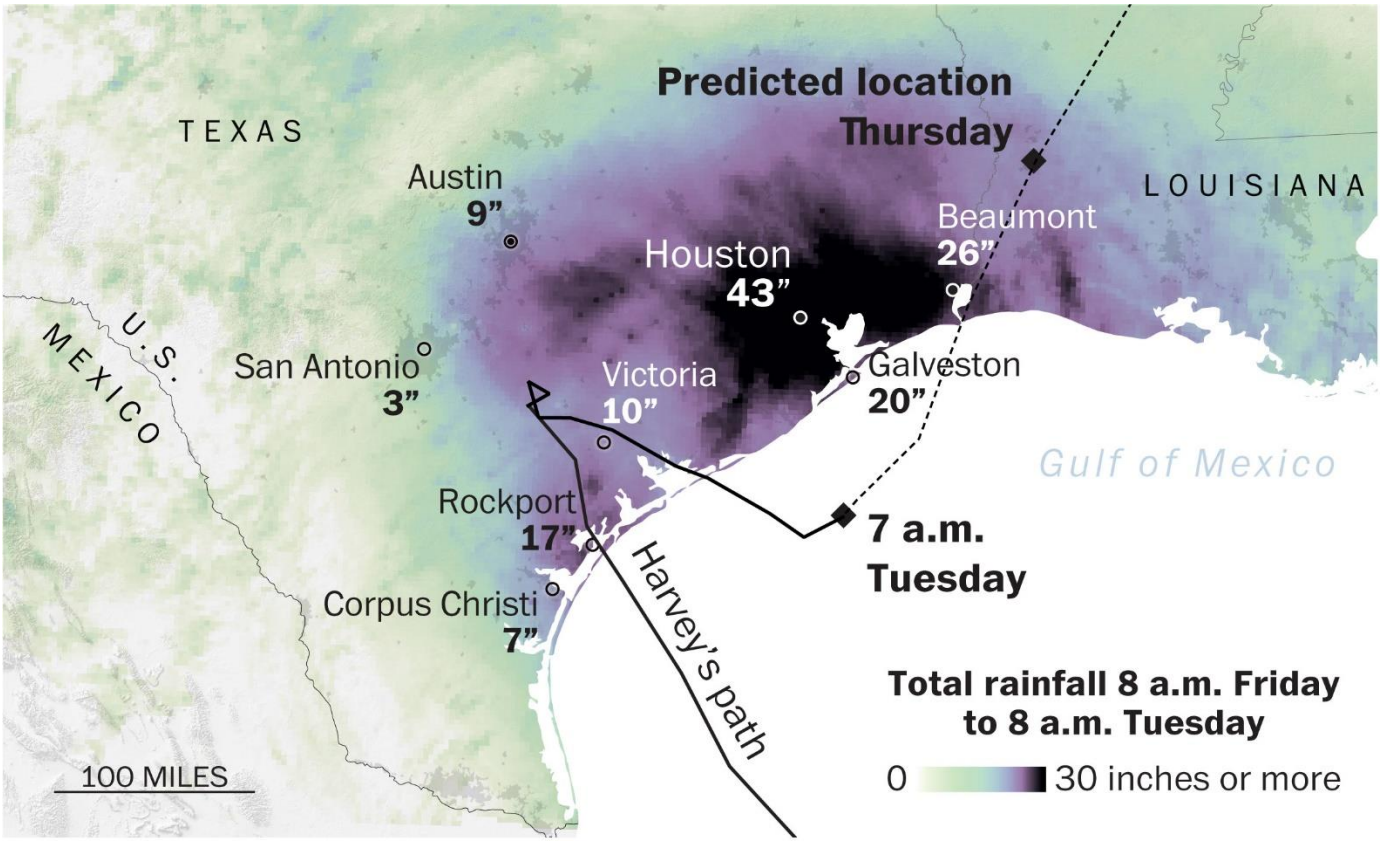

FORT BEND COUNTY LEVEE IMPROVEMENT DISTRICT NO. 19

AFTER ACTION REPORT

BY COSTELLO, INC.

