WSSTP – Urban Pilot Theme 1: Project proposals and Demonstration Sites

Managing rain events and flooding in urban areas

WSSTP – UPT1: 14-03-2008

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1. Introduction

The Water Supply and Sanitation Technology Platform (WSSTP) is a platform developed by the European water industry, open to all stakeholders and with the objectives to:

- enhance the competitiveness of the European water industry
- solve the European water problems
- reach the Millennium Development Goals

The participants in the platform have produced a common vision document for the whole European water industry and a strategic research agenda (SRA). The SRA identifies research topics, which have been grouped into six pilot programmes:

1. Mitigation of water stress in coastal zones
2. Sustainable water management in large cities
3. Sustainable water management for agriculture
4. Sustainable water management for industry
5. Reclamation of polluted water zones (surface and ground)
6. Proactive and corrective management of extreme hydro-climatic events

where pilot programme no. 2 also is known as the Urban Pilot. Each pilot programme is going through a process as indicated in figure 1.1., and the Urban Pilot has dealt with 56 Research Topics from the SRA, hereof Generic Research (23 topics) and Enabling Technologies (33 topics).

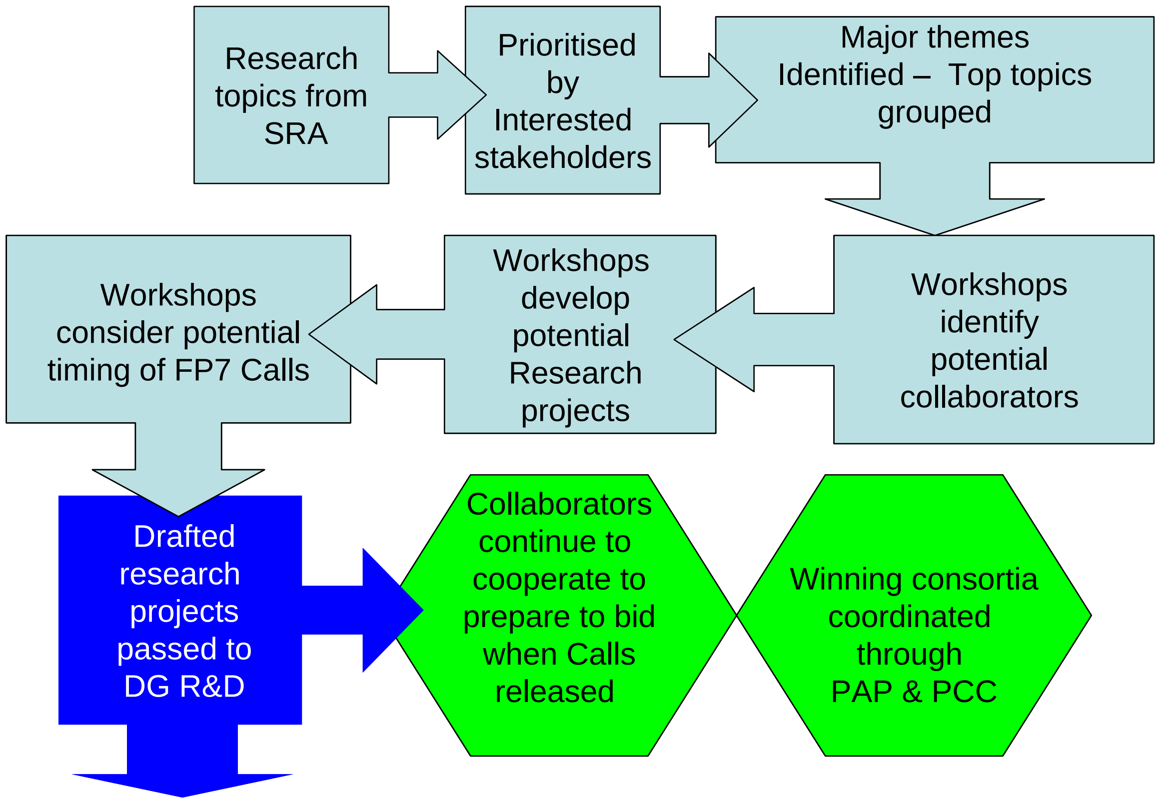

Figure 1.1: Overview of the WSSTP – Pilot Implementation Process.

There are 3 questions for each Research topic, with 4 possible responses for Q1 and Q3 and two responses for Q2

Q1	1 - Is this research item of importance to your company?	not at all	a lttle	medium	vital
Q2	2 - Does your company intend to carry out R&D on this item?	no	yes		
Q3	3 - Is your company willing to collaborate with others?	no	Funds available	in kind support	cash & in-kind

Figure 1.2: Questionnaire structure and priority tool.

In order to give priority to these 56 Research Topics a questionnaire was sent to potential stakeholders, who for each topic had to select an answer for three questions asked (figure 1.2). Answers were received from:

- Aarhus
- Amsterdam
- Barcelona
- Berlin
- Bologna
- Bucharest
- Copenhagen (Avedøre)
- Eindhoven
- Genoa
- Lisboa
- Madrid
- Manchester
- Oslo
- Prague

Major themes were identified and topics grouped/ranked from the answers received. Topics without a score were left out and the remaining 36 topics could be organised as shown in table 1.1. The themes and priorities were discussed at a meeting in Paris in June 2007, where stakeholders were invited to present their own priority of the research topics and suggest how to proceed.

Theme	Number of Topics	Sum of priority scores	Rank
Urban Flooding	8	701	1
Asset management	7	647	2
Supply/demand balance	7	619	3
Sludge management	5	414	4
Sensors	6	393	5
Drinking water treatment	2	272	6
Pollution control	1	65	7

Table 1.1: Organisation of themes and topics within the Urban Pilot.

Further, the following questions were asked:

- Are the topics grouped correctly?
- Are there too few/too many themes?
- Are there any topics in the SRA which should be included in a theme?

and the participants were asked to take lead on a theme in order to bring the process into the second row of activities (figure 1.1). The themes, leads and actions agreed were:

1. **Flooding (or other possible title)**, Aarhus, Workshop in September/October
2. **Assets**, Genoa, Workshop in October
3. **Supply/demand balance**, Berlin, Workshop in July (later agreed to be 27-28 August) to define "Sub-themes"
4. **Sludge/Wastewater and energy**, Prague, Workshop in October
5. **Sensors (or other Theme title to be agreed)**, workshop on this Theme should follow all the other workshops, which should include "sensors" as an item in their agenda in order to identify the need for sensors.
6. **Water Treatment**, the FP6 project, Techneau, will be used to host a workshop on research needs (KIWA to organise)
7. **Pollution Control**, to be discussed again at the next meeting of the Group

The agreement of the grouping of topics and if any topics from the SRA were missing, was that in general this was OK, but it is up to the different themes workshops to check and discuss this – if needed. Each workshop shall be arranged as a 2 day event for approximately 20 delegates and be based on:

- All survey respondents invited
- At least one WSSTP Board member
- 2 - 4 invited "experts"
- Review material circulated in advance
- Current EU project information available

and with the following output:

- Groups of utilities/cities willing to collaborate
- Outline proposals developed for major work programmes
- Potential demonstration sites agreed

More information concerning WSSTP and the process of formulating Research Projects can be found on http://www.wsstp.org, where also the Strategic Research Agenda (SRA) can be found.

2. Working Group Urban Pilot Theme 1

2.1 Workshop preparation

As a result of the Paris meeting an invitation to a workshop for further development of Urban Pilot Theme 1 (at this time called Urban Flooding) was sent to the same persons/organisations as invited to the Paris meeting. The invitation included a request for information from utilities/cities willing to collaborate under this theme.

The utilities/cities were asked to produce a short description (max. 4 pages including figures, 2 columns, 10pts.) – a fact sheet - of their potential pilot/demonstration project including the research topics addressed. Headings should be:

- Introduction
- Infrastructure
- Project description
- Theme 1 Topics covered (and other Urban Pilot topics as well)

further, utilities/cities preparing a fact sheet was also asked to prepare a presentation including:

Project overview
- Why are you doing the project
- What are the problems to be solved
- Why do you want to make it under WSSTP

Project Presentation
- The infrastructure
- The analysis of the problems
- The expected outcome
- The suggested solutions

Research Topics
- Which theme 1 research topics are the most important for your project
- Are you aware of any existing EU projects that addresses (more or less) these topics

Instruments
- Which instruments fits best your project and organisation
    - Training
    - Networks
    - Research
    - Demonstration

Finally, all invited persons/organisations were asked to send information concerning any existing EU projects that addresses (more or less) the theme 1 topics.

From the fact sheets received before the workshop, it became clear that it was necessary to include two research topics more from the Urban Pilot topics to the list presented in Paris for this theme (E1 and partly E12; see below), and that a better heading for this theme would be “Managing rain events and flooding in urban areas”. Therefore, the topics for Urban Pilot Theme 1: Managing rain events and flooding in urban areas are (heading and topics confirmed at the workshop)

Generic Research

- G6: Integrated risk assessment on urban water systems
- G8: Optimization of systems monitoring (water quality, hydrology and hydraulics of rain events)
- G10: System solutions for flood management and reduction (integrated forecasting modelling and control, online storage, individual retention)
- G11: Design forecasting and early warning systems suited to quick events in large urban areas
- G14: Integrated modelling platforms of sewer and drainage systems including storage and treatment

Enabling Technologies

- E1: Cheap, reliable and maintenance less energy sources and sensors
- E2: On-line monitoring of water quality and of treatment processes, for collective systems
- E12: Real time monitoring/control of treatment plants (focus on control during rain)
- E29: Multi-hazard and multi-risk modelling tools (natural events, technological hazards, assets failures)
- E31: Real-time forecasting and management of drainage systems and retention facilities

However, the topics G6, G10 and E29 did not come out clearly from the received fact sheets, which lead to an invitation of two experts for presentation of Risk Assessment (G6 and E29, Carsten Jacobsen, Krüger AS, Denmark) and Flooding (G10, Richard Ashley, University of Sheffield, UK).

2.2 Workshop

The workshop, which was held on 24 – 25 September 2007 and hosted by Aarhus Water&Wastewater had the following participants and agenda

Name	E-mail	Company/Organisation	Country
Anders Lynggaard-Jensen	alj@dhigroup.com	DHI - Water, Environment, Health	Denmark
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Richard Ashley	R.Ashley@sheffield.ac.uk	University of Sheffield	United Kindom
Tove Abegg Haugland	Tove.haugland@vav.oslo.kommune.no	Municipality of Oslo	Norway

Agenda:

Monday 24 September:
09:00 – 09:30: Welcome and introduction to Aarhus Water&Wastewater
09:30 – 11:00: Presentation and discussion of potential pilots/demonstration sites
Aarhus, Barcelona, Berlin (Postponed to Tuesday morning due to a cancelled flight)
11:00 – 11:30: Coffee/the break
11:30 – 13:00: Presentation and discussion of potential pilots/demonstration sites
Eindhoven, Genoa, Lyon
13:00 – 14:30: Lunch at the Harbour
14:30 – 17:00: Excursion to sites and infrastructure included in the Aarhus project – having a look at the real world – and ending at the hotel.
19:30 - Dinner at the river side in the town centre

Tuesday 25 September: (re-designed after first day)
09:00 – 09:15: Introduction – Expected outcome of Workshop
09:15 – 09:45: Presentation/discussion of Berlin potential pilots/demonstration site
09:45 – 10:15: Risk Assessment (G6, E29)
10:15 – 10:45: Flooding (G10)
10:45 – 11:15: Break
11:15 – 12:30: Discussion: Topics -> Group of Topics -> Projects ?
12:30 – 13:00: Lunch
13:00 – 14:30: Discussion: Topics -> Group of Topics -> Projects ?
14:30 – 15:00: Conclusions – further work

2.3 Identification of projects and demonstration sites

Prepared presentations were done including discussions on each, and after the break on the second day discussions started on how to compile the information into project proposals and to link these to proper demonstration sites hosted by interested cities/utilities.

A discussion on the number of participating cities took place, but as this workshop is a step in an open process, there is no wish to limit the number – one single project can easily have more demonstration sites. Therefore participants were urged to find more potential cities/utilities who are interested in hosting demonstration activities.

However, it was agreed that all cities/utilities who want to be presented as a candidate in the work of the UPT1 working group have to fill in a table showing the city/utility interest in the research topics, and each city/utility also have to produce a fact sheet documenting the infrastructure and ongoing plans/projects on the demonstration site. Next step was to group related research topics into projects, and the result became 4 projects with the working titles and matching research topics:

I. Risk assessment and hazard – tools (G6, E29)
II. Sensors, monitoring, control.... (G8,E1, E2)
III. Real time operation.... (G11, E12, E31)
IV. QQ planning and solution..... (G10, G14)

In order to start the process a matrix (figure 2.1) was prepared using research topics and their related project number as first dimension and the cities/utilities present at the workshop as the second dimension (UK-cities/utilities represented by the UK participants). The matrix was filled in at the workshop using a projector (figure 2.1). Each city/utility had to give a figure between 1 and 3 indicating the research topic priority.

”City” vs. Topic

	G6 I	G8 II	G10 IV	G11 III	G14 IV	E1 II	E2 II	E12 III	E29 I	E31 III
Aarhus	3	2	3	1	2	1	1	1	3	1
Barcelona	2	3	3	2	1	3	2	1	1	2
Berlin	3	1	3	3	2	1	2	3	3	3
Eindhoven	1	2	1	2	1	1	2	2	2	3
Genoa	2	1	1	3	1	1	2	3	3	1
Lyon	(1)	1	2	3	1	1	1		(1)	
UK	1	3	1	3	1	1	2	3	1	1
Oslo	3	1	3	3	1	1	3	3	3	1

Urban Pilot Theme 1 workshop, 24 – 25 September 2007, Aarhus 6

Figure 2.1: City/utility priority interest in research topics

A lead city/utility to formulate and circulate a draft of each of the 4 suggested projects was identified on the basis of the number of “1s” under each project number. The city/utility with most “1s” became the lead. Further, the identification of the possible demonstration sites and the city/utility priority to be the host was done by grouping each city/utility on the basis of the “1” and a “2” under the project number. (Berlin has after the workshop announced that it wants to give a “1” to E12 and E31 instead of a “3”). The resulting leads and prioritised demonstration sites are:

I. Risk assessment and hazard – tools (G6, E29)
   1. Barcelona, Eindhoven, (Lyon), UK/lead
   2. Genoa
II. Sensors, monitoring, control.... (G8,E1, E2)
   1. Everybody (execpt Barcelona) – Lyon/lead
   2. Barcelona
III. Real time operation.... (G11, E12, E31)
   1. Aarhus/lead, Barcelona, Berlin, Genoa, UK, Oslo
   2. Eindhoven
IV. QQ planning and solution..... (G10, G14)
   1. Barcelona, Eindhoven/lead, Genoa, Lyon, UK, Oslo
   2. Aarhus, Berlin

The resulting project proposals are included in the next chapter, and the Fact Sheets from the cities/utilities are included in Annex 1. During the preparation of project proposals/fact sheets no new cities/utilities showed up and within the time frame give it was not possible to identify a UK city/utility.

3. Project Proposals

3.1 Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution

Research Topics:
- G6: Integrated risk assessment on urban water systems
- E29: Multi-hazard and multi-risk modelling tools (natural events, technological hazards, assets failures)

Title: Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution
Description: The big challenge for decision makers in the EU will be the problems of reconciling flood risk management with pollution control (multi-hazards), balancing the water framework with the floods directive. For this to be done sustainably it will be essential to follow a multi-risk-based approach. Only in this way can the balance of costs against benefits be determined within all of the constraints of changing the way in which (wider) urban water systems are managed. This needs also to include the operation and maintenance of existing assets – perhaps the biggest challenge for the more mature countries in the community who have ageing asset problems. There are a number of approaches already under development across the EU, in the UK for example, there are new approaches to asset management via an agreed 'Common Framework' and the sewerage rehabilitation manual is shortly to be reissued using a similar approach and including flood risk as well as pollution control. However, much more still needs to be done if this is to be applicable more widely and also to include the larger flood risk control assets. A novel consideration needs to include how investment in so-called structural measures are balanced against non-structural – for which new decision support guidance needs to be developed based on a risk-cost-benefit approach. This topic area will draw heavily on the work already completed under the CityNet cluster.

Funding scheme: collaborative project (large-scale integrating project)

Expected impact: *Resilience is a concept that is more easily tackled than sustainability as it indicates the ability of a system to function following disturbance. Here the anthropogenic and other ecological systems will be helped to be more resilient by providing a risk-cost-benefit based approach to assist decision makers in the more effective allocation of resources to balance risks in terms of both flooding (mainly anthropogenic impacts)and also pollution (mainly ecosystem impacts). This will target resources the most effectively to deliver required standards of service in these areas.*

3.2 Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies

Research Topics:
- G8: Optimization of systems monitoring (water quality, hydrology and hydraulics of rain events)
- E1: Cheap, reliable and maintenance less energy sources and sensors
- E2: On-line monitoring of water quality and of treatment processes, for collective systems

Title: Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies
With the increasing intense rainfall events and urban population size and their related on-going detrimental effects on water resources, defining, implementing and testing more resilient, ecological, cost-effective and sustainable urban sanitation processes and storm water collecting practices are needed. This requires the definition of technical elements and management rules to shift from the traditional engineering optimization to a more holistic system resilience. Two complementary and integrated approaches should be considered. The first one should consider traditional systems (mainly based on pipe systems) and the improvement of their efficacy through on-line monitoring and real time control. The second one should consider alternative approaches (e.g. using source control systems management, dual systems, etc.). A key point should be the water quality based integration of both approaches which have traditionally been considered separately. A particular attention should be paid to technological innovations dedicated to peri-urban areas.
Projects should include the development of on-line / continuous monitoring, from upstream components of urban water systems to the receiving water bodies, soils/sediments and biomass, ie:
- development of sensors, their tests and validation (robust technologies adapted to in situ measurement conditions and to WFD objectives, criteria and pollutants, and of other technologies that will enable the tracing of physical, chemical and microbial contaminants (e.g. PCR techniques)
- definition and implementation of scientifically based monitoring strategies (accounting of uncertainties, long term strategies of data acquisition and data analyses, on-line and off-line data validation methods, estimation of performance indicators reflecting ecological, economical and functional aspects of the system, etc.)
- monitoring of key relevant physical, chemical and biological processes within the system to evaluate pollutant/microbial contaminant sources, loads and transfers to water bodies (including soils, plants and organisms).

Funding scheme: collaborative projects (small or medium-scale research projects)

Expected impact*: Current urban water management is limited by the fact of not addressing the water system as a whole. The project should contribute to put in practice the resilience principle on technical assets functioning by the way of “on line” monitoring systems and more reliable, ecologically engineered and cost-effective technological solutions, which also take into account the impacts of climate change on water bodies, mitigation and adaptation policies. It should also help decision makers to assess the immediate and long-term effectiveness of system adaptation and management actions and to design appropriate environmental planning and optimal investment strategies at the urban development scale, in line with the requirements of various water related EU policies.*

3.3 Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems

Research Topics:
- G11: Design forecasting and early warning systems suited to quick events in large urban areas
- E12: Real time monitoring/control of treatment plants (focus on control during rain)
- E31: Real-time forecasting and management of drainage systems and retention facilities

Title: Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems
This action promotes the development of innovative monitoring, forecasting and control methods. Methods for monitoring and short term forecasting of high resolution distributed rainfall shall create important input for methods for monitoring, forecasting and control of combined sewer overflows and retention basins, which in turn shall respect forecasted and controlled dynamic hydraulic capacities of downstream wastewater treatment plants. Together the methods shall minimise the overall environmental impact caused by rain events in urban areas. Results from monitoring and forecasting the environmental impact of such events shall be made public available in Early Warning Systems through efficient real time dissemination of the information at locations where it is needed. Emphasis should be given to uncertainties of monitoring and forecasting – reliable sensors, real time data validation and real time data assimilation of forecasting methods – and to introduce increased system controllability together with measures to handle sudden reductions in the controllability. Evaluation of the integrated solutions should be done through end-user involvement in demonstration activities, through analysis of the socio-economic benefits obtained and further dissemination of results should be made by technology transfer and training activities in end-user networks.

Funding scheme: collaborative project (large-scale integrating project)

Expected impact: *Reduction of health risks caused by combined sewer overflows and creation of better urban environments by enabling the use of surface waters for recreational use. Efficient transport and temporary storage of wastewater in combined sewer systems protecting downstream treatment plants leading to an overall reduced environmental impact caused by heavy rainfalls in urban areas. Support to City development projects in older city centres and the implementation of various water related EU policies and directives.*

3.4 Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management

Research Topics:

- G10: System solutions for flood management and reduction (integrated forecasting modelling and control, online storage, individual retention)
- G14: Integrated modelling platforms of sewer and drainage systems including storage and treatment

Title: Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management

Sustainable urban water management has been insufficiently taken into account in the development of urban regions in Europe. Now the urban regions in Europe are facing flooding and water quality problems. Finding the most efficient and effective solutions is only possible if/when reliable information and calibrated models are available. In this way innovative techniques can be developed, installed and integrated and sustainable quality and quantity solutions will become possible.

An integrated approach is necessary to avoid flooding and minimize impact on receiving (ground)water taken into account the EU framework guideline for surface and groundwater and the effects of climate change. With integrated modelling based on real time information the impact of dynamic elements can be optimised such as detention tanks, pumping stations, wastewater treatment plant, groundwater control in combination with groundwater storage inside and outside urban regions. Emphasis should be given to facts like the increasing urban population, increasing disturbing substances from residues of medicines and hormones in the sewage and water system and existing unknown connections between stormwater and sanitary sewer systems.

Leading high tech research companies , institutes and universities will be involved to find solutions for/near sources which causes the problems, for example:

- Zero based water cycle in urban area: impermeable pavements, with subsurface run-off, usage of green roofs and storage techniques and possibilities for storage in combination with local water treatment and changes of legislation on new buildings and pavements;
- Groundwater measures as aquifer storage recovery techniques;
- Water recycling at wastewater treatment plants and on a small scale, for example application of ultraviolet light and oxidants as a de-infection technology to remove hormone disturbing substances and disruptors.
- Perception change; use of existing infrastructure (visible storm water runoff) will be common in future and attention should be given to the acceptability of solutions through end users involvement;
- Design change in urban area; use existing slope and potential flow paths to control storm water runoff on a large scale.

Funding scheme: collaborative project (large-scale integrating project)

Expected impact: *Reliable integrated dynamic models and sensor techniques will be available, also taking into account the impacts of climate change on water bodies and the EU framework guideline for surface and groundwater. Improved techniques for storm water storage combined with design and perception change in urban area and water recycling on a large and small scale supporting the implementation of various water related EU policies. Efficient and effective use of existing infrastructure and improved decision making tools, for reducing urban flooding with cost-effective solutions.*

ANNEX 1 - Fact Sheets on Demonstration Sites

WSSTP – Urban Pilot Theme 1

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1. Aarhus

Demonstration Site Priority on Project Hosting		
No.	**Project Title**	**Priority**
I	Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution	
II	Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies	**1**
III	Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems	**1**
IV	Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management	**2**

Urban Pilot Theme 1: Managing rain events and flooding in urban areas

Fact Sheet: Demonstration project Aarhus

Integrated Real Time Control of Sewer Systems and Wastewater Treatment Plants combined with an Early Warning System for Water Quality in Lake, River and Harbour in the City of Aarhus, Denmark.

Background

Lake Brabrand today serves as a recreational area close to the city of Aarhus. The lake is laid out as an EU habitat area (information: the area was selected due to the types of nature around it – not because of the water quality itself).

