

Gdańsk, 24-25 June 2019

The 1st Conference on

SOS Climate Waterfront

Climate Change Consequences and Creative Solutions for our Cities



24.06.2019 Gdańsk University of Technology
416 MAIN BUILDING

Sessions: (12 minutes per one presentation)

Opening ceremony:

10.00 at the Gdańsk University of Technology

Krzysztof Wiśniewski, Rector of Gdańsk University of Technology
Pedro Rosendo Garcia, Lusofona University, Lisbon, SOS Climate Waterfront main coordinator
Lucyna Nyka, Gdańsk University of Technology, SOS Climate Waterfront, GUT coordinator

Session 1: 10.15 – 11.45

Coffee break

Session 2: 12.15 – 13.30

Lunch: 13:30 – 14:30

Session 3: 14:30 – 16.00

Session 4: 16:30 – 18.00

25.06.2019 SARP oddział Wybrzeże
ul. Targ Węglowy 27

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**10.00 at The Coast Branch of the Association
of Polish Architects**

Session 1: 10:00 – 12:00

*Presentation of SOS Climate Waterfront concepts for Gdańsk's
stakeholders and local actors. Discussion*

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Open Public Discussion



Shaping Urbanized Waterfronts in the Context of Climate Change



Karolina A. Krośnicka, Ph.D., D.Sc.

