## Current situation

Characteristics of Semerang:
- located in central Java
- Population of 1.8 million people
- Landscapes existing of lowland (polder) and coastal area (north part) and hilly area (south part)
- Indonesia's seventh most populous city
- Growing trade and industy
- Urbanization
- Business district and schools
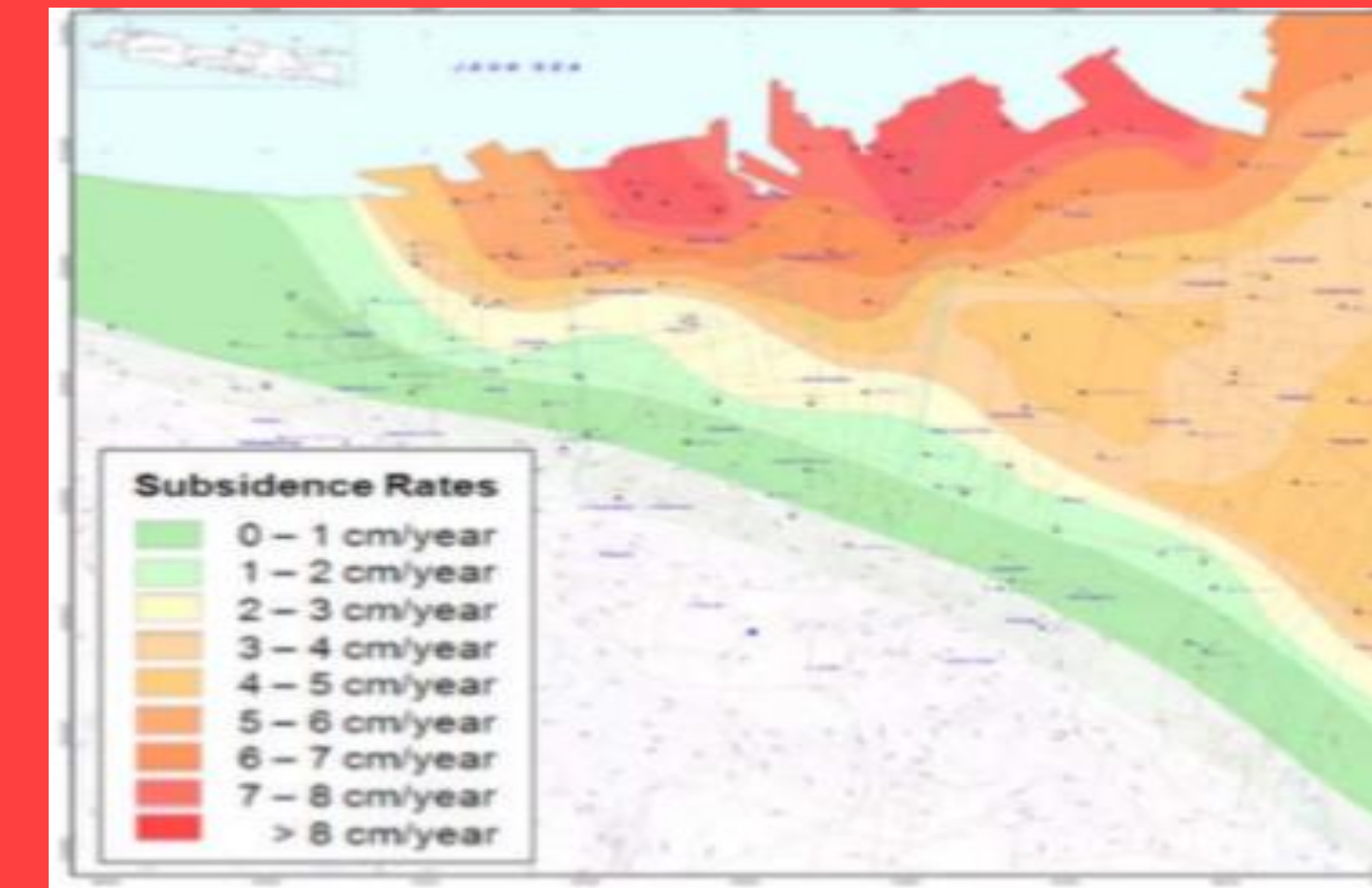- Semerang lays on the Indonesian National Route 1

