PRELIMINARY REPORT ON THE IZARD COUNTY ROAD 70 KARST PROBLEMS (SINKHOLE COLLAPSE), IZARD COUNTY, ARKANSAS

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This site was first visited by Scott Ausbrooks and Angela Chandler of the Arkansas Geological Survey with representatives from the Natural Resource and Conservation Service (NRCS) on August 7th, 2008. A sinkhole had formed at the site of an abandoned water well adjacent to and south of Izard County Road 70, on the property of Mr. Tyler Cooper. The site is in the N ½ N ½ Section 10, T 16 N, R 8 W, Izard County, on the USGS Zion 7.5-minute quadrangle map. The location of the well/sinkhole is Latitude: 36.05971, Longitude: -91.83209, some 30 feet south of County Road 70.

Observations: Photographic documentation and field notes were taken on the first visit by both Scott and Angela. Three images are given below showing the situation as of August 7th, 2008.

Sinkhole is in center of left field of view in pasture, adjacent to Izard CR 70.
Looking west southwest.

Note that in the picture below, no sign of grouting is present on the well casing.

Sinkhole formed around abandoned well bore, view looking northwest. Note soil horizon of ~6 feet and regolith below soil. Looking northwest.

View looking east showing soil horizon – regolith contact.

In discussions with Mr. Cooper, land owner, he stated that during a heavy rain the week before the 2008 visit, he observed water "shooting" out the casing before and during the collapse around the metal pipe. A week later the collapse structure was dry. During this first visit, no fencing or protective structures had been placed around the collapse feature. Pictures of the road at this time revealed no pronounced swag or dip to the roadbed.

The second visit on November 6th, 2009, was prompted by a telephone call from Mr. Jerry Neal, a concerned local citizen, about road collapse on Izard CR 70. Mike Howard and Bill Prior visited the site to make additional observations. Upon arrival, we noticed that the area adjacent to the road no longer had a fence and recently the ground had been disturbed between the existing sinkhole and the road. The road had dropped ~18 inches across a distance of 83.5 feet, centered on Latitude: 36.05988, Longitude: -91.83216. This is down drainage from the previously reported sinkhole. A local individual who was servicing some equipment at the nearby chicken houses informed us that County Road maintenance people had taken a backhoe and trenched between the sinkhole and the roadway trying to find a void. The site had then been backfilled. Where the ground had been disturbed, the surface is now sloped so that runoff from the east and west ditches on the south side of CR 70 could flow into the sinkhole. Minor berming had been done at the edge of the sinkhole, but was inadequate to prevent water flowage into the sinkhole. We observed that the original sinkhole was full of muddy water to within 2 feet of the ground surface. See photos below.

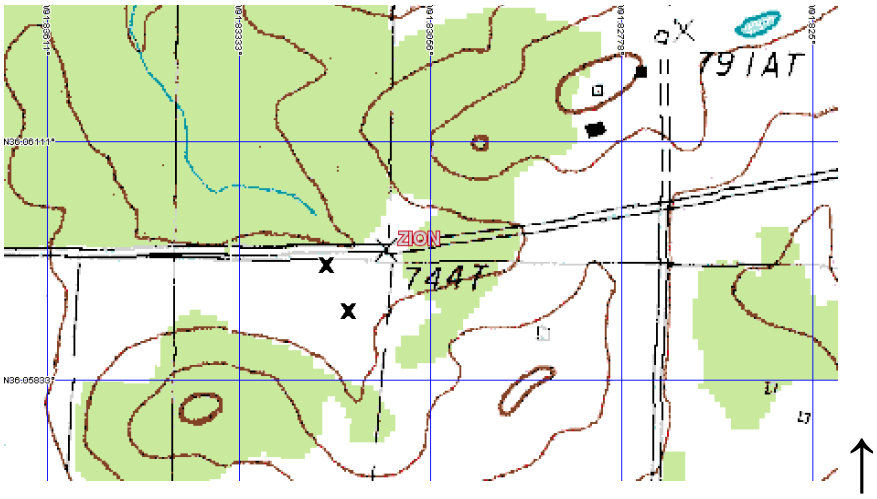
Drop in Izard CR 70 is marked by Dip sign and orange barrel. Mr. Prior is standing adjacent to center of road down drop. Looking east.

Ditch alteration and fence removal next to sinkhole. Note drainage direction sloping towards sinkhole, small berm, and fencing at edge of sinkhole. Looking southwest.

View across sinkhole, looking north towards the center of road collapse area.

Water-filled sinkhole/collapse structure. Looking west.

After examining the road and photographing crack patterns in the asphalt, an exploration of the pastured hillside to the south and the woods to the north was made. A second well with accompanying subsiding ground was discovered at Latitude: 36.05916, Longitude: -91.83179. The sinkhole and the well subsidence feature are depicted on the map below:



The northern **X** marks the site of the first noted sinkhole/collapse structure and the southern **X** marks the site of the second water well with subsiding ground surrounding it. Arrow points North. DeLorme 3-D Topo software image, Zion quad.

