River Restoration and Flood Control

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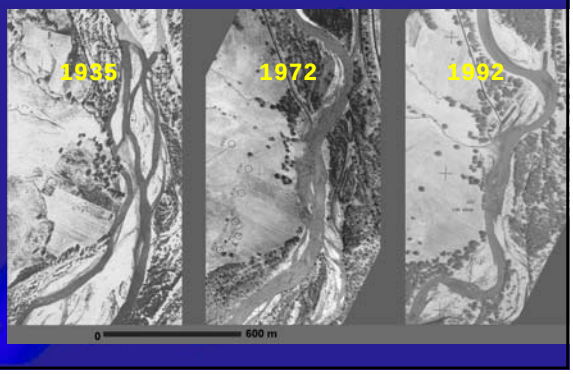
Colorado State University

South Korea, May 2007

Objectives

Brief overview of flood control and river restoration examples from the USA, Malaysia and South Korea.

Hydraulic geometry of the Rio Grande



Rio Grande near Bernardo, USACE 1963

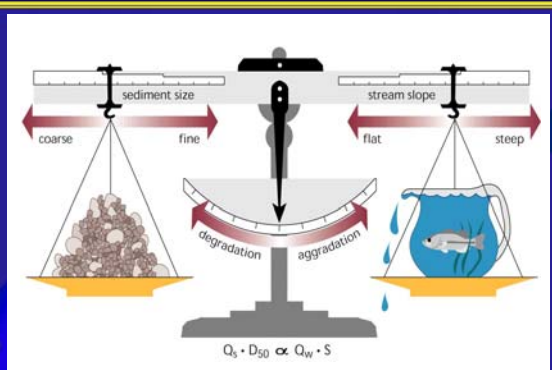
Stream Restoration Concepts

#1 There is no cookbook approach to stream restoration projects.

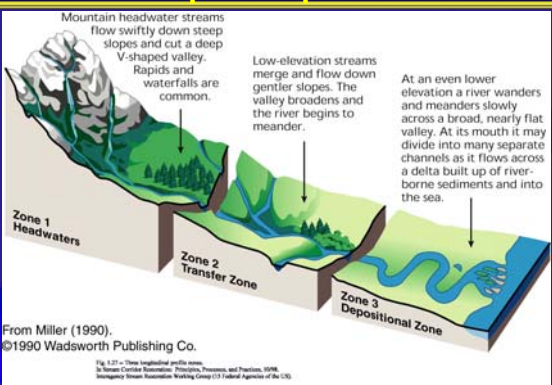
#2 Solutions normally require equilibrium conditions between flow and sediment regimes and knowledge of river mechanics and stream ecology.

#3 Solutions need to be effective, environmentally acceptable and economical.

Concept of Equilibrium



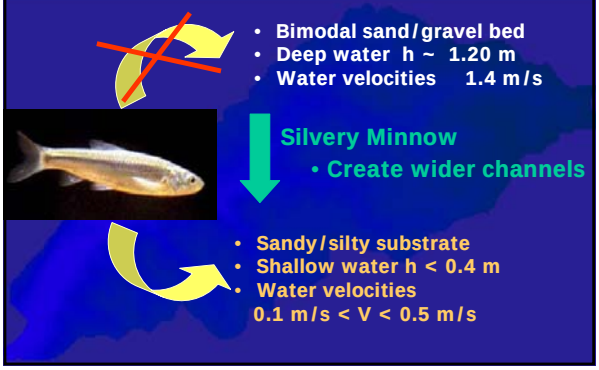
Concept of Equilibrium



Oxbow Preservation

Access to Oxbows

Rio Grande Restoration – Endangered Species



Gradient Restoration Facility

River Realignment
• Construct Bio-engineering Bankline

Habitat Improvement
• Sediment Storage Upstream from GRF
• Low Velocity Overbank Flows
• Planting and Natural Reseeding of Native Vegetation

Stream Restoration Guidelines

1. Clearly define the **OBJECTIVES**
2. **PAST,** Present and **FUTURE**
3. Look at the **UPPER WATERSHED**
4. Look **DOWNSTREAM** for degradation
5. **EQUILIBRIUM** Hydraulic Geometry
6. Appropriate **AQUATIC HABITAT**
7. Examine various design **ALTERNATIVES**
8. **DESIGN** must be Effective, Environmentally sound and Economical
9. Plan **CONSTRUCTION** for the unexpected
10. Post-construction **MONITORING**

