Research & Innovation

Annual Report 2018

waternet
regional public water authority
amstel gooi en vecht
city of amsterdam

Research & Innovation Programme

Waternet innovates and develops expertise by order of the City of Amsterdam and the regional public water authority Amstel, Gooi en Vecht (AGV). We focus on improving drinking water quality, removing and treating wastewater, keeping surface water clean, and maintaining dykes and flood defence systems. Sustainability is Waternet's most important principle, in addition to efficiency and good services, and it is the driving force behind much of our research and innovations.

Waternet wants to reduce the emission of greenhouse gases (CO_2 equivalents) and contribute to energy transition by using hydrothermal energy. We want to recover energy and raw materials from the water cycle and minimise waste using circular methods. By 2050, we will work in a climate-adaptive manner. The challenges posed by climate change, such as flooding, water shortages and flood protection, are considerable. This calls for technological innovation, and even more so for social innovation.

We link our goals for innovation to the Sustainable Development Goals (SDGs) of the United Nations. These successors to the Millennium Development Goals must put an end to poverty, inequality and climate change in 2030. Waternet can make an important contribution to this. These ambitions and goals are an important driving force behind our research programme. We do not do this research alone, because together with other parties we get more out of water.

This report presents the results of the 2018 Research and Innovation Programme. We hope you will enjoy reading it.

Alice Fermont and Jan Peter van der Hoek

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The symbols of the UN Sustainable Development Goals have been used. They refer to innovation themes.

Citizen Science - ‘The Clean Water Experiment 2018’

In 2018, Amsterdam residents were once again able to measure water quality themselves in ‘The Clean Water Experiment’ citizen-science project. The aim was to reach a higher percentage of active participants in 2018 than in 2017 (36%). For the research itself, we wanted to measure the effects of heavy rainfall on water quality and find out where aquatic plants grow.

After a long period of drought, there was a lot of heavy rain on 25 August and 5 September. An SMS call to start measuring yielded many extra measurement results. Due to the heavy rain following a long period of drought, a lot of dirt washed into the water. This was particularly evident in the amount of E. coli bacteria measured. A total of 521 measurements were made by 111 active participants, amounting to 45% of the registered participants.

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Alliances and partnerships

Waternet recognises the importance of Research & Innovation. Innovations contribute to efficiency, sustainability and service. Waternet does not want to be an innovation center itself, but wants to be active in a sophisticated innovation network. Alliances and partnerships therefore play a crucial role in Waternet’s innovation strategy. Waternet participates in the research programmes of Dutch knowledge institutes in the water sector, such as the KWR Watercycle Research Institute, STOWA and the Rioned Foundation. Waternet cooperates with drinking water companies Dunea, PWN and Evides in the DPWE programme.

Waternet also participates in several projects of the Topsector Water and Maritime and cooperates with universities (TU Delft, Wageningen University & Research, UvA and VU in Amsterdam) and with local and international knowledge centres and companies such as the AMS, Massachusetts Institute of Technology, Witteveen+Bos and CycloPure. We also work with foreign water companies and cities that face the same challenges we do.

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Water retarding facilities

Extreme rainfall will also have to be collected and removed better on the street. This applies in particular to the Prinses Irene neighbourhood (Oud-Zuid district), where the groundwater level is relatively high. In this street, a strip of vegetation called ‘green canal’ is being created, measuring seven to nine metres wide and almost half a kilometre long. Its main function is to store and remove rainwater. The strip also provides more greenery in the neighbourhood, brings cooling and removes fine dust and CO_2 from the air.

Artist’s impression of a green canal

Via the delaying effect of the trees and plants and a special soil composition, the rainwater eventually ends up via a 10 to 20 centimeters thick drain pipe in the water system of Beatrix Park and the Zuider Amstelkanaal. The green strip is being created as part of the Amsterdam Rainproof programme.

