

# Reclaimed Water for the Montjuïc Mountain in Barcelona

*An alternative water resource for irrigation of parks, gardens and sport facilities, and for street flushing and sewer system cleaning.*

Barcelona, February of 2011.

January 2011 was the chosen date for the inauguration of the reclaimed water conveyance and distribution system for the supply to several environmental, recreation and public services uses at the Montjuïc mountain, in Barcelona. Reclaimed water is produced at the Water Reclamation Plant (WRP) of El Prat de Llobregat. The main objective of this project is to promote the use of alternative water resources (up to 400,000 m<sup>3</sup>/year, in a first phase), to improve the city's self-sufficiency and to achieve the Commitment for Sustainability – Agenda 21 of Barcelona during the period 2011-2012. An additional objective is to provide alternative water resources to industrial facilities in the Pratense Industrial Park, the Zona Franca Industrial Area and the Barcelona Harbor, so they can replace the underground water resources currently used and consequently promote the storage capacity and the reliability of the Llobregat Aquifer as a strategic water reserve.



Figure 1. Official inauguration of the reclaimed water pumping and distribution system to the Pratense Industrial Park and the Montjuïc mountain in Barcelona.

The project includes a pipeline of 10.5 km, that begins at the WRP of El Prat de Llobregat, on the left bank of the Llobregat River and very close to Barcelona International Airport, continues by Barcelona Zona Franca and reaches the Montjuïc mountain at an upstream storage tank, with 70 m elevation and 100 m<sup>3</sup> capacity in a first phase (an additional tank of 1,000 m<sup>3</sup> is planned), at the intersection of Fuego Street, Olympic Avenue and Pierre de Coubertin Street. From that point, water is pumped to the Vivero de los Tres Pinos storage tank, located at 125 m elevation, so it can be distributed for gravity irrigation and in part pumped to the Montjuïc Castle storage tank, at 175 m elevation.

The construction elements of this project are:

1. A new pumping station located at the WRP of El Prat de Llobregat, equipped with two pumps of 80 L/s each, and enough space for 2 more pumps (second phase of the project).
2. A conveyance pipeline of 5.8 km length and 400 mm diameter that goes along A Street in the Barcelona Zona Franca.
3. A conveyance pipeline of 3.4 km length and 200 mm diameter from the limit of the Barcelona Zona Franca to the upstream storage tank in Montjuïc (70 m elevation).
4. A pumping station that supplies a hydrant (used to supply municipal mobile tanks) and a pipeline of 1.3 km length that conveys reclaimed water from the upstream tank to the storage tank of Vivero de los Tres Pinos.

Reclaimed water supplied by this project is produced at the WRP of El Prat de Llobregat, with a capacity of 300,000 m<sup>3</sup>/day, equivalent to 3.5 m<sup>3</sup>/s and 100 hm<sup>3</sup>/year, which offers the possibility of reclaiming practically all the secondary effluent from the Wastewater Treatment Plant of El Prat de Llobregat. The WRP began operating in 2006, and has two consecutive water reclamation processes, plus an additional onsite treatment facility for agricultural irrigation:

- 1) A basic water reclamation process that includes a coagulation-flocculation stage, a micro sand ballasted lamellar settling, a micro screening process and a disinfection process using ultraviolet light with the option of an additional chlorination stage. This plant is supplied with secondary effluent from the Wastewater Treatment Plant and has a capacity of 300,000 m<sup>3</sup>/day (3.5 m<sup>3</sup>/s).
- 2) An advanced water reclamation process that includes membrane ultrafiltration, reverse osmosis (RO) and additional disinfection with ultraviolet light. This plant is supplied with reclaimed water from the previous water reclamation plant (located nearby) and has a capacity of 15,000 m<sup>3</sup>/day (0.17 m<sup>3</sup>/s).
- 3) An advanced water reclamation process that includes a rapid sand filter and a double stage electro dialysis reversal (EDR) process. This plant is supplied with reclaimed water from the basic reclamation process, has a capacity of 65,000 m<sup>3</sup>/day (0.75 m<sup>3</sup>/s) and is located at the agricultural irrigation areas.

