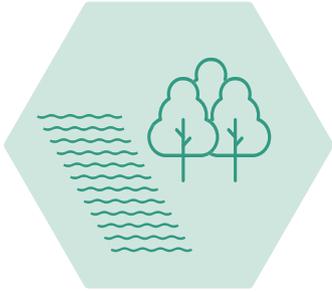


# F01 Forest riparian buffers



Place



Land-use



(Massachusetts Clean Water Toolkit n.d.)

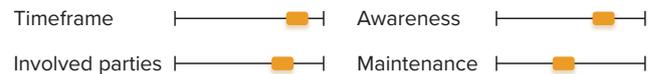
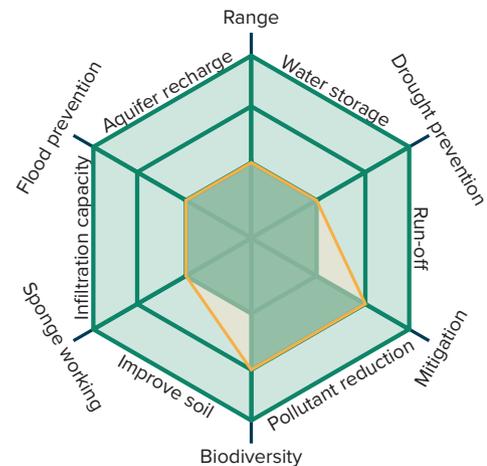
Scale



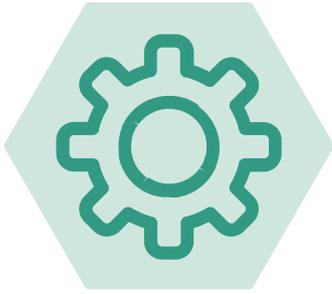
(Dountchev, Dimova et al., 2017)



Forest riparian buffers are forest areas alongside streams and water bodies. They help increase water infiltration into groundwater and aquifers and can positively affect water quality by taking up nutrients. These forest strips along open water can help with slowing down run-off, storing this water and by slowing down run-off also decrease sediments inputs into the river. The roots of the trees help with erosion control and infiltration. Mixed vegetation is more beneficial as a buffer. This buffer is most effective when the space required is proportional to its width in relation to the density of the stream network. For this reason, Forest riparian buffers would be more effective on the Rhine tributaries rather than the stream's main branch.



# F02 Maintenance of forest cover in headwater areas



Scale



(Kutorman 2012)

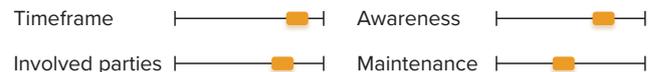
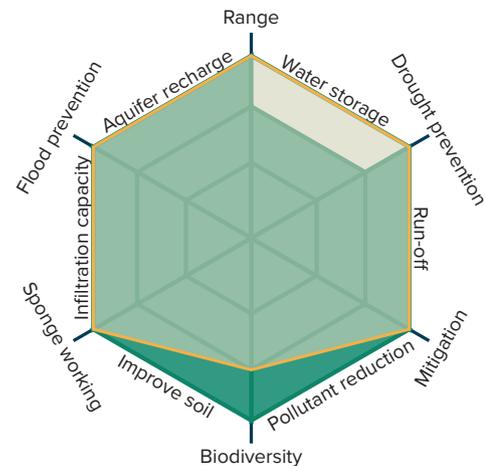
Place



Land-use



Maintenance of forest cover in headwater areas is the management and conservation of forested lands in the upper regions of a river basin. Maintaining these areas is crucial for downstream ecosystems by regulating the quantity and quality of water resources downstream. By implementing forest in headwater areas, the soil has a better infiltration capacity and can help regulate water availability. Forest cover in headwater areas can also reduce the risk of floods and droughts downstream. Maintaining these forest areas is critical to ensure the quality and quantity of water resources. Forest cover in headwater areas is most effective in areas where flood risk reduction or improvements in water quality are needed.



