

Reactivating river dynamics in the Vieux-Rhône River (non-navigable section) at Cornas, Roubion and Petite Île

The operation

Project owner	Compagnie nationale du Rhône (CNR) (Rhône management company)
Category	Improvement of waterways
Type of operation	Removal of riverbank protection or river embankments
Type of environment	Lowland rivers
Issues at stake (water, biodiversity, climate)	Good status of habitats, river continuity
Start of operation	September 2011
End of operation	December 2011
Length of river affected by the works	Cornas: 500 m, Petite Île: 500 m and Roubion: 1,000 m

River in the restored sector

Name	Rhône River
Distance to source	568 - 623 km
Mean width	150 m
Mean flow rate	1,480 m³/s at Viviers

Aims of the project owner

- Encourage self-dredging and natural mobilisation of sediment in order to cut down, if possible, to the original layer of stones in the river margins and to reactivate lateral dynamics.
- Diversify habitats for the species on hand.
- Ensure lateral connections between the riverbed and side channels.
- Acquire project feedback for future operations.

Environment and pressures

The Rhône is a European river 812 kilometres long that originates from the Rhône glacier in Switzerland, at an altitude of 2,209 metres. It flows into Lake Geneva, exits the lake at Geneva and then enters France after having travelled 290 kilometres. It continues on to the Camargue delta and then flows into the Mediterranean Sea. Its basin covers a surface area of 95,500 square kilometres.

The Vieux-Rhône (Old Rhône) flows in the historic riverbed. Over time, its itinerary was modified by the master development programme (hydroelectric generation,

The location

Country	France
River basin	Rhône-Méditerranée-Corse
Region(s)	Rhône-Alpes
Département(s)	Ardèche
Commune(s)	Cornas, Le Teil, Rochemaure



Old Girardon dike along the Rhône where flood debris accumulated, before the dike was opened. September 2011.

Regulatory context	Not applicable
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European directive references

Water-body ref.:	FRDR2007a FRDR2007d
Natura 2000 site ref.:	Not applicable

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Connection of flood storage zones in Cornas, during flooding.
December 2012.

navigation and irrigation) launched by the French State in 1921.

Development work for navigation purposes over the 1800s and 1900s consisted of creating structures intended to facilitate navigation ("Girardon" groynes, low dikes).

The most reliable and long-lasting work on the Rhône, carried out starting in the 1950s, ensured a minimum draft of three metres by raising the water level and creating a canal along the river. As a result, navigation ceased along one part of the natural riverbed (the Vieux-Rhône).

The low dikes were created to consolidate the riverbed and avoid lateral erosion during floods. They in fact constituted lateral obstacles and severely constricted the river. This situation had negative effects in that it encouraged sedimentation of sand and silt outside the main channel in what are called the "river margins". During floods, the sediment deposited in the forests along the banks. The margins aggraded, leading to a reduction in the space available for flood waters and a consequent rise in water levels in the channel. The dikes were thus responsible for the rise in the banks and a reduction in the potential discharge during floods. A consequence of the dikes, that exist along the entire Rhône River, was to reduce the width of the riverbed and to fill in side channels that are a source of biodiversity. The habitats available for the various species were reduced, offering less diversity.

A Type-2 ZNIEFF (high-value ecological zone) called the "Functional group of the mid-Rhône and its side channels" exists where the river passes through the towns of Cornas, Le Teil and Rochemaure. The zone comprises an array of typical Rhône habitats (mixed forests found along large rivers, Mediterranean gravel beds, thickets and woods on gravel bars, etc.) that must be frequently activated to maintain maximum diversity levels.

