

Zegrze Reservoir history and future

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Artificial reservoirs in Poland



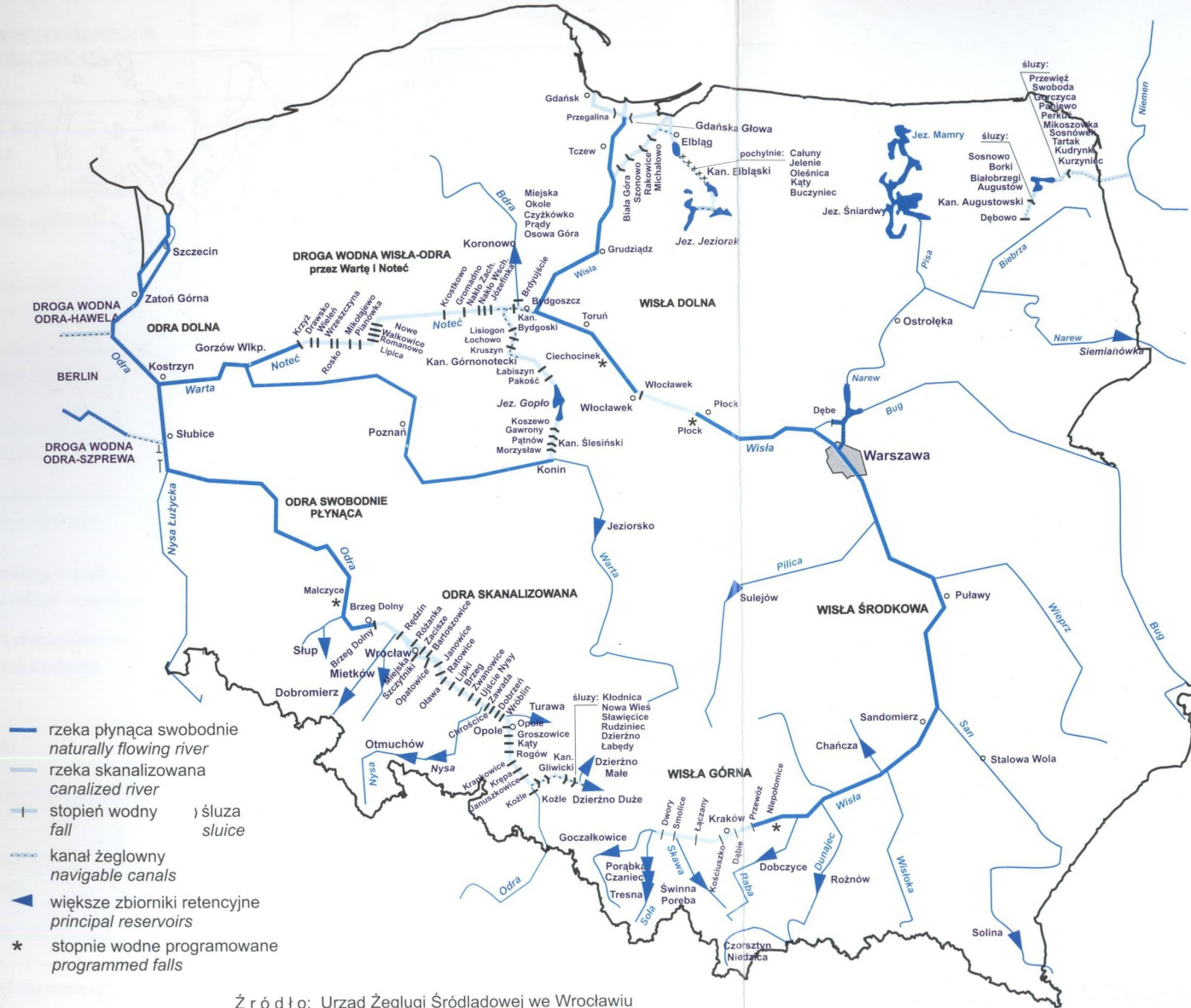
Volume of storage

- natural lakes - 33,0 km³
- **artificial reservoirs** - **3,07 km³**
- fish ponds - 0,60 km³
- river channels - 1,30 km³

Total run-off : **61 km³**

Waterways of Poland

SCHEMAT DRÓG WODNYCH ŚRÓDLĄDOWYCH W POLSCE SCHEME OF INLAND WATERWAYS IN POLAND

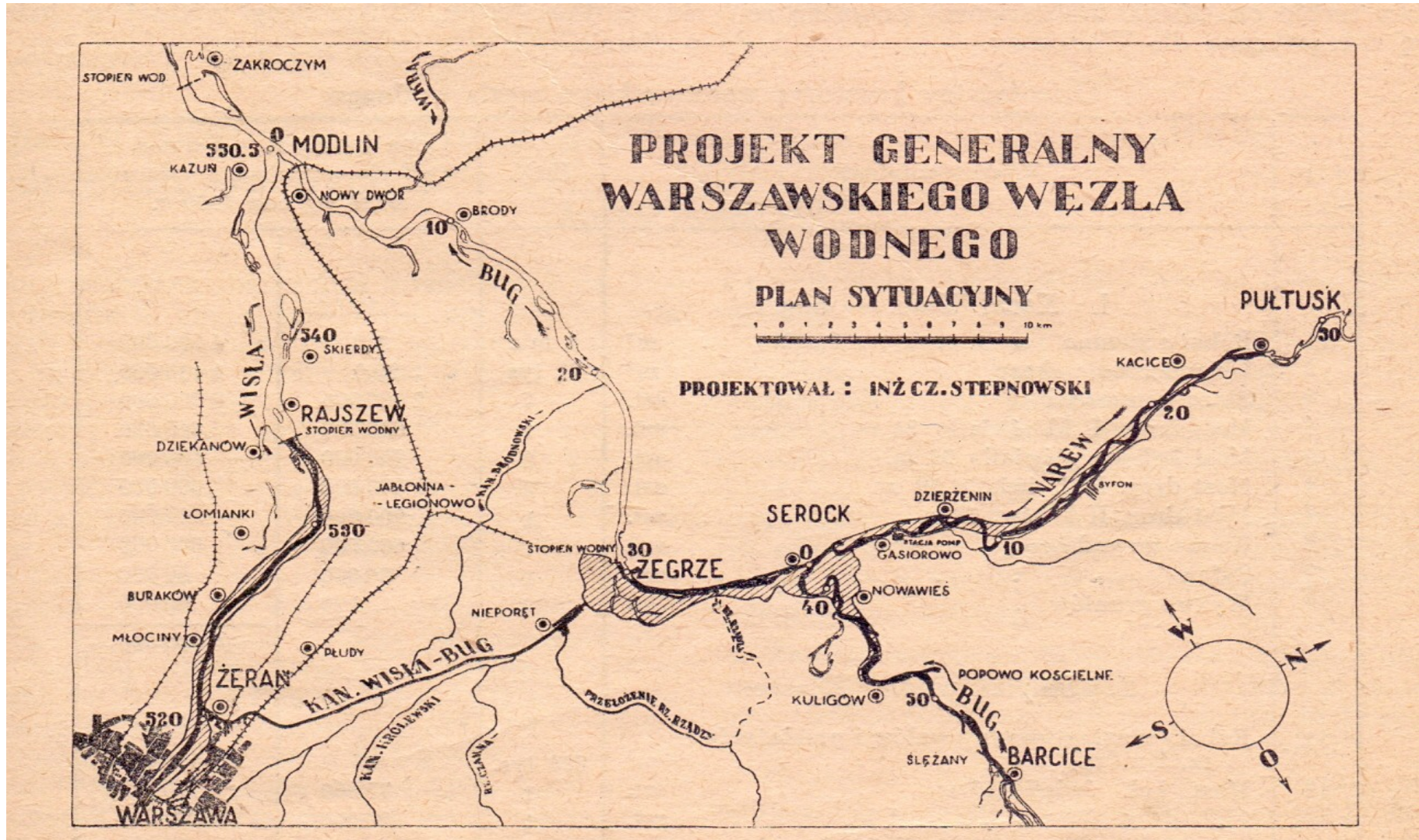


Źródło: Urząd Żeglugi Śródlądowej we Wrocławiu
Source: Inland Navigation Office in Wrocław



