STORMWATER MANAGEMENT

– ENVIRONMENTAL SOLUTIONS IN THE BALTIC REGION

MOMENT
modern water management

RESULTS

THE MOMENT PROJECT

BACKGROUND

The MOMENT project has been implemented through cooperation between seven regions in four countries around the South Baltic Sea. All regions are members of the Euroregion Baltic (ERB) that was established in 1998 with the main objective to develop a long-term, politically governed cooperation between the member regions.

The project has aimed at reducing the discharge of nutrients and hazardous substances to the Sea by using modern water management methods. This has included the establishment of Water User Partnerships (WUP), allowing a "bottom up" approach starting at a local level and working within river catchment areas independent of administrative boundaries.

A central part of the MOMENT project has been to carry out a number of concrete actions of best practice character, aiming at disseminating sustainable technology, decreasing outlet of nutrients and hazardous substances, and/or minimizing the negative effects of these substances, all actions aiming at enhancing the environmental status of the Baltic Sea. Thirteen innovative pilot area measures have been implemented. The project has been co-financed by the South Baltic Cross-border Cooperation Programme 2007-2013.

IMPLEMENTED CONCRETE ACTIONS

I. LAND USE:

Wetlands for nutrient reduction and fish reproduction, Kalmar, SE (Report 4.1.1)
Forestry and water, Kalmar, SE (Report 4.1.2)
Effective uptake of nutrients, Torsas, SE (Report 4.1.3)
Forestry and water quality management, Torsas, SE (Report 4.1.4)

II. SEWAGE FROM SINGLE FAMILY HOUSES:

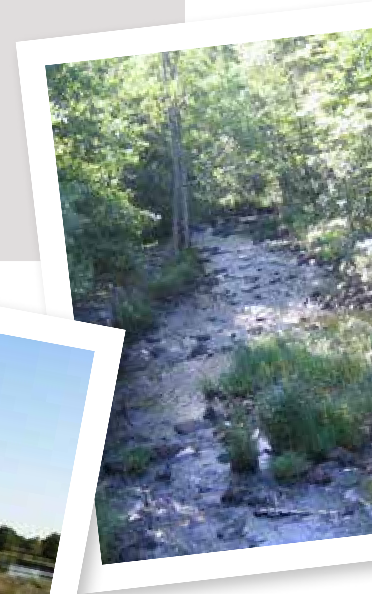
Solutions for treatment of waste water from single houses, Kalmar, SE (Report 4.2.1)
Biogas production using sludge from small scale sewage plants, Ronneby, SE (Report 4.2.3)

III. TREATMENT OF STORMWATER:

Stormwater management plans for Gargzdai and Priekule towns, LT (Report 4.3.1)
Ecological adapted stormwater treatment, Kalmar, SE (Report 4.3.2)
Ecological adapted stormwater treatment, Kretinga, LT (Report 4.3.3)
Stormwater treatment in central urban areas, Kalmar, SE (Report 4.3.4.1)
Restoration of stormwater polluted recipients, Kalmar, SE (Report 4.3.4.2)

IV. INFORMATION AND COMMUNICATION:

GIS information system, Gdansk, PL (Report 4.4.1)
Information campaign on phosphorus free detergents, Klaipeda, LT (Report 4.4.2)



THEMATIC AREA – TREATMENT OF STORMWATER

INTRODUCTION

With every rain, large amounts of pollutants flow directly into surface waterways or are channelled into storm sewers, which eventually discharge to the Baltic Sea. To minimize this risk, stormwater needs to be managed in a sustainable way adapting to ecological treatment solutions and thereby preventing unnecessary discharge of harmful substances. Five measures within the MOMENT project have been carried out within the thematic area Treatment of stormwater, implemented in Snarje catchment area in Sweden and in Minija and Akmene-Dane catchment areas in Lithuania.

STORMWATER SPECIAL PLANS FOR GARZDAI AND PRIEKULE TOWNS, LITHUANIA

The first measure in Minija river catchment area has dealt with designing plans for stormwater treatment in the two towns Garzdai and Priekule. Analyses have been carried out of modern ecological methods for stormwater management. Thereafter a concept has been set up for development of a stormwater drainage infrastructure for the towns.

