Floodways, How Adverse Can You Get?

*Presented at the Association of State Floodplain Managers - 38th Annual Conference - June 4, 2014, Seattle, WA*

Bill Brown, PE, City of Arlington, TX
John Ivey, PE, CFM – Halff Associates, Inc.
Mike Moya, PE, CFM – Halff Associates, Inc.
Outline of Presentation

• Introduction – Reasons for Paper
• Floodway Concept and History
• Floodway Issues/ Impacts /Questions
• Case Studies
• Findings and Conclusions
Key Question:

Is the continued use of the “Floodway Concept”, as a floodplain management tool, appropriate for sustainable, resilient, and prudent floodplain-related decisions and polices, now and in the future?
Introduction – Reasons for Paper

Lots of Attention of Late:

- 2014 - Success of NCTCOG/Corps’ Trinity River Corridor Development Certificate (CDC) program in preserving “Valley Storage” along river
Introduction – Reasons for Paper

• Long time feeling that the floodway concept was **not prudent floodplain management** (since 1971)

• Continued Trend: “**Fill floodway fringe to the Limits**”
Bill Brown has strong opinions regarding floodways:

- A floodway is an administrative tool that has no physical meaning.

- The concept is antiquated and a historical tool whose usefulness is diminishing.

- Becoming obsolete with modeling paradigm shift to dynamic models.
Bill Brown has stronger opinions regarding floodways (continued):

– Floodways need to go away and we should focus on regulatory concepts where conveyance, zero rise, channel stability, and flood storage preservation are the primary factors in cases where encroachment is necessary. Otherwise, don’t encroach into the floodplain!
Bill Brown **FINAL WORDS** regarding floodways:

- A floodway is to hydraulics what the Rational Method is to hydrology 😊...

- They both were useful tools whose time has passed.😊😊

*I sure wish he would make his OPINIONS clear on floodways!*
Some Definitions

THE REGULATORY FLOODWAY:
The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood (1% chance) can be carried without substantial increases (Max. of 1.0’) in flood heights.

NO ADVERSE IMPACT:
NAI is a philosophy that looks at the impacts of land use decisions, identifies adverse impacts, and mitigates them through a variety of actions.
The “Natural” Floodway Concept

Essentially No Encroachment Into “MOVING WATER”

Discussed by Tom Lee, Wisconsin DWR, ASCE Paper, August 1971
The FEMA Floodway Concept

Equal Loss of Conveyance on Both Sides

Conveyance is a function of Area, Wetted Perimeter, and Roughness

Maximum 1.0’ Rise
Current 8 States that enforce more restrictive floodways (state law):

- Illinois (0.1’)
- Indiana (0.1’)
- New Jersey (0.2’)
- Minnesota (0.5)
- Montana (0.5’)
- Michigan (0.1’)
- Colorado (0.5’)
- Wisconsin (0.01’)<<<
Early ASFPM Floodway Target Selection Discussion

+2.0’ RISE!!
1.0’
0.5’
0.01’
MINUS 1.0’ RISE!!
HISTORY OF FLOODWAYS
Flood Hazard Studies Timeline

1950 – 1970’s
TVA Flood Hazard Information Studies
Defined “Regional” and “Maximum Probable Floods”

1968 – 1980’s
FIA – National Flood Insurance Study effort
FHM, FIS-FIRM, FBFM

1960-1980
USACE Floodplain Information Reports
(FPI’s)

1950’s, 1960’s and early 1970’s

Flood Hazard Studies/ Flood Prone QUAD’s
TVA, USACE, USGS, SCS

2000’s – MAP MOD and RISK MAP

FLOODWAY CONCEPT/IMPLEMENTATION
History

• Tennessee Valley Authority (TVA) – 1950’s First floodplain maps; first floodways

• 1960 - Maryville, TN adopted the 1st Floodplain Ordinance with Floodway Map

• FEMA Floodway Concepts, based on 1% Chance (100-year frequency) flood, since the early days of the NFIP
Housing and Urban Development Act of 1968 ... gave birth to the NFIP and ...

