



THE FORENSIC ENGINEERING REPORT

I-ENG-A® [IN-JUH]

VOLUME 12, ISSUE 5

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FORENSIC HYDROLOGY BY ELVIN AYCOCK, PE, I-ENG-A ADVISOR

Forensic hydrologists study the causes and effects of water damage in legal cases, including flooding, erosion, drainage problems, and hydroplaning. This paper offers background on hydrology and forensic hydrology. It also provides examples of real-world situations where forensic hydrologists used their expertise to aid attorneys in legal cases.

Hydrology is the scientific study of water and its properties, distribution, and effects on the earth's surface, in the soil, and in the atmosphere.

The central theme of hydrology is that water moves throughout the Earth in a hydrologic cycle. The most vivid image of this is in the evaporation of water from the ocean, which forms clouds. These clouds drift over land and produce rain and snow. The rainwater flows into lakes, rivers, or aquifers, either evaporating to the atmosphere or eventually flowing to the ocean, completing a cycle.

Some of the water evaporates, some of it is intercepted by vegetation, and some of it travels



over the land surface to streams. The streams flow into larger streams, which flow into rivers, finally flowing back to the ocean.

Water as a liquid or snow covers most of the surface of the Earth. By the process powered by gravity and the action of solar energy, an endless exchange of water, in vapor, liquid, and solid forms, takes place between the atmosphere, the oceans, and the earth's surface. Water circulates in the air and in the oceans, as well as above and below ground.

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I-ENG-A PROFESSIONAL ENGINEERING CAT TEAM ASSISTS WITH HURRICANE STORM DAMAGE ASSESSMENTS

The US Census Bureau calculated that some 2.1 million people in the coastal counties of Texas, Louisiana and Mississippi were affected by Hurricane Gustav as it made landfall on the Gulf Coast. The U.S. Census Bureau calculated that an estimated 13 million people in 132 counties along the Gulf Coast of the United States would be affected by Hurricane Ike. Insured losses from Hurricane Ike alone are now estimated at \$9.8 billion according to the Insurance Information Institute. The path of both storms created additional storm damages in the lower mid-western section of the U.S., such as Arkansas and Oklahoma. With this and other future events in mind, the Investigative Engineers Association headquarters, in conjunction with members in affected areas, and its Advisory Team, have been developing protocols and making efforts to respond with a team of professional engineers trained and ready to handle storm damage assessments.

The Investigative Engineers Association (I-ENG-A® [in-juh]) is a network of independently owned and licensed engineering firms from around the country that have come together in association to offer a quality product to the insurance industry. I-ENG-A's Catastrophe Response Team is organized for a more complete, comprehensive, fast and cost-effective response effort.

Engineering Storm Damage Assessment is a primary service for which our members are called on frequently by the Property & Casualty Insurance Industry following storms and hurricanes. Some points about the association's qualifications for this response effort include:

- I-ENG-A firms in affected areas have been through Storm Damage Assessment training given by major national insurance compa-

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I-ENG-A PROFESSIONAL ENGINEERING CAT TEAM ASSISTS WITH HURRICANE STORM DAMAGE ASSESSMENTS

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nies and it is the Professional Engineers of those firms that are heading up the affected response efforts as the area coordinators.

- Members in affected areas have storm damage assessment experience with catastrophic events and hurricanes such as Katrina.
- Training for members who have not had this experience has been taking place via online meetings and email correspondence.
- I-ENG-A's discussions have included the handling of issues such as OSHA training, housing, transportation, evidence and data storage, budgets, costs, licensing, equipment needed and reporting standards.

I-ENG-A, having the professional engineering human resources already trained and experienced can handle a large volume of assignments within required intervals.

I-ENG-A has area coordinators for events to provide for a much more cost and time effective process than the random selection of firms we have seen in the past. From our experience, members from different parts of the country were called in by insurance companies and assignments were sent sporadically to different firms.

Additionally, according to Tom Poole, PE with PE//I-ENG-A of Southeast Louisiana, claims were not even grouped or organized at all with respect to territory. Assignments came in haphazardly for varying areas requesting engineers to be sent to one county one day and another county the next.

In an effort to organize assignments better, I-ENG-A's online response form is available to assist with directing the flow of assignments to the appropriate area coordinator. This will assist with reduction of windshield time. Additionally, I-ENG-A's area coordinators are able to manage the grouping of assignments by territory as well as managing the pool of professional engineering resources available.

The response effort will make for a much more effective process for the engineering firms and will be more cost-effective for the insurance industry.

