**Network design**

<table>
<thead>
<tr>
<th>Weather station node</th>
<th>Drifters</th>
</tr>
</thead>
<tbody>
<tr>
<td>The W5 node retrieves information from the W5 Atmos 41 which includes 12 weather sensors. It is a 3-wire interface following the SDI-12 protocol for communicating sensor measurements.</td>
<td>In addition to the static nodes, we have developed drifters equipped with a set of sensors and a GPS unit able to collect information as it floats down the river system (i.e. water velocity and water temperature). Collected information can be passed to the static node or to a remote server via a mobile network.</td>
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</table>

**Weather stations and water level nodes**

<table>
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<tr>
<th>Water level node (RiverCore)</th>
<th>RiverDrone</th>
</tr>
</thead>
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<tr>
<td>Uses the non-contact ultrasonic sensors. The RiverCore node composed of: 32 bits microcontroller unit, 3G cellular modem electronic board, Xbee (802.15.4) or LoRa radio shield/daughter board, RS-485 transceivers, Regulated power supply, Solar charge controller, 12v 80Ah battery.</td>
<td>Drone technology is also used to help localize drifters as they float down the river. RiverDrone is composed of: Microcontroller unit, 3G cellular modem, Xbee 802.15.4 or LoRa, LiPo battery.</td>
</tr>
</tbody>
</table>

**Network components**

<table>
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<tr>
<th>Working with local/water authorities</th>
<th>Network design</th>
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<td>Consensus agency of Colima, Meeting the Colima city resilience office, EWH project in the local newspaper</td>
<td>Colima river catchment is located in the north of the Colima state (west-central Mexico), it is one of the tributaries of the Armeria River. The Colima River originates on the slopes of the Colima volcano and has a dynamic riverbank vegetation.</td>
</tr>
</tbody>
</table>

**System integration**

1. **Field survey**
   - Several field campaigns were conducted across the catchment to:
     - Define suitable sites
     - Determine the optimal sites for flood monitoring and prediction
     - Reliably collect and use water data before, during and after floods
     - Access the security of the data loggers/base stations
     - Measure the strength of the 3G/4G signal at each site.

2. **Urban sites**
   - Example of 3G/4G signal strength field measurements.

3. **Suburban sites**
   - Example of 3G/4G signal strength field measurements.

4. **Multiple processes considered: e.g. tributary interactions, nested network, network density.**

5. **Working with local/water authorities**
   - Consensus agency of Colima, Meeting the Colima city resilience office, EWH project in the local newspaper.

6. **Weather stations and water level nodes**
   - 14 locations/nodes have been defined with 8 water level and soil moisture sites and 6 weather stations. Locations of weather stations are placed at different campuses of the University, public buildings and private houses (where rain sensor will be exposed, safe, and easy to maintain.

7. **Non-contact ultrasonic sensors are placed under bridges with data loggers and solar panels placed on towers of 4m high.**

8. **Architecture**
   - **NodeJS modules**
     - RiverCore components
       - RiverCore architecture
       - Sonic 3D Ultrasonic Sensor
       - Soil moisture sensor

9. **Machine learning pipeline**
   - A set of machine learning algorithms are being implemented for short range water level predictions at specific locations using real time data collected, historical and other secondary data.

10. **Data pre-processing**
    - Real-time / Historical data
    - Non-linear models (KNN, SVM, Gradient Boosting)
    - Ensemble tree based method
    - Random Forest

11. **Publish**
    - Surveillance
    - Weather
    - Virtual reality

12. **A web platform is developed to display the water level, soil moisture and weather conditions in real time.**

13. **Visualization**
    - A set of machine learning algorithms are being implemented for short range water level predictions at specific locations using real time data collected, historical and other secondary data.

14. **A set of machine learning algorithms are being implemented for short range water level predictions at specific locations using real time data collected, historical and other secondary data.**

15. **RiverDrone**
    - Drone technology is also used to help localize drifters as they float down the river. RiverDrone is composed of: Microcontroller unit, 3G cellular modem, Xbee 802.15.4 or LoRa, LiPo battery.