Inspection Memo 3 Inspection of Hopin Small Hydropower Station in Hopin, Kachin

26.11.2002

3.1 Township Information

- Hopin, Kachin State

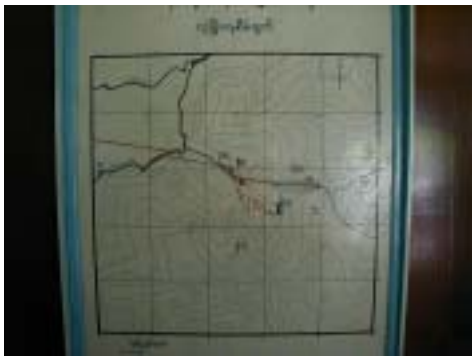
3.2 General Information of Hopin Power Station

- Access

River crossing toward Hopin Station

11 kV Distribution Line
crossing the river

- General layout

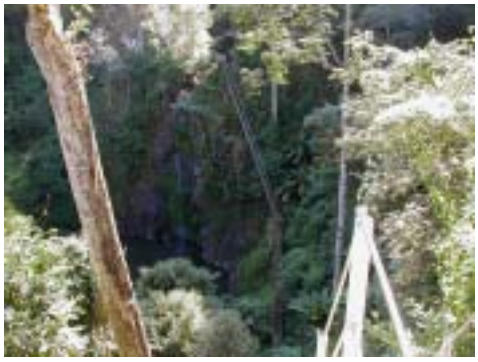


- Intake


Looking intake weir from downstream

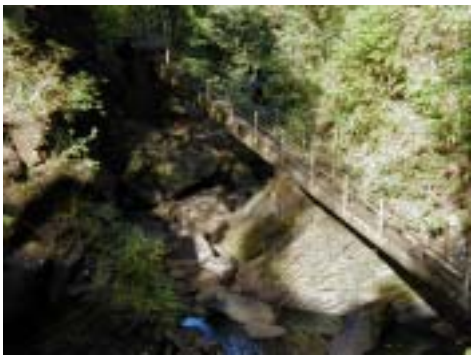

Water flowing into headtank

- Headrace

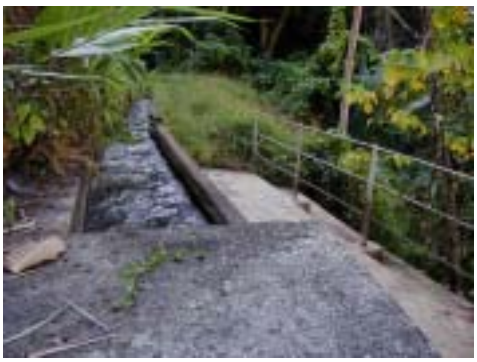



Steps on Siphon Pipes

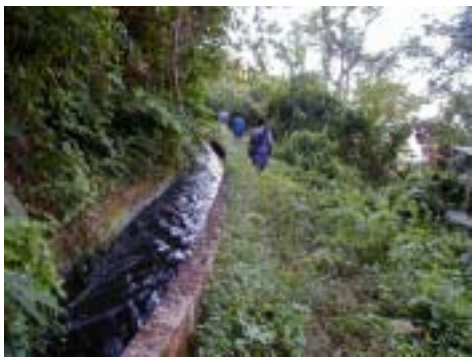
Siphone



Outlet of Siphon

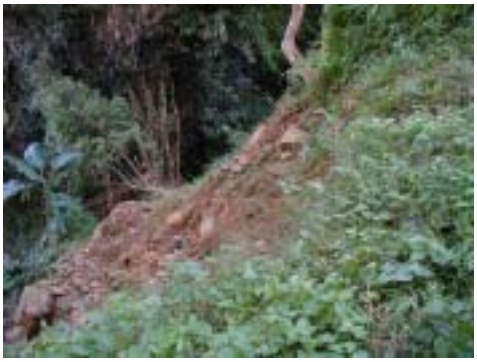


Side-overflow of headrace channel



Headrace channel

Trace of small slide upside the channel



Downside slope much eroded by water

- Headtank with regulating pond and desander

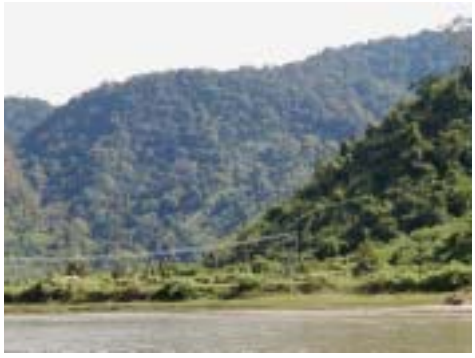
Excess water spillway

Inlet gate

A distant view of approach road and river

- Penstock

Hopin Power Station & penstock



A distant view of penstock

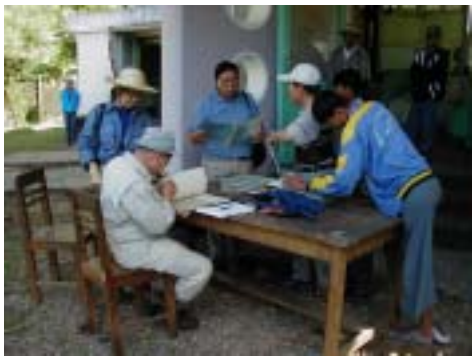
- Powerhouse

- Generating equipment









- Tailrace

- Distribution lines

3.3 Particular Information of Hopin Power Station

- Unit 1 in automatic operation at guidevane opening of 63%
- Unit 2 in manual operation
- 55 Hz, 0.125 MW

