



**Geomorphological processes
of watercourse development,
system of typology
and application of the results in practice**

Part 01

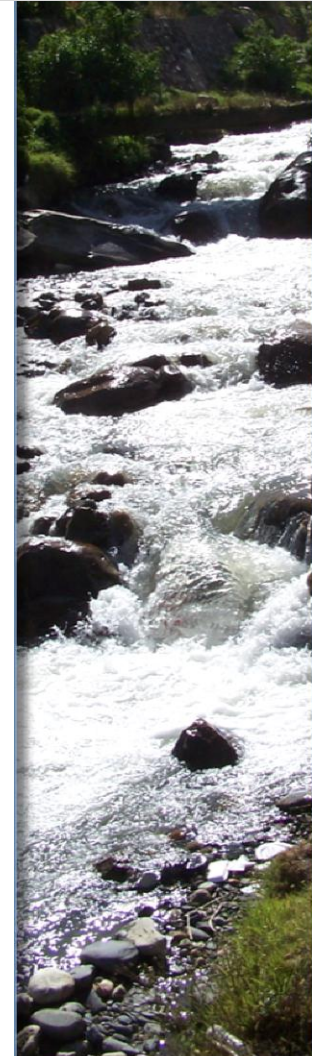
Analysis of geomorphological processes in watercourses

Part 02

The case projects of river restorations

Part 03

Applications in river basin management plans





Part 01 Analysis of geomorphological processes in watercourses

- ✓ Objectives and links to WFD
- ✓ Typology and interpretation of individual processes

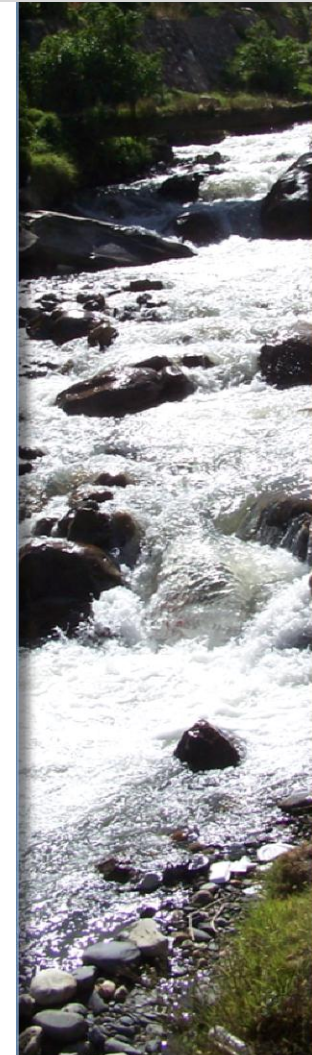




Part 01 Analysis of geomorphological processes in watercourses

Objectives and links to WFD

- ✓ requirements for good ecological and hydromorphological status to focus on parts of water bodies
- ✓ Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (WFD, Water Framework Directive)

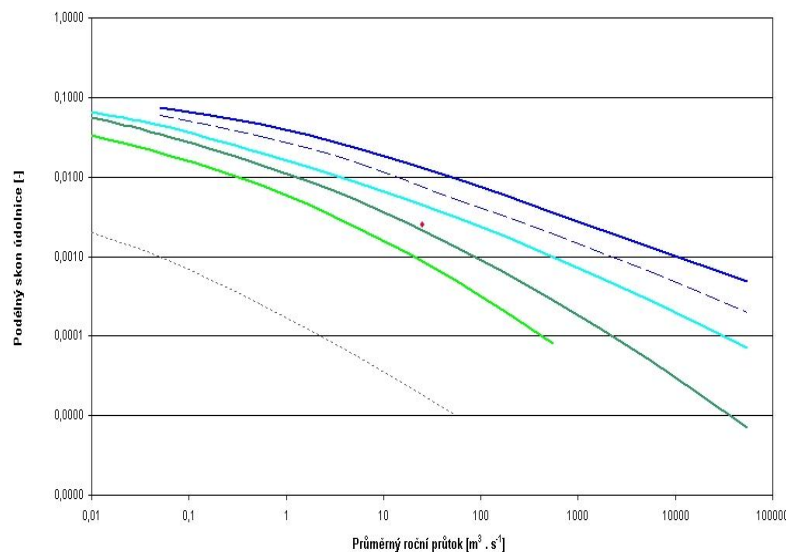




Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of fluvial geomorphological processes

Trends in geomorphological processes



Basic analysis:

The valley energy in the evaluated locality is determined by the relation between:

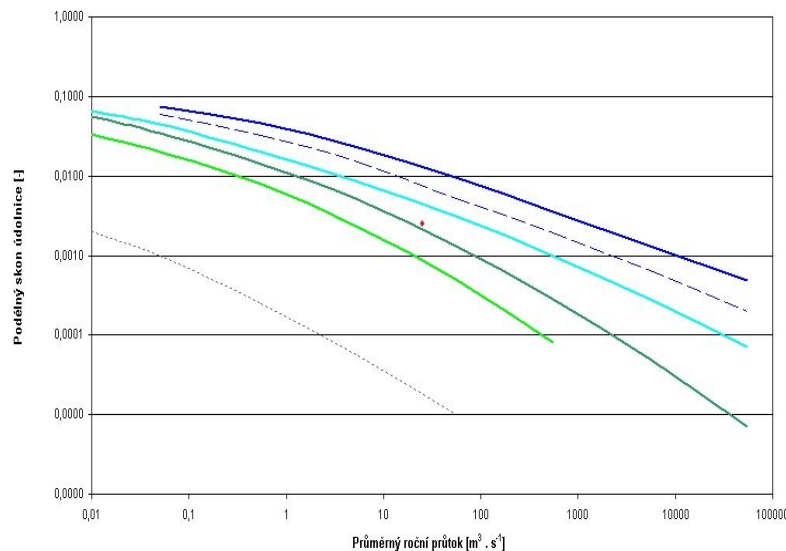
- **longitudinal gradient of the thalweg valley**
- **average annual flow in** closing cross section valley



Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of individual processes

Trends in fluvial geomorphological processes



Typology

- DE** - deep erosion
- AE** - accelerated erosion
- BR** - braided
- GSB** - gravel sand branching
- AB** - anastomotic branching
- MD** - meandering
- DL** - delta
- WS** - wetlands, swamps

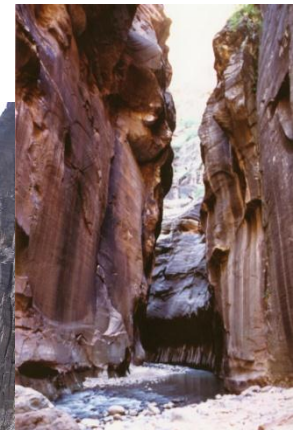
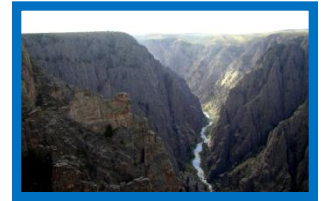


Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of individual processes

Sources of sediment transport

DE - deep erosion

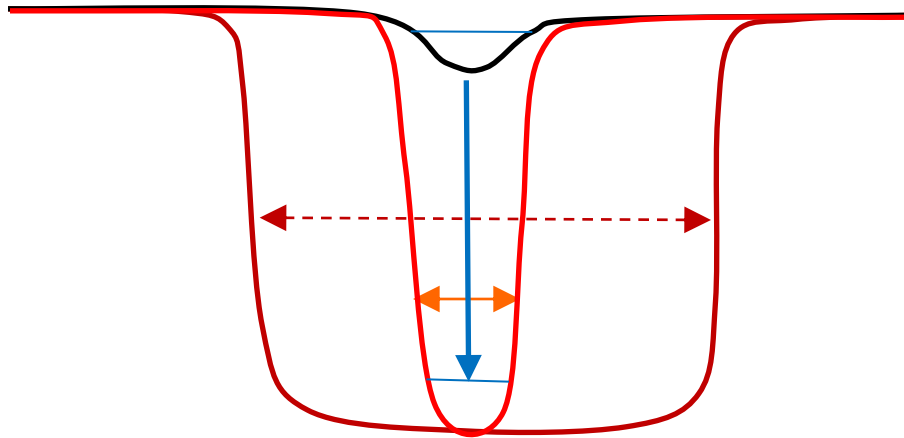




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The principle of accelerated erosion:



AE - accelerated erosion





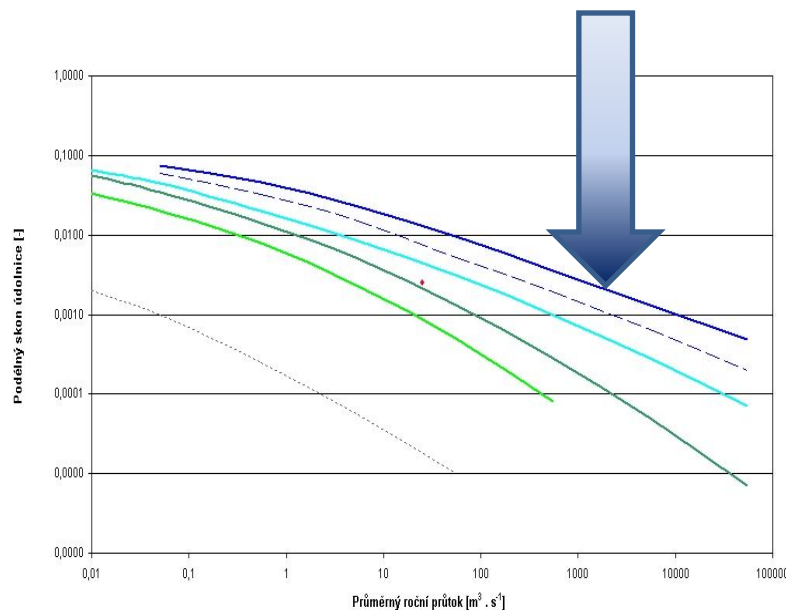
Part 01 Analysis of geomorphological processes in watercourses