# F03 Afforestation of reservoir Catchments



Scale



(Shlomo Aronson Architects, 1986)



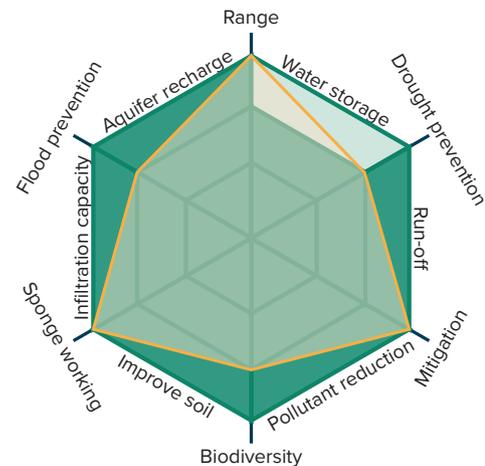
Place



Land-use



The afforestation of reservoir catchments is the practice of planting trees in a reservoir catchment. Afforestation extends the life of the reservoir and improves water quality. This can help control the erosion of soil. The roots of the trees help hold the soil together and prevent erosion. Water quality improvement is achieved by precipitation infiltration the reservoir's surrounding soil, where tree roots help improve soil structure and infiltration rates and in turn improve water quality. When implementing afforestation of reservoir catchments it is essential that enough precipitation still reaches the reservoir to recharge it. Forests in reservoir catchments should be managed as naturally as possible to prevent water quality from depleting. Using afforestation on steep areas can benefit sediment retention and erosion prevention.



# F05 Land use conversion



(Ward, n.d.)



Land-use

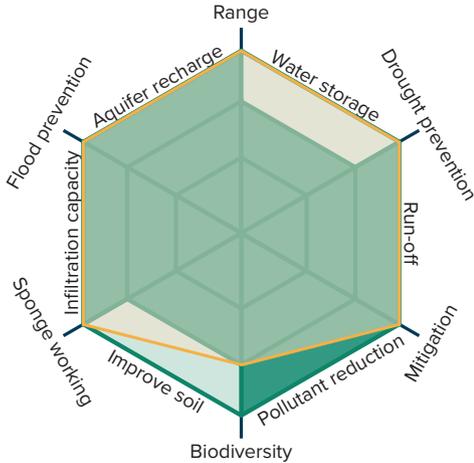


Scale



Land use conversion is the process of transforming the purpose or function of a piece of land from one type to another. This involves changing the way land is utilised. This practice is usually done on a large scale. Land use conversion can have significant social, economic, and environmental implications. It can occur naturally or be a planned change. Afforestation is a form of land use conversion. Land use conversion can have diverse impacts. It can affect ecosystem biodiversity, water resources, and social structures. For rivers, land use conversion is the most effective in headwater areas. Here benefits to infiltration and water quality will be most noticeable.

(European Commission & Office International de l'Eau, 2014a)



# F11 Urban forest park



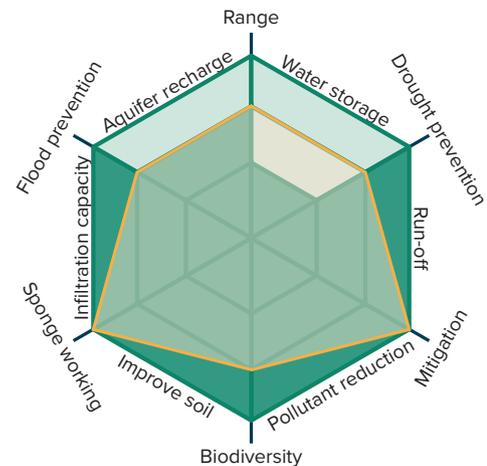
Scale



Land-use

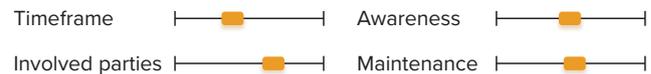


(Vyncke, n.d.)



