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Habitat structure changes of the Wisłoka river as a result of channel restoration

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Introducing the Water Frame Directive means improving river bed contuinity, treating them as a ecological corrodor.

Principles of surface water classification (according to the WFD)

biological parameters	physico-chemical conditions	hydromorphological conditions	State: very good, good, moderate, weak, bad

TASKS:

- improve structure of fish habitat in the section of the Wisłoka River (30 km),
- the modernization of 9 hydraulic structures located on the Wisłoka, Jasiołka and Ropa,
- fish stocking.

Hydromorphological quality classes

CHANNEL

1. Channel **geometry**, planform, longitutual section, cross-section
2. Substrates – artificial, natural **substrate** type
3. Channel and bank **vegetation** and organic debris, structural form of macrophytes present, leafy and woody debris
4. Erosion/Deposition character, features in channel and at base of bank, point **bars**, eroding cliffs
5. **Flow**, flow patterns, flow Features, discharge regime, possibility of water **exchange** between the river bed and alluvial (river and hyporetic waters)
6. Longitudinal **continuity** as affected by artificial structures, artificial barriers affecting continuity of flow, sediment transport and migration for biota

RIVER BANKS/ RIPARIAN ZONE

7. **Bank structure** and modification, bank materials, types of bank protection
8. **Vegetation type**/structure **on banks** and adjacent land, structure of vegetation, types of land-use and type of development

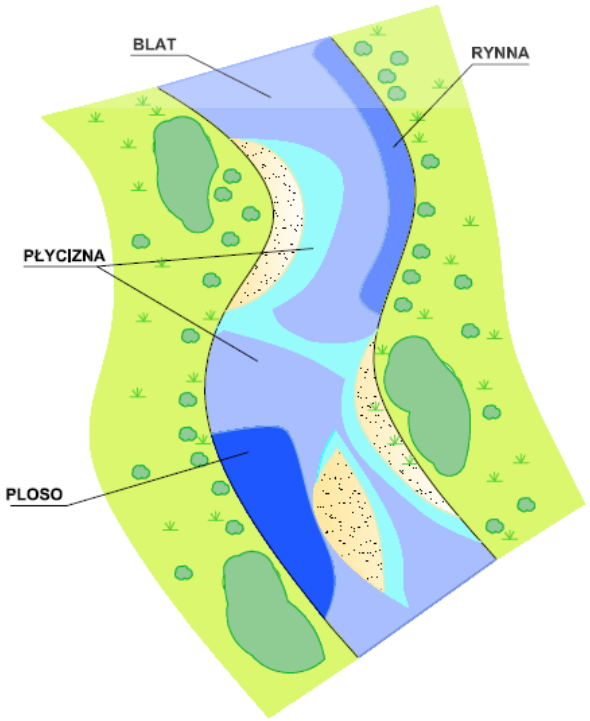
FLOODPLAIN

9. Adjacent **land-use** and associated features, type of land-use, extent and type of development, type of open water/wetland features
10. Degree of **lateral connectivity of river and floodplain** and lateral movement of river channel, degree of constraint to potential mobility of river channel and water flow across floodplain

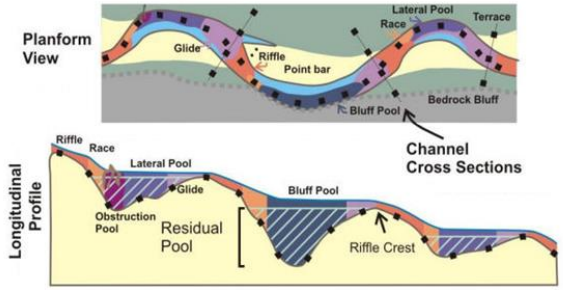
Hydromorphological quality (modification) classes:
1,0 ÷ 1,79 – Near natural,
1,8 ÷ 2,59 – Slightly altered,
2,6 ÷ 3,39 – Moderately altered,
3,4 ÷ 4,19 – Extensively altered,
4,2 ÷ 5,00 – severely altered.

Wyżga B, Zawiejska J, Radecki-Pawlik A, Amirowicz A (2010) A method for the assessment of hydromorphological river quality and its application to the Czarny Dunajec, Polish Carpathians, Cultural landscapes of river valleys. Publishing House of the University of Agriculture in Krakow, 145-164

