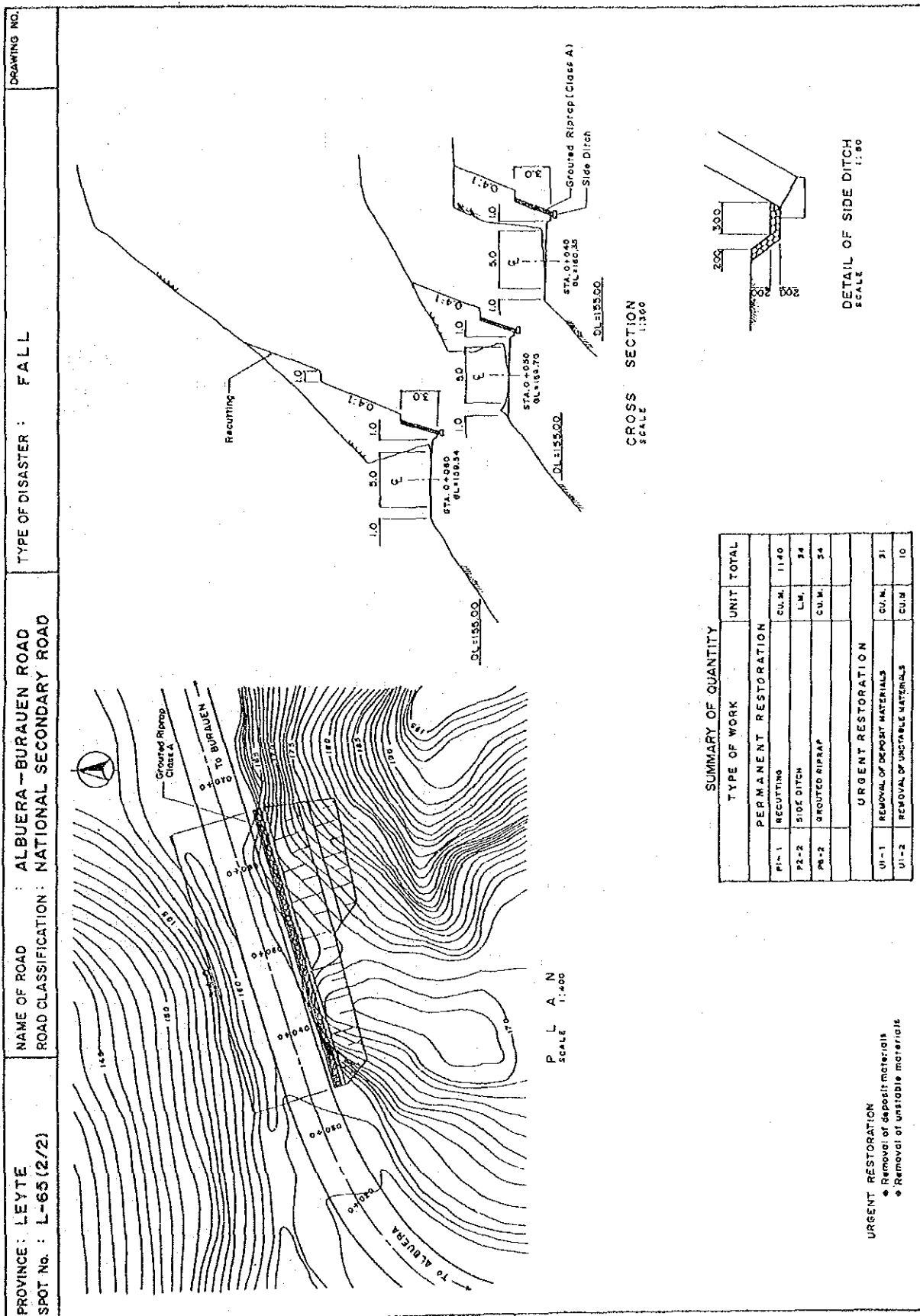


FIGURE 3-2 PROPOSED RESTORATION MEASURES (L-65)



4. Landslide

1) Spot L-47 (Leyte)

Location	:	0.9 km from Km. Post 993
Road Name	:	Baybay - Jct. Mahaplag Road
Road Classification	:	National Secondary Road
Geological Condition	:	Soft Clay
Water Condition	:	Surface and seepage water from hinterland

2) Description of Disaster

On mountain side of the road, the evidence of landslide was found in 0.5 - 1.0 m high scarps along the sliding surface extending over about 40 m in length and 10 m in height. The side ditch on mountain side was displaced, damaged and clogged with soil about 40 m in length.

3) Causes of Disaster

Potential cause is on hillside cutting in road construction, injuring a stability of the slope. Landslide was induced by decrease in shear strength of the earth due to rise of groundwater level during heavy rain.

4) Proposed Restoration Measures

Urgent Measures

The proposed measures are as follows:

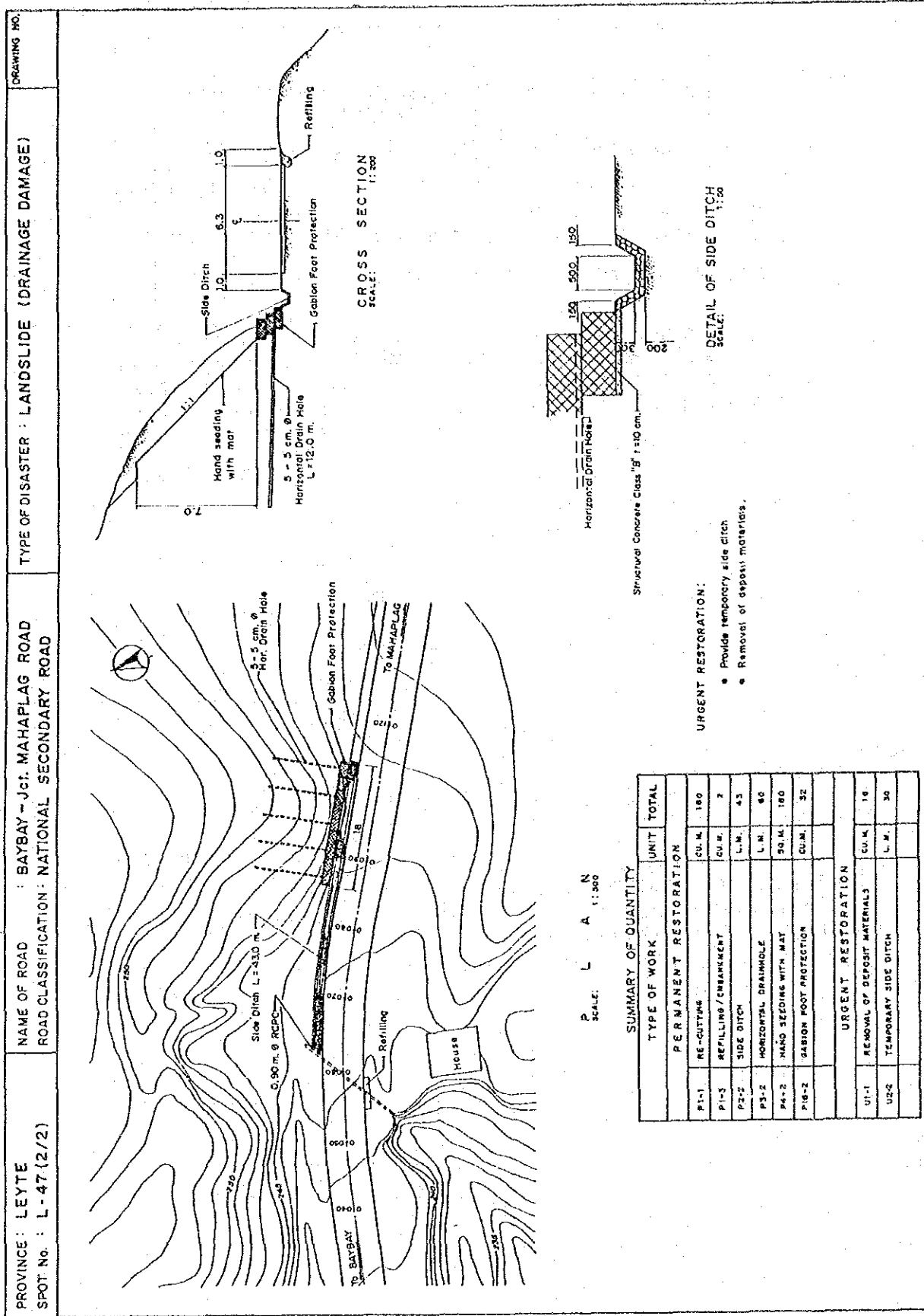
Proposed Measures		Purpose
U1-1	Removal of Deposit Material	To remove traffic obstruction
U2-2	Temporary Side Ditch	To prevent rain water from running on the road surface

