Advance Flooded Roadway Warning Systems Considerations
Part 1 – Protecting Lives and Property

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There has been a large deployment of Advance Warning Signs and Beacons in the traffic industry in recent years. There have been vast improvements in the ability to warn motorists and transportation departments of flooded roadway conditions at low water crossings. A well conceived system using the right technology can provide forecasting benefits as well.

Advance Flood Warning Systems are designed to target two primary goals. The first is to warn motorists they are approaching hazardous road flooding conditions, giving them the opportunity to stay out of harms way. This is normally accomplished by activating warning beacons or Dynamic Message Signs and in some cases by activating automatic crossing gates. These systems also notify transportation and emergency management personnel of the flooded roadway condition so action can be taken. The focus of this article is on the benefits a well-designed system can bring to the region in terms of public safety, improved forecasting and response to flooding events.

While many Advance Flood Warning Systems are in urban settings, others are located in remote areas, away from infrastructure. Regardless of location, most systems are solar powered, even when located in the presence of power infrastructure. The prudent system architect recognizes that heavy storms or other emergencies often disrupt power and communications infrastructure, while battery powered systems will continue to operate.

Solar panel and battery requirements are light, as they communicate with short bursts of data only when needed, using VHF frequencies that are more resistant to fading during heavy rainfall than higher frequency transmissions. This stand-alone operation provides isolation from infrastructure outages.

These warning systems use a sensor to trigger the flood warning beacons and notifications. The most rudimentary systems use a float switch to activate the system at a preset level. With origins in tank monitoring, slightly more advanced systems use a series of several spaced contacts in direct contact with water to indicate relative water level. These systems rely on directly detecting conductivity at each contact for determining the water level. Resolution is coarse and susceptibility to fouling is high, as is the potential for lightning induced damage. State-of-the-art systems use insulated, more accurate water level measurement technology to trigger the system and to give accurate, real time data useful in the prediction of an impending flooded roadway.

Depending on the local geography and construction, a solid state Pressure Transducer (PT) is often used to provide very accurate and continuous level measurement over a wide range of depths. Bubbler sensors are used when particularly hazardous conditions might jeopardize a sensor. Overhead mounted ultrasonic, laser or radar water level sensors are chosen when conditions dictate. These instruments are widely deployed in the hydrological monitoring systems around the world. A
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The chief benefit of choosing state of the art technology for these applications is that rate of rise can be determined and used to provide warnings to transportation and emergency management personnel prior to the road actually flooding.

Even more confident predictions of an impending flooded roadway can be made by using the data from other hydrological sensors to augment the simple observation that water near the roadway is rising.

Equipping a site or a nearby site with a rain gauge can provide further insight as to what conditions are likely to occur there. It’s one thing to know that the stream is rising. Also knowing that it’s still raining hard is better. In some cases data from existing local rain gauges operated by the NWS can be incorporated using the same wireless system with which the Advance Flood Warning System communicates. Include stream flow data from USGS gauges via NESDIS database and you will also know whether the stream is swelling upstream.

The additional minutes of advance warning provided by intelligent gauges can mean saved lives and the opportunity to protect property.

Who’s going to keep an eye on all that data and make these determinations? Even the largest communities can’t dedicate staff to continuously monitor numerous sites for flooding. Comprehensive software systems can track all the gauging described above and send text messages, pages or emails to the people who need to know based on a predetermined threshold and/or combinations of events. The system can activate lighted maps, flash beacons or signal an alarm. The server running the software can serve up web pages for officials and the public to check before venturing out during a storm.

Notifications can be sent to road departments for early barricade mobilization. Flooding at more than one location might call for full deployment of Emergency Management personnel, while automatically alerting Commissioners or the Mayor. Notifications to road crews can keep them informed of other flooded areas so they don’t get trapped between two low water crossings while setting portable barricades or dropping fixed barricade arms.

Lesser events, such as the need for maintenance at a site, can be set-up to notify departments by e-mail for action the following day.

This software monitoring programs can also feed data to other databases in order to populate Advanced Traffic Management Systems (ATMS) in Traffic Management Centers (TMC).

The benefits go even further. Data acquired from an Advance Warning System can be shared with The National Weather Service. When given access to additional hydrological data, the NWS is able to archive data for historical purposes as well as provide improved forecasting information.

Implementing roadway flood warning systems using compatible data technology helps provide better forecasts benefiting the agency and entire region.

Systems designed with the capacity to allow additional sensors at each site provide even more benefits. Valuable real-time insight as to fire danger can be gained by outfitting a few sites with temperature, relative humidity and wind speed/direction.

The equipment and software systems discussed here isn’t limited to flooded roadways. These systems can be used to automatically activate high wind warnings for trucks and RVs or when equipped with visibility sensors can warn motorists of foggy conditions.

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1 USGS data is typically available in fifteen-minute increments hourly, providing insight as to upstream conditions but not entirely timely in the case of locales where rapid flash flooding is common.