Mekong River Commission
For Sustainable Development



Standardization of a vessel and waterway classification in the Mekong River Basin

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December 2023

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ACRONYMS AND ABBREVIATIONS

AIS	automatic identification system
Cb	block coefficient = displacement / Ls x Ws x Ts
Cc	coefficient to calculate over-width in bends
CEMT	Conference of European Ministers of Transport
DH	clearance height
DHNWL	design highest navigation water level
DLNWL	design lowest navigation water level
DT	keel clearance
H	bridge passage height
Hc	cable passage height
HHW	highest high water level
Hs	vessel's height
Hsn	vessel's height not fully loaded
IWT	inland waterway transport
LL	length between the lock heads
LLW	lowest low water level
Ls	vessel's length
OW	additional width in bends
PIANC	World Association for Waterborne Transport Infrastructure
R	bend radius
RIS	river information system
T	water depth
Td	dynamic vessel's draft (Ts + squat)
TL	lock sill depth
Ts	vessel's draft (static)
V	flow velocity
VIWA	Viet Nam inland Waterway Administration
Vs	vessel's velocity
W	fairway width
Wb	bridge passage width
Wbb	bottom width
Wbm1	safety over-width from ship's bow to the starboard bridge pillar
Wbm2	safety over-width from ship's stern to the port bridge pillar
WL	width between the lock chamber walls
Wm	bank clearance
Wm1	safety distance from ship's bow to the starboard channel bottom edge
Wm2	safety distance from ship's stern to the port channel bottom edge
Wms	width of basic manoeuvring lane (Ws + Ls sinβ)
Wp	safety distance between two crossing ships
Ws	vessel's width
β	Angle between ship's axis and navigation direction

DEFINITIONS

HARMONIZATION

Harmonization is the act of aligning different plans and situations. Hence, there are no "harmonized vessels or waterways", but that there can be a "harmonized vessel and waterway classification".

STANDARDIZATION

Standardization is the process of establishing uniform definitions, standards, specifications, methods and procedures. Therefore, for vessel standardization here, it refers to the technical regulations on ship safety, equipment and inspections on the Mekong River between Luang Prabang and the Khone Falls.

VESSEL

The term 'vessel 'refers to any inland waterway craft for traveling on water, including small craft and ferry-boats, as well as floating equipment and seagoing ships.

The term 'boat' refers to a small to mid-sized vessel with a much lower cargo carrying capacity than a ship. Boats are mainly used for recreational purposes, fishing, or for ferrying people.

The term 'ship' is a large vessel, which have all types of floating equipment, seaplanes and other waterborne transportation tools.

The term 'barge' is a long boat with a flat bottom, used for carrying objects on rivers or canals.

The term 'floating equipment' refers to floating structures carrying machinery used for work on waterways or in harbours such as dredgers, elevators, derricks and cranes.

WATERWAYS

A 'waterway' refers to an navigable part of a river or canal.
The term 'fairway' refers to the part of the waterway that can be used for shipping.

VESSEL CLASSIFICATION

Here, the 'vessel classification' provides the maximum dimensions (draft, length, width, height) related to its tonnage of 98% of all registered vessels sailing in the Mekong River Basin in Lao PDR and in the Kingdom of Thailand between the Golden Triangle and the Khone Phapheng. These registered vessels include all cargo, passenger and tanker vessels and floating structures but not fishing and governmental vessels.

Vessel dimensions are defined as follows:

- Height (Hs): Air draught height of the highest point of the vessel's structure above the waterline.
- Draught (Ts): Maximum depth from the waterline to the vessel's bottom.
- Width (Ws): The overall beam width, measured at the widest point of the nominal waterline.
- Length (Ls): The maximum length of the ship between the ship's extreme points.

WATERWAY CLASSIFICATION

The ‘waterway classification’ provides the minimum requirements for navigation channel dimensions (water depth, one-way and two-way channel width, bend radius, lock dimensions, bridge span, bridge and cables height) for the safe navigation of a classified vessel tonnage.

CATEGORIZED RIVER STRETCHES

The categorized river stretches give the available class in the river stretch at low water, at mid to high water, and a proposal of waterway class that should be achieved in 2040.

DEADWEIGHT TONNAGE

Deadweight tonnage (DWT) is a measure of how much weight a ship can carry when fully loaded (vessel's weight carrying capacity or payload capacity), not including the empty weight of the ship and is expressed in tonnes (1,000 kg). It is the sum of the weights of cargo, fuel, fresh water, ballast water, provisions, passengers and crew.

It is distinct from the volumetric measure of gross tonnage (GT), which is a function of the volume of all of a ship's enclosed spaces (from keel to funnel) measured to the outside of the hull framing, as defined by the International Convention on Tonnage Measurement of Ships, 1969, adopted by the International Maritime Organization (IMO), and is expressed in cubic metres (m^3).

REMARKS

REGULATIONS ON SHIP TRAFFIC

One of the main goals of these regulations on ship traffic is to inform the shipping industry and waterway users that the waterway characteristics of a specific class of vessel are available and applicable over the entire length of a stretch of the waterway.

This classification is without prejudice to applicable laws and regulations on ship traffic, and does not release the waterway users of all commercial ships from the obligation to follow the Regulations on ship traffic on the Mekong River between Luang Prabang and the Khone Phapheng.

BRIDGE SPAN AND HEIGHT

In the waterway classification, the bridges span and height, and cable height give the minimum dimensions that are needed for a safe navigation under the bridges or cables for the several classes of vessels.

Only Lao PDR has its own regulations stating that the minimum span of bridges on the Mekong River should be 100 m and 24 m on its tributaries; the minimum bridge height should be 12 m on the Mekong River and 8 m on its tributaries; the minimum cable height should be 15 to 20 ml; and underwater cables and pipes should be at least 2 m under the riverbed (Lao PDR No.7736/ຍທຂ / Vientiane 8/6/2010). Lao PDR will continue to follow these regulations as mentioned in the footnote to the Lao-Thai waterway classification.

1. INTRODUCTION

Under the component "Traffic Safety and Environmental Sustainability" of the Mekong River Commission (MRC) Navigation Programme, it is stated that updating and harmonization of different Standards, Rules and Regulations to Uniform Common Standards is crucial for the development and liberalization of Inland Waterway Transport on the Mekong River System.

The formulation and harmonization of the different national systems are therefore necessary, for, among others, ship classification and certification, and for waterway classification including of bridge heights and lock dimensions.

In January 2015, the MRC Navigation Programme started the formulation of:

> *a "Master Plan for Regional Waterborne Transport on the Mekong River Basin"* in order *to design a short-term and long-term development programme which should rehabilitate and improve the national and international transport network using the Mekong River Basin in the MRC Member Countries*.

Three actions were taken concerning vessel and waterway classifications:

- SFL1 (short term fleet action) Standardize the vessel classifications in line with all the Greater Mekong River States.
- SWD2 (short term waterway development action) Standardize waterway classifications, if possible in line with the Chinese waterway classification in the Upper Mekong Basin related to modern shipping.
- SWD3 (short term waterway development action) Standardize the waterway classification, if possible in line with the Vietnamese waterway classification in the lower part of the Mekong Basin related to modern shipping.

On 25 August 2017, during a workshop with the four MRC Member Countries in Bangkok, Thailand, SFL1, SWD2 and SWD3 under "Standardize vessel and waterway classifications" were designated as having a very high priority.

When a waterway classification is accepted by a nation, and its waterways are categorized according to the different classes, then the relevant country authority assures the shipping industry and the waterway users that the waterway characteristics of a specific class are available and applicable over the entire length of the waterway or a section thereof.

Hence, in addition to the Mekong River, the tributaries and canals should also be classified into standardized categories based on their geometric dimensions with following major goals:

1. To guide technical supervision, tonnage measurement and registration.
2. To inform the shipping and transport industry, determining IWT competitiveness by establishing maximum vessel sizes thus affecting navigation costs.
3. To achieve a more sustainable use of inland waterways.

4. To assure the shipping industry and the waterway users that the waterway characteristics of a specific class are available and applicable over the entire length of a section of the waterway.
5. To increase safety and ease of navigation by ensuring the orderly and efficient control and maintenance of waterways.
6. To assist the authorities responsible for planning and policymaking by highlighting missing links and bottlenecks that should be prioritized.

Therefore, in 2018, a working group was established, composed of:

Ms Ton Nu Thi Thanh Yen, Navigation Operation Specialist, Mekong River Commission Secretariat
Mr Koomplient Narongdaj, Ship Surveyor, Marine Department, Thailand
Mr Somphone Louanglath, Director of Planning and Budgeting Division, Lao PDR
Mr Huon Rath, Chief of Geo-Navigation Office, Department of Waterway Infrastructure, Cambodia
Mr Nguyen Viet Thanh, Lecturer, University of Transport and Communications, Viet Nam
Mr Freddy Wens, TD MRCS Consultant, Belgium.

The scope of this study was:

1. To obtain an overview of existing vessel and waterway classifications in Europe, China and Southeast Asia;
2. To organize a questionnaire in the four MRC Member Countries on the scope, goals and general structure of the vessel and inland waterway classification (one uniform standard or two standards, one for the upper part in Lao PDR and Thailand and one for the lower part in Cambodia and Viet Nam), on the main applications of a Mekong vessel and inland waterway classification, and on the parameters that should be considered in a vessel and inland waterway classification.
3. To analyse the relevant background information for technical and operational criteria of a vessel classification, including an analysis of the fleet situation on the Mekong River Basin and a proposal of a vessel typology for inland waterways classification.
4. To standardize either one waterway classification for the whole Mekong River Basin or two classifications, one for the upper part (Lao PDR and Thailand) and one for the lower part (Cambodia and Viet Nam).
5. To develop a proposal of national/regional waterway classification for each stretch of the Mekong River and its tributaries and canals.
6. To prepare a set of regulations for the vessel and waterway classification for the Mekong River Basin in the four MRC Member Countries.

2. BENCHMARKING WITH CLASSIFICATIONS

2.1. European Vessel Classification (ECMT 1992)

In June 1992, the European Conference of Ministers of Transport (ECMT) adopted "Resolution no. 92/2 on a new classification of inland waterways".

The Conference recommended that:

1. *Governments should give consideration to the new classification of European inland waterways, as set out in Table 1, with a view to classifying their own country's inland waterways. The maps of their network should be brought into line with this classification. Under their responsibility, a document should be set out considering all the characteristics of any waterway or part of it (waterway outline, fairway location, permissible draught, minimum height under bridges, recommended dimensions for locks and other elevators for ships...) in view of achieving the best and as complete as possible exchange of information between each inland waterway user.* With the same objective, the ECMT's maps of European inland waterways are also to be reviewed. This work will be assigned to a group of experts.
2. In view of the completion of a homogeneous European inland waterway network, governments should also take into consideration this new classification in their modernization and improvement programmes of their network or when renewing the structures.

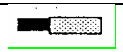
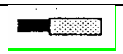
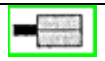
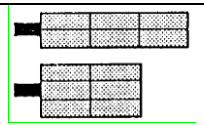
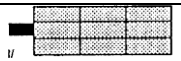
Where a regional or Class IV waterway is to be modernized, the parameters to be adopted should be at least Class Va. When modernizing or creating a waterway of international importance, the parameters to be used should be at least Class Vb with a minimum draught of 2.80 m and a minimum height under bridges of 7.00 m where necessary for container transport. For inland waterways where a bridge clearance of 700 cm is not considered economically reasonable, the possibility of using longer convoys (Class Vb) should be taken into account. The lengths of locks or other structures through which vessels pass must be established with reference to the maximum dimensions of pushed units.



Spits | Kampine barge | Rhein Herne freighter | Push convoy 4 (2 x 2)

Figure 1. Vessels in Europe

Table 1. New Classification of Inland Waterways 1992 – Conference of European Ministers of Transport

Type of inland waterways		Classes of navigable waterways	Motor vessels and barges					Push convoys					Minimum height under bridges (2)	Graphical symbols on maps
			Type of vessel: General characteristics					Type of convoy: General characteristics						
			Designation	Maximum length	Maximum beam	Draught (7)	Tonnage		Length	Beam	Draught (7)	Tonnage		
				L(m)	B(m)	D(m)	T(t)		L(m)	B(m)	D(m)	T(t)	H(m)	
1		2	3	4	5	6	7	8	9	10	11	12	13	14
OF REGIONAL IMPORTANCE	To West of Elbe	I	Barge (spits)	38.50	5.05	1.80–2.20	250–400							
		II	Kampine-barge	50.00–55.00	6.60	2.50	400–650							
		III	Dortmund - Eems canal ship	**67.00–80.00**	**8.20**	**2.50**	**650–1,000**							
	To East of Elbe	I	Gross Finow	**41.00**	**4.70**	**1.40**	**180**							
		II	BM-500	**57.00**	**7.50–9.00**	**1.60**	**500–630**							
		III	(6)	**67.00–70.00**	**8.20–9.00**	**1.60–2.00**	**470–700**		**118.00–132.00**	**8.20–9.00**	**1.60–2.00**	**1,000–1,200**		
OF INTERNATIONAL IMPORTANCE		IV	Rhine -Herne Ship	80.00-85.00	9.50	2.50	1,000–1,500		85.00	9.50 (5)	2.50–2.80	1,250–1,450	5.25 or 7.00 (4)	
		Va	Large Rhine vessel	95.00-110.00	11.40	2.50–2.80	1,500–3,000		95.00–110.00 (1)	11.40	2.50–4.50	1,600–3,000	5.25 or 7.00 or 9.10 (4)	
		Vb	Push convoy 2						172.00–185.00 (1)	11.40	2.50–4.50	3,200–6,000		
		VIa	Push convoy 2						95.00–110.00 (1)	22.80	2.50–4.50	3,200–6,000	7.00 or 9.10 (4)	
		VIb	Push convoy 4 (3)						185.00–195.00 (1)	22.80	2.50–4.50	6,400–12,000	7.00 or 9.10 (4)	
		VIc	Push convoy 6						270.00–280.00 (1) 193.00–200.00 (1)	22.80 33.00–34.20 (1)	2.50–4.50 2.50–4.50	9,600–18,000 9,600–18,000	9.10 (4) 9.10 (4)	
		VII	Push convoy 9					 (8)	195.00–285.00	33.00–34.20 (1)	2.50–4.50	14,500–27,000	9.10 (4)	

Notes:

(1) The class of a waterway is determined by the horizontal dimensions of the vessels or pushed units, especially by their width.

(2) The draught of an inland waterway must be specified with reference to local conditions.

(3) Characteristic tonnage for each class according to dimensions and draughts indicated.

(4) Takes into account a security clearance of 30 cm between the highest point of the vessel or its load and the height under the bridge.

(5) Vessels used in the Oder region and on waterways between the Oder and Elbe.

(6) Adaptfor container transport:
5.25 m for vessels carrying two layers of containers;
7.00 m for vessels carrying three layers of containers;
9.10 m for vessels carrying four layers of containers;
50% of the containers may be empty, otherwise ballast must be used.

(7) The first figure relates to existing situations and the second to future developments or, in some cases, also existing situations.

(8) Takes into account the dimensions of motor vessels proposed for ro-ro transport and shipments of containers; the dimensions given are approximate.

(9) Relates to pushed units on the Danube which often consist of more than nine barges.

Through this classification standard, the European Commission was able to identify four international inland waterway corridors:

- The Rhine corridor, between the North Sea ports and the German industrial sites;
- The North-South corridor, between the Netherlands, Belgium and the French waterway network;
- The South-East corridor, between the Rhine-Main, via the Danube towards the Black Sea; and
- The East-West corridor, between the Northern seaports of Germany (Hamburg and Bremen) via Weser and Elbe to Poland, Czechia and Slovakia.

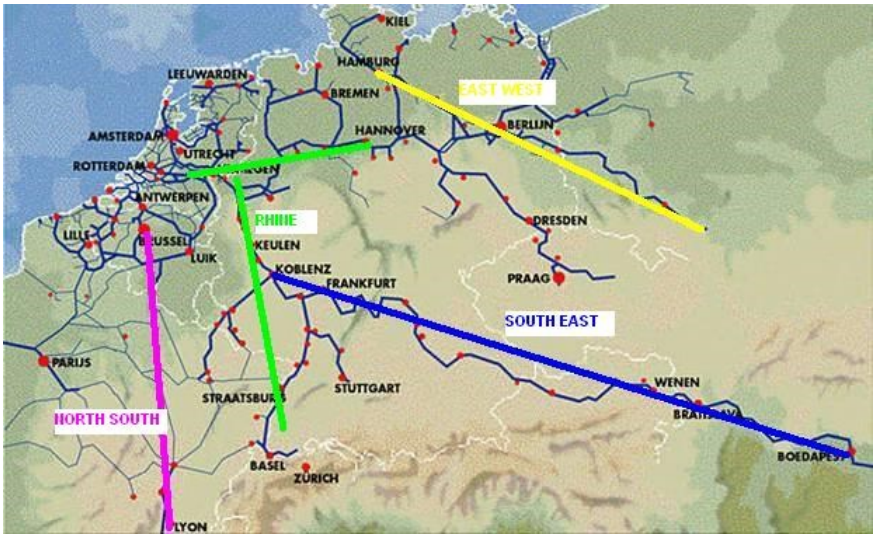


Figure 2. International inland waterway corridors determined by European Commission

For each of these international corridors, bottlenecks and missing links have been defined, and given priority in the European Trans-European Network–Transport (TEN-T) programme, where it is stated that:

> *Uniform standards are vital because IWT tends to span long distances and the load capacity is determined by the worst bottleneck on the whole transport route. The*

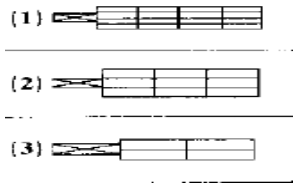
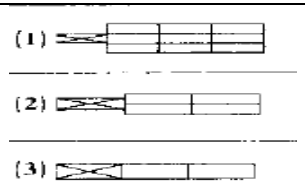
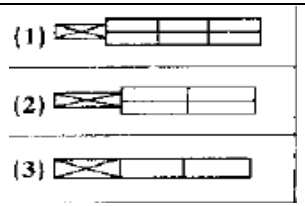
possible draught (particularly important for bulk goods) as well as bridge clearances (particularly important for container traffic) on the weakest stretch of the transport route has considerable effects on the competitiveness of IWT. Taking this into perspective, the European Union compiled an overall policy vision or Strategic Master Plan for the improvement of the EU-25 waterway network, providing a TEN-T list of priority infrastructure projects to guarantee an optimum use of the potential of IWT at the European level.

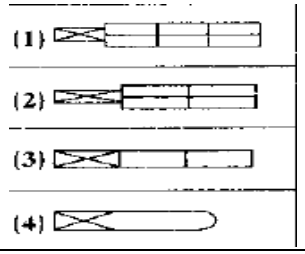
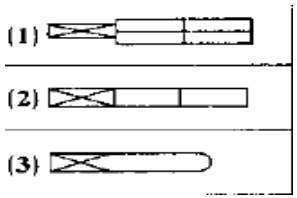
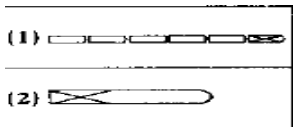
2.2. Chinese Vessel and Waterway Classification

The navigation standard for inland waterways in the People's Republic of China is National Standard GB50139-2004, issued on 1 March 2004 by the Ministry of Communications on behalf of the authorized department of the Ministry of Construction.

Table 2 shows the final classification standard for the People's Republic of China; only for the Heilongjiang River system and for the Zhujiang Delta to Hong Kong SAR and Macao SAR, a special classification is given.

Table 2. Inland waterway classification standard of the People's Republic of China

Class	Ship dimensions					Waterway dimensions				Bridge dimensions		
	DWT	Single ship	Ls x Bs x Ts (m)	Fleet	Ls x Bs x Ts (m)	Depth T (m)	Width one-way B (m)	Width two-way B (m)	Bend radius R (m)	Height H (m)	Width one-way Bb (m)	Width two-way Bb (m)
I	3,000	Barge	90.0 x 16.2 x 3.5		406.0 x 64.8 x 3.5	3.5–4.0	125	250	1,200	24.0	200	400
					316.0 x 48.6 x 3.5		100	195	950	18.0	160	320
		Freighter	110.0 x 16.2 x 3.0		223.0 x 32.4 x 3.5		70	135	670	18.0	110	220
II	2,000	Barge	75.0 x 16.2 x 2.6		270.0 x 48.6 x 2.6	2.6–3.0	100	190	810	18.0	145	290
					186.0 x 32.4 x 2.6		70	130	560	18.0	105	210
		Freighter	90.0 x 16.2 x 2.6		182.0 x 16.2 x 2.6		40	75	550	10.0	75	150
III	1,000	Barge	67.5 x 10.8 x 2.0		238.0 x 21.6 x 2.0	2.0-2.4	55	110	720	10.0	100	200
					167.0 x 21.6 x 2.0		45	90	500	10.0	75	150
		Freighter	85.0 x 10.8 x 2.0		160.0 x 10.8 x 2.0		30	60	480	10.0	55	110

Class	Ship dimensions					Waterway dimensions				Bridge dimensions		
	DWT	Single ship	Ls x Bs x Ts (m)	Fleet	Ls x Bs x Ts (m)	Depth T (m)	Width one-way B (m)	Width two-way B (m)	Bend radius R (m)	Height H (m)	Width one-way Bb (m)	Width two-way Bb (m)
IV	500	Barge	45.0 x 10.8 x 1.6		167.0 x 21.6 x 1.6	1.6–1.9	45	90	500	8.0	75	150
					112.0 x 21.6 x 1.6		40	80	340	8.0	60	120
		Freighter			111.0 x 10.8 x 1.6		30	50	330	8.0	45	90
			67.5 x 10.8 x 1.6		67.5 x 10.8 x 1.6		30	50	330	8.0	45	90
V	300	Barge	35.0 x 9.2 x 1.3		94.0 x 18.4 x 1.3	1.3–1.6	35	70	280	8.0	55	110
					91.0 x 9.2 x 1.3		22	40	270	8.0	40	80
		Freighter			55.0 x 8.6 x 1.3		22	40	270	5.0	40	80
			55.0 x 8.6 x 1.3									
VI	100	Barge	32.0 x 7.0 x 1.0		188.0 x 7.0 x 1.0	1.0-1.2	15	30	180	4.5	25	40
		Freighter			45.0 x 5.5 x 1.0		15	30	180	6.0	25	40
			45.0 x 5.5 x 1.0									
VII	50	Barge	24.0 x 5.5 x 0.7		145.0 x 5.5 x 0.7	0.7-0.9	12	24	130	3.5	20	32
		Freighter			32.5 x 5.5 x 0.7		12	24	130	4.5	20	32
			32.5 x 5.5 x 0.7									

2.3. Thailand Vessel And Waterway Classification

For the drafting of the Master Plan for Waterborne Transport on the Mekong River System in Cambodia in 2006, the following channel dimensions were taken from the Marine Department in Thailand (Table 3).

