Using citizen survey data in planning stormwater management measures

Développer des mesures de gestion intégrée des eaux pluviales en appui sur un sondage auprès des propriétaires

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RÉSUMÉ

En raison de l'urbanisation progressive, le système d'assainissement urbain étudié ici est en situation de surcharge, ce qui entraîne des inondations pluviales répétées pendant les périodes de pluie. Une possibilité pour soulager le système existant est la gestion des eaux pluviales, telle que le découplage des surfaces pavées du système d'assainissement. A cet égard, la volonté des propriétaires est un critère essentiel pour une stratégie de gestion efficace, car de nombreuses solutions ne peuvent être mises en place que par les propriétaires de biens privés eux-mêmes. Pour évaluer la volonté réelle des propriétaires de mettre en place de telles mesures, nous avons effectué un sondage parmi eux. Dans cet article, nous présentons les bénéfices de ce sondage pour la planification des mesures de gestion des eaux pluviales. Le questionnaire offre la possibilité d'étudier la situation actuelle de l'assainissement (diagnostic de situation) dans le secteur étudié, d'évaluer le potentiel de découplage et également de fournir des informations sur les conditions dans lesquelles les propriétaires seraient prêts à mettre en place des mesures de gestion des eaux de pluie. Il montre que les surfaces qu'il est possible de découpler sont différentes des surfaces que les propriétaires sont prêts à découpler. En conséquence, le risque d'erreurs d'estimation dans l'évaluation de l'efficacité des mesures de gestion des eaux de pluie peut être minimisé par cette approche.

ABSTRACT

As a consequence of the progressive urbanisation the urban drainage systems under examination is surcharged resulting in repeated pluvial floods during storm periods. One possibility to relieve the existing system is stormwater management, such as the decoupling of paved surfaces from the sewer system. Besides this, the willingness of the property owners is an essential criterion for an effective management strategy, as numerous solutions can only be effectuated by the owners of private properties themselves. To assess the actual willingness of the property owners to implement measures we conducted a citizen survey. In this paper the benefit of this survey for planning stormwater management measures is shown. The questionnaire enables the possibility to survey the current drainage situation (status analysis) in the research area, to estimate the decoupling potential and also gives information under which circumstances the citizens are willing to implement stormwater management measures. It is shown that the possible surfaces to decouple differ from the surfaces the property owner is willing to decouple. Therefore, the risk of false estimation in evaluating the efficiency of stormwater management measures can be minimized by this approach.

KEYWORDS

Citizen survey, Decoupling potential, Stormwater management measures, Willingness of the property owners

1 INTRODUCTION

Due to increasing urbanisation existing urban drainage systems are often stressed up to the limits of their hydraulic capacity and beyond during storm events. This can lead to (local) urban flooding and potential danger in the affected areas.

One possibility to reduce the pressure on these systems is effective stormwater management i.e. by decoupling. Decoupling means to decouple an existing paved and connected area from the drainage system by instead diverting the surface water into stormwater management facilities (Stemplewski et al., 2006). The decoupling potential is the maximum of economically sensible possible decoupling procedures (Sieker et al., 2003). In already developed areas the “theoretical decoupling potential (TDP)” also includes the willingness of the property owners to implement the measures.

Using the case study of the urban pilot region “Glesingerstraße” in Graz (Austria) this contribution intends to illustrate the benefit of a citizen survey for the evaluation of decoupling potential procedures by comparing the maximum possible decoupling potential with the “theoretical decoupling” potential.

The pilot region is prone to urban flooding. In 2009 a surcharge of the combined sewer system led to a flooding of about 200 residential buildings and basements.

Two research projects are currently investigating the pilot region. Within the project „HouSui“ flow processes of the surface water in the sewer and on the surface in this region are simulated in a hydrodynamic 1D-2D simulation model in order to develop measures to minimize the flood risk. The results of the hydrodynamic simulation model show, that in the case of a design storm with a two year return period no flooding from the combined sewer system occurs, whereas in case of a design storm with a five year return period it does. The second research project “ECOSTORMA” examines possible stormwater management measures to reduce the hydraulic stress on the sewer system.

2 METHODOLOGY

2.1 Pilot catchment

The city of Graz is the capital of Styria with an area of 128 km² and around 270000 inhabitants. It is the second largest city of Austria. The sewer system has a total length of 842 km (71% combined sewer system) and a waste water treatment plant which serves for 500000 population equivalents.

The case study region "Glesingerstraße" is located in the western part of Graz and covers an area of about 48 ha. Analysis of aerial photographs shows that 54% of the area is developed and paved (24% roof surfaces, 19% paved and partially paved surfaces and 11% public streets). Seen developmentally, the region is an urban residential area, with approximately 470 objects.

