26.7.4 Evaluation of channel stabilization plan by computer simulations

(1) Cases of simulations

The following simulation works are carried out for the priority project (2010):

1) Simulations for flood season

Present Condition : Calibration of Flood Season (August 2002, H = 9.3 m)

Alternative 1 : Basic case of Dual Channel (Flood Season, H = 9.3 m)

Alternative 2 : Basic case of Single Channel
(Flood Season, H = 9.3 m, Narrow channels)

Alternative 3 : A variation of Single Channel
(Flood Season, H = 9.3 m, Wide channels. Channel depth is deepened artificially for the portions of the presently sand bars.)

2) Simulations for dry season

After the execution of the above 4 runs, following simulations are made for confirmation of the effects of the facilities in the dry season:

Alternative 1, 2 and 3 : Confirmation in the Dry Season
(Dry Season, January 2002, H = 3.4 m)

3) Supplemental simulations

Lastly, the following cases are planned to be carried out, if necessary:

Chosen Alternative : Confirmation of extraordinary Flood Level and
Flood Drainage Capacity (Very high flood (H = 12.5 ml))

Further Plan : (Long-term Plan until 2020)

(2) Expected effects of channel stabilization countermeasures facilities

Referring to Figure 26.7.3 which shows the locations of comparison, the results of simulation works are summarized by Alternative in **Table 26.7.1 (1)** and **(2)** for the rainy and dry seasons, respectively.

For the flood season, the current vectors are shown in **Figure 26.7.4 (1)** to **(3)**. The degree of difference in current speed of the Alternatives compared with the current speed of the present condition are shown in **Figure 26.7.5 (1)** to **(3)**.

Similarly for the dry season, the current vectors are shown in **Figure 26.7.6 (1)** to **(3)**. The degree of difference in current speed of the Alternatives compared with the current speed of the present condition are shown in **Figure 26.7.7 (1)** to **(3)**.

The major characteristics can be summarized as follows:

1) **Alternative 2** indicates strong effects of Weir 1 on increase in the water level of 18 cm in the Location A. Even **Alternative 3** has an increases in water level of 6 cm. Whereas **Alternative 1** has a limited increase of 3.5 cm. Water level in the Duong River does not change significantly for the all Alternatives, or maximum.

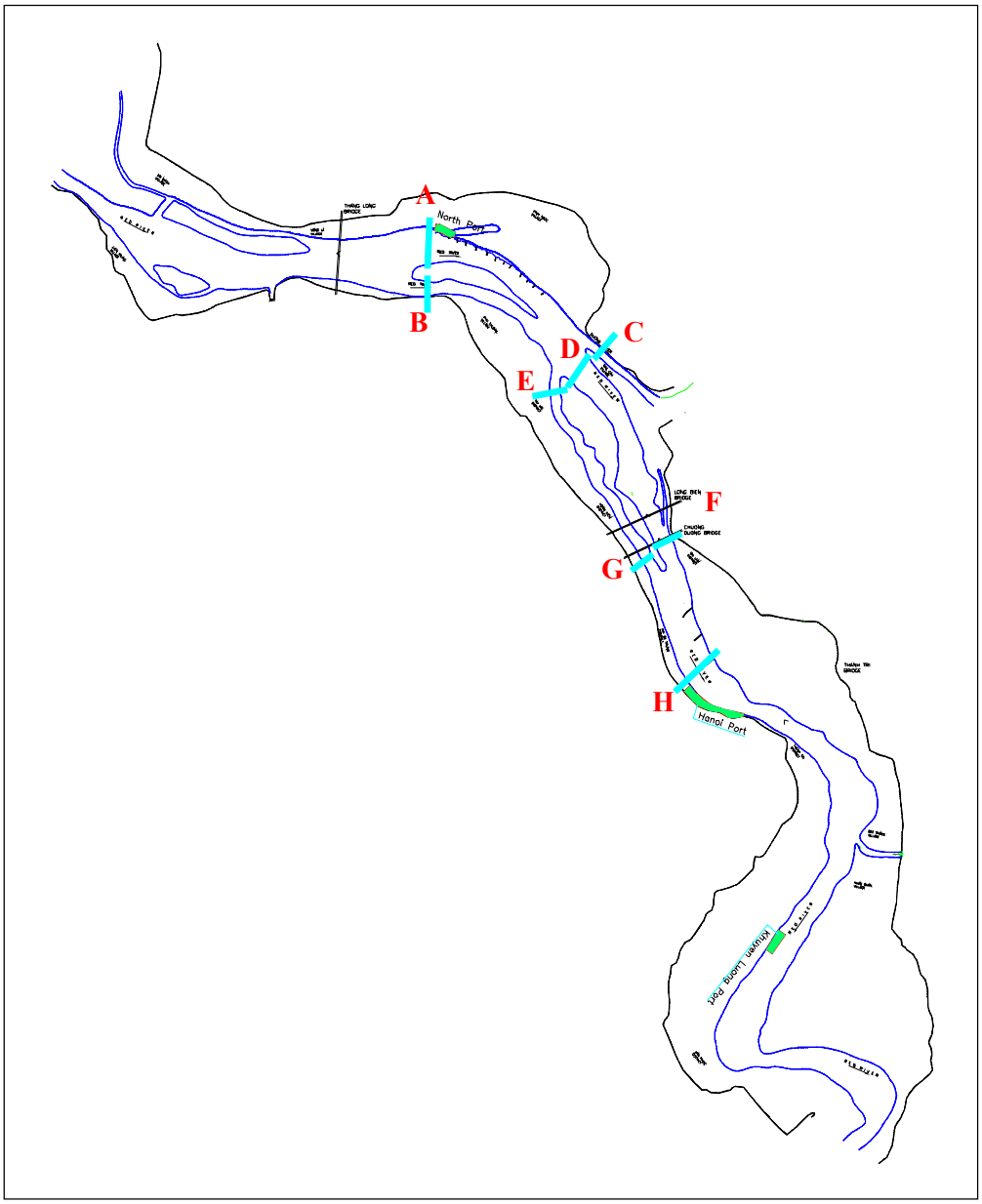
2) Increase in current velocity at Locations A and E, and decrease at Location B are significant in the cases of **Alternative 2** and **3**, and the maximum speed exceed 1.5 m/sec at Location A. **Alternative 1** has moderate increase at the same Location.

   It is noted that, under the present conditions, the 2nd channel of Nhat Tan Sand Bar has a tendency to become the main channel, which should be avoided.

3) Water discharge show the same tendency as the current. It is noted that the discharge in the Duong river decreases slightly in the case of **Alternative 3**.

4) Cross-section/Discharge ratios of **Alternative 1** show relatively stable values along the river sections compared with those of **Alternatives 2** and **3**.

Thus, **Alternative 1** is chosen as the most preferable case of the river stabilization measures. It is necessary to review and examine the plan during the Detailed Design Stage, specifically on optimum width of the main channel to be controlled by the training walls.



Source) JICA Study Team

Figure 26.7.3 Locations of Comparison of Hydraulic Parameters

It is recommended that the above facilities for channel stabilization should be constructed step by step, with careful monitoring of the effects of the facilities by follow up surveys, at least twice a year, and review of the plan taking account of the priority, timing, and extent of the facilities. Flexible and mobile operations of dredging should be incorporated in addition to construction of hard facilities.

Table 26.7.1 (1) Hydraulic Characteristics of Alternatives (Flood Season)

(1) Water Level (m)

Location	Present Condt	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	9.944	9.979	0.035	10.125	0.181	10.004	0.060	NHAT TAN Main Ch
B	9.816	9.793	-0.023	9.703	-0.114	9.679	-0.137	NHAT TAN 2nd Ch
C	9.609	9.619	0.010	9.639	0.030	9.600	-0.009	Duong River
D	9.522	9.535	0.013	9.545	0.023	9.475	-0.046	TU LIEN Main Ch
E	9.490	9.498	0.007	9.321	-0.170	9.323	-0.167	TU LIEN 2nd Ch
F	9.201	9.192	-0.009	9.174	-0.028	9.160	-0.042	TRUNG Ha Main Ch
G	9.123	9.119	-0.004	9.058	-0.066	9.139	-0.016	TRUNG Ha 2nd Ch
H	8.972	8.966	-0.007	8.936	-0.036	8.974	0.002	Hanoi Port

(2) Max Velocity (m/sec)

Location	Present Condt	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	1.228	1.404	0.176	1.662	0.434	1.715	0.487	NHAT TAN Main Ch
B	1.783	1.624	-0.159	0.694	-1.089	0.619	-1.164	NHAT TAN 2nd Ch
C	1.590	1.619	0.029	1.673	0.083	1.565	-0.025	Duong River
D	1.507	1.532	0.025	1.732	0.225	1.791	0.284	TU LIEN Main Ch
E	1.155	1.169	0.014	0.814	-0.341	0.719	-0.436	TU LIEN 2nd Ch
F	1.651	1.696	0.045	1.787	0.136	1.552	-0.099	TRUNG Ha Main Ch
G	1.373	1.397	0.024	1.120	-0.254	0.934	-0.439	TRUNG Ha 2nd Ch
H	1.219	1.214	-0.005	1.194	-0.025	1.216	-0.003	Hanoi Port

(3) Water Discharge (m^3/sec)

Location	Present Condit	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	6.381	6.791	411	8.713	2.332	8.901	2.520	NHAT TAN Main Ch
B	4.064	3.654	-411	1.732	-2.332	1.544	-2.520	NHAT TAN 2nd Ch
A+B	10.445	10.445	0	10.445	0	10.445	0	
C	2.596	2.639	44	2.749	153	2.567	-29	Duong River
D	6.019	5.940	-80	6.538	519	6.852	833	TU LIEN Main Ch
E	1.830	1.866	36	1.158	-672	1.026	-804	TU LIEN 2nd Ch
C+D+E	10.445	10.445	0	10.445	0	10.445	0	
D+E	7.849	7.806	-44	7.696	-153	7.878	29	
F	5.682	5.603	-79	5.935	253	6.395	813	TRUNG Ha Main Ch
G	2.168	2.203	35	1.761	-406	1.484	-684	TRUNG Ha 2nd Ch
F+G	7.849	7.806	-44	7.696	-153	7.878	29	
H	7.849	7.806	-44	7.696	-153	7.878	29	Hanoi Port

(4) Cross-sectional area of flow (m^2)

