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Restoring a floodplain for climate adaptation

Results of changes implemented to the 'Gompels Broek' site by the province of Antwerp

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COLOFON

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Restoring a floodplain for climate adaptation

Upstream of the municipality Mol in the Scheppelijke Nete catchment, the province of Antwerp developed the Interreg 2 Seas PROWATER site 'Scheppelijke Nete' to demonstrate how the region can adapt to the consequences of climate change through Ecosystem-based Adaptation. The site was renamed 'Gompels Broek' by local inhabitants, upon completion.

The province of Antwerp is a regional authority situated within the Flanders region and subscribes the Sustainable Development Goals (SGD's) from the United Nations. The SDG's were made a part of its internal policy. The site 'Gompels Broek' fits within the following SDG's: SGD 11 Sustainable cities and communities; SDG 13 Climate action; SDG 17 Partnerships for the goals. Ecosystem Services are part of the functioning of our province, and we work together with other partners to build knowledge on how to design our landscapes to combat drought, flooding and other consequences of climate change.

By implementing Ecosystem-based Adaptation (EbA) measures, we want to make our province more resistant to the consequences of climate change. Ecosystem-based Adaptation, a Nature-based approach to climate adaptation, harnesses ecosystem services to increase resilience and reduce the vulnerability of human communities and natural systems to the effects of climate change. These EbA measures can be integrated into adapted agriculture, forestry and environmental management.

This publication summarises the EbA measures and results of 'Gompels Broek'. In 'Gompels Broek' we aimed to solve flooding downstream, by restoring the natural floodplain upstream. This also increased resilience to drought as the measures increase the sponge effect of the area. This will make more fresh water available for human activities in dry periods. The riverbed of the river Scheppelijke Nete and brook Burgemeesterloop was restored from a small, normalised bed to a more natural course. The banks that prevented flooding were removed, together with the private recreational infrastructure (such as weekend cottages) and exotic species. New trails for cyclists and pedestrians were created and allow visitors to enjoy the benefits of nature. The site is located close to densely populated parts and is now very popular among residents.

The results are summarised using various steps (chapter 1 to 4) that represent the process for successful planning and implementation of climate change adaptation measures (see Output 1). Presented insights and lessons learnt can help governments (national, provincial and municipal), knowledge institutions, consultancies, managers of nature areas, drinking water companies and landowners in the design of climate change adaptation projects.

Figure 1 - The dot situates the demonstration site for Ecosystem-based Adaptation in the Interreg 2 Seas region.

1 Understanding the catchment

1.1 Geographical & hydrological context

The demonstration site 'Gompels Broek' ('Broek' literally means a forested swamp) is situated in the valley of the Scheppelijke Nete, upstream of the city Mol. The river Scheppelijke Nete and the brook Burgemeesterloop cross the demonstration site. The larger catchment is groundwater dominated, due to the presence of sandy soils. Under natural conditions permanently high groundwater levels, wet soils and local peat formation would occur in the Scheppelijke Nete valley, including the site Gompels Broek.

