

Chapter 9 Present Situation of Inland Waterways in the Red River Delta

9.1 Overview of inland waterways

There are 2,360 rivers, canals and streams with a total length of 41,900 km in Vietnam. The length of rivers and canals exploited for transport is 11,226 km, accounting for 26% of the total length. The length of rivers and canals under management (with investment for maintenance, provided with sign boards, etc.) is 8,036 km (central management: 6,254 km, local management: 1,782 km).

River density in Vietnam is 0.127 km/km² (Northern region: 0.17 km/km²), which is 3 times higher than that of Bangladesh (0.04 km/km²), 12 times higher than that of Myanmar (0.01 km/km²) and Thailand (0.01 km/km²).

Rivers and canals which can be used for transport are classified into 6 classes according to Vietnamese Standard "Technical Classification of Inland Waterways (TCVN 5662-92, effective from 23rd May 1992)". The technical classification is applied to rivers and canals with the depth variation from 1m to 3m and from 1.2m to 4.0m respectively. In case of the waterways being more than 3m in depth, the dimension of the navigation channels and engineering works will be determined by competent authority.

Table 9.1.1 Technical Classification of Inland Waterways

(Unit : m)

Class	Dimension of Navigation Channel					Dimensions of Works			
	River		Canal		Radius	Bridge			Crossing Electric Wire
	Water Depth	Bottom Width	Water Depth	Bottom Width		Span		Air Clearance	Air Clearance
						River	Canal		
I	>3.0	>90	>4.0	>50	>700	80	50	10	12
II	2.0-3.0	70-90	3.0-4.0	40-50	500-700	60	40	9	11
III	1.5-2.0	50-70	2.5-3.0	30-40	300-500	50	30	7	9
IV	1.2-1.5	30-50	2.0-2.5	20-30	200-300	40	25	6(5)	8
V	1.0-1.2	20-30	1.2-2.0	10-20	150-200	25	20	3.5	8
VI	<1.0	10-20	<1.2	10	60-150	15	10	2.5	8

Note: Values in brackets should only be used with agreement of competent authority.

Magnetic safety clearance is not included in values of crossing electric wire.

Source: Technical Classification of Inland Waterways (TCVN 5662-92, effective from 23rd May 1992).

Technical classification for each waterway stretch was declared in 1992 by TCVN 5662-92 and revised in 2000 by the decision of Director of VIWA (No. 862/Qd-CDS, 25/May/2000).

Besides, VIWA decides management class (1, 2 and 3) for major inland waterways for its internal use such as investment prioritizing.

In the Northern region, the rivers are concentrated mainly on the Red River Delta, and most of them are exploited in natural state. The rivers are subject to the meteorological and hydrological regime of the Northern region. Peculiarity of rivers in the Northern region are summarized as follows:

- Minimum width of channel bottom: 30m - 60m
- Minimum depth: 1.5m - 2m
- The flood season: from June to October
- The low water season: from November to May
- The water level difference between the two seasons: 5m - 7m (over 10m in some parts)
- In the flood season, the current velocity is high.
- In the low water season, the water depth and the bend radius are limited.
- After the flood, shoals are usually formed, which change year by year.
- In river mouths, the sediments develop complicatedly.

There are many rivers that can be used to enhance living standards and promote socio-economic development, but they have not been fully exploited. General problems related to the navigational channel are as follows:

(1) Severe natural river conditions

The rivers are exploited mainly in their natural state. They meander largely and sometimes change their course. In some areas, the water depth in dry season is shallow and width is insufficient. They do not meet the technical standards in water depth, width and bend radius.

(2) Shortage of clearance

Many bridges have not met the clearance height and span requirements for vessel. Bridge piers become new horizontal obstacles when the alignment of navigational channel is forced to change due to natural forces. Some electric power lines are

also short of clearance.

(3) Obstacles

There are many trees from upstream, dumped scrap iron and other objects that need to be removed from the channels.

(4) Sedimentation

The river mouths, that of the Red river in particular, are shallow in water depth and unable to accommodate large vessels. Other parts of the rivers suffer from sedimentation problems. Sedimentation in rivers is serious and complicated. To cope with this issue, dredging is usually carried out rather than constructing facilities such as groins. However, there are some cases where the construction of such facilities is more economical in the long term.

(5) Accidents

Vessel accidents occur frequently in narrow sections of the Red River Hanoi segment, Kinh Thay River, Lach Tray River, Phi Liet River, etc., although main reasons of accidents are reported to be carelessness and violation of traffic regulations.

(6) Navigation Aids

The navigation aids system and equipment are still inadequate. The navigation aids equipment should be replaced as the need arises, but this is not being done or not being done properly in some cases.

(7) Lack of investment fund

Above-mentioned problems are mainly due to a shortage of investment funds.

9.2 Inland waterways in the Red River Delta

9.2.1 River system

In the Northern region, Red River and Thai Binh River are the two major river systems. These river systems are linked together by Duong and Luoc Rivers. Both make a convenient waterway network.

(1) Red River system

Red River system is the largest river system in the Northern region. The main stream of Red River system runs in northwest - southeast direction with the length of 1,126km, of which 529km run through Vietnam from Lao Cai to Ba Lat estuary. The slope of the river from Lao Cai to Viet Tri (285 km) is about 23cm/km, from Viet Tri to the sea (244 km) is about 3 cm/km.

Red River system has a lot of tributaries of which **Da River** and **Lo River** are of most importance. Da River has a total length of 1,010 km, of which 527 km run through Vietnam. Lo River has a total length of 470 km, of which 274 km run through Viet Nam. These main tributaries join with the main stream of Red River at Viet Tri and form a complete river system. The upper stretch of Red River from Viet Tri is sometimes called as **Thao River**.

This river system gathers flooding from the mainstream and tributaries, and then brings about high flooding in the Northern region. Red River is flooded in 5 months (from June to October), the amount of water flow accounts for 75% of the whole year, the highest flooding time is in August. The danger of flooding in Red River system is that flooding happens in the whole delta of Red River, not in partial areas.

After the construction of Hoa Binh hydraulic power dam, the combination among flooding in different areas has been limited, although flooding in Thao and Lo Rivers still combine to create a high flooding in downstream area, especially in Hanoi.

Flooding in downstream of Red River is decreased in low tide period and water drainage can be done through **Duong River**, **Luoc River** and **Tra Ly River**. Therefore, flooding in Red River has influence on flooding in **Thai Binh River**.

Dry season in Red River lasts 7 months (from November to May), water level is lowest in March. In dry season, there are a lot of shallow areas created in navigation channels running through Red River. This is the obstacle to navigation activities in Red River system.

In the south of Red River, there are some rivers including **Day River** (237 km) and **Ninh Co River** (61 km to buoy zero). Ninh Co River diverts from Red River at Mom Ro bifurcation and runs to Lach Giang estuary. **Dao (Nam Dinh) River** (33.5 km) connects Red River with Day River.

(2) Thai Binh River system

Thai Binh River system includes three rivers: **Cau River**, **Thuong River**, **Luc Nam River**. Thai Binh River originates from Pha Lai, receiving water from Red River through Duong and Luoc Rivers two times as much as from Thai Binh River. Therefore, Thai Binh River can be considered as a part of Red River System.

Cau River (264km) is considered mainstream of Thai Binh River system, originating from Na Dinh area running through Bac Can, Cho Moi, Thai Nguyen to Pha Lai. Thuong River (157km) comes from Lang Man area, running into Pha Lai. Luc Nam River (167km) flows from Chieng Chang to Pha Lai.

In Thai Binh River system, the flooding season in Cau River is from June to October. The amount of water flow in flooding season accounts approximately for 70% of the whole year. Tide comes to Chu (Luc Nam River) and Bac Giang (Thuong River) in dry season.

In Northern East, Thai Binh river system includes rivers such as **Da Bach River** (23.0km) running from the confluence of **Mao Khe River** and **Phi Liet River** to Pha Rung (N3 Chanh Bach Dang). **Bach Dang River** (19.0km) stretches from Pha Rung to Nam Trieu estuary. **Chanh River** (20.5km) runs from Pha Rung to Lach Huyen. **Cam River** (34.5km) runs from Nong Confluence to Cam estuary.

Connecting rivers to Thai Binh rivers are **Kinh Thay River** (44.5km), **Kinh Mon River** (45.0km), Phi Liet River (8.0km) and Mao Khe River (18.0km). These rivers flow into the sea through Nam Trieu and Cam estuaries. Besides, **Lach Tray River** (23.0km) going to Lach Tray estuary and **Van Uc River** (21.5km) going to Van Uc estuary connect to Thai Binh River system.

9.2.2 Major IWT corridors

Though there are many transport routes by inland waterways in the Northern region, the following four corridors (see **Table 9.2.1**) are particularly important and indispensable for IWT in the Red River Delta.