Location	Present Condit	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	7.391	7.403	12	3.601	210	7.826	435	NHAT TAN Main Ch
B	3.209	3.092	-117	3.009	-200	2.985	-224	NHAT TAN 2nd Ch
A+B	10,600	10,495	-105	10.610	10	10.811	211	
C	2,340	2.341	1	2.367	27	2.347	7	Duong River
D	5,809	5,804	-5	5.881	72	5.802	-8	TU LIEN Main Ch
E	2.117	2.118	1	2.090	-27	2.081	-36	TU LIEN 2nd Ch
C+D+E	10.266	10.264	-2	10.338	72	10,230	-36	
D+E	7.926	7.923	-4	7.971	45	7.883	-44	
F	4.382	4.378	-4	4.408	27	5.729	1.348	TRUNG Ha Main Ch
G	1.745	1.742	-3	1.736	-9	1.700	-45	TRUNG Ha 2nd Ch
F+G	6.127	6.120	-7	6.145	18	7.429	1.303	
H	6.413	6.399	-13	6.400	-12	6.446	33	Hanoi Port

(5) Hydraulic Sh/Q Ratio (sec/m)

Location	Present Condit	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	1.16	1.09	-0.07	0.87	-0.29	0.88	-0.28	NHAT TAN Main Ch
B	0.79	0.85	0.06	1.74	0.95	1.93	1.14	NHAT TAN 2nd Ch
A+B	1.01	1.00	-0.01	1.02	0.00	1.04	0.02	
C	0.90	0.89	-0.01	0.86	-0.04	0.91	0.01	Duong River
D	0.97	0.98	0.01	0.90	-0.07	0.85	-0.12	TU LIEN Main Ch
E	1.16	1.14	-0.02	1.80	0.65	2.03	0.87	TU LIEN 2nd Ch
C+D+E	0.98	0.98	0.00	0.99	0.01	0.98	0.00	
D+E	1.01	1.01	0.01	1.04	0.03	1.00	-0.01	
F	0.77	0.78	0.01	0.74	-0.03	0.90	0.12	TRUNG Ha Main Ch
G	0.81	0.79	-0.01	0.99	0.18	1.15	0.34	TRUNG Ha 2nd Ch
F+G	0.78	0.78	0.00	0.80	0.02	0.94	0.16	
H	0.82	0.82	0.00	0.83	0.01	0.82	0.00	Hanoi Port

Table 26.7.1 (2) Hydraulic Characteristics of Alternatives (Dry Season)

(1) Water Level (m)

Location	Present Condt	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	3.798	3.836	0.038	3.995	0.197	3.982	0.185	NHAT TAN Main Ch
B	3.815	3.819	0.003	3.697	-0.118	3.726	-0.089	NHAT TAN 2nd Ch
C	3.438	3.440	0.001	3.454	0.016	3.451	0.013	Duong River
D	3.463	3.470	0.007	3.503	0.041	3.489	0.026	TU LIEN Main Ch
E	3.595	3.592	-0.003	2.212	-1.383	2.236	-1.359	TU LIEN 2nd Ch
F	3.115	3.117	0.003	3.093	-0.021	3.083	-0.032	TRUNG Ha Main Ch
G	3.348	3.344	-0.004	2.844	-0.504	2.875	-0.473	TRUNG Ha 2nd Ch
H	2.603	2.598	-0.004	2.563	-0.035	2.570	-0.032	Hanoi Port

(2) Max Velocity (m/sec)

Location	Present Condt	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	1.020	1.020	0.000	1.256	0.236	1.263	0.243	NHAT TAN Main Ch
B	0.728	0.719	-0.009					NHAT TAN 2nd Ch
C	0.798	0.812	0.014	0.924	0.126	0.901	0.103	Duong River
D	0.959	0.956	-0.003	1.040	0.081	1.052	0.093	TU LIEN Main Ch
E	0.671	0.671	0.000					TU LIEN 2nd Ch
F	1.023	0.955	-0.068	1.045	0.022	0.966	-0.057	TRUNG Ha Main Ch
G	0.631	0.630	-0.001					TRUNG Ha 2nd Ch
H	1.312	1.302	-0.010	1.221	-0.091	1.238	-0.074	Hanoi Port

(3) Water Discharge (m^3/sec)

Location	Present Condit	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	1.287	1.293	6	1.750	463	1.750	463	NHAT TAN Main Ch
B	463	457	-6					NHAT TAN 2nd Ch
A+B	1.750	1.750	0	1.750	0	1.750	0	
C	606	616	10	703	97	685	79	Duong River
D	975	966	-10	1.047	71	1.065	89	TU LIEN Main Ch
E	169	168	-1					TU LIEN 2nd Ch
C+D+E	1.750	1.750	0	1.750	0	1.750	0	
D+E	1.144	1.750	-10	1.047	-97	1.065	-79	
F	975	966	-10	1.047	71	1.027	52	TRUNG Ha Main Ch
G	169	168	-1					TRUNG Ha 2nd Ch
F+G	1.144	1.134	-10	1.047	-97	1.027	-117	
H	1.144	1.134	-10	1.047	-97	1.065	-79	Hanoi Port

(4) Cross-sectional area of flow (m^2)

Location	Present Condit	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	2.121	2.167	46	2.296	174	2.285	164	NHAT TAN Main Ch
B	742	743	1					NHAT TAN 2nd Ch
A+B	2.864	2.910	46	2.296	-568	2.285	-578	
C	936	937	0	948	12	945	9	Duong River
D	1.399	1.400	1	1.429	30	1.421	22	TU LIEN Main Ch
E	303	301	-2					TU LIEN 2nd Ch
C+D+E	2.638	2.637	0	2.377	-261	2.366	-272	
D+E	1.702	1.701	-1	1.429	-272	1.421	-280	
F	1.331	1.326	-5	1.317	-14	1.362	31	TRUNG Ha Main Ch
G	290	289	-1					TRUNG Ha 2nd Ch
F+G	1.621	1.614	-6	1.317	-304	1.362	-259	
H	1.270	1.271	1	1.224	-46	1.234	-36	Hanoi Port

(5) Hydraulic Sh/Q Ratio (sec/m)

Location	Present Condt	Alt 1	Alt 1-PC	Alt 2	Alt 2-PC	Alt 3	Alt 3-PC	Name of Location
A	1.65	1.68	0.03	1.31	-0.34	1.31	-0.34	NHAT TAN Main Ch
B	1.60	1.63	0.02					NHAT TAN 2nd Ch
C	1.55	1.52	-0.03	1.35	-0.20	1.38	-0.17	Duong River
D	1.43	1.45	0.02	1.37	-0.07	1.33	-0.10	TU LIEN Main Ch
E	1.79	1.79	0.00					TU LIEN 2nd Ch
F	1.36	1.37	0.01	1.26	-0.11	1.33	-0.04	TRUNG Ha Main Ch
G	1.72	1.72	0.00					TRUNG Ha 2nd Ch
H	1.11	1.12	0.01	1.17	0.06	1.16	0.05	Hanoi Port

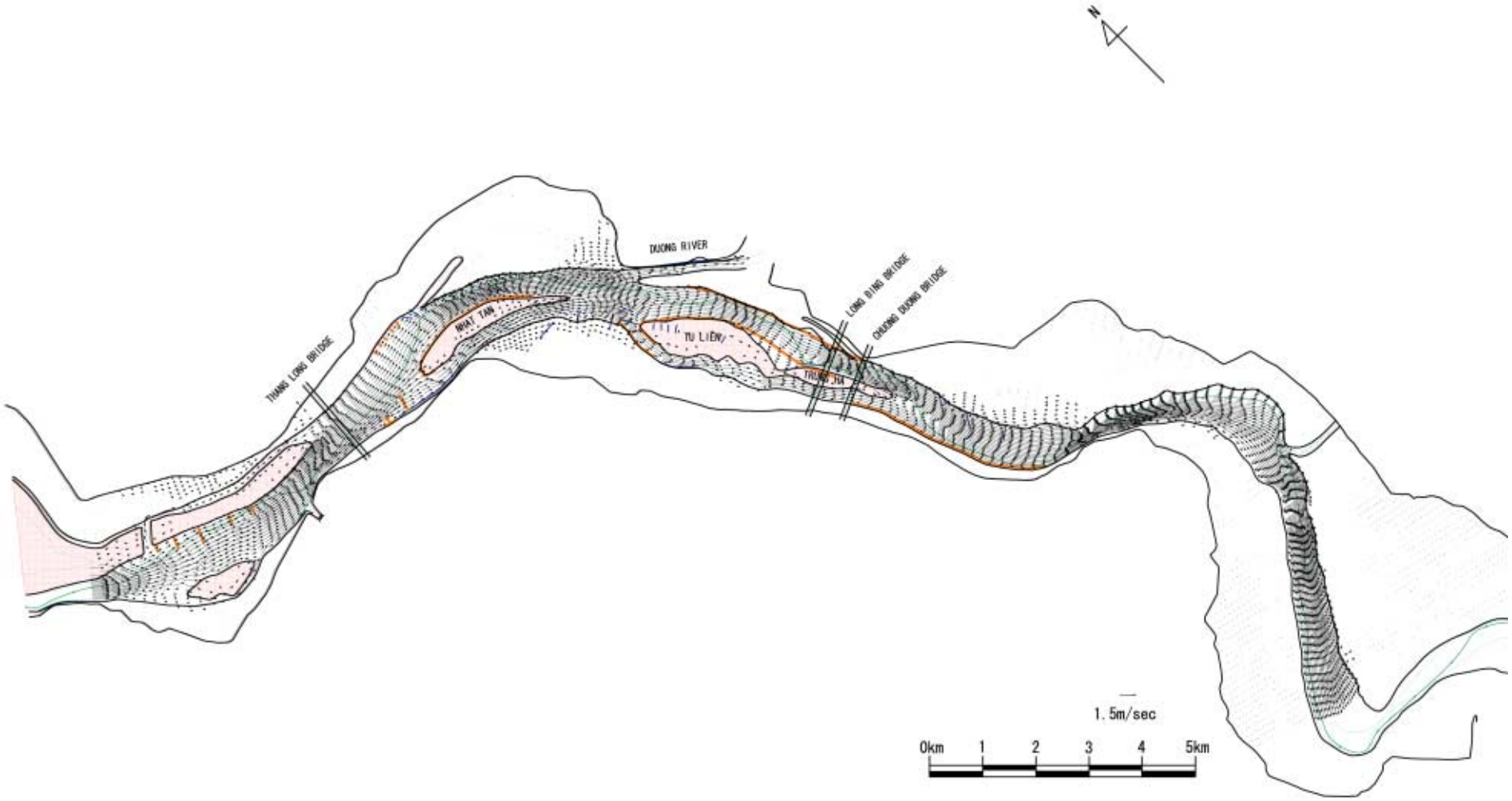


Figure 26.7.4 (1) Current Vectors (Flood Season: Alternative 1)