Planned Bug cascade of the reservoirs from the 50-s

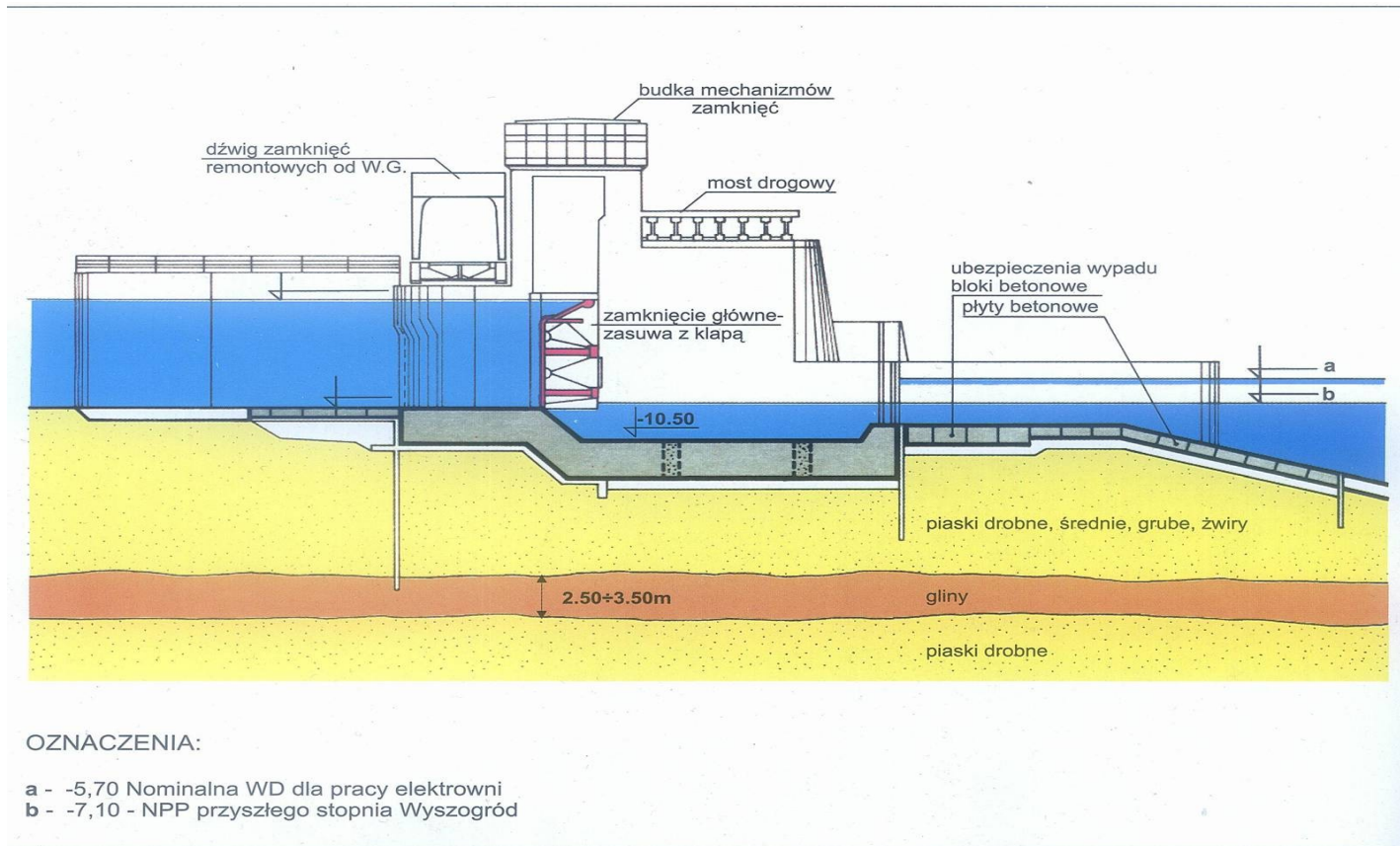
General design of the Zegrze Reservoir 1950