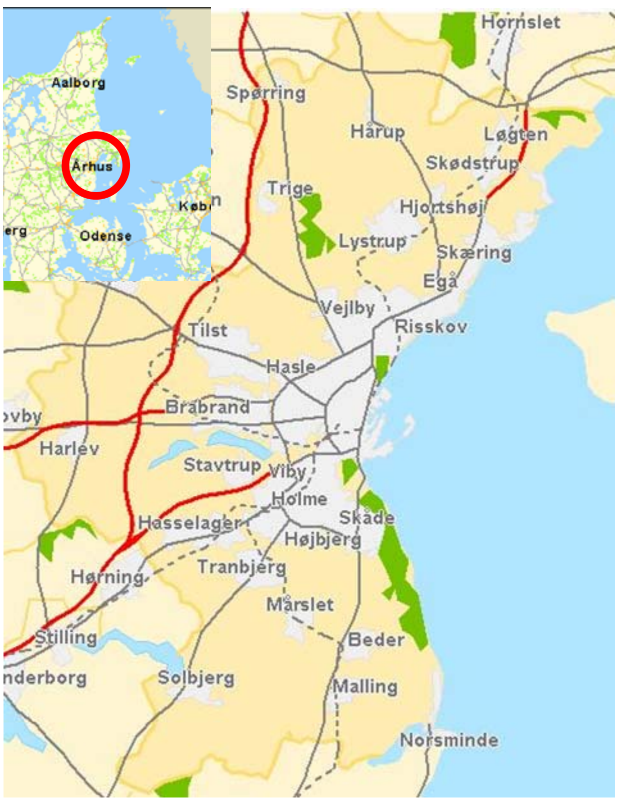
Along parts of River Aarhus and at Aarhus Harbour urban development is rapid and will continue to be so in the coming years. River Aarhus has previously been cased, but now it is being uncovered and will be a recreational element in the city. The part of the harbour close to Aarhus will be converted from industrial harbour to new city areas. Here, too, water and canals will be important recreational elements.

To support the opportunities for recreational use of Lake Brabrand, River Aarhus and the area at Aarhus Harbour close to the city, the Municipality of Aarhus has decided in 2005 to make an extraordinary effort to improve the hygienic water quality in the area. At the same time, these efforts serve to meet the expected requirements as a result of the Water Framework Directive. Proposed improvements are described on the basis of the terms of the new EU Bathing Water Directive.

Today, River Aarhus is affected by approx. 55 combined sewer overflow (CSO) structures in sewage system as well as treated wastewater from among others Aaby and Viby wastewater treatment plants. Approx. half of the water in River Aarhus today consists of treated wastewater. The wastewater from the CSOs will be collected in large retention basins, and the treated wastewater from Viby and Aaby wastewater treatment plants will be disinfected. Lake Brabrand is affected by approx. 20 CSOs. Also here, it is suggested to collect the wastewater.

The costs related to the above initiatives, including the integrated control and early warning system to operate the planned infrastructure, will sum up to almost € 50 mill. In 2007 Aarhus City Council has allocated the necessary funds, and the construction works will be carried out in the period 2007 to 2011.

In overall terms the initiatives will result in an immediate improvement of the hygienic quality.



Municipality of Aarhus (Denmark)

The municipality of Aarhus has approximately 300.000 inhabitants and covers an area of approximately 525 km^2 (35 x 15 km).

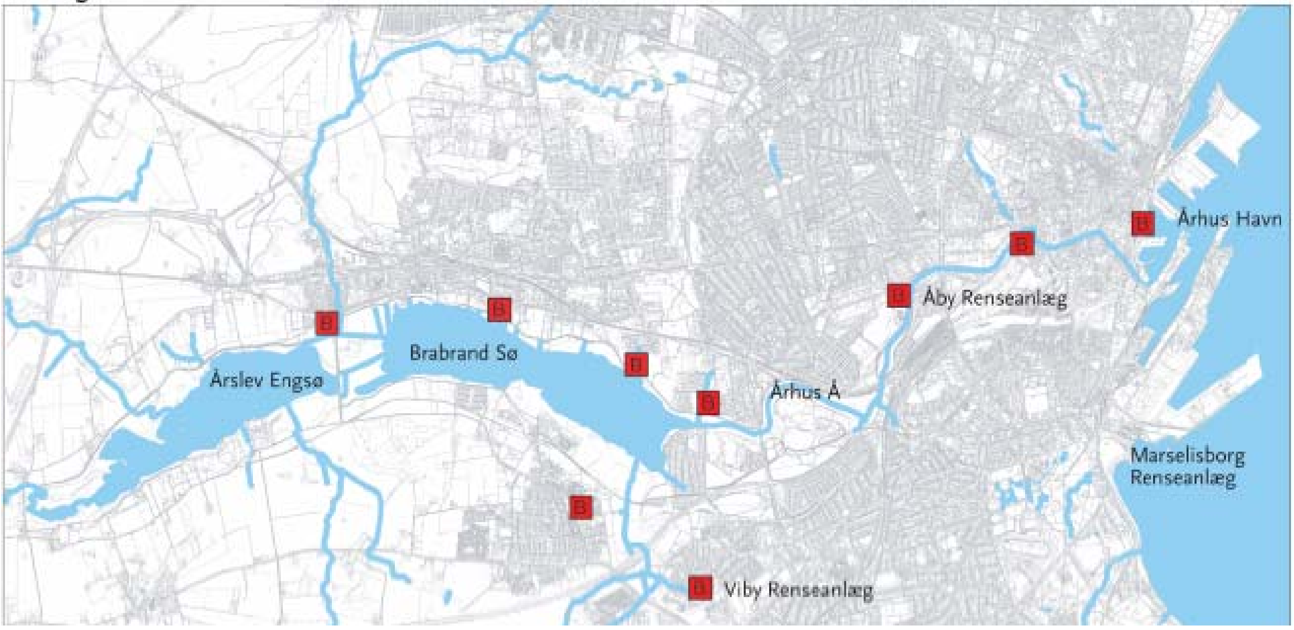
Inside this area almost all different types of water habitats can be found: groundwater in urban and rural areas, surface waters (lakes, rivers, wetlands) in urban and rural areas and coastal water.

Aarhus Water and Wastewater

Aarhus Water and Wastewater is a public utility operating most of the water related infrastructure in the municipality:

Operation of Drinking Water Supply: Total supply 21 mill. m^3/year for consumers and industry, hereof 18 mill. m^3/year from Aarhus Water from 13 water works distributed through 1500 km of main network

Operation of Waste Water Transport and Treatment: Waste water from 450.000 PE collected within a catchment area of 10.000 ha through 2230 km of sewers (900 km combined sewers incl. 300 CSO) to 17 waste water treatment plants (hereof 4 WWTP treating from 50.000 to 200.000 PE)



Overview of City area incl. locations of the planned retention basins.

However, there may still be wash-out of algae from Lake Brabrand to River Aarhus, and thus the visibility depth in the river will not be instantly improved.

For Lake Brabrand there will be a significant improvement of the water quality as a result of the measures combined sewer overflows combined with the measures against sewage water flow from the rural areas. Already today the lake has almost an acceptable bathing water quality – and the bathing water quality will improve.

Reduction of CSO from the sewer system and disinfection of wastewater from Aaby and Viby wastewater treatment plants will result in a significant improvement of the water quality in Lake Brabrand and downstream - in River Aarhus. In addition bathing water quality will be established in Aarhus Harbour close to the city. Thus, a quality enhancement with regard to the recipients will be created, supporting the qualities which the uncovering of the river and the future use of harbour areas will add to the City of Aarhus.

Integrated Control

A system designed for integrated control of sewer systems and wastewater treatment plants can be operated to meet different objectives under different operational conditions:

- Reduce the amount of CSO during rain – alternatively control where their location
- Minimize the number and extent of floodings
- Give early warning of deteriorated water quality according to the Bathing Water Directive
- Balance out the load on downstream wastewater treatment plants
- Control inflow of industrial wastewater – improve C/N conditions on downstream wastewater treatment plants
- Implement energy optimization and savings according to tariff policy, if any
- Handle flow in connection with planned rehabilitation/maintenance works
- Handle flow in connection with unscheduled shutdowns of system components (e.g. pump failure).

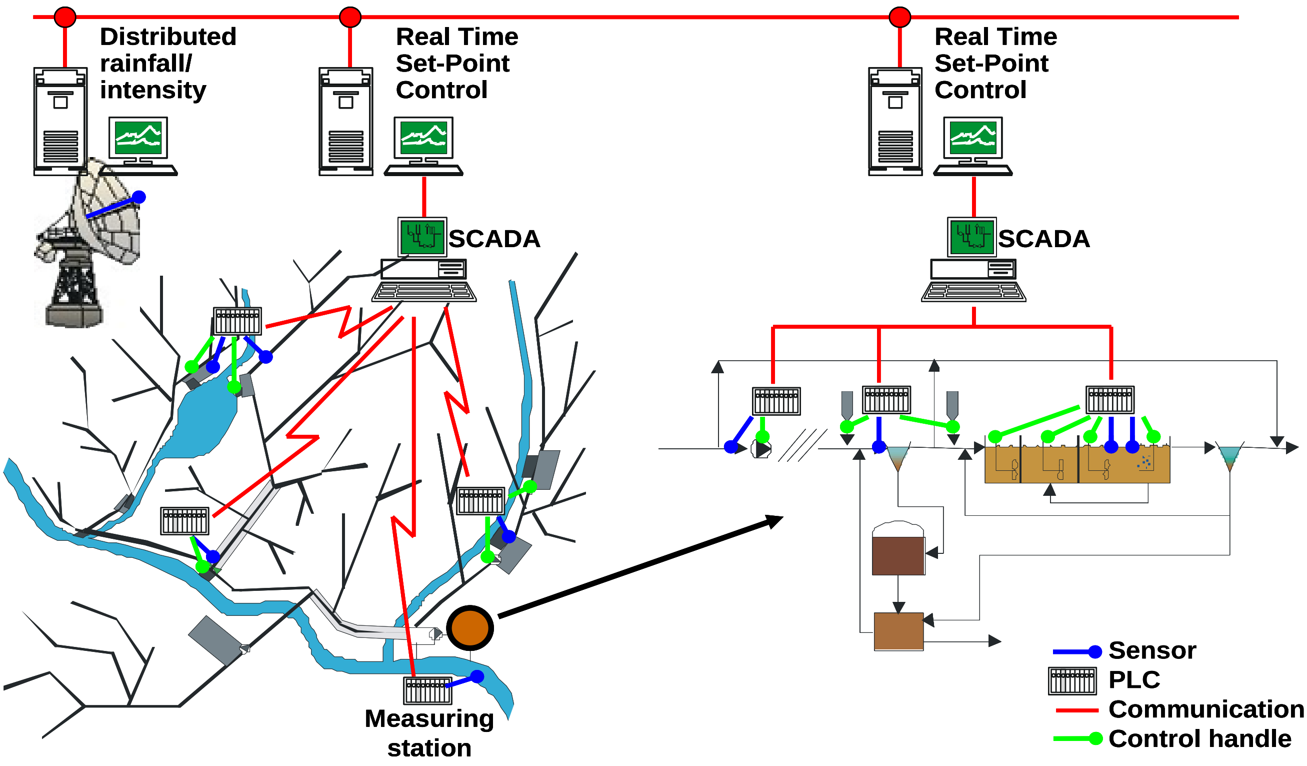
Thus, there are more options that just reducing CSO during rain, however, if the system is designed with this in mind, most other purposes will also be covered, as the necessary infrastructure and its instrumentation and controllability will be present.

The Concept overview shows the state-of-the-art system structure where application specific systems perform set-point control using the standard SCADA systems as frontends. The application specific systems have focus on the functionalities which are not included in the SCADA systems or difficult to use in these systems. The application specific systems shall – using the SCADA as a frontend – in real time be able to carry out:

- system integration
- data collection, validation and storage
- aggregation, presentation and reporting
- modelling, decision support and process control

An important point in the system structure is thus the fact that the process knowledge within a certain application area is moved to an application specific system, which then utilizes the general functionality of the SCADA.

Based on the system structure an overview is shown below of possible objectives/tasks during a rain event



Concept overview: Integrated control of sewer system and wastewater treatment plant

for each of the following application specific systems: weather radar (WR), sewer system (SS) and wastewater treatment plant (WWTP) together with the measurements and control handles available for these systems.

Weather radar (WR)

- Objective
  - Produce area related rain intensities
  - Predict rain events (preferably also the type) and start/stop of the event
- Measurements
  - Radar images
  - Rain gauges
- Tasks
  - (Calibrate and) distribute precipitation on actual catchment areas
  - Predict movement of precipitation

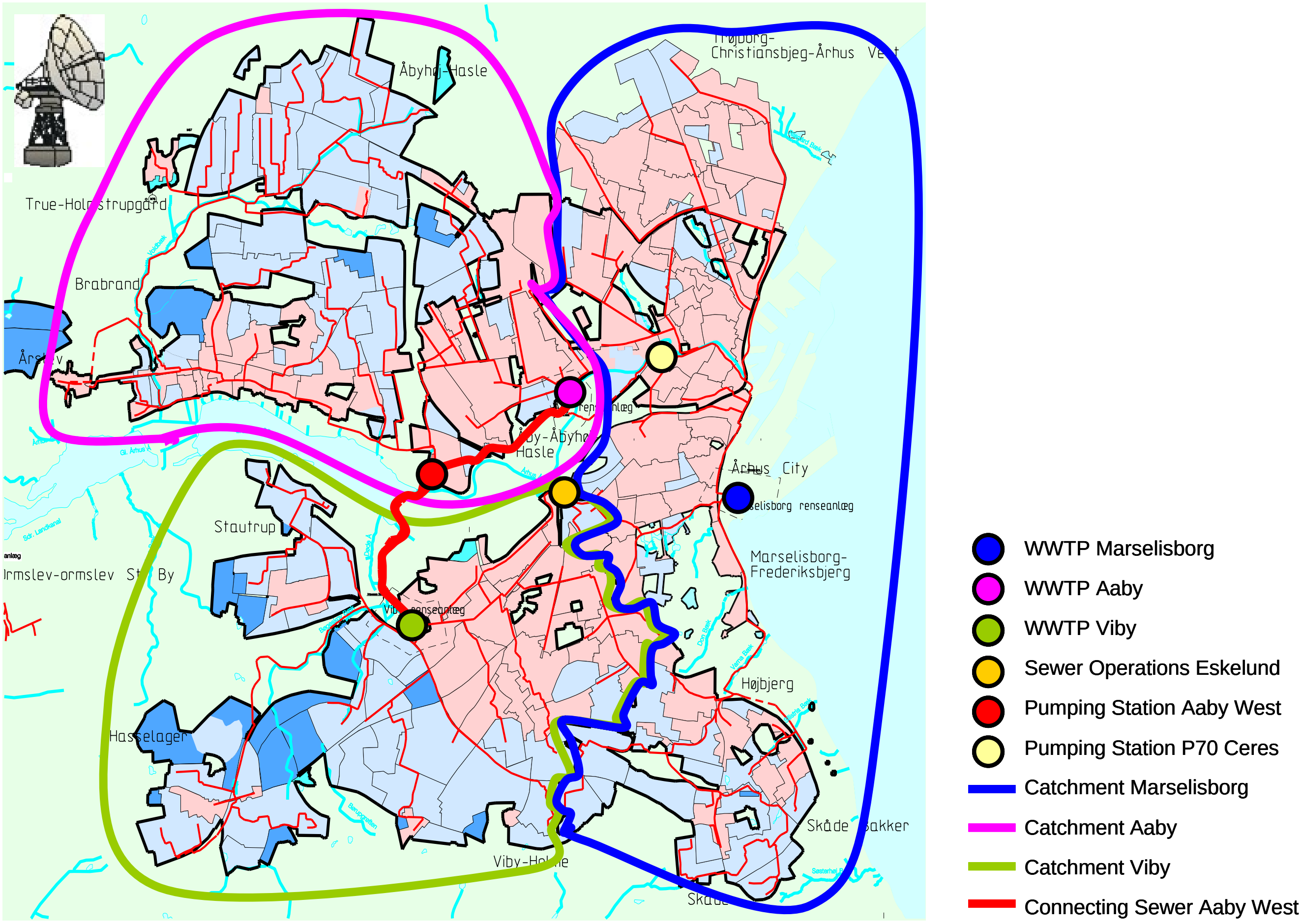
Sewer system (SS)

- Objective
  - Isolate "first flush" and minimize upstream CSO/control location of CSO
  - Store/delay water, get "first flush" to waste water treatment plant after the rain has stopped
- Measurements
  - Flow in sewers, levels at overflow weirs, retention basins and sewers with storage capacity
  - Status of pumping stations, adjustable overflow weirs, gates, etc.
- Tasks
  - Validation of incoming data
  - Choice of control strategy, calculations/ modelling and communication of set-points
- Control handles
  - Adjustable overflow weirs and gates
  - Pumping stations and retention basins

Wastewater treatment plant (WWTP)

- Objective
  - To treat as much wastewater as possible
  - Reduce load on secondary clarifiers/avoid sludge washout
- Measurements
  - Flow (inlet, return sludge, etc.)
  - Sludge volume, suspended solids (return sludge and activated sludge tanks)
  - Sludge blanket in secondary clarifiers, turbidity in the effluent
- Tasks
  - Validation of incoming data
  - Choice of control strategy, calculations/ modelling and communication of set-points
- Control handles
  - Control of return sludge and sludge blanket in secondary clarifiers
  - Sedimentation in activated sludge tanks
  - Move inlet in biological part/disengage activated sludge tanks
  - Bypass biological step of the WWTP or the whole plant

As can be seen the objective of each system can be conceived locally, and each system can be optimized accordingly, however, as described below the overall task requires interaction between the three application specific systems in order to obtain a satisfactory solution.



Overview of the sewer catchments and receiving wastewater treatment plants for integrated control in Aarhus.

Objective
- Minimize environmental impacts caused by precipitation

- Tasks
  - WR (Weather Radar) informs SS (Sewage System) and WWTP (WasteWater Treatment Plant) that it is going to rain and if possible provides an estimate of intensity and type
  - SS and WWTP decide on a control strategy
  - WWTP estimates/predicts available hydraulic capacity of biological part (based on the chosen control strategy)
  - SS predicts resulting flow to WWTP (based on the chosen control strategy)
  - SS and WWTP negotiate modifications of set-points (may result in locally reduced optimal operation)
  - WR sends estimates of intensities
- Loop

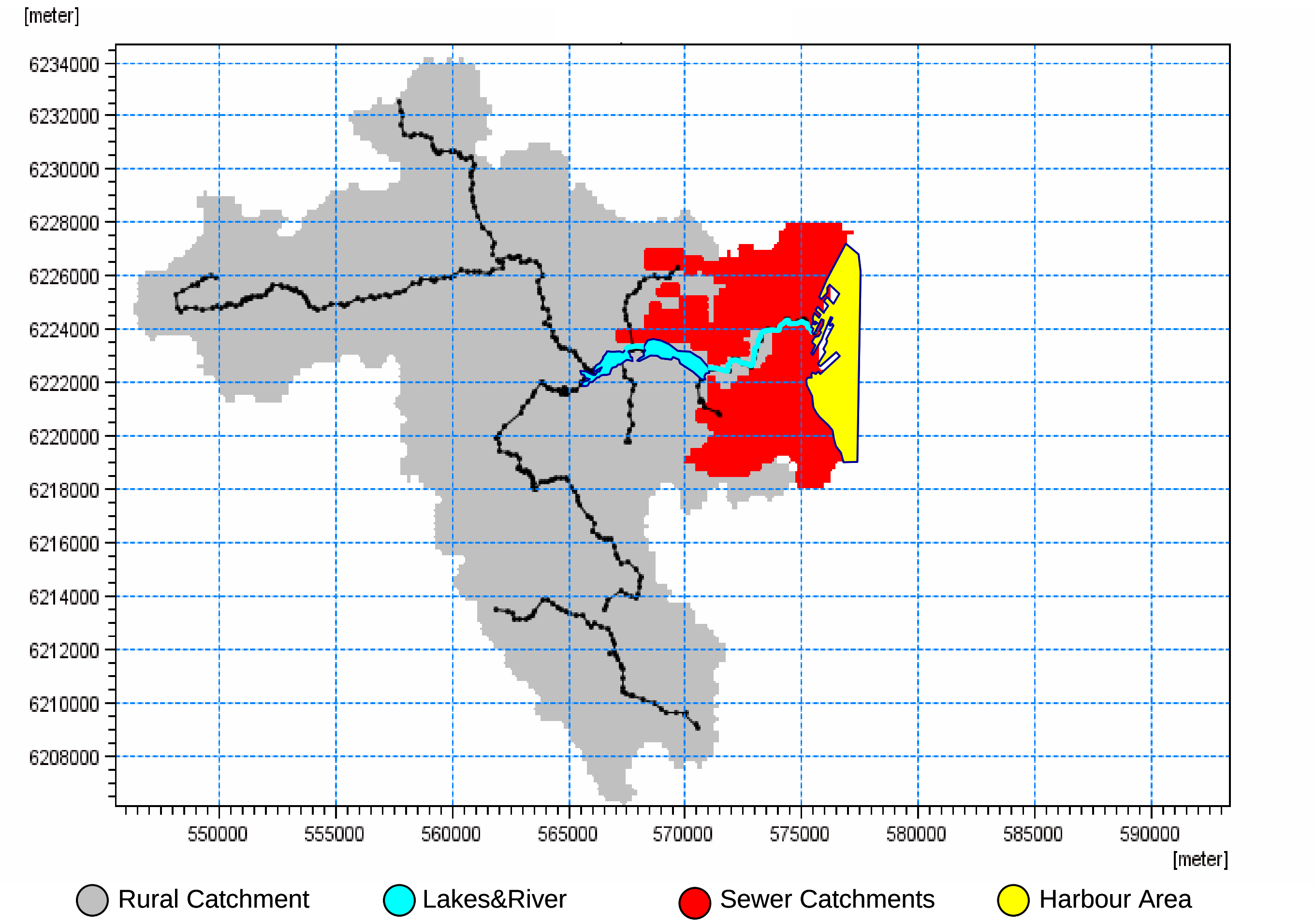
In this example the interaction between the sewer system and the wastewater treatment plant is done by communication between their application specific systems, and the central connecting point is the inlet to the wastewater treatment plant, where the questions are: How much wastewater will arrive and when, and if it is too much to handle for the WWTP, can the SS then store/delay the wastewater, or should untreated diluted wastewater be discharged from the overall system, and if so, where?

This means that the fundamental predictions are the flow to the wastewater treatment plant and the hydraulic capacity of the wastewater treatment plant. These predictions will be the result of the chosen control strategies for the sewer system and the wastewater treatment plant respectively, but with the constraint that the hydraulic capacity of the wastewater treatment plant shall be the downstream boundary for prediction carried out for the sewer system.

Integrated Control in Aarhus

The system design for integrated control to ensure the the hygienic water quality in Aarhus Harbour, River Aarhus and Lake Brabrand follows closely the concept described above.

Three sewer catchments (Marselisborg, Aaby and Viby) each with a downstream WWTP are involved. These can be regarded as independent, but there is a possibility to control the delivery location of flow from the pumping station Aaby West, which already now is equipped with a relatively big retention basin. The flow can either be directed to WWTP Aaby (normal situation) or to WWTP Viby (pumping wastewater from one catchment to another).



Overview of modelling set up used in the planning project. Models have to be adapted to run in real time in order to give Early Warning of deteriorating bathing water quality.

Further, the flow from the pumping station P70 Ceres (effluent from the local brewery) can either be delivered to WWTP Aaby or to WWTP Marselisborg. However, this possibility is more relevant to distribution of easy degradeable carbon source than to the hydraulic load.

Application specific systems exist at the 3 WWTPs for real time monitoring and process control (including a calculation of the dynamic hydralic capacity). At the sewer operations centre Eskelund an application specific system exists for real time monitoring of the 3 sewer catchments. The 4 systems are connected to the same network and able to communicate.

As a part of the project more sensors (levels, flow, etc) will have to be installed in the sewer systems and the controllability (weirs, gates, pumps) will be increased as a part of the infrastructure construction work. Real time modelling of the sewer systems (including data assimilation) have to be established (possibly using reduced versions of the models used for the planning project) together with a local weather radar system for the measurement of distributed rainfall, which can be fed to the models.

Finally, the control algorithms for the sewer systems have to be implemented and integrated with the process control at the WWTPs.

Modelling and Early Warning System

EU has at the end of 2005 passed a new directive for fresh- and marine waters used for bathing. The Bathing Water Directive does not include standards for other recreational activities such as water sports. The directive aims to minimise the risk for diseases caused by a low hygienic quality of the bathing water and divides the bathing water into 4 classes:

excellent, good, satisfactorily and poor

where bathing water at least must be classified as satisfactorily. The classification excellent prescribes (depending on the water type) that the number of E. coli shall be less than 250 – 500 E. coli per 100 ml during 95% of the time in four consecutive bathing seasons. Non-compliance caused by a rainfall intensity which occurs more seldom than every fourth year can be disregarded from the statistical calculation. Further, the use of an Early Warning System, which can forecast the start and stop of a non-compliant event, and make this information available for the public, allows one non-compliant event every fourth year.