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BR - braided



Trends in fluvial geomorphological processes

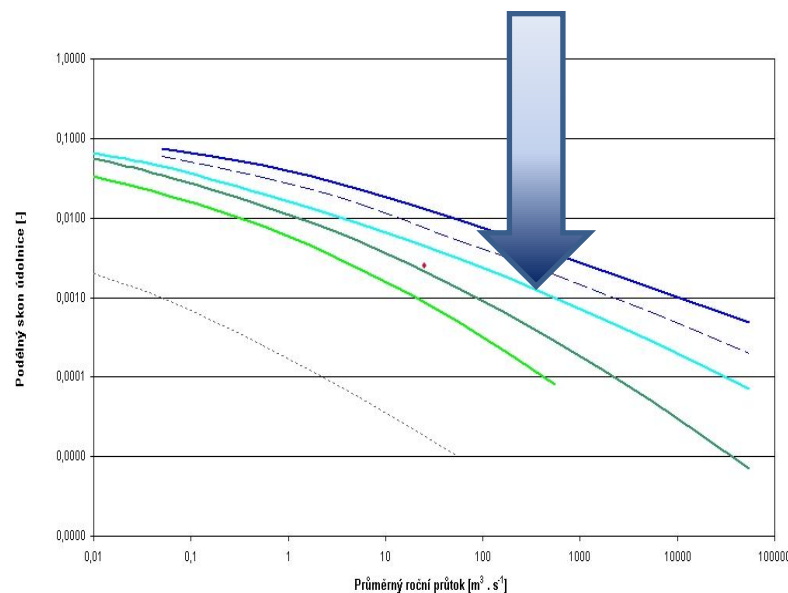




Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of individual processes

Trends in fluvial geomorphological processes



GSB - gravel sand branching





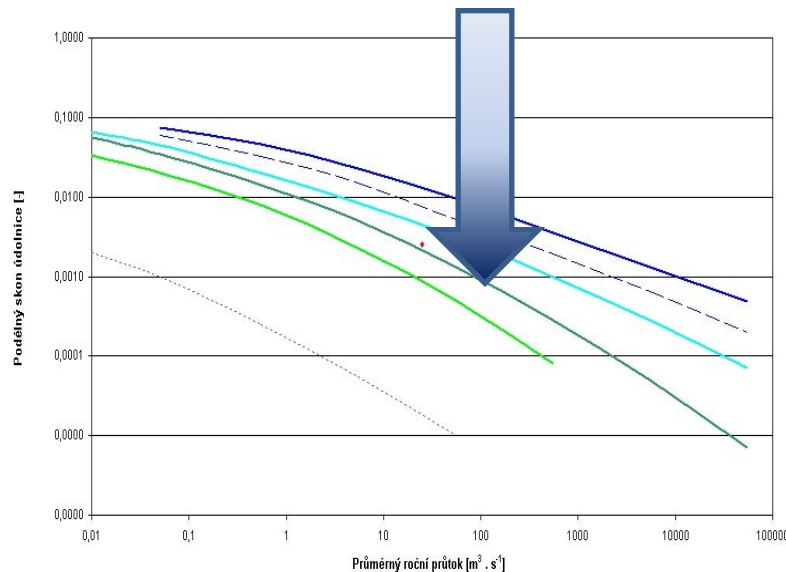
Part 01 Analysis of geomorphological processes in watercourses



Typology and interpretation of individual processes

AB - anastomotic branching

Trends in fluvial geomorphological processes





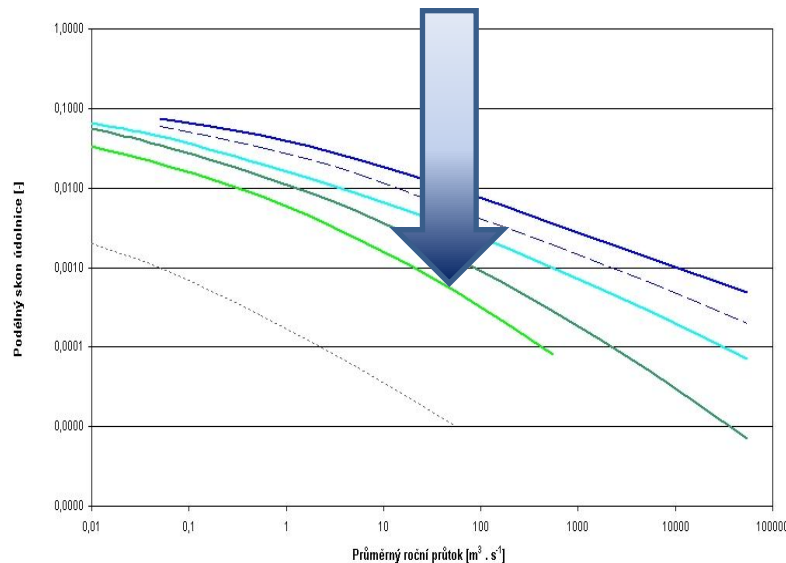
Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of individual processes

MD - meandering



Trends in fluvial geomorphological processes

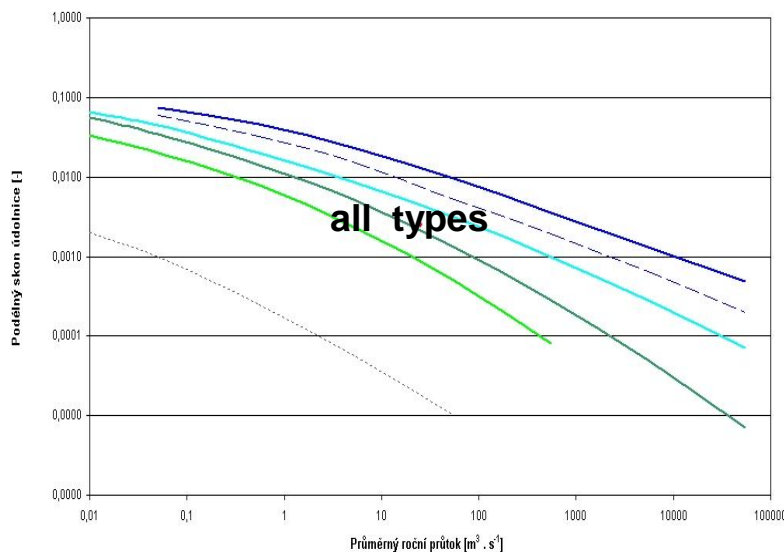




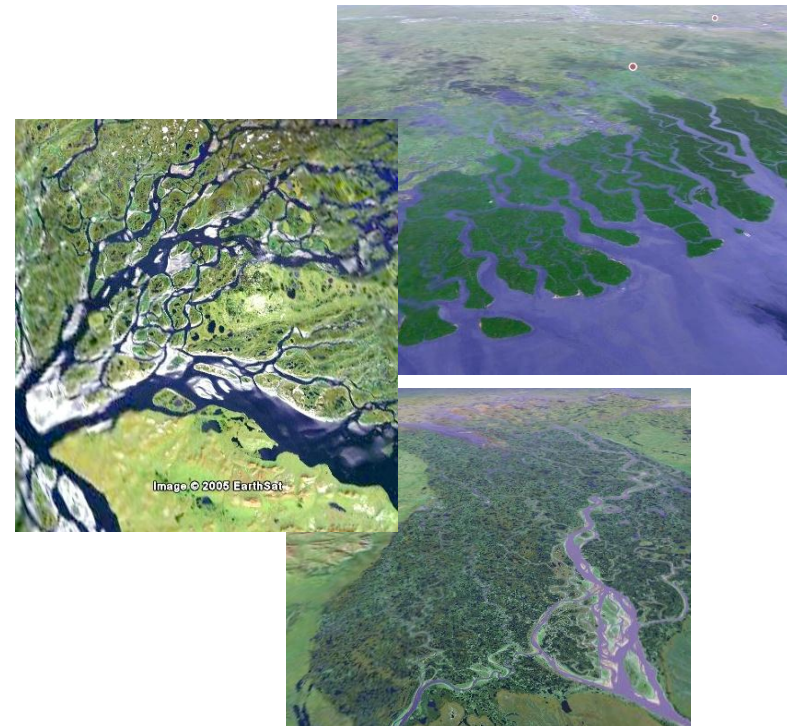
Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of individual processes

