



# FLOWTRACKER HELPS NEPAL RIVER EXPEDITION

Volunteer scientists monitor dramatic changes river discharge and water quality and a resilient community rebuilds after cataclysmic disaster

**Kathmandu, Nepal** -- The Bagmati is both a sacred river and a city sewer, running through Nepal's capital city of Kathmandu before heading into the mountains and over the Indian border. Since 2013, thousands of volunteers have gathered along the Bagmati for weekly river clean-ups on Saturday mornings, and the 100th cleaning event on April 11, 2015 drew more than 100,000 locals to the river's banks.

The next day, a group of students and hydrologists embarked on a 10-day, 160 km (100 mile) hike along the Bagmati from Chovar—the point where the river leaves the Kathmandu Valley—to the Indian border. Sampling every 5 km along the route where the landscape permitted, the UK-based Biosphere Association and Kathmandu's Nepal River Conservation Trust made the first openly available survey of the downstream effects of Kathmandu's pollution in the Bagmati.

The expedition was a massive undertaking, both physically and logistically.

"It was sort of the Nepalese river equivalent of going up one of their mountains," marvels Lee Pimble, European Hydrology Manager for Xylem Analytics, who traveled to Nepal to train the team on hydrometric sampling at the request of organizer Carol Milner, founder of the Biosphere Association.

## Local Heroes

Milner, who is based in the U.K. but has many friends in Nepal, was touched by the impact of pollution in the Bagmati—particularly on its impact on poor residents, who cannot afford clean water but also can't rely on the fouled river to supply



*SonTek Application Engineer and UK Hydrology Manager, Lee Pimble, conducts acoustics training for volunteer researchers working for the Nepal River Conservation Trust.*

their needs.

In 2010, she asked a local when the trash in the river would be removed, and was told that the monsoon would soon wash it to India. That was the last straw.

"I wanted to give assistance to those already fighting to make a change for the future," Milner says.

Delving deeper into the challenges facing the Bagmati, Milner found that water levels in the river were dropping precipitously. Rock mining was altering the porosity of the substrate and changing the flow of the water table. Draws for growing communities, irrigation and industry decreased river flows, and some studies indicated

that recharge was decreasing.

Local hydrologists needed discharge data to create a baseline along the river, explore changes in pollution and fill in blanks in hydrological station readings that are vital to understanding flood risk in the river's basin.

## Donated FlowTracker

In her native England, Milner approached Lee Pimble of SonTek for help. She was hoping to borrow or buy a FlowTracker handheld acoustic Doppler velocimeter (ADV), a rugged, compact flow-measuring instrument that would be ideal for the challenges ahead.

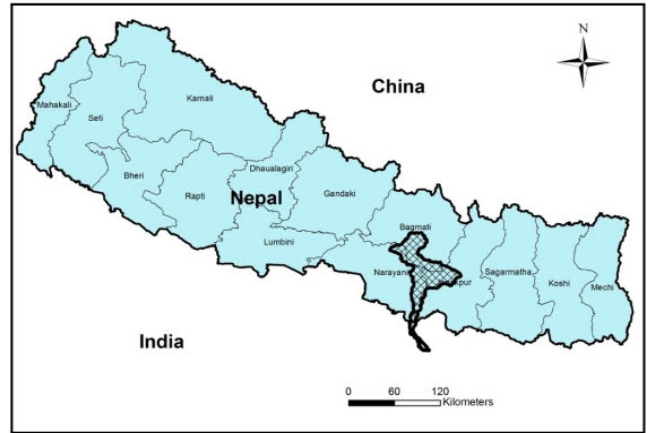
The FlowTracker uses acoustic signals to measure the velocity and direction of flowing water, calculating discharge in its on-board computer. The compact system brings laboratory technology to the field, with a powerful hand-held instrument mounted on a 1.2-meter (4-foot) wading rod that allows the ADV sensor to gather 2-D or 3-D measurements in as little as 2 cm of water. Because the FlowTracker emits beams at an angle to each other, it reads not only velocity but also direction. That means the instrument can identify turbulence, changing angles of flow or even backflow conditions. Readings are recorded in internal memory, eliminating the need for note-taking in the field and streamlining the data gathering process.

"We knew the expedition would be tough, walking remote terrain, and wanted something that would be reliable," Milner explains. "Although we had a small budget, we contacted SonTek mostly for advice at first. Lee Pimble was extremely helpful and engaged in our plight, and his advice was not based on sales, but on actual river experience."