Table 3. Dimensions of navigable channels in Thailand

Item	Channel/ Province	Width (m)	Length (km)	Depth LLW (m)
	Bangkok Channel (channel II)			
1	Thajean Channel, Samuth Sakorn	100	14.0	5.5
2	Bangpakong Channel, Chachoengsao	60	20.50	5.0
3	Ban Laem Thammachart Channel, Trad (inner channel)	60	14.00	5.0
4	Turning Basin	80	1.00	4.0
	Chumporn Channel, Chumporn	200	0.15	4.0
5	Bandon Channel, Surat Thani	60	5.00	4.0
6	Outer Channel			
	Inner Channel	60	25.00	5.0
	Thathong Channel, Surat Thani	60	10.00	3.0
7	Ko Samui Channel, Surat Thani	60	6.80	4.0
8	Ko Phangan Channel, Surat Thani	60	1.00	4.0
9	Khanom Channel, Nakhon Si Thammarat	60–200	3.00	5.5
10	Outer Channel Section I			
	Section II	80	0.70	5.0
	Section III	180	0.40	4.5
	Pak Phanang Channel, Nakhon Si Thammarat	140	0.20	3.0
11	Songkhla Channel, Songkhla	60	27.00	4.0
12	Songkhla Port			
	Inner Channel	120	6.00	9.0
	Pattani Channel, Pattani	250	5.00	5.0
13	Narathiwat Channel, Narathiwat	60	4.00	5.0
14	Kolok Channel, Narathiwat	60	4.00	4.0
15	The Andaman Sea	180	1.35	3.0
	Phuket Port Channel, Phuket			
16	Thajean Canals Channel, Phuket	120	1.5	9.0
17	Thap Lamu Channel, Phangnga	60	4.0	3.0
18	Krabi Channel, Outer Channel, Krabi	60	1.5	5.0
19	Kantang Channel, Trang	60	10.0	5.0
20	Tammalang Channel, Satun	60	27.0	5.5
21	Bangkok Channel (channel II)	60	10.0	4.0

Table 3 shows that all important navigation channels for seagoing vessels in Thailand that are situated on riverbeds (entirely or partly) have a width of at least 60 m. Important channels are: the entry of the port of Bangkok through the Chao Phraya River (item 21); the Bangpakong channel along the Pakong River (item 2); the Thatong channel for the port of Thatong in Surat

Thani (inner and outer: item 6); the Songkhla channel in open sea (27 km long: item 11); and the Kantang channel at the Andaman sea for the port of Kantang in Trang (item 19).

2.4. Cambodian Vessel and Waterway Classification

In the Master Plan for Waterborne Transport on the Mekong River System in Cambodia, one of the 60 actions, which were mentioned in and elaborated on in the final report, was "To calibrate the navigable waterways in Cambodia into a classification standard" (action B6).

In 2009, the Navigation Coordination Committee, Executive Office, established under the Ministry of Public Works and Transport to implement the actions of the Cambodian Master Plan published a report, "Calibrating The Navigable Waterways of the Mekong River System Into a Classification Standard".

This classification system was based both on the characteristics of the waterway and on the 'normal' size of vessel or integrated barge tow, ensuring permanent navigability.

The two objectives of this section is to:

1. Sort all the vessels travelling on the Cambodian Mekong River system into a recognized classification system in accordance with their main characteristics (length, width, draught, DWT, etc.), thus guaranteeing that they can safely operate in certain types of classified waterways that meet the minimum geometric requirements for the corresponding 'design-vessel'.
2. Categorize all the navigable stretches of waterways of the Cambodian Mekong watershed into a classification system that meet, over its entire length, the minimum geometric requirements for a 'designed vessel' corresponding to a recognized category of vessels. These requirements are mainly water depth, channel width, curvature, current velocity and air clearance under the bridges.

For this section, the procedure below was followed:

- A list was prepared of all travelling and registered vessels with their dimensions.
- A vessel classification was prepared according to the vessel tonnage with maximum dimensions for that tonnage or DWT.
- A waterway classification was prepared by applying internationally used formulas to calculate keel clearance, water depth, channel width, bend radius, passage width under bridges, bridge and electric wires air clearance for the maximum dimensions of the different vessel classes.
- The maximum vessel tonnage for vessels that can travel specifically stretch of the river, permanently or during a limited period of the year, was chosen and the waterway characteristics of the corresponding class were identified.

a) <u>Vessel dimensions</u>

In order to study the appropriate navigation channel in the river stretches under the various scenarios, a vessel design must be established on which basis the design of the channel.

The World Association for Waterborne Transport Infrastructure (PIANC) recommendations in its Report of Working Group 16, supplement to Bulletin no. 90 (1996) related to the *"Standardization of Ships and Inland Waterways for River/Sea Navigation"*, advises that fairway classification be directly based on the largest class of *inland* vessels that are allowed to ply a given waterway. It furthermore states that, with a view to increase the competitiveness of maritime transport, it might be recommendable to standardize vessels and inland waterways for *coaster* navigation as well, which is perfectly possible in the Mekong River and some of its tributaries, because both kind of vessels can navigate in the Mekong River and its Delta: inland vessels and seagoing (maritime) vessels up to 10,000 DWT.

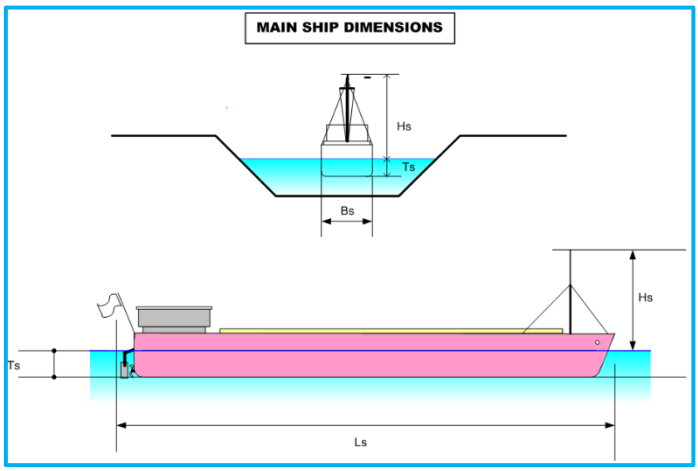


Figure 2. Main ship dimensions

In Cambodia, the main traffic is dedicated to inland shipping for the domestic market and cross-border trade with Viet Nam. Occasionally, seagoing vessels up to 5,000 DWT enter Cambodia through the Mekong, mainly for general cargo, bulk, LPG and oil.

In Cambodia, three bodies that has have specific vessel registration lists:

- The Provincial Public Works and Transport Department: registration of vessels of a tonnage of less than 50;
- The Ministry of Public Works and Transport, The Waterway Transport Department: registration of Cambodian vessels of tonnage of more than 50;
- Phnom Penh Autonomous Port: registration of non-Cambodian cross-bordering vessels.

In total, less than 1,000 vessels are registered of which 256 vessels (dry bulk, general cargo and container vessels, oil tankers, passenger vessels, push and tow barges, ferries and dredgers) between 50 and 2,000 tonnes.

b) Vessel classification

The list of all registered vessels in Cambodia plus a list of 2,107 ships in the ”Lloyds List” with a tonnage between 100 and 10,000 DWT, led to a proposal for the Cambodian Mekong vessel classification (Table 4).[1]

Table 4. Proposal for the Cambodian Mekong vessel classification

Class	Standard vessel dimensions				
	DWT (tonne)	Length Ls (m)	Height Hs (m)	Width Bs (m)	Draft Ts (m)
0a (a)	7,000–10,000	140–160	29.0–33.4	19.0–22.0	7.3–8.0
0b	5,000–7,000	125–140	24.0–29.0	16.0–19.0	6.4–7.3
0c	3,000–5,000	110–125	19.0–24.0	14.0–16.0	5.6–6.4
0d (b)	1,000–3,000	96–110	14.0–19.0	12.0–14.0(c)	4.1–5.6
Ia	800–1,000	90–96	12.5–14.0	11.0–12.0	3.6–4.1
Ib	600–800	80–90	11.0–12.5	10.0–11.0	3.1–3.6
II	300–600	56–80	7.5–11.0(d)	6.5–9.0	1.7–2.6
III	100–300	28–56	3.5–7.5	5.5–7.8	1.7–2.3
IVa	70–100	15–28	2.5–3.5	3.5–5.5	1.3–1.7
IVb	50–70	13–15	1.5–2.5	2.5–3.5	1.0–1.3
V	10–50	11–14	1.2–2.0	2.0–3.0	0.8–1.1
VI	< 10	< 11	< 1.2	< 2.0	< 0.8

(a) Class 0 for river navigating seagoing vessels.
(b) Including container feeder barges up to 2000 tonne and push convoys of 4 x 600 tonnes.
(c) Push convoys of 4 x 600 tonnes have a width of 22 m.
(d) Especially cruise vessels can be high for a relative low tonnage.

c) Waterway classification

Taking into account following criteria (ECE recommendations for minimum channel dimensions) that are often used in the channel design for inland waterways, a Cambodian Mekong River waterway classification was proposed:

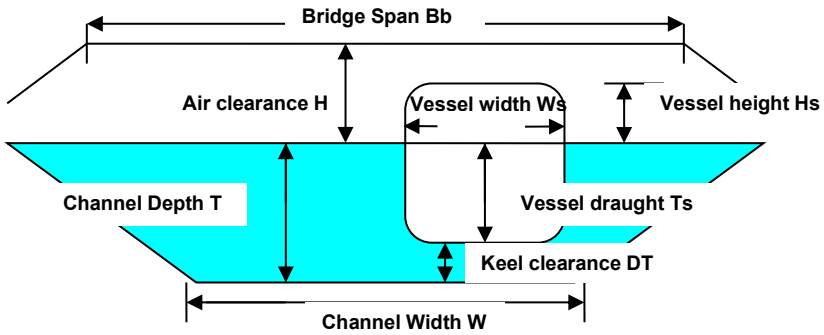


Figure 3. Bridge span Bb

[1] For the Lower Mekong (Cambodia, Viet Nam), it was proposed to use the Vietnamese vessel classification system, but because this classification stops at 1,000 DWT, it was proposed to subdivide the Vietnamese classification into two additional classes, i.e. IVa + IVb and Ia + Ib, and to add four classes, i.e. 0a, 0b, 0c and 0d for river/seagoing ships between 1,000 DWT and 10,000 DWT, container feeder barges of 2,000 tonnes, and push convoys of 4 x 600 tonnes.

R (m)	Bend radius	R (m) = 6 * Ls (m) (if not over-width, OW)
W (m) (normal)	Channel width at keel level	W (m) = 3 * Ws (m) (narrow) to 4 * Ws (m)
H (m)	Passage height	H (m) = Hs + DH (m)
DHb (m)	Bridge clearance height	DHb (m) = 0.20 m + 10% Hs (m)
DHew (m)	Electric wires clearance height	DHew (m) = Hs + 2.00 m
Wb (m) (m)	Bridge passage width	Wb (m) = 4 * Ws (m) (one-way traffic) to 6 * Ws (two-way traffic)
T (m)	Water depth	T (m) = Ts (m) + DT (m)
DT (m)	Keel clearance	10% of Ts (m)
OW (m)	Over-width	Over-widths in the curves, with a bend radius less than six times the length of the longest ship allowed in the channel, are always necessary and calculated as follows: $OW(m) = \frac{Ls^2\ (m^2)}{2 \times R\ (m)}$ or $OW\ (m) = \frac{Ls^2\ (m^2)}{2 \times 10 \times Ls\ (m)}$

A channel must have its full depth over a width that is three times the ship beam of the biggest ship allowed in the channel. Most of the ship sizes plying on the Mekong Delta and listed on the Lloyds registers (between 100 DWT and 10,000 DWT) have a beam of 9.50 to 20 m.

The radius of a curve must be equal or more than six times the LOA of the ship. The longest ship between 100 DWT and 10,000 DWT listed on the Lloyd's registers is 160 m. The minimum radius must therefore be greater than 6 x 160 = 960 m.

If water depth in certain stretches of the Lower Mekong at low low water (LLW) still reach navigable conditions (e.g. 1.50 m water depth), then an increase of the water level with, for example, to 2.50 m water will make these stretches accessible for almost the biggest inland barges and vessels.

From these criteria, and taking into account the proposal for vessel classification, Table 5 shows the proposal for a Cambodian Mekong River waterway classification system.

Table 5. Proposal for a Cambodian Mekong River waterway classification system

Class	Standard vessel dimensions					Minimum navigation channel dimensions					
	Length Ls (m)	Height Hs (m)	Width Bs (m)	Draught Ts (m)	Tonnage DWT (T)	Depth T (m) (a)	Width B (m)	Radius R (m)	Bridge span (m)	Bridge height H	Electric wires
0a (b)	140–160	29.0–33.4	19.0–22.0	7.3– 8.0	7,000–10,000	8.8	66–88 (c)	960	88–132 (d)	37.00	39.00
0b	125–140	24.0–29.0	16.0–19.0	6.4–7.3	5,000–7,000	8.0	57–76	840	76–114	32.00	34.00
0c	110–125	19.0–24.0	14.0–16.0	5.6–6.4	3,000–5,000	7.0	48–64	750	64–96	26.50	28.50
0d	100–110	14.0–19.0	12.0–14.0	4.1–5.6	1,000–3,000	6.2	42–56	660	56–84	21.00	23.00
Ia	90–100	12.5–14.0	11.0–12.0	3.6–4.1	800–1,000 (e)	4.5	36–48	600	48–72	15.50	17.50
Ib	80– 90	11.0–12.5	10.0–11.0	3.1–3.6	600–800	4.0	33–44	540	44–66	14.00	16.00
Ic	70– 80	9.5–11.0	9.0–10.0	2.6–3.1	400–600	> 3.0 (f) 3.4	> 90 30–40	> 700 480	80 40–60	10.00 12.50	12.00 14.50
II	28–70	3.5–9.5 (g)	6.5–9.0	1.7–2.6	100–400	2.0–3.0 2.9	70–90 27–36	500–700 420	60 36–54	9.00 10.50	11.001 2.50
III	15–28	2.5–3.5	3.5–6.5	1.3–1.7	70–100	1.5–2.0 1.9	50–70 20–26	300–500 168	50 26–39	7.00 4.00	9.00 6.00
IV	13–15	1.5–2.5	2.5–3.5	1.0–1.3	30–70	1.2–1.5 1.4	30–50 11–14	200–300 90	40 14–21	5.50 3.00	8.00 5.00
V	11– 13	1.2–1.5	2.0–2.5	0.8–1.0	10–30	1.0–1.2 1.1	20–30 8–10	100–200 78	25 10–15	3.50 2.00	8.00 5.00
VI	< 11	< 1.2	< 2.0	< 0.8	< 10	< 1.0 < 0.9	< 20 6– 8	60–150 66	15 8–12	2.50 1.50	8.00 5.00

(a) T (m) = Ts (m) + DT (m) with DT (m) = 10% Ts (m).
(b) Class 0 for river navigating sea-going vessels.
(c) Narrow (3 x Bs)-normal (4 x Bs).
(d) One-way traffic (4 x Bs)-two-way traffic (6 x Bs).
(e) Container feeder barges up to 2,000 DWT.
(f) Viet Nam Classification 1992 (channel width, bridge span and bend radius are higher because Viet Nam takes into account two-way traffic and also includes wider and longer push convoys).
(g) Tourist cruise vessels with low DWT, in particular, can have high structures.

2.5. Vietnamese Waterway Classification

In Viet Nam, more than 50,000 inland waterway vessels are registered. Services are mainly provided by public operators in the north, and private operators in the south. This is because the fleet capacity in the north is mainly owned by the central government or the provinces, whereas that in the south is mainly owned by private operators.

In 1992, Viet Nam had already issued a classification, "The Standards of Technical Class of Inland Waterways in Viet Nam" (Code TCVN 5664–1992). This classification, which differentiates between the natural rivers and the canals, identifies six categories, of which class I is the largest category.

For modest inland navigation systems, where the largest ships that can navigate have self-propelled barges of no more than 200 DWT, this classification was satisfactory; however, it did not mention pushed convoys (3,000 to 9,000 DWT), self-propelled barges of 1,500 to 2,000 DWT, or river navigating seagoing vessels (1,000 to 7,000 DWT), which can be used in some of the river stretches of the Mekong River System all year round and in most of the Mekong stretches during the high water season.

Table 6. Viet Nam Code TCVN 5664–1992 (TCVN–5664-92)

Class	Size of canal				Curved radius (m)	Size of structure			
	Natural river		Canal			Bridge			Height clearance electrical wires (m)
	Water depth (m)	Bed width (m)	Water depth (m)	Bed width (m)		Navigable span		Vertical clearance (m)	
						River (m)	Canal (m)		
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	20	100–200	25	20	3,5	8
VI	< 1.0	< 20	< 1.2	10	60–150	15	10	2,5	8

In the report *"Facilitating Trade through Competitive Low-Carbon Transport: The Case for Viet Nam's Inland and Coastal Waterways"*, World Bank (2014), the following vessel classification is provided.

Table 7. Vessel classification listed in the World Bank report 2014

Class	Self-propelled vessel							Pushed barge						
	Weight	Length (m)		Width (m)		Draft (m)		Weight	Length (m)		Width (m)		Draft (m)	
	Ton	50%	90%	50%	90%	50%	90%	Ton	50%	90%	50%	90%	50%	90%
I	601-1,050	44.0	50.0	9.0	10.0	2.85	3.10	4 x 600	87.0	92.0	20.6	22.0	2.55	2.80
II	301- 600	39.0	42.0	7.7	8.8	2.50	2.75	4 x 400	87.0	92.0	20.6	22.0	2.55	2.80
III	101- 300	25.0	36.0	6.5	7.5	2.15	2.55	2 x 400	80.0	87.0	8.5	9.4	2.30	2.80
IV	51- 100	18.0	22.0	5.1	5.8	1.80	2.10	2 x 100	71.0	79.0	6.0	9.0	1.10	1.20
V	10- 50	14.0	16.0	3.4	4.4	1.05	1.50	NA						
VI	<10	11.0	13.0	2.3	2.7	0.65	0.85	NA						

Source: VIWA 2014.
Note: NA = not applicable.

In 2016, Viet Nam issued new rules on the technical level of inland waterways:

THE MINISTRY OF TRANSPORT	**SOCIALIST REPUBLIC of VIET NAM**
No. 46/2016/TT-BGTVT	**Independence-freedom-happiness**
	Hanoi, December 29, 2016

CIRCULAR

RULES ON THE RIVER CLASSIFICATIONS

Pursuant to the law on Inland Waterway Transport dated June 15, 2004, and the revised Law with the addition of some articles of the law on Inland Waterway Transport dated June 17, 2014;

Pursuant to the Decree No. 107/2012/NĐ-CP by the Government dated December 20, 2012 on the functions, tasks, powers and organizational structure of the Ministry of Transport;

At the proposals by the Director of Transport and Infrastructure Department and the Director General of Viet Nam Inland Waterway Administration;

The Minister of transport promulgate this circular to regulate the river classifications.

Article 1. The scope of regulation
This circular regulates the river classifications.

Article 2. The subjects of application
This circular applies to organizations and individuals related to the management, construction, maintenance and exploitation of inland waterway transport.

Article 3. Definitions
1. The dimensions of inland waterways are the depth, the width, the radius of curvature of navigational channels corresponding to each river classification.
2. The special river classification is calculated based on ship design and over the level I.
3. Due to the limited river classifications, one of the current actual dimensions is smaller than the minimum corresponding dimension of river classifications.

Article 4. Determination of river classification and exploitation of inland waterway transport
1. The river classification is determined based on:
   a) The national standards ISO 5664:2009 on the technical divisions of inland waterways;
   b) The development planning of inland waterway transport infrastructure approved by the authorities;
   c) The current state of the inland waterways (depth, width, radius of curvature).
2. The inland waterway dimensions corresponding to each of river classifications are regulated in appendix 1 of this circular.
3. The river classifications of the national inland waterways are regulated in the Appendix 2 of this circular complying with the provisions in the Appendix 2 of the Circular No. 15/2016/TT-BGTVT by the Minister of Transport dated 30 June 2016 on inland waterway management.

4. The organizations and individuals exploiting inland waterway transport shall base on river classifications and the flow notification given by competent inland waterway management agencies as specified in the Circular No. 19/2016/TT-BGTVT by the Minister of Transport dated 30 June 2016 on the survey and publication of the flows in order to operate on inland waterways.

Article 5. Responsibilities of the Agencies

1. Viet Nam Inland Waterway Administration has responsibilities to update, supplement, gather and submit to the Ministry of Transport for consideration and modification and decision on national river classifications to ensure in line with reality.
2. The Departments of Transport in the provinces and the central cities have responsibilities to update, supplement, gather and submit to People's Committees of the provinces and the central cities for consideration and modification on national river classifications to ensure conformity with reality.

Article 6. Effect

1. This circular enters in force from 1 February 2017.
2. The circular No. 36/2012/TT-BGTVT by the Minister of Transport dated 13 September 2012 on the provisions of river classifications is abolished.
3. In case that the texts cited in this circular is modified, supplemented or replaced, then they will be applied under the provisions of the amended text.

Article 7. Organization of implementation

The director of the Ministry's Office, the Chief Inspector, the Director General of the Viet Nam Inland Waterways Administration, the directors of the Provincial-level Departments of Transport and centrally-run cities, the heads of the agencies and concerned organizations and individuals shall implement this Circular.

Recipients:

- As addressed in Article 7;
- Government offices;
- Ministries, ministerial agencies;
- The provinces, directly governed cities;
- The Deputy Minister of Transport;
- The Ministry of Justice;
- The Law Gazette
- The Electronic Government Portal
- The electronic portal of the Ministry of Transport
- The Journal of Transportation.

THE MINISTER OF TRANSPORT
Truong Quang Nghia

APPENDIX 1. INLAND WATERWAY DIMENSIONS ACCORDING TO THE TECHNICAL LEVEL

(Accompanied by Circular No. 46/2016/TT-BGTVT of 29 December 2016 of the Minister of Transport) Dimensions (m)

Technical level	Waterway dimensions					Minimum lock dimensions			Bridges		Minimum height		Minimum depth cables/ pipes
	River		Channel		Radius of curvature	Length	Width	Depth	Minimum width		Bridges	Power lines	
	Depth	Width	Depth	Width					Channel	River			River, channel
Special	Depending on ship dimensions					Depending on ship dimensions			Depending on ship dimensions				
Northern, Central													
I	>4.0	>90	>4.5	>75	>600	145.0	12.5	3.8	>70	>85	11	12+ΔH	2.0
II	>3.2	>50	>3.5	>40	>500	145.0	12.5	3.4	>40	>50	9.5	12+ΔH	2.0
III	>2.8	>40	>3.0	>30	>350	120.0	10.5	3.3	>30	>40	7	12+ΔH	1.5
IV	>2.3	>30	>2.5	>25	>150	85.0	10.0	2.2	>25	>30	6(5)	7+ΔH	1.5
V	>1.8	>20	>2.0	>15	>100	26.0	6.0	1.8	>15	>20	4(3.5)	7+ΔH	1.5
VI	>1.0	>12	>1.0	>10	>60	13.0	4.0	1.3	>10	>10	3(2.5)	7+ΔH	1.5
Southern													
I	>4.0	>125	>4.5	>80	>550	100.0	12.5	3.8	>75	>120	11	12+ΔH	2.0
II	>3.5	>65	>3.5	>50	>500	100.0	12.5	3.5	>50	>60	9.5	12+ΔH	2.0
III	>2.8	>50	>3.0	>35	>350	95.0	10.5	3.4	>30	>50	7(6)	12+ΔH	1.5
IV	>2.6	>35	>2.8	>25	>100	75.0	9.5	2.7	>25	>30	6(5)	7+ΔH	1.5
V	>2.1	>25	>2.2	>15	>80	18.0	5.5	1.9	>15	>25	4(3.5)	7+ΔH	1.5
VI	>1.3	>14	>1.3	>10	>70	12.0	4.0	1.3	>10	>13	3(2.5)	7+ΔH	1.5

Notes:

- The technical levels of inland waterways are drawn from table 2 of the ISO standard 5664:2009 on technical divisions of inland waterways.
- The size of the works on inland waterway rivers beyond the national level, specifically on the Tien and the Hau River for ships of 10,000 tonnes, is calculated.
- Values between parentheses (...) are not used.