“A Unified National Approach for Floodplain Management”

The 1968 Act established floodplain and floodway regulations but community enforcement was voluntary
1969 - The Water Resources Council revised the Flood Hazard Evaluation Guidelines and defined the floodway as we know it today.
“to provide for the discharge of the base flood so the cumulative increase in water surface elevation is no more than a designated amount (not to exceed one foot as set by the NFIP)”

“to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains”.
History - Floodway

- James Goddard’s Report to the FIA 1978

“Origin & Rational of Criterion Used in Designating Floodways”
• The **technical requirements** must often be modified by **practical, economic, social, and related considerations**. (i.e. COMPROMISE!)

• The **“Zero” rise** approach could result in **inefficient use** of the flood plain. *(Was this a valid statement?)*
1977 or 1978 Corps’ Floodway Study

• Based on 2,390 cross-sections (Nation-wide)
• Floodway Target was 1.0’
  – Mean increase in water surface was about 0.7 foot.
  – Increase at many points was less than 0.4 foot.
  – Average width of floodway was about 55 percent of the 100-year flood plain width.
## Nine States with More Stringent Floodways (1978)

<table>
<thead>
<tr>
<th>State</th>
<th>Allowable Rise (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>0.1</td>
</tr>
<tr>
<td>Indiana</td>
<td>0.1</td>
</tr>
<tr>
<td>Maryland*</td>
<td>Zero</td>
</tr>
<tr>
<td>Michigan</td>
<td>0.1</td>
</tr>
<tr>
<td>Minnesota</td>
<td>0.5</td>
</tr>
<tr>
<td>Montana</td>
<td>0.5</td>
</tr>
<tr>
<td>New Jersey</td>
<td>0.2</td>
</tr>
<tr>
<td>Ohio*</td>
<td>0.5</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>0.1</td>
</tr>
</tbody>
</table>

*Not in current list.
Once Floodways are designated by a community, usually when the FIRM is referenced by ordinance, floodways can only be changed by LOMC or FEMA’s remap efforts. (1984)
2007 - ASFPM – “National Flood Programs and Policies in Review”

• “A no-rise Floodway, with no impact on water surface and velocity should be required, so that only those areas of insignificant hydraulic conveyance could be filled.”

• Paraphrase: “...Allowing current FEMA floodway standards (1’ Rise), causes increased flood peaks, additional flood damage, and promotes filling of riparian zones...”
Floodway Issues, Impacts and Some Questions
Regulatory and Economic Issues

• Constitutional/Legal (taking issues)

• Economics: Floodway fringe fill is a “Carrot”

• Balance between Technical requirements and practical, economic, social, and environmental considerations (Remember Goddard’s quote, i.e. COMPROMISE).
Technical Issues

Islands

Figure 1

Figure 2

Figure 3

Figure 4
Technical Issues

Some Floodway Encroachments

Bridges

Levees/Treatment Plants

Mobile Homes in Floodway
Technical Issues

- 1D River model top-of-bank
- Typically up to bank full flow is simulated in 1D
- Floodplain/overbank simulated in 2D

XPSWMM 2-D Floodway

Special Flood Hazard Area

Flood Fringe
Simulated Encroachment

Stream Channel

Surcharge

Flood elevation before encroachment

Surcharge not to exceed 1.0 foot [FEMA requirement]

Simulated Encroachment

HALFF
Questions:

• “Do the economic benefits of additional development justify the physical encroachments of the floodway?”

• “Does the floodway concept work in a changing paradigm of Unsteady and Two Dimensional hydrologic-hydraulic modeling?”
Questions:

• “Can a floodway-dominated stream achieve No Adverse Impact?”

• Do we really need floodways in our floodplain management programs?

