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SEDIMENT QUALITY SAMPLING PROTOCOL FOR HAZARDOUS SUBSTANCES IN SURFACE WATERS

**PART OF THE SEDIMENT-QUALITY INFORMATION,
MONITORING AND ASSESSMENT SYSTEM (SIMONA)**

**THE MAIN AIM IS TO SUPPORT TRANSNATIONAL
COOPERATION FOR JOINT DANUBE BASIN WATER
MANAGEMENT**

31/10/2019

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Appendix 1

Recommendations of the SIMONA project: Monitoring active floodplain sediment

Appendix 2

List of Priority Substances and Danube River Basin Specific Pollutants

Appendix 3

Field observation sheet for sediment sampling

**The appendixes are downloadable
from the SIMONA website:
<http://www.interreg-danube.eu/simona/>**



1. INTRODUCTION

Fluvial systems can be strongly influenced by human activity, acting as and/or the carrier of pollutants, becoming a source of pollution if environmental conditions change. The transport of potentially toxic elements (PTEs) and persistent organic pollutants (POPs) depends on topography, the oxic-anoxic conditions and kinetics of the sorption/desorption processes. Moreover, pH, salinity, and the presence of organic matter, clay minerals, sulphates, and carbonates also affect metal mobility in the sediments (bottom and stream sediments, suspended matter sediment, floodplain sediment). Sediments provide detailed information on the historical record of pollution in a watershed, and if the PTEs and POPs are attached to stored alluvium, it can turn them from being a sink to a source of pollutants for the sediment interface, bioturbation and resuspension during dredging or flooding (Audry et al., 2004).

Nevertheless, all **river channel sediments are a sink as well as a source of hazardous substances (HSs) in an aquatic environment**. The HSs in sediments may represent a risk to the environment and consequently, they should be monitored. Monitoring of HSs includes sampling, chemical analyses and producing risk assessments of the sediments. The aim of this protocol is to provide a proposal for the sampling strategy of the sediments in accordance with the 2000/60/EC Water Framework Directive (WFD). It includes general consideration about the different types of sediments deposited in the river system and lakes, list of HSs for monitoring in sediment, then selection of the sediment sampling stations, sediment collection, sampling equipment and transport of samples. The most risky – for waters and related ecological system – HSs are identify as Priority Substances (PSs) or Priority Hazardous

Substances (PHSs) by WFD Annex X. More four substances are identified as Danube River Basin Specific Pollutants (RBSPs) based on their relevancy in the Danube basin, such as high percentage of usage. SIMONA is focusing on these PSs, PHSs and RBSPs, for easy communication these cite as hazardous substances in the protocol. See the full list of hazardous substances in **Appendix 2**. HSs are listed according to the requirements of the Directive 2013/39/EU on environmental quality standards (EQS) in the field of water policy which amend Directives 2000/60/EC and 2008/105/EC.

Over the years, monitoring has been carried out on the concentration of pollutants dissolved in water and only a small degree has concerned hazardous substances (HSs) in sediments. The environmental significance of quality management of the sediments in water quality management was only recognised recently. Chemical and physical analysis of the sediments could serve as a tool for the monitoring of contaminant releases to a river or lake system. Furthermore, sediments are used to locate historical and/or current sources of pollution.

The Water Framework Directive, the EQS Directives (2013/39/EU and 2008/105/EC) and CIS Guidance Documents 7, 19, 25 and 27 (EC, 2003, 2007, 2010, 2018) recognised the general term “*sediments*”. This term was used to describe any kind of sediments carried by water or deposited in the river bed. Generally, three types of sediment: stream/bottom, floodplain and suspended sediment, are distinguished in the river systems and lakes in various scientific studies. These types of sediments are deposited in different parts of the river, and they are genetically, physically and chemically distinctive. The appropriate monitoring of the HSs in sediment should take into account all these sediment types, not just the stream/bottom and suspended sediments, to comprehensively investigate sediment-associated contaminants in the Danube river basin. As the WFD requirements do not include floodplain sediment, we recommend sampling this sediment type as an additional option (**Appendix 1**).

2. DEFINITION AND TYPES OF SEDIMENTS FOR MONITORING

The deposition of drainage sediment in a river environment takes place at the river bed (bottom sediments), river sides (stream sediments/bottom), on the river bank (floodplain sediment) with additional particulate matter carried in the water (suspended sediment or suspended solids).

There is series 5667 of the ISO standards prescribed for water sampling, but only two of these are focused on standard procedures for the collection of sediments:

- ◆ ISO 5667-12:2017 Water quality – Sampling – Part 12: Guidance on sampling of bottom sediments from rivers, lakes and estuarine areas. International Organization for Standardization.
- ◆ ISO 5667-17:2008 Water quality – Sampling – Part 17: Guidance on the sampling of bulk suspended solids (reviewed and confirmed in 2017). International Organization for Standardization.

The ISO standards prescribe the methodology for the collection of bottom sediments as well as suspended sediments for the determination of sediment quality.

ISO 6107-2:2006 standard defines **bottom sediment** as “*solid material deposited by settling from suspension onto the bottom of bodies of water, both moving and static*”. Bottom sediments consist of suspended material that has been transported by water and deposited on the river bed. These sediments comprise particulate matter of terrestrial origin and substances precipitated as a result of chemical and biological processes. In addition to the geogenic origin of the particles, anthropogenic input through atmospheric deposition is also present, as well as runoff from the land or direct discharge into the water is signifi-

cant. Organic contaminants, metals, nutrients, sludge, industrial waste and other man-made material deposited in water become associated with particulates. These particulates then settle out and accumulate in the bottom sediments.

Stream and bottom sediments are considered as synonyms in this protocol. Scientists usually use the term *bottom sediment* for sediment settled out in larger rivers or lakes and the term *stream sediments* in small rivers for fine material deposited at the side of the river bed. Stream sediments, as well as bottom sediments, are deposited as the fine fraction of bed load material (silt, clay, sand). According to the Geochemical Atlas of Europe–FOREGS, stream sediment represents the small drainage basins (< 100 km²). These sediments should be collected upstream from the confluence with the main channel of the large drainage basin (Salminen et al., 2005). Stream sediment is susceptible to anthropogenic contamination and represents the condition (geochemical composition) of the upstream drainage basin.

According to ISO 5667-17:2008 **suspended solids** are “solids with a diameter greater than 0,45µm that are suspended in water” and bulk suspended solids are “solids that can be removed from water by filtration, settling or centrifuging under specified conditions”.

The fine-grained fraction (silt and clay) is transported by rivers in suspension, where saturation is mostly dependent on the rock and soil erosion compliance and water velocity. The saturation of suspended sediments varies with changes in current velocity. Upstream areas are typically regions which are characterized by high high-velocity flows of water and consequently high erosion. Thus, the composition of river suspended sediment depends mostly on lithology. Downstream in lowland-rivers with slower flow rates, the composition of suspended sediment is, generally, less influenced by the parent material and more by anthropogenic input.