Table 9.2.1 Major IWT Corridors in the Red River Delta

No.	Corridor	Main River	Length (km)	Classification	LAD (m)
1	Quang Ninh - Hai Phong	Kinh Thay, Duong Red	37 - 99	II (I+II)	1.5
	Hai Phong - Hanoi		150	III (II+III)	
	Hanoi - Viet Tri		75	II	
2	Quang Ninh - Hai Phong	Luoc, Dao, Day	37 - 99	II (I+II)	1.8
	Hai Phong - Ninh Binh		219	III (I+II+III)	
3	Cua Day - Ninh Binh	Day	72	I	3.6
4	Lach Giang - Hanoi	Ninh Co, Red	187	II	2.0

Table 9.2.2 Passing Vessels in the Red River Delta counted by IWMS (2001)

No.	IWMS (sub-station)	Corridor	River	km+ ADB	km+ VIWA	<50DWT		51-100DWT		101-300DWT		>300DWT		Total	
						No.	Total DWT	No.	Total DWT	No.	Total DWT	No.	Total DWT	No.	Total DWT
3	Viet Tri	1	Lo	104	114	57,020	1,025,327	10,330	878,050	27,362	2,122,403	6,055	1,937,600	100,767	5,963,380
4	Son Tay	1	Red	19	22	34,262	1,421,790	58,991	5,321,355	2,158	431,600	824	494,400	96,235	7,669,145
5	Chem	1	Red	55	55	11,956	514,425	35,312	2,726,500	30,000	3,000,000	6,068	1,824,000	83,336	8,064,925
6	Hanoi	1,4	Red	69	71	2,542	38,654	13,846	924,200	16,483	2,340,360	253	77,000	33,124	3,380,214
8	Duong Ha	1	Duong	11	10	424	9,188	6,637	627,740	8,494	1,525,768	2,261	878,300	17,816	3,040,996
9	Minh Dao	1	Duong	31	(-)	1,440	57,600	7,800	546,000	10,118	2,547,000	3,948	2,368,800	23,306	5,519,400
10	Bac Giang		Thuong	(-)	31	4,200	189,000	2,520	176,400	4,992	748,800	900	540,000	12,612	1,654,200
11	Yen Tap		Cau	(-)	74	4,200	210,000	4,800	336,000	11,916	2,383,200	396	316,800	21,312	3,246,000
12	Pha Lai		Thai Binh	(-)	2	4,464	223,200	7,092	496,440	15,720	3,144,000	3,960	2,376,000	31,236	6,239,640
16	Yen Hung	1,2	Chanh	5	4	2,400	120,000	6,000	420,000	9,840	2,460,000	3,960	2,376,000	22,200	5,376,000
Total						122,908	3,809,184	153,328	12,452,685	137,083	20,703,131	28,625	13,188,900	441,944	50,153,900
Fleet Share						28%	8%	35%	25%	31%	41%	6%	26%	100%	100%
Average DWT Size						31		81		151		461		113	

Note) A barge train (e.g. Pusher + 4 barges) is counted as 1 vessel not 5 vessels.

Note) Data of IWMS which does not distinguish the class of (>300DWT) is omitted.

Source) VIWA

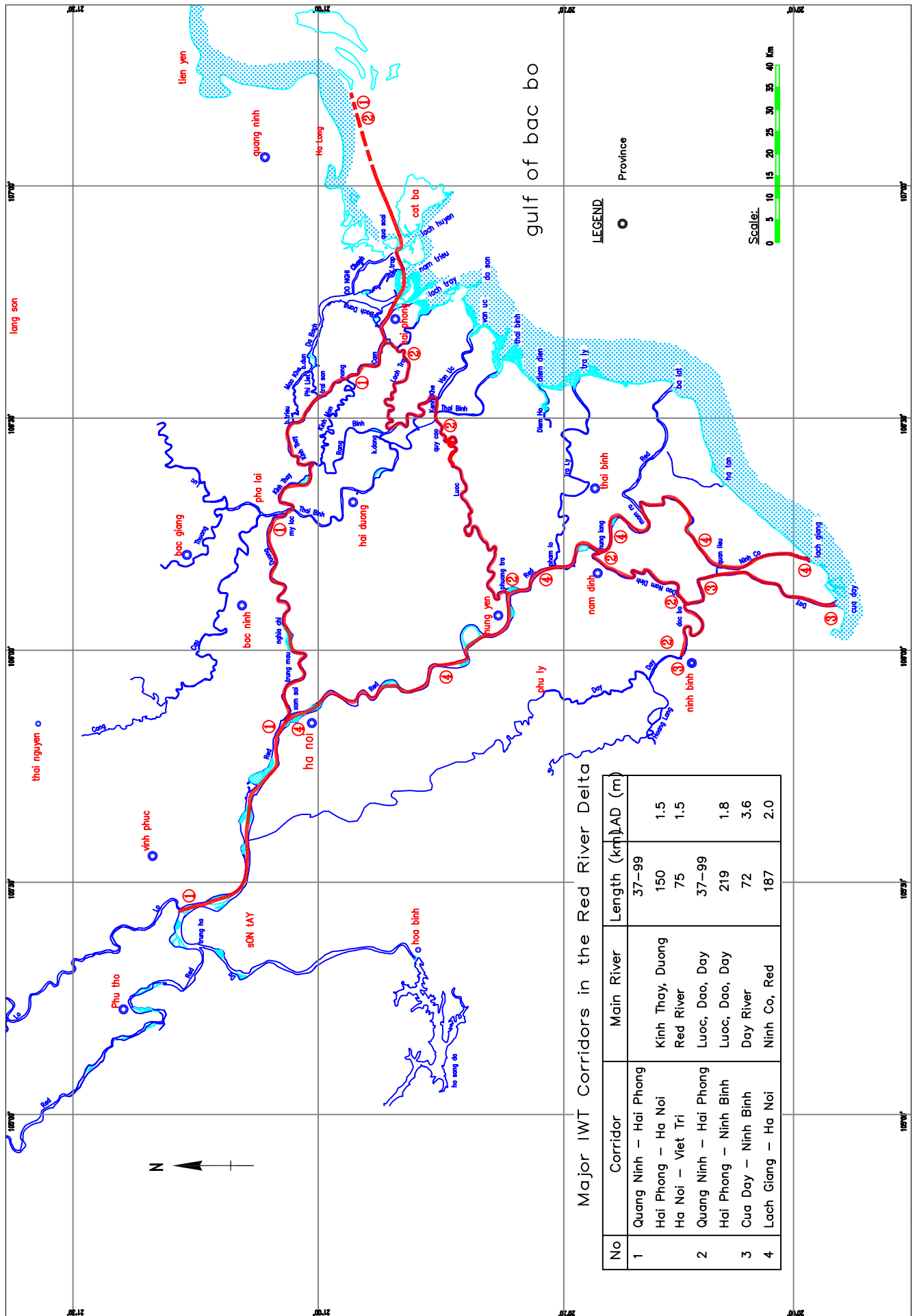
Table 9.2.3 Passing Vessels in Sections nearby Hanoi counted by IWMS (2001)

No.	IWMS (sub-station)	Corridor	River	km+ ADB	km+ VIWA	<50DWT		51-100DWT		101-300DWT		>300DWT		Total	
						No.	Total DWT	No.	Total DWT	No.	Total DWT	No.	Total DWT	No.	Total DWT
5	Chem	1	Red	55	55	11,956	514,425	35,312	2,726,500	30,000	3,000,000	6,068	1,824,000	83,336	8,064,925
6	Hanoi	1,4	Red	69	71	2,542	38,654	13,846	924,200	16,483	2,340,360	253	77,000	33,124	3,380,214
8	Duong Ha	1	Duong	11	10	424	9,188	6,637	627,740	8,494	1,525,768	2,261	878,300	17,816	3,040,996
9	Minh Dao	1	Duong	31	(-)	1,440	57,600	7,800	546,000	10,118	2,547,000	3,948	2,368,800	23,306	5,519,400
Total						16,362	619,867	63,595	4,824,440	65,095	9,413,128	12,530	5,148,100	157,582	20,005,535
Fleet Share						10%	3%	40%	24%	41%	47%	8%	26%	100%	100%
Average DWT Size						38		76		145		411		127	

Note) A barge train (e.g. Pusher + 4 barges) is counted as 1 vessel not 5 vessels.

Note) Data of IWMS which does not distinguish the class of (>300DWT) is omitted.

Source) VIWA



Major IWT Corridors in the Red River Delta

No	Corridor	Main River	Length (km)	AD (m)
1	Quang Ninh – Hai Phong Hai Phong – Ha Noi Ha Noi – Viet Tri	Kinh Thay, Duong Red River	37–99 150 75	1.5 1.5
2	Quang Ninh – Hai Phong Hai Phong – Ninh Binh	Luoc, Dao, Day Luoc, Dao, Day	37–99 219	1.8
3	Cua Day – Ninh Binh	Day River	72	3.6
4	Lach Giang – Ha Noi	Ninh Co, Red	187	2.0

Figure 9.2.1 Major IWT Corridors in the Red River Delta

Table 9.2.4 Temporary Classification of Waterways in the Northern Region (1)

