



Flow Regime Recommendations, Implementation Rules and Testing



Matrix Format

- Flows and volumes rounded to avoid unwarranted precision
- Flows <1 cfs are rounded up to 1 cfs
- “Flashy” locations regime different from mainstem locations with larger drainage areas
- Overbank and High Flow Pulses (HFPs)
 - Q_p – peak flow required
 - Volume
 - Duration

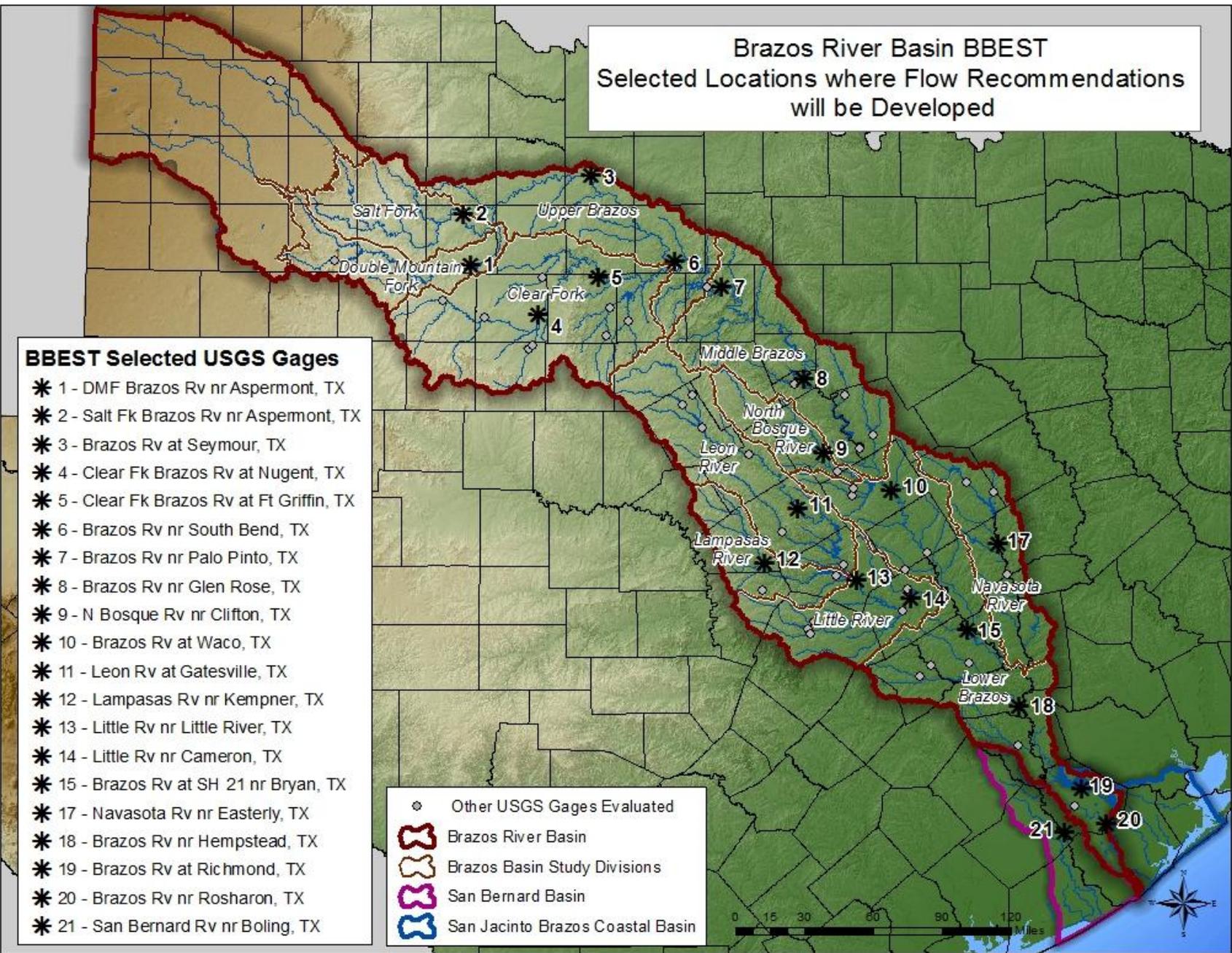


Brazos River Basin BBEST
Selected Locations where Flow Recommendations
will be Developed

BBEST Selected USGS Gages

- * 1 - DMF Brazos Rv nr Aspermont, TX
- * 2 - Salt Fk Brazos Rv nr Aspermont, TX
- * 3 - Brazos Rv at Seymour, TX
- * 4 - Clear Fk Brazos Rv at Nugent, TX
- * 5 - Clear Fk Brazos Rv at Ft Griffin, TX
- * 6 - Brazos Rv nr South Bend, TX
- * 7 - Brazos Rv nr Palo Pinto, TX
- * 8 - Brazos Rv nr Glen Rose, TX
- * 9 - N Bosque Rv nr Clifton, TX
- * 10 - Brazos Rv at Waco, TX
- * 11 - Leon Rv at Gatesville, TX
- * 12 - Lampasas Rv nr Kempner, TX
- * 13 - Little Rv nr Little River, TX
- * 14 - Little Rv nr Cameron, TX
- * 15 - Brazos Rv at SH 21 nr Bryan, TX
- * 17 - Navasota Rv nr Easterly, TX
- * 18 - Brazos Rv nr Hempstead, TX
- * 19 - Brazos Rv at Richmond, TX
- * 20 - Brazos Rv nr Rosharon, TX
- * 21 - San Bernard Rv nr Boling, TX

- Other USGS Gages Evaluated
- ▭ Brazos River Basin
- ▭ Brazos Basin Study Divisions
- ▭ San Bernard Basin
- ▭ San Jacinto Brazos Coastal Basin





Flow Regime Elements

- Overbank Flows – blue
 - If no recommendation, historical occurrence greater than 1 per 5 years, increased number of HFPs at these sites
 - Multiple overbank recommendations occur at sites with flat channels and banks
- HFPs – black to gray gradation
 - Black = larger, less frequent events
 - Light Gray = smaller, more frequent events
- Seasonal Events – Baseflows and some HFPs
 - Box empty – no recommendation for HFP for that season based on infrequency of HFPs in historical data
- Base Flows – three per season, three levels based on hydrologic condition (dry, average, wet)
- Subsistence - tan



Flow Regime Recommendations

Double Mountain Fork Brazos River Near Aspermont



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|--------------------------------|--|-----|-----|-----|--|-----|-----|-----|--|-----|-----|-----|
| High Flow Pulses | Qp: 16,300 cfs with Average Frequency 1 per 5 years Regressed Volume is 77,100 Duration Bound is 31 | | | | | | | | | | | |
| | Qp: 9,490 cfs with Average Frequency 1 per 2 years Regressed Volume is 44,900 Duration Bound is 27 | | | | | | | | | | | |
| | Qp: 5,130 cfs with Average Frequency 1 per year Regressed Volume is 24,300 Duration Bound is 23 | | | | | | | | | | | |
| | Qp: 92 cfs with Average Frequency 1 per season Regressed Volume is 610 Duration Bound is 12 | | | | Qp: 2,730 cfs with Average Frequency 1 per season Regressed Volume is 12,500 Duration Bound is 17 | | | | Qp: 2,540 cfs with Average Frequency 1 per season Regressed Volume is 11,900 Duration Bound is 19 | | | |
| | Qp: 30 cfs with Average Frequency 2 per season Regressed Volume is 180 Duration Bound is 8 | | | | Qp: 1,120 cfs with Average Frequency 2 per season Regressed Volume is 5,120 Duration Bound is 14 | | | | Qp: 1,040 cfs with Average Frequency 2 per season Regressed Volume is 4,750 Duration Bound is 14 | | | |
| | | | | | Qp: 570 cfs with Average Frequency 3 per season Regressed Volume is 2,600 Duration Bound is 12 | | | | Qp: 480 cfs with Average Frequency 3 per season Regressed Volume is 2,160 Duration Bound is 12 | | | |
| | | | | | Qp: 280 cfs with Average Frequency 4 per season Regressed Volume is 1,270 Duration Bound is 10 | | | | Qp: 230 cfs with Average Frequency 4 per season Regressed Volume is 990 Duration Bound is 9 | | | |
| Base Flows (cfs) | 15 | | | | 8 | | | | 7 | | | |
| | 4 | | | | 3 | | | | 2 | | | |
| | 1 | | | | 1 | | | | 1 | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

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| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1940 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 8 cfs, or when the flow is below 45 cfs and the flow drops from one day to the next by less than 5%.