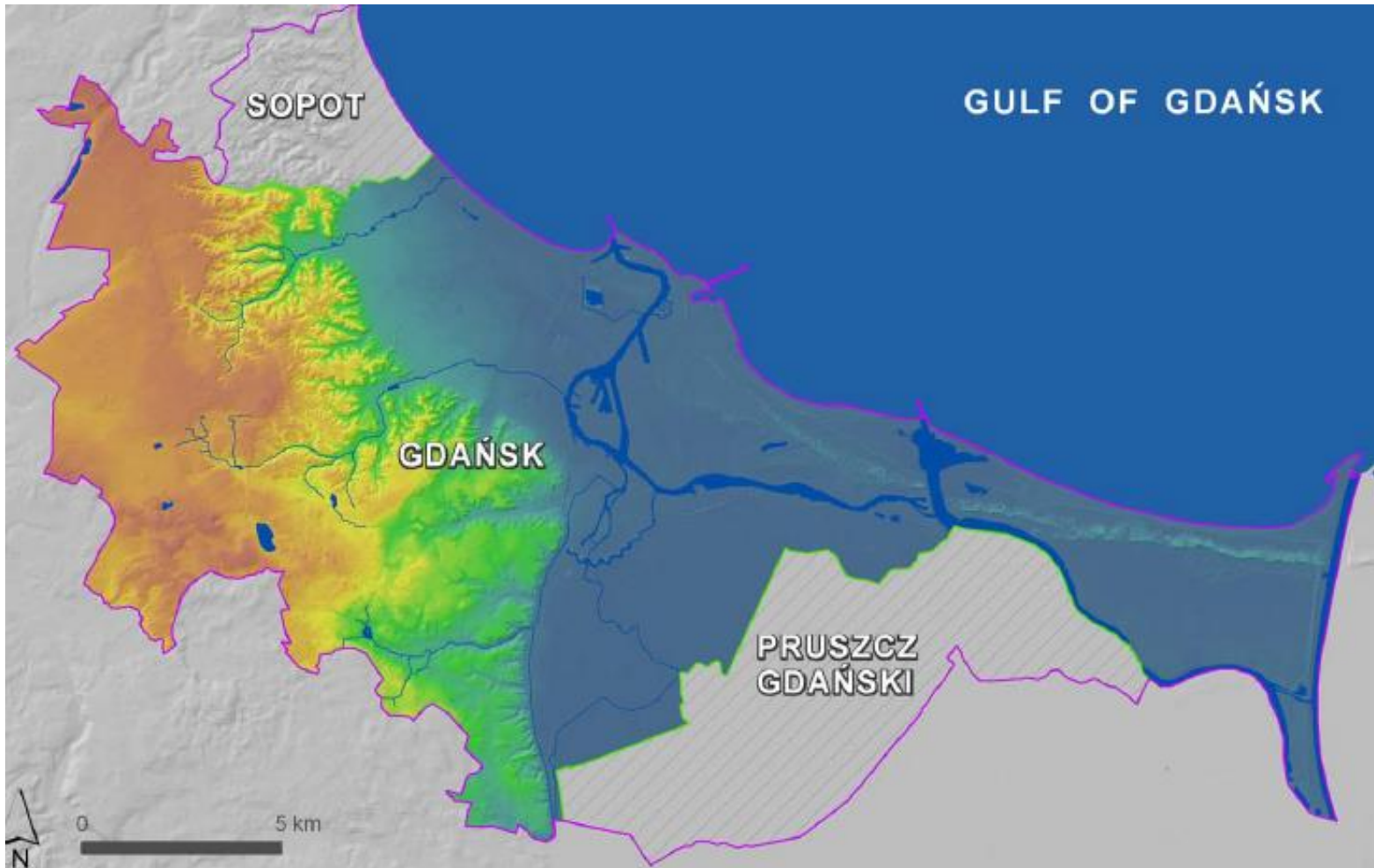
Associate Professor

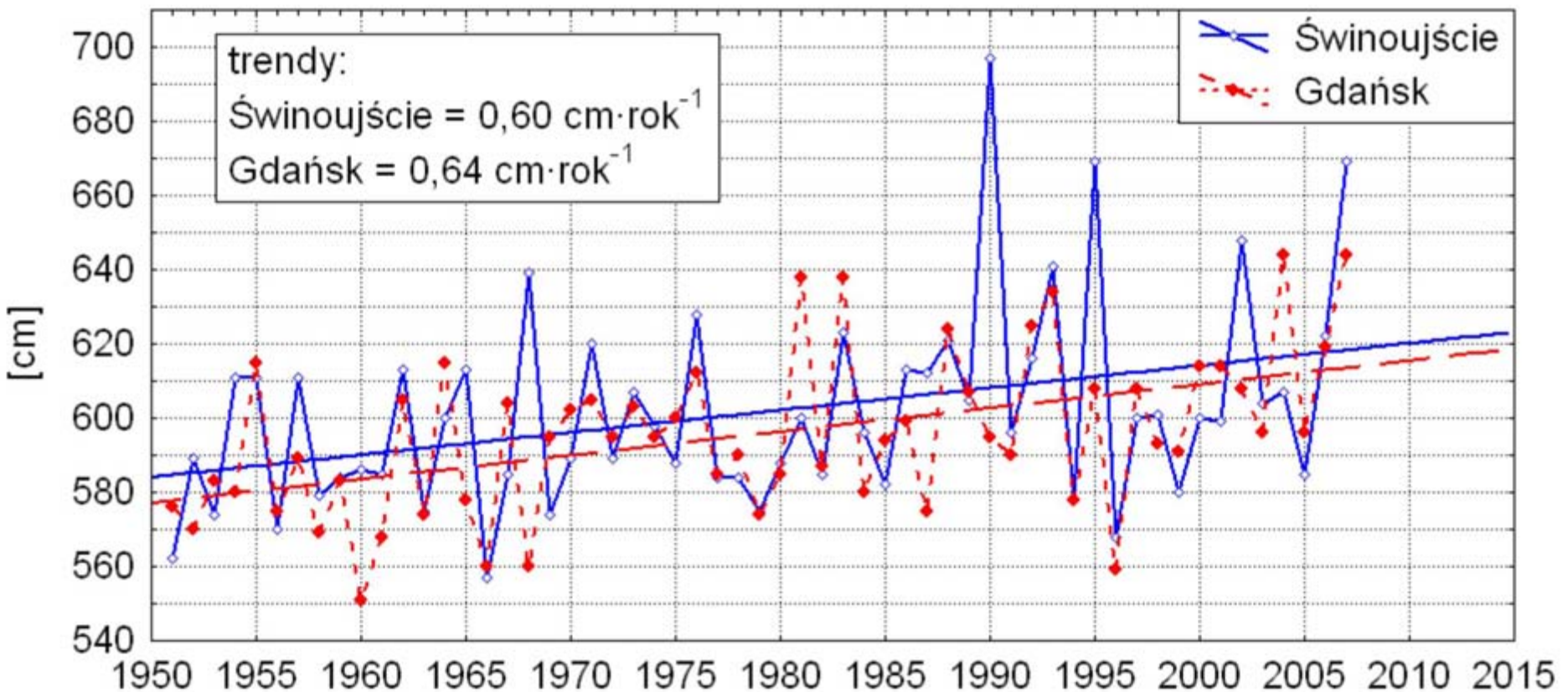
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- **over 30% of area of Gdansk is situated below 2.5m**
- **over 8% bellow sea level**





Zmiany maksymalnych w danym roku poziomów morza notowanych w Świnoujściu i Gdańsku w latach 1951-2007 i ich trendy, według danych Wiśniewskiego i Wolskiego [2009]

- **Sea level rise** in the years 2009-2015, caused by storm surges, should be regarded as a significant change in the climate of the Southern Baltic Sea.
- Number of storm surges as a function of time practically does not increase, but their height is getting bigger
- An increase in **the maximum sea level by 0.6 cm per year** seems to be a small value, which gives 60 cm / 100 years. However, this is a much higher value than expected by IPCC 2007, the increase in the average level of the World Ocean in the next century (47 cm).

Mean storm surge

- Baltic sea on Polish coast: 1.6 m (warning level: 560 cm, alarm level - 580 cm)

B1, A1B, A2 - scenarios of greenhouse gas emissions and other pollution

stacja	Scenariusz emisyjny B1		Scenariusz emisyjny A1B		Scenariusz emisyjny A2	
	H _{sr} [cm]	H _{95%} [cm]	H _{sr} [cm]	H _{95%} [cm]	H _{sr} [cm]	H _{95%} [cm]
Świnoujście	4,5	6,3	5,2	7,0	4,3	5,7
Kołobrzeg	4,6	6,3	5,3	7,2	4,3	5,8
Ustka	4,6	5,8	5,4	6,7	4,3	5,3
Łeba	4,6	5,6	5,5	6,6	4,3	5,1
Władysławowo	4,6	5,5	5,5	6,6	4,3	5,2
Hel	4,6	5,7	5,5	6,7	4,3	5,2
Gdynia	4,6	5,6	5,5	6,6	4,3	5,1
Gdańsk	4,6	5,7	5,5	6,7	4,3	5,3
Gdańsk – Ujście Wisły	4,5	5,9	5,6	6,8	4,3	5,0

Tabela 6 Przewidywane wzrosty w cm średniego (H_{sr}) i maksymalnego (H_{95%}) poziomu morza wzdłuż polskiego wybrzeża w skali roku w okresie 2011-2030, w stosunku do wartości średnich z okresu referencyjnego 1971-1990

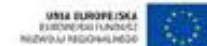
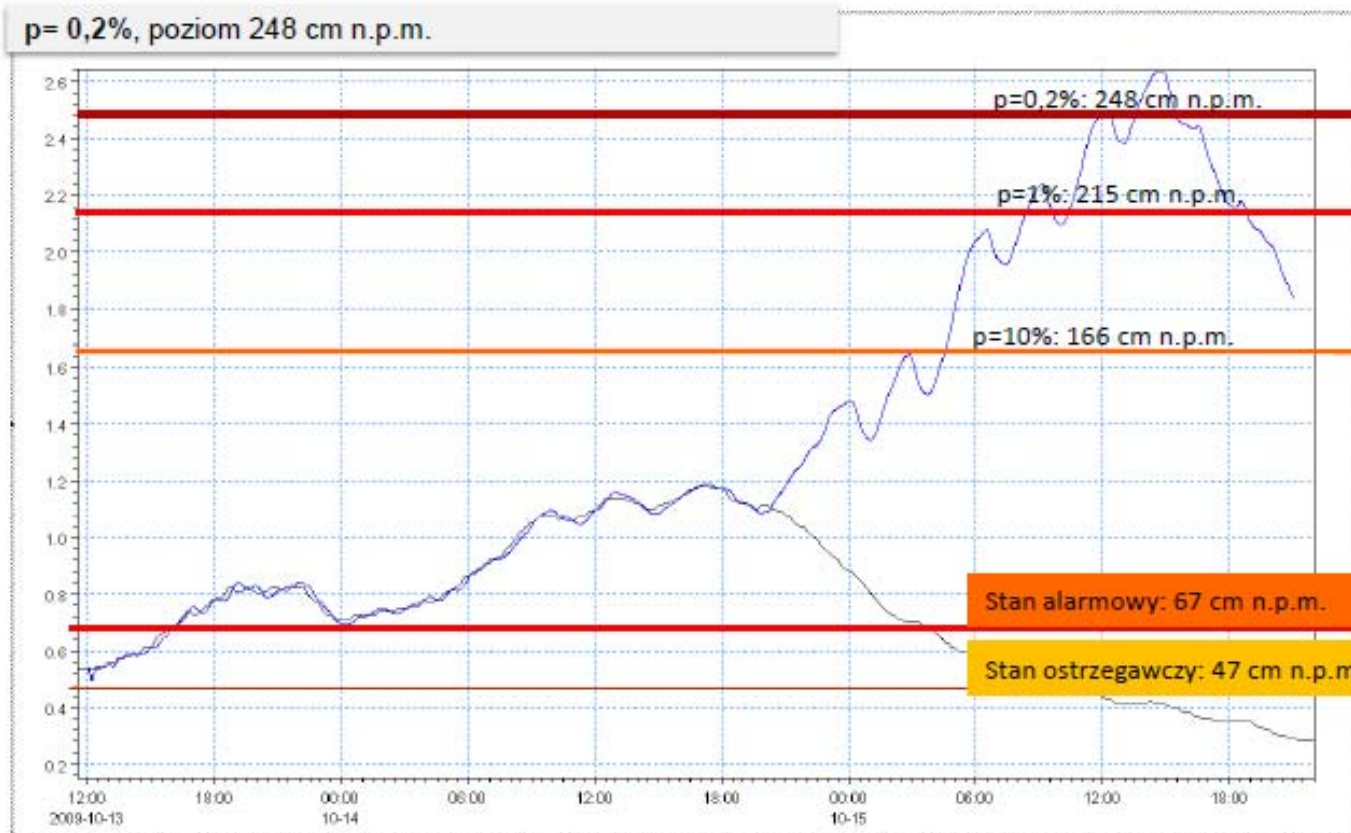
Zagrozenie powodziowe od Martwej Wisly w przypadku wystapienia wezbrania sztormowego w Zatoce Gdanskiej o okreslonym prawdopodobienstwie przewyzszenia z uwzględnieniem falowania:



$p=10\%$, poziom 166 cm n.p.m.

$p=1\%$, poziom 215 cm n.p.m.

$p=0,2\%$, poziom 248 cm n.p.m.



Projekt współfinansowany ze środków Europejskiego Funduszu Rozwoju Regionalnego w ramach Programu Operacyjnego Innowacyjna Gospodarka

Designation of hazard zones in flood plains

- **model analyzes** allowing to determine the extent of the flood of a given size. It used to be assumed that such flood is the authoritative for planning purposes, there is a flood with the probability of occurring during the year equal to 1% (so-called hundred-year-old water)
 - **ranges of the largest historical flood registered in this area**, especially if it was greater than 1% flood
-

Significant flood risk - is determined as a result of the flood risk assessment carried out for areas potentially endangered by flooding, in terms of the following criteria:

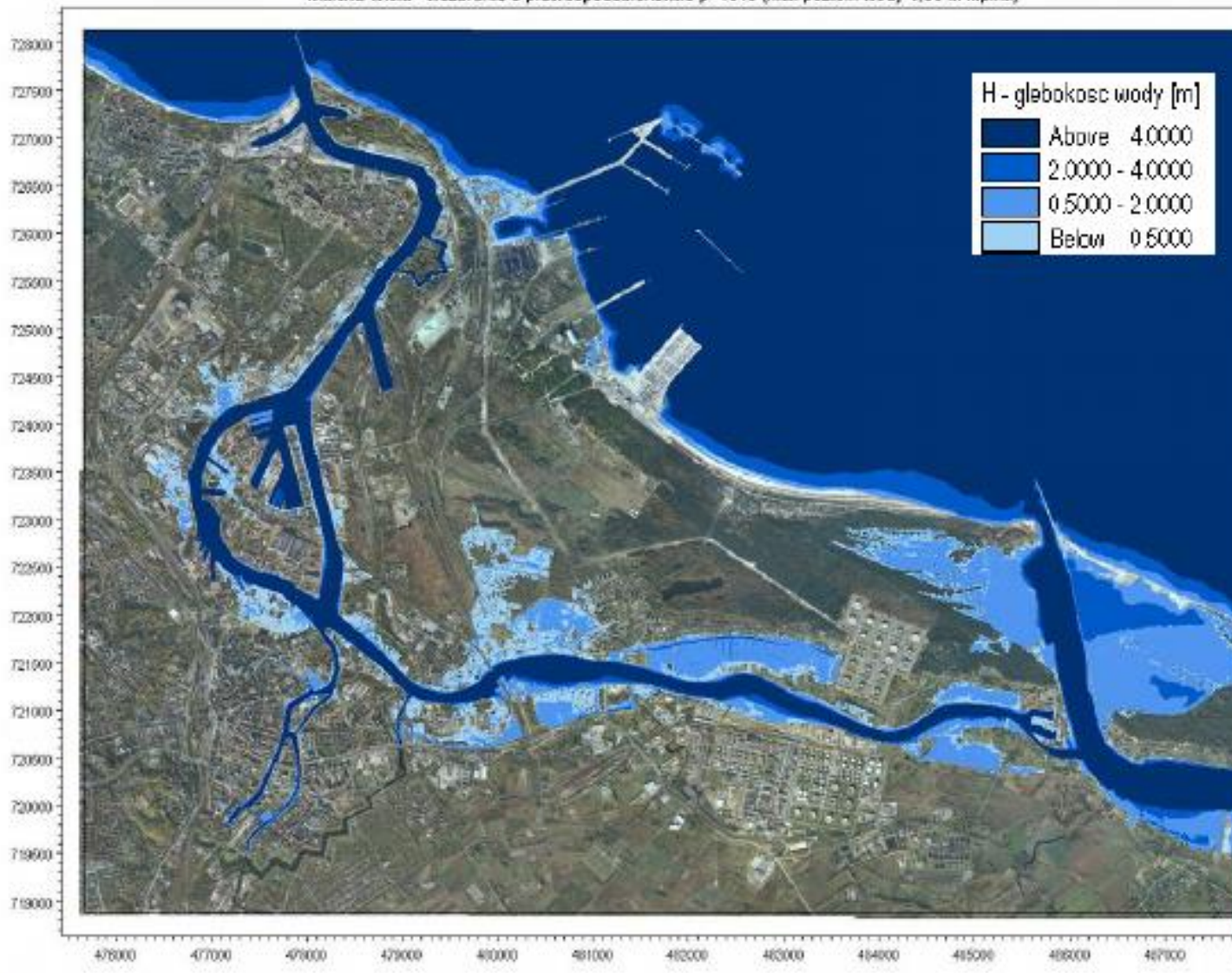
- The direct impact of flooding on human life and health,
- The impact of flooding on business areas along with infrastructure,
- The impact of flooding on cultural heritage
- The impact of flooding on the environment
- Effectiveness of existing flood protection structures,
- The influence of spatial development in the area of population density and population distribution on occurrence of floods,
- The impact of climate change on the occurrence of floods.

