APPENDIX D

RESULTS OF STORM SURGE SIMULATION

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APPENDIX D RESULTS OF STORM SURGE SIMULATION

D.1 RESULTS OF STORM SURGE

Table D.1.1 Cyclone Conditions for Storm Surge Simulation

Run No.	Calculation conditions			Remarks
	Track of cyclone	Center atmospheric pressure	Progression velocity	
Run-1	Same as Nargis			Best track
Run-2	2 (deg) east	Same as Nargis		
Run-3	2 (deg) west			
Run-4	Same as Nargis	20% Lower	Same as Nargis	
Run-5		40% Lower		
Run-6	Same as Nargis	Same as Nargis	50% Fast	
Run-7	Same as Nargis	Same as Nargis	33% Slow	

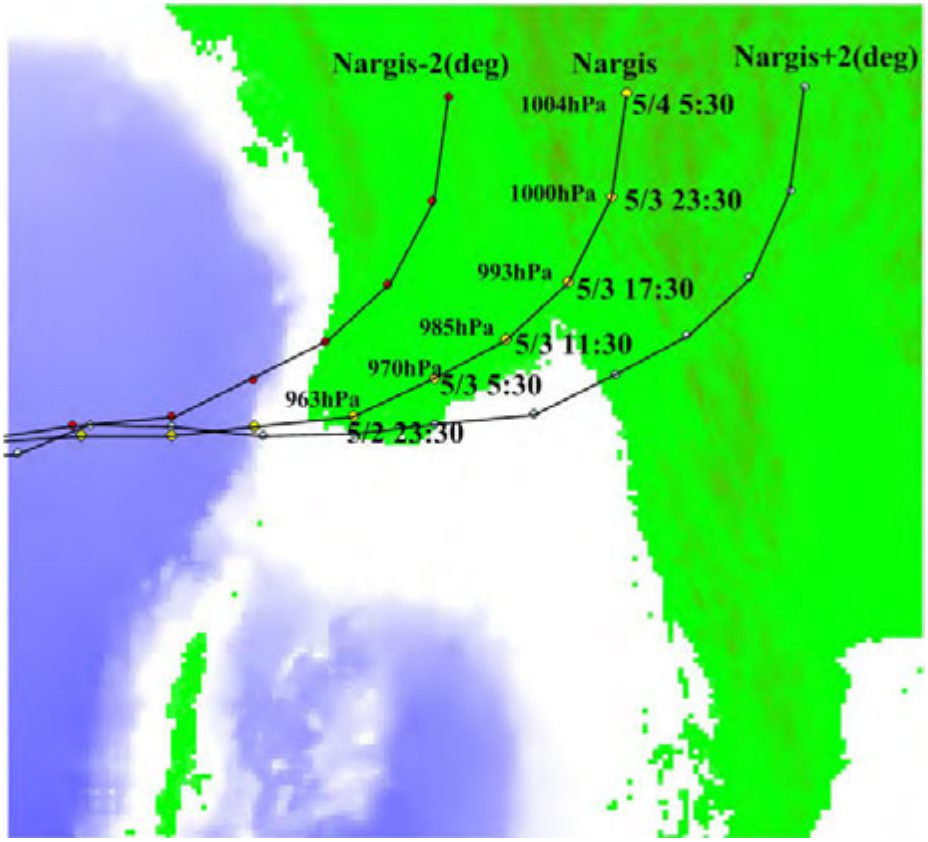
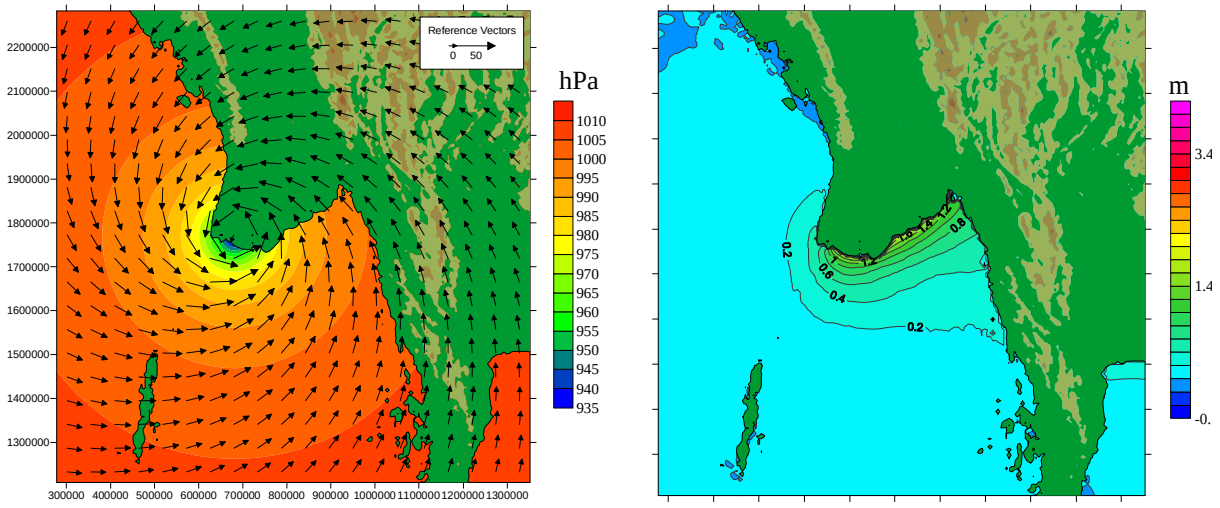


Figure D.1.1 Cyclone Tracks (Moving Horizontally)

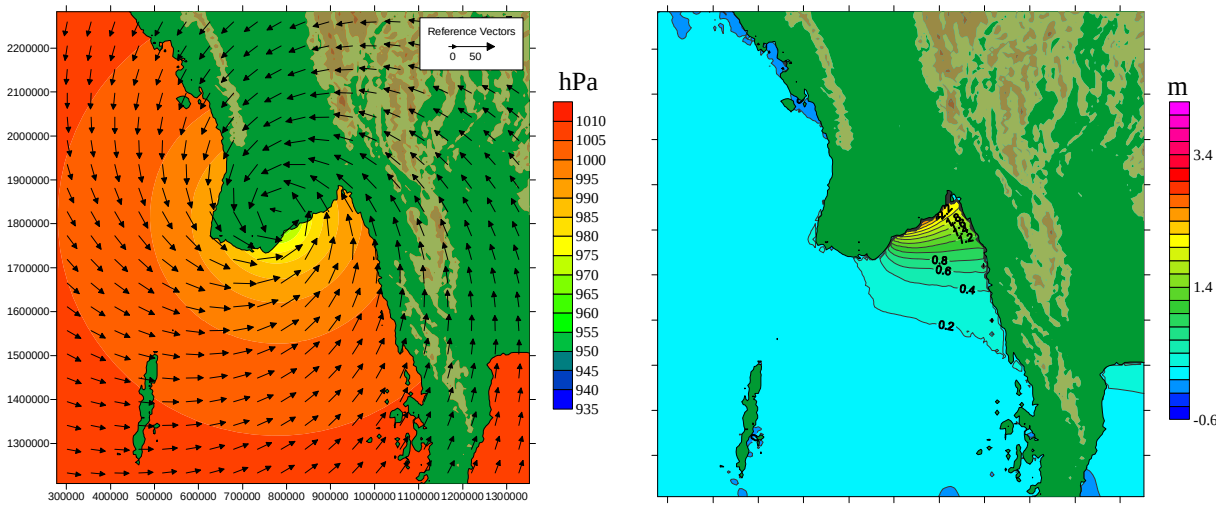
D.1.1 RUN-1 (SAME AS NARGIS)

Figure D.1.2 – Figure D.1.3 shows the simulation results in case of the reproducibility simulation for Cyclone Nargis. The left figure shows the atmospheric pressure (contour) and velocity (vector). Form these figures, the maximum wind velocity was 30m/s and central atmospheric pressure was about 930hPa, respectively. The right figure shows the storm surge tide without the astronomical tide level. It can be seed that the maximum height is about 3m in case of Cyclone Nargis.



Pressure and wind velocity **Storm tide deviation**

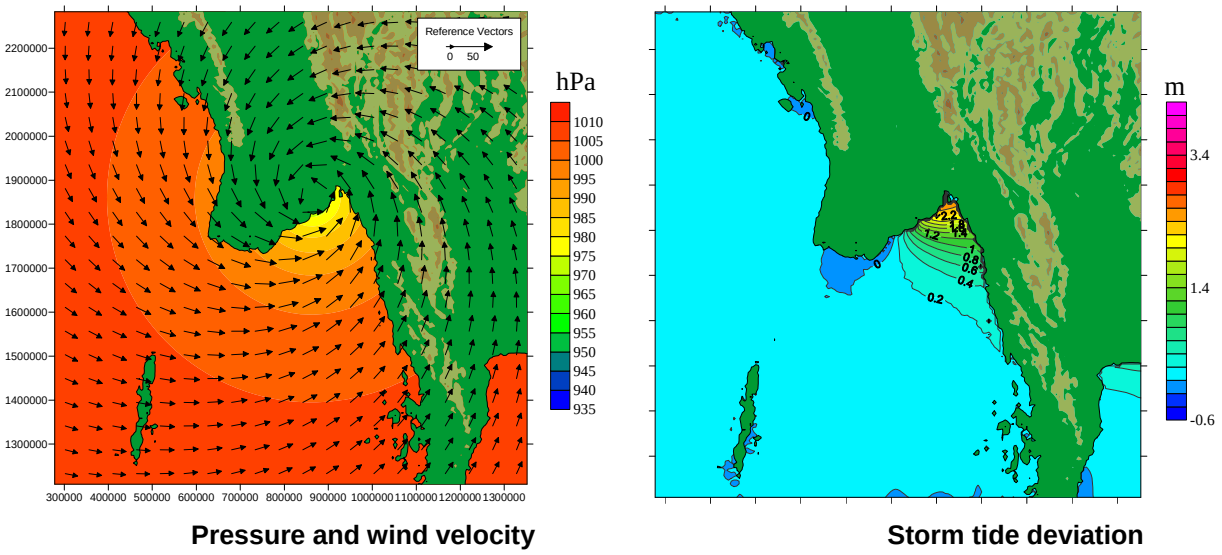
5/2 23:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

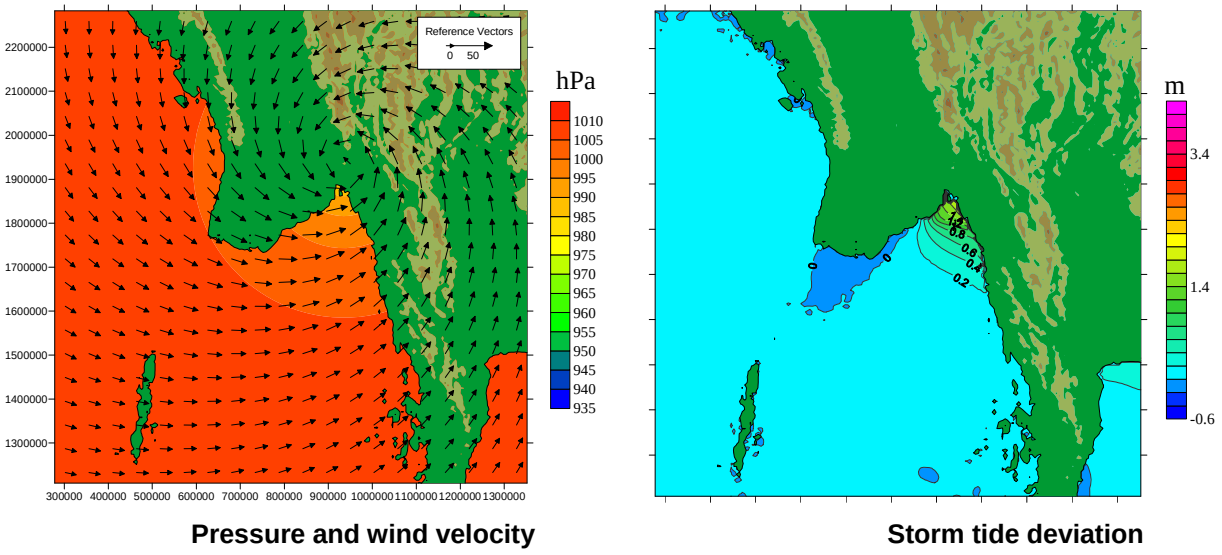
5/3 5:30 (Yangon)

Figure D.1.2 Simulation Results (Run-1, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/3 11:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/3 17:30 (Yangon)

Figure D.1.3 Simulation Results (Run-1, Wide area) (2)

Figure D.1.12 –Figure D.1.4 shows the simulation results around the Yangon River in case of the reproducibility simulation for Nargis. The maximum storm surge level becomes at 5/3 0:00 (UTC, 5:30 at Yangon) near the Yangon port.

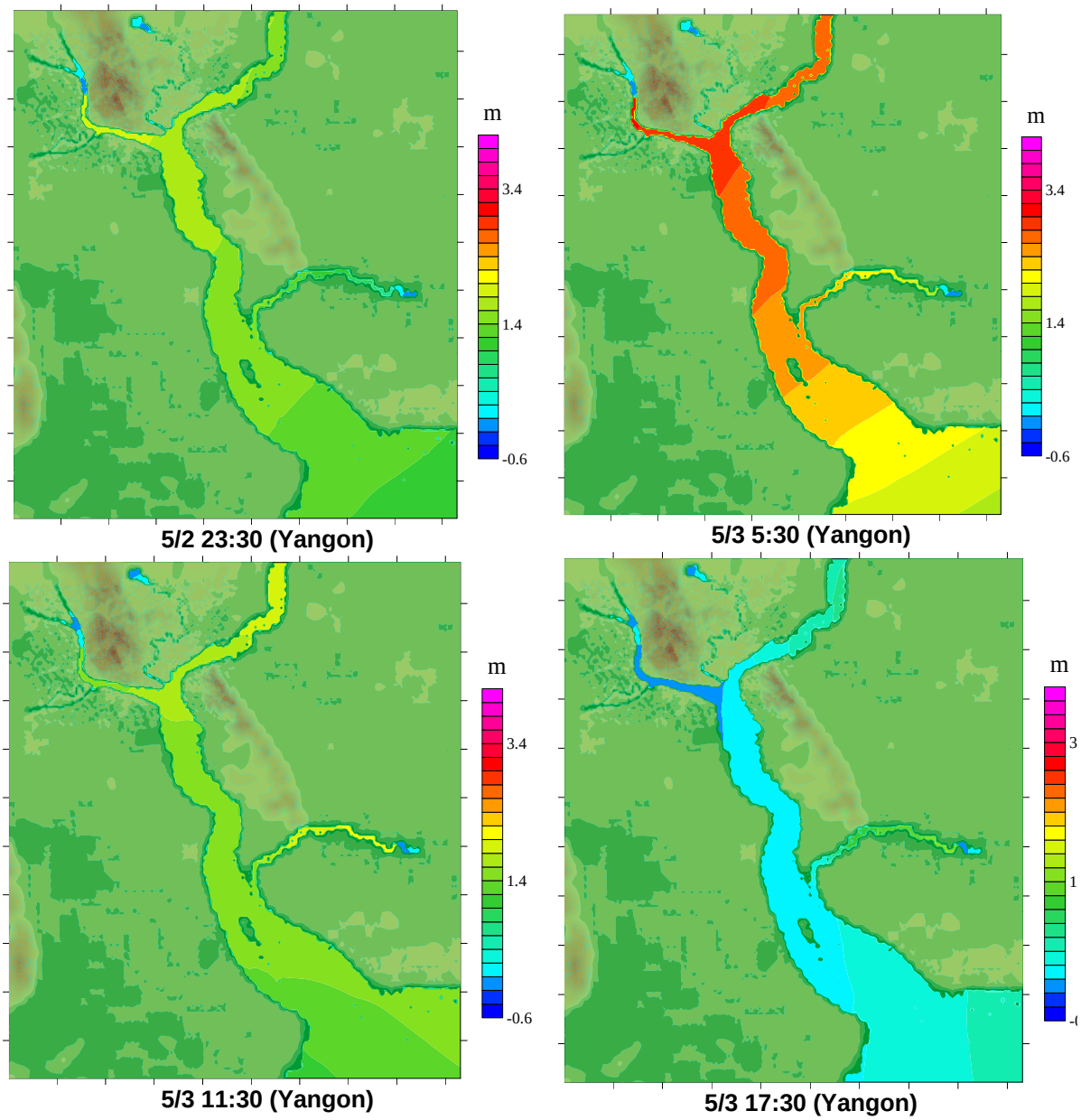


Figure D.1.4 Simulation Results (Storm tide deviation:Run-1, around Yangon River)

In order to check the accuracy of the simulation results, the comparison between the storm surge trace observation by Yokohama National University and Tokyo University of Marine Science of Technology was carried out. Figure D.1.5 shows the survey points around coastal area and Yangon River. Figure D.1.6 shows the Comparison between simulation and survey.

Figure D.1.7 shows the time history of surge tide and atmospheric pressure at St.1-St.4. The storm surge descended at about 5/3 6:00 in all points.

Figure D.1.5 Survey Points around Coastal Area and Yangon River

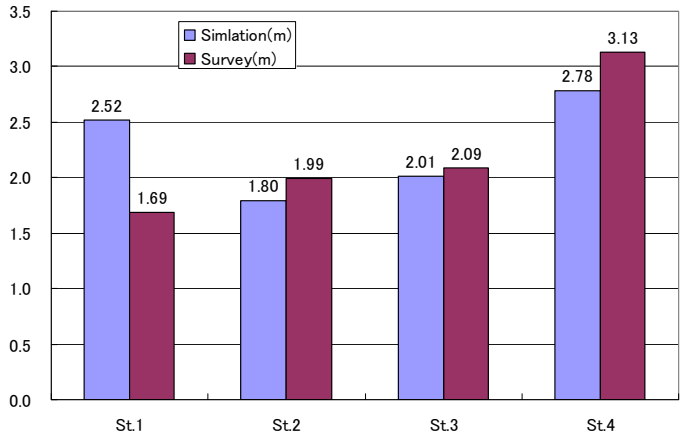


Figure D.1.6 Comparison between Simulation and Survey results

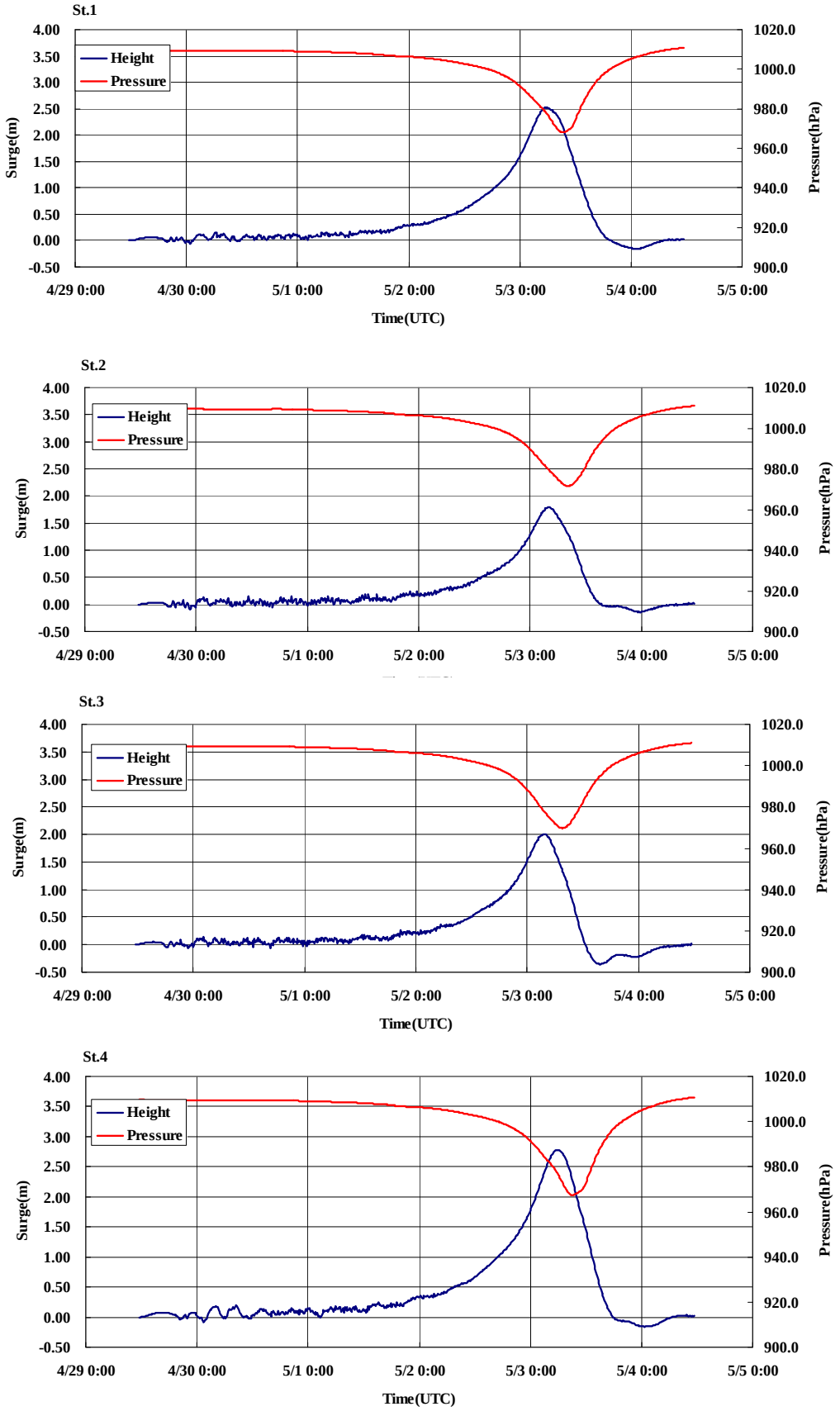


Figure D.1.7 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-1)

Figure D.1.8 shows the time history of observed tide (dot), astronomical tide (solid line), surge tide (black line) and predicted line (dotted line). Under the onslaught of the Nargis, It was predicted that the astronomical tide was high tide. The maximum tide was about 8m at the Yangon Port.

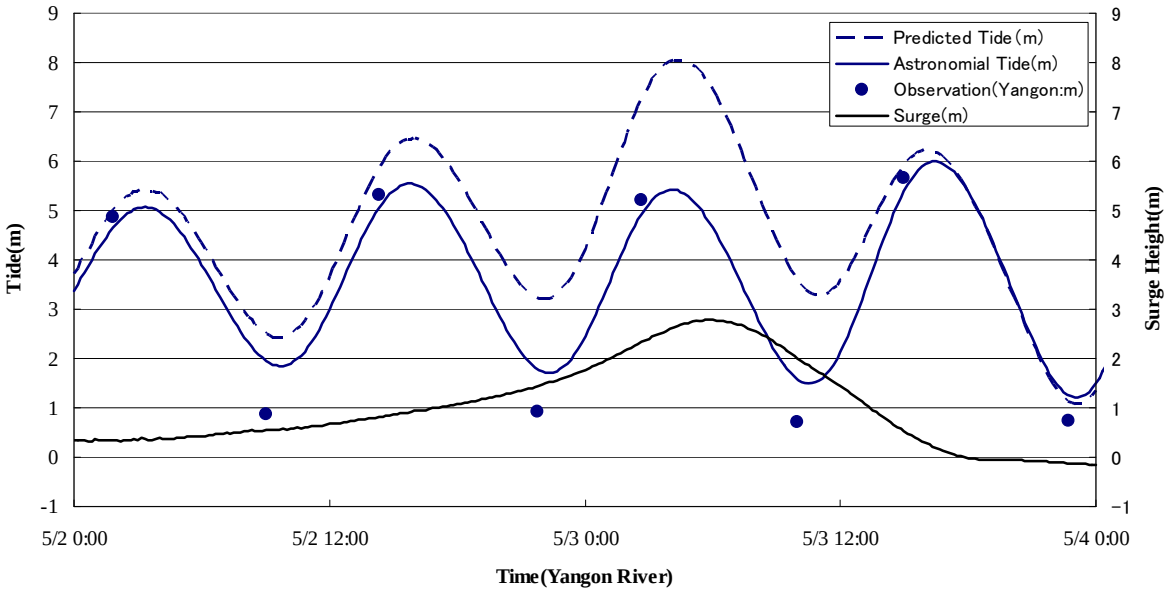
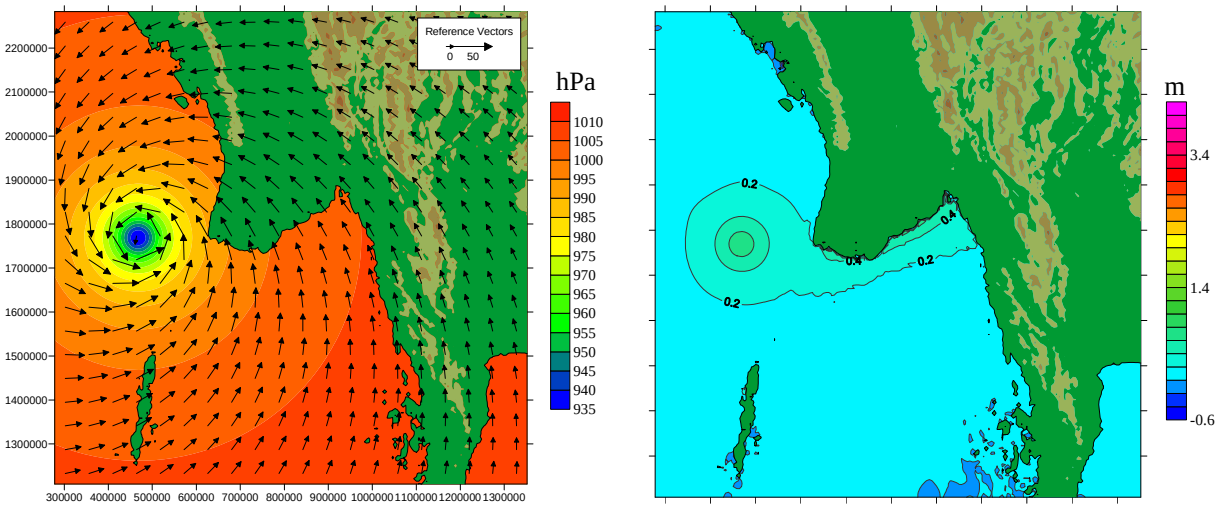


Figure D.1.8 Time History of Tide and Surge

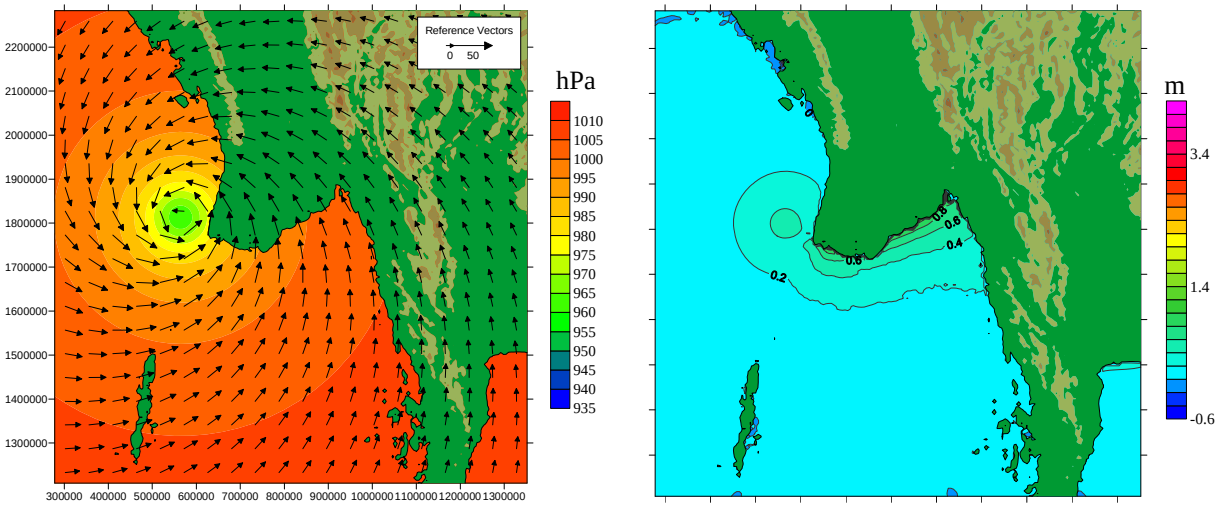
D.1.2 RUN-2 (TRACKS MOVE TO 2 DEGREES WEST)

The simulation of run-2 is in case that the cyclone tracks move to 2 degrees west. Figure D.1.8 shows the simulation results around Myanmar. The storm tide is lower than for the case of Nargis, because the center of the cyclone does not pass along the coast line.



Pressure and wind velocity **Storm tide deviation**

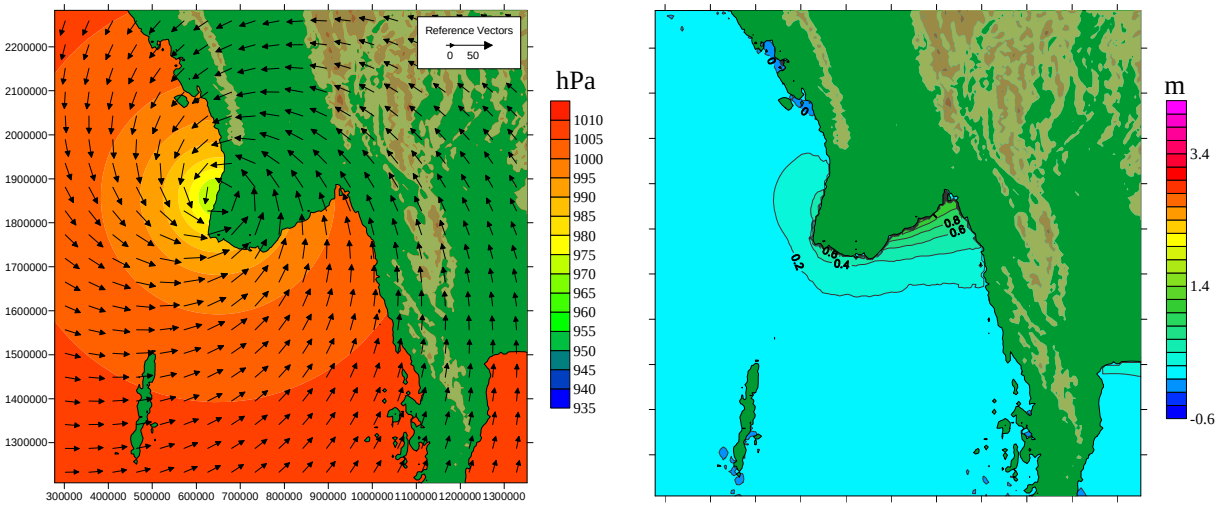
5/2 23:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

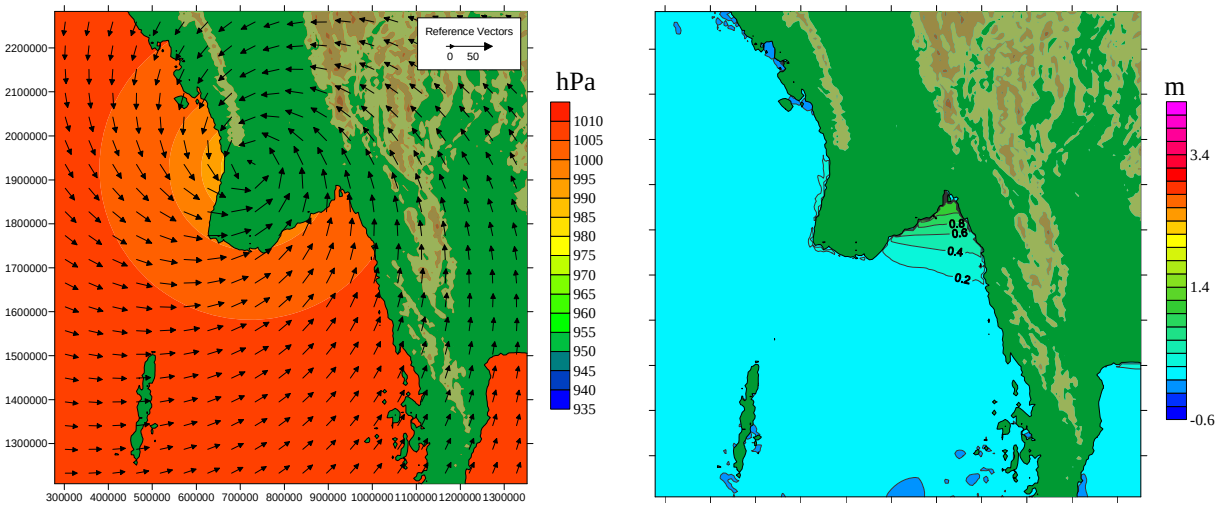
5/3 5:30 (Yangon)

Figure D.1.8 Simulation Results (Run-2, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/3 11:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/3 17:30 (Yangon)

Figure D.1.9 Simulation Results (Run-2, Wide area) (2)

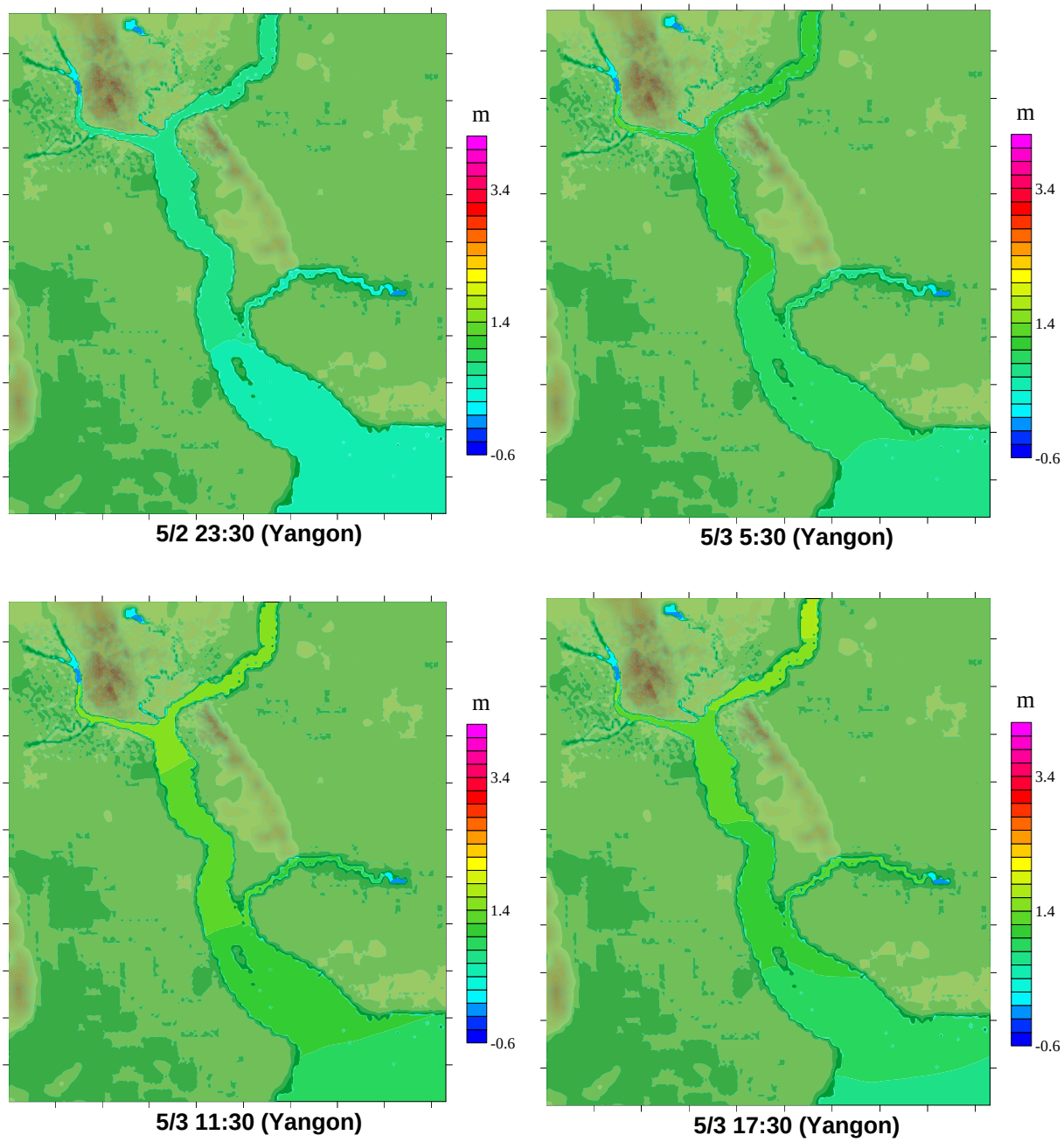


Figure D.1.10 Simulation Results (Storm tide deviation:Run-2, around Yangon River)

Figure D.1.11 shows Time history of surge tide and atmospheric pressure. From these figures, it can be seen that the maximum tide is lower than for the case of Nargis.

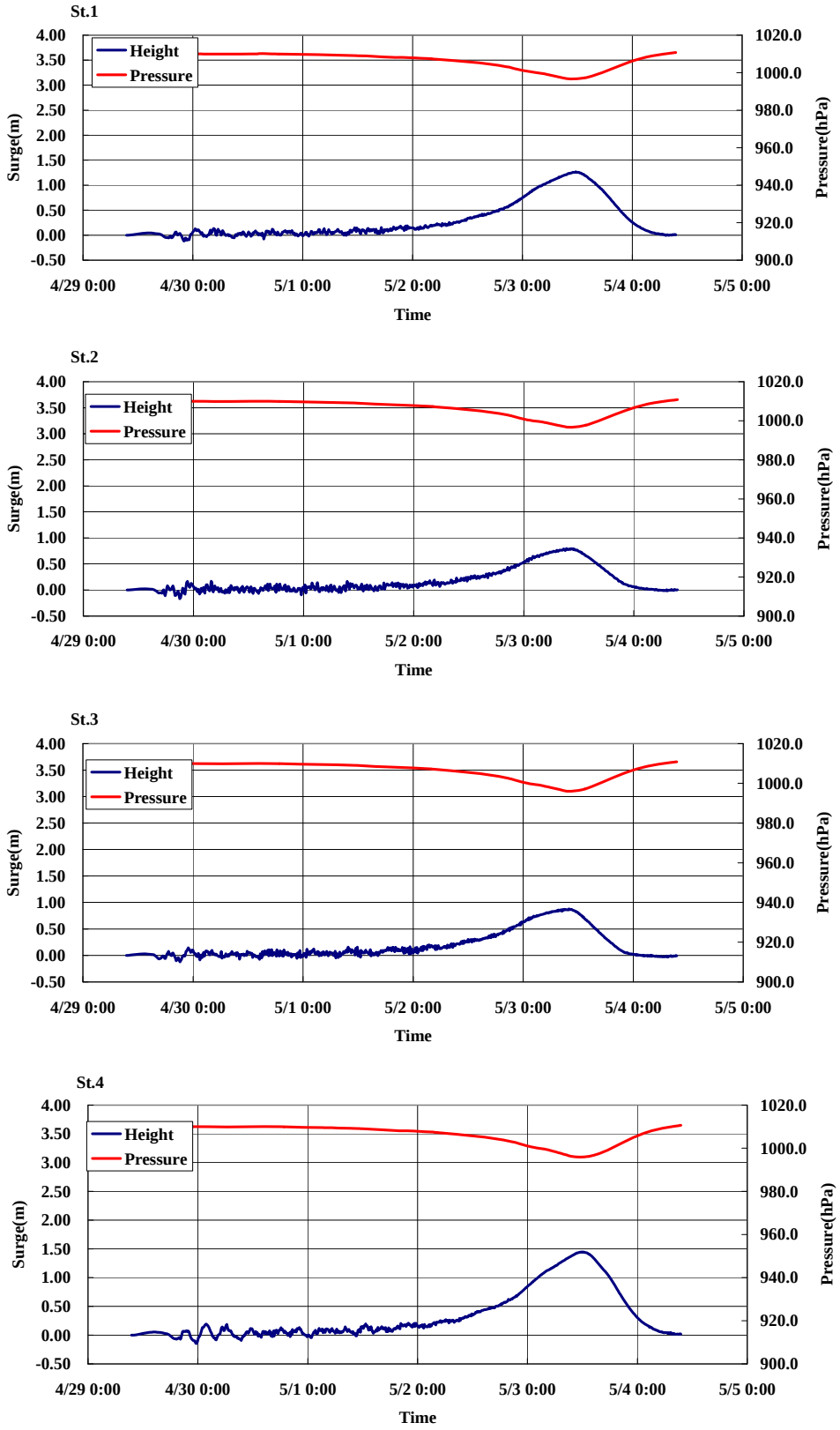
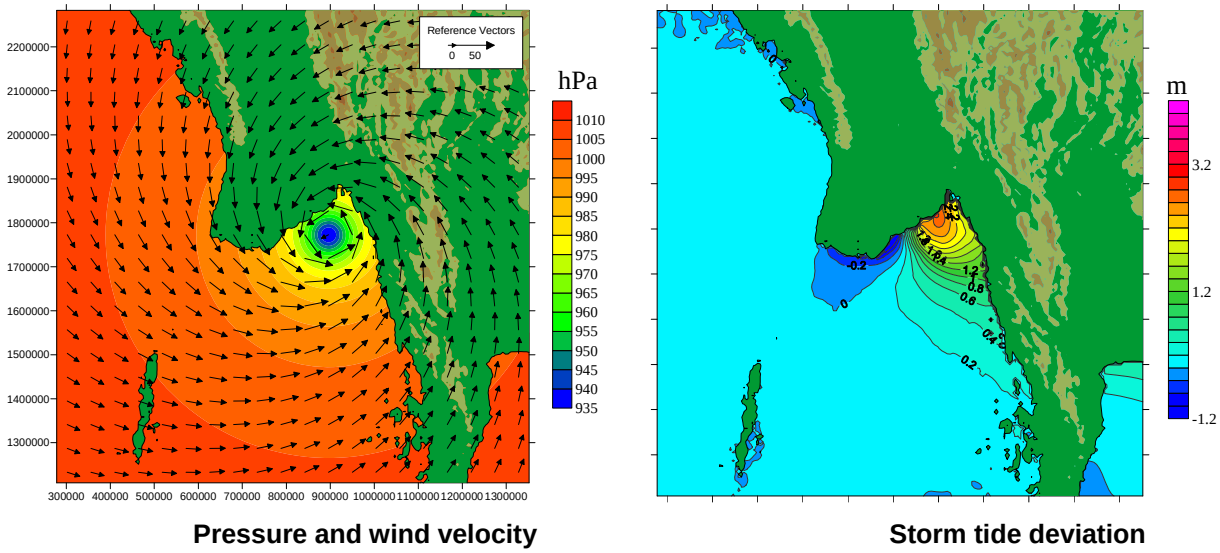


Figure D.1.11 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-2)

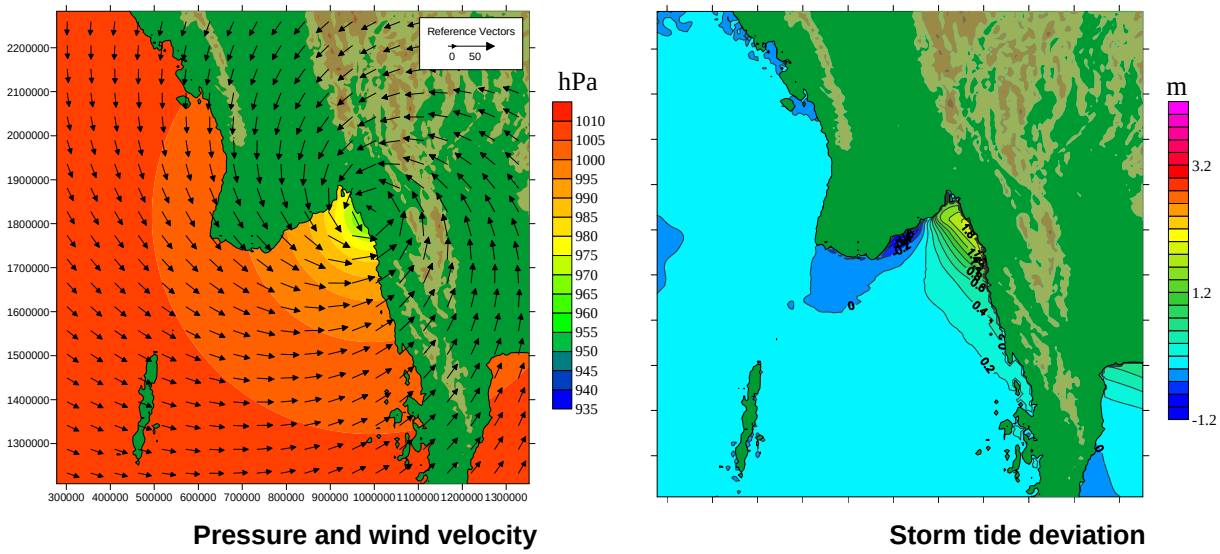
D.1.3 RUN-3 (TRACKS MOVE TO 2 DEGREES EAST)

The simulation of run-3 is in case that the cyclone tracks move to 2 degrees east. Figure D.1.12 shows the simulation results around Myanmar. The storm tide is almost the same as the case of Nargis,



Pressure and wind velocity **Storm tide deviation**

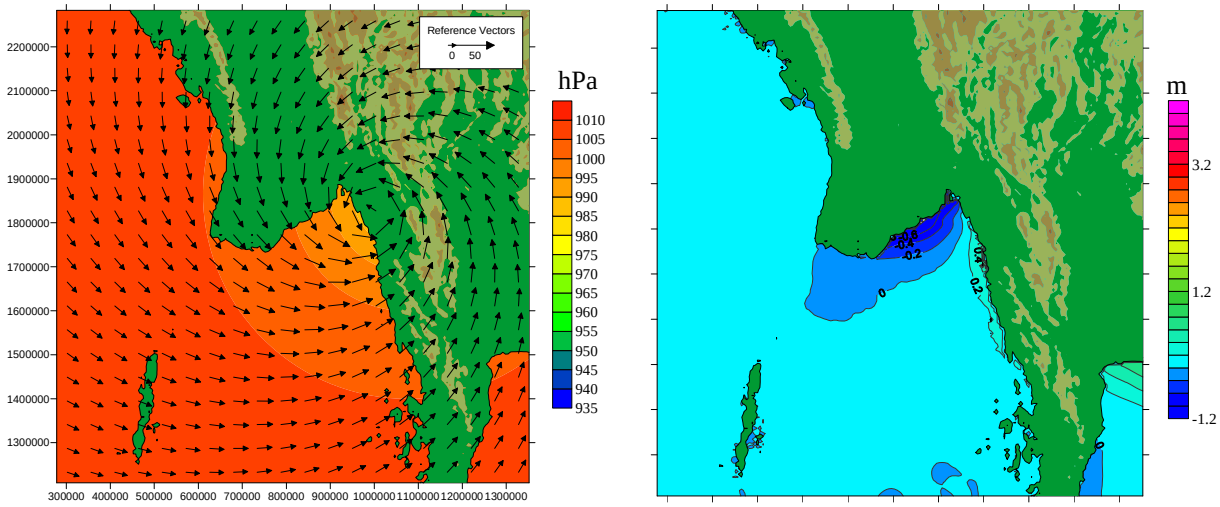
5/2 23:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

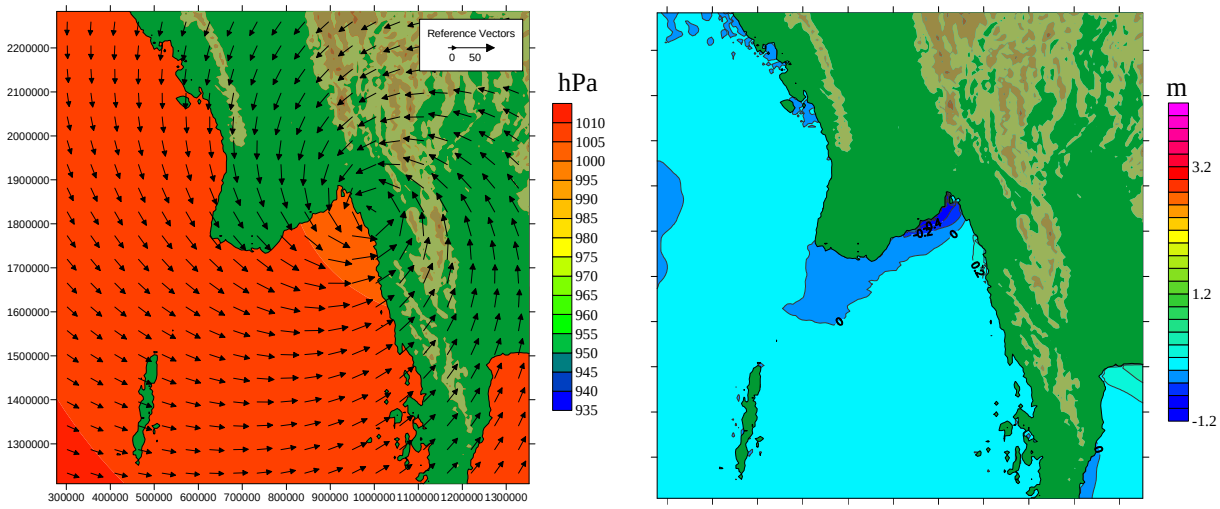
5/3 5:30 (Yangon)

Figure D.1.12 Simulation Results (Run-3, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/3 11:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/3 17:30 (Yangon)

Figure D.1.13 Simulation Results (Run-3, Wide area) (2)

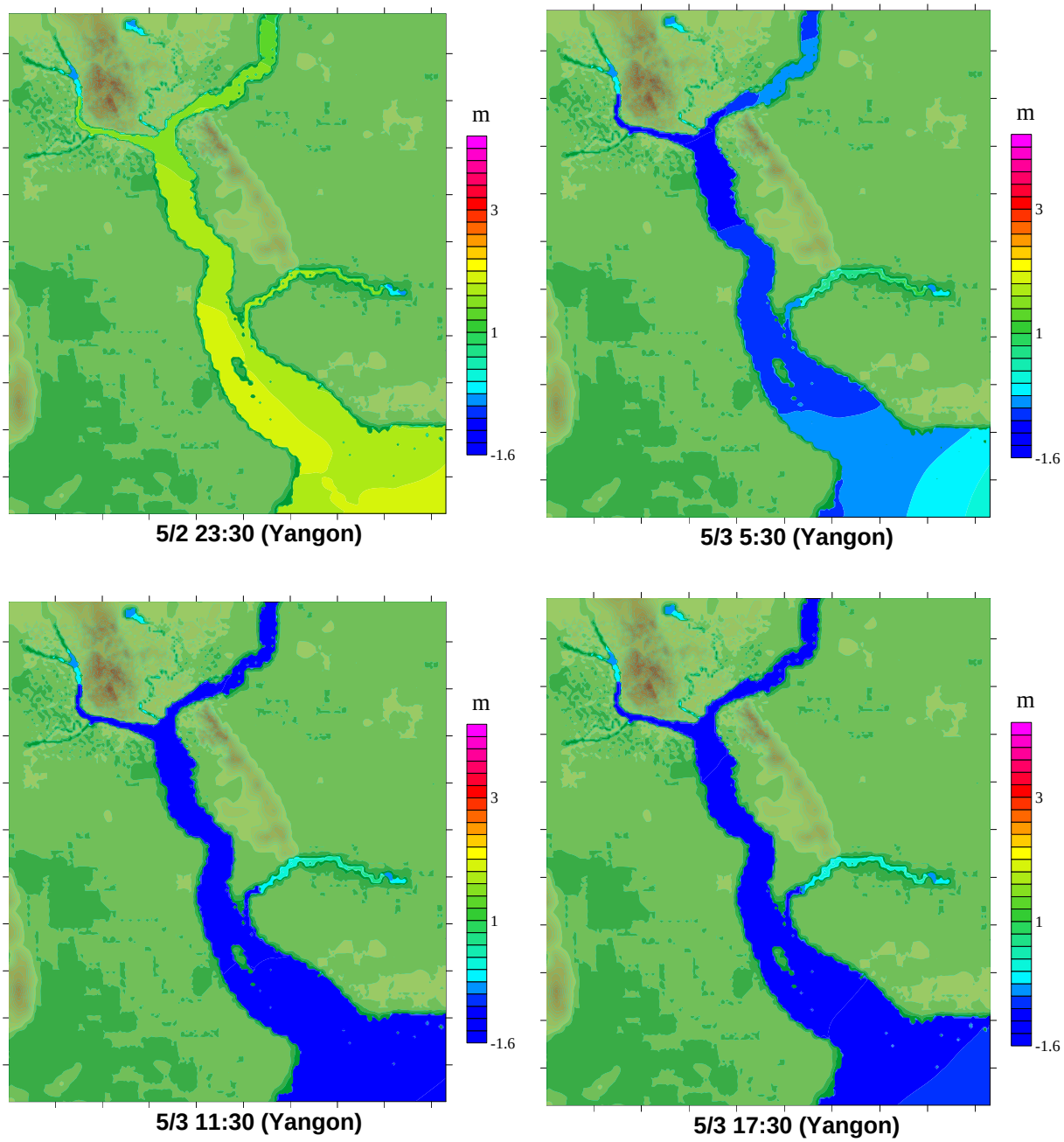


Figure D.1.14 Simulation Results (Storm tide deviation:Run-3, around Yangon River)

Figure D.1.15 shows Time history of surge tide and atmospheric pressure. From these figures, it can be seen that maximum tide is lower than the case of Nargis.