Salt Fork Brazos River Near Aspermont



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|-------------------------|--|-----|-----|-----|--|-----|-----|-----|--|-----|-----|-----|
| Overbank Events | Qp: 6,040 cfs with Average Frequency 1 per 2 years Regressed Volume is 29,400 Duration Bound is 26 | | | | | | | | | | | |
| | Qp: 3,610 cfs with Average Frequency 1 per year Regressed Volume is 17,500 Duration Bound is 23 | | | | | | | | | | | |
| High Flow Pulses | Qp: 71 cfs with Average Frequency 1 per season Regressed Volume is 510 Duration Bound is 14 | | | | Qp: 1,790 cfs with Average Frequency 1 per season Regressed Volume is 8,310 Duration Bound is 16 | | | | Qp: 1,580 cfs with Average Frequency 1 per season Regressed Volume is 7,680 Duration Bound is 18 | | | |
| | Qp: 31 cfs with Average Frequency 2 per season Regressed Volume is 210 Duration Bound is 10 | | | | Qp: 670 cfs with Average Frequency 2 per season Regressed Volume is 3,070 Duration Bound is 13 | | | | Qp: 520 cfs with Average Frequency 2 per season Regressed Volume is 2,310 Duration Bound is 13 | | | |
| | | | | | Qp: 300 cfs with Average Frequency 3 per season Regressed Volume is 1,350 Duration Bound is 11 | | | | Qp: 260 cfs with Average Frequency 3 per season Regressed Volume is 1,090 Duration Bound is 10 | | | |
| | | | | | Qp: 160 cfs with Average Frequency 4 per season Regressed Volume is 720 Duration Bound is 10 | | | | Qp: 140 cfs with Average Frequency 4 per season Regressed Volume is 560 Duration Bound is 8 | | | |
| Base Flows (cfs) | 9 | | | | 5 | | | | 3 | | | |
| | 4 | | | | 2 | | | | 1 | | | |
| | 1 | | | | 1 | | | | 1 | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

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| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1940 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 6 cfs, or when the flow is below 28 cfs and the flow drops from one day to the next by less than 5%.

Brazos River at Seymour



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|-------------------------|--|-----|-----|---|-----|-----|---|--------|-----|-----|-----|-----|
| Overbank Events | Qp: 16,800 cfs with Average Frequency 1 per 2 years Regressed Volume is 125,000 Duration Bound is 35 | | | | | | | | | | | |
| | Qp: 10,400 cfs with Average Frequency 1 per year Regressed Volume is 74,100 Duration Bound is 29 | | | | | | | | | | | |
| High Flow Pulses | Qp: 250 cfs with Average Frequency 1 per season Regressed Volume is 1,560 Duration Bound is 10 | | | Qp: 4,730 cfs with Average Frequency 1 per season Regressed Volume is 30,500 Duration Bound is 20 | | | Qp: 4,570 cfs with Average Frequency 1 per season Regressed Volume is 28,600 Duration Bound is 21 | | | | | |
| | Qp: 97 cfs with Average Frequency 2 per season Regressed Volume is 490 Duration Bound is 6 | | | Qp: 2,000 cfs with Average Frequency 2 per season Regressed Volume is 12,000 Duration Bound is 15 | | | Qp: 1,560 cfs with Average Frequency 2 per season Regressed Volume is 8,910 Duration Bound is 14 | | | | | |
| | | | | Qp: 1,040 cfs with Average Frequency 3 per season Regressed Volume is 5,870 Duration Bound is 12 | | | Qp: 800 cfs with Average Frequency 3 per season Regressed Volume is 4,290 Duration Bound is 11 | | | | | |
| | | | | Qp: 560 cfs with Average Frequency 4 per season Regressed Volume is 2,960 Duration Bound is 10 | | | Qp: 370 cfs with Average Frequency 4 per season Regressed Volume is 1,870 Duration Bound is 8 | | | | | |
| | | | | | | | | | | | | |
| Base Flows (cfs) | 46 | | | 35 | | | 32 | | | | | |
| | 25 | | | 19 | | | 13 | | | | | |
| | 10 | | | 7 | | | 4 | | | | | |
| Subsistence Flows (cfs) | 1 | | | 1 | | | 1 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Winter | | | | Spring | | | | Summer | | | | |

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| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1924 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 42 cfs, or when the flow is below 152 cfs and the flow drops from one day to the next by less than 5%.

Clear Fork Brazos River near Nugent



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|--------------------------------|--|--|-----|--|--|--------|--|--|--|--|--|--------|--|--|-----|--|--|-----|--|--|-----|--|--|-----|--|--|-----|--|--|-----|--|--|-----|--|--|
| Overbank Events | Qp: 7,850 cfs with Average Frequency 1 per 5 years Regressed Volume is 41,700 Duration Bound is 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| High Flow Pulses | Qp: 4,460 cfs with Average Frequency 1 per 2 years Regressed Volume is 23,400 Duration Bound is 24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Qp: 2,390 cfs with Average Frequency 1 per year Regressed Volume is 12,300 Duration Bound is 21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Qp: 110 cfs with Average Frequency 1 per season Regressed Volume is 710 Duration Bound is 15 | | | | Qp: 1,290 cfs with Average Frequency 1 per season Regressed Volume is 6,220 Duration Bound is 15 | | | | Qp: 980 cfs with Average Frequency 1 per season Regressed Volume is 4,980 Duration Bound is 16 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Qp: 26 cfs with Average Frequency 2 per season Regressed Volume is 160 Duration Bound is 9 | | | | Qp: 590 cfs with Average Frequency 2 per season Regressed Volume is 2,800 Duration Bound is 12 | | | | Qp: 390 cfs with Average Frequency 2 per season Regressed Volume is 1,890 Duration Bound is 12 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Qp: 180 cfs with Average Frequency 4 per season Regressed Volume is 860 Duration Bound is 9 | | | | Qp: 100 cfs with Average Frequency 4 per season Regressed Volume is 460 Duration Bound is 8 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Base Flows (cfs) | 13 | | | | 12 | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8 | | | | 6 | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5 | | | | 3 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nov | | | Dec | | | Jan | | | Feb | | | Mar | | | Apr | | | May | | | Jun | | | Jul | | | Aug | | | Sep | | | Oct | | |
| Winter | | | | | | Spring | | | | | | Summer | | | | | | | | | | | | | | | | | | | | | | | |

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| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1925 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 6 cfs, or when the flow is below 29 cfs and the flow drops from one day to the next by less than 5%.

Clear Fork Brazos River near Fort Griffin



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|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| Overbank Events | Qp: 8,630 cfs with Average Frequency 1 per 2 years Regressed Volume is 53,500 Duration Bound is 27 | | | | | | | | | | | |
| | Qp: 4,970 cfs with Average Frequency 1 per year Regressed Volume is 30,700 Duration Bound is 24 | | | | | | | | | | | |
| High Flow Pulses | Qp: 240 cfs with Average Frequency 1 per season Regressed Volume is 1,740 Duration Bound is 16 | | | | Qp: 2,970 cfs with Average Frequency 1 per season Regressed Volume is 17,700 Duration Bound is 18 | | | | Qp: 1,980 cfs with Average Frequency 1 per season Regressed Volume is 11,900 Duration Bound is 20 | | | |
| | Qp: 61 cfs with Average Frequency 2 per season Regressed Volume is 430 Duration Bound is 11 | | | | Qp: 1,230 cfs with Average Frequency 2 per season Regressed Volume is 7,310 Duration Bound is 15 | | | | Qp: 700 cfs with Average Frequency 2 per season Regressed Volume is 4,110 Duration Bound is 16 | | | |
| | | | | | Qp: 360 cfs with Average Frequency 4 per season Regressed Volume is 2,120 Duration Bound is 12 | | | | Qp: 110 cfs with Average Frequency 4 per season Regressed Volume is 620 Duration Bound is 10 | | | |
| | | | | | | | | | | | | |
| Base Flows (cfs) | 34 | | | | 27 | | | | 20 | | | |
| | 17 | | | | 13 | | | | 5 | | | |
| | 8 | | | | 4 | | | | 1 | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

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|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 2/1/1924 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 6 cfs, or when the flow is below 73 cfs and the flow drops from one day to the next by less than 5%.

Brazos River near South Bend



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|-------------------------|--|-----|-----|---|--------|-----|---|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 25,400 cfs with Average Frequency 1 per 2 years Regressed Volume is 228,000 Duration Bound is 35 | | | | | | | | | | | |
| | Qp: 15,800 cfs with Average Frequency 1 per year Regressed Volume is 133,000 Duration Bound is 29 | | | | | | | | | | | |
| High Flow Pulses | Qp: 960 cfs with Average Frequency 1 per season Regressed Volume is 6,870 Duration Bound is 12 | | | Qp: 9,560 cfs with Average Frequency 1 per season Regressed Volume is 72,100 Duration Bound is 21 | | | Qp: 7,440 cfs with Average Frequency 1 per season Regressed Volume is 57,200 Duration Bound is 23 | | | | | |
| | Qp: 280 cfs with Average Frequency 2 per season Regressed Volume is 1,640 Duration Bound is 7 | | | Qp: 4,550 cfs with Average Frequency 2 per season Regressed Volume is 31,100 Duration Bound is 16 | | | Qp: 2,560 cfs with Average Frequency 2 per season Regressed Volume is 17,000 Duration Bound is 15 | | | | | |
| | | | | Qp: 2,480 cfs with Average Frequency 3 per season Regressed Volume is 15,700 Duration Bound is 13 | | | Qp: 1,180 cfs with Average Frequency 3 per season Regressed Volume is 7,050 Duration Bound is 11 | | | | | |
| | | | | Qp: 1,260 cfs with Average Frequency 4 per season Regressed Volume is 7,280 Duration Bound is 10 | | | Qp: 580 cfs with Average Frequency 4 per season Regressed Volume is 3,140 Duration Bound is 8 | | | | | |
| Base Flows (cfs) | 120 | | | 100 | | | 95 | | | | | |
| | 73 | | | 60 | | | 46 | | | | | |
| | 36 | | | 29 | | | 16 | | | | | |
| Subsistence Flows (cfs) | 1 | | | 1 | | | 1 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

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|------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1939 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 115 cfs, or when the flow is below 388 cfs and the flow drops from one day to the next by less than 5%.