Using these statistical facts the planning project was able to estimate the size and number of necessary retention basins (and possibly the use of disinfection) and measures to be taken at the WWTPs (extension of secondary clarifiers and disinfection of effluents) for different scenarios. The scenario set up had to take into account that construction of sub-surface retention basins at desired locations and volumes can be quite difficult in urban areas.

A model for the bathing water quality in a given area consists of a hydraulic model superpositioned with an advection/dispersion model which describes the transport and dilution of E.Coli and a model describing the decay of E.Coli.

The model for Lake Brabrand, River Aarhus and Aarhus Harbour is divided into four coupled parts:

- Rural catchment model driven by rainfall calculating the run off from the rural area as an input for the Lake&River model
- Sewer catchments models driven by rainfall and dry weather flows calculating flows, run-off, CSOs and E.Coli transport (WWTP as a part of these only changing water quality – not flow) as input to the Lake&River model.
- Lake&River model calculating flow and E.Coli transport as input to the Harbour model
- Harbour model calculating flow pattern and E.Coli transport using results from a marine model as the “downstream” boundary.

Running the model for different scenarios showed that an integrated control/early warning system is necessary in order to tie the economy to an affordable level.

Implementation of the chosen scenario will, according to the classification from the Bathing Water Directive produce excellent bathing water quality in Lake Brabrand and Aarhus Harbour and significantly improve the water quality in River Aarhus.

However, as mentioned - compliance will only be obtainable through the use of an Early Warning System, which has to be implemented as a real time version of the type of model used for the planning. Real time here meaning twice a day with increased frequency during rain, and results will be predictions of E.Coli levels at different locations from model start and a couple of days into the future

The Early Warning System shall be built on top of the Integrated Control system, which already delivers most of the upstream boundary information (except run-off from the rural catchment) to the Lake&River model. Downstream model boundary for the Harbour model comes from an accessible commercial real time marine model.

Theme 1 Research Topics covered

The Research Topics – divided into Generic Research and Enabling Technologies – for Urban Pilot Theme 1 have been defined as (list according to priority):

G14: Integrated modelling platforms of sewer and drainage systems including storage and treatment
G8: Optimization of systems monitoring (water quality, hydrology and hydraulics of rain events)
G11: Design forecasting and early warning systems suited to quick events in large urban areas
G10: System solutions for flood management and reduction (integrated forecasting modelling and control, online storage, individual retention)
E2: On-line monitoring of water quality and of treatment processes, for collective systems
G6: Integrated risk assessment on urban water systems
E31: Real-time forecasting and management of drainage systems and retention facilities
E29: Multi-hazard and multi-risk modelling tools (natural events, technological hazards, assets failures)

Demonstration Project Aarhus has direct focus on 6 of these – the G6 and E29 are only addressed indirectly. Further, the Sensors Theme might be integrated in other Urban Pilot Themes and of the Research Topics from this theme the Demonstration Project Aarhus has focus on:

E1: Cheap, reliable and maintenance less energy sources and sensors
E12: Real time monitoring/control of treatment plants

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The planning project for the improvement of the hygienic water quality in Aarhus Harbour, River Aarhus and Lake Brabrand was carried out in a cooperation between Aarhus Water&Wastewater, Krüger AS and DHI - Water, Environment, Health.

2. Barcelona

Demonstration Site Priority on Project Hosting		
No.	**Project Title**	**Priority**
I	Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution	**1**
II	Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies	
III	Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems	**1**
IV	Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management	**1**

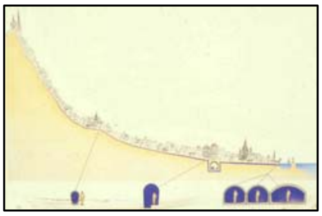
Urban Pilot Theme 1: Managing rain events and flooding in urban areas

Grupo Agbar

Fact sheet: Demonstration Project Barcelona

Background

Barcelona's special characteristics



The drainage in Barcelona has special relevance due to some characteristics:

- Rain regime with high intensity events
- High slopes in the mountain and nearly flat on the coast
- High density of population and land imperviousness

This has effects on:

- Floods
- River and coastal waters pollution during rain events

Some history

The Urban drainage state in 1992 was that the Great Olympic sewerage works had finished, there was a sewer network still insufficient and inflexible and the management was done in a conventional management, so there was a Municipal awareness about the need of a new approach of management.

In 1992 the city council creates CLABSA with the Mission of transforming the drainage of the city in order to be more effective against floods and river and coastal pollution with two main tools: Hydraulic Regulation + Real Time Control. CLABSA is constituted as a Mixed Company with private and public partners: the City council Barcelona (17.50 %), EMSHTR (8.17 %), AGBAR (54.00 %), FCC (20.33 %), with the Main Activity of Urban drainage planning, operation and control.

Barcelona's basic data

City data:

- 1.600.000 Habitants
- Area: 100 Km2
- Densely urbanized
- Steep - plain

Barcelona's sewer network:

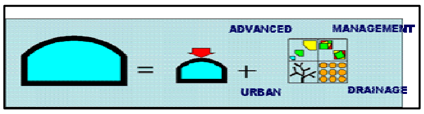
- Combined system
- 1.650 Km; 55% man-entry
- 10 stormwater detention tanks: 500.000m3
- Average age of sewers: 70 years
- 33% of the network with mid or grave defects

Rain data:

- Year average: 600 mm
- Max. intensity in 15 min: 150 mm/h !! (T=10)

Advanced management of urban drainage

It consists on a management philosophy based on: Precise and exhaustive knowledge of the system, Integral Planning, Complete and Coordinated Real Time Management and a Environmental and Sustainable Approach

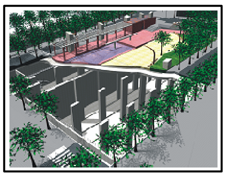


The main instruments for the development of a modern management are the Master Drainage Plan development and the Technological Systems for aid-decision implementation:

- Territorial Information System (SITE)
- Mathematical Modelling System (SIMO)
- Real Time Control System (SITCO)

The main actions developed on the master plan during 1997 and 2005 have been:

- 10 detention tanks (V = 500.000 m3)
- 5 Diverting gates and 1 of storage
- 25 km of Sewers with great dimensions

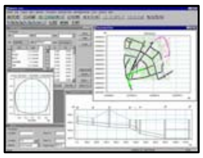


The Territorial Information System has an exhaustive description of the network:

- 1.650 km of network: 41,000 manholes, 60,000 inlets, 69,000 connections
- 500 control instruments
- 1,100 civil works, 173 km of projected network
- 350 km of planned actions

The Mathematical Modelling System allows at any time to have an updated simulation of :

- Levels and flows in the network
- Spills to the receiving waters
- Effects on the receiving waters

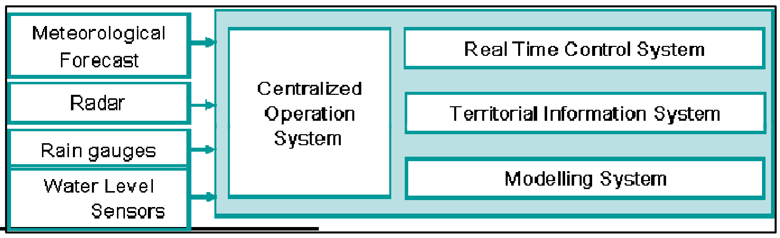


Finally, the Real Time Control System provides information of:

	Control Points
▪ Flows in the network	146
▪ Rain gauges in the city	24
▪ CSO flows	9
▪ Water quality	2

And controls (locally or globally): 10 detention tanks, 19 pumping stations and 36 gates

All this three systems permits to have a Centralized Operation System in order to manage the storm water events:



Research

Research in Agbar Group

Agbar Group has a very important background on research activities:

CLABSA's strategic guidelines has been a sustainable environmental approach, related to storm water management and water quality control. CLABSA offers services for the development of Sewerage Master Plans, as well as technical consultancy, projects, and works management. CLABSA has taken part in several national and international R&D projects, like the European ones: "Phasing out of Combined Sewer Overflow Pollution on Urban Rivers", "Integrated Planning and Management of Urban Drainage, Wastewater Treatment and Receiving Water Systems" or "Computer Aided Rehabilitation of Sewer networks" (CARE-S).

R+i Alliance was created in Januray 2005 to define, finance and execute the R&D programmes of common interest to the main subsidiaries and associated companies of SUEZ Environment in the water business.Five members constitute the company today: Lyonnaise des Eaux (France), United Water (United States), AGBAR (Spain), Suez Environment and Northumbrian Water (UK). R+I Alliance favours and develops collaboration among the centres of expertise of the member companies.

CETaqua, Water Technology Centre, is a not-for-profit organization, integrating and managing R&D and innovation in the field of water, especially the urban cycle. The three foundation partners are AGBAR, the Polytechnic University of Catalunya (UPC) and the National Research Council (CSIC). Then main areas of activities of the centre are the alternative water resources as desalination and reuse, crisis management (floods and droughts), advanced water treatments, sludge management and odour control, operational cost management and implementation efforts on the compliance of the water framework directive development.

Flooding topics already reached

- Multi-hazard and multi-risk modelling tools (natural events, technological hazards, assets failures)
    - Implementation of hydraulic modelling tools for quantity and quality
    - Sewerage deterioration modelling tool, aid-decision
    - …
- Integrated risk assessment on urban water systems
    - Urban Drainage Master Plans,
    - Warning systems
    - …
- System solutions for flood management and reduction (integrated forecasting modelling and control, online storage, individual retention)
    - Gates (storage on line, flow deviation, by-pass), pumping stations and detention tanks, integrated in a remote control center
    - Rain gauges, radar images, weather forecasting, fully integrated in the SCADA system.
    - Protocols and set-up points established
    - …

Flooding topics currently on progress

- On-line monitoring of water quality and of treatment processes, for collective systems
    - Real time water quality monitoring in sewer networks: Quality stations. On-line quality sensors and automatic samplers.
    - Decision support tool for quality stations selection

- Real-time forecasting and management of drainage systems and retention facilities
    - Global optimization of dynamic elements (detention tanks, pumping stations, etc) to avoid flooding and minimize impact on receiving waters

- Design forecasting and early warning systems suited to quick events in large urban areas
  - Flash flood forecast and warning system based on hydrometeorlogical models. Radar integration

Flooding topics to be covered

- Integrated modelling platforms of sewer and drainage systems including storage and treatment
  - Context

    Hydraulic infrastructures for collection and wastewater treatment have traditionally been managed separately, taking into account only the characteristics of the water at the entry and exit points of each installation. The design of the infrastructure solutions of urban drainage, neither use to considered their impact and interactions with the WWTWs.

    Nevertheless, the direction promoted by the Water Framework Directive (WFD, 2000/60/EC) is to treat the river basin as a single area of operations, in which hydraulic infrastructures have to be managed in an integrated manner, taking into account the condition of the receiving waters.

  - Research items

    Survey and analyse the technologies, devices and infrastructure solutions to reduce the pollution to receiving waters in both, urban drainage networks and WWTWs, considering their value for money.

    Develop and implement an Intelligent Environmental Decision Support System to guide the integrated management of drainage and treatment systems

    Develop and implement an operation tool for the global coordinated management in real time of urban drainage and WWTWs

3. Berlin

Demonstration Site Priority on Project Hosting		
No.	**Project Title**	**Priority**
I	Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution	
II	Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies	**1**
III	Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems	**1**
IV	Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management	**2**

FACT SHEET: DEMONSTRATION PROJECT BERLIN

Simultaneous monitoring of CSO and receiving water and realisation of a modelling platform for CSO impact assessment in Berlin, Germany

Background

Today, we face an increasingly acute and complex situation in water resource management worldwide. Urban zones, where over half of the world's population will live by 2010, are under particular pressure.

Urban water problems are growing. Degraded resources (both, in quantity and quality), competition for the use of fresh water and mismanagement heighten the depth of these problems. Increasingly, in urban water resource management the consideration of stormwater impacts on water resources gains in importance. These impacts accelerate with increasing urbanisation and accordant land use and land sealing. According to UNESCO IHP one of the major problems of the industrialised countries is an insufficient capacity to cope with increased loads, causing frequent spills of combined sewer overflows (CSO), jeopardizing the quality of receiving water bodies.

In Berlin, approximately 25 % of the phosphorus input to the receiving waters in the centre of Berlin originates from combined sewer overflows.

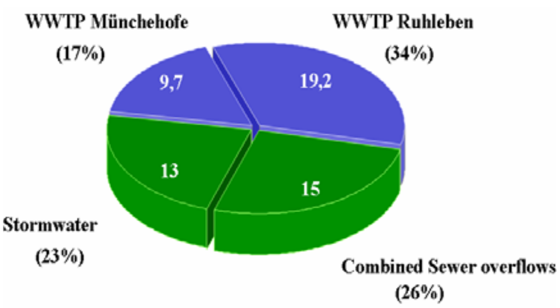


Figure 1: Estimated emissions of phosphorus (in t/a) at the confluence of river Spree into river Havel in 2004

The project aims at the continuous online-measurement and monitoring of pollutant and substance flows at combined sewer overflows (CSO) and their impact on the receiving water. As stated above, CSO is one of the major pathways of pollutants from urban zones and a dominant impact on water resources. The analysis and evaluation of such data will allow for a detailed description of processes at the combined sewer overflow. Furthermore, by parallel measurement within the receiving water the cause-effect chain of CSO discharges can be described.

Major issues that the project will address are:

- Development of CSO monitoring network
- Analysis of pathways of stormwater-bound pollutants
- Analysis of the impact of combined water discharges on receiving water quality
- Simulation of the processes by means of an integrated model for drainage system and receiving water
- Development of a methodology for CSO impact assessment

System description

In Berlin, Germany, drinking water supply has historically been developed almost exclusively within the city boundaries. Berlin is therefore one of the few European cities, where drinking water is almost completely supplied by groundwater and bank filtration within the municipal area, and which at the same time, has to manage its wastewater disposal within the same area.

The usage conflict that occurs between urban development, such as improvement of the existing infrastructure, road building, creation of residential areas and business parks on the one hand and sustainable water pollution control and groundwater protection on the other hand makes particular demands. The close spatial interlock between drinking water supply, wastewater disposal and water use conceals a high potential conflict.

3.4 million inhabitants and an area of around 650 km^2 are connected to the sewage system. The total length of collectors is around 9000 km. Three quarters of the area of Berlin is drained by a separate system, whereas in the city centre a quarter of the total area is drained by a combined system. The wastewater is pumped by 149 pump stations and over 1000 km of pressurized pipelines to six wastewater treatment plants for mechanical and biological treatment. On average, a total of approximately 635000 cubic metres of wastewater are delivered and cleaned per day.

FACT SHEET: DEMONSTRATION PROJECT BERLIN

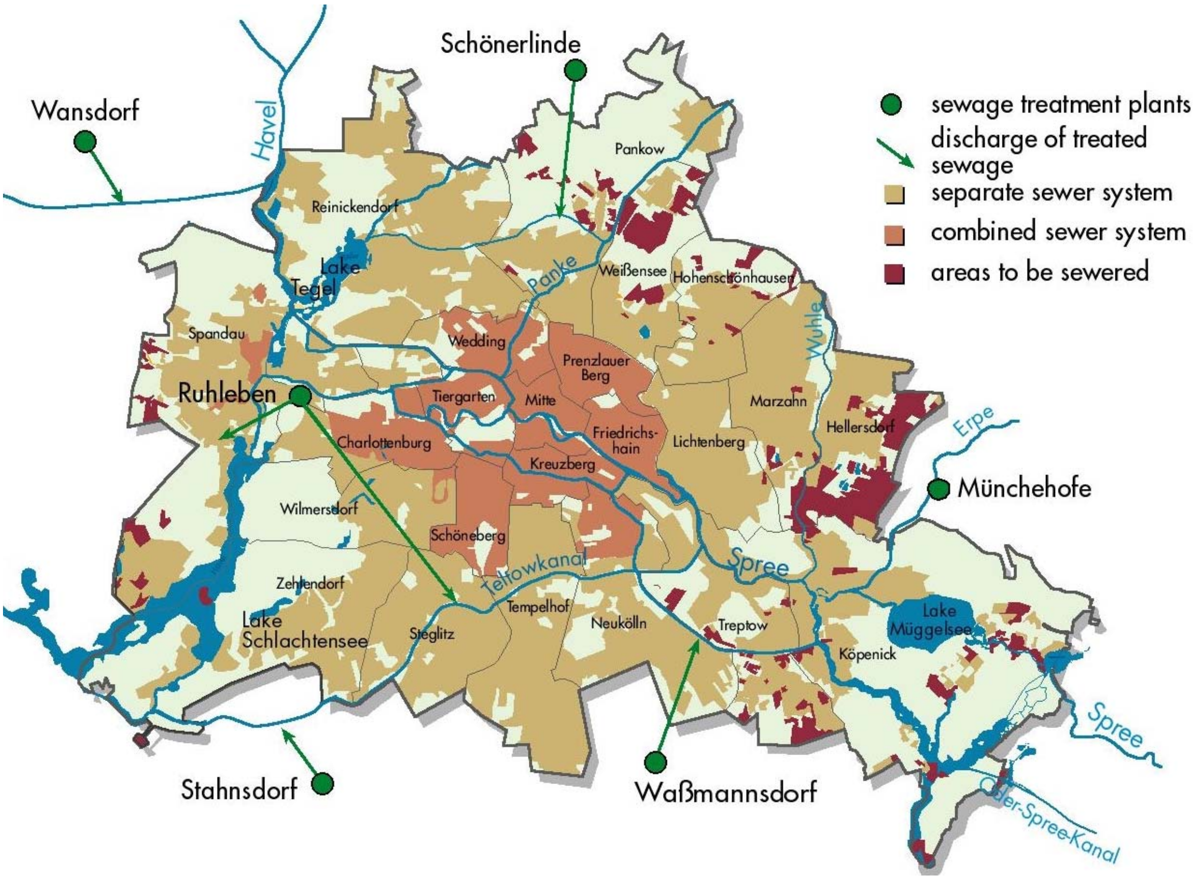


Figure 2: Overview of the Berlin drainage system

From a water quality point of view the small and sensitive rivers Spree and Havel that serve as recipients for the urban discharges impose specific boundary conditions. Due to the low flow velocities and the resulting low self-purification of the watercourses, they are particularly at risk from pollutant inputs, especially from nutrients. During low water periods a transition stage between flow and flow stagnation can be observed, which supports massive algae formation in summer. These unfavourable natural boundary conditions are made even worse by the anthropogenic effects.

Table 1: Comparison of the characteristic figure inhabitants per average low water runoff for different cities

	Population in millions	q m^3/s	Inhabitants/q inh / (l / s)
Berlin (Spree and Havel)	3.50	10	350
Frankfurt (Main)	0.66	59	11.2
Hamburg (Elbe)	1.70	279	6.1
Cologne (Rhine)	1.00	940	1.1

In water management terms the impact on the rivers can be expressed as the ratio between the number of inhabitants served by the water system and the average low water runoff of the water system. Berlin has an unusually unfavourable situation in this respect compared to other German and European conurbations (Table 1).

With an official directive in the year 1998 the federal state of Berlin called for a noticeable reduction of discharges (volumes and pollution loads) from the combined sewer system. Concerning CSO volumes the discharge rates shall be reduced to 25 % of the average annual rainfall runoff volume. Concerning the pollution loads of COD, BOD_5 and TSS the discharge rates shall be reduced to 20 % of the average annual load of the rainfall runoff. To meet these legislative requirements the Berliner Wasserbetriebe (the local water and wastewater service) carries out a rehabilitation programme.

Until 2020 the construction of additional storage assets and the activation of available inline storage capacities will ensure compliance with the legislation. The rehabilitation programme also includes some local actuators for rtc.

Monitoring

The basis for the development of tools for integrated water and wastewater management is sufficient process knowledge and data availability for process description. The project aims at the online-measurement and monitoring of pollutant and substance flows at combined sewer overflows. CSO is one of the major pathways of pollutants from urban zones and a dominant impact on water resources.

The analysis and evaluation of the data will allow for a detailed description of processes at the combined sewer overflow. Furthermore, parallel measurement within the receiving water will be carried out. By monitoring in parallel emissions and receiving water quality the cause-effect chain of CSO discharges can be described. A long-term measurement is planned to ensure the statistical significance of collected data.

The monitoring will cover a river stretch in the centre of Berlin (type of water body: stagnant lowland river) and the significant CSOs that discharge to that river stretch. Simultaneous monitoring of both, processes at CSOs and in the receiving water are planned (hydraulic and water quality). Modern online sensors shall be used for continuous measurement of the dynamic processes.
Objectives of the monitoring are based on long-term interests: Analysis of pathways of stormwater-bound pollutants from urban zones to the natural water body, analysis of the impact of CSO on receiving water quality, better process understanding and process description in modelling.

The following tasks are planned to be carried out in 2008 and 2009:

- Development of a systematic concept for online-quality measurement and monitoring
- Build up of the monitoring stations
- Build up of the data processing system
- Data collection
- First data analysis and evaluation

Modelling

In the past stormwater management scenarios have been evaluated on emission criteria only. However, it is obvious that a holistic approach, taking into account the effect of stormwater discharges within the receiving water, will lead to improved concepts. The identification of sustainable solutions for stormwater drainage as one component of urban water resource management will be furthered.

Consequently, methods and tools have to be developed that allow for basing the evaluation of strategies on an overall view taking into account the integrated system (drainage and receiving water), considering receiving water (immission) criteria.

Therefore, it is planned to develop a model-framework capable of simulating the impact of CSO on stagnant rivers (Berlin situation) and a method for water quality based evaluation of CSO. The results from CSO monitoring will be integrated in the modelling work.

Theme 1 topics covered

- Integrated modelling platforms of sewer and drainage systems including storage and treatment
- Optimisation of systems monitoring
- On-line monitoring of water quality and of treatment processes, for collective systems

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Municipality of Berlin

The municipality of Berlin has approximately 3.4 million inhabitants and covers an area of 890 km^2. The greatest expanse from east to west is 45 km, the greatest expanse from north to south is 38 km. The distribution of land use can be found in the following table.

Buildings / open spaces:	40.6 %
Business / industry:	1.0 %
Recreational areas	11.5 %
Transportation	15.2%
Agriculture	4.9 %
Woodland	18.0 %
Water	6.7 %
Other areas	2.1%

Drinking water supply has historically been developed almost exclusively within the city boundaries. Drinking water is almost completely supplied by groundwater and bank filtration within the municipal area, wastewater disposal is managed within the same area.

www.berlin.de

FACT SHEET: DEMONSTRATION PROJECT BERLIN

Berliner Wasserbetriebe

The Berliner Wasserbetriebe, a public law corporation, is the largest company and core business of the Berlinwasser Group.

In 1856 the first waterworks facility in Berlin went into operation. Today the Berliner Wasserbetriebe provide 3.7 million people in Berlin with drinking water. Alongside the supplying of water, it is also responsible for the ecological disposal and treatment of wastewater of 3.9 million people in Berlin and the surrounding region.

www.berlinwasser.de

KompetenzZentrum Wasser Berlin

The Kompetenzzentrum Wasser Berlin (KWB - Berlin Centre of Competence for Water) is an international non-profit centre for water research and knowledge transfer. Capacities of the Berlin universities and research institutes, the Berlinwasser group and Veolia Environnement are combined into KWB.

www.kompetenz-wasser.de

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4. Eindhoven

Demonstration Site Priority on Project Hosting		
No.	**Project Title**	**Priority**
I	Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution	**1**
II	Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies	**1**
III	Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems	**2**
IV	Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management	**1**

Water management in the Netherlands
Water management in the Netherlands is well organised but responsibilities have been divided between several governmental organisations. Water companies are in charge of public water supply. Municipalities are responsible for collecting wastewater - and rainwater. The water board ensures transport and waste water treatment as well as the management of surface water. As regional government the province supervises the water authorities, is shareholder of the water companies, and is responsible for groundwater management (and protection) and for issuing licenses to water companies and industries for the abstraction of groundwater .

