



Managing Adaptive REsponses to changing flood risk,

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Hannover, The River Leine at Calenberger Neustadt

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City of Hannover in collaboration with the partners of the  
MARE project

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## List of Stakeholders

Ref. No.	Stakeholder	Developers		Long term ownership		Interest																	
						Regulators										Planning bodies						Knowledge development	
						Wild life	Heritage	Environment	Water quality	Water quantity	Emergency planning	Strategy planners	Development control	Building control	Road/Transport	Initiators	Create state of the art knowledge	knowledge maintenance					
		A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D
	Public authorities and water utility organisations																						
	City of Hannover																						
1	• Highways Division		X								X	X	X		X	X	X	X			X		
2	• Planning Division	X													X		X		X				
3	• Department of Greenspaces	X	X												X	X	X	X					
4	Hannover Region – Water Body											X											
	Interest groups																						
5	Students	X																					X
	Knowledge institutions																						
6	Leibniz University of Hannover	X													X		X		X				X



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# 1 Introduction

## 1.1 Aims and objectives

The aim behind this case study is to help improve the flood protection in the Calenberger Neustadt district located in the flood plain of the River Leine. The measure is intended to ensure that the local residents are protected against a flood with a magnitude of HQ<sub>100</sub> (i.e. a flood event with an average return period of 100 years). Previously, the fire service has provided assistance using sandbags to protect the endangered areas against flooding. The objectives of the proposed alleviation measure is to lighten the fire service's workload during a flood emergency and to improve the protection of the local residents.

Although the construction of flood alleviation measures is a voluntary task from the perspective of the municipalities, it is intended, within the framework of the project, to create added value for all affected by and involved in a flood event. This option will provide the fire service with the capacity to carry out other tasks and the local residents

will be protected against an HQ<sub>100</sub> flood. This will improve their quality of life and encourage investment within the Calenberger Neustadt district.

## 1.2 Background

A comprehensive programme of measures towards ensuring enhanced flood protection is currently under development in Hannover. These measures are intended to provide the major part of the population with improved protection against an HQ<sub>100</sub> flood event. The measures currently under development focus specifically on the reduction of the level of flood risk from the Rivers Ihme, but do not reduce the risk of flooding at other locations within the urban area.

One known location is to be found on the banks of the Leine in the area of the Dreyerstrasse road, where the terrain creates a pathway through which the Leine's water can flow into the Calenberger Neustadt district in the event of a flood. Until now, this spot has been protected with sandbags during periods of high water, but the aim now is to permanently secure this problem area by way of a portfolio of adaptive structural and non structural measures.

## 1.3 Regulations, procedures and standards

Article 67 (1) of the German Water Resources Management Act (*WHG*), states that significant reshaping of a waterway or its banks – including the provision of flood protection measures– is classed as waterway development.

Waterway development requires planning permission (Article 68 (1)) unless an environmental impact assessment in line with the German Environmental Impact Assessment Act (UVPG) is not required.

If an environmental impact assessment is not required, then planning approval can be granted instead of the official planning permission procedure (Article 68 (2)).

Implementation of the official planning permission procedure or planning approval is subject to the requirements of the German Administrative Procedure Act (VwVfG).

In view of the estimated construction costs entailed in the project, the implementation of the measure does not require a formal decision on the political side, nor is there any

formally prescribed necessity for participation on the part of the populace.

## 1.4 Timeline

The Calenberger Neustadt district which lies at the bend of the River Leine (*Leinebogen*) is one of 27 risk zones identified as part of the assessment of river flooding in the City of Hannover which commenced in 2006. At the start of this process, the flood risk at this location was perceived to be one of the highest within Hannover, so as soon as the flood risk maps were made available by the State of Lower Saxony, action was taken to reduce the risk. In 2011 a feasibility study was carried out to identify how the risk of flooding within the area could be managed by means of a portfolio of integrated and adaptive treatment measures.

The study was carried out with the assistance of the Leibniz University of Hannover, using the framework being developed within the MARE project.

The options identified by the study team were reviewed by a cross-disciplinary panel in late 2011. This review resulted in the selection of the option which was to be taken forward.

The detailed planning and design process commenced immediately afterwards.

