

Fluvial Restoration of the Manzanares River in the surroundings of the Real Sitio de El Pardo (Madrid) ^[1]

Pursuant to the Water Framework Directive and in accordance with the environmental objectives of the Hydrological Plan of the Tagus River Hydrographic Basin, in coordination with Patrimonio Nacional (as the entity that manages the Monte de El Pardo area), the improvement of the ecological condition of the river has been proposed as well as the recovery of this space of great environmental value, from the Pardo Reservoir to the confluence with the La Trofa stream (a distance of approximately 6 km). This section coincides with Water Body ES030MSPF0428021 «Río Manzanares», which is cataloged in the Hydrological Plan as a water body that is "highly modified" from El Pardo Reservoir to the La Trofa stream.

Case Study Description

Challenges:

The Manzanares River in the vicinity of the El Pardo Royal Site has been affected over the years by a series of hydromorphological alterations that have caused important changes in the conditions of both the riverbed and its riverbank. To the naked eye, the river appears as a succession of backwaters as a consequence of the existence of a series of different types of barriers in the channel. In particular, one of these barriers is a "pseudonatural" dam that forms at the confluence of the Manzanares River with the La Trofa stream, as a result of the accumulation of sediments (mainly sands) from the intense erosion of the basin of this stream. But these are not the only alterations that affect the basin of both channels: the Manzanares River in the study section has a hydrological regime in which, on the one hand, the circulating flow is insufficient to mobilize the sediments at the confluence with the La Trofa stream, and on the other, the lack of sediments in this flow is creating incision problems along the entire stretch and, in general, the loss of fluvial space. Furthermore, a high nutrient content has also been detected in the La Trofa stream.

The aforementioned alterations are very likely to become aggravated in a scenario of climate change, where a decrease of the usual flows is foreseeable as well as an increase in the frequency and intensity of flood events. If we add to this the increase in temperatures, the most immediate expected effects will be the decrease and homogenization of the aquatic biotope, the increase in the processes of incision and greater eutrophication, with the consequent development of helophytes and the decay of riparian vegetation.

Hence, this is why this intervention is proposed: to adapt these bodies of water and associated ecosystems to the effects of climate change, which can be simplified into three main phenomena:

- The increase in temperatures will lead to a greater deterioration of the channel with the eutrophication of its waters, the increase of the existing reeds and the increase in the mortality of the riparian forest.
- The decrease in rainfall will mean that the reservoir upstream of this stretch will have greater capacity to safeguard itself against floods, so that the downstream river will increasingly resemble a wetland with a constant flow. The absence of floods will encourage siltation of the beds and the development of vegetation within the channel.

On the other hand, intense precipitation phenomena will have opposite effects on the La Trofa stream basin, favoring greater erosion than that which exists currently

Objectives:

Contribute to the improvement of the ecological condition of the Manzanares River and the La Trofa stream and serve as a pilot example of a measure of adaptation to climate change in the field of river management.

Contribute to the fulfillment of the environmental and hydrological objectives according to the current regulations (Hydrological Plan and Flood Risk Management Plan of the Tagus River Hydrographic Basin).

Recovery of the natural hydrological, morphological and ecological conditions of the river (permeabilization of artificial structures, recovery of riparian groves and disturbed areas).

Recover the longitudinal and transversal connection of the channel.

Recover the accessibility to the channel, encouraging public use.

Bring the river closer to its users, adapting paths and trails and optimizing public and recreational spaces.

Reduce flood risks in the area and downstream in the city of Madrid.

Extend the environmental corridor of the Manzanares River (establish a meeting point between the city and the natural environment).

Adaptation measures implemented in the case study:

[Structural/physical: Engineering alternatives and options for built environments](#) [2]

[Structural/physical: Ecosystemic options](#) [3]

[Social: Information options](#) [4]

Solutions:**MANZANARES RIVER**

- Actions for recovery and improvement of fluvial habitat
- Previously to the barrier permeabilization works in the Manzanares River, native fish species were rescued (capture and transfer)
- The number and diversity of refuge and reproductive microhabitats for aquatic organisms has increased by placing rocks and/or trunks in the river section
- Actions to improve plant cover
- Silviculture work and elimination of exotic vegetation

They include cleaning of the vegetation by pruning and clearing and, in some cases, removing the specimens that are in poor phytosanitary condition.

- Restoration of riparian vegetation

Plantation of irregular forest of native species in bands parallel to the channel and protection of singular trees

- Recovery and improvement of hydrological continuity

-Removal of sediments in La Trofa stream

The homogenization of the flow regime in the Manzanares River and the increase in erosion and discharges from several sewage treatment plants into the stream basin had created an island of sediments, which have been partially removed to ensure an adequate slope is attained for the bed to recover the original width of the river.

