Sustainable Infrastructure and Asset Management

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What is Asset Management?

- The optimal allocation of the scare budget between the new arrange-ment of infrastructure and rehabilitation/maintenance of the existing infrastructure to maximize the value of the stock of infrastructure and to realize the maximum outcomes for the citizens

Asset management

- Pavement management (highway, runway)
- Railway management
- Bridge management
- Facility management
- Tunnel management
- Water supply system management
- Port facility management
- Embankment management
- Slope management
- River facility/Dam facility management
- Forest management

Dam Facility Management

- Long-term Sustainable Infrastructure

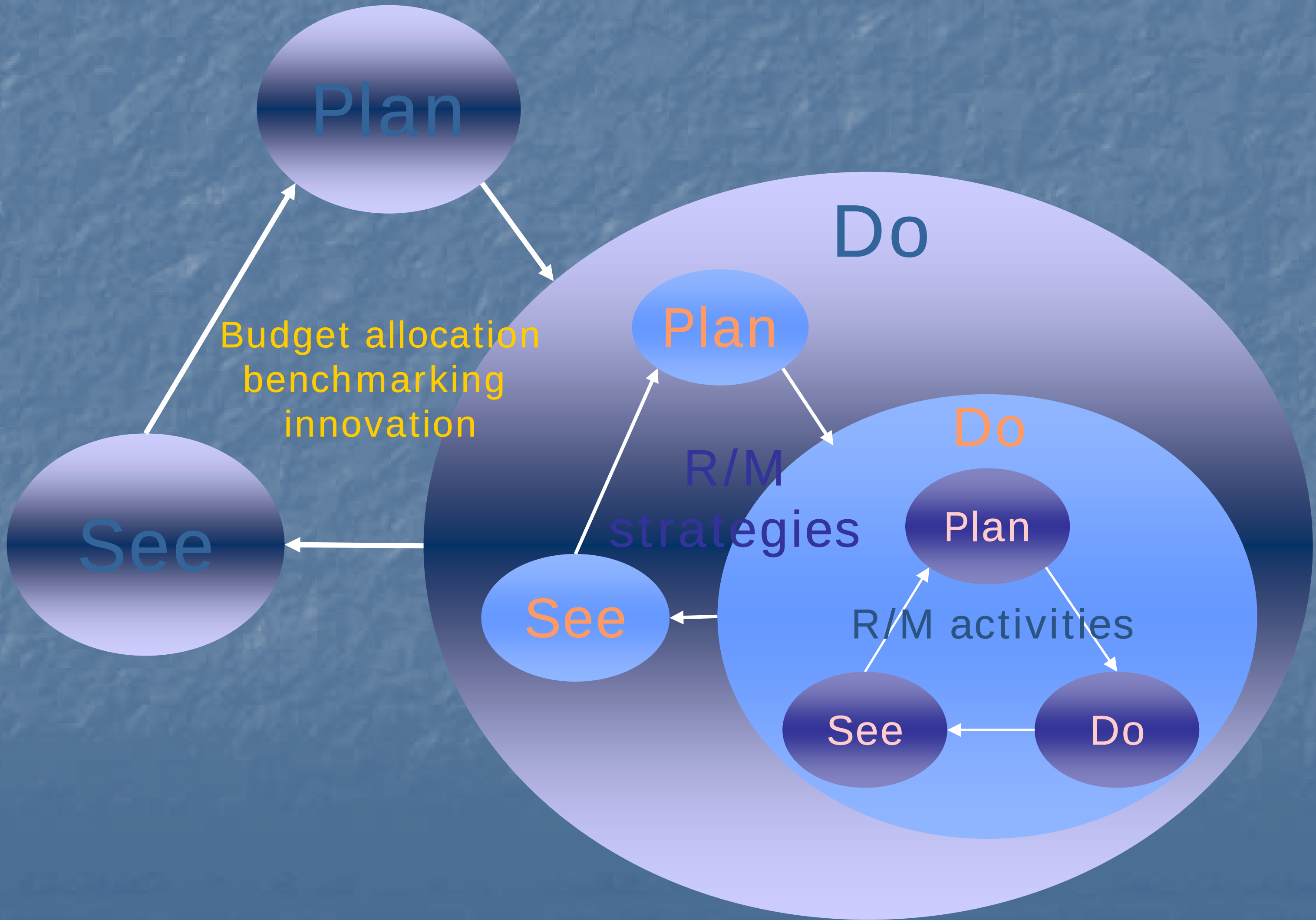
- Comprehensive management of sedimentation systems
  (environmental change, ecological impacts, riverbed degradation, river morphology change, and coastal erosion)