HURRICANE HARVEY – 2017

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1.0 PURPOSE LETTER

Board of Directors

Fort Bend County Levee Improvement District No. 19

Directors: Mr. Robert Walters – President
Mr. Robert Thompson – Vice President / Assistant Secretary
Mr. Kolbe Curtice –Secretary

This After Action Report (AAR) is prepared from the observations of Costello, Inc. during the Hurricane Harvey event in 2017 as it relates to Fort Bend County Levee Improvement District No. 19 (LID 19 or FBCLID 19). The other District consultants may share additional comments with the Board related to this event. A separate report is being prepared by Costello, Inc. for LID 19 that will address our recommendations for changes/improvements to the overall District facilities and operations. Several of the noted recommendations are listed in Section 4.0 Next Steps, but it may not be complete list nor are they fully vetted list with cost estimates and measured benefit.

Costello, Inc.
Fort Bend County LID No. 19
District Engineer

Chad E. Hablinski, P.E.
Sr. Project Manager
TX Firm No. 280

10/10/2017

2.0 EXECUTIVE SUMMARY

2.1 Storm Overview

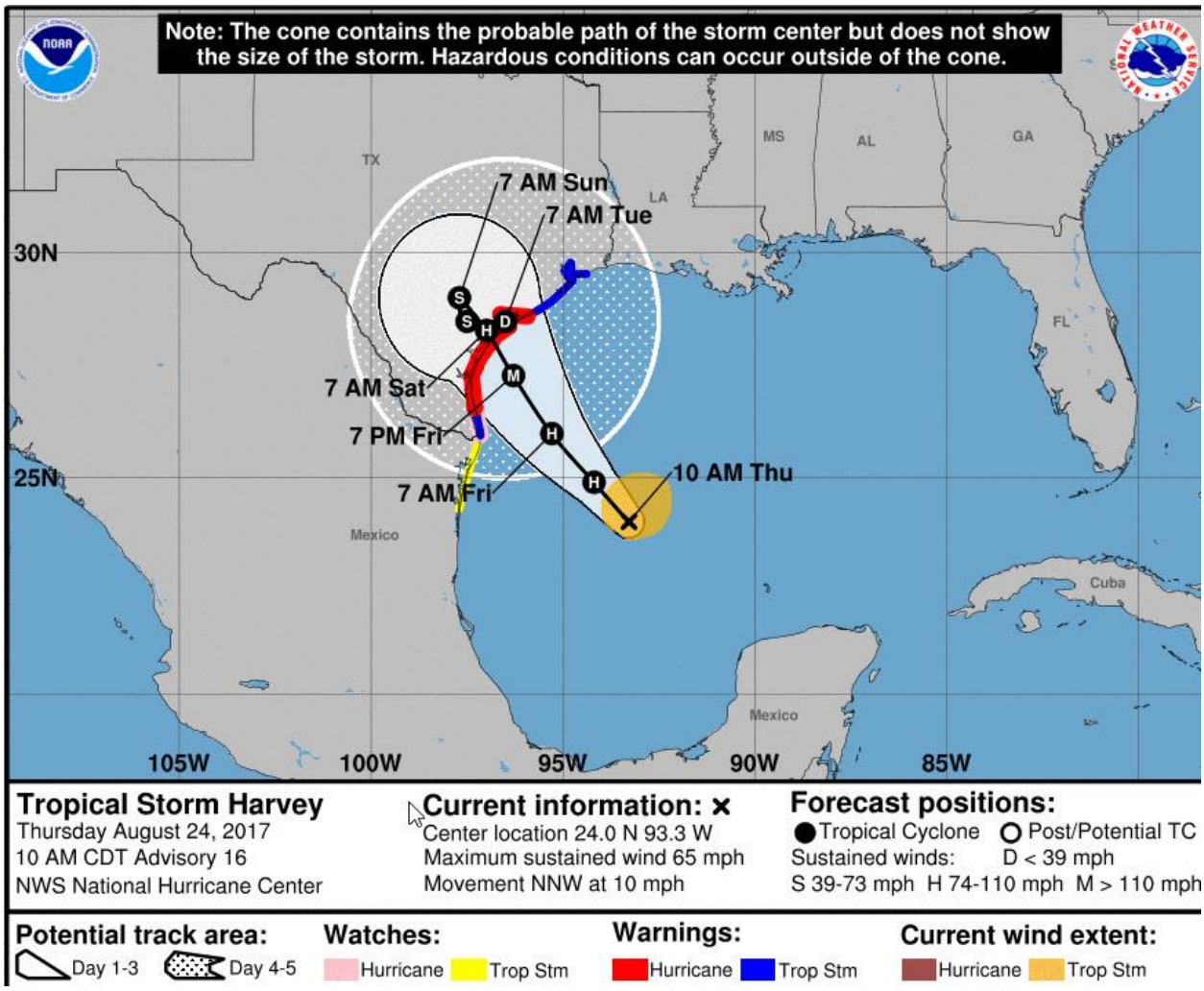
Flooding is the most common natural hazard in the gulf coast. The most likely time for flooding to occur is during the Atlantic hurricane season which lasts from June 1st through November 30th. The proximity to the moisture rich atmosphere near the gulf coast and the semi-permeable soils in the area can lead to street ponding during intense, short duration, rainfall events.

