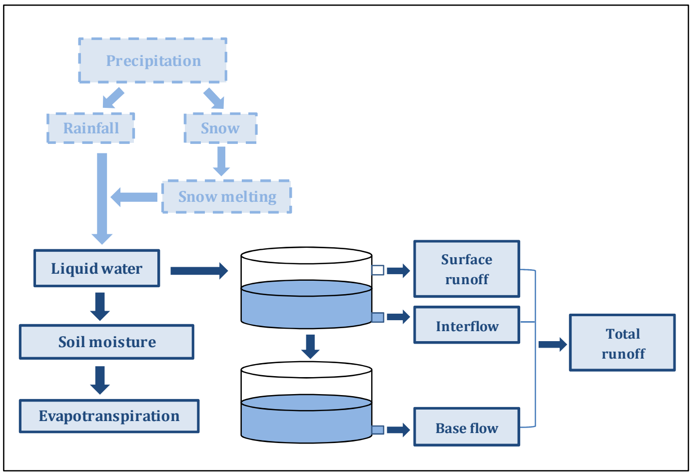


Figure 2. Diagram of the HBV model.

It works at daily or monthly scale and the input data needed are: precipitation and temperature series, and long term estimations for temperature and monthly average evapotranspiration. The general water balance applied by the model follows the equation:

$$P - E - Q = \frac{d}{dt}\left[SP + SM + UZ + LZ + lakes\right]$$

where *P* is the precipitation, *E* represents the evapotranspiration, *Q* the runoff, *SP* the snow pack, *SM* the soil moisture, *UZ* the upper groundwater zone, *LZ* the lower groundwater zone and *lakes* the lakes volume.

- Sacramento soil moisture accounting, SAC-SMA (Burnash et al., 1973): It is a continuous physically based soil moisture accounting model with 16 parameters. It is designed to be used on basins with a response time higher than 12 hours. The model considers two main zones connected with percolation. At the same time, the upper zone is divided in two zones: the evapotranspiration zone and the free water zone in which water can either percolate or became runoff. The lower zone is divided into two more zones: the semi-saturated zone and the saturated zone or aquifer. The aquifer is, in turn, divided in two tanks to better represent the behaviour of real aquifers.

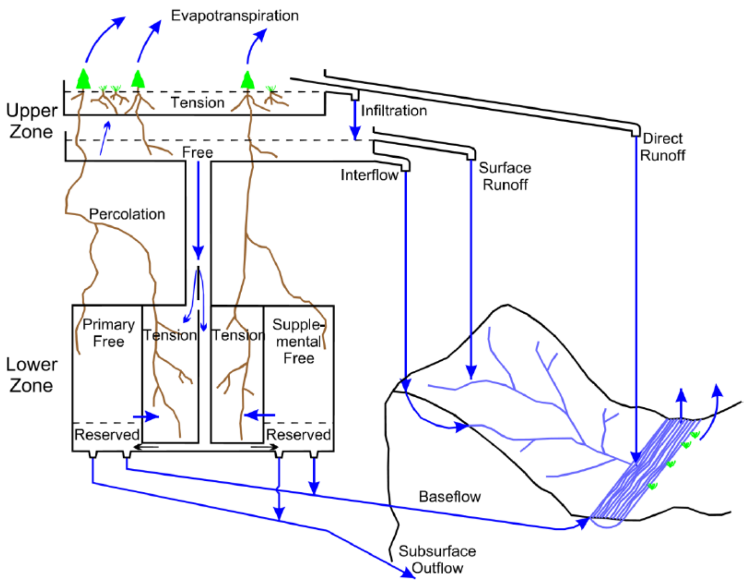


Figure 3. Diagram of the SAC-SMA model (from Burnash et al., 1973).

Apart from these three modes, EVALHID counts with two snow routines which can be used together with all the above mentioned hydrological models:

- Snow N-1: It is a one-parameter model which classifies the precipitation in snow or rainfall using a threshold T_u (usually 0 ^oC). If the air temperature is above the threshold, precipitation is considered directly as runoff; otherwise, it is accumulated in the snow pack. The existent snow pack melts becoming runoff above the threshold temperature or grows below it. The input for the hydrologic models is the sum of rainfall and runoff from snow melting. This is the snow model set out in the HBV model.
- Snow N-2: It allows partially classifying precipitation in rainfall and snow according to a separation factor depending on the air temperature and two temperature thresholds. Then, for the same time step there can be rainfall, which directly becomes runoff, and snow, which is accumulated in the snow pack. The snow melting is defined using a third temperature threshold, so finally the model has three parameters. This is the snow model developed by the École Polytechnique Fédérale de Lausanne for the software Routing System II (Garcia Hernandez et al., 2007).

More information about the models can be found in Annex I.

Although all the aforementioned models are aggregated, EVALHID allows their implementation in subbasins resulting in a semi-distributed model for the whole basin. Given that each subbasin has different features and available data, EVALHID admits to select the model that better represents the behaviour of each subbasin. The results of surface runoff are obtained in each subbasin, but only presented in the drainage points selected by the user. What EVALHID does is to provide the surface runoff at the drainage point as the sum of the runoff generated in the subbasins draining to it. There is no propagation of the flow because EVALHID considers that the response time of each subbasin is negligible compared with the time step used (Mouelhi et al., 2006).

EVALHID considers that the river basins and the "underground basins" coincide from the top view. Then, it provides the underground runoff at the surface drainage points. Though, if this is far from reality or there are specific groundwater models available, the user can define underground drainage points where EVALHID calculates the percolation. Next, these percolations are used as inputs for the independent groundwater models.

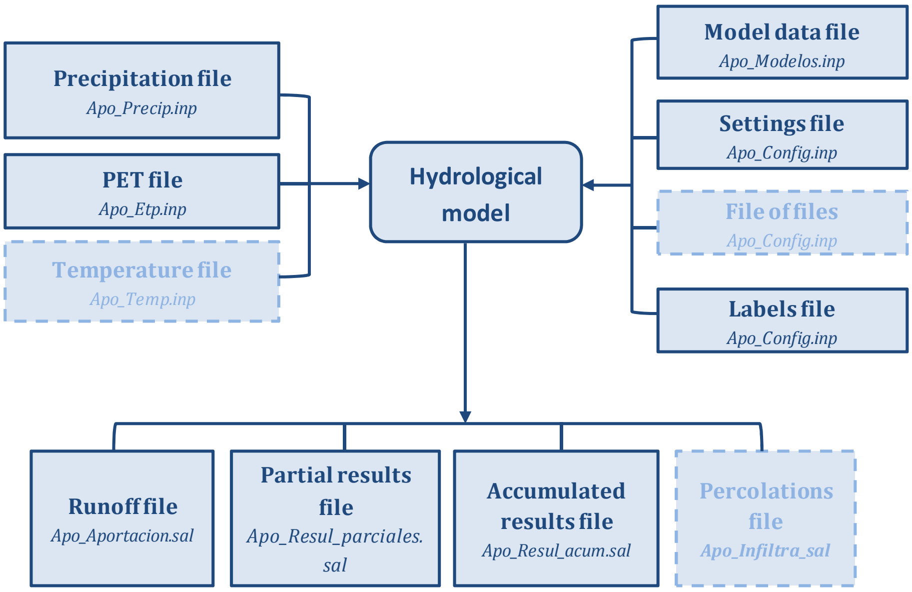


Figure 4. Diagram of files in EVALHID (Paredes-Arquiola et al. 2013a).

2.1.2. Diffuse pollution evaluation

Natural water bodies are subject to waste loads from point sources and diffuse or nonpoint sources which impair the water quality. The point sources are usually inventoried and quantified by the river basin authorities, as they require express authorisation. They come from municipalities, industries, etc. and are poured out into surface water bodies, normally rivers. By contrast, the nonpoint sources are more difficult to identify and estimate, as they are caused by agricultural fertilizers or land drainage. But the distinction between the two types of waste loads sources is not absolute (EPA, 1985). For example, if the location of the urban discharges is not well known, they can be considered as diffuse discharges linearly distributed along river stretches. This can be the case of non regulated rivers in the heads of river basins.

The models for diffuse pollution evaluation consider different waste loads and study their influence on natural water systems. As there are more detailed models for water quality modelling, these models are usually used to analyse diffuse pollution in non-regulated water bodies. The process followed is shown in Figure 5.

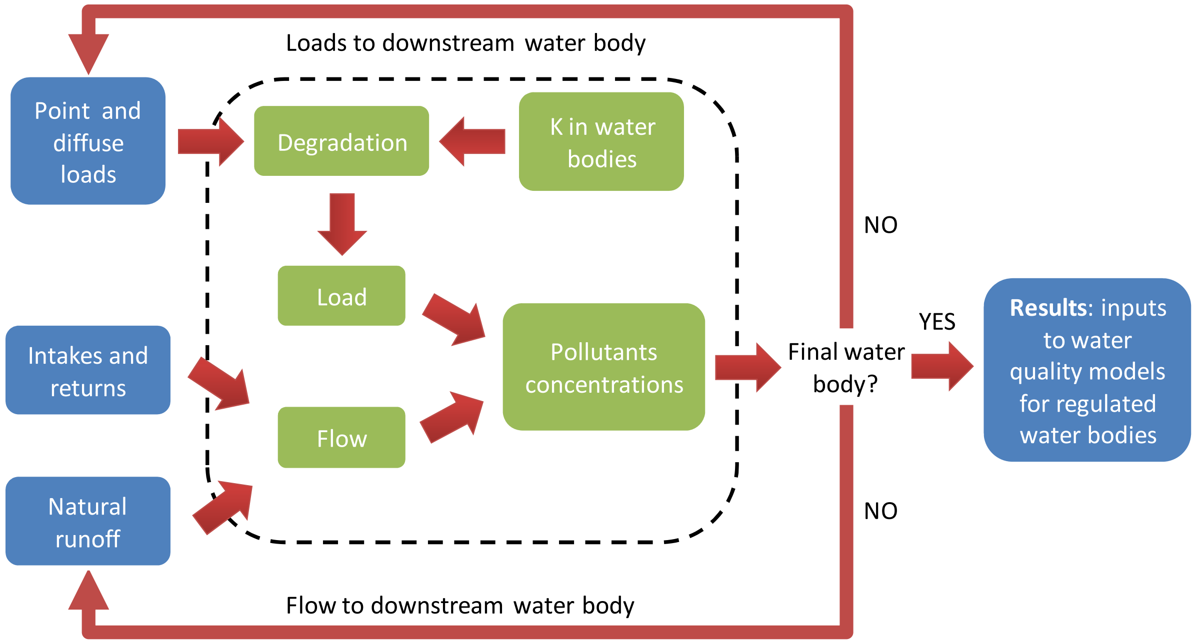


Figure 5. Diagram of the waste loading evaluation process (adapted from MAAA, 2013).

Each water body, considered as a river stretch, receives the flows and loads from the upstream water bodies ($\sum Q_{s,j}\,(j\rightarrow i)$ and $\sum M_{s,j}\,(j\rightarrow i)$, respectively). Then, inside the water body, the corresponding flow generated and loads poured are added ($Q_{gen,i}$ and $M_{gen,i}$, respectively). Finally, considering a first order kinetics for the degradation of pollutants, and the intakes and returns caused by water demands, the output flows and loads are calculated ($Q_{s,i}$ and $M_{s,i}$, respectively). This process is repeated for a whole river system, from upstream to downstream following the stream order (Strahler, 1952), until the final water bodies defined. For each water body, the equations are the following:

$$M_{e,i} = M_{gen,i} + \sum_{j=1}^{n} M_{s,j}(j \rightarrow i)$$

$$Q_{e,i} = Q_{gen,i} + \sum_{j=1}^{n} Q_{s,j}(j \rightarrow i)$$

$$M_{s,i} = M_{e,i} \cdot e^{-k \cdot L}$$

$$Q_{s,i} = Q_{e,i} - Q_{detr,i}$$

where $M_{e,i}$ is the pollutant load at the entrance, $M_{gen,i}$ is the load of the discharges in the water body (coming from databases), $\sum M_{s,j}(j\rightarrow i)$ is the sum of the loads entering from upstream water bodies, $Q_{e,i}$ is the flow at the entrance, $Q_{gen,i}$ is the flow generated in the subbasin corresponding to the water body (coming from a Rainfall-Runoff model), $\sum Q_{s,j}(j \rightarrow i)$ is the sum of the flows entering from upstream water bodies, $M_{s,i}$ is the output load, $Q_{s,i}$ is the output flow, $Q_{detr,i}$ represents the balance between intakes and returns in the water body, k is the degradation constant for the considered pollutant, and L is the length of the water body.

The process presented above is performed by CARFU, a new module of the DSS AQUATOOL which is linked to a Geographic Information System. It is developed based on a previous stationary model used by the Duero River Basin Agency (DRBA) that works with average values. By contrast, CARFU applies the above equations at monthly scale providing time series of pollutants which can be used as inputs for more detailed water quality models of regulated rivers.

2.1.3. Water management

Models for water resources management allow the allocation of the available resources among the different demands in a water resources system. Hence, they are crucial in complex systems with diverse water sources and competing demands, where the resolution of the allocation problem is not trivial (Loucks, 1995).

There are different types of water management models according to the mathematical models they use, their capabilities and the criteria used for the water allocation. On one hand, the simulation models explore the effect of the established operation rules and other variables (controllable or not) on the mathematical model results through indicators of the state of the system. They help to plan the development of water resources systems and to determine their most convenient management, foreseeing the possible impacts of every plan or operation policy (Loucks, 2000). By contrast, the optimisation models can freely change the value of the studied variables to obtain the best management rules for the system. Thus, optimisation requires less information for the control of the system than simulation, but the analysis of results to extract conclusions is more complex (Solera, 2003). However, combining the adherence and flexibility of simulation models and the efficient exploration of mathematical optimisation models provides improved results (Wurbs, 1993).

The main types of mathematical models to control the flows distribution in the water system are: balance of water, linear programming and flow networks. The first one can be only used for simulation, while the others can be used for both simulation and optimisation purposes. Flow networks are computer efficient versions of linear programming. They can solve problems stated as networks of arcs and nodes with certain characteristics. The usual formulation is as follows:

$$Minimise \sum_{i=1}^{m}\sum_{j=!}^{m} c_{ij} \cdot x_{ij}$$

$$Subject\ to \sum_{j=1}^{m} x_{ij} - \sum_{k=1}^{m} x_{ki} = 0 \quad i = 1, \ldots, m$$

$$l_{ij} \leq x_{ij} \leq u_{ij} \quad i,\ j = 1, \ldots, m$$

where x_{ij} represents the flow between nodes i and j, c_{ij} represents the cost of transport of a unit of flow, l_{ij} is the minimum flow limit in the arc ij, and u_{ij} is the maximum flow limit in the same arc.

A network flow problem can be solved with a conventional linear programming algorithm. However, the special structure of a flow network allows the use of more efficient algorithms which significantly reduce the computing time and permits to study bigger problems with more variables and restrictions.

The module SIMGES (Andreu et al., 2007) of the DSS AQUATOOL is a simulation-optimisation model based on a flow network algorithm. It solves the management of complex water resources systems with surface and groundwater storage, intake, transport, artificial recharge, use and consumption elements. The model admits any configuration, so it can be used for any water resources system scheme. The user defines the “user diagram” through the AQUATOOL interface which is a non-conservative flow network. Internally, SIMGES assigns closing nodes and extends all the elements in arcs and nodes to ensure that the hydraulic performance and the management of each element are adequate. From this results an “internal flow network”, conservative and more complex than the one defined by the user. This is the network really managed by the model.

In the simulation-optimisation process, first the water management strategy is defined through operation rules provided by the users of the model. Then, for each time step of the simulation, the flow network algorithm determines the flows in the system trying to satisfy multiple objectives: deficit minimization, maximum adaptation to the reservoir target volume curves and the hydropower production objectives. The Out-of-Kilter algorithm (Bazaraa, 1977) optimises the flow network which has the following target function:

$$Minimise\ \left(T_E + T_{R1} + T_{R2} + T_{R3} + T_{R4} + T_{R5} + T_{DC} + T_{DN} + T_{RA} + T_{BA}\right)$$

where T_E is the term due to the reservoirs state, T_{R1} to T_{R5} are terms due to the conductions of 5 different types, T_{DC} is a term due to the consumptive demands, T_{DN} is a term due to non-consumptive demands, T_{RA} is a term due to artificial recharges, and T_{BA} is a term due to additional pumping. The results are subject to the mass conservancy restrictions and the physical limits of transport of conductions, storage in reservoirs, and other elements. This optimisation is improved with an iterative process of the network resolution, what allows improving the quality of the simulation of non-linear processes such as leakages, evaporation and surface and groundwater relationships.

More information about the model can be found in Annex I.

The possibilities that SIMGES brings to define the management rules of the system are broad and allow the representation of the functioning of complex real water resources systems. In the reservoirs, different zones can be defined establishing the monthly curves for the minimum, target and maximum volumes. Furthermore, there are priority numbers to state the inter-reservoir relationships. For demands, the target supply and the priority numbers can also be defined. In conductions, the minimum and maximum flows can be limited, and priority numbers define the relationship among them. Finally, alarm indicators can be defined as restrictions to supply or flows in conductions conditioned to a certain volume in a reservoir or sum of reservoirs, or to a natural runoff or sum of natural runoffs. With this information, the dummy costs or benefits of storing water in a certain zone of a reservoir or delivering water through certain conduction are established and used in the optimisation problem.

SIMGES works at monthly scale; it applies continuity for the surface subsystem and offers several aquifer models for the groundwater simulation. The results of the model include the evolution of all the relevant variables for water management at monthly and annual scale (supply to demands, volume stored in reservoirs, hydropower production, etc.), the mean values for the simulation period, and indicators about the supply reliabilities and vulnerabilities, as well as the reliability of minimum flows (usually called “environmental flows”).

2.1.4. Water quality modelling

Water quality models are tools that simulate the evolution of constituents and pollutants in water elements. They are usually classified according to the natural system to which they are applied (rivers, lakes, estuaries, etc.). Other classifications attend to the temporal dynamics, spatial dimensions, the mechanistic or empiric focus of processes, the processes considered, etc. The mechanistic or process-based models simulate the changes in water quality in a natural system by attempting to represent the processes that occur in the real system. Thus, they are based on physical and chemical principles (Cox, 2003). The basic equation in which these models are backed is the equation for solute transport:

$$\frac{\partial \vec{c}}{\partial t} = -\vec{u}\frac{\partial \vec{c}}{\partial x} - \vec{v}\frac{\partial \vec{c}}{\partial y} - \vec{w}\frac{\partial \vec{c}}{\partial z} + \frac{\partial}{\partial x}\left(\varepsilon_x \frac{\partial \vec{c}}{\partial x}\right) + \frac{\partial}{\partial y}\left(\varepsilon_y \frac{\partial \vec{c}}{\partial y}\right) + \frac{\partial}{\partial z}\left(\varepsilon_z \frac{\partial \vec{c}}{\partial z}\right) + \Delta\vec{c}$$

where c is a mass concentration vector for each of the determinants; t is time; x, y and z are spatial coordinates; u, v, and w are the corresponding velocity components; ε_x, ε_y and ε_z are turbulent diffusion coefficients in the directions x, y and z, respectively; and Δc represents the internal transformations of pollutants and constituents. This last term can be represented through first-order decay kinetics or more complex formulations.

The module for water quality modelling in the DSS AQUATOOL is GESCAL (Paredes, 2004). It simulates the water quality evolution for a whole water resources system in an integrated way. Although the water quality is considered in all the elements of the simulation models (runoff, returns from demands, etc.), the physical-chemical processes are only taken into account in rivers and reservoirs or lakes. GESCAL uses the results of flows in rivers and volumes in reservoirs from the SIMGES module, together with the Leopold and Maddock (1953) or the Manning equation (Manning, 1891), in order to obtain the hydraulic conditions needed to run the quality evolution. The hydraulic in reservoirs can be modelled as Continuous Stirred Tank Reactor or as a two-layer model with the epilimnion and the hipolimnion.

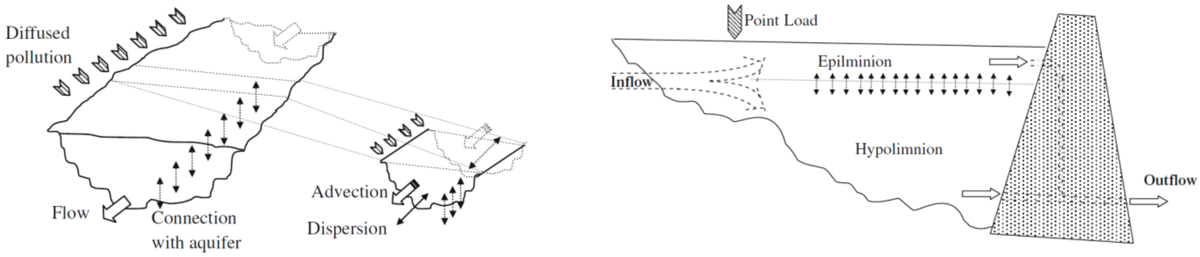


Figure 6. Diagrams of rivers and reservoirs in GESCAL (from Paredes, 2004).

The compounds considered by GESCAL are temperature, dissolved oxygen, nutrients cycle, toxic pollutants and arbitrary constituents (e.g. suspended solids). Temperature can be obtained by the Edinger and Geyer approach (1965) or given as an input. Dissolved oxygen can be considered with three degrees of complexity. The simplest model only considers the relation between dissolved oxygen and carbonaceous biochemical oxygen demand (CBOD). One step more, includes the nitrogen cycle, and the most complex model also takes into account phosphorous and phytoplankton. Figure 7 shows the complete dissolved oxygen model. Toxic pollutants (organic toxics and heavy metals) are modelled together with suspended solids, because of their high interaction. Thus, the evolution of concentrations in the sediment is also performed.

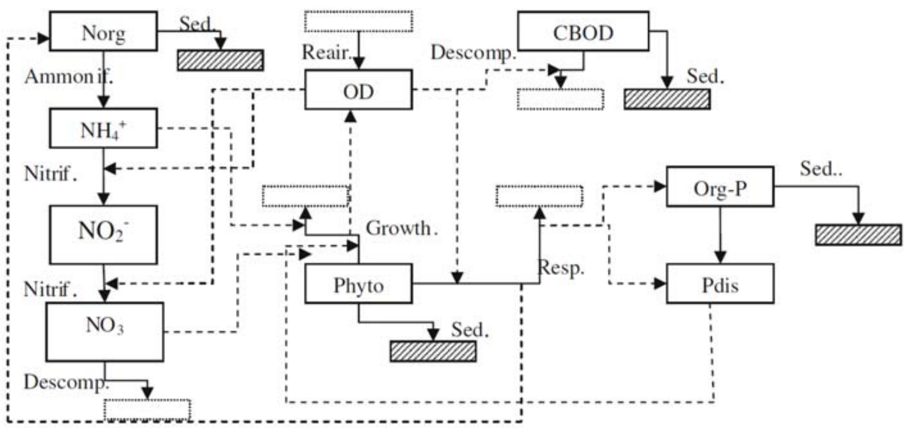


Figure 7. Complete dissolved oxygen model in GESCAL (from Paredes, 2004).

The water quality modelling in rivers is assumed to be stationary and one-directional. Then the resulting equation for the modelling of each constituent or pollutant is:

$$0 = \frac{d}{dx}\left(E\frac{dC}{dx}\right) - \frac{d\,(uC)}{dx} + \frac{S_d + C_e q_e - C q_s + \sum S_i}{V}$$

where E represents dispersion; C concentration, C_e concentration at the beginning of the river stretch; x length; u velocity; V volume; q_e inflow; q_s outflow; S_d diffuse pollution; $\sum S_i$ sources or sinks. The differential equations, particularised to the different constituents, are solved with a finite difference approach, requiring fragmentation of the river into differential elements.

The water quality modelling in reservoirs is considered dynamic and continuously stirred in each of the defined layers. Then, the resulting equations for the modelling of each constituent or pollutant are:

$$\frac{d(V_1C_1)}{dt} = Q_{1e}C_e - Q_{1s}C_1 + E_{12}^{'}(C_2 - C_1) + \sum S_{i1}$$

$$\frac{d(V_2C_2)}{dt} = Q_{2e}C_e - Q_{2s}C_1 + E_{12}^{'}(C_1 - C_2) + \sum S_{i2}$$

where V represents volume of the layer; C concentration; C_e inflow concentration; t time; Q_e inflows at each time step; Q_s outflows at each time step; S sediment flux; S_i sources or sinks; E_{12}' dispersion coefficient between layers. Sub-index 1 indicates values at the epilimnion and 2 at the hipolimnion. To solve this system of differential equations the Runge-Kutta method is used.

As GESCAL uses the results of SIMGES, it also works at monthly scale. The global results of the model include the initial and final concentration at the end of each river stretch and the final concentration in reservoirs. On the other hand, users can demand for partial results which provide the spatial evolution of constituents in the selected river stretches and the temporal evolution of the constituents in reservoirs.

2.1.5. Habitat evaluation

The most broadly accepted method to design environmental flow regimes in rivers is the hydro-biological Instream Flow Incremental Methodology, IFIM (Bovee, 1982; Bovee et al., 1998; Dunbar et al., 1998; Tharme, 2002). One of the tools included in IFIM, the Physical Habitat Simulation Method, PHABSIM (Milhous et al., 1981), evaluates the habitat suitability based on the hydraulics, generating response functions of habitat indicators for each target species and size class in a study site, e.g. Weighted Usable Area (WUA)-Flow curves. These curves are the result of combining a fluvial hydraulic model and the preference curves of the aquatic species. Despite the fact that the elaboration of the hydraulic model and the preference curves require significant simplifications, the usefulness of PHABSIM has been proved in many applications (Stalnaker, 1979; Gowan, 1985; Conder and Annear, 1987; Bovee, 1988; Nehring and Anderson, 1993; Bovee et al., 1994; Gallagher and Gard, 1999).

After determining the WUA-Flow curves and knowing the flows series in the river, IFIM calculates the Habitat Time Series (HTS). This result can be used as a production function (Milhous, 1983), to create a model for potential population (Waddle, 1998) or to identify stressful situations for the aquatic fauna (Cheslack and Jacobsen, 1990). A useful indicator which can be obtained from the HTS is the Habitat Duration Curve (HDC), which shows the percentage of time that a certain WUA value is exceeded. Other habitat suitability indexes are the Continuous Under Threshold index (Capra et al., 1995) or the Uniform Continuous Under Threshold index (Parasiewicz, 2008), which provide the periods where the WUA is under an established threshold.

CAUDECO (Paredes-Arquiola et al., 2011) is a module of the DSS AQUATOOL that jointly evaluates environmental flows and water resources management scenarios. It uses the series of flows in rivers resulting from SIMGES and combines them with the WUA-Flow curves and the bioperiods to generate the HTS and the HDC. This process is directed though the equation:

$$HTS(t) = WUA(F(t)) \cdot BIOP(t) \cdot Long \cdot \sum_{i=1}^{m} k_i \cdot c(t)$$

where *HTS(t)* is the value of the HTS in the time *t, WUA(F(t))* is the value of WUA for the flow *F(t)* in the time *t*, *BIOP(t)* is a function which defines whether the species is present in the time *t*, *Long* is the length of the river stretch only used if the WUA values are given in m^2/m, and the term $\sum k_i \cdot c(t)$ represents the influence of different water constituents or pollutants on the habitat suitability. Figure 8 shows graphically the process to obtain the HTS, excluding the water quality. It is due to the fact that usually there is not enough data to practically apply this term. There are models, like AQUATOX (Clough, 2012), that consider the effect of pollutants on aquatic ecosystems including fish, invertebrates, and aquatic plants; but they do not refer the results to habitat availability indicators.

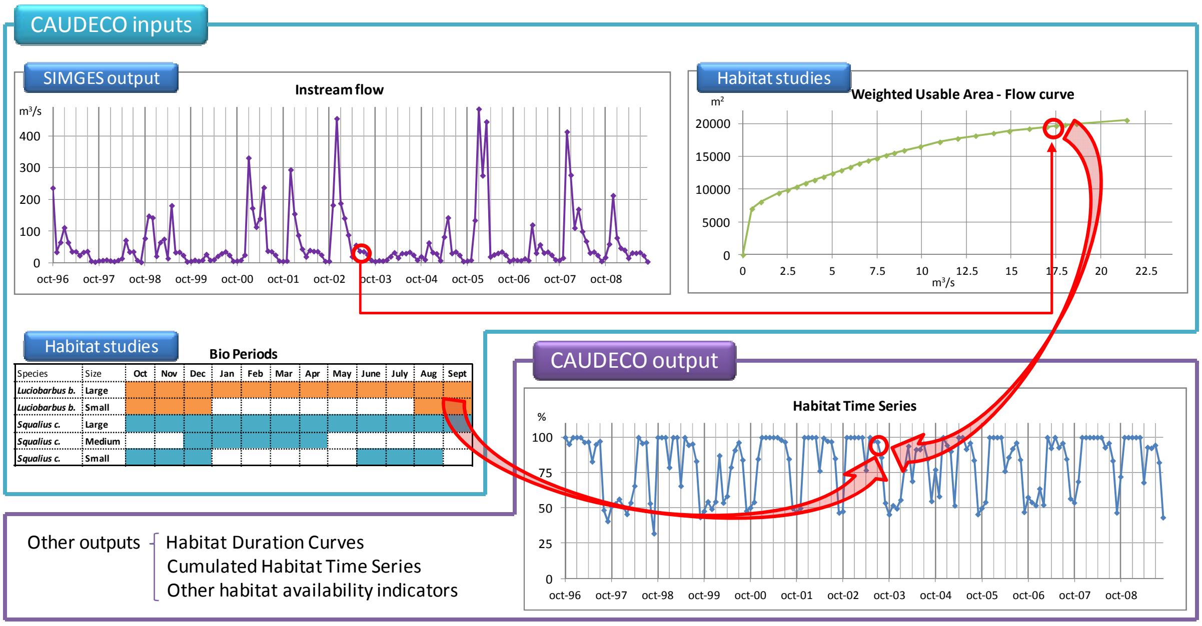


Figure 8. Diagram of the process to obtain Habitat Time Series with CAUDECO.

After this process CAUDECO provides the HTS and the HDC for each species and size class at each studied river stretch. In order to facilitate the global analysis of results, CAUDECO allows accumulating the results in different ways according to the user's preference. It can accumulate the different size classes of the same species in a river stretch, providing one result per species per river stretch (e.g. HTS of the Brown trout in the lower stretch of the river Tormes). Also, it can accumulate the different species in a river stretch, providing one result per river stretch (e.g. HTS in the lower stretch of the river Tormes). Besides, it can accumulate the results in different river stretches, providing one result per species (e.g. HTS of the Brown Trout for the entire Tormes river system).

Regarding the mathematic expressions used to accumulate the results, there are two options available in CAUDECO: the weighted average accumulation and the accumulation by minimum. Given that the results can be obtained in m^2 or in % of the maximum WUA value for the species and size class, each accumulation option presents two formulations which are presented below for the HTS. The accumulated HDC are obtained from the accumulated HTS.

- Weighted average accumulation: it sums the results applying the weights defined by the user for each size class, species or river stretch.

$$HTS\left(m^2\right)=\frac{\sum HTS\left(m^2\right)\cdot p_i}{\sum p_i}$$

$$HTS\left(\%\right)=\frac{\sum HTS\left(m^2\right)\cdot p_i}{\sum p_i\cdot max\left(HTS\left(m^2\right)\right)}\cdot 100$$

- Accumulation by minimum: it takes the minimum value of the results to accumulate for each time step.

$$HTS\left(m^2\right)=min\left(HTS\left(m^2\right)\right)$$

$$HTS\left(\%\right)=min\left(HTS\left(\%\right)\right)$$

The advantage of the accumulations is that they provide a reduced number of results which allow identifying the critical points that require a deeper analysis.

2.1.6. Connection of the models

The proposed methodology links the models above described in order to analyse the effects of the management of the river basin and water resources on the relevant aspects of the system. Figure 9 shows the information flow through the different models. It makes evident that the management of the river basin impacts on the available water resources and the water quality of runoff. Moreover, water resources allocation decisions impact all the basin uses, including the environmental uses and the water quality (Paredes-Arquiola et al., 2013b).

With this methodology, it is easy to conduct tradeoff analyses that help to balance the different significant issues in a whole river basin. In this research we are going to show the influence of different environmental flow regimes on water quality and habitat suitability (Paredes-Arquiola et al., 2013b). But, the new methodology presented here also allows relating changes in the land uses of the river basin to, for instance, changes in water quality or habitat suitability, maintaining the same management rules. So, the potential of the effective linkage of these tools is very broad.