Permanent Measures

Measures for stabilizing the slope by means of partial removal of sliding mass, groundwater drainage and foot protection to resist the sliding force were proposed as permanent measures for this spot. No alternative measures were proposed. The proposed measures include the following works (See Figure 4-1):

Proposed Measures		P u r p o s e
P1-1	Recutting	To remove partially sliding mass
P1-3	Refilling/Embankment	To repair shoulder along valley side
P2-2	Side Ditch	To prevent water from running on road surface
P3-2	Horizontal Drain Hole	To drain groundwater and thus lower its level
P4-2	Hand Seeding w/Mat	To protect slope from erosion
P16-2	Gabion Foot Protection	To increase resisting force against sliding movement

FIGURE 4-1 PROPOSED RESTORATION MEASURES (L-47)



5. Debris Flow

1) Spot Bt-39 (Benguet)

- Location : 15.2 km from Kapangan Municipal Hall
- Road Name : Kapangan-Acop Road
- Road Classification : National Secondary Road
- Geological Condition : Diorite
- Water Condition : Concentrated water from mountain

2) Description of Disaster

Rocks carried by the flow of water from upstream accumulate on the bed of ravine about 40 meters in length and 16 meters in width at the roadside. The deposit rocks often flow over the road during heavy rain. The riprap protecting the slope on valley side of the road is eroded by the water directly running thereon.

3) Causes of Disaster

Debris flow was induced by the force of flow during heavy rain.

4) Proposed Restoration Measures

Urgent Restoration Measures

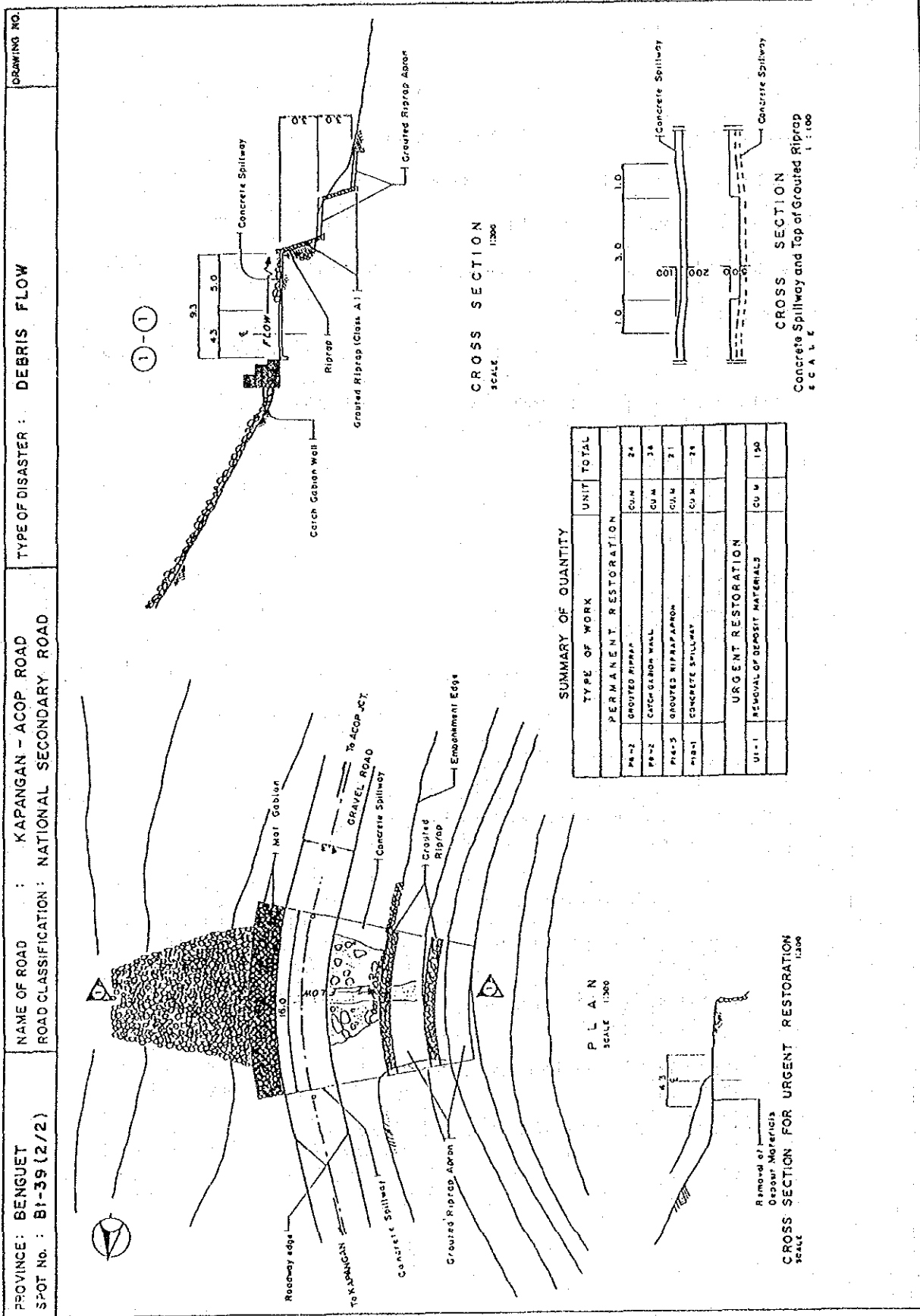
Proposed Measures		Purpose
U1-1	Removal of Deposit Materials	To remove traffic obstruction

Permanent Restoration Measures

Catch work against debris flow, drainage work for surface water and protection work for valley side slope were proposed for this spot. No alternative was proposed. The proposed restoration measures are as follows (See Figure 5-1):

Proposed Measures		Purpose
P6-2	Grouted Riprap	To protect the slope on valley side of the road
P8-2	Catch Gabion Wall	To catch debris and to control flow of debris
P16-3	Grouted Riprap Apron	To protect the foundation of grouted riprap from scour
P18-1	Concrete Spillway	To regulate the flow of surface water and to protect road surface

FIGURE 5-1 PROPOSED RESTORATION MEASURES (B1-39)



6. Scour/Washout of Roadbed

1) Spot Bt-2 (Benguet)

Location	:	0.3 km from Itogon
Road Name	:	Itogon - Balatok Road
Road Classification	:	National Secondary Road
Geological Condition	:	Dacite
Water Condition	:	Embankment is located along river, thus, subject to erosion.

2) Description of Disaster

The roadbed was totally washed out in the section with a total length of about 300 m caused by the July 1990 earthquake and succeeding floods due to typhoons. The road is totally cut and the flood plain is used as detour during dry season.

3) Causes of Disaster

Damage on slope due to earthquake and scouring action of flowing water are the causes of washout.