The following is a description of Hurricane Harvey from the National Weather Service website:

The birth of Harvey occurred on Sunday August 13th, 2017 as a tropical wave emerged off the west coast of Africa, eventually merging with a broad area of low pressure near the Cabo Verde Islands. At first, it was thought the wave and the low-pressure area would have a more west-northwest track, threatening the Lesser Antilles. However, this low stayed more on a westward course as it moved over the open Atlantic Ocean toward the Eastern Caribbean Sea. For a few days on its westward track, "Harvey" remained disorganized, and there was some uncertainty whether the low would become a tropical cyclone. However, by Thursday August 17th, the National Hurricane Center began issuing advisories and forecasts on Tropical Cyclone Nine Thursday morning, and Tropical Storm Harvey Thursday afternoon. Tropical Storm Warnings were issued that afternoon for Martinique, St. Lucia, Barbados, and St. Vincent and the Grenadines. Tropical Storm Harvey impacted the Windward Islands on Friday, August 18th, entering the Eastern Caribbean Sea as a minimal tropical storm, and eventually weakening to a tropical wave late Saturday evening. Although there was some potential for the remnants of Harvey to reorganize into a tropical cyclone, a tropical cyclone failed to form as the remnants of Harvey moved into the Yucatan Peninsula on Tuesday morning, August 22nd.

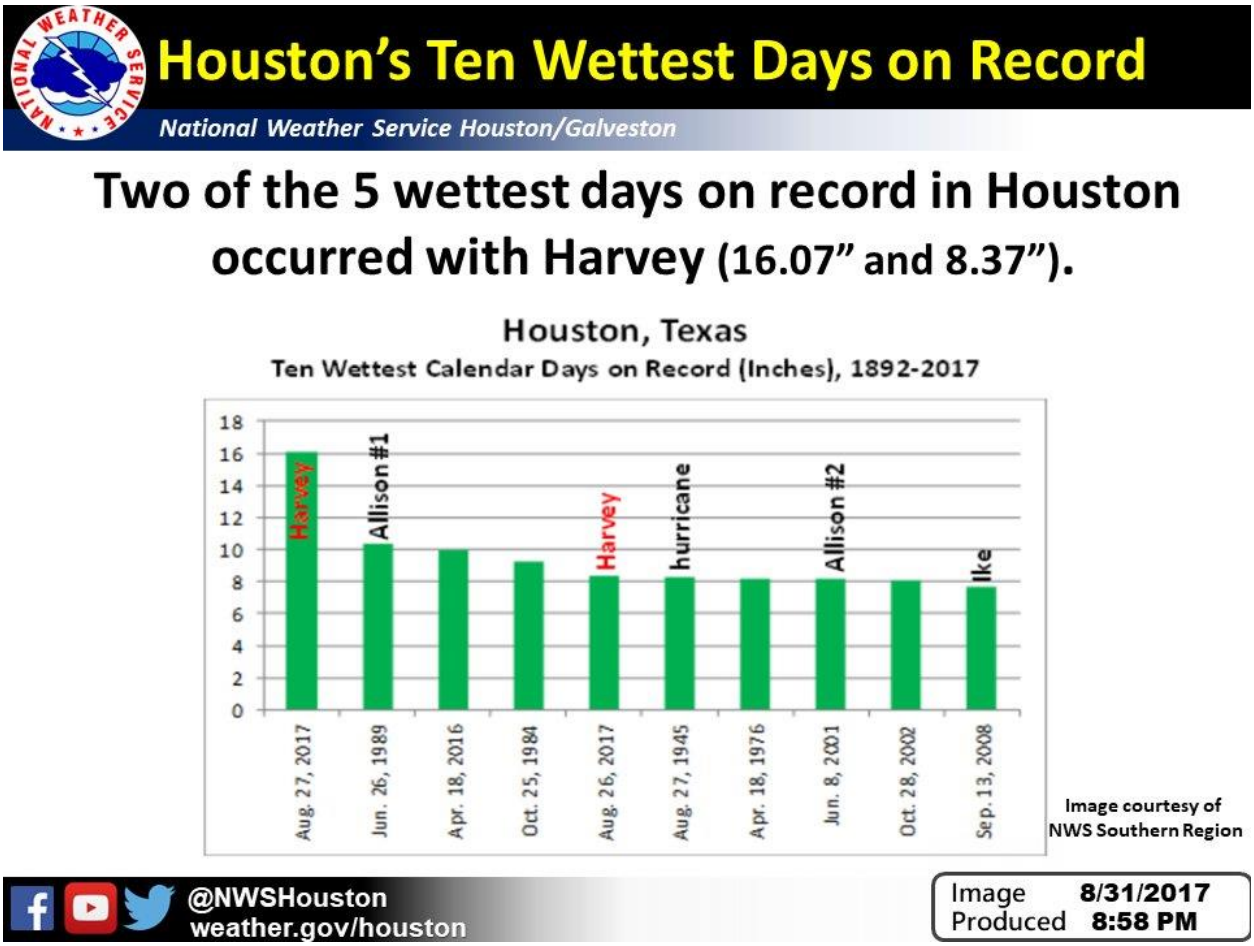
With very warm waters in the Bay of Campeche and the Western Gulf of Mexico, the National Hurricane Center (NHC) was fairly confident that the remnants of Harvey would reform into a tropical cyclone. At 10 AM CDT Wednesday August 23rd, Tropical Depression Harvey reformed. Initially, NHC believed Harvey would become either a strong tropical storm or a Category 1 hurricane before making landfall somewhere between Brownsville (early Friday morning) and Houston (early Saturday morning), with the most likely location near the Rockport area late Friday night . However, with wind shear in the Western Gulf of Mexico weakening, Tropical Storm Harvey was intensifying quickly. By Wednesday evening, Harvey was forecast to make landfall as a hurricane somewhere over the Texas Coast.

