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Atlantic Branch

VISTULA LAGOON CATCHMENT

Atlas of water use

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Vistula Lagoon Catchment: Atlas of water use

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Atlas contains information about the transboundary catchment of the Vistula Lagoon, the Baltic Sea. The following generalized schematic maps of the whole catchment are presented (Chapter 1): physical-geographical map, river network, catchment and administrative structures, relief, drainage network density, slope angles, stream travelling time, specific discharge, land use. Chapter 2 contains information about main subcatchments within the Vistula Lagoon catchment (17 river streams): topographic maps, 3-dimensional relief sketches, altitude profiles for the main river streams, main hydrographic characteristics, photos; diagram of along-stream location of administrative units, which are included in the area of catchment. Chapters 3 and 4 give views to the administrative units in the Russian (17 units) and the Polish (18 units) parts of the Vistula Lagoon catchment respectively. General descriptions of a unit, physical-geographical map with locations of main settlements and their population, diagrams illustrating inter-annual dynamics of water consumption and waste water disposal are presented. The diagram of parts of the subcatchments included in the territory of each administrative unit show fluxes of water running through the administrative unit via main river streams. Chapter 5 includes the similar information for 8 municipal units located on the border of the Vistula Lagoon catchment. Spatial characteristics of the subcatchments and administrative units are presented in table form. The information about water discharge at the final crosssections of subcatchments are presented at first time.

Atlas zawiera opis transgranicznej zlewni Zalewu Wiślanego. Przedstawione są następujące uogólnione schematyczne mapy całej zlewni (Rozdział 1). Rozdział 2 zawiera opis głównych podzlewni w całej zlewni Zalewu Wiślanego (17 rzek). Rozdział 3 i 4 przedstawia obraz jednostek administracyjnych odpowiednio w rosyjskiej (17 jednostek) i polskiej (18 jednostek) części zlewni Zalewu Wiślanego. Rozdział 5 zawiera podobny opis ośmiu jednostek administracyjnych leżących na granicy zlewni Zalewu Wiślanego. Charakterystyki przestrzenne podzlewni jednostek administracyjnych przedstawione są w formie tabelarycznej. Po raz pierwszy przedstawione są informacje o przepływach w ostatnich przekrojach w podzlewni.

В атласе представлен транграницыій водосбор Калининградского/Вислинского залива Балтийского моря. Глава 1 содержит общие карты для всего водосбора. В главе 2 собрана информация по 17 частным водосборам. В главах 3 и 4 представлены соответственно 17 российских и 18 польских административных единиц, полностью расположенных в пределах водосбора Калининградского/ Вислинского залива. В главе 5 дана аналогичная информация для 8 административных единиц, расположенных на границе водосбора залива. В табличной форме представлены основные площадные характеристики водосборов и административных единиц. Впервые приводятся данные о стоке с водосборов для замыкающих створов.

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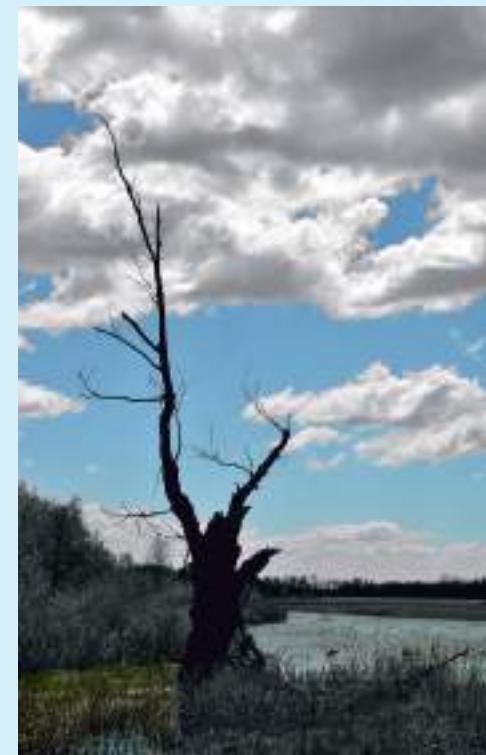
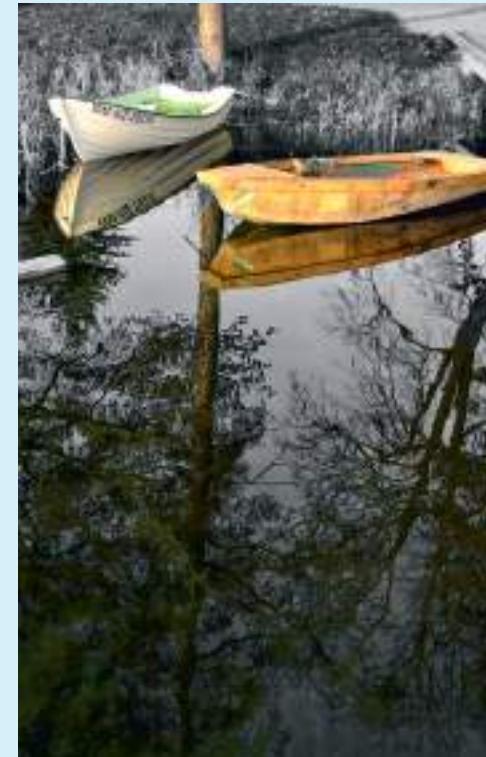


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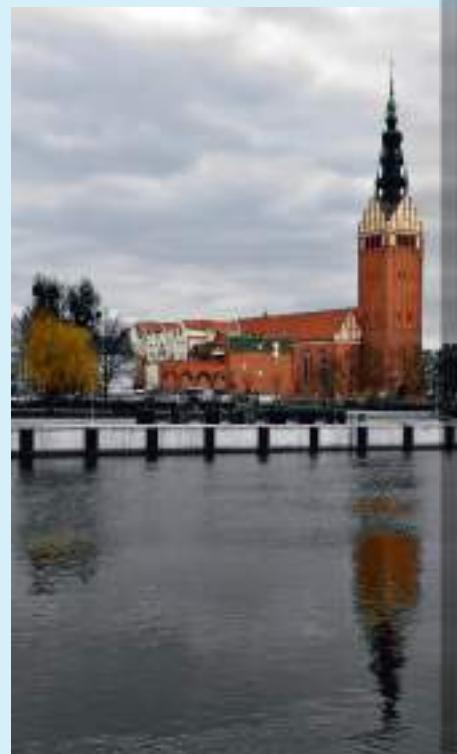


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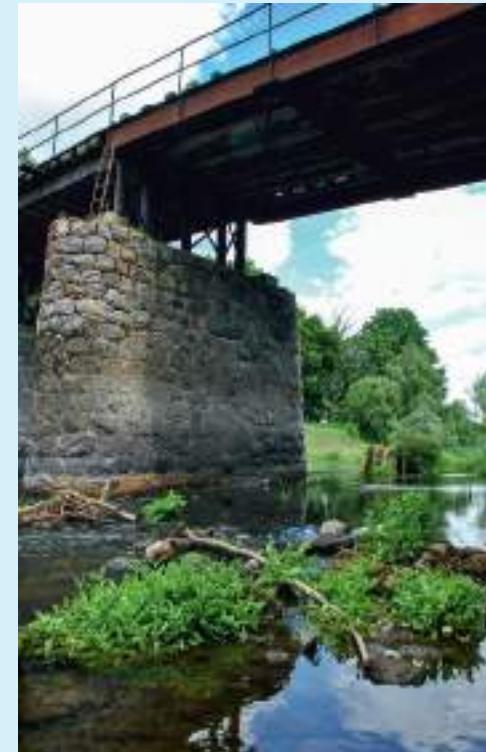
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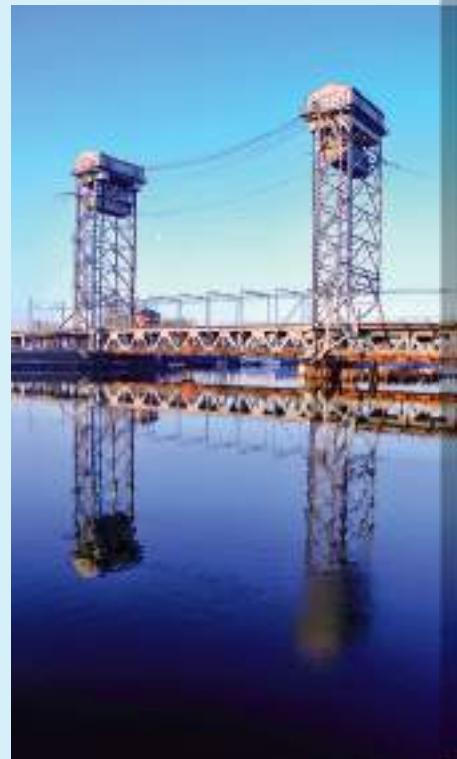
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INTRODUCTION

The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) [Convention ..., 1992] was adopted in Helsinki in 1992 and entered into force in 1996. The countries shared the Vistula Lagoon catchment, the Republic of Lithuania, the Republic of Poland, the Russian Federation as well as almost all countries sharing transboundary waters in the region of the United Nations Economic Commission for Europe (UNECE) are Parties to the Convention.

According to the definition given in the Water Convention [Convention ..., 1992] “transboundary waters” means any surface or ground waters, which mark, cross or are located on boundaries between two or more States ... ”. A river basin is administratively shared if its constituents belong to different administrative unit. In case these constituents belong to different countries, the basin will be an international or transboundary river basin. Within one country, a national river basin might be also shared by different municipalities or communes [Chubarenko, Domnin, 2008].

The analysis applied in the Atlas is based on fact that areas of catchments and administrative units are intercrossed. The mismatch between hydrological and political-administrative boundaries is particularly apparent in international river basins, where river basin boundaries cross administrative boundaries, and this mismatch of different spatial scales is often referred to as “spatial misfit” [Young, 2002].

As concern the South-Eastern Baltic, the approach to analyse spatial misfit between areas of catchment and administrative units was developed in [Chubarenko, Domnin, 2007; Domnin, Chubarenko, 2008; Chubarenko, Domnin, 2008] and practically applied for the Kaliningrad Oblast [Domnin, Chubarenko, 2007]. The present Atlas broads the previous view and presents information for the whole transboundary Vistula Lagoon catchment as well as incorporates new layers of information in addition to spatial characteristics, namely, (a) topography shown as 3-dimensional sketches and altitude profiles and (b) the information about river runoff (discharge) at the final cross-section of the subcatchment.

The Atlas shows information about catchments and river streams for the main rivers of the Vistula Lagoon catchment, which includes areas of Lithuania (LT), Poland (PL) and Russia (RU). These are (in alphabetic order and with indication of national belonging) the Bonówka-Mamonovka (PL-RU), the Bauda (PL), the Deyma (RU), the Elbląg (PL), the Golubaya (RU), the Graevka (RU), the Instruch (RU), the Łyna-Lava (PL-RU), the Nelma (RU), the Nogat (PL), the Pregolya (RU), the Pasłęka (PL), the Pissa (PL-RU-LT), the Primorskaya (RU), the Prokhladnaya (PL-RU), the Szkarawa (PL) and the Węgorapa-Angrapa (PL-RU) rivers.

Chapter 1 contains schematic maps for the whole Vistula Lagoon catchment. The physical map presents relief and river network. The integrative map of both sub-catchments and administrative units for Polish and Russian sides presents a division of the Vistula Lagoon catchment into smaller spatial segments which are the result of overlapping of both natural catchment division and man-made administrative unit division. This map is the core for analysis presented in the Atlas. The map is followed by a diagram which illustrates the connection of all administrative units via river streams. Morphometric characteristics are presented by a map of slopes. The hydrography is illustrated by a map of river network density, a map of specific runoff and a map of stream traveling time for annual average flows. Finally, a land use map is presented.

Chapter 2 contains information about the main sub-catchments within the Vistula Lagoon catchment (17 river streams): physical-geographical map, 3-dimensial relief sketch, altitude profile for the main river stream, main hydrographic characteristics, some photos and a scheme of administrative units in the catchment with indication of direction of river water fluxes from one unit to another. The last scheme clearly shows the upstream and downstream 'neighbours' for a certain administrative unit.

Chapters 3 and 4 provide information on the administrative units in the Russian (17 units) and the Polish (18 units) parts of the Vistula Lagoon catchment, respectively. Main characteristics, locations of main settlements and their population, diagrams illustrating inter-annual dynamics of water consumption and wastewater disposal are presented. The area of each administrative unit is divided by river subcatchments, and presented diagram shows direction of fluxes of water running through the administrative unit via main river streams.

Chapter 5 includes the same information as in chapters 3 and 4, but for eight municipal units (Lithuania, Poland and Russia) located on the border of the Vistula Lagoon catchment and which area is only partly belonged to this catchment.

Collection and analysis of the spatial and statistical information, development of maps and schemes, as well as layout of the Atlas and its printing were made within the project VILA "Opportunities and Benefits of Joint Use of the Vistula Lagoon", ILPR.02.04.00-22-143/10-07/NR (2012-2015). It became clear during the Atlas development that not only spatial characteristics, but the information about river runoff is of crucial importance for practical purposes. All results of numerical modeling of the river run-off in the Vistula Lagoon catchment used in the Atlas and included in the appropriate maps were contributed by BONUS Soils2Sea Project "Reducing nutrient loadings from agricultural soils to the Baltic Sea via groundwater and streams" and its complementary Project № 14-05-91730 of the Russian Fund for Basic Researches (RFBR).

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WSTĘP

Konwencja dotycząca ochrony i użytkowania wód transgranicznych oraz międzynarodowych jezior – Konwencja Wodna - (Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 1992) została przyjęta w Helsinkach w 1992 roku i weszła w życie w roku 1996. Stronami Konwencji są kraje obejmujące położone w zlewni Zalewu Wiślanego – Litwa, Rzeczpospolita Polska oraz Rosja – jak również niemal wszystkie kraje współużytkujące wody transgraniczne w regionie Komisji Ekonomicznej Narodów Zjednoczonych dla Europy (United Nations Economic Commission for Europe - UNCE).

Zgodnie z definicją przyjętą w Konwencji (Konwencja ..., 1992) „wody transgraniczne” oznaczają wody powierzchniowe i podziemne, które wyznaczają, przecinają lub leżą na granicach pomiędzy dwoma, czy więcej państwami. Zlewnia rzeki jest administracyjnie podzielona, jeżeli jej części należą do różnych jednostek administracyjnych. Jeżeli te części zlewni przynależą do różnych krajów, to wówczas zlewnia będzie międzynarodowa lub transgraniczna. W ramach jednego państwa zlewnia rzeki może także być podzielona pomiędzy różne jednostki administracyjne (Chubarenko, Domnin, 2008).

Analiza przyjęta w Atlasie bazuje na fakcie, że obszary poszczególnych zlewni i jednostek administracyjnych wzajemnie się nakładają. Rozbieżności pomiędzy granicami hydrologicznymi wyznaczonymi przez poszczególne zlewnie a granicami polityczno-administracyjnymi są szczególnie widoczne w zlewniach międzynarodowych gdzie granice zlewni przechodzą przez granice administracyjne. Takie rozbieżności o różnej skali przestrzennej nazywane są często „spatialmisfits” (Young, 2002).

W przypadku Południowo-Wschodniego Bałtyku koncepcję analizy przestrzennych rozbieżności w obszarach zlewni i jednostek administracyjnych opracowano w (Chubarenko, Domnin, 2007; Domnin, Chubarenko, 2008) i praktycznie zastosowano dla przypadku Regionu Kaliningradzkiego (Domin, Chubarenko, 2007). Prezentowany Atlas rozszerza poprzednie podejście i przedstawia informację obejmującą cały transgraniczny obszar zlewni Zalewu Wiślanego, a także zawiera dodatkowe informacje w odniesieniu do charakterystyki przestrzennej, a mianowicie (a) topografię przedstawioną w postaci trójwymiarowych szkiców wraz z profilami wysokościowymi (b) określenie przepływu w ostatnim przekroju podzlewni.

Atlas zawiera także informacje dotyczące zlewni Zalewu Wiślanego oraz głównych rzek zlewni i ich dopływów, a obejmujące rejony Litwy (LT), Polski (PL) i Rosji (RU). Rzeki te to (w alfabetycznym porządku wraz z zaznaczeniem przynależności państwowej): Bonówka – Mamonówka (PL-RU), Bauda (PL), Dejma (RU), Elbląg, (PL), Gołubaja (RU) Grajewka (RU), Instrucz (RU) Łyna-Ława (PL-RU), Nelma (RU), Nogat (PL), Pregoła (RU) Pasłeka (PL), Pissa (PL- RU), Primorskaja (RU), Prochłodnaja (RU), Szkarpara (PL), Węgorapa-Angrapa (PL-RU).

Rozdział 1 zawiera schematyczne mapy całej zlewni Zalewu Wiślanego. Mapa fizyczna prezentuje rzeźbę terenu oraz sieć rzeczną. Zintegrowana mapa podzlewni oraz polskich i rosyjskich jednostek administracyjnych przedstawia podział zlewni Zalewu Wiślanego na mniejsze przestrzenne segmenty, co jest wynikiem nałożenia naturalnego hydrologicznego podziału zlewni i granic podziału administracyjnego. Mapa ta stanowi podstawę dalszych analiz prezentowanych w Atlasie. Mapę tę uzupełnia diagram prezentujący połączenie wszystkich jednostek administracyjnych poprzez rzeki. Charakterystyka morfometryczna prezentowana jest na mapie spadków. Hydrografię opisuje mapa gęstości sieci rzeczonej, mapa przepływów charakterystycznych, a także mapa przedstawiająca czas przepływu w odniesieniu do przepływu średniego rocznego. Na zakończenie przedstawiona jest mapa użytkowania terenu.

W Rozdziale 2 opisano główne podzlewnie Zalewu Wiślanego (17 rzek). Przedstawiono mapy fizyczno-geograficzne, trójwymiarowe szkice rzeźby terenu, profil wysokościowy głównych rzek oraz ich charakterystykę hydrograficzną, zdjęcia oraz schemat jednostek administracyjnych w zlewni ze wskazaniem kierunku przepływu wody pomiędzy poszczególnymi jednostkami.

W Rozdziałach 3 i 4 przedstawiono informacje o podziale na jednostki administracyjne w częściach rosyjskiej (19 jednostek) i polskiej (23 jednostki) zlewni Zalewu Wiślanego, a także lokalizację głównych miast oraz ich zaludnienie. Przedstawiono diagramy opisujące roczną dynamikę konsumpcji wody oraz zrzutu ścieków. Obszar każdej jednostki administracyjnej jest podzielony na podzlewnie (wyznaczone przez każdą z rzek) przy jednoczesnym przedstawieniu kierunków przepływu wody przez każdą jednostkę administracyjną głównymi rzekami.

Rozdział 5 zawiera te same informacje jak Rozdziały 3 i 4, ale dla ośmiu jednostek miejskich (Litwa, Polska i Rosja) położonych na granicy zlewni Zalewu Wiślanego i których obszar tylko częściowo należy do tej zlewni.

Zebranie danych, ich przestrzenna i statystyczna analiza, opracowanie map i wykresów, a także układ Atlasu oraz jego druk były wykonane w ramach projektu VILA “*Opportunities and Benefits of Joint Use of the Vistula Lagoon*” ILPR.02.04.00-22-143/10-07/NR (2012-2015). W trakcie opracowywania Atlasu okazało się, że dla celów praktycznych istotna jest nie tylko charakterystyka przestrzenna, ale także znajomość wielkości przepływu w rzekach. Wykorzystane w Atlasie oraz zawarte w mapach wyniki modelowania numerycznego przepływów w zlewni Zalewu Wiślanego pochodzą z projektu BONUS Soils2Sea “*Reducing nutrient loadings from agricultural soils to the Baltic Sea via groundwater and streams*” oraz projektu uzupełniającego Nr 14-05-91730 (2014-2016) w ramach Rosyjskiego Funduszu Badań Podstawowych (Russian Fund for Basic Researches, RFBR).

Autorzy kierują podziękowaniem dla kolegów z Instytutu Oceanologii im. P.P.Szirszowa, Oddział Atlantycki w Kaliningradzie, z Instytutu Morskiego w Gdańsku, Instytutu Ekologii i Hydrosfery, a także personalnie do recenzentów wymienionych na stronie tytułowej oraz wszystkich kolegów za ich cenne uwagi i pomoc w zbieraniu danych. Specjalne podziękowania kierujemy także do Szwedzkiego Instytutu Hydrologiczno Meteorologicznego za udostępnienie bezpłatnego dostępu do modelu HYPE, a także do narodowych służb hydrometeorologicznych w Polsce i Rosji, których ogólnodostępne dane wykorzystane zostały do kalibracji modelu. Wszystkie źródła tych danych zostały z wdzięcznością zacytowane oraz zamieszczone w spisie literatury.

ВВЕДЕНИЕ

Конвенция по охране и использованию трансграничных водотоков и международных озёр (Водная конвенция) [Convention ..., 1992] была принята в 1992 году в Хельсинки и вступила в законную силу в 1996 году. Страны, разделяющие водосбор Калининградского/Вислинского залива¹ (Литовская Республика, Республика Польша и Российская Федерация), также как почти все страны, разделяющие трансграничные воды в регионе Европейской экономической комиссии Организации объединенных наций (ЕЭК ООН), являются сторонами Водной конвенции.

В соответствии с определением, данным в Водной конвенции [Convention ..., 1992], под «трансграничными водами» понимаются любые поверхностные или подземные воды, которые обозначают, пересекают или расположены на границах между двумя или более государствами... ». Речной водосборный бассейн (водосбор) разделён в административном отношении, если его составные части принадлежат к разным административным единицам. В случае, если эти составные части принадлежат к разным странам, водосбор будет считаться международным или трансграничным. Водосбор, находящийся полностью в границах одной страны, может быть также разделен различными административными единицами [Chubarenko, Domnin, 2008].

Анализ, применённый в атласе, основывается на том, что части водосборов и административных единиц пересекаются. Несоответствие между гидрологическими и политико-административными границами, в частности, проявляется в международных речных бассейнах, где границы речных бассейнов пересекают административные границы, и это несоответствие для различных пространственных масштабов часто называют «пространственным» несоответствием (“spatial misfit”) [Young, 2002].

Что касается Юго-Восточной Балтики, то подход к анализу пространственного несоответствия между частями водосбора и административными единицами был разработан в [Chubarenko, Domnin, 2007; Domnin, Chubarenko, 2008; Chubarenko, Domnin, 2008] и практически применён для Калининградской области [Domnin, Chubarenko, 2007]. Настоящий атлас расширяет предшествующие результаты - представляет информацию для всего трансграничного водосбора Калининградского/Вислинского залива и включает в себя новые слои информации. В дополнение к пространственным характеристикам, а именно, рельефу местности, показанному трёхмерными рисунками и профилями высоты, добавлена информация о речном стоке (его расходе) в замыкающем створе водосбора.

Атлас показывает информацию о водосборных бассейнах и речных водотоках для основных рек водосбора Калининградского/Вислинского залива, включающего в себя районы Литвы (LT), Польши (PL) и России (RU). Это водосборы следующих рек (в алфавитном порядке и с указанием национальной принадлежности): Бонувка-Мамоновка (PL-RU), Бауда (PL), Дайма (RU), Эльблонг (PL), Голубая (RU), Граевка (RU), Инструч (RU), Лына-Лава (PL-RU), Нельма (RU), Ногат (PL), Преголя (RU), Пасленка (PL), Писса (PL-RU-LT), Приморская (RU), Прохладная (PL-RU), Шкарпава (PL) и Венгорапа-Анграпа (PL-RU).

Глава 1 содержит схематические карты для всего водосбора Калининградского/Вислинского залива. Физическая карта представляет рельеф и речную сеть. Интегральная кар-

¹В изданиях на польском языке весь залив называется Вислинским (Zalew Wiślany). Немецкое историческое название — Frisches Haff , литовское — Aistmares. В англоязычных изданиях чаще всего употребляется этоним «The Vistula Lagoon». В российских изданиях северная, принадлежащая России часть залива, называется Калининградским заливом, южная (польская) часть — Вислинским заливом. Здесь для всего залива будет использовано название Калининградский/Вислинский залив.

та частных водосборов и административных единиц для польской и российской сторон представляет собой разделение водосбора залива на более мелкие пространственные сегменты, которые являются результатом совмещения естественного разделения на частные водосборы и искусственного деления на административные единицы. Эта карта является основой для анализа, представленного в атласе. Карта сопровождается схемой, которая иллюстрирует соединение всех административных единиц с помощью речных водотоков. Морфометрические характеристики представлены картами углов наклона. Гидрография иллюстрируется картой густоты речной сети, картой модуля стока и картой времени руслового добегания вод при среднегодовых значениях стока. И, наконец, в этой главе представлена карта использования земель.

Глава 2 содержит информацию об основных частных водосборах в пределах водосбора Калининградского/Вислинского залива (17 речных систем). Для каждой речной системы представлена физико-географическая карта, трёхмерная диаграмма земной поверхности, продольный профиль высот для русла главной реки, основные гидрографические характеристики, некоторые фотографии и блок-схемы административных единиц в водосборе с указанием направления водных потоков рек от одного блока к другому. Последняя схема ясно показывает положение верхних и нижних «соседей» в речном водосборном бассейне.

Главы 3 и 4 представляют информацию об административных единицах в российской (17 единиц) и польской (18 единиц) частях водосбора Калининградского/Вислинского залива, соответственно. Основные характеристики для каждой из единиц: расположение основных населенных пунктов с количеством проживающего в них населения, диаграммы, иллюстрирующие межгодовую динамику водопотребления и объёма сброса сточных вод. Площадь каждой административной единицы делится между частными водосборами, и представленная схема показывает части водосборных бассейнов, находящихся в административной единице, и водотоки, протекающие через неё.

Глава 5 содержит ту же информацию, что и главы 3 и 4, но для 8 муниципальных образований (Литвы, Польши и России), расположенных на границе водосбора Калининградского/Вислинского залива, и площади которых лишь малой частью принадлежат к этому водосбору.

Сбор и анализ пространственной и статистической информации, разработка карт и схем, а также макет атласа и его печать были сделаны в рамках проекта VILA «Возможности и преимущества совместного использования Вислинского залива», ILPR.02.04.00-22-143/10-07/NR (2012-2015). В ходе разработки атласа, стало очевидным, что не только пространственные характеристики, но и информация о речном стоке, имеет важное значение для решения практических задач. Все результаты численного моделирования речного стока в бассейне Калининградского/Вислинского залива и соответствующие карты, используемые в атласе, были предоставлены проектом Soils2Sea программы BONUS «Уменьшение биогенной нагрузки с сельскохозяйственных территорий в Балтийское море» и комплементарным ему проектом №14-05-91730 Российского фонда фундаментальных исследований (РФФИ).

Авторы хотели бы поблагодарить своих коллег из Атлантического отделения Института океанологии им. П.П. Ширшова Российской академии наук, Морского института в Гданьске, Балтийского института экологии гидросферы, и лично официальных рецензентов, упомянутых на титульном листе, а также всех других коллег за их ценные замечания и помочь в сборе данных. Особая благодарность выражается Шведскому институту гидрологии и метеорологии (SMHI) за обеспечения свободного доступа к модели HYPE, а также национальным гидрометеорологическим учреждениями Польши и России, открытые данные которых были использованы для калибровки модели. Все источники открытого доступа были процитированы и включены в список литературы.

METHODOLOGICAL REMARKS

General comments

All distances along the river streams mentioned in the Atlas were estimated by GIS using the 1:200,000 topographical map [Kaliningrad Oblast., 2014; Mapa..., 2005].

Spatial characteristics of catchments given in the Atlas were estimated by GIS [Domnin, 2014]. Locations of state borders and border lines of administrative units were taken from [Scheme of modern..., 2010; Mapa..., 2005] and 1:200,000 topographical maps [Kaliningrad map, 2014].

Digital elevation model [SRTM] with spatial resolution of 100 m and vertical resolution of 1 m, with verification using 1:200,000 topographic maps and satellite images LandSAT 7 ETM [Domnin, Chubarenko, 2012] was used for delineating of subcatchment boundaries and slope.

The photos presented in the Atlas illustrate some natural, historical and structural features existing within the catchments or administrative units; they were selected by the authors and are not the subject of commercial advertising. Photos where the photographer is not mentioned were taken by Dmitriy Domnin.

The HYPE model [Lindström et al., 2010; HYPE, 2013] was used to prepare the maps and scheems contained the information about river discharge. The HYPE has been documented to simulate mean annual runoff in the Pregolya River catchment within an accuracy of 10-15% [Chubarenko et al., 2015]. Analysis of daily discharge for the period 1981-2009 showed that maximum discharge is in 3-6 times higher than yearly average used for map developemnet.

Modeling results is always the subject of uncertainty, but the level of uncertainty obtained is defined by using measured date for calibration. The advantage of using the model is that it is covered all streams and gives result for final crossections of each sub-basins, while monitoring points are located only on the few river streams and attributed to some bridges at the low river course, not to final cross-sections of the catchment.

Generalized maps (Chapter 1)

The physical map presents topographic features of the area, the river network and the main towns.

The sub-catchments map shows the hydrographic structure of the Vistula Lagoon catchment and gives an overview of all sub-catchments presented in the Atlas.

The administrative structure map is a core map in the Atlas, as it shows the mosaic structure of the overlapping sub-catchments and administrative units in Poland and Russia. It is followed by a general structural scheme, which illustrates how all administrative units presented in the area are connected with each other via river streams. All elementary structural schemes presented in the descriptions of sub-catchments (Chapter 2) and administrative units (Chapters 3, 4, and 5) are based on this map.

The map of slope presents morphometric characteristics of the area. It was created using data of digital elevation model SRTM mentioned above.

The drainage network density was defined for each cell of 5x5 km as ratio of length of all permanent river streams identified at the map of 1:200,000 to the cell's area (25 km²). The map of drainage network density was developed on the basis of this data by interpolation and gradient color filling.

The specific discharge characterizing the water runoff from a unit area per time unit was estimated from daily discharge data simulated by a numerical model [HYPE, 2013] for 1981-2009. The map represents the mean annual specific discharge as the ratio of river mean annual discharge for this 29 years period at the given point to the area of watershed for this given point.

The map of isochrones of stream travel time shows how quick river water may reach a river mouth from a given point via a river stream. It was developed using average discharge values simulated by the numerical model HYPE for the period 1981-2009 for a number of locations in the river network [Domnin, Chubarenko, 2011].

Empirical relations between discharge and cross-sectional area for measurement points of the Russian state monitoring system [Hydrological yearbooks, 1955-1968] were used to estimate river currents.

The land use map was developed on the basis of [Scheme of modern ..., 2010], the free access satellite images of LandSAT 7 ETM and the CORINE Land Cover [CORINE, 2000] data, using the unified list of land use types: forests, hayfields and pastures, arable lands, fruit orchards, lakes, wetlands, sand areas, urbanized lands, and industrial lands.

River sub-catchments (Chapter 2)

All pages of Chapters 2-5 are facilitated by skeleton maps to help in the identification of a sub-catchment or a municipal unit within the Vistula Lagoon catchment.

The physical maps for each sub-catchment show the sub-catchment boundaries, large lakes, main settlements, borders of swamps and forests, location of hydraulic structures and points of monitoring measurements.

The structural schemes illustrate the connection, via river network, between municipal units partly or fully related to the sub-catchment with indication of areas of municipal units which belong to the sub-catchment [Dominin, Chubarenko, 2008, 2012].

The area of the sub-catchment, its shares within the Polish and the Russian parts of the Vistula Lagoon catchment, the average slope, the minimal and maximal height of the terrain, the main settlements, the locations of monitoring points etc. are presented in a table and in the text.

The river tortuosity (dimensionless value) is expressed by arc-chord ratio of the length of the curve (L) to the distance between the ends of it (C): $\tau=L/C$ [<https://en.wikipedia.org/wiki/Tortuosity>]. Plots of mean annual seasonal variations of river discharge were prepared on the basis of daily discharge data simulated by the numerical model HYPE for 1981-2009.

The 3-dimensional plots of the terrain were prepared from the digital elevation model [SRTM]. These maps also show the locations of the main towns and the sub-catchment boundaries.

The altitude profiles along with main river streams were prepared using topographical maps [Mapa ..., 2005; Kaliningrad map, 2014] with indication of locations of junction points with the main tributaries.

Municipal units (Chapters 3, 4 and 5)

The municipal units belonged to the Vistula Lagoon catchment are presented in three chapters. The Polish and Russian units located within the Vistula Lagoon catchment in full size are presented in Chapter 3 and Chapter 4, respectively, while the units which are crossed by the lagoon catchment boundary are shown in Chapter 5 (one Lithuanian unit, five Polish units and two Russian units). At the page about a municipal unit the following information are present.

The physical maps present borders of administrative units, catchment boundaries, locations of settlements and number of their inhabitants, as well as land use characteristics.

The structural schemes illustrate the principle link between parts of sub-catchments located within the borders of the municipal unit with indication of the areas which belong to this unit. [Dominin, Chubarenko, 2008, 2012].

Diagrams illustrate the annual dynamics of water consumption and water disposal for the municipal unit as a whole disregarding the sub-catchment where waters originated from or discharged to.

The number of inhabitants and the data of water consumption and waste water disposal are given according to statistical data from Russia (2010-2012) [Statistical book, 2006, 2012] and Poland [Województwo ..., 2010, 2013 and Wikipedia]. All pages of Chapters 2-5 are facilitated by skeleton maps to help in the identification of a sub-catchment or a municipal unit within the Vistula Lagoon catchment.

Abbreviations used:

AMSL - above mean sea level

WWTP - waste water treatment plant

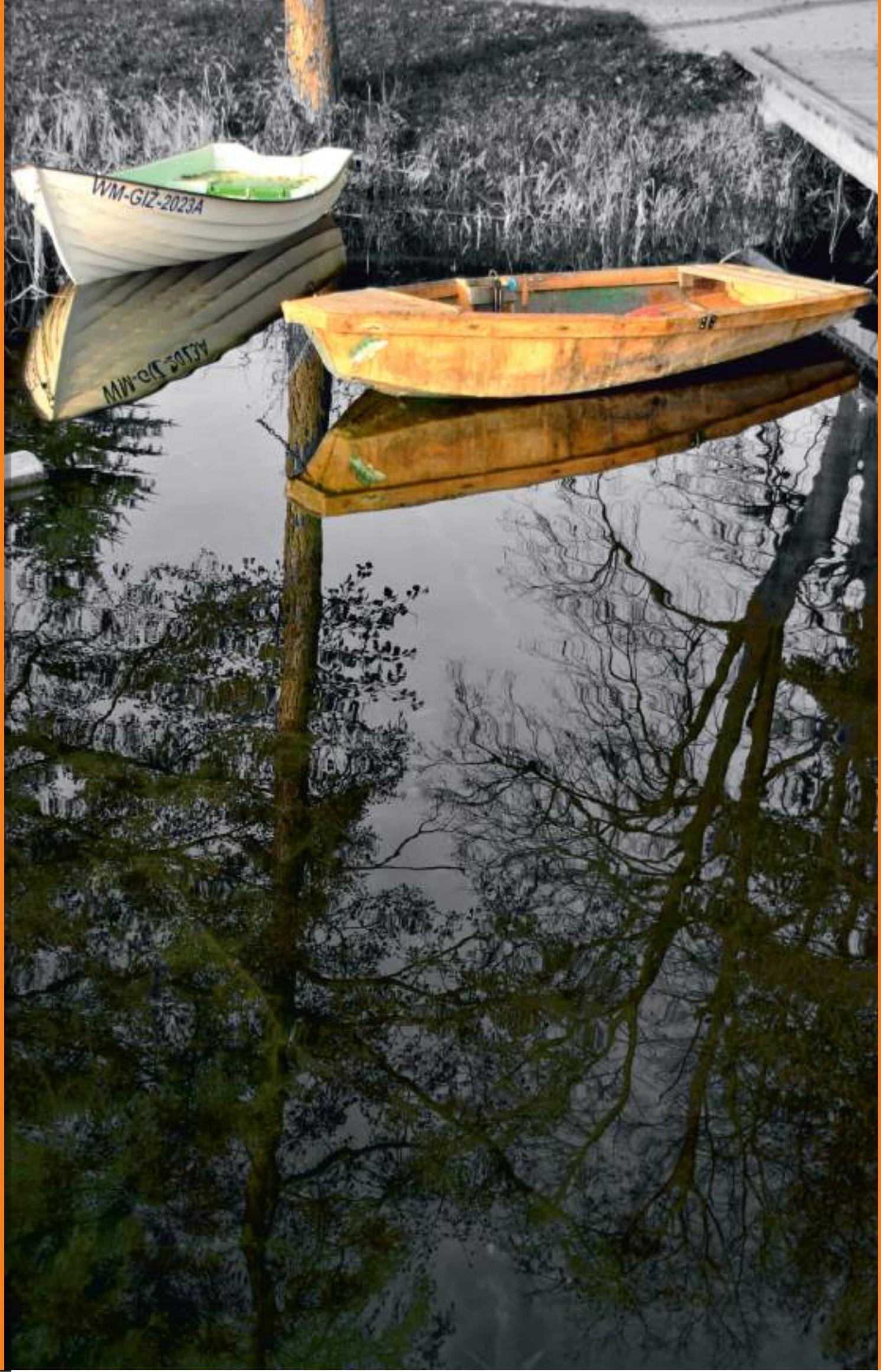
MB - microbiological treatment of waste waters

ths inh. – thousands of inhabitants

ca. – persons or heads of life stocks

ca - approximately

a⁻¹ – per year



CHAPTER I

VISTULA LAGOON CATCHMENT

IN THIS CHAPTER:

Geographical description

Physical map

Sub-catchments

Administrative structure

Catchment-administrative
structural scheme

Hydro-morphometric
characteristics (slope, specific
discharge, drainage network
density, stream travel time)

Landuse

GEOGRAPHICAL DESCRIPTION

The basin is formed by the catchments of the Pregolya River with its tributaries (in an upstream order these are the Łyna-Lava, the Gólbajá, the Instruch, the Węgorapa-Angrapa, and the Pissa) and rivers discharging directly to the lagoon (in a counterclockwise order these are from North to South the Primorskaya, the Nelma, the Graevka, the Prohladnaya, the Banówka-Mamonovka, the Pasłeka, the Bauda, the Elbląg, the Nogat, and the Szkarawa).

The whole area of the Vistula Lagoon catchment was assumed in [Lazarenko, Majewski, 1971] as 23,871 km², that differed by 1.7% from previous estimation [Mikulski, 1960]. Our GIS based estimation gave 23,160 km², that is by 3% less¹.

The Vistula Lagoon catchment could be referred to as a transboundary catchment [Convention ..., 1992], i.e. shared by two countries. The southern part (14,440 km², 62.4%) of it is in Poland (Warmińsko-Mazurskie and Pomorskie Voivodships); the northern part (8,630 km², 37.3%) is in Russian Federation (Kaliningrad Oblast). Tiny upstream part (80 km², 0.3%) is in Lithuania (Vilkaviskis Municipal District).

A shared basin may be of two types: consecutive type - when the upper part of a basin is located within the limits of one administrative unit, while the lower part belongs to another administrative unit; and parallel type - when segments of the main catchment belong to different municipal units and contribute the water into recipient pool in parallel, as for example, left and right sides of the river stream. The Vistula Lagoon drainage basin (Figure 1) is of mixed consecutive-parallel type [Chubarenko, 2008].

River streams which form the «parallel» parts of the lagoon drainage basin collect water from Polish and Russian national territories only and discharge directly to the lagoon (R1 and P1 in Figure 1). The area of the 'parallel' parts of the Vistula Lagoon drainage basin equals 30.3% of its total value, the discharge to the lagoon equals 1.42 km³/yr or 33.9% of the total inflow to the lagoon.

The Nogat, the Pasłeka, the Bauda, the Elbląg the Szkarawa rivers as well as part of the Vistula Spit comprise a Polish national share in this “parallel” part (P1 segment of catchment, Figure 1), which equals 28% of the total Vistula Lagoon catchment. Those rivers supply 30% of the total inflow to the lagoon.

The Primorskaya and the Nelma rivers, as well as other small streams from mainland and the Vistula Spit, form a Russian national share in this «parallel» part (R1 segment of catchment, Figure 1) and discharge to the northern part of the Vistula Lagoon from the Russian territory. Their catchments comprise 2.3% of the total lagoon catchment area and 4% of the total inflow.

Three transboundary rivers form a «consecutive» part of the lagoon drainage basin. These are, in an order of magnitude of discharge, the Pregolya River, the main river of the Vistula Lagoon catchment, which brings of 53% of the total rivers inflow to the lagoon, and two small rivers – the Prokhladnaya and the Banówka-Mamonovka, which together bring 10% of the total inflow to the lagoon. All of them cross the Polish-Russian state border and discharge to the Vistula Lagoon from the Russian territory. The upper parts of their catchments belong to Poland (and in very small part to Lithuania in case of the Pregolya River), while the downstream parts belong to Kaliningrad Oblast of Russia.

This “consecutive” part comprises 69.7% of the total area of the Vistula Lagoon drainage basin (34.4% are in Poland, 35% are in Kaliningrad Oblast of the Russian Federation, 0.3% are in Lithuania). It consists of two independent sub-parts.

¹Taking into account that the length of the Vistula Lagoon catchment border is ca. 1500 km, the 3% uncertainty in the area is corresponded to ca 0.5 km variance of this border location.

The smaller sub-part is formed by the Prokhladnya and the Banówka-Mamonovka rivers, segments R2-P2 (Figure 1), 7.7% of the total Vistula Lagoon drainage basin. The bigger sub-part, the segments R3b-R3a-P3-L3 (Figure 1, their total area is about 62% of the total lagoon drainage basin) is formed by the catchment of the core stream of the Pregolya River, the Instruch River and the sub-catchments of two largest transboundary tributaries of the Pregolya River, namely, the Łyna-Lava and the Węgorapa-Angrapa rivers. Catchment of the Węgorapa-Angrapa rivers includes the segment L3 (Figure 1), 80 km², which belongs to the sub-catchment of Vistytis Lake in Lithuania.

The remarkable feature is that segments R3a-P3-L3 of the Vistula Lagoon catchment are also belong to the catchment of the Curonian Lagoon. The main core of the Pregolya River is divided in the City of Gvardeysk into two streams – the down part of the core stream of the Pregolya River (from Gvardeysk to Kaliningrad, the segment R3b) and the Deyma Branch towards the Curonian Lagoon (the segment R4).

