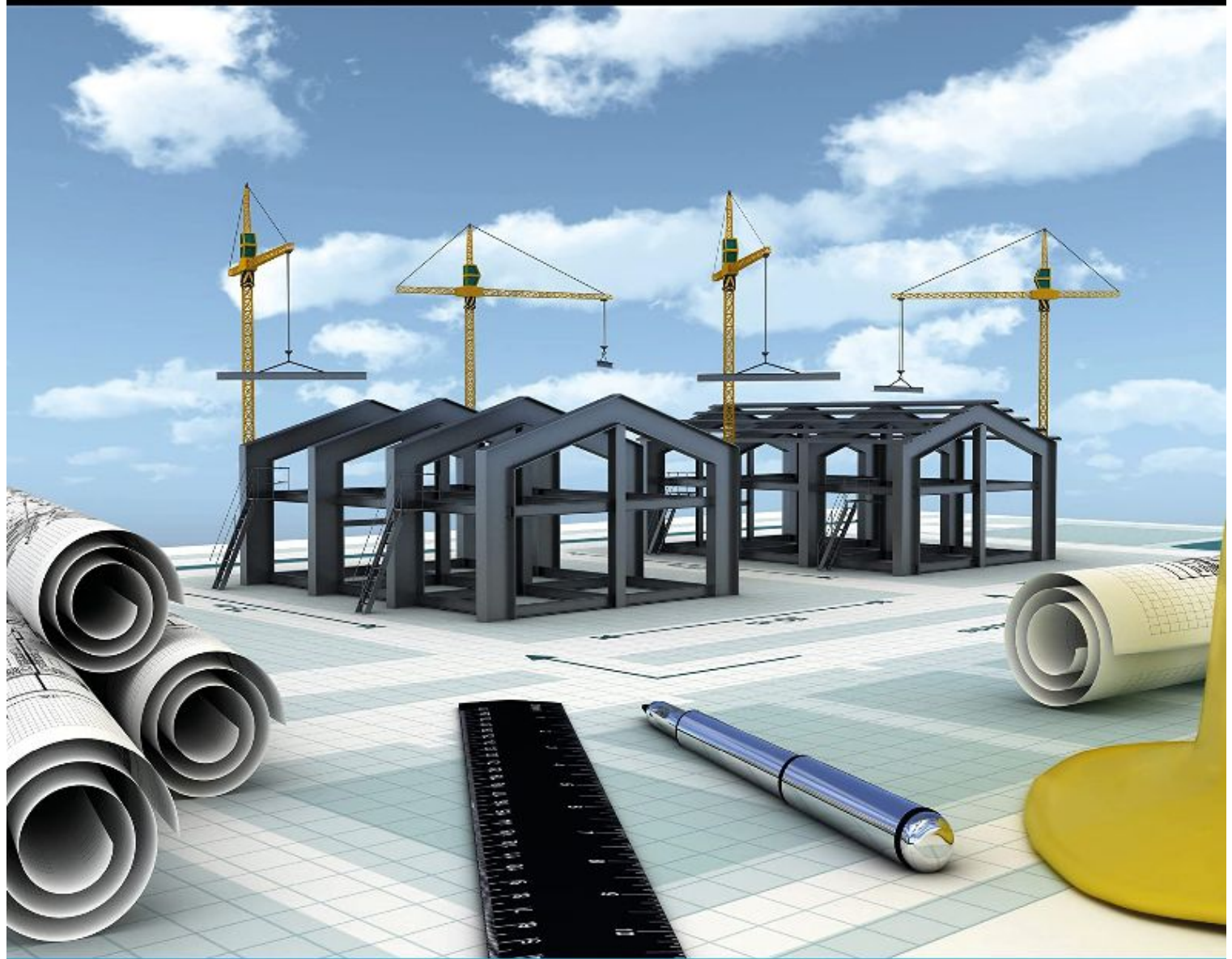


Construction Cost Estimating



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*The Study on Sabo and Flood Control for Western River Basins of Mount Pinatubo
in the Republic of the Philippines
Final Report
Supporting Report*

APPENDIX-X

Construction Plan and Cost Estimate

**THE STUDY ON SABO AND FLOOD CONTROL
FOR WESTERN RIVER BASINS OF MOUNT PINATUBO
IN THE REPUBLIC OF THE PHILIPPINES**

FINAL REPORT

SUPPORTING REPORT

APPENDIX X CONSTRUCTION PLAN AND COST ESTIMATE

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CHAPTER 1 CONSTRUCTION PLAN

1.1 General Description of the Works

This Chapter presents the construction plan for the priority projects which are Construction of the Bucao Bridge on the National Road No.7, and Construction of dikes for flood control in the Bucao and Sto. Tomas River basins. Those projects are situated geographically on the western-most part of Luzon Island in the Philippines. The locations of the Bucao Bridge, and the two river dikes of Bucao and Sto. Tomas are shown in Figure 1.1.1.

1.1.1 Bucao Bridge

The existing Bucao Bridge was constructed in 1939. After 64 years of service, the slab is being damaged severely. Moreover, due to the rising riverbed by lahar deposits, the existing bridge may have insufficient clearance against floods. Therefore, there is an absolute need for reconstruction.

Preliminary design of the Bucao Bridge for reconstruction is conducted and the results are as stated below.

(a) Hydrological Condition

- 1) Design discharge: 4,900 m³/s (50-year probable flood)
- 2) Flood water level: EL. 13.50 m
- 3) Existing riverbed level in 2002: EL. 6.40 m
- 4) Estimated riverbed in 2052: EL. 10.16 m
- 5) Vertical clearance: 3.45 m

(b) Geological Condition

- 1) Bearing layer for abutment at Manila side: EL -10.0 m
- 2) Bearing layer for abutment at Iba side: EL -20.0 m
- 3) Bearing layer for piers: EL -20.0 m

(c) Bridge

- 1) Location: 15 m downstream side of existing bridge
- 2) Length: 321 m
- 3) Type: Steel plate girder
- 4) Span: 46 m + 2x50 m + 50 m + 72 m + 53 m
- 5) Width: 9.54 m (two lanes + two side walks)
- 6) Foundation type: Cast-in-place concrete pile

(d) Road

- 1) Approach road at Manila side: 280 m
- 2) Approach road at Iba side: 346 m
- 3) Width: 10.0 m (two lanes + two shoulders)

1.1.2 Bucao River Basin

Structural measures against flood / mudflow in the Bucao River Basin are the construction of dikes. One is downstream of the Bucao Bridge and the other is upstream of the same Bridge.

(1) Downstream of the Bucao Bridge

This reach from the Bucao Bridge to seashore does not have dike system on both banks at present. The construction of new dike is designed and the lengths are approx. 2.4 km for the right bank and 1.9 km for the left bank.

(2) Upstream of the Bucao Bridge

Construction of the dike for upstream of the Bucao Bridge is designed only on the right bank. The work consists of approx. 7.5 km dike heightening and approx. 0.2 km of strengthening of spur dike near the confluence of the Baquilan River.

1.1.3 Sto. Tomas River Basin

Structural measures for the Sto. Tomas River basin are also construction of dikes. One is downstream of the Maculcol Bridge and the other is upstream of the same bridge. In addition, construction of a diversion channel is also designed for the Gabor River because the existing flow will be totally blocked when the downstream dike on the right bank is constructed.

(1) Downstream of the Maculcol Bridge

This reach from the Maculcol Bridge to the seashore does not have dike system on the right bank at present. Hence, construction of new dike of approx. 2.0 km long is designed for the right bank. On the left bank, 1.4 km of strengthening of the existing dike is designed.

(2) Upstream of the Maculcol Bridge

Construction of dikes for upstream of the Maculcol Bridge is designed for the both banks. The works consist of approx. 3.1 km existing bank strengthening and 4.3 km heightening of existing dike on the right bank, and 9.4 km dike strengthening and 9.0 km dike heightening on the left bank.

(3) Diversion Channel for the Gabor River

The length of the diversion channel will be 1.7 km long and this will be constructed parallel to the proposed dike.

1.2 Basic Conditions

There are various factors and conditions for establishing the construction plan for the projects to be implemented. Such works are much affected by the natural factors particularly the hydrology and geology, and also by the availability of construction resources in and around the project area. The followings are the basic conditions to be adopted for formulating the construction plan.

1.2.1 Hydrology

(1) Rainfall

Heavy rains occur between May and October, which are commonly induced by southwest monsoon winds and tropical cyclones. Rainfall is minimal during the dry season from November to April due to reversal of monsoon wind direction. The monthly mean rainfall at Iba ranges from 4 mm in January to 1,057 mm in August with mean annual rainfall of 3,812 mm. When compared with the amount of rainfall on the western slope of Mount Pinatubo to the eastern slope, the western slope has far greater rainfall.

Monthly rainfall records representing to the Bucao River and the Sto. Tomas River are shown in Figure 1.2.1 “Location of Rainfall Gauge Station,” Figure 1.2.2 “Monthly Rainfall in Iba,” and Figure 1.2.3 “Monthly Rainfall in San Marcelino.” From the records, period from May to October will generally be called as rainy season and from November to April will be called as dry season for this project.

(2) Runoff and Water Level

For construction of the Bucao Bridge in particular, information regarding runoff and water level of the Bucao River based on non uniform flow calculation is expressed in Figure 1.2.4.

1.2.2 Geology

Investigation to determine the prevailing subsoil conditions required for the construction of Bucao Bridge as well as dikes on the Bucao River and Sto. Tomas River has been conducted using triple tube core barrel method and Standard Penetration Test (SPT). Subsoil profile at the Bucao Bridge is shown in Figure 1.2.5. Specific gravity test for the recent lahar deposits results generally ranged from 2.60 to 2.79, with low values ranging from 2.25 to 2.55. The surface deposits usually contain large amount of fines and normally cohesive in nature.

1.2.3 Construction Resources

Locally available construction resources will be used as much as practicable and thus the project becomes economical.

- Skilled and unskilled labors are available in the Philippines and in the Region 3.
- Construction equipment is available in the Philippines for rental or purchase.
- Maximum use of abundant lahar deposits on site.
- Construction materials, such as cement, steel reinforcement bar, and concrete aggregates are available in the Philippines and in the Region 3.
- Boulders for masonry and other works are available in the area.

1.2.4 Other Conditions

Taking into account the above, some other conditions will be applied for the construction.

(1) Annual Workable Days

Annual workable days for the earthworks is determined as 180 days since period from middle May to middle October is considered not practical to carry out due to occasional rainfalls. For concrete and other works, 240 days are workable days but the maintenance of access roads will be difficult and

therefore not much work will be carried out in the rainy seasons.

(2) Working Days and Hours

Working days and hours will be 26 days per month and 10 hours per day in principle but this will need to adjust for each activity.

(3) Access Road

The National Road No.7 from Manila to Lingayen via Iba will be the main access road for this project.

(4) Land for Temporary Work

Necessary space for temporary works, such as construction yard for temporary buildings and repair shops, stockyard and fabrication yard, temporary road, etc. will be provided.

(5) Contract

Construction works are assumed to be implemented by contract system.

1.3 Construction of Bucao Bridge

General view of the designed Bucao Bridge is shown in Figure 1.3.1. Taking the above basic conditions into consideration, general construction procedures will be:-

- Major works will be carried out only in dry seasons as examined at Section 1.2.1 Hydrology.
- Since the new bridge is designed to construct 15 m downstream and parallel to the existing bridge, no detour of National Road No. 7 will be provided.
- Avoiding disturbance of public transportation on the existing bridge, temporary roads will be built on the riverbed for construction purpose.

1.3.1 Temporary Works

(1) Temporary Access Road

Access roads from National Road No. 7 to the riverbed from both banks will be provided parallel to the designed alignment of abutments and piers.

(2) Site Preparation

(a) Removal or Shifting Service Lines

Obstacles such as existing power cables and posts will be shifted away from the space required for construction.

(b) Construction Yard

Proper size of land space is required for construction of temporary buildings, stockyard, fabrication yard, motor-pool, etc. for both Manila and Iba side of the bank.

(3) Temporary Buildings and Supplies

Temporary buildings such as offices and stores, and various supply systems, such as water, power and communication, will be installed on site.

(4) Concrete Plant

Since there is no ready-mixed concrete supply facilities existed in the area, concrete plant will be installed on the site. Considering the maximum volume of concrete to be placed at one time, 100 – 120 m³ at footing concrete, capacity of 15 m³/hr concrete batching and mixing plant will be erected.

(5) Cofferdams

Taking into account of the bridge design, hydrological and geological information, major works will only be carried out in the dry season. However, considering unexpected rain during the dry season, cofferdams for every pier may be required based on the following assumption:

Elevation of the existing ground at river flow center:	EL. 6.45 m
Base of footing concrete	EL. 3.45 m
Earth drill working level	EL. 6.45 m
Groundwater level	EL. 4.45 m
Water level of 2 year probable flood	EL. 8.70 m
Cofferdam crest level	EL. 9.20 m

At the stage of construction, above assumption should be reviewed and modified because the riverbed elevation and ground water level change considerably by every flood.

The cofferdams with steel sheet-pile as shown in Figure 1.3.2 or similar will be applied for this type of project.

1.3.2 Construction Method

(1) Substructure

Abutments and piers are numbered from left bank to right bank as shown in Figure 1.3.1.

(a) Pile Foundation

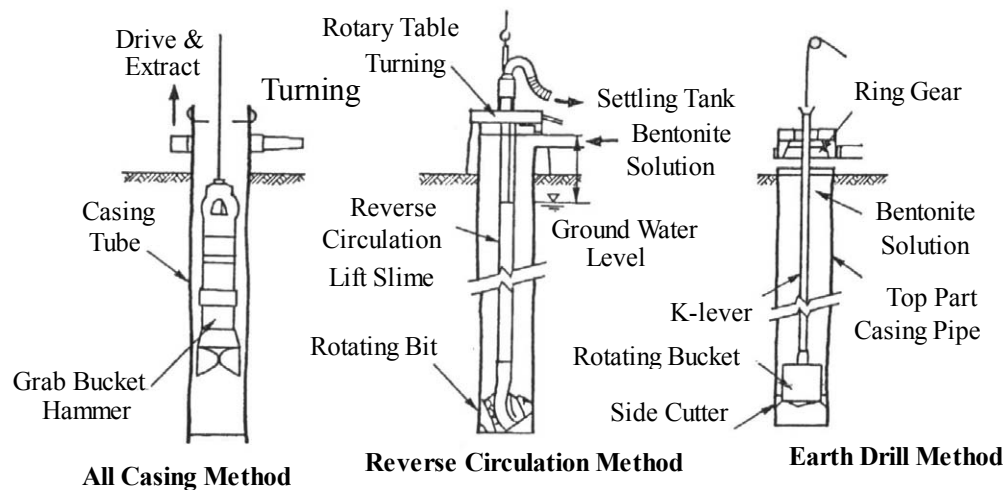
Large diameter of $\varnothing$ 1.2 m bored cast-in-place concrete pile without taper is designed for the foundation of piers and abutments. Following table shows the length and number of piles for each foundation.

