Hurricane Harvey

Fort Bend County Levee Improvement District No. 2

Outline for this evening's meeting

1. Introductions
2. Levee 101
3. What FBC LID 2 does and doesn't do
4. Development and capabilities of the District
5. What happened during Harvey
6. How we're coming on our 8 Step Action Plan
7. Future Projects within the District
8. Paying for Future Projects

Attending Tonight from the City of Sugar Land

- Mayor Joe Zimmerman
- At Large Position 2 Council Member - Mary K Joyce
- District 3 Council Member – Amy L Mitchell,
- District 4 Council Member – Carol K McCutcheon

- Assistant City Manager - Chris Steubing
- City Engineer - Jessie Lee
- Senior Engineer - Jorge Alba
- Community Engagement Coordinator - Kayla Lauhoff

FEMA

- John Miles – NFIP (National Flood Insurance Program)
- Stew Anderson – FEMA External Affairs

NATIONAL FLOOD INSURANCE PROGRAM

FloodSmart.gov

The Official site of the NFIP

Fort Bend County
Levee Improvement District No. 2

- Chairman – Andre McDonald
- Director – Glen Gill
- Director – Bryan Chapline

- General Manager – Mike Stone
- Asst. General Manager – Phil Martin
- District Engineer – Greg Frank P.E.
- Chief Operator – Mike Thelen
- Staff (Megan, Josh, John)

Data Sheet For Each Home

Contact Info – Phone / Email

Data the survey crews have been able to gather.

If you know the times water entered your house, it peaked, and when it was out of the house.

Any other comments that might help us understand this flood event.

Fort Bend County
Levee Improvement District No. 2

Street Name:	Street Number:
MAIN ST	123

Owner Name: JOHN DOE

Phone Number: home 281-232-1234 Cell 713-860-4321

Email: John Doe @ example.com

Slab Elevation:	Curb Elevation:	Gutter Elevation:
65.92	64.4	63.9

Date/Time Water Entered the House: Monday Night around 11:00 pm

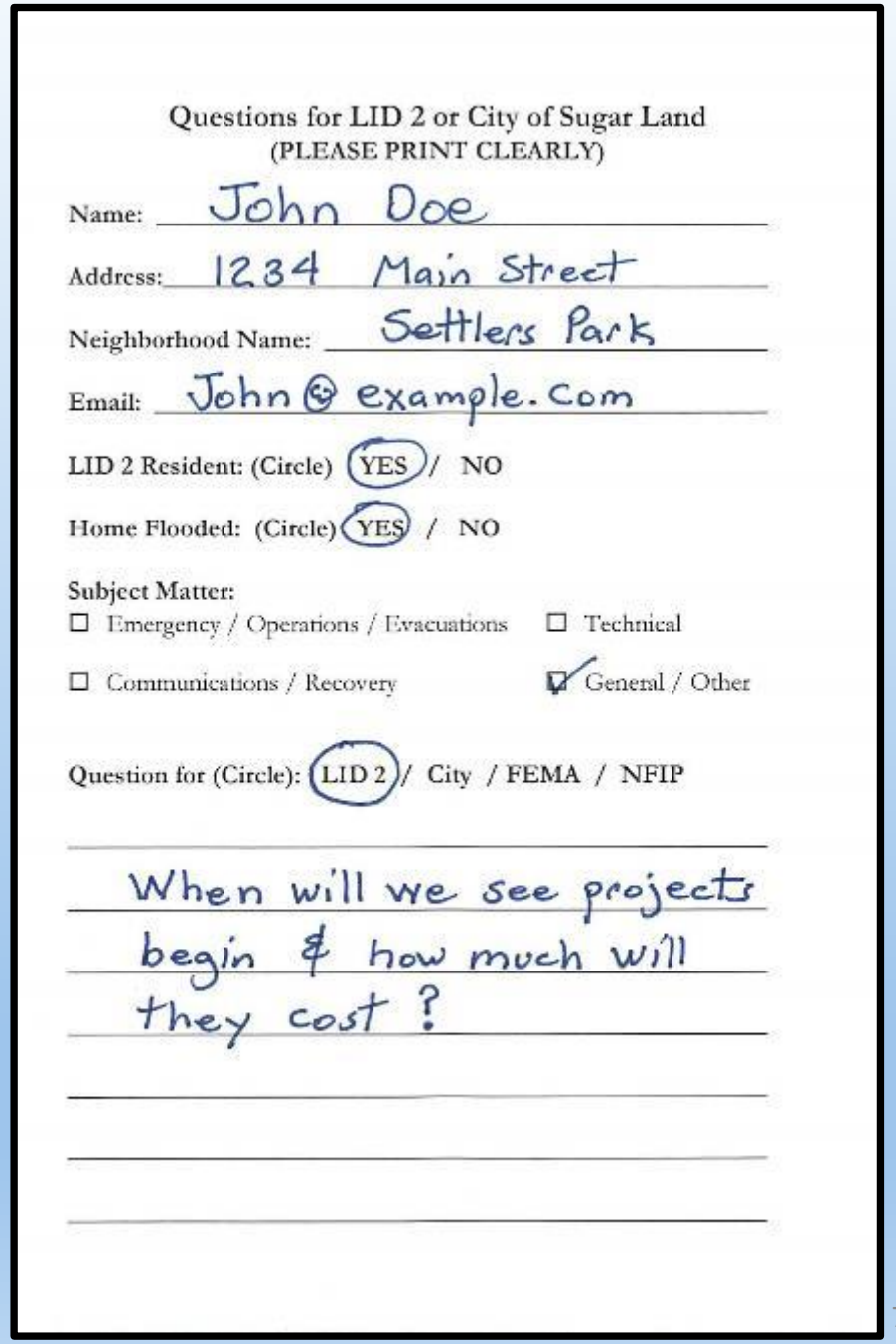
Date/Time Water Level Peaked:	Water Level (in):
Tuesday morning 6:00am	4"

Date/Time Water out of the House: Tuesday afternoon 3:00 pm

Comments: Please keep us informed of any additional meetings & of any projects to prevent this from happening again.

Question Cards….

- During the presentation write your questions down
- We'll gather them up near the end of the presentation
- We'll try to get all of the questions answered before we leave tonight



Questions for LID 2 or City of Sugar Land
(PLEASE PRINT CLEARLY)

Name: John Doe

Address: 1234 Main Street

Neighborhood Name: Settlers Park

Email: John@example.com

LID 2 Resident: (Circle) YES / NO

Home Flooded: (Circle) YES / NO

Subject Matter:

☐ Emergency / Operations / Evacuations ☐ Technical

☐ Communications / Recovery ☑ General / Other

Question for (Circle): LID 2 / City / FEMA / NFIP

When will we see projects begin & how much will they cost?

Levees 101

What is a levee?

That pile of dirt with grass growing on it between your house and the river.

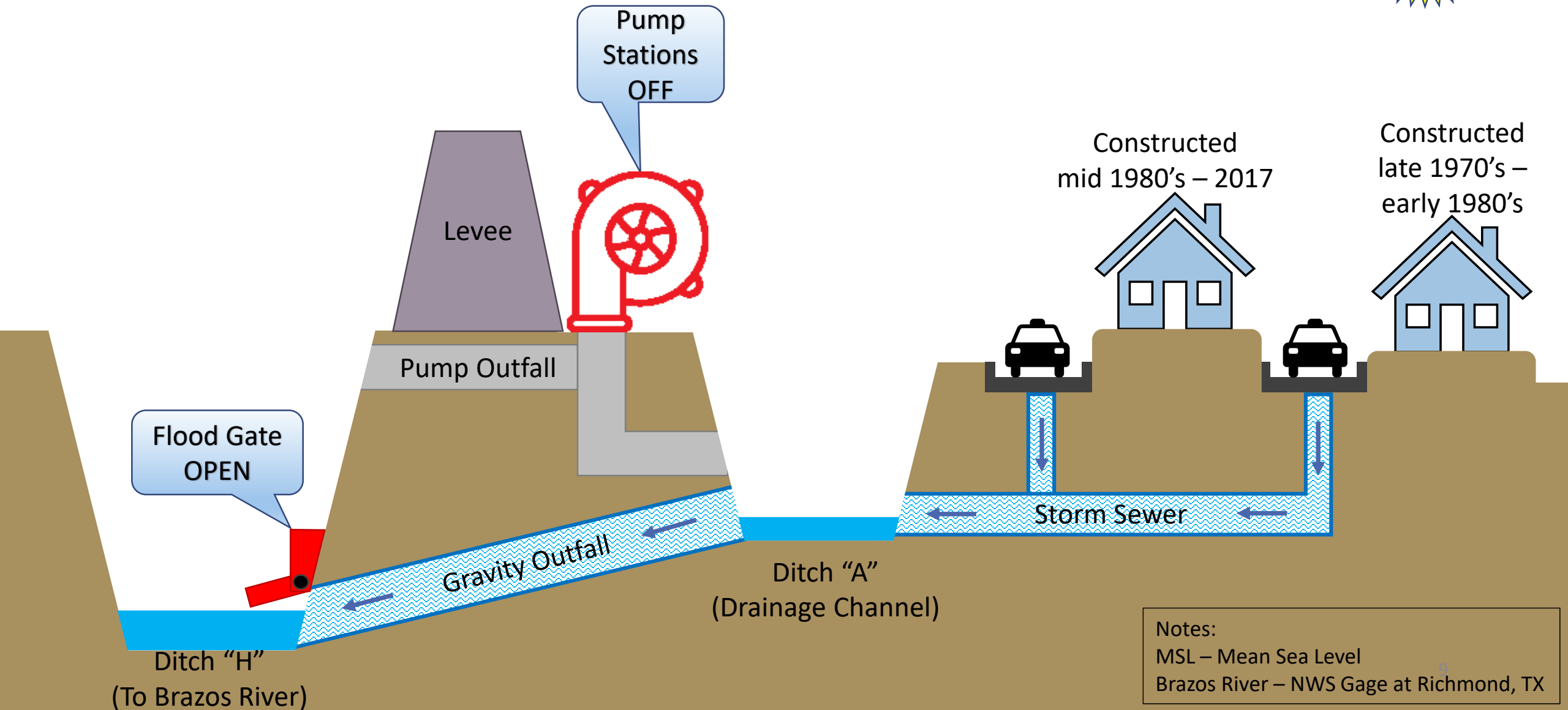
What do levees typically do?

KEEP THE RIVER OUT OF YOUR HOUSE.

What levees can not do?

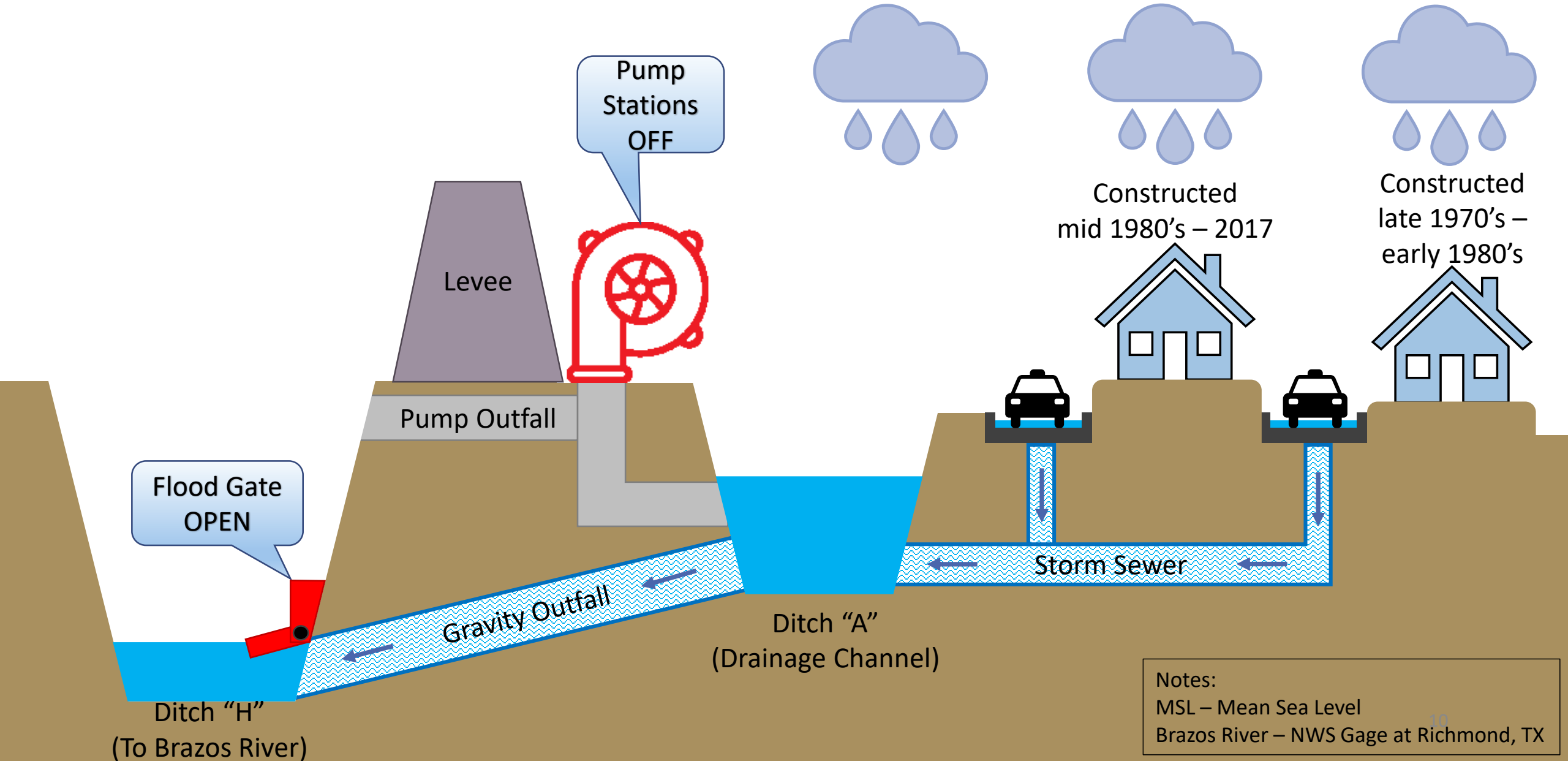
Keep it from raining inside the area with the levee around it!

