TFMA FALL CONFERENCE, SAN ANTONIO

HYDROLOGIC AND HYDRAULIC IMPACTS OF NOAA ATLAS 14

AUGUST 28. 2019

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PRESENTATION TOPICS

- Atlas 14 Basics
- Major Changes in Texas
- New Regulations & Impacts
  - Austin
  - TxDOT
  - Houston
  - San Antonio

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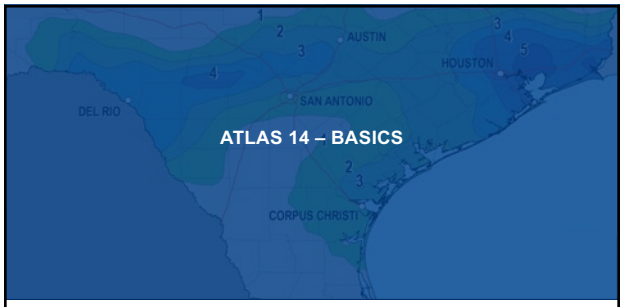

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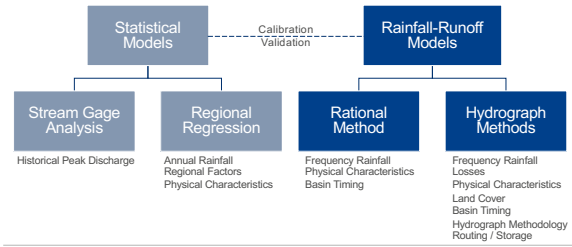
ATLAS 14 | HYDROLOGIC APPLICATION

HYDROLOGY – QUANTIFICATION OF RUNOFF



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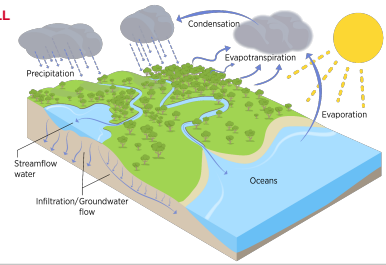
ATLAS 14 BASICS | HYDROLOGIC APPLICATION

APPLICATION OF RAINFALL

- Source
- Storm Duration
- Temporal Distribution
- Spatial Distribution
- Loss Methods



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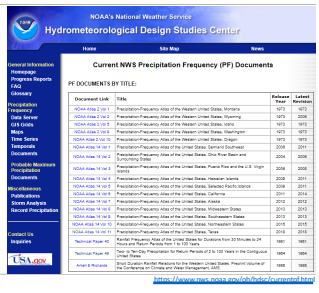
ATLAS 14 BASICS | RAINFALL DATA HISTORY

1961 TP-40

- Weather Bureau Technical Paper 40
  - Rainfall up to 1958
  - Durations 30 Minutes to 24 Hours
  - Return Periods 1 to 100 years
  - Thousands of stations, though most had length of record around 15 years.

1964 TP-49

- Weather Bureau Technical Paper 49
  - Rainfall up to 1958
  - Durations 2 to 10 Days
  - Return Periods 2 to 100 years
  - 94 stations of daily data with 50-year period of record
  - +276 stations with 20-year period of record



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ATLAS 14 BASICS | RAINFALL DATA HISTORY

1977 NOAA/NWS HYDRO-35

- North Dakota to Texas eastward
- 5- to 60-minute Precipitation Frequency
- Updates TP-40, TP-49
  - Most changes in the Appalachians

https://www.nws.noaa.gov/oh/hdsc/PF_documents/TechnicalMemo_HYDRO35.pdf

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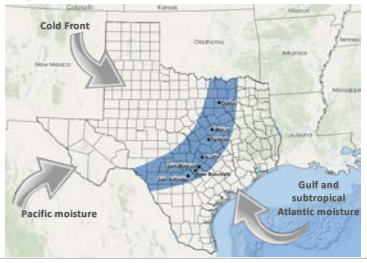
ATLAS 14 BASICS | RAINFALL DATA HISTORY

WHAT ABOUT TEXAS?

