1 - METHOD BACKGROUND

NAME OR CODE	**MImAS - Morphological Impact Assessment Method**
COUNTRY	Scotland
KEY REFERENCE	UKTAG (2008)
WEBPAGE	http://www.wfduk.org/
CATEGORY	It is a morphological impact assessment system (tool) which aims to support stakeholders to identify whether morphological alterations/changes (interventions) may cause risk to fail the achievement of ecological objectives (related to WFD). Developed by SNIFFER (Scotland and Northern Ireland Forum For Environmental Research)

2 - METHOD CHARACTERISTICS

A - SOURCE OF INFORMATION / DATA COLLECTION		Maps/Remote sensing	A desk study is carried out to determine channel type in case there is no typology information in the SEPA River Type database. Maps and aerial photos are also used to identify impacts (Morphology Pressures Database) and the structure and extent of riparian vegetation cover (Riparian Vegetation Database)
		Field survey	To collect data on pressures where needed (Morphological Pressure Survey Guidance). In some cases (high risk; assessment failure; river status falls at class boundary) field survey is needed to support the Desk-study in determining the channel type, as well as to support management activities (fine sediment pollution, catchment scale, coarse sediment management)
		Rapid field assessment	NOT APPLICABLE
		Existing database	It uses data from existing databases in terms of river conditions. It uses database to determine channel types (SEPA River Type database).The SEPA developed a Morphological Pressures Database (MPD) that is a key input for module 4, and a Riparian Vegetation Database.
		Modelling	NOT APPLICABLE
B - SPATIAL SCALE	HIERACHICAL SPATIAL SCALE	River catchment/Water body/ Reach/Cross Section	It uses a first bottom-up hierarchical spatial scale assessment system: it starts from an assessment at the local scale (500 m reach; Stage 1) to go to a larger scale (river surrounding catchment; Stage 2). Then, where needed, more detailed regulatory assessments (at smaller scale) are applied
	LONGITUDINAL SPATIAL SCALE	Fixed length	A 500 m local scale is evaluated in the first phase of risk assessment (Stage 1), which aims to identify: 1) low risk proposals that do not threaten ecological status; 2) proposals that exceed morphological limits (which can potential influence the ecological status) and would need the Stage 2 assessment
		Scaled to channel width	NOT APPLICABLE
		Variable length	In the Stage 2 of the assessment (when morphological limits are exceeded by proposed intervention), all the river body can be assessed (Water Body assessment)
	LATERAL SPATIAL SCALE	Channel Banks/Riparian zones	Channel zone and banks/riparian zone are assessed separately in terms of the river's capacity to support further morphological change (in Stages 1 and 2)
		Floodplain	The surrounding catchment is in part taken into account in the Stage 2 of the assessment (but none floodplain attribute is assessed, except connectivity, and presence of setback embankments)
C - TEMPORAL SCALE		Physical and morphological assessment	It assesses the present morphological conditions and provides an assessment for further morphological interventions. It accounts for both recent and historical engineering modifications
		Hydrological assessment	NOT APPLICABLE
D - TYPE OF METHOD		Characterization/classification	MImAS is used to produce a classification across all five status classes every year. The results of classification are used to feed the Characterisation exercises
		Assessment by index	The method assesses the impact on morphological conditions (system capacity) through 5 semi-independent modules: 1) the attribute module (list of attributes to assess morphological and ecological function and condition); 2) the typology module (to select attributes proper for each river type); 3) the sensitivity module (ecological and morphological sensitivity assessment: resistance and resilience); 4) the pressure module (25 pressures assessed through 2 components: I) assessment of the impact of pressure on morphological attributes, after module 1-2; II) assessment of the impact of the pressure in terms of spatial scale extent = 'zone of impact'); 5) the scoring system (a numerical 'impact rating' by combining results of previous modules). It calculates the '% capacity used' for the section of river considered, given by combining the 'impact rating' to the alteration footprint (type of alteration and affected river length) calculated for that river length, and then added for all morphological alterations. The '% capacity used' is compared to limits for Environmental Standards (also called MCLs = morphological conditions limits), to assess the risk to ecological status. The method takes into account also the effect of a single discrete alteration that may have impact on the ecological integrity, even if the sum of alteration along the entire water body does not impact the ecological status
		Deviation from reference	NOT APPLICABLE
		General assessment / Design framework	It is a decision-making framework: 1) to support river engineering activity in accord to WFD requirement; 2) to assess if present morphological alterations are compatible with the achievement of WFD objectives (good and high ecological status); as well as 3) to assess the morphological status across all five WFD classes. It does not make a quantitative inventorying
		Modelling status / Scenario	It models the risk of impact for morphological and ecological status considering changes in pressure (new impacts)
		Final expert judgment	The expert judgment enters in the assessment process several times: e.g. the assessment of sensitivity (module 3); the Environmental standards are defined/proposed by experts (authors) for each river zone (channel, banks and riparian area)
		Links with other systems	It is a complex protocol assessing: 1) the ecological and morphological sensitivity; 2) the 'impact rating'; 3) the '% capacity used' and compares that to Environmental Standards; 4) the effect of single discrete alterations
E - REFERENCE CONDITIONS			It makes use of theoretical reference conditions through its concept of system capacity. Where a river uses no, or virtually no, system capacity, then all the river processes and forms described by the eco-geomorphological variables for the particular river type are deemed to be present