4) Proposed Restoration Measures

Urgent Measures

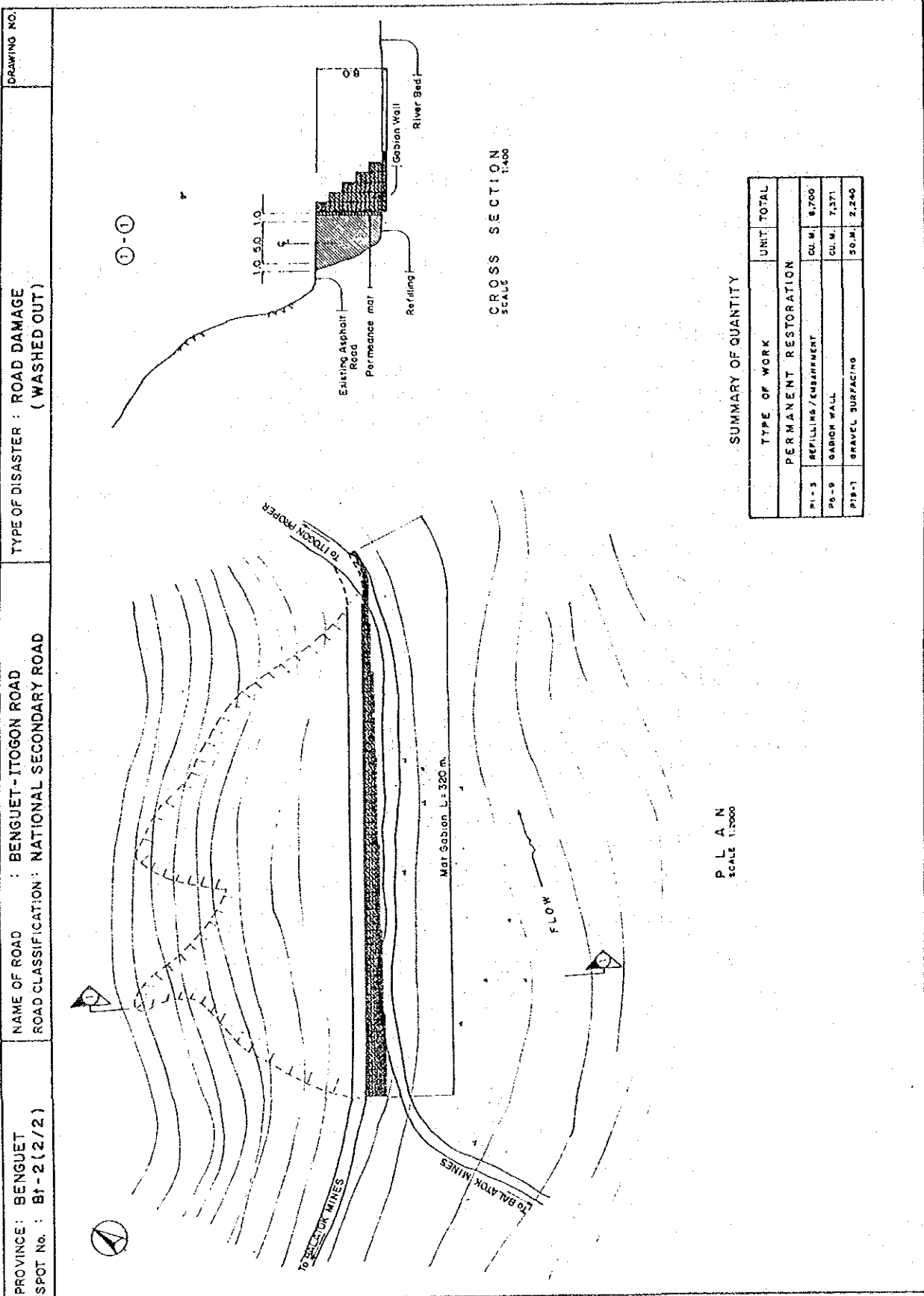
No urgent measures were proposed because of absence of proper measure to be completed in a short period.

Permanent Measures

Gabion wall was selected to support and retain the embankment taking advantage of its strength against erosion by water, availability of stores on the river bed, and lower cost than concrete wall. The proposed measures consist of the following (See Figure 6-1):

Proposed Measures		P u r p o s e
P1-3	Refilling/Embankment	To fill washed-out section
P6-9	Gabion Wall	To retain embankment
P19-1	Gravel Surfacing	To surface the road

FIGURE 6-1 PROPOSED RESTORATION MEASURES (B1-2)



7. Flooded/Muddy Road Surface

1) Spot Bs-14 (Batangas)

Location	:	3.8 km from Mabini Jct. to Malimatok
Road Name	:	Mabini Jct. - Anilao - Solo Road
Road Classification	:	National Secondary Road
Geological Condition	:	Volcanic rocks, predominantly andesite
Water Condition	:	Surface water from hinterland

2) Description of Disaster

A pipe culvert of diameter 0.610 m is laid 42 m away from the lowest portion of the road. The entrance of the culvert is partly clogged with rocks and other debris resulting in insufficient capacity of discharging the rain water. No side ditch is provided. Due to surface water flowing directly on the road surface, the road is very muddy during rainy season.

3) Causes of Disaster

Improper drainage of surface water is the cause of the road surface to be muddy.

4) Proposed Restoration Measures

Urgent Measures

Proposed measures are as follows:

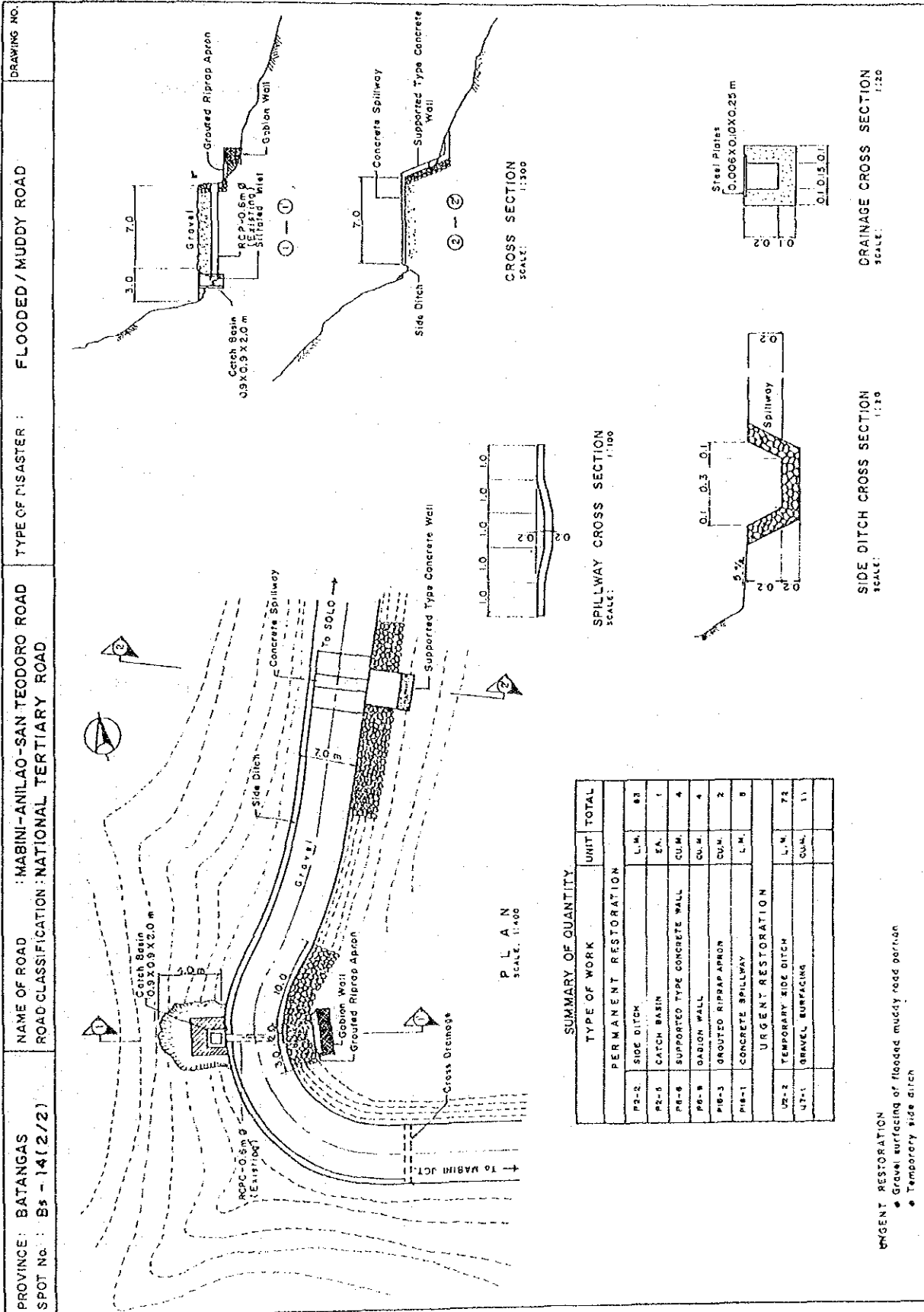
Proposed Measures		P u r p o s e
U2-2	Temporary Side Ditch	To prevent water from running on road surface
U7-1	Gravel Surfacing	To improve road surface condition

