TESTIMONY OF

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REPRESENTING

THE NATIONAL GROUND WATER ASSOCIATION
AT A HEARING OF

THE HOUSE ENERGY AND COMMERCE SUBCOMMITTEE ON ENVIRONMENT AND HAZARDOUS MATERIALS

ON

HURRICANE KATRINA: ASSESSING THE PRESENT ENVIRONMENTAL STATUS

September 29, 2005

INTRODUCTION

Good morning. My name is Dr. Stephen Ragone. I am the Director for Science and Technology for the National Ground Water Association (NGWA). The NGWA is an organization of approximately 15,000 scientists, engineers, contractors, manufacturers and suppliers. The NGWA's overall mission is to provide and protect ground water. I would first like to thank the Committee for this opportunity to speak and acknowledge my colleague, Dr. John Schnieders, principal chemist for Water Systems Engineering, Inc. who helped me prepare these remarks.

Approximately 52% of Alabama's, 100% of Mississippi's and 75% of Louisiana's populations regularly depend on ground water for their drinking water supply.[1] Over 513,000 wells are used to provide drinking water to the three states' residents (Table 1). Of those, an estimated 234,545 household well systems in Alabama, Louisiana, and Mississippi counties are estimated to be in areas impacted by Hurricane Katrina and are eligible for individual disaster assistance funds from FEMA (Table 2). At this time we cannot provide the Committee with a number of wells that have been flooded versus other levels of impact.

WHAT DO WE KNOW

What we have learned so far is that the situation is, understandably, chaotic. Our members report that many in the hardest hit communities still do not have electricity, generators or operational water pumps. Some report that access to these communities has

[1] U.S. Geological Survey, March 2004 report on 2000 water use

been restricted. There also have been reports of saltwater in some wells. NGWA members are in the process of addressing these situations. However, as more residents return, it is anticipated that complaints will continue to come in when people find they have no water or poor quality water. Reports from areas less impacted by the storm are that strides are being made to return public and private water systems to operation. A top concern is whether the municipal distribution infrastructure – the water pipes –remains intact as contamination could result through breaks in the distribution pipes. We've heard that difficulties remain in contacting water system employees. Members expect that the impact of the hurricane will be minimal--even in heavily inundated areas--for those who have properly constructed and maintained wells.

We are also aware of efforts being undertaken to obtain baseline information or provide assistance. For example the Louisiana Department of Health and Hospitals, in conjunction with the U.S. EPA and the Louisiana Rural Water Association, are offering free water testing to residents in certain Louisiana parishes with flooded household wells. As part of this effort, residents are being provided with information on sample collection and water system disinfection. The U.S. EPA and the Louisiana Department of Environmental Quality (DEQ) have information regarding well-testing and disinfection on their website. Additionally, the U.S. Geological Survey is testing wells in inundated areas to assess whether brackish water has entered into the subsurface. We also have reports that Louisiana DEQ is in the initial stages of doing some VOCs testing. A report we received from the Louisiana Department of Transportation and Development indicate they are currently testing public water supplies but an inventory of flooded, and or damaged domestic wells is not yet available. However, our members in the Louisiana Ground Water Association reported that well drillers are working around the clock to return household wells to potability.

It is our general impression from contacts with our members in the region that communication problems, other relief efforts, and citizen displacement remain challenges to identifying the scope of the problem and remediating affected wells. It appears that improved pre-disaster planning, training, and coordination between government officials and private sector water well professionals could have lessened the challenges.

Planning, coordination, and training of local officials and private sector entities prior to the disaster seem to be critical missing components in helping to make existing efforts more effective. Beyond initial and standard protocols being distributed, long-term strategies should ensure that appropriate de-contamination protocols are available for varying levels of contamination, well design, well size, and hydrogeologic variables. For example, shock chlorination – the traditional approach to well disinfection – does not always solve the problem for those with inundated wells or where general ground water quality has been impacted. In fact, shock chlorination can cause more long-term harm than good. This is especially true when floodwaters contain very high loads of sediment, debris, as well as, chemical and biological contaminants. In such cases the wells, both public and private, may require different and/or additional cleaning procedures. This concern is exacerbated in several areas impacted by Hurricane Katrina where refineries and other industries are present. Studies have also shown that older wells are more

susceptible to contamination and flooding, and may require different approaches than more modern wells.[2]

FUTURE STRATEGIES REQUIRE COORDINATION

The National Ground Water Association, under a contract with FEMA, presented a report to the agency in 2002 entitled "Field Evaluation of Emergency Well Disinfection for Contamination Events." This field study examined the 1999 Hurricane Floyd's impact on North Carolina and adjacent Atlantic coastal areas – specifically well disinfection efficacy. We also included in the report recommendations on how to address household water wells in future natural and manmade disasters. If you would like a copy of this report please let us know. (Appendix I).