The suitability of the different types of sediments for monitoring is a topic for discussion. The Fraunhofer Institute (2002) implied that suspended sediment is better for monitoring than bottom sediment since it shows recent contamination and the bottom sediment records past pollution levels.

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In contrast, Horowitz (1991) suggested that suspended sediments are more physically and chemically variable in comparison to bottom sediment, and the quantity of the suspended sediment collected is not always sufficient for the required analysis and consequently, bottom sediments are more suitable for monitoring.

Thus, bottom sediments seem the more appropriate media when it comes to the needs for long-term monitoring of sediments. Several reasons could be pointed out:

- 1) bottom sediments are less chemically and physically variable compared to suspensions, as a result, analyses of bottom sediments would give better perspective of the long-term changes in pollution;
- 2) bottom sediments analyses, when suitable sampling equipment is used, could give time-related changes in the quality of the water body;
- 3) sampling of suspended sediments in amounts and manner suitable for analyses is a laborious task, demanding specific equipment and time, which complicates periodical monitoring, and makes it highly impractical;
- 4) the amount of suspended sediments in small rivers is practically negligible, and the quality of the river sediments in such situations could be very well covered by monitoring stream sediments, i.e. recommendations for suspended sediments monitoring/sampling should be restricted to the lower parts of large rivers.

In summary, both sediment types meet the monitoring requirements of the WFD for the determination of sediment quality. Bottom sediments characterise what is entering a water body from upstream and the suspended sediments describe the transport of contaminants downstream to the next water body.

As a final remark, during the SIMONA project, both bottom and suspended (where possible) sediments will be sampled and analyzed. After the testing of the protocols and after having results from the laboratory analyses further comments regarding the need for monitoring of suspended sediments could be given.

2.1. BACKGROUND AND BASELINE VALUES

Differentiating between the geogenic and anthropogenic contribution to a total concentration of PTEs and POPs in stream sediments and/or soils is fundamental in the quantitative assessment of pollution threats to the ecosystem and human health (Albanese et al., 2007). Different terms and definitions applied to thresholds sometimes create ambiguity and inconsistency. Reimann and Garrett (2005) discuss the terms ‘geochemical background’, ‘threshold’ and ‘baseline’ and their numerous definitions in the literature. In Hawkes and Webb (1962) ‘background’ was defined as the natural concentration of an element in barren earth material. Many studies define **background as the natural concentration of an element from parent material and natural processes combined with contributions from diffuse anthropogenic sources**. Only Fabian et al. (2017) have discovered a new method for detecting and quantifying diffuse contamination at the continental to regional scale based on the analysis of cumulative distribution functions.

In the geochemical literature, the term ‘baseline’ mostly defines the natural concentration of an element in stream or bottom sediments and soils with no human influence. The calculation of geochemical baselines is necessary to assess the current state of the environment and to provide guidelines and quality standards in environmental legislation and policy-making, and in environmental risk assessment. Thresholds are utilised to identify breaks in the data population, but they can also be defined as the upper limit of background variation (Reimann et al., 2005, 2018).

More recently, as the regional variability of the natural geochemical background has become better known, it has been recognized that to identify and quantify anthropogenic pollution it is necessary to have a map of the geological and/or geochemical background.

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One of the problems in determining the extent and source of pollution in river channel sediments, by means of trace element and organic compound concentrations, is estimating the natural background concentrations in the sediments, excluding anthropogenic influences. In general, overestimation of the anthropogenic contribution of a particular trace element in the sediments is possible if the petrography and the origin of the sediments are not taken into account.

The value of the geochemical background is necessary to assess the current state of pollution in the sediments. Baseline value refers to the concentration of the HSs in a drainage basin and concentrations of the HSs in an unpolluted basin should be at or close to a background.

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3. SELECTION OF COMPOUNDS TO BE MONITORED IN SEDIMENTS

Not all substances should be monitored in sediments. The criteria for the selection of the HSs to be monitored from the EQS Directive (2013/39/EU) for sediment and biota is their **insolubility in water, tendency to accumulate in sediments or association with pore water**. Some chemical species become bonded (absorbed or adsorbed) in preference to small mineral particles and organic matter while some are incorporated in residual pore water (ISO 5667-12:2017).

The Guidance Document No. 27 (Updated version 2018) prescribes: “The criteria for triggering an assessment are consistent with those under REACH Regulation (EC) No 1907/2006 (ECHA, 2008, Chapter R.7b). In general, substances with an organic carbon adsorption coefficient (K_{oc}) of $<500-1000 \text{ l}\cdot\text{kg}^{-1}$ are not likely to be sorbed to sediment. Consequently, a $\log K_{oc}$ or **$\log K_{ow}$ of ≥ 3** is used as a trigger value for sediment effects assessment. Some substances can occur in sediments even though they do not meet these criteria so, in addition, evidence of high toxicity to aquatic organisms or sediment-dwelling organisms or evidence of accumulation in sediments from monitoring, would also trigger derivation of a sediment EQS”.

Member States should arrange **monitoring of the PHSs** listed in Part A of Annex I that tend to accumulate in sediment and/or biota, giving particular consideration to the substances numbered in the Directive 2013/39/EU. Additionally, 5 heavy metals and their compounds were added to this protocol from the List of Priority Substances for the Danube River Basin (ICPDR, 2003). All HSs suggested for monitoring in this protocol are specified in **Appendix 2**.

Following Article 4 of Directive 2000/60/EC Member States shall take the necessary steps to ensure that such concentrations do not significantly increase in sediment and/or relevant biota.

4. SELECTION OF SEDIMENT SAMPLING STATIONS

The standards ISO 5667-12:2017 and ISO 5667-17:2008 prescribed the selection of sampling stations for bottom sediments and suspended sediments, respectively.

Depending on the objectives to be achieved the **ISO 5667-12:2017** Water quality – Sampling – Part 12: Guidance on sampling of **bottom sediments** from rivers, lakes and estuarine areas for choice of sampling stations prescribes the selection of the sampling site and then the identification of the precise point at the sampling site. The same procedures could be applied to the stream and floodplain sediments.

Site selection for bottom sediments sampling should consider the following criteria (ISO 5667-12:2017):

- ◆ Meteorological and climatic (e.g. temperature, precipitation, solar radiation);
- ◆ Hydrological (e.g. discharge, water depth, current, velocity);
- ◆ Geological (e.g. characteristics/composition/stratification of sediments, erosion);
- ◆ Biological (e.g. with reference to macrophyte accumulation).