Source) JICA Study Team

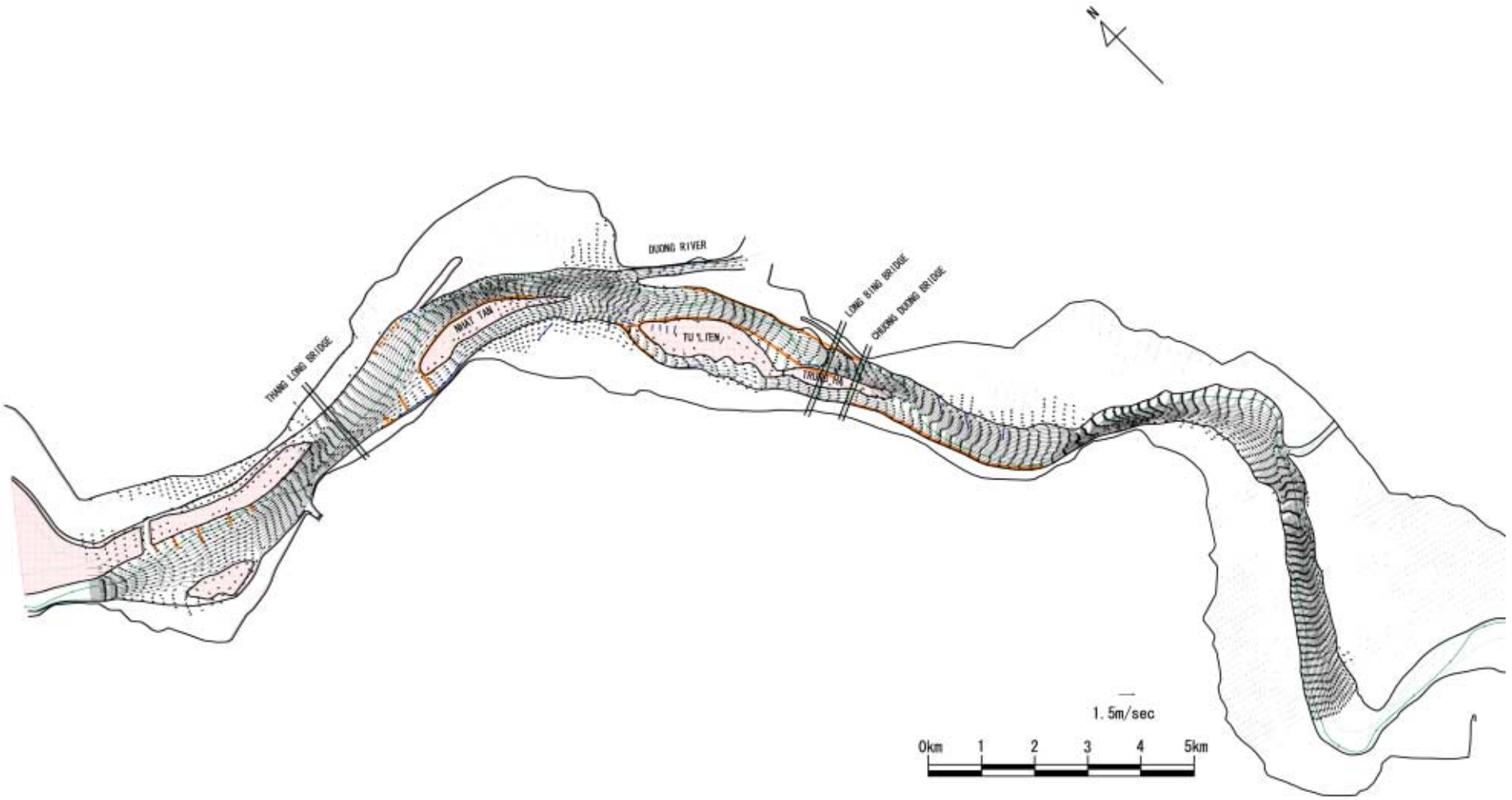


Figure 26.7.4 (2) Current Vectors (Flood Season: Alternative 2)

Source) JICA Study Team

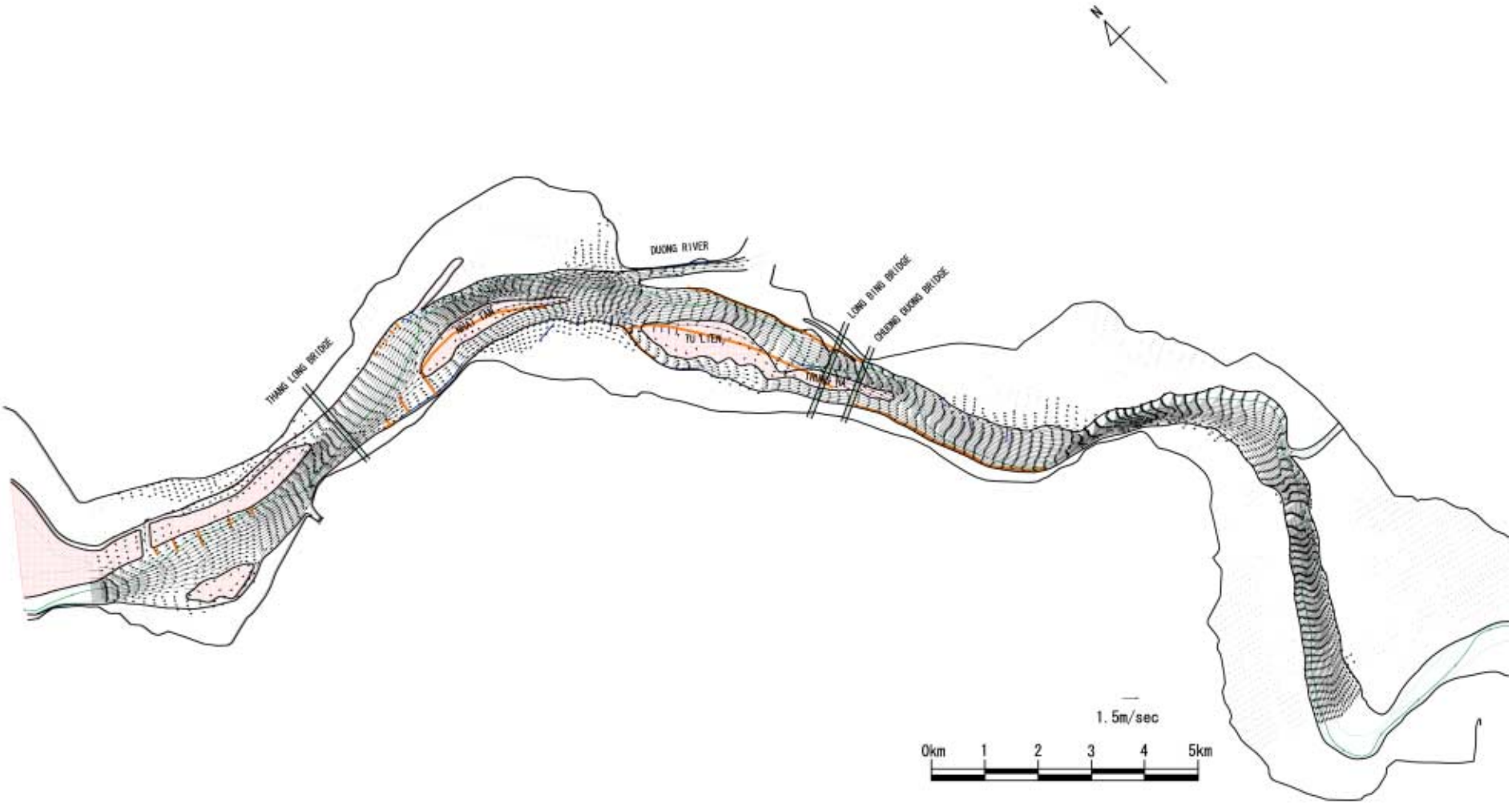


Figure 26.7.4 (3) Current Vectors (Flood Season: Alternative 3)

