*Sabine & Neches Rivers and Sabine Lake Bay Basin & Bay Expert Science Team (BBEST)*

# Perspectives on Application of Hydrology-based Environmental Flow Regime (HEFR) Methods

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HDR

# *Use of the Hydrology-based Environmental Flow Regime (HEFR) Method*

**S&N BBEST used HEFR to provide an initial characterization of environmental systems with readily available data in the absence of definitive data relating flow alteration to ecological response.**

**<u>Advantages</u>:**

**1)Hydrology is a key variable for instream, and a good indicator for estuarine, environmental flows.**

**2)Consistent with TIFP and SAC guidance.**

**3)Lengthy records at multiple streamflow gage locations.**



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# *Use of the Hydrology-based Environmental Flow Regime (HEFR) Method*

**S&N BBEST used HEFR to provide an initial characterization of environmental systems with readily available data in the absence of definitive data relating flow alteration to ecological response.**

**<u>Disadvantages</u>:**

**1)Limited validation with biological, water quality, and geomorphological data.**

**2)Should/will be superseded by SB2 field studies.**

**3)Not useful where gage records are lacking or non-existent.**



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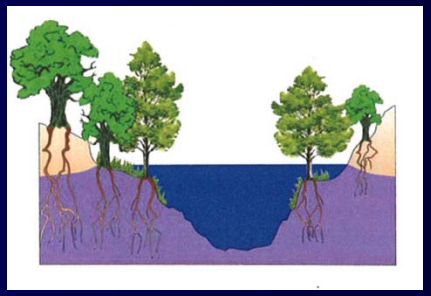
# *Initial Decisions*

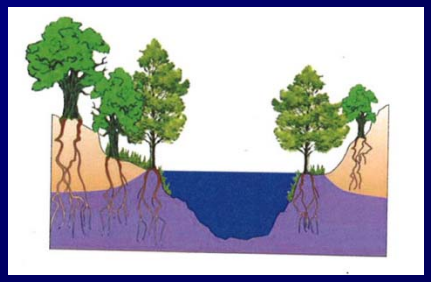
1) Full Period of Record for HEFR Application
2) Four Hydrologic Seasons of Three Months Consistent with Calendar Seasons
3) Hydrologic Conditions (Wet/Average/Dry) Using Default Percentiles Based on Frequency of Cumulative Major Upstream Reservoir Storage and Applicable for Entire Season
4) Hydrograph Separation by Modified Base Flow Index with Threshold (MBFIT)

# HEFR Matrix for Big Sandy Creek, Sabine River Basin

| | | | | |
|---|---|---|---|---|
| Overbank Flows | Qp: 2,930 cfs with Frequency 1 per 2 years<br>Volume is 35,703<br>Duration is 30 | | | |
| | Overbank flows may cause extensive damage to private property and endanger the public. Therefore, the Sabine-Neches BBEST recognizes the ecological benefits of these events, but cannot recommend such events be produced. | | | |
| High Flow Pulses | Qp: 942 cfs with Frequency 1 per season<br>Volume is 14,544<br>Duration is 16 | Qp: 950 cfs with Frequency 1 per season<br>Volume is 12,852<br>Duration is 19 | Qp: 132 cfs with Frequency 1 per season<br>Volume is 2,054<br>Duration is 11 | Qp: 367 cfs with Frequency 1 per season<br>Volume is 6,055<br>Duration is 14 |
| | Qp: 358 cfs with Frequency 2 per season<br>Volume is 5,932<br>Duration is 10 | Qp: 313 cfs with Frequency 2 per season<br>Volume is 5,062<br>Duration is 13 | Qp: 50 cfs with Frequency 2 per season<br>Volume is 671<br>Duration is 6 | Qp: 130 cfs with Frequency 2 per season<br>Volume is 2,189<br>Duration is 9 |
| | Translation of seasonal pulse flows of specified frequencies into environmental flow standards and permit conditions may result in less frequent occurrence of high flow pulses as a result of the issuance of new surface water appropriations or amendments. This reduced frequency of occurrence is deemed an acceptable environmental risk at this time, subject to review as new studies and information become available. | | | |
| Base Flows (cfs) | 163 | 111 | 26 | 63 |
| | 106 | 51 | 18 | 36 |
| | 66 | 30 | 14 | 20 |
| | Seasonal base flows represent thresholds for environmental protection based on current scientific understanding of fluvial and estuarine ecosystems. As new studies and monitoring information become available, these base flow thresholds may be revised. | | | |
| Subsistence Flows (cfs) | 20 | 9 | 8 | 8 |
| | Translation of seasonal subsistence flows into environmental flow standards and permit conditions should not result in more frequent occurrence of flows less than the recommended seasonal subsistence values as a result of the issuance of new surface water appropriations or amendments. | | | |
| | Jan Feb Mar | Apr May Jun | Jul Aug Sep | Oct Nov Dec |
| | Winter | Spring | Summer | Fall |

