

# MAPPING THE PLASTIC

IT'S LONG PAST TIME TO TACKLE THE PLASTIC PROBLEM  
THAT IS BLIGHTING OUR OCEANS. **SIMON IRONSIDE**  
EXPLAINS WHAT SURVEYORS CAN DO





## THE 10 WORST RIVERS FOR PLASTIC

According to the World Economic Forum, these rivers carry 90% of the plastic polluting the oceans:

1. Yangtze – China
2. Hai he – China
3. Yellow – China
4. Mekong – various countries, including China, Myanmar, Laos, Thailand, Cambodia and Vietnam
5. Pearl – China and Vietnam
6. Indus – China, India and Pakistan
7. Ganges – India and Bangladesh
8. Amur – Russia, China
9. Nile – various countries, including Egypt, Sudan, Ethiopia and Kenya
10. Niger – various countries, including Guinea, Mali, Niger, Benin and Nigeria

The effects of plastic pollution on the Earth's oceans are well documented, potentially catastrophic and increasing exponentially year on year. The UN Environment Programme (UNEP) has calculated that only 9% of the nine billion tonnes of plastic produced throughout the world has been recycled and each year, more than eight million tonnes of plastic come to reside in our oceans; 80% of all the litter in our oceans is made of plastic.

This is an intolerable problem that needs immediate and far-reaching action to remedy. FIG represents the interests of surveyors in more than 120 countries. Through a combined initiative of FIG Young Surveyors Network and Commission 4 (Hydrography), FIG has formed a Working Group (WG 4.3) on 'mapping the plastic' to better understand plastic pollution in waterways by providing accurate and reliable information about the magnitude of the problem at source. This will highlight unsustainable practices, identify infrastructure shortcomings and inform robust land-use controls, with the ultimate goal of eradicating the dumping of plastic waste into rivers.

Rivers have been identified as a significant contributor to and enabler of the plastic pollution problem affecting our oceans. UNEP estimates that just 10 major river systems carry more than 80% of the plastic waste that ends up in the Earth's oceans. Much of the available information relating to the scale of the plastic pollution problem is based on relatively crude modelling. Plastic litter is predominantly concentrated on banks, coastal beaches and in the upper limits of surface water bodies. The lack of a way to comprehensively analyse the spatial and temporal extent and quantum of plastic waste at a specific site or on a regional or global level and the tools for ongoing monitoring represents a significant obstacle to addressing and eradicating the plastic waste 'explosion'.

As surveyors and spatial professionals, we have the requisite skills and expertise

to determine the vectors, quantum and frequency of plastic passing through waterways and to accurately quantify the amount and type of plastic litter on riverbanks, coastlines and estuarine areas. Our response to this problem is to provide accurate and repeatable data at specific locations to assist regulators and better inform land-use control decisions.

### Our response to the problem

Remote sensing data from satellites and airborne platforms available in different spatial, spectral and temporal resolutions has the potential to be a reliable source of long-term qualitative and quantitative information over large geographic areas.

## AS SURVEYORS AND SPATIAL PROFESSIONALS, WE HAVE THE REQUISITE SKILLS AND EXPERTISE TO DETERMINE THE VECTORS, QUANTUM AND FREQUENCY OF PLASTIC PASSING THROUGH WATERWAYS

Research by members of the Mapping the Plastic working group at universities in Bosnia and Herzegovina and Serbia is currently under way to distinguish plastics from surrounding litter/debris classes using remote sensing techniques, and the results are very promising.

Assessment of the spatial extent and variability of plastic is possible due to the unique spectral signature of polymers in the near-infrared part of the electromagnetic spectrum and we are looking at defining the data acquisition technology and identification methodology that will enable identification of plastic debris down to 1cm<sup>2</sup> in size.

An object-pixel based algorithm for mapping plastic distribution in surface (fresh) water using RGB and multi-spectral (MS) images from high resolution WorldView-2 satellite images has been developed and is described in the paper Remote Sensing

Data in Mapping Plastics at Surface Water Bodies, written by Gordana Jakovljević, Miro Govedarica and Flor Álvarez-Taboada. Published and presented at the 2019 FIG Working Week held in Hanoi, Vietnam in May last year, the paper describes the creation of algorithms and models for plastic identification and their associated accuracies based on high resolution, eight-band, multi-spectral images from the WorldView-2 satellite of plastic debris in the River Drina in Serbia. This research has subsequently been expanded, focusing on the results from additional study areas in rivers in Bosnia and Herzegovina using a WingtraOne UAV with a high resolution (42 megapixel) RGB camera and a high-quality MS camera. Several surveys

have been undertaken at differing heights and resolutions using specially designed markers. Work is ongoing to refine the analytical processes and survey methodologies for adoption, and the preliminary results are encouraging. However, this project's accuracy and application is uniquely challenged by the lack of existing polymer 'libraries', as this project is one of the first attempts at identifying plastic in this manner.