Source) JICA Study Team

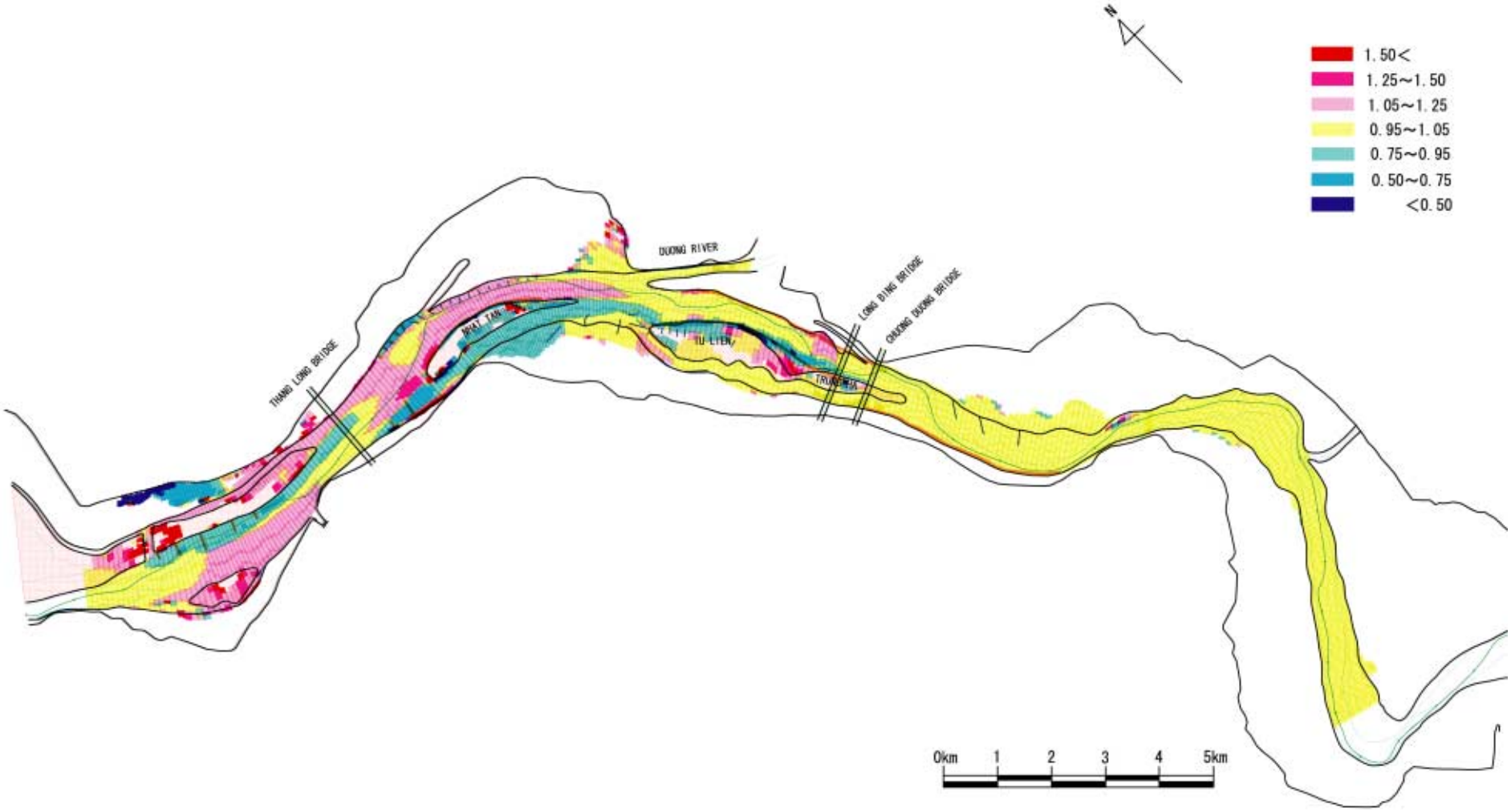


Figure 26.7.5 (1) Ratio of Current Speeds (Flood Season: Alternative 1 / Present Conditions)

Source) JICA Study Team

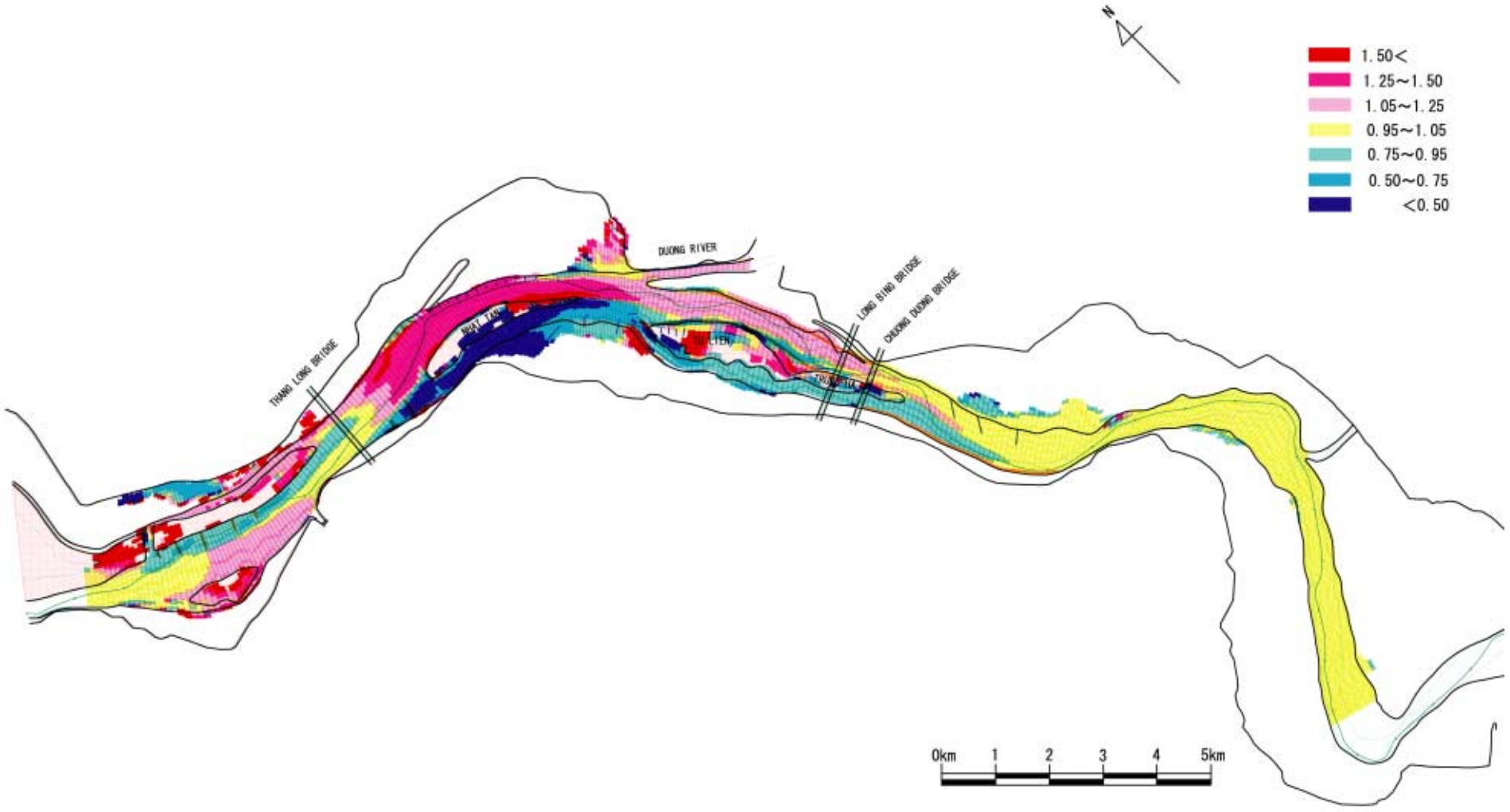


Figure 26.7.5 (2) Ratio of Current Speeds (Flood Season: Alternative 2 / Present Conditions)

Source) JICA Study Team

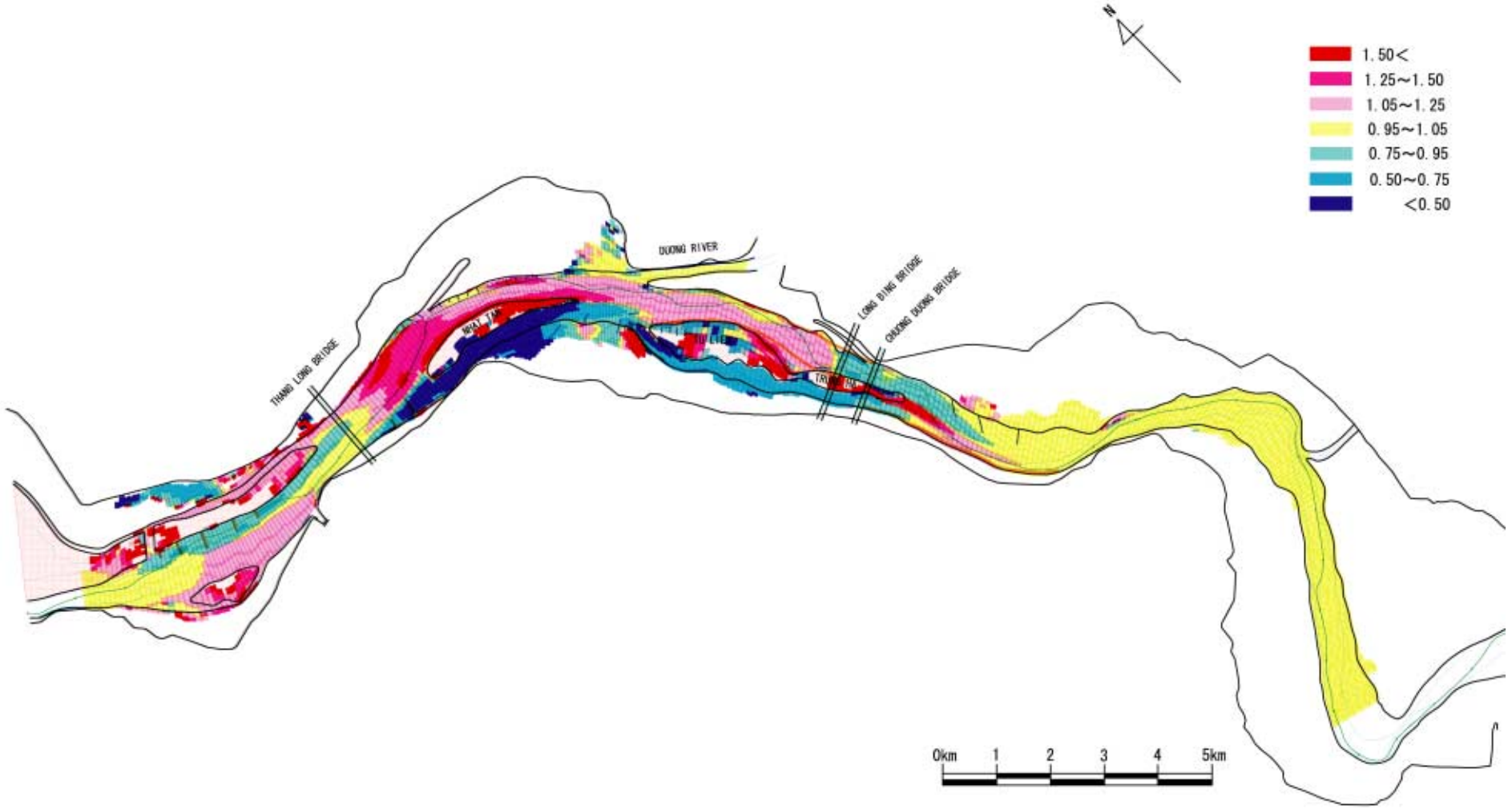


Figure 26.7.5 (3) Ratio of Current Speeds (Flood Season: Alternative 3 / Present Conditions)