2.2 Citizen survey

As information on the property and objects in the study area is essential for model calibration, validation and for implementing possible measures (self-protection measures, stormwater management, etc.), a citizen survey using questionnaires was conducted.

To draw the attention of the citizens concerned to the research projects and the citizen survey, both were announced in regional media and a citizen information event was held directly in the pilot area.

In accordance with an environmental psychologist the questionnaire was split into four topics:

In the first part of the questionnaire roof surfaces, paved and partially paved surfaces of every single property based on aerial photographs were pointed out in colour. The property owners were asked to specify which of the paved surfaces are partially or completely connected to the sewer system. There were further questions essential for the estimating of a “maximum possible decoupling potential”, for example whether the downspouts are accessible, whether a basement exists and if so, whether it has a waterproof construction, whether the person questioned is leaser or owner of the property etc.

To estimate the “theoretical decoupling potential (TDP)” the property owners were questioned about under which circumstances they would implement stormwater management measures. They were asked whether they felt a

- general willingness,
- willingness if there were public funding,

- willingness if there were a rainwater fee (currently the fees in Graz are based on toilet seats) and
- willingness to implement the measures to minimize the flood risk.

In the following parts of the questionnaire some questions were asked about the building, former flooding, flow direction of flood water, etc.

The questionnaire (approx. 470 exemplars) were handed out personally and collected personally after one month. For supporting the citizens, consulting hours were held in the pilot region, which were well attended. In retrospect the effort paid off with an impressive response rate of over 50%.

2.3 Estimating of the maximum possible and the "theoretical potential" of decoupling procedures

In the context of a master thesis (Assinger, 2012) a map of possible stormwater management measures for the city of Graz was developed in accordance to Sieker et.al, (2007).

Under consideration of the parameters:

- Contaminated sites
- Groundwater protection
- Depth to groundwater table
- Soil permeability
- Available surfaces (based on the development structure)
- Thickness of the cohesive top layer and
- Gradient (risk areas)

Areas suitable for the implementation of stormwater management measures were determined.

To estimate the maximum possible and the theoretical decoupling potential every single property was analysed and assessed based on i) the map of stormwater management measures and ii) the results of the citizen survey.

In the context of the project it was not possible to evaluate present industrial areas, because these areas can only be decoupled with increased effort, whereby a more detailed investigation is required.

3 RESULTS AND DISCUSSION

In total 251 of 470 prepared surveys were filled in completely. Due to this high response rate, the current drainage situation of more than 50% of the paved surfaces of detached houses, semi-detached houses, terraced housing and apartment houses could be investigated in detail as shown in Figure 1.

This can be explained by the fact that majority of the objects were built in the 1960's. At that time the sewer operators imposed that paved surfaces have to be connected to the sewer system.

Since 2000, an official obligation exists to infiltrate the stormwater on site, if possible.

The evaluation of the questionnaire also showed that some residents have partly disconnected paved surfaces as a self-protective measure to prevent flood risk.

