Sustainable resilience remediation of the Hajek HCH site using the Wetland+ system

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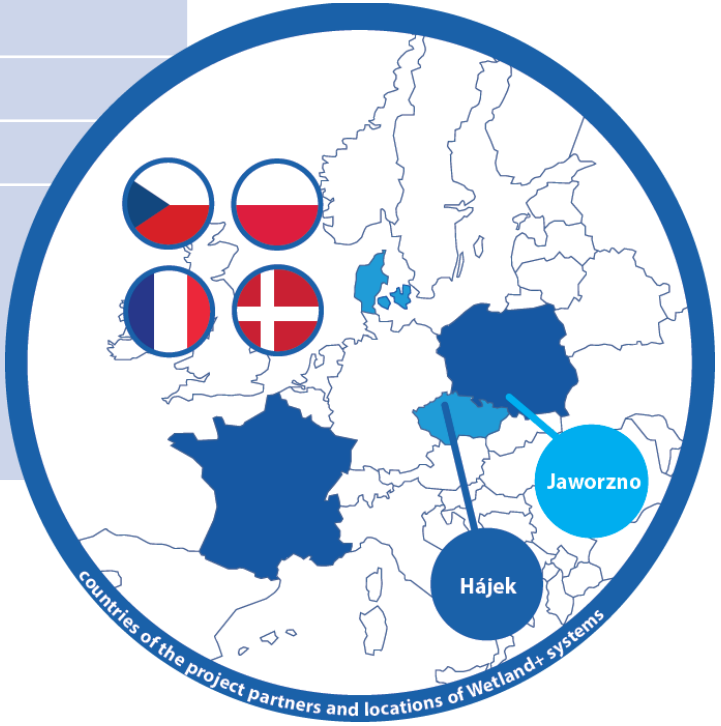
Project title	Innovative technology based on constructed wetlands for treatment of pesticide contaminated waters
Project acronym	LIFEPOPWAT
Duration	48 months (01/2020 – 12/2023)
Total budget	3.16 mil €
Coordinating beneficiary	• Technical university of Liberec (CZ)
Associated beneficiaries	• Central Mining Institute GIG (PL) • City of Jaworzno (PL) • Aarhus university (DK) • SERPOL (FR) • DIAMO state enterprise (CZ) • Photon Water Technology s.r.o (CZ)



LIFEPOPWAT – „LIFE OVER POPS IN WATER“

https://cxi.tul.cz/lifepopwat

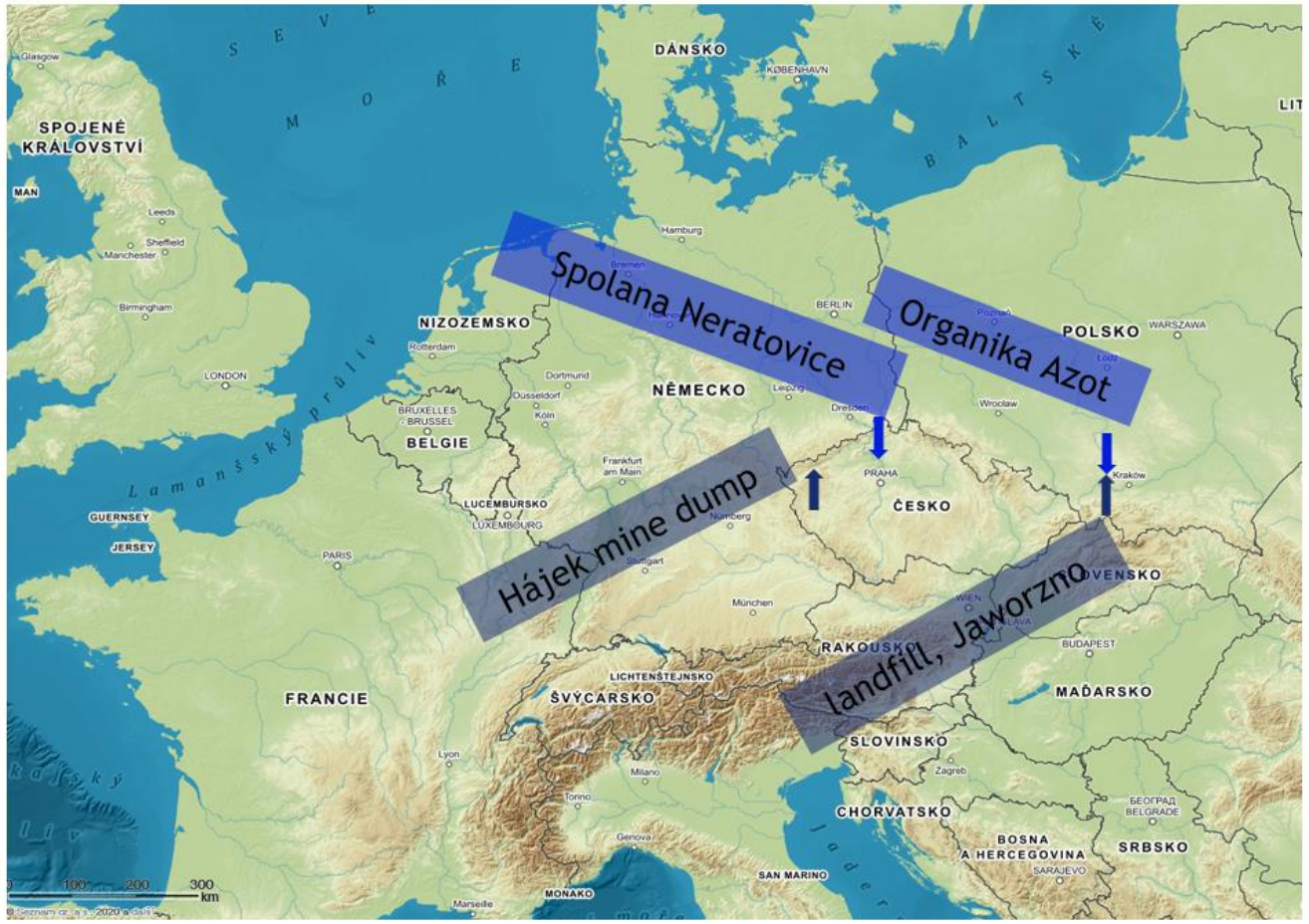
Suitanable Resilience Remediation:

- ✓ optimized solution to cleaning up a hazardeous site
- ✓ maximize social and economic benefits
- ✓ create resilience against increasing threats

Objective:
Treatment of HCH polluted waters by a passive system (Wetland+)

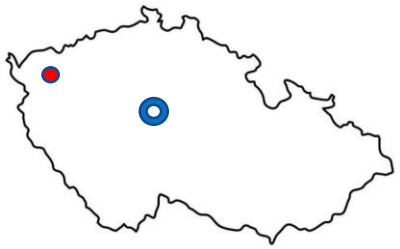
Demonstation sites:

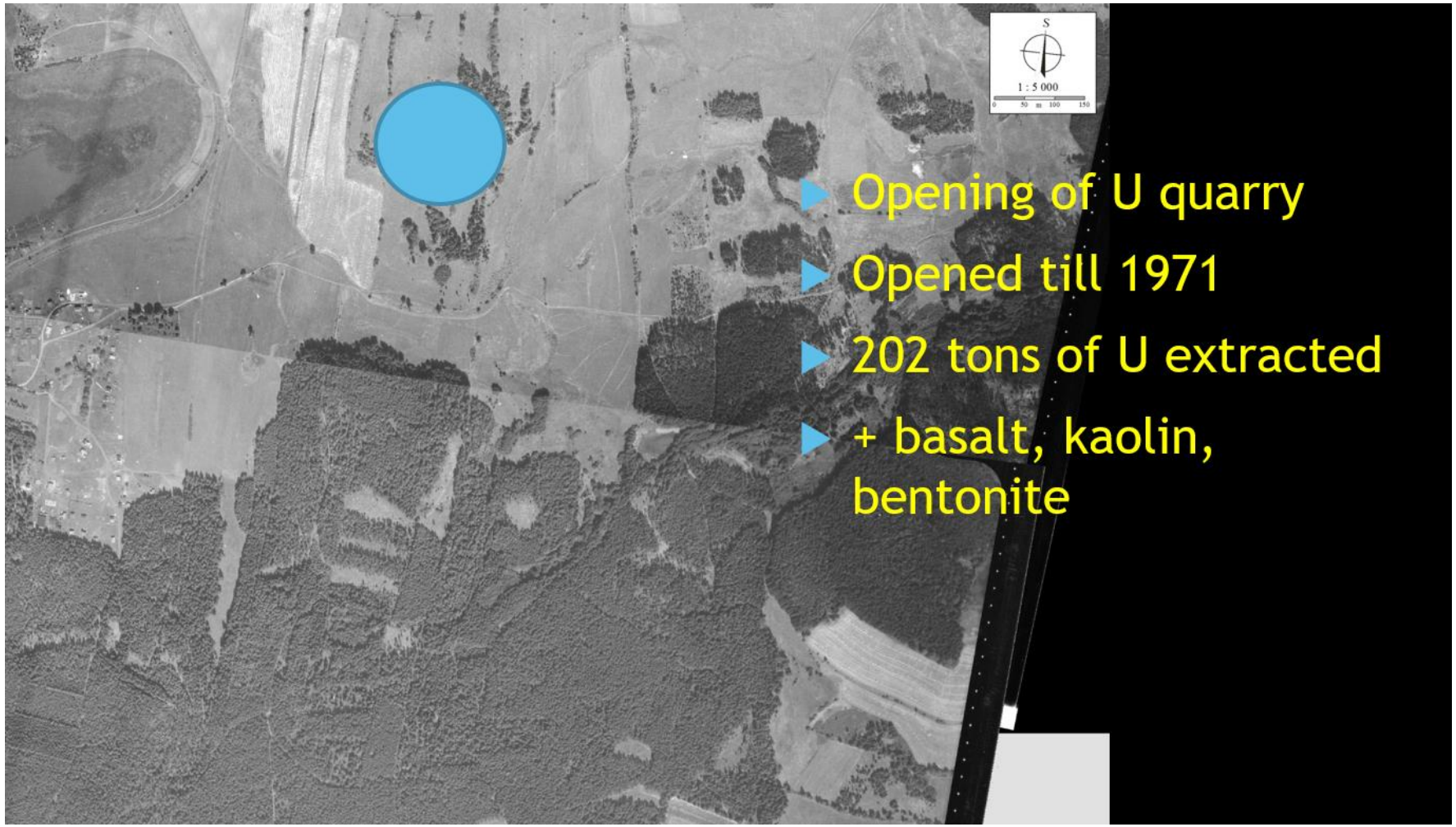
- Hajek (CZ) – full scale remediation (up to 3 L/s)
- Jaworzno – experimental system (HCH +other pestcides, 0.1 L/s)