Dębe

Earth dam
length 230 m
height 7,3 m

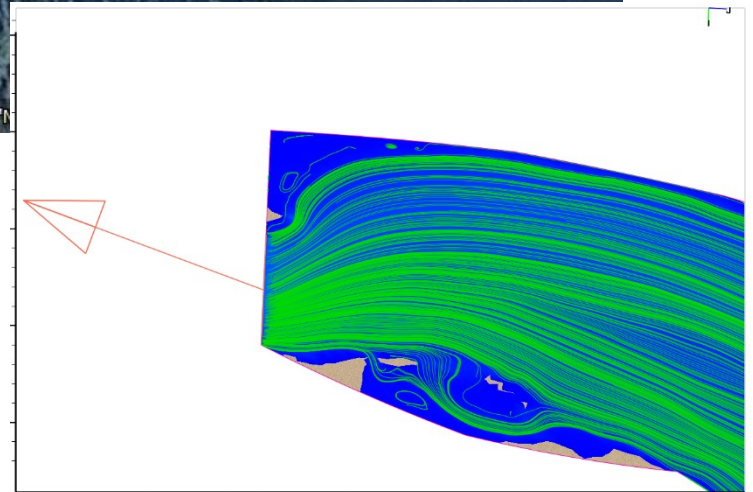
Hydropower 20 MW

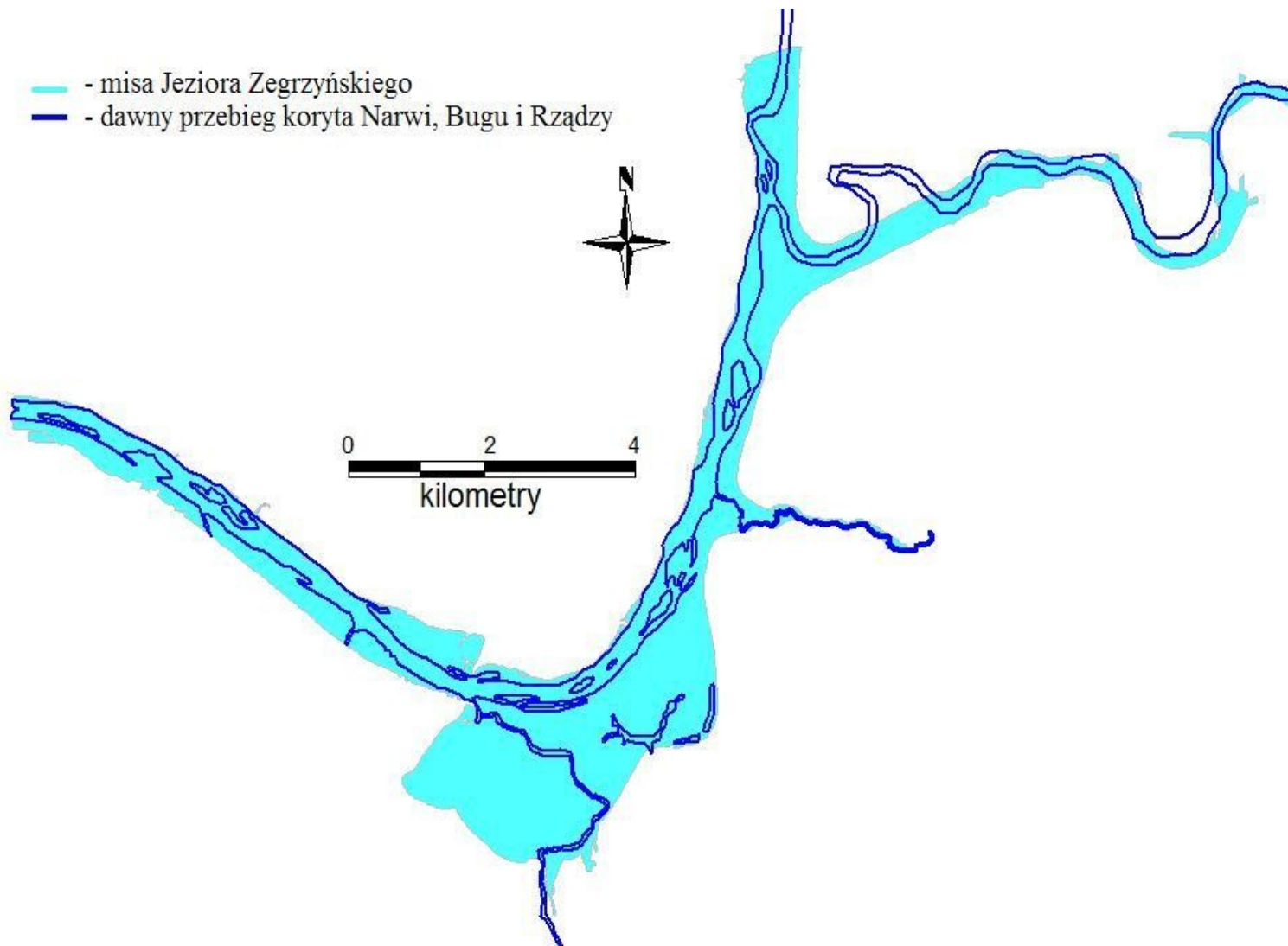




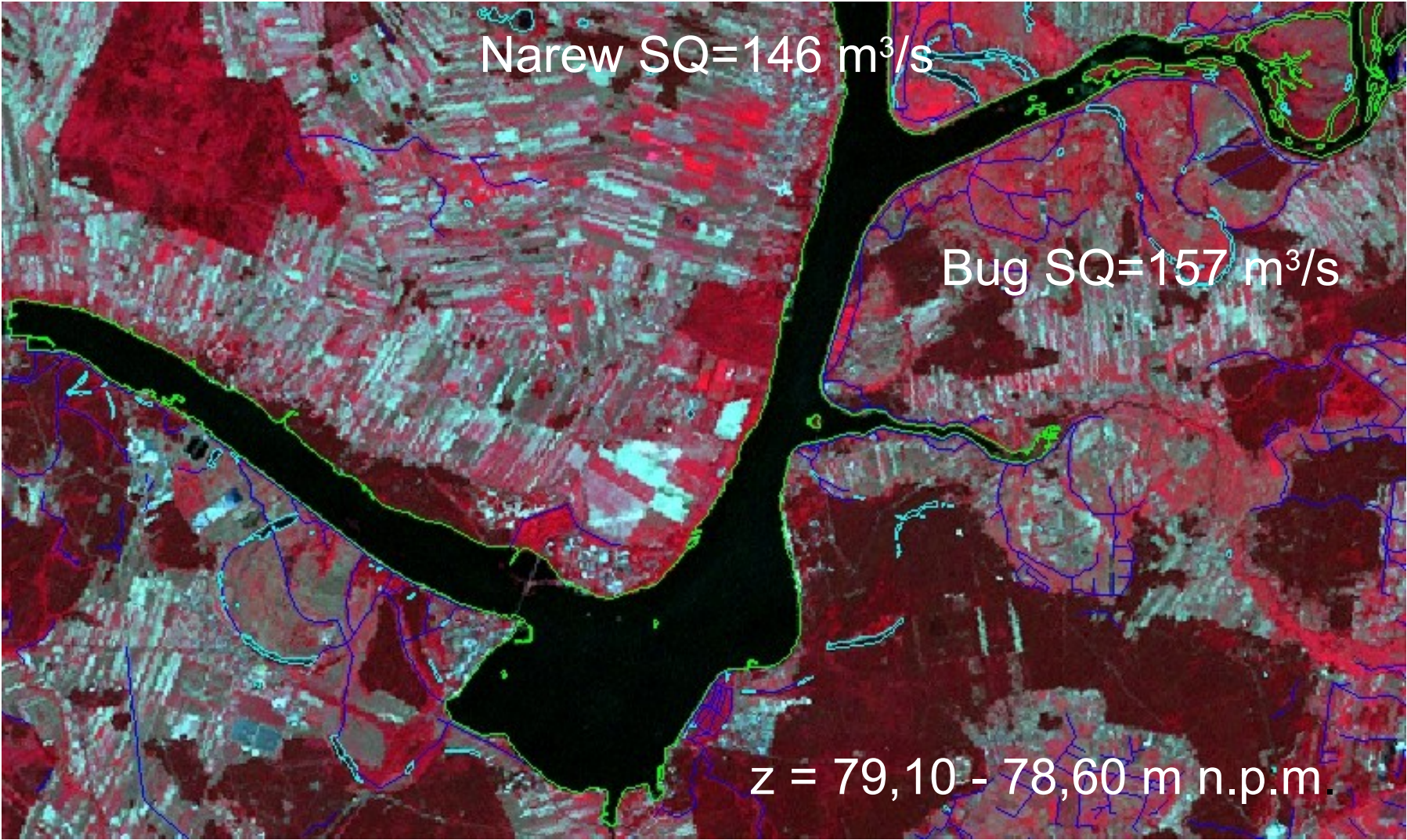
Dębe dam and flow lines from CCHE2D

(Google Earth)





Zegrze Reservoir and old river channels from 30-s. XX c.
(Lewicki, 2007)

An aerial photograph of the Zegrze Reservoir area, overlaid with hydrological data. The reservoir is shown as a large black body of water. The surrounding land is colored in shades of red and cyan, with a network of blue lines representing the river system. The Narew and Bug rivers are specifically labeled with their respective discharge rates (SQ) in m³/s. The elevation range is also indicated at the bottom right of the map.

Narew SQ=146 m³/s

Bug SQ=157 m³/s

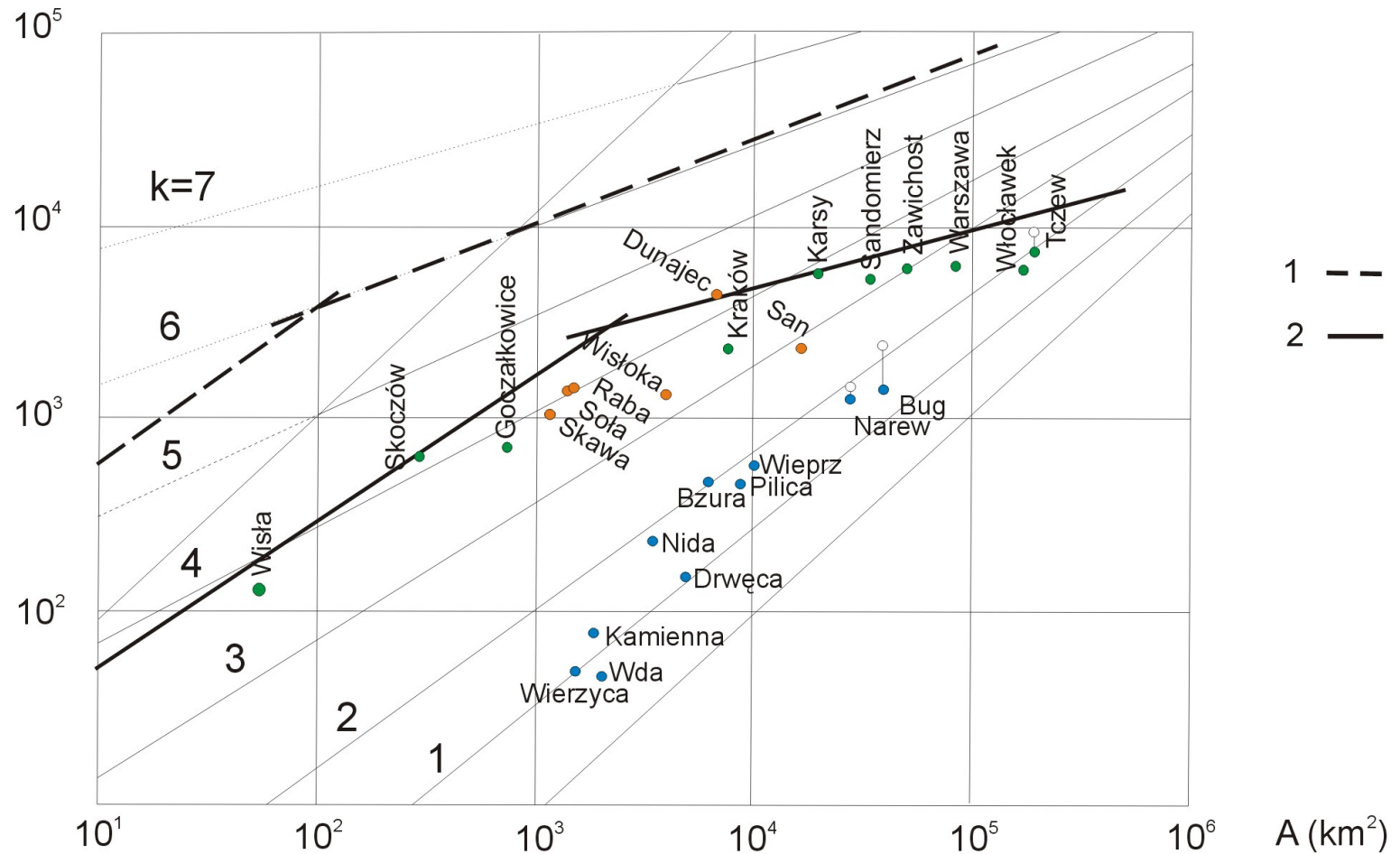
z = 79,10 - 78,60 m n.p.m.

