



Sediment Monitoring and Sluicing Operation in Shihmen Reservoir

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CONTENTS

- I. BACKGROUND
- II. REFORM FOR SLUICING
- III. CONCLUSION

I. Background

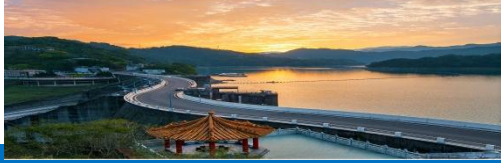
TAIWAN MAP

0 5 30 60 Km



Shihmen Reservoir plays an important role on water supply for irrigation and domestic use of northern Taiwan.

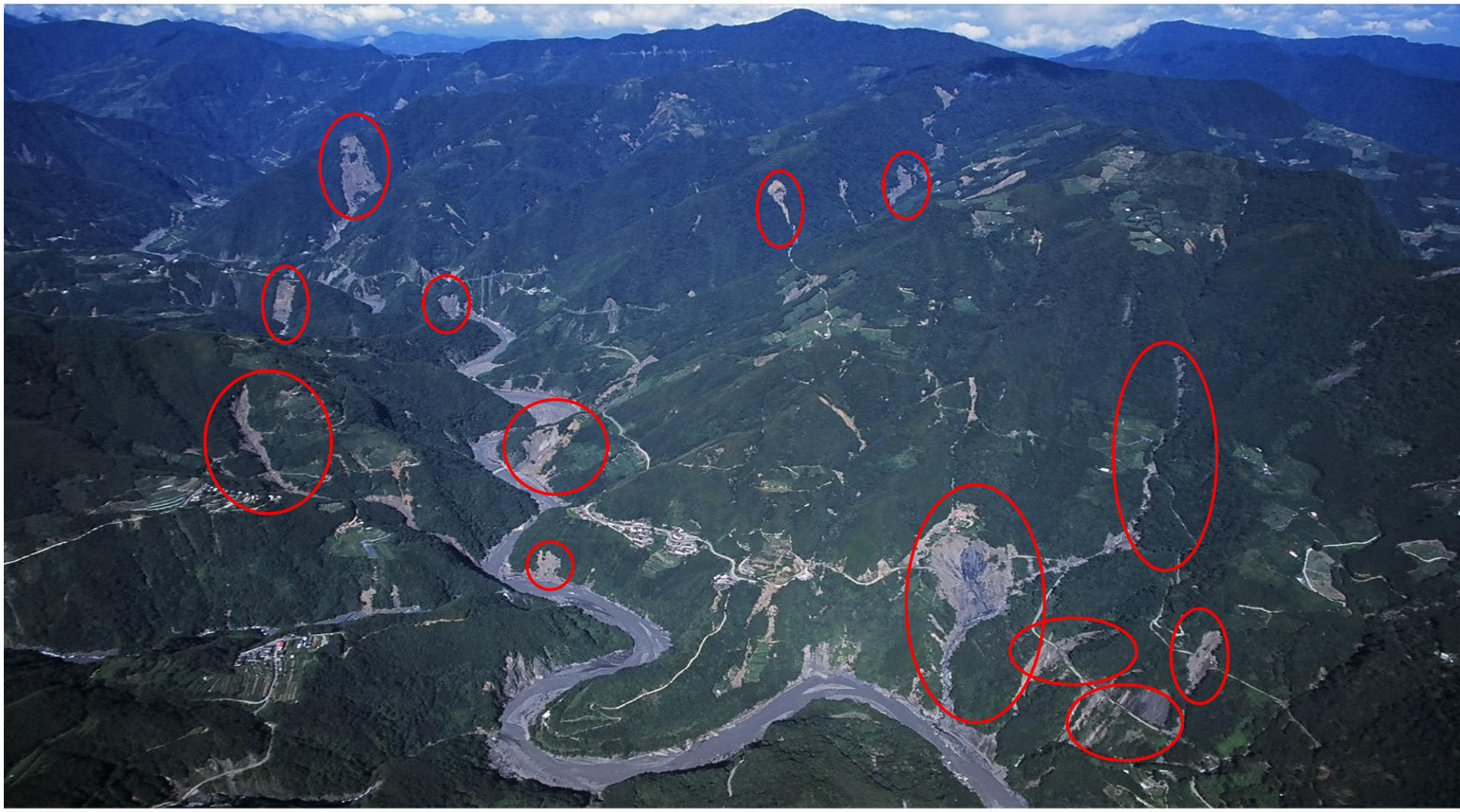




I. Background



Landslides and soil erosion in watershed is the greatest threat to the reservoir.



I. Background

All the check dams were filled with rock and soil.

Zonhua dam

I shin dam

Yuhong dam

Balin dam

Shurun dam

Salunzai dam

榮華壩

巴陵壩

玉峰壩

秀密壩

沙坪壩

763 km²

68.1萬m³

1047萬m³

18.82萬m³

24.9萬m³

I. Background

Water was too muddy during heavy storms.



Inflow

A photograph showing a wide, turbulent flow of muddy brown water entering a reservoir or lake. The water is churning and carries a lot of sediment. In the background, a concrete dam structure is visible on the left, and a steep, forested hill rises on the right. The sky is overcast and grey.



Spillway

A photograph of a large spillway where a massive, churning mass of muddy water is cascading over a concrete structure. The water is extremely turbulent, creating large white foam and spray. In the foreground, there are some industrial buildings and a small green field.



Spillway Tunnel

A photograph showing a large, turbulent flow of muddy water exiting a tunnel. The water is dark brown and very turbulent, with a lot of white foam and spray. The tunnel's concrete structure is visible in the foreground.



