HYDROMORPHOLOGY

Reference: CS-34

Critical assessment tool for the status of water bodies, aiming to support the objectives of the EU Water Framework Directive (WFD).

Hydromorphology is a term used to define the combination of hydrological and geomorphological processes which forms an integral part of the WFD, aiming to achieve good status by 2015 in all water bodies. GWP Consultants LLP has expertise across hydromorphology, hydrology and hydrogeology, enabling a multidisciplinary approach to wide-ranging projects both in the UK and overseas.

Hydromorphology is primarily focused towards the physical modification of water bodies and the management of environmental flows, including both high/flood flows and low flows. It has been identified that hydromorphology and in particular, physical modification of water bodies is a significant factor causing the failure of water bodies to reach good ecological status within the WFD.

Hydromorphological expertise can be applied directly in terms of geomorphological environmental impact assessments (EIAs) for schemes such as water abstraction or impoundment, whilst indirectly it is applied to aspects of flood risk management, including flood risk assessments and surface water management schemes.

GWP has worked on 12 No. micro hydropower schemes across Cumbria and Wales, providing both qualitative and quantitative geomorphological impact assessments as well as providing a revised, environmentally sensitive approach to hydraulic weir design.

Related expertise:

- Geomorphological EIA
- Flood Estimation Handbook techniques
- Design of hydraulic structures
- Rainfall runoff modelling
- Hydrological catchment modelling and flood routing
- Geotechnical design
- Detailed topographic surveying
- Geographic information systems (GIS)

Selected projects

Case Study: Geomorphological impact assessment and sediment transport analysis, Lake District, Cumbria, UK

Field observations, bed sediment sampling, channel dimension surveys and detailed hydrological analysis of the changes imposed upon the flow regime by the proposed abstraction have facilitated hydromorphological assessments of sediment transfer dynamics at 3 No. sites.

A number of quantitative geomorphological approaches were applied to assess whether the derogated hydrological regime would be sufficient to mobilise sediment and rework the bed. Due to the flashy nature of the largely impermeable upland catchments and the relatively limited abstraction rates, calculations predicted that geomorphologically important flows were not significantly affected and the critical velocities and shear stresses required for particle entrainment would continue to be exceeded regularly, thus sediment transfer dynamics remained largely unchanged.

Case Study: Geomorphological impact assessment, North Wales, UK

A total of 7 No. hydropower projects have been completed across the Welsh highlands, comprising qualitative assessments of sediment transport mobilisation. Due to the ungauged nature of the catchments, estimated annual flow duration curves were utilised in order to calculate flow derogation for a range of flow magnitudes.

An assessment of the predicted impacts during all phases of construction, operation and decommissioning were provided, recognising appropriate mitigation measures to improve morphological functioning of the channel and its WFD status.

Case Study: Geomorphological impact assessment and hydraulic weir design, North Wales, UK

Geomorphological assessment and hydraulic weir design for 2 No. proposed hydropower schemes. GWP was involved in both projects from the offset, selecting the most suitable intake location to minimise geomorphological impact.

GWP revised the approach to weir design for high head hydropower intake structures, aiming to enhance sediment transport downstream. By utilising a flume as the hydraulic control to pass the residual flow (Hands off Flow), opposed to the industry standard V-notch weir or orifice, a similar level of accuracy is provided whilst there are many additional benefits; passing sediment and debris, enabling backfilling up to the flume floor level, improvements for passing fish and reduced maintenance.

Case Study: Water quality management and discharge consents

Surface water management strategy for the proposed construction of overburden landforms associated with the extension of the mineral extraction area at a quarry in Leicestershire.

Overburden tips enhance sediment mobilisation in response to increased surface slope, vegetation and topsoil removal, requiring the design and specification of attenuation storage and siltation lagoons.

Vegetated silt ponds were designed to remove suspended solids prior to discharging off-site, by ensuring sufficient residency times and laminar flow conditions, thereby reducing viral and bacterial loading of the discharge effluent. The strategy aims to prevent any deterioration of receiving water bodies in terms of the WFD.

Case Study: Arid zone flood risk management

Flood risk evaluation within arid, ungauged catchments on the island of Zirqu, Abu Dhabi to assess the suitability of the storm drainage network to route ephemeral storm wadi runoff across the site, discharging to the sea.

Rainfall data and the geomorphological characteristics of the wadi catchments were utilised to estimate peak flows within the drainage network using the Rational Method.

Single, 'leaky' gabion 'check' dams were recommended across the wadi channel, in order to reduce erosion and transportation of sediment in the upper wadi catchment, retaining sediment in the catchment and preventing siltation of pipe and box culverts.

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