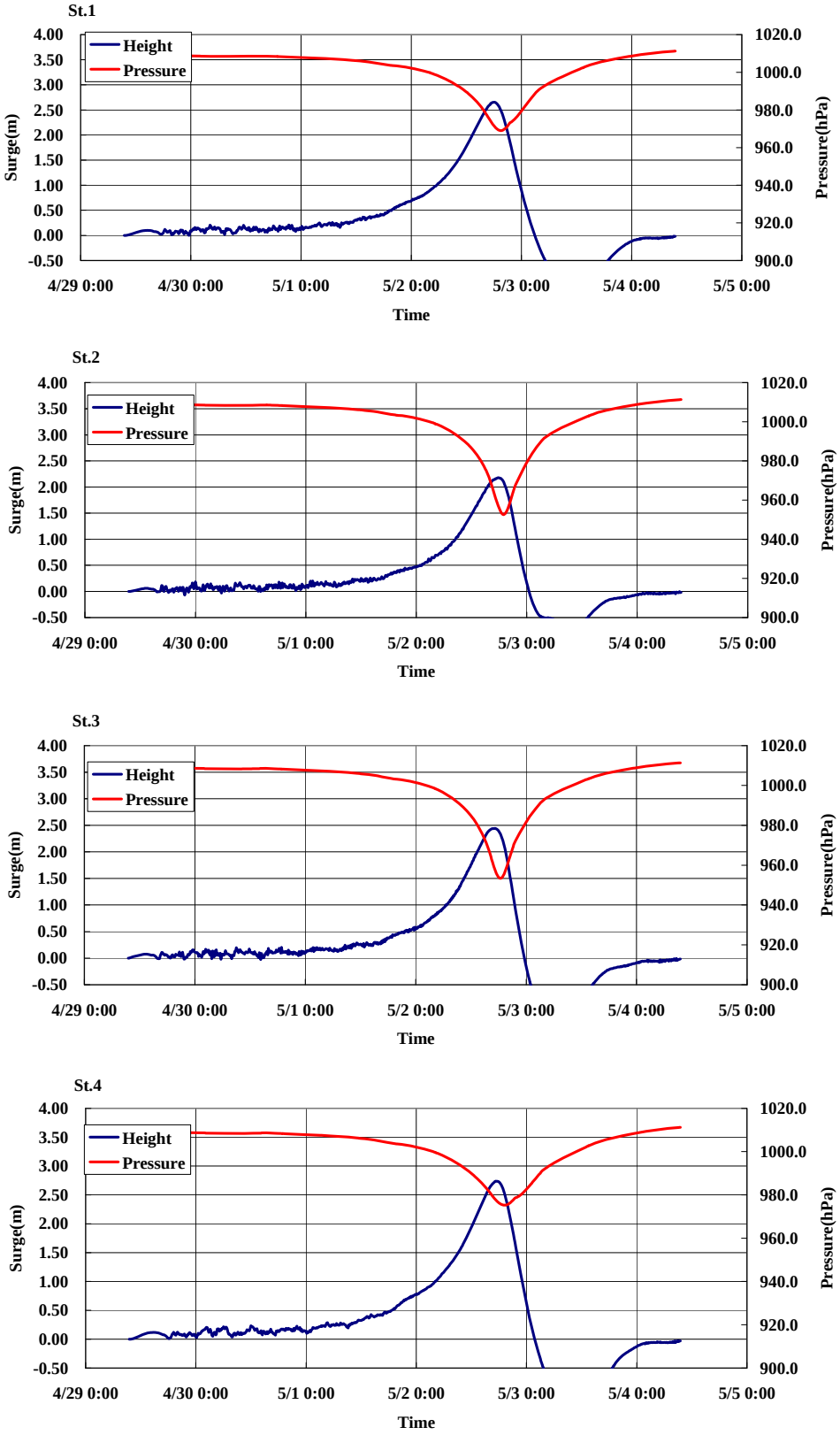
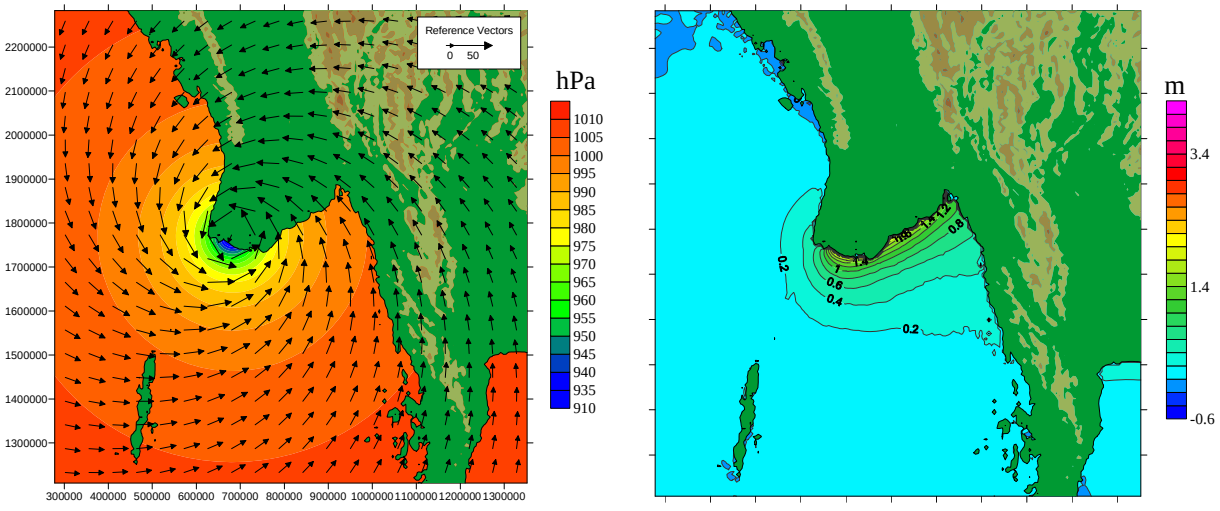


Figure D.1.15 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-3)

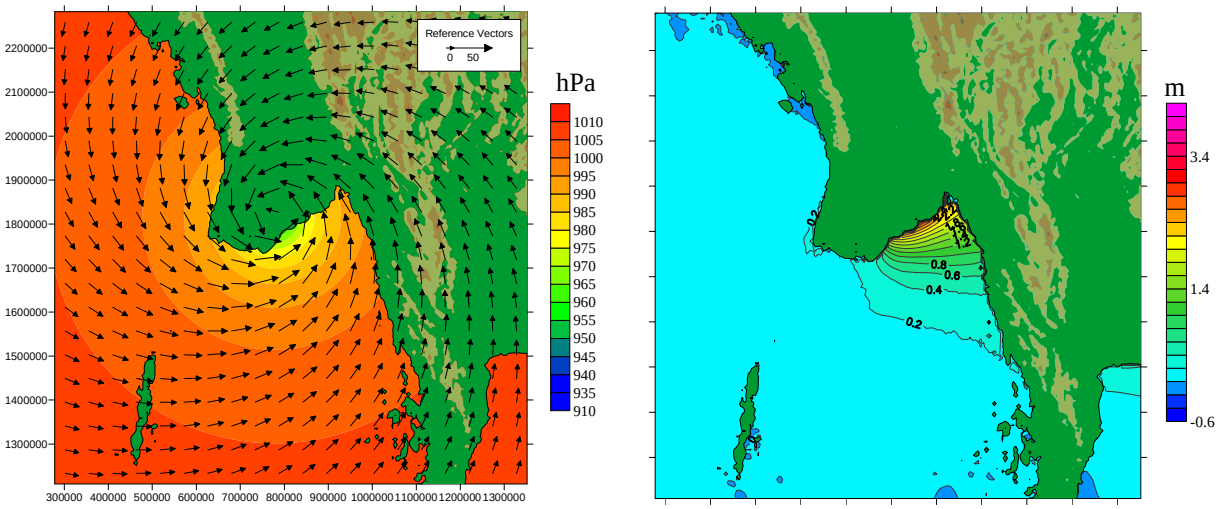
D.1.4 RUN-4 (CENTER ATMOSPHERIC PRESSURE 20% LOW)

The simulation of run-4 is in case that center atmospheric pressure is 20% low. The Figure 1.4.1 shows the simulation results around Myanmar. The storm tide is almost the same as the case of Nargis.



Pressure and wind velocity **Storm tide deviation**

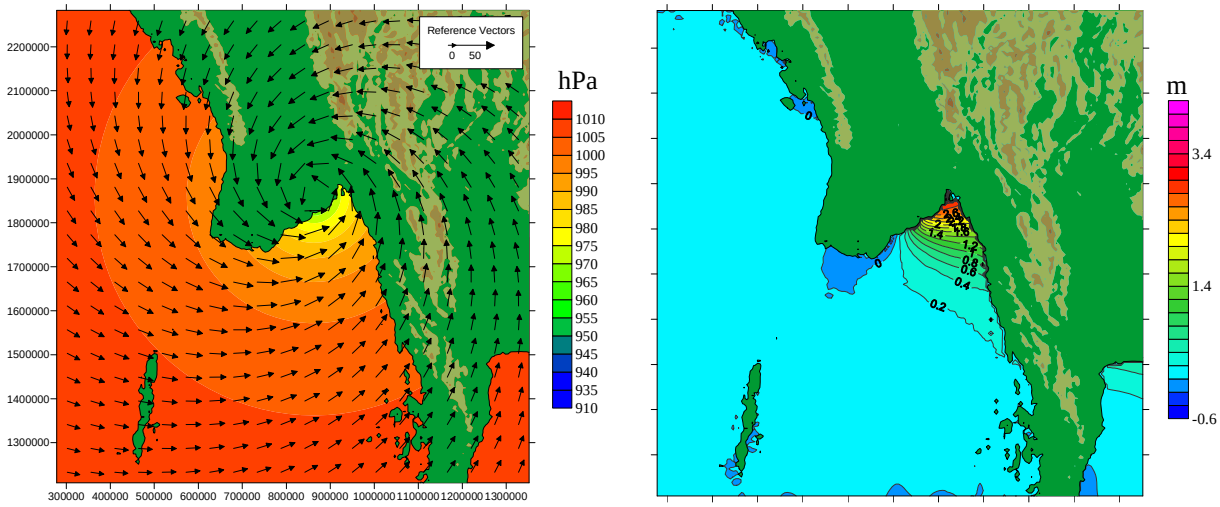
5/2 23:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

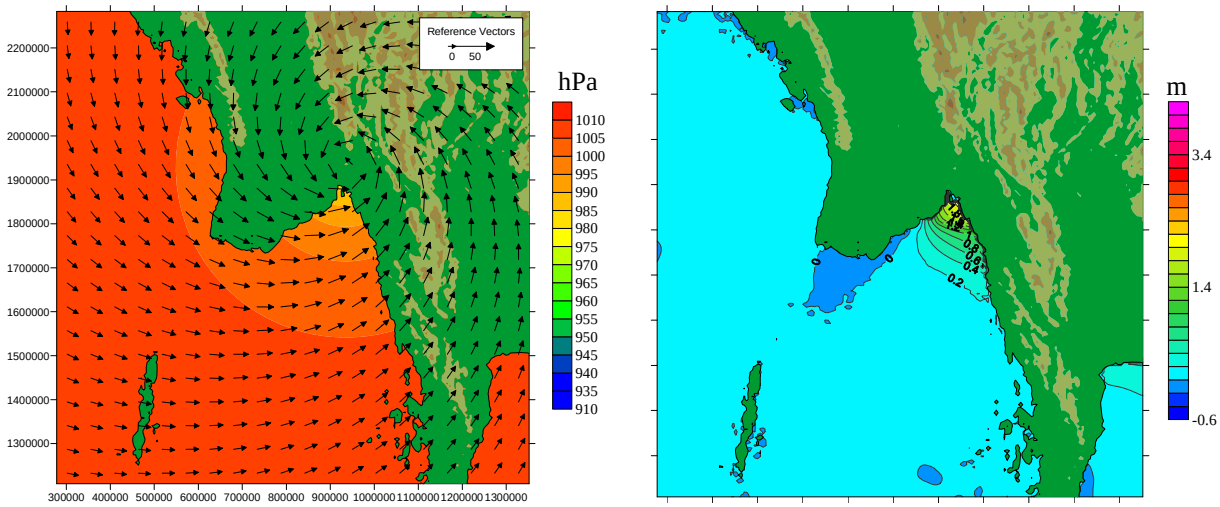
5/3 5:30 (Yangon)

Figure D.1.16 Simulation Results (Run-4, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/3 11:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/3 17:30 (Yangon)

Figure D.1.17 Simulation Results (Run-4, Wide area) (2)

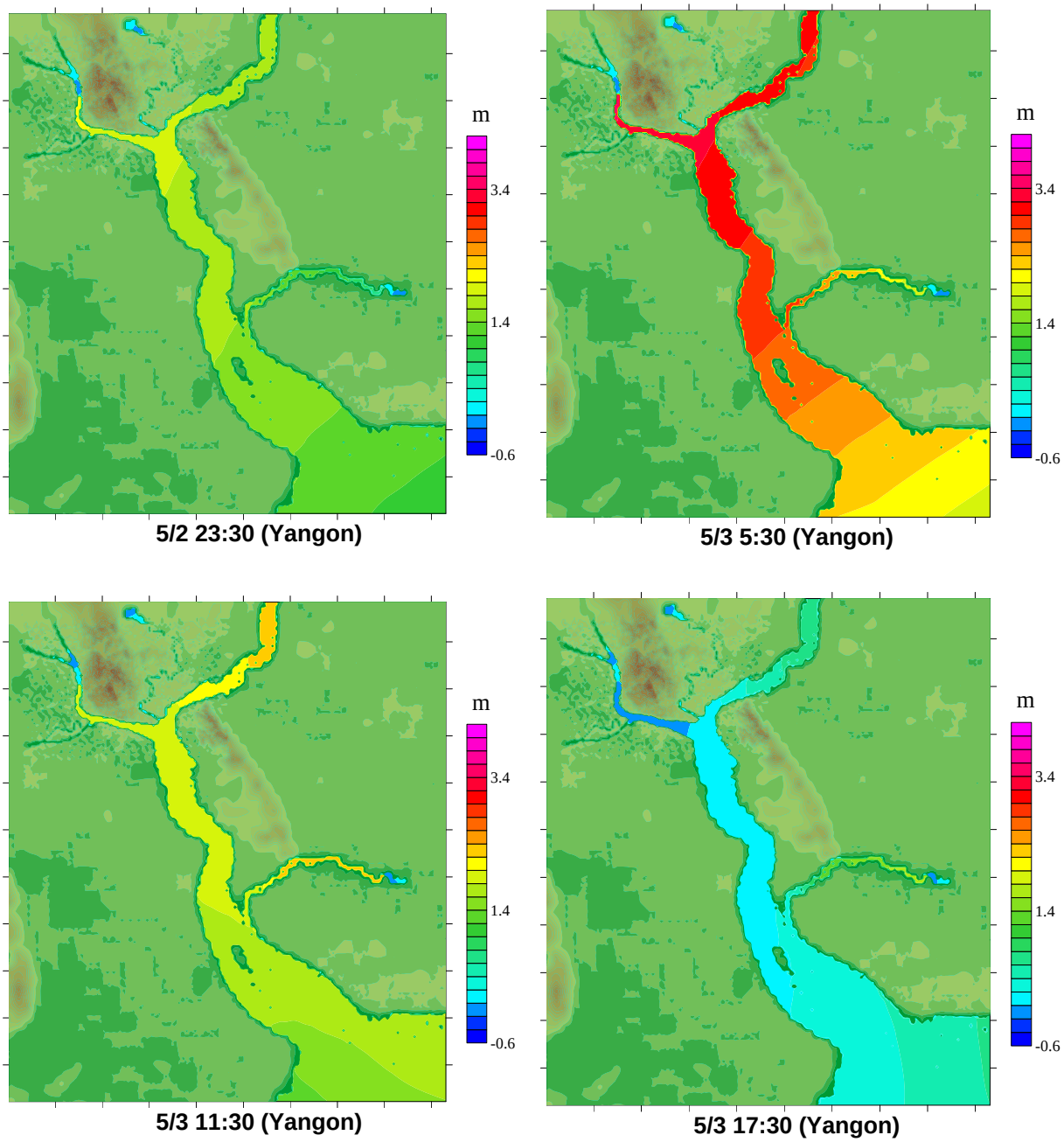


Figure D.1.18 Simulation Results (Storm tide deviation:Run-4, around Yangon River)

Figure D.1.19 shows the time history of surge tide and atmospheric pressure. From these figures, it can be seen that maximum tide is little higher than the case of Nargis.

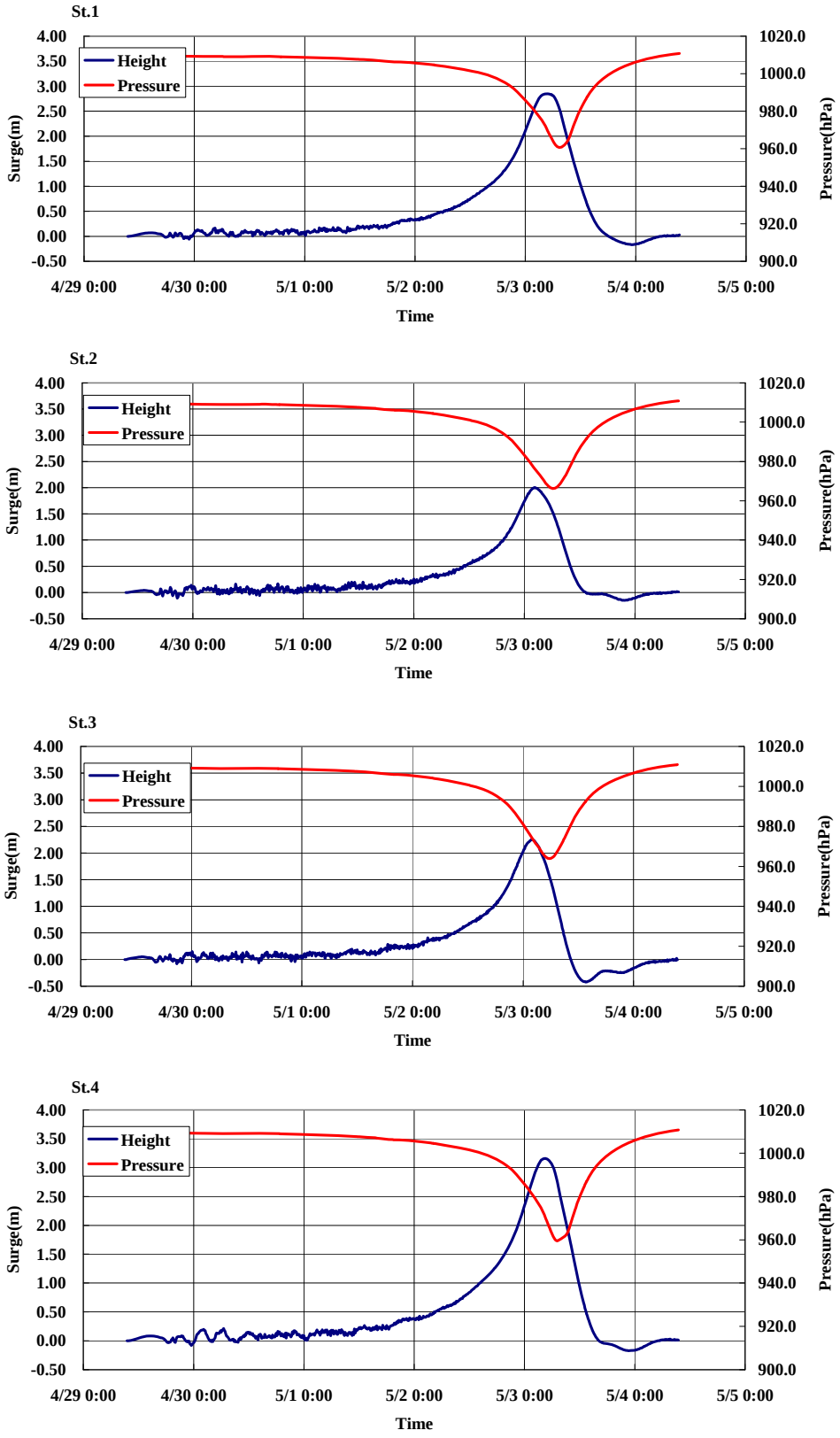
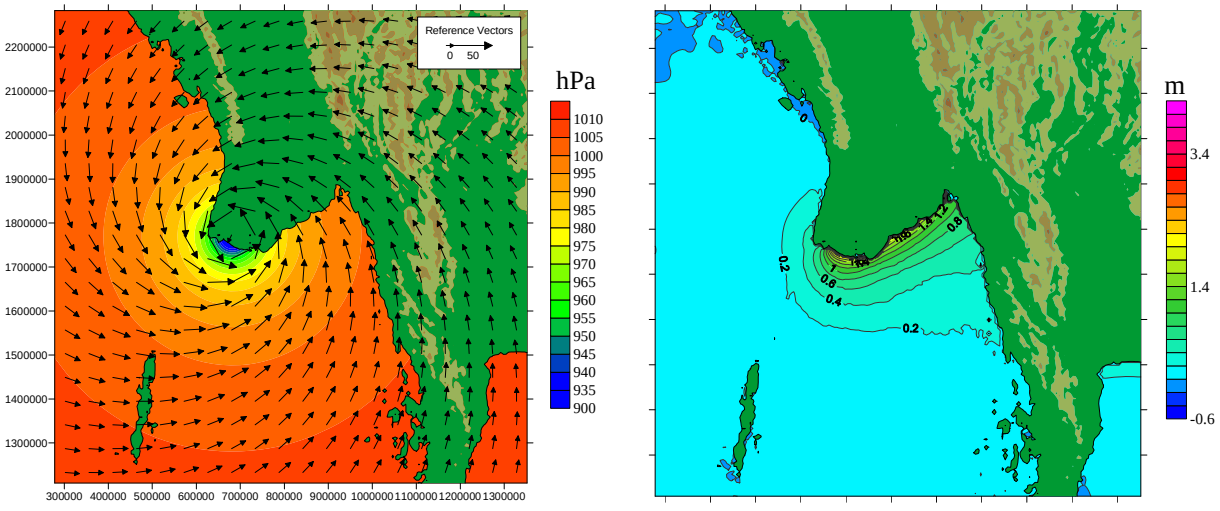


Figure D.1.19 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-4)

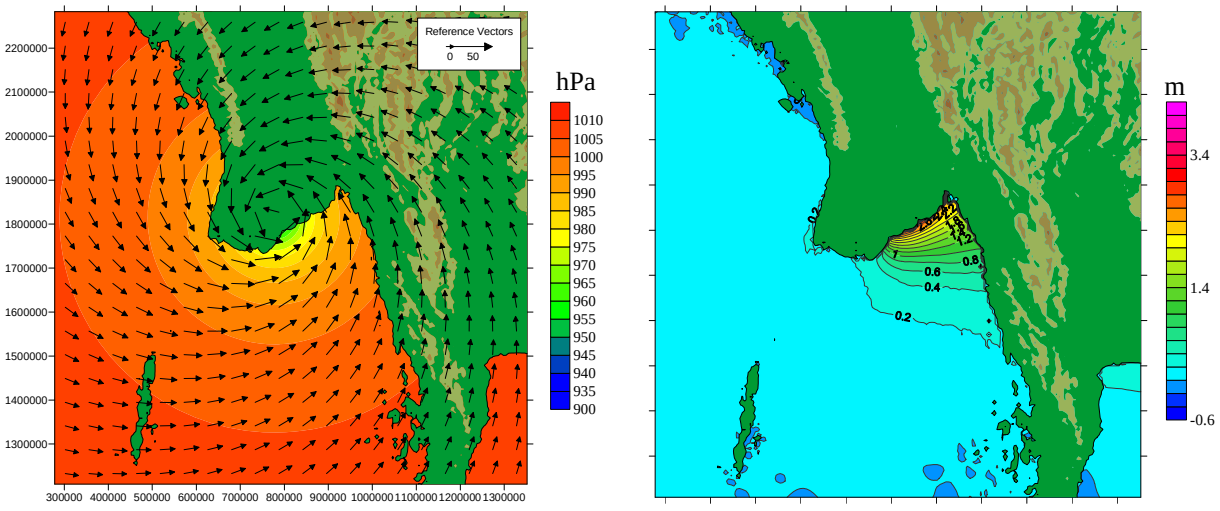
D.1.5 RUN-5 (CENTER ATMOSPHERIC PRESSURE IS 40% LOW)

The simulation of run-5 is in case that center atmospheric pressure is 40% low. The Figure D.1.20 shows the simulation results around Myanmar. The storm tide is almost the same as the case of Nargis.



Pressure and wind velocity **Storm tide deviation**

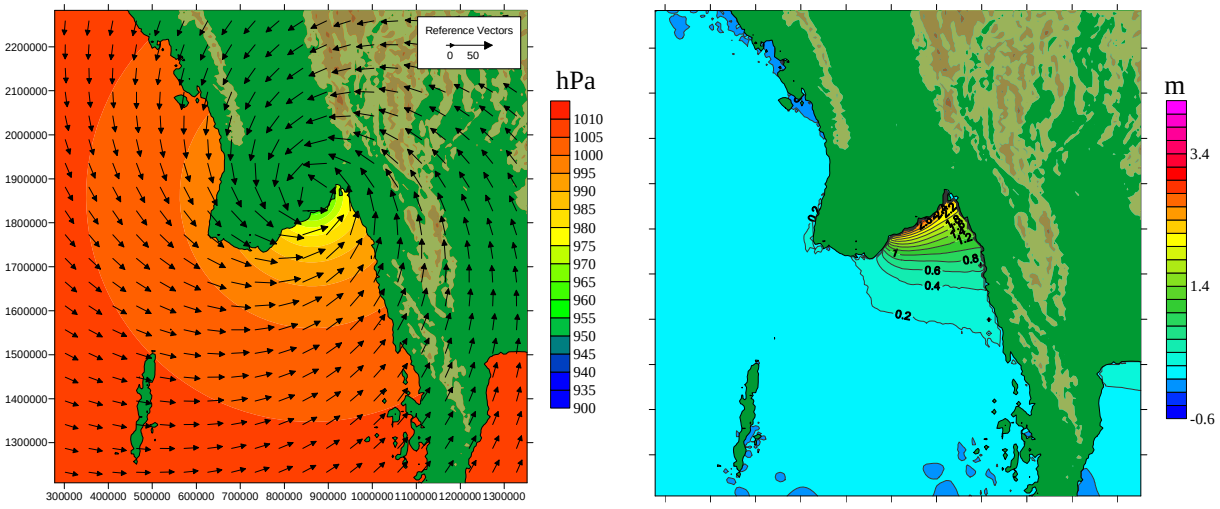
5/2 23:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

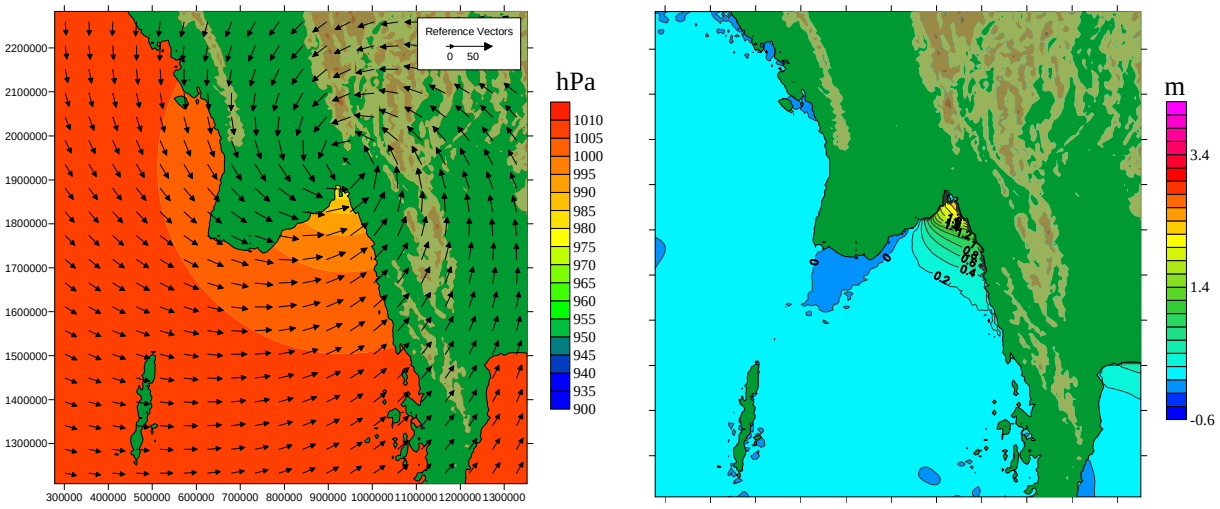
5/3 5:30 (Yangon)

Figure D.1.20 Simulation Results (Storm tide deviation:Run-5, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/3 11:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/3 17:30 (Yangon)

Figure D.1.21 Simulation Results (Run-5, Wide area) (2)

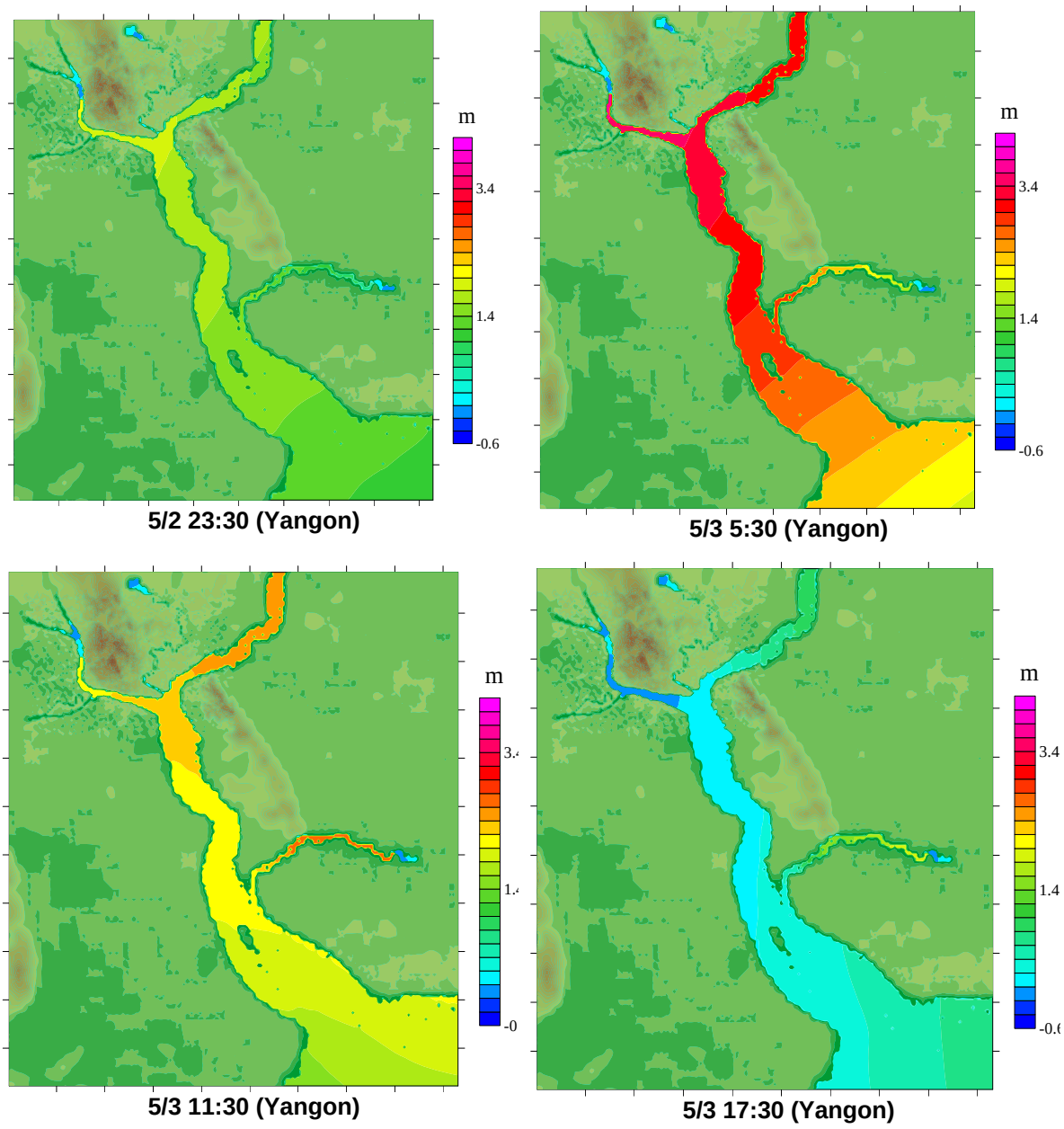


Figure D.1.22 Simulation Results (Storm tide deviation:Run-5, around Yangon River)

Figure D.1.23 shows the time history of surge tide and atmospheric pressure. From these figures, it can be seen that maximum tide is higher than the case of Nargis.

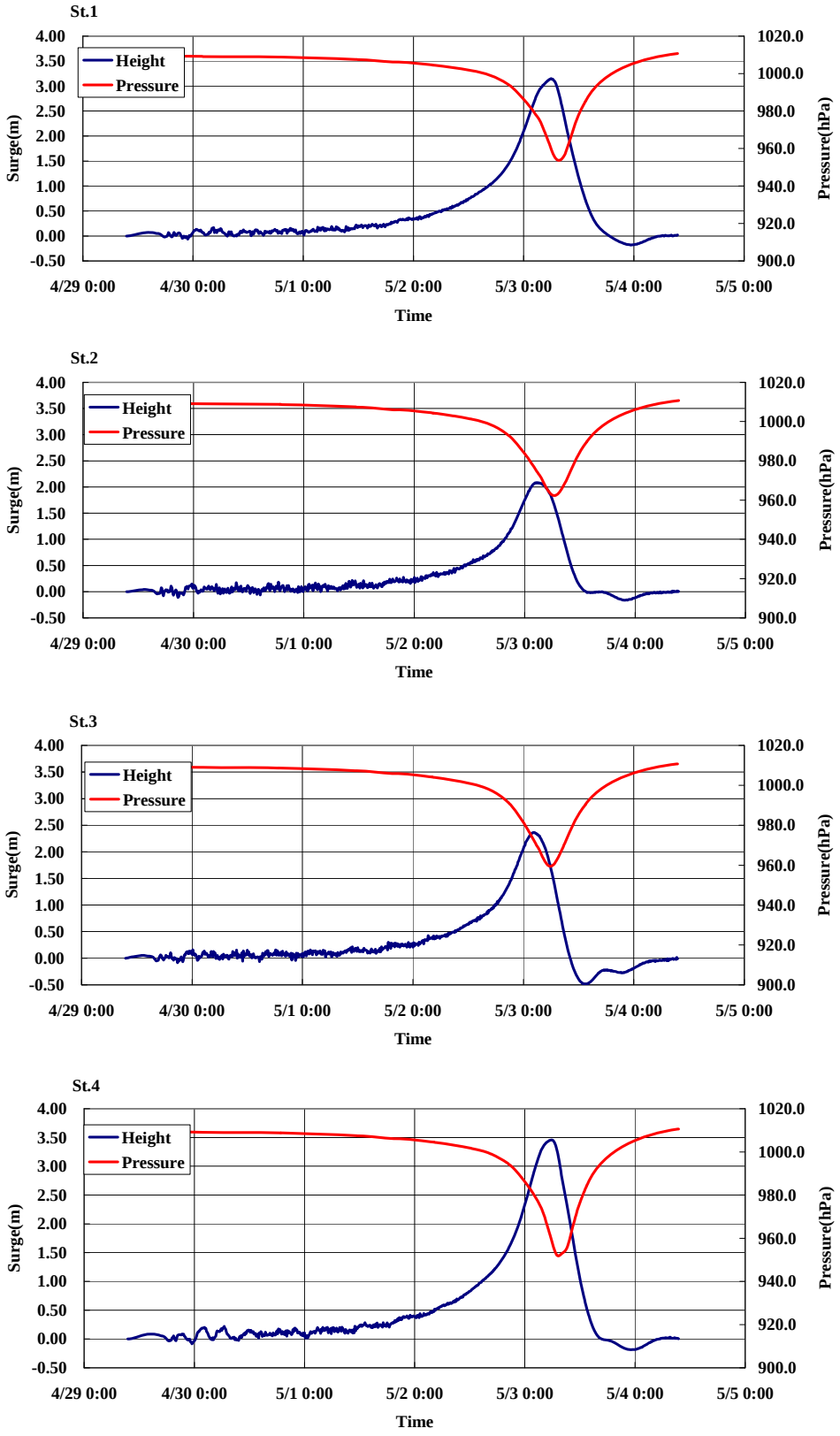
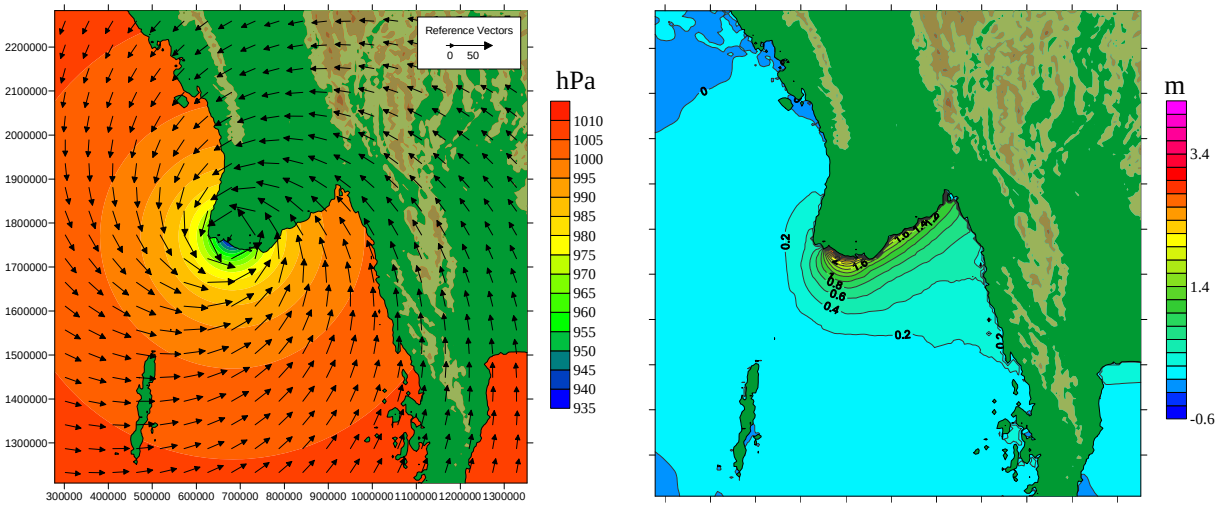


Figure D.1.23 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-5)

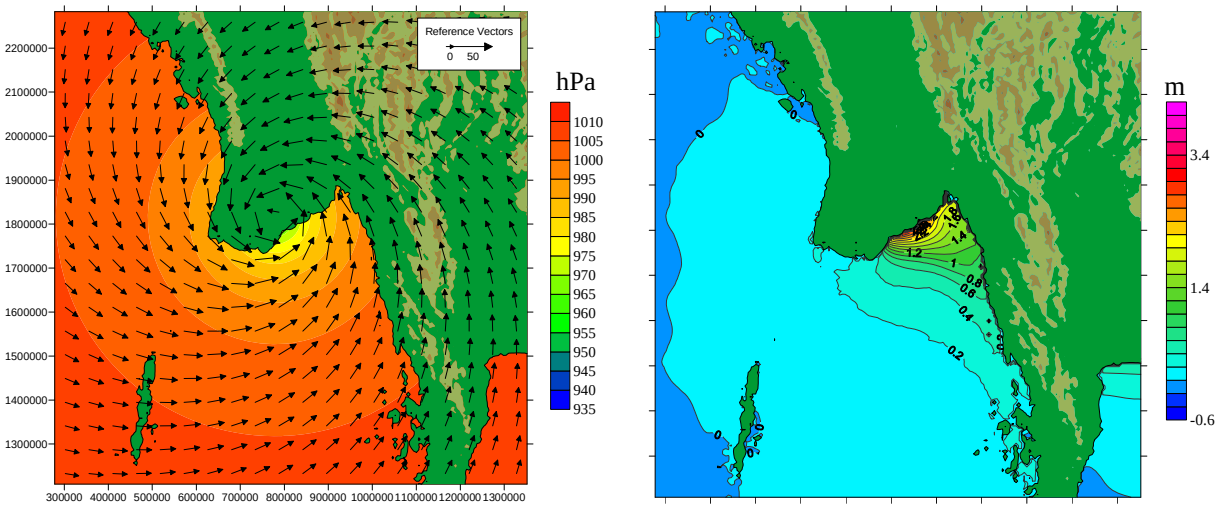
D.1.6 RUN-6 (PROGRESS SPEED OF CYCLONE IS FASTER)

The simulation of run-6 is in case that progress speed of the cyclone is 1.5 times faster than Nargis. The Figure D.1.24 shows the simulation results around Myanmar. The storm tide is almost the same as the case of Nargis.



