WOOLPERT

Memo

To: Steve Kirk, PE

From: James Riddle, PE

Date: January 4, 2016

Subject: Church Creek Watershed Analysis
August and October 2015 Storm Event

Introduction

In August and October of 2015 the Charleston area experienced two significant rainfall events. In addition, both of these storms coincided with a King Tide, the highest seasonal tides that occur each year. During these storm events, numerous homes within the Church Creek watershed experienced flooding above their finished floor elevations (FFE). The August storm occurred August 30th to 31st with a total of 7.4 inches of rain reported at the Charleston Airport with the majority of the rain falling within a six (6) hour period on the 31st. The October event began on October 1st and ended on the 4th. The Charleston Airport rainfall gage reported that it dumped a total of 17.28 inches of rain over the course of four (4) days. The majority of the rain (14.38 inches) fell on October 3rd and 4th.

After these two storm events, residents within the Church Creek watershed expressed concern over the hydrological and hydraulic impacts of two recent projects: the Bees Ferry Road Widening Project (BFRW) and the West Ashley Traffic Circle (WATC). At the request of Charleston County and through a contract with the City of Charleston, Woolpert added these two historic storm and tide events to Church Creek Interconnected Pond Routing (ICPR) model and analyzed the impacts of the BFRW and WATC projects through various scenarios. In addition, Woolpert explored the possibility of adding tide gates to all pipes under the railroad in the southern portion of the watershed. High water marks for both storm events were surveyed and compared to the model results to see how closely they matched.

Bees Ferry Road Widening Project

The Bees Ferry Road Widening project requested and received a waiver for detention requirements from the City of Charleston Ordinance (Section 27-102). Woolpert reviewed and modeled this request and determined that due to the linear nature of the project and the location within the watershed, the impact to water surface elevations within the watershed for a typical design storm would be insignificant. (Refer to the report named *ICPR Model Additions/Revisions – Bees Ferry Road Widening* dated January 30, 2009 for more details.)

There have been many revisions to the Church Creek ICPR model over the past few years. In order to accurately compare the effects of BFRW project during the August and October storm events, Woolpert added these two storm events to the pre- and post- models used in 2009. The results at key locations are located in Table 1: Bees Ferry Road Widening (BFRW) Historical Storm Results. The BFRW project included widening Bees Ferry Road and upgrading a culvert under Bees Ferry Road near Sanders Road and the bridge over the main channel of Church Creek. Minor decreases in the max water surface elevation (WSE) were indicated upstream of Bees Ferry Road and minor increases were shown downstream of Bees Ferry Road in both historical storms. These results confirm that the BFRW project did not increase upstream flooding during the two historical flood events. The decreases in the WSE on the upstream side

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of the bridge are due to the larger culvert near Sanders Road and bridge on Bees Ferry Road near Shadowmoss. The WSE increases downstream of Bees Ferry are also a result upgraded culvert and bridge as more water is allowed to flow through them.

Table 1: Bees Ferry Road Widening (BFRW) Historical Storm Results

Bees Ferry Road Widening (BFRW) Historical Storm Results					
Node	Location	Storm	Pre BFRW Max Stage ft	Post BFRW Max Stage ft	Difference ft
N-G020	US of Bees Ferry Near Sanders Rd	Aug 2015	8.8	8.5	-0.3
		Oct 2015	10.6	9.9	-0.7
N-G010	DS of Bees Ferry Near Sanders Rd	Aug 2015	8.2	8.4	0.2
		Oct 2015	9.2	9.5	0.3
N-D030	Bridge Pointe Condos	Aug 2015	9.7	9.7	0.0
		Oct 2015	10.7	10.6	-0.1
N-B120	Canal Between Hickory Hill and Hickory Farms	Aug 2015	8.8	8.6	-0.2
		Oct 2015	10.0	9.7	-0.3
N-B020	US of Bees Ferry at Bridge	Aug 2015	8.7	8.4	-0.3
		Oct 2015	10.0	9.7	-0.3
N-B010	DS of Bees Ferry at Bridge	Aug 2015	7.5	7.6	0.1
		Oct 2015	9.0	9.2	0.2
N-A120	US of RR on Main Channel	Aug 2015	7.2	7.3	0.1
		Oct 2015	8.9	9.1	0.2
N-A110	DS of RR on Main Channel	Aug 2015	6.9	7.0	0.1
		Oct 2015	8.0	8.1	0.1

West Ashley Traffic Circle

The West Ashley Traffic Circle project also requested and received a detention waiver from the City of Charleston Ordinance requirements due to its linear nature and location within the watershed. The project was modeled and analyzed in ICPR before construction and the full details can be found in Woolpert's report *ICPR Model Additions/Revisions – West Ashley Traffic Circle* dated April 29, 2010.

The pre- and post- models for the WATC were also used to model the August and October storm events to determine any impacts caused by the construction of the traffic circle. The results at key locations are shown in Table 2: West Ashley Traffic Circle (WATC) Historical Storm Results. The WSE changes due to the WATC are less than 0.1 feet throughout the watershed indicating that the WATC had a negligible effect on the watershed for these events.

