



# WASTEWATER SYSTEMS IN SMALL RURAL AREAS IN CROATIA

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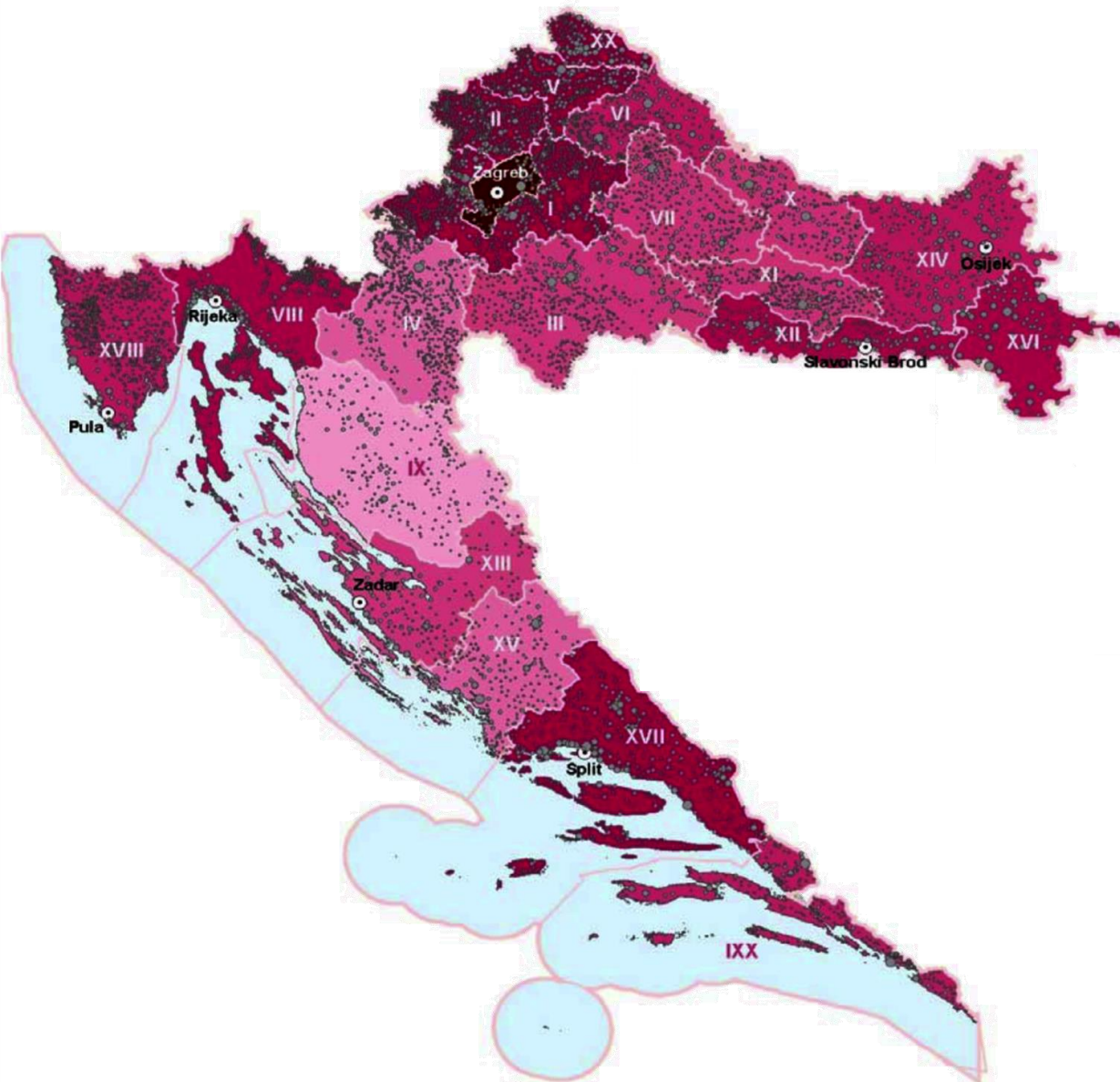
# Croatian population and settlements

## According to Census 2021:

- ❑ 3,878,981 inhabitants
- ❑ 6,562 settlements,
- ❑ 6,358 settlements with less than 2,000 inhabitants, making approx. 40% of the entire national population (1,497,588 inhabitants).