Meteorological and climatic conditions including low temperature, wind direction, storms, heavy precipitation could cause phenomena including large waves, turbidity and flow rate, frozen water and therefore influence the sampling location. These conditions could impact the function of sampling instruments and determine safety factors at the location. In consideration of the

hydrological situation sampling should be carried out during low water levels with low flow rates. The geological background/baseline is very important and the use of either prior knowledge or the results from carrying out a preliminary investigation with geological maps is beneficial. To take account of the biological conditions sampling should be carried out in the habitat layer, **usually in the top 10 cm of the sediment layer.**

Guidance for the **selection of suspended sediment sampling locations** is given in ISO **5667-17:2008** Water quality – Sampling – Part 17: Guidance on sampling of bulk suspended solids:

- ◆ Sampling points should be representative for an extended section of the river;
- ◆ Sampling sites should consider the existing network of water-monitoring sites so that related results could be used;
- ◆ Locations for sampling should be placed taking into account the sources of pollution;
- ◆ The sampling site has to have proper access to the water, a satisfactory site for the portable centrifuge, protection of the sampling equipment from vandals;
- ◆ The knowledge of the tributary loadings;
- ◆ Collection of suspended sediment samples as far downstream as possible, but above any confluence;
- ◆ There should be preliminary investigations at potential monitoring sites to determine the representativeness of the sampling location;
- ◆ Suitable sampling points are often near bridges or gauging stations.

Recommendations for the selection of sediment sampling stations for the monitoring of sediment are given in the Common Implementation Strategy for the Water Framework Directive (2000/60/EC), **Guidance document No. 25** on the chemical monitoring of sediment and biota under the Water Framework Directive (EC, 2010). The sampling site should fulfil the following conditions:

- ◆ Sediment sampling should be performed at sites representative of the water body;
- ◆ There is no need for the even distribution of sampling sites in a water body;

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- ◆ Knowledge of hydrological and geo-morphological characteristics is required;
- ◆ Knowledge of the pollution sources from present or past industries is desirable;
- ◆ Acquaintance of earlier studies and current monitoring programmes is needed;
- ◆ A dedicated preliminary survey should have been conducted;
- ◆ Understanding the hydrogeological conditions including recognition that tributaries often transport different material because they have different geological backgrounds;
- ◆ The sampling site should be located downstream of the discharges or the tributary confluence, at a point where complete mixing has been established;
- ◆ The sampling sites should not be placed in the mixing zones;
- ◆ Sediment homogeneity is determined.

The sediments are more heterogeneous than the waters. Expected variance estimates could, perhaps, be extracted from similar ongoing monitoring programmes or, more reliably, be assessed from a **pilot project** using the same sampling strategy, sampling matrices etc., as the currently planned monitoring programme. The pilot project should test the homogeneity of a sampling area by setting one or more transects (according to the areal extent), where five sampling points for each transect are selected. At each sampling point five or more independent surface sediment samples are collected. Pooling of these individual samples into one composite sample is not recommended in the pilot phase.

The homogeneity check should be performed for the between-sample (between sampling points in transect) and the within-sample (within sampling points) variance, using an Anova/F-test. The whole transect should be considered as a single sampling site if the within-sample variance is of the same order as, or even exceeds, the between-sample variance. The homogeneity checked areas will serve for the identification of the sampling sites and the number of field replicates.

The selection of the sampling site for the monitoring of chemical contamination in suspended sediments in rivers and transitional waters (estuaries)

should be in areas where the water flow is lower (in concave stretches of the river, in accumulation areas within estuaries), in natural estuaries and upstream of the tidal limit and in lakes and reservoirs away from the river inlets.

The **Trans National Monitoring Network (TNMN)** in the Danube River Basin aims to contribute to the implementation of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River (DRPC). Enforcement of the EU Water Framework Directive (2000/60/EC) in the TNMN was completed in 2007. The revised TNMN for surface waters consists of the following elements: (1) Surveillance monitoring I (Monitoring of surface water status), (2) Surveillance monitoring II (Monitoring of specific pressures), (3) Operational monitoring and (4) Investigative monitoring.

Surveillance monitoring I and the operational monitoring both require observation of the status of surface water and groundwater bodies once every six years. Surveillance monitoring II is joint long-term monitoring of selected quality elements of all ICPDR Contracting Parties in order to control concentrations and loads of selected parameters in the Danube and major tributaries once per year.

The Surveillance Monitoring II network is based on the national monitoring networks and the activities are harmonized between all partners to achieve maximum efficiency. Investigative monitoring is carried out if necessary and primarily it is a national task (ICPDR, 2018). 153 sites at 112 TNMN stations were monitored in the Danube River Basin in 2016 (some monitoring stations contain two or three sampling sites - left, middle and/or right side of the river). The data was collected from 74 sampling sites at 40 stations on the Danube River and from 79 sampling sites at 70 stations on the tributaries.

Selection of TNMN monitoring sites fulfilled the following criteria (ICPDR, 2018):

- ◆ Use of pre-existing monitoring sites which are also suitable for long-term trend analysis:
 - ◆ Placed just upstream/downstream of an international border;
 - ◆ Located upstream of confluences between the Danube and main tributaries or main tributaries and larger sub-tributaries;
 - ◆ Positioned downstream of the major point sources and

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- ◆ Posted to control important water uses.
- ◆ Sites relevant for assessing pollutant loads which are transferred across boundaries of the Contracting Parties and are transported into the marine environment.

Selection of sediment sampling stations in the SIMONA project should fulfil as much as possible the criteria prescribed in the standards ISO 5667-12:2017 and ISO 5667-17:2008, recommendations in the Guidance document No. 25 and the accumulated knowledge and experience of the Trans National Monitoring Network (TNMN) in the Danube River Basin.

5. SEDIMENT COLLECTION

The sediment collection, as an important part of the sampling strategy, is defined by the types of samples, sampling depth, sampling frequency, sediment fraction to be analysed and the sample volume. Sampling procedures should agree as much as possible with the requirements of the Water Framework Directive and be in accordance with the relevant ISO norms.

5.1. COMPOSITE SAMPLES

Subsampling composite samples is recommended in order to get representation of larger areas and to reduce analysis costs. According to the ISO 5667-12:2017 composite samples represent the average regional distribution of the concentrations of chemical substances in the sediment and are defined as *“two or more samples or subsamples mixed together in appropriate known proportions, from which the average result of a designed characteristic may be obtained (Note 1 to entry: The individual portions may be derived from the same unit (stratum) or at the same sediment depth below a certain interface. The use of subsamples from the same stratum is limited to situations where a natural mixing of strata is unlikely to have occurred or where the depth of the sediment stratum is sufficient to allow subsampling without artificial mixing during sample operations. Therefore, subsampling from different strata is allowed in relation to the objective of the investigation.)”*

Sampling composite samples of **bottom sediment** is prescribed in the standard ISO 5667-12:2017. The composite samples should be prepared from equal volumes of homogenised single samples. The subsamples should be taken from the same geological unit. The penetration depth by grab system sampling is variable and therefore not suitable for producing a composite sample in the monitoring procedure. **The core system is more suitable for sampling at a consistent depth.**

The composite samples should be prepared at a separate location to avoid the risk of contamination. It is advisable to take samples at locations without foreign matter (e.g. pieces of wood, scrap metal, plastic parts) or if it impossible then these items should be rejected. Samples for the different analyses should be divided on-site into suitable containers. Preparation of composite samples should be undertaken wearing nitrile gloves.

