WEEG NEWSLETTER March / April 2018

The newsletter is published monthly by the University of Southampton's Water and Environmental Engineering Group WEEG, and reports things of interest in this field worldwide, as well as ongoing undergraduate student and research work in WEEG itself.

We believe that water and energy are the most important topics worldwide for the next decades. Our work covers river and coastal engineering, water and wastewater and energy related to water.

Editorial: Today in Europe (and in the US) regulatory authorities remove existing dams in order to create what they call 'more natural rivers'. In the US, the most recent development goes in the opposite direction: build new, beaver-inspired dams to restore rivers, groundwater levels and ecosystems.

Hydraulic Engineering International: *new developments in River Restoration - Artificial Beaver Dams*

Many small streams in the arid and semi-arid western US suffer severely from the effects of the disappearance of beavers: depth incision and groundwater lowering, change in the flow duration curve from perennial to seasonal (or ephemeral, if you prefer that word) and the disappearance of salmon and other fish.

Fig. 1: Erosion and depth incision

Fig, 1 shows a typical example, where erosion and depth incision with reduction of the groundwater level over time is clearly visible. In order to stop and possibly reverse the erosion process, two different paths of action are currently being developed: beaver translocation, i.e. the settlement of beavers in the stream; or the construction of artificial structures: beaver dam analogues or Artificial beaver Dams (ABDs). The re-settlement of beavers is however only possible if the existing stream can support them (not possible e.g. in streams, which have become ephemeral) and if the beaver's activities do not disturb e.g. existing land usage or infrastructure. So, we will focus here on artificial structures which mimic beaver dams (see Fig 2). Currently, 14 such projects are ongoing in the US. This does not sound much, but one project in south western Montana has a total of 305 individual dams in several streams! The first dams were installed in 2014.

Fig. 2: Beaver Dam Analogue

One project in eastern Oregon used shallow rock dams built from local material. The landowner worked together with researchers from Oregon State University and reported that the dams changed the stream from ephemeral to perennial, created small ponds and raised the groundwater level. The vegetation changed from sagebrush to wet meadows, and the agricultural value of the land increased significantly. The regulators are however concerned about the effect of such dams e.g. on fish passage.

Fig. 3: ABDs in Silvies Basin, eastern Oregon

This is of course an interesting if very-short-range view, which does not consider what happened in the 15 or so million years before the beavers were extirpated and their dams removed. In Europe, we have the European Water Framework Directive, which intends to create more natural rivers. The definition of a natural river in the WFD assumes however that there are no blockages such as provided by beaver dams, and ultimately requires the removal of all dams. This again neglects the fact that beavers built their dams for a very long time, that the ecosystems of smaller

rivers evolved in this beaver-created environment and that the structures built by beavers are actually part of a natural river.

In general, it seems that ABDs / BDAs are being widely and increasingly used in the US to improve the hydraulic and ecological conditions of eroding small streams. Most projects have been implemented only recently, so that the long term effects are still unclear and a lot more work is required.

At Southampton, we are working on the engineering aspects of beaver dams in order to develop nature-based solutions which will prevent the negative effects caused by the disappearance of beavers. We will create low-cost technologies to restore streams, improve groundwater recharge, reduce incision and erosion and provide the basis for improved ecosystems around those rivers. And we want to re-write the WFD as well of course.

Implementation of 3rd and 4th year student projects: *Restoration of the Rivers Test and Itchen*

Over the past few years, our 3rd and 4th Year students have completed several projects to improve the environmental characteristics of a number of degraded zones of the Rivers Test and Itchen. Two of the students designs have already been implemented, the largest of which required the removal of a weir, plus 1,700 tons of gravel to re-profile the riverbed.

Last year, Jack Maggs and Tomasz Ciesielski did their individual projects (IPs) for the Environment Agency with the aim to develop a design that will improve the environmental status of the River Itchen just above Winchester, see Fig. 4. Their design will result in a re-profiling of the river bed by the import of gravel and the replacement of a side weir designed to pass 40% of flow to the side stream, and to allow easy passage of fish.

Fig. 4: Failed weir, discharging 50% more water than intended

The design adopted was a boulder pool drop approach, consisting of a series of transverse riprap sills placed on the riverbed, Fig. 5. The Environment Agency proposes to implement this design in October this year. A pretty good outcome for a student IP!

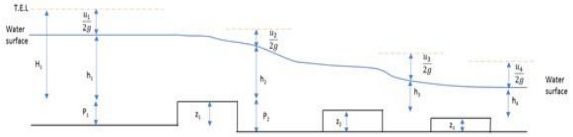

Fig. 5: Schematic of a boulder pool drop.

New PhD positions:

In our WEEG Water and Environmental Engineering Group we have a number of exciting new PhD projects advertised:

Project 1: Producing biofuels from wastewater. Supervisor: Dr Gustavo deAlmeida, email: G.deAlmeida@soton.ac.uk

Project 2: Microbial electrochemical system for wastewater treatment, biofuel production and nutrient recovery

Supervisor: Dr Yue Zhang, email:

Y.ZHANG@soton.ac.uk

Project 3: Low temperature solar thermal energy system for energy generation and desalination

Supervisor: Dr Gerald Muller, email: g.muller@soton.ac.uk

Project 4: Fundamental insights into sediment transport.

Supervisor: Dr Sergio Maldonado, email: S.Maldonado@soton.ac.uk

Project 5: 'Production of high value chemicals from waste in a biofilm based reactor

Supervisor: Dr Y Liu, email:

Y.Liu@soton.ac.uk

If you are interested, please contact the supervisor directly for information.

Civil and Environmental Engineering at Southampton University

WEEG: the Civil and Environmental Engineering pathway offers the chance to deepen your knowledge in water-related areas, and gives you a better preparation for environmental engineering projects.

Contact: Dr Sonia Heaven, s.heaven@soton.ac.uk, Bldg 7, Room 5004

Further information:

We have two Facebook pages, which provide a logbook of our laboratory activities:

www.facebook.com/Hydraulicslaboratory/

www.facebook.com/environmental.lab.university.of.southampton/

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