3 EXISTING BANK PROTECTION WORK

3.1 Around Vientiane City

Bank protection works along the Mekong River around Vientiane City have been implemented since early 1990s as shown in Figure 3.1. Most of the protection works were done by using gabion and Reno mattresses as shown in Table 3.1.

At some locations, the rip-rap work for the bank protection was introduced at Khuy Daene Manh and at Kao Liao Port. At Khuy Daene Manh, granite is used at upper part of the slope and other rock consists of mainly sandstone. Sedimentation is found partly on the slope of the riverbank protection work as shown in Table 3.2.

At Wat Sibounheuang, a new method using Soda mattress using combination of natural wooden material, that is, Soda (fascine) and stone, has been tested. Soda mattresses are used for foot protection work. Slope protection is done by 1) Wooden pile hurdle work and 2) Gabion works. Monitoring has been done since completion of the work in 2001 – 2002. Those are intended to realize a low cost and sustainable bank protection work in Lao P.D.R.
At almost a year has been passed since its completion, some amounts of silt sediment are found especially around the lower hurdle works resulting 0.3m – 0.7m thickness as shown in Table 3.2.

At Hatdokkeo, severely damaged is the bank protection work using Reno mattresses as shown in Table 3.2. At upper reach of the bank protection work, Reno mattresses at the toe of the slope are damaged and stones in the net-cage are lost, resulting a steep slope of toe without being protected. Sand excavation works up-stream and down stream of the site have been done, which might have possibility of influencing the riverbed degradation in front of the work.

Total length of bank protection works necessary is still less than required, by compared with Thai side riverbank protection works.

As for gabion and Reno mattress works, at many locations, silt deposits with partly covered by vegetation of willow trees and similar kinds are found, but some of wire nets has been corroded to become thin and partly damaged in a long period after construction.
Those are to be taken into consideration in other planning and design of river protection works.

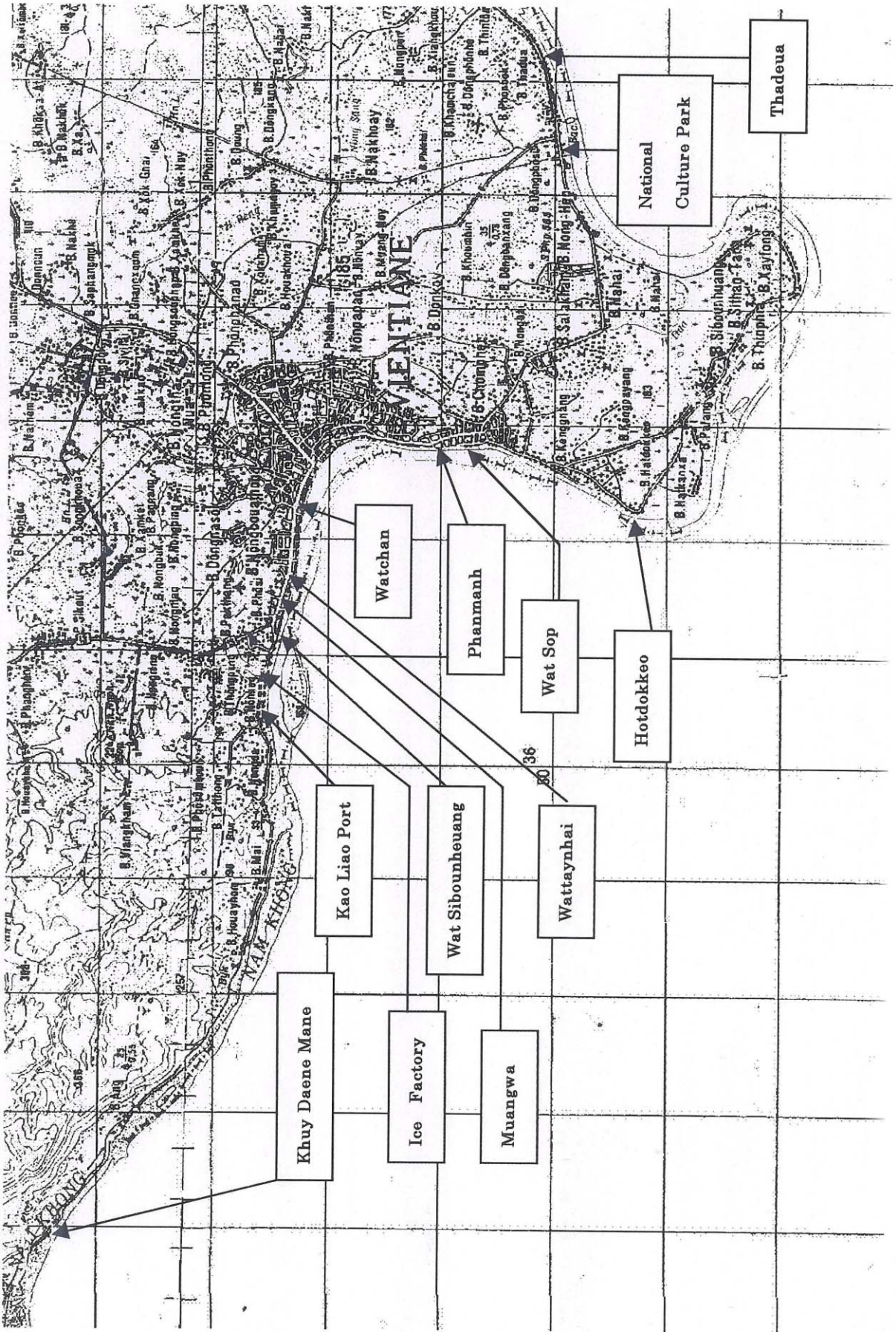


Figure 3.1 Location of Existing River Bank Protection Work along the Mekong River around Vientiane City

Table 3.1 (1/3) Existing Riverbank Protection Works (Thadeua – Wat Thampha)

(As of January, 2004)

No.	Facility	Location	Constructed Year	Length (m)	Type	Condition	Source of Fund	Remark
1	DCTPC B.P. (Thadua)	0.00 km to 0.50 km At L.end N 17°53.327, E 102°44.291	1989/90 1992/93	500	Gabion w/ Reno mattress on the lower and upper slopes	Good w/sedmentation and vegetation	MRC/ Australia	1989/90: 250m 1992/93: 250m
2	Thanaleng Port	1.63 km to 1.84 km At L.end N 17°53.072, E 102°43.419		210	Concrete works w/rip-rap	Minor damages at the foot of slope.	-	
3	B.P. for Friendship Br. (Thanaleng)	2.45 km to 2.88 km At L.end N 17°52.996, E 102°42.935	1993/94	430	Reno mattress on the slope	Good w/sedmentation and vegetation	Australia	
4	JICA Pilot B.P. (Ban Dongphosi)	2.88 km to 3.53 km At L.end N 17°52.957, E 102°42.713	2002	650	Foot protection by soda mattress and slope proitection by cobble stones w/willow branch	Good	JICA	
5	B.P. for National Cuture Park	3.53 km to 3.95 km At L.end N 17°52.889, E 102°42.360	1996/97 1997/98	420	Gabion wall and slope protection works by gabion w/Reno mattress	Good	National budget	1996/97: 420m(lower slope) 1997/98: 400m(upper slope)
6	DCTPC B.P. (Wat Chomthong)	20.61 km to 20.77 km At 65m u/s of L.end N 17°50.014, E 102°38.232	2003	160	Rip-rap works on the lower slope	Good	Private	
7	DCTPC B.P. (Hatdokkeo)	27.42 km to 27.85 km N 17°51.559, E 102°35.742 at L.end	1996/97 2000	430	Gabion w/Reno mattress on the slope	Severe scouring at the foot of bank protection works	EU	1996/97: 30m 2000: 400m
8	Private B.P. (Ban Somhong)	30.43 km to 30.48 km N 17°53.024, E 102°36.423 at L.end	1998	50	Wet masonry	Slope works under repair	Private	
9	DCTPC B.P. (Bo O)	31.27 km to 31.33 km N 17°53.393, E 102°36.615 at L.end	2003	60	Rip-rap works for the protection of foot of slope	Good	National budget	

(Remarks)
1. L.end/U.end: GPS-Coordinates of exixting works at the lower/upper end of structure
2. B.P.: Bankprotection works, MRC: Mekong River Committee
3. Length of structures: Based on data from MCTPC and DCTPD and field measurements by portable distance meter

DCTPC(m):	3,135
JICA and IDI(m	1125
Private(m):	345
Other works(m)	905
(Total in m)	5,510

Table 3.1 (2/3) Existing Riverbank Protection Works (Thadeua – Wat Thampha)

(As of January, 2004)

No.	Facility	Location	Constructed Year	Length (m)	Type	Condition	Source of Fund	Remark
10	Private B.P. (Ban Thana)	31.53 km to 31.62 km N 17°53.616, E 102°36.713 at U.end	2003	90	Gabion wall and slope protection works by gabion w/Reno mattress	Good	Private	
11	Water intake sluice (Chinaimo)	32.98 km to 33.01 km N 17°45.291, E 102°37.007 at L.end		30	Concrete sluice for water intake	Good	-	
12	JICA Pilot B.P. (Wat Chom Cheng)	33.92 km to 34.16 km N 17°54.835, E 102°36.990 at 60m u/s of L.end	2002	240	Wooden pile groins (6) w/soda mattress	Good	JICA	
13	DCTPC B.P. (Wat Sop)	34.63 km to 34.95 km N 17°55.417, E 102°36.953 at 5m d/s of U.end	1997/98	320	Gabion works w/Reno mattress on the slope	Good	R.Korea and Australia	
14	DCTPC B.P. (Phanman)	35.13 km to 35.28 km N 17°55.499, E 102°36.942 at L.end	2000	150	Gabion w/Reno mattress on the slope and rip-rap w/dumped rocks at the toe	Good	National budget	
15	Laxy Port (KM-4)	35.52 km to 35.81 km N 17°55.702, E 102°36.929 at L.end		285	Concrete works for port	Minor damages at the foot of slope.	-	Constructed by the aid of Japan
16	DCTPC B.P. (KM-4)	36.05 km to 36.12 km N 17°55.997, E 102°36.947 at L.end	2003	70	Gabion works w/Reno mattress for upper slope and rip-rap works for lower slope	Good	National budget	Near residences of Vice-Minister
17	DCTPC B.P. (Wattaynhai-1)	43.31 km to 43.35 km N 17°58.089, E 102°34.470 at L.end	2003	35	Rip-rap works on the slopes	Good	National budget	
18	DCTPC B.P. (Wattaynhai-2)	43.49 km to 43.51 km N 17°58.104, E 102°34.389 at L.end	2003	20	Rip-rap works on the slopes	Good	National budget	

(Remarks)
1. L.end/U.end: GPS-Coordinates of exixting works at the lower/upper end of structure
2. B.P.: Bankprotection works, MRC: Mekong River Committee
3. Length of structures: Based on data from MCTPC and DCTPD and field measurements by portable distance meter

DCTPC(m):	3,135
JICA and IDI(m	1125
Private(m):	345
Other works(m)	905
(Total in m)	5,510

Table 3.1 (3/3) Existing Riverbank Protection Works (Thadeua – Wat Thampha)

(As of January, 2004)

No.	Facility	Location	Constructed Year	Length (m)	Type	Condition	Source of Fund	Remark
19	DCTPC B.P. (Wattay)	43.74 km to 43.99 km N 17°58.118, E 102°34.278 at L.end	1995/96	250	Gabion wall and slope protection works by gabion w/Reno mattress	Good	MRC/ Australia	
20	DCTPC B.P. (Wat Muangwa)	44.61 km to 44.86 km N 17°58.220, E 102°33.678 at U.end	1996/97	250	Gabion wall and slope protection works by gabion w/Reno mattress	Good w/sedimentation	MRC/ Australia	
21	JICA Pilot B.P. (Sibounheaung)	45.27 km to 45.43 km N 17°58.279, E 102°33.460 at L.end	2002	155	Protection of lower slope by cobble stone with willow branch works and foot protection by soda mattress	Good	JICA	Adjacent to IDI site
22	IDI Pilot B.P. (Sibounheaung)	45.43 km to 45.51 km N 17°58.304, E 102°33.370 at L.end	2001	80	Gabion wall w/rip-rap works and foundation w/soda mattess works	Good w/sedimentation	IDI-Japan	
23	DCTPC B.P. (Sibounheaung)	45.51 km to 45.55 km N 17°58.314, E 102°33.328 at L.end	2002	40	Sand bag worksfor upper slope and rip-rap works for lower slope	Good	National budget	
24	B.P. for Water Intake Tower	45.78 km to 45.86 km N 17°58.351, E 102°33.183 at L.end		80	Bank protection works by concrete blocks and gabion for intake tower		-	Tower was constructed by the aid of Japan.
25	Private B.P. (Ice Factory)	45.90 km to 46.01 km N 17°58.380, E 102°33.092 at L.end	1995	110	Gabion wall and slope protection works by gabion w/Reno mattress	Good	Private	
26	Private B.P. (Ban Sibounheaung)	46.36 km to 46.42 km N 17°58.450, E 102°32.856 at L.end	2003	55	Gabion wall and slope protection works by gabion w/Reno mattress	Good	Private	
27	Private B.P. (Mekong Breeze H.)	46.61 km to 46.65 km N 17°58.489, E 102°32.684 at L.end	2002	40	Rip-rap works	Good	Private	
28	Kao Liao Port	48.50 km to 48.80 km N 17°58.590, E 102°31.648 at L..end	1990 1997	300	Concrete, masonry and rip-rap works	Minor damage at the foot of slope.	-	1997: Repaired by DCTPC

(Remarks)
1. L.end/U.end: GPS-Coordinates of exixting works at the lower/upper end of structure
2. B.P.: Bankprotection works, MRC: Mekong River Committee
3. Length of structures: Based on data from MCTPC and DCTPD and field measurements by portable distance meter

DCTPC(m):	3,135
JICA and IDI(m	1125
Private(m):	345
Other works(m)	905
(Total in m)	5,510

Table 3.2 Picture of Bank Protection Work around Vientiane City

 Khuy Dane Mane	 Wat Sibounheuang
 Muang Wa	 Watchan (Modern Home)
 Wat Sop	 Hatdokkeo
 National Culture Park	 Thadeua

3.2 Whole Mekong River in Lao P.D.R.

Along the Mekong River in Lao P.D.R., there are many bank protection works have been done so far. Major bank protection works in that are summarized as shown in Table 3.3. The location of the bank protection works is as shown in Figure. 3.2.
In Lao P.D.R., the way of major river bank protection works is mainly classified as: a) Gabion and Reno mattress, b) Groins made of rip-rap stones, c) Wet stone masonry works, d) Rip-rap, and d) Other, as combination of concrete pile and wet stone masonry works / combination of the above with Soda mattress / wooden pile works.

