Research & Innovation

2018 Progress Report

waternet
waterschap amstel gooi en vecht
gemeente amsterdam

Research and Innovation Programme

Waternet innovates and develops expertise by order of the City of Amsterdam and the Amstel, Gooi and Vecht (AGV) Water Board. Our work consists of improving drinking water quality, removing and treating wastewater, keeping surface water clean, and maintaining dykes and flood defence systems. In addition to efficiency and good service, we are committed to sustainability, which is a driving force behind much of our research and innovation. Digitalisation and technological developments present us with new possibilities.

We aim to be climate-neutral by 2020, and we are playing a part in the energy transition in the Netherlands. We are striving to minimize our CO_2 emissions, or, where that is not possible, compensate for them. We recover energy and raw materials from the water cycle and minimise the waste we produce using circular methods. It is imperative that we deal with the consequences of climate change. Together with others, we are working to create an environment that can cope with extreme weather conditions such as downpours and droughts. These ambitions are the bedrock of Waternet's Research and Innovation Programme. We are not doing this on our own: we can get more from water by cooperating with other parties.

This report presents the interim 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 are referring to an innovation theme

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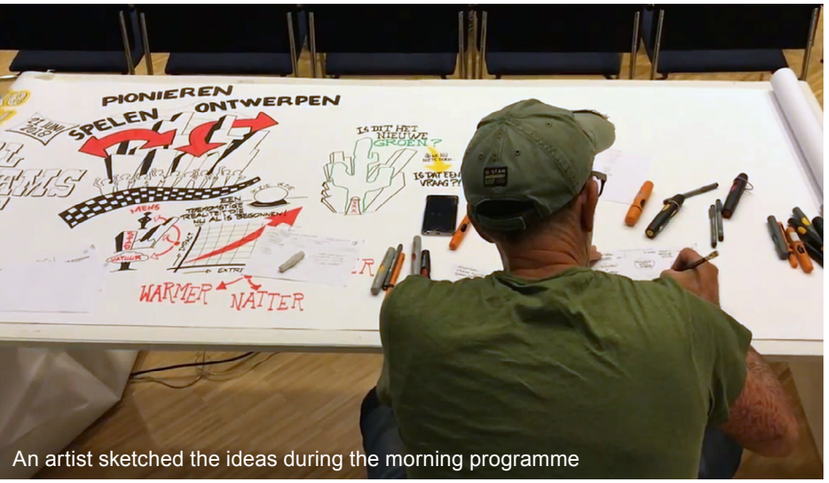
Climate adaptation is one of the most critical challenges facing society. That's why the AGV water board and the City of Amsterdam, along with other authorities, are realising the integrated Climate Adaptation Programme. The programme has a broad approach, ranging from drinking water to sewerage, and from polder to outlet waterway. To some extent we can adjust our assets to climate change ourselves, but to achieve a working area that is resilient and adaptive to climate, we need to work with municipalities, inhabitants, businesses (including agricultural ones), housing corporations and the construction sector.

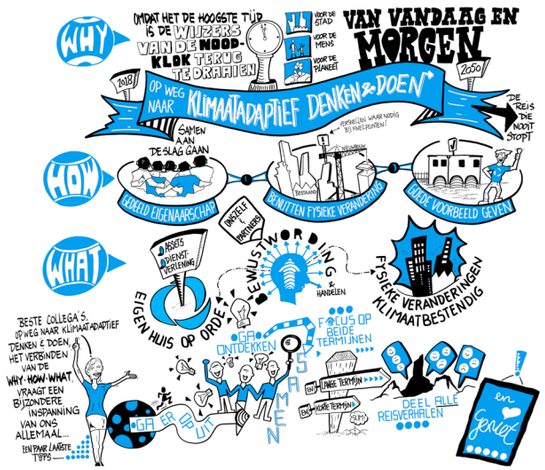
The programme plan lays down AGV's and Amsterdam's ambitions for climate adaptation, as well as Waternet's role in this regard. Climate-proof design is one of the major challenges for construction in the region. Climate adaptation is part of the daily work of many departments and teams of Waternet. It will be one of our main transformation tasks in the coming years.

