



**THE MANZANARES RIVER RESTORATION (NORTHERN  
MADRID -SPAIN-): DEMOLITION OF AN OBSOLETE DAM  
AND RIVERINE ECOSYSTEM REHABILITATION**

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**ABSTRACT**

Manzanares river, in the Tajo basin, has its source within the mountains of the Sistema Central chain, located in the northern part of the Madrid region. During the first few kilometers, the river flows across an area where the granite geology and the pristine nature are so interesting and unique, that has been declared as a Regional Park and as well as an UNESCO Biosphere Reserve since 1992.

In the heart of this area, during the decade of the 40s, a dam was built in the Manzanares river in order to supply water to the village located downstream. Year by year the dam has accumulated such a big quantity of sediments coming from the granite banks and slopes, that at the end of the century it was completely full of sand, in such a way that it became useless and an ecological disaster.

The Confederación Hidrográfica del Tajo (the river basin authority) in collaboration with other authorities, stated as an achievement this dam demolition. The target was to give back to the river the natural features it had before the dam construction.

As the dam was located in a protected area, one of the goals was to preserve -as far as possible- all the natural values of the surroundings, trying to accomplish all the works without damaging the river bed, the banks and the areas nearby, keeping as well flora and landscape features. The works were carried out in three stages: in each one the target was the demolition of a part of the dam through different controlled detonations and then the waste removal. This task was carried out through an helicopter, as the path between the river bank and the granite slope was so narrow that a heavy machine would have caused a significant destruction of it.

The last goal was to restore the river bed and banks that had been affected by the dam -while existing- and the demolition works. During this stage the tasks were just a light reforestation and not much more, as the river flow was able to remove the last sand particles that had been retained near the old dam.

*Key words:* Dam demolition, Manzanares River, Hydromorphic recovery.

## 1. INTRODUCTION

Manzanares river has its source within the mountains of the *Sistema Central* chain, located in the northern part of the Madrid region. It is part of the Tajo basin, one of the big basins demarcations in Spain. During the first few kilometres, the river flows across a zone called “*paraje de el Tranco*”, situated inside the heart of an area where the granite geology and the pristine nature are so interesting and unique, that had been declared as a Regional Park (*Parque Regional de la Cuenca Alta del Manzanares*) and as well as an UNESCO Biosphere Reserve since 1992. This Park has an extension of 528 Km<sup>2</sup>, that means the 7% of the whole surface of Madrid region.

In this area the granite substrate has been shaped for ages by the atmospheric agents erosion, in such a way that the resulting landscape has an astonishing richness of different shapes, tors, rounded massifs, rocky labyrinths made out of huge round polish granite volumes and big natural stone sculptures. All this natural area is crossed by many rivers (among them, the main one is the Manzanares, the river that some kilometers downstream crosses Madrid city) and other small water flows, surrounded by flora and fauna well preserved and characteristic.

As far as the most important and representative elements of the Regional Park are its rivers and streams, the main goal in nature preservation in this area is river protection and, if needed, river restoration.

## 2. GENERAL SETTING

During the decade of the 40s, a small dam (9 meters high, 23 meters width) was built in the Manzanares river, in a site placed inside the Regional Park, in order to supply water to the village –Manzanares del Real- located few kilometers downstream. Year by year the dam has accumulated such a big quantity of sediments coming from the granite banks and slopes, that at the end of the century it was completely full of sand, in such a way that it became useless.

So, this abandoned dam full of sediments and partially damaged, turned into an ecological disaster that was the responsible of the decrease of natural values within the riverine ecosystem, a disruption of the longitudinal and transversal river continuity, a barrier for trouts and other species, a nutrients trap, an obstacle to normal flow and hydrodynamics, as well as a serious danger for the Park visitors if a sudden collapse may occur.

The river basin authority, that belongs to the Spanish Ministry of Environment -Confederación Hidrográfica del Tajo- in collaboration with other authorities (the local Council and the Madrid Autonomous Community), stated as an achievement this dam removal, in order to solve the problems the structure was inducing in the riverine ecosystem. The main

target was to give back to the river the natural features it had before the dam construction and to recover the longitudinal and transversal continuity.



Figure 1 – Manzanares dam before the demolition

### 3. WORK PLANNING

As the dam was located in a protected area, one of the goals was to preserve -as far as possible- all the natural values of the surroundings, trying to accomplish all the works without damaging the river bed, the banks and the areas nearby, keeping as well flora and landscape features. On the other hand the area is part of a Regional Park situated near a big city as Madrid, so it was important to take into account the large amount of daily visitors (walkers, trekkers, climbers...) which can be affected by the works and by the consequences of an intervention within a heavily used route (as the dam access is part of a long path that connects different and very popular areas of the Park).

In order to accommodate all these requirements one of the problems was to decide how to accomplish the dam demolition: it was important not to destroy the river banks and not either the pedestrian path that goes along them, limited in both sides by the riverbed and the granite slopes. So, it was impossible to use heavy machines to remove the dam by mechanical

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impacts, as the transport of them from the car parking up to the dam, would have ruined the narrow path and affected the river banks and slopes.

The same problem had to be solved in order to remove the concrete blocks once the demolition had been carried out.

### 4. WORK STAGES

The decision of which demolition and removal techniques must be followed, was taken after an analysis of the situation and an economical assessment: it was more profitable to use explosive material to break the wall into big pieces and then remove the demolition waste by an helicopter.

The works were carried out in three stages: in each one the target was the demolition of a part of the dam through different controlled detonations and then the masonry and sand removal. Once the detonations had split into big pieces the dam wall, it was necessary to obtain lower sized blocks in order to allow the helicopter carry them into big bags. This task was accomplished by a relatively small mechanical digger, which was chosen because of its “spider-legs” that could allow its access trough the river bed with minimum impact due to the reduced footholds. For this works 500 hours of spider excavator were needed to fill 3.500 bags (1.600m<sup>3</sup> of waste).



Figure 2. Mechanical digger

The most difficult –and expensive- task was actually the demolition waste removal once each part of dam was split into small pieces. This task was carried out through an helicopter because was unfeasible the use of any truck or even a pick-up for the waste transport, as the path between the river bank and the granite slope was so narrow that a heavy machine would have caused a significant destruction of it. For this stage 110 hours of helicopter were needed.

Finally, once the removal was achieved, the next goal was to restore the river bed and banks that had been affected by the dam -while existing- and the demolition works. During this stage the tasks were to remove and set out the sand in order to give more uniformity to the surrounding banks and ground were it was needed, as the river flow was able to remove the last sand particles that had been retained near the old dam. As well it was carried out a light reforestation to give more stability to the slopes and enhance the riverine vegetation recovery. And at the end were removed all the artificial elements that were used during the works, as metallic fences or others. For the whole works, since the very beginning till the end, were needed a total of 1.100 day's wage.



Figure 3 – Manzanares dam after the demolition

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## **5. CONCLUSIONS**

After several months of works and with the aid of the hydraulic dynamics, the Manzanares river has been able to regain the appearance, the longitudinal and transversal continuity and the ecological dynamic that it should have had if the dam wouldn't had been built.

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