ICZM in a climate change perspective

Important issues for the Baltic Sea

Lubiatowo, June 2008

RESEARCH AND ENGINEERING FOR ICZM IN POLAND

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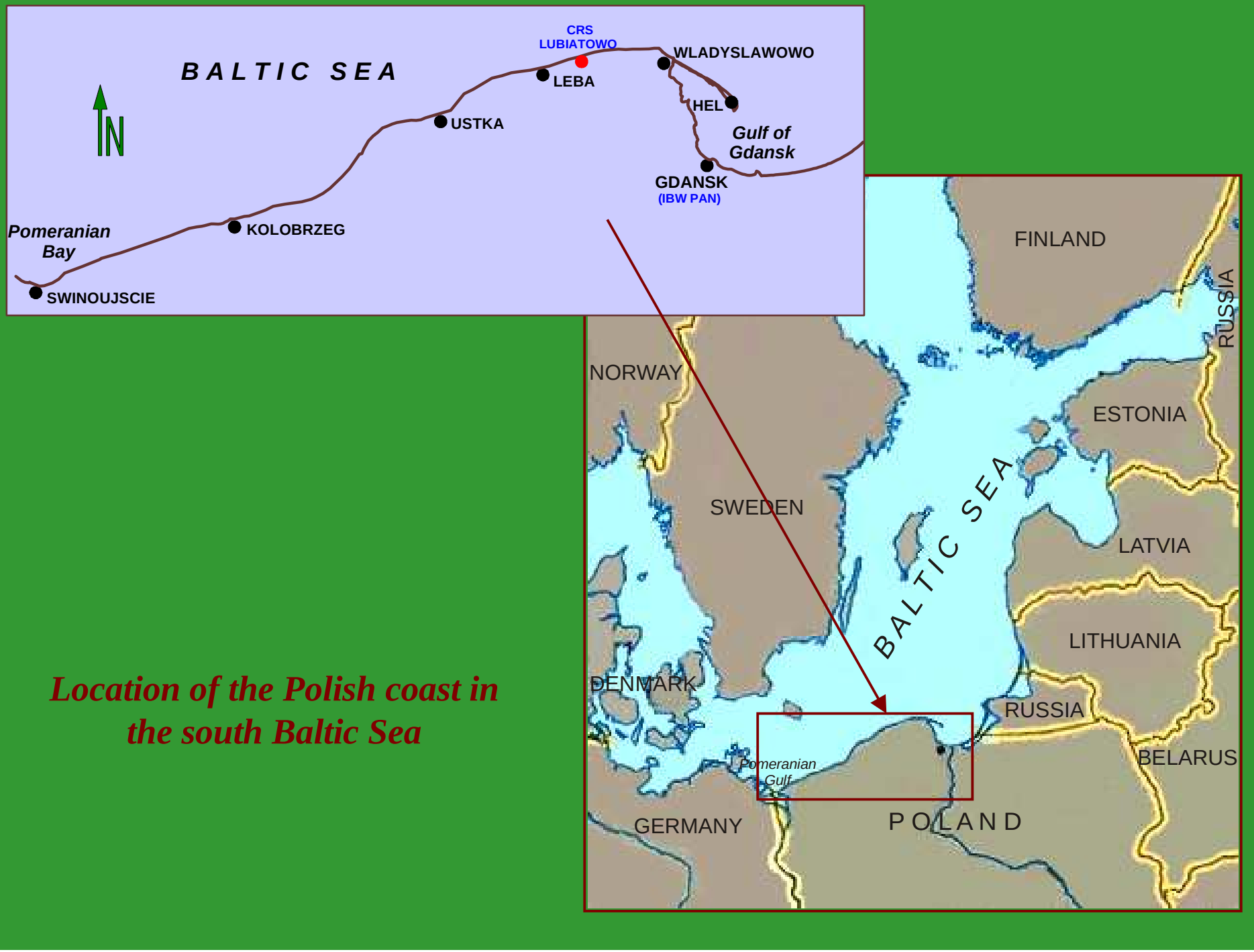
Act of Parliament of Republic of Poland (28 March 2003) on establishment of long-term 'Coastal Protection Programme'

- *protection of sea coast against erosion*
- *implementation 2004-2023*
- *stabilization of shoreline position according to configuration in year 2000 and prevention of beach loss*
- *monitoring of the coast and research activities aimed at determination of current condition of the coast in order to indicate necessary measures aimed at the rescue of sea coast*
- *responsibility for supervision (Ministry) and implementation (Maritime Offices)*
- *allocation of funds*
- *determination of protective methods (beach fills, modernization of shore protection structures, erection of new structures, cliff drainage)*
- *distribution of awarded funds along the coast*

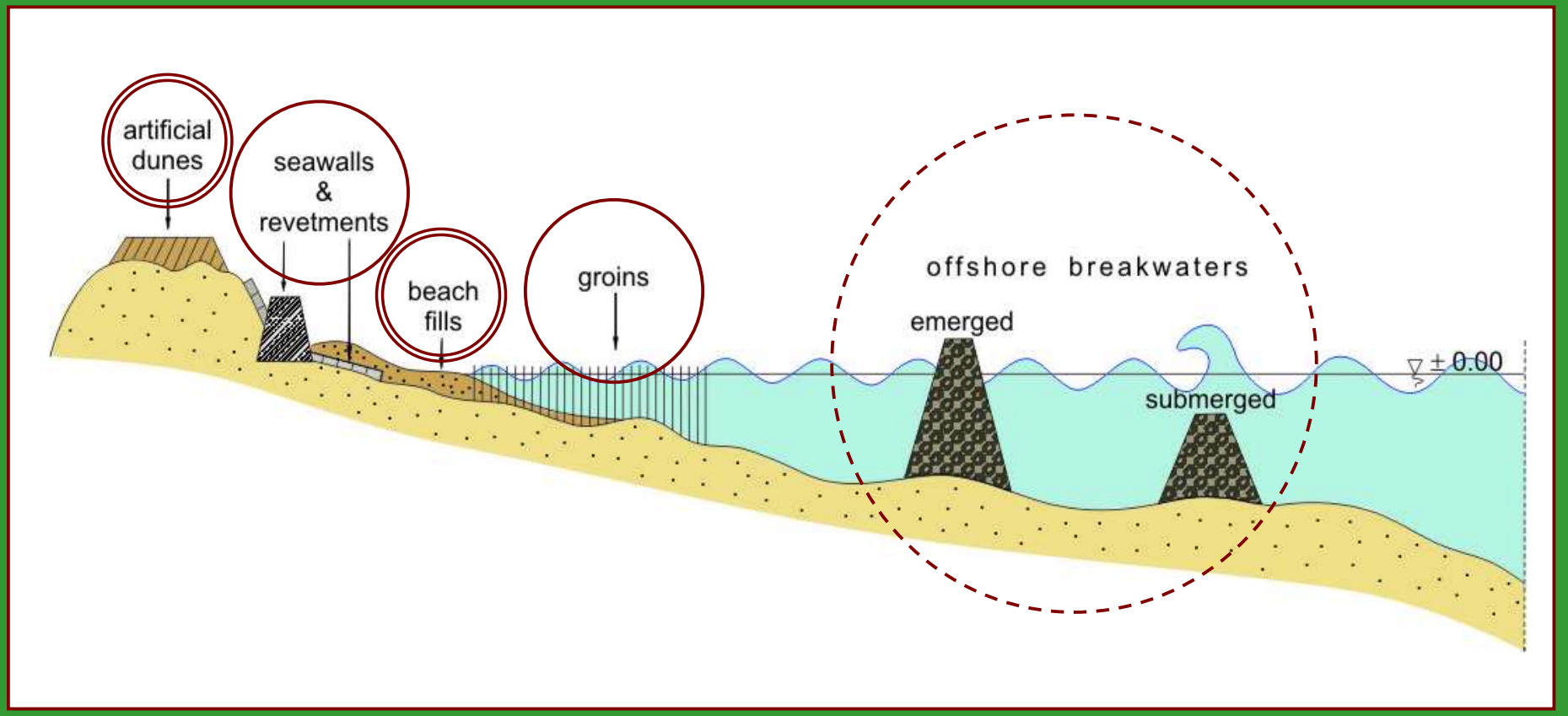
Governmental Directive (29 April 2003) on determination of the width of the coastal technical/protective belt

