Houston Geological Society Presents

An Informational Workshop

Flooding and Floodplains in the Houston Area: Past, Present, and Future: Part 2

Presented May 18, 2018

Dr. William R. Dupre'
Professor Emeritus
Earth & Atmospheric Sciences
University of Houston
wdupre@uh.edu

"I'm OK – I'm outside the 1% floodplain"

BUT!

- People outside of mapped high-risk flood areas file nearly 25% of all National Flood Insurance Program (NFIP) flood insurance claims and receive 1/3 of Federal Disaster Assistance for flooding. https://www.fema.gov/
- Most of the homes flooded in Harvey (~75%), the Memorial Day flood (~55%), and TS Allison (~65%) were outside the mapped 1% floodplains!

Extent of Harvey flooding in Harris County

FEMA Flood Zone	Flooded Area (square miles) in analyzed images	Percent of Flooded Area (totals > 100%)
Floodway	26.37 mi^2	12.45%
Special Flood Hazard Area ("100 year" floodplain; zones A, AE, AH, AO)	89.40 mi^2	**32.26%**
VE (Coastal)	2.48 mi^2	0.89%
Shaded X zone ("500 year" floodplain)	37.23 mi^2	**13.44%**
"Minimal flood hazard"	147.94 mi^2	**53.39%**

66.83%

https://californiawaterblog.com/2017/09/01/

Why does it flood outside the mapped 1% floodplain?

1) It might be greater than a 1% rain
2) Not all flooding is by overbank flow along mapped channels
3) The "100-year" rain/flood/floodplain can change w/time!

Depth/Duration/Frequency Table

HARRIS COUNTY HYDROLOGIC REGION 3 RAINFALL (INCHES)

Duration	Annual-Chance Event			
	10-percent	2-percent	1.0-percent	0.2-percent
5-Minute	0.9	1.1	1.2	1.4
15-Minute	1.5	1.9	2.1	2.5
30-Minute	2.1	2.7	3.0	3.7
60-Minute	2.9	3.8	4.3	5.5
2-Hour	3.7	5.0	5.7	7.7
3-Hour	4.2	5.9	6.8	9.4
6-Hour	5.3	7.7	9.1	13.1
12-Hour	6.4	9.5	11.1	15.9
24-Hour	7.8	11.6	13.5	19.3
2-Day	9.0	13.1	15.1	20.7
4-Day	10.5	14.8	16.9	22.3

HYDROLOGY & HYDRAULICS GUIDANCE MANUAL

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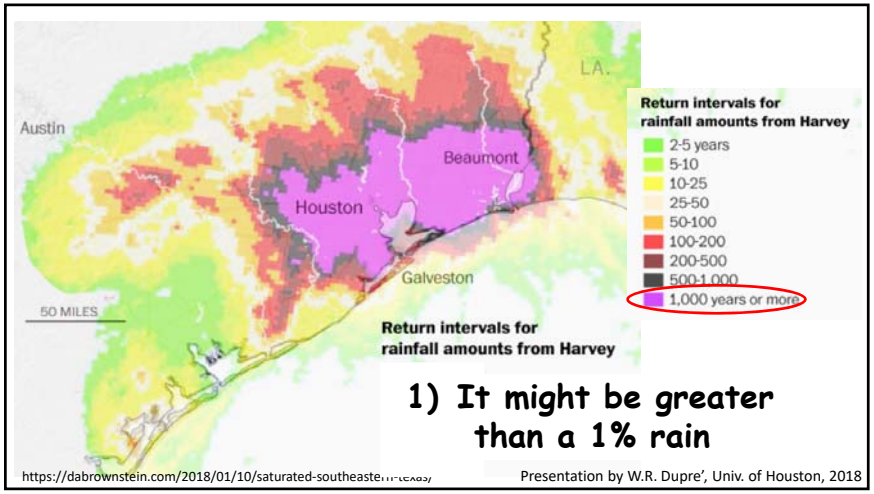

1) It might be greater than a 1% rain

https://dabrownstein.com/2018/01/10/saturated-southeaste...-texas/

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500-40,000 year event???

The Harris County Flood Control District* estimates the four-day rainfall from Hurricane Harvey to be a once in 500 to 40,000 year flooding event.

*HCFCD memo 9/5/17, Immediate Report #1, Hurricane Harvey – Storm and Flood Information

"This area has seen three of these so-called 500-year rains in the past two years. Either our definition of a 500-year rain needs updating or we can hope that we are safe for the next 1,500 years". Michael F. Bloom PE, https://riparianhouston.com/2017/11/01/responses-to-judge-emmetts-post-harvey-suggestions/

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2) Not all flooding is by overbank flow along mapped channels

Ponding & Overland Flow?

Ponding or overland flow flooding occurs when intense local rainfall exceeds the storm sewer capacity, the water can "pond" in the streets deep enough to flood residences that are away from the bayou.

It is NOT identified on floodplain maps, and can occur anywhere!

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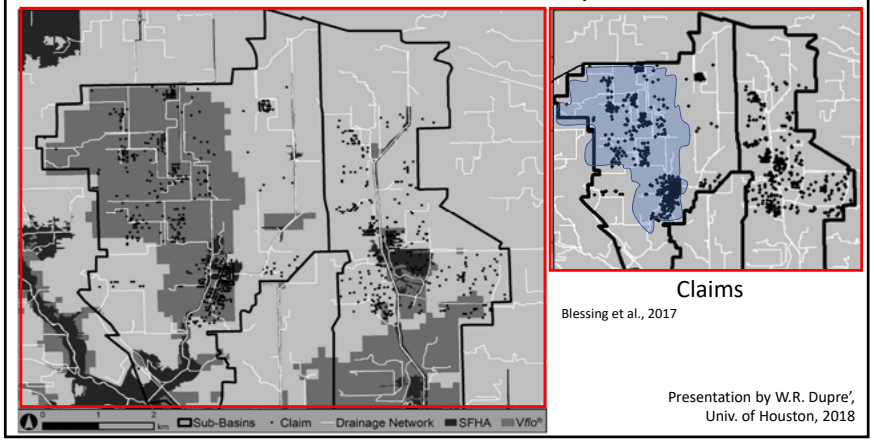
FEMA- vs. *Vflo*-derived Floodplains



Claims

Blessing et al., 2017

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3) The "100-year" rain/flood/floodplain <u>can</u> change w/time!

……but why?

a) More data / longer record
b) Changing land use
c) Structural changes
d) Changing climate

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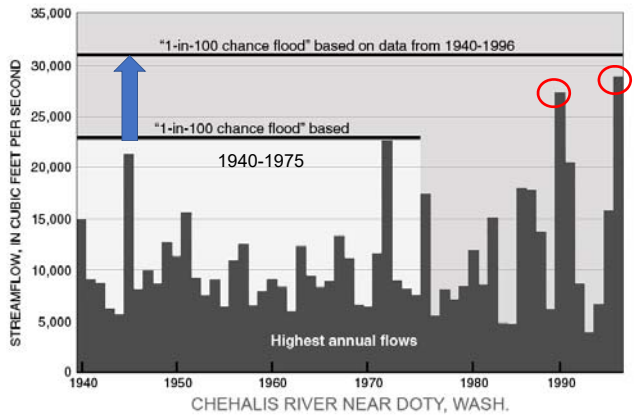

U.S. GEOLOGICAL SURVEY
Fact Sheet 229-96

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Changing Land Use

- **Urbanization**
  Increased impervious surfaces:
  - decreased infiltration (increases runoff)
  - faster runoff (decreases ***lag time***)

  Bridges – (impediments to flow)
  Storm drains (decrease lag time)
  Failure of storm drains

- Deforestation/agricultural changes

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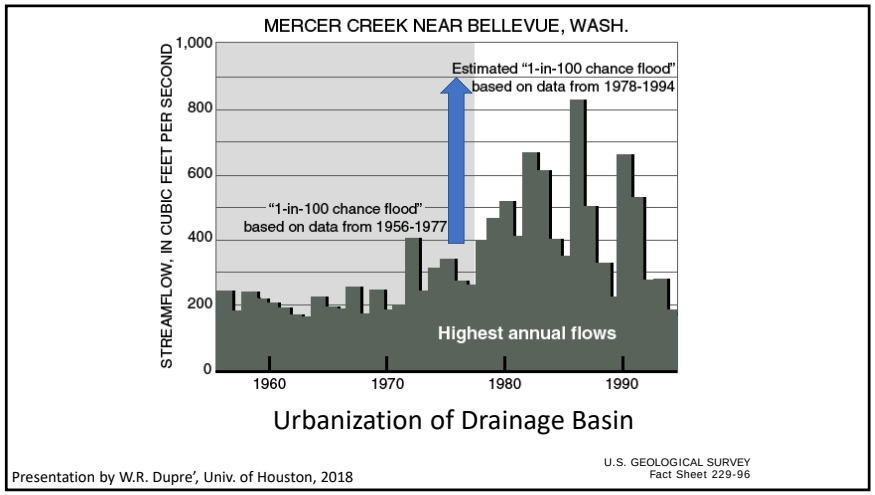
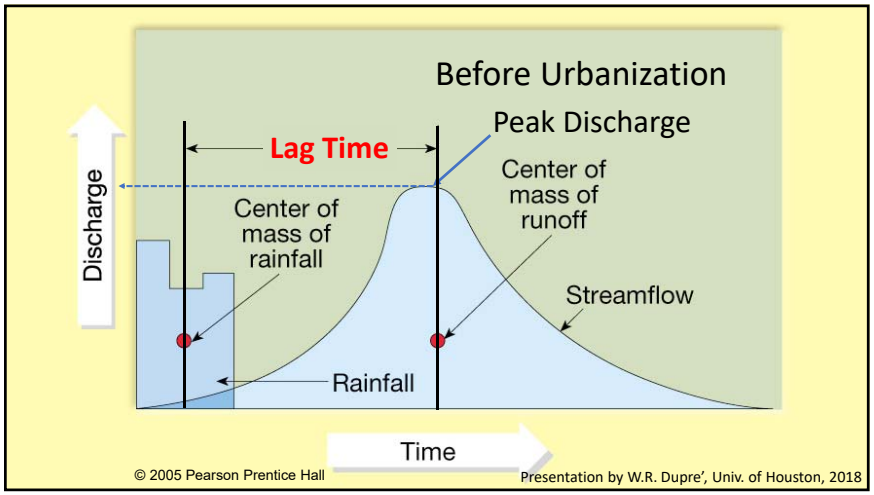

MERCER CREEK NEAR BELLEVUE, WASH.
STREAMFLOW, IN CUBIC FEET PER SECOND
1,000
800
600
400
200
0
1960
1970
1980
1990
Estimated "1-in-100 chance flood" based on data from 1978-1994
"1-in-100 chance flood" based on data from 1956-1977
Highest annual flows
Urbanization of Drainage Basin
U.S. GEOLOGICAL SURVEY
Fact Sheet 229-96
Presentation by W.R. Dupre', Univ. of Houston, 2018