Build in 1963 - Zegrze Reservoir V=94,3 mln m³, F= 30,3 km²

$$k = 10 \cdot \left(1 - \frac{\log WWQ - 6}{\log A - 8}\right)$$

J. Françou (Rodier i Roche, 1984)

Q (m³/s)



Hydrological data

Warszawa

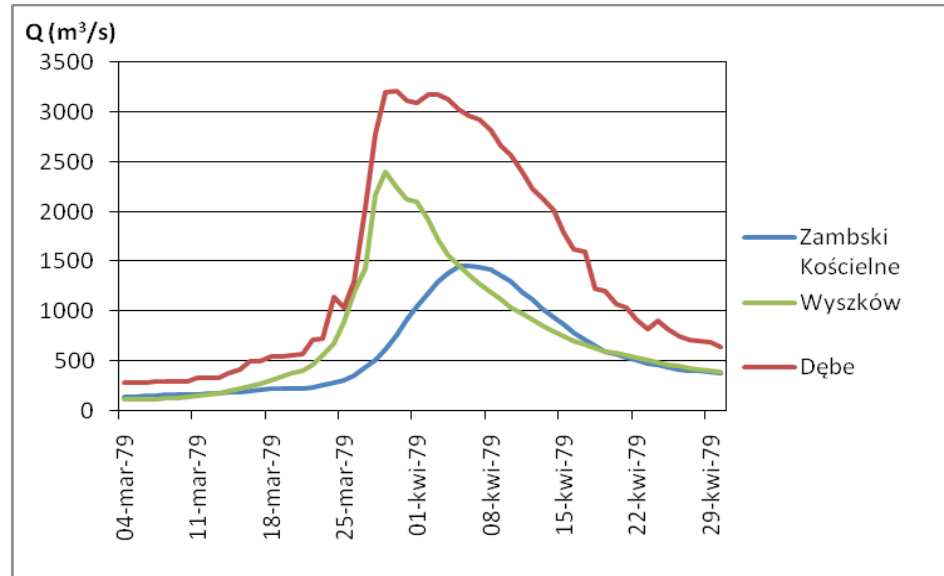
$$Q_{1\%} = 7010 \text{ m}^3/\text{s}$$

$$- Q_{2010} = 5899 \text{ m}^3/\text{s}$$

Dębe

$$Q_{1\%} = 3060 \text{ m}^3/\text{s}$$

$$Q_{1979} = 3450 \text{ m}^3/\text{s}$$



Flood of 2010 y. Reduction of flow at Modlin by 150 m³/s
(Bagiński in, 2010)

Max. storage Zegrze Reservoir – 26 mln m³

Włocławek

$$Q_{1\%} = 8970 \text{ m}^3/\text{s}$$

$$Q_{1979} = 6080 \text{ m}^3/\text{s}$$

Bug is one of the oldest trading ways in Europe connecting Baltic Sea with the Black Sea. The area between Narew and Bug rivers was a Plock Bishop property in medieval times.

Geographical discoveries of 16 century has ended the Hanza dominance and created new trade and industry centers in Holland and England. The new market for a grain has been formed with a supply area in Poland connected with a Baltic Sea by the river transport.

Canals era for connecting river basins has started from 18-th century

Vistula-Oder (Kanal Bydgoski) part of E70

Bug with Prypiat (Kanal Bug-Dniepr)

Narew – Biebrza with Nieman (Kanal Augustowski)

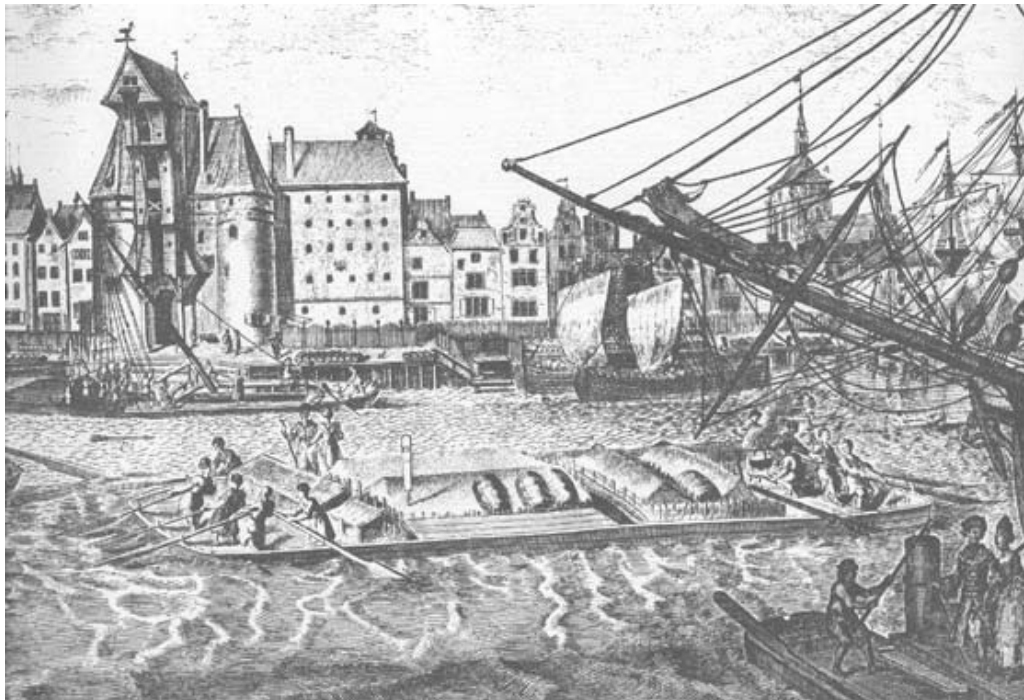
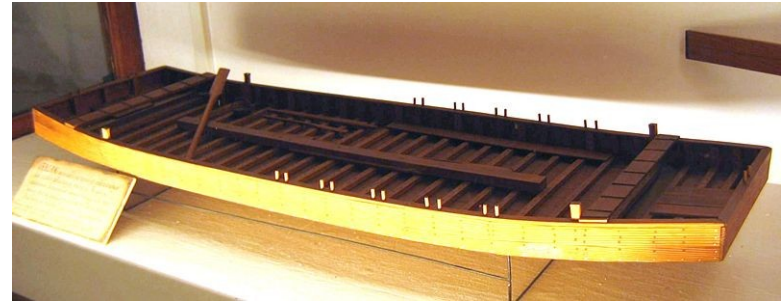
Narew - Mazurian Lakes – Pregola (Mazurian Canal)

Waterways was the only one solution for long distance transport of the mass loads. To transport one 100 t of the grain on the distance 1000 km it would require 100 horse carragies, 200 horses, and 100 drivers. On the poor roads the daily progress was only 30 km. The cost of the transport would be bigger than the load value.



The same load was taken by one barge with only 20 sailors. With a good wind ships could make 70 km/day downstream and against the current only 20 km/day. The sailing was performed only at the high water of the spring time. Usually it was one way trip, barges were sold in Gdansk and disassembled for timber.

galar



Barge used on Wistula river and tributaries for grain transport



Rafts for timber transport



Railway network at year 1899 . (Nueste Reise-Karte..., 1899)

Steamer ships

- First steamer ships have been used on the Vistula River in 1827 r.,
- French company building ships for Loire has been represented by E. Guibert in 1846.
- First steamer ship build in Warsaw in 1849 r.
- Passenger ships operate at the Vistula River and tributaries. There was no alternative for the ship transport due to poor development of the railway lines.



In the 50-s and 60-s one week long holidays at steamer pasenger ships have been very popular. Trips from Warsaw to Gdansk and to Sandomierz.

Picture from the comedy film – Race (Rejs) by Marek Piowski and Janusz Głowacki – nominated in the category of the most intersting Polish movie of the 20-th century

1963-1965 Narew river has been regulated on the distance from Pułtusk to Gnojno (km 64-76) to make possible gravel transport by barges 600 t and pushing tugs class Zubr build in Warsaw river shipyard