- Large-scale risks
  (socio-economic change, volatility in sedimentation, green house effects)

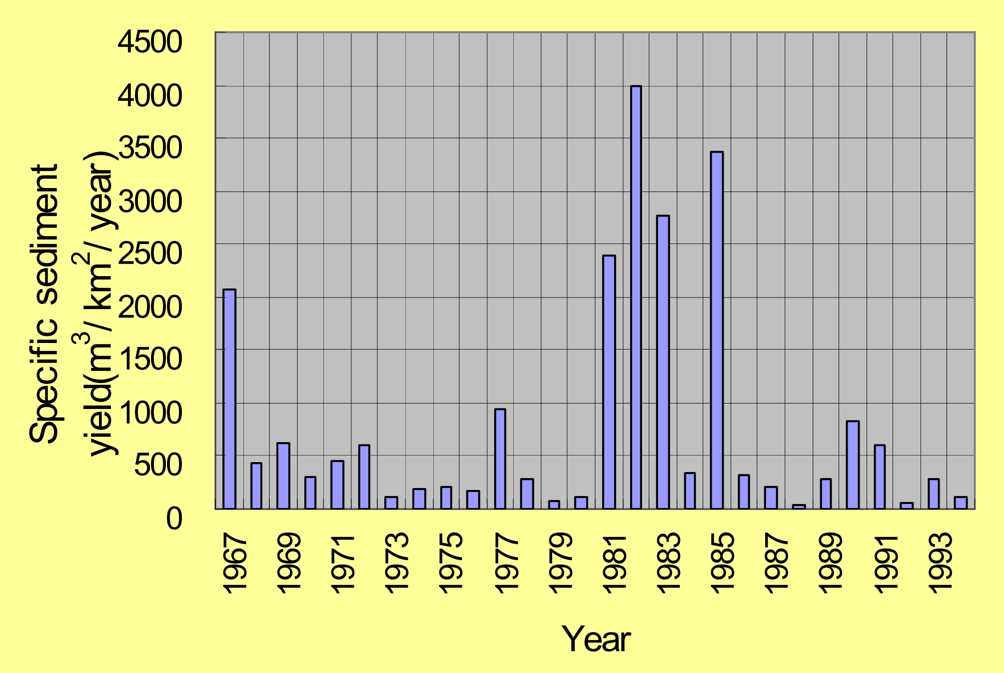
Dam facilities based on renewal duration and management points

Renewal duration	Facilities	Management points	Others
Short Several yrs - Several 10 yrs	Mechanical Electrical Architectural	Reduction of total cost of Inspection， Maintenance， Repair and Renewal	Improvement of service level Technical Innovation
Long Several 10 yrs - Several 100 yrs	**Reservoir （Sedimentation）**	Long Life Reduction of Life Cycle cost	Renewal duration will be expanded by proper countermeasures
Extra long	Dam body	Reduction of Inspection and Maintenance cost Risk assessment	No Renewal will be necessary for extra long duration and present value of the renewal can not be evaluated
Occasional	Reservoir slope Land slide Earthquake	Inspection Immediate action	Respond up to certain level during construction period