The Eindhoven region is facing a number of interesting and ambitious challenges in the area of urban water management. These include various components of the watersystem and the water chain:

- sewage system and rainwater: capacity problems in the sewage system result in "water-on-the streets" and sewer overflow during heavy rainfall.
- surface water and biodiversity. There are insufficient surface water structures to retain and discharge rainwater. This leads to high concentrations of nutrients and heavy metals in solitary surface water and in the channel beds. This affect the biodiversity in and around the water bodies.
- Groundwater: the decrease in the industrial demand for groundwater and a change in the drinking water production (a shift from shallow to deep groundwater) as well as building on former "wetlands" lead to groundwater flooding.

All these problems have their existence in the past. Sustainable urban water management has been insufficiently taken into account in the city development. Many European cities are facing these problems nowadays. Furthermore, new future challenges ask for our attention, especially when they are dealing with climate change and EU framework guideline for surface and groundwater. In order to make the Eindhoven region sustainable, we are looking for solutions to adapt the urban water system to the impact of climate changes. We are both facing, the implementation of the EU water framework guidelines and in search of cost-effective, innovative measurements to improve water quality.

So in the region of Eindhoven a number of dilemmas regarding water management come together. All parties involved have to cooperate to investigate integrated solutions for all the dilemmas.
The dilemmas are:
- An integrated treatment of water nuisance (groundwater) and water quality is necessary, but is it possible?
- restore open water (as it originally has been) in the city, but is realisable and against what costs?
- increase discharge possibilities of the sewer or increase the storage, lower the threshold altitude of the sewer with a link of reducing the groundwater and water level, or a combination of the possibilities mentioned above.
- lowering groundwater table by groundwater abstraction is possible but only acceptable if a sustainable solution can be created by cleaning the polluted soil (and groundwater) and the abstracted groundwater can be transported to the nature areas situated around Eindhoven.
- introduce very complex integrated sensoring and measuring for integral optimising of the groundwater abstraction, sewage system, effluent polishing, silt processing and targets surface water system. Is this challenge possible or realisable only against high costs.
- apply source specific treatment versus end of pipe techniques to extract hormone disturbing substances.

Due to cooperation between governmental organisations, (technological) industry and research institutions it is possible to come to an approved, integrated, feasible and workable solution for the tasks mentioned.

Position and description region Eindhoven
Eindhoven city is with its 210,000 inhabitants the fifth largest city of the Netherlands. The region of Eindhoven has approximately 400,000 inhabitants. Approximately 40% of the total investments in Research & Development in the Netherlands takes place in the surroundings and the city of Eindhoven, mainly by high tech companies and institutions, such as Philips, ASML, DAF, TNO, Technical University.

Hydrology
Eindhoven is situated in a sort of bended bowl. In the lowest part of this bowl the river the Dommel flows. The discharge of the Dommel is very low in a dry period. The average downstream of Eindhoven is between 2 and 5 m3/s. Upstream the quantity is only 0.75 m3/s. At the Eastern part of the city a large waste water treatment plant (WWTP) drains the effluent on the Dommel. The discharge of this water is during dry periods approximately 1.5 m3/s.

The ambition for river the Dommel is to improve the water quality to the most high ecological and chemical value as possible. Because of the low discharge of the river and relatively high amount of water from WWTP and the combined sewer overflow the network have relatively large influence on the river water quality. From that point of view Eindhoven is unique if compared to other large cities in Europe. Most of (large) the cities in the Netherlands are situated near the coastline or have a large volume rate rivers in their direct surroundings.

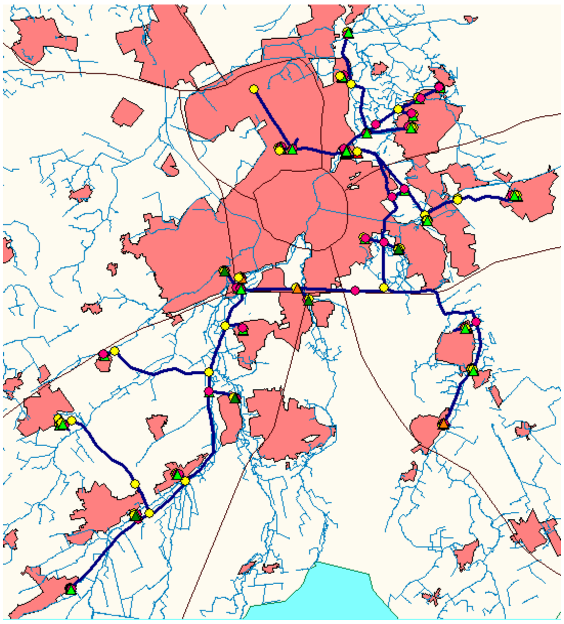
Since 1920 more houses needed to be built as a result of industrial development. Particularly after the second world war, Eindhoven has known a turbulent grow, which resulted in an increasing pressure on public area, which interventions had their impact on the water system. An example of this issue is the river Gender. This little river runs through Eindhoven and was canalised in the first half of the previous century and became a part of a mixed sewage network. Water from the Gender has been used by several large and small companies in the city centre as production water. Due to the fact that the Gender was used as an open sewer, the smell was terrible. A large part of the Gender has been closed in phases and afterwards has been filled up with soil. The last part of this operation has completed in 1950.

By filling up the Gender the draining capacity in the area has been reduced and furthermore less surface water can be stored. The reduced dehydration is further reinforced by the fact that the last years it two large groundwater abstractions are not longer necessary. By stopping these distractions the groundwater level is increased and this causes an increase of the groundwater table in some parts of Eindhoven.

The canalised Gender ends in a pond, with an overflow over in the combined sewer system . This causes relatively “thin water” to flow into the WWTP. This influences the treatment process negatively. The available storage in the sewer decreases as a result of the transport of surface water through the sewer . A research showed that annually in total 10 millions m3 "UNKNOWN-thin" water (wastewater - or rainwater excluded) is transported into the treatment plant.

Sewage and water treatment plant

The sewage of the city Eindhoven is caught in a mainly combined sewer system (85%). The last decades two separated systems have been built, the newest more sustainable is built in the a suburb. In existing parts of the city projects have been carried out, where rainwater is disconnected from the combined sewer system.



The total length of the sewage network in the region of Eindhoven is approximately 4000 km. The dynamic storage of the sewage network scheme is approximately 18 mm rain. The static storage is less, 10 mm rain. The storage capacity is important not only important to discharge the waste water to the WWTP but also for minimising the number of combined sewer overflow. The total area (10 municipalities) has more than 200 combined sewer outlets.
The possibilities for underground storage tanks or on surface water are little. That’s one of the reasons

flooding frequently occurs in some parts in Eindhoven.

The WWTP of Eindhoven treats besides water from Eindhoven city, wastewater of nine other municipalities (200,000 inhabitants) situated in the surroundings of Eindhoven. This WWTP has a capacity of 800,000 p.e. and is the third largest of the Netherlands. It covers an area of approximately 600 km2. The first design of the WTTP dates 1960, and at that time situated outside the city. Due to the growing and development of the city there were no further possibilities for the realisation of a sludge processing installation (SPI). Due to the smell problem the installation was built, 7 km out of Eindhoven. The sludge transport is constructed using three underground pipes. The SPI has no fermentation installation, to create energy. Recently a study showed that profits versus costs was negatively so the project has not started yet.
At the end of 2005 the sewage treatment plant in Eindhoven has been adapted hydraulic. The discharge and quality of the WWTP is now below the European standard guidelines. However a point of care is the quantity of heavy metal (CU and Zn) and it appears that relatively many hormone disturbing substances reach as effluent the surface water. A research program; LOES/comprehend (community programme of Research on Environmental Hormones and Endocrine Disrupters) shows that male fish become more feminine near the sewage treatment plant of Eindhoven. At this location the quantity is the highest of all locations in the Netherlands.

Solutions and action plan
The complex relation between the components of the water system, both water quality and – quantity, as well as the interaction between the treatment plant, rainwater, groundwater and surface water, is the reason for an integrated action plan .
For instance the use of existing infrastructure (sewer system) will be improved using online measurements and a decision supportive model. The continue monitoring of available storage in the sewer system (quantity) is not only important for reducing number and extent of floodings in the centre of Eindhoven but also to control CSO and reducing effects on surface water to what is acceptable to the ecological objectives (water quality).

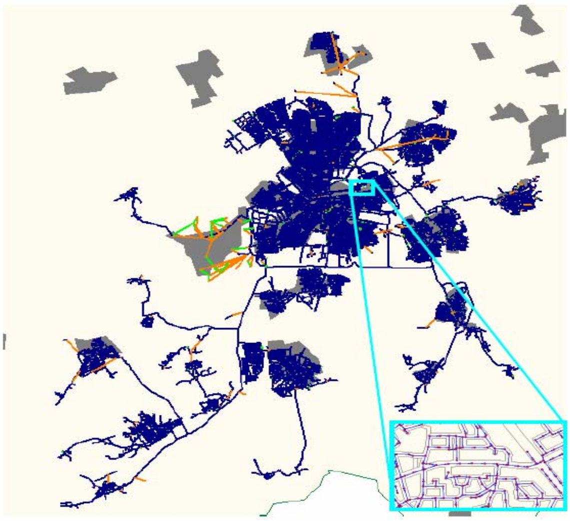
Re-designing open water system
The Gender, a second small river in Eindhoven, will be reopened again and will mainly follow the old track towards the Dommel. From 2007 the river will also be used as drain for two suburbs through which the Gender flows through. Besides this it will also improve the rainwater discharge, due to disconnecting rainwater from combined sewer systems and hereby, increasing (relatively) the sewer storage so the number of flooding area will reduce and less rainwater will reach the WWTP.

Besides the Gender, still a number of other water structures are redeveloped, as a result of which solitary water parties get a quality impulse. An ambitious plan has been made in which the next ten years, a part of the existing city is ”disconnected”, this means that rainwater is collected separately and conducted to the new water structures.

Groundwater
A part of the treatment to reach an acceptable groundwater table in the city, is maintaining of two large abstractions of groundwater. This while there is no industrial need. The water company together with municipality, the water board and the province, have agreed to continue to abstract groundwater until 2009 and until then search for more sustainable solutions Finding a beneficial use for the water is a particularly difficult challenge. Ideally the water should be used as a drinking water supply or to meet industrial needs. However, although the water can be treated using advanced techniques,

this may be insufficient or excessively expensive. The quality of urban groundwater has not been well protected in the past and the degree of protection in future is not known. Moreover existing sources of water readily meet the present regional demand for drinking water and the additional urban groundwater supplies are surplus to requirements. One interesting option is to treat the abstracted water and transport it to rural areas just outside the city where it would be re-introduced to groundwater system artificially.
The FlexNet is a model, which helps making a choice which spot can be used best for re-introduction to groundwater. Supportive or additional to this technique, Aquifer Storage Recovery (ASR), is available. It purifies and stores a surplus of the surface water during wet winter months as drinking water on 200 m deep, for use in the dry summer periods. With the ASR method in combination with Flexnet an anticipation can be made on climate changes (wet winters, dry summers).

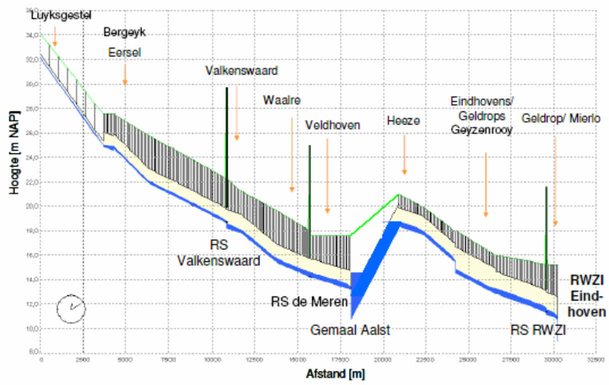
As a result of industrial activities in Eindhoven, there are more than 50 soilpollutions in the areas of current water extractions. Through measurements this situation is made controllable. By the design of the online monitoring programme, real time sensoring of the quality of the source can be controlled with FlexNet and a sustainable system of drinking water can be realised. Flexnet can be made operational for real time measurements of quality and quantity (impact of abstraction etc.) on groundwater. Also for conditioning the stored drinking water in the deeper layers a measuring system is necessary, which is integrated in FlexNet.



Figuur 3.2 Afvalwaterketenmodel inclusief de rioleringsstelsels van de gemeenten.

Modelling the sewer system
Water board De Dommel the Dommel and the municipalities in the Eindhoven region have agreed sharing knowledge and to do research in order to balance out the load on the WWTP and reduce the amount of CSO during rain.

The systems have several large sewers which are not filled entirely with water during rain events as well as in the less large sewers of the municipal system of the 10 different municipalities. The partners have conducted investigation to the possibility of using the existing underground infrastructure (4000 km sewer systems, storage tanks and WWTP) more effectively. Several model studies have been carried out. In the main transport sewer built in the 1970s, three control stations have been built that should control the storage. The fact is that is has not been able to prove itself yet. Model studies of the last years show that there are possibilities when another algorithm of control would be installed. First estimations indicate that by an effective control € 14 million could be saved. And this concerns only the first step.



Figuur 3.3 Dwarsdoorsnede Riool zuid met de aansluitpunten van de diverse gemeenten en het opvoergemaal en de regelstations (RS - stuwen)

Measurements in the wastewater chain network for parameters for both quality and quantity are done in the sewage network scheme. On several places level and discharge measuring equipment have been installed. To monitor the water quality in the sewer system several sensors are installed for COD (using UV/Vis sensors) NH4 + and conduct driven and temperature sensors are introduced.
It showed that controlling the 1,200 km long sewer system of Eindhoven can be a very cost effective measurement.

Modelling the sewer water purification

During the last decade, discharge legislation has become stricter worldwide, which among others, has caused wastewater treatment become more complex. Currently, most new treatment plants are able to perform biological carbon, nitrogen and phosphorous removal in parallel. Understanding of these processes became increasingly challenging because of the complex interactions involved. To this end, mathematical models, and more specifically, dynamic models are regarded as useful tools to gain more insight and in-depth understanding about the processes involved in wastewater treatment.

So far wastewater treatment plant modeling was primarily performed at the level of universities or consulting companies. However, some companies, e.g. water utilities, are starting to incorporate modeling in daily management work. One of these organizations, Water board De Dommel (Noord-Brabant, The Netherlands), has taken such initiative. Together with Ghent University (Belgium), a project was set up in order to evaluate the use of modelling as a support tool for wastewater management. In order to perform reliable modelling work in a company setting, several important requirements need to be met. Firstly, adequate expertise is required at the level of process knowledge and of modelling methodologies. Secondly, the low efficiency of the classical modelling process needs to be improved. Generally speaking, the latter is caused by a lack of standardization (i.e. data collection and quality check, measurement campaign, model calibration, etc.) and automation (i.e. dedicated software support). Thirdly, the obtained model quality needs to be adjusted based on the actual goal of the modelling exercise. Some decisions will need a higher quality model than others, e.g. the testing of a control strategy requires a detailed dynamic model whereas the design of extra volume can probably do with a steady-state simulation.

Integration of quantity and quality

In association with the university of Ghent, Technical University Eindhoven and Technical University Delft a link will be developed between the model of the sewage treatment plant Eindhoven and the sewage network. The aim is an optimization on water quantity and water quality goals. The intention is to create a link with the open water system and bring this in a model as well. Control will take place on the basis of predicted rainfall, available storage in the sewer network and controled CSO on surface water. An example is an intensive rainfall event during night. In current situations this will lead to discharge to the WWTP although at night, sludge volumes are low. The very moment quality measuring in the sewage network and the open water system could indicate a sufficient CSO it should be controled that way. The aim is to have a model which creates process optimisation, develops control strategies and eventually optimises the complete water chain and water system.

Further improvement of effluent quality

For the further treatment of the effluent of the WWTP research will be done to have removed heavy metal and hormone disturbing substances. For this Waterboard De Dommel and water company Brabant Water have made a research programme with Philips. All partners have agreed to focus on "Water and Health". The cooperation goal is developing new products and techniques which must lead to a more efficient management in the water sector and to a strengthen the export position of the Netherlands/Europe. At least two privileged coalitions have been identified for improving the quality of WWTP. These are:

- *Uv-ox* ; In run-up to the effectuation of the European framework directive waterboards are confronted with much stricter standards. By application of ultraviolet light and oxidants as de-infection technology, confessed from the drinking water world, is possible to remove hormone disturbing substances and disruptors in effluent. This broadens the market perspective for drinking water and the effluent sector.
- *Urine monitoring and urine separation* There is a need for reliable information on medicines - and/or drug use in f.e. hospitals and detention centres. At the meantime we create possibilities to coop socially responsible with the discharging of medicines and hormone disturbing substances and prevent polluting discharges by innovative separation techniques on the spot.

Effective use of existing infrastructure and installations

The storage in the sewer system and the use of control stations have already been mentioned. A study has been carried out for processing and realisation of a sludge fermentation installation. Aims regarding water are reducing the sludge quantity and the water quantity in sludge so the number of transports to the sludge combustion installation (100 km further) can be diminished. Further more arousing energy and reducing the rest flow to the sewer system of the region Eindhoven (40,000 p.e.).

Because of the high costs of the realisation of sludge fermentation the implementation is delayed. But at the moment it is possible to deliver energy directly to the WWTP against acceptable costs this project will be carried out.

Conclusion

All different partners involved, believe that a step is made in the right direction to take care of water solutions in the region of Eindhoven. The parties involved have agreed to proceed with a joint initiative that focuses on sustainable solutions. It appears that finding the most efficient and effective solutions is only possible when reliable information and calibrated models are available. This way innovative techniques can be installed and integrated and sustainable quality and quantity solutions become possible. This cooperation will lead to a better knowledge of an integrated approach and reducing costs for research and investment measures.

5. Genoa

Demonstration Site Priority on Project Hosting		
No.	**Project Title**	**Priority**
I	Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution	**2**
II	Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies	**1**
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IV	Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management	**1**

Urban Pilot Theme 1: Managing rain ev ents and flooding in urban areas

Fact Sheet: Demonstration project Genoa

Integrated analysis of drainage systems and WWTPs aimed at optimising their rev amping and the use of retention/first-flush tanks including the definition of best practice for urban flooding and pollution management.

Background

The Ligurian territory, and particularly the urban catchments draining waters of the city of Genoa, is almost totally distributed along the coastline, having upstream high slope of catchments surfaces and consequently a very short time lag of the outflow hydrographs. The catchments surface can be pervious (upstream) or impervious (downstream in the urbanized area), depending on the local land use and on the urbanization rate.

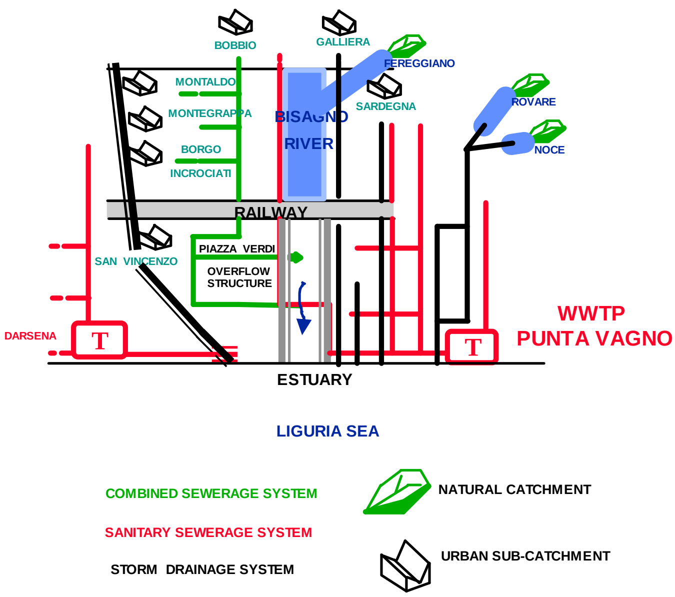
Because of the aforementioned characteristics, on the occasion of intense/extreme rainfall event, water managers have to cope with flooding phenomena due to the incapacity of the drainage system to take the flow. During such events, flooding can come from the sewer systems and/or from rivers.

Flooding in Genoa due to extreme rainfall event occurred in 1970

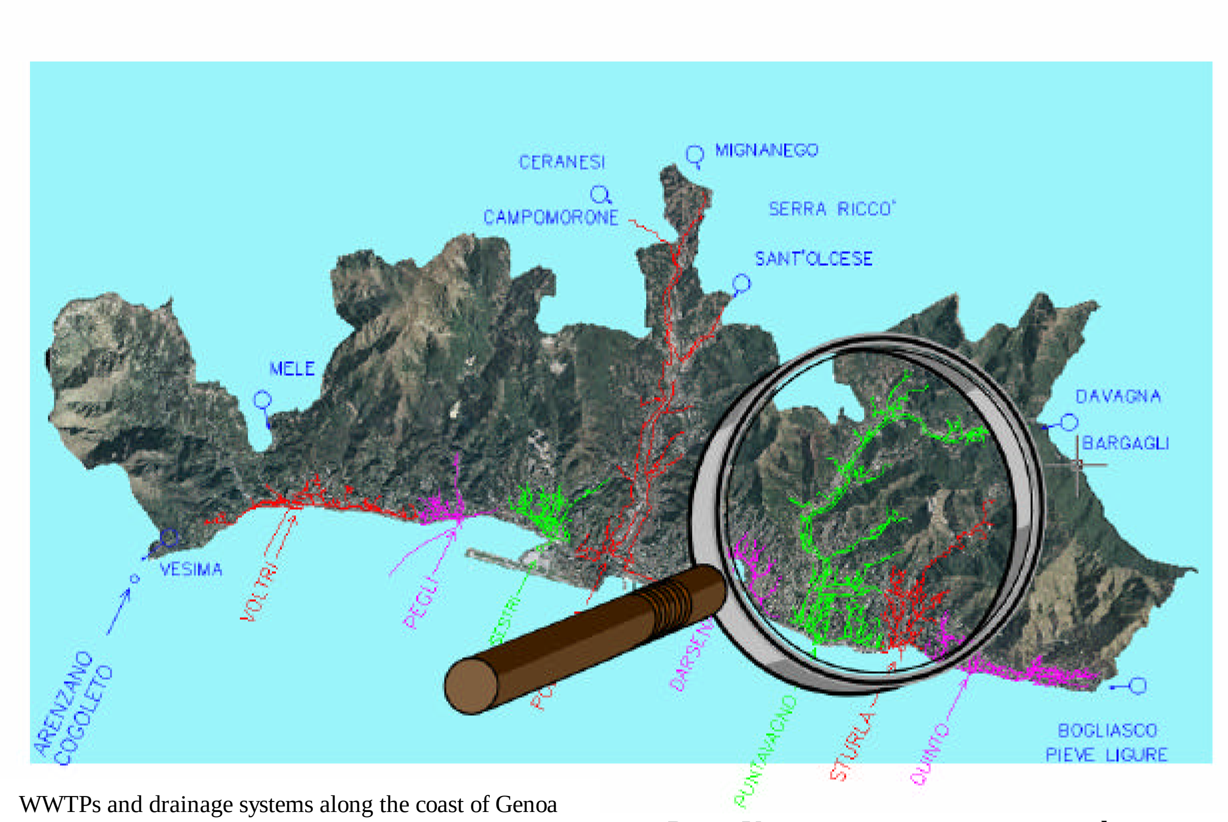
Because of this characteristic, quite common in southern European countries, managers and technicians have studied drainage systems for many years designing upgrading works and applying innovative technologies with the purpose of setting up control strategies aimed at minimizing flooding and pollution phenomena.

The pilot area, which we would like to focus our attention on, is one of the several urban catchments linked to waste water treatment plants, located along the coast and discharging treated waste waters into the Ligurian sea through sea outfalls.

The sewer configuration, consisting of channels, pipes and creeks, has changed during the last decade due to upgrading works executed by local managers to rationalize the drainage system. The latter at present is a mix of combined and sanitary sewer systems together with a storm drainage system characterized by unknown connections to the sewage. This aspect is crucial for the efficiency of the related waste water treatment plant, called Punta Vagno, where incoming flowrate increases on the occasion of rainfall events.



