

1 - METHOD BACKGROUND

NAME OR CODE	RHAT - River Hydromorphology Assessment Technique
COUNTRY	Northern Ireland & Republic of Ireland
KEY REFERENCE	Murphy & Toland (2012)
WEBPAGE	
CATEGORY	The method mostly characterizes physical habitats even though the intent is to give a holistic visual assessment

2 - METHOD CHARACTERISTICS

A - SOURCE OF INFORMATION / DATA COLLECTION	Maps/Remote sensing	A preliminary "Desk-study" is conducted prior to field work (historical maps for historical changes in planform/pattern, vegetation cover types, general river width, info on artificial pressures, preliminary assessment/identification of bank vegetation, etc.)	
	Field survey	Spot-check survey (one 10 m stretch): to assess pressures/specific characters situated not in the selected reach (to better assess the river body as a whole); when there are limitations to carry out a full RHAT field survey (in that case data are collected from a vantage point, such as a bridge). Full RHAT survey: along all the river reach by stopping each 50 m (stretches) + sweep-up survey	
	Rapid field assessment	NOT APPLICABLE	
	Existing database	Information on restoration or management activity	
B - SPATIAL SCALE	Modelling	It uses COMPASS Typology prediction tool, to predict river typology from characters such as sinuosity, etc. (during the Desk-study). Typology must be confirmed in the field	
	HIERARCHICAL SPATIAL SCALE	River catchment/Water body/ Reach/Cross Section	Information is collected at the catchment scale but only the reach scale is assessed
	LONGITUDINAL SPATIAL SCALE	Fixed length Scaled to channel width Variable length	Stretch (& single Spot-check) = 50 m field survey; Sweep-up field observations = 500 m, a full RHAT survey = 10 stretches each 50 m + Sweep-up NOT APPLICABLE NOT APPLICABLE
C - TEMPORAL SCALE	LATERAL SPATIAL SCALE	Channel Banks/Riparian zones Floodplain	Assessed at 10 stretches of 50 m each one, and at the Sweep-up scale (500 m) Assessed at 10 stretches of 50 m each one, and within 1 m, between 1 and 5 m and between 5 and 20 m from the banktop, and at the Sweep-up scale (500 m)
	Physical and morphological assessment Hydrological assessment		The method assesses mainly the present time, but information on channel changes (pattern, adjustments, etc.) is collected during the Desk-study phase NOT APPLICABLE
D - TYPE OF METHOD	Characterization/classification		The method makes a qualitative (sometimes semi-quantitative) inventory presence/absence/excessive presence) and characterization of features The method carries out a classification of hydromorphological status according to 8 criteria: 1.Channel morphology and flow types; 2. Channel vegetation; 3. Substrate diversity and condition; 4. Barriers to continuity; 5. Bank structure and stability; 6. Bank and bank top vegetation; 7. Riparian land cover; 8. Floodplain interaction. 8 classified attributes are scored from 4 (high) to 0 (bad) => Hydromorph Score = sum of attribute scores/32 (from 0 to 1)
	Assessment by index		It classifies river hymo based on the deviation from naturalness (depending on river type)
	Deviation from reference		NOT APPLICABLE
	General assessment / Design framework		NOT APPLICABLE
	Modelling status / Scenario		NOT APPLICABLE
Final expert judgment		NOT APPLICABLE	
Links with other systems		NIEA developed a method to convert RHS survey into RHAT classification using field forms, photographs and maps (Webster et al. (2011), to allow the comparison between recent RHAT surveys and previous RHS surveys	
E - REFERENCE CONDITIONS			The method uses a theoretical approach of reference conditions based on expected (modelled) river type; the scoring system provides a description of each reference river types for each of the 8 assessment categories
F - GENERAL INFORMATION	RIVER TYPOLOGY		Four RHAT river types: bedrock (BED), step-pool-cascade (CSP), pool-riffle-glide (PRG) and lowland meandering (LLM). These are defined on the basis of selected features (system A)
	TYPOLOGY LIMITATIONS		The use of RHAT method is limited to selected river typologies. It does not apply to ephemeral streams and to multi-thread rivers
	TYPE-SPECIFIC (Protocol / Assessment method)		No type specific protocol or assessment method for river types (but river types are considered when attributes are scored/assessed)
	BASIS FOR STANDARDS / THRESHOLDS		A description of deviation from high status is provided in the scoring system for each status class: high = 95-100% natural; good = 85-95% natural; moderate = 65-85% natural; poor = 25-65% natural; bad < 25% natural
	REACH SCALE SURVEY STRATEGY		A reach is selected as representative of the water body: 10 stretch each 50 meters + sweep-up (overview) survey. 2 additional Spot-check are assessed to validate the river status classification
	TIMING AND FREQUENCY		No information on duration is available. For intercalibration and quality control purposes, two sites per surveyor (per survey season May-September) should be surveyed
	DATA PRESENTATION (OUTPUT/LAYOUT)		Field forms, classification status, photos, Hydromorph Score (index)
	METHOD SUPPORT / APPLICATION TOOLS		A manual with Field sheets and Guidance notes is provided, as well as a Scoring System manual. It is also recommended to take photos which will help to record and assess features satisfactorily; a photo detail sheet is provided
	SPATIAL COMPARISON		It may be possible between same river types
	CONNECTION TO ECOLOGY		It could be used to assess eco-relevant habitat changes, given that it records the presence of shading, fallen trees, leafy debris, etc., and it evaluates the diversity and quality of in-channel habitats (attribute 2) and bank/riparian habitats (attribute 6)
	USERS		It is recommended to follow a specific training from RHAT accredited by NIEA/EPA staff (attribution of a surveyor code)
	SCALE INFORMATION		Both large and local scale info are collected to characterize a water body (not catchment scale)
	NUMBER OF END PARAMETERS		4 sheets: Sheet 1 = Site identification info, Desk-study notes and Field notes; Sheet 2 = scoring system (8 attributes assessed); Sheet 3 and 4 = field observations at 10 stretches (3) and Sweep-up (4). Parameters observed (in the field): 5 main and 38 sub-parameters (sheet 3) + 7 main and 26 sub-parameters (sheet 4)