Stormwater study tour in Malmoe in 2011

The developed Stormwater Special Plans differ from other Special Plans in Lithuania since they have been prepared according to experience of Swedish and other MOMENT project partners of stormwater management. Solutions used in the City of Malmoe in Sweden, where rain water is collected in open canals and green roofs used to buffer rainwater, have inspired the plans. Systems like this absorb up to 80 percent of stormwater and consequently a much less quantity of water is passing through the central underground pipe system and its' outlet flows into rivers.

CONCRETE EFFECTS

The Stormwater Special Plans provide overall planning solutions of towns with future stormwater management infrastructure, designated territories for development of stormwater collection and treatment facilities. Therefore, implementation of the planning solutions will set the framework for sustainable and effective territorial planning and development, and the expected effects (impacts) will be positive in a long-term perspective:

- **reduction of formation and collection of stormwater, e. g. waterproof surfaces should be installed only in potentially polluted territories, clean stormwater should be infiltrated or used for watering of green areas, fire extinguishing, etc.**
- **reduction of pollution levels in stormwater, e.g. implement dry cleaning of potentially polluted territories, construct sheds in most hazardous areas, etc.**

After approval in the Klaipeda district municipality council, the Stormwater Special Plans will be mandatory. This will ensure that they must be taken into account when preparing new lower level territory planning documents.

CONCLUSIONS AND RECOMMENDATIONS

- **The prepared Stormwater Special Plans are is not of interest only for Klaipeda District Municipality, but for all other municipalities to which it has been sent. There are though no possibilities for Klaipeda District Municipality to make legal influence of other municipalities of Minija river basin. However, the Special Plans are set up according to all legal acts, special facilities plans, other municipal strategic and action plans and other programmes. Therefore all other municipalities within the catchment area will try to implement the same kind of measures as suggested in the programme. Financial support from EU is needed for this kind of infrastructure investments.**
- **Priekule and Gargzdai towns now have a solid foundation for the future planning and management of stormwater, e.g. the plans provide concrete innovative solutions like wetlands or open surface channels, by installing basin's infiltration and releasing only the excess to stormwater underground networks.**
- **The development and designing of plans for stormwater treatment in the two towns Garzdai and Priekule have been received in a positive way by local officials. The stormwater management plans will be mandatory ensuring long term durability for ecological stormwater solutions. If more towns in Lithuania will adapt similar stormwater management plans this would have a significant positive impact on water quality and long term sustainability. Therefore, an important task is to spread the experiences from the MOMENT project to other towns that need to develop or update new stormwater plans, not only in Lithuania but the entire south Baltic Sea area.**

INFORMATION

For further information, contact
Mr Raimondas Vilas, Klaipeda District Municipality,
e-mail: raimondas.vilas@klaipedos-r.lt

