



Interreg



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**Cross-boundary evaluation and management of lamprey stocks in
Lithuania and Latvia
(LAMPREY) LLI-310**

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**Rivers ranked according to available potential for
spawning of river lamprey and proposed improvement
measures to secure river connectivity**

Lithuania, Klaipėda and Telšiai counties

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1. Rank of rivers

20 rivers of the coastal region with the greatest unused lamprey reproduction potential above the migration barriers are (in priority order): Blendžiava, Danė-Akmena, Šyša, Salantas, Pragulba, Viešтовė, Eketė, Šventoji, Sausdravas, Darba, Šata, Vilka, Mišupė, Karkluojė, Agluona, Žvelsa, Aisė, Alantas, Luoba, Smeltalė (Table 1).

Table 1. Rivers with the greatest unused lamprey reproduction potential in the coastal region

Rank	River	Accessible	Suitable	Index value	Priority class
1	Blendžiava	Yes	Yes	30.1	1 (high potential)
2	Danė-Akmena	Yes	Yes	24.4	1 (high potential)
3	Salantas	Yes	Yes	16.4	1 (high potential)
4	Šyša	Yes	Yes	16.2	1 (high potential)
5	Pragulba	Yes	Yes	8.3	2 (good potential)
6	Viešтовė	Yes	Yes	7.5	2 (good potential)
7	Eketė	Yes	Yes	3.3	3 (moderate potential)
8	Šventoji	Yes	Yes	3.1	3 (moderate potential)
9	Sausdravas	Yes	Yes	2.4	3 (moderate potential)
10	Darba	Yes	Yes	2.3	3 (moderate potential)
11	Šata	Yes	Yes	1.8	4 (low potential)
12	Vilka	Yes	Yes	1.4	4 (low potential)
13	Mišupė	Yes	Yes	1.4	4 (low potential)
14	Karkluojė	Yes	Yes	0.5	4 (low potential)
15	Agluona	Yes	Yes	0.4	4 (low potential)
16	Žvelsa	Yes	Yes	0.1	4 (low potential)
17	Aisė	Yes	Yes	0	4 (low potential)
18	Alantas	Yes	Yes	0	4 (low potential)
19	Luoba	Yes	Yes	0	4 (low potential)
20	Smeltalė	Yes	Yes	0	4 (low potential)

Based on the Index of potential for lamprey reproduction the ranked rivers can be separated into five classes. Class 1 (value of index >10) includes rivers with high unused lamprey reproduction potential upstream the barriers. Removal of migration obstacles and implementation mitigation improvement measures in these rivers would substantially increase the river lamprey recruitment and the rivers in this class have to be prioritized over the other. Class 2 (index from 5 to 10) can be characterized as a river with a good lamprey reproduction potential upstream the barrier. It is expected that mitigation measures in these rivers will improve the reproduction of river lamprey but in smaller extent than Class 1. Class 3 unites rivers with a moderate priority (index value from 2 to 5). These rivers, in general, are suitable for lamprey reproduction, yet due to an intensive modification of natural riverbed or presence of obstacles that under the specific condition the migration upstream is still possible. Class 4 (index <2) represents rivers with a small impact river lamprey reproduction potential. Barriers in these rivers do not have a

significant effect on river lamprey migration or the reproduction potential upstream is very low (this is well indicated by 0 values of Index values).

Planning and implementing mitigation improvement measures it is suggested to prioritise the measure following this ranking to increase the efficiency of implemented measures. However, if it comes to such mitigation improvement measures as removal of migration barriers or construction of fish passes we suggest the opportunistic approach. i.e., if due to some reasons improvement of mitigation of Class 1 is not possible, we suggest aiming for Class 2 or lower. In general, if the migration barrier is a manmade dam, the most beneficial measure from the lamprey perspective will always be the complete removal of this barrier and the second-best option will be the construction of natural bypass channel.

Materials and methods

Sources of information

The information on barriers for upstream migration was obtained while walking or kayaking along rivers. There have also been collected on habitat suitability for river lamprey spawning. According to collected information river there have been identified river stretches of good spawning condition (Habitat type 1 - a typical riffle pool habitats), medium spawning stretches (Habitat type 2 - the riffles suitable for spawning are present but uncommon due to big size of riverbed substrate or prevailing sandy substrates) and low (Habitat type 3 - no spawning habitats are present or there are too few and of low quality). Several data sources were also used to determine if river lampreys enter the particular river for spawning and to assess the existence of lamprey reproduction potential upstream each barrier.

Ranking of rivers for spawning potential above barriers

Rivers were ranked by calculation of the index of potential for lamprey reproduction.

It was a calculation of the index of the importance of the migration barriers for each identified barrier located in 20 most suitable rivers chosen in step 1. Index was calculated by specially developed formula: $II_{\text{barrier}} = (H_1 + H_2 / 2) \times IF_{\text{barrier}} + IF_{\text{barrier}} \times II_{\text{nextbarrier}} \times (1 - IF_{\text{nextbarrier}})$, where:

II_{barrier} – index of importance for each barrier

H_1 – habitat type 1

H_2 – habitat type 2

IF_{barrier} – impact factor of a barrier, from 0 (no impact) to 1 (unpassable)

$II_{\text{nextbarrier}}$ – calculated index of importance for barrier located upstream the next barrier

$IF_{\text{nextbarrier}}$ – impact factor for barrier located upstream, from 0 (no impact) to 1 (unpassable)

To rank the rivers in priority order, the indexes of individual barriers were summed up to get a total index of unused lamprey reproduction potential of all river. Rivers were then listed in accordance to the calculated value of this index. In all rivers, individual indexes for all identified barriers were calculated and included in the calculation of the total index.

2. Description of each river and proposed measures

2.1 Luoba River

General information

Priority class	Total index value	Value for individual barriers
4	0	No obstacles

Length of the river 52 km, the basin area 348 km². The source at Ivoniskes village, 5 km northwest from Seda town. Flows into the river Bartuva 49 km from its mouth at Skuodas town. The average slope of the riverbed of this stream is 1.92 m/km. Approximately 3.6 km of the upper section of riverbed has been straightened while along the rest of the riverbed is natural. All the small tributaries are also straightened and the largest ones are also partially straightened. It is the only of studied rivers that have relatively open migration routes and the only obstacles that were observed were beaver dams located in straightened or nearby sections of the river.

Suitability for lamprey reproduction

Luoba River and its several tributaries are the only rivers of Bartuva/Barta basin in Lithuanian territory that can be accessed by migratory fish. The mix of a swift flowing and slower sections provide river lamprey with both spawning and rearing habitats. The electrofishing inventories carried in the river indicate presence of lamprey ammocoetes and salmonids.

2.2 Šata River

General information

Priority class	Total index value	Value for individual barriers		
4	1.8	1	Former Lyksūdė watermill dam	1.8
		2	Collapsed Lukošaičiai water mill dam	0
		3	Beaver dam	0
		4	Collapsed Derkinčiai earthen dam	0
		5	Beaver dam	0
		6	Beaver dam	0

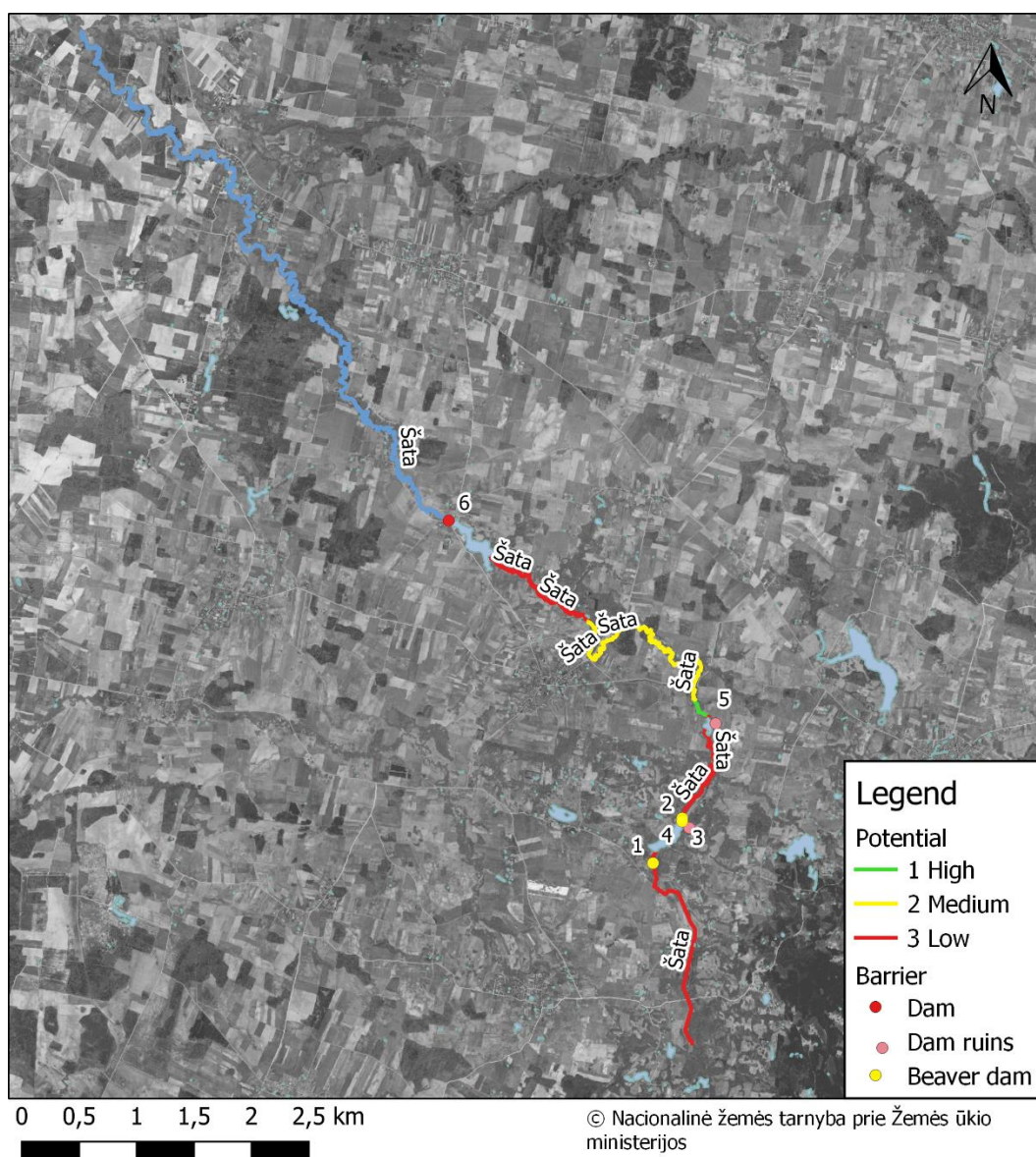


Figure1. Šata River and location of barriers



Figure 2. Former Lyksūdė watermill dam

Šata River is a left coast tributary of Luoba River. This river starts approximately 7 km southeast from Norėnai in the surroundings of Šliktinė village (Fig. 1). The total length of this stream reach 31 km and its catchment area covers 103.5 km². In upper reach, 4 km of this river is straightened and bears several migration barriers of mixed nature. The uppermost barrier is a well-positioned beaver dam that creates a 1.2 ha water reservoir it is followed by the washed away Derkinčiai dam that which is partially fixed by beavers. Another possible downstream barrier is a collapsed dam of Lukošaičiai mill which constantly being fixed by beavers, however, at the time of inventory part of a large beaver dam was washed downstream. The biggest and impassable migration barrier in Šata river is Lyksūdė dam and the water head of the dam is 4.5 m.

Suitability for lamprey reproduction

River lamprey accumulations below the Lyksūde dam is observed annually during the spawning period and illegal collection of spawners is present. Currently, there is only 0.5 km of river section noteworthy for lamprey reproduction upstream the Lyksūde dam (Fig. 2). However, the habitats are degraded due to a cascade of dams and sediment accumulation as well as very intensive beaver activities in the river. In case complete dam and dam remains removal could greatly improve the habitat quality that at the moment supposedly hold low potential for lampreys.