Salient Features:

Name	:	Hopin Ga Lang Chaung Hydropower Station
Location	:	8 miles northeast of Hopin Township, Kachin State
River Name	:	Ga Lang Chaung
Catchment area	:	9.0 sq.mile (23.3 km^2)
Head	:	Net head of 625 ft (190.5 m)
Discharge	:	15 cusec x 2 units = 30 cusec (0.425 x 2 = 0.85 m^3/s)
Output	:	630 kW x 2 units = 1,260 kW
Weir	:	30 ft (L) x H 7 ft (9.1 m L x 2.1 m H)
Siphon	:	550 ft (L) x ϕ2 ft (167.6 m L x ϕ0.61 m)
Power Canal	:	2,300 ft (L) x 3 ft (B) x 2.5 ft (D) (701 m L x 0.91 m B x 0.76 m D)
Head Tank	:	2,425 ft (L) x 50 ft (B) x 6.5 ft (D) (739 m L x 15.24 m B x 1.98 m D)

		108,000 cu ft (3,058 m^3)
Penstock	:	1,900 ft (L) x ϕ2 ft (579 m L x ϕ0.61 m)
Turbine	:	Pelton with 1 nozzle, made in Kunmin China
Annual Energy	:	2.3 GWh

Distribution line : 11kV line, 14km between Station and Hopin + 32km in Hopin, Nammar, and Moe Nyin = 46km in total

Construction	:	Feb 1990 – Sep 1991	
	Commissioning	:	07-Sep-1991
Project cost	:	Public contribution	20.4 x 10^6 Kyat
		MEPE	LC 6.8 x 10^6 Kyat
			FC 0.19 x 10^6 US$ (1.2 x 10^6 Kyat)
			28.4 x 10^6 Kyat in total
Supply Area	:	Hopin, Monyin, and Namma	
Peak Load	:	1,300 kW. Load shedding is made at the peak time from 6 p.m. to 10 p.m.	
Consumer	:	3,147 in total (1,246 in Hopin, 1,223 in Monyin, and 678 in Namma)	
Operation	:	300 kW (1 unit) from March to May	
	:	1,100 kW (2 units) from Jun to Jan	
	:	900 kW (2 units) in Feb	

3.4 Issues

(1) Civil Structures

- It appears that the head tank has not been utilized for peak power generation. A water level gauge in the head tank needs to be installed for peak operation.
- 168 m long siphon consists of the waterway to cross the deep waterfall of Ga Lang Chaung. However, it appears that the debris and/or driftwoods have not been so significant to fill the inside of siphon or attack during floods, seeing from the sedimentation around the weir site.
- 100% of the river flow was taken at the Intake Weir, and led to the Head Tank on 26-Nov-2002. Some of the flow spilled out from the spillway of the Head Tank. The power output was 300 kW (unit-1) and 100 kW (unit-2) at that time.
  Turbine discharge 400 / 1,260 x 0.85 m^3/s = 0.27 m^3/s approx.
  River discharge might be 0.4 ~ 0.5 m^3/s
- The state of flow from the siphon to the canal is of super-critical flow, and changes to sub-critical state.

Assuming slope=1/500, n=0.014 and b=0.90 m, uniform flow depths are as follows:

For Q = 0.50 m^3/s h = 0.49 m

For Q = 0.85 m^3/s (max. design discharge) h = 0.74 m (canal height 0.76 m)

- It was observed at the open canal that slope sliding above the waterway entered the canal once and dammed off the flow, of which overflow induced the slope failure below the canal.
- It appears that the Head Tank was designed to supply the maximum design discharge for just 1.0 hour only (0.85 m^3/s x 3,600 = 3,060 m^3)
- The water leakage was observed at 2 locations of expansion joints of Penstock.

3.5 Plates of Equipment

Automatic Speed Governor

Type : XT-300 Standard No. GB 9652

No. 91-01 Governor Capacity : 3,000 J

Rated Oil Pressure : 2.5 Mpa

Date : 1991

Kunming Electrical Machinery Works Co., Ltd

Oil Pressure Unit

Type : Hyz-01 Standard No. : GB9652

No.91-02

Rated Oil Pressure : 2.5 Mpa

P. Tank Volume : 0.1 m^3

Electromagnetic Generator

Type : TFY05-10 No.512-018

Output : 0.5 kW

	Main	Sub
Voltage :	380, 220, 110V	190, 110 V
Current :	0.608, 1.09, 2.1 A	0.304, 0.525 A
Connection :	∧, △, 2△	∧, △