For more information about the availability of engineering response services, please call Arianne Ciarlo, ACA, at Association Headquarters at (800) 523-3680 ext. 208 - aciarlo@ienga.net

FORENSIC HYDROLOGY CONTINUED

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The quantity of rainfall varies from region to region within the United States. At the same time of year, some regions are dry from lack of rain while other parts of the country experience flooding. It is not unusual for one part of the country to experience a hurricane, while another experiences a drought, and another has flooding.

Civil engineers and hydrologists study surface water—in particular, the measurement of its flow and volume. These studies are used to design the size of pipes for storm drainage systems and culverts. Other studies include designs for detention pond storage for development projects and water surface profiles of flood prone areas.

Local governments, for example, require hydrologic studies before the commencement of all significant building projects, and hydrology is applied when designating and managing flood plains. Hydrologists also are employed in the evaluation of water resources, wastewater systems, and irrigation projects. The public use of water for recreation and power generation also calls upon the work of hydrologists, who assist governments and private companies in controlling and managing water supplies.

Hydrologists use a variety of techniques. Some are simple and time-honored, while others involve the most cutting-edge modern technology, such as highly sophisticated computer models and satellite remote-sensing technology. Or, hydrologists may apply relatively uncomplicated methods for the measurement of snow depth or the flow of rivers and streams.

Hydrologists are particularly important in helping communities protect against flooding by identifying flood hazard areas and minimizing encroachment through the use of recommended state water buffers. By studying historical records, along with geologic maps and aerial photographs, hydrologists and engineers can make recommendations regarding the zoning laws for a particular area.

Forensic hydrologists investigate many issues, including the following:

- Flooding of property from heavy rain events
- Development of land that prevents water from flowing in its natural watercourses
- Erosion of the earth's surface caused by the flow of surface water across unprotected soil created by land disturbing activities

- Hydroplaning on roadways caused by road defects
- Uncontrolled discharge of surface water, which causes flooding downstream

Forensic is a term that is associated with hydrology in legal matters. According to the Merriam-Webster Dictionary, "forensic" means "relating to or dealing with the application of scientific knowledge to legal problems." In this sense, "forensic hydrology" typically refers to investigations of water issues and the need to identify the cause and damage incurred by storm water. The forensic hydrologist uses a number of hydrologic tools to determine the history of an event, such as computer modeling. He or she may need to determine when flooding began or upstream factors that have recently changed due to clearing of land for land disturbance projects.

Forensic hydrologic investigations commence with flow paths, both current and historic, and flow velocities. Changes in water flowing across the ground surface, drainage ditches, and drainage pipes often create adverse conditions downstream. The conversion of wooded land to impervious surfaces increases the quantity of storm water and the velocity of

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the water. The impervious area decreases the time of concentration of the water, which increases the peak flow. All of these effects can cause damage to downstream property owners.

In cases where surface hydrology has caused damage to downstream property owners, hydrologists examine historic aerial photographs to determine locations of land disturbance projects. The timeline of the downstream damage is compared with the timeline of the land disturbing activities.

For example, consider a site where soil erosion has filled in a downstream lake over a period of years. The aerial photographs help identify areas of land disturbance and the time frame for each disturbance. Where several developments have occurred over a period of years, the aerial photographs help the hydrologist identify the size of each development and the period of time the land was susceptible to erosion. The damages can be allocated to the developers based on the data gathered.

Without close oversight by the governmental agencies, developers may omit many of the erosion and sediment control measures shown on engineering plans. Because developers may have gotten away with this practice in the past, they may feel they can skip some of the erosion control measures to save money. This creates a situation where heavy thunderstorms—without appropriate control measures—can cause severe damage to downstream property owners.

A recent case that caused severe damage to the downstream property owner was caused when the developer tied a new storm drainage pipe into an existing pipe that was not adequately sized to handle the drainage from the new development. The property flooded, and the downstream landowners brought suit against the developer.

In another case, a contractor tied the discharge pipe from the detention pond into an existing storm drainage system. The existing pipe was only adequate for storms up to the 25-year storm event. The flooding problem developed because the developer did not clean out the siltation in the detention pond. Silt from erosion was allowed to accumulate in the detention pond, which decreased the volume of the storage for stormwater. When the storm event occurred, the water overflowed the emergency weir of the detention pond and flooded the downstream homeowner. The homeowner sued the developer.

Few developers understand how detention ponds function. Often, the grading contractor will not build the pond to the designed volume. This prevents the pond from being able to function as designed, and water overflows the spillway and floods the downstream residents.

Outlet structure control devices are often improperly sized or are not installed at the correct elevation. This creates a potential problem of more discharge through the outlet structure than the design model allows.

Forensic hydrologists are also called on to work hydroplaning cases. The flow of wa-

ter across the pavement surface can be critical and dangerous to the motorist if the roadway surface is not constructed correctly. Often, this is a roadway defect created by improper construction methods used by the contractor.