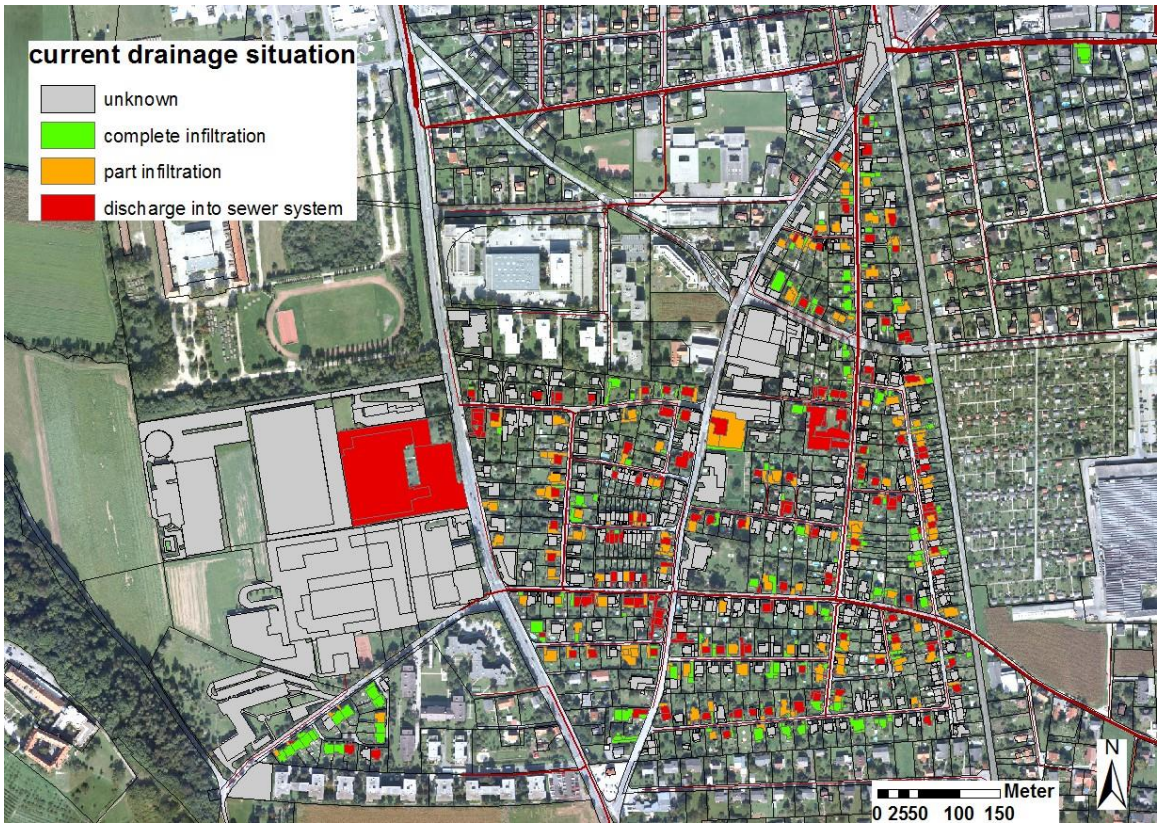

Figure 1: Drainage situation in the pilot area derived from the responses to 251 of 470 questionnaires

For the following analysis only the data of the questionnaires were used which belong to property owners knowing the drainage situation of their paved surfaces (210 of 251 questionnaires).

The circumstances under which the property owners are willing to implement stormwater management measures are illustrated in Figure 2.

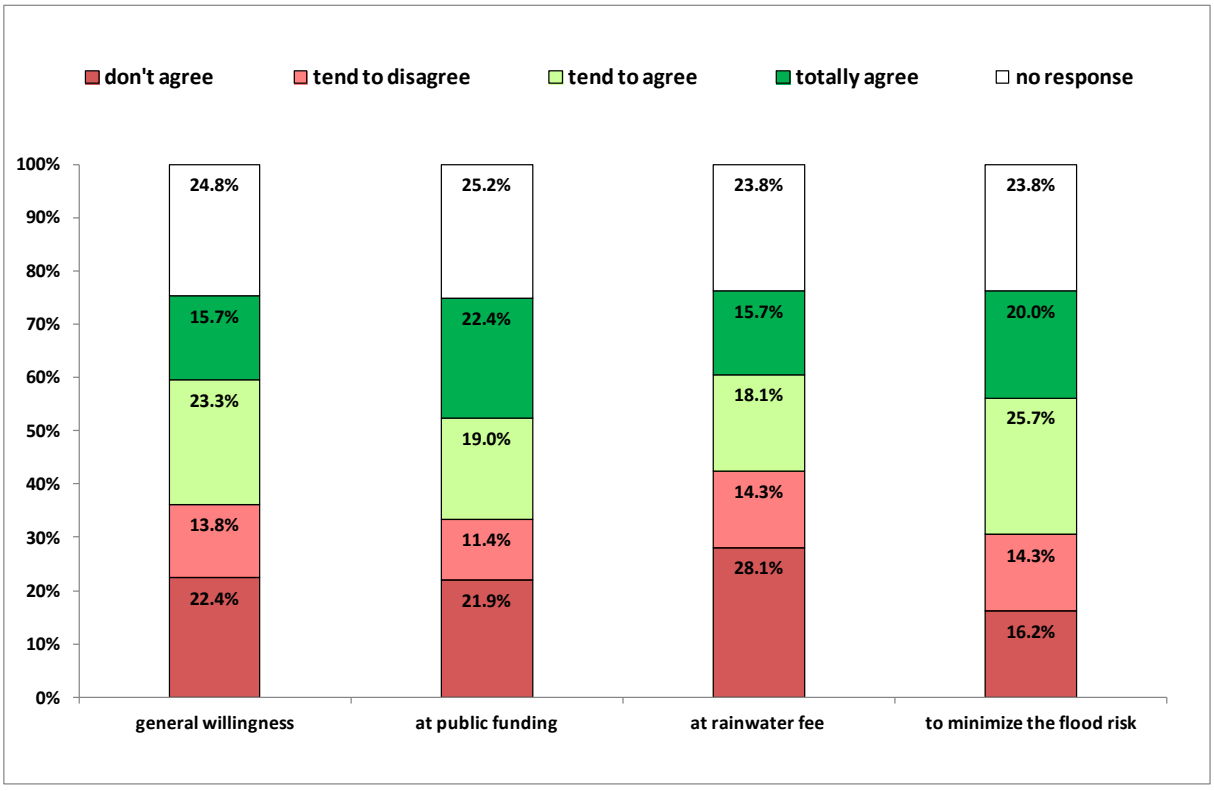

Figure 2: Willingness to implement stormwater management measures (results from 210 of 251 questionnaires)

The results of the evaluation show that the affected owners are most willing to implement measures for passive flood protection. The fact that the pilot area has been repeatedly flooded in storm periods could explain this tendency.