Mezohabitats

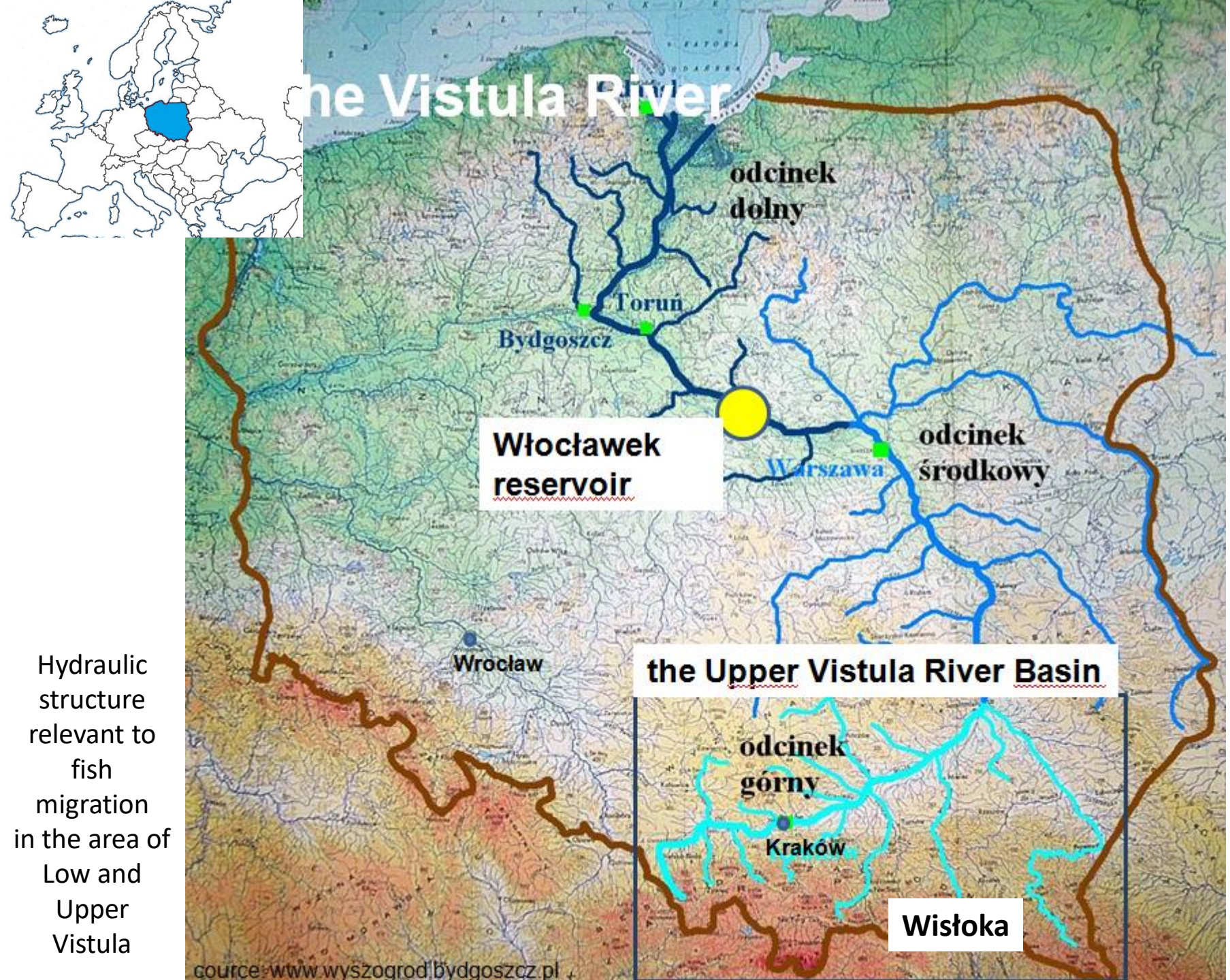


JHM eng	Kolor
Pool	
Riffle	
Run	
Rapid/Race	
Glide	
Shelf	
Backwater	
Side arm	
Bar	



Habitats – the living space of the water organis, the zone on the river bed characterise by relatively constant flow parameters

Mezo – scale/dimension



Hydraulic structure relevant to fish migration in the area of Low and Upper Vistula

Reconstruction of fish ladder – Włocławek Reservoir 2014

Reophile fish - fish that need to grow in fast moving, well-oxygenated water and gravel surfaces:

Trout, Pstrąg potokowy

Aspius aspius, Boleń

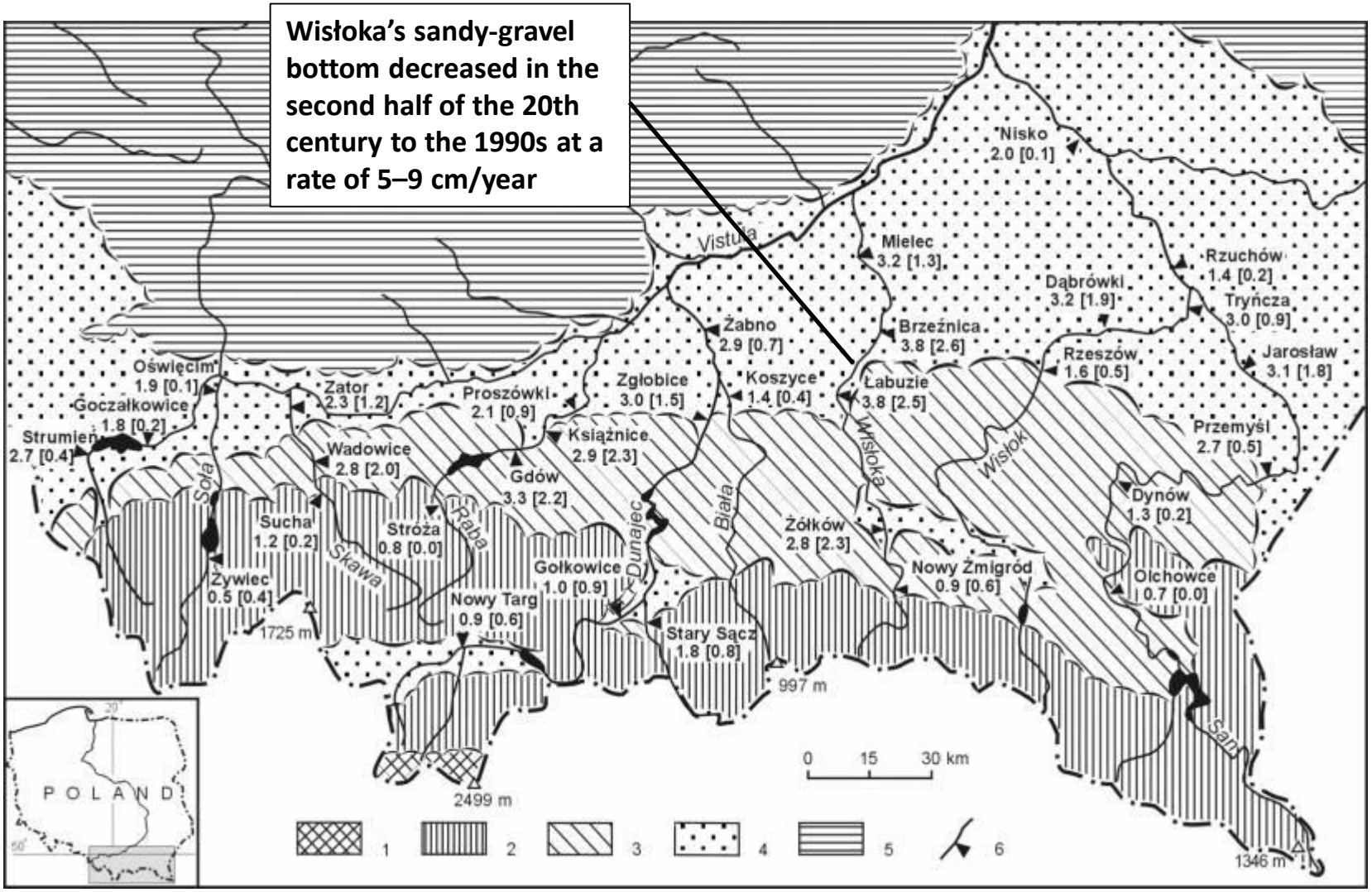
Diadromous fish - travels from the Baltic Sea (salt water) into rivers of spring sections (fresh water) to spawn:

Bull-trout, Troć

Salmon, Łosoś

- Ryby idą - trocie, certy, leszcze - mówi prof. Piotr Dębowski z Instytutu Rybactwa Śródlądowego w Olsztynie kierujący grupą ichtiologów, która przyjechała na tamę - Teraz przeszło około 200 troci. Mamy też silny ciąg certy. Wczoraj zanotowaliśmy sto kilkadziesiąt tych ryb na przepławce.

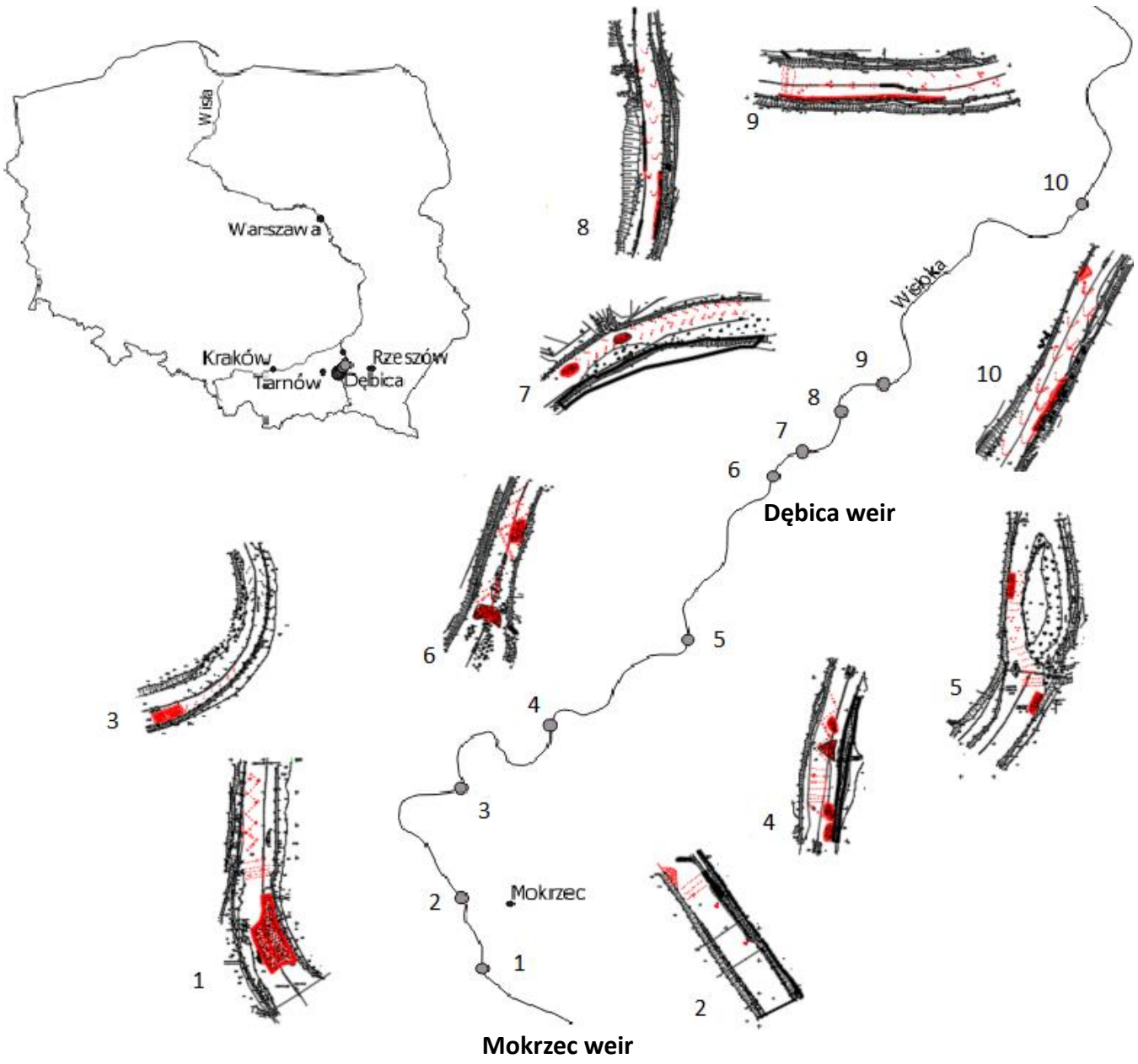
Channel incision of main rivers of the polish Carpations during the 20th century and in secound half [m]