Southern part of Lao P.D.R.
Samples of gabion and Reno Mattress works are seen in Savannakhet and Thakhek, especially in southern part of Lao P.D.R. Some bank protection works in 1970s are done by wet stone masonry works as seen at Pak Se Done project in Champasak province and at Wat Sikhottabong in Khhammouan province as shown in Table 3.3. Those are in good condition even at present.
In Bolikhamxay province at Pakkadan, four groins made of riprap stones have been constructed along the national road No.13. The groins are set at the foot of embankment earth slope and two new groins are under construction. With somewhat low elevation of the groin crown, the sedimentation between the groins is realized under the groin level. Slope of the embankment between the groins is suffered from partly collapse due to high velocity in the flood season as shown in Table 3.4. Slightly higher groins and/or the combination of slope protection works as riprap works between groins are supposed to be effective.
Near the confluence, especially down-stream corner of the confluence at Nam Sang in Paksan, the riverbank was severely damaged during flood season. Repair of embankment, that is founded by groins are under construction. Similar to the above, the slopes between groins are considered still vulnerable against erosion during flood. Riprap protection works are recommended for the slope protection in addition to the groins.
At Thakek of water supply project at Nabo village, riverbank protection works of gabion and Reno mattress protects a water intake facility with concrete piles supported by Soda mattress and wooden pile works as shown in Table 3.4.

Northern part of Lao P.D.R.
In Lang Prabang province of the northern part of Lao P.D.R., riverbank slope along the Mekong River around Laung Prabang city is rather stable except the drainage treatment on the slopes. Some part along the river, retaining wall is under construction, because of sliding down of former wall due to undermining caused drainage water.
Along the Nam Khan just upstream of confluence with the Mekong River, riverbank slope is protected by gabion box as shown in Table 3.4. Some amount of silt deposit is found on the top of rather high steps of the gabions.
Riprap groin works has been done along Ban Tonephueng in Bokeo province as shown in Table 3.4. Amount of sedimentation is found between groins, resulting to protect the riverbank slopes along the area. Further extension of groin arrangement is planned.
At Ban Muangmon Port, the riverbank is well protected by wet stone masonry work founded by concrete pile with riprap as shown in Table 3.4.

Table 3.3 Existing river bank protection along the Mekong River whole Lao P.D.R. other than Vientiane Municipality

Project Name /Location	Province	Year	Length (m)	Type	Condition	Source of Fund	Owner	Designer	Contractor	Remark
Pak Xe Done Project	Champasak	1973-1975		Wet stone masonry work	Backfill soil was flushed away near the bottom of slope at several parts in 2001.					
Downstream of Xaya Phom village	Svanakhet	1994-1995	1000	Reno mattresses with 0.3m thickness founded by rip-rap stones.	Much amount of sedimentation on lower part of slopes are found. Thickness is approx. 1-1.5m.	Local Government	DCTPC			
Bank Protection of Water Supply Project at Nabo village	Khammouan	1999-2000	about 200	Slope of gabion boxes founded by concrete pile at bottom with partly protected by Soda mattresses and wooden groins.	Good condition of the slope protection work. Part of wooden graoin is slightly damaged.	Local Government	DCTPC	DM Co.	DM Co.	DM Co. invested.
Wat Chom Cheng Temple	Khammouan	1999-2000	about 500	Reno mattresses founded at bottom by rip-rap stones.	Good conditon of the slope work.	Local Government	DCTPC	State Co.	SAIKO SAIGON	SAIGON Co. invested.
Wat Sikhottabong	Khammouan	1976	100	Wet masonry work	Good conditon of the slope.					
River Bank Protection at Pakkadan	Bolikhamxay	2000-	135	Four(4) groin works arranged with spacing of about 38-63m. Two groins upstream side are under construction.	Although between groins, sedimentation is found, upper slopes than that is undermined causing slope failiure in some extent.	CEDA, N.B		Modern Home		Total groin number is planned as 27.
Bank Protection at Paksane	Bolikhamxay	1998-present	300	Gabion and Reno mattresses	After damaged in1998, embankment was done in 1999 and planed to construct 2 sets of groins.					
Thaphapheuane Bank Protection Project granted by Secondary Town Project	Luang Prabang	2001	200	Gabion wall with hight of approx. 12m, 15m width	Good condition with rather much amount of sediment are found on rather high position of approx. 0.1-0.3m thickness.	France	DCTPC	Geo Engineering (China)	IGIP-BCECN BETURE	
Ban Tonephueng	Bokeo	1997-2001	800	Groins mode of stones at 9 lines and planned to extend additional 4 groins	Some amount of sedmetation are found between the groins, esp., old	National budget	Dept. CPTC	SDC Vientiane		
Ban Pa Oyl To Tin That	Bokeo		about 450	Rip-rap work with dia. Apprrox. 0.2-0.5m	Sedimentation is not found on the slope.	Private Co.		Lignite VPK Co.	Lignite VPK Co.	Lignite company.
Ban Muangmom Port	Bokeo	-2001	about 200	Concrete pile and wet stone masonry works	Good condition	National budget		V.V Co.	CTC(Vientiane)	

Data source : 1) Ministry of CTPC, Dept. of CTPC of each province concerned
2) JICA Study Team Survey

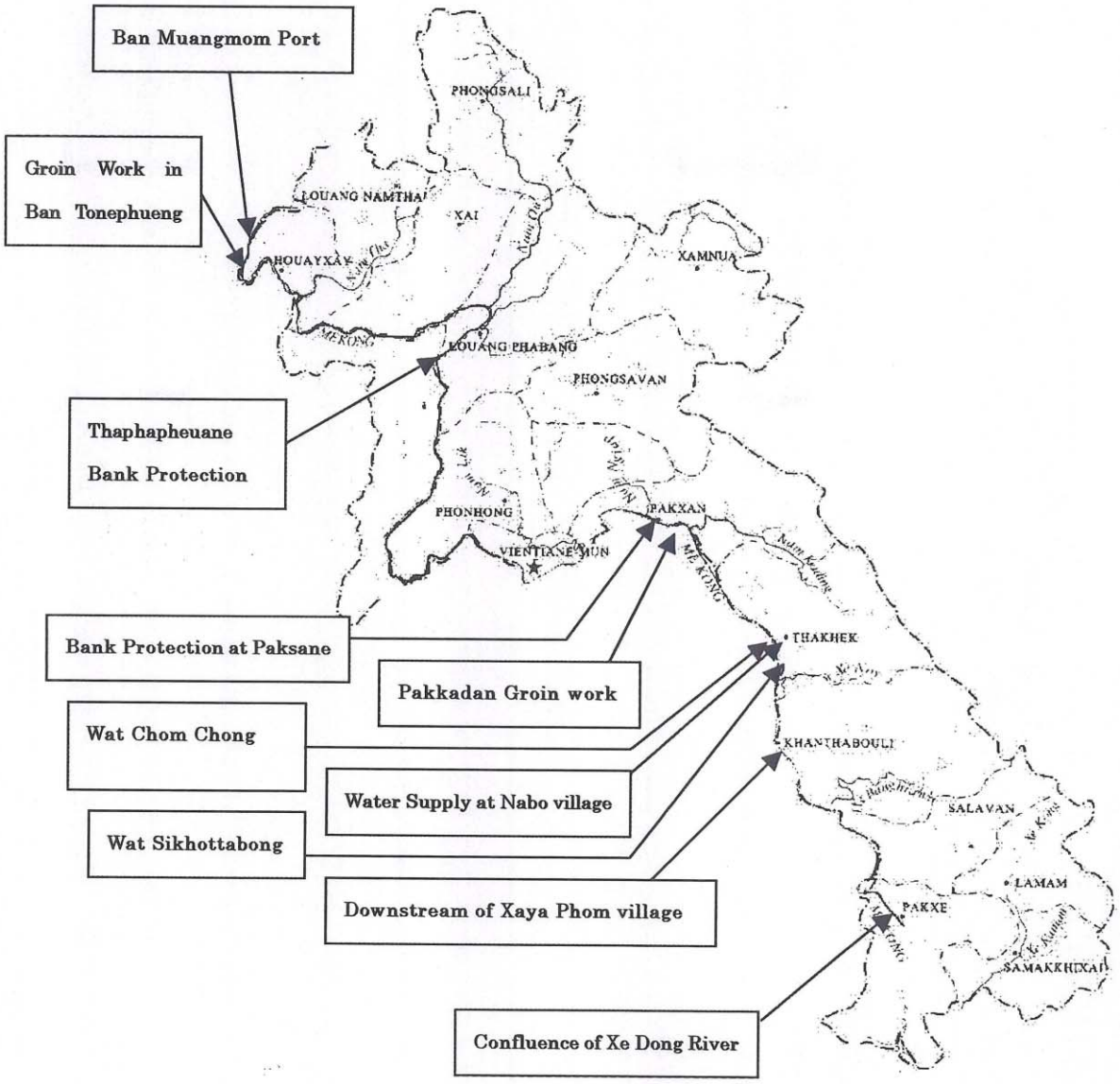
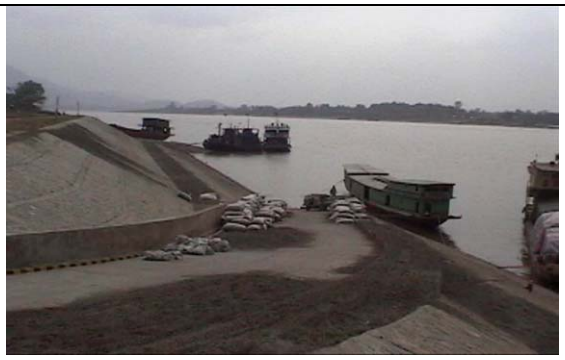


Figure 3.2 Location of Existing River Bank Protection Work along the Mekong River in Lao P.D.R

Table 3.4 Picture of Bank Protection Work in Lao P.D.R.

 Pak Xe Done (Pakse)	 Downstream of Xaya Phom village (Savnakhet)
 Bank Protection at Wat Sikhottanong (Thakek)	 Bank Protection at Water Intake in Thakek
 Pakkadan	 Thaphapheuane Bank Protection Work
 Groins at Ban Tonephueng (Bokeo)	 Ban Muangmom Port

4 PROPOSED PLANS AND PROJECTS IN THE STUDY AREA

4.1 Bank Protection Plans and Projects

Proposed future bank protection plans and projects around Vientiane City (the Study Area) by national budget and other donors are described below and summarized in Table 4.1.

4.1.1 Projects by National Budget

GOL has been implementing bank protection works gradually by using very limited national budget. Proposed projects after 2004 are as follows so far:

1. Sibounheuang (L=410 m): to be implemented after 2005 (survey was started from 2004)
2. Ban Hom/Tha Khek: 60 m to be constructed in 2004, construction to be continued

4.1.2 Lao-Flanders River Works Project

The outline of the project is as follows:

1. On-going capacity development project at Bo O riverbank site (2002-2004) of MCTPC financially assisted by Flanders International Technical Agency (FITA), the Government of Belgium.
2. Survey for L=200 m is completed and the design of bank protection works using gabion has not been completed; the draft drawing is available.
3. Construction work will be executed by national budget; GOL is requesting FITA for the financial aid, though.

4.1.3 Projects by Other Donors

No specific future plans and projects by other donors exist so far except present technical cooperation by JICA and FITA. However, if donor's financial assistance is available in the future, it will help GOL to accelerate the implementation of the Master Plan.

