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The Rifle...

An Allegory of the Practice of
Natural Channel Design
in Ontario

6th Annual TRIECA Conference
March 22-23, 2017

The Riffle Allegory...

- understanding has evolved over last 3 decades ('87 - '17)
- Key pieces available in various guidelines
- This "evolution" mirrors channel design process - worth exploring



Evolution of the Riffle

NATURAL CHANNEL PERIOD

BIOLITHIC EPOCH

I. Rehab

II. Bolder

1991

2001

WOOD
common

VORTEX WEIRS
emerge

CONCRETE
extinct ('94)

Riffle "created"

RIFFLE EPOCH

III. Transition

IV. Reformation

2014

"Riffle on
Streambed"
(OPSD
222.050)

Riffle
"migrates"

Mutations "appear"



1994

1999

2004

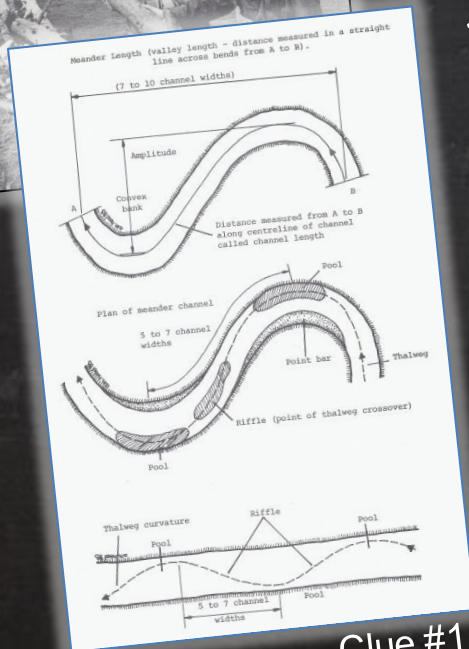
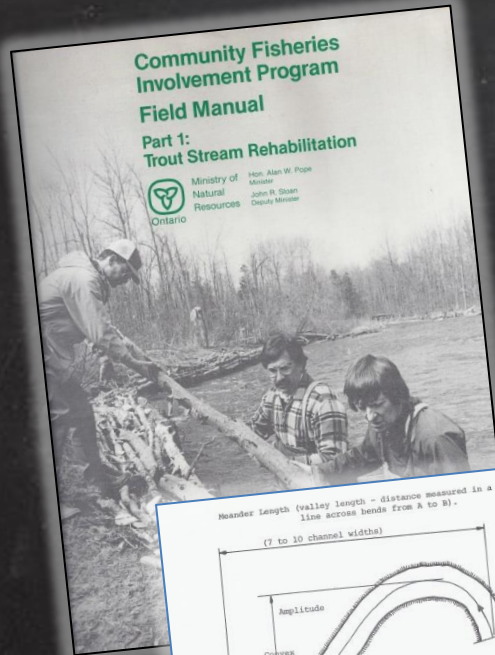
2010

2016

Adapted from S. Wilkerson (with permission)

Rehabilitation Age (<'91)

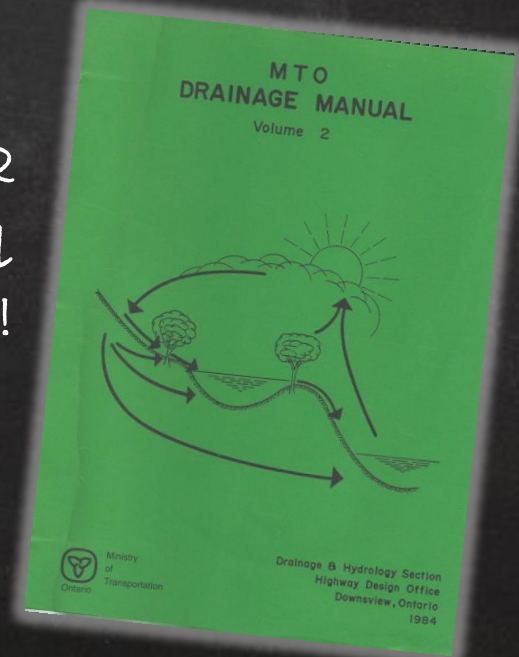
- Streams in poor condition
- Practitioners knew “natural” geometry; not necessarily dimensions
- MNR 1985- CFIP Manual was a good source of information



