xylem
Environmental Solutions

Stormwater Solutions

TAKE CONTROL WITH YSI

YSI

a **xylem** brand

Why Monitor Stormwater?

Combined Sewers and MS4s

Stormwater is often carried through municipal separate storm sewer systems (MS4s) or a combined sewer designed to carry both wastewater and stormwater. Municipalities maintain stormwater management programs for NPDES permits to guard against combined sewer overflows and pollutant discharges.
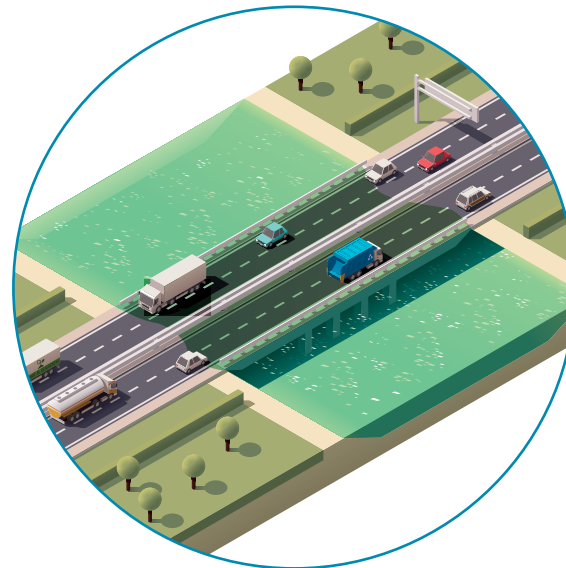
Oil & Gas Stormwater

Clean Water Act section 402(l) defines requirements for non-exempt Oil and Gas activities such as those at refineries, where stormwater discharges must be tracked. Cooperate with local, state, and federal agencies by generating traceable and uninterrupted data streams for NPDES reporting and compliance.

Road Flooding

Extreme weather events are driving flash flooding in many communities, making roadways unpassable and dangerous. Monitoring installations can inform alert systems of flooded roadways, and can do double duty to aid in NPDES permit reporting.
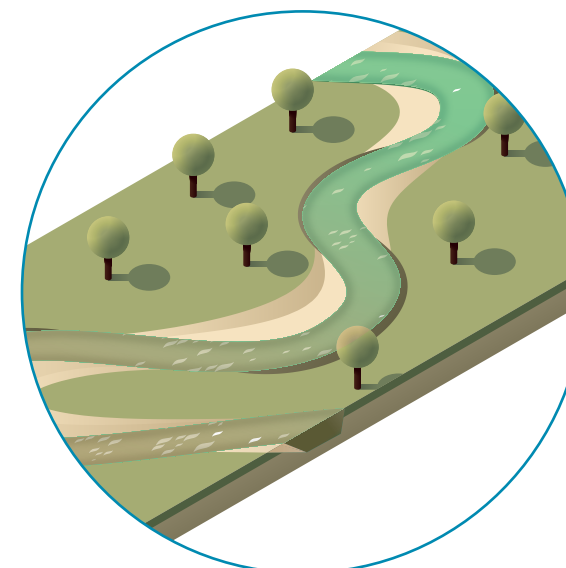
Construction Waste

Make monitoring part of your stormwater pollution prevention plan (SWPP) for maintaining a Construction General Permit (CGP). Sediment, debris, and chemicals in loose soil can be detected with water quality sensors, and adding flow sensors enables the calculation of discharges and loads.

Road Salt and Deicers

Airports can balance FAA requirements for deicing with Airport Deicing Effluent Guidelines that require some airports to maintain NPDES permits as part of the EPA's Industrial Stormwater program. Road salts from urban activities can likewise pollute rivers and streams, especially during melt-off.

Erosion and Sedimentation

One of the EPA's main concerns related to climate change, erosion and sedimentation can be tracked with water quality and water flow sensors. Detect plumes from acute events to understand dynamics that contribute to eutrophication, hypoxia, and harmful algal blooms.

Take Control with YSI

You can't control the weather, but managing stormwater's impacts on your city or watershed starts with reliable monitoring.

Table of Contents

With an ever-changing climate and growing concerns about environmental impacts, our customers are increasingly asking for help in the design of stormwater monitoring solutions. Here we introduce a range of YSI solutions through real-world examples, highlighting key technologies and services. There is a stormwater solution for any budget and need; please let us know what we can design for you!

YSI's Integrated Systems & Services Team
937-767-7241
info@YSI.com
YSI.com

The Benefits of a YSI Solution

Real-time Data Delivery.
Telemetry to HydroSphere, with APIs to your own application, and access you control.

Event Alerts.
Conditional alerts and notifications to your team or to the public – fully controlled by you.

Installation and Maintenance Services.
YSI can design, build, install, and maintain your system so that you can focus on your response.

Hands-off Sample Collection.
Don't send your people into a dangerous situation. Automatic sampling can be triggered by any condition you define.

Industry-leading Sensors.
Any of Xylem's leading brands are at your fingertips, and we can integrate virtually any technology into your final system.

Decision Support.
YSI can manage your data to support your decisions, even providing modeling and forecasting as a full service option.

Types of Stormwater Solutions

On the following pages we share case studies that demonstrate three types of systems YSI has delivered for customers: Event Monitoring, Continuous Monitoring, and Flood Monitoring. For each stormwater solution featured, YSI helped customers walk through five system features shown on the facing page. These drive system complexity, the level of YSI's involvement in your overall program, and of course the price of your stormwater monitoring solution. In all cases, the same quality and customer service people have come to expect of YSI's instruments are delivered through YSI's Integrated Systems & Services, where we help customers design, build, install, and maintain their customized solutions.

What **Stormwater Solution** can we design for you?

Event Monitoring

- Portable, easy-to-deploy, go-where-the-storm is system
- Key is flexibility—easily relocated, easily upgraded, easily reconfigured
- Full telemetry and alert systems are available
- Highly cost-conscious options are available

Continuous Monitoring

- Fixed monitoring stations at critical sites, often in a network of sites
- Multiple sensors, often with autosamplers and met stations included
- YSI can also build critical infrastructure to support and protect systems
- Optional installation of conduits, platforms, and other critical infrastructure
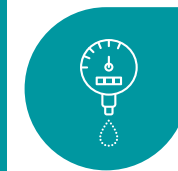

Flood Monitoring

- Early flood warning alerts based on both monitored and modeled data
- Bridge and Road submergence monitoring capabilities
- Flood mapping at the parcel or roadway for risk assessment
- Automated "High Water" street sign flashing based on real time water levels

Features of a Stormwater Solution

Situational Analysis
Define the program scope and objectives • Perform site assessments • Plan staffing and training

Sensor Selection
Define monitoring parameters • Set up a sampling regimen • Consider sensor maintenance

Logging & Telemetry
Map sensor-to-end user route for raw data • Identify data backup and security points • Define alerts and escalation

Power
Derive power budget from sensors, logging & telemetry • Plan redundant or rechargable power

Data Analysis
Clarify data stakeholders and their access • Select data visualization platform • Define data analytics and communication plan

A Proactive Approach to NPDES

NPDES PERMITTING FOR OIL & GAS

A unique portable Stormwater Monitoring System was recently built by YSI for a refinery in North Texas. A contractor had been hired by the refinery to help them monitor stormwater discharges into tributaries that feed a large and heavily used river system, so that they would stay in compliance with their NPDES permit.

The National Pollutant Discharge Elimination System (NPDES) was designed to regulate point source pollution in waters of the United States. It is administered by the Environmental Protection Agency (EPA) in accordance with the 1972 Clean Water Act (CWA). The EPA authorizes individual states to issue NPDES permits on its behalf. Permits are required for pollutant discharges into U.S. waters, and place limits on an organization's discharges. Industries throughout the U.S. navigate policy and the NPDES very carefully because while most violations have manageable consequences and corrective actions, serious or recurring violations can disrupt business operations and cost millions of dollars.

"Discharges" include stormwater runoff. There is a specific **NPDES Stormwater Program** that regulates stormwater discharges from municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. Large industrial sites can function like cities: they are filled with impervious surfaces so that heavy rainfall leads to runoff that can carry industrial chemicals and wastes into nearby waterways. One of the most heavily regulated industries under the NPDES Stormwater Program is the **Oil and Gas Industry, to which Section 401(l)(2) of the CWA is entirely devoted**.

For more on NPDES:
EPA.gov/NPDES

A CHALLENGING SCENARIO

The refinery in Texas wanted to take a proactive stance on their NPDES stormwater permit, both to say in compliance with EPA regulations, and to protect the beautiful natural resource that everyone in the region, including the refinery's own employees, enjoyed.

