BS EN 14614:2020

BSI Standards Publication

Water quality — Guidance standard for assessing the hydromorphological features of rivers

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National foreword

This British Standard is the UK implementation of EN 14614:2020. It supersedes BS EN 14614:2004, which is withdrawn.

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Water quality - Guidance standard for assessing the hydromorphological features of rivers

Qualité de l'eau - Guide pour l'évaluation des caractéristiques hydromorphologiques des rivières

Wasserbeschaffenheit - Anleitung zur Beurteilung hydromorphologischer Eigenschaften von Fließgewässern

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European foreword

This document (EN 14614:2020) has been prepared by Technical Committee CEN/TC 230 "Water analysis", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2021, and conflicting national standards shall be withdrawn at the latest by March 2021.

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Introduction

In the past, many countries in Europe assessed river 'quality' simply in terms of water chemistry or pollution within river channels. A more comprehensive understanding of rivers is needed, however, in view of global issues such as climate change, to answer pressing ecological questions such as those arising from the EC Water Framework Directive (WFD), the EC Habitats Directive and EC Floods Directive, to underpin the International Convention on Biodiversity, or to assess proposed river engineering work and to evaluate the effectiveness of restoration schemes and other catchment developments.

River habitats and physical processes have suffered historically from a wide range of human impacts, especially changes in land use since World War II. In most European countries there is now widespread agreement among environment and conservation agencies to see modified rivers returned to a more natural condition. This implies a need to evaluate areas deserving protection and those requiring restoration, and to encourage sustainable management of river systems throughout Europe.

NOTE In this document, 'assessment' is used as a broad term referring to the general description of features and the pressures affecting them. It is not used to imply the judgement of particular levels of 'quality' or 'value', whether related to status under the WFD or more generally.

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1 Scope

This document is focused on the structural features of rivers, on geomorphological and hydrological processes, and on river continuity. It provides guidance on the features and processes to be taken into account when characterizing and assessing the hydromorphology of rivers. The word 'river' is used as a generic term to describe flowing watercourses of all sizes, with the exception of artificial water bodies such as canals. The document is based on methods developed, tested, and compared in Europe, including the pan-European REFORM project (https://reformrivers.eu/). Its main aim is to improve the comparability of hydromorphological assessment methods, data processing and interpretation. It provides broad recommendations for the types of parameters that should be assessed, and the methods for doing this, within a framework that offers the flexibility to plan programmes of work that are affordable. Although this document does not constitute CIS guidance for the WFD, relevant references provided by the CIS expert group on hydromorphology have been included in the Bibliography.

Although it has particular importance for the WFD by providing guidance on assessing hydromorphological quality, this document has considerably wider scope for other applications. It does not attempt either to describe methods for defining high status for hydromorphology under the WFD, or to link broadscale hydromorphological classification to assessments of ecological status. In addition, while recognizing the important influence of hydromorphology on plant and animal ecology, no attempt is made to provide guidance in this area, but where the biota have an important influence on hydromorphology, these influences are included.

NOTE A case study illustrating the application of this document is given in Gurnell and Grabowski[1].

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
aluvium
sediment deposited by rivers

3.2
anabranching river
river with more than one channel separated by vegetated islands

3.3
aquifer
underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials (gravels, sands) from which groundwater can be extracted

3.4
armouring
where the river bed surface comprises coarser particles than the underlying river bed layers as a result of removal (mobilization and transport) of the finer particles from the bed surface layer

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3.5
attribute
specific recorded element of a hydromorphological feature

EXAMPLE 'Boulders' and 'silt' are substrate attributes; 'sheet piling' and 'gabions' are attributes of engineered banks.

3.6
backswamp
low-lying marshy area that lies between the valley margin and the natural levée of an alluvial channel

3.7
bank
side of a river channel or island which extends above the normal (e.g. mean) water level and is only completely submerged during periods of high river flow

Note 1 to entry: In the context of this document, the bank top is marked by the first major break in slope, above which cultivation or development is possible.