Urban forest parks are forests in urban areas that contribute to various ecosystems and the hydrological system. These parks have a recreational function but also improve urban biodiversity. Urban forest parks generally have greater infiltration capacity than other urban parks. The root structures of the forest improves the infiltration rate and at the same time prevents soil erosion. This contributes then to aquifer recharge. This measure has local benefits on the surrounding urban developments.

(European Commission & Office International de l'Eau, 2014a)



# F14 Overland flow areas



(CDW group, n.d.)

Place



Land-use

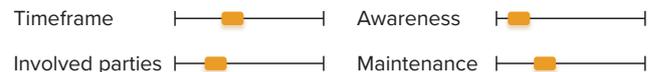
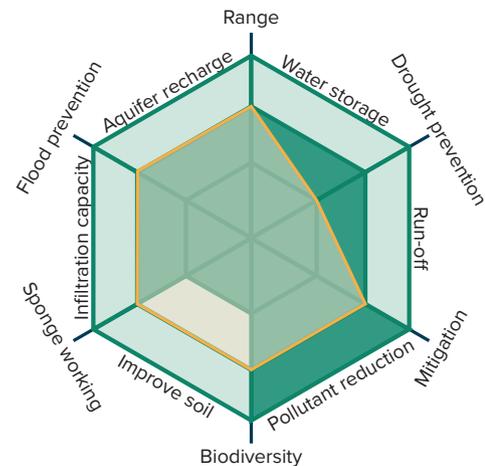


Scale



Overland flow areas are designed to minimise the impact on the water quality by intercepting excess sediment produced from forest management or during harvesting season. Overland flow areas are designed as a semi-permeable dam in a ditch with lateral ditches connected to divert water. During periods of high flow, the ditches overflow allowing the water to reach the receiving streamflow. The water will slow down before it reaches the streamflow, and sediment, carried by the water, will be deposited on land. Wetlands can act as overland flow areas. The overland flow areas only function in smaller scale ditch networks or as part of larger water treatment system.

(European Commission & Office International de l'Eau, 2014a)



# N02 Wetland restoration and management



Land-use



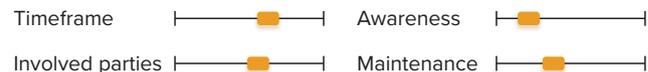
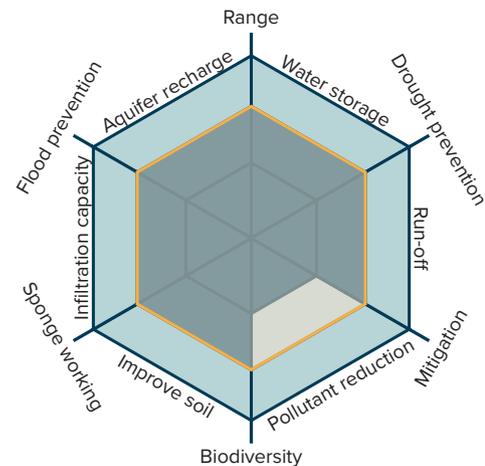
Scale



(PxHere, n.d.)

A wetland is an area of marsh, fen, peatland, or water. It can be a natural or artificial made structure and occur permanently or temporarily. The water in the area can be static as well as flowing. A wetland provides water retention, biodiversity enhancement and water quality improvement. They can be implemented in a wide range of locations but need flat areas or topographic depressions. Restoration and management of wetlands is the practice of rehabilitating and preserving wetland ecosystems. Due to human activities, wetlands have been degraded or lost. Restoring and maintaining them can provide numerous positive benefits, like water purification, flood control, shoreline stabilisation, and habitat diversity.

(European Commission & Office International de l'Eau, 2014a)



# N03 Floodplain restoration and management



(Šafarek, n.d.)