The system that was designed by YSI was based on an Event Monitoring blueprint, though the actual monitoring plan might be described as semi-continuous. Event Monitoring solutions are portable–they can be rapidly deployed only as needed, and easily relocated to adapt to changing circumstances. The refinery client anticipated that the systems would be deployed during seasons when the most rainfall might be expected, and possibly recovered during the dry, intensely hot parts of the year in Texas. The actual sites themselves might change, as well.

In fact the deployment sites required a portable solution design. Members of the project described the monitoring sites as "the middle of nowhere" and it was not feasible to construct any infrastructure that would characterize a typical continuous monitoring solution. The system would be hand-carried to remote locations, so equipment needed to be compact and lightweight. The system needed to be installed in less than half a day by two people. The location would also limit site visits so the system needed to be highly durable in the Texas heat, and data telemetry was a must-have. Finally, ease of use was critical because the equipment operators were experts in oil refining, but not necessarily in water monitoring technologies. They would work with a private contractor to handle their data and reporting requirements.

That contractor recommended a YSI solution because of their previous experience with YSI, and the three parties (the refinery, the contractor, and YSI's Integrated Systems and Services) worked together to adapt an Event Monitoring System for this project.

A PORTABLE SOLUTION

The client's requirements were met with a system that leveraged one of YSI's most widely used stormwater sensors: the **SonTek IQ**. This all-in-one flow, total volume, level, and velocity sensor is precisely made for ease of use. This IQ comes equipped with custom flow algorithms, carefully designed and tested to ensure the data being delivered. The IQ has 4 independent velocity beams for accurately mapping the cross-sectional velocity profile throughout the water column. This allows for very high-accuracy flow data which is instantly obtainable without velocity indexing in natural channels.

The IQ was connected to a **Storm 3 datalogger** that would store and transmit data to YSI's HydroSphere, enabling refinery personnel to access their data on desktops and mobile devices, anytime, anywhere. The Storm 3 was ideal because it is so easy to use–it doesn't require complex programming and it seamlessly transmits data into HydroSphere. The datalogger can communicate through many types of telemetry, including cellular, satellite, and spread spectrum radio modems. A nearby cell tower made cellular communication the best option for these sites.

HydroSphere was also an important choice from the perspective of simplicity, and in this case the contractor would set up and manage the HydroSphere account, and give the team at the refinery full visibility of the data. Importantly it enabled the contractor to set up alerts and notifications. The sites were remote–weather events there might not even be experienced by the team that lived in an urban center about an hour away. In the case of a heavy rainfall event and rising water levels, alerts would be sent to any team member, either from the contractor's roster or at the refinery, via text or email. Sites in a state of alert would also be visible online in HydroSphere. If an action was to be taken, notifications, and escalation of notifications to other team members, could be set up. They could even alert on features like system battery voltage–this would help the team to schedule visits to repair or maintain the system in the event of a power issue or unexpected change in performance. This 24/7 visibility on not just the data but also system health will help the contractor and the client to minimize site visits.

This system is also scalable–it is easy to add sensors or monitoring sites in the future. If one the portable systems was transmitted to a new site that would be very easy to set up in HydroSphere, without losing information about the original site where the system had been placed.

The system electronics, including the Storm 3, power system with a solar regulator, and a cellular modem, were housed in a **portable data collection platform (DCP)**. This rugged chest is a custom designed welded powder coated aluminum NEMA 4X enclosure able to withstand the harshest environments, yet easily handled by two people. YSI engineers have designed an uninterrupted integrated solar power system with this enclosure which ensures long term autonomy, and even battery voltage is reported to HydroSphere to keep tabs on system operability.

All of the system components were delivered fully assembled to make installation on site as easy as possible, and YSI could readily replicate the system for the addition of more sites in the future. In this manner, the client will always stay abreast of their stormwater discharges.

For more on Portable Data Collection platforms:
YSI.com/PortableDCP

Event Monitoring

SonTek
®

Situational Analysis

Objective was to support NPDES stormwater permit • Highly remote sites, no local power, cell towers nearby • Inexperienced staff to be trained in sensor deployment and maintenance, with support from contractor.

Sensor Payload

Water level and flow via SonTek IQ • Manual sampling as needed • Site visits to keep sensor free of debris

Logging & Telemetry

Data transmitted via cellular modem to HydroSphere for 24/7 visibility • Redundant logging of data in both the SonTek IQ and the Storm 3 data logger • Alerts transmitted via text, based on water level.

Power

12-volt battery with a solar panel and regulator for recharging • Solar recharging and battery voltage monitoring through HydroSphere.
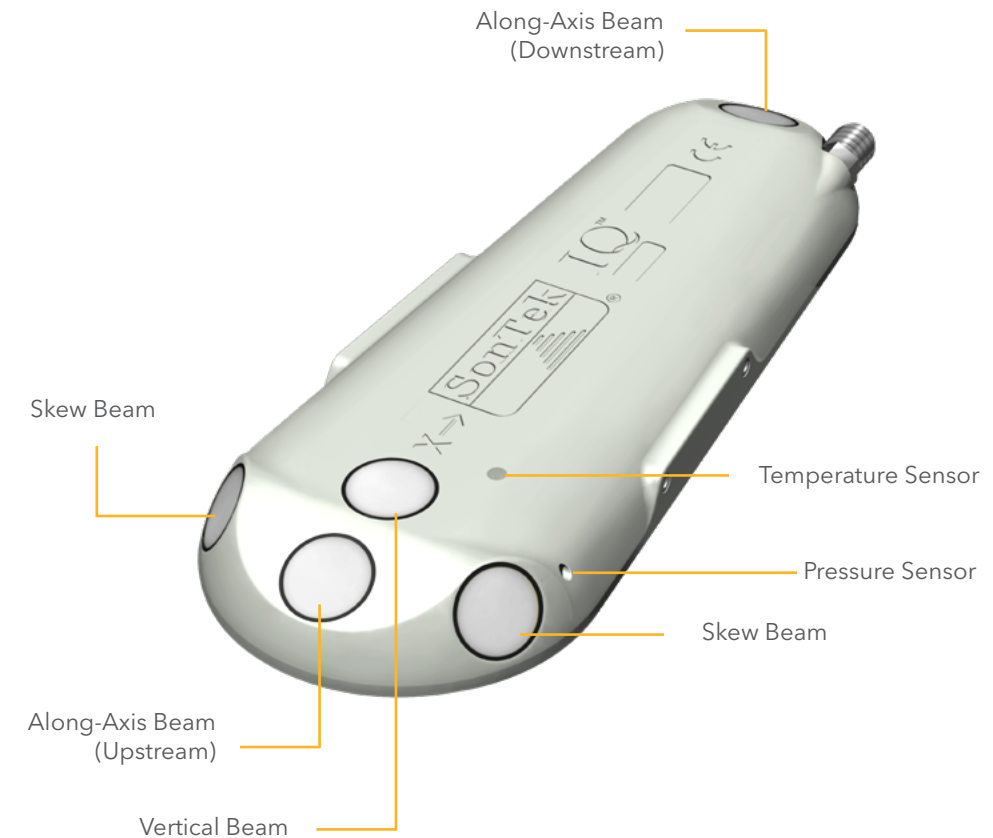
Data Analysis

HydroSphere account administrator was private contractor; refinery personnel set up with data technician or view-only access • Data reports auto-exported by contractor as .csv files for further analyses.

Ideal for stormwater monitoring, the SonTek-IQ starts with a custom flow algorithm derived from hundreds of field measurements. Four velocity beams profile water velocity along both the length and width of the channel, to ensure best possible coverage and most accurate representation of the velocity field. The built-in pressure sensor and vertical acoustic beam work in tandem to measure water level. All stainless steel hardware makes the IQ even more capable in difficult environments and in stormwater.   Simply input the channel geometry using the intuitive software to start getting data right away. ›› **SonTek.com/Sontek-IQ**

Along-Axis Beam (Downstream)

Skew Beam

Temperature Sensor

Pressure Sensor

Skew Beam

Along-Axis Beam (Upstream)

Vertical Beam

Specifications	
Velocity Measurement	
Velocity Range	±5 m/s (16 ft/s)
Resolution	0.0001 m/2 (0.0003 ft/s)
Accuracy	±1% of measured velocity, ±0.5 cm/s (0.2 in/s)
Water Level	
Vertical Beam Range	0.05 – 1.5 m (0.2 – 5.0 ft) (Standard) 0.05 – 5.0 m (0.2 – 16.0 ft) (Plus/Pipe)
Water Level Accuracy	0.1% of measured depth or ±0.003 m (0.01 ft), whichever is greater
Pressure Sensor Range	30 m (98 ft; 42 psi)
Pressure Sensor Accuracy	0.1% of full scale

Key Features

• Fully self-contained, all-in-one design

• Proprietary flow algorithms for irrigation canals, natural streams and pipes

• Uses SonTek's exclusive SmartPulseHD adaptive sampling

• Self-calibrating water level using vertical acoustic beam and pressure

Automatic Samplers

Don't send your personnel into a dangers storm or flooding scenario to collect samples. By using an automatic sampler, on can collect discrete or composite samples based upon on user-defined triggers: gauge height, a water quality threshold, or even a simple time-based collection program. YSI has two autosampler families to choose from: the Global Water WS700 series and the YSI ProSample series.