The original intention was for the measures to be implemented as a matter of urgency, as the options were being considered in detail it became clear that this was not the best course of action. This was because, contrary to the initial assumptions, the need for action, within the context of the city as a whole had not yet been properly defined, prioritised and planned so that the interaction of the different measures to be implemented throughout the city could be taken into account. Therefore, the implementation of the measures was temporarily halted in 2012 until the comprehensive strategy for flood risk management within Hannover had been developed and overall priorities were assessed.

## 2 Details

### 2.1 Analysis and assessment

Large areas of Hannover's inner city would be flooded as a result of an  $HQ_{100}$  flood event. Two projects providing flood protection measures have already been implemented. These are the widening of a narrow section of

the River Ihme and an extension of the dyke in the Ricklingen district. However, there are further such problem areas with inadequate protection, one of which is the bend in the River Leine (*Leinebogen*) in the Calenberger Neustadt district north of Braunstrasse (see Figure 2-1). In this area the Leine bursts over the banks in the left-hand undercut slope and floods large parts of the Calenberger Neustadt district. The assessment of the flood risk was made using the modeling carried out by the State of Lower Saxony and by the Technical University Hamburg Harburg as part of the city wide diagnostic study.



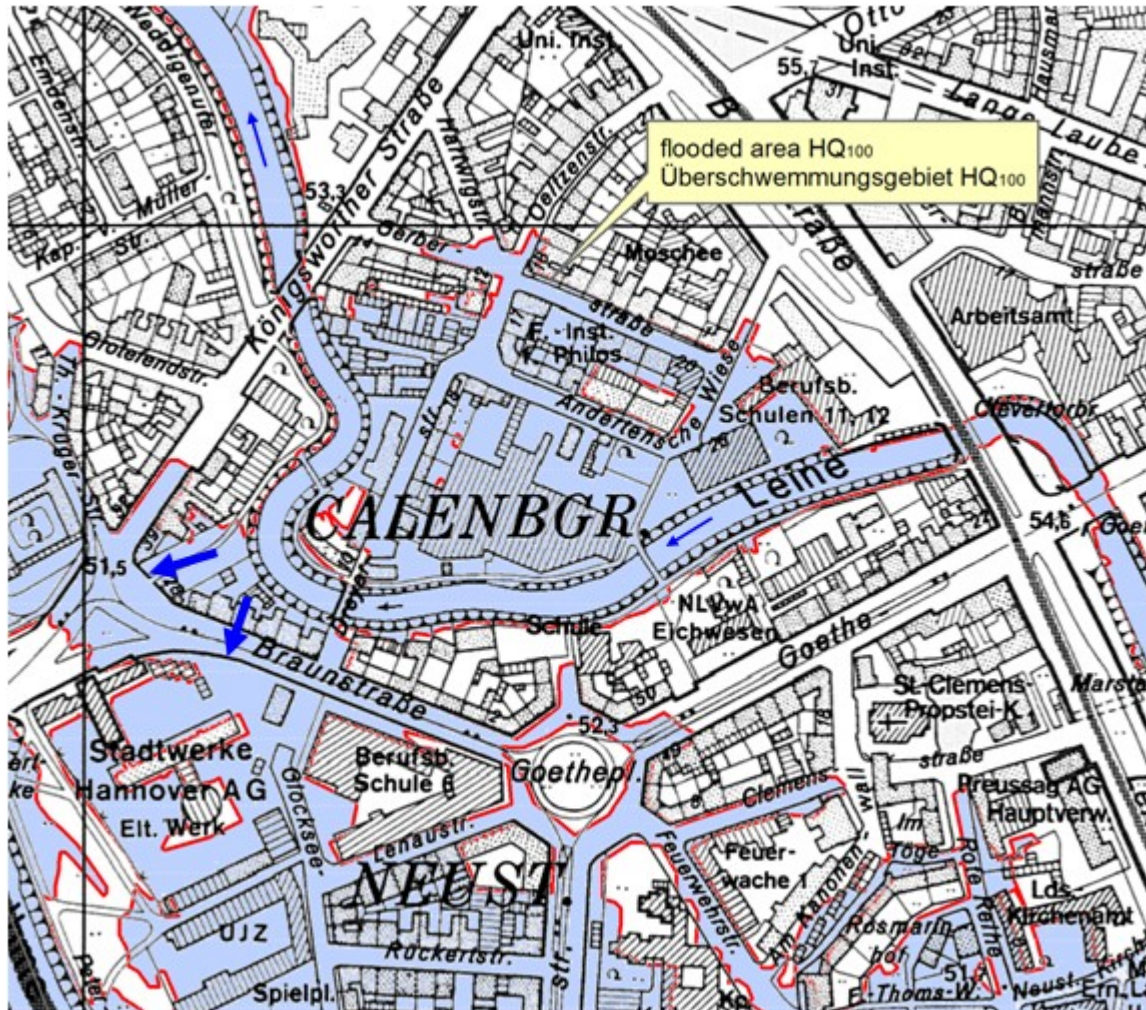


Figure 2-1: HQ<sub>100</sub> flooded area in the *Leinebogen* area

## 2.2 Problem definition

The identified problem area lies to the western of the Leine bend (*Leinebogen*). In common with many inner-city district, the area has a diversity of land and building uses, including residential buildings, small businesses and restaurants. Therefore, there are numerous – in some cases conflicting – concerns and issues to be taken into account. A recreational path for pedestrians and cyclists runs along the Leine. The path crosses from the western to the eastern bank of the river just north of the *Leinebogen* river bend (see Figure 2-2). It then joins Braunstrasse via the depression and the undeveloped plot bordering the crossroads. The plot is vacante and is available for construction.





**Figure 2-2: Overview of the problem area on the bend of the River Leine**

## 2.3 Options considered

There are various possible solutions towards providing flood protection at this spot:

1. No alterations to the locality, floods accepted as a risk.
2. No alterations to the locality, flood events will continue to be combated on a mobile basis with sandbags, etc.
3. Flood protection provided by a dyke.
4. Flood protection in the form of a wall, with possible variations in terms of the wall's positioning and adaptive configuration.
5. Landscaping of the terrain, with integrated flood protection.

With option 1, large parts of the Calenberger Neustadt district (see also Figure 2-1) will be flooded, with resultant damage to the existing buildings as well as material goods such as cars, for example. In extreme cases there can even be danger to life as result of high water depths or high water flow speeds.

With option 2, the Calenberger Neustadt will only be protected in a disaster situation. This entails an extensive commitment in terms of personnel and equipment in the event of a flood.

Moreover, the chance that the temporary protection measures could fail or that they may not be put in place in time means that the residual risk is greater than with permanent protection (options 3 -5).

Option 3 (dyke) requires a large land take, but because it provides continuous protection and, because of its broad crest, it can when necessary be made higher by means of a sandbag wall, etc. The costs of an earthwork structure are less than the costs involved in options 4 and 5.

A flood protection wall (option 4) requires less land take. As with a dyke, this option provides continuous protection, but a wall cannot be quickly made higher in the event that flows exceed the capacity of the system. The costs of erecting a flood protection wall are higher than those of constructing a dyke.

In a fifth option which was developed within the framework of a student project, the flood alleviation measures were designed as part of an improvement of the urban landscape. This option includes the widening of the River Leine, the installation of steps on which people can sit, and flowerbeds in the levelled

parts of the embankment (see Figures 2-3 and 2-4).

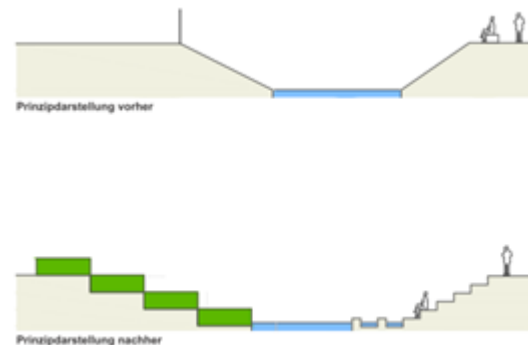


Figure 2-3: Schematic outlines of option 5 before and after the river widening. (MZYK AUND TANTAU, 2011)



Figure 2-4: Schematic plan of option 5 (MZYK AND TANTAU, 2011)

Table 2.1 summarises the factors used to compare the costs and benefits of the options.

## 2.4 Selected option

Option 4 was selected as the preferred option, since its levels of feasibility and effectiveness appear to be the highest.