No	Navigation Routes	Through Rivers	Length (km)	Class	From	To
1	Hanoi - Hai Phong (via Luoc River)		210.5	III		
a		Hong	76	II	Ha Noi Port	N3 Cua Luoc
b		Luoc	72	II	N3 Cua Luoc	Quy Cao ferry
c		Khe canal, Van Uc	25.5	III	Quy Cao ferry	N3 Dong Canal
d		Lach Tray	32.5	III	N3 Dong canal	N3 Dao (Hai Phong)
e		Dao	3	III	N3 Dao river	N3 Cement factory
g		Cam	1.5	II	N3 Cement factory	Hai Phong Port
2	Ha Noi - Hai Phong (via Duong River)		150.5	III		
a		Hong	10	II	Ha Noi Port	N3 Cua Dau
b		Duong	68	III	N3 Cua Dau	N3 My Loc
c		Thai Binh	3	III	N3 My Loc	N3 Lau Khe
d		Kinh Thay	44.5	III	N3 Lau Khe	N3 Trai Son
e		Han	7	III	N3 Trai Son	N3 Nong
g		Cam	18	II	N3 Nong	Hai Phong Port
3	Ha Noi - Viet Tri		75.5	II		
a		Hong	74.5	II	Ha Noi port	N3 Viet Tri
b		Lo	1	II	N3 Viet Tri	Viet Tri port
4	Ha Noi - Lach Giang		186.5	II		
a		Hong	131.3	II	Ha Noi port	N3 Mom Ro
b		Ninh Co	55	II	N3 Mom Ro	Lach Giang
5	Ha Noi - Nam Dinh		111.5	II		
a		Hong	106	II	Ha Noi port	N3 Hung Long
b		Dao - Nam Dinh	5.5	II	N3 Hung Long	Nam Dinh port
6	Hai Phong - Quang Ninh		61.5	II		
a		Cam, Ruot Lon	8.5	II	Hai Phong port	N 3 Dong Vang Chau
b		Bach Dang	8	I	N 3 Dong Vang Chau	N3 Chanh, Bach Dang
c		Chanh	20.5	II	N3 Chanh, Bach Dang	Qua Xoai
d		Ba Mom channel	15	I	Qua Xoai	Vung Dai island
e		Ha Long bay channel	9.5	I	Vung Dai island	Hon Gai port
7	Hai Phong - Ninh Binh		219	III		
a		Route 1 (b, c, d, e, g)	134.5		Hai Phong port	N3 Cua Luoc
b		Red	30	II	N3 Cua Luoc	N3 Hung Long
c		Dao Nam Dinh	33.5	II	N3 Hung Long	N3 Doc Bo
d		Day	21	I	N3 Doc Bo	Ninh Binh Port
8	Hai Phong - Pha Lai		90	III		
a		Cam	18	II	Hai Phong port	N3 Nong
b		Kinh Mon	45	III	N3 Nong	N3 Keo
c		Kinh Thay	20	III	N3 Keo	N3 Nau Khe
d		Thai Bin	7	III	N3 Nau Khe	Pha Lai
9	Quang Ninh - Pha Lai		127.5	III		
a		Ha Long bay channel	9.5	I	Hon Gai port	Vung Dai island
b		Ba Mom channel	15	I	Vung Dai island	Qua Xoai
c		Chanh	20.5	II	Qua Xoai	N3 Chanh, Bach Dang
d		Da Bach	23	I	N3 Chanh, Bach Dang	N3 Dun
e		Phi Liet	8	III	N3 Dun	N3 Trai Son
g		Kinh Thay	44.5	III	N3 Trai Son	N3 Lau Khe
h		Thai Binh	7	III	N3 Lau Khe	Pha Lai
10	Hon Gai - Mui Ngoc		133	I		
a		Hon Gai channel	69	I	Hon Gai port	Mo river mouth
b		Mo river mouth channel	64	I	Mo river mouth	Mui Ngoc
11	Hon Gai - Cat Ba		37.5	I		
a		Hon Gai - Hon Mot	10	I	Hon Gai port	Hon Mot
b		Vach Ngan channel - Cat Ba	27.5	I	Hon Mot	Cat Ba bay
12	Pha Lai - Cong Cau	Thai Binh	34.5	III	Pha Lai	Cong Cau port
13	Pha Lai - Bo Ha	Thuong	62	III	Pha Lai	Bo Ha

Note) Under the management of central authority

N3: Confluence/Bifurcation

Source) Decision No.862/QD-CDS issued by Director of VIWA on 25/5/2000

Table 9.2.5 Temporary Classification of Waterways in the Northern Region (2)

No	Navigation Routes	Through Rivers	Length (km)	Class	From	To
14	Pha Lai - Da Phuc		88	III		
		Cau	83	III	Pha Lai	N3 Cau, Cong
		Cong	5	III	N3 Cau, Cong	Da Phuc
15	Pha Lai - Chu		66	III		
		Thuong	10	III	Pha Lai	N3 Nhan
		Luc Nam	56	III	N3 Nhan	Chu
16	Day river mouth - Ninh Binh	Day	72	I	Day river mouth	Ninh Binh
17	Ninh Binh - Phu Ly	Day	43	III	Ninh Binh port	Phu Ly
18	Phu Ly - Van Dinh	Day	48	IV	Phu Ly	Van Dinh
19	Ninh Bin - Nho Quan		39	III		
		Day	10	III	Ninh Binh	N3 Gian Bridge
		Hoang Long	29	III	N3 Gian bridge	Nho Quan
20	Viet Tri - Tuyen Quang		106	IV		
		Lo	25	III	Viet Tri	Bai Bang
		Lo	81	IV	Bai Bang	Tuyen Quang
21	Tuyen Quang - Chiem Hoa		45	IV		
		Lo	9	IV	Tuyen Quang	N3 Lo and Gam rivers
		Gam	81	IV	N3 Lo Gam	Chiem Hoa
22	Viet Tri - Yen Bai	Hong	122	IV	Viet Tri	Yen Bai
23	Yen Bai - Lao Cai	Hong	166	V	Yen Bai	Lao Cai
24	Viet Tri - Hoa Binh		71	IV		
		Hong	13	IV	Viet Tri	N3 Red and Da rivers
		Da	58	IV	N3 Hong and Da rivers	Hoa Binh dam
25	Bich Ha port - Van Yen	Hoa Binh reservoir	95	I	Hoa Binh Dam	Van Yen port
26	Van Yen - Ta Bu	Hoa Binh reservoir	108	III	Van Yen port	Ta Bu
27	Huong Ly - Cam Nhan	Thac Ba reservoir	42	I	Huong Ly port	Cam Nhan
28	Huong Ly - Thac Ba dam	Thac Ba reservoir	8	I	Huong Ly port	Thac Ba dam
29	Ha Noi - Ba Lat estuary	Hong	178	II	Ha Noi port	Bouy zero in Ba lat
30	Pham Lo - Tra Ly estuary	Tra Ly	70	III	C3 Pham Lo	Tra Ly estuary
31	Ninh Giang - Ba Giai estuary	Hoa	36.5	III	C3 Ninh Giang	Ba Giai estuary
32	Quy Cao - Cua Thai Binh	Thai Binh	36	IV	Quy Cao	Thai Bin river mouth
33	Van Uc estuary - Cong Cau		79	III		
		Van Uc	57	III	Van Uc estuary	Dua estuary
		Gua estuary	4	III	Dua estuary	N3 Gua
		Thai Bin	18	III	N3 Gua	Cong Cau port
34	Van Uc estuary - Cong Cau		78	III		
		Van Uc	45.5	III	Van Uc estuary	N3 Mia & Van Uc
		Mia	3	III	N3 Mia & Van Uc	N3 Mia & Thai Binh
		Thai Bin	29.5	III	N3 Mia & Thai Binh	Cong Cau port
35	Uong Bi channel	Uong Bi	14	III	Uong Bi bridge	N3 Dien Cong
36	Van Don - Co To	Co To channel	5	I	Cai Rong port	Co to port
37	Mong Cai - Van Tam	Mong Cai	17	IV	Mong Cai town	Van Tam
38	Hon Gai - Cat Ba	Cat Ba channel	37.5	I	Hon Gai port	Cat Ba
39	Mo estuary - Mui Chua	Tien Yen	21	I	Mo estuary	Mui Chua
40	Tien Yen - Mui Chua	Tien Yen	10	IV	Tien Yen town	Mui Chua
41	Luc estuary - Khe Tam	Diem vong	17	III	Luc estuary	Khe Tam
42	Tai Xa - Khe Cham	Mong Duong	5.5	III	Tai Xa	Khe Cham
43	C3 Ben Trieu - C3 Dun	Mao Khe	18	IV	N3 Ben Trieu	N3 Dun
44	C3 Vu Xa - C3 Dua estuary	Lai Vu	26	IV	N3 Vu Xa	N3 Dua estuary
45	Yen bridge - C3 Kim Dai	Vac	28.5	III	Yen bridge	N3 Kim Dai
46	C3 Duc Hau - C3 Chinh Dai	Yen Mo	14	IV	N3 Duc Hau	N3 Chinh Dai
47	Cao Bang - Thuy Khau	Bang Giang	56	V	Cao Bang town	Thuy Khau
48	Da Phuc - Ha Chau		26	IV		
		Cong	5	IV	Da Phuc	N3 Cau, Cong
		Cau	21	IV	N3 Cau, Cong	Cai Dan
49	Da Phuc - Cai Dan	Cong	14	IV	Da Phuc	Cai Dan
50	C3 Niem - Lach Tray estuary	Lach Tray	16.5	III	N3 Niem	Lach Tray estuary

Note) Under the management of central authority

N3: Confluence/Bifurcation

Source) Decision No.862/QD-CDS issued by Director of VIWA on 25/5/2000

Table 9.2.6 Management Class of Waterways in the North

No.	River	Stretch		Management Class (km)		
		from	to	1	2	3
1	Bach Dang	N3 Chanh Bach Dang River	N3 Dinh Vu Canal	12.0		
6	Cau	N3 Lac	N3 Cong River		83.0	
8	Cam	N3 Nong	200m upstream of Vat Cach Port	9.0		
9	Chanh	N3 Chanh Bach Dang River	Qua Xoai	20.5		
11	Da	Hoa Binh Dam	N3 Hong Da		58.0	
12	Day	N3 Phu Van	Cua Day (buoy No.0)	115.0		
13	Duong	N3 Cua Dau	N3 My Loc	68.0		
14	Da Bach	N3 Ben Dun	N3 Chanh Bach Dang River	23.0		
18	Han	N3 Trai Son	N3 Nong	8.5		
19	Hong (Red)	N3 Nam Thi	Yen Bai		166.0	
	Hong (Red)	Yen Bai	N3 Hong Da		109.0	
	Hong (Red)	N3 Hong Da	N3 Mom Ro	219.0		
	Hong (Red)	N3 Mom Ro	Ba Lat (buoy No.0)			47.0
24	Kinh Thay	N3 Lau Khe	N3 Trai Son	44.5		
25	Kinh Mon	N3 Keo	N3 Nong		45.0	
33	Lach Tray	N3 Kenh Dong	N3 Ha Ly River	33.5		
34	Lo	N3 Lo Gam	N3 Viet Tri	115.0		
35	Luoc	N3 Cua Luoc	Quy Cao	72.0		
37	Mao Khe	N3 Ben Trieu	N3 Ben Dun	18.0		
41	Nam Dinh	N3 Hung Long	N3 Doc Bo	33.5		
42	Ninh Co	N3 Mom Ro	200m upstream of Hai Thinh Port	51.0		
43	Phi Liet	N3 Ben Dun	N3 Trai Son	8.0		
46	Thai Binh	N3 Lac	N3 Lau Khe	7.0		
	Thai Binh	N3 Lau Khe	N3 Mia River		57.0	
47	Tra Ly	N3 Pham Lo	Thai Binh town	28.0		
	Tra Ly	Thai Binh town	Cua Thai Binh		42.0	
50	Thuong	Bo Ha	N3 Lac		62.0	
52	Van Uc	N3 Cua Dua	N3 Kenh Khe	22.0		
59	Quan Lieu Canal	N3 Ninh Co River	N3 Day River	3.2		
	Sub Total			910.7	622.0	47.0
	Other River Stretch			64.5	512.5	534.5
	Ground Total			975.2	1134.5	581.5

