APPENDIX

APPENDIX IIIA

WAVE CALMNESS STUDY

WAVE HEIGHT RATIO FOR PLANS 1,2,3 AND 4

(Relating to Chapter 4, Part III)

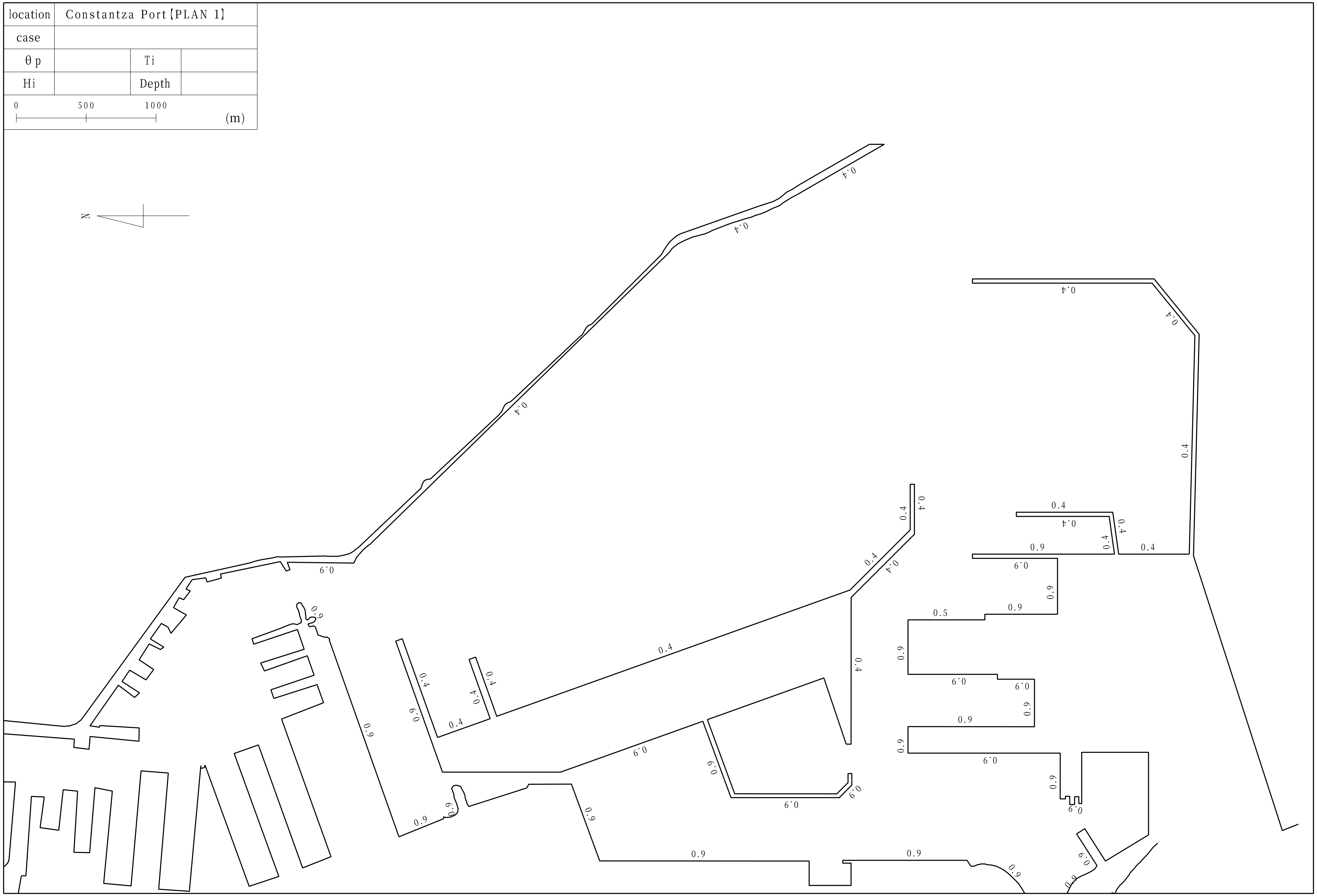


Figure 1 Reflection Coefficient

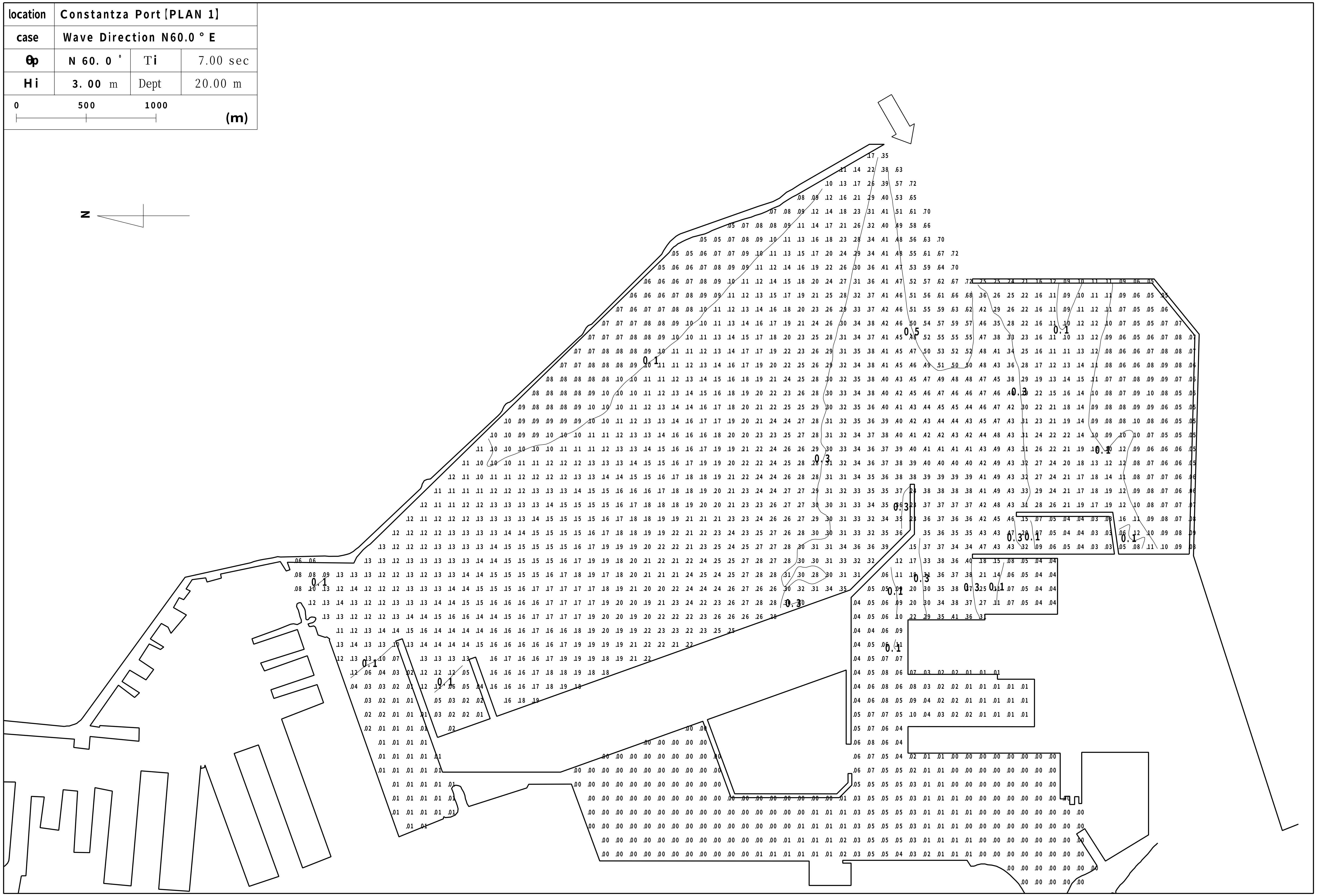


Figure 2 Wave Height Ratio

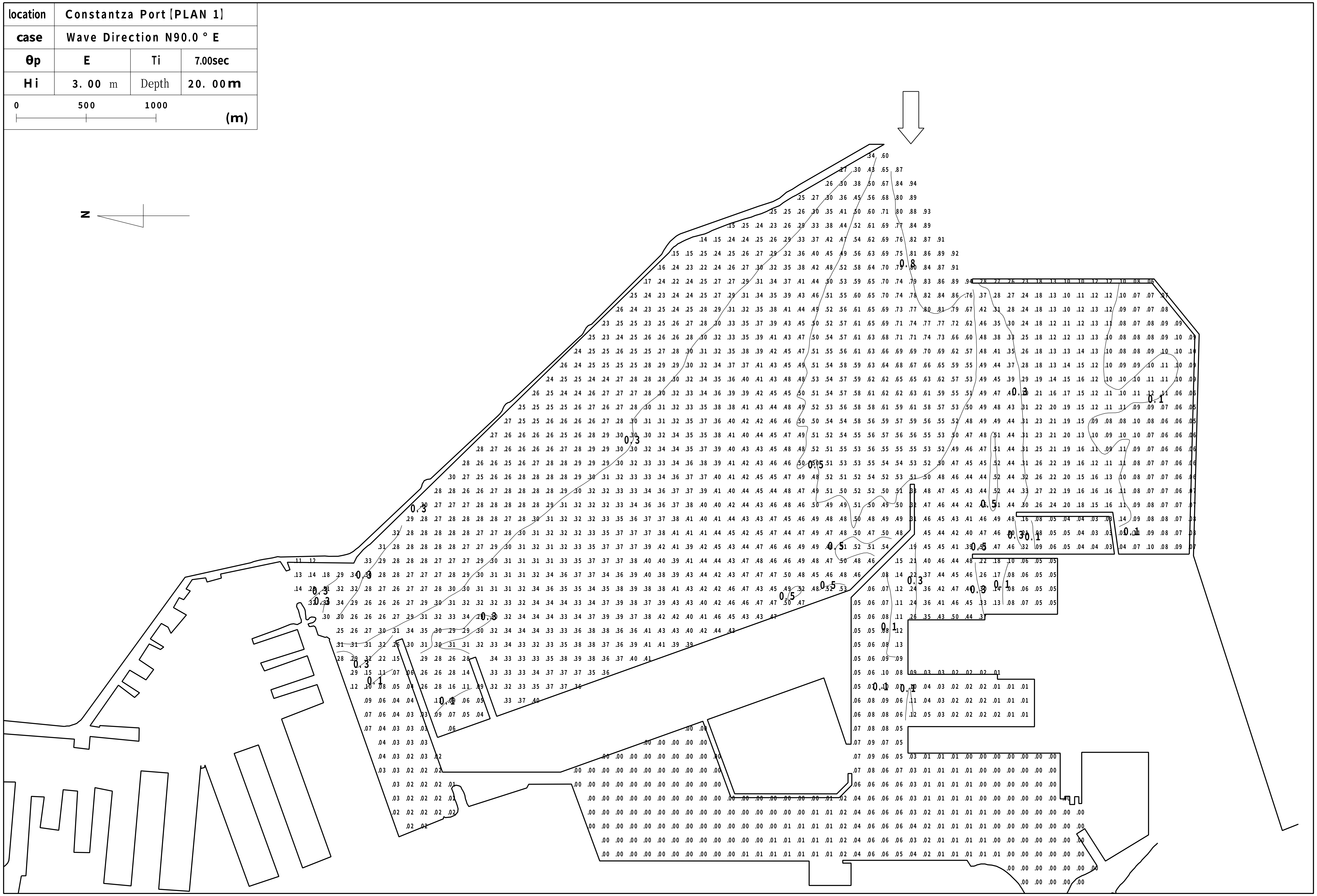


Figure 3 Wave Height Ratio

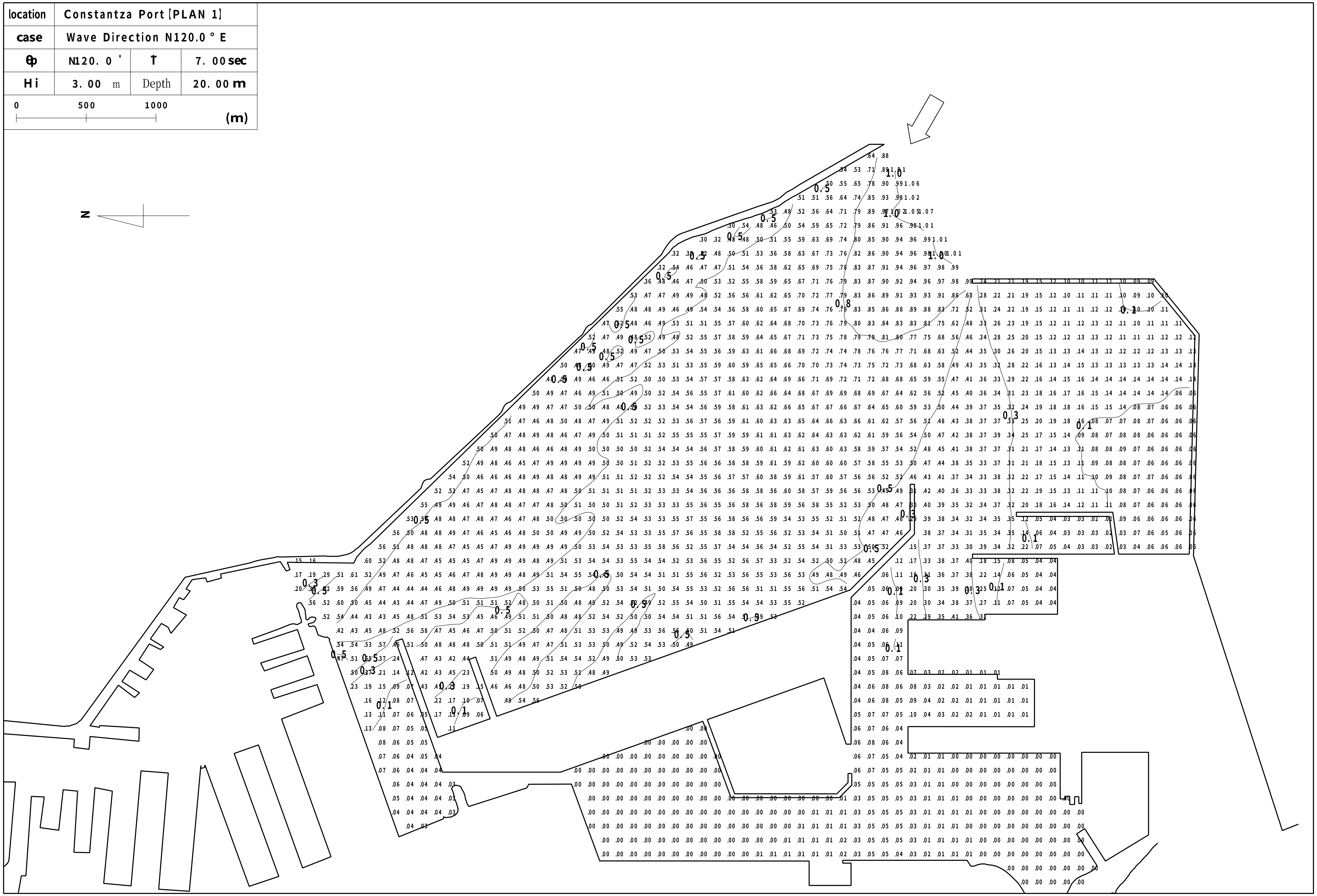


Figure 4 Wave Height Ratio

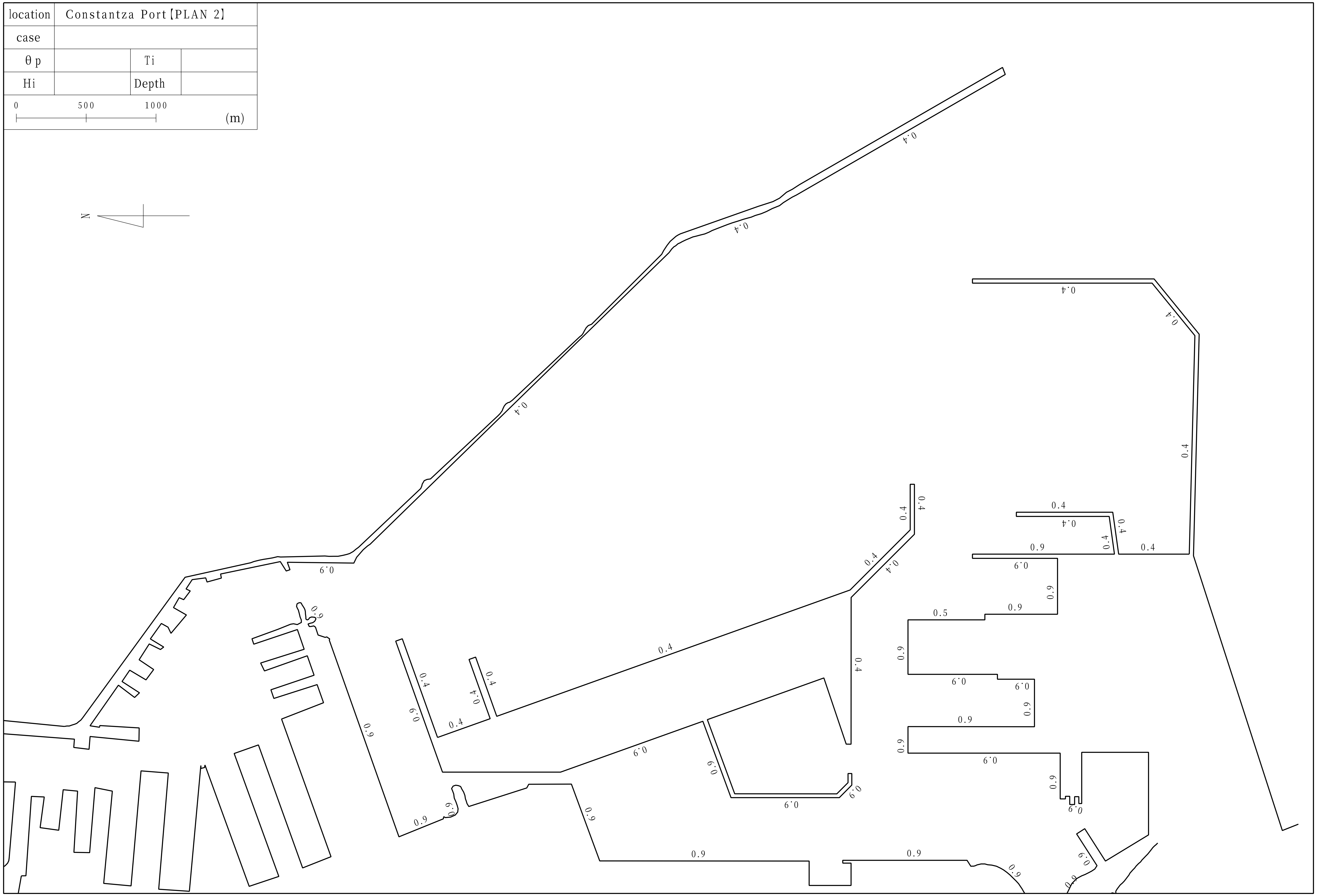


Figure 5 Reflection Coefficient

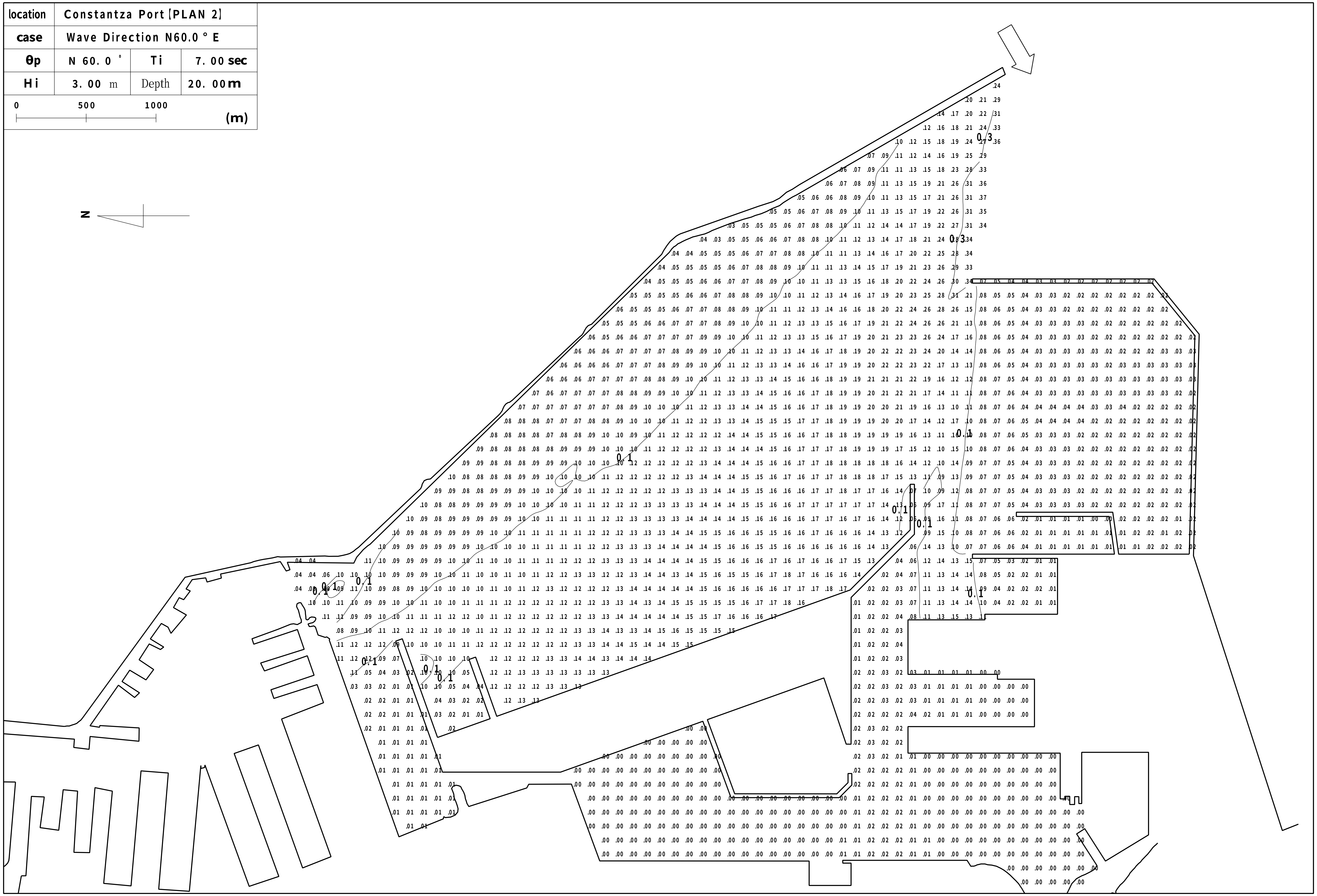


Figure 6 Wave Height Ratio

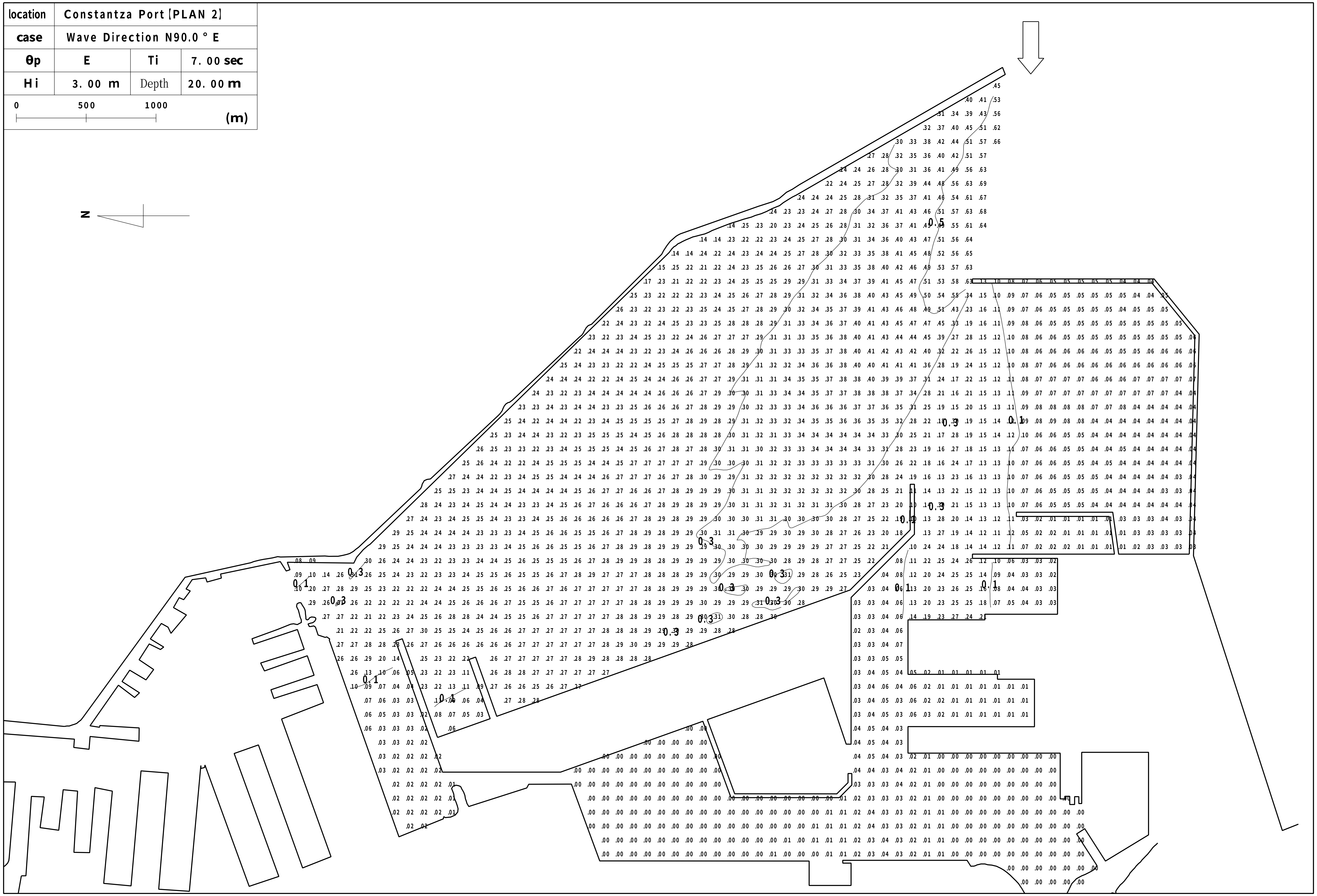


Figure 7 Wave Height Ratio

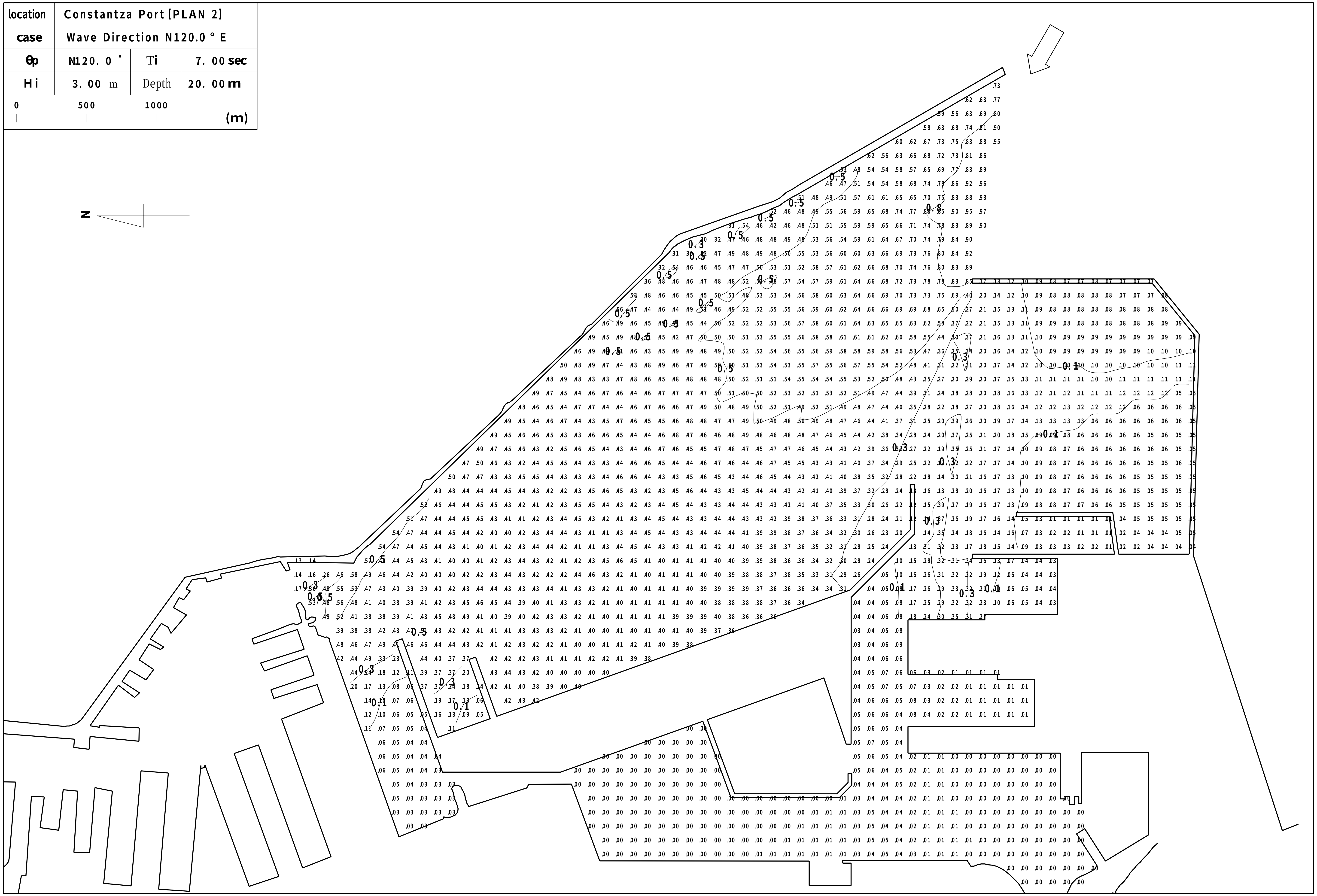


Figure 8 Wave Height Ratio

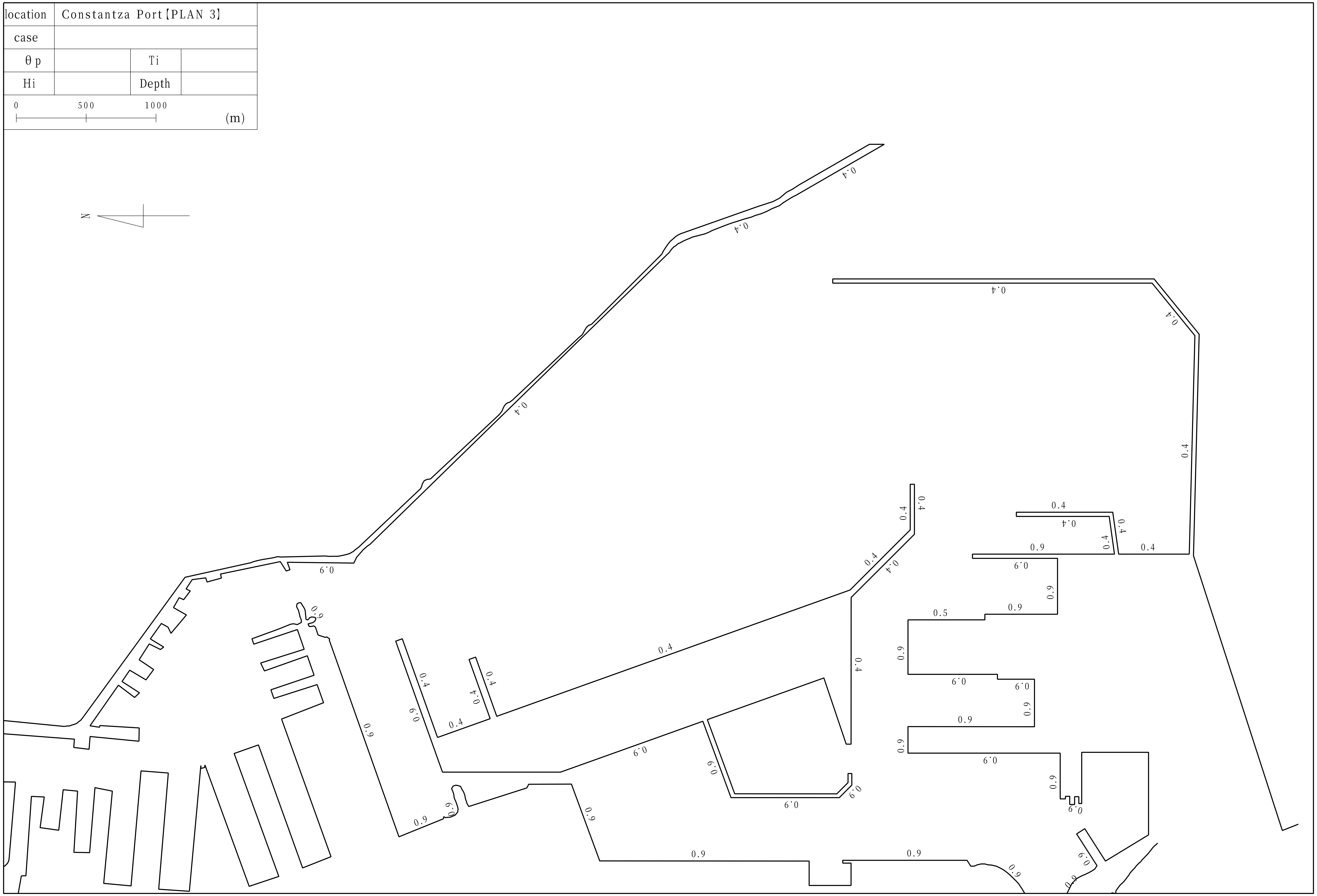


Figure 9 Reflection Coefficient

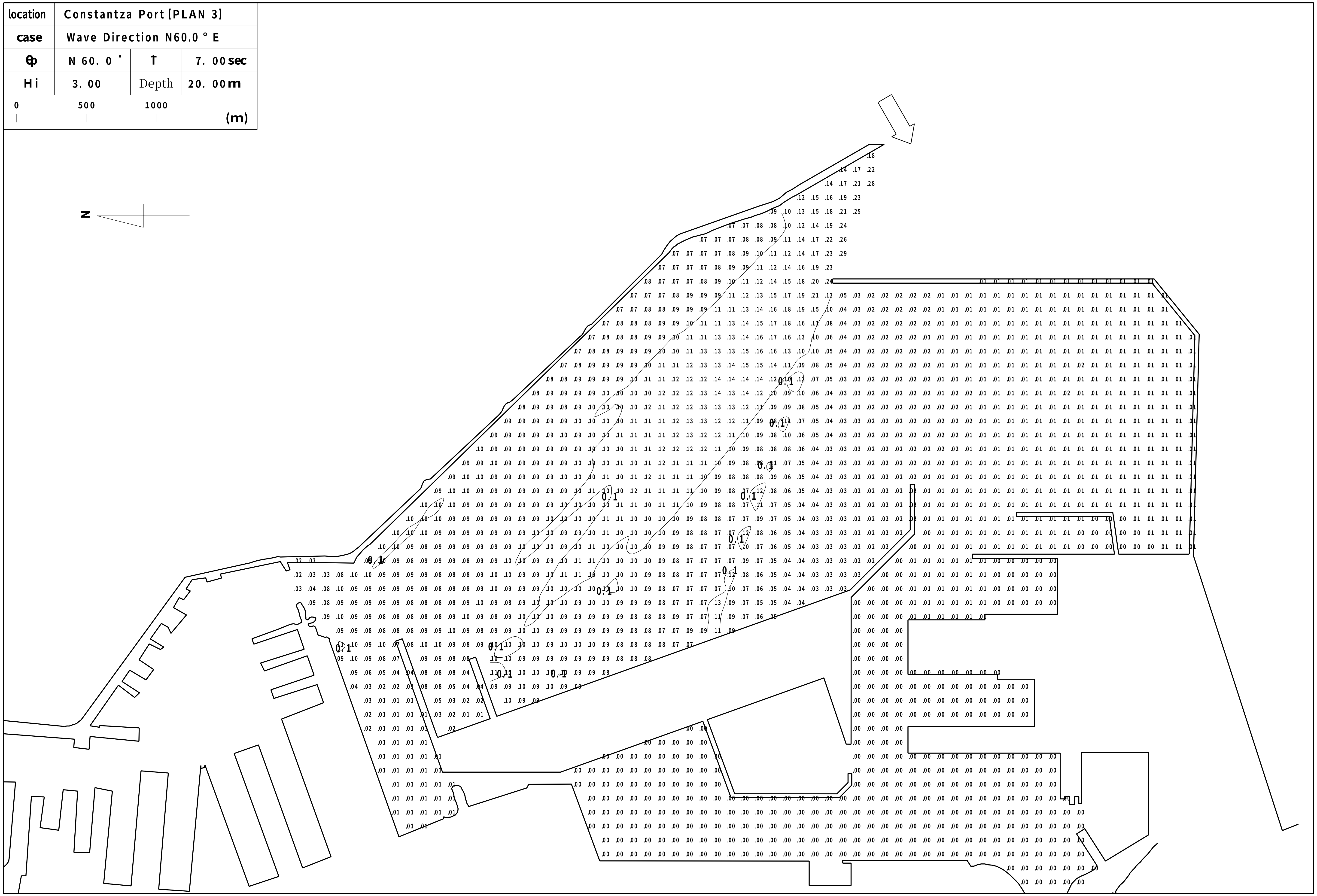


Figure 10 Wave Height Ratio

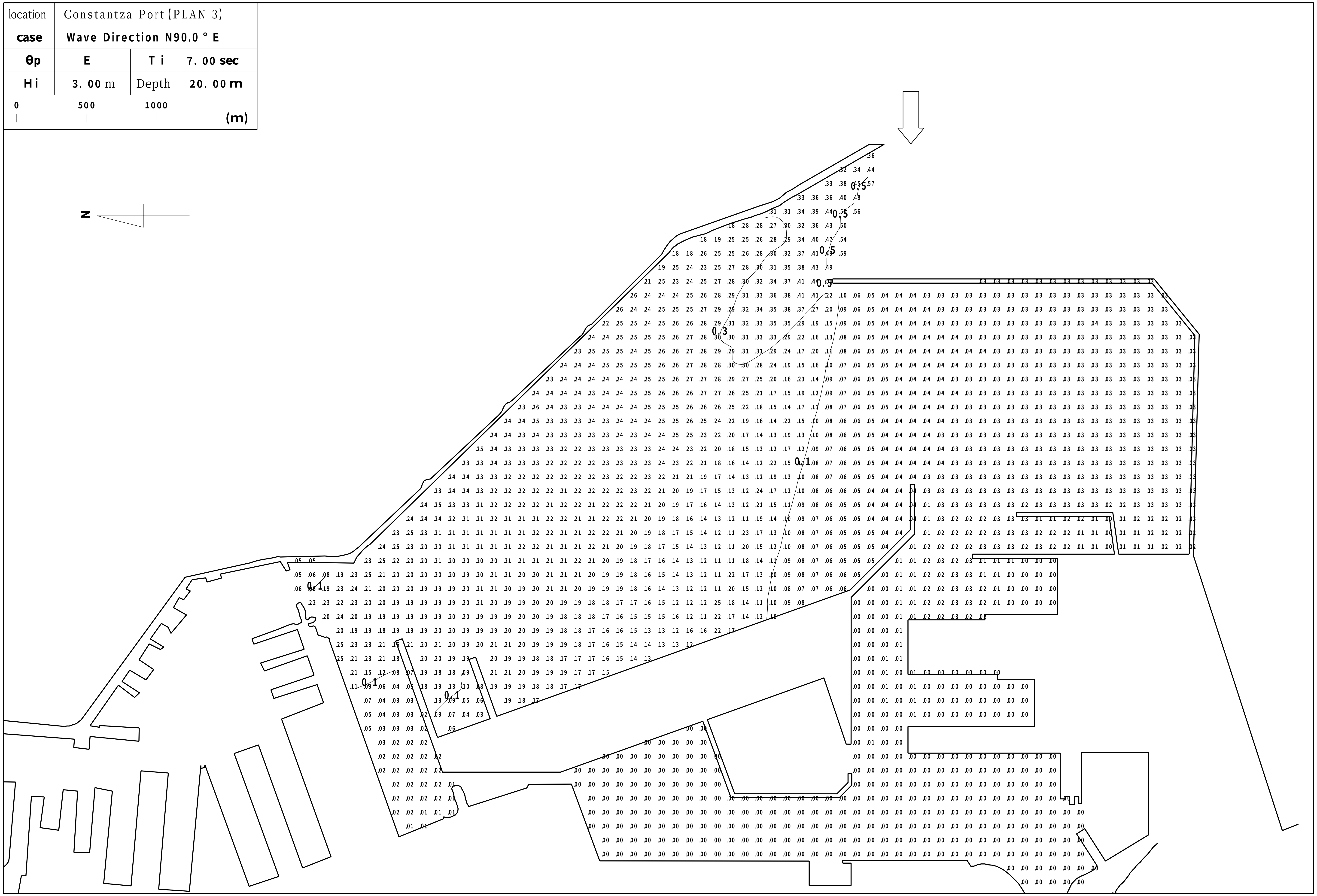


Figure 11 Wave Height Ratio