The handling of **stream sediment** samples (in the context of the small river and catchment area) should be in accordance with the ISO 5667-12:2017 norms applicable to the sampling bottom sediment. According to the FOREGS, it is recommended that 5-10 subsamples of the stream sediment over a river length of 250 – 500m are taken (Salminen et al., 2005).

Recommendations for the SIMONA project: composite samples of stream/bottom sediment should consist of 5-10 subsamples taken from a 250-500m river segment.

5.2. SAMPLING DEPTH

The main aim of the WFD is the protection of ecosystems, in accordance with the CIS Guidance Document No. 25. The top layers of sediments are the habitat of benthic organisms and sources of food. They result from the deposition of particulate matter and biological mixing (bioturbation). Therefore, the sampling depth appropriate for monitoring river sediments is the top layer with the recently deposited material and therefore current pollution status.

The thickness of the top layer is variable; it is usually restricted in most areas to the top 5–10 cm and depends of the deposition rate at the sampling site.

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The sampling depth for the **stream/bottom** sediment depends on the deposition rate: for steady sedimentation and undisturbed sediments (lakes) suitable depths are from 0.5 to 1 cm depth range, in environments where sedimentation rates are variable it is recommended to sample the top 1 to 5cm layer of the sediment and in highly perturbed sediment or in large fast flowing rivers, to sample depths greater than 5 cm. **In the CIS Guidance Document No. 25 is suggested: “The sampling depth should be defined for each sampling site.”**

5.3. SAMPLING FREQUENCY

Sediment sampling frequency should be as frequent as possible in agreement with the requirements of the Water Framework Directive. In compliance with the prescribed rules of the **ISO 5667-12:2017** and **ISO 5667-17:2008** the frequency of systematic sediment sampling should take into account seasonal variation, flow extremes including flooding (avoid sampling during or shortly after flooding), bed transport, intrusion or washout of inorganic and organic fine material. The changes in sediment are slower than those observed for water and therefore detecting changes requires a longer sampling period. The sampling frequency could be increased in order to detect any variation in sediment.

Directive 2013/39/EU regulates that monitoring “should be adapted to the spatial and temporal scale of the expected variation in concentrations”. Article 4 in this directive prescribes the spatial monitoring pattern for substances for which an EQS for sediment and/or biota is applied so that Member States should monitor at least once a year. The sediment is a suitable matrix for temporal monitoring and the directive gives a proposal of an interval of three years for a long-trend monitoring programme. Both intervals could be changed if technical knowledge and expert judgement validate a better alternative interval. According the WFD, the reporting cycle is six years for temporal trend monitoring, but for the first WFD cycle monitoring is recommended to sample annually to provide reliable statistical certainty and then to reduce the frequency.

The recommendation for **the frequency of monitoring stream/bottom and suspended sediment in the SIMONA** project is in agreement with the con-

clusions of the above WFD and EQS directives, ISO 5667-12:2017 and ISO 5667-17:2008 standards and Surveillance monitoring II in TNMN is **once per year and every three years for trend monitoring.**

5.4. SAMPLE FRACTION FOR ANALYSIS

Particle size is one of the most important sedimentary properties and the usual trends reported in the literature present increasing metal concentrations with decreasing particle size. The clay and silt fraction (<63 μm) adsorbs and retains higher concentrations of heavy metals compared to the coarser sediment fractions and dissolved concentration retained in the overlying water. However, high concentrations of heavy metals have also been reported in sand fractions (>63 μm) (Lin et al., 2003). According to Horowitz (1991) the sediment fraction >63 μm should not be ignored in terms of its contribution to the amount of heavy metal concentrations in the sample even though the concentration of trace elements in the fraction <63 μm is significantly higher.

High concentrations of trace elements associated with coarse sediment fractions could have various origins: the agglomeration of smaller particles to form coarser clusters, binding of the fine fractions to the surface of larger particles, the presence of large grains from pre-existing rocks, coarser forms created by binding high organic matter content and Fe/Mn content. Consequently sediment monitoring using the <63 μm particles could omit significant metal contributions from the 63 μm – 2 mm size fraction.

A reasonable solution might be to carry out a **pre-sampling program** to study the physical characteristics of the sediment in a particular river in terms of particle size to determine the best sediment fraction to sample. In rivers where the collection of the <63 μm fraction is difficult because of gravel beds, the <2 mm fraction could be sampled and this fraction used for sediment analysis.

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The coarser fraction of sediment is also important to the biota. Although the <63 µm particle size fraction is where a major food source for benthic organisms occurs, the larger fraction is important as a habitat for sediment dwelling organisms which are still exposed to contaminants.

Guidance Document No. 19 – Guidance on surface water chemical monitoring under the Water Framework Directive suggests the <63 µm fraction should be analysed for metals and the 2 mm fraction of the sediment should be analysed for organic contaminants.

Guidance Document No. 25 states; „*grain size is one of the most important factors controlling the distribution of natural and anthropogenic components in sediments, along with organic matter content*”. Therefore, it is recommended for the <63 µm fraction (the clay-silt fraction, widespread in monitoring).

Considering the different viewpoints and recommendations of the CIS Guidance No. 19 and 25, **the fraction <63 µm** is an acceptable compromise for monitoring programmes and is the **recommendation of the SIMONA project**.

5.5. SAMPLE VOLUME

The collected sample volume should be sufficient to be preserved for all analyses, for quality control analyses and to prepare time-dependent composites (for example, daily samples of sewage sludge could be used to produce a composite for monthly analysis; ISO 5667-15:2009). Additionally sample volume is dependent on the (expected) concentration of the HSs (for organic micro-pollutants the sample volume should be larger than for trace elements), the amount of the fine fraction where pollutants mostly accumulate, sediment porosity and the required sample volume for archiving.

The precise calculation of sample volume is very hard to determine. Each chemical analysis requires a specific amount of sediment (considering adequate replicates and archive samples) and the required volume of sediment per sample should be calculated prior to sample collection. The National Oce-

anic and Atmospheric Administration (NOAA) commonly sample 7-8 litres of sediment at each sampling site for numerous measurement and chemical analyses (Long et al., 1996). According to the EPA for the biological, toxicological, and physicochemical analyses performed on sediment samples more than 10 litres of sediment from each site may be required (EPA, 2001).