Before Urbanization
Lag Time
Peak Discharge
Center of mass of runoff
Center of mass of rainfall
Discharge
Streamflow
Rainfall
Time
© 2005 Pearson Prentice Hall
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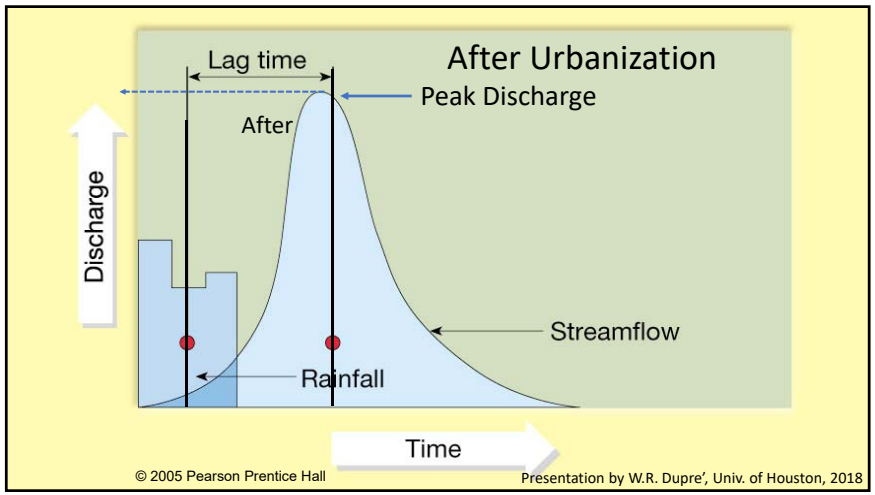
Lag time
After Urbanization
Peak Discharge
After
Discharge
Streamflow
Rainfall
Time
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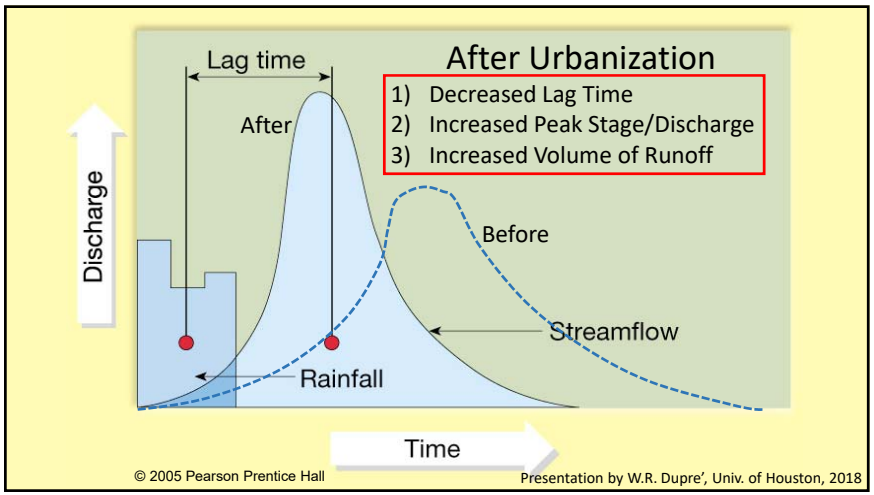
Lag time
After Urbanization
1) Decreased Lag Time
2) Increased Peak Stage/Discharge
3) Increased Volume of Runoff
After
Before
Discharge
Streamflow
Rainfall
Time
© 2005 Pearson Prentice Hall
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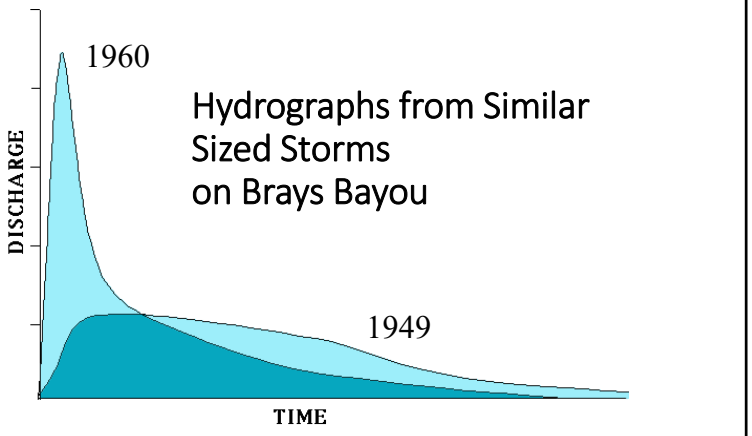
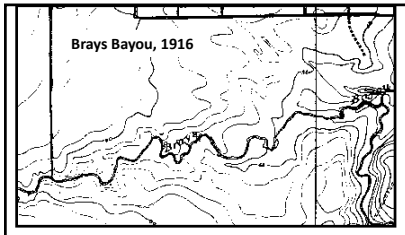
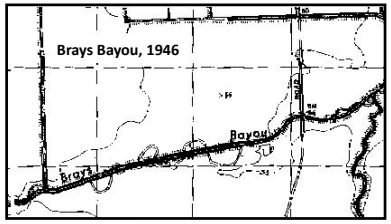


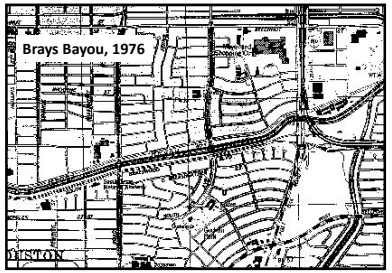
Hydrographs from Similar Sized Storms on Brays Bayou

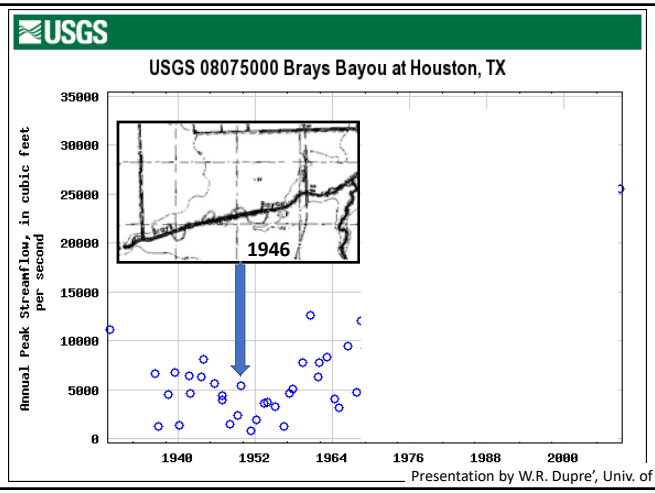
U.S. GEOLOGICAL SURVEY

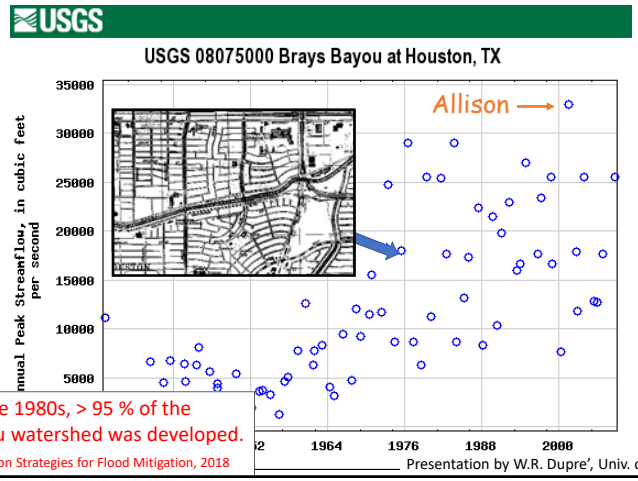




Brays Bayou: 1916-1976

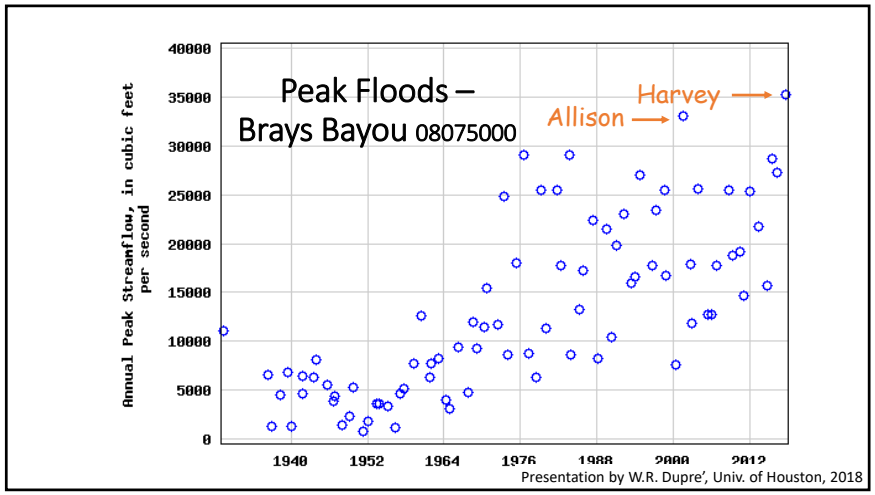






By the 1980s, > 95 % of the Brays Bayou watershed was developed.

Greater Houston Strategies for Flood Mitigation, 2018


Peak Floods –
Brays Bayou 08075000
Harvey
Allison
Annual Peak Streamflow, in cubic feet per second
40000
35000
30000
25000
20000
15000
10000
5000
0
1940
1952
1964
1976
1988
2000
2012
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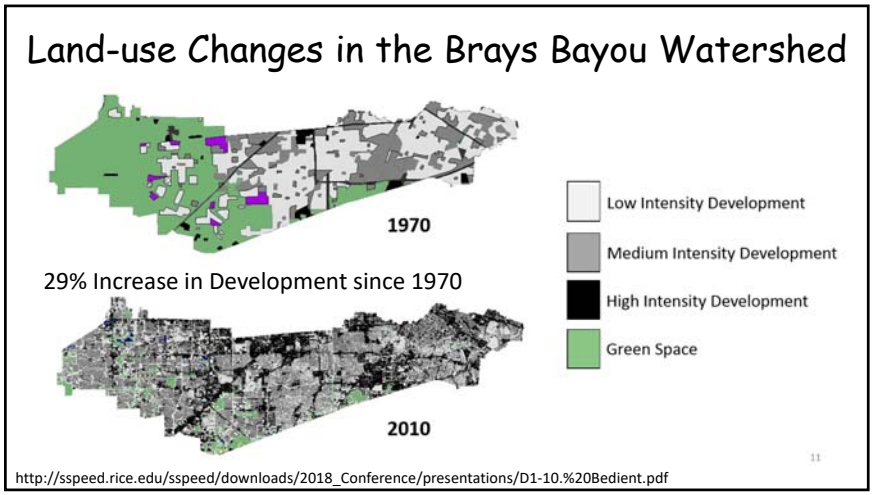
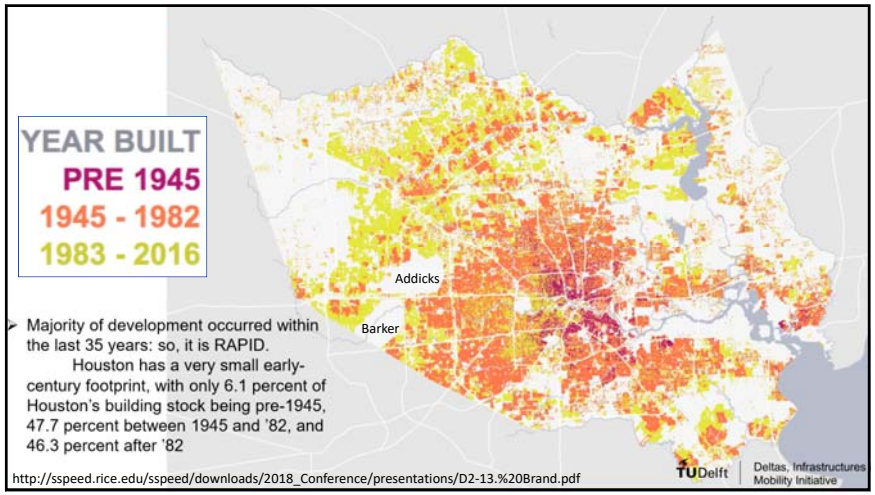
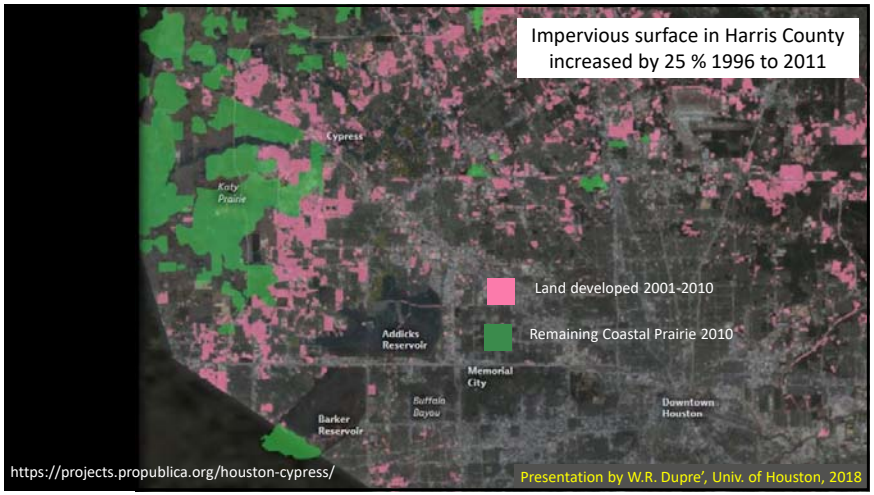

Land-use Changes in the Brays Bayou Watershed
1970
29% Increase in Development since 1970
2010
Low Intensity Development
Medium Intensity Development
High Intensity Development
Green Space
http://sspeed.rice.edu/sspeed/downloads/2018_Conference/presentations/D1-10.%20Bedient.pdf


YEAR BUILT
PRE 1945
1945 - 1982
1983 - 2016
Addicks
Barker
Majority of development occurred within the last 35 years: so, it is RAPID.
Houston has a very small early-century footprint, with only 6.1 percent of Houston's building stock being pre-1945, 47.7 percent between 1945 and '82, and 46.3 percent after '82
http://sspeed.rice.edu/sspeed/downloads/2018_Conference/presentations/D2-13.%20Brand.pdf
TUDelft
Deltas, Infrastructures Mobility Initiative


Impervious surface in Harris County increased by 25 % 1996 to 2011
Cypress
Katy Prairie
Land developed 2001-2010
Remaining Coastal Prairie 2010
Addicks Reservoir
Memorial City
Buffalo Bayou
Barker Reservoir
Downtown Houston
https://projects.propublica.org/houston-cypress/
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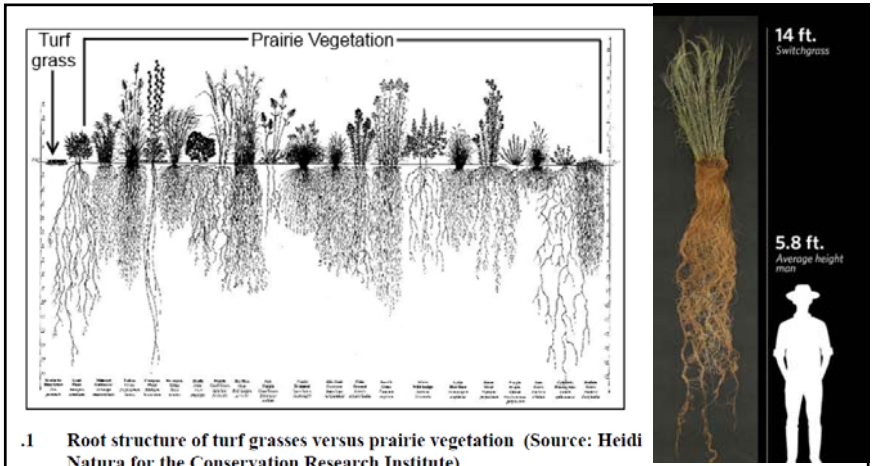

.1 Root structure of turf grasses versus prairie vegetation (Source: Heidi Natura for the Conservation Research Institute)

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Role of Native Prairie Plants

"In particular, native prairie plants are thought to absorb a greater volume of runoff through a higher density of groundcover vegetation, increased depth and density of plant roots, and larger percentage of soil pore spaces...