Inland water transport massive loads

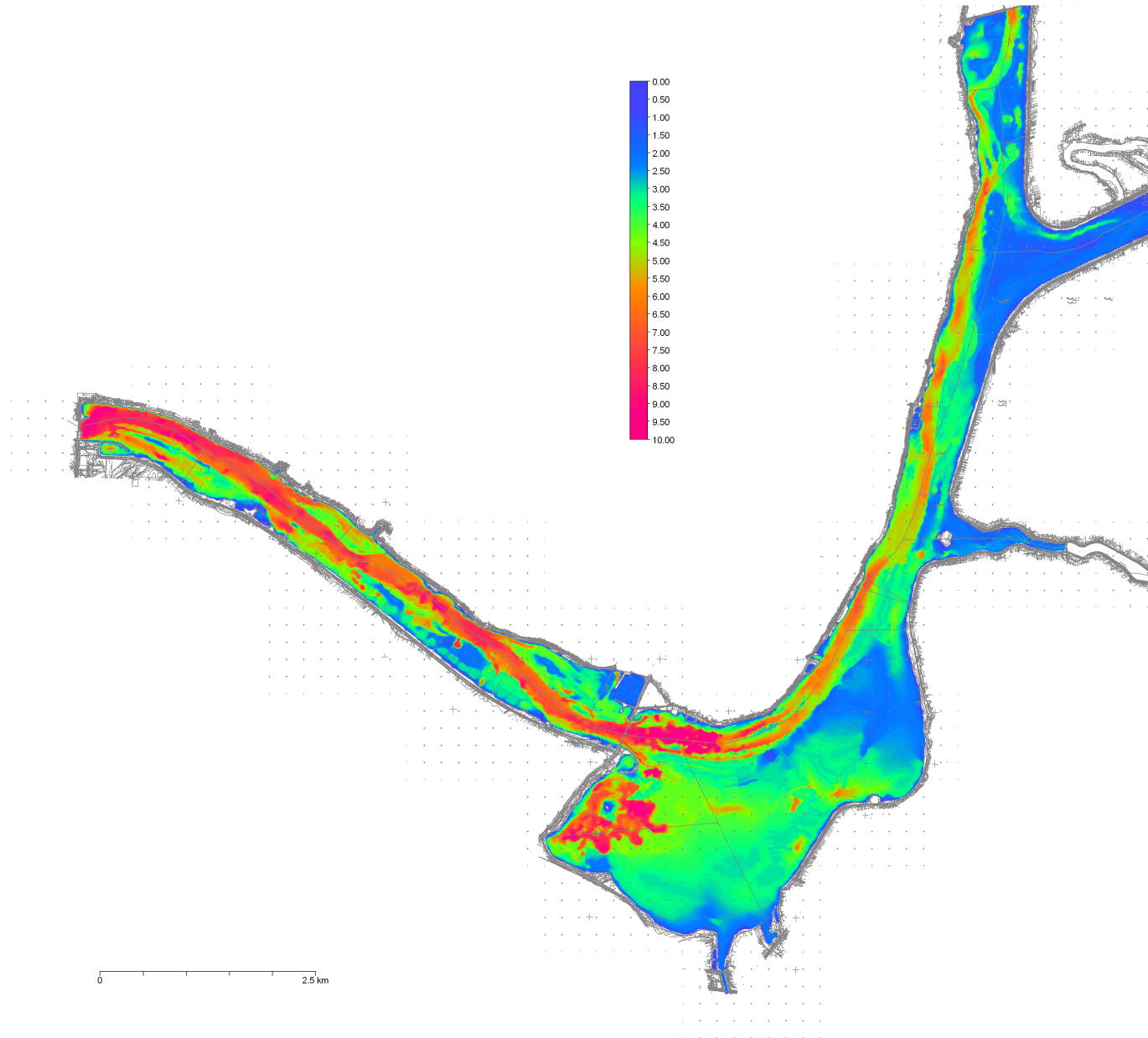


Germany -231, Netherlands – 327, Belgium – 134, France – 67 (million tons)

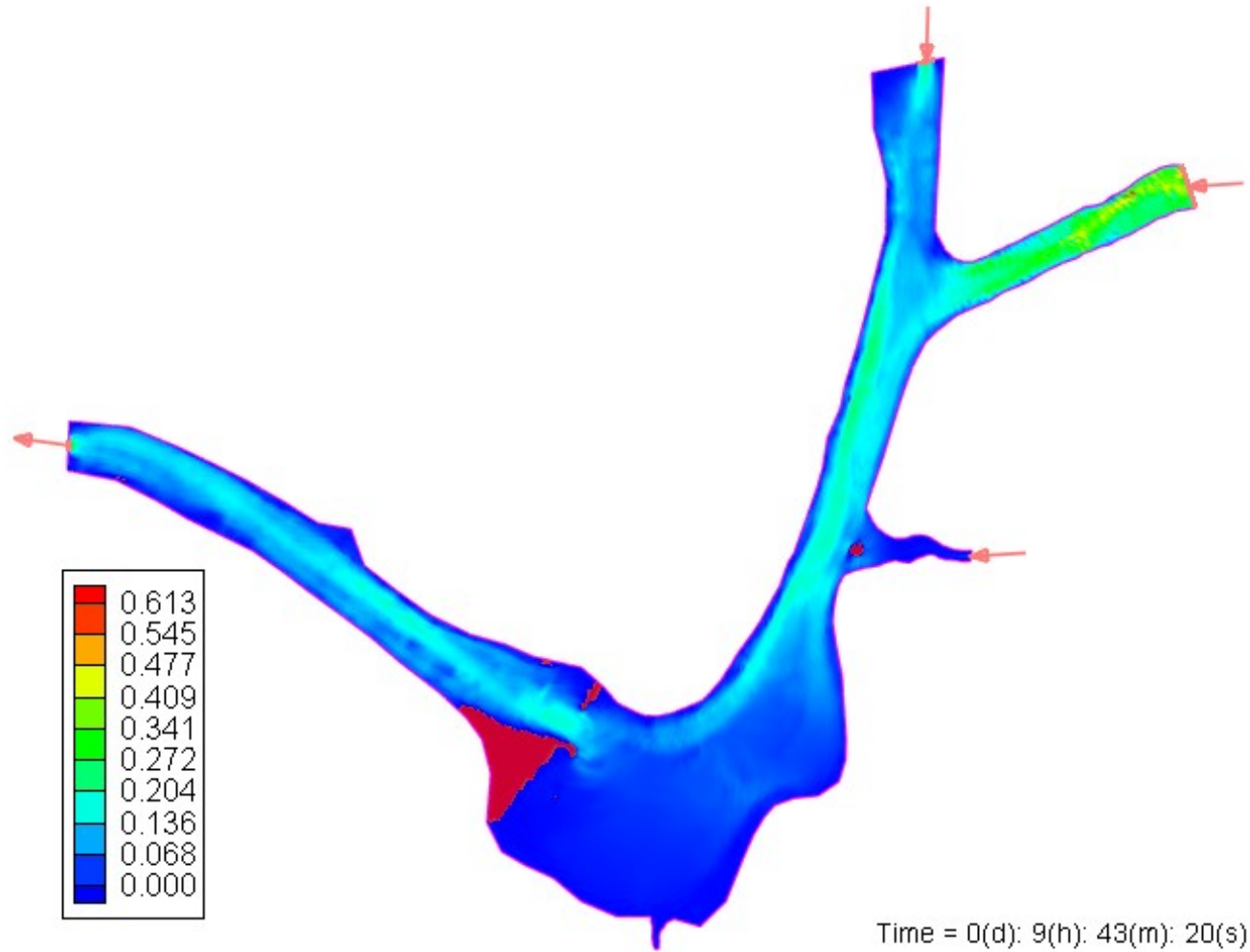
AGN - European Agreement on Main Inland Waterways of International Importance (**Accord Europeen sur les Grandes Voies Navigables d'importance Internationale**)



