wetlands, 4th edition, vol. 18. Ramsar Convention Secretariat, Gland, Switzerland, 2010.
Ramsar Convention Secretariat. *Participatory skills: Establishing and strengthening local communities' and indigenous people's participation in the management of wetlands*. Ramsar handbooks for the wise use of wetlands, 4th edition, vol. 7. Ramsar Convention Secretariat, Gland, Switzerland, 2010.
Renaud, F.G., Sudmeier-Rieux, K. and Estrella, M. (eds.). *The Role of Ecosystems in Disaster Risk Reduction*. Tokyo: United Nations University Press, 2013.
Renaud, F.G., Sudmeier-Rieux, K., Estrella, M. and Nehren, U. (eds.*). Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice*. In Advances in natural and technological hazards research. Switzerland: Springer International Publishing, 2016, pp.598

4.39 Total surface area of restored and/or created wetlands

Project Name: UNaLab (Grant Agreement no. 730052)

Author/s and affiliations: Maria Dubovik, Laura Wendling, Ville Rinta-Hiiro, Arto Laikari, Malin zu-Castell Rüdenhausen

VTT Technical Research Centre Ltd, P.O. Box 1000 FI-02044 VTT, Finland

Total surface area of constructed and/or restored wetlands within a defined area	**Climate resilience** **Water Management**
Description and justification	Wetlands are unique ecosystems that occur in places where the water table is close to the ground level, or where land is covered by water, either seasonally or permanently. Convention on Wetlands (Ramsar, Iran, 1971), or Ramsar Convention, defines wetlands as "… a wide variety of inland habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as saltmarshes, mangroves, intertidal mudflats and seagrass beds, and also coral reefs and other marine areas no deeper than six metres at low tide." Conservation and restoration of wetlands is regarded as one of the critical factors for establishing climate adaptation as part of the disaster risk reduction. Wetlands provide resilience against water-related hazards such as floods, storm surges and droughts by capturing and holding water and gradually releasing it. Peatlands enhance climate resilience by storing carbon.
Definition	Surface area of constructed and/or restored wetlands within a defined area (ha)

Strengths and weaknesses	+ Straightforward assessment of the surface area occupied by constructed and/or restored wetlands - Requires access to local records or international/local spatial datasets
Measurement procedure and tool	The extent of the surface area covered by constructed and/or restored wetlands can be assessed using the land-use raster data (local or EU-wide, e.g., Corine Land Cover) in GIS software that allows to examine the total area. Satellite imagery may be used for visual assessment and manual area calculation.
Scale of measurement	City; municipality
Data source	
Required data	Land-use raster of the area of interest; local records; satellite imagery
Data input type	Quantitative
Data collection frequency	Annually
Level of expertise required	Moderate – requires knowledge of GIS software Low – when assessing visually using satellite images
Synergies with other indicators	Direct relation to *Water management* and *Biodiversity* challenge categories
Connection with SDGs	SDG 6 Clean water and sanitation, SDG 11 Sustainable cities and communities, SDG 13 Climate action, SDG 15 Life on land
Opportunities for participatory data collection	Participatory data collection can be implemented among local people; another opportunity is community involvement in wetland management
Additional information	
References	Kumar, R., Tol, S., McInnes, R.J., Everard, M. and Kulindwa, A.A.. *Wetlands for disaster risk reduction: Effective choices for resilient communities*. Ramsar Policy Brief, (1). Gland, Switzerland: Ramsar Convention Secretariat, 2017. Ramsar Convention Secretariat. *Managing wetlands: Frameworks for managing Wetlands of International Importance and other wetland sites*. Ramsar handbooks for the wise use of wetlands, 4th edition, vol. 18. Ramsar Convention Secretariat, Gland, Switzerland, 2010. Ramsar Convention Secretariat. *Participatory skills: Establishing and strengthening local communities' and indigenous people's participation in the management of wetlands*. Ramsar handbooks for the wise use of wetlands, 4th edition, vol. 7. Ramsar Convention Secretariat, Gland, Switzerland, 2010.

Renaud, F.G., Sudmeier-Rieux, K. and Estrella, M. (eds.). *The Role of Ecosystems in Disaster Risk Reduction*. Tokyo: United Nations University Press, 2013.
Renaud, F.G., Sudmeier-Rieux, K., Estrella, M. and Nehren, U. (eds.*). Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice*. In Advances in natural and technological hazards research. Switzerland: Springer International Publishing, 2016, pp.598

4.40 Soil water flux

Project Name: OPERANDUM (Grant Agreement no. 776848)

Author/s and affiliations: Slobodan B. Mickovski[1], Alejandro Gonzalez-Ollauri[1], Karen Munro[1]

[1] *Built Environment Asset Management Centre, Glasgow Caledonian University, Glasgow, Scotland, UK*

Soil water flux and degree of saturation	**Water Management**
Description and justification	Soil water flux – is the transport of water into the soil from the atmosphere, into the atmosphere from the soil and within the soil, establishing the soil water mass balance. It is intrinsically related to the stress state of the soil and to ecohydrological processes occurring at the plant-soil-atmosphere continuum (e.g., plant uptake and evapotranspiration). Degree of saturation is a measure of the soil water mass balance. It is directly related to soil strength, matric suction, and soil water flux. Vegetation plays a key role in ecosystems by linking biophysical processes—such as absorption of solar radiation, rainfall interception, and evapotranspiration—to biogeochemical processes—such as photosynthesis and volatile organic compound emission. Moreover, vegetation links the terrestrial carbon cycle to hydrology through stomatal aperture (Jarvis and McNaughton, 1986), and through other processes such as soil-water extraction by roots (de Jong van Lier et al., 2006). Terrestrial water fluxes are controlled to a large extent by above-ground and below-ground biological processes where vegetation plays a major role.