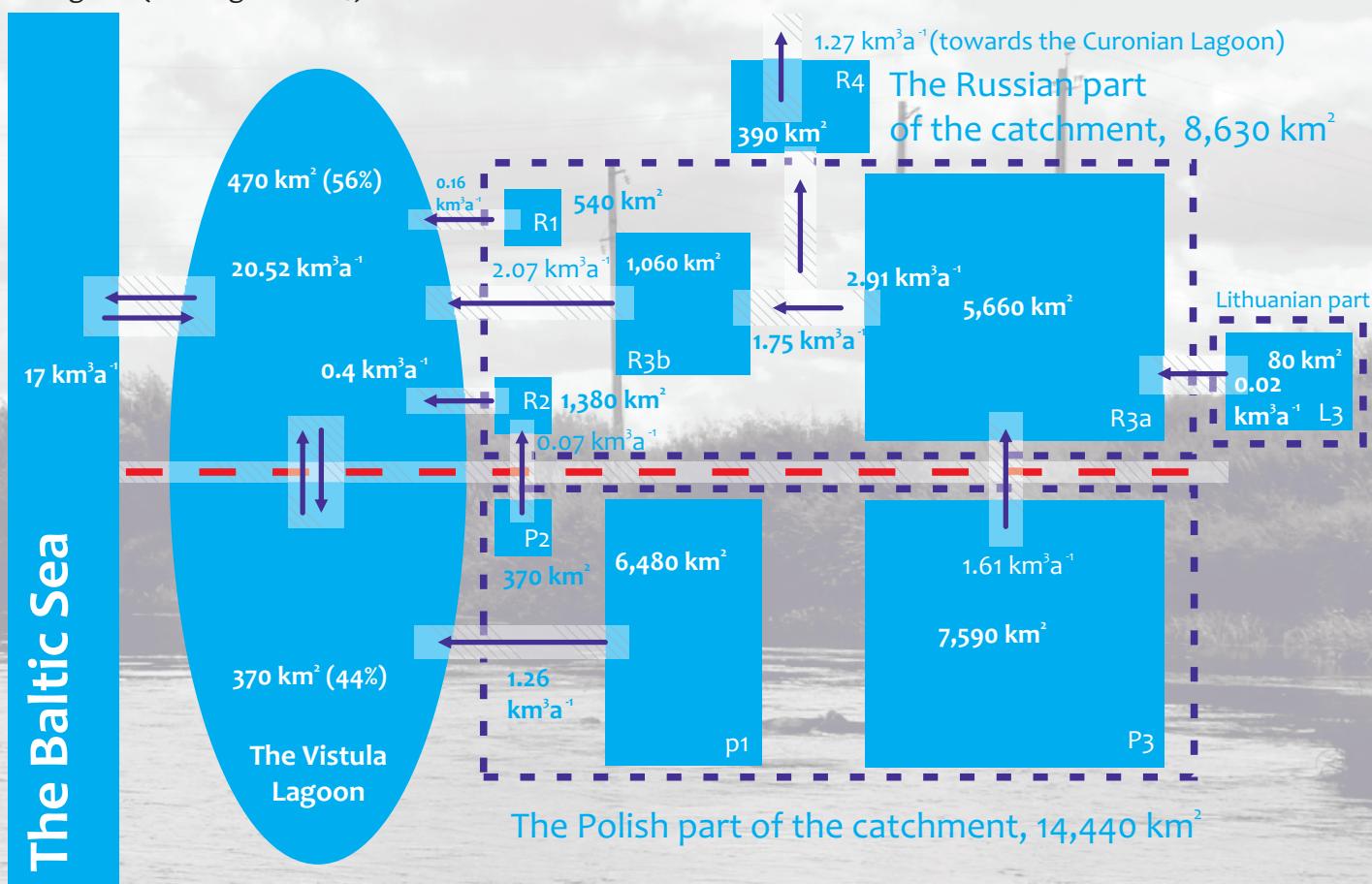
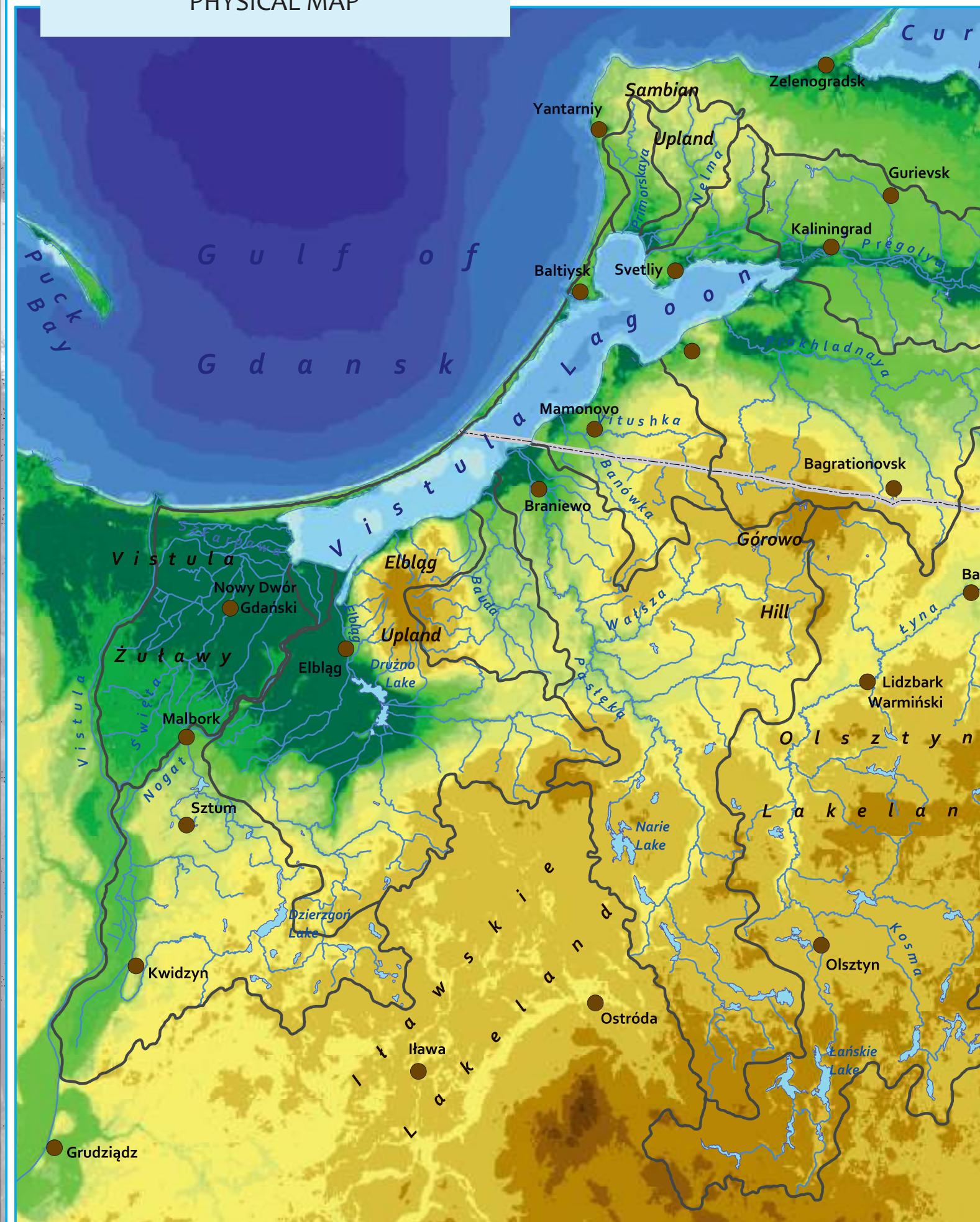


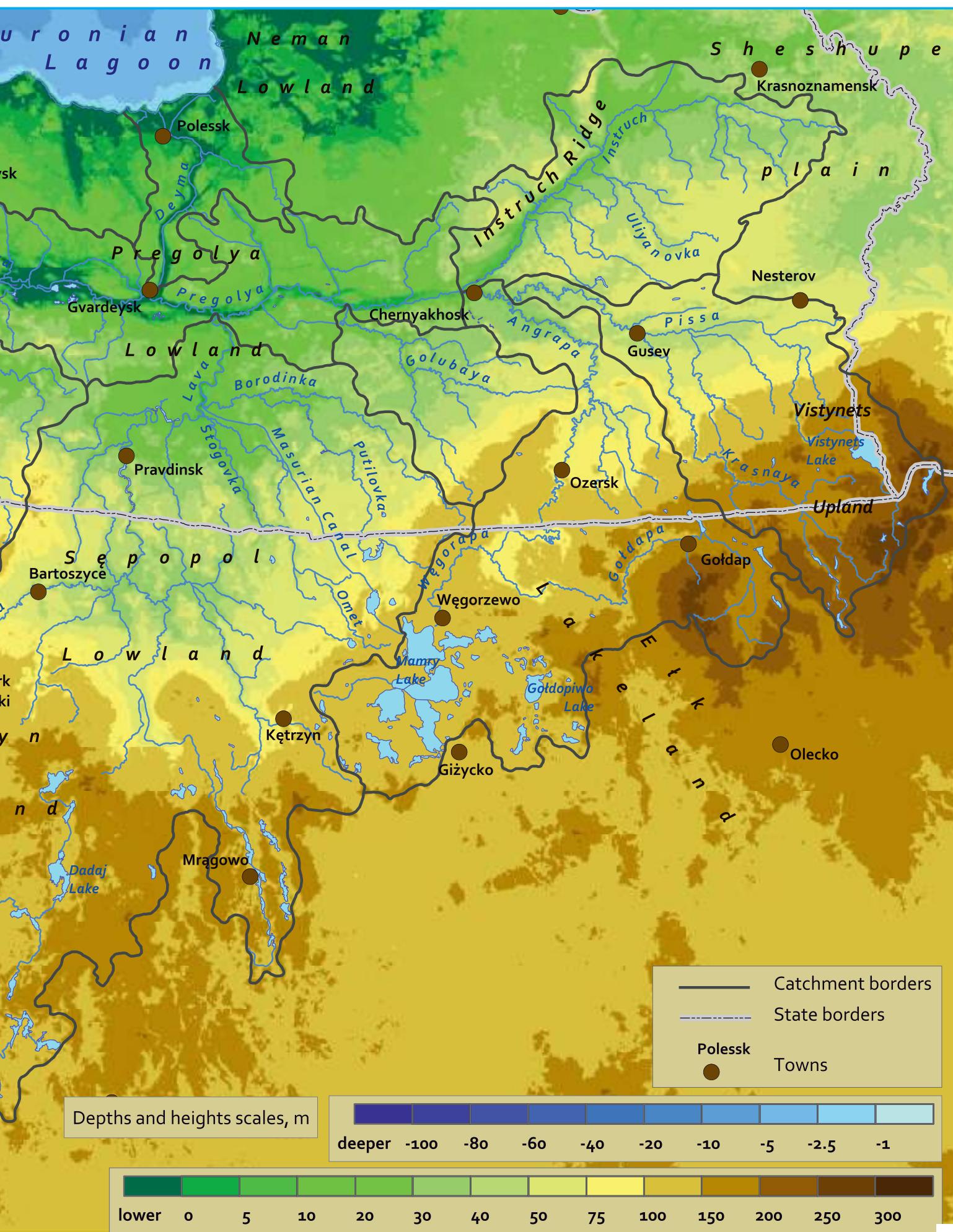
Figure 1. Principal hydrographic scheme² of the transboundary shares of the Vistula Lagoon catchment and water exchange with the Baltic Sea³. The «Parallel» part of the Vistula Lagoon catchment is comprised from two national segments: Russian segment R1 (sub-catchments of the Primorskaya and the Nelma rivers, as well as other small streams form the Russian national share) and Polish segment P1 (sub-catchments of the Nogat, the Pasłęka, the Bauda, the Elbląg, the Szkarrawa rivers and all others smaller streams). The «Consecutive» part of the Vistula Lagoon catchment consists of two independent shares: sub-catchments of the Prokhladnya and the Banówka-Mamonovka rivers (the segments R2-P2), and sub-catchments of the core stream of the Pregolya River, the Instruch, the Łyna-Lava and the Węgorapa-Angrapa rivers (the segments R3b-R3a-P3-L3).

²The scheme was developed after [Chubarenko, 2008] with following corrections: the Prokhladnaya River catchment was included in R2-P2 (instead of R1), a river runoff was estimated by HYPE modeling, that gave additional 0.25 km³/yr of runoff for the segment R3b.

³The fluxes between the Baltic Sea and the Vistula lagoon was taken from [Lazarenko, Majewski, 1971].

PHYSICAL MAP



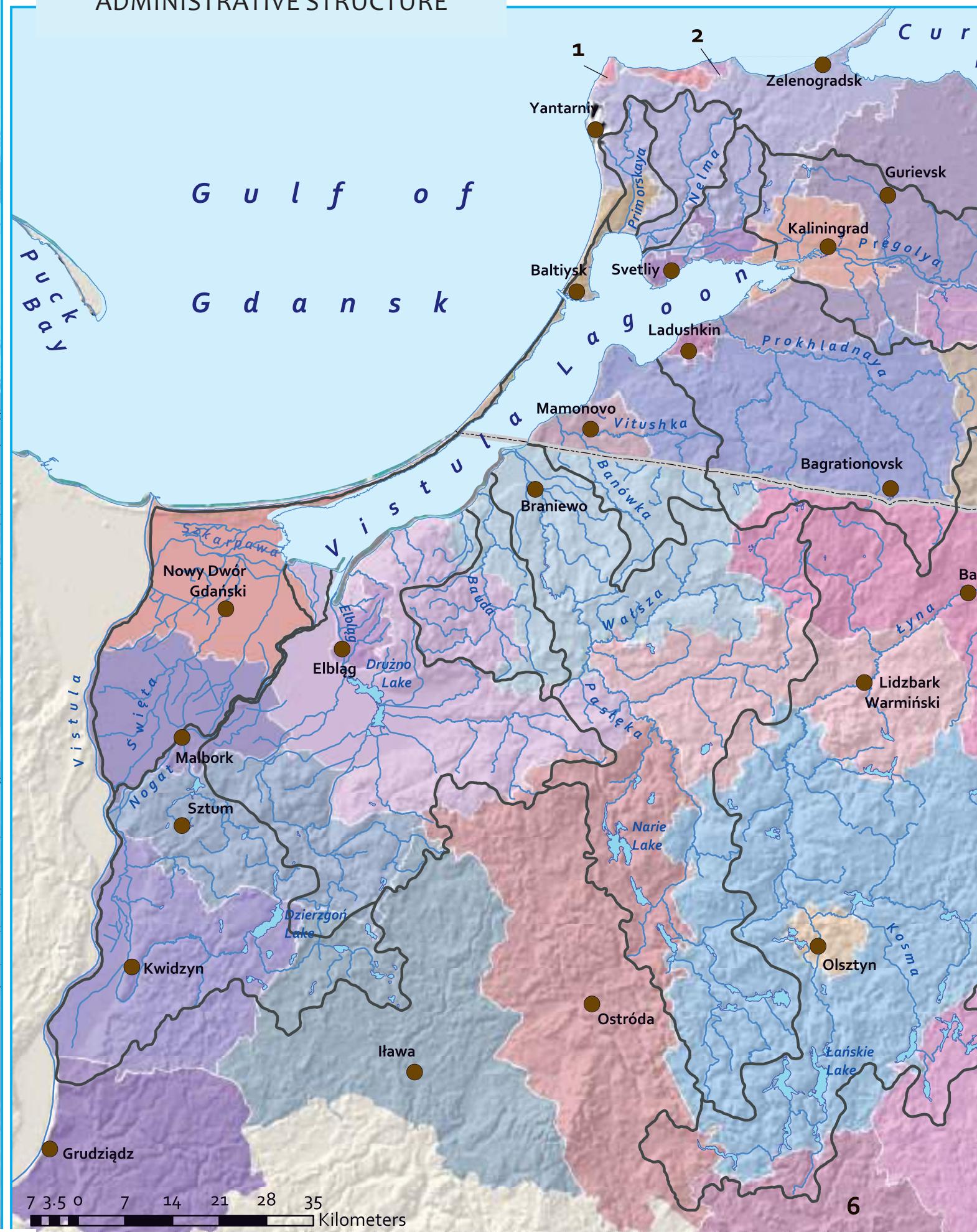


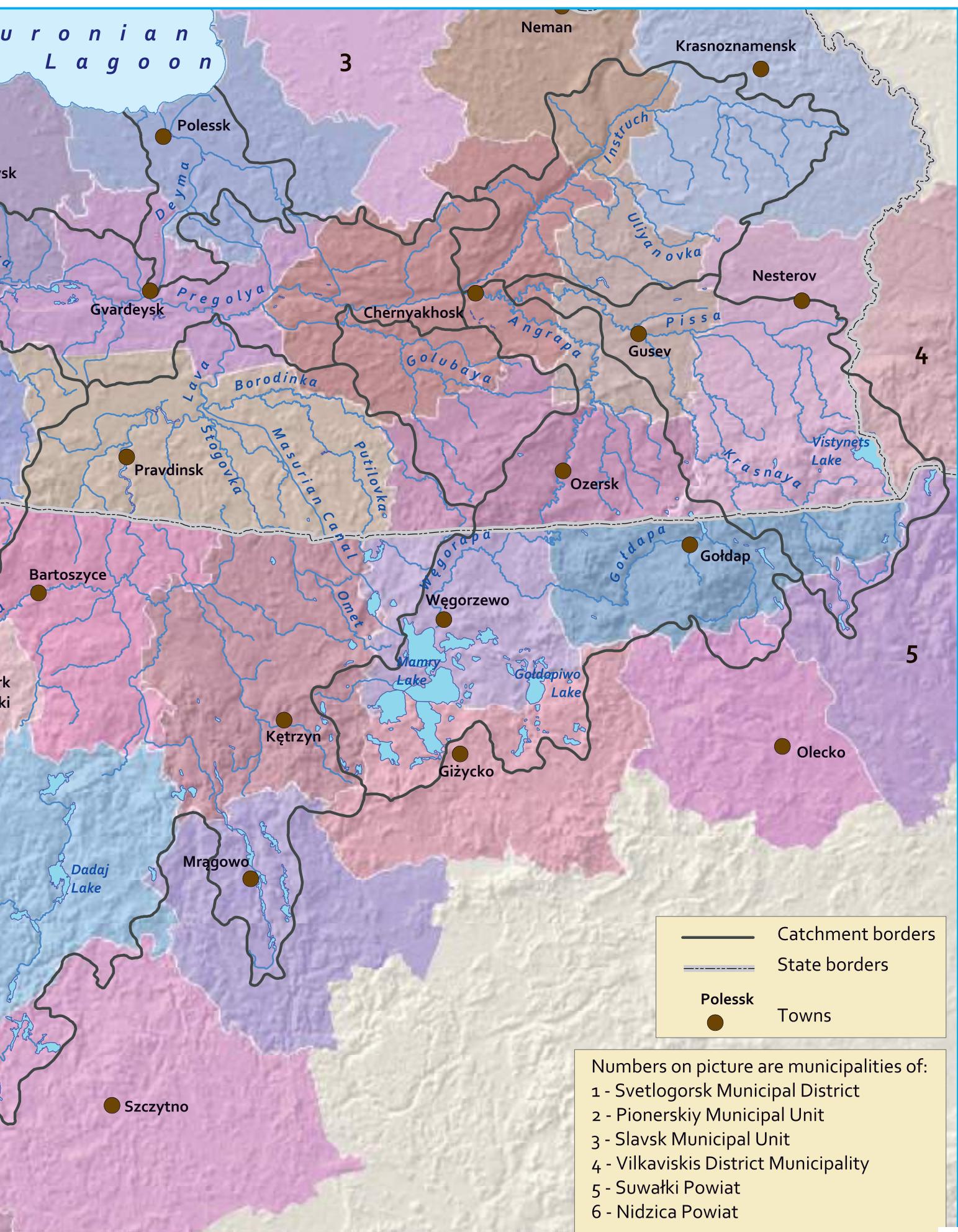
SUB-CATCHMENTS





ADMINISTRATIVE STRUCTURE



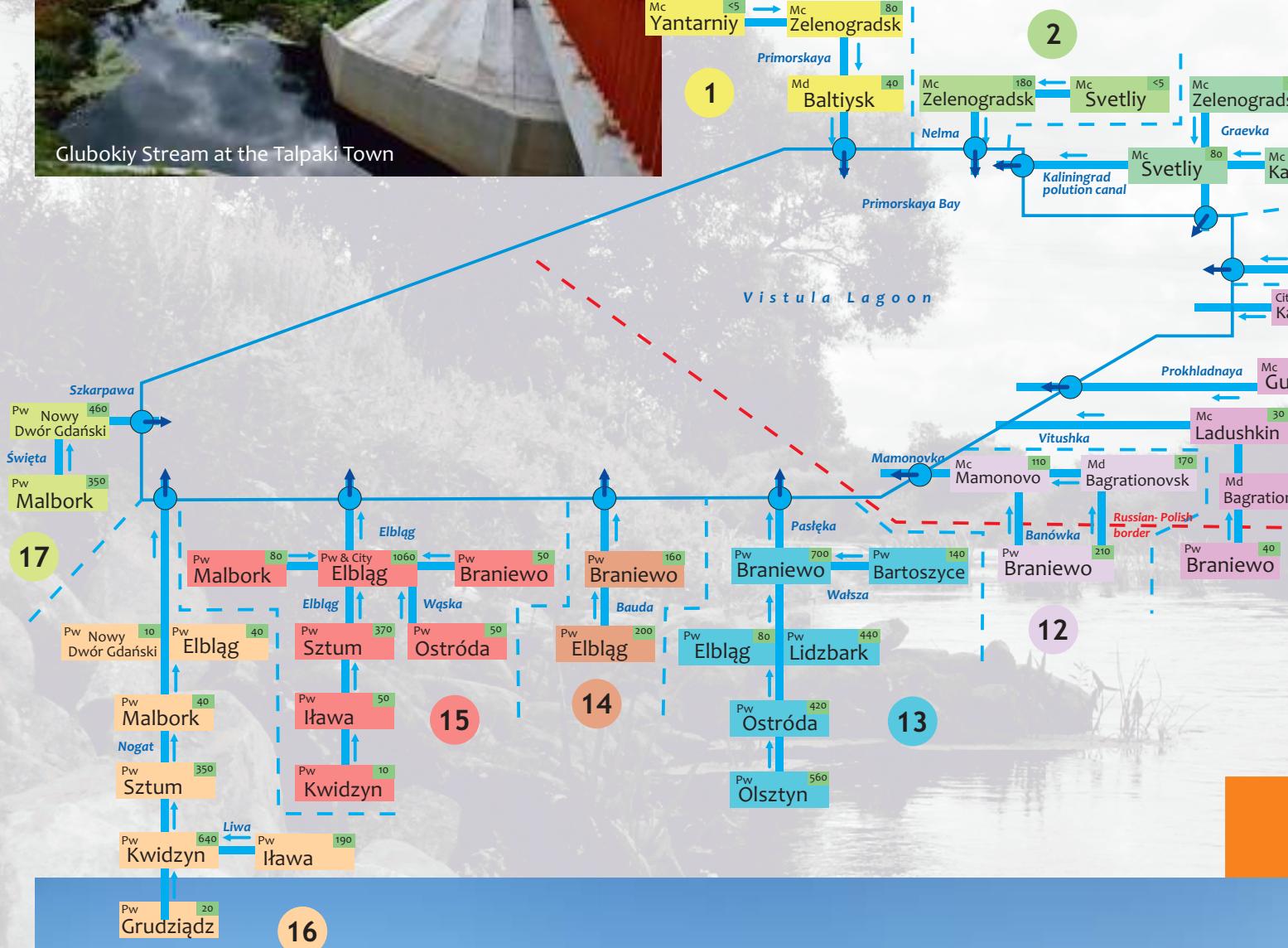


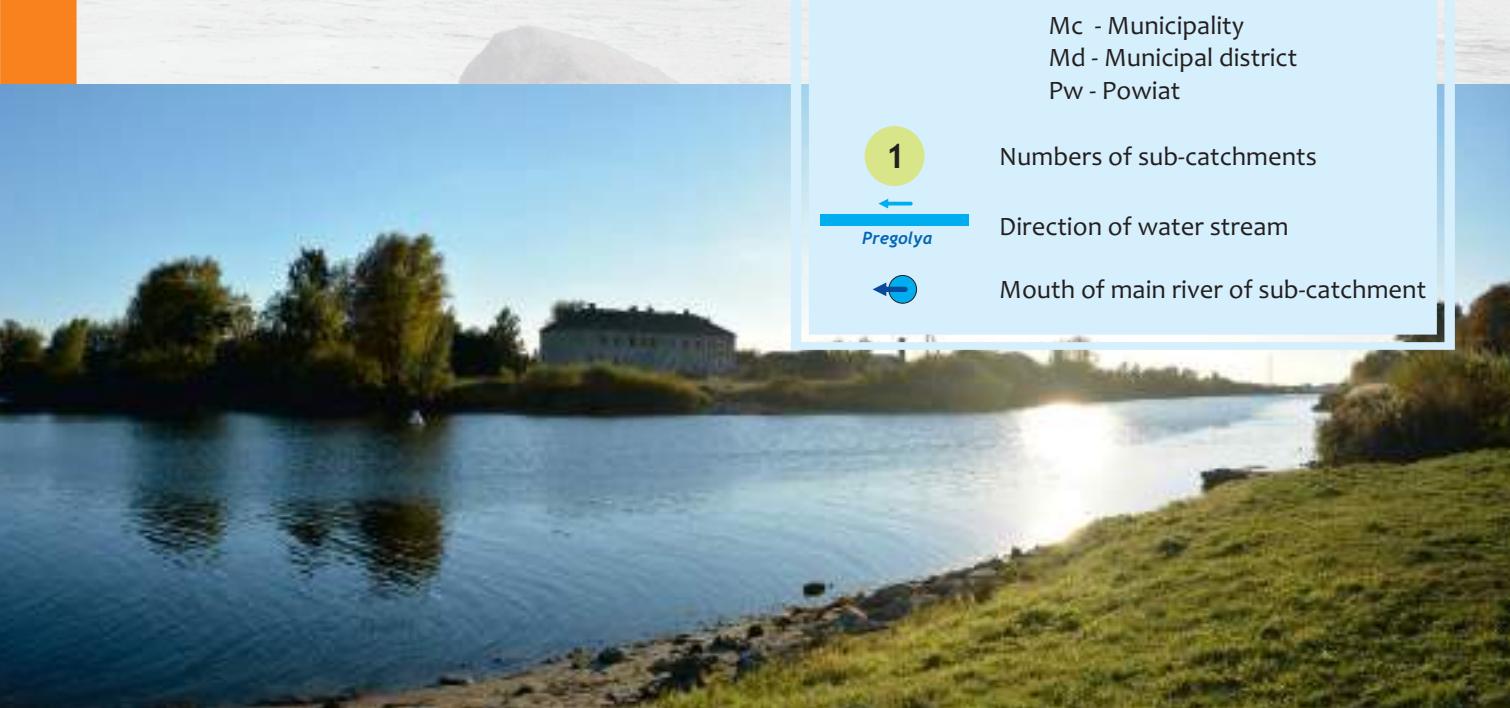
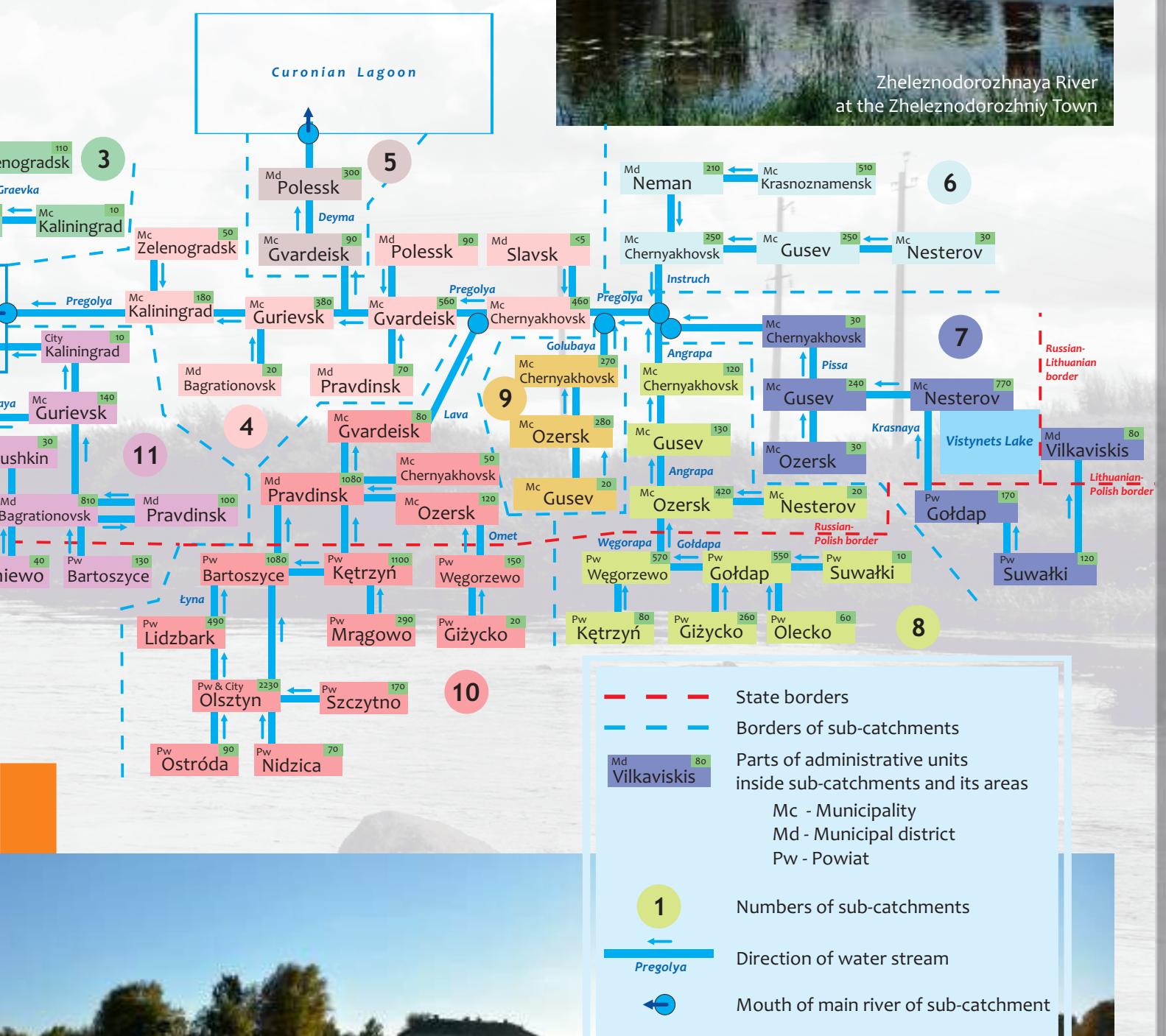
CATCHMENT-ADMINISTRATIVE STRUCTURAL SCHEME



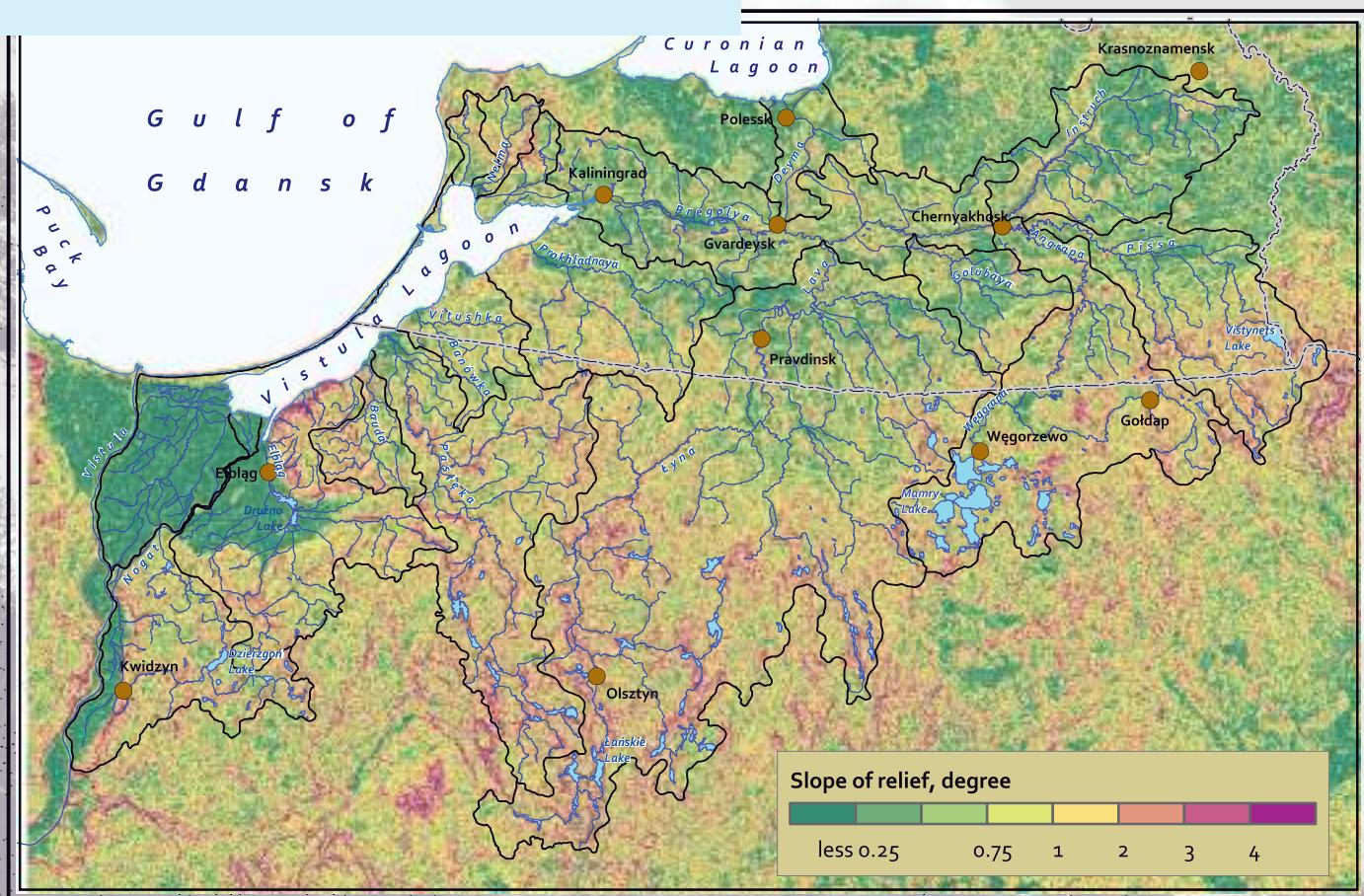
Numbers and river sub-catchments are:

1. Primorskaya
2. Nelma
3. Graevka
4. Pregolya
5. Deyma
6. Instruch
7. Pissa
8. Węgorapa-Angrapa
9. Golubaya
10. Łyna-Lava
11. Prokhladnaya
12. Banówka-Mamonovka
13. Pasłeka
14. Bauda
15. Elbląg
16. Nogat
17. Szkarrawa

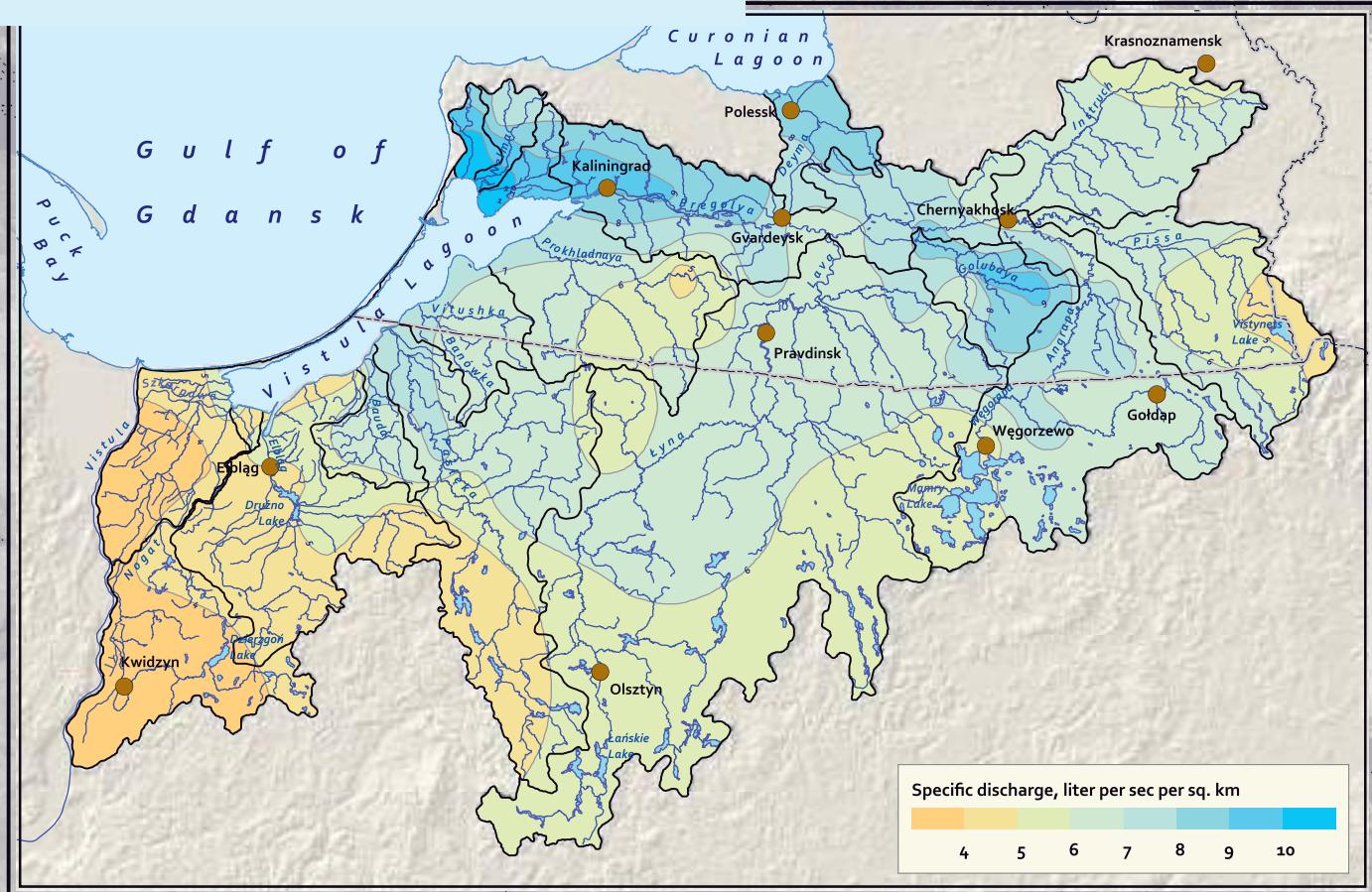




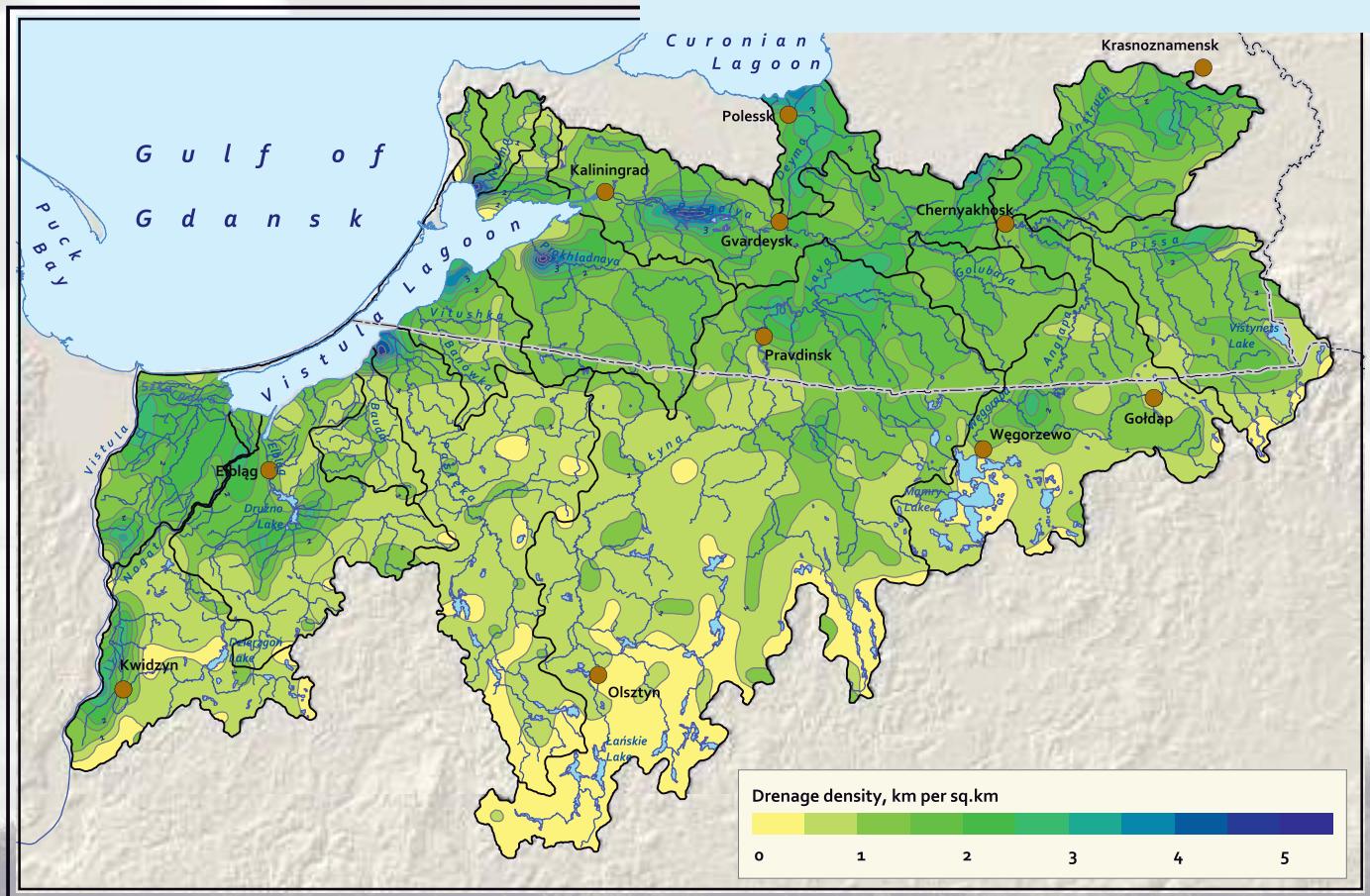
SLOPE



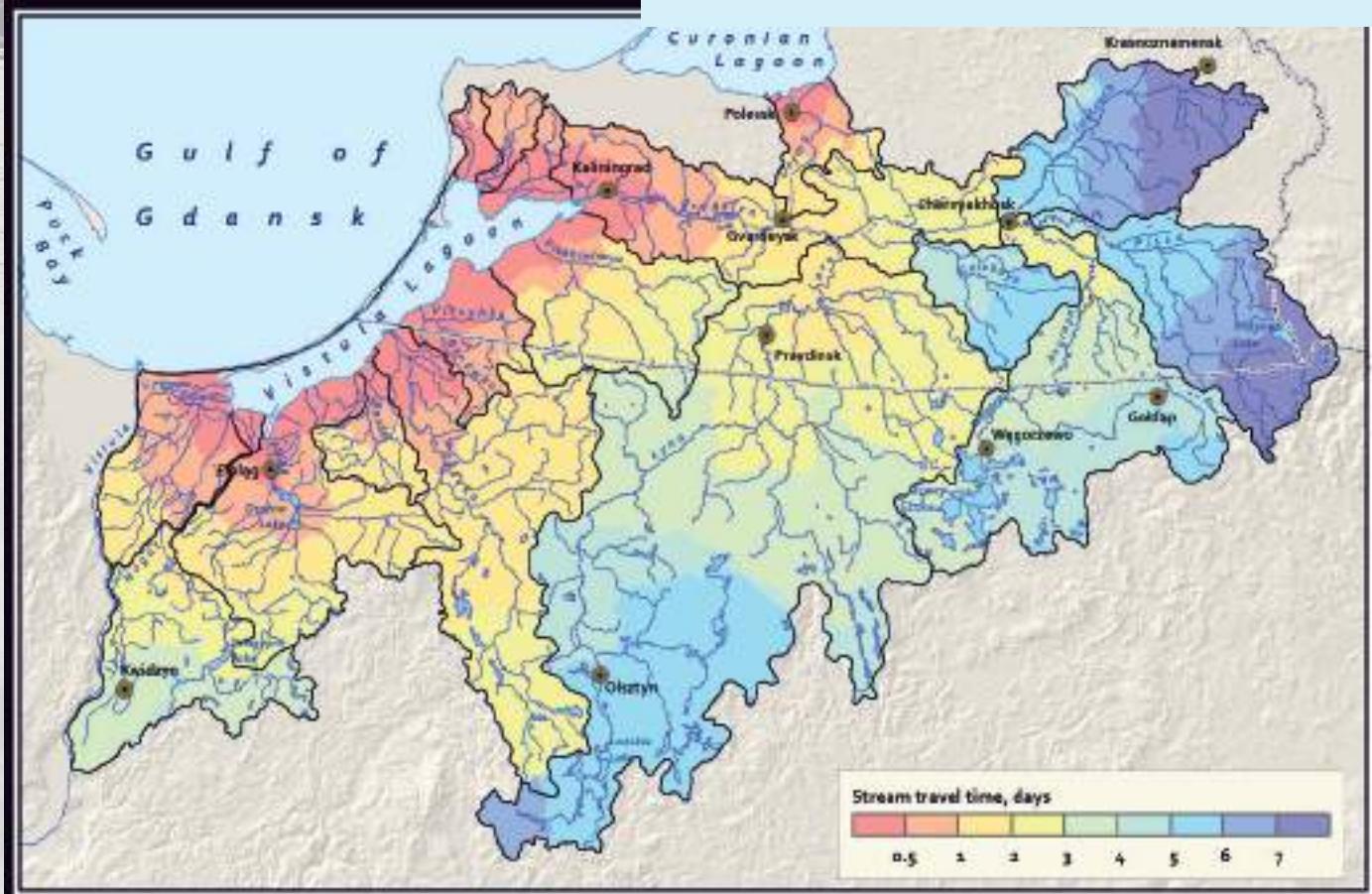
SPECIFIC DISCHARGE



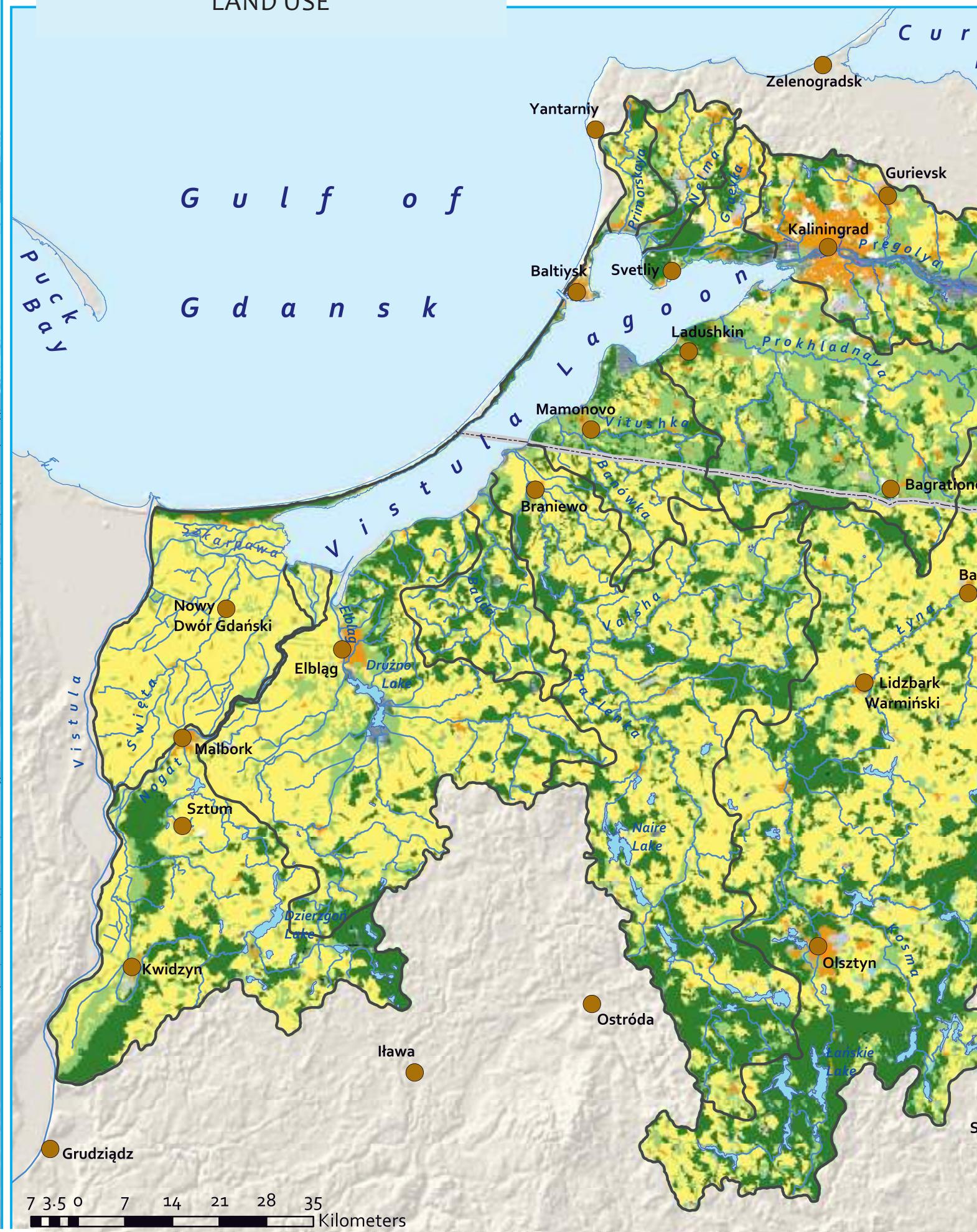
DRAINAGE NETWORK DENSITY

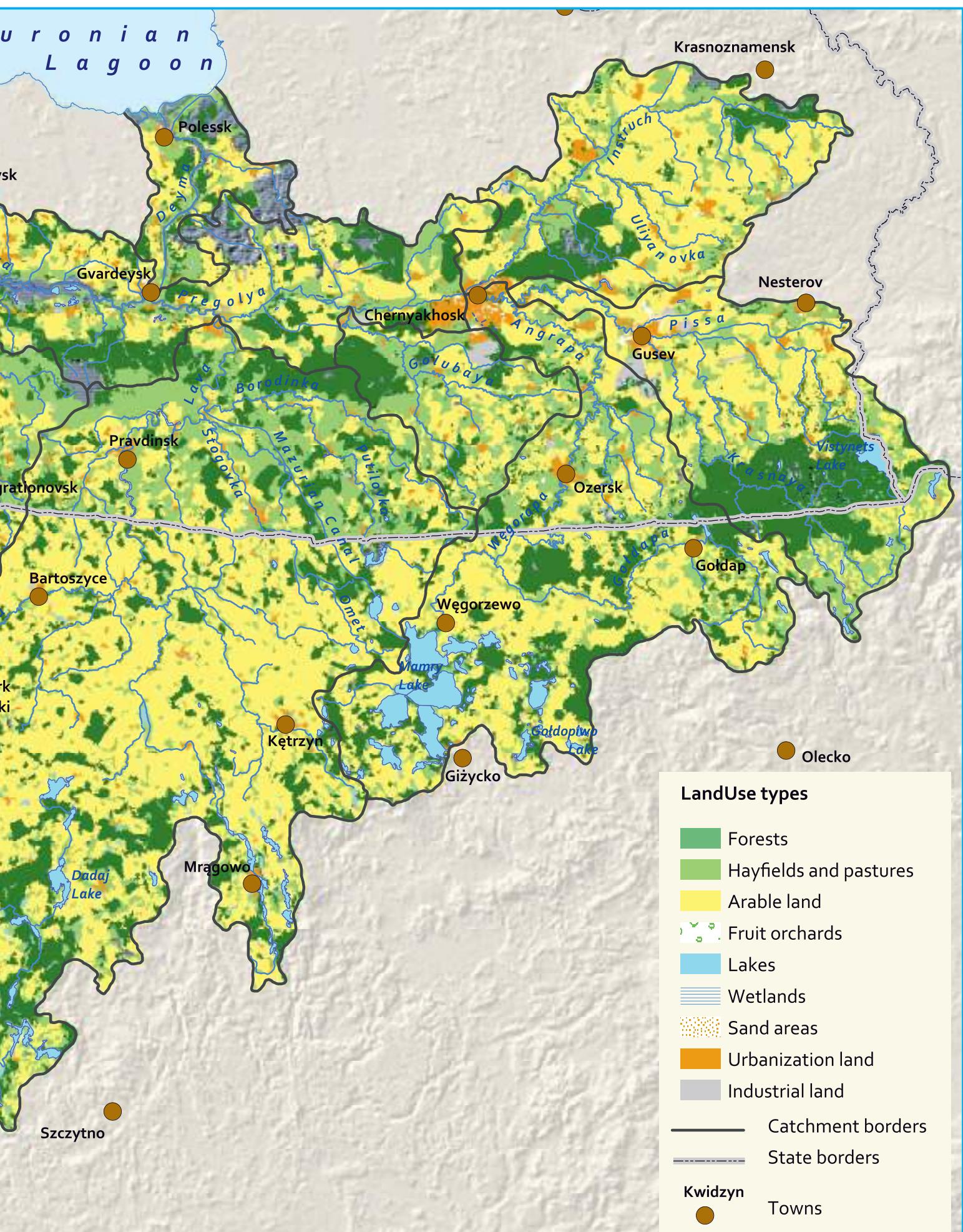


STREAM TRAVEL TIME



LAND USE







CHAPTER II

RIVER SUB-CATCHMENTS

IN THIS CHAPTER:

Primorskaya, Nelma & Graevka

Pregolya

Deyma

Instruch

Golubaya & Węgorapa-Angrapa

Pissa

Łyna-Lava

Banówka-Mamonovka &

Prokhladnaya

Pasłeka

Elbląg & Bauda

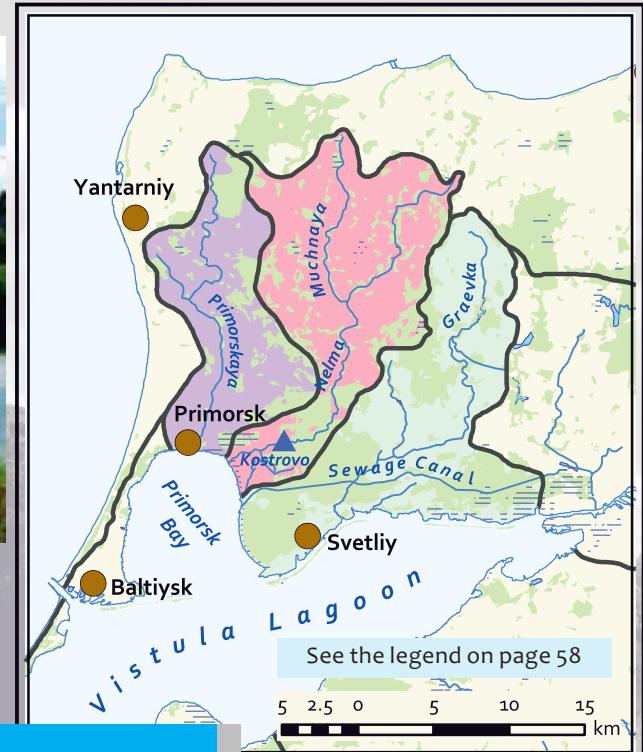
Nogat

Szkarrawa

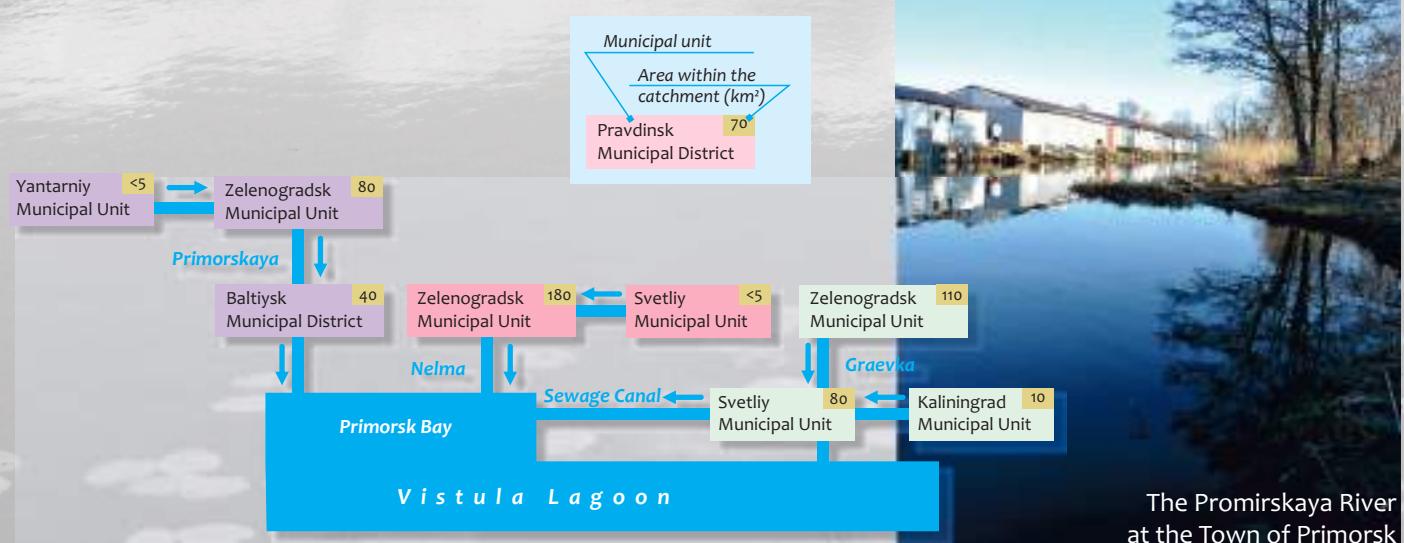
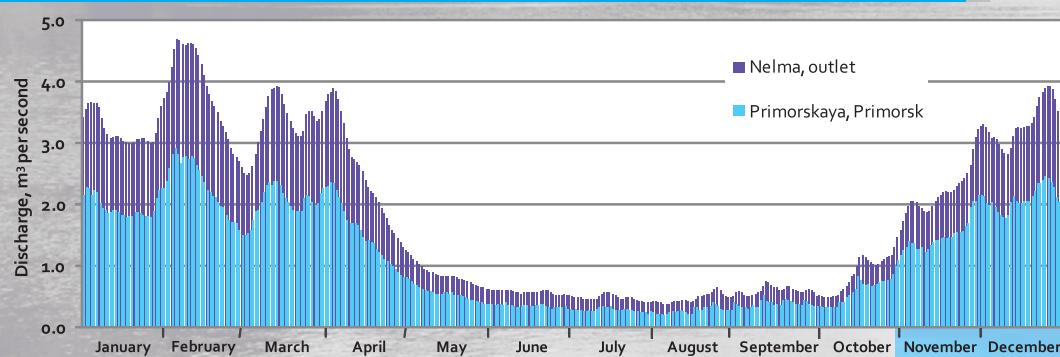
PRIMORSKAYA, NELMA AND GRAEVKA CATCHMENTS



Sub-catchment area



Longterm mean water discharge of the Primorskaya River (Primorsk) & the Nelma River (outlet)



Description:

The Primorskaya and the Nelma rivers are 27 and 33 km long respectively. They spring at the altitude of 50-60 m AMSL. The Primorskaya and the Nelma rivers discharge into the northern part of the Primorsk Bight of the Vistula Lagoon.

The rivers' streams are meandered in a very little degree. The Nelma River catchment is 215 km² and it is twice as big as the one for the River Primorskaya.

The depth of stream is usually 30-50 cm, it exceeds 1 m at the very downstream and only during spring flood.

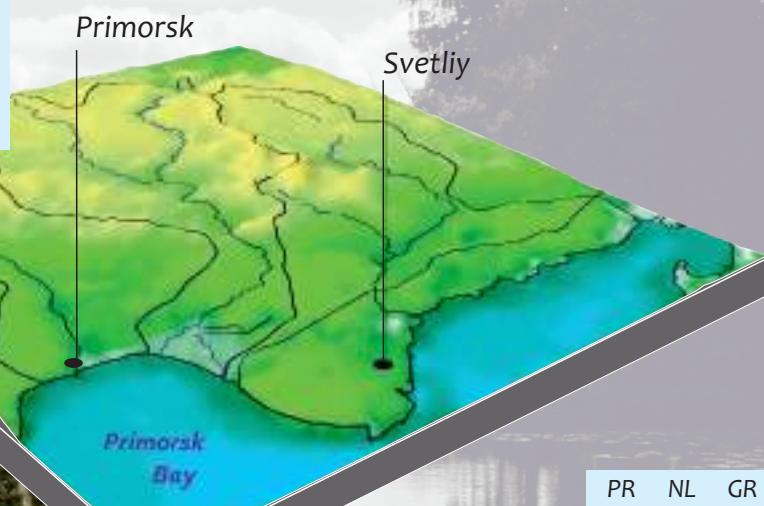
River banks are usually covered by reed. Floodplains of these

rivers' downstream are swampy and bounded by a terrace 2-5 m high. All this makes the river valleys difficult to cross. Mean annual river discharge of the Nelma and the Primorskaya are 2.1 and 0.7 m³/sec respectively. There is one monitoring point of the Russian State Monitoring System at the Nelma River at Kostrovo settlement (5 km upstream the mouth). At the scheme we conventionally marked the catchment of the Graevka River and the Kaliningrad Sewage Canal together, as methods used in the Atlas didn't allow to define them more clearly for such lowland area.

Mouth of the Nelma River



3D elevation model



Kalininograd Sewage Canal

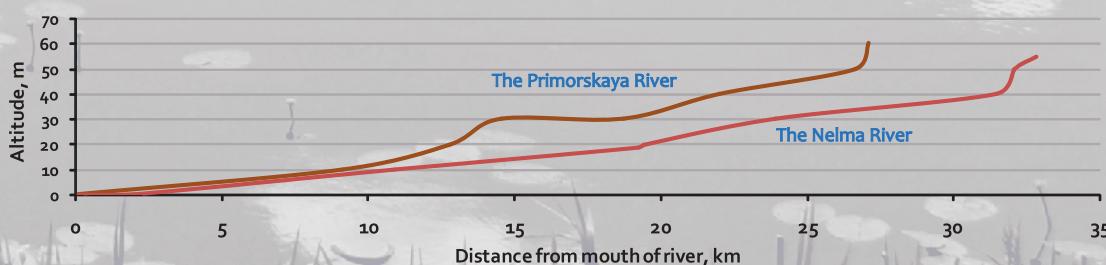


	PR	NL	GR
Catchment area (km ²)	120	180	200
Catchment area within Russia (km ²)	120	180	200
Catchment area within Poland (km ²)	0	0	0
Average slope of the catchment (m/km)	2.0	2.2	1.8
Minimum altitude in the catchment (m AMSL)	0	0	0
Maximum altitude in the catchment (m AMSL)	80	110	77
Tortuosity (dimensionless value)	1.03	1.07	1.11
Average river bed slope (m/km)	1.25	1.67	2.00
Monitoring point: River (Station name)	Nelma (Kostrovo)		

PR - Primorskaya River

NL - Nelma River

GR - Graevka

Longitudinal profile of the river bed

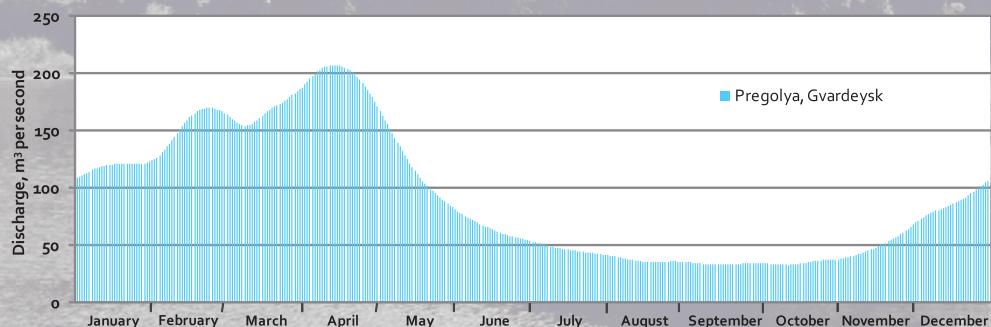
PREGOLYA CATCHMENT



Sub-catchment area



Longterm mean water discharge of the Pregolya River (Gvardeysk)



Catchment area (km^2)	1740
Catchment area within Russia (km^2)	1740
Catchment area within Poland (km^2)	0
Average slope of the catchment (m/km)	1.4
Minimum altitude in the catchment (m AMSL)	0
Maximum altitude in the catchment (m AMSL)	60
Tortuosity (dimensionless value)	1.21
Average river bed slope (m/km)	0.08
Monitoring point: River (Station name)	Pregolya (Gvardeysk, Cherniakhovsk)



Description:

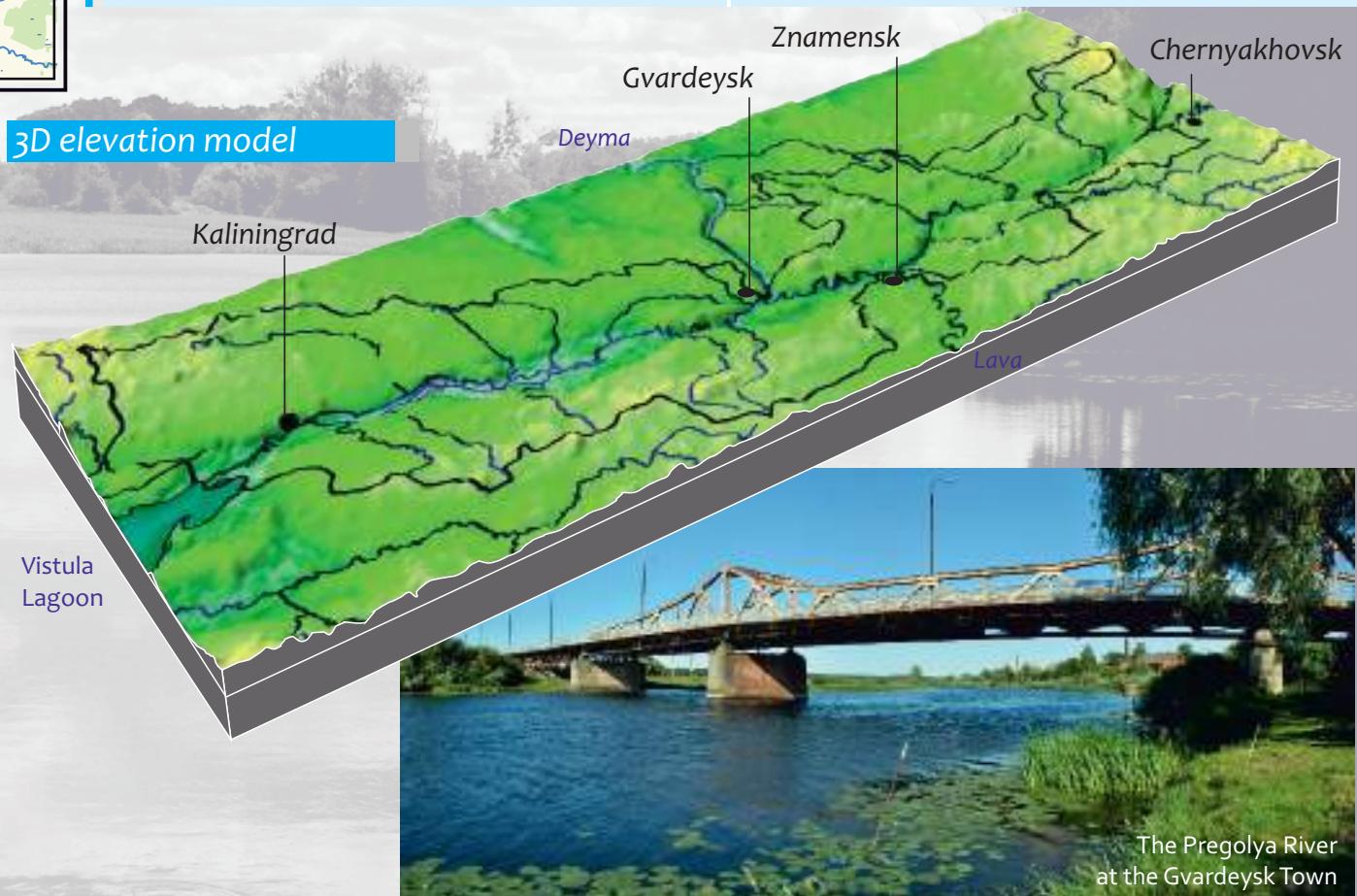
The Pregolya River is the name of the main river (with all tributaries) which supplies the Vistula Lagoon by fresh water. Its catchment (14.1 ths km²) covers nearly all the Kaliningrad Oblast of Russia (61% of catchment) and a part of northern Poland (39% of catchment). The only tiny part of the catchment (70 km², which belongs to the Pissa River) is within the territory of Lithuania in the surroundings of the Vistynets Lake.

The main segment of the Pregolya River (in other words - the proper Pregolya River), which is only named on maps as 'Pregolya River', is only 120 km long. It is formed by merging of the Instruch River and the Węgorapa - Angrapa River near Cherniakhovsk. The main flow is formed primarily by the Węgorapa-Angrapa River and its main tributary – the Pissa River. The main tributaries of the proper Pregolya River are the Lyyna-Lava and the Golubaya rivers discharging to it at 71 and 99 km upstream its mouth respectively. The Pregolya River doesn't dry up, it is covered (but not blocked) by ice in winter.

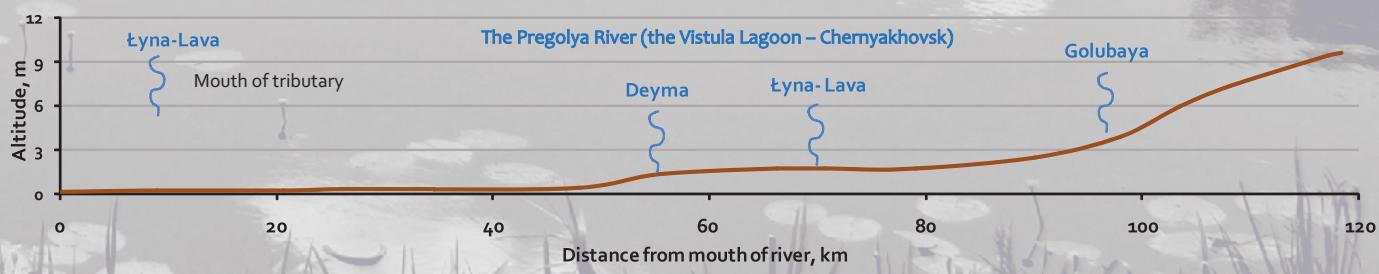
The main stream segment of the Pregolya River is crossing the Pregolya Lowland from the East to the West and discharges into the Vistula Lagoon after passing Kaliningrad. The river valley was modified by anthropogenic influence. The main stream is meandering. It forms 2 branches at the distance of about 35 km upstream the mouth, namely, the New Pregolya - the northern branch, and the Old Pregolya – the southern one. Both branches merge to a single stream in the center of Kaliningrad (about of 10 km upstream the mouth). The last 7 km of river downstream are modified, it is the Sea Port of Kaliningrad with a regularly dredged depth of 8-12 m. There are 6 locks which are disabled nowadays.

The main settlements in the catchments are Kaliningrad (population is 435.5 ths inh.), Gvardeysk and Znamensk with population of 13.5 ths and 4 ths respectively. There are 6 locks which are disabled nowadays. There are 2 points of the State Monitoring System: in Cherniakhovsk and Gvardeysk.

3D elevation model



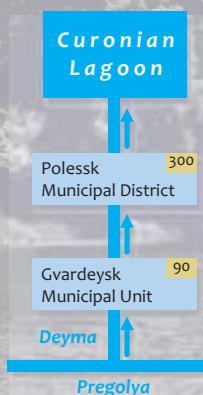
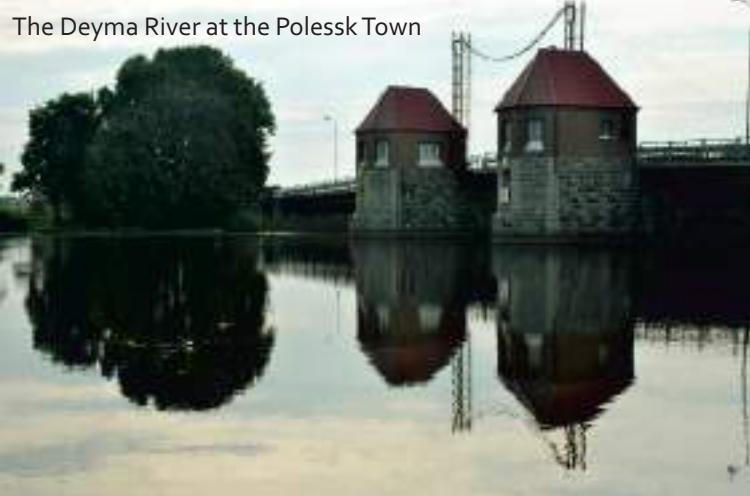
Longitudinal profile of the river bed



DEYMA CATCHMENT



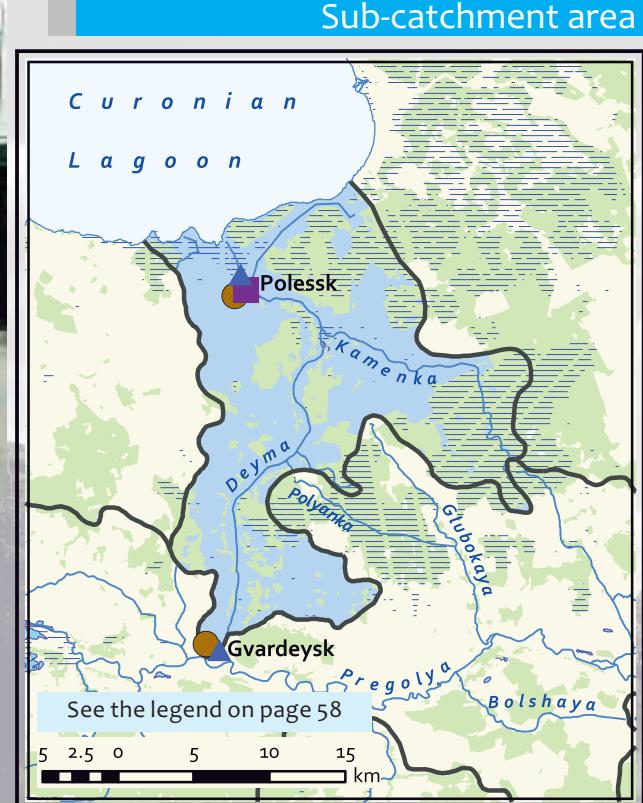
The Deyma River at the Polessk Town



Municipal unit
Area within the catchment (km²)

Pravdinsk Municipal District

Polessk Municipal District



The Deyma River at the Polessk Town



The Deyma River at the Gvardeysk Town

Catchment area (km ²)	420
Catchment area within Russia (km ²)	420
Catchment area within Poland (km ²)	0
Average slope of the catchment (m/km)	1.4
Minimum altitude in the catchment (m AMSL)	0
Maximum altitude in the catchment (m AMSL)	42
Tortuosity (dimensionless value)	1.01
Average river bed slope (m/km)	0.04
Monitoring point: River (Station name)	Deyma (Gvardeysk) Deyma (Polessk)

The Deyma River at the Polessk Town

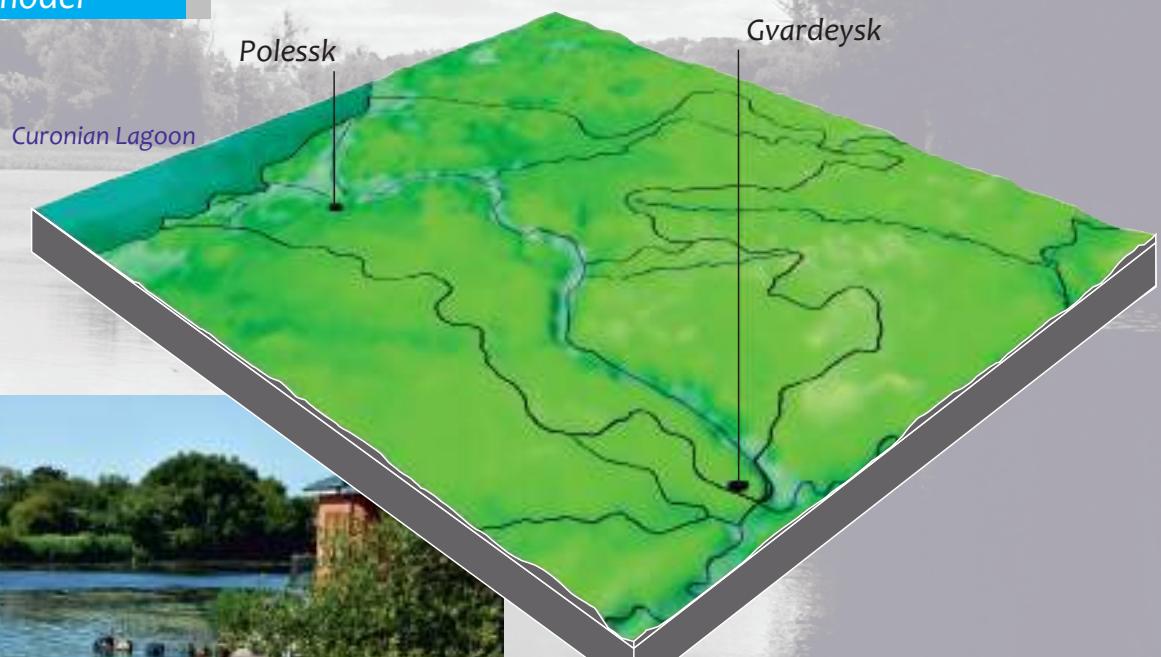


Description:

The [Deyma Branch](#) (or [Deyma Arm](#)) bifurcates to the right from the main stream of the Pregolya River near Gvardeysk, 56 km upstream the Pregolya River mouth, and discharges to the Curonian Lagoon. The total length is 36 km. The water flow and water level variations are influenced by wind surge at the lagoon. The old river valley is swampy, the ground is a mixture of sand and silt. There are numerous small tributaries. The river stream has a width up to 50 -100 m, it was

artificially modified in XIX century, stretched and partly bounded by dikes. The Deima Branch doesn't dry up, it is covered (but not blocked) by ice in winter. The main settlements which are crossed by the Deyma River are the cities of Gvardeysk and Polessk with the population of 4 ths and 7.3 ths respectively. There are no hydraulic facilities. A monitoring point of the State Monitoring System is located in the river downstream in Polessk, at 7 km upstream the river mouth.

3D elevation model

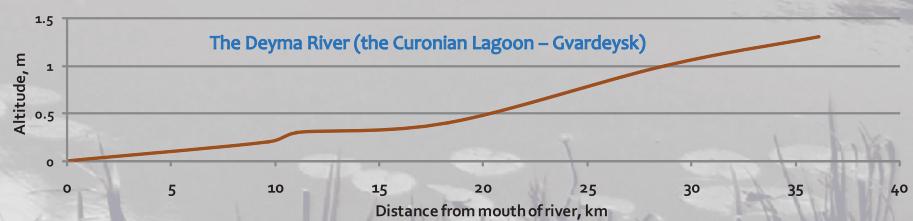


Longterm mean water discharge of the Deyma River

Longterm mean water discharge of the Deyma River was not simulated by the model. The model setup used in the work didn't reproduce the splitting of the Pregolya River into two arms in the Gvardeysk Town.

The Deyma River at the Polessk Town

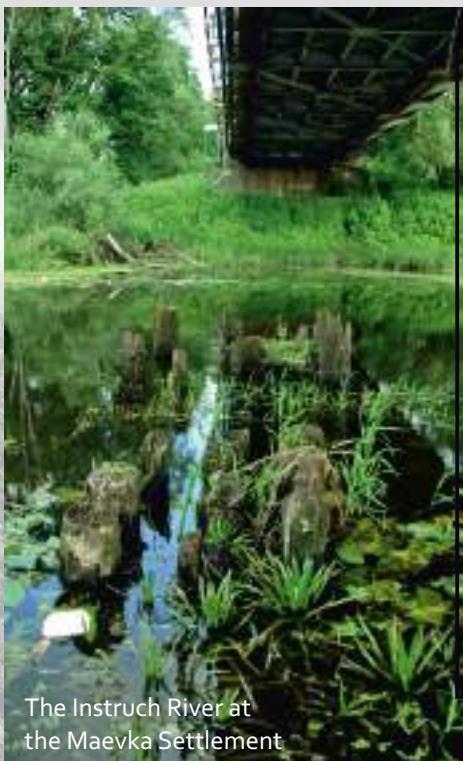
Longitudinal profile of the river bed



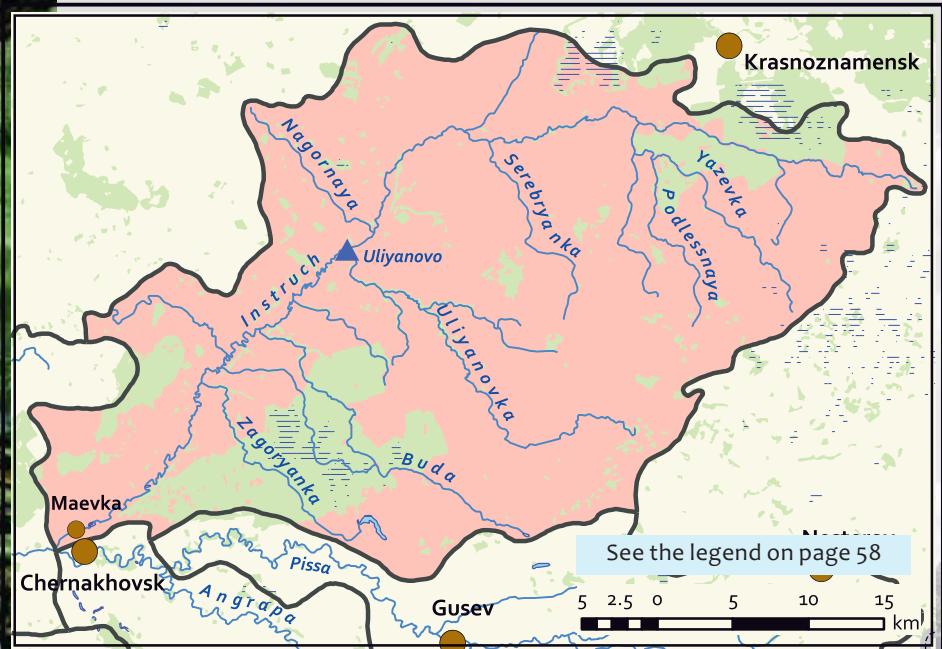
INSTRUCH CATCHMENT



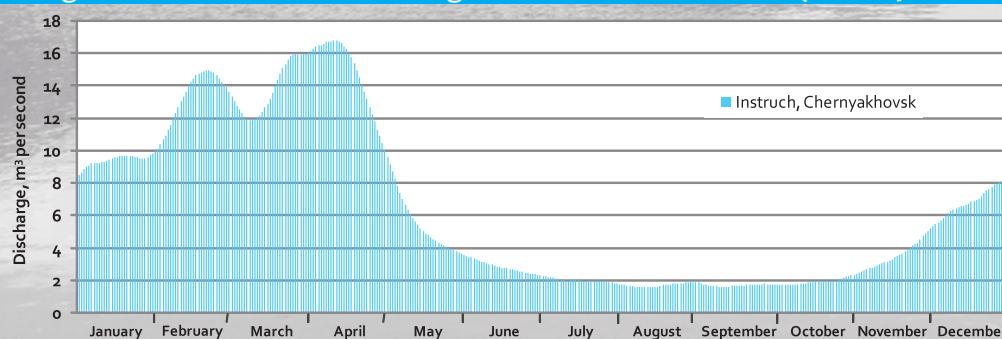
Sub-catchment area



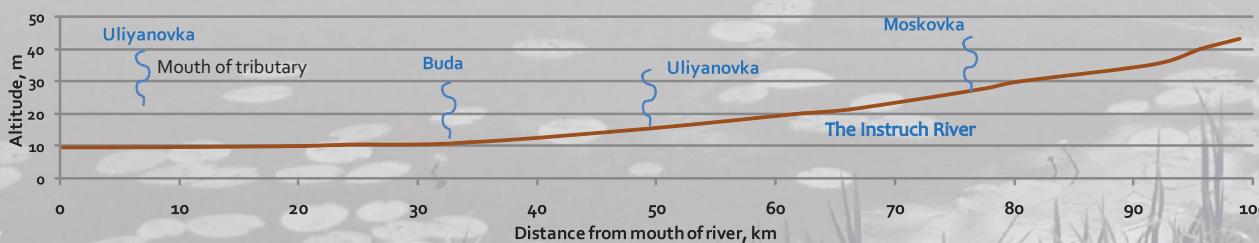
The Instruch River at the Maevka Settlement

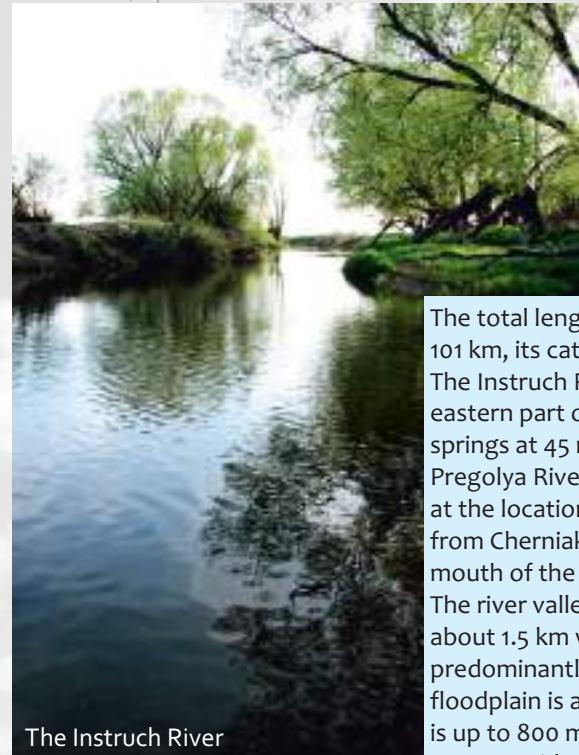


Longterm mean water discharge of the Instruch River (Chernyakhovsk)



Longitudinal profile of the river bed



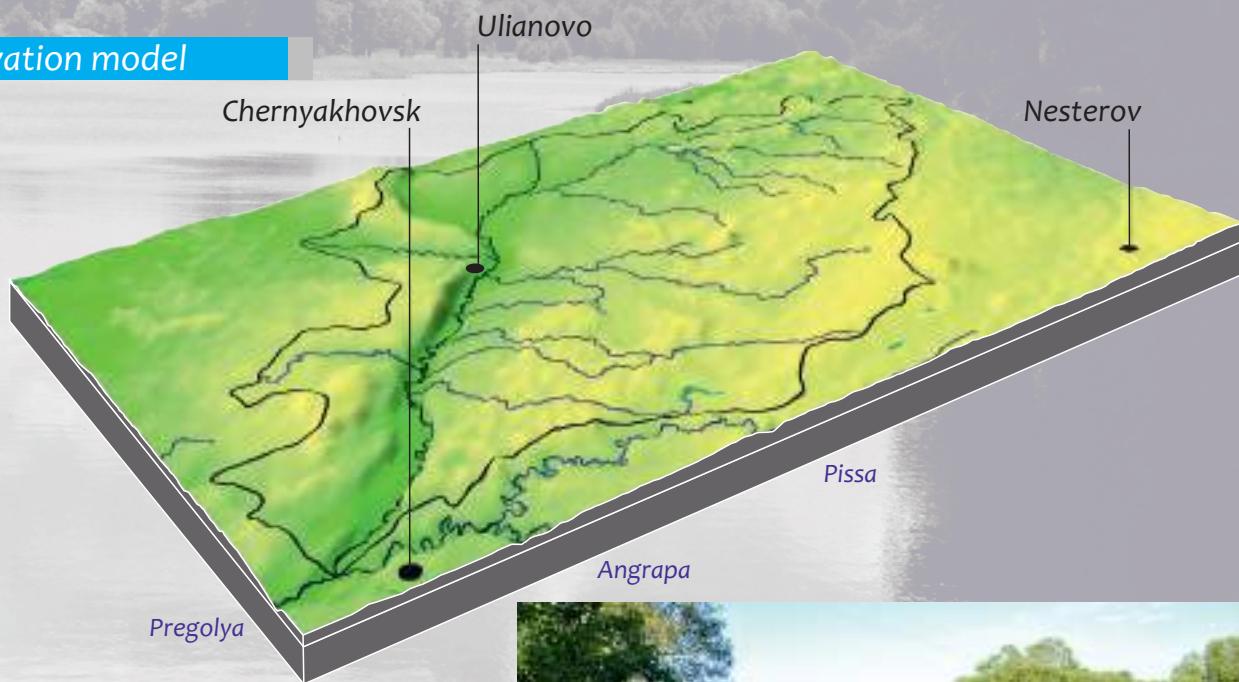


The total length of the [Instruch River](#) is 101 km, its catchment area is 1250 km². The Instruch River flows from the north-eastern part of Kaliningrad Oblast, it springs at 45 meters AMSL and forms the Pregolya River joining the Angrapa River at the location a bit downstream away from Chernyakhovsk (119.5 km from the mouth of the Pregolya River). The river valley is of trapezoidal shape about 1.5 km wide, vegetation is predominantly bushy and foresty. The floodplain is a meadow land, the left side is up to 800 m wide, while right one is up to 50 m wide. The stream is partly meandering, sediments are formed by sand and silt, partly from stones. Banks are covered by bushes. There are a lot of

Description:

small tributaries. The Instruch River doesn't dry up, it is covered (but not blocked) by ice in winter. The main settlements in the catchment are Dobrovolsk (1.7 ths inh.), Vesnova and Kubanovka (both have f 0.7 ths inh.), but they are located close to the border of catchment, rather far from main stream of the Instruch River. The largest settlement which is crossed by the main stream of the Instruch River is Ulianovo village (0.6 ths inh.). There are no hydraulic facilities. A monitoring point of the State Monitoring System is located in Ulianovo, it is 10 m upstream from the junction point of the Ulianovka River - the main tributary of the Instruch River.

3D elevation model



Catchment area (km ²)	1250
Catchment area within Russia (km ²)	1250
Catchment area within Poland (km ²)	0
Average slope of the catchment (m/km)	1.2
Minimum altitude in the catchment (m AMSL)	9.5
Maximum altitude in the catchment (m AMSL)	77
Tortuosity (dimensionless value)	1.38
Average river bed slope (m/km)	0.35
Monitoring point: River (Station name)	Instruch (Ulyanovo)

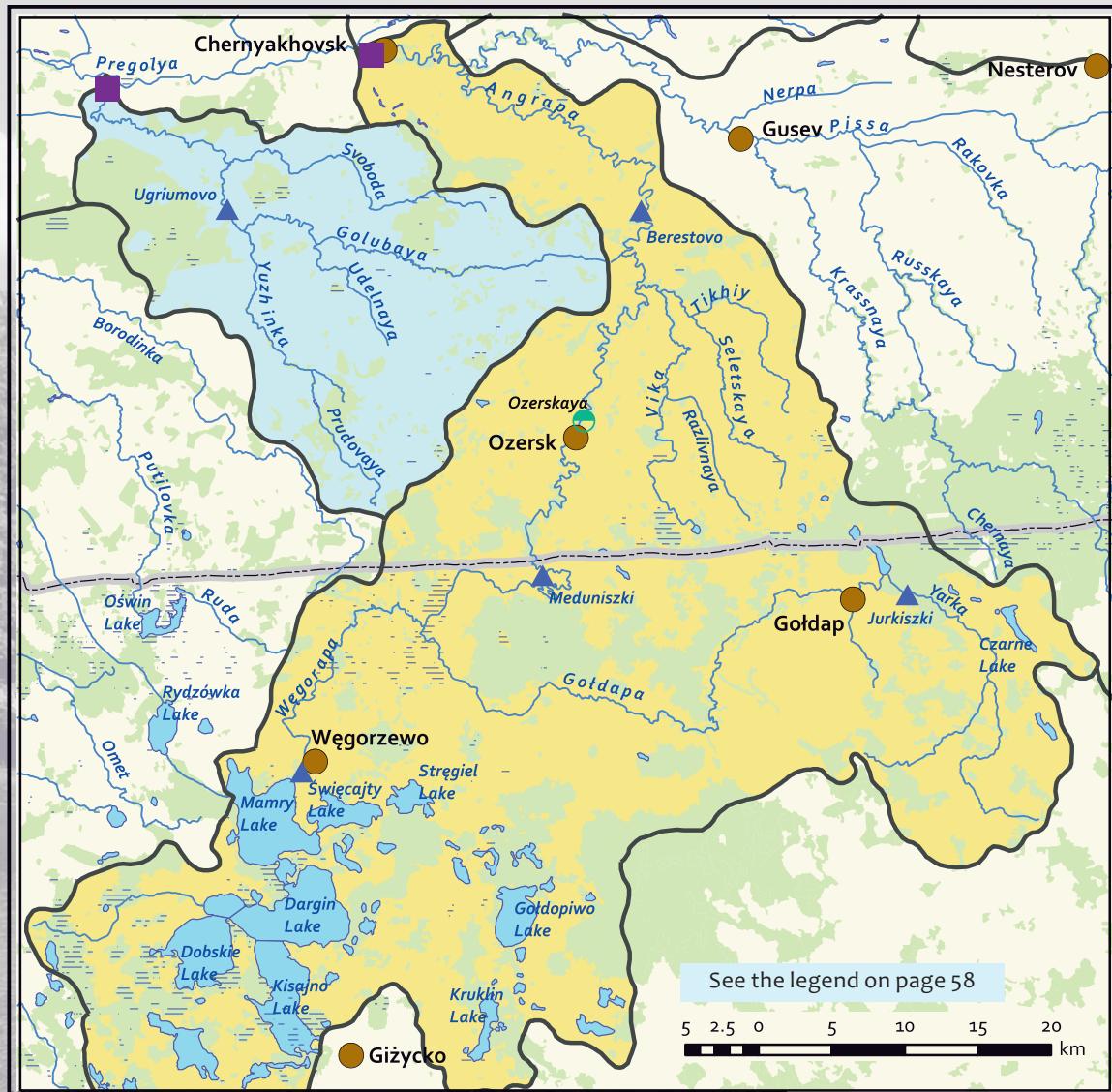


The Instruch River at the Uliyanovo Settlement

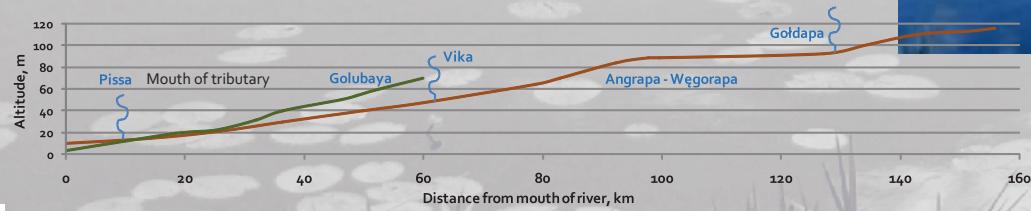
GOLUBAYA, WĘGORAPA-ANGRAPA CATCHMENTS



Sub-catchment area



Longitudinal profile of the river bed



The Angrapa River at the Chernyakhovsk Town

Description:

The Węgorapa-Angrapa River is a transboundary water course with a total length of 139.9 km. (44 km within Poland, 95.9 km in Kaliningrad Oblast). Total catchment area equals 3640 km² (975 km² in Poland, 2665 km² in Kaliningrad Oblast). The source of the river (it flows out of Lake Mamry) is close to Węgorapa village in Poland near the town of Węgorzewo at 116 meters AMSL. The river is called the Węgorapa on the Polish side and the Angrapa on the Russian side of the catchment.