- *definition of the technical belt width for shore segments*
  - *a) with dunes*
  - *b) with cliffs*
  - *c) without dunes or cliffs*
  - *d) built up by coastal structures*



Location of the Polish coast in the south Baltic Sea

Erosive and flooding threats on Polish coast



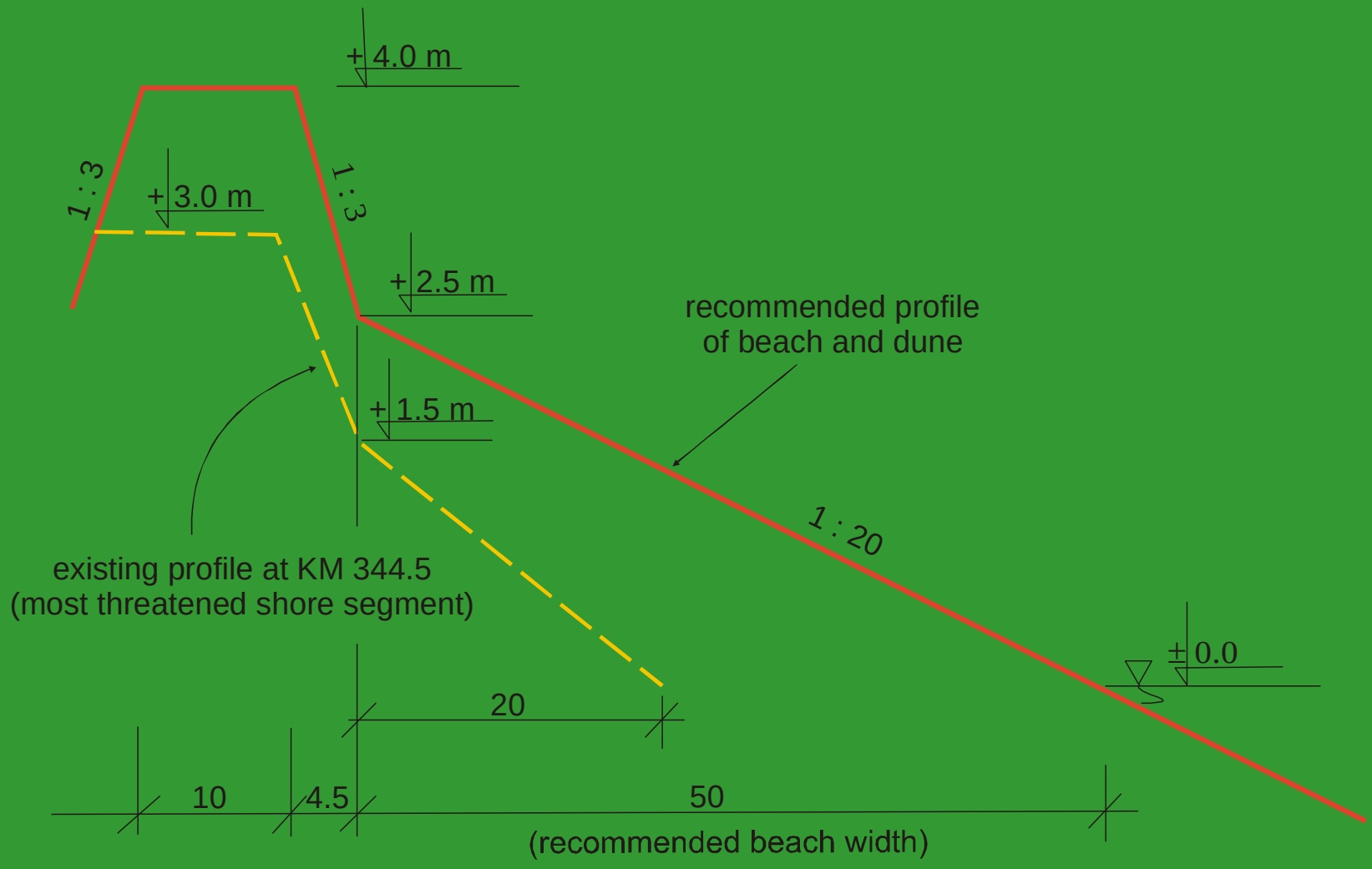
Types and locations of shore protection structures

Eroded ...