Permanent Measures

Proposed measures consist of the following (See Figure 7-1):

Proposed Measures		P u r p o s e
P2-2	Side Ditch	To prevent water from running on road surface
P2-5	Catch Basin	To prevent the entrance of culvert from clogging
P6-6	Supported Type Concrete Wall	To protect the existing riprap from erosion
P6-9	Gabion Wall	To protect outlet portion of culvert
P16-3	Grouted Riprap Apron	To protect outlet portion of culvert
P18-1	Concrete Spillway	To regulate the flow of surface water and to protect road surface

FIGURE 7-1 PROPOSED RESTORATION MEASURES (Bs-14)



8. Permanent/Temporary Bridge Washout

1) Spot Bs-62 (Batangas)

Location	:	2.8 km from Tipas Jct. to Candelaria, Quezon
Road Name	:	Tipas Jct. - Pinagbayanan Road
Road Classification	:	Provincial Road
Geological Condition	:	Alluvial deposit on volcanic tuff and associated rocks particularly tuffaceous shale
Water Condition	:	Alluvial stream with instable channel

2) Description of Disaster

The surrounding area of this spot is flat and low, and water from vast catchment area is drained through this area, submerging the area during heavy rain. Highest flood level reaches 1.50 m above the road surface. A bailey bridge 9.0 m long, together with Tipas side abutment, was washed out in 1990 by overflowing water. The riverbed was widened toward Tipas side both upstream and downstream of the bridge location. Thus, the approach portion is in danger of being washed-out.

3) Causes of Disaster

Overflow of the river submerging the bridge is the cause of this disaster.

4) Proposed Restoration Measures

Urgent Restoration Measures

For temporary bridge to be quickly constructed, bailey bridge with H-pile substructure was proposed.

Proposed Measures		P u r p o s e
U6-1	H-Pile Bent	To serve as substructure of bridge
U6-2	Bailey Bridge	To serve as superstructure of bridge

Permanent Restoration Measures

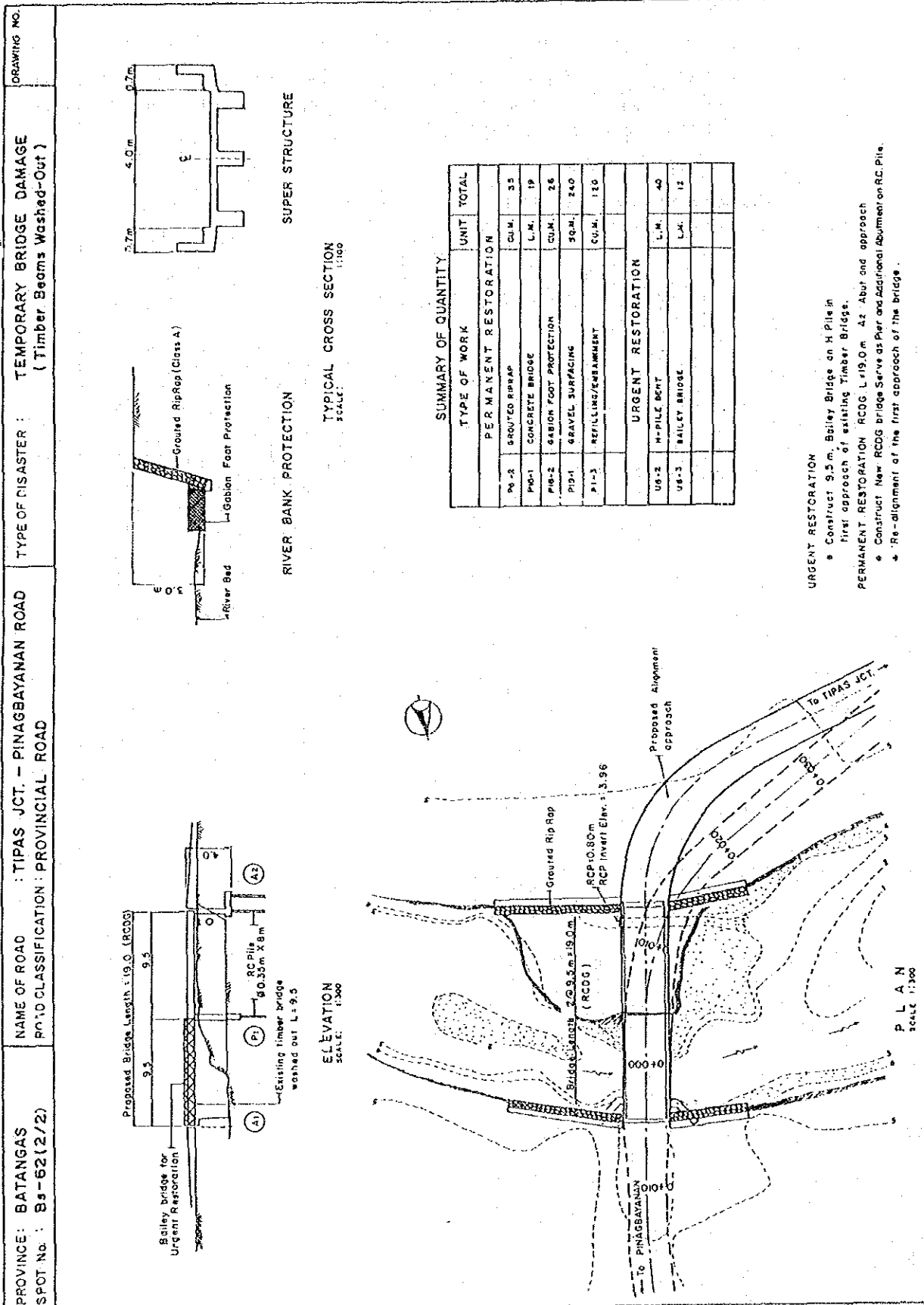
The following considerations were given in proposing permanent restoration measures:

- To raise bridge elevation to prevent the bridge from submergence.
- To add one more span not to encroach on the river stream, otherwise contracted river width may cause a rise of water level upstream and high velocity of flow bringing on severe erosion problem to approach portion.
- To protect river bank.

The permanent restoration measures were proposed as follows (See Figure 8-1):

Proposed Measures		P u r p o s e
P1-3	Refilling/Embankment	To elevate approaches of the bridge
P6-2	Grouted Riprap	To protect river bank
P15-1	Concrete Bridge	To provide permanent river crossing structure
P16-2	Gabion Foot Protection	To protect foot of grouted riprap from scour
P19-1	Gravel Surfacing	To surface the approaches of the bridge

FIGURE 8-1 PROPOSED RESTORATION MEASURES (Bs-62)



9. Permanent/Temporary Bridge Approach Washout

1) Spot Bs-33 (Batangas)

- Location : 18.5 km from Dagatan Jct. to Taysan
- Road Name : Dagatan Jct. - Lobo Road
- Road Classification : National Secondary Road
- Geological Condition : Alluvial deposit, particularly sand fills the whole river.
- Water Condition : Alluvial stream with instable channel

2) Description of Disaster

Lobo bridge, 8-span RCDG bridge with a total length of 124 m, was constructed in 1984. Due to meandering of Lobo river, Malabrigo side bank started to be eroded in about 1986, and washed out about 160 m in width at the bridge location on the occasion of typhoon "Sisang" in January 1988. The bridge itself is sound. A few vehicles cross the stream by fording during dry season.

3) Causes of Disaster

Shift of the main channel in meandering stream resulted in the disaster.

4) Proposed Restoration Measures

Urgent Restoration Measures

For temporary bridge to be quickly constructed, bailey bridge with H-pile substructure was proposed.