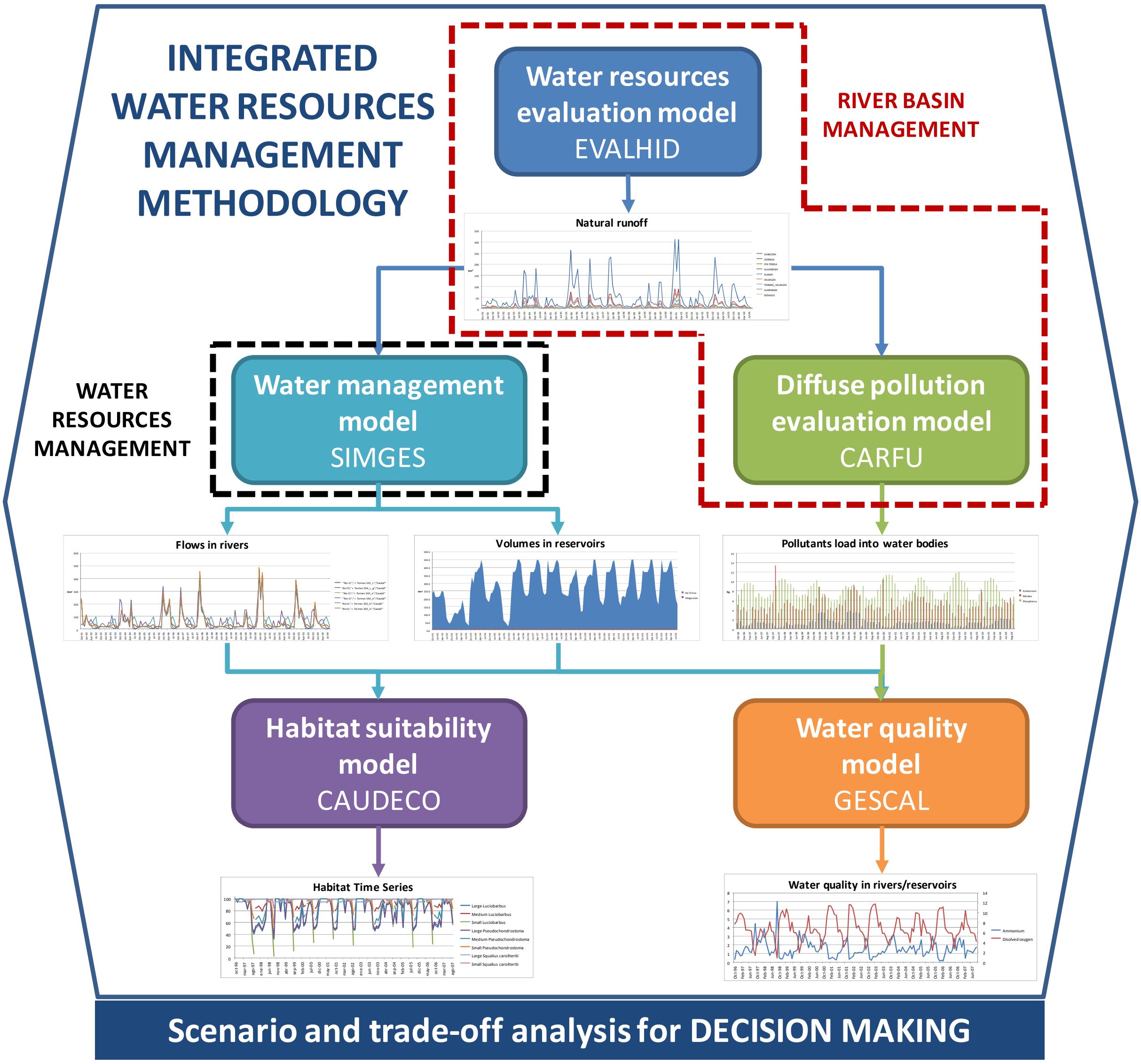


Figure 9. Diagram of the Integrated Water Resources Management methodology.

2.2. Integration of the Ecosystem Services Analysis and the Integrated Water Resources Management (Part I)

As noted by Cook and Spray (2012), the definition of IWRM and ES are very similar because they are both focused on the influence of water and land management on ecosystems. Those concepts are not linked just by their definitions. In fact, water resources management determines the state of some ES like water purification in rivers and lakes or aquatic biodiversity; and ES like nutrients retention by the landscape or water production for economic uses have a direct influence in the water resources systems functioning. Nevertheless, the existent tools for ES analysis do not take into account the water resources management, at least in a dynamic way in time. Specific software like InVEST (Tallis et al.,

2013) and ARIES (Bagstad et al., 2011) take into account the spatial variability of ecosystem services, but they work with average values that cannot represent the influence of changing water management rules or the recovery time for damaged ecosystem services.

If both paradigms, ES and IWRM, are analysed independently, the decisions could only point to nature protection or to demands fulfilling. But, as long as their relationship is so strong, it is necessary to analyse them in an integrated way.

2.3. Description of the Tormes Water Resources System

The TWRS is a subsystem of the Duero River Basin District that spans from the source of the Tormes River basin to upstream of the Almendra reservoir. This reservoir is located at the confluence of the Tormes River and the Duero River. It has predominantly Mediterranean climate, but also Continental due to its orographical isolation.

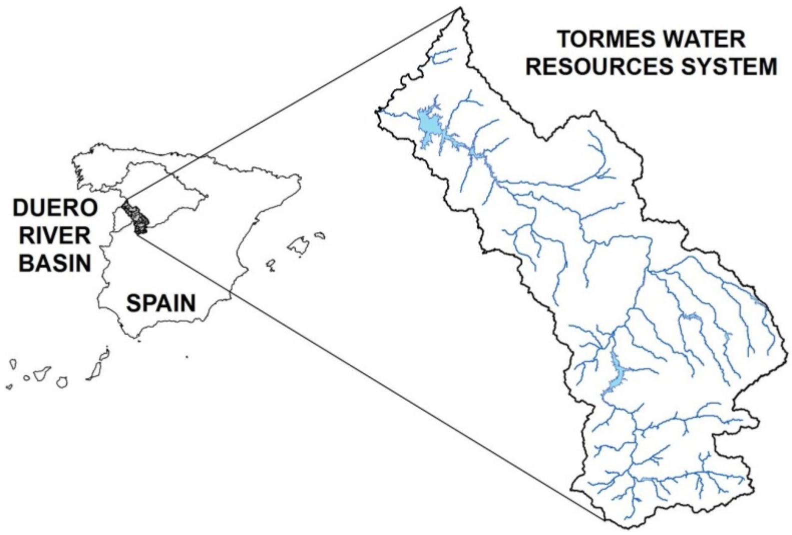


Figure 10. Location of the TWRS.

With an area of 7,107 km^2, the main land cover is natural vegetation, followed by agricultural land use, water bodies and urban land use. The total population is around 280,000 inhabitants from which more 160,000 live in the city of Salamanca. The rest of populated areas have less than 15,000 inhabitants with an average of 200 inhabitants. It is important to highlight that there are big Sites of Community Interest and Special Protection Areas for Birds both at the head and at the lower part of the basin.

Figure 11 shows a simplified diagram of the TWRS that includes its main elements. This is a multipurpose water supply system in which agricultural, urban and hydropower account for the majority of water demand. Aquaculture and industrial demands are less important. The total demand is 38.9 Hm^3/year for urban supply and 319.5 Hm^3/year for irrigation supply. From these amounts approximately 80% is surface water and 20% is groundwater in both types of demands. There are several reservoirs in the system, but only Santa Teresa reservoir has a hyper annual regulatory capacity (maximum storage 496 Hm^3). The average watershed resources amount to approximately 1,312.4 Hm^3/year.

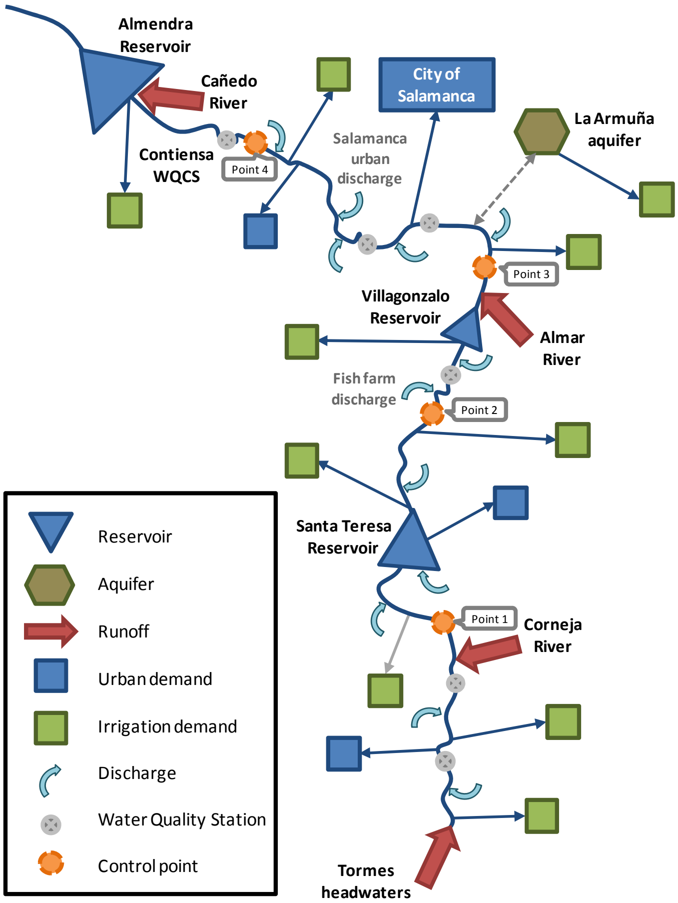


Figure 11. Simplified diagram of the TWRS.

The water quality is generally good in most river segments. Upstream of Santa Teresa dam, the effects of human activities on the water are negligible. In the middle part of the river, from Santa Teresa dam to Villagonzalo dam, the pressures come from diffuse pollution of agricultural activities and urban discharges. Though, water quality is slightly affected by these pressures. But the major environmental pressures are concentrated downstream of the Villagonzalo dam, including several urban and industrial discharges from the city of Salamanca. These environmental pressures modify the physical properties of the water and the chemical concentrations in the water from downstream of Villagonzalo dam to the

Water Quality Control Site (WQCS) at Contiensa. In this section of the river, the water quality worsens and strongly depends on the river flow. Thus, the segment between Salamanca city and the Contiensa WQCS is considered the most critical in the TRWS.

Although low flows are not a serious problem in the Duero River Basin, the management plan of the 90s defined the environmental flows as 10% of the mean annual inflow. The new RBMP (MAAA, 2013) improves the ecological status in water bodies through the definition of new environmental flows, based on biological aspects.

The river segments selected for this study, regarding their relevance in the aforementioned problems, are located near Contiensa WQCS (Point 4) and just downstream of Villagonzalo dam (Point 3). Two more points were analysed to obtain a global view of the river system performance, one between Santa Teresa and Villagonzalo reservoirs (Point 2) and another upstream of Santa Teresa reservoir (Point 1). These four points are identified in Figure 11, and Point 4 is located in the most critical river stretch, where the results of the application will be analysed.

3. Application to the Tormes Water Resources System

3.1. Development of the hydrological model

3.1.1. Information preprocessing

Independently of the hydrological model used, the climatic data needed are precipitation, maximum and minimum temperatures. From Herrera et al. (2012), there are 50-year high-resolution daily gridded datasets which are proper for this study. The period covered by the data is from January 1950 to March 2008. As explained in the previous section, EVALHID applies the hydrological models in a semi-distributed way. Then, the spatial data has to be obtained at the centroid of each subbasin. To do so, the square inverse distance method is used, obtaining the average value for the climatic variables in each subbasin.

In order to calculate the Potential Evapotranspiration (PET), the Hargreaves method is applied (Hargreaves and Samani, 1982). Hence, it is necessary to have the incoming extraterrestrial solar radiation. In this case, the temporal series are obtained with the sole input of temperature data, latitude, and the Julian day to estimate incoming solar energy (Duffie and Beckman, 1980).

3.1.2. Model construction

The flow series are provided by EVALHID at the drainage points defined by the user. Given that the purpose of the series is to feed the SIMGES module, the drainage points have to match with those considered in the water management model. The growndwater in the TWRS is considered to have low influence on the total runoff. In fact, the main part of the recharge into the aquifers beneath the TWRS comes from zones located outside the studied system. That is why, in order to simplify the model, the groundwater drainage points coincide with the surface drainage points. According to this reasoning, Figure 12 presents the subbasins selected to obtain the total runoff.

Figure 12. Subbasins where EVALHID provides the total runoff.

The next step is the selection of the hydrological model for each subbasin, that should be based on the knowledge of the rainfall-runoff proceses in the basin and the level of detail required for the results. Another option is building the three available models in EVALHID and choose the one which better represents the real hydrology after the calibration. In this application, the breakdown of results needed is low. Then, the SAC-SMA model in dismissed also because of the high number of parameters that make the calibration more difficult. The Témez model performance is known because it has been used in other models, e.g. SIMPA (Ruiz, 1998). So finally, the model applied is the HBV. Apart from that, it is necessary to decide whether a snow model is necessary or not, and which of the two available models would be preferable. Consistently with the hydrological model selected, the snow N-1 is chosen because it is set out in the HBV model. This model is applied to the subbasins corresponding to the drainage point 1, because they generate the runoff from snow melting in spring, and this has to be included in the resulting runoff series.

To build the HBV model in all the subbasins of the TWRS and the snow N-1 model in the heading subbasins, the first set of parameters and the initial values of the state variables are assigned the default values defined in EVALHID. Subsequently, an automatic calibration process is performed using the Shuffled Complex Evolution Algorithm, SCEUA (Duan et al., 1992). This is an extremely stable optimisation algorithm for the calibration of rainfall-runoff models (Múnera and Francés, 2009). The optimisation process is based on the average of several target functions:

- Nash-Sutcliffe:

$$F_1 = 1 - \frac{\sum_1^n \left(Q_{sim}(t) - Q_{obs}(t)\right)^2}{\sum_1^n \left(Q_{obs}(t) - \overline{Q}_{obs}\right)^2}$$

- Nash-Sutcliffe of the neperian logarithm:

$$F_2 = 1 - \frac{\sum_1^n \left[ln\left(Q_{sim}(t) + \varepsilon\right) - ln\left(Q_{obs}(t)\right) + \varepsilon\right]^2}{\sum_1^n \left[ln\left(Q_{obs}(t) + \varepsilon\right) - \overline{ln\left(Q_{obs}(t)\right) + \varepsilon}\right]^2}$$

- Pearson:

$$F_3 = \frac{\sum_1^n \left(Q_{sim}(t) - \overline{Q}_{sim}\right) \cdot \left(Q_{obs}(t) - \overline{Q}_{obs}\right)}{\sqrt{\sum_1^n \left(Q_{sim}(t) - \overline{Q}_{sim}\right)^2 \cdot \sum_1^n \left(Q_{obs}(t) - \overline{Q}_{obs}\right)^2}}$$

- Symmetric measure of the adjustment between the average simulation and the average observation:

$$F_4 = 1 - \left(max\left(\frac{\overline{Q}_{sim}}{\overline{Q}_{obs}} ; \frac{\overline{Q}_{obs}}{\overline{Q}_{sim}} \right) - 1 \right)^2$$

These target functions evaluate the statistical similarity between the results of the model and the observed flows in the gauging stations. But, there are some flow series resulting from EVALHID which do not have a corresponding gauging station or that are affected by the river management. Hence, to calibrate them it is necessary to use the data from gauging stations downstream the drainage points, which are normally affected by the management of the river system. In order to make the results comparable with the measured data, there are two possibilities. The first one is the restoration of the gauged series to the natural regime to allow their comparison with the results of the model. The second option, selected in this case, is the modification of the natural flows resulting from the model to the altered regime. This can be done introducing the EVALHID series as inputs to the SIMGES model of the TWRS. In this way, simulating the real conditions of the system management, the resulting flows in the rivers of the model are comparable with the gauged flows, what makes the calibration process possible. Figure 13 shows the calibration process for the flow series generated by EVALHID.

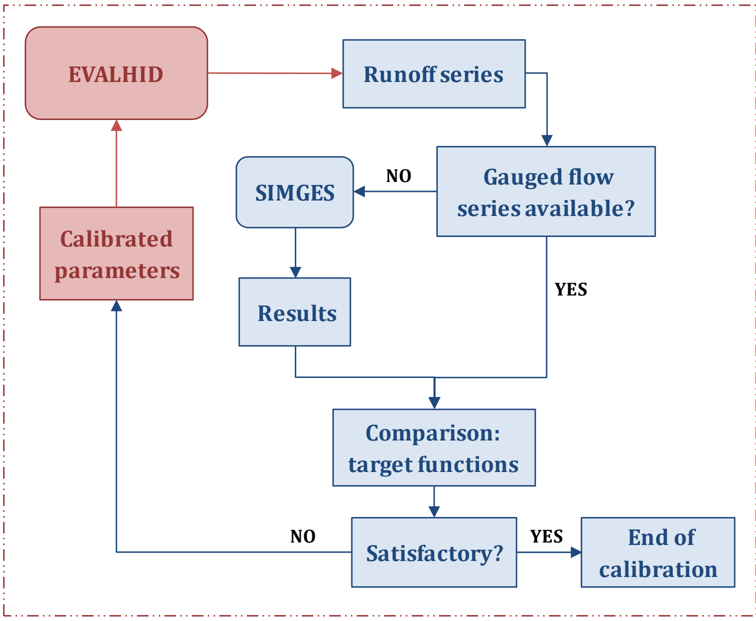


Figure 13. Calibration process diagram for EVALHID.

The above described process is conducted using the results from the hydrological model HBV in all the subbasins, grouped in seven regions with the same values for the parameters (see Figure 14). Then, seven calibration points from the Official Gauging Stations Network (ROEA in Spanish) are used: ROEA 2085, ROEA 2081, ROEA 2149, ROEA 2084, ROEA 2086, ROEA 2087, and ROEA 2088. The total period with gauged data spans from October 1950 to September 2006. Nevertheless, the gauged flows are not available for all this period in all the stations and the calibration period is adapted for each gauging station. The six last years of data are used for validation.

It is obvious that the calibration has to be performed from upstream to downstream. This means that to calibrate the flows generated at a drainage point, it is necessary to calibrate the upstream models first.

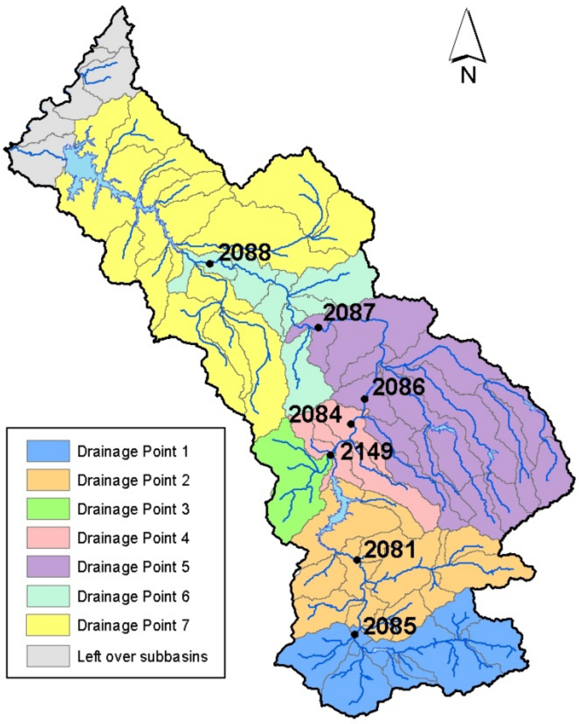
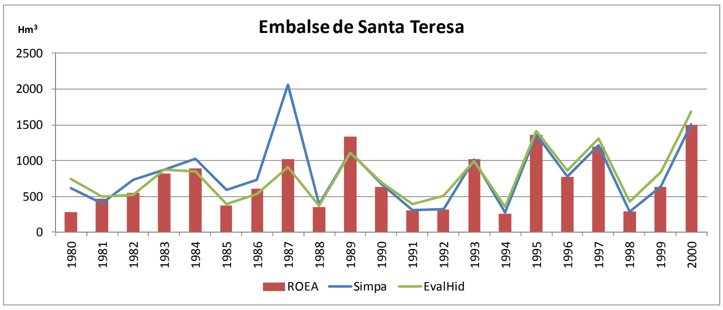


Figure 14. Groups of subbasins for calibration and gauging stations.

Comparing the results obtained with EVALHID using the HBV model with the results of SIMPA using Témez, it is observed that the HBV model represents better the historical data, (see Figure 15). Thus, the HBV model is going to be used in all the subbasins of the TWRS. This comparison is done in the period from October 1980 to September 2000.



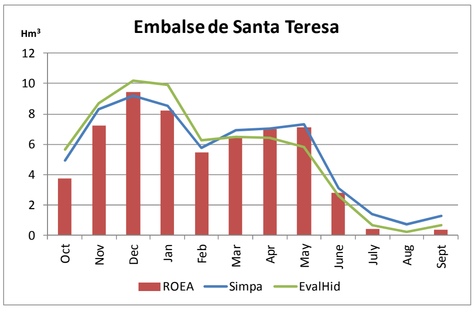


Figure 15. Comparison graphics between the gauged flows and the results of SIMPA (Témez model) and EVALHID (HBV model).

Figure 16 presents the comparison graphics between the measured and simulated flows by EVALHID at ROEA 2085, where the simulated flows include the effect of snow melting and the measured flows are in natural regime. In contrast, Figure 17 shows the same comparison at ROEA 2088, where the simulated flows include the river management influence performed by SIMGES because the measured flows are in altered regime.

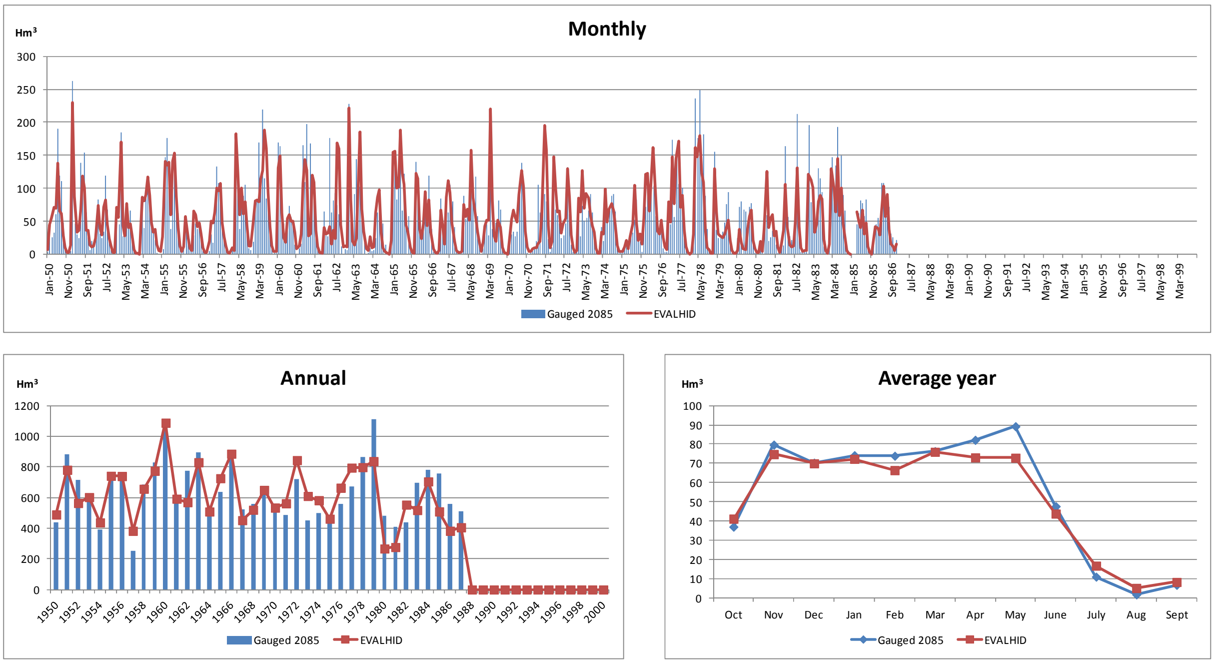


Figure 16. Calibration graphics for ROEA 2085.

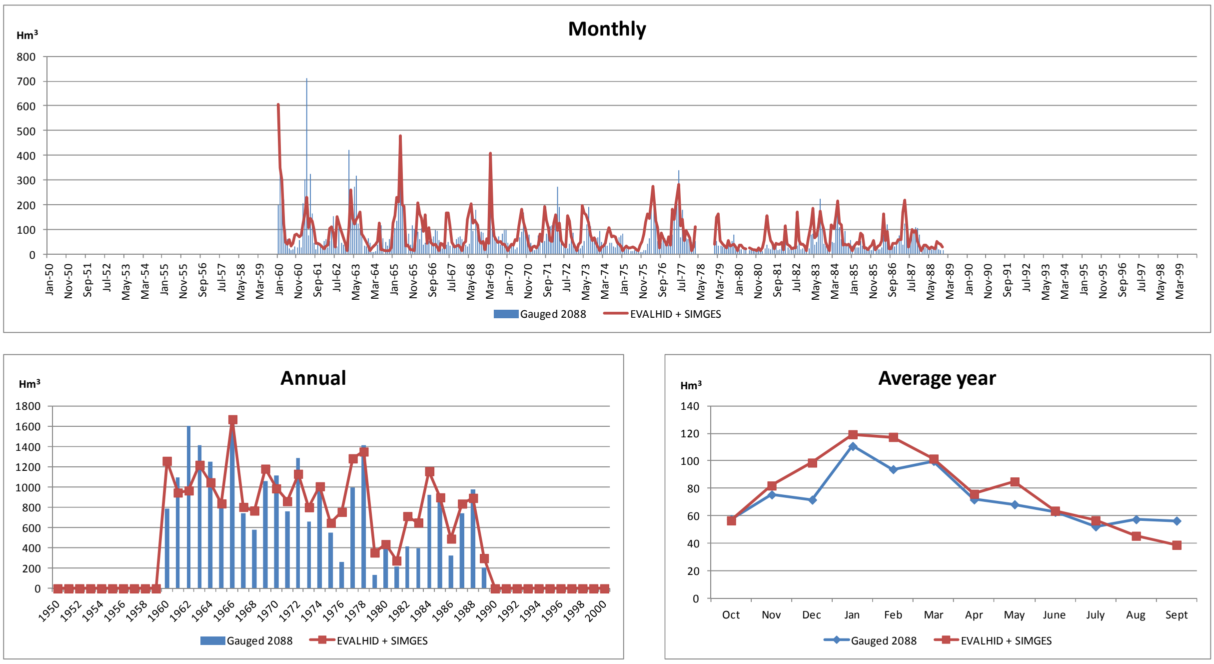


Figure 17. Calibration graphics for ROEA 2088.

Finally, the validation is performed in the period from October 2000 to September 2006 at the calibration point ROEA 2088, because it receives the flows from all the modelled subbasins. Then, the EVALID model for the TWRS is ready to generate runoff series.

This model was built for the DRBA as a part of a consulting contract by the Group of Water Resources Enginering of the Research Institute for Water and Environmental Engineering.

3.2. Development of the diffuse pollution evaluation model

3.2.1. Information preprocessing

The main input of CARFU is the shape file of water bodies for the TWRS, which is available at the DRBA mapping repository. This map includes information about the water bodies' lengths, which are needed to perform the pollutants decay. The flow order in the river network is defined using a Geographic Information System. Thereafter, the associated information for each water body includes the origin and destiny water bodies. This allows accumulating the pollutants loads from upstream to downstream, as established by the equations of CARFU.

In this application, the available data is only referred to point loads. The database of waste water discharges from urban and industrial demands in the TWRS is continuously filled and updated by the DRBA. This database includes the load of pollutants discharged, the water volume returned and the associated water body which receives the spill. Figure 18 shows the location of the inventoried waste loads in the TWRS.

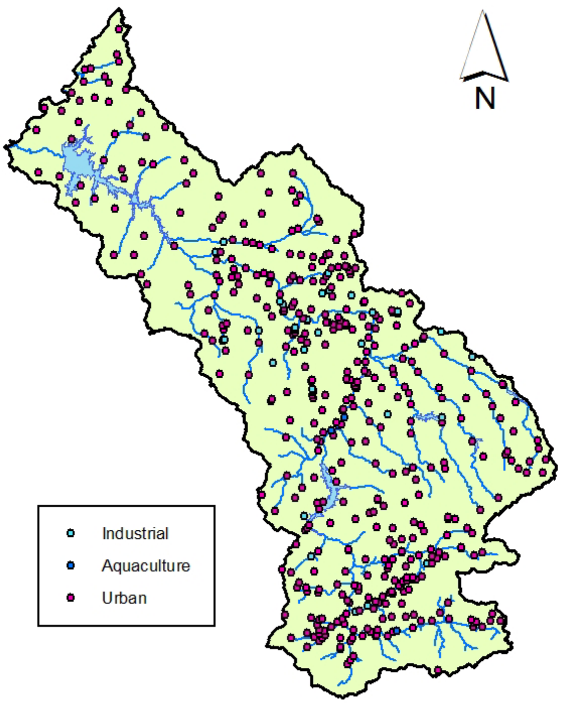


Figure 18. Inventoried waste load discharges in the TWRS.

The constituents modelled should be the same considered in the GESCAL model: dissolved oxygen, CBOD, nitrates, ammonium, phosphorus, conductivity and suspended solids (see

3.4.1). But in this case, the only compounds considered are CBOD and Phosphorous, because they are the main pollutants coming from urban effluents.

Finally, the daily flow series generated in each water body are available from EVALHID. But, they have to be monthly accumulated to be used by CARFU.

3.2.2. Model construction

In order to link this model with the water quality model, the results have to be provided at the drainage points considered in the water quality model, which in turn coincide with the ones used in EVALHID (see Figure 12) and SIMGES. Hence, it is necessary to identify the water bodies where the waste loads are introduced as inputs of the water quality model. This is done defining “final water bodies” in the accumulation process and associating each of them to a receiving water body in GESCAL.

After that, it is necessary to quantify the degradation constants for each of the simulated compounds, CBOD and phosphorus, in every modelled water body; as well as the initial concentrations in all water bodies. From the experience with the stationary model previously used in the DRBA, the values of the parameters and the initial concentrations are established. It is assumed that these values provide quite good results.

In order to see whether the obtained results with CARFU are also satisfactory, it is necessary to compare (validate) the modelling results with measured data. The Integral Network of Water Quality (ICA in Spanish) provides monthly measurements for many water quality indicators, including CBOD and phosphorus. The stations presented in Figure 19 are used for this validation in the period from January 2000 to September 2005.

Figure 19. Stations of the Integral Network of Water Quality used for validation.

Figure 20 and Figure 21 present the comparison graphics between the measured and simulated loads for CBOD and phosphorus by CARFU at ICA 088, respectively. It is evident the similarity between the simulated series of CBOD and phosphorus. This is because the degradation law used to model both compounds is the same, except for the degradation constant value.

It should be noted that due to the degradation law used, which is very simple, the calibration results are acceptable, but not excellent. The Pearson's correlation coefficient amounts 0.5432 for the CBOD and 0.4261 for the phosphorus.

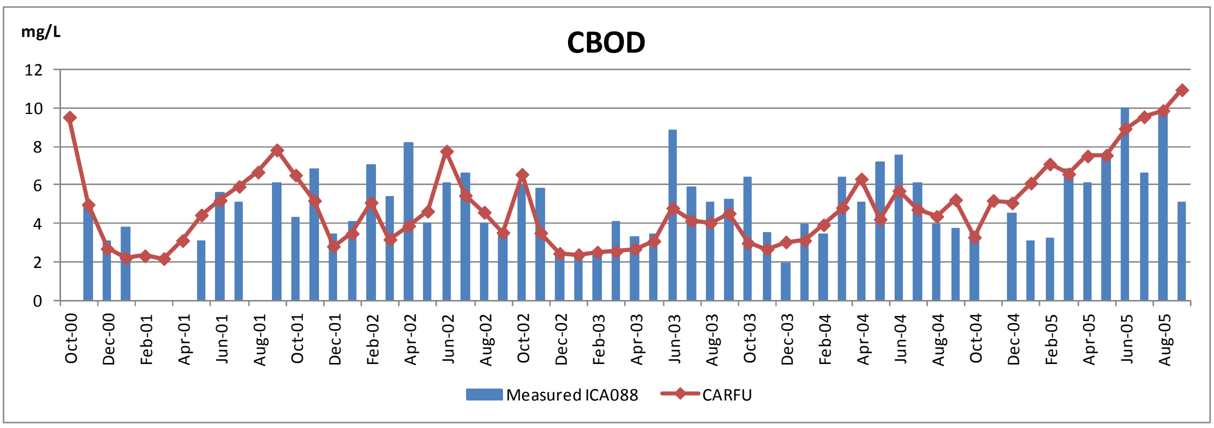


Figure 20. Calibration graphics for CBOD at ICA 088.

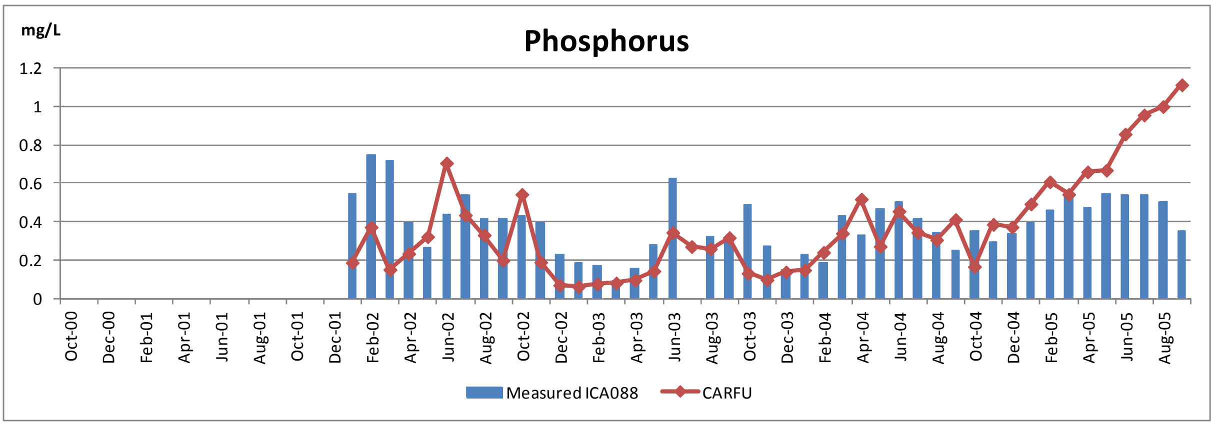


Figure 21. Calibration graphics for phosphorus at ICA 088.

Finally, it is important to highlight that this model was built for the DRBA as a part of a consulting contract by the Group of Water Resources Enginering of the Research Institute for Water and Environmental Engineering. Currently a specifica calibration process in being conducted, but at this point it is considered to be ready to generate waste load series.

3.3. Development of the water management model

3.3.1. <u>Information preprocessing</u>

This model needs mean monthly data about demands and their returns, reservoirs' capacity, bathymetry and evaporation rates, the capacities of rivers and conductions, etc. These data are available in the databases of the DRBA. But others like the aquifers' discharge rates or the management rules have to be adjusted in the calibration process.

The runoff series entering the TWRS from the basin headings and the tributaries are available from EVALHID at daily scale. But, they have to be monthly accumulated to be used by SIMGES.

3.3.2. <u>Model construction</u>

In this case, the model comes from the Water Plan Office of the DRBA, which used it to develop the annex about allocation and reserve of water resources of the last RBMP (MAAA, 2013). Hence, the model is complete and calibrated.

