STORM WATER ADVISORY TEAM REPORT

MARCH 2015

EXECUTIVE SUMMARY

The design basis rainfall amount for Escambia County has been specified as the 25-year storm rainfall of critical duration. Specifically, it is the rainfall amount given in the Florida Department of Transportation Drainage Manual. The 24-hour rainfall level (11 inches) was exceeded four times during the last 100 years, including the most recent rainfall and the previous County record rainfall. In fact a rainfall level of 13 inches was equaled or exceeded four times in the last 100 years. The empirical 25-year rainfall exceeds 13 inches.

The 24-hour, 100-year rainfall for storm water design is given as 14 inches. It has been exceeded twice in the last 100 years. The storm last April 29-30 was officially reported as 19.56 inches, a record 24-hour 100-year rainfall. The rainfall profile (intensity vs. time) is a significant factor in producing flooding and was especially intense in the evening of April 29 – considered by the National Weather Service to be a 200 to 500-year event.

The design rainfall for Florida storms is given by a U.S. Department of Agriculture (USDA) paper published in 1961 that did not use data gathered after 1958. The data recorded after 1958 indicate that the design rainfall probably should be higher.

It seems prudent to the Team that the County adopt the 24-hour 100-year storm from the Drainage Manual as the current design basis rainfall. The County relied upon the Federal and State documents for storm water design and those documents may

have understated the rainfall amounts associated with risk levels that could be expected.

DISCUSSION

None of us can know with certainty when the next intense storm will arrive. Nor can we know how hard it will rain and how long it will rain. Those aspects of the next intense storm are uncertain.

Uncertainty makes decisions difficult. The goal of the Storm Water Advisory Team (Team), according to the resolution, is to "assist the staff in identifying conditions associated with the April flooding and review and comment on staff's recommendations prior to the staff's presentation to the Board of County Commissioners for its review." The type design storm is a condition to be identified as it had direct effects on the resulting flooding associated with the Apr. 29/30th event.

We may not know future events with certainty but we can use probabilities to aid in judging the risk associated with the decisions regarding how to proceed with storm water management. This judgment of the appropriate level of risk is one of the early steps in defining the response for the County to take.

The risk level is generally implied in what is called the return period of the storm. What is called a 25-year storm has a rate of one storm per 25 years. A 100-year storm has a rate of one storm per 100 years. In fact, though, that is shorthand for saying a 25-year storm has a 4% probability of occurring each year; a 100-year storm has a 1% probability of occurring each year.

At present the Escambia County Code of Ordinances Land Development Code (LDC) [1] specifies the design basis rainfall as a 25-year storm; an annual probability of 4%. Given the April 29-30 intense rainfall event there is some question about whether the design basis should be a 24-hour 100-year storm; one having an annual probability of 1%.

The current design guidance is based on the 2015 Florida Department of Transportation Drainage Manual. We believe it will be helpful for you to know how the data in that manual was developed.

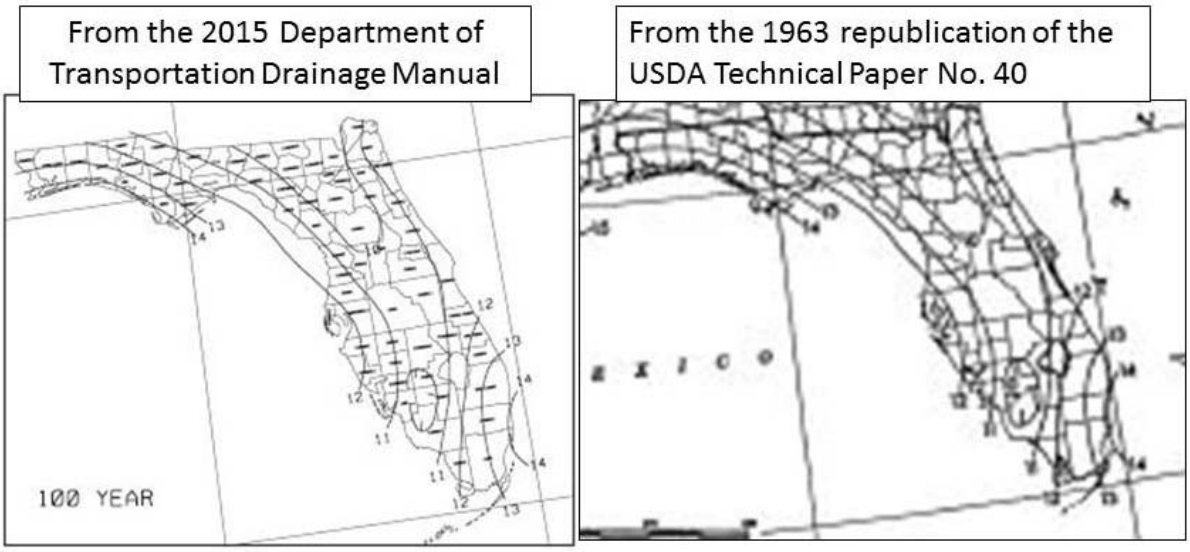
In May 1961 the U.S. Department of Agriculture published Technical Paper No. 40[2], with charts showing constant rainfall (isopluvial) lines for various return periods (probabilities), and specified rainfall durations. The work reported in Technical Paper No. 40 relied on rainfall data processed from the earliest available data through 1958. The data sample was large but the average time spans for recording stations ranged from 14 to 47 years. The data was recorded through 1958.

The charts in Technical Paper No. 40 were intended to provide the design basis for hydrological analysis of the entire United States. This paper was repaginated and republished in 1963. It is a monumental work, and excellent in every regard. As good as it is, though, Technical Paper No. 40 has the limitation of being based on rainfall data taken before 1959.