APPENDIX 2. TECHNICAL LEVELS OF NATIONAL INLAND WATERWAYS

(Accompanied by circular No. 46/2016/TT-BGTVT dated 29 December 2016 of the Minister of Transport)

Example:

No	Inland waterway name	Stretch	Length (km)	Technical level	
				Current	Master Plan 2030
III	**Southern**		2,968.9		
14	Bassac River (including West Island branch, cu lao Ma, Tiger River, Long Island)	**From 500 m upstream My Tho Port of the Viet Nam-Cambodia border**	**221.3**	**Special**	**Special**
		- The main route from 500 m upstream My Tho Port to the Viet Nam-Cambodia border	176.3	Special	Special
		- Long Island branch	10.0	Special	Special
		- Cu lao Ma branch	17.9	Special	Special
		- Tiger River	8.0	Special	Special
		- West Island branch	9.1	I	
31	Mekong River (including Ong Ho branch, Nang Gu–Thi Hoa branch)	**From Rach Ngoi Lon to Tan Chau**	**91.6**		
		- The main route from Rach Ngoi Lon to Binh Long	35.2	Special	Special
		- The main route from Binh Long to Tan Chau	29.8	I	I
		- Ong Ho branch	10.6	Special	
		- Nang Gu–Thi Hoa branch	16.0	III	

2.6. Comparison and Evaluation of the Chinese, Vietnamese and Cambodian Classification Systems

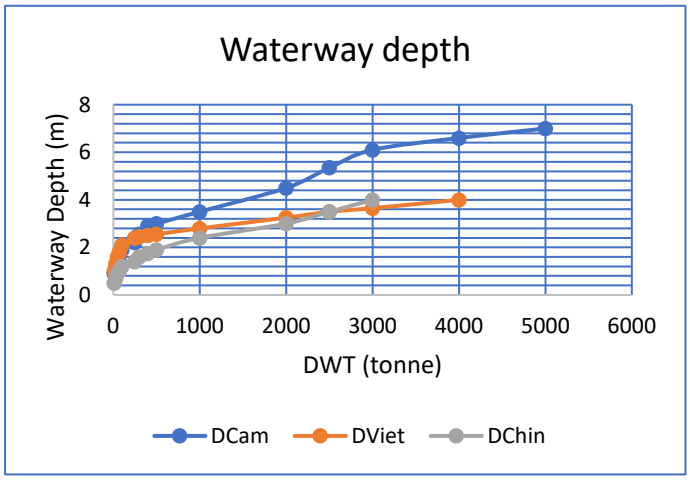
Table 8. Maximum ship dimensions per class

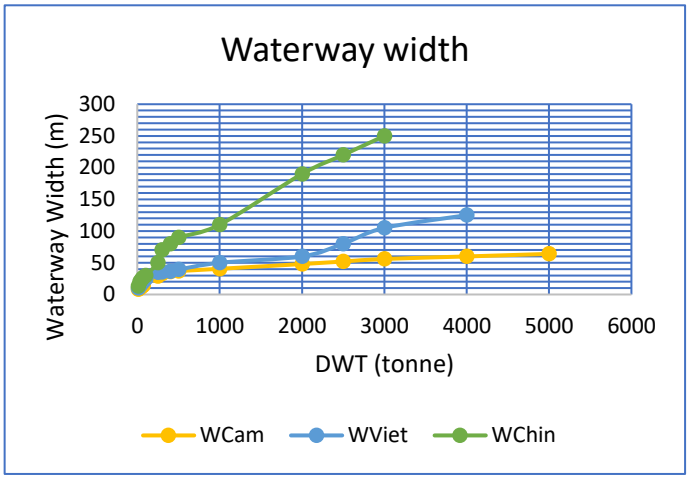
Europe (CEMT)					China					Viet Nam**					Cambodia				
Class	Ls (m)	Ws (m)	Ds (m)	Ton	Class	Ls (m)	Ws (m)	Ds (m)	Ton	Class	Ls (m)	Ws (m)	Ds (m)	Ton	Class	Ls (m)	Ws (m)	Ds (m)	Ton
															0a***	160.0	22.0	8.0	10,000
															0b***	140.0	19.0	7.3	7,000
															0c***	125.0	16.0	6.4	5,000
VII*	285.0	34.2	4.5	27,000											0d***	110.0	14.0	5.6	3,000
VI*	280.0	22.8	4.5	18,000	I	90.0	16.2	3.5	3,000	I	90.0	20.0	3.5	4,000	I	100.0	12.0	4.1	2,000
Vb*	185.0	11.4	4.5	6,000	II	75.0	16.2	2.6	2,000	II	85.0	16.0	3.0	2,500	II	70.0	9.0	2.6	400
V	110.0	11.4	2.8	3,000	III	67.5	10.8	2.0	1,000	III	60.0	12.5	2.5	1,000	III	28.0	6.5	1.7	100
IV	85.0	9.5	2.5	1,500	IV	45.0	10.8	1.6	500	IV	20.0	9.0	2.2	250	IV	15.0	3.5	1.3	70
III	80.0	8.2	2.5	1,000	V	35.0	9.2	1.3	300	V	14.0	6.0	1.8	100	V	13.0	2.5	1.0	30
II	55.0	6.6	2.5	650	VI	32.0	7.0	1.0	100	VI	12.0	3.5	1.2	30	VI	11.0	<2.0	<0.8	10
I	38.5	5.05	2.0	400	VII	24.0	5.5	0.7	50										

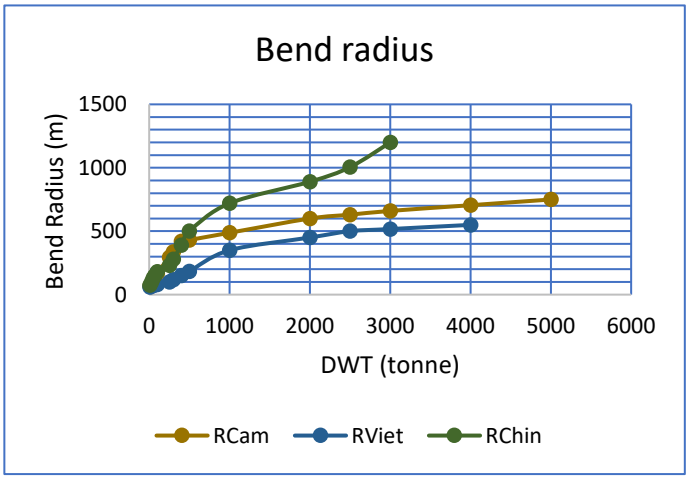
* push convoys ** estimations *** class 0 for seagoing vessels

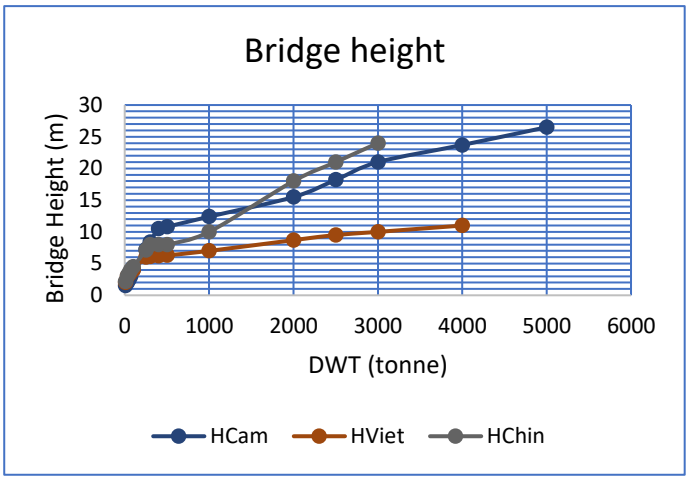
Table 9. Waterway dimensions per class

China							Viet Nam								Cambodia					
Cl	Depth	Width 1 way	Width 2 way	Radius	Bridge width	Bridge height	Cl	Depth river	Width river	Depth canal	Width canal	Radius	Bridge width	Bridge height	Cl	Depth	Width	Radius	Bridge width	Bridge height
															0a	8.8	88.0	960	132.0	37.0
															0b	8.0	76.0	840	114.0	32.0
															0c	7.0	64.0	750	96.0	26.5
I	4.0	125.0	250.0	1,200	200.0	24.0									0d	6.2	56.0	660	84.0	21.0
II	3.0	100.0	190.0	810	145.0	18.0	I	>4.0	>125.0	>4.5	>80.0	550	>85.0	11.0	I	4.5	48.0	600	72.0	15.5
III	2.4	55.0	110.0	720	100.0	10.0	II	>3.5	>65.0	>3.5	>50.0	500	>50.0	9.5	II	2.9	36.0	420	54.0	10.5
IV	1.9	45.0	90.0	500	75.0	8.0	III	>2.8	>50.0	>3.0	>35.0	350	>40.0	7.0	III	1.9	26.0	168	39.0	4.0
V	1.6	35.0	70.0	280	55.0	8.0	IV	>2.6	>35.0	>2.8	>25.0	100	>30.0	6.0	IV	1.4	14.0	90	21.0	3.0
VI	1.2	15.0	30.0	180	25.0	4.5	V	>2.1	>25.0	>2.2	>15.0	80	>20.0	4.0	V	1.1	10.0	78	15.0	2.0
VII	0.9	12.0	24.0	130	20.0	3.5	VI	>1.3	>14.0	>1.3	>10.0	70	>10.0	3.0	VI	<0.9	8.0	66	12.0	1.5









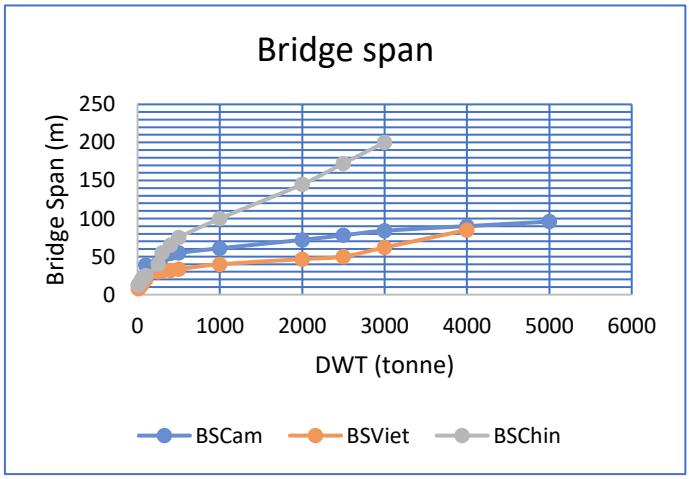


Figure 4. Waterway dimensions

It should be noted that the Chinese classification system is the most detailed but it does not t provide a classification for coasters and seagoing vessels sailing on inland waterways.

For the Vietnamese classification system, it is surprising that no vessel classification is given in the ministerial circular that indicates the maximum dimensions of the vessels that can navigate in a waterway of certain level. Also, coasters and seagoing vessels sailing on inland

waterway are not included (they are given the class “special”), and it is not clear if push convoys are included in the Vietnamese classification system.

In the Cambodian classification system, push convoys are not included, but a special class 0 was created to include seagoing vessels sailing on the Mekong River.

Furthermore, comparing the three classification systems, the following should be noted:

Waterway depth

- For smaller vessels (up to 500 tonnes), the Vietnamese and Cambodian waterway depths are almost the same.
- For larger vessels, the Vietnamese and Chinese waterway depths are almost the same, but the Cambodian ones are greater (the Vietnamese and Chinese classification do not consider seagoing vessels).

Waterway width

- The waterway widths are much greater in the Chinese classification system because push convoys are also considered.
- The waterway widths are almost the same for the Vietnamese and Cambodian classification, except for larger vessels, for which the waterway widths are greater in the Vietnamese classification system. The Vietnamese classification combines fleets with two or three barges next to each other.

Bridge height

- The bridge heights of the Chinese and Cambodian classification system are comparable.
- The bridge heights of the Vietnamese classification system are much lower than in the Cambodian and the Chinese system.

Bridge span

- The bridge spans are much higher in the Chinese classification system.
- The widths are lower in the Vietnamese than in the Cambodian classification system, except for larger vessels, where the bridge spans are comparable.

Bend radius

- For vessels of more than 500 tonnes, the bend radiuses are much higher in the Chinese than in the Cambodian and Vietnamese classification systems (in China, R = 10 to 20 times Ls).
- The bend radiuses are lower in the Vietnamese than in the Cambodian and Chinese classification systems.

Therefore, the Mekong River countries must choose a Mekong Waterway classification system, either based on the prevailing standards, or on the Chinese and Vietnamese classification standards.

3. BENCHMARKING WITH EXISTING EQUATIONS FOR THE CALCULATION OF WATERWAY DIMENSIONS

3.1 The Chinese Equations for The Calculation of Waterway Dimensions

The navigation standard for inland waterways in the People's Republic of China is National Standard GB50139-2004, which was issued on 1 March 2004 by the Ministry of Communications on behalf of the authorized department of the Ministry of Construction. It gives the minimum dimensions for natural and channelled inland rivers, locks and sluices and river crossing constructions for the seven levels of inland waterway ships, categorized according to their tonnage.

Class	I	II	III	IV	V	VI	VII
DWT (tonnes)	3,000	2,000	1,000	500	300	100	50

Starting from the vessel dimensions Ls (length) x Bs (width) x Ts (draft) and Hs (height) following formulas are used to calculate the minimum navigation channel dimensions:

T (m) Water depth T (m) = Ts (m) + DT (m)
DT (m) Keel clearance

Class	I	II	III	IV	V	VI	VII
	0.4 ~ 0.5	0.3 ~ 0.4	0.3 ~ 0.4	0.2 ~ 0.3	0.2 ~ 0.3	0.2	0.2

B (m) Channel width B (m) = b1 + Bs + Ls sinβ + b2 for one-way traffic
B (m) = b1 + 2 Bs + 2 Ls sinβ + C + b2 for two-way traffic

Where:

Bs Maximum width of the ships
b1 Safety distance from the ship's bow to the starboard channel bottom edge = 0.3 to 0.4 Bs
b2 Safety distance from the ship's stern to the port channel bottom edge = 0.3 to 0.4 Bs
β Angle between the ship's axis and navigation direction = 4° to 6°, so sinβ = 0.07 to 0.10
C Safety distance between two crossing ships = Bs.

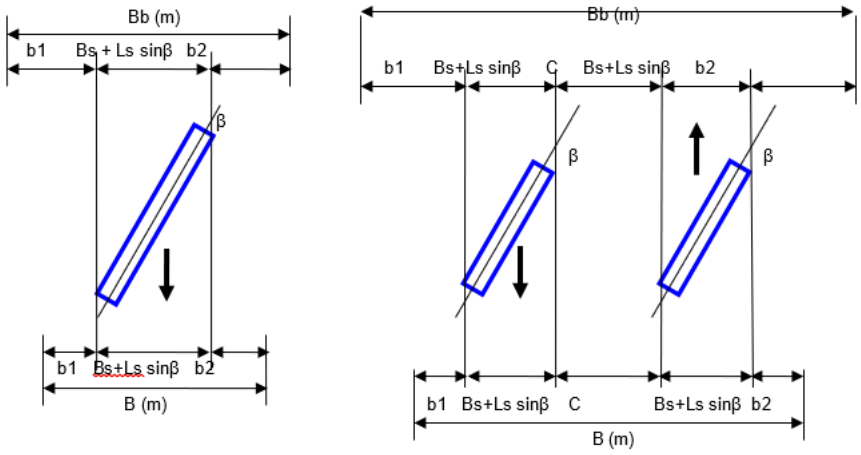


Figure 5. Vessel dimensions following formulas to calculate the minimum navigation channel dimensions

In the Chinese Inland Waterway classification table:
B (m) = 2 x Bs (m) for one-way traffic and
B (m) = 4 x Bs (m) for two-way traffic.
Bb (m) Bridge passage width B (m) = bm1 + Bs + Ls sinβ + bm2 for one-way traffic
B (m) = bm1 + 2 Bs + 2 Ls sinβ + C + bm2 for two-way traffic
where:
bm1 and bm2 is safety over-width under the bridge = 0.6 to 0.8 Bs.

In the Chinese Inland Waterway classification table, Bm (m) = 3 x Bs (m) for one-way traffic and B (m) = 6 x Bs (m) for two-way traffic.

H (m) Passage height (*) H (m) = Hs + DH (m)
DH (m) Clearance height DH (m) = 15% Hs (m)

with H starting from the design highest navigation water level (DHNWL) with a flood period as follows:

Class	I, II and III	IV and V	VI and VII
Flood return period (years)	20	10	5

If tidal effects are obvious in the section of river, the DHVWL should use the year highest tide level, occurring with a frequency of 5%.

The water depth T (see higher) is calculated starting from the design lowest navigation water level (DLNWL) with a return period as follows:

Class	I and II	III and IV	V and VI	VII
Return period (years)	10 to 5	5 to 4	4 to 2	2 to 1

If tidal effects are obvious in the section of a river, the DLVWL should use the ebb tide level occurring with a cumulative frequency of 90%.

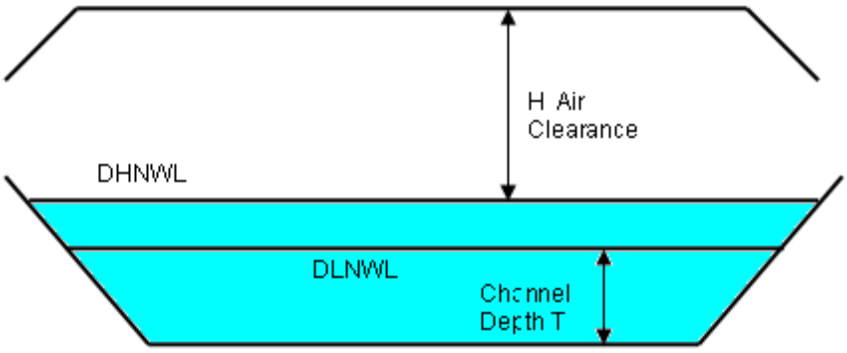


Figure 6. Section of a river

R (m) Bend radius R (m) = 3 x Ls (m) for towing fleet or push convoy, and 4 x Ls for a single ship. With a channel over-width this bend radius can be reduced to 2 x Ls (m) for towing fleet or push convoy,

and 3 x Ls for a single ship; however, with a flow speed higher than 3 m/s, the minimum bend radius should be raised to 5 x Ls for a single ship.

In the Chinese Inland waterway classification table, R (m) = 3 x Ls (m).

Table 10. Summary of the dimensions in the Chinese Inland waterway classification

Waterway dimensions	China
T Depth	Ts + 0.2 to 0.5 m
W Width one-way traffic	2 Ws
W Width two-way traffic	4 Ws
Wb Bridge passing one-way traffic	3 Ws
Wb Bridge passing two-way traffic	6 Ws
H Air clearance bridge	1.15 Hs
Hc Air clearance cables	1.30 Hs
R Bend radius	3 Ls to 4 Ls
LL Lock length (PIANC 2009)	1.10 Ls
WL Lock width (PIANC 2009)	1.10 Ws (min Ws + 0.90 m)
TL Lock depth (PIANC 2009)	1.20 Ts (min Ts + 0.60 m)

The PIANC guidelines for channel design are given in several technical reports:

- Standardization of inland waterway dimensions, InCom report of Working Group 9, 1990
- Standardization of ships and inland waterways for river/sea navigation, InCom report of Working Group 16, 1996
- Design guidelines for inland waterway dimensions, InCom report of Working Group 141, 2019.

3.2 The PIANC Equations 1996 for the Calculation of Waterway Dimensions

In summary, these equations can be given as follows:

WATERWAY DEPTH T

Ship-related factors are the most important in vertical channel calculation. A simple approach depends on ship speed, the design ship with its maximum draught Ts, and on the type of channel.

Table 11. PIANC equation's dimension

Class	Vessel speed	Minimum channel depth (m)	Channel bottom	Minimum under keel clearance (m)
I	≤ 10 kts (5.1 m/s)	1.10 Ts	Mud	0.2
II	10–15 kts	1.12 Ts	Sand / clay	0.4
III	> 15 kts (7.7 m/s)	1.15 Ts	Rock / coral	0.6

WATERWAY WIDTH W

The overall bottom width W of a navigation channel is given for a one-way channel by:

$$W = Wms + 2\ Wm$$

and for a two-way channel by:

$$W = 2\ Wms + 2\ Wm + Wp$$

where:

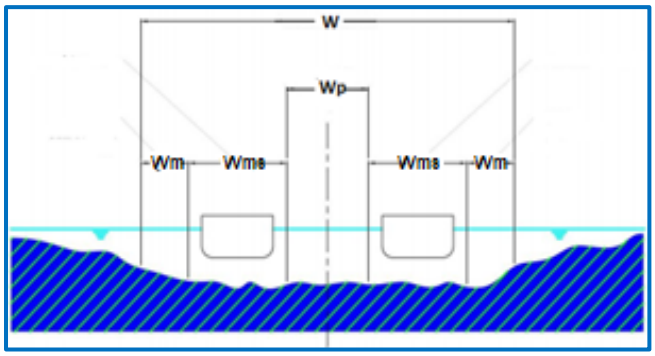


Figure 7. Section of a river

- Wms = width of basic manoeuvring lane as a multiple of the design ship's beam Ws;
- Wm = bank clearance;
- Wp = passing distance, comprising the sum of a separation distance between both manoeuvring lanes Wms and an additional distance for traffic density or speed.

Manoeuvring lane Wms

The width of the swept path, which is the basic manoeuvring lane, will depend on following key elements:

- the inherent manoeuvrability of the ship (depending on the ship's type and water depth /draft ratio);
- the ability of the ship-handler; and
- The visual cues and overall visibility available to the ship-handler.

The first two of these are the most important since the last one can be dealt with by suitable Aids to Navigation (AtN) both outside (e.g. buoys) and onboard the ship (e.g. radar)

Table 12 lists the basic manoeuvring lane widths Wms for ships with good, moderate and poor ship manoeuvring characteristics. Manoeuvrability of tankers and bulk carriers is considered to be generally poor; container vessels, car carriers, LNG and LPG vessels are considered moderate, and twin-propeller ships, ferries and cruise vessels are considered generally good.

Table 12. Ship manoeuvrability

Ship manoeuvrability	Good	Moderate	Poor
Basic manoeuvring lane Wm	1.3 Ws	1.5 Ws	1;8 Ws

According to PIANC MarCom report of Working Group 121, 2014 an additional width must be given to the manoeuvring lane in case of strong winds, strong longitudinal currents or shallow water depth.

