



BEST PRACTICE EXAMPLES

from South Bohemia

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The Region of South Bohemia

Our Project is funded by the Interreg CENTRAL EUROPE Programme that encourages cooperation on shared challenges in central Europe and is supported under the European Regional Development Fund.



BEST PRACTICE EXAMPLES FROM SOUTH BOHEMIA REGION

Date June 2020

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FACTSHEET RISK ASSESSMENT AND MAPPING ACTIVITIES

Critical points analysis

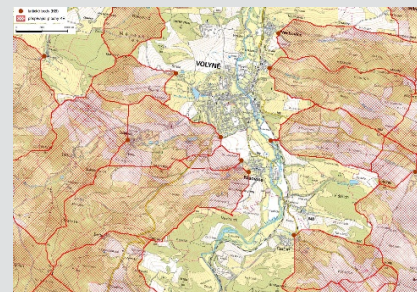
Where was it implemented?

Czech Republic, South Bohemia

Problem/background

The pilot areas have been chosen on the basis of the computation of critical points over the entire country, also taking into consideration recommendations given by the Regional Office of South Bohemia.

Map example:



Description of methodological background and outcomes

The methodology of critical points generally aims at the identification of urban (built-up) areas potentially endangered by concentrated surface runoff. The computation is carried out as follows:

- A digital elevation model (DEM) is used for the identification of the surface runoff direction.
- The accumulation of surface runoff is computed in order to delimit the pathways of concentrated surface runoff.
- The intersections of such pathways with the built-up areas are identified as preliminary critical points.
- Each intersection is an outlet of a contributing area of which basic parameters are analysed (mean slope, percentage of arable land). The contributing areas must not exceed 10 km².
- For each contributing area, a risk factor is calculated, based on statistical analyses of data from other experimental watersheds.
- The preliminary critical points of which the contributing areas exceed a given threshold of the risk factor, are finally selected as priority points.

Area and event characterisation

| | |
|---|---|
| Area type Semi-urban, rural | Topography Hilly |
| Land cover/land use distribution Arable land 40 % at least (may be less in case of steep terrain) | Event Not event-based |
| Receptors Urban areas | Flood type Flash flood, pluvial flood |

Specifications of method/measure and data demands and outputs

| | |
|--|---|
| Level of complexity | 2 |
| Addressed SPRC element | Pathway, Receptor |
| Method group | Empirical/geostatistical approach |
| Spatial scale(s) of application | National, dependent on DEM raster resolution (usually 1 to 5 m), maximum contributing area 10 km ² |
| Time scale/resolution | No temporal resolution |
| Input datasets (type and scale/resolution) | Digital Elevation Model (raster, 1 or 5 m) Land use data (vector) Urban areas (vector/raster) |
| Output datasets (type and scale/resolution) | Critical point and its contributing area |

| Description of implementation | |
|---|--|
| Implementation <ul style="list-style-type: none"> Created in 2009, used 09/2018-04/2019 | Users (reported/designated) <ul style="list-style-type: none"> Local communities, residents, municipalities, farmers, regional office |
| Initiator/responsible <ul style="list-style-type: none"> VÚV (PP5) | Involved stakeholders <ul style="list-style-type: none"> Municipalities, residents, land owners, farmers, spatial planners |
| Lessons-learned | |
| Main success factor: <ul style="list-style-type: none"> In some cases, the identified critical points confirmed existing problems with flash floods. | Main challenge: <ul style="list-style-type: none"> Accurate input data are required, especially in rapidly developing areas. Delineation of flow direction is very sensitive to small elevation changes in the DEM. |
| Synergies/beneficial aspects: <ul style="list-style-type: none"> Ease of application, relatively low demands regarding input data. | Conflicts/Constraints: <ul style="list-style-type: none"> Verification/corrections required (especially in relation to the delineation of urban areas). |
| Key message to others starting with a similar task | Contact |
| <p>Based on the previous experience, the most important factor influencing is the relevance of a critical point resides the accuracy of the delineation of the urban areas shapefile. Some cases have been recorded where the identification of critical points was not accurate due to too large areas classified as urban, and vice versa. Another factor that plays a role, is the resolution of the DEM raster, resulting in the accuracy of delineation of pathways of concentrated surface runoff.</p> <p>One issue should also be emphasised here. A critical point is an indicator of flash/pluvial flood hazard. It expresses an entry spot into an urban area that could potentially be endangered by surface runoff from a contributing area of which the parameters show that a specific area is prone to flash flood generation. The aim of the methodology is not to model the surface runoff through urban areas. Thus, it does not allow to conduct a flash flood risk mapping.</p> | <p>T. G. Masaryk Water Research institute, Mojmírovo nám. 16, 612 00 Brno, Czech Republic</p> <p>Pavla Štěpánková info@vuv.cz</p> |
| References | |
| <p>Methodology of the identification of critical points: http://www.povis.cz/mzp/KB_metodicky_navod_identifikace.pdf (in czech)</p> <p>The assessment of level of flash floods threat of urbanised areas: https://acta.mendelu.cz/media/pdf/actaun_2017065020519.pdf (in english)</p> | |

FACTSHEET RISK COMMUNICATION MEASURES

Lecture at the University of South Bohemia

Where was it implemented?

The South Bohemia Region, Czech Republic

Related to measure from the catalogue of measures

- Communication activities in education
- Visualisation and explanation of the specific risk situation at site

Target group

- Higher education and research



University Campus; Source: The Region of South Bohemia

Message

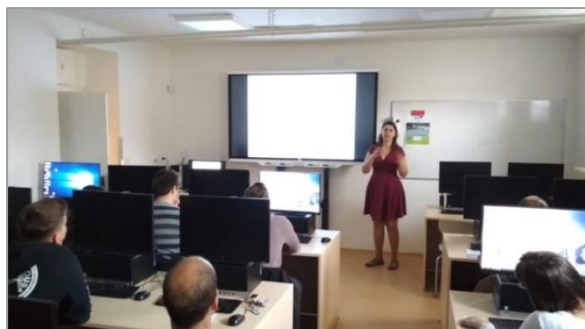
- Through practical demonstrations, students (future experts) gain a comprehensive view of the issue of protection the area from torrential rain.
- Thanks to the Catalog of measures, which summarizes measures from all countries involved in the project and was also presented at the meeting, participants get as well inspiration for solving flood problems from other countries.

Description and aim

The South Bohemian Region organized one lecture at University of South Bohemia. This meeting was organized for students of the fourth year of the study field “Ground Consolidation” and was held as part of the “Hydrology” course.

During this lecture, the RAINMAN project was presented to future experts in the field of water management activities. The first part of the meeting was devoted to basic information about the project. The project’s contents, objective, involved organisations, duration and the main output “RAINMAN-Toolbox” were presented. In the second part the general principle of spatial planning in the legal framework of the Czech Republic was introduced. This introduction was essential for the final discussion, because the main output of the RAINMAN project partner “The Region of South Bohemia” aims at linking professional water management outputs with land-use planning documentation. The next part of the meeting was focused on one of the pilot sites - Lipí. In this part of the meeting a comparison of a proposal developed by RAINMAN project partner “T. G. Masaryk Water research institute, p.r.i.” (professional water management solution designed based on the critical point method) with the applicable land use plans was presented.

The discussion with students was the last part of meetings. The aim was to spread awareness of the project and the issue of flooding caused by torrential rains among students who will be dealing with this topic in their future professional practice.



Source: The Region of South Bohemia, The Section of Territorial Planning

| | |
|---|--|
| Effect of measure | |
| The main effect of the activity is to enhance the awareness of the project and the issue of floods caused by torrential rains among students who will be dealing with this topic in their future professional practice. | |
| Description of implementation | |
| Effect horizon: short-term | Involved stakeholders: students, future experts |
| Implementation: 10 th April 2019 | Initiator / responsible The Department of Regional Development, Spatial Planning and Building Regulation |
| Lessons-learned | |
| Main success factor: Thanks to the involvement of different institutions from six different countries in the RAINMAN project, it was possible to train (approach) the experiences of other countries with problematic flood protection and to increase students' awareness of possible solutions and enable them to build on this knowledge in their future jobs. | Main challenge: The main challenge was to explain to hydrology students the key issue of implementing measures to reduce the risk of heavy rain in municipal plans. During this lecture we tried to show these interdisciplinary links and to explain to the students the basics of spatial planning within the legislative framework of the Czech Republic. |
| Synergies / beneficial aspects: From the students' reactions it became clear that it is necessary to confront the knowledge gained from the theory more often with real situations. | Conflicts / Constraints: Students identified as one of the basic problems the lack of funds for implementing flood protection measures. |
| Key message to others starting with a similar task | |
| „Sensitizing students and future experts in the field of heavy rain risks is very effective, as students are receptive and open to new topics. It is important to explain these problems in practical demonstrations and to emphasize the necessity and usefulness of the topic.” | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |

FACTSHEET RISK COMMUNICATION MEASURES

Trainings on implementing the developed tools within the pilot regions in South Bohemia

Where was it implemented?

The South Bohemia Region, Czech Republic

Related to measure from the catalogue of measures

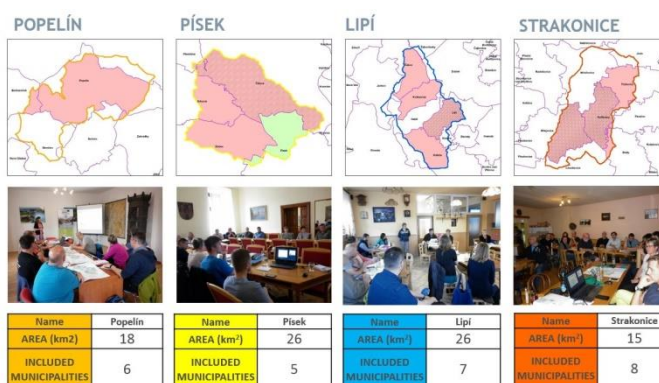
- Interactive communication and participation formats

Target group

- Mayors, local farmers, general public

Message

- Mayors and farmers have a lot of important information about local conditions
- Local target groups appreciate the possibility to discuss with experts and to learn about scientific approaches how to reduce risks of heavy rain



Source: The Region of South Bohemia, The Section of Territorial Planning

Description and aim

The South Bohemian Region, in co-operation with the Research Institute of Water and the Architecture Studio Štěpán, organized four public discussions in pilot areas. The public discussions took place from 20 to 23 May 2019.

Each meeting consisted of a presentation and a discussion. The first part of the meeting was devoted to basic information about the project. The project's contents, objective, involved organisations, duration and the main output "RAINMAN-Toolbox" was presented.

In the second part of the meetings the Water Research Institute (VÚV) explained professional water management solutions based on the critical point method for each of the four pilot sites on the basis of the critical point method. With the critical point methods areas, which are expected to be at high risk of losses in built-up and undeveloped areas in the event of heavy rain, have been identified. For each of these pilot sites, VUV carried out an evaluation of the outflow conditions at the location and proposed risk reduction measures. These outputs build the basic for the "Study of applicability of risk reduction measures in spatial plans" conducted by the Architecture Studio Štěpán under the guidance of the RAINMAN project partner "The Region of South Bohemia". Experts of urban planning and water management presented a comparison of the proposal developed by VÚV with the applicable land use plans.

The discussion with mayors of municipalities and local farmers was the last part of meetings. A lot of important data about local conditions were heard in the discussions.



Source: The Region of South Bohemia, The Section of Territorial Planning

| | |
|---|--|
| Effect of measure | |
| The main effect of the activity is to enhance the awareness of the project and the issue of floods caused by torrential rains among mayors and inhabitants of the municipalities and explain to them possibilities of how to solve the problems with heavy rain events in their own villages/cities. | |
| Description of implementation | |
| Effect horizon: short-term | Involved stakeholders: mayors of municipalities, local farmers, general public |
| Implementation: 20 th - 23 rd May 2019 | Initiator / responsible The Department of Regional Development, Spatial Planning and Building Regulation |
| Lessons-learned | |
| Main success factor: From the knowledge gained during the public hearings it became obvious that the organization of these negotiations was of great importance to the pilot sites. Expert outputs prepared by the Water Research Institute for individual pilot sites were explained to mayors of municipalities and local farmers, thus raising awareness of possible solutions to reduce risks of heavy rain events. | Main challenge: The most difficult thing was to convince the locals that cooperation with experts and the adaptations of spatial plans are important steps for the successful implementation of flood protection measures. |
| Synergies / beneficial aspects: Mayors of municipalities and farmers have a lot of important information about local conditions, that cannot be found anywhere else. | Conflicts / Constraints: It is important to raise people's interest in the issue (e.g. in the form of leaflets on the public boards of municipalities) and to organize discussions directly in the locality in order to facilitate public participation as much as possible. If this fails, the effect of public hearings can be very small. |
| Key message to others starting with a similar task | |
| „It is important to get in contact to local people and discuss with them. Concrete local risks of heavy rain as well as good practice examples on how to mitigate the risks should be addressed.” | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |

FACTSHEET RISK REDUCTION MEASURES

Realization of the culvert in the municipality of Lipí (Pilot area Lipí)

Where was it implemented?