Rotation : 600/1200 rpm Frequency : 50 Hz

Raway Speed : 1050 rpm

Conn : Y cosϕ : 0.3 Phase : 3

Kunming Electrical Machinery Works

Transformer to I.E.C 76

Type : SFW630-11/1180 No.691-06

Capacity: 750 kVA Rated Frequency : 50 Hz

Type of Cooling : Onan

Rated Volt (No Load) : HV 11,000, LV 400 V

Rated Current Load : HV 39.36, LV, 1982 A

Insulation Level : HV 75 kV_p LV 25 kV

Insulation liquid rise : 50 ℃

Winding Resistance Rise : 60 ℃

Year of Manufacture : 1981

Connection Symbol : Dynll

Untaking mass : 1190 kg, Total mass : 2,484 kg

Transportation mass : 2136 kg

Mass of oil : 520 kg Oil : 609 L

Maker's serial No. : 65299/10

Hawker Siddeley Brush Transformer Ltd., England

Turbine

Type : J22-W-92/1x11

Head : 190 m Flow : 0.424 m^3/s

Output : 663 kW Speed : 600 rpm

Weight : 6500 kg No. S91-007

Kunming Electrical Machinery Works Co., Ltd

Special Valve Cabinet

Oper V : 110V Cont P : 2.5 MPa

No. 91-01 Date: 1991

Kunming Electrical Machinery Works Co., Ltd

Generator

Type : SFW630-11/1180 No.691-06

Output : 630 kW

Sta Volt : 400 V Sta Curr 1137 A

Rotation : 1500/1800 rpm Frequency : 50 Hz

Raway Speed : 1050 rpm

Conn : Y $\cos\phi$: 0.3 Phase : 3

Stator 6, Rotor F

Rotation: Nil

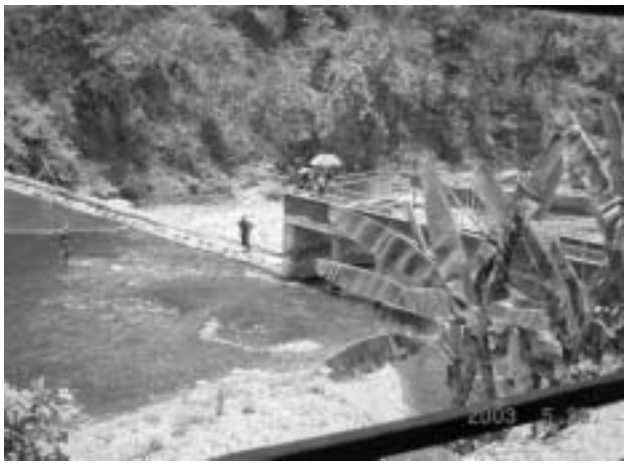
Date : 1991 03

Kunming Electrical Machinery Works Co., Ltd

Inspection Memo 4 Inspection of Zi Chaung Power Station during De-Watering

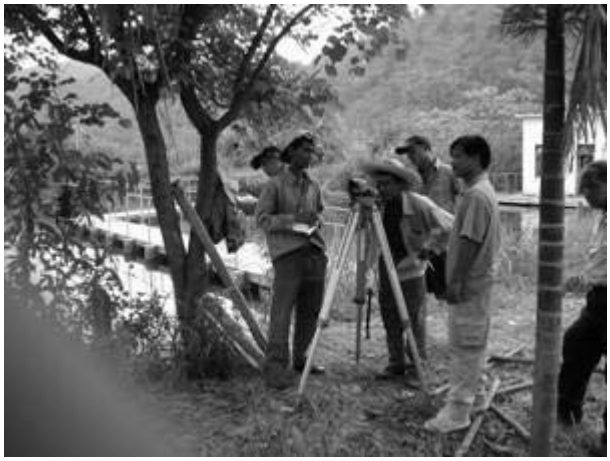
23 to 29 May 2003

4.1 Topographic Mapping of Intake Area



4.2 Lecture on Topographic Survey

Lecture on leveling to MEPE staff



Mapping by Total Station

Lecture on Total Station for mapping survey Mirror for distance measuring

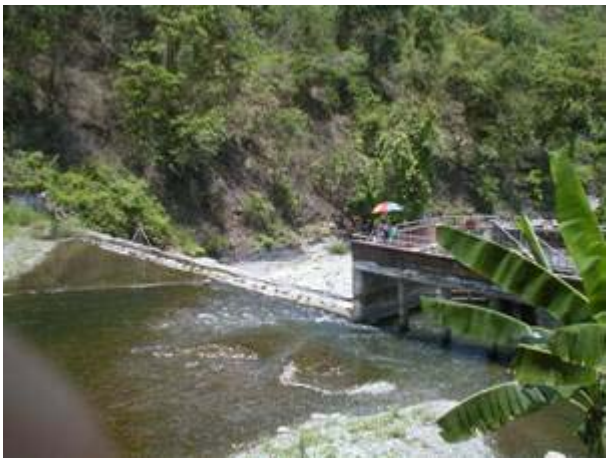
4.3 Discharge Measurement Along Headrace Channel

4.4 Inspection of Headrace Channel

On 26 May 2003, the power station was shut down for inspection of turbine runner etc. On this occasion, the headrace channel was also dewatered and inspected from the intake down to the regulating pond.

The principal findings are:

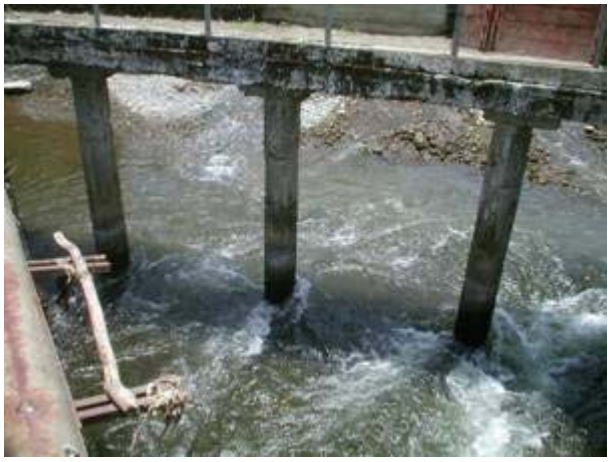
- Sediment deposits had significant depth and volume on the channel floor with maximum thickness of about 35 cm.
- Most of the sediments entered the channel through the intake while the trashracks were left washed out while minor volume were from side slopes beside the channel.
- Sediment deposits are significant immediate downstream of the side spillway where water flow is violent and does not allow sediments to settle.
- Further downstream, much sediments are observed on the straight sections while less or almost nil on the curved sections.
- Joints between the floor slab and side walls received significant erosion probably by flowing sands and gravels.