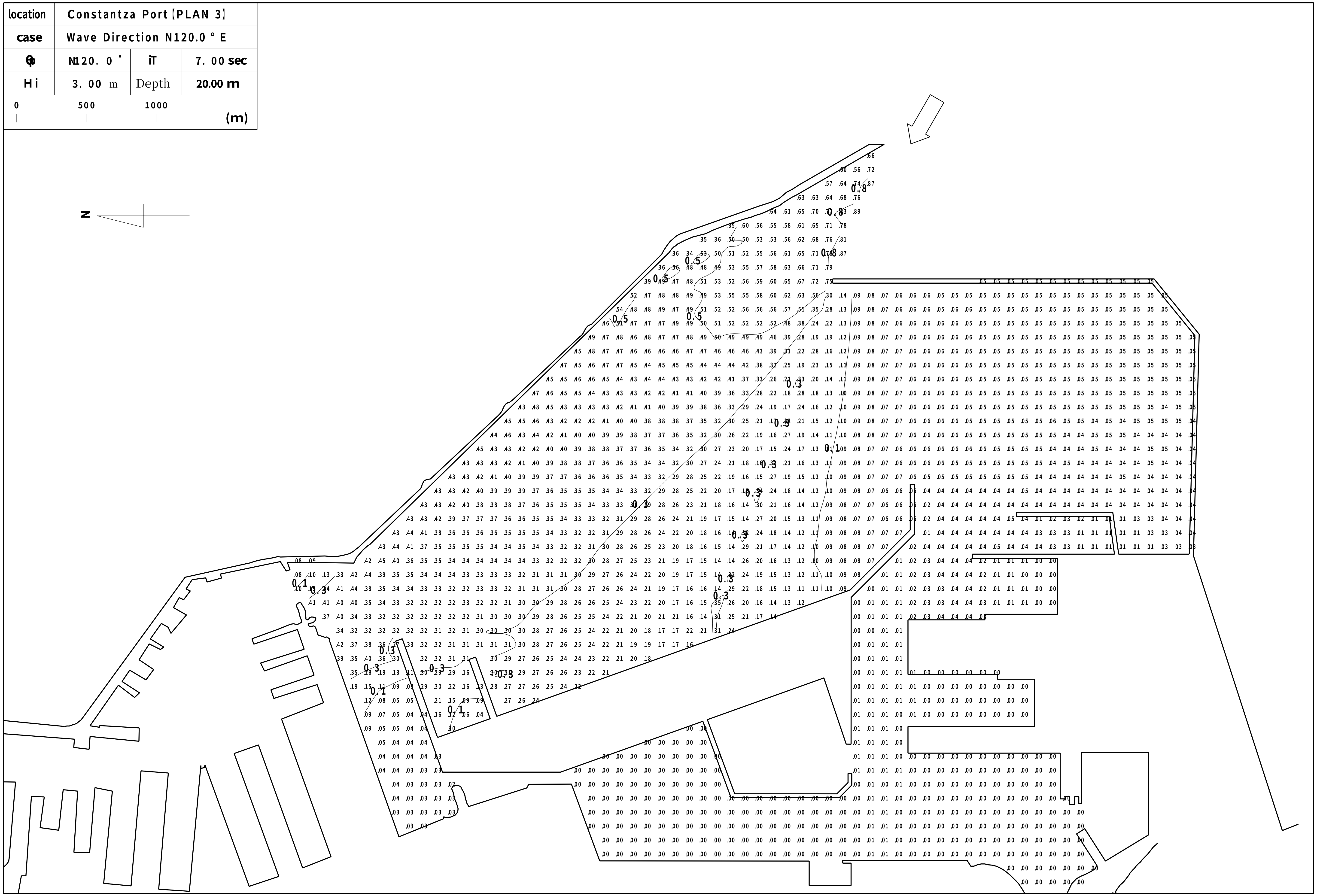


Figure 12 Wave Height Ratio

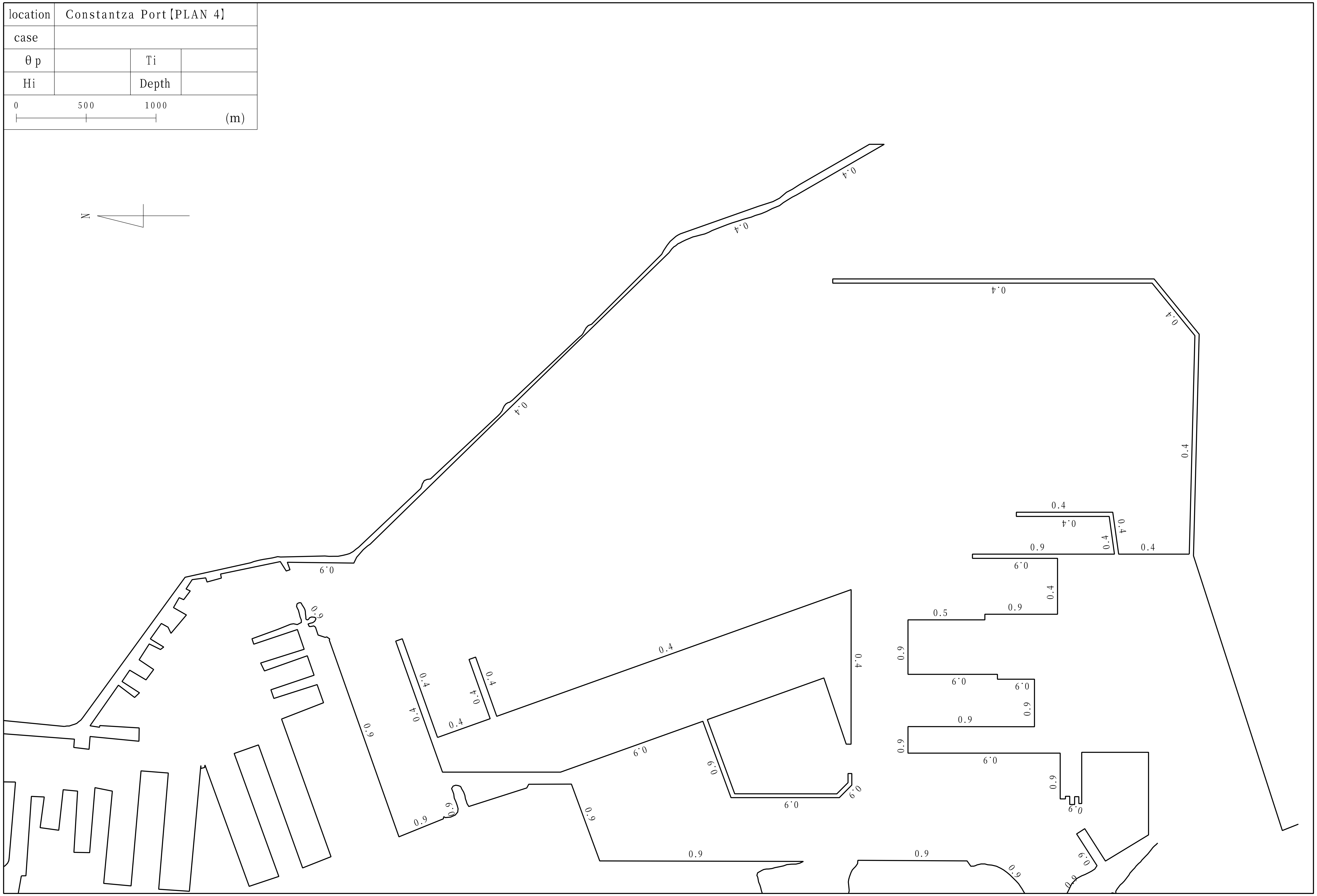


Figure 13 Reflection Coefficient

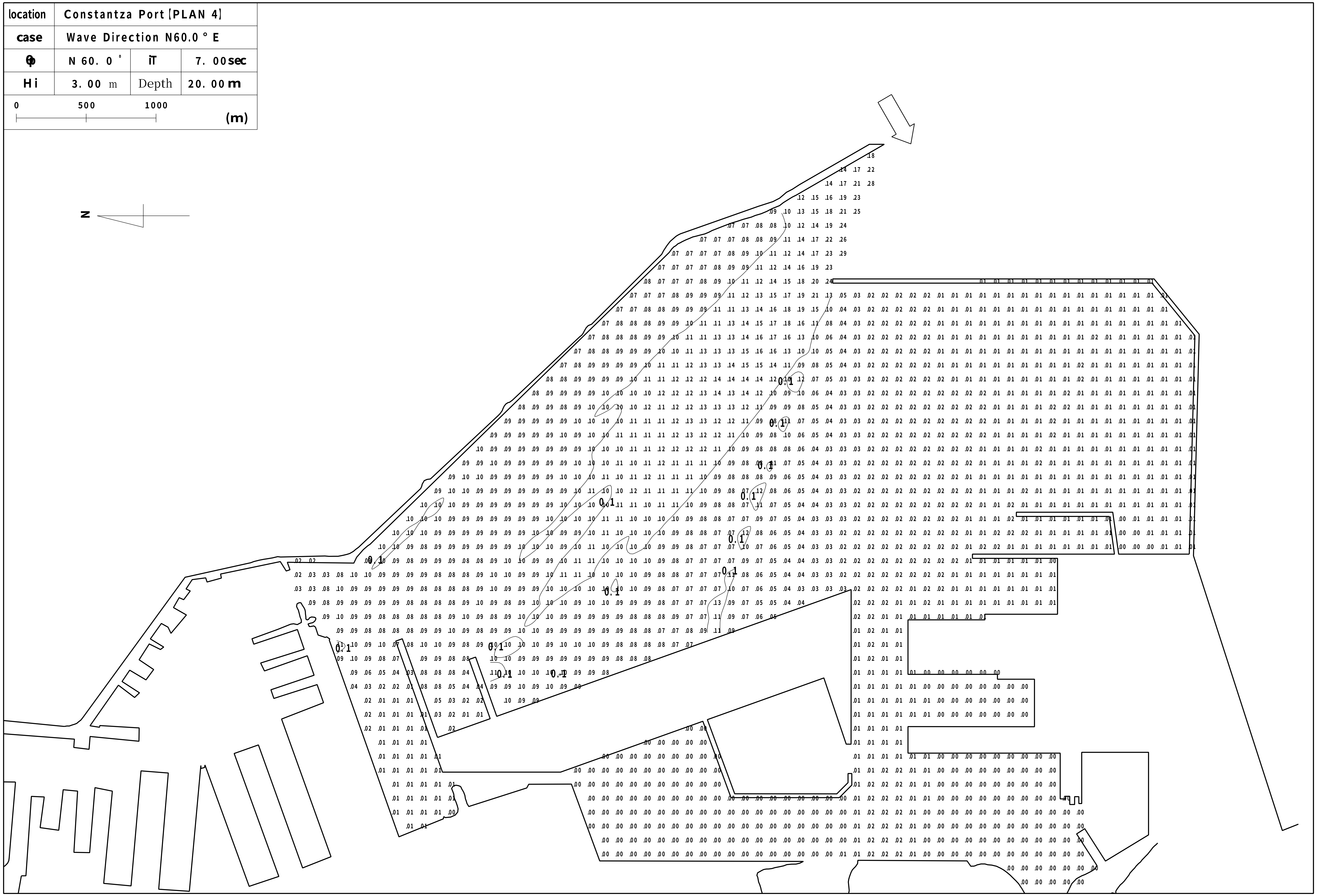


Figure 14 Wave Height Ratio

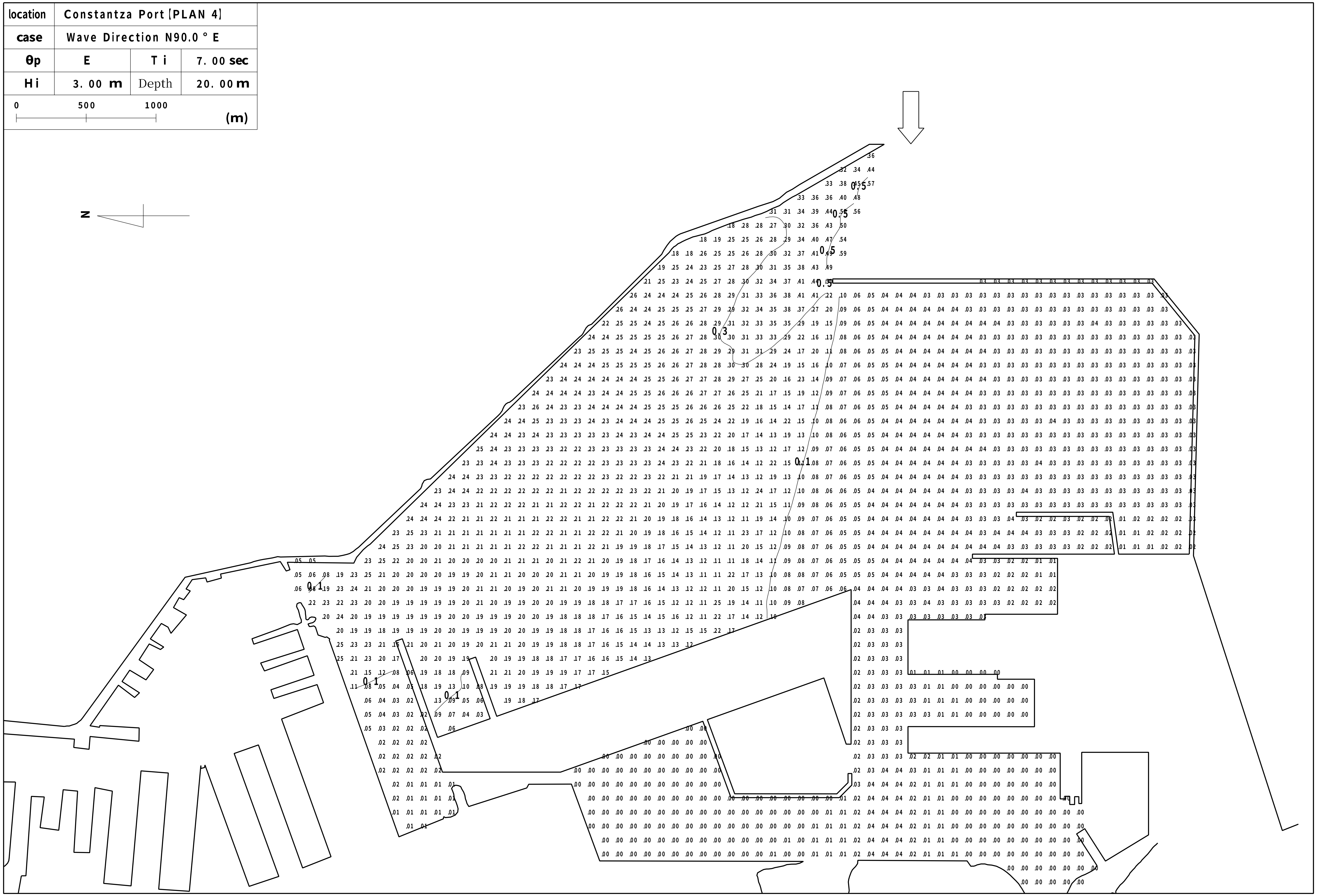


Figure 15 Wave Height Ratio

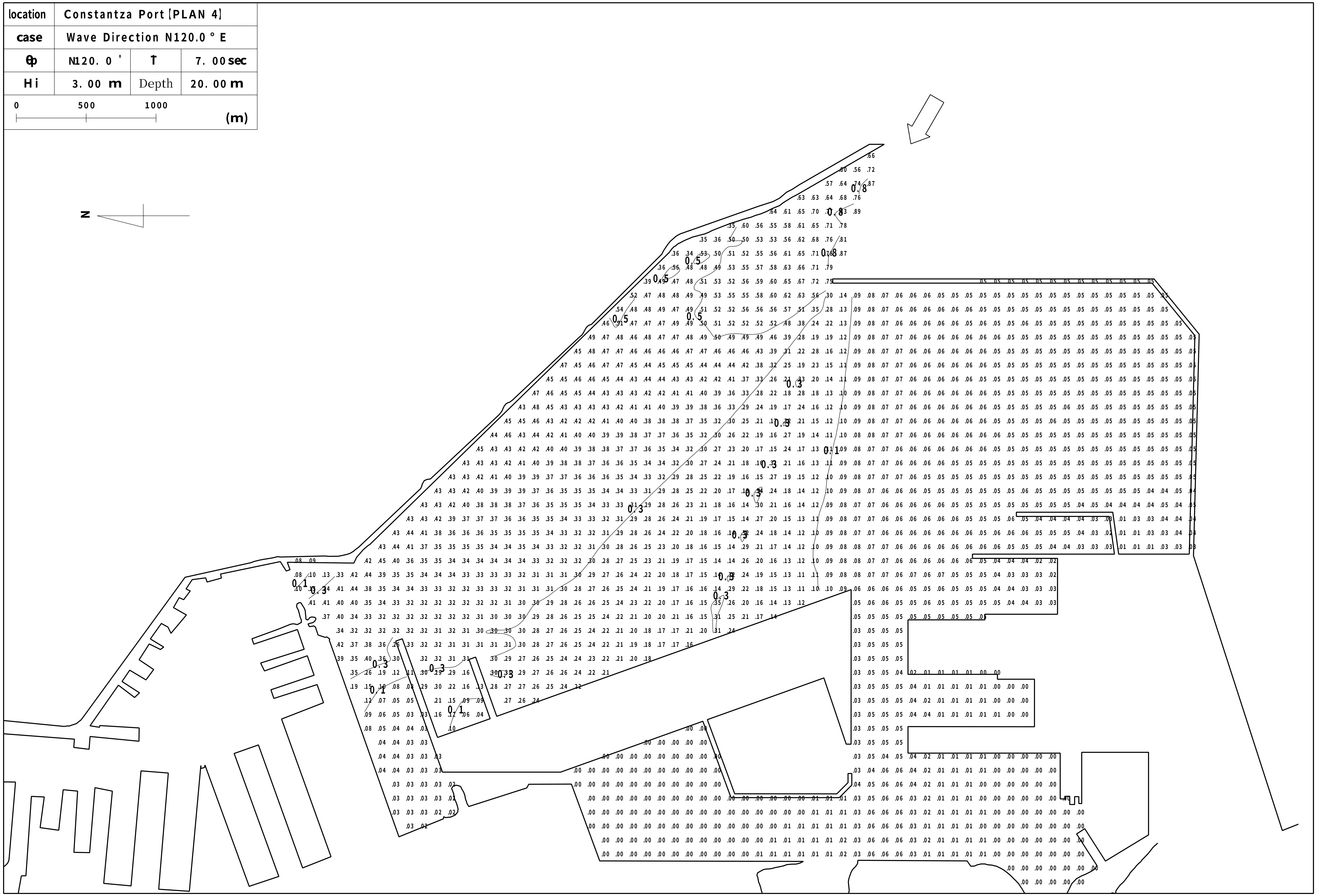


Figure 16 Wave Height Ratio

APPENDIX IIIB

SEAWATER QUALITY SIMULATION
FOR THE ENVIRONMENTAL IMPACT ASSESSMENT

(Reclamation Works and Grain Dust Segregation)

RESULTS OF SEAWATER QUALITY SIMULATION: AT PORT OF CONSTANTZA

1. Modeling the Existing Water Quality

In order to verify the applied computer program and input data, it was confirmed that the model can indicate the existing condition.
Figure 3.2 indicates the location of survey (observation) points. Figure 3.3 shows the distribution of wastewater in COD unit. Table 3.6 indicates the deference by point between the surveyed water quality and computed quality by modeling.

