

## Room for the River Regge, Netherlands - restoring dynamics <sup>[1]</sup>

The Regge River is a typical rain fed river. Starting in the 19th century the first bends were cut and over the years the Regge River was largely turned into a canal. In situations with heavy rainfall, large areas in the valley of the river are flooded. In dry periods, on the contrary, agriculture and the wetlands suffer from the lack of water. Because of climate change, precipitation is projected to become more extreme; showers heavier and dry spells more prolonged. Measures directed at restoring the dynamics of the river must also help to adapt to these projected changes.

### Case Study Description

#### **Challenges:**

Until 1848, the Regge River was quite a meandering river. Starting in the 19th century the first bends were cut and over the years the Regge River was largely turned into a canal. Under flooding conditions, large areas in the valley of the Regge River are flooded and in some places the floods are a mile wide. In severe drought situations, however, the river is no more than a coherent set of stationary eddies. Nowadays, the main stream regularly cuts off meanders, but these are still recognizable in the landscape today.

With climate change the precipitation patterns are projected to change: more rain is expected to fall in shorter periods of time, increasing the risk of floods, while dry periods are expected to become longer and hotter, increasing the need for water retention for nature and agriculture. With the current river structure, such precipitation patterns will lead to severe problems.

Despite the rivers' restricted structure, the Regge is still important for small-scale nature and the cultural landscape. The Water Board Regge and Dinkel (successively merged into the Water Board Vechtstromen) is committed, together with the province of Overijssel, relevant municipalities, landowners and various interest groups, to gradually transform some 50 km of the river into a natural river. The 'climate buffer' Regge will provide more space to store the water in periods of flooding by re-meandering. This transformation will also increase the sponge effect of the soil, preserving more water for dry periods.

In summary, the Regge faces extreme peak discharges and has inadequate basic drainage, while the region faces desiccation of nature and drought damage to agriculture in the summer season. The stream was 'sandwiched' between maintenance paths and water retaining embankments. This provided little room for the necessary restoration of the dynamics of the river. Moreover, the quality of the water and its sediments was moderate to poor.

All in all, the river forms a landscape that provides insufficient basis for a scenic and ecologically well-functioning of the Regge basin. The challenge of the transformation programme, which includes several projects, was to turn the catchment into a string of beads of habitats for plants and animals, and a beautiful 'backdrop' for tourists and holidaymakers to cross by bicycle, boat or on foot or to spend a few days. The aspirations of farmers to broaden their businesses are also connected with this programme.

#### **Objectives:**

The overall objective is to make the Regge 'climate resilient', which implies accounting for the impacts of the

current climate while also taking into consideration the projected future situation. In the Regge Restoration Projects, the canalized river is restored to a dynamic and resilient, meandering river at different places. In addition, the safety of the residents against flooding is taken into account. In general, water retention serves the following objectives:

- Moderating discharge peaks to prevent flooding downstream;
- Restoring natural stream processes and stream character: (i) inundations, (ii) natural drainage course, (iii) smaller profiles (summer bed), (iv) higher flow rates;
- Combating drought: (i) downstream smaller sections are possible so that the drainage base can be placed higher and the flux of groundwater to surface water can be reduced in size; (ii) water supply for weir management, irrigation water and drinking water;
- Improving water quality by: (i) sedimentation and purification on the spot (green cleansing), (ii) realizing (as long as possible) a certain flow rate downstream, (iii) developing (wet) natural and landscape values, for instance as a stepping stone in the ecological structure.

The climate change projections are taken into account in the projects with the aim of ensuring that the river will be climate resilient in the future; ensuring that the abovementioned aspects will also remain valid under projected changing conditions.

### **Solutions:**

To create extra capacity to handle flood water, while maintaining a relatively small meandering river, a flood channel parallel to the meandering river has been introduced along the lower and middle Regge. Barriers just below the floodplain level separate the two channels. During average flow conditions, flow is routed only through the meander channel. During flood periods, flow is routed over the barriers and through the flood channel as well. This design reduces and delays the peak discharge. The peak discharge is reduced because the inundation area increases significantly from the reference situation as a result of the final design. The delay is due to the greater length of the Regge river system and the increased inundation area.