Intake weir site being surveyed

Gravel deposits upstream of the intake

Gravel deposits in front of intake



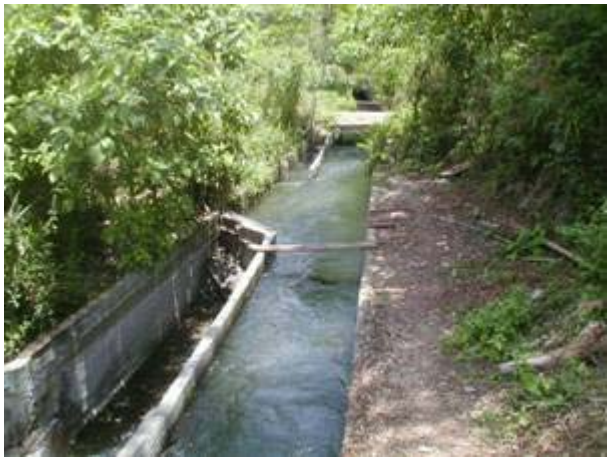
Piers in front of intake trashracks

Intake trashrack and wreck of deck for operator to remove leaves etc.

Intake gates looked from upstream

Sand flushing gate

Sand flushing gate fully opened

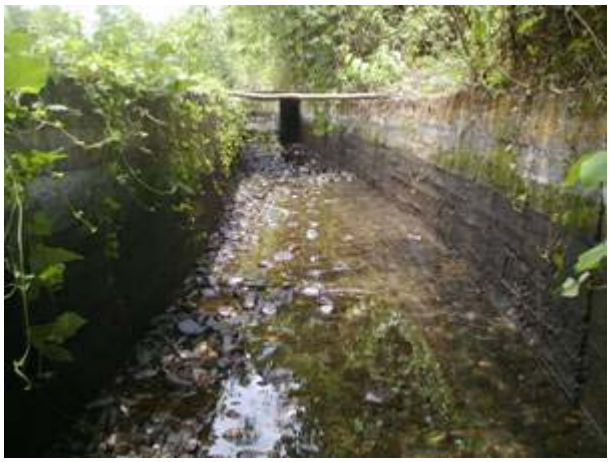


Side overflow spillway section, bow being Blocked with concrete to avoid leakage

Intake gates fully closed for inpsection Water leakage is marginal.

Side spillway section after intake gates fully closed.

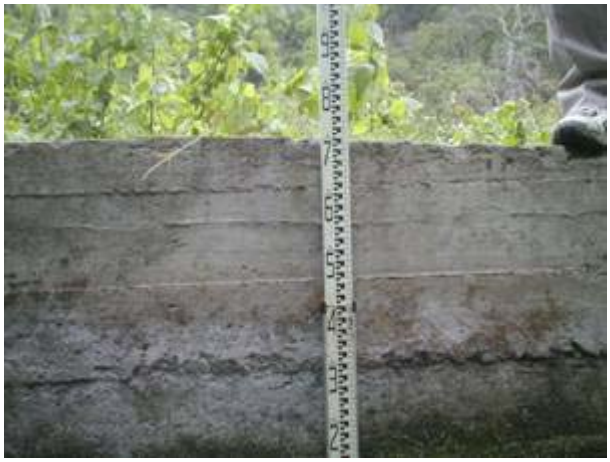
Sediments deposits in the same section.



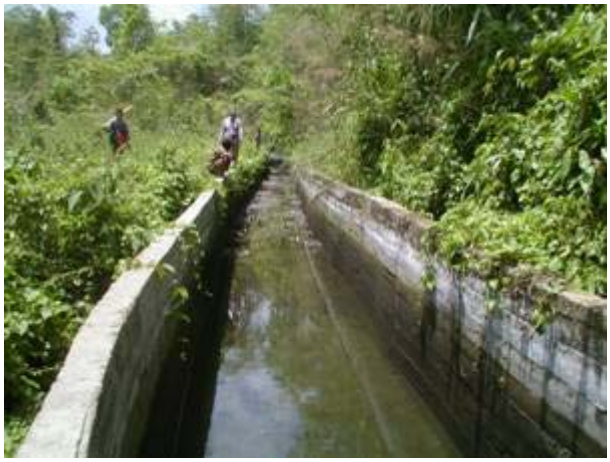
Water remains undrained in the spillway section (left) due to the thick sediments in the downstream section (right) from where water has been mostly drained.

Sediments and test pit on the channel floor

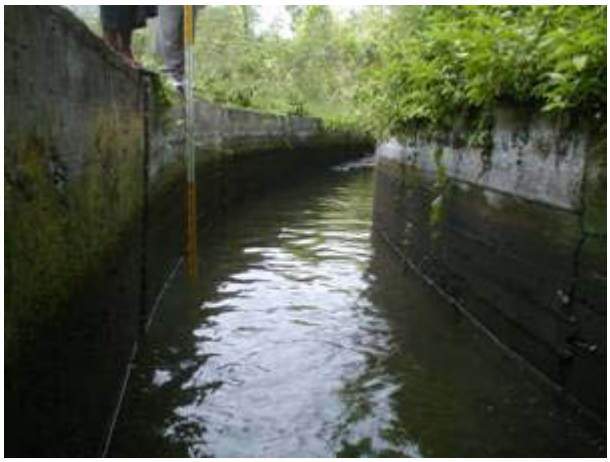
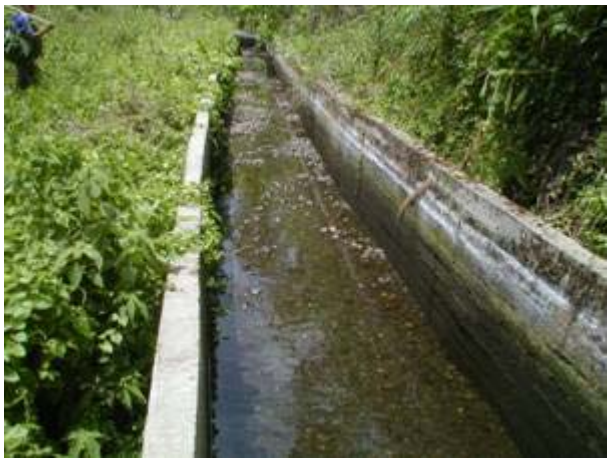
Hole depth so far dug is 32 cm.



