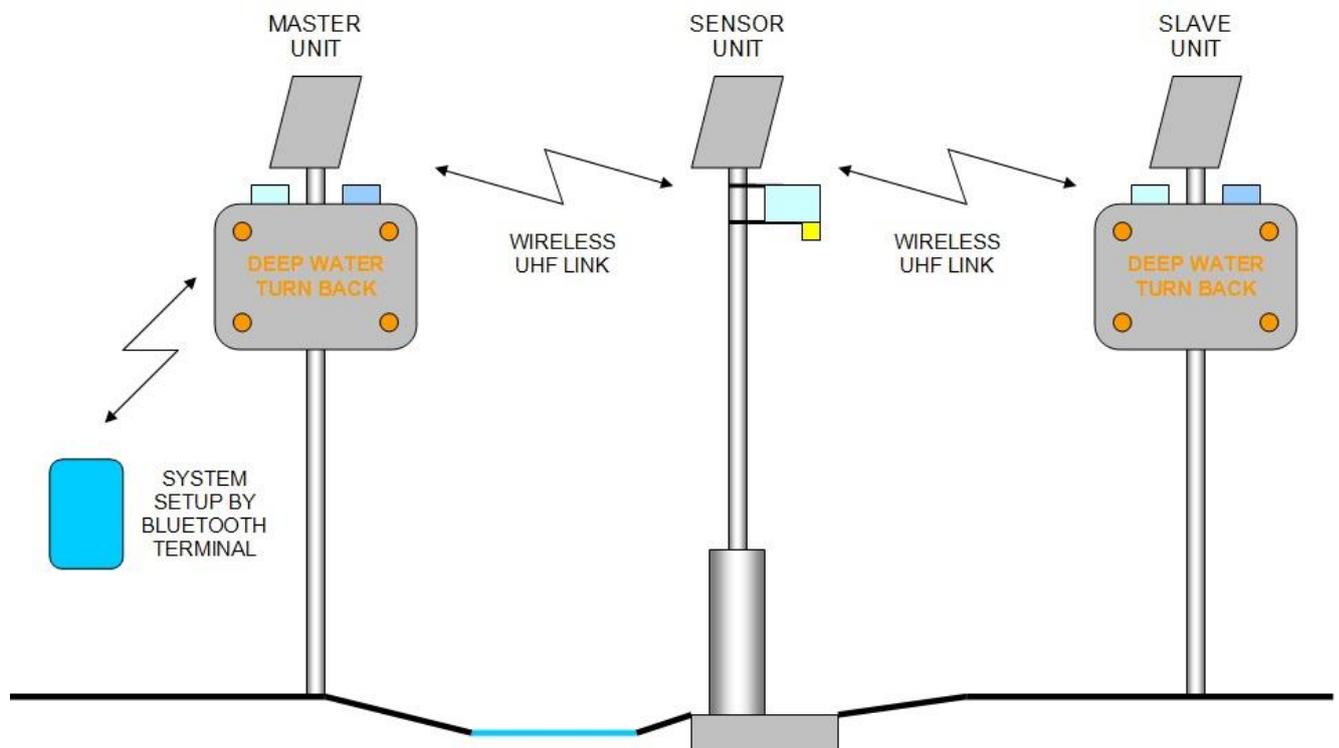


## Coeval Flood Warning System Overview

The Coeval Flood Warning System is designed specifically for installation on roadways approaching areas that are prone to flooding.

### 1 - Full System Overview:



The System comprises primarily of three pole mounted sets of solar powered electronics.

#### The central **SENSOR** location has the pole mounted sensor electronics:

The central sensor pole will be positioned at the location prone to flooding. The sensor electronics at this location periodically measures the depth of water both around the pole base using an ultrasonic sensor, and also inside the pole base using a hydrostatic sensor. The electronics automatically reports the measurements to both the master and slave sign face locations by means of an integral multi-channel 500mW UHF radio unit.