The impact of these root systems is even more prominent in areas of poorly draining soils, such as in Harris County."

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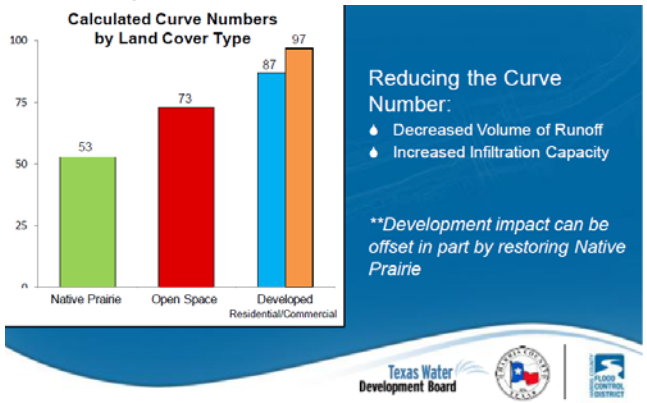
Investigation of Prairie Restoration for Flood Control



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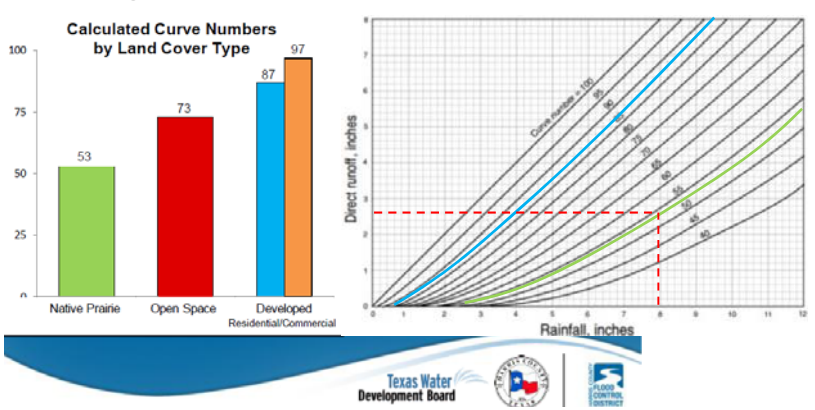
Investigation of Prairie Restoration for Flood Control



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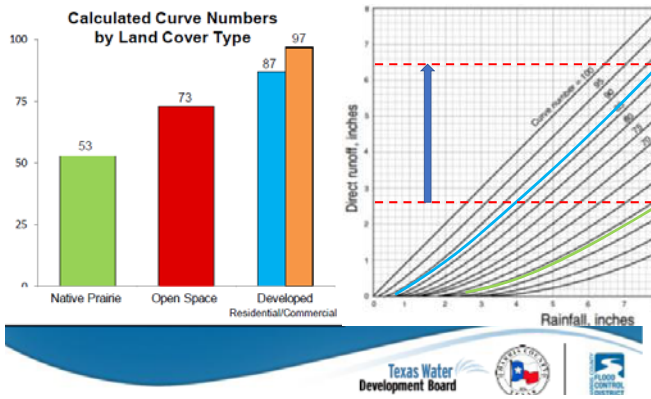


Increased Runoff due to Prairie Development

- development of a single-family subdivision with an impervious cover of 50%, would increase runoff volume by 1.02 " during a 50% (2-year) event, and by 1.79 " during a 1% (100-year) event, and

- development of a commercial or industrial site with an impervious area of 90% would increase runoff volume by 1.83 " during a 50% (2-year) event, and by 3.21 " during a 1% (100-year) event.

Decreased Runoff due to Prairie Restoration

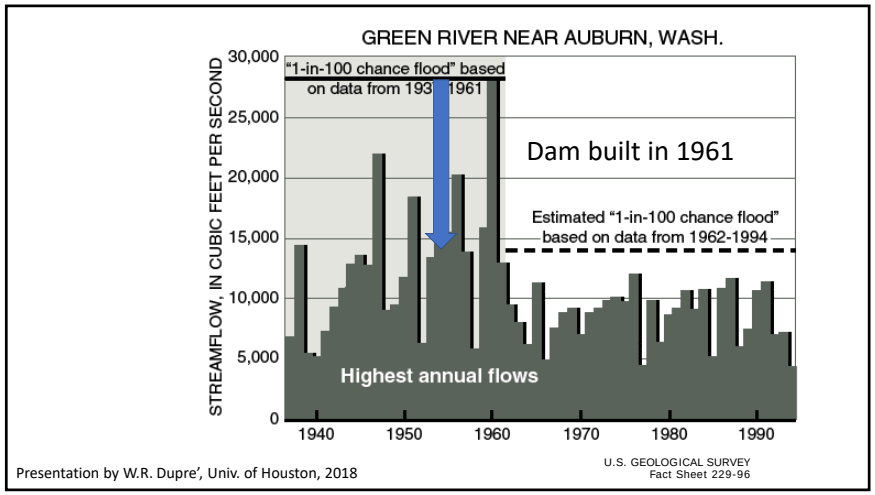
Restoration of 1 acre of prairie would:

- increase the infiltration capacity of undeveloped land by 3.52 inches in a 100-year flood event…

- offset the volume impact of about 2 acres of a single-family subdivision, or about 1 acre of commercial or retail development.

Structural Changes

- **Dams**
- **Floodwalls and Levees**
- **Channelization**
- **Diversion Channels**
- **Detention/Retention Basins**
- **Tunnels (?)**



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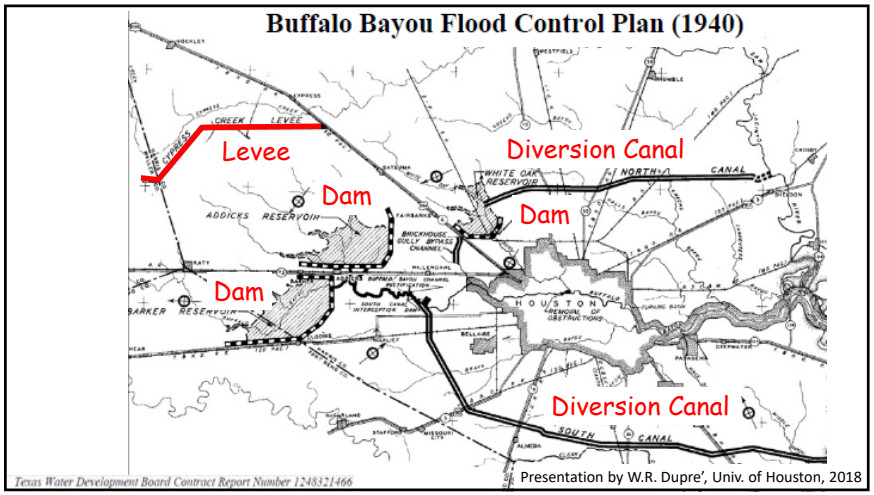

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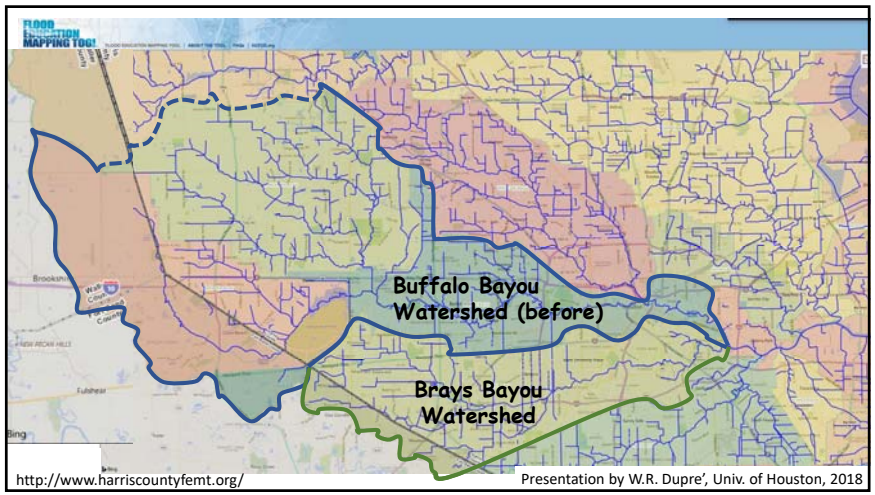
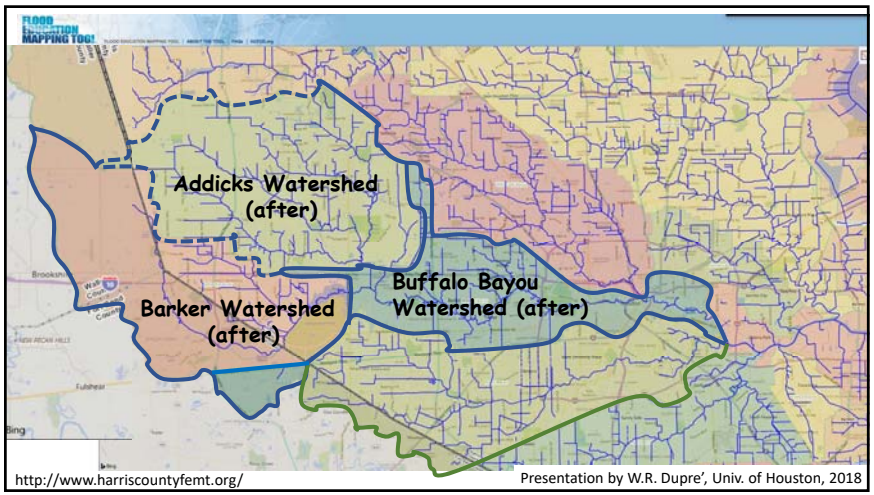


http://www.harriscountyfemt.org/ Presentation by W.R. Dupre', Univ. of Houston, 2018



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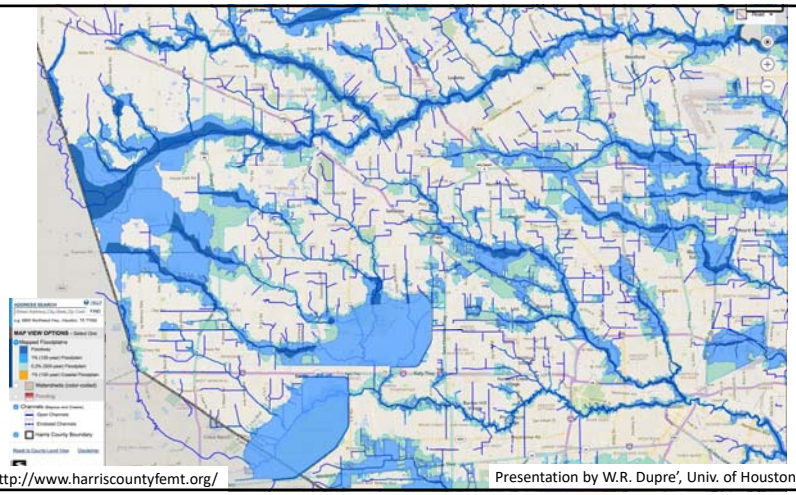

http://www.harriscountyfemt.org/

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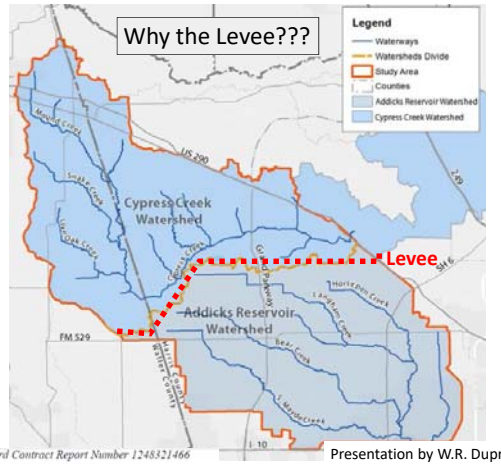

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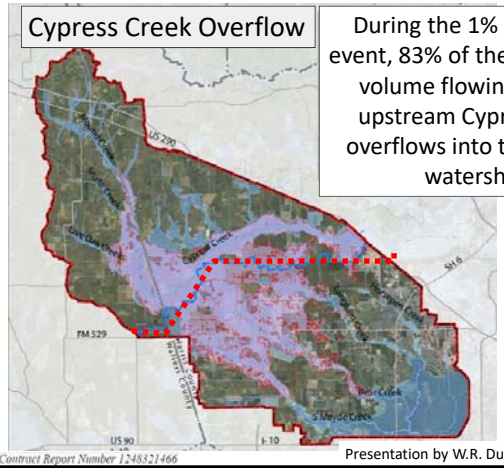