The Węgorapa-Angrapa River gives rise to the Pregolya River merging with the Instruch River downstream of Cherniakhovsk. The main tributaries of Węgorapa-Angrapa River are Goldapa (in Poland) and Pissa (in Russia), which merge with Angrapa at a distance of about 127 and 14 km upstream its mouth.

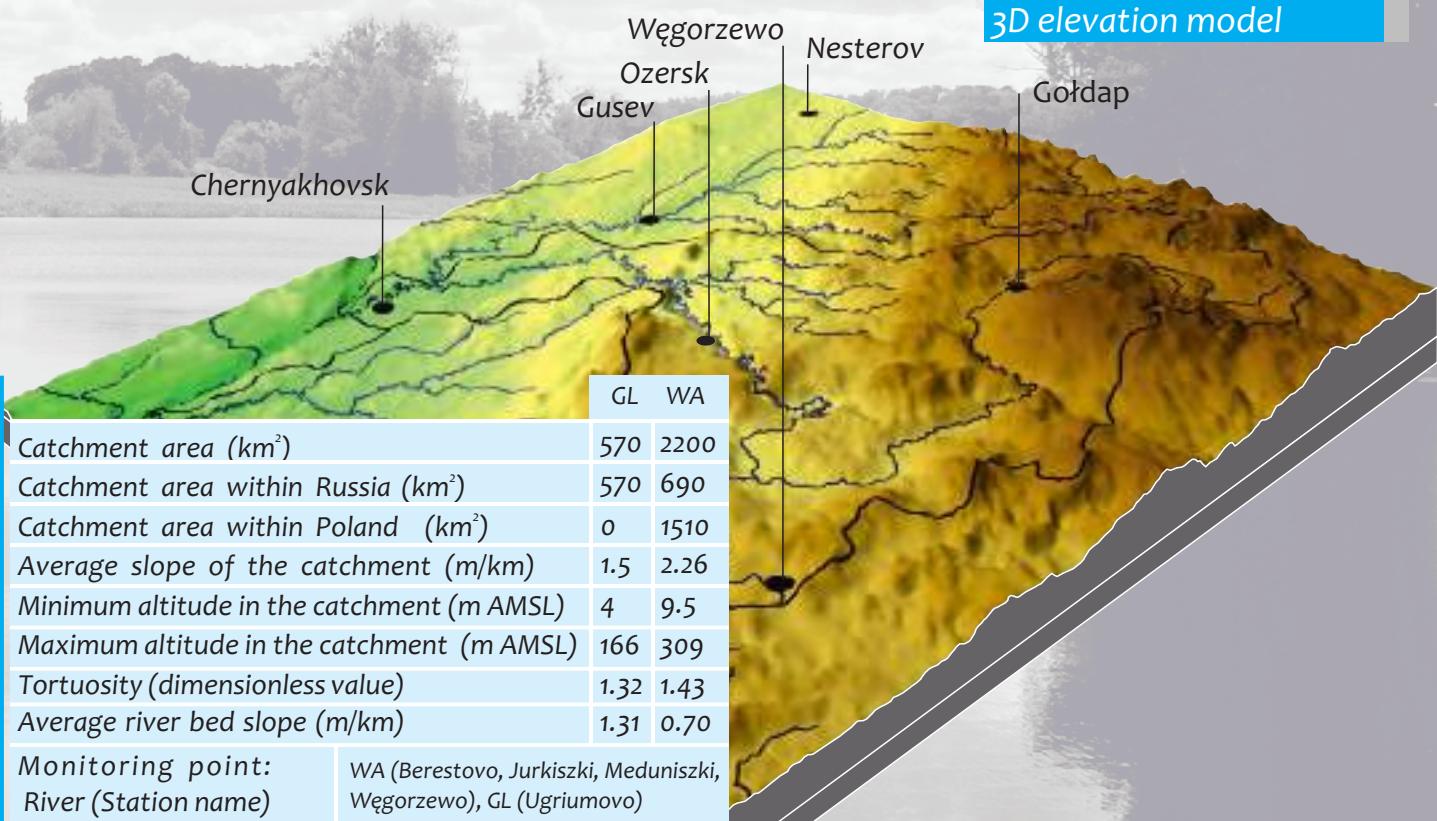
The Węgorapa River valley is formed as flat and ridged floodplain with sand and gravel and peaty under willow, alder, floodplain meadows. The Angrapa River flows between small hills with meadows and mixed forest around, and has two-sided floodplain. The stream is very intensively meandering, rooted vegetation is well developed during summer time, bottom sediments are formed by sand and

pebble, partly from stones. The banks are steep and covered by bush and forest. Sometimes the river has rifts (e.g. in the settlement of Berestovo). The Węgorapa-Angrapa River doesn't dry up, it is covered (but not blocked) by ice in winter.

The main towns along the river course include Węgorzewo in Poland (population is of 12 ths inh.), as well as Ozersk (4.4 ths inh.) and Chernyakhovsk (40 ths inh.) in Kaliningrad Oblast (Russia). There is one hydraulic power plant located in Ozersk. A monitoring point of the Russian State Monitoring System is located 30 km upstream the river mouth within the settlement of Berestovo. There are two monitoring stations of the Polish State Monitoring System located in Mieduniszki and Węgorzewo (98 and 153 km upstream the river mouth), the first one is close to the state border. The monitoring point Jurkiszki (Poland) is on the Jarka River.

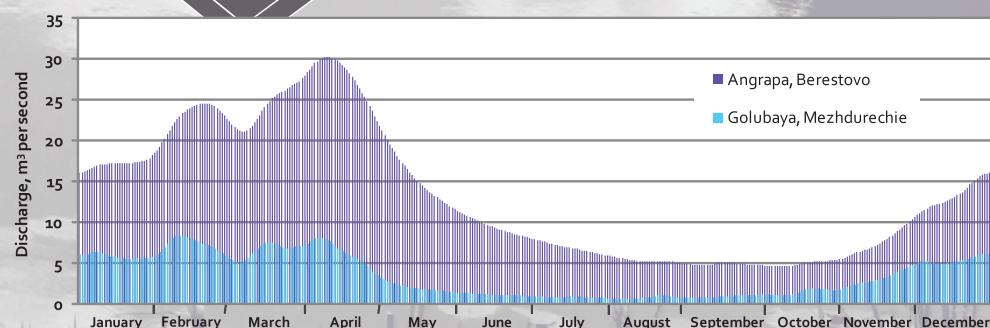
The Golubaya River, 59 km length, discharges to the Pregolya River from the South at 102 km distance from Pregolya mouth. The catchment of the Golubaya River totally belongs to the Kaliningrad Oblast. The river flows out from the Angrapa River as small stream at the Mayakovskoe Settlement (Gusev Municipal Unit).

3D elevation model



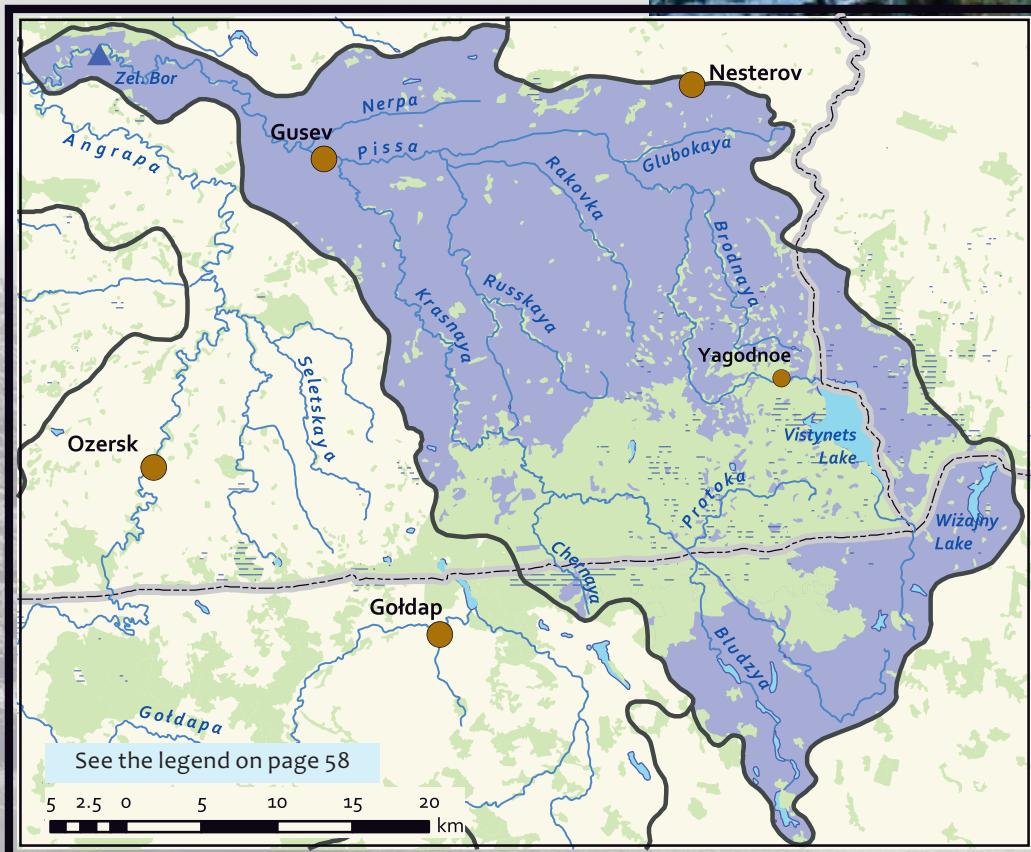
GL - Golubaya River
WA - Węgorapa-Angrapa River

Longterm mean water discharge of the Angrapa river (Berestovo)

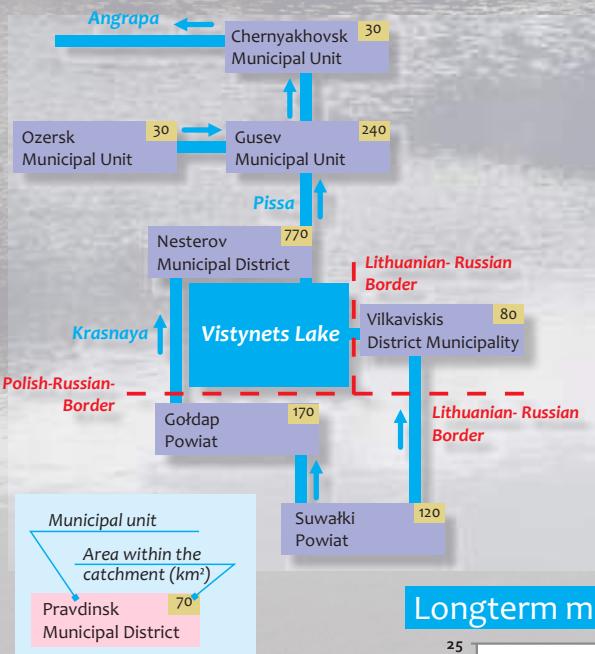


PISSA CATCHMENT

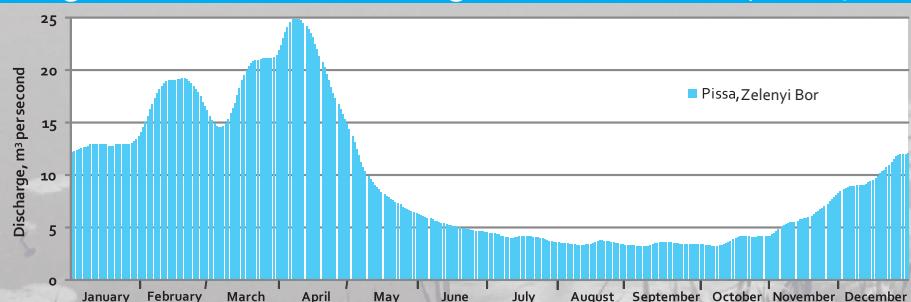
Sub-catchment area



The Pissa River at the Yagodnoe Settlement



Longterm mean water discharge of the Pissa river (Zeleniy Bor)



Description:

The total length of the main stream of the Pissa River is 100 km. The catchment area is 1360 km². The Pissa River is discharged from the Vistynets Lake located at the border between Lithuania and Russia (Kalininograd Oblast) at 172 meters AMSL. The Pissa River is the main tributary of the Wegorapa-Angrapa River. The main tributary of the Pissa River is the Krasnaya River (area of subcatchment is 410 km², junction point – 42 km from the Pissa River mouth). The river valley is of trapezoidal shape, the predominant vegetation is bush and forest. The stream is intensively meandering, rooted vegetation is

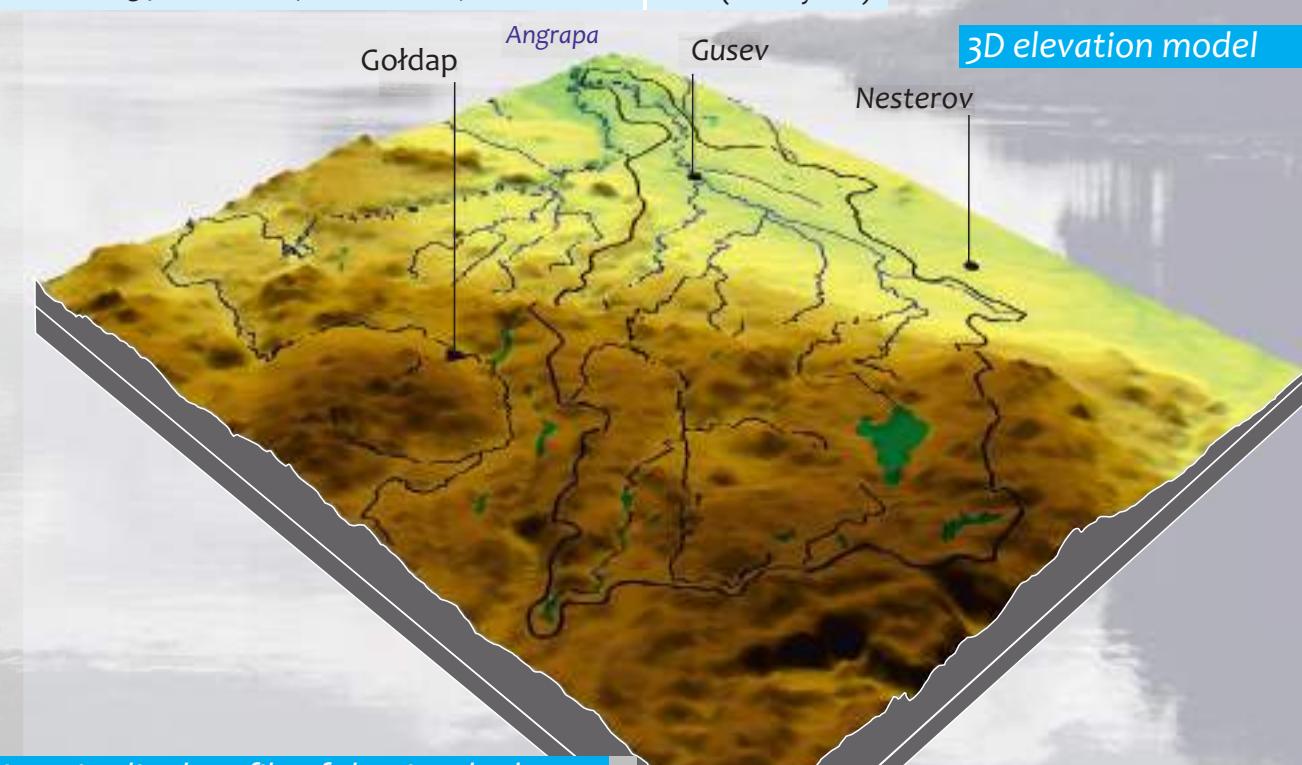
developed, bottom sediments are formed by sand and silt, partly from stones. The banks are steep and partly bluff, covered by bush and forest. The stream is often closed by fallen trees and small ponds are formed. The Pissa River doesn't dry up, it is covered (but not blocked) by ice in winter.

The main settlement of catchment is the City of Gusev (28.5 ths inh.) on the Russian side. There are 2 hydropower plants (in Gusev and at the Priozerne settlement). A monitoring points of the Russian State Monitoring System are located in Zelenyi Bor and Ilushino settlements.

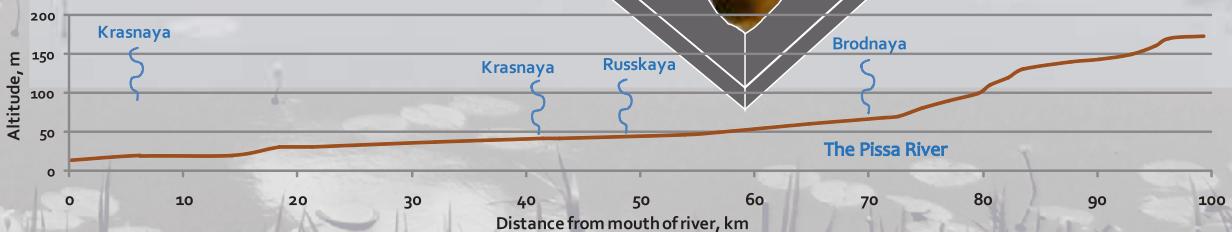


Catchment area (km ²)	1400
Catchment area within Russia (km ²)	1030
Catchment area within Poland (km ²)	290
Catchment area within Lithuania (km ²)	80
Average slope of the catchment (m/km)	2.2
Minimum altitude in the catchment (m AMSL)	14.3
Maximum altitude in the catchment (m AMSL)	292
Tortuosity (dimensionless value)	1.25
Average river bed slope (m/km)	1.58
Monitoring point: River (Station name)	Pissa (Zeleniy Bor)

The Pissa River at the Gusev Town



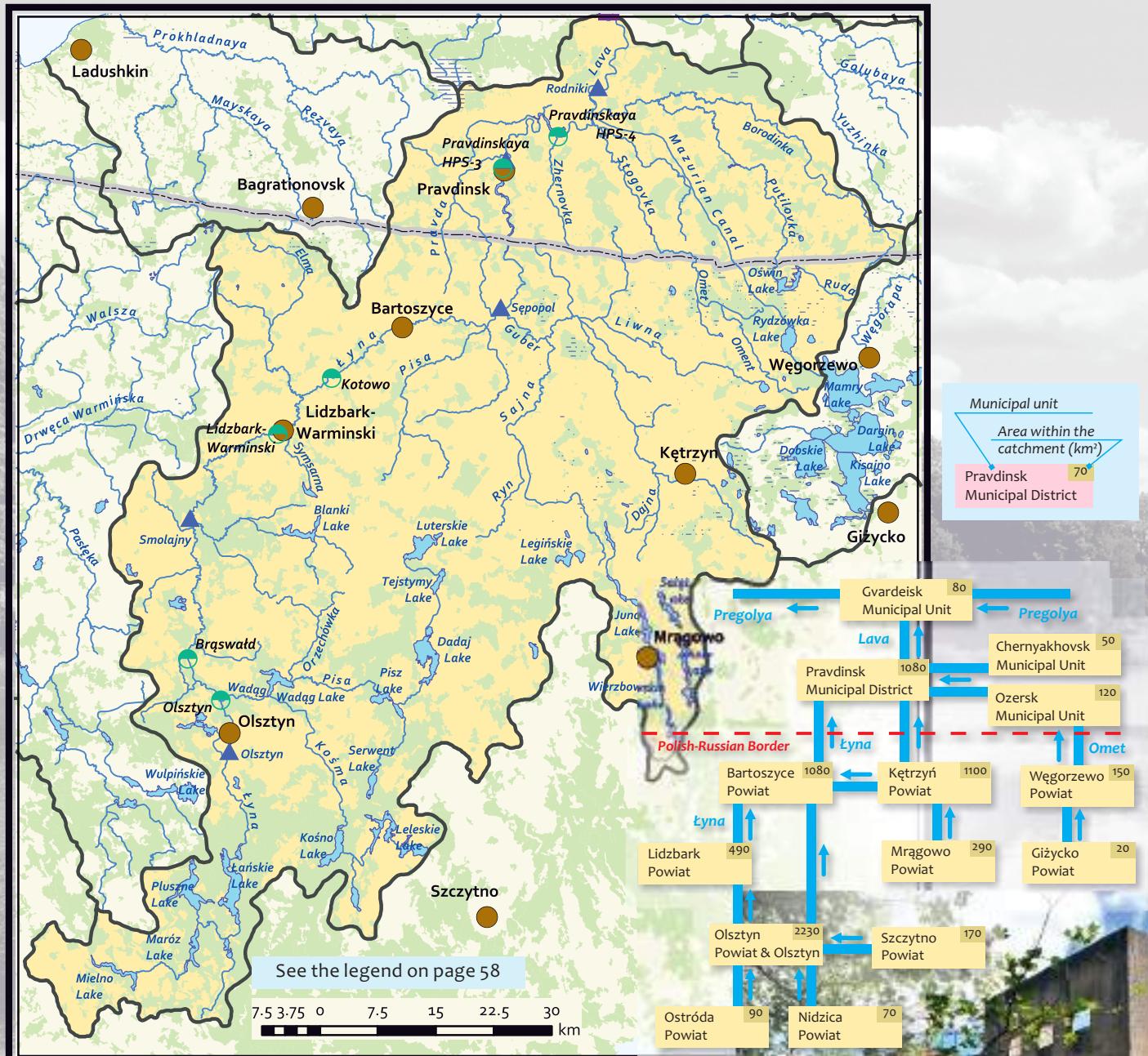
Longitudinal profile of the river bed



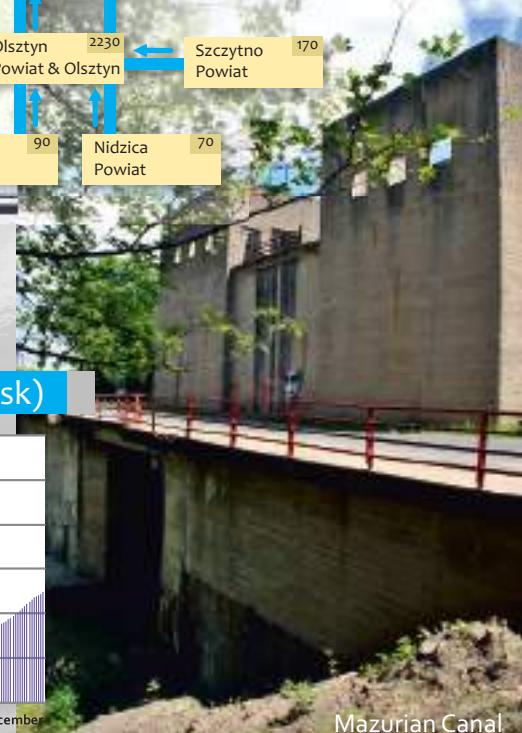
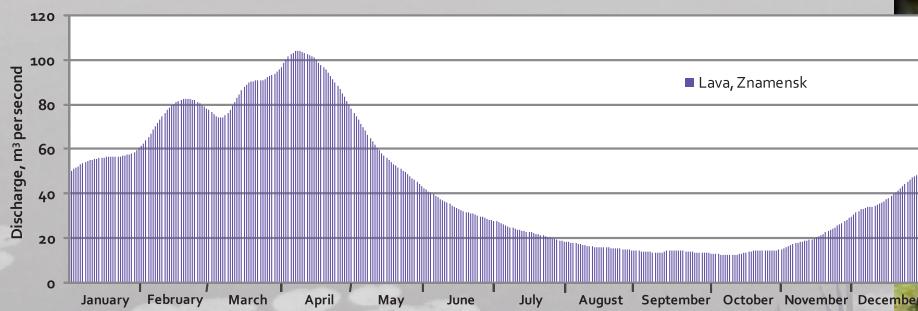
ŁYNA - LAVA CATCHMENT



Sub-catchment area



Longterm mean water discharge of the Lava river (Znamensk)



Description:

The Łyna-Lava River is a transboundary water course with a total length of 264 km (190 km in Poland and 74 km in Russia), its catchment equals 7126 km² (5719 km² is in Poland). It springs nearby Łyna village (Mazurean Swamps on the territory of Olsztyn Voivodship in Poland) at 155 meters AMSL and discharges to the Pregolya River from the south close to Znamensk in Kaliningrad Oblast at 72 m upstream the Pregolya River mouth. The river is called the Łyna River in Poland and the Lava River on the Russian side of the catchment.

In its upper course the Łyna River flows through the Las Warmiński Nature Reserve and then it runs through a number of ribbon lakes, Łąńskie being the biggest and deepest one. The river changes its direction many times crossing a number of end moraines; that is a reason of differences in characteristics of particular sections of the river valley. The Łyna River is connected to Lake Mamry by the 18th-century Masurian Canal.

There is a hydro power plant located at the confluence with the Wadag River.

The valley of the Lava River is of trapezoidal shape, the meadow floodplain is mostly right-hand about 300 m wide.

The stream is meandering, sediments are formed by sand and silt, rooted vegetation is developed. The left bank, 10-13 m high, is steep and covered by deciduous forest. The right bank is sloping and covered by bush.

The Łyna-Lava River doesn't dry up, it is covered (but not blocked) by ice in winter. Water level variations are under backing-up influence of the dam located in the City of Znamensk and direct influence of the hydropower plant located at the confluence with the Wadag River (in Poland) and in Pravdinsk (Russia).

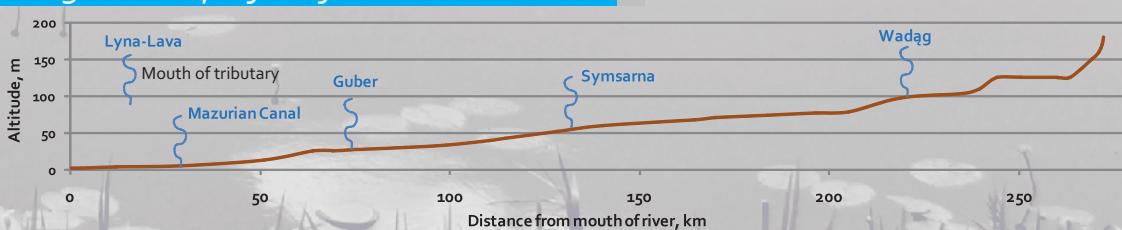
Cities founded by the Teutonic Knights along the river Łyna (Alnā) include: Nidzica (15 ths inh.), Olsztyn (176 ths inh.), Dobre Miasto (11 ths inh.), Lidzbark Warmiński (17 ths inh.), Bartoszyce (25 ths inh.), Sepopol (2 ths inh.), Pravdinsk (4.3 ths inh.), and Znamensk (4 ths inh.).

There are four monitoring stations along the river. One of the Russian State Monitoring System is in the settlement of Rodniki (15 km upstream the river mouth). The other three are located in Sepopol, Smolajny and Olsztyn (120, 200 and 250 km upstream the Łyna-Lava River mouth respectively) and belong to the Polish State Monitoring System.

3D elevation model



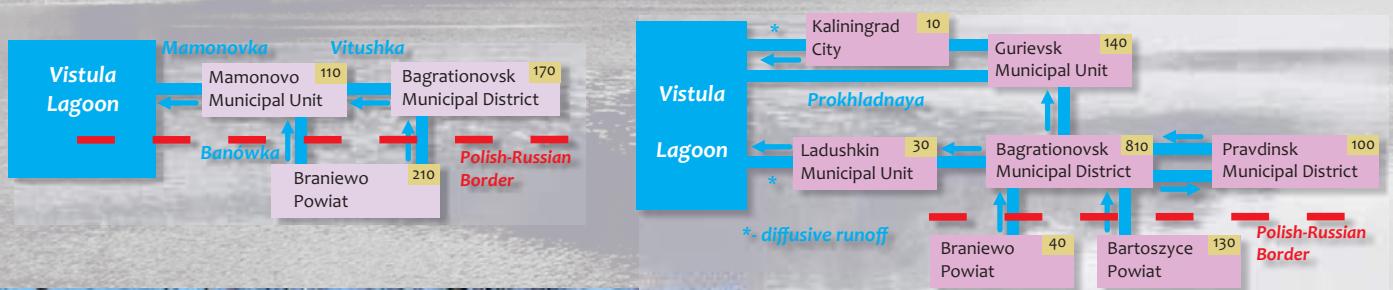
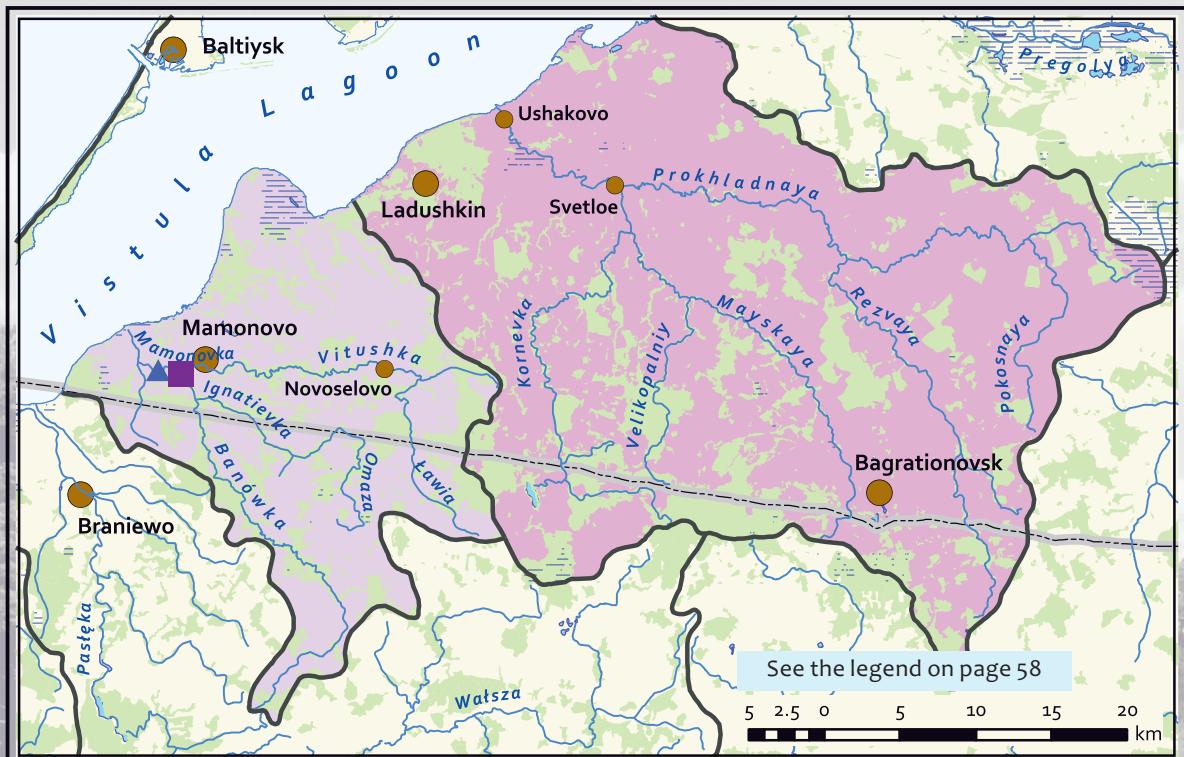
Longitudinal profile of the river bed



BANÓWKA-MAMONOVKA & PROKHLADNAYA CATCHMENTS



Sub-catchment area



	BM	PH
Catchment area (km^2)	490	1260
Catchment area within Russia (km^2)	280	1090
Catchment area within Poland (km^2)	210	170
Average slope of the catchment (m/km)	1.7	1.7
Minimum altitude in the catchment (m AMSL)	0	0
Maximum altitude in the catchment (m AMSL)	142	190
Tortuosity (dimensionless value)	1.28	1.22
Average river bed slope (m/km)	2.70	0.50

Monitoring point: River (Station name) BM - Mamonovo

BM - Banówka-Mamonovka River

PH - Prokhladnaya River

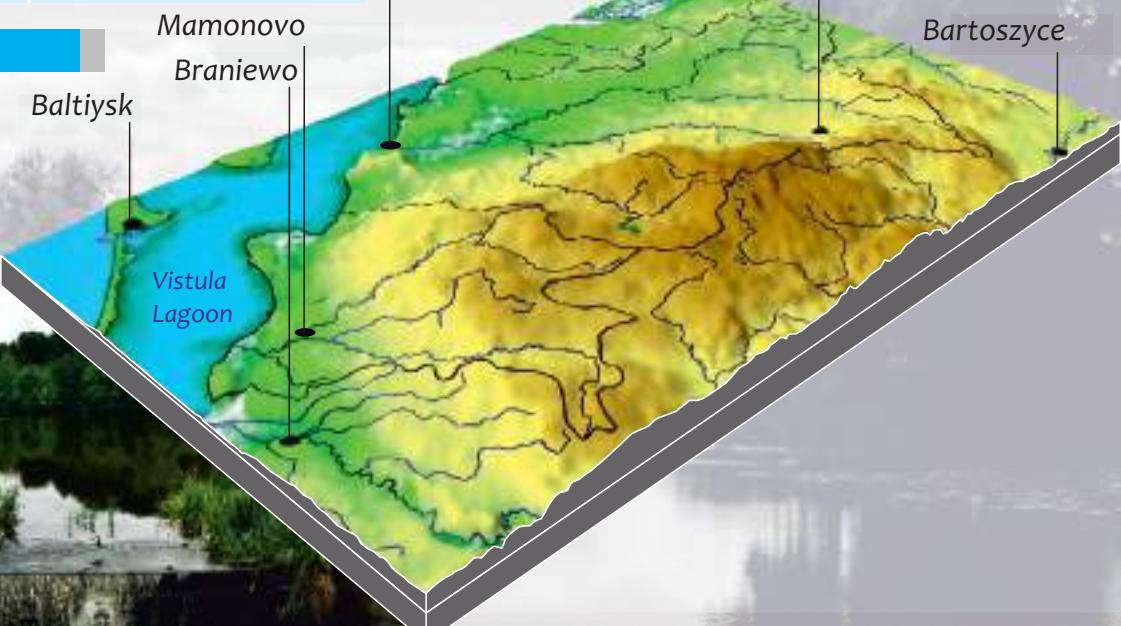
Description:

The **Banówka-Mamonovka River** is the smallest transboundary watercourse (of 51 km long). It springs near the village of Piotrowiec (Poland) at 113 m AMSL and then flows through a region of protected landscape and crossing the Polish-Russian border near Gronowo. Passing by the city of Mamonovo, the river discharges directly to the Vistula Lagoon. The river has 28 tributaries, 6 of them are on the territory of Kaliningrad Oblast. The two-sided valley of the

river is covered by meadows and partly swamped. The river is not regulated, the stream (of 10-16 m width) is meandering a little through the moraine hill landscape covered by bush and trees, stream sediments are presented by sand and mud. The main settlement, namely, Mamonovo (8.1 ths inh.) is on the Russian side of the catchment. There is a monitoring station of the Russian State Monitoring System in Mamonovo (at a distance of 7 km upstream the mouth).

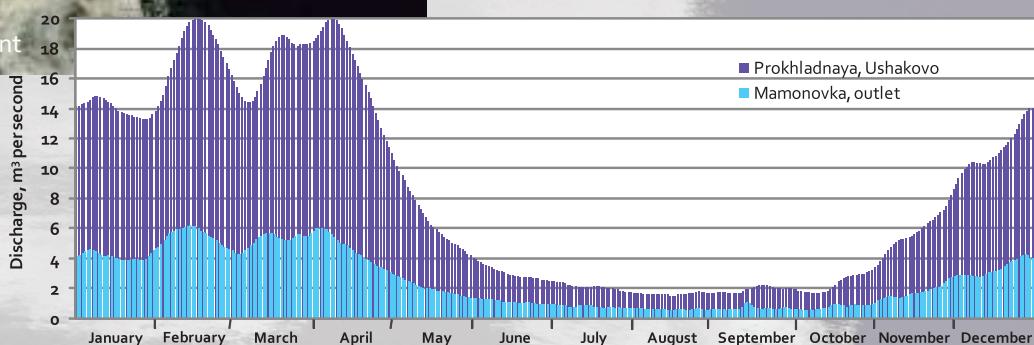


3D elevation model

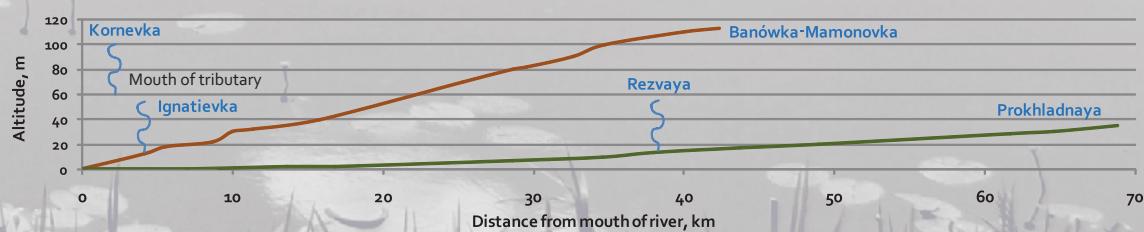


Vitushka River
(tributary of Mamonovka)
at the Novoselovo Settlement

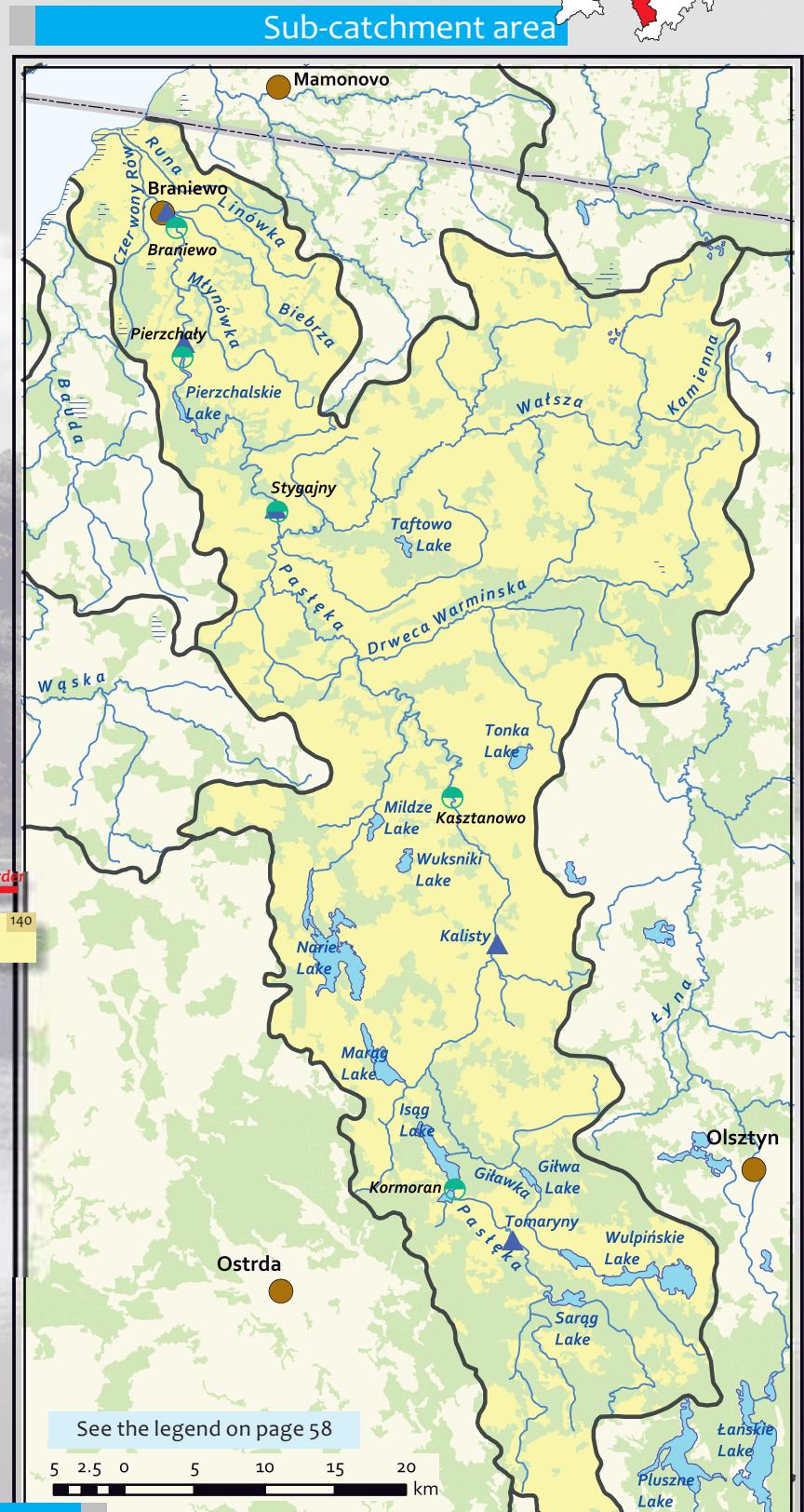
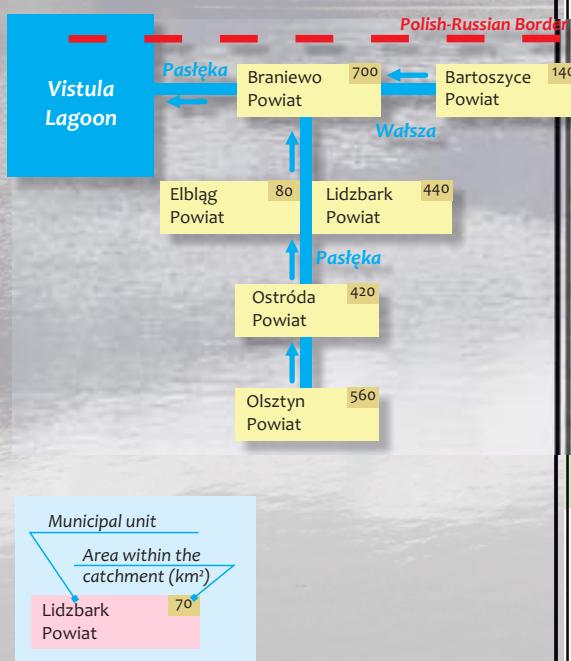
Longterm mean water discharge of the Banówka-Mamonovka and the Prokhladnaya rivers



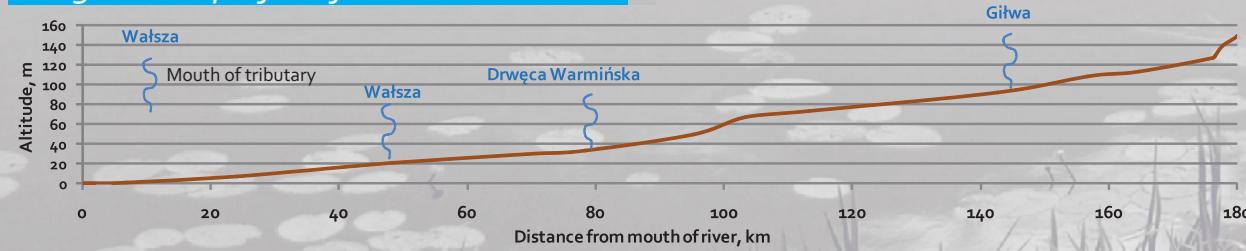
Longitudinal profile of the river bed



PASŁĘKA CATCHMENT



Longitudinal profile of the river bed



Description:

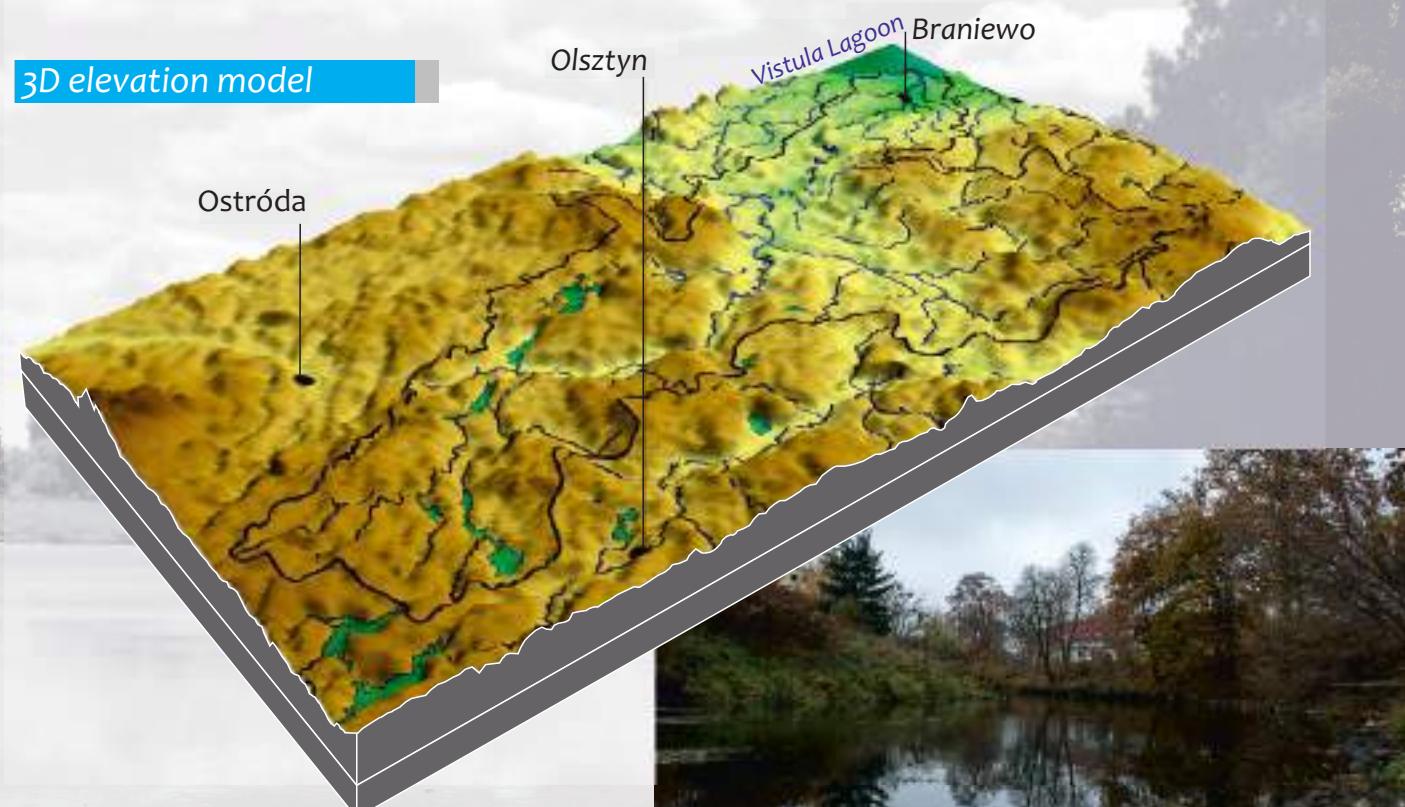
The Pasłeka River is one of the longest rivers in the catchment, it flows over 160 km through the lake areas of Olsztyn and Mrągowo (Mazurian Lakeland). The reported length of the river varies, depending on sources, from 169 to 211 kilometers. The river springs nearby Olsztynek, between Stawiguda and Gryzliny, at 157 meters AMSL (or from lake Plusz southward of Stawiguda), flows through the town of Braniewo and discharges into the Vistula Lagoon. The drainage area of the Pasłeka River spreads over 2330 km² and is located within the River Pasłeka Beaver Refugium Nature Reserve.