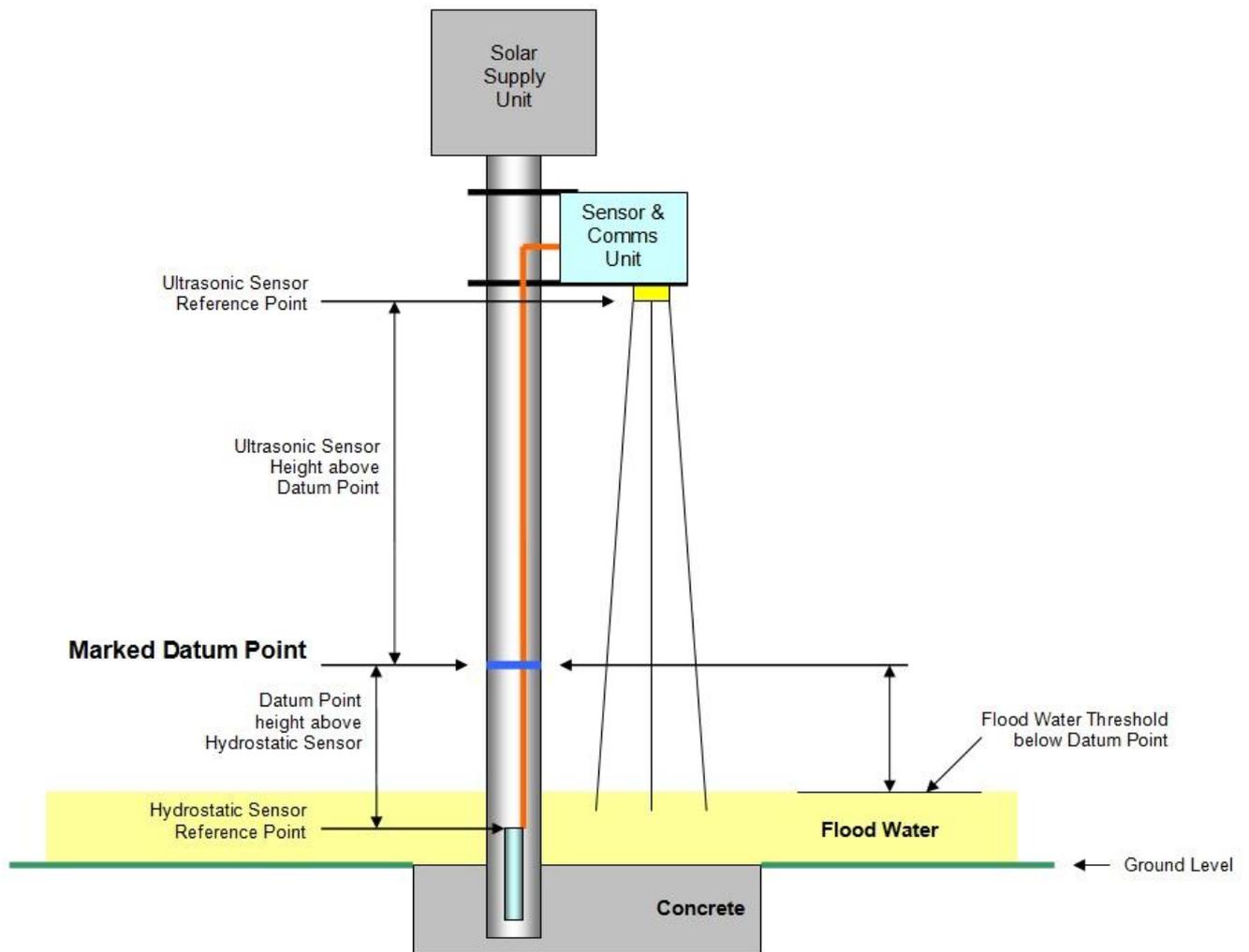
**The MASTER location has a pole mounted sign face, UHF electronics and Bluetooth Setup:**

The master electronics pole will be positioned at the approach to the potential flood area which is easiest to access during a flood situation. The electronics unit at this location listens to the measurement radio communications sent from the sensor unit. During a flood situation, the electronics unit checks either for approaching vehicles using a rear sign mounted vehicle speed radar, or for approaching pedestrians using a pole mounted long range outdoor PIR unit. The sign face will illuminate for a predetermined number of seconds when the sign is approached. The water level 'flood' threshold can be configured at this location using any standard Bluetooth enabled device running a terminal emulator app or programme. Access to the systems Bluetooth connection is password protected.

**The SLAVE location has a pole mounted slave sign face and UHF electronics:**

The slave electronics pole will be positioned at the opposite approach to the potential flood area. The slave electronics unit at this location is identical to that at the master location with the exception of the Bluetooth link. The warning sign face at this location operates on the same water level threshold that was set on the master unit using the Bluetooth device.