Pressure and wind velocity **Storm tide deviation**

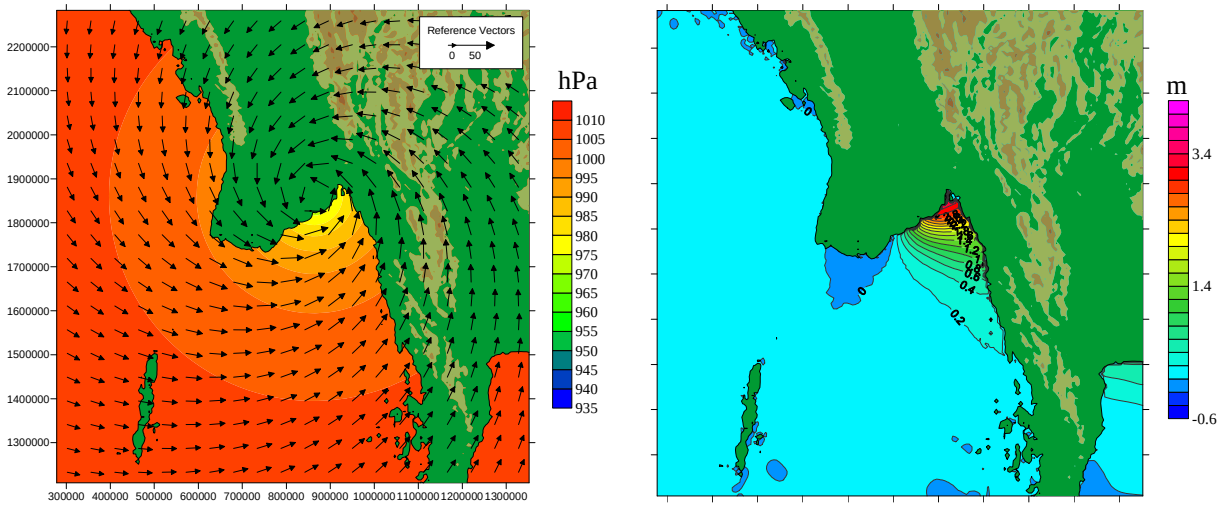
5/1 17:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

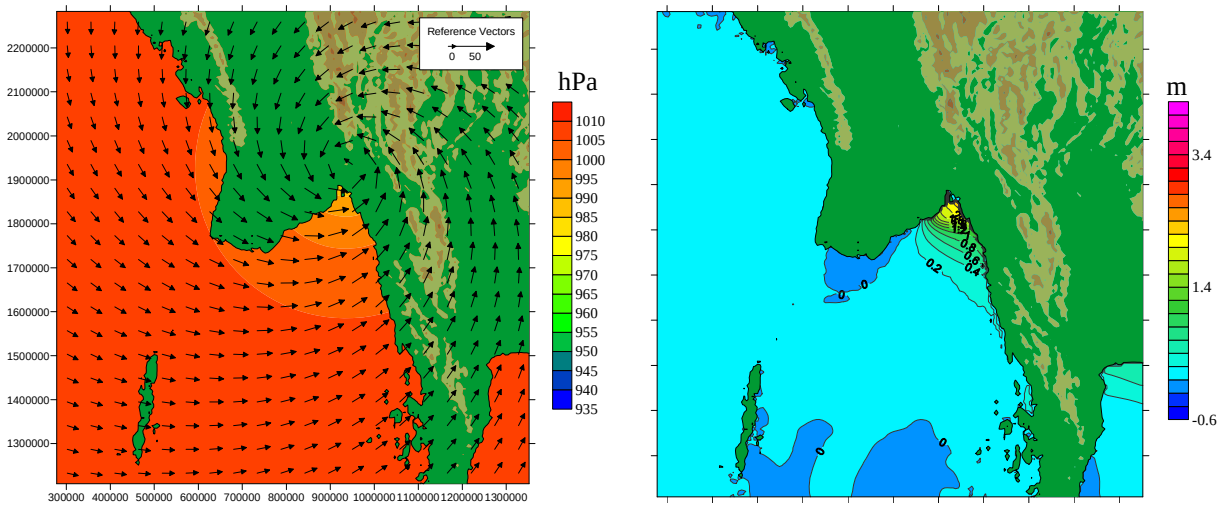
5/1 21:30 (Yangon)

Figure D.1.24 Simulation Results (Run-6, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/2 1:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/2 5:30 (Yangon)

Figure D.1.25 Simulation Results (Run-6, Wide area) (2)

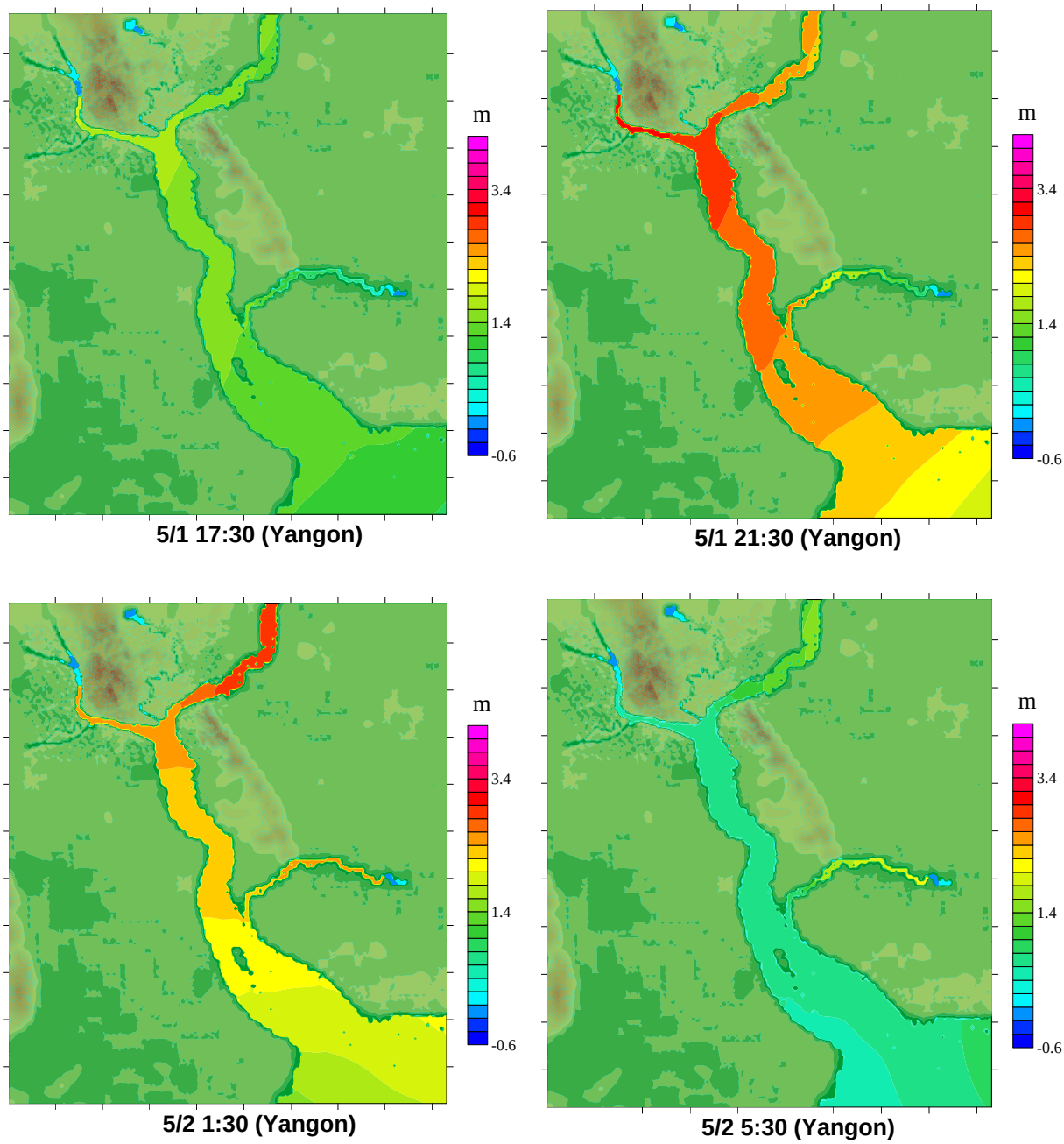


Figure D.1.26 Simulation Results (Storm tide deviation:Run-6, around Yangon River)

Figure D.1.27 shows the time history of surge tide and atmospheric pressure. From these figures, it can be seen that maximum tide is little higher than the case of Nargis.

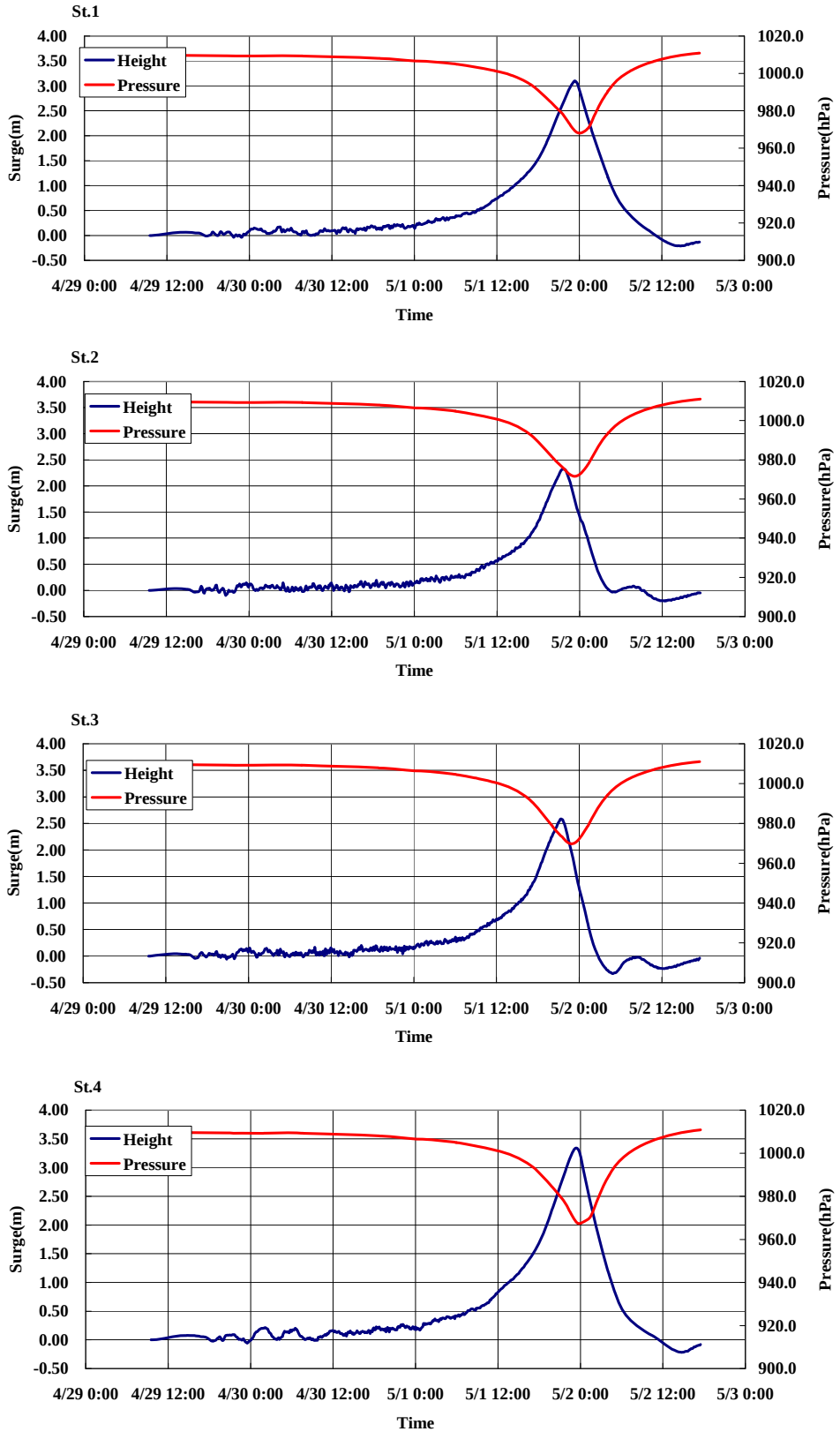
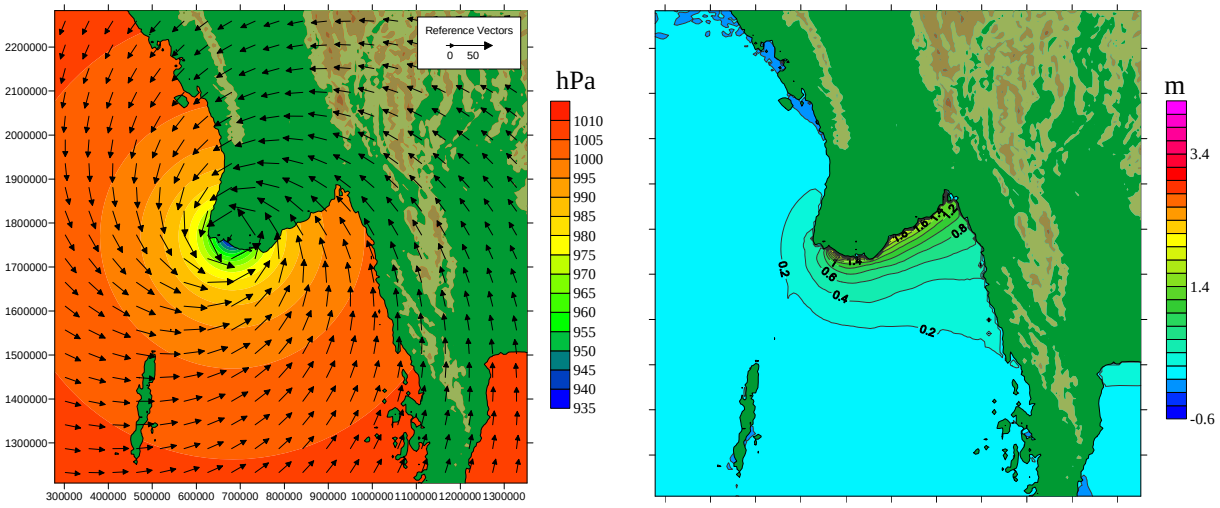


Figure D.1.27 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-6)

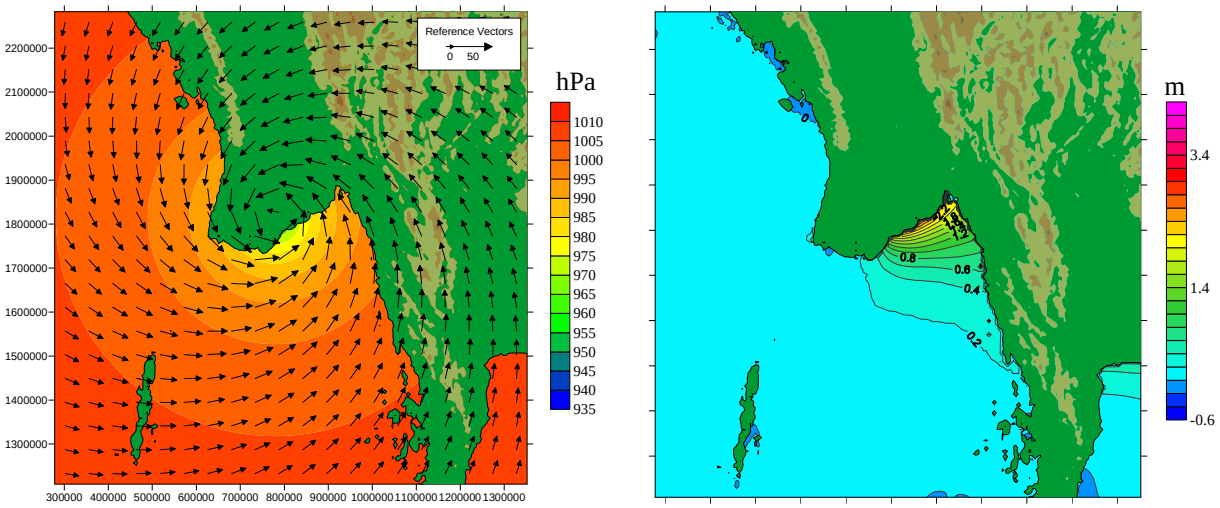
D.1.7 RUN-7 (PROGRESS SPEED OF CYCLONE IS SLOWER)

The simulation of run-7 is in the case that the progress speed of the cyclone is 2/3 times slower than Nargis. The Figure D.1.28 shows the simulation results around Myanmar. The storm tide is almost the same as the case of Nargis.



Pressure and wind velocity **Storm tide deviation**

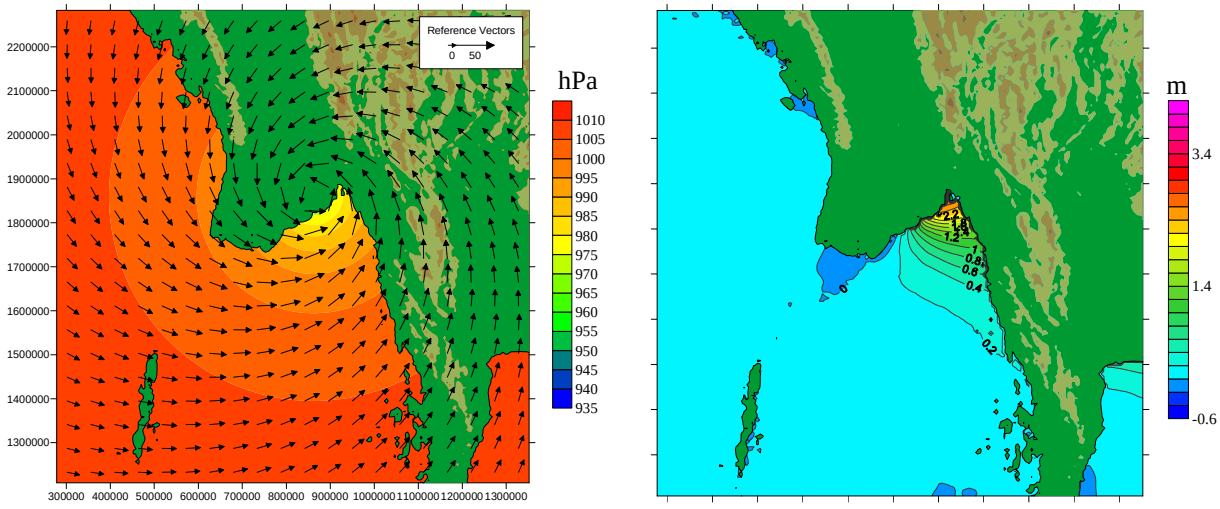
5/4 15:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

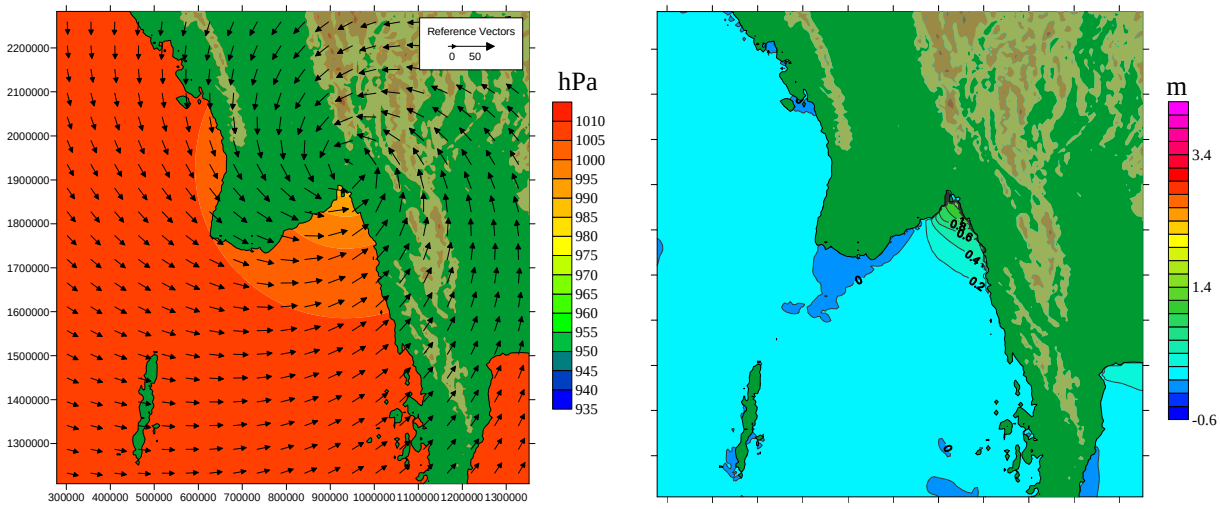
5/5 0:30 (Yangon)

Figure D.1.28 Simulation Results (Run-7, Wide area) (1)



Pressure and wind velocity **Storm tide deviation**

5/5 9:30 (Yangon)



Pressure and wind velocity **Storm tide deviation**

5/5 18:30 (Yangon)

Figure D.1.29 Simulation Results (Run-7, Wide area) (2)

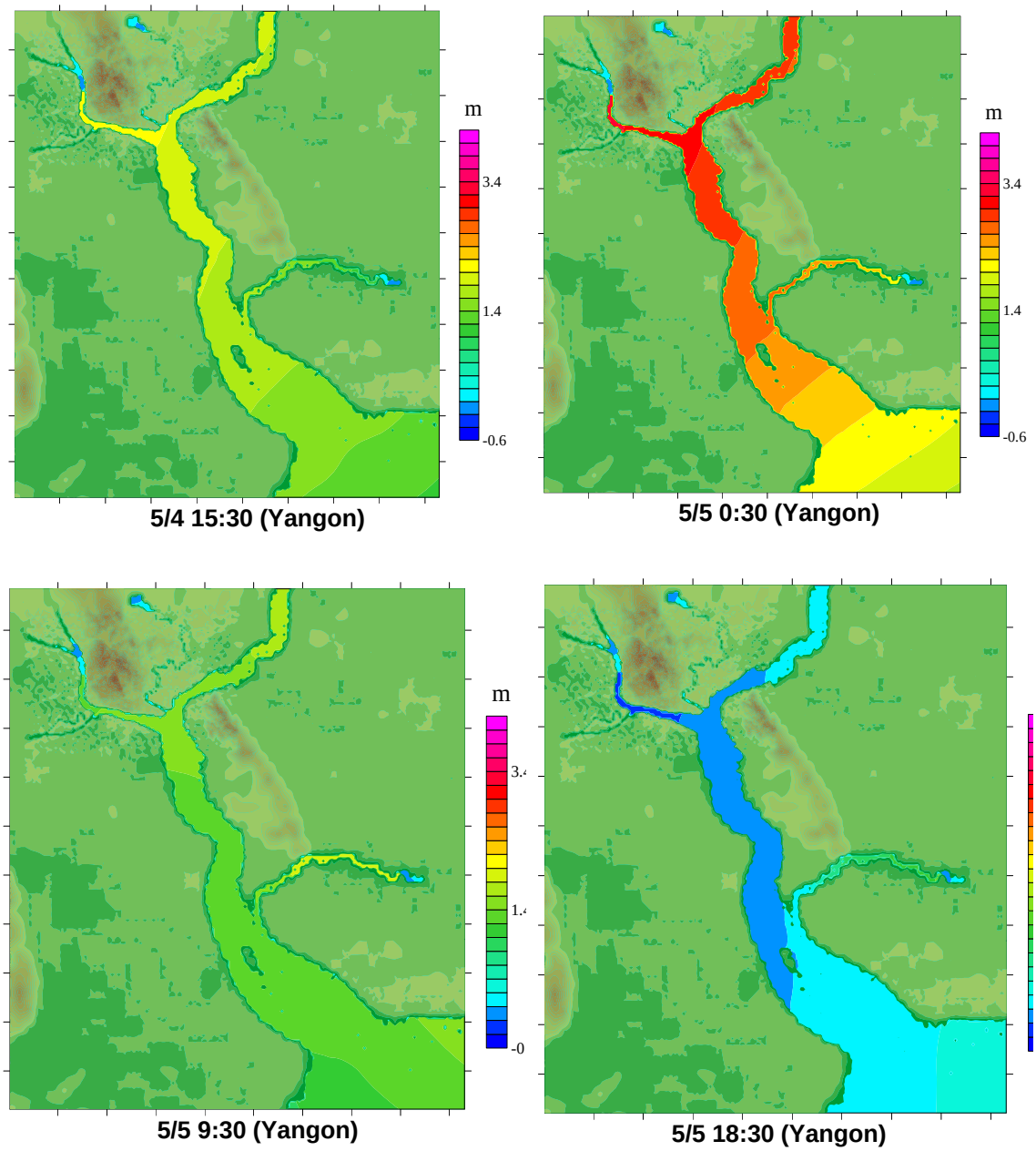


Figure D.1.30 Simulation Results (Storm tide deviation:Run-7, around Yangon River)

Figure D.1.31 shows the time history of surge tide and atmospheric pressure. From these figures, it can be seen that maximum tide is little higher than the case of Nargis.

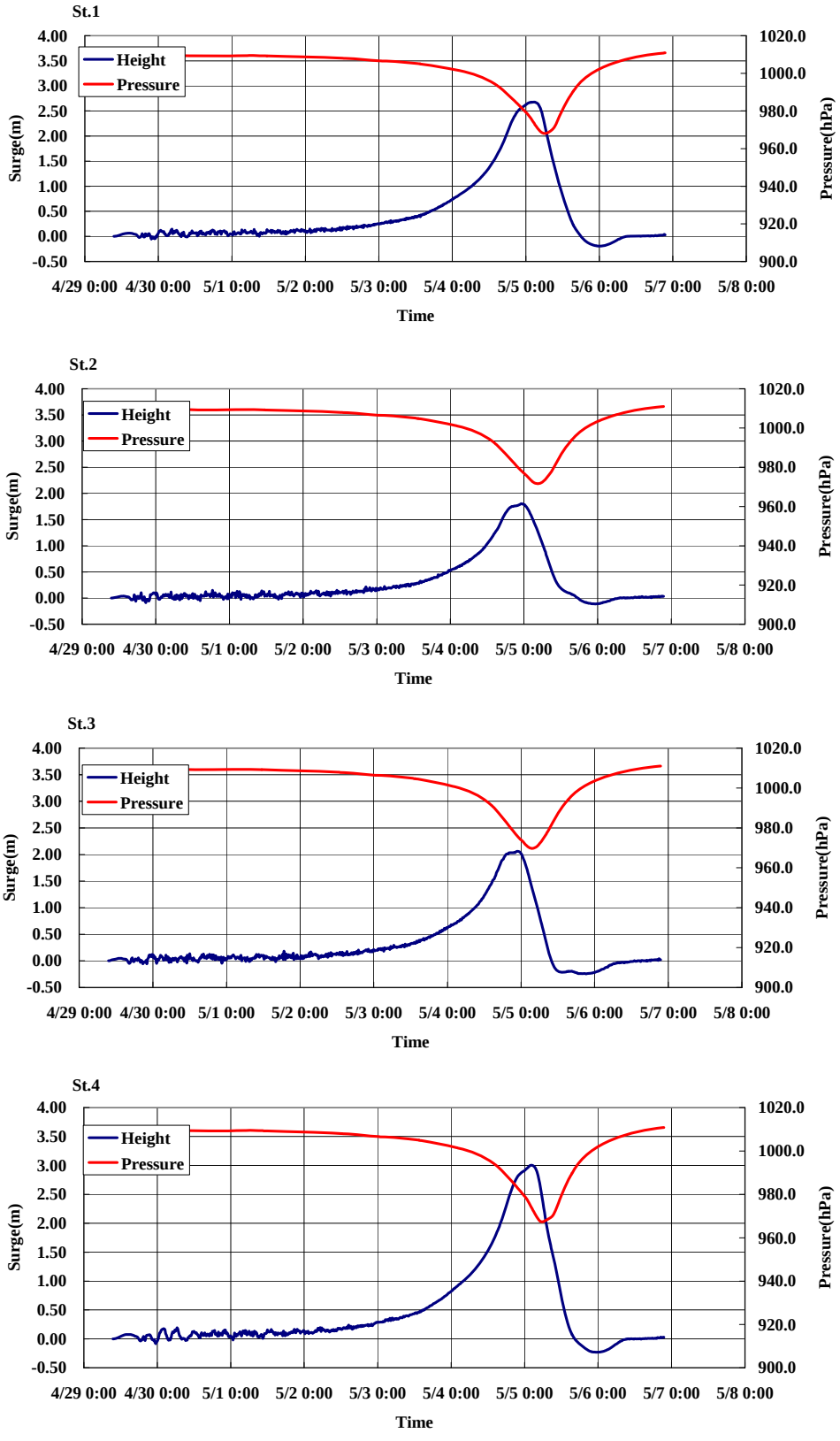


Figure D.1.31 Time History of Surge Tide and Atmospheric Pressure at St.1-St.4 (Run-7)

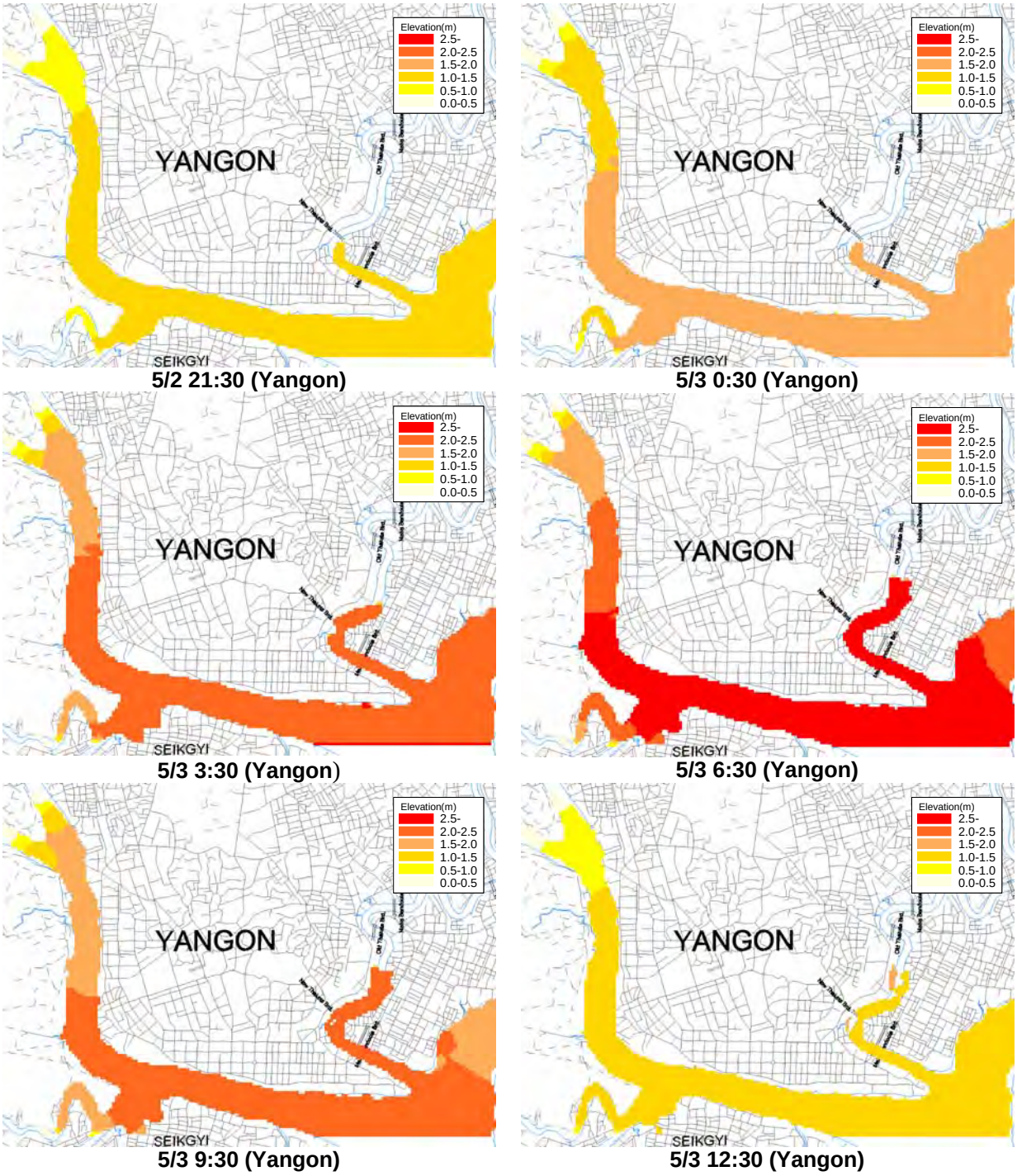
D.2 STORM SURGE RUN UP SIMULATION

D.2.1 SIMULATION CONDITION

Table D.2.1 Simulation Condition of Run up around Yangon Port.

No.	Condition
Run-1	1) Tide: simulation result of domain-5 in case of Nargis 2) Without astronomical tide
Run-2	1) 1.5 times Run-1 2) Without astronomical tide

D.2.2 RUN UP RESULTS OF RUN-1 (NARGIS)

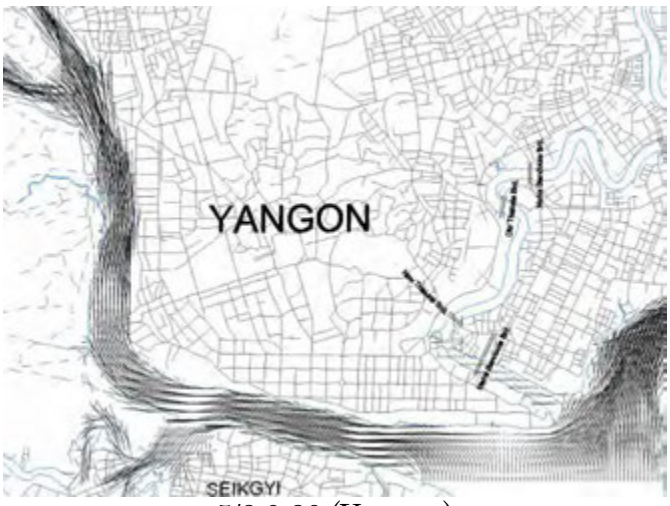


5/2 21:30 (Yangon)　　5/3 0:30 (Yangon)

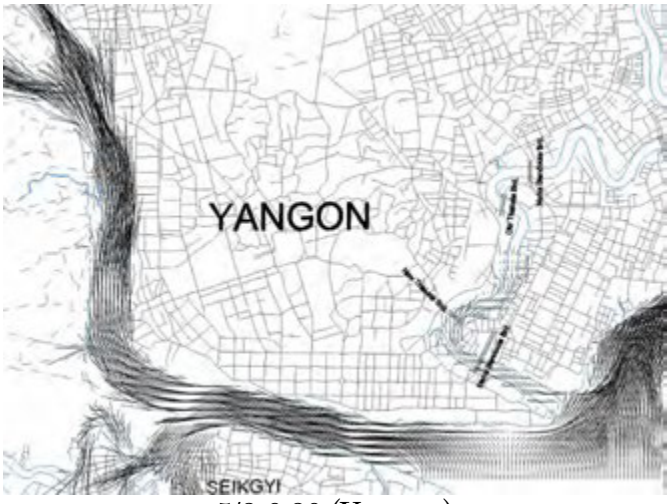
5/3 3:30 (Yangon)　　5/3 6:30 (Yangon)

5/3 9:30 (Yangon)　　5/3 12:30 (Yangon)

Figure D.2.1　Time History of Storm Tide Deviation (Run-1)



5/3 0:30 (Yangon)



5/3 6:30 (Yangon)

5/3 12:30 (Yangon)

Figure D.2.2　Velocity Vector Distribution

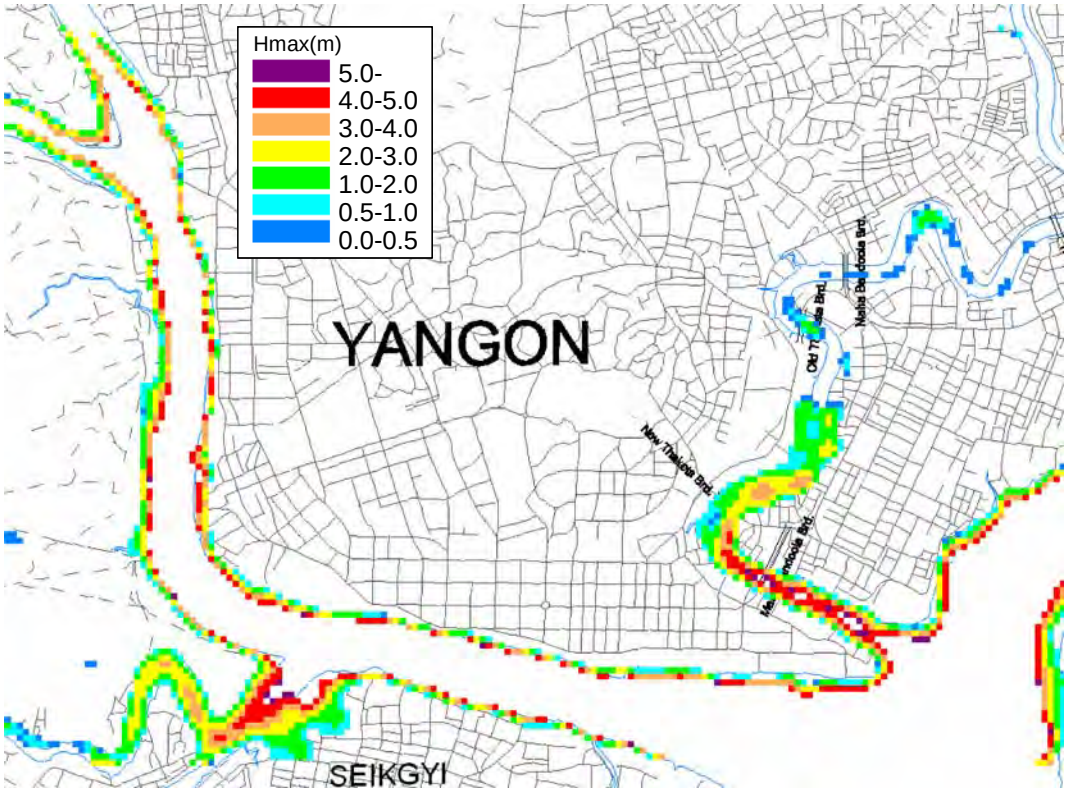


Figure D.2.3 Maximum Inundation Depth (Nargis) (Run-1)

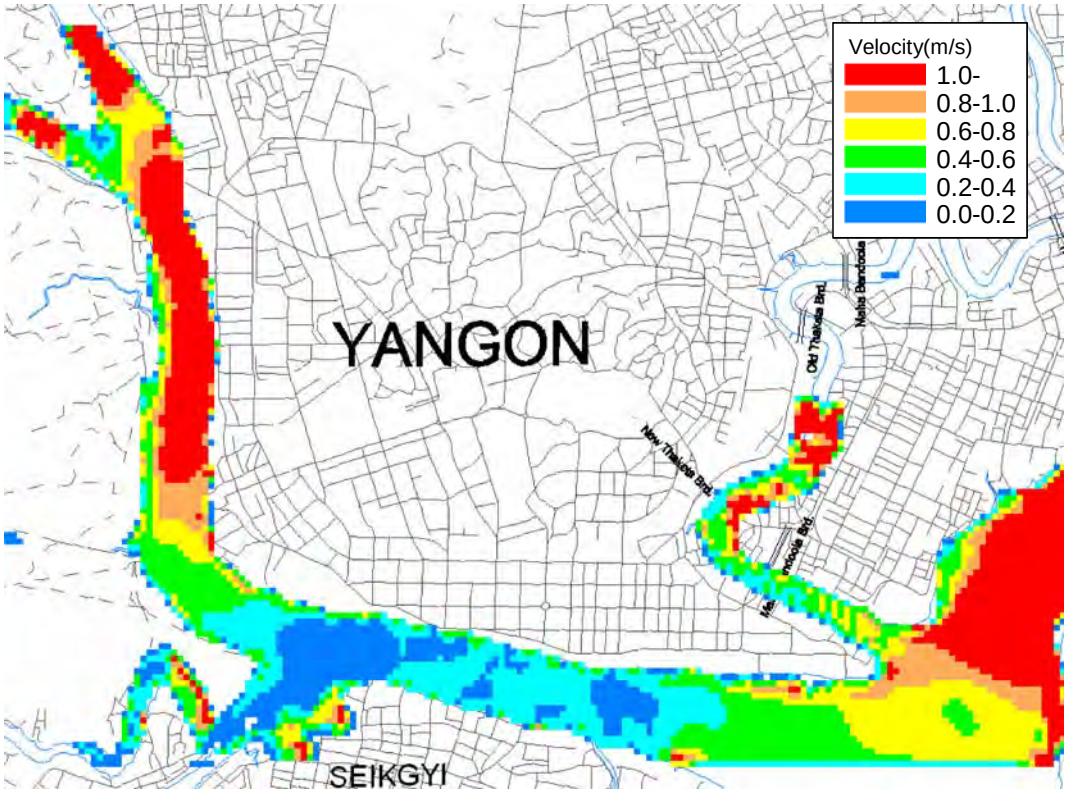
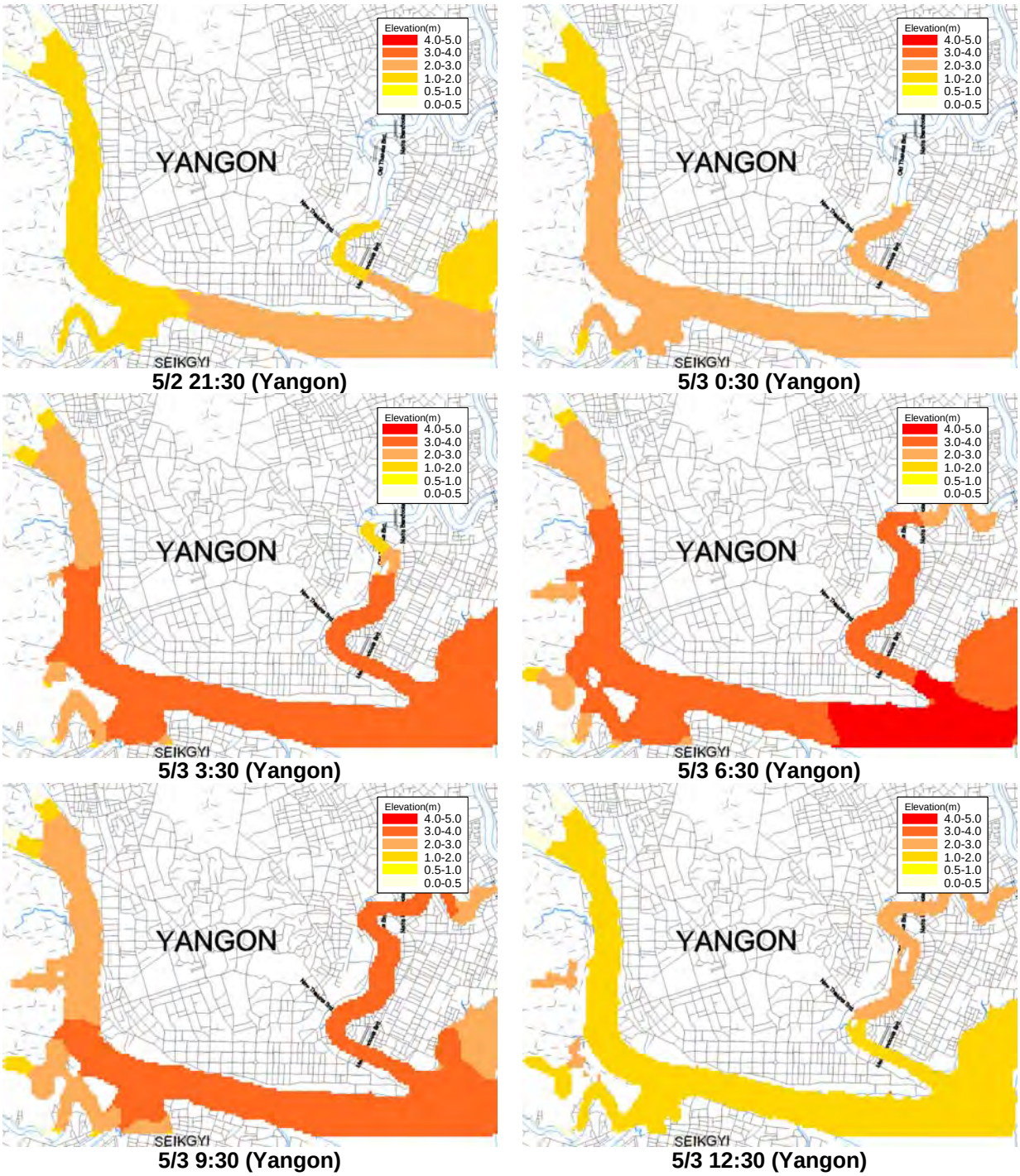


Figure D.2.4 Maximum Velocity (Nargis) (Run-1)

D.2.3 RUN UP RESULTS OF RUN-2 (STORM SURGE TIDE IS 1.5 TIMES HEIGHER THAN NARGIS)



5/2 21:30 (Yangon) 5/3 0:30 (Yangon)

5/3 3:30 (Yangon) 5/3 6:30 (Yangon)

5/3 9:30 (Yangon) 5/3 12:30 (Yangon)

Figure D.2.5 Time History of Storm Tide Deviation (Run-2)

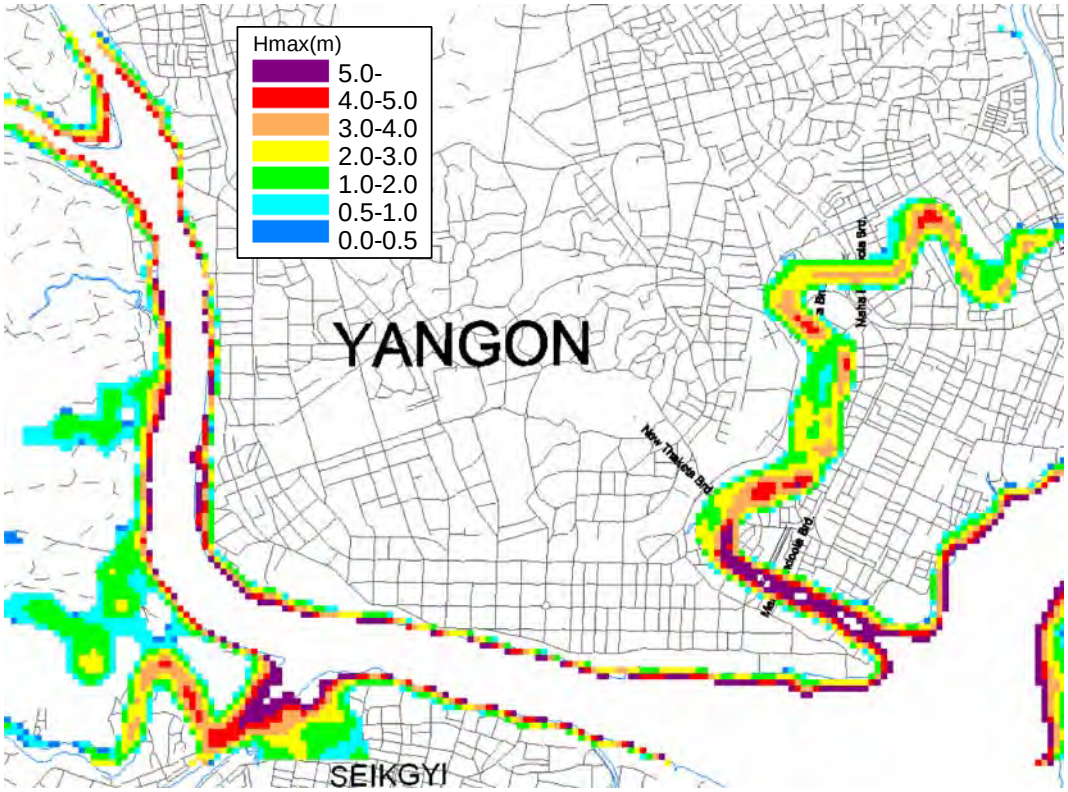


Figure D.2.6 Maximum Inundation Depth (Nargis) (Run-2)

APPENDIX E

CAPACITY DEVELOPMENT TRAINING

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APPENDIX E CAPACITY DEVELOPMENT TRAINING

E.1 CAPACITY DEVELOPMENT OF SHIP CREW OF IWT VESSELS

E.1.1 TRAINING INSTRUCTORS

(1) JICA Experts

Three Japanese experts have attended the training as instructors to perform training during Stage 2 for the education of potential instructors in the further stage.

(2) IWT Instructors

During the Stage 2, fifteen (15) trainees were educated and following four (4) IWT Captains have been selected by Japanese Instructors and attended 3rd Stage Training as Instructor as below list:

E.1.2 SELECTION OF TRAINEES

(1) Selection of Stage 2 Participants

15 participants of Stage 2 were selected by IWT among their management and engineers to educate potential instructors for further training of IWT seafarers in Stage 3.

They were three (3) assistant marine superintendents, two (2) fleet officers, nine (9) captains, and one (1) helmsman.

The list of attendants for the training in Stage 2 is presented in Table E.1.1.

Table E.1.1 List of Participants for Stage 2

Sr.No.	Name	Age	Position	Remarks
1	U Thein Myint	42	AMS	
2	U Moe Zet	52	Fleet Officer	
3	U Khin Maung Aye	50	Captain	
4	U Nyunt Win	46	Captain	
5	U Than Win	50	Captain	
6	U Aung Than Myaing	50	AMS	
7	U Khin Maung Htay	49	Captain	
8	U Than Chaung	54	Captain	
9	U Aung Kyaw Soe	30	Fleet Officer	
10	U Tun Shein	50	Captain	
11	U Myint Than Tun	47	AMS	
12	U Myint Sein	53	Captain	
13	U Soe Tun	57	Captain	
14	U Kyaw Kyaw Lwin	32	Helmsman	
15	U Yan Lin Aung	31	Captain	

(2) Selection of Stage 3 Participants

For the Stage 3 of training, ten (10) captains and five (5) helmsmen were selected by IWT. The list of participants were shown in Table E.1.2.

Table E.1.2 List of Participants for Stage 3

Sr.No.	Name	Age	Position	Name
1	U Khin Maung Aye	53	Captain	
2	U Tun Tun	47	Captain	
3	U Thet Lwin	39	Captain	
4	U Kyaw Htwe	54	Captain	
5	U Sein Thaung	53	Captain	
6	U Hla Oo	49	Captain	
7	U Hla Win	50	Captain	
8	U Aung Min	51	Helmsman	
9	U Than Saung	37	Captain	
10	U Kyaw Win Naing	38	Captain	
11	U San Hla Aung	30	Helmsman	
12	U Soe Min Latt	32	Helmsman	
13	U Moe Win Soe	34	Helmsman	
14	U Than Pe	47	Captain	
15	U Aung Than Naing	31	Helmsman	

E.1.3 POST EVALUATION

E.1.3.1 Questionnaire for Post Evaluation

In order to verify the effectiveness of the training, JICA Instructors provided following Questionnaire Sheet and collected the responses from 15 participants after completion of Training Course of each Stage.

(1) Questionnaire Sheet

14th November 2009

Questionnaire
Capacity Development of Ship Crew of IWT Vessels

Training Course: Navigation Safety and Nautical Instruments (Stage-3)
Period: From 2nd November to 14th November 2009
Place: IWT Head Quarter and Model Ship

Name _____

Dear IWT AMS, Captain, Fleet Officers and Helmsman,

Thank you very much for your joining to JICA Training Course which had been carried out by IWT 4 Masters as instructor. In order to improve the contents of the lecture in near future, please be asked to respond to following questions and write your comment for our convenience.

(Q-1) Do you think that this Training Course was useful for Navigation Safety?
(A-1) • Very useful • Useful • Not useful

(Q-2) If participants respond as useful and very useful, please be asked to select three of the best subjects in the following Table.

(A-2)

- N-1 ISM Code, BRM/BTM
- N-2 Rules and Regulations
- N-3-N-4 Navigation Safety(Passage Planning, IMO Standard Term)
- N-6 Navigation Safety (Behavior In Crisis Situations)
- N-7 Meteorology and River Natural Condition
- N-8-N-13 Nautical Instruments

(Q-3) Do you wish to continue JICA Training Course by Japanese Instructors every year?
(A-3)

- I wish to continue JICA Training Course by Japanese Instructors every year.
- I wish that this Training should be carried out by Myanmar (IWT) Instructors.
- No necessary Training

(Q-4) If you need to continue this Training course, please be asked to describe other than subject in addition.
(A-4) Comments (e.g. your requirement of additional training)

(Q-5) Please describe any comments for the Training, if any.
(A-5) Comments

(2) Contents of Questionnaire

Q-1) Useful or not for the Training

(Q-1) Do you think that this Training Course was useful for Navigation Safety?

(A-1) • Very useful • Useful • Not useful

A-1) Response from Participants

All participants responded as “Very useful” for the Training.