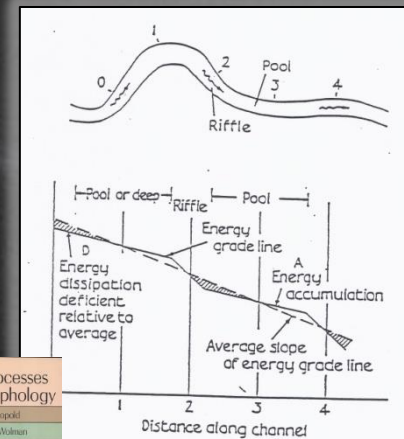
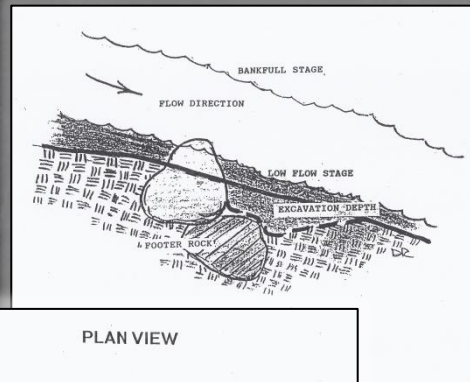
Clue #1

MTO 1982

Chapter on “Open Channel Design” – In Progress!



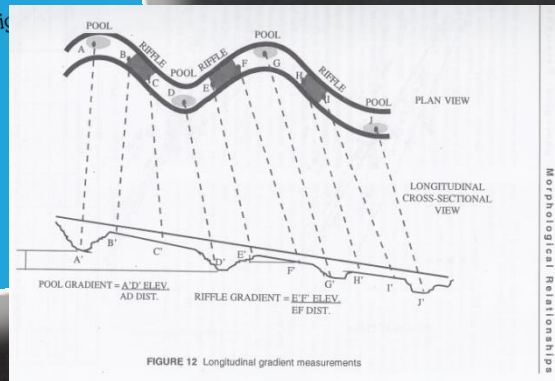
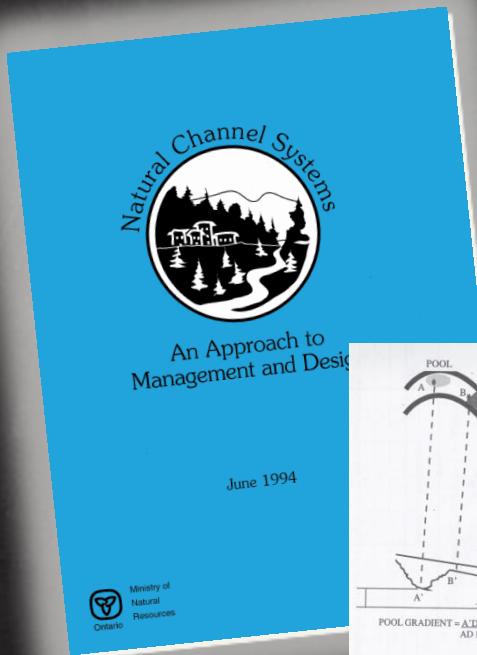
- "Rivers & Applied Fluvial Geomorphology"
- Vortex Rock Weirs introduced
- Practitioners working with geometry AND dimensions