Texas is geographically located to be subject to big floods



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ATLAS 14 BASICS | RAINFALL DATA HISTORY

1998 ASQUITH

- USGS/TxDOT
- Depth-Duration Frequency of Precipitation for Texas
  - Rainfall up to 1994
  - Durations – 2 Distributions:
    - (GLO) 15 Minutes to 24 Hours
    - (GEV) 1, 2, 3, 5, and 7 days
  - Return Periods 2 to 500 years
  - 1000+ NWS precipitation stations
    - 15-minute recording
    - Hourly recording
    - Daily recording

https://pubs.usgs.gov/wri/wri98-4044/pdf/98-4044.pdf

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ATLAS 14 BASICS | RAINFALL DATA HISTORY

2004 ASQUITH/ROUSSEL

- USGS/TxDOT
- Atlas (96 Maps) of Depth-Duration Frequency of Precipitation for Texas
- Updated the 1998 Study
  - SAME DATA (Rainfall data to 1994)
  - Same Return Periods 2 to 500 years
  - Same 1000+ NWS precipitation stations
  - Durations – 1 Distribution:
    - ~~(GLO) 15 Minutes to 24 Hours~~
    - ~~(GEV) 1, 2, 3, 5, and 7 days~~
    - 15, 30 minutes
    - 1, 2, 3, 6, and 12 hours
    - 1, 2, 3, 5, and 7 days

https://pubs.usgs.gov/sir/2004/5041/pdf/sir2004-5041.pdf

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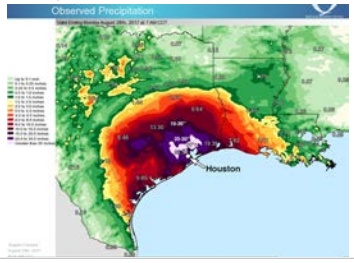
ATLAS 14 BASICS | RAINFALL DATA HISTORY

NOAA ATLAS 14, VOL. 11 - TEXAS

- Hurricane Harvey 2016



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ATLAS 14 BASICS | RAINFALL DATA HISTORY

NOAA ATLAS 14, VOL. 11 - TEXAS

- GIS based, gridded precipitation frequency estimates
- L-moment Statistical distributions
- Supersedes (in National Dataset)
  - Hydro 35
  - TP40
  - TP49
- Data from 1833-2017
- 11,934 precipitation stations (federal/state/local agencies)
- Durations: 5 minutes through 60 days
- Return Intervals: 1 through 1000 years

https://www.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume11.pdf

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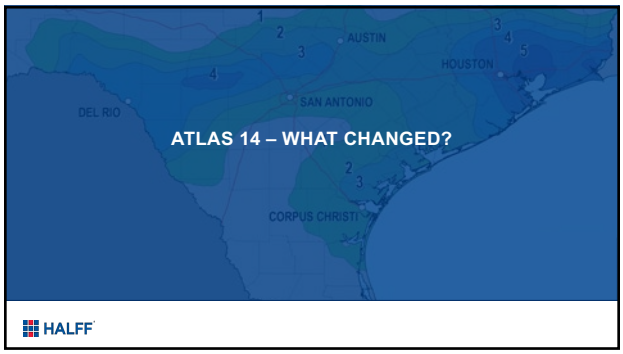
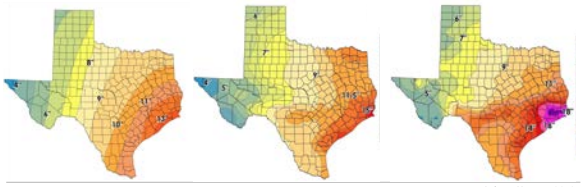


ATLAS 14 | RAINFALL DATA HISTORY

1961 TP-40
- Weather Bureau Technical Paper 40
  Rainfall up to 1958

1998/2004 USGS
- Depth-Duration Frequency of Precipitation for Texas
  Rainfall up to 1994

