

Overview of the Sava planning process

Thomas Dworak, Fresh Thoughts Consulting



Objectives of the support project

- Update the Sava **RBMP** and **FRMP** accompanying PoM
- Develop the first Sava **Sediment Management Plan** (SMP) with PoM
- Analyse and strengthen interlinkages between RBMP, FRMP, and SMP
- Develop a **Joint Plan of Measures** (JPM) for coordinated basin-wide implementation
- Prepare a methodology for **monitoring and evaluating** the implementation of measures.
- Design and implement a comprehensive **stakeholder engagement process** and public consultation campaigns to support the development of basin-wide plans.
- Develop a **Follow-up Strategy** on the Sava Planning Process as a structured and forward-looking framework that builds on the outcomes of the Plans to guide future actions.



Follow an Integrated Approach

- **Comprehensive Analysis:** The primary goal is to outline and analyze the interlinkages and synergies between the River Basin Management Plan (RBMP), Flood Risk Management Plan (FRMP), and Sediment Management Plan (SMP).
- **Strategic Alignment:** Identifying overlaps in content and timing, as well as gaps and opportunities for integration.
- **Policy Links:** Connecting these plans to the Climate Change Strategy and the EU Nature Restoration Regulation.
- **Coordination:** Ensuring implementation occurs smoothly across sectors at both national and transboundary levels



Why Integrate? The Core Connections

- **Common Drivers:** All three plans (WFD, FD, and SMP) address water body status through measures impacting hydromorphology, river continuity, flow velocity, and sediment transport.
- **Environmental Health:** Sediment quality and transport are decisive for assessing ecological and chemical status of surface water bodies.
- **"Win-Win" Solutions:** Integrated planning avoids conflicting measures and creates solutions that benefit both flood risk reduction and environmental protection.



The Joint Plan of Measures (JPM)

- **Efficient Execution:** Activities must be coordinated in time and space to achieve objectives without harmful environmental side effects.
- **Strategic Milestone:** The JPM serves as a milestone for allocating financial resources and effort across the three plans.
- **Team Collaboration:** Ongoing interaction between the teams developing each plan is crucial for objective planning and rapid updates based on basin-wide risk assessments





Stakeholder engagement

Stakeholder engagement 1: Planning & Fora

- **Objective:** support the development of the RBMP, FRMP, and SMP by providing ample opportunity for transparent, inclusive, and cooperative basin-wide planning
- **Stakeholder mapping and characterization**
- **Stakeholder Forum 1 – 23 September 2026**
 - Validate intermediate outputs for RBMP, FRMP and SMP
 - Refine objectives and target levels
 - Brainstorm on potential measures
- **Stakeholder Forum 2 – March/April 2027 (Date TBD)**
 - Gather feedback on the draft plans and accompanying measures



Stakeholder engagement 2: Surveys

- **Objective:**

- Information and feedback from a wider range of stakeholders
- In-depth input on specific technical or policy topics from targeted stakeholder subgroup of stakeholders

- **Surveys:**

- Survey 1: baseline issues, challenges, lessons learned from previous planning cycles, and opportunities for collaboration (June 2026)
- Survey 2: capacity building needs (September 2026)
- Survey 3: survey on intermediate outputs (e.g. Significant Water Management Issues, flood hazard and risk map update, sediment system characterization and conceptual mapping)
- Other potential surveys as needed on a ad-hoc basis



Stakeholder engagement 3: Public consultation

- **Objective:** gather feedback and comply with legal requirements and good practice for transboundary river basin planning
- **Formal consultation** on Draft RBMP, FRMP, SMP and Associated (and coordinated) Programs of Measures
- **Planned date:** Summer 2027



Agenda and workshop objectives

Nuria Hernández-Mora

Fresh Thoughts Consulting



Workshop objectives

- Presentation of intermediate outputs
- Discussion of key management issues
- Preliminary identification of basin-wide measures



Workshop agenda

9:30 **Welcome and Introduction**
ISRBC

9:45 **Overview of the Sava planning process**
Thomas Dworak, Fresh Thoughts Consulting, Project coordinator

10:00 **Agenda and workshop objectives**
Nuria Hernández-Mora, Fresh Thoughts Consulting

10:15 **River Basin Management Plan**
Tanya Milkova, Guido Schmidt & Thomas Dworak, Fresh Thoughts Consulting

11:50 **Coffee Break**

12:15 **Flood Risk Management Plan**
Darren Lumbroso & Marta Roca, HR Wallingford



Workshop agenda

14:00 **Lunch**

15:00 **Sediment Management Plan**
Christopher Hauer, Hauer-Hydraulic-Consulting e.U

16:30 **Next Steps and Milestones**
Thomas Dworak, Fresh Thoughts Consulting

16:45 **Closing Remarks**
ISRBC



Principles for dialogue

Starting point: Dialogue requires openness to considering different possibilities.



Attitude: Be willing to listen and learn. All views are valid. Respect speaking turns.



Sharing insights: We explore the arguments together, learning from each other and, when possible and needed, reaching consensus.



Transparency: We will record all contribution. The results will be accessible in the workshop report



Materials and housekeeping

- Workshop materials
- Please write with capital letters and, if possible, in English
- Please hand in your contributions to table facilitators
- Ask questions and clarifications
- Please return your name tags and pens at the end of the day

Thank you for your time and contributions!





Development of the 3rd
River Basin Management Plan
2028-2033
International Sava River Basin

Tanya Milkova, Fresh Thoughts Consulting

Priorities in the elaboration of the 3rd Sava RBMP

Our aim: to facilitate more synchronized WFD implementation across the Sava River Basin by supporting efforts to address identified gaps and inconsistencies through active ongoing interaction with ISRBC and the Sava countries.

What is most important for effective water management to ensure a healthy environment and high-quality water resources?

To reliably determine the nature and extent of the anthropogenic pressures and impacts on surface and groundwater, and objectively assess their status.

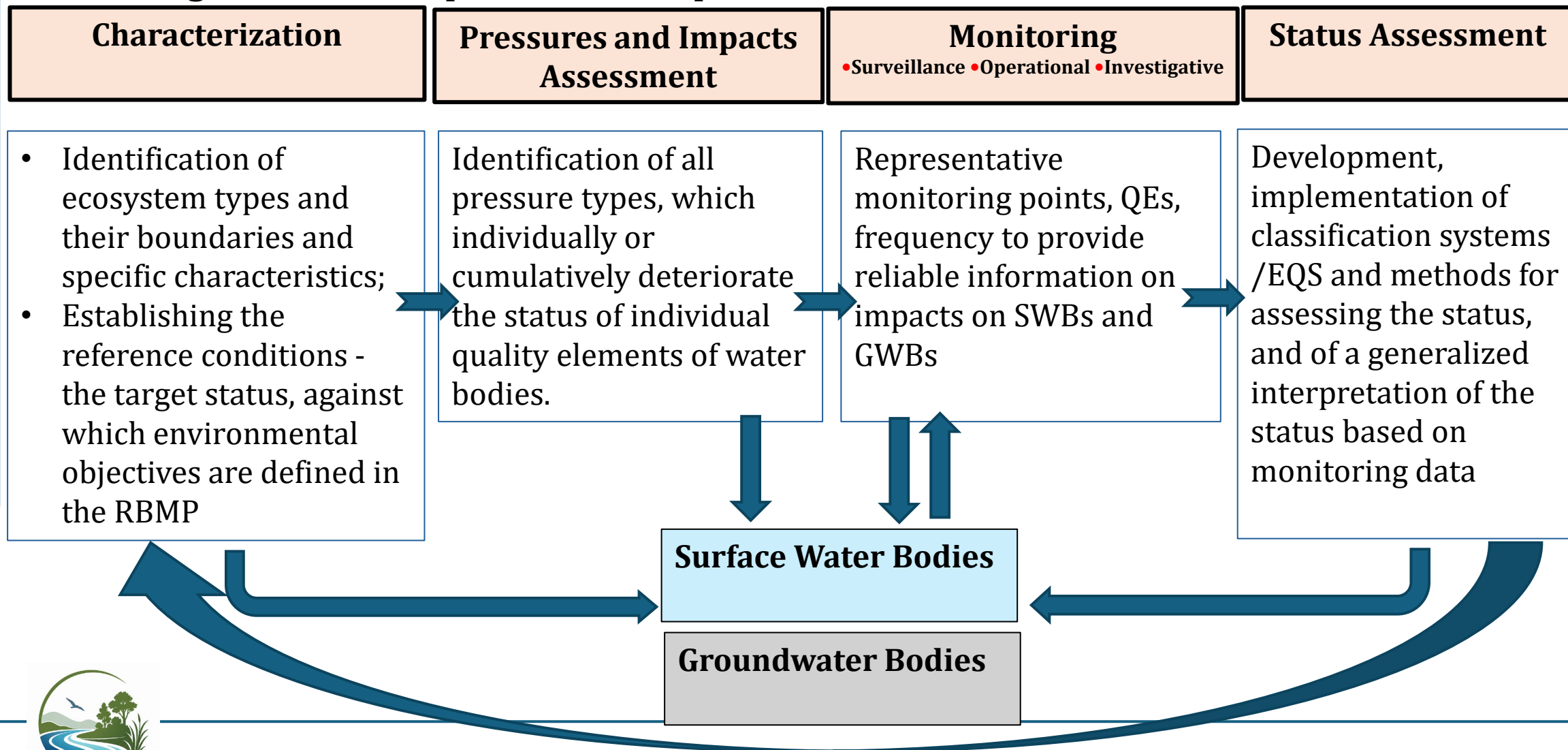


Information basis for the 3rd Sava RBMP: Current national RBMPs.



Logical structure of the RBMP

Main principle: iterative process; reviewing every 6 years, as data sets and knowledge from the implementation process increase.



Ongoing activities

- Data gathering and data processing

Agreed **cut-off date for providing national data** to be integrated into the 3rd Sava RBMP and the SMP: [07 September, 2026](#) - still ongoing clarifications, data checking, and validation

- In-depth review of the national methodologies and assessments.
- Drafted data management templates to be used for data processing and producing the relevant tables and annexes for the 3rd Sava RBMP
- Prepared initial draft of the SWMIs and potential SWMIs – for discussion
- Review of applied exemptions and progress with measures of basin-wide importance.



Characterization of surface and groundwater

Current progress and related activities

- **Typology** approaches and factors - validated typology: SL, HR, BA (Fed. BiH); analysis and comparison of typology approaches of individual countries; identification of common types
- **Established type-specific reference conditions** – review of progress for all SW types/quality elements
- **Intercalibration** – almost completed for HR and advanced for SI, forthcoming for pre-accession countries
- **Delineation of SWB and GWB** - in most countries, SWB and GWB have been revised; ME - initial identification carried out.
- **HMWB** – designated /preliminary designated; review of designation methodologies.