3 Reasons To Use An Autosampler

| High sample volume accuracy with proprietary pump | Up to 12 user-defined programs | Up to 24 discrete samples, or 1 x 26L sample |

GWI WS700 Series

YSI ProSample Series

The GWI WS700 autosamplers come in a rugged, rainproof and lockable wheeled transport case for ease of deployment. Samplers self-clean to clear debris from the strainer, and collect samples on programmed triggers or a timer. The GWI autosamplers are available with a Stormwater Kit that includes a GWI rain sensor, flow sensor and auto-drain rain gauge all in one package, and refrigerated models are also available. **» YSI.com/ws755**

The ProSample is YSI's premium high-accuracy autosampler. ProSample models collect based on time, analog signal, digital pulse, and/or measurement from an SDI-12 sensor like YSI's EXO sondes. The ProSample P is ideal for Continuous Monitoring, and the lighter PM for Event Monitoring. Each sampler can store up to 12 user-defined programs for quick deployment, and can hold ice for keeping samples cool. **» YSI.com/ProSample**

Specifications	
Pump	Type: Peristaltic Max Lift: 6 m Rate: 1000 mL/min at 4 ft head
Samples	Single or dual-bottle models (one or two pumps) Polyethylene bottles Composite or discrete sampling modes Samples ranging from 50 mL to 2 L in composite mode, up to 3 L for discrete
Weight	9-10 kg
Inputs	250mS minimum pulse width switch closure or 4-24VDC
Power	Rechargeable 5Ah gel cell
Certifications	CE

Key Features

- Easy-to-use controller

- Automatic backflush clears strainer and hose

- High portability with wheeled case and handle

- Rugged construction for harsh environments

Key Features

- High sample volume accuracy with proprietary pump

- Up to 12 user-defined programs

- Up to 24 discrete samples, or 1 x 26L sample

- Double-walled, insulated, ruggedized housing

Specifications	
Pump	Type: Peristaltic Max Lift: 8.5 m Rate: >0.61 m/s at suction height up to 7 m with 10 mm ID hose
Samples	Single or multi-bottle models Composite or discrete sampling modes ProSample P Bottles: Polyethylene: 24 x 1 L, 8 x 2 L, 4 x 4 L, 1 x 26 L Glass: 24 x 350 mL, 12 x 950 mL, 8 x 2 L ProSample PM Bottle: Polyethylene: 1 x 10 L
Weight	9-15 kg
Inputs	Analog 0/4-20 mA, Digital SDI-12
Power	12 V/7.2 Ah lead storage, leak proof 115 V or 230 V operation by means of battery charger
Certifications	CE, ISO 5667010, EN16479

Gauging a Hurricane in Real Time

FROM SCIENCE TO SAFETY

There are 16,000 miles of waterways within the Houston-Galveston region of Texas, USA. These waterways provide an estimated 80% of the region's drinking water, however more than 80% of monitored waterways don't meet state water quality standards.

In 1991, the Texas Commission on Environmental Quality (TCEQ) passed the Texas Clean Rivers Program—a program focused on conducting water quality monitoring, at the watershed level, within each river basin.

As part of the ongoing program, the Houston-Galveston Area council (H-GAC) serves as the regional water quality partner for the TCEQ. They contracted the **Environmental Institute of Houston (EIH)** to install and maintain two continuous flow measurement stations in the San Jacinto-Brazos and the Brazos-Colorado Coastal Basins. These sites were selected on Caney Creek in Matagorda County and Oyster Creek in Brazoria County—both located about an hour and a half south and southeast of Houston.

> For more on Environmental Institute of Houston:
> **EIH.UHCL.edu**

REAL-TIME DATA FOR REAL-WORLD MONITORING

Jenny Oakley is an Environmental Scientist for the EIH and leads the research team that installed the stations at both locations in February 2017, and who is responsible for the maintenance and operation on an ongoing basis. They worked very closely with YSI's partner in Texas, Randy Rushin and his company Water Monitoring Solutions.

Rushin suggested the Amazon bubbler for water level monitoring. This low-power system is ideal for a battery-powered station, and the display with anti-sun glare technology is great for working in the Texas sun. The Amazon is also easily set up with the menu-driven display, and has capacitive touch buttons so that wet or muddy fingers won't damage the electronics. The rugged aluminum housing would also protect the electronics and especially the air compressor from water intrusion. The orifice line passes through a desiccant canister on its way into the water where stage would be monitored. The bubbler measures stage height every 15 min of every day. Via a **Storm 3 datalogger** and a **GOES satellite transmitter**, gage level in feet is delivered every hour to EIH's team. GOES was used because cellular reception can be unreliable at these remote sites.

According to Oakley, the team needed to do preliminary work so that ultimately the Amazon's stage data could be used to complete loading calculations. Instantaneous discharge measurements were made using two of SonTek's leading technologies: a **SonTek Flow Tracker** and **SonTek M9 RiverSurveyor**. These were used to develop a flow rating curve based upon a stage-discharge relationship. Basic stream morphology data were collected, and elevation relative to the bubbler was measured for bank full (first terrace) and flood stage (second terrace). These elevations are shown along with the gage height data to illustrate the water level relative to these two stage markers.

HURRICANE HARVEY HITS

In August 2017, Hurricane Harvey made landfall on the Texas coast. This record-shattering storm battered southeastern Texas for several days before moving inland, causing billions of dollars in damage and catastrophic flooding that impacted thousands.

"Prior to [Hurricane Harvey] making landfall, both streams were in typical summer base-flow conditions. We didn't remove any equipment because the storm appeared to be heading much further south…we weren't expecting any major impact from the storm other than rainfall," states Oakley. "Yet, in less than four days, the region received over 127 cm (50 inches) of rain - or approximately an average year of rainfall. My home was flooded and other staff at the Institute experienced the intense flooding as well. The following week when we were able to make it back to work, but still weren't able to reach any of our sites."

Within 30 hours after the hurricane hit, both monitoring stations were above flood stage with Oyster Creek peaking at over 7.9 meters (26 feet) and Caney Creek above 7 meters (23 feet). The roads to the monitoring sites were flooded for weeks, but the team knew that the sites were still active.

"I had been checking the real-time data and it looked reasonable," Oakley continues. "I felt confident in what the state of equipment would be when we got out there. I also knew what the flood stage level was, so I knew we had surpassed those thresholds by just looking at the data."

Oakley and her team were relieved knowing the instruments at the monitoring locations were still functioning, but, unfortunately, the surrounding areas were not as lucky.

"Every single home that you drove past going to and from the [Oyster Creek] site had mountains of people's possessions piled along the flooded streets," she recalls. "Drywall and flooring… furniture and mattresses…everything from their home, out along the street… the entire area was severely impacted. The houses directly next to our site all had some sort of damage from the flood. At a certain point I became a little numb to it because I saw devastation in every direction."

RESOURCE FOR RESIDENTS

EIH has developed a page on the university website to allow landowners in the area to see real-time gauge height and discharge measurements for nearby waterways. This is greatly facilitated by their upgrade from YSI's legacy Storm Central website to **HydroSphere**, the cloud-based platform that facilitates public viewing of real-time data via a public URL that can be shared by EIH.

"There are some landowners that I've had contact with in the direct vicinity of our monitoring stations that have a second home there, don't live there full-time or use the land as rangeland for cattle," Oakley explained. "I know that our data were also used by a family much further downstream to make the decision of whether or not to evacuate [during Harvey]. They were watching the gauge height in real-time to decide whether it looked like the water would get very much higher. Luckily, it ended up not flooding in their area and people were able to stay in their homes, especially because traveling at that time could have been dangerous."

The Environmental Institute of Houston continues to maintain these sites and report the gage level data to the public. Real-time discharge data will be available to the public soon at EIH's website—thanks to a scientist with a creative mind and genuine concern for local residents.

"This is a great resource to have our finger on the pulse of our watershed," she added. "Especially in a situation like this where it was an extreme event and lives and property were at stake."

> For more on this project, read the full Mission: Water article:
> **YSI.com/EIH**

Continuous Monitoring

Designed with simplicity in mind, the Amazon bubbler is an ideal system for long-term, water level monitoring sites. It can be used as a stand-alone system with internal data storage, or as a sensor connected to any manufacturer's data logger. Easily configure and collect data using the browser-based graphical user interface with all standard web browsers on PCs, tablets and smart phones. It's rugged build, and technologically advanced system makes the Amazon Bubbler an attractive solution for real-time monitoring and data collection. ›› **YSI.com/Amazon**

Situational Analysis

Objective was to support an active Total Maximum Daily Load Plan managed by the TCEQ at Oyster Creek • Preliminary discharge data and rating curves were prepared using a SonTek Flow Tracker or a SonTek River Surveyor • Training was minimal with easy-to-use Amazon bubbler technology.