Read more

Normal Amsterdam Climate



An artist sketched the ideas during the morning programme



In the Amsterdam Metropolitan Area we also have to deal with more extreme weather in the form of precipitation, drought and storms, possibly also with flooding. The damage and the societal consequences of this could be considerable. We are not adequately prepared for this risk with the current building assignments and spatial planning.

On 21 June 2018, more than seventy real estate owners, financiers, project developers, builders, government authorities and pioneers met up at Waternet to work on the Normal Amsterdam Climate (NAC). It is a new way of working together for the physical adaptations needed for extreme weather conditions. Climate adaptation will be the new normal, and knowledge on climate-adaptive construction will be shared. With this integrated approach we can include climate adaptation in other transition tasks, such as the energy transition, and we can also serve as an example for the rest of the region.

Read more

Infiltration through drain joints

Due to climate change, the Netherlands will be facing more extreme weather conditions, such as heavy downpours. Therefore we are testing different ways to infiltrate rainwater in the soil on the following properties:

- Heavy rainfall must disappear quickly from the street surface.
- Not all precipitation may be discharged directly to surface water via the sewage system.
- The rainwater has to infiltrate into the local groundwater, so that this stays at the right level.


Close-up of drain joints between paving stones in Egmond aan Zee

Drain joints consist of water-permeable pieces of felt between paving stones, which, in theory, should be able to process 180 mm of rain per hour. Because they were used a few years ago at a re-paving in Egmond aan Zee, we were able to monitor their effect in May 2018 in a test section that was closed off with sand bags. They proved to handle 40 mm of precipitation per hour. This key figure is very useful for us in our own rainproof measures.

Watch video

Micro-pollutant strategy

IIn the water we find more and more chemical substances, such as pesticides and medicines, but also tiny pieces of plastic. We refer to these types of contamination as micro-pollutants. Such substances do not belong in the water, and they are damaging to the aquatic life.

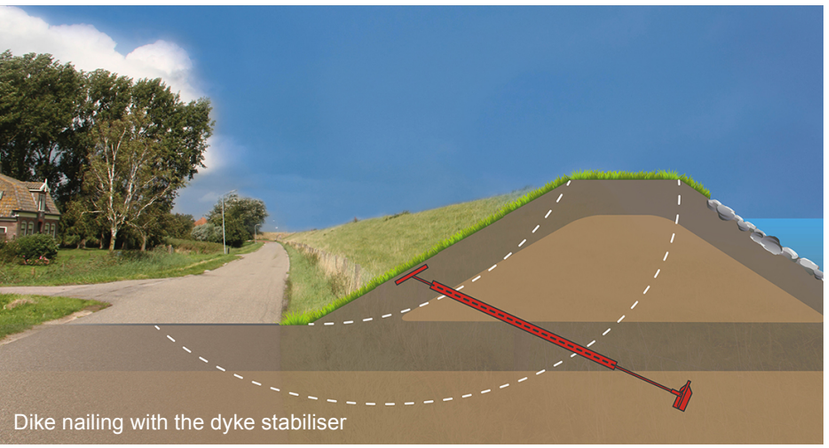
The Amstel, Gooi and Vecht (AGV) Water Authority has established a strategy for tackling micro-pollutants, a contamination concerning many different substances that end up in the water in very different ways. To really address these substances, a chain-based approach is needed, in cooperation with manufacturers, consumers, water managing authorities etc.

This means removing them at the source as well as during use and at the end-of-pipe. For instance, glasshouse horticulture businesses will purify their wastewater from pesticides, and AGV will extend a number of wastewater treatment plants with an additional step to remove medicine traces.