■ Opportunities to act

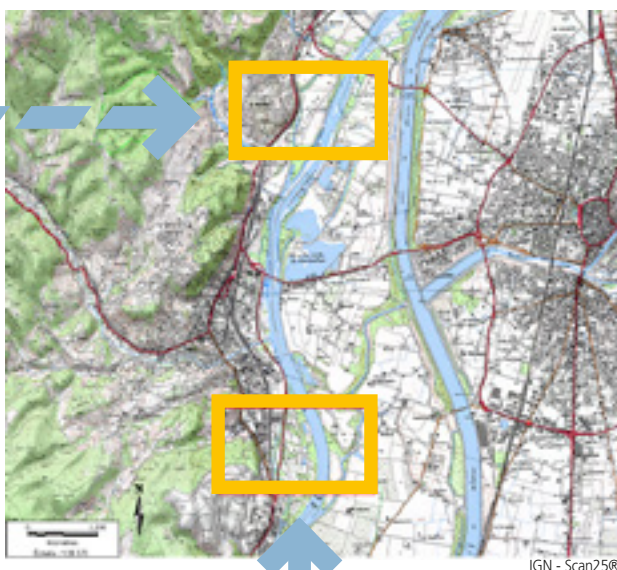
The Rhône plan was a 2007-2013 interregional projects contract signed by the French State, its agencies, the basin committee, the regional councils of the five regions along the Rhône and Saône Rivers and the *Compagnie nationale du Rhône* (CNR). The management plan for water resources was set up following the serious flooding in the years 2002-2003. The objective was to reconcile the development of human activities with improvements to environmental quality (flooding, water quality, habitats and biodiversity).

In order to improve the functioning of the river system and facilitate the passage of flood waters, it was decided to directly address the cause of habitat degradation and lateral disconnection by removing the structures created during the 1800s.

The experimental work undertaken was intended to reverse the trend toward aggradation of the banks and the river margins, still in progress even today, in order to restore the hydraulic and ecological dynamics of the river.

The study of historic aerial photos in June 2005, pertaining particularly to the morphological evolution of the Rhône around the city of Montélimar, revealed that certain sites:

- had a number of favourable characteristics for work to reactivate the river margins;



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Opening of the Girardon dike at Cornas. October 2011.

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The fallow Petite Île site prior to the work. October 2011.

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Vertical earthwork on the Petite Île site. The stratification (gravel layers) is clearly visible.

• did not appear to have any major vulnerabilities concerning their ecological value or any heritage issues. The mobilisation of sediment (self-dredging) by the current appeared to be sufficient. Consequently, three sites (Cornas, Roubion and Petite Île) were selected for removal of the lateral dikes.

■ Works and developments

The work on each site was adapted to the local configuration and to the potential for reactivation.

For the reactivation experiment on the three sites, the work consisted of:

- removing the trunks and stumps of trees where the earthwork was to take place;
- opening gaps in the longitudinal dikes (stone banking) and removing certain transverse groynes. This was a key step in the procedure. The Girardon structures were significantly modified at certain points by lowering the dikes by 30 to 70% in height over a distance of 20 to 100 metres depending on the gap;
- locally lowering sediment bars to initiate openings in the talweg;
- creating or reinforcing "hard spots" to increase the hydraulic disturbances on the site;
- reactivating the network of side channels (pools) that already existed thanks to the river dynamics at the Cornas site.

In terms of volumes, the work represented a total of 42,000 cubic metres of earthwork on the three sites. In detail:

- on the Roubion site (Vieux Rhône near Montélimar), 5,000 m³ of stone banking and 12,500 m³ of finer material (silt, sand);
- on the Cornas site, 1,600 m³ of stone banking and 5,900 m³ of finer materials (gravel-silt mix);
- on the Petite Île site, 1,100 m³ of stone banking and 15,900 m³ of finer material (silt, sand).

The finer materials were spread locally over stone bars for subsequent transport by the river.

■ Regulatory approach

The work was authorised in accordance with the Water law.

3.1.2.0: *Modification of the riverbed long profile or cross profile.*

3.2.1.0: *Maintenance of rivers and canals.*

■ Post-restoration management

The work authorisation by the Prefect included maintenance work on the three sites. It consisted of ploughing and decompacting the sediment on a yearly basis to increase the quantities transported by the river.