The Raba, Skawa, Dunajec Wisłoka Rivers riverbed elevation lowering from 2 to 4 meters, the erosion concerns a tributaries as well

Wyżga B (2007) A review on channel incision in the Polish Carpathian rivers during the 20th century, Developments in Earth Surface Processes, 11, 525-553, doi:10.1016/S0928-2025(07)11142-1

Changes of the river morphology



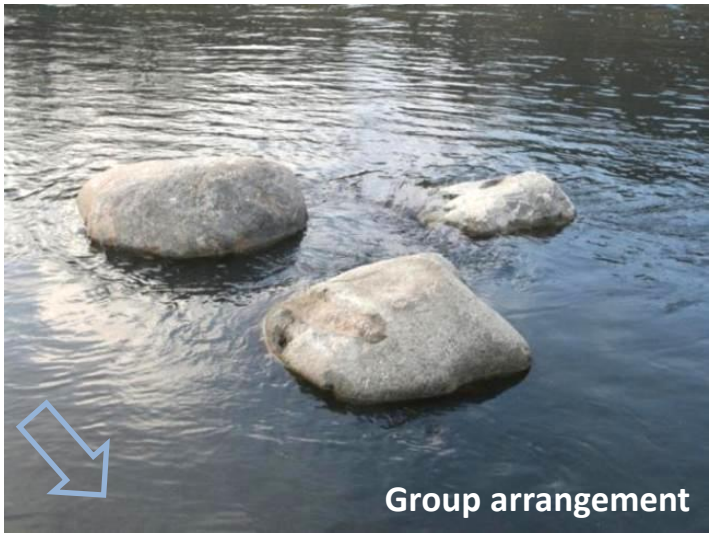
- placing boulders,
- controlled lateral erosion of banks
- deposition of bedload in the river channel

- **Concept**
- **Project**
- **Realization**
- **Monitoring**

Bartnik W., Książek L., Jelonek M., Sobieszczyk P., Florek J., Hawryło A., Leja M., Strużyński A., Strutyński M., Wałęga A., Wyrębek W., Wiśniewolski W., Parasiewicz P., Prus P., Adamczyk M., Depowski R, 2015, Warunki przywracania struktury siedlisk dla ryb na odcinku rzeki Wisłoka w km 73+200 - 42+600, Gospodarka Wodna, 5, 147-152