Table 13. Additional width must be given to the manoeuvring lane

	Additional width to Wm
Strong cross winds ≥ 7 m/s	0.4 Ws
Strong longitudinal currents ≥ 1 m/s	0.1 Ws
Waterway depth T ≤ 1.15 Ts	0.2 Ws

Bank clearance Wm

To avoid uncontrollable situations in a channel with underwater banks, additional width outside the manoeuvring lane is required. Important factors are the ship's speed, the bank slope or bank structures, the cross-section/symmetry of the channel, the under-keel clearance (ratio T/Ts) and the distance between the ship and bank.

Table 14. Bank clearance

Bank clearance width Wb	Vessel speed	Protected water
Gentle underwater channel slope (1/10 or less steep)	Fast (Vs ≥ 12 kts) Moderate Slow (Vs ≤ 8 kts)	0.2 Ws 0.1 Ws 0.0 Ws
Sloping channel edges and shoals	Fast Moderate Slow	0.7 Ws 0.5 Ws 0.3 Ws
Steep and hard embankments, structures (e.g. bridges)	Fast Moderate Slow	1.3 Ws 1.0 Ws 0.5 Ws

Passing distance Wp

The additional width requirement to take into account ship-ship interaction also depends on the traffic density in the two lanes, because the greater the density, the greater the width that is required. To reduce the effects of these interaction forces to an acceptable minimum and ensure navigation safety in a two-way channel, an additional channel width Wp, should be included between both manoeuvring lanes (Wm).

The values given in Table 15 are the distance between the lanes of a two-way channel (not the hull to hull distance). Overtaking requires more width than passing, but is normally not considered.

Table 15. Passing distance

Vessel speed Vs (knots[2])	Passing distance width Wp
Fast Vs ≥ 12 kts	1.8 Ws
Moderate 8 ≤ Vs < 5 kts	1.4 Ws
Slow 5 ≤ Vs < 8	1.0 Ws

AIR CLEARANCE DH

The air clearance DH is concerned with vertical clearances between the top of the ship and overhead structures such as bridges, power lines and cables.

Hs is air draught or height from the water surface to the top of the mast. The water surface is equivalent to the highest navigable water level in this application. Although the Hs height is a unique value for a ship, the air draught varies greatly depending on the value of ship's load and draught Ts. In summary, the air clearance is a function of the ship loading, overall height of the ship, and variable water levels due to tides and meteorological effects.

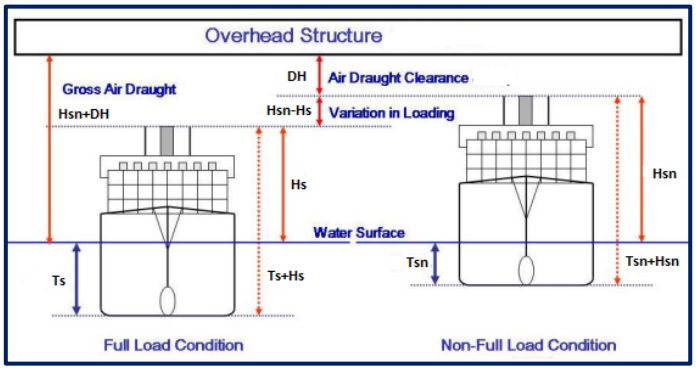


Figure 8. Overhead structure

According to the PIANC report, the air clearance DH should be ≥ 0.05 Hsn and should be ≥ 2.0 m.

Note that power lines may sag due to, *inter alia*, age and temperature, and may require additional allowances. Additional clearance should also be provided to prevent arcing of power lines that might occur if the ship is too close to the line.

BEND RADIUS R

In shallow water, the course-keeping stability of ships is largely improved, but the turning ability is decreased. The bend radius R is given as a function of the ship's type for T/Ts = 1.20 (Table 16).

Table 16. Bend radius by ship type

Ship type	R
Container ship	6 Ls
Cargo ship	5 Ls
Bulk carrier	5 Ls
Tanker	5 Ls
Passenger ship	4 Ls

[2] 1 knot = 0.51444 m/s = 1.852 km/h.

ADDITIONAL WIDTH IN BENDS OW

In bends, an additional channel width OW is always required by increases in:

- the drift angle of the vessel;
- the response time from the moment the vessel deviates from the channel axis and the moment when the correction becomes effective.

Thus, the total additional width in a bend due to the swept path OW is equal to the sum of the additional width due to these two factors.

The *additional width due to drift angle OW1* can be determined by using the simplified formula:

$OW1 = Ls^2 / (a \times R)$
where:
R = bend radius
Ls = ship's length overall
a = factor depending on the ship type: a = 8 for normal ships and a = 4 for larger displacement ships with $Cb^3 \geq 0.8$ (tankers, bulk carriers, etc.).

The *additional width due to response time OW2* is required in bends to compensate for the time delay of the ship's handler in responding to a required alteration of course. The following allowance is recommended: OW2 = 4 Ws.

LOCK DIMENSIONS

In the PIANC report "Innovations in navigation lock design, InCom report of Working Group 106, 2009", the following dimensions of a lock chamber for inland waterway vessels in Europe are given:

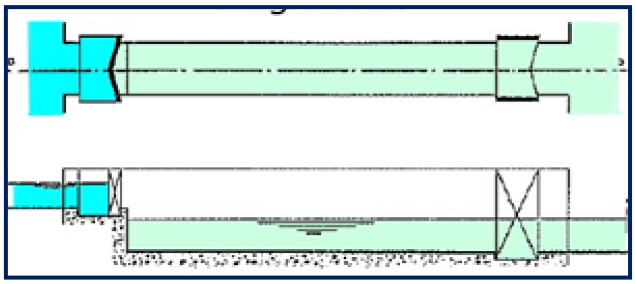


Figure 9. Ship lock sections

Length between the lock heads: LL = 1.10 Ls
Width between the lock chamber walls: WL = 1.10 Ws with a minimum of Ws + 0.90 m
Lock sill *depth*: TL = 1.20 Ts with a minimum of Ts + 0.60 m.

When the lock chamber is designed to accommodate two vessels, either in length or in width, space for manoeuvring will be added only once, since the vessels enter the lock one by one. Hence, the length is LL = Ls+(1.10 Ls), and similarly, WL = Ws+(1.10 Ws) with a minimum of 2Ws + 0.90 m.

The dimensions based on the CEMT table of 1992 are given in Table 17 and are applicable for the 'minimum lock', i.e. a lock operating in a traffic situation where fewer than 1,000 inland navigation vessels. either in the upstream or downstream direction, are locked every year.

[3] Cb = block coefficient = displacement / Ls x Ws x Ts.

CEMT: European Conference of Ministers of Transport (French: Conférence européenne des ministres des Transports, CEMT)

Table 17. CMET dimensions

CEMT classes	Vessel size			Lock chamber dimensions (*)		
	Length (m)	Beam (m)	Draft (m)	Length (m)	Width (m)	Depth (m)
I	38.5	5.05	1.80–2.20	43	6.00	2.80
II	50–55	6.60	2.50	60	7.50	3.10
III	67–80	8.20	2.50	90	9.00	3.10
IV	80–85	9.50	2.50–2.80	95	10.50	3.50
Va	95–110	11.40	2.50–3.50	125	12.50	4.20
Vb	172–185	11.40	2.50–4.00	210	12.50	4.70

Note: (*) The lock chamber dimensions do not take into account that the design ship might be entering the lock chamber with tug assistance.

Table 18. Summary of PIANC 1996 dimensions

Waterway dimensions	PIANC 1996
T Depth	1.10 to 1.15 Ts
W Width one-way traffic	3 Ws
W Width two-way traffic	6 Ws
Wb Bridge passing one-way traffic	3 Ws
Wb Bridge passing two-way traffic	6 Ws
H Air clearance bridge	1.05 Hsn (DH ≥ 2.0 m)
Hc Air clearance cables	1.15 Hsn (DHc ≥ 3.5 m)
R Bend radius	6 Ls
LL Lock length (PIANC 2009)	1.10 Ls
WL Lock width (PIANC 2009)	1.10 Ws (≥ Ws + 0.9m)
TL Lock depth (PIANC 2009)	1.20 Ts (≥ Ts + 0.6 m)

3.3 The PIANC Equations 2019 For The Calculation Of Waterway Dimensions

CANALS

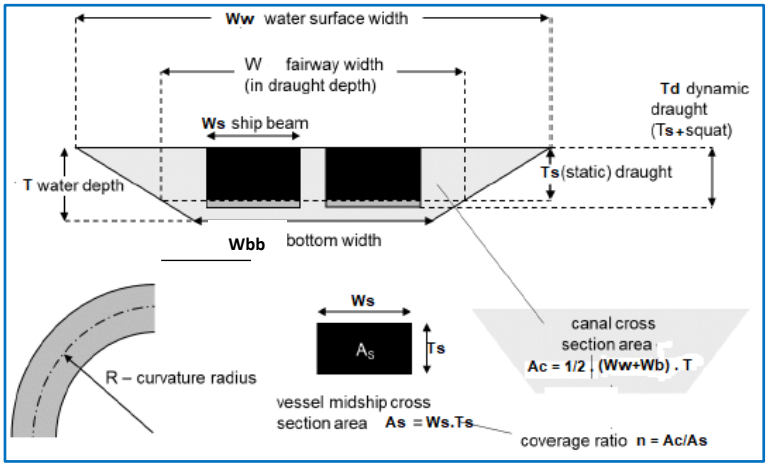


Figure 10. River/canal sections

From a comparison with U.S., Europe, Russian and China waterway dimensions, the following averages can be derived and are recommended:

Two way straight section in a canal
Fairway depth T/Ts = 1.3
Fairway width W/Ws = 3 to 4
Coverage ratio n = 3.5 to 4.5
Bend radius R = 5 Ls.

Single lane straight section in a canal
Fairway depth T/TS = 1.3
Fairway width W/Ws = 2
Coverage ratio n = 5 to 7
Bend radius R = 5 Ls.

For greater detail, Table 19 provides the validity limits of the given numbers where:

- A = High safety and ease navigation quality (nearly unrestricted drive);
- B = Average safety and ease navigation quality (moderate restricted drive);
- C = Low safety and ease navigation quality (strongly restricted drive);
- 2 Ws = 2 x 0.3 Ws bank distance + 1.4 Ws manoeuvring lane;
- 3 Ws = 2 x 0.2 Ws bank distance + 2 x 1.2 Ws manoeuvring lane + 0.2 Ws ship-ship distance;
- 4 Ws = 2 x 0.5 Ws bank distance + 2 x 1.35 Ws manoeuvring lane + 0.3 Ws ship-ship distance; and
- Ws is the average width of the two involved vessels in case of two-way traffic.

Table 19. Alternative fairways

Waterway	Fairway for alternate single lane			Fairway for two-way traffic		
Ease quality	C	B	A	C	B	A
Min W	1.9 Ws	2.1 Ws	2.3 Ws	2.8 Ws	3.5 Ws	4.5 Ws
Min n	2.5	3.5	4.5	3.5	5.0	7.0
Minimum T	1.3 Ts	1.3 Ts	1.4 Ts	1.3 Ts	1.3 Ts	1.4 Ts
Minimum R	4 Ls	5 Ls	6 Ls	4 Ls	5 Ls	6 Ls
Max V_{flow}	0.5 m/s			0.5 m/s		
Max V_{wind}	5–6 BF (8.0-13.9 m/s)			5-6 BF (8.0–13.9 m/s)		

This table is valid for straight canal sections and for both for deep draught and shallow draught vessels with average equipment and average instrumentation.

Even if the specified minimum radii R are not exceeded, corresponding extra widths must be accounted for because the basic widths are valid for straight canal sections. Extra widths are also needed for high traffic densities.

It is further assumed that the pilots sail cautiously and with moderate vessel speeds. This speed reduction at manoeuvres is important to restrict interaction forces and thus the corresponding safety distances, which are included in the basic widths. Thus, the values given in this table are not mandatory and may be interpreted differently from case to case.

BRIDGES

Based on the U.S., Europe, Russian and Chinese examples, the bridge openings and heights are recommended in Table 20.

Table 20. Bridge opening and height

Waterway	Bridge opening/height single lane traffic				Bridge opening/height two-way traffic			
Ease quality	C	B	A	Remarks	C	B	A	Remarks
Minimum Wb	2.0 Ws	2.2 Ws	2.4 Ws	Min. safety Wbm ≥ 5.0 m	3.2 Ws	4.0 Ws	4.8 Ws	Min. safety Wbm ≥ 5.0 m
Minimum H	1.05 Hsn	1.05 Hsn	1.05 Hsn	Min. safety DH ≥ 0.3 m	1.05 Hsn	1.05 Hsn	1.05 Hsn	Min. safety DH ≥ 0.3 m

Notes: Wbm is the safety over-width from ship to bridge pillar
HHW is the highest high water level
Hsn is the vessel's height in non-loaded condition
DH (air clearance) ≥ 0.05 Hsn and certainly should be ≥ 0.3 m for inland barges.
It will be generally assumed that the pilots sail very carefully and with reduced speed while passing the bridge opening.

RIVERS

From a comparison with U.S., European, Russian and Chinese waterway dimensions, the following averages can be derived and are recommended in Table 21.

Table 21. Recommended fairway

Waterway	Fairway for alternate single lane			Fairway for two-way traffic		
Ease quality	C	B	A	C	B	A
Min W	2.8 Ws	3.2 Ws	3.4 Ws	4.0 Ws	5.0 Ws	6.0 Ws
Min n	2.5	3.5	4.5	3.5	5.0	7.0
Minimum T	1.2 Ts	1.3 Ts	1.3 Ts	1.2 Ts	1.3 Ts	1.4 Ts
Minimum R	4 Ls	5 Ls	6 Ls	4 Ls	5 Ls	6 Ls
Max V_{flow}	1.5 m/s			1.5 m/s		
Max V_{wind}	5–6 BF (8.0–13.9 m/s)			5–6 BF (8.0–13.9 m/s)		

The numbers are valid for straight river sections and for average equipped and instrumented vessels, and further restrictions relating to waterway properties such as flow velocity (not more than around 1.5 m/s) or moderate wind speeds of an inland stretch (not more than around 5–6 BF).

The basic widths include safety distances to banks (around 0.7 Ws for normal ship speed and 0.8 Ws for high ship speed) and between vessels; there are allowances for the human factor and wind effects.

Ws denotes the width of the design vessel for single lane traffic or the average width of both vessels in case of two-way traffic.

According to the increase of the existing fairway width in bends (see below), the basic widths should be increased by at least OW = 0.5 Ls^2/R for single lane and 1.0 Ls^2/R for two-way traffic. Note that these are minimum extra widths and that the over-width in bends should be calculated as given below.

The beam multipliers 2.8, 3.2 and 3.4 were taken from the table for canals, multiplied with a factor 3/2 according to the U.S., European, Russian and Chinese examples.

BRIDGES

There are only a few examples of valuable existing bridge opening data on rivers.

Since the proposed bridge openings for canals are only slightly larger than the fairway widths for canals (+ 0.1 Ws for single-lane and around + 0.4 Ws for two-way), and as the fairway widths for rivers (see higher) offer some extra safety margins related to canals and a speed reduction, which will generally be recommended while passing bridge openings, it is proposed to use the same increases for the bridge openings as used for canals (fairway width + 0.1 Ws for single-lane and around + 0.4 Ws for two-way).

For the bridge height, it is proposed to use a minimum safety air clearance DH between ship and bridge of 2.0 m for seagoing vessels and 0.3 m for barges and inland convoys.

Table 22. Recommended bridge opening and height

Waterway	Bridge opening/height single lane traffic				Bridge opening/height two-way traffic			
Ease quality	C	B	A	Remarks	C	B	A	Remarks
Minimum Wb	2.9 Ws	3.3 Ws	3.5 Ws	Min. safety Wm ≥ 5.0 m	3.6 Ws	4.4 Ws	5.2 Ws	Min. safety Wm ≥ 5.0 m
Minimum Hb seagoing	HHW + 1.05 Hsn	HHW + 1.05 Hsn	HHW + 1.05 Hsn	Min. safety DH ≥ 2.0 m	HHW + 1.05 Hsn	HHW + 1.05 Hsn	HHW + 1.05 Hsn	Min. safety DH ≥ 2.0 m
Minimum Hb barge	HHW + 1.05 Hsn	HHW + 1.05 Hsn	HHW + 1.05 Hsn	Min. safety DH ≥ 0.3 m	HHW + 1.05 Hsn	HHW + 1.05 Hsn	HHW + 1.05 Hsn	Min. safety DH ≥ 0.3 m

OVER-WIDTH IN BENDS OW

The over-width should be calculated with the formula $OW = CC \times Ls^2/R \leq Ls$

where:
Ls = overall ship's length
R = radius of curvature
CC = parameter, depending on ship type, loading condition (more precisely on Ts/T), flow velocity, etc.
The factor CC in the aforementioned equation can be assumed to be between 0.25 for a loaded vessel up to 1.1 for an empty convoy in a canal.

Table 23. Summary of the PIANC 2019

Waterway dimensions	PIANC 2019 / Canal	PIANC 2019 / River
T Depth	1.30 Ts	1.30 Ts
W Width one-way traffic	2.1 Ws	3.2 Ws
W Width two-way traffic	3.5 Ws	5.0 Ws
Wb Bridge passing one-way	2.2 Ws	3.3 Ws
Wb Bridge passing two-way	4.0 Ws	4.4 Ws
H Air clearance bridge	1.05 Hsn (DH ≥ 0.3 m)	1.05 Hsn (DH ≥ 2.0 m)
Hc Air clearance cables	1.15 Hsn (DHc ≥ 0.6 m)	1.15 Hsn (DHc ≥ 3.5 m)
R Bend radius	5 Ls	5 Ls
LL Lock length (PIANC 2009)	1.10 Ls	1.10 Ls
WL Lock width (PIANC 2009)	1.10 Ws (≥ Ws + 0.9m)	1.10 Ws (≥ Ws + 0.9m)
TL Lock depth (PIANC 2009)	1.20 Ts (≥ Ts + 0.6 m)	1.20s (≥ Ts + 0.6 m)
		1.21

4. CONCLUSIONS OF THE QUESTIONNAIRE ON THE MAIN APPLICATIONS OF A MEKONG VESSEL AND WATERWAY CLASSIFICATION, AND ON THE PARAMETERS THAT SHOULD BE CONSIDERED

Comparing the known classification systems with those of China, Cambodia and Viet Nam, it can be noted that the Chinese classification system is the most detailed, but does not provide *a classification for coasters and seagoing vessels* sailing on inland waterways.

For the Vietnamese classification, it is surprising that *no vessel classification is given* in the ministerial circular, indicating the maximum dimensions of the vessels that can navigate in a waterway of certain level. Also here, *coasters and seagoing vessels sailing on inland waterway are not included* (they are given the class "special"), and it is not clear if push convoys are included in the Vietnamese classification system.

It is therefore the responsibility of Mekong River countries to make a final choice of a Mekong waterway classification system, either based on the prevailing standards, or on the Chinese and Vietnamese classification standards.

Therefore, a questionnaire was administered to MRC Member Countries on the scope, goals and general structure of a Mekong vessel and inland waterway classification (one uniform standard or two standards, one for the upper part – Lao PDR and Thailand, and one for the lower part – Cambodia and Viet Nam).

Table 24. Questionnaire

Surname:		Names:		Country:	
Organization:		Position:		e-mail:	

1.a	**Do you have an inland vessel classification (or use a foreign vessel classification) in your country ?**
	YES ☐ NO ☐ If YES (*), When was it created (year)? When was it updated the last time (year)? Does it include push convoys (yes/no)? Does it include seagoing vessels (yes/no)? Comments:
1.b	**Which is/are the organization(s) in your country responsible for setting the standards for inland vessels?**
	Comments:

(*) Please, forward your country classification (only for information–in the original language if not available in English)

2.a	**Do you have an inland waterway classification (or use a foreign waterway classification) in your country ?**
	YES ☐ NO ☐ If YES (*), When was it created (year)? When was it updated the last time (year)? Do you have an idea about the used standard formulas (yes/no)?

	Comments:
2.b	**Which is/are the organization(s) in your country responsible for setting the standards for inland waterways?**
	Comments:

(*) Please, forward your country classification (only for information–in the original language if not available in English)

3.a	**Are you in favour of a common Mekong River Basin vessel and inland waterway classification, or of two classification systems, one for the upper part (Thailand and Lao PDR) and one for the lower part (Cambodia and Viet Nam)?**
	Common classification system ☐ Two classification systems ☐ Comments:
3.b	**For Thailand and Viet Nam: Are you in favour of a Mekong specific vessel and inland waterway classification, or should the system also be valuable for other inland waterways ?**
	Mekong specific classification system ☐ Nationwide classification system ☐ Comments:
3.c	**For Thailand, Lao PDR and Cambodia: Would you accept the use of a foreign vessel and inland waterway classification, or should a new classification be set up ?**
	Accept foreign classification system ☐ Set up of new classification system ☐ Comments:

4	**In your opinion, what could be the main applications / potential applications of a common Mekong River Basin vessel and inland waterway classification? (Rank the following options from 1 to 12, 1 for the most relevant)**		
Common language for different stakeholders	?	Use of new technologies (e.g. RIS, AIS)	?
Vessels design/ naval improvements	?	Facilitated access to financing of infrastructure projects	?
Support inland waterways policies and projects in Infrastructure development: planning, monitoring and identifying missing links and bottlenecks that should be prioritized.	?	Serving as the basis for investment decisions and cost estimates by governments and shipping and transport industry	?
Increase safety and ease of navigation **by ensuring the orderly and efficient control and maintenance of waterways.**	?	Planning regional integration projects	?
Make information available as a guarantee for users that minimum dimensions will be respected.	?	Identifying IWT competitiveness by laying down maximum vessel sizes, affecting navigation and transport costs.	?
Inform the shipping and transport industry, determining IWT competitiveness by laying down maximum vessel sizes, affecting navigation costs.	?	Ensuring the orderly and efficient control and maintenance of waterways	?
Assist the authorities in planning and policy making by showing the missing links and bottlenecks that should be prioritized.	?	Achieving a more sustainable use of inland waterways (and transport in general)	?
		Other:	?
Comments:			

5	In your opinion, what the vessel types and tonnages should be included in a vessel classification? (answer Y for yes and N for no)			
Barge, freighter, passenger 0 to 50 tonnes		?	Convoy (push or tow) 500 to 1,000 tonnes	?
Barge, freighter, passenger 50 to 100 tonnes		?	Convoy (push or tow) 1,000 to 2,000 tonnes	?
Barge, freighter, passenger 100 to 300 tonnes		?	Seagoing vessel 2,000 DWT	?
Barge, freighter, passenger 300 to 500 tonnes		?	Seagoing vessel 3,000 DWT	?
Barge, freighter, passenger 500 to 1,000 tonnes		?	Seagoing vessel 5,000 DWT	?
Barge, freighter, passenger 1,000 to 2,000 tonnes		?	Seagoing vessel 7,000 DWT	?
Convoy (push or tow) 100 to 300 tonnes		?	Seagoing vessel 10,000 DWT	?
Convoy (push or tow) 300 to 500 tonnes		?	Other:	?
Comments:				

6	In your opinion, what should be the parameters that should be considered in inland waterway classification? (rank the following options from 1 to 20, 1 for the most relevant)			
Waterway depth (min. and average, per month)		?	Bridge air clearance	?
Navigability (level of difficulty)		?	Power lines air clearance	?
Guaranteed a secured navigability all the year (% of time: 50%, 75%, 90%, 99%)		?	Cables/pipes depth	?
Guaranteed day and night navigation (with suitable traffic aids): 24h/day		?	Navigation obstacles/constraints	?
Availability (or not) of waterways signs and markings, aids to navigation facilities, and River information Services (RIS)		?	Availability of ports and terminal facilities with a multimodal platform	?
Vessel type (barge, convoy, seagoing), the tonnage and the vessel's dimensions (draft, beam, length, height)		?	Existence flow control infrastructure as navigation weir and navigation locks, which limits ship sizes / minimum lock dimensions.	?
Traffic volume (tonnes or passengers) and number of vessels/day		?	Availability of vessel support/assistance services	?
Bridge span		?	Local wind, current and wave characteristics	?
Waterway width		?	Waterway bend radius	?
Other:		?	Other:	?
Comments:				

The answers to this questionnaire were as follows:

Experts and responsible departments

Thailand

Responsible for vessel classification:	Ministry of Transport (MoT), Ship Standard Bureau, Marine Department
Responsible for waterway classification:	MoT, Ship Standard Bureau, Marine Department

Lao PDR

Responsible for vessel classification:	Ministry of Public Works and Transport (MPWT), Department of Waterways (DOW)
Responsible for waterway classification:	MPWT, Department of Waterways (DOW)

Cambodia

Responsible for vessel classification:	MPWT, Department of Inland Waterway Transport, General Department of Inland Waterway Transport, Maritime Transport and Ports
Responsible for waterway classification:	MPWT, Department of Waterway Infrastructure and Port Construction, General Department of Inland Waterway Transport, Maritime Transport and Ports

Viet Nam

Responsible for vessel classification:	MoT, Viet Nam Inland Waterway Administration (VIWA)
Responsible for waterway classification:	Ministry of Science and Technology, Viet Nam Inland Waterway Administration (VIWA)

Table 25. Questionnaire result summary (1)

Vessel and waterway classification

Country	Thai	Lao	Camb	Viet
Does the country have a vessel classification?	Yes (1)	No (5)	No	Yes (3)
Does the country have a waterway classification?	Yes (2)	No (5)	No	Yes (4)
Common or two classification systems?	**Com**	**Two**	**Two**	**Two**
Mekong specific or nationwide system?	Spec	-	-	Nat
Foreign or new classification system	New	New	New	-

1. 1991 Regulation no.19 Thai vessel classification.
   1995 Regulation no.19 Amendment on domestic passenger vessels.
2. 1913 Navigation Act in Thailand Waters – 2017 Amendment.
3. 2005 TCVN 5801-1, Regulation on Rule of Inland – Waterway Ships Classification and Construction.
   2013 QCVN 72/BGTVT, National Technical Regulation on Rule of Inland Waterway Ships Classification and Construction.
4. 1992 TCVN 5664 Standards of Technical Class of Inland Waterways in Viet Nam.
   2006 TCVN 5664, Rules for Technical Classification of Inland Waterways.