Our recommendations outline a plan that educates and trains local private sector personnel to complement government efforts in a forward thinking manner. We discuss the development of county/district teams trained and equipped to evaluate, help and conduct needed immediate repairs of wells as needed to restore private water supply function and potability. These teams would include local government environmental health staff, private-sector personnel experienced in well and pump service and other people with specific knowledge of local ground water quality and occurrence, such as hydrogeologists. The teams would be trained in both evaluation and pump repair. Additionally, these teams would work to train retail workers and 'neighborhood helpers' who work with pumps, plumbing, chemical selection and/or generally mechanical to aide in post-emergency efforts. As for disinfection efficacy, as discussed previously, there are standard disinfection methods but it will be important that residents and water suppliers follow the appropriate protocols for the appropriate water supply and take into account contaminants present, size of well, aquifer hydraulic conductivity, and flood water depth and quality. Local health and water entities, both governmental and private-sector, should have this information readily available for themselves and the public at large.

The NGWA has been working in this area. We have developed web site products, certified professionals, offered training programs and materials, as well as undertaken research to help prepare the industry, well owners and government officials. However, more has to be done. We are looking forward to working with our federal, state, local and private sector partners to fill research, training and information gaps and enhance state and local response planning.

The NGWA is happy to have had the chance to participate in this hearing. An important reason for being here, beyond our concern about the immediate crisis caused by Hurricane Katrina, is to encourage this country to develop a strategy that will ensure immediate, cost-effective and appropriate responses to future natural disasters or terrorist's acts that disrupt our drinking water supplies. We look forward to working with you and serving as a resource as more information on the impacts of Katrina on ground water supplies is collected and analyzed.

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[2] Centers for Disease Control and Prevention. A Survey of the Quality of Wter Drawn from Domestic Wells in Nine Midwest States. September 1998.

Table 1
State Well Numbers

State	Community Wells[3]	Household Wells[4]	Total for State
Alabama	764	201,111	201,875
Mississippi	2,712	122,452	125,164
Louisiana	3,338	182,926	186,264
Total	6,814	506,489	513,303

[3] US EPA, 2004
[4] Based on 1990 Census data, last year in which household wells were counted.

Table 2
Estimated Household Wells in Designated Disaster Counties
(counties where individual assistance available)

Alabama		Louisiana		Mississippi	
Baldwin	11,902	Acadia	6,279	Adams	378
Greene	1,034	Ascension	9,942	Amite	1,755
Hale	1,301	Assumption	92	Attala	807
Mobile	14,708	Calcasieu	10,012	Choctaw	200
Pickens	1,378	Cameron	472	Claiborne	162
Tuscaloosa	3,446	East Baton Rouge	1,031	Clarke	1,144
Washington	2,941	East Feliciana	1,041	Copiah	674
		Iberia	4,392	Covington	414
		Iberville	638	Forrest	853
		Jefferson	54	Franklin	1,280
		Jefferson Davis	1,904	George	4,289
		Lafayette	13,311	Greene	1,323
		Lafourche	3	Hancock	5,424
		Livingston	7874	Harrison	12,726
		Orleans	1,024	Hinds	1,246
		Plaquemines	37	Jackson	8,723
		Pointe Coupee	1,162	Jasper	199
		St. Bernard	10	Jefferson	142
		St. Charles	33	Jefferson Davis	352
		St. Helena	1,016	Jones	640
		St. James	56	Kemper	184
		St. John	239	Lamar	1,470
		St. Martin	2,482	Lauderdale	2,276
		St. Mary	441	Lawrence	483
		St. Tammany	21,787	Leake	860
		Tangipahoa	14,035	Lincoln	4,372
		Terrebonne	23	Lowndes	3,167
		Vermilion	9,867	Madison	506
		Washington	6,594	Marion	1,757
		West Baton Rouge	147	Neshoba	599
		West Feliciana	59	Newton	1,603
				Noxubee	1,128
				Oktibbeha	320
				Pearl River	5,957
				Perry	870
				Pike	4,344
				Rankin	871
				Scott	487
				Simpson	736
				Smith	329
				Stone	1,594
				Walthall	2,204
				Warren	389

				Wayne	1,388
				Wilkinson	499
				Winston	180
				Yazoo	474
	36,710		116,057		81,778

Appendix I

Excerpt from Field Evaluation of Emergency Well Disinfection for Contamination Events: Final Project Report

Plan for Returning Water Supply Wells Inundated by Flood

The following is a set of recommendations for planning and implementing a program of returning water supply wells inundated by flood to potable status. Implementing these activities will require coordination among county departments and among local jurisdictions, the state, and supporting federal agencies such as FEMA, and also with the private sector. An appropriate organizational umbrella under which this process could operate is state/county emergency management.