Scheme of WWTP Punta Vagno Drainage system



WWTPs and drainage systems along the coast of Genoa

In the framework of a wwtp revamping, waste water managers have been asked by the local Municipality to design and carry out further upgrading works to the two interconnected systems (sewerage and wwtp). The project will include tank volumes expected to be used both as retention and as first-flush tanks, with the purpose of optimising the efficiency of the wwtp.
The revamping costs will be funded both by the Ministry of Environment and by Regione Liguria.

An adequate design of the revamped configuration implies a complete and appropriate knowledge of the whole system and application of innovative technologies available to be used for the purpose such as: sewer and wwtp modelling techniques, quality/quantity sensors to be installed in the framework of a monitoring campaign or as fixed installations, scada system for collecting measures and operating control device such as pumping station or sluice gates enabling the tanks to be filled and emptied, system simulations with the purpose of defining the necessary/minimum tank volumes, a proper system integration enabling the supervisory control to be fully integrated into the company information system, other implications related to technical, legislation or political constraints in order to find suitable areas where to built new tanks and pieces of waste water treatment train.

The Genoa pilot demonstration project represents for the proposers a very useful opportunity for sharing common knowledge in the framework of the WSSTP with the purpose of setting up the best practices to be used in several sites in Europe having the same problems/characteristics: coping with flooding and pollution problems through adequate control strategies applied to the management of sewers and wwtp including retention/first flush tanks linked to the network.

Punta Vagno waste water treatment plant

Punta Vagno waste water treatment plant, located along the coast line, has been designed during the 60s and its construction was completed at the beginning of the 80s applying the technologies available at that time for maritime civil works, for electro-mechanical devices and for the applied treatment train.

The plant along the coast consists of a waste water line, including pumping, coarse screening, sand and oil removal, fine screening, pre-aeration, primary sedimentation, biological oxidation (suspended biomass), final sedimentation and discharge into the sea through sea outfall.

The primary sedimentation in the waste water line is connected to the sludge line, located at the Volpara site, through a six-kilometer pipe running upstream, along the Bisagno river left bank. The sludge line consists of static thickening, primary and secondary anaerobic digestion, sludge dewatering and disposal.

The plant was designed for treating waste water from a separated drainage systems (sanitary and storm) from 285.000 P.E.

Actually the drainage system was only partially separated (the separation process was performed during the following decades) and at that time the wwtp has been designed, the appointed firm was unable to carry out a specific study about actual flowrates and related pollution loads, even during rainfall events.

Revamping of the waste water treatment plant is necessary for several reasons such as:

- a functional recovery of the existing structures; even if the plant is currently subject to ordinary maintenance, the obsolescence of electromechanical devices does not allow an efficient proper maintenance activity;

- an increasing of the treatment pollution load and related flowrate: the actual pollution load at the outlet is very close to the threshold established by the current legislation thus not allowing operative variations in flowrate and pollution;
- discharged water quality in compliance with the current legislation about discharges (decr.leg.152/06).

With reference to the discharge of urban wastewater, at European level the basic regulation is represented by Council Directive 91/271/CEE, which has been transposed in Italy through d.lgs. 152/06. The central point of the European regulation is represented by fixed limits for the most representative parameters, which are COD, BOD_5 TSS and, for discharge in sensitive areas, total phosphorus and total nitrogen.

The Italian transposition is even more restrictive, with no mention to the fact that either the limits for concentration or for the percentage of reduction shall apply.

A further, more restrictive regulation, which can be limited to a single plant, may be issued by local authorities, taking into account the characteristics of the receiving body. In the case of the Punta Vagno plant it is represented by the Ligurian sea, which has not been classified as a sensitive area, not being subject to eutrophication.

As a consequence the fixed limits for total phosphorus and total nitrogen, shall not apply, provided that the plant is equipped with a suitable sea outfall. According to law provisions, issued by Region Liguria in 1995, foresees, the outfall must be at least 1,000 m long and 30 m deep, so that the output is discharged far enough from the coast. At present the outfall of the Punta Vagno plant doesn't comply with such requirements but works are in progress to solve this problem.

A specific working group of specialists has been appointed for the purpose; they are currently evaluating several information such as: previous reports stating boundary conditions and future perspectives, analysis of the weak points of the drainage system and related wwtp, analysis of the inhabitants number and growing perspectives into the considered urban catchments, theoretical and actual definition of flowrate and related pollution load at the wwtp inlet, definition of the limits in the water quality at the wwtp outlet, identification of available innovative technologies to be applied for the treatment train and for the system integrated control, definition of the treatment train including a possible re-location of the sludge line.

The first analysis lead to the following assumptions to be considered for the preliminary definition of the wwtp design parameters: 330.000 P.E, an average flowrate of 600 lt/sec, a peak flowrate of 900 lt/sec, a daily BOD5 of 19.800 Kg/day and a concentration of 380 mg/lt.

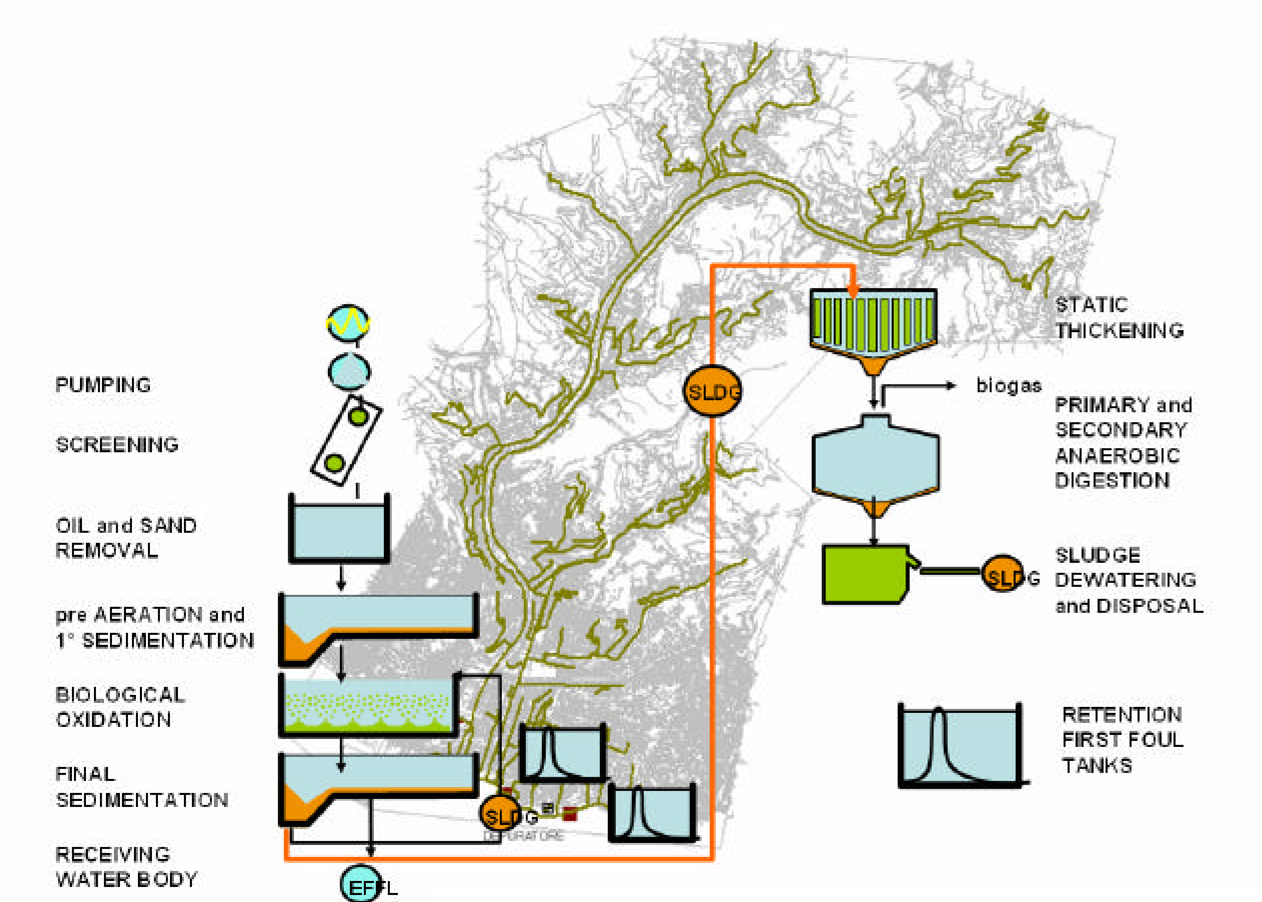
Because of the unknown connection between the storm and the sanitary sewer system, the inlet flowrate has been sized at the pre-treatment (pumping, coarse screening, sand and oil removal) up to three times the dry weather flow, corresponding to 1.800 lt/sec. The flowrate peak to be considered at the inlet of the biological treatment has been fixed 1,5 times the dry weather flow, corresponding to 900 lt/sec.

These thresholds imply an adequate analysis of the upstream drainage system in order not to overtake them in any operational conditions: the construction of retention tanks connected to the drainage system next to the wwtp has been considered.

A proper size of them, also for wwtp equalization purposes needs to be done through an integrated approach which considers the drainage system and the wwtp as a whole integrated system.

Punta Vagno WWTP – View of the urban catchments

For this purpose the analysis will be carried out in a way that guarantees that the output from the drainage system simulation results are used as input for the wwtp model going to be built for adequating the treatment train design to the new boundary conditions.



Model of the drainage system and scheme of the treatment train before the revamping

Integrated analysis by the pilot

As described before in the framework of the pilot, starting from information already collected, an integrated analysis of the system under revamping will be carried out.

The final output of the analysis will be design parameters for the new wwtp treatment train and for an optimal size of the two retention/first foul retention tank.

Further outputs to be achieved are adequate control strategies for managing the whole system in compliance with the current legislation.

The following innovative technologies have to be considered as part of the pilot background:

- Integrated modelling techniques of drainage systems and wwtp
- Installation of quality sensors (spectrophotometers and/or turbidimeter) for measuring COD and SST aimed at characterizing pollution load of dry weather flow and during rainfall events, especially during the first foul flush.
- Data handling and validating the a.m. data including calibration of the quality sensors
- Installation of sluice gates and pumping stations, devices expected to be use for filling and emptying the a.m. tanks.
- Design and installation of SCADA system assuring an adequate management of the acquired measurements for a proper transmission of controls aimed at operating in field devices following optimized control strategies.
- The application of a meteorological low-cost radar for detecting rainfall. MdA has been active since years carrying out research concerning the sensor: a X-band radar has been installed for studying rainfall events in the historical centre of Genoa. It is completely digitally controlled and the obtained images are published in the internet site http://monitoraggio.iride-acquagas.it.

  The developed procedures, still need to be improved in order to solve saturation signal problem and time-processing problem, are likely to be used in the framework of the control strategy to be developed inside the pilot.

Theme 1 Research topics covered

The Research Topics, in terms of Generic Research and Enabling Technologies, for Urban Pilot Theme 1 have been defined as:

G14: Integrated modelling platforms of sewer and drainage systems including storage and treatment
G8: Optimization of systems monitoring (water quality, hydrology and hydraulics of rain events)

G11: Design forecasting and early warning systems suited to quick events in large urban areas
G10: System solutions for flood management and reduction (integrated forecasting modelling and control, online storage, individual retention)
E2: On-line monitoring of water quality and of treatment processes, for collective systems
G6: Integrated risk assessment on urban water systems
E31: Real-time forecasting and management of drainage systems and retention facilities
E29: Multi-hazard and multi-risk modelling tools (natural events, technological hazards, assets failures)

The Genoa demonstration project, focused on an integrated analysis as preliminary activity to the definition of design specifications, is dealing with some/all of the a.m research topics.

As follow-up or further activity to be developed inside a project proposal likely to be finalized, it is important to point out the *definition of best practices* to be used for the management of drainage systems and waste water treatment plants, in compliance with local environmental quality standards and current regulations.

A specific methodology aimed at identifying critical weak points through the application of innovative technologies and/or integrated approaches, will make technicians working in this field aware about the different implications of each topic, whose application will allow managers to cope with flooding and pollution phenomena in urban areas.

Actually there is the need in EU countries to share knowledge on the matter, whatever are the local background, the boundary conditions and the gaps to be filled.

The Water Supply and Sanitation Technology Platform could play an important role in this framework being in contact both with the European Union Commission and with different stakeholders in Europe.

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Mediterranea delle Acque

GRUPPO IRIDE

6. Lyon

Demonstration Site Priority on Project Hosting		
No.	**Project Title**	**Priority**
I	Multi-hazard and Multi-Risk Modelling Tools for Integrated Risk Assessment of Urban Flooding and Pollution	**1**
II	Integrated and Water Quality based Stormwater Management based on Online-monitoring, Ecological Engineering and Cost-effective Technologies	**1**
III	Integrated Real Time Monitoring/Control of Sewer Systems and Wastewater Treatment Plants combined with Early Warning Systems	
IV	Solving Flooding and Water Quality Problems through Integrated approach and improved Decision Making Tools for Urban Water Management	**1**

Lyon’s Urban Area Storm Water Management : technical issues

Lyon city

Lyon is located in the South-Eastern part of France, between the Alps and the “Massif Central”, at the Rhône and Saône rivers confluence. It is an historical city : Lugdunum (Lyon) was founded under the Roman Empire. The ancient part of the city has been listed by UNESCO as a part of the world heritage.
The Urban Community of Lyon (Grand Lyon) is made of 57 municipalities. The Grand Lyon Water Department (GLWD) is in charge of the wastewater and stormwater systems.

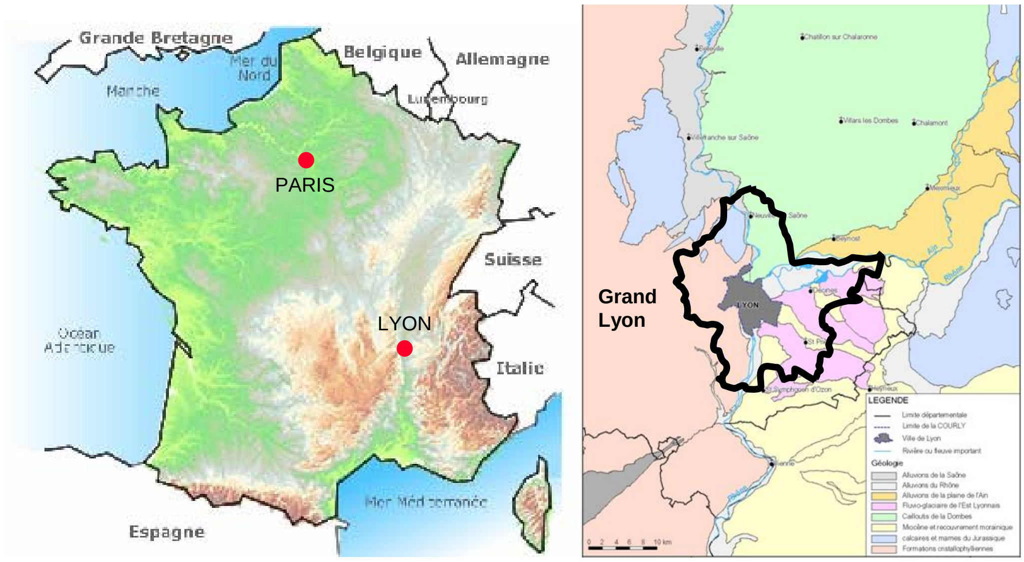

Figure 1

Grand Lyon basic data

- Urban area ~ 600 km^2
- 2005 population survey ~1.7 M inhabitants
- Rainfall-Evaporation ~800-550 mm / y (net import = 250mm/y)
- Rainfall intensity in 15 minutes : 76 mm/h (T = 10 years), 113 mm/h (T = 100 years)
- Climate : continental with a Mediterranean character in September-October
- Water supply~ Alluvial aquifer + ground water – mean consumption 150 L/ cap/d.

Grand Lyon drainage system

- 2700 km of sewers (mostly combined) – 600 km of man-entry sewers
- 70 pumping stations
- 8 wastewater treatment plants (see Figure 2)
- 1.5 million m^3 of detention and infiltration ponds
- 370 CSO structures

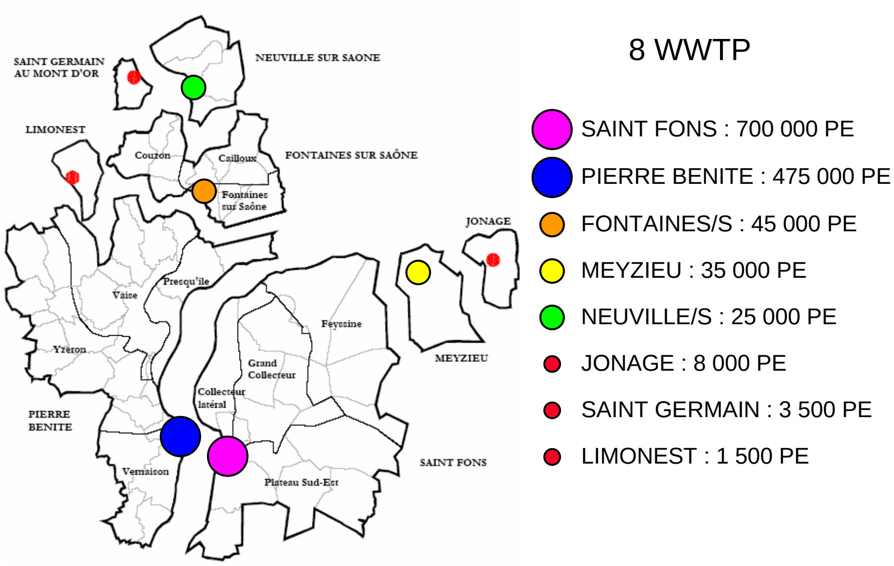

Figure 2

Various sewerage and drainage strategies are used depending on local conditions:

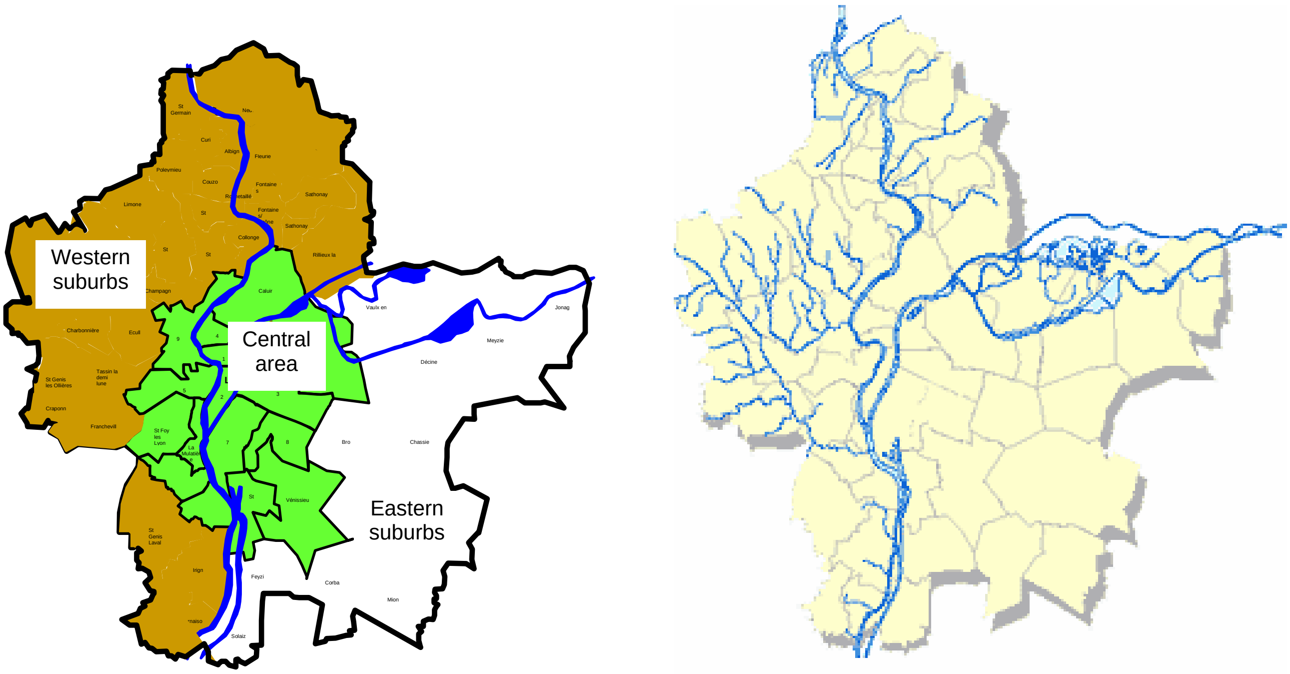

Figure 3

- In Western suburbs, hilly lands predominate, with a dense network of (sometimes) intermittent and seasonal small creeks (Figure 3). Individual housing is quickly developing and main problems are linked to river floodings and river water quality. Sewer system is partly separate
- The central area is highly urbanized, and has a highly looped combined sewer system. Most CSO (combined sewer overflows) structures are located in this area and their management is a key issue.
- The Eastern suburbs extend on a flat fluvio-glaciated alluvial plain, where no surface water courses exist (except the Rhône river itself), due to the very high permeability of the soil. It is the main area for on-going and future urban development. Very low slopes and long distances to possible outlets (receiving streams) do not allow an easy use of traditional network systems, and thus storm water infiltration is the rule. Grand Lyon has a very long experience in the use of alternative techniques (retention, wet and dry ponds, infiltration ponds, trenches, wells,

etc.), and urban water management is one of the key points for sustainable development in this area.

A long history of research and modelling

Grand Lyon began to develop a numerical model of its sewer systems in the early 1970s.
Nowadays, all data describing the sewer system and related territorial informations are stored in a GIS and can be easily used.
In particular, these data are used by the CANOE software that allows the modelling of the sewer system operation under dry and wet weather conditions (with a prediction of water and pollutants transfers and discharges). See Figure 4.
Rainfall data are collected by a network of 30 rain gauges operated since 1985. Models can be calibrated using flow rates data collected in 20 monitoring stations. All measured data are stored in a data base named "Vigilance".

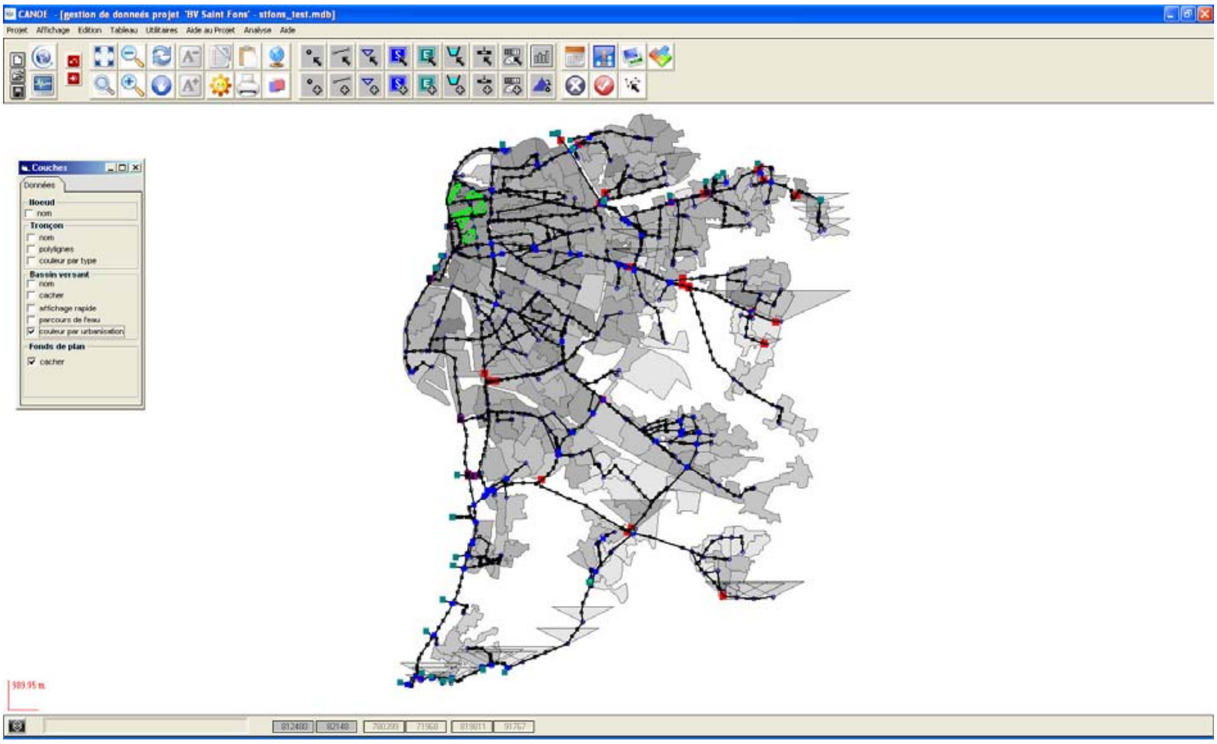

Figure 4

In 1999, the Grand Lyon decided to develop, in cooperation with researchers, a scientific *in situ* observatory named OTHU (in French: Observatoire de Terrain en Hydrologie Urbaine, i.e. Field Observatory on Urban Hydrology).
This observatory gathers scientists from 8 institutions, representing most of academic research fields:

- BRGM Geology
- CEMAGREF Water sciences
- ECL Fluid mechanics
- ENTPE Environmental Sciences
- INSA Urban Hydrology
- University Lyon I Chemistry, hydrobiology, and water microbiology
- University Lyon II Geomorphology
- University Lyon III Climatology

The OTHU long term objective is to develop new strategies for the development and management of the urban drainage system to handle the damaging effects of an increasing urbanisation and of the changing climate conditions on natural waters.

