Geophysical Research Abstracts, Vol. 7, 00604, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00604

Integrated Watershed-based Drainage Restoration Planning

U. Zimmerman, F. Sieker

Institute of Hydrology and Water Resources Management, University of Hanover, Germany, Rennbahnallee 109a, 15366 Hoppegarten, u.zimmerman@sieker.de / FAX: +3342 3595 29 / PHONE: +3342 3595 0

The European Water Framework Directive focuses on watersheds, while urban drainage master planning generally stops at the city border. This paper outlines the results of a project to create and optimize an integrated watershed-wide master plan for the Glems watershed (approx. $200km^2$) in south western Germany. Significantly, this watershed encompasses ten communities, and the planning goal was to determine how best to use combinations of existing stormwater management options to effectively balance issues of water quality and water quantity. The result is an integrated watershed-wide drainage restoration strategy which sets forth appropriate combinations of individual stormwater management measures ideally for balancing quality, quantity and costs.

Simulations of the impact of urban drainage systems on the river system included the following subtargets:

- Pollutants load (e.g. Suspended Solids, COD,)
- Nutrients load (Nitrate and Phosphorus),
- Ammonium and Oxygen concentrations,
- Hydraulic stress (expresses by floods with a return period of 1 yr.),
- Flood runoff (return period 100yrs.), and
- Restoration costs (investments and maintenance)

To achieve these ends, three different water software models (water budget model, urban run-off and flux model, water quality model) were combined. The 30 years rain period used for this simulation was highly spatial distributed (twelve 49 km^2 precipitation cells) and precise (5 min. time step). Additionally, each proposed Best Management Practices (BMP) were analyzed to get realistic estimations of their spatial distribution through a GIS-based preprocessing. Furthermore the modeling results were post-processed and displayed via GIS. In this way, analysis occurred both locally and watershed-wide. Finally, the results of the model simulations were analyzed and optimized by a Multi-Criteria Analysis (MCA-Tools) tool (utility analysis).

Six different restoration scenarios were designed to compare their behavior on the described sub-targets. The scenarios were:

- The present state
- Conventional restoration measures (construction of CSO‘s and retention tanks),
- Source control measures (swale and trench systems),
- An increased combined sewage flow into the waste water treatment plant
- Constructed wetlands and
- The optimized combination of the individual methods.

The results of the calculations can be summarized to the following points:

Regarding models

- Spatially detailed distribution of data is crucial for the simulation of source control measures because of a strong dependency between distribution and impact of proposed measures. Also the spatially and timely detailed distribution of the precipitation in the watershed influences the impact of the measures significantly.
- There is a lack of simulation models with a sufficient modeling of the interaction between increased infiltration and groundwater beneath urban areas.
- The water quality model “ATV-FGSM” was not sufficient for the given task

Regarding Water quality:

- Most of the water pollution (SS, DOC) originates from the CSO not from the treatment plant output. Therefore overflow frequencies and pollutants loads must be constricted, to increase the water quality,.
- The treatment plant output is the dominant cause of nutrition emission
- Source control measures minimize pollutants and hydraulic stress.
- The biggest decrease in pollutant load of the river was obtained by increasing the input flow into the waste water treatment plant, if the treatment plant has additional capacity.
- Constructed wetlands potential to affect the pollutants load were low caused by the limited realization broad.
- Pollution reduction of recieving water bodies can best be reduced by bundling locally reasonable measures

Regarding flood mitigation:

- Source control measures mitigate flood runoff (return period 100 yrs.) significantly; none of the other scenarios show an impact on flood runoff

Regarding watershed master planning:

- Master planning must consider the impact of the sewer system and of the waste water treatment plant to be river?system sensitive
- Using a MCA tool as a decision tool helps to find a optimized restoration strategy. Hence the comparison of the utility of different measures lead to a watershed wide best management practice.

The paper will explore how to set up detailed simulations for watersheds regarding BMP and estimate the impact of urban drainage on the watershed level. Details will be developed of the application of individual restoring methods and their individual impact of water quality and water quantity.

This study outlines an integrated watershed drainage restoration planning methodology. Detailed, integrated watershed management planning, is a crucial step in evaluating the impact of the urban drainage systems on receiving water bodies. The type of planning detailed in this paper provides a detailed simulation of the impacts of source control measures on flood and pollutants for a approx. 200 km^2 large watershed. The different predefined goals could be achieved by combining different restoration methods and analyse the results by Multi-Criteria-Tools.

Further work in watershed-wide urban drainage planning might include farming issues like erosion and nutrition emission into the river system and ground water. With additional attention to forests and recreational needs all stakeholders of a watershed could better target and coordinate efforts to protect water resources.