Latvia-Estonia cross-border cooperation programme 2007-2013 "Coastal and marine spatial planning of the Gulf of Pärnu in Estonia and Latvian coastal municipalities"

Methodological material "Guidelines for coastal erosion mitigation" (identification No. KPR 2013/12/EU43084)

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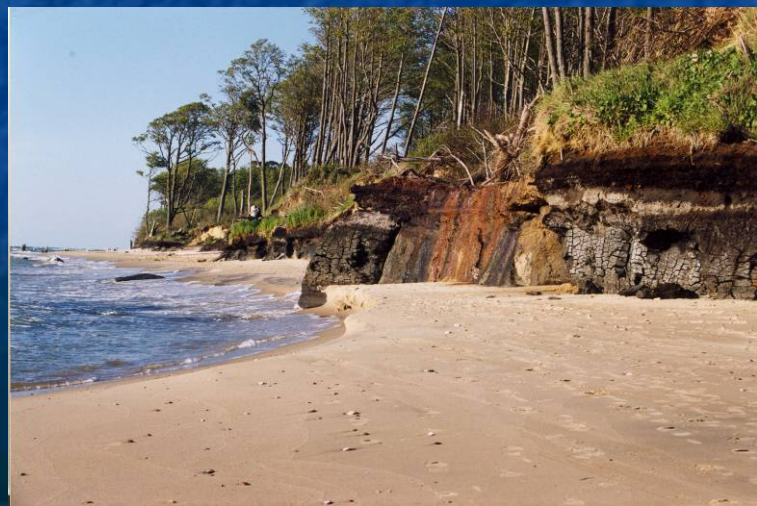

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Target for "Guidelines for coastal erosion mitigation"

- Providing of support to coastal municipalities and landowners in decision-making, territory management and development planning in order to reduce negative consequences of the coastal erosion.
- Target groups are: coastal municipalities, spatial planners, landowners and users, environmental specialists and state institutions.
- Research area: the Baltic Sea and the Gulf of Riga coast in planning regions of Kurzeme and Riga.

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Is coastal erosion an issue in Latvia (or will it be in future)?

- The total length of the coastal sections, where the coastline is retreating today is:
  - 0,1 – 0,5 m/year ~ 120 km;
  - 0,6 – 1,5 m/year ~ 50 km;
  - 1,6 – 3,5 m/year ~10 km.

It is expected that due to coastal retreat territory of Latvia will be reduced by about 9.2 km^2 by year 2060.

- Common trends over the last 20 years, refers to the increasing activity of the coastal processes – there are both increase in the length of coastal sections subjected to erosion and increase in overall retreat rate.
  - There are two main reasons for this: the coastal system is experiencing growing deficit of sediment supply (mostly due to anthropogenic intervention); climate change related stressors in the system.