Q-1	Very useful	Useful	Not useful	No answer	Total
A-1	15	0	0	0	15

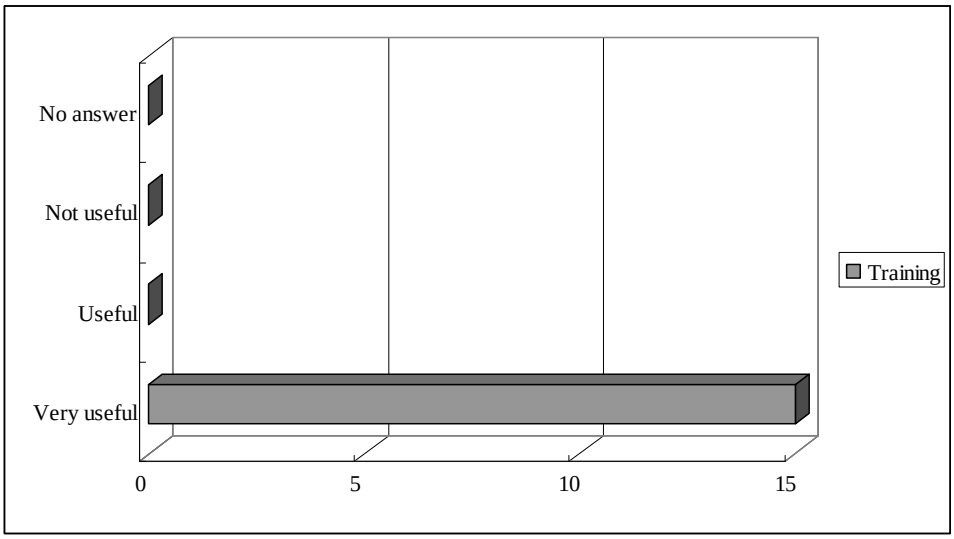


Figure E.1.1 Useful or not for the Training

Q-2) Selection of preferable subjects

(Q-2) If participants respond as useful and very useful, please be asked to select three of the best subjects in the following Table.

(A-2)

- N-1 ISM Code, BRM/BTM
- N-2 Rules and Regulations
- N-3-N-4 Navigation Safety (Passage Planning, IMO Standard Term)
- N-6 Navigation Safety (Behavior In Crisis Situations)
- N-7 Meteorology and River Natural Condition
- N-8-N-13 Nautical Instruments

A-2) Responses from Participants

The subject of N-1(ISM Code & BRM/BTM) was 15 points (34%) as best, next N-7(Natural Condition) 8 points (18%) as 2nd Ranking, and then N-2 (Rules and Regulations), N-3&4 (Navigation Safety) and N-6 (Emergency) were followed as 6 points (13%).

Q-2	N-1	N-2	N-3,4	N-6	N-7	N-8-13	Total
A-2	15	6	6	6	8	4	45

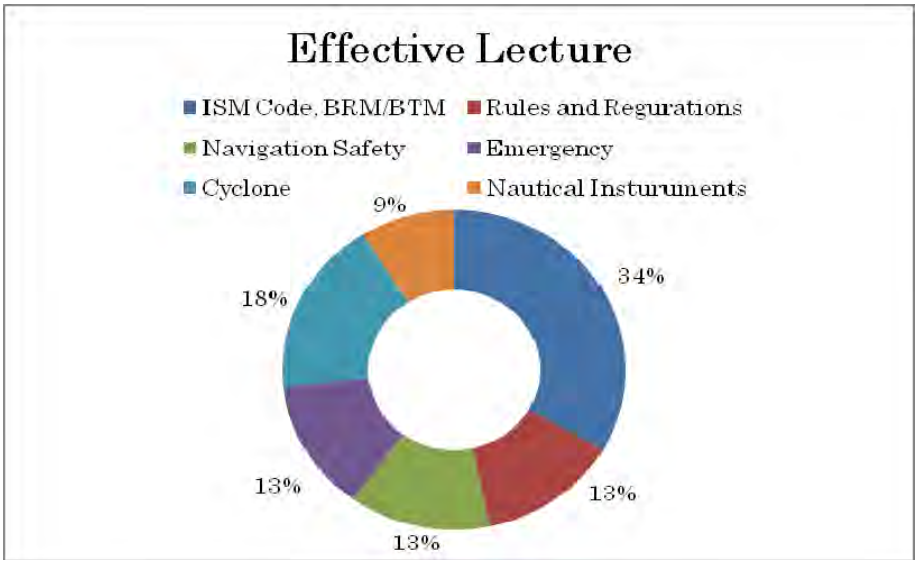


Figure E.1.2 Effectiveness of Lecture

Q-3) Navigation Safety Training in Future

(Q-3) Do you wish to continue JICA Training Course by Japanese Instructors every year?

(A-3)

- I wish to continue JICA Training Course by Japanese Instructors every year.
- I wish that this Training should be carried out by Myanmar (IWT) Instructors.
- No necessary Training

A-3) Responses from participants

Almost participants responded that this JICA Training should be continued in the future. (15 points, 100%)

Q-3	Continue JICA Training	IWT Internal Training	Not Necessary
A-3	15	1	0

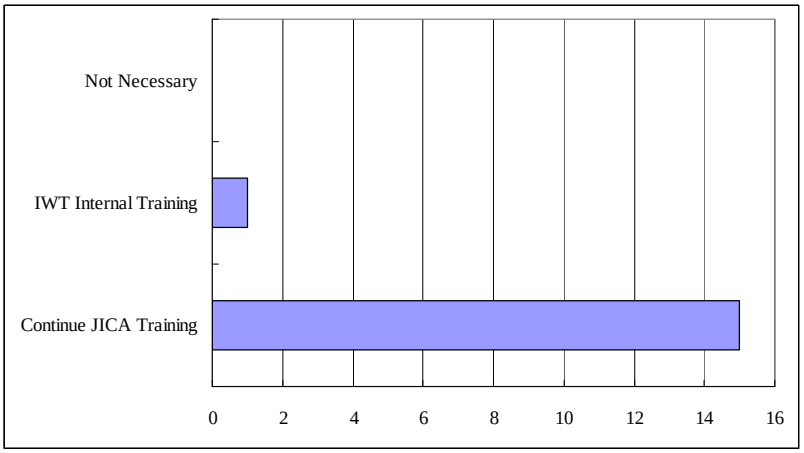


Figure E.1.3 IWT Training in future

Q-4) Training in Future (Additional subjects)

If you need to continue this Training course, please be asked to describe other than subject in addition.

A-4) Responses from Participants

Comments (e.g. your requirement of additional training)

Abstract of Response

Request of additional training

- Not require any additional training (3 trainees)
- First Aid work for requirements of life safety
- Fire fighting exercise including explanation of appliances at jetty, anchorage and underway
- Life-saving appliances including Survival training
- Tasks to be taken step by step, if vessel run into crisis situation including prevention for Cyclone disaster and arrangements
- Damage control
- We especially considered that Radar observation and GPS operation should study through the day on the actually underway vessel as a practical proposition (2 trainees)
- Cargo stowage plan for ship stability

- How to manage the cyclone disaster prevention a in Japan implementation plan and comply technique for Myanmar

Q-5) Please describe any Comments for the Training, if any.

A-5) Responses from Participants

Comments

- This training are many advantage to priority for safety navigation (many trainees)
- Our vessels have not modernized navigational equipments such as GMDSS radio, so we felt need to install the same equipments on our vessel for prevention from dangerous situations
- This training was too short hours so as to understand all of items, therefore we need at least one month duration
- We hope study from the Japanese Inland Water vessels in Japan with Myanmar Instructors at least two weeks duration, so as to obtain more understanding of the subject of this training
- Practical lecture on the model ship during navigation especially night will be more suitable for trainees
- Room of Model ship was very small space for study the installed nautical instruments practice for 15 trainee
- Operation training of Nautical instruments should be during underway which is better than at moored vessel for our easy understanding
- Translation sheets should be attached together with English text
- Need more sufficient of additional for enlarge explanation
- Need more lecture related safety navigation using nautical instruments in future
- Request to consider the whole day's foods for trainees from long distance

(3) Evaluation of Training

1) Method of Evaluation

The fundamental maritime competency and experience had been observed so different among the participants, due to the first training program regarding navigation safety for IWT seafarers and furthermore participants from wide range of position such as Assistant Marine Superintendent (AMS), Captain, Fleet Officer and Helmsman.

We adapted the 5 levels of self-evaluation by setting level 1 as the before start of this program and up to level 5 so as to compare their understanding per each item after finish of this program. When every items of the subject was completed, we requested to entry their self-evaluation (see below sheet) and then we Japanese Instructors had verified their self-evaluation.

Self-Evaluation Sheet

No. **Date:**

The urgent Project for Rehabilitation of Yangon Port
and Main Inland Water transport in the Union of Myanmar

Capacity Development of Ship Crew of IWT Vessels

PARTICIPANT'S REPORT/COMMENT SHEET

Nos	Contents of Training	Understanding Level					Comments
N-1	ISM Code and BRM	1	2	3	4	5	
N-2	Rules and Regulations	1	2	3	4	5	
N-3	Navigation (Passage Planning)	1	2	3	4	5	
N-4	Navigation (Narrow Channels etc.)	1	2	3	4	5	
N-5	Navigation (IMO Standard Terms)	1	2	3	4	5	
N-6	Navigation (Behavior In Crisis Situations)	1	2	3	4	5	
N-7	Meteorology and River Natural Condition	1	2	3	4	5	
N-8	Nautical Instruments(General)	1	2	3	4	5	
N-9	Radar	1	2	3	4	5	
N-10	GPS	1	2	3	4	5	
N-11	Echo-Sounders	1	2	3	4	5	
N-12	Radio(VHF) (HF)	1	2	3	4	5	
N-13	Anemometer/Barometer	1	2	3	4	5	

*** Please marking ○ to your understanding level when each training completed.**
1: It was not possible to understand all.
2: It was possible to understand only a little.
3: It was possible to understand usually.
4: It was possible to understand comparatively well.
5: It was possible to understand very well.

Name & Signature of Participant :

Name & Signature of Instructor

Name & Signature of Instructor

2) Result of Evaluation

The abstract of the evaluation for this training (see below Table 11.3.5)

- According to the participants' self-evaluation, they had evaluated themselves as high level understanding, i.e. their self-evaluation had especially increased from level 1 to level 4.6 in average.

- The items of lectures were categorized as 6 groups for our convenient, i.e. N-1(ISM Code, BRM/BTM), N-2 (Rules and Regulations), N-3 & N-4 (Navigation Safety) (Passage Planning, IMO Standard Term), N-6 (Navigation Safety) (Behavior in Crisis Situations), N-7 (Meteorology and River Natural Condition) and N-8 to N-13(Nautical Instruments).
- N-2 (Rules and Regulations) showed the highest 4.9 point, and N-8 to N-13 (Nautical Instruments) followed 4.8 point. We considered that this project was very fruitful as showing their response, taking account of the main objective of this project which is the familiarization for smooth operation of 7 types of nautical instruments, such as Radar and GPS, equipped on Model ships for the first Training Program for IWT seafarers.
- Even putting this evaluation aside, we evaluated the attitude and degree of concentration of all of trainee during period of this project; we observed that all of trainee had been the excellent results together with their strong motivations to this objective.

Table E.1.3 Summery of Self-evaluation Sheet

Sr. No	Name	Position	N-1 ISM,BRM	N-2 Rule	N-3,N-4 Navi.Safe	N-6 Emergency	N-7 Cyclone	N-8 to N-13 N.Instruments	Total	Average
1	U THEIN MYINT	AMS	4	5	5	4	4	4.7	26.7	4.5
2	U MOE ZET	Fleet Officer	4	5	4.5	4	4	4	25.5	4.3
3	U KHIN MAUNG AYE	Captain	4	5	4.5	5	5	5	28.5	4.8
4	U NYUNT WIN	Captain	4	5	4.5	4	5	4.5	27	4.5
5	U THAN WIN	Captain	4	5	4.5	4	5	4.3	26.8	4.5
6	U AUNG THAN MYAING	AMS	5	5	5	5	5	5	30	5
7	U KHIN MAUNG HTAY	Captain	4	5	4.5	4	5	5	27.5	4.6
8	U THAN CHAUNG	Captain	4	5	4.5	4	4	5	26.5	4.4
9	U AUNG KYAW SOE	Fleet Officer	4	5	4	4	5	4.8	26.8	4.5
10	U TUN SHEN	Captain	4	4	4.5	5	5	5	27.5	4.6
11	U MYINT THAN TUN	AMS	4	5	5	5	5	5	29	4.8
12	U MYIT SEIN	Captain	4	5	5	5	4	5	28	4.7
13	U SOE TUN	Captain	4	5	5	4	5	4.7	27.7	4.6
14	U KYAW KYAW LWIN	Helmsman	4	5	4.5	4	4	4.7	26.2	4.4
15	U YAN LIN AUNG	Captain	4	5	4.5	4	5	5	27.5	4.6
Total			61	74	69.5	65	70	71.7	411.2	68.5
Average			4.1	4.9	4.6	4.3	4.7	4.8	27.4	4.6

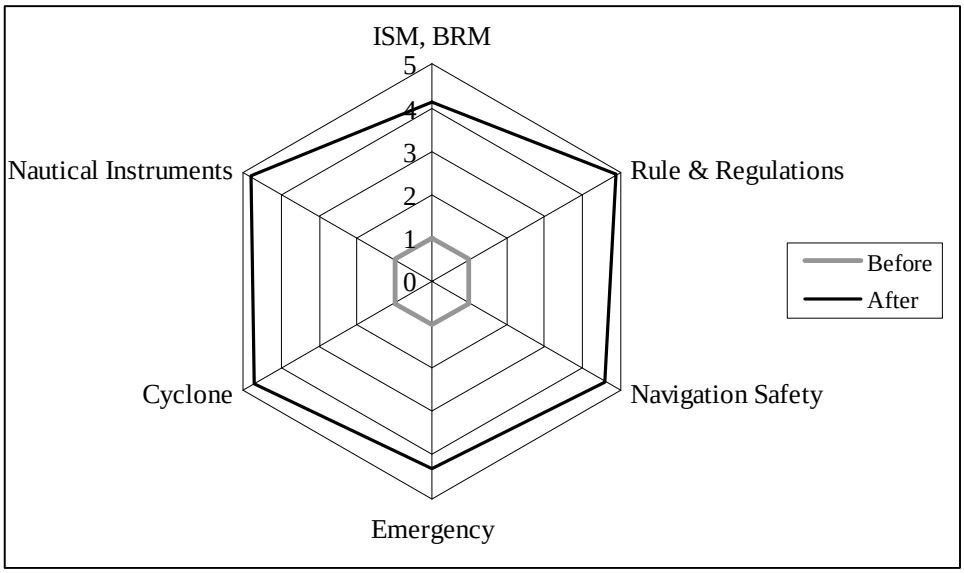


Figure E.1.4 Radar Chart of self-evaluation

E.2 CAPACITY DEVELOPMENT OF SHIP REPAIRING AND METAL STRUCTURE

E.2.1 TRAINING INSTRUCTORS

Two Japanese experts and one assistant of Myanmar have attended the training for the education of potential instructors.

E.2.2 SELECTION OF TRAINEES

Table E.2.1 Officials and Engineer

No	Name	Age	Assignment	Position	Experience	Welding Skill
1	U Khaing Zaw Oo	35	Dalla Dockyard	Assist; Engineer	5 years	B
2	U Naing Naing Win	36	Dalla Dockyard	Assist; Engineer	8 years	B
3	U Myo win Thein	25	Dalla Dockyard	Assist; Engineer	9 moths	B
4	U Tin Mg Wai	27	Dalla Dockyard	Assist; Engineer	9 moths	B
5	U Htain Lin Mg	28	Dalla Dockyard	Assist; Engineer	9 moths	B
6	U Naing Win	25	Dalla Dockyard	Assist; Engineer	9 moths	B
7	U Tin Myo Lwin	25	Dalla Dockyard	Assist; Engineer	9 moths	B
8	U Aung Ye' Kyaw	27	Dalla Dockyard	Assist; Engineer	9 moths	B
9	U Soe Myaing	41	Ahlone Dockyard	Assist; Engineer	8 years	B
10	U Si Thu Kyaw	32	Ahlone Dockyard	Assist; Engineer	9 months	B
11	U Kyaw Shwe Oo	25	Ahlone Dockyard	Assist; Engineer	9 months	B
12	U Ye Zaw	28	Ahlone Dockyard	Assist; Engineer	9 months	B
13	U Tun Win Myint	39	Satsan Dockyard	Deputy Manaver	13 years	B
14	U Zaw Thein	40	Theinbyu Dockyard	Assist; Engineer	12 years	B
15	U Zaw Myo	30	Angyi Dockyard	Assist; Engineer	1 years	B

Note : A means skilled for arc welding, B means unskilled for arc welding, C means no-experience

Table E.2.2 Skilled Technicians/Group Leaders

No	Name	Age	Assignment	Position	Experience	Welding Skill
1	U Hla Myint	50	Dalla Dockyard	Assist; Engineer	30 years	A
2	U Than Soe	42	Dalla Dockyard	Assist; Chargen	14 years	A
3	U Shwe Win	42	Dalla Dockyard	Assist; Chargen	21 years	A
4	U Naing Win Tun	30	Dalla Dockyard	Assist; Chargen	13 years	A
5	U Win Ko Tun	29	Dalla Dockyard	Assist; Chargen	8 years	A
6	U Thein Tun	50	Dalla Dockyard	Foreman	31 years	A
7	U Zay Yar Win	46	Dalla Dockyard	3rd Grade	26 years	A
8	U Win Tun	31	Dalla Dockyard	3rd Grade	8 years	A
9	U Sein Myint	60	Ahlone Dockyard	Foreman	40 years	A
10	U Soe Myint	53	Ahlone Dockyard	Foreman	31 years	A
11	U Maw Win Shwe	51	Ahlone Dockyard	Foreman	26 years	A
12	U Myint Khin	52	Ahlone Dockyard	Chargen	27 years	A
13	U Kyi Tun	58	Angyi Dockyard	Charge-in Grade 1	32 years	A
14	U Kyaw Sein	54	Theinbyu Dockyard	Charge- in Grade 2	25 years	A
15	U Thaung Nyunt Shwe	44	Satsan Dockyard	Charge -in Grade 3	23 years	A

E.2.3 QUESTIONAIRE FOR POST EVALUATION

In order to verify the effectiveness of the training, JICA experts provided two kinds of questionnaires and performed practical test for post evaluation of training.

These are;

1) General question,
2) Knowledge question, and
3) Practical welding test

These questions were given to 30 trainees and practical welding test performed for 15 trainees of skilled technicians.

E.2.3.1 General Question in Attending Training

(1) Questionnaire

Questionnaire used to ask trainees about general impression in attending training is shown below.

Questionnaire

Capacity Development of Repairing Ships and Metal Structure

Training Course: Module 1 (Lecture) and Module 2A and 2B (Practice Training)
Period : From 20th November to 18th December 2009
Place : Ahlone Dockyard and Dalla Dockyard

Dear Sirs
Thank you very much for your joining to JICA training course. In order to refer to improve the contents of training, please be asked to respond to following questions and write your comment for our convenience.

(Q-1) Do you think this training totally was useful for your work and your instruction to staffs and workers?
(A-1) ○ Very useful ○ Useful ○ Not useful

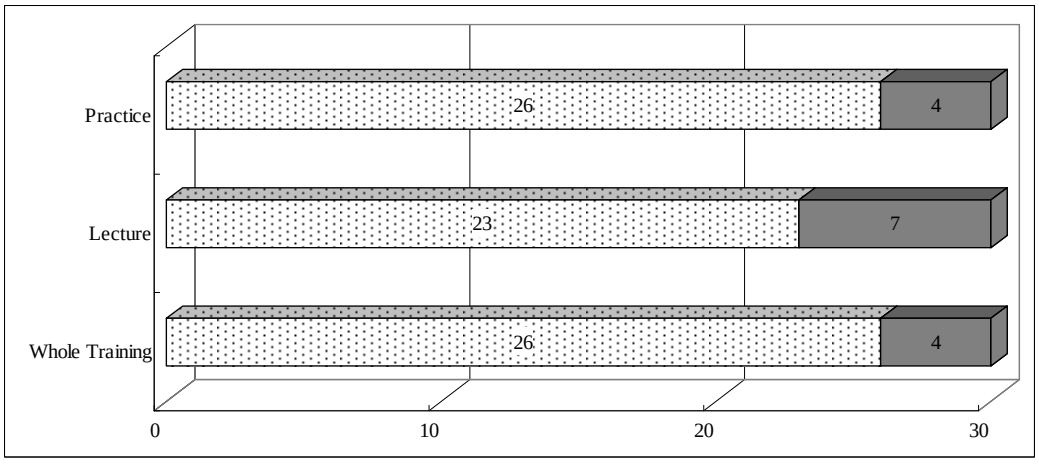
(Q-2) Do you think this lecture was useful for your work and your instruction to staffs and workers?
(A-2) ○ Very useful ○ Useful ○ Not useful

(Q-3) Do you think this welding practice was useful for your work and your instruction to your staffs and workers?
(A-3) ○ Very useful ○ Useful ○ Not useful

Please describe any comments for the training.

(2) Response from Trainees

As to the question if "the whole training" is useful or not, most of the trainees replied "This training is very useful". And for the same questions for "Lecture and Practice" they also replied "very useful for our work and instruct to worker". (See Figure E.2.1)



No. of Trainees	Whole Training	Lecture	Practice
Very useful	26	23	26
Useful	4	7	4
Not Useful	0	0	0

Figure E.2.1 Response from Trainees for this Training Impression

E.2.3.2 Question on Understanding of Welding Knowledge

(1) Questionnaire

Twenty (20) questions made as queries on understanding and knowledge of welding technology are shown below.

1. For getting quality of structure, good workmanship is required to welders. Which functions are contained in workmanship? Choose the correct one from the following mentions.
   a.) skill b.) skill and knowledge c.) good skill and knowledge d.) good skill, knowledge, moral and driving license
2. For manufacturing, welding is the one of key technologies, but its advantage and disadvantage shall be considered at application of welding. Choose the wrong one from the following mentions.
   a.) Welding joint will be able to get the same strength and same mechanical properties with the base material.
   b.) Construction work will be simple and easy and construction cost will be reduced.
   c.) Welding appearance is very important, so the inspection of weld metal inside will not be required.
   d.) Welding sequence shall be considered to reduce deformation and residual stress, at restrain part specially.
3. For SMAW which formally named shielded metal arc welding and generally talked manual welding, welding machine will be used drooping type or constant current type. If the arc length, which is the distance between electrode and base metal, will be longer, arc voltage and welding penetration are how to change. Choose the correct one from the following mentions.
   a.) arc voltage to be higher and penetration to be deeper
   b.) arc voltage to be higher and penetration to be shallower
   c.) arc voltage to be lower and penetration to be deeper
   d.) arc voltage to be lower and penetration to be shallower
4. Mechanical properties of weld metal shall be formed by various materials and have influence on the surrounding condition. Choose the unrelated one from the following mentions.
   a.) chemical composition of base material
   b.) chemical composition of electrode and flux
   c.) humidity of atmosphere and wet on base metal
   d.) diameter of electrode
5. The flux of SMAW has important roles to get sufficient weld metal. Choose the unrelated one from the following mentions.
   a.) arc stability and isolation from the atmosphere b.) alloy elements c.) deoxidization and nitration
   d.) stress release
6. Welding machine and instruments shall be carefully treated and maintained to prevent electric loss and welding disaster. Choose the wrong one from the following mentions.
   a.) Electric terminal, electrode holder, cable and cable connector shall be confirmed the insulation condition before welding.
   b.) Welding machine shall be earthed.
   c.) If rest time is short, removal electrode from holder is not necessary.
   d.) Working table and welding pieces shall be connected to welding machine by electric cable.
7. At welding, before welding and after welding, welding procedure shall be executed properly. Choose the wrong one from the following mentions.
   a.) Groove inside and surface near groove shall be cleaned before welding.
   b.) If electrode is wet, it must be dried and drying temperature is higher is better.
   c.) If groove gap is big and out of standard, its groove shall be repaired in according to repairing procedure before welding.
   d.) As if tack weld is temporal, tack welding shall be executed carefully as same as regular welding not to arise weld defects.
8. Each weld defect has characteristic and its dangerous level is different depend on the purpose of structure. Supposed shipbuilding, at skin plate and internal member of midship, which defect is most dangerous? Choose the most dangerous one from the following mentions.
   a.) many porosities at butt joint on deck b.) very small crack at surface on deck
   c.) big slag inclusion at butt joint on deck d.) lack of penetration inside weld metal at butt joint on deck
9. At shipbuilding and repairing, welding sequence and procedure shall be carefully considered to reduce the deformation and residual stress, and prevent the crack propagation. Choose the wrong one from the following mentions.
   a.) Generally butt joint shall be welded previous to seam joint.
   b.) At repairing crack, small round hole shall be cut at the end of crack before welding.
   c.) At erection stage, fillet joint will be welded previous to butt joint.
   d.) At welding T type internal member, face plate butt joint will be welded previous to web plate.

10. As nondestructive test, visual test, magnetic particle test, penetration test, radiographic test and ultrasonic test are mainly used. Each test has characteristic and suitable test shall be applied depend on type of defects predicted. Choose the wrong one from the following mentions.
    a.) In order to inspect a micro crack on bead surface, penetration test will be used.
        penetration test penetration test
    b.) In order to inspect a crack on bead surface of austenite stainless steel (18Cr-8Ni), magnetic particle test will be used.
    c.) In order to inspect of pits of weld bead of carbon steel, both of penetration test and magnetic particle test will be used.
d.) In order to inspect of slag inclusion, penetration test and magnetic particle test are not used.
11. Welding speed will correspond to welding melting ratio which depends on welding method. Choose the biggest one from the following welding methods.
    a.) SMAW (manual arc welding) b.) SAW (submerged arc welding)
    c.) MAG (CO_2 semi automatic welding) d.) TIG (tungsten inert gas welding)
12. Regarding welding machine, mainly drooping type, constant current type and constant voltage type are used in according to kind of welding method. Choose the wrong one from the following mentions.
    a.) For manual welding, drooping type or constant current type will be used.
    b.) For TIG welding of carbon steel, constant current type will be used.
    c.) For TIG welding of stainless steel, alternative current type will be used.
    d.) For CO_2 semi automatic welding, constant current type will be used.
13. At welding of skin plate of 40kg/mm2 ordinary strength steel in restrain condition like as on deck at erection stage, residual stress will arise at the welding joint. Choose the residual stress level at the above condition from the followings.
    a.) Roughly 35kg/mm2 b.) Roughly 20kg/mm2 c.) Roughly 10kg/mm2 d.) Roughly 5kg/mm2
14. As heat treatment, mainly quenching, tempering, annealing and normalizing are used. Some method will be applied for the purpose to increase the strength and hardness. Choose the one from the followings.
    a.) Quenching b.) Tempering c.) Annealing d.) Normalizing
15. Toughness is important factor for structure and indicated by the absorbed energy and fracture brittle ratio of Chirpy impact test. Choose the wrong one from the following mentions.
    a.) The absorbed energy is bigger, means that toughness is larger.
    b.) The brittle ratio of fracture face is bigger, means that toughness is smaller.
    c.) The transition temperature is high, means that toughness is higher.
    d.) Toughness and strength are different function, so each property shall be kept respectively.
16. Hardness at heat affected zone is important indication to evaluate the weldability of base material. Maximum hardness will correspond with Ceq of base material ($Ceq = C + 1/6\ Mn + 1/24\ Si$). Choose the wrong one from the following mentions.
    a.) Ceq is bigger, means that strength is higher.
    b.) Good steel is to be able to have strength as if Ceq is low.
    c.) Mn has function to increase strength, toughness and weld ability.
    d.) Ceq is bigger, means that toughness is bigger.
17. For inspection of inside of meld metal, radiographic test and ultrasonic test are used depend on the type of defects predicted and condition of structure. Choose the wrong one from the following mentions.
    a.) For inspection of crack of perpendicular direction to surface, radiographic test will be used.
    b.) For inspection of lamination of base material, radiographic test will be used.
    c.) For measurement of the depth of defect, ultrasonic test will be used.
    d.) For applying ultrasonic test, standard test piece shall be used always to adjust the distance, because the speed of sound of ultrasonic is different with the kinds of material to be inspected
18. In arc phenomenon, welding droplet will transfer to base metal and its moving style is classified to short arc, globular transfer and spray transfer depend on arc current and electric density. Choose the wrong one from the following mentions.
    a.) Generally short arc will be used by low current.
    b.) spray transfer Generally manual welding will be used in range of grobular transfer.
    c.) Spray transfer will be used in high current and arc condition will be stable.
    d.) Submerged arc welding is used by spray transfer.
19. At new ship building and ship repairing on a berth or in a dock, special safety attention shall be paid to prevent disaster. Choose the wrong one from the following mentions.
    a.) Scaffolding shall be prepared and equipped not to fall.
    b.) Oxygen and gas in a tank shall be checked before working.
    c.) If cutting and welding work will execute from outside to inside, inside condition shall be confirmed the existence of gas and material to burn.
    d.) When working will execute from inside to outside, attention to outside is not necessary.
20. Many welding methods have been developed in order to weld extremely thin plate, narrow gap thick plate, aluminum and special material. Some welding method shall be executed in a vacuum chamber. Choose this welding method from the followings.
    a.) plasma arc welding (b) electron beam welding (c) laser welding (d) friction welding

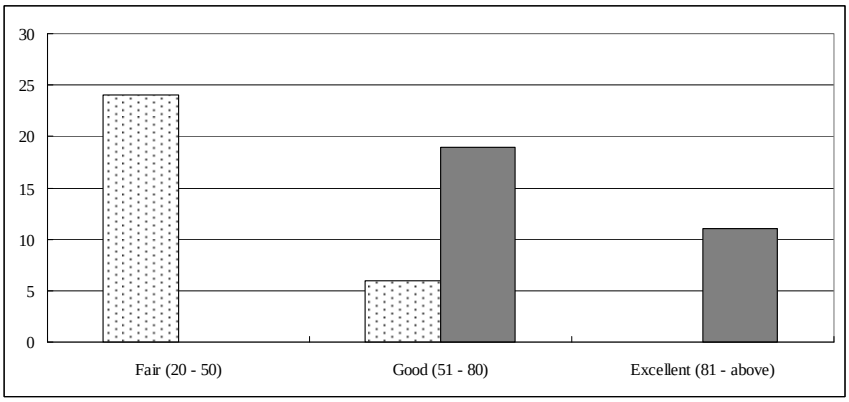
(2) Correct Answers and Response from Trainees

Correct or desired and wrong answers for each question are described below.

1. Correct answer is **c**.
   After welding work done, interior part of welded part cannot be seen by visual inspection. Welder's moral is very important to have good skill and knowledge.
2. Wrong answer is **c**.
   Welding appearance is important and interior part of welding is also very important, so interior part of welding shall be inspected by some method.
3. Correct answer is **b**.
   At using drooping type and constant current type, arc current is almost same as if arc voltage will change. If arc length is longer, arc voltage is higher. And penetration is shallower.
4. Unrelated answer is **d**
   As if diameter of electrode will change, chemical composition is almost same, so change of diameter will not give influence to the mechanical properties of welds.
5. Unrelated answer is **d**.
   Stress release will be applied for reducing residual stress and no relation with the role of flux of SMAW. Arc stability, isolation from the atmosphere, deoxidization and prevention of nitration are the roles of the flux of SMAW.
6. Wrong answer is **c.**
   As electrode will be grasped by holder, electric is running to the naked edge of electrode. At taking rest, electrode shall be removed from the holder to prevent electric shock.
7. Wrong answer is **b**.
   By too high temperature, too much time and too many periods, coating flux will have damages and some chemical material will evaporate from the coating flux.
8. Most dangerous answer is **b**.
   Crack has extreme sharp edge, so stress concentration is very large, so there is the dangerous risk of crack propagation.
9. Wrong answer is **c**.
   Generally butt joint shall be welded prior to fillet joint. Basically welding sequence will be carried out from big stress to small one.
10. Wrong answer is **b**.
    Austenite type of stainless steel has not magnetic characteristic, so magnetic force line will not arise and magnetic particles will not move.
11. The biggest melting ratio is **c**.
    MAG welding is highest melting speed at the same welding current.
12. Wrong answer is **d**.
    For CO2 semi-automatic welding, constant voltage type will be used to utilize the character of self control arc length.
13. Correct answer is **b**.
    Structure will shrink by welding at the restrain condition and some amount will elongate plastically as looping at the yield point, so residual stress will remain roughly yield stress level, which yield point of 40Kg/mm2 mild steel is roughly 22 - 24 Kg/mm2.
14. Correct answer is **a**.
    Quenching is applied to increase strength and hardness. Its crystal grain structure is micro but very hard and brittle. Generally after quenching, tempering treatment will be applied to recover the brittleness.
15. Wrong answer is **c**.
    The transition temperature is high, mean the brittle will arise at high temperature. So its toughness is weak at low temperature.
16. Wrong answer is **d**.
    Ceq is bigger, means hardness and strength is bigger, and material will be brittle and toughness will be weak as increasing hardness. Good material is, as if Ceq is low, strength and toughness are high, it means its material has good toughness and good weldability as if high strength.
17. Wrong answer is **b**.
    Radiographic test is utilized the contrast of film density of defect and defect free, so parallel to surface and thin defects like as lamination of steel is very difficult to detect.
18. Wrong answer is **d**.
    Arc of SAW (submerged arc welding) will berry in slag, so generally named as "berried arc".
19. Wrong answer is **d**.
    At shipbuilding and repairing, attention of safety shall be paid at both inside and outside.
20. Correct answer is **b**.
    Electron beam welding will be done mainly in a vacuum chamber.

Result of questions on understanding of welding knowledge is summarized in the chart below.

Questionnaire survey were performed two times, the first time before and second time after the Module 1 training. Full mark is 100 points in this questionnaire. In the first session of question, no one achieve excellent level score of more than 81, but eleven (11) trainees achieved excellent level in the second session of question survey.



No. of Trainees	Fair (20 - 50)	Good (51 - 80)	Excellent (81 - above)
First Test	24	6	0
Second Test	0	19	11

Figure E.2.2 Distribution chart classified understanding level

Questions of understanding welding knowledge are broadly composed of 5 categories;

a. Welding method and welding procedure,
b. Steel material and welding material, as well as their characteristic,
c. Welding machine and electric arc phenomenon,
d. Weld defect and deformation, and its countermeasure, and
e. Quality control and nondestructive test.

Among the five categories, category d) welding defect and e) quality control achieved comparatively higher score. The score on the category b) steel material and welding material, and category c) welding machine and electric are phenomenon were comparatively low.

Following chart shows balance score diagram revealed weakness and advantage of trainees' technical knowledge.

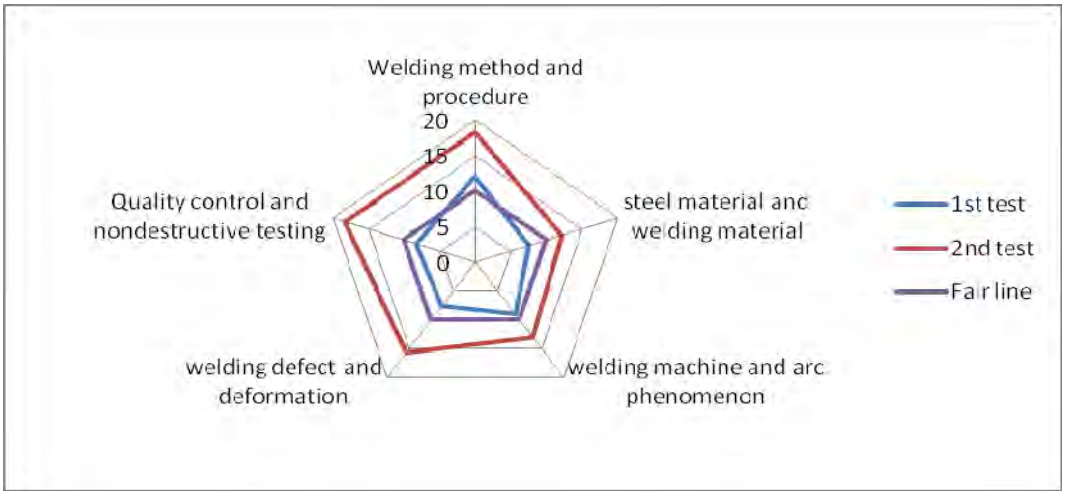


Figure E.2.3 Diagonal Chart of Understanding Level Classified by Five Categories

E.2.3 3 Practical Test

Practical tests were performed to evaluate achievement of technical skill through visual inspection of steel test piece welded and bended. During the course of Module 2A and 2B trainings, practical tests have been carried out one (1) time for officials/engineers and four (4) times/positions for skilled/group leaders.

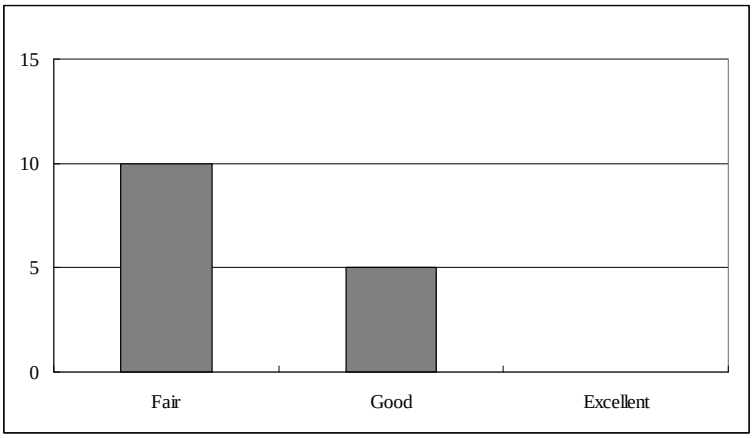
Table E.2.3 Practical Tests Performed

	Test for Welding position	Subject Trainee
(1) During Module 2A	1. Flat position	For Officials/Engineers
(2) During Module 2B	1. Flat Position	For Skilled/Group Leaders
	2. Vertical Position	For Skilled/Group Leaders
	3. Horizontal Position	For Skilled/Group Leaders
	4. Over-head Position	For Skilled/Group Leaders

Evaluation of welding practical test was performed on the following three aspects.

1) Bead appearance: Straightness of welding bead,
   - height of welding bead (low than 3 mm is desirable)
   - width of welding bead
     (less than 3 times electrode diameter is desirable)
   - Undercut (less than 0.5 mm is desirable)
   - Overlap (bead flank angle is desirable less than 90^{o})
2) Penetration condition: Judge by backing strip burned pattern.
3) Bend test: Face bend, Root bend (Side bend in case of thick plate).

Figure E.2.5 shows result of practical test performed for the officials/engineers. All members got the passing rate of more than “fair” and five (5) of fifteen (15) members got level of “good” rating.

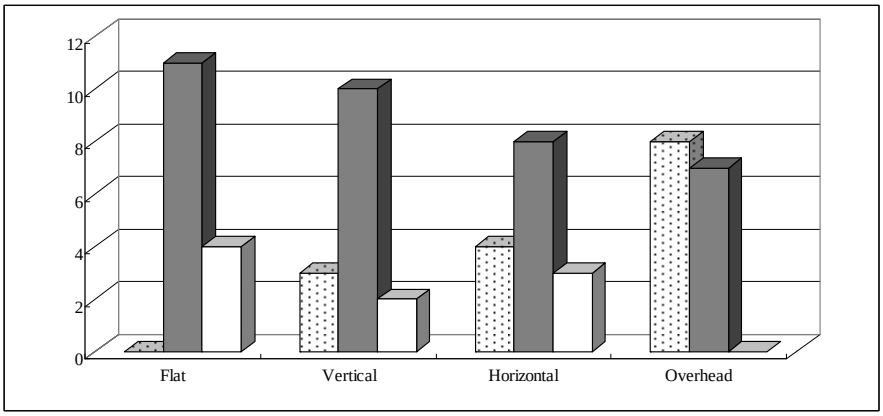


No. of participants	Fair	Good	Excellent
Flat Position	10	5	0

Figure E.2.4 Practical Welding Test Result for Officials/Engineers

For skilled/group leader training, tests were carried out for four (4) kinds of positions, flat, vertical, horizontal and over-head. Some of the trainees were not good at vertical welding at the beginning of the training, but all trainees passed each test finally.

Test results are shown in Figure E.2.6.



No. of Participants	Flat	Vertical	Horizontal	Overhead
Fair (5 - 5)	0	3	4	8
Good (7 - 8)	11	10	8	7
Excellent	4	2	3	0

Figure E.2.5 Practical welding results of skilled/group leaders

APPENDIX F

ENVIRONMENTAL SCOPING PLAN

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APPENDIX F ENVIRONMENTAL SCOPING PLAN

F.1 DATA OF EXAMINATION

Table F.1.1 Data of Examination

No.	Items	Description
1	Full title of the Project and relevant report	Pilot Project for the Urgent project for Rehabilitation of Yangon Port and main Inland Water Transportation in the Union of Myanmar.
2	Type of the study	Pilot Project for Development Study
3	Environmental category and reason for categorization	Environmental Category :B The Project consists of a small scale recovery works of the port facilities including concrete jetties and piling works, and is carrying out inside of the existing port area in the riverbank of Yangon River. Restoration work is not including any significant adverse effects to environment. The proposed project site is not located within an area of protected habitats of endangered species designed by the country's law and international treaties and conventions. Most of the anticipated negative impacts caused by the Project could be managed and minimized by proper project planning, design, construction and operational management of the port.
4	Agency or institution responsible for the implementation of the Project	Myanmar Port Authority (MPA)
5	Outline of the Project	1) Background of the project On the 2nd and 3rd of May 2008, Cyclone Nargis struck the coastal area of Myanmar and moved inland across the Ayeyarwady Delta, causing considerable human loss and damage to properties. The disaster caused widespread destruction of homes and vital infrastructures, including road and port facilities. The facilities and fleets of inland water transport were also battered severely, paralyzing its operation in distributing basic needs and commodities. In response to the official request of the Government of the Union of Myanmar for the rehabilitation of Yangon Port and the main inland water transport, the Government of Japan decided to conduct "the Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transport". The objectives of the Project are: -To make recovery plans of the Yangon port facilities, -To make recovery plans of the main inland water transport in the project area; and -To develop the capacity of MPA and IWT, through the implementation of the pilot project(s). 2) Proposed Pilot Project Restoration works for a part of Botahtaung Jetties 4, 5 and 6 concrete jetty with pontoon system and partial low stage floor adaptable for berthing and cargo handling under a wide range of 6m tide
6	Description of the Project site	Yangon Port is a river port located at the up stream of the river 32km far from Yangon estuary. This port is the biggest port in Myanmar and covered 100 % of import and 90% of export in the country. Locations of MPA jetties and dock yards are illustrated in Figure F.1.1. The project area shall cover Yangon Port and four major routes of inland water transport ways, operated by IWT, as listed below: Route 1: Yangon - Maubin - Myaungmya - Labutta - Kanbet Route 2: Yangon – Kyeikat – Bogale - Mawlamyinegyun Route 3: Myaungmya - Pathein, and Route 4: Kyeikat – Phyarpon Jetties and piers are mainly situated on the left bank of the Yangon River. Wharves including privately operated one for ocean going container or general cargo ships are located at four different locations, namely Ahlone Wharf, Myanmar Industrial Port (MIP), Sule Wharf, Bo Aung Gyaw Street.

7	Legal Framework of environmental and social considerations	One of the main problems of the existing environmental law is the absence of up-to-date laws that regulate pollution. There are also no regulations for environmental impact assessment (EIA) to examine the impact for the Project. Therefore, the Project shall be carried out according to the following major environmental legislations and policies: -National Environmental Policy -Myanmar Agenda 21 -Forestry Law 1992 -Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 1994 -Public Health Law -Ministry of industry Directive 1/95 -Territorial Sea and Maritime Zone Law 1977 Moreover, there are no authorized EIA systems for the Project in Myanmar. At present, A draft of a new environmental law was formulated by NCEA, however this draft is not including IEE and EIA system. The draft is not approved by the cabinet, and timetable of authorization and details for the laws are not yet known.
8	Alternative analysis	This Project is the Urgent Rehabilitation Project of Yangon Port facilities. “without project” option : All of rehabilitation work will be conducted by Myanmar government, it takes long times and recovery of the main inland water transport will be delayed. Alternatives: Damaged jetties will be repaired same as existing design conditions. In this case, if Cyclone struck the coastal area of Myanmar, jetties will be received serious damage again.
9	Result of stakeholder meetings	Stakeholder meeting is not held by the implementing organization of the project.
10	Scoping of environmental and social impact study	Refer to attached Table F.1.2 and Table F.1.3
11	Terms of Reference for Environmental and Social Considerations	Refer to attached Table F.1.4
12	Other relevant information	A part of rehabilitation work of jetties will be carried out in this Project as pilot project, and remained rehabilitation work will be completed by Myanmar government.

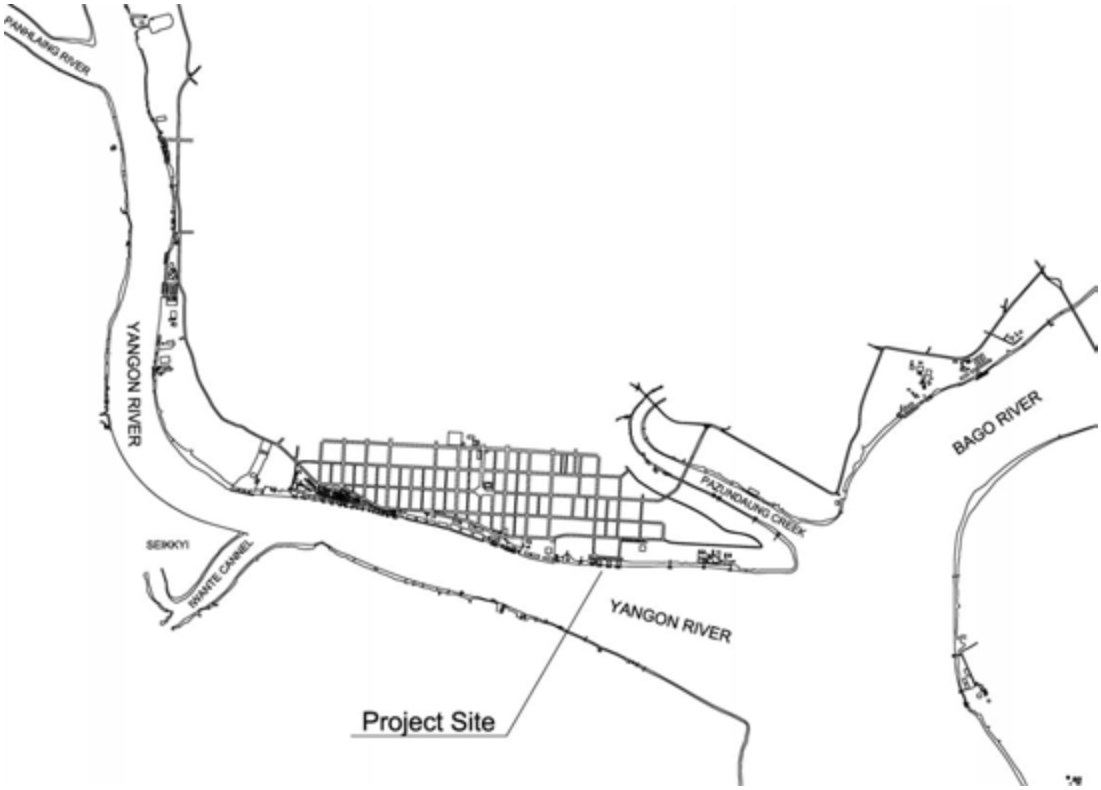

Figure F.1.1 Location of Yangon Port

Table F.1.2 Scoping for Restoration Works of Botahtaung Jetty

Name of Cooperation Project			Pilot Project for the Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transportation in the Union of Myanmar.	
Item			Rating	Reasons
Social Environment: *Impacts on "Gender" and "Children's Right" may be related to all social environment criteria.	1	Involuntary Resettlement	-	The port facilities (Jetty) will be restored in the existing port area, and Involuntary Resettlement is not anticipated by the project implementation.
	2	Local Economy such as Employment and Livelihood, etc	B	Project scale is not so large; however, local people will be employed as workers in this port restoration project. The Port Project will result in overall socio-economic improvement of those people living around the Project area and beyond and hence overall economic development of Myanmar. The Project will have a positive impact. The access route for the transportation of construction materials in the site is limited and there might some possibility to traffic congestion and disturbance of local traffic.
	3	Land Use and Utilization of Local Resources	-	Basically, the recovery Project will be conducted in the existing port or yard operated by MPA; as such, no change of land use and utilization. The Project will be make a positive impact.
	4	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	-	Yangon Port and port facilities are operated by MPA, and inland transportation was conducted by IWT under the Ministry of Transport. Environmental impact is not anticipated by the Project implementation.
	5	Existing Social Infrastructures and Services	-	Project can contribute a large scale benefit to the inland transportation in the country. The project will be made positive impact.
	6	The Poor, Indigenous and Ethnic people	-	There are no poor people, indigenous and ethnic minorities who live in the vicinity of the Project site.
	7	Misdistribution of Benefit and Damage	-	No misdistribution of benefit and damage was expected, instead many people can receive substantial benefit through the Port Rehabilitation Project.
	8	Cultural heritage	-	There is no local archaeological, historical, cultural and religious heritage site in the Project site. Botahtaung pagoda is located beside of access road to the port.
	9	Local Conflicts of Interest	-	The Project will be conducted in the existing Yangon Port, there are no local residents live in this area. No significant impact on the living conditions of inhabitants is anticipated and there are no local conflicts of interest.
	10	Water Usage or Water Rights and Communal Rights	-	Access channel and route of ships are prohibited in the Fishing operation by the government laws. Fishermen living at the mouth of the river and they carry out their fishing operation by small boats at the river in the bay area. No fishing village is observed in the vicinity of proposed Project site. Following facilities were observed in the vicinity of the Project site: -Container yards -Parking areas of trucks -Office building There are no water rights issues involved with the recovery of the Botatoung Jetties.
	11	Sanitation	-	The Project will not cause sanitation problems

	12	Hazards (risk) Infectious Diseases such as HIV/AIDS	B	There might be some possibility for disease to be introduced at the site and surrounding area, because of the expected migration of workers and local entrepreneurs during the construction period.
Natural Environment	13	Topography and Geographical Features	-	The existing port has been maintained at a water depth of 5m by maintenance dredging. All of dredged materials are disposed on shore at current stage.
	14	Soil Erosion	-	Soil erosion is observed in both of the river side, and operation organization (MPA) carry out maintenance dredging every day. Dredging and soil moving work is not included in this Project.
	15	Groundwater	-	A large number of households in the Yangon City utilize water from YCDC, Yangon Port utilize water from YCDC and have not own deep wells.
	16	Hydrological Situation	-	Due to muddy conditions of the river, the water has low transparency, and there is very low visibility in the river water at the expected project area.
	17	Coastal zone	-	2,229 km of Myanmar‘s coastline provide rich resources for fishing; however, the Project area is very far from the coastal zone. The proposed Project site is located in the existing Yangon Port. Bank of river at the existing jetty carried out bank protection and operation yard of Port covered with asphalt paving. No land reclamation and/or increasing land area is included in the Project. It is not anticipated to cause environment problems in river zone.
	18	Flora, Fauna and Biodiversity	-	The proposed Project site is not located within an area of protected habitats of endangered species designed by the country’s law and international treaties and conventions. There are no mangroves in the river at the vicinity of the proposed Project area.
	19	Meteorology	-	Large scale cyclones hit the country several times, however the Project will not cause change of meteorology.
	20	Landscape	-	The jetty will be repaired in the existing port area, however the landscape will not be altered significantly. No significant impact on the landscape is anticipated.
	21	Global Warming	-	Due to the small scale of the Project, serious global warming issues is not anticipated.
Pollution	22	Air Pollution	C	Exhaust gas and dust will be emitted or generated from the construction equipment and vehicles for transportation and facility construction. As for the ships, no significant negative impacts of air pollution are anticipated in the port, because the average number of ships that sail into the port is estimated very few.