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DL - delta



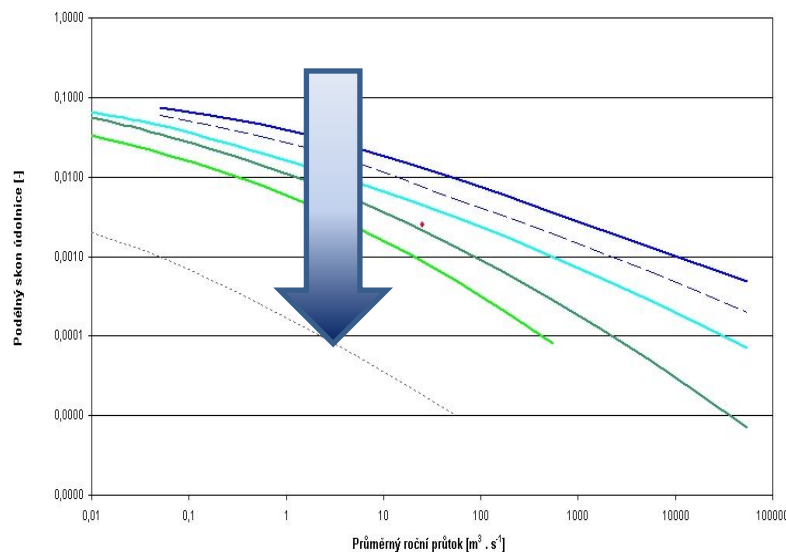


Part 01 Analysis of geomorphological processes in watercourses

Typology and interpretation of individual processes

WS - wetlands, swamps

Trends in fluvial geomorphological processes

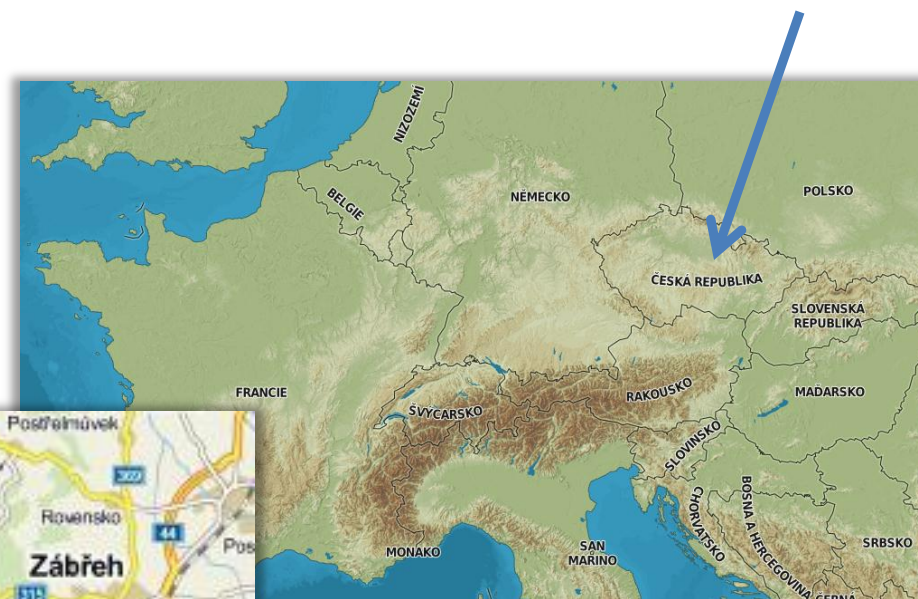
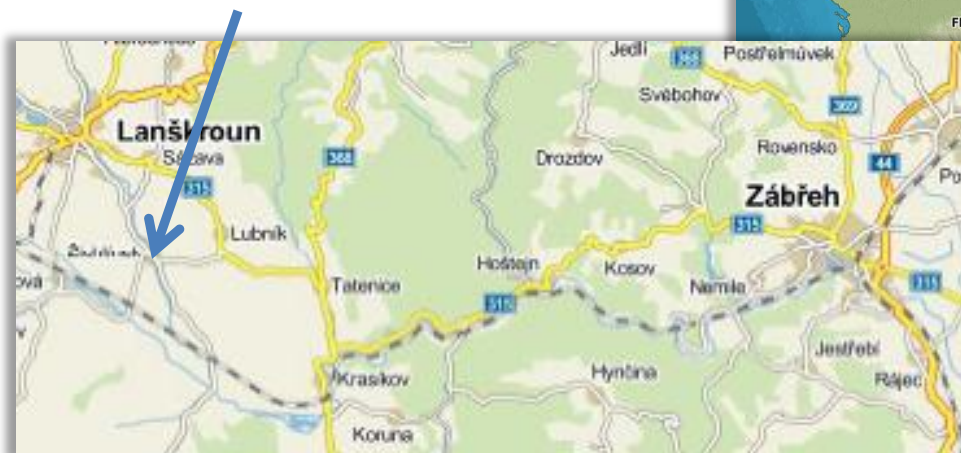




Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

The case project Žichlínek





Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

The case project Žichlínek

Before



Tasks

- Ensure flood wave transformation from Q100 to Q10 (from 200 m³/s to 60 m³/s)
- Suggest ecological design





Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

The case project Žichlín

Tasks

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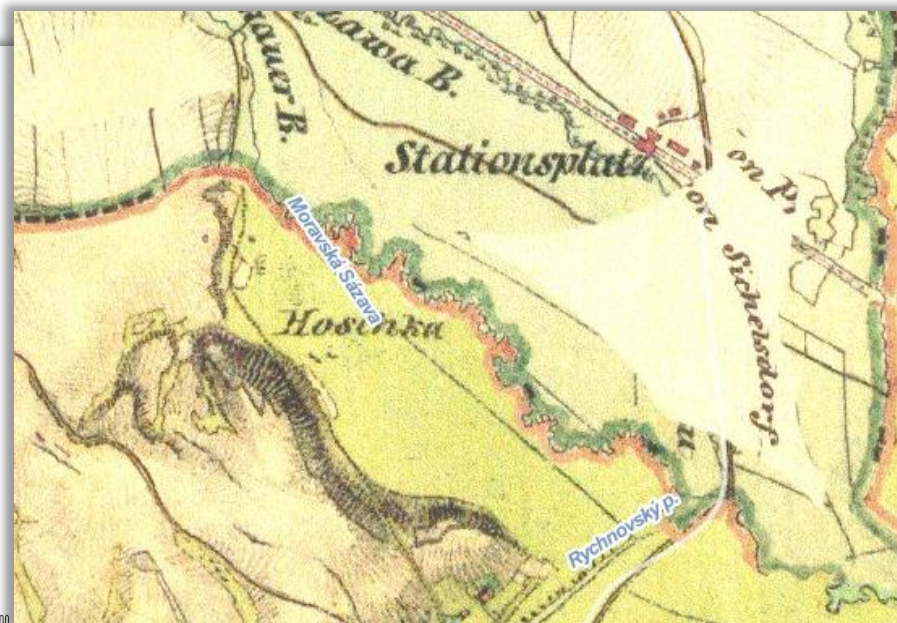
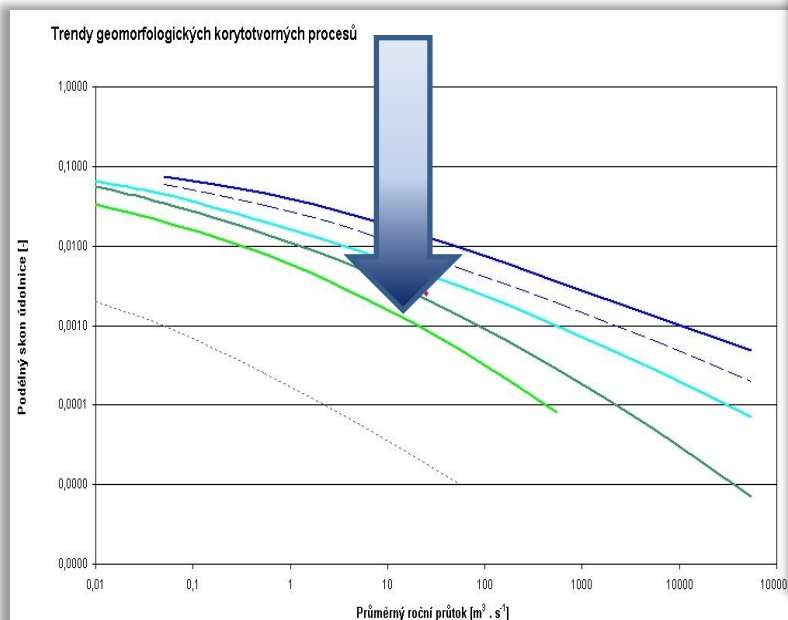
DISCUSSION



Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

The case project Žichlín





Part 02 - The case projects of river restorations

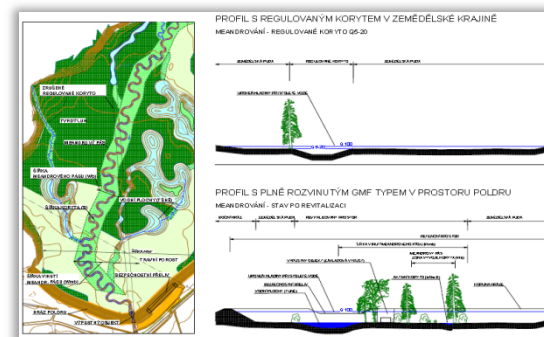
✓ river restoration in flood retention reservoirs

