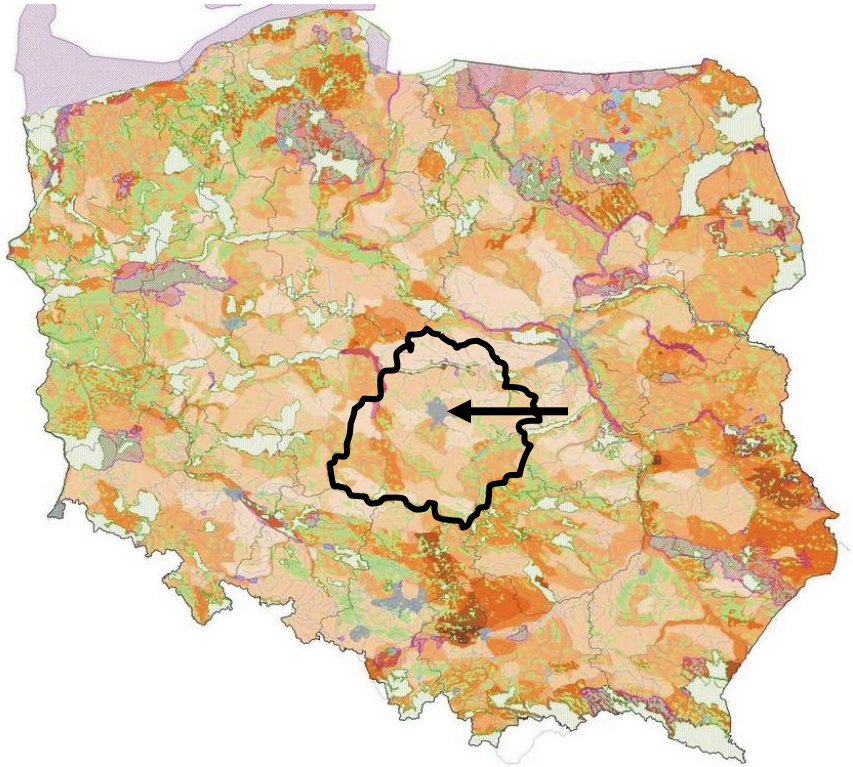
RIVER RESTORATION PROJECTS IN THE CITY OF LODZ
- concepts, goals, implementation

Kinga Krauze & ERCE team

European Regional Centre for Ecohydrology u/a UNESCO,
Polish Academy of Sciences

The Future of Urban Water: Solution for Livable and Resilient Cities
24-26 January 2011, Paris, France

The City of Lodz



Structure of employment :

Agriculture	29,9%
Services	30,6%
Industry	39,5%

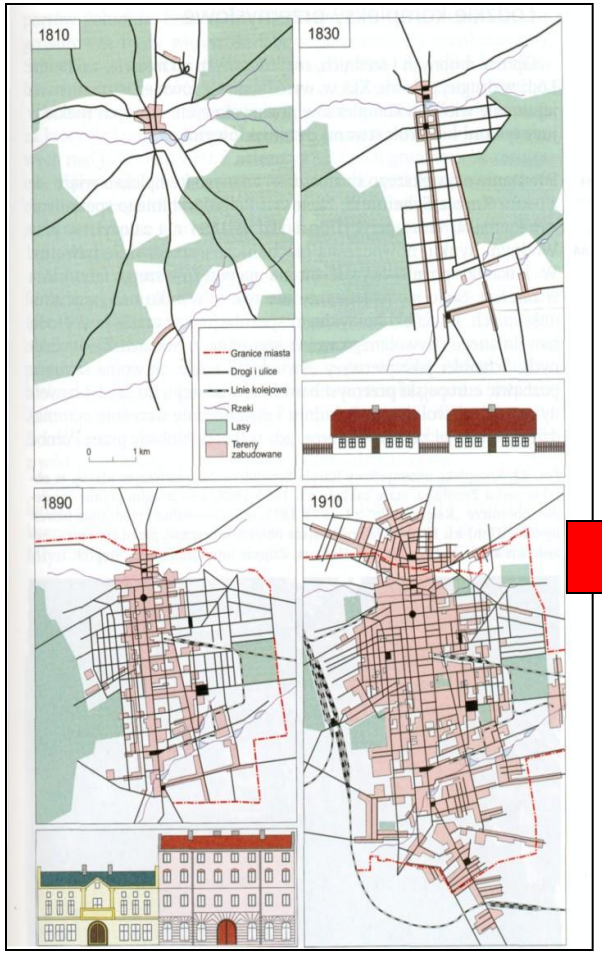
Industry:

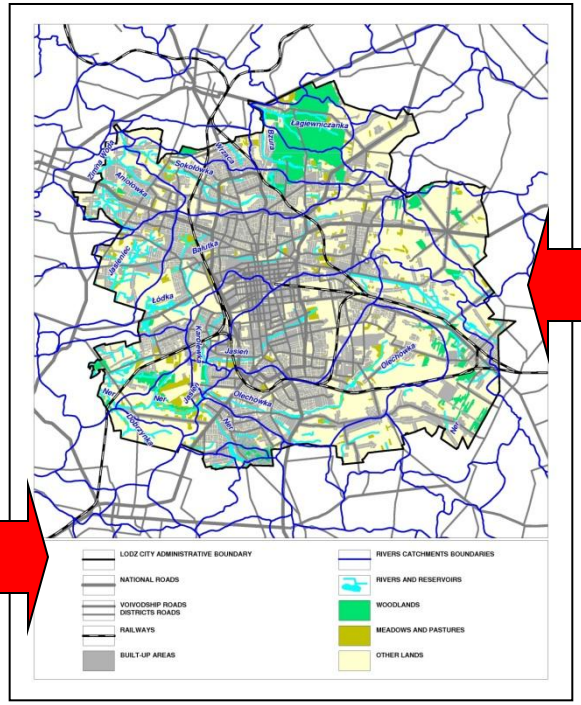
textile, food processing,
coal mining, ceramics

Profile :

education, cinematography,
logistics, technology

- an example of urban area that expensed very rapidly in the first quarter of the XIX Century, based on natural resources (water, forests) essential for establishing textile industry;
- 800 thousand inhabitants;
- has no big rivers but its area is divided into 18 small city catchment





LOW WATER QUALITY
(toxic algal blooms, POP)

Al
nc

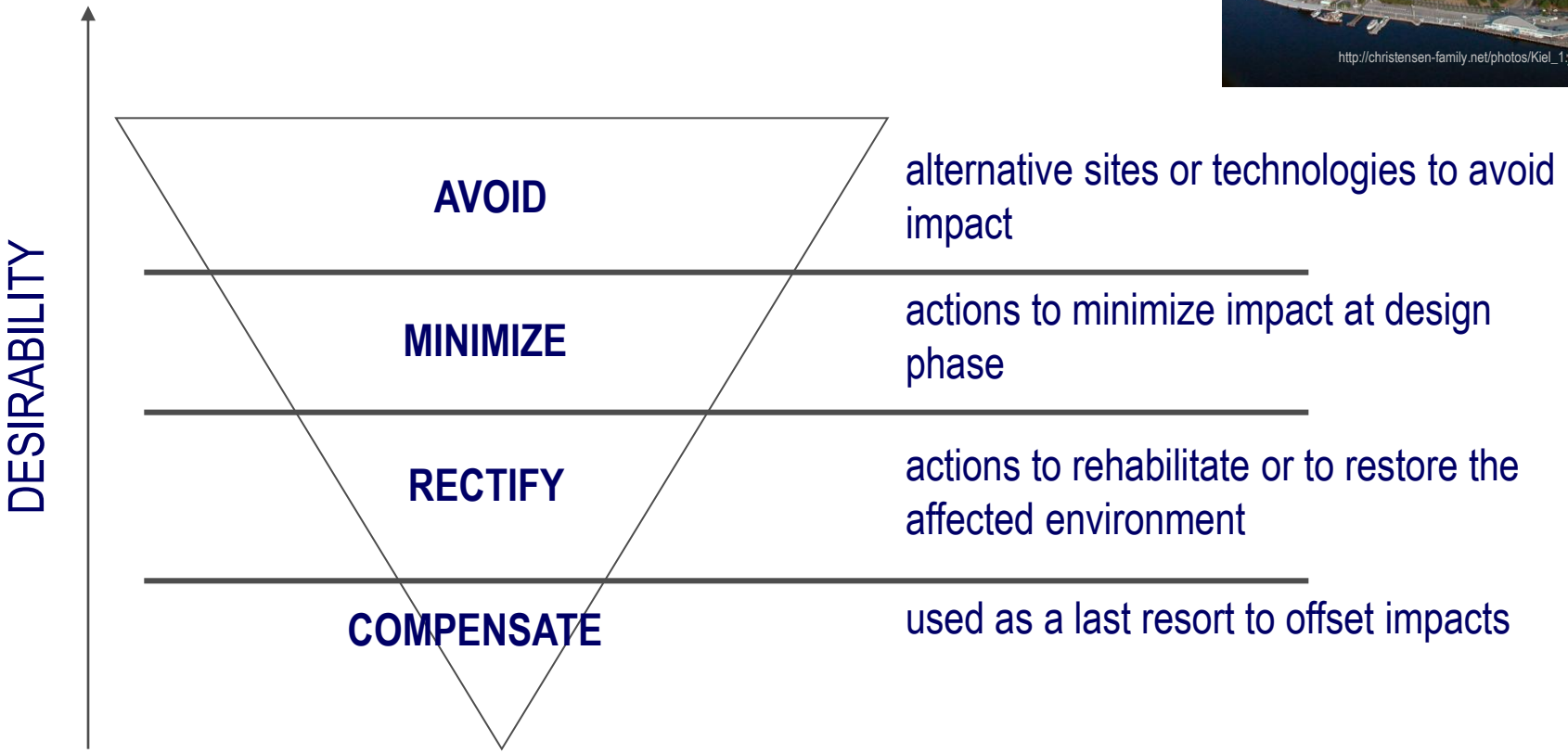
COMMAND-AND-CONTROL APPROACH	RESILIENCE FOCUSED APPROACH
based on steady-state / near equilibrium	adaptability / self-organization
assumption of full control	assumption of limited control
one management outcome	multiply possible mgmt outcomes
the capacity of ecosystem to sustain services GRANTED	variability incorporated into long-term planning
optimisation based on prediction	adaptation to uncertainty
short-term success	long-term view
technology masks feedback from nature	monitoring and management focused on LEARNING
control of disturbances and fluctuations	efforts to reduce the risk of state shift address gradual changes that affect resilience

Folkes et al. 2002

LIVING WITH UNCERTAINTY

ECOSYSTEM SERVICES STILL UNRECOGNIZED

European Initiative on Business & Biodiversity

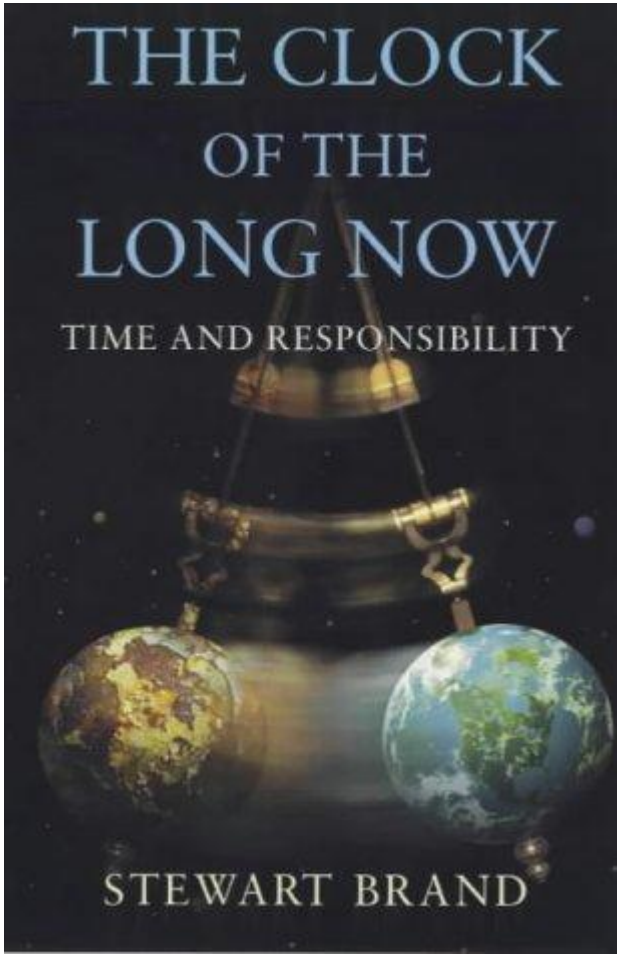


The mitigation hierarchy [Rio Tinto, 2004]

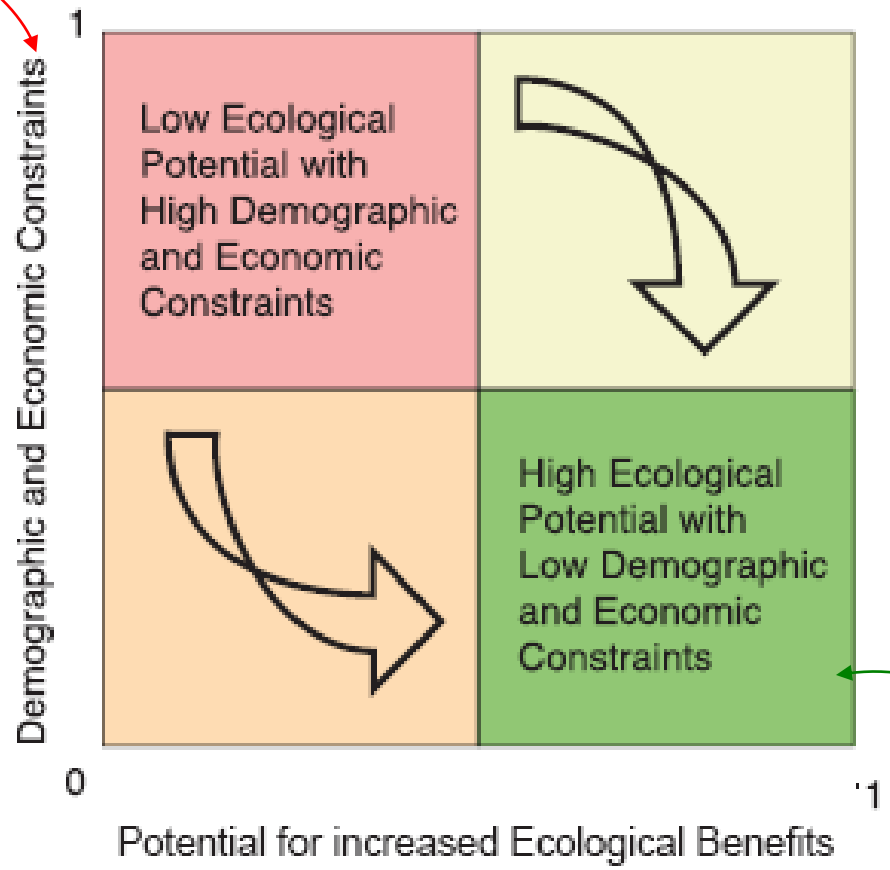
How do we make long term thinking automatic and common, instead of difficult and rare?

How do we make the taking of long term responsibility inevitable?

Stewart Brand (1999), *The Clock of the Long Now*



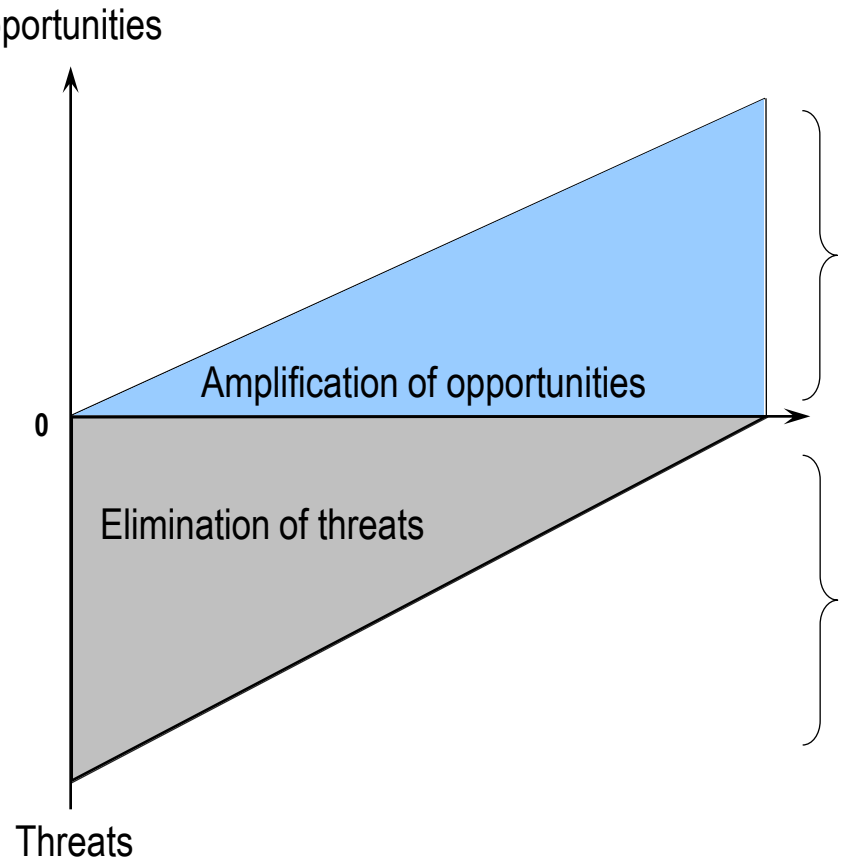
Conceptual framework for prioritizing restoration goals



- ✓ preservation
- ✓ restoration
- ✓ rehabilitation
- ✓ remediation
- ✓ dereliction
- ✓ …..?