Name of Foundation		Length (m)	Nos.	Total length (m)
Abutment	A 1	18	6	108
	A 2	28	6	168
Pier	P 1	22	6	132
	P 2	22	6	132
	P 3	22	6	132
	P 4	22	6	132
	P 5	22	6	132
Total			42	936

There are three different drilling methods in cast-in-place concrete piles.

- Earth drill method
- Reverse circulation method

- All casing method (Benoto pile method)



Considering the site conditions, availability of required equipment, speed and economy as well as the experiences in the Philippines, Earth drill method will be employed for this project.

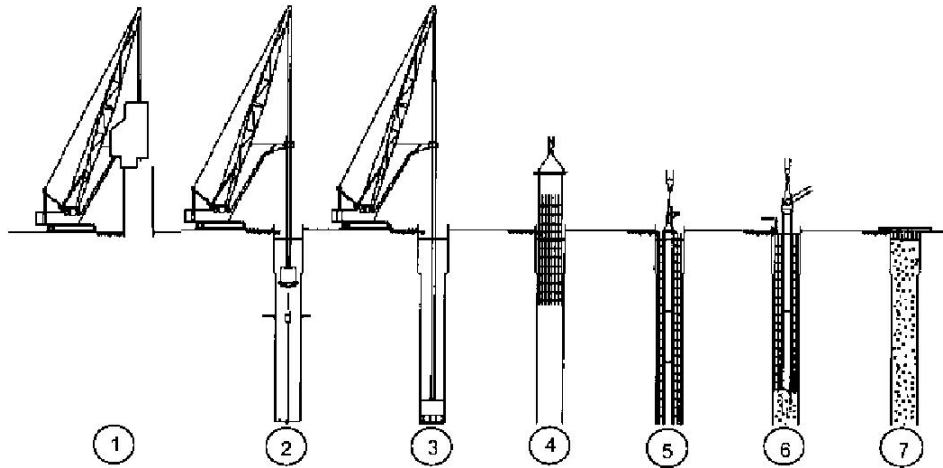
Since the construction site is in the riverbed, water table is high. In addition, as the dominant subsoil is lahar (sand), some underground water flow is expected. Maintaining stability of the sidewall of drilled holes is a key issue. The following measures will be taken:

- Use steel pipe casing (a standpipe), approximately 10 m length.
- Keep water head in the casing 1.5 – 2.0 m higher than the ground water level.
- Use stabilization fluid with controlled specific gravity and viscosity. The mud fluid will provide thin mud films on the surface of sidewall and protect from water seeped into or out.

The most common stabilization agent is bentonite.

General procedure of Earth drill method and its illustrations are –

- ① Installation of standpipe by a vibrator
- ② Excavation by earth drilling bucket
- ③ Removal of slime by bucket (1st treatment)
- ④ Installation of reinforcing steel bar cages
- ⑤ Removal of slime by air-lift or suction method (2nd treatment)
- ⑥ Placing concrete by tremie pipe
- ⑦ Curing



Two working groups will be established for efficient work through a day and night shift, a 24-hour working system. One group operates the earth drilling equipment for drilling works and the other group with a crane works for installation of a standpipe, installation of reinforcement steel cages and placing concrete. The earth drilling machine should be utilized without idling since this is the most critical work item to complete the project in time. It is estimated that excavation of one pile will take approximately 36 hours, one and a half day, on average and 9 – 12 days per foundation in calendar days. Once excavation is commenced, operation should be continued until completion of placing concrete to avoid a risk of failures in bored holes.

For the proper use of bentonite's function and for the environmental considerations, bentonite treatment plant will be provided on site.

For quality assurance, it is important to carry out proper supervision of the works and also to conduct the bearing tests for the cast-in-place piles because some activities are difficult to check if the works are carried out properly during construction, in particular the treatment of slime at the bottom of piles.

(b) Footing

This will generally become mass concrete, steady and proper concrete placement will be required to avoid forming cold joints.

(c) Piers and Abutments

Piers are designed with two columns and abutments are with the reversed T types. Careful concrete placement will be required in particular because some anchors for superstructure will be embedded in the beam support.

(2) Superstructure

Since the height from the ground to the soffit of steel plate girder is approximately 10 m and mobile crane is accessible to erection site through a temporary road in dry seasons, the erection by truck crane with a bent method will be the most economical choice.

Extruder method can be used in the rainy seasons but this will normally require more time and space.

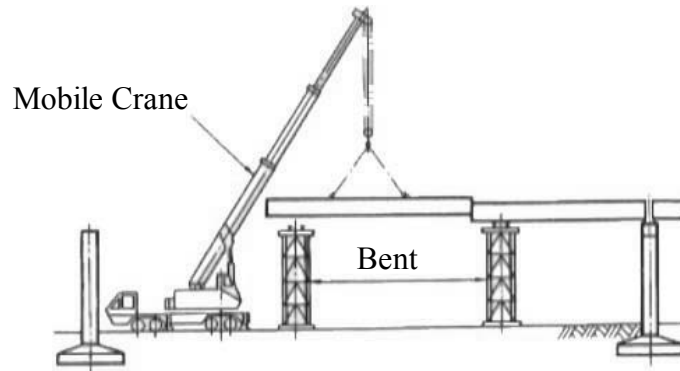
(a) Prefabrication

Steel plate girders will be transported to the site by trailers in about 10 m long piece. This will

be prefabricated to about 20 m in length before erection.

(b) Erection

The prefabricated steel plate girders will be lifted on to the top of bent by a hydraulic truck crane or crawler crane of 120 t capacity on the temporary road. The lifting capacity is determined on the assumption of: 12 ton block weight and 10 m working radius. The bent will be a steel support structure. An image of the erection method is as illustrated as below.



Steel material is designed with non-paint type and therefore no painting is required on site.

(c) Slab and Pavement

Sequence of placing concrete for the deck slab should be arranged to avoid making cracks over the piers due to change of moment and stress during construction.

(3) Approach Road

The construction of approach road will be carried out simultaneously with the construction of the bridge. Because of approx. 10 m high embankment is required, earlier start of embankment work is preferable for less settlement after completion of the project.

(4) Safety Control

Establish safety management code on site and provide safety ropes, hats, life belts to everyone who will go to higher position so as to protect their lives.

(5) Removal of Existing Bridge

The removal of existing bridge will be carried out only after the completion of the Bucao Bridge and after some period of its usage. Therefore, this work will be carried out separately in the following dry season.

1.3.3 Construction Schedule

The proposed construction time schedule for the Bucao Bridge is shown in Figure 1.3.3. Detailed construction schedule for the substructure and typical construction schedule for the bridge pier are also shown in Figure 1.3.3.

Right after the rainy season, construction of abutment A1, left bank - Manila side of the bridge - will be commenced because this foundation is located at the highest place and the designed pile length is the shortest.

Construction period of two years is considered appropriate for this type of bridge construction. However, full use of two dry seasons is the key for completing the project in time. Therefore, some preparatory

works have to be carried out in the rainy seasons and make ready to commence foundation pile drilling in full force from the beginning of dry season.

1.3.4 Construction Resources

(1) Construction plant and equipment

Major construction plant and equipment to be used for this project are listed in the following table.

Major Construction Plant and Equipment

No.	Name	Capacity	Unit	Remarks
1	Earth drill auger	ψ1.2 m, ℓ30 m	1	Drill cast-in-place pile
2	Mobile crane	120 t	1	Erection of girder
3	Mobile crane	50 t	1	General / piling, etc.
4	Backhoe	0.7 m ³	1	General / excavation, etc.
5	Dump truck	10 t	2	General / excavation, etc.
6	Bulldozer	21 t	1	General / road, etc.
7	Concrete plant	20 m ³ /hr	1	Concrete production
8	Vibration hammer	46 – 60 kW	1	Piling
9	Generator	150 – 200 kVA	1	Piling
10	Bentonite plant	Mixer, tank, etc.	1	Bentonite treatment

1.4 Construction of Bucao River Dike

The locations of the Bucao River dikes are shown in Figure 1.4.1. Typical cross sections of the New Dike and Dike Heightening are shown in Figure 1.4.2.

The dike locations, types, lengths, and estimated embankment volumes for construction are summarized below. No rock excavation will be required in the works.

Location	Type	Length (m)	Embankment Volume (m ³)
Bucao Bridge abutment, left bank	New Dike	170	37,300
Downstream of Bucao Bridge, right bank	New Dike	2,350	351,700
Downstream of Bucao Bridge, left bank	New Dike	1,910	217,100
Upstream of Bucao Bridge, right bank	Dike Heightening	5,800	1,096,000
Upstream of Bucao Bridge, Baquilan area	Dike Heightening	1,650	93,200
	Dike Strengthening	200	8,000
Total		12,080	1,803,300

Staged implementation in order from the river mouth toward upstream is normally proposed for river improvement works, however the needs of river improvement depends on local factors; such as height of existing dikes with different degrees of overtopping threat, numbers of resident and values of properties to be protected from inundation. Therefore, one of the sequences for the construction, together with the dike locations, types, and lengths, will be as follows.

- 1) The Bucao Bridge abutment, left bank, and this part will be constructed at the time of bridge construction so that the abutment and approach road of the new bridge will be protected

- 2) Upstream of the Bucao Bridge, right bank
- 3) Downstream of the Bucao Bridge, right bank
- 4) Downstream of the Bucao Bridge, left bank
- 5) Upstream of the Bucao Bridge, Baquilan area, right bank

Taking into the basic conditions for construction, general procedures for the construction of the Bucao River dikes are expressed as follows:

1.4.1 Temporary Works

(1) Access Road

National Road No. 7 is the main access for construction. As a branch from Botolan town, there is road to Baquilan and this will be used for the construction, too. Otherwise needs of access to each site will be solved by construction or use of dikes being built. Considering the required intensive work volume, temporary roads on the riverbed as well as the other landside parallel to the dikes will also be required including necessary ramps to connect the crest of dike.

(2) Site Preparation

(a) Removal or Shifting Service Lines

Obstacles such as existing power cables and posts will be shifted away from the space required for the construction.

(b) Construction Yard

Proper size of land space is required for construction of temporary buildings, stockyard, motor-pool, etc.

(3) Temporary Buildings and Supplies

Temporary buildings and various supply systems, such as water, power and communication, will be provided on site for smooth implementation of the works.

1.4.2 Construction Method

Three types of dike are designed for the improvement of the Bucao River banks. One is the construction of new dike and the remains are heightening and strengthening of existing dikes. The new dike is designed for the riverbank section of no existing dike at present. The dike heightening is applied for the section of insufficient height of existing dikes and the dike strengthening is designed for the section where needs strengthening of existing dikes. Typical cross section of these three types of dike is shown in Figure 1.4.2 and Figure 1.4.3.

The works include embankment with lahar deposits to shape the dike, base concrete at the toe, gabion mattresses with filter cloth, grouted riprap for the riverside slope protection, sodding on borrow soil for landside slope protection, and gravel pavement on top of the dike in common. The removal of existing grouted riprap is required before commencement of embankment in the case of dike heightening. In the case of dike strengthening at existing super dike of 200 m at Baquilan, removal of the existing armor and construction of grouted riprap for both side of slopes and top of the dike are required.

An abundant lahar deposit near the construction site will be utilized as much as possible for the embankment.

In general, the construction works will be carried out by combination of earthmoving equipment such as wheel loaders, backhoe shovels, dump trucks, bulldozers, and vibration rollers. Considering the size of the project and hauling distances, motor scrapers can be used if its mobilization and maintenance are reasonably secured.

1.4.3 Construction Schedule

Construction time schedule for the Bucao River dikes is shown in Figure 1.4.4.

(1) Production Rate Study

Using conventional equipment available for the project, monthly production rate of each group is determined as follows:

Group	Name	Capacity	nos.	Monthly Production (m ³)
A	Tractor Shovel	2.1 m ³	1	19,100
	Dump Truck	12 t	4	
B	Backhoe Shovel	1.0 m ³	1	13,100
	Dump Truck	10 t	4	

The above table is provided based on the following assumptions and calculations.