Proposed Measures		P u r p o s e
U6-2	H-Pile Bent	To serve as substructure of bridge
U6-3	Bailey Bridge	To serve as superstructure of bridge

Permanent Restoration Measures

The river bank on Malabrigo side is still in danger of being further eroded. Preventive measures against bank erosion must be incorporated with extension of bridge to cross the shifted main channel. Thus, the permanent restoration measures for this spot were proposed as follows (See Figure 9-1):

Proposed Measures		P u r p o s e
P6-9	Gabion Wall	To protect bank from erosion
P15-1	Concrete Bridge	To cross the shifted main channel
P17-2	Gabion Spurdike	To control movement of stream

FIGURE 9-1 (1) PROPOSED RESTORATION MEASURES (B9-33)

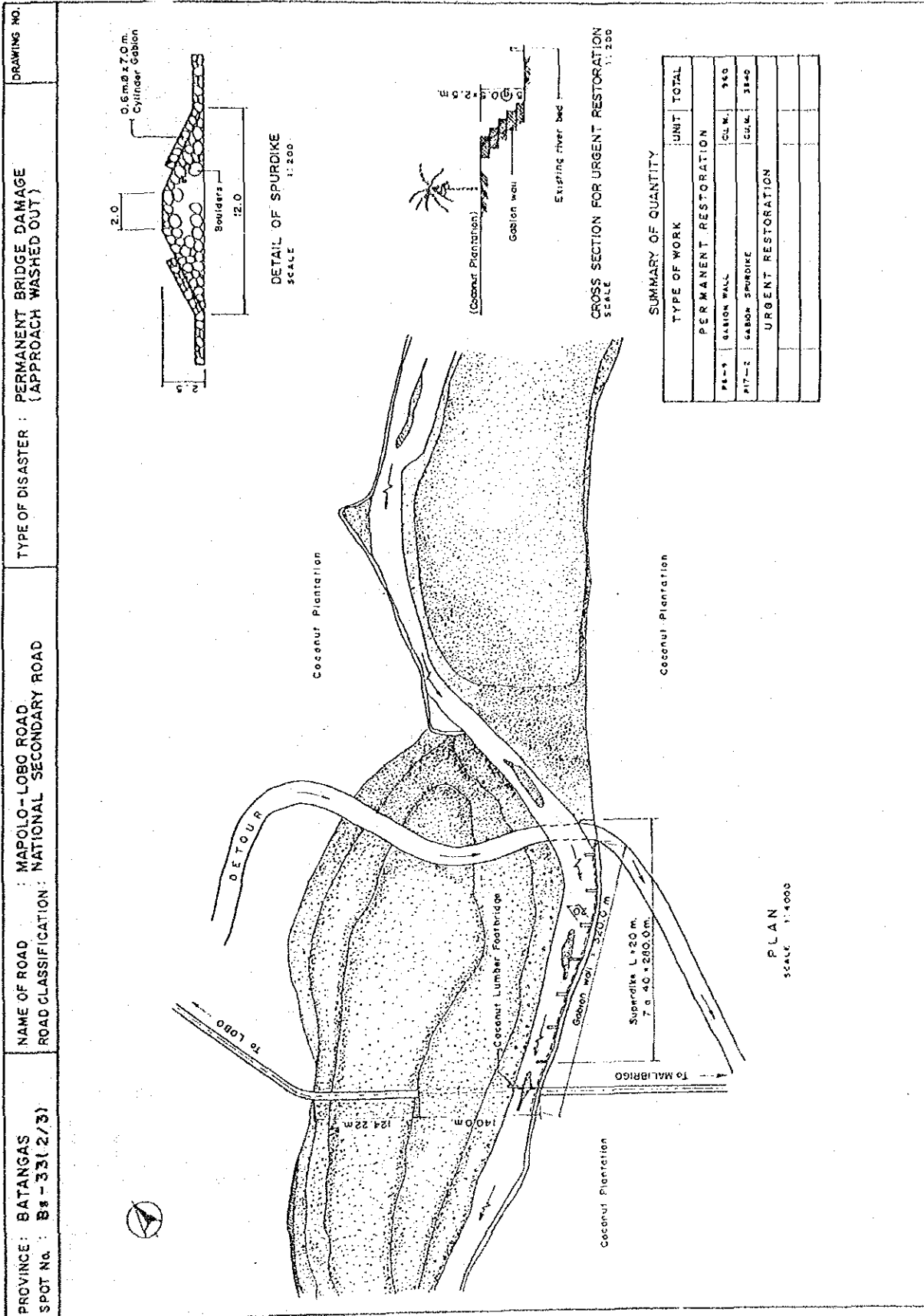
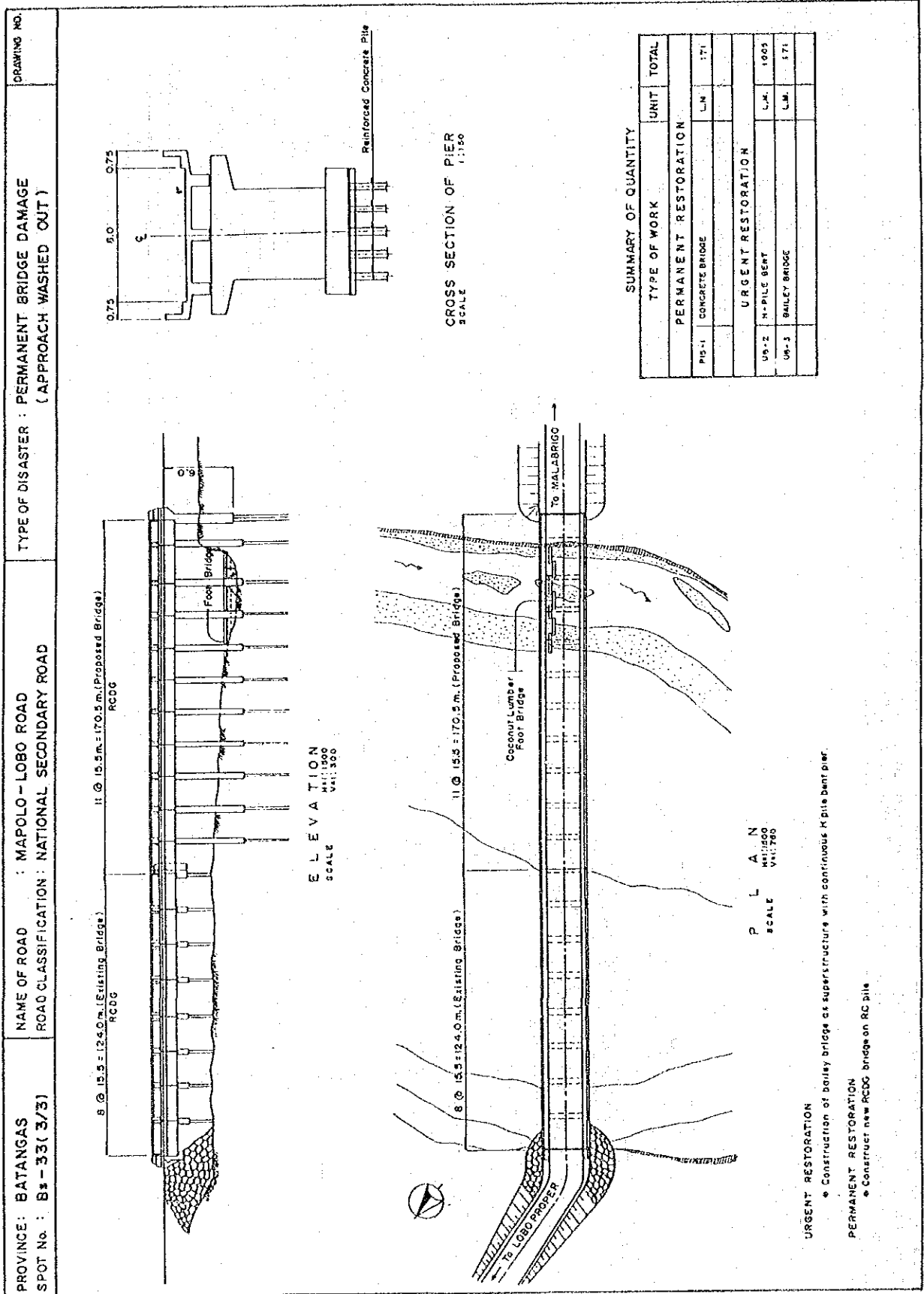


FIGURE 9-1 (2) PROPOSED RESTORATION MEASURES (Bs-33)



10. Permanent/Temporary Bridge Other Damage

1) Spot Bs-6 (Batangas)

Location : 4.3 km from Jct. Calaca to Town Proper
Road Name : Calaca - Mahayahay Jct.
Road Classification : National Secondary Road
Geological Condition : Thick sand, consolidated tuff and conglomerate breccia
Water Condition : Flood plain 30 m wide, main channel 10 m wide

2) Description of Disaster

Sinisian Bridge, 3-span RCDG bridge with total length of 36 m, was constructed in 1983. Scour at the riverbed was noticed and reported in 1985. Presently, the riverbed is lower than the bottom of pier footings by 1.5 - 2.0 m, exposing piles as much. The abutment is protected by gabion wall but it sags due to riverbed lowering.