Note) N3: Confluence/Bifurcation

Note) Management class is only used within VIWA.

Source) VIWA, as of 31/12/2001

9.3 Major restrictions of navigation channel in the Red River Delta

9.3.1 Bridges and electric wires

(1) Bridges

In the Red River Delta, some 45 bridges span or will span over the inland waterways, of which those on major IWT corridors are 12 bridges over corridor 1, 12 bridges over corridor 2, 1 bridges over corridor 3 and 8 bridges over corridor 4.

The vertical clearance of many bridges does not comply with the Vietnamese Standard "Technical Classification of Inland Waterways" except some cases. On the other hand, movable bridge (cabin) system, which can decrease the maximum height of vessel and facilitate passing through bridges of low air clearance, has recently been introduced in IWT with no significant cost.

The Duong Bridge, however, which is located on Highway No.1 and IWT corridor 1 has only 2.86m (= 11.78m: bridge girder bottom -8.92m: H5% water level) of vertical clearance and it causes a major bottleneck to IWT on corridor 1 during flood season. The traffic regulation is conducted by IWMS No.6 when water level becomes more than +6.8m for about 2.5 months a year.

Besides, the Ho Bridge with 6.01m of vertical clearance was built on IWT corridor 1 in 2000. The Ho Bridge is reported to be constructed by making use of materials from old local bridges. As to Long Bien Bridge, its vertical clearance is 5.61m.

(2) Electric wires

The vertical air clearance of electric wires such as power lines spanning waterways almost comply with the Vietnamese Standard "Technical Classification of Inland Waterways" except some cases. A data cable with low clearance spanning over Red River (km+70.0, clearance: 8.1m) and Duong River (km+4.0, clearance: 8.5m) has been raised recently.

Table 9.3.1 Bridge Spanning the Major IWT Corridors

Corridor	Bridge No.	Location				Bridge			
		River	km+	Provinces (City)	Road Railway	Name	Vertical Clearance	Horizontal Clearance	Year Built
1: Quang Ninh - Hanoi - Viet Tri (via Duong River)									
	36	Mao Khe	14.5	Quang Ninh	(-)	Hoang Thach	5.9	30	(-)
	45	Kinh Thay	10	Hai Phong	Road No.183	Binh	7.0m	60.8m	1980
	11	Duong	(-)	Bac Ninh	(-)	(-)	(-)	(-)	Planing
	10	Duong	(-)	Ha Noi	(-)	(-)	(-)	(-)	Planing
	9	Duong	21	Bac Ninh	Highway No.38	Ho	6.0m	66m	2000
	8	Duong	14	Hanoi	Highway No.1	Phu Dong	8.0m	90m	2000
	7	Duong	8	Hanoi	Highway No.1	Duong	2.8m	60m	1980
	1	Red	69	Hanoi	Railway	Long Bien	5.6m	70m	1902
	2	Red	70	Hanoi	Highway No.1	Chuong Duong	8.4m	70.7m	1985
	3	Red	56	Hanoi	(-)	Thang Long	10.4m	80m	1980
	4	Red	76	Ha Noi	(-)	Thanh Tri	(-)	(-)	Building
	43	Lo	104	Vinh Yen	Highway No.2	Viet Tri	7.0m	86.92m	1995
2: Quang Ninh - Ninh Binh									
	39	Dao	2.5	Hai Phong	Highway No.5	Cement	3.35m	31m	1989
	40	Dao	1.5	Hai Phong	Railway	Xe Hoa	3.2m	24m	1976
	41	Dao	0.5	Hai Phong	Highway No.5	An Duong I	6.3m	40m	1994
	42	Dao	1	Hai Phong	Highway No.5	An Duong II	7.3m	80m	2000
	30	Lach Chay	24	Hai Phong	Road No.351	Kien An	(-)	112.6m	1982
	33	Van Uc	7	Hai Phong	Local Road	(-)	(-)	(-)	(-)
	34	Kenh Khe	2	Hai Phong	Local Road	(-)	(-)	(-)	Building
	12	Luoc	6	Thai Binh	Road No.39A	Trieu Duong	9.0m	63m	1995
	13	Luoc	66	Hai Phong	Highway No.10	Quy Cao	13.5m	85m	2002
	24	Dao	6.5	Nam Dinh	Highway No.21	Do Quan Susp.	3.5m	192.4m	1980
	25	Dao	6	Nam Dinh	Highway No.21B	Do Quan	7.0m	61m	1994
	23	Day	0	Ninh Binh	Railway + HW No.10	Ninh Binh	3.2m	60m	(-)
3: Cua Day - Ninh Binh									
	23	Day	0	Ninh Binh	Railway + HW No.10	Ninh Binh	3.2m	60m	(-)
4: Lach Giang - Hanoi									
	27	Ninh Co	31	Nam Dinh	Local Road	Floating	(-)	(-)	(-)
	26	Ninh Co	15	Nam Dinh	Highway No.22	Lac Quan	10.2m	70m	2000
	5	Red	(-)	Thai Binh	Highway No.10	Tan De	15.99m	120m	2000
	6	Red	(-)	Hung Yen	(-)	Yen Lenh	(-)	(-)	Planing
	1	Red	69	Hanoi	Railway	Long Bien	5.5m	70m	1902
	2	Red	70	Hanoi	Highway No.1	Chuong Duong	8.4m	70.7m	1985
	3	Red	56	Hanoi	(-)	Thang Long	10.4m	80m	1980
	4	Red	76	Ha Noi	(-)	Thanh Tri	(-)	(-)	Building

Notes) Vertical clearance: clearance between bridge girder bottom and H5% water level.

Horizontal clearance: clearance between abutments.

km+ is based on source 2.

(-) data unavailable.

Source) 1. VIWA

2. Red River Waterways Project, Jan. 1998 (TA No.2615-VIE)

3. Site survey by JICA Study Team

Table 9.3.2 Bridge Clearance in the Red River Delta

No	Location				Bridge			
	River	km+	Provinces (City)	Road Railway	Name	Vertical Clearance	Horizontal Clearance	Year Built
1	Red	69	Hanoi	Railway	Long Bien	5.6m	70m	1902
2	Red	70	Hanoi	Highway No.1	Chuong Duong	8.4m	70.7m	1985
3	Red	56	Hanoi	(-)	Thang Long	10.4m	80m	1980
4	Red	76	Ha Noi	(-)	Thanh Tri	(-)	(-)	Building
5	Red	(-)	Thai Binh	Highway No.10	Tan De	15.99m	120m	2000
6	Red	(-)	Hung Yen	(-)	Yen Lenh	(-)	(-)	Planing
7	Duong	8	Hanoi	Highway No.1	Duong	2.8m	60m	1980
8	Duong	14	Hanoi	Highway No.1	Phu Dong	8.0m	90m	2000
9	Duong	21	Bac Ninh	Highway No.38	Ho	6.0m	66m	2000
10	Duong	(-)	Ha Noi	(-)	(-)	(-)	(-)	Planing
11	Duong	(-)	Bac Ninh	(-)	(-)	(-)	(-)	Planing
12	Luoc	6	Thai Binh	Road No.39A	Trieu Duong	9.0m	63m	1995
13	Luoc	66	Hai Phong	Highway No.10	Quy Cao	13.5m	85m	2002
14	Tra Ly	Thai Binh	Thai Binh	Highway No.11	Thai Binh	8.4m	53m	1990
15	Tra Ly	Thai Binh	Thai Binh	Highway No.12	Cau Bo	6.7m	40m	1976
16	Day	Ung Hoa	Ha Tay	Local Road	Te Tieu	3.6m	22m	(-)
17	Day	Ung Hoa	Ha Tay	Local Road	Duc Khe	3.2m	37m	(-)
18	Day	Kim Bang	Ha Nam	Local Road	Que	3.5m	30m	1998
19	Day	Phu Ly	Ha Nam	Highway No.11	Hong Phu	3.8m	30m	1998
20	Day	Phu Ly	Ha Nam	Highway No.21	Phu ly	(-)	30m	2002
21	Day	Thanh Liem	Ha Nam	Highway No.1A	Doan Vy	4.1m	30m	(-)
22	Day	Ninh Binh	Ninh Binh	Railway	Do Xa	3.9m	30m	(-)
23	Day	0	Ninh Binh	Railway + HW No.10	Ninh Binh	3.2m	60m	(-)
24	Dao	6.5	Nam Dinh	Highway No.21	Do Quan Susp.	3.5m	192.4m	1980
25	Dao	6	Nam Dinh	Highway No.21B	Do Quan	7.0m	61m	1994
26	Ninh Co	15	Nam Dinh	Highway No.22	Lac Quan	10.2m	70m	2000
27	Ninh Co	31	Nam Dinh	Local Road	Floating	(-)	(-)	(-)
28	Lach Chay	(-)	Hai Phong	D.353	Rao	3.2m	25	1990
29	Lach Chay	(-)	Hai Phong	D.351	Niem	3.2m	24	1990
30	Lach Chay	24	Hai Phong	Road No.351	Kien An	(-)	112.6m	1982
31	Lach Chay	(-)	Hai Phong	(-)	(-)	(-)	(-)	(-)
32	Van Uc	(-)	Hai Phong	Highway No.10	Tien Cuu	10	80	1997
33	Van Uc	7	Hai Phong	Local Road	(-)	(-)	(-)	(-)
34	Kenh Khe	2	Hai Phong	Local Road	(-)	(-)	(-)	Building
35	Da Bach	(-)	Quang Ninh	(-)	Da Bac	(-)	(-)	Planing
36	Mao Khe	14.5	Quang Ninh	(-)	Hoang Thach	5.9	30	(-)
37	Cam (Binh f.)	(-)	Hai Phong	(-)	(-)	(-)	(-)	Planing
38	Cam	(-)	Hai Phong	(-)	Kien	(-)	(-)	Planing
39	Dao	2.5	Hai Phong	Highway No.5	Cement	3.35m	31m	1989
40	Dao	1.5	Hai Phong	Railway	Xe Hoa	3.2m	24m	1976
41	Dao	0.5	Hai Phong	Highway No.5	An Duong I	6.3m	40m	1994
42	Dao	1	Hai Phong	Highway No.5	An Duong II	7.3m	80m	2000
43	Lo	104	Vinh Yen	Highway No.2	Viet Tri	7.0m	86.92m	1995
44	Thai Binh	(-)	Quang Ninh	Highway No.18	Pha Lai	(-)	(-)	2002
45	Kinh Thay	10	Hai Phong	Road No.183	Binh	7.0m	60.8m	1980