Hierarchical asset management cycles

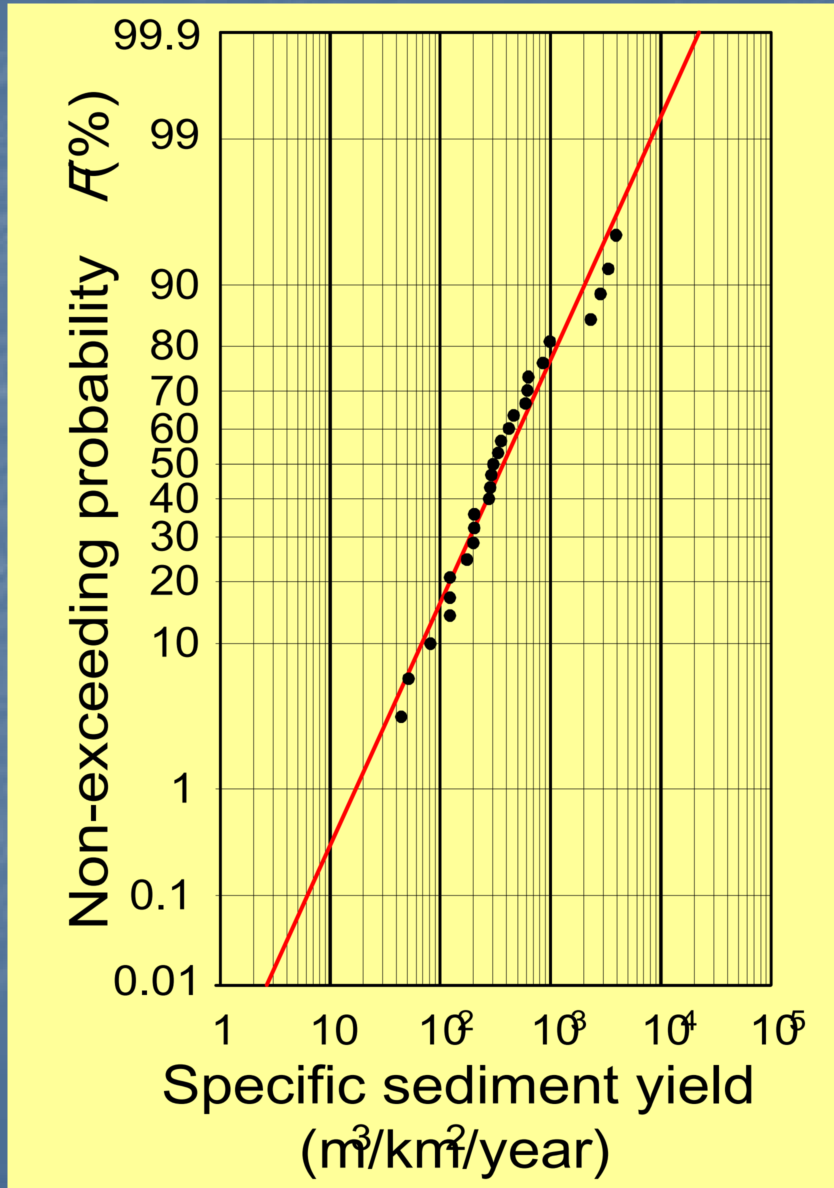


Probabilistic analysis of reservoir sedimentation



KAWAMATA dam (Tone River)

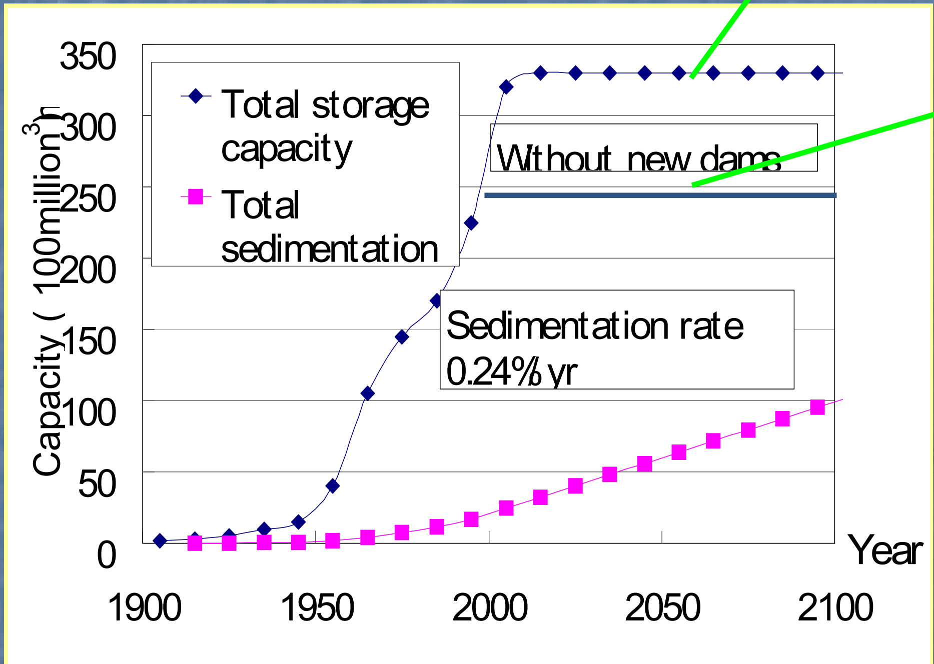
- Annual record of specific sediment yield can be plotted on log-normal probability paper using Weibull plot. $F(x_i)=i/(N+1)$