3.8
bankfull
level at which water begins to spill out of the channel onto the floodplain

3.9
bar
in-channel, elevated sediment deposit exposed during periods of low flow, which could be a side bar (including a point or counterpoint bar, located respectively along the convex or concave bank of a meander bend) or a mid-channel bar

3.10
baseflow
sustained component of streamflow, usually resulting from drainage of groundwater, but also from drainage of large lakes, swamps, soils, snow and ice packs

3.11
baseflow index
measurement of the ratio of the long-term baseflow to total stream flow, often representing the slow, continuous contribution of groundwater to river flow

3.12
baseflow channel width, depth and slope
the width, depth and water surface slope of the part of the channel that conveys the baseflow

3.13
berm
natural or artificial, flat-topped shelf along the margin of a river channel that is exposed above water level during low flows, but is submerged during high flows

Note 1 to entry: Natural berms are vegetated features composed of sediments deposited by the river to the baseflow level.

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3.14
bench
natural flat-topped shelf along the margin of a river channel that evolves from a natural berm as further deposited sediment raises its surface gradually to higher elevations within the river channel

3.15
boulder step
accumulation of boulders (> 256 mm) transverse to and crossing the river channel creating a step in the river's long profile

3.16
braiding
river whose bankfull channel is naturally divided by mid-channel bars into at least two separate flowing threads at baseflow

Note 1 to entry: See also 'bar'.

3.17
burial
accretion of fine sediment over coarser bed material

Note 1 to entry: Burial is the opposite of armouring.

3.18
cascade
stream bed covered with disorganized boulders in steep confined channels

3.19
characterization
selection of properties or special features of a spatial unit that are uniquely relevant to identifying its hydromorphological processes, forms and pressures

3.20
coarse sediment
sediment of grain size at or larger than 'very fine gravel' (diameter ≥ 2 mm, ≤ −1 phi)

EXAMPLE Gravels, cobbles, boulders.

Note 1 to entry: The phi scale defines sediment grain size as the negative logarithm to the base 2 of the grain diameter in millimetres.

3.21
confinement
degree to which the lateral movement of a river channel is confined by the presence of valley sides or terraces

3.22
counterpoint bar
side bar type that develops in the flow separation zone along the concave bank of tight river bends

3.23
crevasse
breach in natural levée

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3.24
crevasse-splay
local accumulation of sand or gravel, deposited by water escaping from the river channel through a crevasse

3.25
culvert
arched, enclosed or piped structure constructed to carry water under roads, railways and buildings

[SOURCE: EN 15843:2010, 3.8]

3.26
dune
usually fine sediment (sand–silt) river bed feature typical of low-gradient, alluvial sand-bed rivers that is linear in plan, aligned perpendicular to the flow, with a gentle upstream and steep downstream cross profile

Note 1 to entry: Dunes can be distinguished from ripples by their larger height (10^{-1} m / 10^{1} m) and wavelength (proportional to the water depth).

3.27
embankment
artificial bank built to raise the natural bank level thereby reducing the frequency of flooding of adjacent land

3.28
fine sediment
sediment of grain sizes equal to or smaller than 'very coarse sand' (≤ 2 mm diameter, ≥ 2 mm −1 phi), i.e. sands, silt, clay

Note 1 to entry: The phi scale defines sediment grain size scale as the negative logarithm to the base 2 of the grain diameter in millimetres.

3.29
floodplain
valley floor adjacent to a river that is (or was historically) inundated periodically by flood waters and is formed of sediments deposited by the river

3.30
flow regime
typical magnitude, frequency, timing, and duration of river flows that drive physical and some ecological processes and so, within the constraints of valley slope and confinement, influence the sizes and types of river channel that could be present

3.31
fluvial geomorphology
scientific study of the physical processes, form and functioning of rivers and streams and their physical interactions with the surrounding landscape

3.32
forced bar
non-mobile bar whose position is forced by the presence of natural (e.g. large wood) or artificial structures

Note 1 to entry: See also 'bar'.

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3.33
forced pool
non-mobile pool whose position is forced by the presence of natural (e.g. large wood) or artificial structures

Note 1 to entry: See also 'pool'.