2.3 Pragulba River

General information

Priority class	Total index value	Value for individual barriers		
2	8.3	1	Beaver dam	0
		2	Beaver dam	0
		3	Beaver dam	0,64
		4	Beaver dam	1,71
		5	Beaver dam	1,23
		6	Beaver dam	1,14
		7	Unregistered dam	1,58
		8	Beaver dam	0,84
		9	Beaver dam	0,41
		10	Beaver dam	0,36
		11	Beaver dam	0
		12	Beaver dam	0,20
		13	Beaver dam	0,23
		14	Beaver dam	0
		15	Unregistered dam/Beaver dam	0
		16	Beaver dam	0
		17	Beaver dam	0
		18	Beaver dam	0

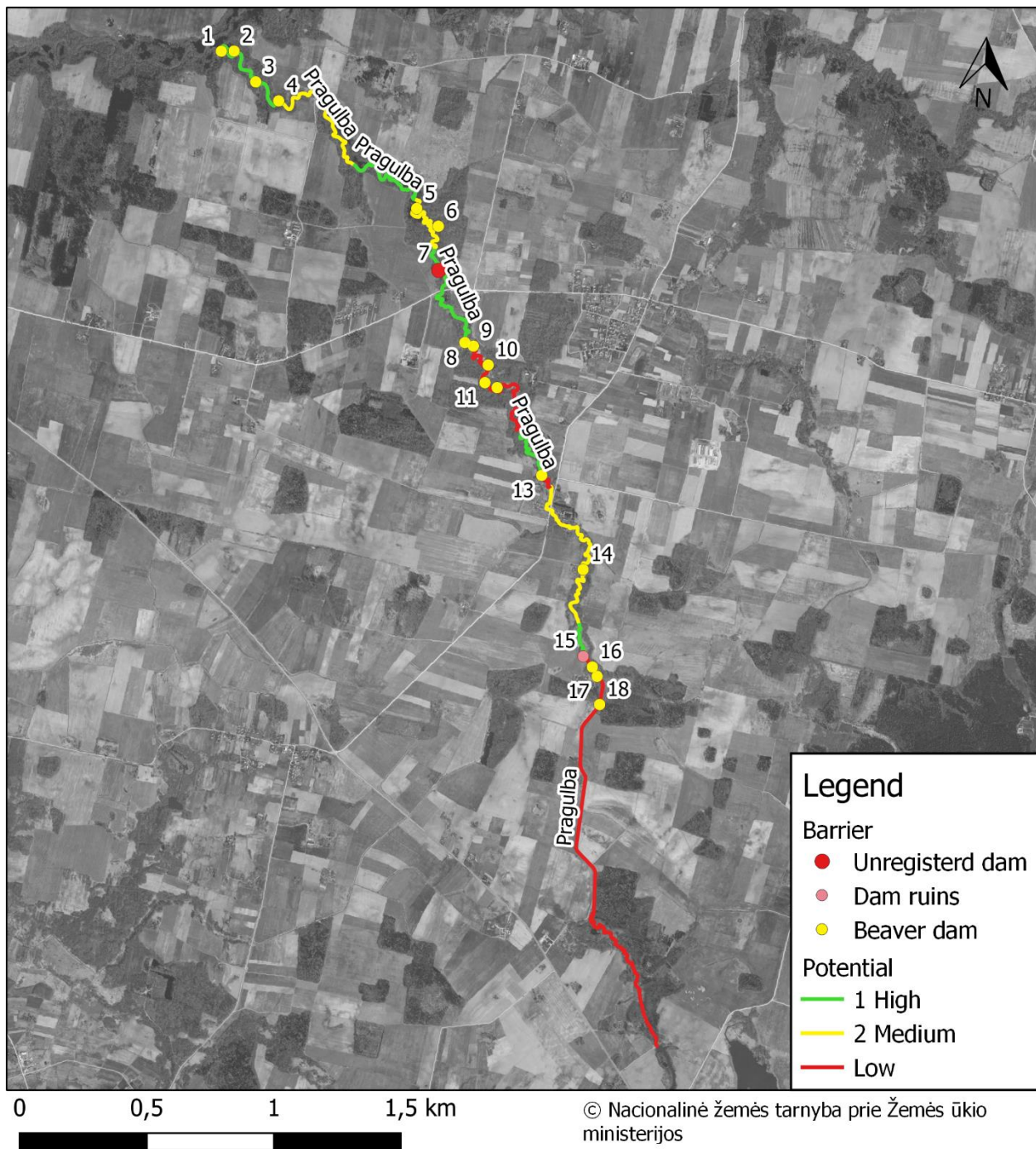


Figure 3. Pragulba River and location of barriers

Pragulba is the left coast tributary of Luoba River. It sources from Laumiai and Barstyčiai reservoirs, approximately 3,5 km northwest from Barstyčiai town and empties in Luoba river 25.5 km from its mouth (Fig. 3). It is one of the smallest rivers among the studied rivers, the length of the river is 14 km. The

average slope is one of the highest in the region 3.77 m/km. Pragulba upstream section of 2.6 km is straightened, all the tributaries of the river are rather small and straightened and the as well. The major obstacle for fish is unregistered/illegal dam and ruins of two obsolete dams with a consecutive cascade of beaver dams that effectively stop the migration.



Figure 4. Unregistered dam in Pragulba River

Suitability for lamprey reproduction

Luoba and its several tributaries that include Pagulba is the only waterfowls of Bartuva/Barta basin that can be accessed by migratory fish. Evaluation of salmonid fishes is performed there. Riverbed in middle and downstream of the river is a mix of the swift flowing and slower sections providing the river lamprey with both spawning and rearing habitats. The electrofishing inventories in the river carried downstream the dam indicate that the annual abundance of salmonids high to very high. This also suggests a very high lamprey spawning potential in the river.

The biggest impact on the river has an exceptionally large beaver population, which should be regulated to keep migration routes open. There is also one unauthorized and unregistered dam (Fig. 4) which impact on lamprey migration upstream capabilities is among the highest in the river.

2.4 Šventoji River

General information

Priority class	Total index value	Value for individual barriers		
3	3.1	1	Laukžemė watermill dam with fish ladder	3.1

Šventoji River is the largest river in Lithuania that directly discharge its waters into the proper Baltic Sea. Šventoji is approximately 73 km long; its catchment area covers 472 km² and average slope of the riverbed is 0.65 m/km. Upper section of 12.5 km together with most of its tributaries are straightened. Most important migration barrier in this river is a dam of former Laukžemė watermill on Šventoji River. In 2008 there have been constructed a fish ladder. However, it is not specially designed for river lampreys and migration over dam is possible only in favourable conditions.

Suitability for lamprey reproduction

Šventoji river is one of a few fishing areas in Lithuania and migration intensity is high. It is known to lampreys to accumulate below the dam and the are reported cases of poching annually. The lamprey spawning potential in Šventoji river above the dam is relatively low with exception to remaining several natural sections in tributaries. However, the monitoring of lamprey larvae confirms that downstream the barrier Šventoji River is well suited for river lamprey reproduction.

2.5 Darba River

General information

Priority class	Total index value	Value for individual barriers		
3	2.3	1	Culvert	0,58
		2	Weir	0,21
		3	Beaver dam	0,14
		4	Weir	0,18
		5	Lazdininkai dam	0,60
		6	Darbėnai watermill dam	0,60
		7	Beaver dam	0,00
		8	Beaver dam	0,00

Darba River is a left bank tributary of Šventoji River. Darba sources is approximately 10 km Northwest from Darbėnai Village and flow into Šventoji River already at the premises of Šventoji town (Fig. 5). The total length of Darba River is 26.2 km and its catchment area cover 119 km². More than half

of the river has been straightened and has quite a few barriers along the channel. Most important barriers for upstream migration are dams in Lazdininkai and Darbėnai, poorly designed and constructed culvert and concrete

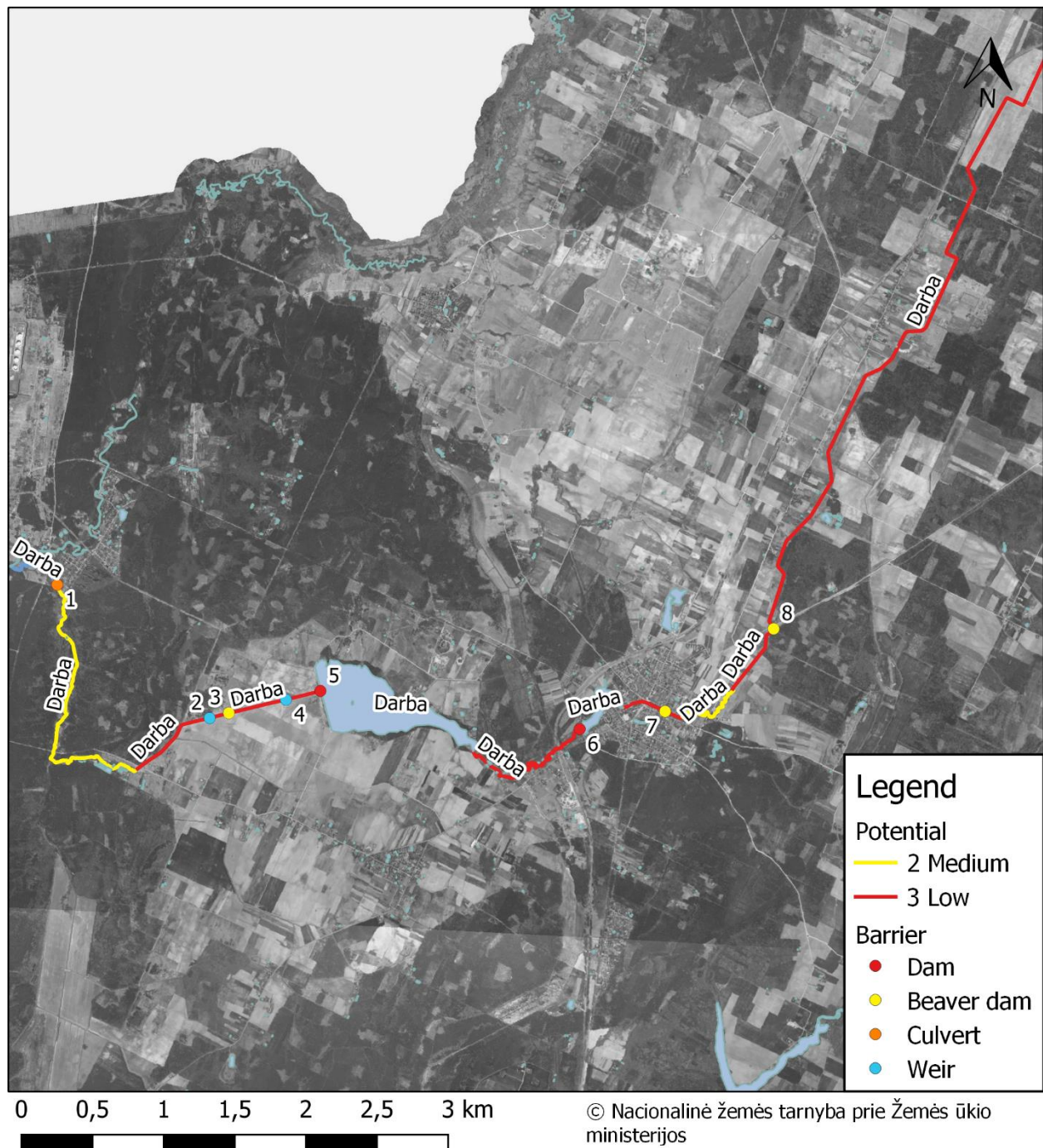


Figure 5. Darba River and location of barriers

weirs below the Lazdininkai dam to control the water flow. Beaver dams constructed in straightened sections do not affect the possible migration.