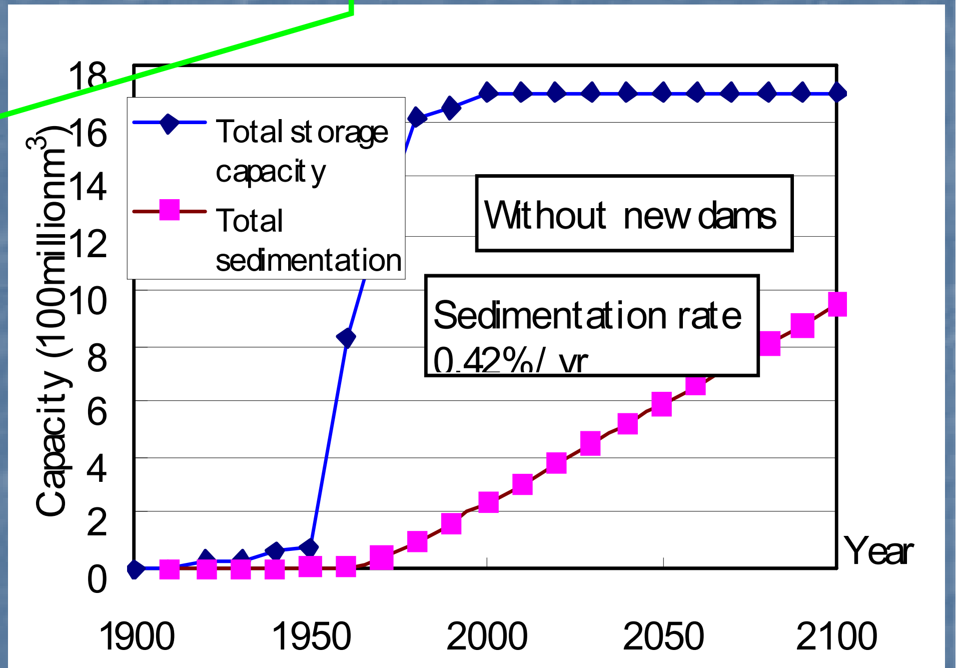
Expected gross storage capacity change without sedimentation management