The quantities of sediments that should be collected will depend on the analyses to be undertaken. **SIMONA recommendation: generally, 1 kg of sediment** from each sample site should be sufficient for the analysis of most contaminants (e.g., 350 g for organics, 50 g for metals and metalloids, 50-200 g for particle size and other physical properties). In addition, 2-3 kg may be required for bioaccumulation or toxicity testing, and these sediment samples should be stored cold (but not frozen).

6. SAMPLING EQUIPMENT

The choice of sampling equipment depends on the type of sediment. There are common rules and equipment for sediment sampling in general. It should be noted, where the sampling device is made of metal, then abrasion and chemical action, for example from sulphides and phosphates, may lead to specific contamination. In cases where sample equipment made from plastics is used, chemical residues may leach from the material into the sample, for example dispersants, or chemicals from the sediment may adsorb onto the plastics.

Quality control measures should be undertaken in full consultation with the receiving laboratory in order to establish the degree of influence of such effects on the survey results. Some study parameters (e.g. sulphides) may require to be maintained in an oxygen-free atmosphere. In such circumstances, storage and handling under an inert gas atmosphere may be needed. If it is necessary to maintain anaerobic conditions while handling samples, tools such as a glove box should be used. For samples where measurements can be affected by exposure to oxygen, analysis should be performed as quickly as possible (ISO 5667-12:2017; ISO 5667-17:2008).

Important rules:

All hand jewellery must be removed!

Smoking is not permitted!

All tools and containers must be free of contaminants!

The following equipment will be necessary to ensure the proper sampling procedures for all kinds of samples (stream/bottom, suspended and flood-plain sediments):

- ◆ GPS or tablet with maps or topographical maps for recording the geographical coordinates of the sample site;
- ◆ Camera or tablet for the required field photos;
- ◆ Permanent marker;
- ◆ Polyethylene bags;
- ◆ Strip-locks for the sample bags;
- ◆ Devices for sampling: stainless steel shovels or scoops (according to DIN 4188-1 (1977));
- ◆ Corer;
- ◆ Stainless steel sieve set (according to DIN 4188-1 (1977) with two preferably wooden or plastic frames containing nylon 2.0 mm mesh and nylon 63 µm mesh screens;
- ◆ Metal free plastic buckets, bottles or containers with lids;
- ◆ Plastic or heavy-duty cardboard boxes for packing samples;
- ◆ Nitrile gloves;
- ◆ Equipment for in situ measurement (pH, temperature, electrical conductivity, transparency according to the standard ISO 7027:2001);
- ◆ Field observation sheets - printed or on the SIMONA IT tool tablet/phone.

Sampling the **stream/bottom sediments** at shallow water depths could be performed by an operator directly entering the water on foot and using a scoop to collect sediment. During sampling caution must be exercised in order to not to mix different layers of sediment (ISO 5667-12:2017).

According to ISO 5667-12:2017, **bottom sediments** in deep water could be sampled by corer or grab system. Core samples are more suitable for monitoring purposes since they do not disturb the sediment layer and it is possible to take single samples (subsamples) to prepare one composite sample from the same depth. The detailed description of the corer systems is given in the norm ISO 5667-12:2017.

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Sampling equipment for **suspended sediments** should be in accordance with the norm ISO 5667-17:2008 for Water quality – Sampling – Part 17: Guidance on the sampling of bulk suspended solids. Different sampling equipment could be used depending on the situation:

- ◆ The continuous-flow centrifuge types include three types of centrifugal samplers multi-chamber, multi-disc, and single-chamber tubular bowls;
- ◆ Sedimentation tank (stationary);
- ◆ Sedimentation box (in situ);
- ◆ Floating collector (BISAM);
- ◆ Plate sediment trap;
- ◆ Flask sediment trap.

7. FIELD OBSERVATION SHEET

The field observation sheet depends on the objectives of the sampling programme (ISO 5667-6:2014; ISO 5667-12:2017). The objective of monitoring is sampling at a specific location over time.

Samples should be labelled at the time of collection and before the collector moves on to the next sampling site. The sample numbers (sample unique identifier - ID) should be alphanumeric:

- ◆ A two or three digit code identifying the country of origin;
- ◆ A two-digit sample number;
- ◆ A code identifying the sample type: BS for stream/bottom sediment and SS suspended sediment.
- ◆ Duplicate samples identified by the same sample number as the original with an additional "D" at the end of the number.

Sample identification codes should be waterproof. A unique identifier with the date, time and sample location should be labelled on the sample container.

In the **field observation sheets** each sample has to contain the following information as a minimum (ISO 5667-15:2009; ISO 5667-6:2014):

- ◆ To register the exact sampling point locations, the use of Global Positioning System (GPS) technology is recommended (ISO 5667-12:2017);
- ◆ The name of the river or stream or lake;
- ◆ Information on sampling at specific locations (bridge, in stream, from the bank) (ISO 5667-6:2014);
- ◆ A description and disposition of sample;

- ◆ Any other information as necessary (about transport, storage, ...);
- ◆ The pH, temperature, and electrical conductivity of the sample should be measured on site and recorded;
- ◆ The temperature of the cooling device for the storage and transport of the sample should be recorded if there are any deviations from standard protocols;
- ◆ Anything noted by the operator that can have potentially influenced the sample (e.g. dust in the air, fish spawning, nearby traffic, solid waste in the river etc);
- ◆ The name of the person who undertook the sampling;
- ◆ The date of sampling.

The proposed field observation sheet for the SIMONA project is given in **Appendix 3**.

8. WET-SIEVING IN THE FIELD

Wet-sieving immediately after sampling at 2 mm is necessary to eliminate detritus and benthic organisms and to avoid the degradation of organic material that would then become part of the sediment sample. Further wet-sieving procedures can be undertaken to separate the fine-grained silt + clay fractions, <63 µm. Wet-sieving re-suspends the fine fraction bound to coarser fractions in the sediment sample. Water from the sampling site should be used for sieving as it reduces the risk of leaching or contamination. The fine fraction remains after sieving deposits in water. Water used for sieving should be reused for sieving subsequent batches (OSPAR, 2018). The sieved fine fraction should be homogenised. More detail about the sieving procedures is described in the Sediment quality laboratory protocol for HSs in the framework of the SIMONA project.

9. TRANSPORT

After sampling, all samples should be stored in plastics (e.g. PE (polyethylene), PTFE (polytetrafluoroethylene), PVC (polyvinyl chloride), PET (polyethylene terephthalate)), glass or borosilicate glass (ISO 5667-15:2009).

The temperature of the sample, especially of the sludge samples, can influence the properties of the sample. Therefore, the initial temperature of the sludge samples should be measured on site and recorded (ISO 5667-15:2009).