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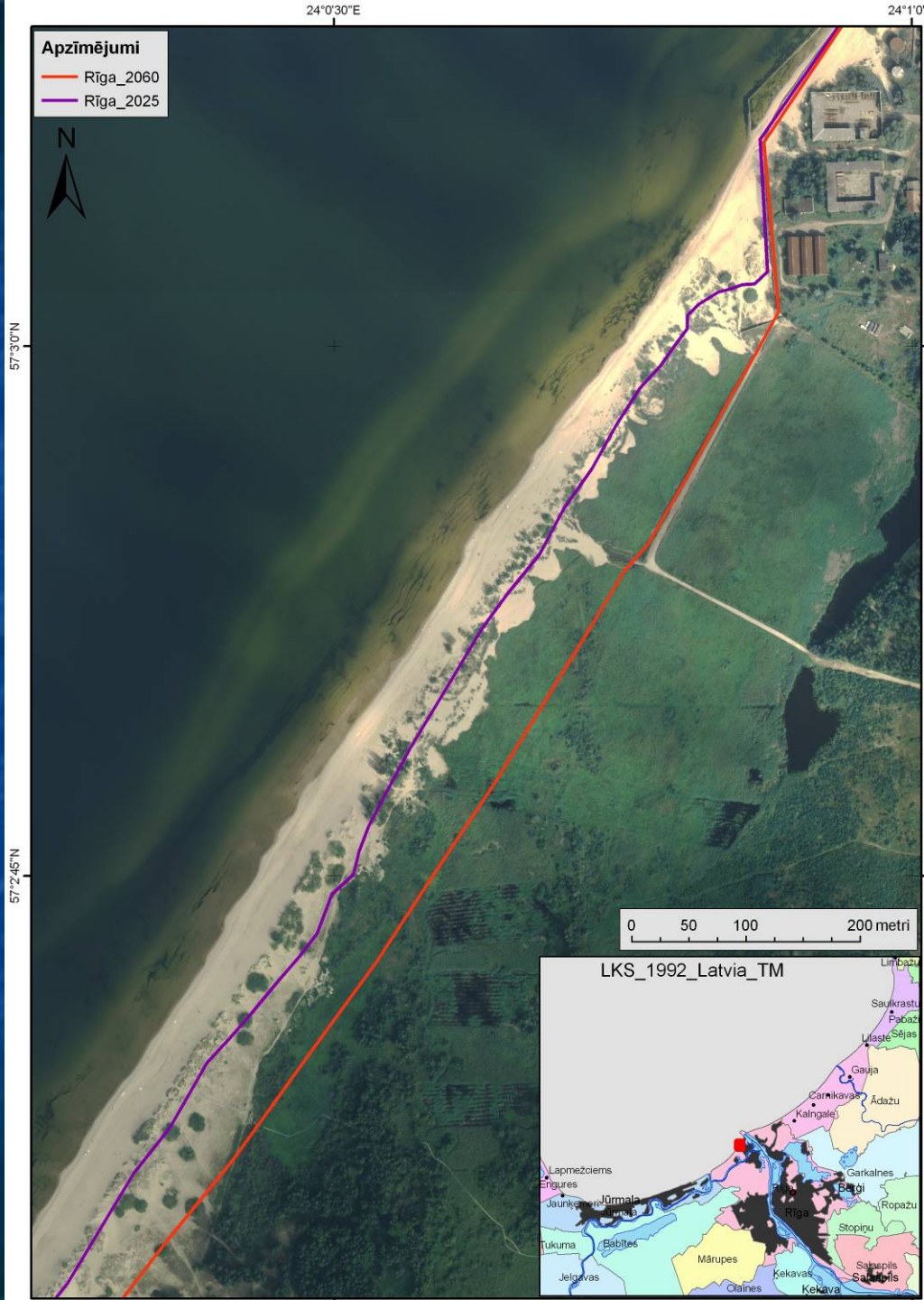
Preparation of Guidelines took place on the basis of the analysis of a wide range of field work material and previously collected data sets, the most important being **data from coastal geological processes monitoring system of Latvia covering time span of the last 24 years**.

Coastal retreat forecast was developed taking into account results from National Research Programme KALME (carried out from 2006 to 2009) and updated on the basis of instrumentally measured coastal changes during the period from year 2010 to 2014.