David Hulse & Stan Gregory, 2004

Ecosystems management in the context of the decision making theory

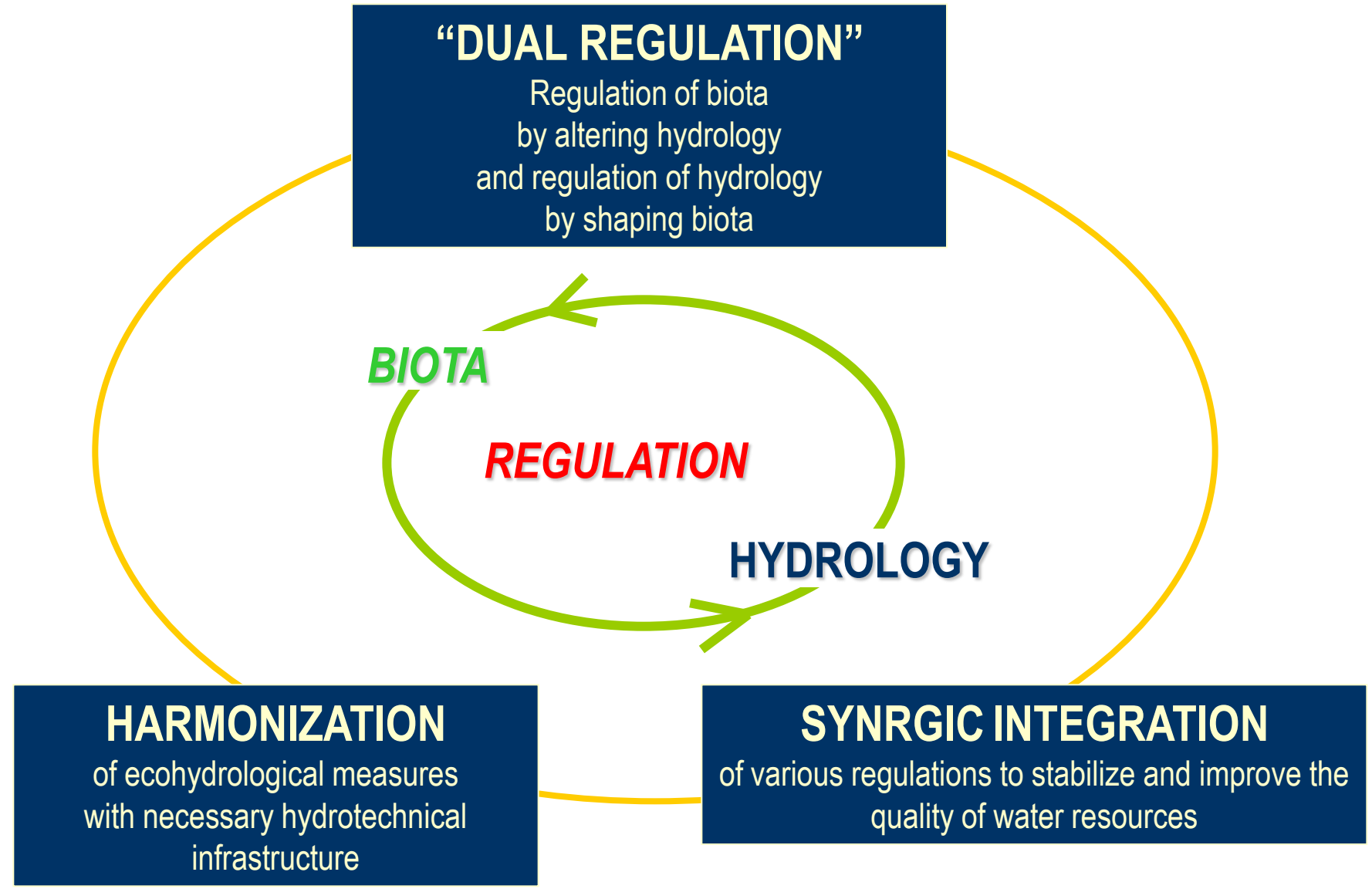


-ecohydrology:
enhancing absorbing capacity (robustness) against human impact;

- preservation
- restoration
- rehabilitation
- remediation

Zalewski, 2000 changed

ECOHYDROLOGY - THE CORE OF THE THEORY



Translation of the scientific knowledge & experiences from the UNESCO IHP Ecohydrology Demonstration Projects

- Vienna University, Austria
- University of Algarve, Portugal
- National University of La Plata, Argentina
- University of Leicester, UK
- Australian Institute of Marine Science
- Universidade Estadual de Maringá, Brasil
- University of Lodz,
- European Regional Centre for Ecology under the auspices of UNESCO, Polish Academy of Sciences, Poland
- Indonesian Institute of Science
- Instituto Nacional de Pesquisas da Amazônia (INPA) Brasil
- Max-Planck-Institute for Limnology, Germany
- National Academy of Sciences of Belarus
- National Academy of Sciences of Ukraine

SWITCH

Sustainable Water management Improves Tomorrow's Cities` Health

SWITCH calls for a paradigm shift in UWM.
There is a need to convert ad-hoc actions
(problem/incident driven)
into a coherent and consolidated approach
(sustainability driven).

SIXTH FRAMEWORK PROGRAMME
PRIORITY [1.1.6.3]
[Global Change and Ecosystems]

DEMONSTRATION CITIES

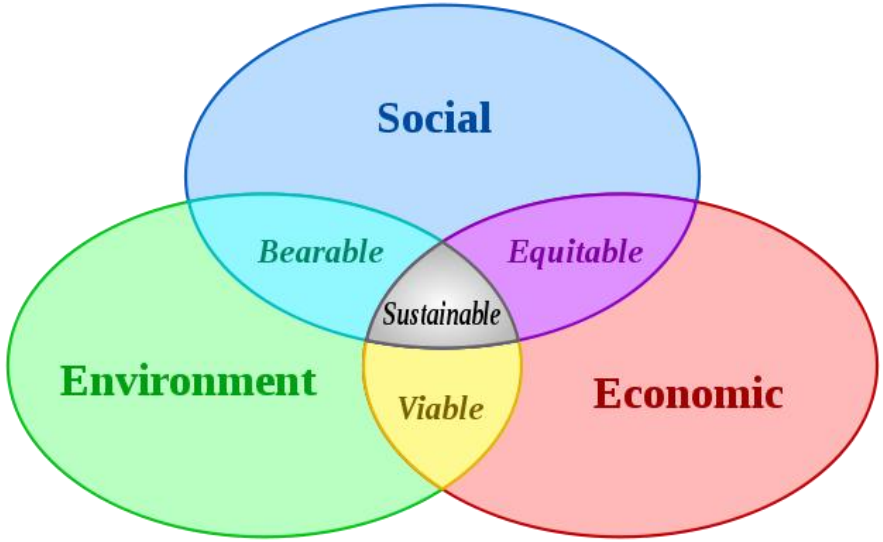
Hamburg, Germany
Birmingham, UK
Lodz, Poland
Saragossa, Spain
Tel Aviv, Israel
Beijing, China
Alexandria, Egypt
Accra, Ghana
Belo Horizonte, Brazil

The purpose of including these demonstration cities is to translate the results of the SWITCH research activities into tangible, socially-relevant demonstration activities.

‘URBAN ECOLOGICAL SECURITY’

Ensuring the protection of cities from the impacts and effects of climate change and resource constraints

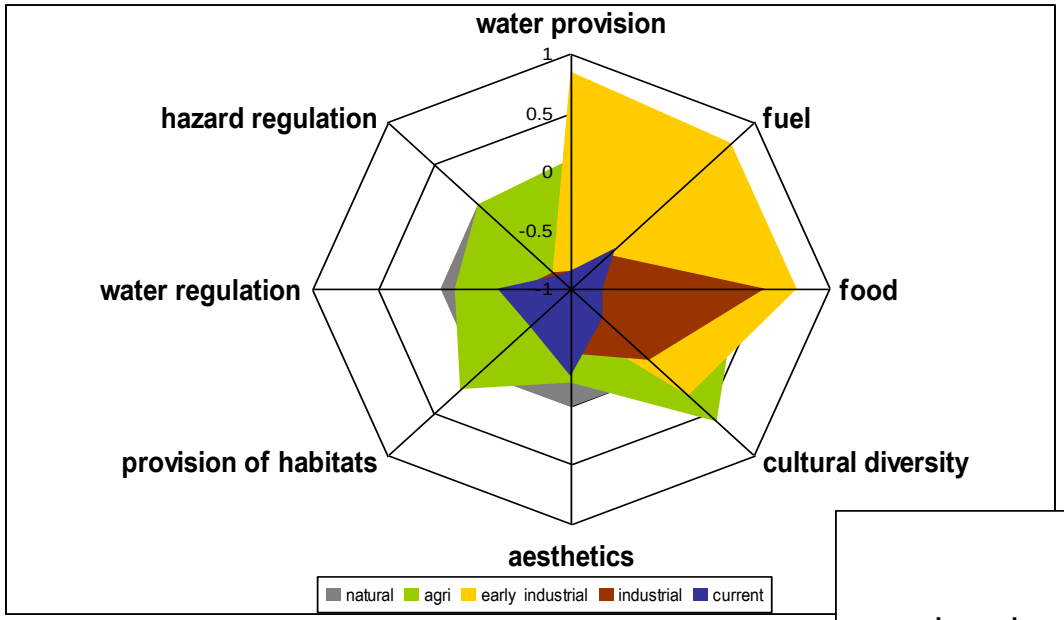
Building self-sufficiency into the supply of water and energy, the mobility of people and goods, and the disposal of wastes

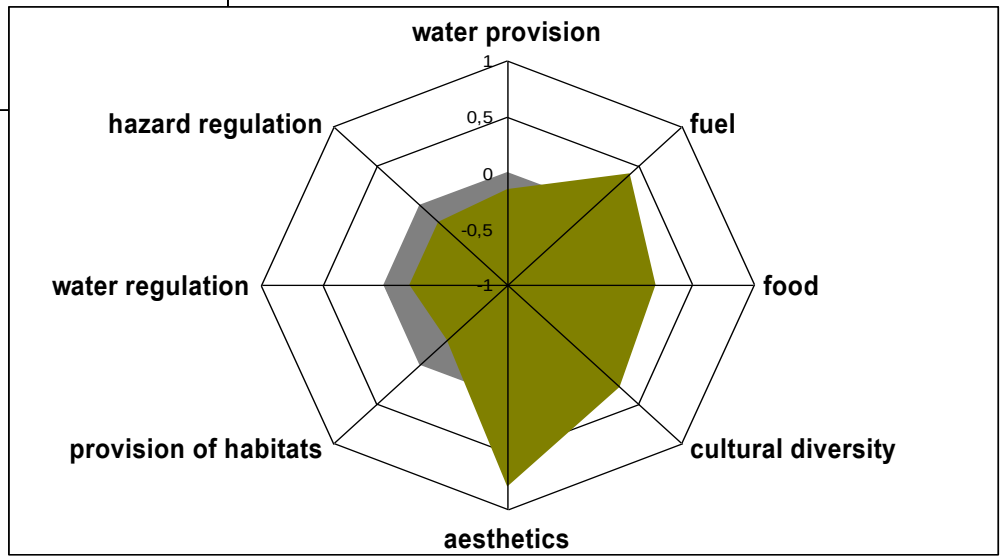


Changes in delivery of ecosystem services resulting from management

Krauze 2010

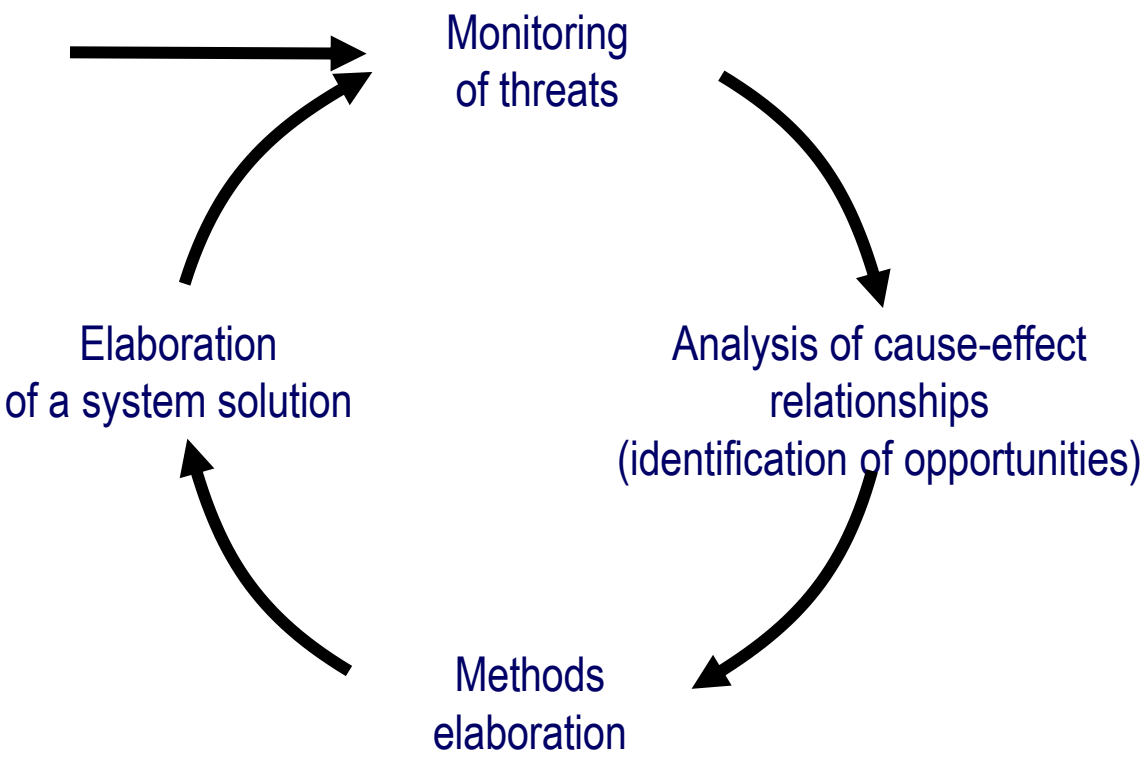
LTER Europe
European Long-Term Ecosystem Research Network





GOAL

Urban Ecohydrology for sustainable developmet, Lodz case, Poland



PROJECT 1

Sokolowka River

Restoration of a municipal river for stormwater management, increase of water retentiveness and improvement of quality of life

Catchment area	44,5 km2
River length	13,4 km
Gradient	0,55 %
River channel regulation	100 %
Annual rainfall	535 mm
Annual runoff	135 mm

Discharge [m³/s]:

average	**0,17**
Min.	**0,02**
Max.	**2,61**

Land use:

Agricultural	60,1 %
Forests and wetlands	7,3 %
Urban	32,7 %

PROJECT 2

Ner River

Sewage system management
for environment quality
and positive socio-economic feedbacks

- limited capacity of sewage treatment system for stormwater purification;

- disposal of treated sewage (2,5 m3 s-1) into a river of natural flow < 0,3 m3 s-1,

- high contamination of the floodplain with heavy metals and organic compounds;

- sewage sludge utilization (200t/day).

Identification of stormwater as key issue of UWM in Lodz

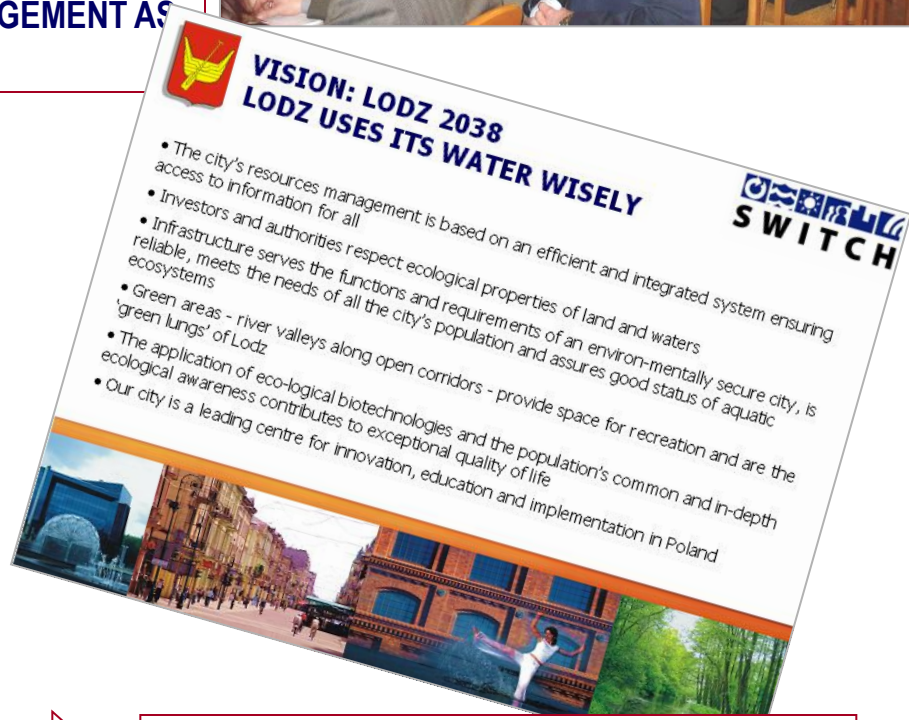
January 2007 - Stormwater management and the GIS tools for decision support systems tools in urban water management
(49 participants)

- LA expressed interest in active collaboration in developing the DSS for Lodz;
- identified further stakeholders to be invited to the SWITCH-Lodz LA;
- identified data and data sources;
- issued a request to the Mayor of the City of Lodz to support the initiative;

IDENTIFICATION OF STORMWATER MANAGEMENT AS KEY ISSUE IN LODZ

Visionning Workshop, January 2008
(60 participants)

The meeting was officially opened by :
-The First Deputy Mayor of Lodz – Mr Wlodzimierz Tomaszewski
-Minister Antoni Tokarczuk, the Director of the Economic Chamber Polish Waterworks



Workshops for elaboration of strategy, 2009, 2010

- Defining of strategic goals and milestones
- Establishing of the task groups
- Elaboration of the Strategic Document ***Lodz 2038***