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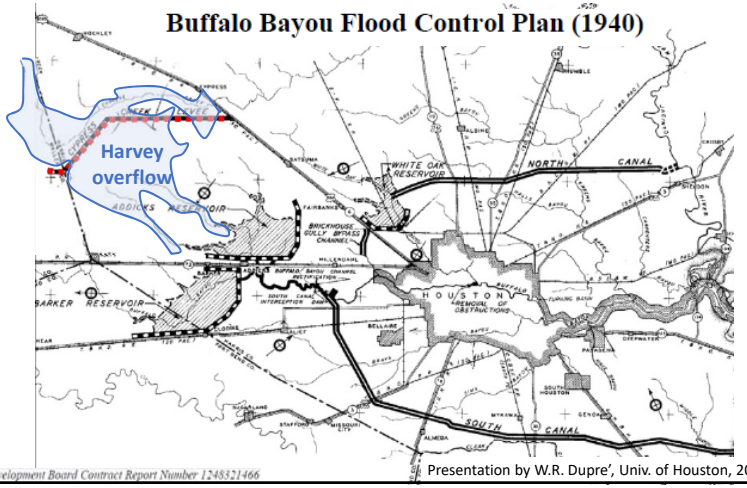

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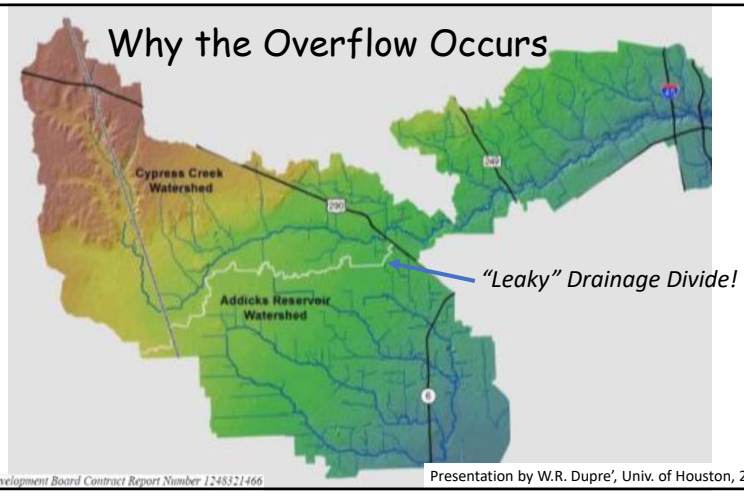

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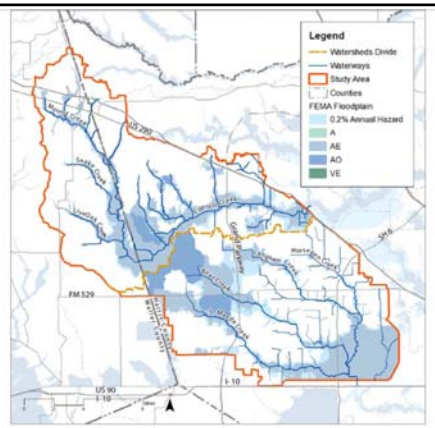

Figure 2.7 Effective special flood hazard areas (from FIRM Panels effective as of April, 2014)

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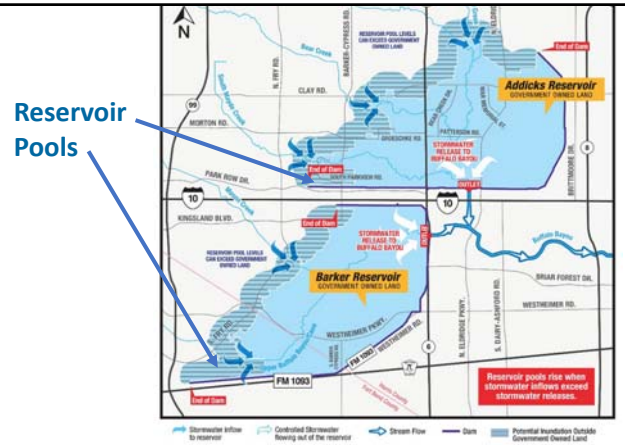

https://www.hcfcd.org/hurricane-harvey/flooding-impacts-in-connection-with-the-reservoirs/

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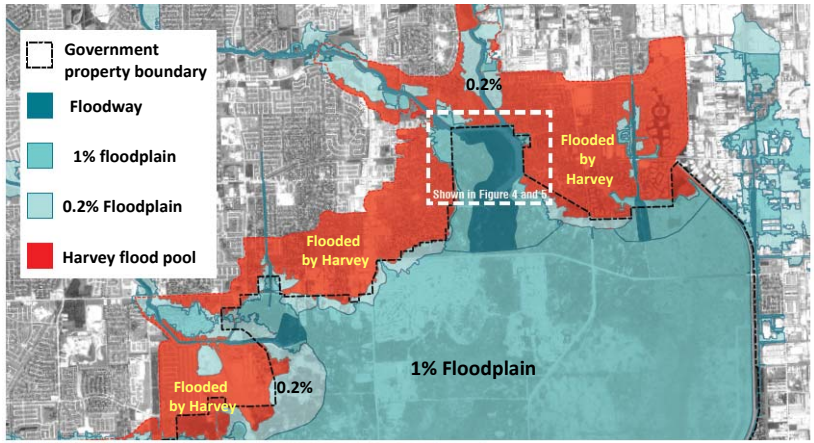

GHFMC Briefing Document 2: How do Addicks & Barker reservoirs work?

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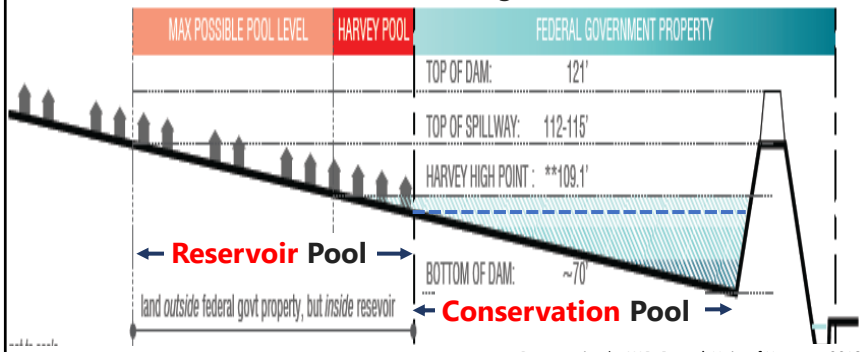
What Reservoir Pools?

i.e. water that lies above the conservation pool in reservoirs used to regulate floodwaters.



GHFMC Briefing Document 2: How do Addicks & Barker reservoirs work?

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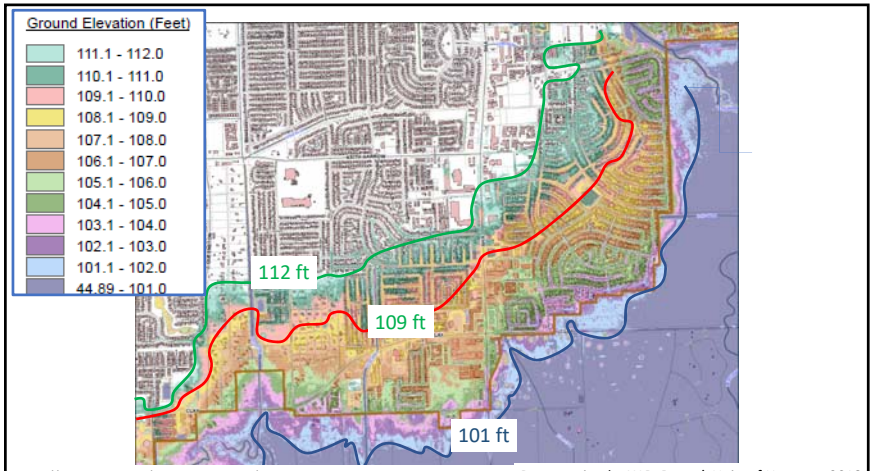


https://www.hcfcd.org/hurricane-harvey/

Presentation by W.R. Dupre', Univ. of Houston, 2018

Dam Safety Issues

"In December 2010 Addicks and Barker Dams were classified as a **DSAC I** by **HQUSACE**.

Studies conducted since 2004 have determined that the existing dams **Addicks** Reservoir and **Barker** Reservoir are a ***high risk of failure due to seepage and piping issues***.

The overriding critical issue of this project is the population of the city of Houston is downstream of the two dams."

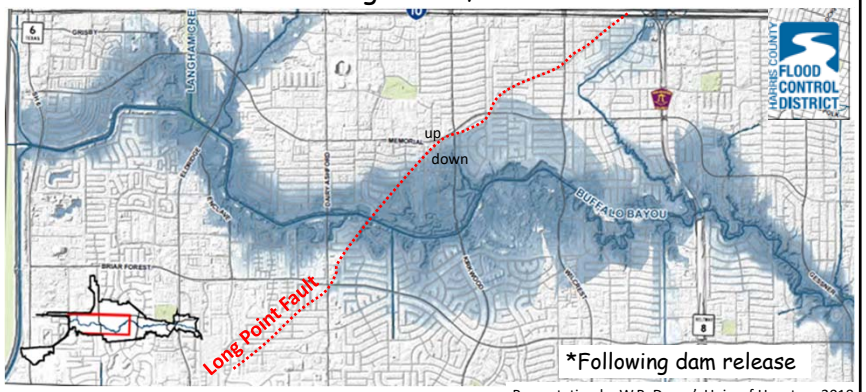
These dams were classified as **two of the six most dangerous dams** in the United States operated by the Corps of Engineers due to the risk of structural failure and its potential impact on people or property.

http://www.swg.usace.army.mil/Portals/26/docs/Planning/Addicks%20and%20Barker%20Decision%20Document%20Review%20Plan.pdf

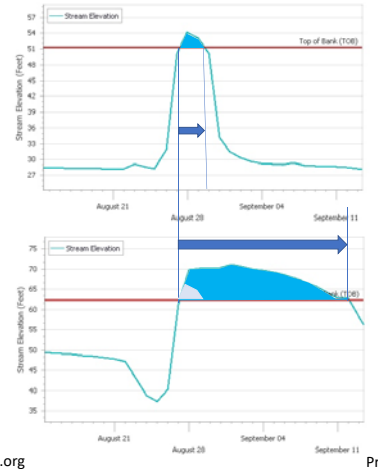
Presentation by W.R. Dupre', Univ. of Houston, 2018

Predicted Buffalo Bayou Inundation* Map:

August 30, 2017



Presentation by W.R. Dupre', Univ. of Houston, 2018

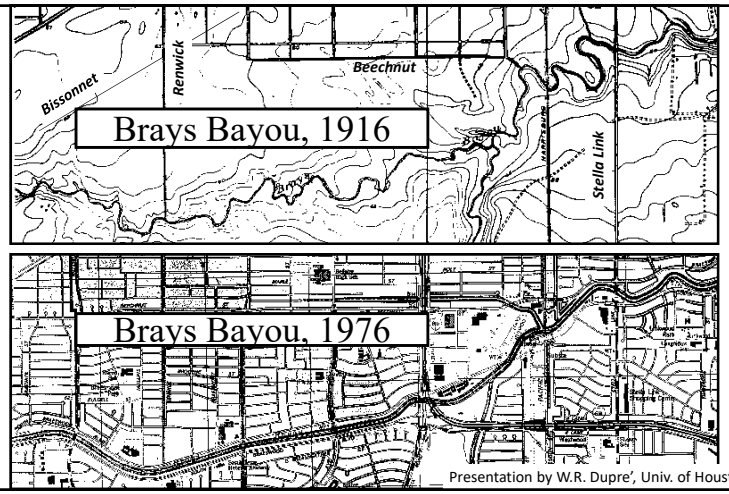


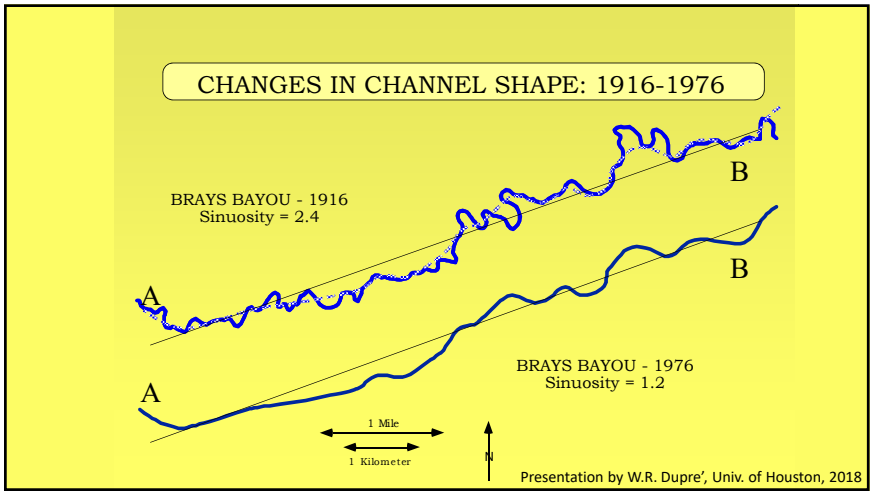
Brays Bayou
@ Rice Ave

Buffalo Bayou
@ West Belt 8

Early Channelization Approaches

- **Increase channel cross section area** to hold more water (widening & deepening);
- **Increase flow velocity**, e.g.
  - **Concrete** lining channel
  - **Straightening** channel
  - Improving cross sectional efficiency