Read more

The AGV management board on a working visit to Berlin concerning organic micro-pollutants

The dyke stabiliser



Dike nailing with the dyke stabiliser

The Watergraafsmeer ring dike must be strengthened. It is a green dike with trees and the houses are aligned closely to it. That is why we are going to reinforce the dike with a nailing technique: the dike stabiliser from JLD International. With this technique the work causes less nuisance and nearly all trees on the dike can be preserved. The dike is reinforced from the inside with dike nails and nailed to the subsoil. This means that it will not be necessary to apply a sheet pile wall in the dike or to apply a lot of soil.

The AGV board established the dike improvement plan involving the first application of this technique in June. The contractor has already tested the functionality and the degree of noise and vibration caused by the dike nailing technique, and given a demonstration to the stakeholders. The reinforcement work on the ring dike will start in September.

Read more

Detecting muskrats

Muskrats are a big problem in the Netherlands. We depend on flood defence systems to keep our country safe, and muskrats destabilise these systems by digging whole networks of tunnels. For active management we need to know where they are. We are therefore developing a new tracking method together with the Amsterdam University of Applied Sciences (HvA), Muskusrattenbeheer (muskrat control in the Netherlands) and the University of Amsterdam (UvA).

A muskrat

A student from the Engineering, Design and Innovation programme developed a water sample module at Waternet which can be attached to a drone to track muskrats. Using this module, a drone can autonomously take four samples per flight from the surface water. Using the eDNA method – a technique for analysing whether environmental DNA is present in the water – the laboratory can determine whether the water contains muskrat DNA markers. In this way, the search area is reduced significantly. Using the water sample module results in a more efficient, accurate and safer primary working process.

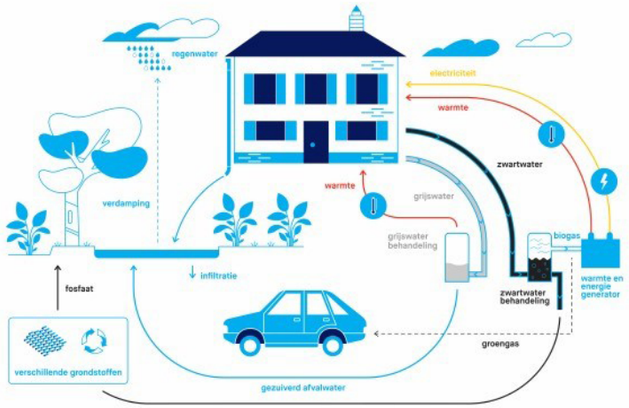
Watch video

New Sanitation and Thermal Energy

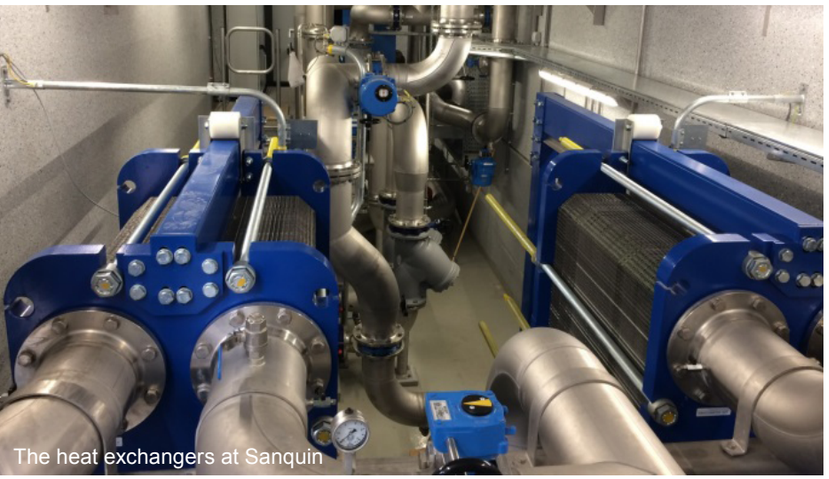
With the New Sanitation (NS) programme, we aim to maximize the (local) recovery and reuse of raw materials and energy from water. The New Sanitation programme tackles the core tasks of sewerage management and purification management. It also supplies energy from the water cycle and thus affects the Thermal Energy programme. We are collaborating with the City of Amsterdam on an implementation project in Buiksloterham and also on an exploratory study for the future Strandeiland (Beach Island).

