Recent Monitoring Innovations for Water Networks

AWT have over the past 5 years been involved with the development of an innovative monitoring service primarily for water, waste water and storm water networks.

AWT New Zealand (AWT) has identified an industry need for reliable monitoring of flows and water levels. This includes (stream/river levels, stormwater levels, soakhole / borehole levels, sewer overflows, water pressure and rainfall) for infrastructure planning, operational maintenance and consent requirements. Prior to 2003, monitoring such a diverse range of data sources would require several types of monitor, often a solar panel or 240V power source and manual data collection or connection to a SCADA / PLC system. Typical costs for a basic system were in the order of $5 – $15K depending on the level of complexity of the monitoring system.

Working together, AWT and Outpostcentral.com have developed a monitoring system that is cost effective, reliable and powered either by 12V battery or 240V mains power. The monitor can take up to eight (8) digital, analogue or pulse inputs, making it possible to monitor ultrasonic sensors, pressure transducers, water quality probes, rain gauges and contact closures from most manufacturers at the same time. As an example; a 4-20mA magnetic flowmeter, a 4-20mA ultrasonic sensor in a wetwell, a 4-20mA ultrasonic sensor in an emergency storage tank, the pump status of the wetwell and storage tank pumps, and a rain gauge on the roof of a wastewater pumping station can all be monitored simultaneously with a single monitor. The monitor comes with a built-in GPRS modem, that can not only provide real-time data, but provides user-defined e-mail, SMS, pager and fax messages on up to 100 alarm conditions to over 50 recipients.

The diagram below illustrates typical operation of the monitoring system at a non-mains powered sewer overflow site.

Typically, a pressure transducer or ultrasonic sensor is installed in or over the 'live' sewer flow adjacent to the overflow structure. AWT has found through installation at many hundreds of sites, that monitoring the 'live' sewer has several advantages over monitoring the overflow structure:

- Operation of the sensor can be verified and field calibrated. A diurnal pattern is recorded during dry weather flow conditions rather than a flat line or zero reading. If a zero reading is the dry weather default it is often difficult to ascertain whether the system was working or not during a potential overflow event.
- The dry weather and overflow level data can be used to calibrate hydraulic models.
- The data can be used to monitor the operational performance of the system – assisting with an understanding of infiltration / inflow.
- Escalating alarm levels can be set to mobilise field crews to remove blockages and flush pipes, before an overflow event occurs.

The depth sensor is wired into the monitor and a 12V battery power supply provided. To conserve power, typically, the depth sensor is configured to switch on and record a value every 5-minutes (Note: pulse outputs such as pump status & rain gauges record a date/time on change of status rather than at a defined time interval). Battery life (12V 24Ahr) for a single 4-20mA depth sensor is in the order of 3-6 months depending on telemetry strength, amount of data transferred and number of alarm messages sent. Data can be transmitted at user-defined intervals varying from real-time to daily. AWT typically house the power supply and data logger in a polycarbonate electrical turret close to the overflow site. AWT has constructed purpose-built waterproof canisters for housing the monitoring system in a manhole when it is not possible, or cost prohibitive, to remove the monitor from the manhole (road sites or paved areas). The aerial is cleverly housed in a road marker (cats-eye) that is bonded to the road and the aerial cable attached to the monitor via an 8-mm hole that is drilled under the manhole frame.

Multiple alarm levels and alarm messages can be programmed to meet client requirements. Upon reaching an alarm level two procedures occur:

1. The data is automatically downloaded to the Outpostcentral.com servers irrespective of defined data transmission rate. Automatic data transfers occur at both reaching and falling below the pre-set alarm condition.

2. An alarm message is sent to user-defined recipients either by SMS, fax, pager or e-mail or a combination of these methods. Each alarm recipient can, independently of other recipients, nominate the method(s) of receiving the alarm message.

A practical example of using the escalating alarm messaging system is:

- First alarm message is sent when the sewer level is 200-mm below the overflow level warning the Environmental Officer of an impending overflow event. This provides time to alert clean-up crews and mobilise to the site if required.

- Second alarm message is sent at overflow - Environmental Officer may visit site to take a manual water quality grab sample.

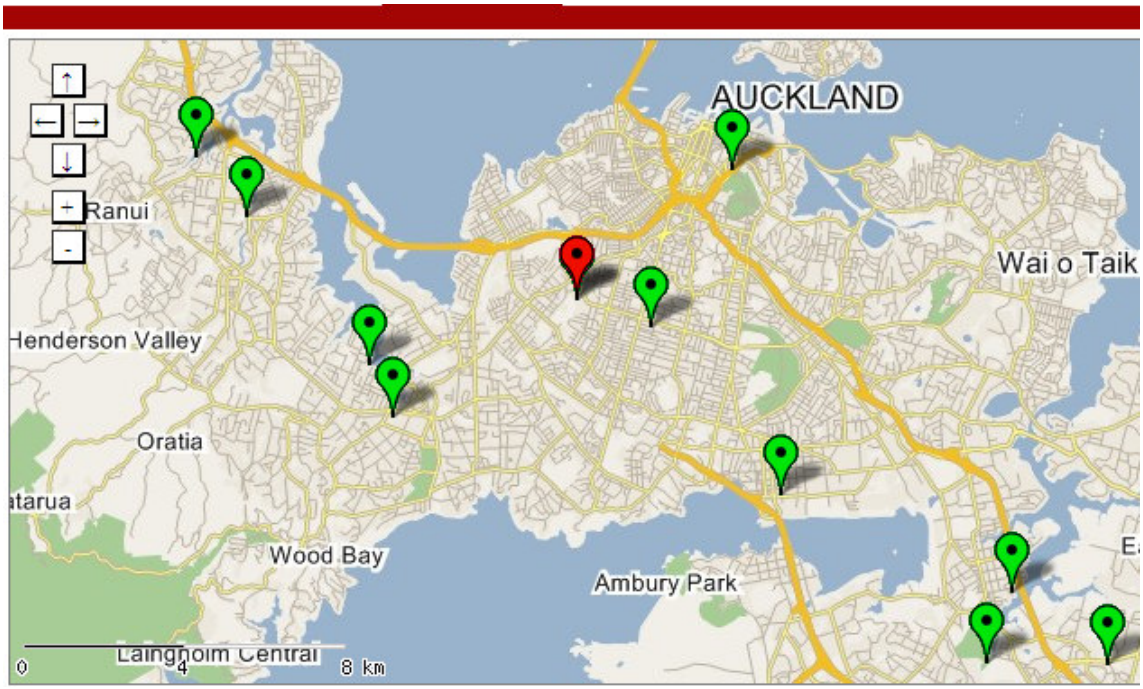
- Third alarm message occurs after 1hr above overflow level – clean-up crew mobilise to put up pollution warning signs.