Current situation
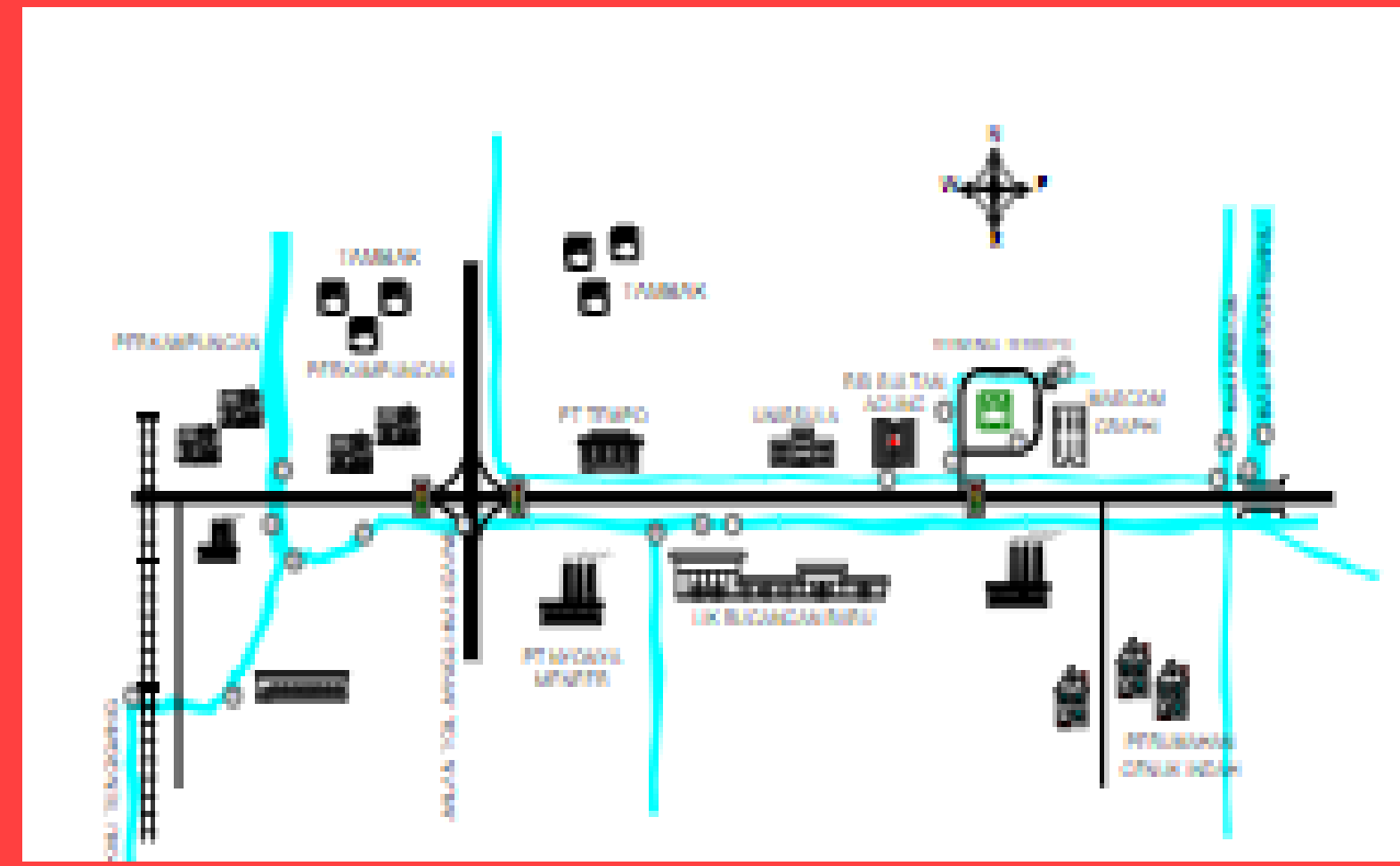
Technical problems

Detected:
- Land Subsidence between 1 to 17 cm/year
- Caused by natural consolidation of soil and the load of buildings and structures.
- Groundwater extraction (Growing population)
- Coastal flooding
- Economic losses
- Buildings and infrastructures get affected (Maintenance cost)
- The living environment is affected

Technical problems

Subsidence Rates
- 0 – 1 cm/year
- 1 – 2 cm/year
- 2 – 3 cm/year
- 3 – 4 cm/year
- 4 – 5 cm/year
- 5 – 6 cm/year
- 6 – 7 cm/year
- 7 – 8 cm/year
- > 8 cm/year

Technical team

Multidimensional team:
- Van hall Larenstein University of applied sciences
- Avans University of applied scienes
- Land and water management
- Civil engineering
- Minor hydraulic engineering (Hogeschool Rotterdam)

How to build a road with extreme subsidence?

Why does the sea level continue rise, while the ground continues sink below us?

I feel that it is a bit different, but how it is different is hard to say. And especially in the Indonesian place Semerang.

Start point

I think i know, we as people are going to weigh more. As a result, the ground below us collapses, with the reslut that the water in the sea is being pushed up.

I think that, this could be a nice subject for a good research.

Social problem

Detected:
- Undesirable situations
- public space is badly connected with each other
- Flooding living environment
- Loss of humans lives, loss of livestock, damage to houses, crop destruction and los of functioning infrastructure
- Providing people with there daly needs becomes hard
- Disrupting of the water quality
- Psygically problems
- Loosing trust political board

Execution of the subsicense calculation

Koppejan method:
- Calculation method for the soil settlement
- Ground parameters need to bedetermined
- Cone penetration test
- Ground information at the KUBRO market
- By means of the excel sheets, ground subsidence is determined
- Outcomes are compared with D-sheet
- Indication that excel sheet functions properly
- Most suitable construction, PlasticRoad

Technical ideas

Ideas:
- Subsidence of the ground is influenced by the load of the road construction
- Lightweight constructions
  - Infiltration box
  - PlasticRoad
  - Lava stones
  - Bamboo chips

New road construction	
Chosen solution	5
Height of top road related to layer 1	1,4
Load (KN/m2)	15,05
Time of subsidence	3650

Fill in the number of days for subsidence calculation

Subsidence calculation table

Layer	Layer thickness	Preconsolidation pressure	Σ oeffective grain pressure (KN/m2)	k̄	Cp	Cs	C'p	C's	Subsidence	Σ Subsidence
Clay weak, silty	6,0	0	25	12	50	340	30	270	0,221	0,423
Clay , silty	6,0	0	67	46	59	240	12	110	0,197	0,202
Loose Sand, silty	4,0	0	107	87	300	1E+09	550	1E+09	0,001	0,005
Medium Sand	6,0	0	161	134	600	1E+09	200	1E+09	0,003	0,004
Coarse Sand	3,0	0	188	174	1800	1E+09	600	1E+09	0,000	0,000
								Total subsidence		0,423

Innovative construction	Land subsidence after 10 years (m)
Traditional asphalt unbounded foundation	0,681
Asphalt + infiltration crates	0,599
Asphalt + lava stones	0,624
Asphalt + bamboo chips	0,534
PlasticRoad +sand	0,432
PlasticRoad + bamboo chips	0,502

Technical solution, PlasticRoad

PlasticRoad:
- Construction that is based on recycled plastic
- After realization the construction does not need a lot of maintenance
- Relatively longer live time
- The height of the construction is easy to adjust with bamboo chips
- Subsidence of 0.432m