Brazos River near Palo Pinto



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|-------------------------|--|-----|-----|-----|--|-----|-----|-----|---|-----|-----|-----|
| High Flow Pulses | Qp: 25,800 cfs with Average Frequency 1 per 2 years Regressed Volume is 301,000 Duration Bound is 32 | | | | | | | | | | | |
| | Qp: 17,500 cfs with Average Frequency 1 per year Regressed Volume is 182,000 Duration Bound is 26 | | | | | | | | | | | |
| | Qp: 1,890 cfs with Average Frequency 1 per season Regressed Volume is 10,900 Duration Bound is 8 | | | | Qp: 10,700 cfs with Average Frequency 1 per season Regressed Volume is 88,000 Duration Bound is 18 | | | | Qp: 7,440 cfs with Average Frequency 1 per season Regressed Volume is 61,100 Duration Bound is 17 | | | |
| | Qp: 1,390 cfs with Average Frequency 2 per season Regressed Volume is 7,180 Duration Bound is 7 | | | | Qp: 3,370 cfs with Average Frequency 2 per season Regressed Volume is 20,200 Duration Bound is 10 | | | | Qp: 2,260 cfs with Average Frequency 2 per season Regressed Volume is 13,000 Duration Bound is 9 | | | |
| | Qp: 850 cfs with Average Frequency 4 per season Regressed Volume is 3,690 Duration Bound is 5 | | | | Qp: 1,400 cfs with Average Frequency 4 per season Regressed Volume is 6,600 Duration Bound is 6 | | | | Qp: 1,230 cfs with Average Frequency 4 per season Regressed Volume is 5,920 Duration Bound is 6 | | | |
| Base Flows (cfs) | 100 | | | | 120 | | | | 120 | | | |
| | 61 | | | | 75 | | | | 72 | | | |
| | 40 | | | | 39 | | | | 40 | | | |
| Subsistence Flows (cfs) | 17 | | | | 17 | | | | 17 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

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| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1925 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 169 cfs, or when the flow is below 693 cfs and the flow drops from one day to the next by less than 5%.

Brazos River at Glen Rose



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|-------------------------|--|-----|-----|---|--------|-----|---|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 33,600 cfs with Average Frequency 1 per 2 years Regressed Volume is 327,000 Duration Bound is 29 | | | | | | | | | | | |
| | Qp: 22,200 cfs with Average Frequency 1 per year Regressed Volume is 203,000 Duration Bound is 24 | | | | | | | | | | | |
| High Flow Pulses | Qp: 3,230 cfs with Average Frequency 1 per season Regressed Volume is 22,600 Duration Bound is 13 | | | Qp: 13,400 cfs with Average Frequency 1 per season Regressed Volume is 109,000 Duration Bound is 19 | | | Qp: 7,760 cfs with Average Frequency 1 per season Regressed Volume is 62,500 Duration Bound is 17 | | | | | |
| | Qp: 1,700 cfs with Average Frequency 2 per season Regressed Volume is 10,800 Duration Bound is 10 | | | Qp: 6,480 cfs with Average Frequency 2 per season Regressed Volume is 46,700 Duration Bound is 14 | | | Qp: 3,090 cfs with Average Frequency 2 per season Regressed Volume is 21,200 Duration Bound is 12 | | | | | |
| | Qp: 930 cfs with Average Frequency 4 per season Regressed Volume is 5,400 Duration Bound is 8 | | | Qp: 2,350 cfs with Average Frequency 4 per season Regressed Volume is 14,300 Duration Bound is 10 | | | Qp: 1,320 cfs with Average Frequency 4 per season Regressed Volume is 7,830 Duration Bound is 8 | | | | | |
| | | | | | | | | | | | | |
| Base Flows (cfs) | 160 | | | 170 | | | 160 | | | | | |
| | 77 | | | 92 | | | 70 | | | | | |
| | 42 | | | 47 | | | 37 | | | | | |
| Subsistence Flows (cfs) | 16 | | | 16 | | | 16 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1924 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 180 cfs, or when the flow is below 920 cfs and the flow drops from one day to the next by less than 5%.

North Bosque River at Clifton



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|-------------------------|---|-----|-----|--------|---|-----|-----|--------|--|-----|-----|-----|
| High Flow Pulses | Qp: 19,800 cfs with Average Frequency 1 per 5 years Regressed Volume is 91,100 Duration Bound is 30 | | | | | | | | | | | |
| | Qp: 13,900 cfs with Average Frequency 1 per 2 years Regressed Volume is 64,300 Duration Bound is 27 | | | | | | | | | | | |
| | Qp: 8,650 cfs with Average Frequency 1 per year Regressed Volume is 40,300 Duration Bound is 24 | | | | | | | | | | | |
| | Qp: 1,490 cfs with Average Frequency 1 per season Regressed Volume is 8,720 Duration Bound is 18 | | | | Qp: 5,820 cfs with Average Frequency 1 per season Regressed Volume is 25,900 Duration Bound is 19 | | | | Qp: 1,080 cfs with Average Frequency 1 per season Regressed Volume is 4,300 Duration Bound is 12 | | | |
| | Qp: 420 cfs with Average Frequency 2 per season Regressed Volume is 2,500 Duration Bound is 13 | | | | Qp: 2,170 cfs with Average Frequency 2 per season Regressed Volume is 10,100 Duration Bound is 15 | | | | Qp: 350 cfs with Average Frequency 2 per season Regressed Volume is 1,380 Duration Bound is 8 | | | |
| | Qp: 120 cfs with Average Frequency 3 per season Regressed Volume is 750 Duration Bound is 10 | | | | | | | | Qp: 130 cfs with Average Frequency 3 per season Regressed Volume is 500 Duration Bound is 6 | | | |
| | | | | | Qp: 710 cfs with Average Frequency 4 per season Regressed Volume is 3,490 Duration Bound is 12 | | | | | | | |
| Base Flows (cfs) | 25 | | | | 33 | | | | 17 | | | |
| | 12 | | | | 16 | | | | 8 | | | |
| | 5 | | | | 7 | | | | 3 | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Winter | | | | Spring | | | | Summer | | | | |

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| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1924 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 24 cfs, or when the flow is below 104 cfs and the flow drops from one day to the next by less than 5%.



Brazos River at Waco

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|--------------------------------|--|---|--|-----|--------|-----|-----|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 42,600 cfs with Average Frequency 1 per 2 years Regressed Volume is 427,000 Duration Bound is 26 | | | | | | | | | | | |
| High Flow Pulses | Qp: 30,800 cfs with Average Frequency 1 per year Regressed Volume is 288,000 Duration Bound is 22 | | | | | | | | | | | |
| | Qp: 8,450 cfs with Average Frequency 1 per season Regressed Volume is 61,100 Duration Bound is 13 | Qp: 23,500 cfs with Average Frequency 1 per season Regressed Volume is 197,000 Duration Bound is 18 | Qp: 10,000 cfs with Average Frequency 1 per season Regressed Volume is 77,900 Duration Bound is 16 | | | | | | | | | |
| | Qp: 4,180 cfs with Average Frequency 2 per season Regressed Volume is 25,700 Duration Bound is 9 | Qp: 13,600 cfs with Average Frequency 2 per season Regressed Volume is 102,000 Duration Bound is 14 | Qp: 4,160 cfs with Average Frequency 2 per season Regressed Volume is 26,400 Duration Bound is 10 | | | | | | | | | |
| | Qp: 2,320 cfs with Average Frequency 4 per season Regressed Volume is 12,400 Duration Bound is 7 | Qp: 5,330 cfs with Average Frequency 4 per season Regressed Volume is 32,700 Duration Bound is 10 | Qp: 1,980 cfs with Average Frequency 4 per season Regressed Volume is 10,500 Duration Bound is 7 | | | | | | | | | |
| Base Flows (cfs) | 480 | | | | 690 | | | | 590 | | | |
| | 210 | | | | 270 | | | | 250 | | | |
| | 120 | | | | 150 | | | | 140 | | | |
| Subsistence Flows (cfs) | 56 | | | | 56 | | | | 56 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1900 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 300 cfs, or when the flow is below 1960 cfs and the flow drops from one day to the next by less than 5%.