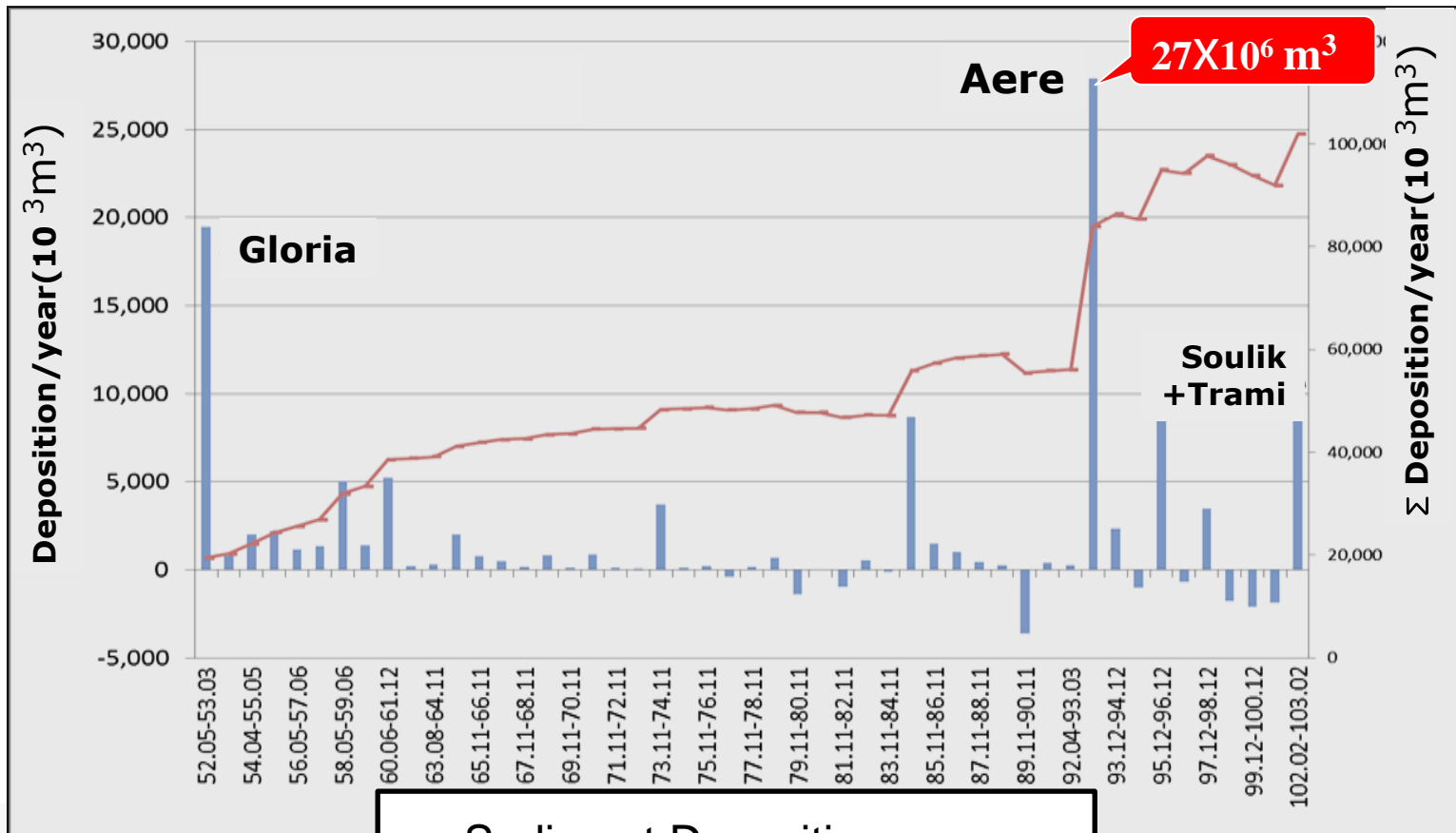
Muddy Lake

An aerial photograph of a large body of water, which is a deep, opaque brown color due to the high concentration of sediment. The lake is surrounded by green, forested hills. A dam structure is visible in the lower part of the image.

I. Background

Typhoon is the greatest factor for sedimentation.

