Canal de Isabel II

Sanitation

The integrated water cycle

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1. The importance of treating waste waters

We use the term waste water to describe the water derived from homes and towns as a result of a population's daily activities and also for the water arising from industrial activities.

When untreated waste water is discharged into a river it can have a number of effects:

- The introduction of large amounts of microorganisms some of which may be pathogens.
- The contamination of the water with chemical products that affect the life in the river.
- The consumption of the dissolved oxygen as a result of the decomposition of the organic material and ammoniacal compounds in the waste water, which can produce bad odours.
- If the waste water contains large quantities of phosphorous and nitrogen it can cause the eutrophication of the receiving waters.
- The wastes will accumulate along a river's banks and invert.

To alleviate these problems it is necessary to treat waste water before discharging it into the rivers in a condition that will not alter the environment.

2. The waste water treatment throughout history

Concerns about the quality of water and the removal of wastes have been present in all civilizations throughout history.

Remains of culvert pipes have been found in the ruins of some ancient cities in Crete and Assyria as well as sewers in cities across the Roman Empire.

In the late Middle Ages in Europe faecal water was deposited in underground excavations and later latrines were built. The contents of these cesspools were used as a fertilizer or they were discharged into nearby waterways. The Roman custom of constructing drains was subsequently revived, these drains were normally open canals or ditches in the street into which it was, in principle, prohibited to throw wastes, which were deposited directly into streams, lakes and estuaries. This caused serious public health problems due to the contaminated water that was transferred to other users.

The continual epidemics of cholera and other diseases in the early nineteenth century resulted in the generalised collection of waste waters in the larger cities. While, in the second half of the century, municipal water supply systems became established in the large cities along with the installation of plumbing in homes. The arrival of toilets and the first modern treatment systems popularised the construction of culverts in the larger cities.

The construction of the first culvert networks contributed to a reduction in the number of discharge points and improved local conditions compared to the previous situation. However, it also increased the concentration of the pollution and led to a worsening of the condition of rivers, creating unacceptable health and environmental conditions. This gave rise to the idea that the waste waters should be used to fertilise the soil.

This led to the first proposals for a waste water treatment system, complementing the previous concept of sanitation, based on the collection and transport of waste water as well as its treatment.

This lead to the emergence of nascent waste water treatment systems, mainly aimed at the elimination of solid materials and, subsequently, to the removal of soluble organic material through biological treatments.

It was only in the early twentieth century, however, when it was finally recognised that the discharge of wastes into rivers was causing public health problems. Disposal wells were introduced at this time as a primary treatment unit for domestic sewage and for processing waste waters both in suburban and rural areas, with initial adoption of the trickle filter technique.

However, the important advances did not arrive until the mid-twentieth century, and it was not until the 1970s when waste water started to be treated in a systematic manner. Although by the late 1960s there was already a good scientific understanding of conventional biological treatments.

Currently, the treatment processes also focus on obtaining water that is suitable for reuse in a variety of uses not directly related to human consumption and thus achieving an improved management of the resource.

3. The Madrid region and the cleaning of its waters

In 1761, during the reign of Carlos III, the Italian architect Francisco Sabatini initiated the use of "Sabatini wells" in buildings; these wells definitively separated waste water from solid wastes. From that time until now the sanitation of the Community of Madrid has developed in the same manner as in the other regions of Europe.

In the mid-nineteenth century it was decided to develop a water supply system for the city of Madrid, which until then had been supplied with water from public sources where the water arrived through water channels that ran through the city's subsoil. This project also included a nascent system of culverts consisting of eight basins with a total of 73 km of pipelines.

Over time the installation of sanitation in homes with the corresponding culverts increased but without resolution of the problem of water purification, as the waste waters continued to reach the rivers in appalling condition.

It was in the 1970s when Madrid City Council drafted and launched the first comprehensive sanitation plan for Madrid (CSPM). This brought about the canalisation of all the sewage and rainwater drains and the construction of 7 large treatment plants to treat all the capital's waste water.

Since 1984 the Community of Madrid has had a regional water supply and sanitation law, which has been followed from the outset by Canal de Isabel II, which at that time was attached to the regional Ministry of the Environment.