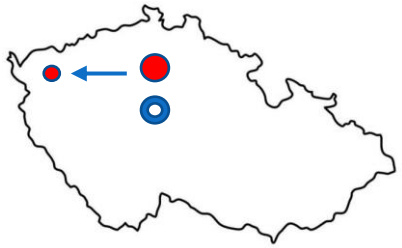
Hajek site

1965

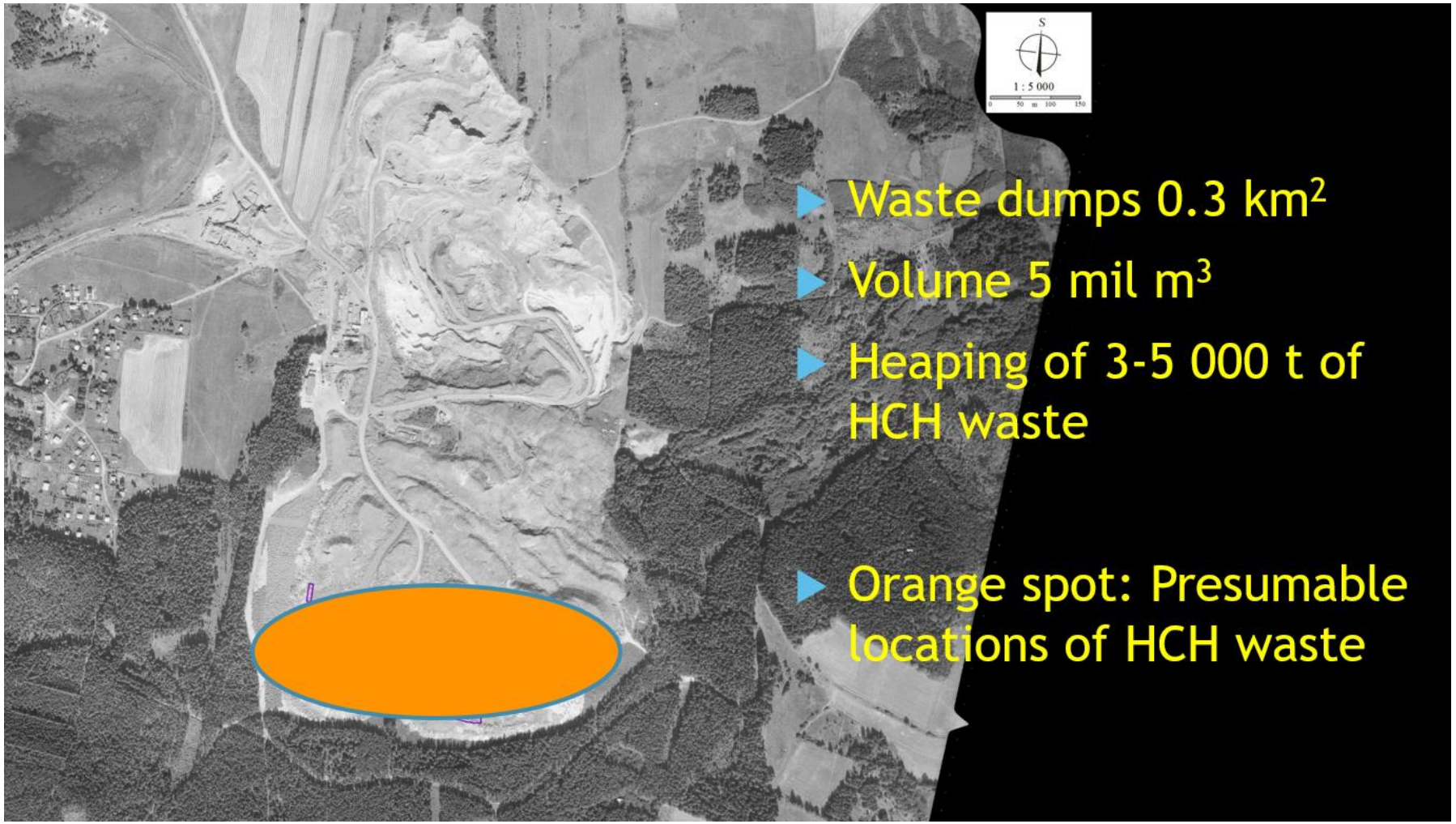



S
1 : 5 000
0 50 m 100 150
Opening of U quarry
Opened till 1971
202 tons of U extracted
+ basalt, kaolin, bentonite