Notes) Vertical clearance: clearance between bridge girder bottom and H5% water level.

Horizontal clearance: clearance between abutments.

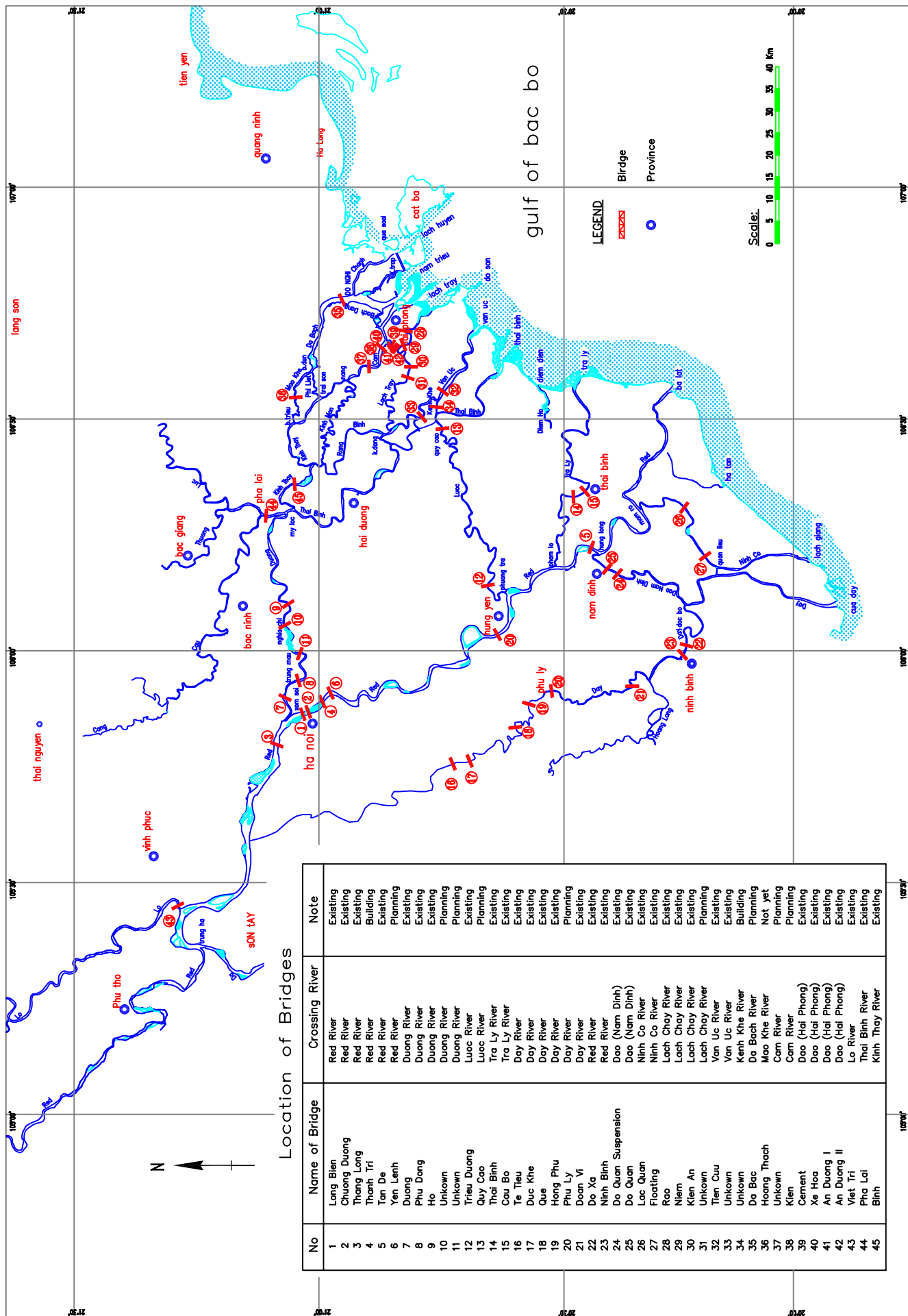
km+ is based on source 2.

(-) data unavailable.

Source) 1. VIWA

2. Red River Waterways Project, Jan. 1998 (TA No.2615-VIE)

3. Site survey by JICA Study Team



Location of Bridges

No	Name of Bridge	Crossing River	Note
1	Long Bien	Red River	Existing
2	Chuong Duong	Red River	Existing
3	Thang Long	Red River	Existing
4	Thanh Tri	Red River	Building
5	Tan De	Red River	Existing
6	Yen Lenh	Red River	Existing
7	Duong	Duong River	Planning
8	Phu Dong	Duong River	Existing
9	Ho	Duong River	Existing
10	Unknown	Duong River	Existing
11	Unknown	Duong River	Planning
12	Trieu Duong	Duong River	Planning
13	Quy Cao	Luoc River	Existing
14	Thai Binh	Luoc River	Planning
15	Cau Bo	Tra Ly River	Existing
16	Te Tieu	Tra Ly River	Existing
17	Duc Khe	Day River	Existing
18	Que	Day River	Existing
19	Hong Phu	Day River	Existing
20	Phu Ly	Day River	Existing
21	Doan Vi	Day River	Planning
22	Do Xa	Day River	Existing
23	Ninh Binh	Red River	Existing
24	Do Quan	Red River	Existing
25	Do Quan	Dao (Nam Dinh)	Existing
26	Lac Quan	Dao (Nam Dinh)	Existing
27	Floating	Ninh Co River	Existing
28	Rao	Ninh Co River	Existing
29	Niem An	Lach Chay River	Existing
30	Kien An	Lach Chay River	Existing
31	Unknown	Lach Chay River	Existing
32	Tien Cuu	Lach Chay River	Existing
33	Unknown	Van Uc River	Existing
34	Unknown	Kenh Khe River	Existing
35	Da Bac	Da Bach River	Building
36	Hoang Thach	Mao Khe River	Not yet
37	Unknown	Cam River	Planning
38	Kien	Cam River	Planning
39	Cement	Dao (Hai Phong)	Existing
40	Xe Hoa	Dao (Hai Phong)	Existing
41	An Duong I	Dao (Hai Phong)	Existing
42	An Duong II	Dao (Hai Phong)	Existing
43	Viet Tri	Lo River	Existing
44	Phu Lai	Thai Binh River	Existing
45	Binh	Kinh Thuy River	Existing

Figure 9.3.1 Location of Birdges

Table 9.3.3 Electric Wires spanning the IWT Corridors

Corridor No.	Location (km+)	River	Air Clearance (m)	Clearance from River Bed (m)	Kind of Electric Wire	Source
1	18.0	Red	12.5		Power Line	3
	56.0	Red	20.0		Power Line	1
	70.0	Red	approx. 10.0		Data Cable	3
	2.0	Duong	21.0		Power Line	1
	4.0	Duong	approx. 10.0		Data Cable	3
	11.0	Duong	21.5		Power Line	1
	35.0	Duong	(-)	28.5	Power Line	2
	2.0	Thai Binh	(-)		Power Line	1
	3.0	Kinh Thay	(-)	24.9	Power Line	2
	4.0	Kinh Thay	25.4		Power Line	1
	11.0	Kinh Thay	23.3		Power Line	1
	20.3	Kinh Thay	20.5		Power Line	1
	33.5	Kinh Thay	24.2		Power Line	1
	40.0	Kinh Thay	24.1		Power Line	1
	2.0	Han	19.1		Power Line	1
	7.0	Cam	18.7		Power Line	1
	11.5	Cam	(-)	18.4	Power Line	2
	13.0	Cam	16.7		Power Line	1
	6.0	Phi Liet	16.5		Power Line	1
	8.0	Phi Liet	14.6		Power Line	1
2	56.0	Red	20.0		Power Line	1
	70.0	Red	8.1		Data Cable	3
	14.0	Ninh Co	(-)	18.0	Power Line	2
	25.0	Ninh Co	18.1		Power Line	1
3	44.3	Day	(-)	23.1	Power Line	2
	45.0	Day	(-)	21.5	Power Line	2
	18.0	Dao	(-)		Power Line	1
	6.0	Luoc	19.0		Power Line	1
	46.5	Luoc	15.6		Power Line	1
	68.5	Luoc	29.0		Power Line	1
	69.0	Luoc	21.3		Power Line	1
	17.0	Lach Tray	(-)	19.4	Power Line	2
	19.0	Lach Tray	20.3		Power Line	1
	25.0	Lach Tray	11.9		Power Line	1
	27.0	Lach Tray	13.0		Power Line	1
	29.6	Lach Tray	12.0		Power Line	1
	30.0	Lach Tray	10.9		Power Line	1

Note) Location (km+) is based on source 1.