Village Lipí, District České Budějovice
(South Bohemia, Czech Republic)

Fields of action

- Watercourse, farmland, settlement area

Related to measure from the catalogue of measures

- Linear protection measures (no 42 / R15)
- Culverts - suitable hydraulic design (no 97)
- Barrages (no 17 / A07)

Area characterisation

- **Area type:** built up area
- **Landscape type:** stream bank



View of the existing culvert under the bridge
Source: Mapy.cz

Problem

In case of torrential rains from the Dehtářský creek, the existing culvert under the road has not sufficient capacity and clogging and wetting of the land north of the culvert occurs.

Description and aim

The need to regulate the Dehtářský brook is mentioned in the spatial plan of the municipality of Lipí, more precisely in the section between the football field and the proposed capacity increase of the culvert on the Dehtářský creek on the road III/14319 on the western edge of the Lipí settlement. The solution is based on the construction of a tubed bypass channel located behind the culvert, because increasing the capacity of the culvert itself would mean building a new bridge including the technical infrastructure. In case of heavy rainfall, the bypass channel helps to partially relocate the excess water, thus relieving the bed of the Dehtářský brook in this section. The bypass channel is again connected to the stream, but at a point where the stream can take larger discharges. In connection with this measure, the bed of the Dehtářský brook was modified and small barrages were built in the section from the culvert to the football field.

Effect of measure

A tubed bypass channel was built along the existing culvert, which relieves the bed of the Dehtářský brook at this point from heavy rainfall. The current culvert and respectively the bridge of the road III/14319 could be preserved in its present form.

Description of implementation

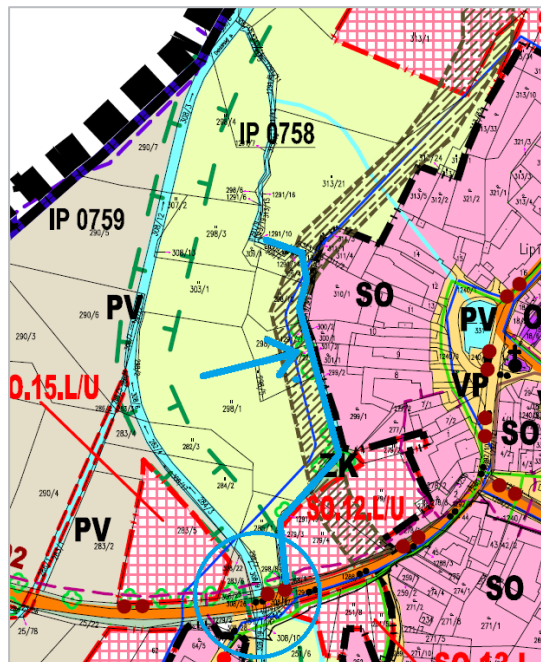
Effect horizon:
long-term

Involved stakeholders:
Landowners, road owner

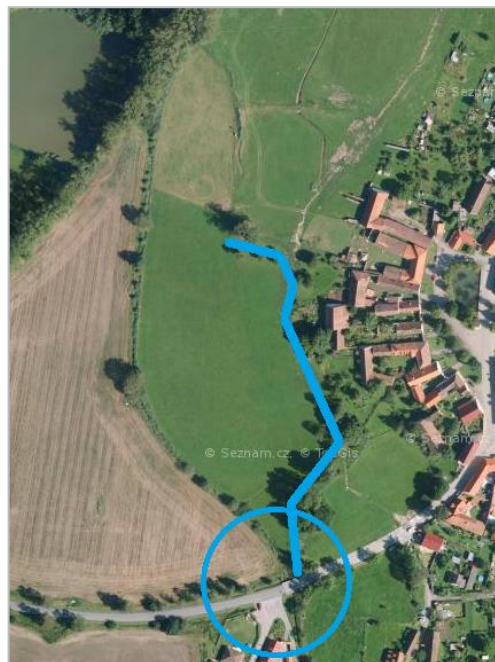
Implementation:
before 2014

Initiator / responsible:
Village Lipí

| Lessons-learned | |
|---|--|
| Main success factor: Effective communication of interested parties, their awareness and willingness to accept the proposed technical solution. | Main challenge: Develop a technical solution that does not interfere with the construction of the existing bridge (culvert) and agree a solution with the parties concerned. |
| Synergies / beneficial aspects: Protection of property of adjacent land owners, protection of agricultural land from waterlogging. | Conflicts / Constraints: Ensuring the appropriate dimension and location of the bypass channel, agreement with landowners. |
| Key message to others starting with a similar task | |
| The flood protection measures must be designed according to the individual conditions ascertained by the field survey. A suitably selected measure with the correct technical parameters can also mean financial savings. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |



Cut-out of zoning plan with drawing of drainage pipeline
(source: The Region of South Bohemia, The Section of Territorial Planning)



Bird view
(source: Mapy.cz)



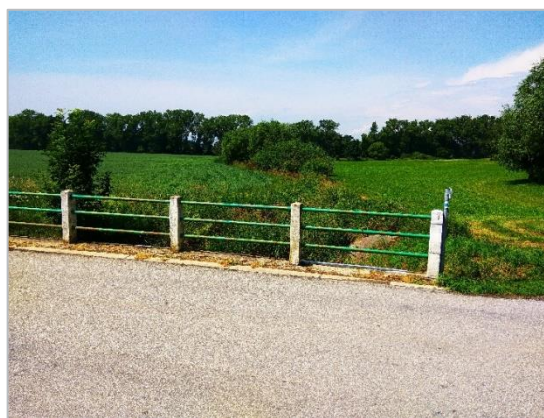
Relief pipe at culvert
(source: The Region of South Bohemia, The Section of Territorial Planning)



Culvert on the road III/14319
(source: The Region of South Bohemia, The Section of Territorial Planning)



Southward view from the culvert
(source: The Region of South Bohemia, The Section of Territorial Planning)



View from the culvert in the direction of the Dehtářský stream, in the north direction
(source: The Region of South Bohemia, The Section of Territorial Planning)



Bed of the Dehtářský stream, the relief pipe is located on the right
(source: The Region of South Bohemia, The Section of Territorial Planning)

FACTSHEET RISK REDUCTION MEASURES

Building the baulk near the village Kuřimany (Pilot area Strakonice)

Where was it implemented?

Village Kuřimany, District Strakonice (South Bohemia, Czech Republic)

Fields of action

- Farmland

Related to measure from the catalogue of measures

- Baulks (no 15 / A04)

Area characterisation

- **Area type:** undeveloped area
- **Landscape type:** farmland

Problem

In case of torrential rains, soil erosion occurs and thus the cultivated soil is degraded.



The realization of a baulk in the village Kuřimany
Source: The Region of South Bohemia, The Section of Territorial Planning

Description and aim

The site is located on a sloping terrain. During a heavy rain event there was an erosive wash from the higher-lying neighbouring plot to the owner's plot. This owner therefore built a baulk at the edge of the farmland, which reduces surface runoff and prevents erosion of the washes, thus helping to safely drain the runoff during increased rainfall events. Moreover, this risk reduction measure has been enriched by appropriate planting, where trees help to increase the ecological stability of the landscape. It also serves as a measure against wind erosion and divides the soil block according to its land use (respectively according to land owners).

Effect of measure

The measure will prevent surface runoff which damages agriculturally cultivated soil, divides the soil block according to the way of use and is also a measure against wind erosion. Overall, this improves the soil used and the development of natural values.

Description of implementation

Effect horizon:
long-term

Involved stakeholders:
land owner, neighbouring owners

Implementation: 2018

Initiator / responsible
private investor

Lessons-learned

Main success factor:
Ensuring flood protection of the location with permanent effect.

Main challenge:
Preparation of flood control measures to make them functional and acceptable by the owner of the neighbouring property.

Synergies / beneficial aspects:
Soil protection and thus better yield possibilities.
Increasing the ecological stability of the landscape.

Conflicts / Constraints:
Scope of landscaping, financial costs.

Key message to others starting with a similar task

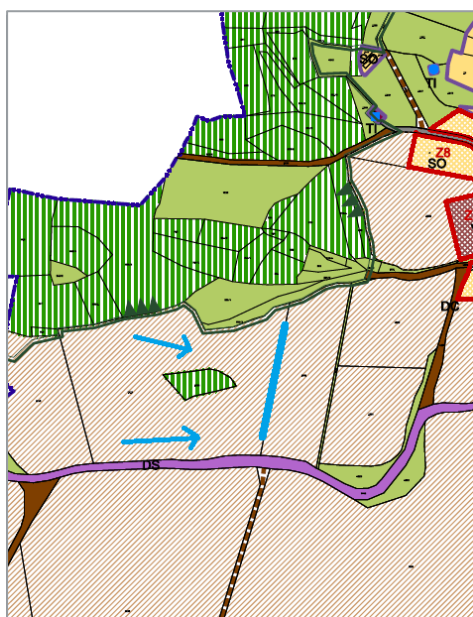
When cultivating agricultural land, it is important to think of the appropriate division of land blocks so as to ensure ecological stability of the landscape. This division can be done, for example, by a baulk, which can be enriched by planting shrubs or trees. The measure can be costly, but it will increase the value of land and will also benefit future generations of owners in the long term.

Contact

The Region of South Bohemia, The Section of Territorial Planning

www.kraj-jihocesky.cz

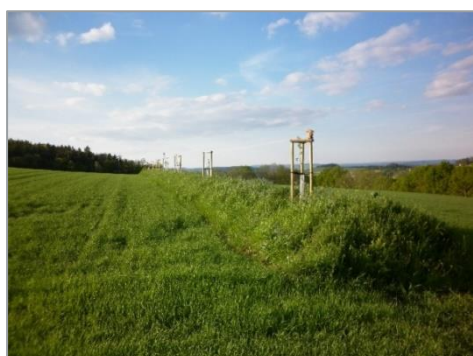
Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94



Part of the spatial plan with proposal of the baulk and erosion flow
(Source: The Region of South Bohemia)



Satellite view
(Source: Mapy.cz)



View to the baulk with planted trees
(Source: The Region of South Bohemia)



View of the former state before realization of the baulk
(Source: Mapy.cz)

FACTSHEET RISK REDUCTION MEASURES

Design of water reservoirs in Horní Olešná (Pilot area Popelín)

Where was it implemented?

Village Popelín, District Jindřichův Hradec
(South Bohemia, Czech Republic)

Fields of action

- Watercourse, farmland, settlement area

Related to measure from the catalogue of measures

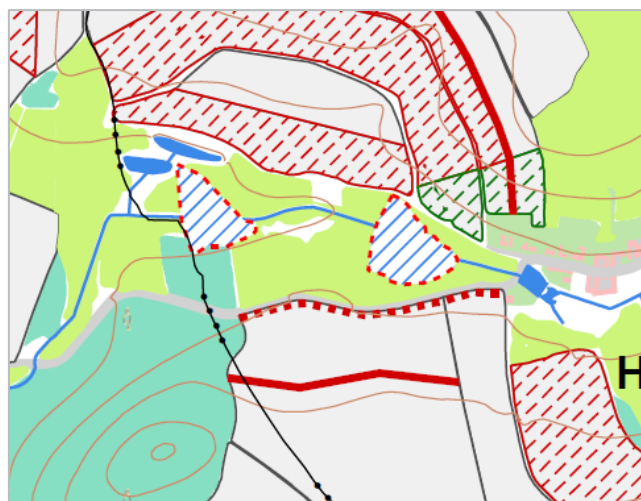
- Small retention reservoirs (no 31 / R02)

Area characterisation

- **Area type:** Undeveloped area
- **Landscape type:** Farmland

Problem

In case of torrential rains, the flow in the brook is increased and thus the lower-lying plots are endangered by soil runoff and landslides.



Study of runoff conditions including design of possible conservation measures in pilot areas (Source: The Research Institute of Water Management T. G. Masaryk, v.v.i. (VÚV))

Description and aim

The locality consists of a grassy land through which the Olešná stream flows. The proposed measure aims to increase the retention capacity of the area in order to slow down runoff during torrential rains and increase the ecological stability of the landscape.

The Research Institute of Water Management T. G. Masaryk, v.v.i. (VÚV) assessed the original spatial plan that includes the location of water reservoirs and confirmed the suitability of this proposal. The current spatial plan of the municipality of Popelín (Horní Olešná is part of this administrative territory), proposes a revitalization of the Olešná watercourse in this locality, where these water reservoirs are also planned to be built. Also a study of the applicability of flood control measures into land use plans evaluated the planned location of the water reservoirs. The study showed for one of the reservoirs a conflict (collision point) with a conceptual solution in the spatial plan (see the collision point HO-1, figure on page 2). The study recommends examining this collision in the spatial plan so that the reservoir can be subsequently realized.

Effect of measure

The implementation of water reservoirs will lead to a reduction of water flow during heavy rain events and will contribute to greater ecological stability of the landscape.