2018 ATLAS 14
- NOAA Atlas 14, Volume 11 Precipitation Frequency Atlas of the Unites States, Texas
  Rainfall up to 2017



24-hour, 100-year Precipitation

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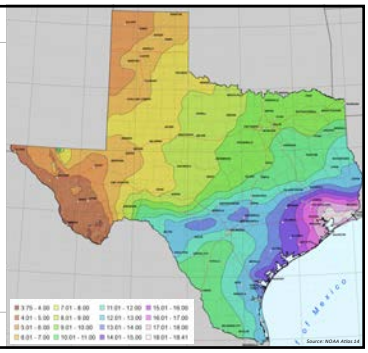
ATLAS 14 | WHAT CHANGED?

RAINFALL CHANGES
- New Rainfall Depths for each return interval



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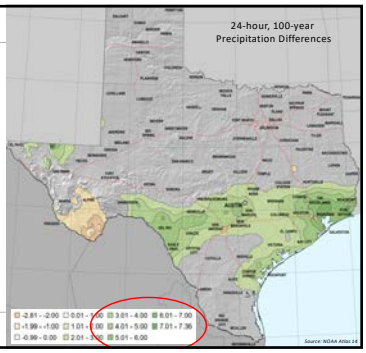
ATLAS 14 | RAINFALL CHANGES

ATLAS 14 – TP40



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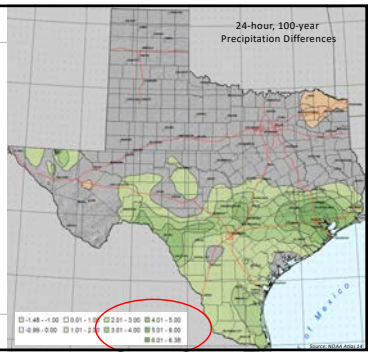
ATLAS 14 | RAINFALL CHANGES

ATLAS 14 – USGS 2004



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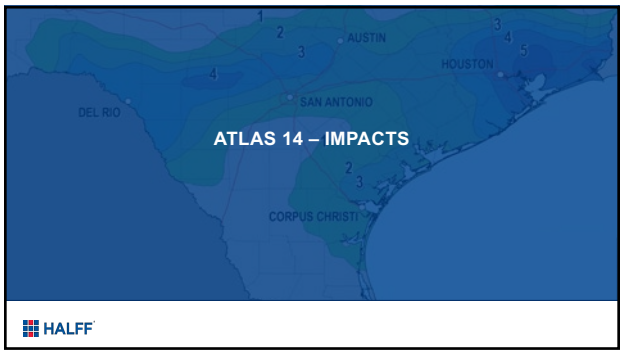

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ATLAS 14 | FLOOD RISK

INCREASED FLOOD RISK

- Existing infrastructure at greater risk
  - Buildings, Roadways, Channels, Dams, Levees, Storm Drains, Ponds
- Larger floodplains
  - Depth of flooding increases
  - Faster moving water
- Increased cost to mitigate risk
  - Capital Improvements
  - Development

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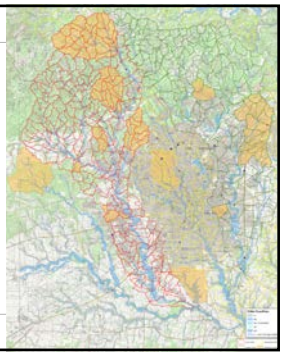
ATLAS 14 | IMPACTS

COMMUNITY IMPACTS

- Updated floodplain maps
- Additional Structures in the floodplain
- Additional Structures requiring flood insurance
- Possible increase in flood insurance premiums

CITIES / AGENCIES IMPACTS

- Capital Projects
  - Ongoing
  - Recently completed
- Infrastructure
- Funding for restudies



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ATLAS 14 | IMPACTS

DEVELOPMENT IMPACTS

- Increase in subdivision construction cost
  - Can vary greatly depending on size, complexity and location
- Increase in drainage infrastructure
- Wider easements
- Adjustment to subdivision layout
- Adverse impact analyses