3) Causes of Disaster

Quarrying of sand and gravel at 100 m downstream may cause scour.

4) Proposed Restoration Measures

Urgent Restoration Measures

Since there is no interference to traffic for the present, no urgent measures were proposed except for preventive measures at abutment as follows:

Proposed Measures		Purpose
U5-1	Gabion Foot Protection	To protect slope at the abutment from erosion

Permanent Restoration Measures

The following three options were proposed and compared as shown in Figure 10-1.

- Concrete foot protection and gabion consolidation downstream
- Concrete foot protection surrounded by gabion foot protection
- Concrete foot protection surrounded by steel sheet pile

The first option was selected from the technical and economical points of view. The proposed measures are as follows:

Proposed Measures		P u r p o s e
P14-2	Gabion Consolidation	To recover scoured river bed
P16-1	Concrete Foot Protection	To protect exposed piles

Note: See Figure 10-2.

FIGURE 10-1 COMPARISON OF ALTERNATIVE RESTORATION MEASURES

TYPE OF DISASTER: PERMANENT BRIDGE OTHER DAMAGE
 PROVINCE AND SPOT NO.: BATANGAS, BS-6


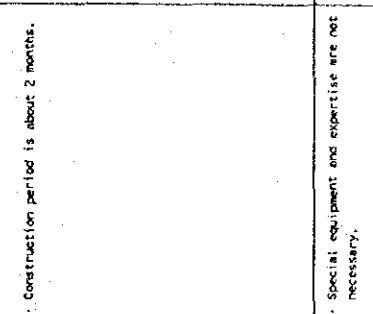
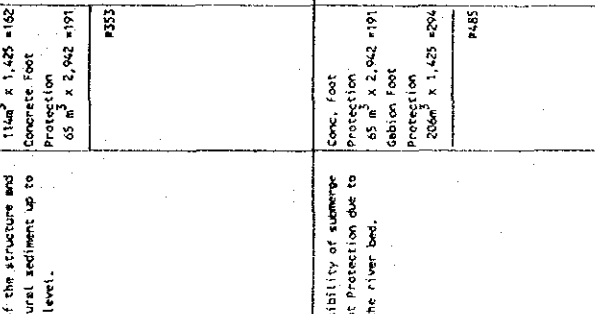
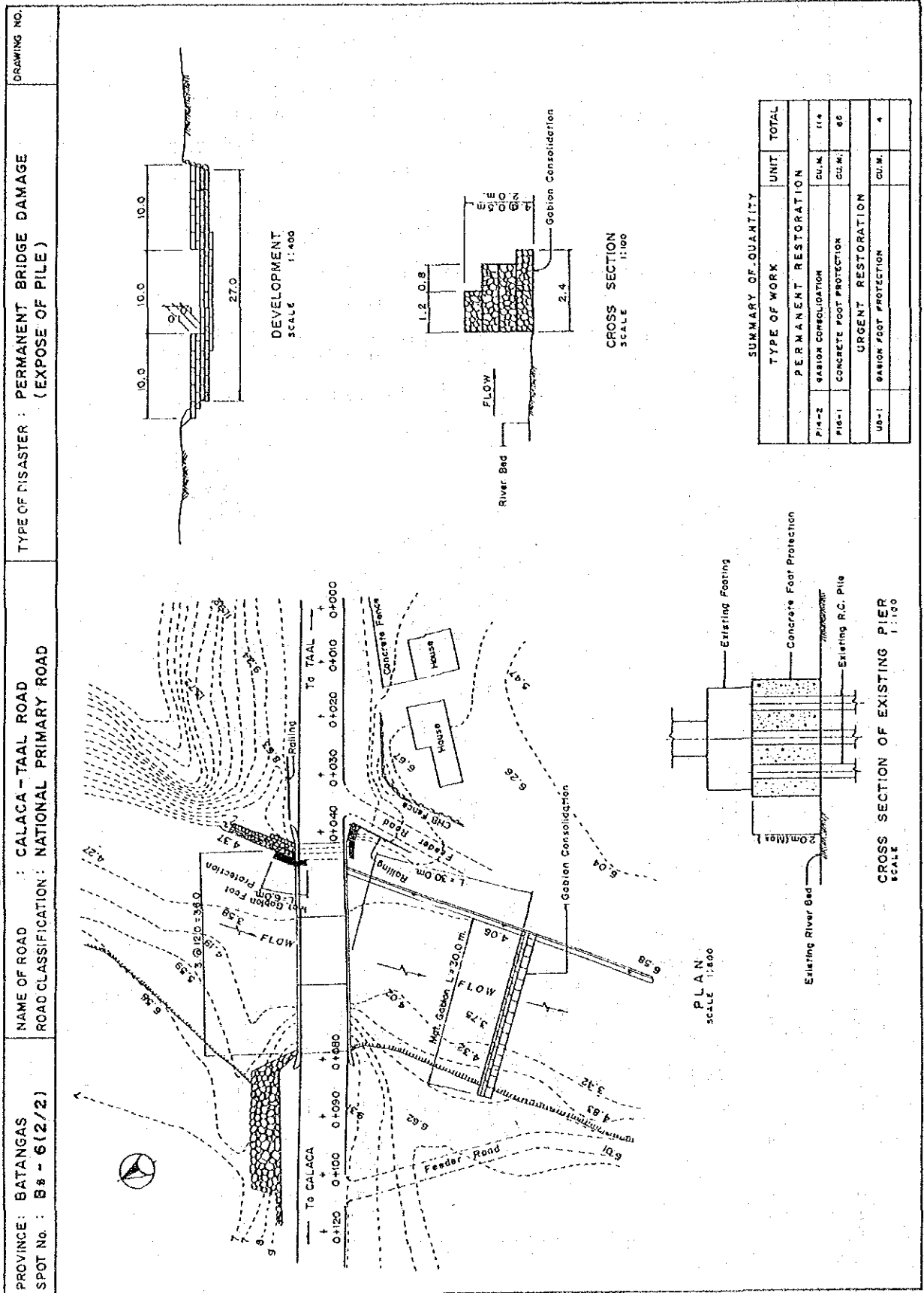
TYPE OF WORK AND ILLUSTRATION	ENGINEERING CHARACTERISTICS	CONSTRUCTION COST (P1,000)	CONSTRUCTION CHARACTERISTICS	ENVIRONMENTAL ASPECTS	REMARKS
(1) Concrete Foot Protection and Gabion Consolidation 	Gabion consolidation is to place gabions on the present riverbed at down stream of the structure and to expect natural sediment up to the original level.	Gabion Consolidation $114m^3 \times 1,425 = 162$ Concrete Foot Protection $65 m^3 \times 2,942 = 191$ P353	Special equipment and expertise are not necessary. Construction period is about 2 months.		- Recommendable for economic reason.
(2) Concrete foot Protection with Gabion 	There is possibility of submerge of Gabion Foot Protection due to scouring of the river bed.	Conc. Foot Protection $65 m^3 \times 2,942 = 191$ Gabion Foot Protection $208m^3 \times 1,425 = 294$ P485	Special equipment and expertise are not necessary. Construction period is about 3 months.		- Applicable.
(3) Concrete Foot Protection with Steel Sheet Pile 	Even if the riverbed is further scoured, the sheet pile affords stability.	Concrete Foot Protection $108m^3 \times 2,942 = 294$ Steel Sheet Pile $181 \times 34,200 = 616$ P910	Sheet piles must be driven from above the bridge because of short height of the bridge, causing traffic disturbance. Automatic pile hammer is necessary. Construction period is about 6 months.		- Not recommendable because of high cost and difficulty in construction.