Table 4.1 Proposed Bank Protection Plans and Projects in the Study Area

Site Name	Existing Bank Protection Works	Surveys and Studies for Bank Protection										Remarks
		Project Type			Length of construction (m)	Work Type	Topo-Survey	Hydrological Survey	Facility Design	Budget (mil Kip)	Source of Funds	Year of Construction	
		New	Exten -sion	Rehabili -tation									
Sithantai	No	Yes	-	-	3,500	Under consideration	Yes (3,500 m in 2000 and 2001)		No	No	National budget	Unknown	
Thakhek - Ban Hom	No	-	Yes	-	2,000	Foot protection work by riprap & backfill	No (to be implemented 2 km in 2005		No	600 (for 60 m in 2004)	National budget	from 2004	
Hatdokkeo	Yes (EU & National budget)	-	-	Yes	100	Foot protection work by riprap	Yes (520 m in 2000)		No	No	National budget	Unknown	
Bo O	Yes	-	Yes	-	200	Backfill, riprap & reno mattress	Yes (200 m in 2002-2003)			No	National budget or GOB aid	from 2005?	*GOL implemented bank protection work in 2002 and 2003. *Government of Belgium (GOB) has been conducting a capacity building project for bank protection here (2002-2004). *GOL is requesting of GOB for the financial aid for the construction.
Chinaimo (near Bo O)	No	Yes	-	-	-	No	No			No	National budget	Unknown	
Wat Chan /Don Chan Island Development	Yes (Land reclamation)	Yes	Yes	-	Unknown	Land reclamation for urban development	Yes			Unknown	Malaysian Private company (RTSB)	from 2003	*Modern Home Co. Ltd. implemented L=840 m. Original plan (L=6,000 m) is greatly scale downed and suspended owing to shortage of funds. *Malaysian private company (RTSB) is now developing Don Chan island (including bank protection).
Sibounheuang	Yes (IDI & JICA, Japan)	-	Yes	-	approx. 410	Soda mattress & Cobble stone with willow branch work	No <to be implemented in 2005.>			50 (for survey & design in 2004)	National budget	from 2005	GOL will implement bank protection work applying JICA's pilot work method.
Kao Liao (between ice factory and Kaoliao port)	Yes (National budget)	-	Yes	Yes	300	Under consideration	No			No	National budget	Unknown	

4.2 Related Plans and Projects

No flood control plan of the Mekong River in Lao P.D.R. is available so far, which will affect riverbank protection. Urban development plans/projects in Vientiane City are closely related to riverbank protection. Outline of the several plans/projects are described here.

4.2.1 Urban Development Project by Land Reclamation at Watchan

Modern Home Co. Ltd, a private company in Lao P.D.R., has been implementing "the Mekong River Bank Erosion Protection and Development Project" by BOT method. The project includes the riverbank protection, however, no serious erosion has been observed in this stretch in particular. The main objectives of the project are virtually to create land for business and recreation facilities by backfill reclamation with a width from 40 to 100 m. Therefore the project area is out of the objective to be protected by the Master Plan.

The reclamation work with a stretch of 840 m between Wat Chan and Lane Xang Hotel was completed in 2002 as 1st phase by dredging up of sand from the Mekong riverbed. The layout of 1st phase project is shown in Figure 4.1. However, next implementation according to the original plan (L=6,000 m) including Don Chan Island development has been abandoned owing to financial difficulty.

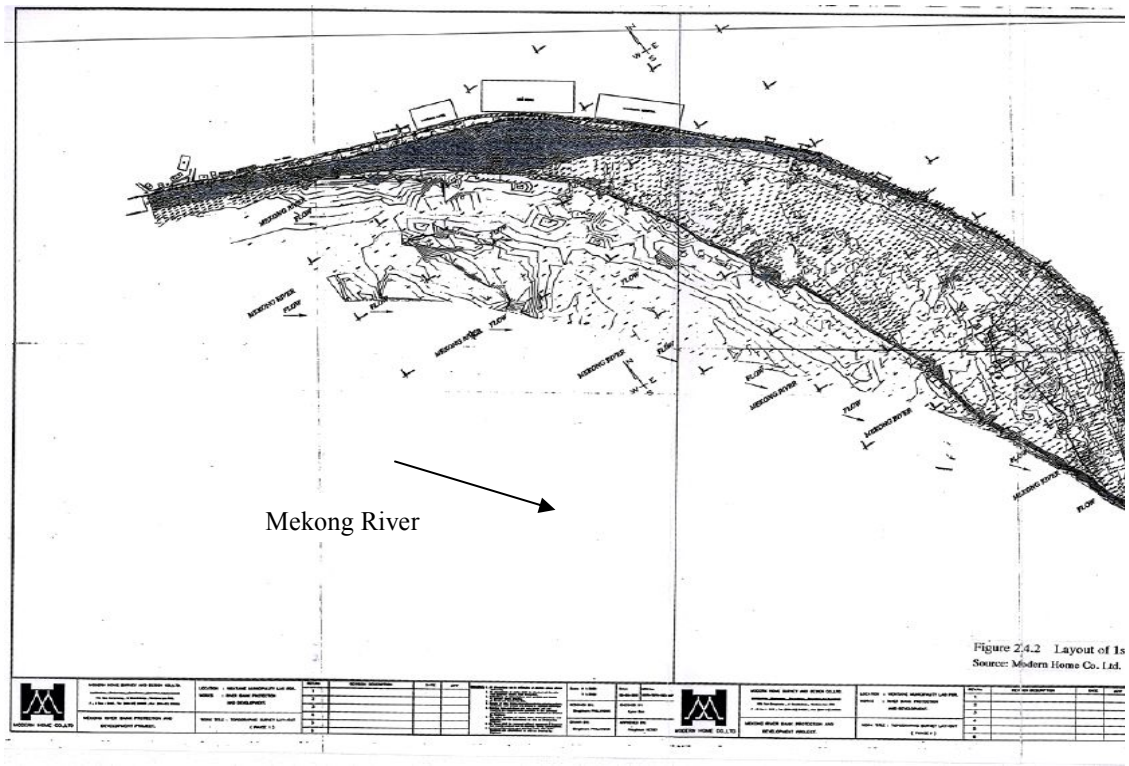


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Figure 4.1 Layout of Land Reclamation by Modern Home's Project
(Source: Modern Home Co. Ltd.)

4.2.2 Don Chan Island Development

Rancang Timur Sdn. Bhd. (RTSB), Malaysian Developer is now conducting Don Chan Island development instead of Modern Home Co. Ltd. The layout with the area of approximately 100 ha is as shown in Figure 4.2. The construction of 5-Star Don Chan Palace Hotel is in progress and to be completed by October 2004. Remaining area of the island will also be fully developed by RTSB in future.

The bank protection of the island will be executed by RTSB as a part of development. However, a large quantity of sand mining in the Mekong riverbed and sandbar for land reclamation might cause some adverse impact to the downstream riverbanks. It is necessary to monitor the condition carefully. On-going MRC study "Environmental Risk Assessment between Non Kai and Vientiane" (Mar. 2003- May 2004) including sediment transportation might be utilized for this issue in near future.

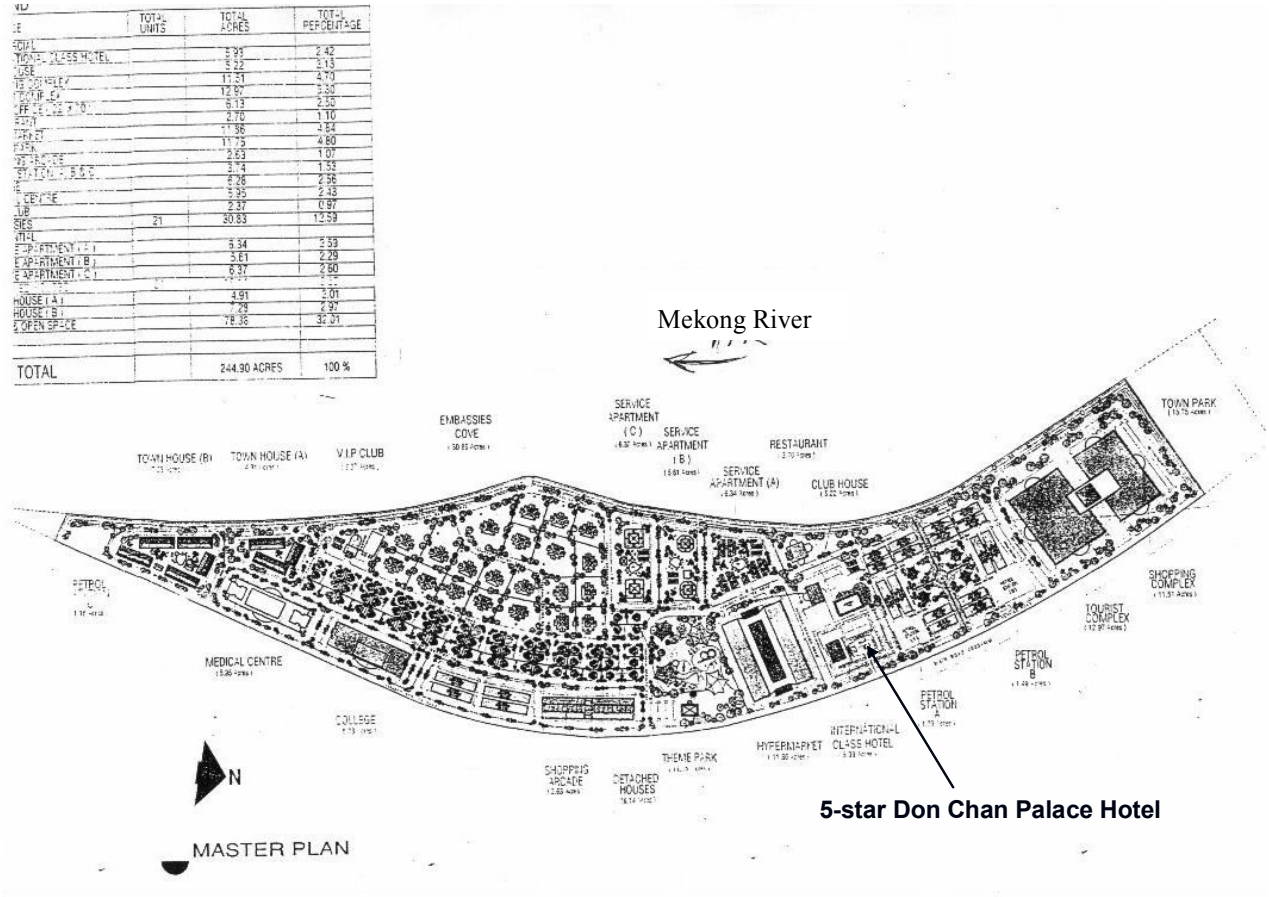


Figure 4.2 General Layout of Don Chan Island Development
(Source: MCTPC)

4.2.3 Vientiane Urban Development Master Plan

The draft of revised Vientiane Urban Development Master Plan (URI-MCTPC, 2003) proposed the land use principles of riverine area as shown in Figure 4.3. The plan has a close relation with the non-structural measures of JICA Master Plan.

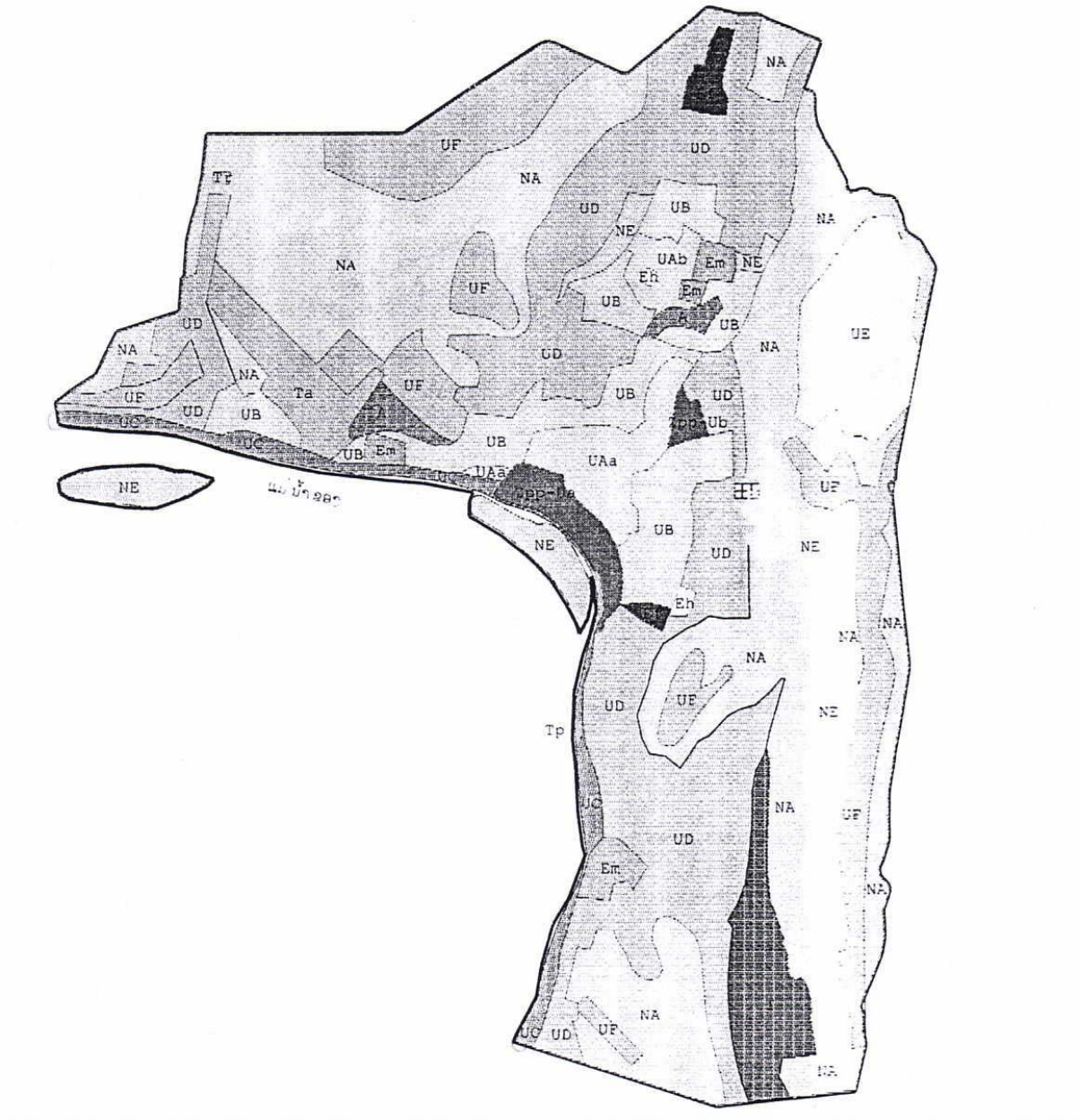


Figure 4.3 Future Land Use Zoning in Vientiane City

Source: "Vientiane Urban Development Master Plan (Draft)" (URI-MCTPC, 2003)

