	EO/RS methods: Boelee E. et al. (2017) Overcoming water challenges through nature-based solutions. Water Policy (2017) 19 (5): 820-836. https://doi.org/10.2166/wp.2017.105 Kumar D (2015) Remote Sensing based Vegetation Indices Analysis to Improve Water Resources Management in Urban Environment. Pages 1374-1380 in G. S. Dwarakish, editor. International Conference on Water Resources, Coastal and Ocean Engineering. Ritchie J., Zimba P.V, Everitt J.H. (2003) Remote Sensing Techniques to Assess Water Quality. Photogrammetric Engineering and Remote Sensing 69(6). DOI: 10.14358/PERS.69.6.695. Massoudieh, A, Maghrebi, M, Kamrani, B, Nietch, C, Tryby, M, Aflaki, S, Panguluri, S (2017) A flexible modeling framework for hydraulic and water quality performance assessment of stormwater green infrastructure. Environmental Modelling & Software 92, 57-73. Shi, P, Zhang, Y, Li, Z, Li, P and Xu, G (2017) Influence of land use and land cover patterns on seasonal water quality at multi-spatial scales. CATENA 151, 182-190.

3.15 Total Suspended Solids (TSS) content

Project Name: CLEVER Cities (Grant Agreement no. 776604), GrowGreen (Grant Agreement no. 730283) and UNaLab (Grant Agreement no. 730052)

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TSS content	Water Management
Description and justification	Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. TSS can include a wide variety of material and can have adsorbed pollutants. High concentrations of suspended solids can affect the health and productivity of the aquatic life. TSS and turbidity are simple indicators of water quality. Sources of TSS include, e.g., sediment runoff from agricultural fields, logging activities, construction sites, roadways, waste discharge, or

	excessive algal growth. The TSS content often increases sharply during and immediately following a rainfall event. The EU Freshwater Fish Directive (2006/44/EC) recommends ≤25 mg/L TSS for salmonid and cyprinid fish health (European Parliament, 2006), whilst the concentration of TSS in wastewater treatment plant effluents is limited to ≤35 mg/L by Wastewater Directive 91/271/EEC (European Parliament, Council of the European Union, 1991).
Definition	Total suspended solids (TSS) or turbidity (%, mg/L and total; units dependent upon measurement technique). A measure of the suspended solids in wastewater, effluent, or water bodies, determined by tests for "total suspended non-filterable solids".
Strengths and weaknesses	+ Simple evaluation + In turbidity measurements, Secchi disk is very commonly used visual method because it is easy to use, inexpensive, and relatively accurate. The turbidity meter method is very accurate - Laboratory measurement of TSS directly quantifies the amount of fine particulate material suspended in water but is relatively time-intensive. - Time consuming TSS measurements, non-continuous compared to turbidity
Measurement procedure and tool	Total suspended solids (TSS) are typically quantified in the laboratory using a gravimetric process, yielding TSS measurement in units of mass per volume (e.g., mg/L or ppm). Measurement of TSS involves filtration of a water sample followed by drying and weighing of the particulates removed. Simply, this means anything that is captured by filtering the sample aliquot through a specific pore size filter. A measured volume (no more than 1 L) of sample is passed through a prepared, pre-weighed filter paper. The filter is dried at 104 ± 1°C. After drying, the filter is reweighed and the TSS is calculated. A semi-quantitative, rapid assessment of TSS can be accomplished by evaluating sample turbidity, a measure of the relative transparency of a water sample. Turbidity measurements rely on comparison of light scattering with standard solutions (turbidity meter) or visual assessment (Secchi disk, transparency tube). Turbidity meters use a light beam with defined characteristics to provide a semi-quantitative measure of the particulates present in the water, providing an integrated measure of light scattering and absorption. The measurement is provided in nephelometric turbidity units (NTU). Turbidity (in NTU) can

	be directly related to TSS (in mg/L) via creation of a standard curve (TSS versus turbidity) for a given location/type of fine particulate material. • Measuring turbidity *in-situ*: o Secchi disk, which is lowered into the water and the level where the disk disappears is registered. o Turbidity meter consists of a light source that illuminates a water sample and a photoelectric cell that measures the intensity of light scattered at a 90° angle by the particles in the sample. o Transparency tube is a clear, narrow plastic tube marked in units with a light and dark pattern painted on the bottom. Water is poured into the tube until the pattern disappears, and the depth is recorded.
Scale of measurement	Plot scale to district scale
Data source	
Required data	TSS or turbidity measurement data
Data input type	Quantitative and semi-quantitative
Data collection frequency	Daily, weekly, monthly or annually
Level of expertise required	Low to moderate
Synergies with other indicators	Synergies with the other water quality indicators in the *Water management* indicator group
Connection with SDGs	SDG 6 Clean water and sanitation, SDG 13 Climate action, SDG 14 Life below water
Opportunities for participatory data collection	Participatory data collection for turbidity is possible under supervision
Additional information	
References	ASTM. (2018). *ASTM D5907-18, Standard Test Methods for Filterable Matter (Total Dissolved Solids) and Nonfilterable Matter (Total Suspended Solids) in Water*. ASTM International, West Conshohocken, PA. Orhel, R.L., & Register, K.M. (2006). *Volunteer Estuary Monitoring. A Methods Manual*. 2nd edition. United States Environmental Protection Agency, Washington, D.C. International Organization for Standardization (ISO). (2016*). International Standard ISO 7027-1:2016 Water quality —*

Determination of turbidity — Part 1: Quantitative methods. International Organization for Standardization, Geneva.

International Organization for Standardization (ISO). (2019). *International Standard ISO 7027-2:2019 Water quality — Determination of turbidity — Part 2: Semi-quantitative methods for the assessment of transparency of waters.* International Organization for Standardization, Geneva.

3.16 Nitrogen and phosphorus concentration or load

Project Name: UNaLab (Grant Agreement no. 730052)

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Water Quality: Nitrogen and phosphorus concentration or load	**Water Management**
Description and justification	Nutrients, including nitrogen (N) and phosphorus (P), can have significant impact on water quality, including effects on plant growth, oxygen concentration, water clarity, and sedimentation rates. Some major anthropogenic sources of nutrients are agricultural and industrial emissions, discharged wastewater and atmospheric deposition. Nitrogen and phosphorus are present in water in many different forms, or as many different chemical species. The forms of N and P that are quantified can include some or all of the following: • Nitrogen: total N (N_{tot}), total Kjeldahl N (TKN), dissolved organic N (DON), nitrate (NO_3^-), nitrite (NO_2^-) and ammonia/ammonium (NH_3/NH_4^+) • Phosphorus: total P (P_{tot}), acid-hydrolysable P (AHP), orthophosphate (PO_4^{3-})
Definition	Nitrogen and phosphorus in surface water and/or groundwater (%, expressed as total annual N or P load and/or reduction of maximum annual concentration)
Strengths and weaknesses	+ Laboratory analyses are accurate but can be quite costly. A full suite of analyses can be done for multiple chemical species of N and P. + Ion selective electrodes (ISEs) are less expensive and easier to use alternative. Whilst ISEs for various N species (NO_2^-, NO_3^-, NH_3/NH_4^+) are readily available from multiple suppliers,