Source: **Zaktualizowana Metodyka Wstępnej oceny ryzyka powodziowego od strony morza, w tym morskich wód wewnętrznych**

Projekt: Przegląd i aktualizacja wstępnej oceny ryzyka powodziowego od strony morza w tym morskich wód wewnętrznych Nr Projektu: POIS.02.01.00-00-0018/17

$p=10\%$, poziom 166 cm n.p.m.

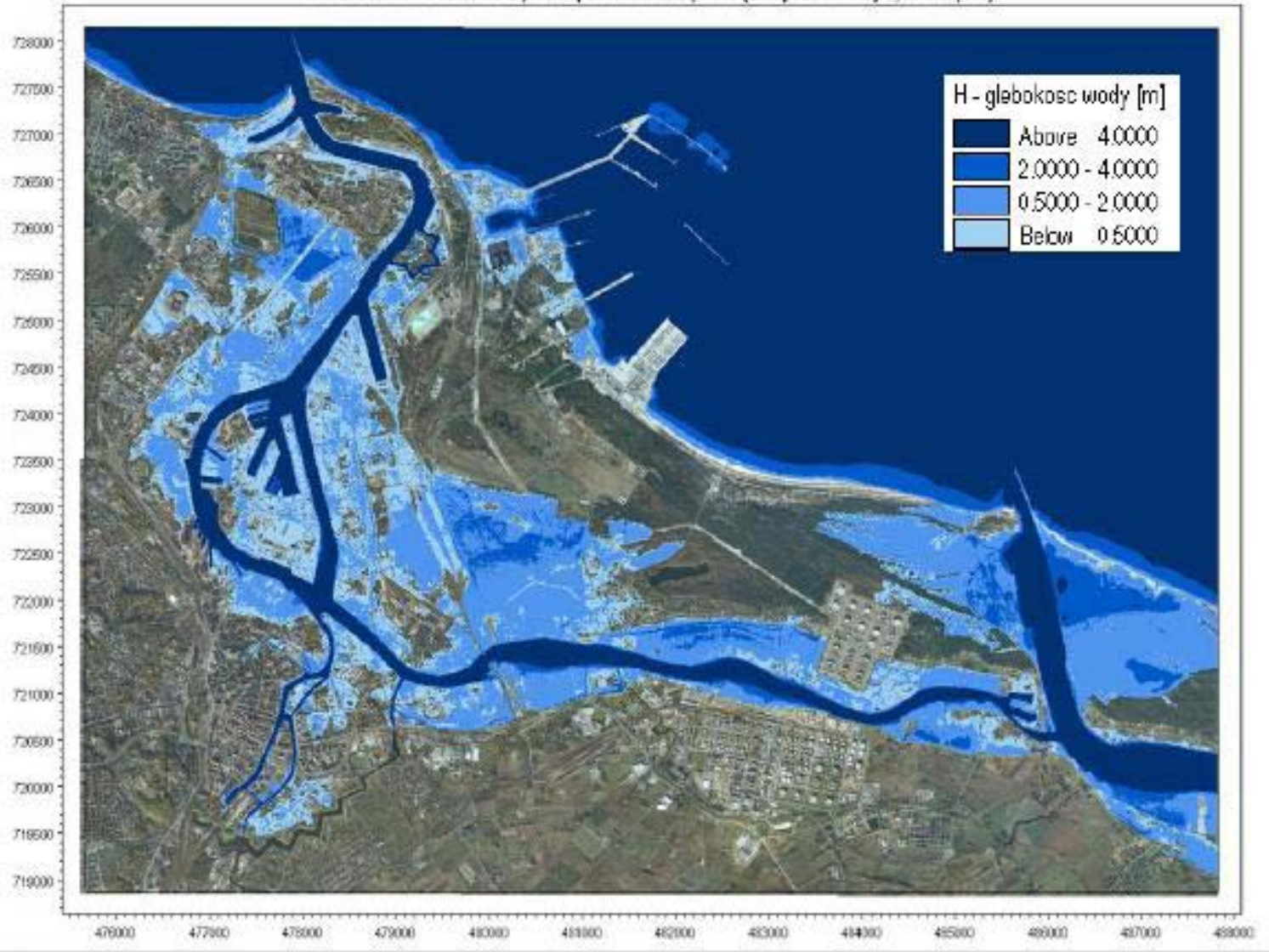
Marwa Wisła - wezbranie o prawdopodobieństwie $p=10\%$ (max poziom wody 1,66 m n.p.m.)



Informacyjny System Ochrony Kraju
przed nadzwyczajnymi zagrożeniami (ISOK)

$p=1\%$, poziom 215 cm n.p.m.