# Croatian population and settlements



Inhabitants / km<sup>2</sup>



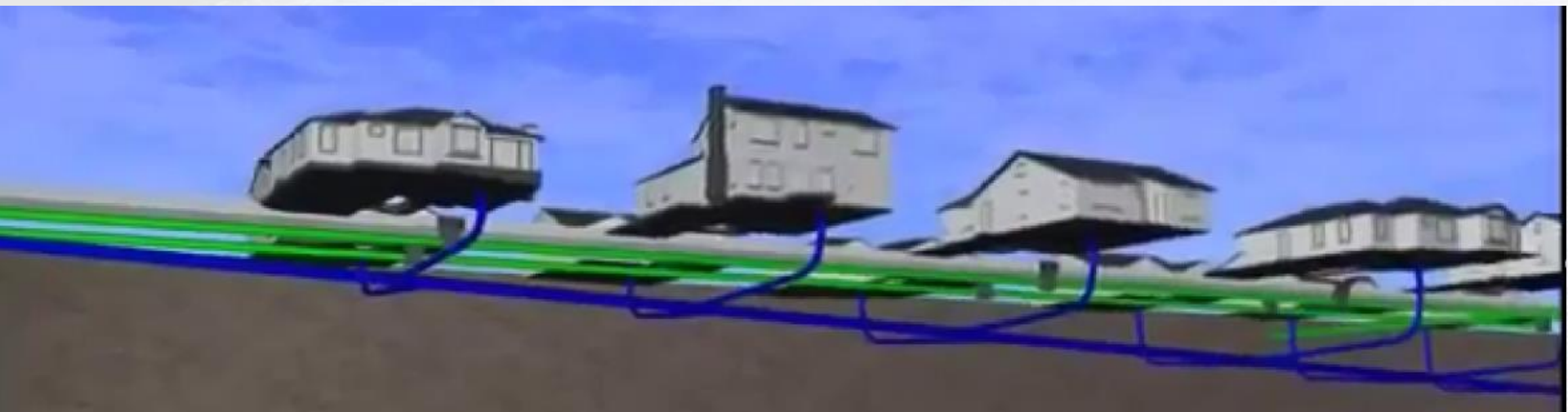
Number of inhabitants





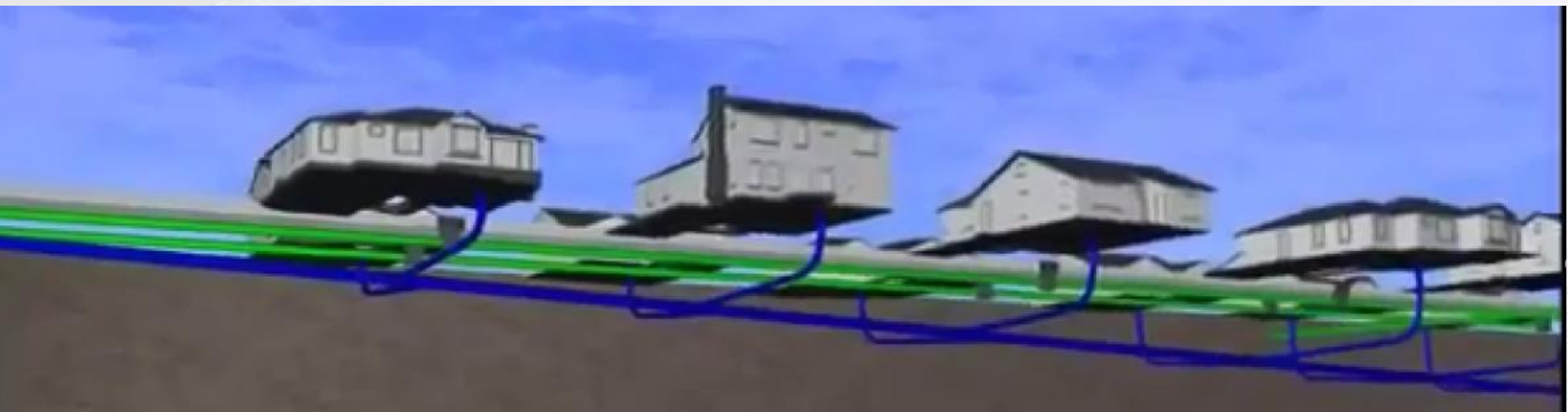
# Public sewer system development

- ❑ 55% of the population is connected to public sewage systems (approx. 1,750,000 inhabitants generate non-point sources of pollution into the environment)
- ❑ Public sewer systems are mainly related to urban centres,
- ❑ Croatian legislation does not define the standards for wastewater disposal in communities without public sewage systems.



# Public sewer system development

- ❑ Sewage systems in Croatia predominantly consist of the centralized gravity sewer network
- ❑ only approx. 44% of wastewater is treated,
- ❑ The problem of environmental pollution by wastewater from rural settlements is not considered a priority by the national legislation and national plans, and is left to local communities for solution.