Samples stored in air-sealed transparent polypropylene bags or bottles should be stored in a refrigerator at a temperature between 2°C and 8°C. If the temperature of the refrigerator is not appropriate, the laboratory should determine how this affects the samples and/or the results of the analyses (ISO 5667-15:2009).

According to the recommendation of Guidance No. 25, samples are transferred into dark glass bottles for organic analysis or into plastic bags or bottles for trace element analysis. Sampling containers should be filled to the top (minimal headspace) to reduce the likelihood of oxidation and loss of acid volatile sulphide (AVS) during transport. Samples should be stored in a refrigerator (at about 4°C) and be transported as soon as possible to the laboratory.

If the monitoring programme requires analysis of the different sediment fractions, the sample should be split using appropriate sieving techniques (ISO 5667-12:2017; ISO 5667-15:2009; OSPAR, 2018).

10. QUALITY CONTROL

Appropriate Quality control (QC) measures assure the quality of the results. QC techniques include training, calibration of the equipment and the recording of data (ISO 5667-14). The field QC includes sampling of the quality control samples such as field duplicates, field replicates, and field blanks.

Collecting **field duplicates** is part of a comprehensive QC. These samples should be collected at the same site and time, using the same sampling method and type of equipment. They should be sieved, transported and archived in the same manner as the original samples. **Field duplicates have to be collected at 5-10 % of randomly selected sampling points throughout investigated area.** These samples are used to measure spatial variability within the sampling area. An assessment of the field variability is particularly important in monitoring programs when the sampling has to be repeated for a number of years to detect any changes over a longer time period (Reimann et al., 2008). The precision of field duplicates can be estimated as those of the analytical duplicates by the formula $CV (\%) = (SD / X) * 100$, where CV is the Coefficient of the Variation of the result; SD is the Standard Deviation and X is the Mean.

Field replicate is a split of the previously collected sample. The collected sample should be homogenised and after mixing divided into two samples: the original and its replicate. The replicate is using for assessing the sample handling variability i.e. to determine sediment heterogeneity within a single collected sample, to check sample preparation techniques, laboratory analyti-

cal variability and comparison of different laboratory results. **It is recommended to sample 5-10 % of the field replicates.**

Field blanks are samples of uncontaminated silica sand sampled using the same sampling equipment and processed as for the sediment sampling. The field blank samples are used to indicate that the relevant concentration of HSs have not entered the samples from the sampling equipment or during sample processing or handling. **Usually 5 % of the samples are blanks.**

11. SAFETY

Safety should always be a priority. Sampling should be undertaken considering the safety factors influenced by weather conditions, local conditions and experience of local tides and local safety regulations.

General safety precautions are given in ISO 5667-1:2006 Water quality – Sampling – Part 1: Guidance on the design of sampling programmes and sampling techniques. They include precautions to avoid inhalation and ingestion of toxic gases and materials through the nose, mouth and skin. Staff responsible for carrying out sampling should be informed about safety measurements according to the national and/or regional health and safety regulations.

Precautions due to climatic conditions include wearing life jackets and life-lines before sampling from ice-covered waters, check the ice, and check underwater breathing apparatus or other diving equipment. Equipment used for sampling (boats or platforms) should be stable, in good condition and appropriate signals should be given to commercial ships and fishing vessels.

Sampling from unsafe sites should be avoided or if this is not possible, sampling should be conducted by a team not by a single person. Sampling from bridges should be preferred then bank sampling. Safe access to sampling sites in all weather conditions is crucial for monitoring (ISO 5667-12:2017).

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OTHER INFORMATION

Project title:

Sediment-quality Information, Monitoring and Assessment System to support transnational cooperation for joint Danube Basin water management (SIMONA)

Partnership of the project SIMONA:

The SIMONA partnership has 17 full partners (11 ERDF, 4 IPA and 2 ENI) and 12 associated partners (ASPs) from 13 Countries, which is a balanced and strong representation of almost the whole Danube River Basin.

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For further information on the project, partnership and the Danube Transnational Programme:
www.interreg-danube.eu/simona



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RECOMMENDATIONS OF THE SIMONA PROJECT: MONITORING ACTIVE FLOODPLAIN SEDIMENT

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APPENDIX 1 OF THE SIMONA SEDIMENT QUALITY SAMPLING PROTOCOL

In various scientific studies of river systems and lakes, there are generally three types of sediments that can be distinguished: stream/bottom, floodplain and suspended. The deposition of floodplain sediments in a fluvial environment takes place outside the river bed during overbank flows. For practical purposes fluvial deposits can be divided into three major groups (Reineck and Singh, 1980):

- ◆ Channel deposits - formed mainly from the activity of river channels. They include channel lag, point bar, channel bar, and channel fill deposits.
- ◆ Bank deposits - sediments formed on the river banks and produced during flood periods. They include levee and crevasse splay deposits.
- ◆ Flood basin deposits - essentially fine-grained sediment layers formed during heavy floods when river water flows over the levees into the flood basin. They include flood basin and marsh deposits.

In some rivers, however, differentiation between bank and flood basin deposits does not exist, and thus fluvial sediments can be differentiated into two groups: (1) Channel deposits and (2) Floodplain deposits (Reineck and Singh, 1980).

Generally, floodplain could be considered as the relatively flat area of land that stretches from the banks of the parent stream to the base of the valley walls and over which water from the river channels flows at times of high discharge (Goudie, 2006). Floodplains are a characteristic trait of the mature and old stages of a river as opposed to the young stage that occurs in the mountainous regions (Reineck and Singh, 1980).

The fine-grained fraction (silt and clay) is transported by rivers as suspended matter, the amount and concentration of which directly depends on the density and size of the grains and water velocity. Indirectly, it depends on the rock and soil type and erosion rates. The concentration of suspended sediments varies with changes in the current profile and velocity.

Upstream sections are typically regions with high water velocities and consequently high erosion rates so that the natural composition of the suspended sediment in rivers directly reflects the lithology in the catchment area.





Downstream in lowland river basins with large catchment areas, the natural composition of the suspended sediment still reflects the parent material but the influence of individual lithologies can be distinguished less clearly. In both upstream and downstream areas, the concentrations of the HSs in the sediment can be overprinted by anthropogenic input.

River floodplains act as sediment sinks for alluvial deposits. While they are being stored the sediments may be reworked by fluvial, aeolian, biological and/or pedogenic agents. The stored sediments may subsequently be eroded and re-incorporated into the deposit budget of the drainage basin. Because of the protracted residence times of heavy metals within rivers and their floodplains, metal-contaminated sediments may act as major sources of future contamination (Goudie, 2006). These characteristics, the relative ease of access and straightaway methods for sampling, make floodplain sediments a suitable media for monitoring the river's environmental status.

