



**Programme of Measures  
2006 – 2015**





**DI Josef Pröll**  
Federal Minister of Environment and Agriculture

## Flood Protection Measures in the City of Graz. Efficient, Near-natural and Sustainable.

Water is the basis of all life and a threat at the same time. Averting the hazards of nature through flood protection measures and, at the same time, creating new habitats in water bodies and in their proximity presents a special challenge to water management.

The necessary holistic approach in implementing state-of-the-art flood protection projects requires that municipalities, citizens, land owners and planners develop a new and better understanding of technology and ecology. The City of Graz has demonstrated that it is aware of the importance of water and water bodies by launching a long-term special programme “The Streams of Graz” and has responded to this change of values by realising a number of flood protection measures in recent years.

The scheme of preventive flood control which is being

planned for the city of Graz aims on the one hand at protecting settlement areas and on the other at creating the basis for new wetland habitats. Both objectives together are signs of the city’s new understanding of water management and will help to safeguard a sustainable future for the city.



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**Johann Seitinger**  
Regional Minister of the Land of Styria

Streams and flowing water bodies in urban areas tend to be neglected and are hardly recognised by the population any more. It is only in the event of a flood that they are all of a sudden perceived as a menace.

In the urban areas of Graz, the flood events of August 2005 showed very dramatically the vast damage which even small streams may cause to settlement areas. With the special programme "The Streams of Graz", a forward-looking approach has been adopted, seeking on the one hand to ensure the best possible protection against floods by technical measures and on the other incorporating all elements of state-of-the-art flood management from early warning systems to optimised disaster relief strategies.

In pursuing the goal of improving the ecological situation of water bodies and by taking appropriate water design measures, the population of Graz should be reminded again of the existence of its streams as a space to live with and as a space to experience. Seeking the optimal combination between the protective and the utility functions should become a hallmark of modern protective water management and bring the streams of the city of Graz back to life.

Graz is not only a green city, but with its 52 name-bearing streams and numerous small channels it is also a city by the water.

This offers many and diverse opportunities to enhance the quality of life in our city. At the same time, however, these intra-urban waters also entail a considerable potential of danger in their wake, as demonstrated very dramatically by the flood events in August 2005.

Against this background, the City of Graz and the Land of Styria have launched a special programme which is dedicated to the streams of Graz and which will be one of the most challenging infrastructure projects of the capital city in the coming decade. Major efforts have already been invested in planning and first key steps undertaken towards realisation in the framework of this near-natural flood protection programme.

The fourth Enquete on the Streams of Graz, which is chiefly focussed on this special programme, provides the opportunity to take stock of what has been achieved so far as well as to give an idea of what still lies ahead of us.