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ATLAS 14 | AUSTIN

CITY OF AUSTIN *www.AustinTexas.gov/Atlas14*

- Atlas 14 Floodplains
  - Restudy of Austin area floodplains
  - Insurance is not affected until new FEMA maps are published
- Floodplain Regulations
  - Interim definition of floodplain
  - Exemptions: Redevelopment & Colorado River
  - Freeboard: 2 feet across City
- Capital Improvement Projects
  - Feasibility or Preliminary Design: Use Atlas 14
  - Design Complete / Construction: Case by case

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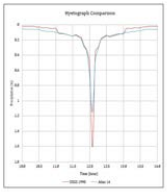
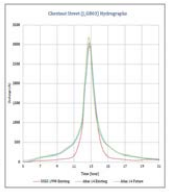
WHAT ARE THE RESULTS? | BASTROP COUNTY





CITY OF BASTROP

- Gills Branch
  - Small Wide Basin
  - Snyder's UH
  - Flow: Similar to previous
  - Volume: ~30% increase

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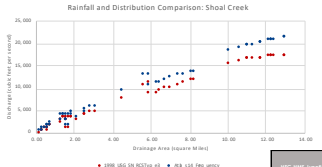
WHAT ARE THE RESULTS? | TRAVIS COUNTY



CITY OF AUSTIN

- Shoal Creek
  - Small Narrow Basin
  - SCS UH
  - Flow: ~20% increase
  - Volume: ~25% increase

HEC-HMS Junction Name	Drainage Area (sq.)	USGS 1998 Peak Discharge (CFS)	USGS 1998 Volume (AC-FT)	Atlas 14 Peak Discharge (CFS)	Atlas 14 Volume (AC-FT)	USGS 1998 vs Atlas 14 Peak Discharge (CFS)	USGS 1998 vs Atlas 14 Volume (AC-FT)
Outlet	12.94	17,584	6,032	21,321	7,304	22%	24%
J-SHL_32a	12.14	17,349	5,639	20,910	7,021	21%	24%
J-SHL_29b	11.22	16,889	5,211	20,073	6,487	19%	24%
J-SHL_29a	10.99	16,768	5,107	19,870	6,357	19%	24%
J-SHL_26_WAL_DSY	10.01	15,901	4,454	18,824	5,793	18%	24%
J-SHL_24	7.39	10,954	3,450	13,069	4,293	19%	24%
J-SHL_18b	5.84	11,394	2,830	13,527	3,518	19%	23%
J-SHL_15_POB_04b	4.30	8,111	2,213	9,845	2,729	21%	23%
J-SHL_13	2.53	4,361	1,273	5,400	1,564	24%	23%
UT Pond	1.54	1,540	794	2,110	972	37%	22%
ZK Pond	0.61	1,048	314	1,471	385	59%	22%

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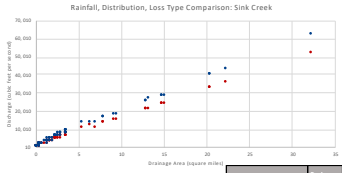
WHAT ARE THE RESULTS? | HAYS COUNTY



CITY OF SAN MARCOS

- Sink Creek
  - Wide Basin Larger Size
  - Snyder's UH
  - Flow: ~20% increase
  - Volume: ~35% increase

HEC-HMS Junction Name	Drainage Area (MI^2)	USGS 1998 Peak Discharge (CFS)	USGS 1998 Volume (AC-FT)	Atlas 14 Peak Discharge (CFS)	Atlas 14 Volume (AC-FT)	USGS 1998 vs Atlas 14 Peak Discharge (CFS)	USGS 1998 vs Atlas 14 Volume (AC-FT)
J_USM0420	0.45	1,822	204	2,159	268	18%	32%
J_USM0430	1.28	4,262	709	4,951	891	16%	26%
J_USM0420	2.93	6,992	1,287	8,049	1,705	15%	33%
J_USM0430	5.44	11,804	2,384	13,742	3,161	17%	33%
J_USM0340_USM0350	7.97	14,556	3,879	17,454	5,011	20%	29%
J_USM0390_USM0400	14.66	23,791	7,840	29,062	9,911	22%	26%
J_USM0440_USM0480	32.01	51,976	15,966	63,331	20,506	22%	28%