It relies on scientifically based continuous monitoring of water and pollutants loads at the outlet of four urban catchments, and of their impacts on both surface and ground water bodies. Figure 5 shows the position of the main measuring stations. It can be noted that station 1 is located outside of the city territory and is dedicated to the study of peri-urbanisation effects on little rivers. Figure 6 shows the scheme of a standard OTHU monitoring station.

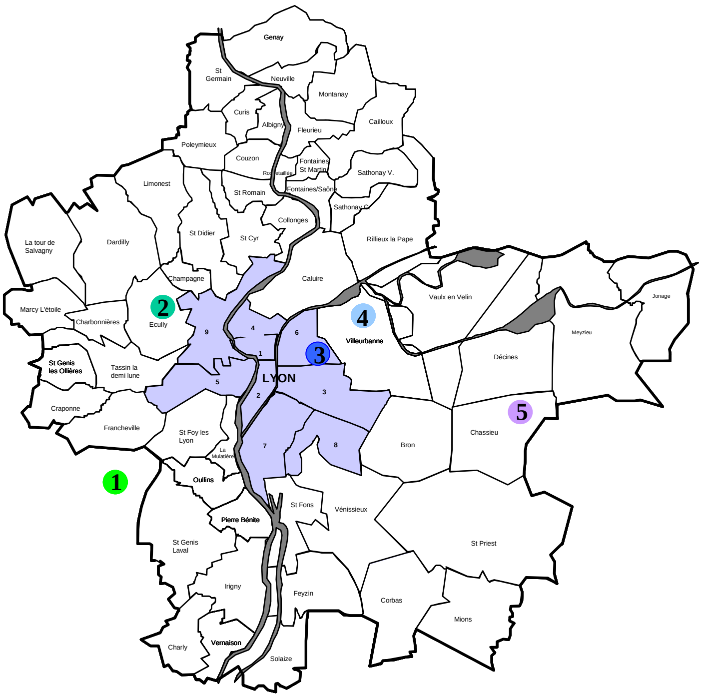

Figure 5

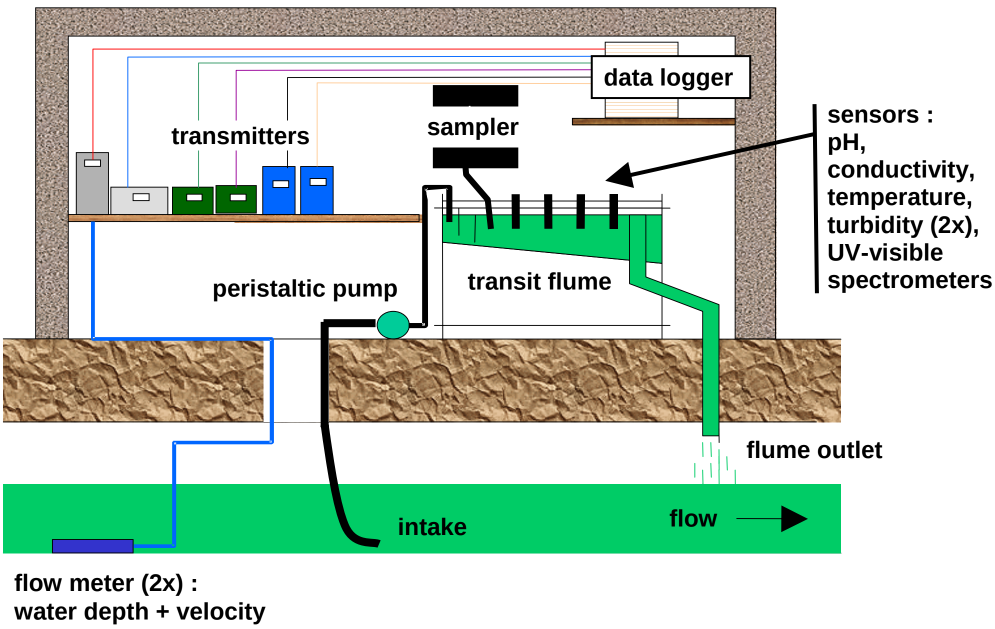

Figure 6

WSSTP. Urban Pilot Theme 1. Managing rain events and flooding in urban areas - Fact sheet: Lyon

The OTHU project in brief (see http://www.graie.org/othu/)

- 45 researchers (eq. 15 Full Time positions) , 4.5 Full Time technicians
- 1 million new data every 3 months
- 40 research projects
- since 1999 : 18 PhD theses, 39 research reports, 172 publications & communications

- total budget : 1,5 M€ / year
- 400 k€ for biological & chemical analyses + site maintenance
- 600 k€ for salaries
- 500 k€ for research activities

- Investment in facilities : 0,9 M€ in 5 years

Description of the Lyon consortium

All OTHU partners will participate in the Lyon consortium and new partners will join under the coordination of the GLWD.

Technical partners

Suez – Environment. The SUEZ Group works in two complementary areas: energy and environment. Within the SUEZ Group, SUEZ Environment federates all the environmental skills in terms of water management, sanitation, and waste services. SUEZ Environment aims to be a reference in both water and waste services. That ambition is backed by asserting the values of professionalism, partnership and value creation for the benefit of the community at large, based on tried and tested principles: local integration, a high level of technical expertise, and an effective contribution to sustainable development.

- 80 million people supplied with drinking water, 50 million people benefiting from sanitation services ;
- Consolidated turnover: € 11.4 billion for 2006 ;
- Headcount: 57,500 associates ;
- More than 10,000 water treatment plants built in 70 countries ;
- Research & development: € 56 million.

Veolia Water is a water cycle manager**.** On behalf of its customers - public authorities and industrial companies - Veolia Water manages all parts of the water cycle so as to use less of the resources and protect them. Veolia water withdraws water from the natural environment, produce and distribute drinking water and industrial water, collect and transport wastewaters and treat them for recycling purposes or their releasing into natural environments. Veolia Water also works on the protection of water resources.

- N° 1 worldwide for water services ;
- Revenue of € 10.9 billions for 2007 ;
- Providing drinking water and wastewater treatment services to nearly 117 million people around the world ;
- 77 841 employees ;
- Permanent operation in 59 countries.

Research Institutes / involved expertise

EEDEMS is a GIS (Public Scientific Network) initiated by 4 public research organisations (BRGM, CSTB, ENTPE and INSA) (see http://www.eedems.com/#). It aims at gathering various skills into a network, co-ordinating research programs and structuring scientific and technical offers. EEDEMS brings complementary skills to OTHU partners:

- Validation of treatment processes ;

- Bio-physical-chemical characterisation and treatment ;
- Modelling of pollutants emissions - leaching behaviour ;
- Ecotoxicity and health impacts;
- Life cycle analysis.

These new partners bring complementary skills in the field of asset management.

<u>Other potential partners</u>

- Water agencies
- Rhône Alpes Région
- French Ministry in charge of ecology and sustainable development
- French Ministry in charge of research
- AXELERA (cluster Chemistry and Environment)
- GRAIE

EEDEMS is involved in the elaboration of a regional platform called PROVADEMSE, one part of which should be held in Lyon and dedicated to water & waste treatment. The aim of this platform is to provide good conditions to develop innovation in this field (important halls for pilot, staff devoted to the platform and in situ tests)

<u>Expectation of the Lyon consortium in WSSTP</u>

The following items are related only to the topic “Managing rain events and flooding in urban areas”.

The Lyon consortium follows different long term objectives and its expectation in WSSTP is mainly to find partners to reach these objectives.

Development of an integrated model of the whole urban water cycle

Develop an integrated model able to simulate the evolution of water and pollutants fluxes in a sewer system (network, wastewater treatment facilities and plants) and their impacts on the natural environment. This model should be able to simulate various global strategies of wastewater and stormwater management and to predetermine their efficiency by mean of sets of forward-looking performance indicators.

Improvement of the knowledge on rainfall at small temporal and space scales

Gather information to develop simulation models, especially time series of representative rainfall events. Create methods allowing the use of ground raingauges and radar data in an optimum way, both off-line and on-line (generating alerts, real time control of the sewer system).

Improvement of CSO operation

Develop technical tools that may help to reduce the overall impact of urban wet weather effluents on receiving water bodies (aquifers and rivers), including RTC.

Improvement of peri-urban rivers management

Develop tools allowing managing urban discharges with the perspective to ensure a given water quality of the aquatic environment exposed to urban pressures. These tools should include decision making aspects. Indicators will have to be complementary to those taken into account within the European Water Framework Directive (WFD). They will have to integrate both the ecological aspects (biota and physical habitat), and the economic, social and climate scenario aspects.

Development of methods to improve stormwater retention/infiltration facilities

Define methods for design, construction and operation of stormwater retention/infiltration facilities in order to improve the overall features of their durability (environmental, economic and social).

Improvement of the preservation of Lyon water resources

- Develop a methodology of evaluation and overall hierarchical organisation of the risks associated with the supply of drinking water to the city.
- Develop tools enabling the reduction of negative impacts.
- Evaluate the long-term efficacy of alternative techniques in terms of aquifer pollution risk.

Improvement of on line and off line monitoring systems

Develop procedures, rules and tools to optimise the collection, validation, storage and use of data about the functioning of the sewer system and the receiving environment.

Contacts for urban Pilot Theme 1: managing rain events and flooding in urban areas. Demonstration project Lyon:

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7. Oslo

Demonstration Site Priority on Project Hosting		
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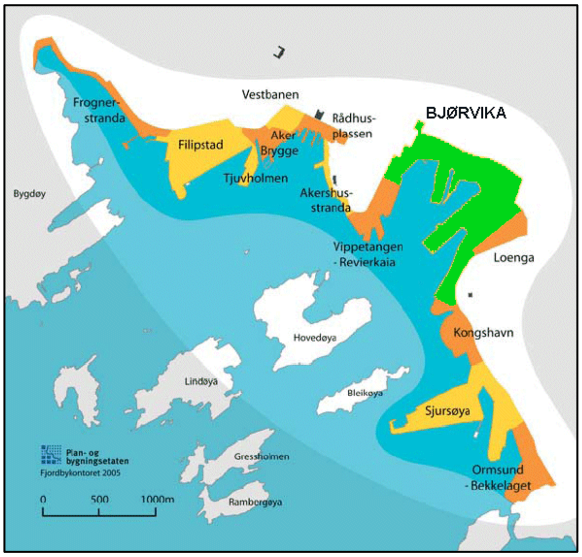
FACT SHEET: DEMONSTRATION PROJECT OSLO
MIDGARDSORMEN – (THE MIDGARD SERPENT)

Background

The Fjord City plan is the overall strategy towards urban development of parts of the waterfront in Oslo. One aim is to create better connections between the City Center and the Fjord. The 225 hectares of development areas included in the strategy are divided into 14 project areas.
(See Area Map).



Area Map of Oslo Waterfront
(Copyright Oslo Waterfront Planning Office)

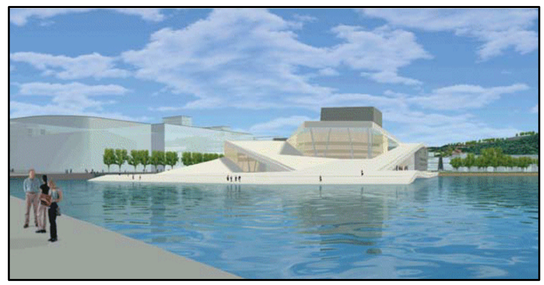
Situated between the ruins of medieval Oslo and the city centre, Bjørvika constitutes Oslo's second most important harbour. The development plan for the area stipulates roughly the building of close to 1 million square meter of residential and commercial use on the 69.6 hectares of land.

Aerial photo of Bjørvika (Copyright Statsbygg)

The development of the Bjørvika area is calculated to require investments of € 6 billions over the 15-20 years to come. Some major construction projects are well underway, the construction of a submerged tunnel that will reduce the amount of traffic in the area will be finished between 2008 and 2011. Construction of the New Opera House in Bjørvika started 2003 and the first proper opera performance will take place in the autumn of 2008.

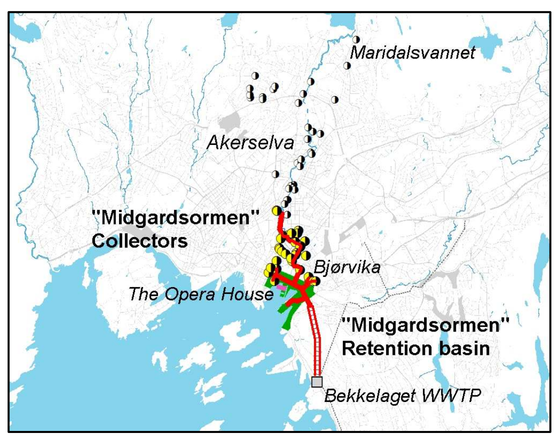
Construction site 2005 (Copyright Statsbygg)

The Opera House is partly on land and partly over the water so it may be perceived as if it "rises up" from the fjord. The long and low slung building is a key to reconnect the City with the water in Bjørvika.



The New Opera House (Copyright Snøhetta)

Southwest-facing with attractive vistas of the fjord, Bjørvika also watches over the mouth of Akerselva, Oslo's most beloved river.

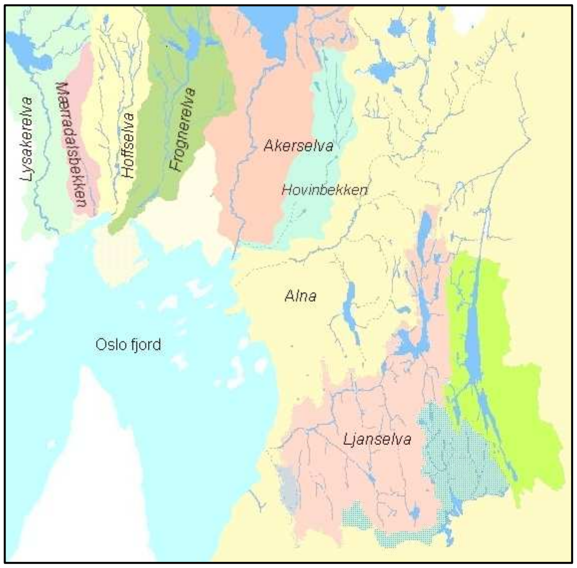


"Midgardsormen"

In Norse mythology "Midgardsormen" was a sea serpent so long that it encircled the entire world. Stories were told of how the sailors would mistake its back for a chain of Islands. "Midgardsormen" is also the name of a potential € 70 mill. project to relief Bjørvika and the lower parts of Akerselva from combined sewer overflow.

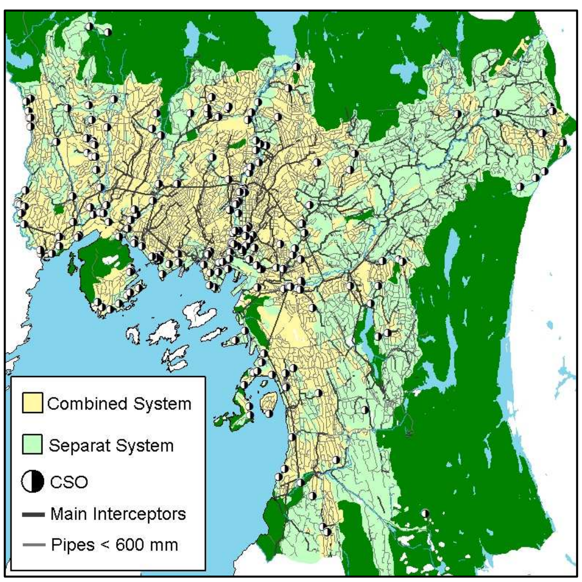
System Description

The City of Oslo is situated between the woods and hills of Nordmarka and Oslo Fjord. Between Nordmarka and the fjord, eight main watercourses pass through the city. These rivers and the fjord itself are popular recreation areas for the city's population of some 510 000 persons distributed over an area of 140 km^2.



The main Watercourses in Oslo

Oslo's sewer system has developed over a period of 150 years. Up to the mid-fifties combined systems were mainly used. Subsequently an effort has been made to develop a separate system.



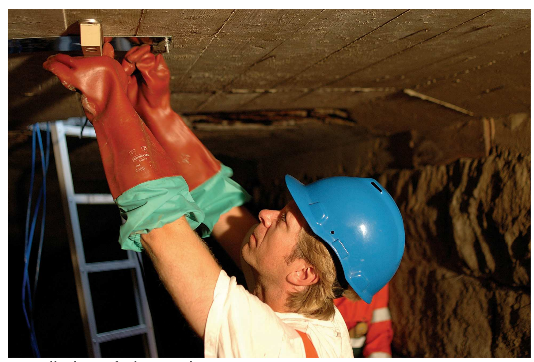
Sewer system

The sewer system includes 2 200 km of sewers and 45 000 manholes. 800 km of sewers is combined. The main interceptors in the sewerage network consist of 300 km of pipes with dimensions of 600 mm and over. The sewer system is relieved by a total of 240 overflows, of which three are main overflows from the tunnel system. The waste water is collected and transported to two treatment plants by an extensive system of tunnels. VEAS treatment plant accepts waste water from the western part of the Oslo region and Bekkelaget treatment plant from the eastern part of the region.

Regional map, Tunnel system

Within the Oslo City boundary the tunnels amount to 41 km. A 24 km long tunnel extends from the city boundary to VEAS.

Monitoring



Installation of ultrasonic sensor

In 1997 a systematic work began on modelling, monitoring and calibration of a city-wide MOUSE (Modelling Of Urban SEwer Systems) model. This work is a long-term undertaking and is regarded more as on-going work than as a project.

The Western and Central part of the Oslo tunnel system includes 29 discharge point structures, most fitted with a Parshall or Khafagi-venturi measurement channel. For flow monitoring at these points Oslo Water and Sewerage Work (VAV) use monitors with ultrasonic level sensors. The monitoring equipment is linked to the remote control system.

During 1998-2000 the existing network of permanent rain gauge stations in Oslo was upgraded and increased from five to ten. The stations are of type Lambrecht and have been linked to the remote control system. All stations have a temperature gauge and a heated bulb for round-the-year measurements.

Lambrecht Rain Gauge Station

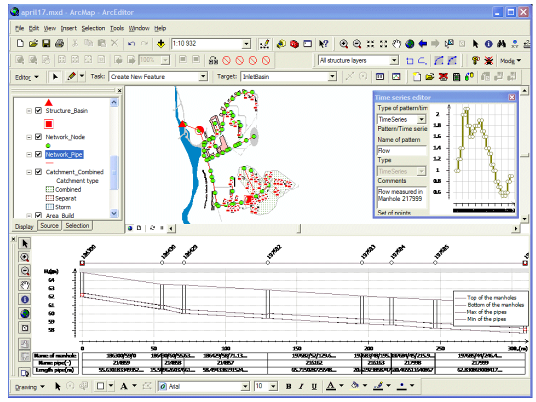
In the period May to November, mobile monitoring equipment is used for seasonal campaign monitoring. The equipment is installed and operated by a team of 3 persons. Beforehand the monitoring program is carefully planned by the modelling group. During the campaign, mobile rain gauges are placed on roof of buildings or pumping stations. Flow monitoring equipment is used to measure flow in main collectors. The overflow loggers are sited in locations identified as primary overflows, i.e. overflows expected to come into use more than once each year. At overflow weirs with a relatively high crest level, level switch loggers is installed. At overflow weirs with a relatively low crest level monitoring equipment with an ultrasonic level sensor is installed.

VAV's mobile monitoring equipment

Mobile monitoring equipment	Number of
CASELLA Mobile rain gauges	10
PCM Pro, ADS, ISCO Flowmeters	16
ISCO Ultrasonic level gauges	15
Float Switch Overflow loggers	26

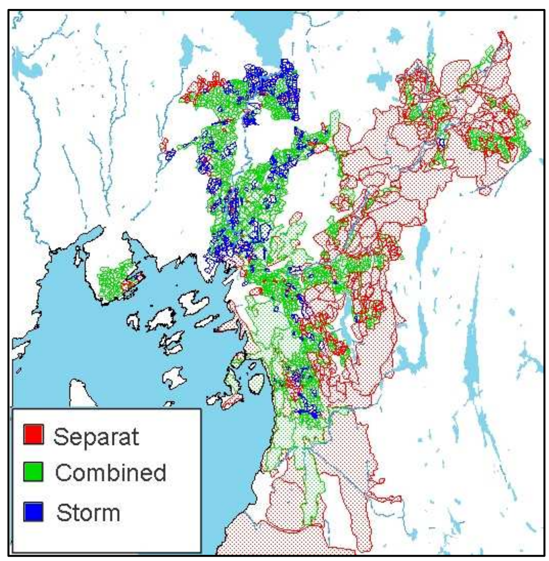
Model building

The "MOUSE model builders" in VAV is a team composed of 5 engineers. The team's most valuable "tool kit" is a Geographic Information System (GIS) enhanced with a comprehensive set of functionality, including an interface to the MOUSE engine. The extension is created and continuously improved in a joint effort between VAV, the Norwegian ESRI vendor and Aqua Rosim.



ArcGIS "model builder" GUI

VAV's preferred strategy is area planning. Field investigations like CCTV inspection, flow monitoring, pollution source tracing and model building focus on the main river basin areas, one at the time. The figure below shows the MOUSE catchments in the existing models.



Catchments in the MOUSE models

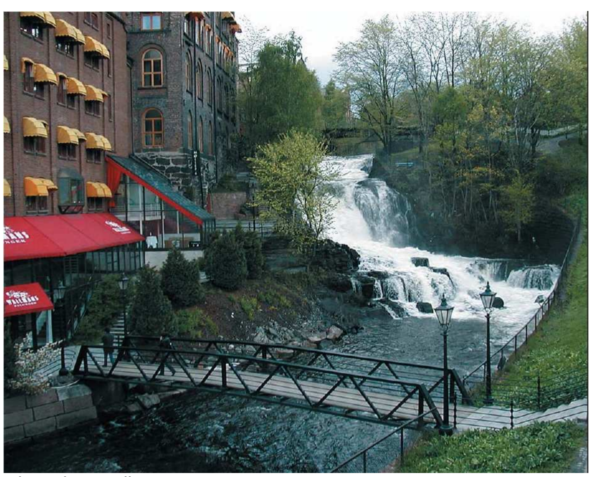
The models running contain about 20 000 pipes and have been calibrated against more than 150 time-series of flow. The models are highly refined in the combined areas.

Midgardsormen

During the eighties, old, worn-down and vacant buildings, deterioration and poor environmental quality characterized the river basin area along Akerselva. To improve these conditions, the project Akerselva Environmental Park was established. The intention was to develop green structures and parks, improve water quality, and enhance cultural heritage sites. In the nineties VAV launched an extensive program for pollution source tracing, renovation of the sewerage system and control of industries close to the river.