Leon River near Gatesville



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| Overbank Events | Qp: 7,580 cfs with Average Frequency 1 per 2 years Regressed Volume is 80,200 Duration Bound is 39 | | | | | | | | | | | |
| High Flow Pulses | Qp: 5,300 cfs with Average Frequency 1 per year Regressed Volume is 52,300 Duration Bound is 33 | | | | | | | | | | | |
| | Qp: 1,010 cfs with Average Frequency 1 per season Regressed Volume is 7,160 Duration Bound is 16 | | | | | | | | | | | |
| | Qp: 280 cfs with Average Frequency 2 per season Regressed Volume is 1,890 Duration Bound is 10 | | | | Qp: 1,390 cfs with Average Frequency 2 per season Regressed Volume is 10,600 Duration Bound is 18 | | | | Qp: 340 cfs with Average Frequency 2 per season Regressed Volume is 1,640 Duration Bound is 9 | | | |
| | Qp: 100 cfs with Average Frequency 3 per season Regressed Volume is 540 Duration Bound is 6 | | | | Qp: 630 cfs with Average Frequency 3 per season Regressed Volume is 4,050 Duration Bound is 13 | | | | Qp: 140 cfs with Average Frequency 3 per season Regressed Volume is 600 Duration Bound is 6 | | | |
| | | | | | Qp: 340 cfs with Average Frequency 4 per season Regressed Volume is 1,910 Duration Bound is 10 | | | | Qp: 58 cfs with Average Frequency 4 per season Regressed Volume is 220 Duration Bound is 4 | | | |
| Base Flows (cfs) | 52 | | | 54 | | | 27 | | | | | |
| | 20 | | | 24 | | | 12 | | | | | |
| | 9 | | | 10 | | | 4 | | | | | |
| Subsistence Flows (cfs) | 1 | | | 1 | | | 1 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1951 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 43 cfs, or when the flow is below 225 cfs and the flow drops from one day to the next by less than 5%.

Lampasas River near Kempner



| | | | | | | | | | | | | |
|-------------------------|---|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| High Flow Pulses | Qp: 13,000 cfs with Average Frequency 1 per 5 years Regressed Volume is 77,000 Duration Bound is 38 | | | | | | | | | | | |
| | Qp: 7,960 cfs with Average Frequency 1 per 2 years Regressed Volume is 46,000 Duration Bound is 32 | | | | | | | | | | | |
| | Qp: 4,690 cfs with Average Frequency 1 per year Regressed Volume is 26,300 Duration Bound is 26 | | | | | | | | | | | |
| | Qp: 740 cfs with Average Frequency 1 per season Regressed Volume is 4,990 Duration Bound is 18 | | | | Qp: 2,650 cfs with Average Frequency 1 per season Regressed Volume is 14,000 Duration Bound is 20 | | | | Qp: 540 cfs with Average Frequency 1 per season Regressed Volume is 2,040 Duration Bound is 9 | | | |
| | Qp: 190 cfs with Average Frequency 2 per season Regressed Volume is 1,150 Duration Bound is 11 | | | | Qp: 1,310 cfs with Average Frequency 2 per season Regressed Volume is 6,860 Duration Bound is 16 | | | | Qp: 190 cfs with Average Frequency 2 per season Regressed Volume is 680 Duration Bound is 6 | | | |
| | Qp: 78 cfs with Average Frequency 3 per season Regressed Volume is 430 Duration Bound is 8 | | | | Qp: 780 cfs with Average Frequency 3 per season Regressed Volume is 4,020 Duration Bound is 13 | | | | Qp: 77 cfs with Average Frequency 3 per season Regressed Volume is 270 Duration Bound is 4 | | | |
| | Base Flows (cfs) | 39 | | | | 43 | | | | 32 | | |
| 27 | | | | 29 | | | | 23 | | | | |
| 18 | | | | 21 | | | | 16 | | | | |
| Subsistence Flows (cfs) | 10 | | | | 10 | | | | 10 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1963 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 40 cfs, or when the flow is below 96 cfs and the flow drops from one day to the next by less than 5%.

Little River at Little River



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| Overbank Events | Qp: 11,700 cfs with Average Frequency 1 per 5 years Regressed Volume is 198,000 Duration Bound is 38 | | | | | | | | | | | |
| High Flow Pulses | Qp: 8,890 cfs with Average Frequency 1 per 2 years Regressed Volume is 134,000 Duration Bound is 32 | | | | | | | | | | | |
| | Qp: 6,740 cfs with Average Frequency 1 per year Regressed Volume is 89,800 Duration Bound is 27 | | | | | | | | | | | |
| | Qp: 2,960 cfs with Average Frequency 1 per season Regressed Volume is 28,300 Duration Bound is 17 | | | | Qp: 5,310 cfs with Average Frequency 1 per season Regressed Volume is 63,400 Duration Bound is 23 | | | | Qp: 2,470 cfs with Average Frequency 1 per season Regressed Volume is 20,300 Duration Bound is 13 | | | |
| | Qp: 1,600 cfs with Average Frequency 2 per season Regressed Volume is 11,800 Duration Bound is 11 | | | | Qp: 3,290 cfs with Average Frequency 2 per season Regressed Volume is 32,200 Duration Bound is 17 | | | | Qp: 1,060 cfs with Average Frequency 2 per season Regressed Volume is 5,890 Duration Bound is 8 | | | |
| | Qp: 520 cfs with Average Frequency 4 per season Regressed Volume is 2,350 Duration Bound is 5 | | | | Qp: 1,420 cfs with Average Frequency 4 per season Regressed Volume is 9,760 Duration Bound is 10 | | | | Qp: 430 cfs with Average Frequency 4 per season Regressed Volume is 1,560 Duration Bound is 4 | | | |
| | Qp: 520 cfs with Average Frequency 4 per season Regressed Volume is 2,350 Duration Bound is 5 | | | | Qp: 1,420 cfs with Average Frequency 4 per season Regressed Volume is 9,760 Duration Bound is 10 | | | | Qp: 430 cfs with Average Frequency 4 per season Regressed Volume is 1,560 Duration Bound is 4 | | | |
| Base Flows (cfs) | 190 | | | | 340 | | | | 200 | | | |
| | 110 | | | | 150 | | | | 120 | | | |
| | 82 | | | | 95 | | | | 84 | | | |
| Subsistence Flows (cfs) | 55 | | | | 55 | | | | 55 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1963 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 242 cfs, or when the flow is below 1110 cfs and the flow drops from one day to the next by less than 5%.

Little River near Cameron



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| Overbank Events | Qp: 29,900 cfs with Average Frequency 1 per 2 years Regressed Volume is 324,000 Duration Bound is 29 | | | | | | | | | | | |
| High Flow Pulses | Qp: 19,700 cfs with Average Frequency 1 per year Regressed Volume is 198,000 Duration Bound is 24 | | | | | | | | | | | |
| | Qp: 9,550 cfs with Average Frequency 1 per season Regressed Volume is 85,600 Duration Bound is 19 | | | | Qp: 12,800 cfs with Average Frequency 1 per season Regressed Volume is 121,000 Duration Bound is 20 | | | | Qp: 4,800 cfs with Average Frequency 1 per season Regressed Volume is 35,300 Duration Bound is 14 | | | |
| | Qp: 4,630 cfs with Average Frequency 2 per season Regressed Volume is 36,700 Duration Bound is 14 | | | | Qp: 7,550 cfs with Average Frequency 2 per season Regressed Volume is 65,400 Duration Bound is 17 | | | | Qp: 2,070 cfs with Average Frequency 2 per season Regressed Volume is 13,200 Duration Bound is 10 | | | |
| | Qp: 2,140 cfs with Average Frequency 3 per season Regressed Volume is 14,900 Duration Bound is 10 | | | | Qp: 4,790 cfs with Average Frequency 3 per season Regressed Volume is 38,400 Duration Bound is 14 | | | | Qp: 990 cfs with Average Frequency 3 per season Regressed Volume is 5,550 Duration Bound is 8 | | | |
| | Qp: 1,080 cfs with Average Frequency 4 per season Regressed Volume is 6,680 Duration Bound is 8 | | | | Qp: 3,200 cfs with Average Frequency 4 per season Regressed Volume is 23,900 Duration Bound is 12 | | | | Qp: 560 cfs with Average Frequency 4 per season Regressed Volume is 2,860 Duration Bound is 6 | | | |
| Base Flows (cfs) | 460 | | | 760 | | | 330 | | | | | |
| | 190 | | | 310 | | | 160 | | | | | |
| | 110 | | | 140 | | | 97 | | | | | |
| Subsistence Flows (cfs) | 32 | | | 32 | | | 32 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1917 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 190 cfs, or when the flow is below 1730 cfs and the flow drops from one day to the next by less than 5%.