(-): data unavailable

- Source) 1. Red River Waterways Project, Jan. 1998 (TA No.2615-VIE)
 2. River & IWT Traffic of Vietnam, 1996, MOT
 3. VIWA

9.3.2 River bottlenecks

(1) Insufficient water depth/width and instability of talweg

Rivers are exploited mainly in natural state and cannot meet the technical standards in terms of water depth and bottom width. The sedimentation in river mouths, that of Red River in particular, is serious and complicated. In addition, instability of talweg in some waterway segments such as Red River Hanoi segment makes safety navigation difficult and it may bring fatal sedimentation at ports.

In the Red River Delta, some 7 million m³ of capital dredging and relating maintenance dredging were proposed in the ADB report in order to realize better performance of inland waterways. The ADB report also proposed that the construction of groynes could considerably reduce the required maintenance dredging volume.

On the other hand, dredging is carried out by VIWA but current dredging volume in the Northern region is only in the order of 0.5 to 1.0 million m³ a year (2002 budget: 0.5 million m³, VND 5 billion=US\$ 0.33 million) which is quite low level compared with ADB proposal.

Table 9.3.4 Capital & Maintenance Dredging proposed in ADB study

Corridor	Target LAD	Capital Dredging	Maintenance Dredging
Viet Tri - Hanoi - Hai Phong - Quang Ninh	2.0m (2.5m)	1.4 million m ³ (2.4 million m ³) for 55m width	30-50% of capital dredging every 2 years
Viet Tri - Hanoi - sea	3.5m (2.5m)	3.9 million m ³ (1.4 million m ³) for 55m width	3-5% of capital dredging every 2 years where combined with construction of groynes
Ninh Binh - Hai Phong - Quang Ninh	2.0m (2.5m)	1.9 million m ³ (2.7 million m ³) for 55m width	

Note) Values in blanket show values in case that target LAD is 2.5m.

Source) Red River Waterways Project, January 1998, ADB

(2) Wrecks and other obstacles

The removal of wrecks and other obstacles such as snags is necessary to improve not only the safety navigation but also improve the efficiency of IWT in the Red

River Delta. In order to carry out this work, it is essential that the waterways should be surveyed on a regular basis so that possible obstacles can be detected and precisely located.

Once located, wrecks and other obstacles should be well marked by buoys so that they are well charted if not removed within a short space of time.

(3) River bends

Sharp bends with radius less than 700m exist at 12 locations in Corridor 1, at 41 locations in Corridor 2, at 2 locations in Corridor 3 and 4 locations in Corridor 4. It should be noted that more than half of sharp bends in Corridor 2 have small radius less than 300m which is minimum requirement for class III in the technical classification of inland waterways.

Table 9.3.5 Existing Bends with Radius less than 700m

Corridors		Bend Radius					Total
		- 300m	301 - 400	401 - 500	501 - 600	601 - 700	
1A	Quang Ninh - Hai Phong - Ha Noi - Viet Tri	4	6	1	1	0	12
1B	Quang Ninh - (Da Bach) - Ha Noi - Viet Tri	5	5	1	1	0	12
2	Quang Ninh - (Luoc) - Ninh Binh	23	6	8	3	1	41
3	Cua Day - Ninh Binh	0	2	0	0	0	2
4A	Lach Giang - Ha Noi	0	2	0	2	0	4
4B	Cua Day - Ha Noi	0	2	0	2	0	4

Source) Measured by JICA Study Team based on "River Charts" of Red River Waterways Project, January 1998, ADB.

Within the above sharp bends, 7 priority locations for modifying river bends are proposed by ADB study in 1998. Land acquisition and resettlement with careful social consideration are necessary before initiating the projects.

- Bend Mom Ro in Ninh Co River
Required land acquisition is approximately 1.8 ha. This land is being used by farmers. The land is located outside the second river dike.
- Confluence of Dao Nam Dinh River and Red River.
The bend modification requires about 0.4 ha of agricultural land.
- Confluence Doc Bo
The Doc Bo Confluence is at an important water route. Estimated land to

be acquired is 3 ha.

- Keo confluence

The project design affects about 3 ha of agricultural land.

- Trai Son confluence

Loss of land is estimated at 0.7 to 1.0 ha.

- Elimination of loop in Luoc River

The land affected is located in outside dike area and is seasonally flooded.

- Improvement of bend in Lach Tray River

The proposed cutting would affect 1.8 ha of newly reclaimed land currently used for rice cropping.

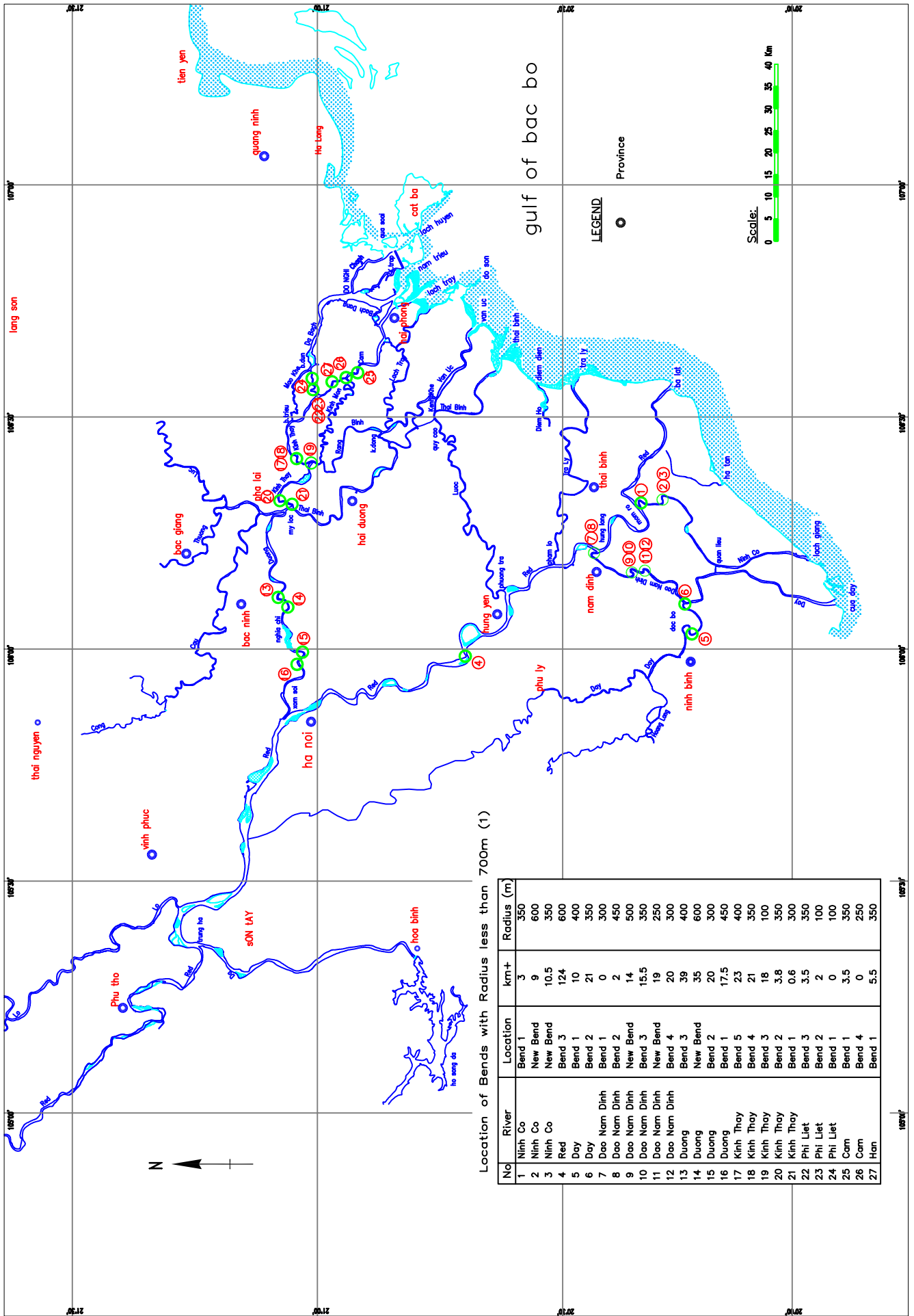


Figure 9.3.2 Location of Bends with Radius less than 700m (1)