On Thursday August 24th, Harvey's impact on the Middle and Upper Texas Coast seemed almost certain and potentially devastating. Not only was Harvey forecast to become a hurricane by Thursday evening, but it was expected to strengthen and make landfall as a major hurricane (Category 3 or higher) on Friday (see forecast below). Worse yet, once the storm moved inland, it was forecast to eventually stall and meander over South or Southeast Texas for days. Thus, Major hurricane Harvey was not only forecast to produce devastating winds, but extremely heavy and excessive rainfall, producing devastating and historic flooding over areas especially east of the center of circulation (still most likely just north of Copano Bay).

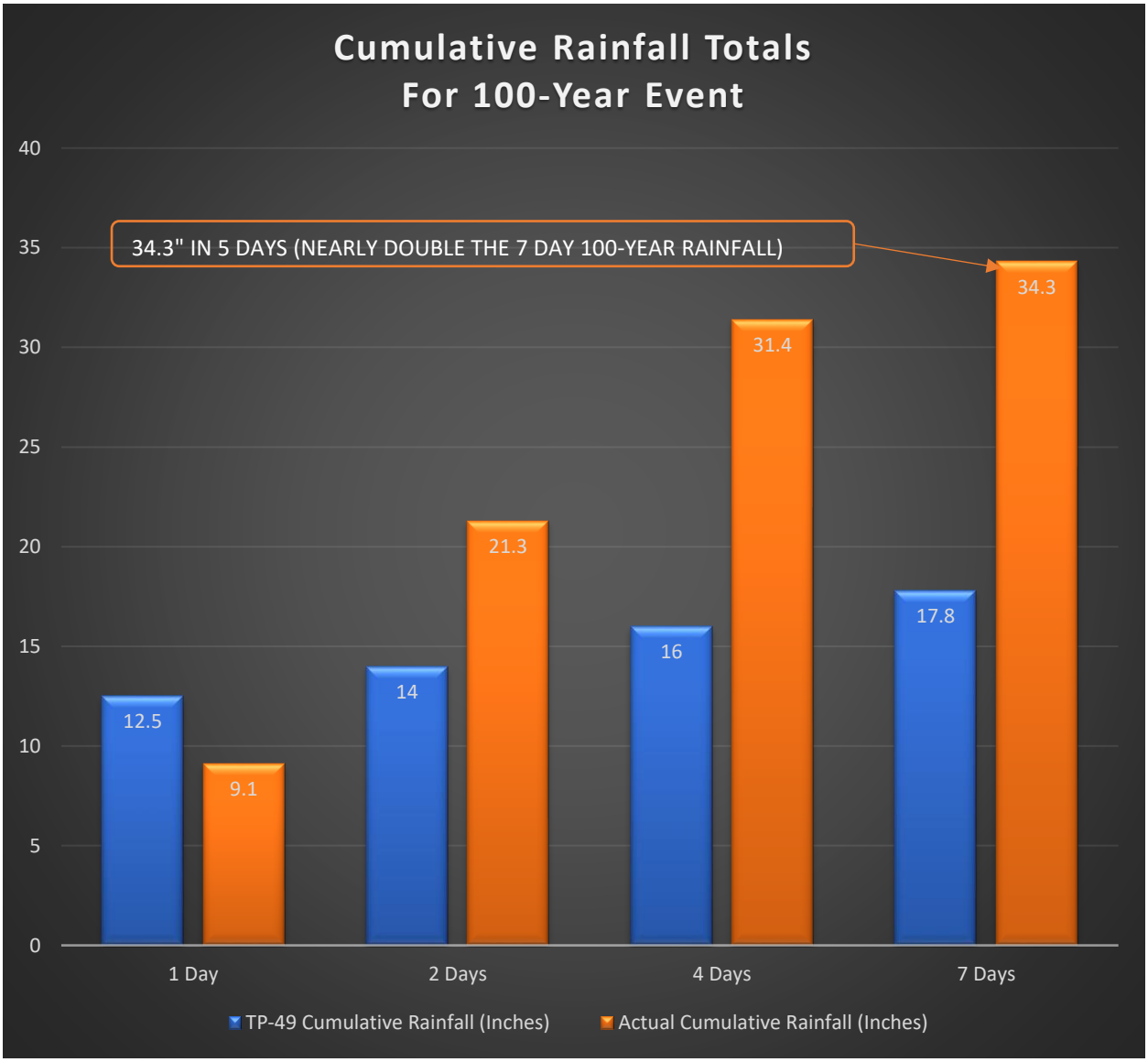


Harvey underwent rapid intensification and quickly became a Category 3 hurricane on Friday at 2 PM (120 mph sustained winds) and then a Category 4 hurricane (130 mph sustained winds) early Friday evening. As Harvey slowly approached the coast, the National Weather Service in Corpus Christi issued a rare Extreme Wind Warning. Extreme wind warnings are issued for landfalling major hurricanes with winds of 115 mph or higher. Harvey was forecast to have winds in the eyewall between 115 and 130 mph! Three extreme wind warnings were ultimately issued for Harvey. The eye of Major Hurricane Harvey first made landfall on San Jose Island and then near the Rockport and Fulton, Texas area at around 10 PM CDT.

Hurricane Harvey produced historic rainfall which led to historic flooding. In Riverstone, 34" of rain was received between Friday night, August 25th and Tuesday, August 29th. In Houston, Harvey produced two of the five wettest days on record. Tropical storm Allison produced similar rainfall amounts in certain areas, but the area affected was substantially smaller.



After the first 24 hours, the storm continued to produce rainfall totals that far exceed the 100-year rainfall that the drainage system is designed to accommodate. The rainfall totals easily exceed the 500-year event and will likely top the 1,000-year event when the statisticians complete their work evaluating the storm.



2.2 Emergency Response Overview

Preparation

Before the storm, in accordance with the Emergency Operations Plan (EAP), all flap gates and sluice gates were cleared of debris and were inspected to confirm they were fully operational at least 24-hours prior to the expected rainfall. The pump station was off, but operable. The natural gas generator was tested at the beginning of hurricane season and was operable.

Coordination with County

There were multiple conference calls daily coordinated through the County's Emergency Operations Center which the operator, engineer and attorney for the District participated. The purpose of the calls was to identify needs by various groups in the County created by the storm. The groups included the County's emergency operations team, the levee improvement districts, several municipal utility districts, various city emergency operations teams, hospitals, school districts, TxDOT and Fort Bend Toll Road Authority. The National Weather Service and the US Army Corps of Engineers were on several calls as well. The some of the typical needs included, providing diesel, high water rescue equipment, location of shelters and supplies for them, and evacuation routes.