(a) Group A

Loading Equipment: Tractor shovel (wheel), Bucket capacity: 2.1 m³ (heaped) / Loading to 12 ton dump truck / Bucket factor: 0.8 / Loose weight at excavation: 1.5 t/m³ / Compacted weight at embankment: 2.2 ton/m³ / Working hour per day: 10 hrs / Working days per month in dry seasons: 26 days / Production efficiency factor in working hour: 0.8 / Loading weight per bucket: $2.1 \times 0.8 \times 1.5 = 2.5$ t / Loading time: 40 sec / Loading time required for 12 t dump truck: $12 / 2.5 = 4.8$ times / 4.8×40 sec = 192 sec = 3.2 min / Working efficiency in loading hour: 0.9 / Production rate in embanked volume: $60 / 3.2 \times 0.9 = 16.9$ nos. truck / $16.9 \times 12 = 203$ t/hr / $203 / 2.2 = 92$ m³/hr / $10 \times 0.8 \times 92 = 736$ m³ per day / $736 \times 26 = 19,100$ m³ per month / Hauling Equipment: Dump truck, Loading capacity : 12 t / Hauling Distance: 500 m / Hauling Cycle Time: Loading : 3.2 min / Hauling : 4 min / Unloading: 1 min / Returning: 4 min / Waiting: 1 min / Total: 13.2 min / Hauling times per hour: $60 / 13.2 = 4.5$ times / Number of Dump Truck required: $16.9 / 4.5 = 3.75 \rightarrow 4$ nos. per Tractor shovel

(b) Group B

Loading Equipment: Backhoe shovel, Bucket capacity: 1.0 m³ (heaped) / Loading to 10 t dump truck / Bucket factor: 0.9 / Loose weight at excavation: 1.5 t/m³ / Compacted weight at embankment: 2.2 ton/m³ / Working hour per day: 10 hrs / Working days per month in dry seasons: 26 days / Production efficiency factor in working hour: 0.8 / Loading weight per bucket: $1.0 \times 0.9 \times 1.5 = 1.35$ t / Loading time: 30 sec / Loading time required for 10 t dump truck: $10 / 1.35 = 7.4$ times / 7.4×30 sec = 222 sec = 3.7 min / Working efficiency in loading hour: 0.85 / Production rate in embanked volume: $60 / 3.7 \times 0.85 = 13.8$ nos. truck / $13.8 \times 10 = 138$ t/hr / $138 / 2.2 = 63$ m³/hr / $10 \times 0.8 \times 63 = 504$ m³ per day / $504 \times 26 = 13,100$ m³ per month / Hauling Equipment: Dump truck, Loading capacity: 10 t / Hauling Distance: 500 m / Hauling Cycle Time: Loading : 3.7 min / Hauling : 4 min / Unloading: 1 min / Returning: 4 min / Waiting: 1 min / Total: 13.7 min / Hauling times per hour: $60 / 13.7 = 4.4$ times / Number of Dump Truck required: $13.8 / 4.4 = 3.1 \rightarrow 4$ nos. per Backhoe shovel

(c) Group B - Soil

Loading Equipment: Backhoe shovel, Bucket capacity: 1.0 m³ (heaped) / Loading to 10 t dump truck / Bucket factor: 0.8 / Loose weight at excavation: 1.5 t/m³ / Compacted weight at embankment: 2.2 ton/m³ / Working hour per day: 10 hrs / Working days per month in dry seasons: 26 days / Production efficiency factor in working hour: 0.8 / Loading weight per bucket: $1.0 \times 0.8 \times 1.5 = 1.2 \text{ t}$ / Loading time: 35 sec / Loading time required for 10 t dump truck : $10 / 1.2 = 8.3 \text{ times}$ / $8.3 \times 35 \text{ sec} = 291 \text{ sec} = 4.8 \text{ min}$ / Working efficiency in loading hour: 0.8 / Production rate in embanked volume: $60 / 4.8 \times 0.8 = 10 \text{ nos. truck}$: $10 \times 10 = 100 \text{ t/hr}$ / $100 / 2.2 = 45 \text{ m}^3 / \text{hr}$ / $10 \times 0.8 \times 45 = 360 \text{ m}^3 \text{ per day}$ / $360 \times 26 = 9,360 \text{ m}^3 \text{ per month}$ / Hauling Equipment: Dump truck, Loading capacity: 10 t / Hauling Distance: 20,000 m / Hauling Cycle Time: Loading : 4.8 min / Hauling : 30 min (Borrow area – 5, National read – 10, Site – 15) / Unloading: 1 min / Returning: 30 min / Waiting: 4.2 min / Total: 70 min / Hauling times per hour: $60 / 70 = 0.86 \text{ times}$ / Number of Dump Truck required: $10 / 0.86 = 11.6 \rightarrow 12 \text{ nos. per Backhoe shovel}$

(2) Construction Time Schedule

In the rainy seasons, more precisely from middle May to middle October, it is considered not practical to carry out any works even dike protection works because the maintenance of temporary roads for transporting construction materials as well as finishing the slope of embankment would be difficult. Construction period of four years (three dry seasons) will be appropriate for this type of construction, based on the required average monthly production of 100,000 m³ in the embankment and this equals to 670 m in length. For relaxing the congested site condition, about three different dikes will be constructed simultaneously with monthly production from 30,000 to 60,000 m³ of embankment at each dike, and this corresponds from 200 m to 300 m in length.

Therefore, depends on the required monthly embankment volume for each dikes, combination of Group A and Group B with necessary number of each set will be employed for the works.

1.4.4 Construction Resources

(1) Construction Plant and Equipment

Major construction plant and equipment with its approximate size and numbers to be used for this project are listed in the following table. Exact numbers of fleet will be determined with required individual work volume.

Major Construction Plant and Equipment

No.	Name	Size	Nos.	Remarks
Embankment				
1	Wheel loader	2.1 m ³ class	4	Excavation / loading
2	Backhoe shovel	1.0 m ³ class	2	Excavation / loading / trimming
3	Dump truck	10 - 12 ton class	20 - 30	Hauling / embankment
4	Bulldozer	28 ton class	3	Bulldozing / grading
5	Bulldozer	21 ton, swamp	2	Bulldozing / grading
6	Vibration roller	10 ton class	3	Compaction
7	Motor grader	3.1 m class	2	Grading
8	Water sprinkler	10 m ³ class	1	Watering
Other works: Borrow soil, minor excavation, etc.				
9	Backhoe shovel	0.7 m ³ class	2	Excavation / loading
10	Bulldozer	21 ton class	3	General purpose
11	Trailer	20 ton class	1	Transportation of Equipment
12	Dump truck	10 ton	20 - 30	Hauling
13	Motor grader	2.7 m	1	Grading
14	Backhoe shovel	0.3 m ³ class	3	Miscellaneous

1.5 Construction of the Sto. Tomas River Dike

The locations of the Sto. Tomas River dikes are shown in Figure 1.5.1. Typical cross sections of the New Dike, Dike Heightening, and Dike Strengthening, are shown in Figure 1.5.2, 1.5.3 and 1.5.4

The dike locations, types, lengths, and estimated embankment volumes for construction are summarized below. No rock excavation will be required in the works.

Location	Type	Length (m)	Embankment Volume (m ³)
D/s of Maculcol Bridge, right bank	New Dike	1,950	77,100
D/s & U/s of Maculcol Bridge, left bank	Strengthening	2,800	257,900 (excavation)
U/s of Maculcol Bridge, right bank	Dike Strengthening	3,100	35,800
	Dike Heightening	4,300	393,200
U/s of Maculcol Bridge, left bank	Dike Heightening	9,000	498,800
	Dike Strengthening	8,000	569,100
Total		29,150	1,831,900

Staged implementation in order from the river mouth toward upstream is normally proposed for river improvement works, however the needs of river improvement depends on local factors; such as height of existing dikes with different degrees of overtopping threat, numbers of resident and values of properties to be protected from inundation. Therefore, one of the sequences for the construction, together with the dike locations, types, and lengths, will be as follows.

- 1) Upstream of the Maculcol Bridge, right bank, up to Paete Hill, dike heightening of 4,300 m
- 2) Upstream of the Maculcol Bridge, left bank, up to Vega Hill, dike heightening of 9,000 m
- 3) Upstream of Vega Hill, left bank, dike strengthening of 8,000 m
- 4) Downstream of the Maculcol Bridge, right bank, new dike of 1,950 m together with a diversion channel of the Gabor River, 1,700 m

- 5) Upstream of the Maculcol Bridge, right bank, dike strengthening of 3,100 m
- 6) Downstream and upstream of the Maculcol Bridge, left bank, dike strengthening of 2,800 m

Taking into the basic conditions for construction, general procedures for the construction of Sto. Tomas River dikes are expressed as follows:

1.5.1 Temporary Works

(1) Access Road

National Road No. 7 is the main access for construction. Public road from San Marcelino to San Rafael is available for left bank upstream part of dike construction. Temporary roads from the National Road and other public road to access each site will be solved by construction or use of dikes being built. Considering the required intensive work volume, temporary roads on the riverbed at riverside as well as the other landside parallel to the dikes will also be required including necessary ramps to connect the crest of dike.

(2) Site Preparation

(a) Removal or Shifting Service Lines

Obstacles such as existing power cables and posts will be shifted away from the space required for the construction.

(b) Construction Yard

Proper size of land space is required for construction of temporary buildings, stockyard, motor-pool, etc. for both Manila and Iba side of the bank.

(3) Temporary Buildings and Supplies

Temporary buildings and various supply systems, such as water, power and communication, will be provided on site for smooth implementation of the works.

1.5.2 Construction Method

Three types of dike are designed for the improvement of the Sto. Tomas River banks. One is the construction of new dike and the remains are heightening and strengthening of existing dikes. In addition, a diversion channel of the Gabor River is also designed.

The new dike is designed for the section of no existing dike at present. The dike heightening is applied for the section of insufficient height of existing dikes and the dike strengthening is designed for the section where needs strengthening of existing dikes. Typical cross section of these three types of dike is shown in Figure 1.5.2, 1.5.3 and 1.5.4.

The works include embankment with lahar deposits to shape the dike, base concrete at the toe, gabion mattresses with filter cloth, grouted riprap for the riverside slope protection, sodding on borrow soil for landside slope protection, and gravel pavement on top of the dike. The removal of existing grouted riprap is required before commencement of embankment in the case of dike heightening where applicable.

An abundant lahar deposit near the construction site will be utilized as much as possible for the embankment.

In general, the construction works will be carried out by combination of earthmoving equipment such as

wheel loaders, backhoe shovels, dump trucks, bulldozers, and vibration rollers. Considering the size of the project and hauling distances, motor scrapers can be used if its mobilization and maintenance are reasonably secured.

1.5.3 Construction Schedule

Construction time schedule for the Sto. Tomas River dike is shown in Figure 1.5.5.

(1) Production Rate Study

Using conventional equipment available for the project, monthly production rate of each group is determined as follows:

Group	Name	Capacity	nos.	Monthly Production (m ³)
A	Tractor Shovel	2.1 m ³	1	19,100
	Dump Truck	12 t	4	
B	Backhoe Shovel	1.0 m ³	1	13,100
	Dump Truck	10 t	4	

The above table is provided based on the following assumptions and calculations.

(a) Group A

Loading Equipment: Tractor shovel (wheel), Bucket capacity: 2.1 m³ (heaped) / Loading to 12 ton dump truck / Bucket factor: 0.8 / Loose weight at excavation: 1.5 t/m³ / Compacted weight at embankment: 2.2 ton/m³ / Working hour per day: 10 hrs / Working days per month in dry seasons: 26 days / Production efficiency factor in working hour: 0.8 / Loading weight per bucket: $2.1 \times 0.8 \times 1.5 = 2.5$ t / Loading time: 40 sec / Loading time required for 12 t dump truck: $12 / 2.5 = 4.8$ times / 4.8×40 sec = 192 sec = 3.2 min / Working efficiency in loading hour: 0.9 / Production rate in embanked volume: $60 / 3.2 \times 0.9 = 16.9$ nos. truck / $16.9 \times 12 = 203$ t/hr / $203 / 2.2 = 92$ m³/hr / $10 \times 0.8 \times 92 = 736$ m³ per day / $736 \times 26 = 19,100$ m³ per month / Hauling Equipment: Dump truck, Loading capacity : 12 t / Hauling Distance: 500 m / Hauling Cycle Time: Loading : 3.2 min / Hauling : 4 min / Unloading: 1 min / Returning: 4 min / Waiting: 1 min / Total: 13.2 min / Hauling times per hour: $60 / 13.2 = 4.5$ times / Number of Dump Truck required: $16.9 / 4.5 = 3.75 \rightarrow 4$ nos. per Tractor shovel

(b) Group B

Loading Equipment: Backhoe shovel, Bucket capacity: 1.0 m³ (heaped) / Loading to 10 t dump truck / Bucket factor: 0.9 / Loose weight at excavation: 1.5 t/m³ / Compacted weight at embankment: 2.2 ton/m³ / Working hour per day: 10 hrs / Working days per month in dry seasons: 26 days / Production efficiency factor in working hour: 0.8 / Loading weight per bucket: $1.0 \times 0.9 \times 1.5 = 1.35$ t / Loading time: 30 sec / Loading time required for 10 t dump truck: $10 / 1.35 = 7.4$ times / 7.4×30 sec = 222 sec = 3.7 min / Working efficiency in loading hour: 0.85 / Production rate in embanked volume: $60 / 3.7 \times 0.85 = 13.8$ nos. truck / $13.8 \times 10 = 138$ t/hr / $138 / 2.2 = 63$ m³/hr / $10 \times 0.8 \times 63 = 504$ m³ per day / $504 \times 26 = 13,100$ m³ per month / Hauling Equipment: Dump truck, Loading capacity: 10 t / Hauling Distance: 500 m / Hauling Cycle Time: Loading : 3.7 min / Hauling : 4 min / Unloading: 1 min / Returning: 4 min / Waiting: 1 min / Total: 13.7 min / Hauling times per hour: $60 / 13.7 = 4.4$ times / Number of Dump Truck required: $13.8 / 4.4 = 3.1 \rightarrow 4$ nos. per Backhoe shovel

(c) Group B - Soil

Loading Equipment: Backhoe shovel, Bucket capacity: 1.0 m³ (heaped) / Loading to 10 t dump truck / Bucket factor: 0.8 / Loose weight at excavation: 1.5 t/m³ / Compacted weight at

embankment: 2.2 ton/m³ / Working hour per day: 10 hrs / Working days per month in dry seasons: 26 days / Production efficiency factor in working hour: 0.8 / Loading weight per bucket: 1.0 x 0.8 x 1.5 = 1.2 t / Loading time: 35 sec / Loading time required for 10 t dump truck : 10 / 1.2 = 8.3 times / 8.3 x 35 sec = 291 sec = 4.8 min / Working efficiency in loading hour: 0.8 / Production rate in embanked volume: 60 / 4.8 x 0.8 = 10 nos. truck : 10 x 10 = 100 t/hr / 100 / 2.2 = 45 m³ / hr / 10 x 0.8 x 45 = 360 m³ per day / 360 x 26 = 9,360 m³ per month / Hauling Equipment: Dump truck, Loading capacity: 10 t / Hauling Distance: 20,000 m / Hauling Cycle Time: Loading : 4.8 min / Hauling : 30 min (Borrow area – 5, National read – 10, Site – 15) / Unloading: 1 min / Returning: 30 min / Waiting: 4.2 min / Total: 70 min / Hauling times per hour: 60 / 70 = 0.86 times / Number of Dump Truck required: 10 / 0.86 = 11.6 → 12 nos. per Backhoe shovel

(2) Construction Time Schedule

In the rainy seasons, more precisely from middle May to middle October, it is considered not practical to carry out any works even dike protection works because the maintenance of temporary roads for transporting construction materials as well as finishing the slope of embankment would be difficult. Construction period of four years (three dry seasons) will be appropriate for this type of construction, based on the required average monthly production of 102,000 m³ in the embankment and this equals to 1,620 m in length. For relaxing the congested site condition, about 3 to 6 different dikes will be constructed simultaneously with monthly production from 6,000 m³ to 36,000 m³ of embankment at each dike, and this corresponds from 360 m to 520 m in length.