The surface water bodies considered in the model are the ones forming the TWRS until Almendra reservoir. The aquifers are introduced in the model to represent the groundwater resource used by demands, but not with the purpose of modelling the aquifer functioning or the relationship with surface water bodies. In order to accomplish the environmental flows requirements, four minimum flow regimes are established; three downstream Santa Teresa, Villagonzalo and Almendra reservoirs and another downstream the discharge point of the waste water treatment plant of the city of Salamanca.

Seventeen urban demands are considered, from which five use groundwater resources. Their total demand amounts 38.9 Hm^3. The agricultural demands sum 319.5 Hm^3 divided into thirty irrigation areas. There are twelve hydropower stations along the Tormes River, with a mean annual productivity of 0.002314 GWh/(Hm^3·m). Aquaculture is also a relevant activity in the system and its effect is introduced in the model as six different water demands. Finally, all the industrial demands are grouped in one.

With respect to the supply priority to demands, the urban and industrial demands have the higher priorities to ensure their total satisfaction. Next, the agricultural demands are served and, finally, the water demands for aquaculture. Other management rule is the restriction for hydropower generation in Santa Teresa reservoir, which regulates the TWRS, under drought conditions. In this reservoir, the monthly target volumes for storage correspond to the mean stored volumes for the period 1991 to 2006.

The calibration of the model is conducted adjusting the priorities of the demands, the target volumes in reservoirs and introducing operation rules, among other actions. Thereafter, the results of the model have to be compared with real measures in key elements of the system. The figures presented below belong to the Duero RBMP. They show this comparison for the flow in a river stretch for the period October 1980 to September 2006, and the volume stored in Santa Teresa from October 1994 to September 2006. In this last graphic are also depicted future scenarios for the horizons 2015, 2021 and 2027, but the calibration scenario is represented by the yellow line.

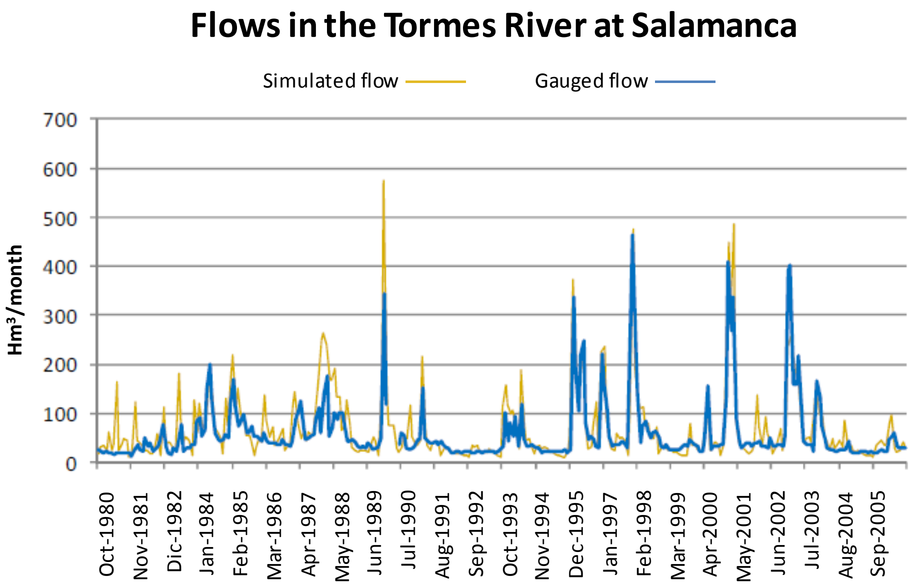


Figure 22. Comparison between the simulated flow (yellow) and the gauged flow (blue) in the Tormes River at Salamanca (from MAAA, 2013).

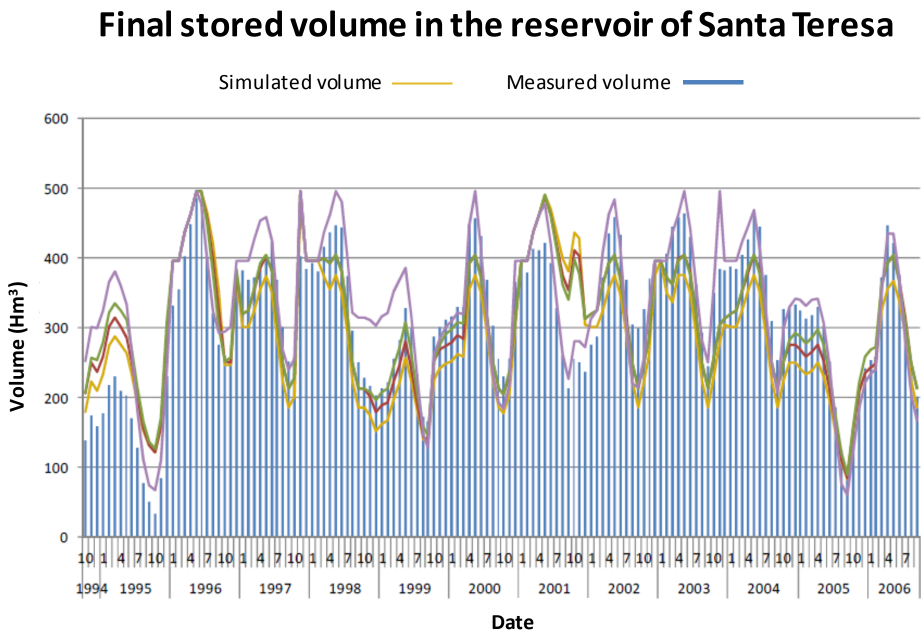


Figure 23. Comparison between the simulated stored volume (yellow line) and the measured volume (blue columns) in the reserovir of Santa Teresa (from MAAA, 2013).

The calibration results are considered acceptable, according to the graphics, and provided that most data are introduced as fixed monthly values, and not as time series. This makes difficult to represent the variability of real water management throughout the calibration period. Then, the SIMGES model for the TWRS is ready to generate different result series.

3.4. Development of the water quality model

3.4.1. Information preprocessing

This model is probably the most data-demanding and also the most difficult to calibrate. It requires information about the hydraulics in all the river stretches and conductions as well as the water quality parameters for the diverse compounds modelled. The first data come from detailed hydraulic models and the water quality parameters need to be calibrated.

It is also necessary to have series of pollutants concentrations in runoff for all the modelled compounds. In this case the waste load series for CBOD and phosphorus come from CARFU, and using the flow series from EVALHID are transformed into pollutants concentrations series. The series for the rest of constituents are estimated from WQCS near the drainage points or, in low altered subbasins, they are assumed as series of natural concentrations.

Although the temperature of water is not modelled, it is considered in the dynamics of the compounds. Temperature curves are provided in every river stretch and reservoir. These curves come from nearby WQCS.

3.4.2. Model construction

In this case, the model comes from the Water Plan Office of the DRBA, which used it to develop the annex about environmental objectives of the last RBMP. Hence, the model is complete and calibrated.

The model considers the evolution of dissolved oxygen, CBOD, nitrates and ammonium; it uses specific sources and sewers for each of them. Moreover, phosphorus, conductivity and suspended solids are modelled as arbitrary constituents with a first order kinetics for their degradation. All the reservoirs are modelled as continuous stirred tank reactors. That is, considering one layer throughout the year.

The calibration is conducted adjusting the water quality parameters. Thereafter, the results of the model have to be compared with real measures in key sites of the system. Figure 24 and Figure 25 are presented in the Duero RBMP. They show this comparison for dissolved oxygen and CBOD at the WQCS of Contiensa for the period October 1996 to September 2004.

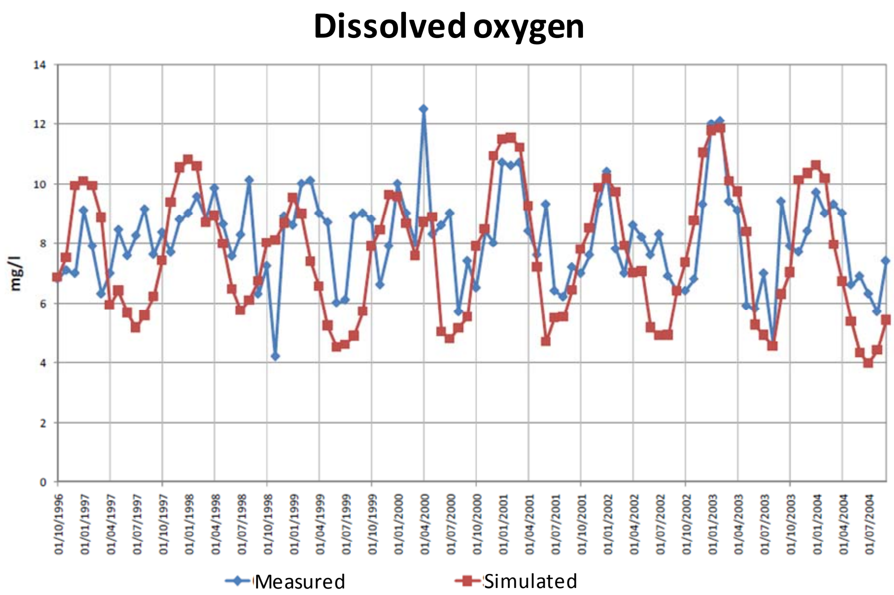


Figure 24. Comparison between the simulated dissolved oxygen concentrations (red) and the measured concentration (blue) in the Tormes River at Contiensa WQCS (from MAAA, 2013).

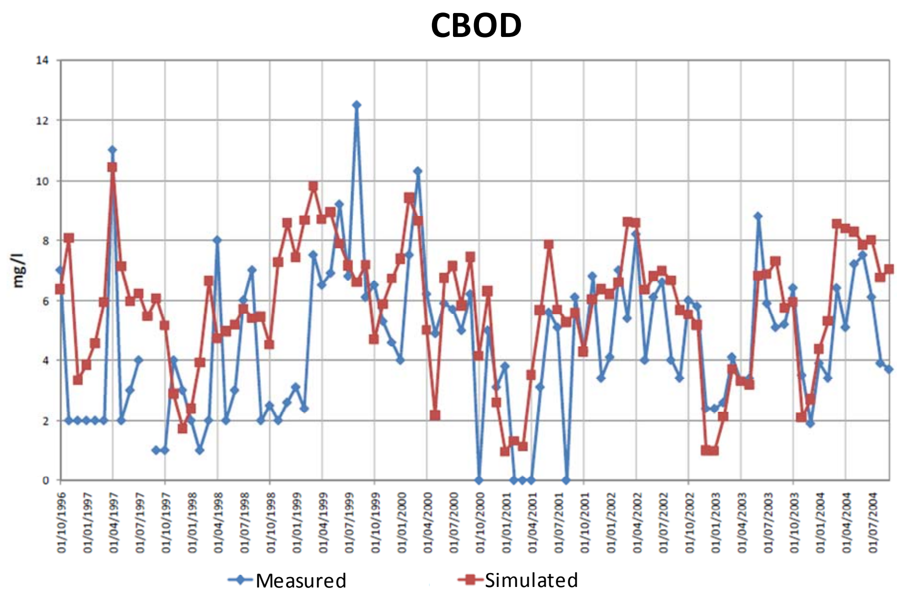


Figure 25. Comparison between the simulated CBOD concentrations (red) and the measured concentration (blue) in the Tormes River at Contiensa WQCS (from MAAA, 2013).

The results are considered acceptable, according to the graphics. It has to be taken into account that the water quality model error includes errors in the flows estimation by SIMGES and the errors of the WQCS measurements. This, linked to the high number of parameters to calibrate, makes difficult to obtain a good adjustment throughout the calibration period. Then, the GESCAL model for the TWRS is ready to generate different result series.

3.5. Development of the habitat model

3.5.1. Information preprocessing

In the TRWS, previous studies defined the WUA-flow curves for different size classes of the most relevant fish species in the river (García de Jalón and Lurueña, 2000; INFRAECO, 2009), as depicted in Figure 26.

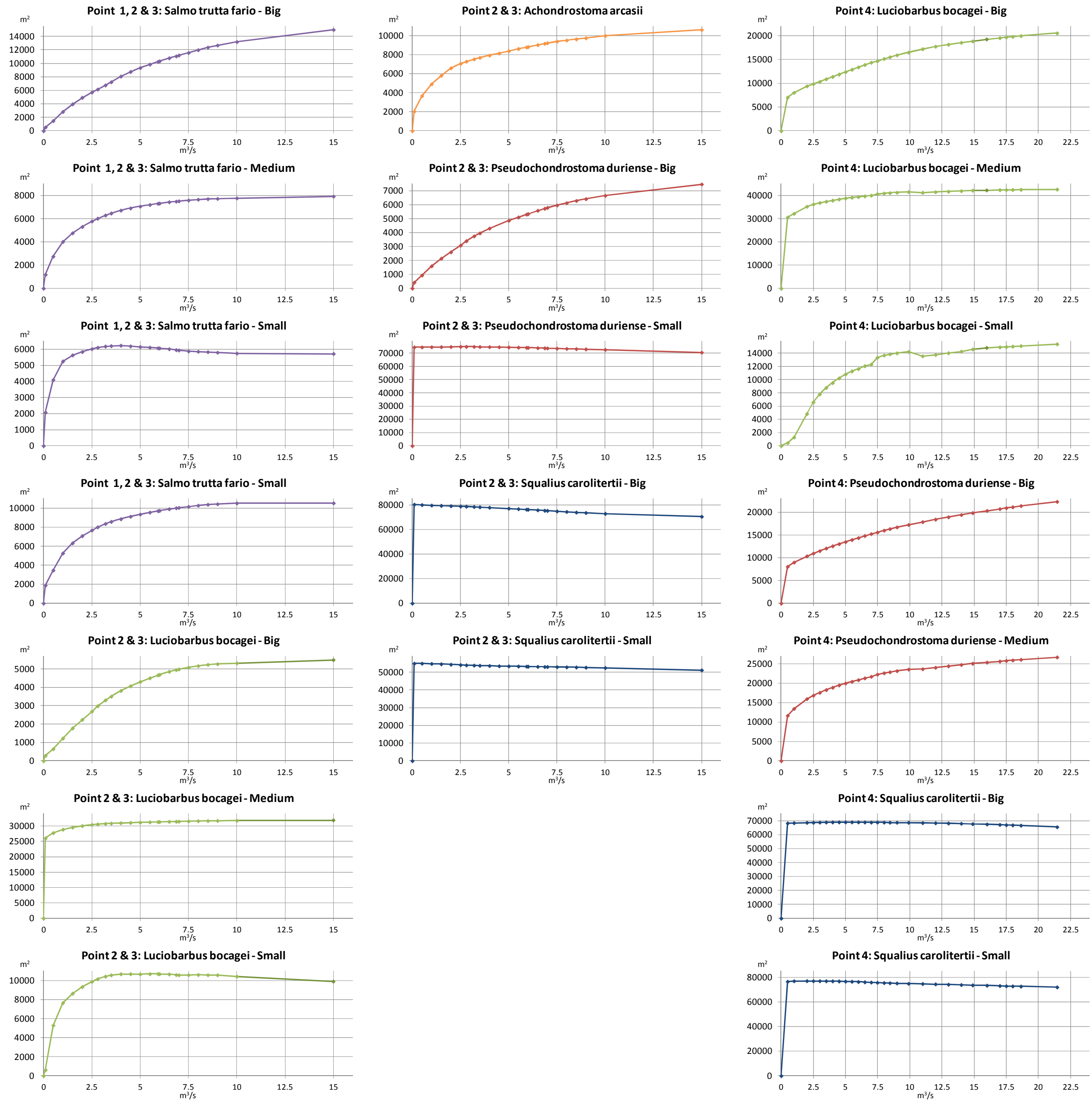


Figure 26. WUA-Flow curves for all the species and size classes considered in the TWRS.

The WUA-flow curves at point 4 were obtained in a river reach at Baños de Ledesma (Salamanca), where the fish species were Luciobarbus bocagei, Pseudochondrostoma duriense and Squalius carolitertii. For the first species there were curves for three size classes. For the other two species there were only two curves size classes. At points 2 and 3, the nearest WUA-flow curves that were developed in a river reach at Villagonzalo de Tormes (Salamanca) are applied. There, the fish species were Salmo trutta fario, Luciobarbus bocagei, Achondrostoma arcasii, Pseudochondrostoma duriense and Squalius carolitertii. The curves for the first species are available in four size classes. There are three curves available by size class for Luciobarbus bocagei, one for Achondrostoma arcasii and two for the last two species. Finally, the curves for Salmo trutta fario were applied at point 1.

Apart from the WUA-flow curves, it is necessary to have the flows in the studied river segments. This information comes directly from SIMGES.

3.5.2. Model construction

The construction of CAUDECO modules is quite simple. It consists in relating the different species and size classes with the water bodies, the WUA-flow curves and the bioperiods.

In this case the results are obtained in % of the maximum HPU. Then, for the WUA-flow curves that do not present a maximum value of WUA, it is necessary to define it. Here, this WUA value corresponds to the percentile 20% of the average daily flows in natural regime of the historical series at each studied point. The accumulation option selected is the accumulation by minimum.

This model does not require calibration because it does not use any parameter. In fact, it just connects the biological information (WUA-flow curves and bioperiods) with the circulating flows. Moreover, the biological information has been validated by their creators.

4. Results analysis and discussion

In order to link all the models, they are run for a common period (October 1996 to September 2007) in consecutive order. First, EVALHID generates the runoff series which are then used by CARFU and SIMGES. Then, the simulations with GESCAL and CAUDECO can be conducted. Finally, all the results can be analysed together to obtain relevant information for decision making (see Figure 9). In this application to the TRWS, because point 4 is critical, decision making should be mainly based on the analysis of its results.

4.1. Generation of runoff series

The flow series are necessary as inputs for the modules CARFU and SIMGES. It is important to highlight that CARFU needs the flow series for each water body. Then, it is required to choose the option of partial results generation in EVALHID which provides the different temporal results of the state variables for all the modelled subbasins.

The basin management aspect which affects the runoff series is the soil use. Basically, it changes the proportion of surface runoff, percolation and evapotranspiration. For instance, a soil covered with natural vegetation has higher evapotranspiration and generates less surface runoff than urban soils, but the former generates more percolation.

Apart from that, all subbasins do not generate the same amount of water resources due to their climatic features, geology and topography. Besides, there are subbasins that do not recharge exploitable aquifers or do not contribute to regulated rivers. Then, there are more strategic subbasins than others; but note that the concept "strategic" can be understood from the point of view of economic water uses or from the river ecosystems side. As an example, in a non regulated river it is important that the upstream subbasins generate enough flow for the river ecosystems, but this is not significant for the economic uses which are mainly fed from regulated rivers.

According to the above facts, it can be assured that land use planning influences the amount of available water resources, the place where they are generated and their distribution between surface and ground water.

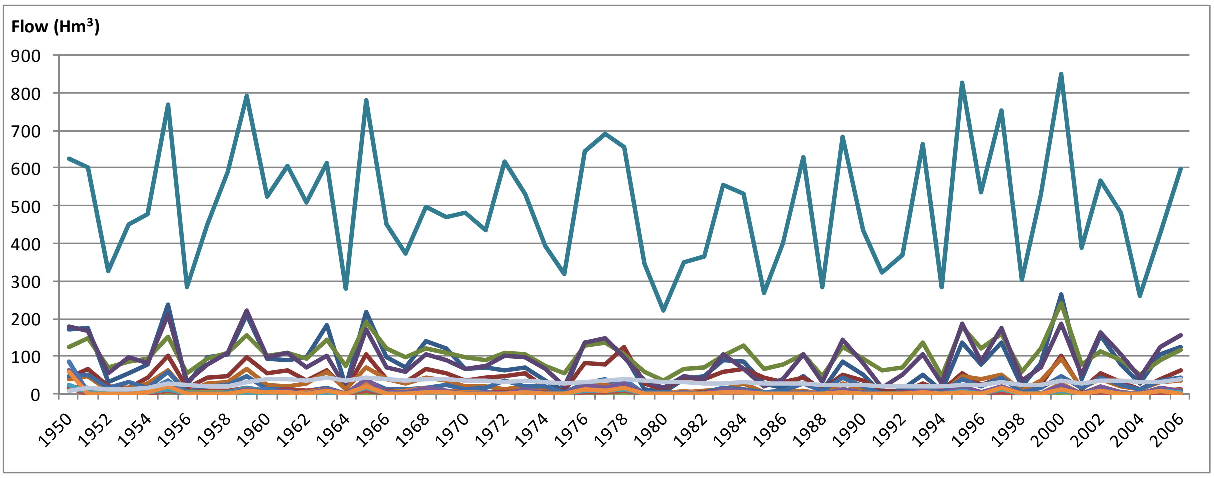


Figure 27. Annual runoff series resulting from the application of EVALHID.

Figure 27 shows the runoff series resulting from the simulation in all the subbasins. It does not include the legend of the series because is almost impossible to distinguish them. But, it can be seen that there is a subbasin that generates the most proportion of flow. This is the heading subbasin in which the snow model is implemented, called “AN 511 Cab Tormes-Barco Avila”. Consequently, any intervention in this subbasin has to take into account the influence on the water resources of the TWRS.

4.2. Generation of diffuse pollution series

The diffuse pollution series are necessary as inputs for the module GESCAL. In turn, CARFU needs the runoff series generated using EVALHID in all the water bodies.

In this case, where only the urban point loads have been considered, the result of the model (the water quality of runoff) is affected by the waste water poured into rivers upstream the drainage points. This means, the volume of water processed in waste water treatment plants (WWTP) and the pollutants removed by them (suspended solids, CBOD, nutrients, etc.).

There are legal prescriptions for the water quality of the effluents of WWTP which finally alter the water quality of runoff. This affects the aquatic species that require certain chemical conditions in water to survive. But apart from that, the water quality of runoff also influences the water management because of the requirements of the different demands with respect to the quality of the water resource. If the water quality is bad, the demands will try to find an alternative water source, but if it is not possible the water will have to be more intensively treated before its use, rising costs.

On the whole, the decisions about the waste water treatments influence the quality of available resources and the suitability of habitat conditions in water bodies.

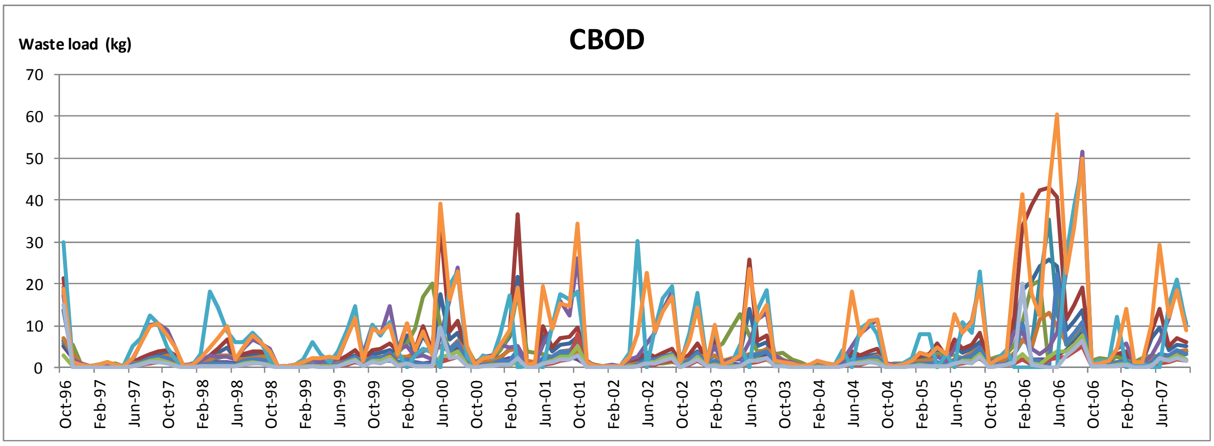


Figure 28. CBOD waste load series resulting from the application of CARFU.

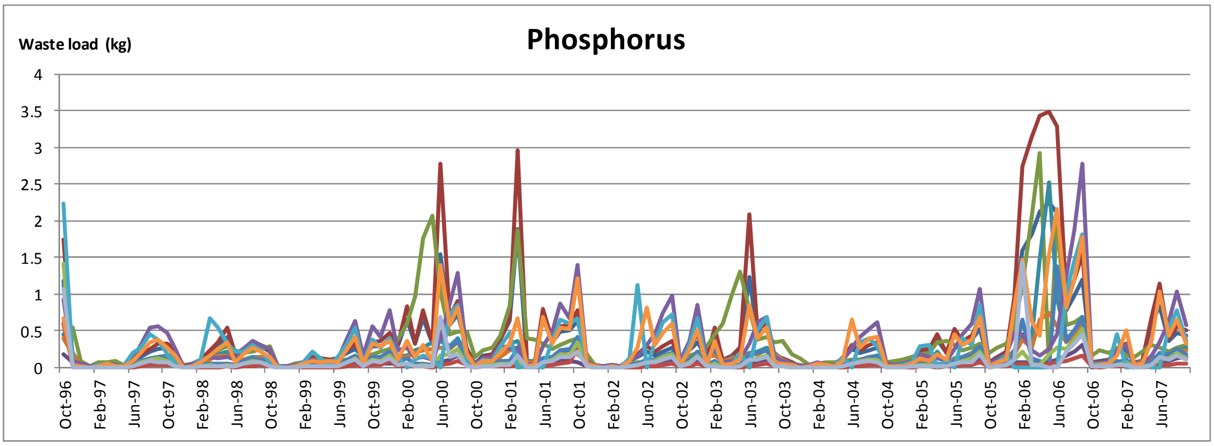


Figure 29. Phosphorus waste load series resulting from the application of CARFU.

According to Figure 28, the subbasin which generates higher loads of CBOD is “AN 526 Caballeruelo”. In the case of phosphorus loads, it is “AN 519 Tormes hasta Almendra”. This does not mean that the higher concentrations are in those subbasins. In fact, the concentration of CBOD in the first water body is under 0.9 mg/L and the phosphorus in the second water body is under 0.0014 mg/L in all the simulated period.

The investments in waste water treatments should be focused in the areas with higher concentrations; otherwise, the water purification treatments downstream would have to be more intense.

4.3. Generation of series of flows in rivers, stored volumes in reservoirs and other results

The flow series in rivers are necessary as inputs for the modules GESCAL and CAUDECO. Besides, the stored volume series are inputs of the module GESCAL. In turn, SIMGES needs the runoff series generated using EVALHID at the defined drainage points.

The management of a river system has big impact on other aspects of the water resources system. First of all, water resources allocation decisions influence all the uses of the basins, including the environmental requirements. A key step in this allocation process is the setting of environmental flows to maintain the desired ecological conditions. Equally important is the influence of river flows on water quality through dilution of pollutants and on the self-purification capacity of rivers. In short, water management has an effect on the satisfaction of economic uses, the suitability of habitat conditions in water bodies and on the water quality.

In order to illustrate the above statements, several scenarios are simulated. First, the SIMGES model is run from October 1996 to September 2007, which is the period of study, without establishing any environmental flow. This is considered the INITIAL scenario. Furthermore, several simulations are conducted with different environmental flow regimes. In QECO-MAX scenario the environmental flows in the points established in the RBMP are set at the maximum level of the legal range at every studied point. That is, the flows are the ones which provide the 80% of the maximum WUA. Finally, OR scenario also considers the maximum environmental flows but applies an operation rule that reduces them to the 50% in drought periods.

Figure 30 and Figure 31 show some results of the simulations with SIMGES, comparing the three management scenarios. On one hand, it can be seen that the low flows at point 4 are the highest in QECO-MAX scenario due to the establishment of the maximum environmental flow regime, while they are the lowest in INITIAL scenario. In contrast, the high flows are a bit lower in QECO-MAX scenario because it is necessary to release more water from reservoirs in order to fulfil the environmental flows and, consequently, the reserves are inferior. On the other hand, the flow in OR scenario can be considered as a mixture of the other two.

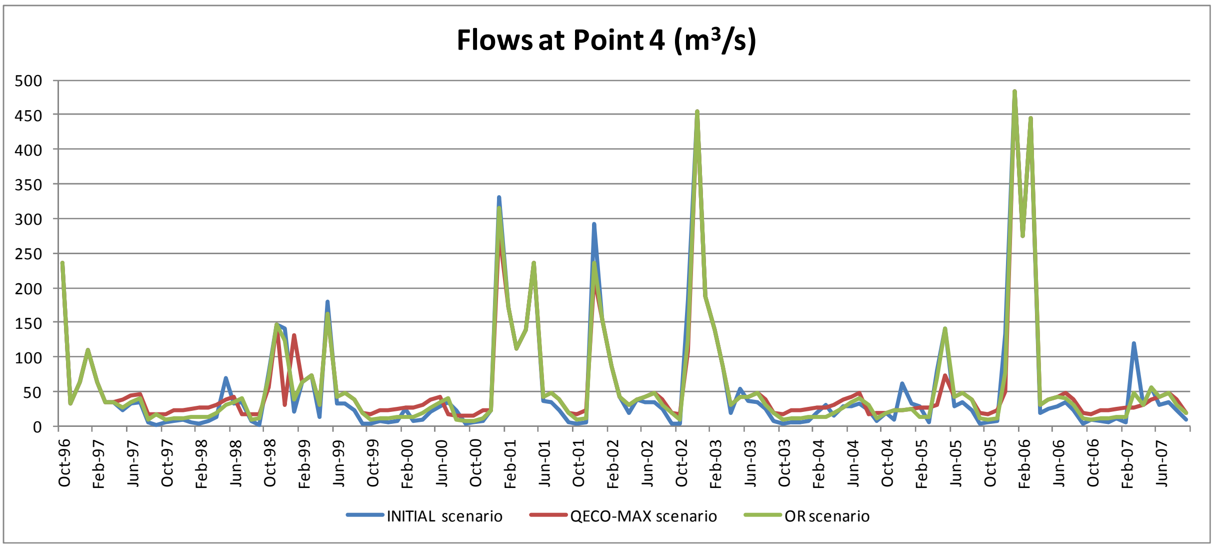


Figure 30. Flow series in m^3/s at the study point 4 in the different management scenarios.

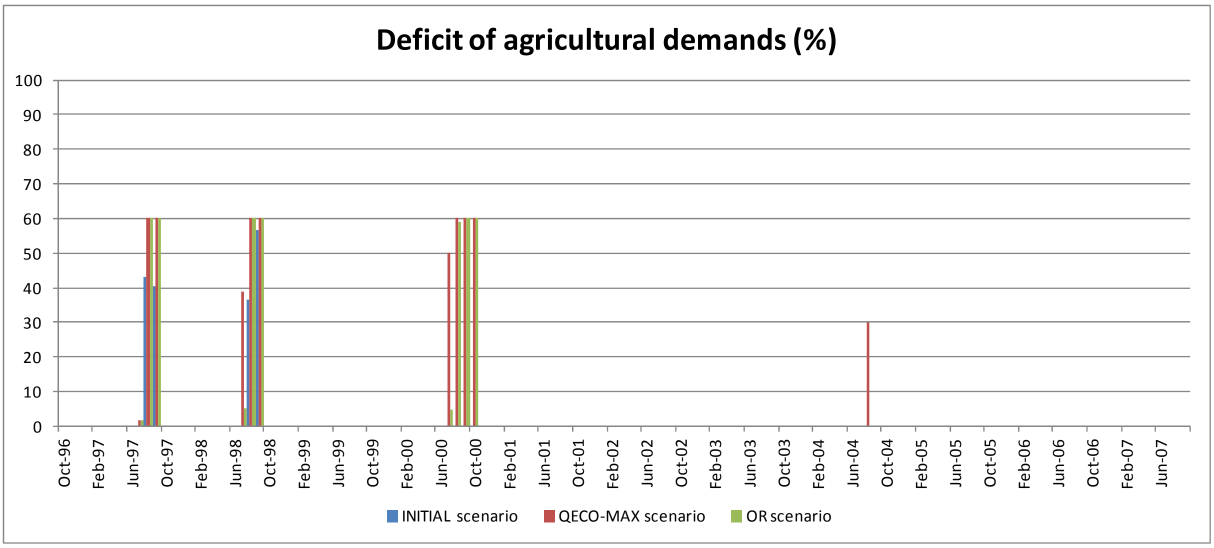


Figure 31. Total deficit of agricultural demands in % with respect to the total monthly agricultural demand in the different management scenarios.

Regarding the deficits of agricultural demands, in INITIAL scenario they are well supplied and only have deficit in the summer months of the driest years. On the contrary, QECO-MAX scenario implies much more deficits because a big part of the available water resources are required to fulfil the environmental flows. Those deficits do not comply with the legislation about agricultural demands, as they almost reach 50% of the annual demand in the hydrologic years 1997/1998 and 1999/2000, and represent more than 100% of the annual demand the first 10 years of the simulation. Again, OR scenario presents an intermediate situation and accomplish the reliability thresholds established.

4.4. Generation of water quality series in rivers and reservoirs

GESCAL is run using the results from CARFU and SIMGES in the three different environmental flows scenarios. The water quality in regulated rivers relies on the waste water management and water resources management. But at the same time, it has an effect on water management because of the requirements of the different demands about chemical composition of water resources. Besides, it influences the habitat suitability for aquatic species given that they cannot develop properly or can even die if, for instance, the dissolved oxygen is under 2-3 mg/L or the ammonium level is higher than 1-2 mg/L.

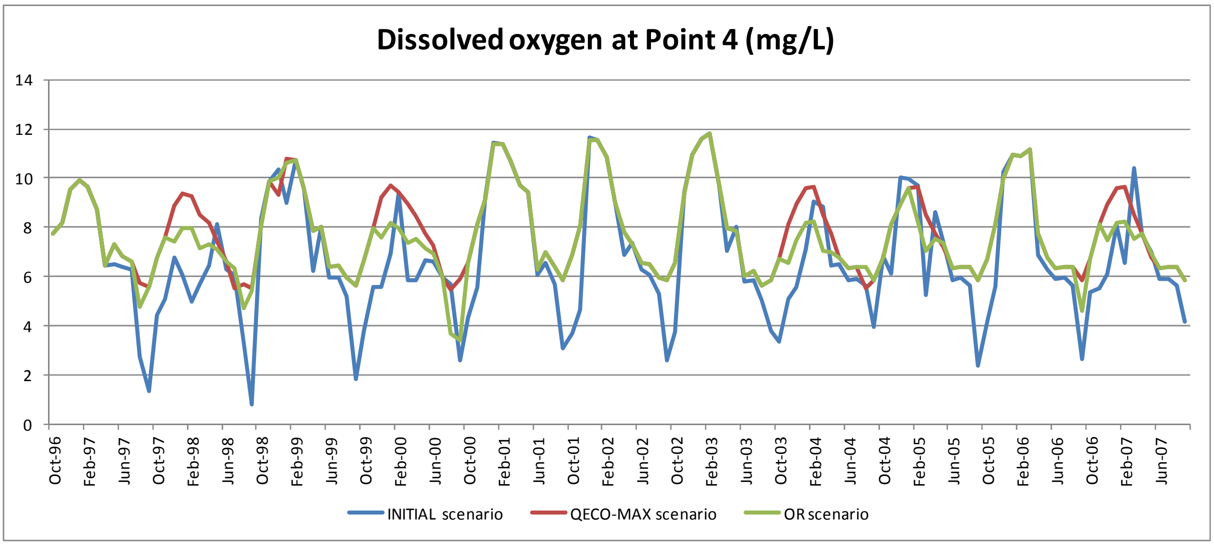


Figure 32. Dissolved oxygen concentration in mg/L at the study point 4 in the different management scenarios.