4.2.4 Vientiane Urban Infrastructure and Services Project (VUISP)

Vientiane Urban Infrastructure and Services Project (hereinafter referred to as "VUISP") was formulated by VUDAA/ADB in 2001. The objective area of VUISP is four (4) of the urban districts comprising 100 villages in Vientiane City, namely VUDAA area.

The objectives of VUISP are as follows:

1. enhanced productivity and improved quality of life for the Vientiane urban residents and particularly the urban poor, and
2. improved management of urban infrastructure, services and facilities by VUDAA.

The proposed projects of VUISP are mainly 1) urban drainage, 2) road construction, 3) solid waste disposal and 4) sanitation as shown below and are scheduled to be implemented from 2001 to 2006. Construction of 1.06 km of river embankment protection in initial plan was excluded from the component to avoid the duplication of project at Sibounheuang by the Infrastructure Development Institute (IDI)-Japan, GOJ.

Structural Measures

1. Construction of a total of 14 km of primary, secondary and tertiary drainage
2. Construction or upgrading of a total of 38.5 km of primary, secondary and tertiary roads and associated drainage lines
3. Provision of three new solid waste collection vehicles and 50 containers
4. Upgrading of infrastructure, services and sanitation in 50 urban villages

Non-structural Measures

1. Capacity building of VUDAA
2. Consulting services for project implementation support
3. Technical assistance
4. Public awareness campaigns
5. Micro-credit

4.2.5 Committee for Prevention of Impacts on River Banks and Ecology System

Prime Minister's Decree on the Appointment of the Committee for Prevention of Impacts on River Banks and Ecology System along the Mekong and Heuang Rivers was issued in April 2003. The present status as of February 2003 is as follows:

1. The committee is National level activities including Vientiane.
2. Setting up of organization and implementation schedule of the committee is now under consideration.
3. Therefore, the activities will have not so much direct relevance to JICA Master Plan so far.

5 VEGETATION

5.1 General Vegetation

Investigation areas are some forests in Vientiane City where wooden materials will be supplied. The kind, quality and shape of trees are investigated. The vegetation of the former sites of the slash-and-burn land along route13 were also investigated

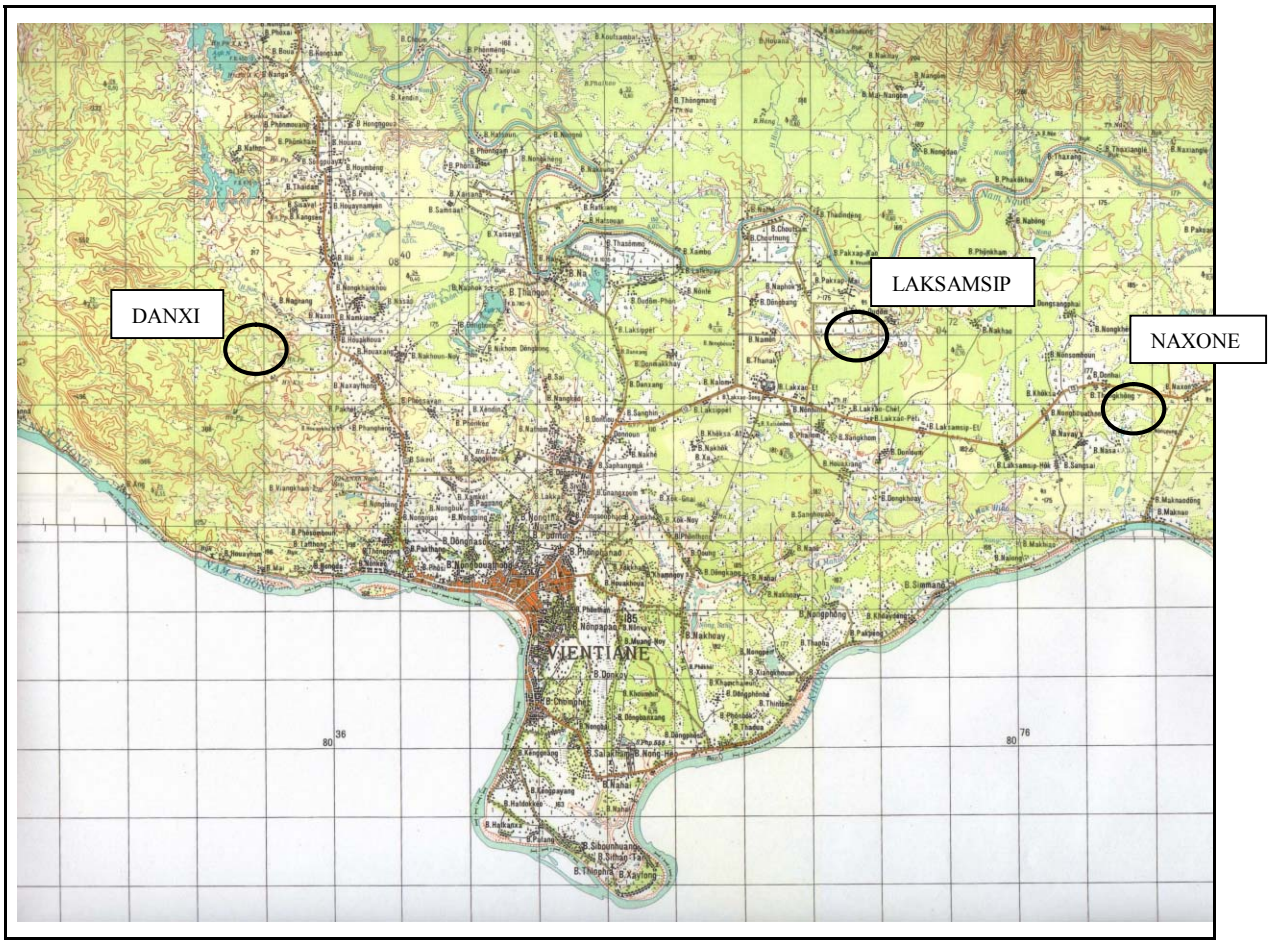


Figure 5.1 Place of Investigation

5.1.1 Forests in Vientiane City

The following three forests were selected as the investigation area. The first was recommended by JICA-FORCAP, other two were the circumference of the area, where soda (fascine) materials in IDI project were obtained. These forests are composed in different flora, respectively. The checked trees are as shown in Table 5.1. The feature in each forest is as follows:

- Around NAXONE Village : There are many kinds of trees and a lot of trees whose diameters at about 3m height is about 3cm are growing.
- Around LAKSAMSIP Village : There are some kinds of trees whose quality is soft and strong.
- Around DANXI Village : There are many kinds of trees and bamboo.

Table 5.1 Trees Checked in Forest

No.	Name of the tree		Quantity	
	In Lao	Scientific name		
1	ไม้มูก (May Mouk)	Wrightia arborea	Many	
2	ไม้กะดูก (May Kadouk)	Gelonium glomerulatum		
3	ไม้มีข่ิน (May Mikhon)	Aporosa sp.		
4	ไม้หนังดำ (May Nang Dam)	Diospyros sp.	Many	
5	ไม้ตี้วหนาม (May Tiou Nam	Cratoxylon prunifolium	Many	
6	ไม้มะหาเมก/ ฮ้าลอด (May Mahamek / xalot)	Croton kongensis	Many	
7	ไม้ขี้เหล็กป่า (May Khi lek pa)	Cassia coma	Many	
8	ไม้ปีหู (May PoHou)	Trema velutina	Many	
9	ไม้ถอมส้ม (Maay Khom Som)	Grewia paniculata	Many	
10	ไม้ตินเปีด (May Tin Pet)	Alstonia scholaris		
11	ไม้เหมือด (May Meuat)	Aporosa microcalyx	Many	
12	ไม้แคป่า (May Khe Pa)	Hapophragma adenophyllum	Many	
13	ไม้เปา (May Pao)	Croton oblongifolius	Many	
14	ไม้ค้บ (May Khap)	Maesa ramentaceaWall	Many	
15	ไม้แต้ฮ่ (May Te Ho)	Sindora siamensis		
16	ไม้ธำฮาว (May Ham Ao)	Pterospermum megalocarpum		
17	กกหนาด (Kok Nat)	Artemisia vulgaris	Many	
18	ไม้จิก (May Chik)	Shorea obtusa	Many	
19	ไม้เฮือก (May Xeuak)	Terminalia tomentosa	Many	
20	ไม้ทิ่ม (May Thom)	Adina cordifolia		
21	ไม้กุง (Maay Koung)	Dipterocarpus tuberculatus	Many	

5.1.2 Former Site of Slash-and-Burn Land

The situation of a former site of the slash-and-burn land along Route13 was inspected as shown in Figure 5.2. Young trees, such as a eucalyptus, a teak, and an acacia, are planted there several years ago. Since trees grow, there are some areas where thinning is required. However, there are some areas where the slash-and-burn agriculture is performed now as shown in Figure 5.3. The present condition is that these areas do not have means of production other than the slash-and-burn agriculture.

Figure 5.2 Bald Mountain after Slash-and-burn

Figure 5.3 Planted Trees at Former Site of Slash-and-burn Land

5.2 Riverine Vegetation

5.2.1 Vegetation on Natural bank

Vegetation seldom grows on the natural bank in Vientiane City. It is because the natural bank is often eroded and vegetation cannot grow as shown in Figure 5.4. In natural bank where vegetation grows, soil has been accumulated and is stabile as shown in Figure 5.5.
The most of plants belongs to the plants of glum florae. They are distributed over all of the riverbank.

Figure 5.4 Little Plant Growing on Natural Bank

Figure 5.5 Vegetation of Natural Bank

5.2.2 Vegetation on Existing Riverbank Protection Area

Results of an investigation show the following things.
- Growing plants change with deposition situations of soil.
- Kinds of distributed plant difference in the upper layer, the middle layer, and a lower layer of the riverbank.
- Growth of a plant is not active for one year after riverbank protection work.

In Vientiane City, the riverbank protection works have been constructed since early 1990s. There are several states of vegetation on the existing riverbank protection works. Vegetation has changed on the existing riverbank protection area after construction. Therefore the vegetation was investigated in several existing riverbank protection areas where the construction year or methods were different. Investigation places and items are shown in Table5.2

Table 5.2 The Situation of Vegetation in the Existing Riverbank Protection Works Areas

Investigation Place	Thadeua	Friend Ship Bridge	National Culture Park	Sibounheuang	Japanese Ambassador Residence
Photograph					
State of Vegetation	- Upper layer: Glumineas - Middle of layer Glumineas and Willow - Lower layer Grass and Willow	- Upper layer: Several kinds of plants strong against dryness - Middle of layer Grass and Glumineas - Lower layer Grass and Willow	- Upper layer: Several kinds of plants strong against dryness - Middle of layer Grass and Glumineas - Lower layer Grass and Willow	- Upper layer: Creeper grows on the natural bank Nothing on Gabion Box - Middle of layer Nothing - Lower layer	- Upper layer: Many kinds of Plants - Middle of layer Many kinds of Plants - Lower layer Willow
Ground Condition	- Upper layer: The soil has accumulated. - Middle of layer A lot of soil has accumulated. - Lower layer The wire of Reno-Mattress corrodes and there are stones, which are not protected.	- Upper layer: The soil accumulates little on Reno-Mattress. - Middle of layer A lot of soil has accumulated. - Lower layer The soil has accumulated a little around willow.	- Upper layer: The soil accumulates little on Reno-Mattress. - Middle of layer The soil accumulates little on Reno-Mattress. - Lower layer The soil accumulates a little around willow.	- Upper layer: The soil is not deposited. - Middle of layer The soil accumulates little on Reno-Mattress. - Lower layer The soil has accumulated a little on the stones.	A lot of soil has accumulated.
Construction Method	Reno Mattress	Reno Mattress	Gabion Box and Reno Mattress	Gabion Box and Soda Mattress Natural Bank and Rensai-Fence and Soda Mattress	Unknown
Constriction Year	1989	1994	1997	2001	Unknown

5.2.3 Willow in the Mekong

a) The distribution situation of the willow

Along the Mekong riverbank in Vientiane City, many communities of the willow were checked on the existing riverbank protection works, which have passed after construction for five years or more. On the other hand, the willow tree seldom grows in natural riverbank. The big community was only checked on the sandbar near Thintom Village as shown in Figure 5.6. A growth distribution of the willow community along the Mekong river is a shown in Figure. 5.7.