Except Points 8 and 9, both data meet well.

2. Influence of Dredging and Reclamation Works.

According to the work quantity estimation, total reclamation volume is about 2 million m^3 for the new land at Pier S3 on which the proposed grain terminal will provided. Fine content in soil at the Canal Bank was estimated and applied to calculation. Fine content amounts to 50% of total volume. Investigation unit is suspended solid, SS.

Reclamation period is one of factor to evaluate. Thus two case of reclamation construction periods were assumed to select the best one.

Calculation was carried out by four steps, namely 10 days, 20 days, 30 days and 60days. Influence of fine material leakage through the seawall was modeled and simulated.

Case 2.1 : Reclamation Period in 7 months, Figures 3.4
Case 2.2 : Reclamation Period in 14 months, Figures 3.5

As seen in the simulation results, data after 30 days indicates it is already stabilized. This means change after 30days after starting reclamation works is minor.
Both model have no serious influence on leakage of fine soil materials (SS: Suspended Solid) out of the existing breakwaters. However it is recommended to adopt the Case 2.2 for more environmental safety.

3. During Operation of New Grain Terminal

Proposed Short Term Development Plan contains a grain terminal and Barge terminal. Grain terminal will generate the grain dust although it depends on the system of grain handling. Barge terminal will have serious environmental impact since it is not for the cargo handling but systematical maneuvering of barges.

Influence of terminal operation against the water quality was thus inspected by possible impact of the grain dust.

As seen in the Part III Chapter 6, proposed grain terminal will be environmentally free system that will not generate serious dust. However this simulation was conducted about five times of estimated dust leaks out of the conveyors or similar.

Figure 3.6 indicates the impact of dust from the Proposed new grain terminal. There is no deference to the existing condition showing in Figure 3.3.

It is concludes that the new grain terminal will not disturb the existing seawater quality conditions.

Fig 3-2 (1) LOCAOTION OF SURVEY POINTS

Table 3-6 Values of COD concentration of sea water

(mg/l)

Station		St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11
Survey	Upper	3.03	2.10	2.44	1.94	2.02	3.20	1.35	0.93	1.16	2.61	1.26
	Middle	1.52	0.81	2.02	0.84	0.59	1.14	0.76	0.76	1.13	1.52	1.01
	Lower	1.09	0.88	1.26	0.42	1.18	0.88	2.95	0.93	0.69	0.93	1.18
	Average	1.88	1.26	1.91	1.07	1.26	1.74	1.69	0.87	0.99	1.69	1.15
Calculation		1.93	1.98	1.53	1.24	1.17	1.27	2.07	2.22	2.56	1.15	1.15