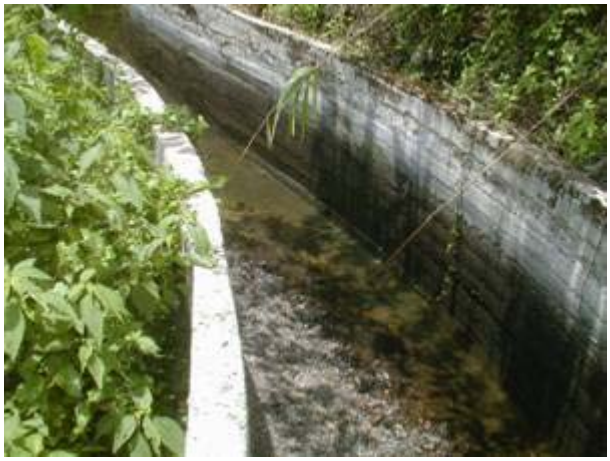
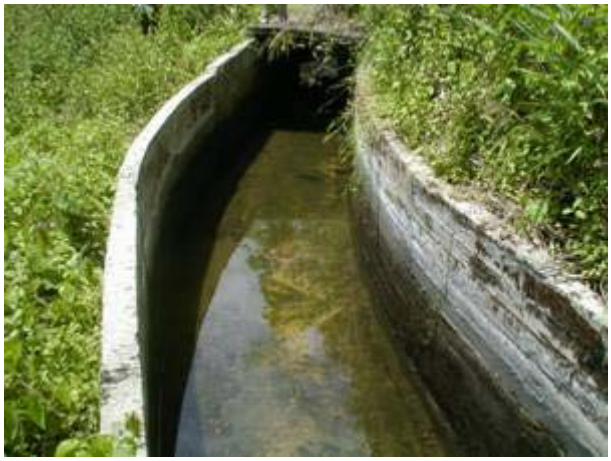
Side wall height at 1.70 m.



Water pond seen in the curved section is created by dam up effect of the sediments downstream, looking downstream

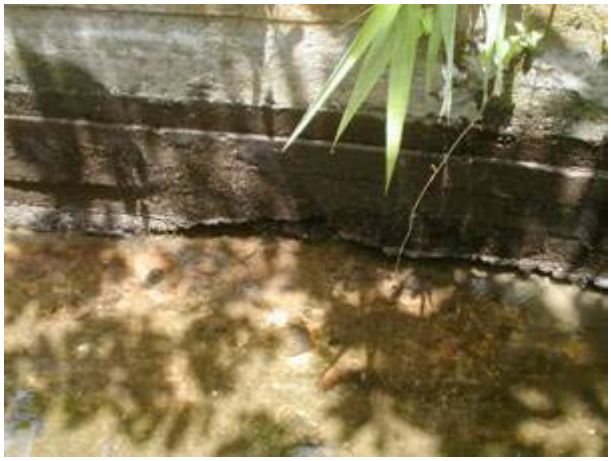



Water depth at this curved section was at 35 cm. Sediments observed mostly in straight sections

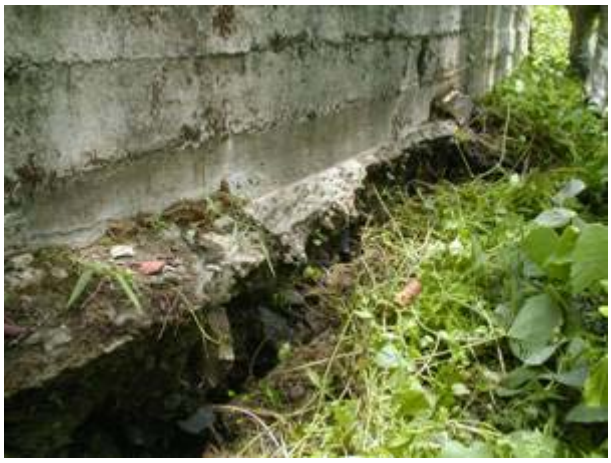



Sediments are limited in curved section (left) or nil in some section (right)