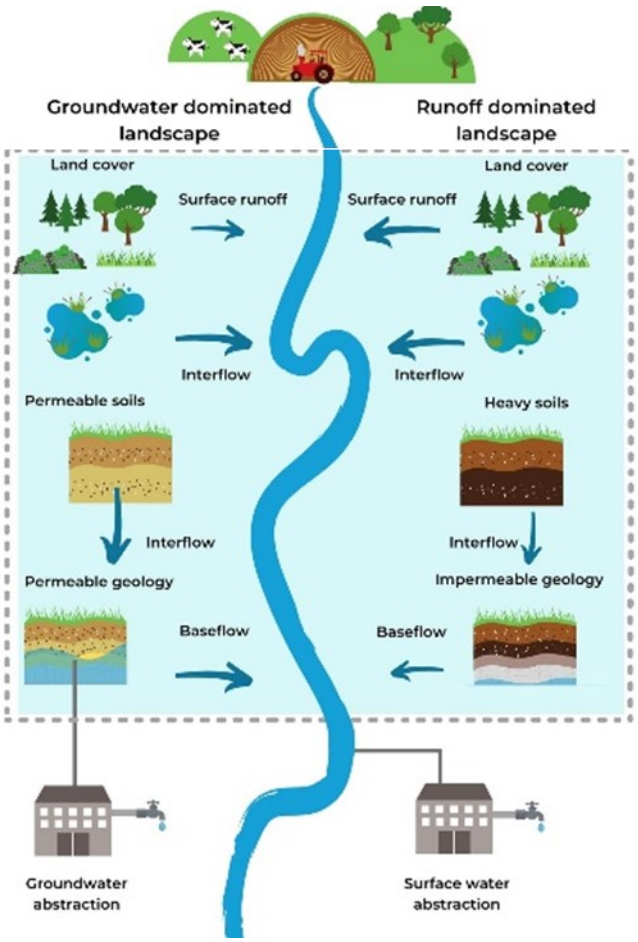


***Figure 2** – The site Gompels Broek is located in a groundwater dominated catchment.*

*In unmodified or sustainably managed **groundwater dominated catchments** there is little runoff following precipitation as water predominately infiltrates through permeable substrates and moves either laterally or vertically below the surface. However, modification such as surface sealing, soil compaction and land drainage reduce the ability of water to infiltrate and therefore result in greater levels of runoff. Groundwater replenishment depends on the hydrological connectivity to the surface. When connectivity is interrupted by these modifications the resilience of this water supply is reduced.*

*In unmodified or sustainably managed **runoff dominated catchments**, water predominantly moves above the surface but interflow and baseflow are still present. As above, when the landscape is modified, surface runoff dramatically increases and interflow and baseflow are further reduced. This leads to an increase in frequency and severity of low river flows during dry periods and an increased risk of flooding following periods of extreme rainfall.*

1.2 Human context

Part of the municipality Mol is situated in the valley of the Scheppelijke Nete. The hamlet Gompel is situated in both the Scheppelijke Nete valley and the Molse Nete valley. Habitation in these valleys resulted in flooding problems. Due to the wet soils and valleys functioning as connecting elements the importance of nature conservation is growing.

An important human influence on the water system, especially in the upstream part of the catchment is the presence of large waterways, crossing the natural hydrology: the Channel of Beverlo and the Channel Dessel-Kwaadmechelen.

The demonstration site ‘Gompels Broek’ was hydrologically manipulated and drained to create many recreational ponds, often with weekend cottages and mostly surrounded by a garden planted with cultivars and species that are not suitable for wet and/or peaty soils.

Due to the flooding problems in the centre of Mol the demonstration site was given a new destination in 2014: an area for water retention (natural flooding area) and nature development.

Figure 3 - Land use & land cover (vegetation types) before restoration of the natural flooding area (status 2017).

1.3 Water resource risks & challenges

The river Scheppelijke Nete regularly flooded in Mol. That water then flowed towards the nearby brook Burgemeesterloop. That small watercourse crossed the gardens of a number of houses and would regularly overflow into the gardens and threaten the houses, because it could not cope with the extra amount of water.