Brazos River near Bryan



| | | | | | | | | | | | | |
|-------------------------|--|-----|-----|---|--------|-----|---|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 66,900 cfs with Average Frequency 1 per 2 years Regressed Volume is 989,000 Duration Bound is 35 | | | | | | | | | | | |
| | Qp: 49,400 cfs with Average Frequency 1 per year Regressed Volume is 675,000 Duration Bound is 30 | | | | | | | | | | | |
| High Flow Pulses | Qp: 22,600 cfs with Average Frequency 1 per season Regressed Volume is 243,000 Duration Bound is 20 | | | Qp: 32,900 cfs with Average Frequency 1 per season Regressed Volume is 421,000 Duration Bound is 25 | | | Qp: 12,100 cfs with Average Frequency 1 per season Regressed Volume is 114,000 Duration Bound is 16 | | | | | |
| | Qp: 11,200 cfs with Average Frequency 2 per season Regressed Volume is 100,000 Duration Bound is 14 | | | Qp: 17,800 cfs with Average Frequency 2 per season Regressed Volume is 193,000 Duration Bound is 18 | | | Qp: 5,000 cfs with Average Frequency 2 per season Regressed Volume is 38,100 Duration Bound is 10 | | | | | |
| | Qp: 5,570 cfs with Average Frequency 3 per season Regressed Volume is 41,900 Duration Bound is 10 | | | Qp: 10,400 cfs with Average Frequency 3 per season Regressed Volume is 97,000 Duration Bound is 14 | | | Qp: 2,990 cfs with Average Frequency 3 per season Regressed Volume is 20,100 Duration Bound is 8 | | | | | |
| | Qp: 3,230 cfs with Average Frequency 4 per season Regressed Volume is 21,100 Duration Bound is 7 | | | Qp: 6,050 cfs with Average Frequency 4 per season Regressed Volume is 49,000 Duration Bound is 11 | | | Qp: 2,060 cfs with Average Frequency 4 per season Regressed Volume is 12,700 Duration Bound is 7 | | | | | |
| Base Flows (cfs) | 1,760 | | | 2,460 | | | 1,470 | | | | | |
| | 860 | | | 1,260 | | | 920 | | | | | |
| | 540 | | | 710 | | | 630 | | | | | |
| Subsistence Flows (cfs) | 300 | | | 300 | | | 300 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1928 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 833 cfs, or when the flow is below 5080 cfs and the flow drops from one day to the next by less than 5%.

Navasota River near Easterly



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|---|--------|-----|--|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 16,700 cfs with Average Frequency 1 per 2 years Regressed Volume is 142,000 Duration Bound is 30 | | | | | | | | | | | |
| | Qp: 10,800 cfs with Average Frequency 1 per year Regressed Volume is 88,500 Duration Bound is 26 | | | | | | | | | | | |
| High Flow Pulses | Qp: 4,390 cfs with Average Frequency 1 per season Regressed Volume is 34,300 Duration Bound is 21 | | | Qp: 5,470 cfs with Average Frequency 1 per season Regressed Volume is 41,100 Duration Bound is 19 | | | Qp: 410 cfs with Average Frequency 1 per season Regressed Volume is 2,340 Duration Bound is 10 | | | | | |
| | Qp: 1,700 cfs with Average Frequency 2 per season Regressed Volume is 12,300 Duration Bound is 16 | | | Qp: 2,380 cfs with Average Frequency 2 per season Regressed Volume is 16,700 Duration Bound is 15 | | | Qp: 120 cfs with Average Frequency 2 per season Regressed Volume is 580 Duration Bound is 7 | | | | | |
| | Qp: 800 cfs with Average Frequency 3 per season Regressed Volume is 5,440 Duration Bound is 12 | | | Qp: 1,340 cfs with Average Frequency 3 per season Regressed Volume is 8,990 Duration Bound is 13 | | | Qp: 49 cfs with Average Frequency 3 per season Regressed Volume is 220 Duration Bound is 5 | | | | | |
| | Qp: 260 cfs with Average Frequency 4 per season Regressed Volume is 1,610 Duration Bound is 9 | | | Qp: 720 cfs with Average Frequency 4 per season Regressed Volume is 4,590 Duration Bound is 11 | | | | | | | | |
| Base Flows (cfs) | 23 | | | 29 | | | 16 | | | | | |
| | 14 | | | 19 | | | 8 | | | | | |
| | 9 | | | 10 | | | 3 | | | | | |
| Subsistence Flows (cfs) | 1 | | | 1 | | | 1 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.
 Period of record used : 1/1/1925 to 12/31/2010.
 Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 27 cfs, or when the flow is below 108 cfs and the flow drops from one day to the next by less than 5%.

Navasota River near Easterly



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|--|-----|-----|-----|
| Overbank Events | Qp: 16,700 cfs with Average Frequency 1 per 2 years Regressed Volume is 142,000 Duration Bound is 30 | | | | | | | | | | | |
| | Qp: 10,800 cfs with Average Frequency 1 per year Regressed Volume is 88,500 Duration Bound is 26 | | | | | | | | | | | |
| High Flow Pulses | Qp: 4,390 cfs with Average Frequency 1 per season Regressed Volume is 34,300 Duration Bound is 21 | | | | Qp: 5,470 cfs with Average Frequency 1 per season Regressed Volume is 41,100 Duration Bound is 19 | | | | Qp: 410 cfs with Average Frequency 1 per season Regressed Volume is 2,340 Duration Bound is 10 | | | |
| | Qp: 1,700 cfs with Average Frequency 2 per season Regressed Volume is 12,300 Duration Bound is 16 | | | | Qp: 2,380 cfs with Average Frequency 2 per season Regressed Volume is 16,700 Duration Bound is 15 | | | | Qp: 120 cfs with Average Frequency 2 per season Regressed Volume is 580 Duration Bound is 7 | | | |
| | Qp: 800 cfs with Average Frequency 3 per season Regressed Volume is 5,440 Duration Bound is 12 | | | | Qp: 1,340 cfs with Average Frequency 3 per season Regressed Volume is 8,990 Duration Bound is 13 | | | | Qp: 49 cfs with Average Frequency 3 per season Regressed Volume is 220 Duration Bound is 5 | | | |
| | Qp: 260 cfs with Average Frequency 4 per season Regressed Volume is 1,610 Duration Bound is 9 | | | | Qp: 720 cfs with Average Frequency 4 per season Regressed Volume is 4,590 Duration Bound is 11 | | | | | | | |
| Base Flows (cfs) | 23 | | | | 29 | | | | 16 | | | |
| | 14 | | | | 19 | | | | 8 | | | |
| | 9 | | | | 10 | | | | 3 | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1925 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 27 cfs, or when the flow is below 108 cfs and the flow drops from one day to the next by less than 5%.

Brazos River near Hempstead



| | | | | | | | | | | | | |
|--------------------------------|--|---|---|-----|--------|-----|-----|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 63,900 cfs with Average Frequency 1 per 2 years Regressed Volume is 1,331,000 Duration Bound is 40 | | | | | | | | | | | |
| High Flow Pulses | Qp: 50,000 cfs with Average Frequency 1 per year Regressed Volume is 952,000 Duration Bound is 35 | | | | | | | | | | | |
| | Qp: 24,800 cfs with Average Frequency 1 per season Regressed Volume is 368,000 Duration Bound is 23 | Qp: 34,200 cfs with Average Frequency 1 per season Regressed Volume is 589,000 Duration Bound is 29 | Qp: 10,300 cfs with Average Frequency 1 per season Regressed Volume is 104,000 Duration Bound is 14 | | | | | | | | | |
| | Qp: 11,200 cfs with Average Frequency 2 per season Regressed Volume is 125,000 Duration Bound is 15 | Qp: 16,800 cfs with Average Frequency 2 per season Regressed Volume is 219,000 Duration Bound is 19 | Qp: 5,090 cfs with Average Frequency 2 per season Regressed Volume is 40,900 Duration Bound is 9 | | | | | | | | | |
| | Qp: 5,720 cfs with Average Frequency 3 per season Regressed Volume is 49,800 Duration Bound is 10 | Qp: 8,530 cfs with Average Frequency 3 per season Regressed Volume is 85,000 Duration Bound is 13 | Qp: 2,620 cfs with Average Frequency 3 per season Regressed Volume is 17,000 Duration Bound is 7 | | | | | | | | | |
| Base Flows (cfs) | 2,890 | | | | 3,440 | | | | 2,050 | | | |
| | 1,440 | | | | 1,900 | | | | 1,330 | | | |
| | 920 | | | | 1,130 | | | | 950 | | | |
| Subsistence Flows (cfs) | 510 | | | | 510 | | | | 510 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1939 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 1200 cfs, or when the flow is below 7680 cfs and the flow drops from one day to the next by less than 5%.