Source) JICA Study Team

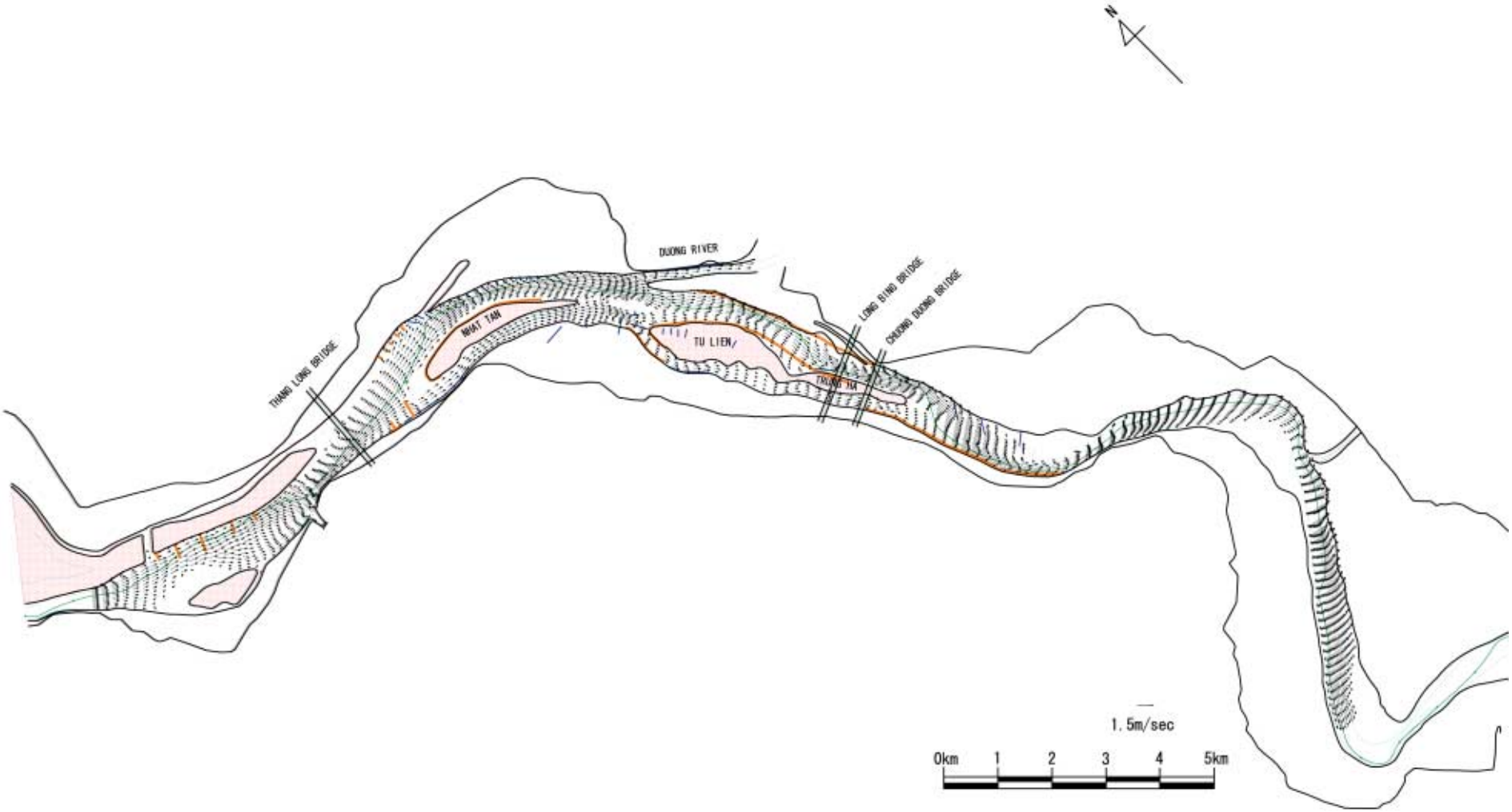


Figure 26.7.6 (1) Current Vectors (Dry Season: Alternative 1)

Source) JICA Study Team

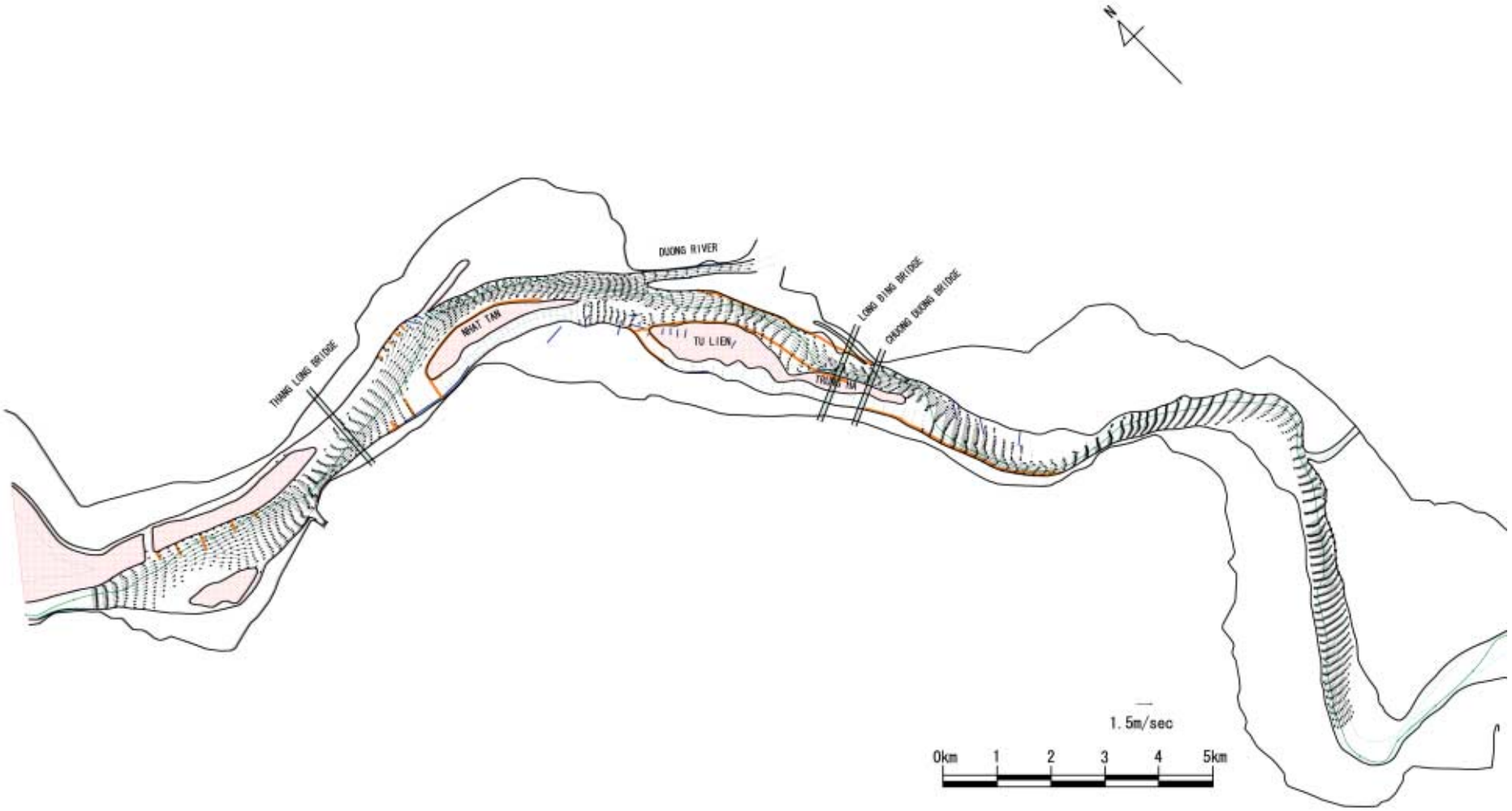


Figure 26.7.6 (2) Current Vectors (Dry Season: Alternative 2)

Source) JICA Study Team

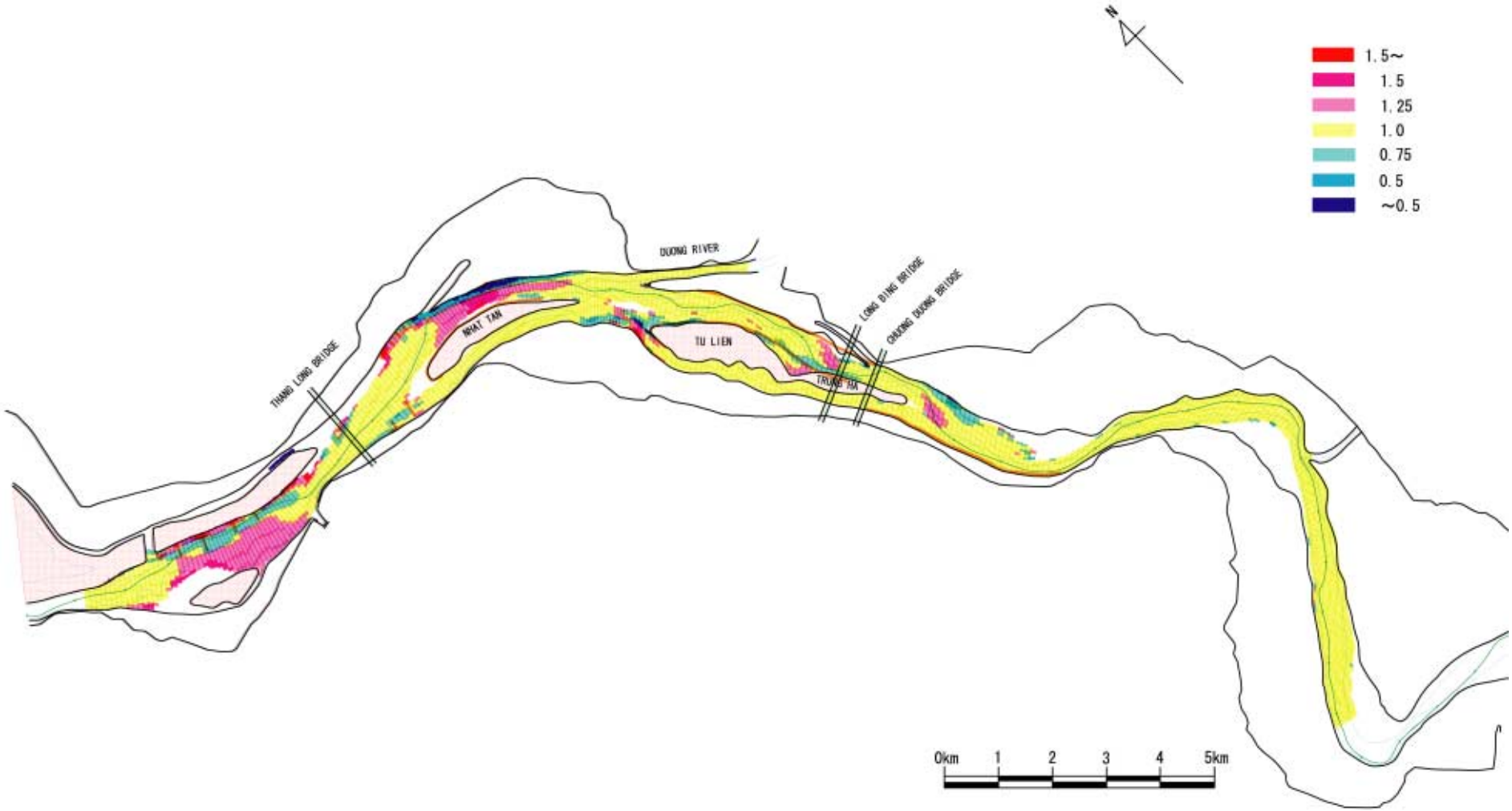


Figure 26.7.7 (1) Ratio of Current Speeds (Dry Season: Alternative 1 / Present Conditions)