Main tributaries are as follows: Stara Pasłeka, Wałsza, Gilwa,

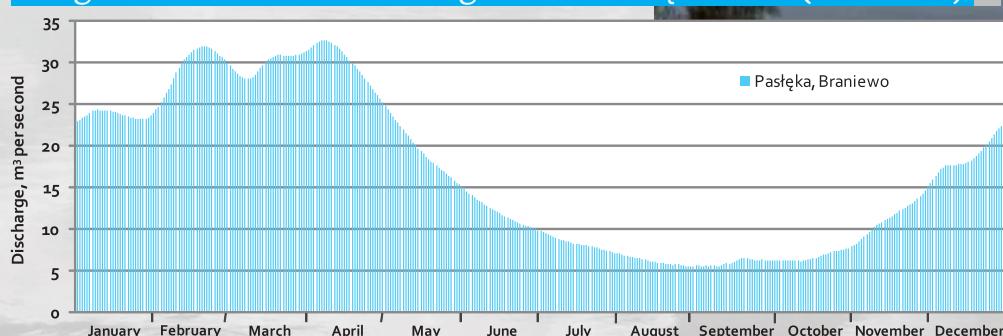
Jemiołówka, and Miłakówka. The river crosses the following lakes: Wymój, Sarąg, Łęguty, and has canals: Kanał Rusy, Kanał Skolity, Kanał Energetyczny. Four hydropower plants are built on the river – in Braniewo, Pierzchaly, Kormoran in Łęgucki Młyn, and in Kasztanowo.

The main settlement is Braniewo (population is of 17 ths inh.). There are 5 monitoring stations of the Polish State Monitoring System located downstream of Tomaryny, then Kalisty, Łozy, Pierzchały, Braniewo (140, 110, 50, 25 and 10 km upstream the mouth respectively) and close to the river mouth in Nowa Pasłeka.

3D elevation model



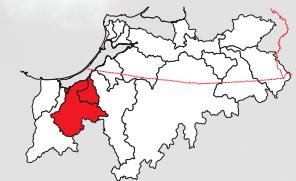
Longterm mean water discharge of the Pasłeka River (Braniewo)



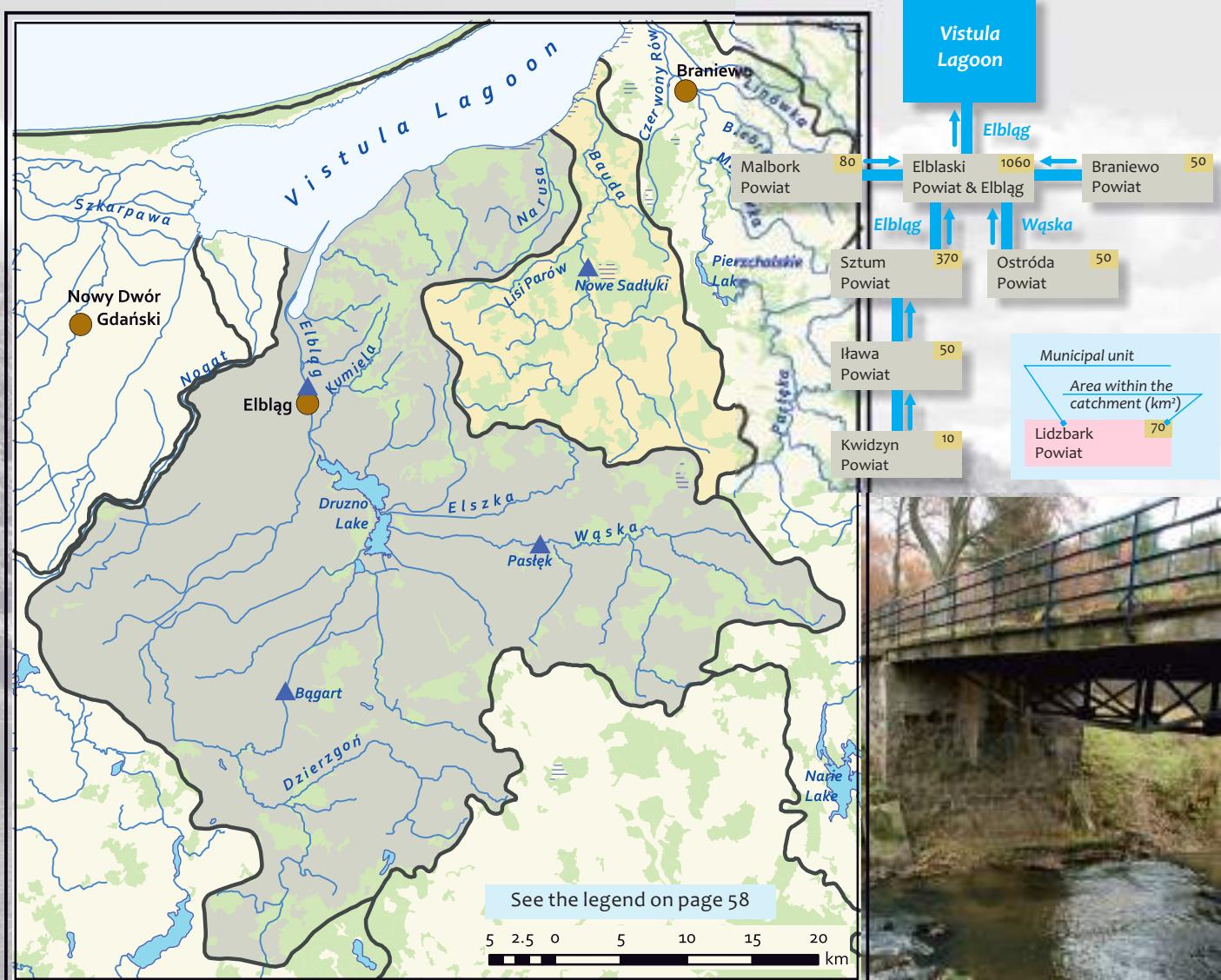
The Pasłeka River at the Braniewo Town

Catchment area (km ²)	2330
Catchment area within Russia (km ²)	0
Catchment area within Poland (km ²)	2330
Average slope of the catchment (m/km)	2.7
Minimum altitude in the catchment (m AMSL)	0
Maximum altitude in the catchment (m AMSL)	216
Tortuosity (dimensionless value)	1.27
Average river bed slope (m/km)	0.85
Monitoring point: River (Station name)	Pasłeka (Tomaryny, Kalisty, Krosno, Bornty, Łozy, Pierzchały, Braniewo)

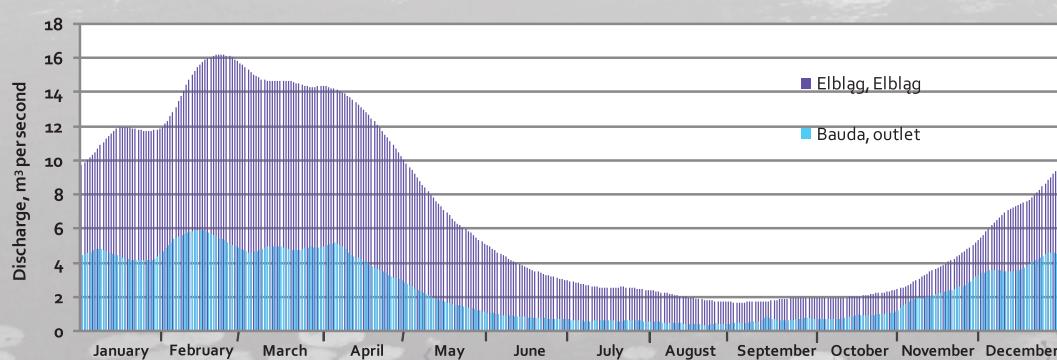
ELBLĄG & BAUDA CATCHMENTS



Sub-catchment area



Longterm mean water discharge of the Elbląg River (Elbląg)



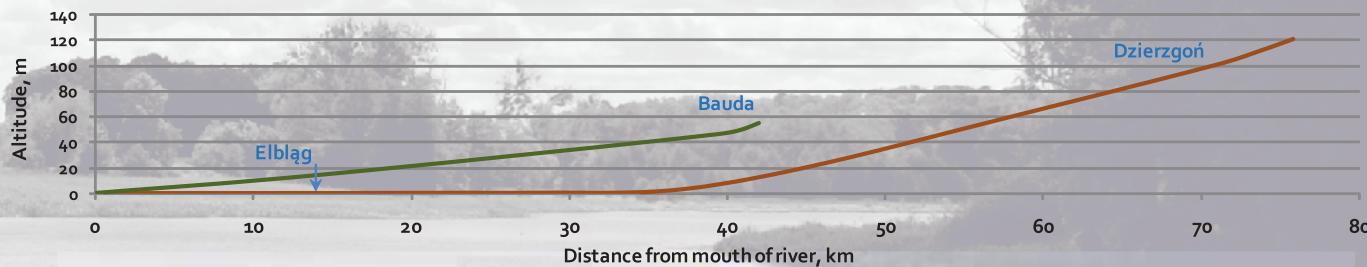
Description:

The Elbląg River is a 14.5-kilometre river in northwestern Poland connecting Lake Drużno with the Vistula Lagoon. It flows through the city of Elbląg (main settlement with the population of 124 ths inh.). There is a port in Elbląg giving the city potential possibility to access the Baltic Sea via the Russian part of the Vistula lagoon and Strait of Baltijsk. The flow velocity of the river is relatively small and depends on the wind direction and water level in the Vistula Lagoon, that's why backwater maybe observed reaching Lake Drużno and causing flood in the city of Elbląg and the neighboring villages. Tributaries of the river are as follows: the Fiszevka, the Kumiela and the Babica rivers. The Elbląg River is navigable at its whole course (lagoonward from the City of Elbląg, the river is treated as internal sea waters), and is seen as an axis of the transportation system. It is connected with the Vistula River via the Jagielloński Canal and the Nogat River, and it is connected with the lakes of Iławskie Lakeland via the Elbląg Canal. During the drought period, river water is used for irrigation of agricultural land of Elbląskie Żuławy. Most of the river

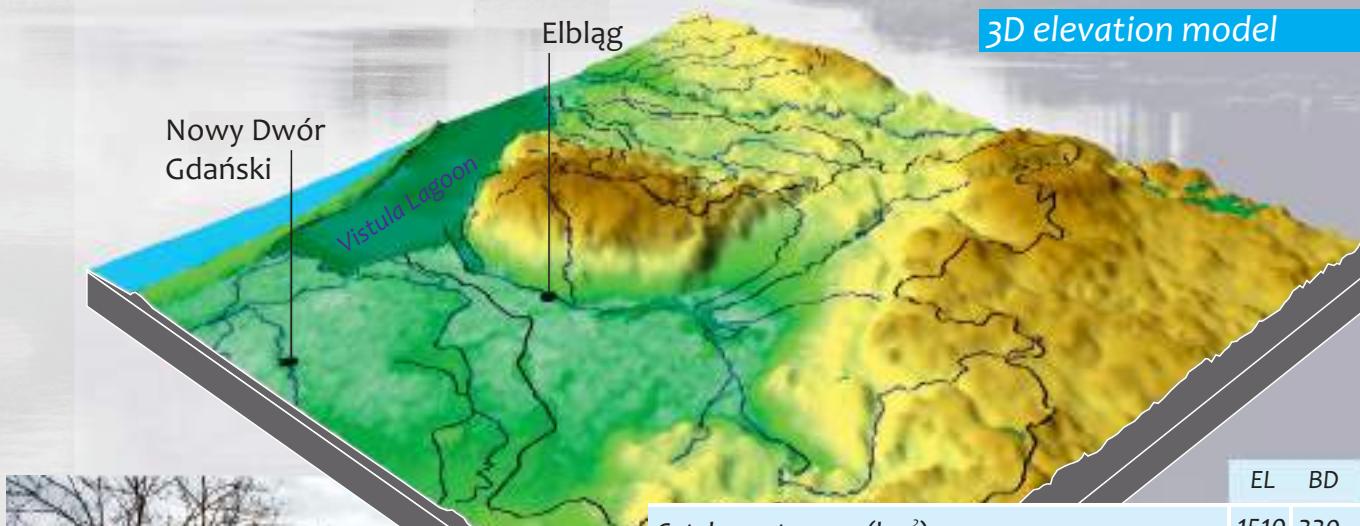
catchment includes the depression areas, that's why the river is embanked from both sides along almost all its course. There are two monitoring stations of the Polish State Monitoring System located in Bałgart (upstream of Lake Drużno) and in the city of Elbląg which is the main settlement along the river course (population 125 ths inh.)

The Bauda River is about 58 kilometers long and has its outflow to the Vistula Lagoon. The catchment area is approximately 560 km². It springs at 55 meters AMSL. Agricultural and forest areas dominate the landscape. As for agricultural area, it is mostly not arable land but grassland and pastures. The catchment area contains several protected areas, such as natural reserves, Natura 2000 areas and protective landscape areas. The catchment is not densely populated. It is mostly rural with three smaller towns (Frombork, Tolkmicko, Młynary) with less than 3000 inhabitants each. There is a water gauge on Bauda (Polish State Monitoring System) at Nowe Sadłuki at a distance of 22 km upstream the mouth.

Longitudinal profile of the river bed



3D elevation model



The Elbląg River at the Elbląg City

EL	BD	
Catchment area (km ²)	1510	330
Catchment area within Russia (km ²)	0	0
Catchment area within Poland (km ²)	1510	330
Average slope of the catchment (m/km)	2.3	2.4
Minimum altitude in the catchment (m AMSL)	0	0
Maximum altitude in the catchment (m AMSL)	198	197
Tortuosity (dimensionless value)	1.05	1.12
Average river bed slope (m/km)	1.54	1.19
Monitoring point: River (Station name)	EL (Elbląg, Pasłęk, Bałgart), BD (Nowe Sadłuki, Baranówka)	

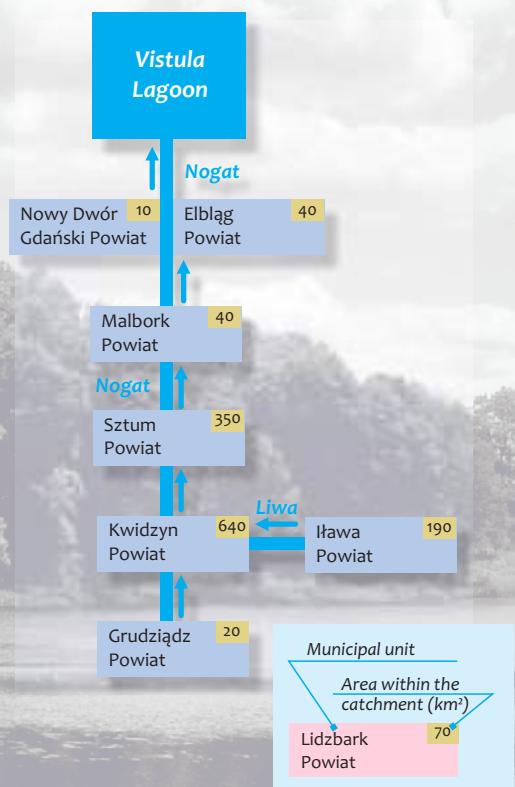
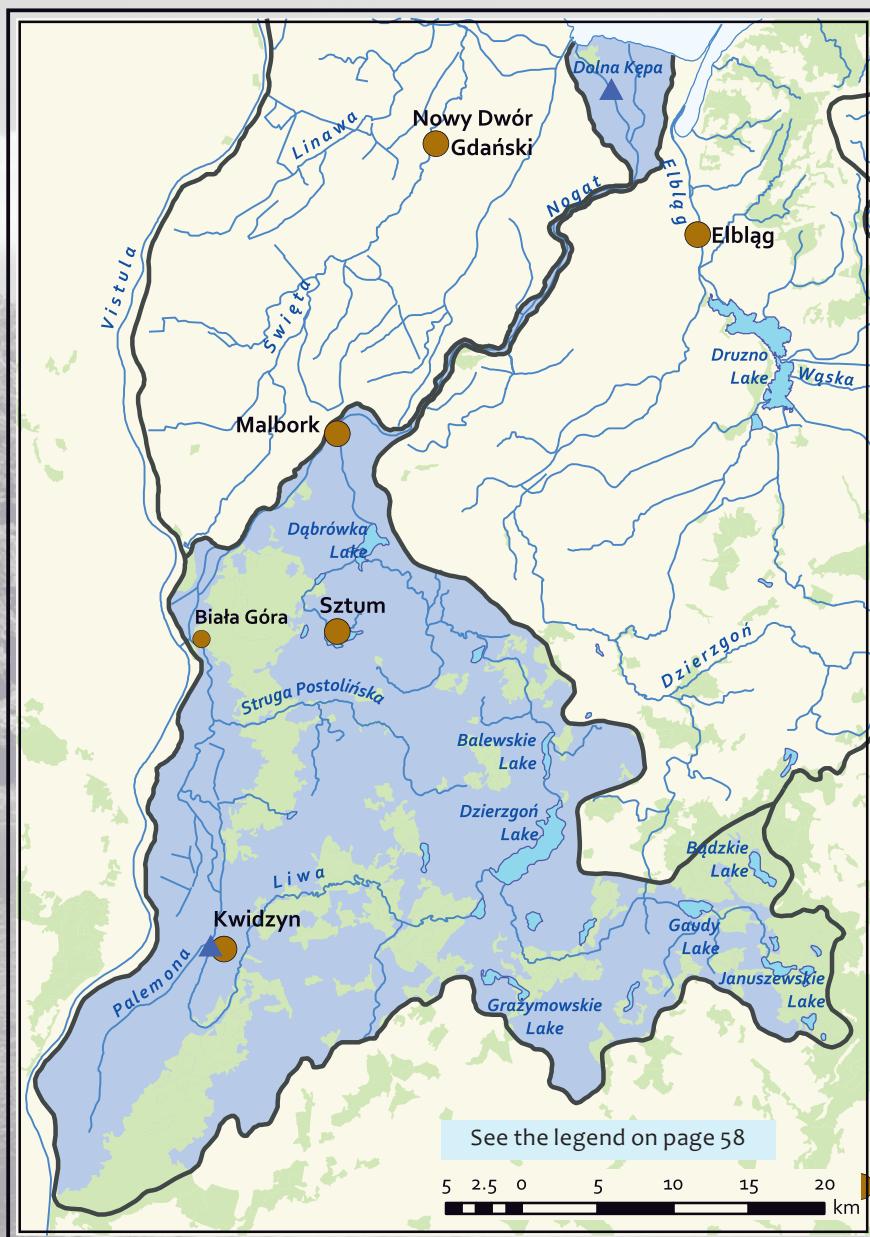
EL - Elbląg River

BD - Bauda River

NOGAT CATCHMENT



Sub-catchment area



Catchment area (km^2)	1530
Catchment area within Russia (km^2)	0
Catchment area within Poland (km^2)	1530
Average slope of the catchment (m/km)	2.0
Minimum altitude in the catchment (m AMSL)	0
Maximum altitude in the catchment (m AMSL)	133
Tortuosity (dimensionless value)	1.03
Average river bed slope (m/km)	0.12
Monitoring point: River (Station name)	Nogat (Dolina Kępa)



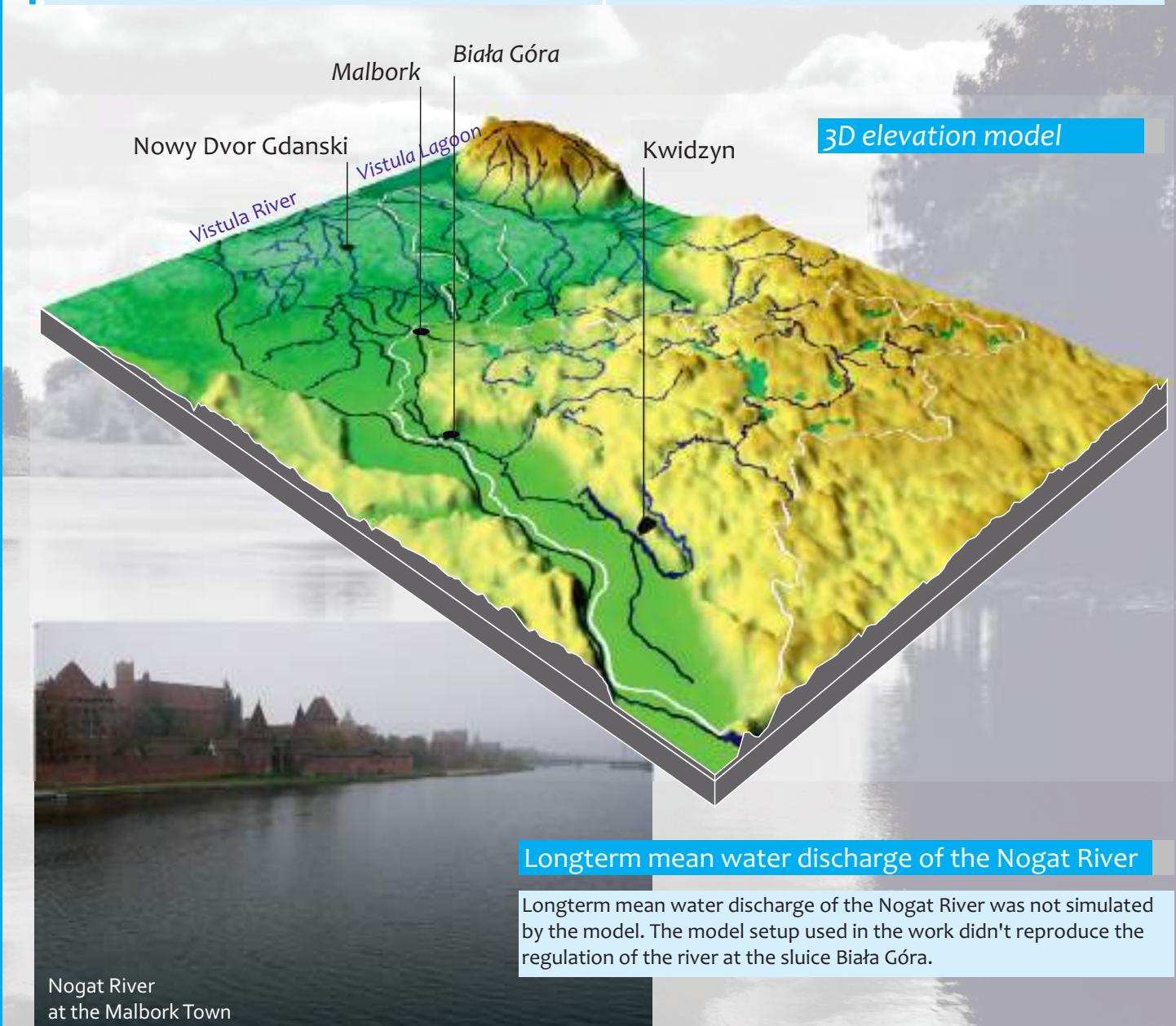
Description:

The [Nogat River](#) is a 62 km long delta branch of the Vistula River and does not empty at Gdańsk Bay, as the main river does, but discharges into the Vistula Lagoon. The Nogat has its origin at the sluice near the city of Biała Góra. Shortly after, the Liwa River flows into the Nogat, then the Nogat passes Malbork and winds to the north-east towards Elbląg, but does not reach the city and turns to the south-western part of the Vistula Lagoon.

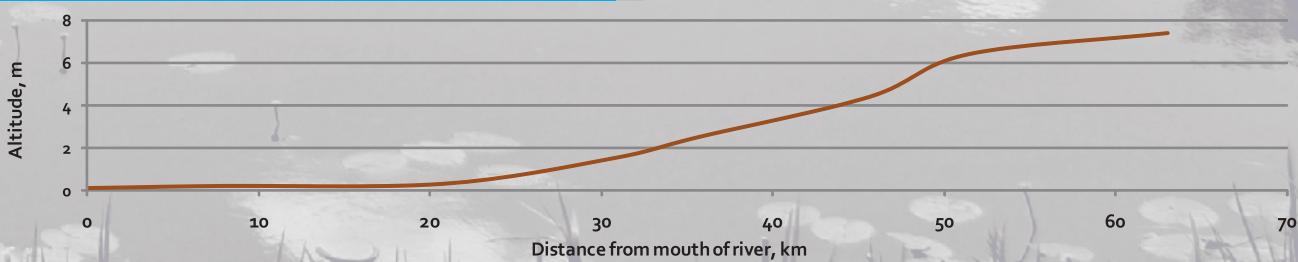
There are five sluices along the river run, so the flow of the river is almost negligible. The first two sluices are located at Biała Góra, the next ones at Szonowo, Rakowiec and

Michałowo where a hydroelectric power station is located. The main settlement is Malbork (population 39 thousand). There is a monitoring station belonging to the Polish State Monitoring System located in Dolna Kępa (3 km upstream the mouth).

The river is navigable along its whole course connecting the Vistula River with the Vistula Lagoon and via the Elbląg River with the lakes of Iławskie Lakeland. In fact, the river is embanked along its course, but after the construction of sluices there is no flood danger at all.



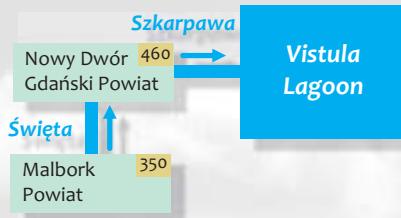
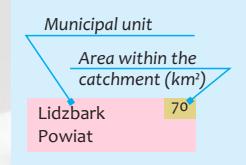
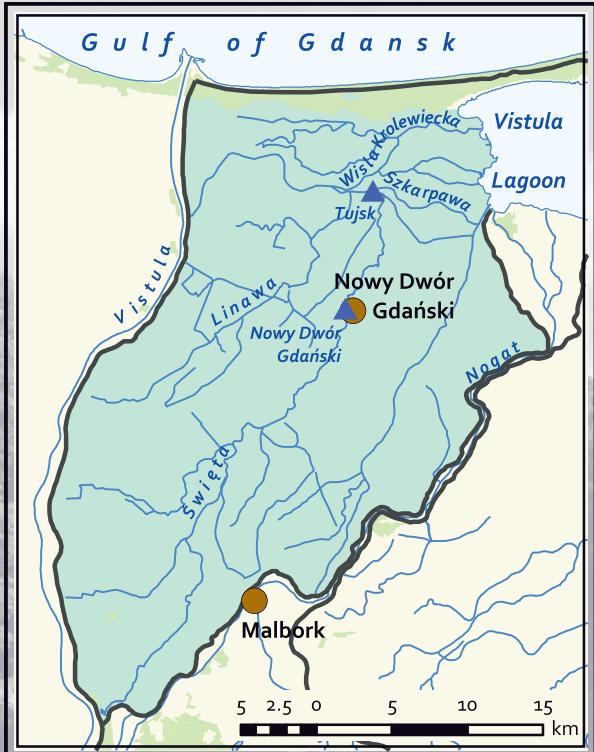
Longitudinal profile of the river bed



SZKARPAWA CATCHMENT



Sub-catchment area



Legend

- Forests
- Wetlands
- Catchment borders
- State borders
- Hydropower stations
- Towns
- Monitoring points**
- hydrological measurements
- hydrochemical measurements

Longterm mean water discharge of the Szkarpawa River

Longterm mean water discharge of the Szkarpawa River was not simulated by the model. The model setup used in the work didn't reproduce the multi-arms structure of the river stream.



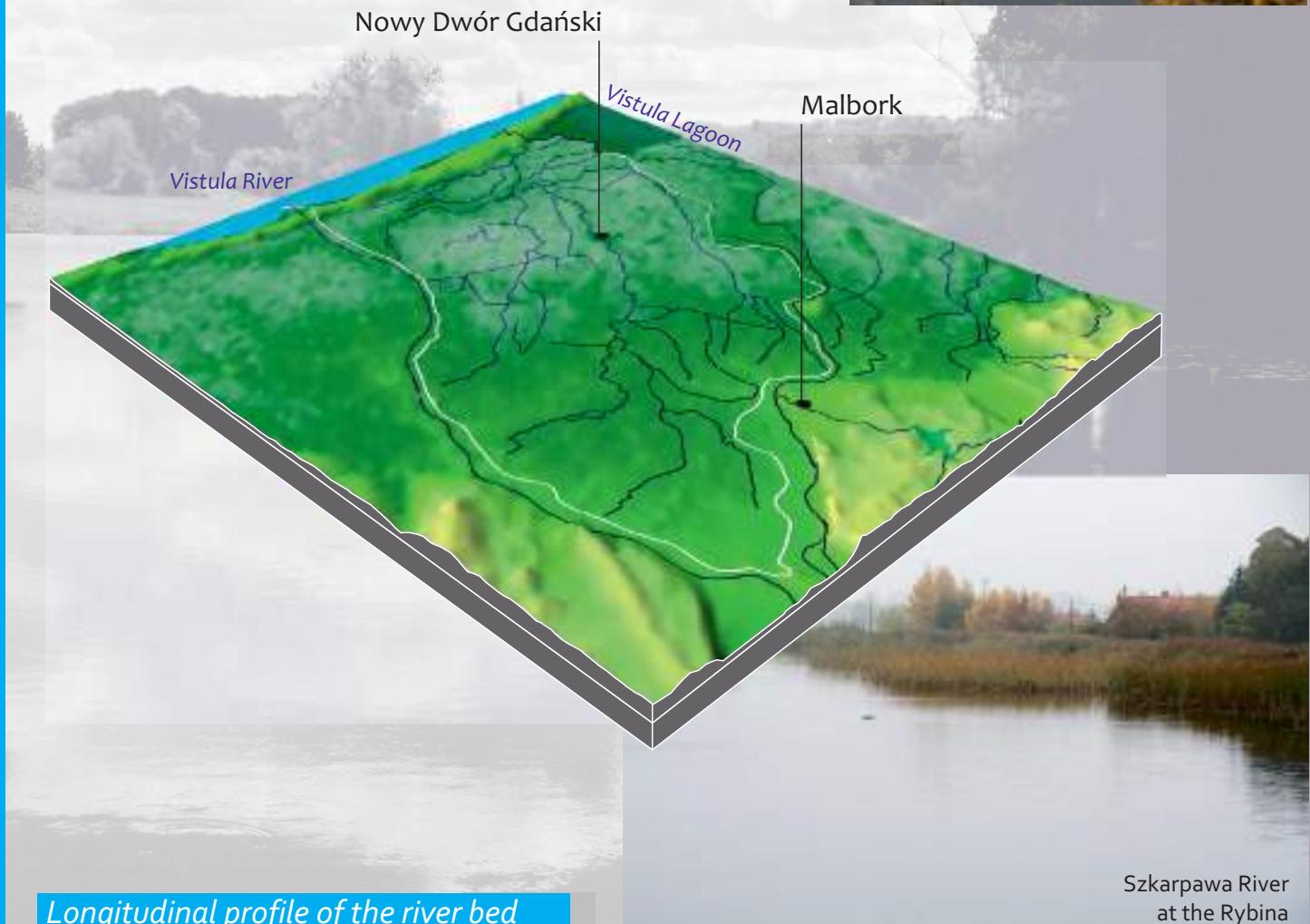
Catchment area (km^2)	750
Catchment area within Russia (km^2)	0
Catchment area within Poland (km^2)	750
Average slope of the catchment (m/km)	0.5
Minimum altitude in the catchment (m AMSL)	0
Maximum altitude in the catchment (m AMSL)	15
Tortuosity (dimensionless value)	1.04
Average river bed slope (m/km)	0.04
Monitoring point: River (Station name)	Szkarpawa (Tujsk, Nowy Dwór Gdańsk)

Description:

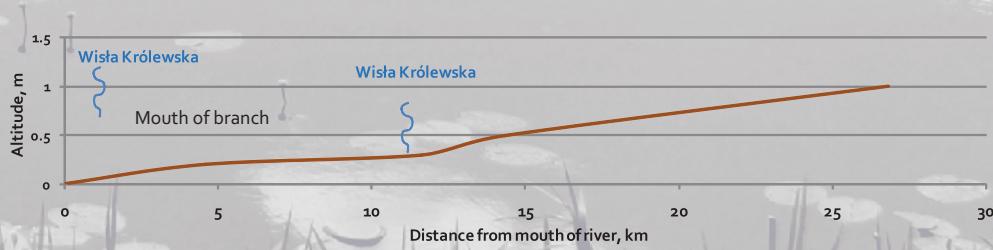
The Szkarpawa River is a 25.4 km long delta branch of the Vistula River and does not empty at the Gdańsk Bay but discharges into the Vistula Lagoon via two branches: as the Szkarpawa River in the village of Osłonka and as the Wisa Królewiecka in Kobyła Kępa. The Szkarpawa has its origin at the right bank of the Vistula River at the sluice of Gdańską Główą. Along the whole length the river is embanked and navigable - a fairway is 2.5 m deep. In all of its course the river is slightly meandering, but there are also straight sections. The Szkarpawa is a part of the Żuławy Loop, which is the main and shortest waterway for yachts and boats sailing from Gdańsk to the Vistula Lagoon. There are monitoring points of the Polish State Monitoring System located in Tujsk and Nowy Dwór Gdańsk.



3D elevation model



Longitudinal profile of the river bed



Szkarpawa River
at the Rybina



CHAPTER III

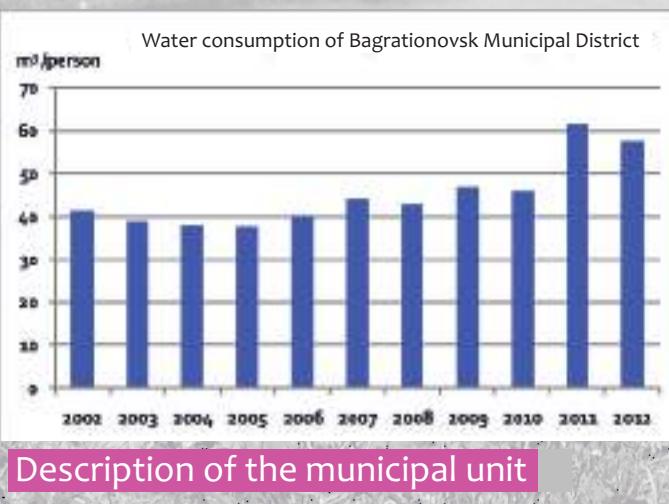
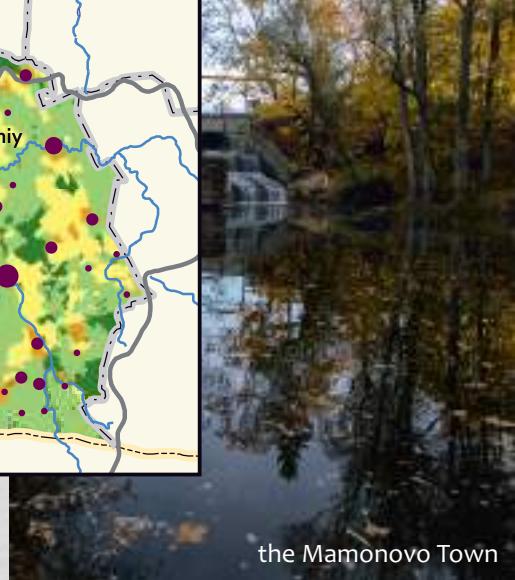
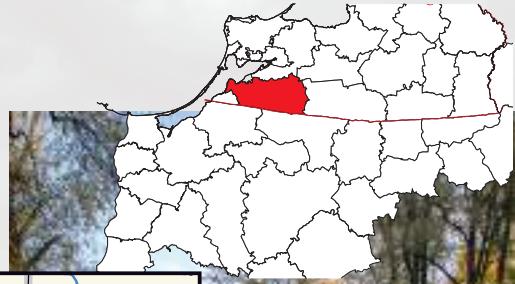
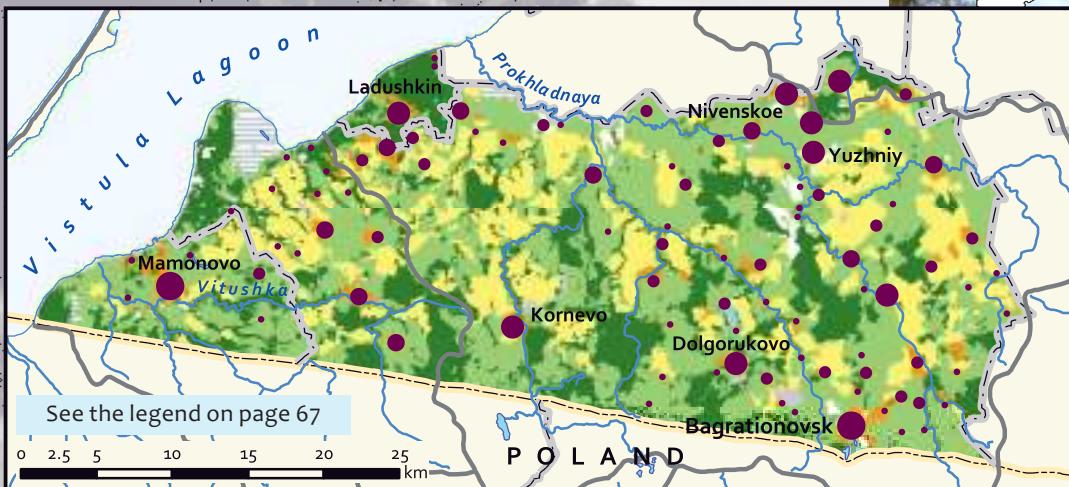
ADMINISTRATIVE STRUCTURE

OF RUSSIAN PART
OF THE VISTULA LAGOON
CATCHMENT

IN THIS CHAPTER:

- Bagrationovsk Municipal District
- Ladushkin & Mamonovo Municipal Units
- Chernyakhovsk Municipal Unit
- Gurievsk Municipal Unit & Kaliningrad City
- Gusev Municipal Unit
- Gvardeisk Municipal Unit
- Krasnoznamensk Municipal Unit
- Neman Municipal District
- Nesterov Municipal Unit
- Ozersk Municipal Unit
- Polessk Municipal District
- Pravdinsk Municipal District
- Zelenogradsk & Svetliy Municipal Units & Baltiysk Municipal District

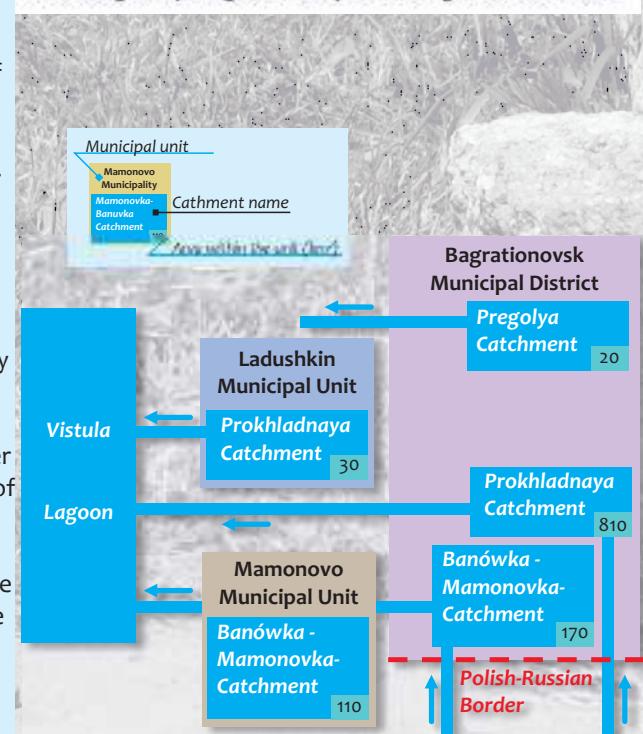
BAGRATIONOVSK MUNICIPAL DISTRICT LADUSHKIN & MAMONOVO MUNICIPAL UNITS

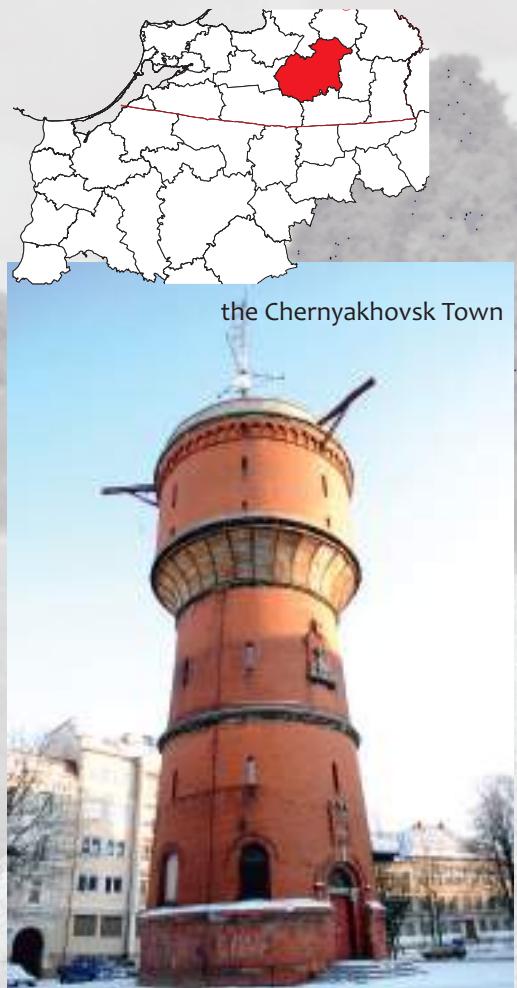


Description of the municipal unit

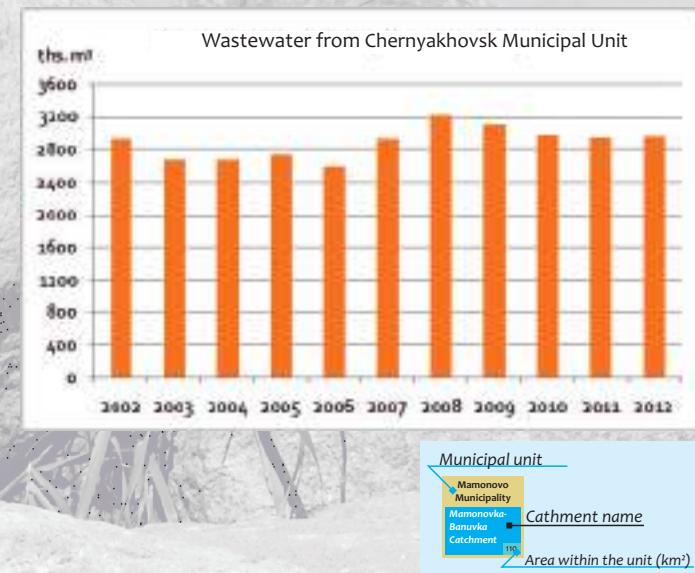
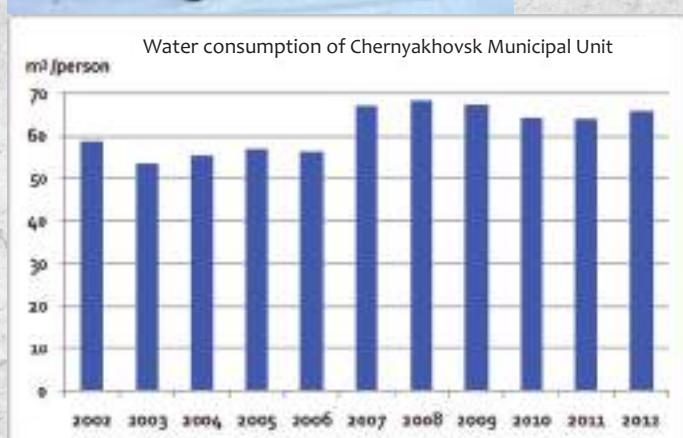
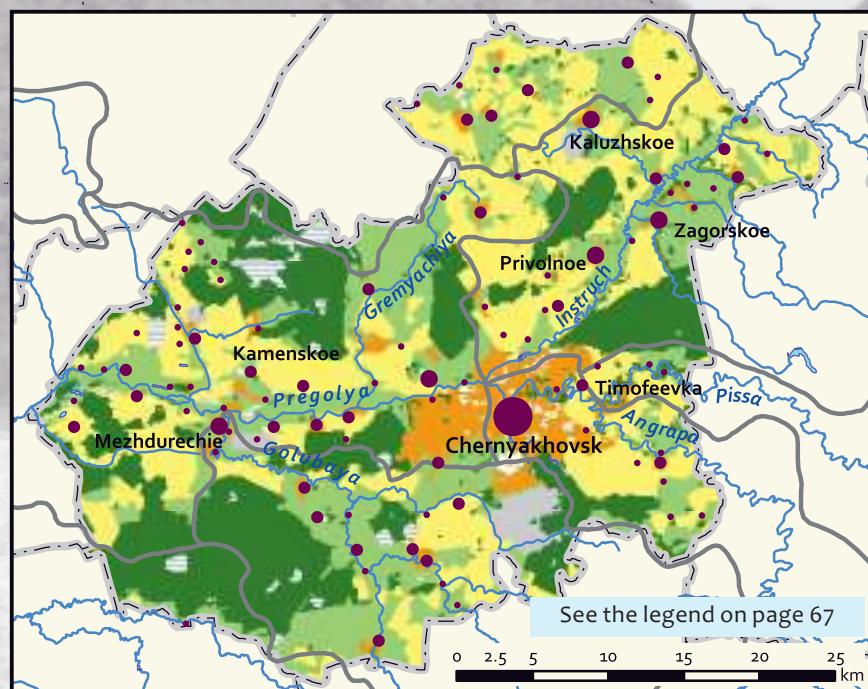
Bagrationovsk Municipal District belongs to Prokhladnaya River catchment. Total population (by 01.01.2014) is of 34.1 ths. of inh., and 6.2 ths. ones from which live in the central town of the Unit, the Town of Bagrationovsk, facilitated by mechanical waste water treatment (3 ths. m³ per day). Rural population is equal to 27.9 ths. of inh., two main settlements are Dolgorukovo and Yuzhnyi with population of 2.9 and 2.8 ths. of inh. respectively. Ladushkin Municipal Unit belongs to the catchments of Prokhladnaya River. It is composed from 3 settlements – Town of Ladushkin, villages Ulyanovka and Ladygino. Total population (by 01.01.2014) is of 4 ths. of inh., and 3.9 ths. from which live in

the central town of the Unit, Town of Ladushkin. Rural population is equal to 0.1 ths. of inh., two main settlements are Ulyanovka and Ladygino with population of 0.05 and 0.03 ths. of inh. respectively. Mamonovo Municipal Unit belong to the catchments of Bonuwka-Mamonovka River. Total population (by 01.01.2014) is of 8.3 ths. of inh. Absolute majority of population (8.1 ths.) live in Town of Mamonovo, and is partly connected to waste water treatment facilities of capacity of 4.3 ths. m³ per day. Rural population is of 0.2 ths. of inh., the biggest rural settlements are Bogdanovka and Zelenodolskoe with population of 0.015 and 0.06 ths. respectively.