Construction on the first waste water treatment plants (WWTP) started in 1985, as scheduled in the Comprehensive Water Plan for Madrid (CWPM), which embodies the idea of the Community of Madrid's water policy, and which has the following objectives:

- Improve the collective wellbeing.
- Contribute to regional development.
- Improve environmental quality.

These first actions were directed at treating the waste water from urban centres that was entering reservoirs, as well as the waste water from the large urban agglomerations with a significant level of industrial development.

Towards the end of this first period the Sanitation and Waste Water Treatment Plan (SPP) 1995-2005 was developed, which included the ambitious project to extend the waste water treatment to all the municipalities within the Community of Madrid. In 1999, a further step was taken with the One Hundred Percent Purification Plan, which went beyond the requirements of the EU directive in providing treatment of all the waste waters from all the region's municipalities.

In 2005, an important management agreement was signed between the Community of Madrid, the City Council and Canal de Isabel II for the provision of sanitation services. This gave the company responsibility for management of all the existing large treatment plants in the capital, which service the needs of nearly four million users.

4. Sanitation in the Community of Madrid

Canal de Isabel II is the company that is currently responsible for all the sanitation services in virtually the whole of the Community of Madrid.

The management of treatment includes the transport of the waste waters through urban drainage networks to the waste water treatment plants (WWTP) and the subsequent purification of these waters to return them to the rivers in good condition. In order to carry out this task Canal has a complex system of facilities comprising municipal sanitation and culvert networks (collectors and outfalls), waste water pumping stations, storm tanks and waste water treatment plants.

Another step occurs with the reclamation of part of this water so that it can be reclaimed and used in cleaning and watering the public parks of the Community.

Watch a sanitation video

4.1 Urban drainage networks

The purpose of the urban drainage network is the collection of domestic and industrial waste waters and of rainwater runoff for its subsequent transport to the waste water treatment plants.

Canal is charged with maintaining these networks –with a current length of 13,069 km- across all the municipalities that have signed the agreement. This maintenance consists of the inspection and cleaning of all the network's elements, as well as carrying out emergency works and cartographic updating. A total of 785 km of collectors and outfalls are managed.

4.2 Waste water pumping stations

The company has a total of 126 waste water pumping stations (WWPS), designed to lift the waters and facilitate their transport to the WWTP wherever this is not possible by gravity feed.

4.3 Storm tanks

The company currently manages 63 storm tanks and retention tanks whose purpose is to avoid floods and discharges into the rivers. These installations can retain up to 1.46 hm^3 of the first rainfall, which are the most pollutive.

4.4 Waste water treatment

The company is responsible for all the water purification in the Community of Madrid, which involves 157 WWTP, constructed across the autonomous territory.

The processes undertaken in the WWTP are aimed at achieving the following objectives:

- The elimination of floating wastes, greases and oils, sand and generally all the larger elements that the water may contain.
- The elimination of settleable materials, both organic and inorganic.
- The elimination of biodegradable organic material dissolved in the water.

However, not all of the WWTP perform each possible treatment process, their design addresses a number of factors, such as: size or number of inhabitants covered, economic imperatives, seasonal variations in river flow, origin of the waste water or possible industrial discharges. The type of process included even determines the plant's physical aspects.

The treatment plants treat both the waste water that they receive -water line- and also the sludge generated by the purification process –sludge line-.

Water treatment line

- **Pretreatment**

  Basically the pretreatment eliminates the large bodies that arrive in the waste water inlet collectors.

- **Primary treatment**

  A process that reduces the solids in suspension as well as achieving a certain reduction in biochemical oxygen demand, as some of these solids are organic material.

- **Secondary treatment**

  Treatment to reduce the organic material in the waste waters after having passed through pretreatment and primary treatment. It consists of an aerobic biological process that can be carried out in a number of different procedures, followed by a secondary settling.

- **Tertiary treatment**

  In some WWTP the water is subjected to a greater degree of treatment than that provided by secondary treatment, which allows its use for irrigation in parks, street washing or industrial uses.

  The interest in tertiary or complementary treatments is mainly in having a filtration stage that includes the whole flow or part of it, to improve the discharge conditions or to allow its use as industrial process water either within the WWTP or outside.