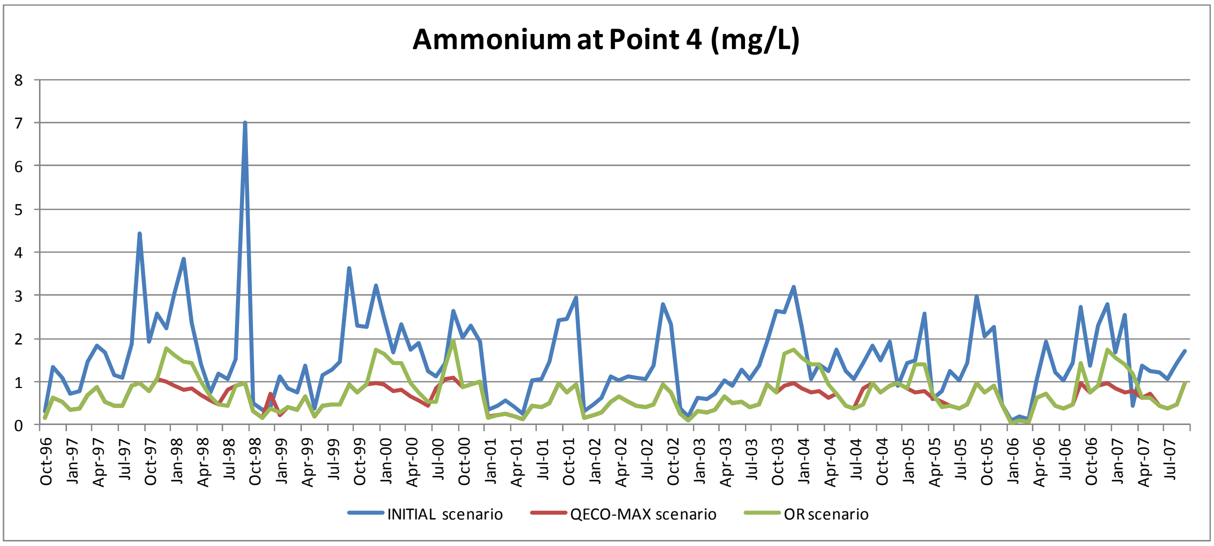


Figure 33. Ammonium concentration in mg/L at the study point 4 in the different management scenarios.

The evolution of dissolved oxygen and ammonium concentrations are presented in Figure 32 and Figure 33. Mostly due to dilution effects, the water quality is better in QECO-MAX scenario. The dissolved oxygen concentrations are always over 5 mg/L and the ammonium is under 1 mg/L, except in punctual situations. However, the water quality conditions are poor in INITIAL scenario with concentrations which do not allow any kind of aquatic life. The dissolved oxygen reaches values of 2 mg/L or even less, and the ammonium rises to 7 mg/L, going up to 3 mg/L quite often. Successfully, the conditions in OR scenario accomplish the legal prescriptions for water quality most of the time, and just breaks them in punctual situations like drought periods.

4.5. Generation of habitat time series

CAUDECO is run using the results from SIMGES in the three different environmental flows scenarios, resulting 35 HTS and 35 HDC for each scenario. This is one HTS and one HDC for each species and size class at each studied point.

In order to reduce the number of results and to obtain a representative value for the analysis of the habitat suitability for the relevant aquatic species in the region, the results are accumulated by size class and species using the minimum accumulation option. Then, there is one accumulated HTS and HDC at each studied river stretch for each scenario that shows the usable area of the most restrictive species-size class in each month.

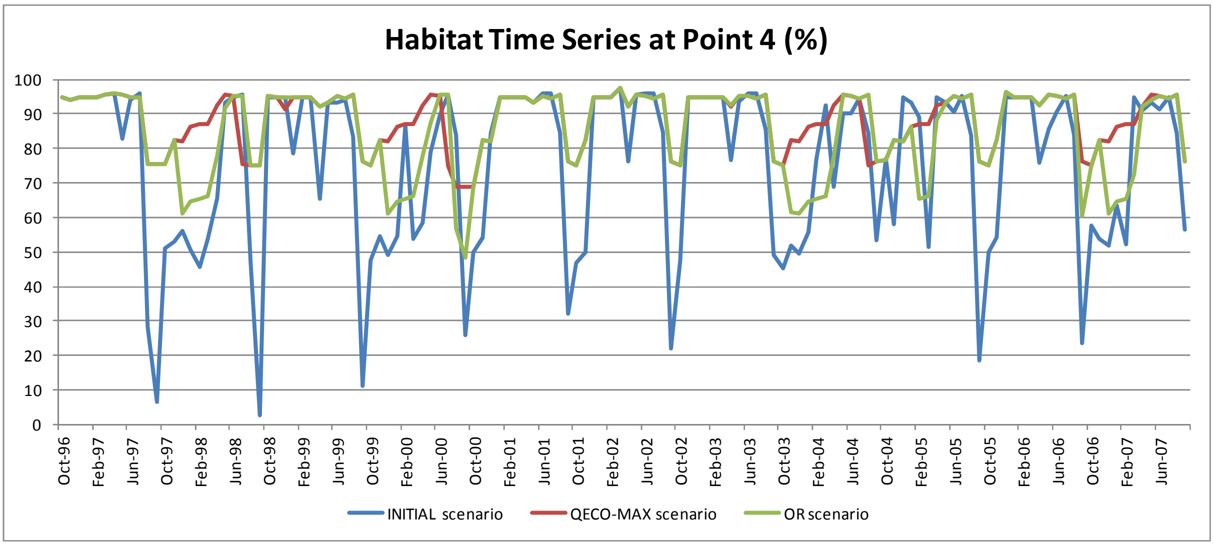


Figure 34. Habitat time series in % of the maximum weighted usable area of the most restrictive species-size class at the study point 4 in the different management scenarios.

Before analysing the HTS, it is necessary to clarify that the environmental flow regime must guarantee that the available usable area for the most restrictive species in each studied point is between 50 and 80% of the maximum in every month. Only under drought conditions it is acceptable to reduce the minimum threshold to 30% of the maximum usable area.

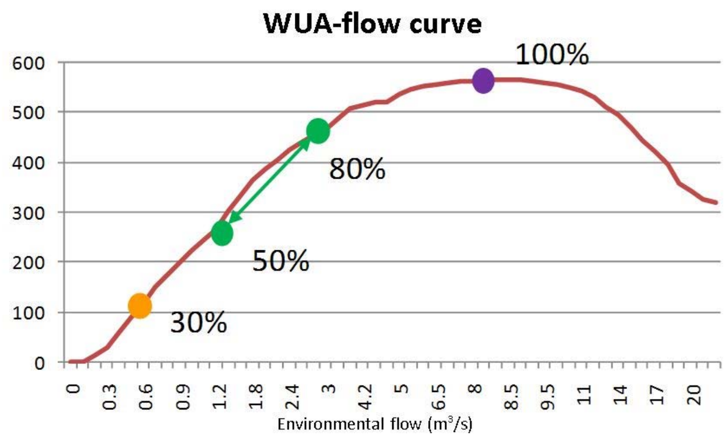


Figure 35. Example of the environmental flow criterion established by the Spanish legislation.

From Figure 34 it can be seen that in many months the usable habitat is close to 100% of the maximum; thus, the river flows potentially provide very good habitat for these fish. However, in most years of INITIAL scenario the potential habitat is reduced dramatically to less than 30% in August, September and October. Then this scenario does not accomplish the legal prescriptions. Nevertheless, in QECO-MAX scenario the usable habitat levels are excellent and always exceed 70% of the maximum usable habitat. Finally, in many months of OR scenario the HTS remain at 100%. This value only falls below the threshold of 50% in August and September of 2000, but this is acceptable in drought conditions according to the Spanish law, as explained before.

4.6. General analysis

The results presented above for the different chained models show that an increase in the environmental flows improves the water quality and the habitat suitability while it is detrimental to the supply to agricultural demands. If a similar scenario analysis was conducted with the water resources evaluation model, the results would show that a reduction in runoff leads to supply failures. Apart from that, due to the reduction of river flows, water quality and habitat availability would also worsen. In the case of the diffuse pollution evaluation model, if the waste loads increase, this affects the water quality and in some cases the management rules to avoid excessive water purification costs. After all, having knowledge about the water cycle and water resources management, it is easy to roughly deduce the consequences of a certain change in the water resources system.

But, in the actual framework of climate change (which implies a reduction in runoff and more intense droughts in Spain, according to Morán-Tejeda et al., 2010) and higher environmental awareness (translated into tougher laws for environmental flows and water quality), the questions to answer are really complex. The difficult thing is to analyse the tradeoffs between the different aspects considered with the aim of finding an intermediate solution. Besides, it can be interesting to develop more complex scenarios which imply more than one change in the system at the same time.

In this case, it is not simple to guess the interactions between the diverse facets analysed. Here is where the proposed methodology for IWRM can play an important role. The concatenation of the five models allows quantifying target variables in order to find a solution which matches all the legal specifications and satisfies the stakeholders.

An important application of this methodology is the optimisation of actual water management to produce the best feasible environmental flows in realistic water management scenarios with water right constraints in the river basin. The scenarios and some of their results have been presented in sections 4.3, 4.4 and 4.5. However, to understand the dynamic interactions between the models, it is better to present the results of all the models together for each scenario. To do so, a set of Simulation-Indicators is selected to represent in a simple way the evolution of the different objectives analysed. It includes the temporal evolution of the percentage of agricultural demand deficits as an indicator of water management, the dissolved oxygen and ammonium concentrations as indicators of water quality, and the HTS of the most affected species, large Luciobarbus bocagei at point 4, as an ecological indicator. Figure 36 shows the Simulation-Indicators at point 4 over the simulation period without defining any environmental flows in the system (INITIAL).

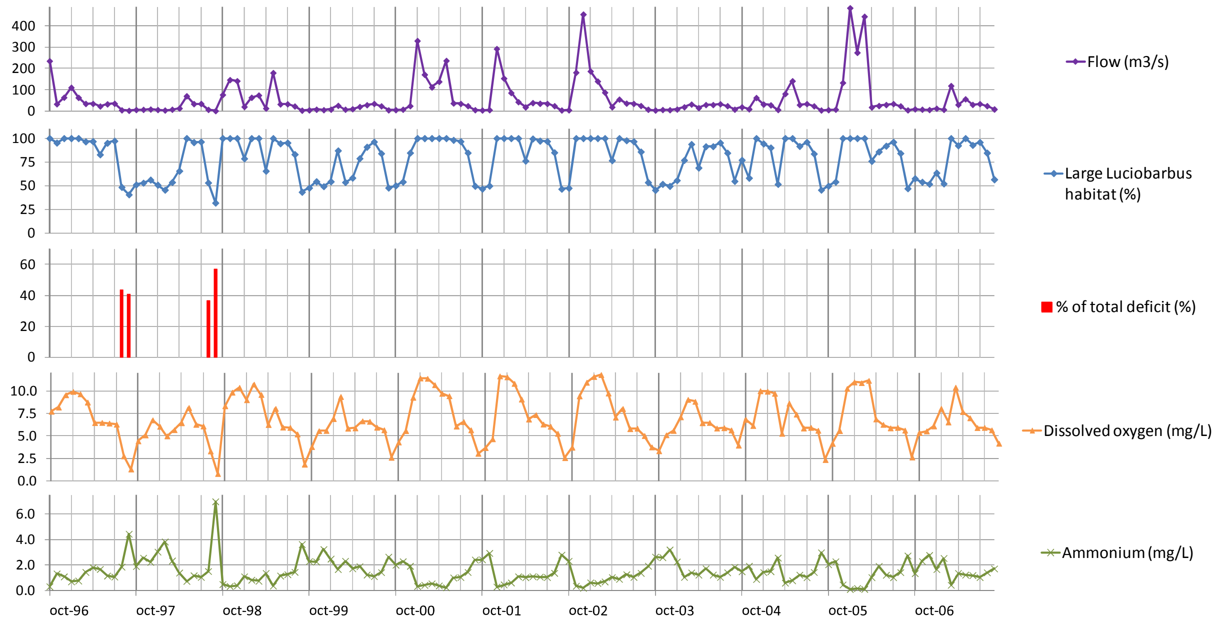


Figure 36. Simulation indicators of SIMGES, CAUDECO and GESCAL for the INITIAL scenario.

In this scenario, the deficits of demands are 30 and 60% of the monthly demand and occur during the summers of 1997 and 1998, respectively. Thus, an annual deficit of demands of 9.87% occurred, although their reliability is inside the limits established by Spanish legislation. In these periods, also the habitat suitability is affected. In many months the usable habitat is close to 100% of the maximum. Hence, the river flows potentially provide very good habitats for these fish. However, in many years, the potential habitat is reduced dramatically to less than 50% in September, October and November. That is because in these months water is not released from the reservoirs, since irrigation demands are low. In addition, the simulation model tends to store water in Santa Teresa reservoir for the future, which reduces river flows. Additionally, in these periods the water quality is poor during these months due to the reduced flow. For example, ammonium concentrations reach more than 6 mgNH_4/L and dissolved oxygen levels drop to 1 mg/L. In 1998, the most critical year, dissolved oxygen concentrations were less than 1 mg/L. Thus, aquatic life would be very difficult at any WUA level.

The same graphic for the QECO-MAX scenario (see Figure 37) presents totally different results. From this, it is clear that the decisions made about water management, deeply influence all the variables of the system, and that this kind of figures are very useful to identify the changes.

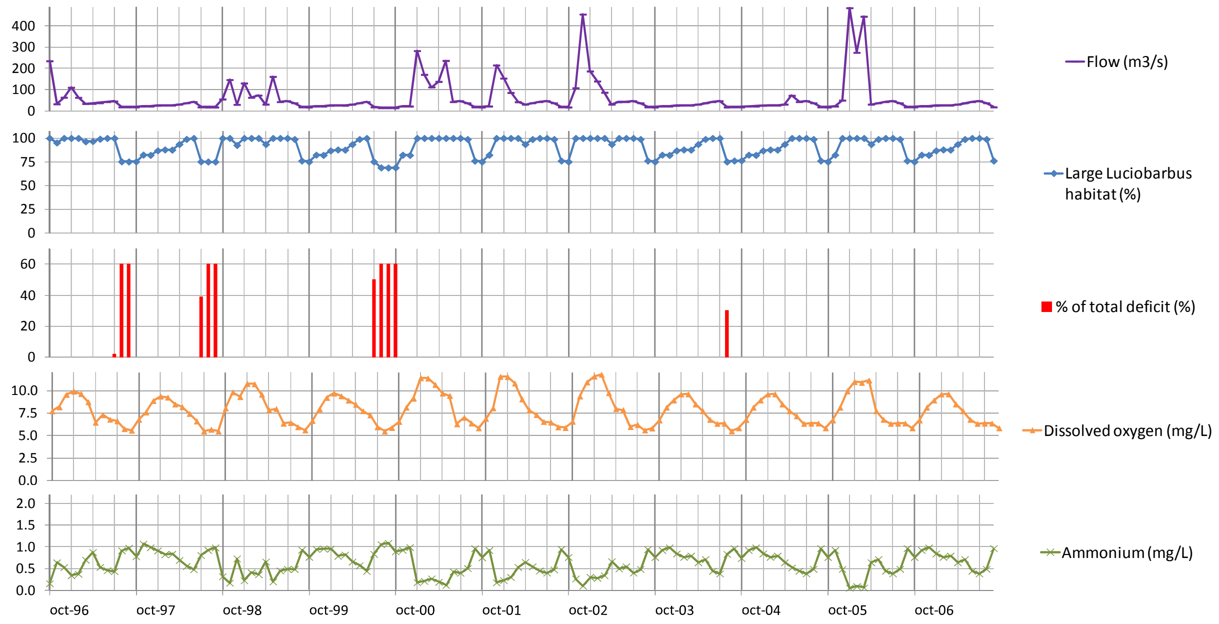


Figure 37. Simulation indicators of SIMGES, CAUDECO and GESCAL for the QECO-MAX scenario.

The results for this scenario show the impacts on the demands reliability, resilience and vulnerability. The reliability decreases due to the increasing number of deficit months. This increase implies an increment of consecutive deficit months. In addition, the deficits raise and impact the vulnerability of the agricultural demands. For example, in this scenario supply deficits occur in a non-deficit year (2000) in the INITIAL scenario. During the summer months, the deficits reach 46.47% of the required annual agricultural demand. Although this value does not meet the minimum legal supply level, 50% of the annual agricultural demand, it is very close.

The degradation of the demands reliability benefits the habitat conditions and water quality. For example, in this scenario, dissolved oxygen concentrations are greater than 5.8 mg/L in most summers and are close to 5.5 mg/L at critical time points. In addition, maximum ammonium concentrations of 1 mg/L occur, which is considered as the acceptable threshold for all types of aquatic life. The habitat conditions in the QECO-MAX scenario are excellent and always exceed 70% of the maximum usable habitat.

A set of intermediate scenarios, which combine different environmental flow levels at different basin points, can be established between INITIAL and QECO-MAX scenarios. To summarise the possible effects of environmental flows, several simulations were performed by increasing the environmental flows from 0 to 100% of the maximum at increments of

10%. To present these results it is important to use easy to understand indicators and graphics that synthesise all the information needed for informed decision making. They should explicitly show the gains and losses in each objective.

Figure 38 shows the Tradeoff-Indicators trends at point 4. In this case, the Tradeoff-Indicators include the following: the maximum percentage of the total agricultural water demand deficit (MADf), the maximum ammonium concentration and the minimum dissolved oxygen concentration during the simulation period, and the percentage to the maximum WUA that corresponds to the 80th percentile of the HTS for the most affected species, the large Luciobarbus bocagei. This last indicator represents the WUA which is exceeded 80% of the time during the simulation period (Lafayette and Loucks, 2003).

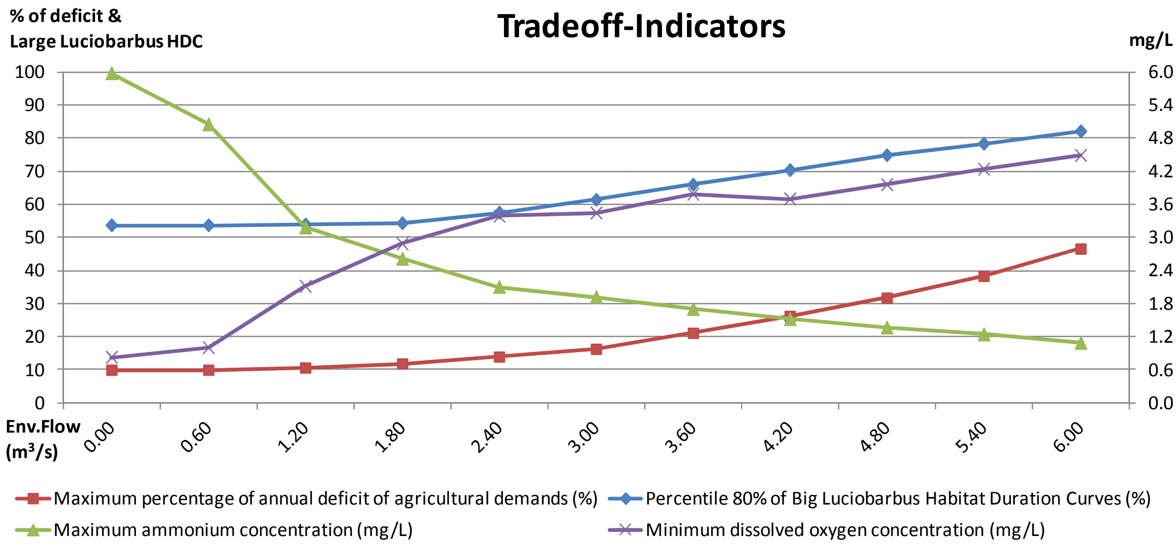


Figure 38. Tradeoff-Indicators with respect to the minimum environmental flows at point 4.

Remarkably, the 80th percentile indicator of habitat remains constant until the flow rate reaches level 3 (1.20 m^3/s). Thereafter, it begins to increase linearly. In addition, the maximum ammonium concentrations strongly decrease at the first environmental flow step. This decrease indicates that an environmental flow at or above step 3 should be chosen. According to the MADf for the irrigation demands, small incremental changes occur in the first steps. However, this indicator rapidly increases as the flow rate increases up to 3.6 m^3/s. This type of figure can help decision makers and stakeholders in the negotiation and establishment of environmental flows that maintain equilibrium among the systems essential components.

Arguably, the QECO-MAX scenario implies a loss of agricultural water demand reliability, which could lead to social and legal problems. Based on this situation, the objective is to maintain a high environmental flow during wet and normal years so that in drought years the impact is not fully absorbed by the agricultural demands. This can be achieved by reducing the environmental requirements and the water quality levels. Therefore, an operation rule is defined to reduce the releases from Villagonzalo dam (OR scenario). This operation rule decreases the environmental flows in the final stretch when the Santa Teresa reservoir inflows are below a threshold. These types of operation rules are commonly used in water system management and are easily understood by managers and stakeholders. However, the problem is complex because the inflow threshold has to be defined for each month. The operation rule selected is defined in the Duero Drought Management Plan as follows: "when the monthly inflows into the Santa Teresa reservoir in the last four months are below the 85th percentile of the historical data, then the environmental flow at *Salamanca* is reduced from *6 to 3 m^3/s*". With this method, it is possible to maintain an optimal environmental situation, where the environmental requirements are only reduced during drought periods. This last scenario provides intermediate results, what helps to balance all the aspects analysed.

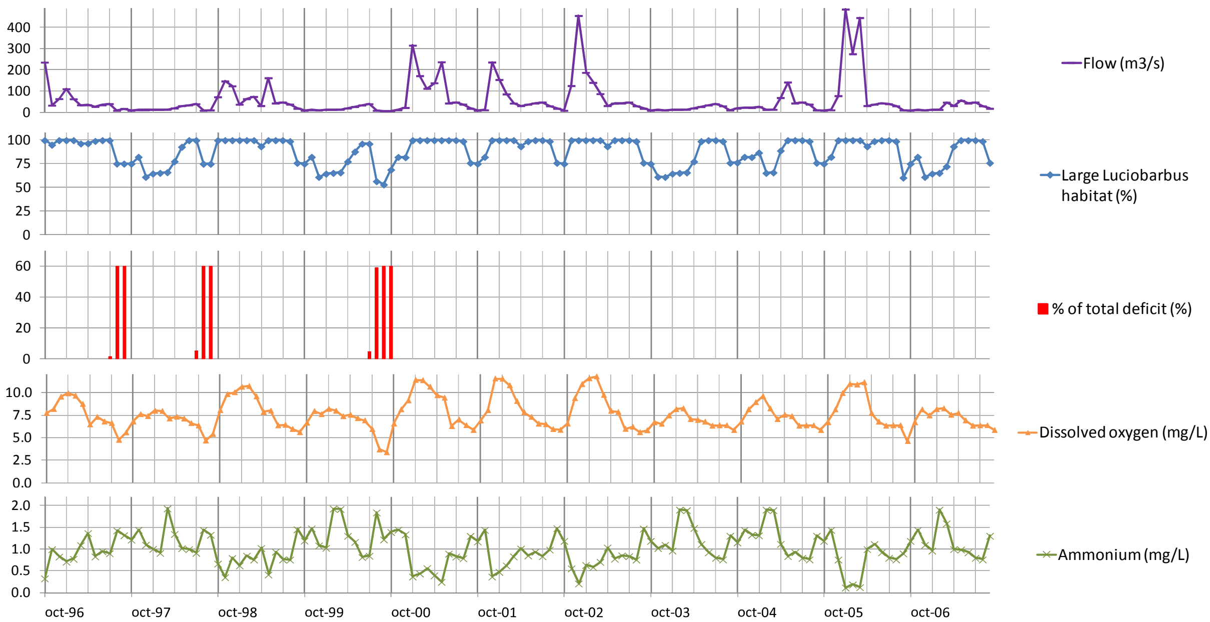


Figure 39. Simulation indicators of SIMGES, CAUDECO and GESCAL for the OR scenario.

Figure 39 presents the Simulation-Indicators for the OR scenario. Relative to the QECO-MAX scenario, the deficit of demands is reduced to a level that meets the water law prescriptions about reliabilities. In terms of HTS, many months remained at 100%. However, in some of the months of dry years the usable habitat is reduced to 60% of the maximum. This value only falls to 50% in August and September of 2000, and it is acceptable according to the Spanish legislation. Regarding water quality, dissolved oxygen concentrations during most summers are greater than 5.8 mg/L. However, in dry years dissolved oxygen approaches 4 mg/L. In these months, ammonium concentrations reach 1.95 mgNH4/L, which is acceptable because it is a punctual situation. The other constituents do not present serious problems for aquatic species.

With this analysis, it is demonstrated that the operation rule allows great habitat levels while maintaining the demand reliability. In some years, due to the application of the operation rule, the habitat values are reduced to between 55 and 80%. However, these values still meet legislation.

Finally, it is also interesting to notice that some years have low autumn and winter inflows. Thus, the OR is activated. But if the spring inflows are high and the situation improves, then the operation rule is unnecessary.

5. Proposal for Ecosystem Services analysis

As it has been demonstrated, the proposed and applied methodology offers many possibilities for decision making, but it does not take into account other relevant aspects related to environmental sustainability and the benefits that people obtain from it. Linking the ES assessment to the IWRM results provides a new standpoint, more integrative, about the effects of different actuations in a river basin.

The ES considered in the revised studies are different depending on the authors. Boyd and Banzhaf (2007) noted that the lack of a standardized definition and measurement of ES is problematic. The divergence is mainly due to the existence of two currents of thought based on the service that has to be valued. Some authors support that only the final products can be considered (Boyd and Banzhaf, 2007; Wallace, 2007); while others believe that the processes that produce the final products have to be also included in the assessment (Brauman et al., 2007; Fisher and Turner, 2008). The real distinction between final ES and processes is that the former are generally tangible entities described in terms of amount, while the latter are operations and reactions and generally described in terms of rates (Wallace, 2007). However, as stated by Costanza (2008), multiple classification systems are needed for different purposes because ecosystem goods and services, whether intermediate services or final services, are all contributors to the end of human well-being.

Currently, the most broadly accepted classification is the proposed in the Millennium Ecosystem Assessment (MEA, 2003). It considers four main categories of ES as presented in Figure 40 that include both final products and processes. It is promoted by many international organisations like the United Nations, or the World Bank. This ES assessment framework is supported by The Economics of Ecosystems and Biodiversity initiative, which aims to promote a better understanding of the true economic value of ecosystem services and to offer economic tools that take proper account of this value (TEEB, 2010).

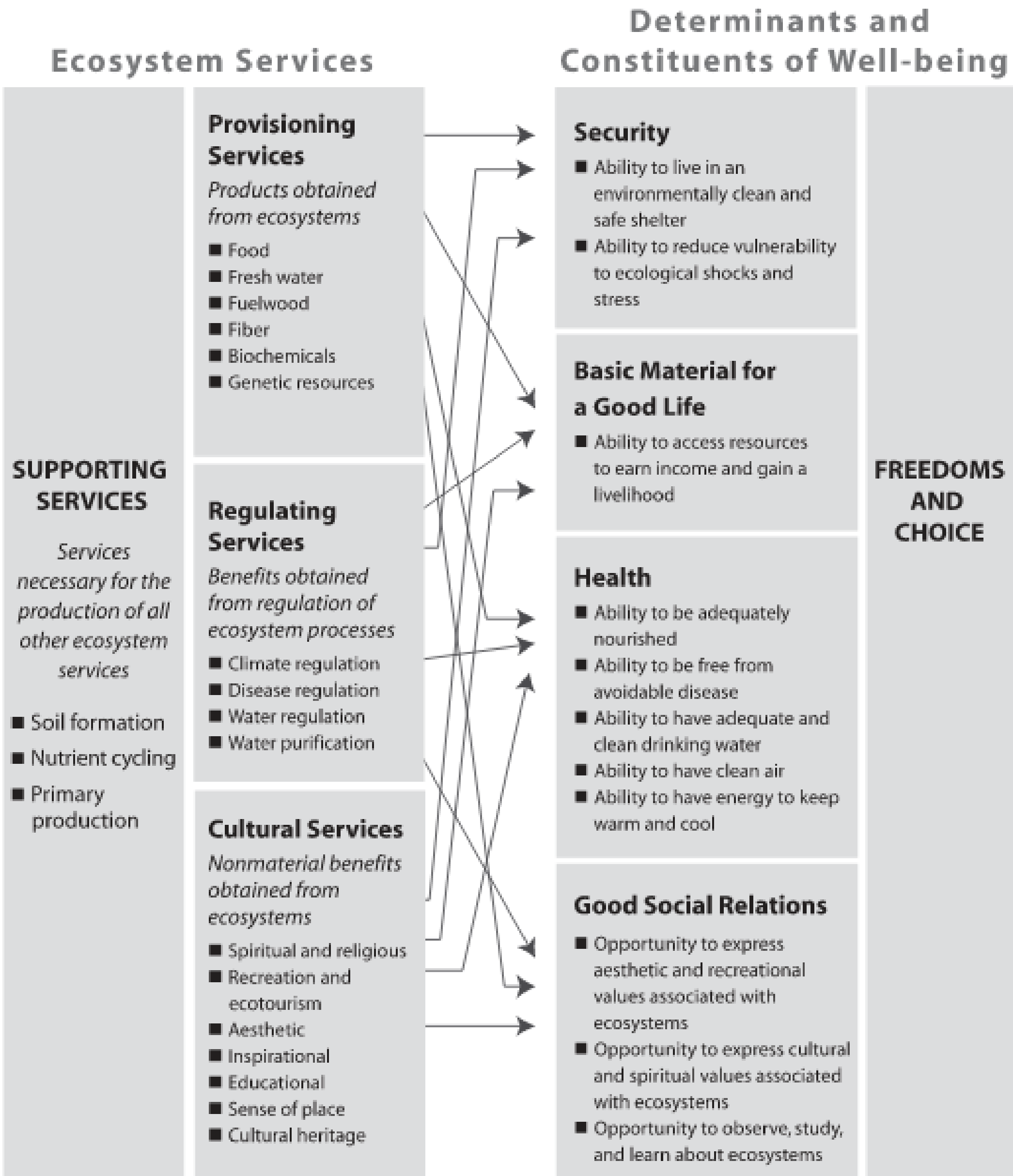


Figure 40. Services provided by ES and their linkages with human welfare (from MEA, 2003).

Since 2009, the Common International Classification of Ecosystem Services, CICES (EEA, 2013), is under development. Its goal is to propose a new standard classification of ecosystem services that is consistent with the accepted categorisations and allows easy translation of statistical information between different applications. Table 1 shows the last version available of CICES. With respect to the MEA, both classifications are very similar in essence, although the last one is more detailed and includes the supporting category into the regulating category.

CICES for ecosystem accounting			
Section	**Division**	**Group**	**Class**
Provisioning	Nutrition	Biomass	Cultivated crops
			Reared animals and their outputs
			Wild plants, algae and their outputs
			Wild animals and their outputs
			Plants and algae from in-situ aquaculture
			Animals from in-situ aquaculture
		Water	Surface water for drinking
			Ground water for drinking
	Materials	Biomass	Fibres and other materials from plants, algae and animals for direct use or processing
			Materials from plants, algae and animals for agricultural use
			Genetic materials from all biota
		Water	Surface water for non-drinking purposes
			Ground water for non-drinking purposes
	Energy	Biomass-based energy sources	Plant-based resources
			Animal-based resources
		Mechanical energy	Animal-based energy
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems
			Dilution by atmosphere, freshwater and marine ecosystems
			Mediation of smell/noise/visual impacts
	Mediation of flows	Mass flows	Mass stabilisation and control of erosion rates
			Buffering and attenuation of mass flows
		Liquid flows	Hydrological cycle and water flow maintenance
			Flood protection
		Gaseous / air flows	Storm protection
			Ventilation and transpiration
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal
			Maintaining nursery populations and habitats
		Pest and disease control	Pest control
			Disease control
		Soil formation and composition	Weathering processes
			Decomposition and fixing processes
		Water conditions	Chemical condition of freshwaters
			Chemical condition of salt waters
		Atmospheric	Global climate regulation by reduction of

CICES for ecosystem accounting			
Section	**Division**	**Group**	**Class**
		composition and climate regulation	greenhouse gas concentrations
			Micro and regional climate regulation
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings
			Physical use of land-/seascapes in different environmental settings
		Intellectual and representative interactions	Scientific
			Educational
			Heritage, cultural
			Entertainment
			Aesthetic
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes	Spiritual and/or emblematic	Symbolic
			Sacred and/or religious
		Other cultural outputs	Existence
			Bequest

Table 1. Updated version of CICES, Version 4.3 (from EEA, 2013).

In this research, only the ES related to freshwater are considered; and among them, those which can be derived from the IWRM methodology are presented. They can be named as Water Services (WS). The classification proposed is based on the above classifications, but limited to the requirements for decision making in the IWRM field. In further research, the usefulness and viability of calculating other ES will be studied.

5.1. Ecosystem Services and other indicators to be assessed

Here, only the outline of the WS assessment and valuation is presented. The development and application of this methodology will be conducted in further research.