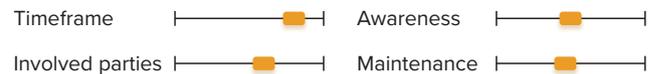
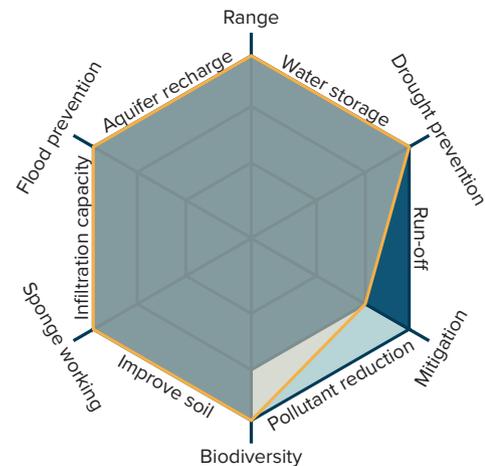
Scale



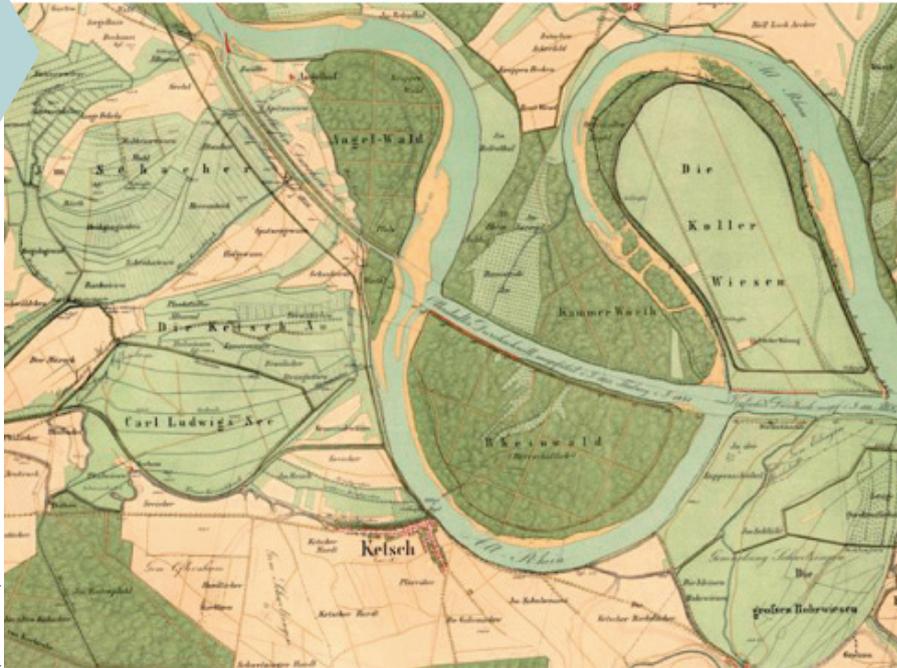
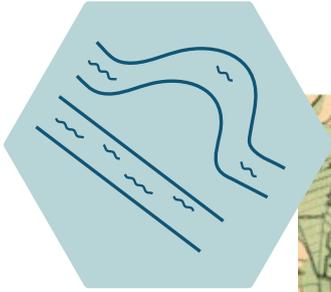
A floodplain is a relatively flat area next to a river or stream. These watercourses can experience periodic flooding. Floodplains are mainly naturally occurring structures shaped by the river's flow and sediment deposition. Because of periodic flooding, the floodplains are often composed of fertile soils. These floodplains have a crucial role in maintaining river ecosystems and often provide habitats for plants and animals adapted to periodic flooding.

Floodplains have often been altered due to human interference. These modifications disrupt the natural functions of the floodplains. The original function can be kept by restoring and maintaining floodplains, and floods are kept in the designated areas.