Sludge line

The purification of waste waters leads to the production of a by-product called sludge. Within an urban waste water treatment plant it is possible to distinguish between primary sludges, solid sediments from primary settling and excess or biological sludges produced by the biological treatment process, which are removed from the system in the secondary settler.

The main processes of the sludge line include:

- Thickening.
- Stabilisation.
- Conditioning.
- Dehydration.

4.5 Waste water treatment plants

The waste water treatment plants are located in the basins of different rivers that cross the Community of Madrid: Alberche, Aulencia, Cofio, Guadalix, Guadarrama, Guatén, Henares, Jarama, Lozoya, Manzanares, Perales, Tajo and Tajuña. Below we will provide a brief summary of them:

River Alberche basin

The River Alberche basin has 9 waste water treatment plants. They provide a service for: Aldea del Fresno, Cadalso de los Vidrios, Cenicientos, Navas del Rey, San Martín de Valdeiglesias, Pelayos, Rozas de Puerto Real and Villa del Prado.

The most important treatment plant in this basin is the one located in Picadas. It entered service in 1987 and was designed for an equivalent of 19,500 inhabitants.

See a table of WWTP

River Aulencia basin

The River Aulencia basin has 4 waste water treatment plants, which provide a service for: Colmenarejo, Universidad Carlos III, San Lorenzo de El Escorial, El Escorial and Villanueva de la Cañada, as well as for the urbanisations of Los Escoriales, El Paraíso and Pinosol.

The most important treatment plant in this basin is that of Los Escoriales, which was designed for an equivalent of 75,000 inhabitants and entered into service in 1986.

See a table of WWTP

River Cofio basin

The River Cofio basin has 8 waste water treatment plants, which provide a service for: Colonias de La Estación, Las Juntas, La Hoya, La Paradilla, Las Herreras, Robledo de Chavela, Robledondo, Santa María de la Alameda and Valdemaqueda.

The most important treatment plant in this basin is that of Robledo de Chavela, which was designed for an equivalent of 20,000 inhabitants and entered into service in 1993.

See a table of WWTP

River Guadalix basin

This basin has 5 waste water treatment plants, which provide a service for: Bustarviejo, Guadalix de la Sierra, Miraflores de la Sierra, Navalafuente and San Agustín del Guadalix.

The most important treatment plant in this basin is that of San Agustín del Guadalix, which was designed for an equivalent of 30,000 inhabitants and entered into service in 1990.

See a table of WWTP

River Guadarrama basin

This basin has 14 waste water treatment plants, which provide a service for: Móstoles, Alcorcón, Fuenlabrada, Las Rozas, Majadahonda, Batres (urban area), Boadilla del Monte, the industrial estate of Alcorcón, Colmenarejo (east basin), Cercedilla, Los Molinos, Guadarrama, Puerto de Navacerrada, Collado Mediano, Villalba, Moralzarzal, Alpedrete, Navacerrada (village), El Escorial (partial), Guadarrama (partial), Galapagar, Sevilla La Nueva, Torrelodones, Villanueva del Pardillo, Villafranca del Castillo, Villanueva de la Cañada, Brunete, Navalcarnero, El Álamo, Arroyomolinos, Serranillos del Valle and Villaviciosa de Odón.

The most important treatment plant in this basin is that of La Reguera, which was designed for an equivalent of 272,210 inhabitants and entered into service in 2008.

Watch a video about La Reguera WWTP

See a table of WWTP

River Guatén basin

This basin has only one waste water treatment plant. The Guatén WWTP entered service in 2004, and was designed for an equivalent of 49,883 inhabitants. It provides a service for: Griñón, Torrejón de la Calzada, Torrejón de Velasco, Cubas de la Sagra and Casarrubuelos.

See a table of WWTP

River Henares basin

This basin has 6 waste water treatment plants, which provide a service for: Alcalá de Henares (partial), Meco, Los Santos de la Humosa, Fresno de Torote, Ribatejada and Valdeavero.

The most important treatment plant in this basin is that of Alcalá Oeste, which was designed for an equivalent of 374,090 inhabitants and entered into service in 1989.

