Synergies with other indicators	Soil type, degree of saturation, moisture content, soil stability (FoS), organic matter content; soil field capacity, wilting point
Connection with SDGs	11,13,15,17
Opportunities for participatory data collection	Yes, especially for sampling
Additional information	
References	Gonzalez-Ollauri, A. and Mickovski, S. B., 2017. Plant-soil reinforcement response under different soil hydrological regimes. Geoderma, 285 (141-150) Gonzalez-Ollauri, A. and Mickovski, S.B., 2017. Hydrological effect of vegetation against rainfall-induced landslides. Journal of Hydrology, 549 (374–387)

8.19.2 Soil water available for plant uptake (SAW metric)

Project Name: Nature4Cities

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Soil Available Water - SAW	**Green Space Management**
Description and justification	**The SAW** represents the capacity of the soil to provide water for plant uptake (Yilmaz et al. 2016; Bouzouidja et al. 2018).
Definition	The use of this indicator aims to : ● Provide water for plants growth ● Favor plant transpiration and cooling effect
Strengths and weaknesses	This indicator can be capable to describe initial planning problems, like soil compaction. It is an important indicator to assess plant water uptake. This indicator is available to everyone and easy to implement. It is possible to apply the indicator in numerous cases (different locations). The indicator has been used in different circumstances (different soil uses) and delivered reasonable results (Nature4Cities D2.1).
Measurement procedure and tool	SWR = (Hfc-Hwp)*Bd*z*F with Hfc is the massic water content at field capacity (in kg water/kg dry soil), Hwp the volumetric water content at the wilting point (m^3/m^3), Bd is the bulk density in (kg/m^3), z is the depth of soil in (m), F is the stone fraction content (in m^3 of small soil per m^3 of total soil)

Scale of measurement	☒ Object
Data source	● Bibliography ● Measurement/Monitoring
Required data	Several input data is required. Measuring these parameters is the best way to calculate this indicator, because urban soil properties are very heterogeneous. If it can't be measured, parameters estimation is possible thanks to the bibliography ● Soil water field capacity (Hfc) ● Soil water content at the wilting point (Hwp) ● Soil thickness (z) ● Soil bulk density (Bd) ● Stone fraction content (F)
Data input type	● Soil physical properties Measurement Unit : mm water / cm of soil
Data collection frequency	In concept and detailed design phase of urban and object planning.
Level of expertise required	Easy to calculate and requires few data
Synergies with other indicators	In Nature4Cities this indicator can be evaluated (SAW score) (Nature4Cities D2.4). It was defined using Bruand et al., (2004) study. It represents the soil water storage capacity available for plant uptake. This is the most common indicator used to assess soil fertility. The SAW score needs soil texture information. Bruand et al. used soil sample depth and % sand, % silt and % clay. SAW score is given in form of a performance bar with numerical values ranked in terms to the best (1) and worst (0) scenario.
Connection with SDGs	SD15 Life on Land
Opportunities for participatory data collection	
Additional information	
References	Yilmaz, D., M. Sabre, L. Lassabatère, M. Dal, and F. Rodriguez. 2016. "Storm Water Retention and Actual Evapotranspiration Performances of Experimental Green Roofs in French Oceanic Climate." European Journal of Environmental and Civil Engineering 20 (3): 344–62. https://doi.org/10.1080/19648189.2015.1036128. Bouzouidja, Ryad, Gustave Rousseau, Violaine Galzin, Rémy Claverie, David Lacroix, and Geoffroy Séré. 2018. "Green Roof Ageing or Isolatic Technosol's Pedogenesis?" Journal of Soils and Sediments 18 (2): 418–25. https://doi.org/10.1007/s11368-016-1513-3. Bruand, Ary, Odile Duval, and Isabelle Cousin. 2004. "Estimation Des Propriétés de Rétention En Eau Des Sols à Partir de La

	Base de Données SOLHYDRO: Une Première Proposition Combianant Le Type d'horizon, Sa Texture et Sa Densité Apparente." Etude et Gestion Des Sols 11: 3–323. Nature4Cities, D2.1 - System of integrated multi-scale and multi-thematic performance indicators for the assessment of urban challenges and NBS. https://www.nature4cities.eu/post/nature4cities-defined-performance-indicators-to-assess-urban-challenges-and-nature-based-solutions Nature4Cities, D2.2 - Expert-modelling toolbox Nature4Cities, D2.3 – NBS database completed with urban performance data https://www.nature4cities.eu/post/applicability-urban-challenges-and-indicators-real-case-studies Nature4Cities, D2.4 - Development of a simplified urban performance assessment (SUA) tool

8.20 Vegetation Wilting Point

Project Name: OPERANDUM (Grant Agreement no. 776848)

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Vegetation wilting point	**Green Space Management**
Description and justification	If vegetation is to thrive in the soil it will need a certain moisture in the soil. Thriving vegetation can prevent/mitigate against shallow landslides or erosion.
Definition	Minimum moisture content in the soil that the plant requires not to wilt. Sometimes defined as the soil water content when the soil is under a pressure of −15 bar.
Strengths and weaknesses	+: can be obtained from predictions using soil survey data. -: can be difficult to measure directly
Measurement procedure and tool	Measurement: soil sample needs to be brought to matric suction of 15 bar, after which a sub-sample is taken, mass measured, put in an oven at 110C, and then dry mass measured. The moisture content at wilting point will be the mass of evaporated water from the sub-sample divided by the mass of dry soil. Prediction: using pedotransfer functions (e.g., Bouma, 1989; Gonzalez-Ollauri and Mickovski, 2017)
Scale of measurement	micro