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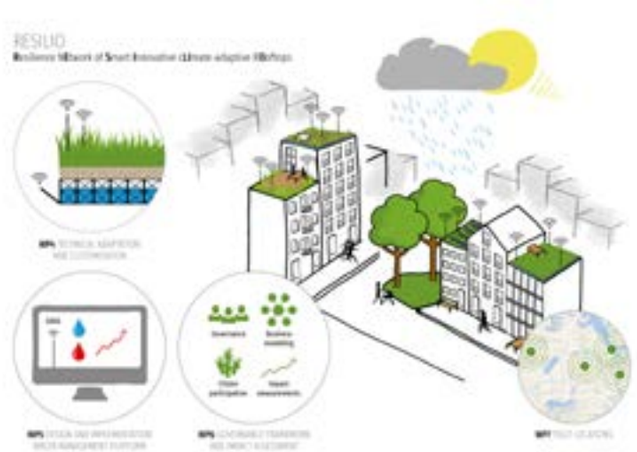
Central control for blue-green roofs



Waternet, The Things Network and MetroPolder have designed software with which the operation of water-retardant (roof) systems can be checked and controlled in one overview. If a large amount of precipitation is expected, the maximum storage capacity can be made available in a single operation. The application is expanded with a precipitation forecast module to be able to automatically control the (roof) systems on a precipitation forecast

This network will play a major role in the RESILIO project, in which a total of 10,000 m^2 of smart blue-green roofs will be installed on housing association properties. The Bellamy neighbourhood, Geuzenveld, Oosterpark and Kattenburg have an increased risk of flooding and damage due to extreme rainfall. In these neighbourhoods there are many housing association properties with suitable roofs, which are in need of replacement. The project therefore has access to a large roof area for testing this new form of water management at districts and buildings levels.

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Bubble screen in the Amsterdam-Rhine canal

In the long, dry summer of 2018, Rijkswaterstaat, the executive agency of the Ministry of Infrastructure and Water Management, worked with Waternet and other parties to install an experimental bubble screen at the entrance to the Amsterdam-Rhine canal.

This limited the creeping of the salt tongue from the IJ, so that the supply of fresh water for agriculture, nature and drinking water was not endangered. It also made more fresh water available for other uses.

Based on this successful test, a permanent bubble screen was installed at the end of 2018. The migration of fish was also taken into account in the design. As far as we know, this is the first bubble screen in the world that is not in a lock, but in a channel.

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Innovative reinforcement Ringdijk Watergraafsmeer

The Watergraafsmeer ring dyke is being reinforced. This is a green, tree-lined dyke with houses adjoining it. Therefore, the dyke will be reinforced with a nailing technique – the JLD International dyke stabiliser. This innovative technique minimises nuisance from works, and nearly all the trees along the dyke can be preserved. The dyke is reinforced from the inside with dyke nails and nailed to the subsurface, so that no sheet pile wall in the dyke needs to be driven from much soil.

Following extensive testing of noise and vibration caused by the dyke nailing technique and a demonstration for local residents, the contractor started installing the first dyke stabilisers in the ring dyke at the end of 2018. Once the work has been completed, an app can be used to monitor the dyke by means of sensors that measure the tension in it.

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Dephosphating surface water

The traditional method of removing phosphate from surface water involves the use of iron chloride. and requires a dosing system with safety devices. A new removal technique is based on the reuse of ferrous sand and gravel used in the preparation of drinking water. This iron gravel can be used for a long time for phosphate removal and afterwards it can be reused for other purposes.

In addition, a new granulate from iron sludge with a very high absorption capacity for phosphate has been developed together with AquaMinerals, KWR and Agravis. Good results have been achieved with this at Sloterplas. The technique does not require any storage tanks or safety devices. With a well-designed filter system, it will be possible to bind phosphate for several years without replacing the filter material. This technique can achieve a minimal impact on the environment, which offers possibilities for using it in nature reserves.

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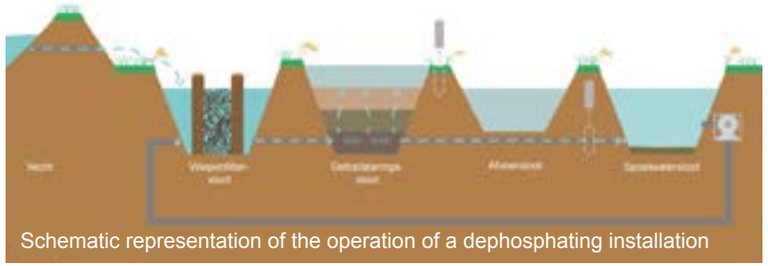

Schematic representation of the operation of a dephosphating installation

New sanitation

Wastewater contains raw materials such as energy in the form of biogas and heat, as well as phosphate. New sanitation is a better way of recovering these raw materials, by immediately separating the wastewater in buildings into black water from toilets and grey water from sinks and showers. New-sanitation projects are currently being carried out in new construction projects in Buiksloterham, and will be carried out in a few years on Strandeiland.