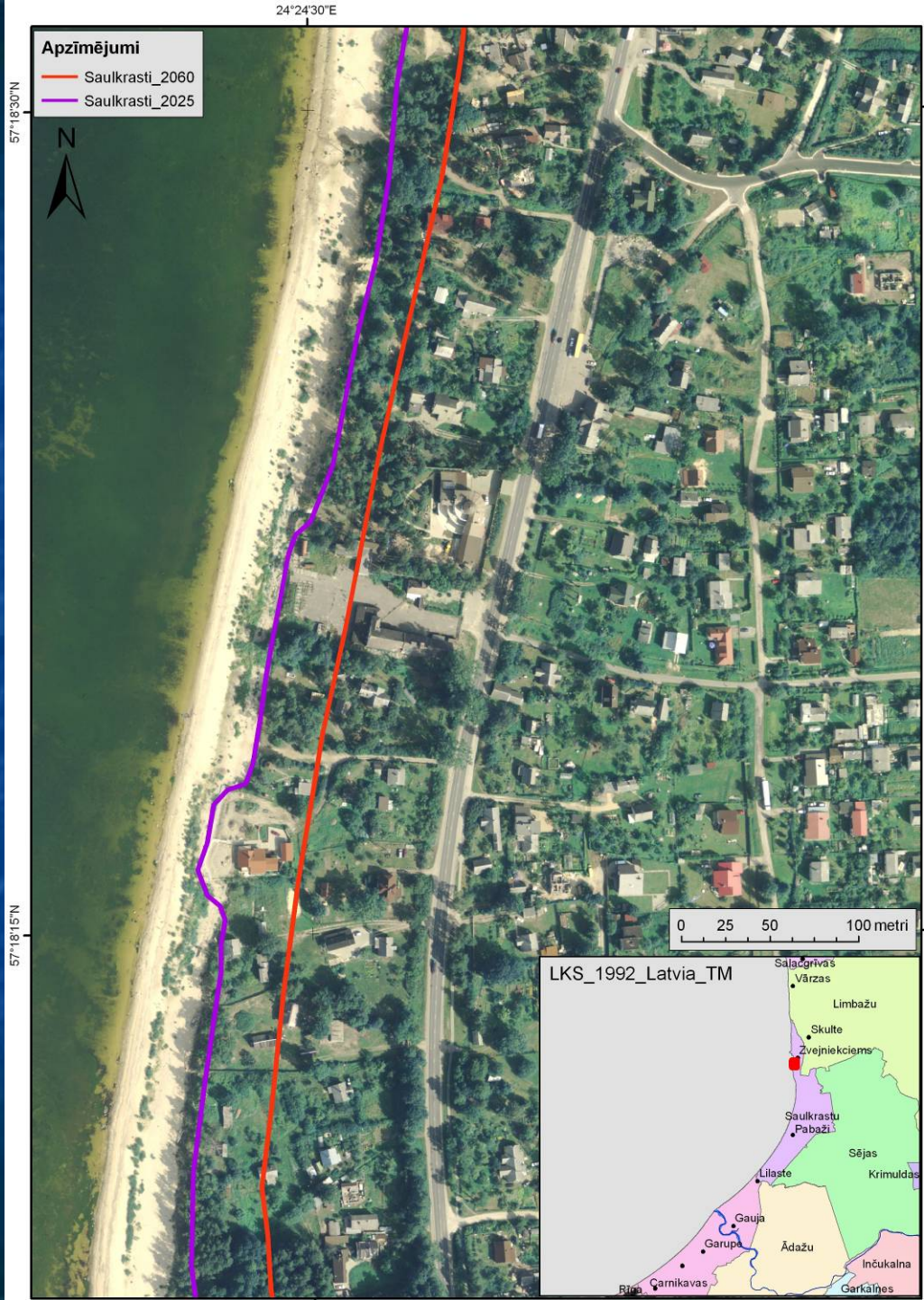
Coastal retreat forecast (examples)

- forecast (projection) for expected coastal retreat maximum in 2025 and 2060 at the NE part of the Daugavgrīva island (Rīga city municipality)



Coastal retreat forecast (examples)

- forecast (projection) for expected coastal retreat maximum in 2025 and 2060 at the southern part of Zvejniekciems town



Coastal retreat forecast (examples)

Jomas iela

Lašu iela

forecast (projection) for expected coastal retreat maximum in 2060 at the SE part of Roja town

Coastal retreat forecast (examples)

forecast (projection) for expected coastal retreat maximum in 2060 at the Nida village