Diversification of water flow conditions

Boulder clusters



Lateral erosion

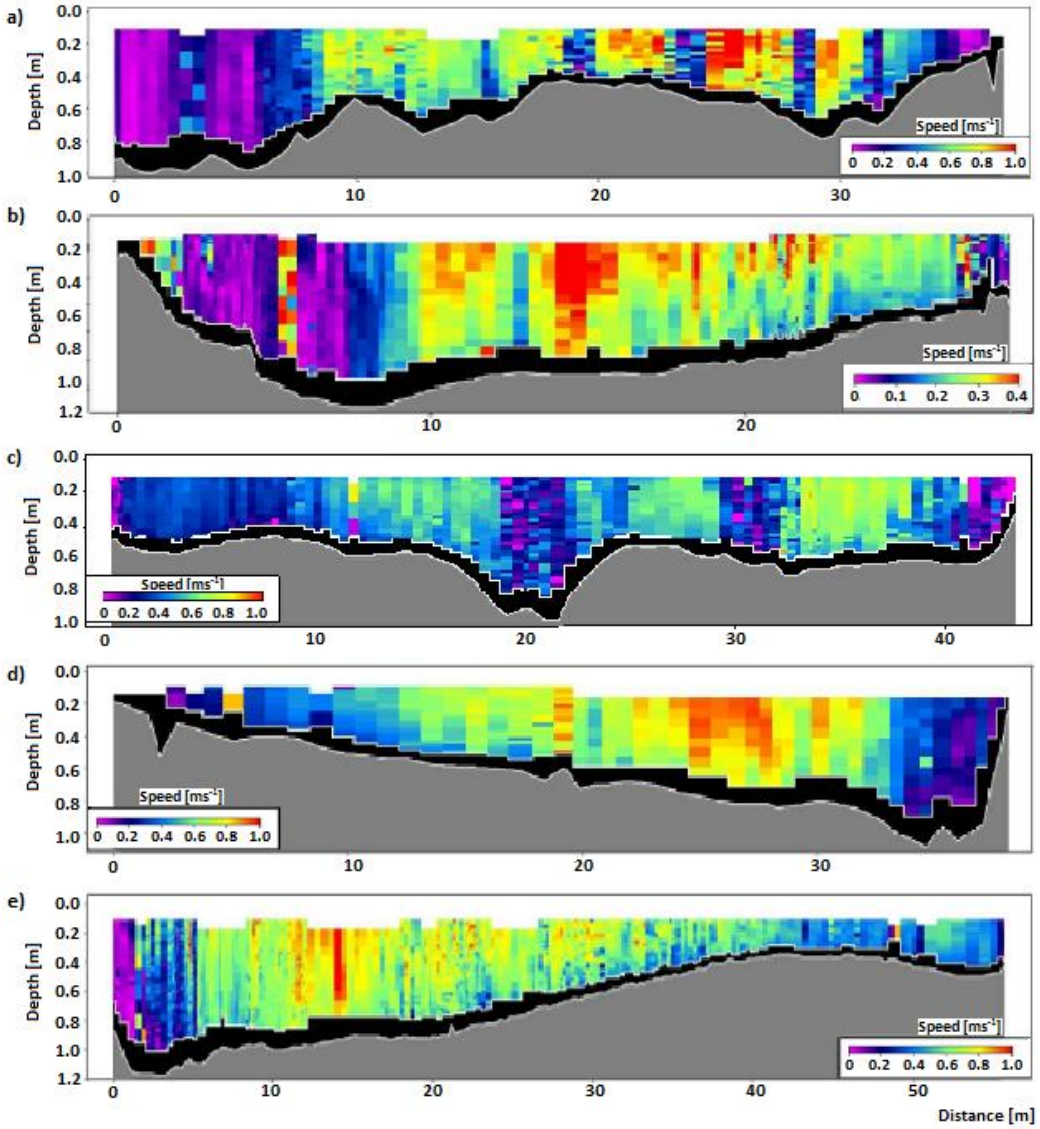
Openwork deflectors

Deposition of bed material

Książek L., Wyrębek M., Strutyński M., Woś A., 2018, Numerical modeling of water flow conditions with spatial distributed boulder in main channel, GeoPlanet: Earth Planetary Science, Monika Kalinowska et al. (Eds): Free Surface Flows and Transport Processes, doi: 10.1007/978-3-319-70914-7_17

Książek L., Woś A., Roche G., 2017, Boulder cluster influence on hydraulic microhabitats distribution under varied instream flow regime, Acta Scientiarum Polonorum, Formatio Circumiectus, Vol. 16 (4), 139-153, doi: 10.15576/ASP.FC/2017.16.4.139

Spatial velocity distribution



Cross-sections

01-03, km 73+090
right after the boulder cluster – openwork arrangement
Q=7.8 m^3s^{-1};

02-09, km 71+309
downstream the deflector
Q=8.9 m^3s^{-1},

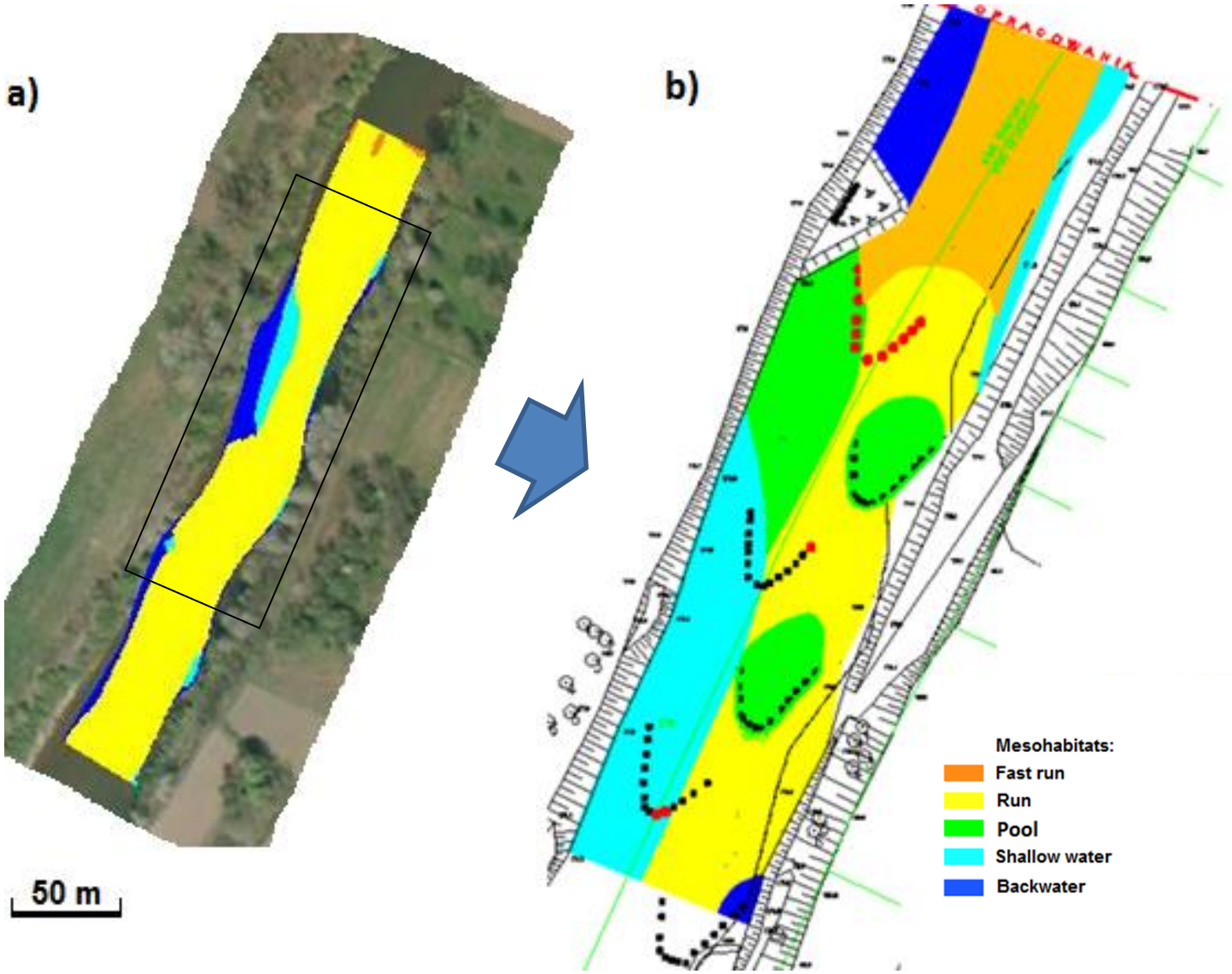
09-03, km 54+482
downstream boulder cluster groups;
Q=11.9 m^3s^{-1},