Source) JICA Study Team

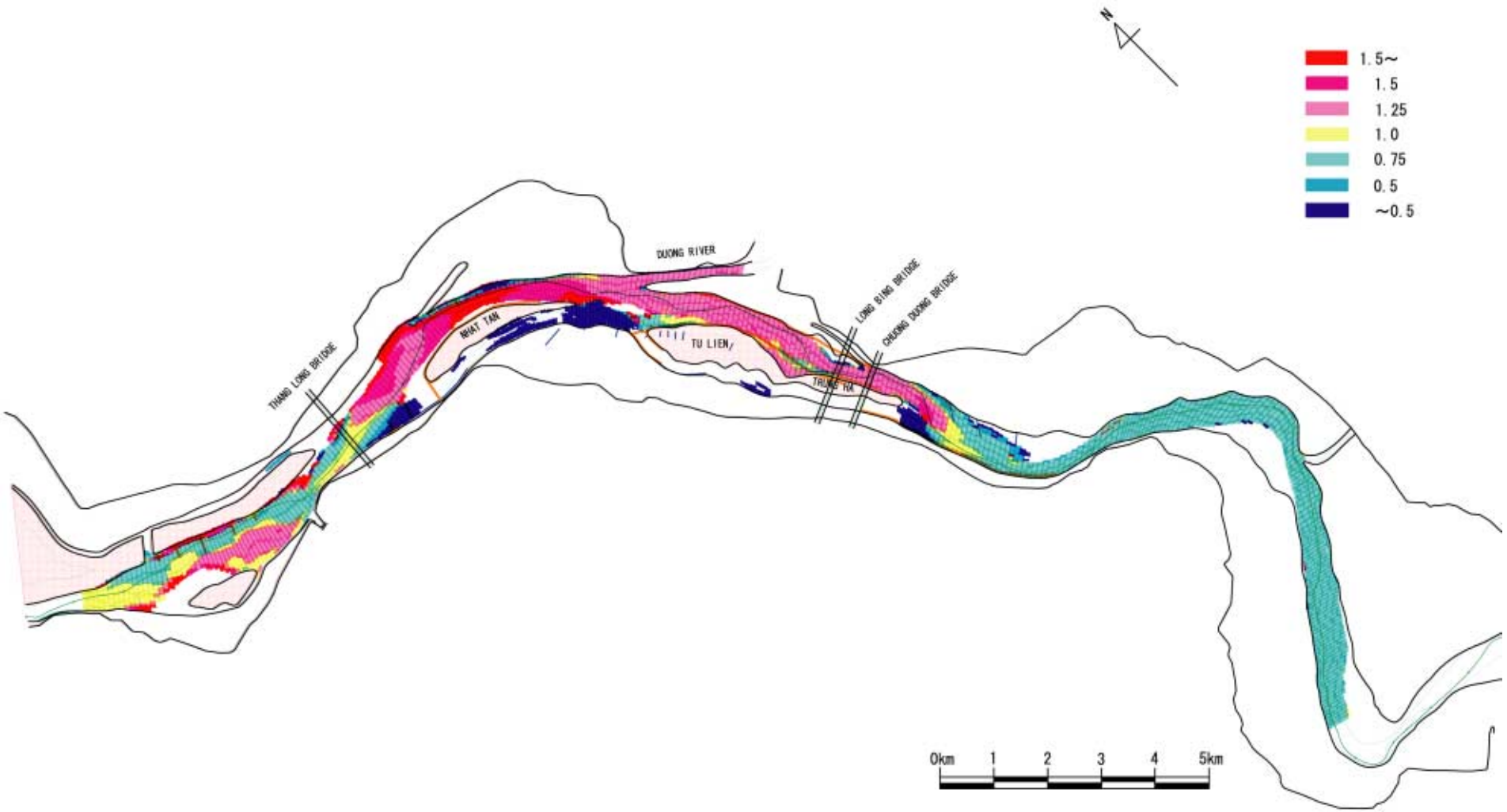


Figure 26.7.7 (2) Ratio of Current Speeds (Dry Season: Alternative 2 / Present Conditions)

Source) JICA Study Team

(3) Confirmation of Flood Drainage Capacity

1) Very High Flood with Fixed Riverbed

The flood drainage capacity is examined by the simulation model for a very high water level of 12.5 m (Water discharge at the upper boundary = 22,700 m3/sec with less than 1% occurrence possibility). The comparison is made on hydraulic parameters for the conditions with and without the facilities of **Alternative 1**. Here, it is assumed that the riverbed profile is maintained as same as that in January 2002.

The result of low vector is shown in **Figure 26.7.8 (1)**. All the banks are inundated in the both sides of the dikes. The flow runs rather smoothly I the river. Comparing with the result of simulation for **Aternative-1**, it is confirmed that the channel stabilization facilities have little effects on the flood discharge.

The sedimentation/erosion pattern simulated is shown in **Figure 26.7/8 (2)**. It is characteristics that considerable accumulation occurs at the head of Nhat Tab Bar, below Chuong Duong Bridge, and the inner corner of Thanh Tri. Erosion happens at Lien Mac, left side of Trung Ha Sand Bar, and the location of Thanh Tri Bridge.

The **increase in water levels** at major points in the Hanoi Segment is summarized in **Table 26.7.2**. Comparison of hydraulic characteristics of Alternative 1 is summarized in **Table 26.7.3** for the dry and flood seasons as well as the case of very high flood.

The increase in water level due to the facilities is an order of cm or minimal. Thus, the effect of he facilities can be neglected on flood conditions.

Table 26.7.2 Increase in Flood Water Level due to Channel Stabilization Facilities
(Water depth: 12.5m at Hanoi H-M Station)

Location	Increase in Water Level	Remarks
Tang Long Bridge	+ 4.1 cm	
New North Hanoi Port	+ 3.2 cm	Hai Boi Commune
Duong River	+ 2.3 cm	
Hanoi H-M Station	+ 1.5 cm	
Hanoi Port	- 1.6 cm	

Table 26.7.3 Summary and Comparison of Hydraulic Characteristics (H = 3.3m, 9.2m and 12.5m, Alternative 1)

Water Level (m)

Water Level (m)	Dry Season	Flood Season	Very High Flood
A	3.836	9.979	13.495
B	3.819	9.793	
C	3.440	9.619	12.985
D	3.470	9.535	12.844
E	3.592	9.498	
F	3.117	9.192	**12.466**
G	3.344	9.119	
H	2.598	8.966	12.137

Current Velocity (m/sec)

Velocity (m/sec)	Dry Season	Flood Season	Very High Flood
A	1.020	1.404	2.177
B	0.719	1.624	1.621
C	0.812	1.619	2.186
D	0.956	1.532	2.240
E	0.671	1.169	1.363
F	0.955	1.696	1.932
G	0.630	1.397	1.800
H	1.302	1.214	1.357

Water Discharge (m^3/sec)

Water Level (m)	Dry Season	Flood Season	Very High Flood
A	1,293.4	6,791.4	2,715.0
B	456.6	3,653.6	
C	616.3	2,639.3	7,127.1
D	965.8	5,939.7	18,905.7
E	167.9	1,866.0	
F	965.8	5,603.1	18,905.7
G	167.9	2,202.7	
H	1,133.7	7,805.8	18,905.7

Cross-sectional area of flow (m^2)

Water Level (m)	Dry Season	Flood Season	Very High Flood
A	2,167.2	7,402.6	18,779.4
B	742.8	3,092.0	
C	936.6	2,341.3	2,569.4
D	1,399.9	5,804.4	13,951.8
E	300.9	2,118.4	
F	1,325.6	4,378.0	13,634.7
G	288.7	1,741.7	
H	1,271.0	6,399.5	15,464.0