Untreated stormwater outlet from Garzdai town, Lithuania

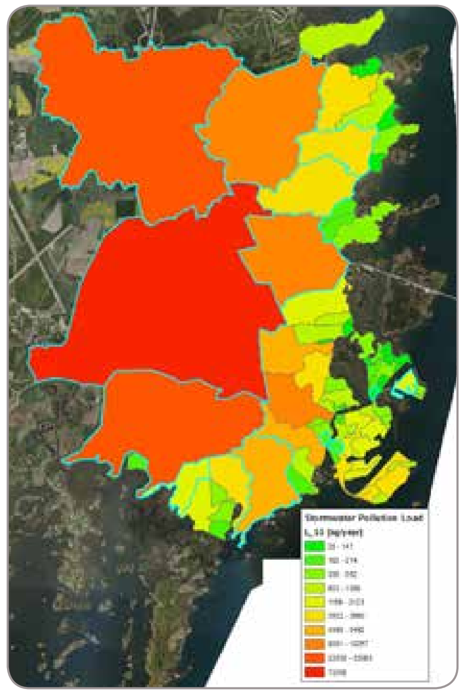
ECOLOGICAL ADAPTED STORMWATER TREATMENT IN KALMAR CITY, SWEDEN

The second stormwater measure is a project in Kalmar Municipality about ecological adapted rain water treatment. The main objective has been to improve the treatment of stormwater within a heavy polluted part of Kalmar Municipality. Kalmar Water Ltd has used a water quality model that was set up for the catchment area in accordance with the USEPA´s Stormwater Management Model (SWMM). In this model stormwater pollution loads for different catchment areas have been calculated through GIS-analysis using input data on land use and traffic volumes, and the corresponding standard pollution concentrations. The company is using the results from the water quality model as a decision support tool for identifying prioritised areas and most effective measures, as well as for future stormwater management.

METHOD

The stormwater treatment facility was planned as a wetland system consisting of three major basins connected in series (see figure beside). At present there are no measures that reduce the discharges of stormwater pollution from the catchment area (see figure beside). There is a large potential in achieving a good reduction of both heavy metals and nutrients in such a system. It was decided to test a technique using grinded limestone in filters as a treatment step. Limestone has been proven to react with phosphorus particles.

The whole design of the facility had to be approved by the County Administrative Board according to the Swedish environmental legislation. The final approval was given in autumn 2011, and the construction started. The opening of the wetland system took place in September 2012.



Stormwater pollution load from suspended solids (SS) within the drainage area of the City of Kalmar. The most polluted part was chosen for the stormwater maesures

RESULTS

The wetland system is receiving and purifying about 800 000 m^3 of stormwater per year. Results from the above-mentioned GIS-analysis together with assumptions on treatment efficiency can be used in estimating the pollution load of nutrients, heavy metals etc. not reaching the Baltic Sea. With an assumed treatment efficiency of 50% for phosphorus and 30% for nitrogen, the wetland system would retain 110 kg phosphorus (P) and 470 kg nitrogen (N) per year. This means that the cost effectiveness of the wetland can be expressed as 275 EUR/kg P and 64 EUR/kg N, based on the overall construction cost and a technical lifespan of 20 years.

CONCLUSIONS AND RECOMMENDATIONS

- **The initial results from the wetland system indicate that it works in a satisfactory manner regarding reduced amounts of nutrients. One could further expect that the wetland system should function even better once the flora and microorganisms are fully developed.**
- **The modelling tool applied when identifying prioritized stormwater polluted areas in Kalmar proved to be a great support throughout the work. The measure chosen could thereby be placed at a location where it was needed the most, which ensures that stormwater investments reach a high level of cost effectiveness.**
- **The actual results of retaining nutrients and hazardous substances from the wetland will be monitored for many years to come. As it takes time, sometimes up to several years, for a wetland to fully establish bacteria populations that can transform dissolved nitrogen to nitrogen gas the full potential of the wetland will not be revealed until later. According to ERB Water Core Group experts there are very few studies that have followed the function of a wetland over many years. Thus are the monitoring results obtained from this wetland of great value to further develop and understanding on how a wetland system like this can function in an optimal way.**

Design plan for the wetland system at Hagbygarde.

INFORMATION

For further information, contact
Mr Stefan Ahlman, Kalmar Water Ltd,
e-mail: stefan.ahlman@kvab.kalmar.se

"The latest results form the monitoring program, taken in June 2013, show that the expected results are being met. The total amount of phosphorus retained by the wetland system is above 50% and the total amounts of nitrogen retained add up to 35%. Once the wetland system is fully functioning the amounts of nutrients retained are expected to increase further."

Ulf Ohlsson, Kalmar Water Ltd

ECOLOGICAL ADAPTED STORMWATER TREATMENT IN KRETINGA TOWN, LITHUANIA

The third measure was twofold, first a Special Plan for stormwater management in Kretinga Town has been prepared and approved, and secondly, two stormwater facilities were designed and constructed in the central parts of Kretinga town.