1970



Spolana → 160 km

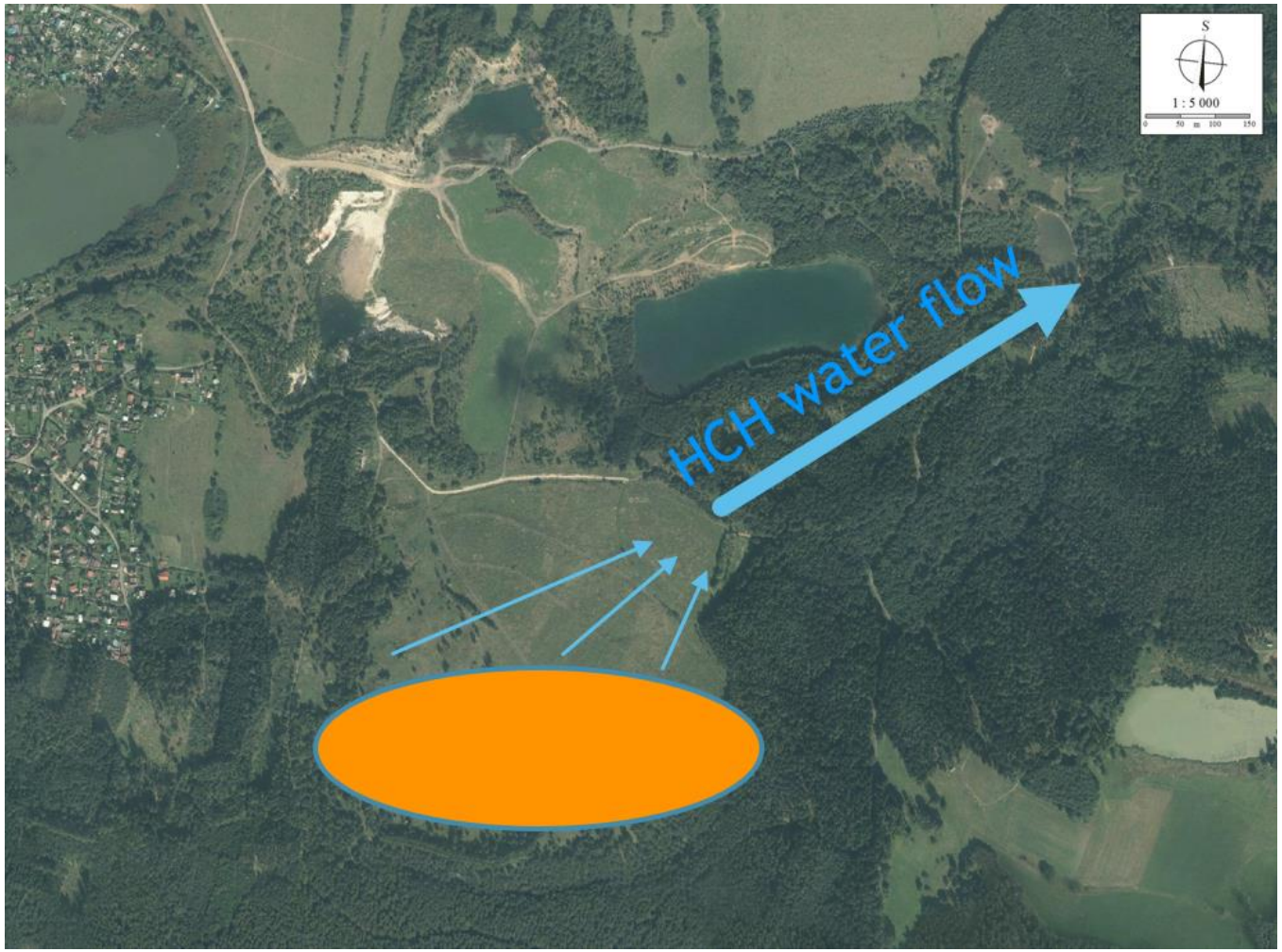


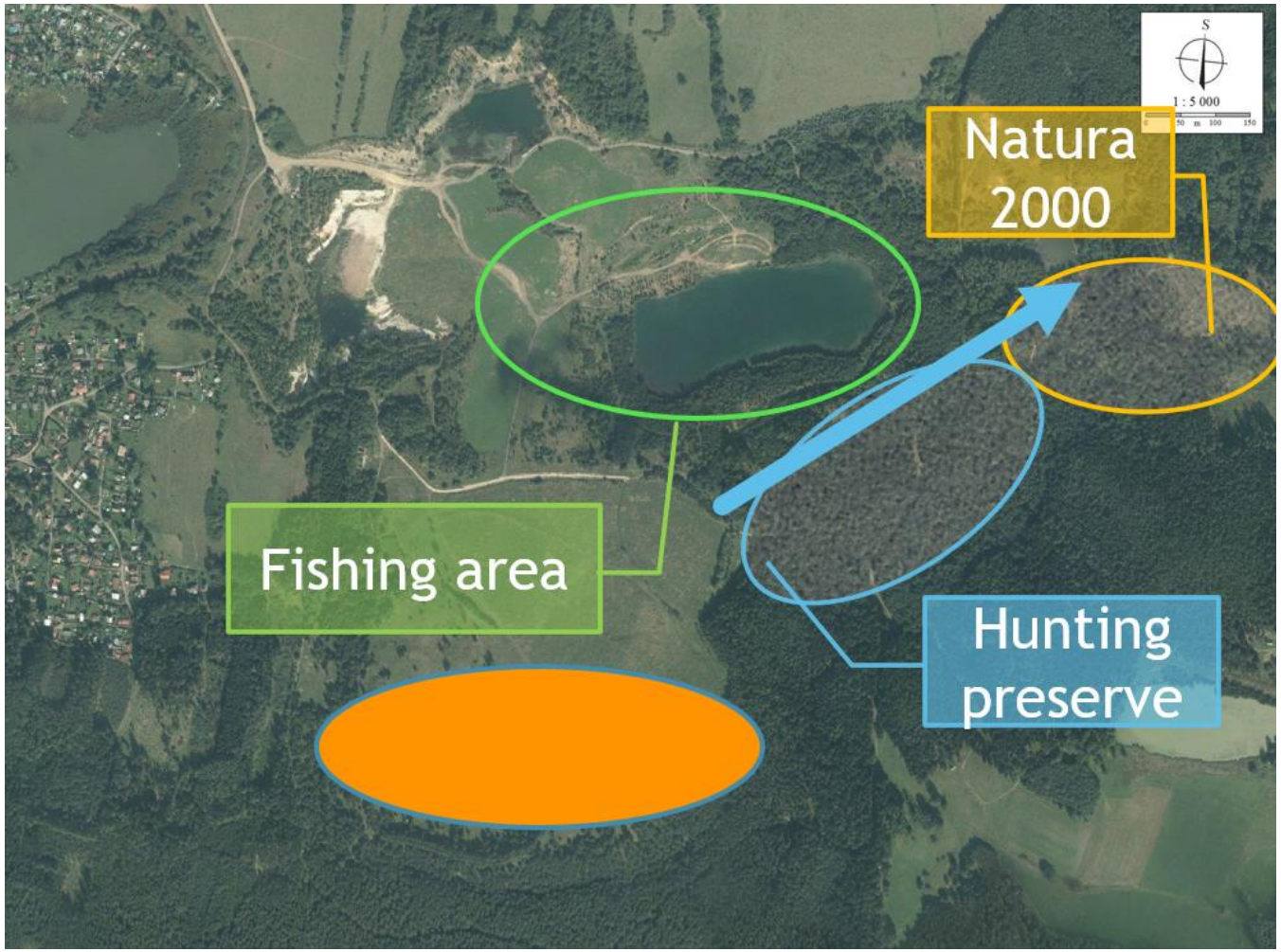
2020

HCH =160 ug/l

Chl.B.=500 ug/l

Flow = 1-3 l/s




Natura 2000
Fishing area
Hunting preserve

SRR:

→ water protection

→ long-term treatment

→ sustainable remed.