Although one would imagine that public funding would be a high motivator and incentive, the evaluation shows that there are hardly differences between the general willingness and the willingness in the case of public funding.

In Figure 3, the current drainage situation of paved surfaces is compared to the maximum possible decoupling potential and the “theoretical decoupling potential (TDP)” with four categories of willingness (such as the general willingness etc.).

Compared to the current situation the results of the evaluation show that a maximum of additional 28% of paved surfaces could be disconnected. Considering the willingness of the property owners, the theoretically decoupling potential only lies between 7.7% to maximum 11%.

It has to be taken into account that willingness does not automatically result in implementation of measures.

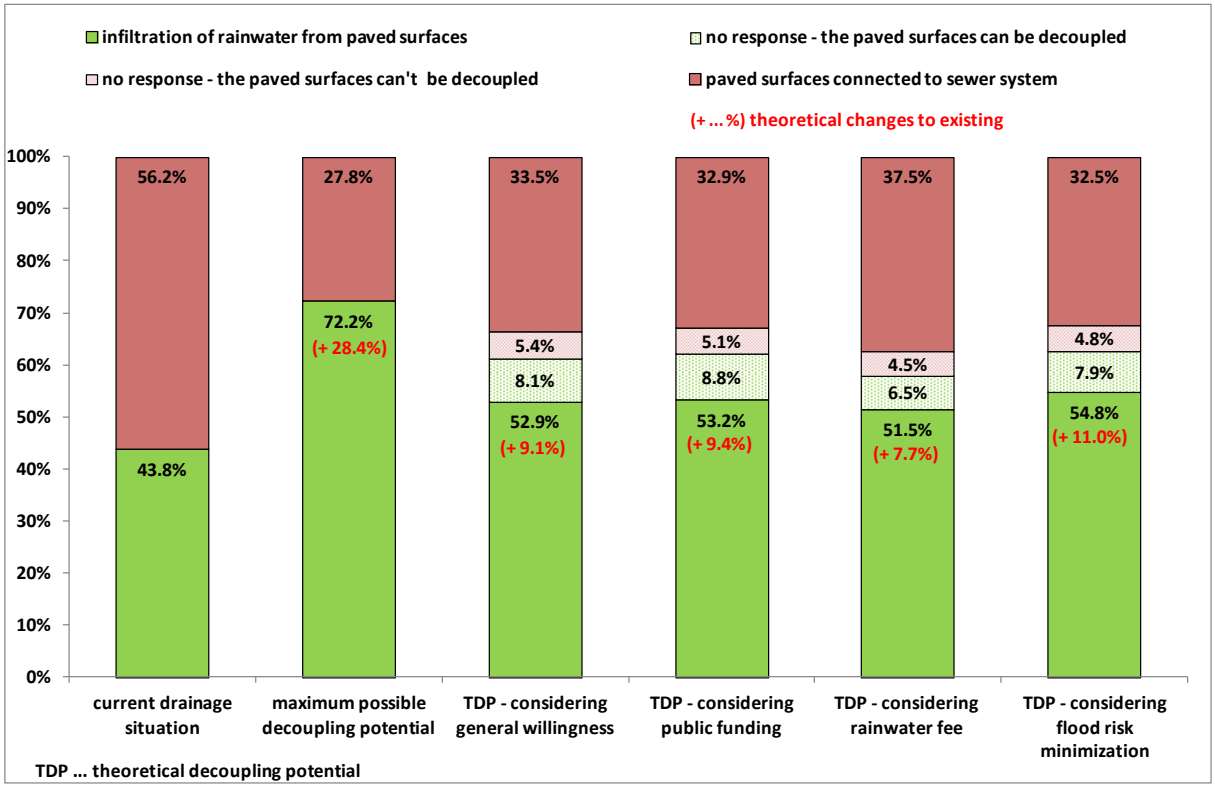

Figure 3: Drainage situation of paved surfaces in comparison to the maximum possible potential of decoupling and four groups of the “theoretical decoupling potential (TDP)”

4 CONCLUSIONS

- By means of a citizen survey valuable expertise for the consideration of decoupling potential can be estimated.
- The risk of a false estimation of decoupling potentials and the efficiency of stormwater management measures can be minimized through a citizen survey.
- On the basis of a citizen survey, selective measures can be developed to increase willingness on the part of property owners to implement measures (for example with information meetings, information brochures, adapted funding systems etc.).
- If the evaluation shows that there is hardly any willingness to implement measures the planning of semi-central stormwater measures on public ground can be realised early on, as far as this is feasible.

- The transfer of the results to similarly structured areas is currently being examined in the ECOSTORMA research project.

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