MAIN OBJECTIVE

The main objectives of the Special Plan are to analyze the current situation of the stormwater collection system in Kretinga town, propose the most feasible stormwater collection and treatment technologies, designate areas for future development of stormwater collection and treatment, ensure availability of public stormwater treatment services for maximum viable number of Kretinga town inhabitants and companies. The main objective of the second part, to design and construct a stormwater facility, was to reduce stormwater pollution of water bodies and to improve the environment within Akmena-Dane river basin.

RESULTS

1) SPECIAL PLAN

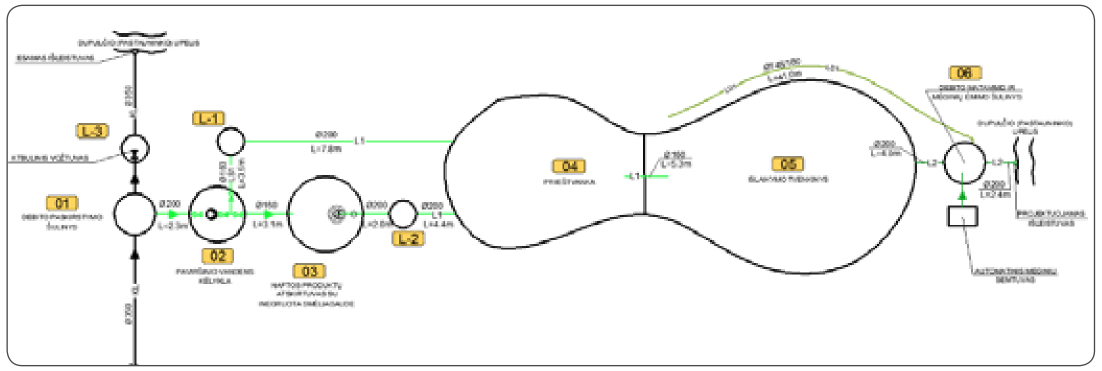
The stormwater management planning solutions are estimated to have positive effects on the overall Kretinga town future development - planning of territories and development of specific economic projects and systems, and will contribute to:

- reduction of formation and collection of stormwater, for example installation of impervious surfaces shall be avoided (except in potentially polluted territories), clean stormwater absorbing soil facilities should be installed, projected areas of potentially polluted territories shall be as small as possible, etc.,
- reduction of the amounts of stormwater, centrally discharged into the environment, e. g. allow utilization of stormwater in the production process, watering of green areas, fire extinguishing, etc., and
- reduction of pollution levels in stormwater, e.g. implement dry cleaning of potentially polluted territories, construct sheds in most hazardous areas.

Cost effectiveness estimations have not been calculated. It would be interesting to compare e.g. construction and operation costs of wetland/retention pond (such stormwater treatment facilities are under construction in Kretinga town) with conventional oil-sludge separator, taking into account removal of pollutants per unit costs. Evaluations will be carried out of the decrease of nutrients (P and N), hazardous substances, suspended solids and BOD from stormwater outlets after the construction of the treatment facilities.

2) STORMWATER INFRASTRUCTURE DESIGN AND CONSTRUCTION

Two different stormwater facilities have been designed and constructed in the central parts of Kretinga. The first facility was a stormwater treatment plant that composes several purification steps (see figure below). The stormwater is first collected in a flow distribution well (01) before it goes to a pumping station (02). The water is then pumped to a separator of oil products with an integrated sand trap (03). After removing bigger fractions of particles the stormwater is distributed in two retention ponds (04-05). The water then finally passes a flow metering and sampling well (06). The site that was chosen had a total drainage area of 9.35 ha and previous assessments of the run-off quality had showed that several parameters where unsatisfactory according to Lithuanian regulations.