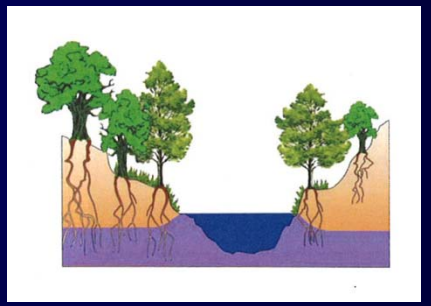
*Overbank*

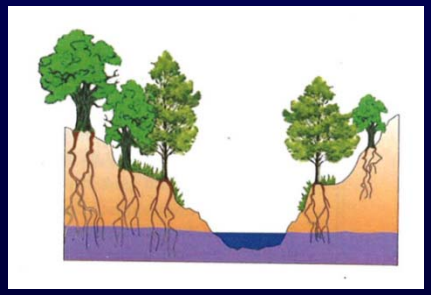




*High Pulse*

*Base*





*Subsistence*

# Subsistence & Base Flows

| | Winter | Spring | Summer | Fall |
|---|---|---|---|---|
| Base Flows (cfs) | 163 | 111 | 26 | 63 |
| | 106 | 51 | 18 | 36 |
| | 66 | 30 | 14 | 20 |
| | Seasonal base flows represent thresholds for environmental protection based on current scientific understanding of fluvial and estuarine ecosystems. As new studies and monitoring information become available, these base flow thresholds may be revised. | | | |
| Subsistence Flows (cfs) | 20 | 9 | 8 | 8 |
| | Translation of seasonal subsistence flows into environmental flow standards and permit conditions should not result in more frequent occurrence of flows less than the recommended seasonal subsistence values as a result of the issuance of new surface water appropriations or amendments. | | | |
| | Jan, Feb, Mar | Apr, May, Jun | Jul, Aug, Sep | Oct, Nov, Dec |

*Wet*

*Average*

*Dry*

*Seasons*

# High Flow Pulses & Overbank Flows

| | | | | | |
|---|---|---|---|---|---|
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| | Qp: 358 cfs with Frequency 2 per season<br>Volume is 5,932<br>Duration is 10 | Qp: 313 cfs with Frequency 2 per season<br>Volume is 5,062<br>Duration is 13 | Qp: 50 cfs with Frequency 2 per season<br>Volume is 671<br>Duration is 6 | Qp: 130 cfs with Frequency 2 per season<br>Volume is 2,189<br>Duration is 9 | *Dry & Average* |
| | Translation of seasonal pulse flows of specified frequencies into environmental flow standards and permit conditions may result in less frequent occurrence of high flow pulses as a result of the issuance of new surface water appropriations or amendments. This reduced frequency of occurrence is deemed an acceptable environmental risk at this time, subject to review as new studies and information become available. | | | | |

# *Instream Flow Regime Application Examples*

**Flow Regime** → **Permit Conditions**

1) Time series of flows from flow regime application examples provide frequency & duration data that support science-based overlays.
2) BBESTs must have some measure of understanding of the actual future flow regimes that may result from implementation of recommended environmental flow regimes in order to ensure that a sound ecological environment can be supported on a long-term basis.
3) Finite infrastructure examples avoid the highly impracticable assumption that, once environmental flow standards are implemented, the only flow remaining in a stream or passing into an estuarine system will be the environmental flow prescription itself.