The case project Žichlíněk

Before



After



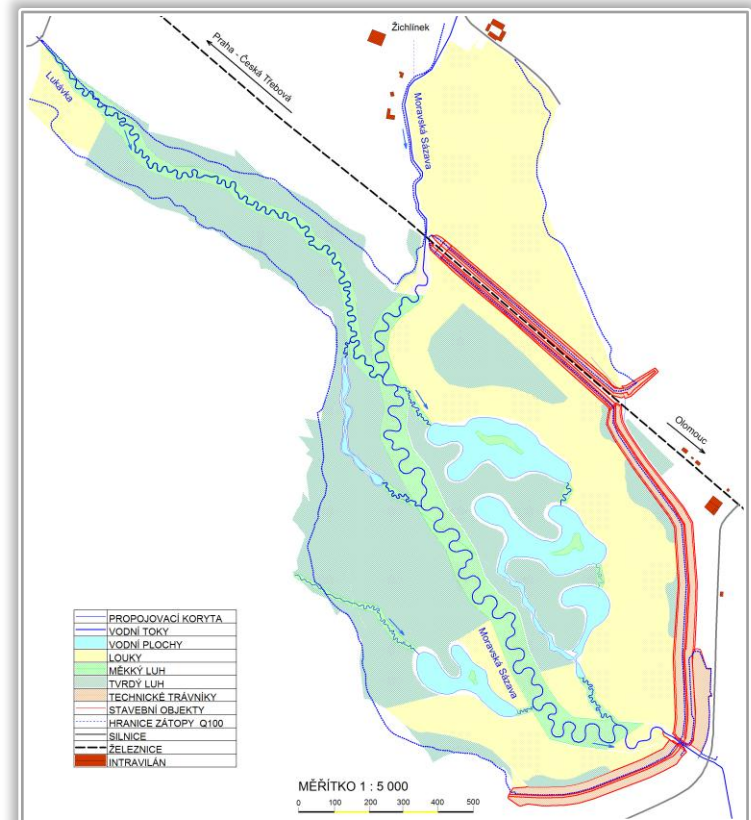
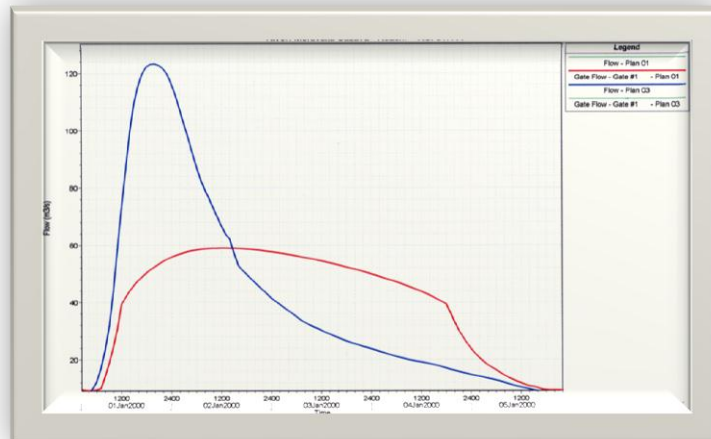


Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

Dry retention reservoir Žichlínek

- The volume of the retention area 6 000 000 m³
- Length of the dam 3 100 m
- Maximum height of the dam 7.5 meters
- The length of the restored meandering riverbeds 5 200 m

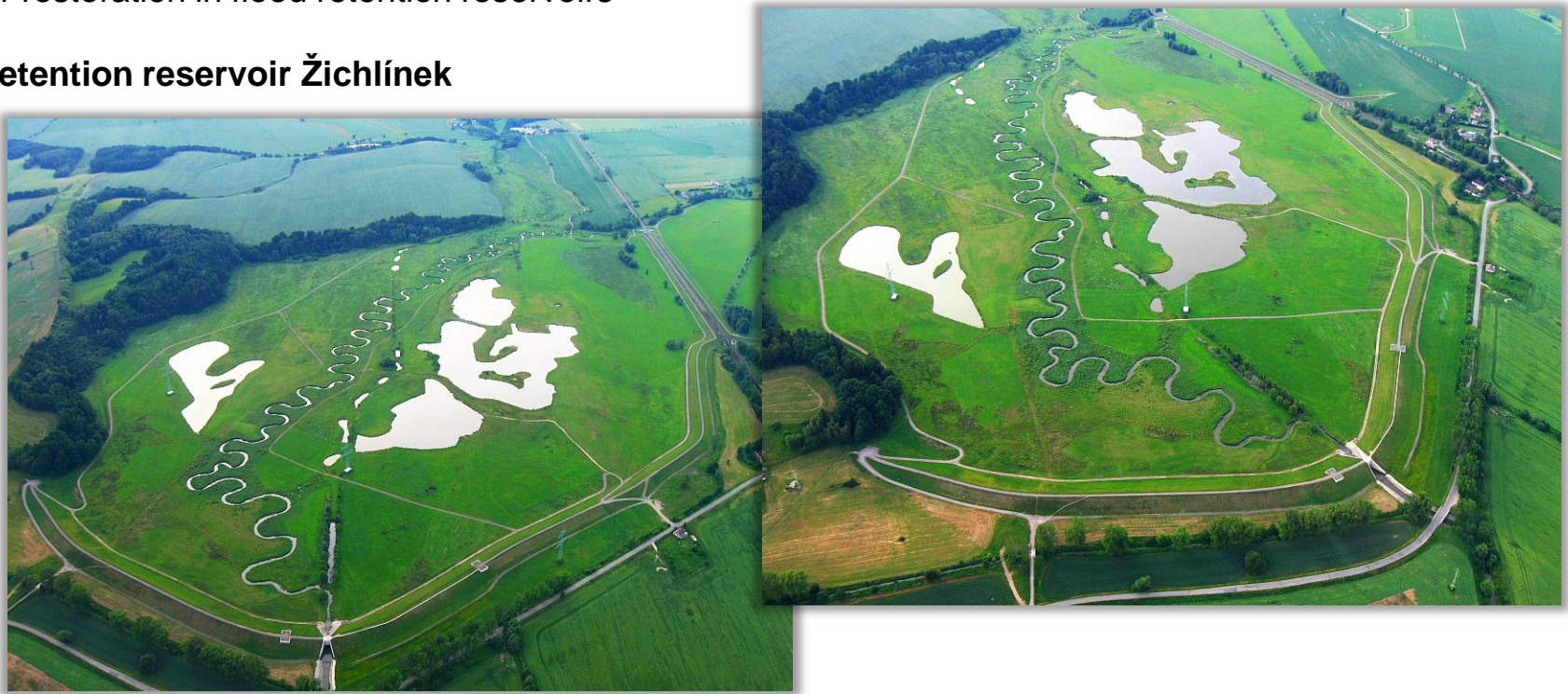




Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

Dry retention reservoir Žichlínek





Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

Dry retention reservoir Žichlínek

Before



After





Part 02 - Examples of river restorations

- ✓ river restoration in open floodplain
- ✓ meandering river and creek

Lukovský creek restoration





Part 02 - The case projects of river restorations

✓ river restoration in flood retention reservoirs

Dry retention reservoir Žichlínek

technical functional objects - dam



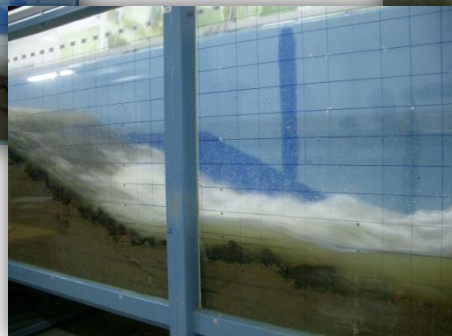
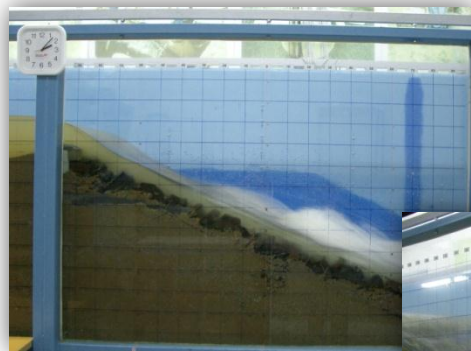


Part 02 - The case projects of river restorations

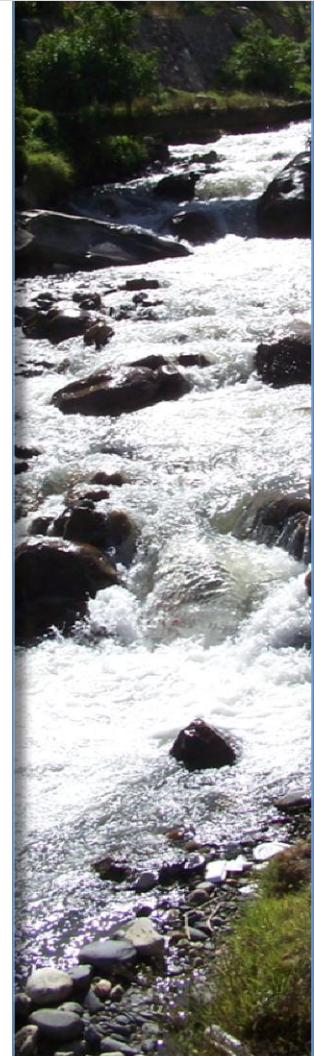
✓ river restoration in flood retention reservoirs

Dry retention reservoir Žichlíněk

technical functional objects - physical model



Thank you for your attention in discussion





Part 02 - The case projects of river restorations

✓ river restoration in urban areas - restoring the mill canal in the city Chrudim

before :





Part 02 - The case projects of river restorations

✓ river restoration in urban areas - **restoring the mill canal in the city Chrudim**

tasks:

- Restoration of artificial mill race
- Architecturally connected to city parks
- Create recreation area for residents



