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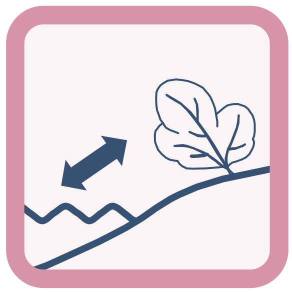
Technical Sheet: Indicator Set 3 Connectivity



Indicators:

- 3.1 Inundation dynamics (Woolsey et al. 2005, no. 13)
- 3.2 Shoreline length (Woolsey et al. 2005, no. 44)

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http://www.bafu.admin.ch/outcome-evaluation-resto
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This publication is also available in French, German and Italian.

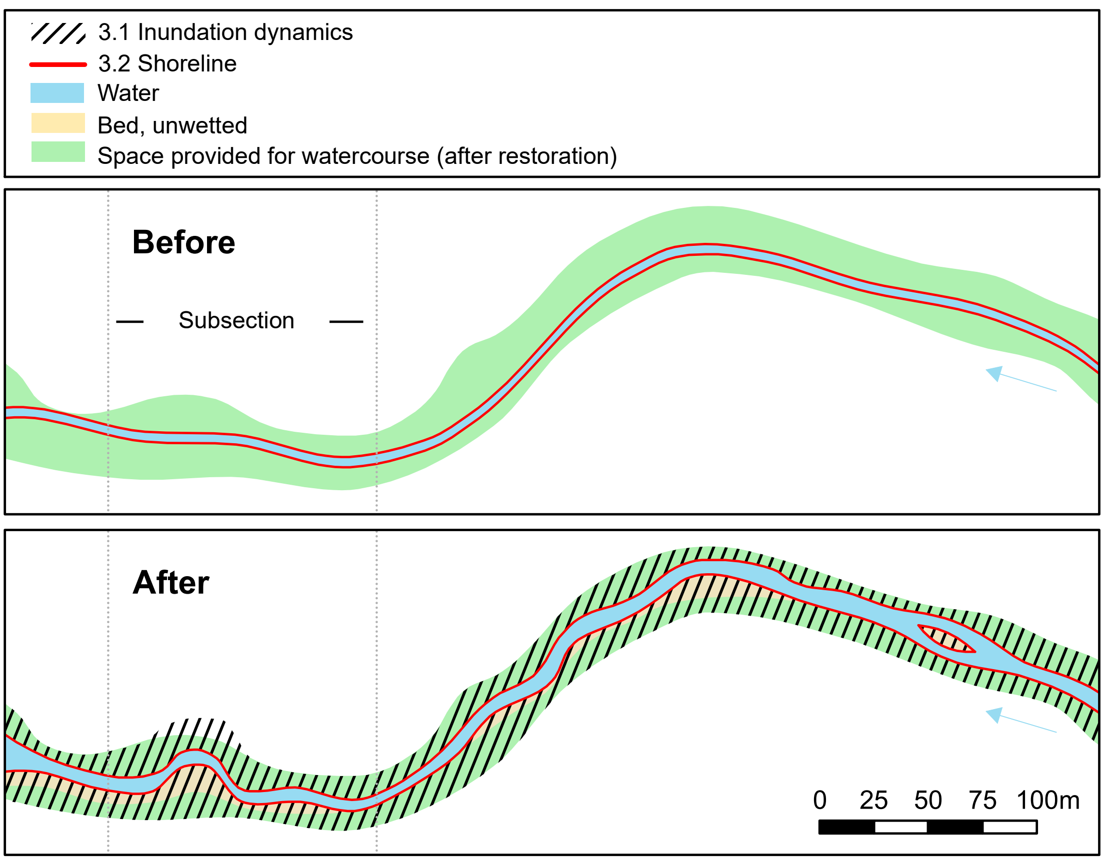
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

Natural watercourses are closely connected with the surrounding area – longitudinally, laterally and below the river bed. During flood events, surface waters overflow and inundate the adjacent floodplains; nutrients, organisms, wood and gravel are transported from water to land and vice versa. However, key ecological processes also occur along the shoreline when water levels are lower. Indicator Set 3 is used to quantify the degree of lateral connectivity, firstly via the shoreline length and secondly on the basis of the inundation area.

Parameters	Area inundated (m^2) under flood discharge conditions expected to occur once every two years (HQ_2) Shoreline length per river length (along the thalweg; km/km)
Applicability	This Indicator Set can only be selected for individual projects.
Special considerations	For individual projects, detailed digital elevation models or hydraulic models are generally available. These provide an ideal basis for modelling of the inundation area and the shoreline. A field survey is thus not required. Afforestation of (parts of) the area within the project perimeter may complicate the drone-assisted production of a digital elevation model.
Survey site	Restored section (see Fig. 3.1)
Timing	Indicator 3.1 (inundation dynamics): Modelling is performed for HQ_2. Indicator 3.2 (shoreline length): Modelling is performed for medium-flow conditions.
Material	Digital elevation model. Software for hydraulic modelling (e.g. BASEMENT) and geographical information system (GIS). Historical maps.