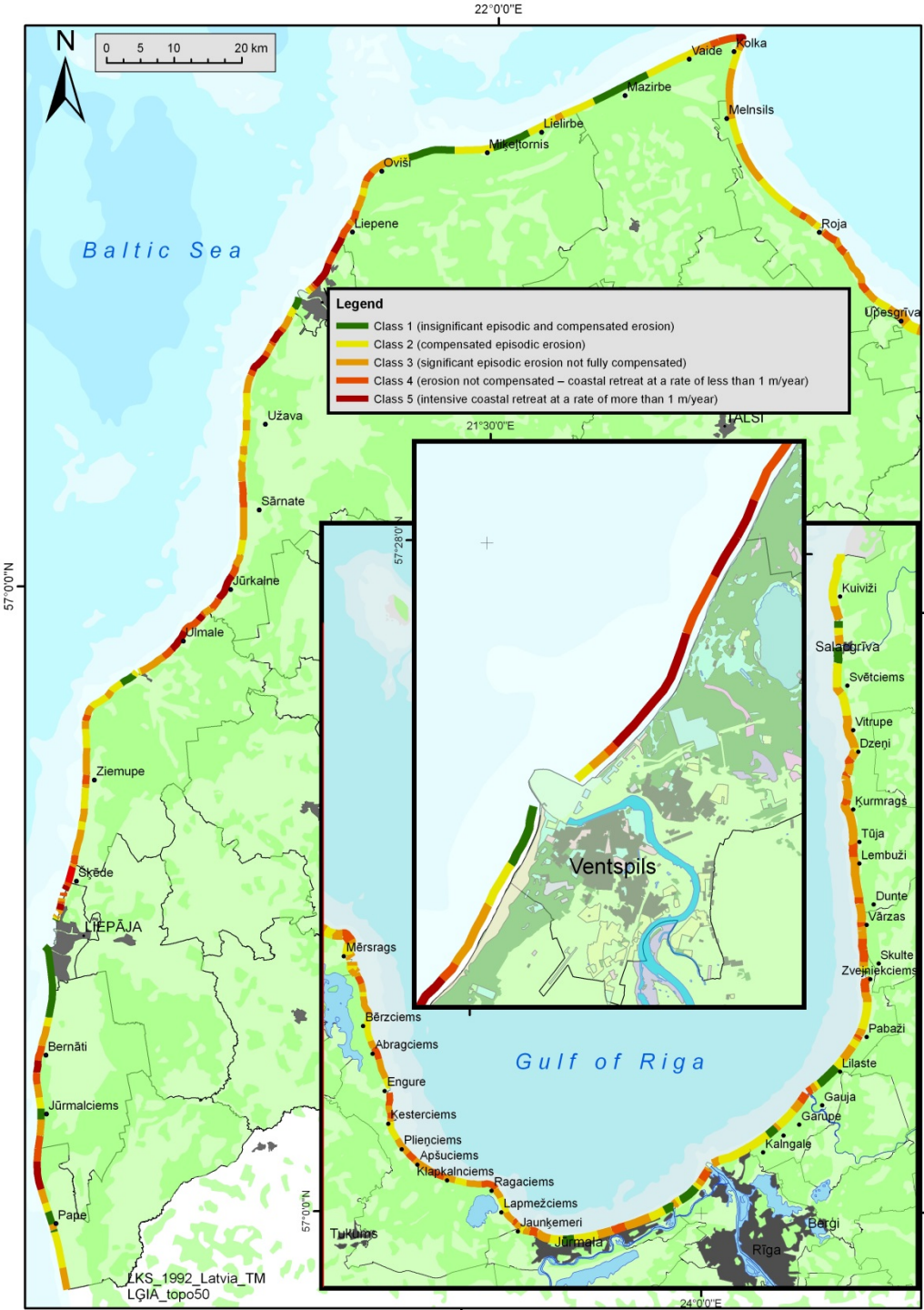
(~1 km to the N from border with Lithuania)

Apzīmējumi

rucava_2060

Classes of the coastal erosion risk level in Latvia, with a resolution of 50-100 m in situ

Five generalized coastal types (classes) were separated, each characterized by a **different degree of erosion risk**



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Erosion risk levels (class descriptions)

- **Class 1** corresponds to coastal sections with well-developed fore-dune (or dune field) and extensive fine sediment beach.
- Within a few years after the storm episode coastal profile regains its pre-storm shape and in the long term, there is a pronounced prevalence of accumulation over erosion.
- Possibility of significant coastal erosion only during extremely powerful storm/hurricane (probability <5%/year).
- Development of permanent coastal retreat during the next 50 years is extremely unlikely.

Class 1

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Erosion risk levels (class descriptions)

- **Class 2** corresponds to coastal sections with a relatively well-developed fore-dune and where the beach width is generally greater than 30 m.
- Recovery after a catastrophic storm events takes a long time (3-6 years).
- In the long term there are very little prevalance of accumulation over erosion.
- Probability of significant erosion episode - 5-20%/year.

Class 2

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Erosion risk levels (class descriptions)

- **Class 3** corresponds to coastal sections with a low and fragmented fore-dunes and chronic, but mildly expressed sediment deficit.
- In many cases low intensity of the erosion is due to beneficial geological structure of the coastal slope (resistance to wave action).
- Recovery after erosion usually occurs very slowly and incompletely, as a result, in the long term there is a very slow (0.1-0.3 m/year) retreat.
- Expected coastal erosion "*penetration*" in one episode is 2-10 m.
- Probability of significant erosion episode - 10-20%/year.