	23	Water Pollution	B	The port is located at the up stream of Yangon River. Due to the muddy conditions of the river, the water has low transparency, and there is very low visibility in the river water at the expected project area. Due to the resulting disturbance of seabed soil during construction, it is anticipated that a part of the seabed soil will become suspended soils by the construction of foundations. There are no data of seabed soil quality presently.
	24	Soil Contamination	-	Soil contamination is not anticipated in the port.
	25	Waste	C	There are no oil treatment and oil disposal facilities in the existing port, it is anticipated that all of the effluent (bilge) from ships are treated by Dock yard / recycling company.
	26	Noise and Vibration	C	The expected noise sources during the construction are the piling work equipment and transportation vehicles. However, almost all construction work will be done inside the port area which is far from the residential area.
	27	Ground Subsidence	-	Ground subsidence is not observed.
	28	Offensive Odor	-	No odor source is anticipated, thus no control measures have been planned yet.
	29	Bottom Sediment	-	The seabed is almost covered by muddy soil at the river area. There are no data of bottom sediment
	30	Accidents	B	Operation of the port will potentially increase the overall traffic density in nearby areas, which may cause some traffic safety problems to the nearby residents, workers and visitors. The access route for the transportation of construction materials in the site is limited and there might be some possibility to traffic congestion and disturbance of local traffic.
		Overall rating	B	Project will be conducted in the existing Yangon Port. It is small scale and is remote from these important coastal ecological resources to cause any significant adverse effects. Most of the anticipated negative impacts caused by the project could be managed and minimized by proper project planning, design, construction and operational management of the port.

Rating;
A: Serious impact is expected,
B: Some impact is expected,
C: Extent of impact is unknown,
No Mark: No impact is expected. IEE/EIA is not necessary.

Table F.1.3 Terms of Reference

Tasks	Description
Introduction	State the purpose of TOR
Background information	Briefly describe the need for, objective of and major components of the proposal
Objective	Summarize the objective of the study
IEE requirement	Identify the regulation and guideline governing the conduct of the IEE and/or specify the contents.
Study area	Outline the project site, jurisdictional boundaries and affected area of the study.
Scope of work	Identify the tasks to be carried out, information deficiencies to be addressed.
Task 1 Description of proposed project	Provide a brief description of the study area, using maps
Task 2 Description of environment	Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area. Include information on any changes anticipated before the project commences.
Task 3 Legislative and regulatory considerations	Describe the pertinent regulations and standards governing environment quality, health and safety, protection of sensitive areas.
Task 4 Determination of the potential impacts of the proposed project	Distinguish the differences between significant positive and negative impact, direct and indirect impact, and immediate and long-term impact.
Task 5 Analysis of alternative to the proposed project	Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives which would achieve the same objective.
Task 6 Development of mitigation plan for negative impacts	Recommend feasible and cost -effective measures to prevent or reduce significant negative impact. -Air pollution, Water pollution, Noise and vibration
Task 7 Development of monitoring plan	Prepare monitoring plan to monitor the impact of the project during construction and operation.
Task 8 Public participation and inter-agency co-ordination	Describe necessity of public participation and distribution of project information
Report	Prepare IEE report for the project based on the field survey and collected data

Table F.1.4 Matrix for Scoping (Ports and Harbors)

Name of Cooperation Project			Pilot Project for the Urgent project for Rehabilitation of Yangon Port and main Inland Water Transportation in the Union of Myanmar.												
				Planning Phase		Construction Phase					Operation Phase				
	No.	Likely Impacts	Overall Rating	Land acquisition	Change of fishing zones, Land use, Restriction of activities	Reclamation of coastlines	Deforestation in coastlines	Alteration to ground by cut land, filling, drilling, etc.	Construction of Moorings, Seawalls, Water facilities, etc.	Operation of Construction Equipment and Vehicles	Drainage	Sailing/ Arrival & Departure of Ship	Operation of Port Facilities	Increase of Traffic Volume	Appearance/ Occupancy of Building Structure
Social Environment * the impacts on "Gender" and "Children's Right" might be related to all criteria of Social Environment.	1	Involuntary Resettlement	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Local economy such as employment and livelihood, etc.	B	-	-	-	-	-	B	B	-	+B	+B	B	-
	3	Land use and utilization of local resources	B	-	-	-	-	-	B	B	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	Existing social infrastructures and services	B	-	-	-	-	-	-	-	-	-	+A	B	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	Misdistribution of benefit and damage	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Water Usage or Water Rights and Rights of Common	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	Sanitation	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Hazards (Risk) Infectious diseases such as HIV/AIDS	B	-	-	-	-	-	B	B	-	-	-	-	-
Natural Environment	13	Topography and Geographical features	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	Groundwater	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	Hydrological Situation	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Coastal Zone	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	Flora, Fauna and Biodiversity	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	Meteorology	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Landscape	-	-	-	-	-	-	-	-	-	-	-	-	-
	21	Global Warming	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	22	Air Pollution	C	-	-	-	-	-	C	-	-	-	-	-	-
	23	Water Pollution	B	-	-	-	-	-	B	C	-	-	-	-	-
	24	Soil Contamination	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Waste	C	-	-	-	-	-	C	-	-	-	C	-	-
	26	Noise and Vibration	C	-	-	-	-	-	C	-	-	-	C	-	-
	27	Ground Subsidence	-	-	-	-	-	-	-	-	-	-	-	-	-

	28	Offensive Odor	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Bottom sediment	-	-	-	-	-	-	-	-	-	-	-	-	-
	30	Accidents	B	-	-	-	-	-	B	-	-	-	+A	B	-

Rating:

A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses)

+ : Positive impact

No mark: No impact is expected. IEE/EIA is not necessary.

Reference:

1) Japan International Cooperation Agency (1992) “I Ports and Harbors: Environmental Guidelines for Infrastructure Projects”, Tokyo, Japan.

2) Norman Lee and Clive George (2002) “Environmental Assessment in Developing and Transitional Countries”, JOHN WILEY & SONS, LTD., London, England.

Table F.1.5 Study of Alternative Plan

		Item	Proposed Plan	No Action	Alternative
Social Environment: *Impacts on "Gender" and "Children's Right" may be related to all social environment criteria.	1	Involuntary Resettlement	*	*	*
	2	Local Economy such as Employment and Livelihood, etc	**++/B**	**--/B**	**++/C**
	3	Land Use and Utilization of Local Resources	**++/B**	*	**++/C**
	4	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	*	*	*
	5	Existing Social Infrastructures and Services	**++/A**	**--/B**	**++/A**
	6	The Poor, Indigenous and Ethnic people	*	*	*
	7	Misdistribution of Benefit and Damage	*	*	*
	8	Cultural heritage	*	*	*
	9	Local Conflicts of Interest	*	*	*
	10	Water Usage or Water Rights and Communal Rights	*	*	*
	11	Sanitation	*	*	*
	12	Hazards (risk) Infectious Diseases such as HIV/AIDS	**--/B**	*	**--/B**
Natural Environment	13	Topography and Geographical Features	*	*	*
	14	Soil Erosion	*	*	*
	15	Groundwater	*	*	*
	16	Hydrological Situation	*	*	*
	17	Coastal zone	*	*	*
	18	Flora, Fauna and Biodiversity	*	*	*
	19	Meteorology	*	*	*
	20	Landscape	*	*	*
	21	Global Warming	*	*	*
Pollution	22	Air Pollution	--/C	*	--/C
	23	Water Pollution	--/B	*	--/B
	24	Soil Contamination	*	*	*
	25	Waste	--/C	*	--/C
	26	Noise and Vibration	--/C	*	--/C
	27	Ground Subsidence	*	*	*
	28	Offensive Odor	*	*	*
	29	Bottom Sediment	*	*	*
	30	Accidents	**++/A**	--/A	**++/B**
Overall rating			**++/B,**--/C	**--/B**	**++/C,** --/C

Note: --/B: Left hand side of each cell represents a direction of impact, right-hand side represents a magnitude of impact.
++: Positive impact --: Negative Impact =: Neutral Impact
A: Serious impact is expected, B: Some impact is expected, C: Extent impact is unknown
*: No impact or no corresponding impact

Table F.1.6 Format for Project Description (Port and Harbors)

Item	Description
Name of Cooperation Project	Pilot Project for the Urgent project for Rehabilitation of Yangon Port and Main Inland Water Transportation in the Union of Myanmar.
Project Proponent	MPA
Background	On the 2nd and 3rd of May 2008, Cyclone Nargis struck the coastal area of Myanmar and moved inland across the Ayeyarwady Delta, causing considerable human loss and damage to properties. The disaster caused widespread destruction of homes and vital infrastructures, including road and port facilities. The facilities and fleets of inland water transport were also battered severely, paralyzing its operation in distributing basic needs and commodities.
Objectives	-Rehabilitation of Botahtaung Jetty 4,5 and 6
Location	-Existing Botahtaung Jetty 4,5 and 6
Population of Beneficiaries	48.8 million
Project Components	-Piling work -Rehabilitation of the existing jetties
Type of Project	Construction (Restoration of the existing jetties)
Type of Port	External/ Internal, Commercial Cargo/Passenger
Demand in general	Cargo: 5.9ton (MPA + IWT) IIWT+MPA) (In year of 2009) Passengers: 27.4 million person (In year of)
Moorings	Jetty Length 130 m
Fringe Facilities (length)	Jetty
Water Facilities (depth)	Depth of Water 9.5m (During the High water level)
Dredging / Reclamation	Not required
Related Development	Remained restoration work will be carried out by Myanmar Government
Others	

Note: The format should be filled in on the basis of the available existing data and information.

APPENDIX G

INITIAL ENVIRONMENTAL EXAMINATIONS

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APPENDIX G INITIAL ENVIRONMENTAL EXAMINATIONS

G.1 GENERAL

As of October 2013, Myanmar has no detailed legal process for the Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) in place. However, the Ministry of Environmental Conservation and Forestry (MOECAF) has been drafting the EIA/IEE Procedures which defined the detailed legal process regarding preparation of EIA/IEE report, Environmental Management Plan (EMP), public involvement, approval of EIA/IEE report by MOECAF etc. It is expected that the procedures of EIA/IEE system will be authorized within this year..

G.2 BACKGROUND OF THE PROJECT

The Dalla Jetty area located near the entrance of Yangon Port faces to the main stream of the Yangon River which empties into the sea and has a wide water area having long fetch over the water. As experienced during Nargis, this area was exposed to the severe natural conditions such as high waves, fast currents and strong winds which caused devastating damage to the pontoon jetties.

Taking into account the severe natural condition of the Dalla area, the structure of Jetty to be renovated at this area should be a more robust structure compared to the previous type to avoid recurrence of damages by possible cyclones in the future.

G.3 PURPOSE OF IEE

The project activities could create adverse impact to the natural and social environment on the surrounding areas caused by carrying out the works. The project if not well planned and implemented properly may lead to delays and improvement of Dalla Jetty would not be done. Capacity of inland transportation will not be improved and the recurrence of damages by possible cyclones in the future cannot be avoided.

The purpose of this IEE is to:

- Investigate the area that would be directly and indirectly affected by the implementation of the proposed project;
- Identify significant environmental and social issues due to the project location, construction, and operation;
- Ensure that environmental considerations are integrated into the project planning and design activities ;
- Ensure that a high standard of environmental performance is planned and achieved for the project ;
- Ensure that environmental and social aspects and impacts are identified, quantified where appropriate, and assessed and mitigation measures proposed;

- Recommend measures to mitigate the adverse effects and/or enhance the beneficial effects of the proposed project;
- Develop an Environmental Management Plan (EMP) for construction project and operation.

G.4 METHODOLOGY OF IEE

An Initial Environmental Examination (IEE) was carried out based on the execution plan for "The Pilot Project of Restoration of Dalla Ferry Terminal Jetty at Dalla Side". The IEE report was prepared according to Screening and Scoping Methodology using existing data and results from a site survey conducted by the JICA project team. Mitigation plan was prepared according to the results of environmental Study.

The purpose of the IEE is to identify the preliminary negative impact and mitigation measures through Screening and Scoping (For results and conditions of the Screening and Scoping. Environmental Scoping Plan). If an Environmental Impact Assessment (EIA) or future study is required at the next stage, environmental and social considerations for the project shall be provided based on this IEE report.

The IEE covers the assessment of physical resources, biological resources, and socio-economic aspects of the proposed improvement project covering the area in the project site.The IEE is based on the project design with proposed facilities for the Restoration of Dalla Ferry Terminal Jetty. Project such as construction of Jetty and Passenger Terminal Building including auxiliaries such as power and water supply, etc. The IEE process is closely linked to the project life cycle elements typically used to characterize the project development. Collectively, the individual phases of project development and evaluation constitute a systematic approach to the assessment of the proposed project in the context of the natural and social environment and the prevailing guidelines.

1) An important part of the IEE process involves developing a detailed understanding of the features and characteristics of the environmental and social setting surrounding the project area which is likely to be affected by the execution of the project.
2) The IEE process commences informally at the prior stage as key elements of the project development, followed by a formal stage that starts with a scoping exercise and preliminary consultation with stakeholders for identification of the key issues associated with the project.
3) Potential hazards to the environment and personnel to be involved in both construction and operational phases of the project are identified through comprehensive baseline study in the project area and the potential risks are assessed preliminarily. The outcomes are reflected to the planning for improvement.
4) In accordance with the environmental and social baselines and the risks involved in the project, particular environmental and social aspects of the project are identified.
5) The planned protection and mitigation measures for the identified environmental and social impacts in the project are assessed.
6) And the Draft IEE report are disclosed and reviewed.

Throughout this procedure, a suitable protection and mitigation measures for potential environmental and socio-economic aspects are developed and reflected in the design, construction and operation plans of all phases of the project.

G.5 PROJECT DESCRIPTION

G.5.1 NAME OF THE PROJECT

The Pilot Project of Restoration of Dalla Ferry Terminal Jetty at Dalla Side under the Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transport Republic of the Republic of Union of Myanmar.

G.5.2 PROJECT OWNER

Name : Japan International Cooperation Agency (JICA) Myanmar Office

Address : #701, 7th Floor, Sakura Tower, No.339, Bogyoke Aung San Road,

Kyauktada Town Ship, Yangon, Myanmar

Telephone : +95 1 255473 ~ 6

Facsimile : +95 1 255477

Relevant Organization: Myanma Port Authority (MPA)

: Inland Water Transport (IWT)

G.5.3 PROJECT ORGANIZATION STRUCTURE

The organization structure at construction phases for the restoration of Dalla ferry terminal is proposed as shown in Figure G.5.1 and Figure G.5.2. The Project proponent is the construction work of Jetty and related facilities. The outsourced contractor will establish a project office where the implementation of the construction work will take place. Also the outsourced Consultant (Nippon koei) will conduct supervision of the construction work, environmental and social consideration, and so on. Overall project management will be done by JICA .

G.5.4 COMPONENTS OF THE PROJECT

In this project following items of construction will be carried out, layout plan is shown in the drawings of Figure G.5.3.

No.	Item	Quantity	Remarks
1.	New Porter Way (East and West)	2	RC pile foundation with roof
2.	New Accessway	1	RC pile foundation
3.	New Movable Steel Bridge	2	Steel structure with roof. Installation of the steel bridge.
4.	New Slipway	1	Pile foundation including staircase.
5.	Passenger Terminal Building (Demolish and Construct)	1	Footing foundation
6.	Concrete Coating of Pontoon	2	Steel Pontoon provided by others
7.	New Walkway	1	Concrete block and concrete pavement

Figure G.5.1 Perspective View of Proposed Dalla Jetty

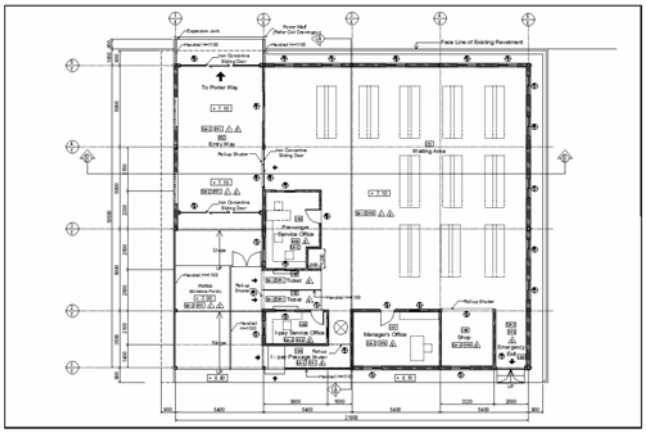


Figure G.5.2 Plan of Passenger Terminal Building

Figure G.5.3 Elevation of Passenger Terminal Building

G.5.5 PROJECT AREA

(1) Study area

Yangon City stretches east to west along the Yangon River. South from the railway is the central district of Yangon. Many government buildings are located in this area, especially near the river. The hinterland of Yangon City is on the southern side of the river. In the Dalla Township there are villages with paddy fields, fruit and poultry farms, as well as a few industries such as ship repair yards. There are many ferry boats between Yangon City and Dalla side. Yangon is also connected by waterway to the Ayeyarwady and Bago divisions.

Yangon Port is a river port located 32km upstream from the Yangon Estuary of the Andaman Sea. The topographic location maps of the port project are shown in Figures G.5.4 and Figure G.5.5.

The proposed site of the pilot project is located at Dalla Township and western port of Yangon Port. Yangon Port is the biggest port in Myanmar covering 100% of imports and 90% of exports for the country.

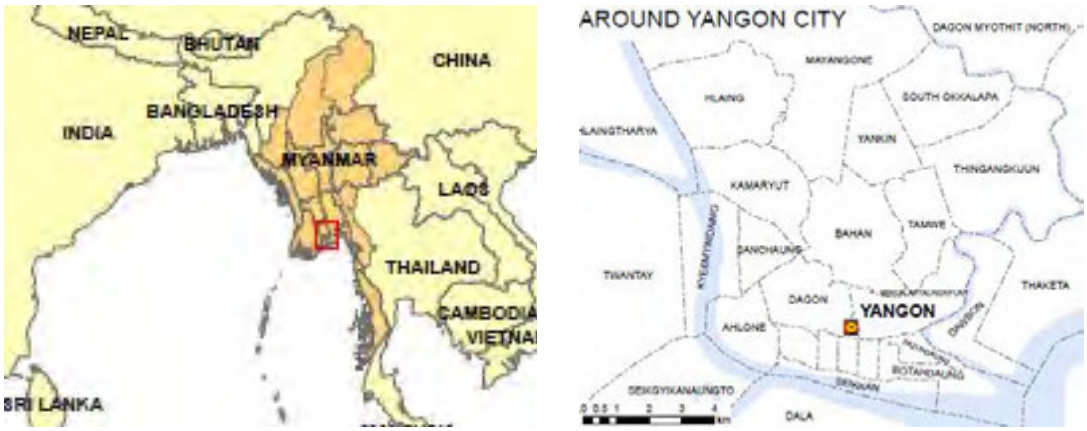


Figure G.5.4 Location of Yangon City

Figure G.5.5 Location of Dalla Ferry Terminal

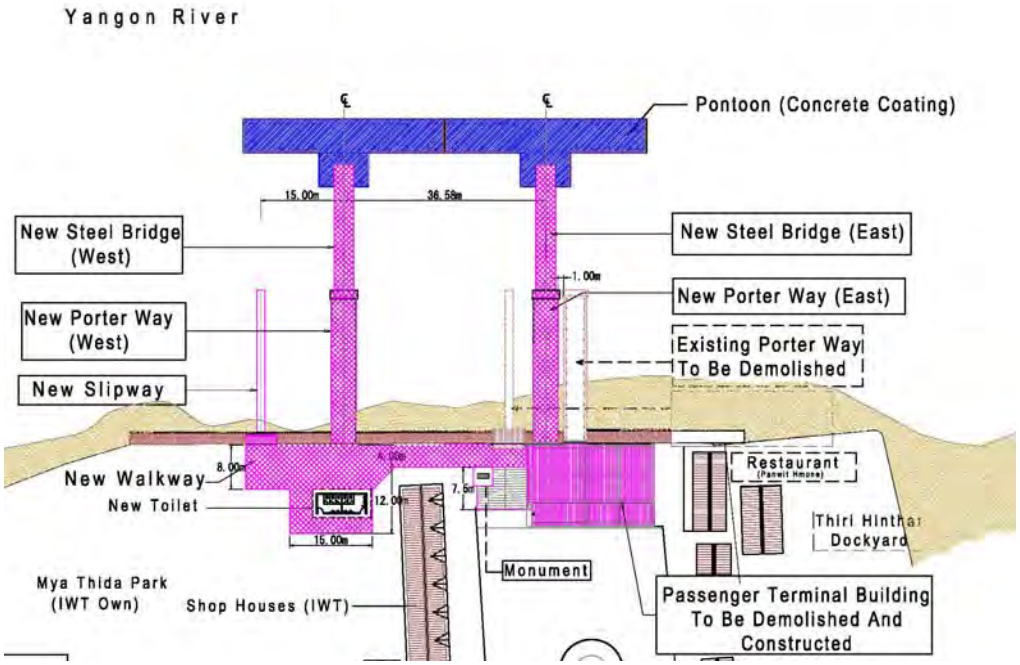


Figure G.5.6 Site Plan of Project Area

Existing Dalla Jetty (1)

Existing Dalla Jetty (2)

Access Road to Dalla Jetty (1)

Access Road to Dalla Jetty (2)

Access Road to Dalla Jetty (3)

Housing Area

View of Yangon River (Opposite Shore)

Hinterland of Project Site (Rice Field)

Photo G.5.1 View of Proposed Project Sites

G.5.6 PROJECT IMPLEMENTATION SCHEDULE

The overall implementation schedule of the The Pilot Project of Restoration of Dalla Ferry Terminal Jetty is planned as follows.

- Engineering services of the project such as detailed design and preparation of tender documents were carried out from December, 2012 to November, 2013.

- Tendering for the construction work was started with prequalification of prospective tenderers in December, 2013.
- Commencement of the construction work by January 2014 and completion of the construction works by the end of October 2014..
- Starting of operation: From November 15th 2014.

G.6 ENVIRONMENTAL LAWS AND REGULATION

G.6.1 ENVIRONMENT LAWS AND REGULATIONS IN MYANMAR

Presently, there are no regulations in place requiring an environmental impact assessment to examine the impact of the project for the pilot project. “Protection and Improvement of the Environment in the Myanmar” was issued as environmental conservation Law in 2012. Based on this Law, MOECAF started study of details for Environmental Conservation Rules presently and which will be promulgated by the Government.

Myanmar has 36 ministries under the Office of the President. The leading ministries in charge of environmental and social consideration are the Ministry of Environmental Conservation and Forestry (MOECAF) and the Ministry of Social Welfare, Relief and Resettlement (MSWRR). The Project shall be carried out according to the following major environmental related legislations and policies.

- Forestry Law (1992)
- Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 1994
- Public Health Law (1972)
- Factory Act (1951)
- Territorial Sea and maritime Zone Law (1977)
- National Environment Policy (1994)
- Freshwater Fisheries Law (1991)
- Law on Aquaculture (1989)
- The Conservation of Water Resources and Rivers Law (October, 2006)
- Environmental Conservation Law (2012)
- Draft Environmental Conservation Rules (under legislation, February 2013)
- Draft EIA Procedures (in process)
- Myanmar Agenda 21
- Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 1994

(1) Waste Effluent Standards

The directive on water pollution control issued by the Ministry of Industry prescribes the effluent discharge permitted, and the maximum level of effluent discharging waste water allowed to enter into public water.

Table G.6.1 Waste Effluent Standard

No	Items	Allowable Rate	Unit	Notes
1.	BOD (5days at 20·℃)	max 20-60	ppm	Depending on geography of waste discharging point
2.	Suspended Solids	max 30	ppm	
3.	Dissolved solids	max 2,000	ppm	
4.	pH Value between 5 and 9 Permanganate value	max 60	ppm	
5.	Sulphide (as HS)	max 1	ppm	
6.	Cyanide (as HCN)	max 0.2	ppm	
7.	Oil and grease	max 5	ppm	
8.	Tar	none	-	
9.	Formaldehyde	max 1	ppm	
10.	Phenols and cresols	max 1	ppm	
11.	Free chlorine	max 1	ppm	
12.	Zinc	max 5	ppm	
13.	Chromium	max 0.5	ppm	
14.	Arsenic	max 0.25	ppm	
15.	Copper	max 1.0	ppm	
16.	Mercury	max 0.005	ppm	
17.	Cadmium	max 0.03	ppm	
18.	Barium	max 1.0	ppm	
19.	Selenium	max 0.02	ppm	
20.	Lead	max 0.2	ppm	
21.	Nickel	max 0.2	ppm	
22.	Insecticides	None	-	
23.	Radioactive Materials	None	-	
24.	Temperature	max 40	ºC	
25.	Colour and Odour	-	-	Not objectionable when mixed in receiving water

Source: Ministry Industry, N0.1 Directive 1/95

(2) WHO Guidelines for Community Noise

There is no noise standard of construction activities to receptors in Myanmar and International Organization's standards such as WHO and Environmental, Health, and Safety (EHS) guidelines prepared by International Finance Cooperation (IFC) in a group member of World Bank, therefore the target noise level at construction stage is set based on the standard in the other foreign countries and international guidelines.

The WHO guideline values in Table G.6.2 are organized according to specific environments. When multiple adverse health effects are identified for a given environment, the guideline values are set at the level of the lowest adverse health effect (the critical health effect). An adverse health effect of noise refers to any temporary or long-term deterioration in physical, psychological or social functioning that is associated with noise exposure. The guideline

values represent the sound pressure levels that affect the most exposed receiver in the listed environment.

The time base for LAeq for "daytime" and "night-time" is 16 hour and 8 hour, respectively. No separate time base is given for evenings alone, but typically, guideline value should be 5 –10 dB lower than for a 12 hour daytime period.

Table G.6.2 WHO Guideline Values for Community Noise in Specific Environment

Specific Environment	Critical health effect(s)	L_{Aeq} (dB)	Time base (Hours)	L_{Amax}, fast (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
Outdoor living area	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Dwelling, indoors, inside bedrooms	Sleep disturbance, night-time	30	8	45
Industrial, commercial, shopping and traffic areas, indoors and Outdoors	Hearing impairment	70	24	110

Source:WHO Guideline for community Noise. WHO, 1999

(3) Air Quality

There is no Air Quality standard of construction activities to receptors in Myanmar, therefore, the target air quality level at construction stage is set based on the standard in the other foreign countries and international guidelines. The Air Quality standard in Japan and Thailand is set as guideline values. Table G.6.3 are organized according to specific environment conditions for construction and port operation stage.

Table G.6.3 Environmental Quality Standard

Parameter	Unit	Environmental Standard (24h)	
		Thailand	Japan
Sulfur dioxide: SO_2	ppm	<0.12	<0.04
Carbon monoxide: CO	ppm	-	<10
Nitrogen dioxides: NO_2	ppm	-	<0.04~0.06
Total suspended particle: TSP	mg/m^3	<0.33	-
Particle matter 10: PM10	mg/m^3	<0.12	-

Source: Notification of National Environmental Board No.10, No.24, No.28
Environmental Standard for Air in Japan

(4) JICA's Policy

JICA's policy provides active support to projects that promote environmental conservation and to projects that contribute to the protection of the global environment, such as projects to reduce greenhouse gas emissions. JICA also has a policy of being actively involved in the support of enhancing environmental and social considerations in developing countries. This project has been categorized as Category B according to JICA's social and environmental guidelines, since some negative impacts are expected by the Project during its construction stage.

G.7 ALTERNATIVES

At a conceptual level in the earliest stage of project planning, an important step in defining a project is to identify viable alternatives to the project so that a workable base-case design may be realized. Consideration of project alternatives occurs at two levels as follows:

- No project option
- Project will be done by Myanmar Government similar to existing design

(1) No Action Alternative

The no action alternative would mean that the improvement of Jetty would not be done if the potential adverse environmental impacts are found to be severe. The final result would be that the renovation of Jetty will not be completed, and if cyclone struck the coastal area of Myanmar, the Jetty will be expected to receive serious damage again. Further, the inland transportation will also receive serious impact and a huge amount of budget for rehabilitation work will be necessary in the future. The state of the existing concrete made Jetty is now seriously deteriorated because of insufficient maintenance being conducted after the construction. In case Jetty is not improved, the condition of the concrete structure will be become more serious in bad state.

The comparison of the various considered project alternatives showed that the proposed project will not cause severe adverse environmental impacts if appropriate mitigation and monitoring measures are identified and fully incorporated during the project design and implementation stages.

(2) Project will be Done by Myanmar Government Similar to Existing Design

In this case, all of the necessary budget have to be prepared by Myanmar Government and the arrangement needed for the required budget may take a long time. In addition, if the facility is constructed with the similar design, and if cyclone struck the coastal area of Myanmar again, the Jetty is expected to experience serious damage again. Further, the inland transportation will also receive serious impact and a huge amount of budget for rehabilitation work is necessary in the future.

Table G.7.1 Evaluation of Alternative Plan

Item			Proposed Plan	No Action	Alternative
Social Environment: *Impacts on "Gender" and "Children's Right" may be related to all social environment criteria.	1	Involuntary Resettlement	D	D	D
	2	Local Economy such as Employment and Livelihood, etc	**+B**	**-B**	**+B**
	3	Land Use and Utilization of Local Resources	**D**	D	**C**
	4	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	D	D	D
	5	Existing Social Infrastructures and Services	**+A**	**-A**	**+A**
	6	The Poor, Indigenous and Ethnic people	D	D	D
	7	Misdistribution of Benefit and Damage	D	D	D
	8	Cultural heritage	D	D	D
	9	Local Conflicts of Interest	D	D	D
	10	Water Usage or Water Rights and Communal Rights	D	D	D
	11	Sanitation	D	D	D
	12	Hazards (risk) Infectious Diseases such as HIV/AIDS	**-B**	-A	-A
Natural Environment	13	Topography and Geographical Features	D	D	D
	14	Soil Erosion	D	D	D
	15	Groundwater	D	D	D
	16	Hydrological Situation	D	D	D
	17	Coastal zone	D	D	D
	18	Flora, Fauna and Biodiversity	D	D	D
	19	Meteorology	D	D	D
	20	Landscape	D	D	D
	21	Global Warming	D	D	D
Pollution	22	Air Pollution	C	D	C
	23	Water Pollution	C	D	C
	24	Soil Contamination	D	D	D
	25	Waste	C	D	C
	26	Noise and Vibration	-B	D	-B
	27	Ground Subsidence	D	C	C
	28	Offensive Odor	D	D	D
	29	Bottom Sediment	D	D	D
	30	Accidents	**-B**	-A	**-A**
Overall rating			**-B**	**-A**	**-A**

Rating;
A: Serious impact is expected,
B: Some impact is expected,
C: Extent of impact is unknown,
D: No Impacts or Impacts are negligible, no further study required
+: Positive impact, -: Negative impact

G.8 TOR FOR SCOPING AND ENVIRONMENTAL CONSIDERATION SURVEY

The purpose of scoping is to select evaluation indicators concerned with environmental and social impact which project could bring and to decide the methodology of survey. The result of scoping is shown in Table G.8.1 and description of survey's TOR is detailed is shown Table G.8.2.

Table G.8.1 Scoping of Environment Impact for Restoration Works of Jetty

Item			Rating		Reasons
			BC/DC Stage	Operation Stage	
Social Environment: *Impacts on "Gender" and "Children's Right" may be related to all social environment criteria.	1	Involuntary Resettlement	D	D	(During construction) The port facilities (Jetty) will be restored in the existing port area, and no Involuntary Resettlement of residents needed in the project implementation.
	2	Local Economy such as Employment and Livelihood, etc	+B	+B -B	(During construction) 1).Project scale is not so large; however, local people will be employed as worker in this port restoration project. The project will be made positive impact. (During operation) 2). The project will result in overall socio-economic improvement of those people living around the project area. In the operation stage, the access route for the transportation is limited and there might some possibility of traffic congestion by increased number of passengers in the future.
	3	Land Use and Utilization of Local Resources	D	D	(During construction) Basically, recovery project will be conducted in the existing Dala Port or yard operated by IWT; as such, no change of land use and utilization. There are many street stalls and small restaurants along to access road to the existing jetty, however this road is not utilized for the project.
	4	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	D	D	(During construction) No residents live in the prospected Project area in the construction stage, only a limited environmental impact would be occurred.
	5	Existing Social Infrastructures and Services	+A	+A	(During operation) Project can contribute a large scale benefit to the inland transportation in the country. The project will be made positive impact.
	6	The Poor, Indigenous and Ethnic people	D	D	(During operation) There are no poor people, indigenous and ethnic minorities who live in the vicinity of the project site.
	7	Misdistribution of Benefit and Damage	D	D	(During operation) No misdistribution of benefit and damage was expected, instead many people can receive substantial benefit through the port rehabilitation project.
	8	Cultural heritage	D	D	(During construction) There are no local archaeological, historical, cultural and religious heritage site in and around the project site. No impact to the environment is anticipated.
	9	Gender	D	D	(During construction and operation) No negative impact to the gender is anticipated by this Project, but it will be confirmed through the field survey.
	10	Children's rights	D	D	(During construction and operation) No negative impact to the children's rights is anticipated by this Project, but it will be confirmed through the field survey.
	11	Local Conflicts of Interest	D	D	(During construction) Project will be conducted in the existing Dalla Port, there are no parmanent local residents live in this area.

	12	Water Usage or Water Rights and Communal Rights	D	D	(During operation) Access channel and route of ships are prohibited fishing operation by the government laws.
	13	Public Health	D	D	(During construction) Workers' camp will not be constructed during construction stage, No negative impact to the public health is anticipated.
	14	Hazards (risk) Infectious Diseases such as HIV/AIDS	-B	D	(During construction) There might be some possibility for disease to be introduced at the site, because of the expected migration of many workers from other region.
Natural Environment	15	Topography and Geographical Features	D	D	(During construction) There are no natural forest in the hinterland areas adjacent to the project site. A part of riverbank of Yangon River is covered with palm tree though almost all of the coast areas are situated in clayey sand.
	16	Soil Erosion	D	D	(During construction) Soil erosion is not observed around proposed project area.Transportation of locally procured construction materials will be transported by vessels in this project.
	17	Groundwater	D	D	(During construction) A large number of households in the Yangon City utilize water from YCDC, Yangon Port utilize water from YCDC and have not own deep wells. There are no water distribution line from YCDC in Dalla Port. No data available for the conditions of groundwater.
	18	Hydrological Situation	D	D	(During construction and operation) Due to muddy conditions of the river, the water has low transparency, and there is very low visibility in the river water at the expected project area.
	19	Coastal zone	D	D	(During construction and operation) This project is not including land reclamation and/or increasing land area, it is not anticipated to cause environment problems in river zone.
	20	Flora, Fauna and Biodiversity	D	D	(During construction and operation) Project site is not located within an area of preserved zone or conservation area for biodiversity regulated by the international treaties or national laws.There are no mangroves in the riverbank at the vicinity of the proposed project site. it is not anticipated to cause impact to flora and fauna.
	21	Meteorology	D	D	(During construction) Civil works implemented in rainy season (May-October) will be affected by the meteorology, careful attention shall be needed. Large scale cyclone hit the country several times, however Project will not cause change of meteorology.
	22	Landscape	D	D	(During construction) The jetty will be repaired in the existing port area, however the landscape will not be altered significantly.
	23	Global Warming	D	D	(During operation) Due to the small scale of the project, serious global warming issues is not anticipated.

Pollution	24	Air Pollution	C	D	(During construction) Exhaust gas and dust generated from the construction equipment and vehicles for transportation will be emitted. (During operation) The average number of vessels that sail into the port is estimated not so big and type of vessel/boat is small.
	25	Water Pollution	C	D	(During construction and operation) Port is located at the upstream of Yangon River. Due to the muddy conditions of the river, the water has low transparency, and there is very low visibility in the river water at the expected project site.
	26	Soil Contamination	D	D	(During construction) Large scale land reclamation work is not needed, and Soil contamination is not anticipated in the port.
	27	Waste	C	D	(During operation) There are no oil treatment and oil disposal facilities in the existing port, it is anticipated that all of the effluent (bilge) from vessels are treated by Dock yard / recycling company.
	28	Noise and Vibration	D	D	(During construction) The expected noise sources during the construction are the piling work, equipment and transportation vehicles. However, almost all construction work will be done inside the port area which is far from the residential area.
	29	Ground Subsidence	D	D	(During construction and operation) Ground subsidence is not observed.
	30	Offensive Odor	D	D	(During construction and operation) No odor source is anticipated, thus no control measures have been planned yet.
	31	Bottom Sediment	D	D	(During construction and operation) The river bed is almost covered by muddy soil at the riverbank area.
	32	Accidents	-B -B	-B +A	(During operation) 1).Operation of the port will potentially increase the overall traffic density in nearby areas, which may cause some traffic safety problems to the nearby residents, workers and visitors. 2). The existing concrete made Jetty is now seriously deteriorated. In case Jetty is not improved, the condition of the concrete structure will be become more serious in bad state.

Evaluation;
A: Serious impact is expected,
B: Some impact is expected,
C: Extent of impact is unknown,
D: No impact or impact are negligible, no further study required,
+: Positive impact
-:Negative impact

Table G.8.2 Details of TOR for the Environment and Social Consideration Survey

Environment factors	Survey items	Survey methods
Local Economy such as Employment and Livelihood, etc.	1) Confirmation of the situation of residents who live in around the proposed Project area	Consultation with local residents through field survey, and evaluation of impact based on the existing data.
Existing Social Infrastructures and Services	1) Survey on social infrastructure and services in proposed Project area	Consultation with local residents through field survey, and evaluation of impact based on the existing data.
Infectious Diseases such as HIV/AIDS	1) HIV/AIDS prevalence and related situation in Dalla area among subcontractors and construction workers	Performance survey on related large projects, and evaluation of impact based on literature review
Accidents	1) Traffic volume of main road and neighboring roads in prospected Project area	Field survey and performance survey on related large projects, and evaluation of impact based on literature review
Water Pollution	1) Understanding of current water quality on Yangon River 2) Impact during construction and operation	Study the results of water quality survey and construction methods will be conducted and carry out study of environmental prediction.
Noise and Vibration	1) Current traffic volume 2) Impact during construction 3) Impact during operation	Prediction of impacts by conducting a field survey, performance survey of related projects and its prospected methods of construction, and transportation.

G.9 EXISTING ENVIRONMENTAL CONDITIONS

G.9.1 NATURAL ENVIRONMENT

(1) Climate

Myanmar is located in a tropical climate, and there are two seasons: South West (SW) monsoon and North East (NE) monsoon. The climate of Yangon City is of tropical monsoon type. The rainy season is from May to October and the period from December to April is the dry season. The tropical wind blows from the southwest during the rainy season and from the northeast during the dry season.

(2) Temperature

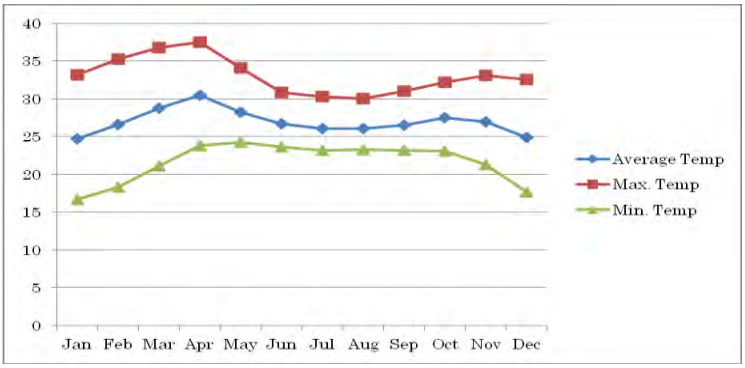
Table G.9.1 shows the monthly average, maximum, minimum and mean temperature recorded. Highest average mean maximum temperature recorded was 37.5 ℃, while the mean minimum temperature was 16.7 ℃ recorded in January in the period from 2001 to 2010 at the meteorological station of Yangon City

Table G.9.1 Monthly Average maximum, Minimum, Mean Temperature Year 1981-2010

(Unit: ℃)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average	24.7	26.6	28.8	30.5	28.2	26.7	26.1	26.1	26.5	27.5	27.0	24.9
max. temp	33.2	35.2	36.8	37.5	34.1	30.8	30.3	30	31	32.2	33.1	32.5
min. temp	16.7	18.3	21.1	23.8	24.3	23.6	23.2	23.3	23.2	23.1	21.3	17.7

Source: Department of Meteorology and Hydorology.



Souse: Department of Meteorology and Hydorology.
Unit: ℃

Figure G.9.1 Monthly Average Maximum/Minimum Temperature (℃)

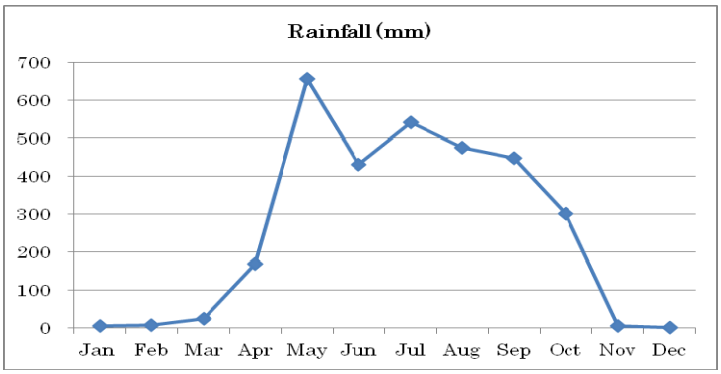
(3) Rainfall

Yangon City receives very high rainfall. The average annual rainfall in Yangon City was 2,866 mm from 2000 to 2010. As shown in Table G.9.2 the annual precipitation varies every year. The rainy season is from May to October. The precipitation is especially high from May to October. On the other hand, the six months period from November to April is the dry season. The average monthly precipitation is lower from December to March. Localized torrential downpours during the rainy season sometimes cause floods.

Table G.9.2 Monthly Rainfall Recorded in (2000-2010)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average	1	2	12	39	440	549	605	525	459	187	32	15

Source**:** Department of Meteorology and Hydorology.
Unit: mm



Source: Department of Meteorology and Hydorology.

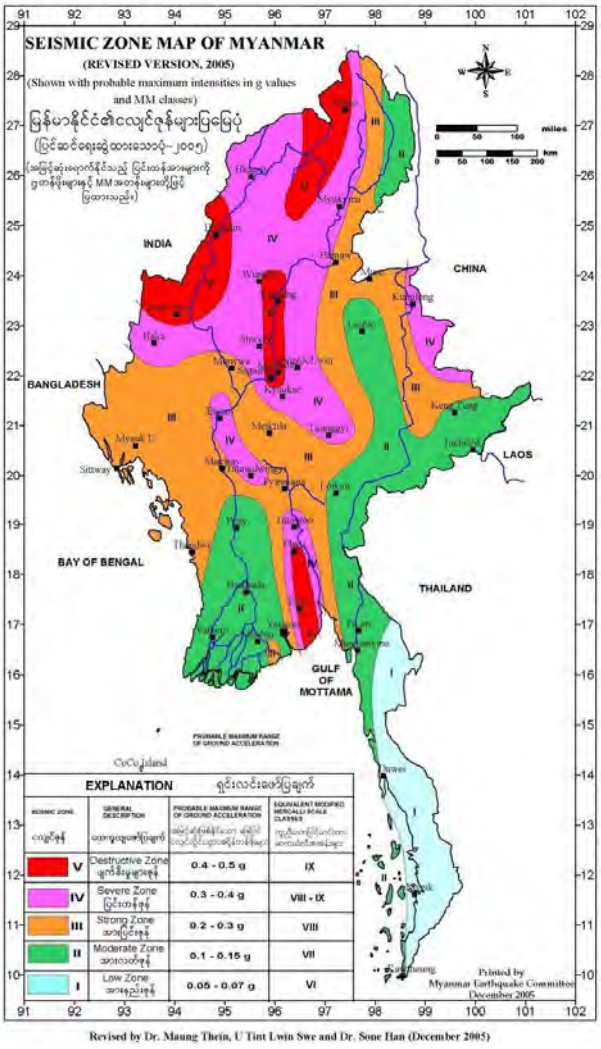
Figure G.9.2 Monthly Rainfall Recorded in (2000-2010)

(4) Wind

The sustained maximum wind speed recorded at Yangon Airport was 30 m/sec during Nargis attack. The design wind speed was assumed by converting landside wind to river surface wind by multiplying coefficient of 1.3. Based on the record at Yangon Airport, the design wind speed is assumed at 40m/sec. The design wind speed was applied for the wave hindcast analysis and estimation of wind pressure acting on the vessels and pontoon.

(5) Earthquick and Seismic Conditions

In Myanmar, most of the earthquake occurred in North-West region (mainly in Sagain Division). The earthquake occurred in the proximity of Yangon is not much frequent. During the period of last 110 years, Yangon experienced large earthquake 6 times which had a magnitude more than 5.0. Among these earthquakes, Bago earthquake in 1930 caused large damage in Bago. Myanmar has been divided into 5-categolized levels of seismic coefficient and Yangon region is classified as level II. From this classification, horizontal seismic coefficient of Yangon region is estimated between 0.10 to 0.15. Figure G.9.3 shows Seismic Zone Map in Myanmar.



Source: Department of Meteorology and Hydorology.

Figure G.9.3 Seismic Zone Map in Myanmar

(6) Conditions of River Water

There are no issued data of the current and water volume for the Yangon River. The Yangon River is a tidal river and the tidal range reaches 6 m at spring tide, and the current is very fast: maximum 6 knots/hr. Table G.9.3 shows Data of Water Quality in Yangon River. SS showed high values at all sites ranging from 260-320mg/L. SS at the bottom layer tended to be higher value than at the surface layer, which may be due to resuspension of sediment by strong current. DO ranged between 5.5-9.0 mg/L. Benthos, it is said to be required for 4mg/L or more DO, may be able to live in this area. BOD showed high values at all sites ranging from 128-288mg/L. The values differed from site to site and no specific trend emerged. Water quality of Yangon River is heavily poluted presently.