SETTING UP COMMON VISION AND STRATEGY

Identifica

January 2007 -

- LA expres
- identif

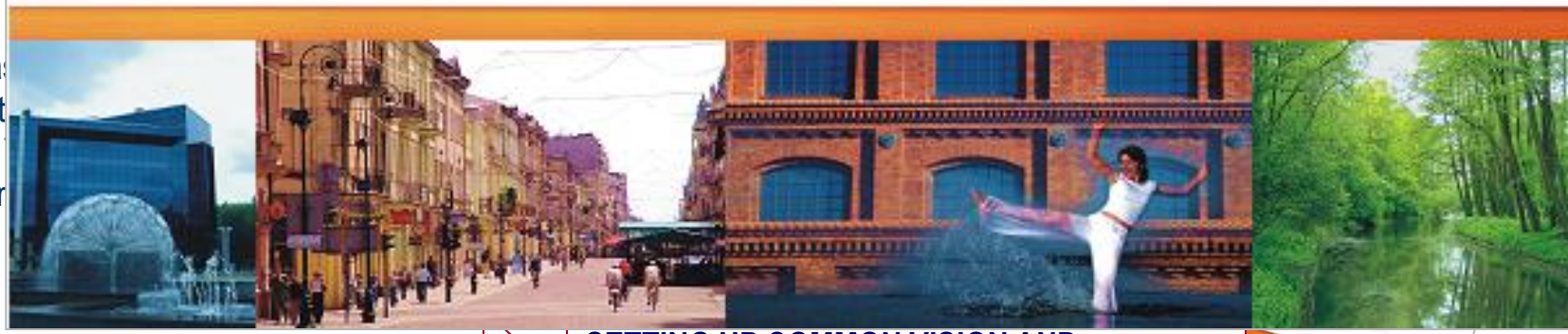
Visionning Wor
(60 participants

The meeting wa
-The First Deput
-Minister Antoni
Polish Waterwor

VISION: LODZ 2038
LODZ USES ITS WATER WISELY

SWITC

- The city's resources management is based on an efficient and integrated system ensuring access to information for all
- Investors and authorities respect ecological properties of land and waters
- Infrastructure serves the functions and requirements of an environ-mentally secure city, is reliable, meets the needs of all the city's population and assures good status of aquatic ecosystems
- Green areas - river valleys along open corridors - provide space for recreation and are the 'green lungs' of Lodz
- The application of eco-logical biotechnologies and the population's common and in-depth ecological awareness contributes to exceptional quality of life
- Our city is a leading centre for innovation, education and implementation in Poland



SETTING UP COMMON VISION AND STRATEGIC OPTIONS

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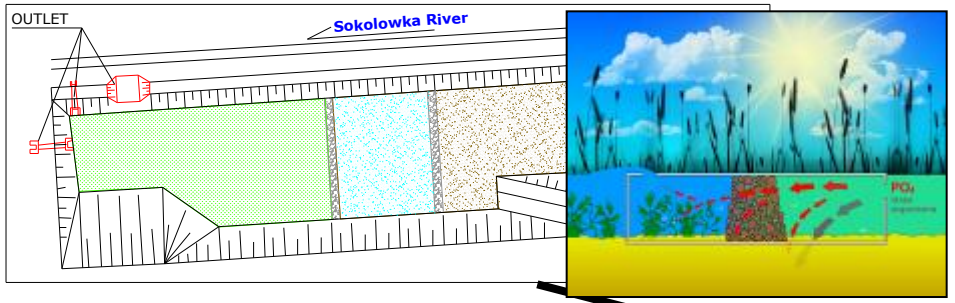
SWITCH demonstration project: Restoration of a municipal river for stormwater management and increase of quality of life



Żabieniec Reseervoir
(2008/2009 - designed)

Wasiak Res.
(planned)

Sedymentary/biofiltration system
(construction in 2009)

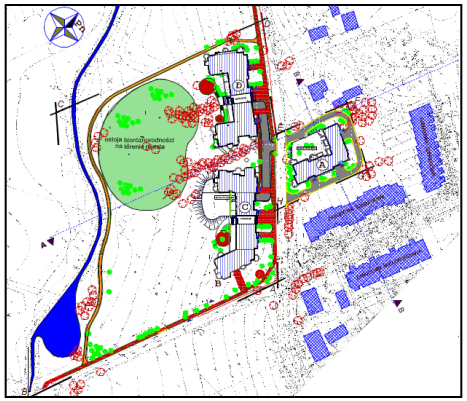
Wycieczkowa Res.
(under constr)

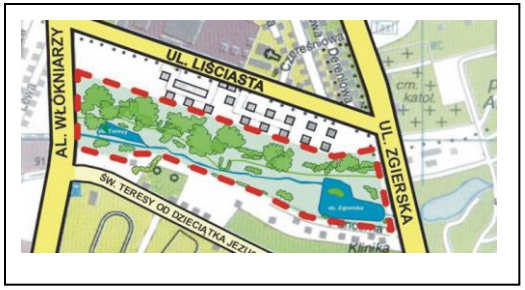
Tree Development
storpmwater BMPs and river rehabilitation
(planned & up-scaling)

Teresa Res.
(finished)

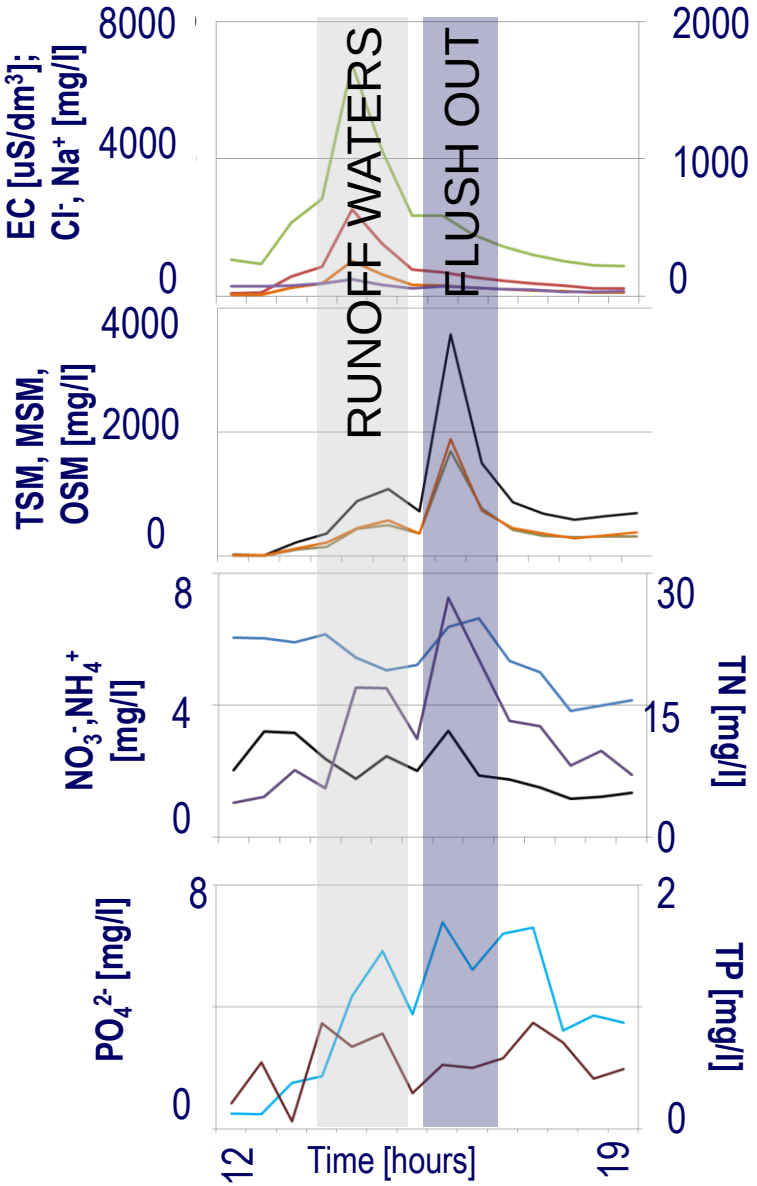
rk Sokołówki
(planning in progress)

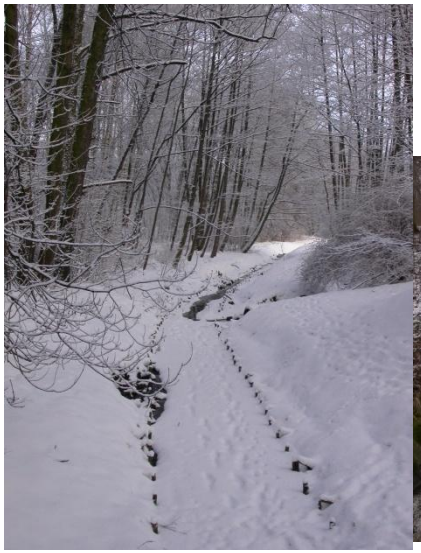
Marina
stormwater BMPs – under construction

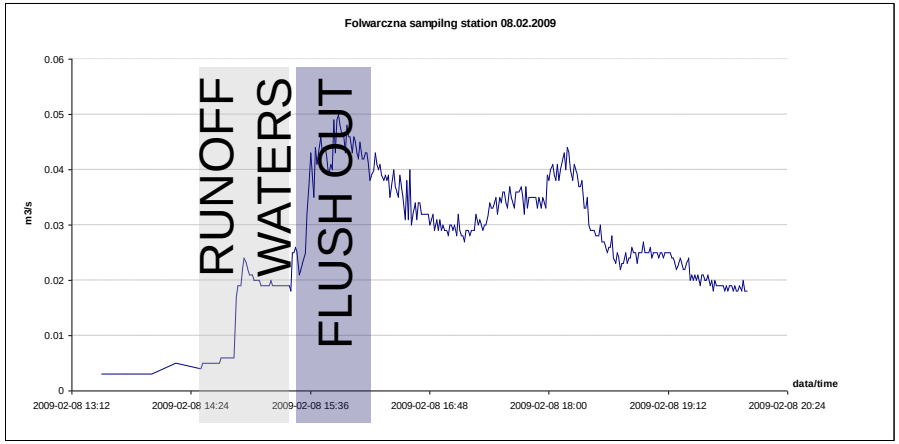




Hydrochemical monitoring of floods

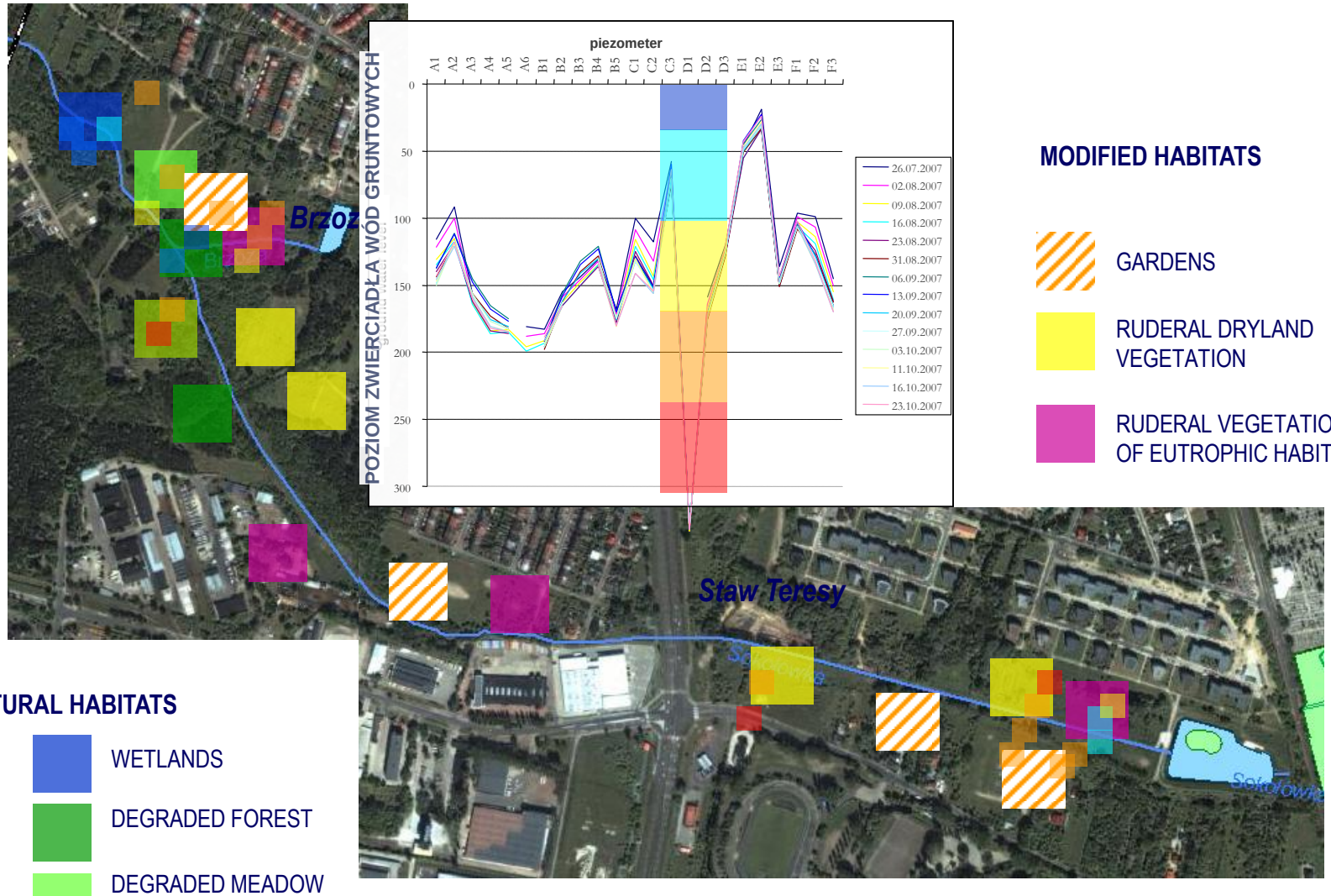






February 2009;
Precipitation 6.1 mm

MONITORING OF GROUNDWATER



MODIFIED HABITATS

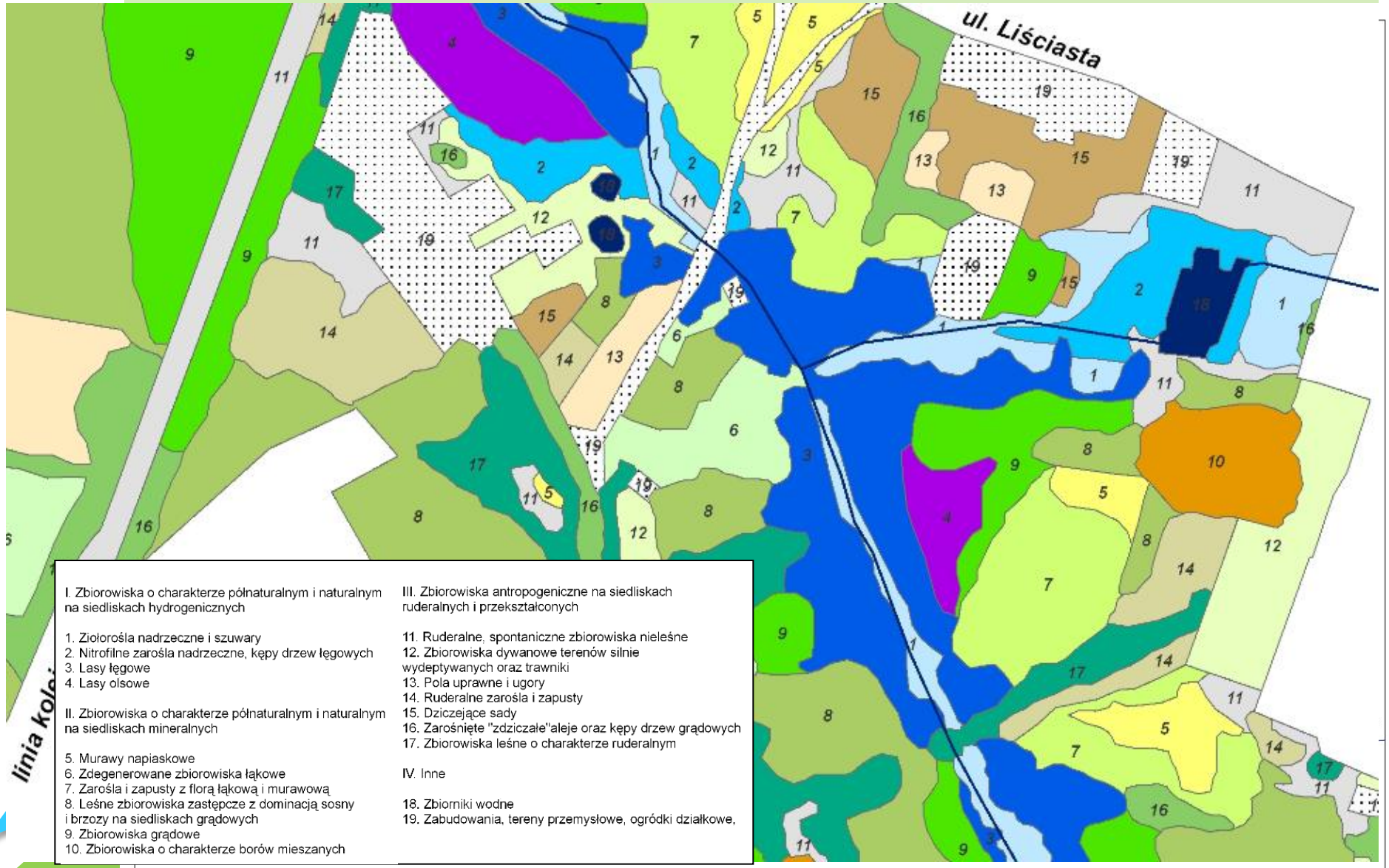
- GARDENS
- RUDERAL DRYLAND VEGETATION
- RUDERAL VEGETATION OF EUTROPHIC HABITATS.

SEMI-NATURAL HABITATS

- WETLANDS
- DEGRADED FOREST
- DEGRADED MEADOW
- DRYLANDS

Dolina Sokołówki – roślinność rzeczywista

Kiedrzyński, Kurowski 2009 msc.