Average deposition : $4 \times 10^6 \text{ m}^3/\text{yr}$



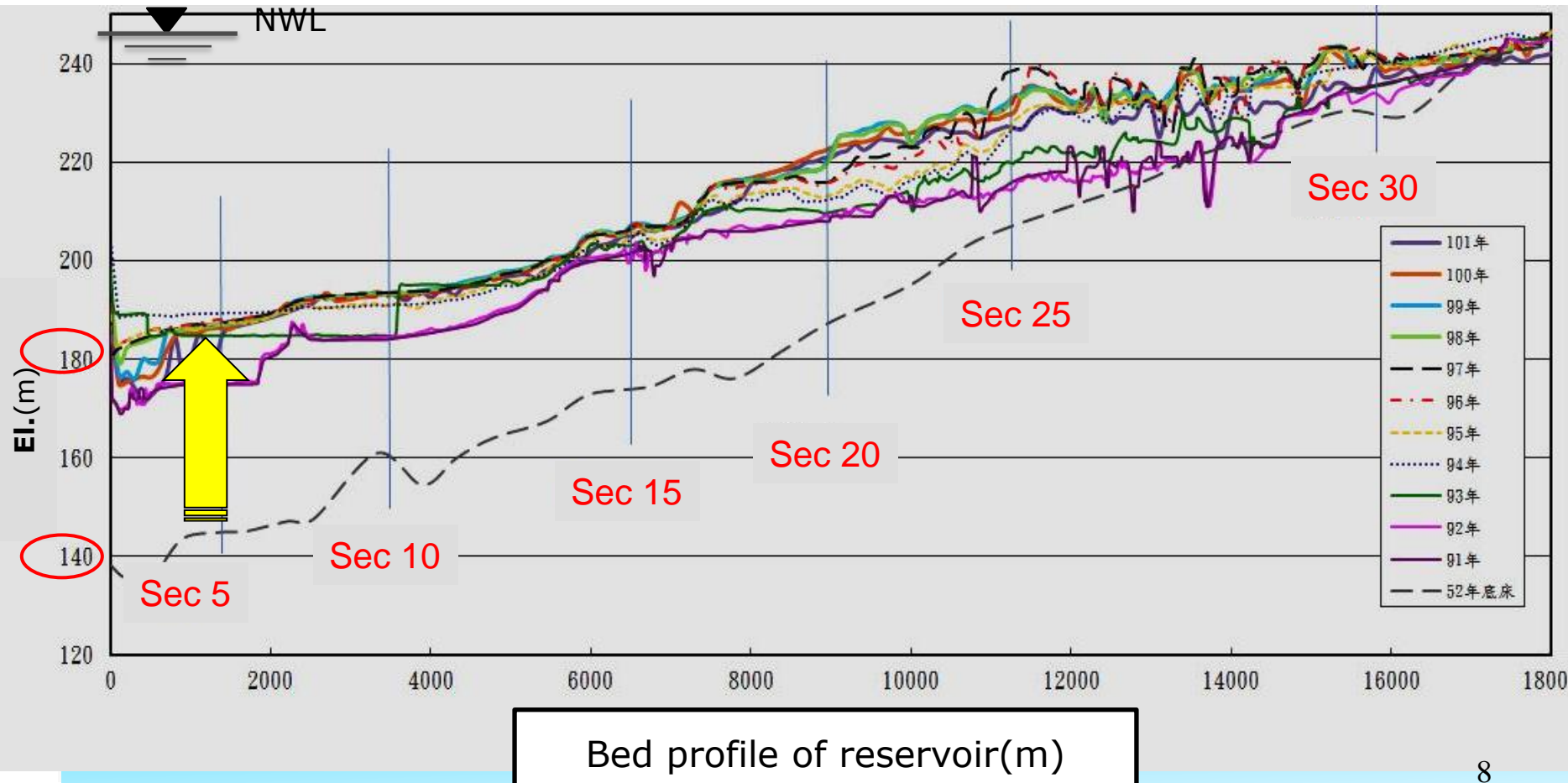
Sediment Deposition curve

I. Background

1/3 of the capacity were occupied by deposition.