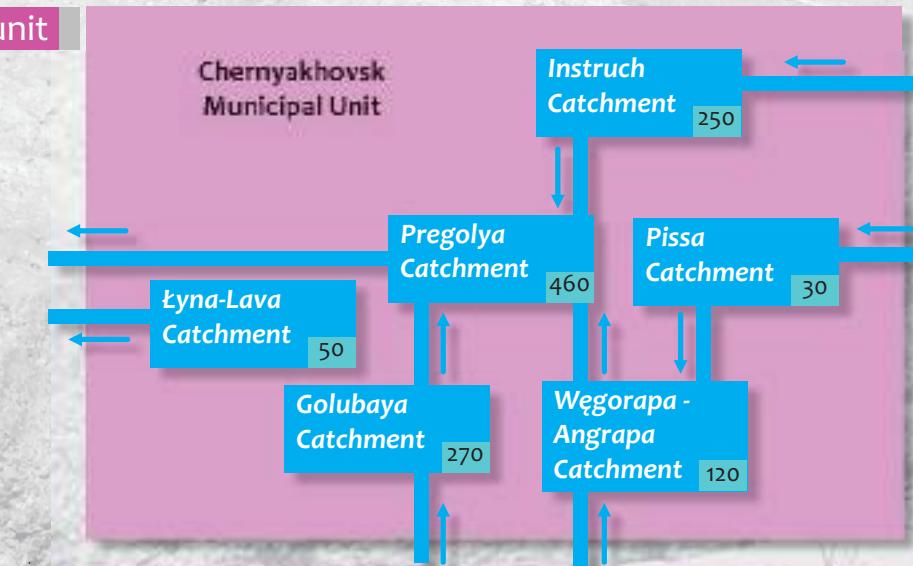
CHERNYAKHOVSK MUNICIPAL UNIT



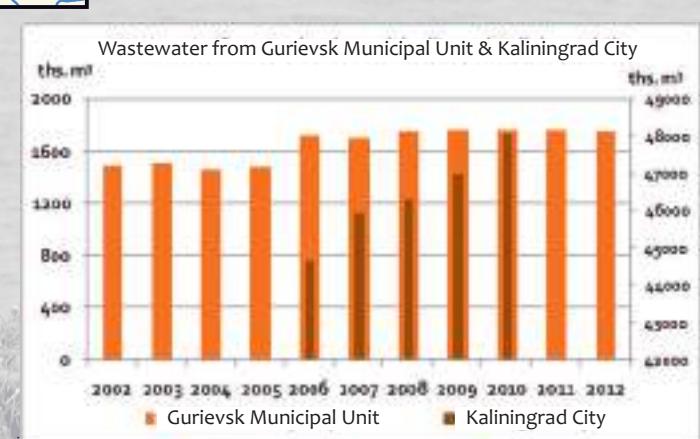
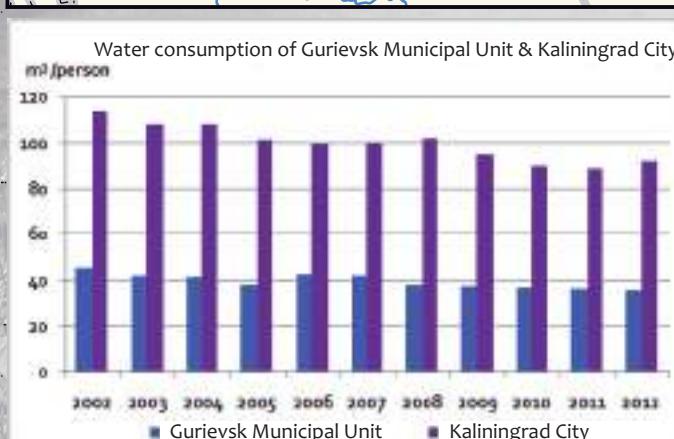
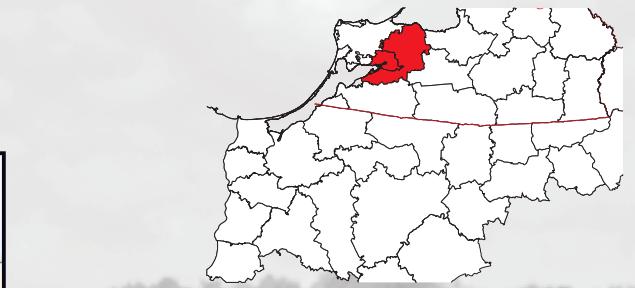
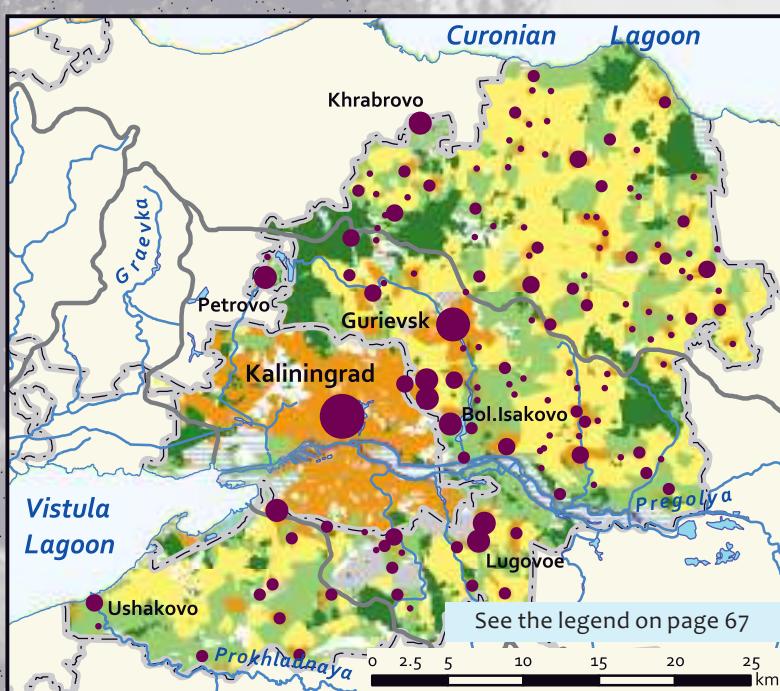
Description of the municipal unit

Chernyakhovsk Municipal District is crossed by Instruch, Pissa, Angrapa and Golubaya rivers. Total population (by 01.01.2014) is of 49.2 ths. of inh., 37.9 ths. ones live in the City of Cherniakhovsk, which will be facilitated in 2015-

2016 by waste water treatment of capacity of 25 ths. m³ per day. Rural population is equal to 11.3 ths. of inh., two main rural settlements are Privolnoe (0.5 ths.) and Mezhdurechje (0.5 ths.).



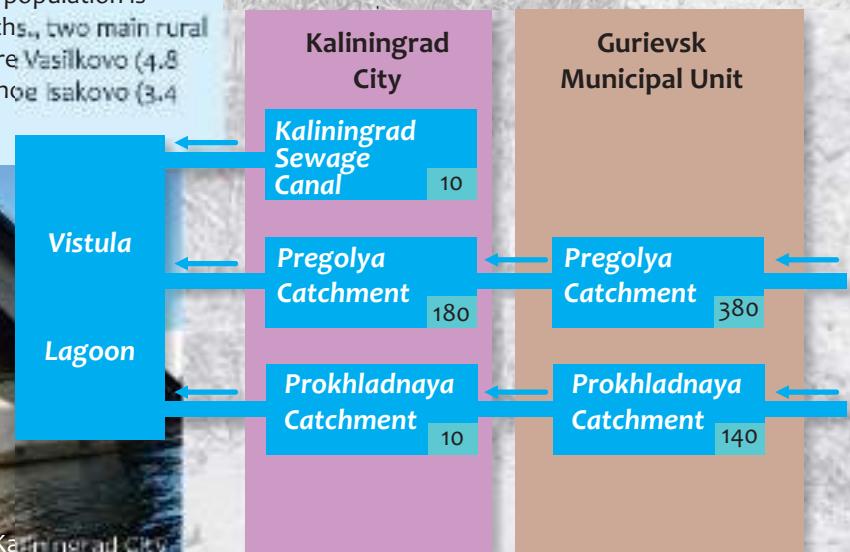
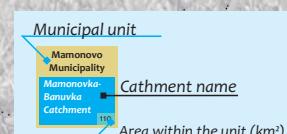
GURIEVSK MUNICIPAL UNIT & KALININGRAD CITY



Description of the municipal unit

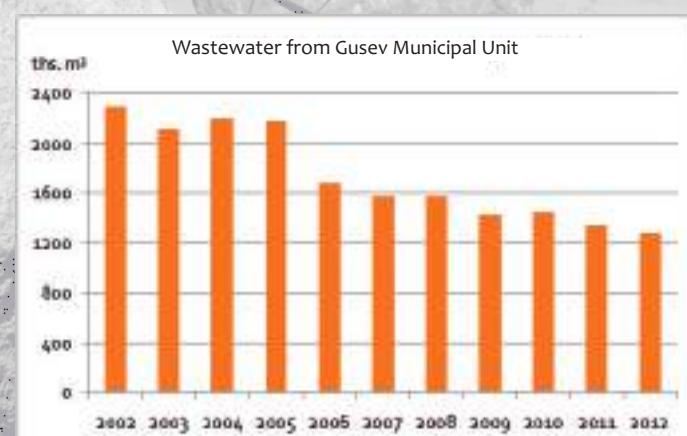
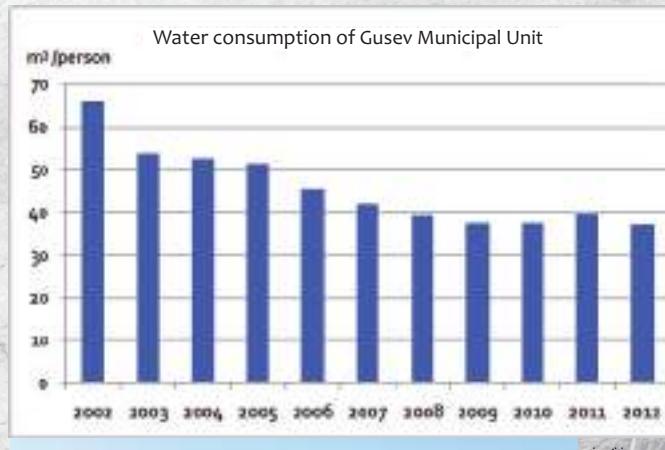
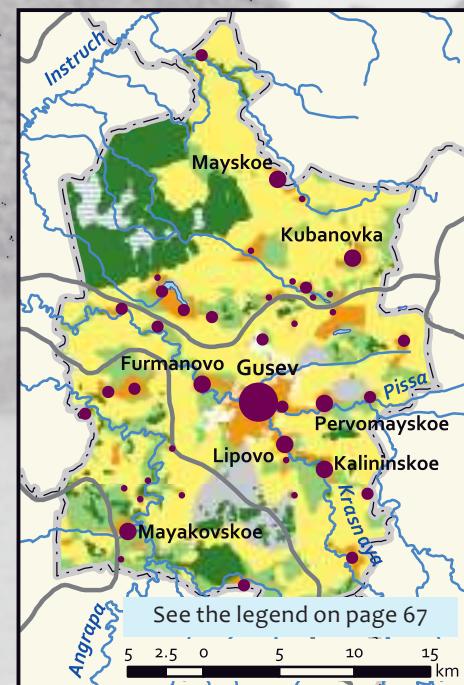
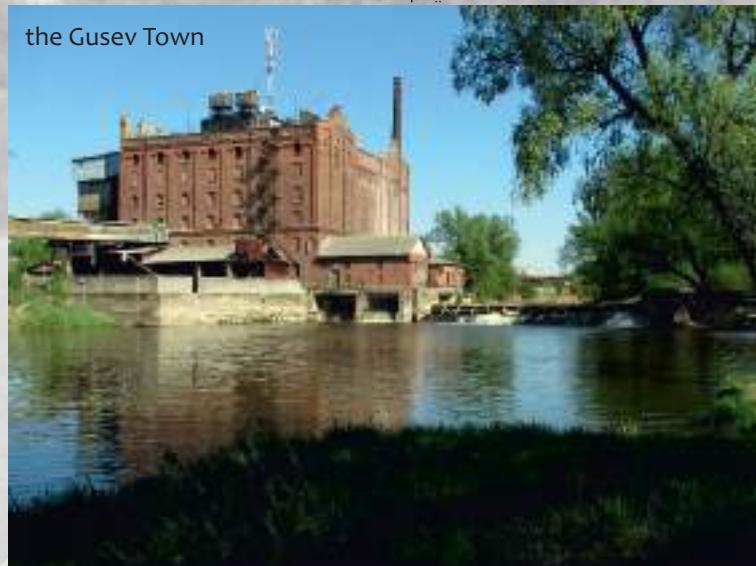
Gurievsk Municipal Unit embraces the Kaliningrad City (460 ths. of inh.) from North, East and South, and is crossed by Pregolya River. Total population (by 01.01.2014) is of 56.8 ths. of inh., and 13.6 ths. ones from which live in the central town of the Unit, the

Town of Gurjevsk. This town will be facilitated by waste water treatment of capacity of 5 ths. m³ per day. Rural population is equal to 43.2 ths., two main rural settlements are Vasilkovo (4.8 ths.) and Bol'she Isakovo (3.4 ths.).





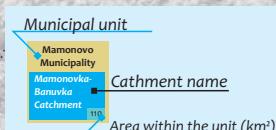
GUSEV MUNICIPAL UNIT



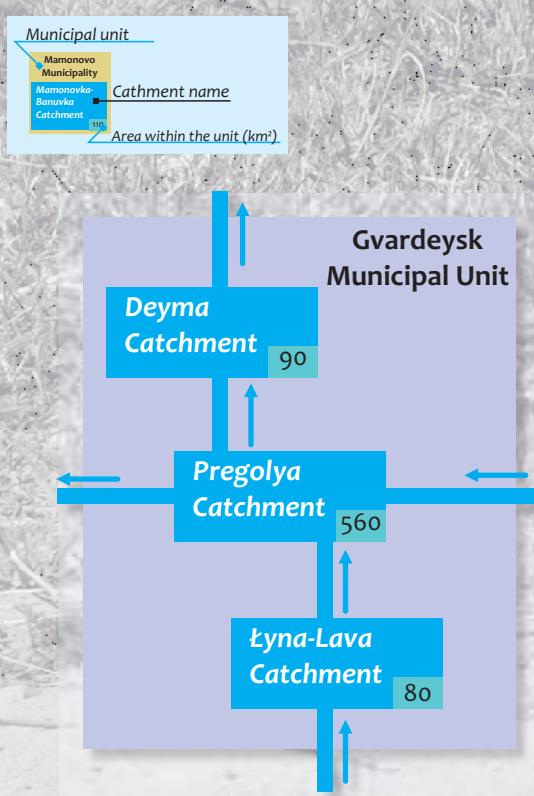
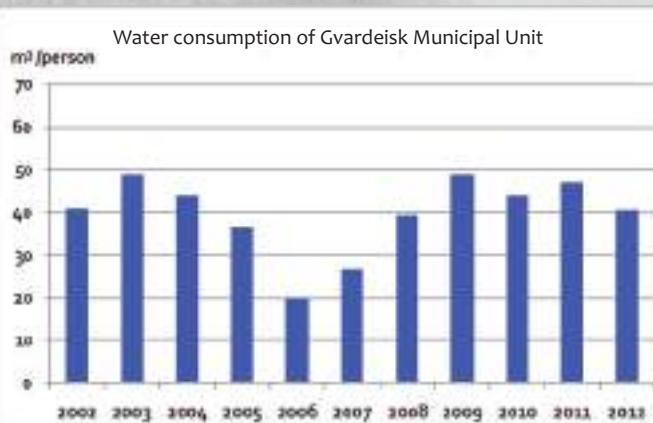
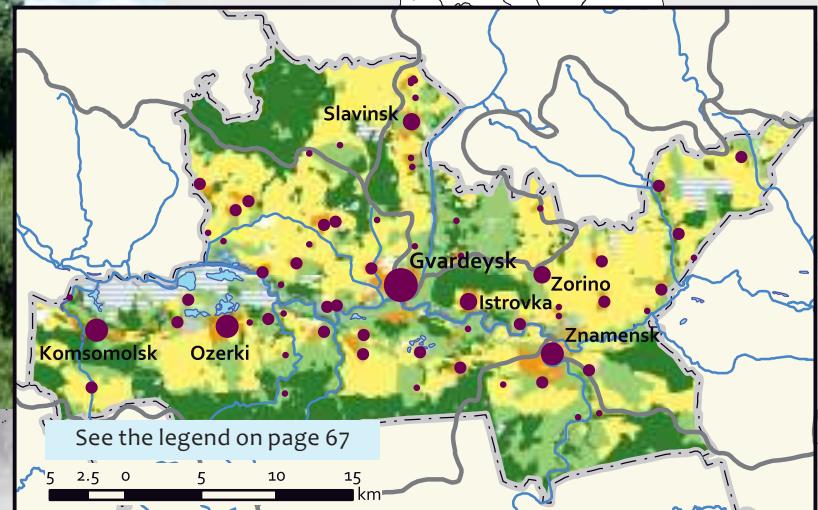
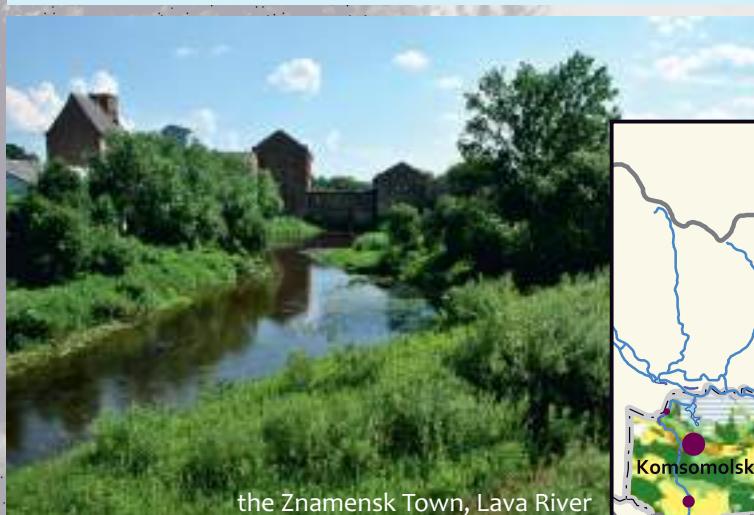
Description of the municipal unit

Gusev Municipal District is crossed by Pissa and Angrapa Rivers and submits water to tributaries of Instruch and Golubaya rivers. Total population (by 01.01.2014) is of 37.6 ths. of inh., and 28.5 ths. ones from which live in the central town of the

Unit, the Gusev Town. Waste water treatment facilities is planned for 10 ths. m³ per day. Rural population is equal to 9.1 ths. of inh., two main settlements are Mayakovskoe and Furmanovo with population of 8.8 and 8.1 ths. respectively.



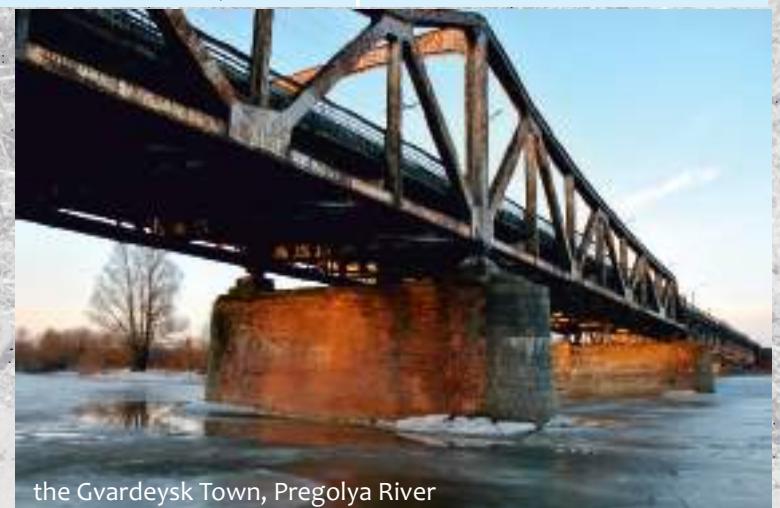
GVARDEISK MUNICIPAL UNIT

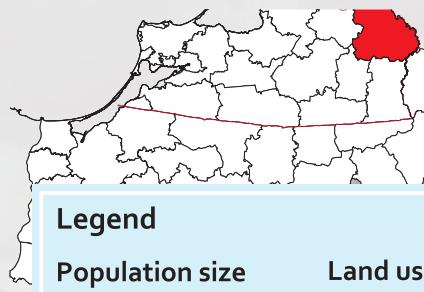


Description of the municipal unit

Gvardeysk Municipal Unit is located at the area where both Lava River meets Pregolya River and Deyma Branch flows out from Pregolya River. Total population (by 01.01.2014) is of 29.5 ths. of inh., and 13.5 ths. ones from which live in the central town of the Unit, the Town

of Gvardeysk. Waste water treatment facilities – no information. Rural population is equal to 16 ths. of inh., Znamensk and Ozerki are two main settlements with population of 4 and 2.4 ths. respectively





KRASNOZNAMENSK MUNICIPAL UNIT

Legend

Population size

- less 100
- 100-500
- 500-1000
- 1000-5000
- 5000-10000
- 10000-20000
- 20000-50000
- more 50000

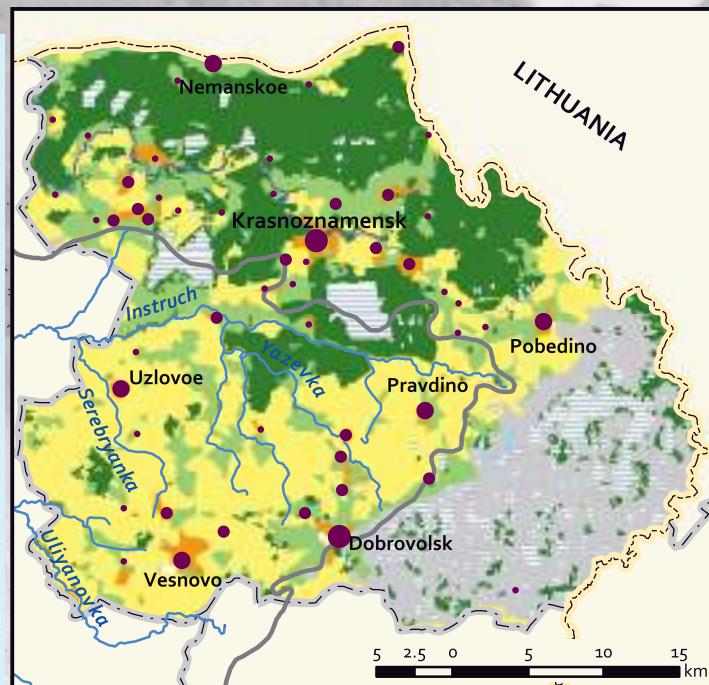
Land use types

- | |
|------------------------|
| Forests |
| Hayfields and pastures |
| Arable land |
| Fruit orchards |
| Lakes |
| Wetlands |
| Sand areas |
| Urbanization land |
| Industrial land |

— Catchment borders

- - - State borders

— - - Administrative borders



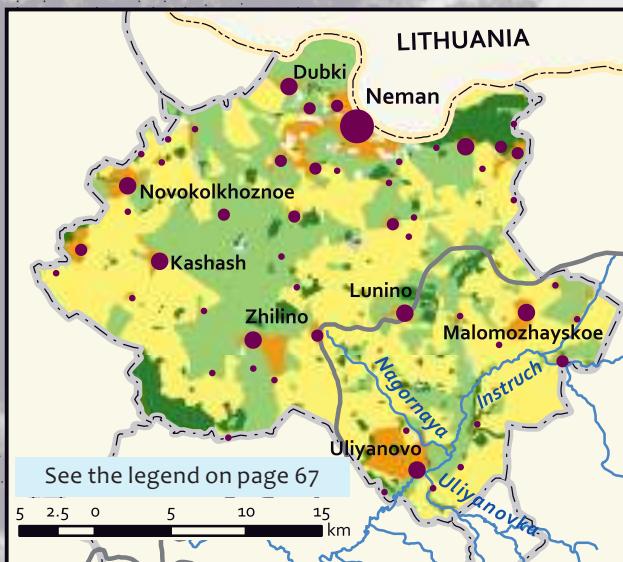
Description of the municipal unit

Krasnoznamensk Municipal District is located in the upstream part of the Instruch River. Total population (by 01.01.2014) is of 12.5 ths. of inh., and 3.4 ths. ones from which live in the central town of the Unit, the Town of

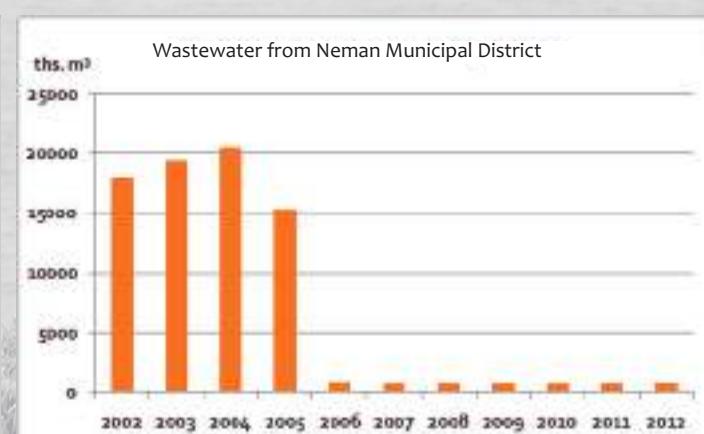
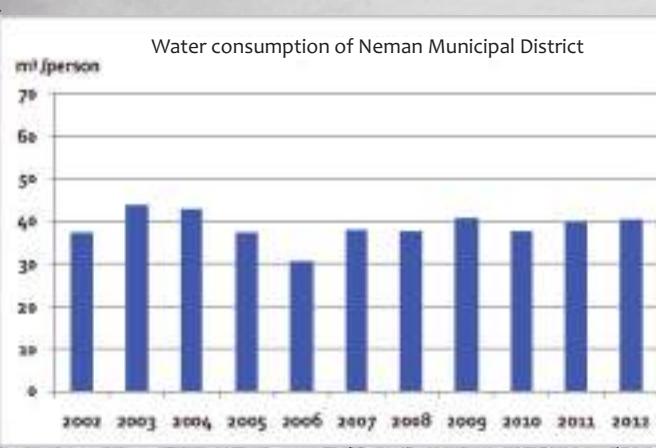
Krasnoznamensk. Waste water treatment facilities – no information. Rural population is equal to 9 ths. of inh., two main settlements are Dobrovolsk and Vesnovo with population of 1.65 and 0.75 ths. respectively.



NEMAN MUNICIPAL DISTRICT



Lake in Neman Municipal District



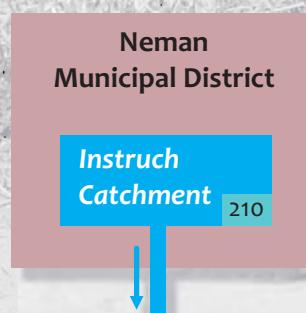
Description of the municipal unit



Lake in Neman Municipal District

Small part of Neman Municipal District partly occupies the upstream of the Instruch River. Total population (by 01.01.2014) in the whole district is of 19.9 ths. of inh., and 11.5 ths. ones from which live in the central town of the Unit, the Town of Neman, which is outside of the

Pregolya River catchment. Waste water treatment facilities in Neman (of 5 thousand m³ per day) are under construction. Rural population is equal to 8.4 thousand of inh., two main settlements are Zhilino and Ulianovo with population of 0.9 and 0.6 thousand respectively.



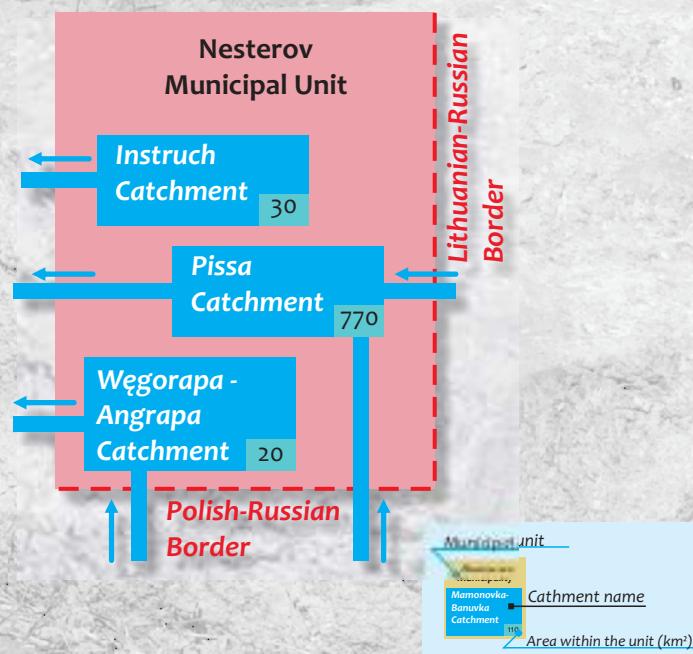
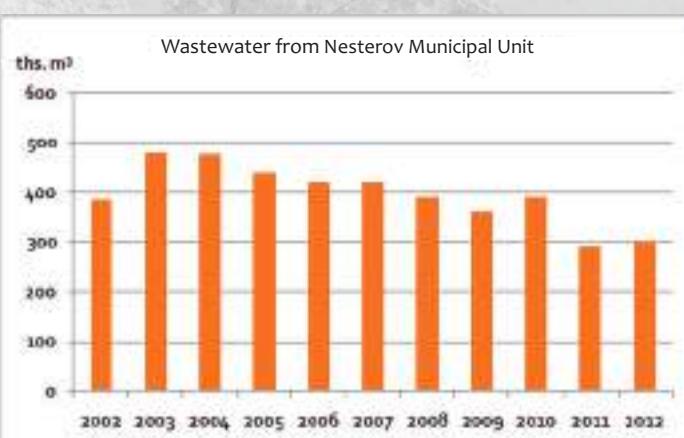
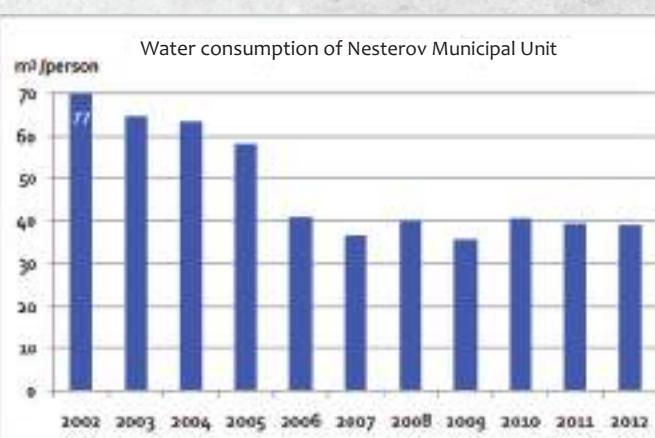
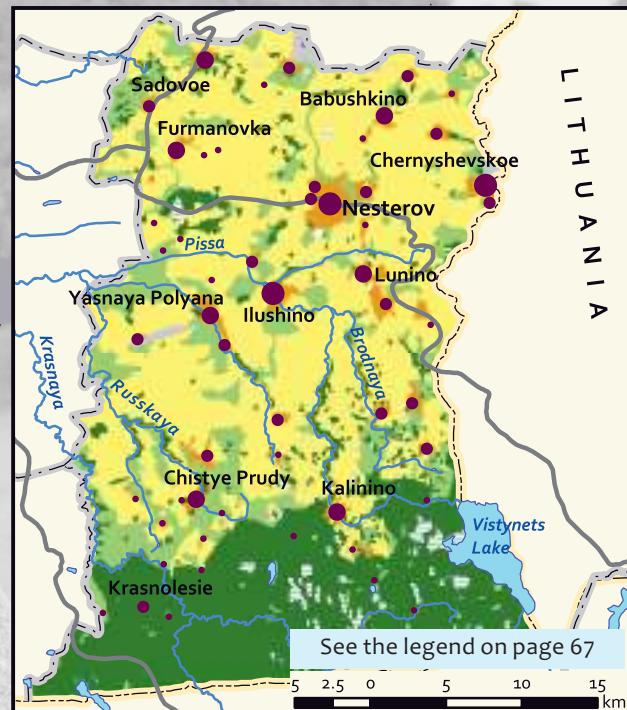


NESTEROV MUNICIPAL UNIT

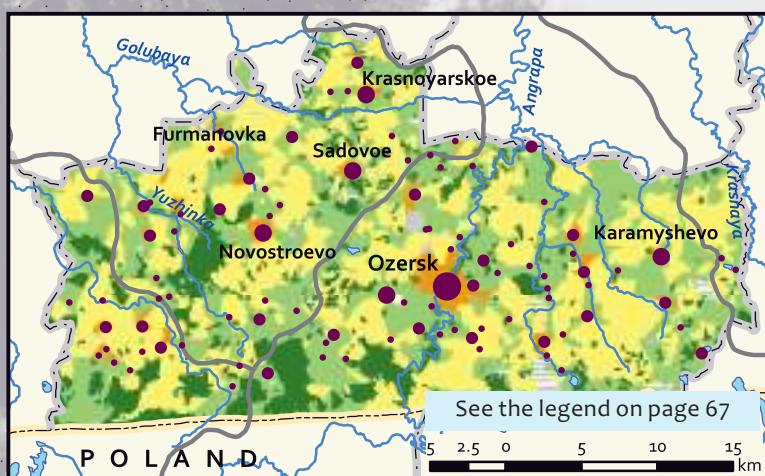
Description of the municipal unit

Nesterov Municipal District occupies upper courses of Pissa River and its tributaries. Total population (by 01.01.2014) is of 15.8 ths. of inh., and 4.4 ths. ones from which live in the central town of the Unit, Town of Nesterov.

Waste water treatment facilities – no information. Rural population is equal to 11.4 ths of inh., two main settlements are Chernyshevskoe and Iliushino with population of 1.15 and 1.1 ths. respectively.

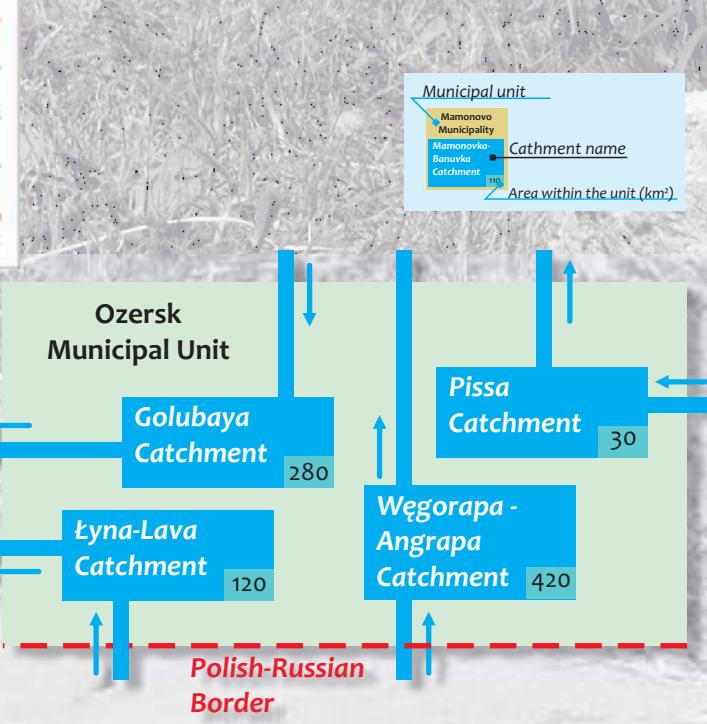
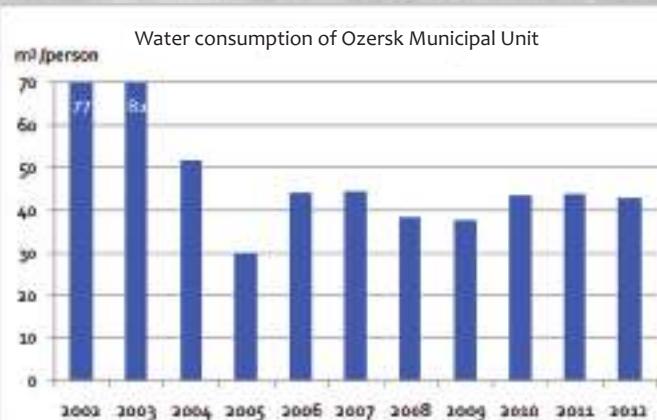


OZERSK MUNICIPAL UNIT



Description of the municipal unit

Ozersk Municipal District occupies the upper course of Golubaya River, and is crossed by Wengorapa-Angrapa River. Total population (by 01.01.2014) is of 14.7 ths. of inh., two main settlements are Krasnoyarskoe and Sadovoe with population of 0.6 ths. both.

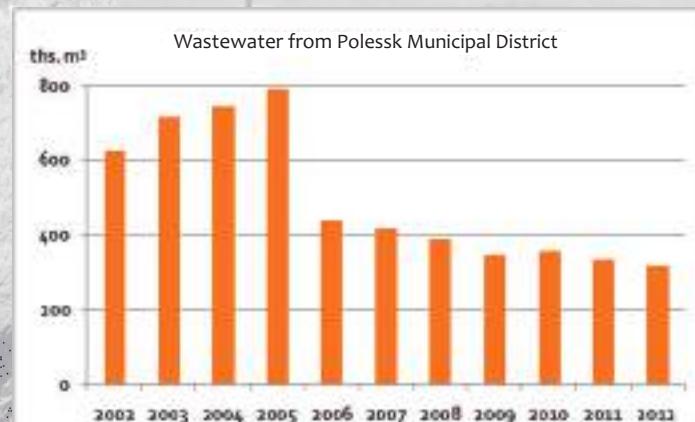
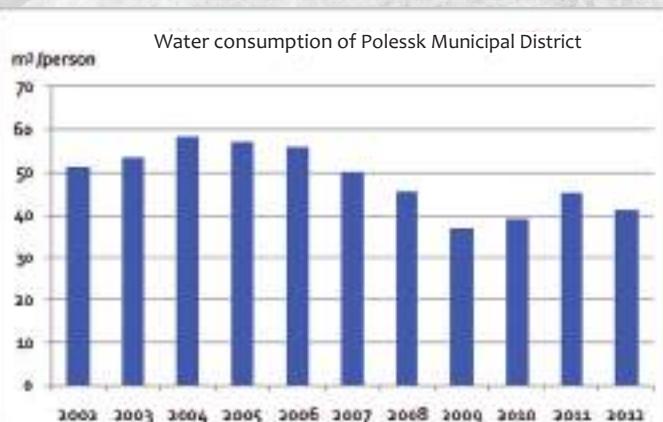
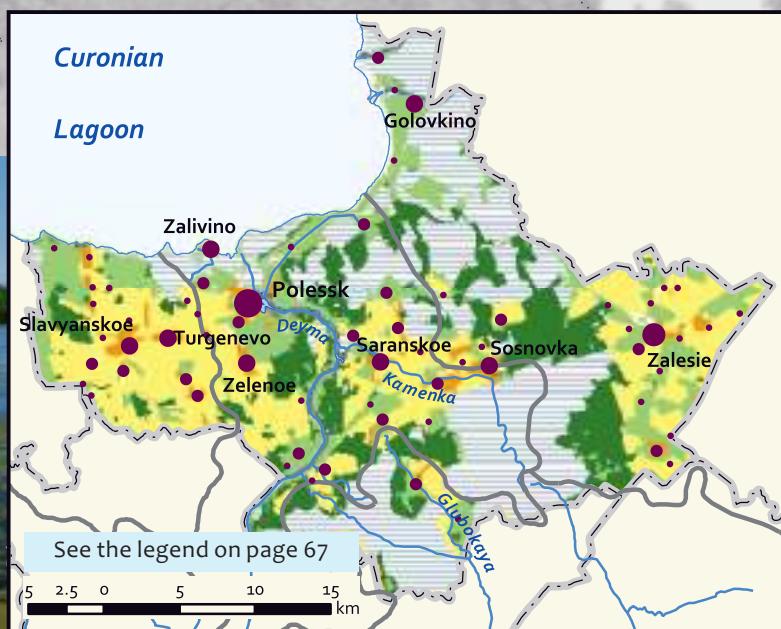




the Polessk Town, Deyma River



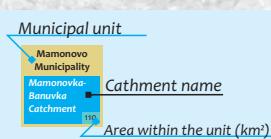
POLESSK MUNICIPAL DISTRICT



Description of the municipal unit

Polessk Municipal District is crossed by Deyma Branch. Total population (by 01.01.2014) is of 20 ths. of inh., and 7.3 ths. ones from which live in the central town of the Unit, Town of Polessk. Rural population is equal to

11.7 ths. of inh., two main settlements are Zalesje and Saranskoe with population of 1.1 and 1 ths. respectively. Only Polessk is facilitated by waste water treatment facilities of capacity of 1.5 ths. m³ per day.