• Is it realistic to think that the floodway concept can be eliminated?
FLOODWAY CASE STUDIES
Colleyville, Tx Floodway Case Study
• A 1992 study for Colleyville, TX determined that in certain reaches of Big and Little Bear Creeks, the FEMA floodway encroachments reduced the valley storage by up to 45% and increased peak 100-year discharges from 25% to 42%.

• These increased discharges would result in increased expected flood elevations by as much as 2.9 feet.
Urbanization
Colleyville, TX
Little Bear Creek

1971 Corps’ FPI

2009 FEMA Map Mod
**Colleyville Case Study**

**TABLE 7 – 100-Year Flood - Little Bear Creek (1992 Colleyville Study - Halff)**

<table>
<thead>
<tr>
<th>Location</th>
<th>Drainage Area* (sq. miles)</th>
<th>1982 FIS (cfs)</th>
<th>Corps of Engineers Ultimate Development (cfs)</th>
<th>1991 Colleyville Storm Drainage Master Plan</th>
<th>Ultimate Development** (cfs)</th>
<th>Ultimate Development*** w/Floodway Encroachments</th>
</tr>
</thead>
<tbody>
<tr>
<td>At St. Louis Railroad</td>
<td>7.99</td>
<td>7,400</td>
<td>12,100</td>
<td>7,400</td>
<td>9,500</td>
<td>+ 37%             13,000</td>
</tr>
<tr>
<td>At State Highway 26</td>
<td>11.17</td>
<td>7,500</td>
<td>11,900</td>
<td>9,400</td>
<td>11,800</td>
<td>+ 25%             14,700</td>
</tr>
<tr>
<td>At Cheshire Road</td>
<td>13.44</td>
<td>9,600</td>
<td>12,100</td>
<td>11,100</td>
<td>13,900</td>
<td>+ 11%             15,400</td>
</tr>
<tr>
<td>Below Tributary LB-1</td>
<td>18.05</td>
<td>12,400</td>
<td>16,600</td>
<td>13,100</td>
<td>16,700</td>
<td>+ 7%              17,900</td>
</tr>
<tr>
<td>At State Highway 121</td>
<td>20.02</td>
<td>12,500</td>
<td>15,200</td>
<td>13,400</td>
<td>16,900</td>
<td>+ 11%             18,700</td>
</tr>
</tbody>
</table>

* Reflects revised drainage areas computed for 1991 Colleyville Storm Drainage Master Plan.
** Discharges based on 1991 existing channel/bridge conditions.
*** Discharges reflect loss of valley storage due to reclamation to FEMA floodway.

Note the effect of floodway encroachments on hydrology!
Observations and Conclusions

The most significant factors related to increased flood peaks and floodway impacts in Colleyville study:

1) The changes, over time, in watersheds due to the effects of urbanization.

2) Decrease in available “valley flood storage”
Case Study – Village Creek

Lake Arlington

2009 Map Mod
Updated DFIRM

Village Creek in Kennedale – 1.4 miles Of Stream

* Drainage Area
At US 287 = 121 SM
Case Study – Village Creek

• Most development in floodway prior to incorporation into city
• June 1970 Corps’ FPI Report – few structures
Case Study – Village Creek
Case Study – Village Creek

Most Development is Industrial, Mobile Home Parks, Limited Residential
Case Study – Village Creek

• Impacts/Factors in Floodplain/Floodway
  – 2012 Flood Study - 133 structures in 100-yr floodplain, many in 5-yr, most in Floodway

  – blight, lower real estate values

  – Stream degradation, pollution

  – Upstream watershed is about 50% developed
Case Study – Village Creek

- Impacts/Factors in Floodplain/Floodway

  - If upstream floodway fringe is filled, potential impacts from lost “Valley Storage”...increased flood elevations/more floodplain/more Damages

  - What could happen if valley storage loss and flood discharges increases similar to the Colleyville (Little Bear Creek) percentages?
Case Study – Village Creek

Flood Damages vs. Storm Event

BASELINE – EXISTING – NO FLOODWAYS

$6.3 Million
For 100-year flood

HALFF™
Case Study – Village Creek

INCREASE Q BY 10% W/FLOODWAYS

+ $1.150 Million
For 100-year flood
Case Study – Village Creek

**Flood Damages vs. Storm Event**

**INCREASE Q BY 23% W/FWAY**

+ $2.0 Million
For 100-year flood
Case Study – Village Creek

INCREASE Q BY 42% W/FW

+ $3.4 Million For 100-year flood
Conclusion: Case Study – Village Creek

• Using the Colleyville pattern: decrease in upstream valley storage, increase in discharges and corresponding flood levels, and more flood damages.