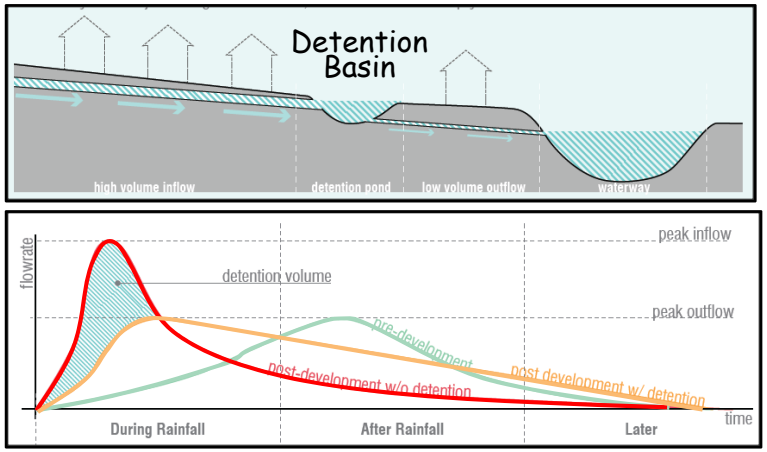


Detention Basins

- **On-site:** detains storm water on site before it enters the channel
- **In-line:** Deep areas along the channel that can store floodwater once it begins rising in the channel.
- **Regional**: built by flood control agencies to address flooding on a larger geographic scale and is funded by taxes or stormwater fees paid by a number of developers. Regional detention is used to reduce existing flooding or help prevent increased flooding from new developments. (may be wet-bottom or dry-bottom)

GHFMC, Strategies for Flood Mitigation, 2018

Presentation by W.R. Dupre', Univ. of Houston, 2018



GHFMC Fact Sheet 3

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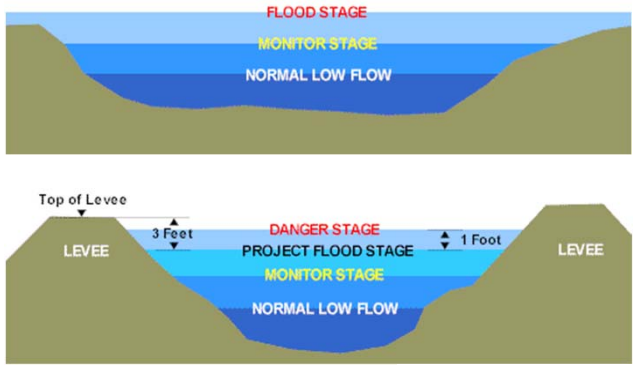
Levees



http://www.cnrfc.noaa.gov/wfo_hydro.php

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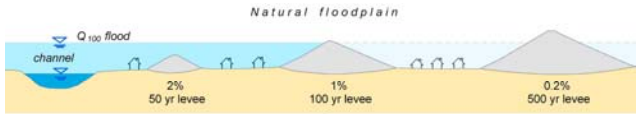

< 100 yr. zone > 100 yr. zone

Properties protected by an accredited levee system are not mapped into the Special Flood Hazard Area and are *exempt from the insurance requirement*.

To *gain accreditation*, the levee system has been designed and constructed to protect against a "1% annual chance" flood.

http://nas-sites.org/levees/files/2013/03

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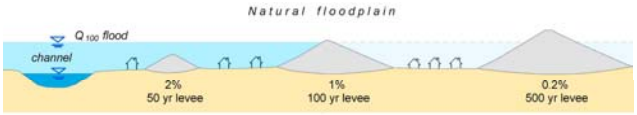
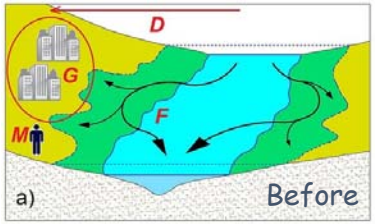


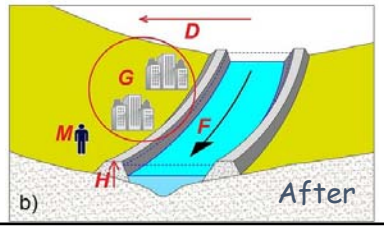
< 100 yr. zone > 100 yr. zone

The certification must demonstrate:

- At least three feet of freeboard above the 100 year protection level.
- Approved levee closure systems
- Embankment protection to prevent erosion
- Foundation stability to show that potential seepage has been addressed
- A plan to assess the potential of future settlement
- Pumps and drains to accommodate for interior drainage
- An approved operation and maintenance plan

www.illinoisfloods.org/documents/IAFSM





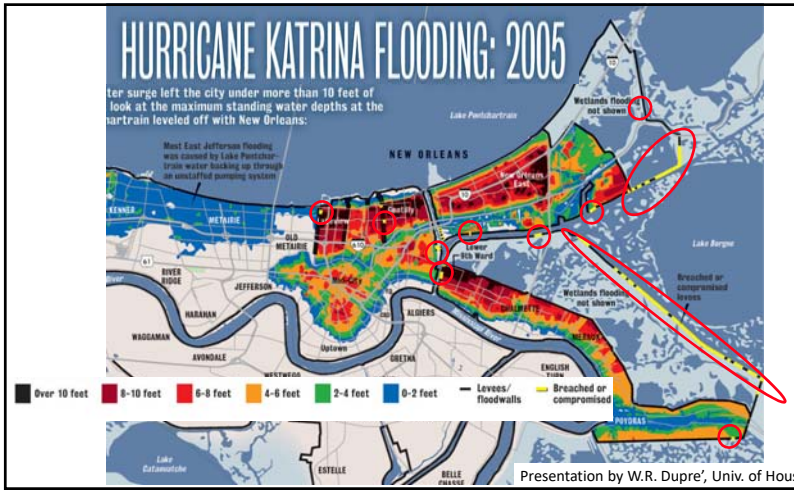
Levees

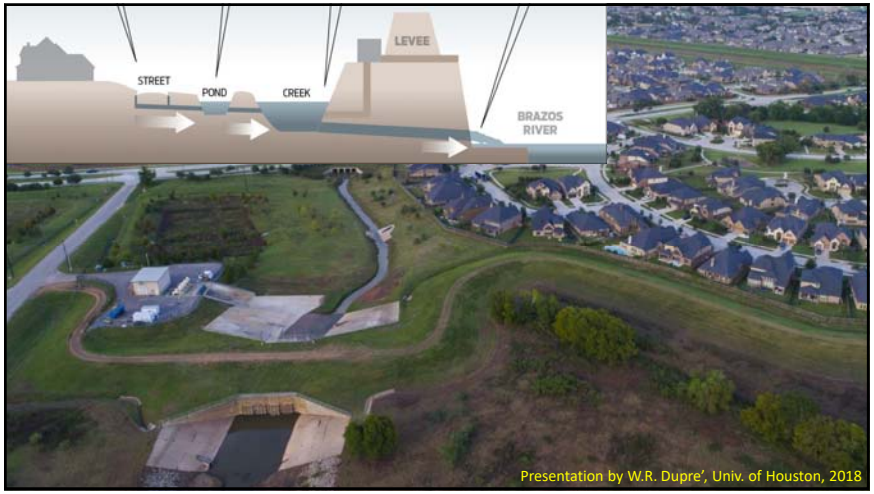
But !

1- Encourages development on prior floodplain

2- Levees can fail, either by:
- overtopping,
- poor maintenance,
- erosion,
- subsidence, or
- under-seeping!

3- Levees can act as dams, trapping water & flooding homes

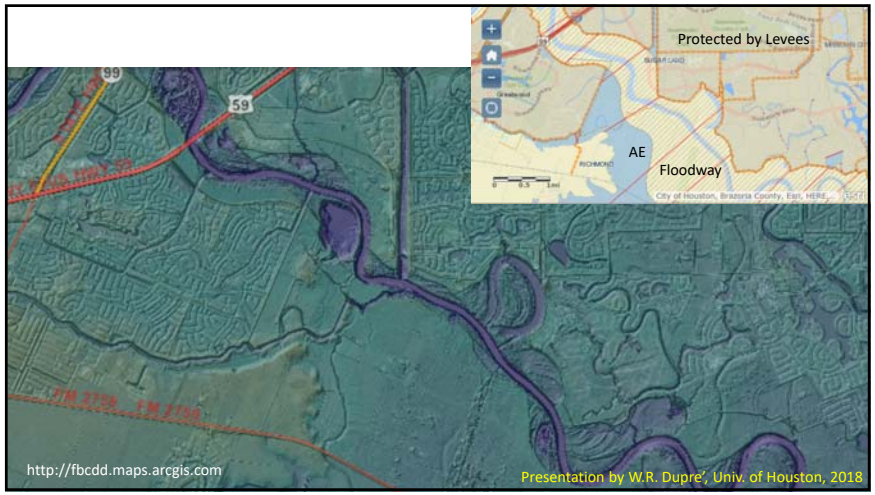


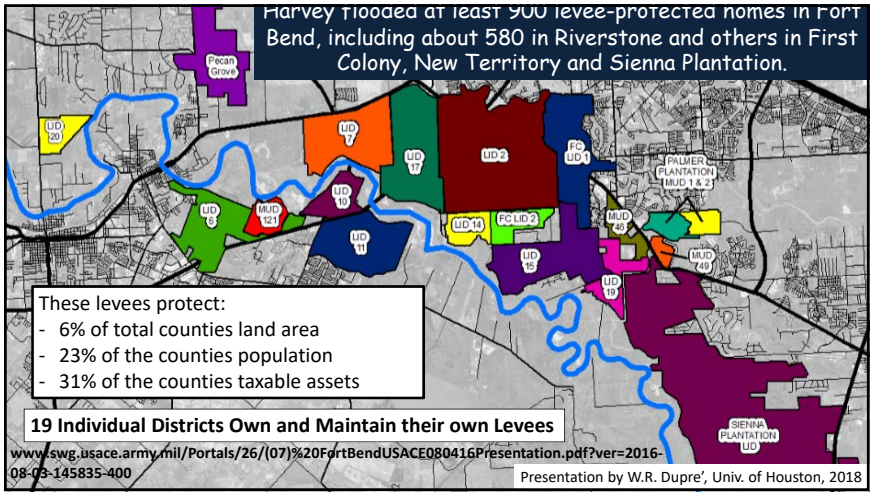


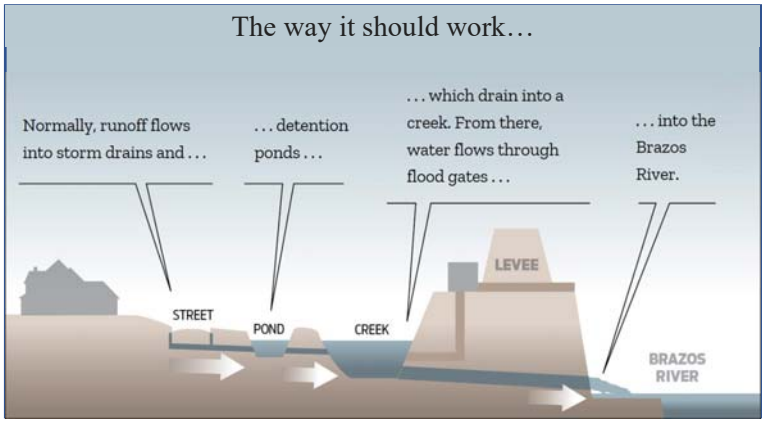
FBC Floodplain Mapping Tool

http://fbcgis.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=cfe8b1a5660f4c5ca07f48aec0690591

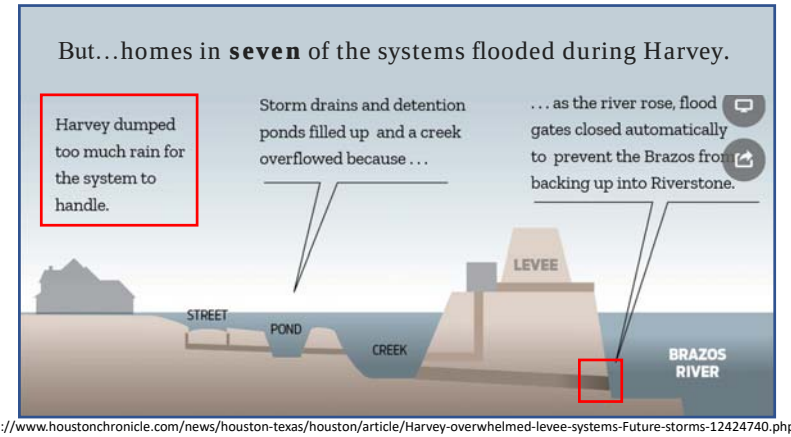
Presentation by W.R. Dupre', Univ. of Houston, 2018