Description of implementation

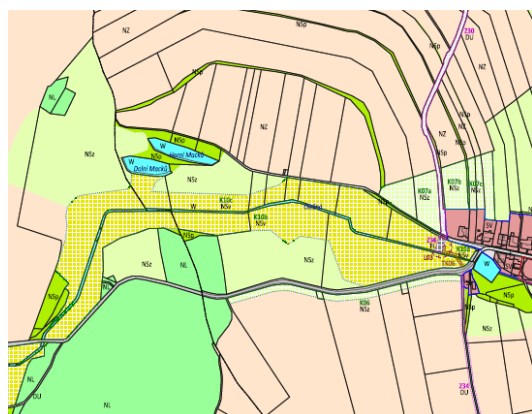
Effect horizon:
long-term

Involved stakeholders:
land owner, neighbouring owners

Implementation:
proposal - not implemented

Initiator / responsible
private investor/municipality

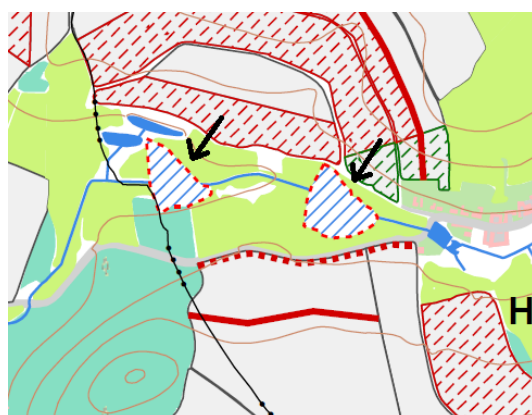
| Lessons-learned | |
|---|--|
| Main success factor: Ensuring flood protection of a large area. | Main challenge: Suitable design of reservoir, retention capacity, planting. |
| Synergies / beneficial aspects: Increase of landscape stability during heavy rain event and its diversity. | Conflicts / Constraints: Range of landscaping (terrain work), financial costs. |
| Key message to others starting with a similar task | |
| Rainfalls often have an impact on increasing water volumes in adjacent watercourses. This should be taken into account when revitalising watercourses. In the event of heavy rain, watercourses should be able to take up, retain or slow down the volume of water. For this purpose, small water reservoirs along the stream are proposed. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |



Spatial plan Popelin with the revitalization of the Olešná watercourse (source: The Region of South Bohemia, The Section of Territorial Planning)



Orthophoto location (source: Mapy.cz)



Proposal of water management measure
- small water reservoirs
(source: The Research Institute of Water Management
T. G. Masaryk, v.v.i.)



Evaluated collision site HO-1 with zoning plan
(source: Architectural Studio Štěpán)



West view to the planned location of both water reservoirs in Horní Olešná (source: Mapy.cz)

FACTSHEET RISK REDUCTION MEASURES

Proposal of the interaction element - Baulk near Drhovle (Pilot area Písek)

Where was it implemented?

Village Drhovle, District Písek (South Bohemia, Czech Republic)

Fields of action

- Farmland

Related to measure from the catalogue of measures

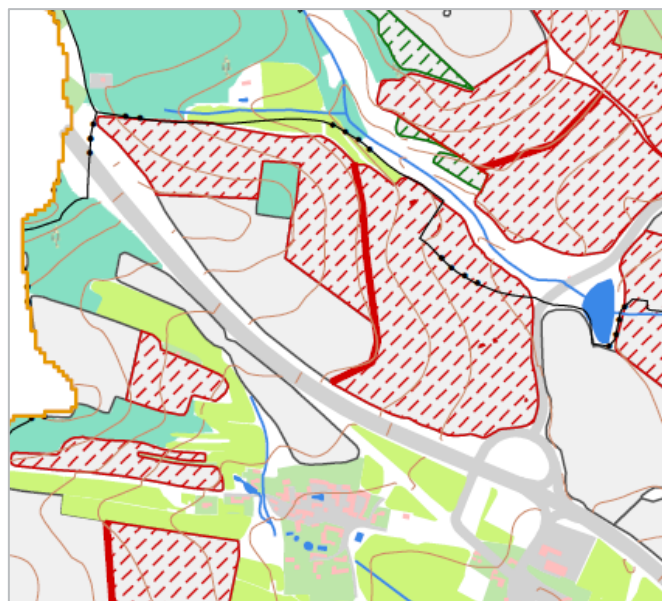
- Baulk (no 15 / A04)
- Field subdivision (no 5 / A17)
- No or low tillage incl. mulching and direct seeding (no 7 / A03)

Area characterisation

- **Area type:** undeveloped area
- **Landscape type:** farmland

Problem

In the event of torrential rains, soil erosion occurs and thus the cultivated land is degraded.



Study of runoff conditions including design of possible conservation measures in pilot areas (Source: The Research Institute of Water Management T. G. Masaryk, v.v.i. (VÚV))

Description and aim

The site is a large block of farmland where heavy rainfall can cause erosion washes. These can then cause damage to the drainage system of the road or flood the road itself. On this piece of land the Research Institute of Water Management T. G. Masaryk, v.v.i. (VÚV) has designed a baulk as a flood protection measure. The baulk limits the soil block and thus helps to increase ecological stability. Furthermore, VÚV proposed a protective soil management (especially sowing into a protective crop, stubble, mulch or post-harvest residues). This often accompanied by limited tillage.

The roughened surface of agricultural land slows down surface runoff and improves the conditions for infiltration of precipitation. For the implementation of anti-erosion agricultural technologies, it is recommended to use post-harvest or intermediate crops, which are partially incorporated by soil cultivators.

Effect of measure

The measure reduces surface runoff and reduces damages of farmland. It is also a measure that mitigates wind erosion. Overall, this improves the quality of farmland and develops natural values.

Description of implementation

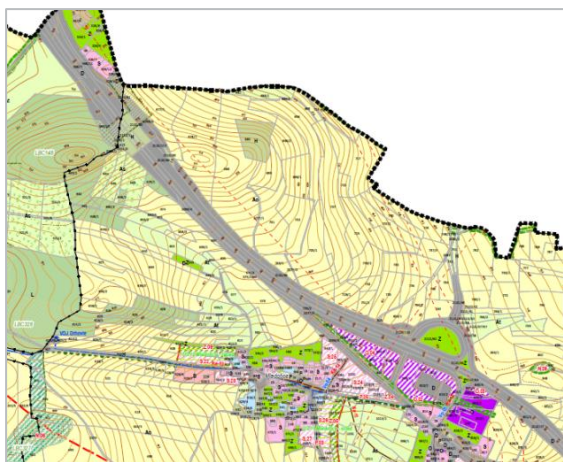
Effect horizon:
long-term

Involved stakeholders:
land owner

Implementation:
proposal - not implemented

Initiator / responsible
private investor

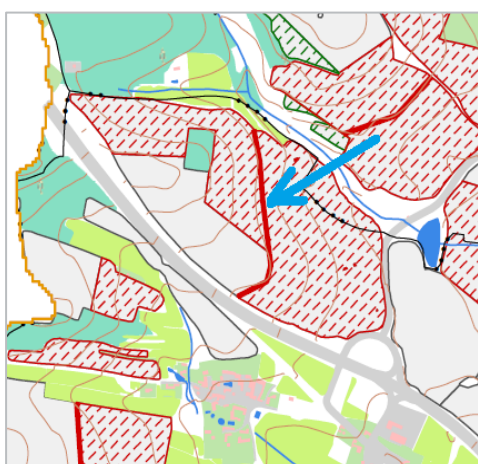
| Lessons-learned | |
|--|--|
| Main success factor: Ensuring flood protection of the site with permanent effect. | Main challenge: Suitable design of the baulk - its width, height, slopes, planting options, types and density. |
| Synergies / beneficial aspects: Soil protection and thus better yield possibilities. Increasing the ecological stability of the landscape. | Conflicts / Constraints: Range of terrain work (landscaping), financial costs. |
| Key message to others starting with a similar task | |
| When cultivating agricultural land, it is important to think about the appropriate limitation of soil blocks to ensure ecological stability of the landscape. This limitation can be done by building a baulk and should be supplemented by planting shrubs or trees. The measure can be costly, but improves the quality of the farmland and will also support future generations of owners in the long term. For sloping plots, it is also important to choose the appropriate agricultural technical tillage. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |



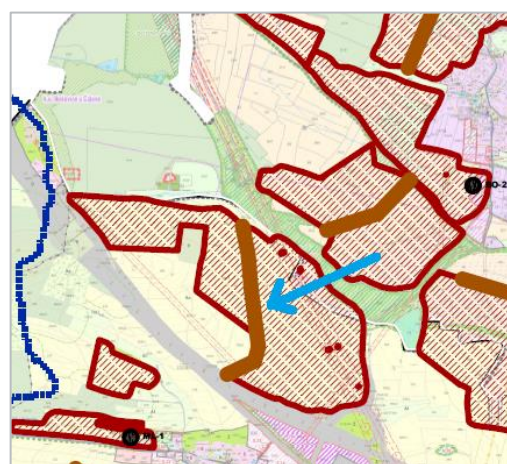
Section of the Spatial plan Drhovle
(source: The Region of South Bohemia,
The Section of Territorial Planning)



Ortophoto location (source: Mapy.cz)



Proposal of flood control measures to protect
the agricultural land - baulk
(source: The Research Institute of Water
Management T. G. Masaryk, v.v.i.)



Proposal of the baulk designed in Study
of the applicability of flood control
measures into spatial plans
(source: Architectural Studio Štěpán)



View of sloping farmland from southwest
(source: Mapy.cz)

FACTSHEET RISK REDUCTION MEASURES

Flood protection measures Strunkovice nad Blanicí

Where was it implemented?

Strunkovice nad Blanicí (South Bohemia Region, Czech Republic)

Fields of action

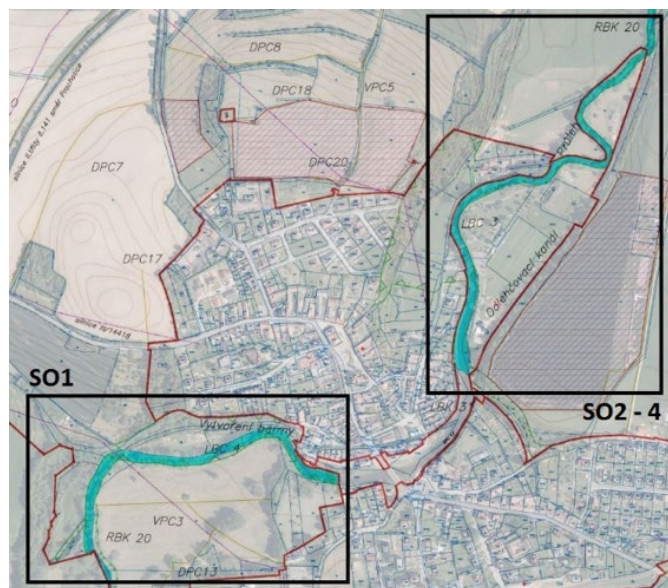
- Farmland, forests, watercourses, settlement area

Related to measure from the catalogue of measures

- Land consolidation processes
- Increasing the retention capacity of existing channels and floodplains
- Linear protection measures
- Small elevation oriented dikes
- Furrows

Area characterisation

- **Area type:** semi-urban
- **Landscape type:** floodplain



Source: The Region of South Bohemia, The Section of Territorial Planning

Problem

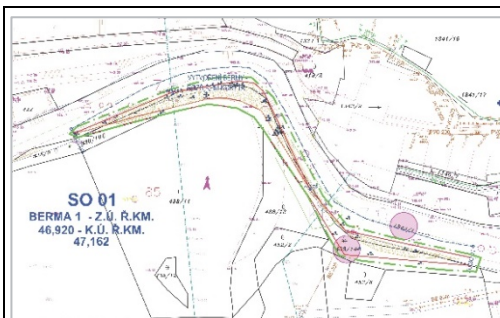
Heavy rain floods in the area destroy sports grounds and repeatedly floods the mill and its surroundings, thereby endangering the lives of the mill's inhabitants and flooding causing great material damage.

Description and aim

The subject of the project is the realization of a part of the joint risk reduction measures, namely the construction of berms, the reduction of the leveling of the terrain and the bypass channel. Everything is in accordance with the approved design of a comprehensive land consolidation process in the cadastral area of Strunkovice nad Blanicí.

The project can be divided into 2 separate localities (see map): In the SO1 locality, the terrain works of the Blanice riverbed was carried out and a berm (terraced, partially flooded part of the riverbed) was created to reduce the flow rate and water pressure to the left bank of the riverbed. In the SO2-4 locality, the riverbed was strengthened with the help of a berm. There were also created furrows to increase the capacity of the river profile. Following this part, a bypass channel (SO3) with a capacity for a 20-year flood (Q20) was also built. Part of the project was the replacement of sewerage under the furrow, the reduction of paved accesses in the furrows and the adjustment of the level of the power line.

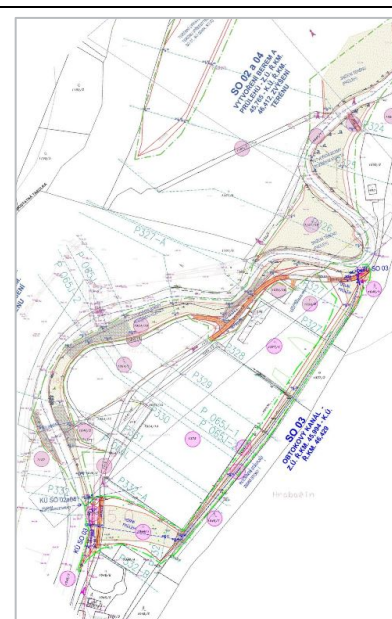
Soil taken from berms and furrows was used to increase the terrain on the plots below the mill.