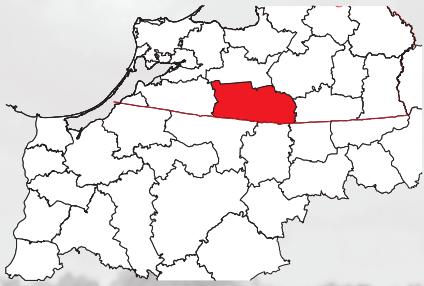
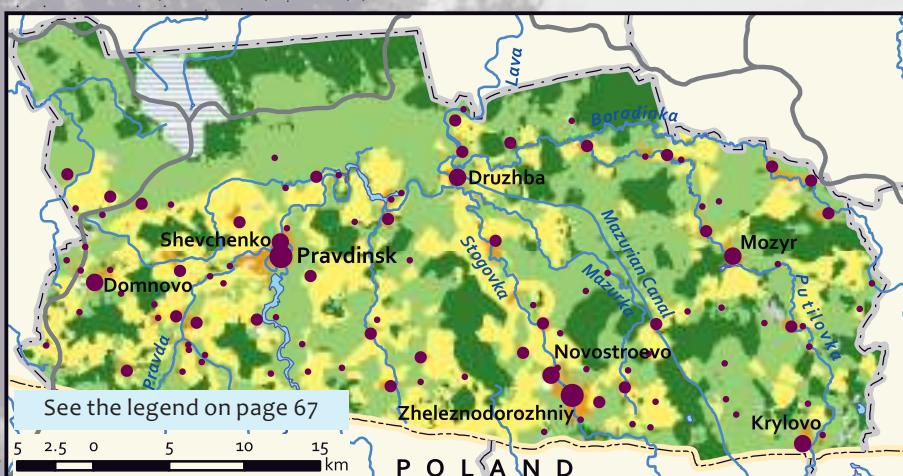
C u r o n i a n
L a g o o n

Polessk
Municipal District

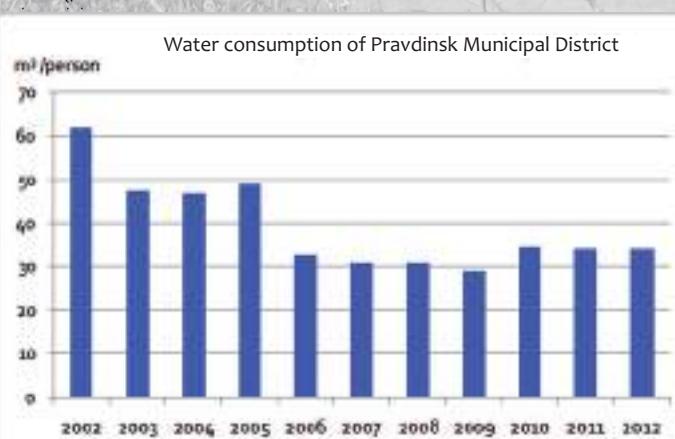
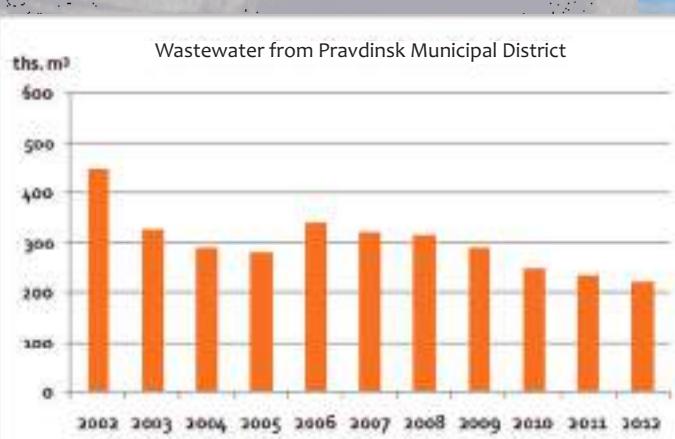
Pregolya
Catchment 90

Deyma
Catchment 300

PRAVDINSK MUNICIPAL DISTRICT



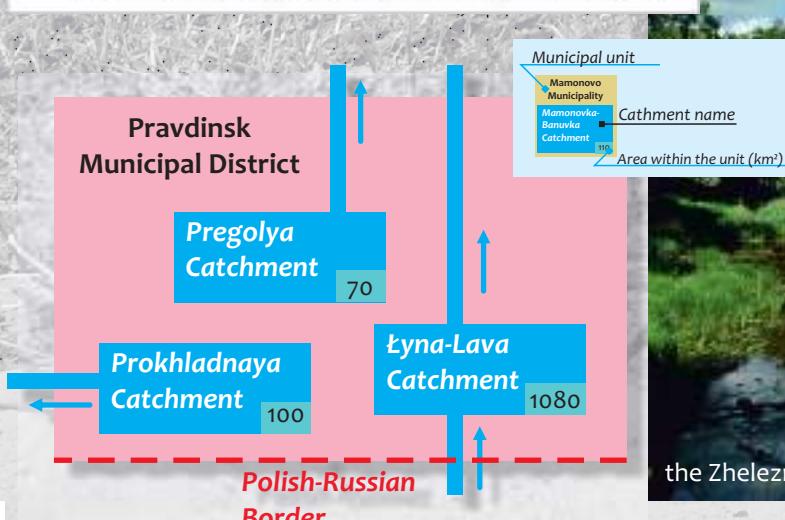
the Pravdinsk Town, Pravda River

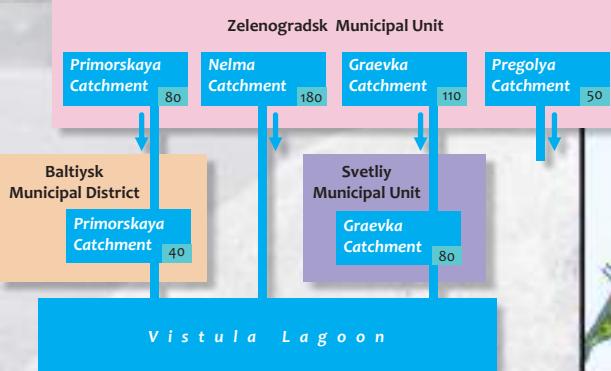
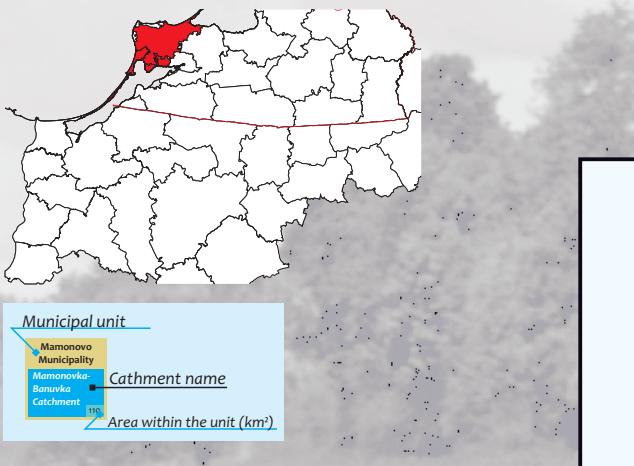


Description of the municipal unit

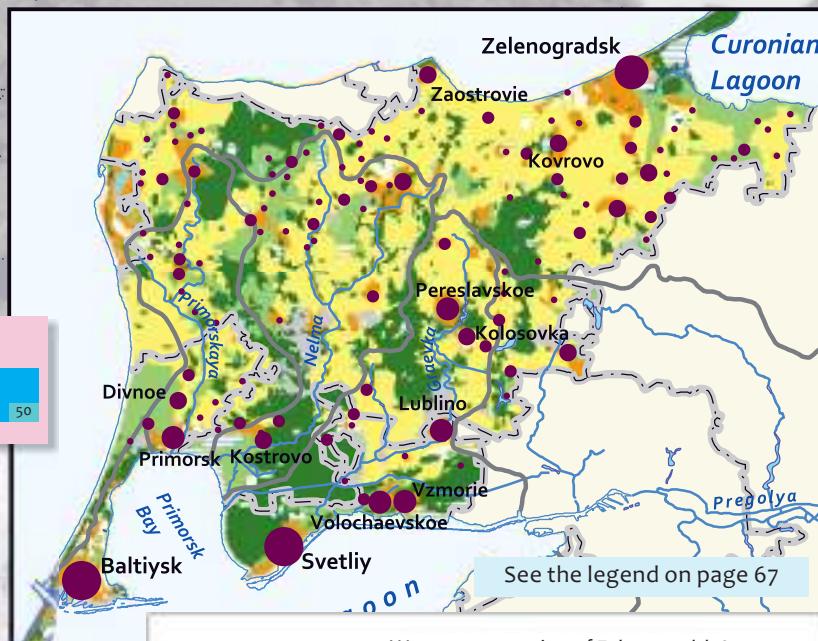
Pravdinsk Municipal District is crossed by Lyna-Lava River and its branches. Total population (by 01.01.2014) is of 19.3 ths. of inh., and 7.1 ths. ones from which live in two towns of the Unit - Town of Pravdinsk (4.3

th.) and Zheleznodorozhnoe (2.8. ths.). Waste water treatment facilities – no information. Rural population is equal to 12.2 ths. of inh., main settlement is Domnovo with population of 0.9 ths.





ZELENORADSK & SVETLIY MUNICIPAL UNITS & BALTIYSK MUNICIPAL DISTRICT

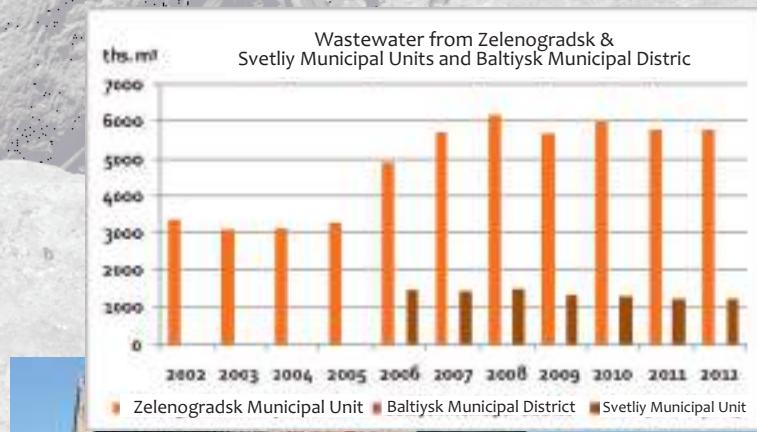
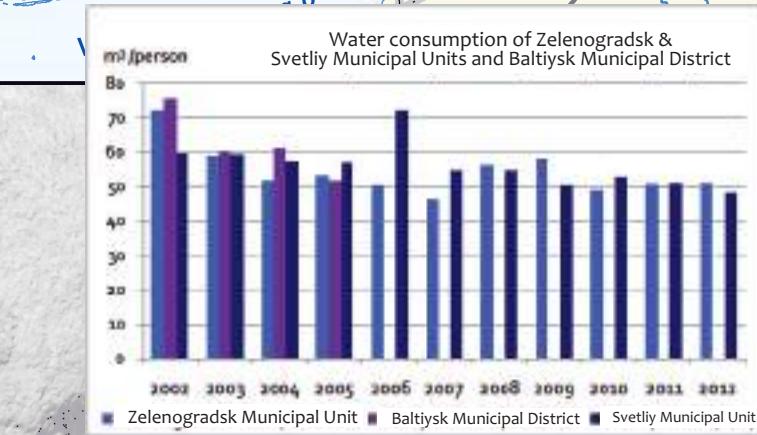


Description of the municipal unit

Zelenogradsk Municipal District is an area where Primorskaya and Nelma rivers are issued from. Total population (by 01.01.2014) is of 33.2 ths. of inh., and 13.6 ths. ones from which live in the central town of the Unit, Town of Zelenogradsk, located outside the catchments of these rivers. Rural population is equal to 19.6 ths. of inh., two main settlements are Kolosovka and Kostrovo with population of 1.6 and 1 ths. respectively, located within the catchment of Nelma River. There is no centralized waste water treatment in these settlements.

Baltiysk Municipal District belongs to Primorskaya River catchment in a very small portion. Total population (by 01.01.2014) is of 36.3 ths. of inh., and 33 ths. ones from which live in the central town of the Unit, Town of Baltiysk.

Waste water treatment facilities – 10.5 ths. m³ per day. The rest of city population, 1.9 ths. of inh., live in second town of the Unit, the Town of Primorsk, waters of sewage system of which is directly discharged to the Vistula Lagoon. Rural population is equal to 1.4 ths. of inh., the main settlement is Divnoe with population of 0.6 ths. Svetliy Municipal Unit is crossed by Graevka River. Total population (by 01.01.2014) is of 28.6 ths. of inh., and 21.8 ths. from which live in the central town of the Unit, Town of Svetliy. Waste water treatment facilities in Svetliy (9 ths. m³ per day) are under construction. Rural population is equal to 6.8 ths. of inh., the main settlement are Vzmirje and Volochevskoe with population of 2.1 and 1.7 ths.





CHAPTER IV

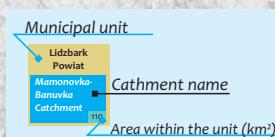
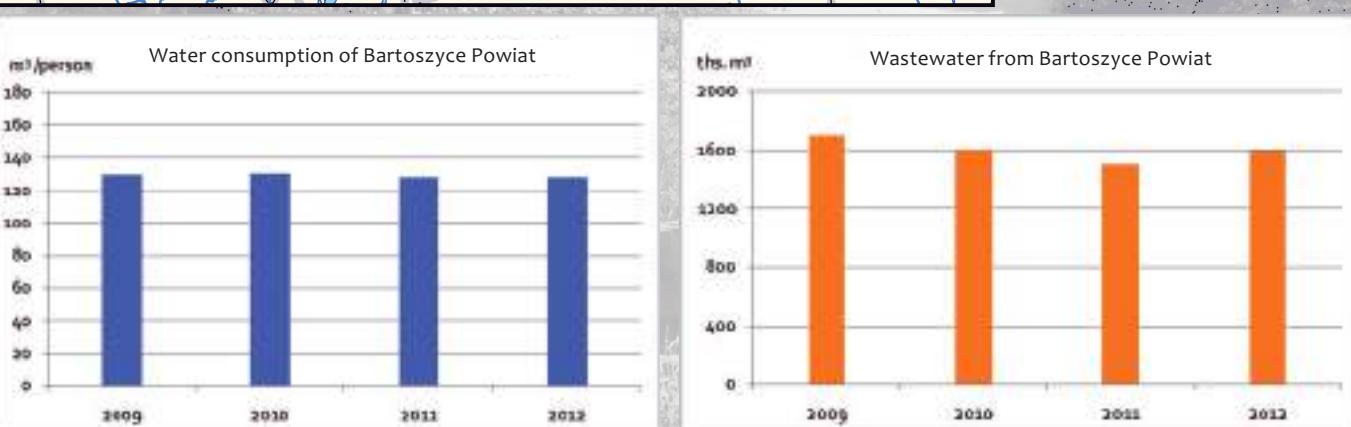
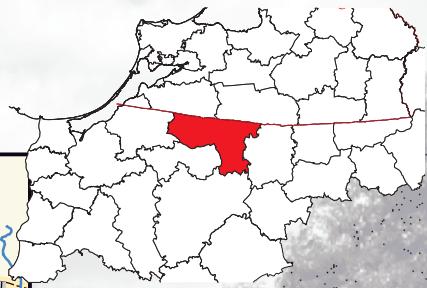
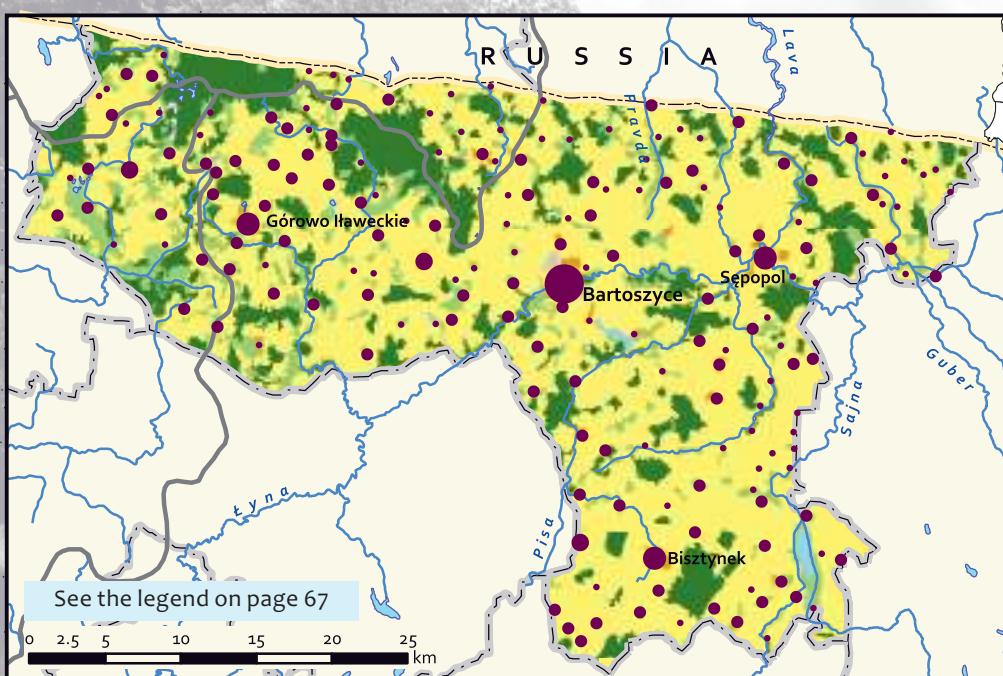
ADMINISTRATIVE STRUCTURE

OF POLISH PART
OF THE VISTULA LAGOON
CATCHMENT

IN THIS CHAPTER:

- Bartoszyce Powiat
- Braniewo Powiat
- Elbląg Powiat & Elbląg City
- Giżycko Powiat
- Gołdap Powiat
- Iława Powiat
- Kętrzyn Powiat
- Kwidzyn Powiat
- Lidzbark Powiat
- Malbork Powiat
- Mrągowo Powiat
- Nowy Dwór Gdański Powiat
- Olsztyn Powiat & Olsztyn City
- Ostróda Powiat
- Sztum Powiat
- Węgorzewo Powiat

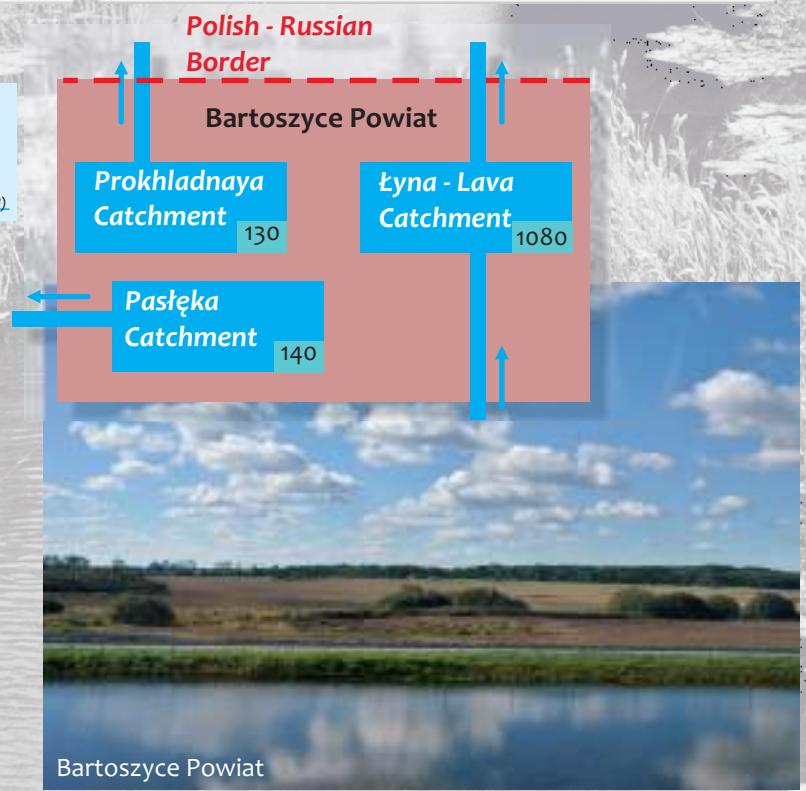
BARTOSZYCE POWIAT



Description of the municipal unit

Powiat Bartoszycki belongs to Warmińsko-Mazurskie Voivodship and borders on the territory of Kaliningrad Oblast. Its area is totally located within the Łyna River catchment. Its total population (by 30.06.05) is 61.7 ths. (34.7 ths. - in cities, 27 ths. - in villages). It is composed of urban

gminas of Bartoszyce and Górowo Iławieckie; urban-rural gminas of Bisztynek and Sępopol; rural gminas of Bartoszyce and Górowo Iławieckie. Its main cities Bartoszyce (25 ths. inh.), Górowo Iławieckie (4.3 ths.), Bisztynek (2.5 ths.), and Sępopol (2.1 ths.) are facilitated by WWTPs (MB).



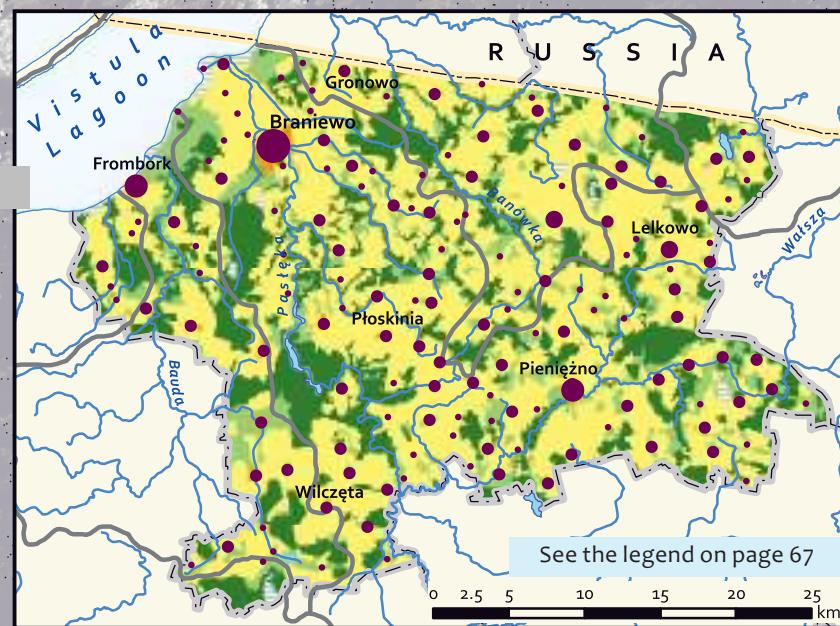


BRANIEWO POWIAT

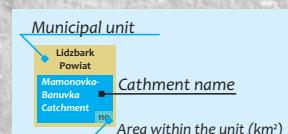
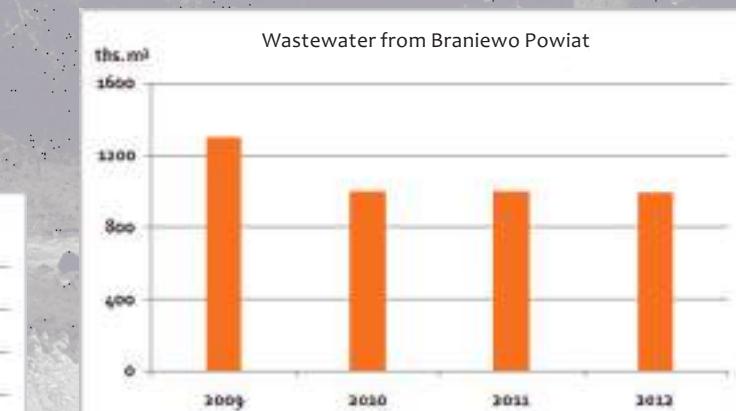
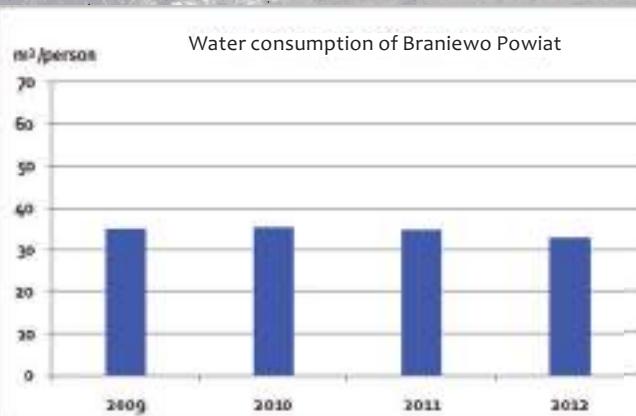
Description of the municipal unit

Powiat Braniewski belongs to Warmińsko-Mazurskie Voivodship and borders on the territory of Kaliningrad Oblast. It covers the upstream section of the Banuwka River, the downstream section of the Bauda River and nearly total catchment of the Pasłeka River. Its total population (by 30.06.14) is 42.5 ths. (22.7 ths. - in cities, 19.8 ths. - in villages). It is composed of the urban gmina of

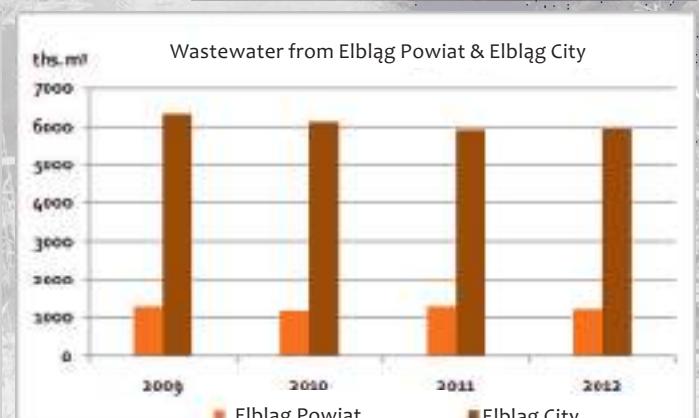
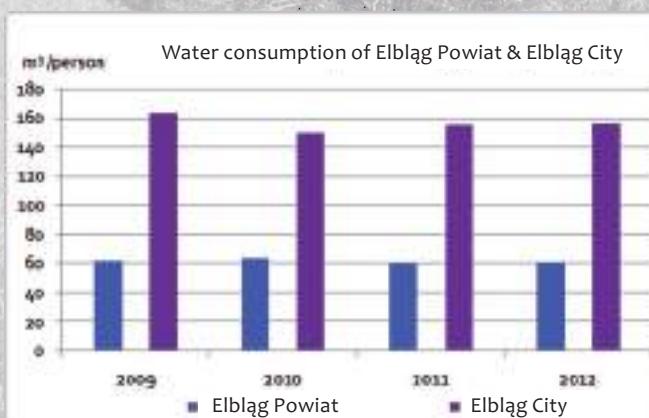
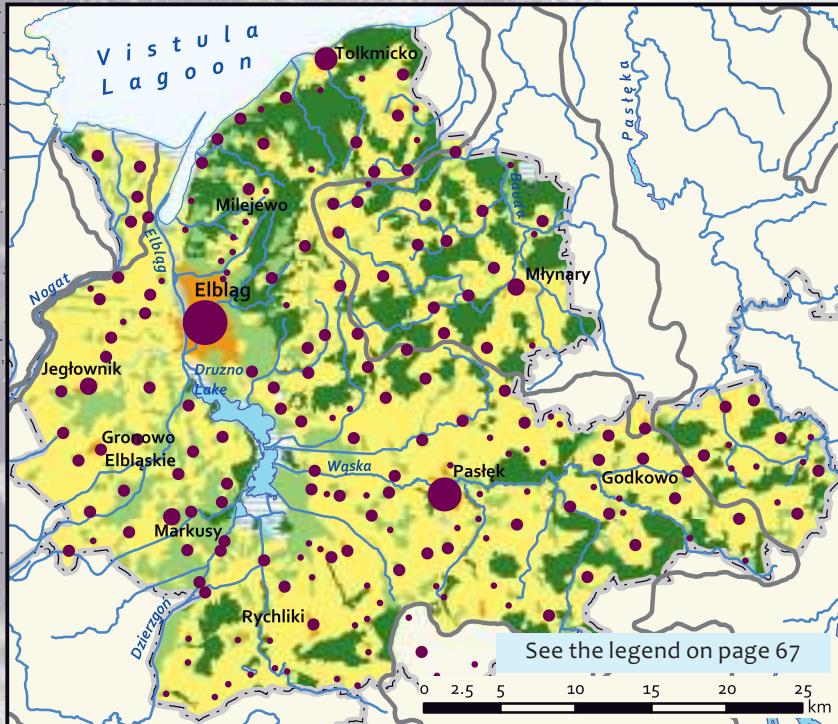
Braniewo; urban-rural gminas of Frombork and Pienezno; rural gminas of Braniewo Lelkowo, Płoskinia, and Wilczęta. The main cities are Braniewo (17.9 ths.of inh.), Pieniężno (2.9 ths.), and Frombork (2.5 ths.). All of them are facilitated by a WWTP (MB). The biggest WWTP is in Braniewo with discharge to Pasłeka river of 12 ths. m³ per day.



Wastewater from Braniewo Powiat



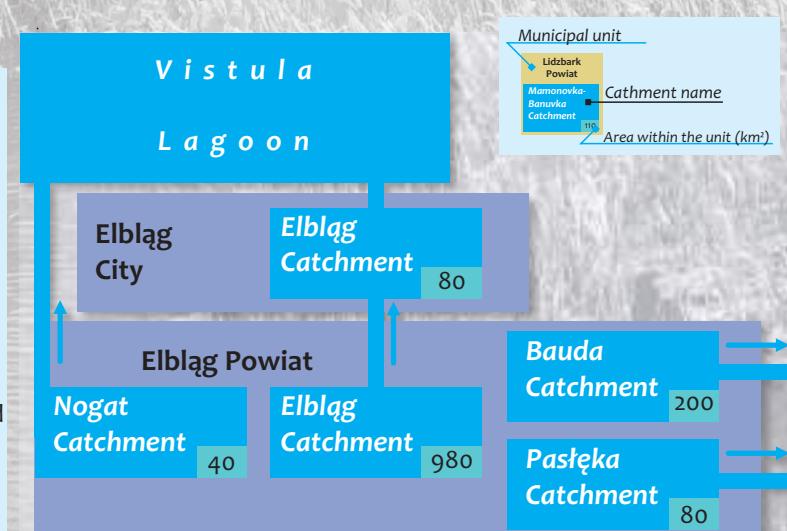
ELBLĄG POWIAT & ELBLĄG CITY



Description of the municipal unit

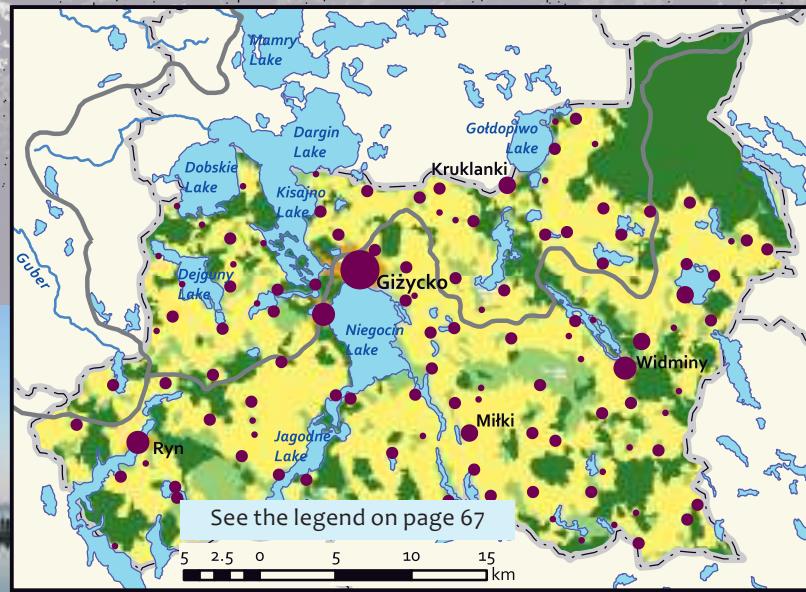
Powiat Elbląski belongs to Warmińsko-Mazurskie Voivodship. Its area covers the most part of the Elbląg River catchment. Its total population (by 30.06.05) is 56.4 ths. (16.8 ths. - in cities, 39.6 ths. - in villages). It is composed of urban-rural gminas of Młynary, Pasłęk, and Tolkmicko (there are no urban gminas in the

powiat); rural gminas of Elbląg, Godkowo, Gronowo Elbląskie, Markusy, Milejewo, and Rychliki. The main cities Młynary (1.9 ths.), Pasłęk (12,45 ths.), and Tolkmicko (2.8 ths.) are facilitated by WWTPs (MB). The city of Elbląg (treated as powiat) has 124.4 ths. inh. and is facilitated by a WWTP (MB).

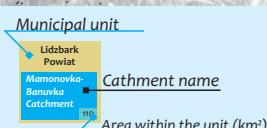
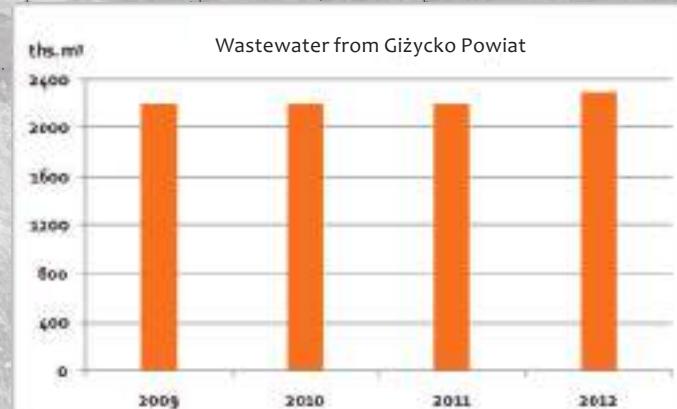
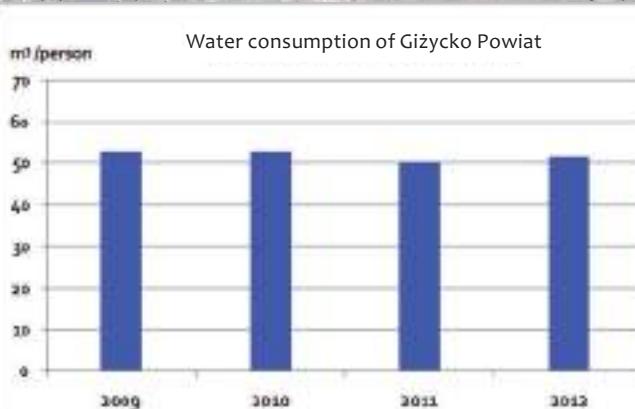




GIŻYCKO POWIAT



The Ryn Town, Ryńskie Lake

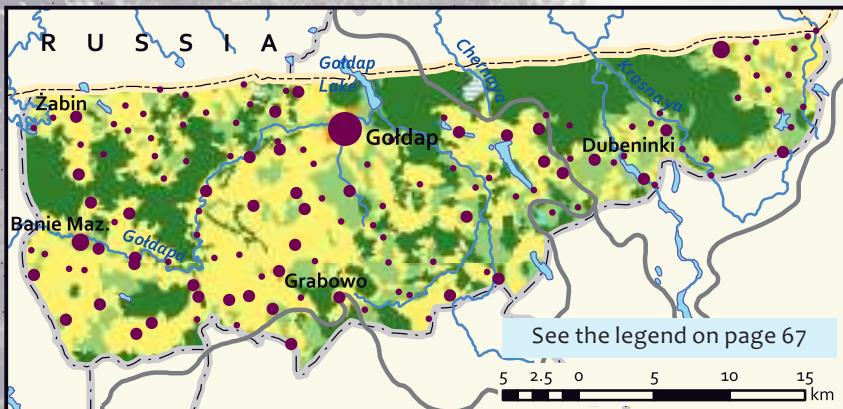


Description of the municipal unit

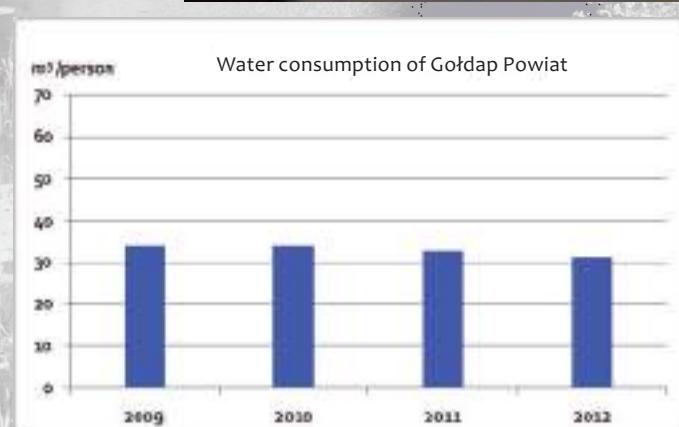
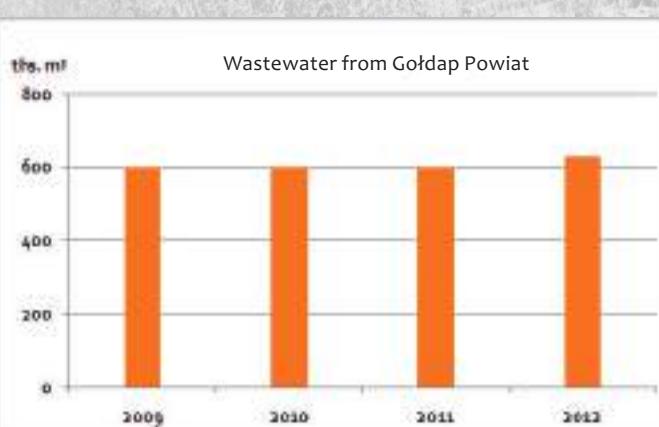
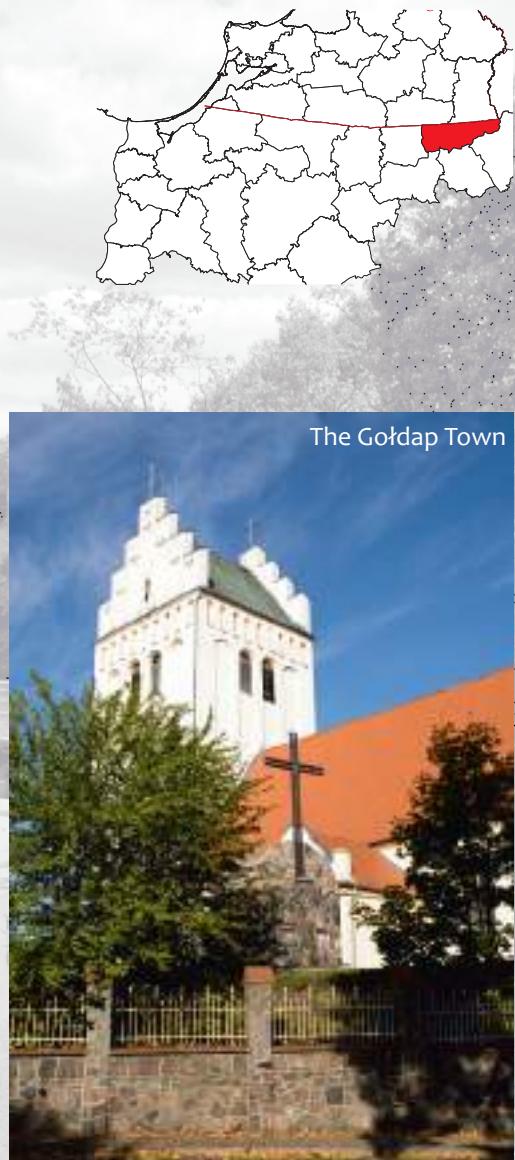
Powiat Giżycki belongs to Warmińsko-Mazurskie Voivodship. Its area covers a small part of the upstream of the Łyna River catchment, a part of Mamry lake and Gołdapiwo lake. Its total population (by 30.06.05) is 56.95 ths. inh. (32.81 ths. - in cities, 24.13 ths. - in villages). It is composed of the urban

gmina of Giżycko; the urban-rural gmina of Ryn; rural gminas of Giżycko, Kruklanki, Miłki, and Wydminy. The main cities Giżycko (29.38 ths. inh.) and Ryn (2974 inh.) are facilitated by a WWTP (MB), both of them don't belong to the Łyna River catchment.

GOŁDAP POWIAT



Municipal unit
Lidzbark Powiat
Mamonovka-Borówka Catchment
Cathment name
Area within the unit (km²)



Description of the municipal unit

Powiat Gołdapski belongs to Warmińsko-Mazurskie Voivodship and borders on the territory of Kaliningrad Oblast. Its area is divided between catchments of the Węgorapa-Angrapa and the Pissa rivers in nearly 2/3 and 1/3 proportions respectively. Its total population (by

30.06.08) is 26.9 thous. (13.5 thous. - in cities, 13.4 thous. - in villages). It is composed of the urban-rural gmina of Gołdap (there are no urban gminas in the powiat); rural gminas of Banie Mazurskie and Dubeninki. The main city Gołdap (13.5 thous. inh.) is facilitated by a WWTP (MB).