Table G.9.3 Data of Water Quality in Yangon River

Site		S1	S2	S3	S4	S5
Date		14-8-2012	14-8-2012*1	13-8-2012	13-8-2012*1	15-8-2012
Hour		7:30	8:00	6:50	7:30	9:00
Depth(m)	-	6	13	3	24	8
Water temp. ℃	Surface.	24.0	24.2	22.8	24.0	24.5
	Bottom	24.0	24.4	22.8	25.6	24.4
Salinity	Surface.	0	0	0	0	0
	Bottom	0	0	0	0	0
pH	Surface.	7.6	7.8	7.8	6.1	7.5
	Bottom	7.5	7.7	6.5	7.8	7.6
SS (mg/L)	Surface.	310	325	260	290	282
	Bottom	300	330	288	308	320
Turbidity (NTU)	Surface.	250	268	240	270	265
	Bottom	245	316	250	300	288
DO (mg/L)	Surface.	6.0	8.0	7.0	6.0	6.0
	Bottom	8.0	7.6	5.5	7.5	9.0
BOD (mg/L)	Surface.	288	160	192	128	240
	Bottom	192	288	160	240	288
Coliform bacteria MPN/100mL	Surface.	>16	>16	>16	>16	>16
	Bottom	>16	21	>16	17	>16
Oil content (mg/L)	Surface.	ND*2	ND*2	ND*2	ND*2	ND*2
	Bottom	ND*2	ND*2	ND*2	ND*2	ND*2
T-N (mg/L)	Surface.	0.55	0.61	0.55	0.55	0.54
	Bottom	0.77	0.75	0.51	0.86	0.59
T-P (mg/L)	Surface.	0.185	0.170	0.173	0.184	0.189
	Bottom	0.303	0.298	0.204	0.323	0.271

*1: Water samples at bottom layer were collected on 30th August at S2 and S4
*2: ND; Not detectable
Data source: JICA Report, The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area

S1 is located upper stream as background. S2 is located in front of MITT which is already operating in Yangon Port in Thilawa. S3 is located in front of the planned new Thilawa Port. S4 is located lower stream as background. S5 is located down stream of Yangon river.

Table G.9.4 Location of Monitoring Point in Yangon River

Sta.	Latitude	Longitude
S1	16°40' 59" N	96°13' 59" E
S2	16°39' 36" N	96°15' 08" E
S3	16°38' 01" N	96°15' 50" E
S4	16°36' 54" N	96°15' 28" E
S5	16°39' 38" N	96°14' 21" E

Data source: JICA Survey Report of thilawa Port Project

(7) Topography

The Jetty and associated facilities that are planned for construction in this project will be located in the riverbank in the Yangon City. The geographical features of the project area consist of leveled ground as hinterland extending to the river lines. It is observed that there are no natural forest in the hinterland areas adjacent to the project site. A part of riverbank of Yangon River is covered with palm tree though almost all of the coast areas are situated in clayey sand. The eroded soils in the upper reaches by heavy rain has been transported to the lower reaches by Yangon River. Due to erosion, it is observed that sedimentation of soils change the geographical conditions of river.

(8) Landscape

The Project site in Dalla Township is located on a riverbank having a gentle slope. There are no high rise buildings nearby the project site, and almost all buildings are below two stories high and constructed of simple wooden structure. Dalla Jetty and buildings are planned in the existing operation yard of port and hinterland area is a rice field. Downtown of Yangon City is located at the opposite side of riverbank also business area and Government buildings are located in the opposite of river. There are many street stalls and small local restaurants along the access road to the existing port (See photo G.5.1).

(9) Biological Resources

There is no significant biodiversity in this proposed Jetty area, there is only a small numbers of palm tree and green grass. Proposed location of river bank is covered with mud field. There is a ship yard beside of the existing port facilities operated by Private company and natural forest is not observed nearby project site.

G.9.2 SOCIAL ENVIRONMENT

(1) Involuntry Resettlement

Bsically, all of construction work for restoration of Jetty will be carriedout in the existing Dalla Port area, and Involuntary Resettlement is not anticipated by the project implementation.

(2) Population

Myanmar is the largest country in South East Asia with a total land area of 676, 578 km^2. It is bounded on the north by China, on the east by Lao People's Democratic Republic and Thailand, on the west by India, Bangladesh, Bay of Bengal and on the south by the Andaman Sea. The biggest city is Yangon with the second major city Mandalay and capital of city is Naypyidaw.

In 2013, the estimated population in the country was 51.41 million. Approximately 70 percent reside in the rural areas and 30 percent are in urban areas. The densest area is in the Yangon City where about 390 people live per km^2, while the least dense is in Chin State, where the population density is only 10 per $km^{2.}$ About 32.67 percent of the population is between 1 and

14 years old, and 5.42 percent is 65 years old and above. Figure G.9.4 shows Population and Population Density in Yangon Region.

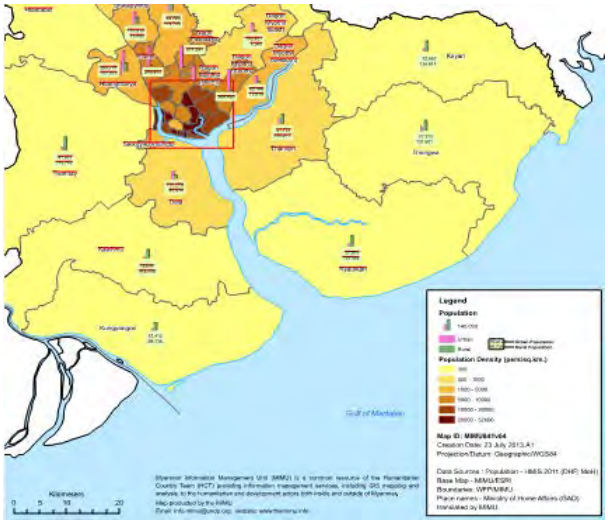
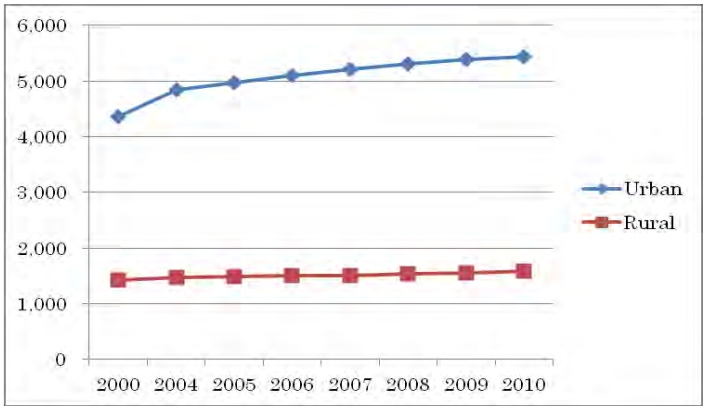


Figure G.9.4 Population and Population Density Map of Yangon Region (1/2)

Figure G.9.4 Population and Population Density Map of Yangon Region (2/2)



Source: Department of Meteorology and Hydorology.
Unit: Thousand (x 1,000)

Figure G.9.5 Population of Yangon City (2000-2010)

(3) Water Usage or Water Rights and Communal Rights

Access channel and route of ships are prohibited fishing operation by the government laws. Fishermen living at the mouth of the river and they carry out their fishing operation by small boats at the river in the bay area. No fishing village is observed in the vicinity of proposed project site. Following facilities were observed in the vicinity of the project site:

- Ship maintenance yards
- Parking areas of vehicles
- Street stalls and small local restaurants

There are no water rights issues involved with the recovery of the Dalla Jetties area.

(4) Cultural Heritage

There is no local archaeological, historical, cultural and religious heritage site adjacent to the project site, Botahtaung Pagoda is located opposite site of Yangon River.

(5) Public Health Conditions

Many kinds of diseases afflict the people in Yangon Region affecting the public health, such as malaria, diarrhea, tuberculosis, and HIV/AIDS infection etc. In order to prevent and to take-care the public health and welfare, the Local Authority had established lots of public and private hospitals, and First Aid Clinic in the Country, and also undertakes mitigation measures by providing education and campaign related to HIV/AIDS prevention to the local residents. In addition there are a lot of NGOs in Myanmar, they provide support on the health and welfare of local residents. Table G.9.5 shows Data of Dengue Homorrhagic Fever.

Table G.9.5 Data of Dengue Hemorrhagic Fever (Yangon District)

Year	Case of DHF	Dead Person
2007	4,786	54
2008	3,604	31
2009	3,333	38
2010	3,162	21
2011	576	4

Data source: JICA Yangon office

(6) Infrastructures

Most of infrastructures in the Yangon City were constructed many years back. In recent years, increases in the demands due to economic recovery and decrease in their capacities due to aging deterioration lead to remarkable shortage of capacity. Utility such as electricity, water, and like, which will be required in the construction work, shall therefore be designed taking the following factors into consideration.

A large number of households in the Yangon City utilize water from YCDC, Yangon Port utilize water from YCDC and have not own deep wells.

- Sufficient and stable supply of electricity and water
- Application of stand-by units for stable construction work if necessary

(7) Vessels

Table G.9.6 shows Data of three Vessels (One standby) which are utilized for operation of passenger boat between Yangon Port and Dalla Jetty in this Project.

Table G.9.6 Data of Vessels

Name of Vessel	Engine Power (Hp)	Nos of Engine	Procurement	Size (m)		
				Length	Breadth	Depth
Anawyahtar	250	2	1990	40.6	9.1	1.8
Tapin Shwehti	250	2	1987	41.3	9	1.8
Kyansitthar	250	2	1989	40.6	9.1	1.8

Note : Presently only two vessels are used for the operation.
Source: IWT

G.10 RESULT OF ENVIRONMENTAL IMPACT

Result of environmental impact according to survey is shown in Table G.10.1.

Table G.10.1 Evaluation of Environmental Impact

No.	Impact factors	Impact evaluation at scoping		Evaluation based on the survey results		Reasons of evaluation
		BC/During Operation	During operation	BC/During Operation	During operation	
1	Involuntary resettlement	D	D	D	D	(Before construction) The port facilities (Jetty) will be restored in the existing port area, and Involuntary Resettlement is not anticipated by the project implementation.
2	Local economies, such as employment, livelihood, etc.	+B	+B +B	+B	+B +B	(During construction) 1) Project scale is not so large; however, local people will be employed as worker in this port restoration project. The port project will result in overall socio-economic improvement of those people living around the project area and beyond and hence overall economic development of Myanmar. The project will be made positive impact. (During operation) 2) In the operation stage, the access route for the transportation is limited and there might some possibility of traffic congestion by increased number of passengers in the future.
3	Land use and utilization of local resources	D	D	D	D	(During construction) Basically, recovery project will be conducted in the existing Dala Port or yard operated by IWT; as such, no change of land use and utilization. The project will be made positive impact. There are many street stalls and small restaurants along to access road to the existing jetty, however this road is not utilized for the project. Materials are transported to site by water traffics. Negative impact is not anticipated by the project implementation.
4	Social institutions such as social infrastructure and local decision-making institutions	D	D	D	D	(During operation) Yangon Port and port facilities are operated by MPA, and inland transportation was conducted by IWT under Ministry of Transport. Environmental impact is not anticipated by the project implementation.
5	Existing social infrastructures and services	+A	+A	+A	+A	(During operation) Project can contribute a large scale benefit to the inland transportation in the country. The project will be made positive impact for local residents (App:30,000 people/day).

No.	Impact factors	Impact evaluation at scoping		Evaluation based on the survey results		Reasons of evaluation
		BC/During Operation	During operation	BC/During Operation	During operation	
6	The Poor, indigenous, or ethnic people	D	D	N/A	N/A	There are no poor people, indigenous and ethnic minorities who live in the vicinity of the project site.
7	Misdistribution of benefits and damages	D	D	D	D	(During construction and operation) If project was carried out according to the Myanmar's laws and regulations. No misdistribution of benefit and damage was expected, instead many people can receive substantial benefit through the port rehabilitation project.
8	Cultural heritage	D	D	N/A	N/A	There are no local archaeological, historical, cultural and religious heritage site in and around the project site.
9	Gender	D	D	N/A	N/A	No negative impact to the gender is anticipated by this Project.
10	Children's rights			N/A	N/A	No negative impact to the children's rights is anticipated by this Project.
11	Local conflicts of interest	D	D	N/A	N/A	(Pre-construction and during construction) Project will be conducted in the existing Dalla Port, there are no parmanent local residents live in this area. No significant impact on the living conditions of inhabitants is anticipated and there are no local conflicts of interest.
12	Water Usage or Water Rights and Communal Rights	-B	D	-B	D	(During operation) Access channel and route of ships are prohibited fishing operation by the government laws. Fishermen living at the mouth of the river and they carry out their fishing operation by small boats at the river in the bay area. No fishing village is observed in the vicinity of proposed project site. Following facilities were observed in the vicinity of the project site: - Parking areas of vehicles and motorcycles - Small local restaurants - Street stalls - Ship maintenance yard There are no water rights issues involved with the recovery of the Jetty.
13	Public health	D	D	D	D	(During construction and during operation) Limited impact to the public health is anticipated in this project. Generated solid waste in the workers' camp during construction stage will be increased, but it is possible that disposal be provided with proper waste management system.
14	Hazards (risk) Infectious Diseases such as HIV/AIDS	D	D	D	D	(During construction) There might be some possibility for disease to be introduced at the site and surrounding area, because of the expected migration of workers and local entrepreneurs during the construction period.

No.	Impact factors	Impact evaluation at scoping		Evaluation based on the survey results		Reasons of evaluation
		BC/During Operation	During operation	BC/During Operation	During operation	
15	Topography and Geographical Features	D	D	D	D	(During construction and operation) The geographical features of the project area consist of leveled ground as hinterland extending to the river lines. There are no natural forest in the hinterland areas adjacent to the project site. A part of riverbank of Yangon River is covered with palm tree though almost all of the coast areas are situated in clayey sand.
16	Soil Erosion	D	D	D	D	(During construction) Ground surface alterations during the site preparation and the transportation of construction materials and equipment, using heavy trucks will disturb the soil surface, making it susceptible to soil erosion occurrence. However, transportation of locally procured construction materials will be transported by vessels in this project.
17	Groundwater	D	D	D	D	(During operation) A large number of households in the Yangon City utilize water from YCDC, Yangon Port utilize water from YCDC and have not own deep wells. There are no water distribution line from YCDC in Dalla Port.
18	Hydrological Situation	D	D	D	D	(During construction and operation) Due to muddy conditions of the river, the water has low transparency, and there is very low visibility in the river water at the expected project area. Yangon River is heavily polluted presently. SS: 260~320 mmg/*l* BOD: 128~288 mg/*l*
19	Coastal zone	D	D	D	D	(During construction and operation) 2,229 km of Myanmar‘s coastline provide rich resources for fishing; however, the project area is very far from the coastal zone. Proposed project site is located in the existing Dalla Port. Access road and operation yard of Port covered with asphalt paving. This project is not including land reclamation and/or increasing land area, it is not anticipated to cause environment problems in river zone.
20	Flora, Fauna and Biodiversity	D	D	D	D	(During construction and operation) Project site is located in the existing port operated by IWT.There are no fauna and flora to be protected. The project site is not located within an area of protected habitats of endangered species. There are no mangroves in the riverbank at the vicinity of the proposed project site. Therefore, it is not anticipated to cause impact to flora and fauna.

No.	Impact factors	Impact evaluation at scoping		Evaluation based on the survey results		Reasons of evaluation
		BC/During Operation	During operation	BC/During Operation	During operation	
21	Meteorology	D	D	-B	D	(During construction) In construction work, special attention to the conditions of meteorology is needed in rainy season, where the heavy rain hindered civil works largely. Large scale cyclone hit the country several times, however Project will not cause change of meteorology.
22	Landscape	D	D	N/A	N/A	(During construction) The jetty will be repaired in the existing port area, however the landscape will not be altered significantly. No significant impact on the landscape is anticipated.
23	Global warming	D	D	D	D	(During construction and operation) Due to the small scale of the project, serious global warming issues is not anticipated.
24	Air pollution	C	D	D	D	(During operation) Exhaust gas and dust generated from the construction equipment and vehicles for transportation will be emitted. As for the vessels, no significant negative impacts of air pollution are anticipated in the port, because the average number of vessels that sail into the port is estimated not so big and type of vessel/boat is small.
25	Water pollution	C	D	D	D	(During construction and operation) Port is located at the upstream of Yangon River. Due to the muddy conditions of the river, the water has low transparency, and there is very low visibility in the river water at the expected project site. Yangon River is heavily polluted presently. SS: 260~320mmg/*l* BOD: 128~288mg/*l*
26	Soil contamination	D	D	D	D	(During construction) Large scale land reclamation work is not needed, and Soil contamination is not anticipated in the port.
27	Waste	C	D	D	D	(During operation) There are no oil treatment and oil disposal facilities in the existing port, it is anticipated that all of the effluent (bilge) from vessels are treated by Dock yard / recycling company.
28	Noise and vibrations	D	D	D	D	(During construction) The expected noise sources during the construction are the piling work, equipment and transportation vehicles. However, almost all construction work will be done inside the port area which is far from the residential area.
29	Ground subsidence	D	D	D	D	(During operation) Project is not include land reclamation and Ground Subsidence will not be caused.
30	Offensive odors	D	D	D	D	(During operation) No odor source is anticipated, thus no control measures have been planned yet.

No.	Impact factors	Impact evaluation at scoping		Evaluation based on the survey results		Reasons of evaluation
		BC/During Operation	During operation	BC/During Operation	During operation	
31	Bottom sediment	D	D	D	D	(During operation) The river bed is almost covered by muddy soil at the riverbank area.
32	Accidents	-B	-B +A	-B	-B +A	(During operation) 1) Operation of the port will potentially increase the overall traffic density in nearby areas, which may cause some traffic safety problems to the nearby residents, workers and visitors. 2) The existing concrete made Jetty is now seriously deteriorated. In case Jetty is not improved, the condition of the concrete structure will be become more serious in bad state. After completion the project, if cyclone struck the coastal area again, the Jetty could be avoid serious damage also the inland transportation could be avoid serious impact.

G.11 THE ENVIRONMENTAL MANAGEMENT AND MONITORING

G.11.1 PURPOSE OF ENVIRONMENTAL MANAGEMENT

The purpose of the Environmental Management Plan (EMP) is to ensure that the Project activities are planned and carried out during the pre-construction, construction and operation phases of the project in a manner that avoids or minimizes impacts on the social and natural environment, in order to maintain a satisfactory status of the environment in and around the project site and conform to the requirements of IEE issued by MOECAF and other environmental laws, rules and regulations

The key elements in the EMP are the proposed mitigation measures that need to be incorporated in the Detailed Design by the Consultant and the Contractor shall be responsible for monitoring the environmental impact of the execution of the works and apply mitigation measures in order to keep to an absolute minimum level any adverse impact on the surrounding areas.

The environmental management performance of the MPA/IWT shall be measured regularly in order to properly assign priorities and identify need for immediate action. This requires operational and environmental data management from which environmental key performance indicators can be derived. The data management system is designed to meet the following criteria:

- Covering all environmental aspects identified in Port operations
- Establishing trend lines by regular monitoring

- Easy to administer by using standard tools and
- Provide basis for mitigation planning, if necessary.

G.11.2 ENVIRONMENTAL MANAGEMENT ORGANIZATION

To ensure the effectiveness of environmental management, it is necessary to appoint an institution to be responsible for the coordination and implementation of the environmental management. Environmental management shall be conducted based on environmental legislations and policies with the support of concerned government authorities (MOECAF). An environmental management institution shall be established in the project execution organization in the MPA/IWT project management section that will be responsible for the coordination of the EMP (See Figures G.11.1 to G.11.3). Required monitoring conditions are shown in Table G.13.1 to G.13.5.

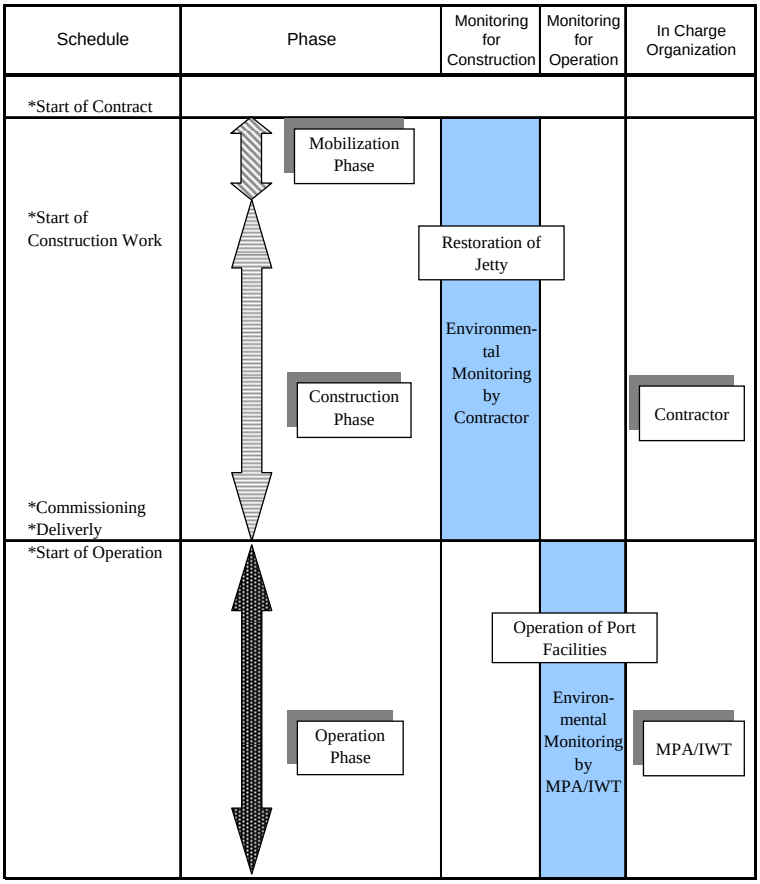


Figure G.11.1 Schedule of Environmental Monitoring

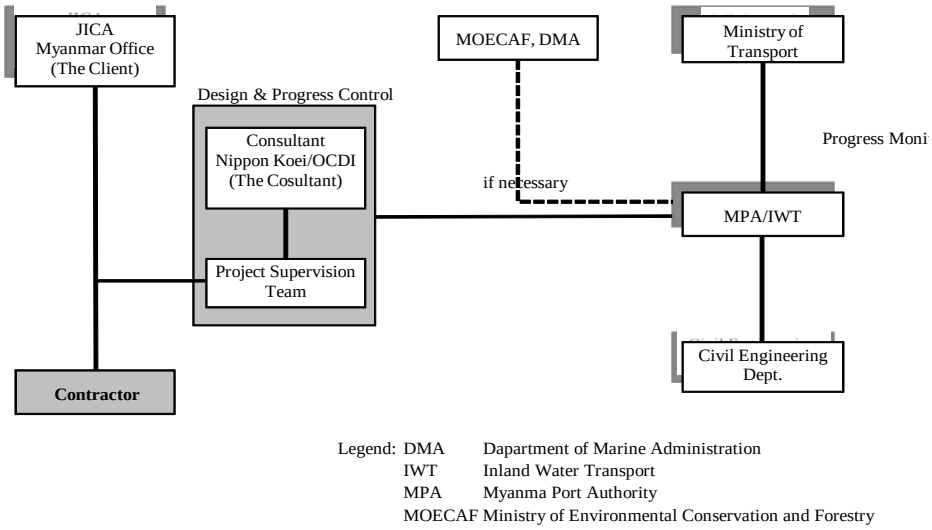


Figure G.11.2 Project Organization (Construction Phase)

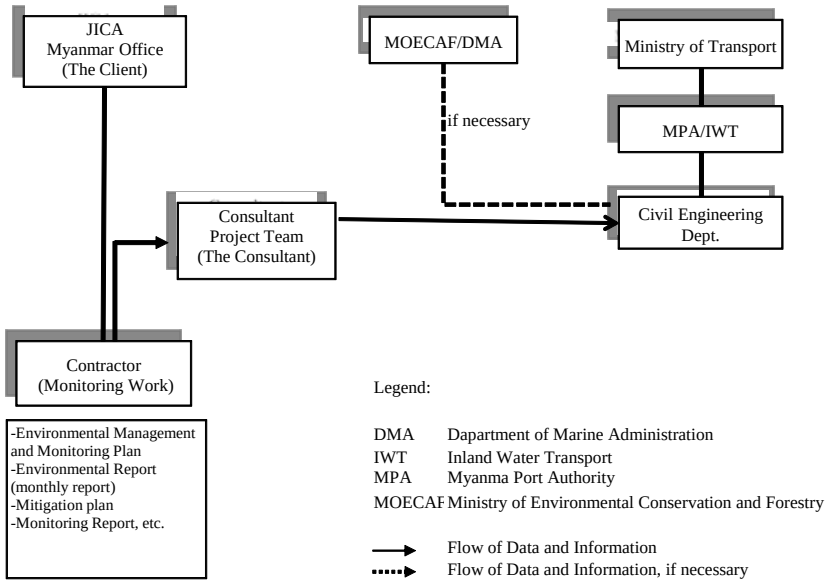
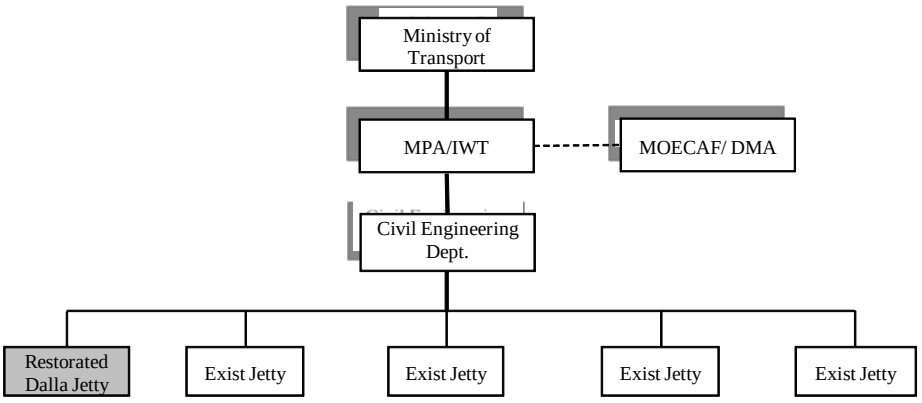


Figure G.11.3 Organization of Environmental Monitoring and Management (Construction Phase)



Operation Phase

Legend: DMA Dapartment of Marine Administration
IWT Inland Water Transport
MPA Myanma Port Authority
MOECAF Ministry of Environmental Conservation and Forestry

Figure G.11.4 Organization of Environmental Monitoring and Management (Operation Phase)

G.11.3 MANAGEMENT AND KEY MITIGATION MEASURES

The main sources causing air pollution are expected to come from transportation activities for construction materials, and the equipment required in this project. As a result, transportation activities will be considered the main sources of air pollution. The construction project will cause dust and increase particulate levels, especially during the dry season. The following activities below are foreseen to contribute to the increase of dust/particulate levels during the construction stage:

- Material transportation
- Earthwork activities required for construction
- Construction equipment (pile driver, crane, truck etc.)
- Concrete batching plant for freshly mixed concrete

The required monitoring conditions related to the construction phase are shown in Table G.13.1 to Table G.13.5. In cases where high environmental impact caused by construction is observed through the monitoring, the Contractor has to take necessary and proper actions as a countermeasure. Treatment and control of environmental impact have to be carried out through mitigation and appropriate countermeasures. The data and information regarding the countermeasures used in the process shall be relayed to each concerned environmental organization (MOECAF) and Department of Marine Administration (DMA) if necessary.

The list of required mitigation measures in the construction phase for each construction item and operation phase of port facilities shall be referred to Table G.11.1 List of Mitigation for Construction Work.

Table G.11.1 List of Mitigation for Construction Work

The following Environmental Management clauses should be included in the contract documents, in order to make sure that the Contractor takes necessary actions to manage the environment during the construction phase:

- All debris from demolition and site preparation work shall be removed and disposed to suitable locations outside the Port premises in a manner that will not be an environmental hazard, or cause it to be an open dump.
- Construction materials (soil, crushed stone etc.) shall be covered with tarpaulin during transportation and precautions (spraying of water or other appropriate adhesive material) should be taken to avoid dust emissions during loading and unloading.
- Hoarding shall be used to control dust emissions to the parts of the Port where normal activities are being carried out. The use of rigid and reusable hoarding is recommended.
- All activities at the construction site shall be managed by the Contractor in such a manner that the Noise Regulations (maximum permitted noise level) or any amendments there to effective at the time of construction is not violated. In case the tolerance limits for construction noise are exceeded, the Contractor shall provide required noise barriers to protect the noise.
- All construction equipment and processes shall be managed by the Contractor in order to satisfy the Standards for the operation of machinery, construction activities and vehicle movement. The Contractor shall be responsible for paying compensation for any damages caused to the existing property during construction period.
- Provide adequate sanitary facilities at site and in the labor camps and quarters for the work force and provide septic tank/cesspool systems, and make sure that these are used and maintained properly.
- Provide covered bins for litter collection, and strictly control the labor force by proper education and discouraging consumption of food at the site.
- Educate the workforce on good health and safety practices and ensure that no dumping grounds are created within the premises by throwing food or other organic substances that would attract birds and animals.
- Provide proper drainage at the site and ensure that drains are not blocked by debris or other materials at all times to prevent stagnation of water either at the site or within Port premises due to the construction activities during the entire construction period.
- Take necessary steps to minimize soil erosion during earthwork by scheduling these activities during the dry season where possible, and avoiding exposure of bare land to rains by covering with suitable material if needed.
- Prepare a traffic management plan in order to minimize the impact of construction vehicles on the normal traffic on the access road. particularly during the morning peak hours.

- Compensate for any fatalities, medical bills or damages to property arising out of accidents at construction site.
- Provide details of how he will implement the environmental monitoring obligations for this project, as set out in the Environmental Management Plan.

G.12 EVALUATION OF ENVIRONMENT IMPACT

The results of the screening and scoping assessment, as well as recommendations, can be found in the following comments regarding the anticipated environmental impact and mitigation measures for "The Pilot Project of Restoration of Dalla Ferry Terminal Jetty at Dalla Side".

G.12.1 SOCIAL ENVIRONMENT

Impacts during construction of the project and associated infrastructure: it is expected that the local and national economies will be beneficially impacted, primarily through increased employment opportunities and diversification of the skill base within the existing workforce. As well as enhanced employment opportunities, the project will create considerable potential for local enterprises to secure contracts for the provision of goods and services. During the construction phase, local firms will be considered for contracts to provide food and building materials, and to supply equipment and personnel, etc. This project will be carried out utilizing a local workforce, which is common practice in the country. Managing the welfare, health and safety of the workers is a necessary requirement.

(1) Employment during Operation Phase

Operation of the port facilities would be managed by IWT. The number of persons employed under IWT Dalla Jetty is estimated at approximately 305 persons (as of the 2012) in total, including officers, maintenance workers, and offices for administration and operational control of the port facilities. After completion of the project, employment opportunities will be increased according to the economy of the country. All of the labor required for cargo handling in the port operation will be supplied through the Department of Labor under the Ministry of Labor.

(2) Employment during Construction Phase

The construction work Contractor shall be decided upon and contracted through JICA's bidding procedure. Accordingly, the Main Contractor will be selected by tendering from bidders. The skilled workers, laborers of the Contractor and Sub-contractor will be local persons (Myanmar nationals). Moreover, preference will be given to employ local people living around the project site. The numbers of the local construction workers needed are estimated as follows:

- Engineers : 06 persons
- Skilled Workers : 30 persons
- Unskilled Workers : 80~100 persons

(3) Traffic

Transportation of construction materials are required for the restoration of the Jetty. It is estimated that only a few materials will be imported from overseas. As to locally procured materials, sand and aggregate for concrete, rocks and concrete piles for the Jetty foundation, and the like, are expected to be transported by large-sized trucks or vessels. When considering traffic operations for construction, it should be noted that the existing port is located beside downtown Yangon City. In order to keep disruption of regular traffic to a minimum, proper planning, as well as the scheduling of transport to off peak hours, and if appropriate night hours, should be carried out.

Basically, almost all materials procured in the local market will be transported through the existing road network. For construction inside of the existing port, it will be necessary to conduct sufficient discussion and consultation with concerned port authorities (MPA/IWT) and traffic police before commencement of the works.

On completion of the restoration of the Jetty, it is foreseen that traffic will increase in the city area around the MPA. To minimize the disruption of regular traffic, proper planning, re-routing, and the scheduling of transport to off-peak hours are recommended. The amount of traffic using Yangon Port is relatively small compared with the amount of general traffic in the city. However, it is necessary to provide counter measures which will minimize the environmental impact on the disruption of regular traffic in the City. If carried out proper project planning and management of the construction work, most of the anticipated negative impacts caused by the traffics can be minimized and would not cause significant environmental impact.

Mitigation measures:

MPA/IWT and Contractor shall ensure implementation of proper traffic control and management system around the port area to facilitate traffic efficiency, including port container truck traffic, in coordination with the traffic police of Yangon City. The following countermeasures shall be considered during construction phase;

1) Land traffic

- Traffic flow and site access will be managed so that tail-backs onto public roads will be avoided.
- Delivery of bulk materials through populated areas during peak traffic flows will be avoided.
- Drivers will be fully trained in road safety.
- Adjustment of transportation route to avoid residential area, school zone, and other sensitive areas as much as possible.
- Transportation will only take place on roads approved by MPA/IWT. No off-road driving will take place outside of the work and lay down area without prior approval and
- All national road and port area speed limits will be observed.

- Maintenance of vehicles be regularly done, and use of well adjusted/equipped trucks and trailers.

2) Water traffic

- Strict compliance of transportation law on waterways.
- Consideration of scheduling of verge trips in consultation with port authority (MPA/IWT).
- Installation of new buoys and modification of the location of existing ones to make access channel safer, if necessary.

(4) Infrastructures

Most of the infrastructures in Yangon City were constructed many years back. In recent years, increases in demands due to economic recovery and decreases in capacities due to aging and deterioration have led to a remarkable shortage of capacity.

Electricity is generated and supplied by the Myanmar Electric Power Enterprise (MEPE), and water is supplied by Yangon City Development Committee (YCDC) in Yangon City, (power supply lines and capacity are limited and a new power supply system is needed for this project). There are no water supply piping in the proposed project site, and the local residents utilized reserved water in pond. Utilities such as electricity, water, and the like, which will be required in the construction work and port operation, shall therefore be designed taking the following factors into consideration.

- Sufficient and stable supply of electricity and water
- Application of stand-by units for stable operation, if necessary

Both the conditions of these infrastructures and the influence on the citizens' lives should be considered in the planning of the port project. If such measures will be taken the infrastructures in construction work of Jetty would not cause any significant environmental impact in the surrounding area.

(5) Local Inhabitants

Fishing operations are strongly prohibited by government laws in the port operation area, however, there are families of fishermen living in the riverbank area who conducting fishing operations in the river in Yangon City. The fishermen carry out their fishing operations utilizing small boats with and without engines. Approximately 300 boats are conducting fishing operations in the Yangon River and they sell fish directly to the central fish market in Yangon City. It is thought that most families in the project site earn their living mainly through fishing and farming. However, the fish catch area is far from construction site, and environmental impact caused by the port construction is very small. Therefore, this impact is considered to be insignificant.

Fishing Operation

Fishermen's Boats

Photo G.12.1 Picture of Fishing Operation and Fishing Boats

(6) Concrete Batching Plant

The location of the concrete batching plant and material storage yard will have potential to cause impact. It is necessary to minimize the airborne particulate and noxious gases created by concrete batching plants or concrete mixer in the construction site. In the case where a batching plant is required to be located near the project site, the location has to be kept at a sufficient distance from the housing areas of the local residents. If such measures will be taken, the concrete batching plant would not cause any significant environmental impact in the surrounding area.

(7) Hazards (Risk)

Public Health Conditions: some negative impact is expected during the construction phase, there are no permanent residents live in the project site but it is presumed that diarrhea is common due to a shortage of sanitary toilets and potable drinking water. Should the present water supply level not be available due to the construction, incidences of diarrhea would likely increase in and near the project site. Therefore, the present water supply level needs to be secured during the construction. Mitigation measures are planned for the construction site. Temporary domiciles for workers shall be duly ventilated and also adequate water closets and sanitary toilet facilities shall be required to ensure worker health protection and sanitation. The construction contractor shall prepare and enforce an Occupational Health and Safety Plan and ensure the provision of related training and instructions to all staff regarding their work duties and safety in work. If proper project planning and management and mitigation measures are carried out, most of the anticipated negative impacts caused by the construction work can be managed and minimized. following mitigation measures are recommended.

Mitigation measures:

- Temporary domiciles for workers shall be duly ventilated and also adequate water closets and sanitary toilet facilities shall be required to ensure workers' health protection and sanitation.
- The contractor shall conduct education/campaign on HIV/AIDS prevention among the construction workers.

- The construction contractor shall prepare and enforce an Occupational Health and Safety Plan.
- Provision to construction workers of protective clothing including masks, helmets, gloves and safety shoes.
- Workers camp will be constructed at locations where noise generation due to construction works is minimized.
- Provide first aid and medical facilities to construction workers.

G.12.2 NATURAL ENVIRONMENT

(1) Impact on Biodiversity and Ecosystem

In the field survey, it was observed that biodiversity in the project area was not rich as the result of increasing population and urbanization because the project area is located in the existing port operated by IWT and is already developed by human being. There are no important biodiversity and ecosystem for conservation at national level such as habitats stipulated in IUCN Red List, it would not be affected by the Project.

(2) Impact on Fauna and Flora

There are no protected areas in the vicinity of project area. Project area is located urban district of Yangon City and there are no fauna and flora which to be protected. It is foreseen one of the outstanding environmental impacts of the implementation of the improvement project of Jetty is caused by spilled oil and drainage to Yangon River, since this may result in environmental pollution which has adverse impact on river biology. If proper project planning and operation/methodology are carried out, construction work would not cause any significant environmental impact on hydrobios such as fishes, seaweed, benthos, plankton etc. which presently live in the River.

(3) Impact by Soil Erosion

Ground surface alterations during the project site preparation and the transportation of construction materials and equipment, using heavy trucks will disturb the soil surface, making it susceptible to soil erosion occurrence. The disturbed soil could easily be transported by surface runoff, causing clogging of nearby drains and sewer pipes. However, transportation of locally procured construction materials will be transported by vessels in this project. This is likely to be temporary impacts, ceasing after the project construction stage is completed. If preventive measures are undertaken during the project design and construction stages, the proposed project would not cause a significant soil erosion to surrounding area.

Mitigation measures:

The soil erosion problem will be addressed during the project design and construction stages when the necessary control measures would be considered and incorporated in the project design and implementation. The soil on site will be investigated prior to site preparation for building construction and appropriate safety procedures developed to reduce the occurrence of increased soil erosion. Measures taken to control erosion will include clearing and grading

the ground surface within approved work limits, stripping the top soil layer from the subsoil, stockpiling the removed soil in approved areas to be retrieved during landscaping and site restoration, clearing the nearby drainage systems and replanting the original vegetation after construction is completed. Restoration of the original environmental condition shall be considered to prevent further soil erosion occurrence. Scheduling the execution of all land preparation work having erosion potential without rain, so as to avoid soil erosion, would be the best option and hence need to be given due attention in construction work planning and scheduling.

(4) Soil Contamination

Civil work and soil moving for the construction of foundations will be done during construction phase, however scale of this earthwork is very small and period is limited. In operation phase there are no possibility of soil moving earthwork. In construction phase, all excavated soil would be filled back to the construction site as embankment soils and excavated soil would not cause any soil contamination in the surrounding area. thus soil pollution from construction would not be anticipated. Hence, it is judged the soil contamination by the construction activity related to the project would not cause any significant environmental impact in the river and surrounding area.

(5) Air pollution

The impact on surrounding air quality from construction will be mainly from the dust and emission gas generated by construction equipment, concrete mixing, earthwork, and vehicles for materials transportation. As for the vessels, no significant negative impacts on air pollution are anticipated by proper operation and maintenance. The impacts of the air quality are deemed to be small and temporary. However, vehicles transporting soil and/or crushed rock shall be: 1) Doused with fresh water. The MPA/IWT have to approve the water body before it can be used as source by the Contractor; and 2) Covered with an industrial-grade tarpaulin. It is important that the tarpaulin completely covers the truck bed. A “flapping” tarpaulin is likely to increase dust levels, and therefore, be counterproductive as a mitigation measure. If preventive mitigation measures are undertaken during the project design and construction stages, the proposed project will not cause a significant air pollution.

Mitigation measures:

- Reduce dust during 1) works on rock and soil, 2) transportation, loading and unloading of construction materials, 3) building material storage, 4) concrete casting.
- Wash and clean the surfaces of road and port operation yard daily or periodically.
- Provide covers for material transport vehicles to avoid air pollution.
- Arrange reasonable transport routes and paths.
- Make a fence to isolate danger zones and inflammable materials, design lighting system for night work areas if necessary.

- Make accurate construction and personnel plan to avoid overlaps; apply modern construction methods, mechanized activities and optimal construction processes.
- Provide adequate instruction manuals for machines and equipment; regularly check technical specifications.

(6) Water Pollution

The port is located on the Yangon River upstream of the Andaman Sea. Due to the muddy conditions of the river during the rainy and dry seasons throughout the year, the water has low transparency, and there is very low visibility in the river water at the expected project area. During the construction of foundations, a part of the seabed soil will become suspended soil due to piling work. However, the scale of this earthwork is very small, and the environmental impact caused by the construction is expected to be small. Therefore, this impact is considered to be insignificant. Presently, MPA carry out maintenance dredging of access routes for ships using four (4) dredging boats, and dredged soils are dumped at a designated disposal area located beside the Yangon River. The impacts of the earthwork on soil and water quality are deemed to be small and temporary. If preventive mitigation measures are undertaken during the project design and construction stages, the proposed project will not cause a significant water pollution.

Mitigation measures:

- Proper selection of disposal area for dumping.
- Careful implementation of earthwork.
- Continuous checking of the function of soil work and dispersion of soil pollution.
- During work, do not discharge construction work waste water and daily sewage directly into the river.
- During the work period, the estimated maximum number of workers is about 140, so mobile lavatories and temporary garbage storage shall be installed to avoid uncontrolled littering and water pollution.
- The fuel storage area must have solid foundation, cover, and enclosing walls to prevent fuel from soaking into the soil or spreading to surrounding areas.

(7) Noise and Vibration

For the proposed restoration of the Jetty, it is planned that structures such as foundations, access bridge, concrete pier and pontoon type landing facility etc. will be constructed. The works will include demolishing work, concrete pilings, concreting, scaffolding, steel structures for the restoration of the damaged Jetties and construction of passenger terminal building. There are no vibration and noise standards applied in temporary construction work in Myanmar, and there are no residential facilities in the port area or near the project site. The impacts of the vibration and noise are deemed to be small and temporary However, vibration and noise levels shall be limited as much as possible so that they are not troublesome to people or structures nearby.

Daytime concrete mixing sites shall be kept at a safe distance from residential facilities. In addition, sites that use heavy duty equipment in the evening shall be situated with enough safe distance from residential facilities. Alternatively, if the Contractor employs noise barriers, then noise levels can be re-calculated and moved closer to residential facilities.

The location of the concrete batching plant, material storage areas and worker camps could potentiality have a environmental impact. All of these facilities have to be located in appropriate areas to minimize environmental impact. In order to minimize the effect of these facilities' activities, a detailed survey shall be conducted before starting the construction work. If such measures will be taken, the noise and vibration in construction work would not cause any significant vibration and noise in the surrounding area.

(8) Operation of Equipment

The expected noise sources during the construction of the project are from the earthworks equipment such as pile drivers, bulldozers, backhoes and heavy trucks. Due to the necessity of concrete piling for the foundation, during construction, it is anticipated that a Diesel Hummer will be used and high levels of noise and vibration generated. There are no residents living in the port area of the proposed Jetty. There are lot of street-stalls selling fruit and miscellaneous goods at the access road to Jetty. However, actual construction period is limited and this is likely to be temporally impact during construction. The expected noise levels at various distances from the equipment are shown in Table G.12.1.

Table G.12.1 Noise Levels of Construction Equipment at Varying Distance

Equipment	Distance (m)					
	15	30	60	120	240	325
Front loaders	75	69	63	57	51	49
Backhoes	85	79	73	67	61	59
Graders	88	82	76	70	64	62
Trucks	91	85	79	73	67	65
Pile drivers	101	95	89	83	77	75
Jackhammers	88	82	76	70	64	62

Data source: JICA report, national road project in Philippine
Notes: Unit: dB (A)

The impacts of the operation of equipment are deemed to be small and temporary. If mitigation measures will be taken, the noise and vibration in the operation of port would not cause any significant environmental impact in the surrounding area.

Mitigation measures:

- Proper planning/scheduling of construction activities having potential to cause high noise/vibration shall be duly considered. For example such work activities may be restricted to holidays and daytime hours as deemed appropriate.
- All construction equipment and vehicles shall be specifically checked and maintained to be in good working order so as not cause unwarranted noise/vibration due to their operation.

- Night time operation of equipment which generates high levels of noise shall be suspended.

In addition to the above, to minimize the impacts of exhaust fumes as well as noise of transport vehicles and construction machines and equipment, the project shall be carried out with the following active measures:

- Rusty vehicles and machines will not be used for transport and construction.
- Noise and vibration level will be checked during the work process, and an appropriate work plan set up to limit the noise.
- Different machines and equipment that cause large amounts of noise will not be used at the same time to avoid any resonant effect.

(9) Solid Waste

Laws and regulations for Solid Waste Management (SWM) have not been well-developed in Myanmar while Yangon City has a by-law which only mentions basic requirements on cleansing and pollution control. YCDC is now preparing the draft of amendment of the by-law. The legal framework for SWM should be prepared or updated to improve the situation of SWM.

Solid waste in Yangon City is hauled by ordinary trucks and compactor trucks. Due to the lack of equipment, only the urban area including the port is served by garbage collectors. A large segment of the rural sector has to dispose of their garbage on their own. All of the collected waste is disposed of at a landfill (Htain Pin and Hta Wei Chaung landfill) in Yangon City. It is possible that the landfill operation (final waste disposal site) contaminates water and gives off offensive odors. At the city level, the by-laws named Pollution Control and Cleansing Law (Order No. 10/99) for managing solid waste, issued about 13 years ago, gives basic responsibilities and restrictions of YCDC, business owners and people in the city.

Table G.12.2 Conditions of the Existing Landfills

Site	Location of Townsip	Disposed Waste (ton/day)	Condition
Htain Pin	Hlaing Thar Yar	847	Open dumping
Hta Wei Chaung	North Dagon	612	Open dumping
Dalla	Dalla	10	Temporary Site Open dumping

Data source: JICA Alumni Association of Myanmar

During construction, all of the waste generated by construction is the responsibility of the Contractor. Waste shall be disposed of by the contractor to a designated landfill site after recyclable content such as steel scrap has been separated. Mitigation and Management Procedures to segregate, store, handle and dispose of all waste streams will be addressed through the implementation of the project-specific Waste Management Plan, a component of the Environmental Management and Monitoring Plan for the project. Hazardous, non-hazardous, and domestic waste will be transported offsite by the contractor to an

MPA/IWT approved landfill site for disposal. Septic waste from portable toilets installed on site will be collected and disposed offsite.

The quantity of construction waste generated is not expected to be large. Still, waste management shall focus on proper waste collection, storage, and sorting, so as to reuse and recycle the generated construction waste to the maximum possible extent.

MPA/IWT shall be fully responsible for the treatment of their own hazardous/toxic wastes including bilge generated by ships. Continuous efforts by MPA/IWT shall be promoted to minimize waste generation, and cleaner production and reuse and recycling of generated waste will be carried out to the maximum possible extent. If carried out mitigations and well controlled management, solid waste would not cause any significant environmental impact. following mitigation measures are recommended.

Mitigation measures:

- Appropriate construction waste management/disposal with utmost focus on waste minimization/reuse/recycle.
- Upgrade the municipal final waste disposal site to a controlled landfill system.
- Bilge from ships shall be treated properly according to regulations.

(10) Pollution by Vessel Bilge

The types of waste oil generated during ordinary operations of a vessels are mainly bilge. Bilge is the waste oil accumulated at the bottom of a vessel. It is composed of fuel and lubricant oil leaked from the engine that has mixed with the water that was originally used to wash out this fuel and oil. Based on the number of vessels utilizing the port, vessel's bilge requiring treatment is expected to increase in the future. There are however no bilge treatment facilities at the existing port. It is anticipated that it will be very difficult to construct such facilities due to economic reasons and maintenance problems. If improved procedures and mitigation measures for the collection and handling of generated bilge will be taken, would not cause any significant environmental impact.

Mitigation measures:

One proposed measure is to install an oil collection container at the port. Furthermore, regulations for the handling of liquid waste, together with a monitoring program, will be recommended.

(11) Safety Procedures

The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein, take full responsibility for the security of the site, the protection of the works, the safety of all persons entitled to be upon the site, the safety and convenience of the public or others, and the health of the persons concerned with the works. The Contractor shall develop and implement a site-specific Security, Safety and Health Program (SSHP) which includes, a statement of security, safety and health policy;

organization and lines of responsibilities including subcontractors and suppliers; training; methods for ensuring security, safety and health; incentive programs and compliance. If such measures will be taken, the safety in construction work would not cause any significant environmental impact.

G.13 ENVIRONMENTAL MONITORING

G.13.1 ENVIRONMENTAL MONITORING PLAN

Currently, water and air quality monitoring has not been carried out in the project site, and there are constraints in terms of the equipment to be used for sampling, and technical capability of the staff in analyzing the samples. In order to ensure a sustainable, practical, and effective monitoring system, monitoring plan specifications, together with a reporting system, should be examined as required. The basic plan of the overall environmental monitoring plan covering both the construction and operational phases of the port is given in Table G.13.1 to Table G.13.5.