1 Normal Operations – Sunny Day



Notes:
MSL – Mean Sea Level
Brazos River – NWS Gage at Richmond, TX

2 Normal Operations – Rainy Day



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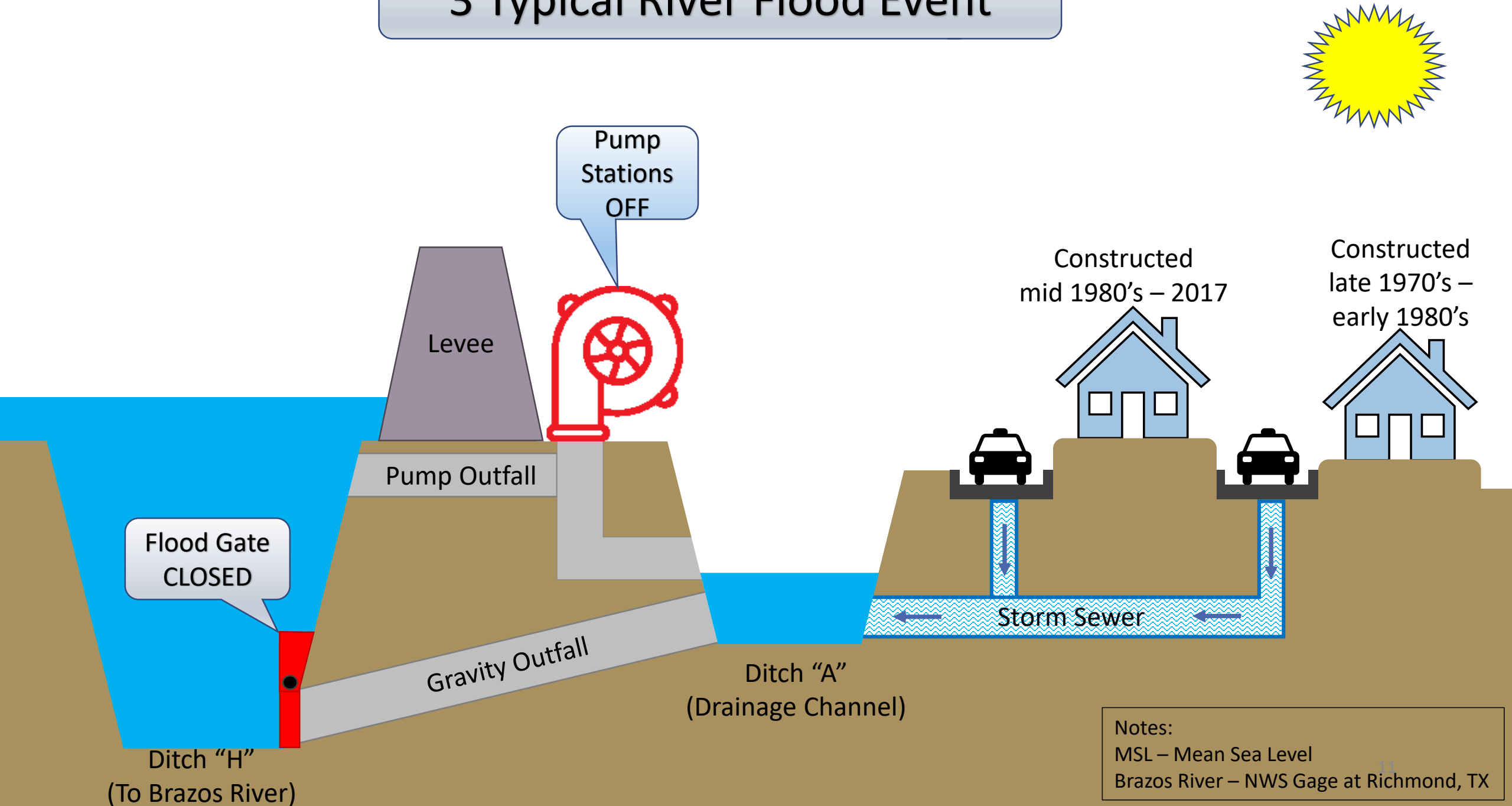
3 Typical River Flood Event



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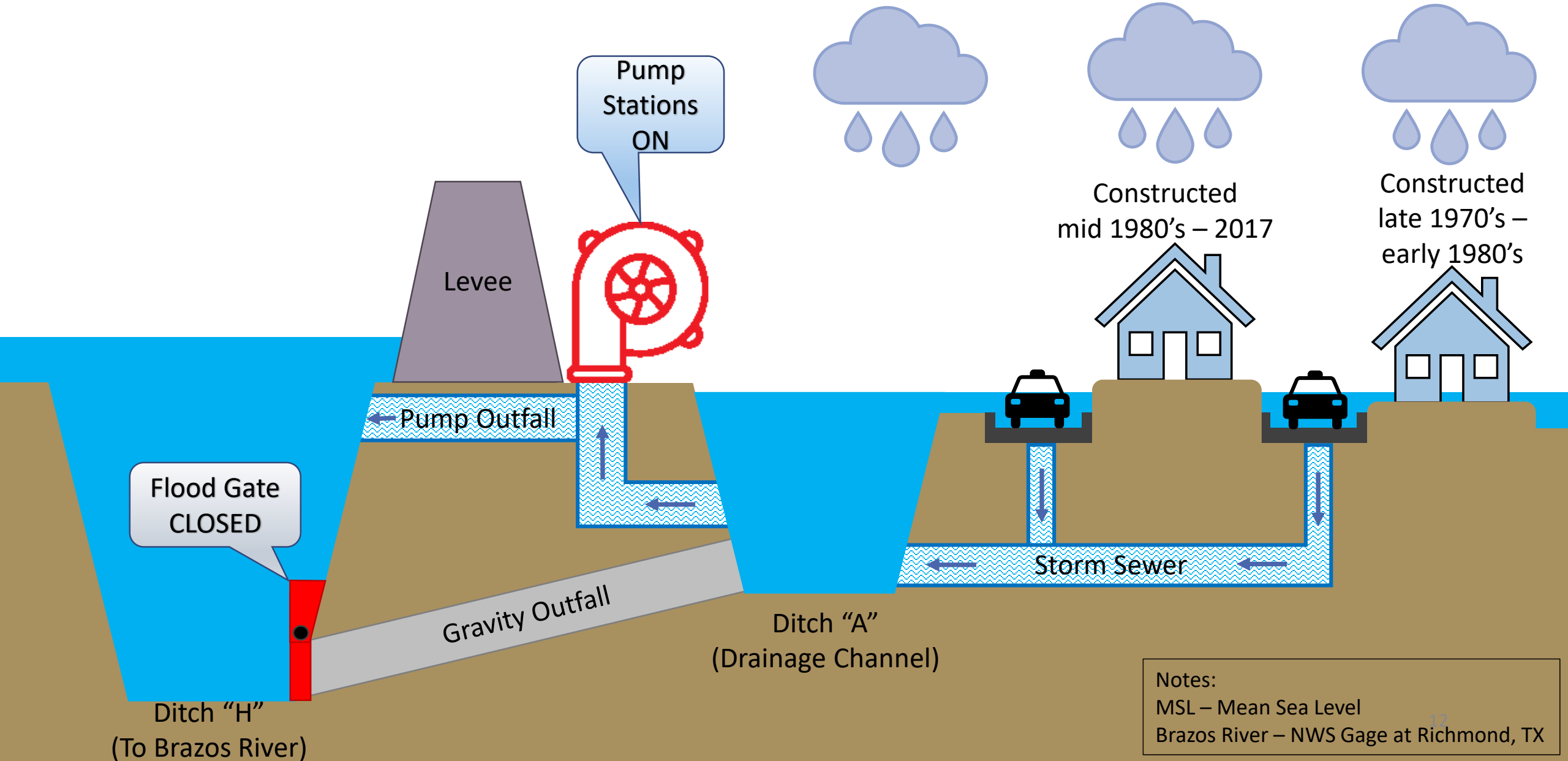
4 Coincidental Event - Harvey



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Explaining the 100 year flood elevation

- 100 year flood elevation is the name of an elevation.
- It really has nothing to do with time.
- It represents the 1% chance of the water level reaching a specific elevation at a given location in a given year.

FBC LID 2 – Responsibilities / Facilities

1. Construct and maintain the levees surrounding the District

2. Construct and maintain the internal drainage ditches that receive the water from the storm sewers within the District

3. Construct and maintain the outfall structures and pump stations to remove rain that falls within the District

FBC LID 2 Facilities:

11.3 Miles of Levees

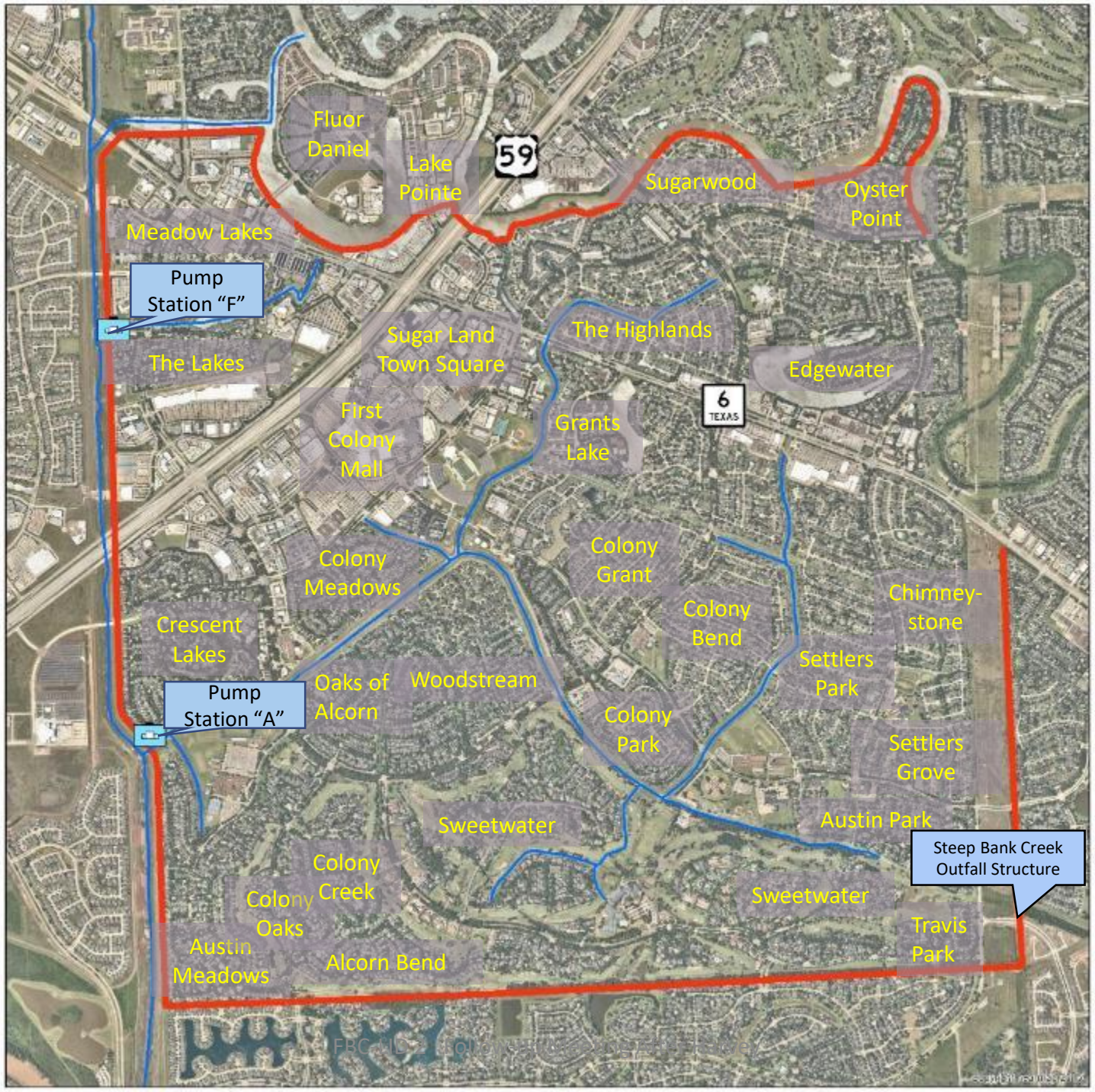
- 3 Miles of Levee exposed to the Brazos River
- 4 Miles of Levee exposed to Oyster Creek & Brooks Lake
- 4.3 Miles of Internal Levees