Location SO 01 - documentation for building permit x spatial plan



Location SO 02 - 04 - spatial plan



Location SO 02 - 04 - building permit

Effect of measure

An increase in the capacity of the Blanice riverbed was achieved by implementing berm along the riverbed and widening the bypass channel and creating furrows.

Description of implementation

Effect horizon:
long-term

Involved stakeholders:
municipality Strunkovice nad Blaníci, land owners, mill's inhabitants

Implementation:
7.3.2019/ 30.10.2018

Initiator / responsible
State Land Office - regional office Prachatice

Lessons-learned

Main success factor:
Completed and approved land consolidation process. Without the process, the implementation of the risk reduction measures would nothave been possible. Administration and negotiation of land consolidation and settlement of the subsidy for implementation - ensured by the State Land Office.

Main challenge:
Development of flood protection measures that are effective and at the same time accepted by the land owners. Part of the modifications took place on the land of foreign owners (non-municipal).

Synergies / beneficial aspects:
Protection of the sports complex from flood damage. In the summer of 2019, a minor flood event occurred and the measures worked well. Only minor shortcomings were revealed, which were subsequently corrected.

Conflicts / Constraints:
A compromise had to be found for the bank of the Blanice River and the deepening of the bottom: Here there was a contradiction between the demands of the fishermen from Vodňany (dredging limited, undergrown shores and old trees to provide shelter for the fish) and the requirements of the town of Strunkovice (to make the river bed as clear as possible).

Key message to others starting with a similar task

"The implementation of the flood control measures in accordance with the approved design of a comprehensive land consolidation plan results in a quick and hassle-free solution without the need for further discussions with the landowners."

Contact

The Region of South Bohemia, The Section of Territorial Planning

www.kraj-jihocesky.cz

Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94

State before implementation:



State during implementation:



State after implementation:



Source of all pictures: State Land Office - regional office Prachatice

FACTSHEET RISK REDUCTION MEASURES

Establishment of principles and regulations in the spatial plan of the municipality Nová Ves

Where was it implemented?

Nová Ves, nearby České Budějovice (South Bohemia Region, Czech Republic)

Fields of action

- Settlement area

Related to measure from the catalogue of measures

- Avoidance of building in hazard zones: Adaptation/re-zoning/shifting of building areas
- Establishing and considering of local and regional landuse planning
- Infiltration belts (grass) and buffer strips (permanent vegetation)

Area characterisation

- **Area type:** non-developed area
- **Landscape type:** meadows



Source: The Region of South Bohemia, The section of Territory Planning

Problem

The village is located in a hilly landscape. Land above the village is agriculturally cultivated (arable land and meadows). Large fields aren't subdivided. The village is endangered in case of a heavy rain event.

Description and aim

There are two specific measures defined in the graphical part of the spatial plan: planting of a vegetation belt (relocation of the local biocorridor due to the road bypass) and the implementation of a water channel (partly open, partly piped). The text part of the spatial plan contains a separate chapter defining heavy rain risk reduction measures: preservation of existing watercourses, including an 8 m wide access strip, maintenance of existing vegetation along watercourses and increasing the natural retention capacity of the area (for example sowing suitable grass cultivars).

Effect of measure

Establishment of general principles for protection against floods caused by heavy rain events.

Description of implementation

Effect horizon:
long-term

Involved stakeholders:
authorities involved in spatial planning process, landowners, inhabitants in Nová Ves, public

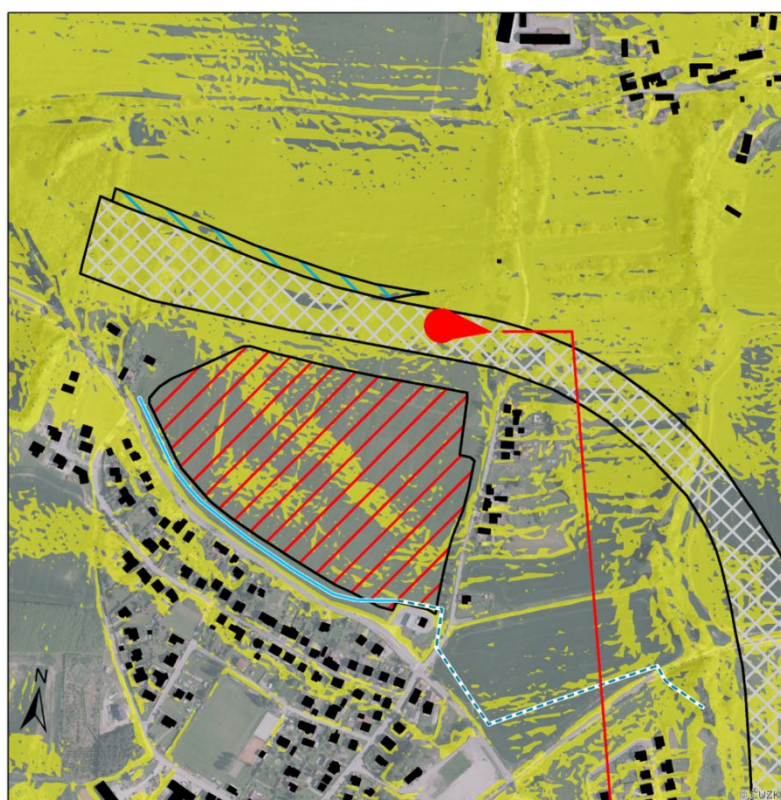
Implementation:
2008 - 2014

Initiator / responsible
Municipality Nová Ves, planner of spatial plan

Lessons-learned

The spatial plan generally proposed measures against flooding during heavy rain events. These measures were also to be specified, for example during land consolidation.

| | |
|---|--|
| Main success factor: Selection of a suitable spatial planner who evaluates problems in the area. | Main challenge: Development of a proposal for appropriate flood protection measures which correspond in size and level of detail to the spatial plan and are acceptable by landowners. |
| Synergies / beneficial aspects: Establishment of general principles of protection against flooding during heavy rain events. | Conflicts / Constraints: Finding the right size and detail of measures against flooding during heavy rain events. The localization of single furrows was evaluated as too detailed. |
| Key message to others starting with a similar task | |
| Protection against heavy rains has to be solved in many spatial plans. However, this is not always a major problem in order to define specific measures. A very effective preventive measure is the establishment of principles and regulations applicable to the location of buildings on sloping terrain. Specific measures should be defined in more detailed documents, e.g. land consolidation, regulatory plan, planning studies. | |



Nová Ves village

risk reduction measures stated in spatial plan

1:5 000

0 75 150 300 m

- proposed water channel
 - - - proposed water channel in pipe
 - ▨ proposed area - residential
 - ▨ proposed relocation of major road
 - ▨ risk reduction measures
 - ▨ building (source RUIAN)
 - ▨ slope gradient more than 3,5° (source DMR 5G ČUZK)
- Background map: ortophoto (ČUZK)
hill shading (DMR 5G ČUZK)



Source: The Region of South Bohemia, The section of Territory Planning

FACTSHEET RISK REDUCTION MEASURES

Flood protection and erosion control measures in Krajníčko

Where was it implemented?

Krajníčko (South Bohemia Region, Czech Republic)

Fields of action

- Farmland, settlement areas, watercourses

Related to measure from the catalogue of measures

- Furrows
- Drainage ditches
- Dikes
- Linear protection measures

Area characterisation

- **Area type:** Non-Developed area and urban area
- **Landscape type:** meadows, arable area, urban area, non-developed area with single trees



Erosion control wall (WP5)

Source: The Region of South Bohemia, The section of Territory Planning

Problem

Although the village is located on the upper course of the stream Bavorovický, there were floods in 2002, in April 2009 (two hours heavy rain event) and in June 2013. The village is threatened by flooding caused by heavy rain events.

Description and aim

In 2009, the spatial plan of Krajníčko was approved, which proposes flood protection measures. The spatial plan locates a retention area, a ditch, an erosion control wall and the revitalization of the watercourses. In urban area, the spatial plan proposes a barrage to increase the capacity of the watercourse and culvert, and the partial demolition of one building. On the outskirts of the village, the spatial plan suggests to build an overflow on the existing pond. All the proposed measures are defined as public benefit buildings or public benefit measures. This means, that the rights to property and buildings can be expropriated in order to realise the proposed measures. The spatial plan with the proposed flood protection measures was the basis for planning the land consolidation project. The selected measures were subsequently included in the plan of joint facilities (a part of land consolidation project) in 2012 (approved in 2014). One of the proposed measures - WP5, erosion control wall - began to be realized in 2019. This measure was realized together with one dirt road. The total costs of both constructions were 9,909,220 Kč including VAT. The investor was the State Land Office.

Effect of measure

Building of a comprehensive protection of the village against floods caused by heavy rain events; field subdivision, reduction of erosion risk, increasing the capacity of the watercourse in the urban area, water retention downstream of the village.

Description of implementation

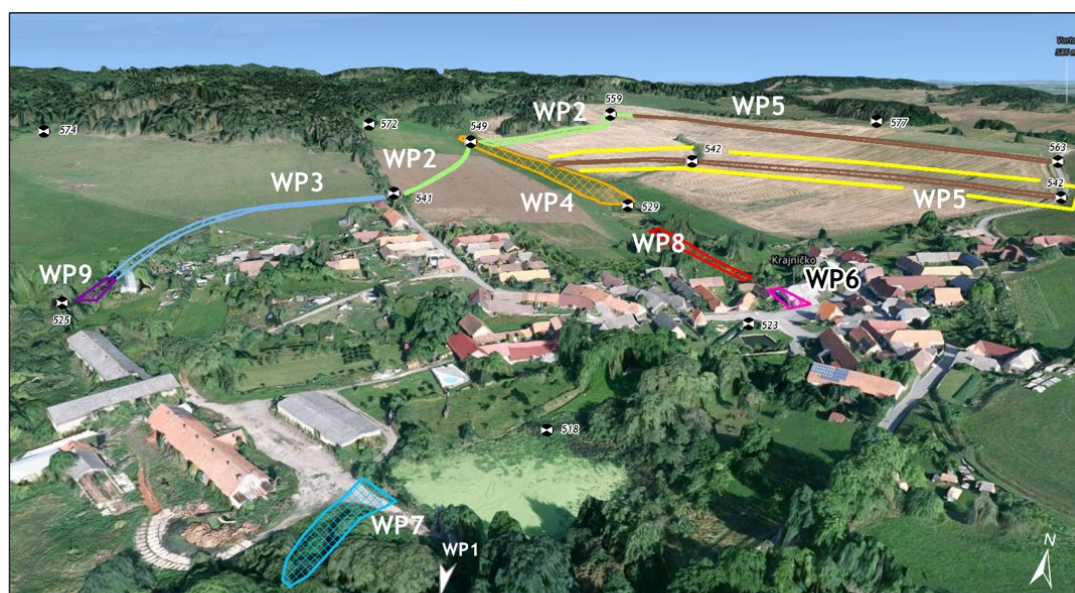
Effect horizon:
long-term

Involved stakeholders:
the authorities involved in spatial planning, landowners, owners of the building, public

Implementation:
spatial plan was solved 2003 - 2009

Initiator / responsible
Municipality Krajníčko

| Lessons-learned | |
|--|--|
| The proposed flood protection measures were respected and partly implemented into the land consolidation plan. One of these measures was set as a priority and then started to be realized. | |
| Main success factor: Selection of a suitable spatial planner who proposed comprehensive flood risk reduction measures. The planner derived the measures from the principles and conditions of quantitative and qualitative protection of agricultural land resources. | Main challenge: Development of appropriate flood protection measures which are acceptable by owners of the land and properties in the neighborhood. |
| Synergies / beneficial aspects: The comprehensive risk reduction measures were proposed in the spatial plan of the village at risk of flooding. Thanks to the implementation of selected measures in the land consolidation, the realization could be financed from sources outside the municipality's budget. | Conflicts / Constraints: One of the agricultural stakeholder appealed against the proposed land consolidation and then challenged it in court. The reason for the appeal was disagreement with the proposed flood risk reduction measures. The court confirmed the correctness of the land consolidation. The other problem was also the small share of land owned by the municipality. |
| Key message to others starting with a similar task | |
| It is more suitable for financing and realization of the construction if the food protection measures are proposed within the complex land consolidation process (in the Czech legal environment). | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |



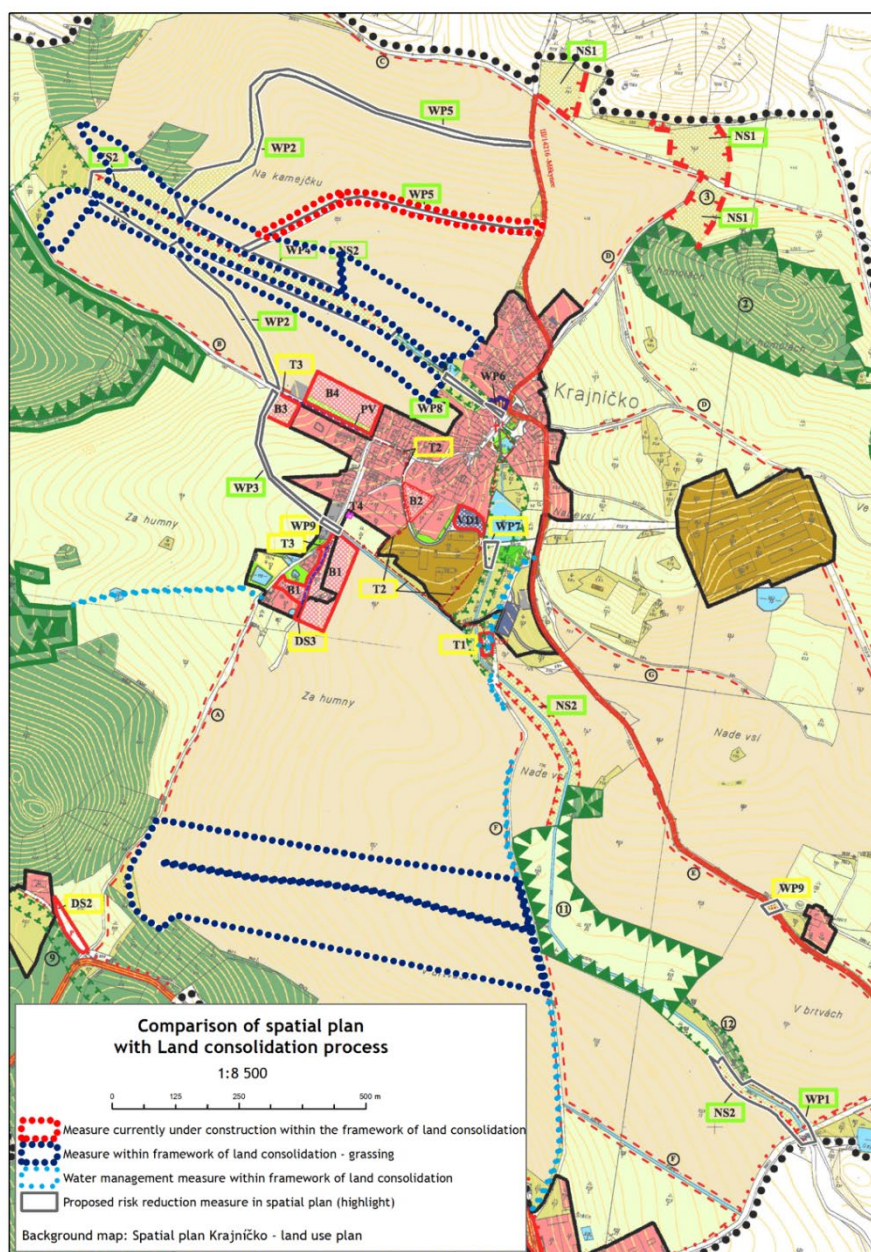
OVERVIEW OF THE RISK REDUCTION MEASURES PROPOSED IN SPATIAL PLAN KRAJNÍČKO

| | | |
|--|---|--|
| <p>altitude (m.a.s.l.)</p> <p>Proposed measure in spatial plan</p> <p>measure out of map WP1 - retention area</p> <p>WP2 - ditch + grassing</p> <p>WP3 - water course + grassing</p> | <p>measure currently under construction within the framework of land consolidation</p> <p>WP4 - revitalization of the watercourse</p> <p>WP5 - erosion control wall</p> <p>WP6 - increasing the capacity of the watercourse</p> | <p>WP7 - overflow</p> <p>WP8 - barrage</p> <p>WP9 - increasing the capacity of the culvert</p> |
|--|---|--|

Source: The Region of South Bohemia, The section of Territory Planning
 Source of background 3D model: mapy.cz



Figures: Terrain works (WP5), November 2019 (left), after realization (WP5), May 2020 (right)
Source: The Region of South Bohemia, The section of Territory Planning



Source: The Region of South Bohemia, The section of Territory Planning

FACTSHEET RISK REDUCTION MEASURES

Flood protection measures in Libín - furrow

Where was it implemented?

Libín (South Bohemia Region, Czech Republic)

Fields of action

- Farmland

Related to measure from the catalogue of measures

- Furrow
- Drainage ditches

Area characterisation

- **Area type:** non-developed area
- **Landscape type:** meadow and arable land

Problem

There were floods regularly due to heavy rain events in the village, the most damages occurred in 2002.



Source: The Region of South Bohemia, The section of Territory Planning

Description and aim

The flood protection measures of the village Libín consists of a bypass channel built as a furrow with a slight side slope. The furrow is dimensioned for a 100-year event. The length of the furrow is 625 m and it is followed by a watercourse in fiberglass pipes. The diameter of the pipes is 900 mm, the length is 155 m and the capacity corresponds to a 50-year event. The pipe outlet flows into a nameless watercourse which flows into the Spolský stream. As part of the realized construction the pressure under road had to be considered, a water pipe was relocated and other technical infrastructures were built. The construction cost amounted to CZK 6 million. (Source: Povodí Vltavy, state enterprise)

The measure was proposed in the spatial plan Libín (amendment No. 2) in 2003.

Effect of measure

Protection of the endangered part of the village against floods caused by heavy rain events; field subdivision, reduction of erosion risk.

Description of implementation

Effect horizon:
long-term

Involved stakeholders:
municipality Libín, landowners, inhabitants of Libín

Implementation:
proposal in spatial plan in 2003, realization in 2012

Initiator / responsible
Povodí Vltavy, state enterprise

Lessons-learned

Despite the difficulties and long time from the amendment of the spatial plan to its realization, the bypass channel is fulfilling its function.

| | |
|---|---|
| Main success factor: Persistent and tough negotiation with all stakeholders | Main challenge: Time and organizational requirements for the preparation and administration of the grant application and negotiations with landowners. |
| Synergies / beneficial aspects: The Czech hydrometeorological institute and joint-stock company Vodohospodářský rozvoj a výstavba processed a study in 2013 confirming the effectiveness of the measure. | Conflicts / Constraints: The municipality did not have the funds for the realization and the negotiations with stakeholders took ten years. A new building permit was necessary due to the change of the developer company. The problem was also a long-standing dispute with a land owner and the administration of the subsidy program. |
| Key message to others starting with a similar task | |
| "Obtaining subsidies for small municipalities is often a problem, and the administration of grant applications is usually handled by outsourcing. This leads to higher costs." | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |

Realization



Source: HYDRO & KOV s.r.o.

Realization



Source: HYDRO & KOV s.r.o.

Realization



Source: HYDRO & KOV s.r.o.

Culvert under the road



Source: HYDRO & KOV s.r.o.

State after implementation



Source: Povodí Vltavy s.p.

Furrow



Source: The Region of South Bohemia, The section of Territory Planning



Source: The Region of South Bohemia, The section of Territory Planning

FACTSHEET RISK REDUCTION MEASURES

Flood protection measures Ledenice - furrow and bypass channel

Where was it implemented?

Ledenice (South Bohemia Region, Czech Republic)

Fields of action

- Farmland, settlement area

Related to measure from the catalogue of measures

- Furrows
- Drainage ditches
- Preservation and creation of meadows and pastures
- Linear protection measures - bypass channel
- Strategic documents

Area characterisation

- **Area type:** non-developed area
- **Landscape type:** meadows (arable area in past)



Source: The Region of South Bohemia, The section of Territory Planning

Problem

The village Ledenice, including its central part, was repeatedly flooded during heavy rain events (1885, 1900, 1925, 1926, 1997, 2000, 2002, 2005) despite the absence of a larger stream and its relatively favorable location.

Description and aim

The subject of the project is the realization of a part of the measures which were defined in the Study of Flood Protection Ledenice, Ing. Daniel Vaclík, 1997. A comprehensive solution of flood protection of the area included the restoration of the Kačerovec pond, the construction of a safety spillway at the Slavíček pond, mud removal and repair of the Lazný pond dam, the safety spillway at the Parčáček pond and drainage on the square, watercourse treatment in Růžov, modification of the dam of the Dolní Hradský pond and construction of a bypass channel. The description of the other measures can be found on a separate factsheet.

The bypass canal is built in sloping terrain (slope 4 - 5%) and is dimensioned for flood for 100-year floods. The bypass channel contains a furrow (length 1250 m) and a channel (length 243 m). The width of the furrow is 20 m. The slope of the bypass channel bottom is between 0.2 % and 2.8 %. The shore side of the bypass channel is exceeded by at least 0.1 m above the flood level during 100-year flood events. The first part of the bypass channel is a water collection site, which is located below the construction of the road from Ledenice to Borovany. It collects water from the ditches on both sides of the road. The drainage system in the form of small outflow objects flows continuously into the bypass channel. The furrow crosses the thalweg in two places. The furrow is reinforced at these crossings by a stone throw or reinforced concrete overflow threshold (southern crossing). The crossing was also set up for cattle migration. This crossing is reinforced by a stone throw. The banks of the channel are reinforced by stone aggregates. The channel flows into a watercourse which flows into Slavíček pond. Trees are planted around the bypass channel. Above the bypass channel the land use has been changed from arable land to meadows.

Effect of measure

Protection of the endangered part of the village against floods of heavy rain events; field subdivision; reduction of erosion risk.

| Description of implementation | |
|---|--|
| Effect horizon: long-term | Involved stakeholders: municipality Ledenice, landowners, inhabitants of Ledenice |
| Implementation: 2 phases 2004 - 2005 and 2008 - 2009 | Initiator / responsible Zemědělská vodohospodářská správa (organizational unit of the state) |
| Lessons-learned | |
| The bypass channel alleviated the flood in 2005; it was damaged by torrential rain in 2008 and it had to be repaired and drafted by quarry stone in several places. After a heavy rain event in 2009, the capacity was fully reached. The bypass channel was half filled during the flood in 2013. | |
| Main success factor: Comprehensive study of flood protection and implementation of other flood control measures. The purchase of the land went without problems, the municipality relied on the cooperating of the initiator. | Main challenge: Development of flood protection measures that are effective and acceptable to landowners. |
| Synergies / beneficial aspects: Protection of a large part of the municipality (including residential buildings) against recurrent flooding caused by heavy rain events. Complementation of the comprehensive flood protection of Ledenice. The bypass channel has already proven its effectiveness in 2009 and 2013. | Conflicts / Constraints: The realization of the second part of the bypass channel was delayed due to the postponement of the land consolidation. |
| Key message to others starting with a similar task | |
| The realization of the risk reduction measure was carried out according to a separate study. Construction of the bypass channel was started before the start of the land consolidation. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |

During realization:



Source: Report on the condition of Water Management in the Czech Republic 2009

Channel filling during heavy rain event in 2009:

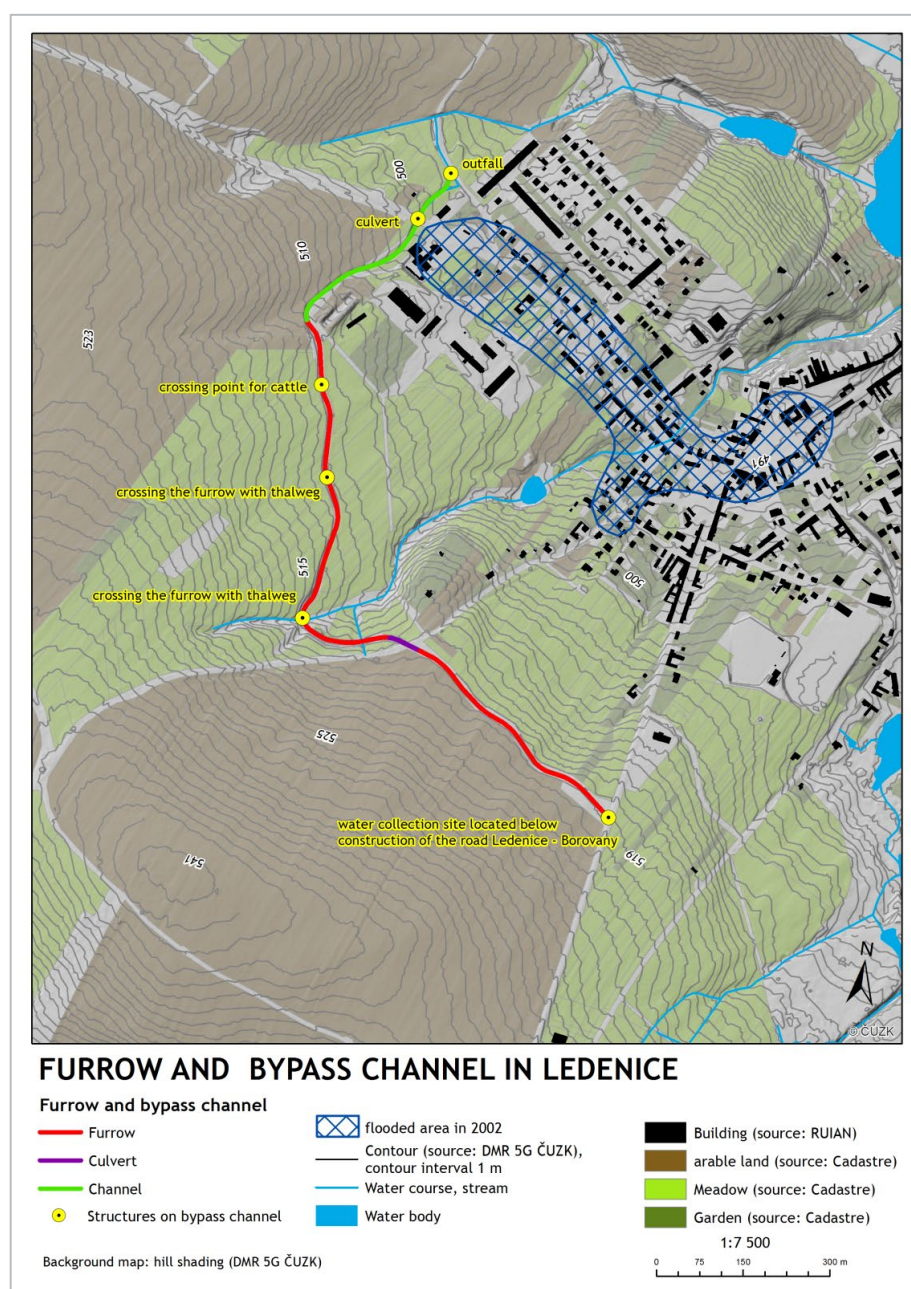


Source: Ledenický zpravodaj (municipality newsletter) 07/08 - 2009

After realization:



Source: The Region of South Bohemia, The section of Territory Planning



Source: The Region of South Bohemia, The section of Territory Planning

FACTSHEET RISK REDUCTION MEASURES

Flood protection measures Ledenice - other measures

Where was it implemented?