Source) JICA Study Team

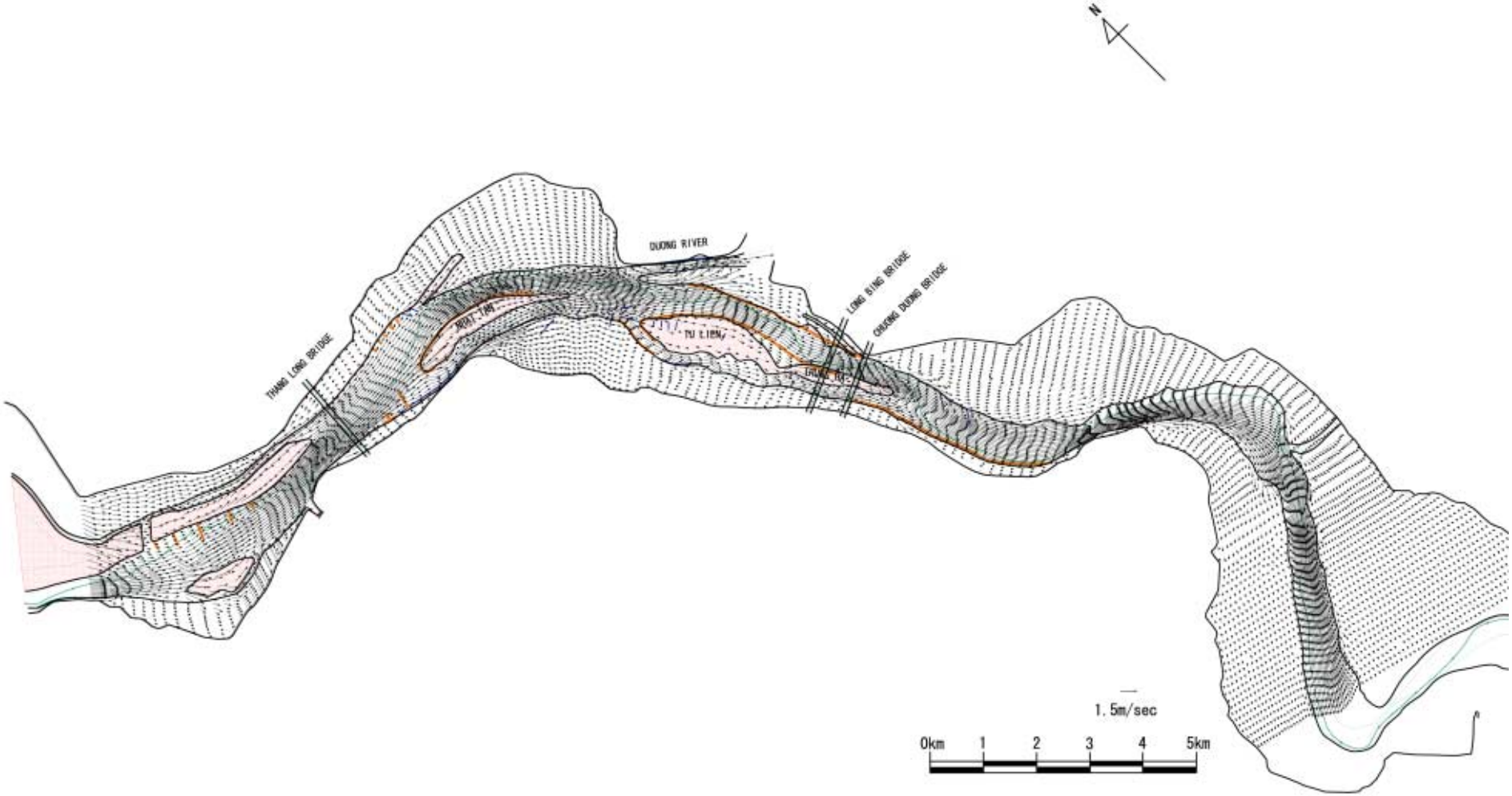


Figure 26.7.8 (1) Flow Vector of Very High Flood (H = 12.5 m, Alternative 1)

Source) JICA Study Team

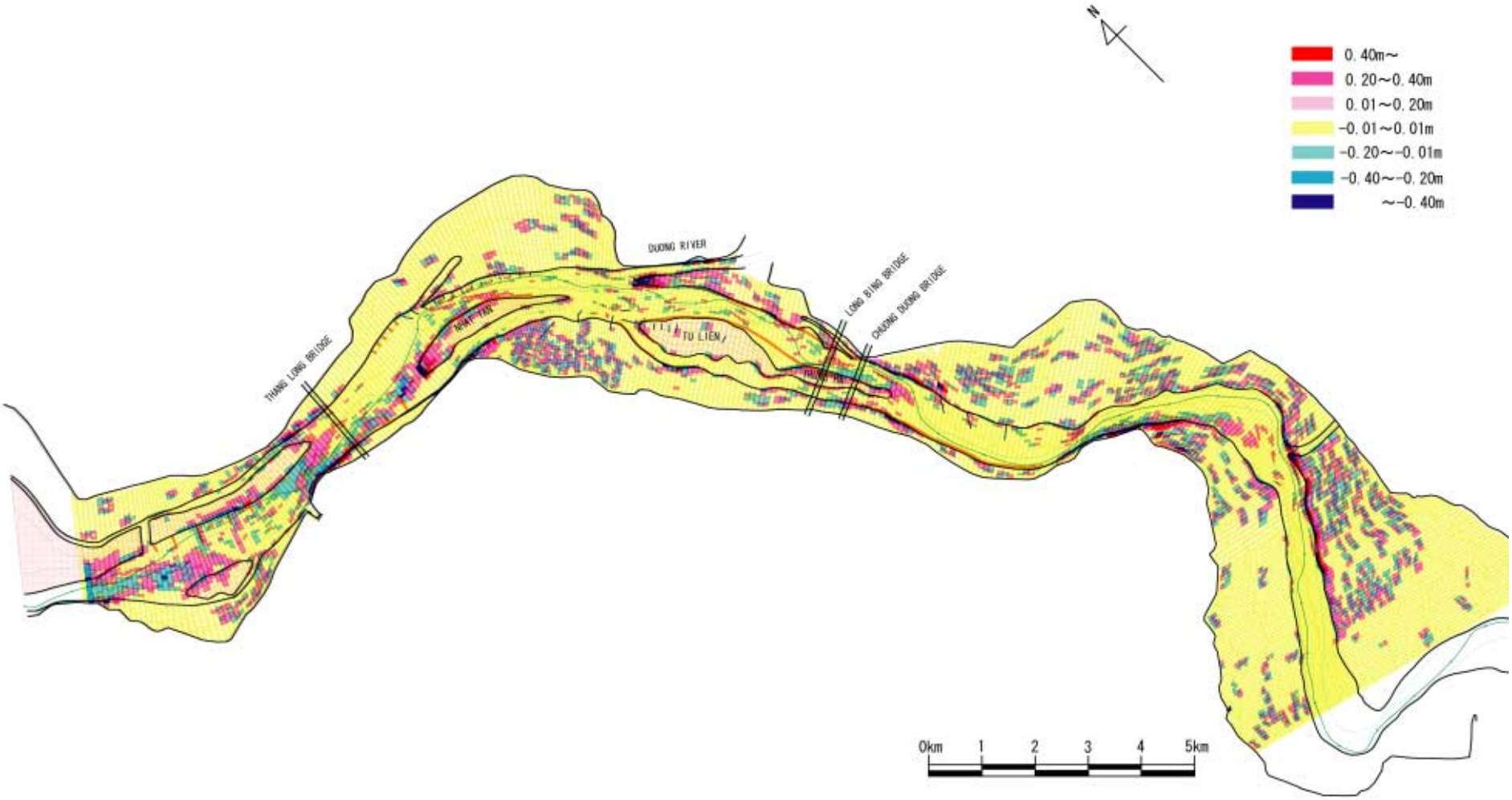


Figure 26.7.8 (2) Sedimentation/Erosion Pattern of Very High Flood (H = 12.5 m, Alternative 1)

Source) JICA Study Team

2) Extremely High Flood with Movable Riverbed

In reality, the riverbed will eventually be eroded or accredited by the effect of construction of channel stabilization facilities and initial capital dredging. It is difficult, however, to simulate long-term change in river morphology, because huge computation time is required to reproduce the riverbed variation under unsteady flow conditions. Here, a simplified method is introduced to predict the hydraulic parameters for the case of an extremely high flood, or the case of a water level of 13.4m.

It is assumed that, owing to construction of channel stabilization facilities and initial dredging, the riverbed along the Basic Sinuosity will be flattened to form a new equilibrium state. In other words in general, some shallow areas will be deepened by self-scouring effect, and deep areas will become shallower. This is represented by artificially adjusted initial depth conditions. **Figure 26.7.9(1)** shows the areas where the depths are deepened artificially by 0 to 2m. The results of numerical simulations are shown in **Tables 26.7.4** and **5**. The patterns of Flow is presented in **Figures 26.7.9(2).**

The water level is expected to be reduced at the upper river portions owing to self-scouring effect due to flood. The increase due to construction of channel stabilization facilities occurs at downstream of Choung Duong Bridge, which is an order of few cm or minimal. The discharge into the Duong River will decrease slightly. Thus, the effect of the facilities can be neglected on flood conditions.

It is noted that, in the above analysis, the **flood drainage corridor** is maintained as same as that of the present conditions, or the area between the existing dikes.

Table 26.7.4 Change in Flood Water Level due to Channel Stabilization Facilities Taken Account of Effect of Riverbed Erosion

(Water depth: 13.4m at Hanoi H-M Station)

Location	Increase in Water Level	Remarks
Tang Long Bridge	- 2 cm	
New North Hanoi Port	-12 cm	Hai Boi Commune
Duong River	-1 cm	
Hanoi H-M Station	-3 cm	
Hanoi Port	+2 cm	

Source) JICA Study Team

Table 26.7.5 Comparison of Hydraulic Parameters for Extremely High Flood (H=13.4m) (Present Condition and Alternative 5s)

Water Level

Water Level(m)	Present Condision	Alternative 5s	Alt 5s-PC	
A	14.777	14.711	-0.066	Main
B	14.289	14.266	-0.024	Main
C	14.295	14.178	-0.117	NHAT TAN Main Channel
D	14.155	14.078	-0.077	NHAT TAN 2nd Cannel
E	14.009	13.991	-0.018	Main
F	13.994	13.969	-0.025	2nd
G	13.829	13.814	-0.014	Duong River
H	13.679	13.664	-0.015	TU LIEN Main Channel
I	13.657	13.644	-0.013	TU LIEN 2nd Cannel
J	13.659	13.627	-0.032	Main
K	13.558	13.552	-0.006	2nd
L	13.594	13.546	-0.048	Main
M	13.474	13.466	-0.008	2nd
N	13.400	13.373	-0.027	TRUNG Ha Main Channel
O	13.320	13.344	0.024	TRUNG Ha 2nd Channel
P	13.112	13.132	0.020	Ha noi port
Q	12.612	12.621	0.009	Main