8.4 Miles of Internal Ditches

Outfall Structures / Pump Stations

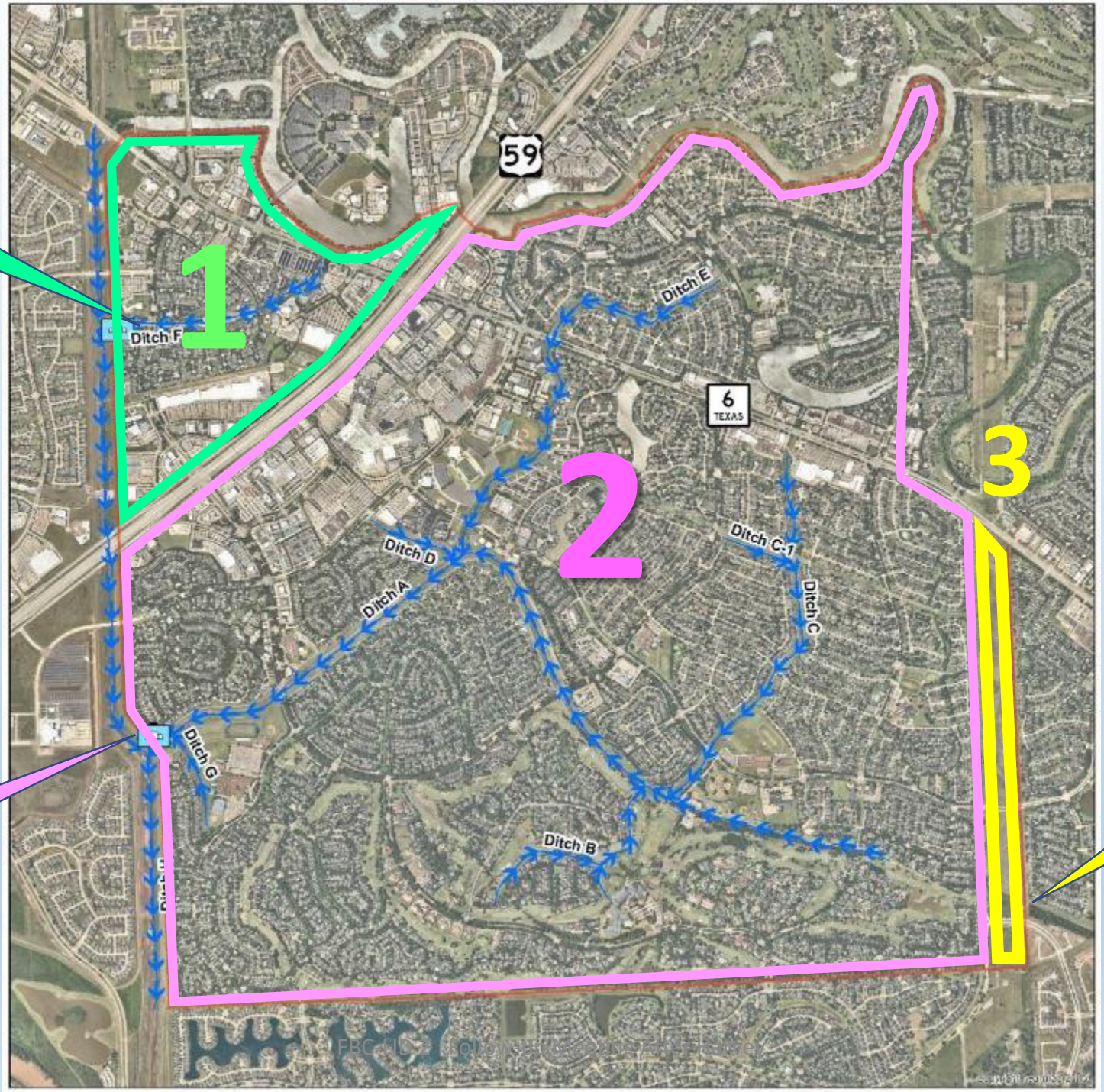
- Pump Station “A” (4,200 cfs gravity / 540 cfs pump or 241,800 gpm)
- Pump Station “F” (900 cfs gravity / 200 cfs pump or 90,000 gpm)
- Steep Bank Creek Outfall Structure (225 cfs gravity only – no pumps)

FBC LID 2 Levee System



FBC LID 2 Internal Ditch System and Pump Stations

PUMP STATION "F"
90,000 GPM



Steep Bank Creek Outfall Structure
Gravity Only
No Pumps

PUMP STATION "A"
241,800 GPM

Timeline

- FBC LID 2 was created in February of 1975
- There were no standards for elevation of house slabs
- There were no standards for levee heights or pump capacity
- Original design was constructed to handle a 7.55” rainfall event

- Chimney Stone / Settlers Park / Austin Park – all were constructed at a time when there were no requirements for the slabs to be above a certain height.

Timeline

- 1987 The Fort Bend County Drainage District issues standards for the design and construction of levee systems.
  - Levees had to be 3’ higher than 100 year flood elevation on the Brazos River.
  - FBC LID 2 must be able to store and/or pump 6.1” of rainfall over 24 hours.
  - New homes had to be constructed with a slab elevation at least 12” above the internal flood elevation.

Timeline

- 1990's through early 2000's – The District becomes substantially developed and land locked.

- 1997 Costello Engineering becomes FBC LID 2's engineer
  - 2002 Costello re-evaluates FBC LID 2 and confirms the District meets the 1987 FBCDD criteria and can handle a 6.1" rainfall event.

Timeline

- 2006 a NEW model is developed for the Brazos River
  - This model indicated the flood levels on the Brazos River could be higher than levels previously used to set the safe height of the levees
- 2007 – FBC LID 2 enters into a Cost Sharing Agreement with other levee districts to increase the height of the levees along the Brazos River
- 2008 – Levee improvements are complete and submitted to FEMA for certification

Timeline

- 2008 Hurricane Ike hits Sugar Land (widespread, prolonged power outages)

- 2010 FBC LID 2 begins construction of an improved "Resiliency Project" for Pump Station "A"
  - Replace 35 year old diesel pumps with electric pumps
  - Maximize the size of the pumps

    (increased total capacity from 200,000 to 241,800 GPM)
  - Modernize the pump control systems
  - Install two generators – 1 natural gas and 1 diesel
  - Harden and expand the building to house staff during a hurricane
  - Expand building to be able to operate and communicate during an emergency

Timeline

- 2011 Fort Bend County Drainage District adopts new design standards
  - FEMA requirement was for levees to be 3’ higher than 100 year flood elevation on the Brazos River
  - Fort Bend County required an additional 1’ above the FEMA standard

- 2014 FEMA adopts the 2006 Brazos River model with the new flood elevations.
  - All levees within Fort Bend County met the FEMA requirement
  - FBC LID 2 meets the FEMA requirement + the “Fort Bend County Foot”

Timeline

- 2014 FBC LID 2 begins work on the Ditch “A”, “D”, “G” Rehabilitation project to de-silt and armor drainage channels.

- 2015 FBC LID 2 begins work on the Steep Bank Creek Outfall Replacement project.

- 2016 FBC LID 2 begins a “Resiliency Project” for Pump Station “F”
  - Added 2 generators (1 natural gas & 1 diesel)
  - Hardened the building
  - Added remote automation so the station could be operated from “A”

Hurricane Harvey – What happened?

- 31-35” of rain over 5 days in FBC LID 2.
- Brazos River rose to a new record flood elevation 55.19’*
- Fort Bend had both Voluntary and Mandatory evacuations called for levee districts (the first time that has ever occurred)
- Approximately 10,000 high water rescues performed in Fort Bend County
- 3 deaths attributed to Hurricane Harvey in Fort Bend County
- 6,824 homes in Fort Bend County experienced flood damage
- 232 homes within LID 2 experienced flood damage
- FBC LID 2 pumped approximately 1.2 billion gallons of water out of the District

*(55.19’ is the gage reading at Richmond, not the actual elevation, previous flood of record was 54.7 set in 2016)

Harvey
What Happened?

FBC LID 2 received nearly 4.9 billion gallons of rain.

Acres in LID 2	5,300
Inches of Rain	34
Feet of Rainfall	2.83
Square Feet/Acre	43,560
Acre Feet of Water	15,017
Cubic Feet of Water	654,126,000
Gallons per Cubic Feet	7.48025
Gallons of Water	4,893,026,012

Why was this event so bad?

1. We've had river floods almost as high before but no significant rain at the same time.

2. We've had high rain fall events before but not at the same time as a record river flood.

3. We've never had a record rainfall and a record river event occur simultaneously!

Formula for Worst Case Scenario

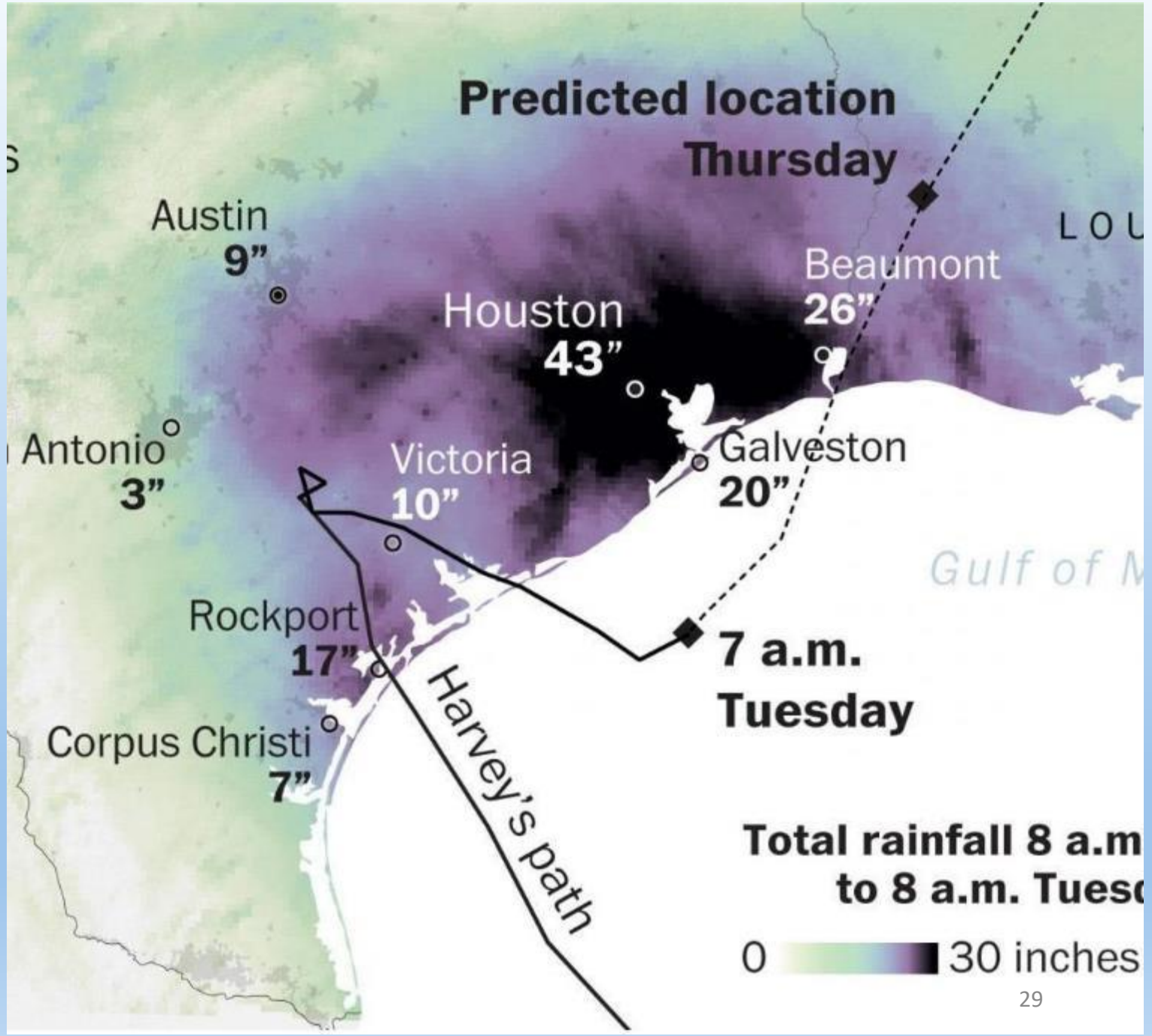
Record Rainfall Event
+ Multiple Day Event
+ Record River Flood