2016 46/TT-BGTVT Circular on Rules on River Classifications, Ministry of Transport.

5. Lao PDR has not yet an inland vessel classification system, but it has a vessels registration system under the Department of Waterways, MPWT and the provincial line agency in accordance with the ship registration regulation no. 00177/PWT, of 4 January 2013 and Ship Registration Guideline No 17069/DOW, of 5 December 2013. Lao PRD has not yet an inland waterways classification. However, it complies with the Atlas Map 1996 and also with the Guidelines on the Maintenance and Improvement of the Navigability of the Lancang-Mekong River, Annex 3 of the Memorandum of Understanding under the quadripartite agreement.

Table 26. Questionnaire result summary (2)

Main applications of a vessel and waterway classification

	Thai	Lao	Camb	Viet	Total
To provide a common language for different stakeholders	11	11	1	1	24
To provide vessel design / naval improvements	7	3	2	6	18
Th support inland waterways policies and projects in Infrastructure development: planning, monitoring and identifying missing links and bottlenecks that should be prioritized.	?	1	3	1	7
To increase safety and ease of navigation by ensuring the orderly and efficient control and maintenance of waterways.	9	7	4	1	21
To provide information for users to ensure that they respect the minimum dimensions.	6	8	6	1	21
To inform the shipping and transport industry, determining IWT competitiveness by laying down maximum vessel sizes, affecting navigation costs.	10	9	7	2	28
To assist the authorities in planning and policy making by showing the missing links and bottlenecks that should be prioritized.	?	10	8	8	35(*)
To use new technologies (RIS, AIS, etc.).	12	3	5	2	22
To facilitate access to financing of infrastructure projects.	3	2	9	3	17
To serve as a basis for investment decisions and cost estimates by Governments and shipping and transport industry.	4	2	10	7	23
To support planning of regional integration projects.	1	1	11	4	17
To identify IWT competitiveness by laying down maximum vessel sizes, affecting navigation and transport costs.	5	4	12	5	26
To ensure the orderly and efficient control and maintenance of waterways.	8	5	?	4	23(*)
To achieve a more sustainable use of inland waterways (and transport in general).	2	6	?	3	15(*)
Others	?	?	?	?	

(*) = total x 4 / 3

Vessel type and tonnages to be included

Country	Thai	Lao PDR	Camb	Viet Nam
Barge, freighter, passenger, 0 to 50 tonnes	Yes	Yes	Yes	No
Barge, freighter, passenger, 50 to 100 tonnes	Yes	Yes	Yes	Yes
Barge, freighter, passenger, 100 to 300 tonnes	Yes	Yes	Yes	Yes
Barge, freighter, passenger, 300 to 500 tonnes	Yes	Yes	Yes	Yes
Barge, freighter, passenger, 500 to 1,000 tonnes	No	No	Yes	Yes
Barge, freighter, passenger, 1,000 to 2,000 tonnes	No	No	Yes	Yes
Convoy (push or tow), 100 to 300 tonnes	No	No	Yes	Yes
Convoy (push or tow), 300 to 500 tonnes	No	No	Yes	Yes
Convoy (push or tow), 500 to 1,000 tonnes	No	No	Yes	Yes
Convoy (push or tow), 1,000 to 2,000 tonnes	No	No	Yes	Yes
Seagoing vessel, 2,000 DWT	No	No	Yes	Yes
Seagoing vessel, 3,000 DWT	No	No	Yes	Yes
Seagoing vessel, 5,000 DWT	No	No	Yes	Yes
Seagoing vessel, 7,000 DWT	No	No	Yes	Yes
Seagoing vessel, 10,000 DWT	No	No	Yes	Yes

Parameters to be considered in the waterway classification

Country	Thai	Lao PDF	Camb	Viet Nam	Total
Waterway depth (min. and average, per month)	7	2	1	1	11
Navigability (level of difficulty)	5	1	4	2	12
Guaranteed a secured navigability all the year (% of time: 50%, 75%, 90%, 99%)	18	11	3	6	38
Guaranteed day and night navigation (with suitable traffic aids) : 24h/day	17	7	2	5	31
Presence (or lack of) of waterways signs and markings, an aids to navigation facilities, as well as the availability or not of river information services (RIS)	6	6	5	5	22
Vessel type (barge, convoy, seagoing), the tonnage and the vessel's dimensions (draft, beam, length, height)	1	1	6	2	10
Traffic volume (tonnes or passengers) and number of vessels/day	16	5	9	10	40
Bridge span	9	3	10	1	23
Waterway width	8	2	7	1	18
Bridge air clearance	10	3	8	1	22
Power lines air clearance	12	9	11	1	33
Cables/pipes depth	11	10	12	1	34
Navigation obstacles/constraints	4	4	13	2	23
Availability of ports and terminal facilities with a multimodal platform	3	13	14	5	35
Presence of flow control infrastructure such as navigation weirs and locks, which limit ship sizes /minimum lock dimensions.	2	4	15	10	31
Availability of vessel support or assistance services	15	12	16	4	47
Local wind, current and wave characteristics	14	14	17	3	48
Waterway bend radius	13	8	18	1	40

Conclusions

Main applications of a vessel and waterway classification

According to the applications which have less than 20 replies in total that were indicated as application 1 by one of the experts, the following main applications are:

- To support inland waterways policies and projects in infrastructure development: planning, monitoring and identifying missing links and bottlenecks that should be prioritized.
- To provide vessel design and naval improvements.
- To provide a common language for different stakeholders.

Vessel type and tonnages to be included in the waterway classification

For Thailand and Lao PDR, only four classes should be considered (from 0- to 500-tonne vessels).

For Cambodia and Viet Nam, all classes from 0 to 10,000 DWT should be considered.

Parameters to be considered in the waterway classification

Taking into account the parameters which have less than 20 in total of or that were indicated as parameter 1 by one of the experts, the following parameters should be considered in the waterway classification:

- vessel type (barge, convoy, seagoing), the tonnage and the vessel's dimensions (draft, beam, length, height);
- waterway depth (minimum, maximum and average) and waterway width;
- bridge span and bridge air clearance;
- power lines air clearance and cables/pipes depth;
- waterway bend radius;
- navigability (level of difficulty).

In addition to the above, for Lao PDR and Thailand, the lock dimensions must also be considered.

The working group for the preparation of a proposal of vessel and waterway classification

To achieve the objective of this project, as mentioned in the introduction to this report, a Working Group was formed, which composed of:

- Ms Ton Nu Thi Thanh Yen, Navigation Specialist, MRCS Planning Division;
- Mr Narongdaj Koomplient, Ship Surveyor, Marine Department, Thailand;
- Mr Somphone Louanglath, Director Planning and Budgeting Division, Waterway Department, Lao PDR;
- Mr Huon Rath, Chief of Geo-Navigation Office, Department of Waterway Infrastructure, Cambodia;

- Mr Nguyen Viet Thanh, Lecturer, University of Transport and Communications, HCM City, Viet Nam;
- Mr Freddy Wens, International Consultant, MRC-S PD, Belgium.

5. VESSEL AND WATERWAY CLASSIFICATION FOR THE MEKONG RIVER SYSTEM IN THE LAO PDR AND THAILAND

5.1. Vessel Dimensions

In November 2018, the **Lao** representative of the working group prepared the following proposal for a vessel classification, based on the registered vessels in Lao PDR (Table 27).

Table 27. Proposed vessel classification Lao PDR-Thailand

Class	Type	Maximum tonnage	Maximum pax	Draft D (m)	Width W (m)	Length L (m)	Height H (m)
I	Cargo barge	1,000		3.60	12.50	65.00	15.00
	Passenger vessel						
II	Cargo barge	500		3.20	10.00	60.00	12.00
	Passenger vessel						
III	Cargo barge	300		2.90	8.00	60.00	10.00
	Passenger vessel						
IV	Cargo barge	100		2.00	5.00	55.00	8.00
	Passenger vessel		100	1.50	5.00	50.00	5.00
V	Cargo barge	50		1.50	4.50	50.00	5.00
	Passenger vessel		60	1.00	4.00	40.00	5.00
VI	Cargo barge	<20		1.00	3.50	45.00	3.00
	Passenger vessel		<20	1.00	3.00	30.00	3.00

In January 2019, the **Thai** representative of the working group prepared the following vessel data for the registered vessels in the Thai ports along the Mekong River (Table 28).

Table 28. Vessel data for the registered vessels in the Thai ports along the Mekong River

Class (tonne)	Type	Tonnage	Pax	Draft D (m)	Width W (m)	Length L (m)	Height H (m)
I (500–1,000)	Cargo barge	568		2.15	9.50	61.50	11.90
	Passenger vessel						
II (300–500)	Cargo barge	474 370 304		2.70 0.70 1.60	8.30 15.06 10.50	52.60 54.06 35.60	11.50 6.00 11.00
	Passenger vessel	418	200	2.00	8.00	39.94	13.00
III (100–300)	Cargo barge	271 297 256 206 230		2.10 2.20 0.60 2.00 2.50	8.72 7.00 12.00 7.00 8.00	55.90 42.30 48.00 42.30 36.15	12.30 12.40 7.10 9.50 3.80
	Passenger vessel	180 226	150 103	1.35 2.00	6.80 7.50	42.40 45.00	12.80 10.60
IV (50–100)	Cargo barge	100 99 90		1.60 1.00 2.00	6.00 6.00 6.25	43.00 27.00 25.40	5.50 4.20 2.65
	Passenger vessel	75 88	120 30	1.40 0.60	5.50 5.00	40.40 36.00	6.00 6.85
V (20–50)	Cargo barge	50 25 25		1.70 1.30 2.00	4.90 3.00 4.50	31.90 23.50 19.80	5.00 5.40 1.70
	Passenger vessel	45 49 36	110 53 42	1.65 0.60 1.50	5.20 4.20 3.70	26.80 28.50 25.20	5.50 4.65 5.00
VI (<20)	Cargo barge	16 20 16		0.70 0.50 1.00	4.12 3.12 2.90	20.10 19.50 17.90	5.50 2.70 4.50
	Passenger vessel	20 19 16 5	90 10 12 20	1.50 0.60 1.00 1.40	7.50 2.76 2.30 3.40	39.00 17.91 15.50 17.00	5.50 2.65 4.50 1.00

The navigation standard for inland waterways in the People's Republic of **China** is National Standard GB50139-2004, which was issued on 1 March 2004 by the Ministry of Communications. It gives the barge and freighter dimensions for the seven classes of inland waterway ships, categorized according to their tonnage.

Table 29. Barge and freighter dimensions – China National Standard GB50139-2004

Class	Type	Maximum tonnage	Maximum pax	Draft D (m)	Width W (m)	Length L (m)	Height H (m)
III	Barge	1,000		2.00	10.80	67.50	
	Freighter			2.00	10.80	85.00	
IV	Barge	500		1.60	10.80	45.00	
	Freighter			1.60	10.80	67.50	
V	Barge	300		1.30	9.20	35.00	
	Freighter			1.30	8.60	55.00	
VI	Barge	100		1.00	7.00	32.00	
	Freighter			1.00	5.50	45.00	
VII	Barge	50		0.70	5.50	24.00	
	Freighter			0.70	5.50	32.50	

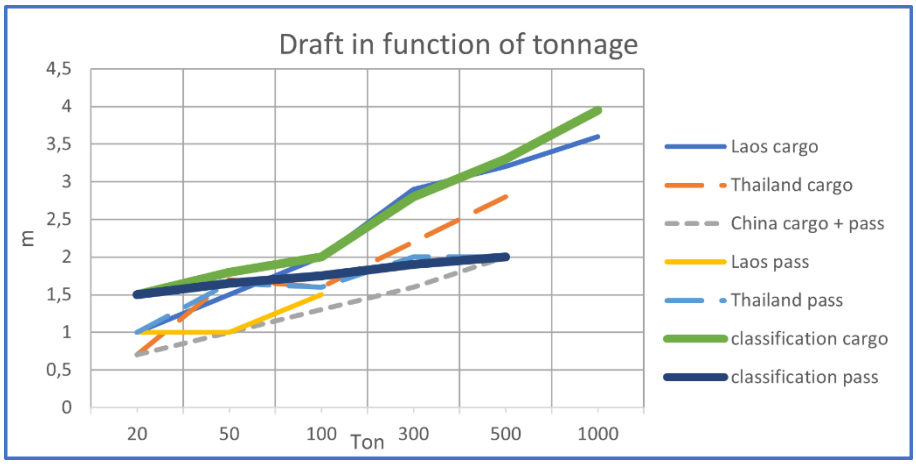


Figure 11. Draft in function of tonnage

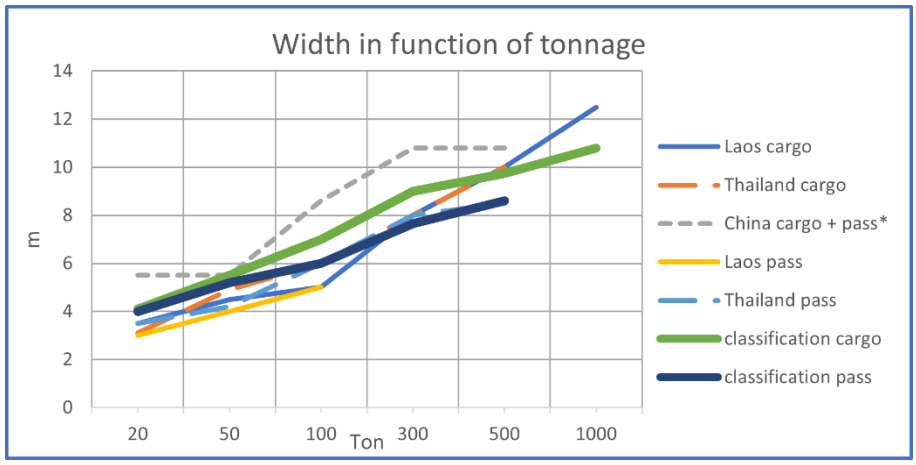


Figure 12. Width in function of tonnage

Note: * In the Joint Committee on Coordination of Commercial Navigation (JCCCN) Lancang-Mekong Agreement, it is planned that only Chinese vessels up to 300 tonnes will sail down to Thailand and Lao PDR.

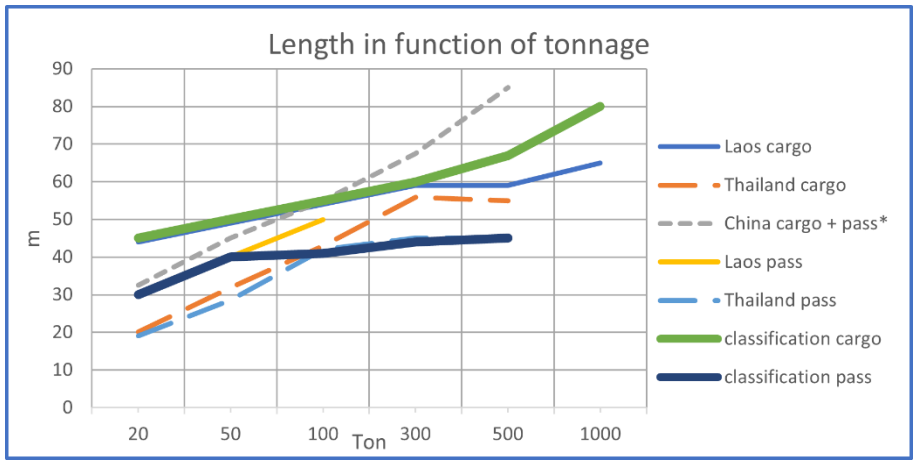


Figure 13. Length in function of tonnage

Note: * In the Joint Committee on Coordination of Commercial Navigation (JCCCN) Lancang-Mekong Agreement it is planned that only Chinese vessels up to 300 tonnes will sail down to Thailand and Lao PDR.

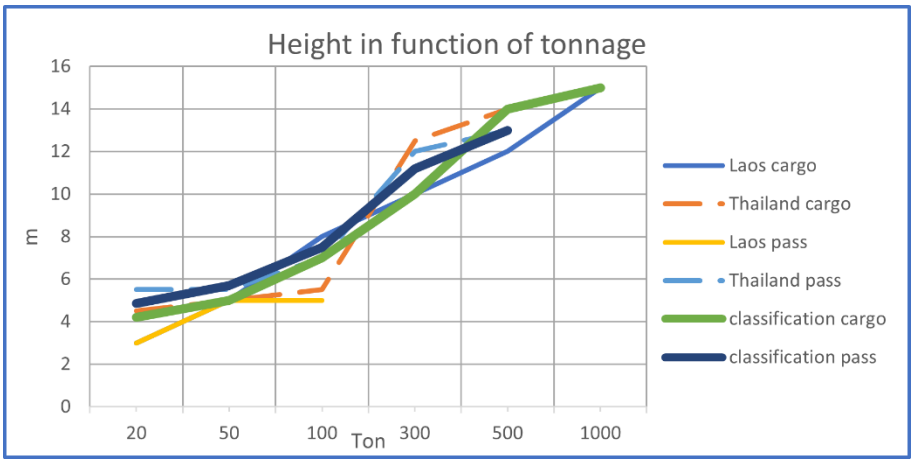


Figure 14. Height in function of tonnage

5.2. Vessel Classification

Based on the prepared data for Thailand and Lao PDR and the Chinese vessel classification, following proposal of vessel classification was presented to the Thai and Lao representatives and authorities for amendments or approval (Table 30).

Table 30. Proposal of vessel classification agreed Thailand

Class	Type	Maximum tonnage	Maximum pax	Draft D (m)	Width W (m)	Length L (m)	Height H (m)
I	Cargo barge	1,000		**3.95**	**10.80**	**80.00**	**15.00**
	Passenger vessel						
II	Cargo barge	500		**3.30**	**9.75**	**67.00**	12.00
	Passenger vessel		200	2.00	8.60	45.00	**13.00**
III	Cargo barge	300		**2.80**	**9.00**	**60.00**	10.00
	Passenger vessel		150	1.90	7.65	44.00	**11.20**
IV	Cargo barge	100		**2.00**	**7.00**	**55.00**	7.00
	Passenger vessel		120	1.75	6.00	41.00	**7.50**
V	Cargo barge	50		**1.80**	**5.50**	**50.00**	5.00
	Passenger vessel		110	1.65	5.20	40.00	**5.70**
VI	Cargo barge	<20		**1.50**	**4.10**	**45.00**	4.20
	Passenger vessel		90	1.50	4.00	30.00	**4.85**

At the Thai meeting on the National Consultation for the proposal for a vessel classification and for formulating waterway dimensions for navigating the Mekong River between Lao PDR and Thailand held on 2 May 2019 in Nongkai, the Thai participants agreed with the proposal for the vessel classification.

At the Lao meeting on the National Consultation for the proposal for a vessel classification and for waterway dimension equations on navigation of the Mekong River between Lao PDR and Thailand held on 3 May 2019 in Vientiane, the Lao participants agree that the proposed vessel dimensions were too big and proposed the vessel classification (Table 31).

Table 31. Proposal of vessel classification revised by Lao PDR

Class	Type	Maximum tonnage	Maximum pax	Draft D (m)	Width W (m)	Length L (m)	Height H (m)
I	Cargo barge	1,000		**3.50**	**10.00**	**70.00**	**15.00**
	Passenger vessel		500	2.50	10.00	70.00	
II	Cargo barge	500		**2.00**	**10.00**	**60.00**	12.00
	Passenger vessel		300	2.00	10.00	60.00	**13.00**
III	Cargo barge	300		**1.70**	**9.00**	**50.00**	10.00
	Passenger vessel		200	1.50	9.00	50.00	**11.20**
IV	Cargo barge	100		**1.10**	**7.00**	**42.00**	7.00
	Passenger vessel		120	1.30	5.50	41.00	**7.50**
V	Cargo barge	50		**1.10**	**4.50**	**30.00**	5.00
	Passenger vessel		100	1.25	5.00	41.00	**5.70**
VI	Cargo barge	<20		**0.8**	**3.00**	**22.00**	4.20
	Passenger vessel		80	0.7	3.5	30.00	**4.50**

At a bilateral meeting between Lao PDR and Thailand held on 8 May 2019 in the MRCS Office in Vientiane, using these new data. It was agreed at the meeting to revise the draft for 300-tonne, 500-tonne and 1,000-tonne vessels in the proposal for vessel classification for the Mekong River between Lao PDR and Thailand (Table 32).