Figure 5.6 Big Community of Willow on Sandbar Near Thintom Village

Figure 5.7 Community of Willow on Existing Riverbank Protection Work

Figure 5.8 Distribution Situation of Willow in Vientiane City

b) Characteristic of the willow
Some characteristics of the willow are as shown below:
- The kind of ground has little influence for growth of the willow.
- Moisture has a strong influence for growth of the willow.
- Community of the willow is formed in several years.
- Community of the willow can catch and hold soil.

The willow can grow not only on the ground but on Reno-Mattress and some sandbar. It is considered that the kinds of ground have little influence for growth of the willow.
However, it can grow only at lower level of a riverbank, considering that moisture has a strong influence for growth of the willow as shown in Figure 5.9.
The community of the willow can catch and hold soil. In the place which willow forms the community, soil has accumulated and the erosion of a riverbank is prevented as shown in Figure 5.10.

Figure 5.8 Community of Willow on Existing Riverbank Protection Work

Figure 5.9 Community of Willow on Existing Riverbank Protection Work

5.2.4 Examination

It is considered that the community of the willow is effective for lower level part of riverbank protection. The community is formed on some existing riverbank protection in several years. However, in order to establish vegetative riverbank protection work, it is necessary to make the willow grow certainty and in early stage. In the Pilot Works, it will be verified about the following items:

- Planting Method
- Planting Timing of Willow

In the upper and middle level riverbank protection slope, it is necessary to find out some effective plants. Investigation of riverine vegetation will be conducted to grasp the actual condition of them. The investigation items are as follows:

- Distribution of vegetation
- Flora

6 AVAILABILITY OF LOCAL MATERIALS FOR BANK PROTECTION

6.1 Quarry Site

6.1.1 Quarry Sites Now under Operation

According to the data collected so far, the companies now permitted to exploit rocks from mountains are as follows:

1) Phatthanakhetphoudoi Company (Exploitation area of 4 ha.)
2) Vientiane City Road-Bridge Construction Company (Exploitation area of 4 ha.)
3) Lao-Souksar (Exploitation area of 20ha.)
4) Sengsouvanh Construction Company (Exploitation area of 15 ha.)
5) First May Road and Bridge Company (Exploitation area of 20 ha.)

All these quarry (expressed only by the company names) are located at B. Sakai, a small village along Mekong River, some 50km WNW from the city center. But at present, actual exploitation is undergoing at the three quarry sites among them located beside the local road.

Rocks of the quarry sites mentioned above are granitic rocks which are intruded into Paleozoic Formation, but host rocks of sandstone, siliceous claystone and conglomerate are simultaneously exploited. These rocks are all massive and very hard, but rather cracky. However, they are judged to be suitable for concrete aggregates.

In the report mentioned above, the quarry site at Hat Samphanna, 25km from the city center, where limestone seems to have been exploited, is listed, but it was already closed 5 years ago according to local people. This quarry site has been already covered by thick forest and now it is difficult to locate it in the forest. It is guessed that the exploitation of rocks was done in such a small-scale manner as gathering of rocks scattered at the foot of a mountain, composed of sandstone and claystone as well as limestone.

6.1.2 The Quarry Sites for Future Development

No matter what methods are applied for riverbank protection works, a considerable amount of rock materials might be necessary. The necessary amount of rocks, of course, may be different from the applied method and the lengths of bank protection. For this project, the necessary rock volume is estimated at about 3 million cubic meters.

Accordingly, the first priority for this project should be laid on the acquisition of rocks at a cheaper cost as possible. However, all the existing quarry sites are located far more than 50 km from the city center. It would be difficult to attain the aim of cheap riverbank construction, if the rock materials were transported from B. Sakai.

Therefore, the geological and environmental investigations were done this time in order to find out more economical candidate quarry sites than those in B Sakai.

The conditions set for the newly developing quarry sites were as follows:

1) The site must be located at the area nearer than B. Sakai.
2) Transportation is favorable.
3) The site must be located at the areas out of the natural conservation area.
4) High quality of rock is not always necessary.

By the way, Vientiane City has a wide flat plain in the east, north and west within a 50km radius except in the west-north-west, where some hilly mountains are developed. Fortunately, there are small hilly mountains that seem to fulfill the above-mentioned conditions at B. Houayhom, some 25km from the city center. Many large-scale exposures of massive sandstone are observed here and there, especially on the dried river floor below the bridge over a local road. Probably, sandstone could be easily found even in the pineapple plantation area by a shallow stripping off the overburden.

The sandstone (partly conglomerate) is inferior in quality to the granitic rocks in B. Sakai and it seemingly is not available for concrete aggregate. However, it must be suitable enough for rock materials for riverbank protection works in view of its massive and compact nature.

6.1.3 Location of Sampling

Rock sampling was done at the following four areas, considering comparison of quality between new quarry sites and B. Sakai.

1) QH-1
It is just under a bridge about 1.2 km from Houayhom towards B. Sakai.
GPS indicates N17° 59.225’、E102° 26.190’
2) QH-2
It is located besides the local road, further 200m west from QH-1.
GPS indicates N17° 59.225’, E102° 26.000’.
3) QS-1
It is located at the junction of the local road and small path to Mt. Lienmant.
GPS indicates N18° 02.391’ E102° 21.680’
4) B. Sakai Quarry Sites now under operation
It is located some 50km from the city center.

6.2 Fascine and Wooden Materials

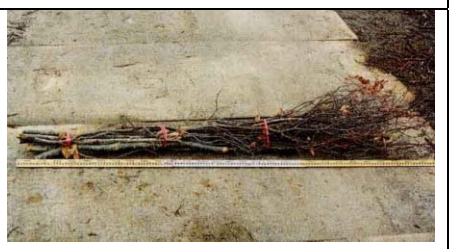
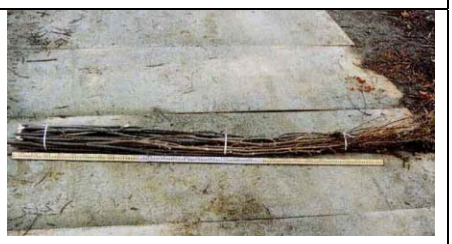
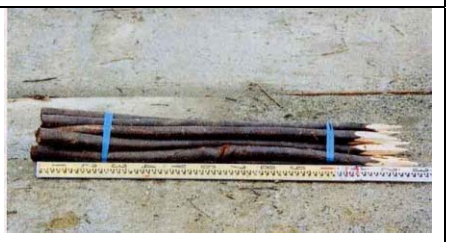
Availability of materials for Soda (fascine) Mattress, Willow Branch Work and Wooden Pile Dike Groin was investigated. Investigation items are name and existing quantity of fascine and wooden materials in Vientiane City.

6.2.1 Fascine Materials

a) Quality and standard

Fascine materials are used for Soda Mattress and Pebble Stone with Willow Branch Work. They are made from the branch with different character. Soda is a branch with the sprig, to be used for Rensai(bundle of fascine) and Shikisoda(flooring fascine). Taisya is a branch that is flexible and strong to be used for the fence called Shigara. Kogui is a short stake connecting an upper lattice and a lower lattice, consisting of pillars of Shigara. Their quality and the standard are as shown in Table6.1.

Table 6.1 Quality and Standard of Fascine Materials

Soda Material	Standard	Quality	Photograph
Soda (Fascine)	Length=2.7-3.0m Periphery = 60cm: Rising 45cm up from starting point (butt end)	Tough With many sprig	
Taisya (Cross Twigs)	Length=2.7-3.0m Diameter=2-3cm: Starting end diameter per twig 25twigs to bundle	Strong and flexible	
Kogui (Short piles)	Length=1.2m Diameter=3-5cm: Starting end diameter (butt end) 10twigs to bundle	The kinds of woods are identical with Soda and Taisya	

b) The Names of Woods

The names of trees were investigated in some forests in Vientiane City along Route 13 to south. The list of fascine materials is as shown in Table2.6.2.

Table 6.2 List of Fascine Materials

No.	Lao Name in English	Soda	Taisya	Note
1	May Mouk	●		
2	May Kadouk	●		
3	May Mikhon	●		
4	May Nang Dam	●		
5	May Tiou Nam	●	●	
6	May Mahamek/xalot	●		
7	May Khilekpa	●		
8	May Pohou	●		
9	Maay Khom Som	●		
10	May Tun Pet	●		
11	May Meuat	●	●	
12	May Khe Pa	●		
13	May Pao	●		
14	May Khap	●		
15	May Te Ho	●		
16	May Ham Ao	●		
17	May Chik	●		
18	May Xeuak	●	●	
19	May Thom	●	●	
20	Maay Koung	●	●	

c) Available quantity

After showing samples of Soda, Taisya, and Kogui to local people in the following five villages as below, and location of those villages is as shown in Figure 6.1, the available quantity was estimated. Consequently, it was verified that Fascine Materials for the Pilot Works could be supplied enough from those villages.

Investigation Place:

- Danxi Village
- Laksamsip Village
- Donlown Village
- Naxone Village
- Nongpen Village

As for Soda, 10,000 or more bundles could be supplied from all villages. About Kogui, the same woods as firewood whose length is required 1.2m can be used. However, about Taisya, since the available trees are restricted, collecting will be difficult. Although they exist a little mixed within the most of forests in Vientiane City. As they are together near Laksamsip, therefore, it is better to obtain from the forest near Laksamsip.

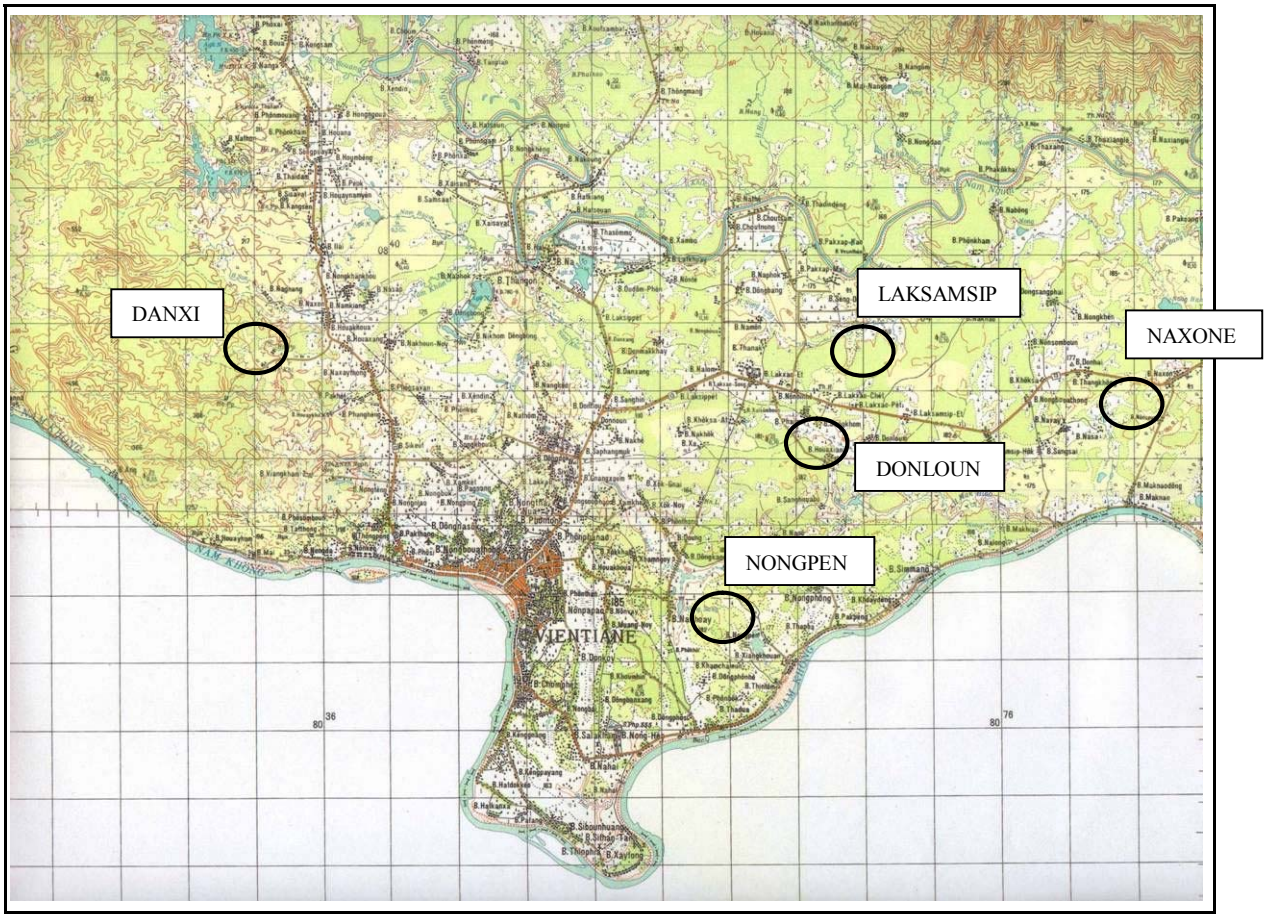


Figure 6.1 Investigation Place of Fascine Materials

6.2.2 Wooden Materials

Wooden materials for Pile Dike Groin were investigated around Vientiane City. The standard length is 4m or more, and diameter is about 20cm. Kinds of available trees were found as the eucalyptus, the pine, the acacia, the teak, etc. Since the tree has not grown in plantations, the place for the wooden materials will be decided on the above information in the next stage.