= Worst Case Scenario

The Washington Post

"Harvey marks the most extreme rain event in U.S. history"

This was written on August 29th before the rain stopped.



Harvey Set New Records In Every Category

This was at least a once in

500 year

and may have been a once in

20,000 year

event.

Duration	Rainfall Amount	Return Interval – years (exceedance probability)
1-Hour		
Maximum	6.8”	1,500 (0.0667%)
Weighted Range	4-5”	50-500 (2.0% - 0.2%)
24-Hour		
Maximum	28.6”	8,000 (0.0125%)
Weighted Range	16-20”	200-1,000 (0.5%-0.1%)
2-Day		
Maximum	35.2”	9,000 (0.011%)
Weighted Range	27-33”	2,500-6,000 (0.04%-0.0167%)
4-Day		
Maximum	47.4”	40,000 (0.0025%)
Weighted Range	35-43”	500-20,000 (0.2%- 0.005%)

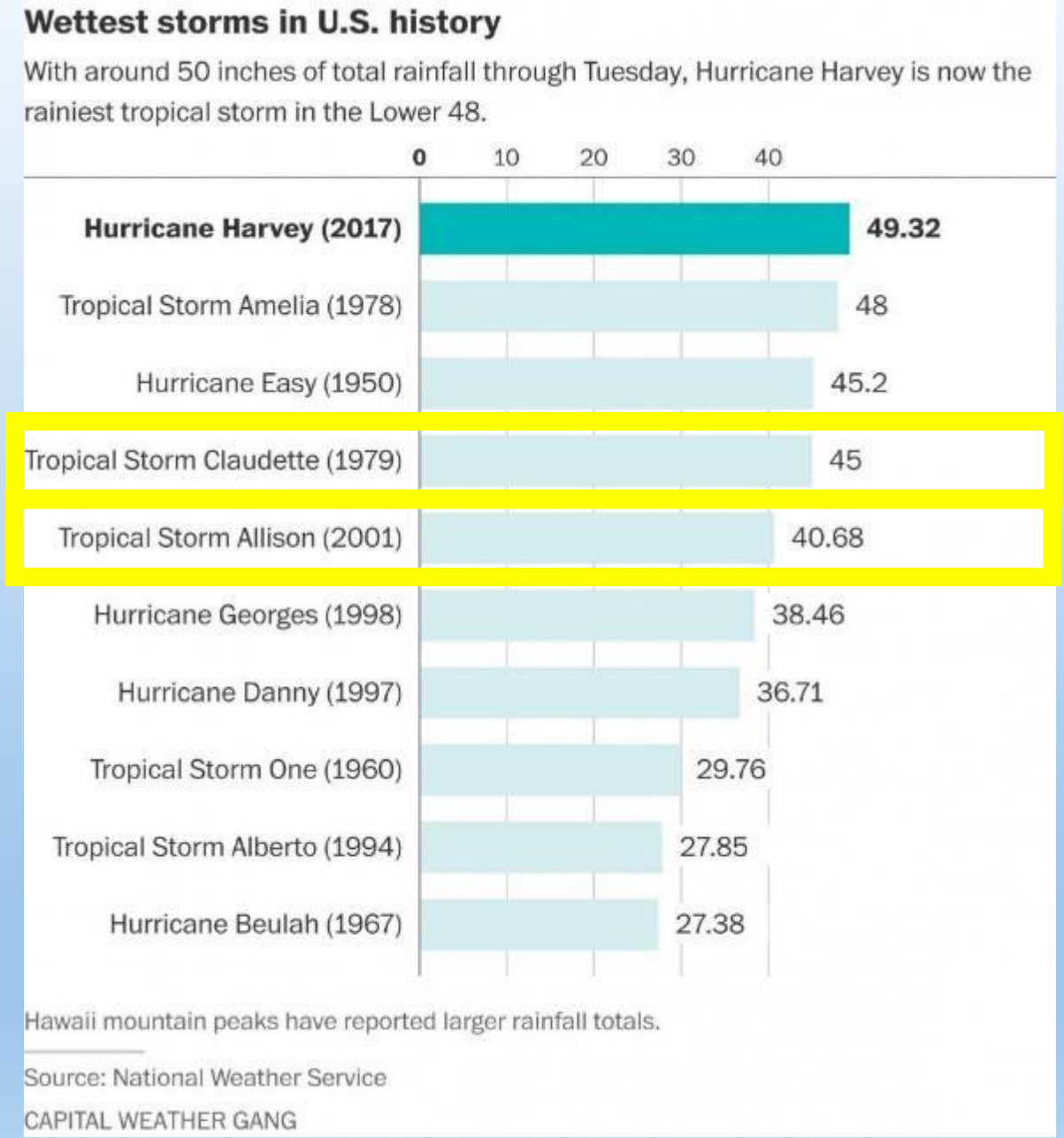
Comparison to Other Major Rain Events

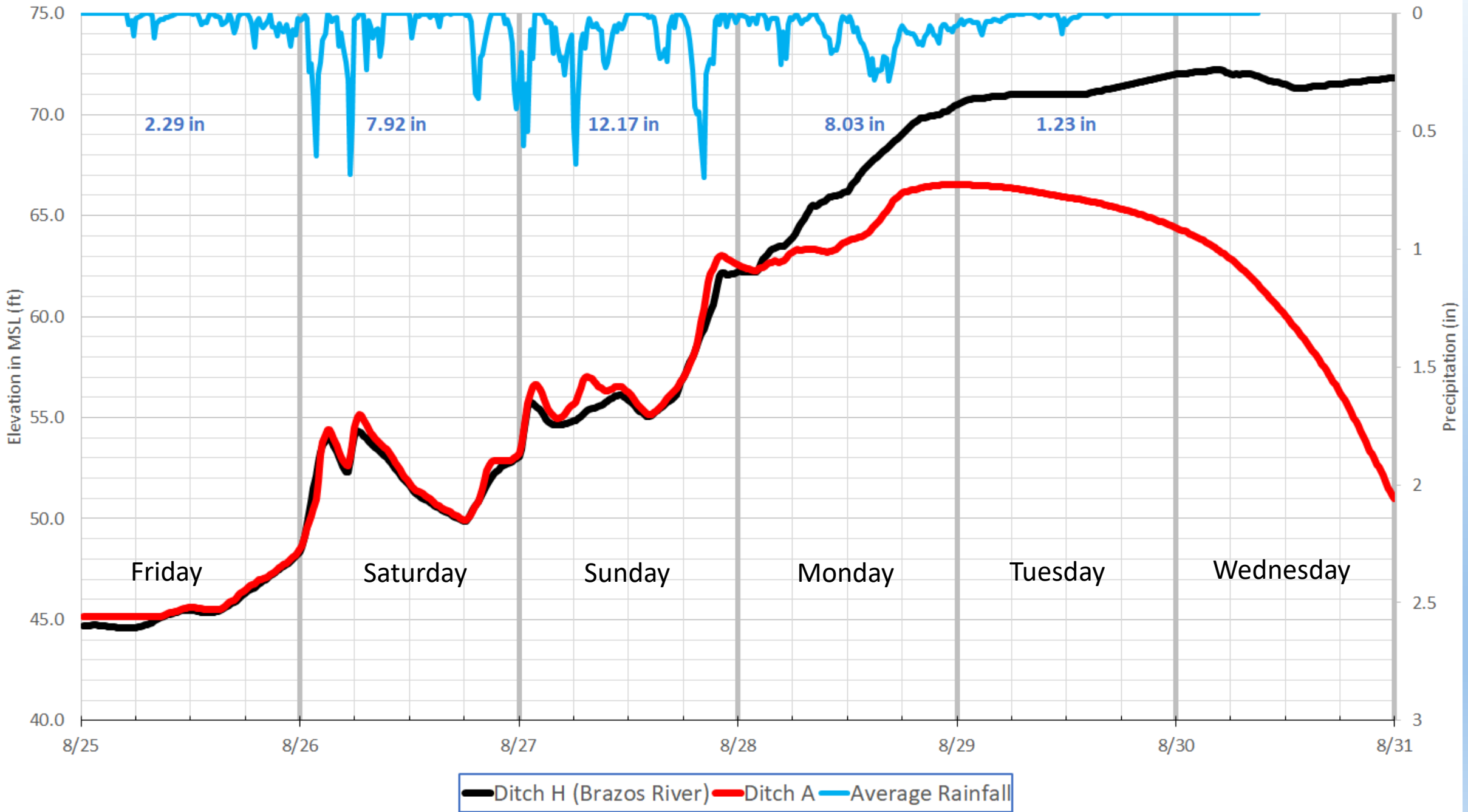
1. Hard Rain – hourly totals
2. Large Cumulative Totals
3. **Persistent**
4. Unprecedented 4 Day Event

Duration	Harvey 2017	Tax Day 2016	Allison June 2001
1 hr	6.8”	4.7”	5.7”
2 hr	11.9”	7.3”	9.9”
3 hr	14.8”	8.3”	13.5”
6 hr	18.9”	13.9”	21.2”
12 hr	20.9”	16.7”	28.3”
1 day	25.6”	17.4”	28.4”
2 days	34.5”	17.5”	28.5”
4 days	47.4”	N/A	38.5”

Major Events In Texas:

