



Rain InfraStructure Adaption (RISA) in the City of Hamburg and suitable funding for Stormwater Management

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Abstract:

Hamburg is a growing metropolitan city that is faced with new challenges. With the building of 6.000 new homes per year as well as the development of industrial estates, comes an increase in surface sealing. These areas produce runoff that place an increased burden on the cities drainage systems (sewer networks, water bodies and trenches). Furthermore there is a potential risk to the drainage infrastructure which comes from an increased intensity and frequency of heavy rainfall that happens as a result of climate change.

These challenges are addressed in the Rain InfraStructure Adaption (RISA) project. RISA is a collective Project between the State Ministry for Urban Development and Environment (BSU), the Free and Hanseatic City of Hamburg (FHH) and HAMBURG WASSER (HW). The Project was started in 2009 with the Goal of reacting to increasing surface sealing, the potential outcomes of climate change, increased living standards, as well as infrastructure requirements. The results of this work are summarized in the RISA Structure Plan, Rainwater 2030. Over the years to come, this plan will act as a guideline towards the sustainable management of rainwater (IRWM = Integrated Rain Water Management) in Hamburg.

RISA acts as a pioneer in the water sensitive urban development of Hamburg. Under the context of water management there are action plans that show that rainwater management measures will become a well-established part of urban development. Water management should be integrated into regional, city and transport planning. The institutional and regulatory frameworks should also be adapted.

Another focus will be laid on suitable funding of stormwater management. RISA was arranged coeval to the implementation of the separated stormwater charge (SSC) by HW in May 2012 to gain synergies out of both projects.

Keywords: Integrated Rain Water Management (IRWM), climate change, Rain InfraStructure Adaption (RISA), surface sealing, suitable funding for Stormwater Management

Introduction

As part of a sustainable sewage disposal system HW invests 60 Mio. € per annum into the maintenance and renewal of the approx. 5.500 km extensive sewer network in Hamburg. In the inner-city area there is a predominantly combined system, whereas in the outskirts there is primarily a separate system (approx. 2.300 km for wastewater and approx. 1.700 km for stormwater). The Sewer network encompasses an area of approx. 360 km², of which approx. 175 km² can be classified as paved areas (a photogrammetric evaluation). This corresponds to

approx. 49 % medium proportion of paved area. Approx. 105 km² of the paved areas are connected to the public sewer network (Evaluation and validation from the surveying of property Owners). An overview of the drainage Methods in Hamburg is shown in figure 1.