Therefore, depends on the required monthly embankment volume for each dike, combination of Group A and Group B with necessary number of each set will be employed for the works.

1.5.4 Construction Resources

Major construction plant and equipment with its approx. size and numbers to be used for this project are listed in the following table. Exact numbers of fleet will be determined with required individual work volume.

Major Construction Plant and Equipment

No.	Name	Size	Nos.	Remarks
Embankment				
1	Wheel loader	2.1 m ³ class	4	Excavation / loading
2	Backhoe shovel	1.0 m ³ class	2	Excavation / loading / trimming
3	Dump truck	10 - 12 ton class	20 - 30	Hauling / embankment
4	Bulldozer	28 ton class	3	Bulldozing / grading
5	Bulldozer	21 ton, swamp	2	Bulldozing / grading
6	Vibration roller	10 ton class	3	Compaction
7	Motor grader	3.1 m class	2	Grading
8	Water sprinkler	10 m ³ class	1	Watering
Other works: Borrow soil, minor excavation, etc.				
9	Backhoe shovel	0.7 m ³ class	2	Excavation / loading
10	Bulldozer	21 ton class	3	General purpose
11	Trailer	20 ton class	1	Transportation of Equipment
12	Dump truck	10 ton	20 - 30	Hauling
13	Motor grader	2.7 m	1	Grading
14	Backhoe shovel	0.3 m ³ class	3	Miscellaneous

CHAPTER 2 MAINTENANCE AND ADMINISTRATION

2.1 General Description of the Works

This chapter makes proposals on the maintenance and administration after the completion of structural measures and they are:

- For Bucao River:
 - Dike heightening / revetment
 - Bridge reconstruction
- For Sto. Tomas River
 - Dike heightening / revetment

2.1.1 Extent of the Works

Maintenance work in this chapter will be defined as periodical patrol for checking the condition of structures and repair works if it comes necessary. And administration means the necessary support for carrying out the maintenance operation.

2.1.2 Remedial Works

No significant maintenance work will be required at the Bucao Bridge because the main member of the bridge will be made with non-paint type steel plate girder.

With regards to the dikes of the Bucao River and Sto. Tomas River, it is assumed that three locations will suffer damages of partial breakdowns of the dike from floods every year. Presumed magnitude of each damage required for maintenance operation is as follows:

- | | |
|---------------------------------|-----------------------|
| - length of damage | 300 m |
| - lost of embankment material | 50,000 m ³ |
| - removal of damaged protection | 900 m ³ |
| - base concrete | 150 m ³ |
| - gabion mattress | 540 m ³ |
| - grouted riprap | 900 m ³ |
| - gravel pavement | 300 m ³ |
| - et cetera | |

2.2 Present Status

(1) Existing Organization

There are five organizations which have been involved with the river basin management and they are Regional Office (III), District Office in Zambales, PMO-MPR, PMO-MPE, Provincial Office of Zambales. Survey results on present status of each office are as follows. District Office at Olongapo City is not included because it will not be involved any of the maintenance works.

Annual Budget of Different Offices

For Year 2002 (in Million Pesos)

Name of Office	Personnel	Equipment	Project	Total
Regional Office (III)	37.25	-	211.80	-
District Office	54.49	-	11.69	-
PMO-MPR	9.27	-	6.50	-
PMO-MPE	12.97	5.46	1,697.15	1,715.58
Provincial Eng. Office	13.12	15.29	0.00	28.41
Total	127.10	-	1,927.14	-

Note: Budget in Project means on-going project's total amount.

Numbers of Personnel at Different Offices (Year 2002)

Name of Office	Engineer	Technician	Others.	Total
Regional Office (III)	49	36	48	133
District Office	28	93	65	186
PMO-MPR	26	39	21	86
PMO-MPE	32	22	30	84
Provincial Eng. Office	23	61	36	120
Total	158	251	200	609

Major Equipment Owned by Different Offices (Year 2002)

Name of Office	Bulldozers	Dump trucks	Others	Total
Regional Office (III)	5	0	33	38
District Office	0	3	24	27
PMO-MPR	26	0	30	56
PMO-MPE	0	0	11	11
Provincial Eng. Office	5	42	151	198
Total	36	45	249	330

Notes: Bulldozers at Regional Office are 24 ton but non-operational, need major repair. One of the Dump trucks at District Office is non-operational. Bulldozers at PMO-MPR are 24 – 26 ton class. Others at PMO-MPE are mostly small cars like pick-ups. Provincial Office's equipment is rather small size, in case of dump truck; their tonnage varies from 15 – 4 ton. Many motor cycles are included in the others.

2.3 Maintenance Works

Required maintenance works will be as follows:

2.3.1 Patrol and Inspection

Through the patrol and inspection, any irregularities or defects of the bridge and dikes are to be detected so that the irregularities and defects can be rectified before they come worse and impair the functions or safety of those structures.

Through the patrol and inspection, places or facilities to be maintained or repaired shall be identified. And the notice to a maintenance and repair section shall be made without delay. When large-scale maintenance and/or repair works are required, action programs should be arranged in order to avoid seriously negative effect on the functions of the structures. In a rainy season, an intensified patrol and

inspection shall be programmed by DPWH. If any irregularities or defects are found in the structures, repair works shall be immediately undertaken to prevent expansion or progression of the irregularities or defects.

Frequency (timing) and objectives of patrol/inspection are described as follows:

Frequency / Objectives of Patrol and Inspection

No.	Patrol / Inspection	Frequency	Objectives
1	Regular Inspection	Once a month (Once a week during rainy season)	To find out the followings: - Irregularities of structures - Maintenance manner of structures
2	Semi-Annual Inspection (End of rainy season)	November, every year	To find out changes in structures To plan the maintenance activity program for the coming dry season
3	Semi-Annual Inspection (Before rainy season)	April, every year	To inspect the results of maintenance activities done before rainy season To prepare required material / equipment for urgent remedial repair works during rainy season
4	Special Inspection	During typhoon	To observe / inspect the conditions of rivers and structures during the flood To take immediate actions for urgent remedial measures to repair structures To observe / inspect the flood damages if any

Required arrangements for the respective inspection are as follows:

List of Manpower / Instrument / Material for Inspections

No.	Items	Regular Inspection	Semiannual (Nov)	Semiannual (April)	Special Inspection
1	Manpower				
	1) Civil Engineer	o	o	o	o
	2) Mechanician	o	o	o	o
	3) Survey crew		o	o	
2	Instruments / Material				
	1) 4WD vehicle (1 unit)	o	o	o	o
	2) Poles / Measuring tape	o	o	o	o
	3) Lubricant	o	o	o	o
	4) Survey instrument		o	o	
	5) Painting tools / materials		o	o	
	6) Sand-bags / Bamboo poles				o

2.3.2 Maintenance Work

(1) The Bucao Bridge:

The proposed bridge length is 321 m long and made of non-paint steel plate girder. The approach road for the bridge is 280 m at Manila side and 346 m at Iba side, and its width is 10.0 m.

For maintenance of the bridge, the following aspects should be taken into account at regular and special inspection.

- (a) Surface condition of pavement including approach roads.
- (b) Surroundings of abutments and piers

- (c) Slopes of approach roads
- (d) Condition of bridge bearing and support
- (e) Handrails

(2) Dikes:

Dike embankment was constructed on the both banks of Bucao River and Sto. Tomas river. The total length of Bucao dikes is 12,080 m. The length of Sto. Tomas dikes is 30,850 m in total including 1,700 m diversion channel.

Typical cross sections of each dike are presented in the chapter 1 of this appendix . The top width of the dikes was designed as 8 m consisting of 5 m gravel pavement and 1.5 m shoulder on both sides. Gabion mattress, base concrete and grouted riprap are the parts of revetment and sodding on borrow soil with drain ditch on the landside as slope protection.

For maintenance of dikes, the following aspects should be taken into account at the time of monthly regular inspection and special inspection during the typhoon / flooding:

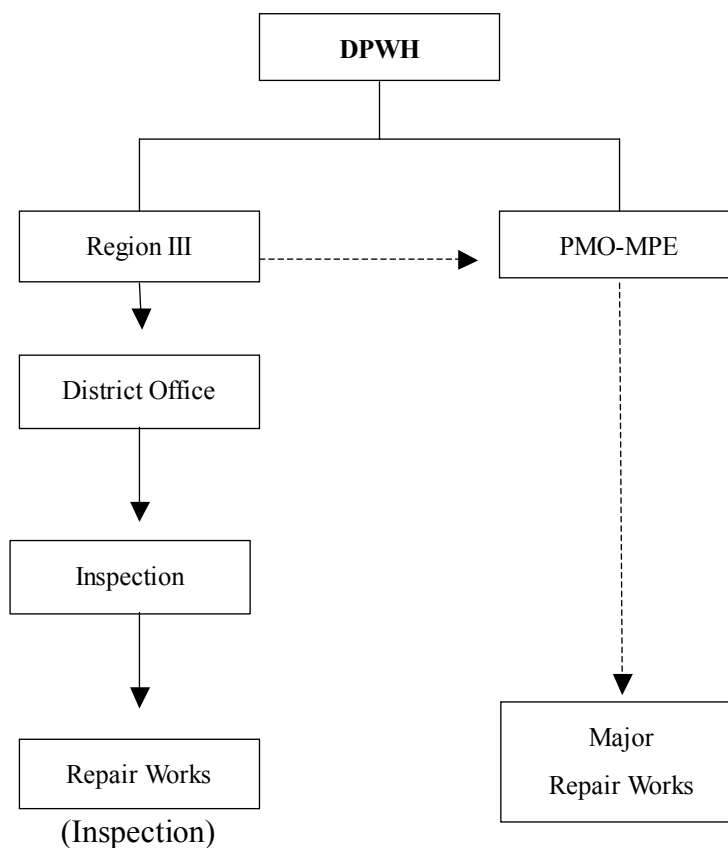
- (a) Gully erosion / sodding on the slope
- (b) Seepage from the riverside to landside
- (c) Settlement of dike
- (d) Crown shape of dike surface

2.4 Organization and Function

(1) Proposed Organization

According to the nature of works, it is suggested that PMO-MPE and the District Office would be required to carry out the maintenance works. Initially because of the location and familiarity of the works, all the works would be managed by the District Office in Zambales, in particular the regular inspection of the structures and following remedial works. However, District Office will report to PMO-MPE about the inspection results together with expected remedial works, and ask PMO-MPE to execute major works which considered beyond the capacity of the District Office.

Proposed Organization for Maintenance Works



Note: Dotted line means the case when such repairs work is considered beyond District Office's capability, the work will be carried out by PMO.

(2) Manpower

In the maintenance of the structure, the District Office and / or PMO-MPE will be required capable to provide following staff when this work comes necessary.

Numbers of personnel:

Engineer	10
Technician	15
Administration	5
Total	30

(3) Instrument and Material

For supporting required regular inspection, cars and instruments with necessary consumables should be arranged for the District Office.

(4) Equipment

The District Office will maintain following equipment through procurement and repair for the maintenance works, all the time.

List of Equipment to be held by the District Office

No.	Name	Size / Capacity	Unit	Remarks
1	Backhoe shovel	0.7 m ³ class	1	
2	Backhoe shovel	0.3 m ³ class	1	
3	Dump truck	10 ton class	6	
4	Bulldozer	21 ton class	1	
5	Bulldozer	13 ton, swamp	1	
6	Motor grader	2.7 m class	1	
7	Vibration roller	8 ton class	1	
8	Truck crane	15 ton class	1	
9	Low-bed Trailer	20 ton class	1	
10	Concrete mixer	0.3 m ³ class	1	

Equipment will be used for 400 working hours every year; based on 4 months per year, 20 days per month, 5 hours per day.

(5) **Materials**

Following materials will be required for the maintenance operation.

- lost of embankment material 150,000 m³
- base concrete 450 m³
- gabion mattress 1,620 m³
- grouted riprap 2,700 m³
- gravel pavement 900 m³

2.5 Schedule and Budget

Expected maintenance schedule with budget is shown in Figure 2.5.1

CHAPTER 3 COST ESTIMATE

3.1 Constitution of Project Cost

The project cost is estimated for major sectors, i.e. (1) Sabo and flood control structure measures (2) Non-structure measures and (3) Community-based disaster prevention measures, which are subdivided into as follows:

- (1) Sabo and flood control structure measures
 - i) Bucao River Basin
 - ii) Sto. Tomas River Basin
- (2) Non-structure measures
 - i) Flood/ Madflow Warning System
 - ii) Evacuation System
- (3) Community-based disaster prevention measures
 - i) Community Based Forest Management
 - ii) Agriculture Development on Lahar Area
 - iii) Community Road Rehabilitation
 - iv) Establishment of Aeta Assistance Station

The project cost of each sub-item consists of the following components:

- (1) Construction Cost
- (2) Land Acquisition and Compensation
- (3) Administration and Engineering Services Cost
- (4) Contingency
 - i) Physical Contingency
 - ii) Price Contingency

3.2 Conditions and Method of Cost Estimate

- (1) Construction Cost

The construction cost is basically estimated by unit price basis which multiply the work quantity and the unit price.

The unit prices of construction works of the sabo and flood control structure are determined in reference to prevailing unit prices which are collected from the ongoing similar projects in Pampanga and Pangasinan provinces. Unit prices of five contract packages of the Pinatubo Hazard Urgent Mitigation Project, Phase II and two contract packages of Agno River Flood Control Project, Phase II are referred. As the price level of the ongoing similar projects is the year of 2001 mostly and that of this study is September 2002, unit prices represented from those projects are adjusted by price inflation rates for one year. Annual inflation rates of 2% for foreign currency portion and 4% for local currency portion are applied, considering the recent inflation trend (details refer to Appendix I). Table 3.2.1.shows applied

unit prices, which is expressed in Philippine Peso and divided into local currency portion and foreign currency portion according to the following composition presented by NEDA.