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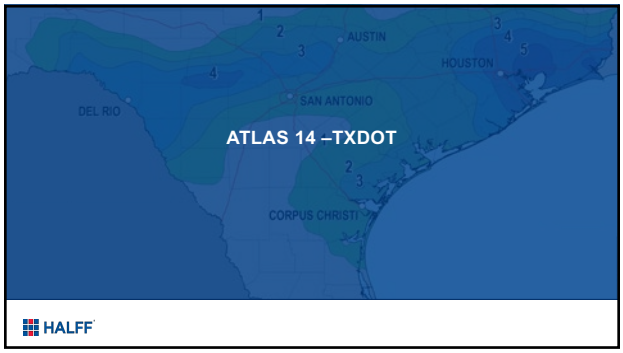

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ATLAS 14 | TXDOT

TxDOT

- Hydraulic Design Manual
  - Changes how we compute runoff: Rational and Hydrograph Methods
- Projects
  - Planning & Schematic: Use Atlas 14
  - Final Design Stage: Case by case
- Timeline
  - End of 2019

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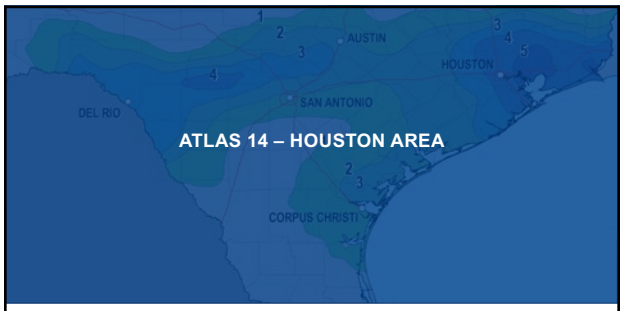

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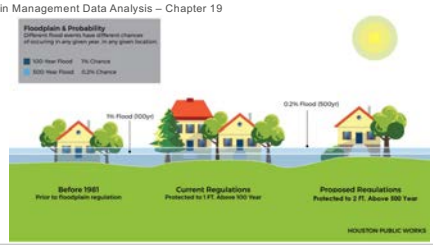
ATLAS 14 | HOUSTON

HOUSTON PUBLIC WORKS https://www.houstontx.gov/council/g/chapter19/Floodplain-Mgmt-Data-Analysis.pdf

- Floodplain Management Data Analysis – Chapter 19



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ATLAS 14 | HOUSTON

HOUSTON PUBLIC WORKS https://www.houstontx.gov/council/g/chapter19/Floodplain-Mgmt-Data-Analysis.pdf

- Floodplain Management Data Analysis – Chapter 19

RULES	EXISTING	PROPOSED
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

Table 4 – Comparison of Existing and Proposed Chapter 19 Provisions

33%
Structures within the 500-year floodplain that were impacted by Harvey.

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ATLAS 14 | HARRIS COUNTY

HARRIS COUNTY https://www.hcfcd.org/technical-manuals/technical-document-library/

- Harris County Flood Control District (HCFCD) Policy Procedure & Criteria Manual (PCPM)
  - Adopted Changes in June 2019
  - Watershed Approach
- MAAP*next* (Modeling Assessment and Awareness Project)
  - Will update FEMA Flood Insurance Rate Maps for all of Harris County
  - Ongoing when Atlas 14 was released