Pictures were taken of the second subsidence structure, along with GPS readings, and from the location of this second water well looking south up the drainage to where a mass of sandy limestone of the Everton Formation is exposed in the field. Pictures were then taken of both that exposure and looking back to the south towards the two structures (images below).

Subsidence around second well is about 24 feet in diameter. Farmer has marked this capped casing to keep from disturbing it when cutting hay. Looking south.

Relationship of 2nd subsidence to sinkhole. Bill is standing on rim of subsidence structure. Looking north.

View up drainage from 2nd collapse structure. Bill is standing on Everton outcrop or knocker near fence line, center of image. Looking south.

Limey sandstone of Everton Formation in outcrop. Lines are possibly scratch marks from hay rake.

View down drainage from Everton exposure. Bill is at 2nd subsidence. Sinkhole fencing and orange barrels along CR 70 are visible. Looking north.

Geology: An examination of E. Glick's mapping on the Melbourne USGS 15-minute quadrangle indicates that the site is mapped within the middle portion of the Everton Formation. Additional filled collapse features and sinkholes are noted on the Melbourne map, some within 3 miles of this site. The Everton Formation is sedimentary unit having considerable differences in lithologic character from one place to another. It is composed of various beds of dolostone, sandstone, and limestone. Limestones tend to be sandy. Within the Everton thick friable sandstone beds are present and bedding varies from thin to massive. Thickness of the Everton varies from 300 to 650 feet. Paleokarst features may exist within the Everton and are often filled with sand and rock fragments from formations above. Such features have been documented in exposures along the upper reaches of the Buffalo River.

Soils in the immediate area of the site are some 4 to 6 feet thick, and underlain by an undetermined thickness of regolith that overlies the actual bedrock. Well sites were searched for in the AGS water well records, but no records of wells in this section were recovered. This dataset only goes back to around 1970 (~40 years). It appears that both wells have been long abandoned. The northern sinkhole site has steel casing still in place and the southern well has an aluminum cap on the casing. No sign of any concrete pads or well housings are present, indicating perhaps the wells were never actually utilized.

Theory of Void Formation: Activation of "stable" filled sinks as described in a case study by Mellet (1995) in Florida, where sinks in carbonate-rich regions are well known, is analogous to the situation along Izard CR 70. Sinks and cavities created in carbonates millions of years ago may be plugged with younger deposits. Often after fluctuation of

the water table caused by extensive pumping of ground water or by heavy rains, the younger sediments may be drained downward, causing a cavity or sink to develop and migrate toward the surface. Alteration of the hydrological regime can induce future collapse, resulting in the surface expression of a sinkhole (P. Vallabh Sharma, 1997, p. 321). Initial drilling of the two wells on this site encountered and, perhaps bottomed in, filled paleokarst structures. Heavy rains have caused significant fluctuations of the local water table, causing fines in the system to move downward and creating cavities that migrated to the surface and near surface.

Conclusions: There is no evidence to indicate whether these wells ever produced water. No sign of grouting is present and no equipment, concrete pads, or electrical service are seen anywhere nearby.

However, it does appear that both wells on this site have penetrated a paleokarst feature, either enlarged joint sets or actual sediment-filled caverns or voids. Surging of water within this system due to heavy rain events caused the collapse of the well nearest the road first, just a week prior to the first visit in 2008. Heavy rains in October 2009 appear to have caused the subsidence of CR 70 into such a void or enlarged fracture system. It is not known which event or if either one affected the southern well site, only that it shows signs of subsidence and may potentially collapse with additional heavy rains to resemble the first sinkhole/collapse structure. Investigations in the woods north of CR 70 during both visits did not indicate any additional subsidence downstream from the study area.

The Future and Planning: At this point in time, it would only be speculation to predict what might happen relative to movement on the subsidence on Izard CR 70 and when such movement might occur. Both local population and county officials do need to be aware of the potential for road failure or significant additional subsidence within hours after any very heavy rainfall. Continued minor subsidence or catastrophic and hazardous failure are both possibilities in the long term. Plans should be in effect to reroute traffic should the road actually collapse.

Typically in the existing early situation of road collapse, county road maintenance personal begin to either fill or pave over the existing recent subsidence. This can make the situation worse in the long run and is a waste of time, materials, and money. Since there is no apparent subsidence north of the present road location, there is time for county officials to contact local property owners to explain the situation and seek the right to relocate the road to the north, should the situation worsen. When the road is constructed, it should be built with proper sub-grade drainage (a culvert) so that water will not pond against the road bed on the south side of the road.

References

Mellet, J.S., 1995, Ground penetrating radar applications in engineering, environmental management, and geology: Journal of Applied Geophysics, V. 33, p.157–166.

Sharma, P. V., 1997, Environmental and Engineering Geophysics: Cambridge University Press, UK, p. 321.