(European Commission & Office International de l'Eau, 2014a)



# N04 Re-meandering



(Yeo 2022)



Land-use

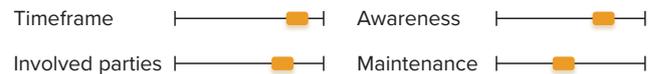
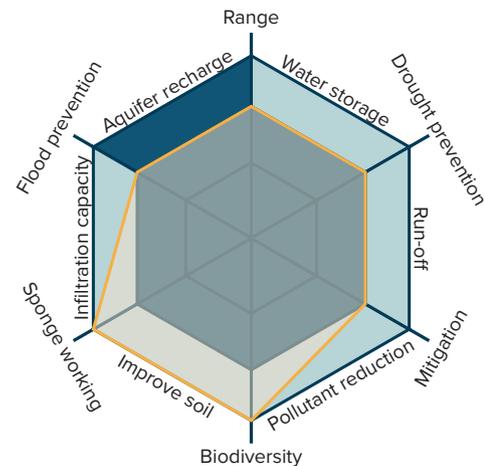


Scale

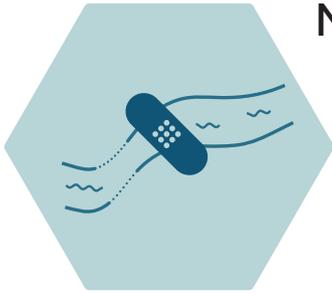


Many rivers in Europe have been straightened and channelled. This has been done due to human activities such as agriculture, urbanisation, or to shorten transport time and problems. A meandering river slows down water velocity due to its U-form. Straightening these meanders can cause various environmental issues such as erosion, the fragmentation of habitats, loss of biodiversity, and reduced water quality. Re-meandering a river is restoring its natural course, which creates more diverse habits and improves biodiversity. Because of the slowed velocity of the water, re-meandering also helps with erosion prevention. The slowed watercourse then improves water quality as sediments and pollutants are reduced. Next to that, the water has more room, which helps prevent floods. There is increased storage for run-off, especially when combined with afforestation patterns. This pattern is mainly implemented in flat or lowland areas.

(European Commission & Office International de l'Eau, 2014a)



# N06 Restoration and reconnection of seasonal streams



(Launay, 2017)



Place



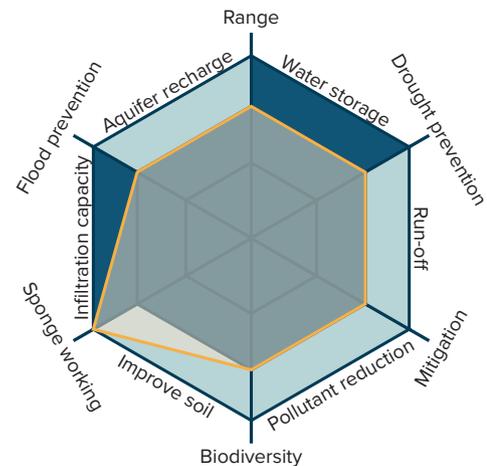
Land-use



Scale



Seasonal streams are dry for some periods of the year. They flow when smaller upstream waters flow and groundwater is high enough. These streams mainly feed from precipitation and meltwater. Because of this flow regime, seasonal streams create room for dynamic habitats. Seasonal streams have, therefore, a high biodiversity value. Seasonal streams can be reconnected by decreasing human pressures and maintaining and protecting the river system. Restoring and reconnecting seasonal streams can improve the overall functioning of the river by restoring connectivity, altering flows, and improving water retention during floods. In upstream situations, the preservation of buffer space should be taken into account, as well as a limitation to pumping groundwater. Downstream the maintenance or prevention of natural dams should be considered, and invasive plants that could jam the river flow should be removed.