Brazos River near Richmond



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| Overbank Events | Qp: 68,100 cfs with Average Frequency 1 per 2 years Regressed Volume is 1,487,000 Duration Bound is 41 | | | | | | | | | | | |
| High Flow Pulses | Qp: 51,600 cfs with Average Frequency 1 per year Regressed Volume is 1,019,000 Duration Bound is 35 | | | | | | | | | | | |
| | Qp: 24,600 cfs with Average Frequency 1 per season Regressed Volume is 383,000 Duration Bound is 23 | | | | Qp: 35,000 cfs with Average Frequency 1 per season Regressed Volume is 617,000 Duration Bound is 29 | | | | Qp: 12,900 cfs with Average Frequency 1 per season Regressed Volume is 144,000 Duration Bound is 15 | | | |
| | Qp: 12,400 cfs with Average Frequency 2 per season Regressed Volume is 150,000 Duration Bound is 16 | | | | Qp: 16,300 cfs with Average Frequency 2 per season Regressed Volume is 215,000 Duration Bound is 19 | | | | Qp: 5,430 cfs with Average Frequency 2 per season Regressed Volume is 46,300 Duration Bound is 10 | | | |
| | Qp: 6,410 cfs with Average Frequency 3 per season Regressed Volume is 60,600 Duration Bound is 11 | | | | Qp: 8,930 cfs with Average Frequency 3 per season Regressed Volume is 94,000 Duration Bound is 13 | | | | Qp: 2,460 cfs with Average Frequency 3 per season Regressed Volume is 16,400 Duration Bound is 6 | | | |
| Base Flows (cfs) | 3,310 | | | | 3,980 | | | | 2,190 | | | |
| | 1,650 | | | | 2,140 | | | | 1,330 | | | |
| | 990 | | | | 1,190 | | | | 930 | | | |
| Subsistence Flows (cfs) | 550 | | | | 550 | | | | 550 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1923 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 1260 cfs, or when the flow is below 8430 cfs and the flow drops from one day to the next by less than 5%.

Brazos River at Rosharon



| | | | | | | | | | | | | |
|--------------------------------|--|-----|-----|-----|---|-----|-----|-----|---|-----|-----|-----|
| Overbank Events | Qp: 60,900 cfs with Average Frequency 1 per 2 years Regressed Volume is 1,463,000 Duration Bound is 42 | | | | | | | | | | | |
| High Flow Pulses | Qp: 51,000 cfs with Average Frequency 1 per year Regressed Volume is 1,133,000 Duration Bound is 38 | | | | | | | | | | | |
| | Qp: 25,700 cfs with Average Frequency 1 per season Regressed Volume is 415,000 Duration Bound is 23 | | | | Qp: 33,700 cfs with Average Frequency 1 per season Regressed Volume is 665,000 Duration Bound is 31 | | | | Qp: 13,300 cfs with Average Frequency 1 per season Regressed Volume is 153,000 Duration Bound is 16 | | | |
| | Qp: 13,600 cfs with Average Frequency 2 per season Regressed Volume is 168,000 Duration Bound is 16 | | | | Qp: 14,200 cfs with Average Frequency 2 per season Regressed Volume is 184,000 Duration Bound is 18 | | | | Qp: 4,980 cfs with Average Frequency 2 per season Regressed Volume is 39,100 Duration Bound is 9 | | | |
| | Qp: 9,090 cfs with Average Frequency 3 per season Regressed Volume is 94,700 Duration Bound is 12 | | | | Qp: 6,580 cfs with Average Frequency 3 per season Regressed Volume is 58,500 Duration Bound is 10 | | | | Qp: 2,490 cfs with Average Frequency 3 per season Regressed Volume is 14,900 Duration Bound is 6 | | | |
| Base Flows (cfs) | 4,700 | | | | 4,740 | | | | 2,630 | | | |
| | 2,090 | | | | 2,570 | | | | 1,420 | | | |
| | 1,140 | | | | 1,250 | | | | 930 | | | |
| Subsistence Flows (cfs) | 430 | | | | 430 | | | | 430 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1972 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 1310 cfs, or when the flow is below 9850 cfs and the flow drops from one day to the next by less than 5%.

San Bernard River near Boling



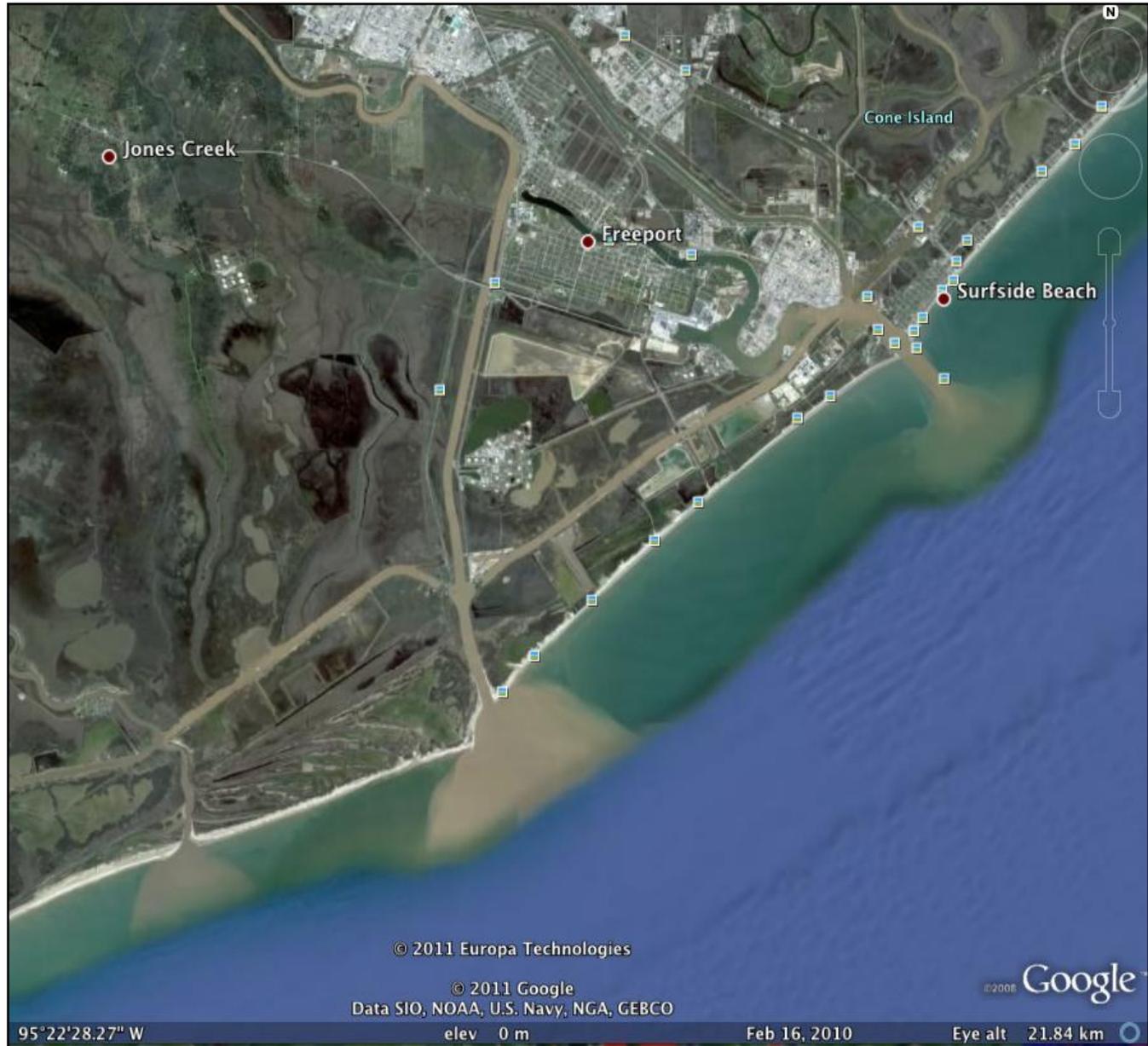
| | | | | | | | | | | | | |
|--------------------------------|---|-----|-----|---|--------|-----|---|-----|--------|-----|-----|-----|
| Overbank Events | Qp: 8,820 cfs with Average Frequency 1 per 2 years Regressed Volume is 123,000 Duration Bound is 32 | | | | | | | | | | | |
| | Qp: 6,110 cfs with Average Frequency 1 per year Regressed Volume is 79,200 Duration Bound is 27 | | | | | | | | | | | |
| High Flow Pulses | Qp: 3,310 cfs with Average Frequency 1 per season Regressed Volume is 39,400 Duration Bound is 21 | | | Qp: 3,220 cfs with Average Frequency 1 per season Regressed Volume is 36,100 Duration Bound is 20 | | | Qp: 2,330 cfs with Average Frequency 1 per season Regressed Volume is 25,000 Duration Bound is 19 | | | | | |
| | Qp: 1,940 cfs with Average Frequency 2 per season Regressed Volume is 20,100 Duration Bound is 16 | | | Qp: 1,570 cfs with Average Frequency 2 per season Regressed Volume is 14,900 Duration Bound is 14 | | | Qp: 780 cfs with Average Frequency 2 per season Regressed Volume is 7,250 Duration Bound is 13 | | | | | |
| | Qp: 1,060 cfs with Average Frequency 3 per season Regressed Volume is 9,370 Duration Bound is 12 | | | Qp: 680 cfs with Average Frequency 3 per season Regressed Volume is 5,300 Duration Bound is 10 | | | Qp: 470 cfs with Average Frequency 3 per season Regressed Volume is 4,050 Duration Bound is 10 | | | | | |
| | Qp: 510 cfs with Average Frequency 4 per season Regressed Volume is 3,710 Duration Bound is 8 | | | Qp: 350 cfs with Average Frequency 4 per season Regressed Volume is 2,360 Duration Bound is 7 | | | Qp: 300 cfs with Average Frequency 4 per season Regressed Volume is 2,480 Duration Bound is 9 | | | | | |
| Base Flows (cfs) | 73 | | | 85 | | | 140 | | | | | |
| | 43 | | | 53 | | | 98 | | | | | |
| | 23 | | | 32 | | | 64 | | | | | |
| Subsistence Flows (cfs) | 11 | | | 11 | | | 11 | | | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|-------------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.
 Period of record used : 1/1/1955 to 12/31/2010.
 Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 120 cfs, or when the flow is below 367 cfs and the flow drops from one day to the next by less than 5%.