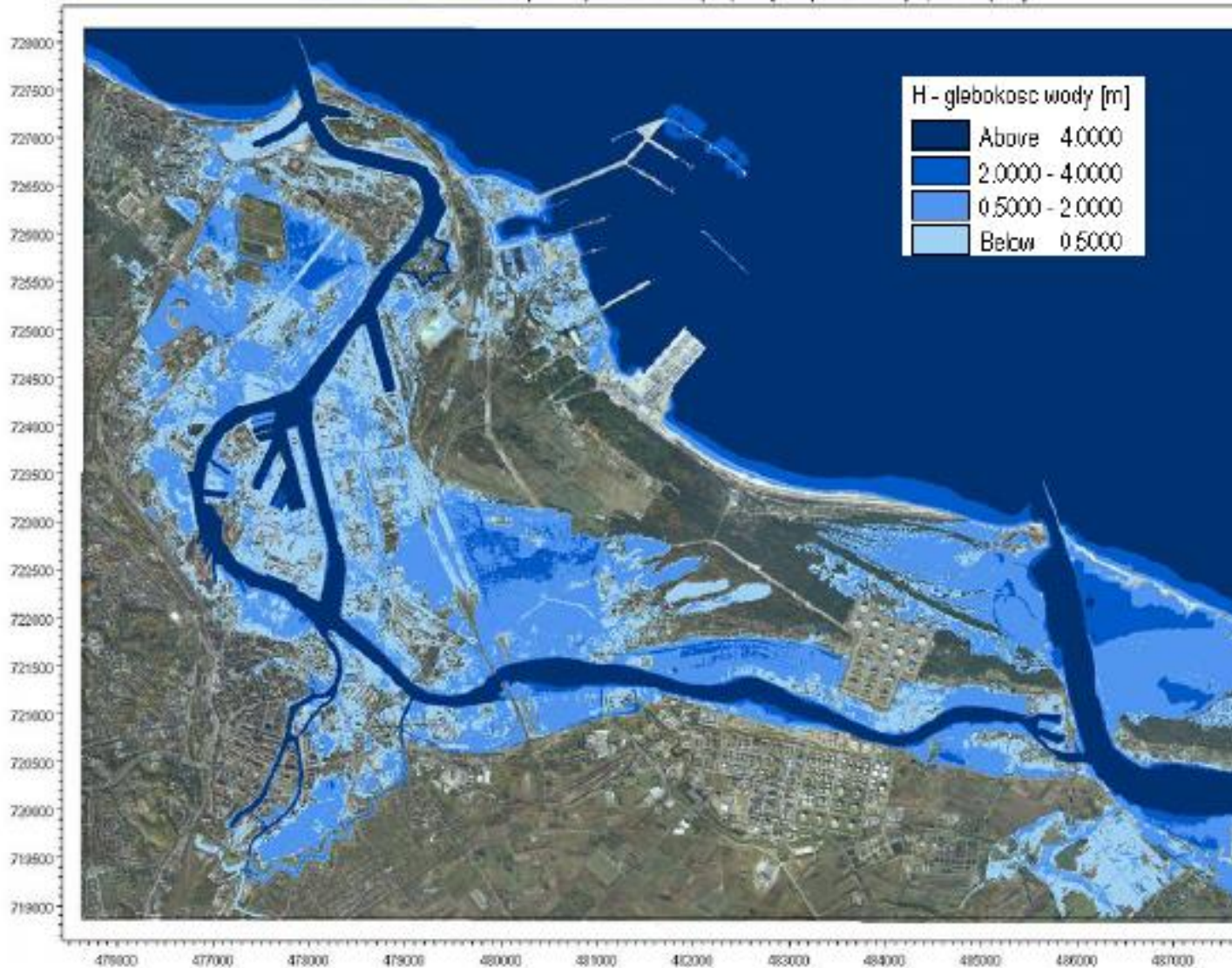
Marbrza Wisła - wezbranie o prawdopodobieństwie $p=1\%$ (max poziom wody 2,15 m n.p.m.)



Informacyjny System Ochrony Kraju
przed nadzwyczajnymi zagrożeniami (ISOK)

$p=0,2\%$, poziom 248 cm n.p.m.

Martwa Wisła - wezbranie o prawdopodobieństwie $p=0,2\%$ (max poziom wody 2,48 m n.p.m.)



Informacyjny System Ochrony Kraju
przed nadzwyczajnymi zagrożeniami (ISOK)

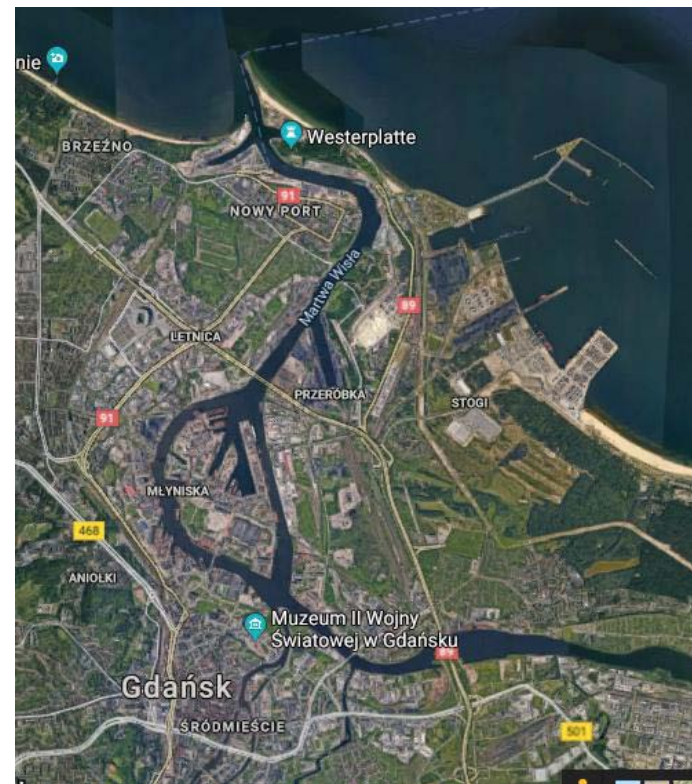
Should we build?

No?



1 % - 215 cm

Yes? – how?



Indicating the flood areas

Dyrektywa Powodziowa - Dyrektywa 2007/60/WE Parlamentu

**Europejskiego i Rady z dn. 23 października 2007 r. w sprawie oceny ryzyka
powodziowego i zarządzania nim**

Dz.U. 2001 nr 115 poz. 1229

Ustawa z dnia 18 lipca 2001 r. wraz z późniejszymi zmianami (2017 r.)

Prawo wodne

**According to Polish law on the areas with high risk of the flood
with probability of **1% and 10% building is not allowed****

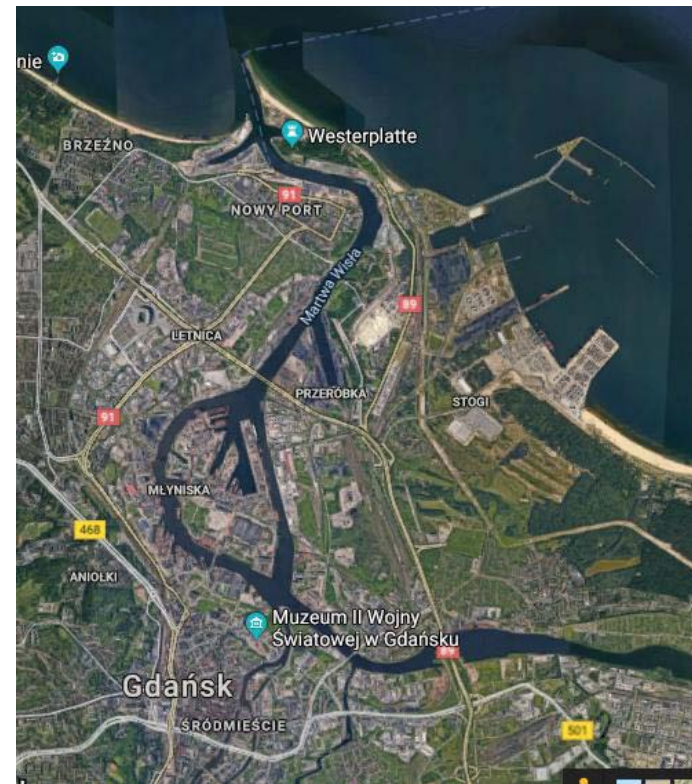
Should we build?