- Fourth alarm message tells Environmental Officer that automated liquid sampler at the site (connected to monitor) has taken a full carousel of samples and is awaiting collection.

- Fifth alarm message alerts Environmental Officer / clean-up crew to the event being over.

An important aspect to the commissioning of this monitor was the ability to securely present the data to a wide range of users in a universal format. Internet Explorer was chosen, as most Users have access on both their office and home computers.

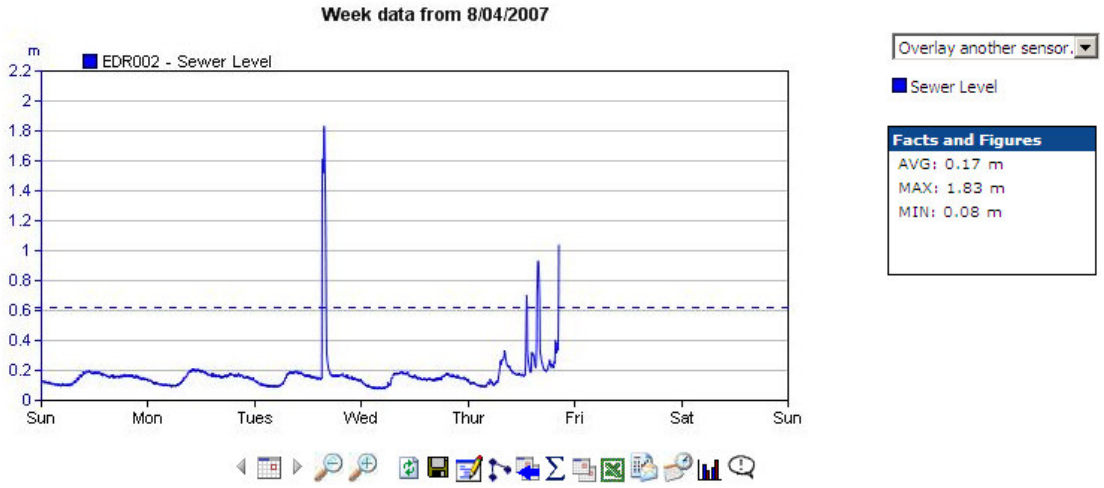
Users log-in to the site using a password protected log-in. A User can only view the data from their own sites and not other clients. Each site in the study is depicted by a marker on a map to simplify the viewing of sites, particularly in projects with a large number of sites (see below). The colour of the marker depicts operational status – green (telemetry and battery OK), orange (telemetry poor or battery low) and red (site offline). The map has zoom in/out mode and sites can be searched for by site name or street or simply by scrolling over the markers.



Clicking on a site marker brings up statistics for the site. Statistics vary according to the type of monitoring. For instance:

- Sewer overflow monitoring – number of overflows this month, this year and data of last overflow.
- River level monitoring – date of maximum & minimum levels in the last month and year.
- Borehole monitoring - date of maximum & minimum levels in the last month and year.

There is also the option to view a graph of the data or download the data.



The graph is user configured to display data at daily, weekly or monthly data spans. The alarm level(s) are clearly displayed. The user can zoom in / out of the graph, select a particular date, download the selected data or e-mail/print the graph.

Displaying data through the internet and using GPRS is a standard option. AWT recognises that GPRS is not always available in remote areas. The system has been designed to be compatible with both radio and satellite communications. Importantly, recent civil emergency events have shown that the New Zealand cellular network is often incapable of coping with cell-phone demand during flooding. Delays of 6hr are not uncommon for receiving SMS alarm messages. Therefore, radio or satellite links remain the preferred communication system where the monitoring and alarming is essential for public or environmental safety. As both radio and satellite communications are expensive to install and maintain, AWT are prioritising the upgrade of monitors to dual network capability for alarm redundancy.

For clients that wish to have their SCADA systems as the primary source of data collection and storage, the monitoring system is compatible with most existing SCADA systems. Data can be transmitted securely and the client's SCADA system can provide the data display and alarm monitoring without need for radio or phone links.

The system has been in operation throughout New Zealand for the past 4 years and is constantly being upgraded to adapt to changing client demands and technology. The new version of the monitor will have power saving features that will extend battery life up to 5 years. The graphical displays and statistics are actually changing to adapt to clients needs. With a complete system typically costing under $2.5K, our numerous clients will attest to the fact that this system provides a cost-effective and reliable method of monitoring level and pressure data from water and wastewater systems.

For further information contact Peter Stephens – peter@awtnz.co.nz