As it has been mentioned in the introduction, some authors believe that economic valuation of ES is not a robust figure, because it varies with the valuation method applied, or with people's preferences. But, economic valuation allows presenting the results in a comparable language, understood by everybody; that is, economical units or money. Since policy decisions are often evaluated through cost-benefit assessments, an economic analysis helps to make ecosystem service research operational (Fisher et al., 2008). With this information the comparison between economic net profits of interventions in water resources systems can be directly compared with the gains or losses in WS. Referring to the variability of economic value according to social preferences, it should not be considered a weakness, but the real reflection of people's priorities at certain time, like market prices do. In fact, decision makers are part of society and if the importance of ecosystems is not well considered, they are not going to take them into account, although an ES analysis shows unbeatable results.

Then in this proposal for WS analysis, the valuation is included. But, more important than valuation is the selection of proper indicators and tradeoff graphics that clarify the results for decision making. This will be also one of the targets of forthcoming research.

5.1.1. Freshwater production for economic uses

Freshwater production is an example of linkages between provisioning and regulating services. It is referred to the magnitude of runoff, its distribution along time, and the water recharge into aquifers. All this is influenced by changes in land cover. Hence, these aspects can be assessed in each subbasin or in the whole river basin through the results of EVALHID. A useful indicator would be the total runoff generated or the duo surface runoff-recharge.

But, in order to assign an economic value to freshwater it is necessary to relate it with a certain water use: urban, agricultural, hydropower production, aquaculture, etc. Then, the performance of water management with SIMGES is required, because its results provide the amount of water supplied to every demand unit in the water resources system. Besides, it is important to distinguish between the water sources, given that each one requires a different infrastructure to be used. The simplified diagram of the process is shown in Figure 41.

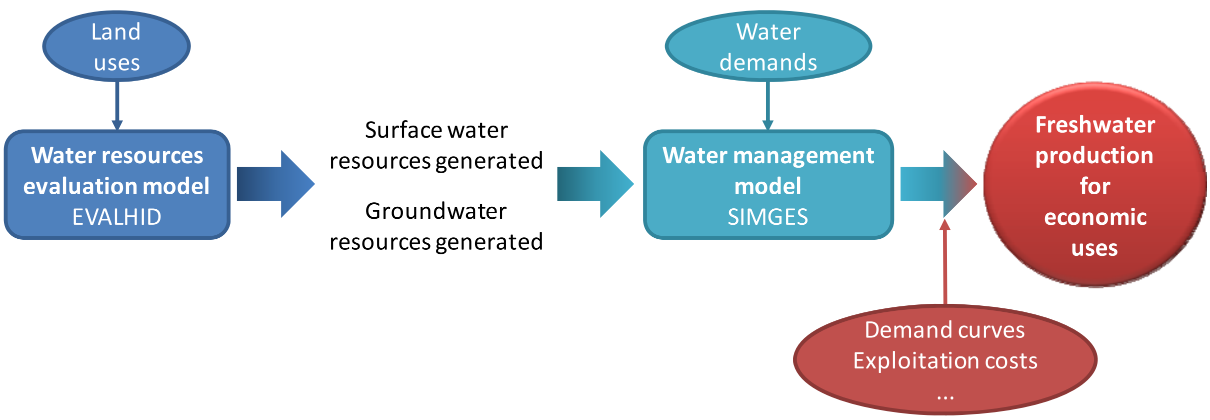


Figure 41. Diagram of the process for the assessment and valuation of Freshwater production for economic uses.

The difficulty that, initially, presents the analysis of this WS is the valuation. The value of water for the different economic uses is not a fixed value, but changes with the supplied volume according to the demand curves. These curves have to be obtained in complex specific studies and vary depending on many aspects like income, market, etc. Moreover, the costs associated to the use of the resource should be included. For instance, groundwater has to be pumped and surface water is stored in reservoirs; also, groundwater usually needs less purification treatments before its use than surface water. But deciding which costs should be consider and how to calculate them is not a trivial issue; it requires a deep economic analysis.

AQUATOOL counts with an economic module called ECOGES that allocates water in a water resources system maximising the economic benefit. This module will be used as a basis for the economical valuation of water according to its use.

5.1.2. Water storage in aquifers

Although this is not a WS separately considered in the presented frameworks, it is relevant in certain water resources system where runoff is very changing and due to technical, economical, social or environmental determinants it is not possible to build a reservoir. Big and hydraulically slow aquifers are considered underground reservoirs that nature places at humans' disposal. One of the critical functions of groundwater as a provisioning service is its storage and retention for domestic, industrial and agricultural uses (Bergkamp and Cross, 2006). So, not only the groundwater resource should be considered as a freshwater resource for economic uses, but the service of storing it for free underground.

This service is affected by alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas. Again, this WS can be assessed through the results of a water resources evaluation model like EVALHID. Apart from that, a specific model for the aquifer is needed in order to relate the recharge and pumping to the exploitable stored volume along the time.

In this case, the valuation should be based on the cost of a substituting infrastructure; that is, a reservoir with the same storage capacity. But frequently, because an aquifer is under the ground surface, it is difficult to know the real storage capacity of an aquifer. Also, the exploitable water volume depends on the recharge the aquifer receives and is limited by the pumping capabilities.

To do things more difficult, the cost of building a dam widely varies with respect to the typology of dam (embankment dam, arch dam, gravity dam, etc.), its magnitude, the features of the site where it is built, among other determinants. A rough approach would be to consider the average cost per unit of volume stored in near reservoirs. Figure 42 shows the diagram of the assessment and valuation process for this WS.

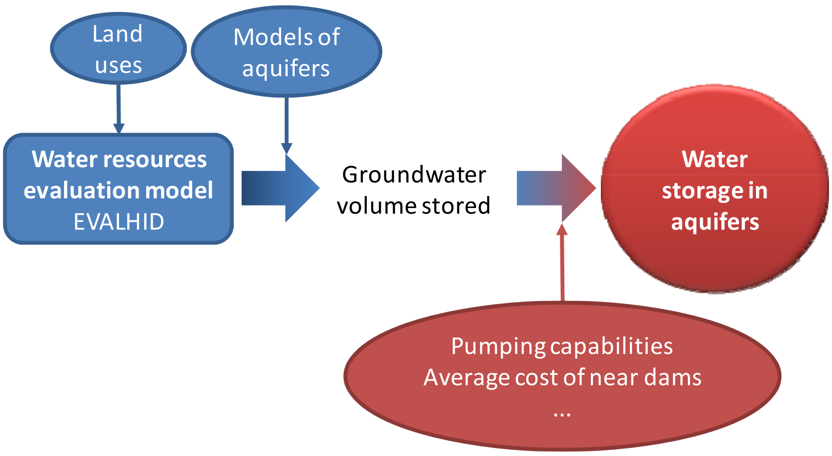


Figure 42. Diagram of the process for the assessment and valuation of Water storage in aquifers.

5.1.3. Water purification in rivers and lakes

Changing water quality affects many aspects of human well-being, and benefits and/or costs accrue to different groups of beneficiaries at varying spatial and temporal scales (Keeler et al., 2012). Ecosystems can help to filter out and decompose wastes introduced into inland water ecosystems. Then, rivers, lakes and reservoirs can be considered as natural water treatment plants due to their self-purification capacity.

The WS water purification in rivers and lakes is influenced by circulating flows in rivers, and by the stored volume and residence stage in lakes and reservoir. That means that the water management is a key factor in the water purification WS. Moreover, water temperature plays an important role in the speed of decomposition and in the dilution processes. The diffuse pollution entering the system is also relevant, because the natural recovery capacity of water quality is not the same with all levels of pollution. That is due to the affection to ecosystems that cannot develop and work properly with high levels of contamination.

The model GESCAL is suitable to quantify the water purification occurred in rivers and reservoirs. It considers the effect of water management, with the input of SIMGES, and the water temperature is considered through its interaction with air temperature and thermal stratification in reservoirs. Besides, CARFU provides the entering pollutants concentration values. Figure 43 presents the diagram for the assessment and valuation of the water purification service.

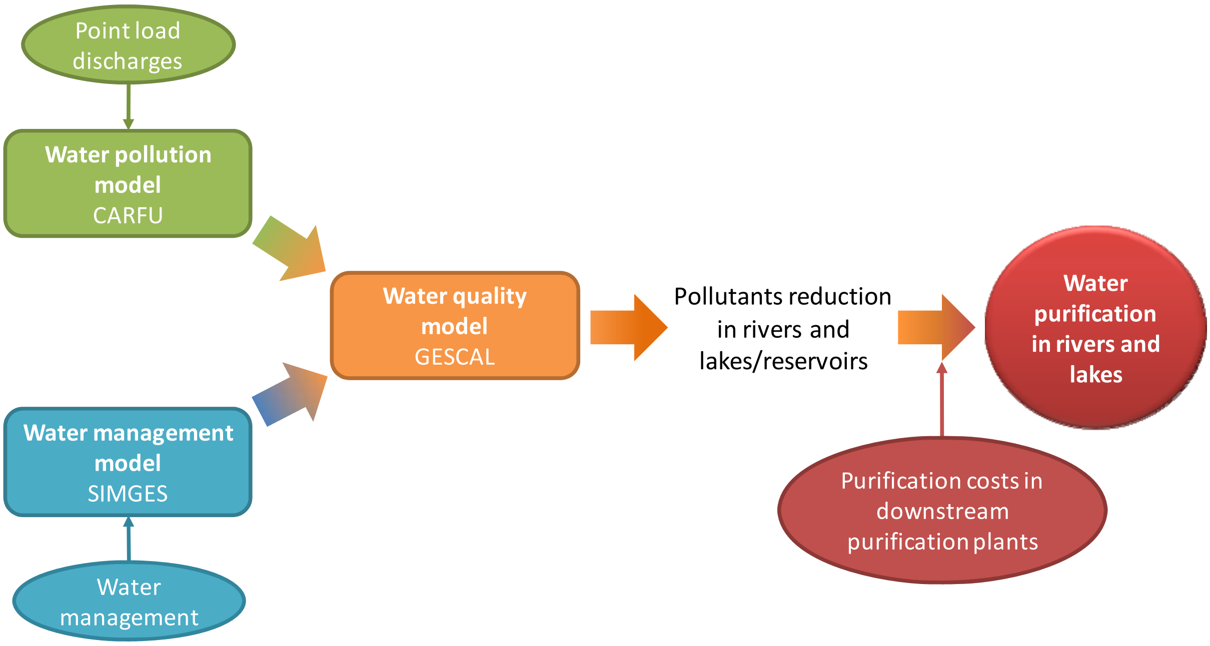


Figure 43. Diagram of the process for the assessment and valuation of Water purification in rivers and lakes.

For the valuation of this WS it has to be considered that it reduces the necessity of water purification treatments before the use of the resource. Thus, one option is to value this pollution reduction as the cost of the equivalent artificial water treatment. That means, assigning to the WS in each river stretch or reservoir the value of reducing the concentrations of pollutants from the initial to final concentration. But each water purification plant has different treatment costs depending on many factors. The proposal is to use the costs of the nearest water purification plant downstream the studied water body, because it would have to carry out the purification task if this WS did not exist.

5.1.4. Biodiversity

Biodiversity is the variability among living organisms. It includes diversity within and among species and diversity within and among ecosystems (MEA, 2003). Biodiversity is the source of food and genetic resources, and it is intimately linked to the production of other environmental services. Specifically in river systems, the biodiversity is referred to aquatic flora and fauna, and to riverbank vegetation.

It is well known that habitat modification is leading to changes in biodiversity. In fact, one of the highest ranking threats for biodiversity reduction is habitat destruction and fragmentation (Hof et al., 2011). In relation to aquatic life, enhanced river flows can improve habitat conditions and restore a diverse fish fauna reflective of a healthy riverine ecosystem (Bain et al., 2000). Besides, water quality has significant influence on aquatic biodiversity. On the other hand, riverbank vegetation is also affected by river flows (García-Arias et al., 2012) and water quality, although the lack of longitudinal continuity and extension are important factors too.

The habitat availability in rivers can be assessed with CAUDECO which reflects the water management influence performed using SIMGES. Despite the fact that in the presented application water quality is not included in the habitat suitability analysis, GESCAL can provide the pollutants concentrations that affect the target species. In order to evaluate the riverbank vegetation state, external models are needed which provide the relation between circulating flows in rivers with the dynamic of vegetation (García-Arias et al., 2012). Finally, it is important to highlight the relation between riparian vegetation and the temperature of water in rivers due to the effect of shadow. Again there is not an AQUATOOL module available to quantify it; but in case it was, the results could be used as temperature series in GESCAL.

In this case, the valuation is even more difficult that in the previous WS. While the costs of maintaining biodiversity are known – restrictions which lead to opportunity costs management costs, and transaction costs (TEEB, 2008) –, the benefits are so wide that are almost impossible to account. They include food production, genetic pool conservation, aesthetic and cultural values, etc. Hence, further research is needed to propose a rigorous valuation method for these two versions of biodiversity in rivers.

Figure 44 presents the diagram for the evaluation of the WS biodiversity. Note that only the result referred to aquatic fauna in rivers can be already assessed (not valuated) with the presented IWRM methodology.

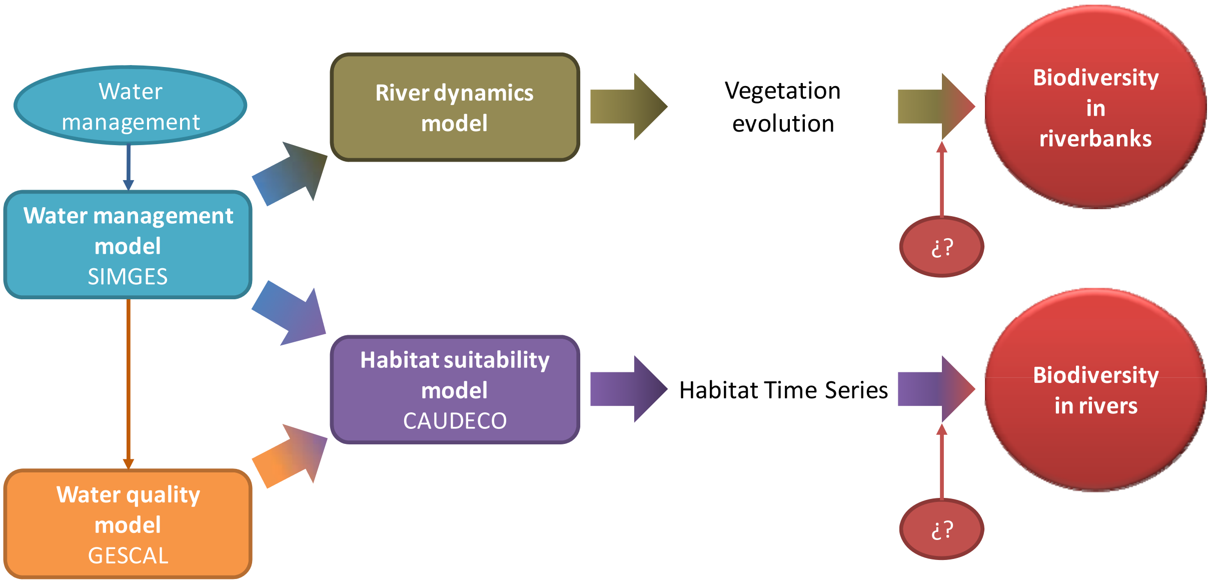


Figure 44. Diagram of the process for the assessment and valuation of Biodiversity.

5.1.5. Other indicators

As explained in the introduction, there are other indicators that can be useful to globally assess the performance of a water resources system. Moreover, they can be derived from the IWRM methodology proposed.

5.1.5.1. System of Environmental-Economic Accounting for water

The System of Environmental-Economic Accounting for Water is the most extended hybrid accounting approach. It shows in 12 tables, the quantitative and qualitative flows existing in the hydrologic system, and their connection with the economic system consistently with the System of National Accounts (UNSD, 1993). It is really difficult to apply these hybrid methodologies to a water resources system because the economical data is usually available at administrative scale, but it is not compiled at hydrological scales.

Most of the values needed to fill the 12 tables can be obtained from the results of AQUATOOL modules. The Flow Accounts include eight tables that present the physical flows of water between nature and economic uses, the emissions of pollutants, and the relation between water flows and the supply and use costs (hybrid tables). The physical tables can be derived from the results of SIMGES; the emissions tables from GESCAL and CARFU; but, the economical information of the hybrid tables cannot be directly obtained. The Asset Accounts are two, and they show the available water resources and the flows between them, which is information that results from EVALHID and SIMGES. Finally, the Quality Accounts can be mostly completed with information from GESCAL, but the Valuation Accounts need external economic information.

5.1.5.2. Water footprint

Formally, the total WF of a territory, like a river basin, is the direct and indirect water consumed inside its boundaries. That is, the “liquid water” consumed (direct WF) and the water needed to produce the goods consumed (indirect WF). Furthermore, this consumption can be analysed from the point of view of the consumer or the producer. To do things worse, in can be internal (water resources come from the territory) or external (water resources come from other territories). Then, this is a concept that has to be clearly defined before its use, because depending on the purpose or the data available it can include different concepts. Here only the direct WF of a water resources system can be assessed.

According to the above statement, the direct Blue WF is referred to the freshwater consumed by the different water uses; the external direct Blue WF accounts for the water transfers from other water resources systems. The direct Green WF measures the water consumed by plants from the non-saturated zone of soil. The direct Grey WF is defined as the volume required to dilute the pollutants from the different water uses down to the standard quality levels. That is, the direct Grey WF involves the polluted water returned after its use, instead of the consumed water.

SIMGES can provide the direct Blue WF as the difference between the supply to demands and their returns. The real evapotranspiration obtained from EVALHID is the direct Green WP. Finally, the direct Grey WF can be derived from the results of GESCAL with a simple calculation of the dilution water volume.

5.2. Methodology for Ecosystem Services analysis

5.2.1. <u>Integration of Ecosystem Services analysis and Integrated Water Resources Management (Part II)</u>

The result of the previous discussion about WS analysis and complementary indicators, and their linkage to the proposed IWRM methodology is captured in Figure 45. It can be seen that every single model contributes to the calculation of a WS or other indicator.

There are diverse analyses that can be conducted backed on the above methodology. It can be used to prioritise the protection of regions in the water resources system; or to develop policy mechanisms like government ownership or control of land, government regulations, government incentive payments, and voluntary payments (Brauman et al., 2007). More simple but not less useful is the selection of alternatives (about land uses change, demands satisfaction, etc.) which accomplish the legislation and satisfy all the stakeholders, that maximise the WS. Another approach would be the optimisation of water treatment costs, through the maximisation of the self-purification capacity of the river; or the maximisation of water resources availability analysing the influence of land uses on the different water cycle variables.

Provided that sometimes data is uncertain, and more in the case of distant future, this kind of methodology presents an opportunity to test effects of uncertainty (Wainger et al., 2010). Then the possibilities that the linkage of IWRM and ES brings are very broad and will be demonstrated in future research.

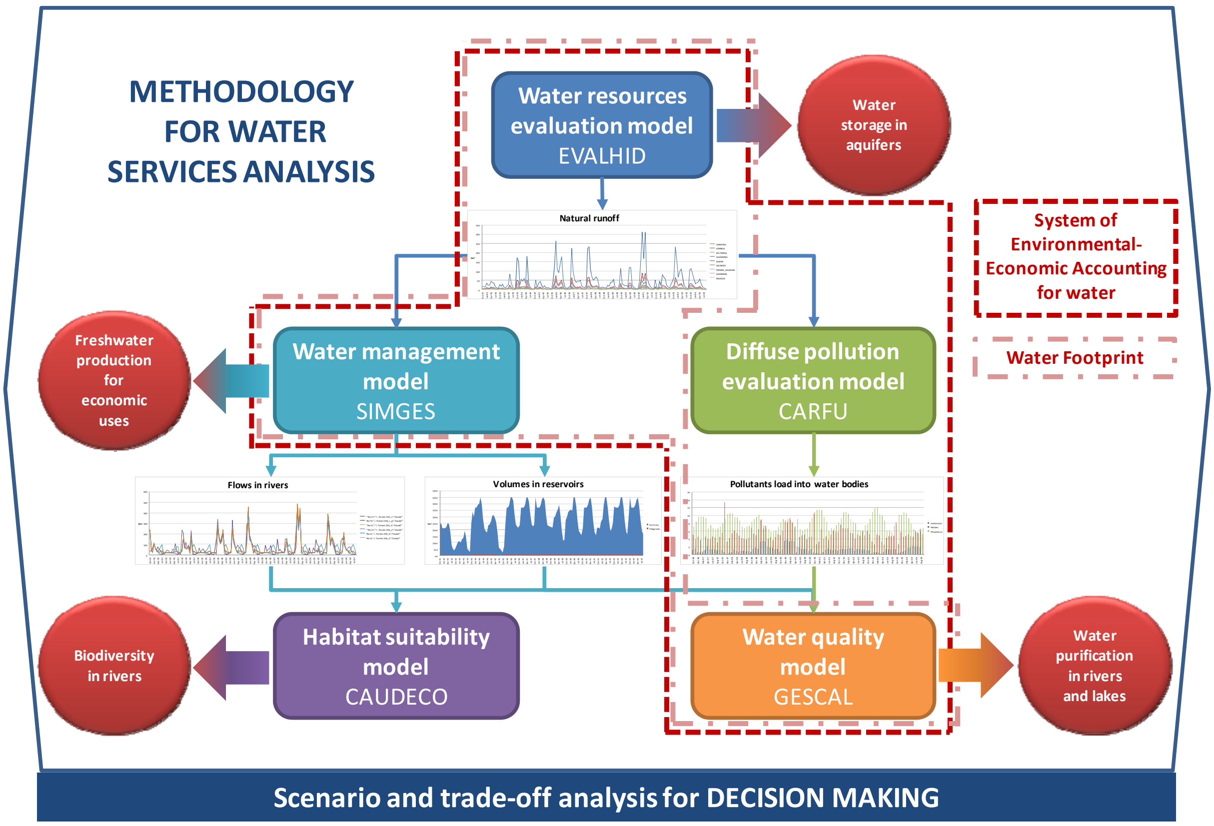


Figure 45. Diagram of the Methodology for Water Services Analysis.

5.2.2. Back to the water body

The above methodology would not be totally resourceful if it just provides the values of WS in a complete river basin. The interesting aspect is to know the contribution of each subbasin, river stretch, reservoir, etc. to the total value of a certain WS. This allows classifying the elements by their importance for WS production. Consequently, the post-processing modules necessary to apply the WS analysis methodology should include a final process to assign a part of the WS value to each element that makes it up (back to the water body). The difficulty of this process depends on the number of models chained to assess the WS.

For the water storage in aquifers it is immediate to share out the total economic value into all the subbasins proportionally to their recharge contribution. On the other hand, the water purification in rivers and lakes is calculated as the difference in concentrations at the beginning and end of each one. Then, the value of the WS in all river stretches and reservoirs or lakes is proportional do this pollution reduction.

In the case of freshwater production for economic uses, the water generated in a subbasin is subsequently managed in the water resources system. Hence, the relation between the producing subbasin and the final water use that assigns an economic value to the water resource is not so easily traceable. It is necessary to bind the total economic value of the water supplied to a demand with the different sources that serve it (each river stretch, reservoir and aquifer), and accumulate the value by water source. This can be difficult, because frequently upstream reservoirs feed the downstream ones, and aquifers also share resources by lateral transfers. Finally, the accumulated economic value in each source has to be related with the subbasins that generate the water resource.

For more complex WS like biodiversity in rivers, the process becomes noticeably difficult because it is not trivial to know which proportion of the total value is due to the water management or to the water quality, for example. A complete proposal and implementation of the back to water body will be developed in further research.

6. Conclusions

Current trends at international level, and specifically at European level, advance towards sustainable and efficient management of natural resources. It is not a matter of protectionism over nature, but the idea of knowing how nature works and where its services are more productive, to minimise the damage caused by humans' development and to take advantage of the benefits they bring. This current is expressed in the "European Water Framework Directive", the strategies "Europe 2020" and "EU biodiversity strategy to 2020", and in "A Blueprint to safeguard Europe's Water Resources", among other official documents.

However, recent research has found that appropriate and feasible methodologies for promoting environmental policy are lacking (Liu et al. 2010). In this sense, the ES assessment can help preserving healthy ecosystems, underpinning effective natural resource decisions (Wallace, 2007). Besides, IWRM supported by DSS allows considering multiple variables of a water resources system, inside the broader objective of sustainable development.

In the present work, a methodology for IWRM has been described and applied. It consists of five chained models that stand for water resources evaluation, diffuse pollution evaluation, water management, water quality modelling and habitat evaluation, in a water resources system. The fact that all the models are integrated in the DSS AQUATOOL facilitates the results transfer and allows massive simulations which are useful to perform analysis scenarios.

The application to the Tormes Water Resources System has illustrated the connection among the models and the possible tradeoff analyses that can be conducted. The implementation of all the models has highlighted the huge volume of data needed to calibrate and run them. In this case, the advantage is that the Duero River Basin Agency is already using some of the models (SIMGES and GESCAL), and has carried out the specific studies and data acquisition necessary to apply the others too. Equally important, is the fact that all these data has been lend for the purpose of this research.

The tradeoff analysis carried on presents the evolution of water quality, satisfaction of demands and habitat availability, as environmental flows change in several points of the water resources system. The result is a graphic that can be easily understood by decision makers and stakeholders, supporting sound and informed decisions. That is important because, as highlighted by Wallace (2007), successful decision-making requires identifying and involving those who should be represented in the evaluation process.

IWRM and hydrologic ES are closely related because they analyse the influence of water and land management on ecosystems. A methodology to integrate both aspects has been proposed here, and will be developed in further research. It consists on assessing the evolution of several WS, calculating their economic value and assigning them to the place where they are produced, using results from the IWRM methodology that has been demonstrated. This union entails the enrichment of the methodology for IWRM, adding to the analysis of supply to demands and environmental flows, other interesting variables to take decisions like freshwater production, water storage in aquifers, water purification and biodiversity to the multipurpose analysis. Apart from that, it has been suggested to include the water accounting and the WF as complementary indicators.

In further research, the final methods to assess the above WS, and possibly others, will be designed and applied. Also, the economic valuation methods and the process to share out the results back to the elements that generate them will be proposed and tested. The focus will be on conducting the research towards more problem-driven rather than tool-driven because ultimately the success of WS valuation will be judged on how well it facilitates real-world decision making and the conservation of natural capital (Liu et al., 2010).

7. Acknowledgments

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9. ANNEX. Additional information of the application to the Tormes Water Resources System

EVALHID

Model features:

Subbasin ID	Parameter name	Parameter value	Model
1	Hmax	0	Snow N-1
1	C	3	Snow N-1
1	Beta	3	HBV
1	FC	180	HBV
1	Pwp	105	HBV
1	Lmax	6	HBV
1	K0	0.13	HBV
1	K1	0.13	HBV
1	K2	0	HBV
1	Kperc	0.22	HBV
2	Beta	3	HBV
2	FC	180	HBV
2	Pwp	105	HBV
2	Lmax	6	HBV
2	K0	0.13	HBV
2	K1	0.13	HBV
2	K2	0	HBV
2	Kperc	0.22	HBV
3	Beta	3	HBV
3	FC	180	HBV
3	Pwp	105	HBV
3	Lmax	6	HBV
3	K0	0.13	HBV
3	K1	0.13	HBV
3	K2	0	HBV
3	Kperc	0.22	HBV
4	Beta	3	HBV
4	FC	180	HBV
4	Pwp	105	HBV
4	Lmax	6	HBV
4	K0	0.13	HBV
4	K1	0.13	HBV
4	K2	0	HBV
4	Kperc	0.22	HBV
5	Beta	3	HBV
5	FC	180	HBV
5	Pwp	105	HBV
5	Lmax	6	HBV
5	K0	0.13	HBV

Subbasin ID	Parameter name	Parameter value	Model
5	K1	0.13	HBV
5	K2	0	HBV
5	Kperc	0.22	HBV
6	Hmax	0	Snow N-1
6	C	3	Snow N-1
6	Beta	3	HBV
6	FC	180	HBV
6	Pwp	105	HBV
6	Lmax	6	HBV
6	K0	0.13	HBV
6	K1	0.13	HBV
6	K2	0	HBV
6	Kperc	0.22	HBV
7	Beta	3	HBV
7	FC	180	HBV
7	Pwp	105	HBV
7	Lmax	6	HBV
7	K0	0.13	HBV
7	K1	0.13	HBV
7	K2	0	HBV
7	Kperc	0.22	HBV
8	Beta	3	HBV
8	FC	180	HBV
8	Pwp	105	HBV
8	Lmax	6	HBV
8	K0	0.13	HBV
8	K1	0.13	HBV
8	K2	0	HBV
8	Kperc	0.22	HBV
9	Beta	3	HBV
9	FC	180	HBV
9	Pwp	105	HBV
9	Lmax	6	HBV
9	K0	0.13	HBV
9	K1	0.13	HBV
9	K2	0	HBV
9	Kperc	0.22	HBV
10	Beta	3	HBV
10	FC	180	HBV
10	Pwp	105	HBV
10	Lmax	6	HBV
10	K0	0.13	HBV
10	K1	0.13	HBV
10	K2	0	HBV
10	Kperc	0.22	HBV
11	Beta	3	HBV
11	FC	180	HBV
11	Pwp	105	HBV

Subbasin ID	Parameter name	Parameter value	Model
11	Lmax	6	HBV
11	K0	0.13	HBV
11	K1	0.13	HBV
11	K2	0	HBV
11	Kperc	0.22	HBV
12	Beta	3	HBV
12	FC	180	HBV
12	Pwp	105	HBV
12	Lmax	6	HBV
12	K0	0.13	HBV
12	K1	0.13	HBV
12	K2	0	HBV
12	Kperc	0.22	HBV
13	Beta	3	HBV
13	FC	180	HBV
13	Pwp	105	HBV
13	Lmax	6	HBV
13	K0	0.13	HBV
13	K1	0.13	HBV
13	K2	0	HBV
13	Kperc	0.22	HBV
14	Beta	3	HBV
14	FC	180	HBV
14	Pwp	105	HBV
14	Lmax	6	HBV
14	K0	0.13	HBV
14	K1	0.13	HBV
14	K2	0	HBV
14	Kperc	0.22	HBV
15	Beta	3	HBV
15	FC	180	HBV
15	Pwp	105	HBV
15	Lmax	6	HBV
15	K0	0.13	HBV
15	K1	0.13	HBV
15	K2	0	HBV
15	Kperc	0.22	HBV
16	Beta	3	HBV
16	FC	180	HBV
16	Pwp	105	HBV
16	Lmax	6	HBV
16	K0	0.13	HBV
16	K1	0.13	HBV
16	K2	0	HBV
16	Kperc	0.22	HBV
17	Beta	3	HBV
17	FC	180	HBV
17	Pwp	105	HBV

Subbasin ID	Parameter name	Parameter value	Model
17	Lmax	6	HBV
17	K0	0.13	HBV
17	K1	0.13	HBV
17	K2	0	HBV
17	Kperc	0.22	HBV
18	Beta	3	HBV
18	FC	180	HBV
18	Pwp	105	HBV
18	Lmax	6	HBV
18	K0	0.13	HBV
18	K1	0.13	HBV
18	K2	0	HBV
18	Kperc	0.22	HBV
19	Beta	3	HBV
19	FC	180	HBV
19	Pwp	105	HBV
19	Lmax	6	HBV
19	K0	0.13	HBV
19	K1	0.13	HBV
19	K2	0	HBV
19	Kperc	0.22	HBV
20	Beta	3	HBV
20	FC	180	HBV
20	Pwp	105	HBV
20	Lmax	6	HBV
20	K0	0.13	HBV
20	K1	0.13	HBV
20	K2	0	HBV
20	Kperc	0.22	HBV
21	Beta	3	HBV
21	FC	180	HBV
21	Pwp	105	HBV
21	Lmax	6	HBV
21	K0	0.13	HBV
21	K1	0.13	HBV
21	K2	0	HBV
21	Kperc	0.22	HBV
22	Beta	3	HBV
22	FC	180	HBV
22	Pwp	105	HBV
22	Lmax	6	HBV
22	K0	0.13	HBV
22	K1	0.13	HBV
22	K2	0	HBV
22	Kperc	0.22	HBV
23	Hmax	0	Snow N-1
23	C	3	Snow N-1
23	Beta	3	HBV

Subbasin ID	Parameter name	Parameter value	Model
23	FC	180	HBV
23	Pwp	105	HBV
23	Lmax	6	HBV
23	K0	0.13	HBV
23	K1	0.13	HBV
23	K2	0	HBV
23	Kperc	0.22	HBV
24	Beta	3	HBV
24	FC	180	HBV
24	Pwp	105	HBV
24	Lmax	6	HBV
24	K0	0.13	HBV
24	K1	0.13	HBV
24	K2	0	HBV
24	Kperc	0.22	HBV
25	Beta	3	HBV
25	FC	180	HBV
25	Pwp	105	HBV
25	Lmax	6	HBV
25	K0	0.13	HBV
25	K1	0.13	HBV
25	K2	0	HBV
25	Kperc	0.22	HBV
26	Hmax	0	Snow N-1
26	C	3	Snow N-1
26	Beta	3	HBV
26	FC	180	HBV
26	Pwp	105	HBV
26	Lmax	6	HBV
26	K0	0.13	HBV
26	K1	0.13	HBV
26	K2	0	HBV
26	Kperc	0.22	HBV
27	Beta	3	HBV
27	FC	180	HBV
27	Pwp	105	HBV
27	Lmax	6	HBV
27	K0	0.13	HBV
27	K1	0.13	HBV
27	K2	0	HBV
27	Kperc	0.22	HBV
28	Beta	3	HBV
28	FC	180	HBV
28	Pwp	105	HBV
28	Lmax	6	HBV
28	K0	0.13	HBV
28	K1	0.13	HBV
28	K2	0	HBV