3. RECORDED FEATURES

	LARGE SCALE CHARACTERISTICS	Geology, vegetation cover types, land cover, large scale pressures
A - CATCHMENT / VALLEY	HYDROLOGICAL REGIME	Hydrological conditions Metrics of hydrological regime
	VALLEY FORM / FEATURES	It also records the weather during the weeks before the survey (if rainy) NOT APPLICABLE NOT APPLICABLE 7 types of river valley form to be assessed on the field
	CHANNEL PATTERN / PLANFORM	Straightening, widening changes from map/photo analysis
	CHANNEL FORMS	Channel forms are partially recorded at the "Bank and Channel Features" section at Sweep-up scale
	BED CONFIGURATION	Their presence/absence is evaluated at the specific river type
	CHANNEL DIMENSIONS	River width estimated on the Desk study and on the field at three places within the first 50 m, to the nearest meter; river depth is also estimated at the start of the survey
B - CHANNEL	FLOW-TYPE	Same as RHS
	PHYSICAL / HYDRAULIC VARIABLES	NOT APPLICABLE
	SUBSTRATE	Same as RHS
	IN-CHANNEL VEGETATION	Marginal emergent plants, Liverworts/mosses/lichens and In-Channel vegetation (several categories)
	WOODY DEBRIS	Called "Woody habitat", includes tree trunks, logs, twigs and branches
	ARTIFICIAL FEATURES AND STRUCTURES	Named "Channel modifications", same as RHS. It also counts the number of bridges and weirs, proportionally to their physical (spatial) impact on stretch. Channel modifications are assessed either at the Stretch (detailed) and the Sweep-up scale of analysis (for the extension)
C - RIVER BANKS/ RIPARIAN ZONE	BANK PROFILE / SHAPE	Indirectly assessed through "eroding/stable cliff"
	BANK MATERIAL	Same as RHS
	RIPARIAN VEGETATION STRUCTURE	Same as RHS (at banktop and bankface)
	LONGITUDINAL CONTINUITY OF RIPARIAN VEGETATION	Same as RHS; assessed at the Sweep-up scale
	RIPARIAN VEGETATION WIDTH	Probably indirectly assessed through riparian land cover types
	VEGETATION COMPOSITION, COVERAGE AND OTHER RIPARIAN VEGETATION CHARACTERISTICS	The presence and qualitative extension of bank non-native/disturbance species
	ARTIFICIAL FEATURES AND STRUCTURES	"Bank modifications" same as RHS. Bank modifications are assessed both at the Stretch (detailed) and the Sweep-up scale of analysis (for the extension)
	LAND USE	Land use and land cover within 1 m, between 1 and 5 m and between 5 and 20 m from the banktop. Riparian land cover status is assessed with attribute 7
D - FLOODPLAIN	FLUVIAL FORMS	Same as RHS. They are recorded at the "Bank and Channel Features" under "other natural features" section at Sweep-up scale
	INFO ON FLOODPLAIN FEATURES	NOT APPLICABLE
	LAND USE	Land use and land cover within 1 m, between 1 and 5 m and between 5 and 20 m from the banktop; Type of resource uses that take place around the river