1. In each county/district of local government environmental health, teams will be trained and equipped to evaluate, help and conduct needed immediate repairs of wells as needed to restore private water supply function and potability. The team should include government environmental health staff, private-sector personnel experienced in well and pump service, and other people with specific knowledge of local ground water quality and occurrence, such as hydrogeologists. The teams need to be trained in both a) evaluation and expedient fixes (pump repair) and b) human interaction (customer relations). Private sector team's members should be on retainer or standing purchase order.

2. These teams in turn should train a) retail workers, such as those working in hardware stores and home-improvement superstores who work with pumps, plumbing, and chemical selection and b) "neighborhood helpers" - those people found in any neighborhood or community who are capable, helpful and competent in fixing things - to assist people with basic pump repair and well disinfection. Train them to safely and effectively deal with the well problems that do not require contractor equipment, such as jet pump repair or shallow well disinfection, the specifics of safety issues, and water sampling. Such trained personnel, upon passing a practical examination, would be awarded a limited-time certification in emergency water supply assistance. The local environmental health agency would maintain and publicize a current list of stores with such certified personnel available. Certified neighborhood helpers would identify themselves to emergency response personnel and neighbors, and be known to well ERP team members. All such responders must be insured or otherwise protected under state "good Samaritan" provisions to the extent appropriate.

3. Draft and supply simply worded and illustrated fact sheets with detailed recommendations for safe pump function restoration, well flushing, and well disinfection, with versions in both English and widely used secondary languages such as Spanish.

4. In support of activities triggered under the local well restoration ERP:

A. Have wells spotted and located on county GIS plat maps, with a database of essential well characteristics (type, depth, diameter). Hard-copy maps and GIS electronic file backups should be generated regularly, made available to the well response teams, and stored safely in case of emergency.

B. Collect data on hydrogeology (aquifer tapped by wells, protective layers, water tables) and a suite of physical-chemical and microbial ecology parameters that provide a basis for understanding an ambient baseline condition. With such an ambient baseline recorded, deviations from the expected hydrogeochemical profile of a well can be recognized, even if basic regulatory parameters are negative or inconclusive. Include this hydrogeochemical data in the GIS database and as map layers for use by the well ERP team.

C. The plan should include a well triage strategy for use in the event of an emergency, as follows:

- Start with a rapid survey (aided by having wells finely located) to assess the situation and to formulate a response.
- Accurately mark and bypass 2-in. deep wells with in-line jets, and 2-in. jetted or driven wells, and other wells requiring specific training and equipment to restore. Have people pump them, but leave treatment or replacement to an equipped contractor.
- Instruct people on how to treat shallow bored wells.
- Sample wells for total coli form once restored to function and pumped. Certified helpers would supplement environmental health in this.
- Plan and implement follow-up testing and additional response, such as ordering and assisting impaired well replacement.

5. Equip response teams as follows:

A. A supply of pump sets for circulating chlorine and pumping, equipped as needed (hoses, valves, fittings) and working. Include a generator, tools, parts and instructions to install functional systems on typical installations. Provide and periodically update reliable telephone numbers for troubleshooting and installation assistance.

B. As only $Ca(OCl)_2$ has a lengthy shelf life (when stored cool and dry), keep some of this on hand in various forms for use until trucks can bring in sodium hypochlorite. Include any associated treatment chemicals such as vinegar for acidizing. Rotate stocks semiannually. Have on hand measuring cups and laminated sheets with information on dosing volumes for wells by diameter and depth.

C. Well water testing equipment similar to that used in this study - maintained, calibrated, and with fresh batteries – and sampling supplies for (limited) onsite and laboratory analysis of TC, nitrates, and selected other contaminants. Testing should be part of triage and follow up.

6. Local environmental health jurisdictions should aggressively work to reduce the number of substandard and unsafe private water supplies vulnerable to flooding inundation.

A. Begin a public information campaign to educate well owners and users about safe and unsafe or vulnerable water supplies and how they can be tested and improved.
B. Deficiencies in specific well and pump installations (poorly designed, vulnerable to inundation or damage during credible flooding events, or otherwise unsafe in addition to not meeting state rules) identified during mapping efforts should be called to the attention of property owners and responsible parties, with procedures and schedules for resolution provided.