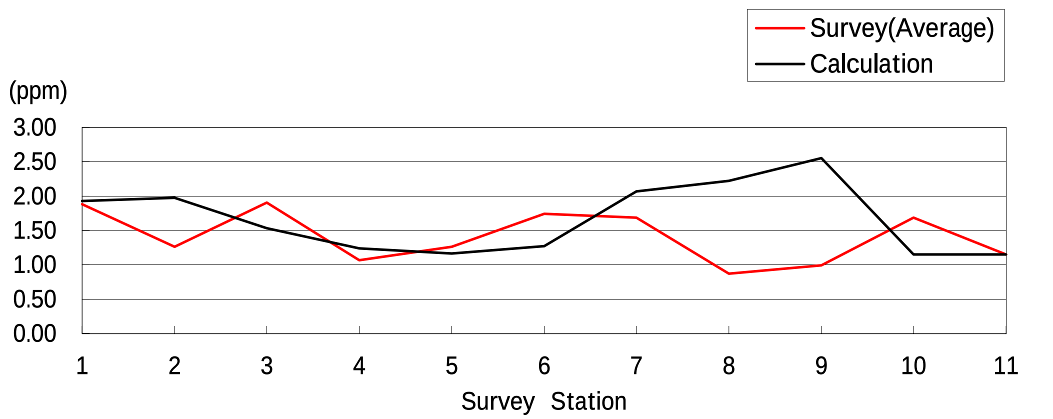
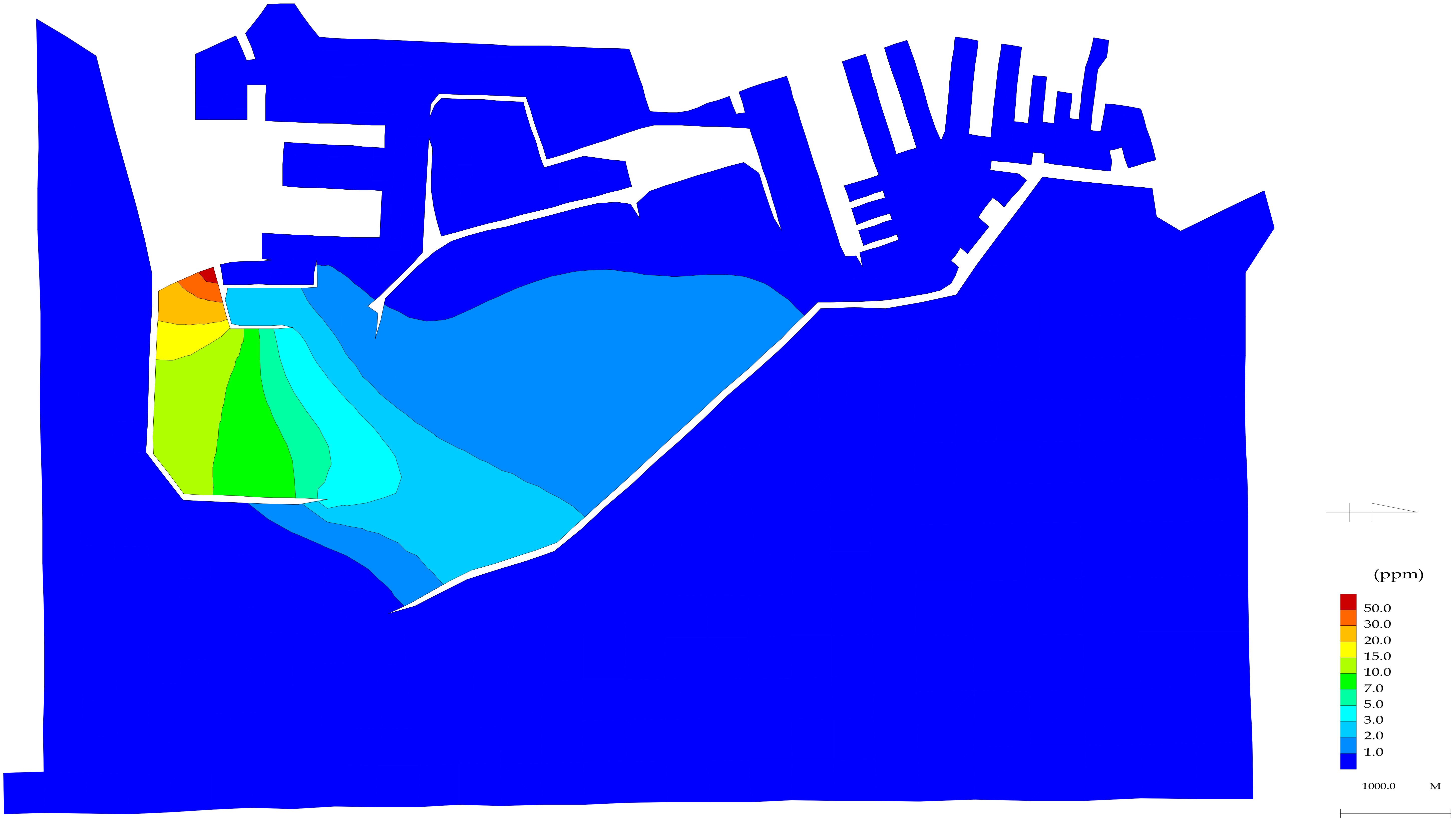
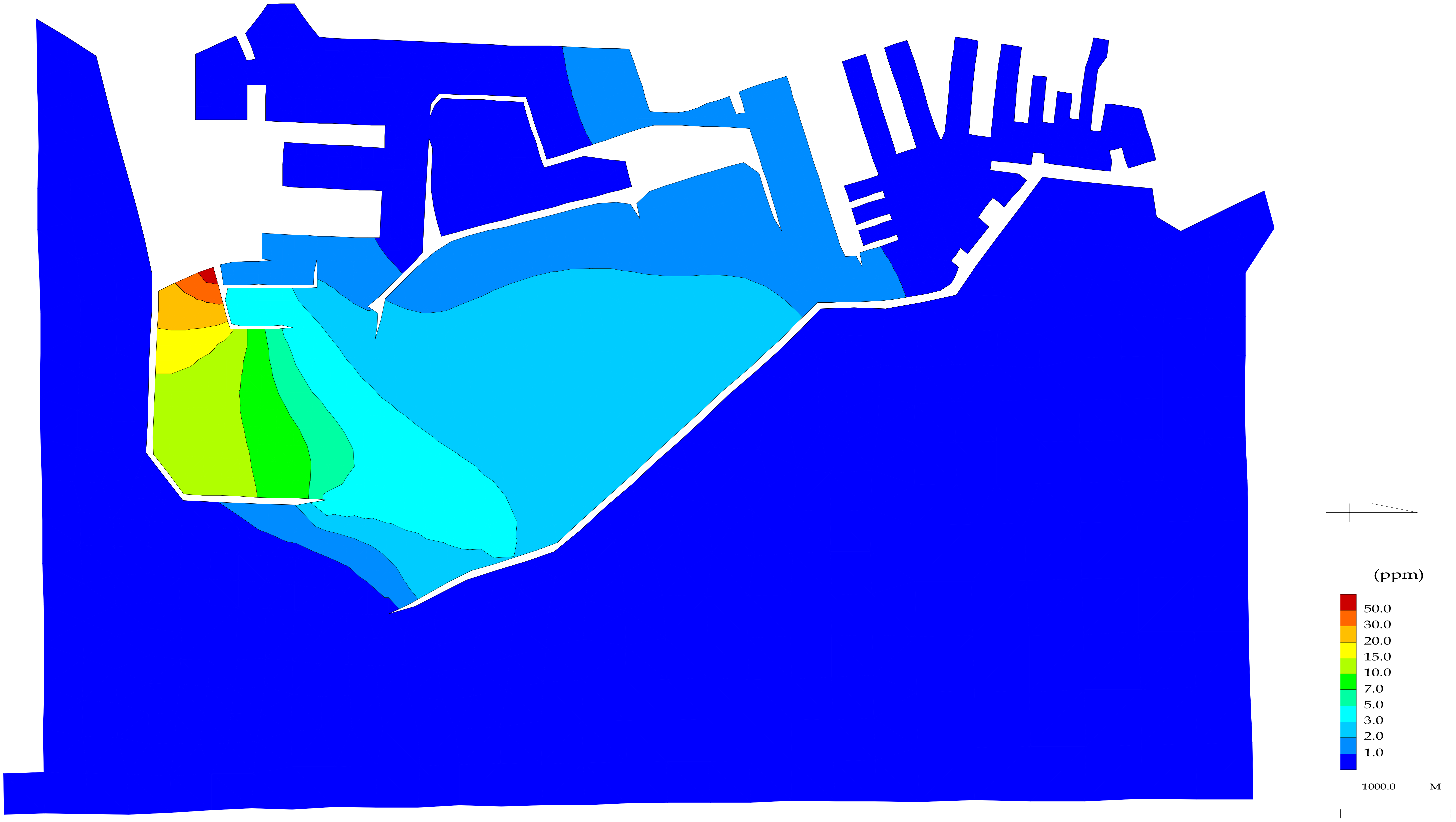


Fig 3-2 (2) Comparison of COD concentrations

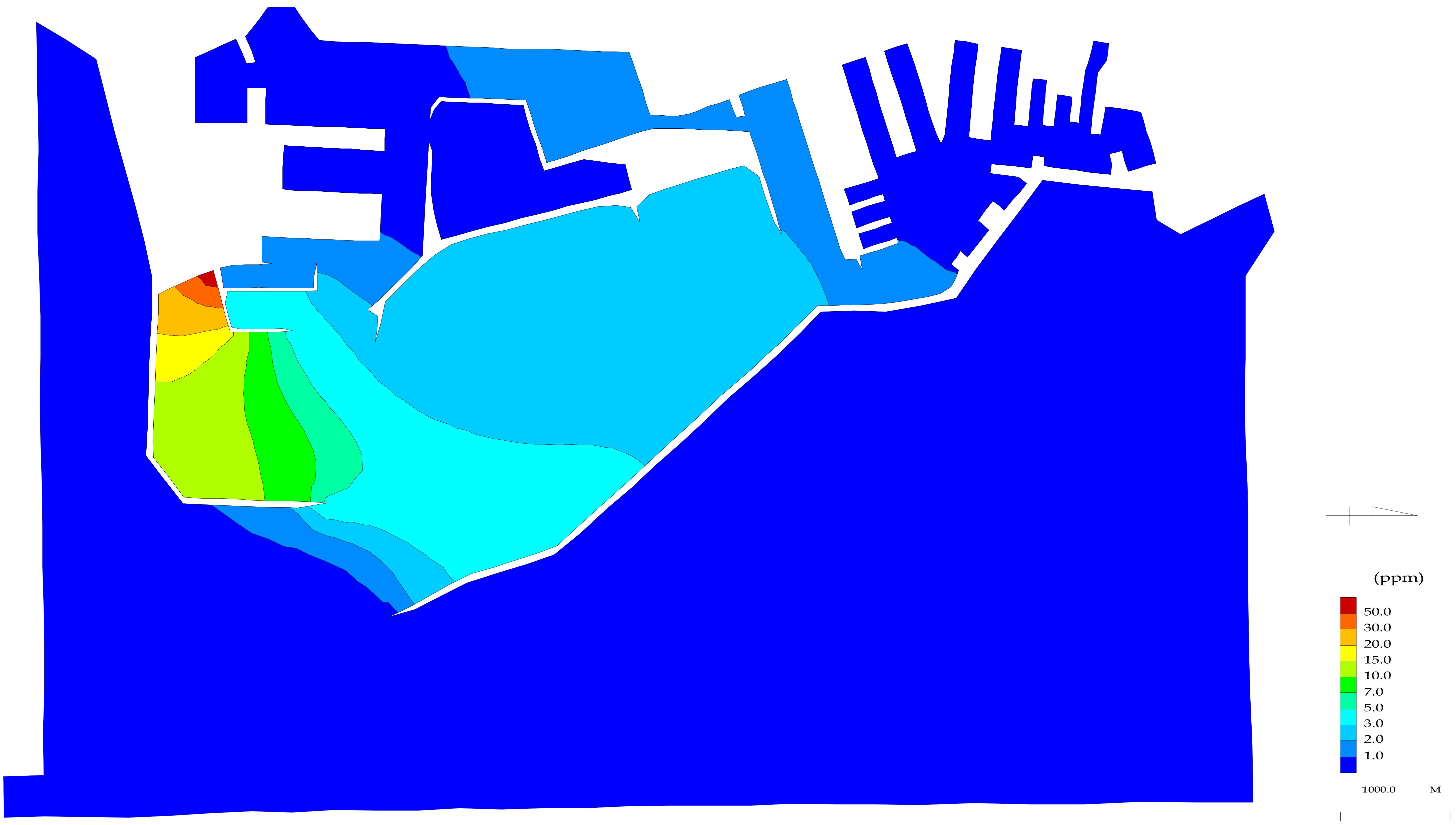
'Fig 3-3 Concentraion of COD (Case - 1.1)



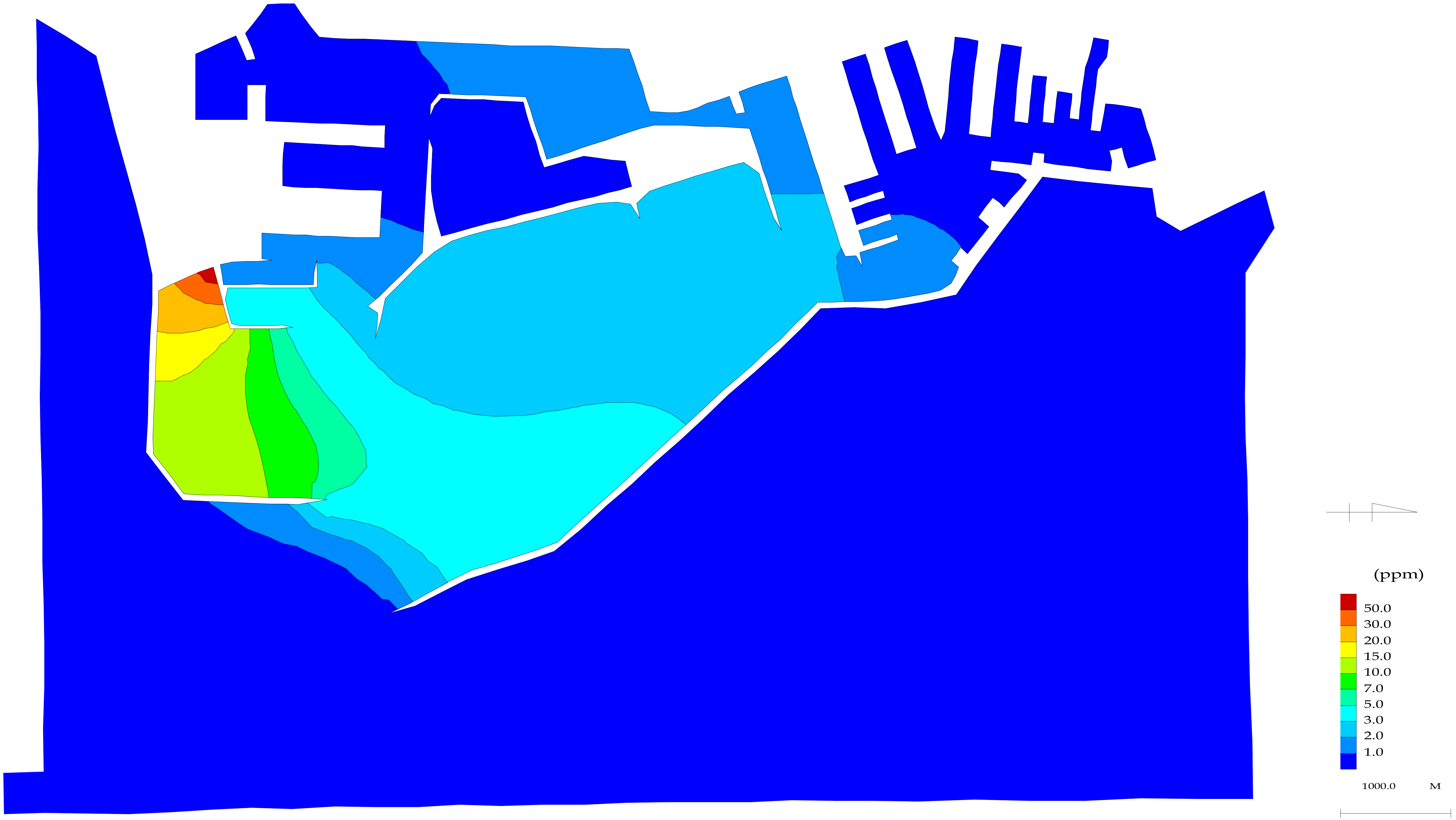
'Fig 3-4(1) Concentraion of SS (Case - 2.1 , 10 days)