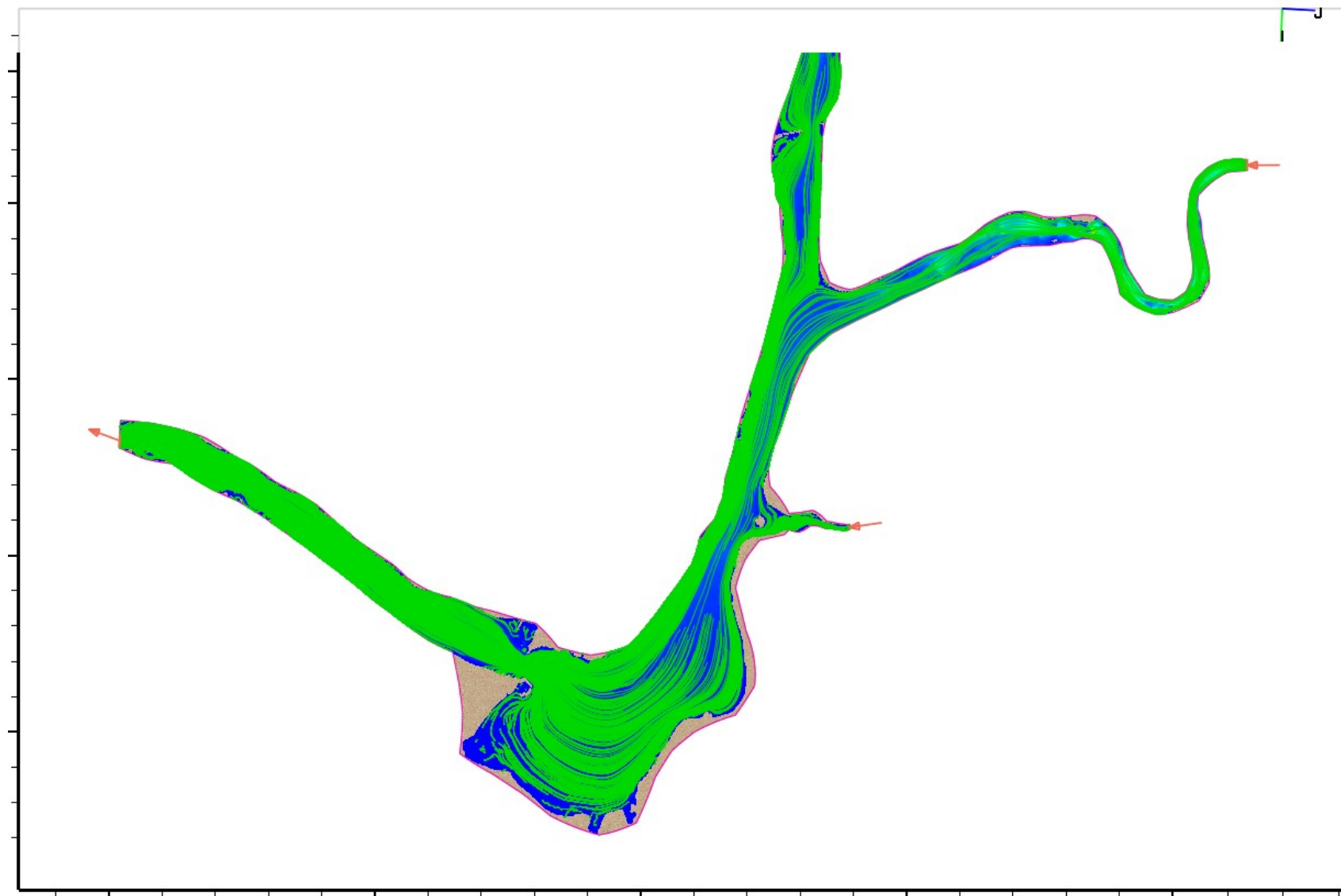
Bathymetric map 2004



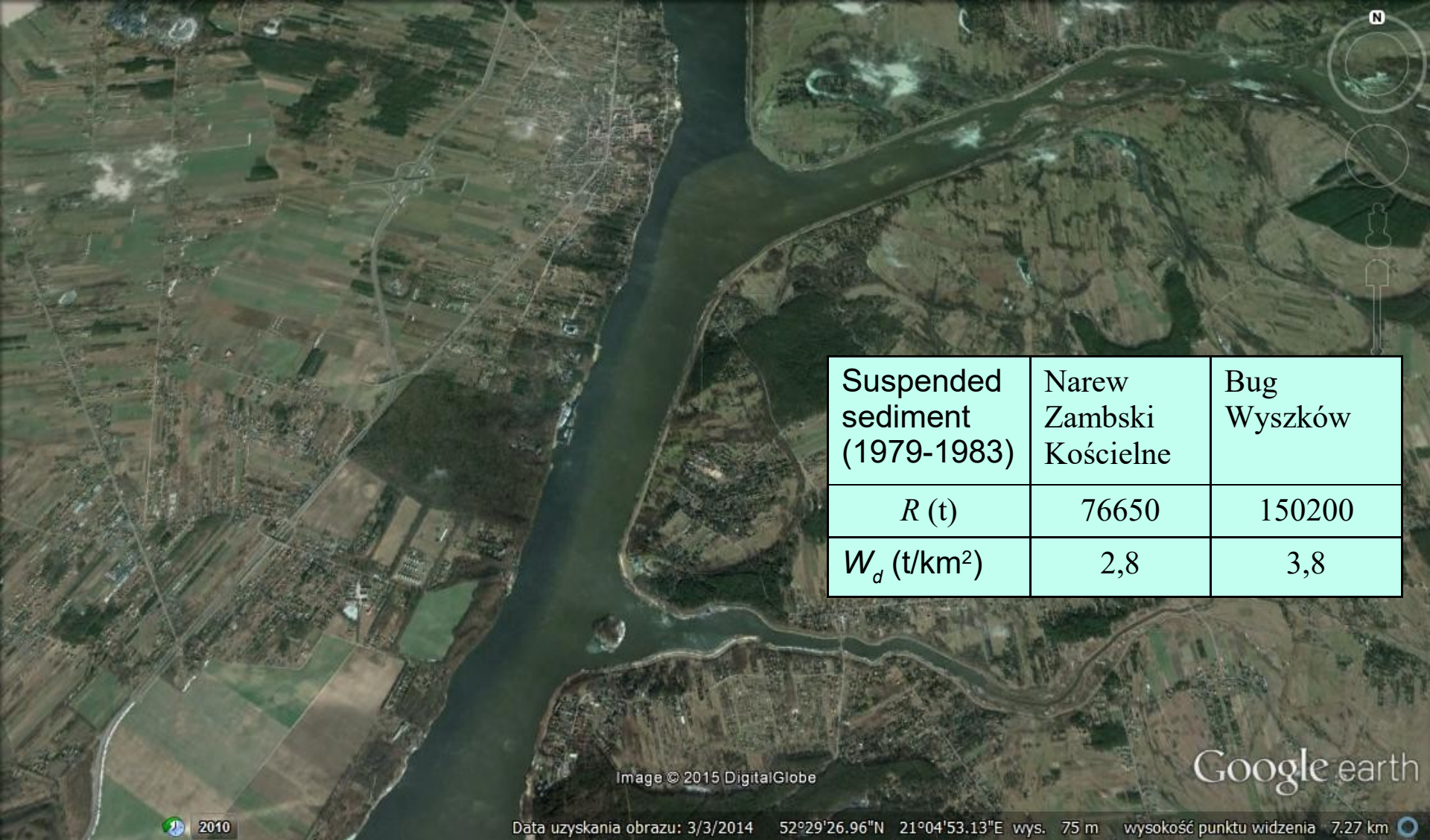
Velocity Magnitude (m/s)



Velocity distribution from CCHE2D model



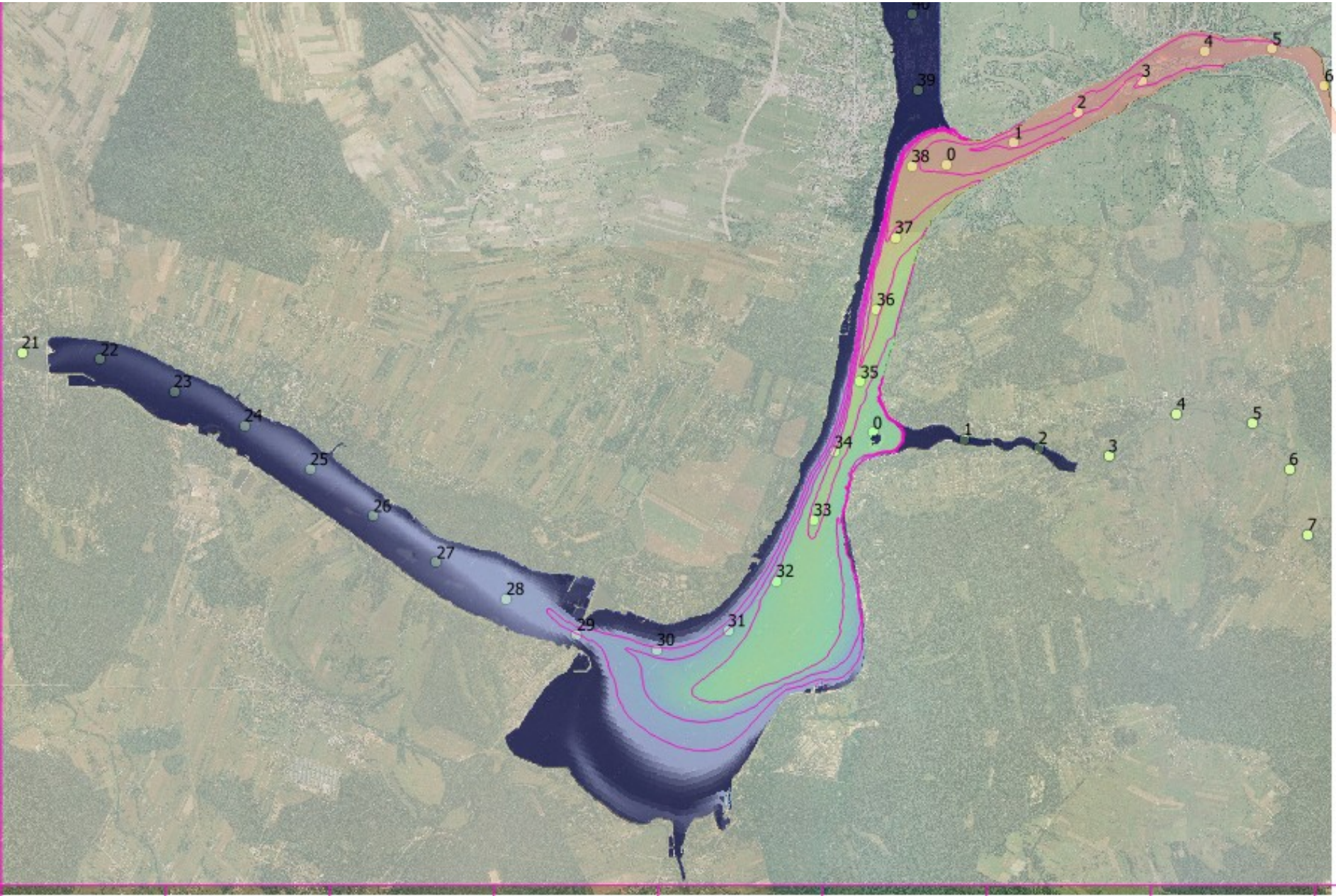
Flow lines from CCHE2D



Narew and Bug rivers confluence in the reservoir

(Google Earth)