Stream Restoration Examples

Sebasticook River Watershed Restoration
Newport, Maine
http://www.me.nrcs.usda.gov/SebasticookRiver.html

Stream Restoration Examples

Upper Chester Creek Restoration, Alaska
http://www.muni.org/salmoninthecity/projects.cfm

Stream Restoration Examples

Perkiomen Creek, Pennsylvania Upper main branch

http://www.esajournals.org/esaonline/?request=get-document&issn=1540-9295&volume=003&issue=05&page=0259

Stream Restoration Examples

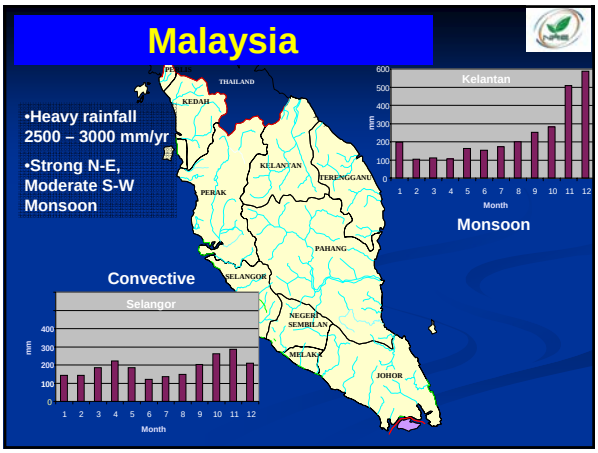
South Branch Tunkhannock Creek Restoration Project
Lackawanna County, Pennsylvania

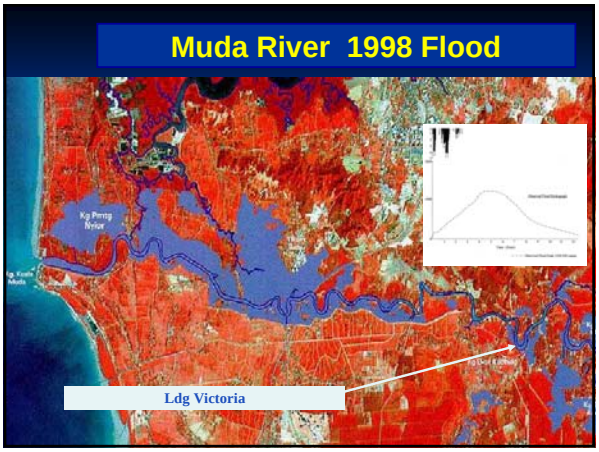
http://www.fxbrowne.com/html/Services/Updates/South%20Branch%20Tunkhannock%20Creek.htm

Stream Restoration Examples

Pike Creek, Maple Grove, Minnesota

http://www.answers.com/topic/restoration-ecology


Malaysia
•Heavy rainfall 2500 – 3000 mm/yr
•Strong N-E, Moderate S-W Monsoon
Convective
Monsoon
Kelantan
Selangor
mm
Month
THAILAND
KEDAH
PERAK
KELANTAN
TERENGGANU
PAHANG
SELANGOR
NEGERI SEMBILAN
MELAKA
JOHOR