Figure 6. Culvert under the road in Darba River



Figure 7. Lazdininkai earth dam



Figure 8. Former Darbėnai watermill dam

Suitability for lamprey reproduction

The available information on river lamprey spawning in River is very limited. The presence of salmonids and other typical community species is uncertain. However, there are observed spawning of lampreys in Darbėnai in the remaining natural riverbed or the straightened sections affected by naturalisation. The largest possible impact of the river is done by the culvert (Fig. 6) which is not lowered enough to allow undisturbed migration, which should be reconstructed. The dams in Lazdininkai and Darbėnai (Fig. 7 & 8) as well have substantial barrier impact estimates, however, the quality of the habitats could be lower than expected due to intensive riverbed modifications in the upstream section

2.6 Danė-Akmena River

General information

Priority class	Total index value	Value for individual barriers		
1	24.4	1	Bajorai dam	0.81
		2	Kretinga dam	7.87
		3	Kurmaičiai earth dam	7.87
		4	Tūbausiai earth dam	7.87

Danė-Akmena River is one of the modified rivers in the region, more than 15 km of riverbed lies under of the cascade of dams, approximately 1.8 km of river upstream is straightened around 3 km till the mouth

is embanked. The regulated part upstream regularly dry up. It is approximately 65 km long and the catchment area covers 595 km². The average slope of the riverbed is 0.88 m/km, however in the lowest part much smaller only 0,07 m/km. The source at Mažieji Žaliniai village, 6 km Southwest to the Salantai town. The lower part (11 km) suitable for navigation. The barrier of the river consists of a cascade of 4 dams: Bajorai, Kretinga, Kurmaičiai and Tūbausiai dams. Bajorai dam is the lowest with a water head of 1.2 m, Kretinga dam is 2.8 m concrete weir, Kurmaičiai and Tūbausia are earthen dams of 7 m and 8 m water head, respectively.

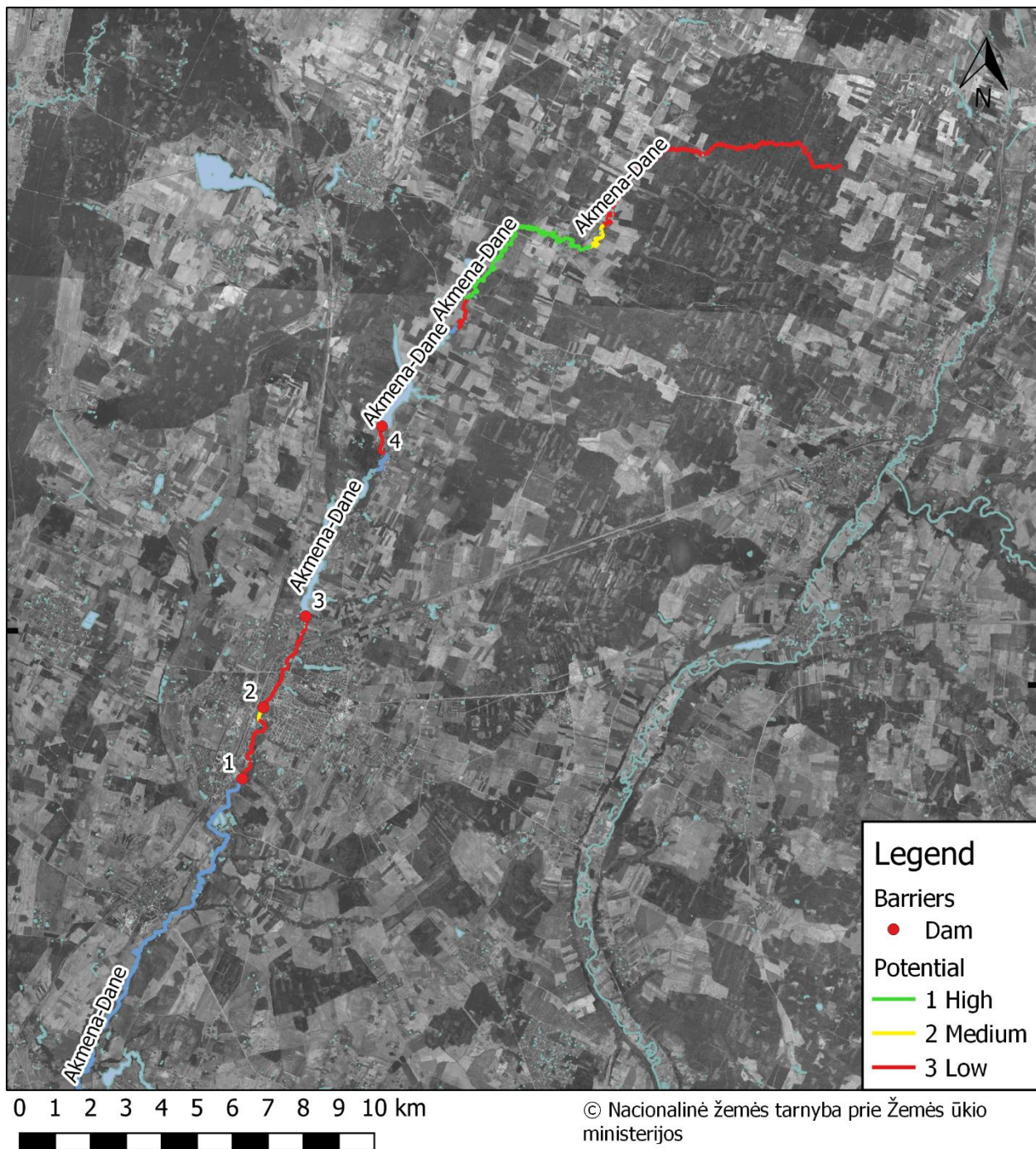


Figure 9. Danė-Akmena River and location of barriers

Suitability for lamprey reproduction

Danė-Akmena river tributaries are actively used by sea trouts for spawning and river lampreys are annually observed below Kretinga dam, in Jaurykla river, in several other rapids and tributaries below Kretinga town. However, the studies of ammocoetes abundance indicate that the spawning conditions

there are unfavourable below the barriers. Only a section of 7.2 km of a high reproduction potential is located above all the listed barriers. To use the potential upstream all three impassable dams should be removed in the one in Tūbausiai where HP is currently operating.

2.7 Eketė River

General information

Priority class	Total index value	Value for individual barriers		
1	3.4	1	Laukžemė earth dam	3.35
		2	Stone weir	0
		3	Plikiai earth dam	0

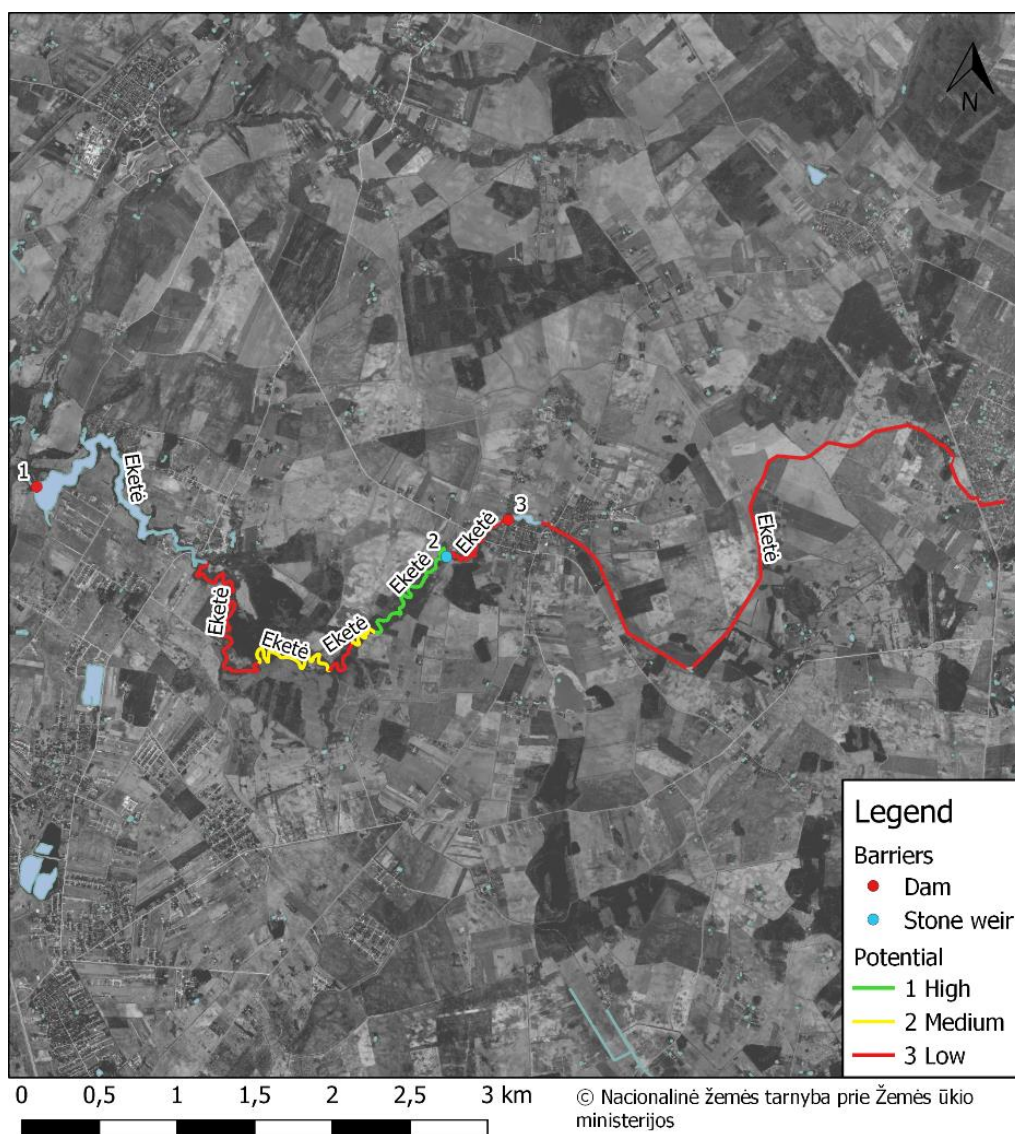


Figure 10. Eketė River and location of barriers

Eketė River is a left coast and largest tributary of Danė-Akmena River. It sources at Vaiteliai village (Fig. 10). The total length of this river is 25 km and its catchment area reach 92 km². Discharges it waters into Danė-Akmena river 16.8 km from its mouth. The average channel flow 2.18 m/km. The major obstacle is Laukžemės earthen dam with the 9,5 water head. The obstacles upstream include are stone weir and Plikiai dam both located in Plikiai village. The water head of Plikiai dam is much lower only 1.7 m. From this dam upstream the riverbed is straightened.



Figure 11. Laukžemė earth dam

Suitability for lamprey reproduction

In Eketė river below the Laukžemė dam lamprey accumulations and spawning is observed annually. It one of the biggest dams in the region (Fig. 11) and has recently been upgraded therefore implementation of any migration improvement measures are doubtful.