Pollution Source Tracing

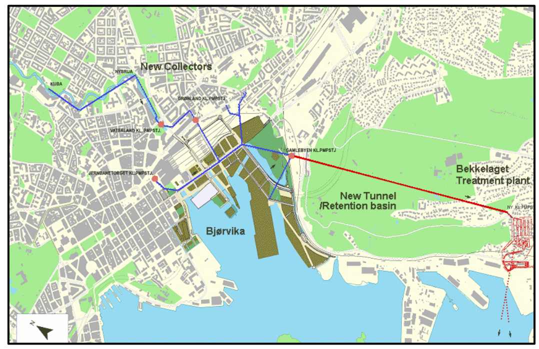
Today, the 10-kilometre corridor from the lake Maridalsvannet to the Oslo fjord has become a very popular area for outdoor life and physical activity in the city, and it constitutes an important green corridor for walking and bicycle transportation. Business development and cultural activities are flourishing along the river. New, modern offices are integrated in an environment of old industry buildings.



Akerselva, Mølla

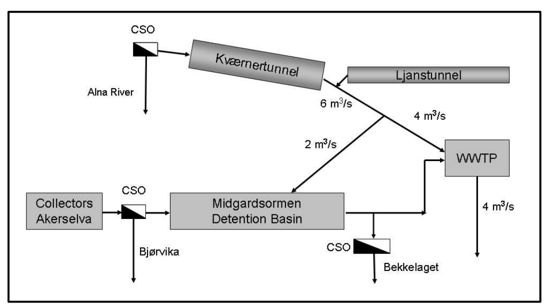
The water quality in the River is close to natural conditions during dry weather periods. In the southern part, the salmon comes to spawn and in the northern part, the beaver lives. More than 100 species of birds have been found along the river, including the national bird, the Fossekall. Swimming is possible at several spots in the upper parts of the river.

Akerselva is the recipient of about 50 combined sewer overflows and 100 stormwater outlets. The goals and ambitions described in the Master Plan 2001-2016, is in general zero discharge of wastewater in the upper part of Oslo's watercourses. This will mainly be accomplished with a variety of local measures and by building smaller retention basins. The CSO's in the lower parts of the watercourses is in general a more complicated and costly matter. The development of Bjørvika and the New Opera House expedites Midgardsormen a project to relief Bjørvika and the lower parts of Akerselva from combined sewer overflow. New pipelines stretching from the fjord and 2 km upstream in the river will serve as interceptor for 24 CSO's and 5 main pumping stations.



Midgardsormen, interceptors and retention basin

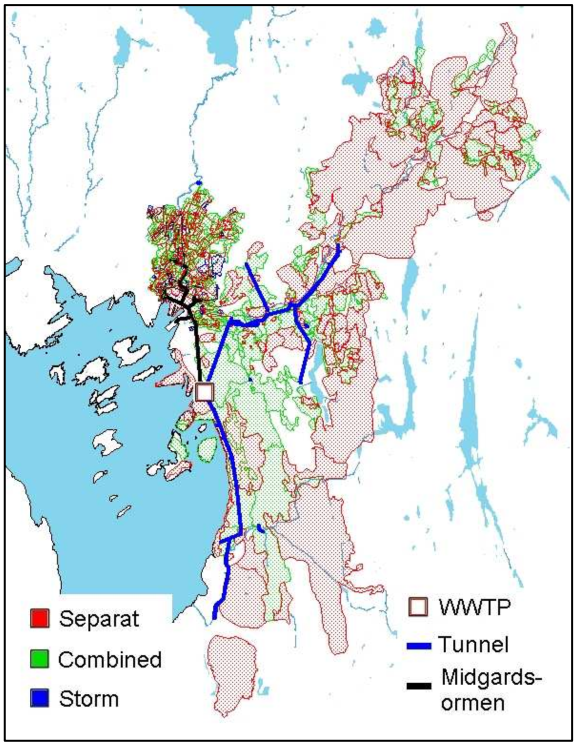
The Akerselva Interceptors will connect to a 2 km combined tunnel and retention Basin extending from Bjørvika to Bekkelaget WWTP. Two new main CSO structures, one discharging to Bjørvika and one discharging at 20 m depth at Bekkelaget will relief the system during heavy rainfall. A new pumping station will lift the waste water from Midgardsormen to the WWTP.



Bekkelaget & the eastern part of the tunnel system

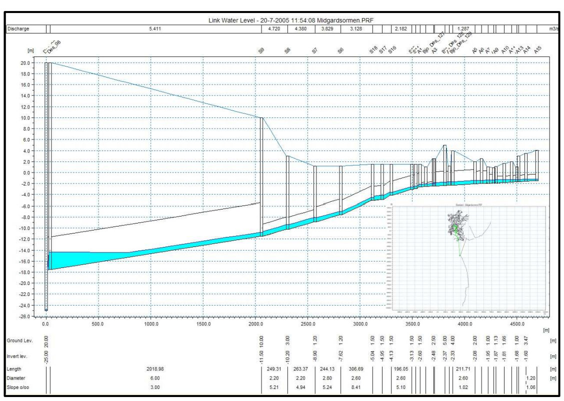
The total investment in collectors, tunnel and pumping station is estimated to € 70 mill. The design criteria for the system is to allow discharge from overflow to Bjørvika only once every third year and to Bekkelaget only once every year in the summer season. Midgardsormen detention basin shall be designed based on a prognosis of change in climate and the urban development year 2100. The project is highly dependent of the progress of activities in the Bjørvika area and the underground works is scheduled to the period 2009-2010.

As a part of the prefeasability study a tailored model including 400 catchments and 1400 pipes has been used. The model includes the total drainage area to Bekkelaget WWTP. The model is highly refined for the network parts that discharge to Midgardsormen.



Midgardsormen – Tailored model

In the prefeasability study the model has been used to design dimension of interceptors and the 50 000 m^3 volume of the retention basin.



Midgardsormen – retention basin and interceptors

The decision to realize Midgardsormen is currently still pending. However the fact that the construction work would be much more difficult and expensive in a later stage of the urban development of Bjørvika, could redeem the project. When the project is approved it will be necessary to further improve and develop the existing models and methods to optimize the system.

<u>Rainfall and flood frequency analysis</u>
In cooperation with the Norwegian Meteorological Institute and use of global and regional climate engines a method for creating regional synthetic "historical" rainfall times-series adjusted to climate changes will be developed. The time-series will be used as the basis for flood frequency analysis in order to design Midgardsormen according to the described criteria's.

<u>Monitoring and calibration</u>
Mobile rainfall, flow and level sensors will be installed in the system to verify the existing hydrological and hydraulic model. Data acquisition and processing during monitoring and calibration will be further improved and developed as a part of the project.

<u>WWTP Model</u>
An existing WWTP model for Bekkelaget will be further developed and calibrated. The model will be used to evaluate the capacity of each process stage at the plant.

<u>Integrated system design</u>
The hydrological and hydraulic model will be used together with the WWTP model in order to balance the storage volume of Midgardsormen and the capacity of Bekkelaget WWTP based on environmental and economic criteria's.

<u>Control Strategies</u>
Data from on-line rainfall, flow and level sensors will be used to develop, evaluate, optimize and fine tune different control strategies for weirs, gates, pumps and Bekkelaget WWTP for different meteorological and hydrological situations.

Theme 1 topics covered

G8: Optimization of systems monitoring (water quality, hydrology and hydraulics of rain events)

G10: System solutions for flood management and reduction (integrated forecasting modeling and control, online storage, individual retention)

G14: Integrated modelling platforms of sewer and drainage systems including storage and treatment

E12: Real time monitoring/control of treatment plants

E31: Real-time forecasting and management of drainage systems and retention facilities

Municipality of Oslo

Oslo is the capital of the Kingdom of Norway. The city has a blue-green image, as it is surrounded by the blue Oslo fjord and green hills and forests. The geographical area of Oslo is 450 km^2. The municipality has 510 000 inhabitants.

Oslo Water and Sewerage Works

Oslo Water and Sewerage Works is a self-financing company within the municipality of Oslo. The agency has supplied drinking water to the city, and treated wastewater, for more than a century. Income is derived from existing legislation to ensure that connection fees for water and sewage are fair and reasonable for the customers.

BEVAS

BEVAS AS is a private company owned by Läckeby Water Group (Sweden). Läckeby also have interests in Purac AB, and offer services within, construction, design, building, equipment and operation. LWG has 180 employees, has a turnover on 600 mill. SEK, and runs businesses in 10 countries. The Municipality of Oslo has signed an operation contract for Bekkelaget WWTP (BRA) with BEVAS for 15 years. The operation contract started in October 2001.

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ANNEX 2 – List of existing EU-Projects

WSSTP – Urban Pilot Theme 1

Table of Contents

1. LIFE-projects

1.1 Preventing pollution and saving water resources by reuse of industrial rainwater

Project reference: LIFE97ENV/F/000183

Objectives: Realisation of a stormwater reuse system on a demonstration site of the car industry. Demonstration of the fiability and stability of its performance for the reuse of treated water in industrial processes. From data collected on eight other demonstration sites, development of a model and a software to evaluate the technical feasability and calculate the profitability of stormwater reuse. The model will be transferable to any other industry.

Duration: 1997-07-01-2000-06-30
Link:

1.2 I.M.O.S. Integrated Multi-Objective System for Optimal management of urban drainage

Project reference: LIFE00 ENV/IT/000080

Objectives: The project uses real time multi-sensors (rain gauges, flowmeters, turbidity monitors, low cost meteorological radar), modelling activities (rain field forecasts and network modelling) and upgrades to infrastructure (sluice gates, pumping stations, volume rehabilitation, new SCADA system), to achieve the integrated multi-objective management of the drainage system in the urban environment of Genoa.

Duration: 1.9.2001-31.8.2004
Link: www.life-imos.com (out of use)

1.3 PISYS - Real-time management and operation of an urban sewage system in relation to the quality of the natural environment

Project reference: LIFE2000 ENV/F/000614

Objectives: The general objective of the PISYS project was to demonstrate the environmental benefits related to the real time management of the flows in the treatment networks of an urban area based on a management strategy that included real time monitoring of the condition of the receiving medium and the quality of the effluent. The principle was to be demonstrated in the greater Metz area.

Six measurement stations and nine alert stations were installed and are operational on the river Seille and the treatment network. These stations are installed in compact metal cabinets and comprise an air conditioner, a pump, measurement probes and instruments and a data transmission module. The probes are continuously measuring flows and physical-chemical parameters, the peak values of which generally indicate pollution. The values are sent through a telephone link to the Haganis centralized management centre. When these values go outside predefined tolerances, a sample of the effluent is automatically taken and an alert is raised. The analysis laboratory can then precisely identify the pollution agents concerned and the technicians can decide whether to direct the water to the treatment station, or to a pollution reservoir.

- A sophisticated modeling software (MOUSE) was developed by the Danish Hydraulics Institute (DHI) to represent the transit flows in dry and rainy weather and the impact of the concentrations on the natural environment. A database (using EMMA validation software) was constructed to record the various parameters and ensure the transfer of the corresponding values to the MOUSE model.

- The transferability of PISYS concept to the Saarebrücken urban area was studied. The Zentraler Kommunaler Entsorgungsbetrieb (SKE) identified three sites within its urban area for which a collection system optimization analysis was conducted with a view to protection of the natural environment. The German operators were considering equipping these sites with continuous quality measurement stations to enable real time control. In the Saarebrücken context, the problem is that certain streams or small lakes lack water during the summer. The objective would be to supply these streams and lakes using residual water treated by simply decanting or a reed filter system. In order to preserve the reeds during periods of drought, a PISYS type station would allow water of sufficient quality to be taken from the decanter, thus maintaining the biological filter. The cooperation between the French and German partners was expected to continue after the LIFE project.
- An interactive CD-Rom, which presents the results of the PISYS project, the analysis of the Saarbrücken urban area and a methodological guide, was produced.

The cost of material to run the 15 stations amounts to €24,000 per year and maintenance represents one full time employee.

The beneficiary, Haganis, had plans to construct a interceptor collector in the river bed. This project, which is part of the river Seille quality recovery action, is to intercept, in rainy weather, single releases in Metz. In light of the PISYS project, new variants of the inceptor were being studied.

Duration: 26-NOV-2001 to 31-OCT -2005
Link: http://www.nancie.asso.fr/life-pisys/origin.htm

1.4 SMURF - Sustainable Management of Urban Rivers & Floodplains

Project reference: LIFE02 ENV/UK/000144

Objectives: Industrial activity in the West Midlands dates back to the 1800s. Since 1980, however, the region has experienced steady industrial decline, which has led to significant land-use changes. The focus of the SMURF project is the River Tame basin which is 73% urban industrial and home to 1.8 million people. River water quality across the basin is among the poorest in the UK. Of the 140kms of river in the basin, 75% are classed as poor or very poor under the “General Quality Assessment” scheme used by the Environment Agency (England and Wales) to test and rank the aesthetic quality of rivers. Such a very large urban area developed over relatively small capacity rivers creates tremendous environmental pressure on the water resources. Under the European Water Framework Directive, Member States are required to bring waters up to “good ecological status”.

The SMURF project aimed to reduce pollution and flooding on the River Tame. Methods and technologies used in the project could possibly be adapted and applied to other places in the UK and the rest of Europe. The project’s specific objectives were to:

- Implement a sustainable land-use and water management plan in the urban floodplain;
- Improve of the amenity, ecological status and sustainable drainage of the river basin;
- Involve local citizens in the planning and urban river basin;
- Establish ecological objectives for the river system and a transferable sustainable indicators set;

• Develop a detailed land-use planning model to govern future redevelopment in the floodplain; and
• Demonstrate how small-scale modifications can significantly improve a heavily modified waterway.

Duration: 01-AUG-2002 to 31-JUL -2005
Link: http://www.smurf-project.info/

1.5 "Diffuse and dispersed pollution - Efficiency of applied policies regarding prevention and control of diffuse and dispersed pollution in surface waters - Inventory and comparison of approaches in six countries."

Project reference: LIFE99 ENV/F/000457

Objectives: The project aimed to make a comparative analysis of the policies for prevention and control of diffuse pollution in surface water implemented in seven countries (Germany, Belgium, France, Netherlands, United Kingdom, Sweden and Denmark). It was to focus on the problem of diffuse and dispersed pollution on the river basin scale.

The sources of pollution covered in the study were to be:
- agricultural pollution
- rain and storm pollution and infrastructures
- pollution due to scattered settlements not connected to a waste water treatment plant
- pollution due to unconnected individual sewerage systems
- scattered toxic wastes
- atmospheric pollution
- historical pollution involving ground water.

For each kind of pollution, the study was to deal with:

- The type of pollution considered by each State, national and/or river district basin, objectives and policies for pollution prevention and control, the measures taken to prevent or mitigate this pollution, the assessment methods used to evaluate pressures and states, relating to the of measures, the effectiveness and cost of pollution prevention and control measures.

- The comparison with National standards to be met for each type of inventoried pollution, evolution or objectives of these standards, the methods used for carrying out surveys and analysis, present and estimated costs.

The dissemination of results:
The national methods used were to be systematically compared between the countries in order to list the convergences and divergences and to explain them during a workshop to be held with the national authorities in charge of water management in each country. The results will also be disseminated to the Meuse Commission and to all of the interstate organizations in Europe and to the countries participating in the study (Official bodies).

Duration: 01-NOV-1999 to 01-MAY -2001
Link: www.oieau.fr

1.6 Multi-parameters surveillance and protection of water quality

Project reference: LIFE99 ENV/F/000492

Objectives: The aim of this LIFE-Environment Project was to validate a new multi-sensor approach using biological and physico-chemical devices for water resource protection and monitoring. The project consisted of: grouping together several water quality monitoring devices at the same site, determining the degree to which the devices are complementary or redundant, integrating the information in order to develop a cheaper system with greater performance.

Presently, data from continuous surveys of continental water quality are treated separately. The multi-sensor programme would allow to optimise this control of quality thanks to a combination of three levels of information:

- fusion of biological answers from biosensors representing each link in the food chain (bacteria, algae, daphnia, mussels, fish);
- fusion of information from basic physico-chemical analysers;
- integration and correlation of these two families of data.

On-line analysis of biological answers with a wide spectrum of detection and classical physico-chemical data will permit: a faster detection of accidental pollution and prediction of degradation in water quality to remedy sensor drift or dysfunctioning to optimise the integrated monitoring system.

In addition, the study of physico-chemical interferences on biological answers lead to a better reliability of the system, excluding false alarms non attributable to toxic conditions.

One of the expected results of the project was the production of a decision-making guide destined for managers to monitor stations for the definition of the most suitable configuration in terms of cost/benefit.

Another expected result was the definition of the first elements of the specifications for a European surveillance unit integrating physico-chemical and biological instruments based on the know-how of European SME's and their partnership.

The project would bring together end users and European technology providers and developers in order to validate this new multi-sensors approach for water resources monitoring and protection.

Duration: 04-OCT-1999 to 04-APR -2003
Link: http://www.nancie.asso.fr/

1.7 Integrated Wastewater Purification Management

Project reference: LIFE06 ENV/D/000478

Objectives: The annual loading of wastewater discharge from sewage treatment plants to the environment could be significantly reduced, if a better equalisation and distribution of wastewater input into the treatment plants was realised. This was the basis of a plan to inter-connect sewage plants and sewer networks in such a way that the equalisation of the inflow peaks and the optimal distribution of nutrients could be steered and controlled. As a result, unused plant capacities could be utilised with significant financial benefits.
The overall objective is to demonstrate how wastewater management and treatment technologies can be improved through an innovative system, increasing the quality of effluent, while reducing

the costs.
The specific objective is to integrate wastewater purification through an innovative combination of electronic link (remote control) and physical connection (biologically activated pipe) of selected sewage treatment plants in order to integrate their technical capacities and to enhance wastewater purification.

Duration: 01-OCT-2006 to 31-JAN -2011
Link:

1.8 RAINMAN - RAINwater MANagement and treatment plant Vienna-Blumental

Project reference: LIFE06 ENV/A/000341

Objectives: In urban areas all over the world, the treatment of rainwater collected in a separate sewage system is a common problem, for which many different solutions are applied. If no surface waters are available as a runoff option, the rainwater is percolated and cleaned in filter systems. If surface waters are available as a runoff option, the rainwater is not cleaned or retained before being discharged. This is unsatisfactory from an ecological point of view. Throughout Europe, standards and regulations relating to the treatment of rainwater are evolving. In the new EU Member States in particular, the trend is to have a separate sewage system, which is likely to aggravate the problem of rainwater treatment and management.
The “RAINMAN” project will demonstrate a new process technology combining several treatment stages for polluted urban rainwater, e.g. water running off from roads. This process is characterised by a mechanical cleaning stage, a deflocculating stage, flood meadows acting as a retention and balancing area and finally a percolation dam. For these process stages, a closed wastewater treatment plant (Kläranlage Blumental) will be adapted.

It is expected, that this treatment will result in an environmentally compliant load of organic matter and suspended solids discharged into the river Liesing. Furthermore, the new plant will enable rainwater management and the prevention of floods.
Due to the separate treatment, rain water will no longer be conducted to the centralised wastewater treatment plant (WWTP). The WWTP will therefore be relieved from hydraulic load and it will be possible to operate it more economically.

Duration: 15-DEC-2005 to 15-JUL -2010
Link:

1.9 Risk based reduction of microbial pollution discharge to coastal waters

Project reference: LIFE06 ENV/F/000136

Objectives: Thirteen percent of Europe’s coastal bathing waters do not meet the standards set by 76/160/EEC Bathing Water Directive. In France, 20 % of bathing waters are expected to be non-compliant, if no action is taken. Pollution mostly comes from particular (rather than diffuse) sources and domestic wastewater.
Tourism and the demographic pressure in coastal areas are increasing the difficulty of reducing pollution, while at the same time setting higher expectations for clean waters.
Conventional solutions for the management of faecal pollution in domestic effluents enable good performance in dry weather conditions, but fail to manage efficiently the flow rates generated by heavy rainfall. In rural areas, the sizes of the sewerage systems present additional difficulties.
The project site covers 1% of the French coasts. It includes 38 registered bathing locations and 15

production areas for mussels and oysters, including the largest site in France. On some days, more than 10,000 persons practice recreational shellfish harvesting on the tideland.
The project covers the management and treatment of wastewater discharged to the sea and aims to prevent infectious diseases. The microbial seawater quality plays a key role in the sustainable development of costal areas. For the 40 km of coast covered, the project should immediately result in a 20 % reduction of point source pollution rising to 70 % with the application of the long-term plan

Objectives for improving the state of the local environment:
- Reduce the number of bathing sites rated “sufficient” according to the Bathing Water Directive from 5 to 2 areas and those rated “insufficient” from 3 to 0.
- Upgrade the mussels/oysters production area rated “D” to “C”, and to improve another rated “B” to “A”. After the completion of the objectives there will be 5 zones rated “A”, 6 zones rated “B” and 1 in “C”.

The project aims to further integrate pollution management into development plans. This will yield long-term economic benefits and avoid conflicts surrounding responsibility for pollution.

At an EU level, the MARECLEAN method will be available for conducting the risk assessment of faecal pollution in coastal areas, creating a local consensus on solutions and optimising environmental and economical benefits.
It will be transferable to the 20 coastal states of the European Union, especially those that border the Atlantic and North Sea. The project will also add to knowledge of faecal pollution transfer.

Duration: 01-OCT-2006 to 30-SEP -2009
Link:

1.10 Optimised environmental rainwater management systems in the sphere of the environmental engineering

Project reference: LIFE02 ENV/D/000399

Objectives: Municipalities are obliged to ensure that wastewater treatment plants operate under service conditions and discharge the purified waste water continuously into the on-site pre-flooder. Generally, conventional sewer systems operate without problems in normal conditions. However, during periods of heavy and persistent rainfall, large water volumes are carried along with wastewater to an extent that the sewage purification plants (SPP) can no longer cope with. In this case, the SPPs have to “open the sluices”: the wastewater is discharged untreated – although considerably diluted – into the waters.
To solve this problem, retention tanks have previously been built which have stored the accruing water volumes until a controlled discharge into the sewage plants can be effected. However, such retention tanks are very costly and also difficult to realise - particularly in residential areas - given the large land requirement.
During the years leading up to the project, the weather conditions became more extreme with heavy rainfalls even in temperate zones. A buffer system is therefore needed as set out under the EU-Directive 91/271/EEC. The HydrOstyX ® system provides a possible solution as it allows the use of the spare capacity available within the sewage network itself as storage volume.
The project aimed to use the capacity of sewer systems to develop internal retention ponds to store precipitation water during heavy rainfall. The installation of discharge brakes in the sewer systems would enable the management of this feature. This work sought to avoid the costs of installing intensive storage basins and to ensure a continuous and manageable discharge after heavy rainfall to

the wastewater treatment plant.
The project intended to establish a formal structure made up of two German towns, Stuttgart and Stockach, two Austrian towns, Götzis and Feldkirch, and the German sewage association AZV Lamer Winkel to demonstrate the functioning of the procedure in different conditions.

Duration: 01-JUL-2002 to 30-JUN -2005
Link: http://www.guethler-ingenieure.de/

1.11 Title: An integrated strategy to prevent water shortage and flooding through stimulating infiltration and local storage of rainwater, and through reduction of runoff.

Project reference:

Objectives: Water shortage and flooding are two environmental problems that are very closely linked. Both phenomena often occur simultaneously. A longer term water shortage on certain grounds arises simultaneously with periodical floods at lower grounds. This is mainly caused by an accelerated surface runoff.

In Europe, many areas face these problems. As a consequence, millions of cubic meters of arable soil are washed out by erosion, ground water levels decrease, soils dry up, water processing costs increase, the cost of flood-related damages rises, and biotopes are impoverished.
The project aimed to tackle the source of the problem – water shortage and flooding - through:
- breaking the accelerated drainage water flow;
- stimulation upstream infiltration and;
- creating storage areas for rainwater.
At the same time the project aimed to reduce groundwater extraction by stimulating a more rational consumption of water.
The pilot area chosen is situated in the upstream part of the river system of the river Demer. Three municipalities were involved, Bierbeek, Hoegaarden and Boutersem, in cooperation with the Flemish Ministry of Environment (AMINAL).
In parallel to the main objectives, the project intended to transfer the know-how acquired to third parties. Dissemination was thus an essential part of the project.