Within the Thermal Energy (TE) programme, we are investigating the role we can play as an operator of heat networks and/or a supplier of heating in the transition to a city that is free of natural gas. We are designing a low-temperature energy system for Strandeiland, and are also working on a way to implement and exploit future energy projects together with the municipal authorities (and the water board).

Watch video



Drinking water for cooling


The heat exchangers at Sanquin

The extraction of thermal energy from the water cycle offers many possibilities for compensating for the emission of greenhouse gases. Waternet provides cooling to Sanquin from a drinking water pipeline. During the winter, the drinking water is heated to a maximum of 15°C using heat exchangers. From November 2017 to April 2018, around 8000 GJ was supplied in energy. Next winter, that will be even more.

Together with TU Delft, Waternet is investigating the effects of cold extraction on microbiological water quality. In a test arrangement, the bacteria numbers turned out not to be raised, but the amount of biofilm in the pipes was higher. In practice at Sanquin, the microbiological parameters were stable. In a new test arrangement in the technological lab at Leiduin we are continuing to investigate the effects of cold recovery on the biofilm.

Read more

Biocomposites, from plant to plank

Every year, Dutch water boards remove millions of pounds of water vegetation and bank vegetation from their waterways. The clippings end up on the banks or are removed as organic waste. Together with other water boards, STOWA and composite manufacturer NPSP, the AGV water board is investigating the feasibility of producing biocomposites from bank vegetation. The clippings should not remain on the banks and rot there, and they should contain as little sand as possible.


Raw materials and biocomposite at NPSP Photographer: Patricia Nauta

We are investigating the quality of biocomposites from reeds, grasses, water plants and cellulose (from wastewater). After the discovery of raised arsenic concentrations in a part of the amount of aquatic plants, the researcg was partially halted and adjusted. We are now testing the sustainability of pondweed instead of our aquatic plants. This summer, we will be carrying out ageing tests on the test material.

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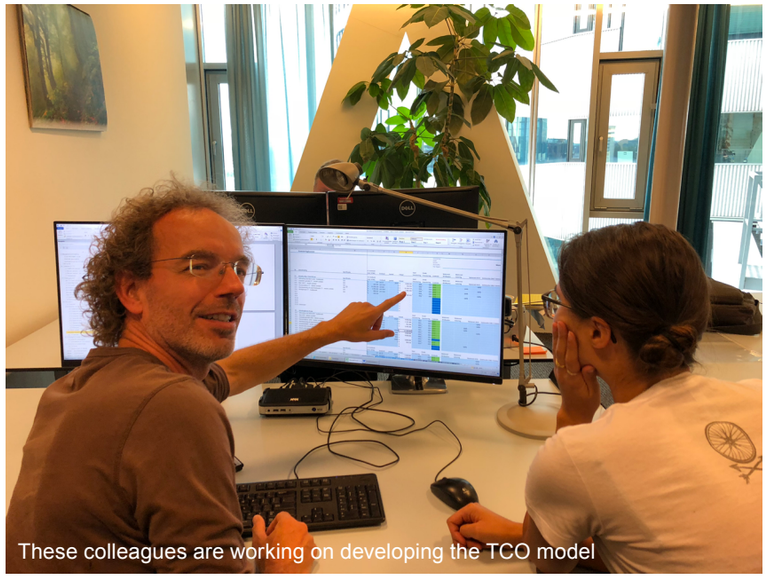
TCO-model Strandeiland

The City of Amsterdam is developing a sustainable district, called Strandeiland (Beach Island). Waternet is comparing a number of new heating facilities and sanitation scenarios in terms of both costs and sustainability. To do this as efficiently and effectively as possible, we apply a very useful tool: the TCO model. TCO stands for Total Cost of Ownership. We can use this model to determine total long-term costs.