2.8 Smeltalė River

General information

Priority class	Total index value	Value for individual barriers
4	0	No obstacles

Smeltalė River one of a few rivers that discharge into Curonian Lagoon. There no general acceptance on the source of the river it is thought to start in Šlapšilė village, however official register gives the start of the river at Gargždai town. The total length of this river is 27 km and its catchment area reach

around 145 km². As the river lies in the Coastal plain the average slope of the riverbed is not big 1.29 m/km. The

Suitability for lamprey reproduction

Lamprids and salmonids are observed spawning in the river annually. There have been observed no obstacles that would significantly hinder the migration of lampreys upstream

2.9 Vilka River

General information

Priority class	Total index value	Value for individual barriers		
4	1.4	1	Beaver dam	0.97
		2	Beaver dam	0.36
		3	Stone weir	0.04
		4	Collapsed unregistered dam	0.04

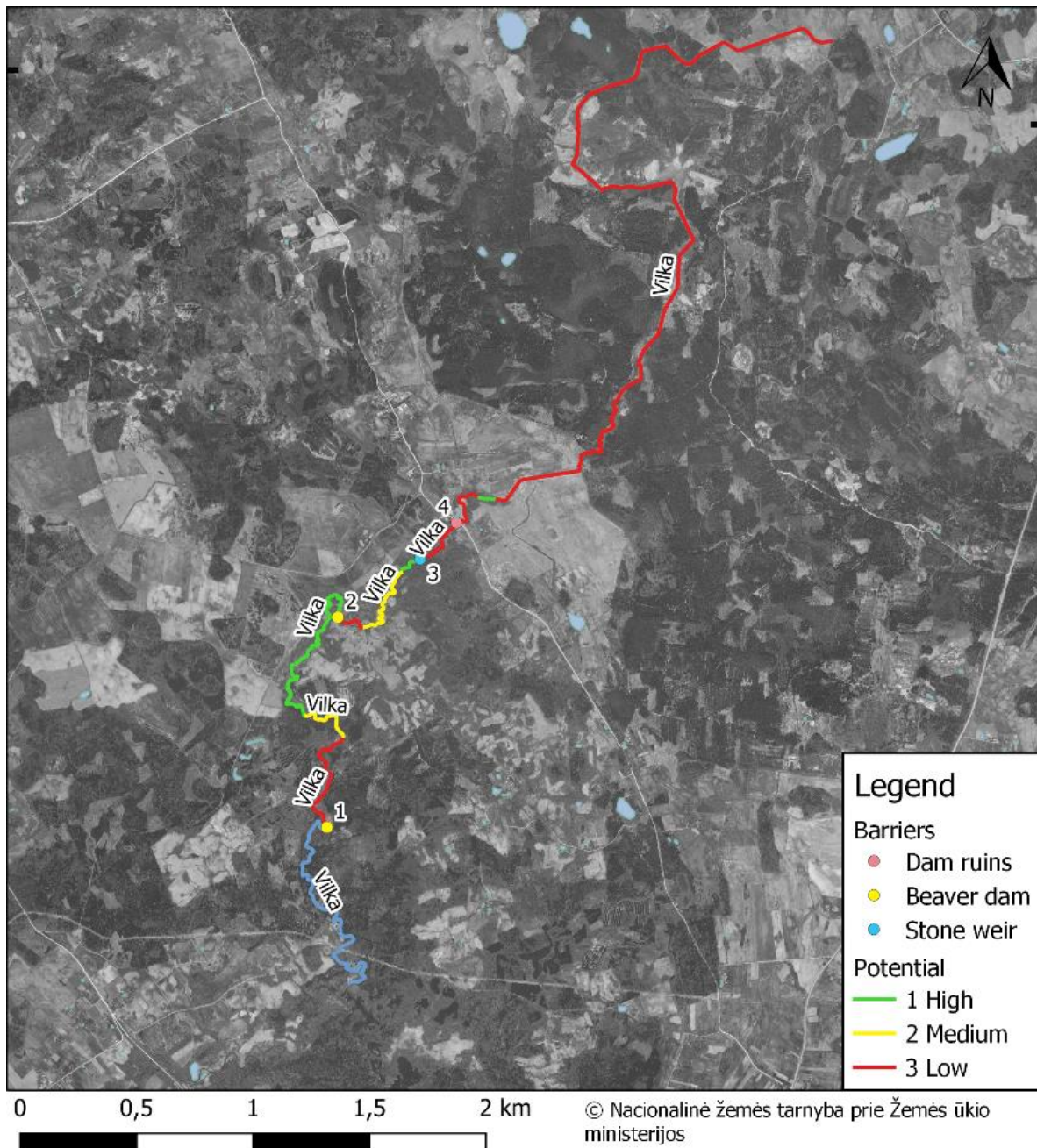


Figure 12. Vilka River and location of barriers

Vilka river length is around 17 km. It is the right bank tributary of Minija river and joins it 185.5 km from the mouth. Its source is located at surrounding of Žilvyčiai village (Fig. 12). The river flows in desolated and unpopulated landscapes. There no impassable obstacles, however, migration can be hindered by stone weirs or beaver dams (Fig. 13).



Figure 13. Largest beaver dam in Vilka River

Suitability for lamprey reproduction

Very little information is available in the fish community. However, it is known to hold brown trout population. Preliminary sampling of ammocoetes indicate that river is inhabited by lampreys, however, accessibility of Vilka river by river lampreys is questionable as molecular studies of ammocoetes from downstream sections refer them to be distinct from the migratory river lampreys. I

2.10 Sausdravas River

General information

Priority class	Total index value	Value for individual barriers		
3	2.4	1	Collapsed formed Stalgėnėnai watermill	1.43
		2	Žlibinai earth dam with fish ladder	0.99

The river Sausdravas flows in Telšiai county, Plunge district, the river Minija left tributary. Length of the river 25 km, the basin area 94 km². The source at Vydeikiai village, 12 km east from Plunge town (Fig. 14). Flows to southeast and southwest. The Sausdravas flows into the river Minija 156 km from its mouth

opposite Stalgėnai village. The slope of the riverbed is 2.4 m/km. Average rated discharge at the mouth of 1.13 m³/s.

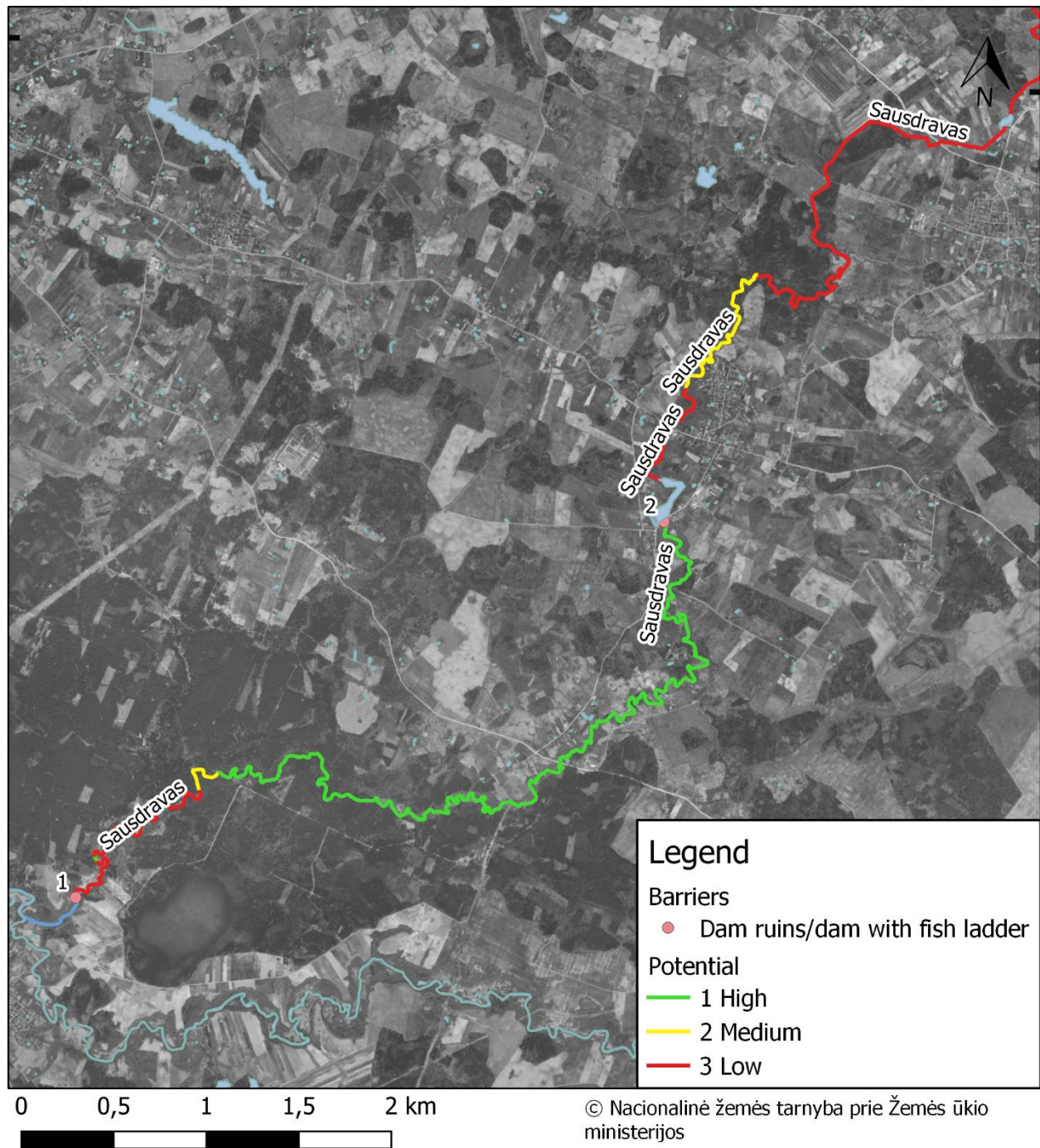


Figure 14. Sausdravas River and location of barriers

Suitability for lamprey reproduction

Communal spawning of river and brook lamprey are observed down the remains of former watermill dam. However, in the upper sections of the river and below the Žlibinai dam only brook lampreys have been observed. This could indicate that the former dam is impassable or the population reaching the river is quite small and the number of habitats downstream are sufficient for spawning

2.11 Vieštovė River

General information

Priority class	Total index value	Value for individual barriers		
2	7.5	1	Former watermill dam	4.85
		2	Beaver dam	1.37
		3	Beaver dam	0.85
		4	Stone weir	0.45
		5	Unregistered dam	2.27

Vieštovė river is a right bank tributary of Minija river. The total length of the river 15.2 km and average slope of riverbed 4 m/km. The source is located in Samogitian Highlands in the surroundings of Rapšaičiai village and it empties in Minija river 132.5 km from its mouth (Fig. 17). The upper third of the river is straightened. The migration barriers include the dam of former watermill dam, illegally constructed dam and weir as well as beaver dams.



Figure 15. Former watermill dam

Suitability for lamprey reproduction

River lampreys spawn in river section until the watermill dam, the study of ammocoetes indicate that the production is medium. In the section above the dam, the spawning potential above is quite high, however, in the straightened section the habitats are degraded. The major reduction in spawning potential is caused by the formed watermill dam in lower reaches of the river (Fig. 15) and illegal damming in the middle section of the river (Fig. 16).