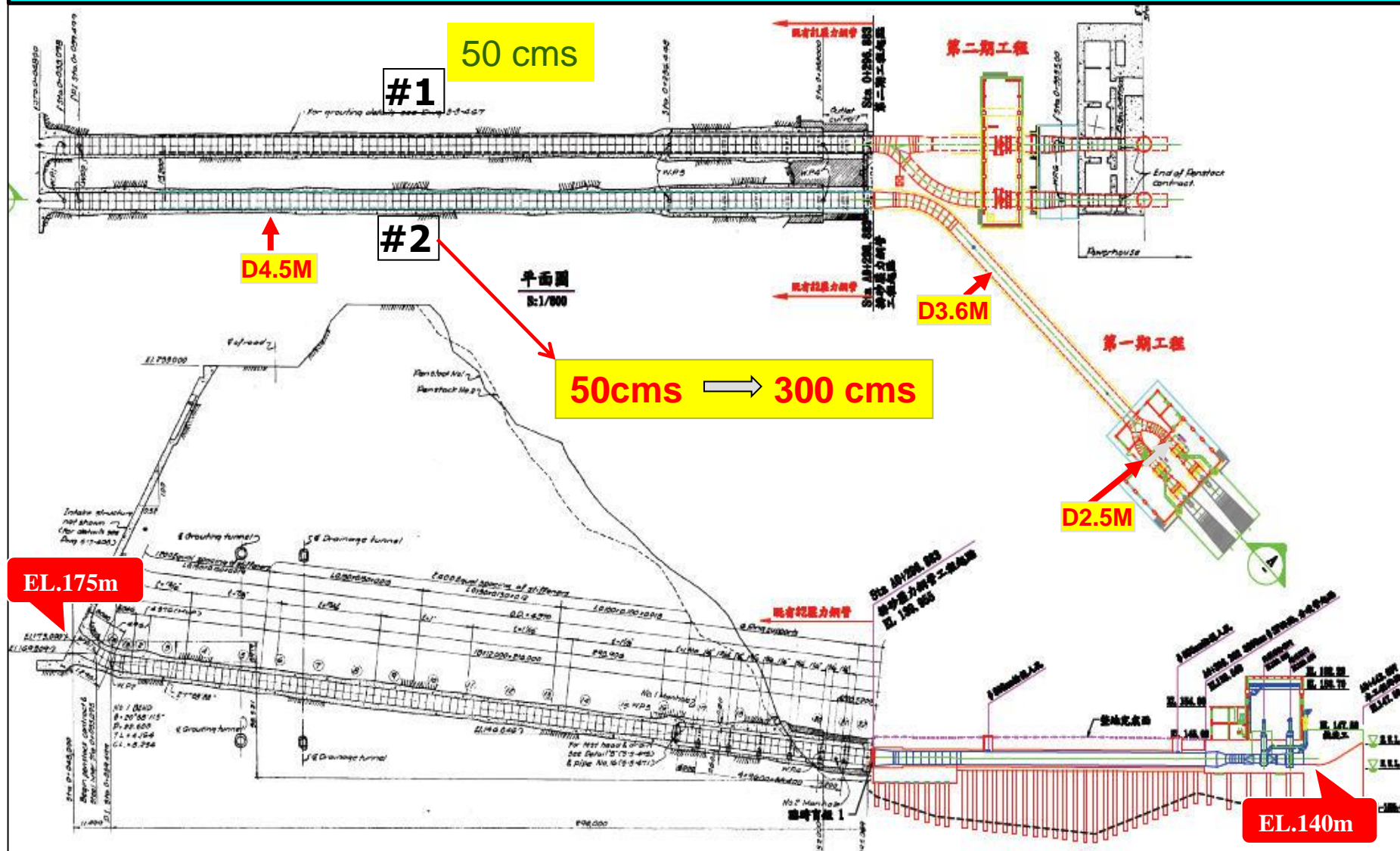
Design capacity:
 $309 \times 10^6 \text{ m}^3$