Suspended sediment concentration by CCHE2D model



Hyperspectral image AISA i HySpex

AISA – 3.08.2013



HySpex – 2.10.2015



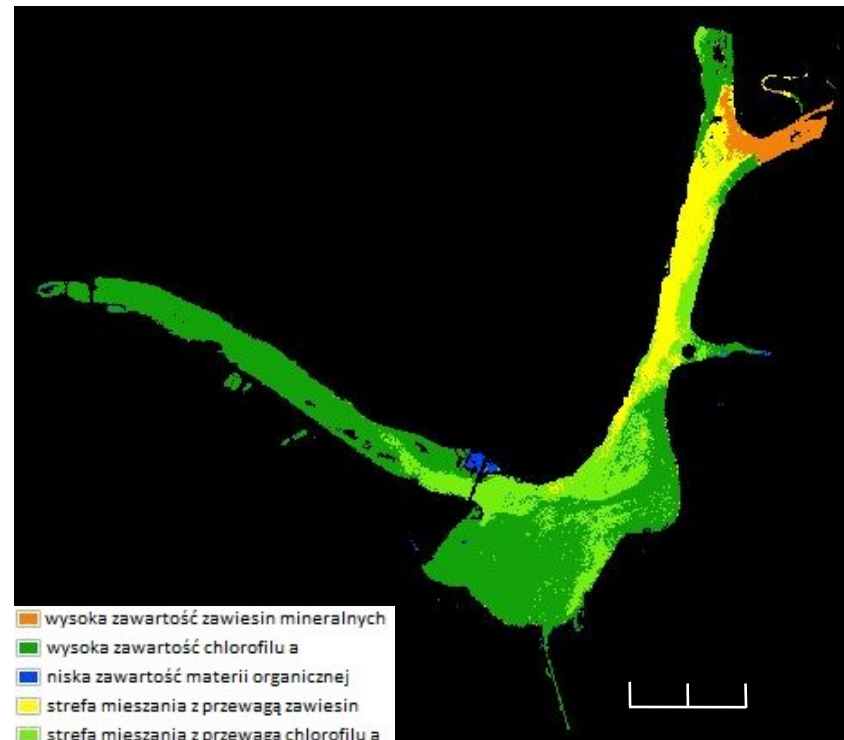
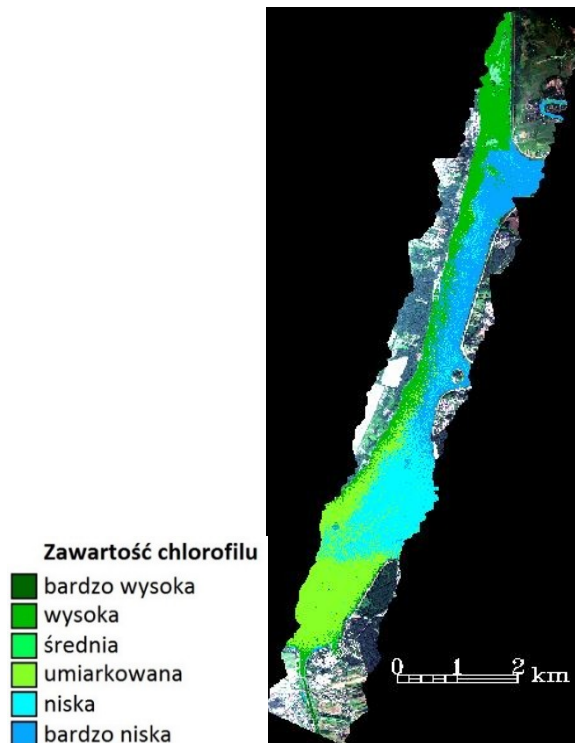
Parametr	AISA <i>Eagle</i>	HySpex
Time of image recording	3.08.2013	2.10.2015
Spatial resolution	1,5 m	2 m
Radiometric resolution	12 bitów	16 bitów
Spectral resolution	401-997 nm	416-2510 nm
No. of canals	129	451