Review of anthropogenic pressures and impacts

Activities

- Update the analysis of the pressures and impacts on the status of surface waters and on groundwater following the principal requirements of the WFD (Annex II).
- Summary overview at the Sava RBD scale, including the **scope, magnitude, and variation of impacts in a transboundary context**, considering available spatial (GIS) information and quality data in temporal and spatial dimensions.
- Review of **criteria for significant pressures** and **consistency of methodologies** used.

The currently identified significant pressures are the basis for our proposal of SWMIs.



Monitoring of surface water status, groundwater status, and protected areas

Activities

- **Review the national monitoring programs** in terms of monitoring network, scope, and frequency, and in accordance with the identified significant pressures, status, and risk for the individual water bodies.
- **Review the national methodologies applied**, including the methods and procedures applied to group water bodies; data processing, and analysis of compliance with the relevant EU legislation.
- **Recommendations for improving** the monitoring strategy and, respectively, the monitoring programs *to achieve proper confidence in the monitoring results and better coherence at the basin-wide scale*.
- **Summarized overview of the monitoring** in place across the Sava River Basin.



Status assessment

Activities

- Overview of progress towards establishment of **WFD-compliant assessment systems**
- **Review the approaches** used by the Sava basin countries for assessing the status and comparability of the assessment at the Sava basin-wide scale:
 - SWBs - ecological and chemical status/potential ;
 - GWBs - chemical and quantitative status.
- **Update SWBs and GWBs** status assessments
- Identifying gaps and inconsistencies; recommendations for improvements in terms of WFD compliance and coherence at a basin-wide scale.



Major challenges

Situation differs across the Sava River Basin

SWBs

- Lack of type-specific reference conditions and classification systems for all types and quality elements – decisive for reliable status assessment
- Insufficient monitoring – coverage, spatial and temporal dimensions (frequency)

GWBs

- WFD-compliant methodologies for the GWB status assessment have not been developed in all basin countries
- Still existing gaps in availability of reliable monitoring data for quantitative and chemical status assessment





The Joint Plan of Measures (JPM)

Thomas Dworak, Fresh Thoughts Consulting

The Joint Plan of Measures (JPM)

- Merges the core requirements of the EU Water Framework Directive (River Basin Management), the EU Floods Directive (Flood Risk Management), and the Protocol on Sediment Management to the FASRB (Framework Agreement on the Sava River Basin).
- Focus is squarely on **transboundary mechanics**, ensuring that actions taken upstream do not negatively impact downstream countries, while maximizing ecosystem and structural synergies.



National vs transboundary measures

National Measures

- **Construction and Upgrading of Urban Wastewater Treatment Plants (WWTPs):** National implementations focus on building secondary and tertiary treatment facilities for major municipal agglomerations to drastically cut nutrient and organic pollutant loads entering local tributaries and the Sava.
- **Implementation of Agricultural Action Plans for Nitrate Reduction:** National measures to curb diffuse pollution by regulating the use of mineral fertilizers and manure, enforcing proper storage of livestock slurry, and establishing code-of-good-agricultural-practice guidelines in intensive farming regions.
- **Rehabilitation and Local Remediation of Contaminated Industrial Sites:** National-level cleanup operations, modernization of industrial water-retention systems, and enforcement of strict discharge permits for heavy industries and chemical plants operating within the basin.



National vs transboundary measures

Transboundary Measures

- **Establishment and Operations of the Sava River Basin GIS and Monitoring Networks:** Harmonizing water quality and quantity monitoring networks across all riparian states, allowing real-time data exchange, shared metrics, and joint assessment of ecological and chemical status along the transnational river corridors.
- **Transboundary Flood Risk Management and Contingency Planning:** Joint development and execution of structural and non-structural flood protection measures (such as coordinating operations of multi-purpose reservoirs, early warning systems) to manage extreme hydrological events safely across borders.
- **Harmonization of Navigation and Environmental Standards:** Coordinating river-training and fairway maintenance projects (aligned with international navigation standards like EGRIN) while simultaneously implementing joint mitigation measures to protect transnational fish migration routes, vital wetlands, and critical habitats.



Sava River Basin Flood Risk Management Plan (FRMP)

Dr Darren Lumbroso, Dr Marta Roca

HR Wallingford

23 September 2026



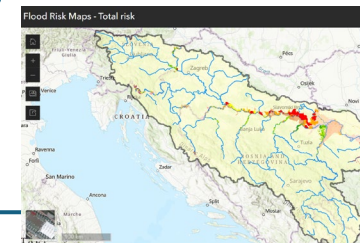
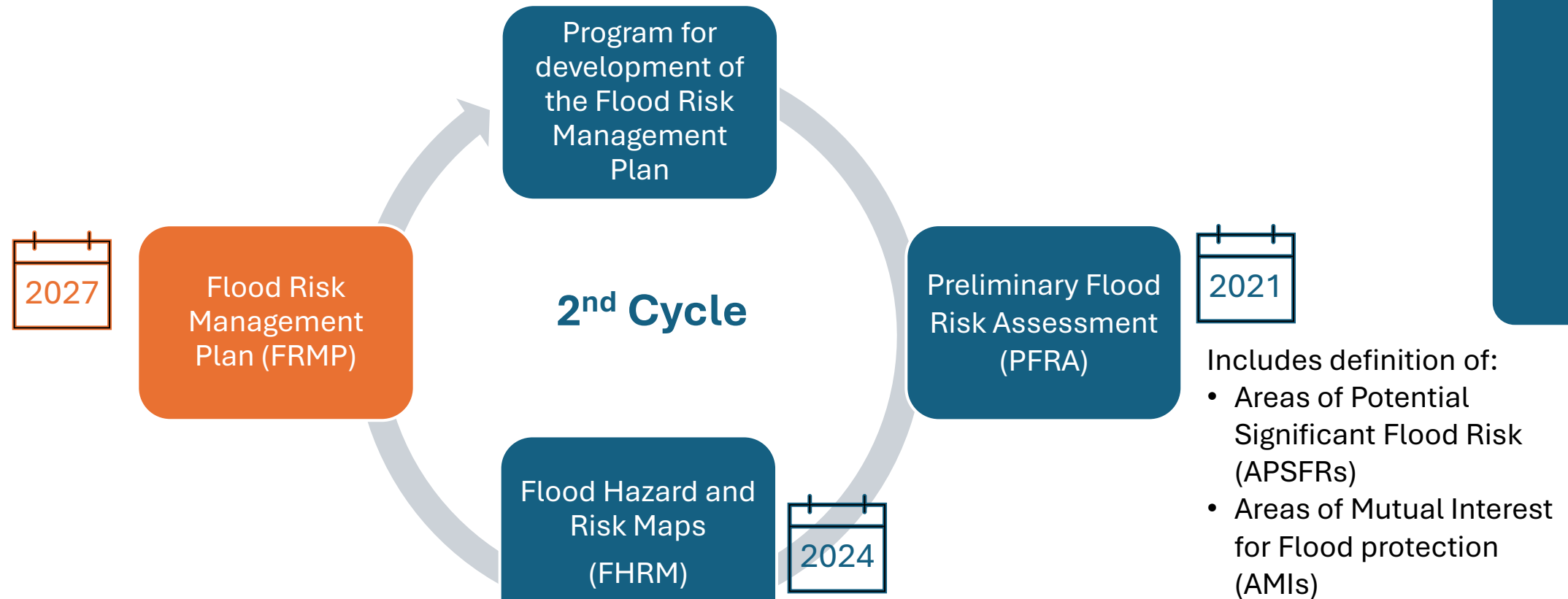
Topics for discussion – from the agenda

From 12:15 to 13:45

- Development and refinement of FRMP objectives
- Presentation and discussion of catalogue of measures
- Priorities for flood risk management measures
- Challenges and measures in transboundary areas of mutual interest



Reminder of the program process



Structure of the 2nd Flood Risk Management Plan (FRMP)

1. Introduction
 2. Description of the Sava River Basin
 3. Conclusions from the Preliminary Flood Risk Assessment (PFRA) 2021
 4. Findings from updated Sava Flood Hazard and Risk Mapping (FHRM) 2024
 5. Objectives of flood risk management
 6. Flood alleviation measures for achieving objectives including the Programme of Measures
 7. Transboundary cooperation in flood emergency management
 8. Stakeholder engagement
 9. Key findings
- Plus various Annexes and Background documents to be agreed



Proposed structure aligned with the EU Floods Directive

Main points to be considered by the 2nd FRMP

- Integration of climate change projections
- Prioritisation of measures, focused on measures at river basin level
- Links to nature-based solutions
- Transboundary operational coordination
- Monitoring, indicators, and evaluation of transboundary measures



FRMP objectives

- From the 1st FRMP
- Based on national FRMP plans, FRMP for the Daube River and other documents of the Sava Commission

1. Avoidance of new flood risks
2. Reduction of existing flood risks (during and after floods)
3. Strengthening resilience
4. Raising awareness about flood risks
5. Implementing solidarity principle



FRMP objectives

- There is the possibility to modify the existing Flood Risk Management Plan objectives



ACTIVITY 1 - FRMP objectives

There is the possibility of changing the Flood Risk Management Plan (FRMP) objectives and their sub-objectives.

Look at the table of suggested FRMP objectives.

- Choose up to five of the objectives in the table below which you think should be included in the Sava River Basin Flood Risk Management Plan
- Are there any objectives missing? If so, what are they?



Catalogue of measures

- Existing catalogue from 1st FRMP has 18 measures based on a high level classification defined at the EU level for reporting purpose
- They are divided by No action (1), Prevention (4), Protection (5), Preparedness (4), Recovery and Review (3) and Other (1) based on the EU's common reporting catalogue
- Some measures address both construction of new defences and maintenance of existing ones
- No detail on Natural Flood Management (NFM) measures – There is only one NFM measure covering very different options
- 51% of the measures selected in the 1st FRMP are in the “Other measures” sub-categories



Catalogue of measures

Our proposal is:

- ❑ Expand the number of sub-categories of measures - taking as example measures included in the 1st FRMP
- ❑ Add more fields to provide more information about the measures such as:
 - Identify the objective they are contributing to
 - Classify the measure as Non-structure/ Structural / Soft-structural / Green
 - Indicate the time horizon to maturity
 - Identify the adaptive capacity of the measure to climate change



Catalogue of measures – Example of possible new sub-categories of measures

- Differentiate between **construction** of new defences and **maintenance** of existing ones
- Include **more NFM** sub-categories of measures to differentiate between measures such as afforestation, channel restoration and flow diversion
- Include **property resilience** and **temporary flood defences**
- Include **technical studies** such as development and updates of flood risk assessments, scientific studies
- Include sub-categories of measures such as coordination activities, improvement of legal frameworks and regulations and measures to enhance public awareness

Activity 2 - Catalogue of measures

Would you agree to modify the catalogue from the 1st FRMP and introduce more sub-categories to it?