All new proposal and under construction projects included

Existing storage capacity

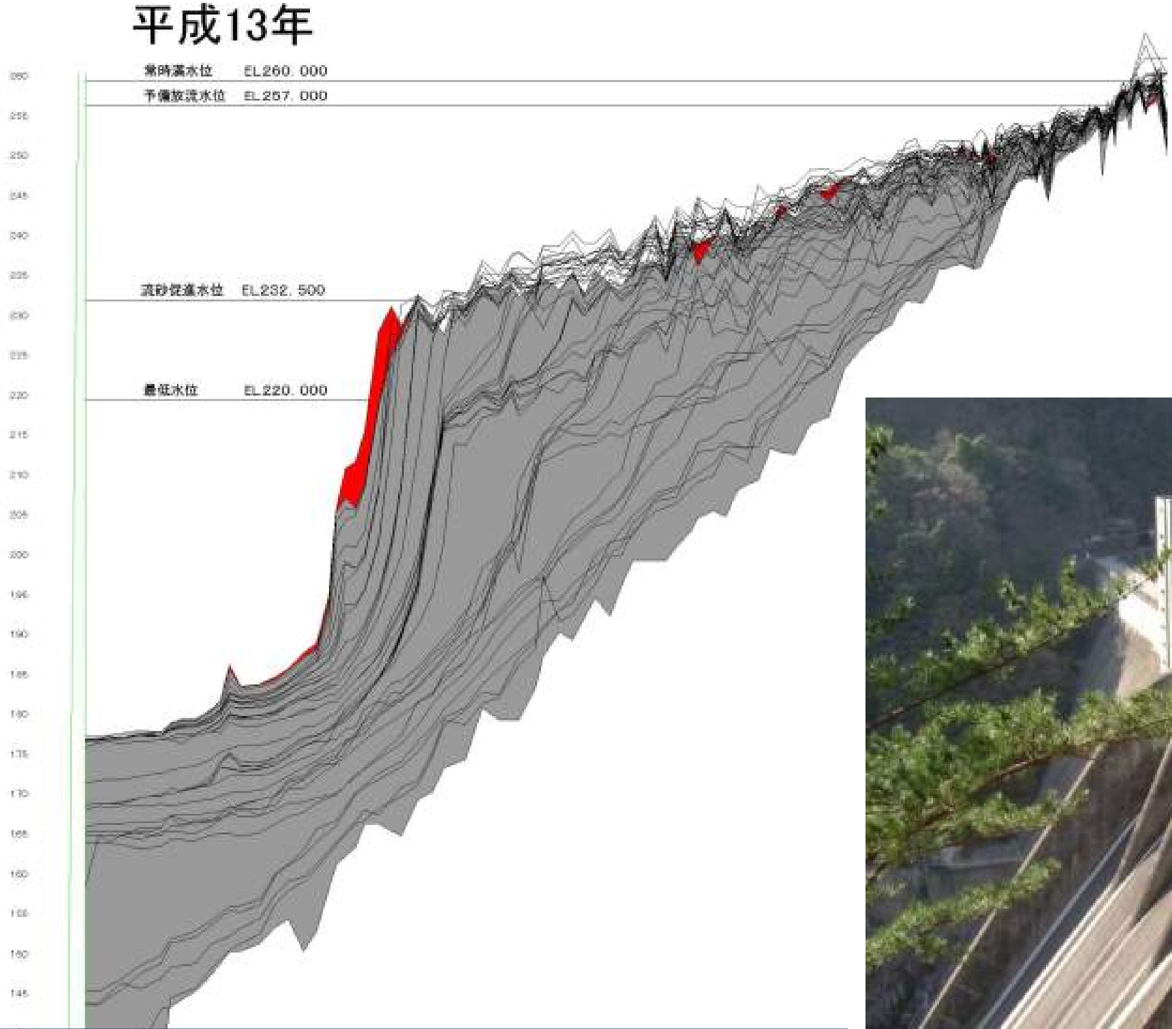


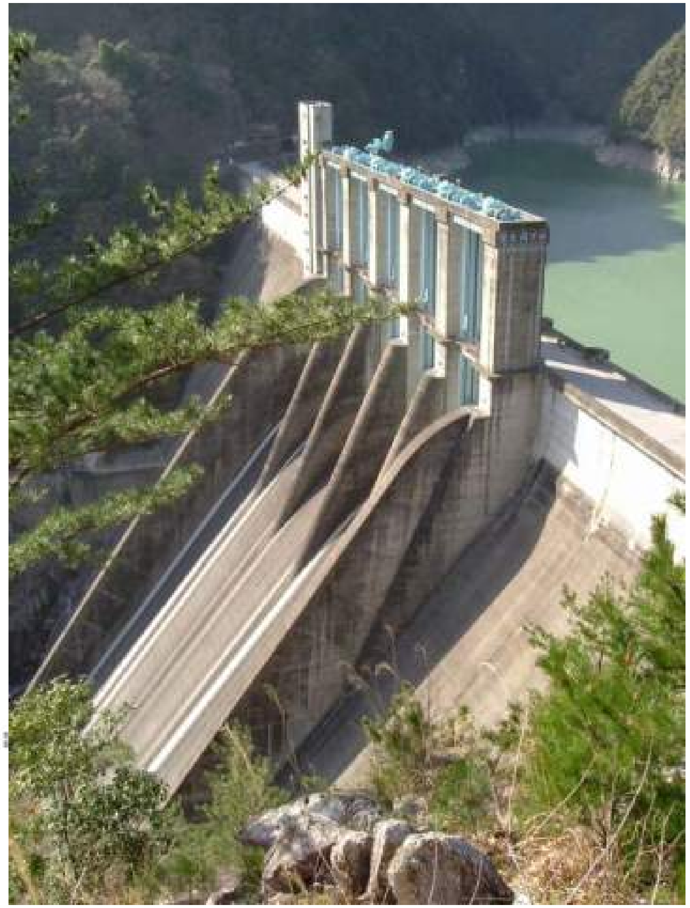
Japan



Chubu Region

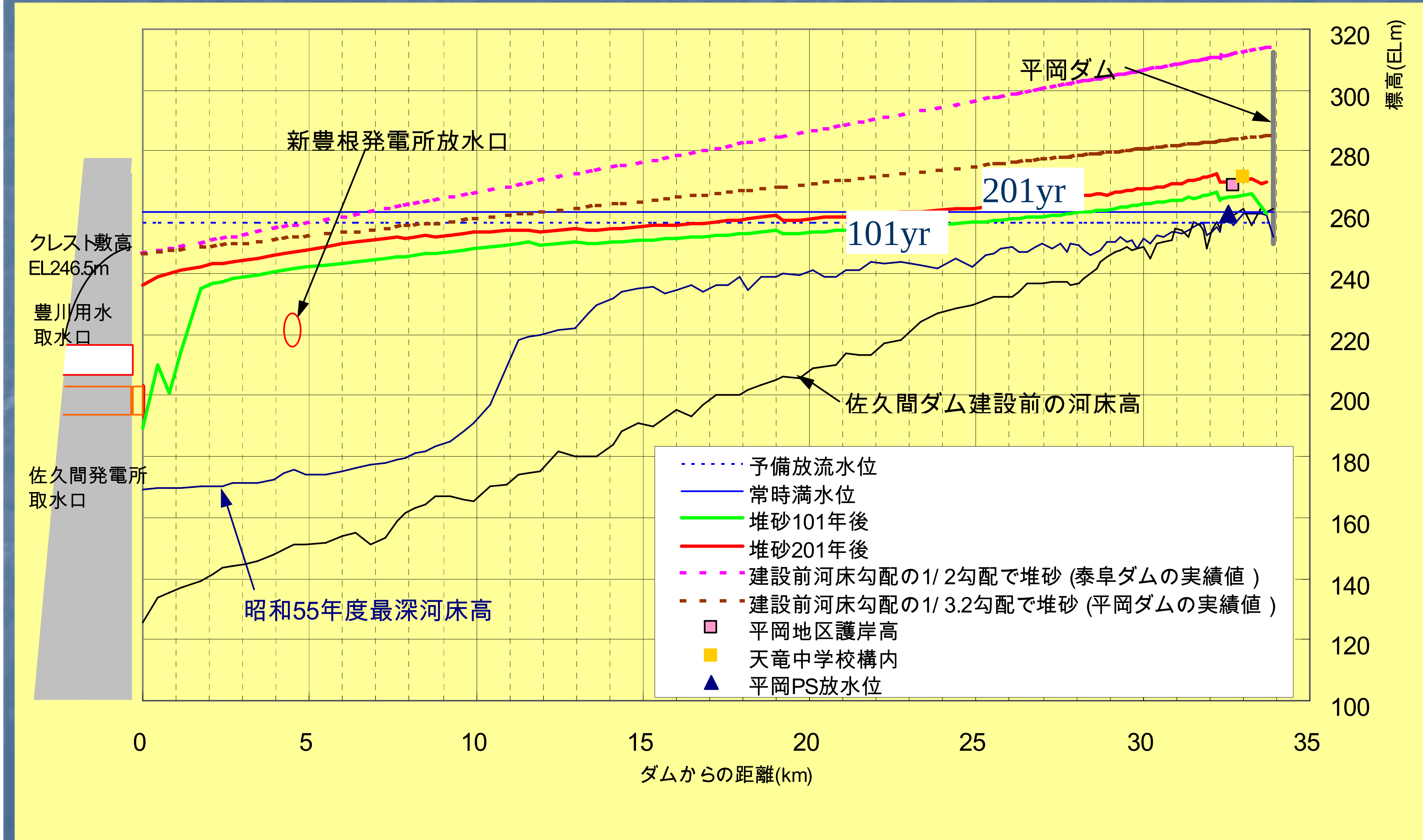
Reservoir sedimentation in Sakuma dam





J-Power (EPDC)
1956　Power generation
Gravity concrete　Height=155.5 m

Future estimation of reservoir sedimentation in Sakuma dam



Sedimentation management dams in Japan

Sediment management

Classification	Place	Details of sediment control measures		Examples in Japan
Reducing sediment flowing into reservoirs	Upstream reservoirs	Reduction of sediment production by hillside and valley works Regulation of reservoirs and sediment by erosion control dams and slit dams Reduction of discharged sediment and river course stabilization by channel works		Sabo area, Changing from sediment check dams to sediment control dams (slit dams)
	End of reservoirs	**Sediment check dam**	Regurally excavating and recycling for aggregate or sediment supply to downstream river	Miwa Dam, **Koshibu Dam**, Nagashima Dam, **Matsukawa Dam, Yokoyama Dam** **57dams**
Sediment routing	End of reservoirs	**Sediment bypass**		**Asahi Dam**, **Miwa Dam**, Koshibu Dam, Matsukawa Dam, Yokoyama Dam