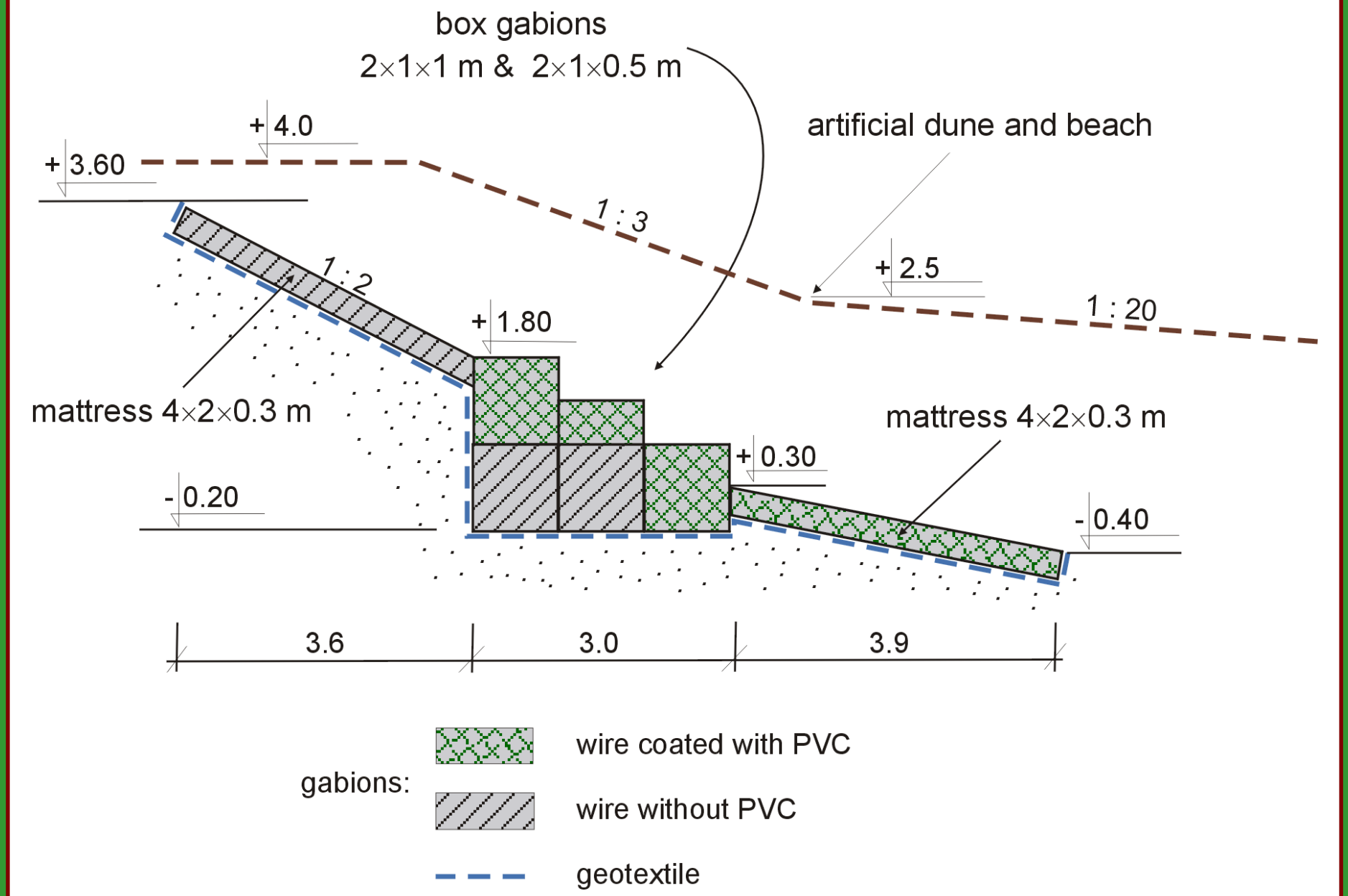
... and protected cliff

at Rozewie

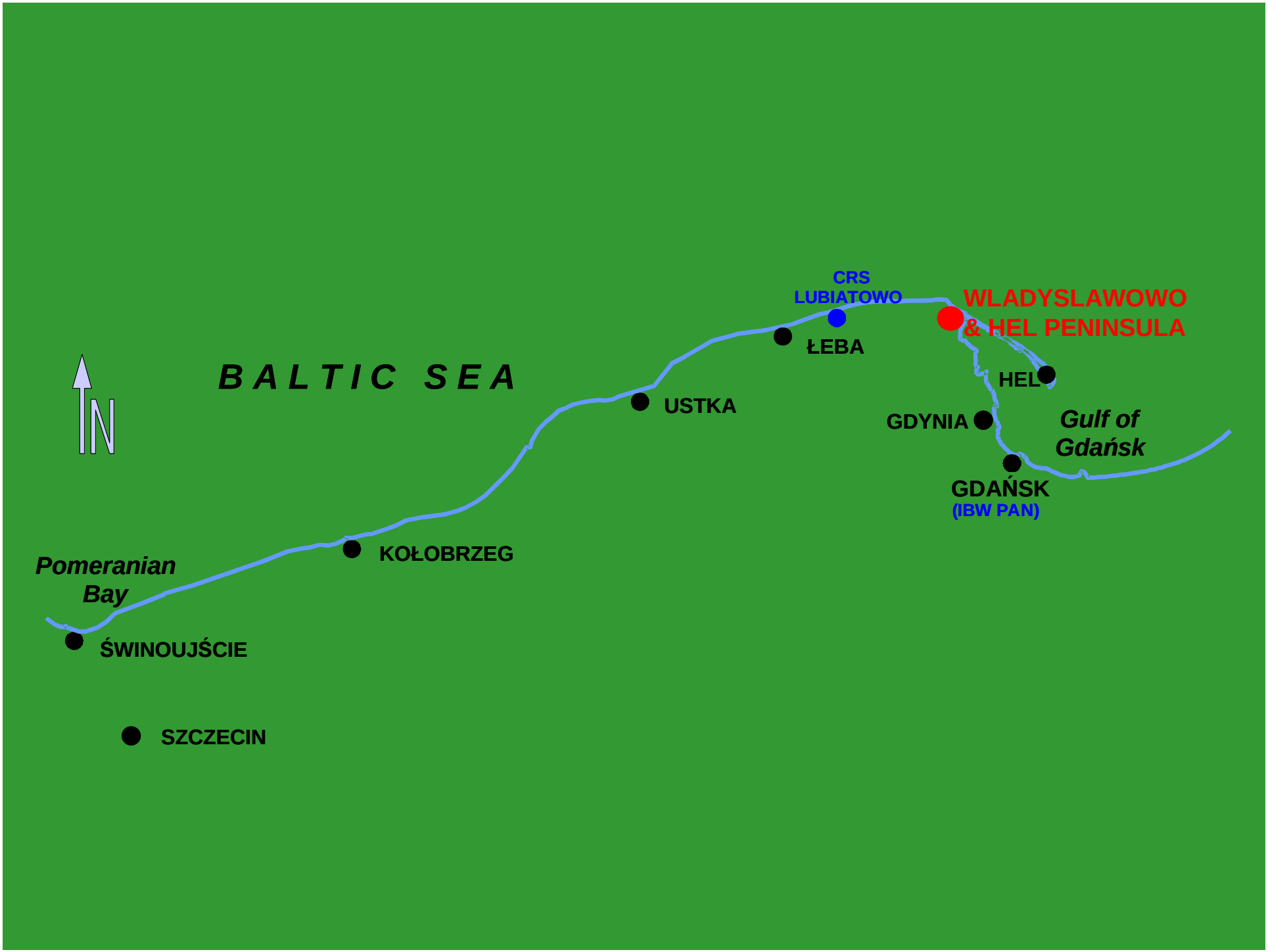
Beach disappearance due to hard structures, Ustronie Morskie



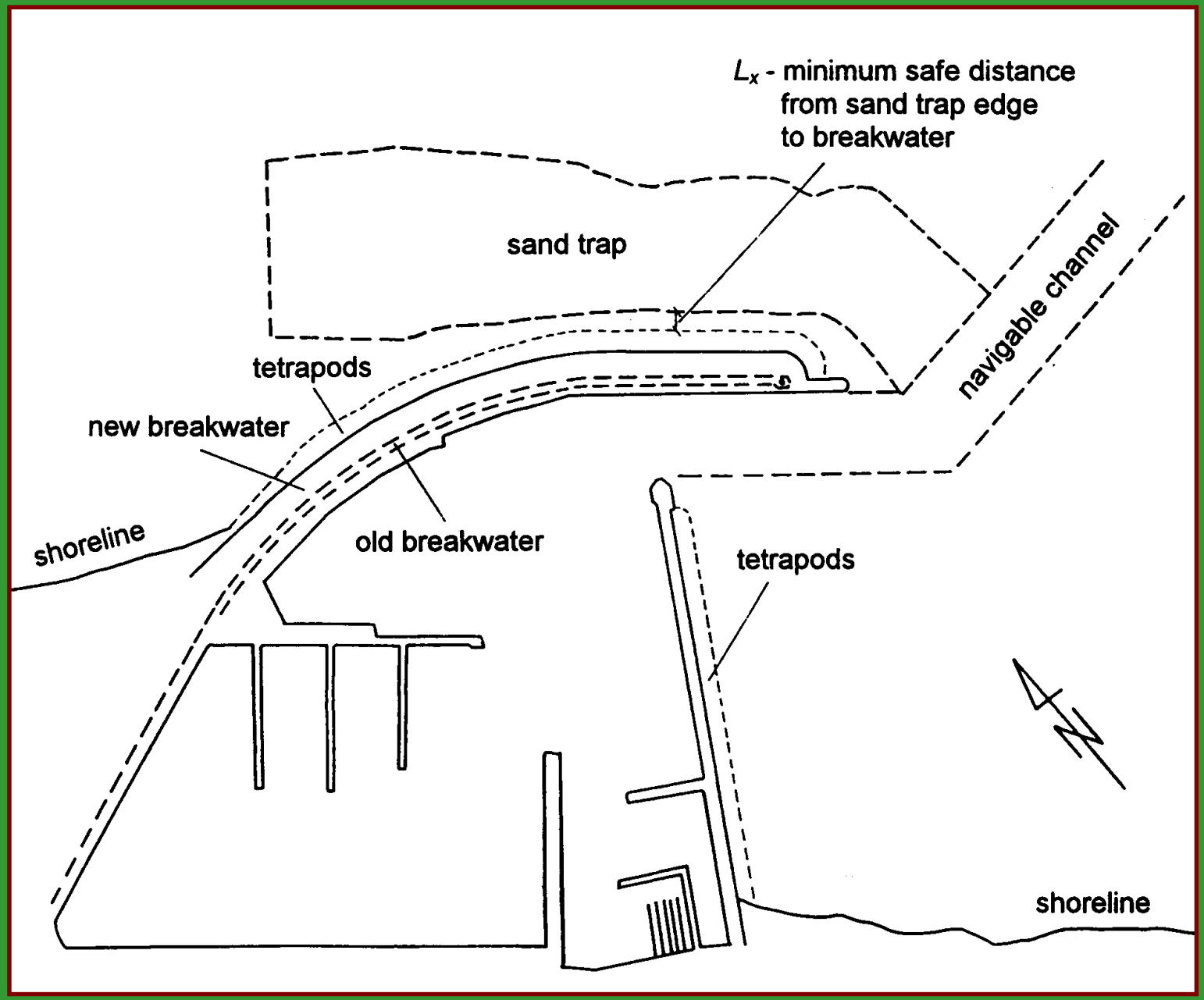
Recommended profile of artificial dune and beach



