

# Major impacts by Reservoir Sedimentation

ダムの安全

貯水池の持続可能性

洪水リスク

下流の河床地形変化

ダム堆砂の影響

**Dam Safety**  
Clogging of intake and outlet

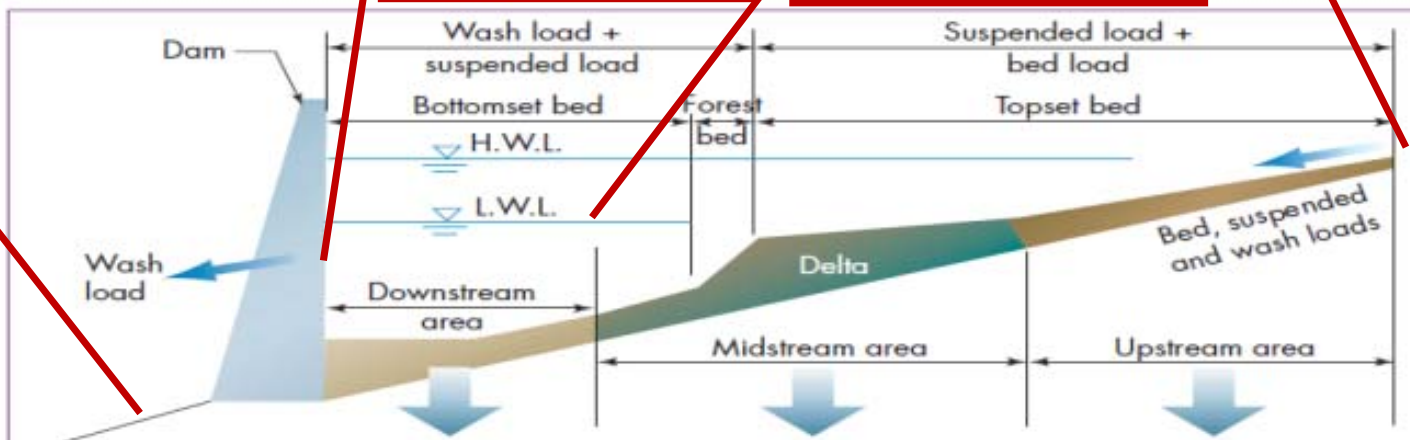
**Reservoir Sustainability**  
Reduction of storage capacity

**Flood Risks**  
Upstream Channel Aggradation

**Downstream Geomorphology**  
Degradation and Bed armoring

下流の生態系

**Downstream Ecosystem**  
Reduced ecosystem health (Biodiversity, quality and quantity of food resources, water quality) with the combination of changes in seasonal flow, flood frequency and magnitude