**2 - Sensor Pole Details:**



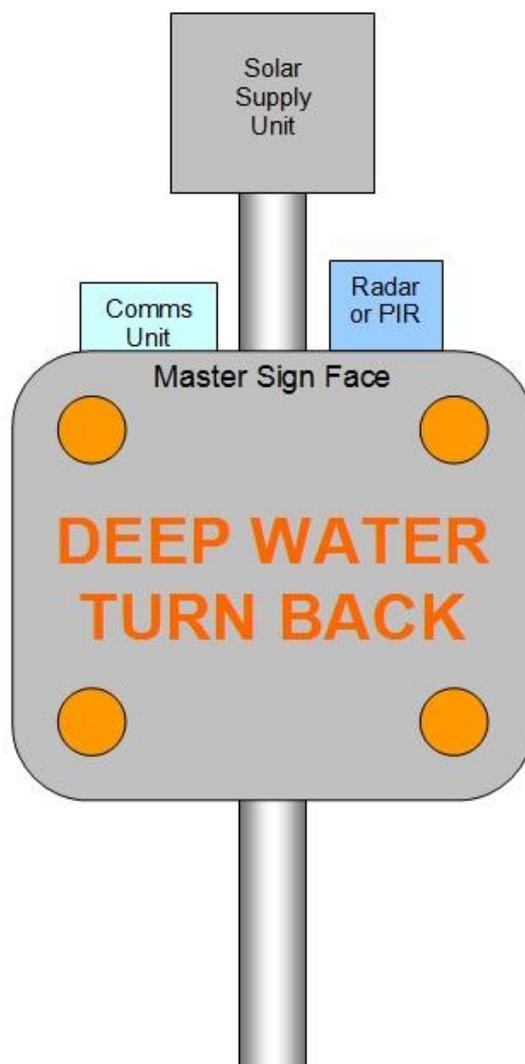
### Measurement Sensors:

The sensor pole takes the flood water depth measurements on a periodic basis. An ultrasonic sensor is mounted at the top of the pole and measures the distance to the flood water. Inside the pole base, a submersible hydrostatic sensor measures the height of the water inside the pole. The rising flood water must have access to the inside of the pole for this to operate.

### Method of depth calculation:

When the system is first installed, the engineer marks a datum point on the pole as shown in the diagram above. The installation engineer first measures the height of the ultrasonic sensor zero reference point above the datum point. He then proceeds to measure the height of the datum point above the hydrostatic sensor zero reference point. These figures are later entered into the master unit by the installation engineer using the Bluetooth link.

The end customer then makes a decision as to what water height would determine a flood situation. The height of the datum point above this decided flood water level is then entered into the master unit by the end customer using the Bluetooth link. This height can be changed at any time by the end customer.



### 3 - Master Pole Details

#### Master Location UHF Radio Electronics:

The master electronics is essentially the base control station radio for the whole system. This operates as per the following sequence of events:

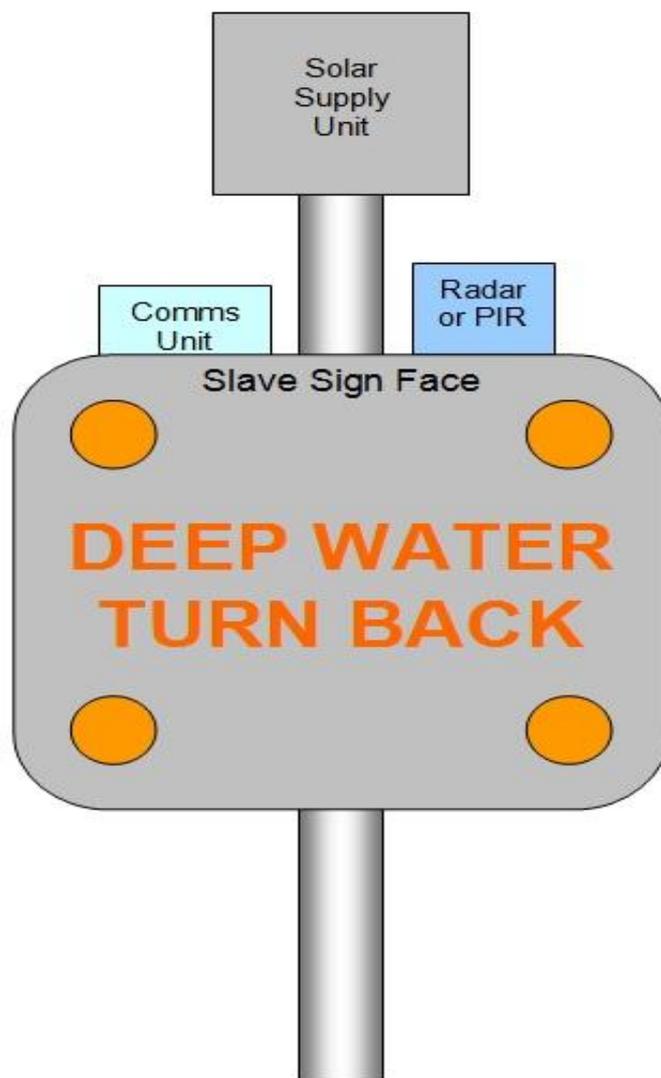
A - Every five minutes or so, the master unit will send a UHF radio message to the sensor electronics unit which contains the absolute flood level thresholds that the slave unit must work to, as per the datum measurements entered into the master unit by the engineer and the customer.