# Public sewer system development

The basic characteristic of the construction of conventional gravity sewerage in smaller rural areas in Croatia

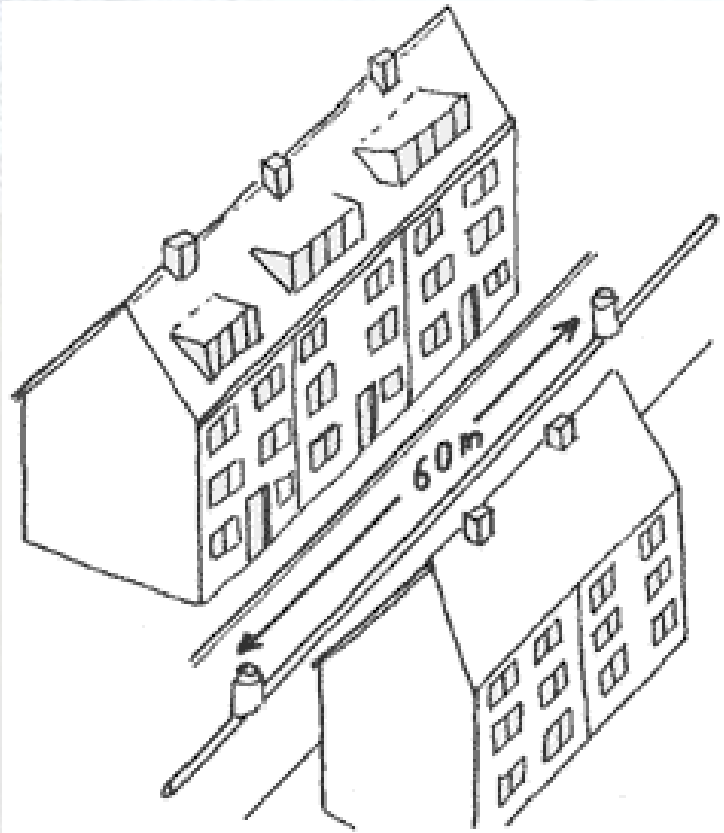


Greater the average length of pipelines per connected user

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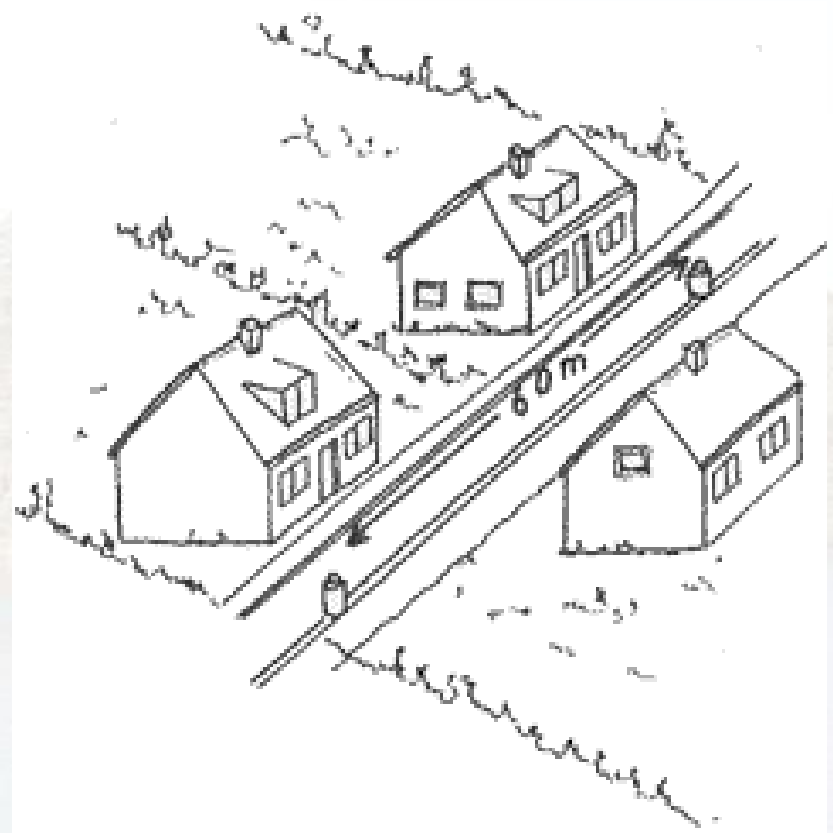
Higher unit investment costs of the system per connected user

# Public sewer system development



**Population: 120 inhabitants**  
**Population density:  $120 : 60 = 2 \text{ inh./m'}$**

**Cost of sewer network: 300 €/m'**  
**Cost of sewer network:  $300:2 = 150 \text{ €/inh.}$**



**Population: 9 inhabitants**  
**Population density:  $9 : 60 = 0,15 \text{ inh./m'}$**

**Cost of sewer network: 250 €/m'**  
**Cost of sewer network:  $250:0,15 = 1666 \text{ €/inh.}$**



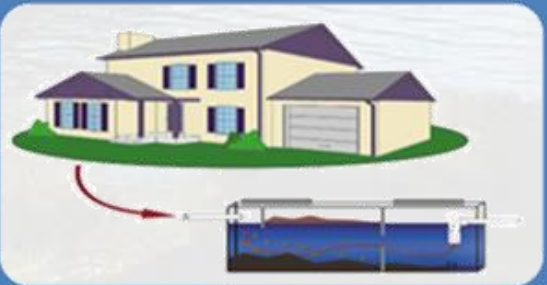
# Alternative wastewater collection systems