■ Monitoring

A brief ecological characterisation study was carried out prior to the work. Following the work, a complete ecological monitoring programme (vegetation, birds, amphibians, odonata, fish) was initiated as part of the overall authorisation procedure.

The year 2012, the year following the end of the work, was selected as a reference point.

In September 2012, the *Compagnie nationale du Rhône* initiated monitoring of the fish compartment in the three pools on the Cornas site. The monitoring will continue until 2016.

Birds, odonata, amphibians as well as the terrestrial and aquatic vegetation are monitored by a consulting firm. The annual campaigns will also be pursued from 2012 to 2016.

■ Outcome of the project and outlook

Connection frequencies were modified on the Cornas and Petite Île sites and now occur annually. In the upper section of the Roubion site, connections take place twice per year.

Costs

In euros ex. VAT

Preliminary studies and monitoring <i>* of which monitoring: 275,000 euros over five years</i>	380,000 €* -
Purchase of land	-
Works and developments	Roubion site: 68,000 € Cornas site: 50,000 € Petite Île site: 111,000 € Total: 249,000 €
Promotion	-
Total cost of project	629,000 €
Financial partners and funding: <i>ERDF (45%), Rhône-Méditerranée-Corse water agency (20%), Rhône-Alpes region (9%), Compagnie nationale du Rhône (CNR).</i>	

For the time being, only preliminary results have been published because the available data concerns only the first year of monitoring. The general idea behind the work to reactivate river dynamics is to initiate a hydraulic and geomorphological process using the energy of the river and its floods. The desired ecological changes and improvements will become visible following floods and over a fairly long time span.

The data from the geomorphological monitoring are still being analysed, however some changes are already visible. For example, signs of river dynamics have been observed on two sites (Cornas and Petite Île) during annual floods.

The main geomorphological indicators are listed below.

On the Cornas site:

- creation of a pool 2.5 metres deep;
- local erosion of banks;
- sand deposits in certain places.

On the Petite Île site:

- removal of all the finer materials by the river;
- erosion at the base of the vertical banks created,
- collapse of the sloping bank and retreat of the crest.

The monitoring of fish populations in the three pools on the Cornas site (only two existed before the work) revealed that the pools are less cut off (improvement in lateral connectivity), that fish can escape more easily during flooding and that the fish community corresponded to that of a "nursery habitat", shielded from predators.

The fish community in the pools is the product of the fish trapped by the floods in May and June 2012 and that survived over the summer. The most common are smaller fish (carp, bitterling, etc.) and juvenile bleak, roach and bream.

In terms of terrestrial and aquatic vegetation, a strip of helophytes has developed on the exposed banks, where a number of indigenous species (*Ranunculus sceleratus*, *Najas marina*, etc.) have appeared.

At Cornas, wetland vegetation has developed in conjunction with pioneer species and undesirable species (Japanese knotweed) along the channel.

Studies on odonata revealed the presence of a dozen species, including *Gomphus simillimus* and *Coenagrion mercuriale*, the latter being protected nationwide. There are indications of amphibian reproduction and various species (natterjack toads, common toads and midwife toads) have been observed.

Comparison of these initial results with those of subsequent monitoring will provide information on changes in biodiversity on the three sites following the work carried out.

As a follow-up to these innovative projects to restore lateral dynamics, similar operations are being considered for the Vieux-Rhône (non-navigable section) on the structures near Montélimar and Péage-de-Roussillon in 2014. And another project is now planned (the feasibility study is under way) near the towns of Donzère and Mondragon.

Promotion of the project

The *Compagnie nationale du Rhône* set up an information sign on the site of the Cornas flood storage zones to explain the objectives and value of the work, as well as the changes observed in the bed and the morphology of the river.

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