I. Zbiorowiska o charakterze półnaturalnym i naturalnym na siedliskach hydrogenicznych

1. Ziołorośla nadrzeczne i szuwary
2. Nitrofilne zarośla nadrzeczne, kępy drzew łęgowych
3. Lasy łęgowe
4. Lasy olsowe

II. Zbiorowiska o charakterze półnaturalnym i naturalnym na siedliskach mineralnych

5. Murawy napiaskowe
6. Zdegenerowane zbiorowiska łąkowe
7. Zarośla i zapusty z florą łąkową i murawową
8. Leśne zbiorowiska zastępcze z dominacją sosny i brzozy na siedliskach grądowych
9. Zbiorowiska grądowe
10. Zbiorowiska o charakterze borów mieszanych

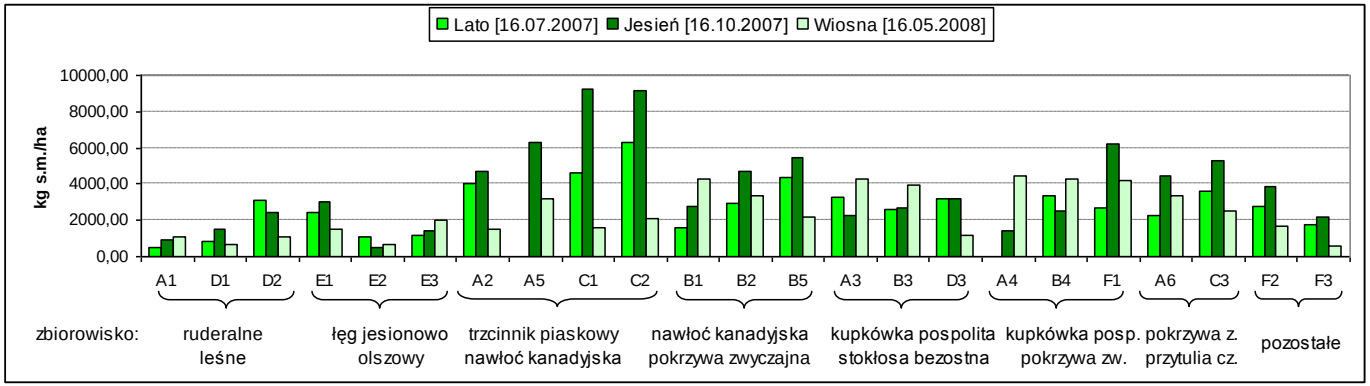
III. Zbiorowiska antropogeniczne na siedliskach ruderalnych i przekształconych

11. Ruderalne, spontaniczne zbiorowiska nieleśne
12. Zbiorowiska dywanowe terenów silnie wydeptywanych oraz trawniki
13. Pola uprawne i ugory
14. Ruderalne zarośla i zapusty
15. Dziczejące sady
16. Zarośnięte "zdziczałe"aleje oraz kępy drzew grądowych
17. Zbiorowiska leśne o charakterze ruderalnym

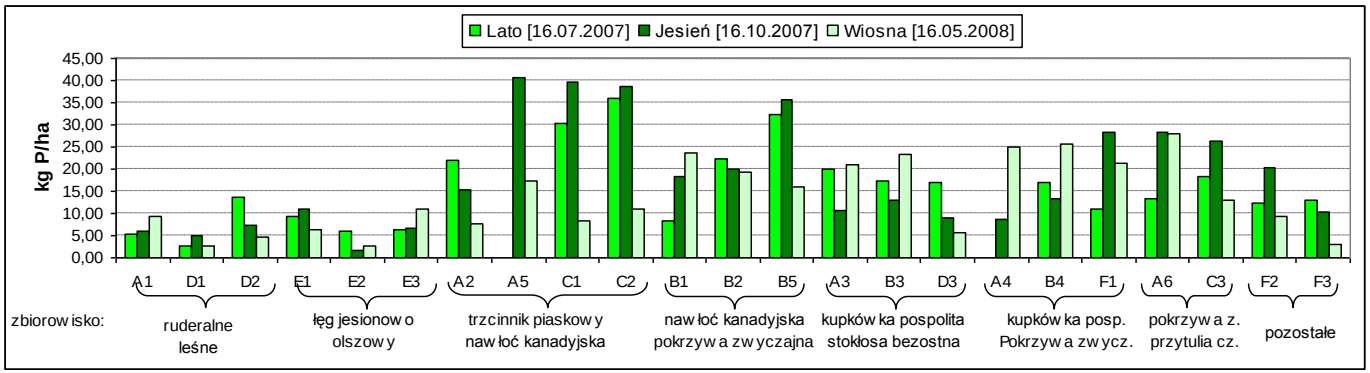
IV. Inne

18. Zbiorniki wodne
19. Zabudowania, tereny przemysłowe, ogródki działkowe,

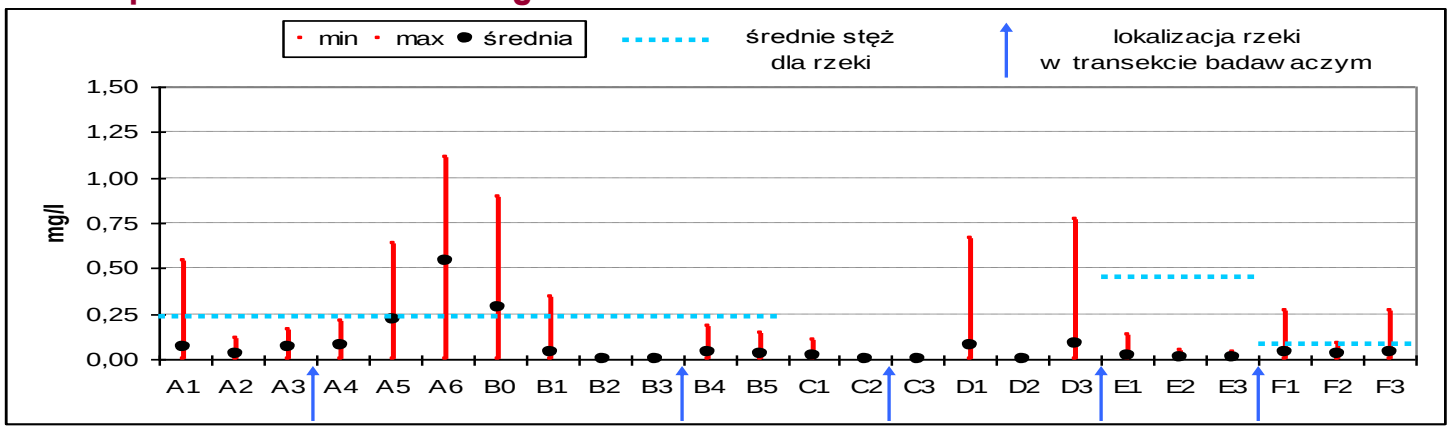
Biomass production in kg of dry weigth/ha per plant community



Phosphorus accumulation in kgP/ha per plant community

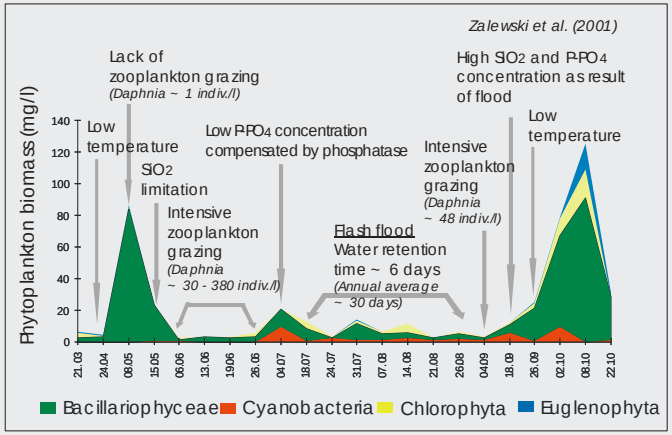


Phosphate concentration in ground waters

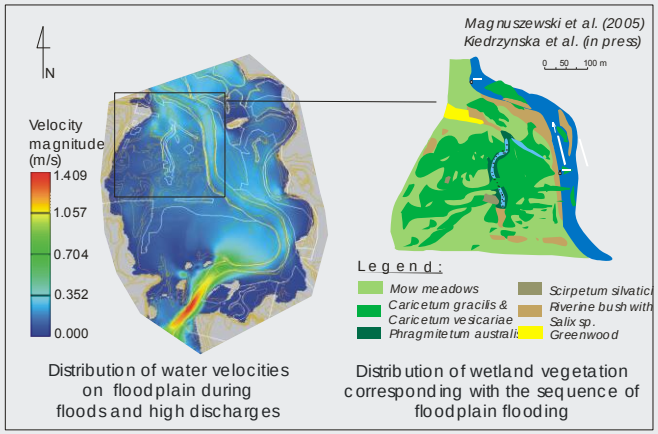


THE PILICA RIVER LTER

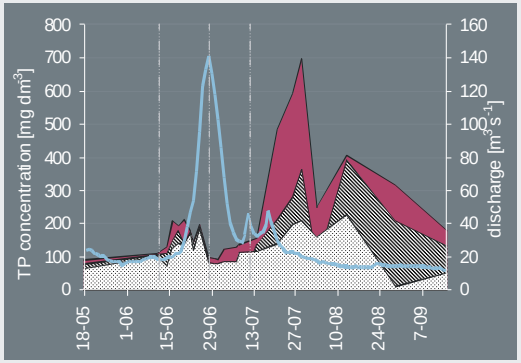
Biotic & abiotic control of reservoir water quality



Hydroperiod as factor shaping vegetation of the floodplain

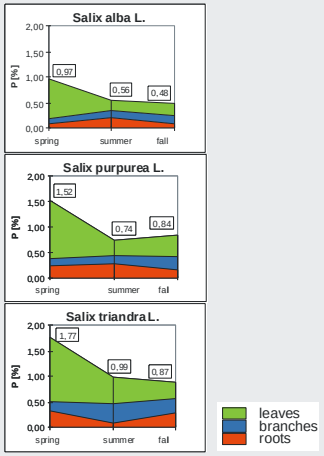


Relationship between discharge & TP concentration in the Sulejowski Reservoir



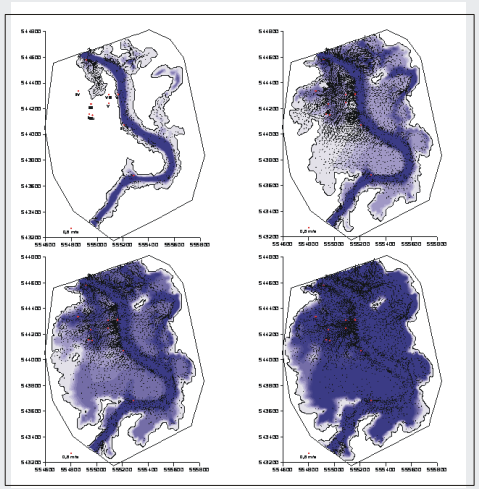
Wagner (2002)

Role of plants in reducing P load to freshwater



Zielinska (2001)

Understanding of floodplain hydrological dynamics



Wagner (2002)

Ecohydrology measures for enhancing of the urban ecosystems capacity for water and pollutants retention

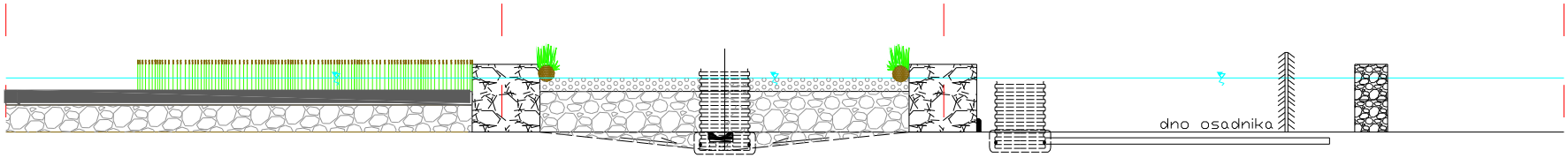
- **Construction of reservoirs** with enhanced resilience to pollution

- **Hydrodynamics adjustment:** for preventing appearance of toxic algae blooms

- **Shaping biotic structure** of reservoirs to increase their absorbing capacity against pollution and eutrophication symptoms

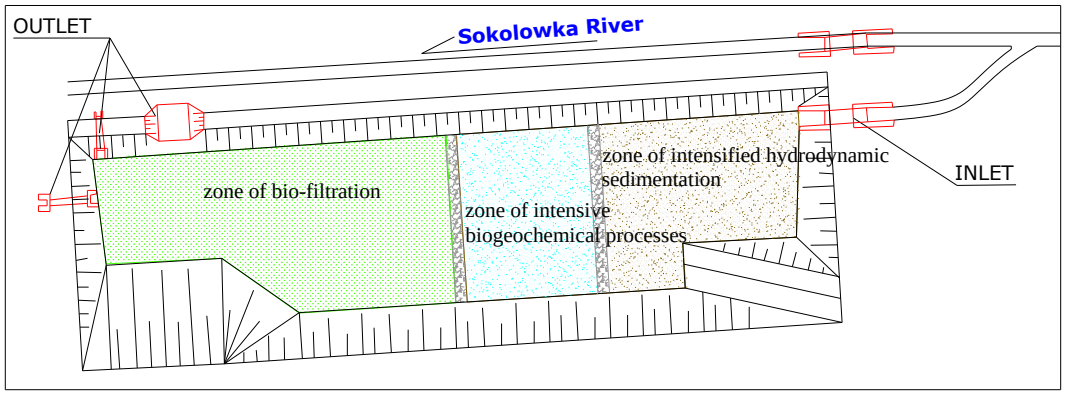
2002 – Reservoir constructed for protection of reservoirs cascade (sedimentation process only)

2009 Feasibility study of the pond modernization (sedimentation, biogeochemical processes and biofiltration)

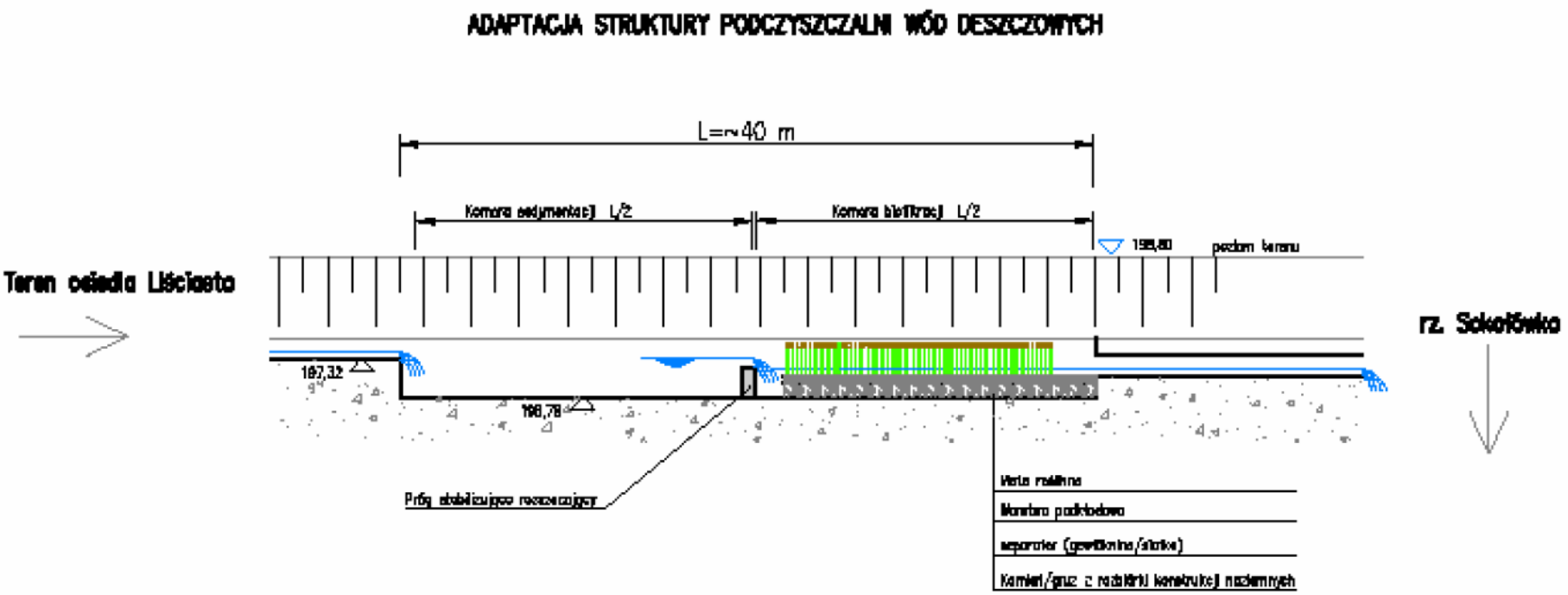


• **Biofilters at stormwater outlets:** allocation of nutrients into unavailable pool and preventing flushing of pollutants during storm flows

• Traditional systems requires space - 1-2 % of catchment area, new approaches allow reduction of required space down to 0,1%



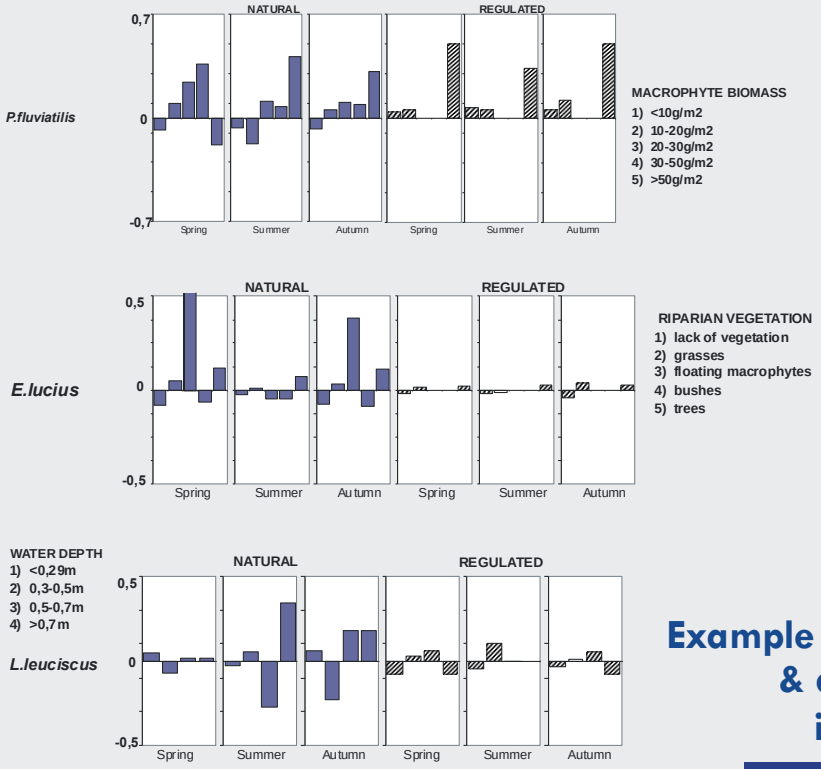
Transformation of flow control tanks into biofilters