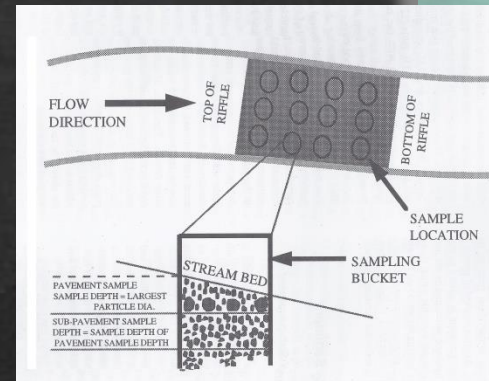
Clue #2a

Bolder Age...cont'd

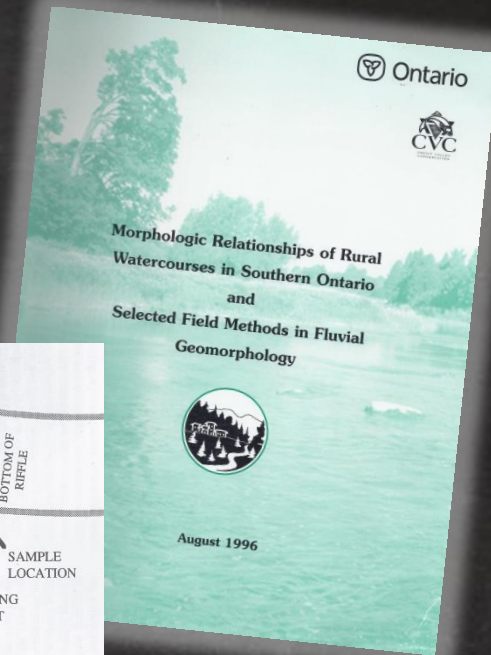
- MNR 1994 "Natural Channel Systems"
- Concrete became "extinct"
- Database + Relationships



Clue #2b – $R_s \approx 2 S_g$



Clue #3 – Pavement ≠ Subpavement



- MTO 1997 – Chapters 5 (Channels), 9 (Fluvial Geo)
- "Creation" of Fieldstone Riffle

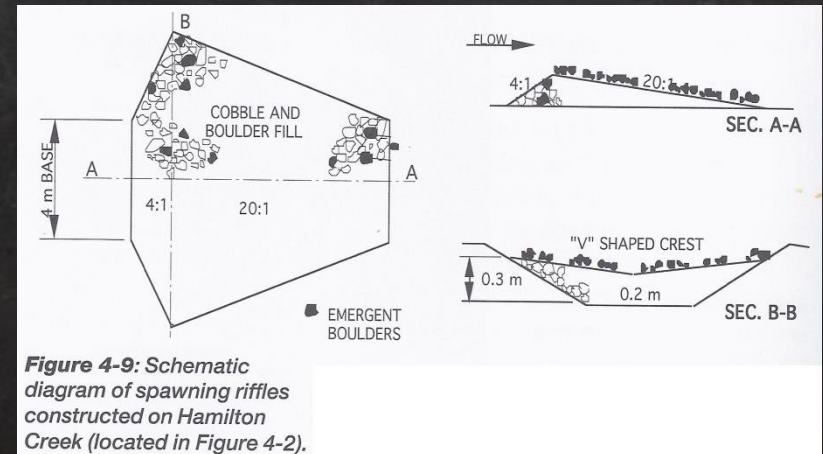
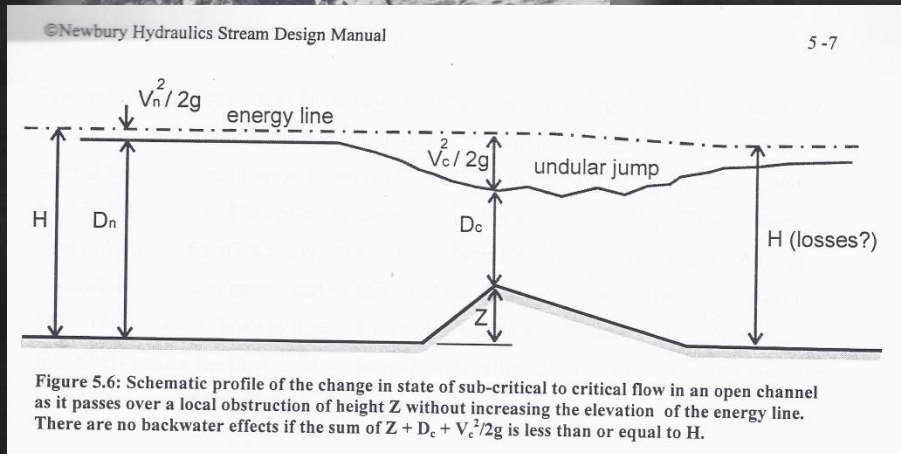
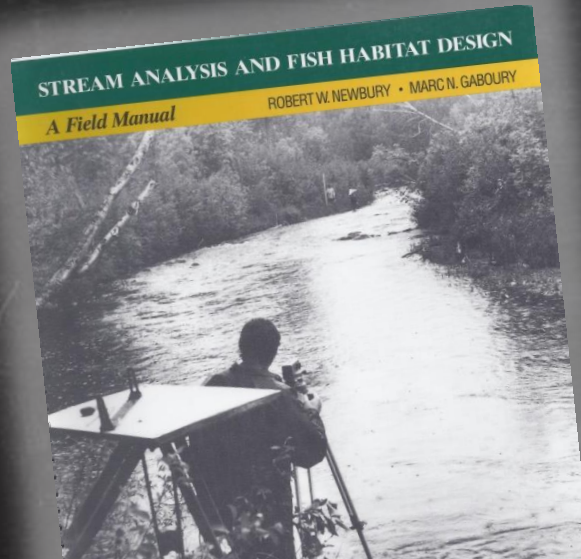
Transition Age ('01-'14)