Region	Representative Watershed	Current Rainfall (in)	Atlas 14 Rainfall (in)	Change (in)
2-year, 24-hour Rainfall Depth				
Region 1	Cypress Creek	4.1	4.8	0.7
Region 2	Greens Bayou	4.4	5.1	0.7
Region 3	Clear Creek	4.5	5.3	0.8
10-year, 24-hour Rainfall				
Region 1	Cypress Creek	7.1	8.2	1.1
Region 2	Greens Bayou	7.6	8.7	1.1
Region 3	Clear Creek	7.8	9.3	1.5
100-year, 24-hour Rainfall Depth				
Region 1	Cypress Creek	12.4	16.3	3.9
Region 2	Greens Bayou	13.2	16.9	3.7
Region 3	Clear Creek	13.5	18.0	4.5
500-year, 24-hour Rainfall Depth				
Region 1	Cypress Creek	17.7	24.2	6.5
Region 2	Greens Bayou	18.9	25.0	6.1
Region 3	Clear Creek	19.3	27.2	7.9

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ATLAS 14 | HARRIS COUNTY

HARRIS COUNTY https://www.hcfcd.org/technical-manuals/technical-document-library/

- **MAAP*next*** and Interim Guidelines
- Floodplain Mitigation Criteria Updates
  - Mitigate Fill placed within the 500-year
  - Bridges and Culverts
    - no impact to the 500-, 100-, or 10-year
  - Bridge Low Chords – placed at the HIGHER of:
    - 1.5' above BFE
    - 500-year WSE
  - GOAL – no adverse impact resulting from structures for storms up to and including the current 500-year event

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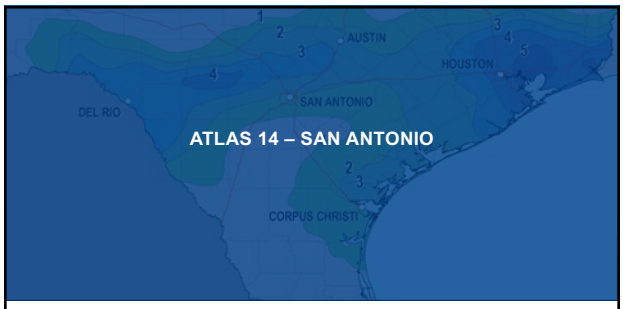

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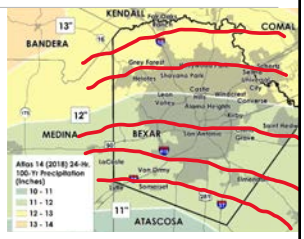
ATLAS 14 | SAN ANTONIO

BRWM

- Took Atlas 14 Data and filtered it through San Antonio River Basin (SARB) Modeling Standards
  - Hyetographs used same Temporal structure
  - Type II Distribution
  - Maintained Aereal Reduction methodology
  - Ellipsoid Orientation
- Interim discussions with Stakeholder Group
- Looked at most effective way to apply the differing rainfall depths that were shown across the County.



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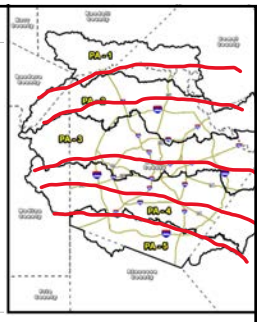

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ATLAS 14 | SAN ANTONIO

NEW DATA

- 5 Precipitation Areas (PAs)
  - Best fit with existing watershed boundaries & major highway divides
- DDF and IDF tables for each of the 5 PAs
- HEC .dss file with rainfall data
- SARB Modeling Standards
- CoSA Chapter 35, Appendix H

Mean Rainfall Depths For 24-HR Duration

Precipitation Area	Area (sq mi)	Depth (Inches) 5-YR	25-YR	100-YR
PA - 1	257	5.51	8.93	12.87
PA - 2	425	5.42	8.74	12.49
PA - 3	558	5.30	8.45	11.97
PA - 4	593	5.18	8.19	11.50
PA - 5	226	5.11	8.01	11.15

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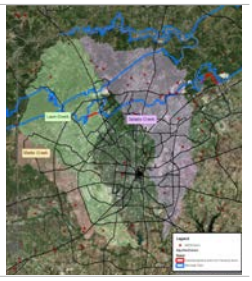
ATLAS 14 | SAN ANTONIO