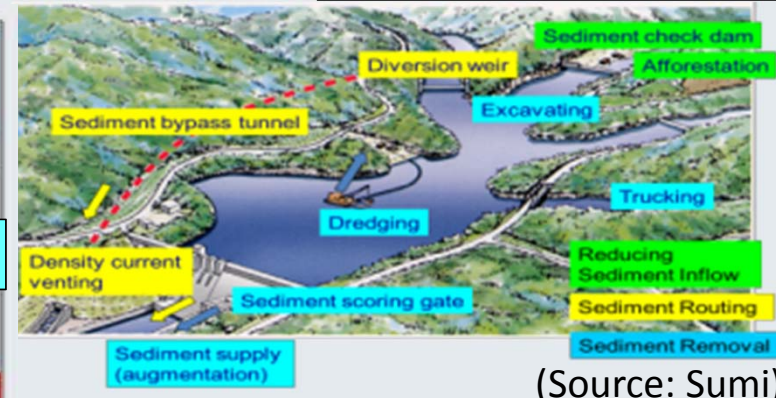
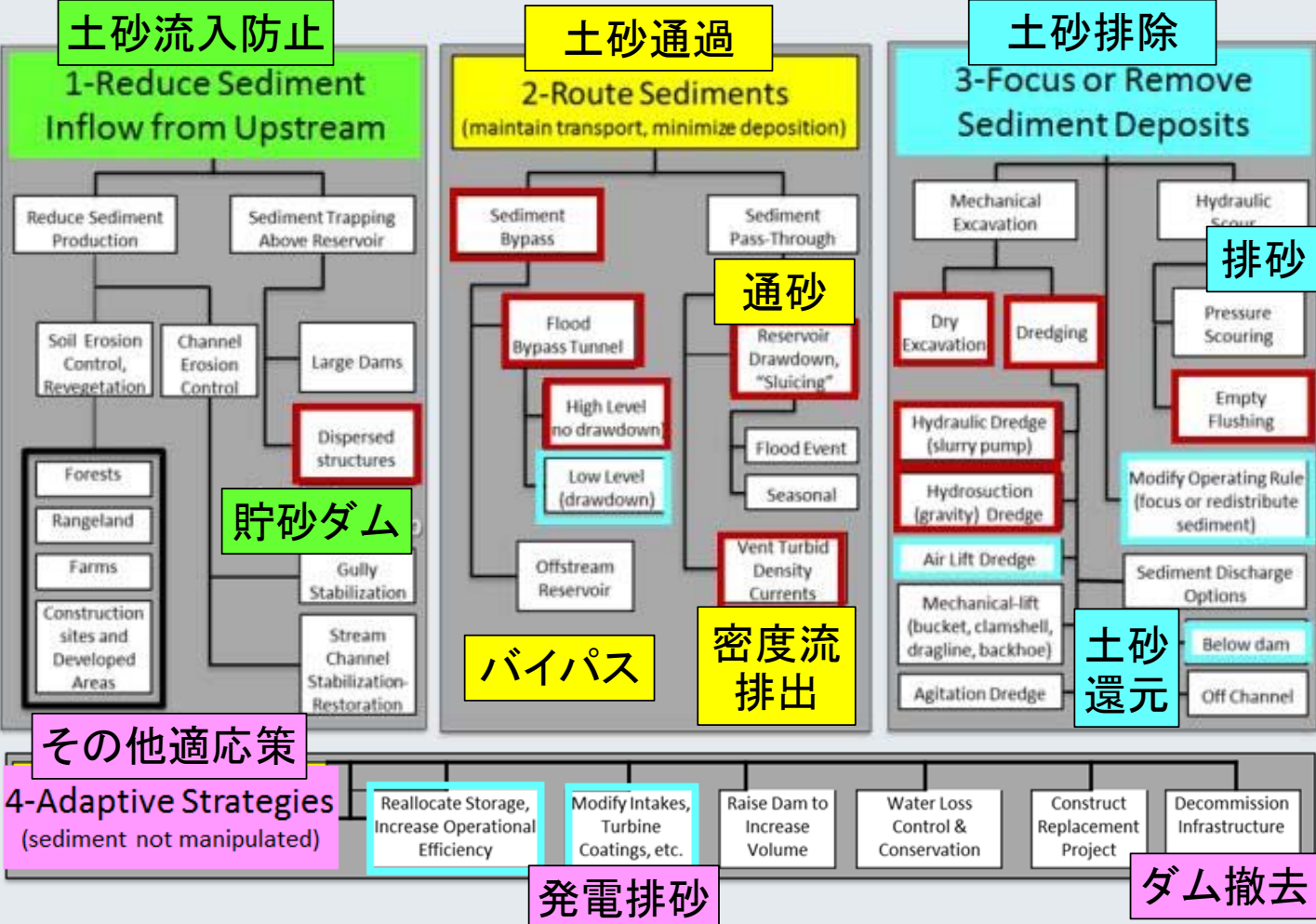
Sediment Property	Soil Classification	Main component: Clay and Silt	Main component: Sand	Main component: Gravel and Sand
	Average size grain distribution (%)	Gravel = 3, Sand = 11 Silt = 50, and Clay = 37	Gravel = 12, Sand = 41 Silt = 32, and Clay = 15	Gravel = 28, Sand = 43 Silt = 21, and Clay = 8
	Fine grained fraction, Fc	Fc = above 90%	Fc = about 50%	Fc = under 30%
	Natural water content, w	w = above 100%	w = about 50 to 60%	w = under 40%
	Density Porosity	Low		High
	Ignition Loss Ig	Ig = about 10%	Ig = about 7%	Ig = about 4%
	Organic materials /Nutrient	High		Low