2014 capacity:
 $207 \times 10^6 \text{ m}^3$



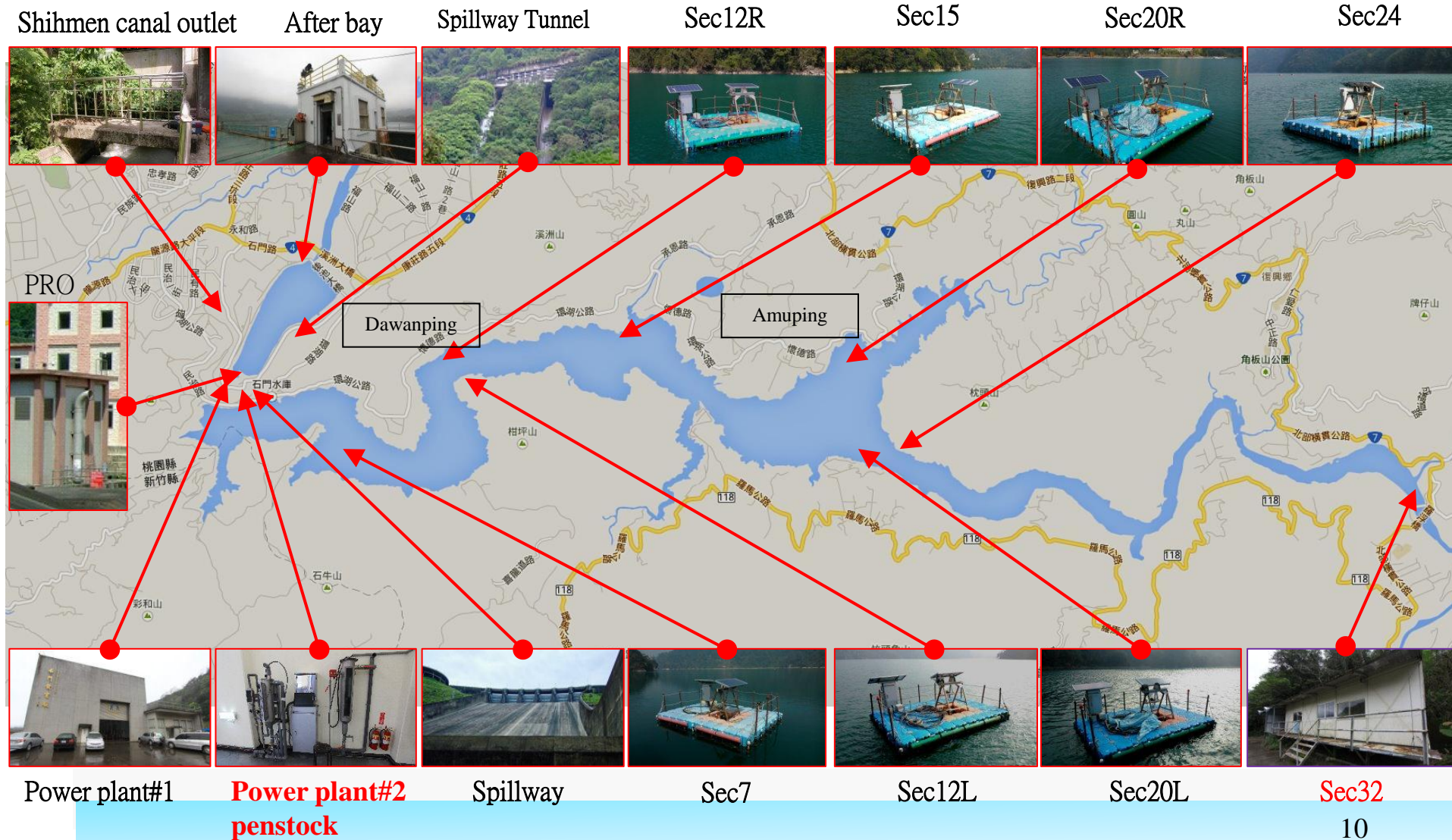
II. Reform for sluicing

1. Modifying Power Plant #2 Penstock as Sluice Tunnel.



II. Reform for sluicing

2. Building suspended solid concentration(ssc) monitoring system. (15 stations from after bay to 16km upstream)



II. Reform for sluicing

Sluicing Operation during Typhoon Soulik (2013)