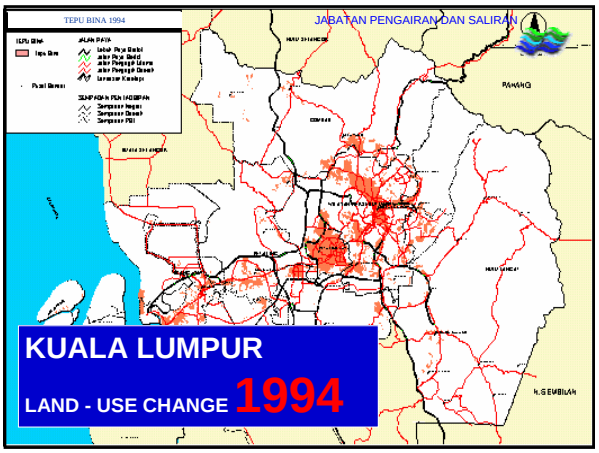

Muda River 1998 Flood
Ldg Victoria

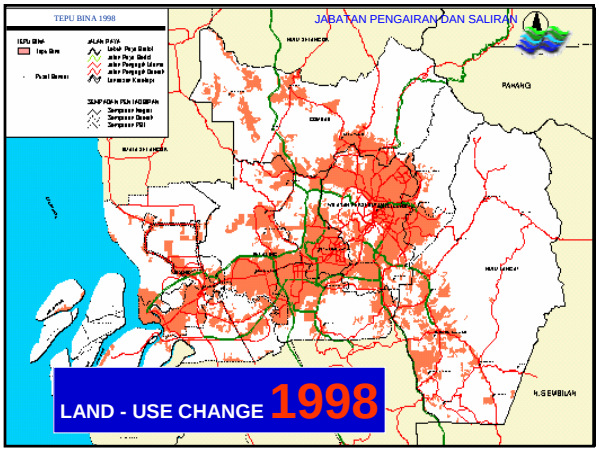
Sand and Gravel Mining
Kampong Kubang Bedengong
Kampong Lubok Segintah
Sand Mining Pumping Activity
River Sand Mining

Riverbed Degradation

Levee Protection

Levee Protection


TEPU BINA 1994
JABATAN PENGAIRAN DAN SALIRAN
PAHANG
N.SEMBILAN
KUALA LUMPUR
LAND - USE CHANGE 1994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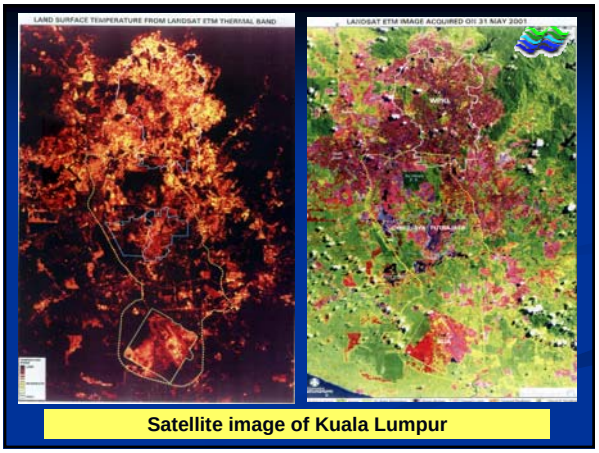
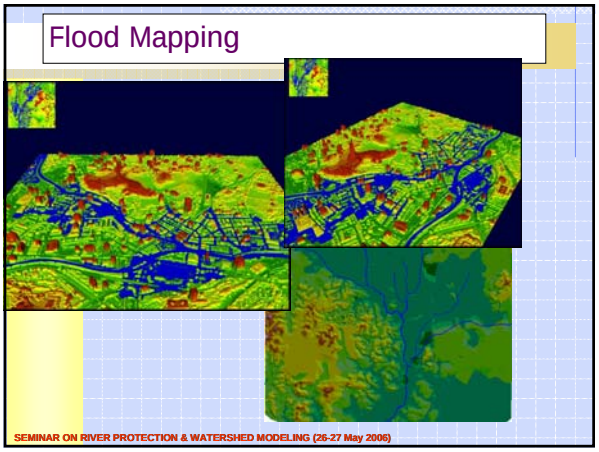

LAND SURFACE TEMPERATURE FROM LANDSAT ETM THERMAL BAND
LANDSAT ETM IMAGE ACQUIRED ON 31 MAY 2001
Satellite image of Kuala Lumpur

Elevated Rapid Transits
JABATAN PENGAIRAN DAN SALIRAN

Jalan Tun Razak pada 10 Jun 2003
Jalan Dang Wangi Pada 10 Jun 2003

10 June 2003 Flood
TELEKOM
TELEKOM
Betul boss,tak tipu....sungguh!!

JABATAN PENGAIRAN DAN SALIRAN
WATER QUANTITY CONTROL
Flash Floods
Damage in Klang Valley RM 50 M /yr


Flood Mapping
SEMINAR ON RIVER PROTECTION & WATERSHED MODELING (26-27 May 2006)