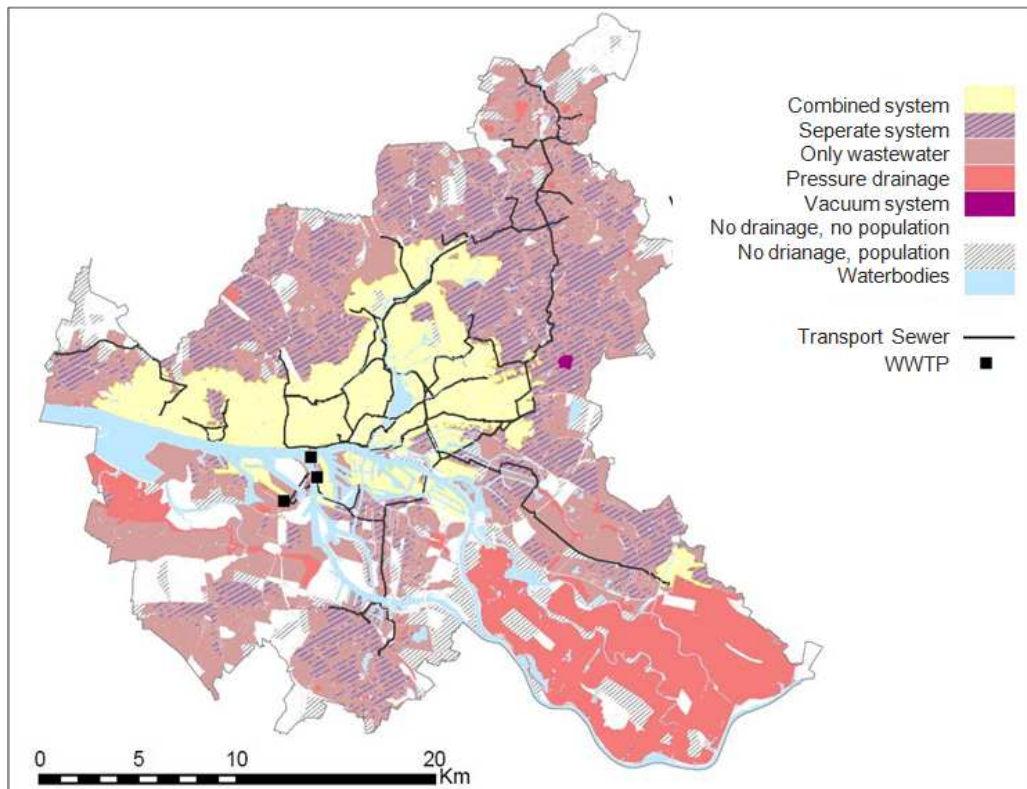


Figure 1: The spatial distribution of drainage Methods in Hamburg (Source: HW)

The bodies of water in Hamburg, for example the Elbe, the inner Alster, the outer Alster, canals and channels have a notable importance for the economy and recreational activities. The overall length of primary and secondary water networks is approx. 640 km [FHH 2005]. As a result of anthropogenic influences or over impression from the preliminary classification using WRRL, the majority of water bodies in Hamburg are defined as artificial or having considerable changes to them [FHH 2005]. Currently only 5 water bodies in Hamburg can be classified as natural [FHH 2005]. The water bodies will be supplemented through numerous trenches and trench canalization.

The water relief programs in the combined system for the Elbe and Alster that have been carried out since the 1980s, the current implementation programs for inner-city relief and the Bergedorfer redevelopment concept have led to a reduction of combined waste water overflow and accordingly this will continue to sink to a low level. The frequency of overflow into inland waters in Hamburg happens at a mean rate of once per year which is exemplary across Germany. This results in a distinct and long-term Relief for inland waters. This is demonstrated yearly with the swim section of the Hamburg Triathlon happening in the Alster.

In contrast in the separate system the storm water runoff that comes from heavily frequented roads flows unhampered into waterways which can contribute to hydraulic problems and contamination. In regards to water pollution abatement RISA lays a clear emphasis on a separate system (see below).

Current Developments - Urban Development

Hamburg is a growing city. In the work program that is guided by the Senate vision „We will create a modern Hamburg” [FHH 2011], the building of additional, low cost housing has been clearly expressed. This low cost additional housing will be built in already populated

areas. The „Agreement for Hamburg’’ between the Senate and the seven Districts has the goal of approving and building approx. 6000 new Homes per year. The so called „Alliance for living in Hamburg’’ Agreement will be supplemented through a verbal agreement between the Senate and the housing/real estate industry. Multiple conflicts of interest and an increasing demand on open and green Spaces in current residential areas is omnipresent.

Furthermore as a result of the growing number of buildings or the increase in paved areas, it can be assumed that there will be an increased pressure on the drainage systems. The current figures from RISA show that there will be a permanent increase of paved areas of approx. 0.4 % (about one square kilometer). p.a.

Climate Change

Initial studies about the hydrological consequences of climate change for the combined system in Hamburg have shown that till the end of the Century a significant increase in the combined sewer overflow is expected [Kuchenbecker et al. 2010]. These initial studies are based on simulated precipitation data from the climate model REMO and were conducted using the A1B scenario from the IPCC (International Panel for Climate Change) [Kuchenbecker et al. 2010].

Detailed Studies done by BMBF research Project KLIMAZUG-Nord for the catchment areas with a separate system [Hüffmeyer 2011] are also based on REMO-Data using the A1B scenario for the catchment area Wandse. Based on the scenario it is also shown that till the end of the century the potential hydraulic effects from climate change on the sewer network will be seen in the form of increased occurrence of Flooding.

On the Basis of the analytical Scenario considerations, RISA includes the potential effects of climate change in a sensitivity analyses based on [Norddeutsches Klimabüro 2011], [Norddeutscher Klimaatlas 2012] and [Daschkeit et al. 2009]. This will also be done with regards to a long term prediction of costs.

Standard Legal Requirements

Water Laws with their hierarchical Structure play a central role in the legal framework for the handling of Rainwater. Building, planning and traffic legislation include key references to rainwater management. The legal framework becomes concretised through the technical **guidelines for building drainage, property drainage, public drainage systems, road drainage** and waterway construction. An overriding derivable Goal of the water legislation is to intervene as little as possible into water resources with regards to the amount of intervention and the amount of materials.