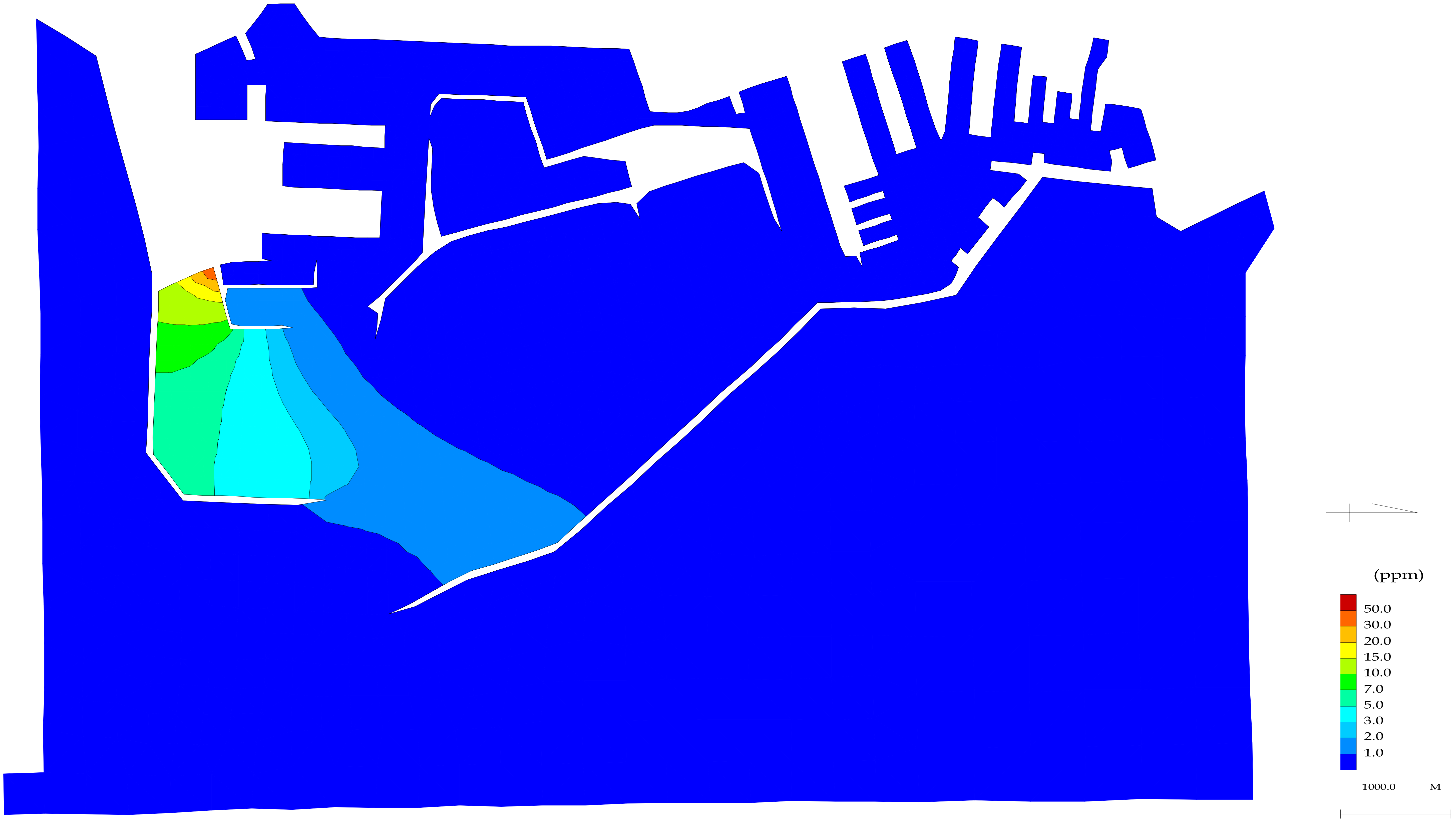
'Fig 3-4(2) Concentraion of SS (Case - 2.1 , 20 days)



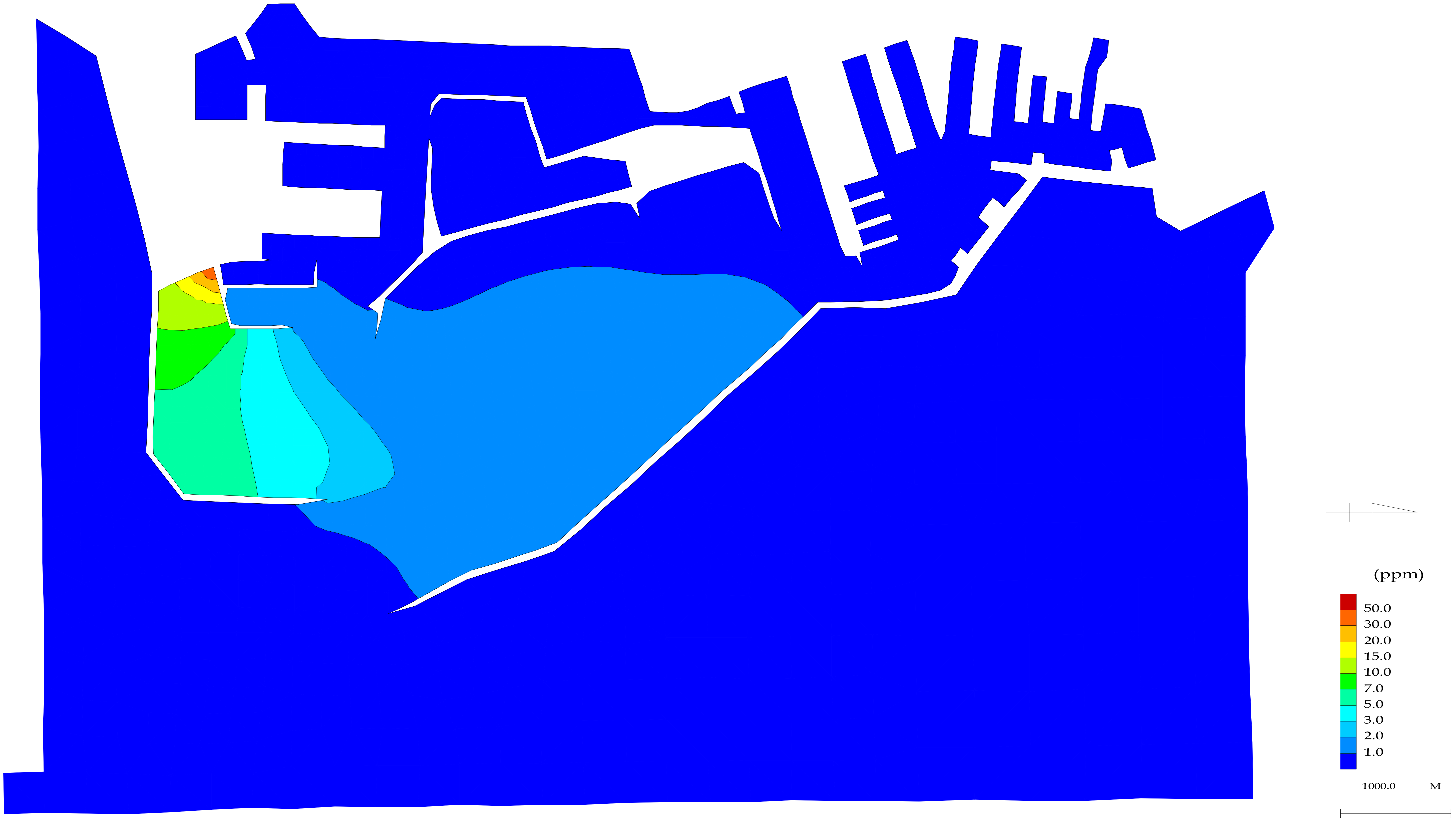
'Fig 3-4(3) Concentraion of SS (Case - 2.1 , 30 days)



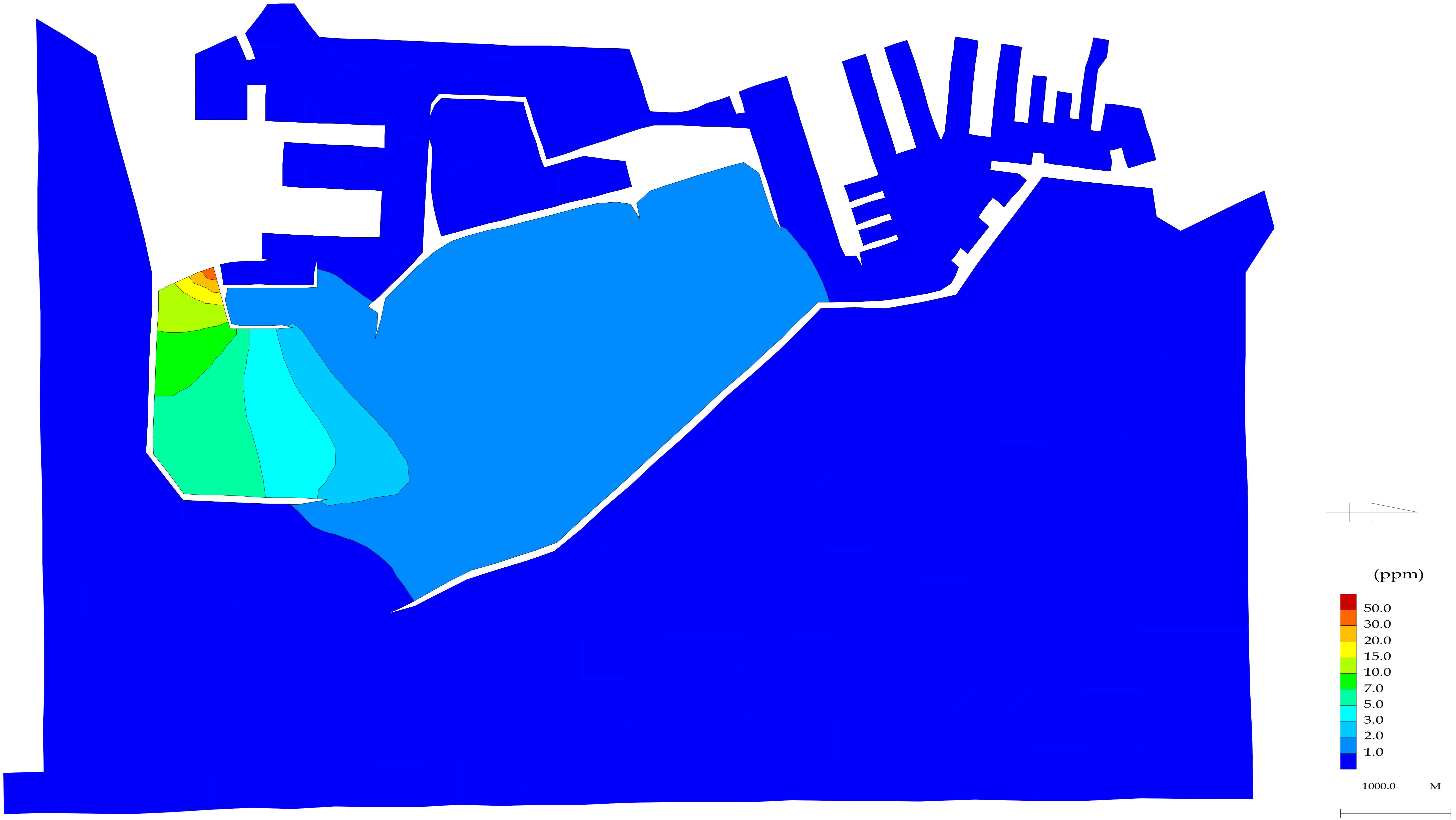
'Fig 3-4(4) Concentraion of SS (Case - 2.1 , 60 days)



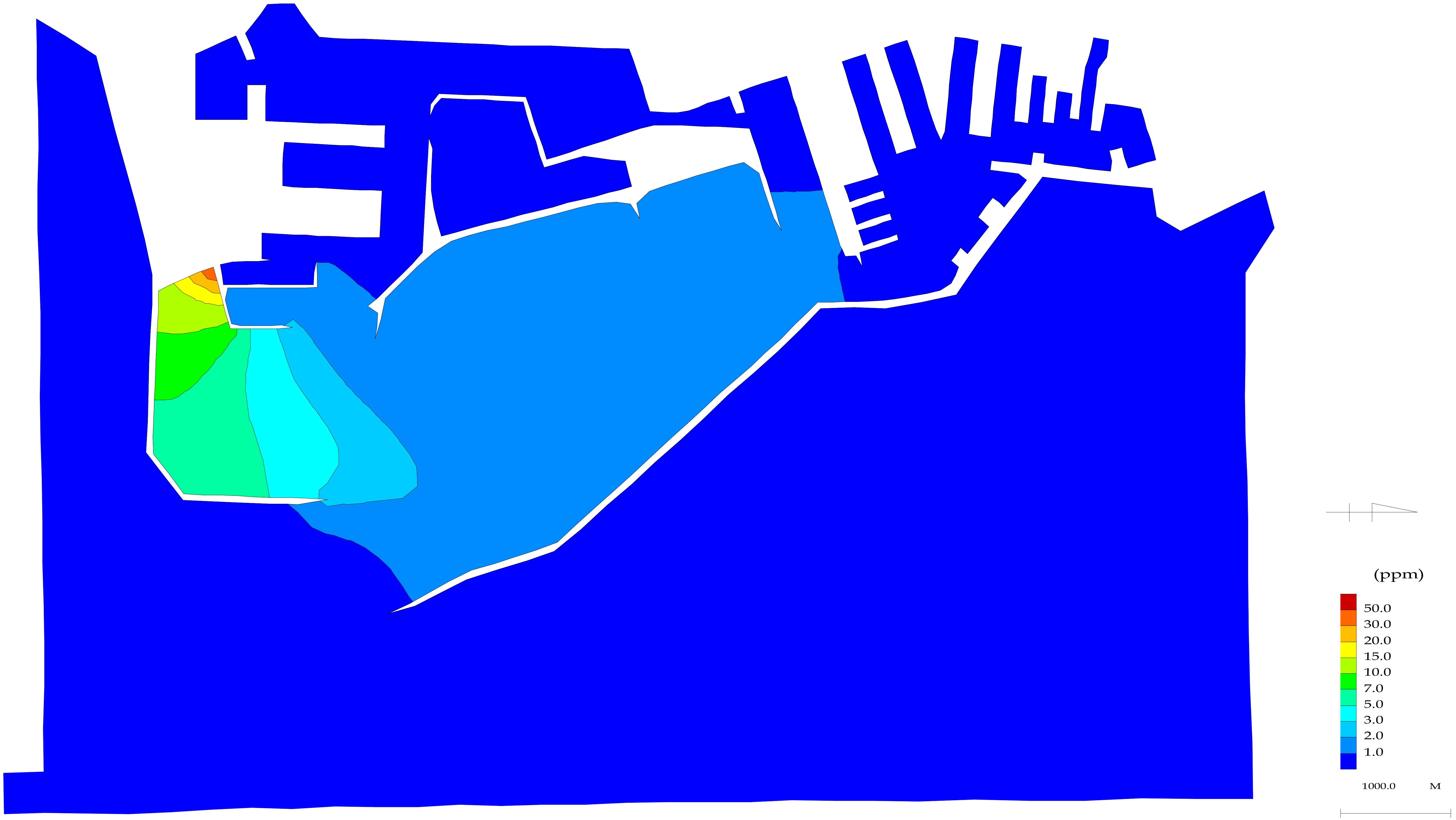
'Fig 3-5(1) Concentraion of SS (Case - 2.2 , 10 days)



'Fig 3-5(2) Concentraion of SS (Case - 2.2 , 20 days)



'Fig 3-5(3) Concentraion of SS (Case - 2.2 , 30 days)



'Fig 3-5(4) Concentraion of SS (Case - 2.2 , 60 days)

'Fig 3-6 Concentraion of COD (Case - 3.1)

Attachment to Appendix IIIB

Background Data of Environmental Water Quality Simulation

By (1) Reclamation Works and
(2) Grain Dust Segregation

For New Grain Terminal at Port of Constantza

Background Information for Environmental Simulation

1 : Reclamation Works

This section deals with the background data for the Environmental Simulation for the water changes by reclamation works.