Ledenice (South Bohemia Region, Czech Republic)

Fields of action

- watercourses

Related to measure from the catalogue of measures

- Small elevation oriented dikes
- Dry retention reservoirs with a constant flow
- Embankments in the bump curves of streambeds, boulder structures
- Strategic documents

Area characterisation

- **Area type:** non-developed area, urban area
- **Landscape type:** floodplain, ponds in urban area



Dry retention reservoir

Source: The Region of South Bohemia, The section of Territory Planning

Problem

The village Ledenice, including its central part, was repeatedly flooded during heavy rain events (1885, 1900, 1925, 1926, 1997, 2000, 2002, 2005) despite the absence of a larger stream and its relatively favorable location.

Description and aim

The subject of the project is the realization of a part of the measures which were defined in the Study of Flood Protection Ledenice, Ing. Daniel Vaclík, 1997. A comprehensive solution of flood protection of the area included the restoration of the Kačerovec pond, the construction of a safety spillway at the Slaviček pond, mud removal and repair of the Lazny pond dam, the safety spillway at the Parčáček pond and drainage on the square, watercourse treatment in Růžov, modification of the dam of the Dolní Hradský pond and construction of a bypass channel. The description of the other measures can be found on a separate factsheet.

The following general measures have been proposed in addition to the bypass channel to reduce the flood risk: increasing the natural retention capacity of the landscape, the use of the valley morphology for the realization of a retention reservoir, increase in flow capacity of watercourses, replacement of non-capacity functional objects of water management works. The restoration of the Kačerovec dam is an essential part of these measures (individual examples of other measures are given in the first paragraph). The original flood dam was ruptured in 1925 and caused a flood in the entire catchment area of the Spolský stream, including damage to the dam of the Svět pond in Třeboň. The Kačerovec dam was realized as a retention reservoir with low water level - in periods without precipitation it can be dried out. The construction costs amounted to 12,936,000 CZK, with the municipality receiving a subsidy of the Ministry of the Environment (revitalization of river systems) in the amount of 10 million. Volume of constant water level - max. 9,730 m³, maximum retention volume 192,727 m³.

Effect of measure

Protection of the endangered part of the village against floods caused by heavy rain events.

| Description of implementation | |
|--|---|
| Effect horizon: long-term | Involved stakeholders: landowners, inhabitants of Ledenice |
| Implementation: January till October 1999 (building permit - realization - dam Kačerovec), other measures till 2016) | Initiator / responsible municipality Ledenice |
| Lessons-learned | |
| The construction of the retention reservoir was the first measure, which was necessary for the construction of subsequent measures, although it did not fully protect the whole municipality against floodings. | |
| Main success factor: Obtaining a subsidy from the Ministry of the Environment - the municipality had previously sought to build a retention reservoir, but without a subsidy implementation was not possible. | Main challenge: Technical design of retention reservoir dam to prevent repeated bursting of the retention reservoir and endangering the entire catchment area. |
| Synergies / beneficial aspects: Protection of a large part of the municipality (including residential buildings) against recurrent floods caused by heavy rain events; complementation of the comprehensive flood protection of Ledenice. The retention reservoir has already proven its effectiveness in 2000 and 2013. | Conflicts / Constraints: The construction was delayed by looking for the necessary funds (the total financing would amount to ¼ of the annual costs in the municipality's budget) |
| Key message to others starting with a similar task | |
| The municipality was not sufficiently protected even after the construction of the retention reservoir. It was necessary to implement follow-up measures. This is an exemplary solution of flood protection in stages. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |



Retention reservoir Kačerovec during flood in 2013

Source: Ledenický zpravodaj - municipality newsletter)



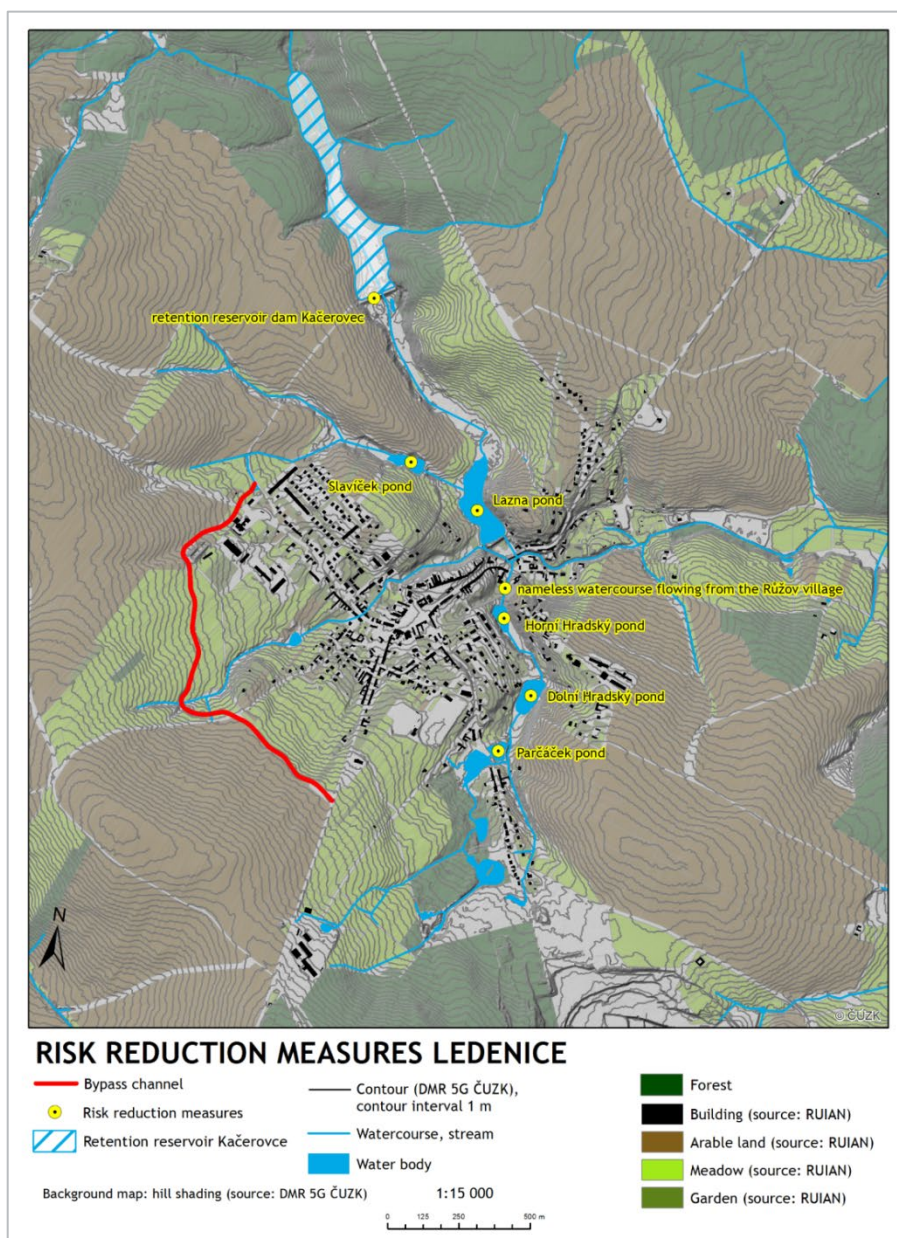
Spillway of the retention reservoir in 2019 (same place)

Source: The Region of South Bohemia, The section of Territory Planning



Retention reservoir dam

Source: The Region of South Bohemia, The section of Territory Planning



Source: The Region of South Bohemia, The section of Territory Planning

FACTSHEET RISK REDUCTION MEASURES

Flood protection measures Přední Ptákovice

Where was it implemented?

Strakonice, district Přední Ptákovice (South Bohemia Region, Czech Republic)

Fields of action

- Farmland, forest, settlement area

Related to measure from the catalogue of measures

- Smal dikes and pits
- Furrows
- Linear protection measures
- Event and damage documentation, event analysis

Area characterisation

- **Area type:** non-Developed area
- **Landscape type:** arable land/field



Source: VRV- Company Vodohospodářský rozvoj a výstavba a.s., Prague

Problem

Heavy rains wash off the arable land and flood the residential area as well as the areas with development potential. The flooded area is 10 ha. During a local heavy rain event in 2014, a 30 cm high layer of mud remained on the streets.

Description and aim

Due to the extensive flood damage, a study was carried out for the endangered area. However, this study was not successfully discussed with the landowners, and despite the efforts of the municipality, not enough land could be purchased. Due to this failure, a second study was carried in 2016 with the same task. The resulting concept proposed a set of infiltration furrows with a total length of 500 m and a potencial capacity of 1,920 m³ of water. The furrows are proposed parallel to the contour lines and have a zero gradient. Rainwater is not drained but absorbed. The total depth of the furrow is 1 meter. The overflows of furrows were built as lowered stone barrage. In this way the water will overflow from one furrow to the next during heavy rain events. After completion of the study, the project preparation and the grant application followed. A subsidy of 1,120,000 Kč was received. Realization took place in 2018.

Effect of measure

Water retention and movement of large quantities of water to another drainage basin. Erosion control measures should restrain a flood wave occuring in case of a 100-year flood event.

Description of implementation

Effect horizon:

-

Involved stakeholders:

land owners

Implementation:

2016 - 2018 (from study to realization)

Initiator / responsible

municipality Strakonice

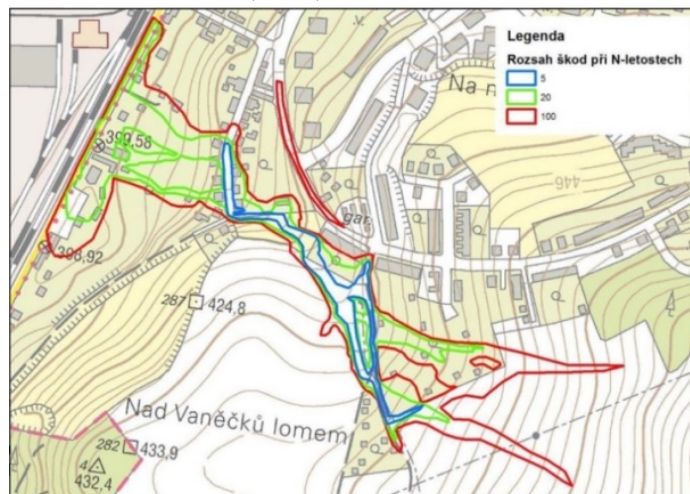
| Lessons-learned | |
|---|--|
| Main success factor: After the failure of the deal with the landowners, the municipality invested in a new study that proposed different solution. | Main challenge: To propose risk reduction measures that are effective and acceptable to landowners and arrange for the purchase of the necessary land. |
| Synergies / beneficial aspects: Protection of the part of the urban area, which was threatened by floods during heavy rain events. | Conflicts / Constraints: After the first study, the purchase of the necessary land was not agreed. The process returned to the very beginning after two years. |
| Key message to others starting with a similar task | |
| If the measure could not be realized, it may be advisable to start the whole process again. The new study was proposed by another planner, the area required for the realization was reduced and the sale of the necessary land was dealt successfully with the landowners. A high quality project and a suitable supplier can significantly speed up the entire realization process. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |

Heavy rain event in 2014



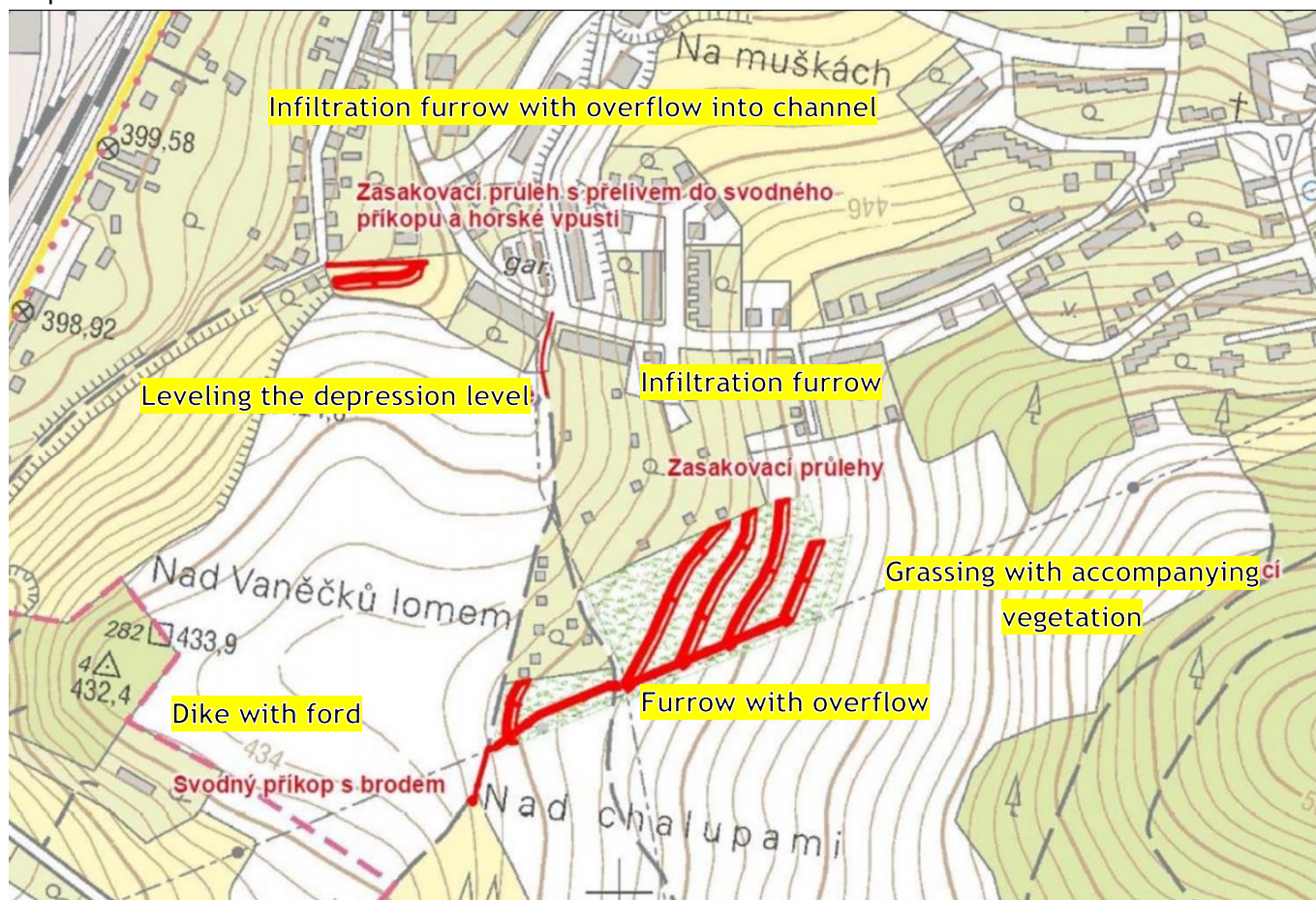
Source: Deník.cz

Vulnerable areas Q5, Q20, Q100



Source: VRV - Company Vodohospodářský rozvoj a výstavba a.s., Prague

Proposed measures



Source: VRV - Company Vodohospodářský rozvoj a výstavba a.s., Prague

State during realization

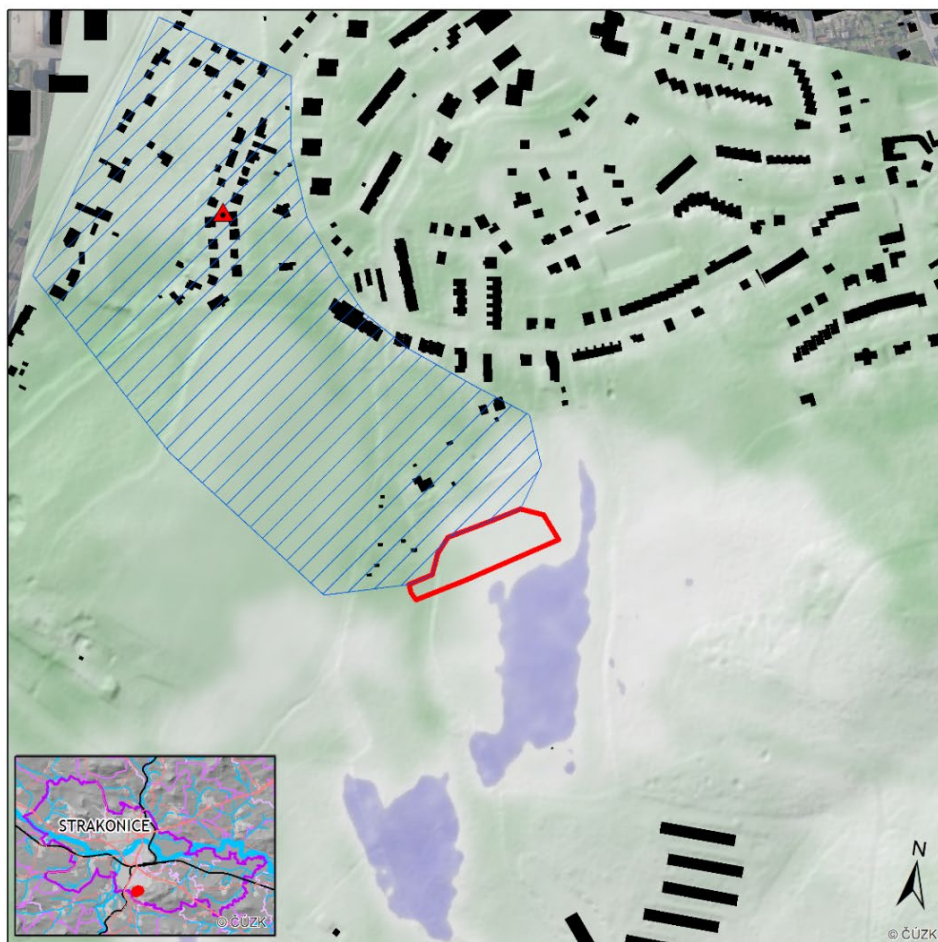


Source: VRV - Company Vodohospodářský rozvoj a výstavba a.s., Prague

Implemented measures



Source: VRV - Company Vodohospodářský rozvoj a výstavba a.s., Prague



SITUATION AFTER HEAVY RAIN

1:5 000

0 75 150 300 m

- ▲ Heavy rain event in 2014 (photo)
- Risk reduction measure
- ▨ Vulnerable area
- Building (source RUIAN)

Background map:

satellite image Sentinel 15.07.2019 - NDWI

Other background maps:

ortophoto (ČÚZK)

hill shading (DMR 5G ČÚZK)

| | | | | | |
|-------|---------|----------|------|------------|--------|
| 00:50 | 16.3 °C | ↗ 5 km/h | 99 % | 1017.8 hPa | 0 mm |
| 01:59 | 17.4 °C | ↘ 2 km/h | 98 % | 1017.8 hPa | 0 mm |
| 11:59 | 15.3 °C | → 4 km/h | 99 % | 1017.5 hPa | 1.8 mm |
| 12:29 | 15.6 °C | ↔ 2 km/h | 99 % | 1017.5 hPa | 5.3 mm |
| 12:59 | 17.1 °C | ↗ 2 km/h | 99 % | 1017.5 hPa | 5.3 mm |
| 13:59 | 18.5 °C | ↘ 2 km/h | 85 % | 1017.5 hPa | 5.3 mm |
| 14:29 | 17.9 °C | ↔ 4 km/h | 86 % | 1017.2 hPa | 5.3 mm |
| 15:29 | 19.1 °C | → 4 km/h | 84 % | 1016.8 hPa | 5.6 mm |
| 15:59 | 20.7 °C | ↗ 4 km/h | 79 % | 1016.8 hPa | 5.6 mm |
| 16:30 | 21.2 °C | ↔ 2 km/h | 79 % | 1016.5 hPa | 5.6 mm |
| 16:59 | 18.4 °C | ↘ 2 km/h | 87 % | 1016.8 hPa | 5.6 mm |
| 17:30 | 20.5 °C | ↔ 4 km/h | 79 % | 1016.8 hPa | 6.1 mm |
| 18:30 | 18.2 °C | ↗ 0 km/h | 83 % | 1016.8 hPa | 6.1 mm |
| 19:30 | 19.1 °C | ↘ 2 km/h | 76 % | 1016.8 hPa | 6.1 mm |
| 20:29 | 17.1 °C | ↘ 2 km/h | 86 % | 1017.2 hPa | 6.1 mm |
| 21:29 | 18.7 °C | ↔ 2 km/h | 85 % | 1017.8 hPa | 6.1 mm |
| 21:59 | 16.4 °C | ↘ 2 km/h | 99 % | 1018.2 hPa | 6.1 mm |
| 22:30 | 16 °C | ↘ 0 km/h | 99 % | 1017.8 hPa | 6.1 mm |
| 23:30 | 15 °C | ↘ 0 km/h | 99 % | 1018.2 hPa | 6.1 mm |

summary of precipitation from 14.07.2019

Source: The Region of South Bohemia, The Section of Territorial Planning

FACTSHEET RISK REDUCTION MEASURES

Land consolidation and furrow in Branná

Where was it implemented?

Village Branná, City Třeboň (South Bohemia Region, Czech Republic)

Fields of action

- Farmland

Related to measure from the catalogue of measures

- Furrow
- Land consolidation

Area characterisation

- **Area type:** non-developed area
- **Landscape type:** arable area, meadow



Source: The Region of South Bohemia, The section of Territory planning

Problem

Despite the flat relief of the landscape, the urban area was threatened by floods (surface water runoff) from fields.

Description and aim

An expert company prepared a study of the runoff conditions as a basis for the land consolidation. The basic measures of this study were implemented into plan of action (a part of the land consolidation).

As a results, the study of the runoff conditions proposed the clean-up of the existing watercourses (except for the channel Opatovická), the realization of new channels and technical measures to reduce the risk of erosion and the reconstruction of a bridge with culvert. It was proposed that the watercourses should be cleaned only at their original level of the channel bed. The total length of the channels is 6,300 meters. The study of the runoff conditions proposed channels and furrows with accompanying vegetation in suitable locations. New channels and watercourses (total length 2,100 meters), furrows (total length 600 meters) and accompanying vegetation (total length 2,000 meters) were proposed. Two significant furrows were implemented in the plan of action. One of them was classified as a priority measure and subsequently realized.

Effect of measure

Field subdivision, furrow which infiltrates rain water.

Description of implementation

Effect horizon:
long-term

Involved stakeholders:
local government, municipality Třeboň, landowners

Implementation:
2005 (processing request) - 2010 (approval)

Initiator / responsible
State Land Office - regional office Jindřichův Hradec

Lessons-learned

Land consolidation became the first strategic document for the area which proposed flood risk and erosion risk reduction measures. The spatial plan, which determines land use, was approved in December 2012.

Main success factor:

For proposing land consolidation a study of the runoff conditions by an expert company was prepared. The main stakeholders - the group of landowners - were very active and supported the risk reduction measures.

Main challenge:

Development of flood protection measures that are effective and acceptable by landowners.