B - When the sensor unit hears the masters message, it broadcasts the absolute sensor measurements and its own battery level back to the master. It also re-broadcasts the absolute sensor measurements along with the absolute flood level thresholds that it just heard from the master, on to the slave unit so that it knows how to determine a flood situation.

C - The slave unit then proceeds to send its battery level back to the sensor unit.

D - The sensor unit then sends the slaves battery level information back to the master unit.

Completion of the above sequence gives the master unit confirmation that all units are working and have received the data. All datum information sent via the above method are stored in non-volatile EEPROM at each location. When a flood situation arises, the master unit will briefly illuminate its auto-dimming sign face when the radar detector or PIR unit is approached.



### Slave Location Electronics:

The slave electronics is identical to the master electronics with the exception of the Bluetooth link electronics.

### 5 - UHF Radio Channel and Software ID Channel selection:

There are four switches accessible inside the communications electronics unit at each location.

Up is ON, down is OFF.

- Switch 1 at the far left hardware enables a buzzer which can provide some service feedback. Normally this will be left in the OFF position.
- Switch 2 selects the Software ID. This switch should normally be in the OFF position. If however there is only one radio telemetry channel free and there already is another Coeval radio system of this type in the area, move this switch to the ON position and they will share the radio channel with the other system. Ideally however, select a different radio channel for each full system using switches 3 and 4 as detailed next.
- Switches 3 and 4 select the radio frequency that the unit will use. A UHF scanning radio for the 458MHz Telemetry band should be used to ensure an unused channel. There are frequently other manufacturers radio units on these channels and these will likely have a range of between 1 to 3 miles. Find an unused channel. There are four radio channel select option as follows:
  - SW3 OFF (down), SW4 OFF (down) = 458.575 MHz
  - SW3 OFF (down), SW4 ON (up) = 458.625 MHz
  - SW3 ON (up), SW4 OFF (down) = 458.675 MHz
  - SW3 ON (up), SW4 ON (up) = 458.725 MHz
- All units in the system MUST have switches 2, 3 and 4 in the same positions or the units will not communicate.

### 5 - Master Location Bluetooth Link Details:

The master electronics provides the Bluetooth setup link. The link is password protected with a six digit PIN number which can be changed by the customer.

Once the unit has been paired on the Bluetooth link and the PIN number has been accepted, the following options area available:

#### Bluetooth Response after entry of the Information Command - 'info'

-----

Coeval Flood Warning System Information:

-----

Switch = 2

Software ID = 0

Radio Channel Freq = 458.675 MHz

-----

Master Unit Battery = 12.7 Volts

Sensor Unit Battery = 12.3 Volts

Slave Unit Battery = 12.4 Volts

-----

Alarm Threshold distance BELOW Datum  $\geq$  50cm

-----

Hydrostatic sensor BELOW Datum = 70cm

Hydrostatic Absolute Alarm Threshold  $\geq$  20cm

Hydrostatic Absolute Measurement = 38cm

Hydrostatic detects FLOOD

-----

Ultrasonic sensor ABOVE Datum = 310cm

Ultrasonic Absolute Alarm Threshold  $\leq$  360cm

Ultrasonic Absolute Measurement = 342cm

Ultrasonic detects FLOOD

-----

### **Bluetooth Response after entry of the Information Command - 'setup'**

Coeval Flood Warning System - End Customer Access

-----

Coeval Flood Warning System - Setup:

-----

The Alarm Threshold distance BELOW the Datum is currently 50cm

What is the NEW Alarm Threshold in cm ? : 50

50cm accepted

Setup is complete.