Part 02 - The case projects of river restorations

✓ Restoring the mill canal in the city Chrudim - SOLUTION

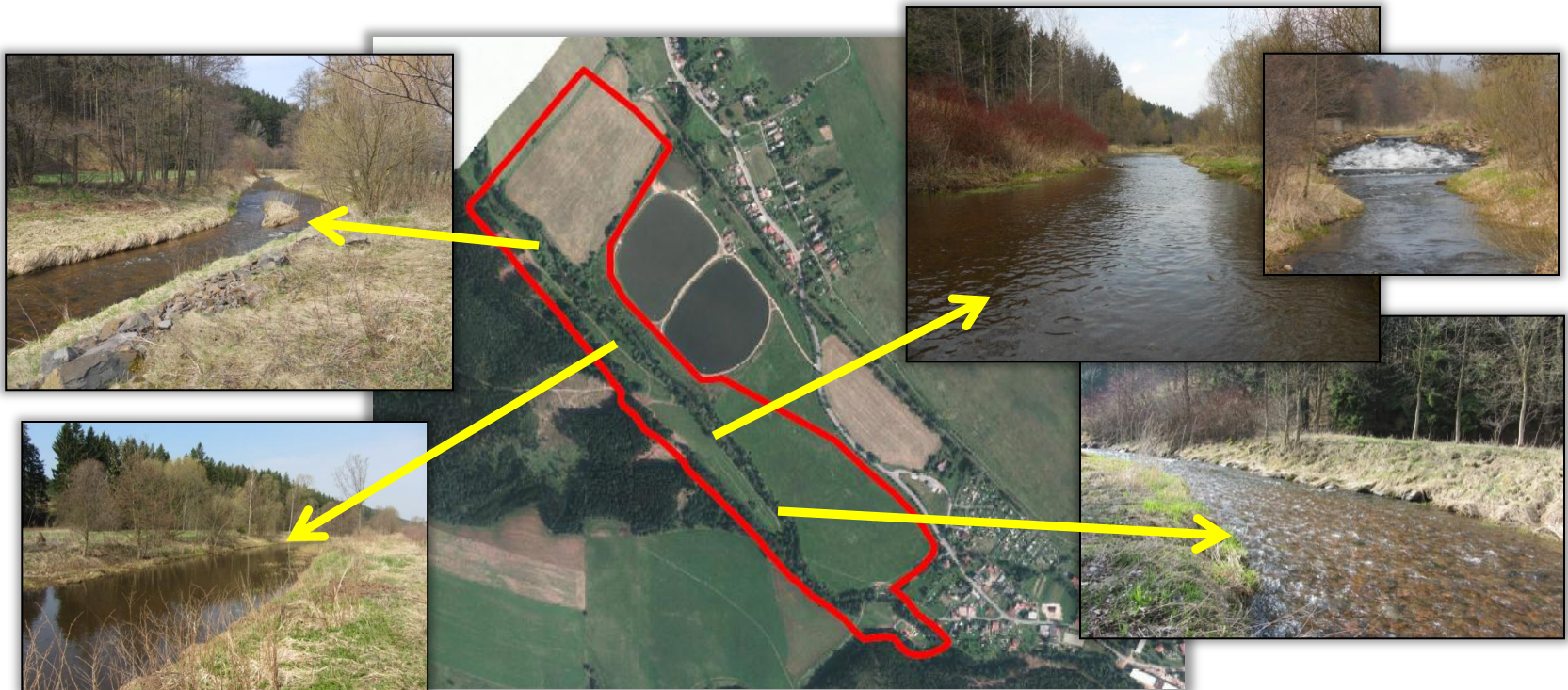
- Architectural features
- Recreational areas in the city
- Town educational trail with information boards about river ecology
- 2010 - bronze medal in the international competition:
The International Awards for Liveable Communities held in Chicago





Part 02 - The case projects of river restorations

- ✓ Creek restoration in protected areas of nature – creek Stěňava above the town Broumov





Part 02 - The case projects of river restorations

✓ River restoration in protected areas of nature - river Stěnava above the town Meziměstí

tasks:

- Restoration of the modified creek channel
- Restoration of of natural habitats and dynamics of channel development
- Retain the existing lateral reservoirs

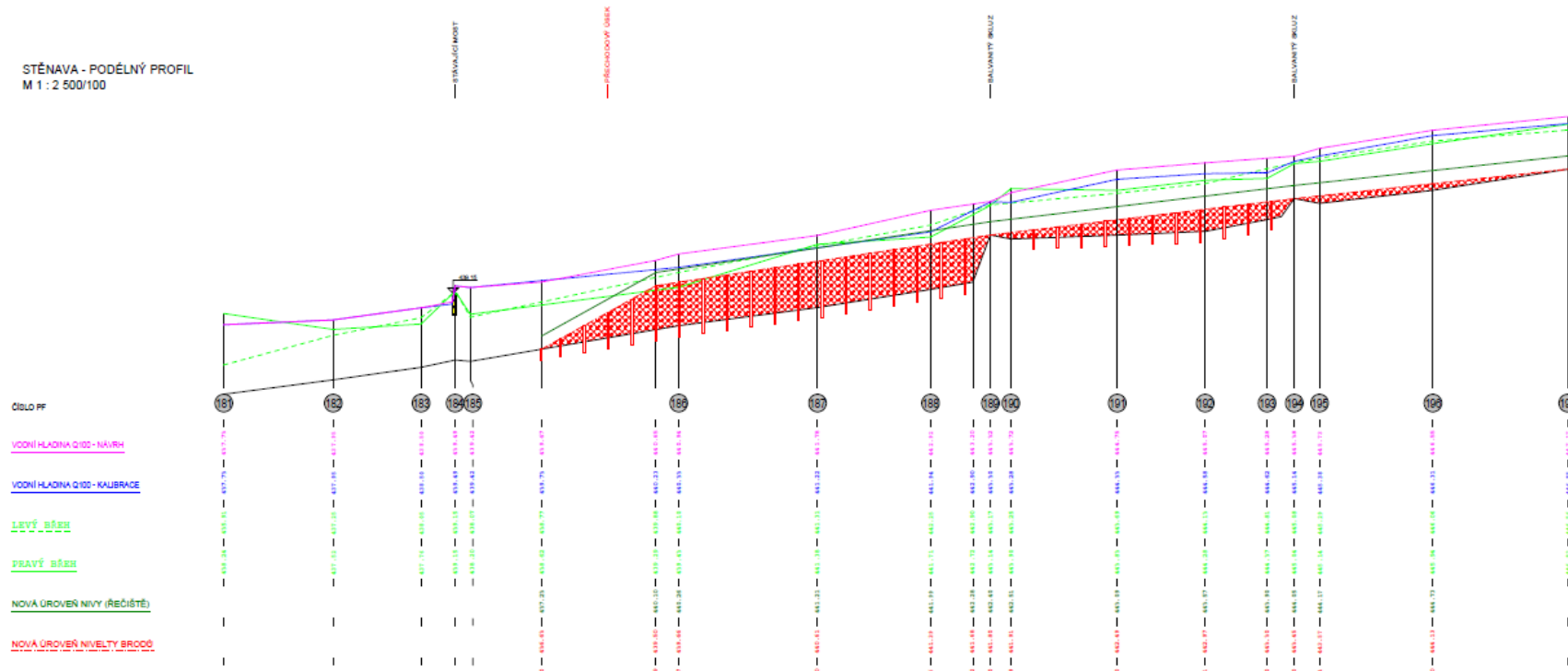
complications:

- Deep riverbed in a short section for the creek restoration
- Limited overflow into the floodplain



Part 02 - The case projects of river restorations

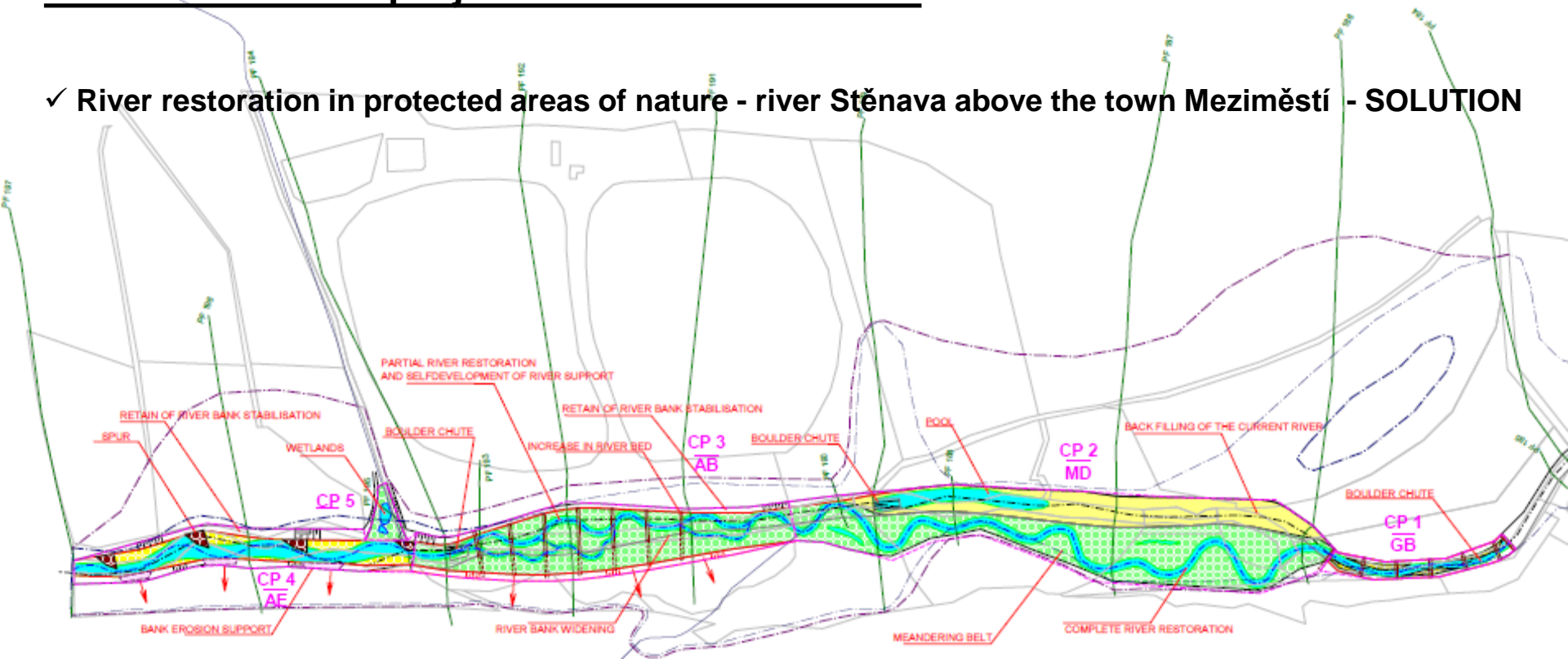
✓ River restoration in protected areas of nature - river Stěnava above the town Meziměstí - SOLUTION