Source: S. A Kantoush, T. Sumi and Y. Takemon 2011



貯水池土砂管理方策

Classification of sediment management strategies for reservoirs



(Source: Sumi)

- (i) Reduction of sediment input by controlling erosion and trapping upstream sediment loads
- (ii) Routing sediments by bypass, off stream reservoirs, sediment sluicing (drawdown routing) and as well as venting of turbid density currents
- (iii) Sediment removal by dry excavation, dredging, drawdown /pressure flushing and Hydro-suction Sediment Removal System.
- (iv) Adaptive strategies by reallocate storage, dam heightening, operational control and dam decommissioning

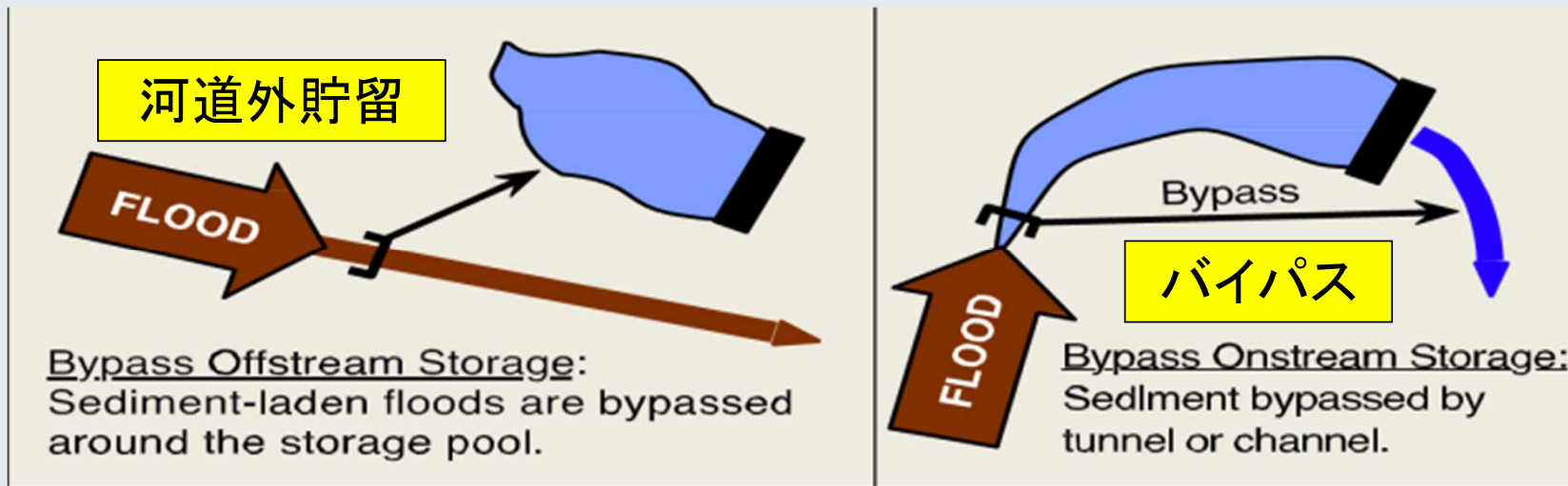
Classification of sediment management strategies for reservoirs (Morris, 2015)

## Chapter 3. SEDIMENT ROUTING BY BOTTOM OUTLETS, SLUICING AND SEDIMENT BYPASS TUNNELS

Sediment Routing is to pass through sediments into the tailwater downstream of the dam.