	<u>Local portion</u>	<u>Foreign portion</u>
(1) Material		
a. Cement, Fuel& Lubricant	30%	70%
b. Aggregate & Lumber	60%	40%
c. Steel	20%	80%
d. Others	50%	50%
(2) Machinery & Equipment Rental	30%	70%
(3) Labor	100%	0%
(4) Indirect costs	100%	0%

While, the cost of general item including miscellaneous items is estimated by lump sum basis which is assumed to be 10% of the sum of construction cost estimated by the unit price basis. Data obtained from the ongoing similar project shows 8% in average for the general item as presented in Table 3.2.2. As for the unit price of non-structure and community based disaster prevention measures, it is discussed in each related section of 3.4 and 3.5.

(2) Land Acquisition and Compensation Cost

The cost estimate for the land acquisition and compensation is based on the cost data obtained from Bureau of Internal Revenue for the zonal valuation of land and village wise information gathered in the field. Data obtained from the field is applied for this study as shown in Table 3.2.3.

(3) Administration and Engineering Cost

Administration and engineering cost to be required for the project implementation is estimated by lump sum basis which is assumed at 3% of the construction cost for the government administration, at 6% of the construction cost for the detail design and 10% for construction supervision as the engineering services cost, which are basis on the DPWH standard.

(4) Contingency

Price contingency until the completion of the project is estimated by annual inflation rates of 4% for local currency and 2% for foreign currency. For the physical contingency, 10 % of construction cost for each item is applied.

3.3 Project Cost for Sabo and Flood Control Structure

The construction cost based on the feasibility design is estimated at P1,035 million for the Bucao River basin including P341 million for the cost of Bucao Bridge replacement and P.1,192 million for the Sto. Tomas River basin, of which detailed breakdowns are shown in Table 3.3.1 for the Bucao River basin and Table 3.3.2 for the Sto. Tomas River basin, respectively. From tables the construction cost of each structure is summarized as follows:

Construction Cost for Each Structure

No.	Description	Amount (P1,000)
1	Bucao River Basin	
(1)	Dike construction	690,624
(2)	Maintenance road	2,790
(3)	Bucao bridge replacement	341,086
	Total (1)	1,034,500
2	Sto. Tomas River Basin	
(1)	Dike construction	1,125,598
(2)	Diversion channel	63,539
(3)	Maintenance road	2,991
	Total (2)	1,192,128
	Grand Total (1 to 2)	2,226,628

Based on the field investigation and the unit price given in Table 3.2.3, the cost of land acquisition and compensation is estimated at P82.9 million in totals of which summary is given in Table 3.3.3.

Detail calculation for the cost of land acquisition and compensation is presented in the report of Resettlement Plan prepared for this study.

Based on the construction cost, the government administration cost, engineering services cost and contingency are calculated as a lump sum basis. Thus, the project cost is estimated at P1,678 million for the Bucao River basin and at P1,960 million for the Sto. Tomas River basin, as shown in Table 3.3.4 and 3.3.5, respectively, which are summarized as follows:

Project Cost

(Unit: 1,000 Pesos)

No.	Description	LC	FC	Total
1.	Construction cost of civil works			
	Bucao River basin	551,281	483,219	1,034,500
	Sto. Tomas River basin	687,044	505,085	1,192,128
2.	Land acquisition & compensation	44,878	0	44,878
	Bucao River basin	44,878	0	44,878
	Sto. Tomas River basin	37,988	0	37,988
3.	Administration			
	Bucao River basin	31,035	0	31,035
	Sto. Tomas River basin	35,764	0	35,764
4	Engineering service cost			
	Bucao River basin	88,205	77,315	165,520
	Sto. Tomas River basin	109,927	80,814	190,741
5	Sub Total			
	Bucao River basin	715,399	560,534	1,275,933
	Sto. Tomas River basin	870,723	585,899	1,456,621
6	Price contingency			
	Bucao River basin	182,428	67,101	249,529
	Sto. Tomas River basin	245,391	79,459	324,850
7	Physical contingency			
	Bucao River basin	89,783	62,763	152,546
	Sto. Tomas River basin	111,611	66,536	178,147
8	Total			
	Bucao River basin	987,609	690,399	1,678,008
	Sto. Tomas River basin	1,227,726	731,894	1,959,619
9	Grand Total	2,215,335	1,422,293	3,637,627

Assuming an annual progress of construction works from the construction schedule discussed in the foregoing chapter 1, disbursement schedule of project cost is produced as shown in Table 3.3.6 for the Bucao River basin and Table 3.3.7 for the Sto. Tomas River basin. The tables show that if the replacement of Bucao Bridge is expected to commence in the year of 2005 and the construction works of both river basins are expected to commence in the year of 2007, the annual disbursement is indicated as follows:

Annual Disbursement

(Unit: Million Pesos)

Project	Currency	2004	2005	2006	2007	2008	2009	2010
Bucao	LC	0	65	136	230	191	198	167
	FC	0	45	99	189	124	127	105
	Total	0	110	235	419	315	325	272
Sto. Tomas	LC	0	0	62	258	327	340	240
	FC	0	0	19	147	208	212	146
	Total	0	0	81	405	535	552	386
Total	LC	0	65	198	488	518	538	407
	FC	0	45	118	336	332	339	251
	Total	0	110	316	824	850	877	658

3.4 Project Cost for Non-Structure Measure

(1) Flood/Mudflow Monitoring & Warning System

The flood/mudflow monitoring & warning system consists of (i) 11 stations of observatory system, (ii) 4 sites of monitoring system and (iii) 35 warning posts, of which cost is estimated for the purchase cost and installation cost of equipment. Major equipment to be required for the system includes the following equipment:

Observatory system:	Rainfall gauge
	Water level gauge
	Cellular phone system
	Power supply unit
Monitoring system:	Computer with soft ware
	Cellular phone system
	UPS
Warning post :	Panzer mast
	Siren
	Power supply unit

Based on the prevailing market price of the above equipment, supply and installation cost is estimated at P33,559 thousand in totals, of which breakdown is listed in Table 3.4.1.

For implementation of the project, government administration cost and engineering services cost is estimated at P1,007 thousand and P40,035 thousand, respectively. As shown in Table 3.4.2, thus, total project cost is estimated at P82,061 thousand including 10% of contingency . The detailed calculation of the estimate is presented in the supporting report: Appendix VIII. The project cost is summarized as follows:

(Unit: 1,000 Pesos)

No.	Description	Amount
1	Supply and installation cost	33,559
2	Administration cost	1,007
3	Engineering service cost	40,035
	Sub total	74,601
4	Contingency	7,460
	Total	82,061

(2) Evacuation Center

As discussed in the supporting report: Appendix VIII, thirty six existing schools will be renovated and sixty evacuation centers are scheduled to construct newly dividing into three stages.

Referring to the prevailing price of building construction and land acquisition collected from the district office and similar projects as shown in Table 3.4.3, the construction and renovation cost is estimated at P1,366 million. Table 3.4.4 shows the construction cost summary for the evacuation center.

Based on the construction cost, the project cost is estimated at P1,788 million including the government administration cost, engineering services cost and contingency as shown as follows:

(Unit: 1,000 Pesos)

No.	Description	Amount
1	Construction and renovation cost	1,366,300
2	Administration cost	40,989
3	Engineering service cost	218,608
	Sub total	1,625,897
4	Contingency	162,590
	Total	1,788,487

The detailed calculation of the estimate is described in the supporting report: Appendix VIII.

3.5 Project Cost for Community Based Disaster Prevention and Social Development

(1) Community Based Forest Management

For the cost estimate of the community-based forest management, unit prices per hectare of forest development were collected from the Forest Sector Project and provincial office. Table 3.5.1 shows the eleven kinds of collected unit prices.

Unit prices obtained from the Forest Sector Project is based on the MC2000-19, which is the guideline governing the updating of cost estimates and intensification of plantation maintenance and protection activities for the project in the forest sector. The unit price of provincial office is obtained from the ongoing project.

Referring to the collected unit prices, the plantation cost is estimated at P460 million for forest tree and at P116 million for agro-forestry as shown in Table 3.5.2.

The project cost is given as follows:

(Unit: 1,000 Pesos)

No.	Description	Amount
1	Plantation cost	576,895
2	Administration cost	17,307
3	Engineering service cost	92,303
	Sub total	686,505
4	Contingency	68,651
	Total	755,156

(2) Agriculture Development

Unit prices of land development in Lahar areas, production cost per hectare for seasonal and perennials crops and production cost of mango per hectare are summarized in Table 3.5.3, Table 3.5.4 and Table 3.5.5, respectively, of which detail analysis of unit prices is referred to the report of Agriculture Development Research for Lahar Area.

Estimated construction cost for 1,726 hectares of seven areas is shown in Table 3.5.6.

The project cost is estimated at P701 million as follows:

(Unit: 1,000 Pesos)

No.	Description	Amount
1	Development cost	535,257
2	Administration cost	16,058
3	Engineering service cost	85,641
	Sub total	636,956
4	Contingency	63,696
	Total	700,652

(3) Community Road Rehabilitation

As described in the supporting report: Appendix VII, the community road network is planned to establish three routes as follows:

A line: Along the Bucao River with the length of 48.1 km

B line: Along the Santa Fe River with the length of 14.9 km

C line: Along the Sto. Tomas River, Mapanuepe Lake and Marella River with the length of 44.9 km

Construction works of the above road lines are composed of as follows:

	<u>A line</u>	<u>B line</u>	<u>C line</u>
i) New road construction (km)	26.06	4.64	23.49
ii) Improvement of existing road (km)	22.04	10.26	21.41
iii) Related structures construction			
- Bridge (no)	5	2	2
- Spillway (no)	9	5	10
- Retaining wall (m)	0	0	2900

To estimate the construction cost of the above, referring to the prevailing unit prices of DPWH, unit

prices to be applied are set as follows:

	<u>Applied</u>	<u>Collected</u>
i) New road construction	: P4,200 /m	3,640 (DPWH) 5,777 (Ago II)
ii) Improvement of existing road,		
- Road width, less than 3 m	: P3,800 (90% of i))	
- Road width, more than 3 m	: P3,400 (80% of i))	
iii) Bridge	: P232,000 /m	190,000~280,000 (DPWH)

The construction cost of community road is estimated at P1,149 million of which breakdown is given in Table 3.5.7.

Based on the estimated construction cost, the project cost including government administration cost, engineering services cost and contingency is estimated at P1,821 million for the full development scheme as follows:

Construction Cost for Community Road Rehabilitation (Unit: 1,000 Pesos)		
No.	Description	Amount
1	Construction cost	1,149,038
2	Administration and engineering service cost	344,711
3	Physical contingency	149,374
	Sub total	1,643,124
4	Price Escalation	178,036
	Total	1,821,160

(4) Establishment of Aeta Assistance Station

Unit prices shown in Table 3.5.8 can be applied for the cost estimate of building construction, land preparation, land acquisition and so on for the Aeta Assistance Station as well as the evacuation center construction.

Estimated detailed cost is calculated in Appendix IX and cost summary is shown as follows:

Cost for Establishment of the Aeta Assistance Station (Unit: 1,000 Pesos)		
No.	Description	Amount
1	Construction cost	
	(1) School of upland entrepreneurship	1,135,000.00
	(2) Ancestral land protection development and Management	4,941,606.40
	(3) Aeta cultural heritage	200,000.00
	(4) Aeta health nutrition and livelihood program	983,200.50
	Sub total (1)	7,259,806.90
2	Administration cost	1,074,905.60
3	Engineering service cost	362,990.35
	Sub total (1 to 3)	8,697,702.85
4	Contingency	869,770.29
	Total (1 to 4)	9,567,473.14

3.6 Overall Project Cost

Based on the project plan discussed in the foregoing chapters, overall project cost is estimated at P7,433 million of which breakdown is given in Table 3.6.1.

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Tables

Table 3.2.1 Unit Price of Construction Works

(Unit: Peso)