A vacuum sewage system has been installed for newly built residential blocks and floating homes in Buiksloterham, which transports the black water from around 800 homes to a small treatment plant, which will first produce biogas and phosphate. For Strandeiland, a new island in IJburg with 8,000 homes, it is being investigated whether new sanitation can be applied, with local waste water treatment and raw material and energy recovery. Heating and cooling of the buildings is done via a low-temperature heating network.

Read more

Thermal energy

Surface water, wastewater and drinking water contain hydrothermal energy that can be used to heat and cool buildings. The water boards want to contribute to the transition of energy by offering hydrothermal energy as a heat source. With this, they expect to be able to provide 25 to 40% of the national heat demand. Waternet explored its contribution to hydrothermal energy on several fronts in 2018. It is being investigated whether 8,000 homes on Strandeiland can be heated and cooled via a low-temperature heating network, for which the heat comes partly from surface water and partly from waste water.

Summer 2018 - Strandeiland is slowly rising above the water

Together with the City of Amsterdam, Waternet is exploring its possible role in the construction and management of this system. At several locations in our service area we are sharing knowledge, providing input and carrying out preliminary studies with external parties in order to be able to use thermal energy from water as a sustainable alternative to natural gas heat.

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Reuse of raw materials

Since November 2018, Waternet has been a shareholder of AquaMinerals on behalf of the regional public water authority Amstel, Gooi en Vecht (AGV). AquaMinerals is the partnership of the drinking water sector that gives recovered raw materials a second life by establishing profitable and sustainable sales channels for the residues and raw materials produced by AGV. We can make optimal use of AquaMinerals's expertise.

Established by the Dutch drinking water companies in 1995 for the management of residues, the Residues Union (Reststoffenunie) was renamed AquaMinerals in mid-2016. The cooperation offered many benefits for the environment, but it also became attractive in economic terms to find new destinations for the residual materials. This concerns struvite, calcite grains or iron sludge from drinking water production and sieves, grate, sand, fat and dried sludge from waste water treatment.

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'Power to Protein': safe protein production from wastewater

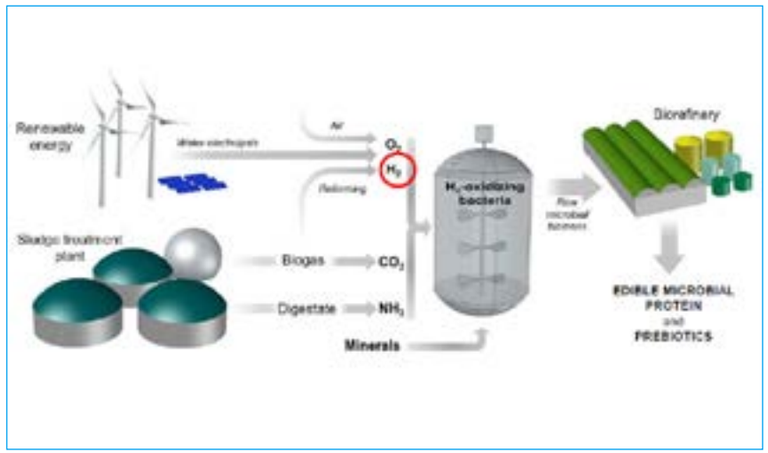

Diagram showing the Power to Protein principle

The 'Power to Protein' concept was tested last year with a pilot study at the Horstermeer wastewater treatment plant. In this concept, autotrophic hydrogen-oxidising bacteria produce protein or single-cell protein (SCP) from our wastewater, with hydrogen gas as an energy carrier and ammonium as a nitrogen supplier. The study showed that it is possible to safely use ammonium from wastewater for the production of protein by means of a reactor in accordance with the 'Power to Protein' concept. The chance of ammonium sulphate introducing biological pathogens from the wastewater chain into the protein is negligible.

A follow-up project focuses on studying the fundamental processes of hydrogen transfer in bioreactors in order to improve the reactor concept. This is necessary in order to make the concept economically viable and to produce a high-quality protein. Parallel to the study, project partners Avecom and Allied Waters are exploring the possibilities from a market perspective.