- YES – What are the main reasons to add sub-categories of measures?
- NO – Why should the catalogues of measures not be modified?

No need to agree how the catalogue will be modified in terms of additional sub-categories but if you have any suggestions, they would be welcomed!



Measures at a river basin level

- ❑ Existing catalogue has **eight main measures** applicable at river basin level
- ❑ Examples of possible additional sub-categories of measures:
 - Development and update of flood risk assessments and evaluations
 - Improved scientific and applied studies
 - Coordination activities related to the international APSFRs included in the AMIs
 - Improved legal frameworks, design standards, regulations and plans for flood risk management
 - Measures to enhance awareness among the public and private entities involved in flood risk management in the Sava River Basin
 - Documenting and analysing flood events



Activity 3 – Measures at a river basin level

- What would be your top three flood alleviation measures at a river basin level?
- Any additional basin wide measures?



Areas of Mutual Interest (AMIs)

- There are 19 AMIs defined in the updated PFRA from 2021

Between Slovenia & Croatia	Between Croatia & Bosnia and Herzegovina	Between Croatia & Bosnia and Herzegovina & Serbia	Between Croatia & Serbia	Between Bosnia and Herzegovina & Serbia	Between Montenegro & Serbia	In Serbia
HR_SI_Sutla_1 HR_SI_Sutla_2 HR_SI_Sutla_3 HR_SI_Bregana HR_SI_Kupa_1 HR_SI_Kupa_2 HR_SI_Kupa_3 SI_HR_Sava	HR_BA_Sava HR_BA_Glina HR_BA_Una_1 HR_BA_Una_2	HR_BA_RS_Sava	HR_RS_Bosut	BA_RS_Drina RS_BA_Lim	ME_BA_Drina ME_RS_Lim	RS_Sava

Slovenia: SI Croatia: HR Bosnia and Herzegovina: BA Serbia: RS Montenegro: ME



Areas of Mutual Interest (AMIs)



Activity 4 - Areas of Mutual Interest (AMIs)

- Identify **challenges/issues** and possible **measures** in those AMIs you are familiar with



- Integrated management of the Sava River Basin -

“Sedimentmanagement”

Dr. Christoph Hauer



1. Annotated Outline SMP



Outline of the Integrated Sediment Management Plan for the Sava River Basin

1. Executive Summary

- 1.1 Purpose of the Sediment Management Plan
- 1.2 Key Sediment Challenges at Basin Scale
- 1.3 Role of the SMP within River Basin Management
- 1.4 Summary of Strategic Directions and Next Steps

2. Introduction and Scope

- 2.1 Background and Rationale for the SMP
- 2.2 Legal and Policy Context
- 2.3 Relationship to River Basin Management and Sectoral Planning
- 2.4 Scope, Limitations and Phased Development of the SMP

3. Conceptual and Methodological Framework

- 3.1 Sediment Processes in Integrated River Basin Management
- 3.2 Sediment Quantity, Quality and Continuity as Management Dimensions
- 3.3 Water–Sediment–Biota Interlinkages
- 3.4 Risk-based and Adaptive Planning Approach

4. Evidence Base and Basin-wide Sediment System Characterisation

- 4.1 Overview of Basin Characteristics Relevant to Sediment Management
- 4.2 Sediment Quantity and Transport Processes
- 4.3 Sediment Quality and Contamination Patterns
- 4.4 Interactions with Water Uses and Ecosystems
- 4.5 Data Availability, Uncertainty and Knowledge Gaps

5. Key Sediment Management Issues and Risks

- 5.1 Basin-scale Sediment Challenges
- 5.2 Upstream–Downstream Interactions and Cumulative Effects
- 5.3 Preliminary Assessment of Risks for Environmental Objectives and Water Uses

6. Spatial Planning Framework for Sediment Management

- 6.1 Rationale and Criteria for Sediment Management Units (SMUs)
- 6.2 Delineation and Characterisation of SMUs
- 6.3 Sediment Management Hotspots and Areas of Potential Concern
- 6.4 Role of SMUs and Hotspots in Planning and Implementation

Present status

Deficit Analysis



7. Synthesis and Prioritisation for Planning

- 7.1 Integration of Evidence across SMUs and Hotspots
- 7.2 Prioritisation Criteria and Planning Logic
- 7.3 Planning Implications of Identified Priorities
- 7.4 Treatment of Uncertainty and Data Gaps

8. Sediment Management Objectives and Target Setting

- 8.1 Basin-level Objectives
- 8.2 SMU-level Objectives
- 8.3 Hotspot-specific Management Targets

9. Indicative Programme of Sediment Management Measures

- 9.1 Measure Typologies and Intervention Logic
- 9.2 Basin-wide Strategic Measures
- 9.3 SMU-level Measures
- 9.4 Hotspot-specific Measures
- 9.5 Linkages to Water Uses and Sectoral Policies

10. Monitoring, Modelling and Knowledge Development

- 10.1 Role of Monitoring in Sediment Management
- 10.2 Monitoring and Sampling Approaches
- 10.3 Use of Sediment Modelling for Decision Support
- 10.4 Knowledge Gaps and Progressive Improvement

11. Economic, Social and Environmental Considerations

- 11.1 Economic Implications of Sedimentation
- 11.2 Ecosystem Services and Biodiversity Considerations
- 11.3 Social and Environmental Safeguards

12. Implementation and Governance Framework

- 12.1 Institutional Roles and Responsibilities
- 12.2 Transboundary Coordination and Data Exchange
- 12.3 Stakeholder Engagement and Capacity Building
- 12.4 Phasing and Indicative Timeline

13. Review, Reporting and Adaptive Management

- 13.1 Monitoring of SMP Implementation
- 13.2 Reporting and Review Cycles
- 13.3 Adaptive Refinement of the SMP

Aims

Measures

Monitoring



2. Program of Measures



Programs of Measures (Deliverable Month 13th)

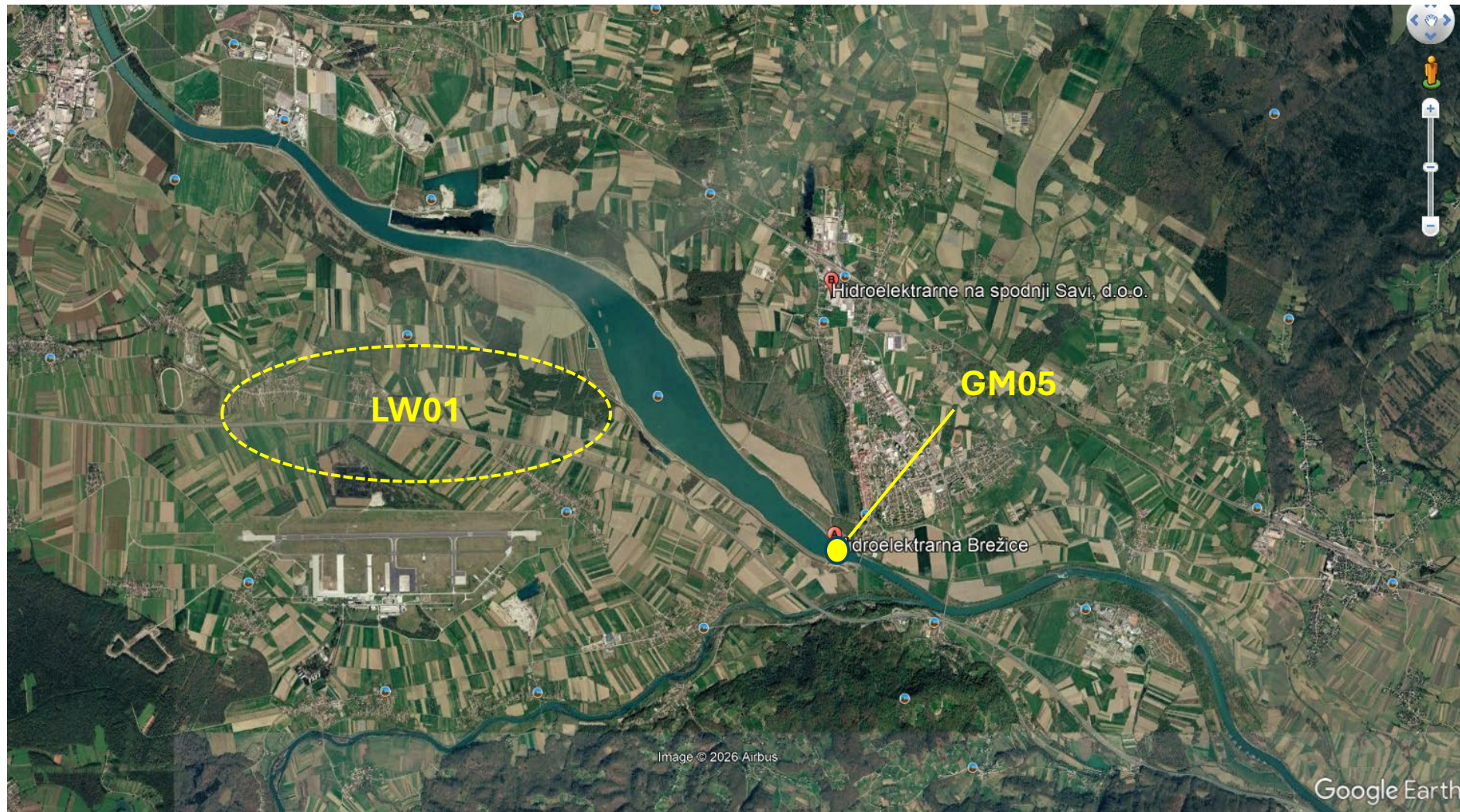
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Main objective(s)		Reduction of erosion by minimizing disturbances to the soil structure																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
Brief Description		Conservation tillage encompasses a variety of measures that farmers can implement in their farming practices to reduce soil loss from cropland. These include direct seeding, mulch seeding, strip seeding, and no-till farming. By minimizing disturbances to the soil structure, the soil's susceptibility to erosion is reduced.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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(Improved) Flushing Management at Dams and Power Plants Code: G									
Scope		Water resource planning							
Main objective(s)		Transport and remobilization of incoming and deposited sediments in the reservoir sediment continuity							
Brief Description		Sediment deposition in reservoirs leads to a reduction in storage capacity and, consequently, to negative impacts on power plant operations. Coarser grain fractions accumulate at the head of the reservoir, and the deposited material is missing in downstream section (Hauer et al., 2020). Efficient flushing management is required to facilitate the transport or remobilization of fine sediments and bedload from a reservoir, always taking into account aquatic ecological and natural landscape requirements. In addition to the aquatic ecological risks posed by excessively high concentrations of suspended solids due to fine sediments, the transport of coarse grain fractions is generally viewed positively from an ecological perspective; however, the mobilization and transport of these fractions is difficult even during flushing usually not possible in reservoirs. The transport of sediment can be optimized through measures that structure the backwater (groynes, guide walls, etc.). Ensuring passability is a major challenge, particularly in power plant chains, because the sediments mobilized in the upstream backwater should not be deposited downstream, with the negative ecological consequences that entails (e.g., silting of the riverbed). A suitable flushing management plan must be developed individually for each power plant or chain of power plants.							