JABATAN PENGAIRAN DAN SALIRAN
MSMA
Roadsides / Swales

MSMA

JABATAN PENGAIRAN DAN SALIRAN

Wet Detention Ponds

MSMA

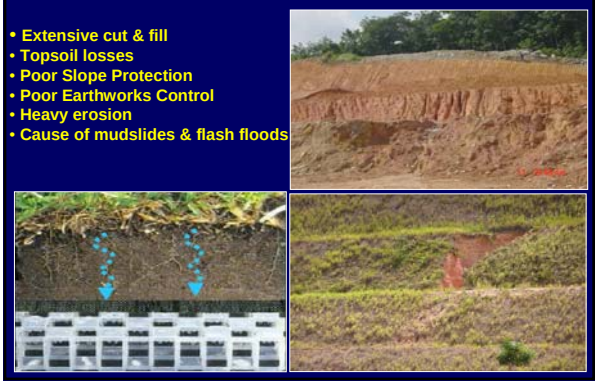
JABATAN PENGAIRAN DAN SALIRAN

Dry Detention Ponds

WATER QUALITY - EARTHWORKS

JABATAN PENGAIRAN DAN SALIRAN

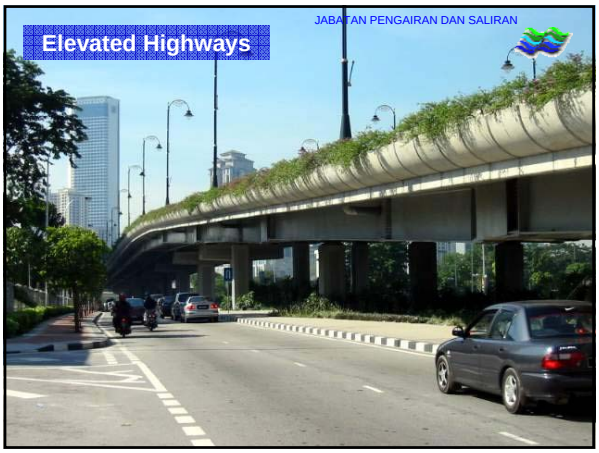
- Extensive cut & fill
- Topsoil losses
- Poor Slope Protection
- Poor Earthworks Control
- Heavy erosion
- Cause of mudslides & flash floods



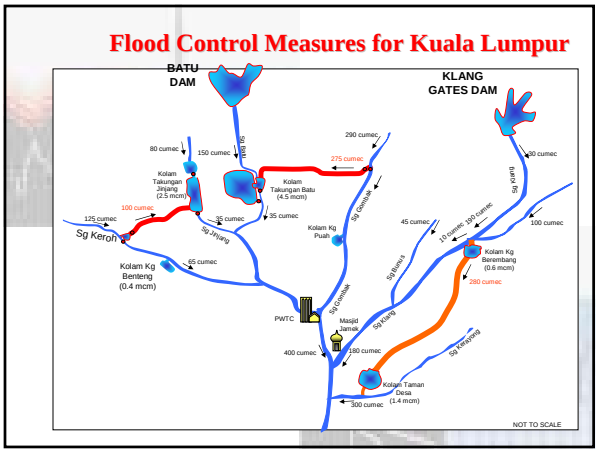
JABATAN PENGAIRAN DAN SALIRAN
Soil Reinforcement mats

JABATAN PENGAIRAN DAN SALIRAN
Road Medians
•Similarly for road dividers and curbs – put in greenery

JABATAN PENGAIRAN DAN SALIRAN
Expressways

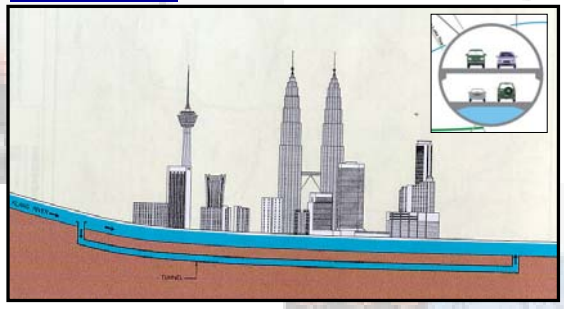

JABATAN PENGAIRAN DAN SALIRAN
Elevated Highways

JABATAN PENGAIRAN DAN SALIRAN
Retrofitting of Urban Drains


Flood Control Measures for Kuala Lumpur
BATU DAM
KLANG GATES DAM
80 cumec
150 cumec
290 cumec
275 cumec
30 cumec
Kolam Takungan Jinjang (2.5 mcm)
Kolam Takungan Batu (4.5 mcm)
100 cumec
125 cumec
35 cumec
35 cumec
Sg Keroh
Sg Jinjang
Kolam Kg Pudu
45 cumec
15 cumec
100 cumec
65 cumec
Kolam Kg Berembang (0.6 mcm)
Kolam Kg Berteng (0.4 mcm)
280 cumec
PWTC
Masjid Jamek
400 cumec
180 cumec
Kolam Taman Desa (1.4 mcm)
300 cumec
NOT TO SCALE