7 BASIC ENVIRONMENTAL CONDITION

7.1 Natural Environment

7.1.1 Climate

The climate around Vientiane has two characteristics of savanna and monsoon. The dry season is from November to April. The rainy season is from May to October. The annual rainfall is about 1,600 mm. About 80 percent of the annual rainfall is concentrated in the rainy season. Table 7.1 shows the average monthly rainfall in Vientiane City. Table 7.2 shows the average monthly temperature in Vientiane City.

Table 7.1 Average Monthly Rainfall in Vientiane City

(mm)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
7.0	15.9	35.7	84.5	254.2	243.7	248.6	340.3	299.8	96.3	7.4	1.9	1635.3

Table 7.2 Average Monthly Temperature in Vientiane City

(℃)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average
22.1	24.1	27.0	28.7	28.5	28.2	28.0	27.5	27.4	26.8	24.8	22.6	26.3

7.1.2 Protected Area

Phou Phanang National Biodiversity Conservation Area (NBCA) and Phou Khao Khoay NBCA as national level protected area are located in and around Vientiane Prefecture. There are some protected forest areas to protect water resources and prevent soil erosion and natural disasters besides NBCA in Vientiane Prefecture, especially steep slope zone. The locations of Phou Phanang and Phou Khao Khoay NBCA are shown in Figure 7.1.

7.1.3 Fauna and Flora

Natural vegetation areas remain well in and around the NBCAs. There are no natural vegetation areas along Mekong River bank in Vientiane Prefecture. The identified large mammal and bird species listed in International Union for the Conservation of Nature and Natural Resource (IUCN) in Phou Khao Khoay NBCA are as follows:

Pangolin sp, Pig-tailed Macaque, Rhesus Macaque, Phayre's Langer, White-checked Crested Gibbon, Dhole, Bear sp, Clouded Leopard, Asian Elephant, East Asian Porcupine, Siamese Fireback, Green Peafowl, Red-collared Woodpecker, Coral-billed Ground Cuckoo, Grey-headed Lapwing, Jerdon's Baza

The identified fishes in main Mekong River reach more than 200 species, which are mainly *Cyprinidae, Siluridae, Bagridae (Siluriformes)* and *Pangasiidae (Siluriformes)*.

7.1.4 Water Quality

The water quality of Mekong River at Vientiane City is good on organic substance and nutrient level. In Vientiane, Mekong River water is used as water resources for public water supply. The total suspended solids are changeable by year and generally tend to increase in the high-water season. Table 7.3 shows the water quality of Mekong River at Vientiane City. Table 7.4 shows the total suspended solids of Mekong River at Vientiane City.

Table 7.3 Water Quality of Mekong River at Vientiane City

	Teem. (℃)	pH	Conductivity (μ S/m)	Total Fe (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)	Total P (mg/l)	DO (mg/l)	COD Mn (mg/l)
Ave.	26.0	7.9	227	0.243	0.184	0.039	0.081	7.6	1.4
Min.	19.8	6.0	114	0.000	0.001	0.000	0.005	5.6	0.0
Max.	34.3	8.7	325	1.922	0.528	0.332	0.494	9.5	6.6

Period: May 1985-April 1997

Table 7.4 Total Suspended Solids of Mekong River at Vientiane City

(mg/l)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ave.	132	63	60	79	137	470	1263	1262	1546	1199	697	261
Min.	18	5	7	1	10	42	80	8	524	32	284	104
Max.	290	153	284	360	468	1468	5716	4074	3013	3204	1987	553

Period: May 1985-April 1997

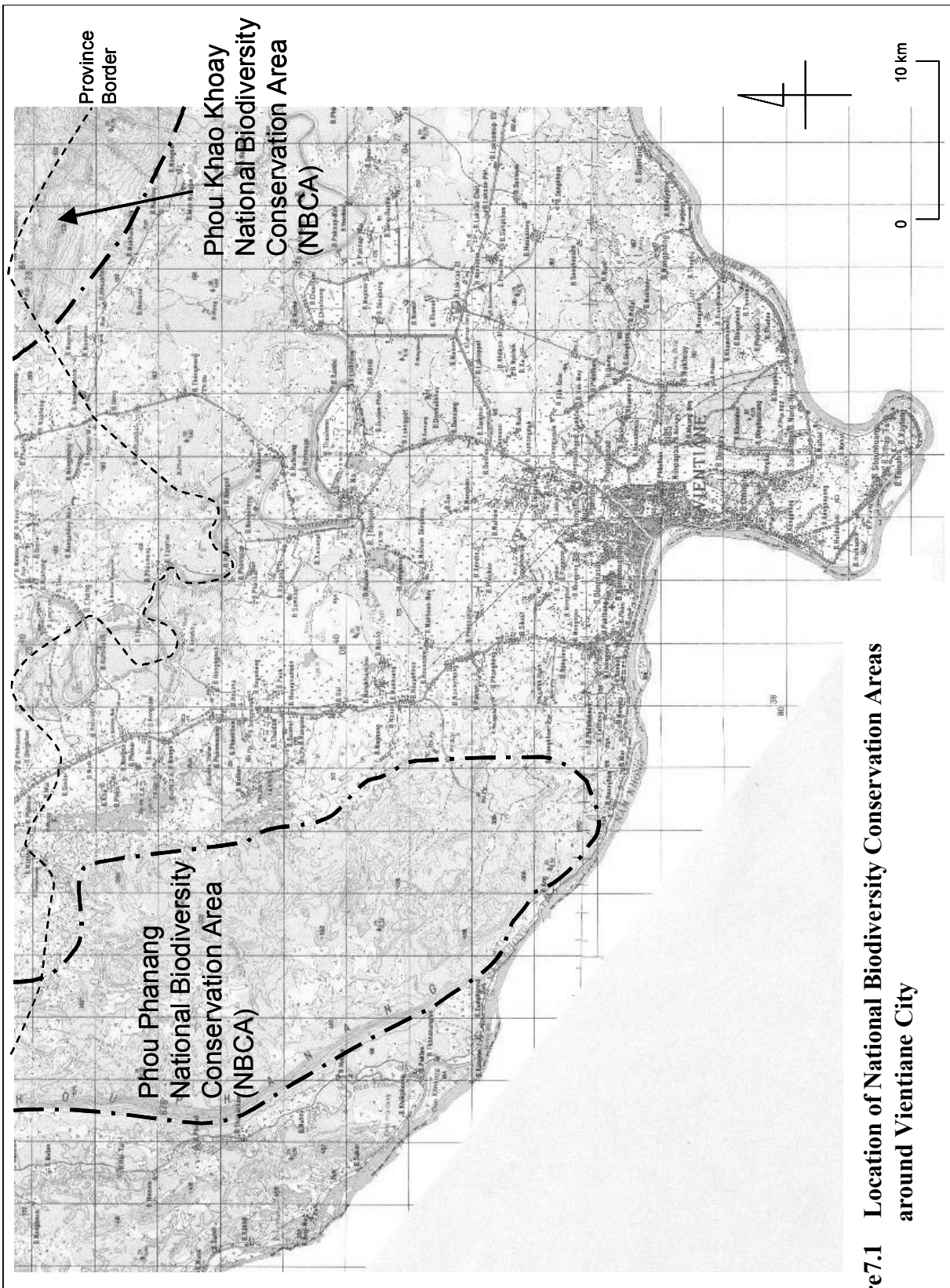


Figure7.1 Location of National Biodiversity Conservation Areas around Vientiane City

7.2 Social Environment

7.2.1 Water Law in Lao P.D.R.

Water and water resources usage is divided into three levels that are independently regulated. These water usage levels are as follows:

- Small-scale usage
- Medium-scale usage
- Large-scale usage

Small-scale usage is the use of water and water resources for the following purposes (which are not of business nature):

- General household requirement
- Athletics
- Fishing and raising fish or other aquatic animals
- Collecting rocks, gravel, sand, or vegetation in and around a water source
- Agro-forestry or raising livestock for family use and consumption

Such small-scale usage may be freely undertaken by any person or entity, unless otherwise prohibited by the State or local administration.

Medium-scale usage is the use of water or water resources for the following purposes:

- Constructing small dams or reservoirs for various purposes
- Harvesting rocks, gravel, sand, soil or trees in and around a water source that has a nominal effect on the environment
- Installing small water pumps for commercial purposes
- Using water sources for athletics, tourism, and various other cultural uses

Medium-scale usage must be approved by governmental agencies and must be registered with a written agreement.

Large-scale usage is the use of water or water resources for the following purposes:

- Constructing medium to large reservoirs
- Constructing buildings, plants and factories, and using large equipment and machinery in and around a water source
- Large-scale industrial plant production

Large-scale usage requires government approval. The approval will only be granted on the submission of a feasibility study and an impact assessment statement.

7.2.2 Forestry Law in Lao P.D.R.

Forests in the Lao P.D.R. are categorized as follows:

- Protected forests
- Forest reserves
- Production Forests
- Rehabilitated forests
- Degraded forests

Protected forests are forest areas to protect water resources and prevent soil erosion and

natural disasters, and strategic areas for national defense. Forest reserves are forest areas to preserve forest resources such as flora, fauna, for historical, cultural, educational, environmental and scientific reasons. Production forests are forest that are set aside for the development of the Nation's economy and to provide a source of sustenance for the Lao people. Rehabilitated forests consist of young reed forests that are protected so that they can be restored into mature national reed forests. Degraded forests consist of heavily damaged forest areas that are scheduled for reforestation or assigned to an individual or juristic entity for reforestation, permanent agro-forestry, livestock production or some other purpose according to National Socio-Economic and Environment Development Plan.

Wood and other forest products may be exploited only in the production forests. The production forests have been surveyed and allocated for exploitation. Wood and other forest products from a village production forest may be exploited for family consumption in according with the village regulations. Each family is entitled to a maximum of five cubic meters of wood. Trees planted by humans may also be exploited for family consumption. If such trees will be exploited for commercial purposes, the approval must be obtained from the Provincial or Prefectural Agriculture and Forestry Division.

Planting of trees and rehabilitation of forests must be conducted in according with the Government's forestry development plans and local forestry agency plans that regulate the species of tree to be planted and the location for such planting.

There are four levels of governmental agencies to administer forest and forest activity. There are as follows:

Ministry of Agriculture and Forestry
Provincial and Prefectural Agriculture and Forestry Division
District Agriculture and Forestry Office
Village Administrative Authorities

7.2.3 Utilization of Mekong River Bank

The Mekong River Bank in the study area is variously utilized by the local people and entities. Secondary or rural roads are constructed on the most part of the riverbank. Some parts of the riverbank are reclaimed by the local people and used for construction of barns or cultivation. In some area of the city center, restaurants and pubs stand in a row on the riverbank. Most areas along the riverbank in the suburbs of Vientiane are used as farmlands. Some riverbanks are directly planted farm products.

There are three major intake facilities, two facilities for water supply and one facility for irrigation, in the Study area. Some local people set a small pump and directly take water from Mekong River. Some local people also set a thin drainpipe for family use and directly drain their wastewater to Mekong River.

Many access paths to landing places, wharves and fishponds are constructed by the local people on most of the riverbank including steep bank. Shade of big trees such as pipal on the riverbank presents a place of recreation and relaxation to the local people. Some gabion banks

have the playing spots for the local children. Figure 7.2 shows the land use and location of major facilities along Mekong River bank.