SRR solution: impossible

- excavation
- containment
- active WWTP

A Sedimentation of suspended particles to prevent clogging (Fe-OH)

B Chemical reduction of HCH, formation of reducing conditions

C Biofilters and biodegradation

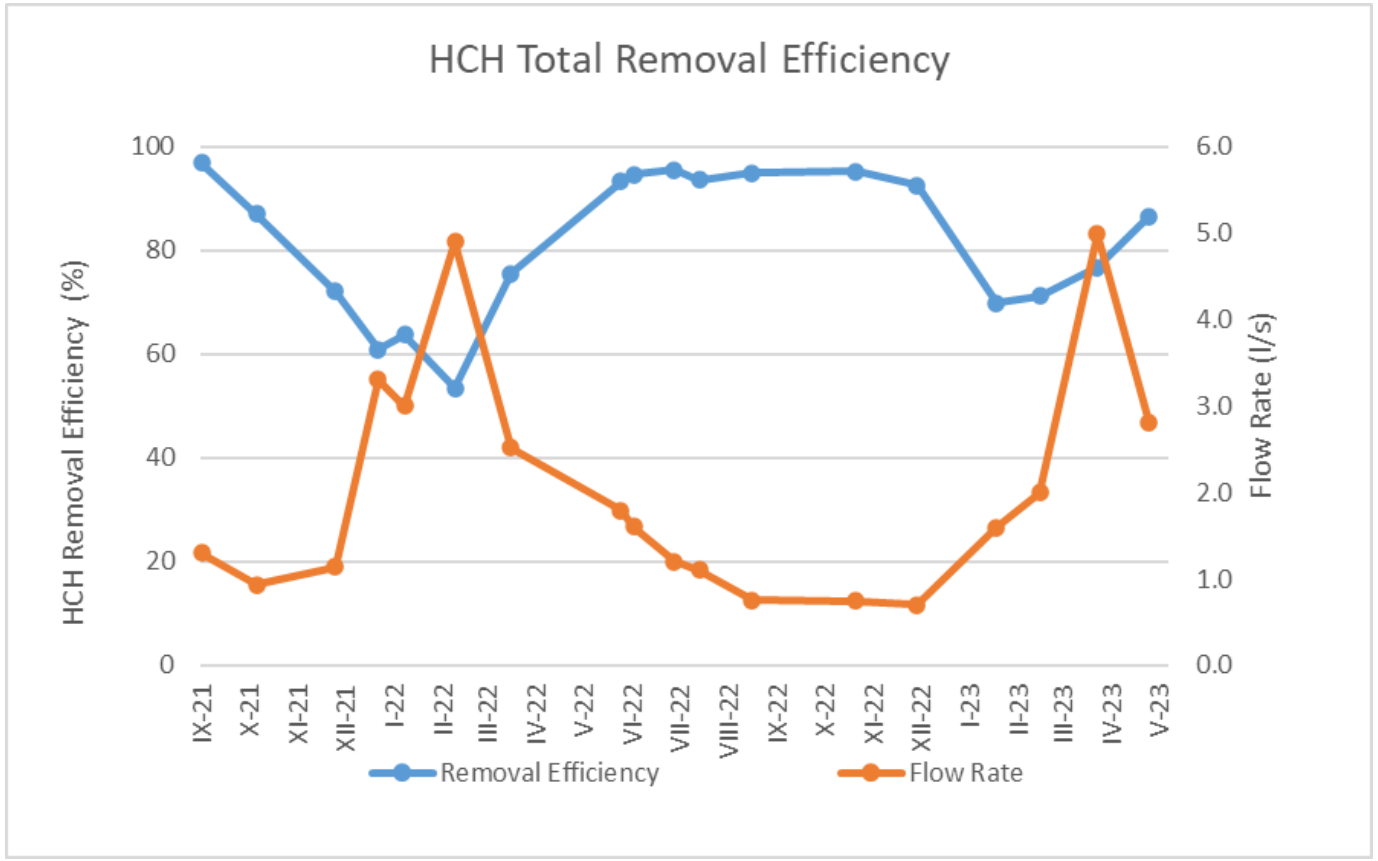
D Polishing treatment step – aerobic wetland