• Result: Even a 10% increase, due to upstream floodway fringe filling will increase damages significantly!
Regional Case Study
NCTCOG – Corridor Development Certificate
Regional Case Study
NCTCOG – Corridor Development Certificate

- Trinity River and Major Tributaries in DFW Metroplex – 9 cities, three counties, 2 river authorities – Adopted 1st CDC Criteria Manual on May 23, 1991

- 1991-2014 Cities permitted over 100 floodplain reclamation or transportation projects
1. No rise (0.0’) in the 100-year flood or significant rise in the SPF.

2. Maximum allowable loss in valley storage capacity for 100-year flood and SPF discharges will be 0% and 5% respectively.

3. No erosive velocities (on or off site)
1990 Corp’s Recon Study
Estimated Average Annual Damages

1. Without CDC Criteria in full force
   AAD = $684 M

2. With CDC Criteria in place
   AAD = $194 M

3. Average Annual Benefit = $490 M
Preserved Valley Storage—Trinity River

After 24 Years of Reclamation

From 2013 Corp’s Updated CDC H&H Report
Re-distributed Valley Storage
Trinity River

After 24 Years of Reclamation

From 2013 Corp’s Updated CDC H&H Report
1. The strict CDC criteria allows floodplain reclamation and still preserves the needed Valley Storage,

2. The FEMA floodway is often altered, but there is a “no rise” result, due to valley storage mitigation.

3. Significant flood damages are prevented.
Overall Observations

• In North Texas, there is a **definite trend to fully utilize the floodway fringe**, filling to the limits, on both large rivers and small streams.

• It would be very prudent for communities to **use “extra” freeboard** to account for future changes in flood elevations.

• It is clear: Floodways have **ADVERSE IMPACTS!**
Conclusions

• There is an obvious need to analyze the hydrologic, as well as hydraulic impacts of the FEMA floodway concept, as it is utilized in floodplain management (specifically FIS).

• Even better would be to eliminate the floodway concept entirely, such as many cities have done or proposed.
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Case Study – Mountain Creek

• Pre-Flood Control Dam – Hydrology and Hydraulics (includes floodway)

• Post-Flood Control Dam – Revised and lowered flood discharges, profiles, and floodway

• Floodway included split flow, created “islands”
Case Study – Mountain Creek

- Pre-Flood Control Dam – Hydrology and Hydraulics (includes floodway) - 1982 FBFW*

* Not a FIRM 😊
Case Study – Mountain Creek

- Post-Flood Control Dam – Revised and lowered flood discharges, profiles, and revised the floodway (with “islands” *)

Current DFIRM
Case Study – Mountain Creek
Compare Pre- and Post- Flood Control Dam/Revised Floodway

- 1982 Floodway = 2,800’ in Corporate Limits
- 2014 Floodway = 1,050’ in Corporate Limits
- 63% Reduction in FW Width
Case Study – Mountain Creek - Issues

- Post- Flood Control Dam – Revised and lowered flood discharges, profiles, and floodway (reduced width by 63%)
- Lack of access (traffic, emergency vehicles)
- Reduced Floodway Width and “islands” and Increased “developable” area
- Created development issues for FPA at city
- Adverse impacts?
Regulatory and Economic Issues

- Public’s difficulty in understanding concepts
- Costs for more detailed studies/floodway computations
- Freeboard (Elevate fill and finished floors)
- Political and land development pressures