Various effective techniques can be applied:

- ✓ Direct bypassing around the dam using tunnels or channels
- ✓ Diverting to an off-channel reservoir
- ✓ Passing sediments through the reservoir by either sluicing or turbidity current venting



(Source: Morris)

# Sediment Bypass Tunnels バイパス

- Worldwide, limited numbers of sediment bypass tunnels (SBTs) have been constructed because of topographical, hydrological or economic conditions.
- Bypass tunnels have many advantages
  - Can be constructed even at existing dams
  - Prevents a loss of stored reservoir water caused by the lowering of the reservoir water level.
  - Relatively small impact on the environment downstream because inflow discharge can be passed through tunnels naturally during flood time.
- Recently, Switzerland and Japan have started initiative
  - 1<sup>st</sup> Workshop in Zurich (2016, ETH-VAW), 2<sup>nd</sup> Workshop in Kyoto (2017, KU-DPRI), 3<sup>rd</sup> Workshop in Taipei (2019, NTU).
- In submitted four reports, (R.22) is summarizing all SBT data worldwide and Swiss and Japanese experiences are reported in (R.40) and (R.19).
- Upgrading **anti-abrasion design** for flood tunnel based on the Swiss experience is reported in (R.4).



スイス



日本



台湾

トンネルインバートの摩耗対策



# New challenges on Sediment Bypass Tunnel

April. 9-12  
Taipei-Taiwan  
2019



3rd International Workshop on  
Sediment Bypass Tunnels

Prof. Dr. Tsang-Jung Chang  
Director General, Hydrotech Research Institute,  
Professor, National Taiwan University, Taiwan



第3回排砂バイパス国際会議  
(2019, April 9-12) 国立台湾大学



下流河川の環境変化の評価

Riverbed geomorphology, Water quality, Aquatic environment etc

Downstream

2nd International Workshop on Sediment Bypass Tunnels  
May 9-12 2017 Kyoto-Japan

Workshop Statement:  
Sediment bypass tunnels (SBT) are hydraulic structures that gain worldwide importance as a measure to counter reservoir sedimentation. Sediments are bypassed around a dam in the tailwater reach reducing sediment aggradation in the reservoir on the one hand and allowing for re-establishing sediment continuity on the other. The latter is more and more absent at least an ecological point of view since their last creation. Moreover, the dam is deteriorated along with an increase of ecological and ecological variability.

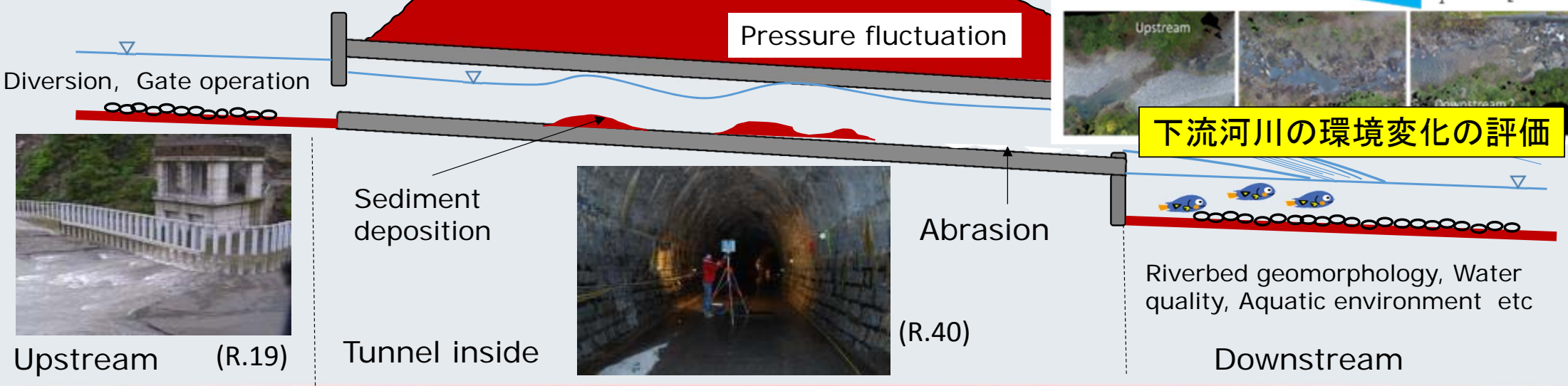
2nd Announcement:  
The 2nd SBTTW in April 2017 hosted by the Institute of Hydrology, Hydrology and Glaciology at ETH Zurich, Switzerland, was a great success with 80 participants from 12 countries gathering to exchange and discuss latest research findings and experiences.