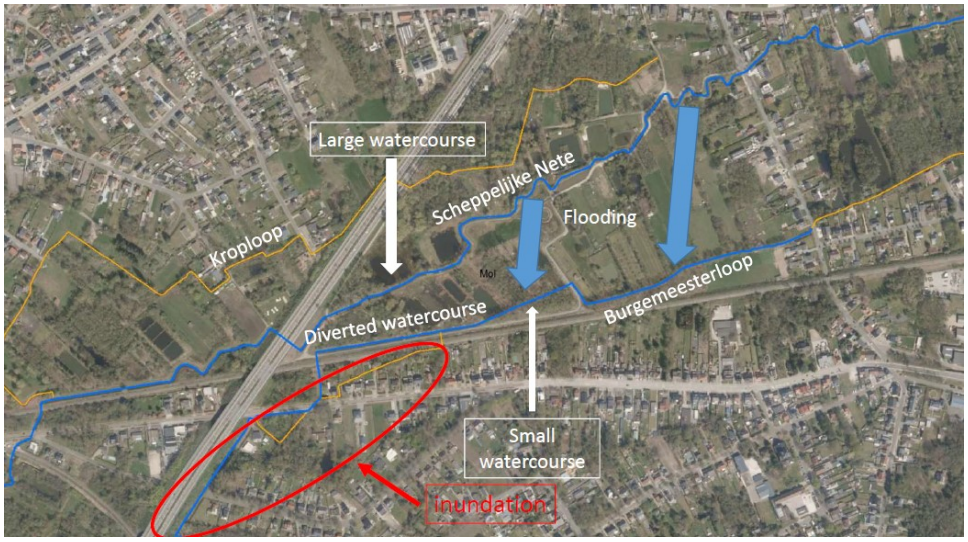


Figure 4 - Flooding and related problems near the demonstration site

Moreover, continued climate change would exacerbate flooding in the area, as prolonged periods of drought would regularly be followed by periods of extreme precipitation.

2 Identifying and engaging buyers, sellers and brokers

The basic idea behind the PES (Payment for Ecosystem Services) financing model is that investments made by 'buyers' in climate change adaptation measures result in the targeted provision of ecosystem services provided by the 'sellers' (see Output 2). The site Gompels Broek was financed in the more traditional way, with the help of (European and regional) subsidies, including the European Regional Development Fund (ERDF). However, the theoretical application of the PES financing model can help identify opportunities for future financing.

In the Gompels Broek site, the inhabitants of the province of Antwerp can be considered as the interested 'buyers' of the ecosystem services. By paying taxes, they finance the demonstration site (and many other water management activities and projects in the province). The targeted ecosystem services that these buyers receive in return are increased water retention resulting in a lower risk for flooding (and a more stable supply of freshwater) downstream, increased biodiversity, and more healthy nature in which recreation can take place (cf. § 4).

The total cost for restoring the flooding area was*:

- Design: 46.084,01€ incl. VAT
- Construction works: 614.440,58€ incl. VAT

*the cost for buying the necessary land and replacing the Burgemeesterloop (phase 1) not included.

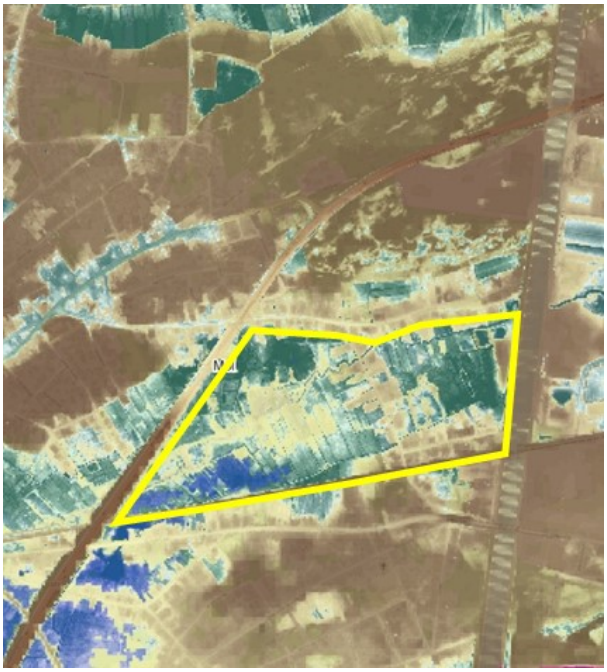
The area is historically polluted with heavy metals. This resulted in very high costs to remove nutrient rich and polluted topsoil. To prevent further pollution when the area is flooded, a sediment trap was constructed upstream the flooding area. This was challenging in the wet and peaty soil and also had a big impact on the budget. The cost for the construction of the sediment trap was 140.174,05€ (23% of the construction cost).

3 Prioritising locations for climate adaptation measures

3.1 Prioritisation by means of the water system map

For the project PROWATER, the University of Antwerp applied the water system map to the Interreg 2 Seas area (including catchments in Flanders, the Netherlands and South England) (Output 3). This map helps prioritise where to best apply EbA measures to infiltrate and retain water, based on hydrological characteristics, soil typology and topographical information. The map identifies 'natural places' in the landscape for seepage (groundwater coming back to the surface) and infiltration.

As manager of the river Scheppelijke Nete, the Province of Antwerp looked for solutions to prevent flooding of residential areas. The map shows that Gompels Broek is suitable for the development of permanent and temporary wetlands (figure 5). Considering that the site is located upstream to the municipality Mol, it is possible to restore its function as a buffer for high surface water peaks downstream, during heavy rainfall events.



