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September 13, 2020

Kristy Ellenberg
Public Participation Coordinator
Environmental Affairs, Bureau of Water
South Carolina Department of Health and Environmental Control
E-mail: ellenbke@dhec.sc.gov

Dear Ms. Ellenberg,

Thank you very much for the honor of meeting with you and your colleagues from the South Carolina Department of Health and Environmental Control last Thursday, September 10. I would like to take this opportunity to put in writing my comments from that meeting.

I understand from that meeting that the City of Charleston has stricter regulations for stormwater permitting than the State of South Carolina. Moreover, it is of no interest to the State of South Carolina whether the City of Charleston is or is not acting in compliance with their strict regulations.

On the other hand, neither the regulations for the State of South Carolina nor the City of Charleston specifically mention the need for accurate model input data. There is no need to do so because the regulations do not make sense without accurate model input data. In the case of the 2013 City of Charleston Stormwater Design Standards Manual, the expectation of accurate model input data is subsumed under general statements such as "This manual is not intended to restrain or inhibit engineering creativity, freedom of design, or the need for engineering judgment…The Stormwater Design Standards Manual is not intended as a textbook or a comprehensive engineering design reference. It was developed under the assumption that the user possesses a thorough understanding of stormwater control design, construction, and land development."

There were two initial events that led me to question the accuracy of the model input data for the proposed Central Park development. The first was the discovery by James Maczyk, a former Charleston police officer and retired firefighter, that a 42" stormwater outfall pipe was completely sealed with rocks. The response from the City of Charleston was that they had no records of such an alteration to the stormwater infrastructure. According to the City of Charleston, "From the records of the work we did to rehabilitate this system in 2016 it looks like the pipe must have been closed off before that. As a result, it would have been done before most of us working in stormwater engineering at the City and County were here. We are looking into if we have any records of what might have happened on this system or if any of the longer

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tenured maintenance employees have any knowledge on this and will let you know if we find anything out."

The issue is not the effect of this particular outfall pipe, but that the City has been altering its stormwater infrastructure without keeping records. This raises the question as to what other alterations to the stormwater infrastructure have occurred with no record-keeping by the City. In this regard, it should be noted that there is no map or database of the stormwater infrastructure that local residents could use to compare against the visible infrastructure in their neighborhoods. Inaccuracies in the mapping of the stormwater infrastructure can be observed only when they are strikingly egregious, such as in the sealing of a major outfall pipe.

The second event was local residents, including the same James Maczyk, supplying me with photos of drainage channels that were nearly full of mud, vegetation, woody debris, trash, and even shopping carts. These drainage channels would be essentially non-functional for the conveyance of stormwater. These two events led me to conclude that the stormwater infrastructure in the vicinity of the proposed Central Park development was poorly known and was in poor condition.

I would like to review for you the typical steps in the creation of a stormwater model for comparison with the steps that went into the creation of the stormwater model for the proposed Central Park development.

The first step is the collection of input data, including topography and the physical characteristics of the components of the stormwater infrastructure, such as pipes, culverts, open channels, and ponds. This data collection involves the compilation of existing maps and databases, as well as field surveys.

The second step is the verification (or validation) of the model. This step involves the use of previous precipitation events as an input to the stormwater model. The model is used to make back-predictions that can be compared with observations. Those observations might include records of which streets were flooded for what durations, watermarks on homes or buildings, or records of the water levels in drainage channels or pipes. If the comparison between back-predictions and observations is very poor, it is necessary to return to the first step of collection of input data.

If there is a partial match between back-predictions and observations, then the third step is the calibration of the stormwater model. In this step, the characteristics of the components of the infrastructure are adjusted until there is an optimum match between the back-predictions and observations. These adjustments are particularly applied to the components of the stormwater infrastructure that were never field-checked. In this step, special attention is paid to components

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of the stormwater infrastructure that might be "insensitive." This means that, for certain precipitation events and observations, the back-predictions of the model might be independent of the characteristics of certain infrastructure components. It is necessary to use enough precipitation events and enough observations so that all components of the stormwater model become reasonably "sensitive."

All of the preceding steps might seem like lot of work, but they are what people do when they actually care about whether a model is correct, as opposed to when they are simply going through the motions of a stormwater modeling exercise.

My knowledge of the steps involved in the creation of the stormwater model for the proposed Central Park development comes from my reading of the Comprehensive Stormwater Pollution Prevention Plan and from meeting with the Director of the City of Charleston Department of Stormwater Management.

The input data came from three sources. The first source was the LIDAR elevation data that were collected by the County in 2017. The second source was the ArcGIS files for the stormwater infrastructure that were obtained from the City. The Director of the Department of Stormwater Management described these data as "historical" and said that they came with no guarantees as to their accuracy. The third source was field-checking that was done by the consultants for the developer. According to the Director of the Department of Stormwater Management, there is no document that describes this field-checking. The field-checking was certainly not sufficiently thorough to discover that a major outfall pipe was completely sealed with rocks.

In the creation of the stormwater model, the sediment load in the drainage channels was assumed to be whatever it was at the moment that the LIDAR data were collected in 2017. All stormwater pipes were assumed to be free of sediment. The model was verified by using it to predict where flooding should occur in the Laurel Park neighborhood. The predictions were consistent with where the city engineers believed that flooding typically occurred. This comparison was not based on records, but upon the impressions and recollections of the engineers. There is no document that describes the verification of the stormwater model. The stormwater model was not calibrated in any way, nor was there any sensitivity analysis of the stormwater model.

The steps in the creation of the stormwater model for the proposed Central Park development should be regarded as very low level. They would not be acceptable for a course project for an undergraduate stormwater class.

In this insistence on the accuracy of a stormwater model, I am not simply acting as a pedantic retired hydrology professor. The seriousness that goes into the creation of a model should reflect the consequences of being wrong.

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I was quite moved when I heard Councilmember Ross Appel state that flooding was an "existential threat" to James Island. By this, I understood that flooding threatened the continued human inhabitation of James Island. In the face of these consequences, I would expect the stormwater models that were used for decision making to be 99.9% accurate (not an exaggeration).

In your consideration of the stormwater permit for the proposed Central Park development, I would encourage you and your colleagues to consider the following questions:

1) Are you 99.9% confident that the predictions are based upon an accurate stormwater model?
2) Are you 99.9% confident that the Central Park development will not increase the frequency and severity of flooding?

I thank you very much for reading this letter. Please do not hesitate to contact me if I can clarify anything or help in any way.

Best wishes,

Steven H. Emerman

cc:
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