Table 32. Final proposal of vessel classification

Class	Type	Maximum tonnage	Maximum pax	Draft Ts (m)	Width Ws (m)	Length Ls (m)	Height Hs (m)
I	Cargo barge	1,000		~~**3.95**~~ **3.50**	**10.80**	**80.00**	**15.00**
	Passenger vessel						
II	Cargo barge	500		~~**3.30**~~ **3.00**	**9.75**	**67.00**	12.00
	Passenger vessel		200	2.00	8.60	45.00	**13.00**
III	Cargo barge	300		~~**2.80**~~ **2.50**	**9.00**	**60.00**	10.00
	Passenger vessel		150	1.90	7.65	44.00	**11.20**
IV	Cargo barge	100		**2.00**	**7.00**	**55.00**	7.00
	Passenger vessel		120	1.75	6.00	41.00	**7.50**
V	Cargo barge	50		**1.80**	**5.50**	**50.00**	5.00
	Passenger vessel		110	1.65	5.20	40.00	**5.70**
VI	Cargo barge	<20		**1.50**	**4.10**	**45.00**	4.20
	Passenger vessel		90	1.50	4.00	30.00	**4.85**

When, in the future, the waterway classification will change for a specific river stretch due to human intervention such as dam construction, dredging or river regulations works, the competent authorities will include these changes in an annex to these regulations.

5.3. Channel Design Equations

Both Lao PDR and Thailand agreed to use the Chinese equations to calculate the waterway dimensions for the waterway classification. At the meeting, participants as proposed to have a minimum water depth of Ts + 0.4 m for all classes and to have a bend radius of 4 Ls for all classes.

Moreover, Lao PDR participants proposed follow the MRC guidelines for the lock dimensions as 120 m x 12 m x 4 m for all classes (Table 33).

Table 33. Waterway dimensions by China

Waterway dimensions	China
T Depth	Ts + ~~0.2 to 0.5 m~~ 0.4 m
W Width one-way traffic	2 Ws
W Width two-way traffic	4 Ws
Wb Bridge passing one-way	3 Ws
Wb Bridge passing two-way	6 Ws
H Air clearance bridge	1.15 Hs
Hc Air clearance cables	1.30 Hs
R Bend radius	~~3 Ls to~~ 4 Ls
LL Lock length (~~PIANC 2009~~)	~~1.10 Ls~~ 120 m
WL Lock width (~~PIANC 2009~~)	~~1.10 Ws (min Ws + 0.90 m)~~ 12 m
TL Lock depth (~~PIANC 2009~~)	~~1.20 Ts (min Ts + 0.60 m)~~ 4 m

5.4. Waterway Classification

Based on the agreed vessel classification and adapted Chinese equations to calculate the waterway dimensions, it was agreed at the meeting to use the following waterway classification shown in Table 34.

Table 34. Final proposal of waterway classification

Class	Ton	Minimum waterway dimensions				Minimum lock dimensions			Bridges		Cables
		Water depth T(m)	1-way width W1(m)	2-way width W2(m)	Bend radius R(m)	Length LL (m)	Width WL (m)	Depth TL (m)	Min. span Wb(m)	Min. height Hb(m)	Min. height Hc(m)
I	1,000	3.9	22	43	320	120	12	4	65	17	20
II	500	3.4	19	39	270	120	12	4	58	15	17
III	300	2.9	18	36	240	120	12	4	54	13	15
IV	100	2.4	14	28	220	120	12	4	42	9	10
V	50	2.2	11	22	200	120	12	4	33	7	7.5
VI	20	1.9	8	16	180	120	12	4	24	6	6.5

5.5. River Stretches

After approval of the waterway classification by both national authorities, each navigable stretch of the Mekong River and its tributaries should be given a class at the high water level and at the low to mid water level, based on its dimensions and a future 2040 planned class, based on the Master Plan.

To collect the data on river and canal dimensions, the Mekong River Basin in Lao PDR and Thailand was subdivided in four areas:

a) The Mekong River from the Golden Triangle to Khone Phapheng, and the Hueang River between Lao PDR and Thailand;
b) The Mekong River tributaries in Lao PDR from the Mekong River to downstream the first dam;
c) The Mekong River tributaries in Lao PDR from upstream to downstream of dam(s); and
d) The Mekong River tributaries in Thailand.

Figure 15 shows the following navigable waterway stretches for the Mekong River and its tributaries, which were completed with the dimensions of each stretch.

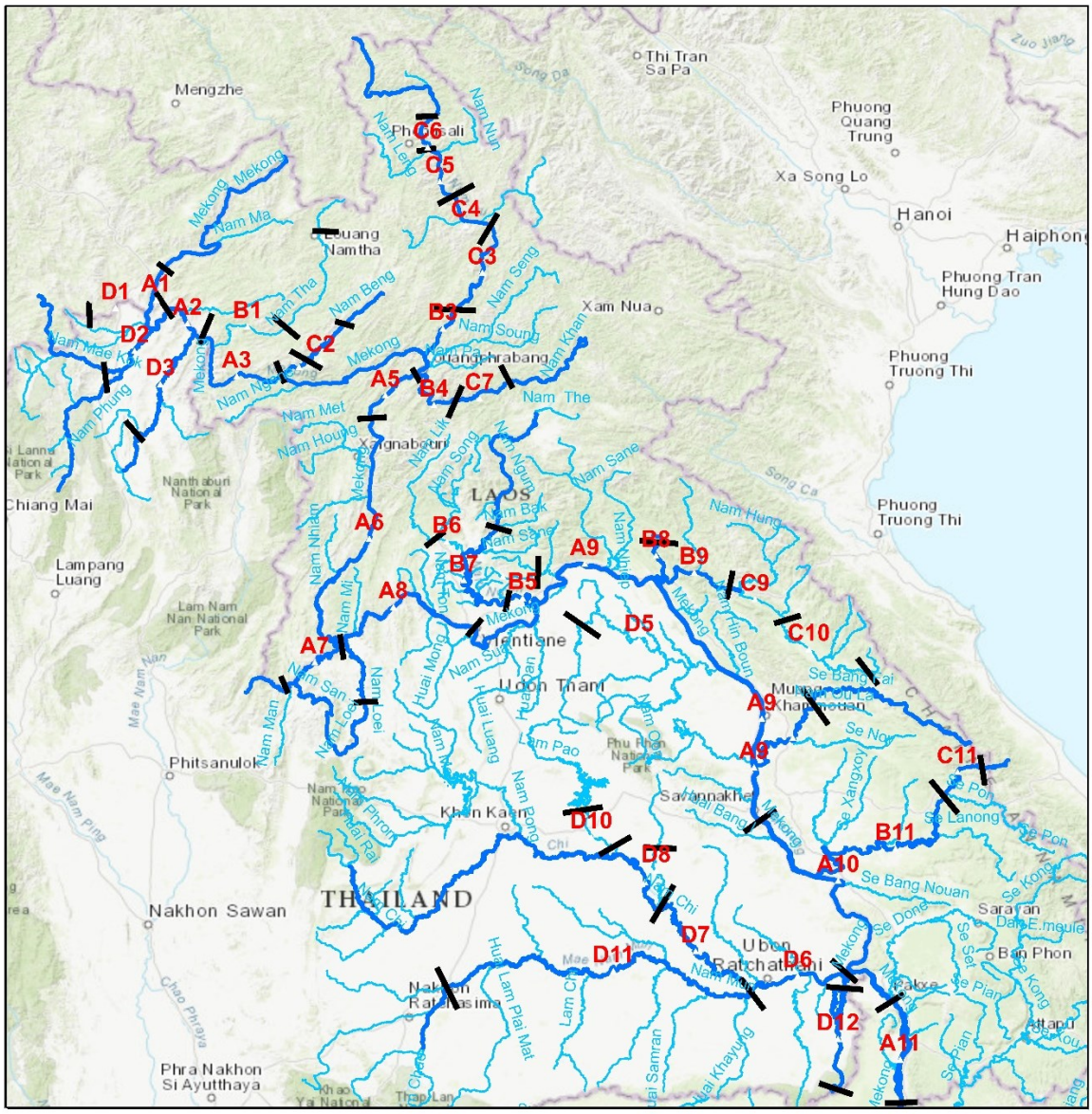


Figure 15. Navigable waterway stretches for the Mekong River and its tributaries

Table 35. Navigable waterway stretches with dimensions (Lao PDR–Thailand)

	River/canal	T/L *	From	To	From km**	To km**	Length (km)	Min. depth HHW (m)	Min. depth LLW (m)	Min. width (m)	Bend radius (m)	Bridge span (m)	Bridge height (m)	Clear height (m)	Obstacles
A1	**Mekong River**	T,L	Golden Triangle	Chiang Saen	2,373	2,364	9	2.60	1.57	100.0	230≤	120.0	-	10.00	
D1	Ruak River	T	Golden Triangle	Mae Sal	0	40	40	2.40	1.55	21.95	230≤	-	-	-	Dam
D2	Kok River	T	Mekong (2,365)	Chiang Rai	0	80	80	2.50	1.66	47.01	230≤	24.30	7.00	7.00	
A2	**Mekong River**	T,L	Chiang Saen	Huay Xai	2,364	2,314	50	2.00	1.78	90.00	230≤	120.0	10.00	10.00	
A3	**Mekong River**	L	Huay Xai	Pak Beng	2,314	2,172	142	2.92	1.57	100.0	230≤	110.0	45.00	16.00	
D3	Ing River	T	Mekong (2,306)	Meuang Thoeng	0	130	130	2.30	0.80	19.57	230≤	15.00	12.00	9.00	
B1	Tha River	L	Mekong (2,281)	Nam Tha I dam	0	60	60	2.39	0.50	22.00	-	25.00	25.00	8.00	
C1	Tha River	L	Nam Tha I dam	Luang Namtha	60	230	170	11.90	0.60	17.00	-	19.00	22.00	8.00	Dam
B2	Beng River	L	Mekong (2,172)	Nam Beng dam	0	16	16	2.92	0.40	9.00	-	12.00	10.50	6.00	
C2	Beng River	L	Nam Beng dam	Muang Houn	16	46	30	3.06	1.94	9.00	-	12.00	11.90	8.00	Dam
A4	**Mekong River**	L	Pak Beng	Luang Prabang	2,172	2,010	162	4.20	2.92	90.00	230≤	142.0	53.00	28.80	
B3	Ou River	L	Mekong (2,033)	Nong Khiao dam (2)	0	85	85	5.00	1.91	22.00	-	29.00	17.00	12.00	
C3	Ou River	L	Nong Khiao dam (2)	Muang Khua dam (3)	85	175	90	18.80	0.50	-	-	60.00	-	-	Dam
C4	Ou River	L	Muang Khua dam (4)	Muang Samphanh (5)	175	220	45	16.45	1.90	-	-	-	-	-	Dam
C5	Ou River	L	Muang Samphanh (5)	Hathsa (6)	220	275	55	15.50	4.00	-	-	60.00	-	-	Dam
C6	Ou River	L	Hathsa (6)	Ou River Ou Ricer (7)	275	288	13	14.88	-	-	-	-	-	-	Dam
B4	Khan River	L	Mekong (2,010)	Nam Khan dam III	0	40	40	2.30	1.00	-	-	-	-	-	
C7	Khan River	L	Nam Khan dam III	Nam Khan dam II	40	75	35	7.35	4.30	-	-	-	-	-	Dam
A5	**Mekong River**	L	Luang Prabang	Xayaburi dam	2,010	1,935	75	37.09	1.92	70.00	230≤	120.0	29.00	20.00	Dam
A6	**Mekong River**	L	Xayaburi dam	Hueng River mouth	1,935	1,735	200	5.60	3.42	70.00	230≤	100.0	49.00	12.00	
A7	Hueang River	T,L	Hueng River mouth	Ban Na Kha	0	100	100	3.42	0.60	22.00	230≤	25.00	25.00	8.00	
A8	**Mekong River**	T,L	Hueng River mouth	Vientiane	1,725	1,585	160	1.62	0.83	273.0	230≤	-	50.00	10.00	
D4	Loei River	T	Mekong (1,715)	Wang Saphung	0	110	110	3.74	1.84	29.00	230≤	20.00	30.00	12.00	
A9	**Mekong River**	T,L	Vientiane	Savannakhet	1,585	1,126	459	2.40	1.50	160.0	230≤	105.0	15.00	10.00	
B5	Ngum River	L	Mekong (1,485)	Nam Ngum dam I	0	180	180	3.00	1.50	22.00	-	30.00	22.00	12.50	

	River/canal	T/L *	From	To	From km**	To km**	Length (km)	Min. depth HHW (m)	Min. depth LLW (m)	Min. width (m)	Bend radius (m)	Bridge span (m)	Bridge height (m)	Clear height (m)	Obstacles
B6	Lik River	L	Ngum River	Pak Houay	0	55	55	1.50	0.56	-	-	-	-	-	
B7	Song River	L	Lik River	Vang Vieng	0	65	65	1.50	0.43	-	-	-	-	-	
C8	Ngum River	L	Nam Ngum dam I	Nam Ngum dam II	65	105	40	4.78	1.20	-	-	-	-	-	Dam
B8	Ngiap River	L	Mekong (1,400)	Thaviang	0	125	125	10.00	4.00	-	-	-	-	-	
B9	Xan River	L	Mekong (1,395)	Nam Lao	0	105	105	5.72	4.63	-	-	-	-	-	
B10	Theun River	L	Mekong (1,352)	Nam Theun dam I	0	100	100	2.55	0.89	22.00	-	25.00	-	-	
C9	Theun River	L	Nam Theun dam I	Nam Theun dam II	100	170	70	3.64	0.89	-	-	-	-	-	Dam
C10	Theun River	L	Nam Theun dam II	Keng Cheng	170	260	90	3.64	0.80	-	-	-	-	-	No bridge
D5	Sonkhram River	T	Mekong (1,260)	So Phisai	0	250	250	2.86	0.80	80.00	230≤	20.00	14.00	9.00	
B11	Xe Bang Fai River	L	Mekong (1,169)	Mahaxay	0	140	140	1.50	0.70	26.00	-	52.00	-	-	
A10	**Mekong River**	T,L	Savannakhet	Pakse	1,126	869	257	1.50	0.53	88.00	230≤	80.00	13.00	10.00	
B12	Xe Banghiang	L	Mekong (1,036)	Sepon	0	285	285	8.40	4.91	29.00	-	50.00	-	-	
C11	Xe Banghiang	L	Sepon	Dansavan	285	325	40	1.70	0.50	18.00	-	43.00	-	-	
A11	**Mekong River**	L	Pakse	Khone Falls (Khone	869	721	148	2.40	1.01	-	-	-	-	-	

Notes: * L = Lao PDR, T = Kingdom of Thailand.

** The number of kilometres referring to the Mekong River are drawn from the Updated Hydrographic Atlas (UHA) Mekong River 1996; the kilometres of its tributaries are measured from e to the mouth of the river along the thalweg.

5.6. River Stretch Classes

Starting from the waterway classification and the minimum navigation channel dimensions that need to be available for a classified vessel tonnage in the different river stretches, the categorized river stretches give the available class in the river stretch at low water, at mid to high water and a proposal of waterway class that should be achieved in 2040.

Table 36. Waterway classes for the Mekong River from the Golden Triangle to Khone Phapheng between Lao PDR and Thailand

No.	River/Canal	L/T *	From	To	From km**	To km**	Length km	Class at Low Water	Class at Mid to High	Planned Class 2040
A1	Mekong River	T,L	Golden Triangle	Chiang Saen	2,373	2,364	9	IV	III	II
A2	Mekong River	T,L	Chiang Saen	Huay Xai	2,364	2,314	50	IV	III	II
A3	Mekong River	L	Huay Xai	Pak Beng	2,314	2,172	142	V	III	II
A4	Mekong River	L	Pak Beng	Luang Prabang	2,172	2,010	162	V	III	II
A5	Mekong River	L	Luang Prabang	Xayaburi dam	2,010	1,935	75	V	III	II
A6	Mekong River	L	Xayaburi dam	Hueng River mouth	1,935	1,735	200	V	III	II
A7	Hueng River	T,L	Hueng River mouth	Ban Na Kha	0	100	100	VI	V	N/A***
A8	Mekong River	T,L	Hueng River mouth	Vientiane	1,725	1,585	160	V	III	II
A9	Mekong River	T,L	Vientiane	Savannakhet	1,585	1,126	459	V	III	II
A10	Mekong River	T,L	Savannakhet	Pakse	1,126	869	257	VI	VI	II
A11	Mekong River	L	Pakse	Khone Phapheng	869	721	148	V	III	II

Notes: * L = Lao PDR, T = Kingdom of Thailand

** On the Mekong River km = km of Updated Hydrographic Atlas (UHA) Mekong River 1996, on the tributaries km = distance to the mouth of the river along the thalweg

*** N/A = not applicable

Table 37. Waterway classes for the Mekong River tributaries in Lao PDR from the Mekong River downstream to the first dam

No.	River/canal	L *	From	To	From km**	To km**	Length km	Class at low water	Class at mid to high water	Planned Class 2040
B1	Tha River	L	Mekong (2,281)	Nam Tha I dam	0	60	60	VI	VI	N/A***
B2	Beng River	L	Mekong (2,172)	Nam Beng dam	0	16	16	VI	VI	N/A
B3	Ou River	L	Mekong (2,033)	Nong Khiao dam (1)	0	85	85	VI	VI	N/A
B4	Khan River	L	Mekong (2,010)	Nam Khan dam III	0	40	40	N/A	N/A	N/A
B5	Ngum River	L	Mekong (1,485)	Nam Ngum dam I	0	180	180	VI	V	N/A
B6	Lik River	L	Ngum River	Pak Houay	0	55	55	VI	VI	N/A
B7	Song River	L	Lik River	Vang Vieng	0	65	65	VI	VI	N/A
B8	Xan River	L	Mekong (1,395)	Nam Lao	0	105	105	VI	V	N/A
B9	Theun River	L	Mekong (1,352)	Nam Theun dam I	0	100	100	VI	V	N/A
B10	Bang Fai River	L	Mekong (1,169)	Mahaxay	0	140	140	VI	V	N/A
B11	Banghiang River	L	Mekong (1,036)	Sepon	0	285	285	VI	V	N/A

Note: *L = Lao PDR.
** On the tributaries, km = distance to the mouth of the river along the thalweg.
*** N/A = not applicable.

Table 38. Waterway classes for the Mekong River tributaries in Lao PDR from upstream to downstream of dam(s)

No.	River/canal	L *	From	To	From km**	To km**	Length km	Class at low water	Class at mid to high water	Planned Class 2040
C1	Tha River	L	Nam Tha I dam	Luang Namtha	60	230	170	VI	VI	N/A***
C2	Beng River	L	Nam Beng dam	Muang Houn	16	46	30	VI	VI	VI
C3	Ou River	L	Nong Khiao dam (1)	Muang Khua dam (3)	85	175	90	VI	V	N/A
C4	Ou River	L	Muang Khua dam (4)	Muang Samphanh d. (5)				VI	V	III
C5	Ou River	L	Muang Samphanh d. (5)	Hathsa (6)				VI	V	III
C6	Ou River	L	Hathsa (6)	Ou River Ou Ricer (7)				VI	V	III
C7	Khan River	L	Nam Khan dam III	Nam Khan dam II	40	75	35	VI	V	V
C8	Ngum River	L	Nam Ngum dam I	Nam Ngum dam II	65	105	40	VI	V	N/A
C9	Theun River	L	Nam Theun dam I	Nam Theun dam II	100	170	70	VI	III	II
C10	Theun River	L	Nam Theun dam II	Keng Cheng	170	260	90	VI	IV	N/A
C11	Banghiang R.	L	Sepon	Dansavan	0	40	40	VI	VI	N/A

Note: *L = Lao PDR.
** On the tributaries, km = distance to the mouth of the river along the thalweg.
*** N/A = not applicable.

Table 39. Waterway classes for the Mekong River tributaries in Thailand

No.	River/canal	L *	From	To	From km**	To km**	Length km	Class at Low Water	Class at Mid to High Water	Planned Class 2040
D1	Ruak River	T	Golden Triangle	Mae Sal	0	40	40	VI	IV	II
D2	Kok River	T	Mekong (2,365)	Chiang Rai	0	80	80	VI	IV	II
D3	Ing River	T	Mekong (2,306)	Meuang Thoeng	0	130	130	VI	V	II
D4	Loei River	T	Mekong (1,715)	Wang Saphung	0	110	110	VI	II	II
D5	Sonkhram River	T	Mekong (1,260)	So Phisai	0	250	250	VI	III	II

Note: * T = Kingdom of Thailand.
** On the tributaries, km = distance to the mouth of the river along the thalweg.
*** N/A = not applicable.

6. VESSEL AND WATERWAY CLASSIFICATION FOR THE MEKONG RIVER SYSTEM IN CAMBODIA AND VIET NAM

6.1. Vessel Dimensions

In January 2019, the **Vietnamese** representative of the working group prepared the following vessel classification, based on the registered vessels in Viet Nam along the Mekong River (Table 40).

Table 40. Viet Nam vessel classification

Class	Type	Maximum tonnage	Draft (m)	Width (m)	Length (m)	Height (m)
Ia	Seagoing	5,000	8.10	16.00	134.00	32.30
Ib	Sea-river	5,000	6.20	15.60	85.00	
IIa	Seagoing	3,000	7.00	13.30	116.00	29.50
IIb	Sea-river	3,000	5.60	15.40	74.50	
IIIa	Seagoing	2,000	4.85	13.00	110.00	27.20
IIIb	Barge	2,000	3.90	11.60	59.50	16.50
IVa	Barge	1,000	3.30	10.00	60.00	14.00
IVb	Convoy	4 x 400	2.20	15.20	114.00	
Va	Barge	600	2.70	8.60	43.50	11.00
Vb	Convoy	2 x 400	2.50	9.50	110.00	
VIa	Barge	300	2.60	6.60	24.80	9.50
VIb	Convoy	2 x 200	2.30	8.50	108.00	
VII	Barge	100	2.40	5.30	21.50	8.60
VIII	Barge	50	2.40	5.30	17.40	7.40
IX	Barge	20				

In January 2019, the **Cambodian** representative of the working group prepared the following vessel classification, based on the registered vessels in Cambodia (MPWT, PPAP and provincial departments) (Table 41).

Table 41. Cambodia vessel classification

Class	Type	Maximum tonnage	Draft (m)	Width (m)	Length (m)	Height (m)
Ia	Seagoing	5,000	6.50	16.00	97.00	33.50
Ib	Sea-river	5,000				
IIa	Seagoing	3,000	5.60	13.00	73.00	13.50
IIb	Sea-river	3,000				
IIIa	Seagoing	2,000	4.85	13.00	110.00	27.20
IIIb	Barge	2,000	3.90	11.60	59.50	16.50
IVa	Barge	1,000	3.60	12.00	60.00	12.50
IVb	Convoy	4 x 400				
Va	Barge	600	3.00	10.50	47.00	8.00
Vb	Convoy	2 x 400				
VIa	Barge	300	2.50	11.00	57.00	9.50
VIb	Convoy	2 x 200				
VII	Barge	100	2.00	8.80	36.50	8.60
VIII	Barge	50	1.40	7.00	27.00	7.40
IX	Barge	20	1.10	3.80	19.50	4.00

6.2. Vessel Classification

Based on the prepared data for Cambodia and Viet Nam, following proposal of vessel classification was presented to the Vietnamese and Cambodian representatives and authorities for amendments or approval (Table 42).