### How we do it

A combination of high-resolution satellite and UAV data has been processed using the developed algorithms to detect floating plastic in surface water, combined with 'ground truthing' land surveying measurements, bathymetric and water current data. This data will enable teams of volunteers to accurately map plastic concentrations at



global 'hot spots' to enable regulators to better understand the extent of the phenomenon they are dealing with and inform decisions that impact the potential solution.

To undertake the field work required to infill gaps in the satellite/UAV data, Trimble has kindly donated a suite of surveying hardware and software to the Mapping the Plastic working group, consisting of

- R10 GNSS receivers
- A Greenseeker crop sensor
- Trimble Business Centre
- eCognition software

On behalf of FIG, I would like to express my gratitude to Trimble for their assistance. This equipment will be of enormous benefit and is greatly appreciated. Negotiations are ongoing to secure a UAV to assist with the plastic surveys.

### Volunteers

Our principal volunteer base is the FIG Young Surveyors Network (YSN), with their interconnecting networks in each of the more than 100 FIG Member Associations and other members such as academic, corporate and affiliate (cadastral and mapping agencies) members. However, youth is not necessarily a prerequisite and we are seeking volunteers of all ages with a strong sense of social responsibility, commitment and adventure – surveying and spatial expertise would be an advantage! The YSN is coordinating the Mapping the Plastic training programme through their networks including at the FIG Working Week 2020 to be held in Amsterdam, the Netherlands, in May.

Those wishing to volunteer for this demanding but satisfying work should contact YSN chair Melissa Harrington ([melissa\\_harrington@trimble.com](mailto:melissa_harrington@trimble.com)).

### Alliances

The (anti) plastics 'movement' worldwide is dynamic, motivated, concerned (verging on angry!), well informed and growing rapidly. The problem is huge, if not overwhelming, and one of the things the surveying profession has learned is that forming alliances with groups in the plastics movement is the

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most effective way of directly influencing positive outcomes. It also enables the profession to understand where and how we can contribute most effectively.

The 2019 FIG Working Week in Hanoi, Vietnam, was an opportunity to form a relationship with GreenHub – a young, dynamic and green Vietnamese NGO – and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), which is doing great work in the plastics field. GreenHub and CSIRO have undertaken a large plastic survey along the Hai Phong coastline near Hanoi and attendees were fortunate that these organisations were able to present the results of their survey at the Mapping the Plastic session in Hanoi. A representative of the Vietnamese government

presented a rather gloomy picture of Vietnam's plastic problem and World Bank representatives in attendance expressed interest in uses of the plastic detection algorithm that the working group have developed, particularly the ability to identify individual plastic manufacturers. One of the 'hot spot' areas the working group has discussed with GreenHub and the Vietnamese government is the Mekong Delta in the south of Vietnam. Unfortunately, there are no shortage of hotspots that require attention.

### Mapping the plastic

I hope you can join us in Amsterdam in May. As part of the programme, we will be undertaking a plastic waste survey to raise awareness of the problem and to train our volunteers. Using data from the survey, we will also be hosting a hackathon to refine our plastic-detection algorithms and survey 'deliverables', as well as presenting technical papers in a dedicated Mapping the Plastic stream. This hackathon/mapathon aims to:

- Raise public awareness of the plastic waste problem

- Raise the awareness of the Working Week, FIG, the UN SDG's particularly SDG 14
- Develop surveying techniques for citizen-surveying and Working Group 4.3 volunteers to undertake plastic waste surveys at hotspots around the world
- Develop data processing and reporting techniques for future surveys
- Report the survey findings once the data is processed.

The 2020 Working Week is an ideal gathering as it enables us to discuss the issues surrounding plastic waste with delegates from different countries, particularly 'hotspot countries' and the ways in which we can assist.

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