No.	Description	Unit	Pinatubo Hazerd Urgent Mitigation Project, Phase II										Agno River Flood Control Project, Phase II				Represated Unit Price (Average)	Rasio of LC & FC		Escalated Unit Price		
			P-1		P-3		P-4		P-5		P-6		P-III		P-IV			LC	FC	LC	FC	Total
			Ref. No.	Unit price	Ref. No.	Unit price	Ref. No.	Unit price	Ref. No.	Unit price	Ref. No.	Unit price	Ref. No.	Unit price	Ref. No.	Unit price						
1	Dike and channel works																					
	(1) Demolition of Existing Revetment	m ³								101(1)	1,339.40						1,339	53.36%	46.64%	743.32	637.16	1,380.48
	(2) Clearing & Grabbing, t=20cm	m ²	100(1)	7.31	100(1)	12.23	100(1)	7.03	100(1)	18.10	100(1)	10.74					11	52.87%	47.33%	9.075	7.965	17.04
	(3) Backfilling	m ³	103(7)	109.94			103(7)	24.00									67	52.39%	47.61%	36.51	32.53	69.04
	(4) Excavation	m ³			1701(2)	59.71	102(2)	39.00	1701(2)	61.54	1701(2)	52.95					53	56.24%	43.77%	31	23.66	54.66
	(5) Embankment (Lahar Material)	m ³	104(1)a	131.54	1704(1)	76.30	104(1)a	105.00	1704(1)	113.14	1704(1)	76.77					101	53.51%	46.49%	56.21	47.89	104.10
	(6) Base Concrete	m ³			405(6)	2,820.00	405(6)	2,798.00			405(6)	2,170.59					2,596	64.62%	35.38%	1744.58	936.89	2,681.47
	(7) Wet Stone Masonry, t= 30cm	m ³					504(5)	1,993.00									1,993	54.96%	45.04%	1139.08	915.68	2,054.76
	(8) Covering Borrow Soil, t=50cm	m ³	104(1)b	566.90			104(1)c	248.00									407	55.94%	44.05%	236.79	182.86	419.65
	(9) Gabion Mattress, 0.3x2x6m	m ³	509(C)	2,551.75			509(b)	2,211.00	509(2)	2,052.27	509(2)	1,592.87					2,102	67.18%	32.82%	1468.7	703.59	2,172.29
	(10) Filter Cloth, t= 10mm	m ²	SPL-510D	113.56	SPL-510E	89.59	SPL-510c	95.00	SPL-510C	124.31	SPL-510E	104.51					105	64.30%	35.70%	70.22	38.23	108.45
	(11) Gravel Pavement, t=20cm	m ³	300(2)	862.07	300(1)	452.55	300(2)	607.00	300(1)	961.31	300(2)	767.72					730	58.73%	41.28%	445.91	307.34	753.25
	(12) Sodding	m ²	610	80.92	610	60.74	610	53.00	610	48.88	610	30.44					55	66.88%	33.13%	38.25	18.58	56.83
	(13) Leveling Concrete	m ³			405(6)	2,820.00	405(6)	2,798.00			405(6)	2,170.59					2,596	64.16%	35.84%	1665.54	930.46	2,596.00
	(14) Structure Concrete	m ³	405(1)	3,833.59	405(1)	3,340.00	405(1)	2,985.00			405(1)	3,344.49					3,376	62.25%	37.75%	2101.49	1274.51	3,376.00
	(15) Reinforcing steel bar	ton	404	37,120.00	404	23,000.00	404	23,000.00			404	27,930.00					27,763	47.19%	52.79%	13107.64	14655.81	27,763.00
2	Bridge and Road works																					
	Road																					
	(1) Clearing & Grabbing, t=20cm	m ²				100(1)	7.03						2.1.1	9.40	cw2.2.2	6.64	8	45.22%	54.79%	3.76	4.47	8.23
	(2) Backfilling	m ³				103(7)	55.00						3.2.1.2	61.00	cw2.5	158.99	92	49.24%	50.76%	47.12	47.63	94.75
	(3) Excavation	m ³				102(5)	56.00	103(2)	154.19	103(2)	114.92	2.1.10.1	137.03	cw2.3.4	139.14	120	50.78%	49.23%	63.37	60.26	123.63	
	(4) Embankment (Lahar Material)	m ³				104(1)a	105.00						2.1.3	268.08			187	43.17%	56.84%	83.96	108.41	192.37
	(5) Base Concrete	m ³				405(6)	2,798.00	405(6)	4,381.74	405(6)	2,170.59	2.1.10.3	3,221.02				3,143	67.25%	33.53%	2198.08	1075.05	3,273.13
	(6) Wet Stone Masonry, t=30cm	m ³				504(5)	1,993.00						2.1.7	1,845.97			1,919	65.82%	34.20%	1313.51	669.33	1,982.84
	(7) Covering Borrow Soil, t=50cm	m ³				104(1)c	248.00						2.1.3	268.08	cw6.2.3	695.02	404	51.51%	48.49%	216.42	199.82	416.24
	(8) Gravel Pavement, t=20cm	m ³				300(2)	607.00						2.2.4	486.60	cw6.2.5	752.25	615	54.40%	45.60%	347.94	286.05	633.99
	(9) Sodding	m ²				610	53.00						2.1.8	35.12	cw2.6	73.61	54	57.78%	42.21%	32.45	23.25	55.70
	Superstructure																					
	(1) Steel plate girder	ton													cw8.6.3&4	164,089.81	164,090	38.46%	61.54%	65638.17	102995.91	168,634.08
	(2) Deck slab	m ²													cw10.4.10	8,578.25	8,578	62.25%	37.75%	5553.22	3303.13	8,856.35
	Substructure																					
	(1) Concrete	m ³				405(1)B	5,268.06	405(1)	4,795.56	405(1)	4,220.17				cw3.7(1)	6,356.51	5,160	71.04%	28.96%	3812.29	1524.22	5,336.51
	(2) Reinforcing steel bar	ton				404	23,000.00	404	31,690.00	404	27,360.00				cw3.6(3)	38,857.16	30,227	45.56%	54.44%	14322.59	16784.38	31,106.97
	(3) Cast in place pile, 1.2m Dia.	m				400(16)	33,966.20								cw4.5	44,276.78	39,121	46.03%	53.97%	18726.06	21537.47	40,263.53
	Removal of existing bridge																					
	7m x 35m	m				S2-B	15,186										15,186	53.36%	46.64%	8427.7	7224.1	15,651.80

Note;

1. Source of data

(1) Pinatubo Hazard Urgent Mitigation Project, Phase II

Package 1 : Rehabilitation and Improvement of the Southwest Corner of the Megadike

Package 3 : Improvement of Baluyot Channel

Package 4 : Tail Dike, Evacuation Roads and Gugu Channelization

Package 5 : Dredging in the Delta Area/Pilot Channel Dredging & Third River

Package 6 : Downstream Channel Improvement Passing Sasman

2. Cost of cast in place pile of P-4 includes cost of test and permanent casing piles.

3. Annual inflation rate apply : LC = 4%
FC = 2%

(2) Agno River Flood Control Project, Phase II

Package III : Social Development for Poponto Retarding Basin

Package IV : Hector Mendoza Bridge

Table 3.2.2 Salient Features of Contract Price Obtained from Three Projects

(Unit: Peso)

No.	Description	Time of Bidding	Total Contract Price (P)	Foreign Portion	Local Portion	Amount of Part A (P)	Amount of Part B (P)	General Item /Total A &	% of Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)=(7)+(8)	(10)=((9)/(4)
1	Pinatubo hazard								
	Package I	10-00	456,471,942			8,845,562	2,109,606	10,955,168	2.4%
	Package III	5-01	233,303,765			7,881,268	1,240,661	9,121,928	3.9%
	Package IV	3-01	419,062,732			17,689,502	8,002,648	25,692,150	6.1%
	Package V	5-01	900,245,064			15,274,495	43,155,517	58,430,011	6.5%
	Package VI	5-01	345,430,948			10,249,672	11,471,900	21,721,572	6.3%
	Average % of General Item for Pinatubo project								5.0%
2	Agno I	11-97	1,121,078,114	68%	32%			129,588,188	11.6%
	F.C(P)		762,213,715	68%				86,662,852	
	L.C(P)		322,408,068		29%			32,668,654	
	VAT(P)		36,456,331		3%			10,256,682	
3	Agno II								
	Package III	12-01	496,940,728	1%	99%			33,954,590	6.8%
	F.C(P)		5,511,412	1%				5,511,413	
	L.C(P)		446,735,769		90%			25,838,965	
	VAT(P)		44,693,546		9%			2,604,212	
	Package IV	1-02	726,231,750	56%	44%			58,475,808	8.1%
	F.C(P)		408,371,682	56%				26,618,312	
	L.C(P)		296,473,407		41%			28,427,998	
	VAT(P)		21,386,661		3%			3,429,499	
	Average % of General Item for Agno project								7.4%
	Average % of General Item for the above three project								8.0%

Note;

1. Data of Item 1 are taken from the Monthly Progress Report (No.33).
2. Item 2 and Item 3 are taken from the Contractor's priced Bill of Quantities.
3. Contract prices of Item 1 do not show the foreign and local currency portion and also VAT.
4. General Item of Item 2 and 3 is not divided into Part A and B.

Table 3.2.3 Unit Price for Land Acquisition

No.	Municipality	Barangay	Selling / Buying Rate (Peso/m ²)
1	Botolan	Porac (Residential)	200 - 400
		Carael (Commercial)	750
		San. Juan (Residential)	100 - 150
2	San Marcelino	San Rafael (Residential)	100 - 200
		Rabanes (Agricultural)	200 - 300
		Mangricmot (Agricultural)	100 - 150
3	San Narciso	Alusius (Residential)	150 - 200
		Paite (Residential)	200
		San Pascual (Residential)	200 - 400

Source: Table 8.1.1 of the report of Resettlement Plan, Appendix XI

Table 3.3.1 Construction Cost of Bucao River Basin

(Unit: Peso)																						
	Description	Unit	Work Quantity	Unit Price			Amount			1. Equipment		2. Labor		3. Material		4. VAT		5. Overhead				
				LO	FO	Total	LO	FO	Total			a. Skilled labor	b. Unskilled labor	a. Cement	b. Aggregate	c. Steel	d. Lumber	e. Others				
1	Dike construction																					
1.1	Left bank																					
	i) New dike																					
	General Item	%	10%																			
	Clearing & Grabbing	m2	100.500	9.08	7.97	17.04																
	Backfilling	m3	6.300	36.51	32.53	69.04																
	Excavation	m3	32.700	31.00	23.66	54.66																
	Embankment (Lahar Material)	m3	254.400	51.00	43.00	94.00																
	Base Concrete	m3	1,100	1,744.58	936.89	2,681.47																
	Wet Stone Masonry	m3	9.400	1,139.08	915.68	2,054.76																
	Covering Borrow Soil	m3	31.700	236.79	182.86	419.65																
	Gabion Mattress	m3	4.200	1,468.70	703.59	2,172.29																
	Filter Cloth	m2	13.900	70.22	38.23	108.45																
	Gravel Pavement	m2	2.900	445.91	307.34	753.25																
	Sodding	m2	46.800	38.25	18.58	56.83																
	Sub total (1.1)																					
1.2	Right bank																					
	ii) New dike																					
	General Item	%	10%																			
	Clearing & Grabbing	m2	126.600	9.08	7.97	17.04																
	Backfilling	m3	7.000	36.51	32.53	69.04																
	Excavation	m3	36.900	31.00	23.66	54.66																
	Embankment (Lahar Material)	m3	351.700	51.00	43.00	94.00																
	Base Concrete	m3	1,300	1,744.58	936.89	2,681.47																
	Wet Stone Masonry	m3	11.400	1,139.08	915.68	2,054.76																
	Covering Borrow Soil	m3	40.700	236.79	182.86	419.65																
	Gabion Mattress	m3	4.700	1,468.70	703.59	2,172.29																
	Filter Cloth	m2	15.600	70.22	38.23	108.45																
	Gravel Pavement	m2	3.200	445.91	307.34	753.25																
	Sodding	m2	62.600	38.25	18.58	56.83																
	Sub total (i)																					
	ii) Dike heightening																					
	General Item	%	10%																			
	Demolition of Existing Revetment	m3	28.300	743.32	637.16	1380.48																
	Clearing & Grabbing	m2	471.500	9.08	7.97	17.04																
	Backfilling	m3	22.100	36.51	32.53	69.04																
	Excavation	m3	156.400	31.00	23.66	54.66																
	Embankment (Lahar Material)	m3	1,189.200	62.33	52.56	114.89																
	Base Concrete	m3	3.900	1,744.58	936.89	2,681.47																
	Wet Stone Masonry	m3	44.300	1,139.08	915.68	2,054.76																
	Covering Borrow Soil	m3	154.600	236.79	182.86	419.65																
	Gabion Mattress	m3	14.800	1,468.70	703.59	2,172.29																
	Filter Cloth	m2	49.200	70.22	38.23	108.45																
	Gravel Pavement	m3	9.900	445.91	307.34	753.25																
	Sodding	m2	245.000	38.25	18.58	56.83																
	Sub total (ii)																					
	iii) Spur dike																					
	General Item	%	10%																			
	Demolition of Existing Revetment	m3	400	743.32	637.16	1380.48																
	Clearing & Grabbing	m2	7.400	9.08	7.97	17.04																
	Backfilling	m3	1.200	36.51	32.53	69.04																
	Excavation	m3	7.600	31.00	23.66	54.66																
	Embankment (Lahar Material)	m3	8.000	51.00	43.00	94.00																
	Base Concrete	m3	8.000	1,744.58	936.89	2,681.47																
	Wet Stone Masonry	m3	2.400	1,139.08	915.68	2,054.76																
	Covering Borrow Soil	m3	0	236.79	182.86	419.65																
	Gabion Mattress	m3	8.000	1,468.70	703.59	2,172.29																
	Filter Cloth	m2	2.700	70.22	38.23	108.45																
	Gravel Pavement	m3	0	445.91	307.34	753.25																
	Sodding	m2	0	38.25	18.58	56.83																
	Sub total (iii)																					
	Sub total (1.2)																					
	Total (1)																					
2	Division channel of swampy area																					
2.1	Open channel																					
	General Item	%	10%																			
	Clearing & Grabbing	m²	25.700	9.08	7.97	17.04																
	Backfilling	m³	0	36.51	32.53	69.04																
	Excavation	m³	21.400	31.00	23.66	54.66																
	Embankment (Borrow Soil)	m³	39.700	236.79	182.86	419.65																
	Wet Stone Masonry	m³	7.700	1,139.08	915.68	2,054.76																
	Sodding	m²	30.300	38.25	18.58	56.83																
	Sub total (2.1)																					
2.2	Box culvert																					

Table 3.3.2 Construction Cost of Sto. Tomas River Basin

(Unit: Peso)