Table 42. Proposed vessel classification for Cambodia and Viet Nam

Class	Type	Maximum tonnage	Draft (m)	Width (m)	Length (m)	Height (m)
0	Seagoing	7,000	9.00	20.00	151.00	36.20
Ia	Seagoing	5,000	**8.10**	**18.00**	**134.00**	**33.50**
Ib	Sea-river	5,000	6.40	15.60	97.00	24.00
IIa	Seagoing	3,000	**6.60**	**15.20**	**116.00**	**29.50**
IIb	Sea-river	3,000	5.60	14.00	74.50	19.00
IIIa	Seagoing	2,000	**5.50**	**13.00**	**110.00**	**27.20**
IIIb	Barge	2,000	4.40	12.90	67.5	16.50
IVa	Barge	1,000	**3.60**	12.00	60.00	**14.00**
IVb	Convoy	4 x 400	2.70	**15.40**	**114.00**	10.50
Va	Barge	600	**3.10**	**10.50**	47.00	**11.00**
Vb	Convoy	2 x 400	2.70	9.50	**114.00**	10.50
Via	Barge	300	**2.50**	**8.50**	30.00	**9.50**
VIb	Convoy	2 x 200	2.30	7.20	**78.00**	9.00
VII	Barge	100	**2.00**	**5.30**	**21.50**	**7.40**
VIII	Barge	50	**1.70**	**5.00**	**17.40**	**6.00**
IX	Barge	20	**1.10**	**2.80**	**12.00**	**4.00**

At the Cambodian meeting on the National Consultation for the proposal for a vessel classification and for waterway dimension equations on Navigation of the Mekong River between Cambodia and Viet Nam held on 27 February 2019 in Siem Reap, the participants agreed in principle with the proposal of vessel classification, but made the following proposals:

- PPAP requested to add passenger vessels, oil tankers and tugboats to the classes.
- The values in the table for a river classification should use “from-to-values” and not single values as in Table 48.

Table 43. Example of Cambodia vessel dimension

Class	Standard vessel dimensions				
	DWT (tonne)	Draft Ts (m)	Width Ws (m)	Length Ls (m)	Height Hs (m)
IV	800–1,000	3.6–4.1	11.0–12.0	90–100	12.5–14.0
V	600–800	3.1–3.6	10.0–11.0	80–90	11.0–12.5
VI	400–600	2.6–3.1	9.0–10.0	70–80	9.5–11.0
VII	100–400	1.7–2.6	6.5–9.0	28–70	3.5–9.5
VIII	70–100	1.3–1.7	3.5–6.5	15–28	2.5–3.5
IX	30–70	1.0–1.3	2.5–3.5	13–15	1.5–2.5

In the same month, the Viet Nam inland Waterway Administration (VIWA) organized a technical assessment seminar to discuss the new inland waterway design standard in Viet

Nam, were the participants agreed with the proposal of vessel classification but asked to mention t that these maximum dimensions are valuable for 98% of all registered vessels.

At a bilateral meeting between Cambodia and Viet Nam held on 14 May 2019 in the MRC-S Office in Phnom Penh, taking into account the remarks from Viet Nam, the following conclusions were made:

- A footnote should be added to the table indicating that barges must include inland waterway cargo vessels, inland waterway passenger vessels, inland waterway tankers and tugboats.
- Concerning the use of "from-to-values" instead of single values, in all international vessel classifications and most national classifications, only the maximum dimensions are provided for each class. Therefore, it is proposed to provide only the single maximum dimensions for each class.
- A footnote should be added to the table indicating that these maximum dimensions apply to 98% of all registered vessels.

Table 44. Maximum dimensions applicable to 98% of all registered vessels

Class	Type	Maximum tonnage	Draft (m)	Width (m)	Length (m)	Height (m)
0	Seagoing	7,000	9.00	20.00	151.00	36.20
Ia	Seagoing	5,000	**8.10**	**18.00**	**134.00**	**33.50**
Ib	Sea-river	5,000	6.40	15.60	97.00	24.00
IIa	Seagoing	3,000	**6.60**	**15.20**	**116.00**	**29.50**
IIb	Sea-river	3,000	5.60	14.00	74.50	19.00
IIIa	Seagoing	2,000	**5.50**	**13.00**	**110.00**	**27.20**
IIIb	Barge	2,000	4.40	12.90	67.5	16.50
IVa	Barge	1,000	**3.60**	12.00	60.00	**14.00**
IVb	Convoy	4 x 400	2.70	**15.40**	**114.00**	10.50
Va	Barge	600	**3.10**	**10.50**	47.00	**11.00**
Vb	Convoy	2 x 400	2.70	9.50	**114.00**	10.50
VIa	Barge	300	**2.50**	**8.50**	30.00	**9.50**
VIb	Convoy	2 x 200	2.30	7.20	**78.00**	9.00
VII	Barge	100	**2.00**	**5.30**	**21.50**	**7.40**
VIII	Barge	50	**1.70**	**5.00**	**17.40**	**6.00**
IX	Barge	20	**1.10**	**2.80**	**12.00**	**4.00**

(1) Barges include inland waterway cargo vessels, inland waterway passenger vessels, inland waterway tankers and tugboats.
(2) These maximum dimensions apply to 98% of all registered vessels.

6.3. Channel Design Equations

Both Cambodia and Viet Nam agreed to use the PIANC 2019 equations to calculate the waterway dimensions for the waterway classification.

Table 45. PIANC 2019 equations

Waterway dimensions	PIANC 2019 / Canal	PIANC 2019 / River
T Depth	1.30 Ts	1.30 Ts
W Width one-way traffic	2.1 Ws	3.2 Ws
W Width two-way traffic	3.5 Ws	5.0 Ws
Wb Bridge passing one-way	2.2 Ws	3.3 Ws
Wb Bridge passing two-way	4.0 Ws	4.4 Ws
H Air clearance bridge	1.05 Hsn (DH ≥ 0.3 m)	1.05 Hsn (DH ≥ 2.0 m)
Hc Air clearance cables	1.15 Hsn (DHc ≥ 0.6 m)	1.15 Hsn (DHc ≥ 3.5 m)
R Bend radius	5 Ls	5 Ls
LL Lock length (PIANC 2009)	1.10 Ls	1.10 Ls
WL Lock width (PIANC 2009)	1.10 Ws (≥ Ws + 0.9m)	1.10 Ws (≥ Ws + 0.9m)
TL Lock depth (PIANC 2009)	1.20 Ts (≥ Ts + 0.6 m)	1.20s (≥ Ts + 0.6 m)

6.4. Waterway Classification

Based on the agreed vessel classification and the PIANC 2019 equations to calculate the waterway dimensions, the meeting agreed with following waterway classifications:

For Viet Nam

Table 46. Proposed waterway classifications for Viet Nam

Class	Type	DWT (tonne)	Min. waterway dimensions (*)				Bend radius R (m)	Min. bridge dimensions			Cables
			Natural river		Canal			River span Wbr (m)	Canal span Wbc (m)	Min. height Hb (m)	Min. height Hc (m)
			Water depth Tr (m)	Bed width Wr (m)	Water depth Tc (m)	Bed width Wc (m)					
0	seagoing	7,000	11.7	100	11.7	70	750	88	80	38.2	39.7
I	seagoing	5,000	10.5	90	10.5	63	670	79	72	35.5	37.0
	sea-river	5,000									
II	seagoing	3,000	8.6	76	8.6	53	580	67	61	31.5	33.0
	sea-river	3,000									
IIIa	seagoing	2,000	7.2	65	7.2	45	550	57	52	29.2	30.7
IIIb	Barge (**)	2,000	5.7		5.7		335			18.5	20.0
IVa	barge	1,000	4.7	60	4.7	42	300	53	48	16.0	17.5
IVb	convoy	4x400		77		54	570	68	61		
Va	barge	600	4.0	52	4.0	37	235	46	42	13.0	14.5
Vb	convoy	2x400		47		33	570	42	38		
VIa	barge	300	3.2	42	3.2	30	150	37	34	11.5	13.0
VIb	convoy	2x200		36		25	390	31	29		
VII	barge	100	2.6	26	2.6	18	105	23	21	9.4	10.9
VIII	barge	50	2.2	25	2.2	17	85	22	20	8.0	9.5

Notes: * These minimum dimensions are valid for 98% of all registered vessels.

** Barges include inland waterway cargo and passenger vessels, tankers and tugboats.

For Cambodia

Because Cambodia has no convoys and no canals, its waterway classification can be much simpler as shown in Table 47.

Table 47. Proposed waterway classifications for Cambodia

For Cambodia (including a riverbed width for one-way traffic)

Class	Type	Ton	Min. waterway dimensions (*)			Bend radius R (m)	Min. bridge dimensions		Cables
			Water depth T (m)	Bed width one-way	Bed width two-way		Span two-way Wb (m)	Height Hb (m)	Min. height Hc (m)
I	seagoing	5,000	10.5	58	90	670	79	35.5	37.0
II	seagoing	3,000	8.6	48	76	580	67	31.5	33.0
IIIa	seagoing	2,000	7.2	42	65	550	57	29.2	30.7
IIIb	barge (**)	2,000	5.7			335		18.5	20.0
IV	barge	1,000	4.7	38	60	300	53	16.0	17.5
V	barge	600	4.0	33	52	235	46	13.0	14.5
VI	barge	300	3.3	27	42	150	37	11.5	13.0
VII	barge	100	2.6	17	26	105	23	9.4	10.9
VIII	barge	50	2.2	16	25	85	22	8.0	9.5
IX	barge	20	1.4	9	14	60	12	6.0	7.5

Notes: (*) These minimum dimensions are valid for 98% of all registered vessels.
(**) Barges include inland waterway cargo and passenger vessels, tankers and tugboats.

6.5. River Stretches

After approval of the waterway classification by both national authorities, each navigable stretch of the Mekong River and its tributaries should be given a "class" at high water level and at low to mid water level, based on its dimensions and a future 2040 planned class, based on the Master Plan.

To collect the data on river and canal dimensions, the Mekong River Basin in Cambodia and Viet Nam was subdivided in four areas:

a) Cambodia–Mekong River (ឆ្នេរមេគង្គ - Tônlé Mékôngk);

b) Viet Nam–Mekong River (Sông Tiên) and Northern Delta;
c) Viet Nam–Mekong River (Sông Tiên) - Bassac River (Sông Hậu) and Middle Delta;
d) Viet Nam–Bassac River (Sông Hậu) and Southern Delta.

Therefore, following proposal of list of navigable waterway stretches for the Mekong River and its tributaries should be completed with the dimensions of each stretch.

For Cambodia

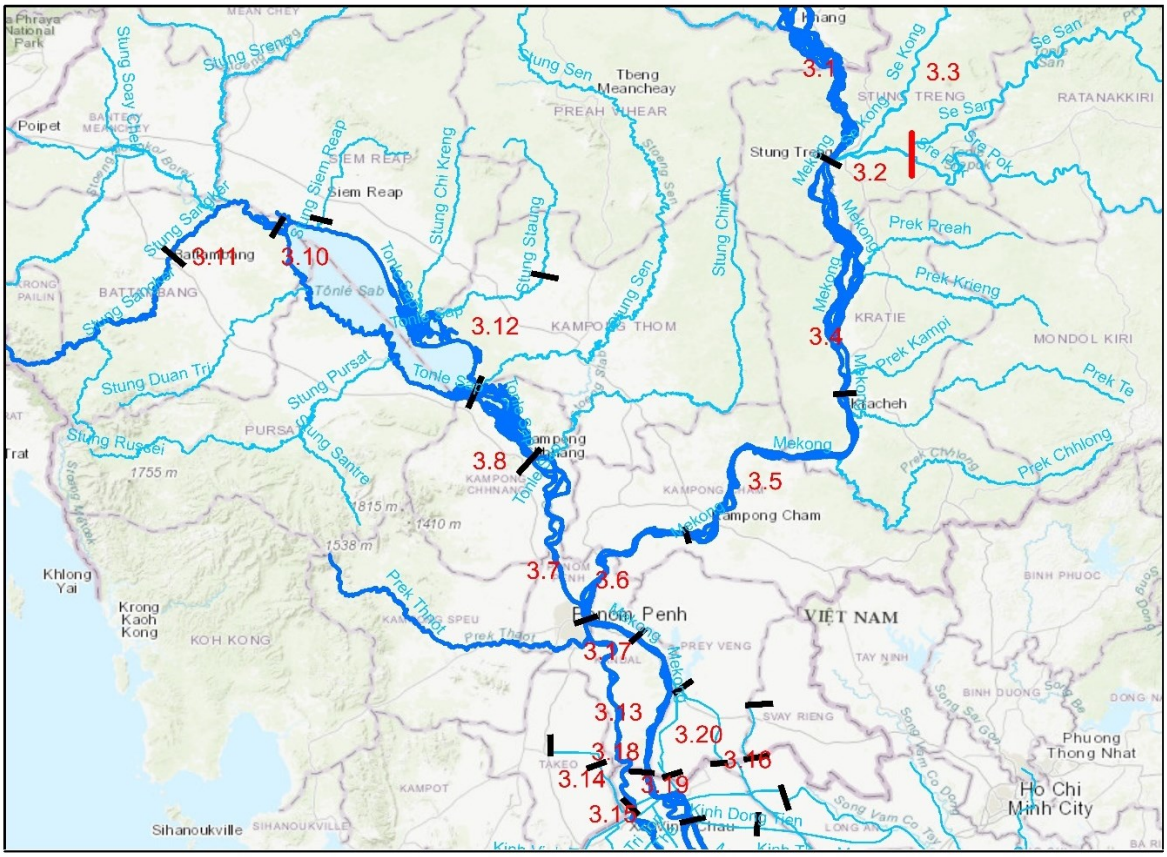


Figure 16. Navigable waterway stretches for the Mekong River and its tributaries (Cambodia)

Table 48. Navigable waterway stretches with dimension – Cambodia

No.	River/canal	From	To	From km**	To km**	Length (km)	Min. depth HHW (m)	Min. depth LLW (m)	Min. width (m)	Bend radius (m)	Bridge span (m)	Bridge height (m)	Obstacles *
3.1	**Mekong River**	Khone Phapheng)	Stung Treng	721	684	37	12.20	1.70	2,500	-	-	-	
3.2	Se San River	Mekong River (685)	Lower Se San 2 dam	0	38	38	9.00	2.50	800	-	-	-	
3.3	Se Kong river	Se San River (9)	Cambodia-Lao border	0	143	143	9.00	2.20	800	-	-	-	
3.4*	**Mekong River**	Stung Treng	Kratie	684	561	123	8.00	1.70	2,500	-	100	15	Rock islands
3.5	**Mekong River**	Kratie	Kampong Cham	561	448	113	8.00	0.60	1,000	2,422	100	15	Kr1-Kr2-Kr3-Kr4
3.6	**Mekong River**	Kampong Cham	Chaktomuk	448	348	100	14.80	2.50	1,070	2,942	120	14	KgCh1-KgCh2-
3.7	Tonle Sap River	Mekong River (348)	Kampong Chhnang	0	104	104	11.30	1.50	250	883	120	10	Ts1-Ts2-Ts3
3.8*	Tonle Sap Lake	Kampong Chhnang	Chhnok Tru	104	145	41	11.30	0.60	350	-	-	-	KgCh1-KgCh2
3.9*	Tonle Sap Lake	Chhnok Tru	Chong Kneas	145	252	107	11.00	0.70	-	-	-	-	Area1-Area2
3.10	Tonle Sap Lake	Chong kneas	Sangker River	252	263	11	11.00	0.70	-	-	-	-	
3.11*	Sangker River	Tonle Sap Lake	Battambang	0	96	96	5.00	0.80	-	-	-	-	
3.12*	Sen River	Tonle Sap Lake	Stung Sen City	0	78	78	11.40	5.60	70	-	-	-	
3.13	Bassac River	Chaktomuk	Cambodia-Viet Nam	335	252	83	6.00	0.50	220	556	117	5	B1-B2-B3-B4-B5
3.14*	Ankhor Borei Canal	Doun Kaev (Takeo	Ankhor Borei	0	22	22	5.00	3.00	70	-	-	-	
3.15*	Ankhor Borei River	Anchor Borei	Cambodia-Viet Nam	22	37	15	5.00	3.00	70	-	-	-	
3.16	Stung Ta Keo	Thmasor	Cambodia-Viet Nam	0	25	25	5.00	3.00	60	-	-	-	
3.17	**Mekong River**	Chaktomuk	PPAP-NCT	348	323	25	14.50	6.00	800	-	-	-	P1
3.18	**Mekong River**	PPAP-NCT	Cambodia-Viet Nam	323	251	72	11.00	6.00	650	-	330	37	P2-P3-P4-P5
3.19	Stung Slot River	Touch River (Peam	Cambodia-Viet Nam	0	92	92	9.00	1.80	25	-	-	-	
3.20	Kampong Trabek	Va Mi River	Cambodia-Viet Nam	0	60	60	8.00	1.50	35	-	-	-	

Notes: * The Cambodian delegation was asked to explain the obstacles, given as Kr1-Kr2-Kr3-Kr4–KgCh1-KgCh2-KgCh3–Ts1-Ts2-Ts3–KgCh1-KgCh2–Area1-Area2–B1-B2-B3-B4-B5–P1-P2-P3-P4-P5.

**Proposed river stretches that need new surveying are shown below.

No.	River	From	To	From km	To km	Length km
3.4	Mekong River	Stung Treng	Kratie	684	561	123
3.8	Tonle Sap Lake	Kampong Chhnang	Chhnok Tru	104	145	41
3.9	Tonle Sap Lake	Chhnok Tru	Chong Kneas	145	252	107
3.11	Sangker River	Tonle Sap Lake	Battambang	0	96	96
3.12	Sen River	Tonle Sap Lake	Kampong Thom	0	78	78
3.14 3.15	Ambel-Kbal Kaoch	Bassac River (287)	Ankhor Borei	0	38	38

For Viet Nam

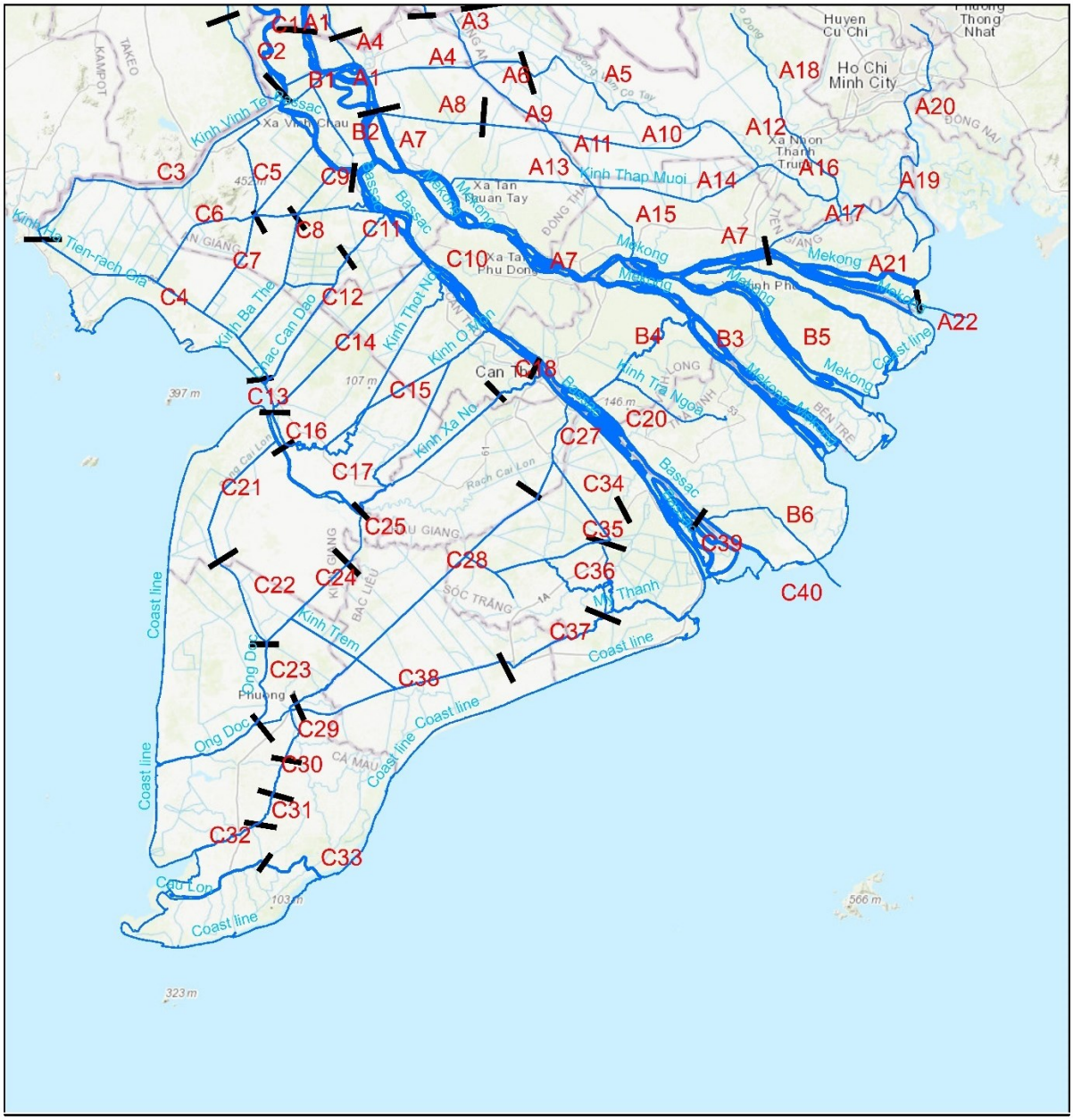


Figure 17. Navigable waterway stretches for the Mekong River and its tributaries completed with the dimensions of each stretch (Viet Nam)

A. Viet Nam–Mekong River and Northern Delta

Table 49. Viet Nam–Mekong River and Northern Delta

No.	River/Canal	From	To	From km*	To km*	Length (km)	Min. depth (m)	Min. width	Bend radius (m)	Bridge span (m)	Bridge height (m)	Obstacles
A1	**Mekong River**	Vietn.-Camb. Border	Vam Nao River	251	216	35	5.50	200.00	90	-	-	
A2	So Thuong River	Vietn.-Camb. Border (Stung Slot River)	Mekong River (226)	0	15	15	3.70	50.00	-	-	5.00	So Thuong bridge
A3	N5 Canal	Vietn.-Camb. Border (Trabek River)	Tan Phuoc (Trung Uong Canal)	0	65	65	1.80	15.00	-	-	-	Irrigation channel
A4	Trung Uong Canal (Hong Ngu-Vinh Hong Canal)	Mekong River (225)	Vinh Thanh (Vam Co Tay River)	0	44	44	5.50	20.00	90	19.00	3.50	
A5	Vam Co Tay River	Vinh Thanh (Trung Uong C.)	Tuyen Nhon	155	84	71	3.70	80.00	900	40.00	5.50	
A6	Phuoc Xuyen (N5) Canal	Tan Phuoc (Trung Uong C.)	Truong Xuan (An Long C.)	0	28	28	2.26	36.00	-	30.00	4.50	Tân Phước Bridge
A7	**Mekong River**	Vam Nao River	Cho Gao Canal	216	59	157	8.50	80.00	-	-	-	
A8	Dong Tien Canal (Thap Muoi So1 C.)	Mekong River (213)	Phu Cuong	0	28	28	2.50	20.00	-	20.00	2.50	
A9	An Long Canal	Phu Cuong	Truong Xuan	0	17	17	2.50	20.00	-	20.00	2.50	
A10	Duong Van Duong Canal	Truong Xuan	Tuyen Nhon Vam Co Thay R. (84)	0	46	46	2.50	20.00	-	20.00	2.50	
A11	Nguyen Van Tiep (N5) Canal	Truong Xuan (An Long C.)	My An (Thap Muoi So2 C.)	0	17	17	2.50	20.00	-	20.00	2.50	
A12	Vam Co Tay River	Tuyen Nhon	Long An	84	42	42	3.70	80.00	-	35.00	5.00	
A13	Thap Muoi So 2 Canal	Mekong River (182)	My An	0	-	-	-	-	-	5.00	1.80	Rạch Chanh culvert
A14	Nguyen Van Tiep C.	My An (Thap Muoi So 2 C.)	Long An Vam Co Tay R. (42)	17	78	61	1.80	15.00	-	-	-	
A15	N5 Canal	My An, Thap Muoi	Mekong River (113)	0	34	34	3.50	18.00	-	-	-	
A16	Vam Co Tay River	Long An	Vam Co River (34)	42	0	42	3.70	80.00	-	27.00	3.50	Mộc Hóa Bridge
A17	Cho Gao Canal	Mekong River (59)	Vam Co River (26)	0	29	29	2.50	25.00	-	-	-	Shallow bar
A18	Vam Co River	Soai Rap River	Tay Ninh	0	160	160	3.00	22.00	-	-	-	
A19	Soai Rap River	South Sea	Saigon Port (Saigon Riv.)	0	51	51	6.50	100.00	500	-	-	
A20	Soai Rap River	Saigon Port (Saigon River)	Bien Hoa	51	95	44	8.50	100.00	500	-	-	
A21	**Mekong River**	Cho Gao Canal	South Sea	59	15	44	2.50	25.00	-	-	-	Tidal
A22	**Mekong River**	South Sea	Deep Sea Buoy	18	0	18	6.50	100.00	500	-	-	Tidal

B. Viet Nam–Mekong–Bassac River and Middle Delta

Table 50. Viet Nam–Mekong–Bassac River and Middle Delta

No.	River/Canal	From	To	From km*	To km*	Length (km)	Min. Depth (m)	Min. width (m)	Bend radius (m)	Bridge span (m)	Bridge height (m)	Obstacles
B1	Xang Canal	Mekong River (240)	Bassac River (224)	0	12	12	2.80	30.00	-	-	-	
B2	Vam Nao River	Mekong River (216)	Bassac River (185)	0	6	6	5.50	80.00	-	-	-	No bridge
B3	Co Chien River	Mekong River (126)	South Sea	98	0	98	4.60	150.00	-	-	-	
B4	Mang Thit Canal/River	Co Chien River	Bassac River (76)	0	52	52	6.50	100.00	350	20.00	7.00	
B5	Ham Luong River	Mekong River (99)	South Sea	78	0	78	5.00	150.00	500	-	-	
B6	Quan Chanh Bo Canal	Bassac River (33)	South Sea	31	0	31	5.00	100.00	500	-	-	

Note: ** On the Mekong River and the Bassac River, km = km of Updated Hydrographic Atlas (UHA) Mekong River 1996, on the tributaries and canals km = distance to the mouth of the river or canal.