Subbasin ID	Parameter name	Parameter value	Model
28	Kperc	0.22	HBV
29	Beta	3	HBV
29	FC	180	HBV
29	Pwp	105	HBV
29	Lmax	6	HBV
29	K0	0.13	HBV
29	K1	0.13	HBV
29	K2	0	HBV
29	Kperc	0.22	HBV
30	Beta	3	HBV
30	FC	180	HBV
30	Pwp	105	HBV
30	Lmax	6	HBV
30	K0	0.13	HBV
30	K1	0.13	HBV
30	K2	0	HBV
30	Kperc	0.22	HBV
31	Beta	3	HBV
31	FC	180	HBV
31	Pwp	105	HBV
31	Lmax	6	HBV
31	K0	0.13	HBV
31	K1	0.13	HBV
31	K2	0	HBV
31	Kperc	0.22	HBV
32	Beta	3	HBV
32	FC	180	HBV
32	Pwp	105	HBV
32	Lmax	6	HBV
32	K0	0.13	HBV
32	K1	0.13	HBV
32	K2	0	HBV
32	Kperc	0.22	HBV
33	Beta	3	HBV
33	FC	180	HBV
33	Pwp	105	HBV
33	Lmax	6	HBV
33	K0	0.13	HBV
33	K1	0.13	HBV
33	K2	0	HBV
33	Kperc	0.22	HBV
34	Beta	3	HBV
34	FC	180	HBV
34	Pwp	105	HBV
34	Lmax	6	HBV
34	K0	0.13	HBV
34	K1	0.13	HBV
34	K2	0	HBV

Subbasin ID	Parameter name	Parameter value	Model
34	Kperc	0.22	HBV
35	Beta	3	HBV
35	FC	180	HBV
35	Pwp	105	HBV
35	Lmax	6	HBV
35	K0	0.13	HBV
35	K1	0.13	HBV
35	K2	0	HBV
35	Kperc	0.22	HBV
36	Beta	3	HBV
36	FC	180	HBV
36	Pwp	105	HBV
36	Lmax	6	HBV
36	K0	0.13	HBV
36	K1	0.13	HBV
36	K2	0	HBV
36	Kperc	0.22	HBV
37	Beta	3	HBV
37	FC	180	HBV
37	Pwp	105	HBV
37	Lmax	6	HBV
37	K0	0.13	HBV
37	K1	0.13	HBV
37	K2	0	HBV
37	Kperc	0.22	HBV
38	Hmax	0	Snow N-1
38	C	3	Snow N-1
38	Beta	3	HBV
38	FC	180	HBV
38	Pwp	105	HBV
38	Lmax	6	HBV
38	K0	0.13	HBV
38	K1	0.13	HBV
38	K2	0	HBV
38	Kperc	0.22	HBV
39	Beta	3	HBV
39	FC	180	HBV
39	Pwp	105	HBV
39	Lmax	6	HBV
39	K0	0.13	HBV
39	K1	0.13	HBV
39	K2	0	HBV
39	Kperc	0.22	HBV
40	Hmax	0	Snow N-1
40	C	3	Snow N-1
40	Beta	3	HBV
40	FC	180	HBV
40	Pwp	105	HBV

Subbasin ID	Parameter name	Parameter value	Model
40	Lmax	6	HBV
40	K0	0.13	HBV
40	K1	0.13	HBV
40	K2	0	HBV
40	Kperc	0.22	HBV
41	Beta	3	HBV
41	FC	180	HBV
41	Pwp	105	HBV
41	Lmax	6	HBV
41	K0	0.13	HBV
41	K1	0.13	HBV
41	K2	0	HBV
41	Kperc	0.22	HBV
42	Beta	3	HBV
42	FC	180	HBV
42	Pwp	105	HBV
42	Lmax	6	HBV
42	K0	0.13	HBV
42	K1	0.13	HBV
42	K2	0	HBV
42	Kperc	0.22	HBV
43	Beta	3	HBV
43	FC	180	HBV
43	Pwp	105	HBV
43	Lmax	6	HBV
43	K0	0.13	HBV
43	K1	0.13	HBV
43	K2	0	HBV
43	Kperc	0.22	HBV
44	Beta	3	HBV
44	FC	180	HBV
44	Pwp	105	HBV
44	Lmax	6	HBV
44	K0	0.13	HBV
44	K1	0.13	HBV
44	K2	0	HBV
44	Kperc	0.22	HBV
45	Hmax	0	Snow N-1
45	C	3	Snow N-1
45	Beta	3	HBV
45	FC	180	HBV
45	Pwp	105	HBV
45	Lmax	6	HBV
45	K0	0.13	HBV
45	K1	0.13	HBV
45	K2	0	HBV
45	Kperc	0.22	HBV
46	Hmax	0	Snow N-1

Subbasin ID	Parameter name	Parameter value	Model
46	C	3	Snow N-1
46	Beta	3	HBV
46	FC	180	HBV
46	Pwp	105	HBV
46	Lmax	6	HBV
46	K0	0.13	HBV
46	K1	0.13	HBV
46	K2	0	HBV
46	Kperc	0.22	HBV
47	Beta	3	HBV
47	FC	180	HBV
47	Pwp	105	HBV
47	Lmax	6	HBV
47	K0	0.13	HBV
47	K1	0.13	HBV
47	K2	0	HBV
47	Kperc	0.22	HBV
48	Beta	3	HBV
48	FC	180	HBV
48	Pwp	105	HBV
48	Lmax	6	HBV
48	K0	0.13	HBV
48	K1	0.13	HBV
48	K2	0	HBV
48	Kperc	0.22	HBV
49	Hmax	0	Snow N-1
49	C	3	Snow N-1
49	Beta	3	HBV
49	FC	180	HBV
49	Pwp	105	HBV
49	Lmax	6	HBV
49	K0	0.13	HBV
49	K1	0.13	HBV
49	K2	0	HBV
49	Kperc	0.22	HBV
50	Beta	3	HBV
50	FC	180	HBV
50	Pwp	105	HBV
50	Lmax	6	HBV
50	K0	0.13	HBV
50	K1	0.13	HBV
50	K2	0	HBV
50	Kperc	0.22	HBV
51	Beta	3	HBV
51	FC	180	HBV
51	Pwp	105	HBV
51	Lmax	6	HBV
51	K0	0.13	HBV

Subbasin ID	Parameter name	Parameter value	Model
51	K1	0.13	HBV
51	K2	0	HBV
51	Kperc	0.22	HBV
52	Beta	3	HBV
52	FC	180	HBV
52	Pwp	105	HBV
52	Lmax	6	HBV
52	K0	0.13	HBV
52	K1	0.13	HBV
52	K2	0	HBV
52	Kperc	0.22	HBV
53	Hmax	0	Snow N-1
53	C	3	Snow N-1
53	Beta	3	HBV
53	FC	180	HBV
53	Pwp	105	HBV
53	Lmax	6	HBV
53	K0	0.13	HBV
53	K1	0.13	HBV
53	K2	0	HBV
53	Kperc	0.22	HBV
54	Beta	3	HBV
54	FC	180	HBV
54	Pwp	105	HBV
54	Lmax	6	HBV
54	K0	0.13	HBV
54	K1	0.13	HBV
54	K2	0	HBV
54	Kperc	0.22	HBV
55	Beta	3	HBV
55	FC	180	HBV
55	Pwp	105	HBV
55	Lmax	6	HBV
55	K0	0.13	HBV
55	K1	0.13	HBV
55	K2	0	HBV
55	Kperc	0.22	HBV
56	Beta	3	HBV
56	FC	180	HBV
56	Pwp	105	HBV
56	Lmax	6	HBV
56	K0	0.13	HBV
56	K1	0.13	HBV
56	K2	0	HBV
56	Kperc	0.22	HBV
57	Beta	3	HBV
57	FC	180	HBV
57	Pwp	105	HBV

Subbasin ID	Parameter name	Parameter value	Model
57	Lmax	6	HBV
57	K0	0.13	HBV
57	K1	0.13	HBV
57	K2	0	HBV
57	Kperc	0.22	HBV
58	Beta	3	HBV
58	FC	180	HBV
58	Pwp	105	HBV
58	Lmax	6	HBV
58	K0	0.13	HBV
58	K1	0.13	HBV
58	K2	0	HBV
58	Kperc	0.22	HBV
59	Beta	3	HBV
59	FC	180	HBV
59	Pwp	105	HBV
59	Lmax	6	HBV
59	K0	0.13	HBV
59	K1	0.13	HBV
59	K2	0	HBV
59	Kperc	0.22	HBV
60	Beta	3	HBV
60	FC	180	HBV
60	Pwp	105	HBV
60	Lmax	6	HBV
60	K0	0.13	HBV
60	K1	0.13	HBV
60	K2	0	HBV
60	Kperc	0.22	HBV
61	Beta	3	HBV
61	FC	180	HBV
61	Pwp	105	HBV
61	Lmax	6	HBV
61	K0	0.13	HBV
61	K1	0.13	HBV
61	K2	0	HBV
61	Kperc	0.22	HBV
62	Beta	3	HBV
62	FC	180	HBV
62	Pwp	105	HBV
62	Lmax	6	HBV
62	K0	0.13	HBV
62	K1	0.13	HBV
62	K2	0	HBV
62	Kperc	0.22	HBV
63	Beta	3	HBV
63	FC	180	HBV
63	Pwp	105	HBV

Subbasin ID	Parameter name	Parameter value	Model
63	Lmax	6	HBV
63	K0	0.13	HBV
63	K1	0.13	HBV
63	K2	0	HBV
63	Kperc	0.22	HBV

Table 2. Values for the parameters in all the subbasins.

CARFU

Decay constants in all water bodies:

- Initial $\text{concentration}_{CBOD}$ = 10 mg/L, k_{CBOD} = 0.01 kg/m
- Initial $\text{concentration}_{Phosphorus}$ = 0.2 mg/L, $k_{Phosphorus}$ = 0.001 kg/m

Exceptions:

Water body ID	**Water body name**	**Comments**
r. Tormes 615_c	PUENTE CONGOSTO	k_{CBOD} = 0.2 kg/m
E. Santa Teresa	EMBALSE DE SANTA TERESA	Initial concentrations: CBOD = 2 mg/L , Phosphorus = 0.02 mg/L
E. Almendra	EMBALSE DEL ALMENDRA	Initial concentrations: CBOD = 2 mg/L, Phosphorus = 0.025 mg/L. k_{CBOD} = 0.001 kg/m, $k_{Phosphorus}$ = 0.005 kg/m

Table 3. Exceptions in the decay constants and initial concentrarions of CARFU.

SIMGES

Model features:

N.NUDOS SISTEMA FISICO: 98
N. DE EMBALSES: 6
N.TRAMOS RIO TIPO 1: 73
N.TRAMOS RIO TIPO 2: 8
N.TRAMOS RIO TIPO 3: 11
N.CONDUCCIONES TIPO 4: 0
N.CONDUCCIONES TIPO 5: 0
N.APORTACIONES INTERMEDIAS: 34
N.DEMANDAS CONSUNTIVAS: 41
N.DEMANDAS NO CONSUNTIVAS: 12
N.RECARGAS ARTIFICIALES: 0
N.ACUIFEROS: 6
N.BOMBEOS ADICIONALES: 0
N.RETORNOS: 26
N.GRUPOS ISOPRIORITARIOS 7
N.INDICADORES DE RESTRICCION: 0

****
EMBALSES
****

* 1 - E. Santa Teresa
NUDO 5 NUDO VERTIDOS 5
NUMERO PRIORIDAD 5
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.0000E+00 C= 0.0000E+00
MAX. SUELTAS CONTROLADAS 1000.00
VOLUMEN INICIAL: 431.00
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL.MAXIMO 450.000 450.000 371.000 371.000 371.000 391.000 451.000 450.000 450.000 450.000
450.000 450.000
VOL.OBJET. 450.000 450.000 371.000 371.000 371.000 391.000 451.000 450.000 450.000 450.000
450.000 450.000
VOL.MINIMO 50.000 50.000 50.000 50.000 50.000 50.000 50.000 50.000 50.000 50.000 50.000
50.000
EVAP.(mm) 67.130 45.970 29.440 24.880 33.560 56.640 65.810 78.530 101.130 121.760 120.190
86.920
TABLA COTA-SUPERFICIE-VOLUMEN
COTA(m) 832.700 842.700 847.700 852.700 857.700 862.700 867.700 872.700 880.450 885.700
SUPERF(Ha) 0.000 80.000 240.000 395.000 590.000 910.000 1420.000 1680.000 2100.000 2579.000
VOLUM(Hm3) 0.000 4.000 12.000 27.860 52.000 90.000 150.000 225.000 371.212 496.000

* 2 - E. Villagonzalo
NUDO 7 NUDO VERTIDOS 7
NUMERO PRIORIDAD 5
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.0000E+00 C= 0.0000E+00
MAX. SUELTAS CONTROLADAS 1000.00
VOLUMEN INICIAL: 5.90
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL.MAXIMO 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900
VOL.OBJET. 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900 5.900
VOL.MINIMO 1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200 1.200
EVAP.(mm) 49.160 25.480 15.720 14.830 23.250 47.600 67.480 93.630 132.930 160.060 144.980
89.120
TABLA COTA-SUPERFICIE-VOLUMEN
COTA(m) 794.300 795.300 796.300 798.300 799.300 800.300 801.100 802.300 803.300 804.300
SUPERF(Ha) 0.000 8.000 17.000 36.000 48.000 62.000 78.000 104.000 132.600 208.000
VOLUM(Hm3) 0.000 0.100 0.280 0.770 1.122 1.700 2.472 3.415 4.500 5.914

* 3 - E. Almendra
NUDO 10 NUDO VERTIDOS 10
NUMERO PRIORIDAD 5
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.0000E+00 C= 0.0000E+00
MAX. SUELTAS CONTROLADAS 1000.00
VOLUMEN INICIAL: 1139.00
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL.MAXIMO 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340
2586.340 2586.340 2586.340
VOL.OBJET. 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340 2586.340
2586.340 2586.340
VOL.MINIMO 173.505 173.505 173.505 173.505 173.505 173.505 173.505 173.505 173.505 173.505
173.505 173.505
EVAP.(mm) 92.230 57.460 50.730 37.680 47.340 61.800 64.650 73.960 110.330 124.600 131.750
110.150
TABLA COTA-SUPERFICIE-VOLUMEN
COTA(m) 540.000 640.000 658.000 676.000 685.000 694.000 703.000 712.000 721.000 730.000
SUPERF(Ha) 0.000 347.000 1050.000 1538.000 1920.000 2555.000 3342.000 4483.000 5884.000 7940.000

VOLUM(Hm3) 0.000 173.500 310.090 532.180 687.750 889.180 1154.520 1506.640 1973.120 2586.350

* 4 - E. Riolobos
NUDO 12 NUDO VERTIDOS 12
NUMERO PRIORIDAD 5
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.0000E+00 C= 0.0000E+00
MAX. SUELTAS CONTROLADAS 1000.00
VOLUMEN INICIAL: 10.00
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL.MAXIMO 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870
VOL.OBJET. 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870 13.870
VOL.MINIMO 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
EVAP.(mm) 47.990 24.870 15.350 14.480 22.690 46.460 65.860 91.390 129.750 156.230 141.510 86.980
TABLA COTA-SUPERFICIE-VOLUMEN
COTA(m) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 78.000
SUPERF(Ha) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 387.000
VOLUM(Hm3) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 13.880

* 5 - E. Irueña
NUDO 61 NUDO VERTIDOS 61
NUMERO PRIORIDAD 1
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.0000E+00 C= 0.1000E+01
MAX. SUELTAS CONTROLADAS 1000.00
VOLUMEN INICIAL: 0.00
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL.MAXIMO 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
VOL.OBJET. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
VOL.MINIMO 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
EVAP.(mm) 88.890 55.370 48.890 36.310 45.620 59.550 62.300 71.280 106.330 120.080 126.970 106.150
TABLA COTA-SUPERFICIE-VOLUMEN
COTA(m) 1.000 2.000 3.000 4.000 5.000 6.000 7.000 8.000 10.000 100.000
SUPERF(Ha) 0.000 10.000 20.000 30.000 40.000 50.000 60.000 70.000 80.000 100.000
VOLUM(Hm3) 0.000 10.000 20.000 30.000 40.000 50.000 60.000 70.000 80.000 110.000

* 6 - E. Águeda
NUDO 64 NUDO VERTIDOS 64
NUMERO PRIORIDAD 1
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.0000E+00 C= 0.1000E+01
MAX. SUELTAS CONTROLADAS 1000.00
VOLUMEN INICIAL: 12.00
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL.MAXIMO 22.431 22.431 22.431 22.431 22.431 22.431 22.431 22.431 22.431 22.431 22.431 22.431
VOL.OBJET. 8.000 8.000 8.000 8.000 8.000 8.000 8.000 8.000 8.000 8.000 8.000 8.000
VOL.MINIMO 5.000 5.000 5.000 5.000 5.000 5.000 5.000 5.000 5.000 5.000 5.000 5.000
EVAP.(mm) 70.960 33.460 28.460 23.600 34.450 54.560 69.630 92.640 152.360 172.060 166.950 118.640
TABLA COTA-SUPERFICIE-VOLUMEN
COTA(m) 605.000 607.000 609.000 613.000 619.000 623.000 627.000 631.000 632.000 635.000
SUPERF(Ha) 0.000 7.000 14.000 30.000 57.000 79.000 105.000 132.000 140.000 177.000
VOLUM(Hm3) 0.000 0.200 0.400 1.300 3.700 6.400 9.380 14.300 15.700 22.431

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CONDUCCIONES
****

TIPO: 1
============
* 1 - r. tormes 642
NUDO INIC. 1   NUDO FINAL   2   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 2 - r. tormes 412_a
NUDO INIC. 10   NUDO FINAL   15   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 3 - C1-12
NUDO INIC. 12   NUDO FINAL   0   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 4 - salidas sistema
NUDO INIC. 15   NUDO FINAL   0   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 5 - r.Tormes 614_a
NUDO INIC. 2   NUDO FINAL   16   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 6 - r. Tormes 614_b
NUDO INIC. 16   NUDO FINAL   17   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 7 - r. Tormes 614_c
NUDO INIC. 17   NUDO FINAL   3   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.
CAUD.MIN.   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
CAUD.MAX.   10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 8 - r. Tormes 615_a
NUDO INIC. 3   NUDO FINAL   4   I. COSTE: 0   COSTE: 0.0
OCTUBR.   NOVIEM.   DICIEM.   ENERO   FEBRERO   MARZO   ABRIL   MAYO   JUNIO   JULIO   AGOSTO
SEPTIE.

CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 9 - r. Corneja 624
NUDO INIC. 18 NUDO FINAL 4 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 10 - r.Tormes 615_b
NUDO INIC. 4 NUDO FINAL 19 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 11 - r. Tormes 615_c
NUDO INIC. 19 NUDO FINAL 20 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 12 - r. Tormes 615_d
NUDO INIC. 20 NUDO FINAL 21 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 13 - r. Tormes 615_e
NUDO INIC. 21 NUDO FINAL 22 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 14 - r. Tormes 615_f
NUDO INIC. 22 NUDO FINAL 5 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 15 - r. Tormes 568_a
NUDO INIC. 5 NUDO FINAL 23 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 16 - r. Tormes 568_b
NUDO INIC. 23 NUDO FINAL 6 I. COSTE: 0 COSTE: 0.0

OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 17 - r. Tormes 568_c
NUDO INIC. 6 NUDO FINAL 24 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 18 - r. Tormes 568_d
NUDO INIC. 24 NUDO FINAL 25 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 19 - r. Tormes 568_e
NUDO INIC. 25 NUDO FINAL 26 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 20 - r. Tormes 569_a
NUDO INIC. 26 NUDO FINAL 27 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 21 - r. Tormes 569_b
NUDO INIC. 27 NUDO FINAL 28 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 22 - r. Tormes 569_c
NUDO INIC. 28 NUDO FINAL 29 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 23 - r. Tormes 569_d
NUDO INIC. 29 NUDO FINAL 30 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 24 - r. Tormes 569_e
NUDO INIC. 30 NUDO FINAL 31 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 25 - r. Tormes 569_f
NUDO INIC. 31 NUDO FINAL 32 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 26 - r. Tormes 569_g
NUDO INIC. 32 NUDO FINAL 33 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 27 - r. Tormes 682_a
NUDO INIC. 33 NUDO FINAL 34 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 28 - r. Tormes 682_b
NUDO INIC. 34 NUDO FINAL 35 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 29 - r. Tormes 682_c
NUDO INIC. 35 NUDO FINAL 7 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 30 - r. Tormes 545_a
NUDO INIC. 7 NUDO FINAL 36 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 31 - Trasvase río Lobos
NUDO INIC. 7 NUDO FINAL 12 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 32 - r. Tormes 545_c
NUDO INIC. 8 NUDO FINAL 37 I. COSTE: 0 COSTE: 0.0
PRIORIDAD: 1 UMBRAL DEF 0.010
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 15.600 18.564 19.188 20.748 20.748 19.812 23.244 22.308 17.472 15.600 15.600 15.600
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 33 - r. Tormes 546_b
NUDO INIC. 13 NUDO FINAL 14 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 34 - r. Tormes 546_c
NUDO INIC. 14 NUDO FINAL 38 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 35 - r. Tormes 546_a
NUDO INIC. 37 NUDO FINAL 13 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 36 - r. Tormes 680_c
NUDO INIC. 39 NUDO FINAL 40 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 37 - r. Tormes 680_d
NUDO INIC. 40 NUDO FINAL 41 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 38 - r. Tormes 680_e
NUDO INIC. 41 NUDO FINAL 42 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 39 - r. Tormes 502_a

NUDO INIC. 42 NUDO FINAL 43 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 40 - r. Tormes 502_b
NUDO INIC. 43 NUDO FINAL 44 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 41 - r. Tormes 503_a
NUDO INIC. 45 NUDO FINAL 46 I. COSTE: 0 COSTE: 0.0
PRIORIDAD: 1 UMBRAL DEF 0.010
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 15.600 18.600 19.200 20.700 20.700 19.800 23.200 22.300 17.500 15.600 15.600
15.600
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 42 - r. Tormes 503_c
NUDO INIC. 47 NUDO FINAL 48 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 43 - r. Tormes 503_d
NUDO INIC. 48 NUDO FINAL 49 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 44 - r. Tormes 503_b
NUDO INIC. 46 NUDO FINAL 47 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 45 - r. Tormes 504_a
NUDO INIC. 49 NUDO FINAL 50 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000

* 46 - r. Tormes 504_b
NUDO INIC. 50 NUDO FINAL 51 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 47 - r. Tormes 505_a
NUDO INIC. 52 NUDO FINAL 53 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 48 - r. Tormes 505_b
NUDO INIC. 53 NUDO FINAL 54 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 49 - r. Tormes 505_c
NUDO INIC. 54 NUDO FINAL 55 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 50 - r. Tormes 505_d
NUDO INIC. 55 NUDO FINAL 56 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 51 - r. Tormes 505_e
NUDO INIC. 56 NUDO FINAL 10 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 52 - Huebra 513_b
NUDO INIC. 58 NUDO FINAL 57 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 53 - Huebra 513_c
NUDO INIC. 57 NUDO FINAL 0 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 54 - Huebra 513_a
NUDO INIC. 59 NUDO FINAL 58 I. COSTE: 0 COSTE: 0.0

OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 55 - Águeda 687
NUDO INIC. 60 NUDO FINAL 61 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 56 - Águeda 626_a
NUDO INIC. 61 NUDO FINAL 62 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 57 - Águeda 626_b
NUDO INIC. 62 NUDO FINAL 63 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 58 - Agadón 617
NUDO INIC. 65 NUDO FINAL 64 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 59 - Águeda 606
NUDO INIC. 64 NUDO FINAL 66 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 60 - Águeda 626_c
NUDO INIC. 63 NUDO FINAL 64 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 61 - Águeda 522_a
NUDO INIC. 67 NUDO FINAL 68 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 62 - Arroyo Pasiles 607
NUDO INIC. 70 NUDO FINAL 69 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 63 - Águeda 524
NUDO INIC. 71 NUDO FINAL 72 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 64 - Águeda 525
NUDO INIC. 72 NUDO FINAL 0 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 65 - Aravalle 643
NUDO INIC. 73 NUDO FINAL 16 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 66 - Yeltes 538_586
NUDO INIC. 75 NUDO FINAL 74 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 67 - Rio Valmuza 518-520
NUDO INIC. 11 NUDO FINAL 54 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 68 - Agueda_522_b
NUDO INIC. 68 NUDO FINAL 77 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 69 - Agueda_522_c
NUDO INIC. 77 NUDO FINAL 69 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 70 - Agueda_522_d
NUDO INIC. 69 NUDO FINAL 78 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 71 - Agueda_523_a
NUDO INIC. 78 NUDO FINAL 79 I. COSTE: 0 COSTE: 0.0
PRIORIDAD: 1 UMBRAL DEF 0.010
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 2.500 2.500 2.500 2.500 2.500 2.500 2.500 2.500 2.500 2.500 2.500 2.500
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 72 - Agueda523_b
NUDO INIC. 79 NUDO FINAL 71 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

* 73 - Yeltes538_b
NUDO INIC. 80 NUDO FINAL 59 I. COSTE: 0 COSTE: 0.0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000

TIPO: 2
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* 1 - Rec Lluvia 12.03
NUDO INIC. 83 NUDO FINAL 81
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 3 N. ACCION ELEM. 1

* 2 - Transf Lateral 12.03 a 12.05
NUDO INIC. 82 NUDO FINAL 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 4 N. ACCION ELEM. 1

* 3 - Rec. Lluvia 12.05
NUDO INIC. 84 NUDO FINAL 85

OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 4 N. ACCION ELEM. 1

* 4 - Rec. Lluvia 12.02
NUDO INIC. 86 NUDO FINAL 76
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 2 N. ACCION ELEM. 0

* 5 - Rec. Lluvia 12.04
NUDO INIC. 88 NUDO FINAL 89
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 6 N. ACCION ELEM. 1

* 6 - f. Transf. lateral b. 12.04 a
NUDO INIC. 90 NUDO FINAL 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 4 N. ACCION ELEM. 1

* 7 - f. Rec. Lluvia 12.01
NUDO INIC. 87 NUDO FINAL 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 1 N. ACCION ELEM. 1

* 8 - f. Transf. Lateral2 12.05 a 08
NUDO INIC. 91 NUDO FINAL 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
COEF. FORMULA INFILTRACION: A= 0.0000E+00 B= 0.1000E+01 C= 0.1000E+01
ACUIFERO 5 N. ACCION ELEM. 1

TIPO: 3
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* 1 - Águeda 521_g

NUDO INIC. 66 NUDO FINAL 67
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
ACUIFERO 1 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 10%

* 2 - Huebra 535_g
NUDO INIC. 76 NUDO FINAL 59
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
ACUIFERO 1 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 30%

* 3 - Yeltes538_a_g
NUDO INIC. 74 NUDO FINAL 80
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
ACUIFERO 1 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 60%

* 4 - r. Tormes 680_a_g
NUDO INIC. 38 NUDO FINAL 9
PRIORIDAD: 1 UMBRAL DEF 0.010
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 20.000 20.000 20.000 20.000 20.000 20.000 20.000 20.000 20.000 20.000 20.000 20.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
ACUIFERO 3 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 30%

* 5 - r. Tormes 502_c_g
NUDO INIC. 44 NUDO FINAL 45
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
ACUIFERO 3 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 30%

* 6 - r. Tormes 504_c_g
NUDO INIC. 51 NUDO FINAL 52
PRIORIDAD: 1 UMBRAL DEF 0.010
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 18.200 22.568 22.386 25.844 26.572 26.390 30.394 28.756 20.566 18.200 18.200 18.200
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
ACUIFERO 3 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 34%

* 7 - Transf. Lateral 12.05
NUDO INIC. 81 NUDO FINAL 82
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000
ACUIFERO 3 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 5%

* 8 - r. Tormes 680_b_g
NUDO INIC. 9 NUDO FINAL 39
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000
ACUIFERO 4 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 15%

* 9 - f. Transf. Lateral 12.04 a 12.
NUDO INIC. 89 NUDO FINAL 90
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000
ACUIFERO 6 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 5%

* 10 - r. Tormes 545_b_g
NUDO INIC. 36 NUDO FINAL 8
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000
ACUIFERO 6 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 94%

* 11 - f. Transf. lateral1 12.05 a 08
NUDO INIC. 85 NUDO FINAL 91
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MIN. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CAUD.MAX. 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000 10000.000
10000.000 10000.000 10000.000
ACUIFERO 4 N. ACCION ELEM. 1 N.PARAMETRO CONTROL: 2 VALOR CONEXIÓN 85%

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DEMANDAS CONSUNTIVAS
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* 1 - DA (5001) RP Cabecera Río Torm
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.016 0.002 0.013 0.020 0.048 0.164 0.285 0.505 0.980 1.252 1.002 0.245
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5001) RP Cabecera Río To
NUDO 1 DOT.ANUAL 5.000 C.ESCORR. 0.50 C.CONSUMO 0.32 ELEM.RET. 2 COTA 0.00
N.PRIORID. 10 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.016 0.002 0.013 0.020 0.048 0.164 0.285 0.505 0.980 1.252 1.002 0.245

* 2 - DA (5002) RP Río Tormes Alto

OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.031 0.006 0.036 0.065 0.196 0.632 1.315 2.471 4.059 5.067 3.563 0.585
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5002) RP Río Tormes Alto
NUDO 2 DOT.ANUAL 20.672 C.ESCORR. 0.58 C.CONSUMO 0.27 ELEM.RET. 24 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 0.031 0.006 0.036 0.065 0.196 0.632 1.315 2.471 4.059 5.067 3.563 0.585

* 3 - DA (5003) RP Río Aravalle
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.034 0.007 0.040 0.072 0.217 0.700 1.455 2.734 4.491 5.605 3.942 0.647
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5003) RP Río Aravalle
NUDO 73 DOT.ANUAL 21.607 C.ESCORR. 0.54 C.CONSUMO 0.30 ELEM.RET. 24 COTA 0.00
N.PRIORID. 0 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 0.034 0.007 0.040 0.072 0.217 0.700 1.455 2.734 4.491 5.605 3.942 0.647

* 4 - DA (5004) RP Río Tormes
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.021 0.004 0.025 0.045 0.135 0.434 0.903 1.697 2.788 3.480 2.447 0.402
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5004) RP Río Tormes
NUDO 3 DOT.ANUAL 14.100 C.ESCORR. 0.57 C.CONSUMO 0.28 ELEM.RET. 3 COTA 0.00
N.PRIORID. 10 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 0.021 0.004 0.025 0.045 0.135 0.434 0.903 1.697 2.788 3.480 2.447 0.402

* 5 - DA (5005) RP Río Corneja
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.016 0.003 0.018 0.033 0.099 0.319 0.662 1.245 2.045 2.552 1.795 0.295
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5005) RP Río Corneja
NUDO 18 DOT.ANUAL 9.838 C.ESCORR. 0.49 C.CONSUMO 0.33 ELEM.RET. 3 COTA 0.00

N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.016 0.003 0.018 0.033 0.099 0.319 0.662 1.245 2.045 2.552 1.795 0.295

* 6 - DA (5006) ZR La Maya
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.086 0.016 0.100 0.180 0.542 1.744 3.626 6.814 11.194 13.972 9.826 1.614
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5006) ZR La Maya
NUDO 5 DOT.ANUAL 500.000 C.ESCORR. 0.33 C.CONSUMO 0.48 ELEM.RET. 13 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.086 0.016 0.100 0.180 0.542 1.744 3.626 6.814 11.194 13.972 9.826 1.614

* 7 - DA (5007) ZR Elevación Aldearr
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.014 0.002 0.016 0.030 0.090 0.288 0.600 1.126 1.850 2.308 1.624 0.266
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5007) ZR Elevación Aldea
NUDO 6 DOT.ANUAL 500.000 C.ESCORR. 0.19 C.CONSUMO 0.61 ELEM.RET. 13 COTA 0.00
N.PRIORID. 10 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.014 0.002 0.016 0.030 0.090 0.288 0.600 1.126 1.850 2.308 1.624 0.266

* 8 - DA (5008) ZR Ejeme-Galisancho
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.068 0.014 0.080 0.146 0.436 1.408 2.926 5.498 9.032 11.274 7.928 1.302
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5008) ZR Ejeme-Galisanch
NUDO 26 DOT.ANUAL 500.000 C.ESCORR. 0.65 C.CONSUMO 0.24 ELEM.RET. 25 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.068 0.014 0.080 0.146 0.436 1.408 2.926 5.498 9.032 11.274 7.928 1.302

* 9 - DA (5009) ZR Alba de Tormes
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.014 0.002 0.016 0.030 0.092 0.294 0.612 1.150 1.888 2.358 1.658 0.272
ACUIFERO RECARGADO 6 N. ACCION ELEM. 1
COEF. GARANTIAS:

GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5009) ZR Alba de Tormes
NUDO 32 DOT.ANUAL 500.000 C.ESCORR. 0.25 C.CONSUMO 0.52 ELEM.RET. 26 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 0.014 0.002 0.016 0.030 0.092 0.294 0.612 1.150 1.888 2.358 1.658 0.272

* 10 - DA (5010) ZR Almar y Vega de A
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.044 0.008 0.052 0.092 0.278 0.898 1.866 3.506 5.758 7.188 5.054 0.830
ACUIFERO RECARGADO 6 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5010) ZR Almar y Vega de
NUDO 7 DOT.ANUAL 500.000 C.ESCORR. 0.14 C.CONSUMO 0.61 ELEM.RET. 9 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 0.044 0.008 0.052 0.092 0.278 0.898 1.866 3.506 5.758 7.188 5.054 0.830

* 11 - DA (5011) ZR Babilafuente-Vil
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.576 0.112 0.676 1.218 3.648 11.760 24.450 45.950 75.472 94.208 66.252 10.882
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5011) ZR Babilafuente-Vi
NUDO 7 DOT.ANUAL 500.000 C.ESCORR. 0.47 C.CONSUMO 0.37 ELEM.RET. 9 COTA 0.00
N.PRIORID. 10 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 0.576 0.112 0.676 1.218 3.648 11.760 24.450 45.950 75.472 94.208 66.252 10.882

* 12 - DA (5012) ZR Florida-Liébana
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.036 0.006 0.042 0.074 0.222 0.716 1.490 2.800 4.600 5.740 4.038 0.664
ACUIFERO RECARGADO 3 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5012) ZR Florida-Liébana
NUDO 42 DOT.ANUAL 500.000 C.ESCORR. 0.26 C.CONSUMO 0.51 ELEM.RET. 11 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0

OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.036 0.006 0.042 0.074 0.222 0.716 1.490 2.800 4.600 5.740 4.038 0.664