Groundwater dominated catchment

Hill top / Plateau – infiltration area, where water can infiltrate to groundwater bodies (indicated in brown)

Valley height – infiltration area, where water can infiltrate to groundwater bodies (indicated in yellow). Water that infiltrates here will have less residence time before it emerges in streams. However, flood attenuation can be achieved by infiltration.

Hill depression / Valley depression – Temporarily wet area, where runoff can be retained and slowly infiltrate. (indicated in green)

Floodplain – Temporarily wet area, where runoff and seepage can be retained and slowly infiltrate. (indicated in blue)

Figure 5 - The yellow outline indicates the location of the floodplain on the water system map. The map confirms the suitability to restore the previously degraded floodplain (with the potential for permanently and temporarily wet areas indicated in blue and green).

In a first phase, the brook Burgemeesterloop was moved so that it no longer flows through the gardens and the risk of flooding in residential areas was eliminated. Then it was time for part two of the solution. A flooding area with natural gradients was created in the valley of the river Scheppelijke Nete upstream of the municipality Mol, thus creating extra buffer capacity for flood water. To this end, we removed exotics and pines, removed all constructions, naturalized the artificial fishponds (removing the artificial embankment), and excavated the elevated areas and banks (due to placing the sediment on one riverbank). Water can now flow to the flood plain on both sites of the river. The more natural gradients in water depth and specific management allows nature to restore. The sediment trap, although artificially, is a solution to prevent polluted sediment to enter the restored floodplain. A sudden widening in depth and width creates a drop in flow rate, allowing the sediments to drop to the bottom.

3.2 Refining spatial prioritisation & EbA opportunities

Spatial planning and the choice of EbA measures to implement by the province of Antwerp, was also influenced by the following elements. Due to the flooding problems in the centre of Mol the demonstration site was given a new destination in 2014: area for water conservation and nature development. Instead of applying solely technical solutions to protect the municipality of Mol from flooding, there was a positive choice to implement Ecosystem-based Adaptation measures where possible. The process for changing the destination already started In 2009. After this the province started buying the ground, facilitating the implementation of climate change adaptation measures.

3.3 The expected impact

In 'Gompels Broek' we aimed to solve flooding downstream in Mol-Gompel, by restoring the natural floodplain upstream. This also increases resilience to drought as the measures increase the sponge

effect of the area. This will make more fresh water available for human activities in dry periods. In wet periods, there will be less high peak discharges and therefore less flooding downstream.

This EbA measure also increased the natural value by restoring the wetland habitats. New (bike-)paths increase the recreational value for visitors.

Restoring the natural flooding area targeted the following ecosystem services:

1. Retaining more water (from precipitation surplus/runoff) for a longer time, to prevent flooding in residential areas further downstream in Mol-Gompel. The province completed over 40.000 m³ of buffering
2. Increasing (wetland) biodiversity through nature management. For this Natuurpunt (also partner in PROWATER) was engaged by the province to manage the area.

Additionally a public pathway was realised along the project. This path also serves a double goal:

1. A safe connection for cyclists and pedestrians between the hamlet Gompel and the city Mol. The province completed 1,8 km of new bicycle and walking paths.
2. Enjoying nearby nature. Since the COVID-19 crisis, there was a sudden awareness on the importance of nearby green infrastructure for physical and mental health.

Along the Scheppelijke Nete, there is also a maintenance path which can be used by walkers. In the spring of 2022, Natuurpunt realised a signposted walk combining the public pathway and the maintenance path.

4 Monitoring and Evaluation

4.1 Monitoring and evaluating the impact of EbA on ecosystem services

Both surface water and groundwater levels are monitored in the demonstration site. The monitoring already started in 2016 before any work was done. One measuring point was installed on the Scheppelijke Nete to monitor surface water levels and 6 monitoring wells were placed to measure groundwater levels. The monitoring points are equipped with pressure sensors. The surface water level is recorded every hour and groundwater levels every 12 hours. This monitoring is still active and so we are capable to produce time series over a long period of time. The sensors will remain on site for several more years. Combined with other data, like rainfall, we hope to get a clear image on the effects of restoring the flooding area.