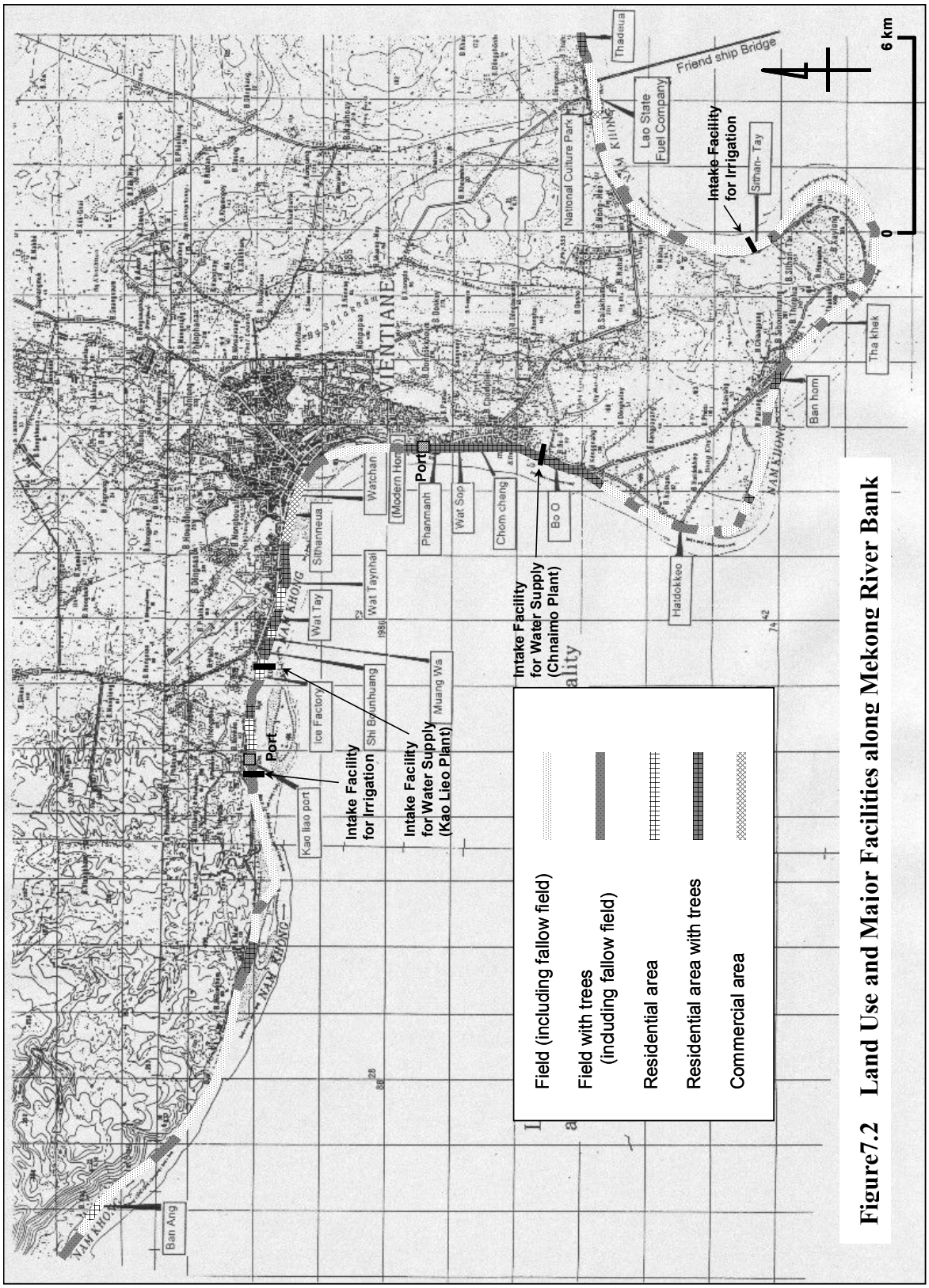


Figure7.2 Land Use and Maior Facilities along Mekong River Bank

8 SOCIOECONOMIC AND FINANCIAL CONDITIONS

8.1 Socioeconomic Condition of the Study Area

Objective areas of the Master Plan for riverbank protection are located along the Mekong River around Vientiane City. The city stretches over 130 km from east to west, and 30 km from north to south along left bank of the Mekong River. It is the capital city of Lao PDR with an area of 3,920km^2 and a population of approximately 639,000 in 2003. It has a status of special city, the same administrative level as provinces. Socioeconomic conditions of Lao PDR and Vientiane City are summarized in Table 8.1.

Table 8.1 Socioeconomic Condition of Lao PDR and Vientiane City

Item	Unit	Lao PDA	Vientiane City
1. Population in 2002	1,000	5,526	639 (2003)
Average annual growth rate (1995-2002)	%	2.73	2.51
Area	km^2	236,800	3,920
Population density	person/km^2	23	163
2. Labor force population (1995 Census)	1,000	2,221	235
Unemployment rate (1995 Census)	%	2.4	4.3
3. Gross Domestic Product			
Current Price (2002)	Bn Kip	18,259	6,128 (2002/03)
In US$ (2002)	M US$	1,815	582 (2002/03)
Average growth rate (1992-2002, actual)	%	6.3	9 (2002/03)
4. Growth/share of industry (2002)			
- Agriculture	%	4.1/50.1	5/21
- Industry & construction	%	6.2/23.5	11/55
- Services, tourism & trade	%	8.3/26.4	9/24
5. GDP per capita	US$/person	329	887
6. Total value of exports (2002)	M US$	321.0	
Total value of imports (2002)	M US$	513.6	
7. Inflation rate			
1998	%	61.4	
1999	%	134.0	
2000	%	27.0	
2001	%	7.8	
2002	%	10.6	
2003	%	15.5	
8. Foreign exchange rate			
1998	Kip/US$	3,296	
1999	Kip/US$	7,106	
2000	Kip/US$	7,846	
2001	Kip/US$	8,871	
2002	Kip/US$	10,060	
2003	Kip/US$	10,545	
February 1, 2004	Kip/US$	10,420	

Source: 1) The National Poverty Eradication Programme, A Comprehensive Approach to Growth and Development, September 2003
2) Statistical Yearbook 2002, NSC 2003
3) Results from the Population Census 1995, NSC, Apr.1997
4) Basic Statistics of Vientiane Capital City 2002-2003, Nov.12, 2003
5) Summary of Economic Development in 2002/03 and Development Policy for 2003/04 in Vientiane City, Nov.12, 2003
6) Country Report Laos, EIU, November 2003

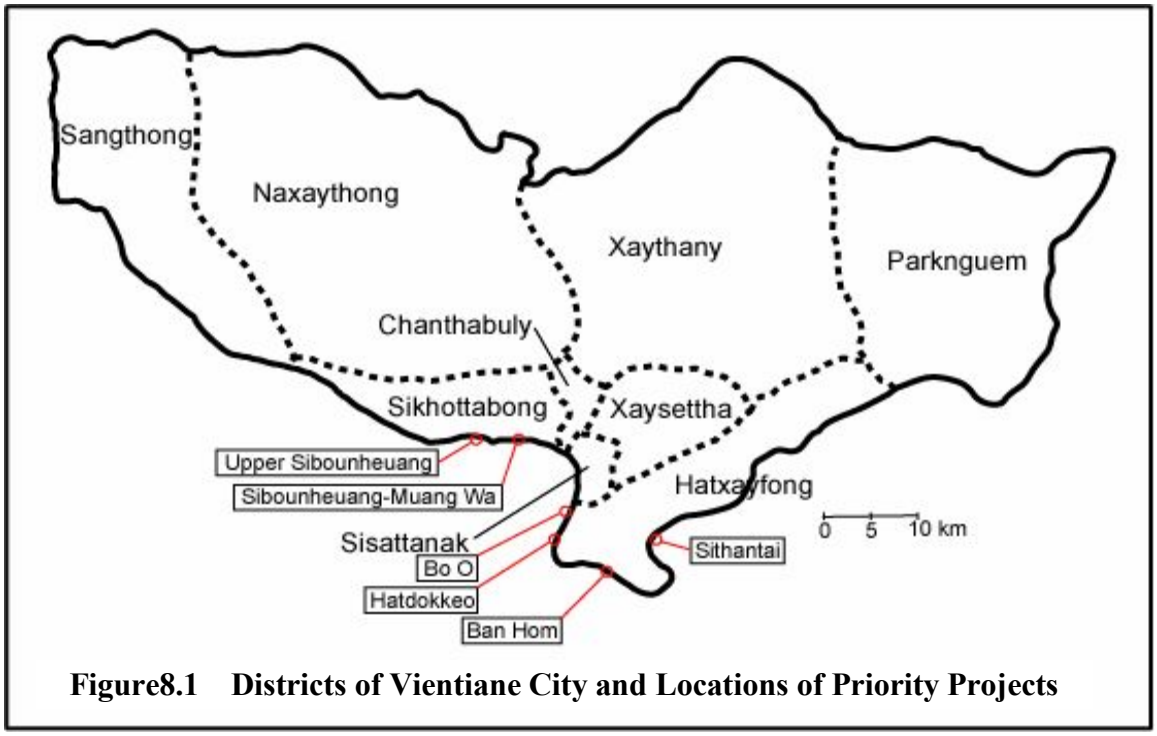


Figure8.1 Districts of Vientiane City and Locations of Priority Projects

Vientiane City consists of nine districts of Chanthabuly, Sikhottabong, Xaysettha, Sisattanak, Naxaythong, Xaythany, Hatxayfong, Sangthong, and Parknguem. The districts are further divided into 496 Villages. Figure 8.1 shows location of the districts and the high priority stretches nominated for the Master Plan. As seen in the figure, all the high priority stretches are located in two districts of Sikhottabong and Hatxayfong. Population growth of Vientiane City by district is shown in Table 8.2.

Table 8.2 Population Growth of Vientiane City

District	Population (1,000)			Average Annual Growth (%)		
	1995	2000	2003	1995-2000	2000-2003	1995-2003
Chanthabuly	58,855	61,253	65,307	0.8	2.2	1.3
Sikhottabong	74,251	77,255	93,761	0.8	6.7	3.0
Xaysettha	75,255	79,205	87,661	1.0	3.4	1.9
Sisattanak	58,178	57,822	62,550	-0.1	2.7	0.9
Naxaythong	44,104	49,604	54,978	2.4	3.5	2.8
Xaythany	97,829	113,699	135,529	3.1	6.0	4.2
Hatxayfong	64,962	70,351	73,233	1.6	1.3	1.5
Sangthong	16,728	20,728	22,764	4.4	3.2	3.9
Parknguem	33,945	38,862	43,460	2.7	3.8	3.1
Total	524,107	568,779	639,243	1.6	4.0	2.5

Source: Population Census 1995, NSC
Population and household of Vientiane 2000 from database of NSC
Basic Statistics of Vientiane Capital City 2002 - 2003

Sikhottabong District, where Upper Sibounheuang and Sibounheuang - Muang Wa locate, shows significant population growth in the recent years with annual growth rate of 6.7%. Meanwhile, Hatxayfong District, where Sithantai, Ban Hom, Hatdokkeo, and Bo O belong to, indicates relatively low and stable population growth these eight years.

8.2 Socioeconomic Development Plans

The Government of Lao PDR has three kinds of socioeconomic development plans at national level. They are a long-term plan up to 2020, a medium-term plan up to 2010, and a five years plan (2001 - 2005). Based on these plans, the National Poverty Eradication Programme has also been prepared. Outlines of the plans are as described in the following sub-sections.

8.2.1 Long-term Development Plan to 2020

The long-term development plan to 2020 especially emphasizes that the socio-economic development of Lao PDR should progress efficiently, continuously, and evenly with keeping balance among economic growth, socio-cultural development, and environmental preservation. Also efforts to eliminate poverty are the key target of the development plan. The major objectives of the development plan are summarized below:

- To develop agriculture, industry, and service sectors simultaneously step-by-step improving living standard of the people both physically and mentally,
- To disseminate education and health services through out the country,
- To enlarge national cultural attractiveness,
- To improve social welfare,
- To improve the capability of human resources, and
- To open up broadly for international cooperation and integration under the world's changing environment

The concrete targets of the plan for 2020 are summarized in Table 8.3.

Table 8.3 Targets of Development Plan for 2020

Item	Target
1. Annual GDP growth	around 7% p.a.
2.Total investment	25 - 30% of GDP
Public investment	12 - 14% of GDP
Private investment	13 - 16% of GDP
National saving	at least 15% of GDP (in 2020)
3.Population	8.3 million (in 2020)
Average growth rate	2.2% p.a.
4.GDP per capita	1,200 - 1,500 US dollars
5.Literacy rate (15years and over)	90%
6.Life expectancy	70 years

8.2.2 Medium-term Strategy to 2010

To achieve the long-term strategy, the Government divides the period of development into to stages: 2001 - 2010 and 2011 - 2020. The main targets for 2010 are:

- To accelerate improving a basic economic factor supporting strong and stable economic growth
- To expand agricultural production, especially import-substitution, and to eliminate slash and burn cultivation,
- To reduce poverty,
- To grow infant industries, qualified and sufficient human resources to be ready for industrialization,
- To be a commercial center of the region,
- To develop basic infrastructure such as electricity network, hydro-power, processing industry, cross-country highways, transportation system, communication, etc., and
- To reduce various dangerous tropical diseases such as malaria and diarrhea by introducing effective health programs

The concrete targets of the plan for 2010 are summarized in Table 8.4.

Table 8.4 Targets of 2010 Development Plan

Item	Target
1. Annual GDP growth	7% p.a.
2.Population	6.7 million (in 2010)
Population growth rate	2.4% p.a.
3.GDP per capita	700 - 750 US dollars
4.Literacy rate (15 years and over in 2010)	84%
5.Life expectancy	67 years

8.2.3 Five Years Socio-economic Development Plan V (2001 - 2005)

The plan includes the following challenges:

- To ensure the progress of social security and political stability,
- To create continuous economic growth,
- To reduce current poverty levels by half,
- To achieve a food security program,
- To solve a problem of slash and burn cultivation and to strictly prohibit opium plantation by allocating new permanent jobs for the people,
- To enhance national saving,
- To seriously pay attention to both state and private enterprises reform,
- To develop human resources in various areas, and
- To support the development of modern industry in the next stage

The concrete targets of the plan are summarized in Table 8.5.