Levee Condition

Throughout the event, the engineer and operator monitored the levee condition. However, we were required to cease vehicular traffic on the levee due to the continuous rain causing rutting on the levee top. Visual inspections were performed by the operator via helicopter as the rain subsided and the river continued to rise. A number of calls were fielded about levee breaches and other levee "weaknesses." The operator and engineer inspected the areas in question, but none of the reports were found to be valid. The levee, flap gates and sluice gates performed as designed throughout the event.

Pump Station

When the pump station on Steep Bank Creek was activated on Sunday morning (August 27th) and was manned 24-hours a day by the operator.

Supplemental pumps were ordered on August 27th and they were delivered to the Steep Bank Creek outfall late on August 30th to help draw down the water in the system quicker than could have been accomplished by the pump station alone. 40,000 GPM of supplemental pumps were operational on Thursday, August 31st. They ran continuously until September 4th.

At no time was power lost at the pump station, but the natural gas generator was available if needed. There were several reports of the Steep Bank Creek pump station being "broken" or not running. The pump station ran all pumps from Sunday morning, August 27th, until they were turned off because of lack of water on Tuesday, September 5th.

Damage within the District

In Fort Bend County LID No. 19, no District facilities were damaged outside of some fencing on the river side of the levee. However, 570 homes flooded in the area south of Hagerson Road which consists of Sweetbriar, The Orchard, Shadow Glen, Lost Creek and Millwood communities. In addition to the structural flooding in these communities, many of the streets in Stonebrook were impassable until

Saturday, September 2nd. Additionally, Oilfield Road and May Ridge Lane in Creekstone were similarly impassable until Friday, September 1st. The rainfall produced by Hurricane Harvey between Friday and Tuesday was significantly above what the storm drainage system was designed for. The slow recession of the ponded water was due to the river level being elevated to a point where gravity drainage was unavailable. All storm water drainage after Sunday evening was facilitated by pumped discharge. Gravity drainage was reacquired on Wednesday, September 6th.

The structural flooding occurred due to internal rainfall well in excess of the design capacity of the drainage system. This condition was further exacerbated by the Brazos River level increasing to a point to where drainage via gravity was no longer possible. Due to the detention storage being over-capacity from rainfall occurring early during Harvey and the continuing rainfall, the pump station in the watershed was insufficient to deal with this level of a flood event.

3.0 After Action Report Focus Areas

3.1 Notifications

3.1.1 What worked?

Classic Messaging and the District web site were very beneficial in getting factual information out to the District residents. The Muller Law Group provided CI updates twice a day for review to be posted to the website.

3.1.2 What needs improvement?

Several residents indicated that without power, the notifications to the District residents would not have been possible. We were lucky in that respect. Providing a method to keep in contact with residents without power should be part of a plan moving forward.

Reaching more residents should be a priority to avoid the problems with false information being posted on various social media platforms.

More frequent information updates during events like this would be beneficial. This is particularly true for evacuation orders.

3.1.3 What didn't work?

Several residents indicated that they should be able to reach the District by phone when events like this occur. As the District has no full-time employees, it doesn't have a "call center."

Social media platforms where distributing false, incorrect, or misleading information works counter to the District's desire to post factual information. Once the information is in those exterior platforms, it is impossible for the District to get in front of it to correct the message.

3.2 Communications

3.2.1 What worked?

Communication between the District consultants was not impaired. Power was available throughout the event.

Communication between facilities was accomplished through cell phones as the networks were active.

3.2.2 What needs improvement?

The ability to monitor the various outfalls and pump stations from a centralized location would be a great benefit. Also having the ability to monitor those same locations remotely would be advantageous to the operator and engineer.

Having multiple points of contact between the engineer and operator can provide benefit and some difficulties. Ideally, one point of contact for each is preferable, but may not be possible during certain times due to availability.

Coordination between other Districts that discharge storm water into the Steep Bank Creek watershed should be explored further. Their cooperation after Harvey in closing their sluice gates before their systems were back to "normal" allowed FBCLID 15 and FBCLID 19 to access their streets and homes sooner.

Coordination with the City of Sugar Land and City of Missouri City which discharge their regional wastewater treatment plants into Steep Bank Creek. Neither City was amenable to reducing their discharges during the event even though they were both sending flows far in excess of their permitted amounts.

Providing for radio communication between the District's consultants during power outage would be beneficial.

3.2.3 What didn't work?

No issue.