Pimble requested permission from headquarters to lend an instrument to Milner or find a demonstration model to sell her. His pitch excited the product team, and Pimble was told the company would donate a brand-new FlowTracker instead. At Milner's request, he agreed to travel to Nepal to teach the Nepal River Conservation Trust team how to use the instrument.

"This was the perfect opportunity to put our technology to work, using science in a very practical way to help solve environmental challenges," explains SonTek product manager Janice Landsfeld at the company's headquarters in San Diego, California. "We could put a powerful tool in the hands of a really committed group of people halfway around the world and help them in their efforts to rescue their sacred river."

## Fast Training



Location of the Bagmati basin in a map of administrative zones in Nepal. [Full Biosphere report can be found here.](#)

Pimble says he was concerned at first about training the group to use the FlowTracker. The Nepal River Conservation Trust team was comprised of a group of enthusiastic, young hydrologists and ecologists. Some had masters degrees and field experience. Others were undergraduate students, eager for real-world experience and committed to working their way into the conservation world. But most had been trained in Nepal, a poor country where even the top government agencies were measuring flow with old impeller flow meters. Those who had any prior experience measuring flow had been taught to carefully count the clicks of the spinning impeller.

"They had no knowledge of the acoustic instrument," Pimble says. "But they took to it. Considering they were novices with the technology, they were very quick. We spent half a day ensuring that they understood hydrometric techniques. Once they grasped that, we were probably an hour in the field using the FlowTracker before I was comfortable saying, 'go ahead' and they were away."

## Location, Location, Location

In fact, says Pimble, most of his two-day training session focused on site selection, not equipment operation.

"The FlowTracker allows them to take a very straightforward, step-by-step procedure," he notes. "If you follow the FlowTracker, step by step, you will get good results. But if you don't choose a good sampling location, you won't get a good measurement, no matter what instrument you have."



Expedition team members collect flow and discharge data at cross sections along the Bagmati river. Courtesy NRCT. [More photos of expedition here.](#)

Pimble points out that the FlowTracker allowed the Nepal team to measure water where velocity and depth were below the thresholds of old, mechanical current meter technology. That permitted far greater breadth in site selection and the opportunity to build a much more comprehensive picture of conditions in the river.

"We went to the river and tried different scenarios," Pimble adds. "We looked at velocity distribution and how that affects the measurement. We looked at debris in the channel. In the UK, when we think of 'debris,' we think of vegetation. In Nepal, it could easily be a dead goat or maybe pieces of a car. It could be anything. By the third day, we worked at some interesting sites. They practiced keeping themselves safe in the water, and not so much on the use of the instrument."

With Pimble's training course and a few hours of experience in the river, the group headed down the valley to begin their expedition, toting the compact FlowTracker.

"They were walking the whole stretch," says Pimble. "They carried everything—the FlowTracker, the rod, the batteries, their food, the water quality equipment. Everything."

The physical challenges of operating on foot made the FlowTracker's reliability as vital as its portability.

"Because we were hiking in remote areas, it was difficult to re-measure a site," Milner points out. "It would have involved hiking 10 or 20 km back to it, so the immediate feedback of the system to look for potential errors was vital."

In the field, the team quickly learned to trust the instrument. Back in the lab, their confidence was rewarded.

"I got to see some of the data, and it was great," Pimble says. "On a couple of occasions, they didn't do as many point velocity measurements as they would have liked, for safety

reasons, so some of the data had uncertainties that we typically wouldn't use—12 percent or more—but remember, they were gauging in tough conditions. Most of the data had really acceptable values ranging around 4 percent. Anybody would be pleased with that, anywhere."

## New FlowTracker2

Ease of use and assurance of good data are improved further with the introduction of the new FlowTracker 2, released in late 2015. With a larger screen, tactile keypad and wizard-like, intuitive graphical user interface, the new generation of FlowTracker handheld ADVs walks users through the process of good flow measurement. Features like a graphical representation of the acoustic beams allow new users—like the members of the Bagmati team—to better understand the instrument while providing information that permits expert users to make sophisticated adjustments in the field, notes Landsfeld.

"It's also easy to set QC parameters like standard deviation in the field," she adds. "You can set an alarm to sound if you record an angle of flow above a certain percentage of downstream, prompting the user to make sure the instrument is being used correctly, or to note if unusual conditions appear in the stream. And if you've made a mistake in your data gathering, you can even edit data in the field quickly and intuitively, then move on."