- Lowering of gauging station slab

The foundation slab of the Mingorrubio gauging station has been removed to lower the current bed level and eliminate the backwater generated upstream.

- Installation of fish ramp in the El Pardo dam to facilitate the migration of native fish species.

- Morphological recovery of the riverbank space

- Removal of fillings and softening of slopes, improving accessibility to the river

- Restoration of the "Las Madroñeras - Freijo" ravine

The Las Madroñeras ravine is a gully complex used for the extraction of aggregates at the time of the construction of El Pardo dam.

- Sustainable public use and interpretation of nature

- Pedestrian footbridge installation to recover pedestrian communication between both banks, which was eliminated with the demolition of the old Mingorrubio gauging station.

- Adaptation of different types of paths and trails

Those affected by earthworks have been made fit to ensure the safety of users.

- Interpretive material. Signage and information panels

Information panels have been placed that show the main natural and/or cultural characteristics of the river. In addition, the network of paths and trails has been marked.

UNDERTAKINGS IN THE LA TROFA STREAM

- Zone limited to wildlife

- Hunting enclosure

To minimize the causes of erosion, the area stretching from the stream crossing with the railway line to its mouth in the Manzanares River has been delimited.

- Drinking troughs - rafts

Since the enclosure results in usage restrictions of part of the stream basin, it is considered necessary to install troughs outside the enclosure.

- Enclosure at the confluence with the Manzanares River

At the point of confluence, the fence delimiting the Monte de El Pardo periodically suffers breakage due to flooding of the stream. A permanent structure has been built to withstand strong floods and allow the evacuation of large volumes of water and sand.

- Riverbed elevation and lateral reconnection

- Installation of hydraulic elements

It facilitates earthworks and smoothing of slopes, which raises the bed and enhances the functionality of the floodplain, favoring the connection of vegetation with the water table.

The recovery of the vegetation and the natural purification of the waters coming from the municipalities of the upper part of the basin will also contribute to sediment retention.

- Sediment traps

To contribute to the stability of the materials supplied from earthworks, "fixed points" are established in the channel which, acting as a sediment trap, produce a backwater upstream.

- Recovery of riparian and undergrowth vegetation

In the band closest to the stream, deep-rooted ash trees have been planted and staked out with willows, while shrubs, scrub and trees native to the area have been planted in areas further away from the stream.

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High nutrient values have been detected due to effluents reaching the stream. Macrophytes with high phytodepuration potential have been planted while a biotope of interest for birds and amphibians has been generated.

GENERAL UNDERTAKINGS

- Maintenance and conservation

- Replanting

- Maintenance irrigation

- Path/trail maintenance

- Sanitation of riverside vegetation

- Ecological and Environmental Monitoring

During the three subsequent years, the effect of the measures on the ecological conditions of the water body, hydromorphological conditions, state of vegetation, etc. will be evaluated. The works already carried out in this sense have allowed to design part of the undertakings to be performed in phase 2 of the project.

Additional Details

Stakeholder engagement:

- Promoting Agency: General Directorate of Water. Confederación Hidrográfica del Tago (Ministerio para la Transición Ecológica (MITECO)).

-Collaborating Agencies: General Directorate of the Spanish Office of Climate Change (OECC), Patrimonio Nacional, City of Madrid, Region of Madrid.

-University: Escuela Técnica Superior de Ingeniería de Montes, Forestal y del Medio Natural (Universidad Politécnica de Madrid)

-Research Centers: Centro de Estudios y Experimentación de Obras Públicas (CEDEX)

-Other entities involved: "El Pardo Neighborhood Association" and "El Pardo en Común Neighborhood Association".

After drafting the project under the coordination of the General Directorate of Water and the Tagus River Hydrographic Confederation of the Ministry for Ecological Transition (MITECO), with the collaboration of the Spanish Office of Climate Change (MITECO), river restoration activities in this stretch of the Manzanares River began, with the goal to achieve its environmental recovery and adaptation to climate change.

Regarding the surrounding population, several meetings have been held with the neighborhood associations to explain the projected actions and resolve doubts about its execution. During the months of March and April of 2017, a study was conducted to learn about the valuation of the Manzanares River restoration project, the valuation of the surroundings, characterization of visitors and knowing their influx and habits.

A project website was created as one of the initiatives that favored the dissemination of the project, which allows to know the progress of the works and the results obtained.

A project information booth was installed next to the Somontes car park, where on weekends the public was informed about the river restoration activities that were to be carried out.

Project interest:

It is intended that this project serve as a pilot example of a measure of adaptation to climate change through an impulse to the management of the fluvial environment.