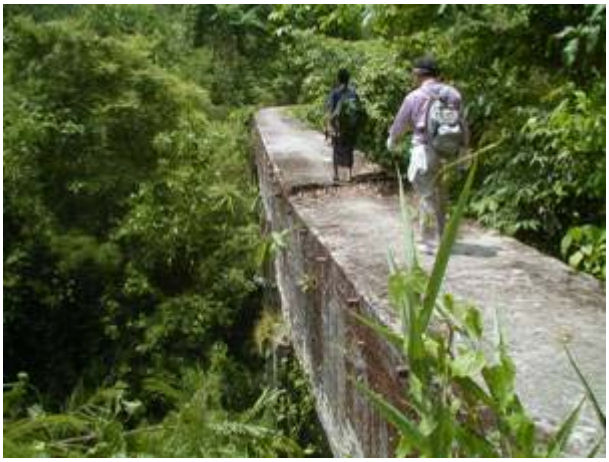

Erosion of channel floor


Erosion of side wall foot

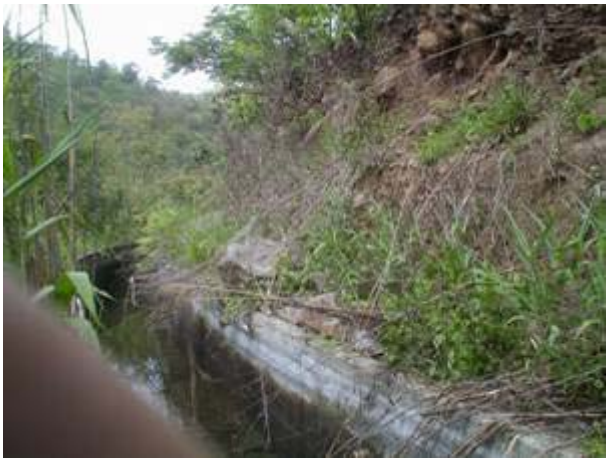
Channel floor in the leakage section right



Outside foundation of leakage section (it seemed the foundation has been eroded by leakage water.)

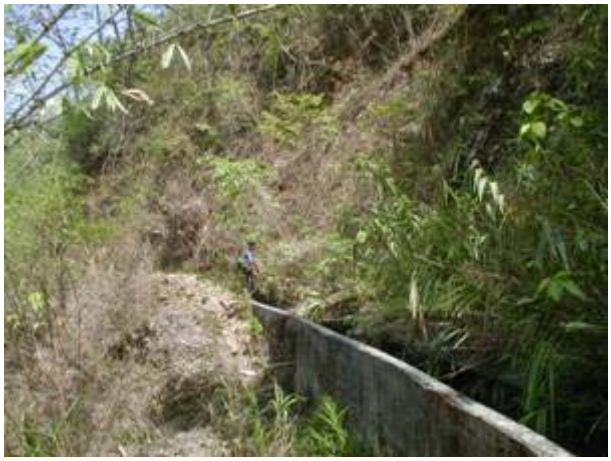


Channel bridge over a tributary

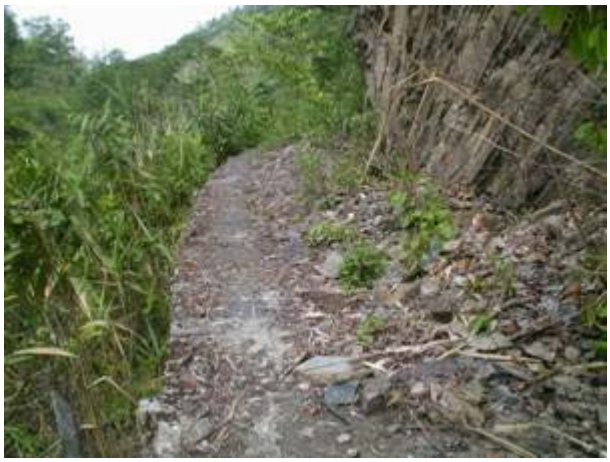


Rock from side slopes

Rock fallen in the channel.



Debris once entered into and removed outside beside the channel. These channel sections should be placed with concrete cover.

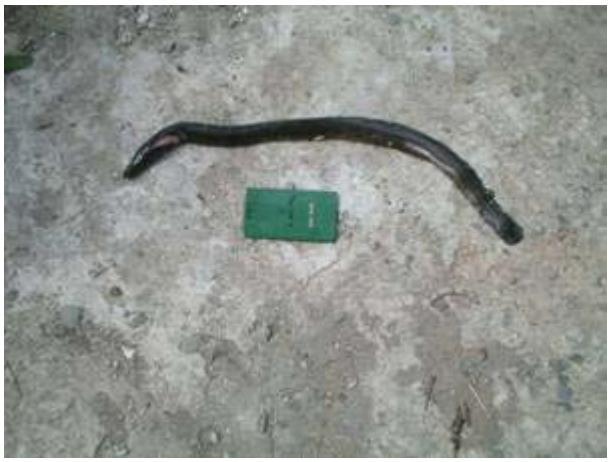


Debris on the channel cover, proving effectiveness of the cover.