* 13 - DA (5013) ZR Villamayor
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.020 0.004 0.024 0.042 0.126 0.406 0.846 1.590 2.612 3.260 2.292 0.376
ACUIFERO RECARGADO 3 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5013) ZR Villamayor
NUDO 45 DOT.ANUAL 500.000 C.ESCORR. 0.25 C.CONSUMO 0.56 ELEM.RET. 11 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.020 0.004 0.024 0.042 0.126 0.406 0.846 1.590 2.612 3.260 2.292 0.376

* 14 - DA (5014) ZR Zorita
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.022 0.004 0.026 0.046 0.136 0.440 0.916 1.722 2.830 3.532 2.484 0.408
ACUIFERO RECARGADO 3 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5014) ZR Zorita
NUDO 46 DOT.ANUAL 500.000 C.ESCORR. 0.57 C.CONSUMO 0.30 ELEM.RET. 11 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.022 0.004 0.026 0.046 0.136 0.440 0.916 1.722 2.830 3.532 2.484 0.408

* 15 - DA (5015) ZR Campo de Ledesma
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.003 0.001 0.003 0.006 0.017 0.056 0.117 0.219 0.360 0.450 0.316 0.052
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5015) ZR Campo Ledesma
NUDO 10 DOT.ANUAL 1.600 C.ESCORR. 0.25 C.CONSUMO 0.56 ELEM.RET. 0 COTA 0.00
N.PRIORID. 10 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.003 0.001 0.003 0.006 0.017 0.056 0.117 0.219 0.360 0.450 0.316 0.052

* 16 - DA (5016) RP Cabecera Río Yelt
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.028 0.010 0.027 0.116 0.285 0.749 1.084 1.183 0.673 0.138
ACUIFERO RECARGADO 2 N. ACCION ELEM. 1

COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5016) RP Cabecera Río Ye
NUDO 75 DOT.ANUAL 4.675 C.ESCORR. 0.70 C.CONSUMO 0.19 ELEM.RET. 22 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.000	0.000	0.028	0.010	0.027	0.116	0.285	0.749	1.084	1.183	0.673	0.138

* 17 - DA (5017) RP Cabecera Río Águe

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.000	0.000	0.012	0.004	0.011	0.048	0.118	0.312	0.451	0.491	0.278	0.057

COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5017) RP Cabecera Río Ág
NUDO 60 DOT.ANUAL 2.000 C.ESCORR. 0.33 C.CONSUMO 0.44 ELEM.RET. 21 COTA 0.00
N.PRIORID. 0 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.000	0.000	0.012	0.004	0.011	0.048	0.118	0.312	0.451	0.491	0.278	0.057

* 18 - DA (5018) RP Río Agadón

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.000	0.000	0.014	0.005	0.013	0.058	0.143	0.377	0.545	0.593	0.336	0.069

COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5018) RP Río Agadón
NUDO 65 DOT.ANUAL 2.300 C.ESCORR. 0.25 C.CONSUMO 0.50 ELEM.RET. 20 COTA 0.00
N.PRIORID. 0 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.000	0.000	0.014	0.005	0.013	0.058	0.143	0.377	0.545	0.593	0.336	0.069

* 19 - DA (5019) ZR MI Águeda

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.000	0.000	0.194	0.068	0.186	0.794	1.965	5.197	7.506	8.171	4.626	0.951

ACUIFERO RECARGADO 1 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5019) ZR MI Águeda
NUDO 64 DOT.ANUAL 32.017 C.ESCORR. 0.84 C.CONSUMO 0.10 ELEM.RET. 19 COTA 0.00
N.PRIORID. 2 IND.RESTR. 0

OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.194 0.068 0.186 0.794 1.965 5.197 7.506 8.171 4.626 0.951

* 20 - DA (5020) RP 1ª Elevación MD Á
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.012 0.004 0.012 0.050 0.123 0.326 0.471 0.512 0.290 0.060
ACUIFERO RECARGADO 1 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5020) RP 1ª Elevación MD
NUDO 66 DOT.ANUAL 2.012 C.ESCORR. 0.22 C.CONSUMO 0.51 ELEM.RET. 18 COTA 0.00
N.PRIORID. 2 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.012 0.004 0.012 0.050 0.123 0.326 0.471 0.512 0.290 0.060

* 21 - DA (5021) RP 2ª Elevación MD Á
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.009 0.003 0.008 0.036 0.089 0.236 0.340 0.371 0.210 0.043
ACUIFERO RECARGADO 1 N. ACCION ELEM. 1
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5021) RP 2ª Elevación MD
NUDO 68 DOT.ANUAL 1.444 C.ESCORR. 0.64 C.CONSUMO 0.24 ELEM.RET. 16 COTA 0.00
N.PRIORID. 2 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.009 0.003 0.008 0.036 0.089 0.236 0.340 0.371 0.210 0.043

* 22 - DA (5022) RP Arroyo Pasiles
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.003 0.001 0.003 0.013 0.032 0.085 0.123 0.134 0.076 0.016
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5022) RP Arroyo Pasiles
NUDO 70 DOT.ANUAL 0.513 C.ESCORR. 0.25 C.CONSUMO 0.51 ELEM.RET. 16 COTA 0.00
N.PRIORID. 0 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.003 0.001 0.003 0.013 0.032 0.085 0.123 0.134 0.076 0.016

* 23 - DA (5023) RP Río Águeda Bajo
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.008 0.003 0.007 0.032 0.079 0.209 0.302 0.328 0.186 0.038
COEF. GARANTIAS:

GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DA (5023) RP Río Águeda Bajo
NUDO 71 DOT.ANUAL 1.266 C.ESCORR. 0.25 C.CONSUMO 0.50 ELEM.RET. 15 COTA 0.00
N.PRIORID. 2 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.000	0.000	0.008	0.003	0.007	0.032	0.079	0.209	0.302	0.328	0.186	0.038

* 24 - DU Ab Barco de Ávila

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031

COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DU Barco de Ávila
NUDO 1 DOT.ANUAL 0.400 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 4 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031

* 25 - DU Ab Guijuelo

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228

COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T. DU. Ab. Guijuelo
NUDO 5 DOT.ANUAL 30.000 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 13 COTA 0.00
N.PRIORID. 10 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500

* 26 - DU Ab Ledesma

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008

COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T. DU. Ab. Ledesma
NUDO 55 DOT.ANUAL 30.000 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 12 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010

* 27 - DU Ab Salamanca
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 2.083 2.009 2.083 2.083 1.887 2.083 2.009 2.083 2.009 2.083 2.083 2.009
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 2
TOMA: 1-T. DU. Ab. Salamanca
NUDO 9 DOT.ANUAL 22.500 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 10 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 1.904 1.837 1.904 1.904 1.725 1.904 1.837 1.904 1.837 1.904 1.904 1.837
TOMA: 2-T.DU. Salamanca desde Villagon
NUDO 7 DOT.ANUAL 2.200 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 10 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.179 0.172 0.179 0.179 0.162 0.179 0.172 0.179 0.172 0.179 0.179 0.172

* 28 - DU Abastec, golf Zarapicos y D
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T. DU Abastecimiento , golf Za
NUDO 47 DOT.ANUAL 0.000 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 12 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 29 - DU Abastecimiento
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.111 0.107 0.111 0.111 0.100 0.111 0.107 0.111 0.107 0.111 0.111 0.107
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DU Abastecimiento
NUDO 58 DOT.ANUAL 4.000 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 14 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.320 0.308 0.320 0.320 0.290 0.320 0.308 0.320 0.308 0.320 0.320 0.308

* 30 - DU Ciudad Rodrigo
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.213 0.205 0.213 0.213 0.213 0.213 0.213 0.213 0.213 0.213 0.213 0.213

COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 2.0% 2A: 3.0% 10A: 10.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DU Ciudad Rodrigo
NUDO 67 DOT.ANUAL 3.528 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 17 COTA 0.00
N.PRIORID.*** IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294

* 31 - DI Planta Bioetanol

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066

COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T. DI. Pl. Bioetanol
NUDO 13 DOT.ANUAL 30.000 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 1 COTA 0.00
N.PRIORID. 20 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066

* 32 - DI Zona Salamanca

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

COEF. GARANTIAS:
GAR.MENS.: 0.0%
CRITERIO TIPO P.H.: M.: 30.0% A.: 15.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T. DI Zona Salamanca
NUDO 9 DOT.ANUAL 31.000 C.ESCORR. 0.80 C.CONSUMO 0.20 ELEM.RET. 10 COTA 0.00
N.PRIORID. 20 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.030	0.000	0.000	0.000	0.000	0.000	0.040	0.160	0.200	0.250	0.220	0.100

* 33 - DP Gestiones e Inversiones Gra

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	5.520	5.520	5.520	5.520	5.520	5.520	5.520	5.520	5.520	5.520	5.520	5.520

COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DP Gestiones e Inversiones G
NUDO 27 DOT.ANUAL 70.000 C.ESCORR. 0.95 C.CONSUMO 0.05 ELEM.RET. 6 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.

CAUD.MAX. 5.520 5.520 5.520 5.520 5.520 5.520 5.520 5.520 5.520 5.520 5.520 5.520

* 34 - DP Las Veguillas
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DP Las Veguillas
NUDO 24 DOT.ANUAL 10.000 C.ESCORR. 0.95 C.CONSUMO 0.05 ELEM.RET. 5 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000

* 35 - DP Zorita Illana
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DP Zorita Illana
NUDO 29 DOT.ANUAL 80.000 C.ESCORR. 0.95 C.CONSUMO 0.05 ELEM.RET. 7 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070 5.070

* 36 - DP Zorita Illana (Alba de Tor
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-T DP Zorita Illana (Alba de T
NUDO 34 DOT.ANUAL 60.000 C.ESCORR. 0.95 C.CONSUMO 0.05 ELEM.RET. 8 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.MAX. 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140 4.140

* 37 - Bomb MAS 63 (Ciudad Rodrigo)
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
VOL DEM : 0.000 0.000 0.000 0.000 0.000 0.002 0.004 0.010 0.015 0.016 0.009 0.002
ACUIFERO RECARGADO 1 N. ACCION ELEM. 1
ACUIFERO BOMBEO 1 N. ACCION ELEM. 1 Q MAX BOMBEO 0.100
PARAM.CONT 0 UMBRAL : 0.000
COEF. GARANTIAS:
GAR.MENS.: 1.0%

CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-Toma Bomb MAS 63 (Ciudad Rodri
NUDO 66 DOT.ANUAL 0.058 C.ESCORR. 0.00 C.CONSUMO 0.75 ELEM.RET. 0 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 38 - Bomb MAS 59 (San Esteban)
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.000 0.000 0.020 0.007 0.020 0.084 0.207 0.548 0.791 0.861 0.487 0.100
ACUIFERO RECARGADO 2 N. ACCION ELEM. 1
ACUIFERO BOMBEO 2 N. ACCION ELEM. 1 Q MAX BOMBEO 0.870
PARAM.CONT 0 UMBRAL : 0.000
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-f. Toma Bomb MAS 59 (San Esteb
NUDO 74 DOT.ANUAL 3.125 C.ESCORR. 0.00 C.CONSUMO 0.75 ELEM.RET. 23 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 39 - Bomb MAS 52 (La Armuña)
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.041 0.008 0.048 0.086 0.257 0.827 1.719 3.231 5.308 6.625 4.659 0.765
ACUIFERO RECARGADO 3 N. ACCION ELEM. 1
ACUIFERO BOMBEO 3 N. ACCION ELEM. 1 Q MAX BOMBEO 6.700
PARAM.CONT 0 UMBRAL : 0.000
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-f. Toma Bomb MAS 52 (La Armuña
NUDO 82 DOT.ANUAL 0.000 C.ESCORR. 0.00 C.CONSUMO 0.75 ELEM.RET. 0 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.MAX. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 40 - Bomb MAS 52 (Alba Tormes-Peñar
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
VOL DEM : 0.022 0.004 0.026 0.047 0.140 0.451 0.938 1.763 2.895 3.614 2.541 0.417
ACUIFERO RECARGADO 6 N. ACCION ELEM. 1
ACUIFERO BOMBEO 6 N. ACCION ELEM. 1 Q MAX BOMBEO 4.000
PARAM.CONT 0 UMBRAL : 0.000
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%

CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-f. Toma Bomb MAS 52 (Alba Torm
NUDO 90 DOT.ANUAL 14.487 C.ESCORR. 0.00 C.CONSUMO 0.75 ELEM.RET. 0 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* 41 - Bomb MAS 52 (acuífero profundo

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
VOL DEM :	0.011	0.002	0.013	0.023	0.070	0.226	0.469	0.881	1.448	1.807	1.271	0.209

ACUIFERO RECARGADO 3 N. ACCION ELEM. 1
ACUIFERO BOMBEO 4 N. ACCION ELEM. 1 Q MAX BOMBEO 1.900
PARAM.CONT 0 UMBRAL : 0.000
COEF. GARANTIAS:
GAR.MENS.: 1.0%
CRITERIO TIPO P.H.: M.: 15.0% A.: 30.0%
CRIT.TIPO UTAH DWR: 1A: 50.0% 2A: 75.0% 10A: 100.0%
CRIT. IPH2008 DEMANDA URBANA: 1m: 8.%; 10a: 10.%
N. TOMAS 1
TOMA: 1-f. Toma Bomb MAS 52 (acuífero
NUDO 84 DOT.ANUAL 0.000 C.ESCORR. 0.00 C.CONSUMO 0.75 ELEM.RET. 0 COTA 0.00
N.PRIORID. 1 IND.RESTR. 0

	OCTUBR.	NOVIEM.	DICIEM.	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIE.
CAUD.MAX.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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RETORNOS
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NO.	NOMBRE	NUDO
1	Ret. Pl. Bioetanol	14
2	Ret. RP Cabecera Río Tormes	2
3	Ret. RP Río Tormes y Río Corne	4
4	Ret. DU Barco de Ávila	17
5	Ret DP Las Veguillas	25
6	Ret DP Gestiones e Inversiones	28
7	Ret DP Zorita Illana	30
8	Ret DP Zorita Illana (Alba de	35
9	Ret Aguas Abajo del Almar	13
10	Ret Salamanca El Marín	43
11	Ret. ag. abajo Salamanca	52
12	Ret. ag. arriba Almendra	56
13	Ret AgAbStaTeresa	24
14	Ret. Abastecimiento	57
15	Ret. RP Río Águeda Bajo	72
16	Ret. RP 2ª Elevación MD Águeda	69
17	Ret. Ciudad Rodrigo	68
18	Ret. RP 1ª Elevación MD Águeda	67
19	Ret. ZR MI Águeda	68
20	Ret. RP Río Agadón	64
21	Ret. RP Cabecera Río Águeda	61
22	Ret. RP Cabecera Río Yeltes	74
23	Retorno Bomb MAS 59	59
24	Ret Río Tormes Alto	16
25	Ret Ejeme-Galisancho	32
26	Ret E. Villagonzalo	7

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CENTRALES HIDROELECTRICAS
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* 1 - CH Villarino
NUDO TOMA 10 NUDO VERTIDOS 15 CAUD.MAX. 602.640 CAUD.MIN. 0.000 PRIORIDAD: 15
CENTRAL FLUYENTE SALTO BRUTO: 402.17 COEF.PROD.(GWH/(HM3.M)): .2540E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 2 - CH San Fernando
NUDO TOMA 20 NUDO VERTIDOS 21 CAUD.MAX. 71.280 CAUD.MIN. 0.000 PRIORIDAD: 15
CENTRAL FLUYENTE SALTO BRUTO: 20.50 COEF.PROD.(GWH/(HM3.M)): .2320E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 3 - CH Santa Teresa
NUDO TOMA 5 NUDO VERTIDOS 23 CAUD.MAX. 132.192 CAUD.MIN. 0.000 PRIORIDAD: 15
EMBALSE: E. Santa Teresa COTA DE CENTRAL: 0.00 COTA MIN TURB. 833.05
COEF.PROD.(GWH/(HM3.M)): .2000E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 4 - CH Villagonzalo
NUDO TOMA 7 NUDO VERTIDOS 36 CAUD.MAX. 129.600 CAUD.MIN. 0.000 PRIORIDAD: 15
EMBALSE: E. Villagonzalo COTA DE CENTRAL: 0.00 COTA MIN TURB. 795.00
COEF.PROD.(GWH/(HM3.M)): .2360E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 5 - CH Salto de la Flecha
NUDO TOMA 13 NUDO VERTIDOS 14 CAUD.MAX. 77.760 CAUD.MIN. 0.000 PRIORIDAD: 15
CENTRAL FLUYENTE SALTO BRUTO: 4.00 COEF.PROD.(GWH/(HM3.M)): .2546E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 6 - CH Tejares
NUDO TOMA 40 NUDO VERTIDOS 41 CAUD.MAX. 51.840 CAUD.MIN. 0.000 PRIORIDAD: 1
CENTRAL FLUYENTE SALTO BRUTO: 2.36 COEF.PROD.(GWH/(HM3.M)): .2420E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 7 - CH Valverdón
NUDO TOMA 47 NUDO VERTIDOS 48 CAUD.MAX. 77.760 CAUD.MIN. 0.000 PRIORIDAD: 15
CENTRAL FLUYENTE SALTO BRUTO: 4.00 COEF.PROD.(GWH/(HM3.M)): .2360E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 8 - CH Almenara
NUDO TOMA 50 NUDO VERTIDOS 51 CAUD.MAX. 34.992 CAUD.MIN. 0.000 PRIORIDAD: 15
CENTRAL FLUYENTE SALTO BRUTO: 2.68 COEF.PROD.(GWH/(HM3.M)): .2000E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO
SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 9 - CH Ledesma

NUDO TOMA 55 NUDO VERTIDOS 56 CAUD.MAX. 103.680 CAUD.MIN. 0.000 PRIORIDAD: 15
CENTRAL FLUYENTE SALTO BRUTO: 5.35 COEF.PROD.(GWH/(HM3.M)): .2340E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 10 - CH Molino de Andrés
NUDO TOMA 62 NUDO VERTIDOS 63 CAUD.MAX. 64.800 CAUD.MIN. 0.000 PRIORIDAD: 1
CENTRAL FLUYENTE SALTO BRUTO: 17.90 COEF.PROD.(GWH/(HM3.M)): .2080E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

* 11 - CH Agueda
NUDO TOMA 64 NUDO VERTIDOS 66 CAUD.MAX. 51.840 CAUD.MIN. 0.000 PRIORIDAD: 1
EMBALSE: E. Águeda COTA DE CENTRAL: 30.00 COTA MIN TURB. 605.00 COEF.PROD.(GWH/(HM3.M)): .2320E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.OBJ. 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800

* 12 - CH Puerto Seguro
NUDO TOMA 71 NUDO VERTIDOS 72 CAUD.MAX. 2.074 CAUD.MIN. 0.000 PRIORIDAD: 1
CENTRAL FLUYENTE SALTO BRUTO: 88.00 COEF.PROD.(GWH/(HM3.M)): .2080E-02
OCTUBR. NOVIEM. DICIEM. ENERO FEBRERO MARZO ABRIL MAYO JUNIO JULIO AGOSTO SEPTIE.
CAUD.OBJ. 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

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APORT.INTERMEDIAS
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NO.-	NOMBRE	NUDO ENTRADA	N.COLUMNA APORTACION
1	AN Cab Tormes - Barco Avila	1	1
2	AN E. Sta Teresa	5	3
3	AN Rio Valmuza	11	6
4	AN E. Almendra	10	8
5	AN Rio Almar	8	5
6	AN Rio Alhandiga	6	4
7	AN Tormes confl con Duero	15	9
8	AN río Corneja	18	2
9	V Babilafuente	13	13
10	V Junta Compensacion UR-3R	39	14
11	V Kimberly-Clark	44	15
12	V Villamayor de Armuña	45	16
13	AN Tormes confluencia con Valm	54	7
14	V. Piedrahita	18	18
15	V. Guijuelo	5	10
16	V. Alba de Tormes	7	12
17	V. Terradillos Urb. El Encinar	7	11
18	Ap. Tramo Bajo Huebra	57	27
19	Ap. Cabecera Águeda	60	19
20	Ap. Emb Águeda	65	20
21	Ap. Pasiles	70	21
22	Ap. Tramo Bajo	72	22
23	Ap. Aravalle	73	28
24	Ap. Tenebrilla	74	24
25	Ap. Yeltes	75	23
26	Ap. Arganza	76	25
27	Ap. Huebra	76	26
28	Vert_Enusa	77	29
29	VertYeltes	80	30

30	Inf. Lluvia 12.03	83	0
31	Inf. Lluvia 12.05	84	0
32	Inf. Lluvia 12.02	86	0
33	Inf. Lluvia 12.01	87	0
34	Inf. Lluvia 12.04	88	0

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ACUIFEROS

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 * 1-12.01.Detrítico de Ciudad RodrTIPO:    2:  MODELO UNICELULAR
     PARAM.CONTROL BOMBEO  0    UMBRAL  : 0.0000E+00
     COEFTE.DE DESAGUE   0.7500E-01   VOLUMEN INICIAL:       0.00

 * 2-12.02.Detrítico San Esteban   TIPO:    2:  MODELO UNICELULAR
     PARAM.CONTROL BOMBEO  0    UMBRAL  : 0.0000E+00
     COEFTE.DE DESAGUE   0.8500E-01   VOLUMEN INICIAL:       0.00

 * 3-12.03.Detrítico de La Armuña  TIPO:    2:  MODELO UNICELULAR
     PARAM.CONTROL BOMBEO  0    UMBRAL  : 0.0000E+00
     COEFTE.DE DESAGUE   0.9500E-01   VOLUMEN INICIAL:       0.00

 * 4-12.05.Detrítico Profundo SalamTIPO:    2:  MODELO UNICELULAR
     PARAM.CONTROL BOMBEO  0    UMBRAL  : 0.0000E+00
     COEFTE.DE DESAGUE   0.2500E-01   VOLUMEN INICIAL:       0.00

 * 5-08.19.Detrítico Profundo Los ATIPO:    4:  MODELO DEPOSITO
     PARAM.CONTROL BOMBEO  0    UMBRAL  : 0.0000E+00
     VOLUMEN INICIAL:            0.00
           OCTUBR.  NOVIEM.  DICIEM.   ENERO   FEBRERO   MARZO   ABRIL    MAYO    JUNIO    JULIO   AGOSTO
SEPTIE.
     REC.LLUVIA    0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000


 * 6-12.04.Detrítico Alba Tormes-PeTIPO:    2:  MODELO UNICELULAR
     PARAM.CONTROL BOMBEO  0    UMBRAL  : 0.0000E+00
     COEFTE.DE DESAGUE   0.1350E+00   VOLUMEN INICIAL:       0.00
```

Operation rule:

- Type: Monthly variable curve evaluated at the begining of each the month.
- Based on the state of runoff:
  - AN Cab Tormes – Barco Avila
  - Ap Aravalle
  - AN río Corneja
  - AN E. Sta Teresa
- Number of months to accumulate: 4

Month	Volume	Restriction coefficient
January	10	0.5
	240	0.5
	241	0
February	10	0.5
	280	0.5

Month	Volume	Restriction coefficient
	281	0
March	10	0.5
	280	0.5
	281	0
April	10	0.5
	320	0.5
	321	0
May	10	0.5
	240	0.5
	241	0
June	10	0.5
	210	0.5
	211	0
July	10	0.5
	180	0.5
	181	0
August	10	0.5
	120	0.5
	121	0
September	10	0.5
	60	0.5
	61	0
October	10	0.5
	30	0.5
	31	0
November	10	0.5
	70	0.5
	71	0
December	10	0.5
	180	0.5
	181	0

Table 4. Operation rule values.

GESCAL

Model features:

Simulacion calidad del sistema:
Escenario de cálculo
Datos generales de Contaminantes*
0 3 1 1 0 0
Temperatura
r. tormes 642 Águeda 521_g Rec Lluvia 12.03 Transf Lateral 12.03 a 12.05 Rec. Lluvia 12.05 Rec. Lluvia 12.02 Huebra 535_g Rec. Lluvia 12.04 Yeltes538_a_g r. Tormes 680_a_g f. Transf. lateral b. 12.04 a 12.05 r. tormes 412_a r. Tormes 502_c_g f. Rec. Lluvia 12.01 f. Transf. Lateral2 12.05 a 08.19 C1-12 r. Tormes 504_c_g Transf. Lateral 12.05 r. Tormes 680_b_g salidas sistema f. Transf. Lateral 12.04 a 12.05 r. Tormes 545_b_g f. Transf. lateral1 12.05 a 08.19 r.Tormes 614_a r. Tormes 614_b r. Tormes 614_c r. Tormes 615_a r. Corneja 624 r.Tormes 615_b r. Tormes 615_c r.

Tormes 615_d r. Tormes 615_e r. Tormes 615_f r. Tormes 568_a r. Tormes 568_b r. Tormes 568_c r. Tormes 568_d r. Tormes 568_e r. Tormes 569_a r. Tormes 569_b r. Tormes 569_c r. Tormes 569_d r. Tormes 569_e r. Tormes 569_f r. Tormes 569_g r. Tormes 682_a r. Tormes 682_b r. Tormes 682_c r. Tormes 545_a Trasvase río Lobos r. Tormes 545_c r. Tormes 546_b r. Tormes 546_c r. Tormes 546_a r. Tormes 680_c r. Tormes 680_d r. Tormes 680_e r. Tormes 502_a r. Tormes 502_b r. Tormes 503_a r. Tormes 503_c r. Tormes 503_d r. Tormes 503_b r. Tormes 504_a r. Tormes 504_b r. Tormes 505_a r. Tormes 505_b r. Tormes 505_c r. Tormes 505_d r. Tormes 505_e Huebra 513_b Huebra 513_c Huebra 513_a Águeda 687 Águeda 626_a Águeda 626_b Agadón 617 Águeda 606 Águeda 626_c Águeda 522_a Arroyo Pasiles 607 Águeda 524 Águeda 525 Aravalle 643 Yeltes 538_586 Rio Valmuza 518-520 Agueda_522_b Agueda_522_c Agueda_522_d Agueda_523_a Agueda523_b Yeltes538_b

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E. Santa Teresa E. Villagonzalo E. Almendra E. Riolobos E. Irueña E. Águeda

1 1 20 20 20 20

4 7 1 1 1 1

20 20 20 20 20 20

1 1 1 1 1 1

1 1 1 1 1 1

Contaminantes de 1er Orden

1 1 1

Conductividad

r. tormes 642 r. tormes 412_a C1-12 salidas sistema r.Tormes 614_a r. Tormes 614_b r. Tormes 614_c r. Tormes 615_a r. Corneja 624 r.Tormes 615_b r. Tormes 615_c r. Tormes 615_d r. Tormes 615_e r. Tormes 615_f r. Tormes 568_a r. Tormes 568_b r. Tormes 568_c r. Tormes 568_d r. Tormes 568_e r. Tormes 569_a r. Tormes 569_b r. Tormes 569_c r. Tormes 569_d r. Tormes 569_e r. Tormes 569_f r. Tormes 569_g r. Tormes 682_a r. Tormes 682_b r. Tormes 682_c r. Tormes 545_a Trasvase río Lobos r. Tormes 545_c r. Tormes 546_b r. Tormes 546_c r. Tormes 546_a r. Tormes 680_c r. Tormes 680_d r. Tormes 680_e r. Tormes 502_a r. Tormes 502_b r. Tormes 503_a r. Tormes 503_c r. Tormes 503_d r. Tormes 503_b r. Tormes 504_a r. Tormes 504_b r. Tormes 505_a r. Tormes 505_b r. Tormes 505_c r. Tormes 505_d r. Tormes 505_e Huebra 513_b Huebra 513_c Huebra 513_a Águeda 687 Águeda 626_a Águeda 626_b Agadón 617 Águeda 606 Águeda 626_c Águeda 522_a Arroyo Pasiles 607 Águeda 524 Águeda 525 Aravalle 643 Yeltes 538_586 Rio Valmuza 518-520 Agueda_522_b Agueda_522_c Agueda_522_d Agueda_523_a Agueda523_b Yeltes538_b Rec Lluvia 12.03 Transf Lateral 12.03 a 12.05 Rec. Lluvia 12.05 Rec. Lluvia 12.02 Rec. Lluvia 12.04 f. Transf. lateral b. 12.04 a 12.05 f. Rec. Lluvia 12.01 f. Transf. Lateral2 12.05 a 08.19 Águeda 521_g Huebra 535_g Yeltes538_a_g r. Tormes 680_a_g r. Tormes 502_c_g r. Tormes 504_c_g Transf. Lateral 12.05 r. Tormes 680_b_g f. Transf. Lateral 12.04 a 12.05 r. Tormes 545_b_g f. Transf. lateral1 12.05 a 08.19

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E. Santa Teresa E. Villagonzalo E. Almendra E. Riolobos E. Irueña E. Águeda

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Solidos

r. tormes 642 r. tormes 412_a C1-12 salidas sistema r.Tormes 614_a r. Tormes 614_b r. Tormes 614_c r. Tormes 615_a r. Corneja 624 r.Tormes 615_b r. Tormes 615_c r. Tormes 615_d r. Tormes 615_e r. Tormes 615_f r. Tormes 568_a r. Tormes 568_b r. Tormes 568_c r. Tormes 568_d r. Tormes 568_e r. Tormes 569_a r. Tormes 569_b r. Tormes 569_c r. Tormes 569_d r. Tormes 569_e r. Tormes 569_f r. Tormes 569_g r. Tormes 682_a r. Tormes 682_b r. Tormes 682_c r. Tormes 545_a Trasvase río Lobos r. Tormes 545_c r. Tormes 546_b r. Tormes 546_c r. Tormes 546_a r. Tormes 680_c r. Tormes 680_d r. Tormes 680_e r. Tormes 502_a r. Tormes 502_b r. Tormes 503_a r. Tormes 503_c r. Tormes 503_d r. Tormes 503_b r. Tormes 504_a r. Tormes 504_b r. Tormes 505_a r. Tormes 505_b r. Tormes 505_c r. Tormes 505_d r. Tormes 505_e Huebra 513_b Huebra 513_c Huebra 513_a Águeda 687 Águeda 626_a Águeda 626_b Agadón 617 Águeda 606 Águeda 626_c Águeda 522_a Arroyo Pasiles 607 Águeda 524 Águeda 525 Aravalle 643 Yeltes 538_586 Rio Valmuza 518-520 Agueda_522_b Agueda_522_c Agueda_522_d Agueda_523_a Agueda523_b Yeltes538_b Rec Lluvia 12.03 Transf Lateral 12.03 a 12.05 Rec. Lluvia 12.05 Rec. Lluvia 12.02 Rec. Lluvia 12.04 f. Transf. lateral b. 12.04 a 12.05 f. Rec. Lluvia 12.01 f. Transf. Lateral2 12.05 a 08.19 Águeda 521_g Huebra 535_g Yeltes538_a_g r. Tormes 680_a_g r. Tormes 502_c_g r. Tormes 504_c_g Transf. Lateral 12.05 r. Tormes 680_b_g f. Transf. Lateral 12.04 a 12.05 r. Tormes 545_b_g f. Transf. lateral1 12.05 a 08.19

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Fosforo
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Oxígeno disuelto
Conducciones
r. tormes 642 r. tormes 412_a C1-12 salidas sistema r.Tormes 614_a r. Tormes 614_b r. Tormes 614_c r. Tormes 615_a r. Corneja 624 r.Tormes 615_b r. Tormes 615_c r. Tormes 615_d r. Tormes 615_e r. Tormes 615_f r. Tormes 568_a r. Tormes 568_b r. Tormes 568_c r. Tormes 568_d r. Tormes 568_e r. Tormes 569_a r. Tormes 569_b r. Tormes 569_c r. Tormes 569_d r. Tormes 569_e r. Tormes 569_f r. Tormes 569_g r. Tormes 682_a r. Tormes 682_b r. Tormes 682_c r. Tormes 545_a Trasvase río Lobos r. Tormes 545_c r. Tormes 546_b r. Tormes 546_c r. Tormes 546_a r. Tormes 680_c r. Tormes 680_d r. Tormes 680_e r. Tormes 502_a r. Tormes 502_b r. Tormes 503_a r. Tormes 503_c r. Tormes 503_d r. Tormes 503_b r. Tormes 504_a r. Tormes 504_b r. Tormes 505_a r. Tormes 505_b r. Tormes 505_c r. Tormes 505_d r. Tormes 505_e Huebra 513_b Huebra 513_c Huebra 513_a Águeda 687 Águeda 626_a Águeda 626_b Agadón 617 Águeda 606 Águeda 626_c Águeda 522_a Arroyo Pasiles 607 Águeda 524 Águeda 525 Aravalle 643 Yeltes 538_586 Rio Valmuza 518-520 Agueda_522_b Agueda_522_c Agueda_522_d Agueda_523_a Agueda523_b Yeltes538_b Rec Lluvia 12.03 Transf Lateral 12.03 a 12.05 Rec. Lluvia 12.05 Rec. Lluvia 12.02 Rec. Lluvia 12.04 f. Transf. lateral b. 12.04 a 12.05 f. Rec. Lluvia 12.01 f. Transf. Lateral2 12.05 a 08.19 Águeda 521_g Huebra 535_g Yeltes538_a_g r. Tormes 680_a_g r. Tormes 502_c_g r. Tormes 504_c_g Transf. Lateral 12.05 r. Tormes 680_b_g f. Transf. Lateral 12.04 a 12.05 r. Tormes 545_b_g f. Transf. lateral1 12.05 a 08.19
0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 -1 0.1 0.1 -1 0.1 0.1 0.1 0.35 0.35 0.35 0.35 3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 -1 0.1 0.1 0.1 0.1 0.1 0.1 0.5 -1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 -1 0.1 0.1 0.35 3.5 3.5 0.1 0.35 0.1 -1 0.1
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0.001 0.001
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0 0 0 0 0 0
1 1 1 1 1 1
0.02 0.02 0.02 0.02 0.02 0.02
0.01 0.01 0.01 0.01 0.01 0.01
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0.001 0.001 0.001 0.001 0.001 0.001
0.1 0.1 0.1 0.1 0.01 0.01
0.001 0.001 0.001 0.001 0.001 0.001
Datos Generales Elementos
Conducciones
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50 50 50 5 50 5 50 50 50 50 50 50 50 10 5 50 50 5 50 10 5 50 5 50 50 50 50 5 50 5 50 50 5 50 50 50 5 10 50 50 50 5 10 50 50 5 50 50 50 5 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50
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0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.18 0.065 0.065 0.065 0.065 0.065 0.065 0.065 0.065 0.18 0.18 0.18 0.18 0.18 0.18 0.065 0.18 0.065 0.18 0.065
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0.585 0.238 0.238 0.238 0.238 0.238 0.238 0.585 0.238 0.585 0.238 0.585
0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4
0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4
0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.4 0.4 0.4 0.4 0.4 0.4 0.45 0.4 0.45 0.4 0.45
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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Embalses
E. Santa Teresa E. Villagonzalo E. Almendra E. Riolobos E. Irueña E. Águeda
1 1 1 1 1 1
0 0 0 0 0 0
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30 90 30 30 30 30
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0 0 0 0 0 0
1 1 1 1 1 1
Datos de elementos de contaminación difusa
9
NumConducc Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
r. Tormes 568_b
16 0 0 0 42.22 0.656 7.931 3.366 32.522
r. Tormes 568_c
17 0 0 0 11.735 0.205 2.051 0.191 14.052
r. Tormes 569_b
21 0 0 0 17.148 0.29 60 64 19.198
r. Tormes 546_c
34 0 0 0 1000000 0 0 0 0
r. Tormes 680_c
36 0 0 0 1000000 0 0 0 0
r. Tormes 680_d
37 0 0 0 1000000 0 0 0 0
r. Tormes 680_e
38 0 0 0 1000000 0 0 0 0
r. Tormes 680_a_g
88 0 0 0 1000000 0 0 0 0
r. Tormes 680_b_g
96 0 0 0 1000000 0 0 0 0
*****Flujos de Sedimento en embalse*****
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NumEmb Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
1 0 0 0 0 0 0 0 0
Datos Condiciones Iniciales
Acuíferos
Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
400 5 0.0001 2 8 0.0001 0.0001 20
400 5 0.001 2 8 0.001 0.001 20
439 5 0.0001 2 8 0.001 0.001 31
752 5 0.001 2 8 0.001 0.001 65
0 0 0 0 0 0 0 0

400 5 0.001 2 8 0.001 0.001 20
Embalses
Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
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CO2
Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
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Elementos de depuración-Contaminación
Elementos de retorno
Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
1872 25 1.11 27.5 6.08 3 0.23 8.16
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-1 -1 -1 -1 -1 -1 -1 -1
483.048 50 2.785 56.238 5.37 3 10.918 17.917
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72.33 -1 1.308 -1 5.317 3 0.383 1.7
72.33 -1 0.1 -1 5.317 3 0.383 1.7
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868.107 200 5.345 209.308 5.428 3 25.14 13.216
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912.2 200 7.76 344 3.552 3 38.68 10.026
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718 22 12.82 48 4.11 2 31.75 2.34
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Tomas
Conductividad Solidos Fosforo DBO OD Norg Nh4 No3
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Indicadores de Alarma de Calidad
0
Descripción de los indicadores
Curvas de Modulacion
14
oct nov dic ene feb mar abr may jun jul ago sep
Ctte
1 1 1 1 1 1 1 1 1 1 1 1
1 Barco de Ávila
12.1 7.7 5.2 3.7 4.9 6.7 7.8 10.7 15.7 19.5 20.6 16.6
2 Puente Congosto
12.7 8 5.5 3.9 4.6 7.3 8.7 12.3 17.3 20.8 21.4 17.5
3 Embalse de Santa Teresa
20 12 7.5 6.5 7.1 8.9 11.9 15.6 19.3 21.2 21.8 22
4 Embalse de El Milagro
14.9 7.4 7.3 5.2 6.2 8.6 11.2 15.7 20.1 22.3 24.5 22
5 Encinas de Arriba
14.8 10.2 7.2 5.7 6 7.3 9.4 11.8 14.3 15.1 16.2 16.5
6 Azud de Villagonzalo
15.3 9.6 6.6 5.8 5.6 7.8 10.6 13.1 18.5 19.8 19.7 17.6
7 Salamanca Abastecimiento
14.6 10.4 6.9 5.9 6.4 10.3 12 15.3 19.7 19.9 21.7 18.1
8 Salamanca El Marín
15.6 10.7 6.9 6.2 6.4 9.5 12.2 15.9 20.3 21.1 21.9 18.3
9 Contiensa
15 10.7 7.1 6.3 6.6 10 12.8 16.3 20.7 21.9 22.6 18.5
10 Embalse de La Almendra Sayago
15.4 13.5 10.8 8.8 7.8 9.1 12 15.8 19.8 22.6 23.1 18.2
11 Embalse de la Almendra
15.2 13.3 11.6 12.5 13.4 17.3 21.7 22.7 25.5 26.4 25.6 22.7
Huebra
17 10.48 6.76 5.96 8.13 11.12 14.77 17.74 20.54 20.5 21 19
Agueda
15.2 9.8 6.2 5.12 6.8 9.6 11.44 15.04 19.51 22.07 21.42 19.24

CAUDECO

Model features:

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titulo2
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2	1	'BogaDuero'
3	1	'Bordallo'
4	1	'Bermejuela'
5	1	'Trucha'
6	1	'Boga'
<ETAPAS>
4
1	1	'Adulto'
2	1	'Juvenil'
3	1	'Alevín'
4	1	'Freza'
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235	1	1	'r. Tormes 545_c'
274	1	1	'r. Tormes 503_a'
29	1	1	'r. tormes 412_a'
<BIOPERIODOS>
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0	0	0	0	0	0	0	1	1	1	1	1
2	'CP-Juveniles'
1	1	1	1	1	1	1	0	0	0	0	0
3	'CP-Adultos'
1	1	1	1	1	1	1	1	1	1	1	1
4	'SL-Alevines'
0	0	0	0	1	1	1	1	0	0	0	0
5	'SL-Juveniles'
0	0	0	0	0	1	1	1	1	1	1	0
6	'SL-Adultos'
1	1	1	1	1	1	1	1	1	1	1	1
7	'SL-Freza'
0	1	1	1	1	0	0	0	0	0	0	0
<Curvas_HPU>
31
'BermejuelaAdultoAlmendra'
169	29	4	1	3	-1
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
```