(1) Source of Material

Following two sources are taken in account for reclamation materials.

- ✓ **Canal Bank Deposit-piling** **1.05 million m^3**
- ✓ **Port deepening dredging** **1.05 million m^3**
- ✓ **Total volume of earth** **2.10 million m^3**

Cost estimation for the grain terminal was carried out based on this assumption. If the port dredging material is not available at the proper time, all the earth could be carried from earth piled at the Canal Bank.

(2) Required Transport Capacity per Month: Q

For the evaluation of environmental impact of reclamation works, the required period of this reclamation is assumed of seven (7) and fourteen (14) months.

In case reclamation works in 7 months

Q = 2,100,000 / 2 /7
= 150,000 m^3/month

In case reclamation works in 14 months

Q = 2,100,000 /2 / 14
= 75,000 m^3/month

If the source is available only at the canal bank,

Q = 2,100,000 / 14
= 150,000 m^3/month

Thus the study will be carried out in 150,000 m^3/month removal from the canal bank.

(3) Study Conditions

- Carrying distance: 10km
- Navigation speed: 5knot in down, /8knot in up
- Loading earth at the canal bank: Buck hoe plus dumping-truck
- Unloading earth at the grain terminal site: Grab-backet
- No major navigation constrains

Cycle Time Estimation

- Navigation time of Barge
  Down to the site: 10km/(5knotx1.852km) = 1h 5minutes
  Up to canal site: 10km/(8knot x1.852km) = 40minutes

- Loading time(Buck hoe $2m^3$ and dumping-truck $10m^3$)
  $10m^3$ x 12trips = $120m^3$/h
  barge: $3,000m^3$ / $120m^3$/h = 25h

* Unloading at the grain terminal site by grab backet in $3m^3$:
  $3m^3$ x 0.9x 20cycles/h x 24h = $1,300m^3$/day one unit
  2units x $1,300m^3$/day one unit = $2,600m^3$/day two units
  $3,000m^3$ / $2,600m^3$ = 27h 40minutes

(4) Required Time and Capacity Estimation

The required time for one cycle (Canal bank to port site and up to canal bank)

1.	Berthing at canal bank	10 minutes
2.	Loading	25 hr 00 minutes
3.	De-berthing	10 minutes
4.	Sailing (loaded) to the terminal site	1 hr 5 minutes
5.	Berthing at grain terminal	10 minutes
6.	Unloading	27 hr 40 minutes
7.	De-berthing	10 minutes
8.	Sailing (empty) to canal site	40 minutes
	Total Required Time	55 hr 05 minutes

Estimated Work Progress

3,000m^3 of earth can be transported within 55 hr 05 minutes

3,000m^3 / (55 hr 05 minutes) x 24hr = 1,300m^3/day 1barge
1,300m^3/day 1 barge x 4 barge 5,200m^3/day 4 barge
5,200 m^3 /day 4 barge x 30 day = 156,000m^3/Month 4 barge :
Acceptable, since this is smaller than 150,000m^3/month
Required Equipment are shown as below List

1. Tug Boat 1,500HP 2 units
2. Barge 3,000m^3 4 units
3. Grub 3.0m^3 4 units
4. Buck hoe 2.0m^3 2 units
5. Dumping Truck 10m^3 6 units

Required Temporary Facilities will be as follows.

1. Temporary Jetty at loading site : 2 berths (L=150m/berth)
2. Silt Fence: Installation of submerged fence preventing the natural water from serious contamination.

(5) Considerations

Following consideration should be studied during detailed design stage.

a) According to the soil investigation results, earth for reclamation is containing a large number of silt and clay, earth after dumping to site will increase than original volume of canal site.
b) Leak of silt content to open sea can be mostly preventing by submerged silt fence locating outer outlet of the spill-way.
c) When dumping the earth to the grain terminal site, excess water will over-flow to the open sea. This water should goes out through the spill-way not over-flow the dike or similar.
d) Water content in dumped earth will vary by the construction equipment. Evaluation on the typical equipment for the earth dumping is made as follows:

Methods	Efficiency	Cost	Soil Improvement
Bottom-opining Barge	Best	Best	Fair
Back hoe	Good	Good	Good
Grab-bucket	Fair	Fair	Best

Note: Bucket should be opened near the sea bottom.

e) It is recommended to undertake the soil investigation when the reclamation works were completed in order to verify the soil condition and existence of soft layers.

(6) Dredging in the Port Area

The dredging and reclamation works will be undertaken simultaneously by the appropriate dredging machines, including a pump dredger of required capacity. The so estimated dredging volume per month, as needed for the works, will be estimated accordingly.

The total dredging volume will be estimated by the soil and area that is to be dredged, for example, by the existing fairway, or fairway extension and basin. According to the IPTANA' estimation there is about 1.1 m3 million in the port area to dredge the base rock.

(7) Soil Indicators

Soil conditions of canal bank are not known however it is assumed through the soil investigation data at the south port Piers I and II. The Study Team received various soil data which IPTANA carried out previously.

Refer to Table 1.1 for the geotechnical information at the grain terminal site.

Most sensitive aspect during the reclamation works is contamination of existing clean seawater by fine materials leaking from reclamation works, (under high SS contents). For this regards the content of fine materials (clay and silt) should be evaluated carefully.

As seen in the table, the fine materials are ranging between 48% to 61%.

Table 1.1 Assuming the Soil Character of Reclaiming Materials by Existing Soil Data

Case 1 Representing by Two Layers per Hole									
Hole		in m		Clay	Silt	Sand	Gravel	Cobbles	Notes
	Upper	Lower	Thick	%	%	%	%	%	
F4	0	3	3	54	18	23	5	0	
	3	11.5	8.5	31	22	24	23	0	
	11.5	14.5	3	44	24	20	11	1	
F5	0	4.1	4.1	44	49	7			
	4.1	5.2	1.1	42	52	6			
	5.2	10.2	5	12	18	50	20		
	10.2	13	2.8	22	52	26			
F6	0	4	4	42	51	7			
	4	7.5	3.5	24	35	23	18		
	7.5	13	5.5	44	46	10			
	Average		28.1	33	31	23	13	0	100
Case 1 Representing by One Layer per Hole									
F4	0	3	3	54	18	23	5	0	
	3	11.5	8.5	31	22	24	23	0	
	11.5	14.5	3	44	24	20	11	1	
F5	0	4.1	4.1	44	49	7			
	4.1	5.2	1.1	42	52	6			
	5.2	10.2	5	12	18	50	20		
	10.2	13	2.8	22	52	26			
F6	0	3.5	3.5	42	51	7			
	3.5	7.5	4	24	35	23	18		
	7.5	13	5.5	44	46	10			
			17.5	24	24	31	21	0	100

Notes
1 All boring holes are located at the reclaimed land at the South Pier No.3.
2 Depth of layer are corresponding only to reclaimed materials.
3 These borings were carried out druing the detailed design of container terminal S2.

2 Environmental Simulation (1): Water Quality Simulation by Reclamation Works

(1) General Description

It is recommended to undertake simulation analysis on the water quality, SS distribution by the reclamation works. Soil condition is based on the recently surveyed data as seen in the previous subsection.

Total reclamation volume is about 2million m^3.

In order to select the most suitable reclamation period, two case, namely seven months and 14 months are used for simulation.

Refer to detailed data in **Appendix III B.**

(2) Estimation of the Fine Material Contents

Estimation of the Fine Material Contents during the reclamation works is carried out in order to undertake the water quality simulation.

<u>Estimation of Discharge Volume of High Fine Material</u>

a) Density of Discharge through spillway: D

Assuming D = 5,000ppm of fine materials

b) Volume of Fine Material Discharging: Vf

Vf = V x Ca x Cb x Cc m^3

Where, V: Total Reclamation volume: 2,000,000m^3
Ca: Average fine contents (clay and silt content) of reclamation soil: 25% plus 25%
Cb: Separation rate of fine materials from mother soil by transportation: 5% (grab) to 50% (pump) taking 20%
Cc: Reduction rate by construction method: 10% (chemical additive spillway) to 50% (Simple dike or mole taking 30%

Thus,

Vf = V x Ca x Cb x Cc

= 2,000,000 x 0.50 x 0.20 x 0.30

= 2,000,000 x 0.030

= 60,000 m^3

c) Daily Fine Material Discharging: Df

In case of Reclamation Period: T, seven months or 210 days.

Df7 = Vf / T7

= 60,000 / 210

= 285.7 m^3/day

In case of Reclamation Period: T, 14 months or 420 days.

Df14= Vf / T14

= 60,000 / 420

= 142.9 m^3/day

d) Daily Total Volume Discharging: Dd

In case of seven months reclamation,

Dd7 = Df7 / D

= 285.7 / 0.005

= 57,140 m^3 say 60,000 m^3

In case of 14 months reclamation,

Dd14= Df14 / D

= 142.9 / 0.005

= 28,580 m^3 say 30,000 m^3

e) Thus, 30,000 m^3 to 60,000 m^3 of high SS water (5,000) will be daylily discharged for 14 month reclamation or seven month reclamation respectively. According to the results of simulation, 14 month reclamation is recommended in order to maintain environmental impact by the project minimum.

3 Environmental Simulation (2): Water Quality Simulation by Segregated Grain Dust

This section deals with estimation of littering grain dusts out of covered equipment to be installed in the proposal new Grain Terminal of two million tons capacity.

(1) Basic Conditions

1） Belt Conveyor Capacity: 2 units x 800t/hour
2） Objective Grain: Wheat, Maize, in 50%50%
3） Mainly, for Exports
4） Silo capacity in 100,000 tons
5） Annual Handling Capacity：2,000,000 tons
6） Loader on the Quay: 2units x 800/hour
7） Size of Vessel:10,000 DWton to Panamax, 60,000DWton
8） Average berth occupancy rate: about 50%

（2） Daily Average Original Grain Dust: Lo

Lo＝A x 2000,000 / 365
=5479 A ton/day

Where:

A: Rate of dust contain assuming 0.1% to 0.5%

Source：Oklahoma State University ; Preventing Grain Dust Explosions, P-2

Lo=5479x 0.001 to 5479x 0.005
=5.48 ton/day to 27.4 ton/day
or =5,480 kg/day to 27,400 ｋg/day

(3) Rate of Dust Segregation by Transport Distance

1） Belt Conveyor at 100m long a day：ｂ, (1 % to 5% , average ３%)

ｂ＝3% /100m day

2） In the Vessel hold ：ｈ

It is assume that one loader generates the same dust by 1000m long of Belt Conveyor：Dd

ｈ=3% /day.unit

（4） Rate of Daily Dust Segregation without Dust Protection: D

Lb: Belt Conveyor Length about 500m

D＝Lb/100 ｘ b ＋ 2units ｘ h
=500m/100 x 3%/100m.day ＋ 2units x 3%/day.unit
=15%/day + 6%/day
=21%/day

(5) **Daily Dust Segregation without Dust Protection:** Ld

Ld=Lox Dx Cx W

Where:

Ld: Daily Dust Segregation without Dust Protection

Lo: Daily Average Original Grain Dust、 5480kg/day to 27,400kg/day

D: Rate of Daily Dust Segregation without Dust Protection: 21%/day

C: Covering ratio： C1：No covering 1.00、C2：50% covering 0.50, C3：Closing 0.10

W：Oiling / Watering for dust preventing：W1 ：None=1.00、W2：50%=0.６0, W3： Opt.=0.30

Ld=(5480 to 27400) x 21% x C x W

=(1151 to 5754) x C x W kg/day

(6) Dust Generating Volume Difference by Covering Ratio

1) Dust Generation : No cover and no oiling /watering

Ld=(1151 to 5754) x C x W

＝(1151 to 5754) x 1.00 x 1.00

＝ 1151 to 5754 kg/day

＝ 3.45 t/day average

2) Dust Generation : 50% cover and random oiling /watering

Ld=(1151 to 5754) x C x W

＝(1151 to 5754) x 0.50 x 0.60

＝ 345 to 1726 kg/day

＝ 1.04 t/day average

3) Dust Generation : Good cover and good oiling /watering

Ld=(1151 to 5754) x C x W

＝(1151 to 5754) x 0.10 x 0.30

＝ 35 to 174 kg/day

＝ 0.10 t/day average

(7) Selection of Dust Level to the Water Quality Simulation

Equipment design of the project is undertaken with condition of "Good cover and good oiling /watering", thus the estimated dust separation by that is to be 0.1 ton a day. However, simulation analysis is carried out with the worst condition " No cover and no oiling /watering ". One ton a day of dust was inputted in the water quality simulation.