Channel floor at one of the leakage points

Joint between floor slab and side wall

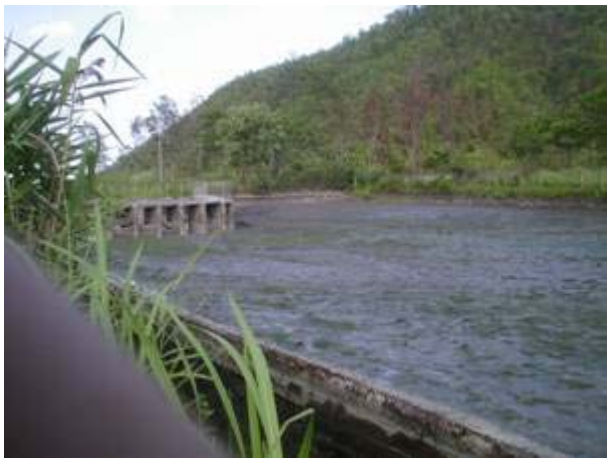
De-sanding basin



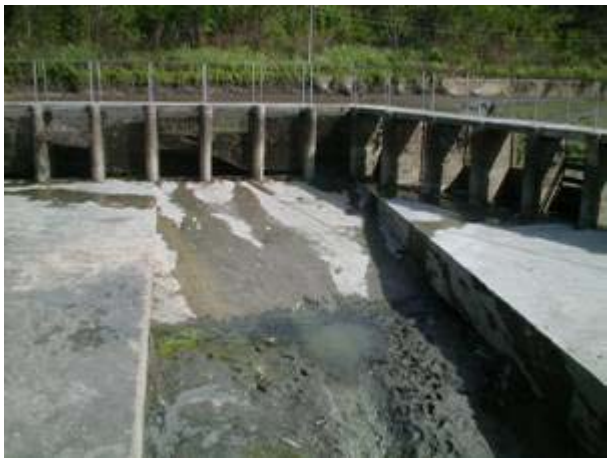
Eel found from the waterway for

A hole is made on side wall to divert water

flushing works in the Regulating Pond



Sediments in the upper part of Regulating Pond, mainly consisting of silt



Sloped pond floor towards penstock inlet looking upstream

Looking penstock inlet. Sediments were flushed in mid-May 2003

Sediment top covered with algae

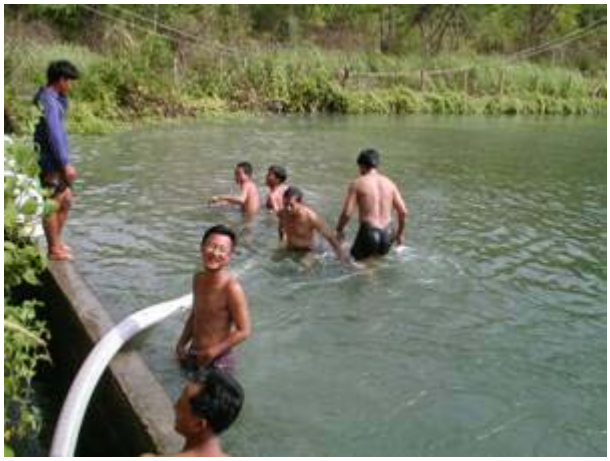
Sediment surface in the Regulating Pond

4.5 Sand Flushing Tests

4.5.1 Testing of Flute Type Flushing Head (stationary, to be fixed to floor)

Flute made for testing purpose

Flute buried in the pond with sand



Water filled to the Pond

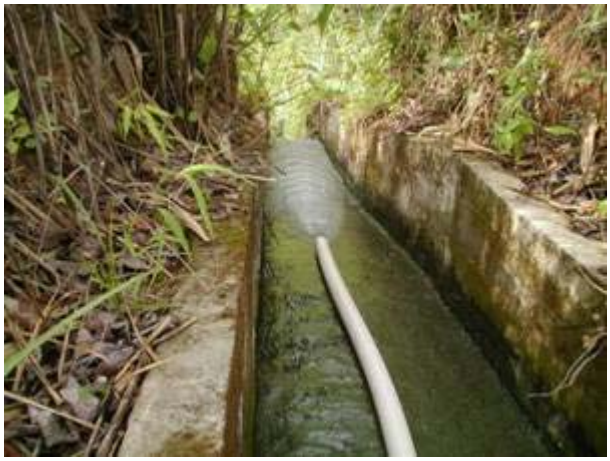
Flute under the water after sand flushing, part of horizontal pipe seen in the bottom of depression that was created by flushing sands around

PVC pipe connected to gain a higher head

Flushing by siphon action at a head of 0.8 m

Flushing at a head of 4 m

ditto



Flushing at a head of 5.5 m

Witnesses

Visitors from villages nearby

4.5.2 Testing of Saxophone Type Flushing Head (movable, to be operated from on raft)

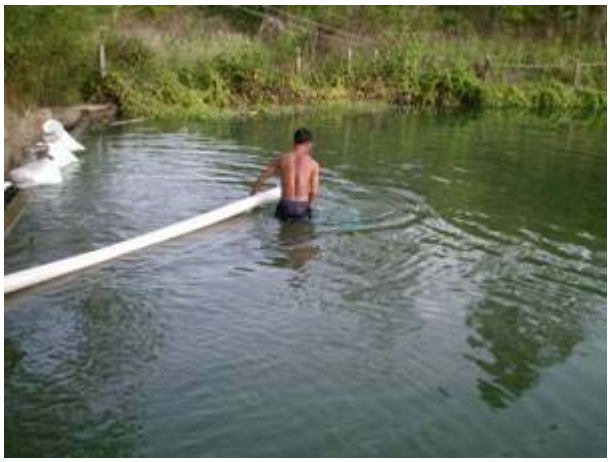
Three suction head made for testing

Saxophone Type 1 (with smaller slits)

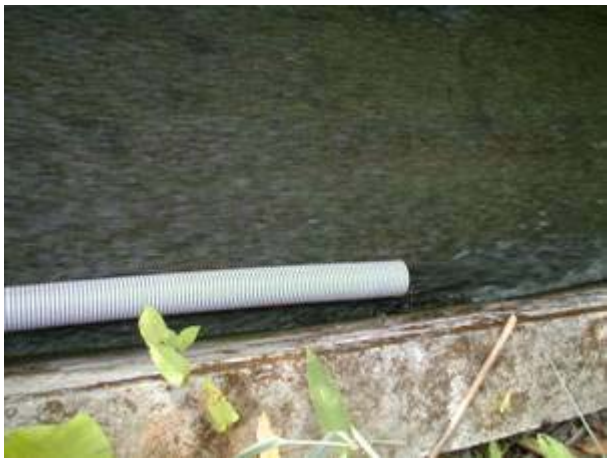
Saxophone Type 2 (with larger slits)