Sensor Payload

Primary parameter of interest is stage height measured with a YSI Amazon bubbler • Loading calculations are made from stage height data and the preliminary discharge data • Data points are collected every 15 min.

Logging & Telemetry

Storm 3 Datalogger transmits data every hour via an external GOES satellite transmitter • Amazon has redundant logging should lightning or any other event knock out the datalogger.
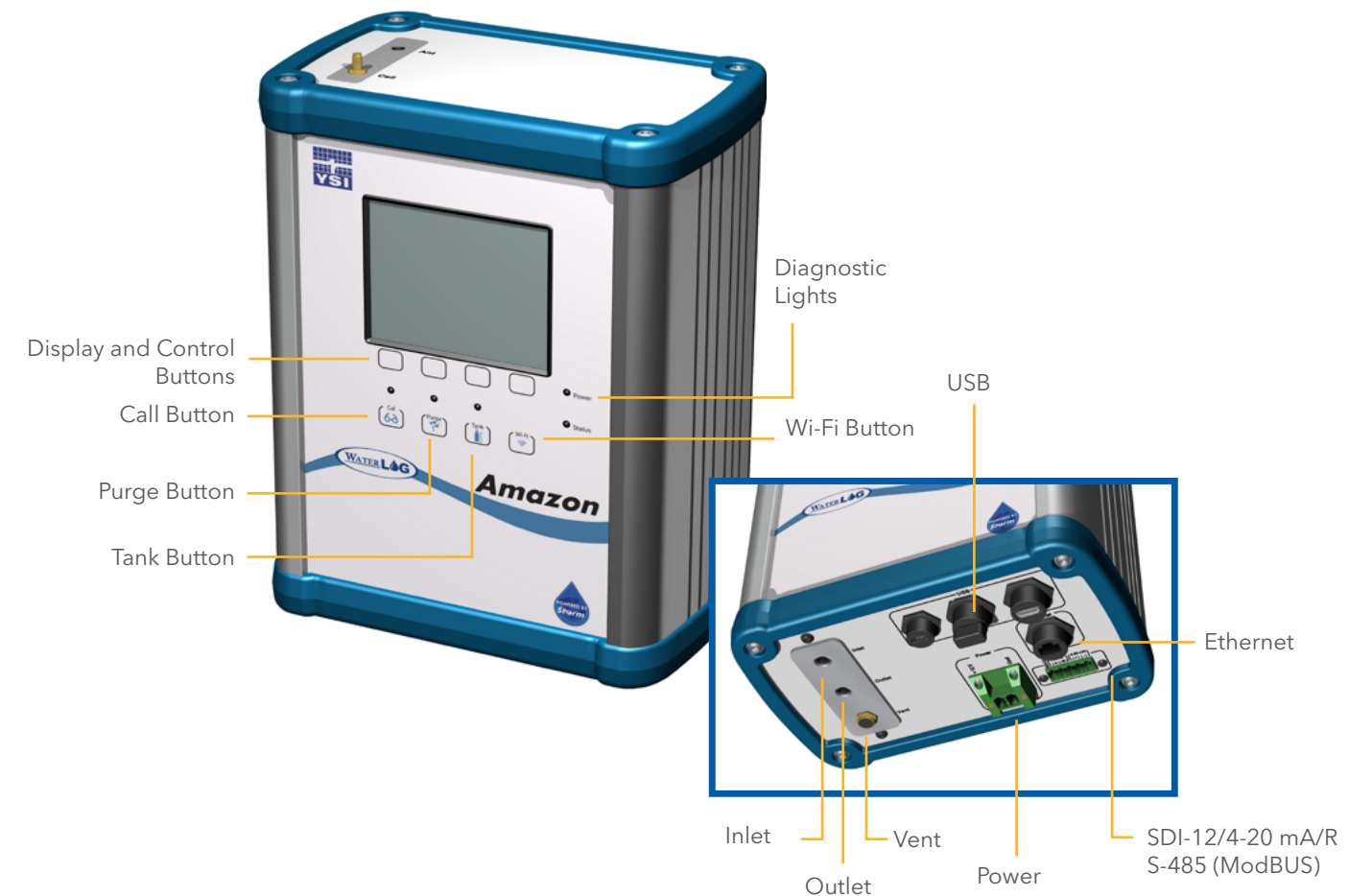
Power

A sealed lead acid 12V/35 Ah battery with 30 watt solar panels • Battery voltage is also monitored via telemetry.

Data Analysis

Amazon data are transmitted to Xylem's HydroSphere platform • Data can be viewed by the public and even downloaded by other researchers • Visit **https://uhcl.edu** and search for Oyster Creek.

Diagnostic Lights

Display and Control Buttons

Call Button

Purge Button

Tank Button

USB

Wi-Fi Button

Ethernet

Inlet

Vent

Outlet

Power

SDI-12/4-20 mA/RS-485 (ModBUS)

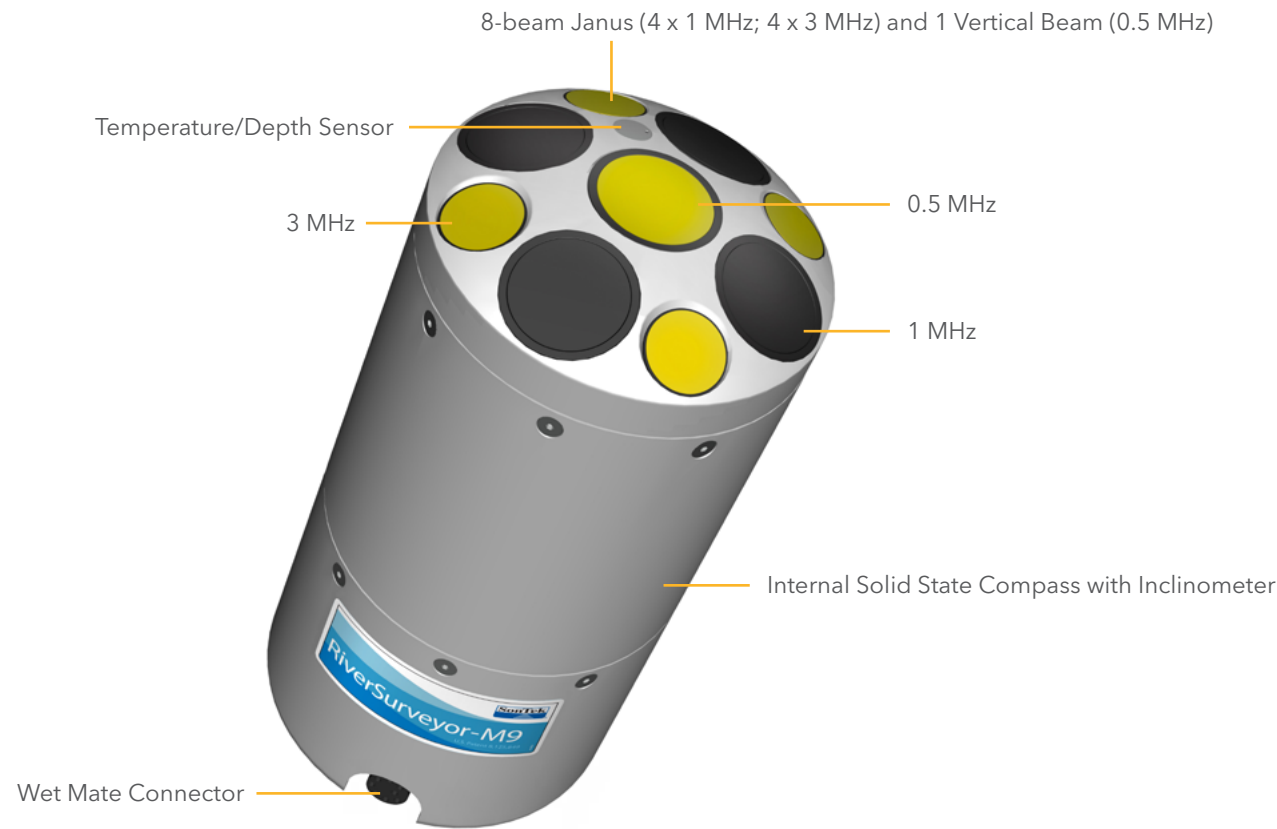| Specifications				
Accuracy	Pressure	Less than or equal to 0.02% of full scale output (FSO) over temperature range		
Range	Pressure	0 to 15 PSI	0 to 30 PSI	0 to 50 PSI
	Depth	0 to 10.54 m (34.58 ft)	0 to 21 m (69.20 ft)	0 to 35.15 m (115.34 ft)
	Accuracy	±2.1 mm (0.007 ft)	±4.3 mm (0.014 ft)	±7.11 mm (0.02333 ft)
Bubbler Gas Delivery	Microprocessor controlled unit			
	Gas Flow Technology	Constant mass technology		
	Gas Flow Control	Bubble rate is user programmable from 30 to 120 bubbles per minute based on 6.35 mm (1/4 in) tubing		