10-01, km 48+250
through openwork deflector
Q=13.6 m^3s^{-1},

10-11, km 48+072
after the deflector outside the impact zone; Q=13.6 m^3s^{-1}.

The spatial velocity flow distribution, water depth, channel geometry, discharge - measured using ADCP

Conversion of a homogeneous flow (riverbed) into a rich mosaic of habitats



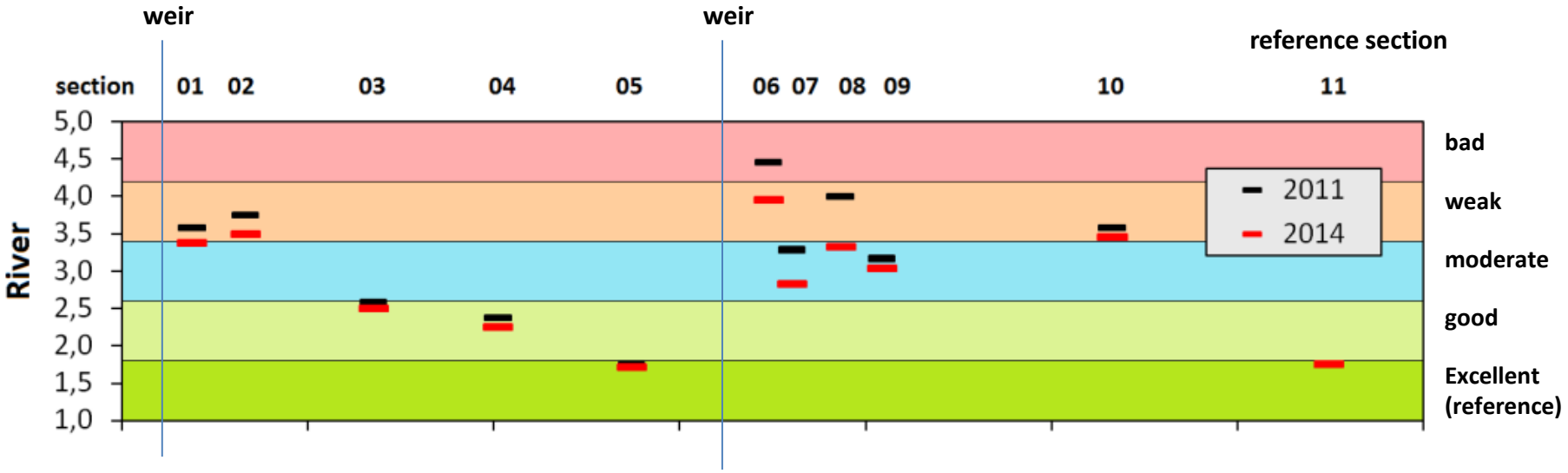
Before (Q_{dec}):
riffie – 0.2%,
fast run –7.4%,
run – 55.6%, shallow water – 25.0%,
backwater – 11.9%,
pool – 0%.

After (Q_{pom}):
riffie – 0.8%,
fast run –18.1%,
run –33.2%,
pool –23.5%, shallow water – 13.9%,
backwater –10.5%.

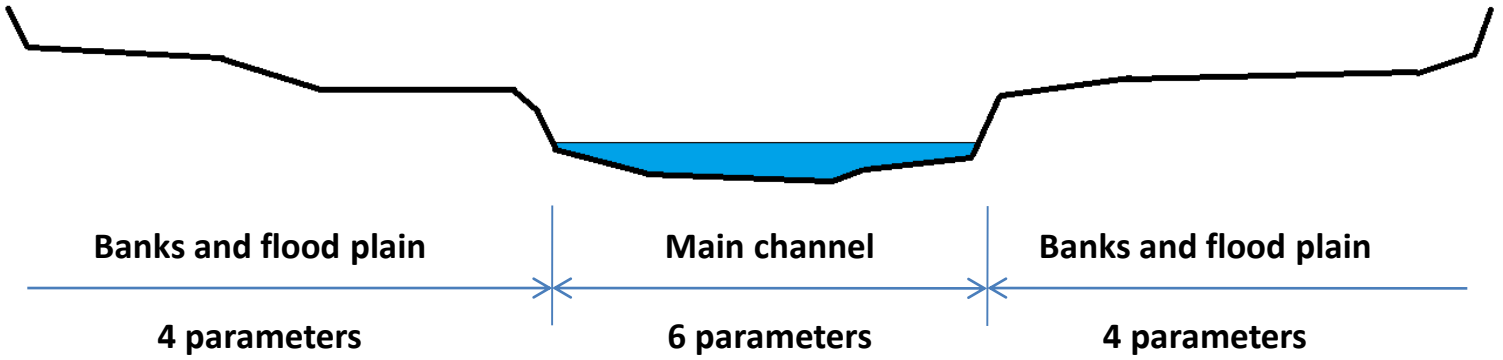
Low energy habitats (shallow water and backwater) from 36.9% to 24.4% - decrease,
fast flow from 9.6% to 18.9% - increase
medium energy (pool) - increase