- Fieldstone Riffle migrates to Ontario!
- Riffle knowledge continues to grow...

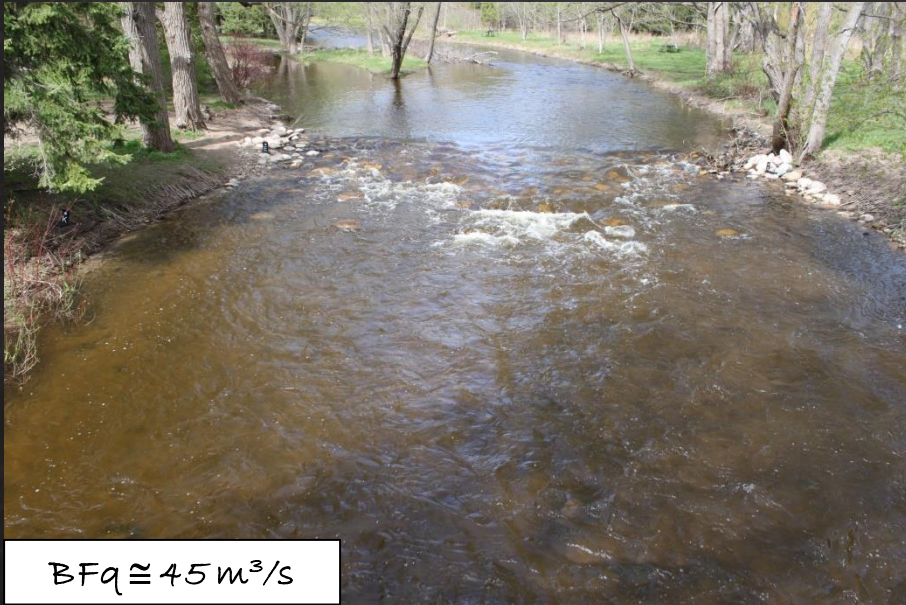
Gradually Varied Flow - Transitions
 Riffle geometry (4:1, 20:1)
 Setting elevation of riffle crest
 Riffle stone size

Clue #4

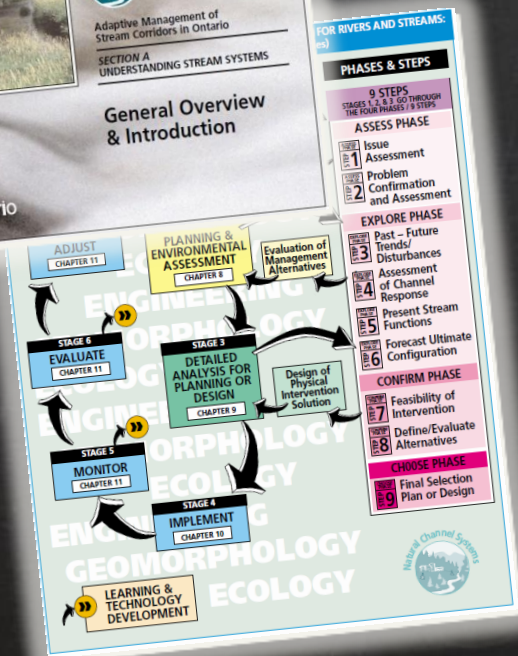
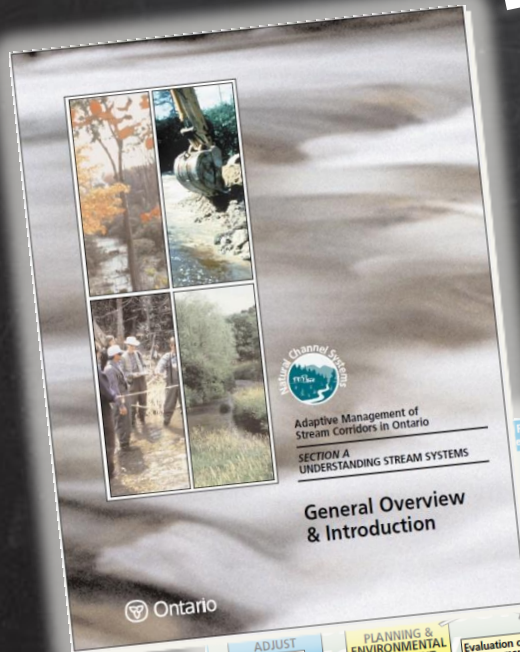
Clue #5