Brazos River Estuary





Brazos and San Bernard Estuarine Flows

- Both riverine estuaries, not lagoon-type
 - Longitudinal continuum of habitats
- Not directly estimated
 - Extremely limited site-specific information regarding ecological dynamics
- Assumption – flows recommended for river would satisfy needs of estuaries



Brazos River Authority

Implementation Rules



Subsistence Flow Rules

- Substantial increase in frequency of flows at subsistence values should not result from the issuance of new water appropriations or amendments
- 50% of the difference between daily flow and the recommended subsistence flow be passed when inflows are between seasonal base low flow and subsistence values under dry hydrologic conditions



Subsistence Rule Example

- San Bernard at Boling
 - Subsistence = 11 cfs
 - Baseflow-Low, Summer = 64 cfs
 - Daily flow = 40 cfs
 - Amount must be passed = 25.5 cfs



Base Flow Rules

Average and Wet Hydrologic Conditions

1. If mean daily stream flow $<$ applicable base flow then seasonal base flows must be passed, no diversion or impoundment authorized
2. If mean daily stream flow $<$ lowest HFP and $>$ applicable base flow then seasonal base flows must be passed but remaining balance may be impounded or diverted



Base Flow Rules, continued

Dry Hyrdologic Conditions

3. If mean daily stream flow $<$ applicable base flow and $>$ subsistence, 50% of the difference should be passed



Base Flow Example #1

- Brazos River at Seymour
 - Hydrologic condition = wet
 - Spring, High Baseflow = 35 cfs
 - Mean daily flow = 33 cfs
 - No diversion or impoundment



Base Flow Example #2

- Brazos River at Seymour
 - Hydrologic condition = wet
 - Spring, High Baseflow = 35 cfs
 - Lowest, Spring HFP = 560
 - Mean daily flow = 80 cfs
 - 35 cfs must be passed
 - 45 cfs may be diverted or impounded



Base Flow Example #3

- Brazos River at Seymour
 - Hydrologic condition - dry
 - Spring, subsistence = 1 cfs
 - Baseflow-Low, Spring = 7 cfs
 - Mean Daily flow = 3 cfs
 - Amount must be passed = 2 cfs



HFPs and Overbank Rules

- Initiated when daily flow $\geq Q_p$
 - Events counted in season or year in which they begin
 - Higher magnitude events satisfy all lower magnitude events
1. If during an event, flows increase to meet the next level, the highest qualifying pulse requirements control passage of flows

Clear Fork Brazos River near Nugent



| | | | | | | | | | | | | |
|-------------------------|--|-----|-----|-----|--|-----|-----|-----|--|-----|-----|-----|
| Overbank Events | Qp: 7,850 cfs with Average Frequency 1 per 5 years Regressed Volume is 41,700 Duration Bound is 28 | | | | | | | | | | | |
| | Qp: 4,460 cfs with Average Frequency 1 per 2 years Regressed Volume is 23,400 Duration Bound is 24 | | | | | | | | | | | |
| High Flow Pulses | Qp: 2,390 cfs with Average Frequency 1 per year Regressed Volume is 12,300 Duration Bound is 21 | | | | | | | | | | | |
| | Qp: 110 cfs with Average Frequency 1 per season Regressed Volume is 710 Duration Bound is 15 | | | | Qp: 1,290 cfs with Average Frequency 1 per season Regressed Volume is 6,220 Duration Bound is 15 | | | | Qp: 980 cfs with Average Frequency 1 per season Regressed Volume is 4,980 Duration Bound is 16 | | | |
| | Qp: 26 cfs with Average Frequency 2 per season Regressed Volume is 160 Duration Bound is 9 | | | | Qp: 590 cfs with Average Frequency 2 per season Regressed Volume is 2,800 Duration Bound is 12 | | | | Qp: 390 cfs with Average Frequency 2 per season Regressed Volume is 1,890 Duration Bound is 12 | | | |
| | | | | | Qp: 180 cfs with Average Frequency 4 per season Regressed Volume is 860 Duration Bound is 9 | | | | Qp: 100 cfs with Average Frequency 4 per season Regressed Volume is 460 Duration Bound is 8 | | | |
| | | | | | | | | | | | | |
| Base Flows (cfs) | 13 | | | | 12 | | | | 9 | | | |
| | 8 | | | | 6 | | | | 4 | | | |
| | 5 | | | | 3 | | | | 1 | | | |
| Subsistence Flows (cfs) | 1 | | | | 1 | | | | 1 | | | |
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| | Winter | | | | Spring | | | | Summer | | | |

| | |
|------------------|--------------------|
| Base Flow Levels | High (75th %ile) |
| | Medium (50th %ile) |
| | Low (25th %ile) |

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1925 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 6 cfs, or when the flow is below 29 cfs and the flow drops from one day to the next by less than 5%.



HFP Example #1

- Clear Fork Brazos River near Nugent
 - Flow Day 1 = 190 cfs, meets 4/season
 - Flow Day 2 = 600 cfs, meets 2/season
 - Flow Day 5 = 1,500 cfs, meets 1/season
 - 1/Season Requirements will control the event, so:
 - Volume = 6,220 acre-feet
 - Duration – 21 days
 - If 1/season requirements met then count event as meeting the following HFP requirements:
 - 1/season rHFP requirement
 - 1, 2/season HFP and
 - 1, 4/season HFP



HFP Termination Rules

2. When volume requirements are met, **or**
3. When duration requirements are met, **or**
4. When the flow drops below the minimum value for a pulse. (The minimum value for a pulse for the particular gage is given.), **or**
5. When the flow is below the maximum value for base flow and the change in flow is a decrease of less than 5 percent. (The maximum value for base flow for the particular gage is given.)



HFP Termination Examples #2-5

- Clear Fork Brazos River near Nugent
 - HFP Spring, 1/season
 - $Q_p = 1,290$ cfs
 - Volume = 6,220 acre-feet
 - Duration 12 days
 - Event terminates when:
 - Volume passed $\geq 6,220$ acre-feet, **or**
 - Duration ≥ 12 days, **or**
 - Mean daily streamflow ≤ 6 cfs, **or**
 - Mean daily streamflow ≤ 29 cfs and decreases by 5% or less in a day



HFPs and Overbank Rules, continued

6. If applicable pulse recommendations have been satisfied and inflows $>$ seasonal base flow, then seasonal base flow must be passed, remaining flows may be diverted or impounded



HFP Example #6

- Clear Fork Brazos River near Nugent
 - HFP Spring, 1/season = 1,290 cfs, requirements met
 - Spring, Wet Baseflow = 12 cfs
 - Mean daily stream flow = 200 cfs
 - 12 cfs must be passed
 - 188 cfs may be diverted or impounded



Testing of Scenarios



Scenario Locations

- Brazos River at Seymour
- Brazos River at Richmond
- San Bernard – no specific alternative scenarios evaluated



Hydrologic Scenarios

- **Gaged** – daily flows from 1940 – 1997
- **WAM** – monthly flows intended to represent current conditions with respect to water rights, considering full utilization of all rights
 - **WAM 8** – actual, current diversion rates
 - **G WAM** – WAM model adjusted to represent conditions expected to be in place in 2060
- **With Projects** – conditions expected in the future if various water supply projects are completed
- **E-flow Only** – environmental flow recommendations only



With Projects

- Seymour
 - Double Mountain Fork-West Reservoir
- Richmond
 - Double Mountain Fork-West Reservoir
 - Millican Panther Creek Reservoir
- Used estimated daily project outflows based on daily inflows and projected reservoir capacity



E-Flows Scenario Unrealistic

- Supposes “infinite infrastructure”
 - Capacity to divert or impound all water in excess of the e-flow recommendations
 - In reality, projects have limits on diversion rates or total volume impounded
- Does not consider downstream water rights
 - Some water that could physically be diverted via a new project is already legally obligated downstream