*At its core, SonTek's new [FlowTracker2](#) uses SonTek's tried-and-true ADV technology, vetted for decades by experts across the globe, in hydraulics labs and wide-ranging field environments.*

*Improved and perfected for FT2, the acoustic-based ADV sensor offers unparalleled accuracy, particularly in low flow, and in the shallowest water of any wading device. 2-D data in the horizontal plane (2D/3D option available) allows the most comprehensive QC and understanding about flow conditions.*



[FlowTracker2 Overview \(YouTube\)](#)

Pimble says the next-generation user interface and data quality control in the FlowTracker2 allows field teams to have even greater faith in their work.

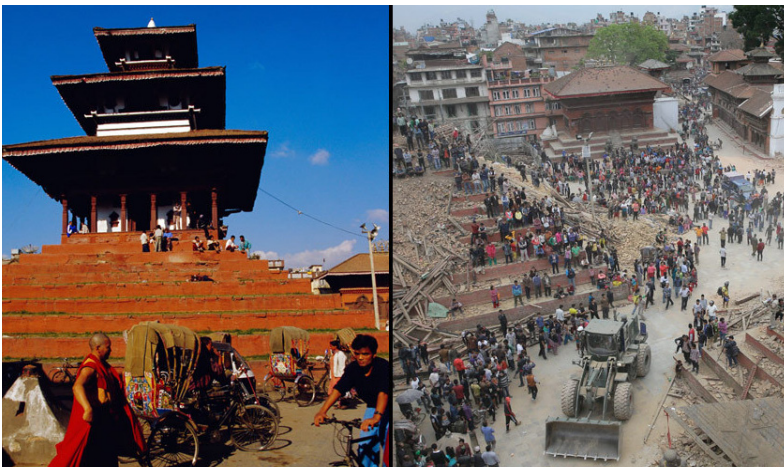
“They can be more confident in the data the moment they leave the field,” he notes. “They don’t have to drive back 30 miles to confirm that they got good measurements. They can have that knowledge before they actually step out of the water.”

## Tragedy Strikes

The Bagmati Team had arrived back in Kathmandu and attended a city river clean-up, when the next morning on April 25, 2015 the ground shook from an earthquake that registered 7.8 on the Richter Scale and devastated the capital and the surrounding area. In a matter of moments, hundreds of thousands of people were left homeless. The quake injured approximately 22,000 people and killed nearly 9,000, including friends and family of some of the members of the hydrology team.

Pimble, back home in England, started calling his new friends in Nepal to check on their safety, and immediately began sending money to first-response groups. Meanwhile, Xylem mounted a company-wide campaign through its foundation, [Xylem Watermark](#). Xylem employees donated more than \$25,000; the company double-matched the gifts and added a corporate contribution of its own, amassing a total donation of more than \$218,000 to Mercy Corps’ Nepal operations.

“The work we do is about more than projects and data,” says Landsfeld. “It’s about the people we work with, the bonds we create, and the passion we share for environmental work. Xylem’s response to the earthquake in Nepal, through the individual generosity of our colleagues like Lee and the company’s contribution, reflects that personal concern and connection.”



Site of temple in Kathmandu before and after April 25 7.8 quake.

## Future Goals

The earthquake delayed the analysis of the Bagmati Expedition’s data—for good reason—but Milner already has future missions in mind for the FlowTracker. Using the lessons learned along the Bagmati, she is planning a similar expedition along the Karnali River, a major tributary of India’s famous Ganges.

The Karnali team will use the FlowTracker to measure discharge of many tributaries to the river, Milner says, and is exploring ways to use the instrument from a raft to measure flows in the main stem. The FlowTracker is also at the heart of a program led by a former member of the Bagmati team to train and inspire Nepalese university students, giving them an exciting chance to use top-shelf hydrology tools and techniques.

As Nepal engages in the long, difficult process of rebuilding the nation in the wake of the devastating earthquake, Pimble remains in touch with his colleagues in Nepal. He says he’s confident the Nepal River Conservation Trust team will persevere in its efforts to clean up the Bagmati with the calm, grace and grit he observed when he visited on his training mission.

“They’re going to carry on,” he says. “The earthquake put them back, but they are still trying to do their work of restoring the river. They’re that sort of people.”



Photo of the expedition team. Courtesy NRCT.



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