3.34
gabion
wire basket containing stones, used for river-bed or bank protection

3.35
hyporheic zone
spatio-temporally dynamic ecotone between the surficial benthic substrate and the underlying aquifer

[SOURCE: EN 16772:2016, 2.13]

3.36
hydromorphology
morphological and hydrological characteristics of rivers including the underlying processes from which they result

3.37
large wood
piece of wood that is more than 1 m long and 10 cm in diameter

3.38
landscape unit
area displaying distinctive combination of environmental attributes such as altitude, topography and geology

3.39
lateral connectivity
lateral continuity
freedom for water, sediments and biota to move between the channel and the floodplain/hillslopes

3.40
lateral movement
freedom for a river channel to move across a floodplain

3.41
longitudinal connectivity
longitudinal continuity
freedom for water, sediments and biota to move along the river channel

3.42
meander
one of a series of regular, sinuous curves along the course of a stream

3.43
planform
the geometric form of a river channel viewed from above

EXAMPLE Sinuous, straight.

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3.44
pool
distinctly deeper part of a river bed that is usually no longer than one to three times the channel's bankfull width, and where the hollowed river bed profile is sustained by scouring

3.45
pseudo-meandering
river with a meandering, baseflow channel, defined by alternate side bars within a less sinuous bankfull channel

3.46
rapid
area of steep confined river bed composed of boulders and large cobbles, often organized into irregular lines approximately perpendicular to the channel and partially or completely crossing the channel width that are only exposed at low flow

3.47
reach
section of river along which boundary conditions are sufficiently uniform that the river maintains a near consistent internal set of process–form interactions

Note 1 to entry: In some situations, chemical changes along the length of a river, as well as physical and hydrological ones, could also be important in defining river reaches.

3.48
reinforcement
strengthening of river beds and banks for various purposes (e.g. ford construction, erosion control) using materials such as boulders, sheet piling, geotextiles, etc

[SOURCE: EN 15843:2010, 3.21]

3.49
ridge and swale
arcuate, alternating floodplain features, where the ridge is a rising, elongated deposit and the swale is a depression, which develop from scrolls as they are incorporated into the floodplain

3.50
riffle
fast-flowing shallow water area of a river bed with a distinctly broken or disturbed water surface over a gravel/pebble or cobble substrate

3.51
riparian zone
transitional, semi-terrestrial area of land adjoining a river channel (including the river bank) that is regularly inundated and influenced by fresh water and can influence the condition of the aquatic ecosystem (e.g. by shading and leaf litter input and through biogeochemical exchanges)

Note 1 to entry: 'Riparian corridor' is the linear extension of this concept along a channel or reach length; in this document, the term 'riparian zone' does not include the wider floodplain.

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3.52
ripple
small fine sediment (sand-silt) river-bed features of a few centimetres high, linear in plan, with a long crest perpendicular to the flow

Note 1 to entry: See also 'dune'.

3.53
river bed incision
process where a river has cut vertically to lower its bed

3.54
river channel cross profile
two-dimensional representation of river channel morphology perpendicular to the flow

3.55
river hydromorphological type
group of river channels displaying similar morphological and hydrological characteristics and their associated processes

3.56
river long profile
two-dimensional representation of river bed topography, where bed elevation is plotted against longitudinal distance downstream along the channel

3.57
restoration
establishment of natural physical processes (e.g. variation of flow and sediment movement), features (e.g. sediment sizes and river shape) and physical habitats of a river system (including submerged, bank and floodplain areas)

3.58
runoff
net discharge of water into the stream from surface-water and groundwater sources with losses occurring from evapotranspiration and other consumptive uses

3.59
scour hole
scour pool
local, often deep, scouring of the river bed, exploiting weakness in bedrock or downstream of roughness elements such as rock, boulder or wood steps

3.60
scroll
linear ridge deposit formed on point and counterpoint bars of meandering rivers, which, when incorporated into the floodplain develop into ridges and swales

3.61
sediment transport
movement of sediment particles of a range of sizes by flowing water, which could include mobilization and deposition

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3.62
sheet piling
material used for vertical bank protection

EXAMPLE Corrugated metal sheets.