FIGURE 10-2 PROPOSED RESTORATION MEASURES (Bs-6)



11. Spillway Damage

1) Spot L-90 (Leyte)

Location	:	1.5 km from Kananga proper
Road Name	:	Jct. Kananga - Tagaytay Road
Road Classification	:	Provincial Road
Geological Condition	:	Sand and gravel
Water Condition	:	Main channel 30 m wide, alluvial flow with instable channel

2) Description of Disaster

30 m long and 4 m wide spillway with 7 pieces of reinforced concrete pipe culverts crosses a meandering stream at about 20 m downstream of a bend. Approaches were washed out about 10-15 m in length on each side of the spillway during typhoon "Ruping" in November 1990. At that time, flood level reached about 1.0 m above the spillway. The spillway itself was still sound but traffic was totally interrupted.

3) Causes of Disaster

Erosion of bank by flood water is a cause of approach washout.

4) Proposed Restoration Measures

Urgent Restoration Measures

Proposed were the following measures, which would be utilized later as a part of permanent measures.

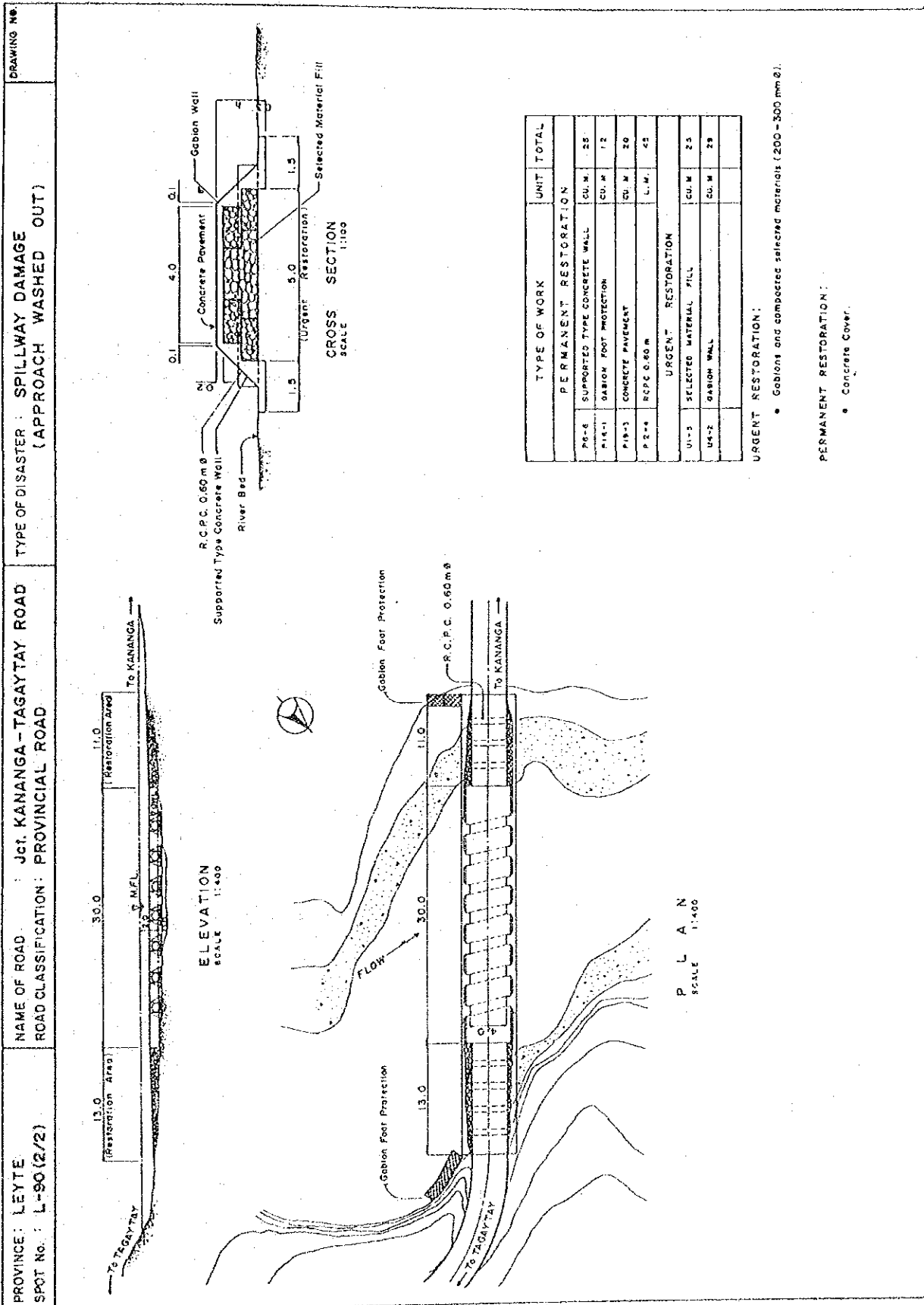
Proposed Measures		P u r p o s e
U1-5	Selected Material Fill	To provide the stream crossing
U4-2	Gabion Wall	To protect the fill from erosion

Permanent Restoration Measures

Proposed permanent measures are to protect the approaches constructed as urgent measures, including the following works (See Figure 11-1):

Proposed Measures		P u r p o s e
P2-4	Culvert R.C.P.C. 0.6 m	To provide the smooth water flow during the high flow
P6-6	Supported Type Concrete Wall	To provide permanent protection of the approach road constructed as urgent measures
P16-2	Gabion Foot Protection	To protect the upstream side river bank
P19-3	Concrete Pavement	To provide permanent surfacing

FIGURE 11-1 PROPOSED RESTORATION MEASURES (L-90)



12. Culvert Damage

1) Spot L-13 (Leyte)

Location : 8.8 km from Matag-ob Proper
Road Name : Matag-ob-Palompon Road
Road Classification : National Secondary Road
Geological Condition : Sandstone, gravelly soil
Water Condition : Concentrated water from hinterland

2) Description of Disaster

A pipe culvert of diameter 0.610 m was installed at curved portion of the road in mountainous terrain. Inlet was partially clogged with debris. Unprotected slope on valley side was eroded about 10 m in length and 2 m in width at top of slope.

3) Causes of Disaster

Insufficient capacity of culvert and accumulation of debris at inlet caused water to overflow on the road surface and run directly on bare slope surface resulting in slope failure.

4) Proposed Restoration Measures

Urgent Measures

The proposed measures consist of the following:

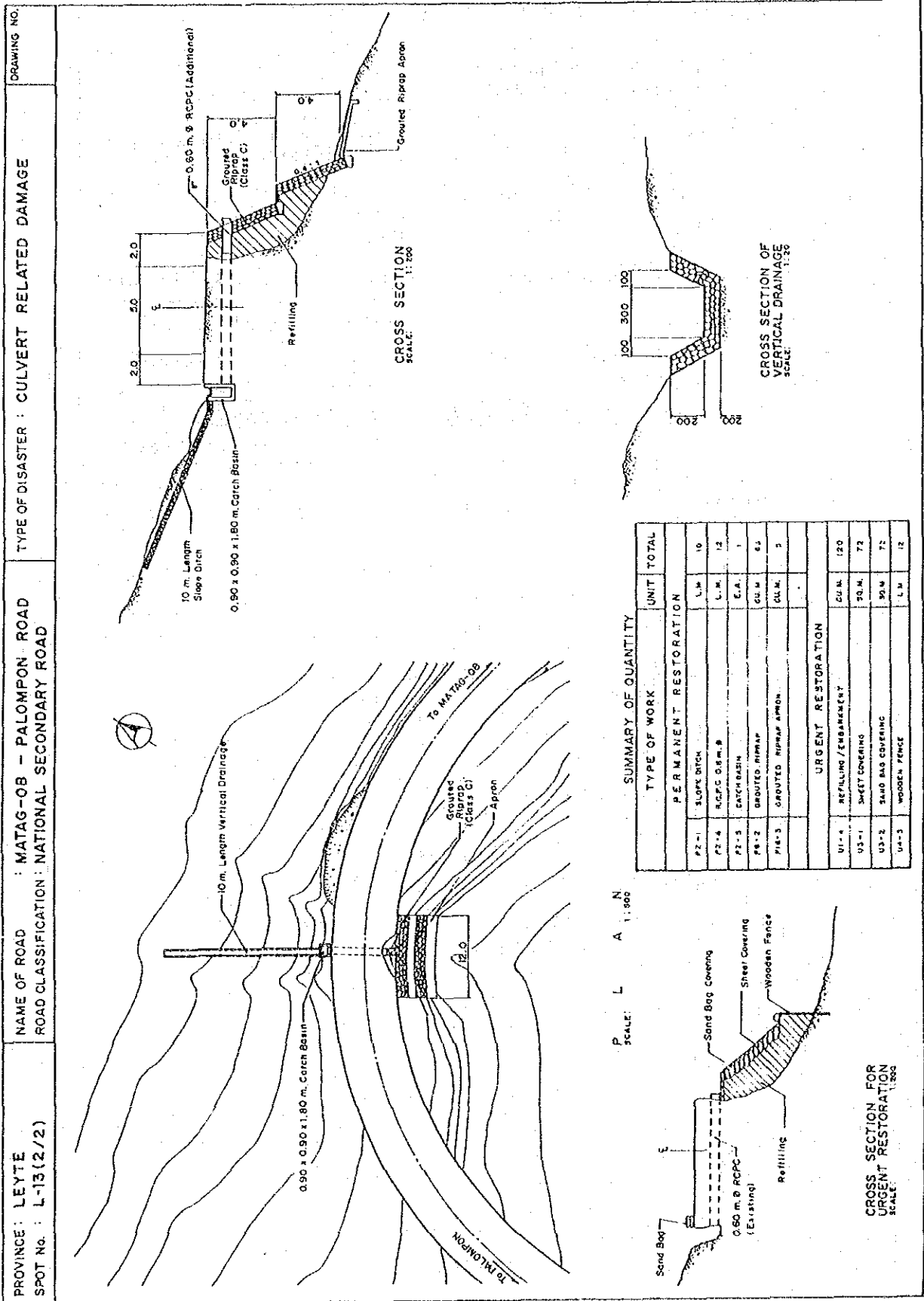
Proposed Measures		P u r p o s e
U1-4	Refilling	To fill eroded portion of slope on valley side
U3-1	Sheet Covering	To prevent surface water from running directly on sand bag covering
U3-2	Sand Bag Covering	To protect fill surface
U4-3	Wooden Fence	To support temporarily fill material and sand bag

Permanent Restoration Measures

The following measures were proposed (See Figure 12-1):

Proposed Measures		P u r p o s e
P2-1	Slope Ditch	To provide waterway along mountain slope thus protect slope surface from erosion
P2-4	RCPC, 0.610 m in diameter	To extend the existing pipe culvert beyond the surface of slope
P2-5	Catch Basin	To connect slope ditch with pipe culvert reducing the energy of running water
P6-2	Grouted Riprap	To protect slope on valley side
P16-3	Grouted Riprap Apron	To protect foundation of grouted riprap from scour

FIGURE 12-1 PROPOSED RESTORATION MEASURES (L-13)



13. Seawall Damage

1) Spot Bs-51 (Batangas)

- Location : 0.65 km from Banoyo Jct. to Baguilaua
Road Name : Banoyo Jct. - San Luis Jct.
Road Classification : Provincial Road
Geological Condition : Clay, silt, sand, gravel and limestone fragments
Water Condition : Within affected zone of seawave

2) Description of Disaster

A seawall of 200 m in length and 2.1 m in height was initially constructed in the early 1970's and reconstructed in 1987 with grouted riprap. During the November 1988 typhoon, 42 m northern portion of the seawall was totally collapsed and 18 m southern portion was partially damaged.

3) Causes of Disaster

The damage was caused by seawave and backwash actions.

4) Proposed Restoration Measures

Urgent Restoration Measures

The following measures were proposed:

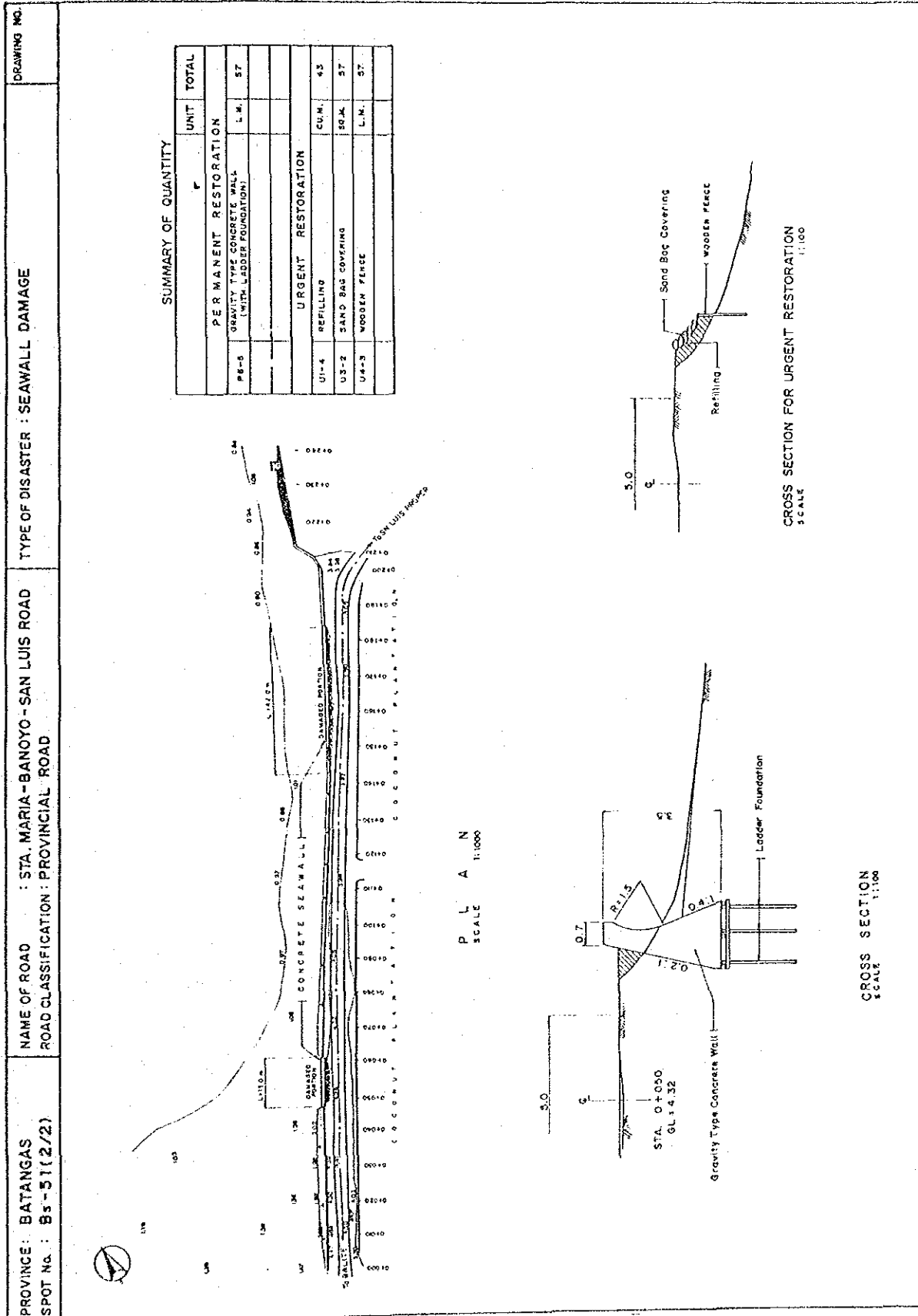
Proposed Measures		Purpose
U1-4	Refilling	To fill washed-out portion
U3-2	Sand Bag Covering	To protect fill surface
U4-3	Wooden Fence	To support temporarily fill material and sand bag

Permanent Restoration Measures

The following measures were proposed (See Figure 13-1):

Proposed Measures		Purpose
P6-5	Gravity Type Concrete Wall (With Ladder Foundation)	To retain embankment protecting it from erosion by seawave

FIGURE 13-1 PROPOSED RESTORATION MEASURES (Bs-51)



JICA