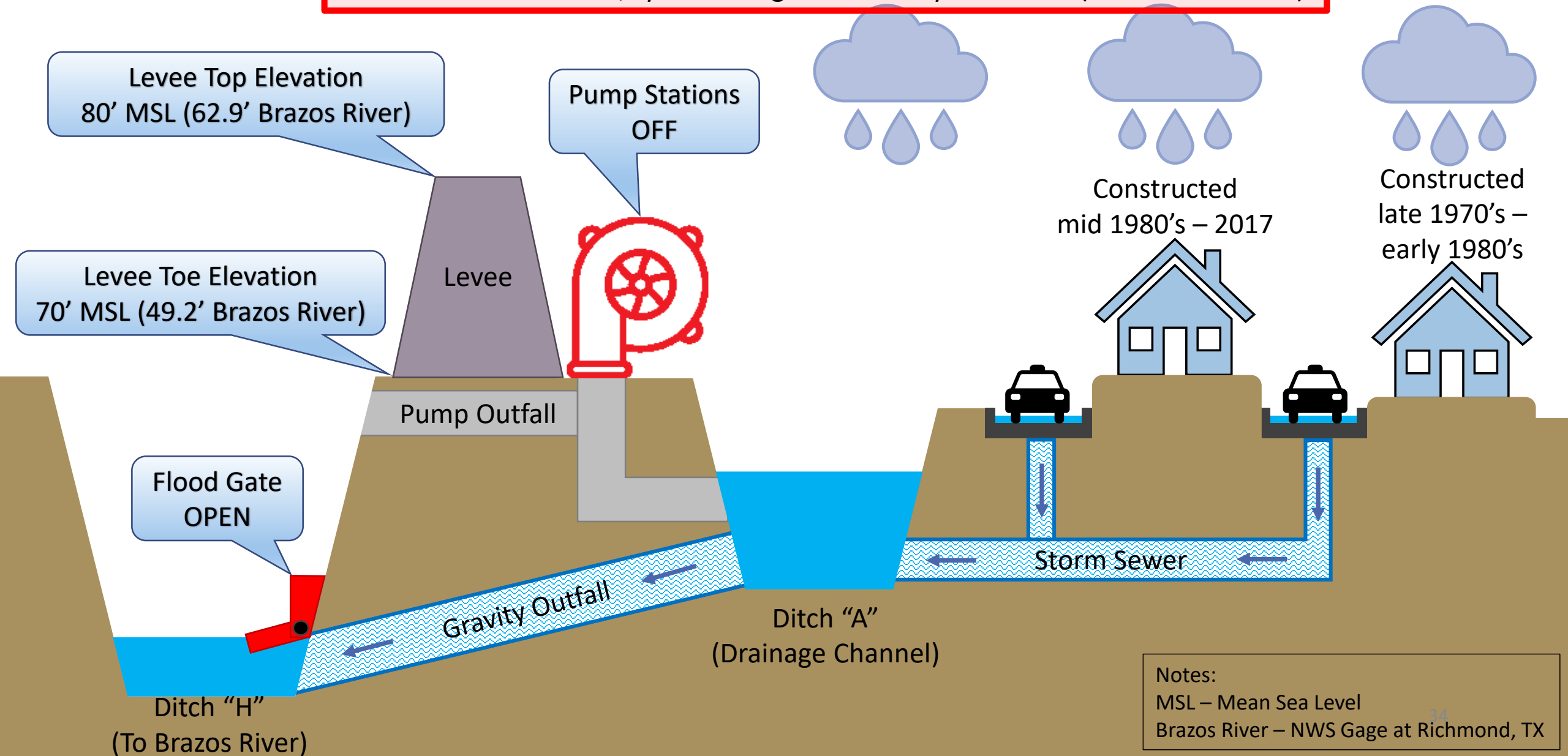
- Harvey – Houston, Texas
- Amelia – Medina, Texas
- Claudette – Houston, Texas
- Allison – Houston, Texas
- Beulah – Brownsville, Texas




75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
Elevation in MSL (ft)
0
0.5
1
1.5
2
2.5
3
Precipitation (in)
2.29 in
7.92 in
12.17 in
8.03 in
1.23 in
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
8/25
8/26
8/27
8/28
8/29
8/30
8/31
Ditch H (Brazos River)
Ditch A
Average Rainfall

Friday As Harvey Made Landfall

With Flood Gates OPEN, system designed for 100-year rainfall (12 ½" in 24 hours).



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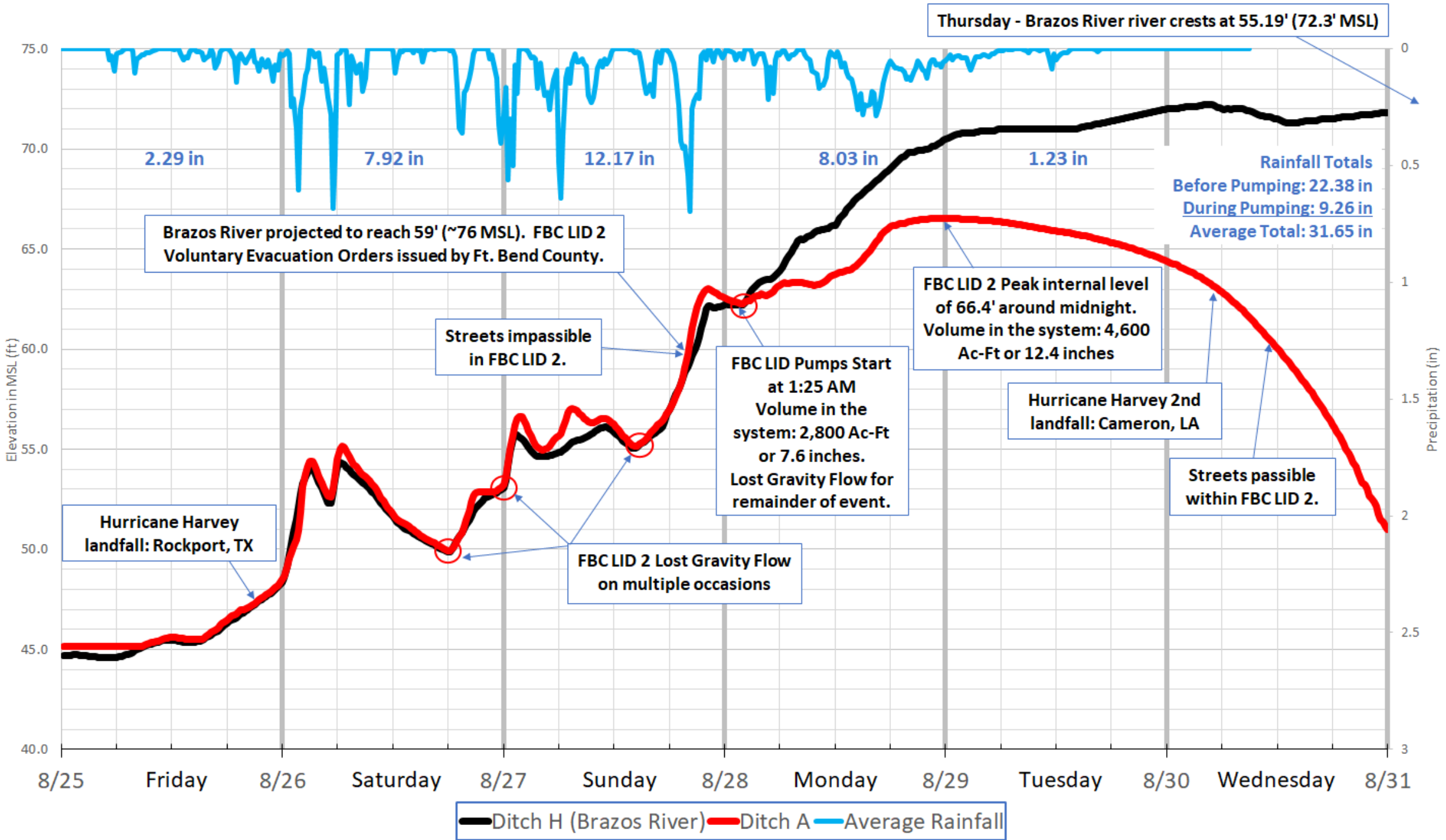
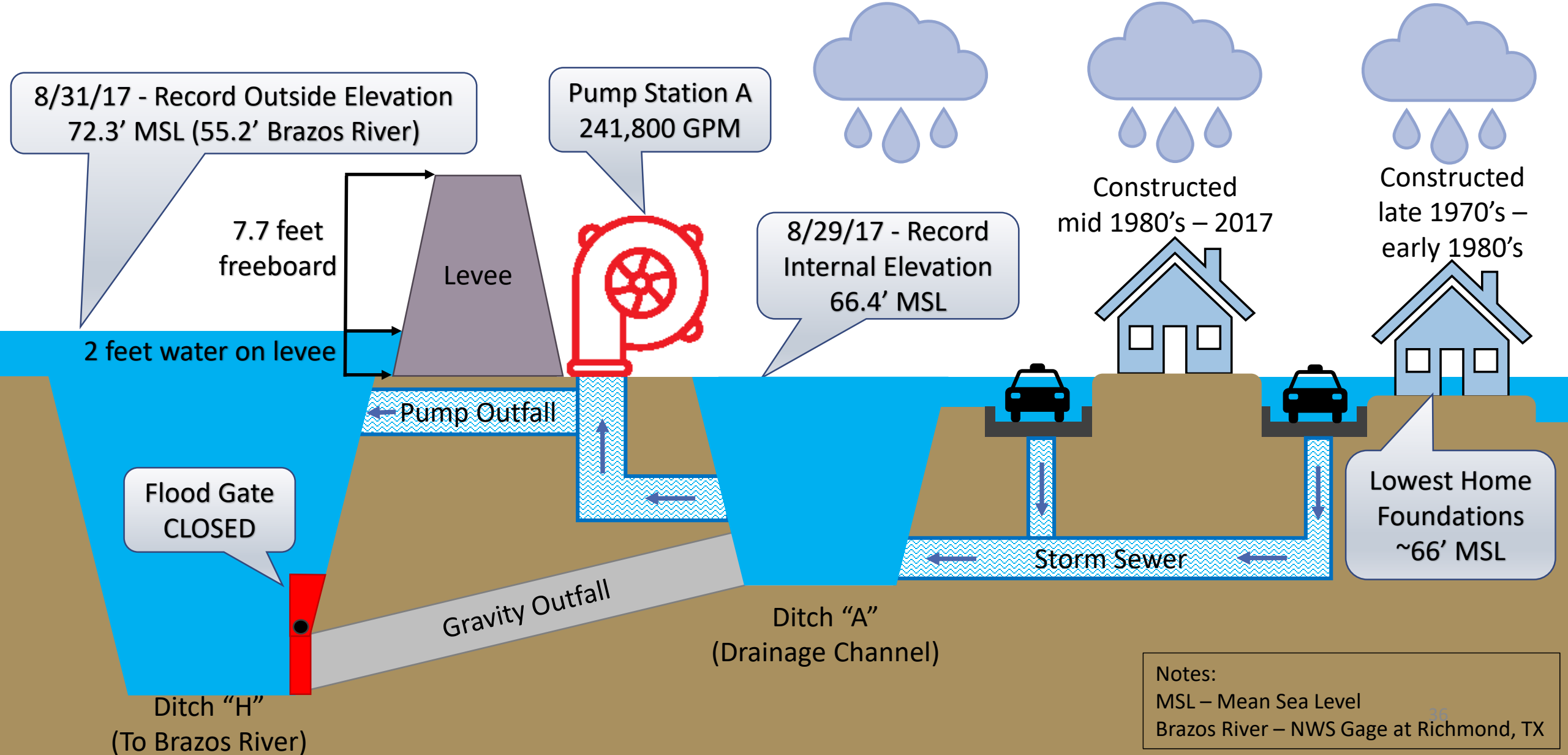

Thursday - Brazos River river crests at 55.19' (72.3' MSL)
2.29 in
7.92 in
12.17 in
8.03 in
1.23 in
Rainfall Totals
Before Pumping: 22.38 in
During Pumping: 9.26 in
Average Total: 31.65 in
Brazos River projected to reach 59' (~76 MSL). FBC LID 2 Voluntary Evacuation Orders issued by Ft. Bend County.
Streets impassible in FBC LID 2.
FBC LID Pumps Start at 1:25 AM Volume in the system: 2,800 Ac-Ft or 7.6 inches. Lost Gravity Flow for remainder of event.
FBC LID 2 Peak internal level of 66.4' around midnight. Volume in the system: 4,600 Ac-Ft or 12.4 inches
Hurricane Harvey 2nd landfall: Cameron, LA
Streets passible within FBC LID 2.
Hurricane Harvey landfall: Rockport, TX
FBC LID 2 Lost Gravity Flow on multiple occasions
Elevation in MSL (ft)
Precipitation (in)
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
0
0.5
1
1.5
2
2.5
3
8/25
Friday
8/26
Saturday
8/27
Sunday
8/28
Monday
8/29
Tuesday
8/30
Wednesday
8/31
Ditch H (Brazos River)
Ditch A
Average Rainfall

Peak of High Water During Harvey

Flood Gates closed by water pressure beginning at elevation 58’ MSL (32’ Brazos River).