**Gerhard Rüschi**  
City Councillor

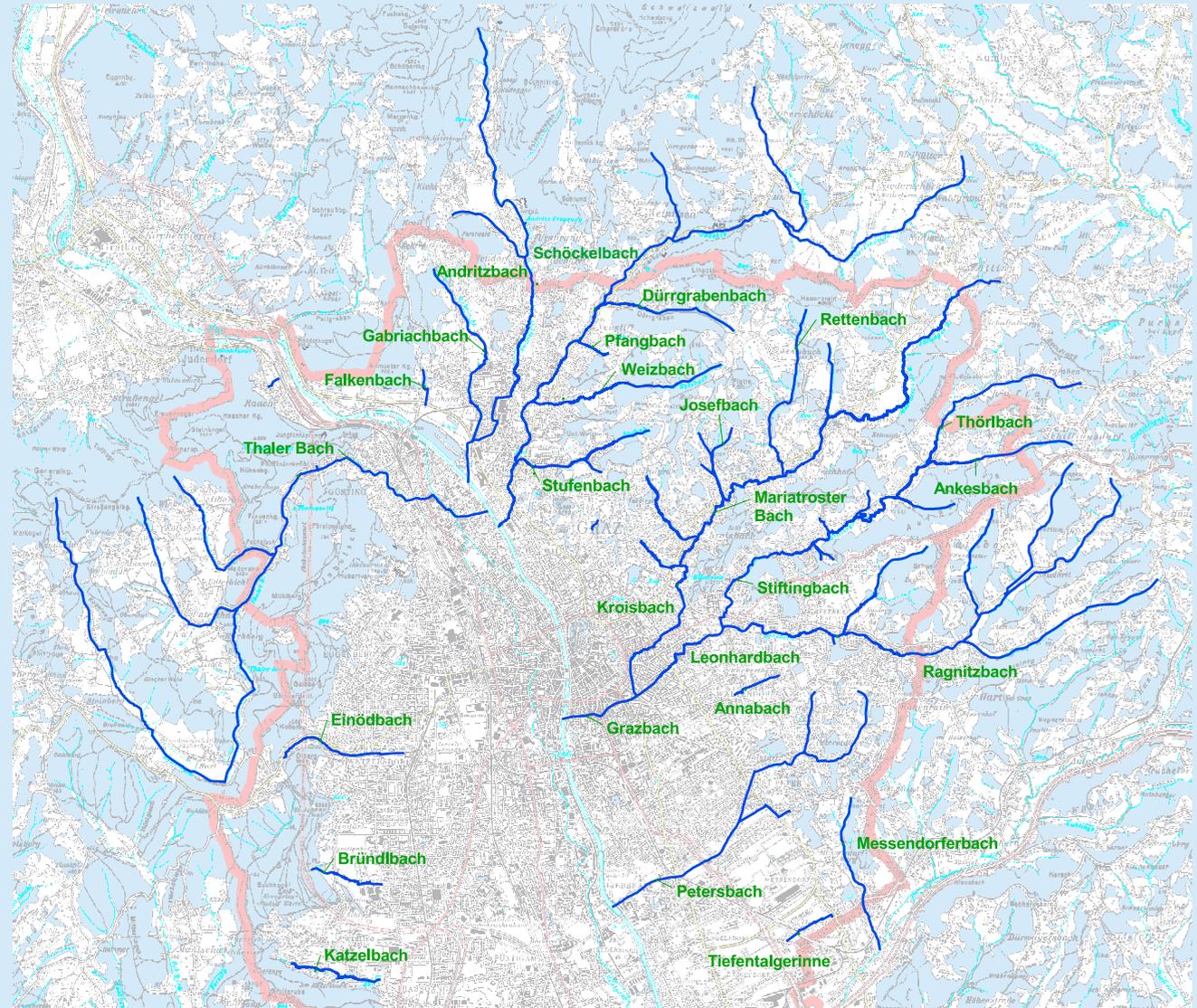
# The Streams of Graz

As many as 52 “name-bearing” streams and numerous small channels and ditches exist in the city of Graz. The streams of Graz have a total length of about 270 km, of which some 125 km are located within the urban area of Graz. This means that only half of their entire catchment area of 140 km<sup>2</sup> lies in the city itself.

In former days, streams were cheap and simple routes for the disposal of faeces and waste produced by the city’s residents. As the municipal sewer system was built to improve the hygienic situation, streams were encased, piped or fed into the sewers, especially in the city centre. On the outskirts they remained largely open. However, since the areas in the proximity of these streams were increasingly built up, their beds became more and more contracted in width. Today, the streams present themselves in greatly differing conditions – from naturally flowing sections to concrete ducts.



 Gabriachbach stream, flooding of Hoffeldstrasse on 21 August 2005





**Andritzbach stream**, flooding of Satteggerstrasse on 21 August 2005

During the past few decades, settlements have spread continually to areas close to the streams, as a consequence of which the hazard potential along the streams of Graz has grown continually as well.

The “**Special Programme – The Streams of Graz**” is a project of the Federal Ministry of Agriculture and Forestry, Environment and Water Management (BMLFUW), the Land of Styria and the City of Graz and is designed to run for a period of ten years.

Its elements are:

- Flood protection for endangered zones in Graz based on a catalogue of measures as coordinated with spatial planning.
- Improvement of the ecological status of the streams of Graz.
- Turning the streams and their adjacent space into nearby recreational areas for the population where they can reconnect with nature.

## Objectives

Documentation on flood events in Graz can be traced back to the year 1573. In the past three decades and in particular in 1975, 1989, 1996 and 2005, Graz was repeatedly the victim of major floods. The damage caused by the 2005 flood event alone amounted to some five million euros. Discharge measurements performed in 1997 showed that more than 1,000 buildings would be endangered in the urban area of Graz in the event of a flood with a return period of 100 years ( $HQ_{100}$ ).

### Main problems

- The streams are no longer able to fulfil their ecological functions or can fulfil them to a very limited extent only.
- The flood discharge capacity of the contracted streams is insufficient.
- They can hardly be experienced any more by the population and do not offer space for recreational activities in the city.



**Schöckelbach stream**, flooding of the district centre of Andritz (several hundreds of metres from the Schöckelbach stream on 21 August 2005

- They are partly concealed in pipes and are partly fed into the public sewer system.

### Main goals

The endangered settlement areas are to be protected as far as possible against floods. While protection up to an event of  $HQ_{100}$  is striven for, space constraints do not permit this everywhere. Damage to objects is to be prevented by these protective measures in the future. Existing inundation areas must be preserved and extended, if possible. The streams of Graz should be turned back into nearby recreational areas for the city's residents wherever this is reasonable, and made accessible more easily.



**Petersbach stream**, flooding of the Banngrabenweg settlement on 21 August 2005

# Flood Protection

Flood protection measures are elaborated in close co-operation with experts in the fields of spatial planning, ecology and urban water management.