Velocity

Velocity(m/sec)	Present Condision	Alternative 5s	Alt 5s-PC	
A	1.661	2.125	0.465	Main
B	3.090	3.376	0.286	Main
C	2.117	1.941	-0.176	NHAT TAN Main Channel
D	2.296	1.396	-0.900	NHAT TAN 2nd Cannel
E	2.084	1.937	-0.147	Main
F	2.255	1.870	-0.385	2nd
G	2.362	2.372	0.010	Duong River
H	2.370	2.255	-0.115	TU LIEN Main Channel
I	1.331	1.360	0.029	TU LIEN 2nd Cannel
J	2.679	2.617	-0.062	Main
K	1.243	1.207	-0.036	2nd
L	1.798	1.721	-0.076	Main
M	1.357	1.324	-0.034	2nd
N	1.821	1.728	-0.093	TRUNG Ha Main Channel
O	1.914	1.776	-0.138	TRUNG Ha 2nd Channel
P	1.479	1.477	-0.002	Ha noi port
Q	1.956	1.975	0.019	Main

Discharge

Discharge(m^3/s)	Present Condision	Alternative 5s	Alt 5s-PC	
A	32381.3	32381.3	0	Main
B	32381.3	32381.3	0	Main
C	32381.3	32381.3	0	NHAT TAN Main Channel
D				NHAT TAN 2nd Cannel
E	32381.3	32381.3	0	Main
F				2nd
G	10381.3	9988.0	-393.3	Duong River
H	22000.0	22393.3	393.3	TU LIEN Main Channel
I				TU LIEN 2nd Cannel
J	22000.0	22393.3	393.3	Main
K				2nd
L	22000.0	22393.3	393.3	Main
M				2nd
N	22000.0	22393.3	393.3	TRUNG Ha Main Channel
O				TRUNG Ha 2nd Channel
P	22000.0	22393.3	393.3	Ha noi port
Q	22000.0	22393.3	393.3	Main

Cross-sectional area of flow

(m^2)	Present Condision	Alternative 5s	Alt 5s-PC	
A	17214.1	18009.4	795.3	Main
B	14267.4	14775.2	507.8	Main
C	20434.2	19981.3	-452.9	NHAT TAN Main Channel
D				NHAT TAN 2nd Cannel
E	23049.1	22117.1	-932.1	Main
F				2nd*
G	2882.9	2838.1	-44.8	Duong River
H	15195.0	14438.0	-757.1	TU LIEN Main Channel
I				TU LIEN 2nd Cannel
J	18229.2	17054.0	-1175.3	Main
K				2nd
L	18311.1	16967.6	-1343.5	Main
M				2nd
N	12662.1	12704.0	42.0	TRUNG Ha Main Channel
O				TRUNG Ha 2nd Channel
P	15066.7	14429.9	-636.8	Ha noi port
Q	16578.8	15078.2	-1500.5	Main

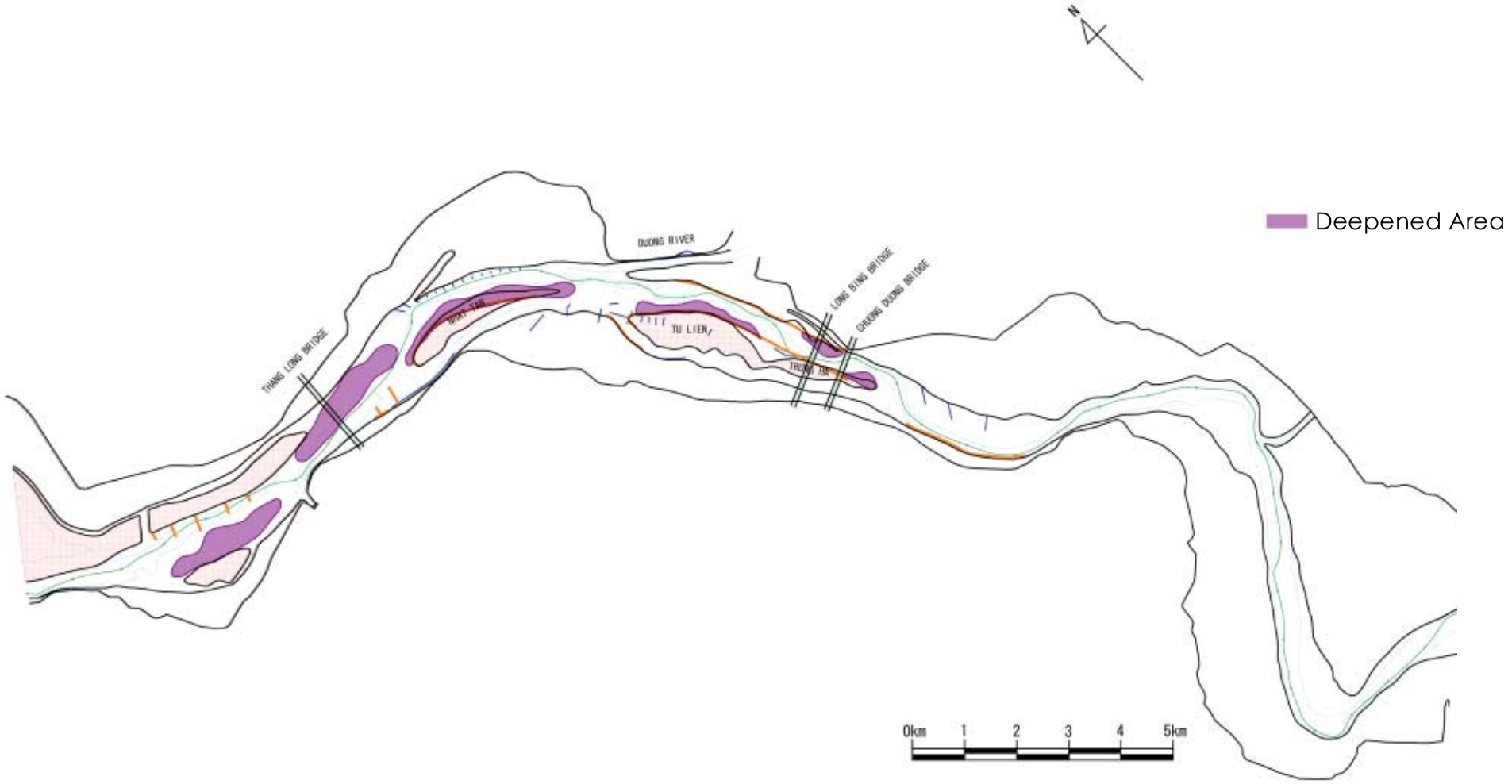


Figure 26.7.9 (1) Deepened Areas Assumed as Effect of Facilities and Dredging (Alternative 5s)

Source) JICA Study Team

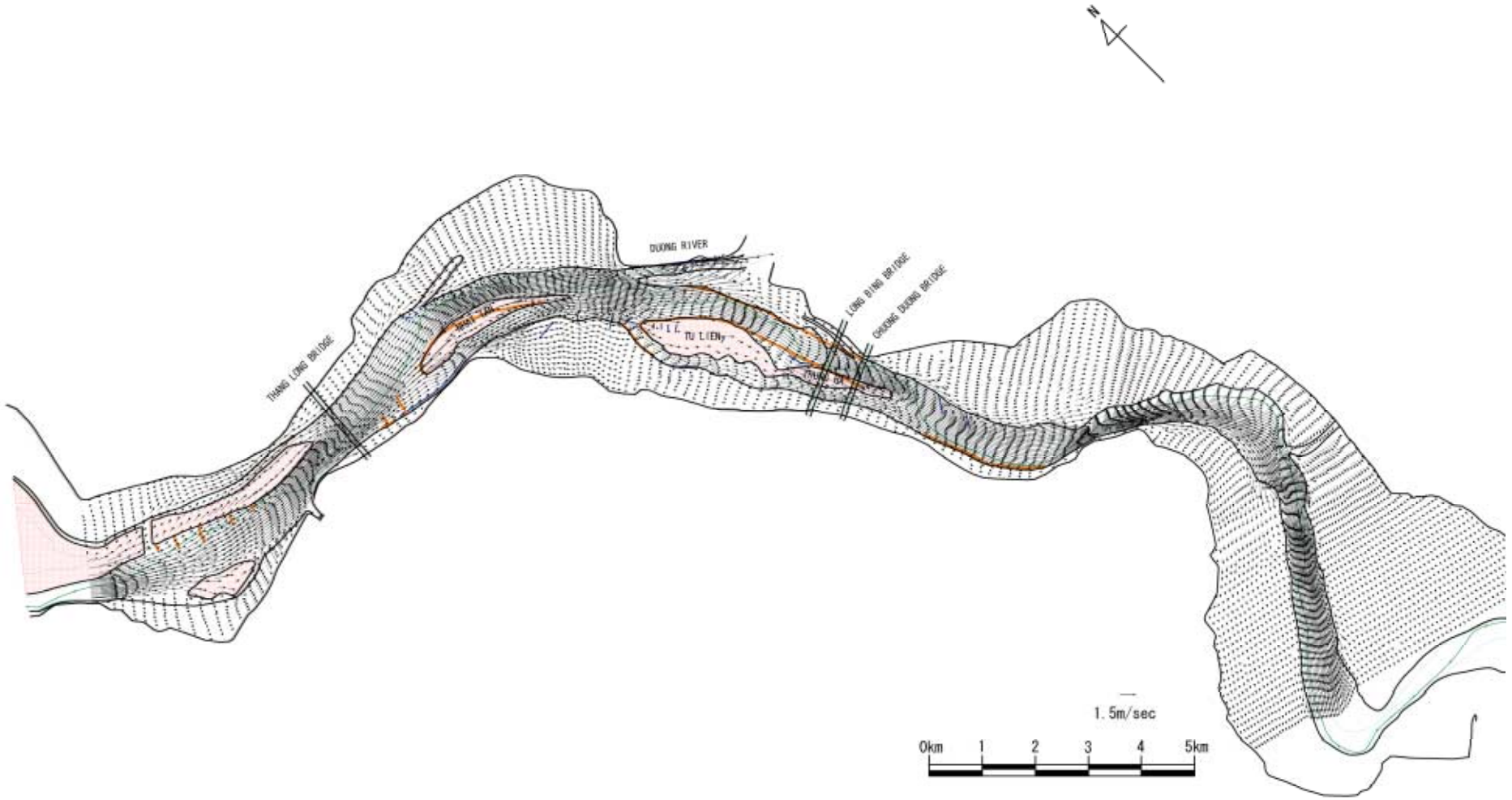


Figure 26.7.9 (2) Flow Vector of Extremely High Flood (H = 13.4 m, Alternative 5s)

Source) JICA Study Team