		Impact		G	Minor	M	Medium	H
Impact	Parameter							
	Hydrology	Water retention						
		Groundwater						
	Hydraulics / Hydrodynamics	Water table						
		Flow velocity						
		Bed shear stress						
	Sediment dynamics	Erosion prevention						
		Sediment supply		H				
		Transport capacity						
		Sediment retention						
		Passability		H				
	Morphodynamics	River morphology		M				
	Aquatic ecology	Habitat diversity		M				
Naturalness of Sediment			M					
Implementation	Spatially	☐ Local	☒ Regional			☐ Catchment area		
	Temporal	☐ short-term	☒ medium-term			☐ long-term		
	Effort	☐ relatively simple	☒ moderate			☐ time-consuming		
	Timing/Frequency	One-time + maintenance						



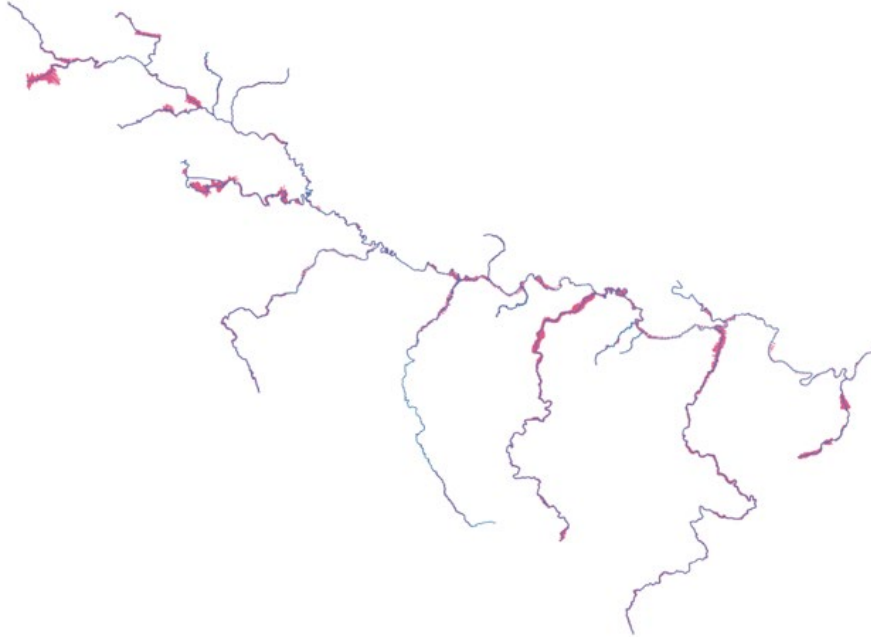
Programs of Measures (Deliverable Month 13th)



3. Methods on Sediment Quantity and Quality

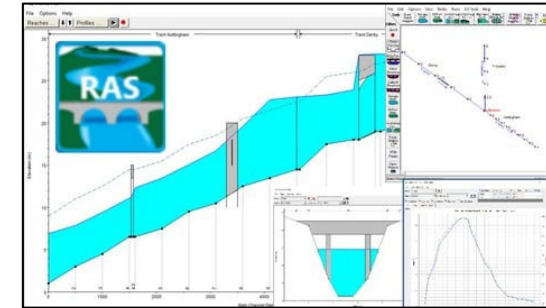


Proposed Methodology (based on existing HEC-RAS models) :



— Rivers
— CrossSections

0 50 100 km

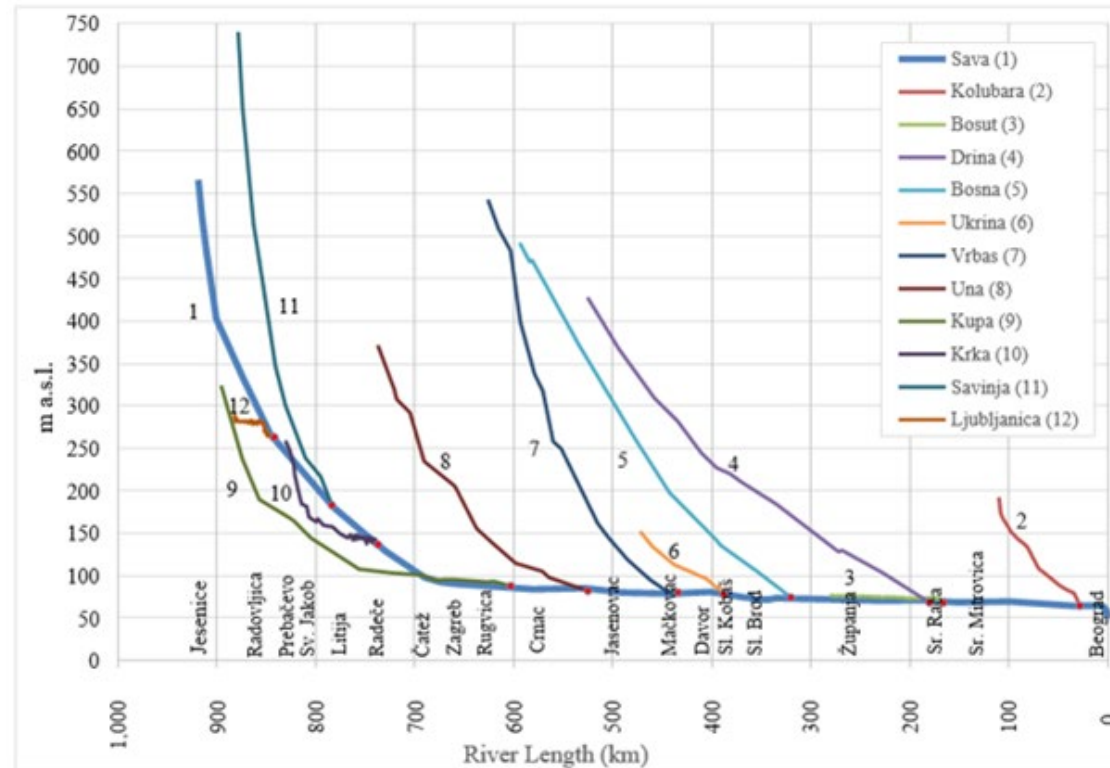


**US Army Corps
of Engineers®**

Overview of HEC_RAS models of the Sava River and its main tributaries (Source: Sava Commission).



Proposed Methodology (based on existing HEC-RAS models) :



(a)



(b)



(c)

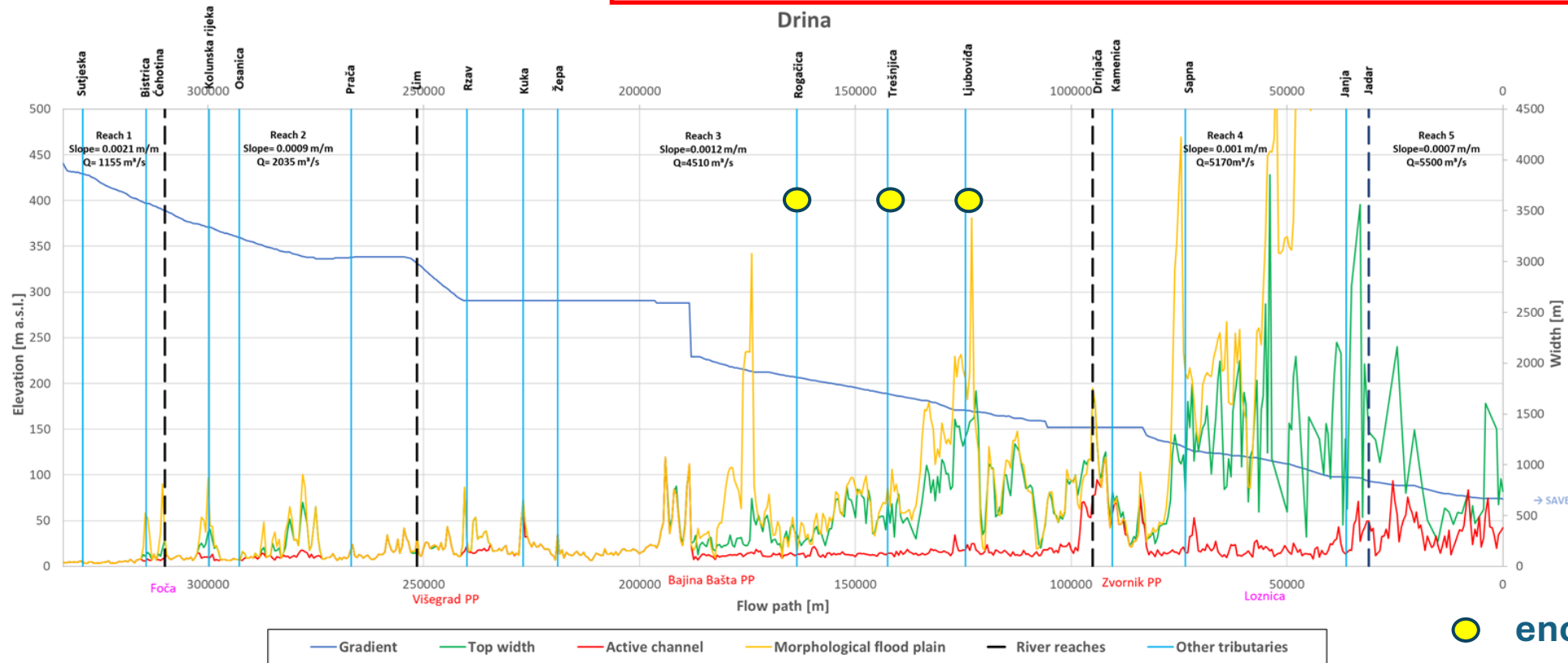
AC = active channel
AF = active floodplain (HQ₅)
MF = morphological floodplain

Schematic longitudinal profiles of the Sava River and its main tributaries (Source: Sava Commission).