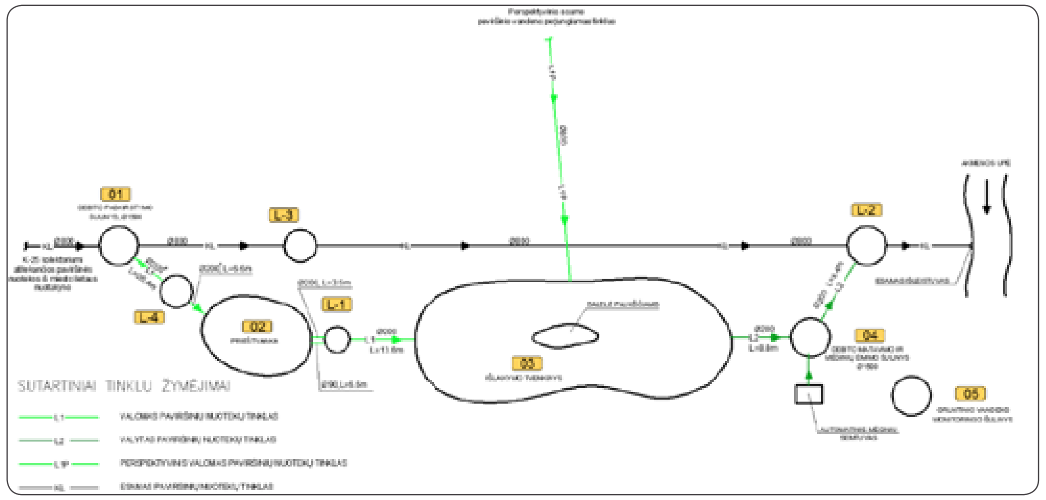


Technological scheme of the stormwater treatment plant within the Akmena-Dane river basin.

The planned water retention time in the two ponds is around 48 hours, however, under heavy rainfalls; the time can be reduced to around 24 hours. The estimated reduction of contaminants in the designed and constructed facilities is:

- *Suspended solids – 80 %.*
- *Total phosphorus – 50 %.*
- *Total nitrogen – 30 %.*
- *Metals – cadmium, copper, lead and zinc – 50 %.*
- *Pathogenic bacteria – 70 %.*

The second stormwater facility is also a stormwater water treatment plant quite similar to the one described above. In the flow distribution well (01) separated stormwater goes to the first-small (02) retention pond. Under the flow distribution well there is an installed safety shutoff valve, which serves for protection of the treatment plant (retention ponds) from contaminants in emergency cases. From the first pond (02) evenly distributed stormwater flow to the main part of the pond (03). This also preserves that settled contaminants would not be uplifted from the bottom. In this way a two-stage waste water treatment is made. A significant difference with this treatment facility is that the pond (03) is constructed over an existing layer of sand which leads to infiltration. The water is than naturally purified before reaching the Akmena-Dane River. Therefore, a ground water sampling well is installed behind the retention ex-filtration pond.



Technological scheme of the stormwater treatment plant beside Akmena Dane river.

Estimated reduction of contaminants in the designed and constructed facilities:

- *Suspended solids – 80 %.*
- *Total phosphorus – 50 %.*
- *Total nitrogen – 30 %.*
- *Metals – cadmium, copper, lead and zinc – 50 %.*
- *Pathogenic bacteria – 70 %.*

CONCLUSIONS AND RECOMMENDATIONS

- **This is the first time that this type of ecological adapted stormwater investments have been implemented in Lithuania. If they function as well as predicted and can be disseminated through appropriate channels, there should be good possibilities to introduce similar investments in other Lithuanian towns.**
- **The stormwater Special Plan developed introduces a new approach towards more sustainable stormwater solution from an environmental perspective. A next step would be to introduce likewise Special Plans in other towns/cities in the south Baltic Sea area. If more towns would follow the example by Kretinga this could, in a long term, have a significant positive impact of decreasing harmful substances to the Baltic Sea.**

INFORMATION

For further contacts, contact Mr Valdas Langas,
Coastal Research and Planning Institute of Klaipeda University,
e-mail: vlangas@hotmail.com

STORMWATER TREATMENT IN CENTRAL URBAN AREAS, KALMAR CITY, SWEDEN

The fourth measure on stormwater management is about development of treatment techniques in urban areas. The project has been implemented in central Kalmar by Kalmar Water Ltd (MOMENT Report 4.3.4.1). The main objective of the measure has been to test, within a city centre area, different possible techniques to remove hazardous substances and nutrients from stormwater. The basic idea has been to use known techniques in a new and innovative way to achieve sustainable solutions and at the same time tackle restrictions of implementing measures within a dense urban city area.