No?



1 % - 215 cm

Yes? – how?



Designation of hazard zones in flood areas

two hazard zones are usually marked:

- **flood route** (the so-called flood corridor) - an area within the floodplains it flows through practically all large flood water, where both depth and speed of water cause that it has an extremely destructive nature,

- **flood plains** (also known as retention or staging areas) - areas between the route floods and flood ranges for 100-year-old water, on which flood waters only come they spill over creating the stagnant or they flow without having a great depth or devastating speed.

The lines designating both zones should be introduced into the local spatial development plan. Within each of them you can introduce different development rules.



Conditions of building

Flood route - building is not usually allowed, permitting at the same time for the use of these areas for agriculture, forestry, location of parks and other forms for recreation, cattle grazing, etc.

Flood plain (retention areas) - in those areas characterized by a smaller area flood hazard, they usually apply:

- **a ban on the construction of facilities** such as, for example, hospitals, schools, kindergartens, nursing homes, social and other similar types that users can not cope with themselves at the time of danger and may require special care,
- **prohibition of the location of facilities** such as sewage treatment plants, landfills municipal waste, toxic waste storage, chemical storage, etc., which in the case of floods pose a secondary threat,
- **permission for the construction of residential and public facilities**, provided locating their usable parts (e.g. residential) above the level of reliable flood (so-called one-year-long flood), e.g. on an embankment or object security by enclosing it with shields or shafts.



Polish documents on good practice:

PROGRAM BEZPIECZEŃSTWA POWODZIOWEGO W REGIONIE WODNYM ŚRODKOWEJ WISŁY

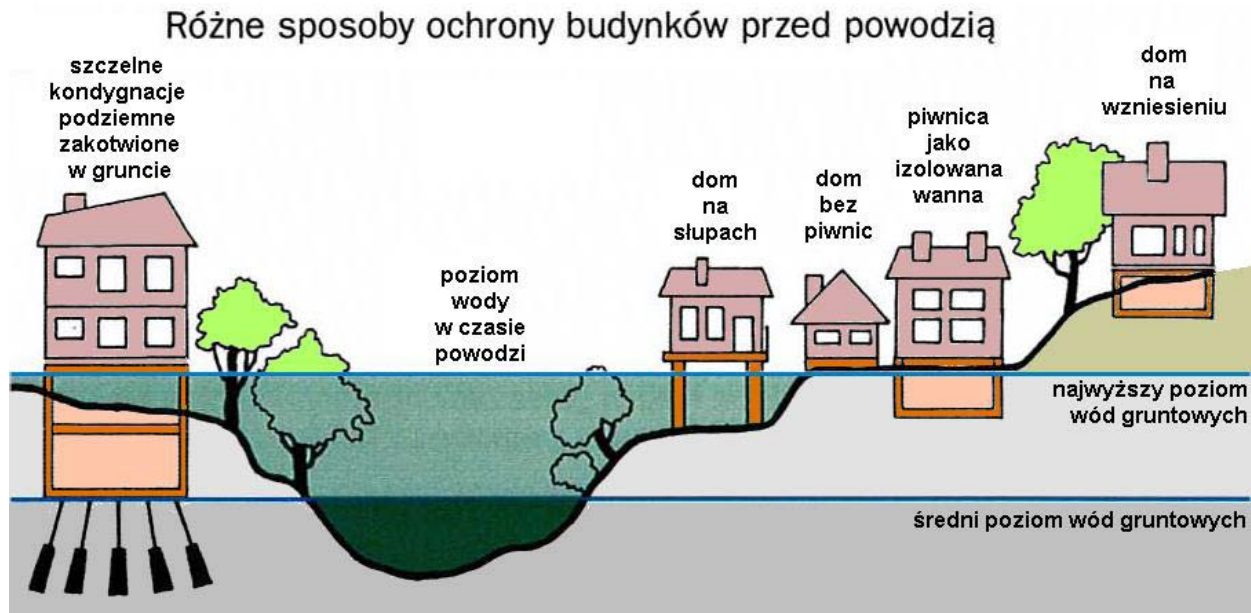
- załącznik 14 - Zestaw dobrych praktyk w formie standardów technologicznych dla terenów zagrożonych powodzią.
- załącznik 15 - Zestaw dobrych praktyk w formie standardów architektonicznych dla terenów zagrożonych powodzią (za: Homeowner's Guide to Retrofitting. Six Ways to Protect Your Home From Flooding. FEMA P-312, June 2014 <https://www.fema.gov/media-library/assets/documents/480>)
- załącznik 22 - Zestaw dobrych praktyk w formie standardów urbanistycznych dla terenów zagrożonych powodzią.

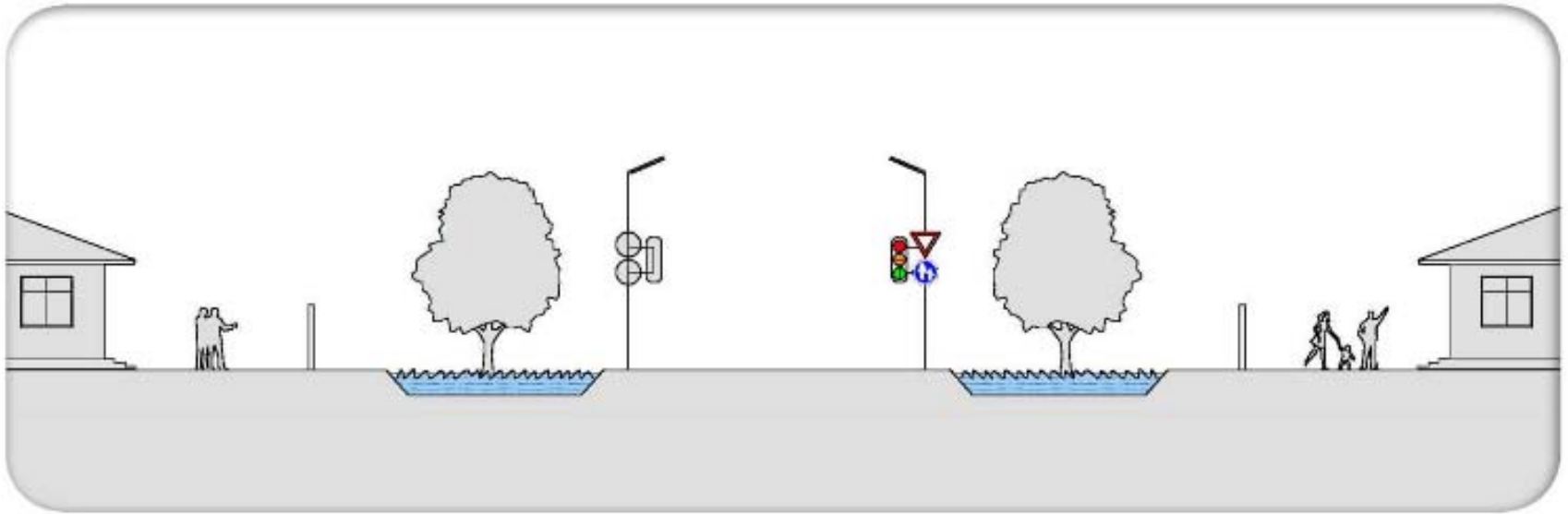
<http://www.bialystok.uw.gov.pl/Informacje+wyzdzialow/Zarzadzanie+Kryzysowe/Projekt+programu+bezp+powodz+dorzecza+Wis%C5%82y+%C5%9Arodkowej.htm>