	Inside reservoirs	Sediment sluicing		Sabaishigawa Dam Dashidaira Dam-Unazuki Dam (Coordinated sluicing)
			Non-gate botom outlets (natural flushing)	**Masudagawa Dam**
		Density current venting	Botom outlets for flood control	Koshibu Dam, Futase Dam, Kigawa Dam
			Non-gate conduits with curtain wall	**Katagiri Dam**
			Selective withdrawal works	Yahagi Dam
Sediment flushing	Inside reservoirs	**Drawdown flushing**	Sediment flushing outlet	**Dashidaira Dam-Unazuki Dam (Coordinated flushing)**
		Partial flushing without drawdown	Sediment scoring gate	Senzu Dam, Yasuoka Dam
			Sediment scoring pipe	Ikawa Dam
		Excavating & Dreging	**Recycling for concrete aggregate**	Miwa Dam, **Koshibu Dam**, Sakuma Dam, Hiraoka Dam, Yasuoka Dam
			Soil improving material, Farm Land filling, Banking material	Miwa Dam, Yanase Dam
			Sediment replacing inside reservoir	Sakuma Dam
			Sediment supplying to downstream rivers	Akiba Dam, **Futase Dam**, Miharu Dam, Nagayasuguchi Dam, Nagashima Dam

Reservoir sedimentation

Excavated and utilized for Kobe Airport

Development of efficient and environmentally compatible sediment management techniques

- "Take", "Transport" and "Discharge"
  - Sediment flushing/sluicing and sediment bypassing should be introduced more.