2013 7/13 15:00

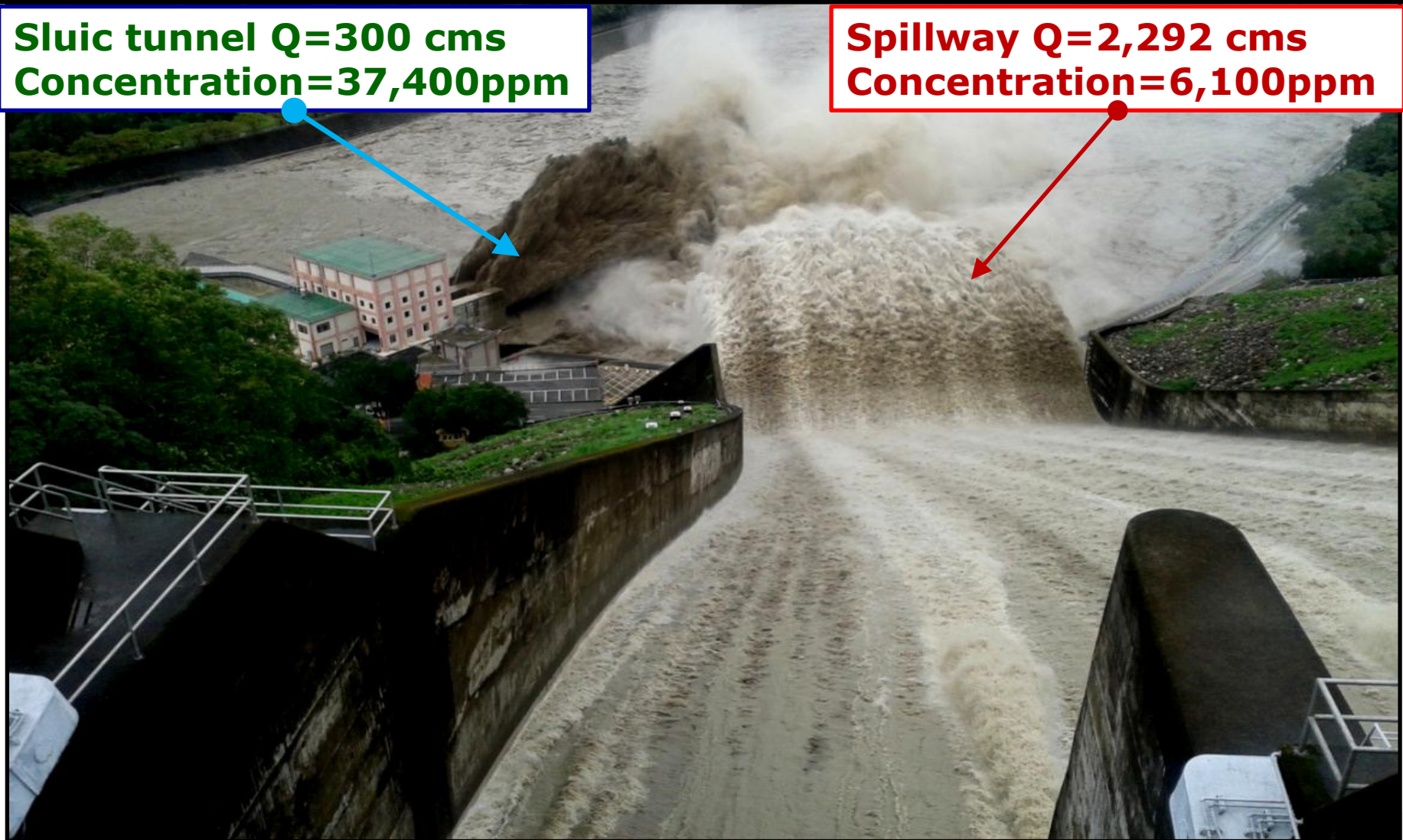


II. Reform for sluicing

Sluicing Operation during Typhoon Soulik (2013)