Part 02 - The case projects of river restorations

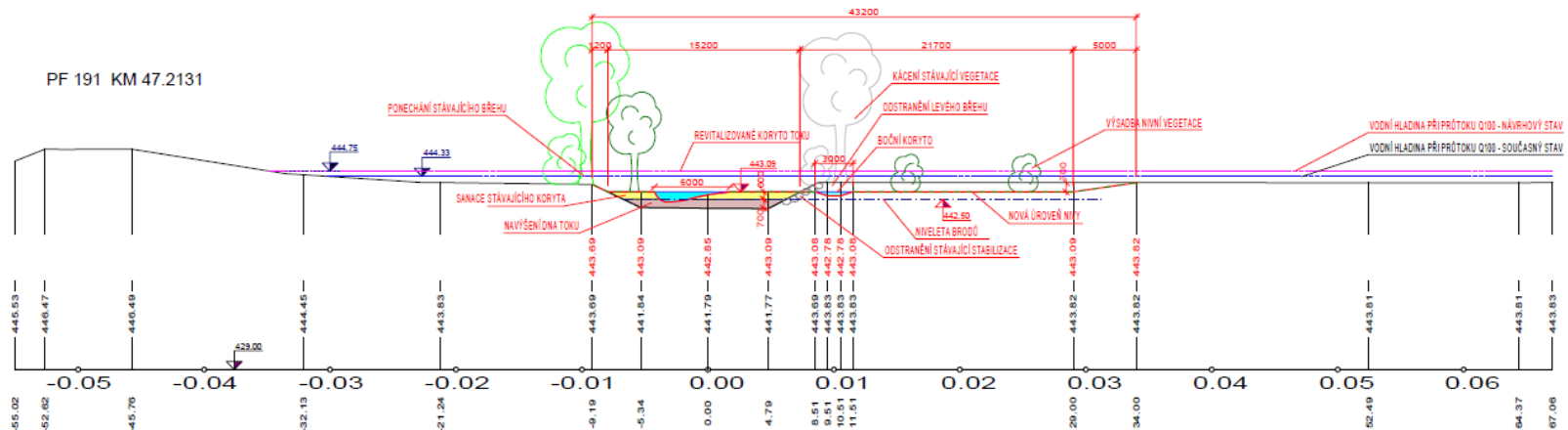
✓ River restoration in protected areas of nature - river Stěnava above the town Meziměstí - **SOLUTION**





Part 02 - The case projects of river restorations

✓ River restoration in protected areas of nature - river Stěnava above the town Meziměstí - SOLUTION

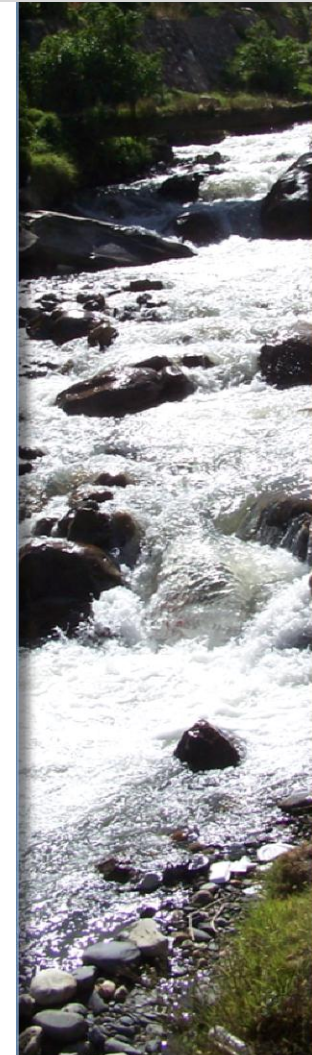




Part 03 Applications in river basin management plans

SOLUTION

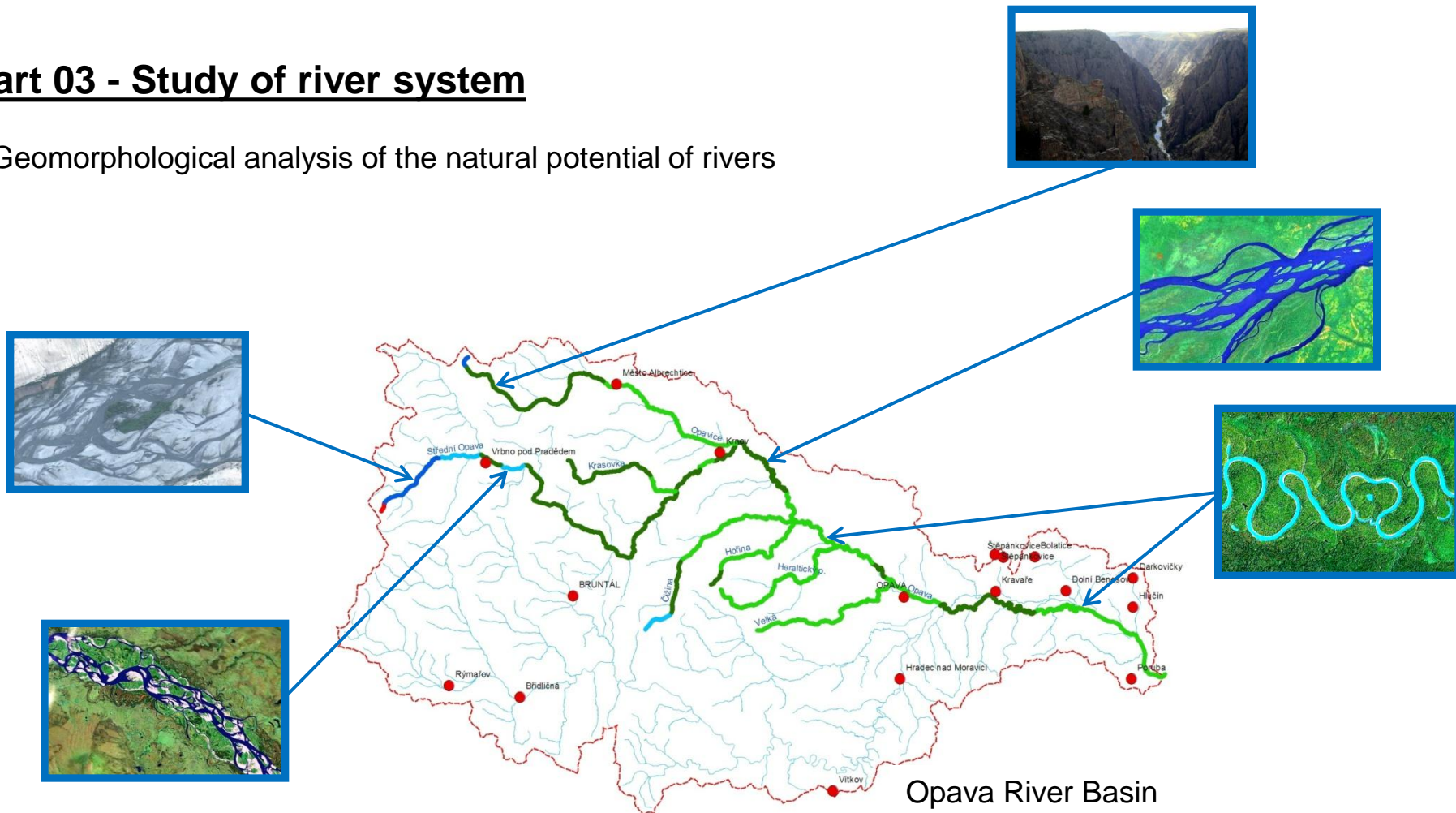
- ✓ Maps for evaluation of hydrographic network
- ✓ Links to flood protection
- ✓ Nature-like flood control measures – catalogue
- ✓ Determination of efficiency of measures





Part 03 - Study of river system

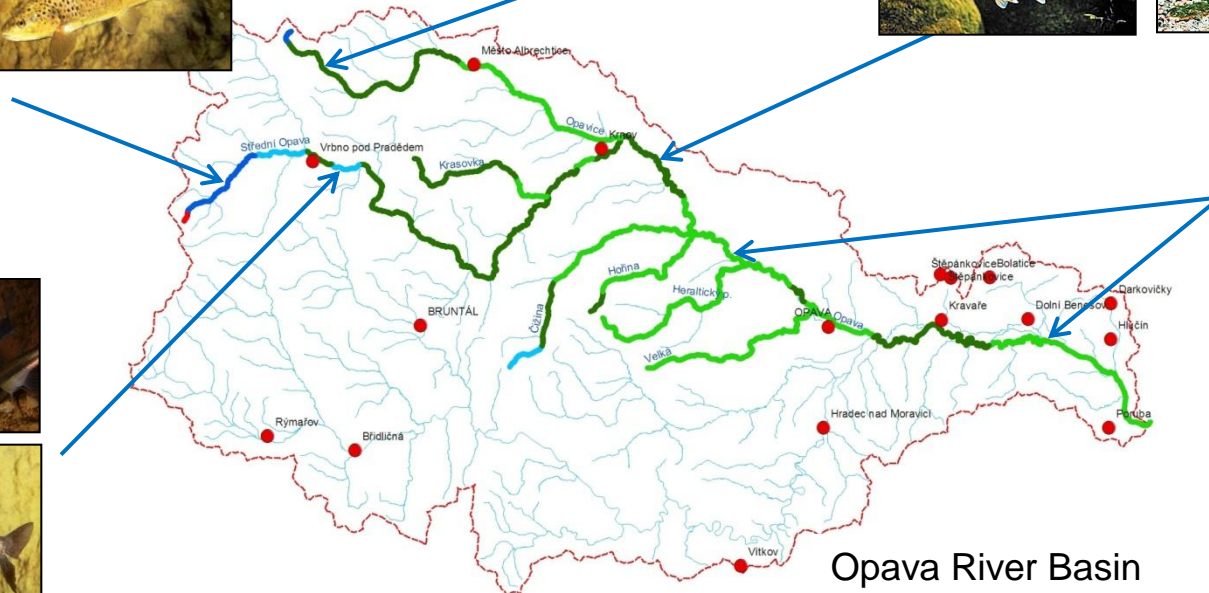
✓ Geomorphological analysis of the natural potential of rivers