Gabion revetment built into artificial dune


CRS
LUBIATOWO
WLADYSLAWOWO
& HEL PENINSULA
ŁEBA
HEL
BALTIC SEA
N
USTKA
GDYNIA
Gulf of
Gdańsk
GDAŃSK
(IBW PAN)
KOŁOBRZEG
Pomeranian
Bay
ŚWINOUJŚCIE
SZCZECIN

Władysławowo harbour: accretion on west side (bottom), lee side protected by groins and beach fills (top left hand side)

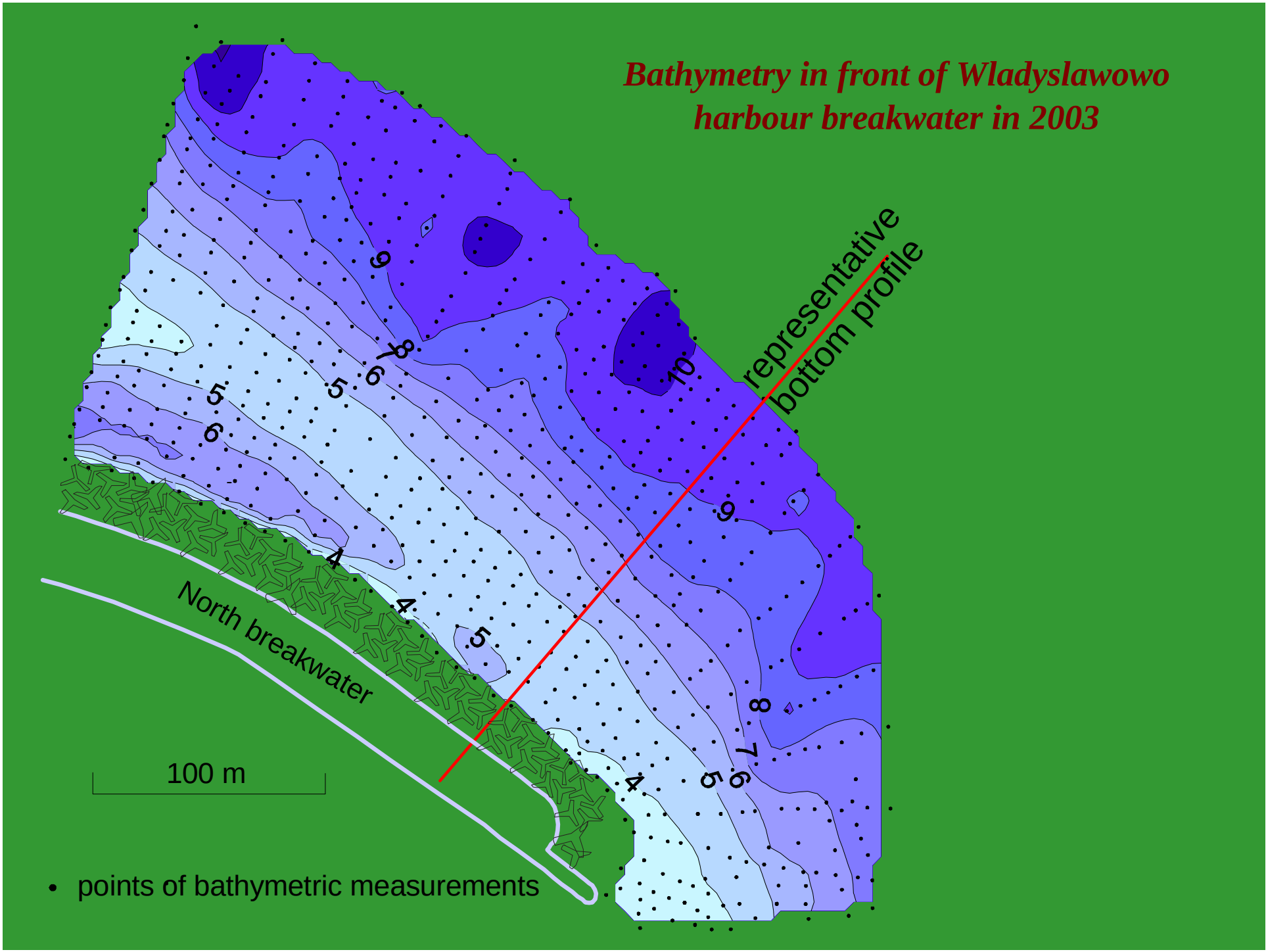


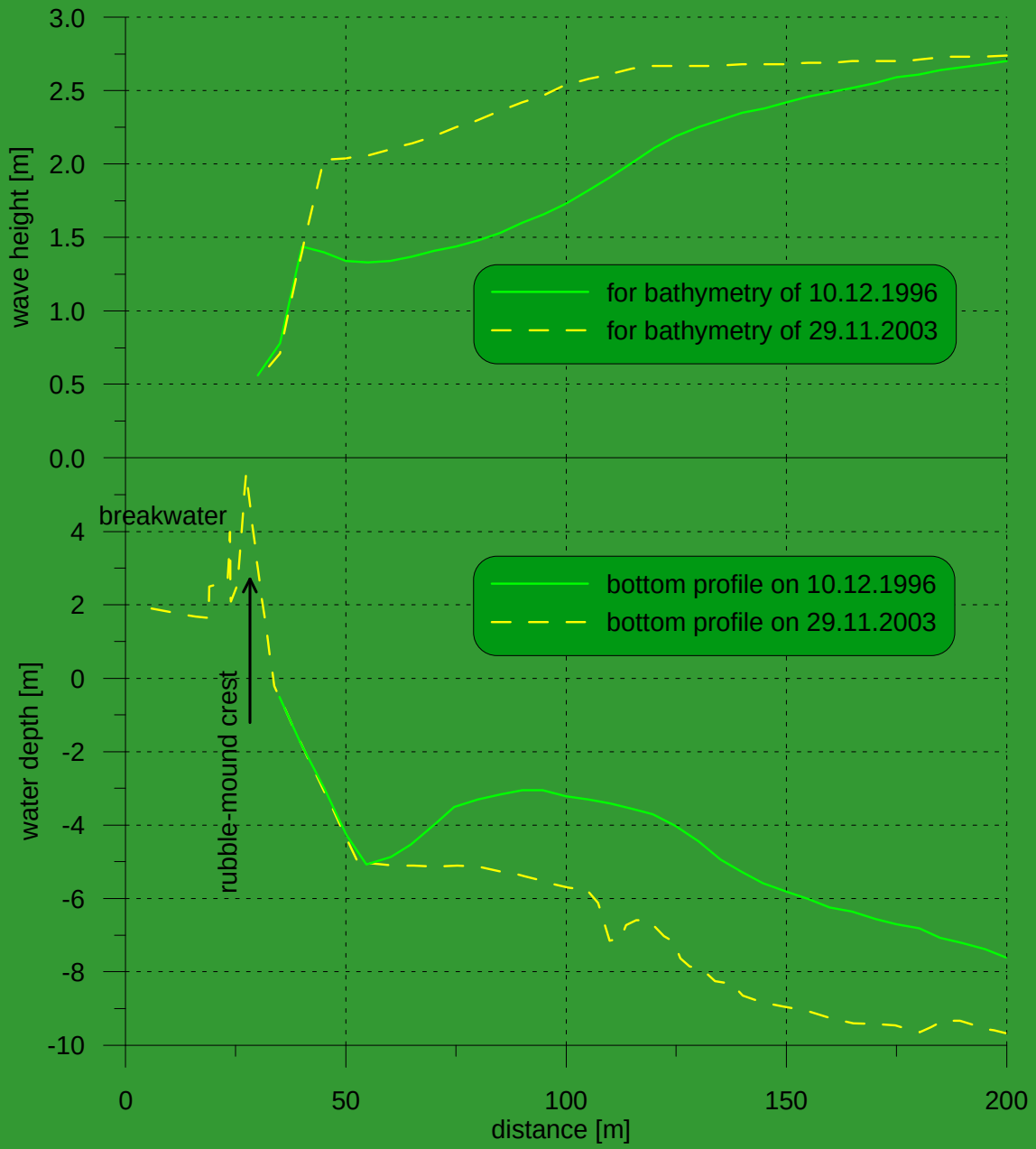
Sand trap at Wladyslawowo harbour