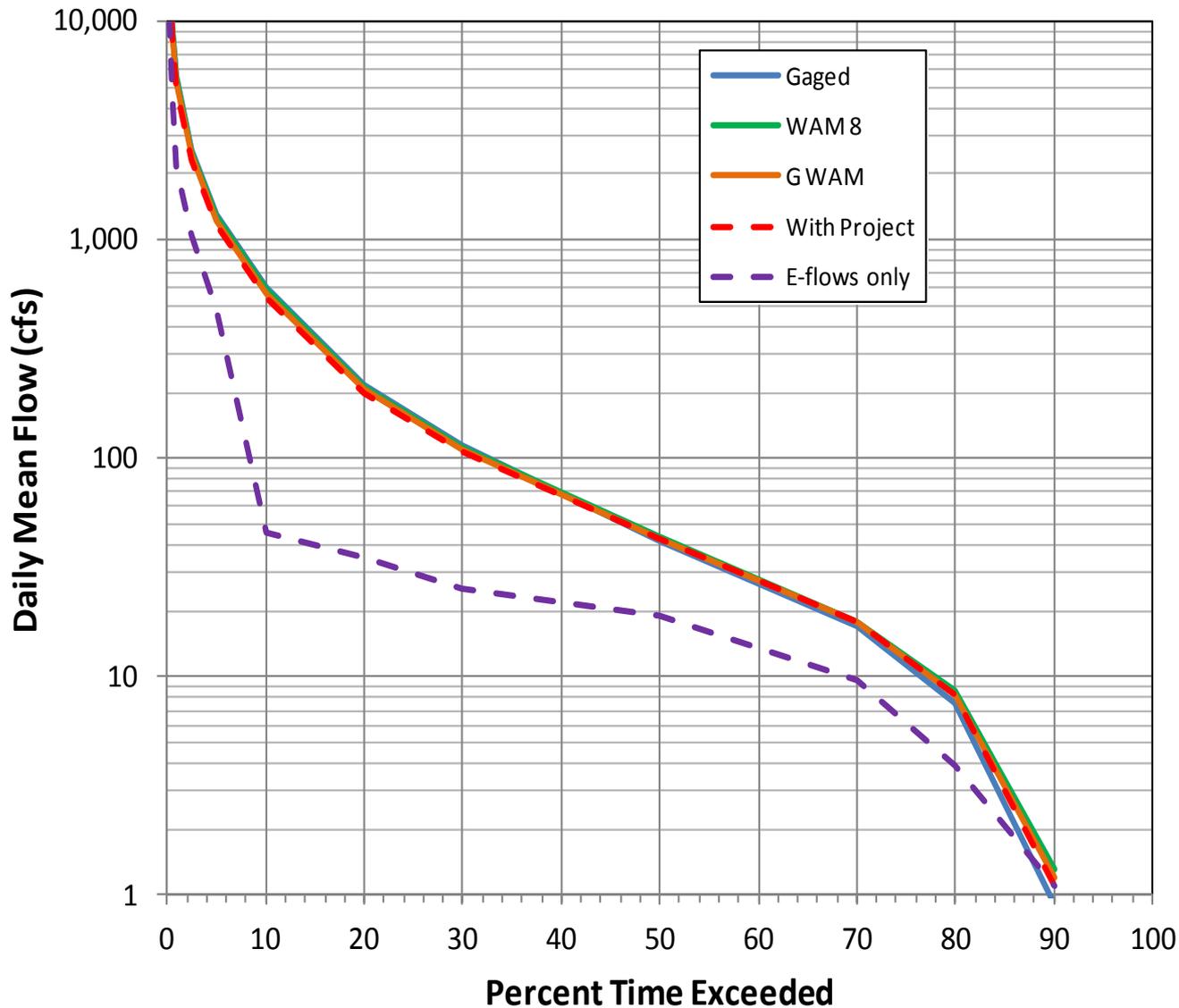


Scenarios Results

- Gaged flows consistently greater than those in any of the other scenarios
 - Differences in operations of water supply systems historically
- Substantial differences in the daily flows among the different scenarios
- Largest difference between Gaged and WAM-modeled flows
 - attributed to difference in monthly flows computed by the WAM versus observed flows

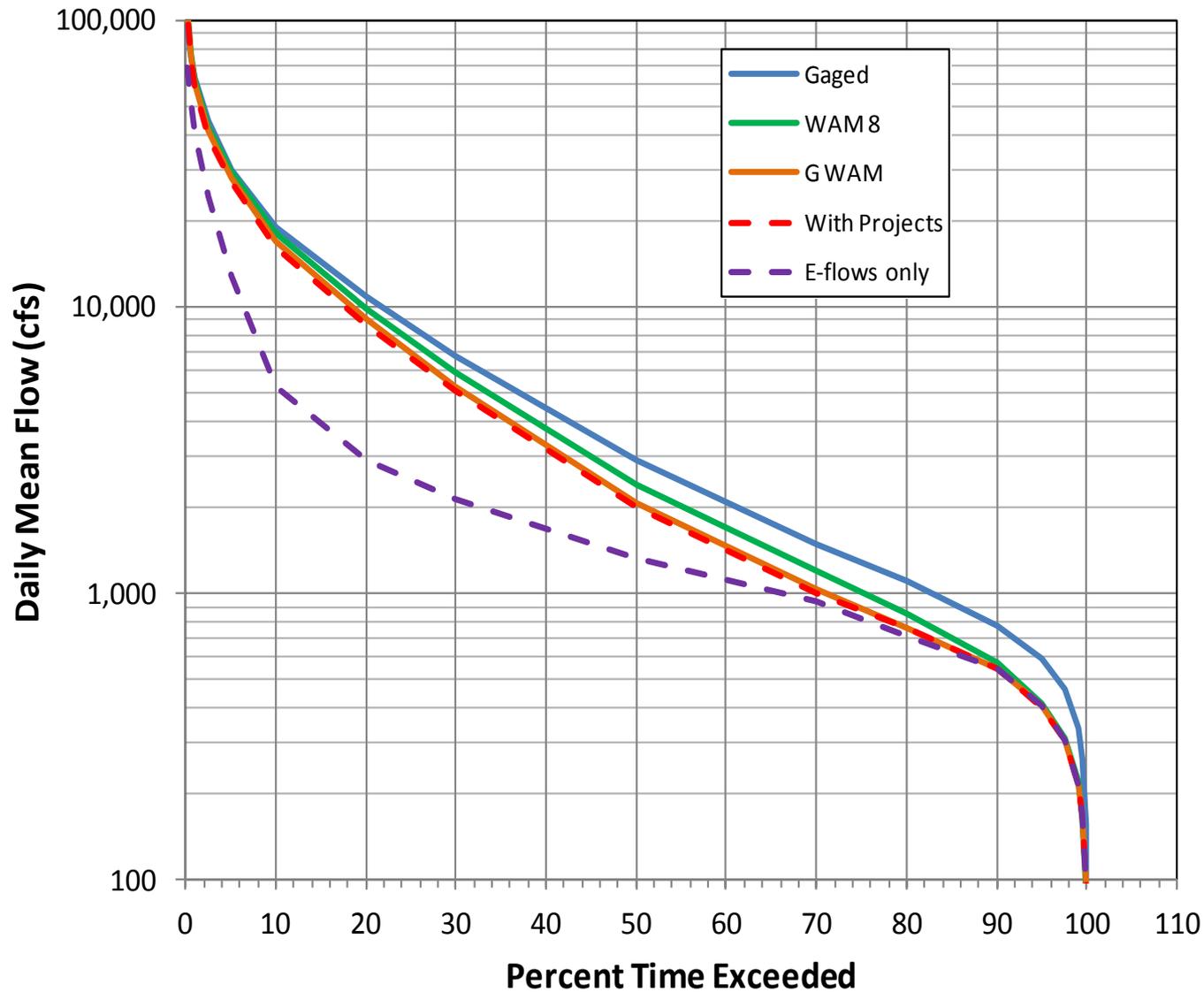


Brazos River at Seymour





Brazos River at Richmond





Geomorphology and Sediment Transport Analysis

- Historical data indicates both locations experiencing modest geomorphic change (channel widening)
- Transport formulas all significantly underestimate transport at the larger discharges
- Channels at both sites have not reached dynamic equilibrium
- Cannot determine if a new project subject to flow alterations would move channel towards stability or increase instability
- E-flow regimes, as recommended, provide approximately 80% of the annual average sediment yield compared to baseline conditions



Oxbow Connectivity – Brazos River

- Negligible influence on the frequency of connections under scenarios
 - WAM 8
 - G WAM
 - With Projects
- E-flows Only results in >50% reduction in lateral connections
 - Potential for significant negative ecological impact



Estuarine Inflows – Brazos Estuary

- Reductions in inflows not biologically significant
 - WAM 8
 - G WAM
 - With Projects
- E-flows scenario causes significant reductions in freshwater inflows and sediment delivery
 - Potential for significant negative ecological impact