4. RIVER PROCESSES

A - LONGITUDINAL CONTINUITY	Sediment and wood	The method assesses the impact of Barriers to continuity (attribute 4) from a large point of view
	Water flow	The method assesses the impact of Barriers to continuity (attribute 4) from a large point of view
B - LATERAL CONTINUITY	Lateral hydraulic continuity	The method records whether the channel is naturally or artificially confined, or not confined, and it uses this information for the score of Floodplain interaction (attribute 8)
	Sediment (and wood) lateral continuity	The method assesses sediment diversity and conditions (attribute 3), specifically for each river types; in relation to upstream network contribution (mainly from tributary)
C - BANK EROSION / STABILITY		Bank erosion/stability is assessed in terms of deviation from natural expected dynamic for each river type (attribute 5)
E - CHANNEL ADJUSTMENTS	Planimetric (pattern & width)	The method uses historical maps/photos during the Desk-study phase to highlight and support the assessment of historical changes in planform/pattern (attribute 1)
	Vertical	NOT APPLICABLE (it is considered only in terms of floodplain connection, attribute 8)
F - VERTICAL CONTINUITY	Groundwater connection	NOT APPLICABLE

5. APPLICATION TO WFD

OFFICIAL METHOD (WFD implementation) / COMMONLY USED METHOD (not compulsory)	The method has been developed from the RAT (Richards, 1996) previously developed on the basis of RHS and US-RBP. It complies with CEN standard and WFD requirements. RHAT has been developed specifically for Water Framework Directive compliance
APPLICATION TO ALL WATER BODIES	Consistently with WFD, the method records resource uses that take place around the river (so potentially used for the designation of HMWBs and AWBs)
USED IN THE CLASSIFICATION OF HIGH-STATUS / OTHER STATUS CLASSES	Used in the classification of any status: a minimum of one full RHAT survey and 2 spot checks (to confirm or reject the results of RHAT survey) are required to water body classification using RHAT
USED TO PREDICT RISK OF DETERIORATION	Potentially able to detect risk of deterioration
USED TO IDENTIFY IMPROVEMENT TARGETS	It could be used in deciding what indirect and direct efforts are needed to improve status
USED TO HELP IDENTIFY CAUSE OF ECOLOGICAL IMPACTS	Following the authors, RHAT plays a vital role in identifying why a water body might be failing to achieve good ecological status
KEY STRENGTHS FOR RIVER MANAGEMENT	Easiness of application, cost-effective, flexible in the field (e.g. the score is adjusted when a feature is not visible on the field), it provides results closely aligned to expert-based assessments (at least in Irish rivers)