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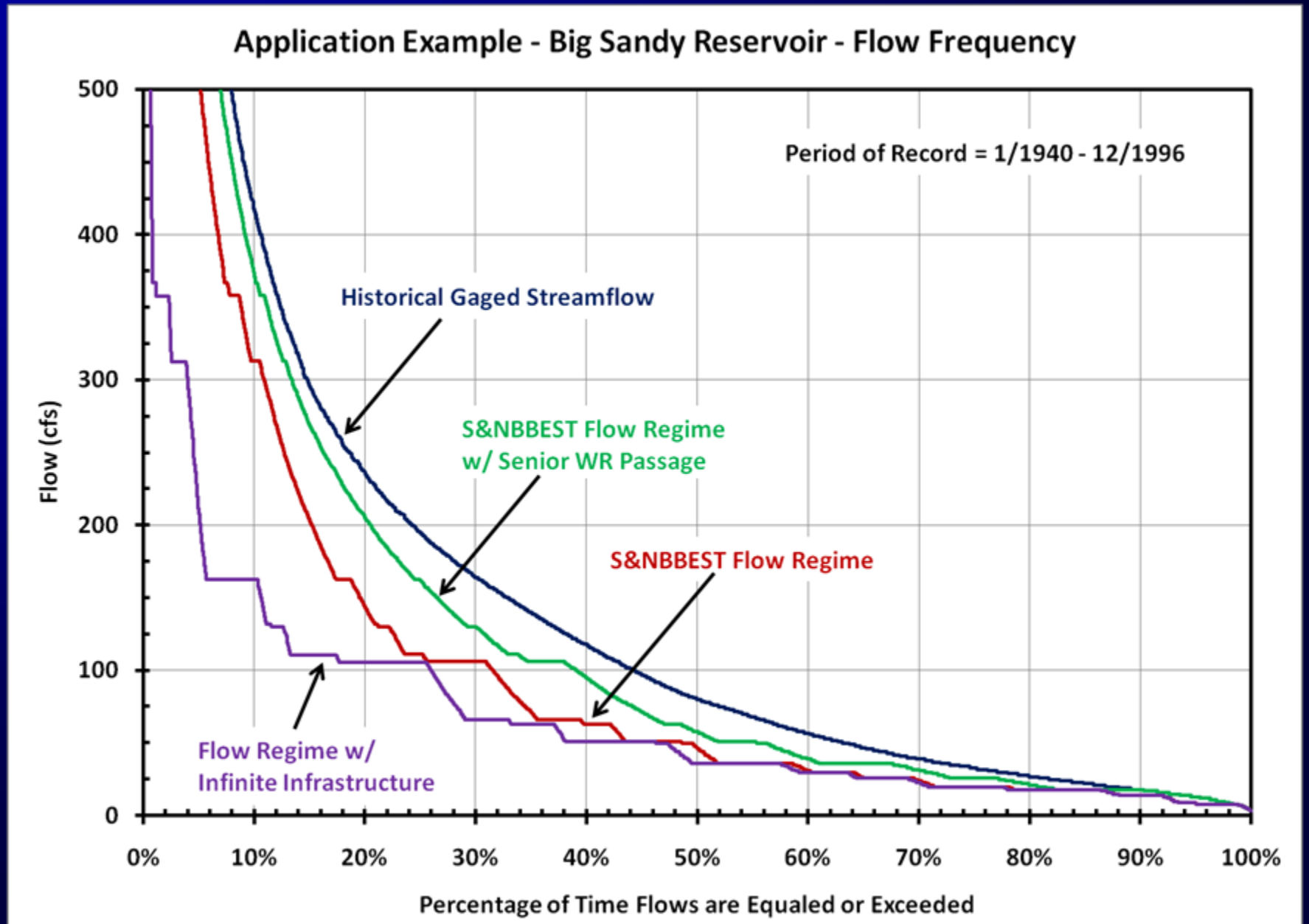
Application Example - Big Sandy Reservoir - Flow Frequency
Period of Record = 1/1940 - 12/1996
Historical Gaged Streamflow
S&NBBEST Flow Regime
w/ Senior WR Passage
S&NBBEST Flow Regime
Flow Regime w/
Infinite Infrastructure
Flow (cfs)
500
400
300
200
100
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage of Time Flows are Equaled or Exceeded

# *Attainment Frequencies*

1) Preservation of the full range of historical flow components (and their historical frequencies of occurrence) is logically considered to support a sound ecological environment.
2) Based on review and analysis of currently available information (hydrology, sediment dynamics, water quality, & biology), the S&NBBEST recognizes that some lesser quantities of flow and/or lesser frequencies of occurrence may be adequate for environmental protection.

# *Attainment Frequencies (cont'd)*

3) There is decreasing certainty regarding flow frequency necessary to sustain a sound ecological environment as one moves up through the flow regime components.
4) Translation of seasonal subsistence flows into environmental flow standards and permit conditions should not result in more frequent occurrence of flows less than the recommended seasonal subsistence values.
5) Seasonal base flows represent thresholds for environmental protection based on current scientific understanding of fluvial & estuarine ecosystems.

# *Attainment Frequencies (cont'd)*

6) Reduced frequency of seasonal pulse flow occurrence is deemed an acceptable environmental risk at this time, subject to review as new studies and information become available.
7) Ecological benefits of overbank flows are recognized, but it is not recommended that such events be produced.

# *Questions, Comments, & Discussion*