Example: Drina river

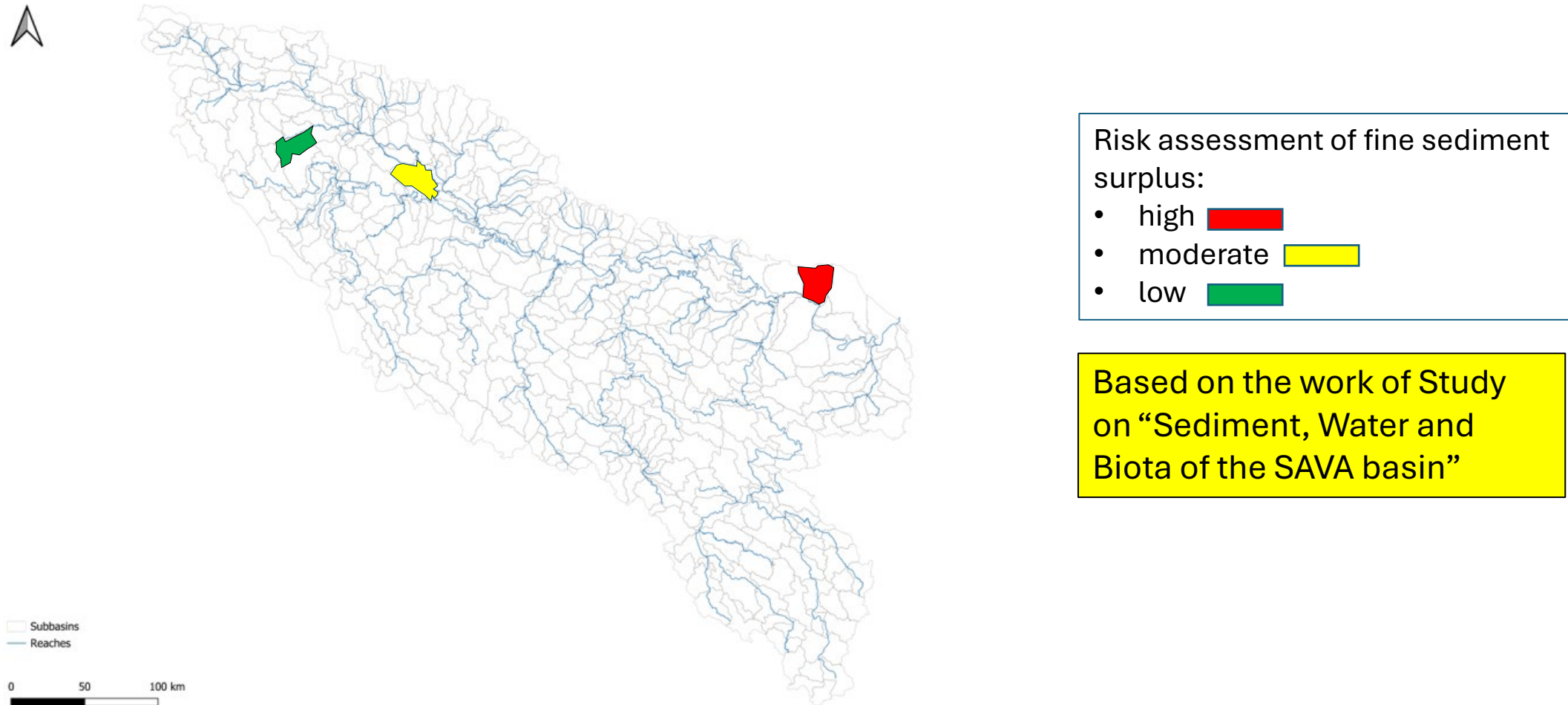
How sensitive?



● enough bed load supply?



Link of the Analysis to the „Sediment, Water & Biota study“

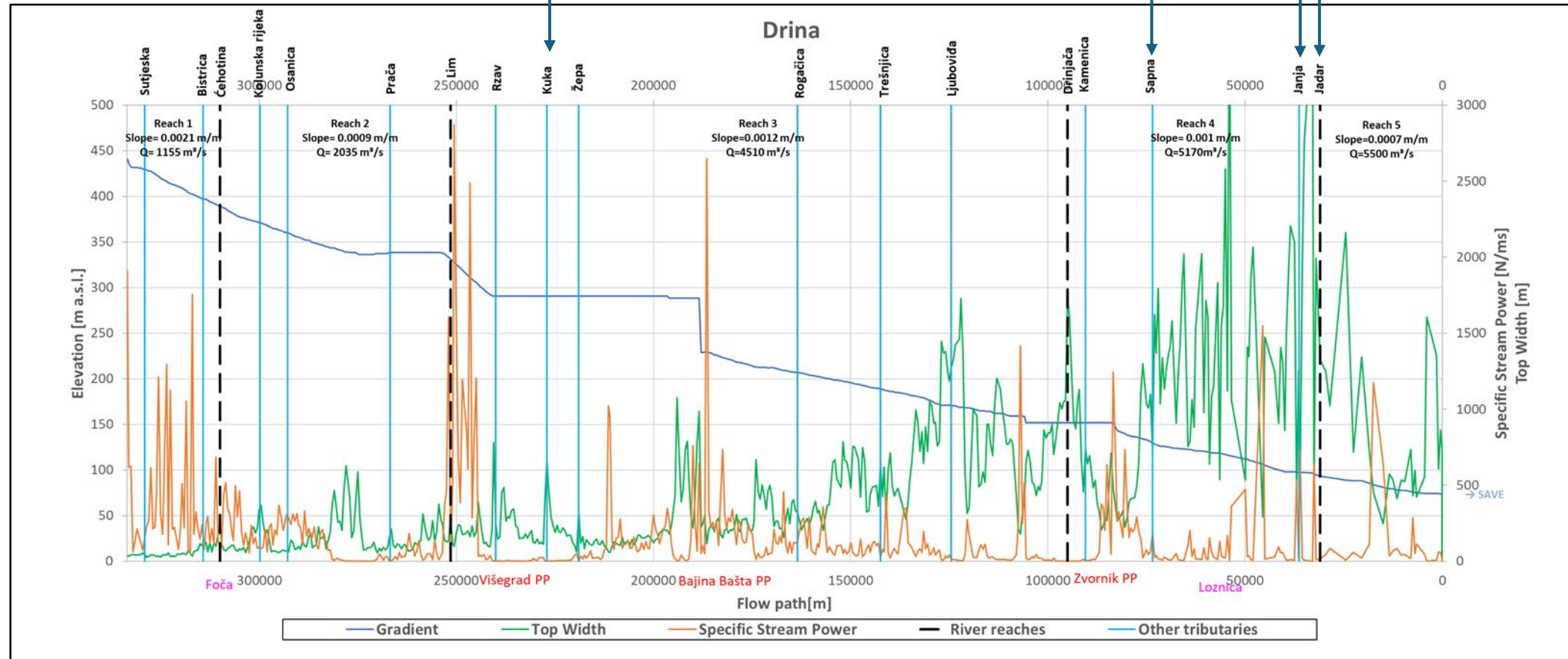


Overview of HEC_RAS models of the Sava River, its main tributaries + **subbasins** (Source: Sava Commission).



Proposed method:

Based on the work of Study
on “Sediment, Water and
Biota of the SAVA basin”



4. Monitoring / Stakeholder engagement



Monitoring strategies / guidelines for sediment sampling







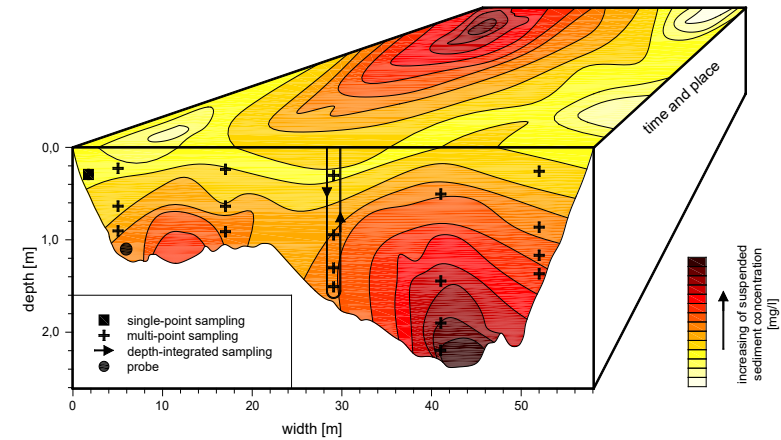

Universität für Bodenkultur Wien

Sediment measurement methods

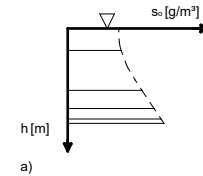
Guidelines for measuring and monitoring sediment transport in rivers and reservoirs

CD-Laboratory for:
Sediment Research and Management

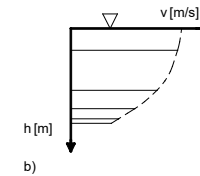
Head of Laboratory:

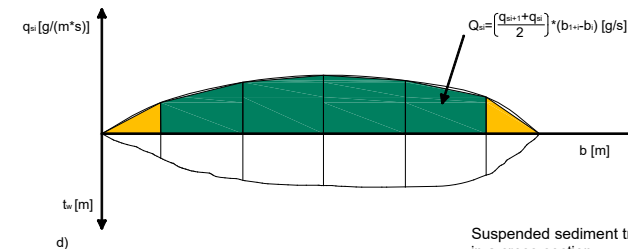
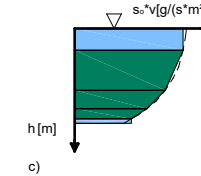
Suspended sediment concentration



Flow velocity



Suspended sediment transport in a vertical i (q_{si} [g/(m²s)])