Artificial beach nourishment at Hel Peninsula

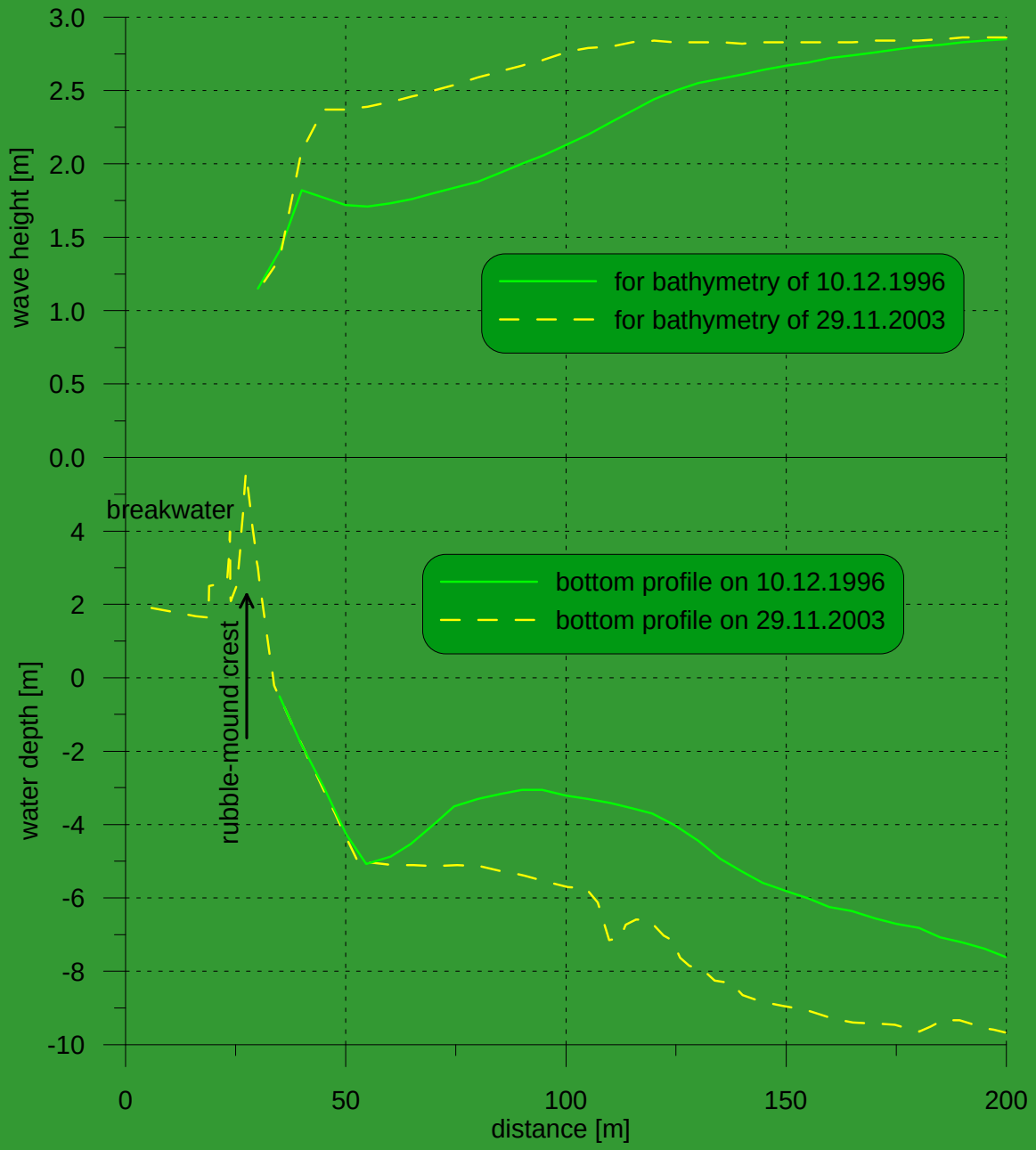
Failure of breakwater armour made of tetrapods

Reconstruction of armour at Wladyslawowo harbour breakwater in September 2003

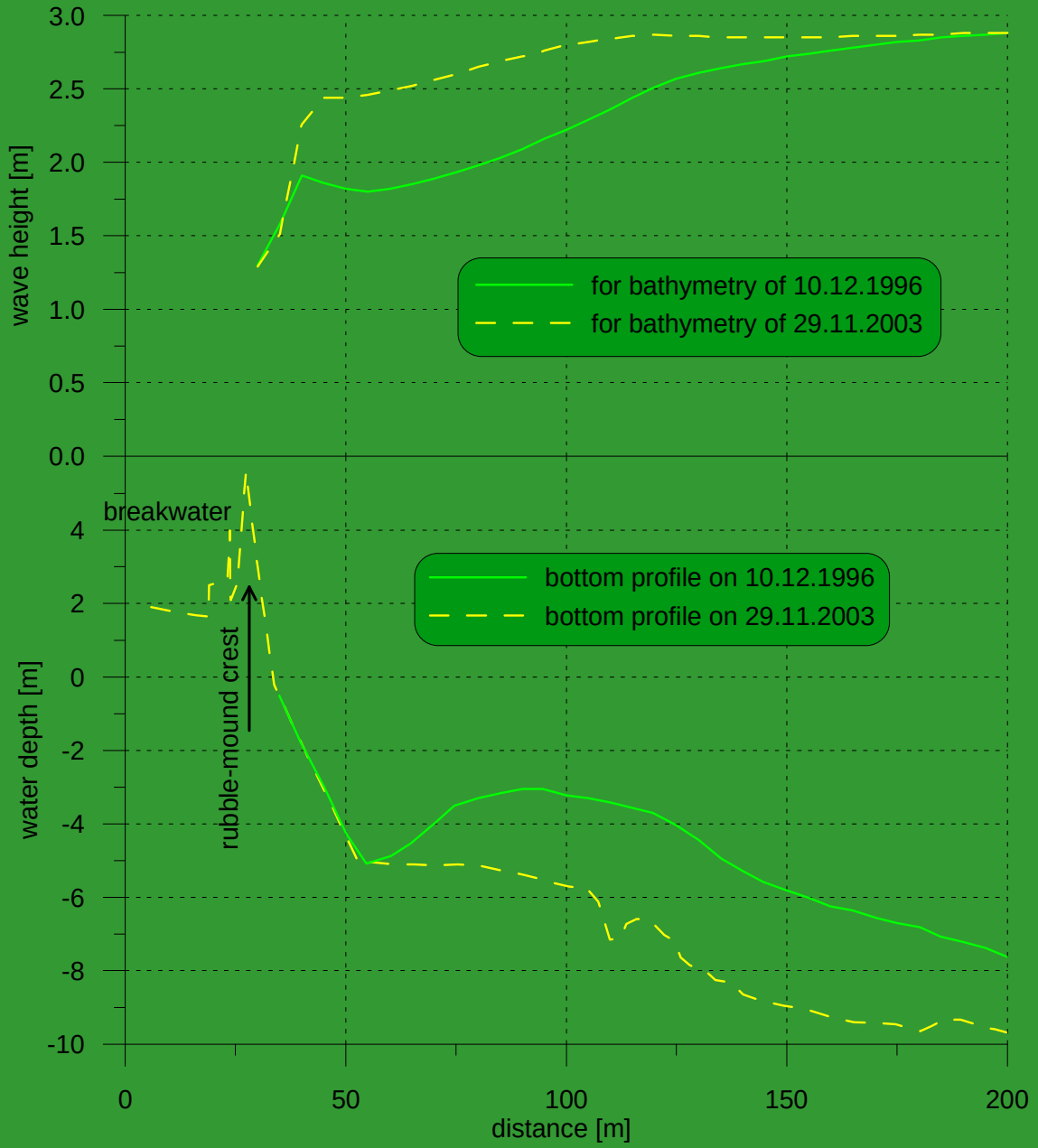

Bathymetry in front of Wladyslawowo harbour breakwater in 2003
representative bottom profile
North breakwater
100 m
• points of bathymetric measurements