Figure 3.1: Survey site for indicators from Indicator Set 3 before and after restoration. The dotted line shows the location of the subsection.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Determination of the current inundation area	• Modelling of inundation (HQ_2) based on a current digital elevation model. Modelling can be in 1D or 2D, depending on the topographic material; 2D modelling requires more detailed topographic images, in both the wetted and unwetted parts of the bed. For large watercourses where the topography of the unwetted part of the bed can be identified using aerial photographs (readily visible), 2D modelling is probably more efficient. • Determination of the current inundation area (m^2) at HQ_2 before and after restoration. The inundation area is defined as the area wetted at HQ_2 minus the area wetted under mean-flow conditions.	3.1
Determination of the current shoreline length	• Modelling of the current shoreline length under mean-flow conditions, using the digital elevation model. • Determination of the current shoreline length under medium-flow conditions as the shoreline length per river length (along the thalweg; km/km).	3.2
Determination of the potential inundation area	• Estimation of the potential inundation area (m^2). This comprises the part of the surrounding area which is inundated at HQ_2 in the near-natural reference condition. The estimation is made with the aid of historical maps (e.g. based on gravel areas, contours, etc.), historical cross sections and records (e.g. photos, newspaper articles, description of typical flooded areas).	3.1
Determination of the historical shoreline length	• Determination of the historical shoreline length (km/km) based on historical records [e.g. the Topographic Atlas of Switzerland (Siegfried Map)].	3.2

Evaluation

The evaluation approaches given below are taken from the original indicator method sheets in the "Handbook for evaluating rehabilitation projects in rivers and streams" (Woolsey et al. 2005). They serve as a guide and will be revised in the coming years on the basis of the experience accumulated in the STANDARD and EXTENDED outcome evaluations.

Indicator	Description
3.1 Inundation dynamics	The normalised value is derived from the proportion of the potential inundation area which is currently inundated at HQ_2 (see Fig. 3.2). A value of 1 is attained if the potential inundation area is entirely inundated at HQ_2, and a value of 0 if no additional area is inundated at HQ_2 (e.g. in a channelised section). Between these two extremes, the value function describes a parabola.
3.2 Shoreline length	For the evaluation, the current shoreline length is compared with that under historical conditions: Current shoreline length as a proportion of the reference shoreline length $\frac{Current\ shoreline\ length\ (km/km) - 2}{Historical\ shoreline\ length\ (km/km) - 2}$ This proportion corresponds to the normalised value between 0 and 1 (Fig. 3.3).

Figure 3.2: Normalisation of the inundation dynamics indicator (3.1).

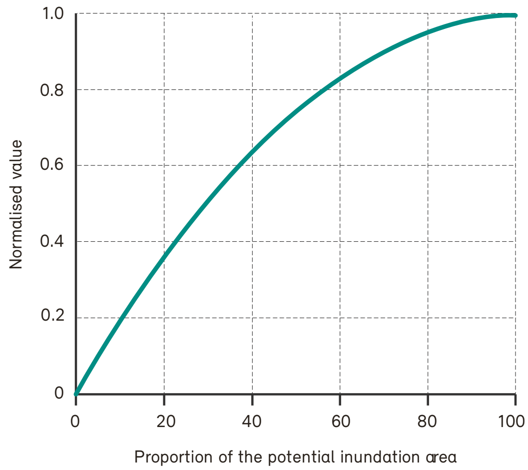
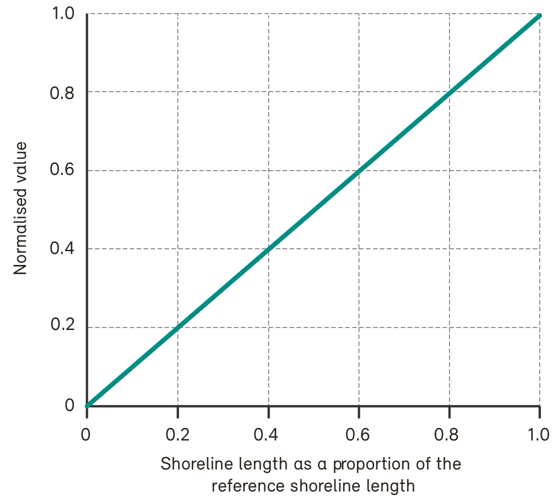


Figure 3.3: Normalisation of the shoreline length indicator (3.2).



Time required

Table 3.1: Estimated time required in person-hours for the determination and evaluation of Indicator Set 3. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation (importing elevation model, obtaining historical maps and aerial photographs)			1	8
Hydraulic modelling (1D/2D)	1	12	1	12
Data processing, site map	1	12	1	12
Evaluation	1	8		
Total person-hours	32		32	
Notes: -				

Further information

Data arising	• Data entry form for Indicator Set 3: KT_ProCode_ERHEBUNG_Set3_V#.xls • Inundation areas as polygon shapefile: KT_ProCode_ERHEBUNG_Set3_Ind3_1 • Shorelines as line shapefile: KT_ProCode_ERHEBUNG_Set3_Ind3_2.shp Elements of the file naming scheme (see Factsheet 5) • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	The field protocol, data entry form and other useful documents are available at: https://www.bafu.admin.ch/wirkungskontrolle-revit