Class 3

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Erosion risk levels (class descriptions)

- **Class 4** corresponds to coastal sections which nowadays has virtually no aeolian accumulation (fore-dunes or embrional dunes).
- Inland boundary of coastal strip is marked by bluff or cliff face.
- During periods between the storms recovery of the coastal slope is practically nonexistent.
- The average coastal retreat rate reaches 0.3 to 0.7 m/year. Expected coastal erosion "penetration" in one episode is 2-10 m.
- Probability of significant erosion episode - 10-30%/year.
- During particularly severe storms (probability <10%/year) erosion "penetration" may exceed 10 m.

Class 4

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Erosion risk levels (class descriptions)

- **Class 5** corresponds to coastal sections, which nowadays is characterized by a very pronounced sediment deficit and lack of any aeolian accumulation whatsoever.
- Narrow and coarse sedimented beach is bordered by cliff/bluff face. These sections usually are located in areas affected by more frequent SW and W storm events (W Kurzeme coast).
- During periods between the storms, recovery of the coastal slope is practically nonexistent.
- The average coastal retreat rate reaches 1.0 to 1.7 m/year). Probability of significant erosion episode – 20-50%/year.
- Expected coastal erosion "penetration" in one episode is 2-15 m. During particularly strong storms (probability <10%/year) erosion "penetration" may exceed 15 m.

Class 5

Distribution of the coastal sections with different erosion risk level and expected retreat maximum in the coastal municipalities of Latvia

Municipality		Total length of the coastal sections with the highest erosion risk classes nowadays (km)			Total length of erosion risk sections by 2025 (km)	Coastal erosion „penetration" or retreat maximum by 2025 (m)	Total length of erosion risk sections by 2060 (km)	Coastal erosion „penetration" or retreat maximum by 2060 (m)
		Class 5	Class 4	Class 3				
Rucava		4,1	3,0	5,0	12,3	7-12	19,0	40-80
Nīca		1,8	5,9	6,8	14,9	20-30	15,4	100-200
Liepāja city		1,6	1,7	1,3	4,8	15-20	5,1	100-180
Grobiņa		-	2,4	0,4	2,8	15-20	2,8	30-60
Pāvilosta	Vērgale parish	-	2,8	10,7	13,5	4-9	13,5	30-40
	Sakas par.	4,1	5,6	7,7	17,5	7-10	18,0	40-80
	Pāvilosta town	-	-	0,7	0,7	10-15	1,0	40-50
Ventspils	Jūrkalnes par.	4,1	3,6	2,6	10,9	8-22	13,0	90-110
	Užavas par.	-	3,9	13,2	17,6	8-15	23,2	25-50
	Vārves par.	4,7	2,6	3,2	10,7	15-20	11,4	70-110
	Tārgales par.	1,1	5,4	8,4	15,3	5-12	17,0	60-90
Ventspils city		5,3	2,1	0,6	8,0	10-25	8,3	60-110
Dundaga		1,0	4,8	8,0	14,3	10-30	17,0	15-100
Roja		-	5,7	22,4	28,9	8-12	32,3	25-50
Mērsrags		-	1,4	7,0	9,0	5-12	9,9	30-50
Engure	Engure par.	-	8,1	16,5	25,8	10-15	28,0	30-40
	Lapmežciems par.	-	3,9	7,0	11,5	10-15	13,1	30-60
Jūrmala city		-	3,2	9,3	12,9	10-15	15,0	30-60
Rīga city		-	1,6	2,9	4,8	3-8	5,5	20-100?
Carnikava		-	2,2	2,7	5,3	20-30	6,8	50-90
Saulkrasti		-	4,6	5,7	11,5	7-15	14,0	25-60
Limbaži		-	2,3	3,6	5,9	2-6	5,9	10-25
Salacgrī-va	Liepupe par.	-	3,8	13,7	17,5	3-10	17,5	20-50
	Salacgrīva	-	1,1	12,1	16,2	5-10	18,5	10-40
	Ainaži	-	-	-	0	?	0?	0-10?
Σ:		27,8	81,7	171,5	292,6	→	331,2	

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Global experience in mitigating and limiting the effects of coastal erosion