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Dredge spoil for peat dykes

Peat silt and woven willow branches are being used to restore the peat dykes in the Loosdrechtse Plassen lakes. Due to this innovative application of woven fascine mattresses, it is not necessary to use expensive techniques with sheet pile walls and the like. A three-metre high frame of woven willow branches is sunk from a pontoon and then protrudes thirty centimetres above the water surface. Landfill stones will be placed on the bottom to hold the mattress in place. This is topped with dredge spoil, dredged from silted up waters in the area. Biocovers are used to keep the silt in the frame. Reed banks come along the edges and grass is sown on the dried-in dredge.

This solves three problems in the area. The silt that obstructs water traffic is reused. Dredging the peat silt improves water quality. And, in addition, lost sections of the peat dykes are restored using a sustainable technique.

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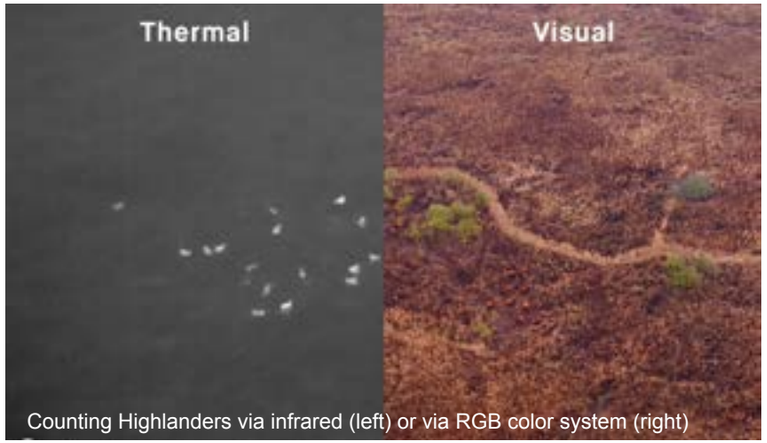
Panoptes - multi-purpose drones

In 2018, Waternet achieved many milestones, such as the RPAS Operator Certificate (ROC) license, making Waternet the first fully certified water company in the Netherlands. With this certificate, we used our drones for seepage detection in a cold period. We were able to use a thermal camera to clearly show the contrast between the warmer upwelling groundwater and the cold surface water at various locations.

Our drones were used for the Rivierenland water board and the Dutch Society for Nature Conservation (Natuurmonumenten) in a project near the island of Tiengemeten, in which both thermal images and regular images were used for research. In addition, a check was carried out on the amount of soil supplied by the contractor for raising a dyke. It turned out that approximately 35% too much soil had been applied.

Read more



Counting Highlanders via infrared (left) or via RGB color system (right)

‘Digital canal’

The ‘digital canal’ is a dashboard on which Waternet brings together all the information that sensors and smart cameras collect about the traffic on Amsterdam’s waterways. The system collects data from different systems and converts it into useful information. This information is enriched with the knowledge of staff and by means of artificial intelligence for the prediction of hotspots for monitoring and enforcement.

Amsterdam’s canals get very busy, especially on sunny days, leading to dangerous situations, nuisance and noise pollution on the water. Using the information collected by the sensors and smart cameras, artificial intelligence predicts the busiest areas. The ‘digital canal’ dashboard enables traffic measures to be taken to minimise nuisance, keeping Amsterdam’s water traffic pleasant and safe. The programme is supported by broad cooperation.

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Innovation greenhouse Prodock

In 2018, Waternet opened her greenhouse in Prodock, the innovation hub for circular economy in the Amsterdam port. In this greenhouse, Waternet employees can work together with students and entrepreneurs. It is the home base for Waternet’s drone pilots, who can develop new applications for our flying drones here. Work is also being carried out on the self-propelled floating trash fishing boat Nautonomous and on Emily, the water drone that can quickly identify obstacles below the water surface with an underwater manpower so that we can remove them efficiently..

At the end of November 2018, Halimah Yacob, the President of Singapore, visited the Netherlands at the invitation of King Willem-Alexander. The state visit was largely about innovation and the economy. During her visit to the innovation greenhouse, several innovations were explained, including the ‘digital canal’, a dashboard that monitors ships in order to prevent nuisance and dangerous situations.

Read more

Colophon

Front photo: The drone specialists in the innovation greenhouse
Back photo: Restoration of the peat dykes in the Loosdrechtse Plassen

Text editing: Peter Beemsterboer
Design and layout: Marjan Schermerhorn
Final editing: Alice Fermont

Published by Waternet Research & Innovation

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