-----

### **Bluetooth Response after entry of the Information Command - 'setup'**

Coeval Flood Warning System - Service Access

-----

Coeval Flood Warning System - Setup:

-----

The Alarm Threshold distance BELOW the Datum is currently 50cm

What is the NEW Alarm Threshold in cm ? : 50

50cm accepted

Hydrostatic sensor BELOW the Datum is currently 70cm

What is the NEW Hydrostatic Sensor distance in cm ? : 70

Set to 70cm

Ultrasonic sensor ABOVE the Datum is currently 310cm

What is the NEW Ultrasonic Sensor distance in cm ? : 310

Set to 310cm

The Low Battery Threshold is currently 11.2 Volts

What is the NEW Low Battery Threshold ?

Please enter in VoltsX10, e.g. for 11.2V enter 112 : 112

Set to 11.2 Volts

Setup is complete.

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#### **Bluetooth 'CPW' Command:**

The 'CPW' command allows the customer to change their password.

#### **Bluetooth 'Exit' Command:**

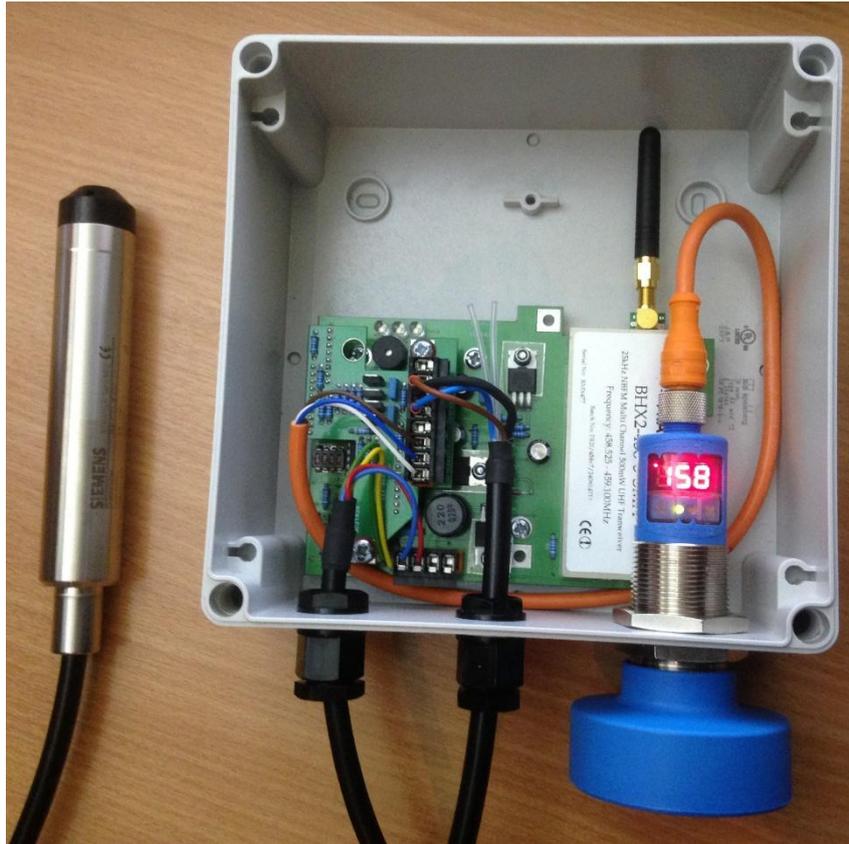
The 'exit' command effectively logs the engineer or the customer out of the system. However, the system will force a log out after five minutes of Bluetooth inactivity.

#### **5 - Sensor Unit Electronics Enclosure:**

The image below shows the inside of the communication and measurement unit at the sensor location.

The hydrostatic sensor can be seen at the far left. This sensor is located down the inside of the pole and the cable runs back up to the enclosure. As the hydrostatic sensor is a differential measurement device, the cable from this sensor contains two air tubes to measure the atmospheric pressure above water.