Due to the varying frequency of flooding events, defining the extent of a floodplain in a given fluvial system as the area inundated during floods could be problematic. Wolman and Leopold (1957) defined the term “**active floodplain**” as the area subjected to the annual flood (i.e. the highest discharge each year). Though this definition could be a subject of discussion, in terms of monitoring a river's environmental status, defining the active and former floodplains (river terraces) is of high importance. **The floodplain sediments suitable for monitoring are deposits of suspended material onto active, regularly flooded floodplains and levees along rivers with variable water flow.**

The sediments deposited in the natural levees and the crevasse splays could be monitored and would present more realistic results about the quality of the water body, than marsh and flood basin sediments. The latter two sub-environments could be used for monitoring purposes with the precondition of sampling soon after the flooding event.

Other reasonable deposits for sediment monitoring are the silty and clayey layers on the top of the point bars. Despite point bars being part of the channel deposits, these top sections are often hard to distinguish from the levee deposits. This and their fine-grained nature make them a suitable sink and subsequently sampling media for HSs in river systems.

The background value for a given area could be defined either from earlier geological and geochemical investigations or by sampling sediments that date from pre-industrial times. For the floodplain sediment, the local background value should be defined as a geochemical composition of the deeper, natural, preindustrial fluvial sediments at the sampling site. The surficial floodplain is normally affected by recent anthropogenic activities and may be contaminated. Deeper samples, which are optional sampling media, normally show the natural background variation (Šajn et al., 2011). Thus, for floodplain sampling, it is advisable to determine background values at the sampling site by sampling the deeper pre-industrial level of the river bank. The reliable assessment of the drainage basin contamination could be performed by comparing pre- and post-industrial floodplain sediments.





In summary, the analysis of the HSs in floodplain sediments will reflect natural background values and historical contamination, while the regular monitoring in bottom sediment will show baseline values and more recent contamination. The analysis of suspended sediment (especially during high flow events), as well as the occasional analysis of floodplain sediments (i.e. the deposits of the last major flood event), will reveal the current state of contamination including material from soil erosion.

The selection of the sediment sampling stations should follow the FOREGS Atlas recommendations (Salminen et al., 2005). The field manual for the FOREGS Atlas suggests sampling of floodplain sediment from the lowermost point of the larger drainage basin (area 1,000 – 6,000 km²) to which the small catchments are connected (Salminen et al., 2005).

Furthermore, when choosing floodplain sediments for monitoring media, fluvial sub-environments suitable for the purposes should be very carefully determined. For example, the approach of Reineck and Singh (1980) that combines bank and overbank deposits into the "floodplain" environment seems more appropriate for monitoring goals.

Additionally, some further criteria should be applied when choosing a sampling site for floodplain sediments:

- ◆ Distance from the river bed – closer to the river channel should be preferred to minimize the effect or chemical overprint of external agents;
- ◆ Frequency of flooding – sites with frequent flood events (for example annual) are preferable;
- ◆ Localities, where floodplains are used for agriculture or near the field from which surface waters gravitationally flow to the site should be avoided;
- ◆ Sites, where there is a possibility of strong air pollution should be avoided;
- ◆ Having in mind the ability of different plant species to extract certain chemical elements from the soils, habitat, where vegetation is missing or is scarce are preferable than thickly vegetated ones.

Composite samples for floodplain sediment should be comprised of 5 - 10 subsamples.

The prescribed **sampling depth** for floodplain sediments in the FOREGS Atlas is 0 – 25cm (Salminen et al., 2005). This provides a comprehensive indication of the recent state of contamination. However, the accumulated floodplain sediments record (historical) contamination within the drainage basin over time. The separate sampling of individual flood events (e.g. the pre-industrial level (once) and the latest flood event (occasionally)) is preferable and the results are more meaningful. In this case, **sampling depth and thickness depend on the deposition rate**. Geological experience is necessary to identify the sediment layer (depth interval) to be sampled.





The frequency for floodplain sediment monitoring is for discussion. Bearing in mind that the multitude of processes, besides fluvial, that rework these sediments could overall alter the river's chemical print, sampling should be performed **soon after flood event, at least annually**. The time(s) of a year should be defined locally based on annual water regime.

Furthermore, the susceptibility of floodplain sediments to be altered by non-fluvial processes, an appropriate approach could be more frequent monitoring at shallower depths (for example, sediment that represent the last flood event or the top 5 cm). This will secure the obtaining of more reliable results for the changes in the environmental status. Such higher frequency, however, could be well reasoned after a sufficient amount of data from sediment monitoring has been accumulated.

Another approach is choosing longer intervals for floodplain sediments monitoring. The frequency of monitoring for floodplain sediment **could be once every six years**, which complies with the six-year cycles suggested by the WFD directives.

The analysed **size fraction** for floodplain sediment samples in the FOREGS Atlas is <2 mm, the SIMONA Sediment quality sampling protocol for HSs prescribes the <63 µm fraction (Šorša, The SIMONA Project Team, 2019). **Both fractions of floodplain sediment (0 – 63 µm and 63 µm – 2 mm) are recommended for analysis.**

In the **Field observation sheet** in the SIMONA Sediment quality sampling protocol for the HSs, there is a field "Others" where information about the floodplain sediment could be entered (Šorša, The SIMONA Project Team, 2019, Appendix 3).

The sample volume, sample equipment, and other sample preparation procedures should be in accordance with the FOREGS Atlas (Salminen, 2005).

The description of **the field Quality control (QC)** is presented in the SIMONA Sediment quality sampling protocol for the HSs (Šorša, The SIMONA Project Team, 2019).

SIMONA recommendation: The appropriate monitoring of the HSs in river sediments should take into account all types of the sediment: stream/bottom, floodplain and suspended sediments to comprehensively investigate the sediment-associated HSs.





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LIST OF PRIORITY SUBSTANCES AND DANUBE RIVER BASIN SPECIFIC POLLUTANTS APPENDIX 2 OF THE SIMONA SEDIMENT QUALITY SAMPLING PROTOCOL

List of priority substances (PS) in the field of water policy (Part A, Annex I; Directive 2013/39/EU)