An Environmental Monitoring Plan will be carried out throughout the period of the project (Pre-construction, Construction and Operation phase). During the Pre-construction and Construction phase of the project the construction contractor shall be responsible for environmental monitoring including occupational health and safety of all personnel working at the construction site. The construction contractor will also be responsible for submission of an integrated occupational health and safety and environment performance report, referred to as HSE (Health, Safety and Environment) report, on a monthly basis to the employer. MPA/IWT shall forward the monthly HSE report submitted by the construction contractor to the relevant environmental authorities (MOECAF) if necessary.

During the operation of the Jetty, management authority of MPA/IWT prepare an annual report on environmental performance of the overall Jetty operation justifying its environmental compliance and safety record of operation, any environmental issues identified and the relevant corrective actions taken and the results of relevant overall environmental quality monitoring and submit the same to the relevant environmental authorities (MOECAF).

The purpose of the Environmental Monitoring Plan is to evaluate the changes in the environment due to the project activities, in order to make sure that the design is satisfactorily mitigating anticipated impacts and the Contractor is carrying out the proposed management plan during the construction phase, and during the operation phase MPA/IWT is taking precautionary measures to avoid environmental impacts. When the Environmental Monitoring Plan is being implemented, it will be possible to detect any deviations quickly and take corrective action before the situation becomes catastrophic.

The purpose of this document is to provide details of a comprehensive environmental monitoring program which will address any issues during the construction phase and operational phase of the Jetty Project. The monitoring plan is aimed at ensuring that the Contractor adheres to the requirements stated in the Environmental Monitoring Plan, as well as to ensure that the mitigation measures prescribed in the Environmental Management Plan

are effective in controlling the environmental impacts, during the construction as well as the operation of the Jetty.

G.13.2 ENVIRONMENTAL MONITORING PROGRAM

The Monitoring program should cover all three phases of the project, namely: pre-construction, Construction and Operation. The purpose of the pre-construction monitoring is to establish a baseline against which any subsequent construction and operational period monitoring can be compared. While the environmental standards provide the absolute standard against which to assess the results of the later monitoring it is important to know the conditions prior to start of the construction and operation. It would be unreasonable to penalize the Contractor if the construction phase monitoring were to show exceeding of the standards, which were present prior to the start of his work. Similarly, any public complaints on the discharges or emissions from the Project activities should be assessed in terms of the changes taken place due to the Project activities, and therefore, it is important to know the situation before the Project started.

In general, environmental monitoring programs will collect data for the following purpose:

- to establish a baseline by gathering information on the basic site characteristics prior to the development or to establish current conditions,
- to determine long term trends in natural unperturbed systems to establish natural baselines,
- to estimate inherent variation within the environment, which can be compared with the variation observed in another specific area,
- to make comparisons between different situations to detect changes, and
- to make comparisons against a standard or target level.

Monitoring during the construction phase would give the opportunity for the Contractor to take corrective action before much damage is done to the environment, thus reducing the final cost of mitigation and also providing a satisfactory environment for the smooth functioning of the facilities in the Jetty while construction is being carried out. Monitoring during the operation phase is important to ensure the sustainability of the natural and social environment and for the smooth operation of the new Jetty.

(1) Monitoring During Pre-construction Phase – Baseline Data

It is very important to collect Baseline Data on all parameters that are likely to be impacted by the Project Activities before the construction commences. All existing data should be gathered from available sources, and where data is not available, field studies and sample testing need to be carried out. Baseline data should cover all likely conditions such as dry and wet weather, day time and night time, peak and off peak hours, wherever relevant.

(2) Monitoring During Construction Phase

Monitoring during the construction phase would give the opportunity for the Contractor to take corrective action before much damage is done to the environment, thus reducing the final

cost of mitigation and also provide a satisfactory environment for the smooth operation of the port facilities while construction is being carried out. Proposed monitoring shall be carried out according to Environmental Specification and EMP.

(3) Monitoring During Operation Phase

Environmental Monitoring during the operation phase is important to ensure the sustainability of the natural and social environment and for the smooth operation of the Jetty. Monitoring shall be carried out according to list of mitigation in operation phase. The Contractor shall be primarily responsible and accountable for the actions and activities of his subcontractors and suppliers, and for their compliance with the EMP. The Contractor shall assume the responsibility of securing all the necessary licenses, permits, clearances and their attendant costs and fees prior to start of any construction activities.

G.13.3 MONITORING PROGRAM

(1) Water Quality Monitoring

The objective of water quality monitoring is to identify any contamination of surface and ground water due to the construction works. The sources of contaminated water discharges into the environment during the construction phase are mainly from the earthwork. The wash water from construction activities and surface runoff during rainy day would contain high concentrations of suspended solids. The impact of discharge for sewage and wastewater from construction workers shall be monitored. The examination result will be utilized to evaluate the impact of the project in the targeted area.

Samples of river water should be collected and tested from all targeted locations for analysis of water during construction phase. However, if there is any visible pollution of the water during construction, due to high suspended solids or oil, or if there is any public complaint reported, immediate action should be taken, sample of the water at the specified locations should be tested to identify the source of pollution. The following parameters should be monitored at monitoring points during operational phase:

- Water Temperature
- Turbidity NTU
- Total Suspended Solids (TSS) mg/l
- pH Value at Ambient Temperature
- Biochemical Oxygen Demand (BOD5) mg/l
- Dissolved Oxygen (DO) mg/kg
- Chemical Oxygen Demand (COD), mg/l,
- Total Nitrogen (T-N) mg/l
- Total Phosphorus (T-P) mg/l
- Oils and Greases, mg/l

- Coliform Bacteria

In addition, the records should contain information about the date and time of sampling, weather condition and the construction activities being carried out at the time of sampling. The procedures for sampling, storage and transport of samples and analysis should be according to the International Standard Methods for Examination of Water and Wastewater, approved by MOECAF. If any other methodology is adopted, it should be clearly stated and approved by the MPA/IWT.

(2) Air Quality Monitoring

The objectives of air quality monitoring during Pre-construction phase is to determine the base line condition of air quality, while during operation phase it is required to determine the impacts of Jetty operation activities in the air at sensitive location.

During the operational phase, the critical issue is the odor, gases or smoke, which would be generated impact to environment. The air quality has to be monitored at locations where the operation activities are likely to cause any impacts on the normal activities being carried out in the Jetty area. Air quality measurements should be carried out at a location downwind from the source of contamination. However, since the dominant wind direction changes seasonally, it is better to locate sampling points on both sides of the activity during operation. Air Quality Monitoring should be carried once a year during the operational phase. Following parameters should be monitored at monitoring point of air during operational phase:

- Particulate matter- Aerodynamic diameter < 10μm in size (PM10)
- Nitrogen Dioxide (NO_2)
- Sulfer Dioxide (SO_2)
- Carbon monoxide (CO)

The procedures for sampling, storage and transport of samples and analysis should be according to the International Standard Methods for Examination of Air approved by MOECAF. If any other methodology is adopted, it should be clearly stated and approved by the MPA/IWT.

(3) Solid Waste

The objective is to make sure that the Contractor does not allow accumulation of solid waste, including site clearing and demolition debris, excess construction materials such as rubble, sand and hardened concrete, lying around in the premises for long periods. This monitoring is not regulated by law, but should be carried out to make sure that no unsightly dumps are formed. Liquid and Solid waste shall be disposed off-site which is approved by MPA/IWT by the Contractor.

Monitoring should be carried out daily and report shall be prepared once in a weeks. Volume of solid and liquid waste generated in construction site and worker's camp being collected by the Contractor should be physically observed. Following mitigation measures and disposal of generated waste shall be inspected daily by the Contractor;

- Conditions of excess materials such as excavation
- Conditions of recycling
- Final treatment of waste
- Conditions of segregation
- Final disposal of waste
- Solid and liquid waste management etc.

(4) Accidents

The objective of monitoring for accidents at the construction site is to ensure safety for the workers and persons working in the construction site for normal activities during the construction period. Even though Labor Regulations require the record keeping for accidents, there are no environmental regulations for monitoring accidents concerning persons other than workers at sites. The Contractor shall monitor accidents and take immediate corrective actions. The number of fatal, non fatal and minor accidents in each of the construction packages should be recorded. The partial accident report shall be submitted to the MPA/IWT within one week after accident.

Daily record of accidents should be maintained, and reported on monthly basis. Number of fatal, non fatal and minor accidents, date, time, location and cause of accident should be recorded.

(5) Traffic Congestion

Objective of monitoring the traffic congestion is to find out conditions transportations of materials, if there is a lowering of the level of service provided to the public during construction and operation of the project, and if so, to improve the situation, by proper management of activities.

Traffic counts should be taken at the access road of Jetty approved by the MPA/IWT. During pre-construction phase, traffic counts should be carried one time to determine the baseline conditions of the road. During material transportation in the construction phase, the Contractor shall carry out daily monitoring (visual inspection) of traffic conditions. Traffic counts should be done once in a week according to instructions of the MPA/IWT.

During operation phase, traffic counts needs to be done if there are complaints or observed traffic congestion. The traffic volumes, time, and categories (type of vehicles including motorcycles) should be counted during Peak and Off Peak periods, and lane widths measured, in order to determine the level of traffic congestion.

(6) Reporting

The monitoring program during the pre-construction phase should be carried out by a suitably qualified organization and existing baseline data, test results and other data should be compiled into a Baseline Survey Report.

During the construction phase, the contractor shall be responsible for ensuring that the formal environmental monitoring program shall be carried out by a suitably qualified organization and approved by the MPA/IWT. The Contractor should submit copies of all laboratory reports and site inspection reports to the MPA/IWT.

The MPA/IWT will complete a site environmental audit report, with copies of all test reports as attachments every month, and make it available to the MPA/IWT as and when needed.

During the operational phase, environmental reporting will be the responsibility of the MPA/IWT. Close cooperation of the environmental study shall be done with MOECAF, Traffic Police, for review at quarterly meetings during construction phase. Public complaints, if any, could be taken up at such meetings, and resolved without much delay, as all concerned parties will be aware of the ground situation.

G.13.4 MONITORING CONDITIONS

(1) Monitoring

Monitoring work shall be carried out according to the following conditions as shown in Table G.13.1 to G.13.5.

Table G.13.1 List of Monitoring Requirements

Monitoring Element and Sampling Location	Parameter	Frequency			Notes
		Base Line data	During Construction	During operation	
Water Quality of Yangon River	1. Water temperature 2. Turbidity 3. Total suspended solids (TSS) 4. pH 5. Dissolved oxygen (DO) 6. Chemical oxygen demand (COD) 7. Total nitrogen (T-N) 8. Total phosphorus (T-P) 9. Oil content 10. Coliform bacteria	Once in pre-construction phase	Once in dry season and once in rainy season	Once in year	Each two (2) stations and two (2) samples (surface & bottom),. total four (4) samples Unit: mg/l
Water Quality of Surface Drainage	Monitoring of surface drainage including scheduling and technical mitigation measures	Once in pre-construction phase	Every working days of construction period	Monthly	visual inspection
Soil Erosion of Earthwork Site	Monitoring of earthwork including scheduling and technical mitigation measures	-	Every working days of construction period	-	visual inspection
Air Quality of Construction Site	Visual inspection	Once in pre-construction phase	Daily	-	Equipment and vehicle : visual inspection
Air Quality of Port Operation	1. Particulate matter PM10 2. Nitrogen Dioxide NO2 3. Sulfur Dioxide SO2 4. Carbon monoxide CO	-	-	Once in year	Total two samples.
Solid Waste Accumulation at Site and Disposal of Solid Waste	Amount of collected waste at site	-	Daily	Monthly	
	Conditions of collection/disposal site	-	Daily	Monthly	Visual inspection
Compliance with Contractor's Health and Safety Plan	To be identified	-	Daily	-	
Noise and Vibration	Construction equipment/vehicles	Once in pre-construction phase	Daily	Daily	Visual inspection
Traffic Congestion	Traffic volumes and categories at peak and non-peak hours on access road to port	Once in pre-construction phase	Daily	Monthly	Visual inspection

Table G.13.2 Monitoring Locations and Requirements

Monitoring Element	Location	Monitoring Needed During			Remarks
		Baseline	Construction	Operation	
Water Quality of Yangon River	Designated sites	√	√	√	
Water Quality of Surface Drainage	Designated sites	√	√	√	-Monitoring shall be done at the construction site.
Soil Eerosion of Earthwork Site	Construction site	-	√	-	
Air Quality	Air quality of construction site	√	√	-	Construction equipment/ vehicles : visual inspection
Air Quality	Air quality of port operation	-	-	√	
Solid Waste Accumulation at Site	To be identified by the Contractor will be solid waste dumping sites allocated to the contractor, and any other vacant areas where the contractor is depositing the debris	-	√	√	
Accidents at Site	Every site under contract	-	√	√	
Noise and Vibration	Every site under contract	√	√	√	Construction equipment/vehicles, close to the housing area which may be affected
Traffic and Public Facilities	-Access road to construction area, detour road and any other temporary construction works related to road..	√	√	√	

Note
√ : Proposed monitoring
1) All of monitoring and sampling in the operational phase shall be carried out by MPA/IWT.
2) Data collection during construction phase shall be carried out by the Contractor.
3) Data collection of baseline data shall be carried out by the Contractor.

Table G.13.3 Monitoring Conditions (Pre-construction Phase)

Monitoring Elements	Monitoring Activities	Monitoring Location	Frequency
Water Quality of Yangon River	Refer table G.13.1 and 13.13.2	Refer table G.13.1 and G.13.2	Refer table G.13.1 and G.13.2
Water Quality of Surface Drainage	Ditto	Ditto	Ditto
Air Quality of Construction Site	Ditto	Ditto	Ditto
Noise and Vibration	-Check of traffic noise as baseline data Visual inspection	-Construction site and access road -Worker's camp -Concrete batching plant etc.	Once at sites
Traffic Congestion	-Traffic counts (Numbers and time) -Passenger counts (Numbers and time)	-Construction site and access road -Worker's camp -Concrete batching plant etc.	Once at sites

Table G.13.4 Monitoring Conditions (Construction Phase)

Monitoring Elements	Monitoring Activities	Monitoring Location	Frequency
Water Quality of Yangon River	Refer table G.13.1 and G.13.2	Refer table G.13.1 and G.13.2	Refer table G.13.1 and G.13.2
Water Quality of Surface Drainage	Ditto	Ditto	Ditto
Soil Erosion of EarthWork Site	Ditto	Ditto	Ditto
Air Pollution of Equipment	-Check of vehicles and construction equipment.	Construction site and access road	Every working day during construction period
Solid Waste Accumulation at Site	-Conditions of excess materials such as excavation -Conditions of recycling -Final treatment of waste -Conditions of segregation -Hazardous waste management -Soil and liquid waste management etc.	-Construction site -Worker's camp -Disposal sites	Every working day during construction period
Accidents at Site	-Number of fatal, non fatal and minor accident -Date, time, location -Cause of accident and analysis -Counter measures etc.	Every Site under the contract	Ditto
Noise and Vibration	-Check of vehicles, construction equipment and concrete plant etc.	-Construction site -Worker's camp -Concrete batching plant etc.	Ditto
Traffic and Public Facilities	-Traffic counts -Speed control of construction vehicles, -Timing/scheduling of construction vehicles, -Traffic control, -Site attention sign/traffic flag man etc.	-Construction site -Access road to construction site	Ditto
Health and Safety	-Health conditions of workers -Security	-Construction site -Camp	Ditto
Common	Monitoring of mitigation measures	Construction site	Weekly

Table G.13.5 Monitoring Conditions (Operation Phase)

Monitoring Elements	Monitoring Activities	Monitoring Location	Frequency
Water Quality of Yangon River	Refer table G.13.1 and G.13.2	Refer table G.13.1 and G.13.2	Refer table G.13.1 and G.13.2
Water Quality of Surface Drainage	Ditto	Ditto	Ditto
Air Quality of Port Operation	Ditto	Ditto	Ditto
Solid Waste Accumulation at Site	-Conditions of recycling -Final treatment of waste -Conditions of segregation -Management of bilge and hazardous waste -Soil and liquid waste management etc.	Jetty site	Monthly Visual inspection
Noise and Vibration	-Check of traffic noise as baseline data Visual inspection	Jetty site	Daily Visual inspection
Traffic Congestion	-Traffic counts (Numbers and time) -Passenger counts (Numbers and time)	-Jetty site -Access road, etc.	Monthly Visual inspection

(2) Monitoring Cost

The scope of the proposed EMP is quite extensive and its implementation will require the allocation and expenditures of an estimate $12,500 for the 9 months construction period beginning February 2014.

Table G.13.6 Cost for Environmental Monitoring

(Unit: US$)

No.	Items of Monitoring	Cost	Notes
1	Pre-Construction Phase		
a.	Baseline monitoring; Water quality	2,500	Laboratory analysis
	Baseline monitoring; Air quality	500	
b.	Water quality of surface drainage	500	Vixsual inspection
c.	Noise and vibration	500	Ditto
d.	Traffic and public facilities	500	Ditto
2	Construction Phase (9 months)		
a.	Traffic and public facilities	1,500	Vixsual inspection
b.	Air pollution	1,000	Ditto
c.	Health and safety	1,000	Ditto
d.	Solid waste	1,000	Ditto
e.	Hazards/accident	1,000	Ditto
f.	Water pollution	1,000	Ditto
g.	Noise and vibration	1,500	Ditto
	Total	12,500	
3	Operation phase		
a.	Traffic and public facilities	-	
b.	Air pollution	-	Laboratory analysis
c.	Health and safety	-	
d.	Solid waste	-	
e.	Hazards/accident	-	
f.	Water pollution	-	Laboratory analysis
g.	Noise and vibration	-	

Cost for operation phase: Conditions will be fixed at later stage

Table G.13.7 Environmental Monitoring Plan for the Project

Issue	Impact to be mitigated	Monitoring activities	Monitoring frequency	Monitoring Location	Related organization (person)
Traffic and Public facilities (Construction Phase)	Nuisance or danger of traffic accidents caused to school children and local residents near the port access road due to construction vehicular traffic.	- Speed control of construction vehicles. - Timing/scheduling of construction vehicles. - Traffic control and site attention signs/traffic flag man. - Visual inspection	Every day of the construction period.	- Access roads to port area - Detour road and any other temporary construction work related road as appropriate.	- Local Traffic Police - Contractor - Site supervision engineer - MPA/IWT
Traffic and Public facilities (Operation Phase)	Increased traffic density nearby port area may cause similar traffic safety issues to school children and local residents including port employees.	- Speed limit/traffic signs for vehicles near port area. - Proper traffic management to effectively separate uses of Main access and Detour roads. - Visual inspection	Monthly	- Access roads to port area	- Local Traffic Police - MPA/IWT
Air pollution (Construction Phase)	Dust and air pollutant emission due to construction equipment, vehicles, and activities like land clearing, transport/storage of dust prone materials at the site.	Monitoring of proper operational functioning of all heavy equipment/vehicles, transport/storage of materials and regular water sprinkling of site. - Regular ambient air quality monitoring at site. - Visual inspection	Every day of the construction period.	Construction equipment/vehicles and at one location of the construction site for ambient air monitoring.	- Contractor - Site supervision engineer - MPA/IWT
Air pollution (Operation Phase)	Dust and air pollutant emission from the port operation.	- Check of vehicles/equipment and associated facilities.	Ambient air quality monitoring at site by MPA/IWT. Once a year.	Port area for ambient air monitoring.	- MPA/IWT
Noise and vibration (Construction Phase)	Nuisance caused to nearby residences due to construction equipment and heavy vehicles, and construction activities.	Check of heavy vehicles and construction equipment and timing of high noise/vibration activity. -Visual inspection	Every day of the construction period.	Jetty construction site.	- Contractor - Site supervision engineer - MPA/IWT
Noise and vibration (Operation Phase)	Nuisance caused to nearby residences due to port operation including equipment and vehicles.	- Monitoring of noise control - Check of vehicles/equipment and associated facilities -Regular ambient noise monitoring along with air quality monitoring at port.	Ambient noise monitoring along with air quality monitoring at port by MPA/IWT on quarterly basis.	One location in the port area for ambient noise monitoring.	- MPA/IWT

G.14 CONCLUSION

(1) Evaluation at Construction Phase

At the construction phase, the project activities impact on the livelihood of local people could be evaluated as negative or relatively small impact, because there are no residents living in the project area. The access route for the transportation of construction materials in the site is limited. However, almost all of the construction materials will be brought to site via water transportation by ships and therefore have less possibility to traffic congestion and disturbance of local traffic. Traffic control for transportation of construction materials should be considered to mitigate the impact. In addition, the impact on noise and vibration during the pile-installation stage is evaluated as negatively small, and the impact terms of piling work is limited. The impact can be mitigated by the construction methods. Also, the residential area located beside the port is far from construction sites and therefore the impact is limited.

(2) Impact at Operational Phase

Total number of passengers who utilize the Jetty will be increased in the future. Therefore, several environmental impacts on accident, waste, air, and water quality will be increased and evaluated as relatively negative at the operational stage of Jetty. However, this impact can be mitigated by the proper design of facilities and proper management of operation methods in the operation phase. If proper planning and operation method are carried out, port operation activities would not cause any significant environmental impact.

(3) Conclusion and Recommendations

In this project, only small scale facilities are to be constructed and the expected impact of the construction work will only take a short period of time (Maximum 9 months). In the case of the construction works, it is estimated that the environmental impact to the riverbank zone will be relatively small. However, it is still recommended that appropriate construction methods which will minimize the environmental impact to the riverbank and river area be adopted.

The screening/scoping process and the subsequent analysis of potential social and environmental impacts (adverse effects), and mitigation measures as described in the sections above, indicated that though there is potential for some small adverse effects due to the Jetty project, all potential adverse effects are still manageable, and could be mitigated with well-known, tested and feasible mitigation methods. Most of the anticipated negative impacts caused by the Jetty project can be managed and minimized by proper project planning, design, construction and operational management of the port. Table G.13.8 shows the List of Mitigation Measures.

Table G.13.8 List of Mitigation Measures

Environmental Items	Mitigation Measures	Responsible Org.	Cost
• **Pre-Construction and Construction Phase:**			
1. Traffic and Public Facilities	· Proper traffic management and control. · Proper route scheduling for construction vehicles. · Construction materials and equipment are not to be transported during peak traffic hours. · Adjustment of transportation route to avoid sensitive zone such as residential area, school, clinic, etc., if necessary. · Strict compliance of transportation law on waterways as well as consideration of scheduling of barge trips in consultation with MPA/IWT · Refer to Chapter G.12.1 (3) Traffics.	Contractor	$ 3000
2. Air Pollution	· Reduce dust during 1) works on rock and soil, 2) transportation, loading and unloading of construction materials, 3) building material storage, 4) concrete casting. Wash and clean the road surfaces daily or periodically. · Provide covers for material transport vehicles to avoid air pollution. · Regular maintenance of vehicles and equipments to minimize noise, vibration and emission gas. · Consideration of driving manner to limit the speed of vehicles to minimize noise and dust generations · Refer to Chapter G,12.2 (5) Air Quality.	Contractor	$ 2000
3. Health and safety	· Provide education/campaign on sanitation and HIV/AIDS awareness to construction workers. · Provide temporary sanitary closets and toilet facilities for construction workers. · Provision to construction workers of protective clothing including masks, helmets, gloves and safety shoes. · Workers camp will be constructed at locations where noise generation due to construction works is minimized. · Provide first aid and medical facilities to construction workers. · Hiring of NGOs as sub-contractor to conduct and monitor integrated health protection program.	Contractor	$ 3000
4. Waste	· Appropriate construction waste management/disposal with utmost focus on waste minimization/reuse/recycle. · Upgrade the municipal final waste disposal site to a controlled landfill. · Bilge from ships shall be treated properly according to regulations. · Installation of waste bins and notice board. · Waste paper and wood packages are to be reused as firewood for workers camp, · Excess materials such as excavation materials are to be reused as backfill and extension area. · Non-hazardous wastes which cannot be reused or recycled are to be collected and stored temporarily in construction site, and then hauled to non-hazardous landfill sit	Contractor	$ 2500
5. Hazards	· Proper planning and implementation of occupational health and safety of all construction workers. · Appropriate management of hazardous/toxic and flammable substances. · Training and enlightenment activities of workers	Contractor	$ 2500
6. Water Pollution	· Proper management of all construction work related waste. · Earth work plan of the project will be designed so as to minimize cutting and filling volume as much as possible. · Proper selection of disposal area for dumping. · Refer to Chapter G12.2(6) Water Quality.	Contractor	$ 3000

7. Noise and Vibration	· Proper servicing and operational management of all construction vehicles, machinery and equipment. · Appropriate construction work schedule/planning/management of high noise/vibration prone work such as piling. · For the berth piling work, minimize impact of noise pollution and vibration caused by piling work. · Study noise data for the equipment and tools which are to be used in this project and prepare noise mitigation plan, if necessary. · Refer to Chapter G.12.2 (7) Noise and Vibration.	Contractor	$ 1500
8. Others	1) Global Warming Minimization of GHGs emission by construction machines and vehicles will be planned. 3) Accident Accident prevention measures will be planned inside and outside of the project area	Contractor	$ 3000
• **Operation Phase:**			
1. Traffic and Public Facilities	· Proper traffic management and control. · Proper route scheduling for operational vehicles.	MPA/IWT	
2. Air and Water Pollution	· Effective traffic management including regular emission checks on vehicles and associated facilities for gas emissions. · Regular monitoring of ambient air quality at the port area.	MPA/IWT	
3. Public Health Conditions	· Continuous education/campaign on sanitation and HIV/AIDS infection to MPA staff/employees.	MPA/IWT	
4. Waste	· Effective implementation of solid waste collection and transportation system focused on waste minimization through cleaner production by industries/waste reuse and recycle. · Research and planning on the solid waste disposal field as well as the technologies of the treatment system. · Installation of waste tanks to receive oil-contaminated waters and used oil, and waste bins for garbage and solid waste with bunds or ditches to prevent from their spillage. ·	MPA/IWT	
5. Water pollution	· Effective operational management of wastewater including monitoring of river water. · Effective operational management of dredging and land reclamation. · Effective pretreatment of toxic/hazardous wastewater. · Regular monitoring of river water quality at port.	MPA/IWT	
6. Noise and Vibration	· Effective operational management of noise and vibration.	MPA/IWT	
7. Others	1) Global Warming Minimization of GHGs emission by construction machines and vehicles will be planned. 2) Accident Accident prevention measures will be planned inside and outside of the project area	MPA/IWT	

APPENDIX H

TRAFFIC COUNT SURVEY

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APPENDIX H TRAFFIC COUNT SURVEY

Survey Data of Traffics at Access Points

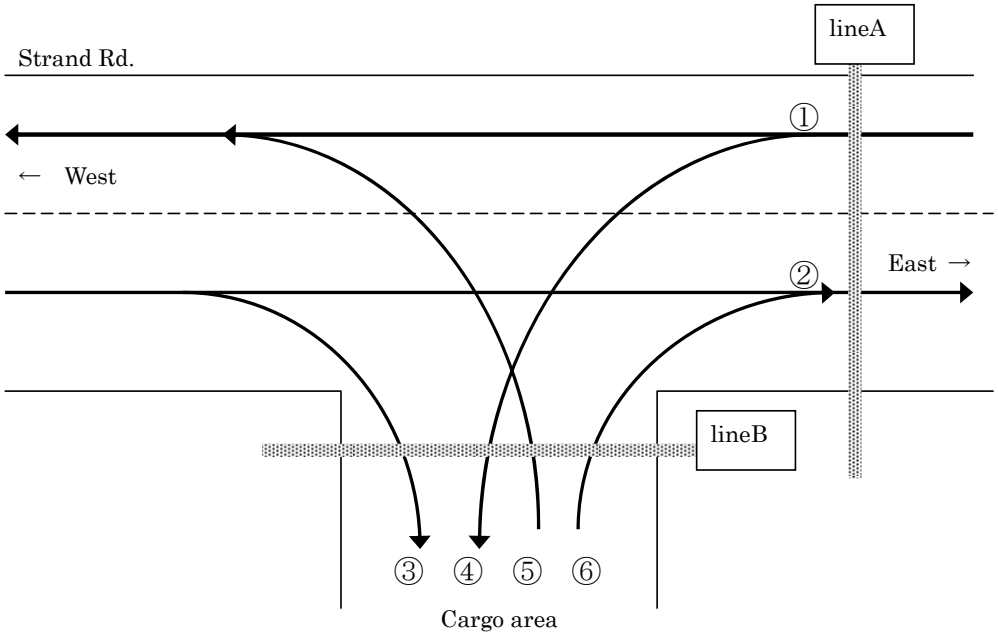
Date	Sep.29, 2009	Time	6:00-20:00
Site	 **Site Plan of Access Point of the Jetty**		
Methodology	6:00-9:00; Counted vehicles passing each point of the road during a 60 minutes period. 9:00-20:00; Counted vehicles passing each point of the road during a 10 minutes period at every hour, number of vehicles per hour is calculated as follows; X= Y x 6 X: Total number of passing vehicles per hour Y: Counted vehicles during a 10 minutes period in each hour		
Results	Refer to Table H.1-H.2 and Figure H.1-H.2		

Table H.1 Survey Data of Traffics at Strand Road

time	①		②		③		④		⑤		⑥	
	cars	tracks	cars	tracks	cars	tracks	cars	tracks	cars	tracks	cars	tracks
6:00- 7:00	111	23	62	23	4	11	0	4	6	0	0	0
7:00- 8:00	197	47	133	48	5	15	4	7	4	0	6	0
8:00- 9:00	250	60	165	91	7	17	4	16	5	7	5	24
9:00-10:00	228	48	276	66	12	6	6	6	6	0	0	24
10:00-11:00	408	96	216	138	12	0	0	6	12	0	0	18
11:00-12:00	282	78	210	108	12	6	0	6	18	12	12	6
12:00-13:00	318	66	192	36	18	6	6	0	18	6	0	6
13:00-14:00	234	30	276	114	24	24	12	0	24	6	0	0
14:00-15:00	258	48	270	48	6	6	6	12	0	6	12	0
15:00-16:00	216	48	180	54	12	6	0	0	0	18	6	0
16:00-17:00	282	54	228	72	6	18	0	0	0	12	0	6
17:00-18:00	264	54	210	102	18	6	0	6	0	12	0	0
18:00-19:00	228	18	162	66	6	12	6	6	24	0	0	18
19:00-20:00	150	18	72	30	0	6	6	0	6	12	0	6

Notes
Cars：Small Type Vehicles,
Tracks：Large Type Buses & Tracks.

Table H.2 Survey Data of Traffics at Access Road to Jetty

time	Strand Rd.			Port Entrance				
	cars	tracks	total	cars		tracks		total
				in	out	in	out	
6:00- 7:00	173	46	219	4	6	15	0	25
7:00- 8:00	330	95	425	9	10	22	0	41
8:00- 9:00	415	151	566	11	10	33	31	85
9:00-10:00	504	114	618	18	6	12	24	60
10:00-11:00	624	234	858	12	12	6	18	48
11:00-12:00	492	186	678	12	30	12	18	72
12:00-13:00	510	102	612	24	18	6	12	60
13:00-14:00	510	144	654	36	24	24	6	90
14:00-15:00	528	96	624	12	12	18	6	48
15:00-16:00	396	102	498	12	6	6	18	42
16:00-17:00	510	126	636	6	0	18	18	42
17:00-18:00	474	156	630	18	0	12	12	42
18:00-19:00	390	84	474	12	24	18	18	72
19:00-20:00	222	48	270	6	6	6	18	36
Total	6078	1684	7762	192	164	208	199	763

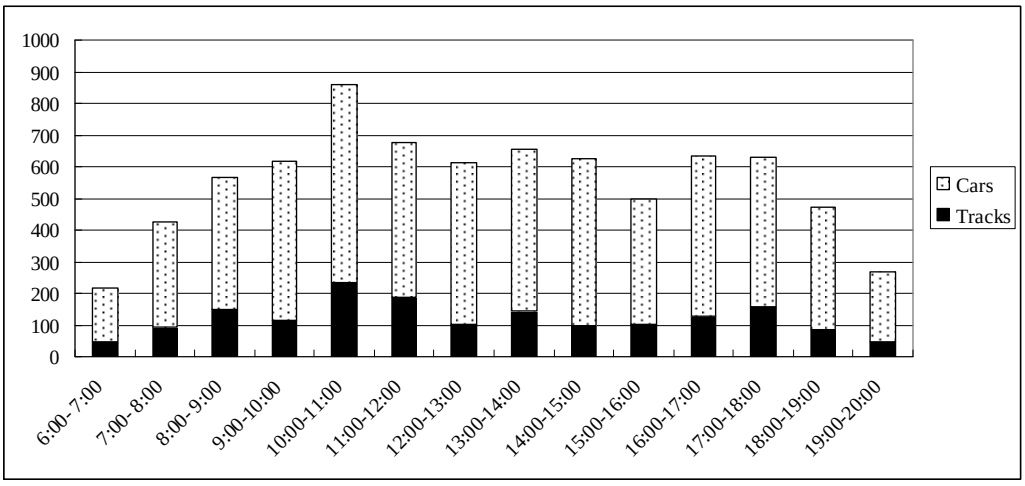


Figure H.1 Traffic of Strand Road.

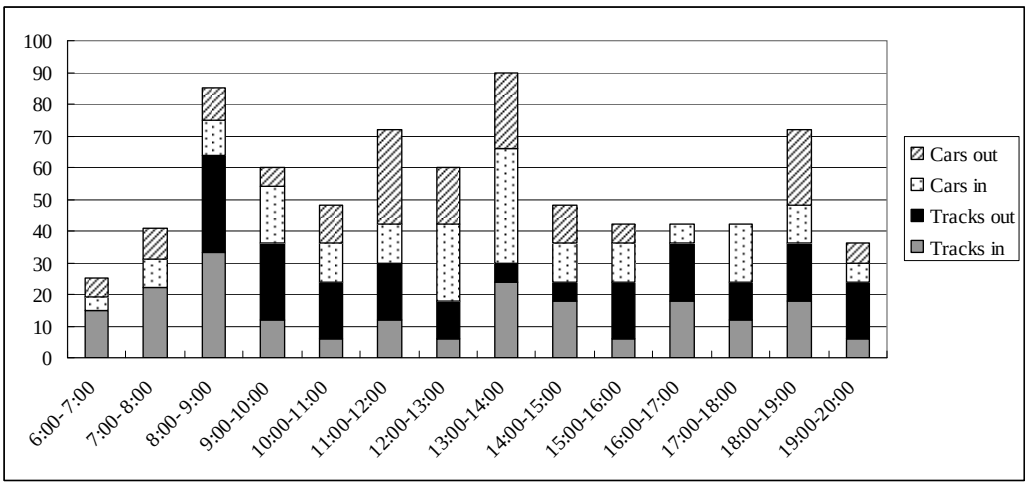


Figure H.2 Traffic at Access Road to Port

APPENDIX I

SETTING OF CROSS SECTION OF RIVER CHANNEL

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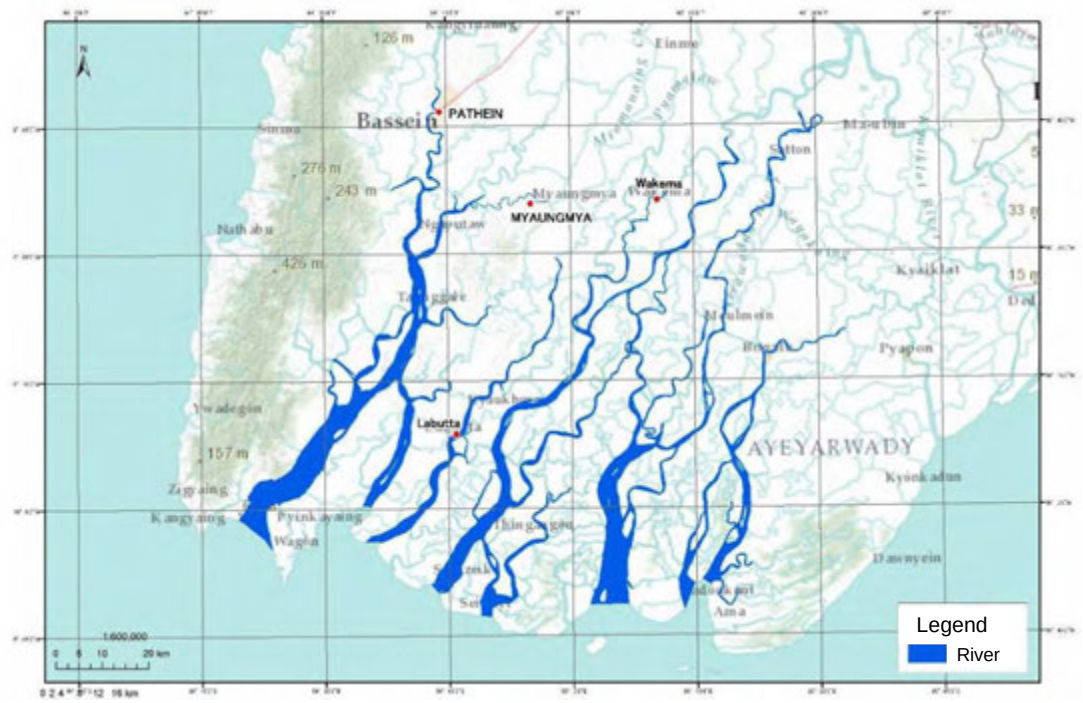
APPENDIX I SETTING OF CROSS SECTION OF RIVER CHANNEL IN AYEYARWADY DELTA AREA

I.1 COLLECTION OF DATA

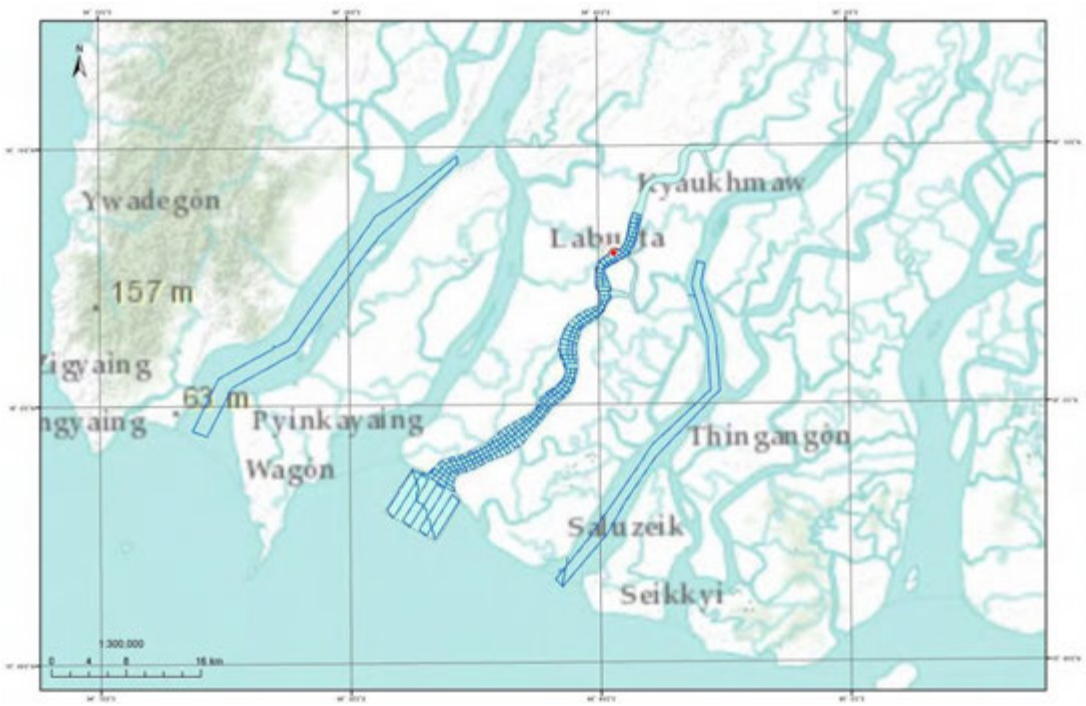
To prepare the river channel mesh data, the land use data from "The Study on the Establishment of Geographic Database for the National Rehabilitation and Development Programme in the Union of Myanmar (August, 2004)" were utilized as shown in Figure I.1.1. Blue areas in Figure I.1.1 show the target river channels.

In addition, the geodetic survey was conducted in the Project, of which survey area was shown in Figure I.1.2. The survey did not completely cover all target river channels. The longitudinal profile and the cross section survey were conducted in the Ywe River, while only the longitudinal profile survey was conducted in the Pathein River and the Pya Ma Law River.



Source: JICA Project Team

Figure I.1.1 Land Use Data



Source: JICA Project Team

Figure I.1.2 Survey Area

I.2 STUDY OF MESH PREPARATION METHOD

I.2.1 METHODOLOGY

In this clause, the method to prepare the mesh data of river height based on the survey result was discussed.

The relation between river and the survey conducted were divided into the following three cases.

1. Ywe River: Both the profile and cross section surveys were conducted.

2. Pathein River and Pya Ma Law River: The longitudinal profile survey was conducted.

3. Other rivers: Any survey was not conducted.

In addition, the channel shape can be obtained from the land use data reported in "The Study on Establishment of Geographic Database for the National Rehabilitation and Development Programme in the Union of Myanmar (August, 2004)".

The method to create data for each river was discussed below.

1. Ywe River

Because there was enough data from the survey, the mesh data will be prepared directly.

2. Pathein River and Pya Ma Law River

Since the longitudinal profile survey was conducted, it is needed to create the data of the cross section according to the river width, referring the river shape data from the land use data, and the depth of water.

3. Other rivers

Because there was neither the profile nor cross section data, they were prepared by the following procedure.

1) Setting of Channel Profile

Channel profile was set first, since the longitudinal profile is important factor in considering tsunami run-up to upstream of a river. Here, the channel profile was set based on the longitudinal profile data of Ywe River.

2) Cross Section Setting

Cross section was set by the longitudinal profile data of other rivers and the river width determined by the land use data.

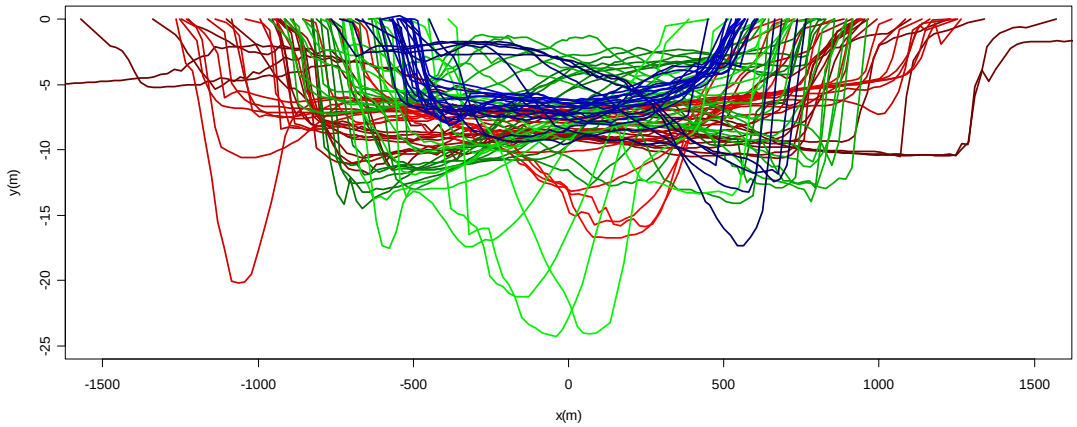
To establish the method to set the cross sections, the characteristics of the cross section of Ywe River were analyzed first, as described below.

I.2.2 CHARACTERISTICS OF CROSS SECTION OF YWE RIVER

Cross sections of Ywe River were examined, prior to preparing the mesh data of the river channel.

Figure I.2.1 shows the overlaid cross sections in color in order of red, green, and blue from its downstream. The tendencies that can be judged from the figure are described below.

- The river width was 3 km at the downstream side of the river and about 1 km at the upstream.
- The depth of water was from about 5 m to about 25 m.
- There were cross sections with deep scouring and without deep scouring.
- The shape of cross section without deep scouring was mostly in a trapezoidal shape.
- The shape of cross section with deep scouring was mostly in almost rectangular triangle.



Source: JICA Project Team

Figure I.2.1 Overlaid Cross Section Profiles of Ywe River

The remarkable shape of the cross sections was the effect of deep scouring. The shape of scouring is discussed in the next clause.

I.2.3 SCOURING

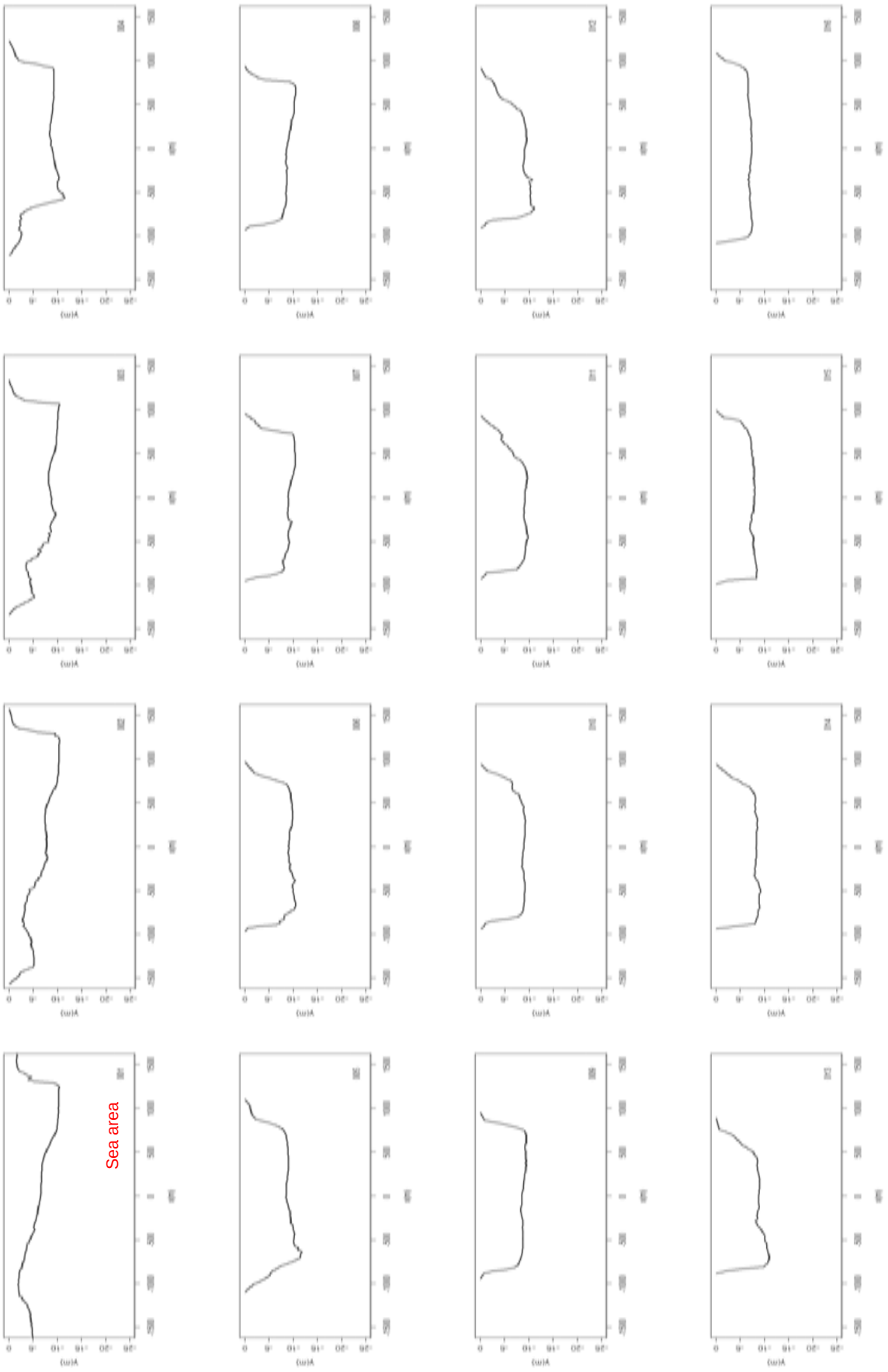
The causes to create deep scouring are listed below (reference: Koichi Yamamoto, Alluvial rivers, Sankaido, 1994).

1) Sand bank
2) River bend
3) Change of river width
4) Small sand waves
5) Structure
6) Others (such as lowering of riverbed due to a drop-down curve when the debacles occur around a river mouth)

Among above, No. 1, 4, and 6 have little impacts on this study. In addition, effect of No. 5 was not considered in this study either, because No. 5 affects only locally.