Workshop Organizing Committee:  
Kansai Electric Power, ETN zürich, KAWASUMI, etc.

International Workshop on Sediment Bypass Tunnels  
April 27-29 2015 ETH Zurich

Abstract:  
A worldwide gap of research requires long-term solutions against reservoir sedimentation. World-wide sedimentation affects the reservoir storage capacity, leading to sea-level rise in the near future. The topic of reservoir sedimentation therefore attracts scientific attention. Sediment bypass tunnels are an effective countermeasure to significantly reduce sediment accumulation, particularly for small to medium sized reservoirs in its mountainous environment. During floods bypassing sediment is routed around the dam into the reservoir. Besides the shunting effect, reservoirs beneficially operate also when due to increased water and sediment their reaches, thereby accumulating sediment continually. However, high flow velocities and flood transport cause severe hydrodynamic effects on the banks, requiring continuous maintenance works.

Program:  
ETN zürich, KAWASUMI, etc.



Upstream (R.19)

Tunnel inside (R.40)

(R.40)



# History of SBT in Japan and Switzerland

## 排砂バイパストンネルの歴史

### Japan

Tachigahata Dam(1905)  
Nunobiki Dam(1908)  
Muko-no-ike(1916)

Asahi(1998)  
Miwa(2005)  
Koshibu(2016)  
Matsukawa(2016)



Pfaffensprung(1922)

Runcahez(1962)  
Egshi(1976)  
Palagnedra(1977)

Rempen(1986)  
Solis(2012)

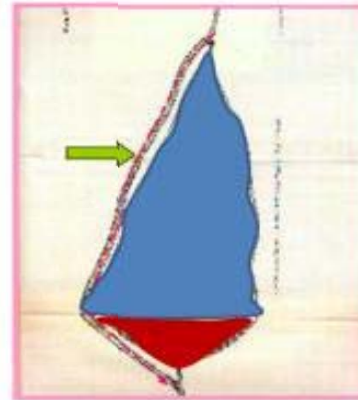
### Switzerland

Tachigahata Dam (1905)

## Sediment Bypass in Kobe (Plan View)

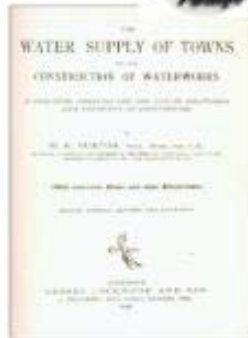
Nunobiki Dam (1908)

“Water Supply of Towns”



## Water Supply of Towns and the construction of waterworks

- W. K. Burton
- Printed by Crosby Lockwood, London in 1894



ブラタモリ (神戸港編)

2017.2.18

「赤道を越えても腐らない水」を供給＝有機物を含む土砂の流入防止、として紹介

1900 布引五本松ダム(バイパスなし)

流入土砂による堆積が顕著(危機感)

1908 布引五本松ダムに逆導入(バイパス設置)

1905 立が畑ダム(当初からバイパスあり)

土砂流入を効果的に防止

3rd International Workshop on

# SEDIMENT BYPASS TUNNELS

2019 Taipei-Taiwan  
April 09-12

Home Organization Program Submission Registration Travel / Tour

## Submission Information

On-line Abstract Submission System Open  
15th September, 2018

Deadline for Abstract Submission  
15th November, 2018

Online Full Paper / Extended Abstract Submission System Open  
15th January, 2019

Deadline for Full Paper Submission  
15th March, 2019

## Themes

We kindly invite you to submit your abstract on one of the following topics:

### A. Upstream Aspects

Hydrology  
Sediment yield

### B. Tunnel / Reservoir

Hydraulics & Sediment Transport  
Planning / Design  
Tunnel / Inlet / Outlet Works  
Invert Abrasion

### C. Downstream Aspects

Morphological Changes  
Ecological Effects

### D. Other Aspects

Construction  
Maintenance  
Monitoring  
Operation

第3回排砂バイパス  
国際会議  
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国立台湾大学



<https://www.iwsbt2019.info/>

**Field trip 2.5 days (April 10 – April 12)**