Figure 16. Newly constructed dam on Vieštovė River

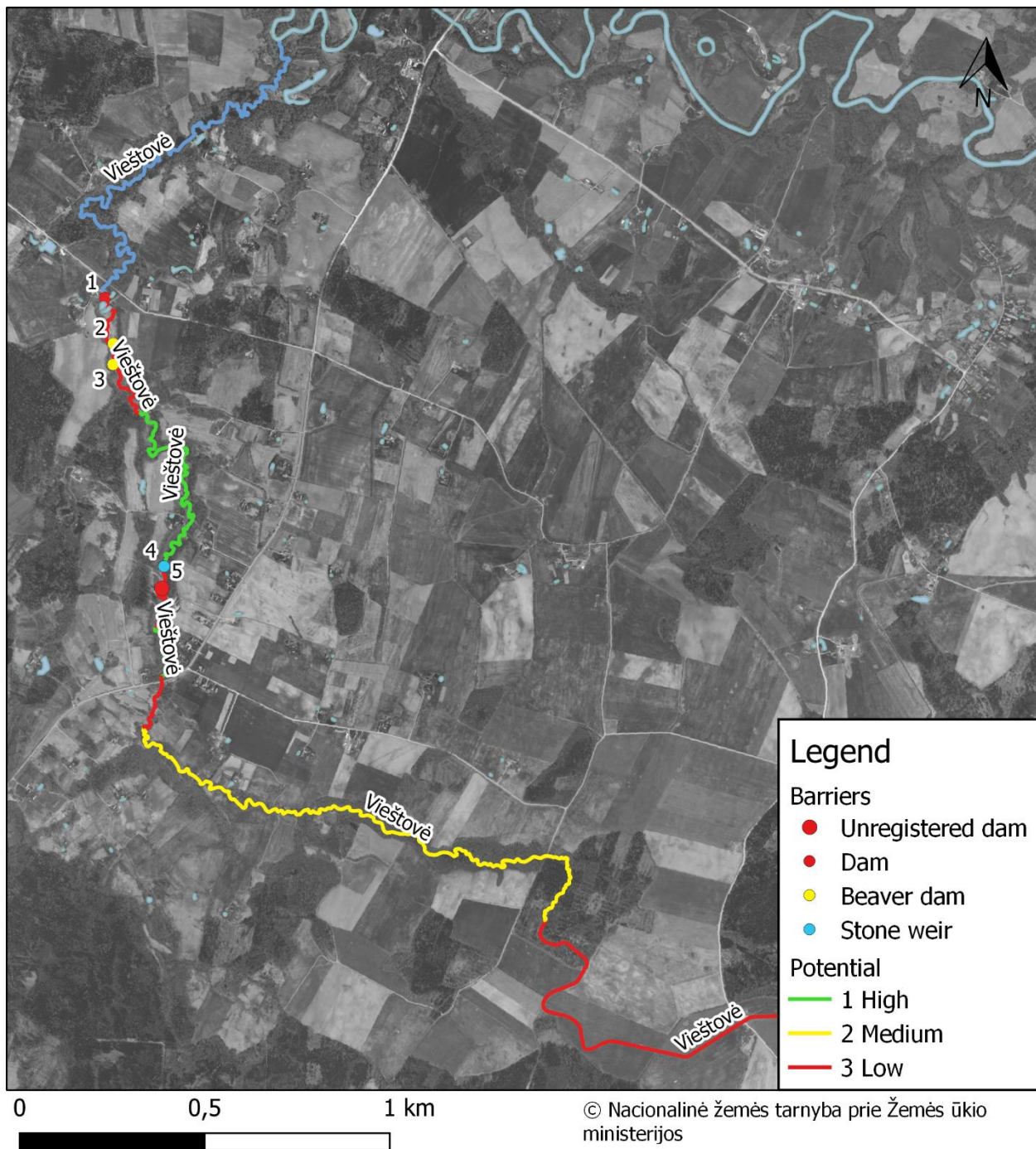


Figure 17. Vieštovė River and location of barriers

2.12 Mišupė River

General information

Priority class	Total index value	Value for individual barriers		
4	1.4	1	Stove weir	0.90
		2	Beaver dam	0.18
		3	Former Mišėnai watermill dam	0.30
		4	Beaver dam	0.00
		5	Beaver dam	0.00

Mišupė river starts at Siurbliai village surroundings, 7 km from Plungė town, and flows through Remtis and Mišė natural lakes. Discharges directly into Minija river 103 km from the river mouth at Prystovai village. The average slope is quite similar to other smaller studied rivers – 3.55 m/km, however, the lowest 2 km is very steep and is around 9 m/km. The obstacles in the river consist of Mišėnai dam, the stone weir at Seleniai village and a couple of beaver dams. Stone weirs at Seleniai village and former mills in downstream sections do not significantly affect migration. However, the lamprey potential upstream is low mainly because of the impact of Lakes in the upstream section.

Suitability for lamprey reproduction

River lampreys spawn in all river section until the watermill dam the river is also known to hold sea trout and brown trout populations. Ammocote studies that the spawning intensity in the river is one of the highest in the region.

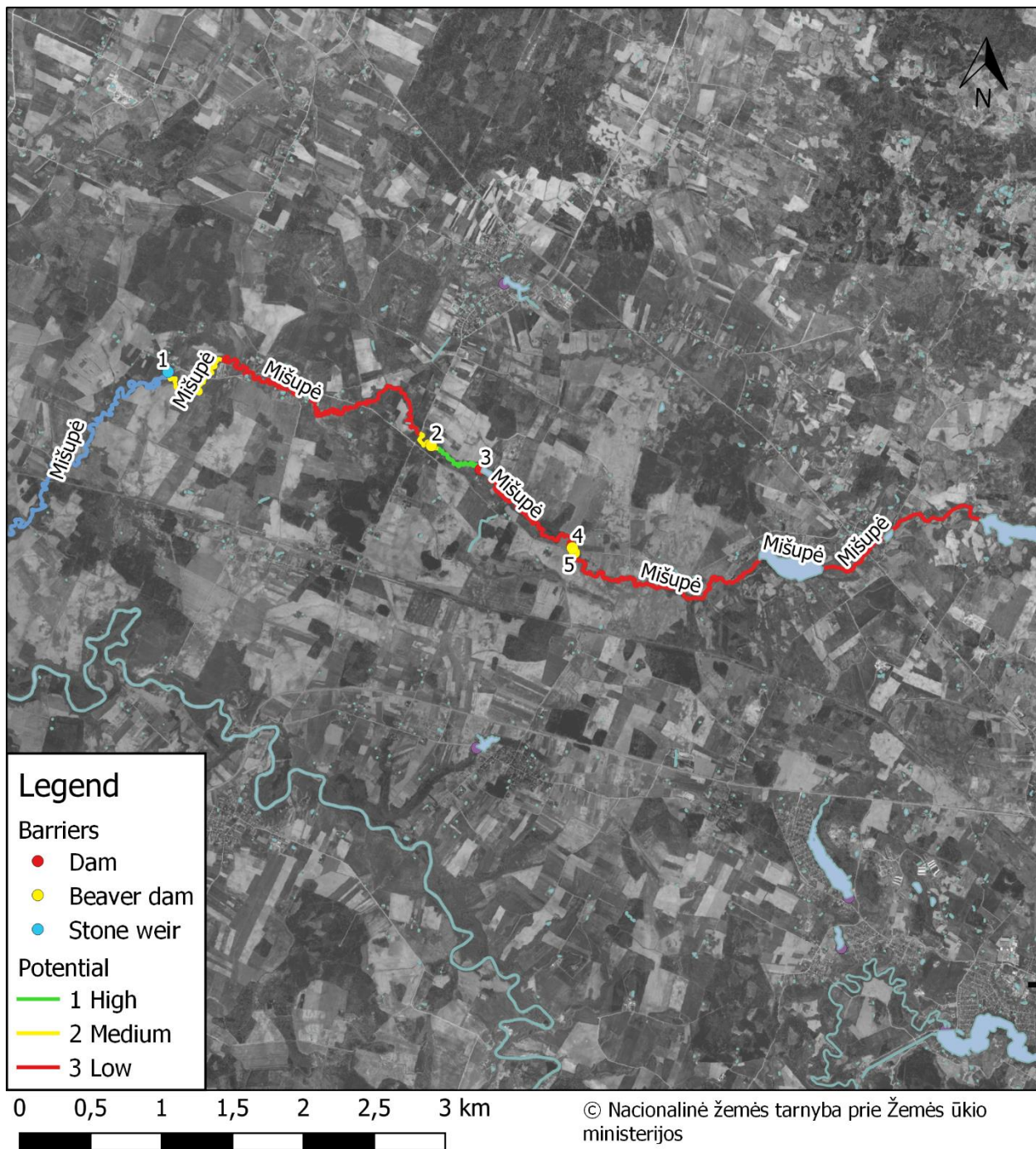


Figure 18. Mišupė River and location of barriers

2.13 Salantas River

General information

Priority class	Total index value	Value for individual barriers		
1	16.4	1	Reconstructed formed Salatai watermill dam	7.10
		2	Collapsed formed Laiviai watermill	0.63
		3	Stone weir	0
		4	Collapsed formed Plateliai manor watermill	1.25
		5	Tūzai earth dam	6.83
		6	Beaver dam	0.63

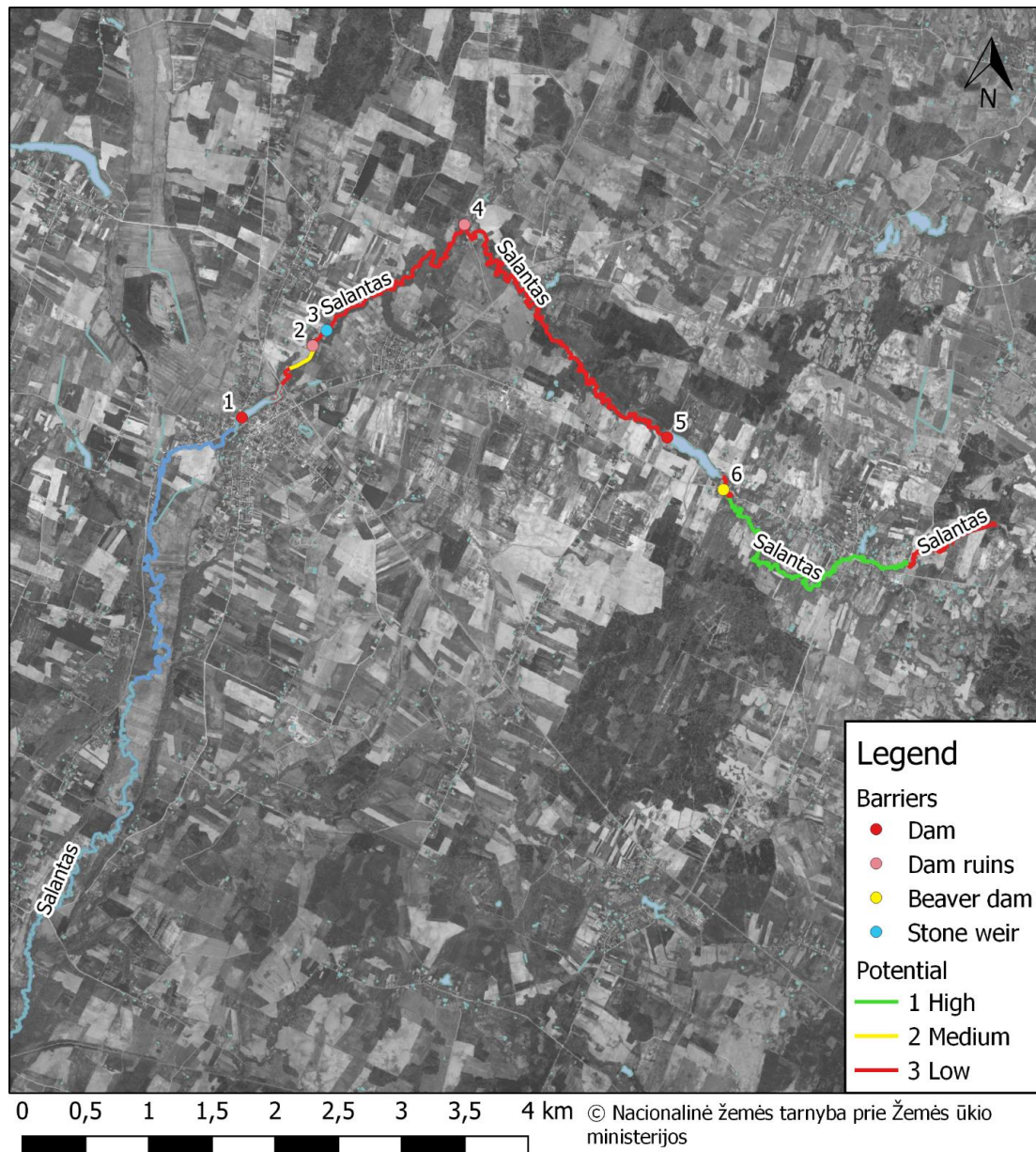


Figure 19. Salantas River and location of barriers



Figure 20. Reconstructed formed Salatai watermill dam



Figure 21. Tūzai earthen dam

Salantas River sources at Plateliai town and flows into the river Minija at 99 km from its mouth at Kulupenai village (Fig 19). This river is 43 km long; its catchment area covers 275, km² and average slope of the riverbed is 2.96 m/km. All the river from the source next to Plateliai village is natural and only tributaries are straightened. Most important migration barrier in this river is in 1993 reconstructed mill dam at Salantai town (Fig. 20) and in 1982 constructed dam at Tuzai village (Fig. 21). Other barriers that could affect lamprey migration are two is obsolete and collapsed dams in the section between the dams.

