



Arroyofresno storm water tank in Madrid

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The Arroyofresno storm water tank is a rainwater storage with a capacity of 400.000 m³, making the largest in his category in the world at this time. This tank is located within the city of Madrid, so it has been built with an underground park on the top of the tank, and there is a golf course on surface.

Location	Madrid
Developer	Madrid City Council Department for the Environment
Finishing date	June of 2009

Project to build a storm water tank for storing the water collected in the new Arroyofresno sewer. The area of action covers the banks of the River Manzanares from the El Pardo dam to the Viveros WWTP.

General description of the project

The general design of the project consists of:

- A divider where flows that cannot be carried by the Viveros outfall during rainy periods are diverted to the storm water tank.
- Mains inlet to the tunnel and work necessary to attenuate the energy caused by the difference in level between the mains and the tunnel.
- Storm tank with a capacity of 400,000 m³ equipped with inlet work to attenuate the difference in energy between the incoming flow and the water storage areas.

- Two pumps with capacities of 4.8 and 10.5 m³/s to send the water stored in the tank to the sewer system.

Arroyofresno sewer	
Tunnel length	3017.83 m
Cross section	Ø 6.70 m
Design flow	30 m ³ /s
Maximum flow	100 m ³ /s

The normal way of working is that during rainy periods, the flow that cannot be handled by the Viveros WWTP is diverted through the new main into the tunnel for storage in the storm tank until it can be treated in the waste water treatment plants downstream after pumping it to the sewer system on the banks of the River Manzanares.

New Arroyofresno sewer

The new sewer is a tunnel bored with an EPBS (Earth Pressure Balance Shield) tunnel boring machine and has an interior diameter of 6.70 m. This main has a capacity of 112,77 m³/s which is 80 times the flow of the inlet sewage. The flow entry is regulated by the Arroyofresno divider.

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Divider and tunnel entrance

The new divider was designed to provide a flow of up to 30 m³/s in normal situations although it can divert the entire flow reaching the divider, limited to 70 m³/s, to the tunnel and tank.

Before the water enters the tunnel, it must drop some 11 m, the difference in level between the divider's control lip and the tunnel entrance. This requires a waterfall and shock absorbing bed so that the water enters the tunnel at suitable speeds.

Tank inlet

The level at which the tunnel reaches the tank and its gradient were established using the following premises:

- The height or water level must not be greater than 80% of the free height of the cross section at peak flow.
- The level at which the tunnel passes under the river must leave a covering of 1.00 m to allow a slab to be built.
- The necessary traffic handling and diversions for carrying out the work were made.
- The level at the tank inlet must be the maximum compatible with the river crossing.
- The gradient must be the maximum possible compatible with the maximum speed to reduce the initial drop between the mains in the Arroyofresno Street and the level of the tunnel.
- The final level in the tank must be the maximum possible to reduce excavation to the maximum.

Storm tank

The tank is divided into two areas so that in short storms, with smaller accumulated water volume and of greater frequency, the water remains in the first area and only during larger volume storms, of lower frequency, will fill the second area.

The criterion used to set the volume needed for each area was the availability for the first one of a capacity of 20 m³ per hectare of impermeable soil.

The Arroyofresno water course has an area of 2,237 ha, of which 85% is impermeable soil and the rest, green areas, so that the maximum necessary capacity would be 38,030 m³, although, because of the convenience of locating the pumping station inside it and setting the maximum level for this area as the threshold of the tunnel outlet, this area has a volume of 48,000 m³.

Pumping station

The capacities of the pumping stations for the right and left bank mains were set at 10,5 and 4,8 m³/s respectively.

Two criteria govern the sizing of the draining of the storm tank:

- The tank drainage time.
- The capacity of the treatment installations located downstream.

In this case, the tank drainage must be compatible with the treatment capacity of the installations downstream, which are:

- La China WWTP and Southern WWTP on the left bank
- Butarque WWTP on the right bank.

The right bank main takes the water to the Butarque WWTP, with a treatment capacity of 10.5 m³/s. In normal operation, the sewage from the Butarque water course is led to the existing treatment station.

The left bank main takes the water to the La China WWTP and, downstream, to the Southern WWTP. The maximum pumping flow on the left bank was set at 4.8 m³/s, this being the maximum flow in the pre-treatment in the La China WWTP. This plant has a flow bypass before the biological treatment.

Looking for sustainability

Because the Arroyofresno Storm Water Tank is within the city of Madrid it was designed to allow its surface to be made use of: an underground car park has been built on top of the tank freeing the space currently occupied on the surface, and on top of this underground car park there is a golf course.

To reduce the environmental impact of bad odours from the stored wastewater, and to avoid problems with the users of the car park and the golf course, the latest generation deodorising treatments have been installed to eliminate them completely.