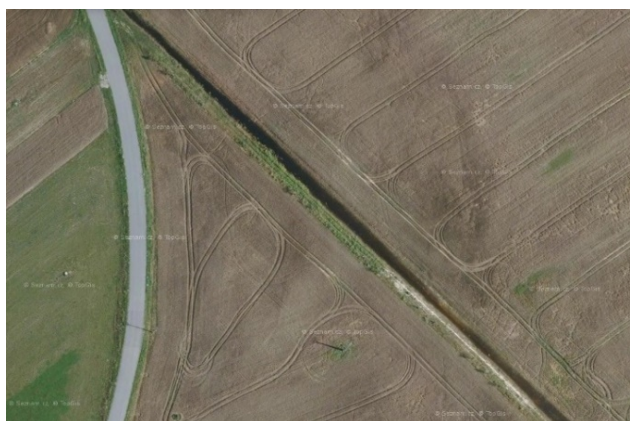
| | |
|---|--|
| <p>Synergies / beneficial aspects: Protection of a part of the urban area and field subdivision.</p> | <p>Conflicts / Constraints: Development of effective land consolidation acceptable to landowners. No spatial planning documentation was available in the Branná cadastral area.</p> |
| <p>Key message to others starting with a similar task</p> | |
| <p>Risk reduction measures should also be proposed in flat areas. In the absence of a spatial plan for the location, land consolidation is a suitable tool for determining risk reduction measures. If land consolidation and spatial plans are proposed simultaneously, close cooperation of both planners is crucial and necessary.</p> | |
| <p>Contact</p> | |
| <p>The Region of South Bohemia, The Section of Territorial Planning: www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94</p> | |

Furrow after realization



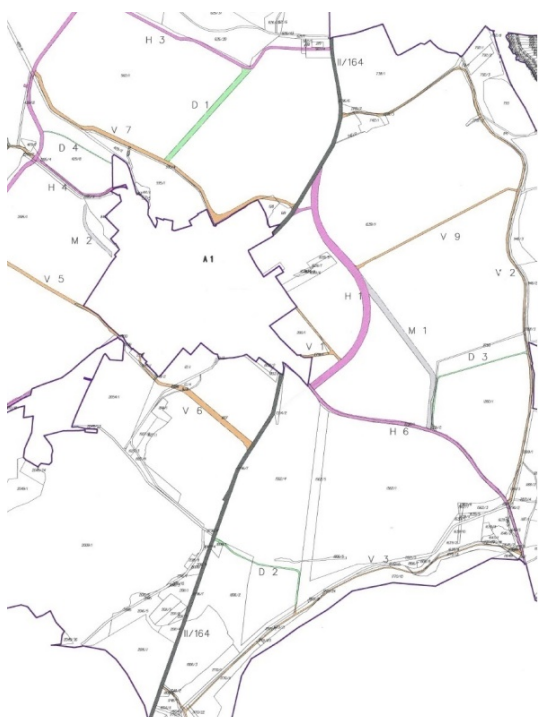
Source: The Region of South Bohemia, The section of Territory planning

Furrow full of rain water



Source of ortophoto: MAPY.CZ

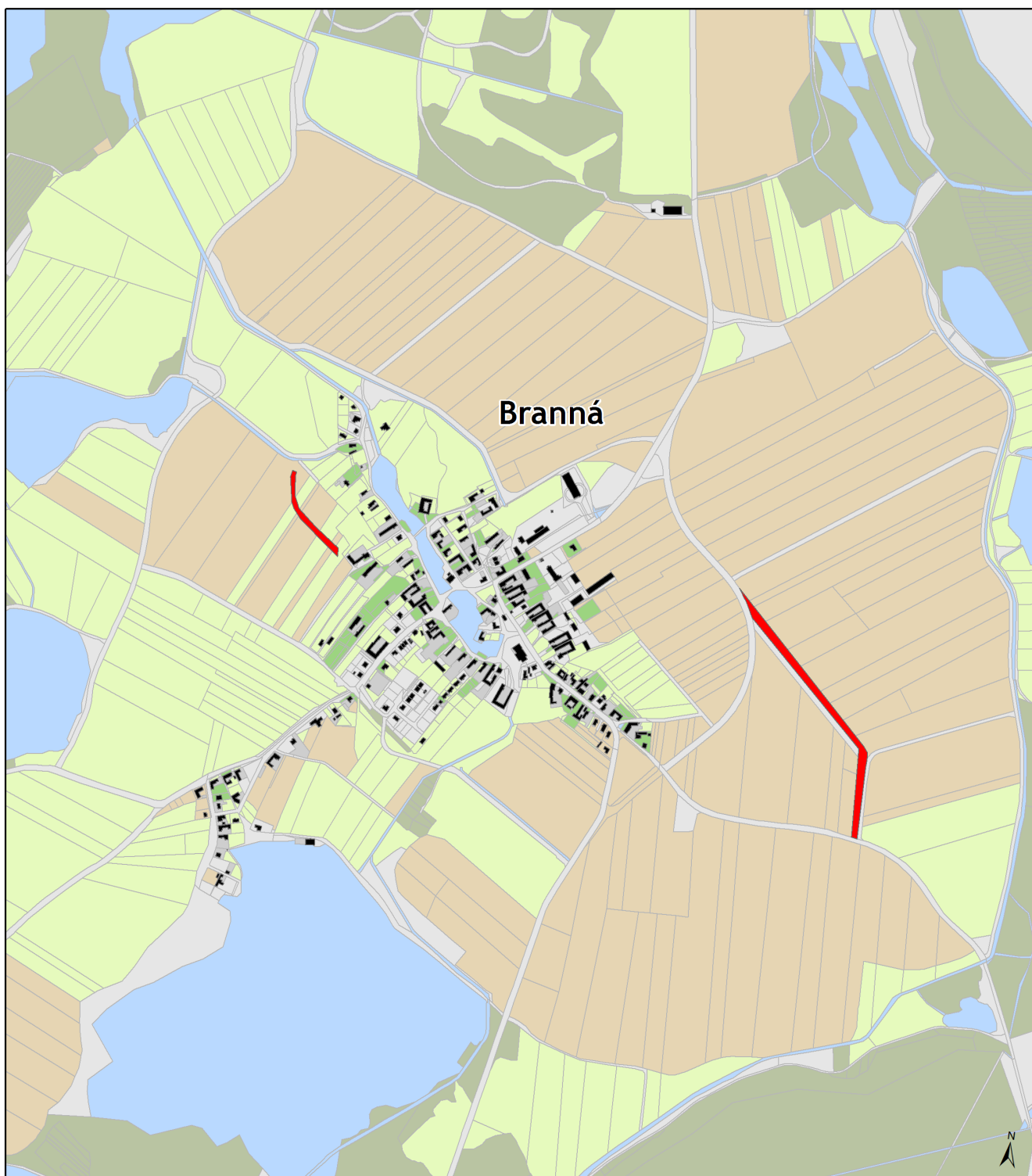
Land consolidation process in Branná village - Measure plan



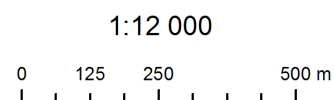
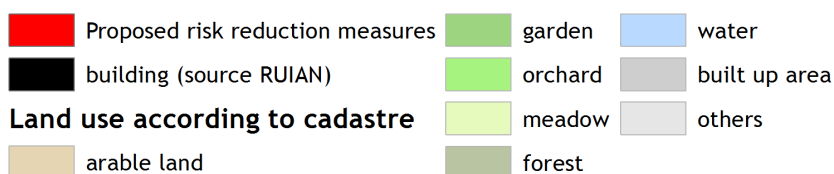
Legend

| | |
|------------------------------|------------------------|
| | Plan boundary |
| | Major road |
| | Minor road |
| Proposed dirt roads : | |
| | Major dirt road |
| | Dirt road |
| | Minor dirt road |
| | Proposed Baulk, furrow |

Source: The Region of South Bohemia, The section of Territory planning



Proposed risk reduction measures in Land consolidation process in Branná village



Source: The Region of South Bohemia, The section of Territory planning

FACTSHEET RISK REDUCTION MEASURES

Setting conditions for certain risk areas in spatial plan of municipality Ratiboř

Where was it implemented?

Ratiboř (near Jindřichův Hradec, South Bohemia Region, Czech Republic)

Fields of action

- Settlement area

Related to measure from the catalogue of measures

- Avoidance of building in risk areas
- Avoidance of building in risk areas zones: Designation of specific grassland or protection zones

Area characterisation

- **Area type:** Non-developed area
- **Landscape type:** arable land



Source: The Region of South Bohemia, The section of Territory Planning

Problem

A part of the urban area of Ratiboř is located at the foot and slope of a hill. A plateau, which is located above the village, is used for agriculture. The village is endangered by torrential water from heavy rainfalls. In case of a heavy rain event, a concentrated runoff of surface water can occur and as a consequence, buildings can be flooded.

Description and aim

A planner proposed possible measures to reduce the risks of heavy rain in the spatial plan. But the municipality did not have adequate resources and had a limited budget. Therefore, only a drainage channel was included in the spatial plan and regulations were set for a certain area.

Extract from spatial plan Ratiboř- regulations for land use

Admissible land use: buildings, installations or other measures for risk reduction of ecological and natural disasters; measures and structures used to drain of or retain water during heavy rain events (for example: dry retention reservoirs, small dikes, ditches, furrows); activities, measures and uses which can be considered as risk reduction of water erosion and which increase the retention capacity of the landscape (for example grassing, cultivation on the slope, baulks, furrows, realization of infiltration belts, small dikes, crop rotation and other agrotechnical and technical measures); technical and transport infrastructure.

Inadmissible land use: permitting structures (including temporary structures), that are excluded from the permitted use in the spatial plan in the respective area; land use that would make it impossible to realize the proposed measures; measures and land use that would accelerate the runoff conditions or could make them secondary.

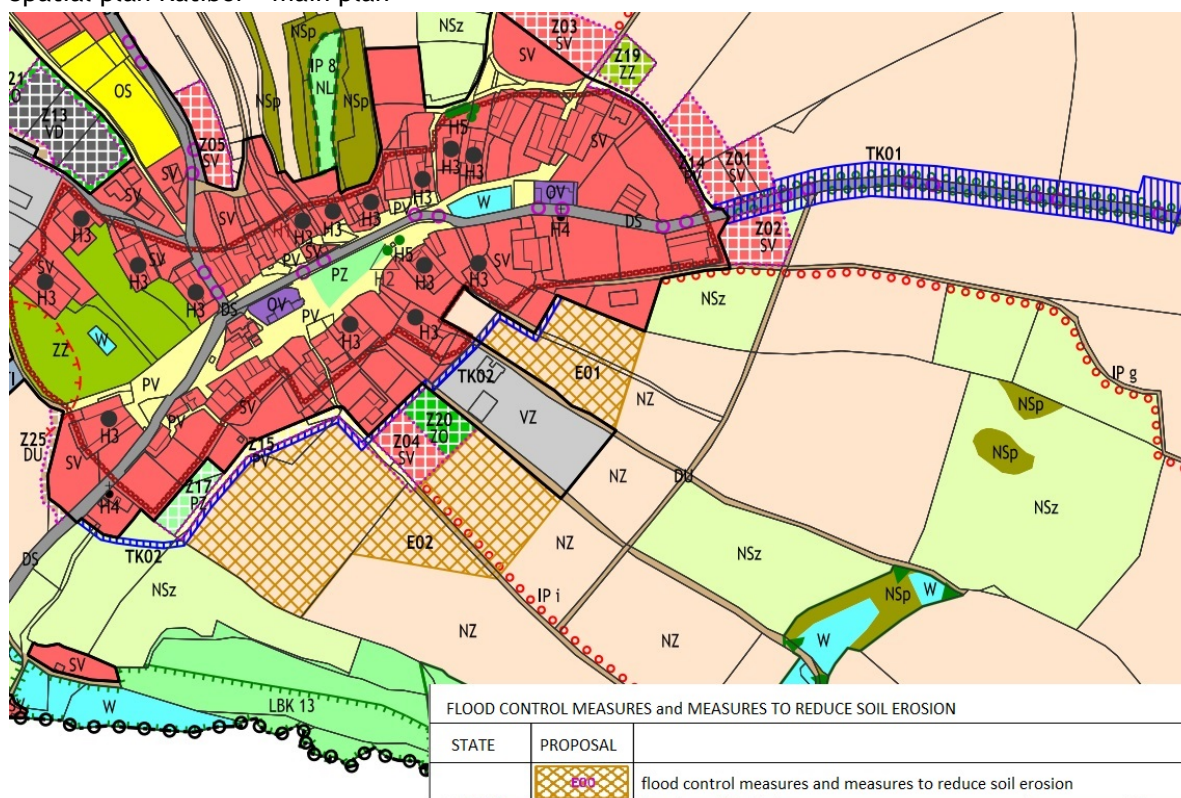
Erosion and flood risk reduction measures, measures for water retention in the landscape, construction and revitalization of water surfaces and watercourses are made possible by the land use conditions in the whole investigated area.

Effect of measure

Protection of the endangered part of the village against floods in heavy rain events.

| Description of implementation | |
|---|--|
| Effect horizon: long-term | Involved stakeholders: the authorities concerned in the spatial planning process, landowners, inhabitants of Ratiboř, public |
| Implementation: spatial plan was solved 2015-2018 | Initiator / responsible Municipality Ratiboř, planner of the spatial plan |
| Lessons-learned | |
| The proposed land use regulations will prevent the implementation of unsuitable structures, while at the same time it will enabling the construction of specific field measures such as a ditch, a drainage channel, etc. | |
| Main success factor: Selection of a suitable spatial planner who cooperates with the municipality and the procurer. | Main challenge: Development of a proposal for flood protection measures that are functional and correspond in size and detail to the spatial plan. |
| Synergies / beneficial aspects: The municipality can ensure the flood protection of its urban area with minimal costs. | Conflicts / Constraints: Limited municipal budget. |
| Key message to others starting with a similar task | |
| If the municipality does not have a sufficient budget for constructions, it is possible to set conditions for certain risk areas in the spatial plan. | |
| Contact | |
| The Region of South Bohemia, The Section of Territorial Planning www.kraj-jihocesky.cz Contact list: https://www.kraj-jihocesky.cz/ku_tseznam/os?id_os=94 | |

Spatial plan Ratiboř - main plan



Source: The Region of South Bohemia, The section of Territory Planning

RAINMAN Key Facts

Project duration: 07.2017 – 06.2020

Project budget: 3,045,287 €

ERDF funding: 2,488,510 €

RAINMAN website &

newsletter registration: www.interreg-central.eu/rainman



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Region of South Bohemia



Croatian Waters



Middle Tisza District Water Directorate



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and Water Management
National Research Institute



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Project support



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