

EXISTING SOLUTIONS:

In Loudoun County there are three methods used by local authorities to identify and close roads when flooding occurs; 911 calls from drivers reporting water over a road, visual inspection by the sheriff's office or VDOT and data received from stream gauges at the Office of Emergency Management (OEM).

911 calls often occur after a driver becomes trapped by flood water and do not provide much if any warning to on coming traffic.

According to Deputy Young, from the Loudoun Counties Sheriff's Department, it requires between 2 & 4 police cruisers to close a flooded road. The deputies check the height and speed of the water, to verify weather the road should be closed. The Sheriff's Office coordinates their efforts with both the OEM and VDOT to organize how best to close the road.

Stream gauges measure the height and flow of water by various methods, including floats, radar, and pressure transducers. They record this data and then transmit it through satellites to the USGS and the OEM. According to Jim Kolva, a senior hydrologist with the USGS, they can cost from \$30,000 to over \$100,000 to build and \$15,000 to maintain. They need to be calibrated every six weeks, due to riverbed changes.

Currently there are no low cost solutions which both measure the height of flood water and warn drivers and public agencies to close a road .



Stream Gauge on the Goose Creek



PRIMARY SOURCES

During the course of our research, we met and corresponded with the following scientists, engineers, and first responders:

- Mark Spring and Jeff Beach - **VDOT**
- Kyle Struckman, metrologist **NOAA**
- Jason Elliott, Senior Hydrologist- **NWS**
- Jim Kolva, Senior Hydrologist- **USGS**
- Jeff Fletcher, Deputy Coordinator- **OEM**
- Deputy Young- **Loudoun Sheriff's Dept.**
- Cuong Ly, Hydraulic Engineer- **Army Corps of Engineers**



INNOVATIVE SOLUTION SHARED WITH:

VDOT
USGS
YouTube
LOUDOUN COUNTY SHERIFF'S DEPT.
DRIVER EDUCATION PRESENTATION AT THE
ASHBURN PUBLIC LIBRARY

Geared UP! Team 20



Inventing today :: Changing tomorrow

HOW TO KEEP DRIVERS SAFE



RESEARCH INTO AN INNOVATIVE APPROACH TO WARNING DRIVERS ON ROUTE 15 AND THE GOOSE CREEK ABOUT FLOODED ROADS USING THE AUTOMATIC STAGED ALERT SYSTEM (ASAS).



BACKGROUND INFORMATION:

Rt 15 & Goose Creek is a very flood prone area in Loudoun County VA. While road flooding occurs here on a regular basis there are no signs or warning systems to help prevent drivers from trying to cross dangerously flooded roads. Just last year during Hurricane Sandy the water rose 18' feet above it's normal level closing many roads in this area.

NOAA states that flash floods cause more deaths yearly than any other natural disaster in the US, and 64% of those fatalities were in cars. The USGS ranked Virginia the 4th most flood prone state, and the OEM stated that Goose Creek, VA, was one of the most commonly flooded areas in Loudoun County.

Most people don't realize it only takes six inches of flood water to float a small vehicle, due to the tire's buoyancy. One foot of water can sweep away most cars, and two feet can overturn them.

The USGS maintains stream gauges both 3 miles above and below our community but these do not cover this location.

Team on-site @ Crooked Bridge off Rt15



2008 & 2010 flooding @ Crooked Bridge



INNOVATIVE SOLUTION:



Our solution-the Automatic Staged Alert System (**ASAS**) uses flood water to trigger one of three driver warnings using motion, sound and light.

It is an inexpensive, road-side solution that both measures and warns drivers about the amount of water on flooded roads. As the water rises, it completes each circuit making it progressively more noticeable at each stage.

At six inches of water stage one activates a rotating, illuminated, yellow and black striped beacon. According to our research, more people notice signs which move over those that are stationary. Stage one can be seen both day & night.

At twelve inches of water stage two activates a 108db two tone siren to warn drivers not to cross the flooded road.

At eighteen inches of water stage three activates a string of high intensity waterproof LED's.

FUTURE IMPROVEMENTS:

Based on feedback from Mark Springs and Jeff Beach at VDOT we plan to make the following design changes on our next prototype:

1. Relocate the water level triggers to inside the tubes to make it more vandalism proof.
2. Add a trigger point at the 2" mark which can send VDOT a single to come out and close the road.
3. Add a below ground foundation system for better support during a flood.

VDOT liked our design and did not know of any similar signage system like the ASAS. They encouraged us to continue developing our prototype and to come back for additional review.

Jim Kolva, Senior Hydrologist with the USGS, reviewed the ASAS and suggested we consider adding the ability to send/ receive data from the near-by stream gauges and to add a sensor to measure water flow rates. He also had not seen or heard of a roadside system like the ASAS which both measures the water and warned drivers when it has reached a dangerous level.

COST TO BUILD PROTOTYPE:

We estimate the ASAS to cost less then \$200.00 to make and install based on our bill of materials.

ASAS PARTS LIST AND BILL OF MATERIALS

Part Name	Quantity	Cost	Supplier	Total Cost
8 AA battery Holder	1	\$2.99	Radio Shack	\$2.99
1.5-3volt DC motor	1	\$3.49	Radio Shack	\$3.49
LED water proof light s	1	\$29.99	Radio Shack	\$29.99
Wire	1	\$7.99	Radio Shack	\$7.99
9-Volt Battery Clips	1	\$3.99	Radio Shack	\$3.99
Knob	1	\$3.44	Radio Shack	\$3.44
2-Tone Piezo Alert	1	\$12.99	Radio Shack	\$12.99
Solar Cell	1	\$9.99	Radio Shack	\$9.99
1-1/2**2' PVC Pipe	2	\$2.90	Home Depot	\$2.90
1-1/2" PVC Coupling	4	\$2.31	Home Depot	\$4.62
1-1/2" PVC Tee	1	\$1.87	Home Depot	\$7.48
1-1/2" PVC Pipe	5	\$2.90	Home Depot	\$2.90
1-1/2 PVC Elbow	1	\$2.26	Home Depot	\$11.30
PVC Electrical Tape	1	\$4.27	Home Depot	\$4.27
1-1/2" to 1-1/4 Adapte	1	\$7.25	Home Depot	\$7.25
Sales Tax				\$5.78
TOTAL COST				\$121.37