Key Features

- Advanced rugged and sealed design
- Intuitive menu with field-compatible display for easy setup
- High accuracy water level measurements
- Flexible inputs and outputs, including SDI-12

SonTek M9

SonTek FlowTracker2®

The RiverSurveyor M9 is a river discharge measurement system without the traditional limitations. Small, portable and easy to use, the patented and award-winning RiverSurveyor measures in extreme flood or drought situations within a single instrument, and without changing user settings. The results speak for themselves - the RiverSurveyor M9 has revolutionized the way discharge is measured in rivers and canals. ›› **SonTek.com/RiverSurveyor**

The FlowTracker2 (FT2) handheld Acoustic Doppler Velocimeter (ADV®) has all the technology you have grown to know and trust with the original FlowTracker, but now comes with functional, modernized features (Bluetooth, GPS and large color screen, to name only a few) based on the evaluation and feedback from hydrologists, researchers and scientists who have made the FlowTracker their instrument of choice. ›› **SonTek.com/FlowTracker2**

8-beam Janus (4 x 1 MHz; 4 x 3 MHz) and 1 Vertical Beam (0.5 MHz)

Temperature/Depth Sensor

3 MHz

0.5 MHz

1 MHz

Internal Solid State Compass with Inclinometer

Wet Mate Connector

Intuitive workflow and rich graphics to view beam check or QC plots directly, get real-time plots of parameters, view a discharge summary, edit data, and more

Battery compartment is easy to access in the field – no tools required!

The SonTek deluxe wading rod, features a sturdy grip and bubble level

Wet Mate Connector

10 MHz

Specifications

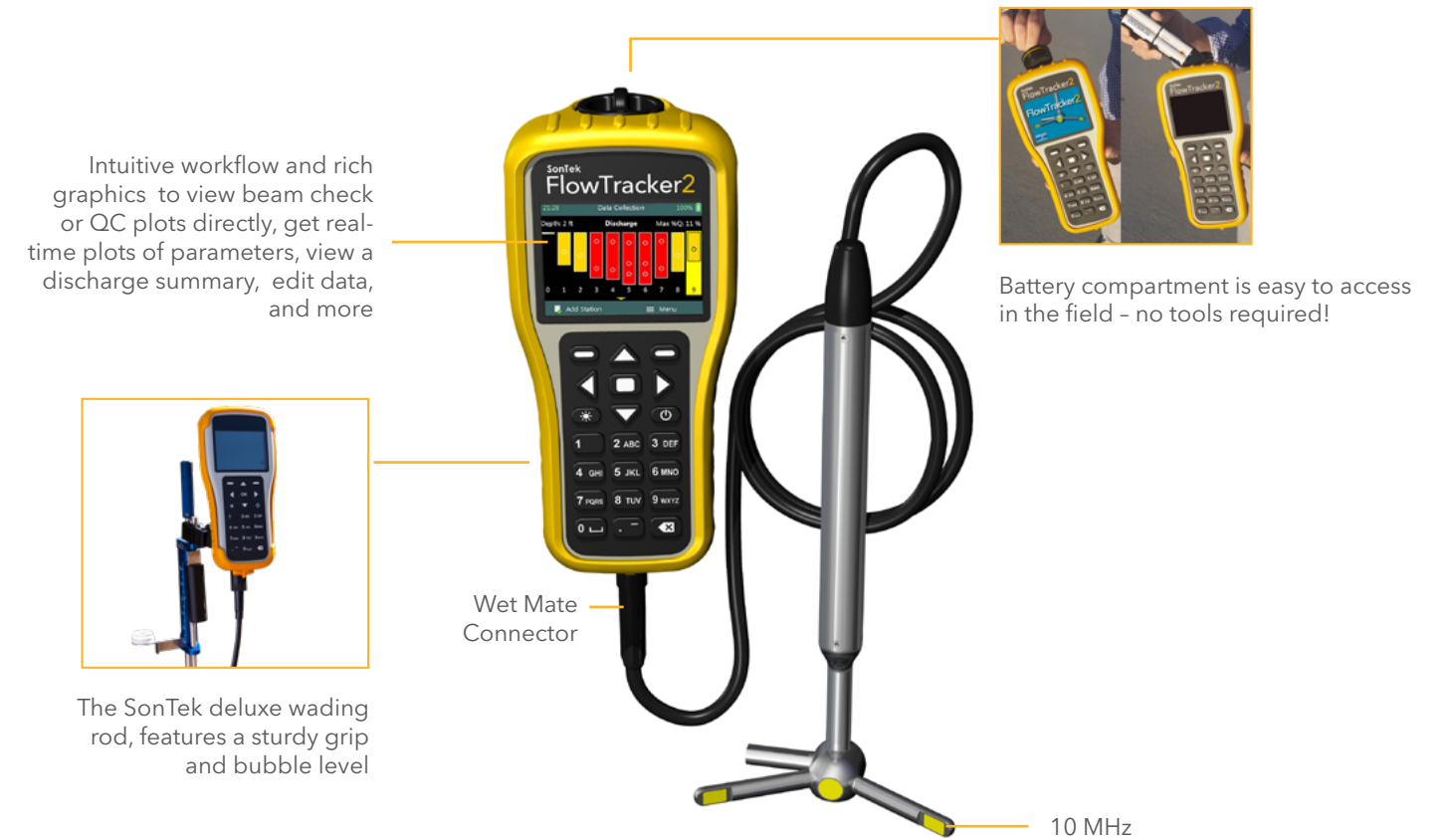| Velocity Measurement	
Profiling Range (Distance)	0.06 m to 40 m
Profiling Range (Velocity)	±20 m/s
Accuracy	Up to ±0.25% of measured velocity; ±0.2 cm/s
Resolution	0.001 m/s
Number of Cells	Up to 128
Cell Size	0.02 m to 4 m
Depth Measurement	
Range	0.20 m to 80 m
Accuracy	1%
Resolution	0.001 m

Key Features

- Multi-Band - Multiple acoustic frequencies

- Uses SonTek's exclusive SmartPulseHD adaptive sampling

- High precision vessel tracking and depth measurement without GPS requirement

- All discharge computations are done internally; no lost data from communication drop outs
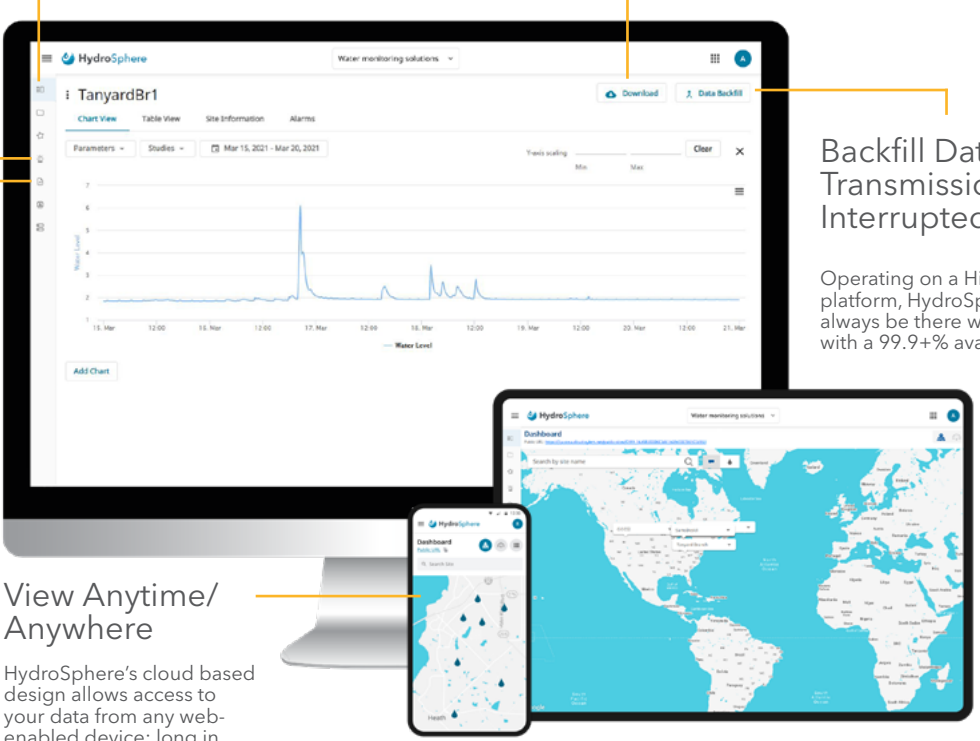
Key Features