See a table of WWTP

River Jarama basin

This basin has 32 waste water treatment plants, which provide a service for: Algete, Aranjuez, Alcobendas, San Sebastián de los Reyes, Cabanillas de la Sierra, Campo Real, San Fernando de Henares, Coslada, Torrejón de Ardóz, Ajalvir, Daganzo de Arriba, Cobeña, El Vellón, El Molar, Pedrezuela, Fuente el Saz, Valdemoro, Alalpardo, La Cabrera, Arganda del Rey, Madrid (San Blas, Ciudad Lineal, Hortaleza and Fuencarral-El Pardo), Barajas, El Molar (industrial area), Patones de Abajo, Pozuelo del Rey, Redueña, Valdemoro, Ciempozuelos, San Martín de la Vega, Talamanca del Jarama, Titulcia, Torrelaguna, Torremocha del Jarama, Tres Cantos, Paracuellos del Jarama, Valdepiélagos, Valderrey urbanisation, Valdetorres de Jarama (Los Sililos and Matadero urbanisations), Velilla de San Antonio, Mejorada del Campo, Loeches, Torres de la Alameda, Villalbilla and Venturada.

The most importand WWTP is Torrejón de Ardóz, which entered service in 2009, and was designed for an equivalent of 450,000 inhabitants.

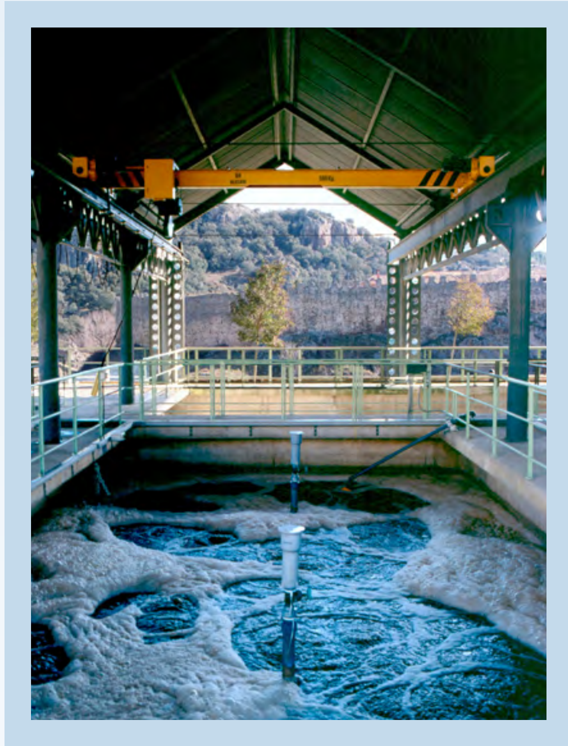
See a table of WWTP

River Lozoya basin

This basin has 31 waste water treatment plants, which provide a service for: Aoslos, Cervera de Buitrago, Cinco Villas, Gascones, Braojos, La Serna, Villavieja, El Atazar, El Berrueco, Gandullas, Horcajo de la Sierra, Horcajuelo de la Sierra, La Hiruela, Lozoyuela, Madarcos, Manjirón, Montejo de la Sierra, Navarredonda, Navas de Buitrago, Paredes de Buitrago, Rascafría, Alameda, Oteruelo, Pinilla, Lozoya, Pinilla de Buitrago, Piñuécar, Prádena del Rincón, Puebla de la Sierra, Buitrago, Berzosa del Lozoya, Canencia, Garganta de los Montes, Gargantilla de Lozoya, Robledillo de la Jara, Robregordo, San Mamés, Serrada de la Fuente, Sieteiglesias and Somosierra.

The most importand WWTP is Riosequillo, which entered service in 1990, and was designed for an equivalent of 14,083 inhabitants.