Opava River Basin



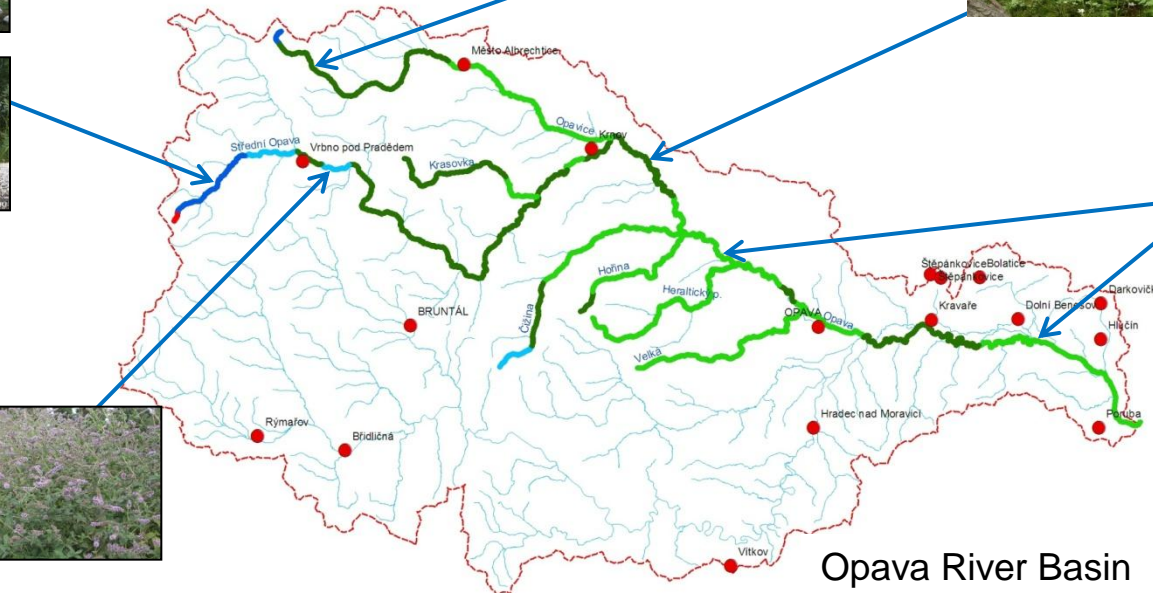
- ✓ Analysis of biological indicators of ecosystem quality
ichthyology and fish migration





Part 03 - Study of river system

- ✓ Analysis of biological indicators of ecosystem quality
botany and dendrology, floodplain vegetation

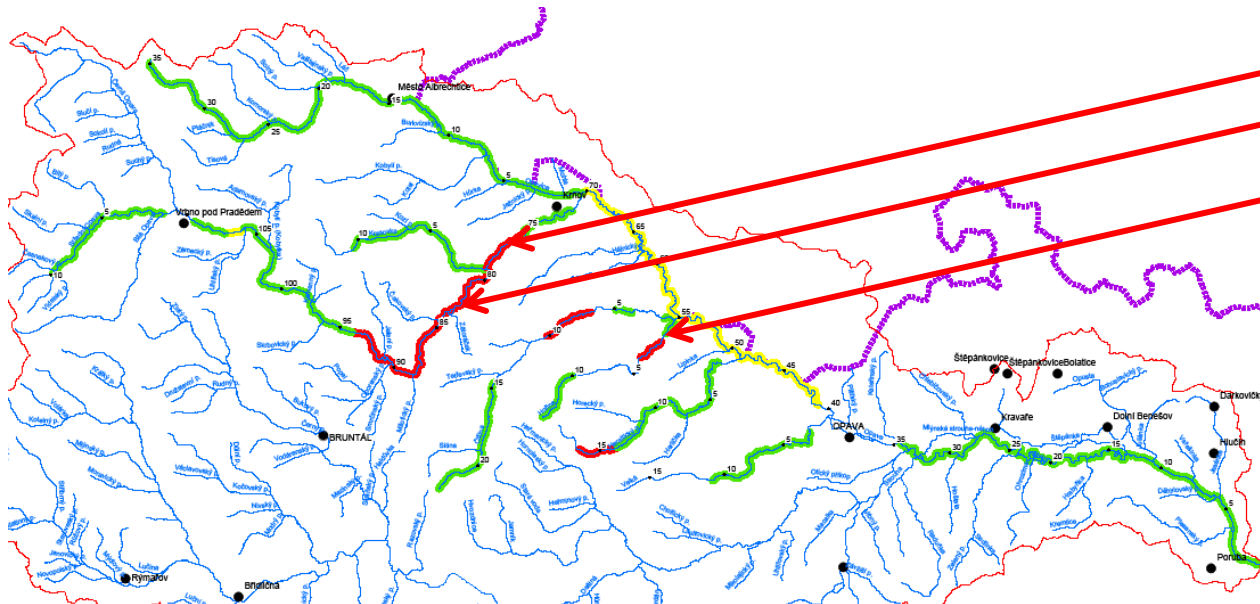


Opava River Basin



Part 02 Applications in river basin management plans

✓Links to flood protection - **priorities of flood protection**





Part 03 Applications in river basin management plans

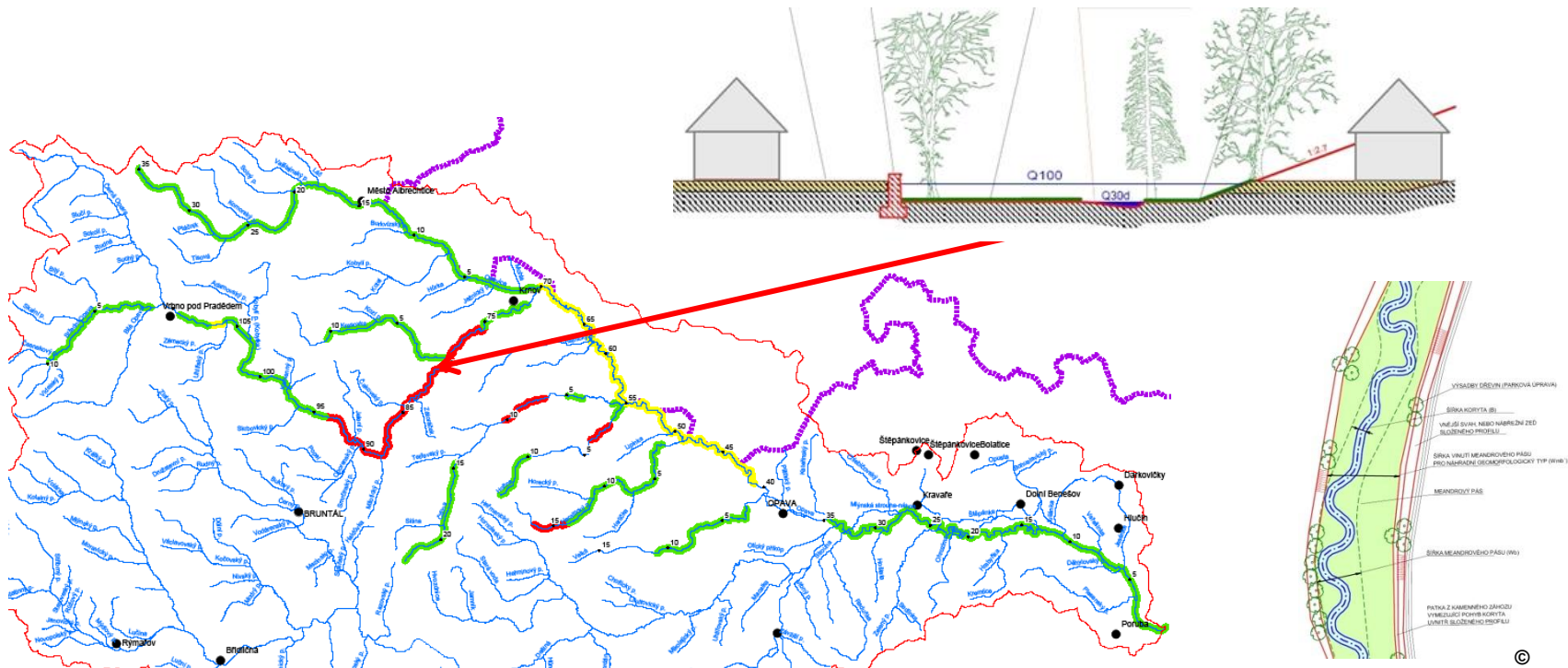
✓ Nature-like flood control measures – **Catalogue**

- 1. Outside the urban areas.** River and riparian vegetation restoration for transformation of flood in floodplain. Erosion protection in the catchment area.
- 2. Inside the urban areas.** Increasing the capacity and speed up the outflow from channel. New bridges, flood control dams, protective walls. River restoration concept in new channels.
- 3. Transformation of floods in dry retention reservoirs and polders.** River and riparian vegetation restoration in polder area.
- 4. River restoration in cities,** adjustment of regional master plans.
- 5. Protection of floodplains** means preservation of places that naturally transform floods – e.g. national parks, protected areas, open landscape.
- 6. Combination** of previous types.