- Embedded GPS for georeferencing with automatic or manual fixes

- Improved ADV acoustics: faster pinging, lower noise and better standard error

- Probes and handhelds are interchangeable – flexibility within agency teams and when sending equiptment for service

- Set up and save templates

Specifications

Velocity Measurement	
Range	±0.001 to 4.0 m/s (0.003 to 13 ft/s)
Resolution	0.0001 m/s (0.0003 ft/s)
Accuracy	±1% of measured velocity +/- 0.25 cm/s (0.01 in/s)
Depth Measurement	
Range	0 to 10 m (0 to 32.81 ft)
Accuracy	±0.1% of FS (temperature compensated over full operating range) ±0.05% Static (steady-state at 25°C/77°F)
Resolution	0.001 m (0.003 ft)

HydroSphere™

HydroSphere

HydroSphere™ is a scalable collaborative data visualization platform for outdoor water monitoring. It has a simple user interface that allows users to view sensor data and quickly make data-based decisions. Sensor data can be viewed in different formats, downloaded, analyzed with many types of tools. HydroSphere allows you to build networks of monitoring sites, and you can even create public websites for visualization of curated data.

Configure Data Dashboard

Make your data tell an instant story with a custom, configurable data dashboard.

Customizable reports, graphs and tables

View your data in different formats, apply your parameters, download and share

Alarms/Escalation Path

Create alarms so you never miss an event, and with alarm escalation paths, you can notify others if you're not available to react.

Export Customized Reports

HydroSphere allows you to create and manage custom reports that you can share with anyone; present your data how you want it to be seen.

Backfill Data When Transmission is Interrupted

Operating on a High Availability platform, HydroSphere will always be there with your data, with a 99.9+% availability rating.

View Anytime/Anywhere

HydroSphere's cloud based design allows access to your data from any web-enabled device; long in anytime, anywhere.

For more on HydroSphere:
YSI.com/HydroSphere

Simple

- Data is available anywhere, anytime, on any web-enabled device
- Menu-driven setup of sites
- Easy addition of contacts and users
- Easily designed, customized graphs and tables
- Simple data-backfill for when transmissions from the field are interrupted
- Easy connection to your telemetry-enabled device

Smart

- 99.9+% availability rating of the platform
- Advanced alarm settings combine multiple parameter option
- Alarm escalation involving multiple users
- Define the content for automated reports
- Export reports when, how, and to whomever you define

Secure

- Hosted on Amazon's AWS data center
- 24/7 system monitoring
- State-of-the art security controls on the applications, servers, and networks
- Protection of personalized login credentials

Closing the Flood Gates in Terrebonne Parish, Louisiana

PROTECTING TERREBONNE PARISH FROM HURRICANES

With 987 square miles (2,556 km²) of land and 1,079 square miles (2,795 km²) of lakes and waterways, Terrebonne Parish in Louisiana is actually more water than land. Though the water is the basis for a unique and cherished way of life, it also poses a serious threat to the 112,000 residents of the Parish as climate change drives sea level rise, hurricanes, and stormwater surges that lead to flooding.

After hurricanes Katrina and Rita in 2005, and Gustav and Ike in 2008, residents raised their own money via sales taxes to start building the **Morganza to the Gulf Hurricane Protection System**. Overseen by the Terrebonne Levee and Conservation District, the Morganza includes 98 miles of levees, peaking at 18 to 20 feet in height. Floodgates manage canals, rivers and bayous—the sluggish outlets of rivers that are characteristic of the region—while environmental gates permit flow to wetlands.

The flood gates are based on a highly innovative design called a barge gate, as detailed in **Issue 6 of YSI's Mission Water Magazine**. Opening and closing the gates is aided by tides and natural water flows, but it is ultimately a manpower-based operation. As one operator described, "You have 18 operations employees trying to operate 13 flood gates across 60 miles." It can take six workers as long as 1.5 hours to move a barge gate from the open position to closed. Deploying that entire team is both difficult and dangerous during storm conditions, so timely, accurate data on water velocity, direction and stage is vital to the district.

Monitoring stations for just that purpose were the responsibility of Delta Coast Consultants, and they turned to YSI's Integrated Systems and Services team to fulfill that mission.

MONITORING ON THE MORGANZA

Rather than beginning system design with the sensors, the leading consideration for the Morganza was power and communications, because those are the first things to fail during a hurricane. The team needed a constant and reliable stream of data to not only operate the barge gates, but also to manage other aspects of the intricate water network of the region. It was decided early on, then, that the mains power available at all of the barge gates would be the primary system, but that backup batteries that were recharged with solar panels were a must-have. Battery voltage was among the "parameters" that would be continuously tracked, via the telemetry subsystems. Like mains power, cellular networks could not always be relied on in the throes of a storm or hurricane, so both cellular modems and satellite transmitters were used. Data would be transmitted every 6 minutes using these channels.

The telemetry components were integrated with a datalogger that also had the ports for the primary sensors in the system. **YSI's Nile radar** is a leading non-contact water level sensor that was ideal for this system. The highly accurate Nile radar could track very wide swings in water level, and since it was not in the water it was not at risk of being carried off with high-energy flow, as a submersible transducer might be, and changing flows would not affect the way they might a bubbler.

Changing flows were certainly a major consideration across the entire Morganza system. Jason Kennedy of Delta Coast Consultants pointed out that an incoming tide at one monitoring system can push an outgoing flow two miles away, and notes that flood stages can vary by half a foot (15 centimeters) from one bayou to another. This is why multiple stations were needed to manage flooding across the entire region.

The **SonTek-SL** (side-looker) is ideal for placement at multiple stations across the levee so that operators always have eyes on these dynamics. The SL can be easily side-mounted on bridges, canal walls, riverbanks, and yes, the infrastructure that accompanies barge gates. Operating on the acoustic Doppler principle, the SL is popular for water velocity profiling in coastal applications, because it also has a wave spectra option that calculates and outputs wave-height and period, in real-time.

Between the Nile and the SL the team would have a good handle on the movement of water throughout the region, but anticipating what's to come requires also keeping and eye on the weather in a highly localized manner. "We have more effect from 25-knot south wind now than we ever had—tremendously high tidal events because of normal frontal passages," Kennedy notes. "Ahead of a front, 30-knot southeast winds are almost like a little hurricane."

R.M. Young wind sensors were integrated into the systems, as well as **YSI tipping bucket rain gauges** so that wind speed and direction, and rainfall could also be transmitted to the levy district's command center. Thus the team always knew when storms were blowing in.

Altogether these monitoring stations have enabled the district to operate the flood gates with half the staff that might otherwise be required, which makes this innovative system sustainable from a management and budgeting perspective. The public is also now reaping the benefit of their tax dollar investment.

PUBLIC INTEREST

It didn't take long for residents of Terrebonne Parish who rely on the waterways—the shrimpers and oystermen, the barge haulers, the recreational fishing enthusiasts—to ask for access to the data streaming into the levee district's system.

The district commissioned a public app, then switched to an online service at **www.tlcd.org/mobile**.

Visitors can click on any of the floodgates that have instruments and get an instant, up-to-date look at flood-side stage, wind direction and wind speed, and the status of the gate. Those who subscribe by sharing their emails and cell numbers can get alerts when the gates are closing or opening.

Kennedy says pilots on the system can use the website and alerts to adjust their routes on the Gulf Intracoastal Waterway and other channels based on gate closures — decisions that can keep them working during changes in the weather or get them home safely as storms close in.

News on the gates also allows them to get back to work after storms blow through.

"Everybody wants to know not only when it's going to close, but when it's going to open," Kennedy notes. "We don't want to keep things closed any longer than we have to. There's so much commercial interest in getting out to the water."

To Kennedy, commercial interest is just one part of what the levee system is being built to protect. "You're protecting life and property of the people who live here," he says.

"But the other aspect is you're protecting the culture and the environmental resources. If we were to lose these coastal wetlands, Louisiana would lose its identity. If we lose our coastal wetlands, there's no more seafood, no more crawfish, no more Cajun culture. The communities that have been built here, that's what they're built on."