Wetland+ prototype P1 – 2 years of operation

2021

2023

Wetland+ monitoring



Wetland+: Present efficiency of HCH and other contaminants removal

	Σ CLB [ug/l]	Σ CLF [ug/l]	Σ HCH [ug/l]
inlet	773,0	27,9	154,9
outlet	2,5	1,5	5,6
efficiency %	**99,7**	**94,8**	**96,4**

Sustainable remediation process – not only environment

- Benefit is greater than its impact
- Sustainable remediation is site and project specific
- Best solution is selected based on balanced decision-making process (e.g. CL:AIRE 2010 by SuRF-UK, ISO 18504:2017)
- Indicators: environmental, society, economic (balanced)
- It is a multifactorial task → 15 indicator categories, > 70 questions

Three scenarios – Wetland+ x WWTP x No intervention

Wetland+

+ Low emission
+ Biodiversity increase
+ Less expensive solution
+ Increase of land value
+ Education facility
- Not-proven technology

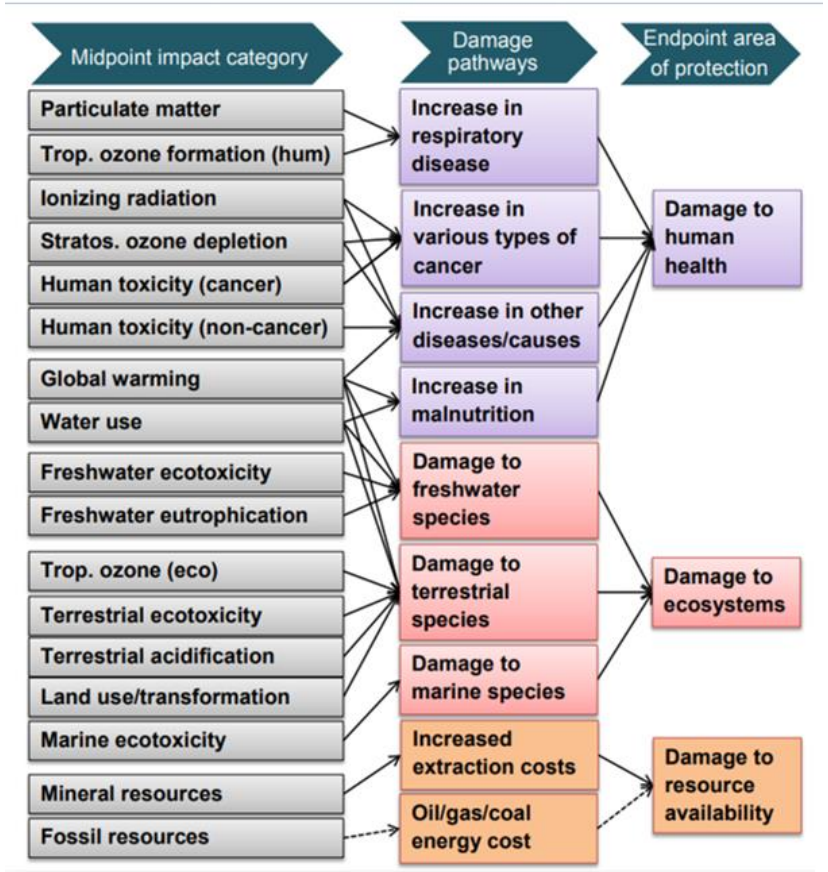
WWTP

+ Creation of jobs
+ Robust and standard treatment
- Waste production
- Operational costs
- Workers risks
- Risk of crime

Life Cycle Assessment: Wetland+® vs. WWTP

4 stages:

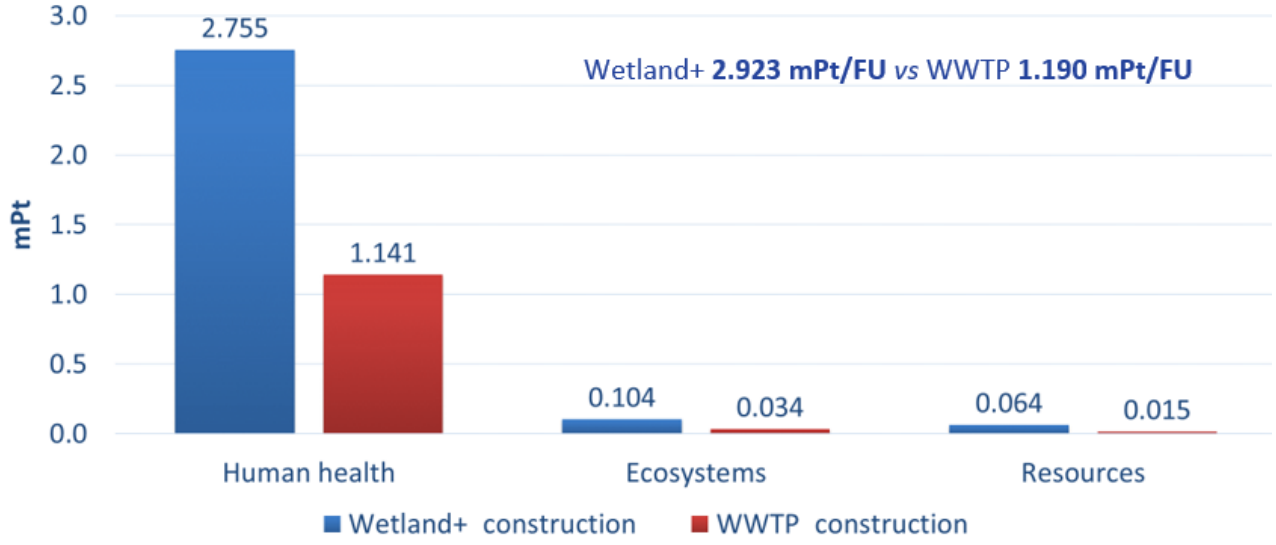
- defining the boudaries
  - – amount of treated drainage water
  - - 25-year lifetime of the systems
- inventory analysis (Life Cycle Inventory – LCI),
  - - construction stage x operation stage
- impact assessment (Life Cycle Impact Assessment),
  - - ReCiPe2016 method → Sima Pro software
- interpretation (LCA)



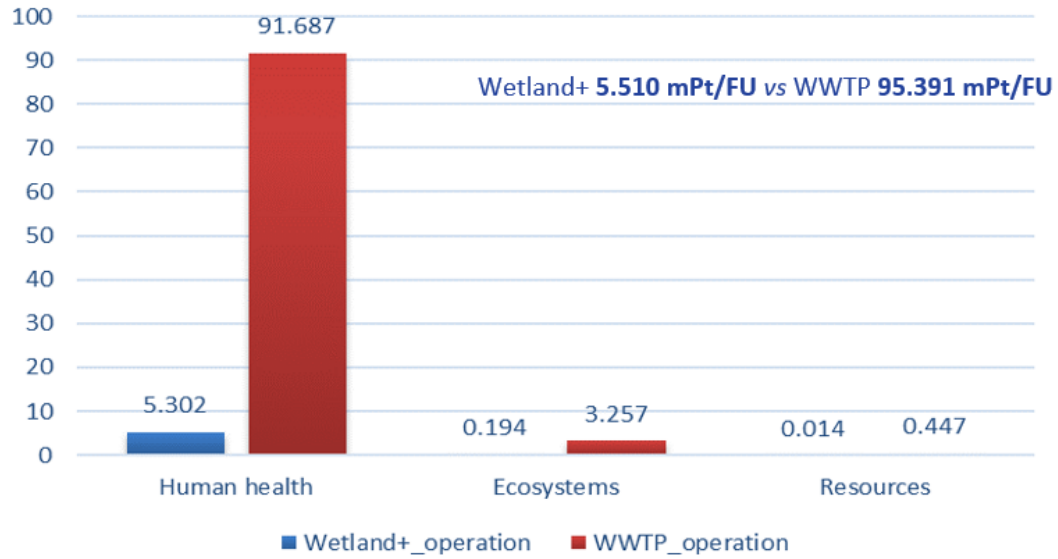
ReCiPe 2016 method (Huijbregts et al. 2016)

LCA results

Wetland+® vs. WWTP



Comparison of ReCiPe Endpoint H/A results after the weighing stage for the construction stage of the Wetland+ and WWTP systems



Comparison of ReCiPe Endpoint H/A results after the weighing stage for the operational phase of the Wetland+ and WWTP systems.

Conclusions

- ✓ Wetland+® at Hájek site (CZ) led to a decrease of HCH concentrations at the outlet <10 µg/l, and an efficiency at 95%;
- ✓ Various removal efficiency for individual HCH isomers: α = γ = δ > **β = ε** δ-HCH dominates at the inlet, **ε-HCH dominates at the outlet**;
- ✓ HCH mass discharge to the Ostrovský Creek 25 g/day → 0.8 g/day;
- ✓ In a year we removed approximately:

  8 kg HCH + 25 kg ClB + 0.5 kg ClPh
- ✓ LCA analysis showed also economic and social advantages of the system

Thank you for your attention....

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