The rainfall isopluvial lines were published again in 1975 and 1986 as Technical Report No. 55. That report was referenced in the 2015 Department of Transportation Drainage Manual with the charts made available on-line as a separate document. The charts can be found in the on-line document linked to Appendix B of the manual. Charts

with the 24-hour 100-year isopluvial lines are shown below and it is evident that those from Technical Paper No. 40 are indistinguishable from those in the 2015 DOT Drainage Manual. This is true also of the 24-hour 25-year rainfall.

The conclusion we may draw from this is that the charts currently approved for storm water management design in Florida are based on data that was gathered before



1959. That data has not been updated since then, some 55 years.

The previous Escambia County record 24-hour rainfall of 15.29 inches was set in 1934. This was exceeded in 2014 with a 19.56 inch rainfall that the National Weather service lists as the full day rainfall for April 29-30, 2014[3].

The 24-hour 25-year rainfall shown on the design manual charts is approximately 11 inches, and the 24-hour 100-year rainfall on the same isopluvial line is 14 inches.

Looking back 100 years there have been four rainfall events equaling or exceeding the 25-year design basis (11 inches). Worse than that, those four rainfall events equaled or exceeded a 13-inch rainfall. Using the 24-hour 25-year rainfall as the Storm Water management design basis has been shown by experience to be inadequate.

In that same 100 year period the County experienced 24-hour rainfalls of 15.29 inches and 19.56 inches, yielding a 24-hour 50-year storm rainfall greater than 15.29 inches; an annual probability of 2% .

The storm of last April 29-30 had the greatest 24-hour rainfall. It was the largest 24-hour storm in the last 100-years, officially reported as 19.56 inches. This storm was unusual in several respects, it was a large total rainfall and the rainfall intensity for a 1-hour period was 5.68 inches, estimated to be a 200 to 500 year event.

Considering only this limited sample of empirical evidence one could conclude that neither the current 25-year design basis (11 inches) nor the potential 100-year design basis (14 inches) are sufficient for the long term. It appears that both would fall short of the design basis needed to prevent surprises from intense rainfalls in the future.

It is little consolation to know that neighboring communities also suffered damage from flooding because of similarly high rainfalls. Rainfall totals are shown in the table alongside for communities from Mobile to Milton. This does illustrate, however that storms of this magnitude are not just a problem for the City of Pensacola but are a County-wide, even area-wide problem.

Station[1] Number	Station Name	Daily Precip Sum (in)
AL-MB-50	Mobile 5.1 S	17.20
AL-BW-45	Silverhill 5.0 SW	21.80
AL-BW-9	Foley 0.5 ESE	20.76
AL-BW-27	Orange Beach 2.1 NE	20.53
FL-ES-21	Pensacola 9.2 NW	19.56
FL-SR-9	Milton 10.9 SSW	20.39

The extreme rainfall from the April 29-30 storm was caused by a cold front that slowed the progress of the storm inland. Storms slowed in their passage inland are most unusual but have accounted for other even larger rainfall events. The record rainfall for Florida of 38.7 inches occurred in 1950 when Hurricane Easy was stalled by a front to the North of Yankeetown. Tropical storm Claudette's passage was also hindered by a blocking front. Claudette produced the one-day record rainfall for the contiguous United States of 42 inches at Alvin, Texas (near Houston) in 1979.

One of the Team members prepared an evaluation of the last 50 years of the maximum daily rainfall at the Pensacola Airport. The data appeared to be represented fairly well by a lognormal probability distribution. The evaluation indicates that considering the data missing from the charts referenced in the design basis could produce significantly different results, and more difficult design criteria.

The results of that evaluation are based on a relatively small sample, though, and other probability distributions (e.g., Gumbel, Extreme Value) may be more appropriate. A more practical consideration is that it may differ from the rainfall used in FEMA flood analysis. It seems advisable to have the County's basis for flood analysis consistent with that used by FEMA. As yet the Storm Water Advisory Team has not been able to determine the rainfall values used by FEMA.

CONCLUSIONS/RECOMMENDATIONS

It was reasonable for the County to rely on the design guidance related to rainfall amounts provided by the State and Federal governments. Certainly, in the past, the County could not have been expected to supplant the agencies of the Federal government. It does seem, though, that the County must treat the present design guidance with some skepticism and if necessary use the data from state/federal agencies to develop more location specific design criteria.

The Team recommends that Escambia County adopt the 100-year storm defined by the FDOT in the Drainage Manual as the current basis for the design of storm water management facilities. The Team also recommends that the Board of County Commissioners pursue a scientific study to aid the BCC in judging the probability of the time between extreme storms of various intensities as an aid in planning and prioritizing mitigation work.

End Notes:

[11] *7.15.06. Design and performance standards for stormwater management plans.* Stormwater management plans shall …meet the following standards:

A. The hydrography for the developed or redeveloped site shall not exceed the rate of flow of runoff procured by conditions existing before development or redevelopment for the 25-year storm of critical duration. [emphasis added] …

[2] Technical Paper No. 40. Rainfall Frequency Atlas of The United States, for Durations from 30 Minutes to 24 Hours and Return Periods from I to 100 Years. Prepared by David M. Hershfield, Cooperative Studies Section, Hydrologic Services Division for Engineering Division, Soil Conservation Service, U.S. Department of Agriculture

[3] National Weather Service. North Central Gulf Coast Historic Flash Flood Event – 29-30 April 2014. http://www.srh.noaa.gov/mob/?n=flashflood_04292014