Desirable option 5 is ruled out because it entails various conflicts of objectives. The process is made complicated through the involvement of various participants, and conflicts of interest (landscaping vs. construction on the plot of land) cannot be eliminated. As regards an attractive green area, questions arise as to the requirement for green spaces in this area, the user groups, social safety and follow-up costs for care of the spaces. It is not possible for these criteria to be answered positively across the board, so this option has to be ruled out.

**Table 2.1: Comparative overview of the options**

	<b>Option 1</b>	<b>Option 2</b>	<b>Option 3</b>	<b>Option 4</b>	<b>Option 5</b>
	No action	Sandbags	Dyke	Wall	Landscaping
Protective effect	None	Not put into place until flood event	Continuous	Continuous	Continuous
Personnel requirement in a flood event	Not necessary	Response personnel involved not available for other tasks	Not necessary	Not necessary	Not necessary
Costs	None	Deployment must be financed	Low	Medium	High
Adaptability (adaptive measure)	High	High	Available	Available	Available
Other benefits	No impacts	No impacts	Can be integrated into green areas	Technical construction	Positive changes to the surroundings
Feasibility	-	-			High degree of coordination required, conflicts with the marketability of the undeveloped plot of land
Availability of space	-	-	Medium	Small	High
Owner	-	-	City	City	City, private
Planning requirements	-	-	Permit under water-related law	Permit under water-related law	Permit under water-related law
Overall rating	Poor	Poor	Good	Good	Desirable

## 2.5 Implementation

The following steps were planned for the implementation of the measure:

- Detailed design and technical planning
- Legal processes
- Obtaining the necessary permit(s)
- Information for the politicians and decision makers
- Tendering of the construction work
- Construction and commissioning of the measure

Because it was considered that the selected option only involved a minor intrusion into the natural environment, it was judged that there will be no need for an environmental impact study. This meant that the process can probably be carried out within the framework of a planning permission procedure.

## 2.6 Performance and effects of selected option

The selected option meets current requirements for protection against flooding and can be adapted in the future to cope with increased flows resulting from for example, climate change

From a financial perspective the selected option has minimal upkeep and maintenance costs and the wall requires little space, so that only land owned by the City of Hannover will need to be used. The option entails little change to the existing local environment, and the existing functionality will remain as it is. No new areas are being created which would be socially difficult to control.

The short planning times mean the project can be realized in the short term once priorities have been finalised.

However, it was recognised that the location of the wall was critical as this would affect the cross section of the river channel and hence the balance between discharge and depth of flow. This would affect the depth of flow in the upstream reaches and also the rate of discharge downstream. This contributed to the decision to suspend implementation until a comprehensive assessment of measures throughout the city was completed.

## 2.7 Difficulties encountered

Traditionally it has not been common practice for public administration bodies to include and integrate various different specialist disciplines in the planning and selection

process of water management projects. Until now it has been more a matter of leaving things to the water management specialists. In this case it would have been "normal" for flood risk management to be viewed solely from a technical perspective. However, it has not only proved possible to involve the technical departments within Hannover, it has also been possible to engage with and include other specialist disciplines such as Urban Planning and Landscape Planning, and discuss and weigh up the various concerns and requirements with them.

Flood protection is a topic which, as a rule, needs to be discussed within the context of the entire course of a river. However, in the past, solutions for known problem areas were often considered without consideration of the upstream and downstream impacts. Furthermore, if problems are considered in isolation, then actions taken upstream of a particular location can significantly change flow regimes, making the measures taken at that location inappropriate. Within this context it was necessary to raise the awareness of all involved so that they would think globally and not just locally.

Following the selection of option 4 as the preferred option, the left bank in the *Leinebogen* river bend was surveyed in preparation for the planning, and it was found that the necessary flood protection line reaches well beyond the municipally owned property. While the municipally owned property has no trees or shrubs and it could therefore be assumed that there was no necessity for an environmental impact study, the extended area to be protected contains many large trees. Contrary to the original assumption it now looks as if an environmental impact study will be required and this means that there will be a time-consuming planning permission procedure.