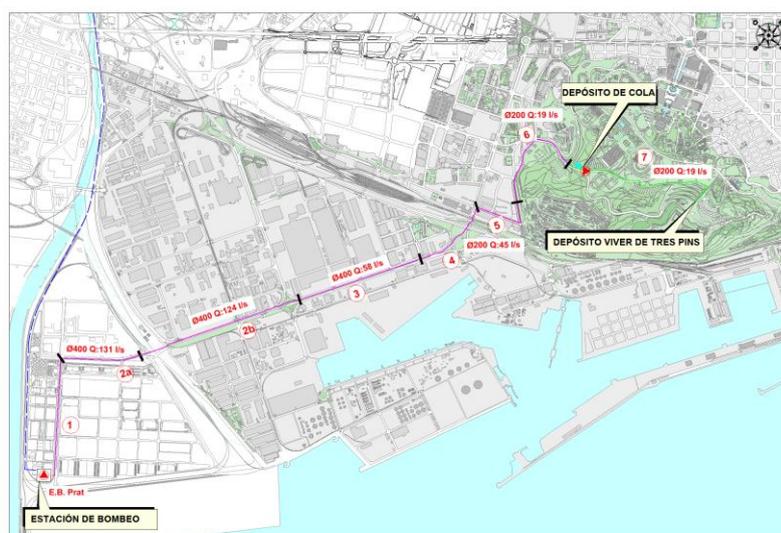


Figure 2. Reclaimed water pumping and distribution system to the Pratense Industrial Park and the Montjuïc mountain in Barcelona.

The basic reclaimed water satisfies the quality limits required for Urban Uses, Quality 1.1: Residential, established by Royal Decree 1620/2007 that sets the legal framework for water reuse. This basic reclaimed water is applied to several uses, such as restoration of natural wetland areas, agricultural and landscape irrigation, augmentation of in-stream flows in the Llobregat River, groundwater recharge at the Llobregat aquifer, supply to the advanced water reclamation process and supply to industrial parks and landscape irrigation at the Montjuïc mountain. The quality of the advanced reclaimed water is very similar to drinking water quality and meets the requirements of Royal Decree 1620/1977, both for Urban Uses and for groundwater recharge of drinking aquifers by direct injection. Advanced reclaimed water (using RO) is used to supply the 14 injection wells that form the seawater intrusion barrier located under Barcelona Zona Franca.

The planned uses for reclaimed water in the Montjuïc project include irrigation of the Pierre de Coubertin landscape areas, the landscape areas near the Botanical Garden, the moat of Montjuïc Castle and the gardens of Mossèn Cinto Vedaguer and Joan Brossa. The irrigation plans also include the sport facilities of the Montjuïc mountain, such as the Carlos Pérez de Rozas municipal baseball field and the Parc Negre/Parc del Migdia municipal sports centre. In addition, the pipeline going along A Street in the Barcelona Zona Franca will supply reclaimed water to numerous industries that currently have their own groundwater supply and that are experiencing increasing difficulties with water salinity, due to a long term and localized seawater intrusion process promoted by water over-extraction.

A demonstration project with Clariant Ibérica S.A. company should begin shortly to provide reclaimed water as a raw material for its industrial processes. Plans are also considered for drafting new metropolitan regulations to authorize drinking water supply companies to participate in the management of reclaimed water for supply to industrial users. The future collaboration with researchers of the Montjuïc Botanical Garden will provide a very valuable assessment of the benefits and the requirements to be considered when using reclaimed water for landscape irrigation.

The development of this Project has required an investment of 8.1 M€, corresponding to the following construction elements:

1. The pumping station and the conveyance pipeline from the WRP of El Prat de Llobregat to the limits of the Montjuïc mountain, through the Barcelona Zona Franca, has required an investment of 4.1 M€, which was managed by the Metropolitan Agency for Hydraulic Services and Solid Waste Treatment and was financed by the Catalanian Water Agency, as the river basin authority in Catalonia.
2. The portion of pipeline going along A Street in the Barcelona Zona Franca has required an investment of 2.1 M€, financed by the Catalanian Water Agency.
3. The pipeline that conveys reclaimed water from the limit of the Barcelona Zona Franca to the Montjuïc mountain facilities, including the upstream storage tank and the pumping facilities to bring water to the Vivero de los Tres Pinos tank, has required an investment of 1.9 M€, financed by Barcelona's City Council.

Planning, construction and operation of this water reclamation supply project have been possible thanks to a close political and technical collaboration, as well as to the budgetary contribution of the three competent institutions in the area:

1. The Catalanian Water Agency, as the river basin authority in Catalonia, interested in promoting new water resources.
2. The Metropolitan Agency for Hydraulic Services and Solid Waste Treatment and its public company EMSSA, responsible for water supply and sanitation in the

metropolitan area, as well as for the operation and maintenance of the WRP of El Prat de Llobregat that provides the reclaimed water.

3. The Barcelona City Council, as the final user of this new, additional, alternative water resource interested in promoting self-sufficiency, reliability and sustainability of the available water resources.

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