Suitability for lamprey reproduction

The number of suitable habitats below the Salantai dam is limited to a few rapids. The inventory showed that the best suited suitable section for lamprey reproduction is upstream both of the dams. Suitability for lamprey reproduction is also confirmed by the presence of a typical fish community for species for lamprid and salmonid rivers. Currently, it is planned to remove Salantai dam, in this case, Tūzai dam would be still limiting the utilization of more than 90% of potential.

2.14 Blendžiava River

General information

Priority class	Total index value	Value for individual barriers		
1	30.1	1	Stone weir	0
		2	Stone weir	0
		3	Stone weir	0
		4	Unreiterated dam	15.09
		5	Beaver dam	0
		6	Stone weir	0
		7	Remains of collapsed watermill dam	3.32
		8	Beaver dam	4.11
		9	Stone weir	0
		10	Beaver dam	1.13
		11	Remains of collapsed watermill dam	0.83
		12	Beaver dam	2.07
		13	Stone weir	0
		14	Stone weir	0
		15	Stone weir	0.43
		16	Former Šateikiai watermill dam	3.15

Blendžiava river is the biggest tributary of Salantas river that discharges its water in the downstream section of Salantas river 4 km from its mouth (Fig.22). The length of the river is 30.5 km and its catchment

area covers 85.5 km². The average slope is one of the biggest in the region and constitutes for 3.58 m/km. The source is located 6 km to the south from the lake Plateliai, at Siurbliai village.

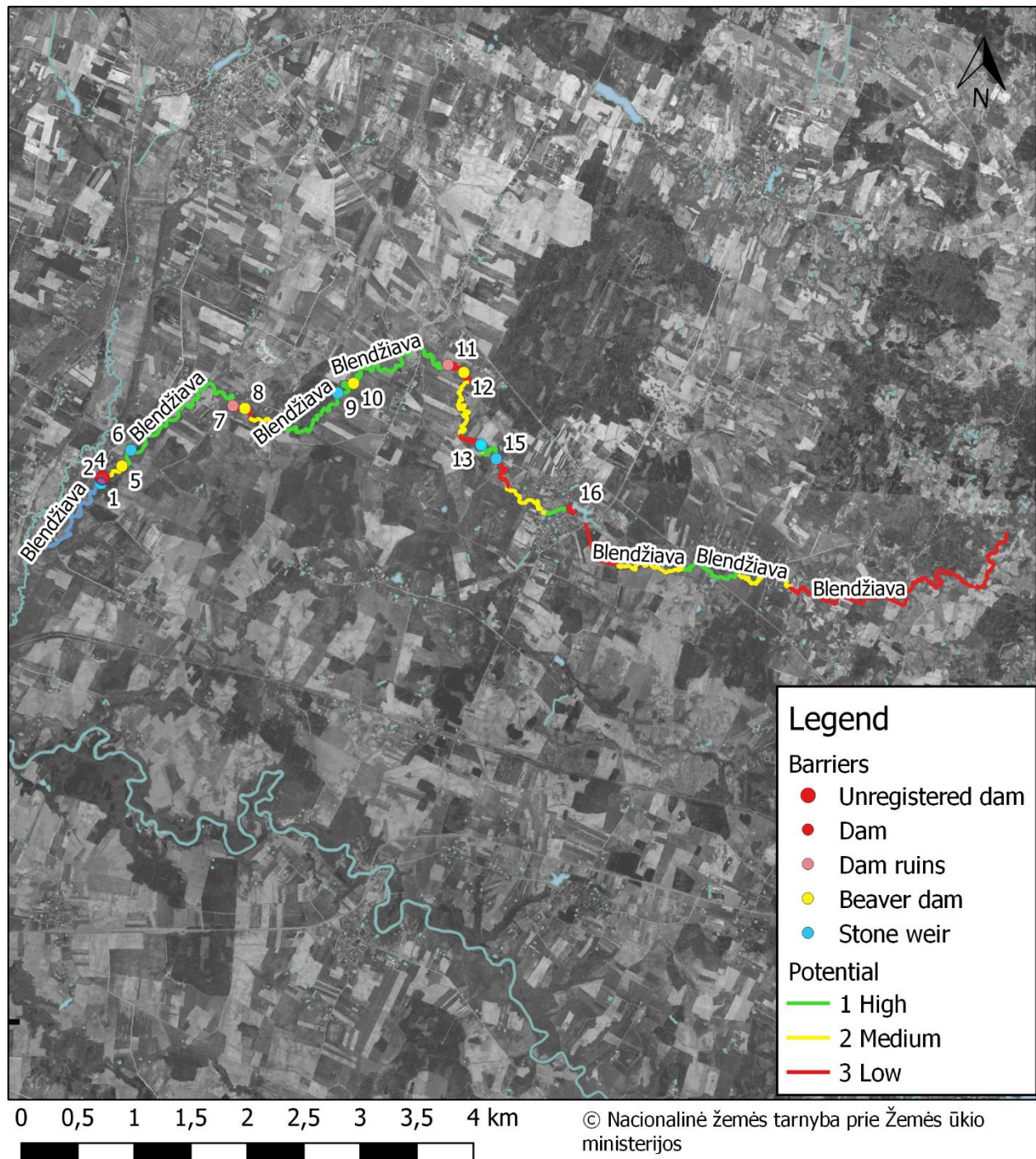


Figure 22. Blendžiava River and location of barriers

Suitability for lamprey reproduction

The electrofishing inventories are carried downstream the dam next to Reketė village. The abundance of sea trout parrs is one of the highest in Lithuania and is belied to have fully employed the carrying capacity of the accessible section. The inventory showed that the best-suited section for lamprey reproduction in-between the dams, upstream unregistered dam in Skaudaliai village. The removal of this 0.8 m dam alone could have a significant impact on the regional population.

2.15 Alantas River

General information

Priority class	Total index value	Value for individual barriers		
1	0	1	Kuliai I dam	0
		2	Stone weir	0
		3	Unregistered dam	0
		4	Stone weir	0
		5	Kuliai II dam	0
		6	Kuliai III dam	0

Alantas River sources in the swamps around Mižuikiai village and discharges into Minija River 91 km from the mouth at Kartena town. This river is 39 km long; its catchment area covers 139 km² and the average slope of the riverbed is 2.96 m/km (Fig. 23). All the river from the source to Kuliai village is natural and all the tributaries except for Karkluojė are straightened. The cascade of barriers is present in Kuliai village or its premises. The barriers are either dams and weirs or small scale damming done by local inhabitants.

Suitability for lamprey reproduction

River lamprey is observed spawning in river annually and is one of the best rivers for lamprey spawning in the region. In Alantas River mix of swift-flowing and slower sections provide river lamprey with both spawning and rearing habitats and the potential above impassable obstacles is very low.

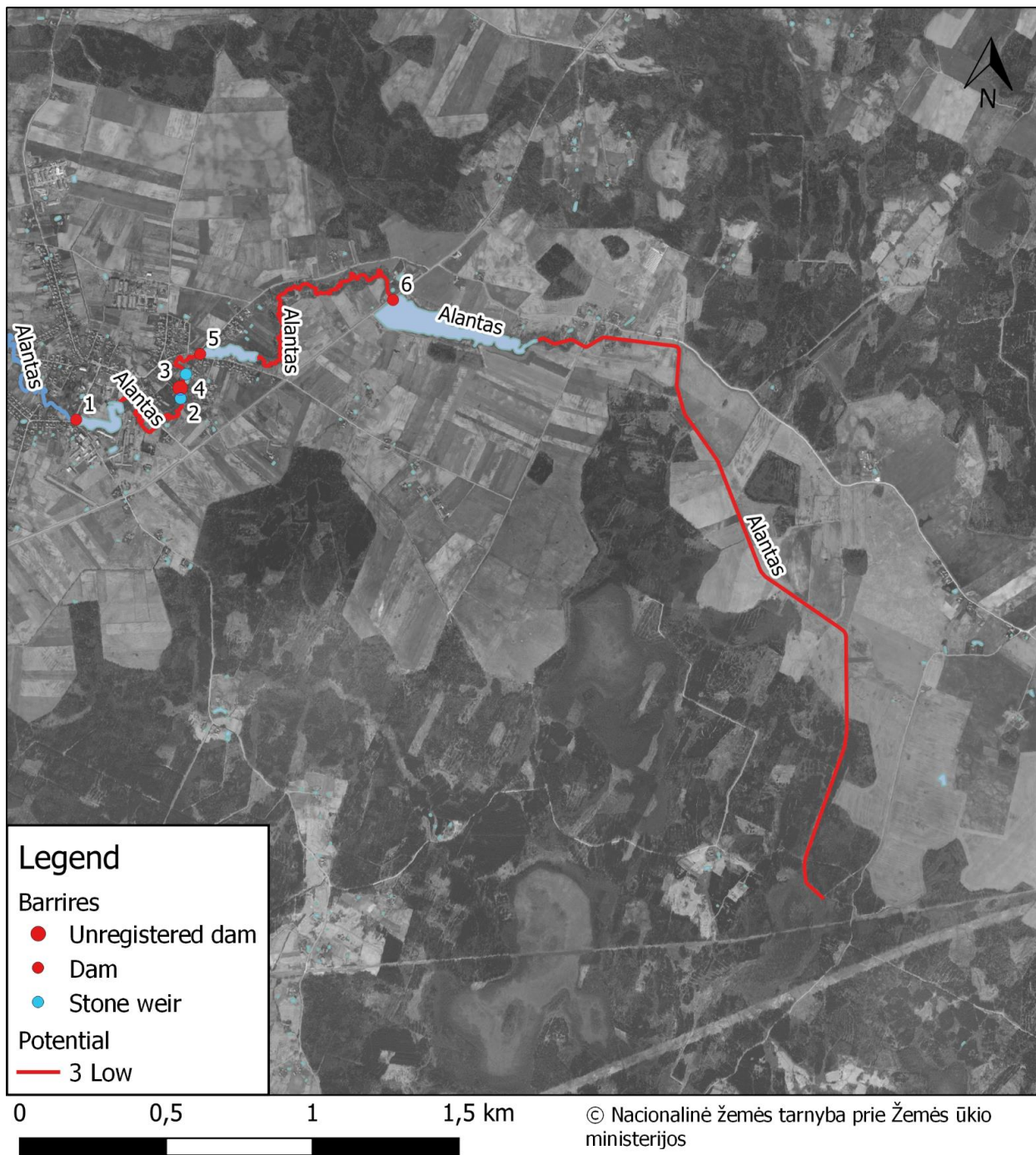


Figure 23. Alantas River upstream and location of barriers

2.16 Karkluojė River

General information

Priority class	Total index value	Value for individual barriers		
4	0.5	1	Beaver dam	0.11
		2	Beaver dam	0.21
		3	Beaver dam	0.18
		4	Beaver dam	0.01