Examples of Fieldstone Riffles...

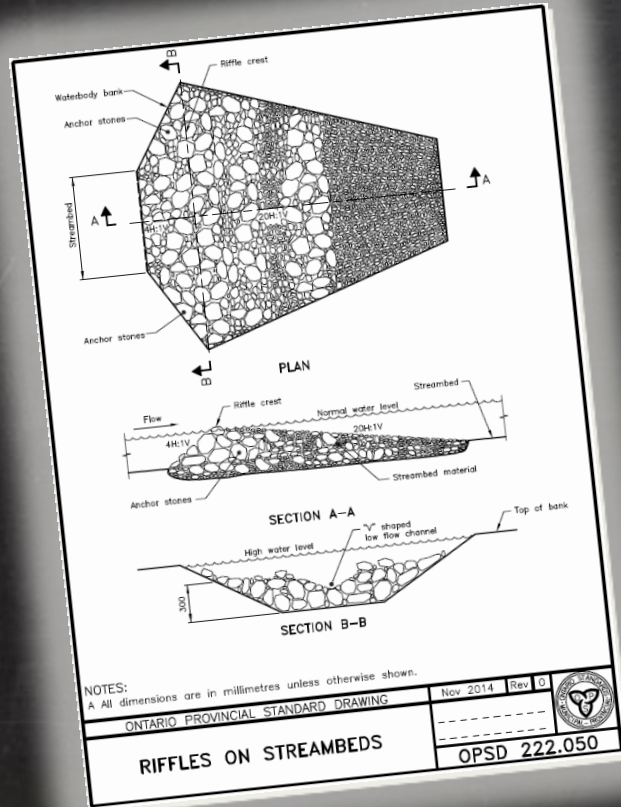


Transition Age...cont'd



- MNR 2002 "Adaptive Management of Stream Corridors"...
 - Introduces 9-Step Adaptive Management Process
 - Describes co-ordination amongst engineers, geomorphologists & biologists
- Statutes/Regs enforced - DFO/CA
- Design Drawings + Report + Compensation Plan + Monitoring Program
- Fisheries Act 2013...
 - HADD to Serious Harm

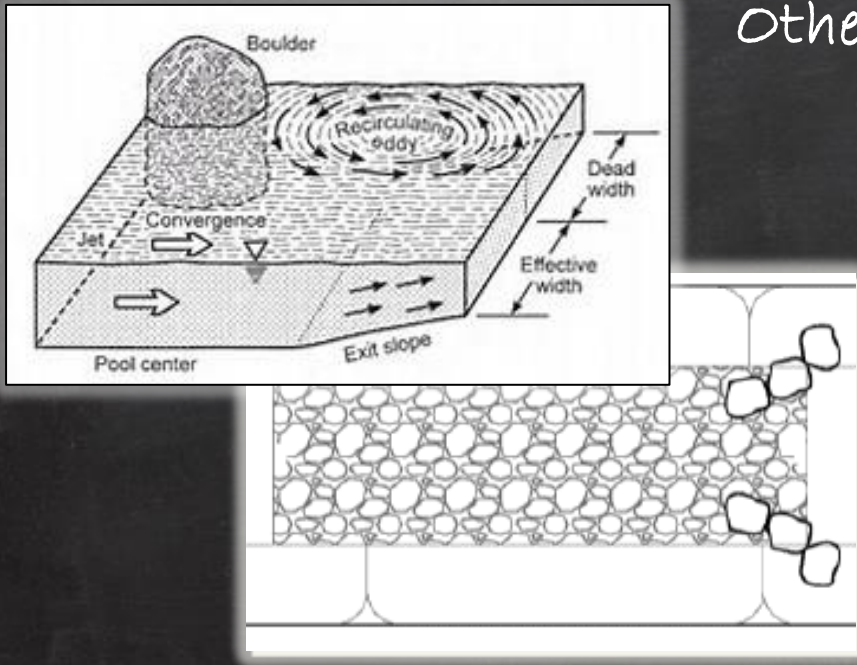
Reformation Age (>'14)