	RIVER TYPOLOGY		The module 2 (Typology module) identifies 6 river types on the basis of river morphological similarities (from high energy to low energy rivers) and as function of their response to morphological alteration. This module is used to select significant attributes of module 1 (the attribute module), relevant for the assessment of a given river type, and to assess river sensitivity (module 3). The method considers that the response of a rivers morphology to an engineering or other pressure is predictable for that type of water body
	TYPOLOGY LIMITATIONS		It applies to the 6 identified river types. It directly applies to river that are longer than 5 km; for rivers less than 5 km long, the method must be applied in conjunction with another water body on the same tributary/main stem (to reach 5 km). Apparently it does not apply to temporary streams
	TYPE-SPECIFIC (Protocol / Assessment method)		Specific attributes are used to assess specific river types. River types are used to make the preliminary assessment of the river sensitivity (Module 3; morphological and ecological sensitivity). In the module 4 (pressure module), not type specific, differences between types are derived by combining river type sensitivity and type of pressure. Each morphological alteration (pressure module n. 4) has its own impact rating, which is specific to each channel type
	BASIS FOR STANDARDS / THRESHOLDS		The 'impact rating' = combining info obtained from each module (3 modules: typology * ecological sensitivity * morphological sensitivity * impact of pressure on attribute); the rating is calculated for each attribute and then averaged for channel, banks and riparian zone; the value is multiplied for impact zone to get an overall impact rating for each morphological alteration. Environmental standards are given in terms of '% capacity used', where the system capacity is defined as the ability to absorb morphological variations without affect the ecological integrity. Environmental Standards are defined/proposed by authors for each river zone: higher morphological conditions are, lower is the % capacity used (condition limits are not type specific)
F - GENERAL INFORMATION	REACH SCALE SURVEY STRATEGY		During the Stage 1 all the 500 m reach is assessed; in general the assessment depends upon the extent (L) of morphological alteration considered
	TIMING AND FREQUENCY		The assessments represent a snapshot in time. Some assessment of change through time could be obtained as pressures are modified (added or removed) and the calculation re-run
	DATA PRESENTATION (OUTPUT/LAYOUT)		A final PDF report (from the Oracle software) is obtained which summarises all versions of the current assessment calculations (predicted morphological status, '% capacity used', the risk of deterioration assessment)
	METHOD SUPPORT / APPLICATION TOOLS		An Oracle-based application and a database containing the present state of surveyed reaches; Morphological Pressure Survey (MPS) Guidance; Morphology Pressures Database (MPD; the field method, to update data); Riparian Vegetation Database
	SPATIAL COMPARISON		It allows for comparison between same river types
	CONNECTION TO ECOLOGY		The connection is either direct and not. the method aims to support ecological assessment (surrogate for robust ecological assessment methods). It assumes the existence of a relationship between the extent of morphological alteration and the impact on ecological status. The assessment of ecological sensitivity (module 3) considers whether a degradation of community or species integrity is likely to occur in response to a disturbance to individual attributes, and for each river type (attributes of module 1)
	USERS		It has been developed to be used by non-experts
	SCALE INFORMATION		It provides reach scale information (500 m length) and water body scale information, according to the type of assessment
	NUMBER OF END PARAMETERS		5 modules. Module 1 (attributes): 2 main groups of parameters according to fluvial zones (channel and banks/riparian area) and several parameters. Module 2 (typology): 6 channel types. Module 3 (sensitivity): divided into 2 parts, ecological (all WFD BQEs) and morphological (for each attribute and river type). Module 4 (pressure): between 15 and 25 different types of pressures are included; either 'type of impact' (likelihood) and 'zone of impact' are considered. Module 5 (the scoring system): 'impact rating' (from previous modules), '% capacity used' (impact rating, footprint of the alteration, reach length)