	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	745.38	963.36	1148.22	1331.28	1359.36	1366.56	1327.32	1301.58	1306.98	1295.82	1299.78	
	1305.194	1333.62	1366.92	1396.8	1429.2	1458.9	1486.26	1512.36	1518.438	1535.04	1554.12	
	1573.92	1592.28	1610.28	1626.3	1629.427	1641.78	1655.64	1669.86	1687.86	1705.5	1724.4	1745.1
	1763.64	1780.92	1798.2	1814.58	1831.68	1849.32	1867.5	1884.96	1902.6	1920.42	1937.16	
	1945.26	1953.36	1968.48	1985.04	2000.88	2015.1	2029.14	2042.1	2053.44	2064.6	2076.3	
	2087.64	2099.34	2110.32	2120.04	2129.76	2140.2	2151.36	2161.98	2171.88	2181.06	2191.14	2200.5
	2209.32	2218.14	2227.14	2236.5	2246.22	2256.3	2266.56	2277.72	2289.6	2301.3	2313.54	2325.6
	2337.48	2348.46	2359.62	2371.32	2383.38	2395.26	2406.96	2418.84	2430.72	2442.78	2454.84	
	2467.44	2480.4	2493.72	2506.5	2518.92	2530.98	2542.68	2554.2	2565.36	2576.7	2587.86	2599.2
	2610.54	2621.52	2632.14	2643.12	2653.02	2662.56	2671.38	2680.02	2688.48	2696.76	2704.86	
	2713.32	2721.96	2730.78	2739.6	2748.42	2757.6	2766.78	2775.42	2783.88	2792.34	2800.62	
	2808.36	2816.1	2823.48	2830.68	2837.88	2844.9	2851.92	2858.76	2865.6	2872.08	2878.74	
	2885.22	2891.88	2898.54	2905.02	2911.68	2918.52	2925	2931.66	2938.32	2944.62	2951.1	2957.4
	2963.88	2970.72	2977.56	2984.76	2991.6	2998.62	3005.46	3012.3	3018.96	3025.98	3032.82	
	3039.66	3046.5	3053.52	3060.72	3067.74	3074.4	3080.88	3087.54	3094.02			
'BarboAdultoContiensa'												
30	274	1	1	3	-1							
0	0.5	1	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
	7	7.48	8	8.452	9	9.903	11	12	13	14	14.885	16
	17	17.5	18	18.641	21.448							
0	7027.15	8048.07	9407.87	9861.11	10334.62	10892.44	11380.4	11877.42	12378.73	12879.85	13371.15	
	13894.43	14368.35	14686.8	15156.02	15518.58	15916.66	16499.65	17214.67	17739.52	18161.65	18558.15	
	18855.31	19227.35	19532.45	19679.35	19805.91	19970.23	20540.53					
'BarboAlevinContiensa'												
30	274	1	3	1	-1							
0	0.5	1	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
	7	7.48	8	8.452	9	9.903	11	12	13	14	14.885	16
	17	17.5	18	18.641	21.448							
0	435.42	1294.72	4832.77	6593.47	7800.28	8770.69	9507.67	10215.69	10809.21	11265.93	11621.5	
	12054.48	12301.88	13338.33	13668.26	13839.19	14002.34	14207.16	13554.89	13755.35	14013.66	14253.52	
	14587.83	14784.45	14894.62	14955.95	15009.03	15083.6	15365.76					
'BarboJuvenilContiensa'												
30	274	1	2	2	-1							
0	0.5	1	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
	7	7.48	8	8.452	9	9.903	11	12	13	14	14.885	16
	17	17.5	18	18.641	21.448							
0	30545.78	32122.47	35189.06	36145.65	36769.66	37328.43	37811.31	38302.14	38718.92	39053.47	39334.1	
	39631.11	39932.34	40607.11	40844.94	41021.49	41214.15	41471.51	41173.99	41426.88	41658.51	41873.7	
	42079.12	42207.61	42314.68	42363.63	42405.58	42463.73	42574.43					
'BogaAdultoContiensa'												
30	274	6	1	3	-1							
0	0.5	1	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
	7	7.48	8	8.452	9	9.903	11	12	13	14	14.885	16
	17	17.5	18	18.641	21.448							
0	8059.2	8998.95	10373.86	10976.32	11527.89	12083.67	12583.05	13052.85	13508.55	13958.25	14383.82	
	14843.22	15259.77	15592.31	16018.53	16356.6	16720.63	17260.3	17888.6	18443.74	18957.27	19447.77	
	19868.39	20343.79	20756.21	20962.8	21161.33	21428.37	22346.95					
'BogaAlevinContiensa'												
30	274	6	3	1	-1							
0	0.5	1	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
	7	7.48	8	8.452	9	9.903	11	12	13	14	14.885	16
	17	17.5	18	18.641	21.448							
0	18142.87	20011.42	22590.29	23400.07	24080.37	24676.34	25226.44	25740.07	26141.43	26489.92	26853.91	
	27172.13	27426.06	27912.17	28161.11	28309.46	28455.91	28659.14	28548.79	28711.16	28840.38	28949.51	
	29076.11	29125.11	29132.74	29118.21	29102.05	29096.72	29003.34					
'BogaJuvenilContiensa'												
30	274	6	2	2	-1							
0	0.5	1	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
	7	7.48	8	8.452	9	9.903	11	12	13	14	14.885	16
	17	17.5	18	18.641	21.448							

0 11665.31 13455.46 15968.64 16860.16 17590.64 18300.53 18910.7 19493.39 19990.21 20429.3 20857.05
21335.53 21730.46 22293.26 22646.11 22908.59 23189 23583.22 23681.63 24063.13 24433.39 24780.98
25097.89 25399.7 25676.18 25813.02 25943.54 26109.65 26728.38
'BordalloAdultoContiensa'
30 274 3 1 3 -1
0 0.5 1 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5
7 7.48 8 8.452 9 9.903 11 12 13 14 14.885 16
17 17.5 18 18.641 21.448
0 68157.71 68343.97 68576.47 68607.58 68735.56 68814.36 68888.22 68913.62 68925.81 68938.68 68941.37
68867.23 68725.18 68790.43 68715.59 68687.51 68646.67 68605.37 68407.99 68281.4 68111.85 67903.19
67652.74 67410.68 67081.98 66919.41 66751.91 66557.79 65451.71
'BordalloAlevinContiensa'
30 274 3 3 1 -1
0 0.5 1 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5
7 7.48 8 8.452 9 9.903 11 12 13 14 14.885 16
17 17.5 18 18.641 21.448
0 76546.92 76979.12 77076 77021.41 77018.16 76975.87 76913.12 76820.99 76684.81 76521.82 76345.89
76121.66 75939.98 75713.81 75516.88 75342.59 75151.83 74897.33 74705.05 74421.25 74173.65 73884.46
73634.14 73363.3 73064.54 72911.76 72784.98 72617.02 71983.58
'BarboAdultoVillagonzalo'
25 235 1 1 3 -1
0 0.1 0.5 1 1.5 2 2.5 2.8 3.2 3.5 4 4.5 5
5.5 5.918 6 6.5 6.861 7 7.5 8 8.5 9 10 15
0 288.98 642.92 1223.76 1777.52 2241.59 2690.8 2983.45 3302.63 3504.64 3815.61 4071.25
4306.16 4506.64 4665 4692.54 4860.6 4949.81 4990.15 5086.59 5170.63 5239.69 5275.51 5320.1
5474.85
'BarboAlevinVillagonzalo'
25 235 1 3 1 -1
0 0.1 0.5 1 1.5 2 2.5 2.8 3.2 3.5 4 4.5 5
5.5 5.918 6 6.5 6.861 7 7.5 8 8.5 9 10 15
0 610.68 5299.82 7665.41 8647.98 9348 9888 10180.35 10441.76 10584.77 10697.92 10703.02
10679.83 10707.47 10713.84 10703.72 10681.47 10612.64 10589.33 10597.72 10618.34 10600.68 10587.59
10443.19 9921.14
'BarboJuvenilVillagonzalo'
25 235 1 2 2 -1
0 0.1 0.5 1 1.5 2 2.5 2.8 3.2 3.5 4 4.5 5
5.5 5.918 6 6.5 6.861 7 7.5 8 8.5 9 10 15
0 26036.32 27758.34 28851.26 29547.7 30040.37 30400.12 30560.88 30742.26 30842.34 30964.73 31065.4
31144.32 31246.74 31320.51 31335.29 31411.23 31442.91 31466.17 31539.2 31602.75 31660.16 31703.55
31761.1 31806.89
'BogaAdultoVillagonzalo'
25 235 6 1 3 -1
0 0.1 0.5 1 1.5 2 2.5 2.8 3.2 3.5 4 4.5 5
5.5 5.918 6 6.5 6.861 7 7.5 8 8.5 9 10 15
0 422.65 982.38 1707.51 2300.64 2798.92 3312.75 3664.07 4038.52 4271.43 4635.4 4935.47 5213
5456.43 5660.32 5696.45 5937.25 6083.59 6144.18 6314.01 6476.93 6634.65 6764.61 6999.67
7782.11
'BogaAlevinVillagonzalo'
25 235 6 3 1 -1
0 0.1 0.5 1 1.5 2 2.5 2.8 3.2 3.5 4 4.5 5
5.5 5.918 6 6.5 6.861 7 7.5 8 8.5 9 10 15
0 4718.63 6852.18 8285.72 9190.6 9896.15 10408.54 10653.7 10950.07 11147.33 11419.06 11626.22
11789.24 11945.72 12076.38 12110.04 12233.71 12291.19 12324.95 12388.15 12460.74 12525.25 12562.34
12590.52 12549.25
'BogaJuvenilVillagonzalo'
25 235 6 2 2 -1
0 0.1 0.5 1 1.5 2 2.5 2.8 3.2 3.5 4 4.5 5
5.5 5.918 6 6.5 6.861 7 7.5 8 8.5 9 10 15
0 2600.51 4262.05 5518.53 6367.15 7061.71 7640.38 7953.96 8344.13 8610.68 9001.51 9331.04
9624.37 9899.9 10119.38 10164.61 10400.24 10539.18 10608.82 10798.4 10993.4 11169.54 11314.29
11589.68 12586.44
'BogaDueroAdultoVillagonzalo'

24	235	2	1	3	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	5	5.5
	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15	
0	425.18	939.27	1595.79	2136.85	2597.35	3073.07	3392.09	3737.23	3953.49	4296.6	4855.16	
	5094.85	5296.65	5332.79	5573.46	5719.69	5780.41	5951.61	6117.72	6278.56	6409.2	6648.31	
	7461.76											
'BogaDueroAlevinVillagonzalo'												
25	235	2	3	1	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	74466.1	74487.01	74589.5	74682.07	74782.29	74833.93	74839.8	74814.27	74775.61	74691.8	74578.78	
	74432.63	74272.78	74130.28	74102.47	73910.88	73773.9	73722.03	73533.75	73341.17	73156.62	72980.78	72589
	70475.95											
'BermejuelaAdultoVillagonzalo'												
25	235	4	1	3	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	2042.36	3675.13	4915.38	5812.14	6596.63	7070.67	7291.06	7534.58	7690.05	7931.76	8154.59	
	8393.54	8626.61	8792.49	8823.71	9029.21	9173.62	9235.87	9398.93	9517.17	9639.13	9753.4	
	9994.47	10614.5										
'BordalloAdultoVillagonzalo'												
24	235	3	1	3	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	5	5.5
	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15	
0	80269.59	79960.87	79627.23	79334.79	79076.46	78821.29	78642.58	78390.04	78184.81	77830.61	77058.88	
	76639.04	76261.86	76192.75	75707.75	75375.35	75244.39	74789.72	74345.1	73917.08	73549.98	72857.36	
	70455.21											
'BordalloAlevinVillagonzalo'												
25	235	3	3	1	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	54879.21	54876.92	54751.87	54565.91	54328.13	54088.76	53957.8	53803.54	53696.45	53559.64	53451.58	
	53356.96	53268	53194.18	53180.45	53085.61	53020.32	52994.74	52906.8	52815.5	52734.07	52649.45	
	52423.83	51092.76										
'TruchaAdultoVillagonzalo'												
25	235	5	1	6	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	536.42	1487.2	2833.76	3962.71	4926.86	5712.47	6140.64	6758.83	7232.46	8074.16	8751.06	
	9325.35	9845.38	10252.48	10320.52	10776.95	11058	11191.79	11567.26	11984.49	12368.33	12665.51	
	13184.92	14980.07										
'TruchaAlevinVillagonzalo'												
25	235	5	3	4	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	2071.79	4101.22	5251.16	5633.92	5841.35	6018.25	6102.24	6180.45	6207.33	6230.13	6189.32	
	6152.97	6111	6074.4	6064.75	6016.11	5956.63	5936.69	5875.16	5854.6	5832.91	5799.43	
	5746.08	5720.52										
'TruchaFrezaVillagonzalo'												
25	235	5	4	7	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	1889.71	3479.3	5267.12	6327.22	7084.58	7681.36	8011.47	8366.28	8579.03	8861.43	9121.6	
	9349.37	9560.9	9713.79	9740.27	9917.15	10014.61	10051.43	10169.23	10286.86	10379.26	10440.16	
	10524.75	10534.14										
'TruchaJuvenilVillagonzalo'												
25	235	5	2	5	-1							
0	0.1	0.5	1	1.5	2	2.5	2.8	3.2	3.5	4	4.5	5
	5.5	5.918	6	6.5	6.861	7	7.5	8	8.5	9	10	15
0	1184.36	2745.46	4011.75	4754.15	5294.87	5770.82	6008.8	6278.61	6454.59	6702.37	6893.7	
	7049.13	7189.05	7287.93	7308.32	7423.33	7474.52	7505.4	7572.61	7641.04	7688.21	7711.24	
	7758.25	7909.73										

'BarboAdultoAlmendra'												
169	29	1	1	3	-1							
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	216	271.98	329.58	395.1	456.66	533.34	605.34	667.8	727.02	775.98	820.62	
	826.927	860.04	897.66	932.22	963.9	996.84	1029.06	1060.38	1069.015	1092.6	1124.82	
	1155.78	1185.48	1213.74	1242	1247.381	1268.64	1294.56	1318.68	1342.62	1367.46	1390.32	
	1412.46	1434.6	1457.28	1478.52	1500.48	1522.26	1543.14	1562.94	1582.38	1601.28	1618.92	
	1636.92	1645.47	1654.02	1670.22	1686.96	1702.08	1717.2	1733.22	1749.78	1765.98	1782	
	1798.56	1815.3	1832.04	1847.88	1864.26	1880.64	1896.3	1911.78	1927.26	1942.2	1956.96	
	1972.26	1987.02	2001.96	2017.8	2032.92	2047.68	2062.44	2076.84	2091.06	2105.1	2119.14	2133
	2146.5	2160.18	2174.58	2188.62	2202.48	2216.16	2229.48	2242.62	2255.94	2269.26	2282.4	
	2295.72	2308.86	2322.18	2335.32	2348.46	2361.6	2374.56	2387.16	2399.76	2412.18	2424.6	2437.2
	2449.8	2462.4	2474.46	2486.16	2498.04	2510.1	2522.52	2535.3	2548.08	2560.86	2574	
	2587.14	2600.28	2613.42	2625.66	2637.54	2649.06	2660.76	2672.1	2683.44	2694.6	2705.58	
	2716.56	2727.72	2738.7	2749.68	2760.48	2771.1	2782.44	2793.6	2804.94	2816.28	2827.44	
	2838.24	2849.04	2859.84	2870.1	2880.54	2890.98	2901.6	2912.22	2922.84	2933.1	2943.54	2953.8
	2963.88	2973.96	2983.86	2993.76	3003.48	3013.2	3022.74	3032.46	3041.82	3051.36	3060.9	
	3070.26	3079.62	3088.98	3098.34	3107.7	3116.88	3126.06	3135.42	3144.6	3153.96	3163.14	
'BarboJuvenilAlmendra'												
169	29	1	2	2	-1							
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	354.78	447.84	543.06	638.28	720.54	799.2	874.62	941.76	1000.98	1055.52	1105.02	
	1111.702	1146.78	1186.56	1226.7	1263.42	1299.6	1335.06	1370.16	1379.326	1404.36	1439.28	
	1474.74	1509.66	1543.68	1577.16	1583.705	1609.56	1640.7	1670.94	1700.46	1729.8	1757.7	
	1785.06	1812.06	1838.88	1865.34	1891.62	1917.9	1943.82	1969.2	1993.68	2017.62	2040.84	
	2063.52	2074.5	2085.48	2106.72	2127.78	2147.76	2167.74	2187.72	2207.52	2227.86	2247.66	
	2267.64	2287.62	2307.6	2327.4	2346.84	2366.28	2385	2403.36	2421.36	2438.82	2456.28	
	2473.56	2490.48	2507.4	2524.32	2541.24	2558.16	2574.72	2591.46	2608.02	2624.76	2641.5	
	2658.24	2674.62	2690.64	2706.48	2722.68	2738.88	2754.9	2770.92	2786.58	2801.88	2817	
	2832.12	2847.06	2861.82	2876.58	2891.16	2905.56	2919.96	2934.18	2948.22	2962.26	2976.12	
	2990.16	3004.02	3018.06	3032.1	3046.32	3060.36	3074.4	3088.08	3101.94	3115.8	3129.48	
	3143.34	3157.2	3171.06	3184.92	3198.96	3213	3226.86	3240.72	3254.4	3268.08	3281.58	
	3295.26	3308.58	3321.9	3335.04	3348.36	3361.5	3374.82	3387.78	3400.92	3413.88	3427.02	
	3439.98	3452.94	3465.9	3478.86	3491.82	3504.42	3516.84	3529.26	3541.68	3553.92	3566.16	3578.4
	3590.46	3602.52	3614.76	3626.64	3638.7	3650.58	3662.28	3674.16	3685.86	3697.56	3709.26	

	3720.96	3732.3	3743.82	3755.34	3766.68	3778.02	3789.18	3800.34	3811.5	3822.48	3833.46	
	3844.62	3855.6										
'BarboAlevinAlmendra'												
169	29	1	3	1	-1							
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	23.4	20.34	25.02	29.88	30.6	32.4	34.38	36.72	38.52	40.14	41.58	41.81
	43.02	44.1	45.18	46.26	46.98	47.7	48.24	48.385	48.78	48.96	49.14	49.32
	49.5	49.68	49.753	50.04	50.22	50.58	50.94	51.12	51.3	51.66	51.84	52.02
	52.2	52.38	52.56	52.74	52.92	53.1	53.1	53.28	53.46	53.46	53.46	53.64
	53.82	53.82	53.82	54	54	54	54.18	54.18	54.18	54.36	54.36	54.36
	54.54	54.54	54.72	54.72	54.9	55.08	55.08	55.26	55.44	55.44	55.62	55.8
	55.8	55.98	56.16	56.16	56.34	56.52	56.52	56.7	56.88	56.88	57.06	57.06
	57.24	57.42	57.42	57.6	57.6	57.78	57.78	57.96	57.96	58.14	58.14	58.14
	58.32	58.32	58.32	58.32	58.32	58.32	58.32	58.5	58.5	58.5	58.5	58.5
	58.5	58.5	58.5	58.5	58.32	58.32	58.32	58.32	58.32	58.32	58.14	58.14
	58.14	58.14	57.96	57.96	57.96	57.96	57.78	57.78	57.78	57.78	57.78	57.6
	57.6	57.6	57.6	57.6	57.6	57.42	57.42	57.42	57.42	57.42	57.42	57.42
	57.42	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24
	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24	57.24
'BogaDueroAdultoAlmendra'												
169	29	2	1	3	-1							
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	1998.36	2430.36	2857.68	3208.14	3521.7	3752.64	3938.22	4119.48	4255.2	4373.1	4493.34	
	4510.447	4600.26	4705.38	4805.64	4903.38	4997.7	5087.52	5175.54	5198.261	5260.32	5344.38	
	5427.18	5508.72	5589.18	5670.18	5686.542	5751.18	5832	5911.2	5988.06	6061.5	6132.78	6202.8
	6271.2	6338.34	6404.94	6470.28	6534.36	6599.16	6662.52	6724.98	6786.54	6848.64	6909.66	
	6939.36	6969.06	7028.64	7086.42	7143.48	7200.18	7256.52	7312.86	7368.3	7423.74	7479.36	
	7535.16	7591.32	7646.94	7702.38	7757.1	7811.1	7864.92	7918.56	7971.84	8024.22	8076.06	8127
	8177.04	8226.18	8274.96	8323.02	8370.72	8418.42	8465.76	8513.1	8559.9	8606.52	8653.14	
	8699.22	8744.94	8790.66	8836.2	8881.56	8926.56	8971.02	9014.04	9056.7	9099.72	9142.2	
	9184.68	9226.98	9269.1	9311.22	9352.8	9394.56	9436.14	9477.54	9518.58	9559.44	9600.3	
	9640.98	9681.48	9721.98	9762.48	9802.98	9843.12	9883.08	9923.04	9962.82	10002.6	10042.02	
	10081.44	10120.5	10159.74	10198.98	10238.22	10277.64	10316.7	10355.76	10394.82	10434.24	10473.84	
	10513.62	10553.22	10592.82	10632.42	10671.66	10710.9	10749.96	10789.02	10828.08	10866.96	10905.84	
	10944.72	10983.42	11022.12	11060.64	11098.8	11136.78	11174.76	11212.92	11250.9	11288.88	11326.68	
	11364.3	11401.56	11438.82	11475.9	11512.8	11549.52	11586.42	11623.14	11659.86	11696.04	11732.04	

	11767.86	11803.32	11838.6	11873.52	11908.44	11943.18	11977.56	12011.76	12045.96	12079.98	12113.82	
	12147.48											
'BogaDueroAlevinAlmendra'												
169	29	2	3	1	-1							
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	1389.42	1725.3	2108.52	2472.3	2873.16	3163.5	3417.48	3647.34	3842.1	3996.9	4150.98	
	4173.358	4290.84	4431.96	4565.34	4696.92	4824.54	4948.02	5068.98	5100.577	5186.88	5302.62	
	5416.92	5527.08	5637.42	5748.3	5770.807	5859.72	5970.42	6078.24	6183.54	6285.42	6382.62	
	6478.56	6572.16	6662.52	6751.44	6839.28	6926.04	7013.52	7099.74	7185.42	7269.84	7355.7	
	7440.48	7481.88	7523.28	7606.98	7688.7	7769.16	7849.26	7928.82	8008.38	8086.86	8164.98	8243.1
	8321.94	8400.78	8478.36	8555.04	8630.82	8705.52	8779.5	8852.94	8925.12	8996.04	9066.06	9135
	9202.14	9268.02	9333.36	9397.62	9461.7	9525.42	9588.6	9652.32	9714.96	9777.42	9839.34	
	9900.54	9961.92	10022.94	10084.32	10145.52	10206.36	10266.48	10324.62	10382.4	10440.54	10498.32	
	10556.1	10614.6	10673.1	10731.24	10789.2	10847.34	10904.94	10962.18	11019.06	11075.58	11132.1	
	11188.44	11244.6	11300.76	11356.92	11413.26	11469.06	11524.32	11579.76	11635.02	11689.92	11744.82	
	11799.54	11854.08	11908.8	11963.16	12017.7	12072.42	12126.6	12180.96	12234.96	12289.5	12343.86	
	12398.04	12452.22	12506.22	12560.22	12613.68	12666.96	12720.24	12773.52	12826.8	12879.9	12933	
	12986.1	13039.02	13091.76	13144.32	13196.16	13248.18	13299.84	13351.68	13403.7	13455.18	13506.66	
	13557.96	13608.9	13659.48	13709.88	13759.74	13809.6	13859.28	13908.78	13958.28	14007.06	14055.48	
	14103.54	14151.42	14198.94	14245.92	14293.08	14339.7	14385.96	14432.22	14478.12	14524.2	14569.92	
	14615.46											
'BordalloAdultoAlmendra'												
169	29	3	1	3	-1							
0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	5.58
	6	6.5	7	7.5	8	8.5	9	9.134	9.5	10	10.5	11
	11.5	12	12.101	12.5	13	13.5	14	14.5	15	15.5	16	16.5
	17	17.5	18	18.5	19	19.5	20	20.5	21	21.25	21.5	22
	22.5	23	23.5	24	24.5	25	25.5	26	26.5	27	27.5	28
	28.5	29	29.5	30	30.5	31	31.5	32	32.5	33	33.5	34
	34.5	35	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46
	46.5	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52
	52.5	53	53.5	54	54.5	55	55.5	56	56.5	57	57.5	58
	58.5	59	59.5	60	60.5	61	61.5	62	62.5	63	63.5	64
	64.5	65	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75	75.5	76
	76.5	77	77.5	78	78.5	79	79.5	80	80.5	81	81.5	82
0	1695.24	2086.56	2422.62	2705.22	2980.08	3169.08	3344.58	3488.58	3606.66	3705.66	3803.94	
	3818.254	3893.4	3987.72	4072.5	4156.2	4236.48	4313.34	4389.3	4408.789	4462.02	4534.38	
	4607.28	4678.02	4747.32	4815.36	4828.995	4882.86	4950.18	5016.24	5080.86	5143.5	5204.52	
	5263.56	5321.52	5378.4	5434.2	5488.74	5542.74	5597.28	5651.46	5705.1	5758.2	5811.66	5864.4
	5890.23	5916.06	5968.08	6019.02	6069.24	6119.1	6168.6	6217.92	6266.7	6315.12	6363.54	
	6411.96	6460.38	6508.26	6556.14	6602.94	6648.84	6694.56	6740.1	6785.28	6829.74	6873.66	
	6917.22	6959.88	7002	7043.76	7084.98	7126.02	7167.06	7207.92	7248.96	7289.28	7329.42	
	7369.38	7408.98	7448.4	7487.82	7527.06	7566.12	7605.18	7643.7	7681.14	7718.58	7756.02	
	7792.92	7829.82	7866.9	7903.8	7940.7	7977.24	8013.96	8050.5	8086.68	8122.86	8158.68	8194.5
	8230.32	8265.78	8301.42	8336.88	8372.52	8407.8	8442.72	8477.64	8512.56	8547.12	8581.68	
	8616.06	8650.44	8684.82	8719.2	8753.4	8787.78	8822.16	8856.18	8890.2	8924.4	8958.42	
	8992.26	9026.1	9059.94	9093.78	9127.26	9160.74	9194.04	9227.34	9260.64	9293.94	9327.06	

9360.18 9393.12 9426.24 9459 9491.4 9523.98 9556.38 9588.78 9621 9653.22 9685.44
9717.48 9749.16 9780.84 9812.52 9843.66 9874.98 9906.12 9937.26 9968.4 9999 10029.6
10060.02 10090.26 10120.32 10150.2 10180.44 10210.14 10239.48 10268.82 10297.98 10327.14 10356.12
10385.1
'BordalloAlevinAlmendra'
169 29 3 3 1 -1
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 5.58
6 6.5 7 7.5 8 8.5 9 9.134 9.5 10 10.5 11
11.5 12 12.101 12.5 13 13.5 14 14.5 15 15.5 16 16.5
17 17.5 18 18.5 19 19.5 20 20.5 21 21.25 21.5 22
22.5 23 23.5 24 24.5 25 25.5 26 26.5 27 27.5 28
28.5 29 29.5 30 30.5 31 31.5 32 32.5 33 33.5 34
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76.5 77 77.5 78 78.5 79 79.5 80 80.5 81 81.5 82
0 609.84 754.02 879.12 990.9 1078.56 1131.48 1170.18 1199.7 1236.78 1263.42 1290.6
1295.496 1321.2 1354.14 1384.92 1415.16 1443.42 1471.14 1497.78 1504.534 1522.98 1547.82
1572.48 1596.42 1619.46 1641.96 1646.396 1663.92 1685.7 1707.66 1729.8 1751.94 1773.9
1794.96 1815.3 1834.92 1854 1872.9 1891.62 1910.52 1929.24 1947.96 1966.14 1984.14
2001.78 2010.6 2019.42 2036.88 2054.34 2071.44 2088.54 2105.28 2122.2 2138.94 2155.68
2172.24 2188.8 2205 2221.38 2237.58 2253.42 2268.9 2284.2 2299.5 2314.26 2328.84
2343.42 2357.82 2372.22 2386.62 2400.84 2415.06 2429.28 2443.5 2457.72 2471.94 2485.8
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