Suspended sediment transport in a cross-section

$$Q_s = \sum q_{si} [g/s]$$

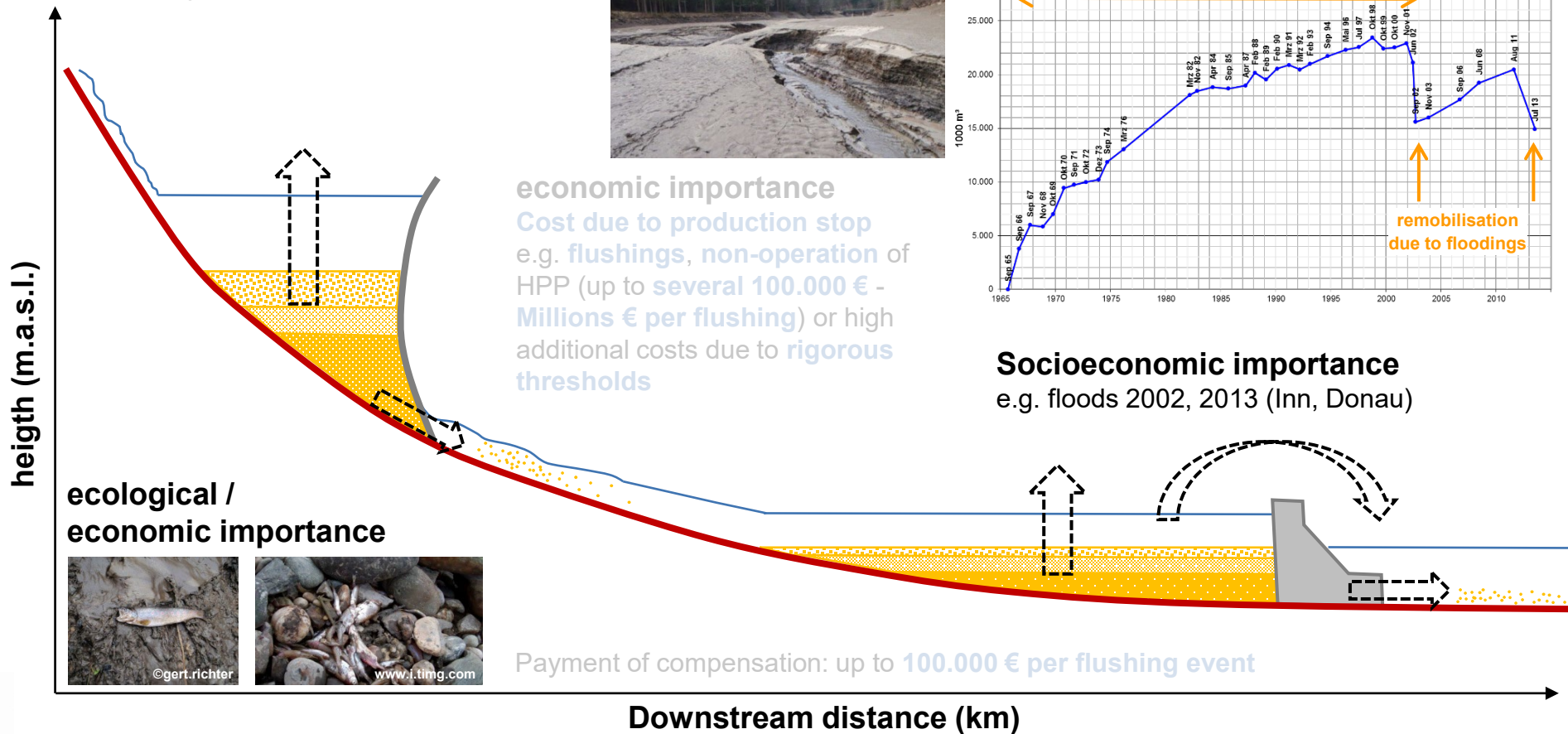
Legend:	rectangle	h	water depth
	trapezoid	s _v	suspended sediment concentration
	triangle	v	flow velocity
		q _{si}	suspended sediment transport in a vertical
		Q _s	suspended sediment transport in a cross-section



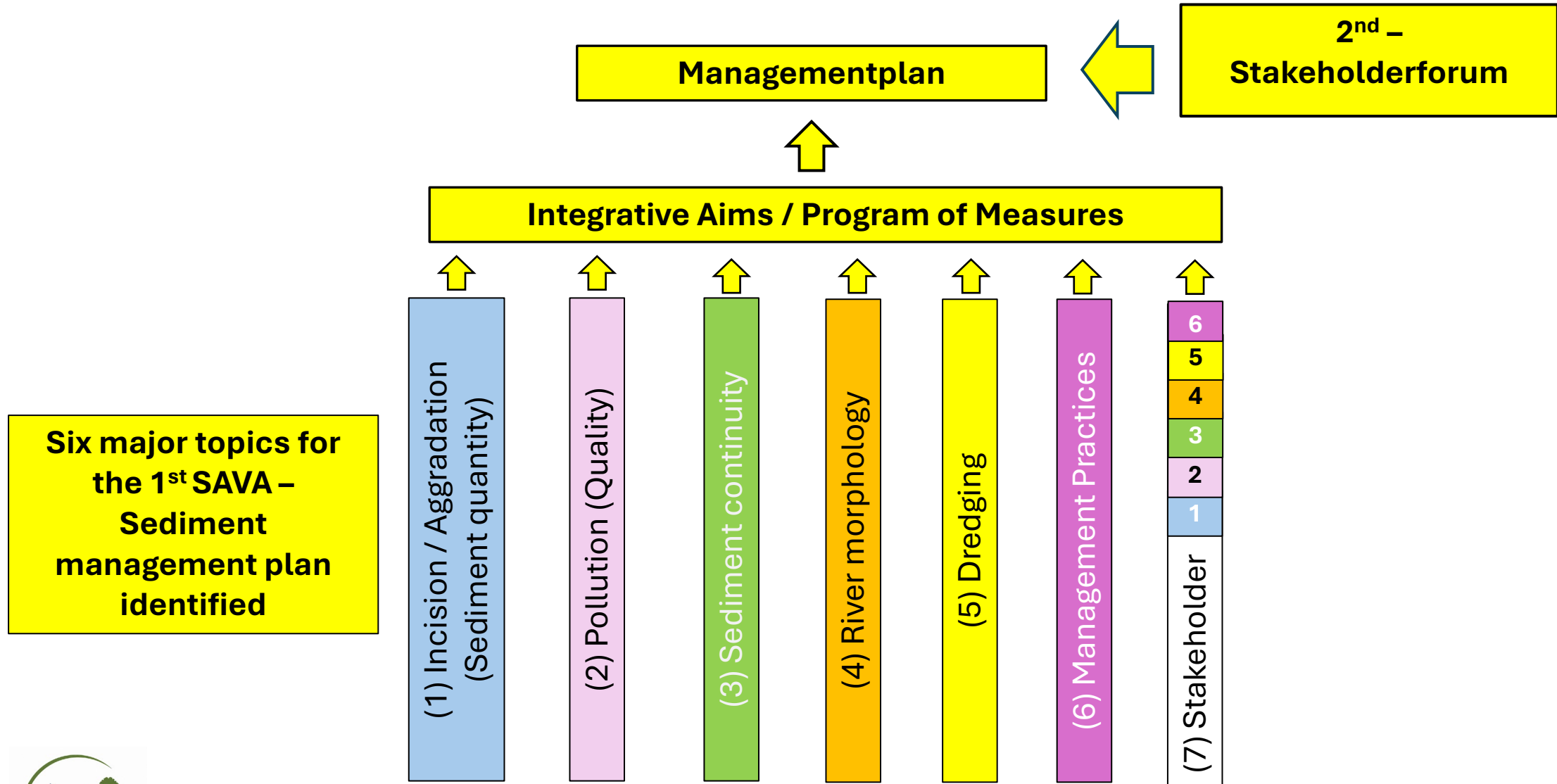
Multi-stakeholder engagement: e.g. Sediment management hydropower

economic importance

➔ At the moment **costs** for **depositing** of dredged material in Austria **10 – 20 € per m³**.



1st Stakeholderforum „Sedimentmanagement Plan“



2. Program of Measures



Sediment & Biota Study

„The SMP shall therefore explicitly account for **interactions** between ***sediment processes*** and ***water uses***, as well as for ***cross-compartmental linkages*** between water, sediment, and biota.“

„The SMP shall be prepared using a ***pragmatic, phased, and evidence-based approach***, considering ***uncertainties***, applying a ***risk-based prioritization*** of measures, and ***support adaptive management***.“



Programs of Measures (Deliverable Month 13th)