Mesohabitats structure, Wisłoka, section 10; before (a) (the 2D model) and after (b) restoration, Q=13.6 m^3s^{-1}

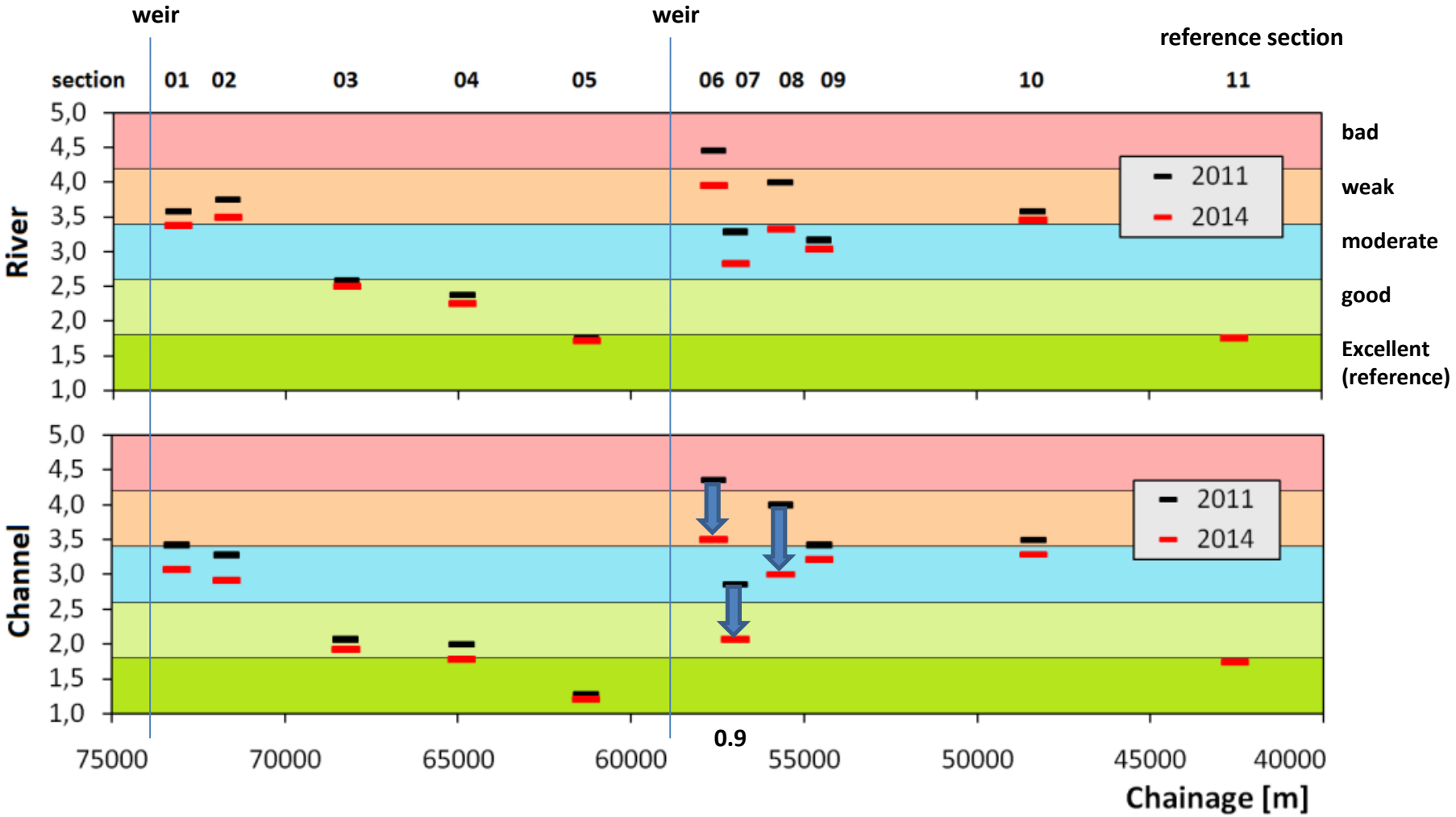
River hydromorphological quality before and after restoration



The average; main channel with flood terraces: 2011 (before) – 3.25, 2014 (after) – 3.00.



River hydromorphological quality before and after restoration



The average; main channel without flood terraces: 2011 (before) – 3.02, 2014 (after) – 2.60.

Restoration did not include changes of bank protection and the river valley.

Conclusions:

- after restoration, all types are represented in the habitat structure. There is a noticeable decrease in the contribution of low energy habitats, the appearance of areas with medium energy and increase in areas with hight energy habitats.
- channel restoration activities improved the morphological quality of the channel but did not cause a significant change of the all river valley - in seven locations increased their channel grade by one class.