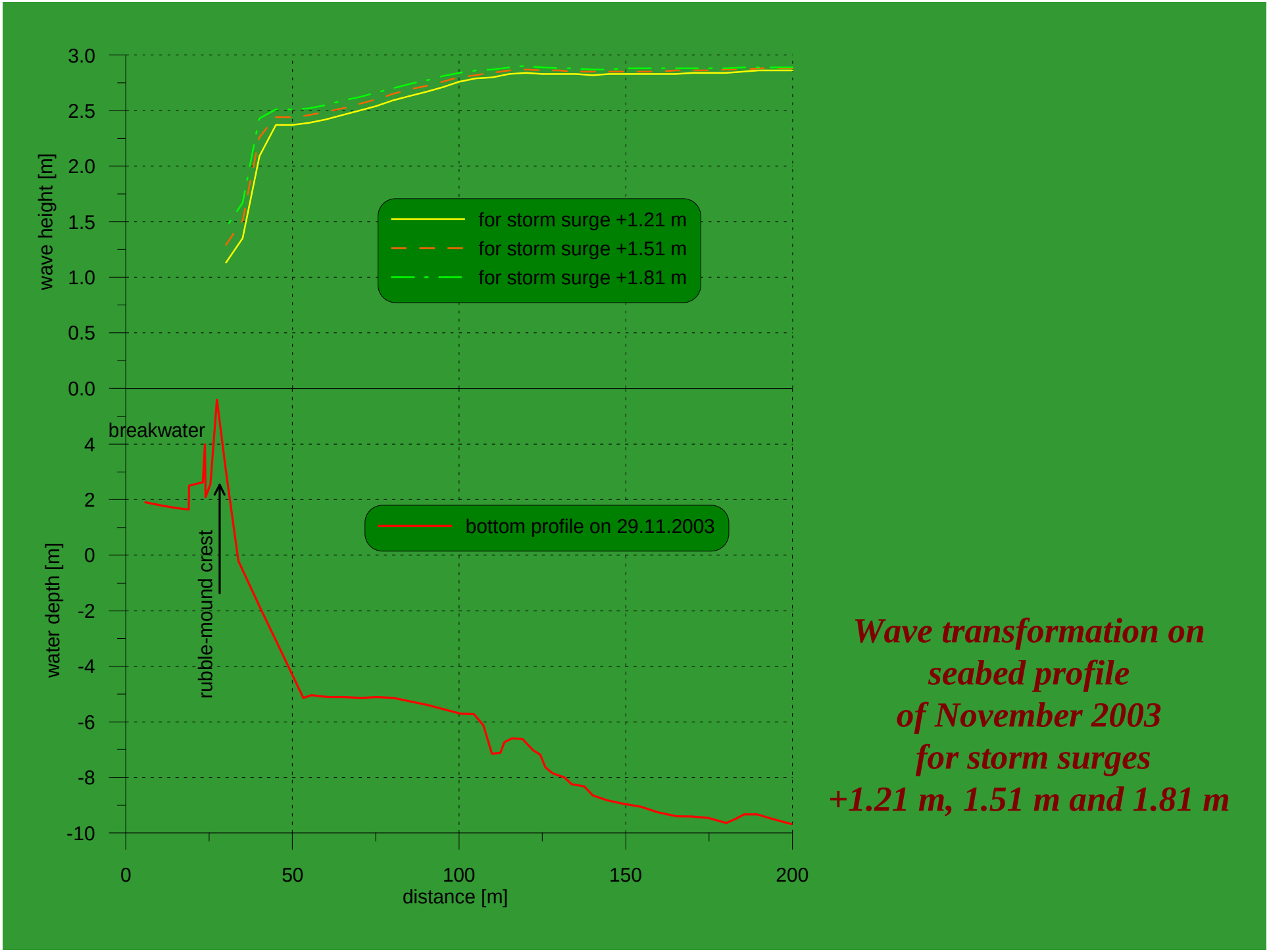
Wave transformation on seabed profiles of December 1996 and November 2003 for normal water level



Wave transformation on seabed profiles of December 1996 and November 2003 for storm surge +1.21 m



Wave transformation on seabed profiles of December 1996 and November 2003 for storm surge +1.51 m



Wave transformation on seabed profile of November 2003 for storm surges +1.21 m, 1.51 m and 1.81 m

Shore Protection Manual, Vol. II

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot \theta}$$

where

W = weight in pounds of an individual armor unit in the primary cover layer. (When the cover layer is two quarry stones in thickness, the stones comprising the primary cover layer can range from about 0.75 W to 1.25 W with about 75 percent of the individual stones weighing more than W. The maximum weight of individual stones depends on the size or shape of the unit. The unit should not be of such a size as to extend an appreciable distance above the average level of the slope.)

w_r = unit weight (saturated surface dry) of armor unit, lbs./ft.^{3},

H = design wave height at the structure site in feet. (See Section 7.372.),

S_r = specific gravity of armor unit, relative to the water at the structure, ($S_r = w_r/w_w$),

w_w = unit weight of water, fresh water = 62.4 lbs./ft.^{3}, sea water = 64.0 lbs./ft.^{3},