These colleagues are working on developing the TCO model

In order to make an accurate and fair comparison, inflation, price hikes in gas and electricity, and the ‘greening’ of electricity have all been taken into account in the model. Furthermore, we can divide these costs between the various partners, such as occupants, Waternet, the municipal authorities etc., enabling us to make choices between different types of heating and sanitation.

Read more

Sustainable energy in Nieuwegein with Power to X

A solar park has been installed at our site in Nieuwegein with a capacity of around 8.6 MW. The new solar park will provide energy and heating to 900 homes in the residential area of Rijnhuizen – not directly but via heating pumps and thermal energy storage (TES) in the ground.

Using electrolysis, part of the sustainable electricity is converted into other energy carriers (X), such as hydrogen. It has been calculated that this will provide a service station with 200 kg of hydrogen per day (for around 600 cars). The conversion also produces clean water for e.g. washing machines. Encouraged by the positive results of the economic analysis, we are continuing with the realisation of Power to X. KWR Research Institute, Waternet, the company VolkerWessels and mains operator Stedin are all collaborating in this exceptional project.

Read more

Solar panels on our drinking water production location in Nieuwegein

Recycled toilet paper for asphalt

Cellulose recovered from sewage water

Every year, 180,000 tonnes of toilet paper are flushed to wastewater treatment plants, where it used to be treated as a waste product. We now have the technology to filter the cellulose from the toilet paper out of the sewage water and reuse it, for example in the production of insulating material, biocomposite, synthetic window frames and façade panels.

It is also used in the production of noise-reducing asphalt. The cellulose fibre binds the bitumen and stone mixtures in the asphalt together, so that the bitumen during the production, the transportation and the processing does not “drip” off the stone and sand particles. Because the cellulose fiber functions as a drip inhibitor, the asphalt works better and is more sustainable.

Watch video

Innovation glasshouse Prodock

Waternet is keen to speed up innovations in the innovation glasshouse, where Waternet staff can work together with students and entrepreneurs. This will also promote cross-fertilisation between the various disciplines. We will start by further developing our airborne drones, the self-propelled Nautonomous boat for removing floating debris, and our latest acquisition, the water drone Sonar Emily. At an open day organised by Prodock on Tuesday 10 July 2018, the fourteen tenants at Prodock presented the products they were developing. Gerhard van der Top opened our innovation glasshouse.


Gerhard van den Top officially opens the Innovation glasshouse

Prodock is the innovation hub of the Amsterdam port, where ambitious entrepreneurs – both up-and-coming and established ones – get to work. In a 4.000 m² dock warehouse the Amsterdam Port Authority offers an industrial workshop, offices, outside space, and all that is needed for the testing, development and launching of new technologies.

Read more

Datalab

Dykes and machine learning

Sonar Emily

Since May 2018, Waternet owns the autonomous water drone called Sonar Emily (EMergency Integrated Lifesaving LanYard) for inspection purposes, such as locating underwater obstacles, sources of water pollution and bank deformation. Sonar Emily is a compact sonar system that was originally developed to help beach life guards save people from drowning. The drone can be transported by car and can be used in places that are difficult or impossible to access by boat.

The first inspection concerned a possible contamination of lock tresholds, which could hamper lock gate closing. Any obstacles near to the gates can be identified and removed in time. During an inspection of a sheet pile wall, holes were discovered in the wall which were causing subsidence. Sonar Emily can draw up a depth chart on location and send the data to the base station over a distance of 500 metres, where it can be converted to GIS data for further applications.

Read more

Using data analyses and data-driven models, we can serve our clients even better and faster, while continuing to improve our business processes. The Datalab scrum team, which officially kicked off on 7 May 2018, will be further developing data science expertise and skills at Waternet, thus contributing to our digitalisation objectives.

Datalab's work is highly diverse. For instance, several data sources relating to water surfaces were compared in order to produce unambiguous data. In addition, Datalab is helping to make Waternet the best public service provider. By analysing the effect of the time it takes to process client questions, a machine-learning-based prediction model has been developed which will enable us to improve a number of client processes. Other examples are water meters that are read out using machine learning, and a purification plant that will perform more efficiently with the aid of artificial intelligence.