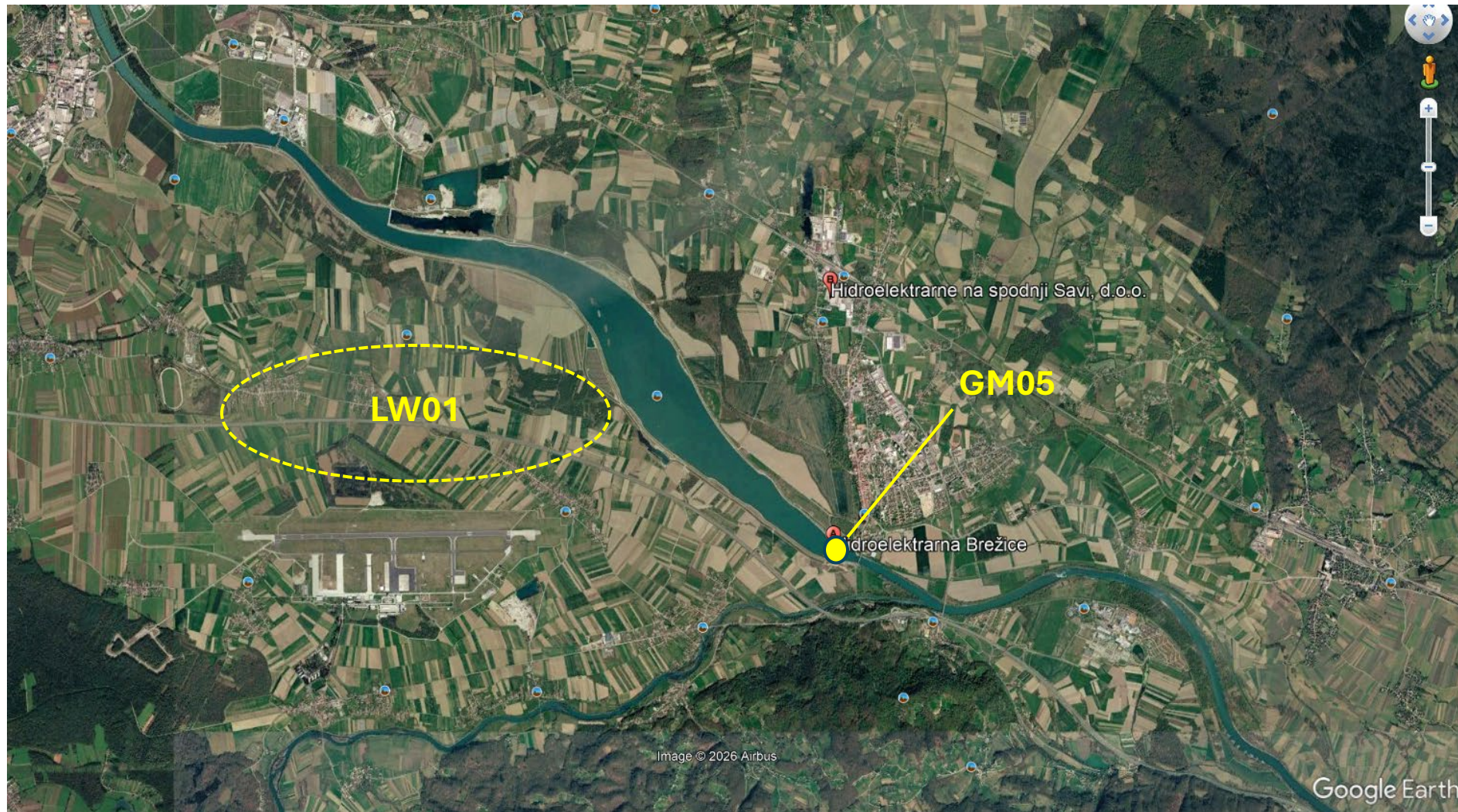
Conservation tillage				Code: LW_01																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Scope		Agriculture, arable farming																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
Main objective(s)		Reduction of erosion by minimizing disturbances to the soil structure																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
Brief Description		Conservation tillage encompasses a variety of measures that farmers can implement in their farming practices to reduce soil loss from cropland. These include direct seeding, mulch seeding, strip seeding, and no-till farming. By minimizing disturbances to the soil structure, the soil's susceptibility to erosion is reduced.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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(Improved) Flushing Management at Dams and Power Plants Code: G									
Scope		Water resource planning							
Main objective(s)		Transport and remobilization of incoming and deposited sediments in the reservoir sediment continuity							
Brief Description		Sediment deposition in reservoirs leads to a reduction in storage capacity and, consequently, to negative impacts on power plant operations. Coarser grain fractions accumulate at the head of the reservoir, and the deposited material is missing in downstream section (Hauer et al., 2020). Efficient flushing management is required to facilitate the transport or remobilization of fine sediments and bedload from a reservoir, always taking into account aquatic ecological and natural landscape requirements. In addition to the aquatic ecological risks posed by excessively high concentrations of suspended solids due to fine sediments, the transport of coarse grain fractions is generally viewed positively from an ecological perspective; however, the mobilization and transport of these fractions is difficult even during flushing usually not possible in reservoirs. The transport of sediment can be optimized through measures that structure the backwater (groynes, guide walls, etc.). Ensuring passability is a major challenge, particularly in power plant chains, because the sediments mobilized in the upstream backwater should not be deposited downstream, with the negative ecological consequences that entails (e.g., silting of the riverbed). A suitable flushing management plan must be developed individually for each power plant or chain of power plants.							

		Impact		G	Minor	M	Medium	H
Impact	Parameter							
	Hydrology	Water retention						
		Groundwater						
	Hydraulics / Hydrodynamics	Water table						
		Flow velocity						
		Bed shear stress						
	Sediment dynamics	Erosion prevention						
		Sediment supply		H				
		Transport capacity						
		Sediment retention						
		Passability		H				
	Morphodynamics	River morphology		M				
	Aquatic ecology	Habitat diversity		M				
Naturalness of Sediment			M					
Implementation	Spatially	☐ Local	☒ Regional		☐ Catchment area			
	Temporal	☐ short-term	☒ medium-term		☐ long-term			
	Effort	☐ relatively simple	☒ moderate		☐ time-consuming			
	Timing/Frequency	One-time + maintenance						



Programs of Measures (Deliverable Month 13th)



A. Agriculture

main objective, starting point					fraction			interventions				location						
reduction of erosion	improving the retention of water and fine sediment in the improved sediment supply / remobilisation of sediment	optimisation of the hydraulic system (preventing further improvement in morphology and dynamics)	withdrawal from the system / reduction of sedimentload	other targets	fine sediment	silting	gravel		subject areas	intervention	code	catchment area	outflow channels	by the water / on the bank	in the water / stretches of flowing water	in the water / dams (power stations / weirs)	other locations	
▪					▪	▪		agriculture, rural planning, nature conservation	arable farming	conservation tillage (direct-, mulch- and strip sowing, ploughless cultivation)	LW_01	▪						
▪					▪	▪				maintaining soil fertility (humus formation, liming)	LW_02	▪						
▪					▪	▪				tracking management / headland management	LW_03	▪						
▪	▪				▪	▪				cultivation of catch crops and maintenance of the mulch layer	LW_04	▪						
▪					▪	▪				undersowing / green cover in permanent crops	LW_05	▪						
▪	▪				▪	▪				special precautions for root crops	LW_06	▪						
▪					▪	▪				adapted crop rotation	LW_07	▪						
▪					▪	▪				stroke division	LW_08	▪	▪					
▪					▪	▪				cross-furrows to block drainage channels	LW_09	▪	▪					
▪	▪				▪	▪				contour farming / contour-parallel cultivation	LW_10	▪	▪					
▪					▪	▪				strip cultivation	LW_11	▪	▪					
▪	▪				▪	▪				terracing	LW_12	▪	▪					
▪	▪				▪	▪			pasture and grassland farming	extensification of wet meadow areas	LW_13	▪	▪	▪				
▪	▪				▪	▪				do not fence off water bodies and wet areas in pastures	LW_14	▪	▪	▪				
▪					▪	▪				avoid open areas in pastures, change feeding spots	LW_15	▪						
▪	▪				▪	▪			rural planning, nature conservation	create drainage barriers, for example by raising farm tracks	LW_16		▪	▪				
▪	▪				▪	▪				prevent runoff from sealed surfaces / neighbouring properties	LW_17	▪	▪					
▪	▪				▪	▪				greened runoff routes	LW_18	▪	▪					
▪	▪				▪	▪				green belts / buffer strips (riparian strips, roadside verges, etc.)	LW_19	▪	▪	▪				
▪	▪			▪	▪	▪				retention, sedimentation and filtration areas for ditches and drainage systems	LW_20	▪	▪	▪				

(1) Aggradation (Sediment quantity)

(2) Pollution (Quality)

(6) Management Practices

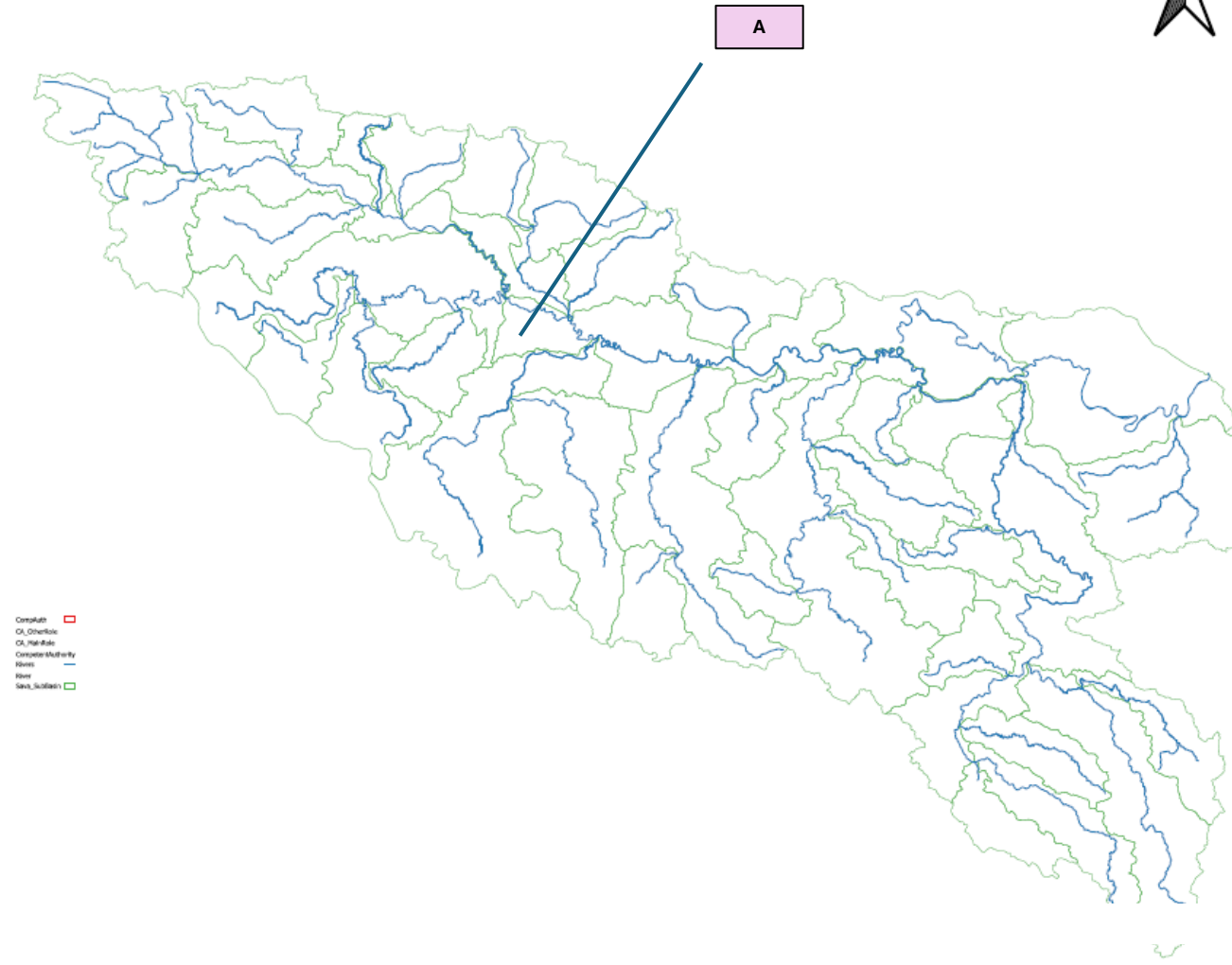
A

A



SAVA-Plan (A0 – Format)