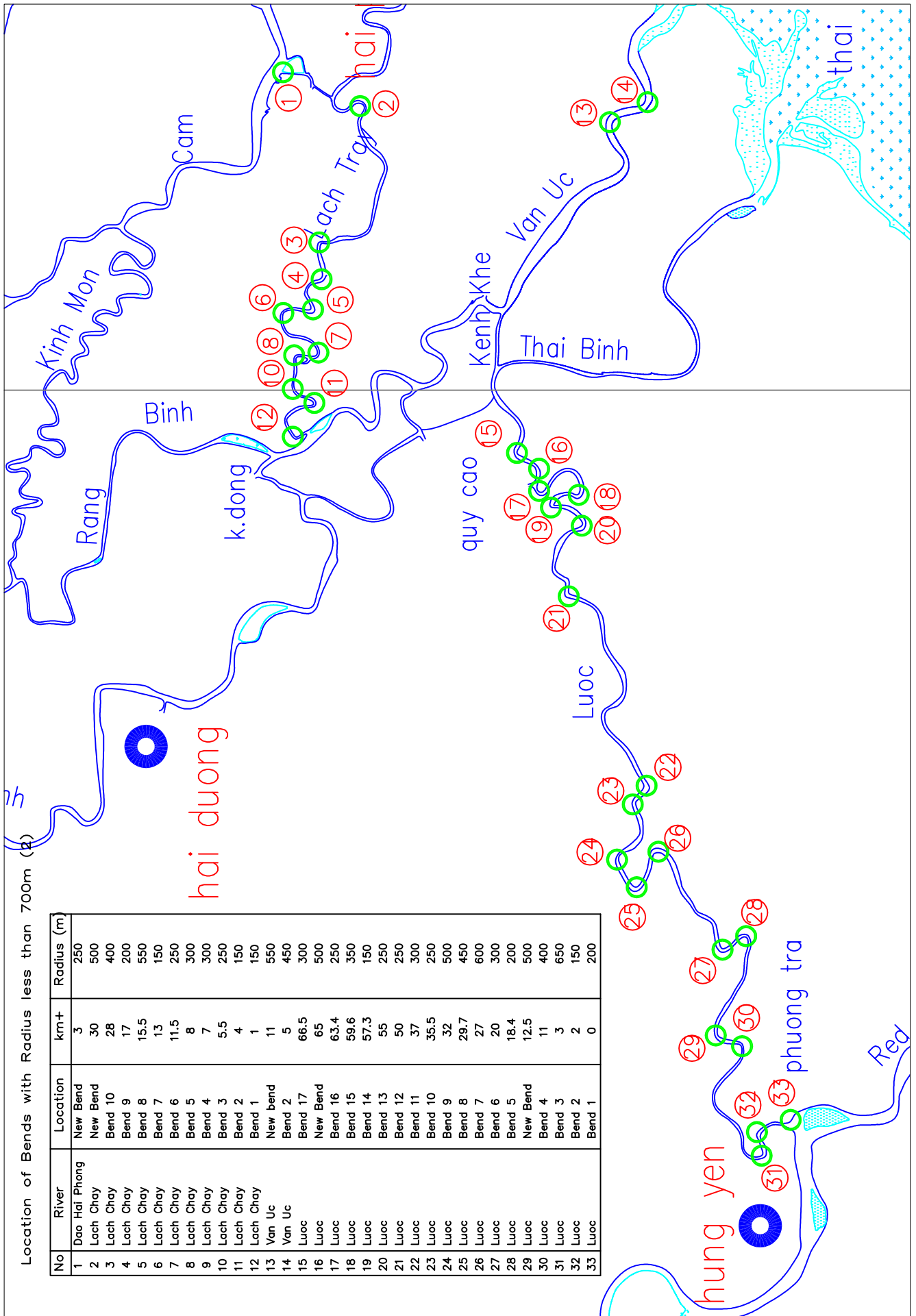


Figure 9.3.3 Location of Bends with Radius less than 700m (2)

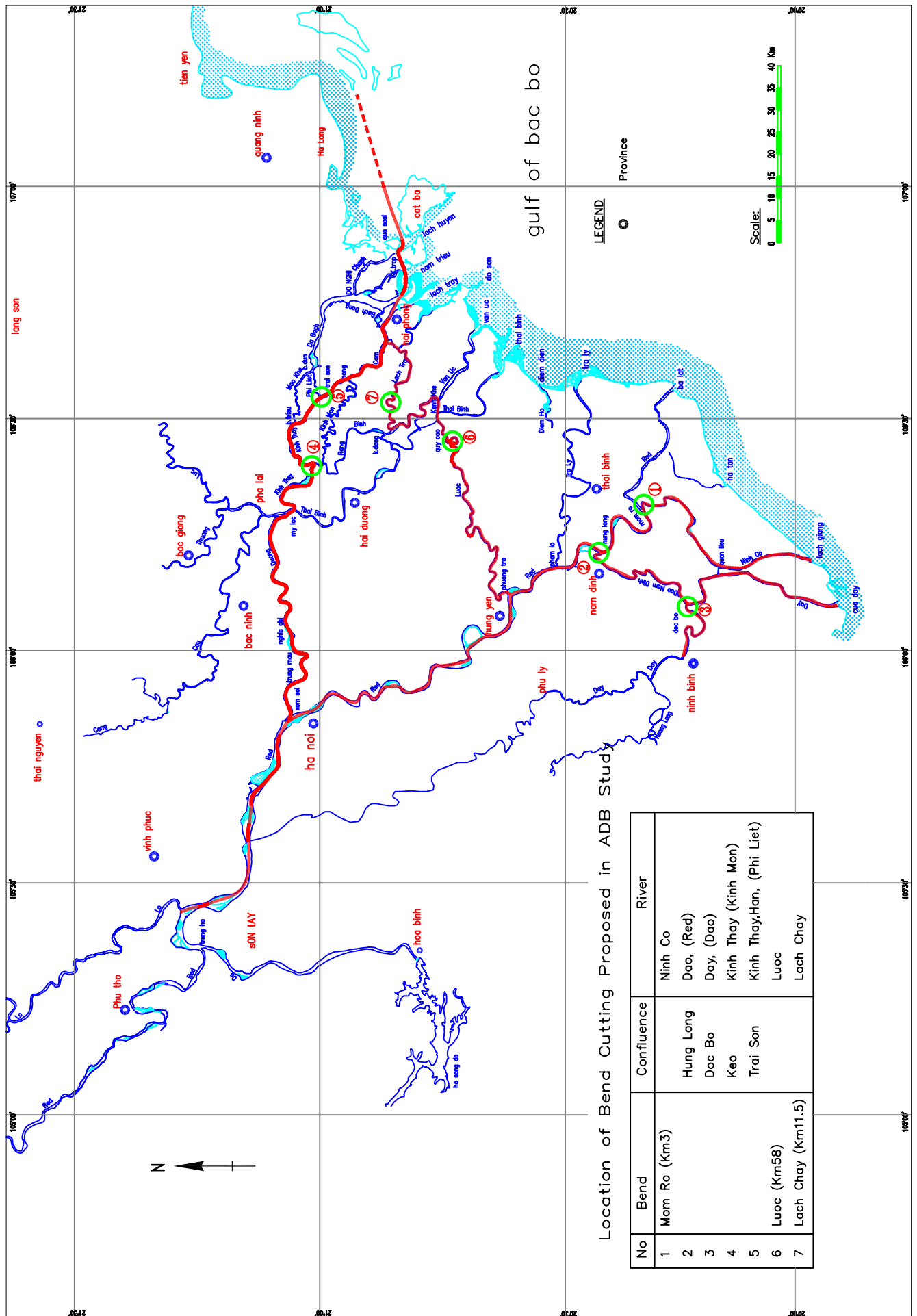


Figure 9.3.4 Location of Bend Cutting Proposed in ADB Study

9.4 Waterway traffic accidents in the Red River Delta

Major findings from the analysis of waterway traffic accidents in the RRD recorded by VIWA and analyzed by the Study Team are as follows:

- In 1999-2001, total number of accidents is 118 cases (collision: 37 cases, bottom touch: 26 cases, others: 55 cases).
- The number of accidents in dry season is larger than that of flooding season. The reasons are considered to be decrease of water depth and width as well as increase of traffic in dry season.
- As to the location of accidents, many accidents occur in Red River (19 cases), Kinh Thay River (17 cases), Lach Tray River (8 cases) and Dao Nam Dinh (6 cases).
- As to the location of accidents per km, the stretch from N3 Cua Dau and Hanoi Port within Red River Hanoi Segment is the highest (0.70 cases/km). Phi Liet River (0.50 cases/km), Kinh Thay River (0.38 cases/km), Thai Binh River (N3 Lau Khe - N3 My Loc, 0.33 cases/km), Han River (0.29 cases/km) and Lach Tray River (0.25 cases/km) follow Red River Hanoi Segment.

On the other hand, the reasons analyzed by VIWA of traffic accidents in inland waterways under the management of central authority in 2001 are violating regulations (42%), carelessness (23%), operating vessel without license (18%), bad condition of transport means (6%), overloading (3%), etc.