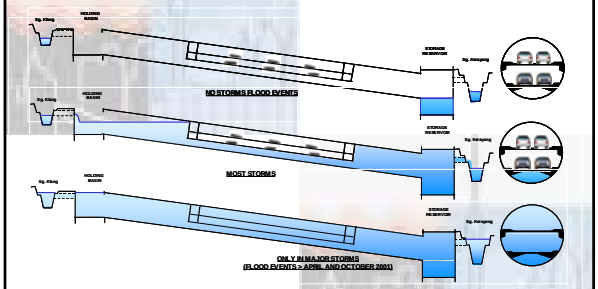
SMART TUNNEL

JABATAN PENGAIRAN DAN SALIRAN



SCHEMATIC DIAGRAM OF A FLOOD TUNNEL UNDER KLANG RIVER

Operation Modes For The Smart Project

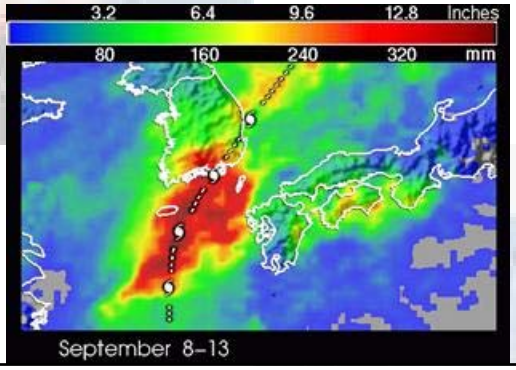


TBM No.1 – SOUTH DRIVE

Tunnel Boring Machine break-through, June 2005

South Korea

Total rainfall of Typhoon Maemi from 9/8/2003 to 9/13/2003)

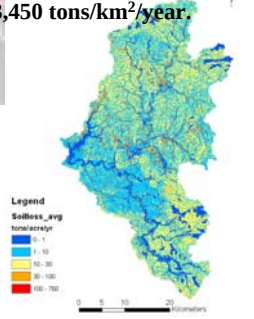


Mangun mountain, South Korea

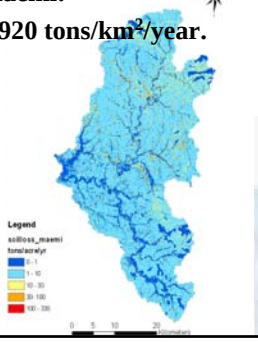
Imha reservoir

Soil loss maps

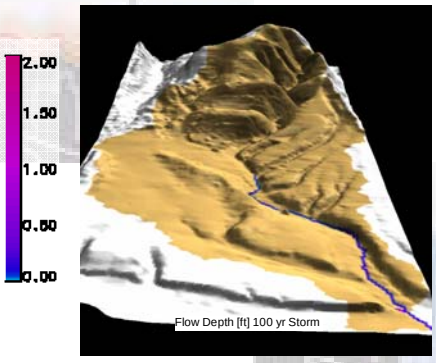
Annual average:
3,450 tons/km^2/year.



Maemi:
2,920 tons/km^2/year.