Construction and architectural solutions for flood plains

Raising the floor in the building above the expected level of flood waters associated with the appropriate method of deep foundations:

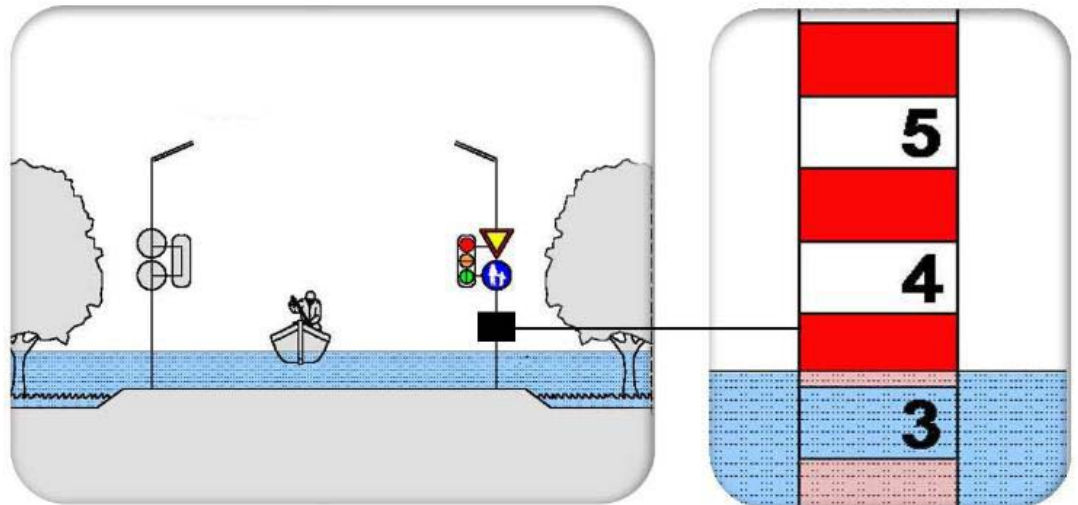
- **Building on the walls**
in the areas of low water flow rates, the space under the building can be used as a ventilation space or, if the appropriate height is exceeded, as a non-useable floor. If the elevation was to reach over 1.0 - 1.2 m, it is advisable to erect the building by the full storey height (in Polish conditions approx. 2.80 m).
- **Building on poles / piles**
on the coastal areas, a solution adapted to significant flooding depths and additional loads in the form of dynamic pressure of water (tides, waves) or impacts of floating objects. Buildings with smaller dimensions are erected on wooden constructions. Heavier works are built on steel or reinforced concrete structures.





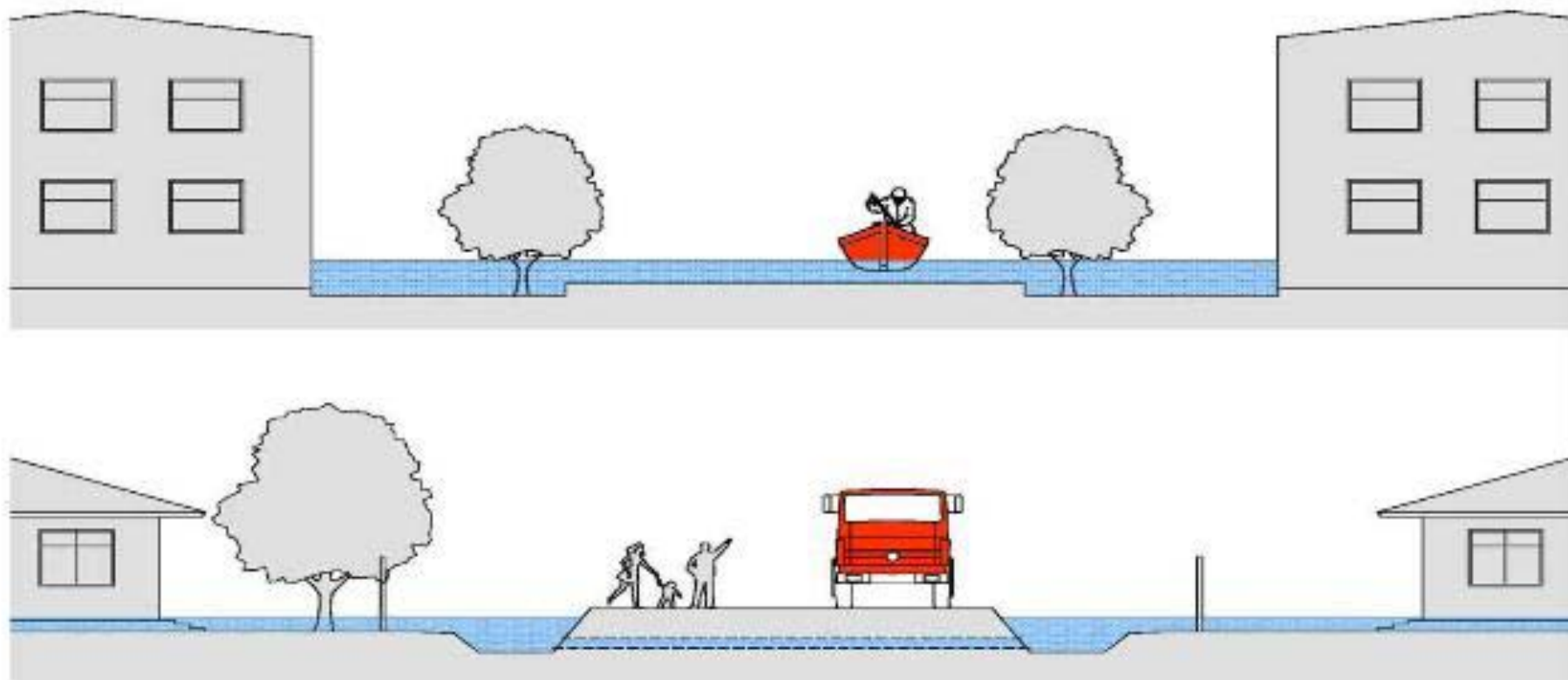
Rys. A.1. Rozgraniczenie pasów komunikacji pieszej i kołowej.