Saxophone Type 3 (with horizontal slits)

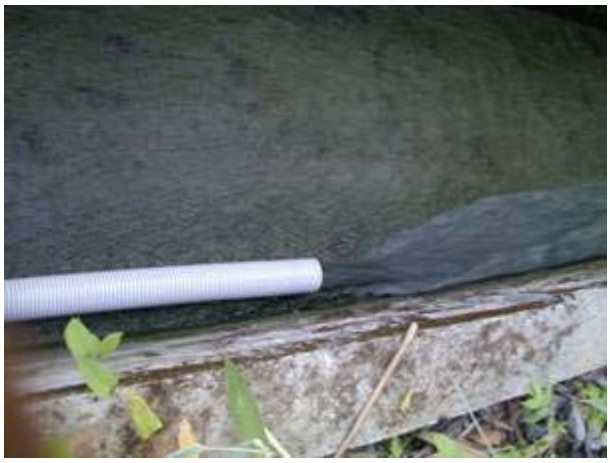
Saxophone Type 3 (with horizontal slits)



Test operation of Saxophone Type 3 (with horizontal slits)

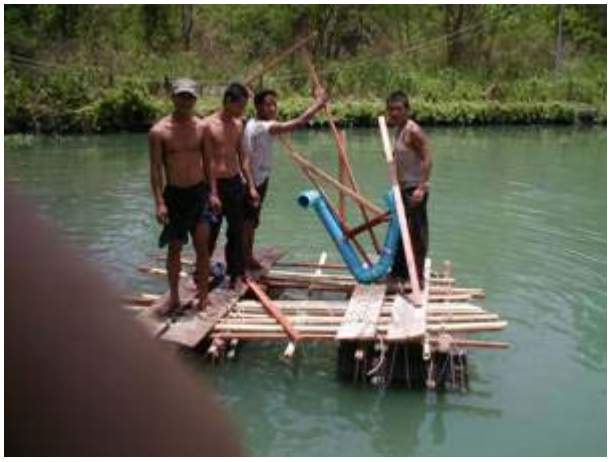


Flushing at a head of 4 m

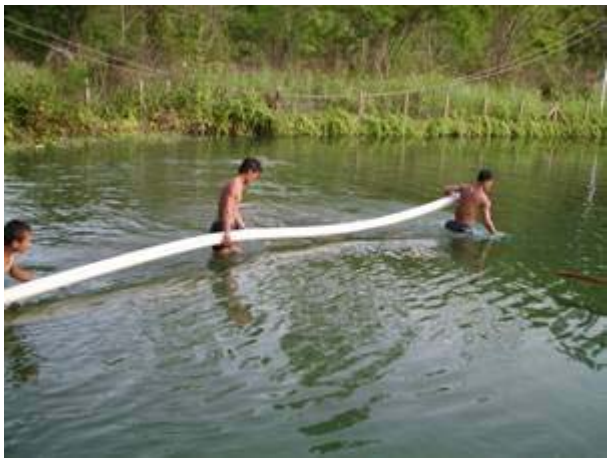


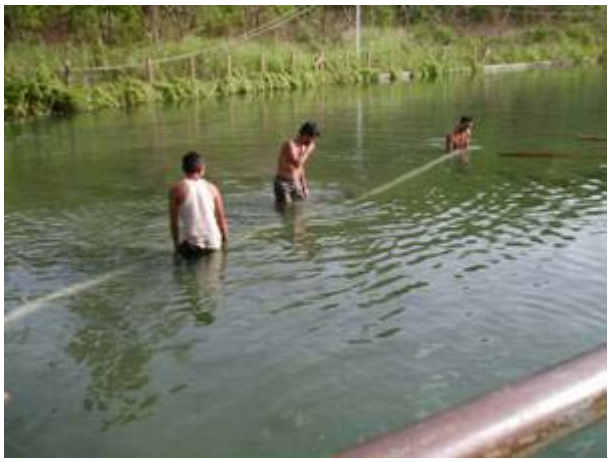
Flushing at a head of 4 m

Saxophone Type 1 (with smaller slits)

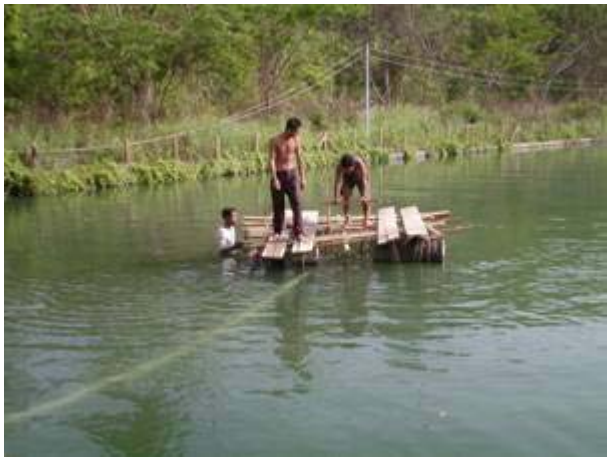


Test operation of Saxophone Type 1 (with smaller slits) from on a raft





Pipe connection to Flushing head and removing air from pipe




under flushing operation with Flushing head being moved


White color of the pipe shows less sacking of sand (left) while black full sacking (right)

Flushing at a head of 4 m

Flushing at a head of 1.8 m

Flushing at a head of 0.8 m