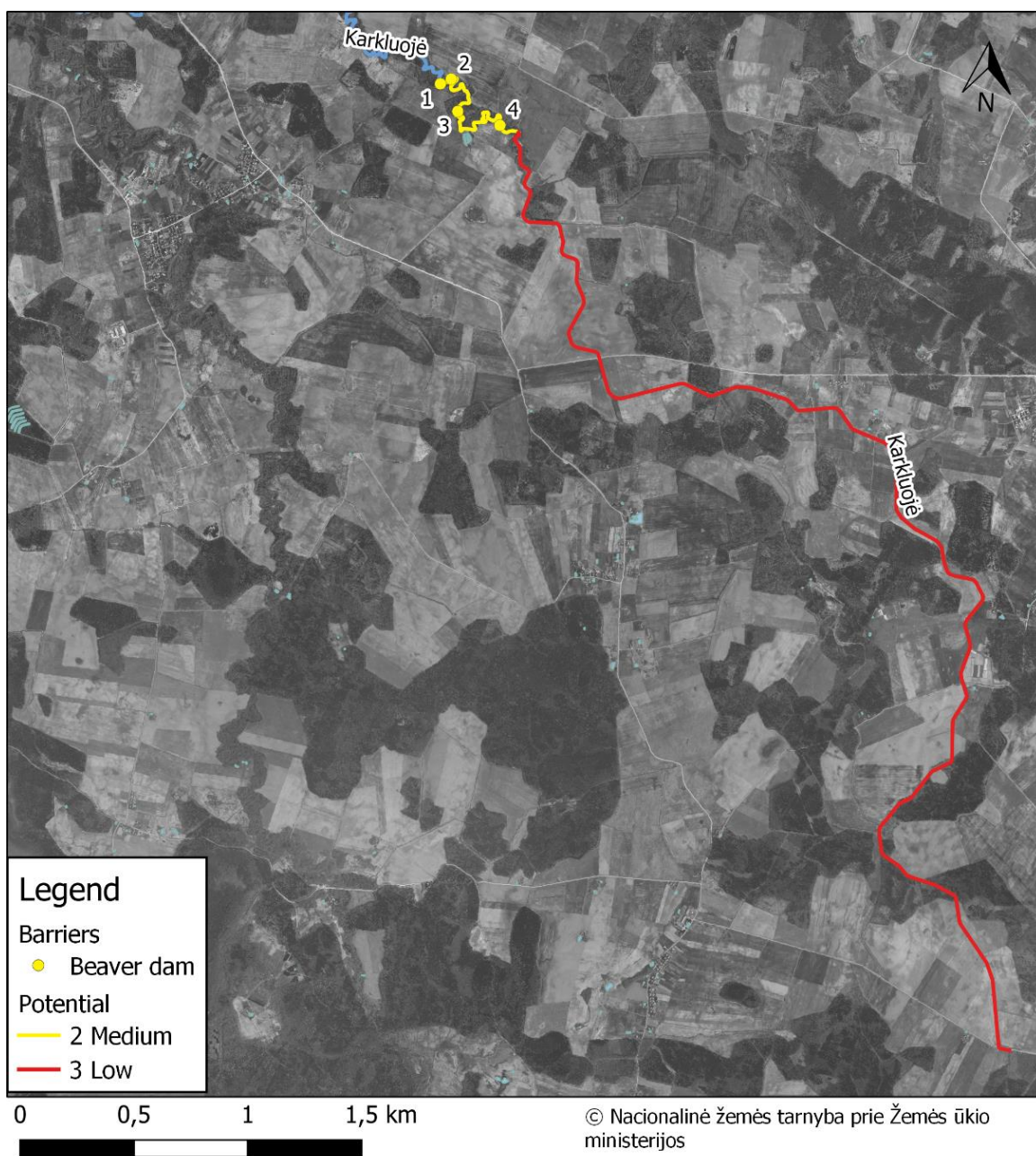


Figure 24. Karkluojė River and location of barriers

Karkluojė River is largest left bank tributary of Alantas River. The length of the river is 21.8 km, the catchment area 118 km². It sources at Mažieji Mostaičiai surroundings, 3.5 km north east of Kuliai village and flows to west till discharges into Alanatas River 6.9 km from its mouth (Fig. 24). Over half of the river is straightened and the only barriers found during inventory are beaver dams located just below the straightened section of the river (Fig. 25).



Figure 25. Largest beaver dam Karkluojė River

Suitability for lamprey reproduction

The straightened hold no potential for spawning with exception of two small rapids in place of former beaver dams, just before the start of remaining natural section. Swift flowing and slower sections are uniformly distributed along the natural part of the river and makes it ideal for river lamprey both spawning and rearing.

2.17 Žvelsa River

General information

Priority class	Total index value	Value for individual barriers	
4	0.1	1	Stone weir
			0.12

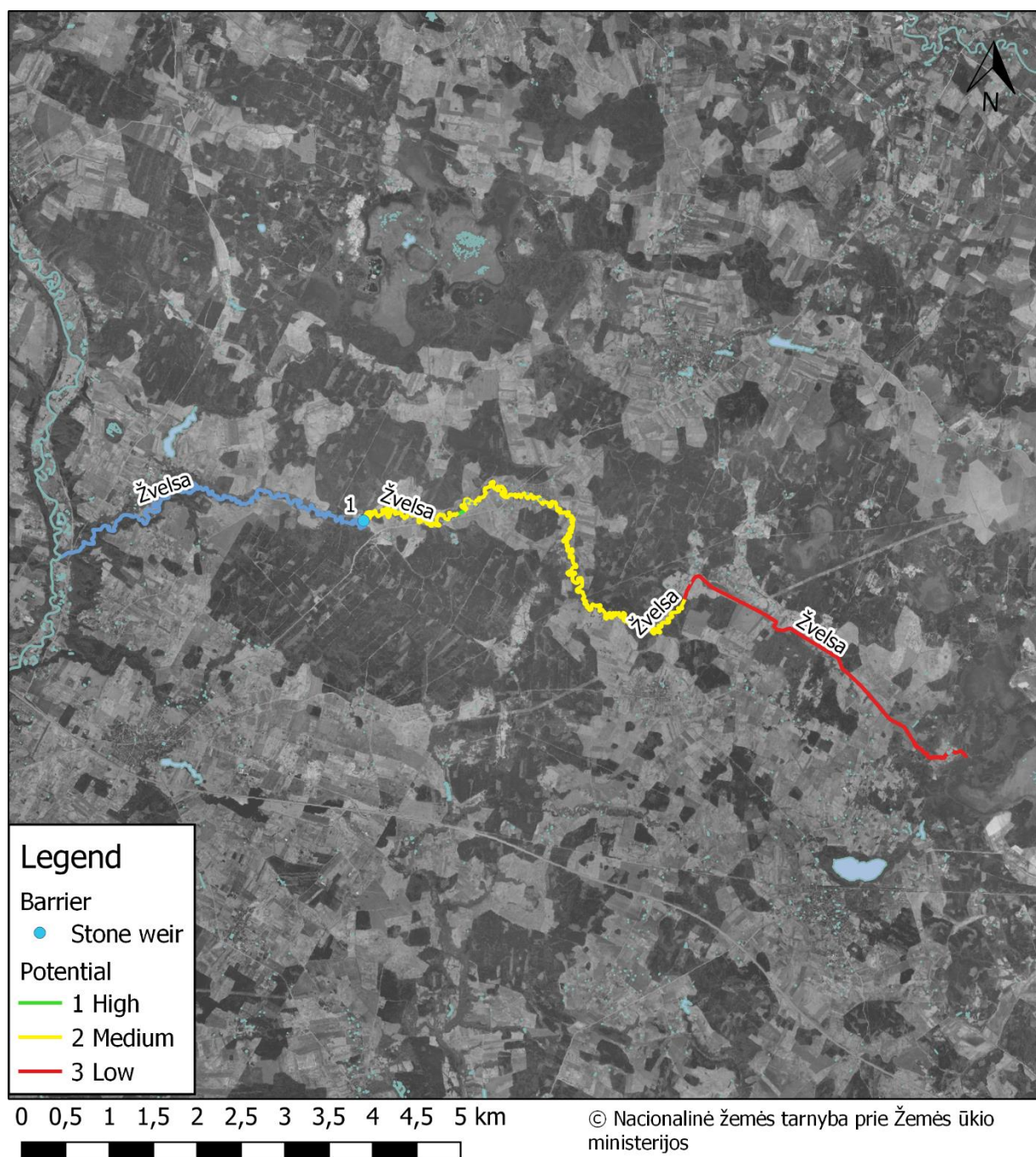


Figure 26. Žvelsa River and location of barriers

Total Length of Žvelsa river 38 km, the catchment area is 144 km². It sources at Dausynas forest, 5 km north from Endriejavas town. The river flows to the west and discharges into Minijs River 62 km from its mouth at Žvelsėnai village. Average riverbed slope is 2.68 m/km, with an exceptionally steep slope in the section from Trumpė confluence to the mouth where it is 6.81 m/km and is considered one of the steepest in the region. The river can be considered relatively open for lamprey migration; the only obstacle could be named partly collapsed stone weir in the middle section of the river (Fig, 27) that should not be considered as a serious obstacle for river lamprey migration.



Figure 27. The only possible migration obstacle in Žvelsa River

Suitability for lamprey reproduction

Ammocoete studies indicate that lower part of the river is not suitable for spawning due to big current and lack of preferable size substrate. However, according to locals, they do spawn in the middle section of the river, not in big number. There are also present brook lamprey population that can be found spawning even in the straightened section of the river where suitable rapids with gravel are almost non-existent.

2.18 Aisé River

General information

Priority class	Total index value	Value for individual barriers		
4	0	1	Stone weir	0.01
		2	Beaver dam	0

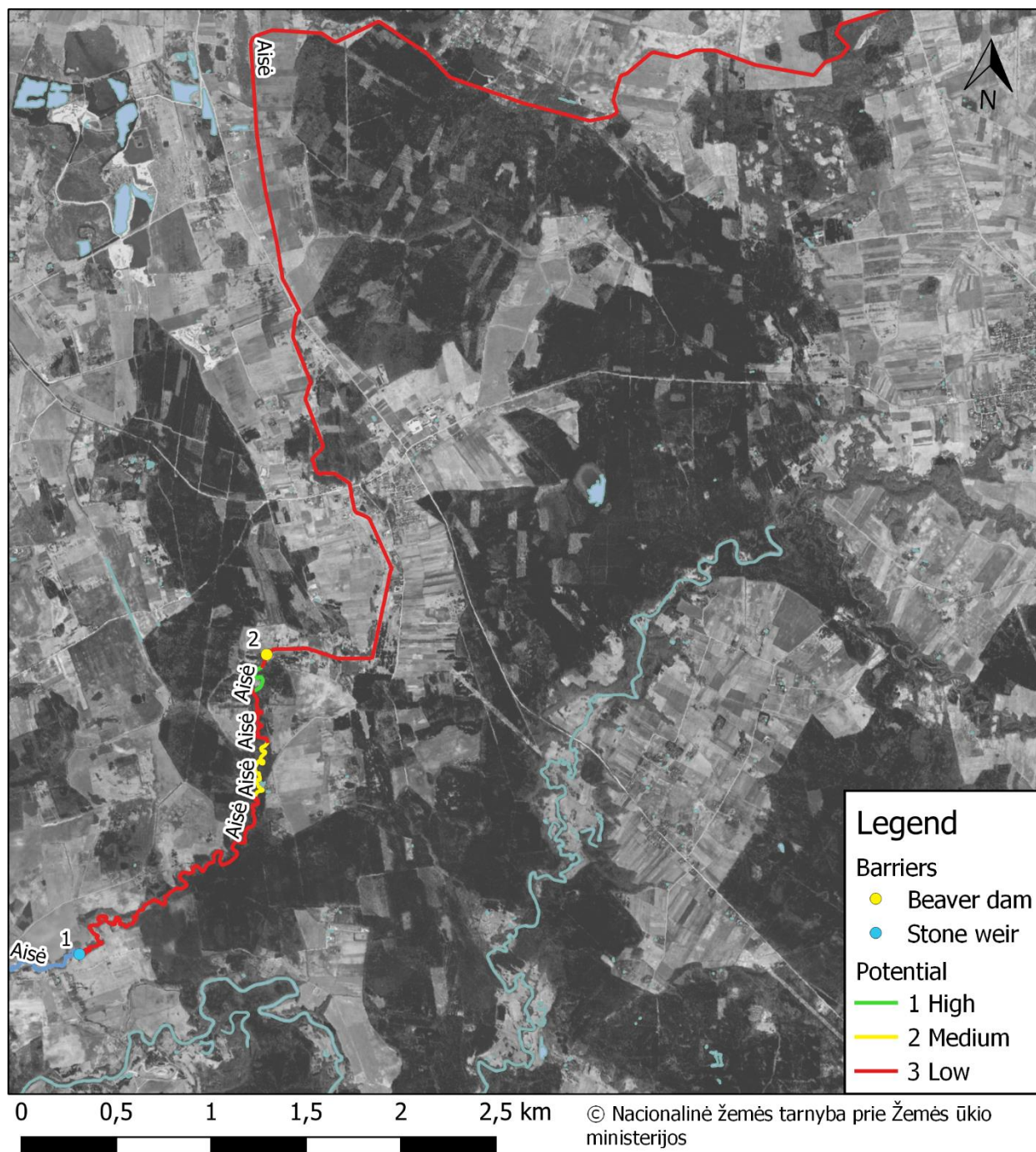


Figure 28. Aisė River and location of barriers

Total Length of Aisė river is 25 km, the catchment area is 88 km². It sources at Klausteikiai village, 3 km North to Veiviržėnai (Fig. 28). Average riverbed slope is 2.29 m/km. Aisė river is intensively straightened over 17 km section to be modified. The only found obstacles in the river one stone weir and occasional beaver dams.