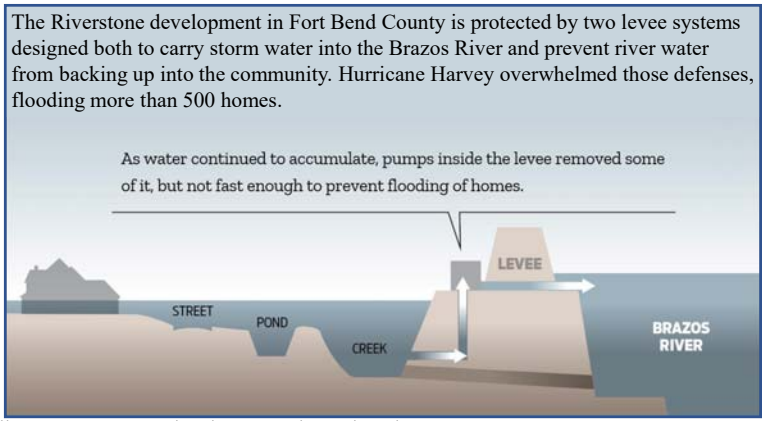




https://www.houstonchronicle.com/news/houston-texas/houston/article/Harvey-overwhelmed-levee-systems-Future-storms-12424740.php



https://www.houstonchronicle.com/news/houston-texas/houston/article/Harvey-overwhelmed-levee-systems-Future-storms-12424740.php



https://www.houstonchronicle.com/news/houston-texas/houston/article/Harvey-overwhelmed-levee-systems-Future-storms-12424740.php

Changing Climate

ANALYSIS OF IMPACTS OF NON-STATIONARY CLIMATE ON PRECIPITATION FREQUENCY ESTIMATES

*"There has been a growing concern among users of **NOAA Atlas 14** products that they ..... may not be appropriate in presence of non-stationary climate."*

www.nws.noaa.gov/oh/hdsc/current-projects/progress/201804_HDSC_PR.pdf

ANALYSIS OF IMPACTS OF NON-STATIONARY CLIMATE ON PRECIPITATION FREQUENCY ESTIMATES

- The current **NOAA Atlas 14** frequency analysis methods are based on the ***assumption of stationary climate*** in both **historic** and **future** precipitation records.
- As such, they ***may not be suitable*** for frequency analysis in the presence of non-stationary climate conditions…
- It has thus ***become necessary to assess the potential for incorporating non-stationarity in precipitation frequency estimates***.

www.nws.noaa.gov/oh/hdsc/current-projects/progress/201804_HDSC_PR.pdf

Presentation by W.R. Dupre', Univ. of Houston, 2018

NOAA's National Weather Service
Hydrometeorological Design Studies Center

Home | Site Map | News | Organization | Search | NWS | All NOAA | Go

PF DOCUMENTS BY STATE/TERRITORY AND DURATION:

State/Territory	Duration (D)		
	D < (≤) 1 hr	1 hr ≤ (<) D ≤ 24 hr	D > 24 hr
States			
Alabama	NOAA Atlas 14 Vol 9	NOAA Atlas 14 Vol 9	NOAA Atlas 14 Vol 9
Alaska	NOAA Atlas 14 Vol 7	NOAA Atlas 14 Vol 7	NOAA Atlas 14 Vol 7
Oklahoma	NOAA Atlas 14 Vol 8	NOAA Atlas 14 Vol 8	NOAA Atlas 14 Vol 8
Oregon	Arkell & Richards	NOAA Atlas 2, Vol 10	Technical Paper 49
Pennsylvania	NOAA Atlas 14 Vol 2	NOAA Atlas 14 Vol 2	NOAA Atlas 14 Vol 2
Rhode Island	NOAA Atlas 14 Vol 10	NOAA Atlas 14 Vol 10	NOAA Atlas 14 Vol 10
South Carolina	NOAA Atlas 14 Vol 2	NOAA Atlas 14 Vol 2	NOAA Atlas 14 Vol 2
South Dakota	NOAA Atlas 14 Vol 8	NOAA Atlas 14 Vol 8	NOAA Atlas 14 Vol 8
Tennessee	NOAA Atlas 14 Vol 2	NOAA Atlas 14 Vol 2	NOAA Atlas 14 Vol 2
Texas	NWS HYDRO-35	Technical Paper 40	Technical Paper 49

1977 1961 1964

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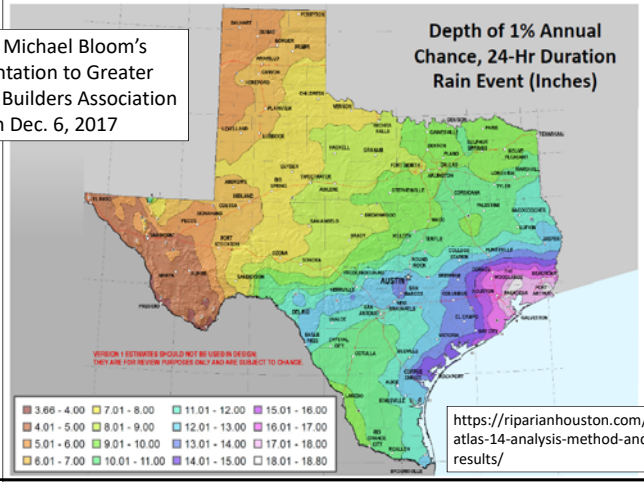
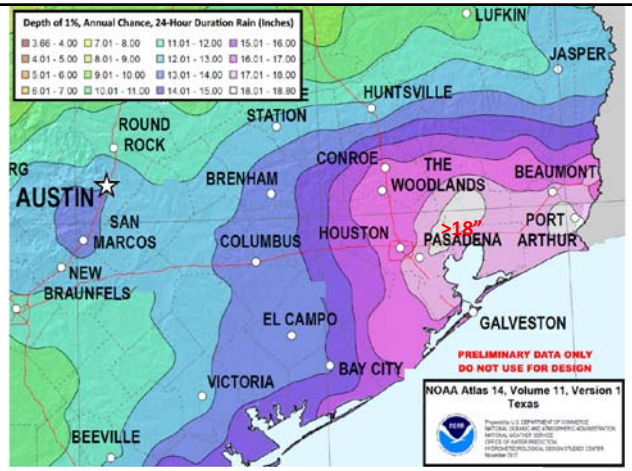
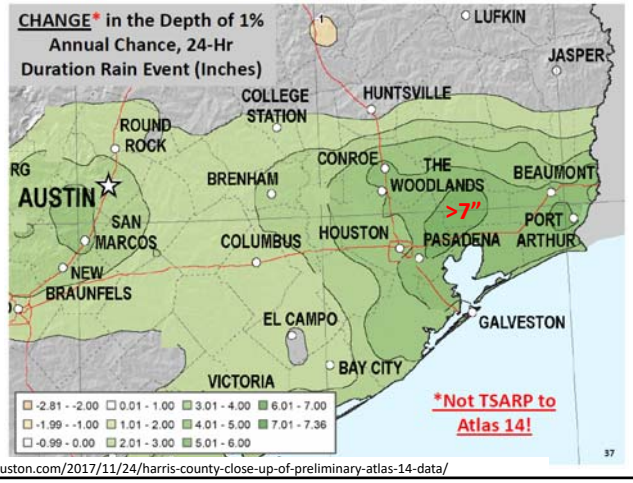
From Michael Bloom's presentation to Greater Houston Builders Association on Dec. 6, 2017



https://riparianhouston.com/2017/12/07/atlas-14-analysis-method-and-preliminary-results/

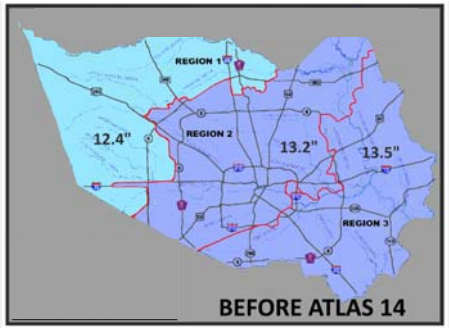


https://riparianhouston.com/2017/11/24/harris-county-close-up-of-preliminary-atlas-14-data/



https://riparianhouston.com/2017/11/24/harris-county-close-up-of-preliminary-atlas-14-data/

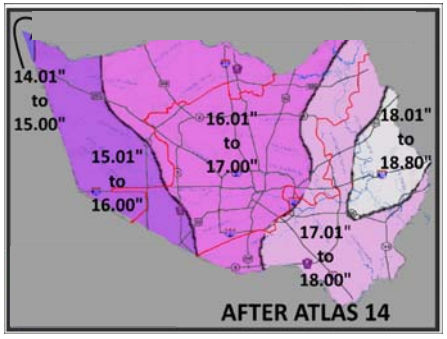
1%, 24-hour Rainfall Depths



https://riparianhouston.com/2017/11/24/harris-county-close-up-of-preliminary-atlas-14-data/

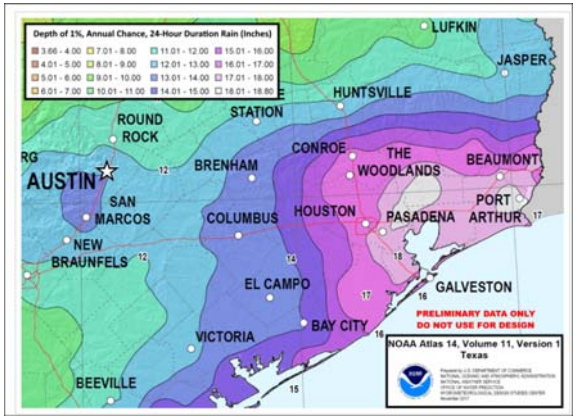
Region	Before
R1	12.4
R1	12.4
R1	12.4
R1	12.4
R2	12.4
R2	13.2
R2	13.2
R2	13.2
R2	13.2
R2	13.2
R2	13.2
R3	13.5
R3	13.5
R3	13.5
R3	13.5
R3	13.5
R3	13.5
R3	13.5

1%, 24-hour Rainfall Depths

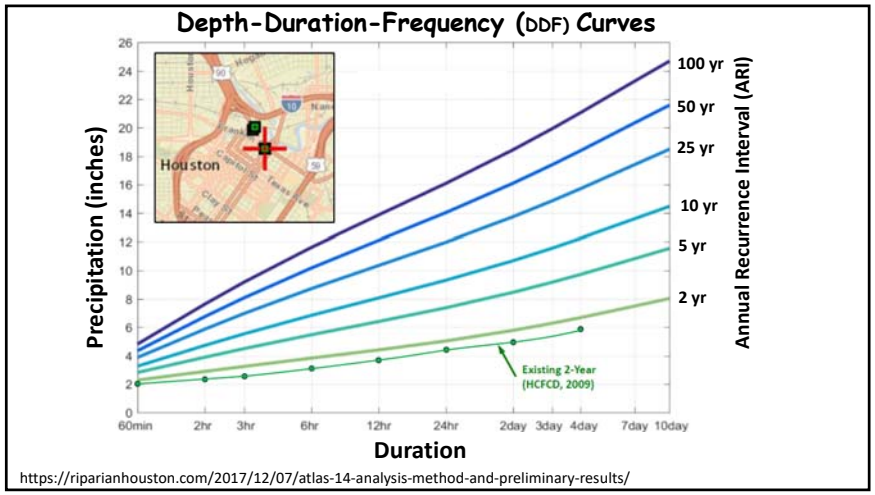


https://riparianhouston.com/2017/11/24/harris-county-close-up-of-preliminary-atlas-14-data/

Region	Before	After	% Increase
R1	12.4	14.01	13%
R1	12.4	15.00	21%
R1	12.4	15.50	25%
R1	12.4	16.00	29%
R2	12.4	16.50	33%
R2	13.2	15.50	17%
R2	13.2	16.00	21%
R2	13.2	16.50	25%
R2	13.2	17.00	29%
R2	13.2	17.50	33%
R2	13.2	18.00	36%
R3	13.5	16.00	19%
R3	13.5	16.50	22%
R3	13.5	17.00	26%
R3	13.5	17.50	30%
R3	13.5	18.00	33%
R3	13.5	18.40	36%
R3	13.5	18.80	39%



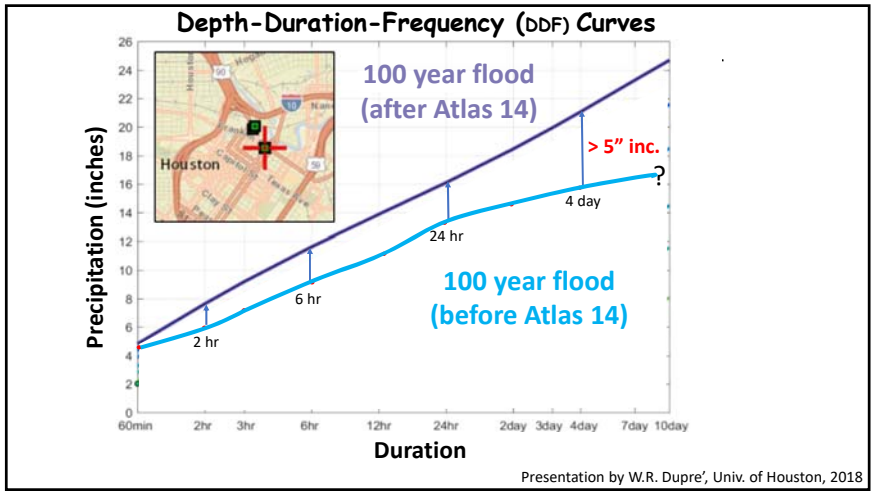
https://riparianhouston.com/2017/11/20/draft-provisional-atlas-14-data-out-for-peer-review/



https://riparianhouston.com/2017/12/07/atlas-14-analysis-method-and-preliminary-results/