SAVA - Sediment Management Plan



B. Forestry

main objective, starting point						fraction			interventions				location					
reduction of erosion	improving the retention of water and fine sediment in the improved sediment supply / remobilisation of sediment	optimisation of the hydraulic system (preventing further improvement in morphology and dynamics)	withdrawal from the system / reduction of sediment load	other targets		fine sediment	silting	gravel		subject areas	intervention	code	catchment area	outflow channels	by the water / on the bank	in the water / stretches of flowing water	in the water / dams (power stations / weirs)	other locations
▪	▪					▪	▪		forestry	forest management	species and age composition close to natural conditions; increase water retention capacity	FW_01	▪					
▪	▪					▪	▪				natural vegetation along riverbanks, particularly near bodies of water	FW_02	▪	▪	▪			
▪						▪	▪			transport, storage	more appropriate, crop-friendly use of machinery	FW_03	▪	▪				
▪	▪					▪	▪				professional forest road construction, including erosion control measures	FW_04	▪	▪				
▪	▪					▪	▪			ditches	erosion control measures: forest ditches	FW_05	▪	▪				

(1) Aggradation (Sediment quantity)

(2) Pollution (Quality)

(6) Management Practices

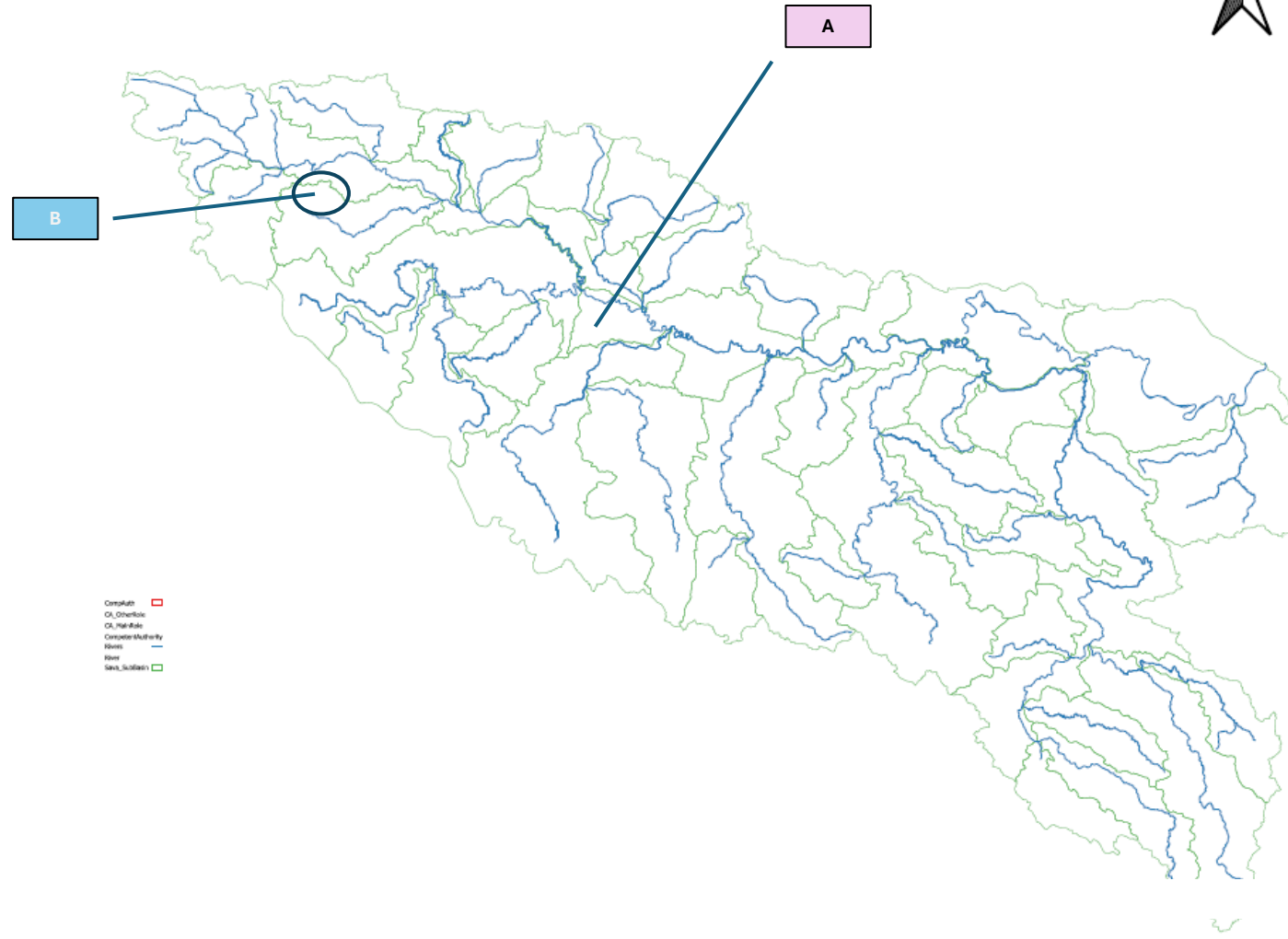
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B



SAVA-Plan (A0 – Format)

SAVA - Sediment Management Plan



C. Catchment management

main objective, starting point								fraction			interventions			location					
reduction of erosion	improving the retention of water and fine sediment in the improved sediment supply / remobilisation of sediment	optimisation of the hydraulic system (preventing further improvement in morphology and dynamics)	withdrawal from the system / reduction of sediment load	other targets				fine sediment	silting	gravel			code	catchment area	outflow channels	by the water / on the bank	in the water / stretches of flowing water	in the water / dams (power stations / weirs)	other locations
▪								▪	▪		traffic infrastructure	landscaping of new road sections	VP_01	▪	▪				
	▪			▪				▪	▪			adapting the road drainage network to include near-natural pre-treatment of road runoff	VP_02		▪				
▪								▪	▪		urban areas, spatial planning	greater consideration of drainage routes in spatial planning	RP_01		▪				
▪	▪			▪				▪	▪			increased infiltration of rainwater, urban rainwater management	RP_02		▪				
	▪			▪				▪	▪		fisheries and aquaculture	careful cleaning of ponds	FT_01		▪	▪			
			▪					▪	▪	▪		microstructures in water bodies	FT_02				▪		
								▪	▪	▪		adapted management / spawning ground maintenance (addition of spawning gravel)	FT_03				▪		
▪	▪	▪				▪		▪	▪	▪	water management	improving sediment monitoring to provide a basis for planning	WW_01	▪	▪	▪	▪	▪	
▪	▪	▪				▪		▪	▪	▪		greater consideration of sediment issues in water management planning	WW_02	▪	▪	▪	▪	▪	

C1

C2

C3

C4



D. (Nature-based) Hydraulic Engineering

main objective, starting point							fraction			interventions			location					
reduction of erosion	improving the retention of water and fine sediment in the	improved sediment supply / remobilisation of sediment	optimisation of the hydraulic system (preventing further improvement in morphology and dynamics)	withdrawal from the system / reduction of sediment load	other targets		fine sediment	silting	gravel	subject areas	intervention	code	catchment area	outflow channels	by the water / on the bank	in the water / stretches of flowing water	dams (power stations / weirs)	other locations
▪	▪						▪	▪		 (nature-based) hydraulic engineering,	inflows	outlet conditions: ditches, drainage channels, newly created, semi-natural filtration and sedimentation areas	GÖ_01			▪		
▪	▪		▪	▪			▪	▪	▪		design and maintenance of ditches and small tributaries	GÖ_02		▪		▪		
	▪		▪	▪			▪	▪	▪		installation / connection of a branch line, extension, etc.	GÖ_03				▪		
		▪	▪	▪			▪	▪	▪		removal / relocation of paths and embankments	GÖ_04				▪		
		▪	▪	▪			▪	▪	▪		bank removal / partial bank removal	GÖ_05			▪	▪		
▪		▪	▪	▪			▪	▪	▪		raising the riverbed (e.g. using deadwood) to encourage faster silting and thus facilitate sedimentation	GÖ_06			▪	▪		
▪		▪		▪			▪	▪			create a sedimentation area; lower the banks / remove sediment in the area of the – restoration of well-connected floodplains	GÖ_07			▪	▪	▪	
	▪		▪	▪			▪	▪	▪		improvements to the aquatic environment in the main watercourse	introduce structural elements to increase dynamism (preferably deadwood, but also structural stones, etc.) to create heterogeneous flow and sediment patterns	GÖ_08				▪	▪
▪	▪	▪	▪				▪	▪	▪		major river restoration projects, including widening measures to reduce drag (particularly during high flow) and the integration of the surrounding area	GÖ_09			▪	▪		

D



E. Technical solutions

main objective, starting point								fraction			interventions			location					
reduction of erosion	improving the retention of water and fine sediment in the water and fine sediment supply / remobilisation of sediment	optimisation of the hydraulic system (preventing further improvement in morphology and dynamics withdrawal from the system / reduction of sediment load	other targets					fine sediment	silting	gravel	subject areas	intervention	code	catchment area	outflow channels	by the water / on the bank	in the water / stretches of flowing water	in the water / dams (power stations / weirs)	other locations
											technical solutions	removal of unnecessary cross structures and sediment barriers	GM_01						
												lowering weirs	GM_02						
												conversion of bed-load barriers into bed-load control barriers	GM_03						
												storage space reorganisation	GM_04						
												(improved) flushing management at weirs and power stations	GM_05						
												bed-load bypasses	GM_06						
												technical modifications to power stations (installation of bottom outlets or special weir gates, etc.)	GM_07						
												innovative types of power station that have less of an impact on sediment passage	GM_08						
												remobilisation of compacted gravel banks, breaking up the surface layer	GM_09						
												removal of sediment (from sediment traps, retention basins, flood-prone areas, etc.)	GM_10						
												removal of sediment from navigation channels and optimised replenishment	GM_11						
												relocation of coarse surface material to areas prone to subsidence (granulometric sub-base improvement)	GM_12						
												sediment supply (transport of coarse-grained material from gravel pits)	GM_13						
												continuous removal of coarse bed load, sand and fine material	GM_14						
												bank and riverbed stabilisation	WB_01						
												structural features (e.g. special types of groynes) or the construction of a low-	WB_02						

E



F. Further points of consideration

main objective, starting point								fraction			interventions			location					
reduction of erosion	improving the retention of water and fine sediment in the	improved sediment supply / remobilisation of sediment	optimisation of the hydraulic system (preventing further improvement in morphology and dynamics	withdrawal from the system / reduction of sedimentload	other targets			fine sediment	silting	gravel			code	catchment area	outflow channels	by the water / on the bank	in the water / stretches of flowing water	in the water / dams (power stations / weirs)	other locations
					▪			▪	▪	▪	further points of consideration	further training, public relations (general public, schools, etc.)	WA_01						▪
					▪			▪	▪	▪		private law	WA_02						▪
					▪			▪	▪	▪		climate protection	WA_03						▪

F

