WEEG NEWSLETTER February 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: Water is essential to life. In arid countries such as Libya, the water supply for cities and agriculture is very problematic: or in technical terms, the country suffers from high water stress. In Libya, a very specific solution was found, relying on gigantic aquifers discovered 500 m below the Sahara desert: the Great Man-Made River.

Hydraulic Engineering International: *The Great Man-Made River – its story and what's happening today*

During oil exploration drills in the 1950s, a group of four very large aquifers was discovered below the Sahara. In the 1980s the Libyan government decided to exploit this resource by building pumping stations, reservoirs and several large pipelines to supply water to the big cities and for irrigation. This project was termed the 'Great Man Made River' or GMMR. Construction started in 1984, and reached Tripoli in 1996. The project comprises 1300 wells and 2,800 km of underground pipelines, and in its final stage supplies a total of 6,500,000 m^3 per day or 75 m^3/s. For comparison: the River Thames has an average flow volume of Q_{50} = 65.8 m^3/s. With an irrigated area of more than 100,000 hectares, the GMMR was also termed the largest irrigation project in the world.

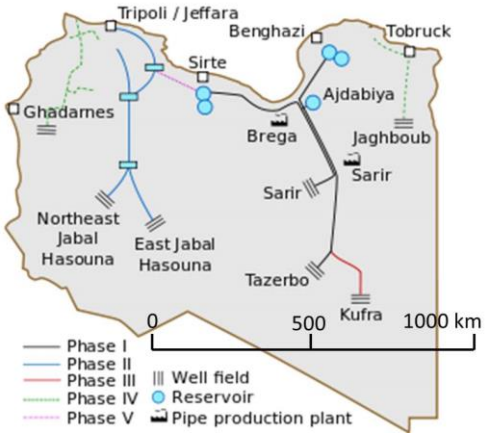

Fig. 1: the main system

Just to give you an idea of the distances: it's like pumping water from Southampton to Orkney, in the very North of Scotland. The total cost of the project is estimated at US$25bn, so you can see that hydraulic engineering projects can indeed be very large. The unit costs per m^3 of fresh water are supposed to be in the range of 10% of the costs for desalination. The estimates about how long the aquifer will last vary from 60 years to 1000 years.

Fig. 2: The concrete pipe sections give an impression of the dimensions of the project.

Phase III of the project has been completed, and today the GMMR delivers around 2,500,000 m^3 per day, or 28.9 m^3 per second. The water forms an essential part of Libya's water supply. It has a high salinity, but this however is deemed acceptable.

From 2011 onwards, the GMMR project suffered from political and military interference. The strong dependency of Libya's large cities and agricultural centres on the GMMR as the principal source of fresh water, in combination with external military involvement and the subsequent internal political instability, has created a very unstable supply situation. Again, one has to think of water as a weapon (see Newsletter April 2017). Then there's the question of sustainability…

This is of course a big issue with mega-projects such as the GMMR. Pumping groundwater which is not replenished cannot really be called a sustainable solution. It is often argued that pumping water is very similar to mining. Metal, however, can be re-used and a better comparison would be oil exploitation.

The reality seems to be that Libya has become very dependent on the GMMR; and not much seems to have been done to create a decentralised and more sustainable water supply system. The current political instability of course does not help. Here, it needs to be remembered that Libya was the principal agricultural country of the Roman Empire with a not abundant, but sufficient and well

managed water supply. The dependence on centralised big solutions, which are impressive as technological achievements, has today however created a vulnerability which is certainly not desirable.

PhD position available: "Multi-time-scale modelling framework for long-term prediction of coastal environments

To produce accurate long-term predictions of coastal response to varying natural conditions such as sea level rise and other effects of climate change is of paramount importance. There is usually a trade-off, however, between model accuracy, complexity and length of prediction.

Fig. 3: How will the shoreline react in the long term to sea level rise and proposed engineering strategies? (Photo: Andros, The Bahamas)

This PhD project aims at the development of a framework where different types of models can mutually interact and feed each other. This will translate into a general prediction tool capable of delivering accurate and fast, long-term predictions of any coastal environment. If you are interested, please contact Dr Sergio Maldonado: S.Maldonado@soton.ac.uk

Upcoming MSc projects: Physical modelling of Tsunami effects

Most of our readers will have heard of Tsunamis, earthquake-induced waves which appear suddenly, leaving a trail of destruction. Hydraulic engineers of course want to design for tsunamis, and one of our principal design tools is physical models. The problem with Tsunami waves here is simply one of dimensions: the waves are very long compared with their height, say 10,000 m long for a height of 1 m. Scaling such waves in our facilities is not really possible, because if we scale the length correctly, then the height will be in the millimetre range and barely measurable. In this project we will look at a different approach: we will try to distort the length scale of the problem to ensure that our wave does have a measurable effect on coastal structures. This should be interesting, since a distorted length scale changes the seabed slope, the width of buildings and obstacles etc. Needless to say, nobody has ever tried this before. Supervisor: Dr Gerald Muller, email: g.muller@soton.ac.uk

Upcoming WEEG Seminar: 3 minute research breakthroughs!

You may have heard that our PhD students do a 3-minute research presentation where each of them presents his or her project in the said three minutes. We are taking this one step further: in the last week before the Easter break, we have a WEEG Seminar where every academic gives a strictly three minute lecture on their most important scientific achievement or breakthrough of the last three years. There are of course conditions: the work must have been published or accepted for publication, the work must not violate accepted scientific principles etc., the usual.

Everybody is invited, there will be 6 to 7 presentations with some refreshments and discussions afterwards. Should be an interesting and thought-provoking hour, time well spent so to say. Exact time and place to be announced.

Jobs in water engineering:

This gives you an idea of the type of work you can do when working in industry.

Advert: A job in a different area of water-related engineering - and an important issue for many employers

Water Leakage Engineer

https://www.themuse.com/jobs/stantec/water-leakage-engineer-reading-and-high-wycombe

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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