For more on Louisiana's Strategic Adaptations for Future Environments:
LAsafe.LA.gov

Flood Monitoring

Situational Analysis

Objective was to provide advanced warning of flood-promoting events so that operators could safely and rapidly close barge gates in the Louisiana Delta • Excellent infrastructure and highly trained personnel could be leveraged for system design and data delivery

Sensor Payload

Water stage with Nile radar • Velocity, flow, waves with SonTek SL • R.M. Young wind speed and directional sensor • YSI tipping bucket rain gauge for rainfall

Logging & Telemetry

Primary data transmission was via cellular modem to client's private network • Redundant satellite transmitters to ensure operability during a storm event • Proprietary mobile app and alerts transmitted via text, email, or SMS to both operators and the public
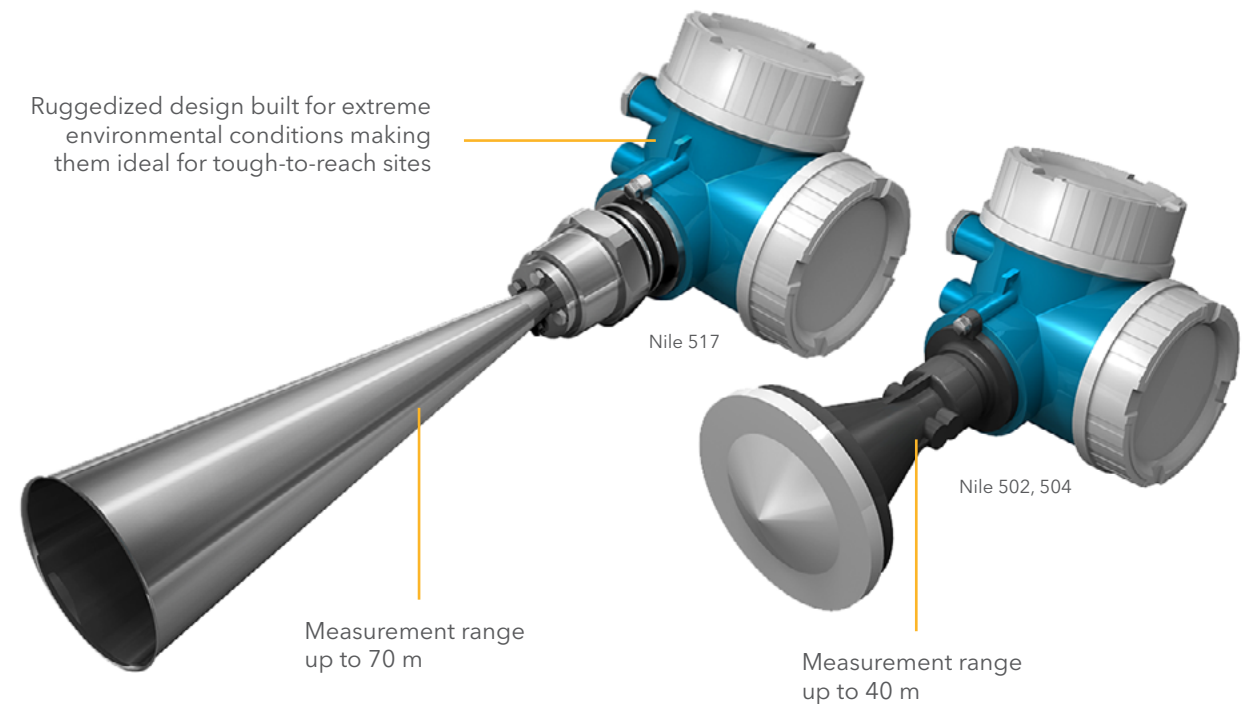
Power

Mains power was backed up by a 12-volt battery with a solar panel and regulator for recharging • Battery voltage was included in the transmitted data

Data Analysis

Data are used in real-time, but building historical record improves overall management of the levee system • Data are available to the public for multiple purposes

Designed for non-contact water level measurement, the WaterLOG Nile Series (502/504/517) combines high accuracy with an out-of-the-box measurement range of up to 70 m. The rugged, innovative design was built for extreme environmental conditions - making this series ideal for tough to reach sites. Its reliable interface and simple SDI-12 and RS-232 communication ensure seamless integration with current water monitoring stations. ›› **YSI.com/Nile**

Ruggedized design built for extreme environmental conditions making them ideal for tough-to-reach sites

Nile 517

Nile 502, 504

Measurement range up to 70 m

Measurement range up to 40 m

Specifications	
Velocity Measurement	
Velocity Range	±5 m/s (16 ft/s)
Resolution	0.0001 m/2 (0.0003 ft/s)
Accuracy	±1% of measured velocity, ±0.5 cm/s (0.2 in/s)
Water Level	
Vertical Beam Range	0.05 – 1.5 m (0.2 – 5.0 ft) (Standard) 0.05 – 5.0 m (0.2 – 16.0 ft) (Plus/Pipe)
Water Level Accuracy	0.1% of measured depth or ±0.003 m (0.01 ft), whichever is greater
Pressure Sensor Range	30 m (98 ft; 42 psi)
Pressure Sensor Accuracy	0.1% of full scale

Key Features

- High accuracy
- Continuous operation, no warm-up or "lock on"
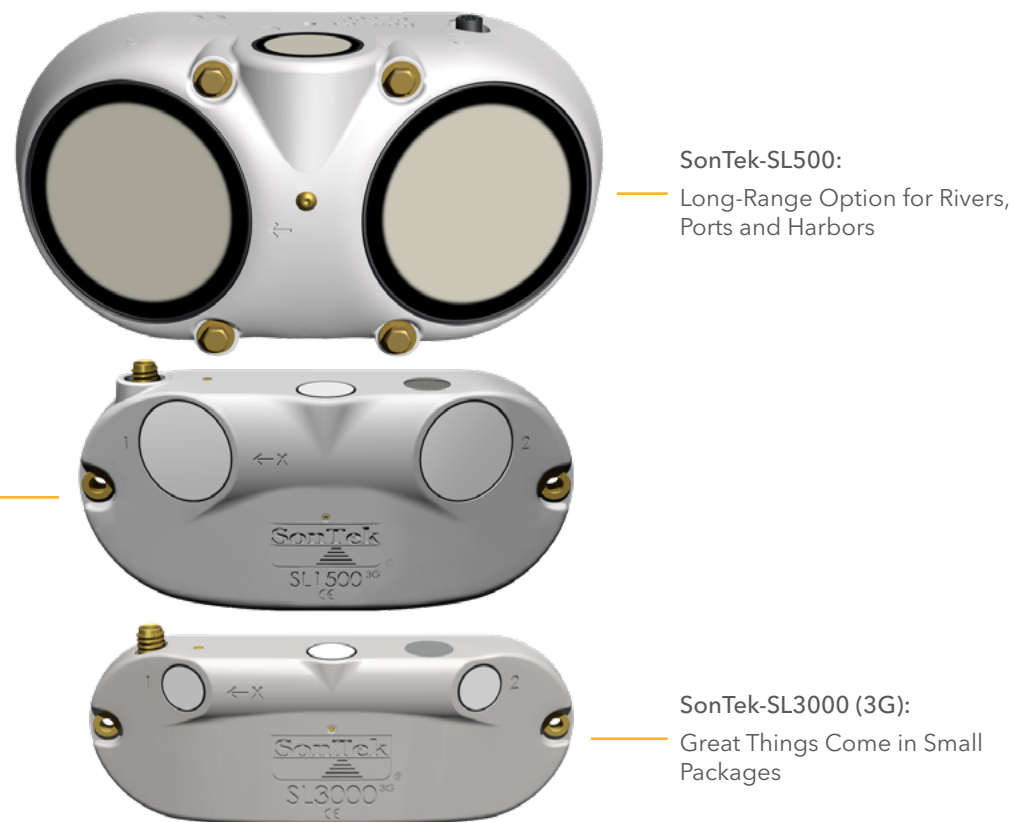- Surge protection
- Multi-Echo Tracking

SonTek-SL

WaterLOG Rain Gauge

Designed specifically for side mounting on bridges, canal walls, or riverbanks, the SL's sleek, low-profile housing makes installation easy. With three models to choose from, the SL can be used in small channels or rivers as wide as the Amazon. Ultra narrow beam widths combined with unmatched side lobe suppression provide superior acoustic directivity necessary for achieving maximum horizontal range, free of interference from surface or bottom boundaries.
›› SonTek.com/SonTek-SL

Whether you're new at rain measurement technology or know the systems like the back of your hand, you'll love the features of the SDI-12 Tipping Bucket Rain Gauge (H-3401)—such as the built-in microprocessor that automatically corrects errors. It also has a magnetic reed bucket tip sensor and an internal leveling mechanism with a 'bulls-eye' level to ensure high accuracy data. **›› YSI.com/Rain-Gauge**