AISA – 3.08.2013

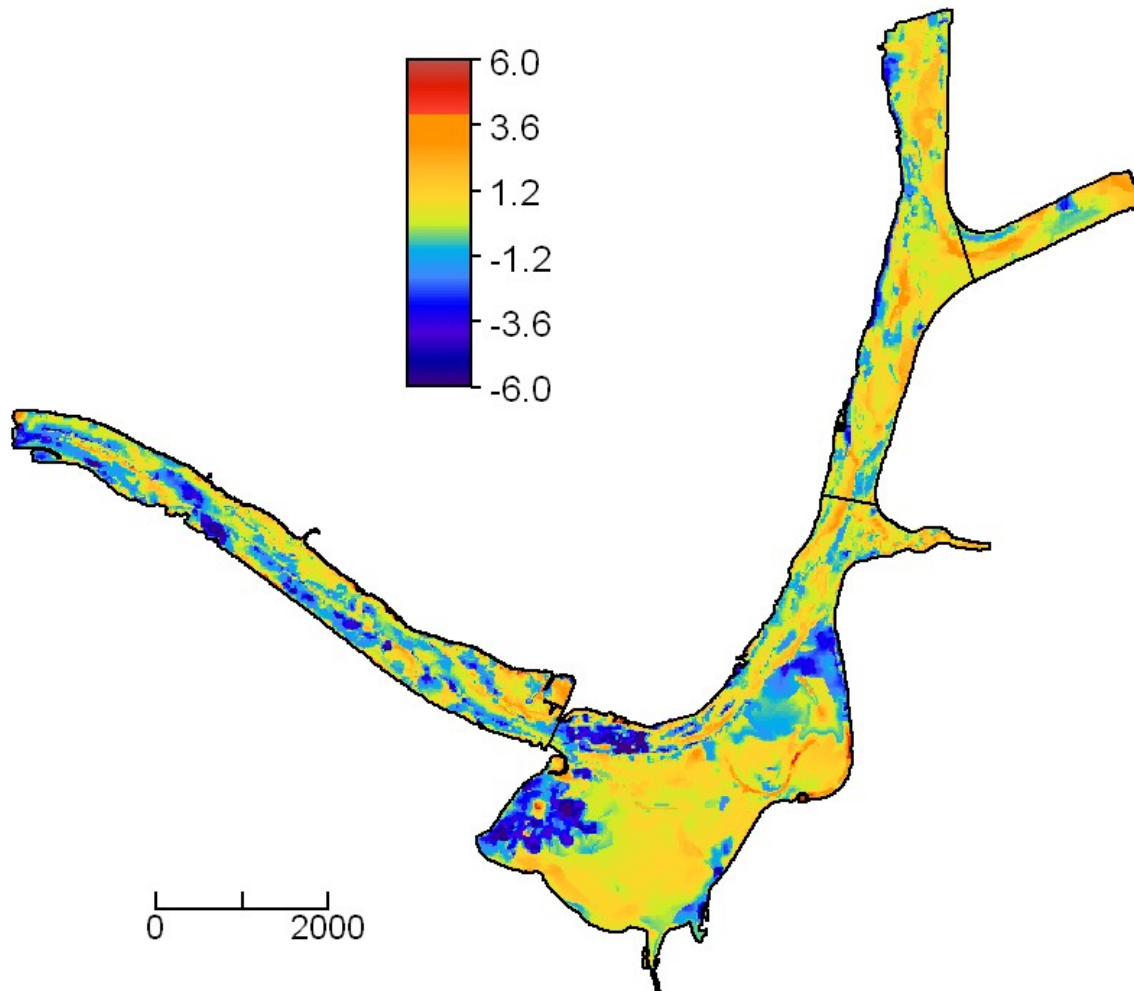
Unsupervised classification
IsoData

HySpex – 2.10.2015

Supervised classification
Support Vector Machine

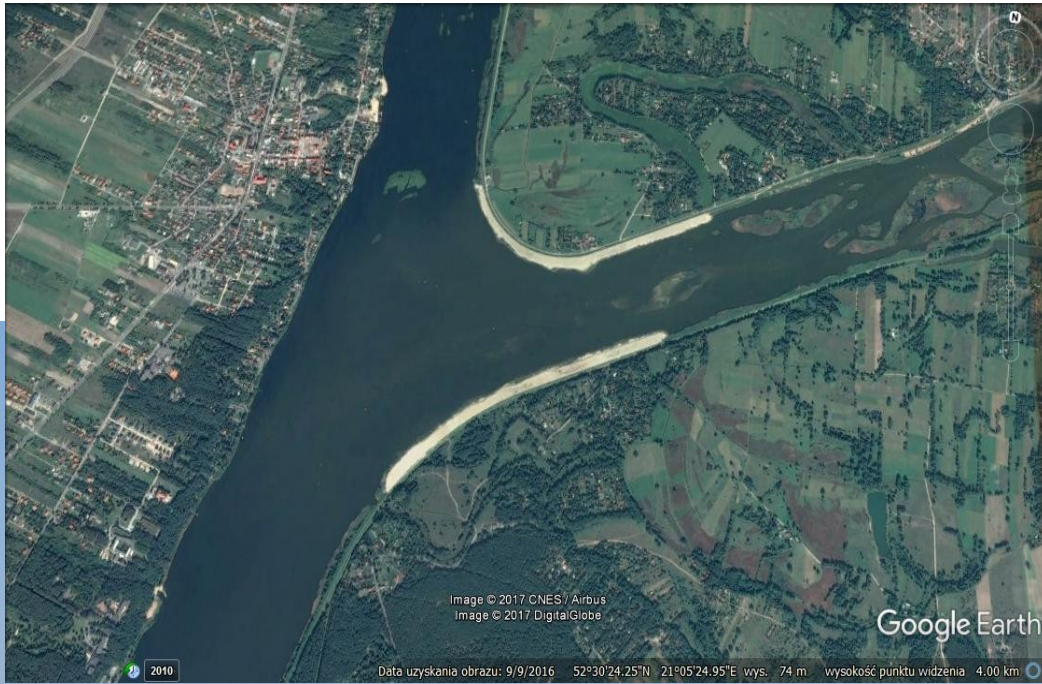


Sabat et. al, 2017

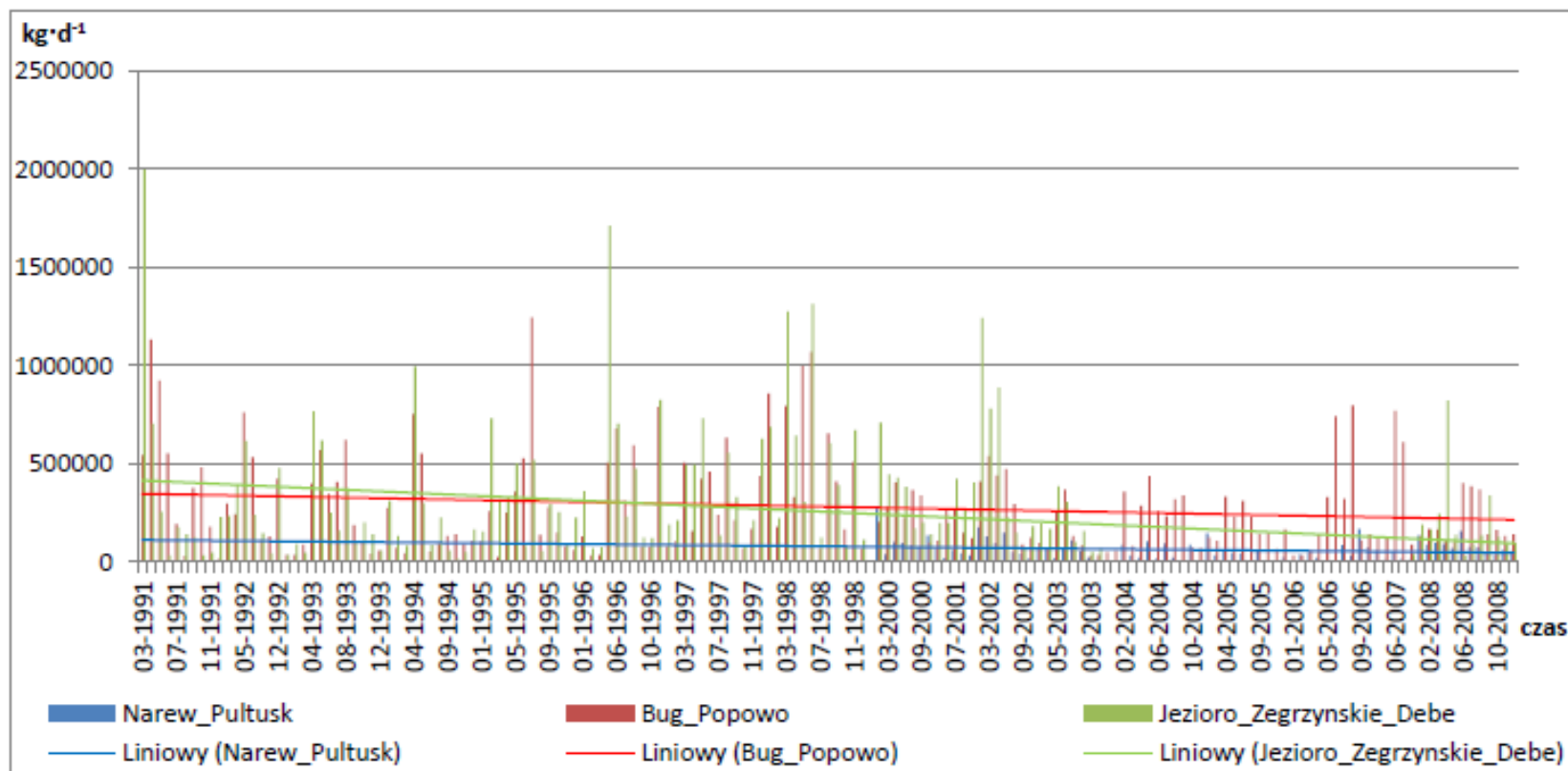


Bed elevation change 1963-2004

Dredging works at Bug mouth



Load of suspended sediment years 1991-2008



Rysunek 6.36. Ładunek zawiesiny ogólnej w profilach pomiarowo – kontrolnych: Narew – Pultusk, Bug – Popowo, Jezioro Zegrzyńskie – Dębe w latach 1991 – 2008

Warowna (2015)



Fot. Kacper Kowalski / aeromedia.pl dla MPWiK



MIEJSKIE PRZEDSIĘBIORSTWO
WODOCIĄGÓW I KANALIZACJI
W M. ST. WARSZAWIE SPÓŁKA AKCYJNA

Northern pipeline intake for Warsaw water supply instalation

Warsaw's Sea



(archiwum Hydroprojektu)



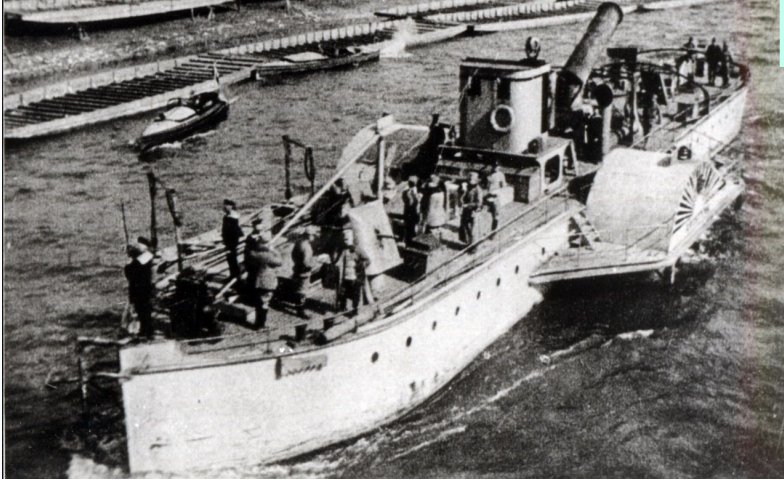
(Muzeum Sportu i Turystyki)



(T. Żero)



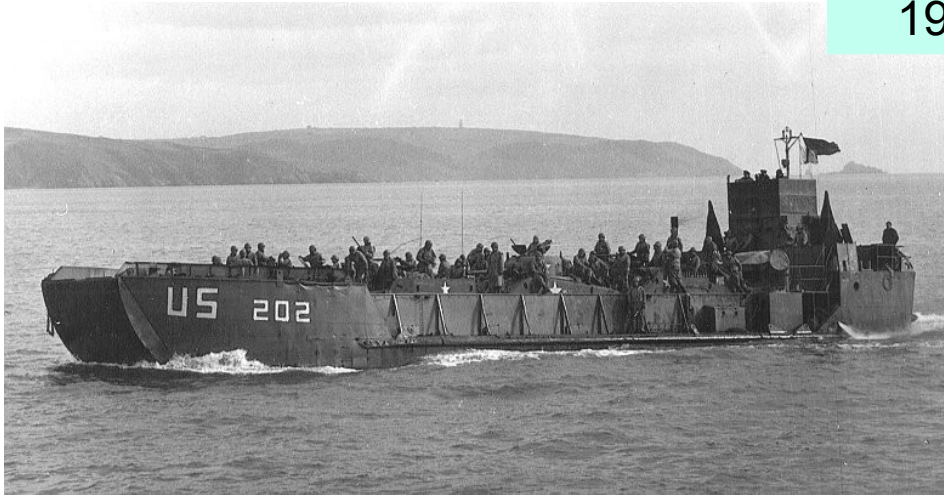
Dunajec
1903



Ziemowit
1907



LCT Mk 5
1942



1944 „Utah” Normandy



1957 „Teatr Ziemi Mazowieckiej”



1963 „Pomoc Wodna”

(http://en.wikipedia.org/wiki/Landing_craft_tank)
(<http://www.navsource.org/archives/10/18/180135.htm>)
(fot. M. Holzman, pocztówka ze zbiorów fotopolska.eu)

Fishing on Narew river can be impressive





Serock church / Narew River sight-seeing cruising

Napoleon army battle on Pultusk fields 26 XII 1806



fr. *la boue de Pultusk / l'hiver de Pologne*



Arc de triomphe - Paris



„war feeds the war”



Zegrze stronghold gun powder storage

E40 waterway ???

