

AAA UCAYALI, PERU

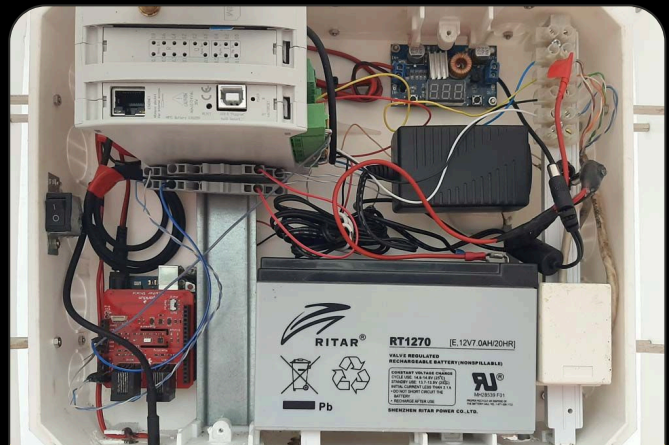
The Ucayali river, every minute. **One M-Duino 19R** sends the level.

Level sensor, cellular link, MQTT and a web app. Solar powered.

[Read the interactive success story online ›](#)



The station on site in Pucallpa: enclosure with the AAA Ucayali and ANA logos and a small solar panel on top.



Inside the cabinet: the Industrial Shields PLC with its cellular antenna (label GPRS/GSM Controller 19R), a 12 V 7 Ah battery, a DC-DC converter and a second Arduino format board whose role the case does not publish.

1 min

default send interval, and it can be changed

0 to 10 m

water column, piezometric sensor on Modbus RTU

4,358.8 m³/s

base flow on 3 June 2020, during the test at LPO

232,744.6 km²

sub-basin with only one drainage station

THE CHALLENGE

A huge river basin. Almost no flow data.

The Ucayali sub-basin covers 232,744.6 km², and the case says it has only one drainage station. AAA Ucayali needed an automatic system that records river level and flow at the hourly level. This is the brief of the case.

01

Hourly flow data

Flow values at the hourly level for a large Amazon basin, similar to the Requena station.

02

Real time

Record the change of river level and flow at different points as it happens.

03

Off the grid

A solar panel and a battery power the station. The mains is an alternative where it exists.

04

Run by the team

The pilot lets AAA Ucayali install, operate, maintain and monitor the station itself.



Built by AAA Ucayali

AAA Ucayali built the measurement equipment. The data supports its work on water use rights, marginal strips, hydraulic works, early alerts, gauging campaigns for the Q-H curves of floods and droughts, and basin planning with GETRAM, the multi-sector work group of Ucayali.

HOW IT WORKS

Three loops: measure, convert, keep going.

Loop 1 · Measure and send

From the river bed to a phone screen

A piezometric sensor measures the water column from the river bed to the water surface, from 0 to 10 m. The PLC reads it over RS-485 with Modbus RTU and sends the data over the cellular network. In the figures of the case, an MQTT broker (EMQ) receives the messages, a Node.js MQTT client writes them into MySQL, and a web app shows them on a computer or a phone. The default send interval is 1 minute, and it can be changed.

- Piezometric sensor: 0 to 10 m, 12 to 24 V, IP68
- RS-485 with Modbus RTU to the PLC
- MQTT over the cellular network, every minute by default

Loop 2 · Level to flow

A level becomes a flow with a calibration curve.

In the case, the flow comes from the level through a calibration curve $Q = a \cdot H^b$. The curve comes from gauging campaigns on the river. The case publishes the Pucallpa curve, $Q = 1E-71 \cdot H^{34.7575}$, from the gaugings of 2018 and 2019. With this curve, 141.9772 m a.s.l. gives 6,393.5 m³/s: the same pair the app shows on 8 June 2020.