## General

The flood protection measures were planned chiefly on the basis of discharge studies performed in 1997. The findings obtained then were complemented by the flood data of August 2005. The current status is documented by the existing high water marks of  $HW_{30}$  and  $HW_{100}$  as well as by the Red and Yellow hazard zones



**Precipitation discharge modelling** with catchment areas and sub-basins and different forms of land use

as identified by the Austrian Service for Avalanche and Torrent Control (WLV). These data were updated only in case of substantial changes in general conditions.

After evaluating stream inspection tours and analysing the 2005 flood events and existing deficits, state-of-the-art measures of flood control could be developed. The individual projects were coordinated and optimised in workshops and through an intensive exchange of results with spatial planning and environmental experts, attempting to assess the effects of flood protection measure on existing inundation areas and to determine which level of protection could be provided by individual streams or partial sections of streams, once the measures were implemented.



**Schöckelbach stream**, footpath and cycle path Peneffgründe, flood on 21 August 2005.

## Hydrology and precipitation discharge model (P-D model)

To provide a basis for the dimensioning of the flood protection measures, P-D models were established for all catchment areas of the streams of Graz. When planning retention basins, it is crucial to know the relationship between precipitation and the discharge capacity of a given stream. This means that flood protection measures are planned on the basis of P-D models. These include the frequency and intensity of precipitation, how long characteristic precipitation lasts, information on the topography, and how quickly the streams are able to discharge the water. By changing these models, different conditions are simulated.



**Cycle path Peneffgründe**, comparative picture without flood

## Retention and linear measures

Protective measures against floods include retention structures as well as projects to improve the water regime, also called linear measures. Retention basins decrease discharge to a certain extent. The sections further downstream are thus able to cope more easily with the remaining discharge, and there is no risk – up to the desired level of protection – that the stream will burst its banks. Flood peaks are thus mitigated.

The 2006 programme proposed that 29 retention basins be provided, seven of them even outside the urban area of Graz. As far as protective measures along torrents are concerned, bedload and wood debris transported by the water are a matter of special concern. Retention areas and flood plains are zones along water courses into which floods may spread without presenting a hazard. These zones are hardly to be found any more in the city of Graz. Wherever they still exist, they must, by all means, be kept free from any development.

If the discharge capacity downstream of flood retention basins is not sufficient to safely drain the flood, additional linear measures have to be taken to provide the necessary protection. These include:

- widening of the streambed
- raising the embankment or the adjacent terrain
- removing discharge obstacles
- pruning streamside vegetation and removing narrow passes

In certain cases, linear measures are taken without providing an upstream flood retention basin.

Meanwhile, the following projects have been completed: the flood retention basins “Schirmleiten” and “Am Eichengrund” on the Gabriachbach stream and the linear improvement works at St. Veiter Straße / Gustav-Klimt-Weg as well as the works for the combined infiltration and retention basin on the Einödbach stream. Construction work for further protective measures along the Einödbach stream and for the first building phase

on the lower course of the Schöckelbach stream will commence shortly.

Planning and preparatory work for a variety of measures are in progress for the Schöckelbach stream, the Andritzbach stream, the lower course of the Gabriachbach stream, the Stufenbach stream, the Mariatrosterbach stream, the Bründlbach stream, the Petersbach stream, the Thalerbach stream and the Falkenbach stream. (Status: end of September 2007)



 Messendorferbach stream with settlement area and planned flood retention basin

## Alarm and disaster contingency plans

Provided the general conditions permit it, technical flood protection measures provide safety up to an  $HQ_{100}$  event. For events of greater magnitude, the “Special Programme - The Streams of Graz” seeks to optimise alarm and contingency plans. The objective is to be prepared for these disasters and to respond to them as early and as efficiently as possible. These plans lay down the time sequence at which the respective authorities have to be informed, where relief teams are to be deployed and, above all else, when the residents who are likely to be affected are alerted and evacuated, if necessary.

## Cost estimate

According to today’s estimates, the total costs for flood protection measures along the streams of Graz will amount to approximately 65 million euros. Of these, about 59 million fall within the responsibility of the Federal Water Management Administration of Styria and roughly 6 million euros within the responsibility of the Austrian Service for Torrent and Avalanche Control. When dividing up the total cost between retention measures and linear measures, the ratio is about 39 million euros for retention measures to about 26 million euros for linear measures.

## Prioritising

The necessary measures are implemented according to priority. Depending on their damage potential, the individual streams are assigned to different categories of urgency.