Part 03 Applications in river basin management plans

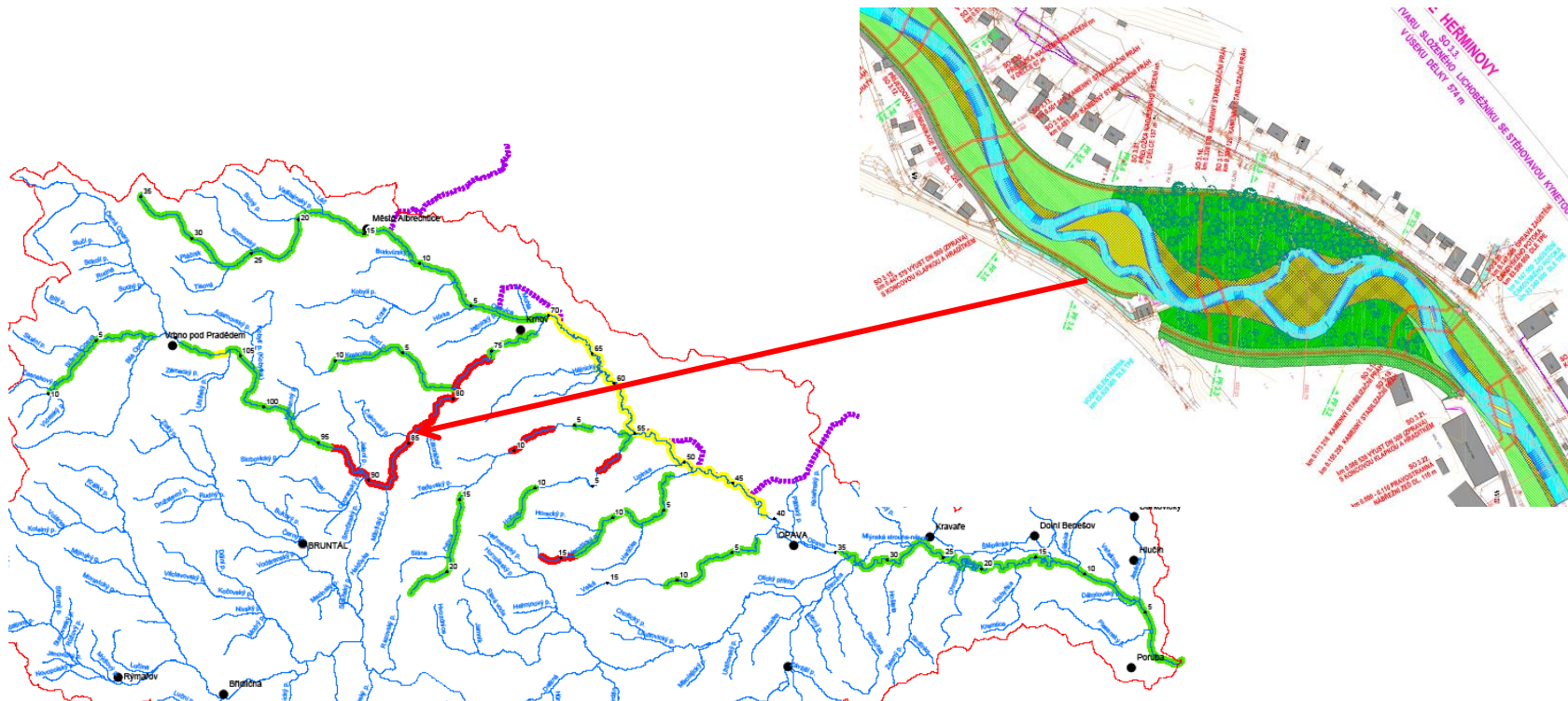
✓ All types of measures need parameters from geomorphological analysis !!!!





Part 03 Applications in river basin management plans

✓ All types of measures need parameters from geomorphological analysis !!!!





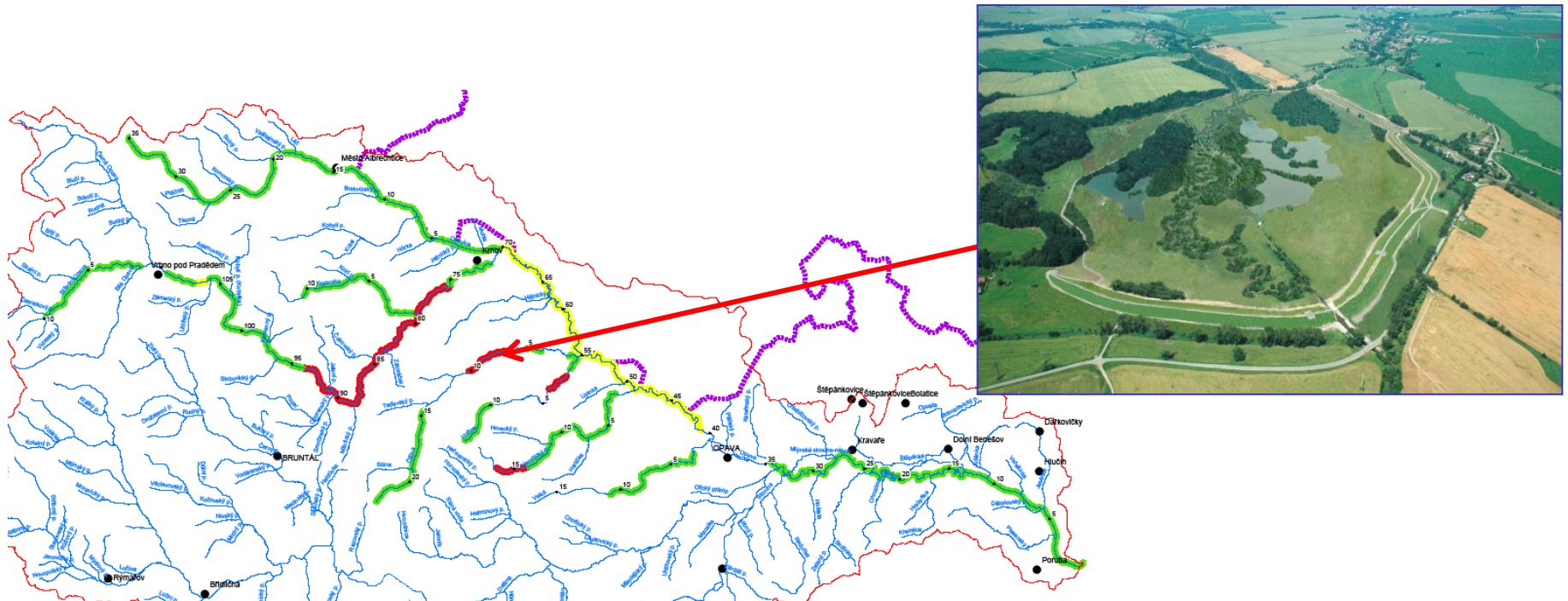
✓ All types of measures need parameters from geomorphological analysis !!!!





Part 03 Applications in river basin management plans

✓ All types of measures need parameters from geomorphological analysis !!!!





Part 03

Applications in river basin management plans

✓ Determination of efficiency of measures

Evaluation of effectiveness of the investment:

- Protects property and lives of people
(the standard method - value of property protected and number of people protected)
- The maintenance or revitalization of the natural ecosystem
(criteria assessment of the degree achieved of the natural potential of the river ecosystem)

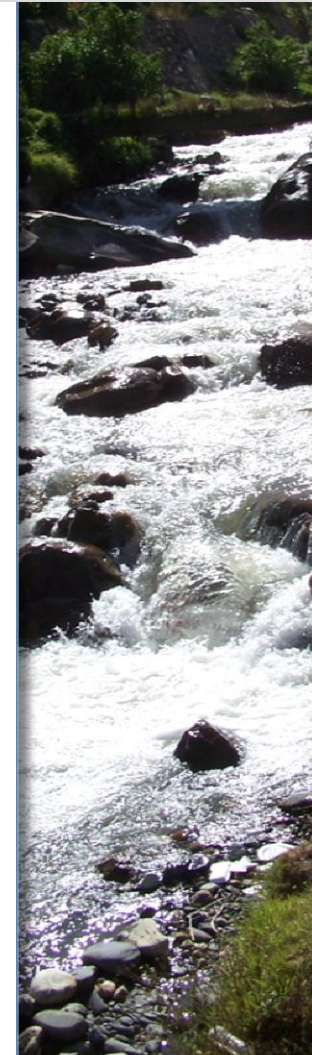


Part 03

Conclusion

Analysis of geomorphological processes in watercourses enables:

- ✓ Determination of a reference state that enables description of the present state of the hydrographic network
- ✓ Proposals of project parameters for river restoration that combine flood control and biodiversity protection
- ✓ Constructive solutions to the conflicts between traditional water management measures and nature protection

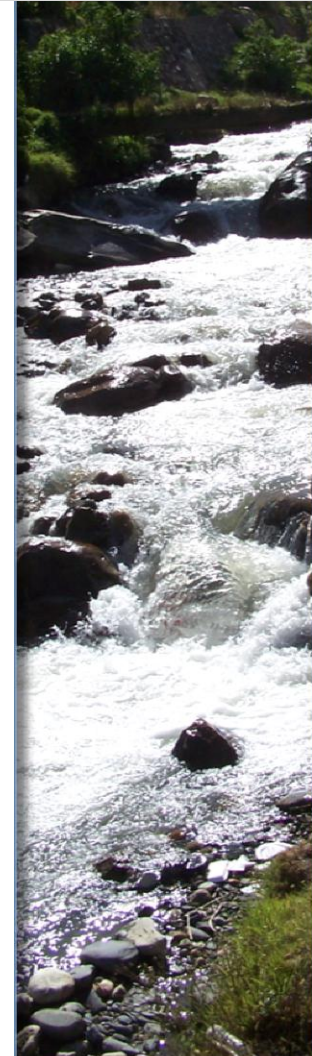


Our Mission:

Sustainable use of water and natural resources for all people

Our Strategy:

**Our solutions are complex, protect environment and natural values
and utilize renewable natural resources**



Thank you for your attention