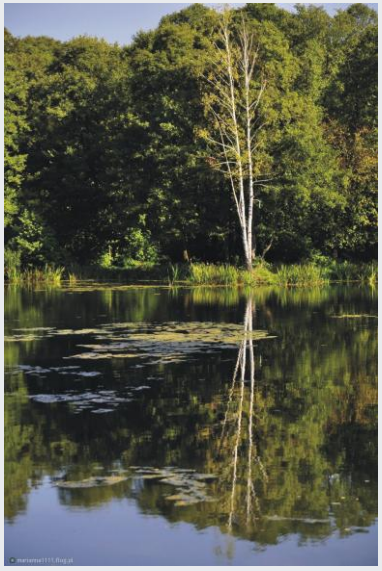


THE GRABIA RIVER LONG-TERM RESEARCH

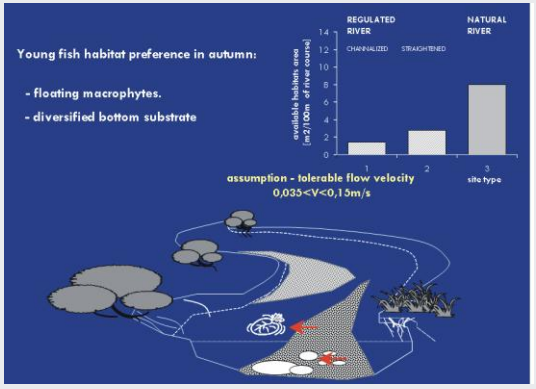
Elaboration of habitat preference profiles of common fish species in regulated & natural river bed

Krauze, (2002)

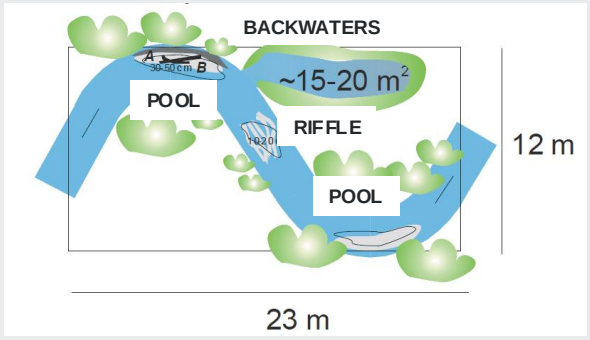




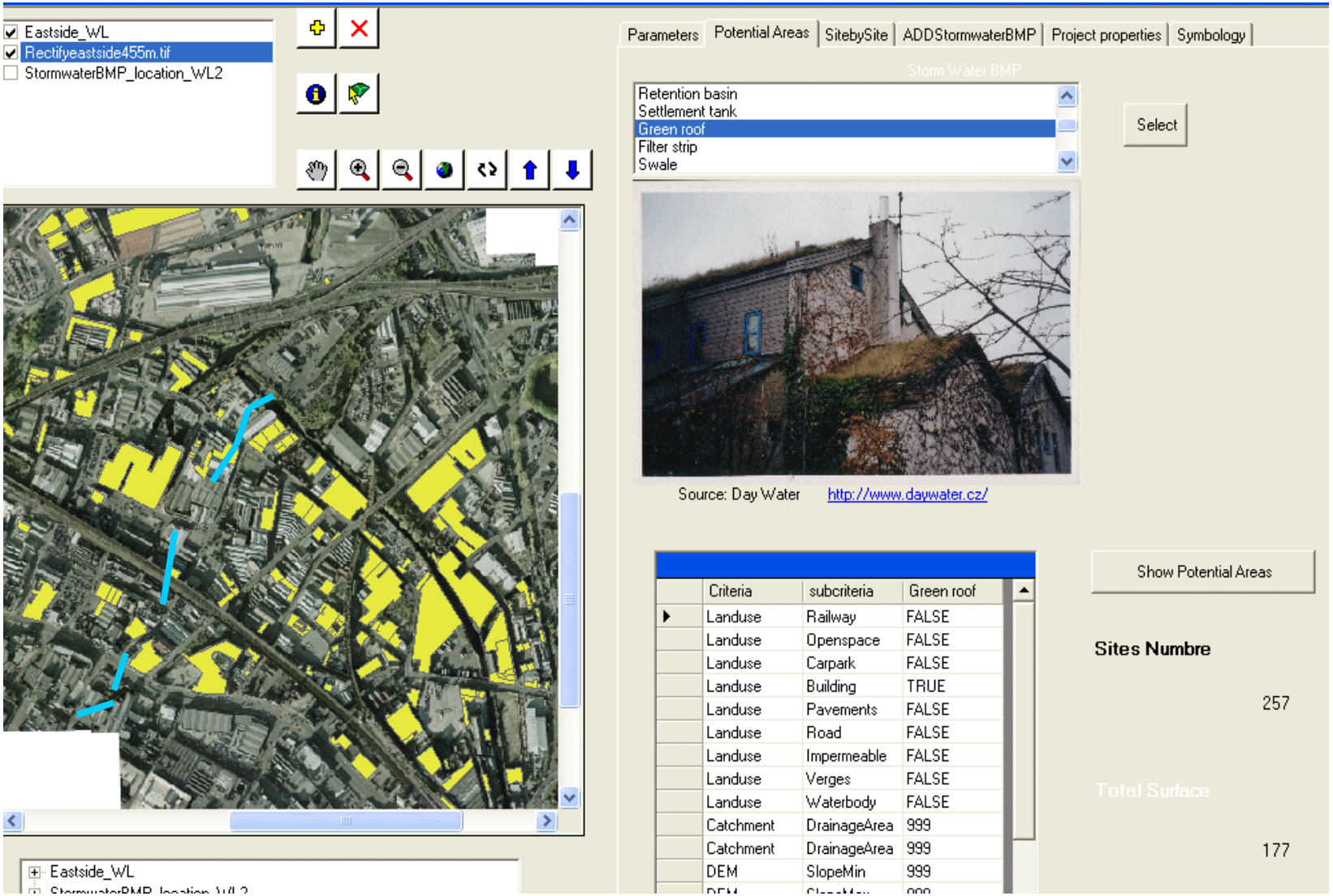
Example of 1+ fish habitat preference & availability of habitats in modified channels



Optimal river bed structure

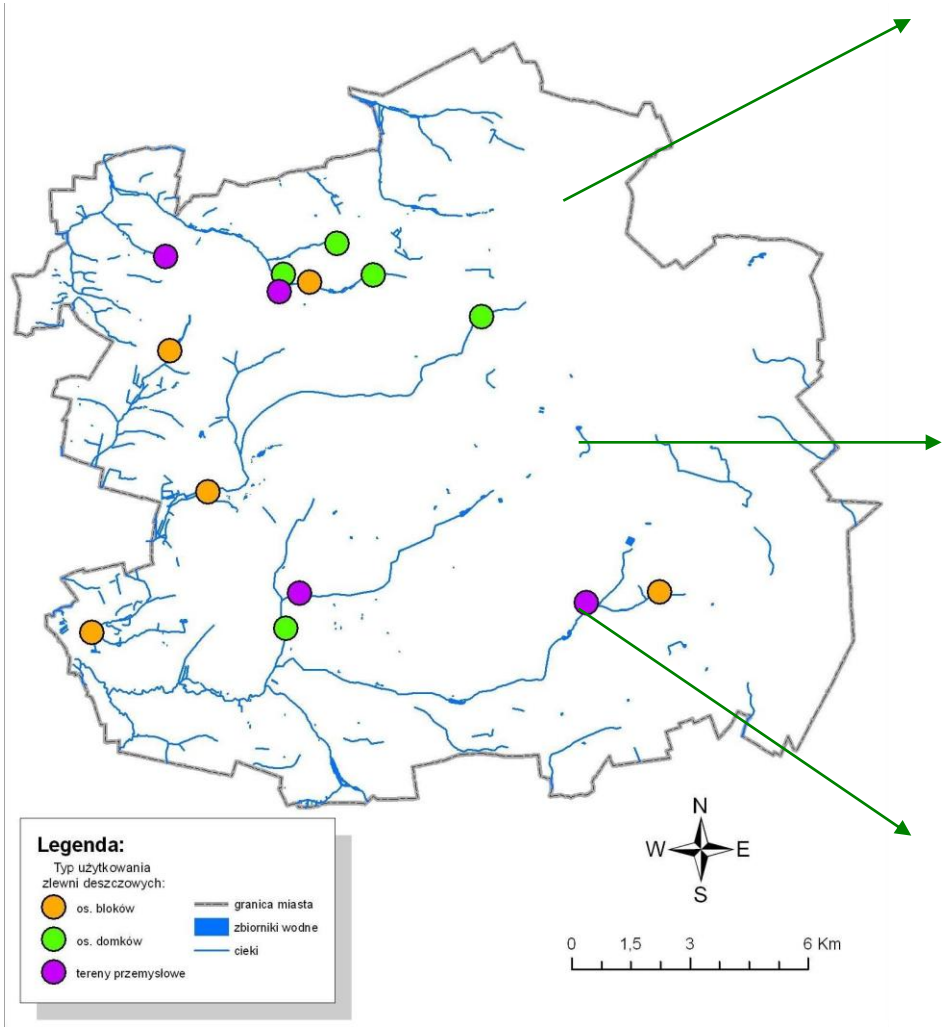


INTERACTIVE MAP FUNCTIONALITY: POTENTIAL AREAS TOOL



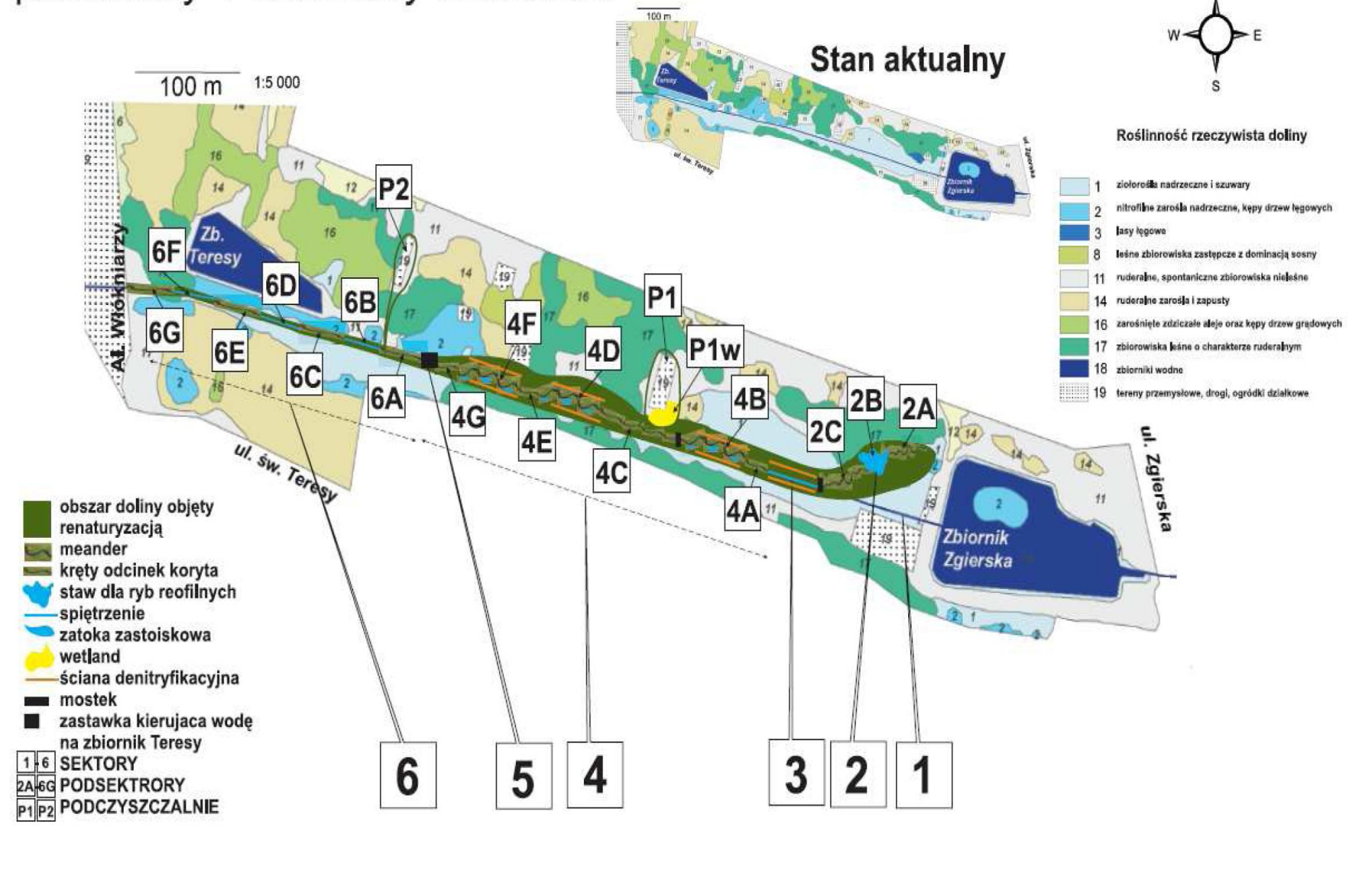
Stolarska i in., 2010

RECOMMENDATIONS FOR AREAS WHERE BMPS COULD BE FIRST IMPLEMENTED CONSIDERING COST-EFFICIENCY EFFICIENCY



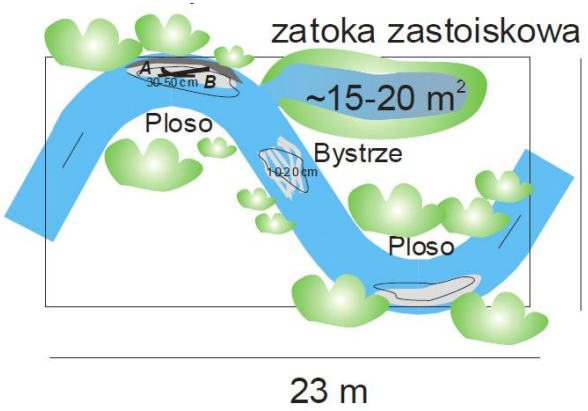
Stolarska i in., 2010

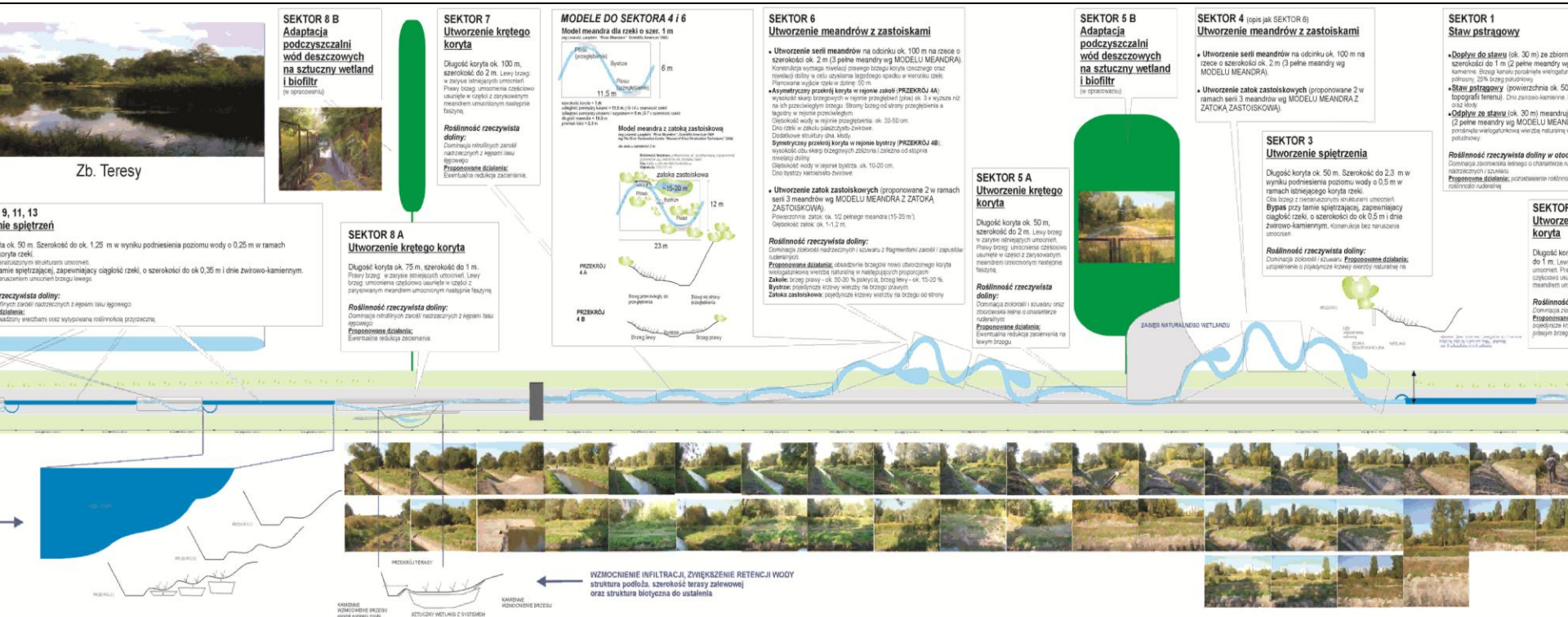
Koncepcja renaturyzacji rzeki Sokołówki - odcinek: planowany *"Park Doliny Sokołówki"*