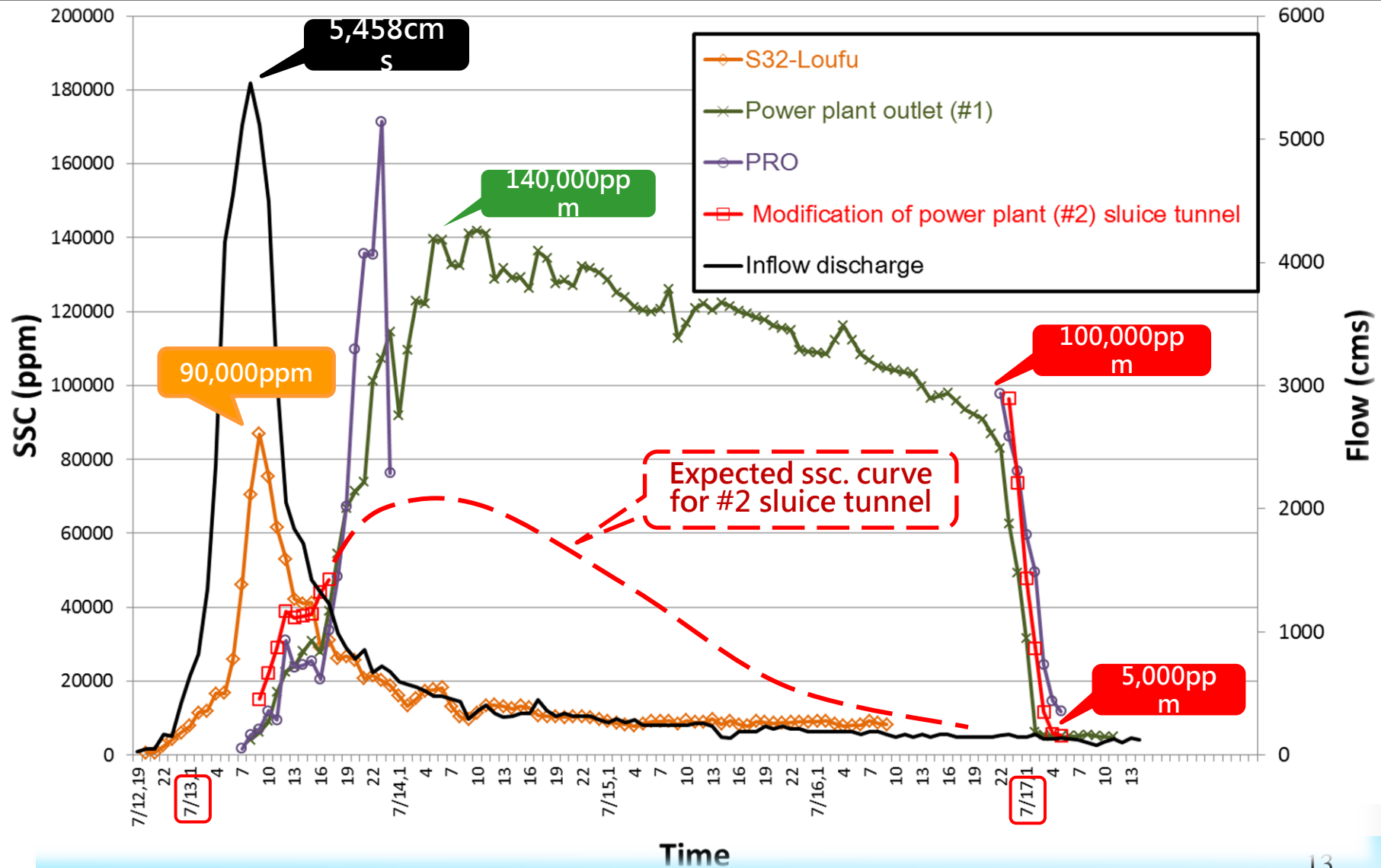
**Sluic tunnel $Q=300$ cms
Concentration= $37,400$ ppm**

**Spillway $Q=2,292$ cms
Concentration= $6,100$ ppm**



II. Reform for sluicing

Monitoring Results during Typhoon Soulik (2013)



II. Reform for sluicing

Sediment Sluicing Rate during Typhoon Soulik and Trami in 2013

	Soulik (7/12 19:00 ~ 7/17 11:00)		Trami (8/21 9:00 ~ 8/24 7:00)	
Inlet	Inflow ΣV (10^6 m^3)	Inflow ΣVs (10^6 ton)	Inflow ΣV (10^6 m^3)	Inflow ΣVs (10^6 ton)
	264.1	9.2	165.3	3.2
Outlet :	Outflow ΣV (10^6 m^3)	Outflow ΣVs (10^6 ton)	Outflow ΣV (10^6 m^3)	Outflow ΣVs (10^6 ton)
	126.7	0.5	70.7	0.2
1.spillway	84.0	0.2	57.8	0.1
2.tunnel spillway	16.7	(15hr) 0.6	28.1	(20hr) 0.4
3.penstock(#2) sluice tunnel	17.6	(99hr) 1.6	10.7	(60hr) 0.2
4. penstock(#1)power plant	6.6	0.3	8.3	0.2
5.PRO etc.	251.7	3.2	175.5	1.1
Outlet Total	35%		37%	
Sluicing rate				



III. Conclusion

- **Sediment transport(density flow) monitoring data is very useful for sluicing operation.**
- **Modification of power plant penstock as sluiceway can reduce sediment deposition in Shihmen Reservoir.**
- **No matter how effective the sluiceway is, a big portion of sediment was still kept in the reservoir.**

THANK YOU



Thank you for your attention.

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