SonTek-SL500:
Long-Range Option for Rivers, Ports and Harbors

SonTek-SL1500 (3G):
Mid-Range Option with Wide Array of Use

SonTek-SL3000 (3G):
Great Things Come in Small Packages

Two removable stainless steel funnel screens

Rustproof enclosure

H-3401

Specifications			
	SL3000 (3G)	SL1500 (3G)	SL500
Velocity Measurement			
Range	±7 m/s (23 ft/s)		±6 m/s (20 ft/s)
Resolution	0.0001 m/s (0.0003 ft/s)		0.001 m/s (0.003 ft/s)
Accuracy	±1% of measured velocity; ±0.0005 m/s (0.015 ft/s)		
Water Level			
Vertical Beam Range	0.1 to 5.0 m (0.3 to 17 ft)	0.15 to 10 m (0.5 to 33 ft)	0.2 to 18.0 m (0.7 to 59 ft)
Vertical Beam Accuracy	(depth < 3m): ±3 cm (0.01 ft); (depth > 3m): ±0.1%		(depth < 6m): ±6 cm (0.02 ft); (depth > 6m): ±0.1%
Pressure Sensor Range	30 m		20 m
Pressure Sensor Accuracy	0.1% of full scale		0.25% of full scale

Key Features

- Measures multiple parameters from one easy-to-use instrument

- Uses SonTek's exclusive SmartPulseHD adaptive sampling

- Compact, hydrodynamic design

- Self-calibrating water level using vertical acoustic beam and pressure

Key Features

- Two removable stainless steel funnel screens

- Rustproof, power painted aluminum enclosure and cart base

- Anodized aluminum or stainless steel internal parts

- Magnetic reed bucket tip sensor

- Internal leveling mechanism with 'bulls-eye' level

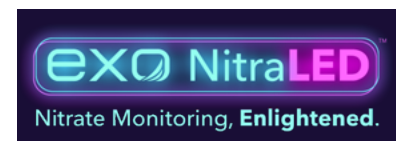| Specifications	
Accuracy	H-3401: ±2%, 100 mm/hr (4 in/hr) H-3401 SDI: ±3%, 0-635 mm/hr (0-25 in/hr)
Resolution	0.1 in, 0.1 mm and 0.2 mm
Funnel Aperture	200 mm W (8 in)
Protocol	SDI-12, version 1.3
Electronic Operating Temperature	-40° to +60° C (-40° to 140° F)
Mechanical Operating Temperature	0° to +50° C (32° to 122° F)

Featured Product
EXO Sonde

EXO Multiparameter Sondes -- the best-in-class platform for the highest quality data. Stormwater Solutions that employ EXO can deliver a real-time look at runoff, discharge, and plumes from point sources.

The unmatched benefits of **EXO** include:

Highest Data Quality
Onboard monitoring systems verify sensor operation

Industry-leading Antifouling
Extend deployments and sensor life with the industry's best antifouling wiper

Smart Sensors
SmartQC™ tracks calibrations and sensor positions, and enables multi-sensor calibrations

EXO NitraLED
Nitrate Monitoring, **Enlightened**.

Transformative optical nitrate sensor available only on the EXO

For more on EXO Sonde:
YSI.com/EXO

EXO3   EXO1   EXO2

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exo™

Smart Sensor Suite
A dynamic range of sensors for multiparameter applications

- Central Wiper
- DO
- pH/ORP
- NitraLED
- TAL-PC
- fDOM
- C/T (Wiped)
- Turbidity
- Depth

Shown: An EXO2 bulkhead with smart sensors

EXO sondes feature universal smart ports for sensor installation

Calculated Parameters

The following parameters are calculated from one or more sensors listed above. More information may be found in the EXO User Manual.

- Absolute Pressure
- Ammonia
- DO% Local
- DO% LocalB
- Gauge Pressure
- nLF Conductivity
- Resistivity
- Salinity
- Specific Conductivity
- Total Algae cells/mL
- Total Dissolved Solids
- Total Suspended Solids
- Vertical Position
- Water Density

Sensors Not Shown

- Total Algae-PE
- Rhodamine
- pH
- Non-wiped Conductivity/Temperature (C/T)
- ISEs for Ammonium, Chloride, Nitrate

After your Stormwater monitoring system is installed, the hard work begins. Let our service specialists support you.

Our experts can provide:

Installation

Harsh environments, remote locations, and sites accessible only by boats, airboats, helicopters, or swamp buggies won't stop our team. YSI technicians have construction and installation experience in the field including hardware installation, civil engineering work, and complete system implementation.

Commissioning

We can verify that your system is working, including helping you get started with HydroSphere and training your team. Let our experts help your experts.
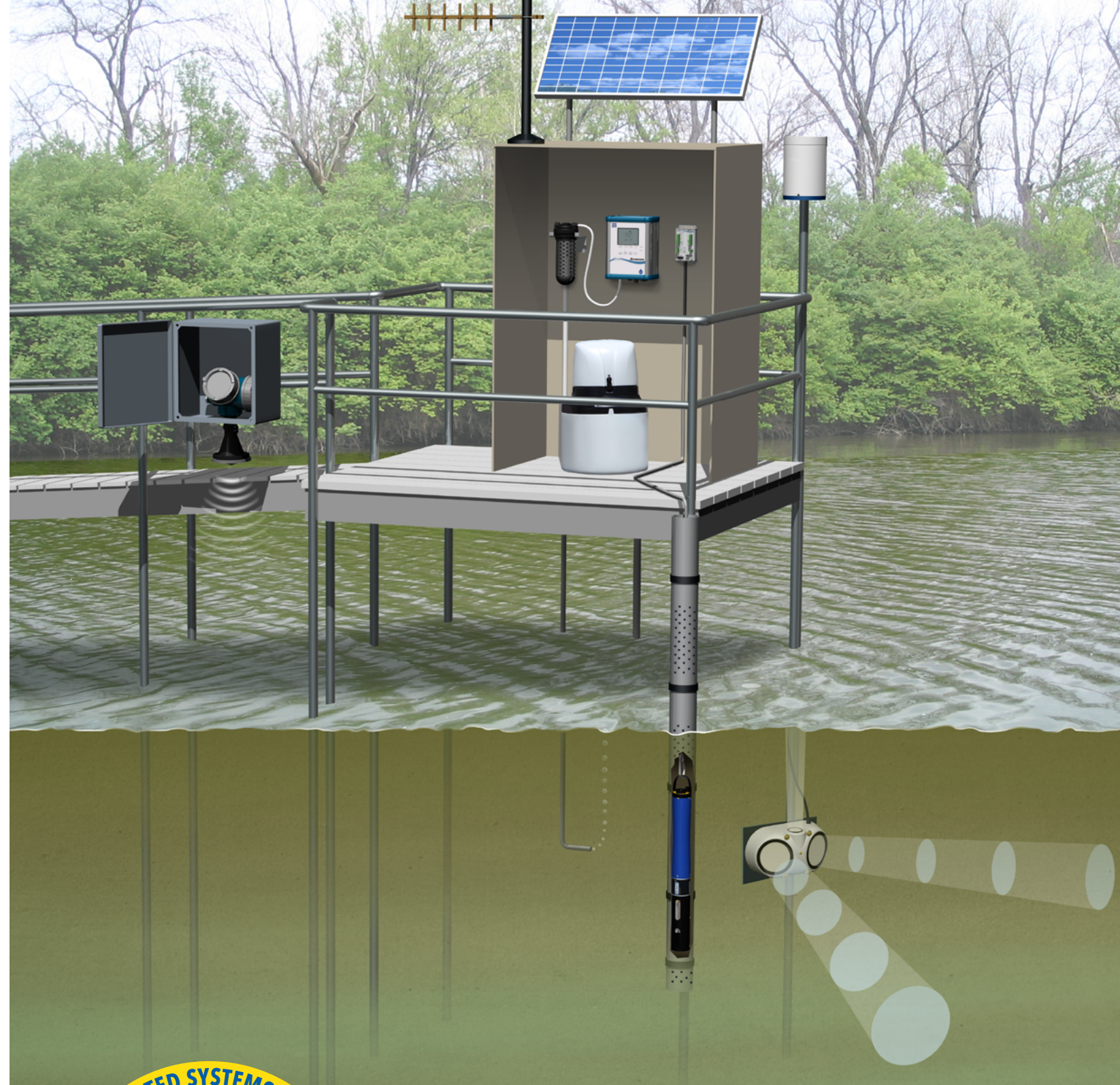
Maintenance

Maybe you need to keep the data moving, but don't have the people to do routine maintenance of your sites. No problem--we have instrument experts that can take care of calibration, site upkeep, communication verifications, system upgrades, and data quality control. Contact us to discuss the scope of your needs!

For more on ISS Services:
YSI.com/Services

Your Stormwater system and monitoring environment are unique. Talk with our hands-on application specialists to get started and enjoy years of high-quality data!

YSI INTEGRATED SYSTEMS & SERVICES

BETTER DATA • BETTER DECISIONS

Let us help you solve your water monitoring challenges.

Contact YSI Integrated Systems & Services about your next project!

YSI.com/Systems   YSI.com/Services   937-767-7241

Xylem |ˈzīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

Who's
Minding
the Planet?®

xylem
Let's Solve Water

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