HARRIS COUNTY HYDROLOGIC REGION 2 RAINFALL (INCHES)
(Current – i.e. before Atlas 14)

Duration	Annual-Chance Event			
	10-percent	2-percent	1.0-percent	0.2-percent
5-Minute	0.9	1.1	1.2	1.4
15-Minute	1.5	1.9	2.1	2.6
30-Minute	2.1	2.7	3.0	3.8
60-Minute	2.9	3.8	4.3	5.5
2-Hour	3.6	5.0	5.7	7.6
3-Hour	4.1	5.8	6.7	9.2
6-Hour	5.1	7.6	8.9	12.8
12-Hour	6.2	9.2	10.8	15.5
24-Hour	7.6	11.3	13.2	18.9
2-Day	8.6	12.5	14.5	20.0
4-Day	9.8	14.0	15.9	21.1



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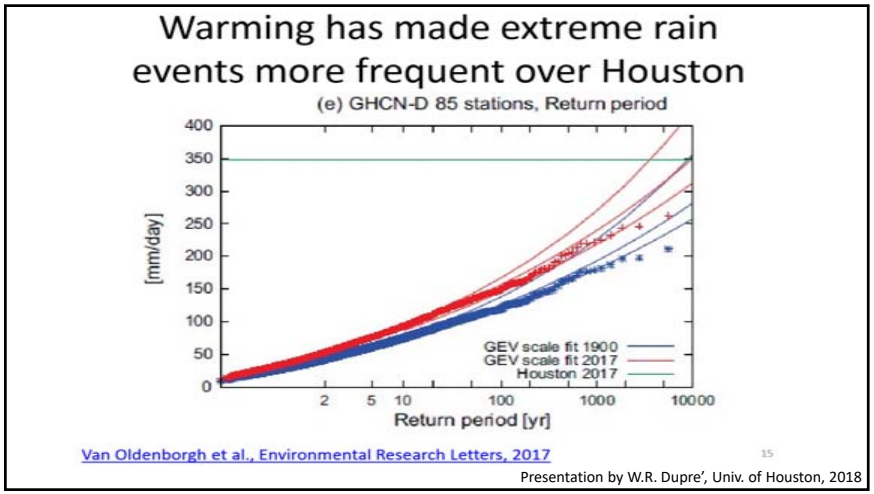
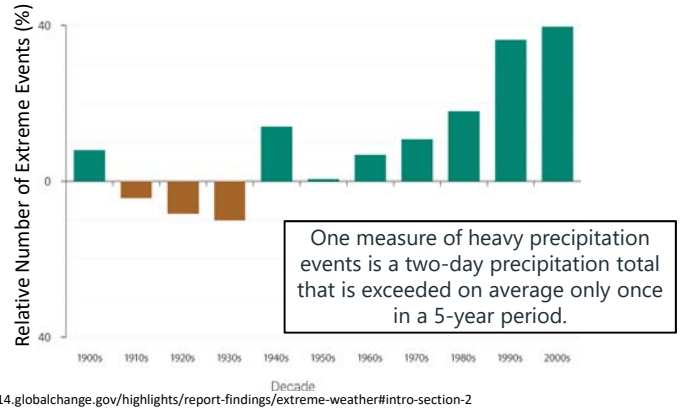


Presentation by W.R. Dupre', Univ. of Houston, 2018

U.S. Trend in Heavy Precipitation



One measure of heavy precipitation events is a two-day precipitation total that is exceeded on average only once in a 5-year period.

https://nca2014.globalchange.gov/highlights/report-findings/extreme-weather#intro-section-2

U.S. had more floods in 2016 than any year on record

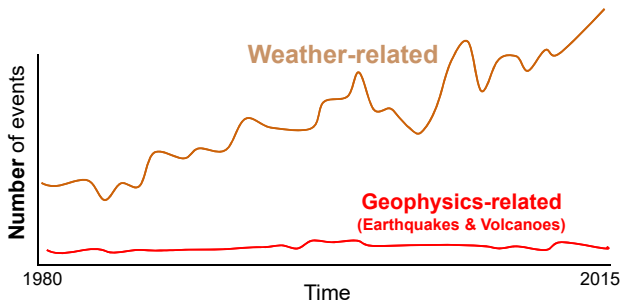
Published on Tuesday, August 16, 2016 by Common Dreams

Scientists Say Expect More 1,000-Year Events Like Louisiana Flood

Louisiana's devastating rainfall was the state's second "1,000-year" flood this year

by Nika Knight, staff writer

Number of Global Natural Disasters: 1980-2015



Munich Re Topics Geo 15

What can we do about flooding?

Structural Responses: (1930's-present): e.g. building dams, levees, floodwalls, channelization
-Flood Control Act of 1936.

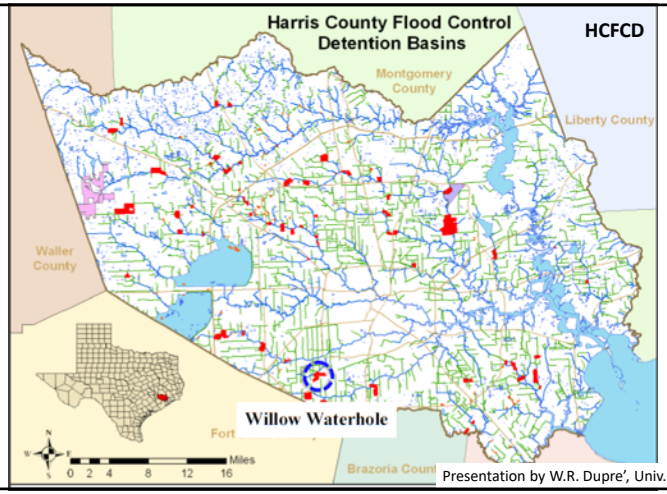
Floodplain Management: (1960's-present): Combined floodplain management with structures
-National Flood Insurance Program of 1968;
-National Disaster Protection Act of 1973;
~~*-Biggert-Waters Flood Insurance Reform Act 2012*~~.

Post-flood Non-structural Mitigation: (1980's-present): Includes property acquisition and Δ land use.

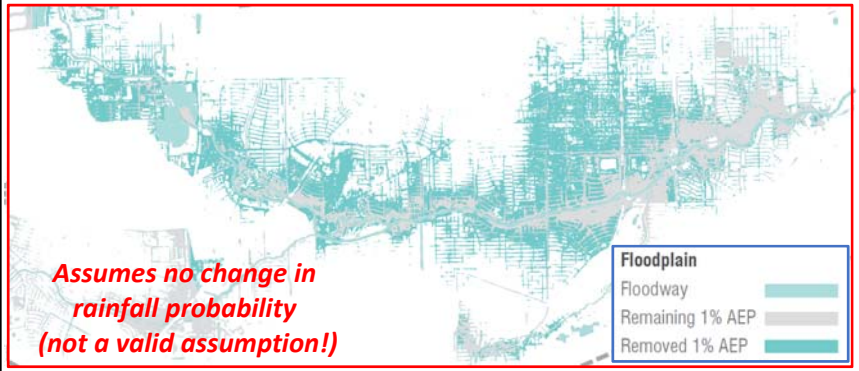
Project Brays

- "Project Brays", started in 1998, is a federally and locally funded partnership between **USACE** and **HCFCD**. Total projected cost is now estimated to be **$480 million**.
- **Phase 1**: (2004-2016), Four stormwater **detention basins** have been created that will hold approximately 3.5 billion gallons of stormwater and cover about 900 acres when completed.
- **Phase 2**: (ongoing) **channel widening** and/or **deepening** in more than 21 miles of its middle and lower reaches and replacing or renovating 30 **bridges**.
- When completed in 2021, Project Brays is projected to *remove over 15,000 homes/businesses from the current 1 % floodplain*.

https://www.projectbrays.org



Floodplains Before and After (?) Project Brays



GHFMC: Strategies for Flood Mitigation, 2018

Other **Structural** Flood Mitigation Plans

- Channel improvements & detention basins
  -e.g. White Oak Bayou, Greens Bayou, Cedar Bayou, etc.
- Remove storm debris (and sediment)
- Repair (and deepen?) Barker and Addicks Dams
- Add a third dam and reservoir - (Location?)
- Storm-surge barrier(s) – ("Ike Dike"?)

Non-structural Flood Mitigation Measures

Reduce **Susceptibility** to Floods	Reduce **Impact** of Floods
➡ Acquisition/buyout and demolition of structures	➡ Public education and information access
Land swaps and relocation of structures	➡ Updated flood maps
➡ Elevation of structures in place	Flood emergency measures to reduce loss of life
Dry floodproofing (make structures watertight)	➡ Flood insurance to reduce financial impacts
Wet floodproofing (allow water to flow through)	➡ Disaster assistance to reduce financial impacts
Non-structural berms and secondary levees	➡ Tax adjustments to reduce financial impacts
➡ Floodplain regulations and building codes	Long-term recovery assistance
Zoning and land use	
Development policies	
➡ Flood forecasting and warning systems	
Disaster preparedness and response plans	

GHFMC: Strategies for Flood Mitigation, 2018

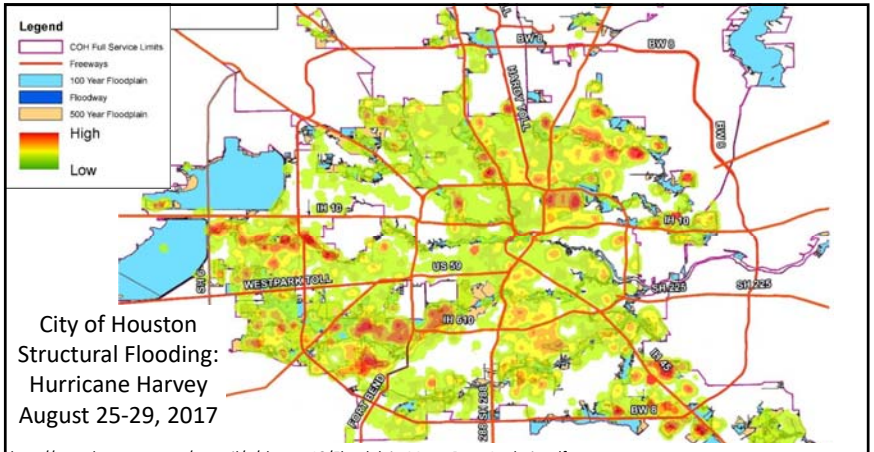
Presentation by W.R. Dupre', Univ. of Houston, 2018

Harris County approves new building regulations

- The Harris County Commissioners Court unanimously approved new construction requirements. Starting January 1, 2018 all new buildings – homes as well as commercial – must be ***at least 24 inches above the 500 year flood plain***. Harris County Judge Ed Emmett believes these new building regulations are the nation's toughest.
- There are some experts that estimate in some areas of the 100 year flood plain, new construction would need to be built almost eight feet above ground. This new building code is for unincorporated Harris County only. *December 5, 2017*

https://www.houstonpublicmedia.org/articles/news/2017/12/05/

Presentation by W.R. Dupre', Univ. of Houston, 2018



City of Houston Structural Flooding: Hurricane Harvey August 25-29, 2017

http://www.houstontx.gov/council/g/chapter19/Floodplain-Mgmt-Data-Analysis.pdf

Presentation by W.R. Dupre', Univ. of Houston, 2018

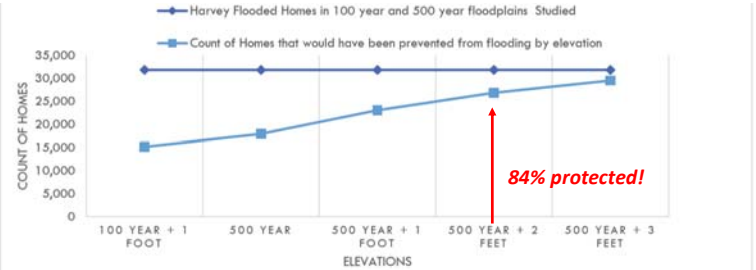
Houston Floodplain Regulations

RULES	EXISTING	PASSED (4/4/18)
REGULATED AREA	100-year	100 + 500-year
ELEVATION	100-year + 1 foot	500-year + 2 feet
ZERO NET FILL	100-year	100 + 500-year
SUBSTANTIAL IMPROVEMENTS	100-year	100-year
ELEVATION OF ADDITIONS	100-year + 1 foot	500-year + 2 feet (exemption for small additions in 500-year)
FOUNDATION	All types permitted outside floodway	All types permitted outside floodway

http://www.houstontx.gov/council/g/chapter19/Floodplain-Mgmt-Data-Analysis.pdf

Presentation by W.R. Dupre', Univ. of Houston, 2018

Homes flooded by Harvey but protected by elevation



http://www.houstontx.gov/council/g/chapter19/Floodplain-Mgmt-Data-Analysis.pdf

Chart 1 – Harvey flooded Homes Protected by Elevation (Houston Public Works, 2017) (City of Houston, 2017) (Harris County Flood Control District, 2009) (FEMA Current Effective FIRM, 2018) (FEMA Individual Assistance, 2018)

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Repetitive Loss (RL) properties

Any insurable building for which **two** or more claims of more than $**1,000** were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978.

Severe Repetitive Loss (SRL) properties*

Any NFIP-insured residential property that has met at least 1 of the following paid flood loss criteria since 1978, regardless of ownership:

- **Four** or more separate claim payments of ***more than $5,000*** each (including building and contents payments); or
- **Two** or more separate claim payments (building payments only) where the total of the payments ***exceeds the current value of the property***.

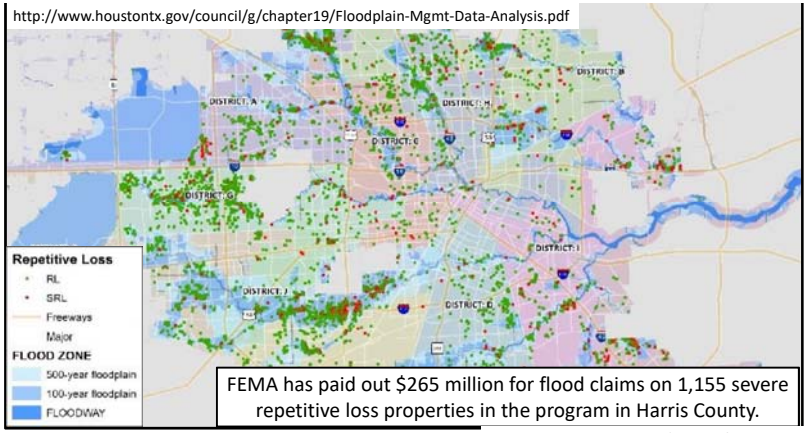
In either case, two of the claim payments must have occurred within 10 years of each other

https://www.fema.gov/pdf/nfip/manual201205/content/20_srl.pdf

*More than 30,000 "severe repetitive loss properties in the US have been covered under the NFIP.

Severe Repetitive Loss and Repetitive Loss (FEMA Current Effective FIRM, 2018)

http://www.houstontx.gov/council/g/chapter19/Floodplain-Mgmt-Data-Analysis.pdf



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- FEMA has paid out $265 million for flood claims on 1,155 severe repetitive loss properties in the program in Harris County.

- An evaluation of repetitive flood losses in Harris County, Texas, from 1978 to 2008 calculated that over 47% of these losses were located outside the 100-year floodplain boundary

- Payments for **389** properties in Harris County have cumulatively added up to more than **twice** the current value of the property.

- A house in NE Houston has received 18 flood insurance payments totaling $1.8 million; >15 times the property's market value.

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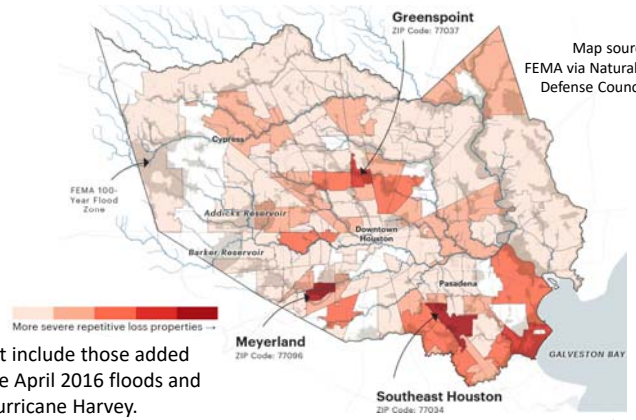
Severe Repetitive Loss (SRL) Flood Claims 1978-2015* – Harris County



Map sources:
FEMA via Natural Resources Defense Council, FEMA

*doesn't include those added after the April 2016 floods and 2017 Hurricane Harvey.

https://projects.propublica.org/graphics/houston-srlp

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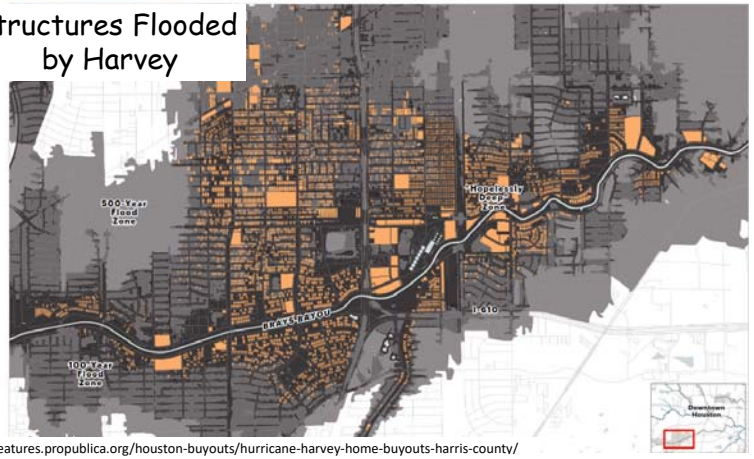
Structures Flooded by Harvey



https://features.propublica.org/houston-buyouts/hurricane-harvey-home-buyouts-harris-county/

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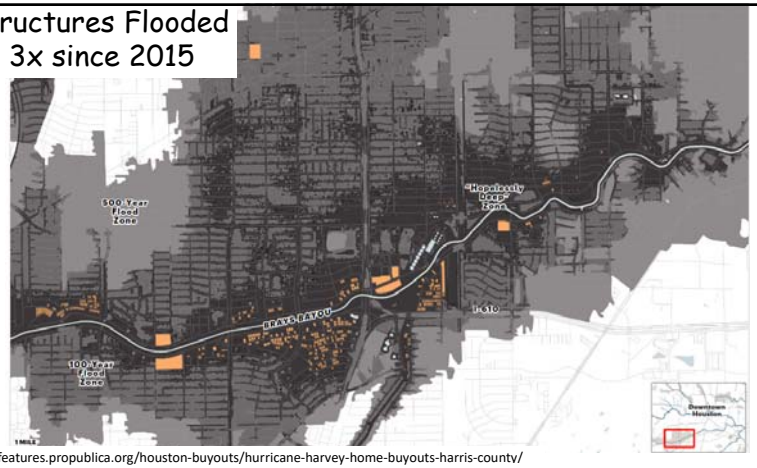
Structures Flooded 3x since 2015



https://features.propublica.org/houston-buyouts/hurricane-harvey-home-buyouts-harris-county/

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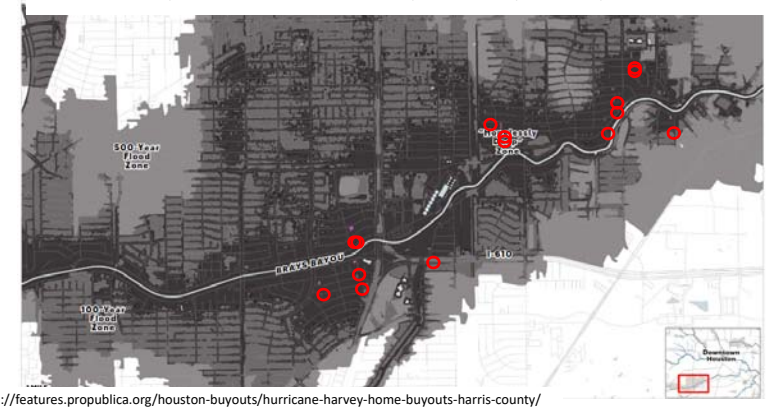
Home Buyouts in the "Hopelessly Deep Zone"



https://features.propublica.org/houston-buyouts/hurricane-harvey-home-buyouts-harris-county/

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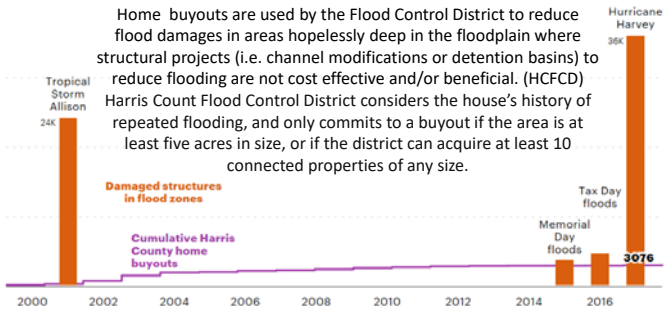
Harris County Buyouts

Home buyouts are used by the Flood Control District to reduce flood damages in areas hopelessly deep in the floodplain where structural projects (i.e. channel modifications or detention basins) to reduce flooding are not cost effective and/or beneficial. (HCFCD) Harris Count Flood Control District considers the house's history of repeated flooding, and only commits to a buyout if the area is at least five acres in size, or if the district can acquire at least 10 connected properties of any size.



https://features.propublica.org/houston-buyouts/hurricane-harvey-home-buyouts-harris-county/

Source: Harris County Flood Control District, FEMA

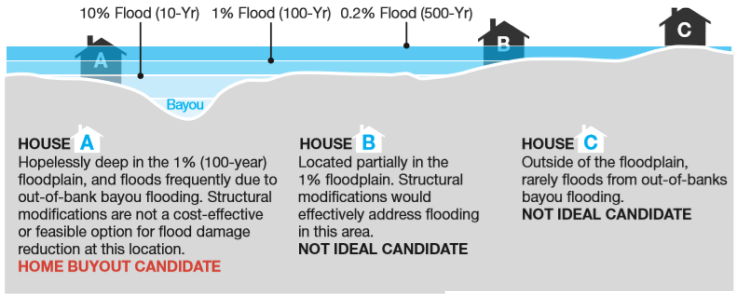
HCFCD HOME BUYOUT ELIGIBILITY REQUIREMENTS

- Source of flooding.
- Location and depth within the floodplain.
- Cost effectiveness as a solution to the property's flooding problem.
- Potential for future floodplain preservation and/or flood damage reduction projects.
- Compatibility with community and natural values.

https://www.hcfcd.org/hurricane-harvey/home-buyout-program/

Flood Control District Home Buyout Considerations

BEFORE



HOUSE A
Hopelessly deep in the 1% (100-year) floodplain, and floods frequently due to out-of-bank bayou flooding. Structural modifications are not a cost-effective or feasible option for flood damage reduction at this location.
HOME BUYOUT CANDIDATE

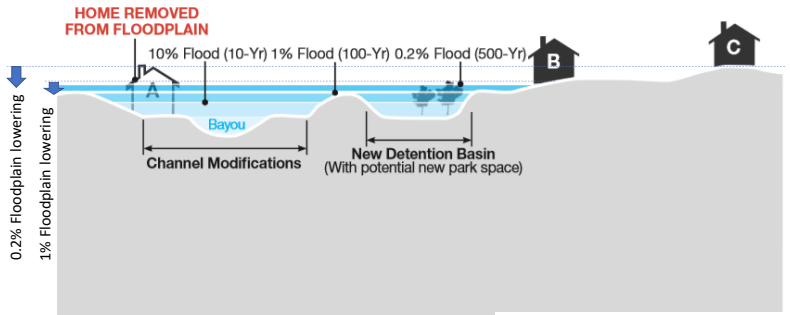
HOUSE B
Located partially in the 1% floodplain. Structural modifications would effectively address flooding in this area.
NOT IDEAL CANDIDATE

HOUSE C
Outside of the floodplain, rarely floods from out-of-banks bayou flooding.
NOT IDEAL CANDIDATE

https://www.hcfcd.org/hurricane-harvey/home-buyout-program/

Flood Control District Home Buyout Considerations

AFTER



https://www.hcfcd.org/hurricane-harvey/home-buyout-program/

Policy	Support	Oppose	Nonresponse
A program to buy homes in areas that have repeatedly flooded with local state and federal moneys	63.2%	27.5%	9.2%
Construction of a new reservoir to protect west Houston	84.7%	8.2%	7.1%
Greater restrictions on construction in flood plains	82.7%	10.7%	6.7%
Establishment of a regional flood agency with taxing authority to plan for the prevention of regional flooding	67.1%	22.0%	10.9%
Denying federally financed flood insurance to homeowners whose homes that have flooded three of more times since 2001	42.0%	48.7%	9.4%

www.uh.edu/class/hobby/harvey/ Presentation by W.R. Dupre', Univ. of Houston, 2018

Policy	Support	Oppose	Nonresponse
Not allow homes that have flooded three or more times since 2001 to be rebuilt by buying out these homeowners with local and federal moneys	61.5%	28.4%	10.1%
Requiring sellers of homes to fully disclose prior flood damage to their homes and prior flooding in the surrounding neighborhood	89.2%	6.6%	4.2%
Preventing development/construction on native prairies and wetlands in western and northwestern portions of Harris County	67.3%	19.2%	13.5%
Require government compensation for homes that are flooded due to the release of water from local reservoirs	77.2%	14.7%	8.1%
New building codes that require homes built in flood prone areas be elevated/raised to avoid flooding	85.6%	9.9%	4.5%

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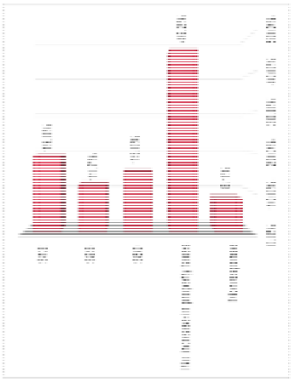
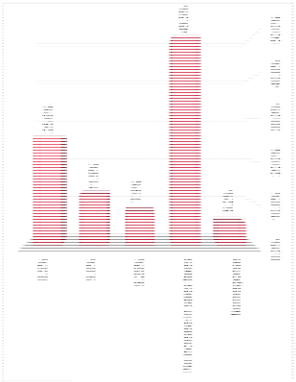
Increase in property tax?



Increase in sales taxes?



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