Vacuum sewer system



Pressure sewer system



Small diameter gravity sewer system





# Vacuum sewer system

- ❑ Settlements Županja, Galdovo, Rovinj, etc.
- ❑ One of the biggest vacuum sewer system in the world - Galdovo with 7,000 inhabitants connected





# Alternative wastewater collection systems

## Galdovo-Hrastelnica vacuum station





# Alternative wastewater treatment systems

## Onsite treatment – bioreactor units



# Alternative wastewater treatment systems

## Zone treatment – constructed wetlands





# Alternative wastewater treatment systems

## Kašteliir-Labinci constructed wetland (2000 PE)





# Alternative wastewater treatment systems

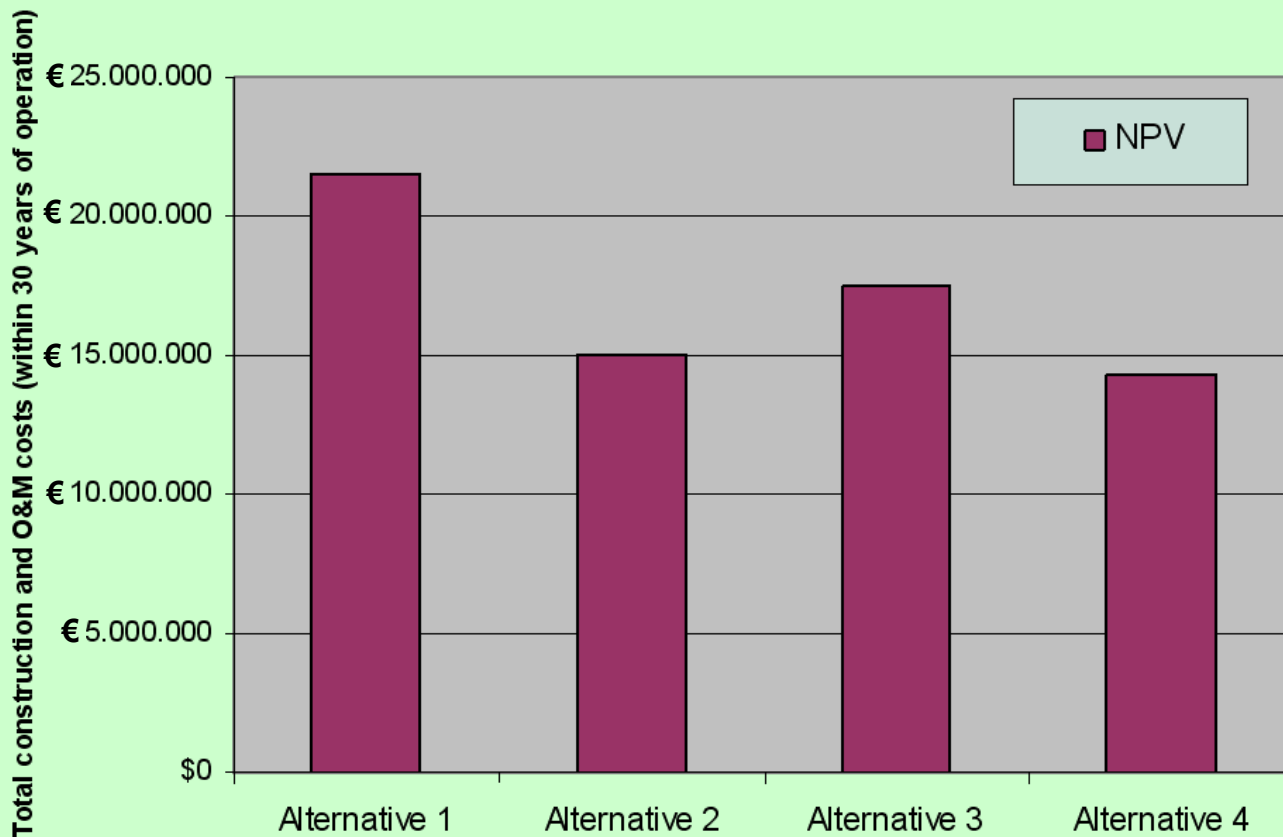
## Zone treatment – rotating biological contactors





# Economic analysis done by GF

The results of the economic analysis show great advantage of decentralized solutions, with the highest advantage on the zone system with vacuum sewerage and constructed wetlands and onsite treatment system with aerobic treatment units.



*Comparative net present values of analyzed alternatives*



**Thank you for your attention!**