To increase groundwater levels in dry periods, the surface water levels have to be raised. The design is adapted by increasing the flow width by 20%, resulting in a higher bottom level, which leads to a reduced draining effect.

By removing weirs from the Regge, surface water levels and groundwater levels drop significantly during dry periods. Reduction of the flow area, increase of the hydraulic roughness and the increase in the length of the Regge slightly compensates for this. The surface and groundwater conditions are less favourable for wetland development than they are in the reference situation, while the initial idea was that a more natural river would have positive effects on wetlands.

For the Lowland Regge (a blue/green ribbon through the Twente landscape), a wide flood plain is needed. Often, old meanders are the starting point for new meandering. The profile of the Regge is adjusted to provide the desired flow in the summer and sufficient variation in morphology, erosion and sedimentation processes.

### **Importance and relevance of the adaptation:**

Case mainly developed and implemented because of other policy objectives, but with significant consideration of CCA aspects.

Additional Details

### **Stakeholder engagement:**

Since 2000, the Water Board Regge and Dinkel together with other stakeholders have worked to achieve the Regge Restoration Projects. Along the whole stretch of the Regge, there is cooperation with all parties through intensive consultations. The Regge Restoration Projects were realized in collaboration with:

- Private landowners and users;
- Municipalities Ommen, Twenterand, Hellendoorn, Wierden, Rijssen-Holten and courtyard of Twente;
- The Province of Overijssel;

- The Department of Public Works;
- Twente region;
- Conservation organizations: Landscape Overijssel, Natuurmonumenten, Forestry Commission.

In all projects, the consultation has led to local support. The Water Board throughout the implementation phase worked to actively involve the public through providing information and through integrated design processes for the redevelopment plans.

### **Success and limiting factors:**

Success factors:

- The Water Board Regge and Dinkel has a strong drive towards integrated water management;
- The vision for the Regge was formally adopted by the Water Board;
- National and European legislation and policy helped towards developing and implementing the plans;
- The re-meandering projects are all integrated projects with multiple purposes;
- The measures are based on research;
- The WFD objectives are not the only objectives for the projects;
- The integrated approach adopted and combining objectives has led to cost-efficiency;
- All projects have sufficient support from the local communities.

Limiting factors are:

- The current board of the Water Board (Water Board elections take place every four year) was not involved in developing the vision, but now has to make related decisions;
- Maintenance after implementation is not integrated into the plans;
- Re-meandering may lead to local flooding;
- The Water Board has only limited insight into the effectiveness of the restructuring measures for the ecology policy goals;
- In some places, private landownership hindered implementation of the plans. In some instances, expropriation was required.

### **Budget, funding and additional benefits:**

Total cost of the various projects is around 25 million euro. Enhancement of the natural design of the Regge is an integral part of many of the projects accompanied by the creation of new nature. By creating an ecological corridor the intention is to increase the coherence of these nature areas. This corridor allows plants and animals to spread. In addition, space is created for viable and profitable agriculture around the Reggedal. The enhanced natural design of the Regge also is intended to boost recreation and tourism in the municipalities through which the Regge flows. Plans also include establishing housing next to the water and improving the perception of water in urban areas. A monetary assessments of benefits was not included in designing the projects. Nevertheless, the projects were considered necessary to deal with the current and projected future problems. Moreover, benefits were to be found in improved agricultural possibilities as well as recreation and nature. An evaluation of the projects was done in 2012. This included evaluating if the projects were appropriate in reaching the goals of developing a resilient hydrological system and improving the ecology, and if they were effective (i.e. were the efforts and expenditure reasonable related to the goals and realised benefits). For most of the projects, the evaluation showed that to a large extent the hydrological and ecological goals had been achieved.

### **Legal aspects:**

The projects are based on the 4th National Policy Document on Water Management (1998), the European Water Framework Directive (2000), National Water Policy for the 21st Century (2000), The National Water Plan (2009) and Natura 2000.

### **Implementation time:**

The implementation of the plan started in 2010 and will continue until 2015.

Reference Information

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**Websites:**

<http://www.klimaatbuffers.nl/english-homepage-2> [3]

<http://www.vechtstromen.nl/projecten> [4]

**Sources:**

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