With this background in RISA the framework for the IRWM in water legislation, building legislation, nature protection legislation, land legislation, planning legislation, roading legislation and right of way legislation, will be analysed and discussed within the relevant technical regulations. Where possible the knowledge and recommendations from RISA will flow into the current revision of technical regulations.

Administrative Framework

The responsibility of the water management administration in Hamburg has partially grown in the past which points to a high grade of complexity in this day and age. The BUE (formerly BSU) which is the supreme technical authority has the ministerial task of managing water resources. Where as on the local level the districts, which are the lower water authorities, are responsible for the operative tasks as well as planning and approval decisions. Another important partner in the FHH is the Authority for Economy, Transport and Innovation (BWVI) who are responsible for the major roads. Measures are carried out through the State Office for Roothing, Bridges and Water Bodies (LSBG). The ongoing considerations of flow paths and

water management of catchment areas will be made difficult with the increasing orientation on small political territorial units.

Within RISA this situation will particularly be faced with development and recommendations of new planning instruments (compare New Planning Instruments for the IRWM in the Results and Discussion section).

Methods - RISA Structure, Function and Collaboration

In light of the factors mentioned, the BSU (now the BUE) in cooperation with HW initiated Project RISA with the overall Goals of Near-natural local water balance, Extensive water pollution abatement and Flood protection and inland flood control RISA acts as a pioneer in the water sensitive urban development of Hamburg. Under the context of water management there are action plans that show that rainwater management measures will become a well established part of urban development. Water management should be integrated into regional, city and transport planning. Thus from the outset RISA planned a project structure that saw the forming of four interdisciplinary work groups (AGs) from the areas of environmental/sanitary engineering, urban and landscape planning, traffic planning and water body planning.

RISA Structure Plan 2030

The Project Results and Recommendations will be summarised in the RISA „Structure Plan Rainwater 2030“. In the coming Years this will serve as an orientation framework for the IRWM in Hamburg. As well as an inventory of the current status of rainwater management the structure plan provides recommendations to the future handling of rainwater. The recommendations lay a distinct focus on the decentralisation of drainage for all new and renovated buildings. Therefore the structure plan illustrates technical solutions, the legal foundation, new planning foundations, new planning instruments and procedures as well as communication paths. The content will be supplemented through prediction of costs, funding approval and the discussion of new funding options for the IRWM.

The Structure plan is the technical foundation for the Senate Document RISA which is a current work in progress. The Document, which has essential recommendations towards long term strategic action, shall be submitted for approval to the Hamburg Senate.

Results and Discussion

There have been many studies done within RISA. Therefore only a selection of results and pilot projects will be discussed here. This should enable an insight into the range of projects.

Planning Basics and Information System for the IRWM

At present a comprehensive GIS-based analysis-, planning- and information system for rainwater management at the property level is being worked on for Hamburg. This is being done to plan and implement appropriate rainwater management measures in terms of ecological and economical aspects.

In the area of „near-natural local Water Resources“ an essential component in the planning and information system is the so called Infiltration potential Map (VPK). The VPK is based on hydrological, geological and topographical data in the RISA project that was validated, extended and updated. Furthermore knowledge about potential areas is essential for the IRWM. Paved areas, availability of areas, area use, building structure and the drainage situation are a crucial basis for the Potential Area Maps (FPK). VPK and FPK will be linked together to form a Decoupling Potential Map (APK). Thus providing concrete planning fundamentals and potential analysis at various levels of detail for the IRWM in Hamburg. Further-

more water resource balances will be provided. The results would be depicted in a Water Resource Potential Map (WPK).