Sonar Emily on shore

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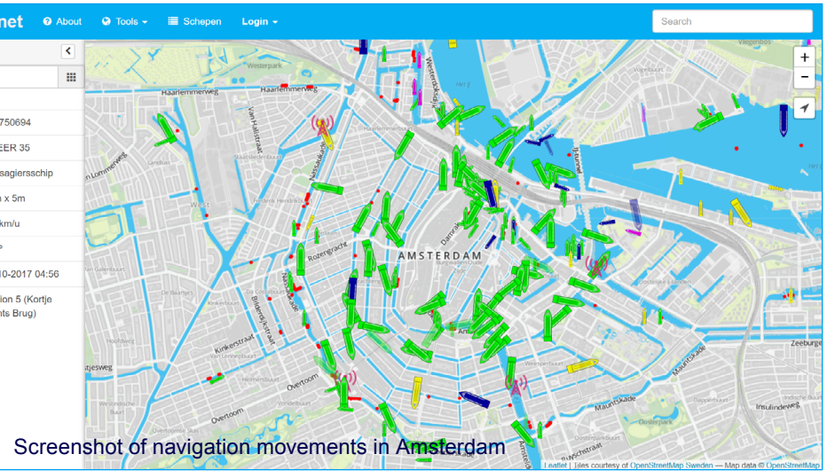
The digital canal

In 2017, Waternet started developing the ‘digital canal’, a digital platform that can be used to link up all current and new information systems concerning the canals.



Screenshot of navigation movements in Amsterdam

Waternet wants to make all the Amsterdam waterways that it manages digitally accessible for:

- enforcement (speed limits, illegal berthing, noise pollution, theft, illegal passenger transportation)
- quay detection (inspection of the state of a quay)
- control and overview of water traffic density
- detection of all vessels entering the city
- informing and involving central/targeted city enforcement bodies
- wreck registration and environmental records
- alignment of the central operation service (bridges and locks) to shipping movements for a smoother flow
- data analysis for reports and traffic modelling
- link to the VaarWater App, developed for the discovery of the Amsterdam waterways, which we are constantly supplementing.

Watch video

Waternet behind the camera


Colleagues during a recording of “Waternet behind the camera”

To do our work as well as possible, we collaborate with various parties in the city and surroundings. This is a very energetic way of working, and collaboration takes many different forms. To make all this visible, the “Waternet filmt verbinding” project (Waternet films connections) was launched in the summer of 2017, and resulted in a number of short films that illustrate the work we do.

Successful cooperation was achieved in the Horstermeer polder, where the brackish seepage water that was rising to the surface had a detrimental effect on the water quality in and around the polder. Introducing water that is not originally from the area or raising the groundwater level are not ideal solutions. Through intensive contact with polder inhabitants, we arrived at a solution that was acceptable to all.

Watch video

Cooperation with knowledge institutions

We are preparing for the future by anticipating and working on climate change, the energy transition, water quality and quantity, and the circular economy. We are working on these challenges together with partners such as other water authorities, the business sector, universities and knowledge institutions. In 2018, our collaboration with the Amsterdam Institute of Advanced Metropolitan Solutions (AMS) was consolidated.

The development of Nautonomous is linked to the “Roboat” project by AMS and MIT, the Massachusetts Institute of Technology. AMS, water authorities and consultancies have launched the NUWTS (New Urban Water Transport Systems) project to recover raw materials from drinking and waste water in the future. A feasibility study has been launched with TUD and Witteveen+Bos into cyclodextrine polymer: a new adsorbent for removing medicines. Waternet wants to strengthen cooperation with the UvA in combating organic micropollutants in the water cycle.

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Colophon

Front photo: Sonar Emily full speed ahead on the canals of Amsterdam

Back photo: Test of the functioning of drain joints between paving stones in Egmond aan Zee

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