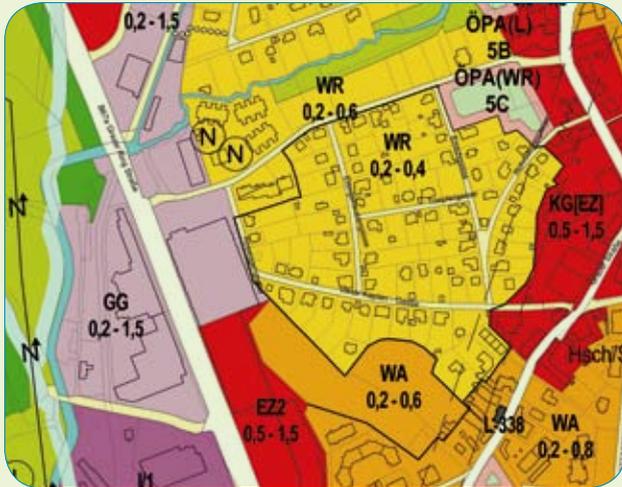
## Spatial Planning - Urban

The discharge measurements performed in 1997 on the streams of Graz revealed that both open spaces and areas already built-up or designated as building ground would be massively affected by floods having a return period of 30 and 100 years respectively. Equally, the hazard zone map drawn up by the Austrian Service for Torrent and Avalanche Control have shown extensive settlements areas to be located in Red and Yellow hazard zones. Considering this fact, the following recommendations suggest themselves:

## Revision of Master Plan 3

All planned retention basins (primary and secondary options) should be defined as priority areas for protective water management measures. Open areas within the existing  $HW_{100}$  high water marks (discharge study Graz streams 1997) should be identified accordingly to ensure that they remain free as priority areas for the discharge of floods and as inundation zones.

# Development



## Changes in the land-use plan

To set aside these areas, retention basins and retention zones should be assigned to the category 'open space with special uses' and, in part, additionally designated as 'reservation areas'. Depending on the level of protection which is to be achieved until protective measures have been implemented, building land, development areas and open space with special uses are to be distinguished in the land-use plan according to the system in use.

# Open Space Planning

Flowing water bodies such as the streams of Graz are very important spaces, especially in densely built-up urban areas, where people can spend their leisure time and indulge in recreational activities. However, at the moment these spaces cannot be used at all or to a very limited extent only. The reasons are that the streams are partly in a very poor ecological state, are difficult to reach and have little to offer in terms of natural amenities.

To remedy these deficits, proposals have been elaborated for so-called 'development and/or design sections' along the streams.

These should allow the population access and enjoy the streams actively and safely. Plans are to make various stream sections easily accessible, provide for



places to rest, and allow children to experience fun and adventure.

One of the chief goals pursued by the special programme "The Streams of Graz is to design them to fulfil these functions once more. However, in order to achieve this, the eco-morphological conditions of the various stream sections need to be improved first.

So far, drafts have been elaborated for twelve select sections which can already be accessed via footpaths or cycle paths.



# Water Ecology

The zones where the Schöckelbach stream, the Andritz stream, the Thalerbach stream, the Auenbach stream and the Petersbach stream flow into the River Mur are to be converted to render them passable once more so that fish and other species can use the ecological potential of these streams.

The streams of Graz could thus again become a habitat, spawning ground and sanctuary for fish fauna, functions, which they do not fulfil or fulfil only very poorly at present, since they run partly in pipes or are provided with bottom or fall structures at their mouths, which act as barriers for fish and other fluvial wildlife.

The current water-ecological status of the streams of Graz was mapped on site and evaluated. Existing maps and data were adopted and verified.

Experts in flood protection and ecology evaluated jointly whether the sites intended to serve as flood retention basins were suited from the perspective of water ecology, focussing on the question how to maintain or how to restore the continuity of flow, how to structure the streambeds and how to improve shores and embankments.



 Mariatroster Bach



 Kroisbach



 Zugangsbereich Leonhardbach



 Weizbach



**Erlebnisraum Bach** - school project Petersbach stream



**Andritzbach stream** with drop structure and hard control works, conversion in the framework of the Special Programme – The Streams of Graz



## Résumé

The “Special Programme - The Streams of Graz” aims to achieve the following:

- improving flood protection for Graz
- enhancing the safety for the population
- improving the ecological condition of “The Streams of Graz”
- improving the quality of life in the city by creating and upgrading nearby recreational areas.

This requires a coordinated approach of the Federal Water Engineering Administration for Styria, the Austrian Service for Torrent and Avalanche Control, the City of Graz and of all institutions concerned with the city’s streams. It is important to seek to reconcile the diverse interests and intentions concerning the “Streams of Graz” and to involve the population of Graz.

As about half of the catchment area of “The Streams of Graz” lies outside of Graz, the surrounding municipalities are important partners in implementing the flood protection measures for the urban area of Graz.

State-of-the-art flood protection helps to enhance safety for the population. The synergies which arise by implementing the projects can be exploited to improve the ecological status of the “Streams of Graz” and turn formally unsightly parts of the city into safe and attractive local recreational areas.

## Project Team

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