C. Viet Nam–Bassac River and Southern Delta

Table 51. Viet Nam–Bassac River and Southern Delta

No.	River/Canal	From	To	From km*	To km*	Length (km)	Min. Depth (m)	Min. width (m)	Bend radius (m)	Bridge span (m)	Bridge height (m)	Obstacles
C1	**Bassac River**	Viet Nam-Cambodia b.	Vam Nao Pass	251	185	66	3.50	80.00	500	-	-	
C2	Chau Doc River	Viet Nam-Cambodia b.	Bassac River (217)	0	28	28	3.50	70.00	500	-	-	
C3	Vinh Te Canal	Chau Doc	Ha Tien	0	96	96	2.00	36.00	-	24.00	4.00	Vĩnh Ngươn bridge
C4	Ha Tien-Rach Gia Canal	Ha tien	Rach Gia	0	80	80	2.50	25.00	-	-	-	
C5	Vinh Tre Canal	Bassac River (200)	Tri Ton (Tam Ngan Canal)	0	26	26	2.20	20.00	-	-	-	
C6	Tam Ngan Canal	Tri Ton (Vinh Tre Canal)	Ha Tien-Rach Gia Canal	0	37	37	2.20	20.00	-	-	-	
C7	Tri Ton Canal	Tri Ton (Vinh Tre Canal)	Ha tien-Rach Gia Canal	0	32	32	2.20	20.00	-	-	-	
C8	Mac Can Dung Moi Canal	Tri Ton (Vinh Tre Canal)	Ba The Canal	0	13	13	1.20	22.00	-	-	-	
C9	Ba The Canal	Bassac River (192)	Ha Tien-Rach Gia Canal	0	57	57	2.20	20.00	-	-	-	
C10	**Bassac River**	Vam Nao Pass	Can Tho	185	107	78	3.50	80.00	-	-	-	
C11	Rach Chua River	Bassac River (159) (Long Xuyen)	Nui Sap	0	30	30	1.50	20.00	150	-	-	Bend at Nguyễn Trung Trực Bridge
C12	Rach Gia-Long Xuyen Canal	Nui Sap (Rach Chua River)	Rach Gia (Ha Tien-Rach Gia Canal)	0	33	33	0.90	36.00	-	22.00	4.70	Nguyễn Trung Trực Bridge
C13	Rach Gia-Cai Be R. Canal	Rach Gia	Cai Be River	0	16	16	2.50	12.00				Stone bar
C14	Rach Soi-An Giang Canal	Bassac River (150) (My Thanh)	Rach Soi (Rach Gia-Cai Lon Canal)	0	60	60	2.80	22.00	-	-	-	
C15	Thot Not-Cai Be Canal	Bassac River (127) (Thot Not)	Giong Rieng (Cai Be River)	0	58	58	3.00	28.00	-	-	-	Shallow bar
C16	Cai Be River	Rach Gia Bay	Giong Rieng	0	31	31	2.90	35.00	-	-	-	Shallow bar
C17	Cai Lon River	Rach Gia Bay	Vinh Hoa	0	118	118	4.00	54.00	-	-	-	Shallow bar
C18	Can Tho River	Bassac River (106) (Can Tho)	Nhon Nghia	0	16	16	6.50	80.00	500	-	-	
C19	Xa No Canal	Nhon Nghia (Can Tho R.)	Vinh Hoa (Cai Lon River)	0	43	43	0.80	28.00	-	-	-	
C20	**Bassac River**	Can Tho	Quan Chanh Bo Canal	106	33	73	5.00	100.00	500	-	-	
C21	Xeo Ro Canal	An Bien (Cai Lon River)	Bien Bac (Trem River)	0	47	47	2.40	18.00	350	-	-	

No.	River/Canal	From	To	From km*	To km*	Length (km)	Min. Depth (m)	Min. width (m)	Bend radius (m)	Bridge span (m)	Bridge height (m)	Obstacles
C22	Trem River	Bien Bac	Ho Thi Ky (Ong Doc River)	0	84	84	4.00	32.00	350	-	-	
C23	Ong Doc River	Ho Thi Ky	Gulf of Thailand	0	44	44	3.00	40.00	350	-	-	
C24	Chak Bang Canal	Ho Thi Ky (Trem River)	Phong Dong (Nga Ba Dinh R)	0	35	35	2.50	12.00	-	70.00	5.20	Tac Thu lock
C25	Nga Ba Dinh River	Phong Dong	Vinh Phuoc (Cai Lon R.)	35	51	16	3.12	36.00	350	-	-	
C26	Ca Mau River	Khanh An (Ong Doc R.)	Ca Mau	0	9	9	2.00	20.00	150	30.00	3.80	Ca Mau bridge
C27	Cai Con Canal	Bassac River (90)	My Tu	0	28	28	2.20	20.00	-	-	-	
C28	Quan Lo-Phung Hiep Canal	My Tu	Ca Mau (Gang Hao River)	0	93	93	2.30	36.00	-	20.00	3.50	Phan Ngọc Hiển I&II bridge
C29	Gang Hao River	Ca Mau	Hoa Thanh	0	10	10	1.15	25.00	-	22.00	4.70	
C30	Gang Hao-Bay Hap Canal	Hoa Thanh	Cai Nuoc	10	20	10	1.50	20.00	-	22.00	4.70	
C31	Bay Hap River	Cai Nuoc	Tran Thoi	20	45	25	1.90	52.00	-	-	-	
C32	Bay Hap-Cua Lon Canal	Tran Thoi	Nam Can (Cua Lon River	45	56	11	1.70	52.00	-	-	-	BC Tân Duyệt bến Bào
C33	Cua Lon River	Nam Can	South Sea	32	0	32	3.60	60.00	1,000	80.00	7.00	
C34	Dai Ngai Canal	Bassac River (58)	My Xuyen	0	21	21	6.50	100.00	-	-	-	
C35	Song Dinh	My Xuyen	Thanh Thoi Thuan	21	34	13	4.50	60.00	150	-	-	
C36	Song Cai	Thanh Thoi Thuan	Vinh Chau	34	53	19	6.50	60.00	500	-	-	
C37	Song Bac Lieu	Vinh Chau	Bac Lieu	53	80	27	1.60	50.00	-	-	-	
C38	Bac Lieu-Ca Mau Canal	Bac Lieu	Ca Mau (Gang Hao River)	80	145	65	1.70	38.00	350	20.00	3.80	Sập-Hòa Bình bridge
C39	**Bassac River**	Quan Chanh Bo Canal	South Sea (Dinh an)	33	23	10	3.00	100.00	500	-	-	Tidal
C40	**Bassac River**	South Sea	Deep Sea Buoy	23	0	23	3.00	100.00	500	-	-	Tidal

6.6. River Stretch Classes

Starting from the waterway classification and the minimum navigation channel dimensions that are required for a classified vessel tonnage in the different river stretches, the categorized river stretches give the available class in the river stretch at low water, and at mid to high water, and a provide a proposal of waterway class that should be achieved in 2040.

Table 52. Waterway classes for Mekong River and tributaries stretches in Cambodia

No.	River/canal	From	To	From km*	To km*	Length (km)	Class at Low Water	Class at Mid to High Water	Planned Class 2040
1	**Mekong River**	Khone Falls	Stung Treng	721	684	37	IX**	V**	N/A***
2	Se San River	Mekong River (685)	Lower Se San 2 dam	0	38	38	VIII**	V**	N/A
3	Se Kong River	Se San River (9)	Cambodia-Lao PDR border	0	143	143	VIII**	V**	N/A
4	**Mekong River**	Stung Treng	Kratie	684	561	123	IX**	V**	N/A
5	**Mekong River**	Kratie	Kampong Cham	561	448	113	IX	V	IIIb****
6	**Mekong River**	Kampong Cham	Chaktomuk	448	348	100	V	II	II****
7	Tonle Sap River	Mekong River (348)	Kampong Chhnang	0	104	104	IX	VIII	N/A
8	Tonle Sap Lake	Kampong Chhnang	Chhnok Tru	104	145	41	IX	VI	N/A
9	Tonle Sap Lake	Chhnok Tru	Chong Kneas	145	252	107	IX	VI	N/A
10	Tonle Sap Lake	Chong kneas	Sangker River	252	263	11	IX	VI	N/A
11	Sangker River	Tonle Sap Lake	Battambang	0	96	96	IX**	VI**	N/A
12	Sen River	Tonle Sap Lake	Stung Sen City	0	78	78	IV**	III**	N/A
13	Bassac River	Chaktomuk	Cambodia-Viet Nam border	335	252	83	IX	IX	N/A
14	Ankhor Borei Canal	Doun Kaev (Takeo City)	Ankhor Borei	0	22	22	VII	IV	N/A
15	Ankhor Borei R.	Anchor Borei	Cambodia-Viet Nam border	22	37	15	VII	IV	N/A
16	Stung Ta Keo	Thmasor	Cambodia-Viet Nam border	0	25	25	VII	IV	N/A
17	**Mekong River**	Chaktomuk	PPAP-NCT	348	323	25	IIIb	I	I
18	**Mekong River**	PPAP-NCT	Cambodia-Viet Nam border	323	251	72	IIIb	I	I
19	Stung Slot R.	Touch River (Peam Ror (	Cambodia-Viet Nam border	0	92	92	IX	IIIb	N/A
20	K. Trabek River	Upper Stung Slot	Cambodia-Viet Nam border	0	60	60	IX	IIIb	N/A

Notes: * On the Mekong River, km = km of Updated Hydrographic Atlas (UHA) Mekong River 1996; on the tributaries, km = distance to the mouth of the river along the thalweg.
** No commercial navigation.
*** N/A = not applicable.
**** According to the Feasibility Study on waterway improvement for port logistics development in Cambodia, KOIKA, 2017.

Table 53. Waterway classes for Mekong River, tributary and canal stretches in Viet Nam

Table 53A. Viet Nam–Mekong River and Northern Delta

No.	River/canal	From	To	From km	To km	length	Class at low water	Class at mid to high water	Planned Class 2040
A1	**Mekong River**	Vietnam.-Cambodia border	Vam Nao River	251	216	35	IIIb	II	II
A2	So Thuong River	Vietnam.-Cambodia border (Stung Slot River)	Mekong River (226)	0	15	15	N/A	N/A	N/A
A3	N5 Canal	Vietnam.-Cambodia border (Trabek River)	Tan Phuoc (Trung Uong Canal)	0	65	65	VIII	VIII	VIII
A4	Trung Uong Canal (Hong Ngu-Vinh Hong Canal)	Mekong River (225)	Vinh Thanh (Vam Co Tay River)	0	44	44	VIII	VIII	N/A
A5	Vam Co Tay River	Vinh Thanh (Trung Uong canal)	Tuyen Nhon	155	84	71	VIII	VIII	N/A
A6	Phuoc Xuyen (N5) Canal	Tan Phuoc (Trung Uong Canal)	Truong Xuan (An Long Canal)	0	28	28	VIII	VIII	N/A
A7	**Mekong River**	Vam Nao River	Cho Gao Canal	216	59	157	IIIb	IIIb	IIIb
A8	Dong Tien Canal (Thap Muoi So1)	Mekong River (213)	Phu Cuong	0	28	28	VIII	VIII	N/A
A9	An Long Canal	Phu Cuong	Truong Xuan	0	17	17	VIII	VIII	N/A
A10	Duong Van Duong Canal	Truong Xuan	Tuyen Nhon Vam Co Thay R. (84)	0	46	46	VIII	VIII	N/A
A11	Nguyen Van Tiep (N5) Canal	Truong Xuan (An Long Canal)	My An (Thap Muoi So2 Canal)	0	17	17	VIII	VIII	N/A
A12	Vam Co Tay River	Tuyen Nhon	Long An	84	42	42	VIII	VIII	N/A
A13	Thap Muoi So 2 Canal	Mekong River (182)	My An	0	45	45	VIII	VIII	VIII
A14	Nguyen Van Tiep Canal	My An (Thap Muoi So 2 Canal)	Long An Vam Co Tay R.(42)	17	78	61	VIII	VIII	VIII
A15	N5 Canal	My An, Thap Muoi	Mekong River (113)	0	34	34	VIII	VIII	VIII
A16	Vam Co Tay River	Long An	Vam Co River (34)	42	0	42	VIII	VIII	N/A
A17	Cho Gao Canal	Mekong River (59)	Vam Co River (26)	0	29	29	VII	VII	N/A
A18	Vam Co River	Soai Rap River	Tay Ninh	0	160	160	VIb	VIb	N/A
A19	Soai Rap River	South Sea	Saigon Port (Saigon Riv.)	0	51	51	IIIb	II	I
A20	Soai Rap River	Saigon Port (Saigon River)	Bien Hoa	51	95	44	II	I	I
A21	**Mekong River**	Cho Gao Canal	South Sea	59	15	44	VIII	IIIb	IIIb
A22	**Mekong River**	South Sea	Deep Sea Buoy	18	0	18	IIIa	II	N/A

Table 53B. Viet Nam–Mekong-Bassac River and Middle Delta

No.	River/Canal	From	To	From km	To km	length	Class at Low Water	Class at Mid to High Water	Planned Class 2040
B1	Xang Canal	Mekong River	Bassac River (224)	0	12	12	VII	-	N/A
B2	Vam Nao River	Mekong River	Bassac River (185)	0	23	23	IIIb	II	II
B3	Co Chien River	Mekong River	South Sea	98	0	98	IVb	-	N/A
B4	Mang Thit Canal/River	Co Chien River	Bassac River (76)	0	52	52	VIII	-	N/A
B5	Ham Luong River	Mekong River	South Sea	78	0	78	IVb	-	N/A
B6	Quan Chanh Bo Canal	Bassac River (33)	South Sea	31	0	31	0	0	0

Table 53C. Viet Nam–Bassac River and Southern Delta

No.	River/Canal	From (km)	To (km)	km	km	length	Class at Low Water	Class at Mid to High	Planned Class 2040
C1	**Bassac River**	Viet Nam-Cambodia border	Vam Nao Pass	251	185	66	VIb	-	N/A
C2	Chau Doc River	Viet Nam-Cambodia border	Bassac River (217)	0	28	28	VIb	-	N/A
C3	Vinh Te Canal	Chau Doc	Ha Tien	0	96	96	VIII	-	N/A
C4	Ha Tien-Rach Gia Canal	Ha tien	Rach Gia	0	80	80	VII	-	N/A
C5	Vinh Tre Canal	Bassac River	Tri ton (Tam Ngan	0	26	26	VIII	-	N/A
C6	Tam Ngan Canal	Tri Ton (Vinh Tre Canal)	Ha Tien-Rach Gia Canal	0	37	37	VIII	-	N/A
C7	Tri Ton Canal	Tri Ton (Vinh Tre	Ha tien-Rach Gia	0	32	32	VIII	-	N/A
C8	Mac Can Dung Moi Canal	Tri Ton (Vinh Tre Canal)	Ba The Canal	0	13	13	VIII	-	N/A
C9	Ba The Canal	Bassac River	Ha tien-Rach Gia	0	57	57	VIII	-	N/A
C10	**Bassac River**	Vam Nao Pass	Can Tho	185	107	78	VIb	I	I
C11	Rach Chua River	Bassac R. (159) (Long Xuyen)	Nui Sap	0	30	30	VIII	-	N/A
C12	Rach Gia-Long Xuyen Canal	Nui Sap (Rach Chua River)	Rach Gia (Ha Tien-Rach Gia Canal)	0	33	33	VIII	-	N/A
C13	Rach Gia-Cai Be R. Canal	Rach Gia	Cai Be River	0	16	16	VII	IVb	N/A
C14	Rach Soi-An Giang Canal	Bassac R. (150) (My Thanh)	Rach Soi (Rach Gia-Cai Lon Canal)	0	60	60	VII	-	N/A
C15	Thot Not-Cai Be Canal	Bassac R. (127) (Thot Not)	Giong Rieng (Cai Be River)	0	58	58	VII	-	N/A
C16	Cai Be River	Rach Gia Bay	Giong Rieng	0	31	31	VII	-	N/A
C17	Cai Lon River	Rach Gia Bay	Vinh Hoa	0	118	118	Vb	-	N/A
C18	Can Tho River	Bassac R. (106) (Can Tho)	Nhon Nghia	0	16	16	IIIb	-	N/A
C19	Xa No Canal	Nhon Nghia (Can Tho River)	Vinh Hoa (Cai Lon River)	0	43	43	VIII	-	N/A
C20	**Bassac River**	Can Tho	Quan Chanh Bo	106	33	73	0	0	0

C21	Xeo Ro Canal	An Bien	Bien Bac	0	47	47	VIII	-	N/A
C22	Trem River	Bien Bac	Ho Thi Ky	0	84	84	Vb	-	N/A
C23	Ong Doc River	Ho Thi Ky	Gulf of Thailand	0	44	44	VIb	-	N/A
C24	Chak Bang Canal	Ho Thi Ky	Phong Dong (Nga Ba Dinh River)	0	35	35	VIII	-	N/A
C25	Nga Ba Dinh River	Phong Dong	Vinh Phuoc	35	51	16	VIb	-	N/A
C26	Ca Mau River	Khanh An	Ca Mau	0	9	9	N/A	N/A	N/A
C27	Cai Con Canal	Bassac River (90)	My Tu	0	28	28	VIII	-	N/A
C28	Quan Lo-Phung Hiep Canal	My Tu	Ca Mau	0	93	93	VIII	-	N/A
C29	Gang Hao River	Ca Mau	Hoa Thanh	0	10	10	VIII	-	N/A
C30	Gang Hao-Bay Hap Canal	Hoa Thanh	Cai Nuoc	10	20	10	VIII	-	N/A
C31	Bay Hap River	Cai Nuoc	Tran Thoi	20	45	25	VIII	-	N/A
C32	Bay Hap-Cua Lon Canal	Tran Thoi	Nam Can	45	56	11	VIII	-	N/A
C33	Cua Lon River	Nam Can	South Sea	32	0	32	VIII	-	N/A
C34	Dai Ngai Canal	Bassac River (58)	My Xuyen	0	21	21	IIIb	-	N/A
C35	Song Dinh	My Xuyen	Thanh Thoi Thuan	21	34	13	V	-	N/A
C36	Song Cai	Thanh Thoi	Vinh Chau	34	53	19	IIIb	-	N/A
C37	Song Bac Lieu	Vinh Chau	Bac Lieu	53	80	27	VIII	-	N/A
C38	Bac Lieu-Ca Mau Canal	Bac Lieu	Ca Mau	80	145	65	VIII	-	N/A
C39	**Bassac River**	Quan Chanh Bo Canal	South Sea	33	23	10	VIb	IIIa	N/A
C40	**Bassac River**	South Sea	Deep Sea Buoy	23	0	23	VIb	I	N/A

7. CONCLUSIONS AND A PROPOSAL FOR FURTHER PLANNING

Through the efforts of the national experts and the national authorities in the four MRC member countries, a proposal for a harmonized and standardized vessel and waterway classification for Lao PDR and Thailand, as well as for Cambodia and Viet Nam could be drafted, which would lead to increased safety and ease of navigation in the Mekong River Basin.

The proposal aims to finalize the classification project + as follows:

1. In the lists of river stretches, some information and data are still missing. All delegations were asked to gather new information where lacking regarding water depths, channel widths, radius of bends, air clearances under bridges and high-tension cables, etc. and to doublecheck if all names and dimensions of rivers and canals were correct.
2. For Lao PDR and Thailand, the waterway classes A1 to A4 (Golden Triangle to Luang Prabang) should be discussed at the Joint Committee on Coordination of Commercial Navigation on the Lancang-Mekong River (JCCCN).
3. The Vietnamese delegation should hold a cooperation meeting with VINAMARINE for the river stretches under their management (seagoing vessels), and with VINALINES, which is responsible for the vessel classification in Viet Nam.
4. For Cambodia and Viet Nam, a Navigation Facilitation Committee meeting should be organized to discuss and approve the proposal for the Mekong River vessel and waterway classification.
5. After approval by the bilateral committees, the regulations should be translated into the Lao, Thai, Khmer and Vietnamese languages.
6. After translation, the proposal of regulations, vessel and waterway classes should be remitted to the relevant competent authorities to be legalized.
7. For the impact of new dams and climate change, especially on the water levels, the list of navigable stretches with their classes should be regularly updated every five years.

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