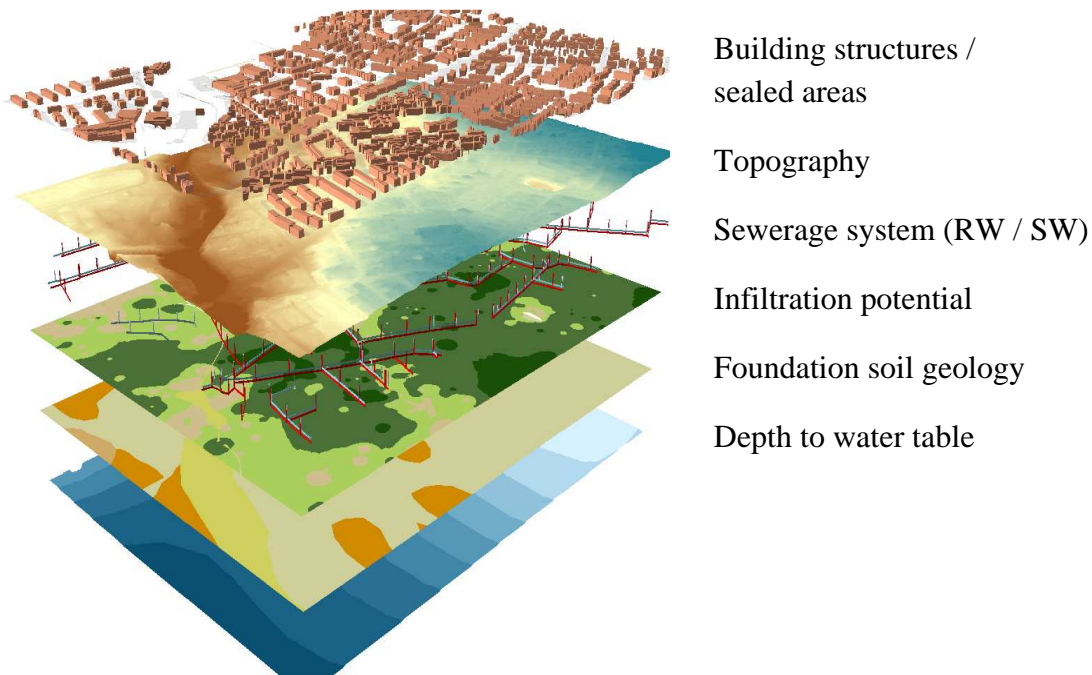


Figure 2: Exemplary representation of „Data Layers” with essential Fundamental Data for Information and Planning Systems for the IRWM in Hamburg (Source: HW)

In the area of „Inland Flood Protection” hazard and damage maps were created. The Hazard and Damage Maps were created to estimate the flood risk to infrastructure objects. This information shall contribute towards the cooperation between administration, planners and more importantly property owners in providing enhanced flood precautions. In addition to this it is possible through the improved analysis of large-scale hazard potentials to compare the use of flood precaution measures and the associated costs, hence providing a base for political/economic decisions.

In the area of „extensive water pollution abatement” the so called Emission Potential Maps (EPK) were developed. These are based upon the yearly mean load pollutant removal rates (calculated with suspended solids) from developed areas and they provide an improved detection of the main pollution areas in settled Regions. The series of maps is the basis for the compilation of stormwater treatment concepts in which the necessity, the extent, the expense and emission orientated uses of the stormwater treatment measures are represented.

The cartography and background data (e.g. ALKIS®, ATKIS®, digital Terrain Model, Tree Registry, types of Biotope, Water Book, Groundwater levels, Engineering Geology, Sewer Registry, Sealing Land Register, Property drainage Data) will ultimately be combined to form a comprehensive information system for the IRWM. The information system will be updated and developed when required (Figure 2).

New Planning Instruments for the IRWM

A survey done for RISA, of the planning participants at all planning levels came up with the following optimisation Proposals: The current planning practice of very small-sized water management concepts and resolutions should be transformed into a planning culture that constructs a complete water management concept, in which spatial planning (city, transport and landscape planning) based drainage concepts are on the development plan and project levels [Andresen et al. 2011]. Furthermore water management statements and concepts for large developed areas that are recorded in small numbers in development plans should be devel-

oped. There are seldom water management concepts for these areas. Exceptions are the water pollution abatement concepts for individual flowing waters (compare **Introduction**).

As a result of the identified optimisation options, two „new” planning instruments were developed as a part of RISA. The instruments, toward the introduction and implementation of a water-sensitive urban development, form an important of the IRWM in Hamburg. In the future they are to be developed and implemented [Andersen et al. 2013]:

- The Hamburg Water Plan’ (scale level land development plan and landscape program)
- The „Water Management Support Plan” (mandatory scale level urban development planning or within informal preliminary planning for example through competitions, framework planning etc.)