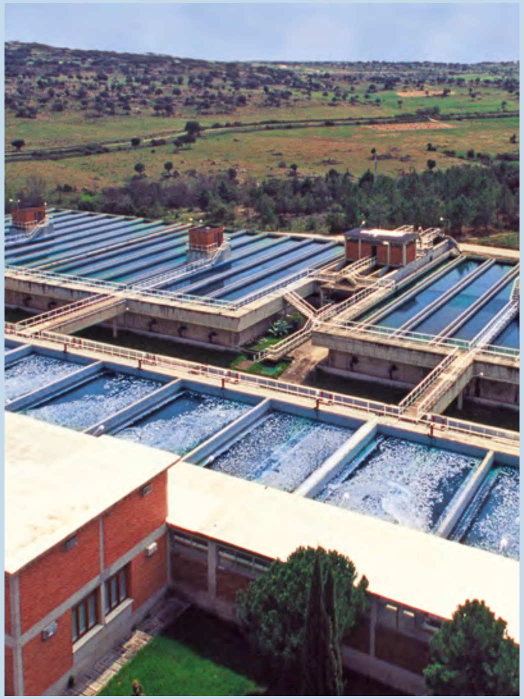
See a table of WWTP



River Manzanares basin

This basin has 16 waste water treatment plants, which provide a service for: Academia de Ingenieros (Hoyo de Manzanares), Getafe, Pinto, Fuenlabrada, Parla, Leganés, Humanes, Madrid (Villaverde, Usera, Latina, Carabanchel, Moncloa-Aravaca, Chamartín, Tetuán, Chamberí, Centro, Arganzuela, Retiro, Ciudad Lineal, Salamanca, Moratalaz, Puente de Vallecas, Vicálvaro and Villa de Vallecas), Pozuelo de Alarcón, Alcorcón, Hoyo de Manzanares, La Mina industrial estate, Las Matas, Los Peñascales, Las Rozas, Colmenar Viejo, Becerril, Moralzarzal, El Boalo, Manzanares, Soto del Real, Rivas Vaciamadrid, Majadahonda and Las Rozas.

The most important treatment plant in this basin is that of La Navarrosillos, which was designed for an equivalent of 113,333 inhabitants and entered into service in 2008.



Watch a video about Arroyo Culebro Upper Middle Basin WWTP

See a table of WWTP

River Perales basin

This basin has 11 waste water treatment plants, which provide a service for: Chapinería, Colmenar del Arroyo, Fresnedillas de la Oliva, Navalagamella, El Peralejo urbanisation, Quijorna, Valdemorillo, Villamanta, Villamantilla, Villanueva de Perales and Zarzalejo.

The most important treatment plant in this basin is that of Valdemorillo, which was designed for an equivalent of 13,000 inhabitants and entered into service in 1993.

See a table of WWTP

River Tajo basin

This basin has 7 waste water treatment plants, which provide a service for: Aranjuez, Brea del Tajo, Colmenar de Oreja, Estremera, Fuentidueña de Tajo, Villaconejos and Villamanrique de Tajo.

The most important treatment plant in this basin is that of Aranjuez, which was designed for an equivalent of 157,500 inhabitants and entered into service in 1989.

See a table of WWTP

River Tajuna basin

This basin has 12 waste water treatment plants, which provide a service for: Belmonte de Tajo, Carabaña, Chinchón, Ambite, Nuevo Baztán, Olmeda de las Fuentes, Villar del Olmo, Morata de Tajuña, Orusco de Tajuña, Perales de Tajuña and Tielmes, Pezuela de las Torres, Valdaracete, Valdelaguna, Valdilecha and Villarejo de Salvanés.

The most important treatment plant in this basin is that of Chinchón, which was designed for an equivalent of 15,260 inhabitants and entered into service in 2004.

See a table of WWTP

5. Reclamation of treated water and cogeneration

By definition reclaimed waters are purified waste waters that have been subjected to an additional or complementary process to make its quality suitable for the use it is destined for (irrigation of green areas and sports facilities and certain industrial uses). In our country, this use is regulated through Royal Decree 1620/2007, which established the legal framework for the reuse of reclaimed waters.

The discharge of effluents to river courses throughout history has provided naturally reclaimed water for use where required downstream. With increasing pollution the reclamation process of the water should be performed in a direct and planned manner, focussing on it as another task in the integrated management of water.

The reclamation of treated waste water contributes to the net increase in availability of water in the region. Over the last few years, Canal has increased the distribution of reclaimed water for facilities that do not require drinking water.

Canal has 29 production facilities with a capacity to produce 204,428 m^3 of reclaimed water daily (the figure does not include the Madrid City Council WWTP) and operates 428 km of specific networks that facilitate the distribution of reclaimed water for irrigation of parks and public gardens, streat cleaning and industrial uses.

We also have 11 power plants that generate electricity for biogas produced by the processes of the WWTP, a cogeneration plant associated with the thermal drying of sludges and a small waste water weir.

Canal de Isabel II