# N12 Lake restoration



(IISD Experimental Lakes Area)

Place



Land-use

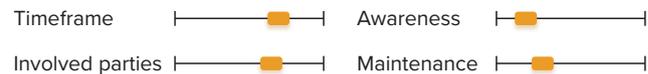
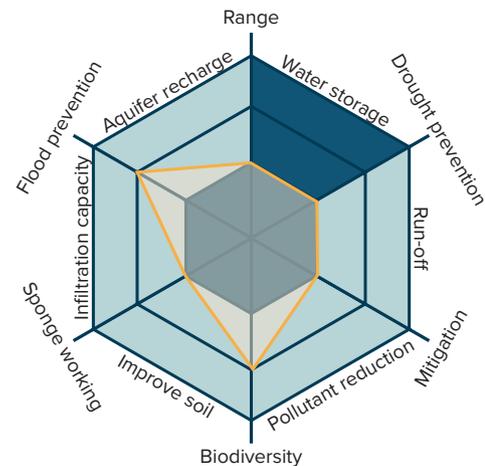


Scale



A lake is a water retention facility. By storing water, its primary purpose can be water supply irrigation, fishing and recreation. Lake restoration is the process of improving the functionality of a lake's ecosystem. Human activities or natural factors have damaged these ecosystems. Lake restoration aims to restore the balance of the aquatic environment, improve water quality and promote biodiversity. Lake restoration applies to many different scale types but requires different methods for each scale.

(European Commission & Office International de l'Eau, 2014a)



# N14 Re-naturalization of polder areas



Scale



(Frans lemmens, 2014)

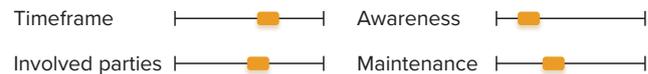
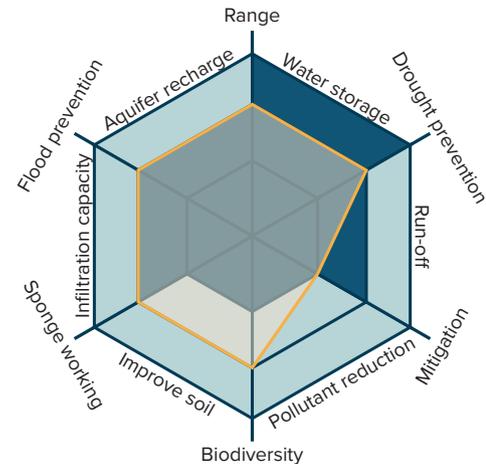
Place