7. This inspection and response plan should have a regular review and revision cycle with measurable goals set.

Immediate Response and Prioritizing Follow-up Response

1. Determine that an emergency exists, assess its magnitude and implement the well restoration ERP elements appropriate to the emergency.

2. Broadcast instructions for safely restoring well function and activate the network of certified well responders and professional contractors. Make instructions for disinfection that can be attempted by well owners and contacts for assistance available to affected residents.

3. As soon as it is safe, well ERP teams begin the reconnaissance to determine necessary responses for specific wells and assign them to the appropriate responders. Use the predetermined well designations from disaster-preparedness inspections (Section 7.1).

A. Inform residents of the response plan and schedule. Provide a point of contact for residents, and assist them as needed in obtaining emergency potable and wash water.
B. In a site visit: 1) Identify and record (narrated video or by photography with notation) problems for follow up later. 2) As soon as possible, restore well function and instruct residents to pump wells several hours to clear contamination. 3) Sample for contamination parameters.

4. If analysis results indicate that contamination has occurred (or may have occurred), implement disinfection as follows.

Emergency Disinfection Methods

While disinfection procedures are somewhat specific to the individual well's dimensions, design and conditions, the following are general requirements of emergency disinfection in response to inundation.

1. As needed, restore pump function as needed and pump inundated wells clear for several hours to clear dirt and flood water contaminants. Do not pump flush water through treatment and distribution systems, but discharge from the first flushing tap. The time required is dependent on well size, aquifer hydraulic conductivity, and flood water depth and quality. As few as three hours and as many as 24 may be needed, and reasonable numbers should be determined for local conditions.

2. In a clean mixing tank or container, mix a solution with 100 mg/L (ppm) chlorine, maximized for hypochlorous acid: In the appropriate volume (one well bore volume – determine by well diameter, depth, and depth to water level) of clean water, acidify with white distilled food-grade vinegar or more concentrated food-grade acetic acid to approximately pH 5.9 (varies according to water pH and buffering capacity). Then mix in the sodium hypochlorite solution (generally 5-12 %) volume needed to make a 100-ppm solution. Adjust pH as needed to pH 6.5 or less. Alternative: Use powdered or granular calcium hypochlorite for chlorine and muriatic or sulfamic acid for acidifier. People conducting this mixing must be trained in the specific chemical safety issues of these chemicals and mixtures and their use and be equipped to avoid injury and to respond to spills.

3. Drain or pump to the bottom of the well.

4. Start agitation or pumping to pull solution upward throughout the water column.

5. Allow to react up to 24 hr.

6. Pump off to waste, avoiding environmental harm, until measured total chlorine is <0.2 mg/L.

7. Conduct water system disinfection per state rules or recommendations.

8. After one week, test for total coli form bacteria and nitrates. In the interim, instruct residents to boil water for drinking and cooking. Exception: Boiling should be avoided if a history of high nitrates exists, substitute filtration.

9. If wells are substandard at inspection, or do not respond to treatment, follow up with action to require replacement or repair, and provide the appropriate assistance to make this happen.

Specific steps for a 2-in in-line jet well)

1. Pump clear 3 well volumes or fresh ground water by parameters

2. Mix in large plastic tubs: vinegar for acidifying and sufficient NaOCl to treat 2 well volumes

3. Pull in-well pipe and jet (inspect and clean)

4. Displace in chlorine solution: Air used to displace solution downward and a bailer to pull solution upward through the water column

5. Wait 24 hr

6. Reinstall pump components and hook up jet pump

7. Pump off to clear

8. Pump one well volume + after Cl is < 0.2 mg/L and test for TC and ion parameters.

9. In one week, test for indicator parameters.

Specific steps for a bored well:

1. In clean, new 32-gallon plastic trash cans, mix vinegar and NaOCl or $Ca(OCl)_2$ to make a well-bore volume of 100-mg/L solution, and permit residues to settle.

2. Pump well down and clear.

3. Dose with chlorine solution and brush well walls

4. Let refill if slow to respond after emptying

5. Recirculate with jet pump

6. Wait 24 hr

7. Pump clear (to < 0.2 mg/L by chlorine test kit)

8. Pump more than one well volume, then test for indicator parameters

Follow up

1. Take steps to replace vulnerable and substandard well water supplies, with specific plans, goals and schedules, developed through consultation with the public, regulatory officials, stakeholders, and funding sources, and prevent installation of at-risk private water supplies in the future.

2. Review the well restoration ERP and its implementation and make adjustments needed.

The above recommended protocols should be viewed as being preliminary and subject to review and revision by the implementing agencies.