The transition of the roadway from a tangent section to a highly elevated section can create an area of ponding. Unless viewed during or after rainfall, the area of ponding cannot be identified by the naked eye. A detailed elevation survey is needed to determine the area of ponding and the flow direction of water.

In one hydroplaning case, it was determined that the water on the roadway ran at an angle across the travel lanes onto the paved median. The water turned back and ran across the roadway again. This created a dangerous condition and caused a vehicle to hydroplane and crash into the median barrier. This section of roadway ran downgrade and entered into a highly elevated section. No inlets were provided to collect the water in the median, and as the grade increased to create the elevation, the water flowed from the paved median across the travel lanes. The depth of water on the roadway caused the vehicle to hydroplane.

The forensic hydrologist with an inquisitive mind and the use of sound engineering principles can help identify the cause that creates these types of problems. He or she can provide a valuable service to the attorney handling storm water drainage cases. ■

Elvin Aycock, PE, ACTAR , I-ENG-A Advisor

COMEDY RELIEF CORNER

Jim's barn burned down. Julie, his wife, called the insurance company and said, "We had that barn insured for fifty thousand and I want my money."

"Whoa there, just a minute, Julie, it doesn't work like that. We will assess the value of the building and provide you with a new one of comparable worth." the agent replied.

Julie, after a pause, said, "Well, in that case, I'd like to cancel the policy on my husband."



An insurance sales rep, an administration clerk and their manager are walking to lunch when they find an antique oil lamp.

They rub it and a genie comes out in a puff of smoke. The Genie says, "I usually only grant three wishes, so I'll give each of you just one."

"Me first! Me first!" says the admin clerk. "I want to be in the Bahamas, driving a speedboat, without a care in the world." Poof! She's gone.

In astonishment, "Me next! Me next!" says the sales rep. "I want to be in Hawaii, relaxing on the beach with my personal masseuse, an endless supply of Pina Co-

ladas and the love of my life." Poof! He's gone.

"OK, you're up," the Genie says to the manager. The manager says, "I want those two back in the office after lunch."

Moral of the story: Always let your boss have the first say.



Compliments: I-ENG-A of New Hampshire Babar Khan, PE - newhampshire@ienga.net

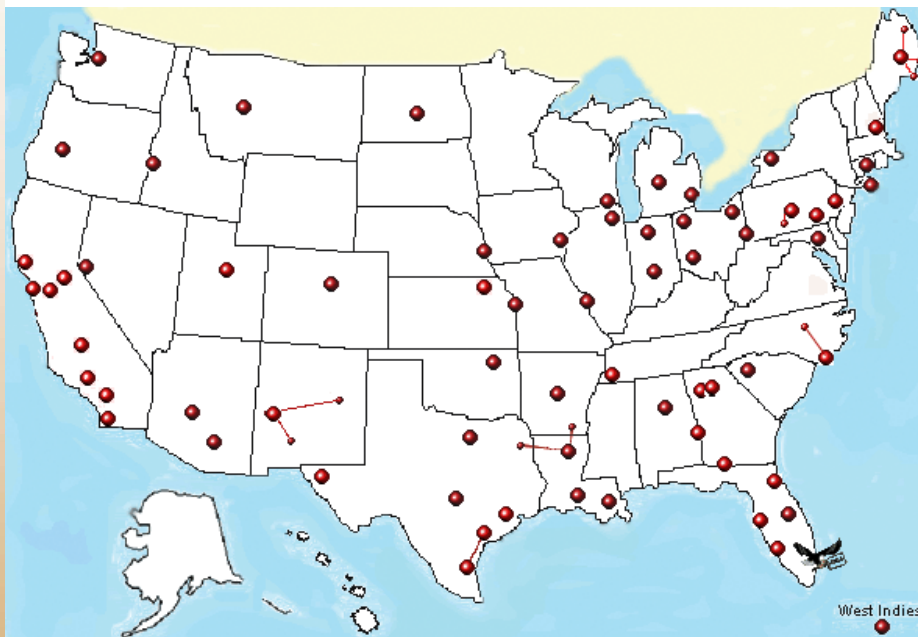


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The **Investigative Engineers Association** is the nation's **largest** and oldest network of independently owned professional engineering firms committed to providing thorough, timely and cost-effective **forensic investigations** for the property & casualty insurance industry, legal community and other industries.

CURRENT MAP OF MEMBER FIRM LOCATIONS



3 Ways to Place an order for Claim Investigation

1. Visit www.ienga.net and click 'Request Claim Assistance'
2. Call (800) 523-3680 for the firm nearest you and/or for expert referral.
3. Go to www.ienga.net and click on locations. Click on the map to identify firm closest the claim location. Click on the firm name for contact information or to assign a claim.

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