θ = angle of structure slope measured from horizontal in degrees,

and

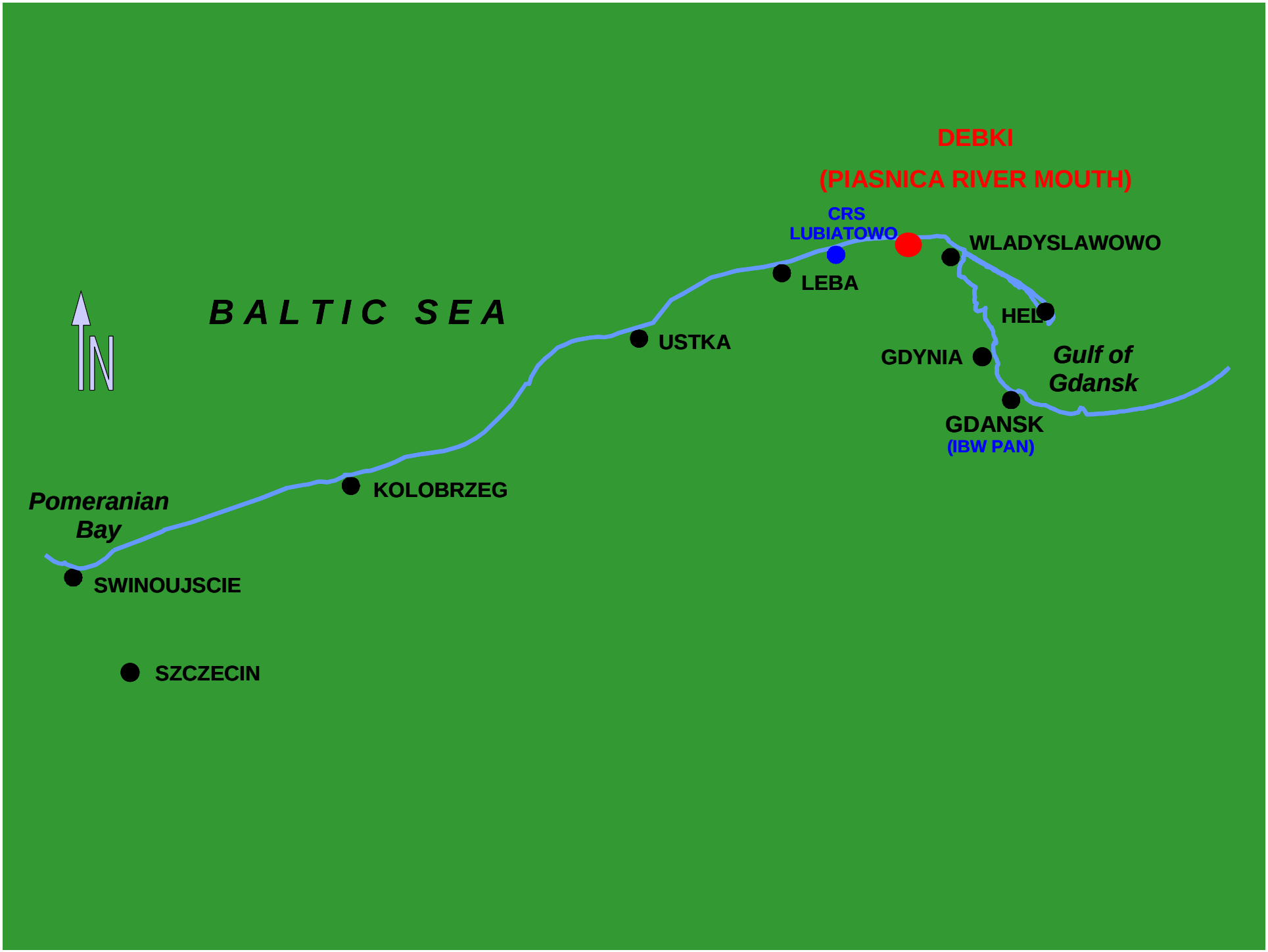
K_D = stability coefficient that varies primarily with the shape of the armor units, roughness of the armor unit surface, sharpness of edges and degree of interlocking obtained in placement. (See Table 7-7.)

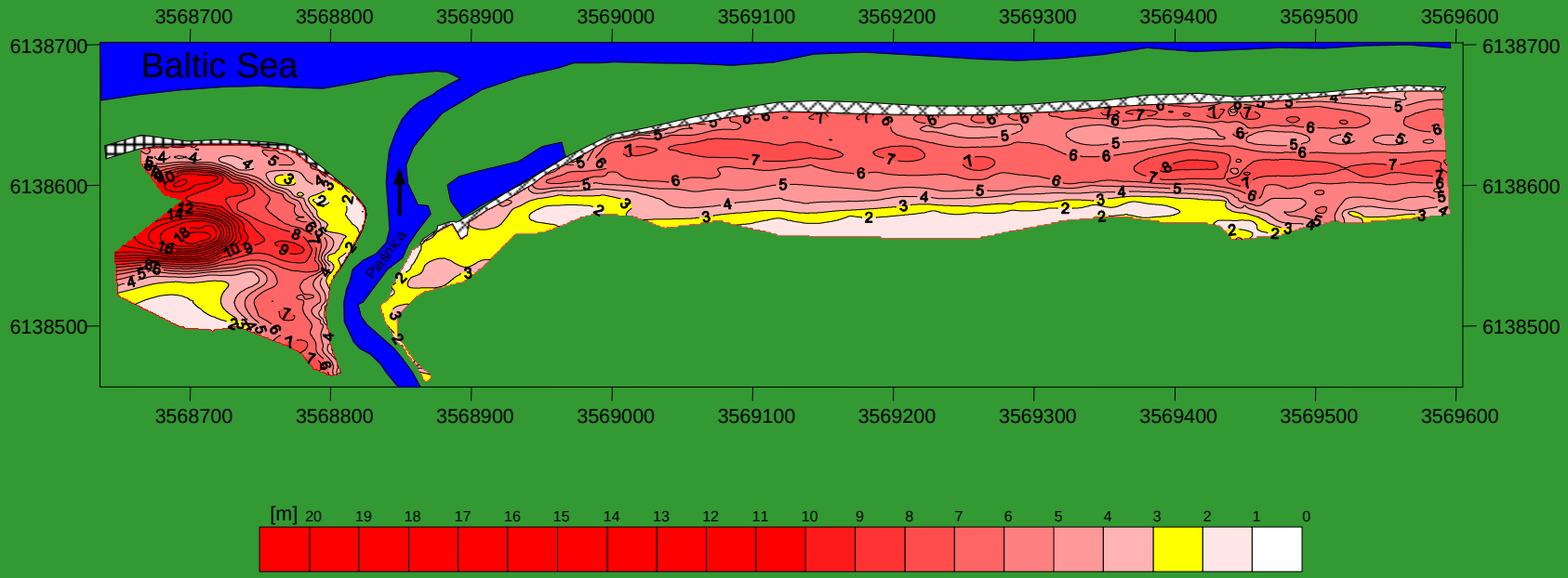
Table 7-7. Suggested K_D Values for Use in Determining Armor Unit Weight

No-Damage Criteria and Minor Overtopping							
Armor Units	n *	Placement	Structure Trunk		Structure Head		
			K_D §		K_D		Slope
			Breaking wave	Nonbreaking wave	Breaking wave	Nonbreaking wave	cot θ
Quarrystone							
Smooth rounded	2	random	2.1	2.4	1.7	1.9	1.5 to 3.0
Smooth rounded	>3	random	2.8	3.2	2.1	2.3	‖
Rough angular	1	random †	†	2.9	†	2.3	‖
Rough angular	2	random	3.5	4.0	2.9 2.5 2.0	3.2 2.8 2.3	1.5 2.0 3.0
Rough angular	>3	random	3.9	4.5	3.7	4.2	‖
Rough angular	2	special ‡	4.8	5.5	3.5	4.5	‖
Tetrapod and Quadripod	2	random	7.2	8.3	5.9 5.5 4.0	6.6 6.1 4.4	1.5 2.0 3.0
Tribar	2	random	9.0	10.4	8.3 7.8 7.0	9.0 8.5 7.7	1.5 2.0 3.0
Dolos	2	random	22.0	25.0	15.0 13.5	16.5 15.0	2.0 ¶ 3.0
Modified Cube	2	random	6.8	7.8	—	5.0	‖
Hexapod	2	random	8.2	9.5	5.0	7.0	‖
Tribar	1	uniform	12.0	15.0	7.5	9.5	‖
Quarrystone (K_{RR}) Graded angular	–	random	2.2	2.5			

Sea level	*H* [m]	Mass* [kg]
Extreme 20-year storm surge (+1.21 m)	4.65	~8000
Extreme 20-year storm surge + anticipated sea level rise by 0.3 m (+1.51 m)	4.76	~8600
Extreme 20-year storm surge + anticipated sea level rise by 0.6 m (1.81 m)	4.88	~9250