Table 8.5 Targets of Five Years Socio-economic Development Plan V (2001 - 2005)

Item	Target
1. Annual GDP growth	7 - 7.5% p.a.
2.Annual growth and share by industry	
(1) Agriculture and forestry	4 - 5% p.a./47% of GDP
(2) Industry	10 - 11% p.a./26% of GDP
(3) Services	8 - 9% p.a./27% of GDP
3.Annual inflation rate	**LESS THAN 10%**
4.Exchange rates	Stabilize
5.Annual budget revenue	To increase up to 18% of GDP (during 2004-2005)
Budget deficit	To decrease to 5% of GDP
6.Trade balance	To decrease deficit to 6% of GDP
7.Public investment	12 - 14% of GDP
National saving	12% of GDP (in 2005)
8.Population	5.9 million (in 2005)
9.GDP per capita	500 - 550 US dollars

8.3 Financial Conditions

8.3.1 National Revenue and Expenditure

Fiscal balance of the government finance of Lao PDR runs a structural deficit, with revenue covering approximately three-quarters of expenditure. Table 8.6 shows revenue and expenditure of the national government for the recent 10 years. The government revenue and expenditure have grown significantly on a nominal basis, but actually it was caused by serious inflation especially surged in the aftermath of the Asian economic crisis. Average annual growth rate of both the revenue and expenditure is approximately 8% on an actual basis, which is higher than that of economic growth rate of the country (6.3%) during the same period.

Table 8.6 Government Finance

Unit: Billion Kip

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total revenue	131	156	209	241	284	335	823	1,403	2,485	2,317	2,858
Total expenditure	175	189	266	310	375	463	1,146	1,709	3,016	3,055	3,749
of which current expenditure	93	130	148	166	173	200	299	541	1,095	1,296	1,419
of which capital expenditure	82	58	118	144	202	264	847	1,167	1,921	1,759	2,329
Fiscal balance	-45	-33	-57	-69	-91	-128	-323	-305	-531	-738	-890
Ratio (revenue/expenditure)	75%	83%	78%	78%	76%	72%	72%	82%	82%	76%	76%

Source: The National Poverty Eradication Programme, September 2003

The fiscal deficit has been covered by foreign and domestic financing including ODA loans and grants. According to Foreign Aid Report 2001-2002, around three-quarters of the capital expenditure come from ODA on average as shown in Table 8.7.

Table 8.7 Source of Capital Expenditure Budget

Unit: Million US$

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02
Capital Expenditure	210	216	240	276	303	235	245	192
from ODA	166	161	181	204	233	171	147	93
from Government	44	55	59	72	70	64	98	99
Ratio of ODA	79%	75%	75%	74%	77%	73%	60%	48%

Source: Foreign Aid Report 2001 - 2002, June 2003

The National Socio-economic Development Plan (NSEDP) 2001 - 2005, the Medium Term Expenditure Framework (MTEF), and the Public Investment Plan (PIP) set out a sharp decline in the fiscal deficit by increase revenue and a better balance between current and capital expenditure as one of the crucial targets.

At the end of 2000, the total external debt of Lao PDR was US$2.5 billion, equivalent to 147% of the GDP. Nearly all of this is medium- and long-term ODA loans with low interest

rates and long repayment schedules, of which 43% is from multilateral sources and 57% from bilateral creditors. Total debt service aggregated to US$37.4 million in 2002. Debt-service ratio (DSR), a kind of country risk assessment factors, has been increasing gradually and has reached 11.7% in 2002, which is still manageable level of indebtedness. The National Poverty Eradication Programme clearly states that the Government firmly commits to gradually lessen the country's high dependency on ODA.

Table 8.8 Foreign Debt Service

Million US$

	1996	1997	1998	1999	2000	2001	2002
Total value of export	317.2	312.7	336.8	301.5	330.3	309.8	321
Total debt service	15.5	19	21.3	28.4	28.8	34.9	37.4
Debt-service ratio	4.9%	6.1%	6.3%	9.4%	8.7%	11.3%	11.7%

Source: The National Poverty Eradication Programme, September 2003

8.3.2 Expenditure for Riverbank Protection

With regard to riverbank protection of the Mekong River around Vientiane City, in principle, MCTPC is responsible for planning, design, and management and DCTPC of Vientiane City is responsible for implementation of construction works. Figure 8.2 shows extension of riverbank protection works around Vientiane City implemented so far. The significant extension in FY 2002/03 is achieved by the pilot riverbank protection works implemented in this JICA study.

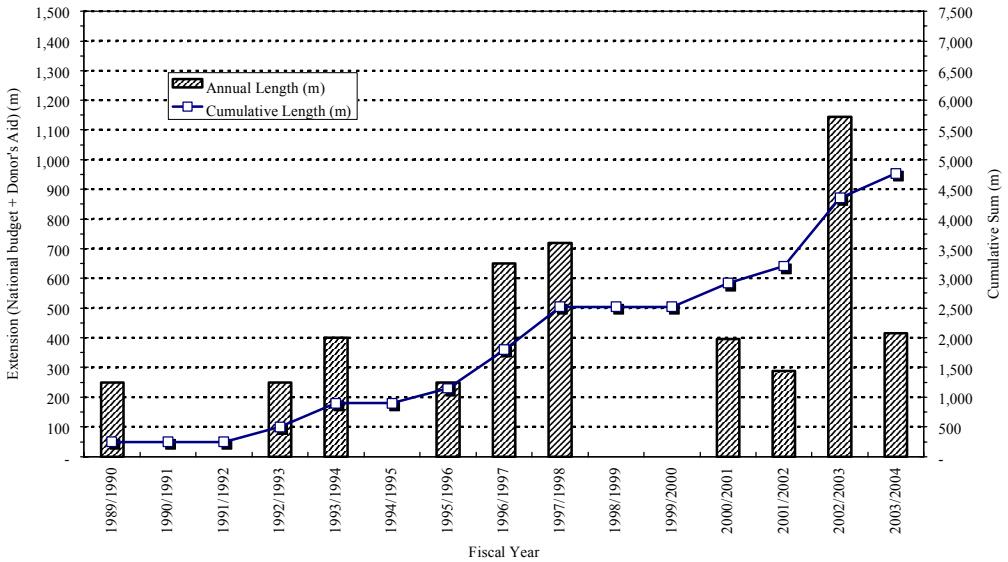


Figure 8.2 Extension of Existing Bank Protection Works in Vientiane

Riverbank protection works of the Mekong River is basically implemented by the budget of MCTPC except some urgent cases. In 2002 and 2003, DCTPC of Vientiane City implemented several riverbank protection works with the budget of Vientiane City as urgent works after the severe flood in 2002.

MCTPC is the largest ministry in public investment of the Government, which accounts for

approximately 40% of the total public investment. Table 8.9 shows changes of annual budget of MCTPC since FY1996/97.

Table 8.9 Budget of MCTPC

Unit: Billion Kip

	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
MCTPC Total	65.3	130.4	391.3	670.9	705.1	420.3	519.5	760.6
of which Road Construction (A)	65.0	75.0	168.4	575.0	473.1	410.2	345.2	615.5
Ratio of Road Construction	99%	57%	43%	86%	67%	98%	66%	81%
of which River works (B)	0.5	0.5	0.3	1.6	1.4	2.6	15.6	4.1
Ratio (B)/(A)	0.7%	0.6%	0.1%	0.3%	0.3%	0.6%	4.5%	0.7%

Source: MCTPC

Total budget of MCTPC for FY2003/04 is 761 billion Kip (equiv. US$72.8 million), of which 615 billion Kip (equiv. US$58.9 million) or 81% is allocated for road construction. On the other hand, investment for river works is extremely small. The changes of the annual investment indicate that the river works has been implemented on an ad hoc basis. The annual investment has remained less than 1% of the budget for road construction except FY2002/03, when JICA Pilot Works were implemented as illustrated in Figure 8.3.

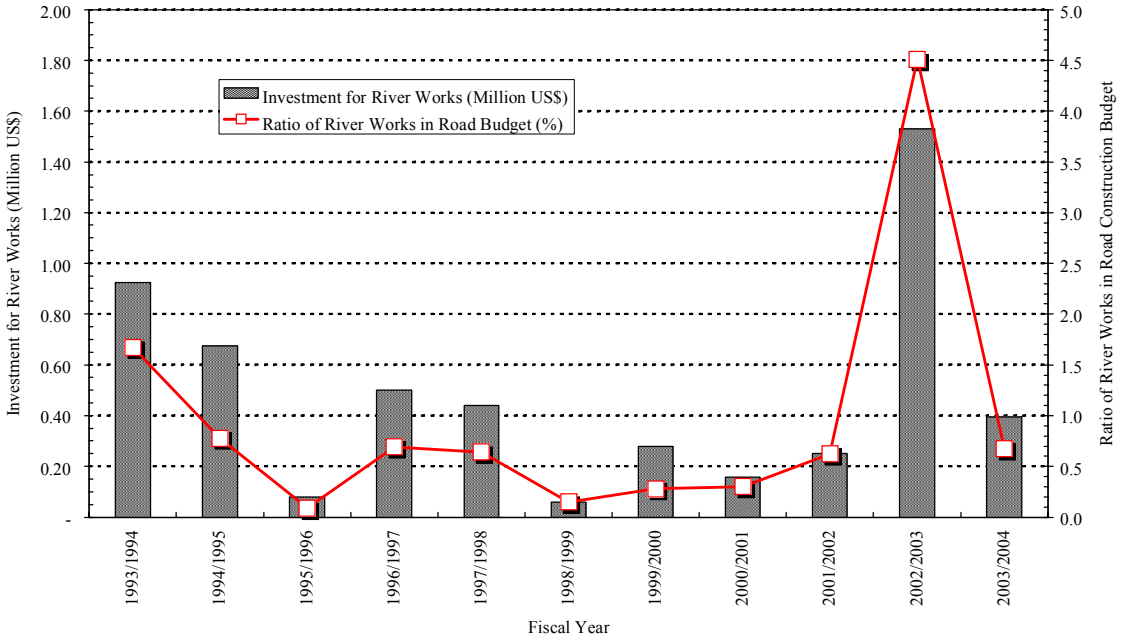


Figure 8.3 Investment for River Works in Lao PDR

Figure 8.4 shows extension of riverbank protection works around Vientiane City by source of finance. Before FY1996/97, almost all riverbank protection works had been implemented by external assistance. Some of the works were implemented by Mekong River Committee with financial assistance of Australia. Since FY1997/98, riverbank protection works has been gradually undertaken by national budget. However, on the contrary, external assistance for riverbank protection has decreased significantly except Japanese test construction.

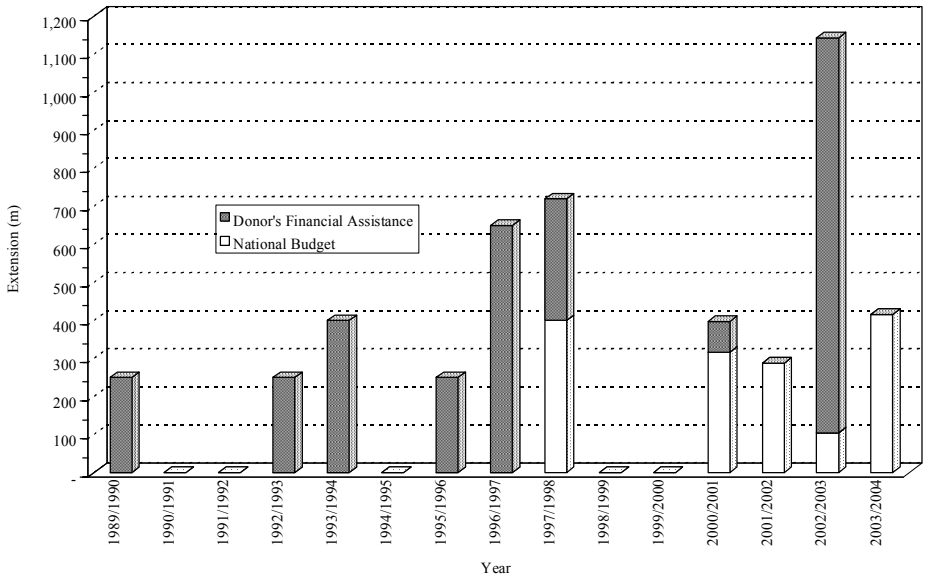


Figure 8.4 Riverbank Protection Works around Vientiane City by Source of Finance

Though the riverbank protection works are one of the indispensable public investments to conserve national land, maintain the border, and protect valuable assets of the nation and people, it is difficult to value effects and also their direct beneficiaries are quite limited. Therefore, the bank protection works may not go with ODA schemes. MCTPC has a plan to invest 2,300 million Kip (equiv. US$220,000) for FY2003/04 from the national budget for riverbank protection around Vientiane City. It is advisable that MCTPC will steadily implement the riverbank protection works according to financially achievable plan with national budget.