As part of the Manzanares River restoration project in El Pardo (Madrid), a host of actions and some spatial planning and management guidelines were collected, in order to improve the state of the river and its surrounding environment and ensure its conservation and value.

Given the great potential of the Manzanares River for public use and environmental education and due to its proximity to the city of Madrid, restoration of the river is considered of great interest in the vicinity of the El Pardo Royal Site, contributing to the improvement of the ecological state of the river and the recovery of this area of ??great environmental value.

In addition, in this first phase of the project, pilot actions have been incorporated on which subsequent monitoring has been established, which has allowed a first evaluation and redefinition of the actions for subsequent phases. Phase 2 is scheduled to begin in the coming months, and it has already included more widespread these pilot actions once proven effective, which can also be exported to other scenarios with similar problems.

Success and limiting factors:

One of the key aspects of the project has been to improve the perception among the citizens of the problems that threaten the fluvial ecosystem and that result in those symptoms that can be seen at a glance: dry vegetation, deepening and narrowing of the channel, areas of dammed water ... The project area is one of the areas most used by locals for enjoying leisure activities. From the beginning, it has been considered that information to the population is a priority issue in order to win acceptance and achieve success of the project. To this end, several informative days have been held in the drafting phase and in the execution phase and explanatory posters have been installed. These information tasks will continue as the project progresses.

Another key issue is the coordination and collaboration between administrations. It is an area where the competences of various administrations converge. Achieving good coordination was one of the determining factors when it comes to realizing the project's objectives. Thanks to the involvement of all of them, the project is being executed according to plan and it is foreseen that in the next months, once the environmental processing is finished, phase 2 of the project will begin, which extends from the confluence with the La Trofa stream to the San Fernando Bridge (Madrid).

Budget, funding and additional benefits:

This project is financed by the PIMA Adapta Plan (*Plan Impulso al Medio Ambiente* for adaptation to Climate Change in Spain), with an investment of 2,151,798.62 €.

The costs of this action comprise the cost of execution of the project. As for the benefits, these are derived from the improvements achieved in the manner in which the rivers function, which contribute to the objective of fulfilling the requirements of the Water Framework Directive and guaranteeing also the provision of goods and services to society, including the decrease in expected damages due to flooding and the costs allocated annually to the conservation of the public hydraulic domain, which will be significantly reduced.

Legal aspects:

The project is part of the Hydrological Plan of the Spanish portion of the Tagus River Hydrographic Basin. This project fulfills, among the hydromorphological measures proposed, those related to the reduction of the pressures derived from flow regulation elements thanks to the improvements in fluvial continuity and restoration it comprises.

In turn, this stretch of the Manzanares River is identified as one of the areas with significant potential risk of flooding. The project complies with the measures contemplated in the Flood Risk Management Plan of the Spanish portion of the Tagus River Hydrographic Basin.

River restoration seeks to fulfill the objectives of the Water Framework Directive and the Floods Directive.

In addition, this section is within the Special Conservation Area of ??the "Manzanares River Basin" and is also a "Monte de El Pardo" Special Protection Area for Birds. It has a Management Plan that includes among its Natural Resource conservation Guidelines some that focus on the fluvial restoration of its water masses and the improvement of the riparian vegetation.

The project has been submitted for an environmental evaluation and has been the subject of a Resolution from

the State Secretariat of Environment who formulates the project's Environmental Impact Report, which includes all the environmental requirements of the project. (Resolution of October 10, 2016, from the State Secretariat of Environment, which formulates the environmental impact report of the Manzanares River restoration project in the surroundings of the Real Sitio de El Pardo (Madrid) BOE nº 259 of October 26, 2016)

Implementation time:

November 2016 – November 2019

Reference Information**Contact:**

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Websites:

<http://restauracionfluvialriomanzanares.es/> [7]

https://www.miteco.gob.es/es/agua/temas/delimitacion-y-restauracion-del-dominio-publico-hidraulico/estrategia-nacional-restauracion-rios/Plan_PIMA_ADAPTA_rio_Manzanares.aspx [8]

<http://restauracionfluvialriomanzanares.es/> [7]

Sources:

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- Elaboración de un estudio sobre la integración de la adaptación al cambio climático en la planificación y gestión de las áreas protegidas en España. Fundación González Bernáldez, EUROPARC-España, por encargo de la OECC.
- Elaboración de la Estrategia Estatal de Infraestructura verde y la conectividad y restauración ecológicas. MNCN – CSIC, por encargo de la DG de Calidad, Evaluación Ambiental y Medio Natural.
- Los bosques y la biodiversidad frente al Cambio Climático: Impactos, Vulnerabilidad y Adaptación en España.

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