* originally designed as 5000 kg

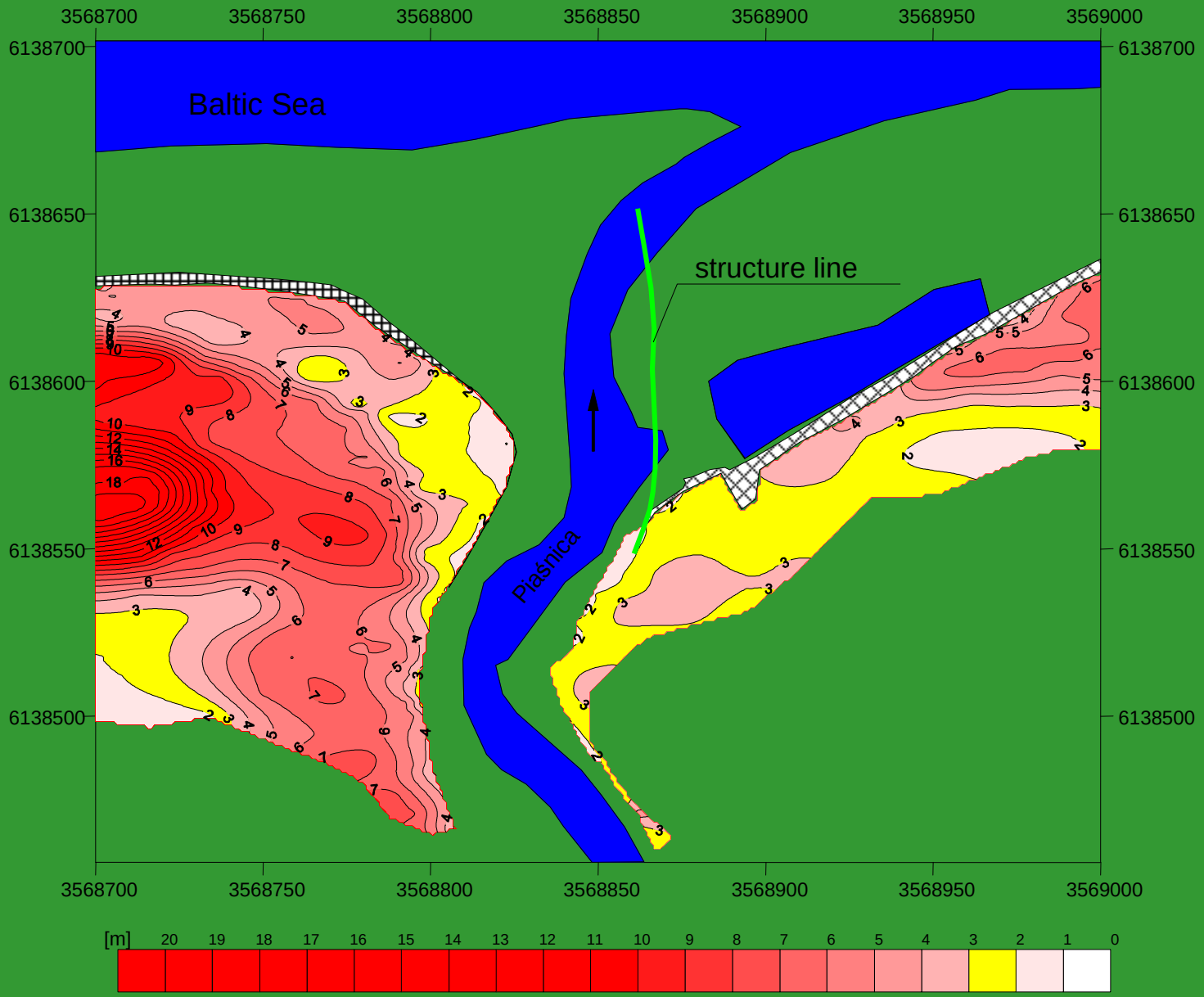

DEBKI
(PIASNICA RIVER MOUTH)
CRS
LUBIATOWO
WLADYSLAWOWO
LEBA
HEL
BALTIC SEA
N
USTKA
GDYNIA
Gulf of
Gdansk
GDANSK
(IBW PAN)
KOLOBRZEG
Pomeranian
Bay
SWINOUJSCIE
SZCZECIN



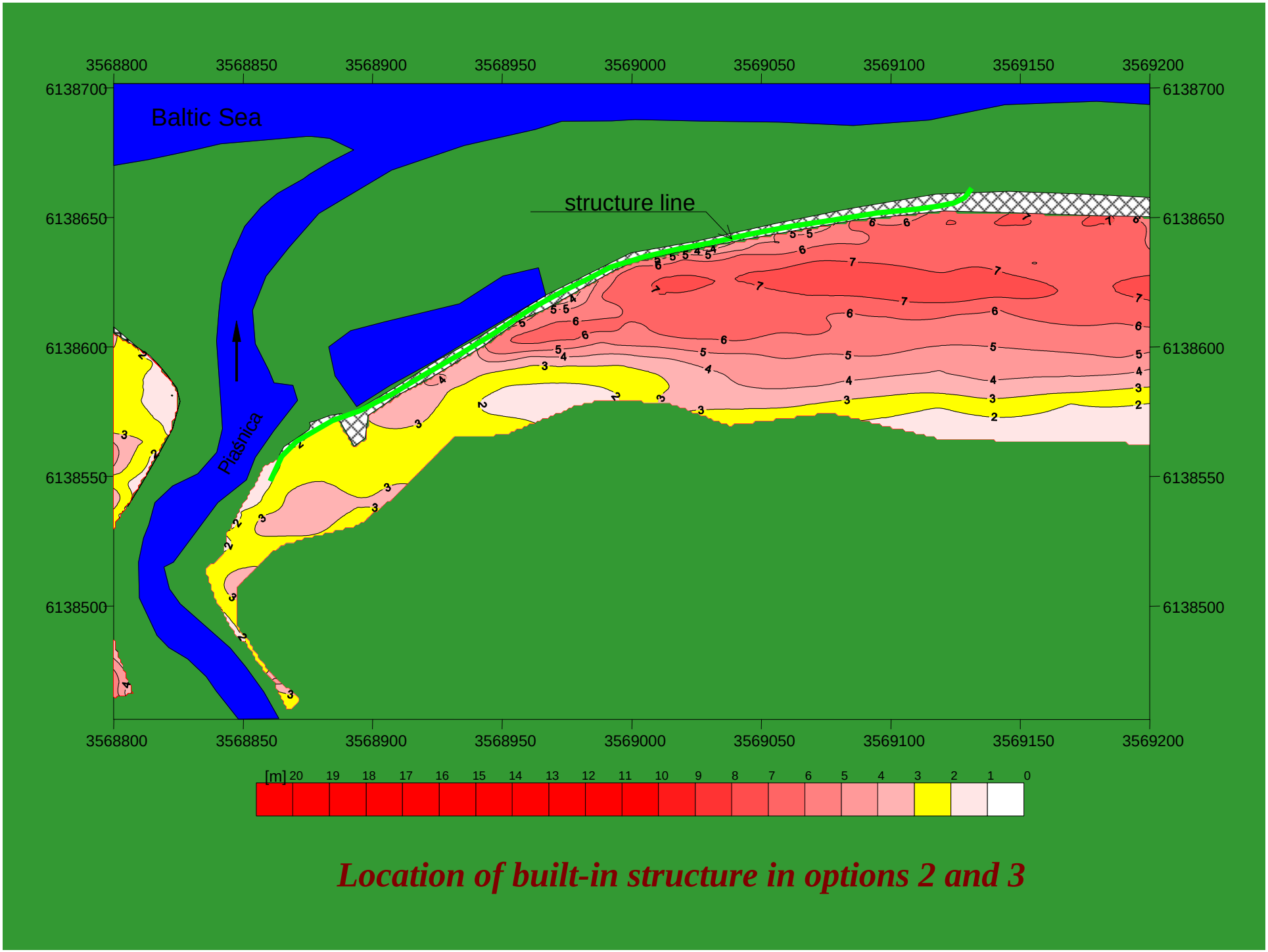
Piaśnica river mouth in February 2008

Storm surge in Nov. 2004, photo by W. Lipiec (after Basiński, 2007)

Storm surge in Nov. 2004, photo by W. Lipiec (after Basiński, 2007)



Location of built-in structure in option 1



Location of built-in structure in options 2 and 3

Conclusions

- *legal regulations (allocated money, defined areas)*
- *monitoring*
- *assessment studies*
- *preferences for environment-friendly measures*
- *need of compromise*