3.63
sinuosity
distance from upstream to downstream along the channel centre line between two point, divided by the distance along the valley course between the same points

Note 1 to entry: The two points need to span a sufficient distance to differentiate river channel from valley curvature.

3.64
spatial unit
subdivision of a catchment at various geographical scales

EXAMPLE Catchment, landscape unit, valley segment, reach

3.65
stream power
rate of energy dissipation against the bed and banks of a river per unit downstream length, which when divided by channel width gives the specific stream power

3.66
substrate
material making up the bed of a river

3.67
valley segment
section of river subject to similar valley-scale influences and energy conditions

3.68
wandering
transitional river planform between single-thread and multi-thread (braiding, anabranching), displaying a single flowing thread within the bankfull channel that splits locally into two or more threads separated by bars, or channels separated by permanently vegetated areas (islands)

3.69
watershed
line delimiting the outer topographic boundary of a catchment or drainage basin

3.70
weir
artificial structure across a river for controlling flow and upstream surface level, or for measuring discharge

3.71
wetland
habitat occupying the transitional zone between permanently inundated, and generally dry, environments

EXAMPLE Marsh, fen, shallow temporary water.

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4 Principle

A standard protocol is described for recording the physical features and assessing the processes of river channels, banks, riparian zones and floodplains. The range of features and processes to be taken into account, and the methods used for assessment, might vary according to river character and the objectives of the study. This document provides a common framework for these different methods. Guidance is given on the characteristics that should be used for defining river hydromorphological 'types' (see Clause 3) and for further assessment of hydromorphological integrity through comparisons with reference conditions. The document recognizes that rivers are dynamic, and observing the way that they have changed in the past helps in understanding their present condition, how they might look in a less modified (reference) state, and how they could change in the future. The selection of features and processes for survey and assessment will depend upon geographical scale and on the purpose of the exercise, with some suitable for characterizing river hydromorphological types, some for assessment, and some for both.

5 Study context and requirements

5.1 Investigating hydromorphology across both space and time

The hydromorphological features of particular lengths or 'reaches' of river reflect the biogeographical region in which they are located. These features vary along a river and over time in response to local gradient, river flows, sediment movements, and vegetation colonization and growth, as well as human interventions and pressures that disrupt or alter processes in the channel and in the wider catchment.

A river could be responding to several factors operating over different timescales. Many of the features observed today are strongly influenced by characteristics and processes beyond the river reach, notably across the surface of the river's catchment and its different landscape units and also within the valley segment that contains the reach. Therefore, it is important not only to identify features and processes found within a river reach but also to understand how these relate to processes in the catchment, landscape and valley within which the reach is located (Figure 1). By understanding the catchment setting of reaches and changes over time, it is possible to establish:

— why certain hydromorphological features are present within reaches;

— how they could have changed in the past and might change in the future;

— whether the features found within a particular river reach are responding to natural river processes, human pressures and interventions, or a combination of both;

— whether a particular reach is suitable to serve as a reference state for river assessment purposes and to inform restoration of other reaches within a particular landscape, catchment and biogeographical setting.