	Number in PS directive	WISE-SoE code (CAS/EEA) number ¹	Name of priority substance
1	2	CAS_120-12-7	Anthracene
2	5	EEA_32-04-2	Brominated diphenylethers (congener numbers 28, 47, 99, 100, 153 and 154)
3	6	CAS_7440-43-9	Cadmium and its compounds
4	7	CAS_85535-84-8	C10-13-chloroalkanes
5	12	CAS_117-81-7	Di(2-ethylhexyl)phthalate (DEHP)
6	15	CAS_206-44-0	Fluoranthene
7	16	CAS_118-74-1	Hexachlorobenzene
8	17	CAS_87-68-3	Hexachlorobutadiene
9	18	CAS_608-73-1	Hexachlorocyclohexane
10	20	CAS_7439-92-1	Lead and its compounds
11	21	CAS_7439-97-6	Mercury and compounds
12	23	CAS_7440-02-0	Nickel and its compounds
13	26	CAS_608-93-5	Pentachlorobenzene
14	28	EEA_33-56-7	Total PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Indeno(1,2,3-cd)pyrene)
15	30	CAS_36643-28-4	Tributyltin-cation
16	34	CAS_115-32-2	Dicofol
17	35	CAS_1763-23-1	Perfluorooctane sulfonic acid and its derivatives (PFOS)
18	36	CAS_124495-18-7	Quinoxifen
19	37	EEA_33-58-9	Dioxins and dioxin-like compounds (7 PCDDs + 10 PCDFs + 12 PCB-DLs)
20	43	EEA_33-57-8	Hexabromocyclododecane (HBCDD)
21	44	EEA_33-50-1	Heptachlor and heptachlor epoxide

List of River Basin Specific Pollutants for the Danube River Basin (ICPDR, 2003)

	CAS number ¹	Name of Substance
22	CAS_7440-38-2	Arsenic and its compounds
23	CAS_7440-50-8	Copper and its compounds
24	CAS_7440-66-6	Zinc and its compounds
25	CAS_7440-47-3	Chromium and its compounds

¹ WISE-SoE: European Environment Information and Observation Network reporting systems; CAS: Chemical Abstracts Service; EEA: European Environment Agency registration number (if CAS is not acceptable)





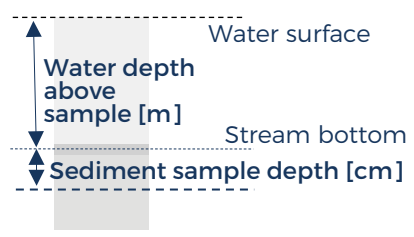
FIELD OBSERVATION SHEET FOR SEDIMENT SAMPLING

APPENDIX 3 OF THE SIMONA SEDIMENT QUALITY SAMPLING PROTOCOL

MONITORING PROGRAMME/ SAMPLING PROJECT INFORMATION:			
Project name:		Sample identifier (ID):	
Collection date (DD/MM/YYYY):		Collection time (HH:MM):	
Sampling matrix: <input type="checkbox"/> stream/bottom sediment; <input type="checkbox"/> suspended sediment; <input type="checkbox"/> other (floodplain sediment, ...):			
Sampling: <input type="checkbox"/> accredited; <input type="checkbox"/> not accredited		Sampling standard:	
MONITORING SITE IDENTIFICATION:			
Monitoring Site ID (WISE-SoE):		Monitoring Site ID (national):	
Name of the Monitoring Site (e.g. name of the surface water and the city):			
Sample location description with specific information (bridge, high power electric lines, railway line, major road, natural park, ...) (provide map on opposite side):			
Type of the monitoring site (can be different from representing waterbody): <input type="checkbox"/> river; <input type="checkbox"/> lake; <input type="checkbox"/> wetland; <input type="checkbox"/> other (floodplain, ...):			
Aim of sampling: <input type="checkbox"/> general status; <input type="checkbox"/> reference site (without/small anthropogenic sources); <input type="checkbox"/> investigation site – find contamination source; <input type="checkbox"/> investigation site for other:			
WGS84	Latitude:	National Coordinate system	Latitude:
	Longitude:		Longitude:
MONITORING SITE REPRESENTING THE FOLLOWING WATERBODY AND ITS BASIN:			
Is it the same waterbody as the Monitoring Site has? <input type="checkbox"/> YES or <input type="checkbox"/> NO			
If no, describe the connection between waterbody and monitoring site (tributary, recipient, ...):			
Waterbody ID (WISE-SoE):		Waterbody ID (national):	
Name of the Waterbody:			
Type of the Waterbody: <input type="checkbox"/> river; <input type="checkbox"/> lake; <input type="checkbox"/> wetland; <input type="checkbox"/> coastal; <input type="checkbox"/> transitional			
MONITORING SITE CONDITIONS (PART I):			
River width [m]: <input type="checkbox"/> estimated; <input type="checkbox"/> measured value	Depth of water estimated average depth [m]:	Flow rate [m/s]: <input type="checkbox"/> estimated; <input type="checkbox"/> measured value	
Water temperature [°C]:	Water electrical conductivity [µs/cm]:		
Water pH:	Water transparency (Secchi disk method) [cm]:		
Geology and background value of parent material/lithology in the area:			





MONITORING SITE CONDITIONS (PART II):	
Extreme conditions: <input type="checkbox"/> none; <input type="checkbox"/> flooding status; <input type="checkbox"/> ice; <input type="checkbox"/> pollution plume; <input type="checkbox"/> contaminated coast/bank; <input type="checkbox"/> other:	
Weather conditions: <input type="checkbox"/> hot; <input type="checkbox"/> sunny; <input type="checkbox"/> cloudy; <input type="checkbox"/> changeable; <input type="checkbox"/> rainy; <input type="checkbox"/> frosty	
SEDIMENT COLLECTION INFORMATION:	
Water depth above sample [m]:	 <p style="font-size: small; margin: 0;">Water surface</p> <p style="font-size: small; margin: 0;">Water depth above sample [m]</p> <p style="font-size: small; margin: 0;">Stream bottom</p> <p style="font-size: small; margin: 0;">Sediment sample depth [cm]</p>
Sediment sample depth [cm]:	
Collection device: <input type="checkbox"/> stainless steel scoop; <input type="checkbox"/> corer; <input type="checkbox"/> sampler for suspended sediment; <input type="checkbox"/> other:	
Sample type: <input type="checkbox"/> composite - number of subsamples: _____	
Distance between the first and last sampling site? [m]:	
Sample replicate collected? <input type="checkbox"/> YES or <input type="checkbox"/> NO	Replicate ID/name:
Sample is duplicated? <input type="checkbox"/> YES or <input type="checkbox"/> NO	
SAMPLE INFORMATION:	
Sampling volume estimated, wet weight [liter]:	
Temperature of sample (field observation, right after sampling) [°C]:	
Sediment pH (undisturbed):	Sediment pH (post-homogenization):
Colour (Munsell soil colour chart number):	
Texture (particle size description):	
Odour: <input type="checkbox"/> none; <input type="checkbox"/> light; <input type="checkbox"/> strong; <input type="checkbox"/> earthy; <input type="checkbox"/> mildewed; <input type="checkbox"/> putrid; <input type="checkbox"/> farm slurry; <input type="checkbox"/> fishy; <input type="checkbox"/> aromatic; <input type="checkbox"/> sewage; <input type="checkbox"/> fuel/oil	
Information on sediment components (seashells, animals, peat, wood, tar, stones, waste, plastics, etc.):	
Sample photograph identification:	
Additional comments (e.g. map of the sampling site):	
Sampler name (readable):	Signature:

