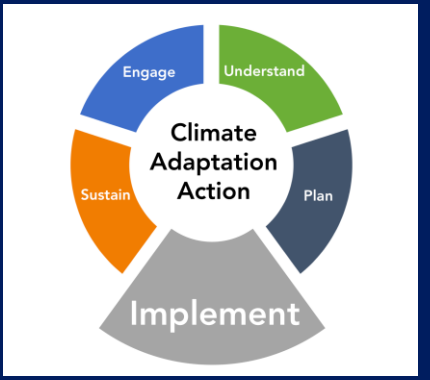
HOUSTON PUBLIC WORKS

HOUSTON STRONG: BUILDING RESILIENCE TO CLIMATE CHANGE

SHARON CITINO

MAUREEN CROCKER



CITY OF HOUSTON TEXAS

HOUSTON WATER

SERVICE AREA

650 square miles
2.2 million people

DRINKING WATER OPERATIONS

1.2 BGD surface water supply
200 MGD groundwater supply
3 reservoirs
3 surface water plants
49 groundwater plants
7,000 miles of waterlines

WASTEWATER OPERATIONS

250 MGD treatment capacity
39 wastewater treatment plants
384 lift stations
6,000 miles of wastewater lines

TRANSPORTATION & DRAINAGE OPERATIONS

SERVICE AREA

650 square miles

2.2 million people

TRANSPORTATION

16,000 lane miles

5,700 centerline miles

2,460 signalized intersections

1,382 bridges

DRAINAGE OPERATIONS

3,900 storm drains

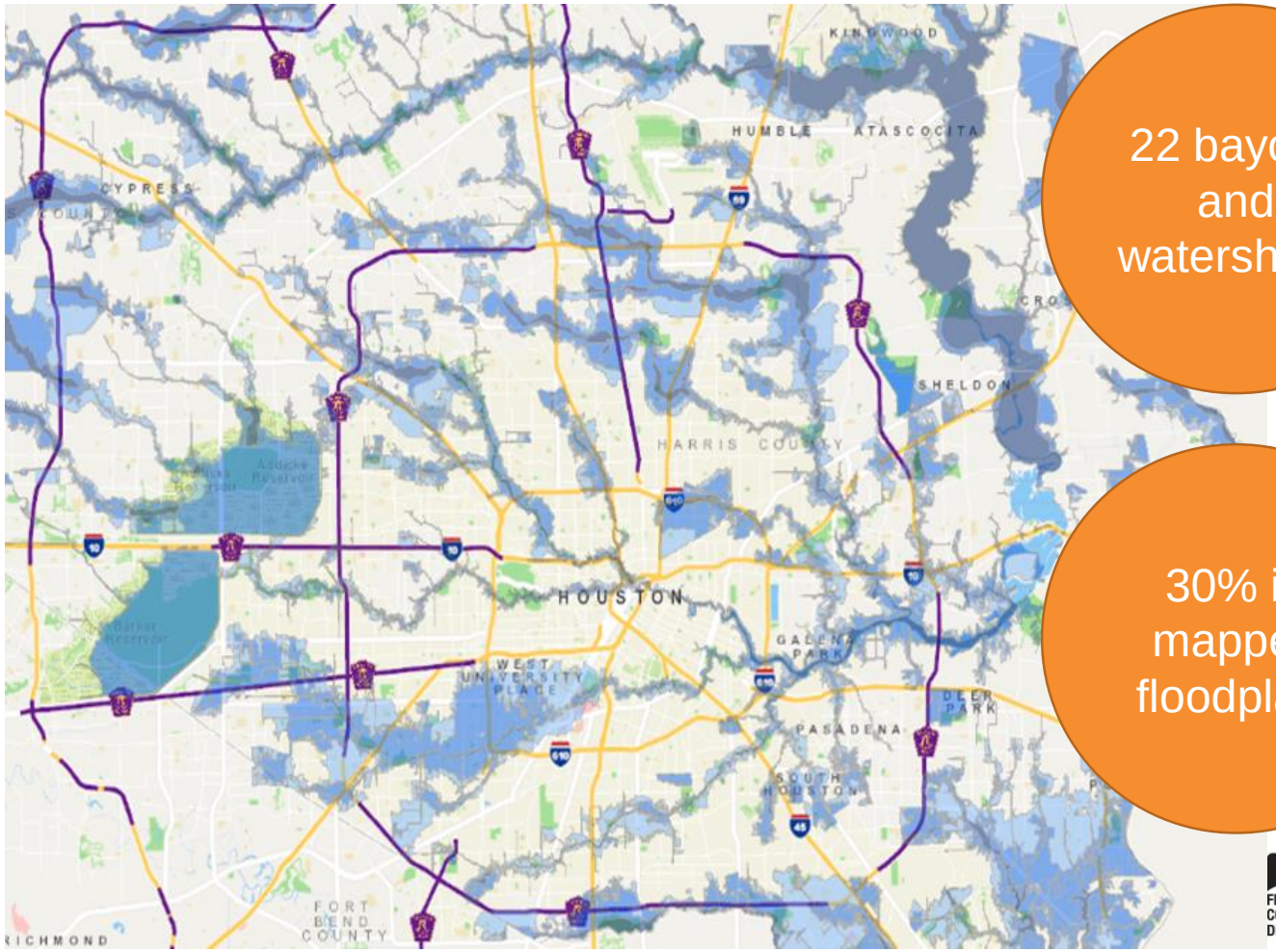
6,600 outfalls

2,500 miles of roadside ditches

28 roadway underpasses

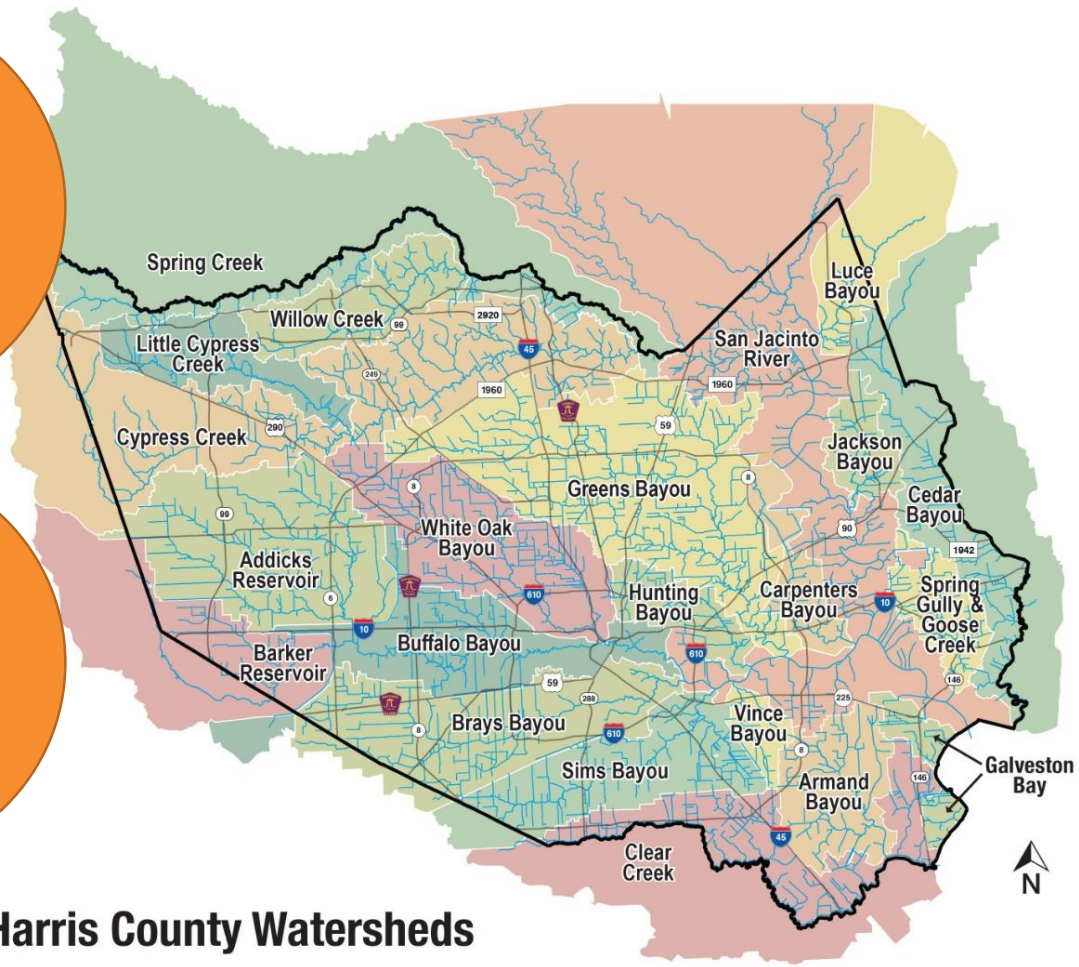
33 detention basins

LIVING WITH WATER IN THE BAYOU CITY



22 bayous and watersheds

30% in mapped floodplain



FLOOD CONTROL DISTRICT | Harris County Watersheds

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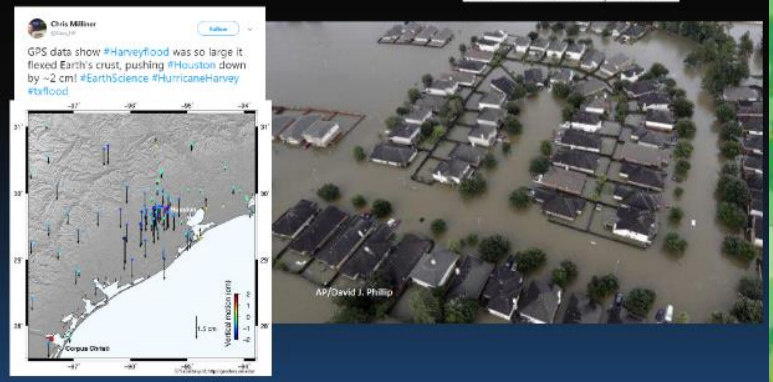
CLIMATE CHANGE IN HOUSTON

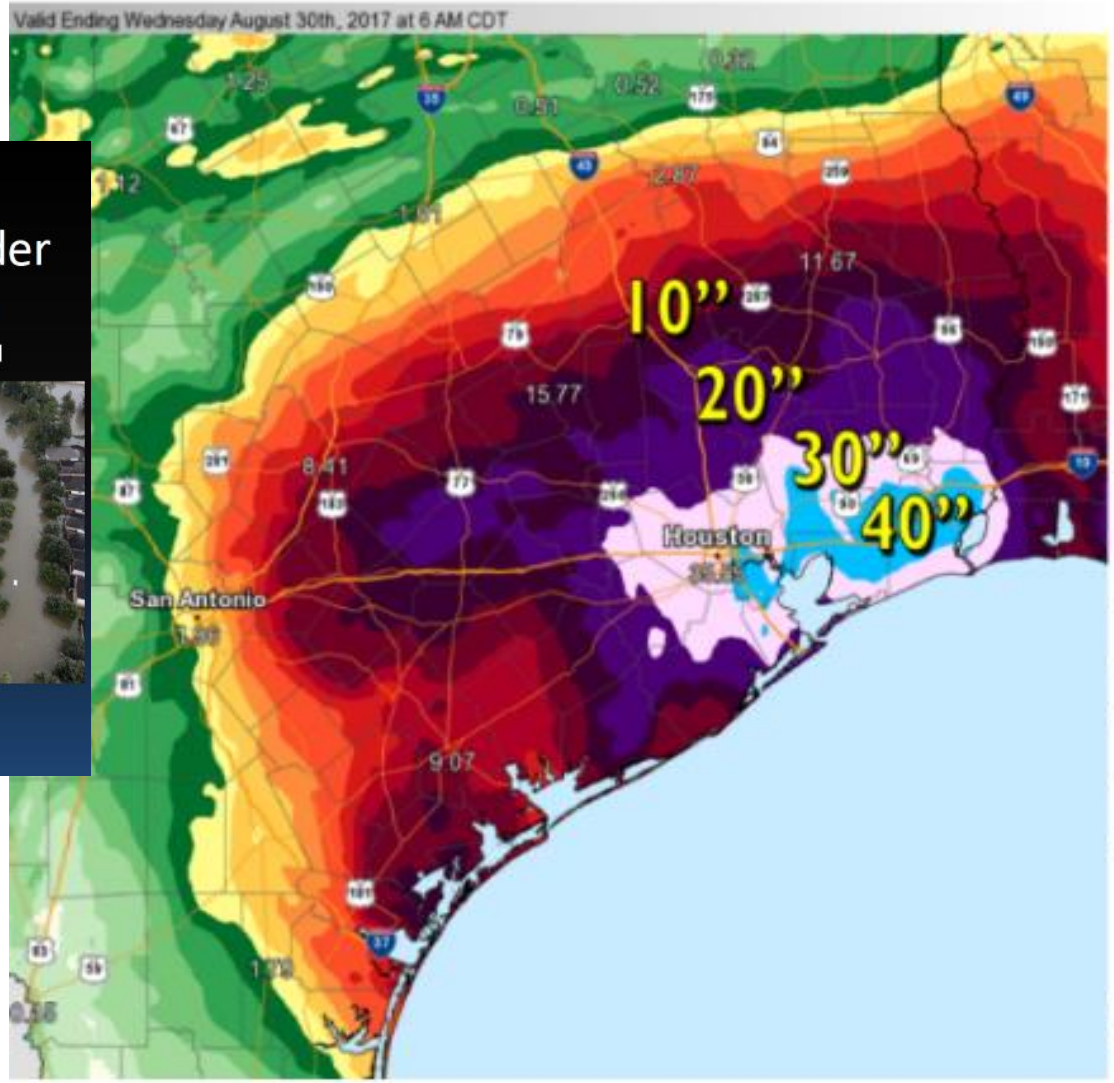
HURRICANE HARVEY, AUGUST 2017

2 cm is estimate how much Houston sank into the Earth under weight of water from Harvey

Source- Chris Milliner, NASA JPL



LOTS OF WATER, BUT NO WIND



5 Day Point Rainfall Amounts in Inches

- Harvey continued to produce record breaking **rainfall totals** of **45 to over 50 inches**… with continued rainfall
- **Cedar Bayou - 51.88**
- **Berry Bayou - 44.88**
- **League City - 49.84**
- **Mary's Creek - 49.80**
- **Goose Creek - 44.08**
- **Greens Bayou - 41.36**
- **Buffalo Bayou - 35.60**
- **Addicks Dam - 33.44**

Point rainfall data courtesy

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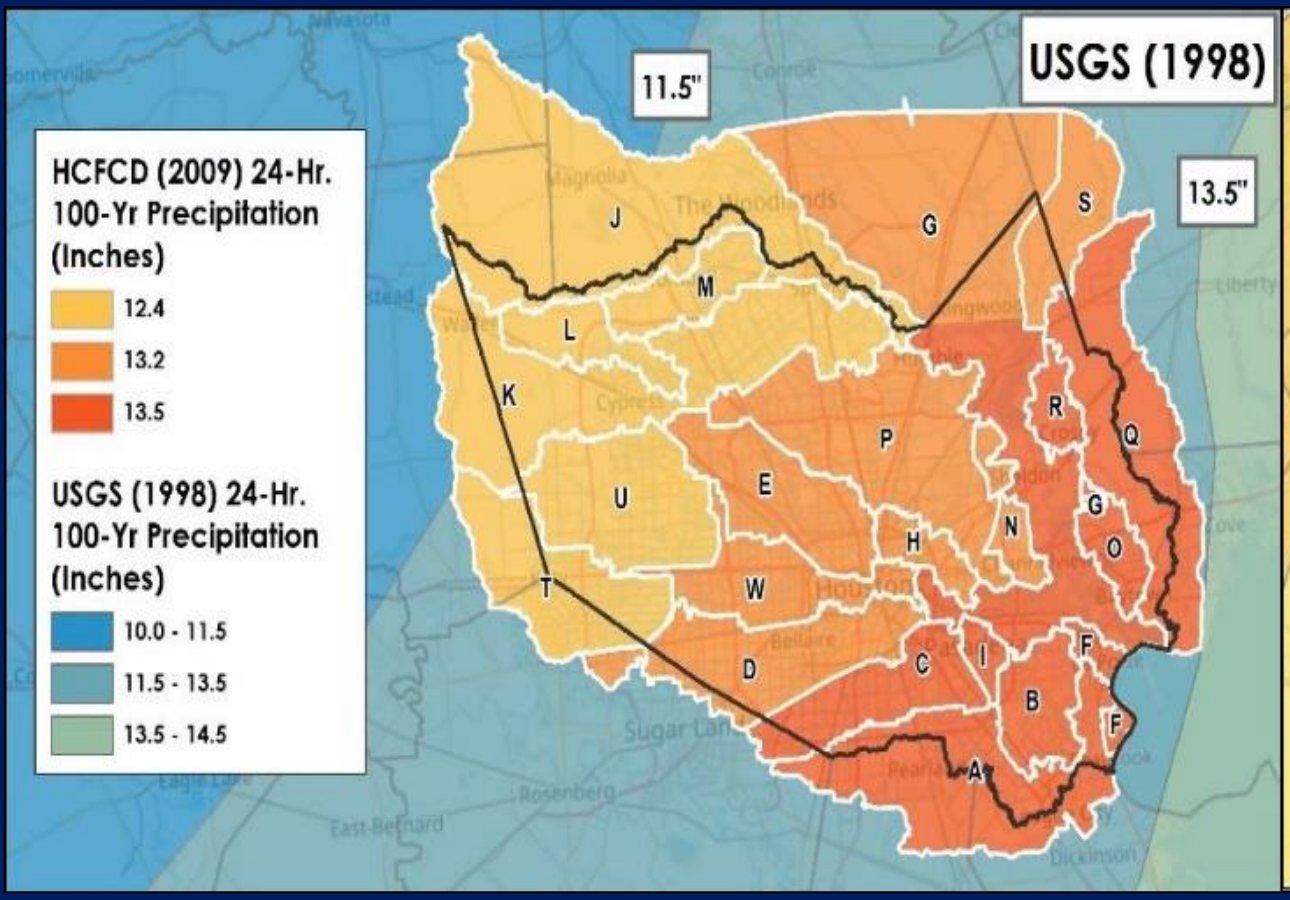
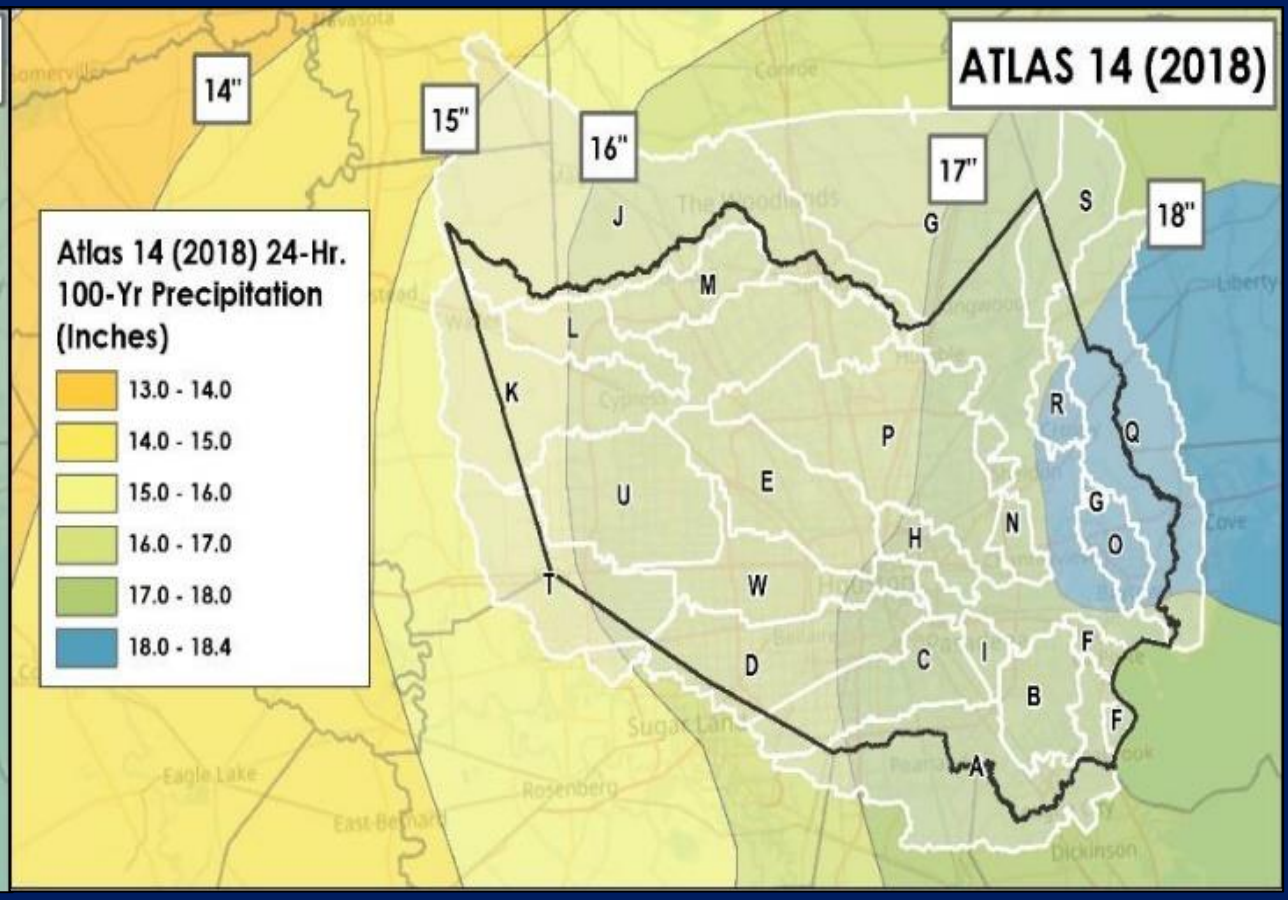
ATLAS 14 – RAINFALL INTENSITY





DRINKING WATER OPERATIONS

Drinking water remained safe

Post-Harvey transmission and distribution line leaks

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WASTEWATER OPERATIONS

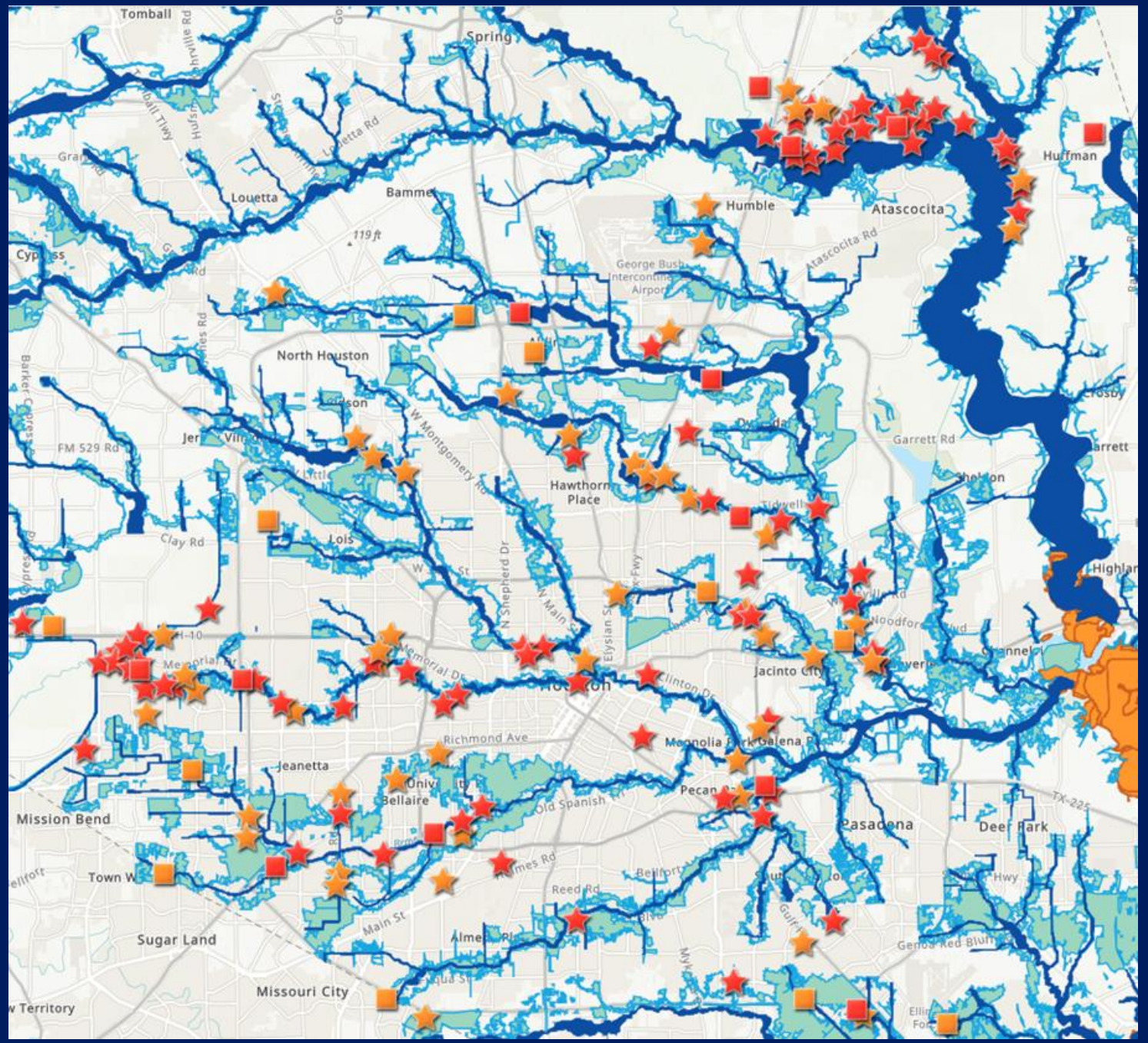
100 lift stations damaged

4 plants flooded

All 39 plants operational within 3 weeks

Flood Hazard Zone	Citywide WWTP	Harvey Impacted WWTP	% WWTP Impacted
Floodway	4	3	75%
100-yr Floodplain	23	12	52%
500-yr Floodplain	7	5	71%
Flood Zone X	6	4	67%
Overall	**40**	**24**	**60%**

Flood Hazard Zone	Citywide Lift Station	Harvey Impacted Lift Station	% Lift Station Impacted
Floodway	24	11	46%
100-yr Floodplain	97	46	47%
500-yr Floodplain	71	29	41%
Flood Zone X	193	48	25%
Overall	**385**	**134**	**35%**



WHAT DOES BUILDING RESILIENCE LOOK LIKE FOR HOUSTON WATER?

OPERATIONS	PLANNING	TECHNOLOGY
• Temporary joint operations protocol for two water storage reservoirs • Water treatment	• Elevating infrastructure • Re-siting groundwater wells • Regionalizing lift stations • Consolidating WWTPs • Strategic storage and deep tunnels • Integrated water master plan	• Real-time monitoring of infrastructure operations • Predictive analytics for sanitary sewer overflows • Collaboration with research institutions and other utilities • Technology hub

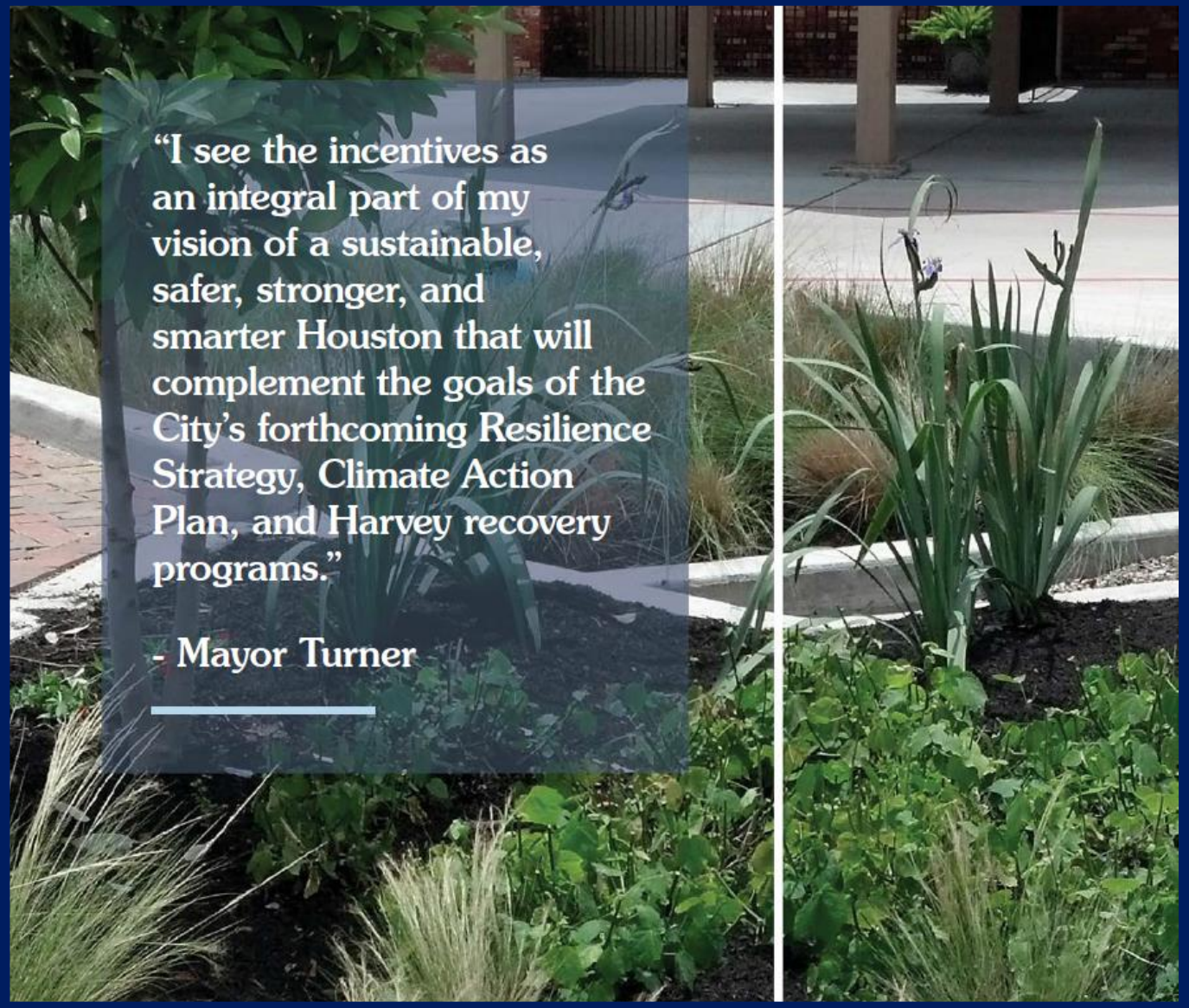
WHAT DOES BUILDING RESILIENCE LOOK LIKE FOR STORMWATER?

- Storm water action team

- Green stormwater infrastructure
  - Bioretention
  - Green roofs
  - Permeable pavement
  - Rainwater harvesting
  - Soil amendments
  - Urban forestry
  - Vegetated filter strips

INCENTIVES FOR GREEN DEVELOPMENT

- Integrated GSI development rules
- Property tax abatements
- Increased permitting process certainty and speed



HOUSTON CLIMATE IMPACT ASSESSMENT

TEMPERATURE

Basic Indicators:
- Cumulative temperature
- Duration
- Extremes: daily records
- Extremes: daily exceedances

Intermediate Indicators:
- Temperature range

PRECIPITATION

Basic Indicators:
- Cumulative precipitation
- Extremes: daily records
- Extremes: daily exceedances

Intermediate Indicators:
- Drought index
- Frequency of historic rain events

LEVERAGING EXISTING PARTNERSHIPS AND OPPORTUNITIES

A ONE WATER APPROACH

RESILIENT HOUSTON STRATEGY

REGION How can flood mitigation projects be better coordinated across agencies and jurisdictions, including not just flood management agencies but also school districts, housing authorities, and economic development groups that can play an important role? What are opportunities and roadblocks to consistent regulations and standards across jurisdictions? What is a regional vision for water management from “Prairie to Bay”? How can the region consider positive and negative upstream and downstream (full watershed) impacts? How can we better translate science to action by creating tactical plans and projects for climate adaptation and water resilience? **CITY** What are the critical data and resources needed to develop a comprehensive long range plan for flooding and climate adaptation? What climate risk projections and data exist, what are the gaps, and what should climate targets be? How do we plan based on future projections and uncertainty and not the past? What are the opportunities and barriers to developing a long range plan for flooding and climate adaptation? How can short-term land management and acquisition enable better long term development? (also region and bayou scale) How can we better connect water resilience to other major shocks and stresses? **BAYOU** How can bayous and watersheds be an organizing structure for stronger cross-jurisdictional communication, planning, and data collection? How can decision-making be informed by a wider lens of factors (including ongoing coordination, climate projections, project funding, regulatory levers)? Space for bayous? How can we better integrate surface and subsurface water management (including subsidence issues)? How can the co-benefit approach of tying flood infrastructure with green space be pursued more broadly and systematically? **NEIGHBORHOOD** Incentives for resilient development How can we develop a framework for buyouts (and land swaps)/elevation/adaptation with a goal of keeping flood-prone neighborhoods whole? How do climate and flood risks relate to health, transit, and housing opportunities in neighborhoods? How can Houston more concretely tie water resilience and flood protection discussions to discussions about equity and environmental justice issues? **INDIVIDUAL** How do we address homes and structures built before floodplain regulations were put into place? How can Houstonians better protect their homes and belongings by reducing stormwater runoff on their properties? **ACROSS SCALES** How can we promote multi-scaled and integrated water planning and interventions from the region to the individual lot?

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