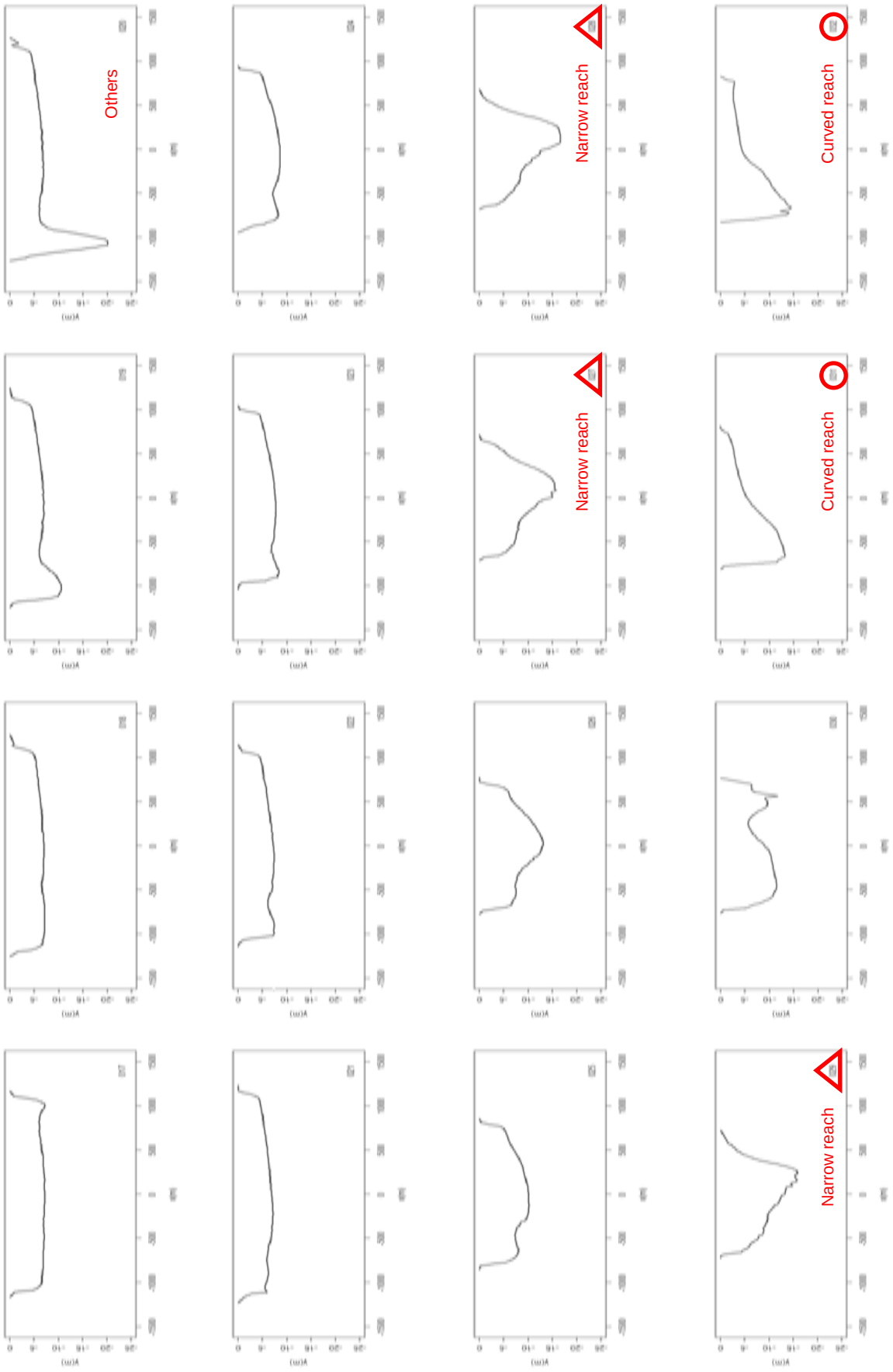
Therefore, deep scouring discussed in this study was effects by “No. 2 River bend” and “No. 3 Change of river width”.

When examining the cross sections, they were divided into two groups, or the cross section profiles with deep scouring by the river bend and the other cross section profiles in order to clarify the differences of the cross sections. Also, the locations of deep scouring were identified.



Source: JICA Project Team

Figure I.2.2 Cross Section of Ywe River (1/5)

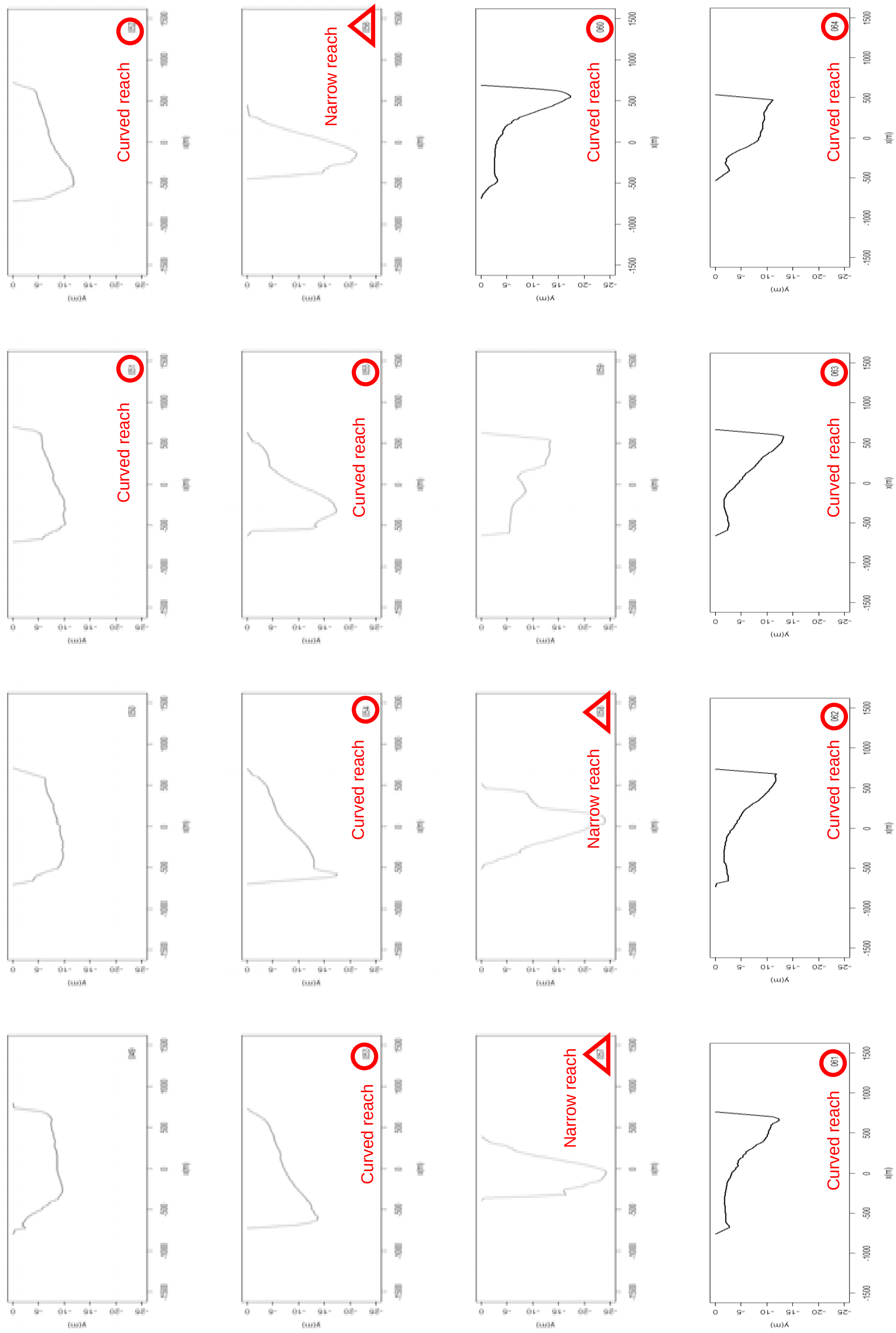


Source: JICA Project Team

Figure I.2.2 Cross Section of Ywe River (2/5)

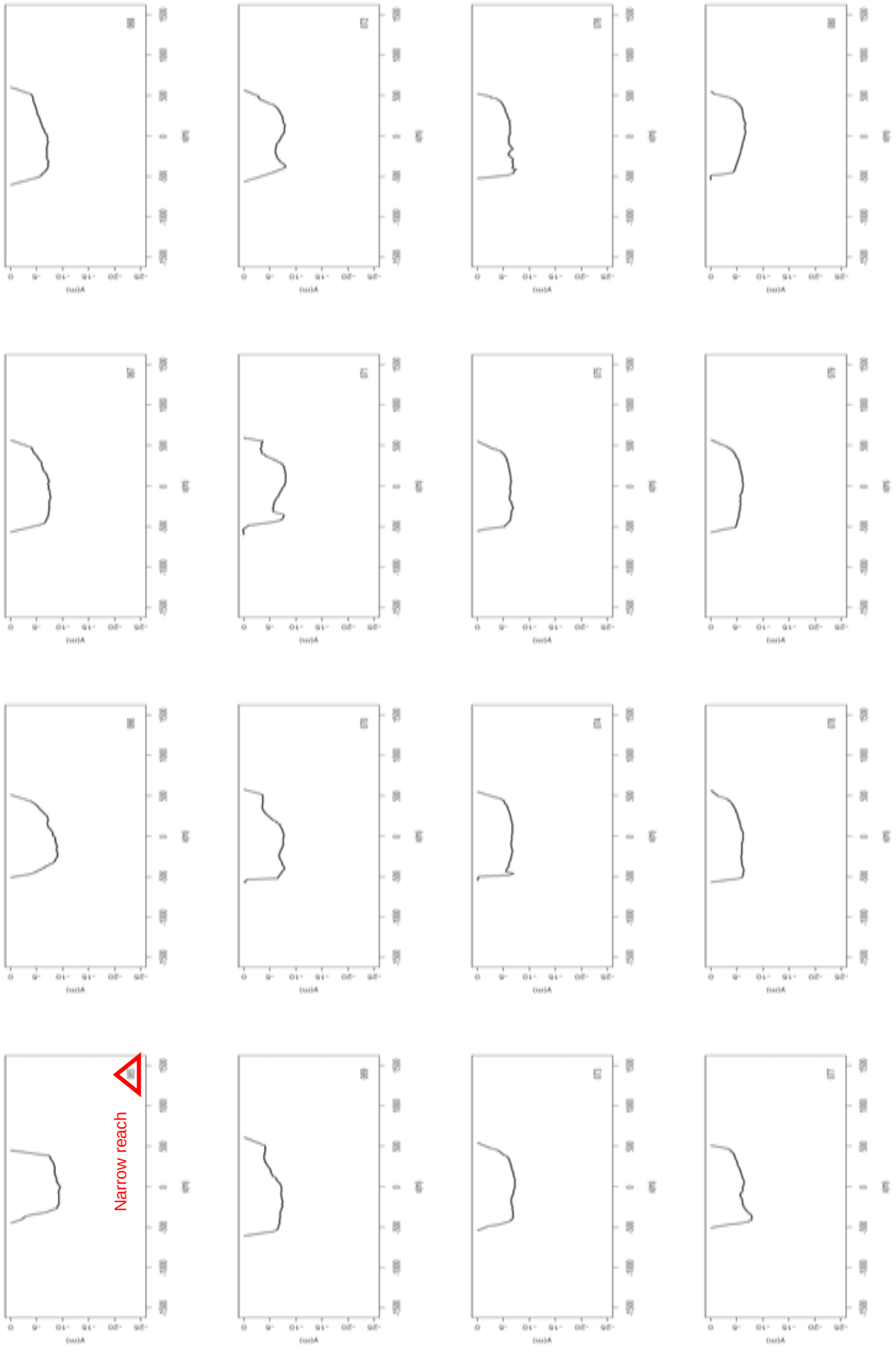
Source: JICA Project Team

Figure I.2.2 Cross Section of Ywe River (3/5)



Source: JICA Project Team

Figure I.2.2 Cross Section of Ywe River (4/5)



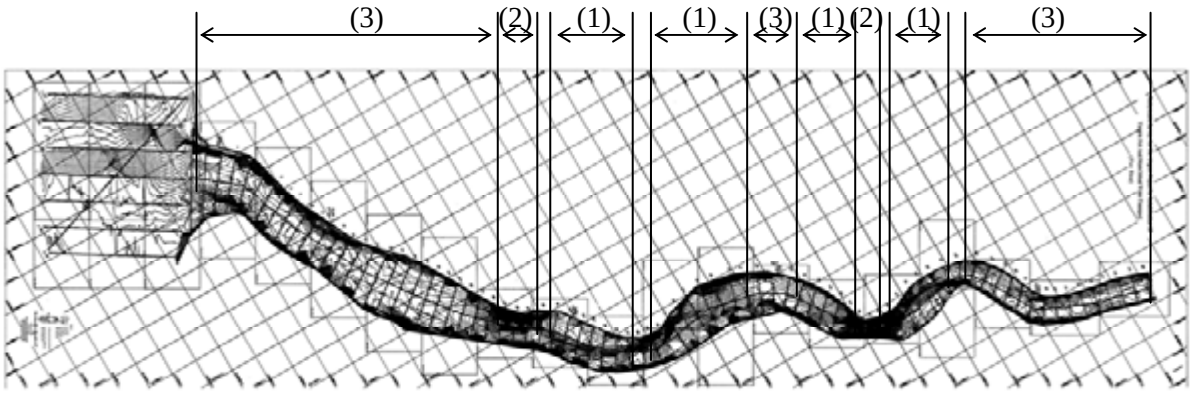
Source: JICA Project Team

Figure I.2.2 Cross Section of Ywe River (5/5)

I.2.4 LOCATION OF SCOURING

The locations of deep scouring were identified on the surveyed map of the Ywe River. Identification was conducted by classifying the river channel into three groups as shown in Table 3.1. It was observed that the scouring occurs at the directly downstream of curved reach.

1) Curved reach (scouring at the outer side of curve)
2) Narrow reach (scouring at the center of cross section)
3) Others reach



Note: Station number starts from the river mouth to the upstream. Station 1 (St. 1) is located in the river mouth, shown in the left side of figure.
Source: JICA Project Team

Figure I.2.3 Location of Scouring

Table I.2.1 Results of Classification

Station	Classification
St.2-26	3. Others
St.27-29	2. Narrow reach
St.30	3. Others
St.31-37	1. Curved reach
St.38-39	2. Narrow reach
St.40-47	1. Curved reach
St.48-50	3. Others
St.51-55	1. Curved reach
St.56-58	2. Narrow reach
St.59	3. Others
St.60-64	1. Curved reach
St.65	2. Narrow reach
St.66-80	3. Others

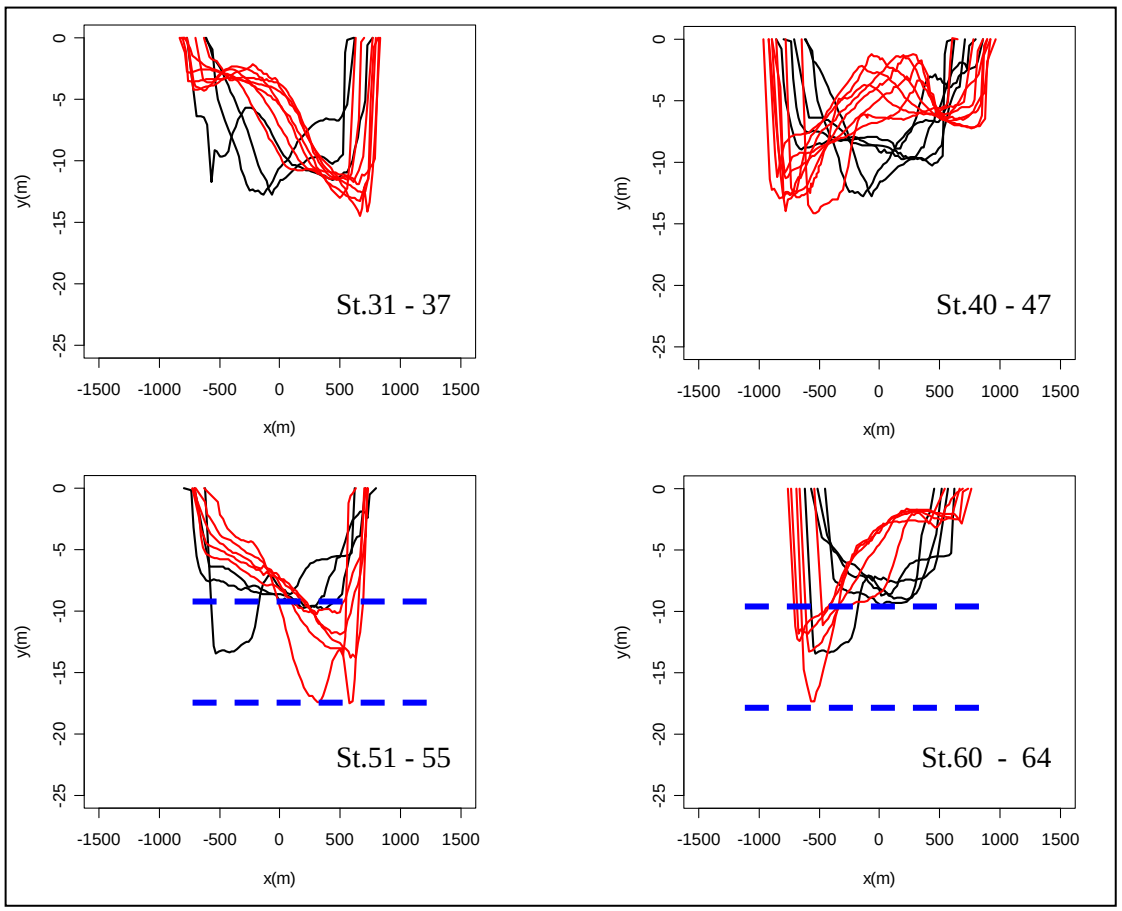
Note: St. 1 is excluded from the table, because it is located in the sea area.
Source: JICA Project Team

In the next section, where and how deeply scouring occurred, in each cross section of the curved reach and the narrow reach, were examined.

I.2.5 CROSS SECTION AT CURVED REACH OF YWE RIVER

Figure I.2.4 shows the cross sections at the river bend (shown as red lines) and the cross sections at the upstream and downstream of the river bend (shown as black lines).

At St.31-37 and St.40-47, there was no clear tendency due to the effects of the narrow reach near those cross sections. At St.51-55 and St.60-64, the deepest depth at the river bend was about twice the depth of normal cross sections in the directly upstream and downstream. Also, the deepest point was identified to be located very close to the river bank, or the outer side of curved reach.



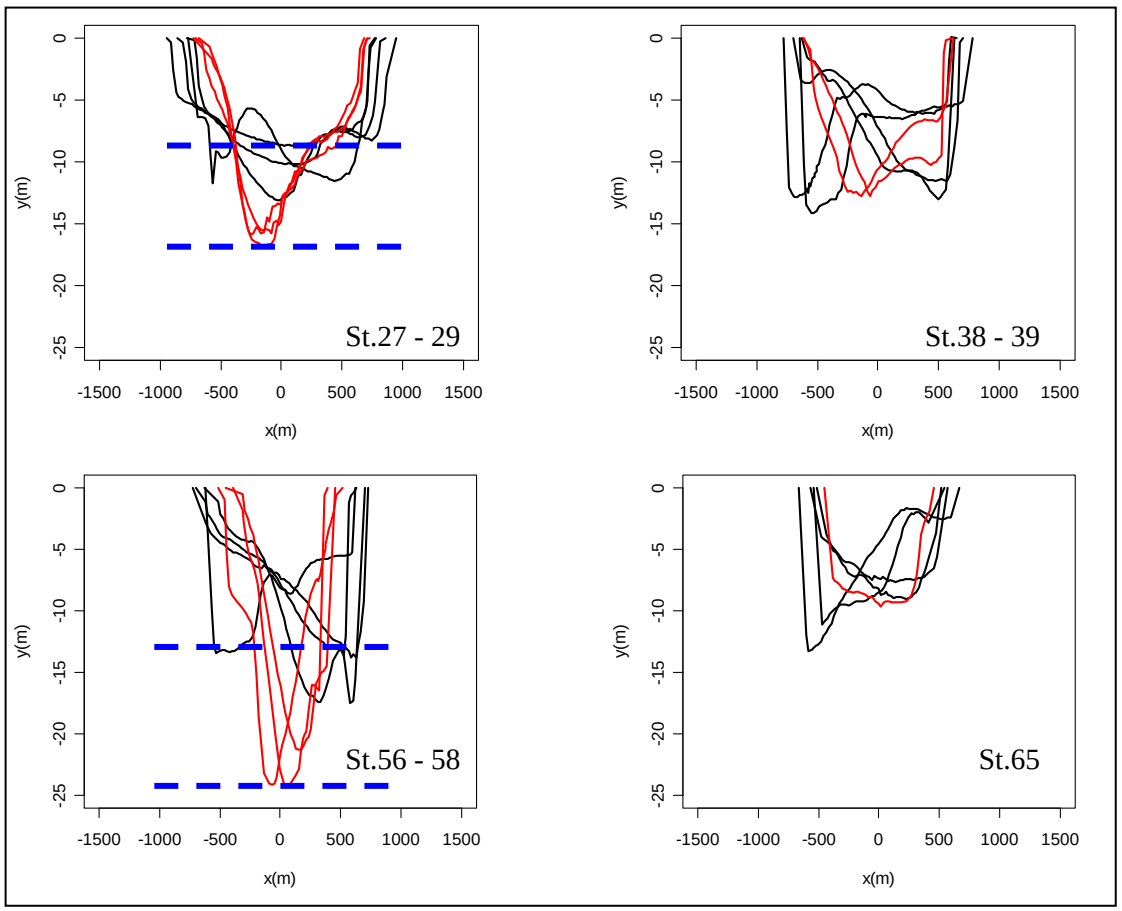
Note: The red and black cross sections indicate ones at the curved reach and at the upstream and downstream of the curved reach, respectively.
Source: JICA Project Team

Figure I.2.4 Cross Sections at the River Bend

I.2.6 CROSS SECTION AT NARROW REACH IN YWE RIVER

Figure I.2.5 shows the cross sections at the narrow reach (shown as red lines) and the cross sections at directly upstream and downstream (shown as black lines).

At St.38-39 and St.65, there was no clear tendency because the narrow reach was located between the river bend. However, at St.27-29 and St.56-58, the deepest depth at the narrow reach was about twice as deep as depth of cross sections at directly upstream and downstream. Also, the deepest point was identified to be located almost in the middle of the cross section.



Note: The red and black cross sections indicate ones at the narrow reach and at the upstream and downstream of the narrow reach, respectively.
Source: JICA Project Team

Figure I.2.5 Cross Sections at the Narrow Reach

I.2.7 SETTING METHOD OF CROSS SECTIONS OF RIVER CHANNEL

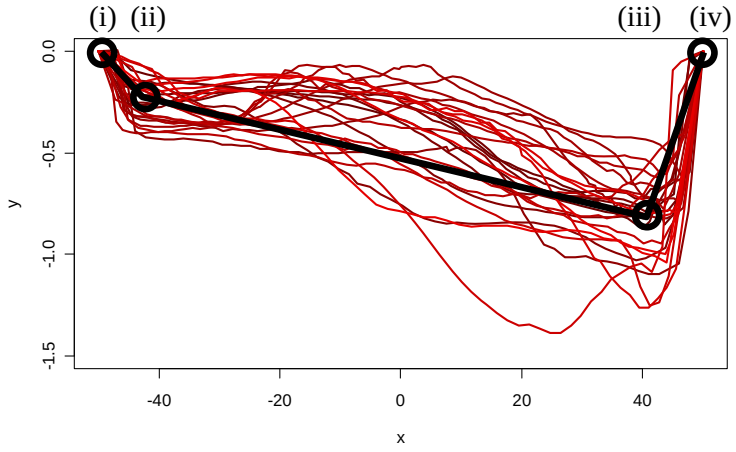
The setting method of river channel cross sections based on the data prepared in the last clause is described in this clause. The overlaid figure of classified cross sections and generated cross section were prepared by setting the width of each cross section as 100 with maintaining horizontal to vertical ratio, because the widths of cross sections varied widely.

(1) Curved Reach

The cross sections at the river bend were set as below.

- Point (i) and (iv) were set as both ends of the river channel.
- Point (ii) was located inner side of the river bend. Its depth was determined from the channel profile, and its position of the x axis was set at 1/10 of the channel width from inside end of the river channel.
- Point (iii) was located outer side of the river bend. Its depth was twice as deep as the depth setting by the channel profile. Its position of the x axis was set at 1/10 of the channel width from outside end of the river channel.

The longitudinal location of scouring at the river bend was set to be at the downstream portion of curved reach, considering the data of Ywe River.



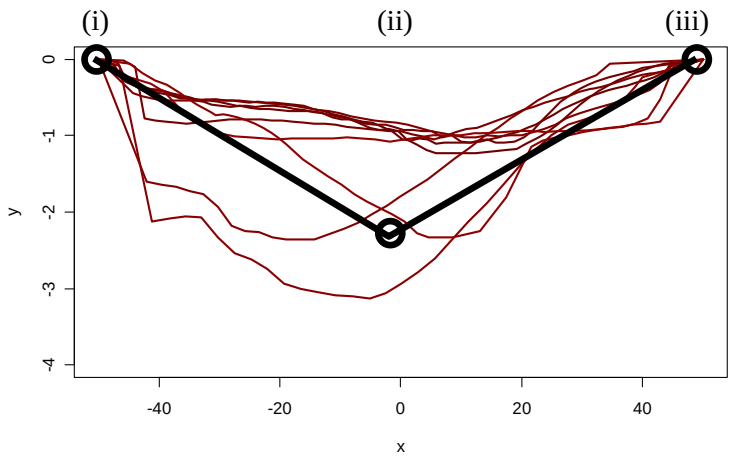
Note: Sections with scouring at the left bank are mirrored around x=0.
Source: JICA Project Team

Figure I.2.6 Image of Overlaid Cross Sections at River Bend

(2) Narrow Reach

The cross sections at the narrow reach were set as below, based on the figure of overlaid cross sections.

- Point (i) and (iii) were set at both ends of the river channel.
- Point (ii) was located at the middle of the river channel. Its depth was twice as deep as the depth from the channel profile.



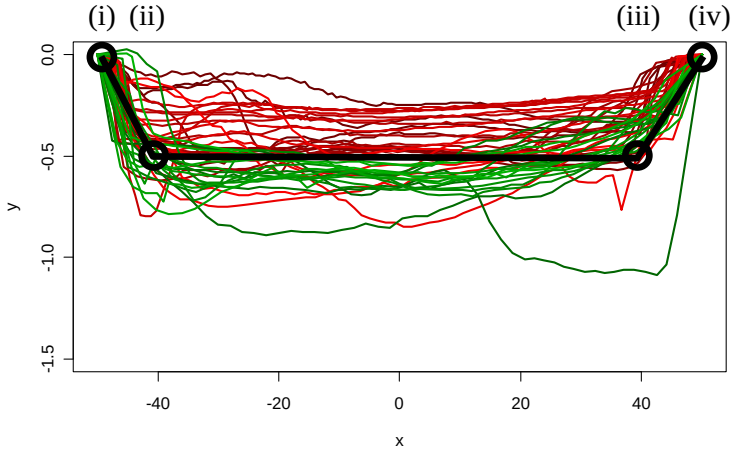
Source: JICA Project Team

Figure I.2.7 Image of Overlaid Cross Sections at Narrow Reach

(3) Other Reach

The cross sections at other reaches were set as below, based on the figure of overlaid cross sections.

- Point (i) and (iv) were set at both ends of the river channel.
- Point (ii) was located at 1/10 of the channel width from the left bank of the river channel. Its depth was set from the channel profile.
- Point (ii) was located at 1/10 of the channel width from the right bank of the river channel. Its depth was set from the channel profile.



Source: JICA Project Team

Figure I.2.8 Image of Overlaid Cross Sections at Other Reach

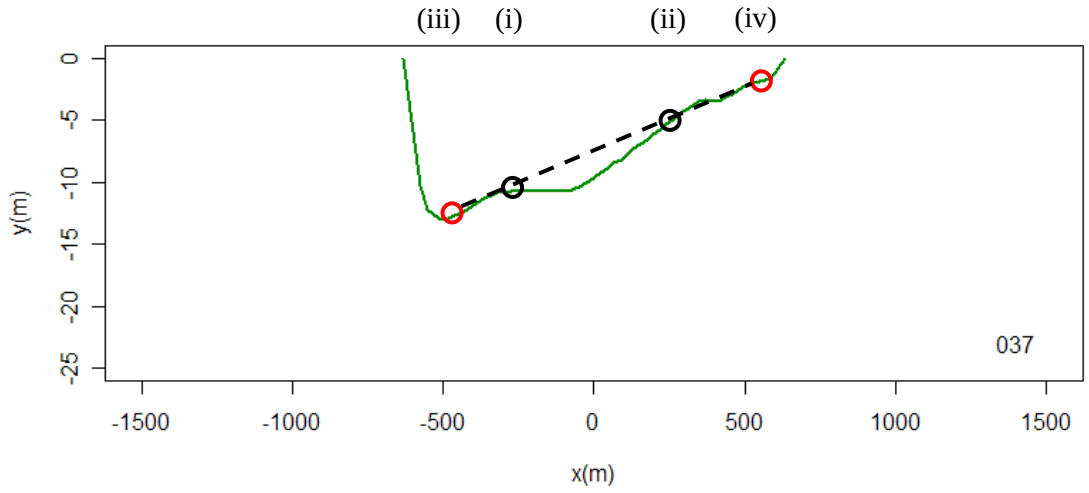
(4) Rivers with Longitudinal Profile Survey

Since the longitudinal profile survey with two survey line was conducted in the Pathein River and Pya Ma Law River, the cross section data was prepared by utilizing these survey results. The procedure is described below.

- The cross sections were determined (green line in the figure below).

- The depth of intersection point (black circle (i) and (ii) in the figure below) of the determined cross section (green line) and the profile survey line was set from the interpolation of profile survey data.
- The intersection point (black circle) on the cross section was extrapolated to 1/10 of the channel width from both the left and right bank to set those depths (red circle in the figure below).
- The mesh elevation data was created by using the four points (black and red circle).

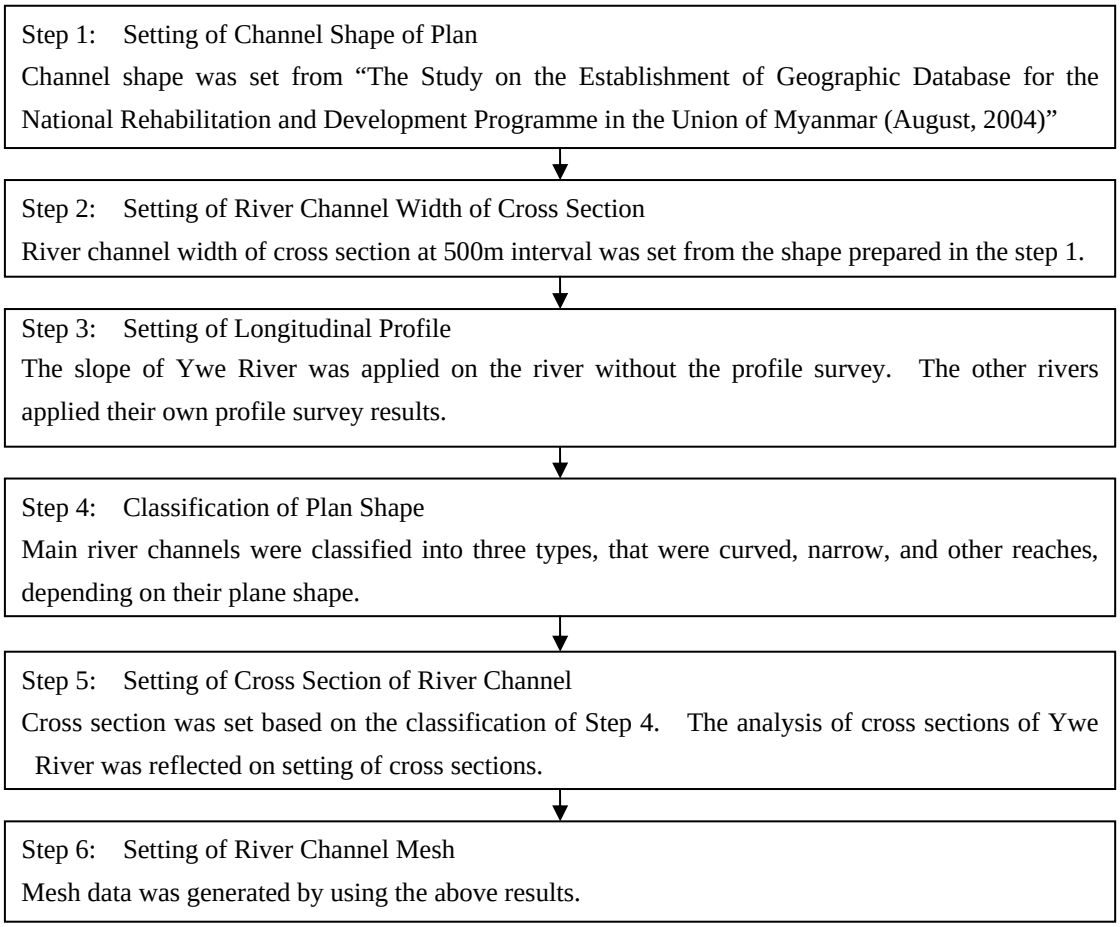
Since there was the survey data, river channel classification and reflection to the data was not performed.



Source: JICA Project Team

Figure I.2.9 Schematic Illustration of Data Preparation Method for Rivers with Longitudinal Profile Survey

The preparation method of the river channel set was summarized in the flowchart below.



Source: JICA Project Team

Figure I.2.10 Flowchart of Preparation Method of River Channel Mesh Data

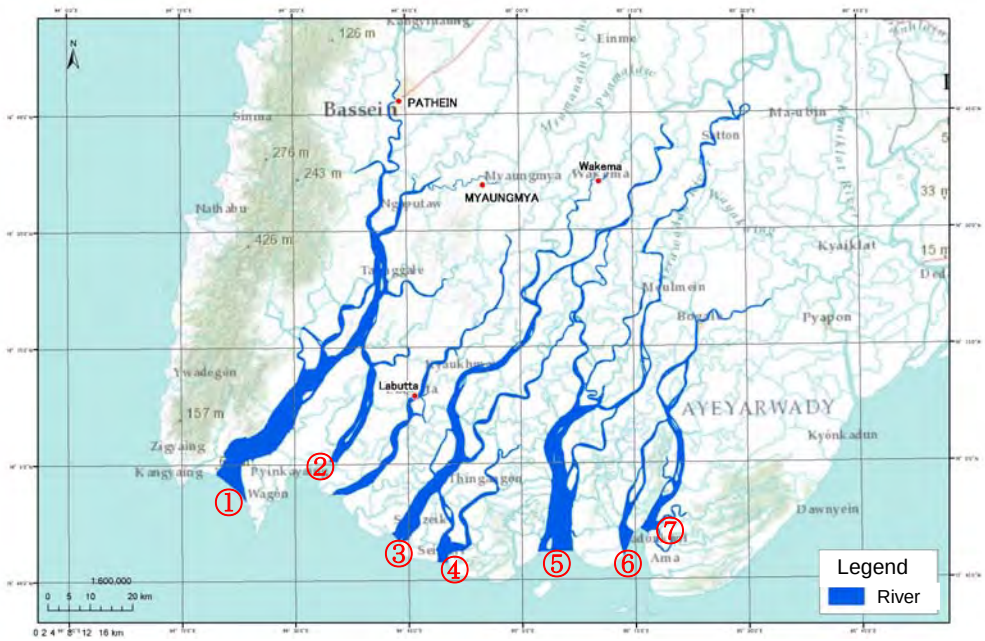
Preparation of the river channel mesh data according to the flow chart is described in the next section.

I.3 SETTING OF THE RIVER CHANNEL MESH DATA

I.3.1 SETTING OF CHANNEL SHAPE

The channel shape was obtained from the land use data (ESRI Shape format) reported in "The Study on Establishment of Geographic Database for the National Rehabilitation and Development Programme in the Union of Myanmar (August, 2004)".

The target rivers are indicated as ① to ⑦ in Figure I.3.1.



Source: JICA Project Team

Figure I.3.1 Channel Shape

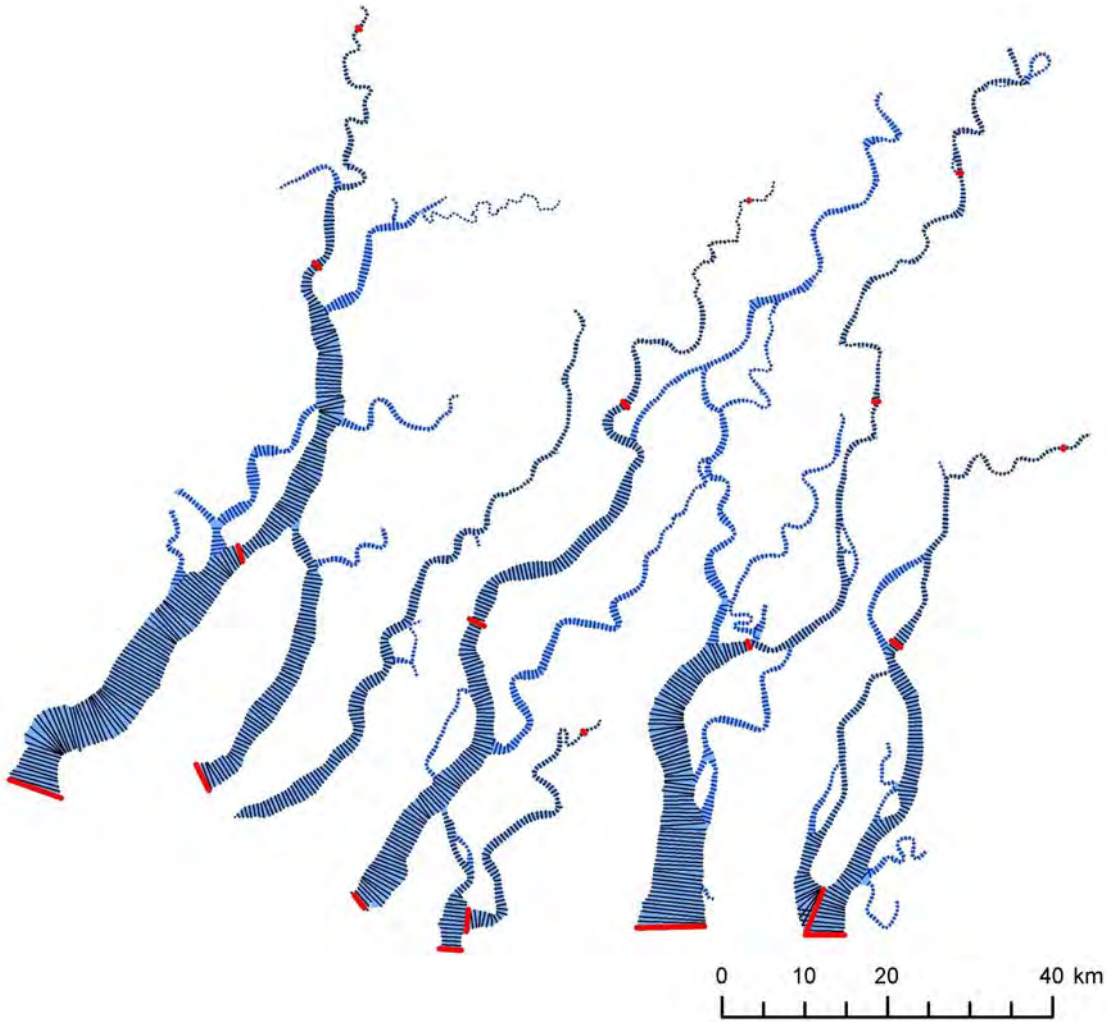
I.3.2 SETTING OF RIVER CHANNEL WIDTH

The above-mentioned land use data was used for setting of the river channel widths.

The procedure was as follows.

- To set center lines of rivers on the land use data
- To set positions of cross sections on the center lines at 500 m interval starting from the river mouth
- To identify intersections of the cross sections and the river banks
- To calculate widths of the river channels

The cross sections of target rivers are shown in Figure I.3.2

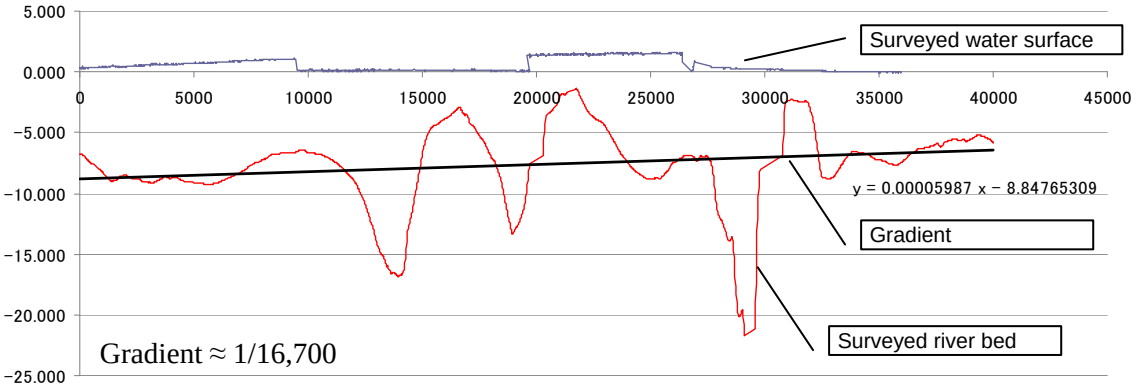


Source: JICA Project Team

Figure I.3.2 Position of Cross Section

I.3.3 SETTING OF CHANNEL PROFILE

Channel profile of Ywe River is shown below. The gradient was almost 1/16,700. Since the survey was conducted from the river mouth of the Ywe River to 40 km upstream, the same slope (1/16,700) was given to other rivers from the river mouth to 40 km upstream except for Pathein River and Pya Ma Law River where profile survey was conducted.



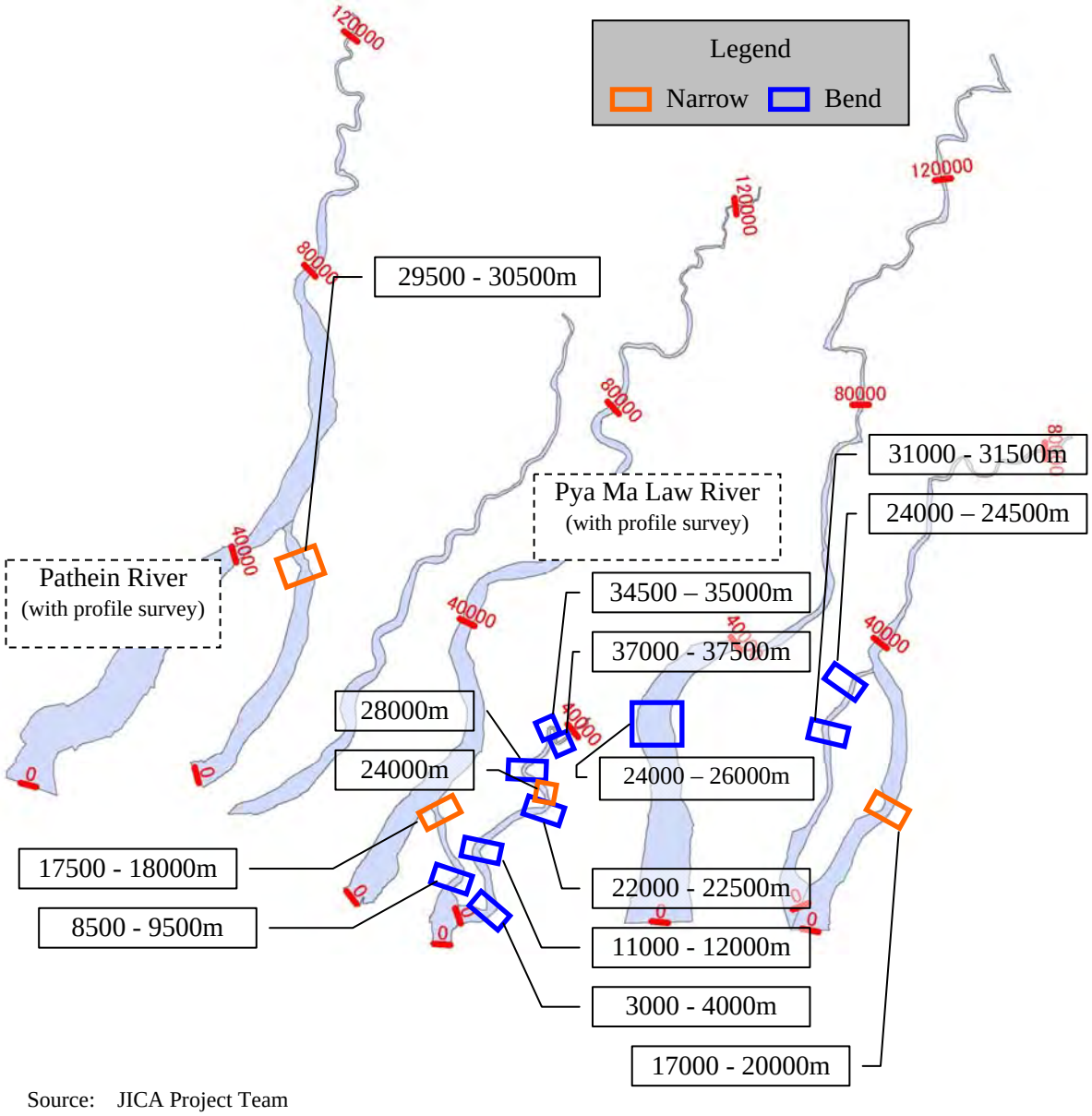
Source: JICA Project Team

Figure I.3.3 Channel Profile of Ywe River

- The modeled profile was applied from the river mouth to 40 km upstream, and the depth of water above 40 km upstream was considered to be a constant value.
- The water depths of tributaries was set as constant in consistent with the water depth of the main river at the confluence. If the tributary has a looped network or connection to another main river, the slope between the upstream and downstream confluence will be given.

I.3.4 CLASSIFICATION OF PLANE SHAPE

Classification of the plane shape of the rivers without the survey is shown in the following figure. Pathein River and Pya Ma Law River were not classified, because the cross section was estimated from the result of longitudinal profile survey.

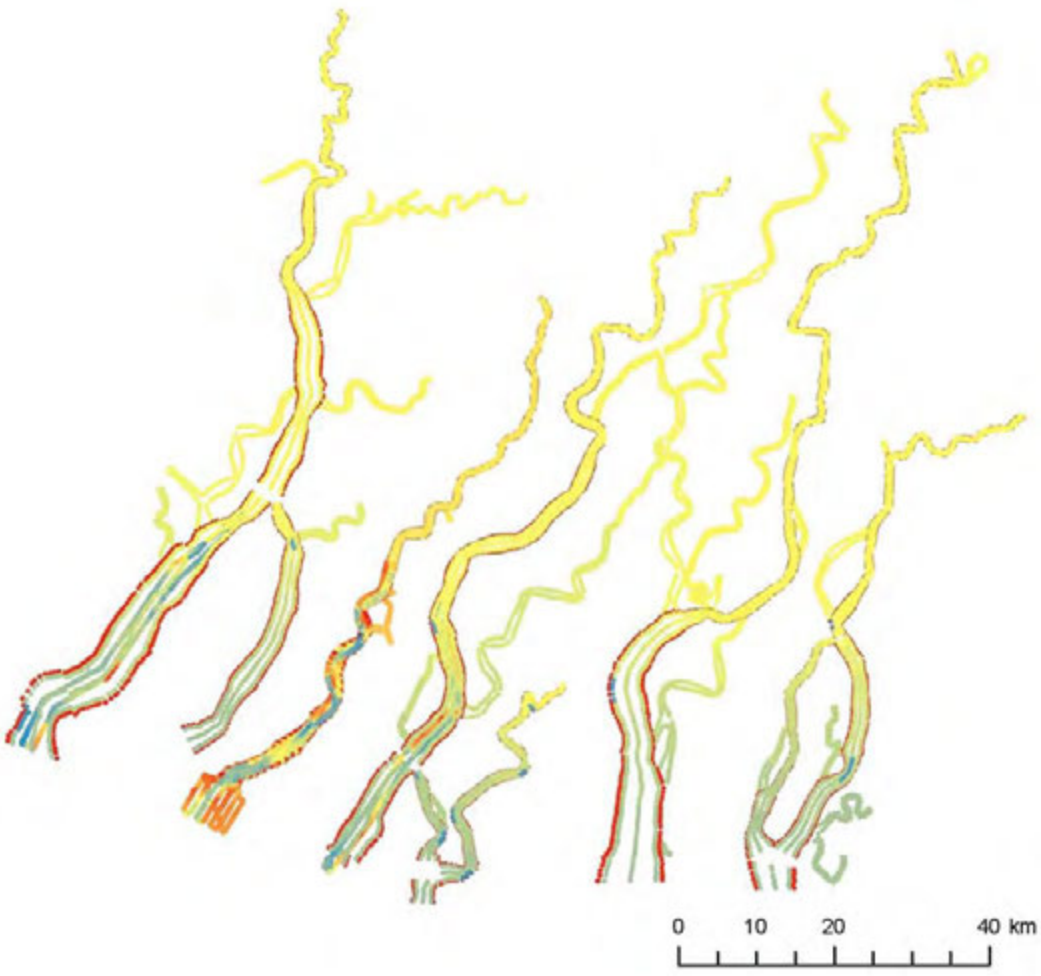


Source: JICA Project Team

Figure I.3.4 Classification of the Plane Shape

I.3.5 GENERATED RIVER ELEVATION DATA

The point data of the target rivers was generated from the cross section data.



Note: The colors of points indicate water depth.
Source: JICA Project Team

Figure I.3.5 Channel Point Data