Spring 2022 the manual monitoring point SCNS04x (upstream the project area, Gompeldijk) was replaced by a real time level sensor. This sensor measures and transmits data every 15 minutes. The sensor was installed for a specific reason: the Scheppelijke Nete is a watercourse with an overwhelming growth of water plants. These plants push up the water resulting in higher water levels in spring and summer then in wintertime. Although this retention is desirable, the high nutrient levels in the water result in excessive growth of aquatic vegetation and consequently too high water levels. Combined with the influx of channel water from the Channel of Beverlo this often results in flooding during dry periods. For this reason it is also necessary to manage the water plants several times a year. Due to climate change winters are less cold and the growing starts earlier. Real time monitoring allows us to anticipate this.

Despite the intense rainfall in spring and summer of 2021, there was no flooding in the downstream residential areas of the municipality Mol! However, the natural flooding area has completely filled in spring which also resulted in flooding of recreational and agricultural areas upstream. At this moment the river Scheppelijke Nete indirectly receives water from the Channel of Beverlo. This extra water is sometimes the last straw that breaks the camel's back. In a final phase, the province of Antwerp will therefore analyse the impact of the artificial feeding of water from the canal into the natural rivers Scheppelijke Nete and Molse Nete and how this may reduce flooding.

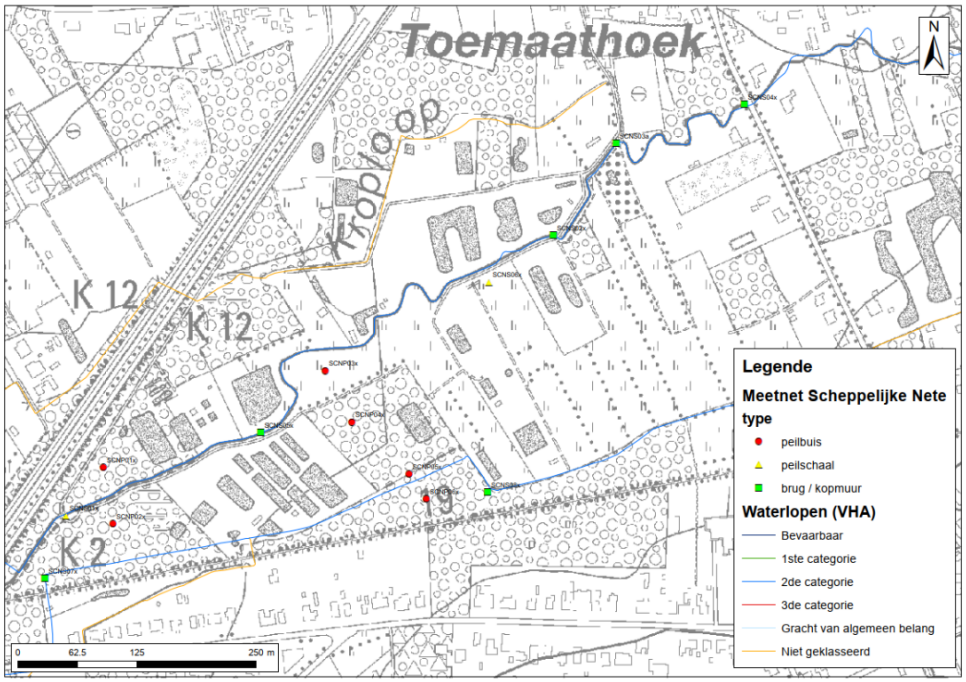


Figure 6- Monitoring surface and groundwater levels in the project area

4.2 Evaluating the participatory planning and implementation process

Due to the flooding problems in the centre of Mol the demonstration site was given a new destination in 2014: area for water conservation and nature development. The process for changing the destination already started In 2009. After this the province started buying the ground. This is a difficult process, and it took several years to acquire all the ground.

After land acquisition, the initial concept was transformed into a technical plan. This was the base to get a building permit which we received in 2019. Since the main goal of the initial project was reducing flooding problems in residential areas in Mol the project was very often presented and discussed with the municipality.

The realisation of this demonstration stie for EbA did not only resolve a flooding problem, but also resulted in water retention, higher base flow downstream, higher groundwater levels, increased biodiversity, halting peat degradation and providing health benefits to visitors.