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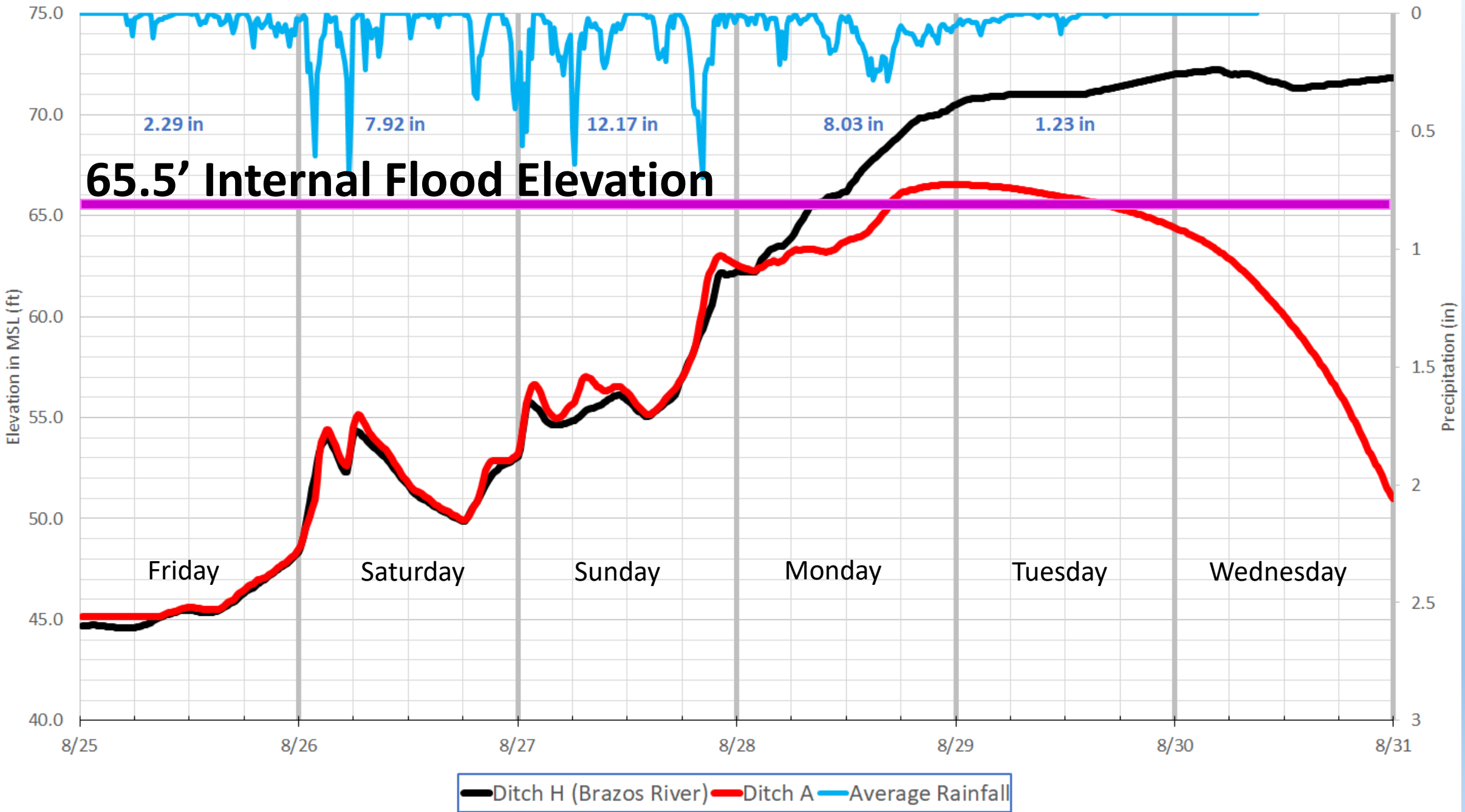
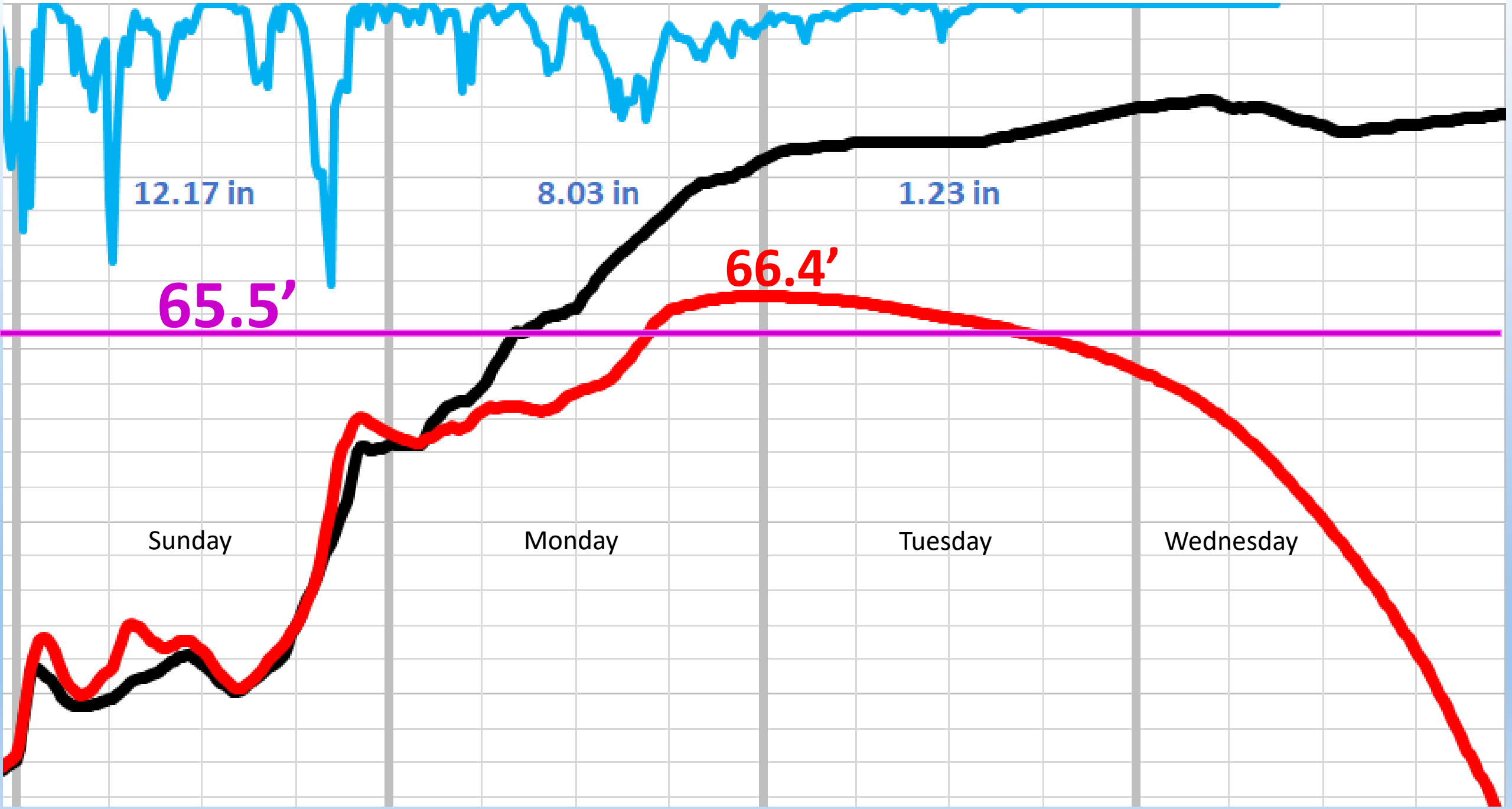
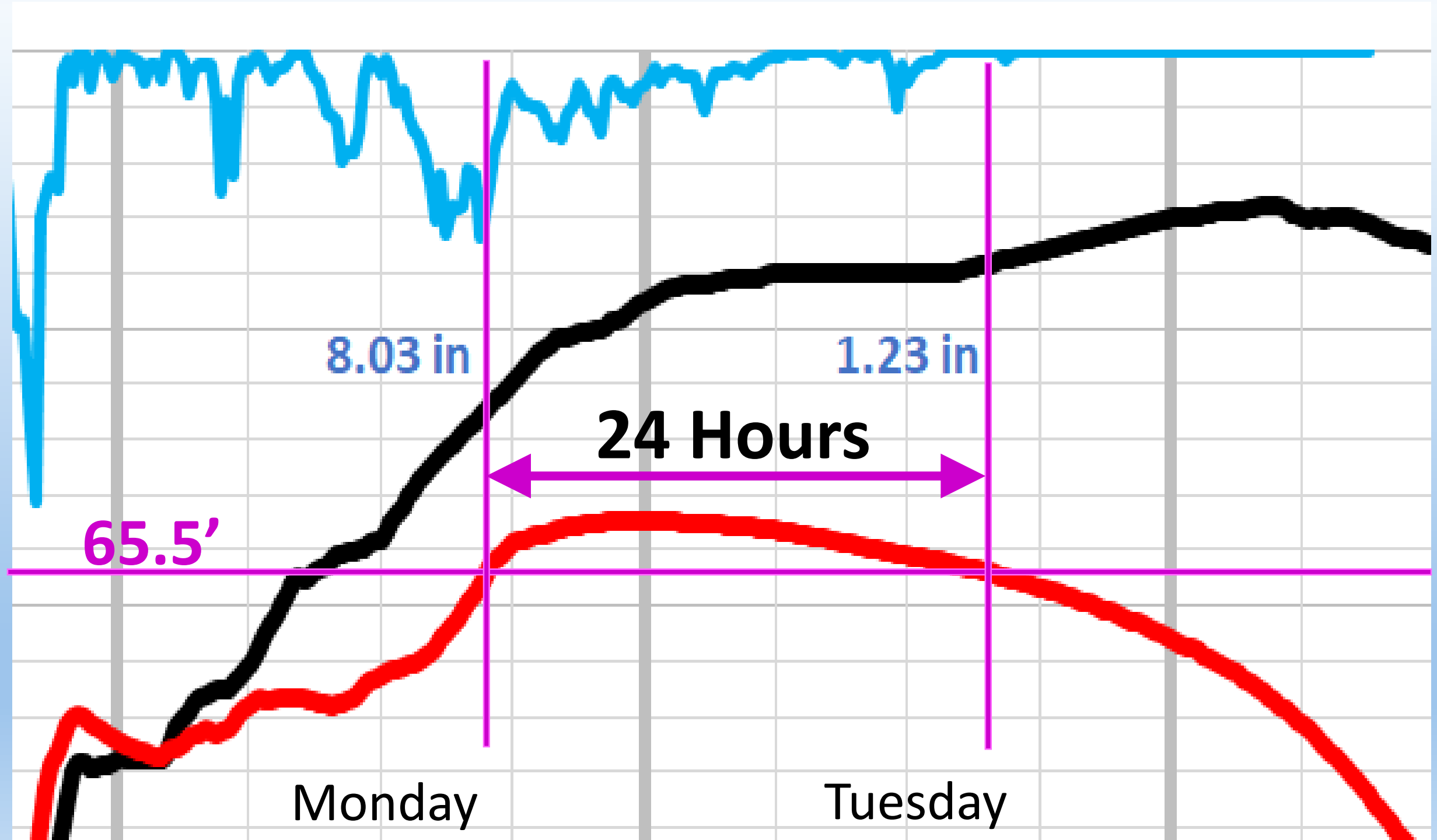
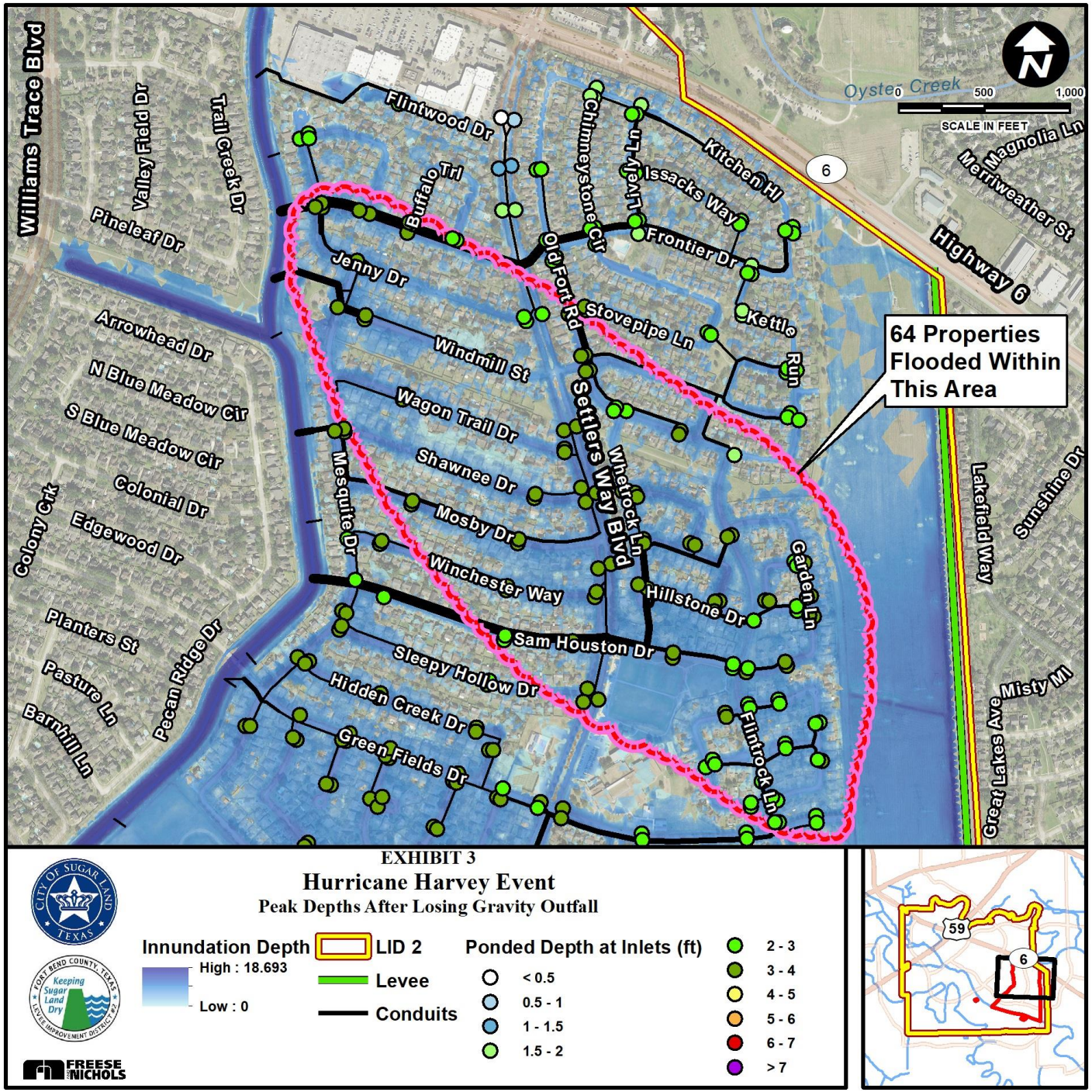