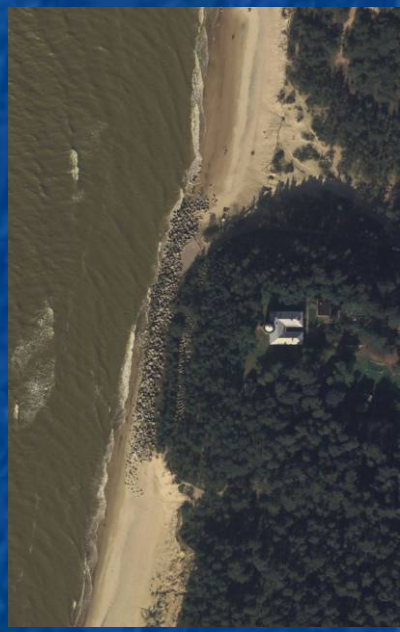
Among the main recommendations for management of coastal erosion the most important is **restoring the sediment balance and providing space for coastal processes.**

Taking into account the complexity of issues of coastal erosion and aspects related to environmental protection, as well as the risks associated with problem of high irreducible uncertainty of such a huge natural process, **non-intervention strategy is highest priority** from all the possible coastal erosion management strategies. Therefore prioritization should be as follows:

1. No intervention (adaptation);
2. Non-invasive or minimally invasive anti-erosion measures (dune planting, beach nourishment and other "soft" measures);
3. "Aggressive" anti-erosion measures (structures) with relatively short service life and short "cowered" length of the coastline;
4. Highly "aggressive" measures (seawalls, impermeable groins) with long lifetime and high level of coastal alteration.

Current coastal defenses and mitigation of the effects of erosion in Latvia

- Outside of the port areas there are about 5.3 km of coastal sections in Latvia witch are strengthened or protected by massive and semi-massive methods (revetments, gabions, sea-walls etc.);
  - Length of each particular coastal protection structure usually is very small (50-500 m) and all belong to passive structure types, therefore negative impact is occurring very locally. Nevertheless structures cause typical consequences – beach instability and intensification of erosion in adjacent coastal sections.
  - <40% of the existing coastal protection structures can ensure some level of short term or partial protection of the endangered objects. Most are inappropriate for local situation and are in bad shape.



Current coastal defenses and mitigation of the effects of erosion in Latvia
Case study area Pāvilosta town

- Taking into account extreme erosion which took place during the 2001 storm, in the NE part of Pāvilosta beach 100 m long protection structure in form of wire basket filled with boulders (gabions) were installed.
- In January 2005, during hurricane «Gudrun» a swell intensity and wind surge level was consistent with 2-5% probability. Lower part of structure was substantially deformed during the storm and lost its functionality. Sea-facing side of the gabion perched for 0.3 to 1.1 m.
- The biggest disadvantage is associated with acceleration of erosion behind the ends of the structure, and, in particular – to the NE.

Current coastal defenses and mitigation of the effects of erosion in Latvia
Case study area Engure municipality

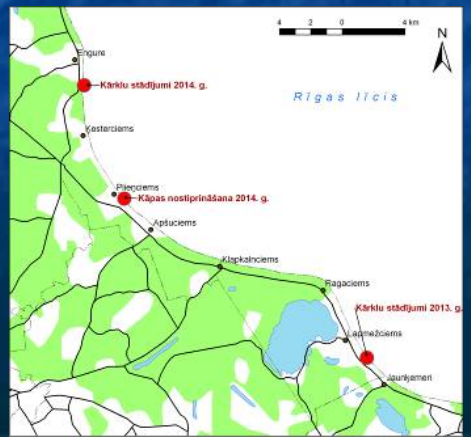
- Experience with coastal anti-erosion and mitigation measures in Engure county extends quite far in the past. In many cases osier plantings, as well as simple passive reinforcement installation using mainly natural materials there has been applied at least during the last 50 years.
- Effectiveness of applied measures varies in a very wide range – and is tended to depend on the initial coastal erosion intensity of a given location.
- In areas with higher erosion rate at the outset, application of the anti-erosion measures has caused further amplification of erosion rate and overall beach instability.
- Efficiency of osier plantations in most cases is rather low.
- It can be argued that osier plantings, like massive defenses, but to a much lesser extent, degrades the overall coastal system stability, indirectly increasing the risk of erosion in adjacent coastal sections.
- In addition to this, "overgrown" fore-dunes are not attractive to beach visitors.