Suitability for lamprey reproduction

In 2003 Veiviržas river catchment including whole Aisė River length an ichthyological reserve was designated to save brown trout and sea trout, lampreys and European bullhead.

2.19 Agluona River

General information

Priority class	Total index value	Value for individual barriers		
4	0.4	1	Agluonėnai dam with fish ladder	0.38
		2	Beaver dam	0.01

Agluona River is a left bank tributary of Minija River. Agluona sources at the surrounding on Girininkai village, approximately 8 km Southeast from Gargždai town. The total length of Agluona River is 22 km and its catchment area cover 76 km². More than 13 km of Agluona River upstream is straightened (Fig. 29). Average riverbed slope is 0.98 m/km. The only obstacle on the river is Agluonėnai dam which also has a fish ladder. Agluona riverbed below the dam is natural and only approximately 1 km river section holds the potential for lamprey spawning.

Suitability for lamprey reproduction

The lower reach of the river is used by migratory salmonids which due to the fish ladder manage to migrate over the dam. Migration of lampreys over is most likely limited due to the design the fish ladder (Fig. 30), therefore there is a need to modify it. One of the cost-effective solutions could be the installation of lamprey tiles – the only mass-produced product available for this purpose.

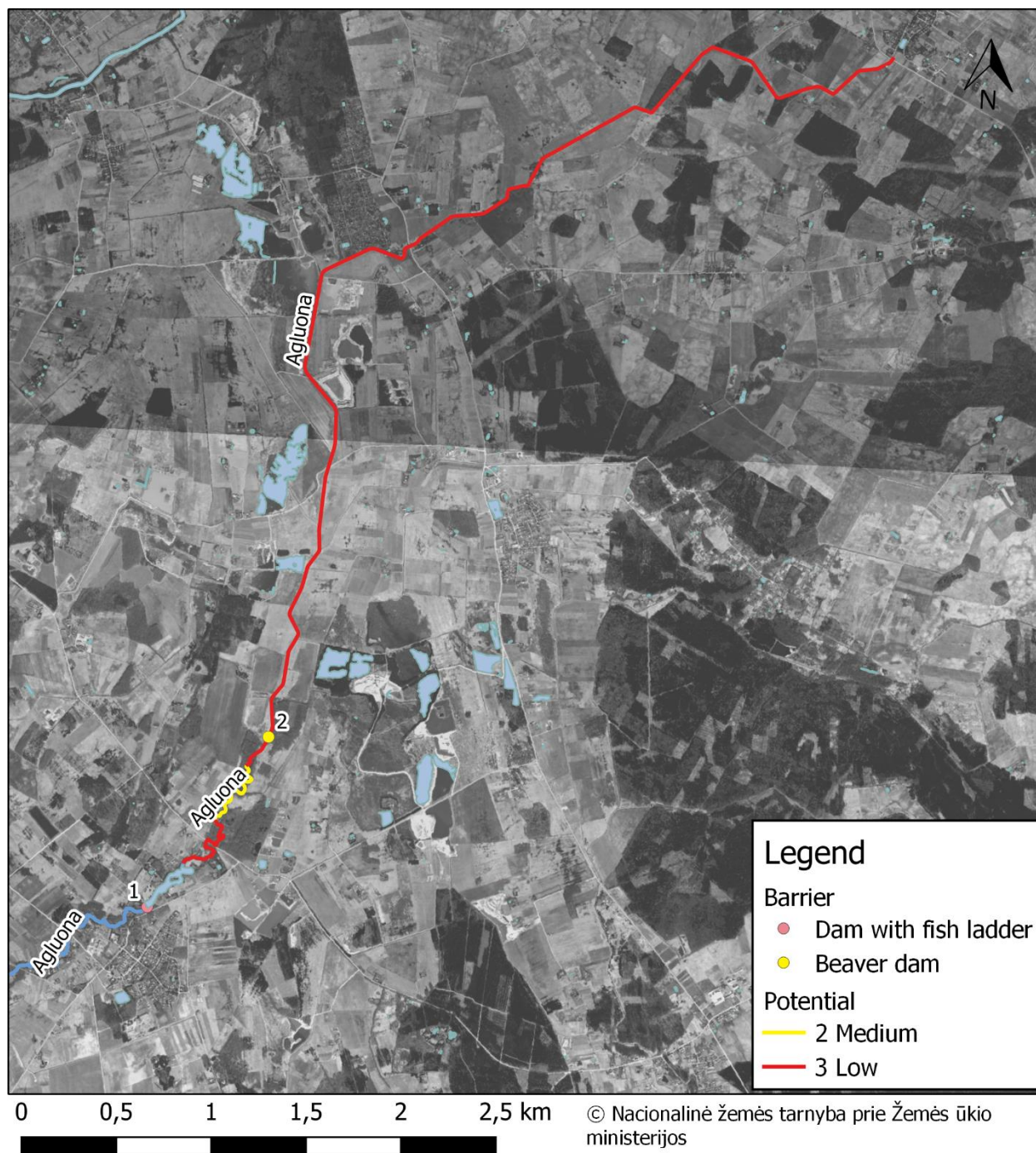


Figure 29. Agluona River and location of barriers



Figure 30. The fish ladder on Agluonėnai dam

2.20 Šyša River

General information

Priority class	Total index value	Value for individual barriers		
1	16.2	1	Šilutė dam with fish ladder	7.52
		2	Stone weir	0
		3	Colapsed dam	1.17
		4	Unregisterd dam	4.67
		5	Stone weir	0
		6	Former Katyčiai watermill dam	0
		7	Beaver dam	1.08
		8	Stone weir	0
		9	Stone weir	0.75
		10	Beaver dam	0.69
		11	Beaver dam	0.32

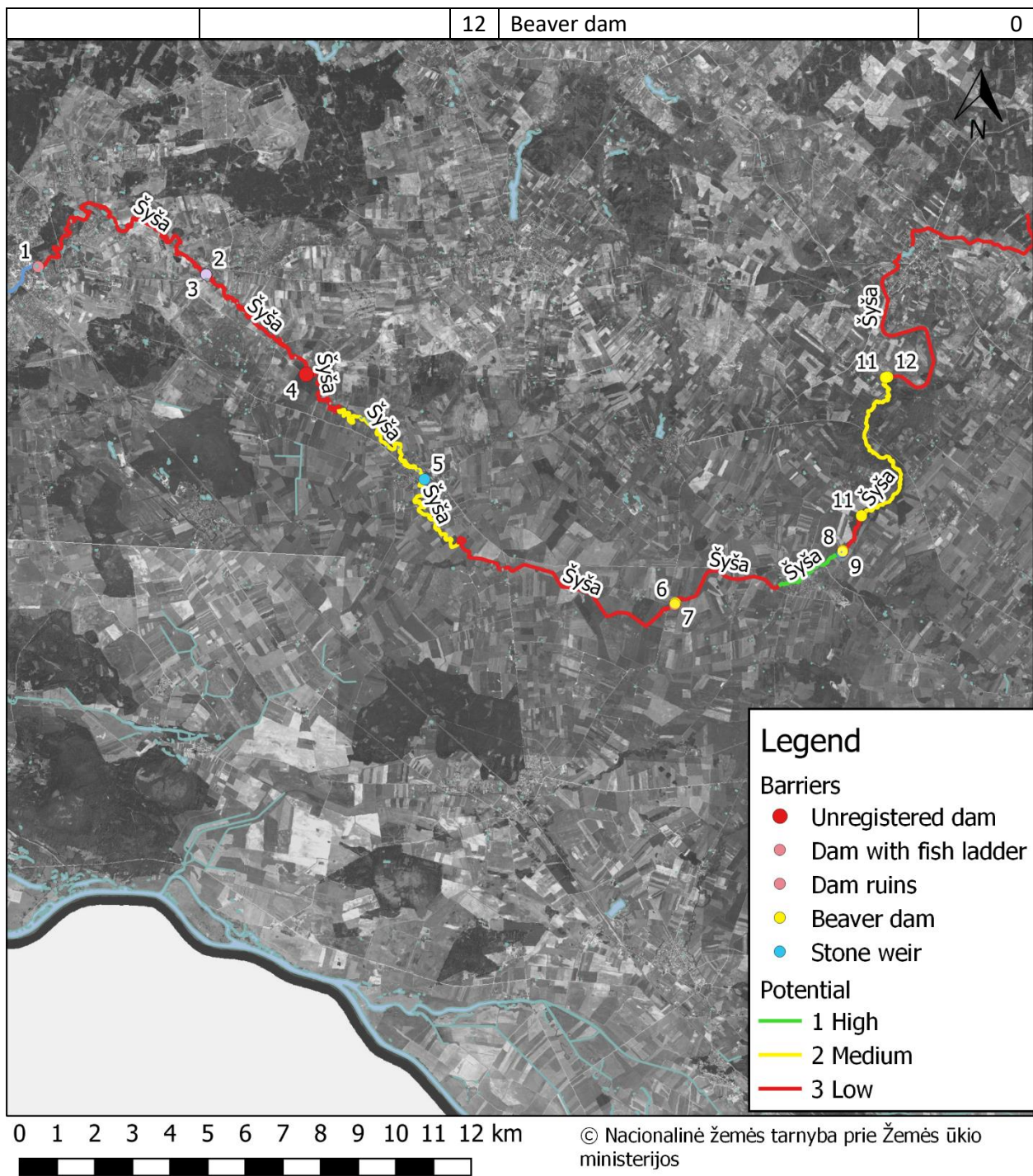


Figure 31. Šyša River and location of barriers

Šyša is direct Nemunas River tributary. The length of the river is 61 km and its catchment area covers 410 km². The river starts at the surroundings of Vainutas village. Discharged at one of the main distributary channels – Atmata (Fig. 31). The average slope is relatively small 0.95 m / km, however, the indicate it is affected by the small slope of 0.27 -0.55 in the downstream section of the river. The most downstream section of 4.6 km is channelized and used for navigation and 22.5 km is straightened. All the tributaries except for one (Šūstis) is also straightened. The biggest obstacle for lamprey migration is possibly the Šilutė dam with the constructed fish ladder located 8.7 km from the mouth (Fig. 32). Other obstacles include illegally constructed dams/weir (Fig. 33), remains of collapsed dams, stone weirs and beaver dams. It is known that lampreys accumulate below Šilutė dam where occasionally poachers fined.



Figure. 32. Šilutė dam with fish ladder



Figure 33. Unregistered dam in Šyša River

Suitability for lamprey reproduction

There are no suitable sections for lamprey reproduction below the Šilutė dam. The number of suitable habitats above the dam is also limited to a few rapids and Šūstis tributary. Suitability for lamprey reproduction is confirmed by the capture of brook lamprey brook lamprey larvae, sea trout and other gravel spawning species in electrofishing surveys in the upper section of the river and tributary Šūstis. However, there was so far no registered cases of river lamprey spawning.