SARA

- Atlas 14 Floodplains (2-4 years)
  - Salado Creek (In Progress)
  - Leon Creek (In Progress)
  - Medina/Medio Creeks (In Progress)
  - Upper San Antonio (Soon)
  - Cibolo Creek (Soon)
- Insurance is not affected until new FEMA maps are published
- Floodplain Regulations
  - New projects use Atlas 14 for Adverse Impact Analysis
  - Design Complete / Construction: Case by case



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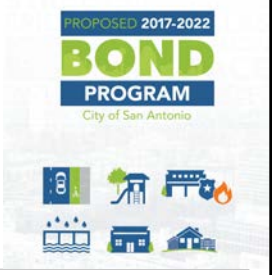
ATLAS 14 | SAN ANTONIO

CITY OF SAN ANTONIO

- Capital Improvement Projects
  - Feasibility or Preliminary Design: Use Atlas 14
  - Design Complete / Construction: Case by case
  - 2017 Bond Projects affected
  - City and several consultants have been doing Atlas 14 "checks" to better understand the impacts.



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PROJECT CHECK #1 | BARBARA DRIVE PHASE 2

- Project Site drains 1.75 Square Miles (1120 Acres)
- Multiple Phases
  - Phase 1- Buyouts, Channel Improvements
  - Phase 2: Addressing Barbara Drive Floodplain and McCullough Low Water Crossing
  - Phase 3- Future Upstream Improvements
- Phase 2 Improvements
  - 3-10 x 9 RCB ~2700LF
  - ~400 LF Inlet Improvements
  - Lateral tie-ins @McCullough and Mountaintop

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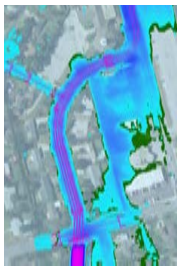
PROJECT CHECK #1 | BARBARA DRIVE PHASE 2



POST-PROJECT RESPONSE TO ATLAS 14:

- Increases in surface discharge, WSE and velocity within project area and downstream channel

Critical Result: Greater Risk shown at low water crossing at McCullough (100-year WSE increase of 0.3'), lower mitigation impact shown for original design

Modest Result: Downstream channel has 2' freeboard, 0.3' increase is not as crucial but maybe a problem for other projects with limited channel capacity

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PROJECT CHECK #2 | LADDIE PLACE REGIONAL DETENTION

- Project Site Drains 1.6 Square Miles
- Laddie Phase III
  - 28.5-acre site
  - Two Detention Ponds
  - 266 acre-feet Storage
- Laddie Phase II
  - New Facilities
  - Utility Adjustments
- Laddie Phase I
  - Drains down Kampman Blvd to Woodlawn Lake

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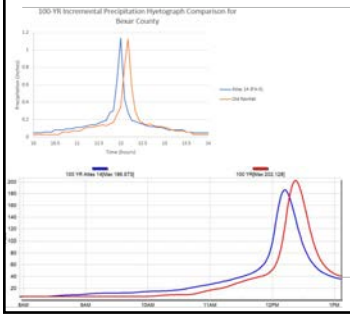
PROJECT CHECK #2 | LADDIE PLACE REGIONAL DETENTION



RESULTS

- HYETOGRAPH
  - Peaked earlier
  - More area under the curve (Volume)
- Runoff Hydrograph
  - Volume increased by 8%
  - Peak Flow 8% less
  - 11 minutes earlier
  - Volume passes through the system before the peak

ATLAS 14 | SAN ANTONIO

FLOODPLAIN MAPPING – INTERIM

- *Current status*
  - CoSA regulatory floodplains use Atlas 14 data
  - Adverse Impact Analysis uses Atlas 14 data
  - CLOMR/LOMR use 2010 rainfall data
- *After* CoSA and SARA accept revised DFIRM, ALL will use Atlas 14 data.

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ATLAS 14 | THANK YOU

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