3.3 Field Operations

3.3.1 What worked?

All pump stations were manned 24-hours a day during the event.

Operator responded to CI inquiries and concerns throughout the event.

Levee was monitored for breaches and failures.

Gates / pumps were not impacted by debris.

3.3.2 What needs improvement?

Better access between District facilities and other levees during internal flood events would be beneficial. Reliance on the availability of boats and high-water vehicles is not ideal in emergency conditions.

Access to restrooms/showers/beds during emergency conditions should be an item to address in the plan moving forward.

3.3.3 What didn't work?

Nothing noteworthy.

3.4 Emergency Action Plan

3.4.1 What worked?

The plan was followed as directed as gates were cleared, pumps were checked and ditches were cleaned of debris.

3.4.2 What needs improvement?

A closer flood gauge would be beneficial to help determine the actual flood stage adjacent to the District. It takes several hours for river levels at Richmond to reach Fort Bend County LID No. 19.

Staff gauges at the outfall from the levee (internal and external) would aid our ability to determine when best to activate the pump station and when we can reopen the backup sluice gates to regain gravity outfall. Video monitoring of these gauges would be ideal to keep operators from having to leave shelter to take readings.

3.4.3 What didn't work?

A predictive model has never been performed for an event like Harvey. The timing of the flap gates being closed by the river and intense local rainfall that continued to fall on an already full collection system was not predicted by anyone. The EAP should be updated to include conditions experienced during this event so that upgrades can be considered, and Evacuation Orders can be better anticipated and implemented.

3.5 Facilities

3.5.1 What worked?

The Steep Bank Creek Pump Station operated as designed, but was activated before the flap gates fully closed to help facilitate more water getting out of the system more quickly. Power was never lost, but the generator was available if it were.

The flap gates and sluice gates operated as designed.

The levee operated as designed with no deficiencies noted.

3.5.2 What needs improvement?

Interconnection between the watersheds with Fort Bend County LID No. 15 would provide for one pump station to carry more of the pumping load if necessary. It would also provide for an alternative pumping solution should something catastrophic happen at the pump station. Fort Bend County LID No. 19 is located entirely within the Steep Bank Creek watershed, but interconnection between the Snake Slough and Alcorn Bayou watersheds could help provide some additional pumping volume if the excess capacity is available. There was a temporary interconnection between the watersheds because of the excessive ponding throughout the system. However, once the water was back below the curb elevation the connection was lost.

Access to the pump station would be greatly improved by being able to use the levee as the access.

Remote video monitoring of the pump station would eliminate a number of conversations between consultants.

3.5.3 What didn't work?

Everything that was supposed to work, did work. However, the pump station and associated storage facilities are significantly undersized to accommodate an event like Harvey which produced rain far in excess of the standard design criteria for the region.

4.0 Next Steps

Moving forward Fort Bend County LID No. 19 will develop a plan to address the issues raised in the AAR Focus Areas section above. The engineer will work with the Board, operator and the attorney to develop a prioritized list of steps and projects to implement and a cost estimate to accomplish the improvements. The District will re-prioritize as necessary and will explore options for funding the improvements.