75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
Elevation in MSL (ft)
0
0.5
1
1.5
2
2.5
3
Precipitation (in)
2.29 in
7.92 in
12.17 in
8.03 in
1.23 in
65.5' Internal Flood Elevation
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
8/25
8/26
8/27
8/28
8/29
8/30
8/31
Ditch H (Brazos River)
Ditch A
Average Rainfall


12.17 in
8.03 in
1.23 in
66.4’
65.5’
Sunday
Monday
Tuesday
Wednesday


8.03 in
1.23 in
24 Hours
65.5’
Monday
Tuesday


Williams Trace Blvd
Valley Field Dr
Trail Creek Dr
Pineleaf Dr
Flintwood Dr
Buffalo Trl
Chimneystone Cir
Livey Ln
Issacks Way
Kitchen Hl
Oyster Creek
0 500 1,000
SCALE IN FEET
Magnolia Ln
Merriweather St
Highway 6
6
Frontier Dr
Jenny Dr
Old Fort Rd
Stovepipe Ln
Kettle Run
64 Properties Flooded Within This Area
Arrowhead Dr
Windmill St
N Blue Meadow Cir
S Blue Meadow Cir
Wagon Trail Dr
Settlers Way Blvd
Shawnee Dr
Colonial Dr
Mesquite Dr
Wheirock Ln
Mosby Dr
Colony Crk
Edgewood Dr
Winchester Way
Hillstone Dr
Garden Ln
Lakefield Way
Sunshine Dr
Planters St
Sam Houston Dr
Pecan Ridge Dr
Sleepy Hollow Dr
Pasture Ln
Hidden Creek Dr
Misty Ml
Barnhill Ln
Green Fields Dr
Flintrock Ln
Great Lakes Ave
EXHIBIT 3
Hurricane Harvey Event
Peak Depths After Losing Gravity Outfall
Innundation Depth
High : 18.693
Low : 0
LID 2
Levee
Conduits
Ponded Depth at Inlets (ft)
< 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
59
6
FREESE NICHOLS

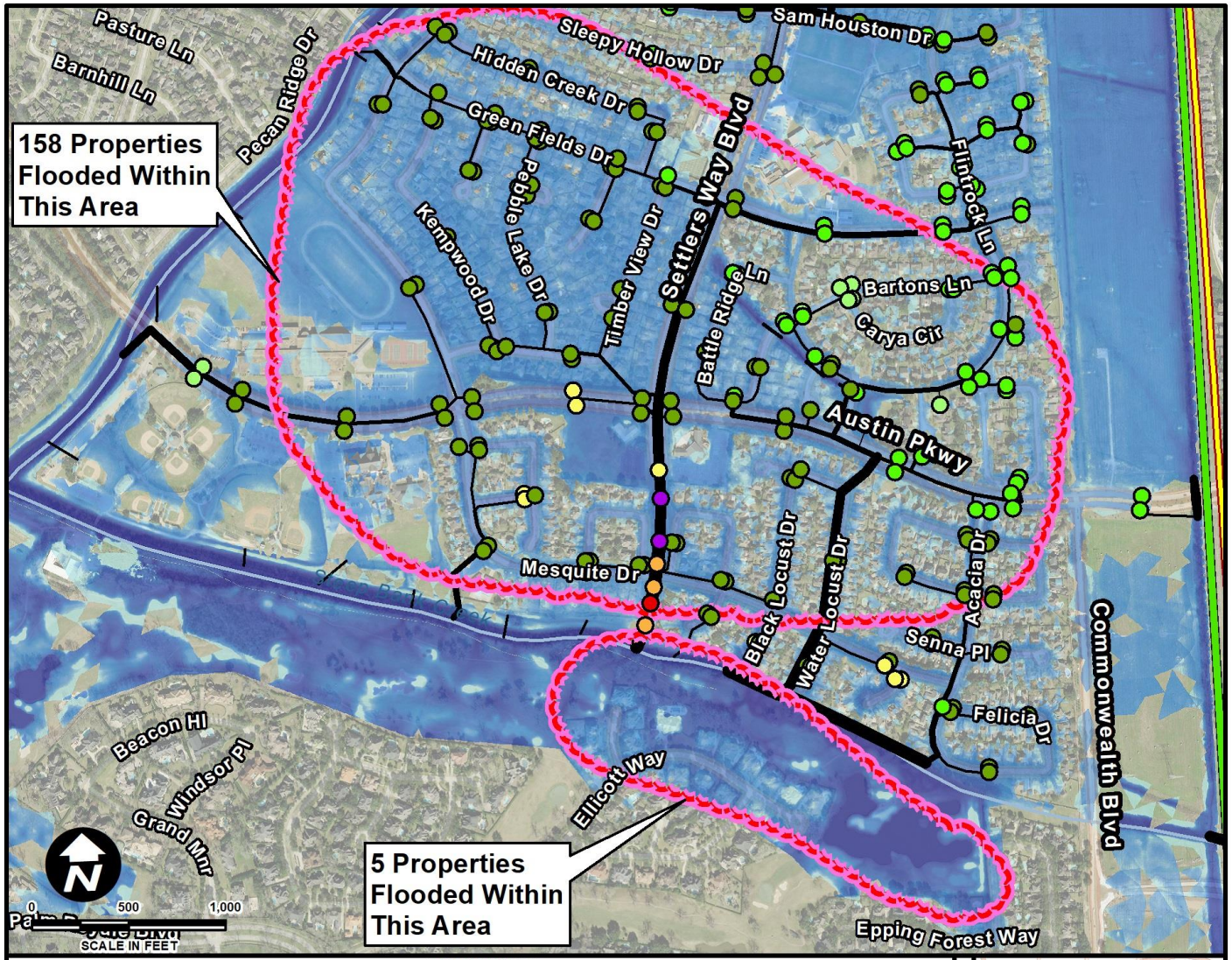


EXHIBIT 3

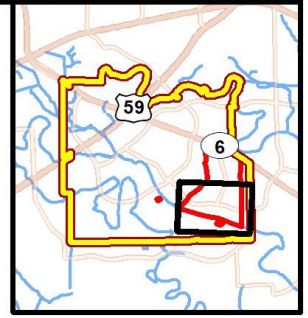
Hurricane Harvey Event

Peak Depths After Losing Gravity Outfall

Innundation Depth
High : 18.693
Low : 0

LID 2
Levee
Conduits

Ponded Depth at Inlets (ft)
< 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7



Pump Station "F"

Drains Water From the Area North of US 59

- 4 Stormwater Pumps – 90,000 gallons per minute
  - 3 – 25,000 gallon per minute pumps
  - 1 – 15,000 gallon per minute pump
- 2 Generators
  - 450 kW Natural Gas Generator
  - 450 kW Diesel Generator w/8,000 gallons (7 days) of fuel stored on site

Pump Station "A"

Drains Water From the Area South of US 59 / North of CPE Easement

4 Stormwater Pumps – 241,800 gallons per minute

- 2 – 84,400 gallon per minute pumps
- 2 – 36,500 gallon per minute pumps

3 Generators

- 1,750 kW Natural Gas Generator
- 1,750 kW Diesel Generator 75 kW Natural Gas Generator for House Power

Steep Bank Creek Outfall Structure

On East Levee between Austin Parkway and LJ Parkway

8’ x 5’ Box Culvert – 225 CFS

Allows gravity flow of water from Drainage Area 3 out of the District and into Steep Bank Creek

LID 2 – 8 Step Action Plan

(Where are we in the execution of our plan.)

☑ 1. Work with the City of Sugar Land to identify every home that had water in it

☑ 2. Map all of those homes that flooded

☐ 3. Interview the owner's of each of those homes and ask permission to survey their property to obtain:

- Elevation of the Slab
- Elevation of the Curb
- Do our best to obtain the high water elevation
- Determine the time the water entered the home

LID 2 – 8 Step Action Plan (cont'd)

- ☑ 4. Analyze all of the data to determine the cause of the flooding in each specific neighborhood / area.
- ☐ 5. Determine what actions might be possible to prevent this from recurring. (In progress)
- ☑ 6. Present the findings to all of the affected home owners at a public meeting as-soon-as-possible.
- ☐ 7. Have a public meeting with any and all LID 2 resident's about this event and the plan moving forward.
- ☐ 8. Begin work on any projects identified.

Plan moving forward from today…

1. Rehabilitation of the remaining Ditches: “B”, “C”, and “E”

2. Add a third pump station (near Pump Station “A”)

3. Evaluate what it takes to offer older homes with slabs at a lower elevation the same protection as homes constructed today