Current coastal defenses and mitigation of the effects of erosion in Latvia

Case study area Engure municipality

Evaluation of direct impact and overall effectiveness of aeolian accumulation "boosters" – osier hedge planting in Bigauņciems:

- plantings took place in May 2013,
- the total length of hedge – 700 m,
- width of planting strips (rows) – 0.6-0.8 m,
- location of hedge – parallel to the coastline, at the highest part of the beach ,
- planting material – osier branches 3-5 cm in diameter (>5 years old sprouts),
- the distance between the plants – 0.8-1.0 m,
- species - sand osier (*Salix daphnoides*),
- rooting success in the autumn of 2013 – 93%,
- damaged and dead plants in the autumn of 2014 – 12-15%;
- sand accumulation above background levels in two years -- 0.01-0.03 m^3/m.



Recommendations for coastal erosion management (according to the erosion risk) I

- **Class 1. Any measures of coastal protection are not recommended.** Exceptions to this are coastal sections where wind erosion develops due to extremely high recreational load or other degrading human activity.

- **Class 2. Any measures of coastal protection are not recommended.** It is recommended to organize and limit the movement of beach visitors via boardwalks and fences in foredune area, as well as episodic dune vegetation replanting (once every 3-5 years or after the severe storm event) **to compensate for the interference caused by the recreational load in affected sections**.

Recommendations for coastal erosion management II

- **Class 3.** Coastal protection is **permitted** only to those sections of coast **where buildings or permanent infrastructure features are located within the year 2025 erosion risk area or close (<5 m) to it (this also applies to the class 4 and 5).** If the coastal section is extensively used for recreational purposes or associated with protected nature areas, any anti-erosion structures installation is not recommended. Prioritization of applicable measures as follows:
  - Episodic nourishment of upper part of the coastal slope with the appropriate (site-specific) fine-grained material (sand);
  - "Green", aeolian accumulation facilitating measures (osier and dune grass planting) and the conservation of the existing dune vegetation (fencing, pedestrian boardwalks, fascine mats etc;
  - In exceptional cases using of simplified eased type (boulder revetments and other structures made of unconnected elements) of invasive anti-erosion measures can be permitted in very short (<100 m) sections, making compulsory implementation of compensatory measures (priorities 1 and 2). The proportion of “covered” area within coastal section of given erosion risk class is limited to 5%.

Recommendations for coastal erosion management III

- **Class 4.** Coastal protection is permitted only to those sections of coast where the above-mentioned objects are in the risk area or close (<5 m in the Gulf of Riga and <10 m in the Baltic Sea). Priority of applicable measures as follows:
  - Moderate intensity coastal nourishment. In coastal sections where acceleration of erosion rate is mainly due to the disruption of longshore sediment circulation by harbour external hydrotechnical structures, unambiguously the most appropriate solution to be considered is utilization of the uncontaminated sediments dredged in harbour and access channel maintenance works (this applies to all risk classes);
  - In cases where despite of deficiency the coast is dominated by natural fine grained sediments, it is recommended to apply "after the storm repairs" – green measures to promote recovery;
  - It is acceptable to use simplified type of invasive anti-erosion measures in a short (<300 m) sections. The proportion of "covered" area within coastal section of given erosion risk class is limited to 10%.

Recommendations for coastal erosion management IV

- **Class 5.** Coastal protection is permitted only to those sections of coast where the above-mentioned objects are in the risk area or close (<10 m). Priority of applicable measures as follows:
  - Nourishment at the rate of 20-50 m^3/m every 2-5 years (should be accompanied by "green" sand stabilization methods).
    - In other cases within the class 5 risk sections "green" methods is to be considered as useless. Recreational load impacts on coastal stability of this class are negligible, so the factor of temporary coastal infrastructure type and density is insignificant. Installation of temporary infrastructure shall be carried out with taking into account other environmental and nature conservation aspects and management convenience;
  - Simplified type of invasive anti-erosion measures;
  - Conventional anti-erosion structures with massive interconnected elements (gabions, sea walls, impermeable groins, steel sheet piling and other). Utilization of second and third priority measures is acceptable in less than 500 m long sections. The proportion of "covered" area within coastal section of given erosion risk class is limited to 10%.

KURZEMES PLĀNOŠANAS REĢIONS

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