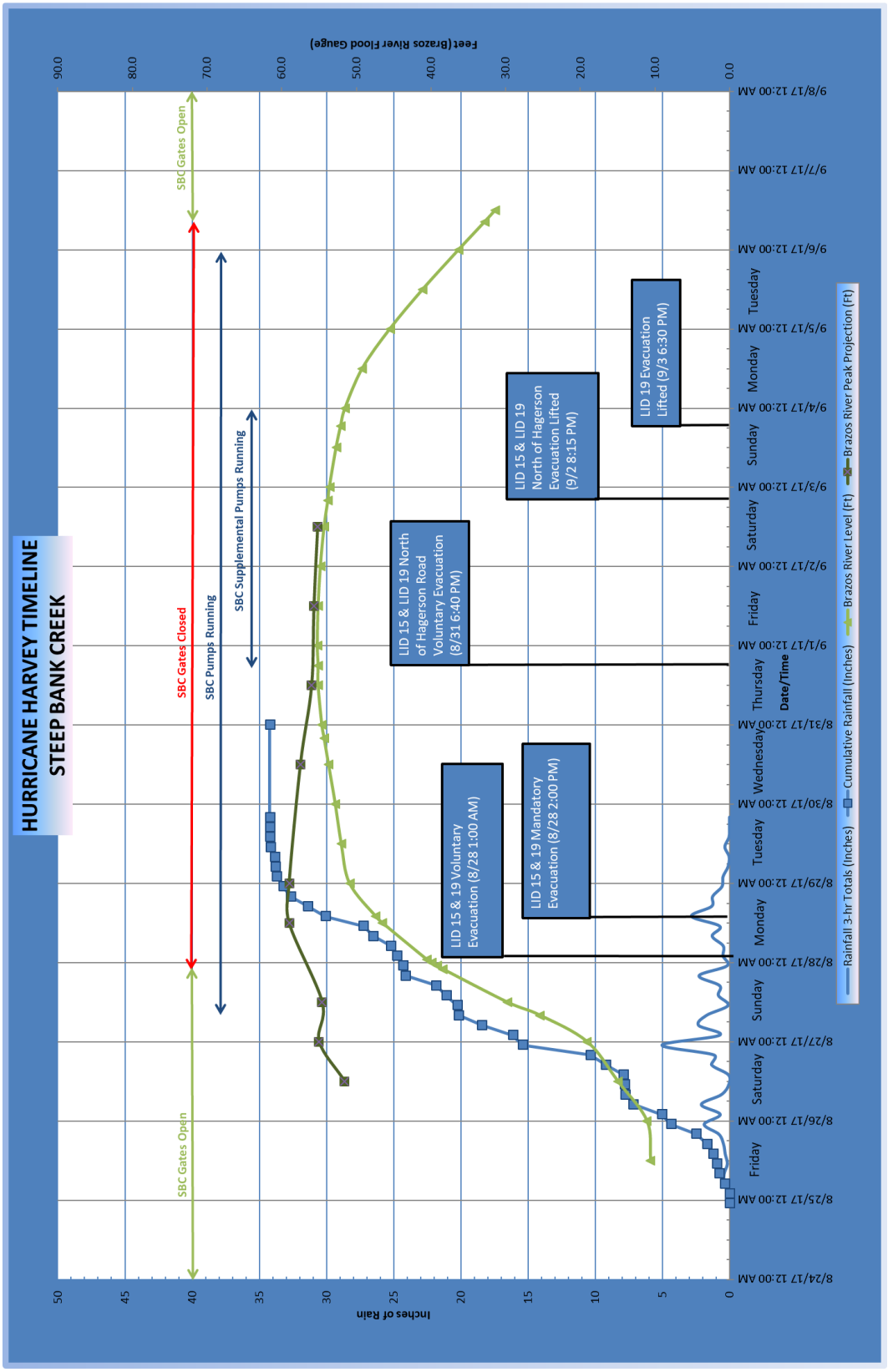
One of the items under consideration will be upgrades/expansion to the pump systems. This is not a straight forward analysis and will likely require multiple meetings between the County Engineering Department, the Fort Bend County Drainage District and the LID community. Determining the new or upgraded criteria for sizing the pump station systems in LIDs might be a District by District analysis rather than one criteria fits all because every LID has different external and internal conditions. This is currently our top priority as it requires the most lead time to get accomplished. Costello, Inc. has already had some preliminary conversations with the Drainage District about this subject.

Once the sizing for the pump systems is completed, Fort Bend County MUD No. 115, Fort Bend County LID No. 19, Fort Bend County LID No. 15 and First Colony LID will coordinate efforts to complete the upgrade/expansion in the Steep Bank Creek watershed. A cost sharing arrangement should be implemented.

1. Consider pump station expansion(s).
2. Consider new pump station(s).
3. Consider additional storage within the collection system.
4. Consider inter-watershed connections.
5. Consider conveyance system improvements (to get water out of the system more quickly).
6. Consider housing facilities within the pump station facilities for operator/engineering staff during emergency event(s).
7. Consider all weather surfacing on levee tops.
8. Consider additional river gauge closer to District.
9. Consider adding staff gauges internal and external to the levee at all outfalls.
10. Consider remote video monitoring of staff gauges and pump stations.
11. Consider other platforms to reach residents when power is lost.
12. Consider more frequent updates regarding conditions in the District for residents.
13. Consider a call center for emergency events.
14. Consider coordination of storm water controls between the District and other Districts that discharge into shared watersheds.
15. Prepare a predictive model for event(s) similar to Harvey and/or in excess of the standard drainage criteria.

5.0 Appendix

5.1 Steep Bank Creek Timeline



5.2 Watershed Map