- Fieldstone Riffle "standardized"
- OPSD 222.050 (2014) – may oversimplify a complex structure
(OPSS 820 "Construction Spec'n for Riffles on Streambeds")
- Riffle geometry (4:1, 20:1) set?
- Crest elevation 300mm?
- Normal / High Water Levels?

Reformation Age...

- Riffle "mutations" – new structures?



Other "Constructed" Riffles...

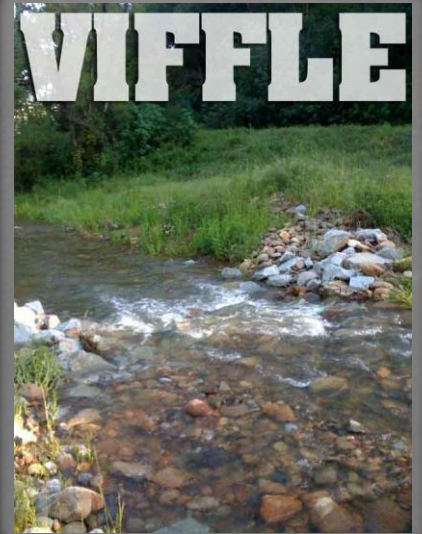
⇐ Forced Riffle/Pool

Boulder Tail

Interrupted Riffle

⇐ Jazz Riffle

viffle ⇒



- What are expectations for riffle design (hydraulics, stability, sediment transport)?
- How to define success (Alluvial – Threshold)?

Evolution of the Riffle...cont'd

NATURAL CHANNEL PERIOD

BIOLITHIC EPOCH

I. Rehab

II. Bolder

1991

2001

Clue #1
Plan view
(Spacing)

Clues #2 & #3
Profile (Slope)
Substrate

RIFFLE EPOCH

III. Transition

IV. Reformation

2014

2020

Clues #4 & #5
Hydraulics
Geometry

2017

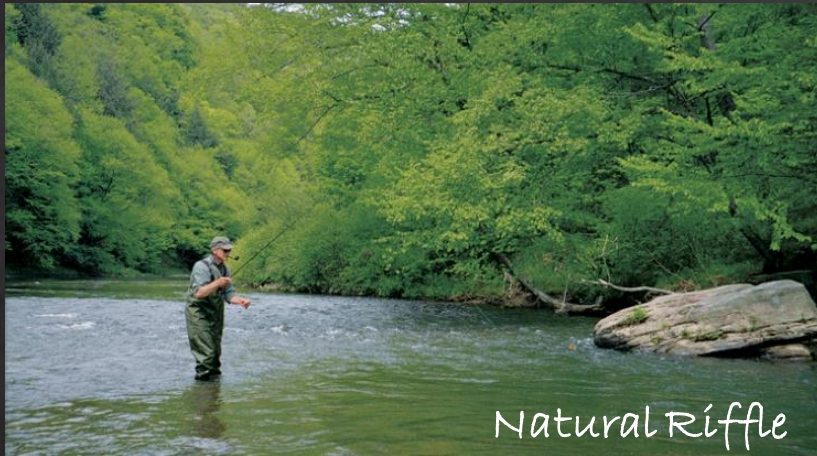
INTER-
DISCIPLINARY
CO-ORDINATION

1. How to apply current Riffle BOK?
2. How to expand Riffle BOK?
3. Riffle - integrator of
engineer/fluvial geo/fish bio

Adapted from S. Wilkerson (with permission)

Evolution worth Exploring!

- Natural Riffle template applied to Constructed Riffle
- Riffle Body of Knowledge is growing
- Integrator of Disciplines...continued discussions required



"...it seems probable that in the future a closer co-ordination of the two fields [engineering & geomorphology] will exist to the advantage of both"

Lane (1954) "The Importance of Fluvial Morphology in Hydraulic Engineering"



Thank You

Special Thanks:

Bill Annable

Robert Newbury

Roger Phillips

Shawn Wilkerson

More information?

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