Table 2: West Ashley Traffic Circle (WATC) Historical Storm Results

West Ashley Traffic Circle (WATC) Historical Storm Results					
Node	Location	Storm	Pre WATC Max Stage ft	Post WATC Max Stage ft	Difference ft
N-D030	Bridge Pointe Condos	Aug 2015	9.1	9.1	0.0
		Oct 2015	10.9	10.9	0.0
N-B120	Canal Between Hickory Hill and Hickory Farms	Aug 2015	8.5	8.4	-0.1
		Oct 2015	9.7	9.6	-0.1
N-B020	US of Bees Ferry at Bridge	Aug 2015	8.3	8.2	-0.1
		Oct 2015	9.6	9.5	-0.1
N-B010	DS of Bees Ferry at Bridge	Aug 2015	7.5	7.4	-0.1
		Oct 2015	9.2	9.1	-0.1
N-A120	US of RR on Main Channel	Aug 2015	7.2	7.2	-0.1
		Oct 2015	9.1	9.0	-0.1
N-A110	DS of RR on Main Channel	Aug 2015	6.9	6.9	0.0
		Oct 2015	8.1	8.1	0.0

Tidal Impact Analysis

Because the August and October storm events both occurred during a King Tide, the County wanted to evaluate the possible benefit of installing tide gates on all of the culverts under the railroad. Currently there are ten (10) culverts under the railroad in three (3) different locations. To approximate the effect of a tide gate, the tidal information was removed from the model and a constant water stage of 0 feet was set at the Ashley River, a very conservative assumption. After running the model, the results were compared to the current model during the two (2) storm events. Table 3: Historical Storms Without Tidal Influence shows the results of this analysis. For these large storm events, the tide has negligible effect on the peak water surface elevations upstream of the railroad; however, the tide may have some impact on smaller intensity storm events. This indicates that even though Charleston was experiencing King Tides during these storm events (August and October 2015), the higher tides did not contribute to the structural flooding in the Church Creek Watershed.

Table 3: Historical Storms Without Tidal Influence

Historical Storms Without Tidal Influence					
Name	Location	Simulation	Current Max Stage ft	No Tide Max Stage ft	Difference ft
N-D030	Bridge Pointe Condos	Aug-15	9.2	9.2	0.0
		Oct-15	10.9	10.9	0.0
N-B120	Canal Between Hickory Hill and Hickory Farms	Aug-15	8.6	8.6	0.0
		Oct-15	9.7	9.7	0.0
N-B020	US of Bees Ferry on Main Channel	Aug-15	8.3	8.2	0.0
		Oct-15	9.6	9.5	0.0
N-A120	US of RR on Main Channel	Aug-15	7.2	7.2	0.0
		Oct-15	8.9	8.9	0.0
N-A110	DS of RR on Main Channel	Aug-15	6.9	6.9	0.0
		Oct-15	8.0	8.0	0.0
N-C080	US of Shadow Pt Dr on Diversion Canal	Aug-15	11.6	11.6	0.0
		Oct-15	11.3	11.3	0.0
N-A100	US of RR on Diversion Canal	Aug-15	9.2	9.2	0.0
		Oct-15	9.1	9.1	0.0
N-A090	DS of RR on Diversion Canal	Aug-15	8.3	8.3	0.0
		Oct-15	8.3	8.3	0.0
N-G020	US of Bees Ferry Near Sanders Rd	Aug-15	8.4	8.4	0.0
		Oct-15	9.6	9.6	0.0

Surveyed High Water Marks

After the two (2) Storm Events, both Woolpert and City of Charleston personnel photographed clear high water marks within the Church Creek watershed. For this effort, Woolpert surveyed four (4) clear high water marks in and around the Bridge Pointe Condominiums. Two high water marks were selected for each storm event and compared to the nearest node within the ICPR model.

Table 4: August 2015 High Water Marks shows the surveyed high water marks from the August storm on two different condo units and compared them to node N-D030. The surveyed high water mark closely matched the model max water surface elevation indicating that the Church Creek ICPR model produced accurate results under these conditions.

Table 4: August 2015 High Water Marks

August 2015 High Water Marks				
Survey Location	High Water Elevation (ft)	Nearest Model Node	Model Max WSE (ft)	Difference (ft)
Bridge Point Unit 608	9.30	N-D030	9.2	-0.1
Bridge Point Unit 508	9.40	N-D030	9.2	-0.2

Table 5: October 2015 High Water Marks compares a surveyed high water mark in the Bridge Pointe Condos and a second high water mark on the Shadowmoss Golf Course Restrooms. Both surveyed locations were compared to the closest model node. The October results did not match as closely as the August event as the model did not simulate the magnitude of the flooding that was observed. This difference could be attributed to other factors such as variations in rainfall measured at the airport versus the Bees Ferry Road area, differences in actual temporal and spatial distribution versus that used the model, the actual pond levels prior to the event due to antecedent rainfall, or some of the culverts may have been partially blocked with debris.

Table 5: October 2015 High Water Marks

October Storm High Water Marks				
Survey Location	High Water Elevation (ft)	Nearest Model Node	Model Max WSE (ft)	Difference (ft)
Bridge Point Unit 512	11.77	N-D030	10.9	-0.9
Golf Course Restroom	11.86	N-I100	11.2	-0.6

Conclusion

The modeling results for the Bees Ferry Road Widening Project and West Ashley Traffic Circle indicate that neither project contributed to the structural flooding caused by the August 2015 and October 2015 storm events. In addition, installing tide gates on the ten (10) pipes under the railroad to prevent the tide from backing up into the watershed would provide negligible benefit to the peak water surface elevations within the Church Creek Watershed, and would not have prevented flooding during the two storm events. Both of the recent events far exceed conditions associated with a typical design storm, but model results for the August event still closely match those that occurred in the watershed.