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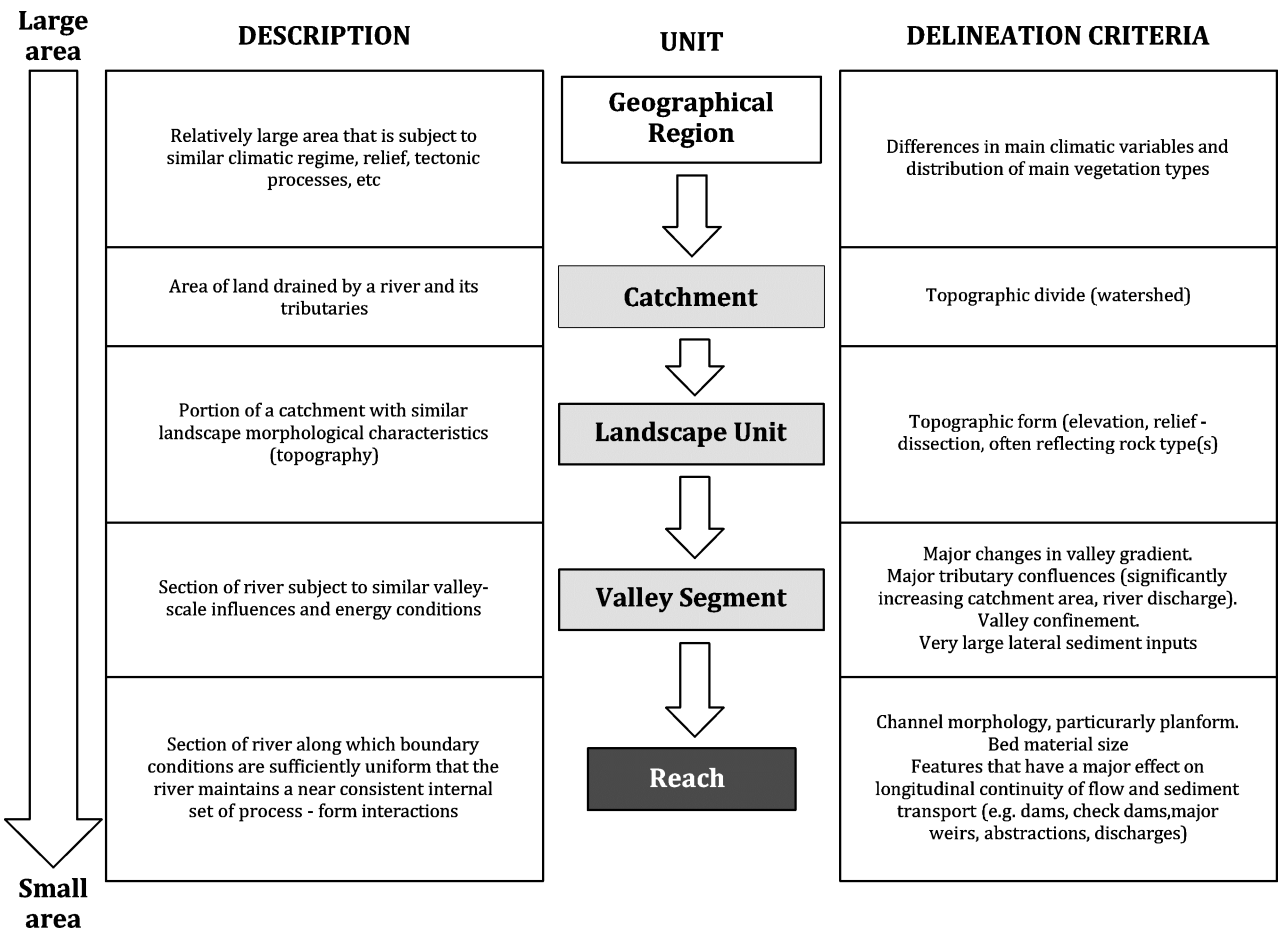

Figure 1 — The spatial units that govern the processes affecting the hydromorphology of river reaches, their typical size and the criteria that can be used to delineate them

5.2 Desk study

The first stage in a thorough investigation of the hydromorphology of rivers is a desk study. This gathers information from a wide variety of contemporary and historical sources including maps, remotely-sensed images, time series (e.g. river flow records) and other sources such as technical records (e.g. structures in the river channel, bank/bed reinforcement, sediment mining/removal) relating to particular locations, including previous hydromorphological survey work. When using aerial imagery, it is useful to establish the flow at the time of image capture and the recent flow history (e.g. 3 to 5 years for dynamic rivers) to ensure a correct interpretation. In addition to local sources of information, there are many freely available pan-European data sets (Annex A) that can complement local data sources to support desk studies.

A desk study helps to delineate spatial units within a catchment (Figure 1) and to characterize them. Such a desk study allows information to be compiled about the river catchment, its different landscape units, valley segments and river reaches, including information about changes that could have occurred in the past. Wherever possible, changes should be investigated over at least the last 100 years or the period since major human impacts have occurred.

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