The blue ultrasonic sensor can be seen at the bottom right. It is kept inside the enclosure, as is the antenna for the UHF radio communications. The units at the master and the slave location are very similar but they have a different circuit board to handle the control of the sign face and the vehicle detection radar and the PIR detector.



### 6 - Optional Modem Unit Electronics Enclosure:

The image below shows the inside of the optional GPRS / SMS unit which provides Email messages or SMS alarm messages in the event of a flood situation arising.



## **Key Features of the System:**

- The Entire System can be powered from Solar or Wind Powered Battery units.
- The Signs Faces are UHF Radio Linked to the Depth Measurement Sensor pole.
- The Signs Face electronics can be up to one mile line of sight from the measurement sensor.
- The Warning Sign Faces use Low Power LED Technology.
- The UHF units are multi channel and are licence exempt.
- There are two remote alerting options available, SMS text message or Email alert.
- The LED Warning Signs are normally unlit and only illuminate when a vehicle approaches during a flood situation, giving much greater confidence to the driver that this Flood Warning sign is informing about a 'Live Situation'.
- The water depth threshold to activate the signs faces is adjustable by the end user at the Master Sign Face location.
- Configuration of the system is achieved at the Master Sign Face using a simple Bluetooth terminal link. This connection is password protected and can be changed by the user.
- Measurement of the water level is done periodically using both Hydrostatic and Ultrasonic water level detection.
- Designed to operate for 3 to 4 weeks or more during extended flood situations.
- All radio connection antenna's are located inside the enclosures but external antennas or repeater units can be provided for extreme terrain situations where line of sight is not possible or mobile coverage is poor.

## **Key Benefits of the System:**

- The entire system functions totally independent of any mains supply.
- The system does not rely on any external mobile network for it's core functions i.e. detecting raised water levels, remotely communicating to the Sign Face locations and illuminating the Sign Faces to alert approaching vehicles.
- The sign faces have an auto-dim function for night time operation.
- Dual sensor level detection using high quality industrial hydrostatic and ultrasonic sensors.
- Configuration and monitoring of the system can be done at ground level at the master sign face location using a Bluetooth link on any Smartphone running a terminal emulator App.
- Sealed maintenance-free LED sign faces.
- All equipment and wiring is pole mounted to minimise risk of vandalism.
- Optional remote alerting via SMS text message or Email.

## **Provisional Specifications:**

- Radio units - 500mW UHF FM multi-channel transceivers on the 458MHz Licence Exempt band.
- Radio range - Up to 1 mile line of sight between each sign face pole and the sensor pole.
- UHF antennas - For normal line of sight operation the antennas are housed inside the waterproof enclosures.
- Bluetooth link providing a terminal emulator connection.
- 12V DC Battery life - Under normal clear sky locations there will be up to one months battery backup.
- Sign face LED type - Cree Amber LED's
- Sign face LED dimming - Automatic two level dimming according to the natural ambient light level which is sensed by a detector on the rear of each sign face.
- Sign face message - 'DEEP WATER' and 'TURN BACK' over two rows with four corner amber LED flashers.

## **Outline of why a Flood Warning Sign system is beneficial:**

During times of extended rainfall, as we have all witnessed in news reports over the past decade or so, many roads become impassable and villages have become isolated for days, if not weeks.

Unfortunately, all too often it is locals who are caught out, especially when returning home late at night as they tend to take elevated risks by attempting to drive through apparently shallow water, but which is often much deeper and faster flowing than they anticipated.

This frequently causes vehicles to cut out, and their electrics to eventually fail with the outcome that whole families can become stranded overnight in increasingly deepening and faster flowing water levels, adding to this, the cold and the darkness, this can quickly become a very hazardous and increasingly life threatening situation.

Attempting to abandon a vehicle in the dark in water even just a foot deep, can be extremely dangerous, especially if the water is next to a fast flowing stream or river.

This is a very disorientating and potentially deadly situation, and statistics over the past decade have proven that the final outcome in these scenarios can all too often prove to be lethal.

The Coeval Flood Warning System is designed to attempt to stop this deadly situation from arising by providing advance warning of dangerously deep water to approaching drivers, cyclists, horse riders and pedestrians.

The system is powered by renewable energy and does not rely on any mobile network for its core function of detecting raised water levels and alerting approaching vehicles.



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