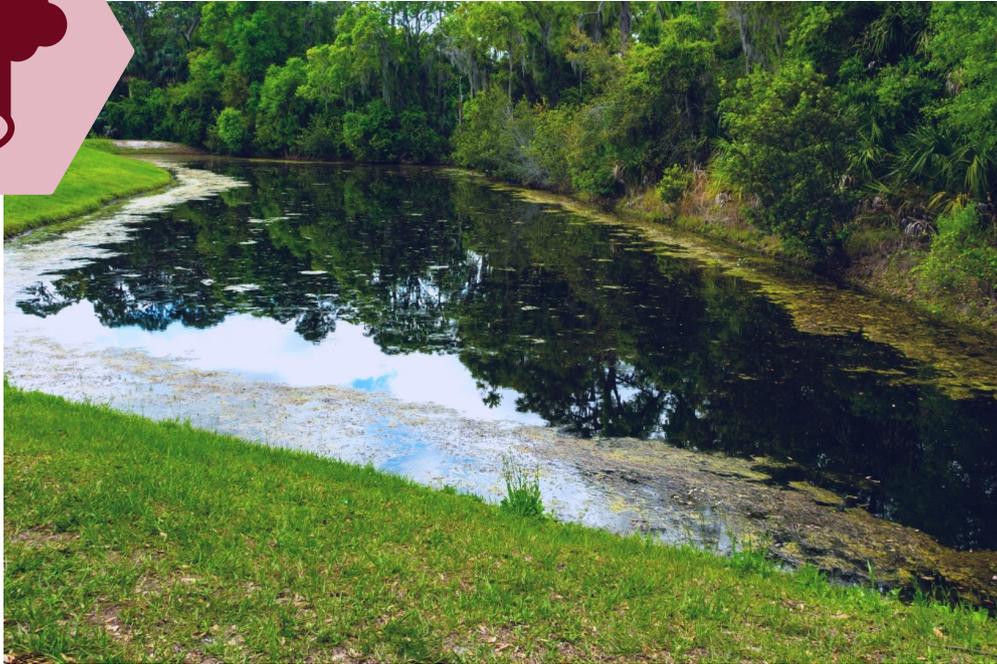
Land-use



A polder is a piece of land surrounded by dikes with its own hydrological system. In this area, groundwater can be artificially controlled, and it has no connection to other water structures other than an artificial system. A polder can be used as a flood prevention measure. Because it is mainly located downstream of larger river structures, it has a high flood storage capacity. Seasonal flooding can improve ecological situations in polder areas. However, rising groundwater levels and subsidence can decrease the infiltration capacity of polder areas and have consequences for agricultural use.

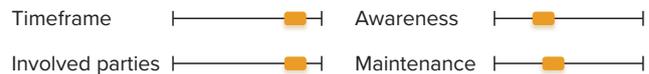
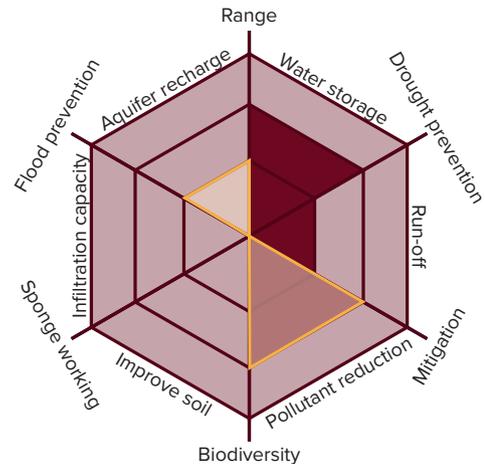


# U11 Retention ponds

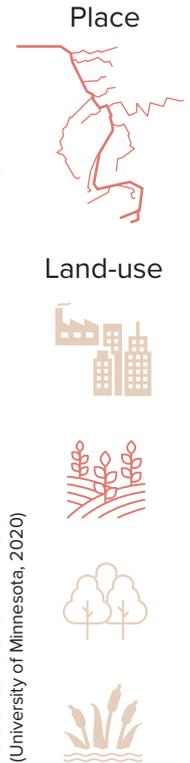


Retention ponds are ponds designed to hold excess run-off. These permanent ponds support the surrounding area during heavy rainfall and flooding by providing additional storage capacity. The ponds then release water at a controlled rate. Through sedimentation and vegetation, the water quality of the water can be improved before releasing it back into the streamflow. Retention ponds consist of a pre-treatment area and a permanent pool that remains wet throughout the year. Most ponds will also contain temporary storage volume and a shallow edge to provide space for wetland vegetation. Ponds cannot be too small, because they will run the risk of drying out during period of drought. Because of the design of these ponds, they are applicable in the urban landscape.

(European Commission & Office International de l'Eau, 2014a)



# A03 Crop rotation



(University of Minnesota, 2020)

Scale



Crop rotation is an agricultural practice that enhances soil fertility, promotes sustainable farming and mitigates the risk of crop diseases. The practices involve changing the crop types in a field over a defined period. With the rotation, yields are optimised, and chemical fertilisers and pesticides are unnecessary. By creating a rotation pattern in the implementation of crops, the soil will not be depleted of specific nutrients. In between different crops, the soil has time to recover. When implementing crop rotation, crops with different root lengths can be implemented. This improves the natural infiltration of the soil.

(European Commission & Office International de l'Eau, 2014a)