- Gauging with an ADCP M9, 16 June 2020: 5,122.84 m³/s
- Distance across the section 671.404 m, area 5,212.816 m², max depth 20.642 m
- Alert line on the level chart: 146.5 m a.s.l.

Loop 3 · Remote site

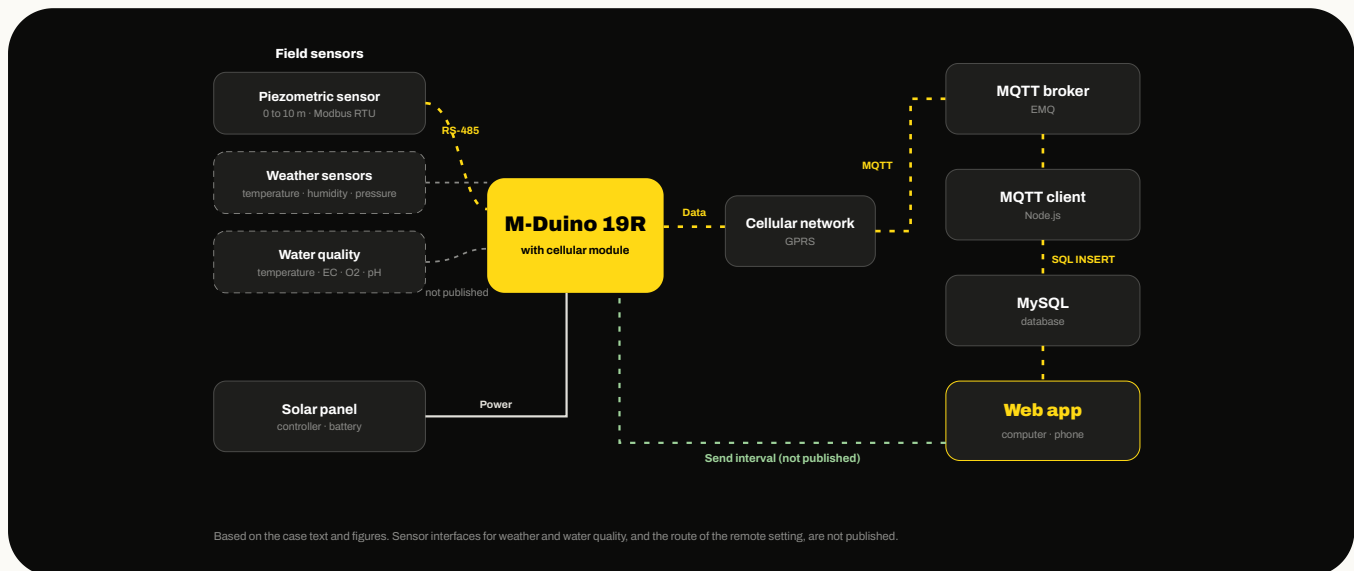
Sun for power. A cell tower for data.

A solar panel, a charge controller and a maintenance free battery power the station. The app shows the battery voltage. The case also names a limit: data reaches the web app only with cellular service. Where there is no coverage, a satellite link can be the remedy. The panel shows a typical way to keep readings during a gap.

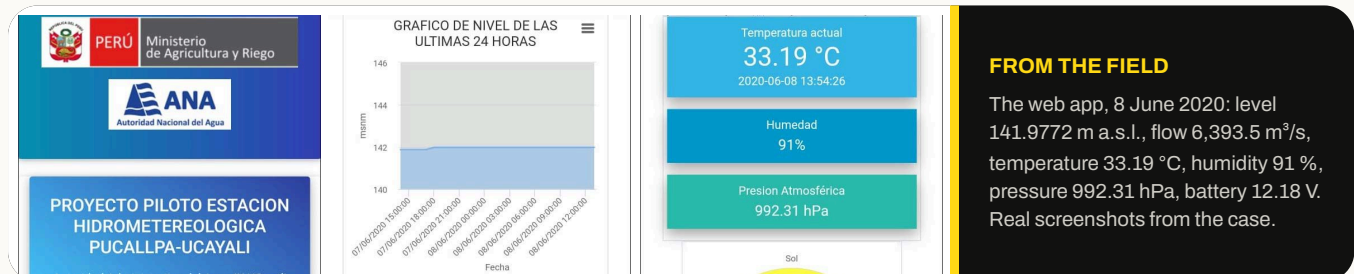
- Solar panel, charge controller and battery
- Battery voltage on the web app: 12.18 V
- No coverage: satellite link as the alternative

How does one M-Duino 19R report a river from a pier?