	Description	Unit	Work Quantity	LC	FC	Total	LC	Amount	FC	Total	1. Equipment	2. Labor		3. Material			4. VAT		5. Overhead						
												a. Skilled labor	b. Unskilled labor	a. Cement	b. Aggregate	c. Steel	d. Lumber	e. Others							
1	Dike construction																								
1.1	Left bank																								
	i) Dike strengthening																								
	General Item	%	10%				17,250,812	12,796,779	30,047,591	0.1	8,600,273.71	0.1	985,626.43	0.1	1,102,600.53	0.1	0.00	0.1	0.00	0.1	13,442,560.70	0.1	1,061,203.36	0.1	4,849,457.94
	Demolition of Existing Revetment	m3	10,900	743.32	637.16	1,380.48	8,102,188	6,945,044	15,047,232	0.5234	7875721.229	0.047	704210.4576	0.008	126396.7488	0	0	0	0	0.2	3009446.4	0.05	812550.528	0.164	2460222.432
	Clearing & Grabbing	m2	612,100	9.08	7.97	17.04	5,554,808	4,875,377	10,430,184	0.6151	6415606.178	0.063	657101.592	0.044	455799.0408	0	0	0	0	0.08	870920.364	0.07	750973.248	0.123	1279783.577
	Backfilling	m3	8,300	36.51	32.53	69.04	303,033	269,999	573,032	0.6801	389719.0632	0.018	10028.06	0.071	40627.9688	0	0	0	0	0	0	0.08	44008.8576	0.155	88648.0504
	Excavation	m3	403,400	31.00	23.66	54.66	12,505,400	9,544,444	22,049,844	0.5103	11252035.39	0.075	1662558.238	0.033	732054.8208	0	0	0	0	0.16	3545614.915	0.06	1364885.344	0.158	3492695.29
	Embankment (Lahar Material)	m3	569,100	56.21	47.89	104.10	31,989,111	27,254,199	59,243,310	0.5812	34432211.77	0.043	2541537.999	0.036	12150532.153	0	0	0	0	0.12	6878148.291	0.07	3910058.46	0.158	9330821.325
	Base Concrete	m3	1,500	1,744.58	936.89	2,681.47	2,616,870	1,405,335	4,022,205	0.0131	52690.8855	0.011	43842.0345	0.109	438018.1245	0	0	0	0	0.69	2772505.907	0.01	53495.3265	0.165	661652.7225
	Wet Stone Masonry	m3	8,200	1,139.08	915.68	2,054.76	9,340,456	7,508,576	16,849,032	0.0026	43807.4832	0.084	1417003.591	0.006	1118775.725	0	0	0	0	0.67	11246728.86	0.02	257790.1896	0.164	2764926.151
	Covering Borrow Soil	m3	283,800	236.79	182.86	419.65	67,201,002	51,895,668	119,096,670	0.1874	22318715.96	0.002	178645.005	0.009	1012321.695	0	0	0	0	0.62	73685109.73	0.02	2346204.399	0.164	19555673.21
	Gabion Mattress	m3	5,600	1,468.70	703.59	2,172.29	8,224,720	3,940,104	12,164,824	0.0423	514572.0552	0.067	818692.6552	0.097	1177554.963	0	0	0	0	0.6	7263616.41	0.02	250595.3744	0.176	2139792.542
	Filter Cloth	m2	18,500	70.22	38.23	108.45	1,299,070	707,255	2,006,325	0.008	16050.6	0.042	83864.385	0.069	138035.16	0	0	0	0	0.7	1410045.21	0.01	23875.2675	0.167	334454.3775
	Gravel Pavement	m3	14,300	445.91	307.34	753.25	6,376,513	4,394,962	10,771,475	0.0953	1026521.568	0.022	240203.8925	0.012	133566.29	0	0	0	0	0.69	7453860.7	0.01	140029.175	0.165	1777293.375
	Sodding	m2	496,600	38.25	18.58	56.83	18,994,950	9,226,828	28,221,778	0.059	1665084.902	0.053	1498576.412	0.124	3502322.65	0	0	0	0	0.58	16289610.26	0.02	657567.4274	0.163	4608616.347
	Sub total (i)						189,758,933	140,764,870	330,523,802		94,603,011		10,841,891		12,128,606		0	0	0		147,868,168		11,673,237		53,344,037
	ii) Dike heightening																								
	General Item	%	10%				21,350,638	15,724,113	37,074,751	0.1	8600273.709	0.1	1,777,528.83	0.1	1,730,750.03	0.1	0.00	0.1	0.00	0.1	17,367,450.50	0.1	1,220,144.45	0.1	6,054,079.84
	Demolition of Existing Revetment	m3	37,200	743.32	637.16	1,380.48	27,651,504	23,702,352	51,353,856	0.5234	26878608.23	0.047	2403360.461	0.008	431372.3904	0	0	0	0	0.2	10270771.2	0.05	2773108.224	0.164	8396355.456
	Clearing & Grabbing	m2	414,500	9.08	7.97	17.04	3,761,588	3,301,493	7,063,080	0.6151	4344500.508	0.063	444974.04	0.044	308656.596	0	0	0	0	0.08	589767.18	0.07	508541.76	0.123	866639.916
	Backfilling	m3	26,700	36.51	32.53	69.04	974,817	868,551	1,843,368	0.6801	1253674.577	0.018	32258.94	0.071	130694.7912	0	0	0	0	0	0	0.08	141570.6624	0.155	285169.0296
	Excavation	m3	316,700	31.00	23.66	54.66	9,817,700	7,493,122	17,310,822	0.5103	8833712.467	0.075	1305235.979	0.033	574719.2904	0	0	0	0	0.16	2783580.178	0.06	1071539.882	0.158	2742034.205
	Embankment (Lahar Material)	m3	498,800	56.21	47.89	104.10	28,037,548	23,887,532	51,925,080	0.5812	30178856.5	0.043	2227585.932	0.036	1884880.404	0	0	0	0	0.12	6028501.788	0.07	3427055.28	0.158	8178200.1
	Base Concrete	m3	4,700	1,744.58	936.89	2,681.47	8,199,526	4,403,383	12,602,909	0.0131	165098.1079	0.011	137371.7081	0.109	1372456.79	0	0	0	0	0.69	8687185.174	0.01	167618.6897	0.165	2073178.531
	Wet Stone Masonry	m3	41,500	1,139.08	915.68	2,054.76	47,271,820	38,000,720	85,272,540	0.0026	221708.604	0.084	7171420.614	0.066	5662096.656	0	0	0	0	0.67	56919420.45	0.02	1304669.862	0.164	13993223.81
	Covering Borrow Soil	m3	173,800	236.79	182.86	419.65	41,154,102	31,781,068	72,935,170	0.1874	13668050.86	0.002	109402.755	0.009	619948.945	0	0	0	0	0.62	45124989.68	0.02	1436822.849	0.164	11975954.91
	Gabion Mattress	m3	17,900	1,468.70	703.59	2,172.29	26,289,730	12,594,261	38,883,991	0.0423	1644792.819	0.067	2616892.594	0.097	3763970.329	0	0	0	0	0.6	23217631.03	0.02	801010.2146	0.176	683964.017
	Filter Cloth	m2	59,400	70.22	38.23	108.45	4,171,068	2,270,862	6,441,930	0.008	51535.44	0.042	269272.674	0.069	443204.784	0	0	0	0	0.7	4527388.404	0.01	76658.967	0.167	1073869.731
	Gravel Pavement	m3	11,900	445.91	307.34	753.25	5,306,329	3,657,346	8,963,675	0.0953	854238.2275	0.022	199889.9525	0.012	111149.57	0	0	0	0	0.69	6202863.1	0.01	116527.775	0.165	1479006.375
	Sodding	m2	284,200	38.25	18.58	56.83	10,870,650	5,280,436	16,151,086	0.059	952914.074	0.053	857622.6666	0.124	2004349.773	0	0	0	0	0.58	9322406.839	0.02	376320.3038	0.163	2637472.344
	Sub total (ii)						234,857,020	172,965,238	407,822,258	3.3178	89047690.41	0.527	17775288.32	0.678	17307500.32	0	0	0	0	5.11	173674505	0.45	12201444.47	1.921	60540798.43
	Sub total (1.1)						424,615,952	313,729,808	738,345,760	3.3178	183650701.2	0.527	28617179.07	0.678	29436106.19	0	0	0	0	5.11	321542672.8	0.45	23874681.43	1.921	113884835.8
1.2	Right bank																								

Table 3.3.3 Summary of Cost for Land Acquisition and Compensation

(Unit: Peso)

Description	Bucao R.B	Sto. Tomas River Basin				Total
	Botolan	S. Marcelino	S. Felipe	S. Narciso	Sub total	
1 Land	34,807,300.00	4,750,000.00	1,125,000.00	4,735,944.00	10,610,944.00	45,418,244.00
2 House	3,264,402.70	2,184,177.02	9,109.16	407,077.26	2,600,363.44	5,864,766.14
3 Structure						
(1) Business establishments	973,657.79				0.00	973,657.79
(2) Rest house	150,719.43	6,599.49	1,115.41	2,974.42	10,689.32	161,408.75
(3) Kitchen	1,161.88	3,392.69			3,392.69	4,554.57
(4) Toilet	36,111.32	7,319.86			7,319.86	43,431.18
(5) Storage	27,885.19				0.00	27,885.19
(6) Deepwell	15,000.00	30,000.00	15,000.00		45,000.00	60,000.00
(7) Piggins	16,173.42	27,885.18		6,692.44	34,577.62	50,751.04
Sub total (3)	1,220,709.03	75,197.22	16,115.41	9,666.86	100,979.49	1,321,688.52
4 Trees	5,234,602.38	7,046,580.13	201,330.86	3,422,624.63	10,670,535.62	15,905,138.00
5 Disturbance compensation	351,000.00	472,500.00	13,500.00	229,500.00	715,500.00	1,066,500.00
Total (1 to 5)	44,878,014.11	14,528,454.37	1,365,055.43	8,804,812.75	24,698,322.55	69,576,336.66
6 Additional Land & House compensation(*1)	0.00	13,289,890.00	0.00	0.00	13,289,890.00	13,289,890.00
7 Total (1 to 6)	44,878,014.11	27,818,344.37	1,365,055.43	8,804,812.75	37,988,212.55	82,866,226.66

Source: The report of Resettlement Plan in the appendix XI

Note: (*1) Additional compensation at Barangay San Rafael of 23 families, which newly resettled after February 2003.

Table 3.3.4 Project Cost of Bucao River Basin

(Unit: x1000 Peso)

(Unit: x 1000 Peso)

No.	Description	LC	FC	Total	2003		2004		2005		2006		2007		2008		2009		2010	
					LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC
1	Construction Cost																			
	(1) Diike Construction	395,714	294,910	690,624																
	(2) Maintenance road	1,568	1,222	2,790																
	Sub total ((1) to (2))	397,282	296,132	693,414	0	0	0	0	0	0	0	0	59,592	44,420	119,185	88,840	119,185	88,840	99,321	74,033
	(3) Bucao bridge replacement																			
	i) General item	14,000	17,008	31,008	0	0	0	0	11,200	13,606	1,400	1,701	1,400	1,701	0	0	0	0	0	0
	ii) Super structure	84,949	116,975	201,924	0	0	0	0	0	0	25,485	35,093	59,464	81,883	0	0	0	0	0	0
	iii) Substructure	46,882	44,646	91,529	0	0	0	0	14,065	13,394	32,817	31,252	0	0	0	0	0	0	0	0
	iv) Approach road	5,332	5,978	11,310	0	0	0	0	0	0	0	0	5,332	5,978	0	0	0	0	0	0
	v) Removal of existing bridge	2,836	2,479	5,315	0	0	0	0	0	0	0	0	2,836	2,479	0	0	0	0	0	0
	Sub total (1)	551,281	483,219	1,034,500	0	0	0	0	25,265	27,000	59,702	68,046	128,625	136,460	119,185	88,840	119,185	88,840	99,321	74,033
2	Land acquisition and compensation cost	44,878	0	44,878	0	0	0	0	8,976	0	22,439	0	13,463	0	0	0	0	0	0	0
3	Administration cost	31,035	0	31,035	0	0	0	0	4,655	0	6,207	0	7,759	0	4,655	0	4,655	0	3,104	0
4	Engineering services cost	88,205	77,315	165,520	0	0	0	0	13,231	11,597	17,641	15,463	22,051	19,329	13,231	11,597	13,231	11,597	8,821	7,732
	Sub total (1 to 4)	715,399	560,534	1,275,933	0	0	0	0	52,126	38,597	105,989	83,509	171,898	155,789	137,071	100,437	137,071	100,437	111,245	81,765
5	Price contingency	182,428	67,101	249,529	0	0	0	0	6,509	2,362	18,003	6,884	37,242	16,215	36,367	12,671	43,305	14,934	41,001	14,036
6	Physical contingenc 10%	89,783	62,763	152,546	0	0	0	0	5,863	4,096	12,399	9,039	20,914	17,200	17,344	11,311	18,038	11,537	15,225	9,580
	Total (1 to 6)	987,609	690,399	1,678,008	0	0	0	0	64,498	45,056	136,391	99,432	230,054	189,204	190,782	124,419	198,413	126,907	167,470	105,380

X-T8

X-T8

X-T8

X-T8

Table 3.3.6 Disbursement Schedule of Bucao River Basin

(Unit: x 1000 Peso)

No.	Description	LC	FC	Total	2003		2004		2005		2006		2007		2008		2009		2010	
					LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC
1	Construction Cost																			
	(1) Dike Construction	395,714	294,910	690,624																
	(2) Maintenance road	1,568	1,222	2,790																
	Sub total ((1) to (2))	397,282	296,132	693,414	0	0	0	0	0	0	0	0	59,592	44,420	119,185	88,840	119,185	88,840	99,321	74,033
	(Annual progress rate)												0.15	0.15	0.3	0.3	0.3	0.3	0.25	0.25
	(3) Bucao bridge replacement																			
	i) General item	14,000	17,008	31,008	0	0	0	0	11,200	13,606	1,400	1,701	1,400	1,701	0	0	0	0	0	0
	(Annual progress rate)								0.8	0.8	0.1	0.1	0.1	0.1						
	ii) Super structure	84,949	116,975	201,924	0	0	0	0	0	0	25,485	35,093	59,464	81,883	0	0	0	0	0	0
	(Annual progress rate)										0.3	0.3	0.7	0.7						
	iii) Substructure	46,882	44,646	91,529	0	0	0	0	14,065	13,394	32,817	31,252	0	0	0	0	0	0	0	0
	(Annual progress rate)								0.3	0.3	0.7	0.7								
	iv) Approach road	5,332	5,978	11,310	0	0	0	0	0	0	0	0	5,332	5,978	0	0	0	0	0	0
	(Annual progress rate)												1	1						
	v) Removal of existing bridge	2,836	2,479	5,315	0	0	0	0	0	0	0	0	2,836	2,479	0	0	0	0	0	0
	(Annual progress rate)												1	1						
	Sub total (I)	551,281	483,219	1,034,500	0	0	0	0	25,265	27,000	59,702	68,046	128,625	136,460	119,185	88,840	119,185	88,840	99,321	74,033
2	Land acquisition and compensation cost	44,878	0	44,878	0	0	0	0	8,976	0	22,439	0	13,463	0	0	0	0	0	0	0
	(Annual progress rate)								0.2		0.5		0.3							
3	Administration cost	31,035	0	31,035	0	0	0	0	4,655	0	6,207	0	7,759	0	4,655	0	4,655	0	3,104	0
	(Annual progress rate)								0.15		0.2		0.25		0.15		0.15		0.1	
4	Engineering services cost	88,205	77,315	165,520	0	0	0	0	13,231	11,597	17,641	15,463	22,051	19,329	13,231	11,597	13,231	11,597	8,821	7,732
	(Annual progress rate)								0.15	0.15	0.2	0.2	0.25	0.25	0.15	0.15	0.15	0.15	0.1	0.1
	Sub total (1 to 4)	715,399	560,534	1,275,933	0	0	0	0	52,126	38,597	105,989	83,509	171,898	155,789	137,071	100,437	137,071	100,437	111,245	81,765
5	Price contingency	182,428	67,101	249,529	0	0	0	0	6,509	2,362	18,003	6,884	37,242	16,215	36,367	12,671	43,305	14,934	41,001	14,036
	LC : 4% FC: 2%				0.0400	0.0200	0.0816	0.0404	0.1249	0.0612	0.1699	0.0824	0.2167	0.1041	0.2653	0.1262	0.3159	0.1487	0.3686	0.1717
6	Physical contingency : 10%	89782.67	62763.44	152546.11	0	0	0	0	5,863	4,096	12,399	9,039	20,914	17,200	17,344	11,311	18,038	11,537	15,225	9,580
	Total (1 to 6)	987,609	690,399	1,678,008	0	0	0	0	64,498	45,056	136,391	99,432	230,054	189,204	190,782	124,419	198,413	126,907	167,470	105,380
				1,678,008																