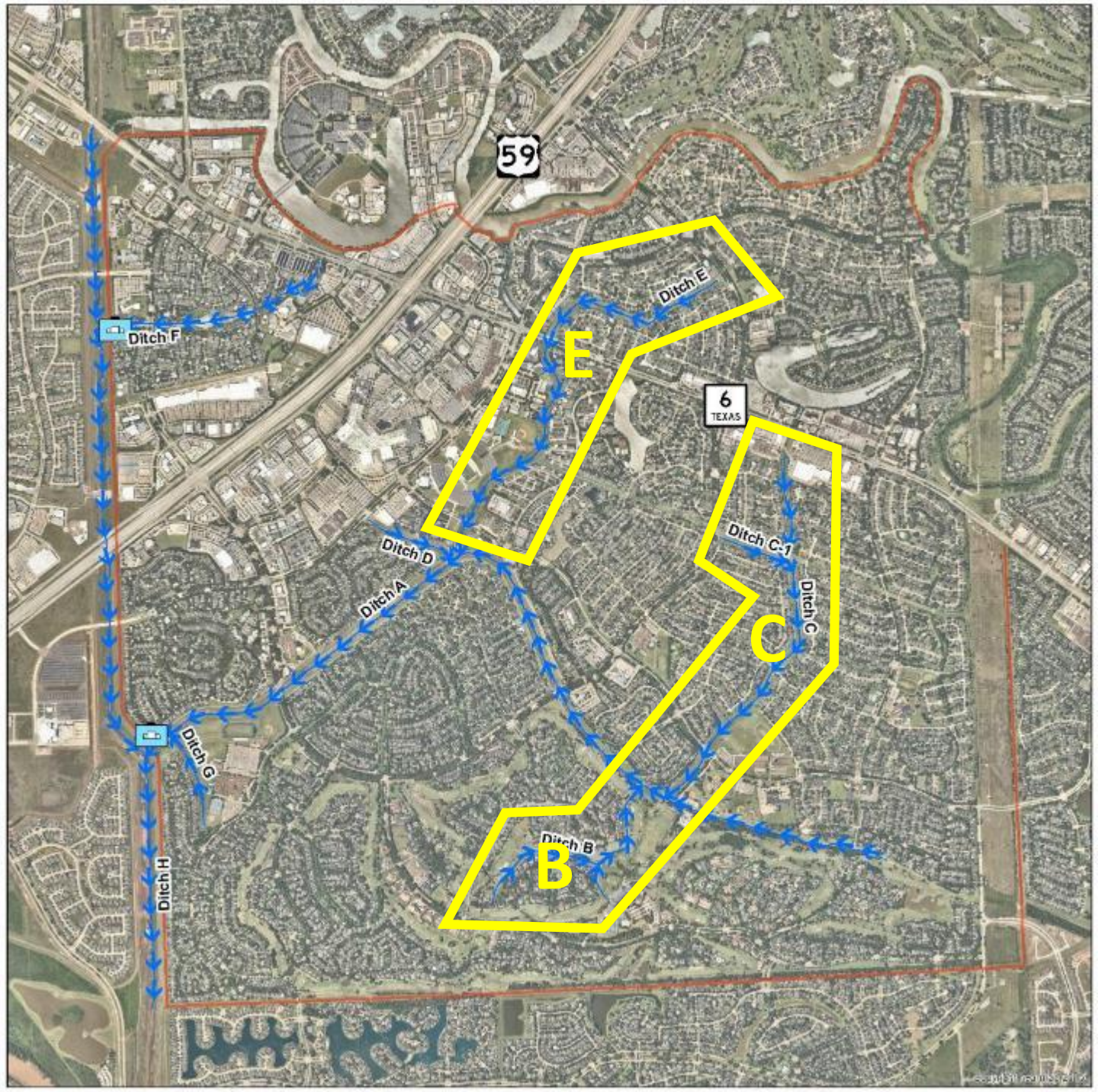
   (lower the internal flood elevation, <u>if feasible</u>)

1 – Improvements to Ditches B, C, & E

- Preliminary Design was completed in 2014.
- The District has been waiting for Federal approval on this project for more than two years.
- Federal approval was received on October 4, 2017.
- Final design is underway – begin construction in 2018

FBC LID 2

Rehabilitation of Ditches "B", "C", & "E"



2 – Add a Third Pump Station

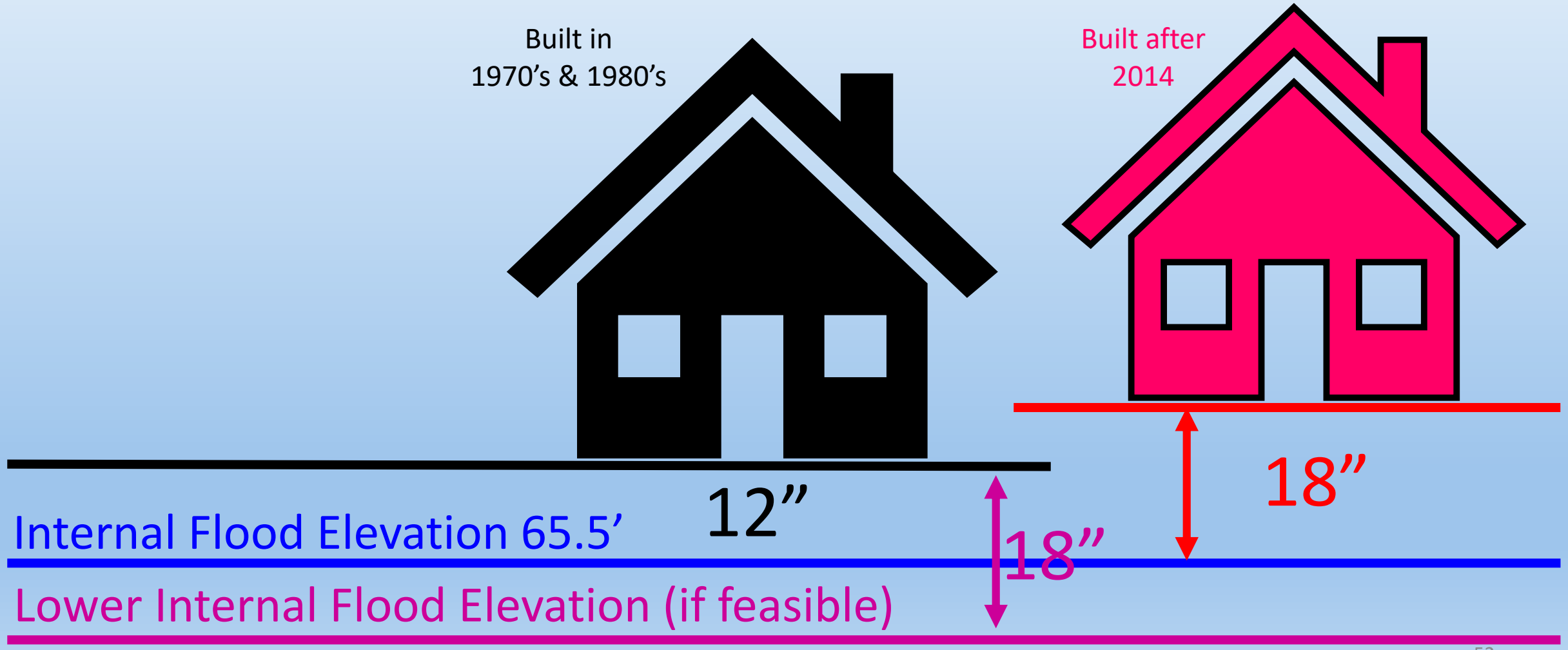
- The District has already issued a Request for Qualifications for engineering services for a third pump station.
- The District does not currently own the land needed to construct an additional pump station but has already begun the process of obtaining the property.
- The size of the station will be determined by additional hydrology and hydraulic studies to determine what is feasible and practical.
- Engineering will take at least one year – expect construction to begin late 2018 or early 2019.

3 – Lower the Internal Flood Elevation

- The internal flood elevation has always been 65.5’.
- During Harvey the peak internal flood elevation at Pump Station “A” reached 66.4’.
- The survey work we’ve done following Harvey show the slabs for some homes around 66’ with a few below 66’.
- New home slabs must be over 67’ (65.5’ + 1.5’= 67.0’)

  The difference between the internal flood elevation and slab elevation is the margin of safety between the internal flood level and your house flooding.

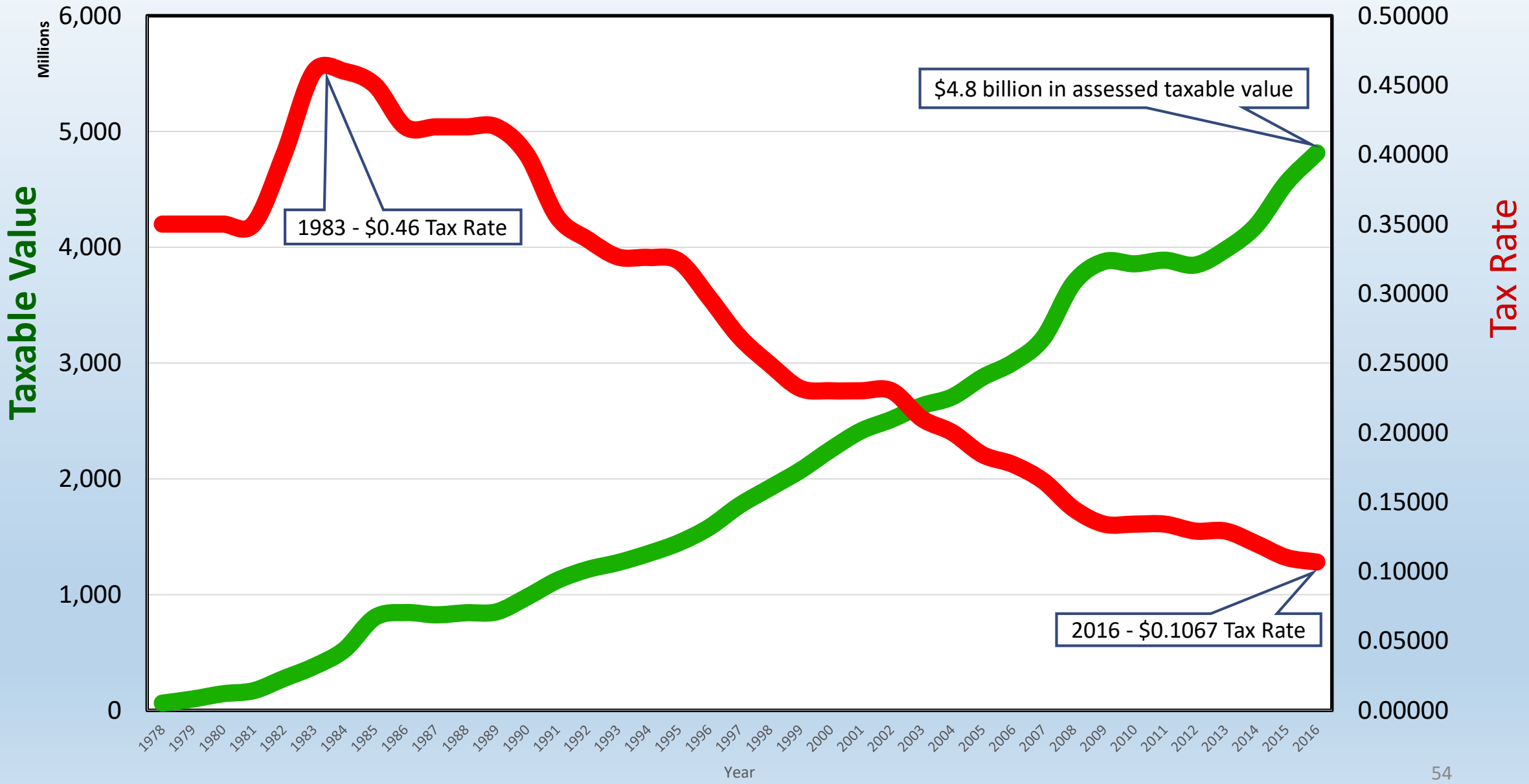
Effect of Lowering the Base Flood Elevation Within the District



How / who pays for the improvements…

- First – the taxpayers within LID 2
- Some projects may be partnering with the City
  (same taxpayers)
- Possible partnering opportunities with other agencies
- Possibility of grant money

Ft. Bend LID No. 2 - Taxable Value vs. District Tax Rate



Tax Rate for 2017

- 2017 Tax Rate $0.111
  - $0.0043 increase from last year – Direct Response to Harvey
  - Amounts to an average increase of $24.30 per home in LID 2
  - $0.087 for Operation and Maintenance
  - $0.024 for Debt Service (Repayment of previously issued bonds)

- First Tax Rate increase since 1983.

Reminder to pass your question cards to one of the staff members.

Mandatory Evacuation Orders

- Texas Government Code 418.185 – Mandatory Evacuation
  - In advance of a natural disaster
  - The County Judge or Mayor may “compel” a person to evacuate (not clear exactly how far compel goes)
  - May establish a credentialed re-entry program
  - A person who remains after a Mandatory Evacuation order may be liable to a governmental entity or non-profit entity for their rescue

Voluntary Evacuation Orders

- A “recommendation” in advance of a natural disaster
- No re-entry program, means you can come and go as you please
- Not liable to any government entity or non-profit for your rescue

Communications

- The District is working with the City of Sugar Land on an improved communications plan to get information concerning flood events to residents.
- The City of Sugar Land will continue to be the primary information source for residents during an emergency.
- Continue discussions and coordination with City of Sugar Land and Fort Bend County regarding evacuation orders.

National Flood Insurance Program (NFIP)

- Should you have flood insurance?
  - **<u>YES !!!</u>** Everyone that lives in this part of Texas should have flood insurance.
- Most private homeowner policies do not cover flooding.
- Flood insurance is relatively cheap. The maximum cost in FBC LID 2 is around $600 for $250,000 of coverage.

NATIONAL FLOOD INSURANCE PROGRAM

FloodSmart.gov

The Official site of the NFIP

Questions?

- We'll go through the questions from the cards first?
- After we've gone through those we'll take questions from the floor?
- We'll be glad to visit after the conclusion of the meeting as well.

Finally…

- If you didn’t sign in when you arrived, please do so before you leave.
- Please return your individual survey forms.
- Thanks for you time and for coming out.