3. RECORDED FEATURES

A - CATCHMENT / VALLEY	LARGE SCALE CHARACTERISTICS		Large scale characteristics are intrinsic in the channel typology definition (e.g. geology, slope, confinement)
	HYDROLOGICAL REGIME	Hydrological conditions	NOT APPLICABLE
		Metrics of hydrological regime	NOT APPLICABLE
		Hydro-peaking	NOT APPLICABLE
	VALLEY FORM / FEATURES		Degree of channel confinement to obtain channel type
B - CHANNEL	CHANNEL PATTERN / PLANFORM		Hydraulic geometry (planform)
	CHANNEL FORMS		Hydraulic geometry (planform, cross section); erosion/deposition character (bar character)
	BED CONFIGURATION		Hydraulic geometry (cross section, profile); erosion/deposition character (bedform pattern)
	CHANNEL DIMENSIONS		NOT APPLICABLE
	FLOW-TYPE		NOT AVAILABLE
	PHYSICAL / HYDRAULIC VARIABLES		NOT APPLICABLE
	SUBSTRATE		Substrate conditions (size, embeddedness, compaction)
	IN-CHANNEL VEGETATION		In-channel vegetation (structure and extent of in-stream vegetation)
	WOODY DEBRIS		In-channel vegetation (structure and extent of woody debris)
	ARTIFICIAL FEATURES AND STRUCTURES		E.g. bed modification/reinforcement; sediment removal; culvert, pipes, flow deflectors; bridge piles; impoundment; channel straightening
C - RIVER BANKS/ RIPARIAN ZONE	BANK PROFILE / SHAPE		Banks and riparian zone (bank morphology; bank roughness)
	BANK MATERIAL		NOT APPLICABLE
	RIPARIAN VEGETATION STRUCTURE		Banks and riparian zone (riparian vegetation structure)
	LONGITUDINAL CONTINUITY OF RIPARIAN VEGETATION		Continuous record of the structure and the presence of tree cover (through the Riparian Vegetation DB)
	RIPARIAN VEGETATION WIDTH		NOT APPLICABLE (riparian vegetation is assessed over a width of 2m from the bank top)
	VEGETATION COMPOSITION, COVERAGE AND OTHER RIPARIAN VEGETATION CHARACTERISTICS		Presence of Invasive Non-Native Species
	ARTIFICIAL FEATURES AND STRUCTURES		E.g. embankments and set-back embankments (< or > 10 m from the channel or one channel width); alteration of riparian vegetation structure complexity (e.g. removal, total and/or partial); bank revetment/reinforcement (soft = with vegetation; hard = without vegetation)
	LAND USE		NOT APPLICABLE

D - FLOODPLAIN	FLUVIAL FORMS	NOT APPLICABLE
	INFO ON FLOODPLAIN FEATURES	NOT APPLICABLE
	LAND USE	Presence of setback embankments on the floodplain is assessed as a pressure

4. RIVER PROCESSES

A - LONGITUDINAL CONTINUITY	Sediment and wood	The method assesses the impact of impoundments in terms of total length of channel impounded upstream from a dam or a weir. Longitudinal connectivity (sediment transport, migratory movement) is not directly accounted for
	Water flow	
B - LATERAL CONTINUITY	Lateral hydraulic continuity	The method assesses the impact of minor and major embankments. Floodplain connectivity is taken into account
	Sediment (and wood) lateral continuity	The method assesses the impact of the alteration of vegetation structure (vegetation and wood removal). Floodplain connectivity is taken into account
C - BANK EROSION / STABILITY		Erosion/deposition character
E - CHANNEL ADJUSTMENTS	Planimetric (pattern & width)	Erosion/deposition character (lateral rate of adjustment)
	Vertical	NOT APPLICABLE
F - VERTICAL CONTINUITY	Groundwater connection	NOT APPLICABLE

5. APPLICATION TO WFD

OFFICIAL METHOD (WFD implementation) / COMMONLY USED METHOD (not compulsory)	It is the tool used for WFD classification in Scotland by the SEPA
APPLICATION TO ALL WATER BODIES	HMWBs and AWBs are not considered
USED IN THE CLASSIFICATION OF HIGH-STATUS / OTHER STATUS CLASSES	It is used to classify water bodies into all five status classes
USED TO PREDICT RISK OF DETERIORATION	It has also been developed for this purpose
USED TO IDENTIFY IMPROVEMENT TARGETS	It has been developed to identify when deteriorations of status may need to be managed
USED TO HELP IDENTIFY CAUSE OF ECOLOGICAL IMPACTS	It is also a tool to allow for the assessment of risk of failing the Good ecological status
KEY STRENGTHS FOR RIVER MANAGEMENT	It can be used to support the feasibility of engineering works, through the assessment of risk that an intervention may cause in terms of morphological (and then ecological) impact; it is practicable and not time-spending (not inventorying); it allows to generate a classification - every year, or as frequently as needed - and to undertake assessments of engineering licence applications (as when required) for all baseline water bodies in Scotland; it's modular nature means that different bits of the method can be incrementally updated as and when further data are collected or when better understanding of the interactions between pressures, geomorphological and ecological processes is reached; the expert judgment is 'coded' into the framework, allowing the expert judgment assessments to be applied consistently to every single assessment and in a way that is transparent and auditable.