WORKING TOWARDS BETTER WATER WITHIN KALMAR CITY

The central part of Kalmar City consists of islands connected by several bridges. Kalmar City has set up a vision that the water surrounding the central part should in the future be purified to a level witch will meet the requirements set up in the 2006 Bathing Water Directive. Thus enabling its citizens and tourists to take a swim and at the same time using this to promote the town as sustainable and environmentally friendly. The main pollutants are found within the sediments which in turn receives most of its pollution from stormwater outlets. The identified pilot catchment area has a mixed land use, with a dominance of housing and educational/commercial areas. There are some larger streets running through the catchment area with a daily traffic of about 10 000-15 000 vehicles.

METHOD

Stormwater samples were collected at six sampling locations for two different rain events and tested for a large matrix of substances. Technological solutions were developed in collaboration with the Linnaeus University in Kalmar and a Swedish private company that is specifically working with solutions for meeting the environmental quality standards in the EU Water Framework Directive. Several treatment measures at different locations were discussed and analysed. The chosen solution consists of a water pond that takes care of sedimentation of particles, a pump, an oil separator and a filter system. In addition to this, about 20 catch basins have been selected for installation of filters to take care of stormwater pollutions directly from the busiest street in the area.

A water quality model has been set up for the catchment area in accordance with the USEPA's Storm Water Management Model (SWMM) which is used throughout the work for planning, analysis and design related to drainage systems.

Stormwater catch basins selected for filter treatment (marked with blue dots) along the dense trafficated street.

Location of the three existing ponds in the area, reconstructed to one pond, a pump, an oil separator and a filter system.

RESULTS

The results from the stormwater quality modelling together with assumptions on treatment efficiency can be used in estimating the pollution load of nutrients, heavy metals etc. not reaching the Baltic Sea. The results show that the treatment measures potentially would retain 13 kg P and 94 kg N per year. This means that the cost-effectiveness of the stormwater pond can be expressed as 1.150 EUR/kg P and 160 EUR/kg N. The cost-effectiveness is based on the overall construction cost and a technical lifespan of 20 years.

In cooperation with the Linnaeus University, a program will be set up to monitor the water quality of the filter system. The purpose of the monitoring is to get an indication of the expected treatment efficiency of this innovative filter system.

The treatment efficiency of the catch basin filters at the dense trafficked street in the catchment area will also be evaluated. The filters will be replaced twice a year, and a selection of the replaced filters will be sent to a laboratory for analysis.

CONCLUSIONS AND RECOMMENDATIONS

- **The project has been subjected to several challenges. Design and construction of stormwater treatment measures, especially in such a dense city area, with little or no space available requires careful planning. Concerning the sedimentation pond, several security and site planning compromises had to be made.**
- **Many Cities across the Batlic Sea share similar challenges of contaminated stormwater in urban areas with limited space of implementing required measures. The ERB Water Core Group considers stormwater measures adapted for urban areas to be interesting for the entire south Baltic Sea area.**
- **Contacts with city officials, permissions and tender procedures are often required early in the process and unforeseen changes in the working plan should be considered as normal.**
- **The Stormwater Management Model (SWMM) has been an important tool pointing out where measures should be placed and of which amounts and types of pollutants they need to cope with. The conclusions drawn from the treatment measures implemented in this project will be an important input for Kalmar City future working process.**

INFORMATION

For further information, contact
Mr Stefan Ahlman, Kalmar Water Ltd,
e-mail: stefan.ahlman@kvab.kalmar.se

RESTORATION OF STORMWATER POLLUTED, CITY-CLOSE BAYS IN KALMAR CITY, SWEDEN

The fifth measure deals with methods of taking care of contaminated bottom sediments in city-close bays in the City of Kalmar. The water quality in city-close bays of Kalmar has deteriorated partly due to poor water circulation and supplies of nutrients and other substances from stormwater. These waters are frequently used for boating and rowing, bathing and swimming, fishing and other recreational activities. Development of new, cost-effective and environmentally friendly methods for taking care of polluted sediments is therefore very interesting for Kalmar Municipality. New technology has been tested within the project – methods of dredging and dewatering of sediments. Kalmar City has set up a vision that the water surrounding the central part should in the future be purified to a level witch will meet the requirements set up in the 2006 Bathing Water Directive.