One sensor wire goes down to the river bed. One PLC reads it and sends the data over the cellular network. The rest runs on servers: an MQTT broker, a Node.js client, a MySQL database and a web app. The case does not publish the interfaces of the weather and water quality sensors.



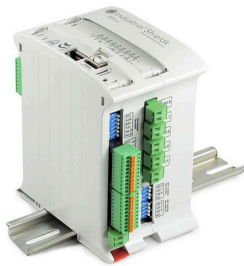
— Data from the station
 — Setting back to the station
 — Detail not published by the case



Signals and data

Flow	Between	Type	Purpose
River level	Piezometric sensor → M-Duino 19R	RS-485 Modbus RTU	Water column from the river bed to the surface, 0 to 10 m
Weather	Sensors → station	Not published	Temperature, humidity and atmospheric pressure on the web app
Water quality	Sensors → station	Not published	Temperature, EC, dissolved oxygen and pH, daily and hourly records
Power	Solar panel, controller, battery → M-Duino 19R	DC supply	Runs the station on site. Mains as an alternative
Data out	M-Duino 19R → MQTT broker (EMQ)	MQTT over cellular	Sends the readings, every minute by default
Storage	Node.js MQTT client → MySQL	SQL INSERT	Writes each message into the database by topic
Web data	MySQL → web app	Not published	Level, flow, weather and battery on a computer or a phone
Send interval	Operator → M-Duino 19R	Not published	Changes how often the station sends its data

One M-Duino 19R reads the level and sends the data.



M-Duino Ethernet PLC Arduino 19R

An industrial PLC built on an original Arduino Mega 2560, with 17 inputs and outputs, Ethernet, RS-485 and RS-232, for DIN rail. In this station it reads the piezometric sensor over Modbus RTU and sends the data over the cellular network.

Inputs	6: 4 analog/digital (0-10 V), 2 digital optoisolated with interrupt
Outputs	11: 8 relays, 3 analog/digital/PWM (0-10 V)
Comms	Ethernet (RJ45), RS-485, RS-232, TTL, I2C, SPI
Built in	Real time clock, microSD slot
Power supply	12 to 24 Vdc
Mounting	DIN rail TS35, IP20

The case dates from 2020 and uses an M-Duino 19R with a cellular module: the label on the PLC reads GPRS/GSM Controller 19R. The same product page now sells its current version, the M-Duino 19R+. The GPRS/GSM versions are in the M-Duino GPRS family datasheet.

[See the M-Duino 19R+ ›](#)

Open, with no licence fees

The case uses open hardware and software. No payment for the right to use the technology. The PLC is programmed with the Arduino IDE.

Room to grow

The case values a modular solution: the specifications can be extended in the future. The M-Duino family expands up to 127 modules over I2C, up to 7,100 inputs and outputs in master and slave links.

Industrial hardware for a remote site

A DIN rail PLC designed and made for industrial use, with RS-485 for the level sensor, a cellular module for the data and a 12 to 24 Vdc supply.

SIMILAR PROJECT?

Tell us your river and your sites. An engineer will answer.

Tell us what you measure (level, flow, weather, water quality), how many stations you plan, which link you have on site (cellular, satellite or radio) and where the data must go. We will tell you which controller fits and how to connect it.

READ IT ONLINE

industrialshields.com/success-story-hydrometric-station-arduino-plc-piru

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