Rehabilitation of the Sokolowka River

(implementation: 2011)





PROJECT 2

Ner River

Sewage system management
for environment quality
and positive socio-economic feedbacks

- limited capacity of sewage treatment system for stormwater purification;

- disposal of treated sewage (2,5 m3 s-1) into a river of natural flow < 0,3 m3 s-1,

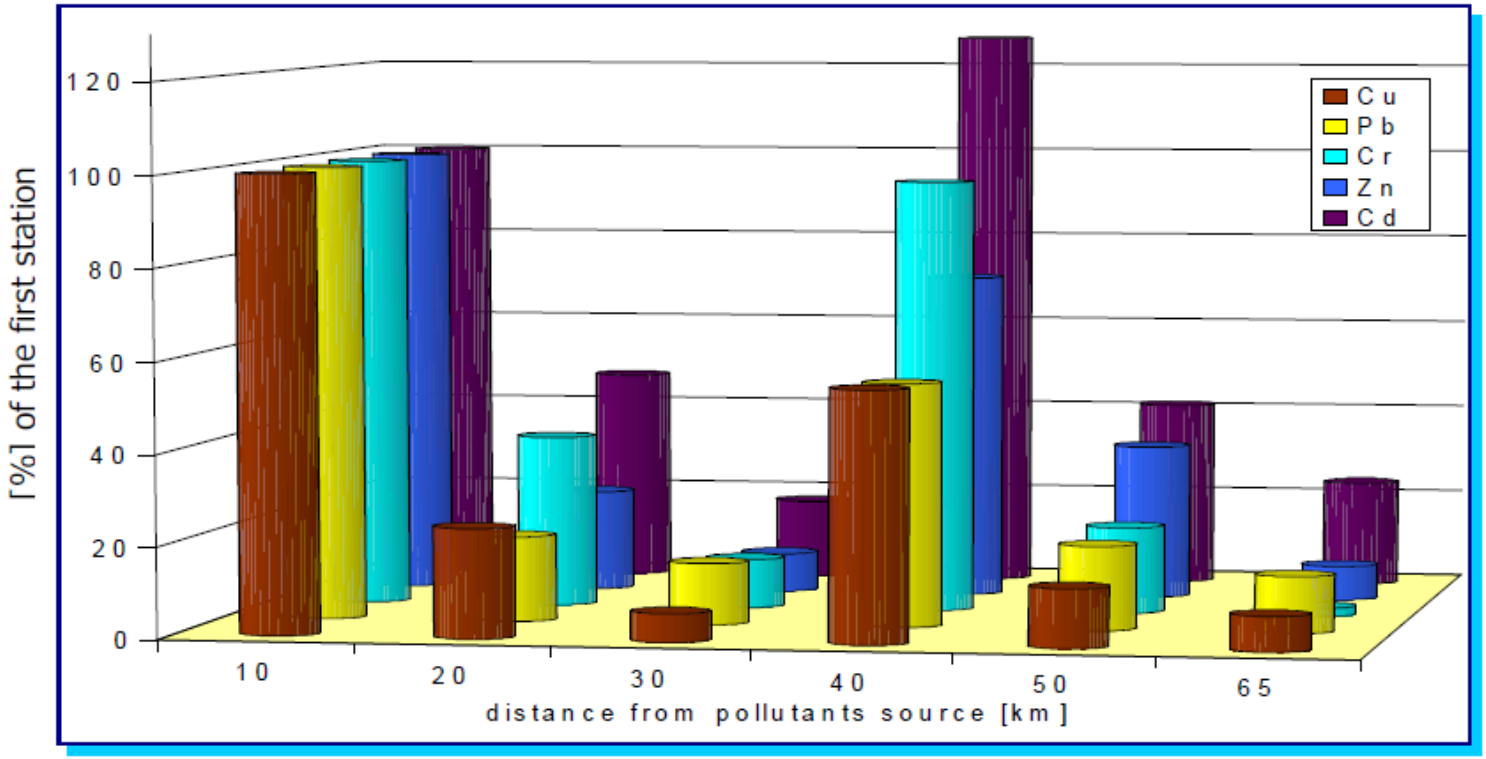
- high contamination of the floodplain with heavy metals and organic compounds;

- sewage sludge utilization (200t/day).


(c) modgik.lodz.pl

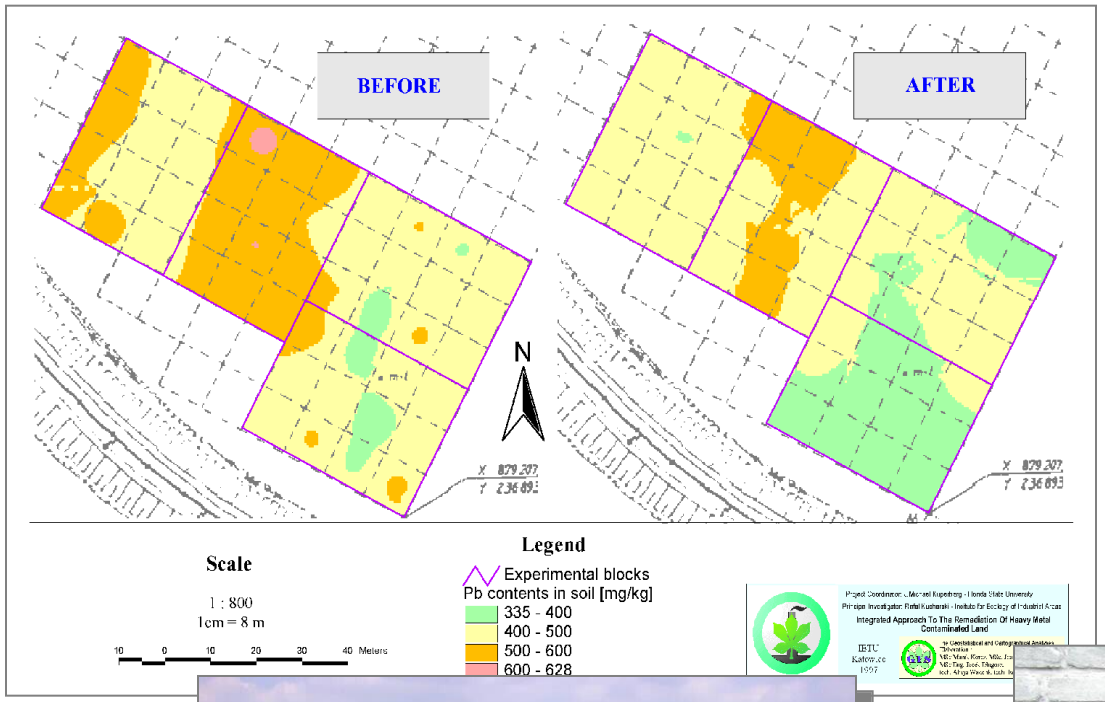
Concentrations of heavy metals in soils of the Ner river 10km from the source of pollution [mg/kg]

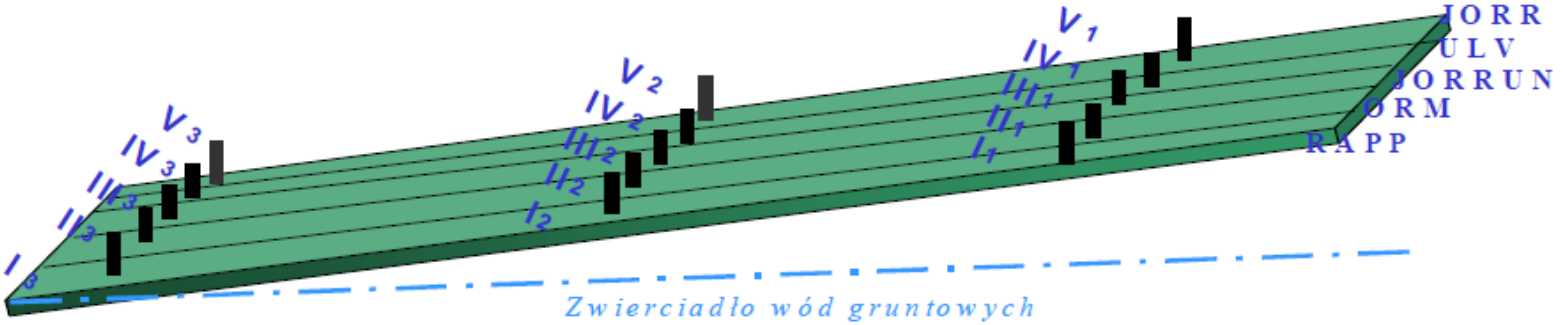
	Łąki meliorowane	Łąki niemeliorowane
Cu	64,3	10,8
Pb		
Cr		
Zn		
Cd		

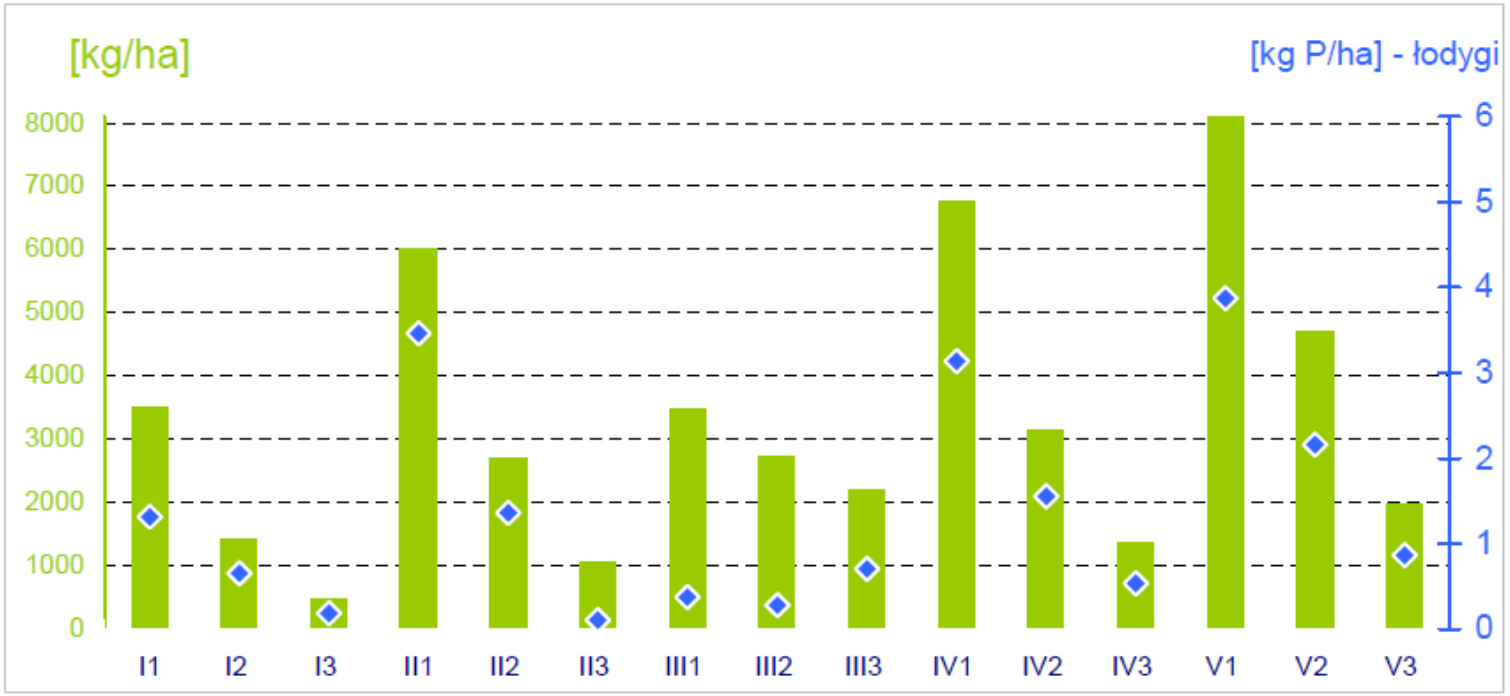


Distribution of heavy metals along river valley (surface soil layer)

SOIL PHYTOREMEDIATION

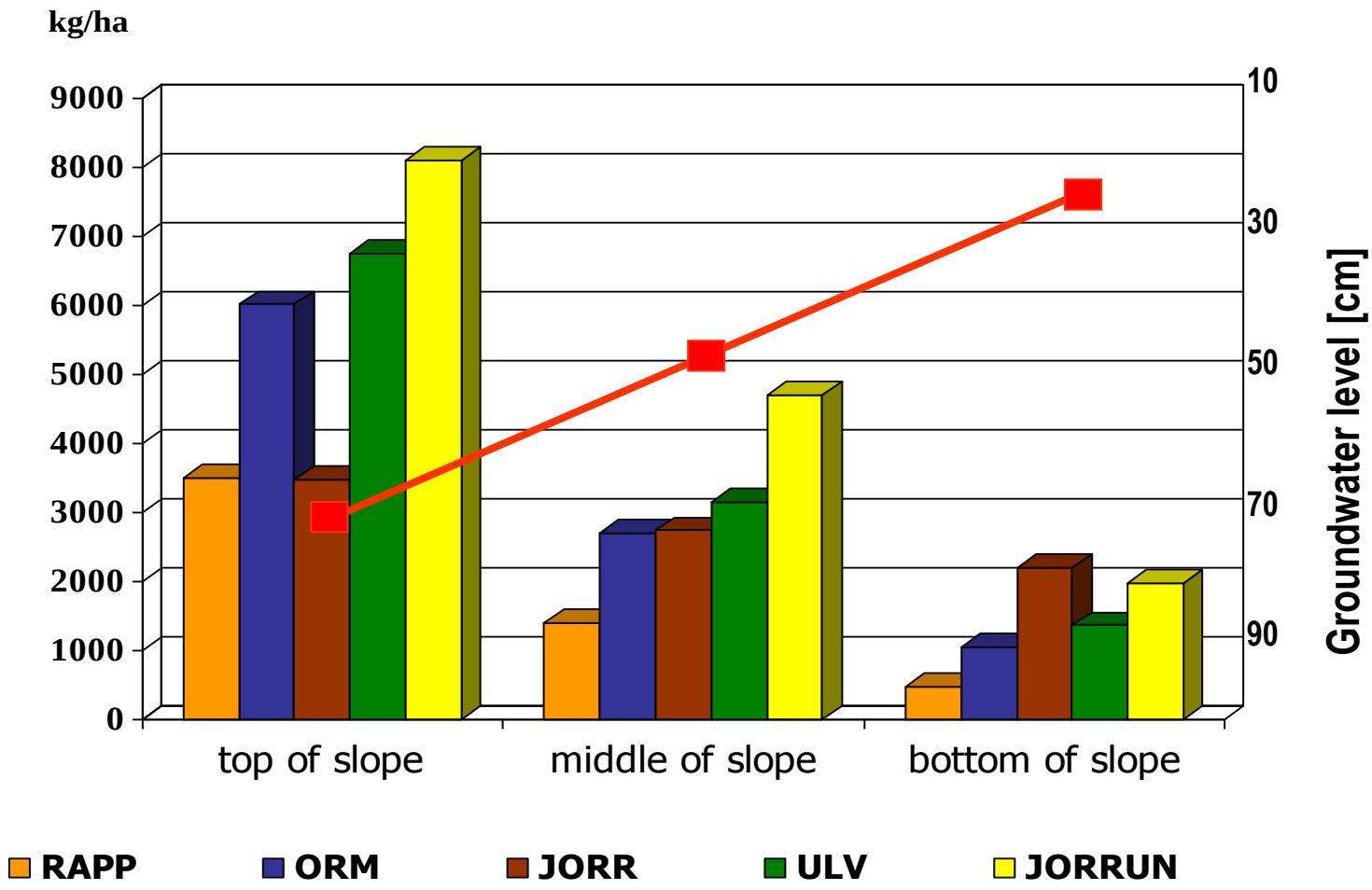






Phosphorus concentration in the stems of Salix viminalis cultivars compared to biomass production rate