MAIN OBJECTIVE

The main objective has been to test methods for separating water from sediment in order to reduce the amount of phosphorous and heavy metals. Furthermore, this has included evaluating costs and effects of new technical solutions, to gain experience, to increase the general public's understanding for the Baltic Sea's environmental problems by means of informing about the project, to visualise the cultural history of the walled city and its connection to the Baltic Sea.

METHOD

The methodology used includes investigation of appropriate technology for dewatering, finding suitable areas for screen tests and dewatering of sediment, in cooperation with Kalmar Water Ltd select areas where run-off water enters the pilot area and contributes with pollutants as well as implementing measures to prevent such contribution, analyses of application procedures with the appropriate authorities, and implementation of activities.

On-the-spot water separation preserves the seafloor and the plant and animal life. It leads to decreased volumes of treated material and saves on transport costs, all of which contributes to a more cost-efficient process. On top of that, separation of nutrients in the device is possible, so that nutrient-rich water is not returned into the sea. After treatment, the sludge can be processed further so that it can be used as a resource for the production of biogas.

Aerial view of the bays in central Kalmar City.

Researchers of Linnaeus University digging up sediment from the bottom of one of the city-close bays with a Van-Veer Grabbe.

MAIN RESULTS

In comparison to traditional dredging, using e.g. a dig- and pump dredging device, the new technology will be gentler on the environment and also less costly. Dredging with traditional dredgers to a depth of 0.5 meters and dredging a total of 15 000 m^3/year for 5 years costs approximately 700 000 EUR. Corresponding cost using the dewatering machine will be about half, 350 000 EUR. The potential of the new dewatering technology is evident as it is possible to apply the technology on a larger scale.

CONCLUSIONS AND RECOMMENDATIONS

- **A great environmental benefit is dredging at low flow that is gentle on plant and animal life. The need for transportation decreases with 70-90 % when the sediments are dewatered on site. The transport costs will be low. There is also no need for long time storage for dewatering in big pools.**
- **With the new technology, nutrients can be separated before the water is released back into the sea and the sediments can be used for other purposes as e.g. soil, covering material or for biogas production. If masses contain metals, the new technology "mining" can be used in the future.**
- **The technique can easily be used elsewhere for similar purposes and it is possible to apply the technology on a larger scale.**
- **The ERB Water Core recognizes the need to purify sediments in City bays all across the south Baltic Sea area.**

INFORMATION

For further information, contact
Ms Kerstin Ahlberg, Kalmar Municipality,
e-mail: kerstin.ahlberg@kalmar.se

THE MOMENT PROJECT

In cooperation between seven regions in four countries around the South Baltic Sea area the project MOMENT aims at reducing the outflow of nutrients and hazardous substances by modern water management. This includes the establishment of Water User Partnerships allowing a "bottom up" approach starting at a local level and working within river basins letting the water set its own independent borders. The project is co-financed by the *South Baltic Cross-border Cooperation Programme 2007-2013* and runs from September 2009 until June 2013.

Find information and all reports on www.momentproject.eu

CONTACT US

PROJECT MANAGER:
Tobias Facchini
The Regional Council in Kalmar County
tel +46 (0)480 44 83 83
tobias.facchini@rfkl.se

PROJECT EXPERT:
Carolina Gunnarsson
The Regional Council in Kalmar County
tel +46 (0)480 44 83 82
carolina.gunnarsson@rfkl.se

South Baltic PROGRAMME

Investing in your future
EUROPEAN UNION
European Regional Development Fund

MOMENT
modern water management