CSU Watershed Model TREX

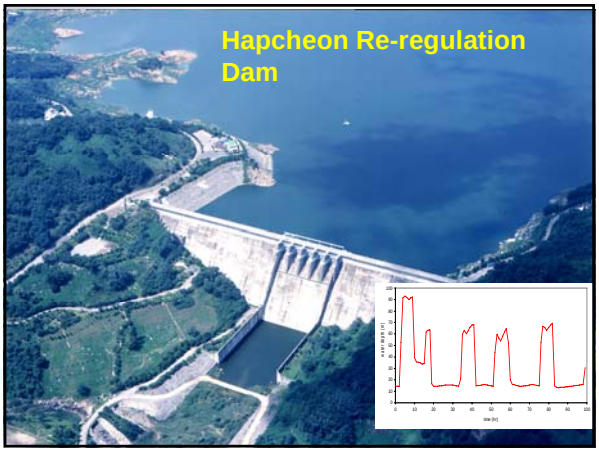


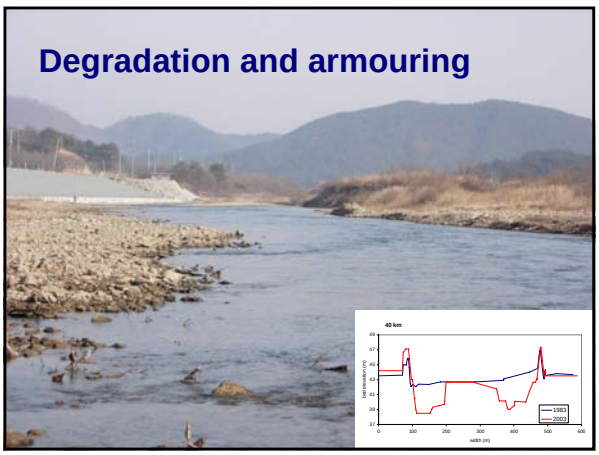
Stream Restoration Examples

River restoration project of Yangjae stream in Seoul metropolitan area (Gwacheon city)

Stream Restoration Examples

River restoration project of Yangjae stream in Seoul metropolitan area (Seocho-Gu)



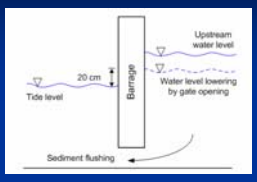


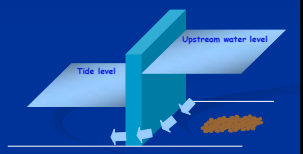
River changes below Hapcheon dam

Nakdong River and NREB | Unsteady modeling for the upstream of NREB

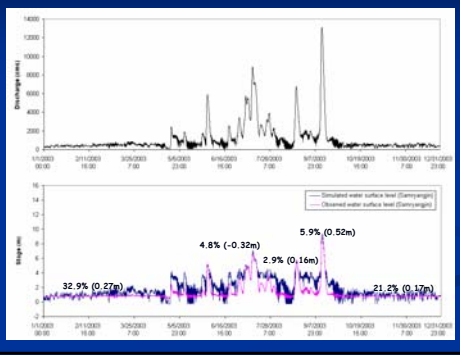
Nakdong River Estuary Barrage

Quasi-steady state model





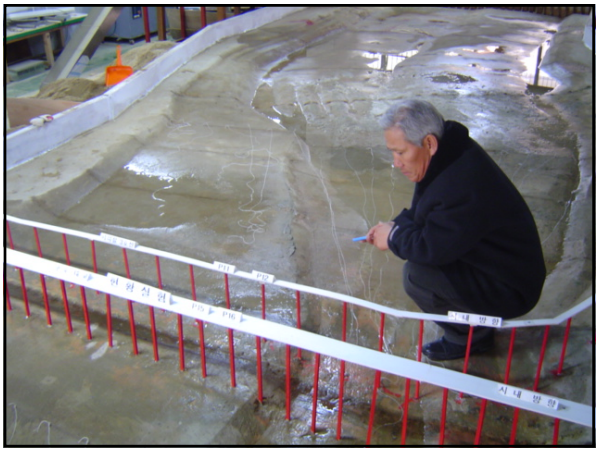
Quasi-steady state model
(Model validation 2003 – with dredging)



Flood Damages

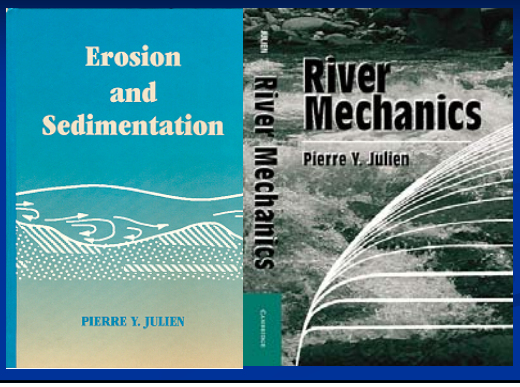
Gupo Bridge during Typhoon Maemi

P10



P15

Erosion and River Mechanics Textbooks



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