Afforestation of peatlands using Salix viminalis

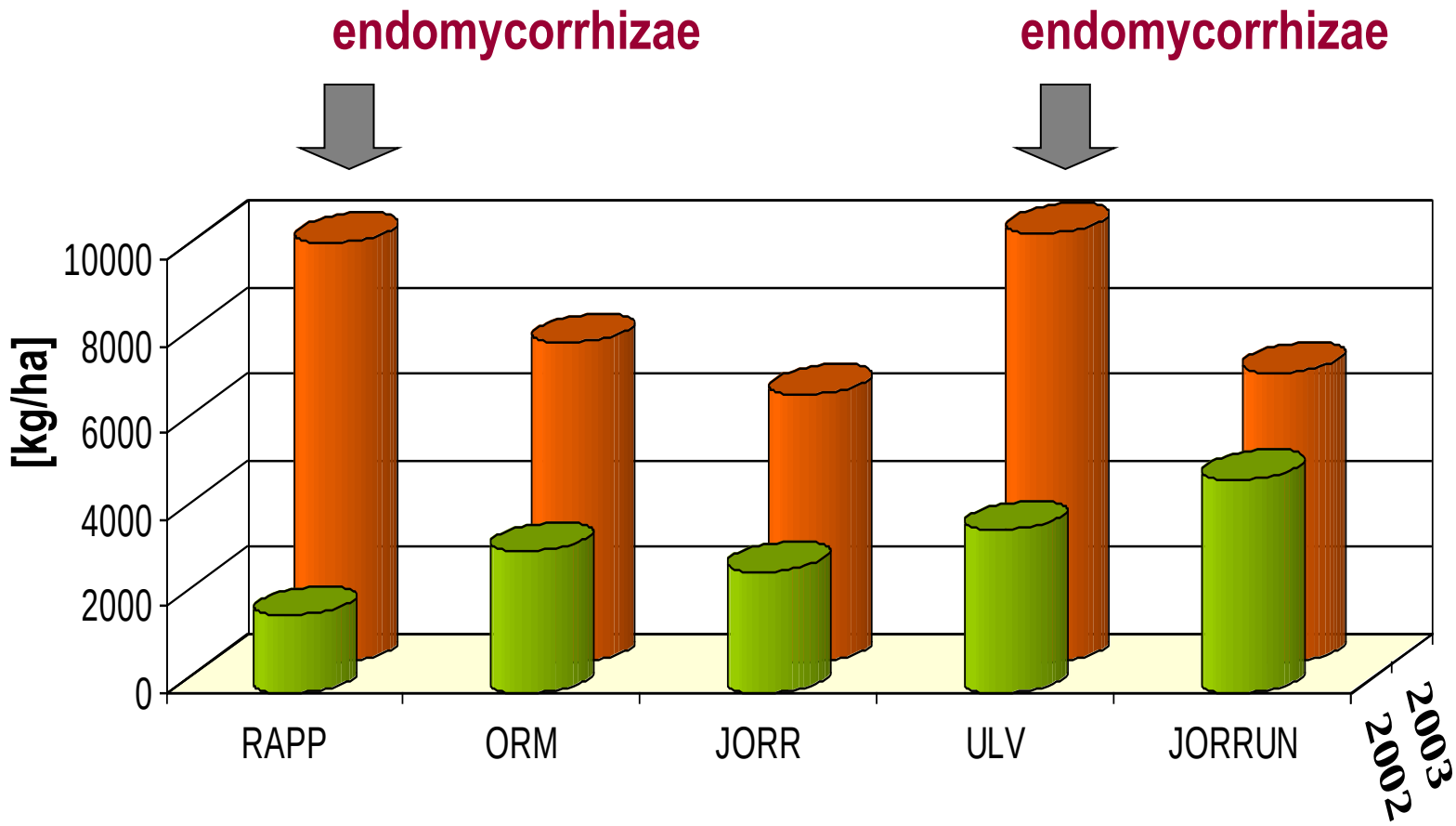


Rogalewicz M., 2003

stanowisko	Pb	Cr	Cu	Fe	Mn	Cd	Zn	Ni
Roślinność nasadzona - ***Salix viminalis*** - *liście*								
Rapp - 1	9,25	2,71	4,82	213,00	25,25	0,98	46,23	0,97
Rapp 2	1,51	6,53	13,48	327,00	21,80	0,96	48,72	1,74
Rapp 3	11,03	4,34	7,51	154,00	26,50	0,45	41,68	2,35
Orm 3	10,54	1,20	2,01	205,00	12,96	1,24	40,82	2,36
Jorr 1	5,36	8,17	10,41	221,00	16,63	0,74	35,64	2,01
Jorr 1	2,51	3,74	9,12	144,00	25,72	0,25	69,11	1,36
Jorr 2	3,36	2,35	4,16	171,00	23,30	0,52	24,17	0,63
Jorr 3	5,24	5,83	11,90	209,00	12,13	0,94	39,12	0,91
Ulv 1	12,36	3,56	2,33	96,00	20,75	0,63	25,85	0,36
Ulv 2	11,90	8,28	8,10	233,00	23,01	0,45	46,64	1,69
Ulv 3	18,77	2,56	7,63	198,00	16,09	0,74	69,74	1,98
Jorrun 1	15,89	5,66	5,64	174,00	27,25	1,08	37,75	1,56
Jorrun 2	5,40	6,58	10,32	94,00	17,36	0,62	41,02	0,78
Jorrun 3	14,30	3,99	6,92	352,00	15,79	1,19	98,21	1,52

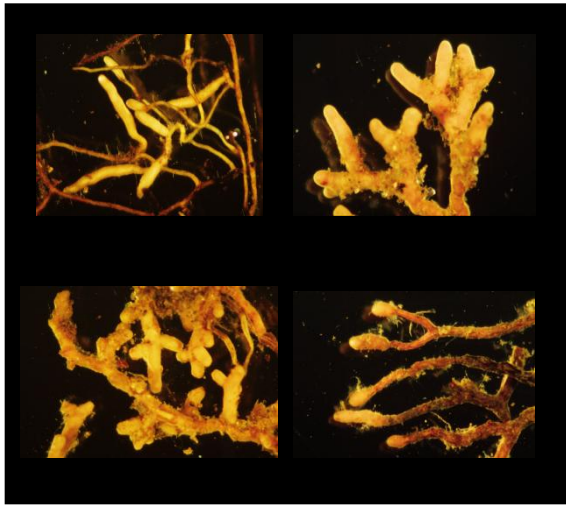
Concentration of haevy metals in leaves of different Salix viminalis cultivares [mg/kg dry weight]

Increase of Salix viminalis biomass in the first and second year of planting

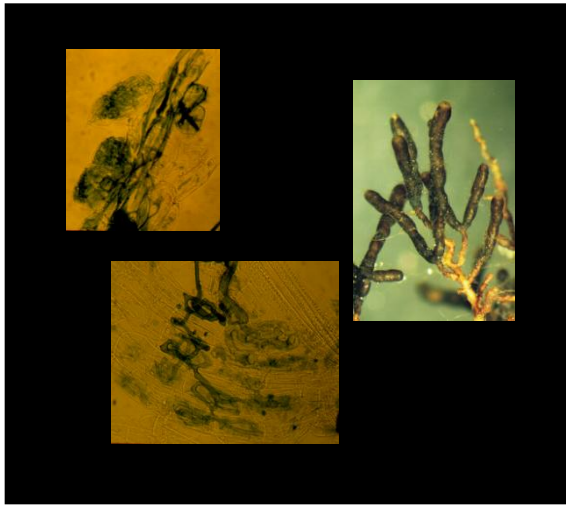


Sumorok B., Rogalewicz M., 2003

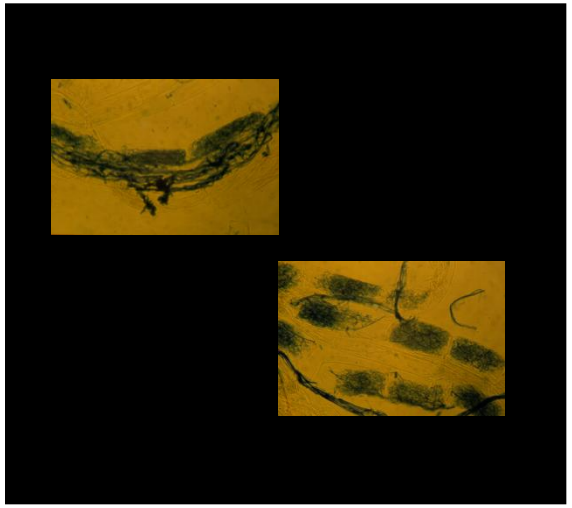
Distribution and biodiversity of mycorrhizae from wet to dry sites on the floodplain



Ectomycorrhizae - many types



Endomycorrhizae and ectomycorhizae



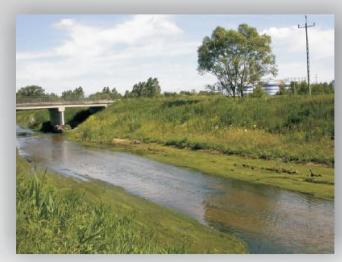
Endomycorrhizae

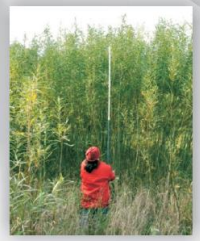
absent

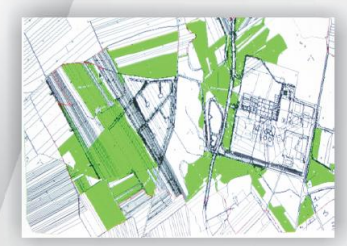
DRY → **WET**

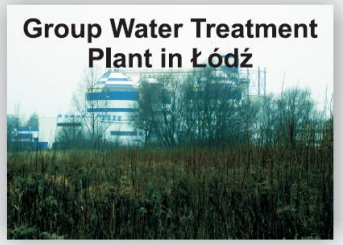
(Sumorok B., 2003)

- ✓ Water qulity improvement
- ✓ Reduction of health hazards
- ✓ Biomass production
- ✓ Workplaces
- ✓ Aestetics



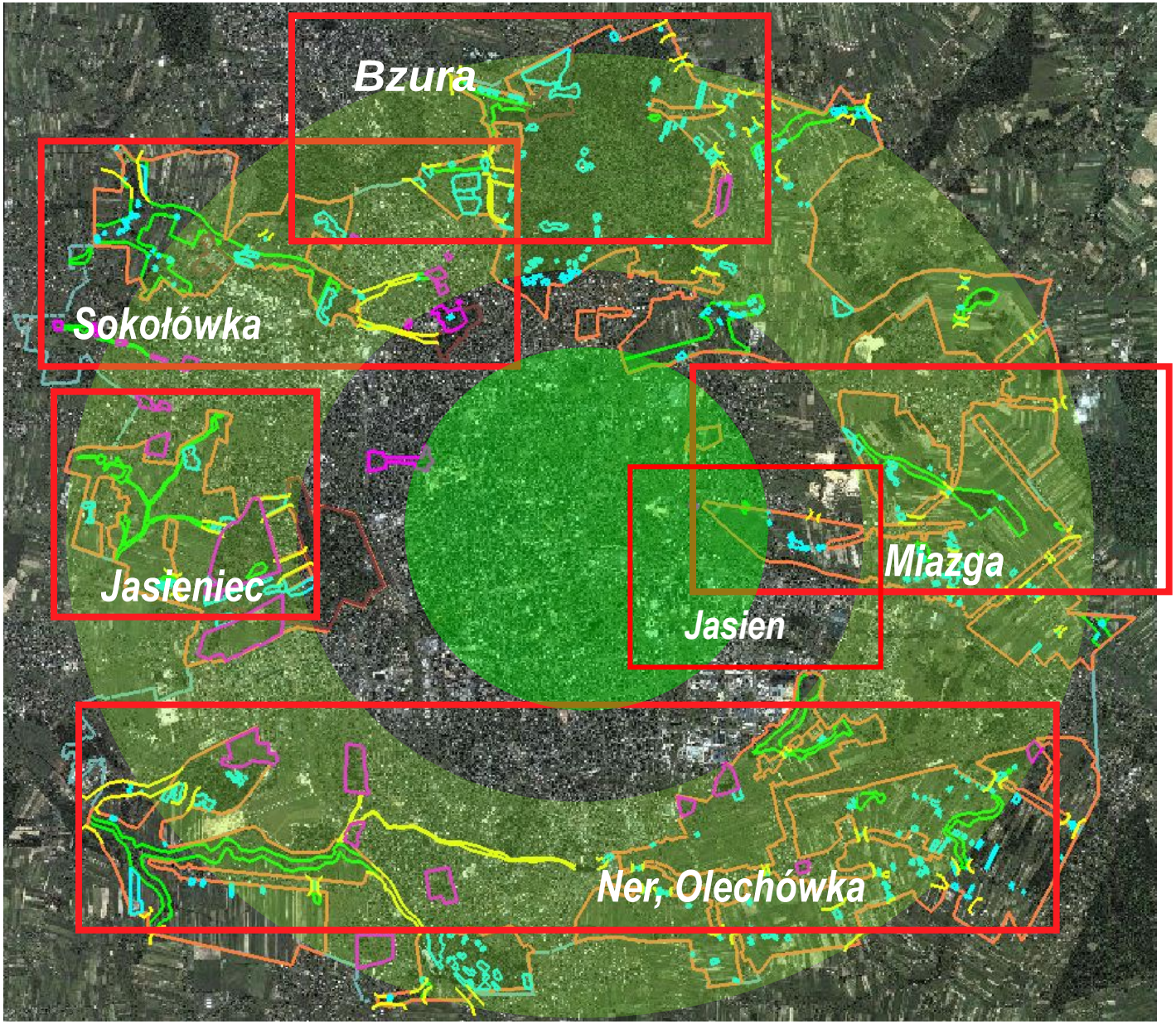






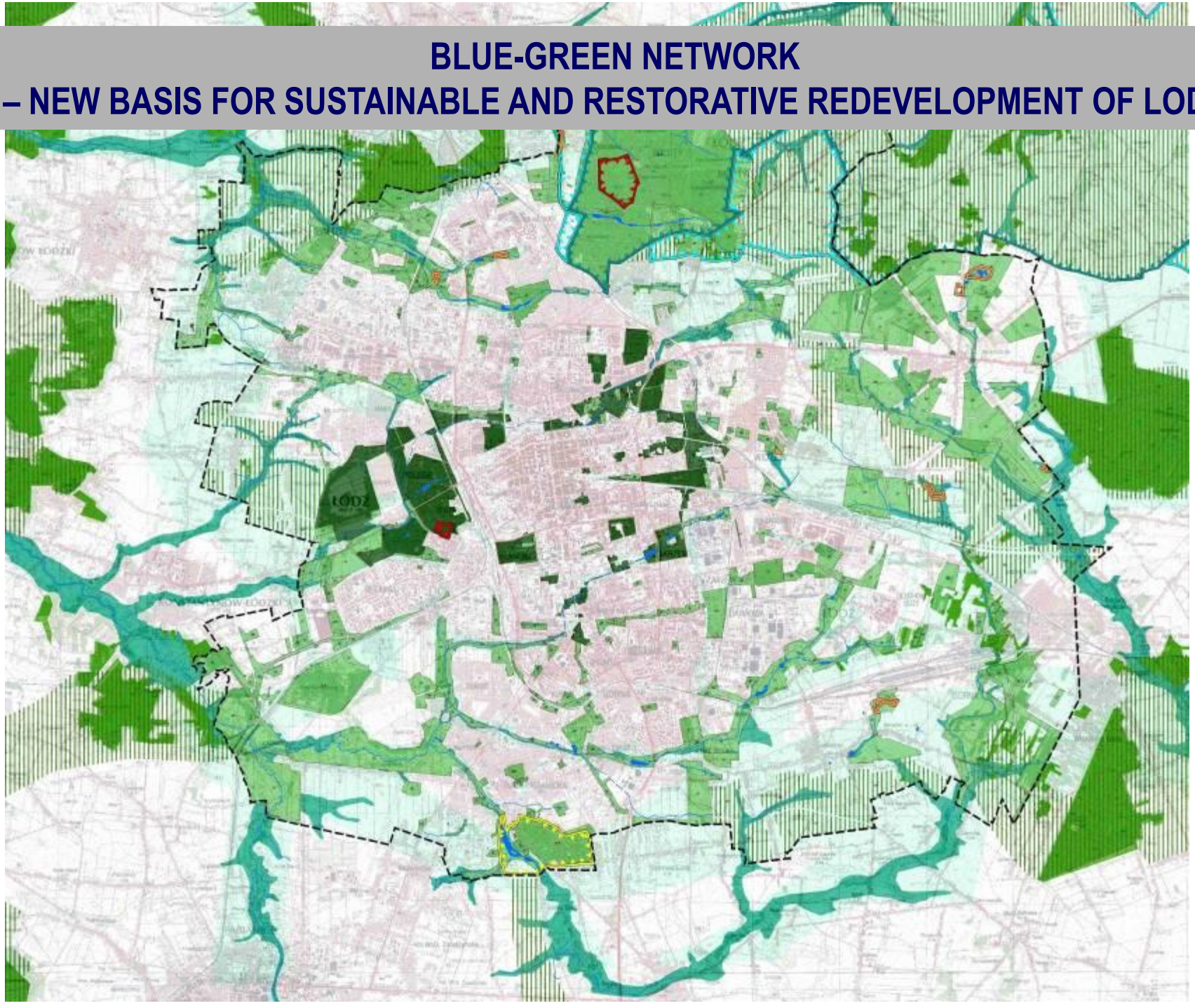
- modelling – DSS;
- sewage sludge for deciduous ornamental shrub production;
- compost use for sewage utilisation