Duration: 01-JAN-2000 to 01-JAN -2003
Link: www.igo.be

1.12 Treatment and re-use of urban stormwater runoff by innovative technologies for removal of pollutants

Project reference: LIFE06 ENV/DK/000229

Objectives: Surface waters and stormwaters from urban areas and from roads present a considerable problem when discharging pollutants to the sewage system. The types of volumes of the pollutants depends mainly on the land use related functions like traffic volumes, characteristics of buildings (housing and industrial) and building and construction materials. Together with the overflows and stormwater run-off outlets these waters contribute significantly to the pollution of the aquatic ecosystem.

The impacts of stormwater pollutants in the receiving waters are varying, depending on the characteristics of the waterbody. Eutrofication as well as more direct detoriation of water quality are the main impacts presenting risks to the human health in the vicinity of urban areas. Recent

investigations have clearly shown adverse ecotoxicological impacts in streams receiving stormwaters. Also the accumulated sediments present a risk. The EU Water framework directive provides that the water pollution from surface waters is prevented.
The project aims at demonstrating technologies that efficiently reduce diffuse urban pollutant loads onto receiving waters. With respect to pollutant loads from households and industries there are effective technologies while tackling pollution from urban run-off waters is not largely addressed. Especially phosphorus and toxic substances and their removal from the urban run-off waters will be addressed.

The projects aims at reducing the outflow of toxic substances, mainly heavy metals and organic micropollutants, originating and charged with stormwaters in urban areas, by 80-90 %. The technologies used present robust and technically simple interventions, which should be easily adopted in the existing urban land-use structures. The pilot activities will be run in three different urban structures in Aarhus, Odense and Silkeborg.

Duration: 01-OCT-2006 to 01-OCT -2009
Link:

1.13 Vital Vaasa-Pilot framework and action programme for revitalisation of the water cycle in an urban landscape structure

Project reference: LIFE99 ENV/FIN/000216

Objectives: The phenomenon of urbanisation has taken place all over Europe. Many cities and especially old traditional city centres have gone through remarkable changes. The vitality and bio-diversity of the natural environment, landscape structure and ecological balance have been forced into retreat. In Vaasa for example, the environmental damages have resulted in the sinking of the ground water level by 10 metres over the last 20 years. Both ground and rain water in urban areas tend to acidify causing acidity problems. Rain and drainage water is led into the Baltic Sea without any treatment. Urbanisation and its impact on water conditions puts great demands on the tolerance of the fragile Scandinavian natural environment. Efforts for revitalisation of the water-cycle are therefore required.
The specific aim of the project was to test and develop methods for the restoration of rainwater circulation in a city area using new technical methods as well as to create models for problem solving within the planning and implementation stages. The target area was the densely populated Vaasa city-centre.
Another aim of the project was to develop cleaning methods for rainwater as well as ecological methods for using the rainwater. The aim was also to create an aesthetically-pleasing, healthier city environment.

Duration: 01-SEP-1999 to 01-SEP -2002
Link: www.vaasa.fi/vitalvaasa/eng/

1.14 ESTRUS - Enhanced and Sustainable TReatment for Urban Stormwater

Project reference: LIFE05 ENV/IT/000894

Objectives: Pollution resulting from storm water runoff in urban areas has been identified as one of the major causes of the deterioration of the quality of water collected. The first flush rain is the most polluted. First flush detention tanks have been successfully tested but the system presents some problems not easy to be solved, such as the availability of space. In addition, the system requires

very sophisticated numerical models. Distributed Treatment Solutions (DTSs) have been recently proposed as an alternative. Pollutants are removed from storm water by trapping them directly in the gully-hole or the initial pipe of the drainage network by means of appropriate hydraulic and/or chemical/physical devices. This last solution is quite promising and cost-effective, although full-scale applications are still scarce and validation of the technology will require further testing.
The project aims to demonstrate the sustainability and cost-effectiveness of Distributed Treatment Solutions (DTSs) for storm water runoff in harbour infrastructures and industrial sites. In these areas, traditional treatment solutions, such as first flush detention tanks, are too costly or unfeasible due to lack of space. The innovative component of the ESTRUS project consists of a full-scale treatment solution (hydraulic and chemical/physical) which has been so far tested in laboratory.

Duration: 01-OCT-2005 to 30-SEP -2008
Link: www.estrus.it

1.15 Integrated sustainable urban drainage Infiltration & Transport system Dordrecht, filtering of rainwater at the source

Project reference: LIFE98 ENV/NL/000195

Objectives: The city of Dordrecht is situated in the West of what can be described as the lower region of the Netherlands. Distinguishing features of this environment are the clay-peat soil and a high groundwater level. Creeks, ponds and rivers form an integral part of the landscape. In the municipality of Dordrecht the following drainage-related problems can be listed:

- The quality of the open water does not meet the standard requirements of the purification authority.
- The drainage capacity of the sewerage system is inadequate to cope with large supplies of storm water.
- Groundwater reaches unacceptably high levels.
- Vegetation is insufficient.
- It is the policy in the Netherlands to reduce unnecessary transportation of clean storm water to water treatment plants for purification.

Traditional solutions to these drainage problems are for example, the use of storage tanks for controlling quantities and equalizing flows, enlarging pipe diameters to increase capacity; laying drains and planting vegetation to control groundwater levels. In general if the problem is approached from a wider perspective, opportunities can be taken advantage of to manage an integrated water management system.

A study group comprised of participants from the Dordrecht City council, the purification authority “Hollandse Eilanden en Waarden” (ZHEW) and the district water board “Waterschap de Groote Waard” (WGW), has developed a new concept, based on the infiltration and transportation of storm rain water. The theory has been analyzed thoroughly and a feasibility study has been carried out with positive results.
The objective of the project was to implement, under the site specific conditions, storm rain water transport and infiltration systems, including:

- the adoption of an integral approach to implement the infiltration system in the district of Kinkelenburg and Luchtenburg;
- the acquisition of an insight into the functioning of different infiltration systems; and
- the validation the theoretical models applied to the water system.

Based on a former study, the Municipality of Dordrecht decided to adopt an infiltration-transport system (IT system).

Duration: 02-FEB-1998 to 02-FEB -2001
Link:

1.16 TEMPQSIM - Evaluation and improvement of water quality models for application to temporary waters in southern European catchments

Programme for research, technological development and demonstration on "Energy, environment and sustainable development, 1998-2002"
Project reference: EVK1-CT-2002-00112

Objectives: The aim of the project is to provide advanced tools to significantly improve the efficiency of integrated water management in the Mediterranean and semiarid river catchments. There are major problems in the application of existing water quality models during periods without runoff and the extreme first flush effects at the beginning of the rain period. The dynamic process in sediments during the period of no Surface runoff and the interaction of re-suspended matter and water quality is often not considered. It is proposed that selected models will be improved by development of new hydrological and sediment modules. They will be tested in a rigorous experimental catchment framework, at various Mediterranean case study sites at the sub-basin scale. Experience of data needs and model application, through close interaction to a range of end-users, will be used to prepare guidelines for the operational use of models and adapted management strategies.

Duration: 2002-11-01- 2006-04-30
Link:

1.17 WATER MONITOR - Water management system based on innovative monitoring equipment and dss

Project reference: EVK1-CT-2002-30022

Objectives: WATER MONITOR project will provide a monitoring system of water sources, both quantitative and qualitative, on the basis of a new analysis technology set up.
This innovative instrumentation, an UV-Vis spectrometer, enables the tests of water quality in real time, providing a complete monitoring of water characteristics measuring in stable way the concentration of important substances present in the liquid such as nitrates, organic carbon and detergents. Through the combination and optimisation of data acquired from optics sensor and electronics sensor, the spectroscope make effective the analysis of the collected champions and translate instantaneously the data collected in an optical spectra.
The instrument can be connected with the main transmission and processing devices therefore transmitting in real time the processed spectra.

Problems to be solved:
WATER MONITOR answers to requirements of new European set of rules about sustainable growth. These rules provide mainly for defence and retraining of environmental goods: water is one of the most precious and important natural resource.
The main aims of WATER MONITOR project are:
- A rational management of the available water resources

- To guarantee the quality of drinking water, as recommended in Drinking water quality directive (98/83/EC)
- Management of water resources that means pollution risk prevention, water loss reduction and reliable supply. These are also explicit objectives of the European Community, fully justified by the warring future of water supply.

The project envisaged fully complies with the European policy towards a sustainable development, improving European technology level by new tools and instruments protecting the environment.

Expected Impacts:
The advantages are clear for all the subjects involved:
- Improvement of water quality standard (usually Consortia of Reclamation): the quality control system installed in the river basin networks will allow warranting a higher security of the drinkable water to customers.
- Reduction of operational costs and potential costs deriving by damages: the utilisation of the in situ instrument capable of control quality and quantity of water will reduce the operational costs with respect to the actual long procedure used to obtain the same data. In fact, several advantages could be foreseen by using the proposed instruments.
- the measurement in situ is more cheap than campaign of withdrawals with high frequency
- the control of the operating costs for water networks and the rational

The benefit of real-time UV-spectrometry concerns both the reduction of risk and the economic efficiency of the respective water uses.
As an additional benefit, trough the detailed knowledge about the evolution of water quality parameters over space and time, but chronic polluter identification can be brought forward.
Due to enormous importance that water protection is assuming nowadays, an ever-increasing importance of water management technology is assured.

Duration: 2003-01-01- 2004-12-31
Link:

2. FP6-Projects

2.1 CRUE (EraNet)

Project reference: ERAC-CT-2004-515742

Objectives: CRUE ERA-NET aims to introduce structure within the area of European Flood Research by improving co-ordination between national programmes. The vision for the CRUE ERA-NET action on flooding is to develop strategic integration of research at the national funding and policy development levels within Europe to provide knowledge and understanding for the sustainable management of flood risks.

Project Deliverables:
A shared understanding of flood risk management research in the participating states (WP1 & WP2)
A network of interactions between partners (WP1)
Trans-national and regional research (WP6 & WP7)
Improved coherence and coordination across Europe of research programmes (WP3 & WP4)
National programmes taking on tasks collectively that they might not have been able to tackle independently (WP5 & WP7)
The start of harmonising FRM research across Member Countries (WP5 & WP7)
Expansion of the network (WP8)

Project Outcomes
Contribution to improved standards of FRM
Linking Policy and Research
European added value
Contribution to international activities
Contribution to policy development
Contribution to national and regional policies
Improved exploitation and dissemination of FRM research
Positive economic impact – better decisions & savings
Improvements to national and regional research programmes

Relevant publications: Good Practice Guide for Research Programme Identification, Promotion and Validation, (http://www.crue-eranet.net/publications.asp)

Link: http://www.crue-eranet.net/

2.2 Floodsite

Project reference: GOCE-CT-2004-505420

In April 2007, the Parliament and Council of the European Union agreed the wording on a new European Directive on the assessment and management of flood risks. The Integrated Project FLOODsite is listed as one of the European actions which support the Directive.

FLOODsite covers the physical, environmental, ecological and socio-economic aspects of floods from rivers, estuaries and the sea. It considers flood risk as a combination of hazard sources, pathways and the consequences of flooding on the "receptors" – people, property and the environment.

Flood risk management is a process which comprises pre-flood prevention, risk mitigation measures and preparedness, backed up by flood management actions during and after an event.
Floods often cross international borders and so must flood risk management research. Our research on these topics is being integrated through decision support technologies, uncertainty estimation and pilot applications for river, estuary and coastal sites in Belgium, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Spain, and the UK.

FLOODsite is active in stimulating the uptake of research advances through guidance for professionals, public information and educational material.

FLOODsite is an "Integrated Project" in the Global Change and Ecosystems priority of the Sixth Framework Programme of the European Commission. The FLOODsite consortium includes 37 of Europe's leading institutes and universities and the project involves managers, researchers and practitioners from a range of government, commercial and research organisations, specialising in aspects of flood risk management.

Duration: 2004 – 2009
Link: http://www.floodsite.net/

2.3 NeWater

Project reference 511179 (GOCE)

Summary: The central tenet of the NeWater project is a transition from currently prevailing regimes of river basin water management into more adaptive regimes in the future. This transition calls for a highly integrated water resources management concept. NeWater identifies key typical elements of the current water management system and focuses its research on processes of transition of these elements to adaptive IWRM. Each key element is studied by novel approaches. Key IWRM areas where NeWater is expected to deliver breakthrough results include

- governance in water management (methods to arrive at polycentric, horizontal broad stakeholder participation in IWRM)
- sectoral integration (integration of IWRM and spatial planning; integration with climate change adaptation strategies, cross-sectoral optimisation and cost-benefit analysis)
- scales of analysis in IWRM (methods to resolve resource use conflicts; transboundary issues)
- information management (multi stakeholder dialogue, multi-agent systems modelling; role of games on decision making; novel monitoring systems for decision systems in water management)
- infrastructure (innovative methods for river basin buffering capacity; role of storage in adaptation to climate variability and climate extremes)
- finances and risk mitigation strategies in water management (new instruments, role of public-private arrangements in risk-sharing)
- stakeholder participation; promoting new ways of bridging between science, policy and implementation

The development of concepts and tools that guide an integrated analysis and support a stepwise process of change in water management is the corner-stone of research activities in the NeWater project. To achieve its objectives the project is structured into six work blocks, and it adopts a management structure that allows effective exchange between innovative and cutting edge research on integrative water management concepts, with practical applications and testing through participatory stakeholder processes in selected river basins.

Link: http://www.newater.info/everyone

2.4 SWITCH - Sustainable Water Management Improves Tomorrow's Cities' Health

Project reference:

Objectives: Increasing global change pressures, escalating costs and other risks inherent to conventional urban water management are causing cities to face ever increasing difficulties in efficiently managing scarcer and less reliable water resources. As well, satisfying water uses/services and waste water disposal without creating environmental, social or economic damage is an ever more difficult challenge.

The overall goal of the SWITCH project it to catalyse change towards more sustainable urban water management in the “City of the Future”.

- Technological options for storm water control under conditions of uncertainty.
- Decision-making processes for effective urban stormwater management.
- Environmental change studies for stormwater control and reuse options

Duration: 1.2.2006 until 31.1.2011
Link: http://www.switchurbanwater.eu/

2.5 SCOREPP, Source control options for reducing emissions of priority pollutants

Project reference: 37036

Objectives: The overall aim of the SCOREPP project is to develop comprehensive and appropriate source control strategies that authorities, cities, *water* utilities and chemical industry can employ to reduce emissions of priority pollutants (PPs) from urban areas into the receiving *water* environment. The SCOREPP project focuses on the 33 priority substances identified in the *Water* Framework Directive (WFD), and specifically on the 11 priority hazardous substances. However, this list may be expanded to include emerging pollutants or reduced if appropriate model compounds can be identified, depending on the local context.

The specific scientific objectives of the SCOREPP project are to identify the sources of PPs in urban areas, to identify and assess appropriate strategies for limiting the release of PPs from urban sources and for treating PPs on a variety of spatial scales. Furthermore to develop GIS-based spatial decision support tools for identification of appropriate emission control measures, to develop integrated dynamic urban scale source-and-flux models that can be used to assess the effect of source control options on PP-emissions and to optimise monitoring programmes, and to assess the direct and indirect costs, the cost-effectiveness and the wider societal implications of source control strategies.

The developed approaches, models and assessments will be used to formulate a set of appropriate PP-emission reducing strategies, and a multi-criteria approach will be used to compare and evaluate these strategies in relation to their economic, societal and environmental impacts. The SCOREPP project will interact with the European chemical industry and *water* utility trade associations together with representatives from ministerial, regional, municipal and community organisations to ensure that these key urban stakeholders can provide input to framing the scope of the project, adapting the project outcomes and communicating the results of the project to a wide audience.

Duration: 2006-10-01- 2009-09-30
Link: http://www.scorepp.eu/

3. FP5-Projects

3.1 MANTISSA - Microwave attenuation as a new tool for improving stormwater supervision administration

Project reference: EVK1-CT-2000-00060

Objectives: The principal objective of the present work is to apply a stochastic state space modelling approach to the assimilation of a multitude of rainfall and runoff data for planning and real time control. This work will utilise new, and novel research utilising the attenuation of microwave signals to give improved measurements of the quantity of water in weather systems in spatial and temporal terms. The aim is to construct a comprehensive and flexible tool for the entire rainfall -runoff system and to examine the importance of various measurements when applied to planning and model predictive real time control. The work includes a number of field experiments that will gather data for use in the development of the new models and techniques. The fieldwork will also provide proof that the deployment of the new microwave technologies is technically feasible and that it can be cost effective and affordable.

Duration: 2001-02-01-2004-07-31
Link: http://prswww.essex.ac.uk/mantissa/

3.2 Optimal management of wastewater systems

Project reference: COST Action 624

Objectives: The environmental problems of the world are to a large extent global issues and cannot be solved on a national basis. International cooperation and joint efforts are necessary to set up common goals and strategies and to determine how the environmental work should proceed to be most efficient. The spreading of information between different research groups, universities, and companies are of vital importance for this effort. For this reasons an EU research program named COST 624 has been initiated. The Memorandum of Understanding has been signed in Brussels on July 8, 1998.

The COST Action 624 is dedicated to the optimization of the performance and cost-effec tiveness of wastewater management systems by increasing the knowledge of microbial systems and by implementation of integrated plant-wide control based on a description of the entire wastewater system, thereby providing new concepts for dealing with wastewater in a future sustainable society.

The COST Action 682 'Integrated Wastewater Management" (1992-1998) was focused on the biological wastewater treatment processes and the optimization of their design and operation on the basis of process dynamical models.

COST 624 covers all aspects of wastewater management systems (i.e. collection , treatment and disposal) with regard to optimizing the performance of the complete system and also focuses on the development of new sustainable wastewater management strategies.

Duration: 1998-07-08- 2003-07-07
Link: http://www.ensic.inpl-nancy.fr/COSTWWTP/

3.3 MOSWANET - Computer aided management of sustainable water and sewer networks

Project reference: EVK1-CT-1999-35003

Objectives: One of the mayor challenges of man-kind is to protect and provide high quality of water in sufficient quantity at affordable costs. For that, advanced integrated information management can support the water industry in general. emerging markets, new structures in water and wastewater utilities (especially in former East-European countries such as East-Germany, Poland etc.), the needs for sustainable development and advanced information technologies call for new methods and solutions. The project concerns the development and implementation of building blocks for information management of water and wastewater networks with special regard to medium-size systems, consisting of network information system as the data centre, coupled GIS with data base and tools for planning, design, control and maintenance, advanced simulation systems and (multi-criteria) decision support systems. Results will be both, a generalised framework for information management as well as methods and software modules for practical implementation. The practical application will be demonstrated in pilot studies.

Duration: 1999-11-26- 2000-07-25
Link:

3.4 SMAC - Smart control of wastewater systems

Project reference: EVK1-CT-2000-00056

Objectives: Wastewater systems that comprise sewer network and wastewater treatment plants are subject to large fluctuations in flow and concentrations of the waste waster. During storm water situations large amounts of pollutants are diverted untreated to the receiving waters. Sudden changes in the load deteriorate the removal of nitrogen and phosphorus. Biological wastewater treatment relies on microorganisms. New knowledge on the potential and limitations of these still needs to be put into practice in the wastewater systems. Most systems are designed for peak situations and thus a spare capacity is available in most situations. This is not exploited. Today the control of wastewater systems is performed in local sub-optimising units. Results of one control affect others this is not taken into consideration. The control of sewer system and the treatment plant is normally not co-ordinated.

Duration: 2001-03-01- 2004-02-29
Link: http://www.smac.dk/ (out of use)

3.5 Citynet Cluster

The Objectives of CityNet are to understand, describe, analyse and provide decision support for a problem-oriented, cost-efficient, and sustainable urban water management in European cities, including their water resources, technical infrastructure and management challenges. Form a network of excellence and expertise on urban water management available to advise the EU-Commission and other governmental and administrative bodies on state-of-the-art and research needs in urban water management. Link individual project and integrated cluster activities to other ongoing European, international and national research projects. Position the outcomes of the individual projects and the cluster for application and commercialisation in Europe and worldwide.

Summary: The CityNet project cluster consists of of six individual 5 FWP projects and dealswith the integrated aspects of water management in urban areas (water supply, sewerage, drainage) including their urban/rural interfaces (raw water sources, receiving waters, groundwater). The CityNet cluster consists of 47 research partners and 59 end-users I thus comprising a significant part of the European R&D capacity and implementation potential in urban water systems. This proposal for Accompanying Measures (AM) aims to widen and deepen the joint activities of the cluster partners with respect to three aspects of integration, i.e. (1) the urban water system and its water resources (2) the necessary infrastructure for water supply, urban drainage and wastewater management, and (3)the socioeconomic aspects of urban water management.

Duration: 01-02-2003 to 31-12-2006
Link: http://www.eugris.info/displayProject.asp?Aw=CityNet&Cat=Project&ProjectID=4239

Relevant CityNet Cluster projects:

3.6 DAYWATER - Adaptive decision support system for stormwater pollution control

Project reference: EVK1-CT-2002-00111

Objectives: The project aims at developing an adaptive decision support system (ADSS) for use by stakeholders involved in urban storm water management where decisions are made on many scales reflecting the spatial topology of urban catchments and the dynamic nature of urban development. The ADSS is a combination of simulation models, assessment tools, databases, guidance documents, road maps etc. Part of the research focuses on the functional behaviour of structural and non-structural best management practices (BMPs). Models will be developed for simulating pollution fluxes and assessing their possible source-elimination and fate in structural BMPs, and procedures for environmental risk assessment related to discharge of storm water priority pollutants to surface waters as well as urban soils and ground waters will be developed. The project is carried out by a multi-disciplinary research team and includes end-users and case studies in four European cities.

Duration: 2002-12-01- 2005-11-30
Link: http://www.daywater.org/

3.7 C4DWC – Cost effective development of urban wastewater systems for Waterframework directive

Project reference: EVK1-CT-2002-00118

Project objectives:
This project deals with public sewer and storm water networks of any dimension. It includes problems caused by ageing, structural failures, inflow/infiltration, exfiltration (leaking) and insufficient capacity which can cause floods, pollution of receiving waters, pollution of ground water and soil, treatment plant impacts and increasing maintenance costs.
The ultimate project goal is to develop a suite of tools, which provides the most cost-efficient system of maintenance, repair and rehabilitation of sewer networks, with the aim to guarantee security of sanitary sewage collection and storm water drainage in order to meet social, health, economic and environmental requirements. This will be done within the context of integrated catchment management and the strategic objective of ensuring security of water resources. The tools will include a set of Performance Indicators, models for sewer deterioration and methods for multi-criteria decision making.

Project Summary:
This project deals with public sewer and storm water networks and their problems caused by ageing such as structural failures, insufficient capacity causing floods, local pollution, and increasing maintenance costs.The ultimate goal is to develop a suite of tools, which provide the most cost-efficient system of maintenance, repair and rehabilitation of sewer networks, with the aim to guarantee a security of sanitary sewage collection and stormwater drainage which meets social, health, economic and environmental requirements as well as the re-use of water for consumption

Duration: 2003-02-01- 2006-07-31
Link: http://www.eugris.info/displayProject.asp?ProjectID=4503&Aw=CD4WC&Cat=Project

3.8 Watertime

Summary: Watertime addresses the issue of how to improve the quality of urban life by reaching economically, socially and environmentally sustainable decisions on water systems in cities. The team of partners is drawn from different parts of Europe - Spain, Italy, UK, Germany, Finland, Hungary - and with a range of expertise, including economics, political science, environmental science and law, water institutions. The project will study current decision-making on water systems in 29 European cities, and long-term historical experience. Two final reports will be produced: one on best practices, and the other developing a model for participative decision-making. The work will be disseminated to stakeholders and public authorities, who will also be involved during the course of the research.The work will be disseminated to stakeholders and public authorities, who will also be involved during the course of the research. The team of partners is drawn from different parts of Europe - Spain, UK, Germany, Finland, Hungary - and with a range of expertise, including economics, political science, environmental science, law, and water institutions.

Duration: December 2003 – November 2005
Link: http://www.watertime.net/