  - The sediment trucking and supply, and the Hydro-suction Sediment Removal System (HSRS) are needs to be improved furthermore and introduced as supplementary measures.

Asset management

- Life cycle cost (LCC) minimization
  Rehabilitation and Maintenance
  from proactive maintenance to preventive maintenance
- Operation, Replacement, Expansion, Removal,
  Real Option

Asset management technology 1

- Inspection technology
- Inventory Database
- Tool box
- Performance curve (Markov matrix)
- LCC evaluation (Markov decision model)
- Computer systems

Asset management technology 2

- Process evaluation/reengineering
- Policy evaluation (outcome/output/input)
- P erformance-based asset management contract
- Citizen participation

Two-staged project

t_0 —30→ t_1 —70→ t_2

Cost	30 billion JPY	100 billion JPY
	70 billion JPY	

Benefit **three scenarios**

1/3 18 billion JPY

1/3 90 billion JPY

1/ 3 0 billion JPY

Cost-benefit analysis

B = (1/3) 180 + (1/3) 90 + (1/3) 0 = 90

C = 100

B - C = 90 -100 = - 10 **decline**

Real Option

Additional cost 70 billion JPY

B – C = 180-70 = 110 **Scenario 1**

B – C = 90 – 70 = 20 **Scenario 2**

B – C = 0 - 70 = - 70 **Scenario 3** → decline

(1/3) 110+ (1/3) 20 + (1/30) 0 =43.3

Real Option = 43.3- 30 = 13.3 > 0 **investment**

Life cycle course decision making as a real option


integrity
responsibility
accountability