The cumulative effect:

- **creating an ecological corridor of the river Wisłoka,**
- **reducing the fragmentation of the catchment area,**
- **restore the integrity of the NATURA 2000 ''Wisłoka Tributaries“.**

Thank you

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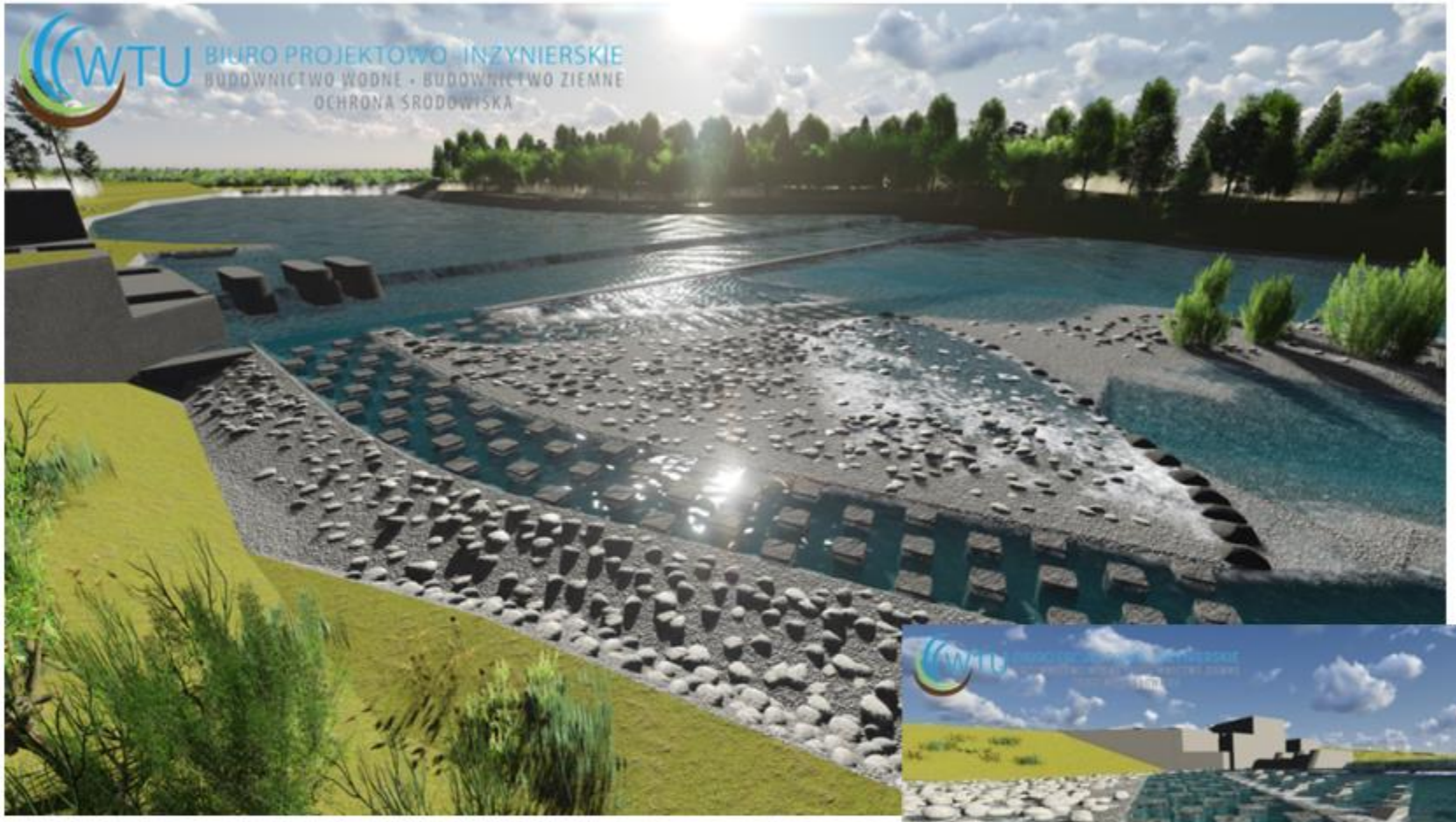
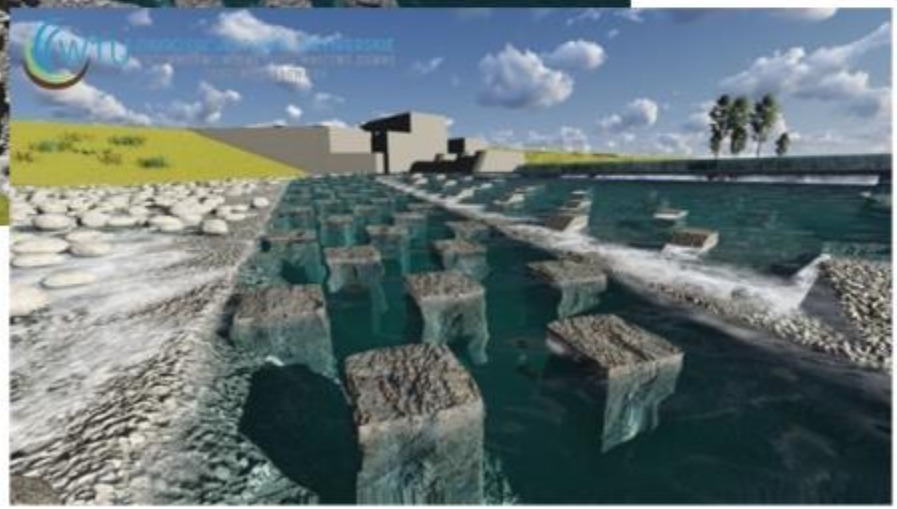
Dębica





Fishway project
Dębica, Wisłoka River km 56+180

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