Emergency
transportation
network



Rys.A.2. Schemat oznakowania terenów zalewowych.

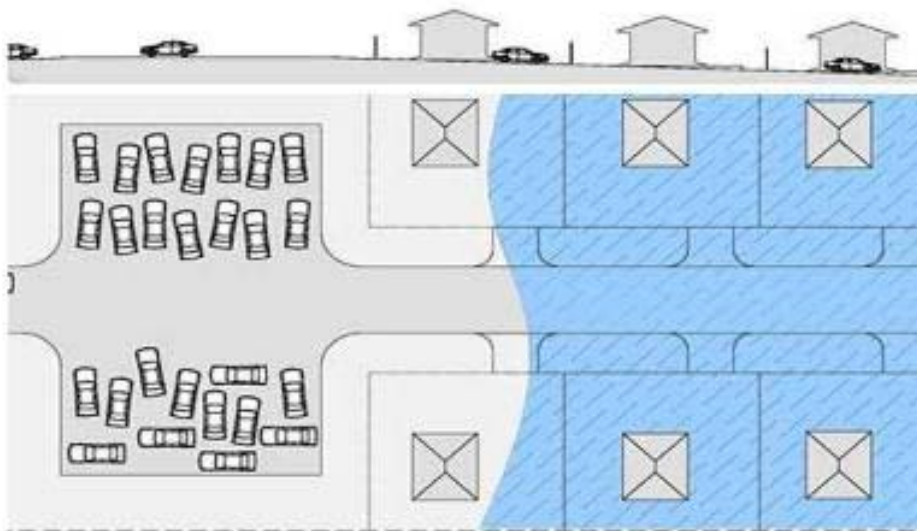
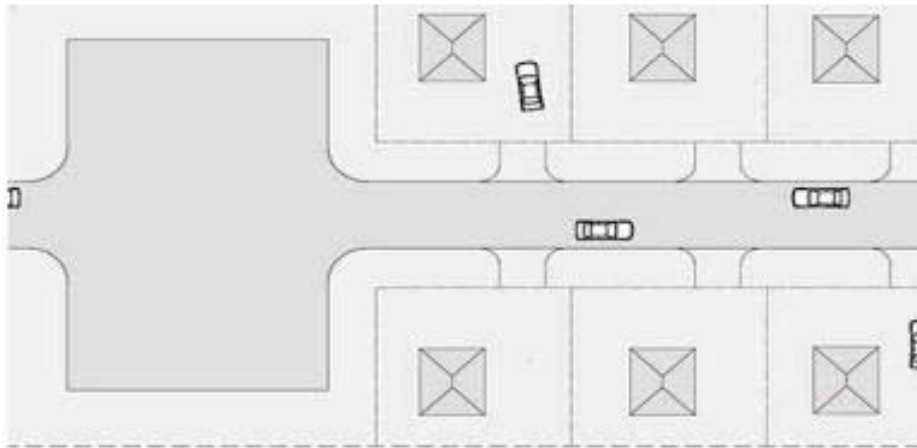
Emergency transportation network



Rys.A.6. Schemat zasady ochrony budynków lub komunikacji.

Evacuation areas

- Everyday use
- Emergency use



Rys.A.3. Schemat placów dla samoevakuacji terenów zurbanizowanych.

Construction and architectural solutions for flood plains

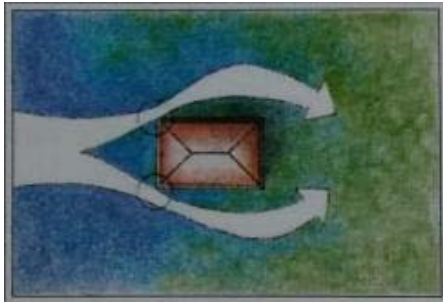
- **Low ground embankments** - construction of land embankments around the property, assuming that the required embankment height is within the limits of 0.75 - 1.50 m.

Flood barriers - walls and flood barriers, fixed and portable (assumed). Permanent masonry structures must be made in the form of massive, sealed baffles, made of waterproof materials (stone walls on cement mortar, reinforced concrete walls, metal-wood constructions properly secured). Mostly portable barriers are aluminum barrier systems. Permanently installed elements are sections in which the installed beams are periodically inserted (developed warning system)



How to locate building on flood risk areas

Kształt budynku a zagrożenie zniszczeniem przez falę powodziową

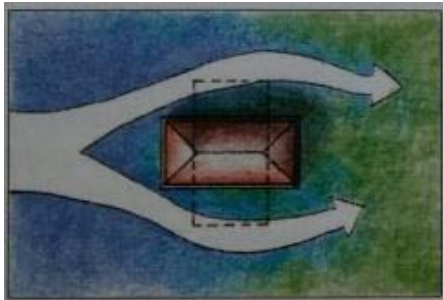


budynek nieprzystosowany
do uderzeń fali powodziowej



budynek łagodzący
swym kształtem siłę naporu wody

Ustawienie budynku względem fali powodziowej

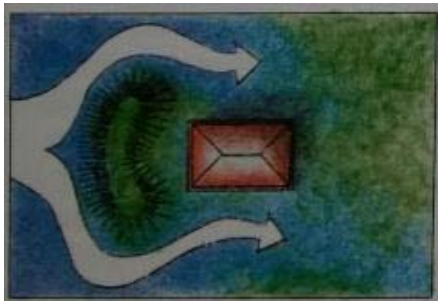


linią przerywaną zaznaczono
najbardziej niekorzystne
ustawienie

najlepsze –
pod kątem do kierunku
spodziewanej fali powodziowej



Zmniejszenie ryzyka uszkodzenia domu przez falę powodziową



obwałowanie obiektu

stworzenie bariery
ze zwartej zieleni i krzewów





Sheet piling
lock
Shaft



Safety
– flood protection



Safety
– flood protection

**Walls
and IBS
system**



Walls and IBS system



Safety
– flood protection

Do not waste space!



What we still lack?

Is (among others):

- experience in shaping urban waterfronts in conditions of seawater rise
- a culture of building in the potentially flooded space
- methods and concepts of using the potentially flooded space intensively

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