In view of the considerable outlay that is likely and the need to get it right, the planning process will not be progressed further for the time being. Instead, the options will be reviewed as part of the development of the development of the flood risk management plan. This requires an assessment of the interaction of the preferred options for all the risk zones using the tipping point approach and including the potential impacts of climate change. The assessment which will include an assessment of the impact of extreme flows in

excess of the design criteria will be used to fine tune the design of individual measures by defining the required flow regimes (depth and discharge, upstream and downstream of each measure. The assessment will also help to identify the implementation plan based on current levels of risk, the climate change tipping points and the costs and benefits associated with each measure.

### 3 Review

#### 3.1 Discussion

The interest of the the politicians and the administration of the City of Hannover in flood risk management was triggered by the last large-scale flood event in 2003.

As a result of this event, flood risk zones were identified and potential solutions were considered and from this a strategy for the management of flood risk within the city started to emerge.

The discussions within the administrative and political circles were structured within the city's planning framework, and a public consultation was initiated using the city's normal processes.

Parallel to the planning and design of measures for high priority areas, a dialogue was conducted with the upstream and downstream regions and work on the Leine flood protection plan was carried out at the state level. This made it possible to sound out the potential alternatives to the measures being planned in Hannover.

The more advanced the development of the measures in Hannover became, the more interested the local residents became since they were now more aware that they would be directly affected. Public events took place to provide information about flood risk management in general and the specific measures being developed in Hannover.

#### 3.2 Learning points

In the course of the discussions it became clear that it would be beneficial to have a coordinating point within the city administration which would have responsibilities for flood risk management within the city including the establishment, nurturing and maintenance of the networks and contacts within the administration and to the neighbouring communities and authorities. A Learning and Action Alliance .



Experience has shown that public awareness of the problem quickly diminishes after flood events, and the necessity for flood risk management measures is then increasingly questioned. It appears necessary to provide regular information on flooding and flood risk management to maintain the awareness of the politicians, professions in other related disciplines and the public about the subject. In addition, strategies and structures need to be developed in order to be able to maintain this flow of information. Cologne is a good example in this respect, having set up a flood protection centre.

The process of public engagement was continually reviewed and the need to consider and take account of differing perspectives was identified. One view was that the provision of regular and comprehensive information would be sufficient. Another was that the public ought to be able to help develop and work on design concepts. However it needs to be recognised that it is the politicians that ultimately take the decisions on the measures to be taken, and proposals put forward by local members of the public do not necessarily correspond to what the politicians would like to see from a city wide perspective. Against

this background, an ideal solution would be to listen to and take note of the wishes of the public by way of a workshop held at the beginning of the planning process – provided that the public is already interested and has been provided with all the relevant background information at that point in time. In addition, working parties within the framework of the planning process in which the affected members of the public put forward their ideas, wishes and concerns could raise the degree of acceptance among the citizens for "their" measures. However, the formal line of procedure is regulated by law, in which the participation of the public is also provided for – and the laws have to be adhered to.

### 3.3 Conclusions

Within the framework of the processing of possible solutions for the *Leinebogen* river bend, it has become very clear that a city-wide concept for improving flood protection makes sense and is necessary. In particular the interaction between flood risk zones and the necessity to set priorities for the elimination of weak spots have to be addressed. Initially, the *Leinebogen* project was seen as involving "simple" and "speedy" measures, an opinion

which has since proved to be incorrect after the details had been considered. In the light of the increased outlay for the realization of a measure and thus, as a rule, higher costs for the implementation, the question arose as to whether the resources (personnel and funding) for the planning and implementation of flood protection measures in the urban area could be used differently and more effectively.

Parallel to the case study an analysis was of the flood risk zones within the urban area was carried out within the framework of flood risk management planning. On this basis it makes sense to re-assess and prioritize the *Leinebogen* measure in comparison with the other measures.

The participation of various specialist disciplines in the planning process was a positive experience for all concerned, since it was possible to make the individual partners' problems and constraints more comprehensible and transparent.

### 3.4 Recommendations

Two concrete recommendations can be derived from the work on the *Leinebogen* measure:

- Individual measures should be derived from the overall strategy and developed accordingly, and
- the participation and involvement of various specialist disciplines makes for interesting and new planning concepts and makes for a better understanding of each other.

## Sources

Mzyk and Tantau, 2011: "Hannover macht blau, urbane Flusslandschaften entwerfen"; BM18 documentation; Specialist project in WS 2010/11; Leibniz University Hannover, Faculty of Architecture and Landscape, Institute for Open Space Development