The technical planning basis for these instruments is provided in the planning frameworks for the IRWM as mentioned previously in *Planning Basics and Information System for the IRWM*. The position of the planned planning instruments and at which planning level they are is shown in Table 1:

Table 1: New Planning Instruments at different Planning Levels

Planning Level	Current Planning Instruments	”New” Planning Instruments
Informal Planning	Spatial Model Quality offensive Free Space Environmental Program 2012-2015	Water Plan Hamburg
Preparatory Urban Development Planning	Land Use Plan Landscape Program	
Informal Planning	Competitions Urban Development Framework Master Plan ¹ Function Plan ²	Accompanying Water Management Plan WBP
Mandatory Urban Development Planning	Development Plans	Accompanying Water Management Plan WBP
Planning Permission	Planning Approval Building Applications	Water Pass

¹e.g. Result of Idea and Realisation Competitions (e.g. Master Plan Hafency)

²e.g. Urban Fuction Plans for Campus Bundesstraße Eimsbüttel

IRWM Road Construction Policy in Hamburg

„Water Sensible Street Space Planning” has the goal of draining traffic zones, through the IRWM measures into „open” systems. Therefore the roads will not necessarily connect to Pipes. Flooding that happens as a result of heavy rainfall cannot always be avoided despite optimal drainage systems and the other solutions that were developed within RISA. Therefore the considerations aim at constructing the street space so that it can also be used to transport overflowing rainwater and as a storage space for overflowing rainwater.

In this overall context the knowledge document „Suggestions for a Water sensible Street Space Planning” , for different types of city streets was developed [FHH 2015]. This was currently released in the Hamburg Code for Planning and Design of City Streets (ReStra) [FHH 2015]. This is a first step toward implementing the IRWM strongly into the road construction policies of Hamburg or rather allowing it to be long term standard practice. Figure 3 is an Illustration of what a possible Water sensible Street Space Planning could look like.



Figure 3: Draft Situation Connecting Road (Left), Water Sensitive Street Space Planning over an absorbent Roadside Tree Grate (right) [FHH 2015]

Suitable funding for Stormwater Management

RISA was arranged coeval to the implementation of the separated stormwater charge (SSC) by HW in May 2012 to gain synergies out of both projects. The SSC was led in 2012 by the Hamburger Stadtentwässerung (HSE) as a part of the HAMBURG WASSER group after three years of preparation work to ensure a high transparency of costs, a fair arrangement of the charge and to get at the same time ecological guided effects. The wastewater fee now amounts 2.09 €/m³ based on the measured consumption of drinking water. On the other hand the SSC is calculated by the sealed area of a property which is connected to the public sewer system for rain water and amounts actually 0.73 €/m² p.a. (www.hamburgwasser.de/gebuehrensplittung.html).

The large collection of data for the change in charges gave coeval new awareness and knowledge for the storm water management. In this case the area-wide recording of the surface drainage situation enabled the development of new tools for planning and analyze. These tools like the “disconnection potential map” are now basics of the day-to-day business of the storm water management which is more and more connected directly to proprietors and area management.

In future an area-wide GIS-based storm water management information and planning system should be established for whole Hamburg. It enables to work on a scale-independent data base even on a very small scale zoom, which is based on the data collection made during the introduction of the SSC.

Conclusions - RISA setting of Agenda and Forecast

RISA has produced numerous conclusions and recommendations towards the adaption and potential improvements of rainwater management in Hamburg. Several projects towards the implementation of the RISA measures were successfully implemented or they are currently at the planning phase. The establishment of developed planning foundations and the further formulation of new planning instruments are important work steps. In the areas of responsibility and process organisation as well as the areas of Finance there is considerable effort required in order to ensure the long term success of RISA.

Therefore the project moves into a permanent „RISA Process“, towards the long term approach of the overarching key objectives. For this the following long term „Setting of Agenda“ and the fundamental recommendations respectively, that should, through political acceptance show a long term effect in Hamburg:

- Creation of a legal and management framework, that plans the drainage of additional stormwater into the sewer network only in exceptional situations,

- Further development and introduction of the RISA planning instruments “Water Plan Hamburg” and the “Accompanying Water Management Plan”,
- Further development and introduction of the principles of flood precautions under the framework of the integral risk management for Hamburg,
- Introduction of uniform guidelines towards the prioritisation and implementation of stormwater treatment concepts for Hamburg,
- Development and introduction of a sustainable financial and administrative concept for surface water drainage facilities in Hamburg,
- Incorporation of water pollution abatement and flood protection into the road construction policies of Hamburg,
- The establishment of long term communication and training concepts for the IRWM in Hamburg.

Ultimately the transfer of knowledge and recommendations gained, at present in a similar, concrete and continuous action in the City State of Hamburg, is only possible through the resolution of the Hamburg Senate and where necessary through the Hamburg City Parliament. Currently there is a Senate Document in progress for this purpose, which forms the technical foundation for the described RISA Structure Plan Rainwater 2030.

All project results and reports will shortly be available for download from the following website: www.risa-hamburg.de

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