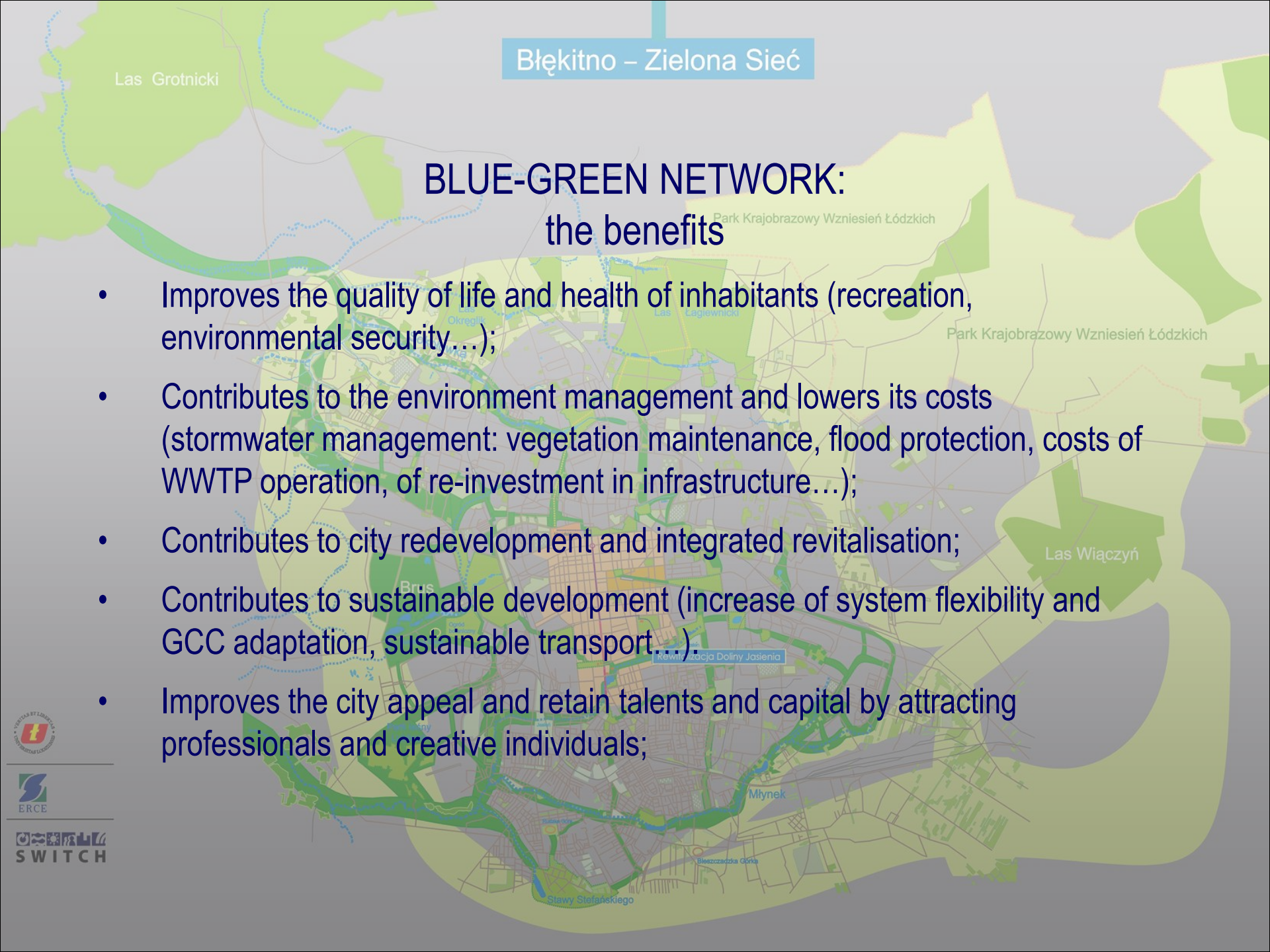
Drobniewska, 2008



Kurowski et al. 2002

BLUE-GREEN NETWORK
– NEW BASIS FOR SUSTAINABLE AND RESTORATIVE REDEVELOPMENT OF LODZ





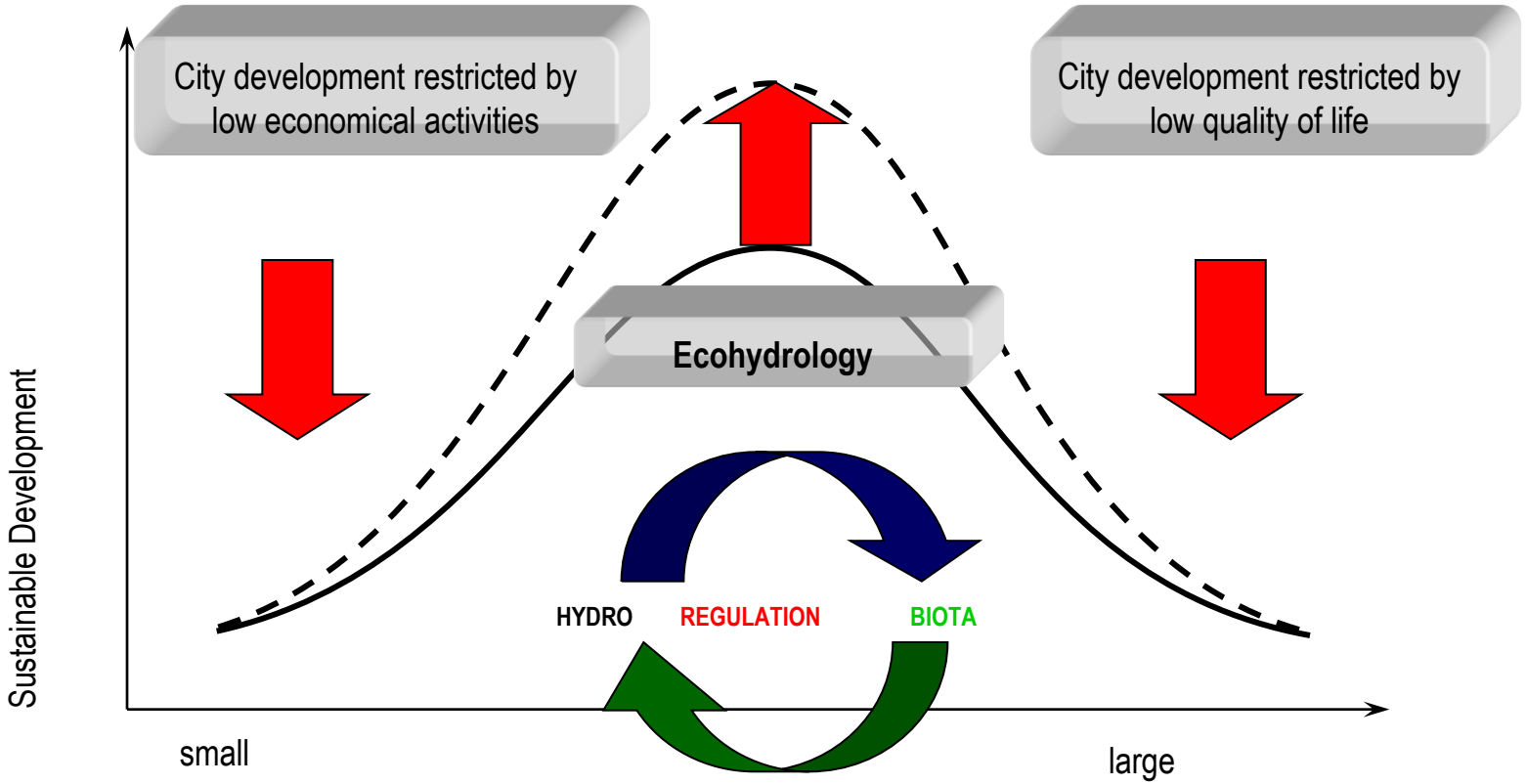
BLUE-GREEN NETWORK: the benefits

- Improves the quality of life and health of inhabitants (recreation, environmental security…);
- Contributes to the environment management and lowers its costs (stormwater management: vegetation maintenance, flood protection, costs of WWTP operation, of re-investment in infrastructure…);
- Contributes to city redevelopment and integrated revitalisation;
- Contributes to sustainable development (increase of system flexibility and GCC adaptation, sustainable transport…).
- Improves the city appeal and retain talents and capital by attracting professionals and creative individuals;

ERCE

SWITCH

Importance of balanced landscape for the city development



In cities landscape has FUNCTIONS, not just aesthetic values

EH application enhances ecosystem services
(e.g., stormwater retention and purification, microclimate and health)

Implementation of Blue-Green Network:

- **Remediation of the Sokolowka River** (UML, LSI)

- **Remediation of the Jasien River Valley** (Studium of Spatial Plan & Local Stakeholders)

- **Local management plan for the Brzoza River** (Dept. Environmental Protection, UML)

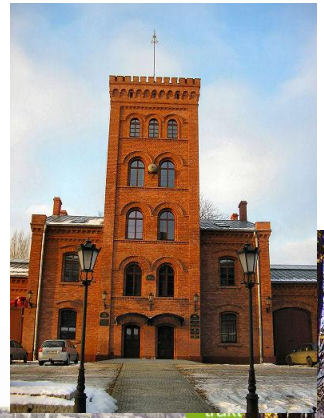
- **Plans for the Mlynek Recreational Area (**Delegatura Łódź Górna, UML)

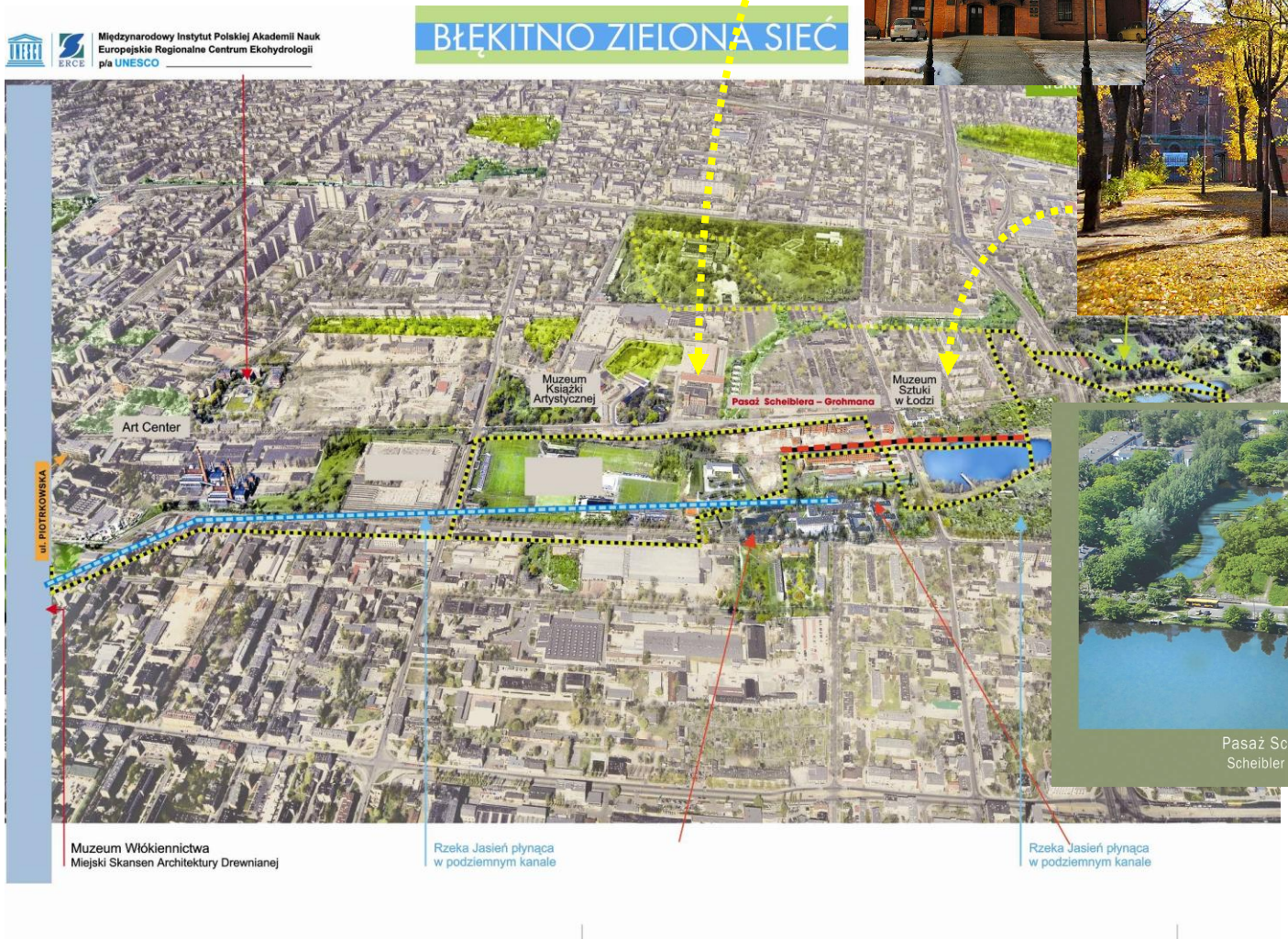
- **Rehabilitation of the Arturowek Recreational Area** (project EU Life +)

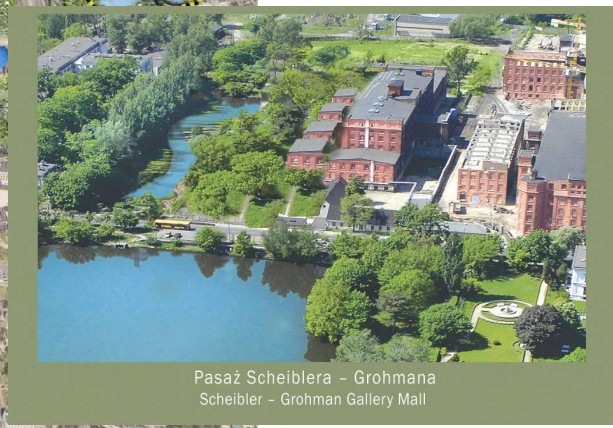
- **Rehabilitation of the Stefanski Ponds** (monitoring & project proposal)

CREATIVE CITY - Revitalization

Ksiezy Mlyn PARTNERSHIP







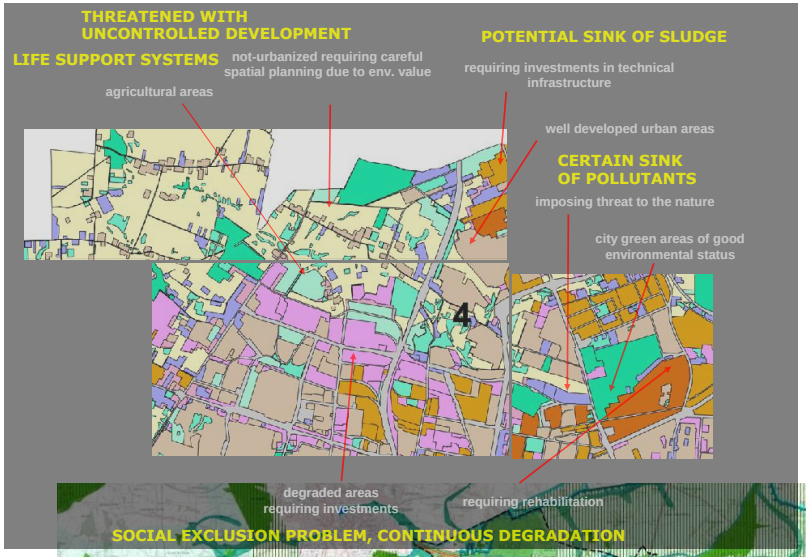
Pasaż Scheiblera – Grohmana
Scheibler – Grohman Gallery Mall

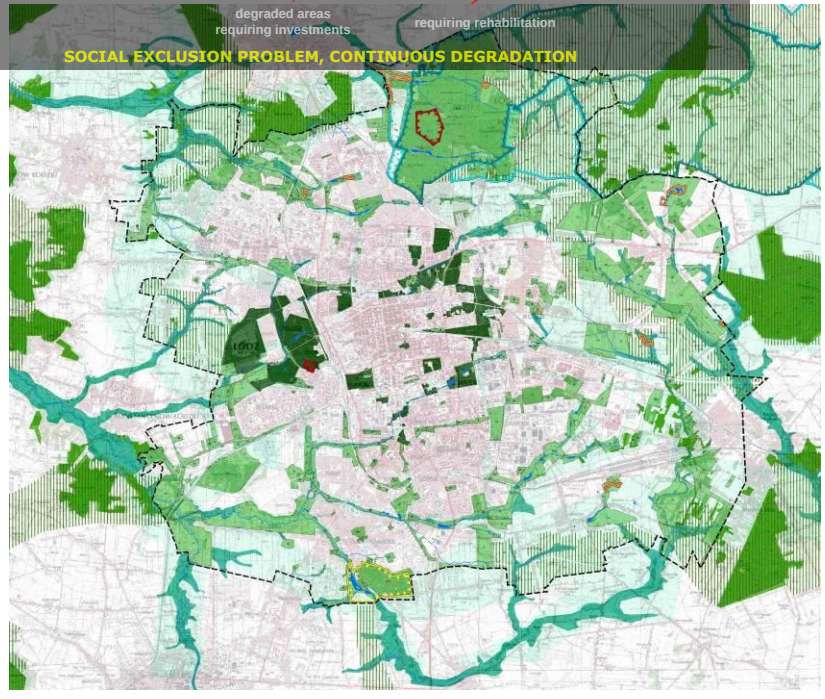
Urban gardens as a component of Blue-Green Network

More water, better water

Więcej wody, czystszej wody

Growing green





System of values

Organic / ecological
Close to nature
Economic /self-sustaining
Independence / land ownership
Appearance / status
Social

Life approaches

Anthropocentric
Ecocentric

Landscape features

Agricultural, Living
Recreation, Aesthetics
Mixed

FUTURE DEVELOPMENTS

ROLE IN CLIMATE CONTROL

LEAK OF CHEMICALS

WATER CONSUMPTION / USE

LEAK OF NUTRIENTS

WATER QUALITY

LANDSCAPE ESTHETICS

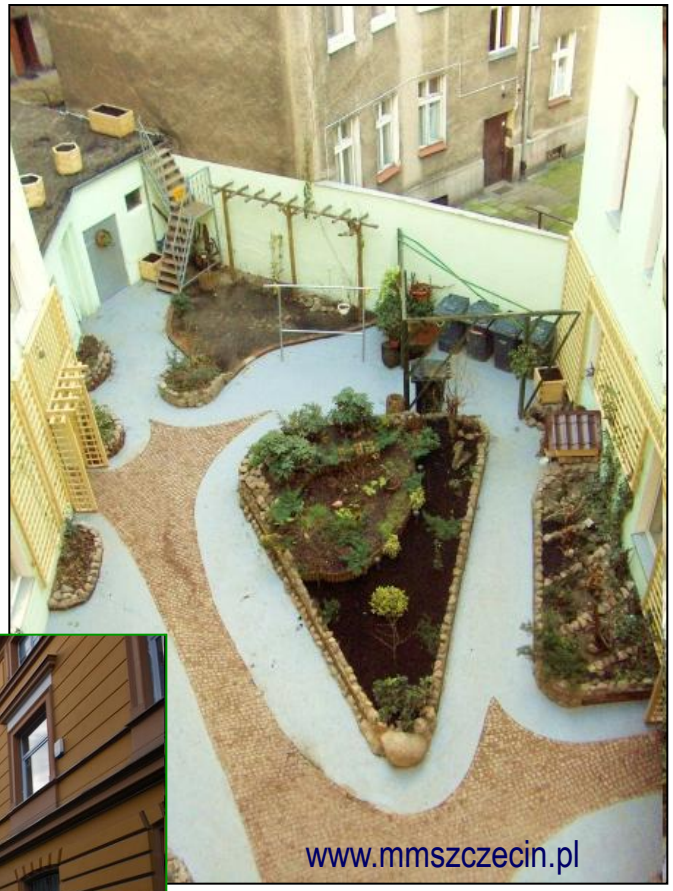
COLLABORATION FOR BGN

LTER Europe
European Long-Term Ecosystem Research Network

BEST PRACTICES IN GREENING - Green backyards

Fundation Zoo, Piotrkowska Street Partnership

Stormwater management should include greening of city backyards for increasing infiltration, improvement of microclimate, better look



GREEN TRANSPORT

NGOs – Lodz Rowerowa,
Grupa Pewnych Osob, UNILOGISTICS

Life+ Project

EH-REK: Ecohydrologic rehabilitation of recreational reservoirs “Arturówek” (Łódź) as a model approach to rehabilitation of urban reservoirs.

www.arturowek.pl