Table 3.3.7 Disbursement Schedule of Sto. Tomas River Basin

(Unit: x 1,000 Peso)

No.	Description	LC	FC	Total	2003		2004		2005		2006		2007		2008		2009		2010	
					LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC
1	Construction Cost																			
	(1) Dike Construction	648,484	477,115	1,125,598																
	(2) Diversion channel of the Gabor Riv	36,875	26,664	63,539																
	(3) Maintenance road	1,685	1,306	2,991																
	Sub total (1)	687,044	505,085	1,192,128	0	0	0	0	0	0	0	0	137,409	101,017	206,113	151,526	206,113	151,526	137,409	101,017
	(Annual progress rate)												0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2
2	Land acquisition and compensation co	37,988	0	37,988	0	0	0	0	0	0	18,994	0	18,994	0	0	0	0	0	0	0
	(Annual progress rate)										0.5		0.5							
3	Administration cost	35,764	0	35,764	0	0	0	0	0	0	7,153	0	8,941	0	7,153	0	7,153	0	5,365	0
	(Annual progress rate)										0.2		0.25		0.2		0.2		0.15	
4	Engineering services cost	109,927	80,814	190,741	0	0	0	0	0	0	21,985	16,163	27,482	20,204	21,985	16,163	21,985	16,163	16,489	12,122
	(Annual progress rate)										0.2	0.2	0.25	0.25	0.2	0.2	0.2	0.2	0.15	0.15
	Sub total (1 to 4)	870,723	585,899	1,456,621	0	0	0	0	0	0	48,132	16,163	192,826	121,221	235,251	167,688	235,251	167,688	159,262	113,139
5	Price contingency	245,391	79,459	324,850	0	0	0	0	0	0	8,176	1,332	41,776	12,617	62,417	21,156	74,323	24,933	58,699	19,421
	LC : 4% FC: 2%				0.0400	0.0200	0.0816	0.0404	0.1249	0.0612	0.1699	0.0824	0.2167	0.1041	0.2653	0.1262	0.3159	0.1487	0.3686	0.1717
6	Physical contingency : 10%	111,611	66,536	178,147.24	0	0	0	0	0	0	5,631	1,750	23,460	13,384	29,767	18,884	30,957	19,262	21,796	13,256
	Total (1 to 6)	1,227,726	731,894	1,959,619	0	0	0	0	0	0	61,939	19,245	258,062	147,221	327,435	207,729	340,532	211,883	239,758	145,817

**Table 3.4.1 Summary of Supply and Installation Cost
for Flood/Mudflow Monitoring & Warning System**

(Unit : Peso)

No.	Description	Unit	Quantity	Amount
1	Observatory system (11 stations)			
	(1) Equipment purchase cost	lot	1	10,081,883
	(2) Installation cost	%	15%	1,512,282
	Sub total (1)			11,594,166
2	Monitoring system (4 sites)			
	(1) Equipment purchase cost	lot	1	7,022,595
	(2) Installation cost	%	10%	702,259
	(3) Vehicle for maintenance	no	1	1,856,540
	Sub total (2)			9,581,395
3	Warning post (35 posts)			
	(1) Equipment purchase cost	lot	1	11,257,595
	(2) Installation cost	%	10%	1,125,759
	Sub total (3)			12,383,354
	Total (1 to 3)			33,558,915
	Equivalent in JPY, P1.0 = JPY 2.37			79,534,627

Table 3.4.2 Project Cost for Flood/Mudflow Monitoring & Warning System

(Unit : Thousand Peso)

No.	Description	Amount
1	Supply and installation cost for Flood/Mudflow Monitoring & Warning System	33,559
2	Government administration cost 3%	1,007
3	Engineering service cost	
	(i) Remuneration, 35M/M x JPY2,500,000	36,920
	(ii) Direct cost, 20% of (i)	3,116
	Sub total (3)	40,035
	Sub total (1 to 3)	74,601
4	Contingency 10%	7,460
	Total (1 to 4)	82,061

Table 3.4.3 Unit Price for Evacuation Center Construction

No.	Description	Unit	Quantity	Total Cost (P)	Unit Price
(1)	(2)	(3)	(4)	(5)	(6)=(5)/(4)
Local Base (Obtained from Provincial Office)					
1	One family dwelling				
	IA : Reinforced concrete, steel truss, concrete/masonry wall	m ²			7,370
	IA : Reinforced concrete, steel truss, concrete hollow block wall	m ²			6,530
	IA : Reinforced concrete, 1st wood truss, concrete hollow block wall	m ²			5,040
2	School building				
	IA : Reinforced concrete, steel truss, concrete/masonry wall	m ²			6,340
	IA : Reinforced concrete, steel truss, concrete hollow block wall	m ²			5,940
	IA : Reinforced concrete, 1st wood truss, concrete hollow block wall	m ²			4,960
3	Condominium, Hotel, Bank, Hospital, Office				
	IA : Reinforced concrete, steel truss, concrete/masonry wall	m ²			7,810
	IA : Reinforced concrete, steel truss, concrete hollow block wall	m ²			6,530
	IA : Reinforced concrete, 1st wood truss, concrete hollow block wall	m ²			5,600
Local Base (Obtained from Agno II Project)					
1	Provincial road paved with 3.05m wide concrete, W=10.1m	m	6,660	55,124,779	8,277
2	Barangay road paved with gravel , W=5m	m	12,092	69,860,618	5,777
3	Mound dike (Embankment)	m ²	113,000	53,480,197	473
4	Evacuation center building : Reinforced concrete, 2 floor	m ²	25,300	270,516,025	10,692
	Foundation pile works	m ²	11,725	16,212,520	1,383
	Evacuation center building without foundation pile	m ²	13,575	136,449,410	10,052
	Evacuation center building with foundation pile	m ²	11,725	134,066,614	11,434
JICA Base (Obtained from Vietnam project)					
1	Training center building : Reinforced concrete, 3 floor with foundation pile	m2	1,598	127,763,713	79,952
Unit Price for Land Acquisition (Prevailing market price)					
No.	Municipality	Barangay		Selling / Buying Rate (Peso/m2)	
1	Botolan	Porac (Residential)		200 - 400	
		Carael (Commercial)		750	
		San. Juan (Residential)		100 - 150	
2	San Marcelino	San Rafael (Residential)		100 - 200	
		Rabanes (Agricultural)		200 - 300	
		Mangricmot (Agricultural)		100 - 150	
3	San Narciso	Alusius (Residential)		150 - 200	
		Paite (Residential)		200	
		San Pascual (Residential)		200 - 400	
(Source: Table 8.1.1 of the report of Resettlement Plan, Appendix XI)					

Table 3.4.4 Summary of Construction Cost of Schools for Evacuation

(Unit : Thousand Peso)

No.	Description	Number of School	Amount
1	Renovation of existing school	35	178,700
2	New construction		
	(1) Initial stage	10	143,700
	(2) Middle term stage	22	442,500
	(3) Long term stage	28	601,400
	Sub total (2)	60	1,187,600
	Total (1 to 2)	95	1,366,300

Note: 1. Land acquisition cost is included in the above construction cost.

Table 3.5.1 Unit Price for Forest Management

(Unit : Peso/Hectare)

No.	Description	Standard Unit Price Estimated by Forest Sector Project										Provincial Office	
		Forest tree (Gmelina, Mangium, Eucalyptus, Falcata)		Agroforestry : (a) Agroforest tree & Other tree (b)				Silvopasture				"Adopt Mountain Project" (Botolan)	
		spacing 5 x 2	4 x 4	(a)10x10 (b) 2x2	(a) 6x6 (b) 6x6	(a) 4x4	3x3 (Coffee)	Grass & Legume		Grass & Hedgerow		Total Cost	Per ha
w/o fence	w/ fence	w/o fence	w/ fence										
A	Operation Cost												
1	Nursery operation	3,639.36	2,395.54	9,639.36	9,577.16	2,395.54	3,874.57	8,059.70	8,059.70	8,509.70	8,509.70	1,468,400.00	8,157.78
2	Plantation Establishment	4,875.00	3,121.88	6,372.76	5,507.95	3,785.63	6,442.22	7,040.75	7,040.75	7,032.33	7,246.72	1,337,580.00	7,431.00
3	Maintenance & protection	18,107.31	12,186.67	17,885.61	14,211.54	16,591.96	24,312.79	10,168.43	10,678.43	13,894.13	15,765.44	713,142.50	3,961.90
4	Infrastructure	1,043.83	1,043.83	1,043.83	1,043.83	1,043.83	1,043.83	113.33	113.33	113.33	113.33	242,000.00	1,344.44
5	Establishment of live fence								2,699.98				
	Sub total (A)	27,665.50	18,747.92	34,941.56	30,340.48	23,816.96	35,673.41	25,382.21	28,592.19	29,549.49	31,635.19	3,761,122.50	20,895.13
B	Project Management	2,213.24	1,499.83	2,795.32	2,427.24	1,905.36	2,853.87	2,030.58	2,287.38	2,363.96	2,530.82	450,000.00	2,500.00
	(8% of A)												
	Grand Total (A + B)	29,878.74	20,247.75	37,736.88	32,767.72	25,722.32	38,527.28	27,412.79	30,879.57	31,913.45	34,166.01	4,211,122.50	23,395.13

Note;

- 1 Standard Unit Price Estimated by Forest Sector Project is based on the MC2000-19 which is the guidelines governing the updating of cost estimates and intensification of plantation maintenance and protection activities for the project in the forestry sector.
- 2 Cost of establishment of live fence for Grass and Hedgerow is included in the cost of Item 2 and Item 3.
- 3 Adopt Mountain Project is scheduled to carry out under the provincial office from 2003 to 2007.
- 4 Plants of Adopt Mountain Project are Mahogany, Gmelina, Eucalyptus and fruit trees including Mango and Cashew.

Table 3.5.2 Plantation Cost for Forest Management

Unit: Pesos

No.	Description	Quantity (ha)	Unit Price	Amount
1	Tree plantation	18,370	25,064	460,425,680
2	Agro-forestry			
	(1) Mango	1,470	31,701	46,600,470
	(2) Cashew	1,102	31,701	34,934,502
	(3) Corn	1,102	31,701	34,934,502
	Total (2)			116,469,474
	Grand Total (1 to 2)			576,895,154

Table 3.5.3 Summary of Unit Prices of Land Development for Agriculture in Lahar Areas

Unit: Pesos/ha

Item	Description	Option		
		A	B	C
1	Development areas with no plants			
	(1) Land development	16,500	10,500	7,500
	(2) Soil improvement	5,200	2,700	1,500
	(3) Fertilizer provision	9,980	7,480	6,000
	(4) Water supply	59,500	41,500	30,500
	(5) Cropping pattern	27,542	12,476	13,956
	Total	118,722	74,656	59,456
2	Development areas with pioneer plants			
	(1) Land development	14,000	9,500	6,500
	(2) Soil improvement	5,200	2,700	1,700
	(3) Fertilizer provision	9,980	7,480	4,000
	(4) Water supply	59,500	41,500	30,500
	(5) Cropping pattern	27,542	12,476	12,476
	Total	116,222	73,656	55,176
3	Development for cultivated areas			
	(1) Land development	1,500	1,500	1,500
	(2) Soil improvement	3,500	6,300	6,300
	(3) Fertilizer provision	9,980	13,840	17,720
	(4) Water supply	500	500	500
	(5) Cropping pattern	27,542	39,587	33,292
	Total	43,022	61,727	59,312

Table 3.5.4 Production Cost of Seasonal and Perennial Crops per Hectare

Unit: Pesos/ha

Item	Description	Labor cost	Material cost	Tool & Equipment cost	Total
A	Seasonal and medium term				
1	Rice - direct seeded	5,750	14,206	0	19,956
2	Corn	10,925	16,048	0	26,973
3	Sweet potato	11,325	22,416	0	33,741
4	Mungbean	12,200	5,366	0	17,566
5	Peanut	14,825	7,790	0	22,615
6	Watermelon	12,250	15,792	0	28,042
7	Squash	13,350	17,706	0	31,056
8	Tomato	19,675	29,754	0	49,429
9	Garlic	27,750	60,250	0	88,000
10	Onion	43,750	35,306	0	79,056
11	Cassava	20,600	13,920	0	34,520
12	Gabi	10,125	10,800	0	20,925
B	Perennials				
13	Banana				
	1 year	21,150	34,060	6,200	61,410
	2 year	7,750	12,580	0	20,330
	3 year	7,750	12,580	0	20,330
	4 year	7,750	37,699	0	45,449
	5 year	7,750	62,818	0	70,568
	Total	52,150	159,737	6,200	218,087
14	Pineapple				
	1 year	40,500	23,800	6,600	70,900
	2 year	42,250	9,810	0	52,060
	3 year	6,250	1,010	0	7,260
	4 year	40,500	8,800	0	49,300
	5 year	46,750	9,810	0	56,560
	6 year	6,250	1,010	0	7,260
	Total	182,500	54,240	6,600	243,340
15	Papaya				
	1 year	19,475	49,600	5,700	74,775
	2 year	24,500	11,980	0	36,480
	3 year	24,500	11,980	0	36,480
	4 year	24,500	11,980	0	36,480
	5 year	24,500	11,980	0	36,480
	Total	117,475	97,520	5,700	220,695