Table 9.4.1 Seasonal change of waterway traffic accidents

Month	Collision		Bottom touch		Others		Total	
	No	%	No	%	No	%	No	%
Jan	4	11%	2	8%	7	13%	13	11%
Feb	3	8%	3	12%	5	9%	11	9%
Mar	4	11%	1	4%	8	15%	13	11%
Apr	2	5%	6	23%	4	7%	12	10%
May	1	3%	3	12%	5	9%	9	8%
Jun	1	3%	1	4%	5	9%	7	6%
Jul	1	3%	1	4%	4	7%	6	5%
Aug	2	5%	2	8%	5	9%	9	8%
Sep	5	14%	0	0%	1	2%	6	5%
Oct	3	8%	4	15%	3	5%	10	8%
Nov	5	14%	2	8%	4	7%	11	9%
Dec	6	16%	1	4%	4	7%	11	9%
Total	37	100%	26	100%	55	100%	118	100%

Source) Analysed by JICA Study Team based on VIWA data (1999-2001)

Table 9.4.2 Waterway Traffic Accidents in Major Corridors (1999-2001)

Corridor	Waterway	from	to	Distance (km)	Accident				
					Collision	Bottom Touch	Others	Total	per km
1A	Quang Ninh - Hai Phong - Hanoi - Viet Tri (Cam route)								
	Ha Long Cay Channel	Hon Gai Port	Vung Dai island	9.5				0	0.00
	Ba Mom Channel	Vung Dai island	Qua Xoai	15.0				0	0.00
	Chanh	Qua Xoai	N3 Chanh, Bach Dang	20.5	3			3	0.15
	Bach Dang	N3 Chanh	N3 Dong Vang Chau	8.0	1			1	0.13
	Cam, Ruot Lon	N3 Dong Vang Chau	Hai Phong Port	8.5				0	0.00
	Cam	Hai Phong Port	N3 Nong	18.0	1			1	0.06
	Han	N3 Nong	N3 Trai Son	7.0		2		2	0.29
	Kinh Thay	N3 Trai Son	N3 Lau Khe	44.5	6	4	7	17	0.38
	Thai Binh	N3 Lau Khe	N3 My Loc	3.0		1		1	0.33
	Duong	N3 My Loc	Ben Ho	32.0	2	1		3	0.09
	Duong	Ben Ho	N3 Cua Dau	36.0	2	1	1	4	0.11
	Red	N3 Cua Dau	Hanoi Port	10.0	1	3	3	7	0.70
	Red	Hanoi Port	N3 Viet Tri	74.5	2	5	5	12	0.16
	Lo	N3 Viet Tri	Viet Tri Port	1.0				0	0.00
	Total Distance			287.5					
1B	Quang Ninh - Hanoi - Viet Tri (Da Bach route)								
	Ha Long Cay Channel	Hon Gai Port	Vung Dai island	9.5				0	0.00
	Ba Mom Channel	Vung Dai island	Qua Xoai	15.0				0	0.00
	Chanh	Qua Xoai	N3 Chanh, Bach Dang	20.5	3			3	0.15
	Da Bach	N3 Chanh, Bach Dang	N3 Dung	23.0		1	2	3	0.13
	Phi Liet	N3 Dung	N3 Trai Son	8.0	1		3	4	0.50
	Kinh Thay	N3 Trai Son	N3 Lau Khe	44.5	6	4	7	17	0.38
	Thai Binh	N3 Lau Khe	N3 My Loc	3.0		1		1	0.33
	Duong	N3 My Loc	Ben Ho	32.0	2	1		3	0.09
	Duong	Ben Ho	N3 Cua Dau	36.0	2	1	1	4	0.11
	Red	N3 Cua Dau	Hanoi Port	10.0	1	3	3	7	0.70
	Red	Hanoi Port	N3 Viet Tri	74.5	2	5	5	12	0.16
	Lo	N3 Viet Tri	Viet Tri Port	1.0				0	0.00
	Total Distance			277.0					
2	Quang Ninh - Ninh Binh (Luoc route)								
	Ha Long Cay Channel	Hon Gai Port	Vung Dai island	9.5				0	0.00
	Ba Mom Channel	Vung Dai island	Qua Xoai	15.0				0	0.00
	Chanh	Qua Xoai	N3 Chanh, Bach Dang	20.5	3			3	0.15
	Bach Dang	N3 Chanh	N3 Dong Vang Chau	8.0	1			1	0.13
	Cam, Ruot Lon	N3 Dong Vang Chau	Hai Phong Port	8.5				0	0.00
	Cam	Hai Phong Port	N3 Cement Factory	1.5				0	0.00
	Dao HP	N3 Cement Factory	N3 Lach Tray	3.0			1	1	0.33
	Lach Tray	N3 Dao HP	N3 Kenh Dong	32.5	3	1	4	8	0.25
	Kenh Khe, Van Uc	N3 Kenh Dong	Quy Cao ferry	25.5				0	0.00
	Luoc	Quy Cao ferry	N3 Cua Luoc	72.0			2	2	0.03
	Red	N3 Cua Luoc	N3 Hung Long	30.0		1	2	3	0.10
	Dao N. D.	N3 Hung Long	N3 Doc Bo	33.5	2	2	2	6	0.18
	Day	N3 Doc Bo	Ninh Binh	21.0		1	1	2	0.10
	Total Distance			280.5					
3	Cua Day - Ninh Binh								
	Day	Cua Day	Ninh Binh	72.0			4	4	0.06
	Total Distance			72.0					
4A	Lach Giang - Hanoi (Ninh Co route)								
	Ninh Co	Lach Giang	N3 Mom Ro	55.0	1			1	0.02
	Red	N3 Mom Ro	Hanoi	131.3	2	3	2	7	0.05
	Total Distance			186.3					
4B	Cua Day - Hanoi (DNC Canal route)								
	Day	Cua Day	N3 DNC Canal	30.0			1		
	DNC Canal	N3 Day	N3 Ninh Co	1.0					
	Ninh Co	N3 DNC Canal	N3 Mom Ro	39.0	1				
	Red	N3 Mom Ro	Hanoi	131.3	2	3	2	7	0.05
	Total Distance			201.3					

Source) Analysed by JICA Study Team based on VIWA data (1999-2001)

9.5 Navigation aid system

The Vietnamese navigation aid system consists of buoys and land signs as defined in "Vietnam Rules of Inland Waterway Signals" issued under Decision 4099/2000 QD-BGTVT on 28/12/2000 by the MOT (22TCN 269-2000). This system is based on the same principles as the IALA system.

Major corridors in the RRD are provided with light buoys and land signs in order to facilitate navigation 24 hours a day. Barge trains of the big transport companies usually sail throughout the night, although not all the ships sail 24 hours a day.

The average spacing of buoy and land sign is 0.28km - 0.61km. Due to variations in the navigation conditions in various stretches of waterways the spacing may vary considerably, but for the Study the above given averages are an appropriate indication.

The light buoys and a part of land signs are powered with batteries and therefore require considerable maintenance. It may make the lights unreliable for night navigation in case the electric power is not sufficient. It is preferable that the present batteries be replaced by solar power packs.

Table 9.5.1 Inventory of Navigation Aids in the Major Corridors

Corridor	Stretch		Waterway	Length (km)	Buoy			Land Sign			Buoy + Land Sign					
	from	to			Day Only	24hrs	Total	Day Only	24hrs	Total	Day Only	24hrs	Total			
1	Hai Phong	Hanoi	Cam	18.0	0	5	5	1	11	12	1	16	17			
			Han	7.0	0	2	2	0	21	21	0	23	23			
			Kinh Thay	44.5	0	22	22	81	117	198	81	139	220			
			Thai Binh	3.0	0	3	3	10	14	24	10	17	27			
			Duong	68.0	0	52	52	161	68	229	161	120	281			
			Total	140.5	0	84	84	253	231	484	253	315	568			
	Average km						1.67	1.67	0.56	0.61	0.29	0.56	0.45	0.25		
	Haoi	Viet Tri	Red	74.5	0	134	134	19	45	64	19	179	198			
			Total	74.5	0	134	134	19	45	64	19	179	198			
			Average km			0.56	0.56	3.92	1.66	1.16	3.92	0.42	0.38			
	Corridor 1 Total		Total	215.0	0	218	218	272	276	548	272	494	766			
	Average km						0.99	0.99	0.79	0.78	0.39	0.79	0.44	0.28		
2	Hai Phong	Ninh Binh	Dao HP	3.0	0	1	1	0	18	18	0	19	19			
			Lach Tray	32.5	0	0	0	0	86	86	0	86	86			
			Khenh Khe, Van Uc	25.5	0	5	5	0	21	21	0	26	26			
			Luoc	72.0	0	35	35	84	164	248	84	199	283			
			Red	30.0	0	13	13	0	58	58	0	71	71			
			Dao Nam Dinh	33.5	0	1	1	52	59	111	52	60	112			
			Day	21.0	0	9	9	18	23	41	18	32	50			
			Total	217.5	0	64	64	154	429	583	154	493	647			
			Average km						3.40	3.40	1.41	0.51	0.37	1.41	0.44	0.34
			Day				72.0	0	28	28	40	79	119	40	107	147
Total				72.0	0	28	28	40	79	119	40	107	147			
Average km						2.57	2.57	1.80	0.91	0.61	1.80	0.67	0.49			
3	Cua Day	Ninh Binh	Day	72.0	0	28	28	40	79	119	40	107	147			
			Total	72.0	0	28	28	40	79	119	40	107	147			
			Average km						2.57	2.57	1.80	0.91	0.61	1.80	0.67	0.49
			Average km						3.73	3.73	3.80	0.91	0.73	3.80	0.73	0.61
4	Lach Giang	Hanoi	Ninh Co	55.0	0	10	10	33	82	115	33	92	125			
			Red	131.3	0	40	40	16	123	139	16	163	179			
			Total	186.3	0	50	50	49	205	254	49	255	304			
			Average km						3.73	3.73	3.80	0.91	0.73	3.80	0.73	0.61
Ground Total			Total	690.8	0	360	360	515	989	1,504	515	1,349	1,864			
Average km						1.92	1.92	1.34	0.70	0.46	1.34	0.51	0.37			

Source) VIWA, as of Feb. 2002