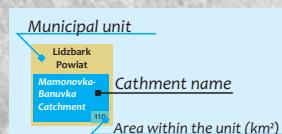
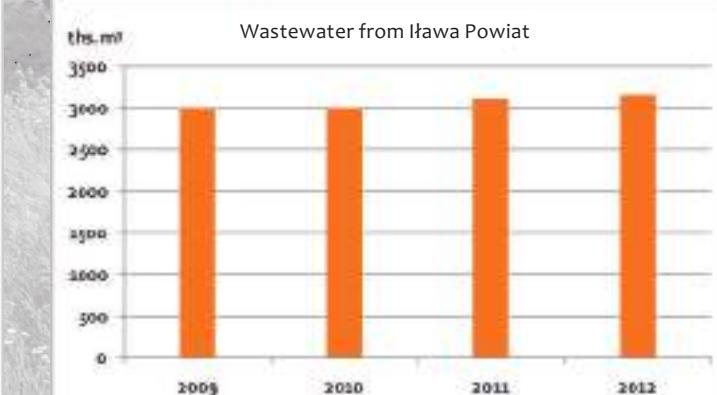
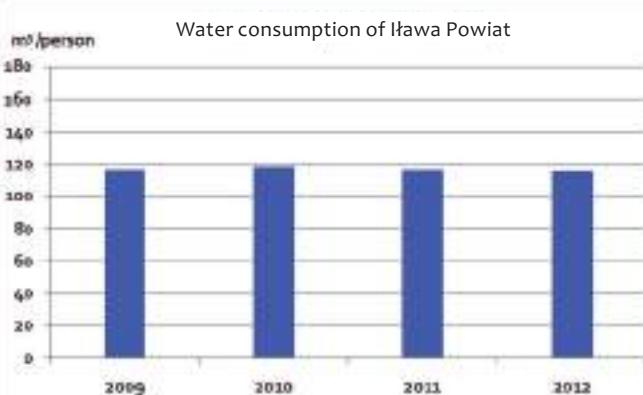
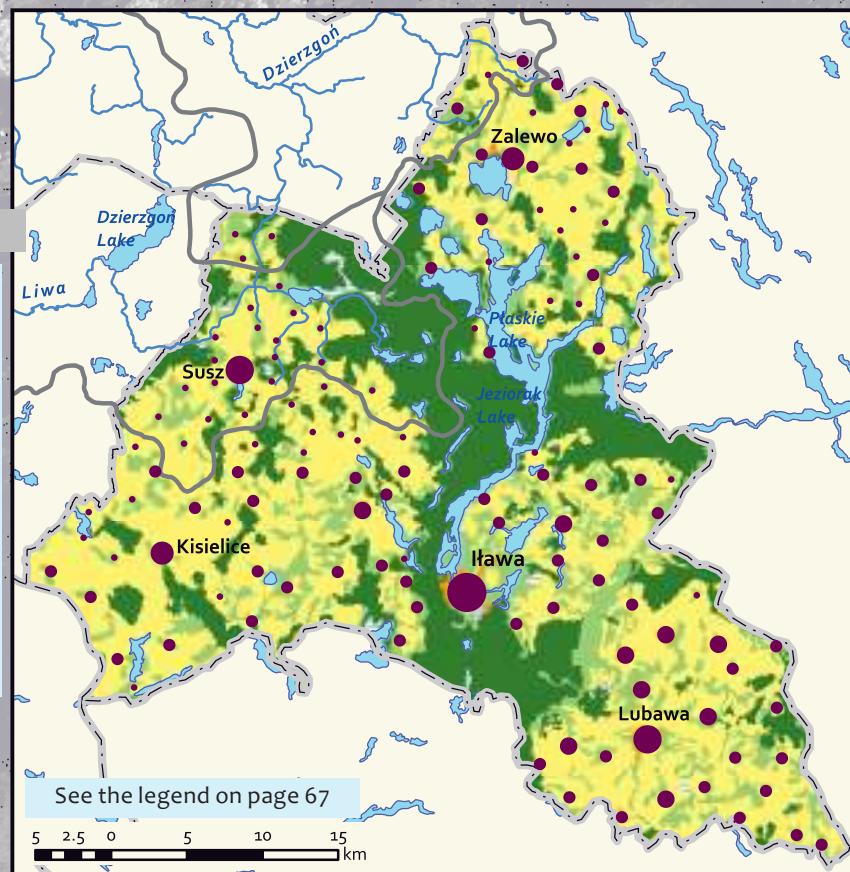


IŁAWA POWIAT

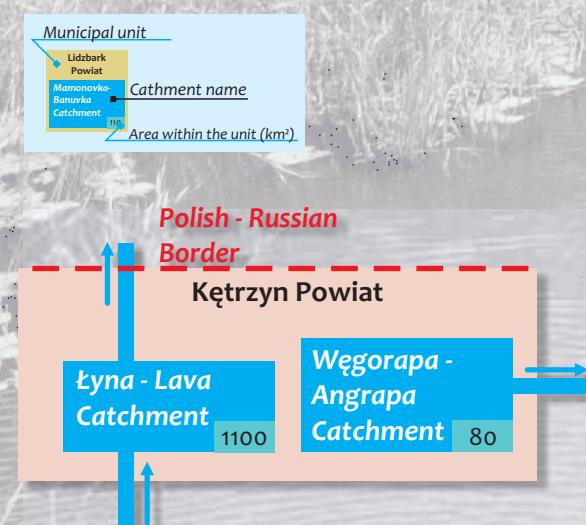
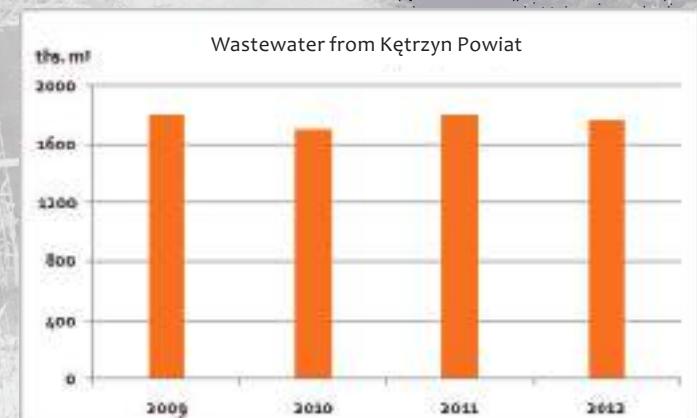
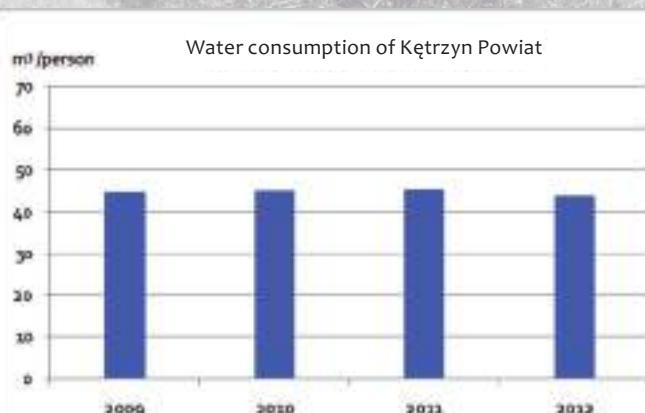
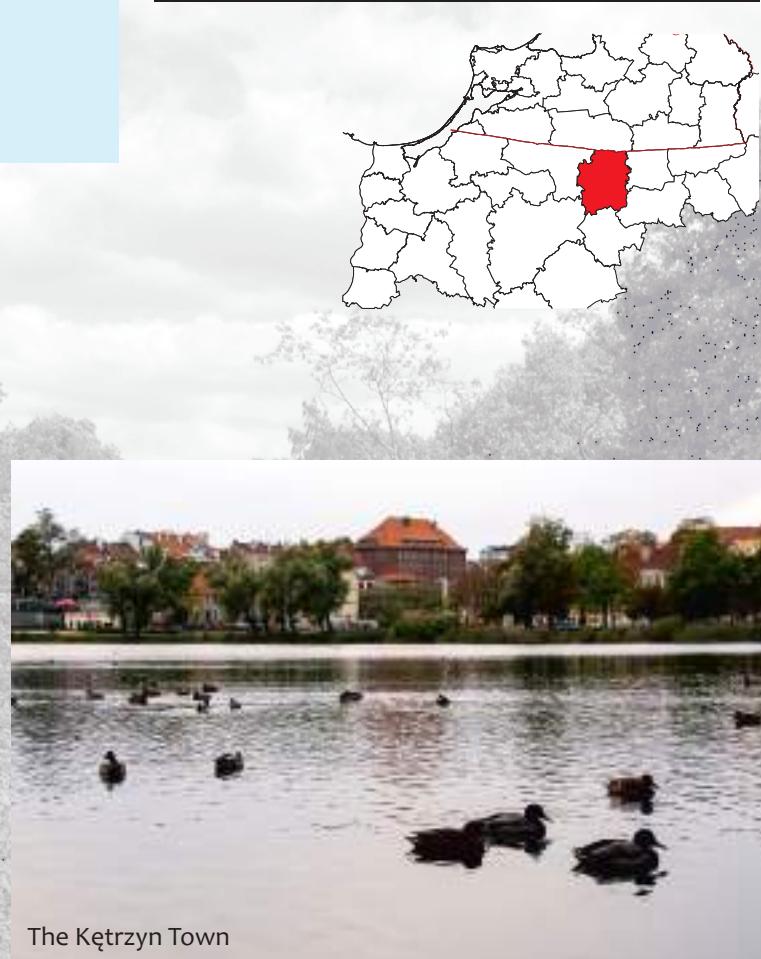
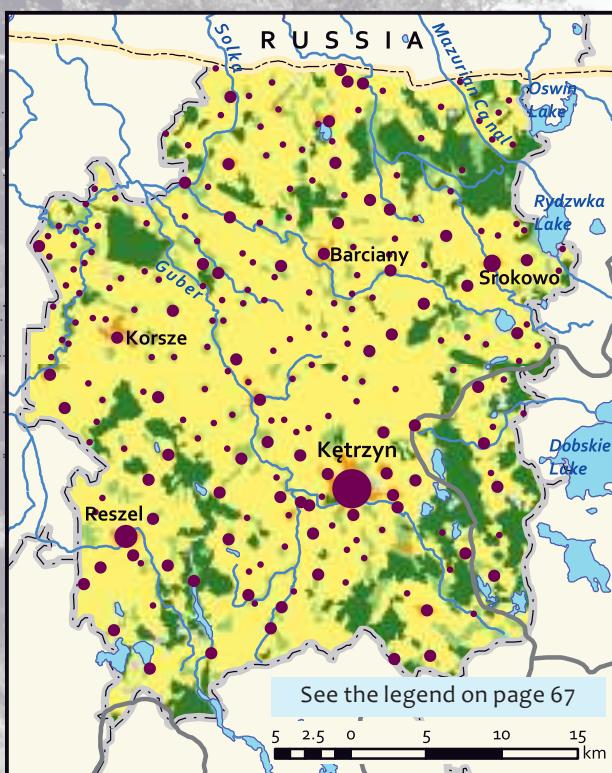
Description of the municipal unit

Powiat Iławski belongs to Warmińsko-Mazurskie Voivodship. Nearly one sixth of its area covers some segment of upstream part of the Nogat River catchment. Its total population (by 30.06.05) is 70 ths. inh. (51.7 ths. - in cities, 38.3.6 ths. - in villages). It is composed of the

urban gminas of Iława and Lubawa; urban-rural gminas of Kisielice, Susz, and Zalewo; rural gminas of Iława and Lubawa. The main cities Iława (32.3 ths. of inh.), Lubawa (10.1 ths.), Kisielice (2.2 ths.), Susz (5.7 ths. inh.), and Zalewo (2.2 ths.) are facilitated by WWTPs.



KĘTRZYN POWIAT



Description of the municipal unit

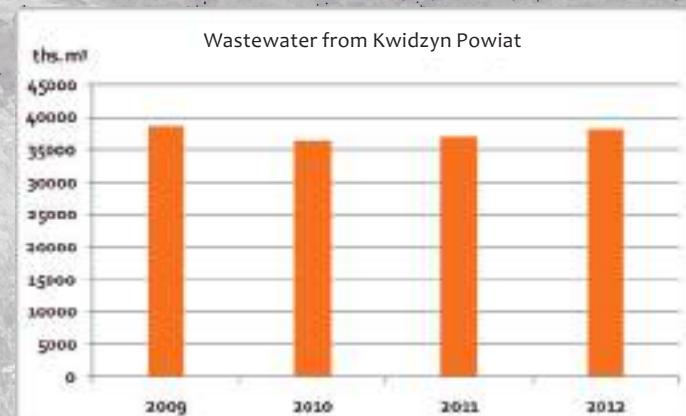
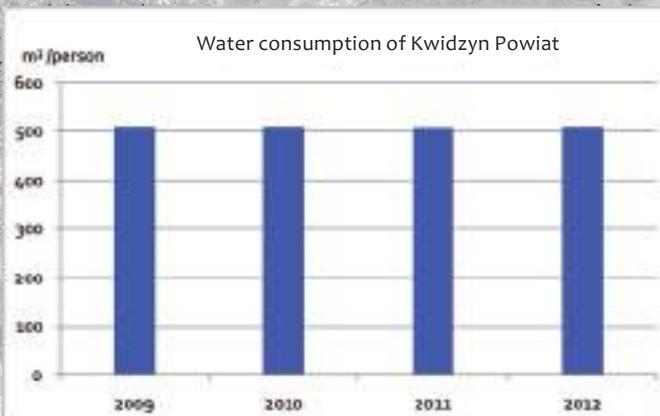
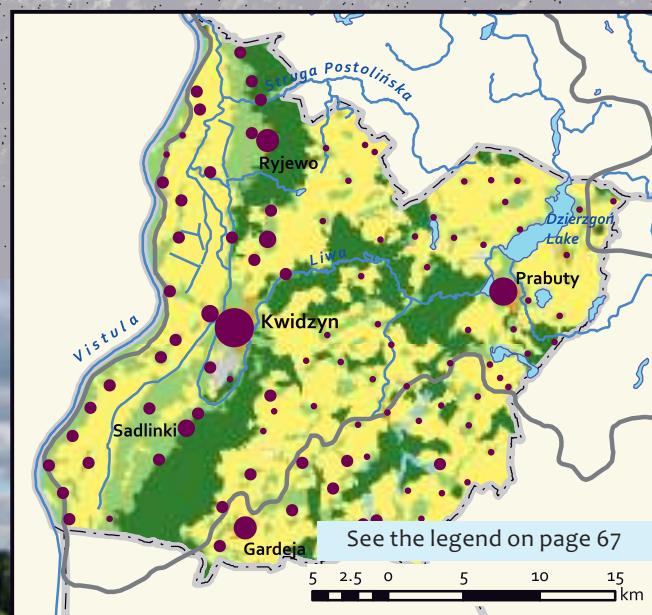
Powiat Kętrzyński belongs to Warmińsko-Mazurskie Voivodship and borders on the territory of Kaliningrad Oblast. Its area is totally located within the Łyna River catchment and covers its eastern part. Its total population (by 30.06.05) is 66.8 thous. (38.2 thous. - in cities,

28.6 thous. - in villages). It is composed of the urban gmina of Kętrzyn; urban-rural gminas of Korsze and Reszel; rural gminas of Barciany, Kętrzyn, and Srokowo. The main cities Kętrzyn (28.5 thous. of inh.), Korsze (4608. inh.), and Reszel (4896 inh.) are facilitated by a WWTP (MB).



The Kwidzyn Powiat

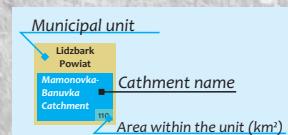
KWIDZYN POWIAT



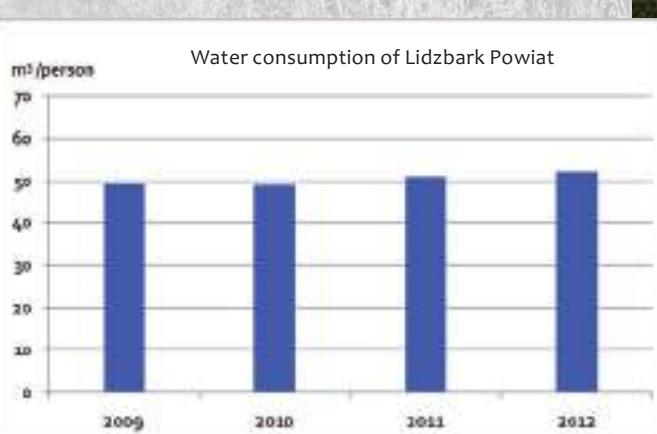
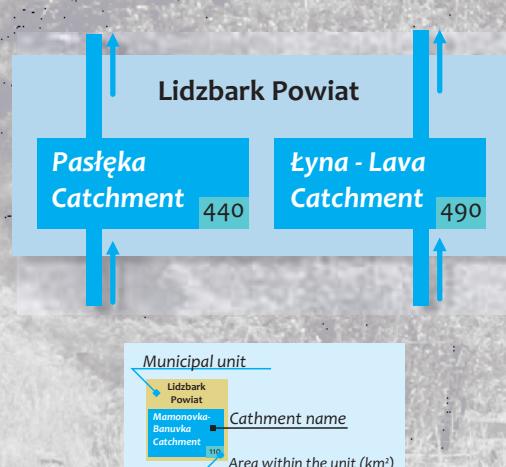
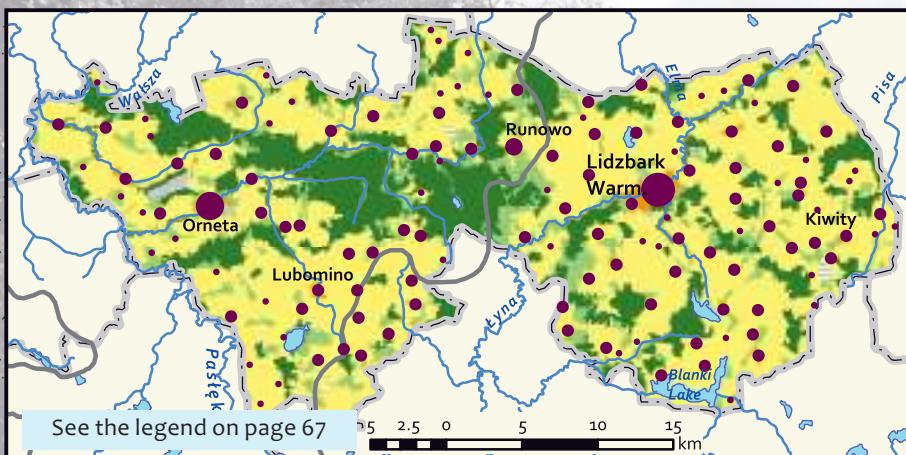
Description of the municipal unit

Powiat Kwidzyński belongs to Pomorskie Voivodship. Its area covers upstream of the Nogat River catchment. Its total population (by 30.06.13) is 83.7 ths. inh. (47.7 ths. - in cities, 36 ths. - in villages). It is composed of the urban gmina

of Kwidzyn; the urban-rural gmina of Prabuty; rural gminas of Gardeja, Kwidzyn Ryjewo, and Sadlinki. The main cities Kwidzyn (38,65 ths. inh.) and Prabuty (8.9 ths.) are facilitated by a WWTP (MB).



LIDZBARK POWIAT



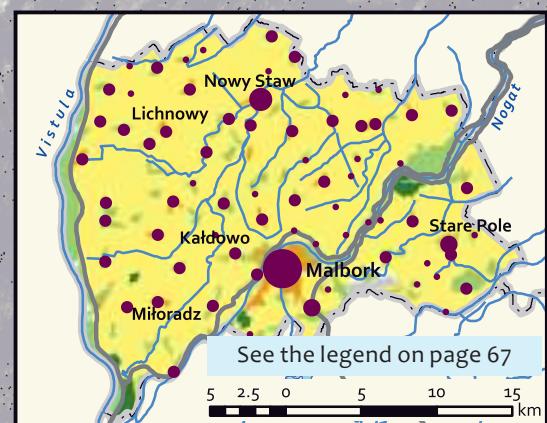
Description of the municipal unit

Powiat Lidzbarski belongs to Warmińsko-Mazurskie Voivodship. Its area in nearly equal proportions is divided between catchments of the Łyna and the Pasłęka rivers. Its total population (by 30.06.05) is 43.3 ths. (26 ths. - in cities, 17.3 ths. - in villages). It is composed of the urban gmina of Lidzbark Warmiński; the

urban-rural gmina of Orneta; rural gminas of Kiwity, Lidzbark Warmiński, and Lubomino. The main cities Lidzbark Warmiński (16.9 ths.of inh.) and Orneta (9.2 ths.) are facilitated by WWTPs (MB). The biggest WWTP is in Lidzbark Warmiński, it discharges 3.3 ths. m³ per day to the Łyna River.



MALBORK POWIAT

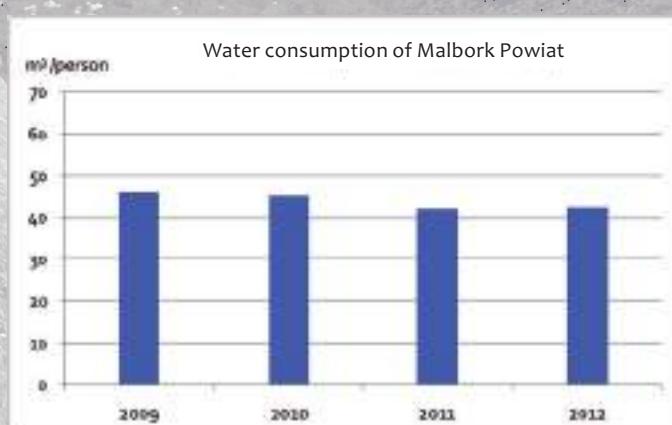
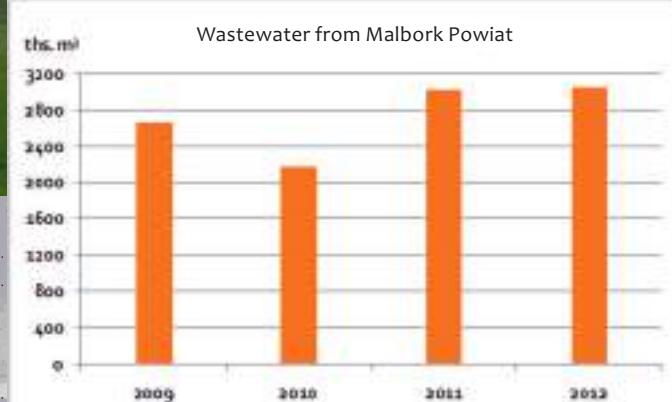


The Malbork Town

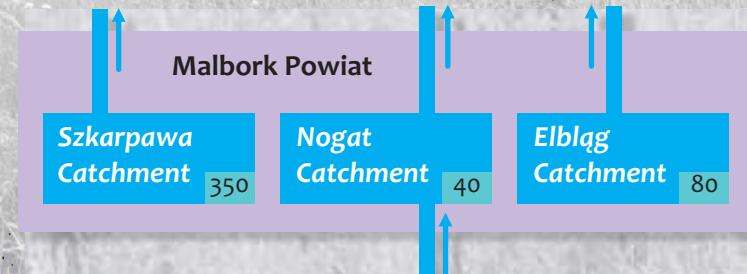
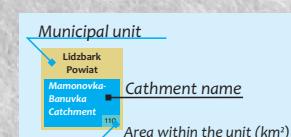
Description of the municipal unit

Powiat Malborski belongs to Pomorskie Voivodship. Its area is divided between catchments of the Skarpawa and the Nogat rivers in nearly 2/3 and 1/3 proportions respectively. Its total population (by 30.06.13) is 64.5 ths. inh. (43.5 ths. - in cities, 21 ths. - in villages). It is composed of

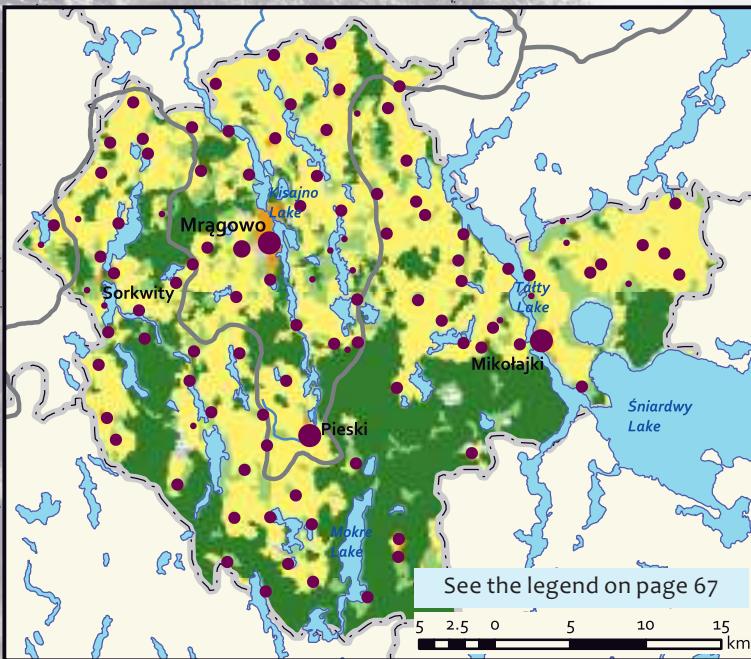
the urban gmina of Malbork; the urban-rural gmina of Nowy Staw; rural gminas of Lichnowy, Malbork, Miłoradz, and Stare Pole. A WWTP (MB) in Kałdowo collects waste water from the city of Malbork (38.6 ths. inh.), gmina Malbork, gmina Nowy Staw (7.8 ths.) and gmina Lichnowy (4.6 ths.).



The Malbork Town



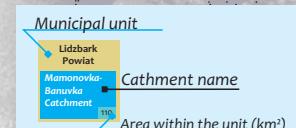
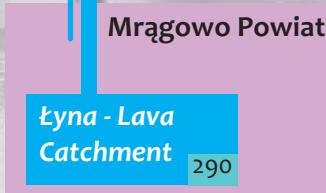
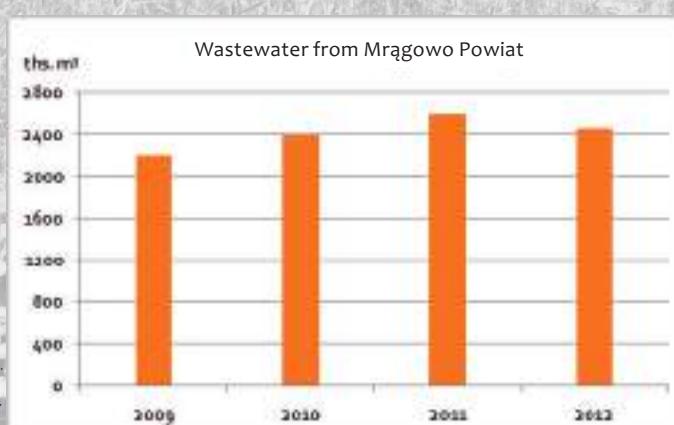
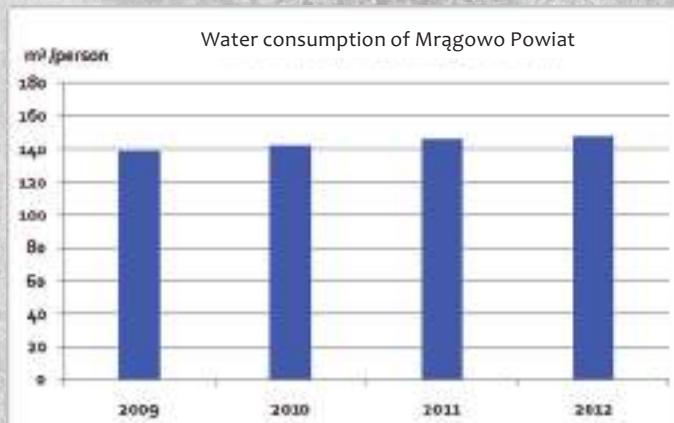
MRĄGOWO POWIAT



Description of the municipal unit

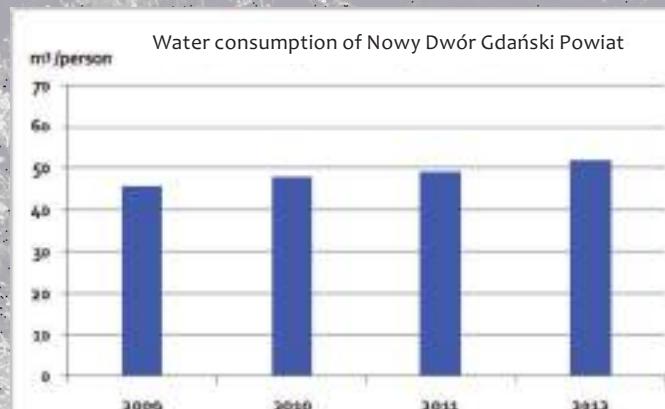
Powiat Mrągowski belongs to Warmińsko-Mazurskie Voivodship. Its area covers a small part of the upstream of the Łyna River catchment. Its total population (by 31.12.06) is 50 ths. inh. (25.5 ths. - in cities, 24.5 ths. - in villages). It is composed of the urban

gmina of Mrągowo; the urban-rural gmina of Mikołajki; rural gminas of Mrągowo, Piecki, and Sorkwity. The main cities Mragowo (22.2 ths. inh.) and Mikolajki (3.9 ths.) are facilitated by a WWTP (MB), both of them belong to the Łyna River catchment.



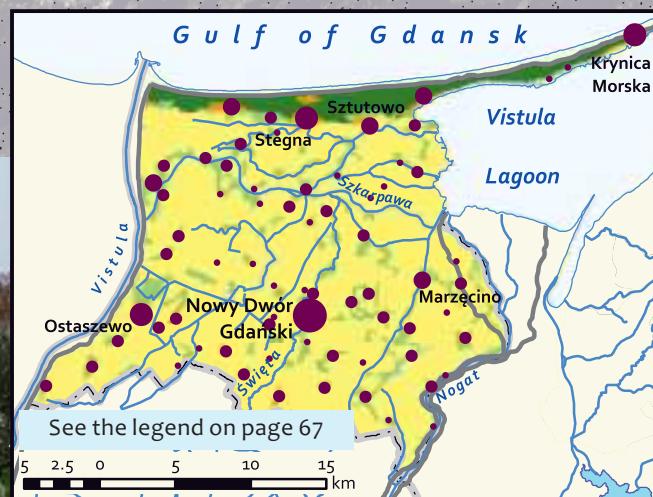


The Nowy Dwór Gdańskie Town



The Nowy Dwór Gdańskie Town

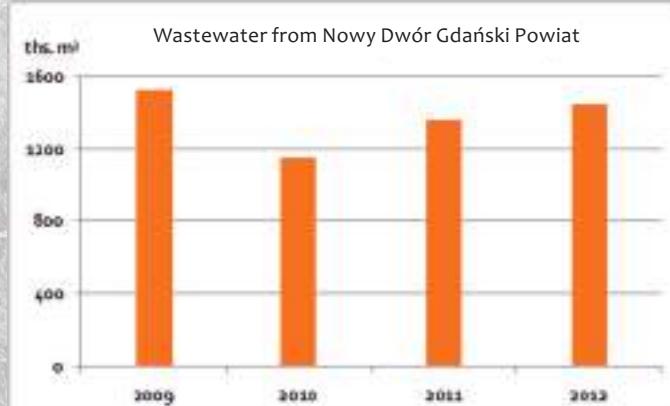
NOWY DWÓR GDAŃSKI POWIAT



Description of the municipal unit

Powiat Nowy Dwór Gdańskie belongs to Pomorskie Voivodship. Its area (671.3 square km) covers the downstream section of the Szkarpawa River catchment. Its Total population (by 30.06.13) is 36.4 ths. inh. (11.5 ths. - in cities, 24.9 ths. - in villages). It is composed of

the urban gmina of Krynica Morska; the urban-rural gmina of Nowy Dwór Gdańskie; rural gminas of Ostaszewo, Stegna, and Sztutowo. The main cities of Krynica Morska (1.4 ths. inh.) and Nowy Dwór Gdańskie (10.2 ths.) are facilitated by a WWTP (MB).



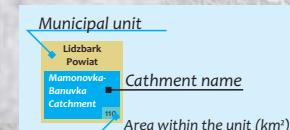
Nowy Dwór Gdańskie Powiat

Szkarpawa Catchment 460

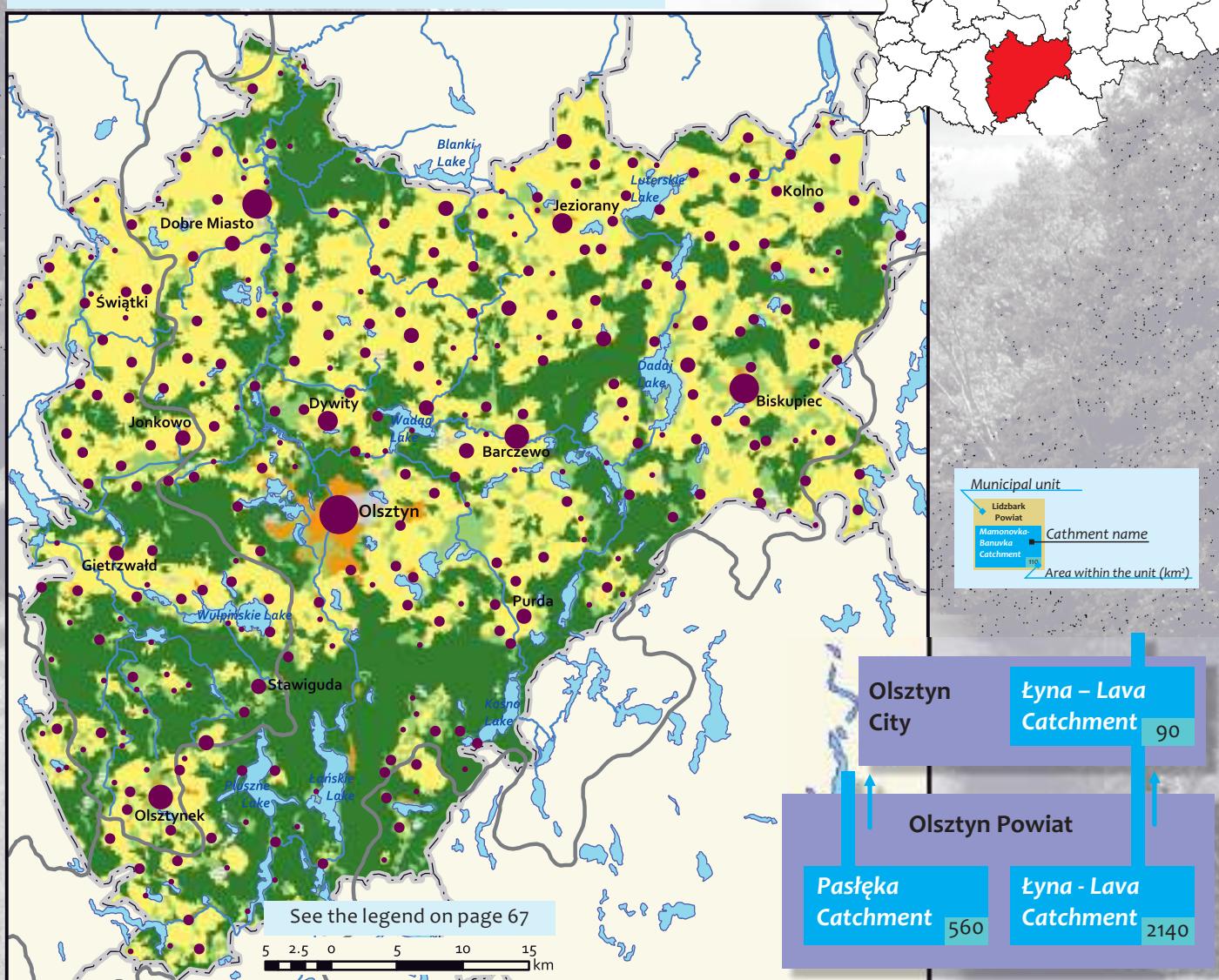
Nogat Catchment 10

Vistula

Lagoon



OLSZTYN POWIAT & OLSZTYN CITY



Description of the municipal unit

Powiat Olsztyński belongs to Warmińsko-Mazurskie Voivodship. Its area covers upstream parts of the Lyna and Pasłeka rivers' catchments. Its total population (by 31.10.10.) is 113 ths. inh. (39.5 ths. - in cities, 73.5 ths. - in villages). It is composed of urban-rural gminas of Barczewo, Biskupiec, Dobre Miasto, Jeziorany, and Olsztynek (there are no urban gminas in the powiat); rural gminas of Dywity, Gietrzwałd,

Jonkowo, Kolno, Purda, Stawiguda, and Świątki. Main cities Barczewo (7.3 ths. of inh.), Biskupiec (10,7 ths.), Dobre Miasto (10,6 ths.), Jeziorany (3.3 ths.), and Olsztynek (7.7 ths.) are facilitated by a WWTP (MB). City of Olsztyn (treated as powiat) has 174.7 ths. inh. and is facilitated by a WWTP which, in addition to MB purification, has a stage of nitrogen and phosphorus chemical removal.

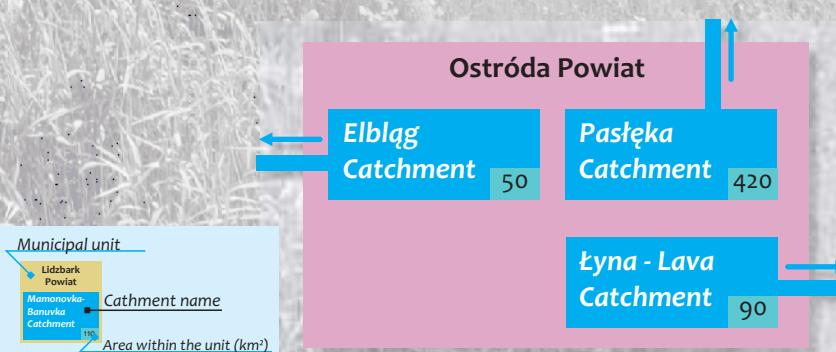
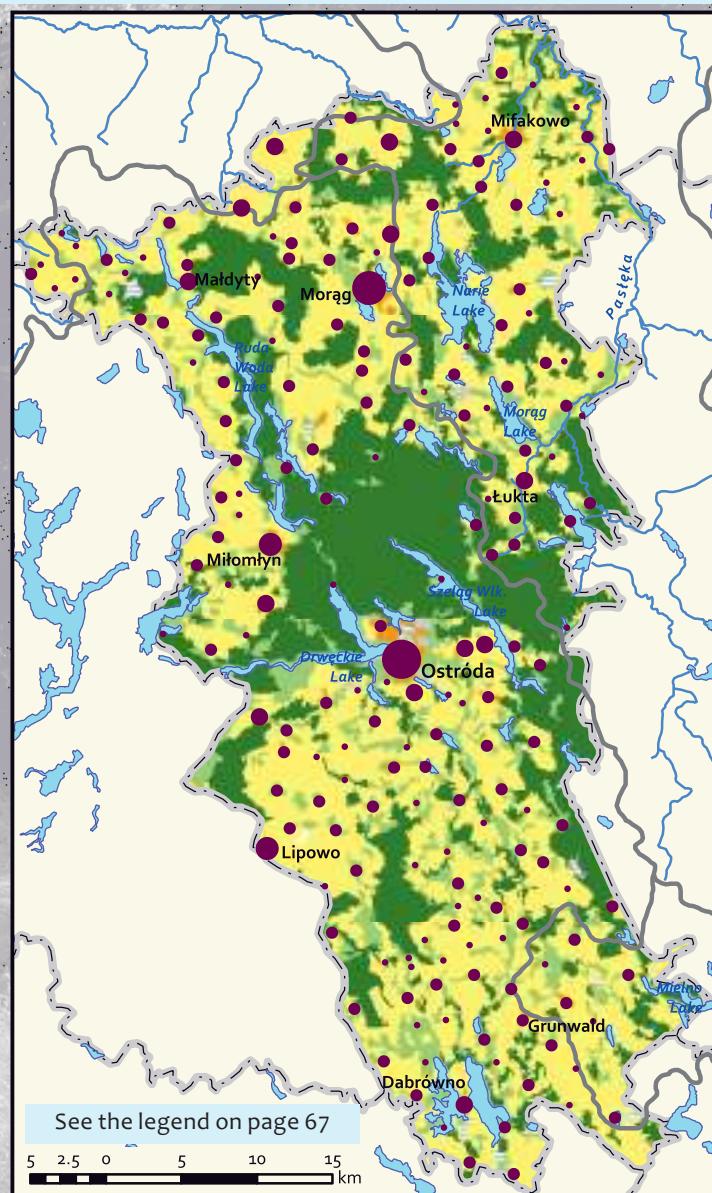
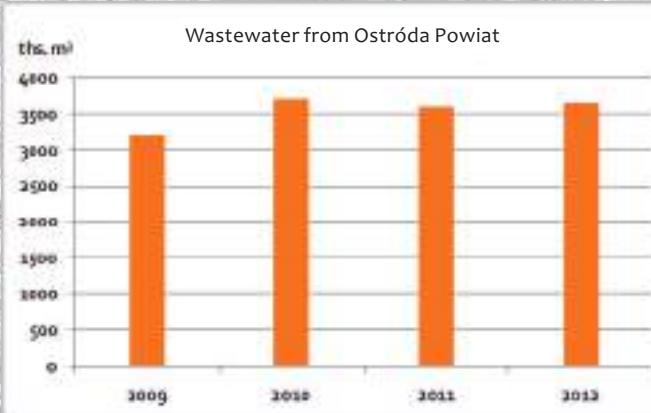
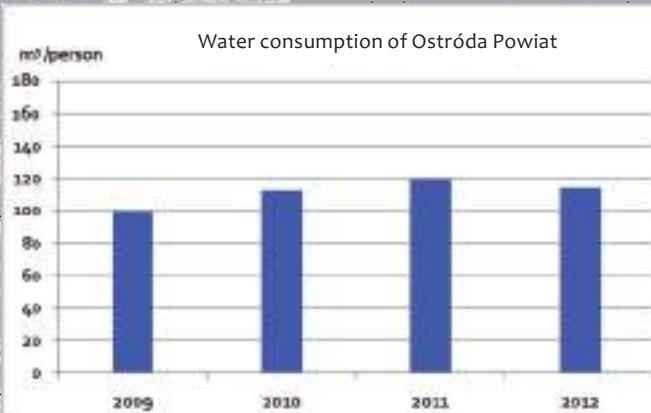


OSTRÓDA POWIAT

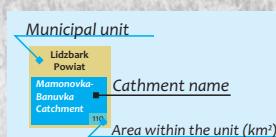
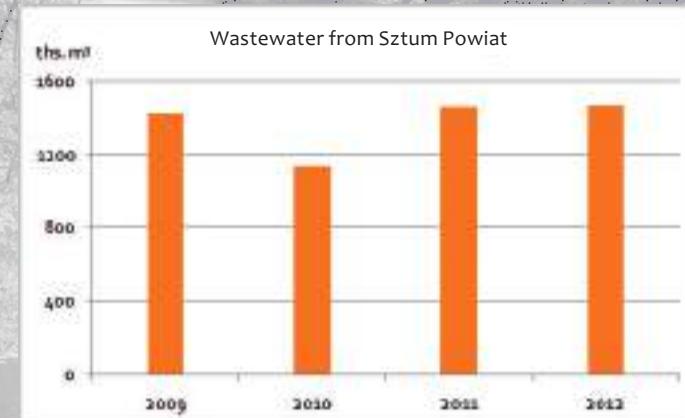
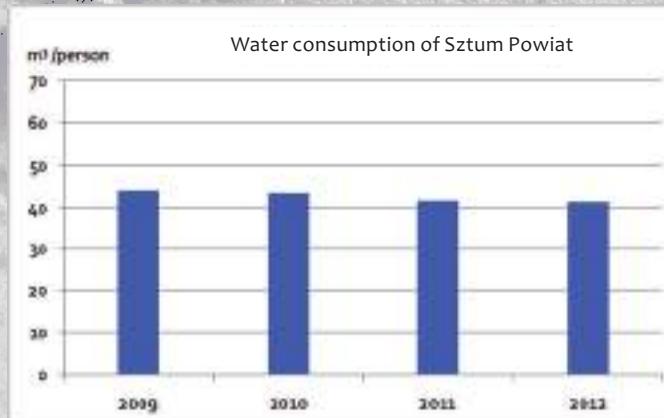
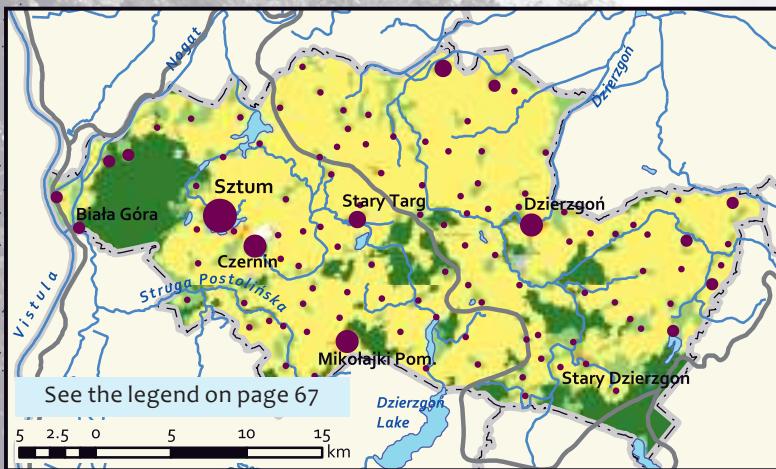
Description of the municipal unit

Powiat Ostródzki belongs to Warmińsko-Mazurskie Voivodship. Nearly one fifth of its area covers the very upstream part of the Pasłeka River catchment. Its total population (by 30.06.05) is 105.5 ths. (53 ths. - in cities, 52.5 ths. - in villages). It is composed of the urban gmina of

Ostróda; urban-rural gminas of Miłomłyn, Morąg, and Miłakowo; rural gminas of Dąbrówko, Grunwald, Łukta, Małdyty, and Ostróda. The main cities Miłomłyn (2.4 ths. of inh.), Morąg (14.5 ths.), Miłakowo (2.7 ths.), and Ostróda (33.5 ths. inh.) are facilitated by WWTPs (MB).



SZTUM POWIAT



Description of the municipal unit

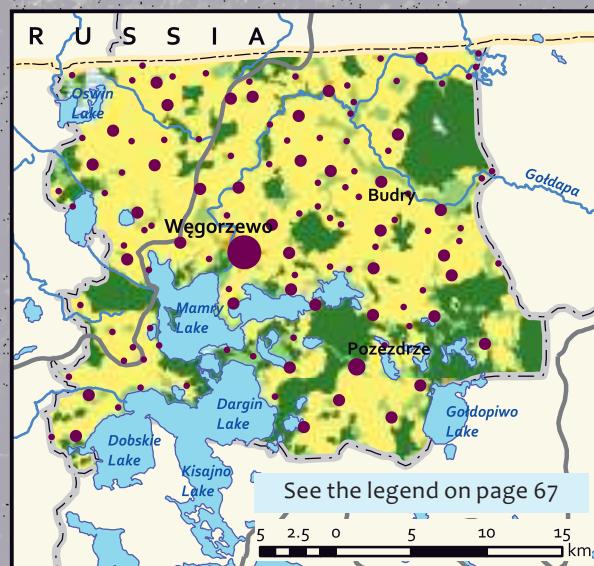
Powiat Sztumski belongs to Pomorskie Voivodship. Its area is divided between catchments of the Nogat and the Elbląg rivers in nearly equal proportions. Its total population (by 30.06.13) is 42.6 thous. (16 thous. - in cities, 26.6 thous. - in villages). It is composed

of urban-rural gminas of Dzierzgoń and Sztum (there are no urban gminas in the powiat); rural gminas of Mikołajki Pomorskie, Stary Dzierzgoń, and Stary Targ. The main cities of Sztum (10,42 thous. inh.) and Dzierzgoń (5.6 thous.) are facilitated by a WWTP (MB).

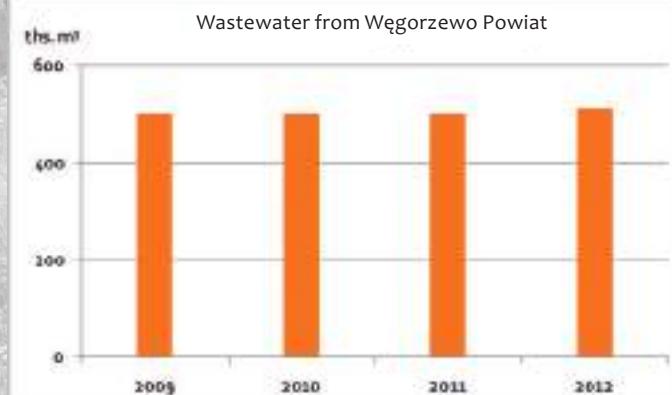
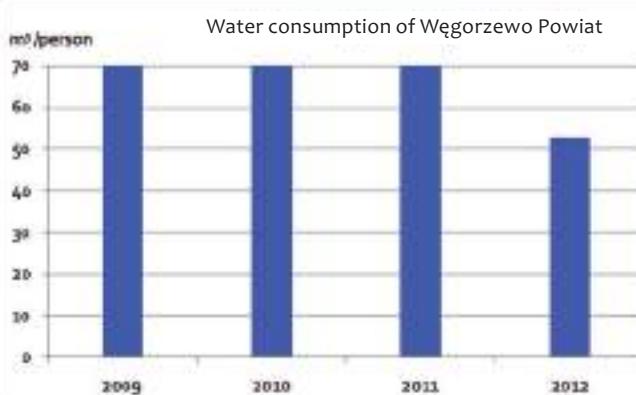




WĘGORZEWO POWIAT



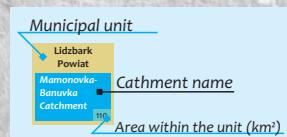
Węgorzewo Powiat



Description of the municipal unit

Powiat Węgorzewski belongs to Warmińsko-Mazurskie Voivodship and borders on the territory of Kaliningrad Oblast. Its area is divided between catchments of the Łyna and the Węgorapa-Angrapa rivers in nearly equal proportions. Its total population (by 31.12.10) is

23.2 ths. (11.4 ths. - in cities, 11.8 ths. - in villages). It is composed of the urban-rural gmina of Węgorzewo (there are no urban gminas in the powiat); rural gminas of Budry and Pożedrza. The main city Węgorzewo (11.4 ths.of inh.) is facilitated by a WWTP (MB).





CHAPTER V

MUNICIPAL UNITS ON THE BORDER

OF THE VISTULA LAGOON
CATCHMENT

IN THIS CHAPTER:

Grudziadz Powiat

Nidzica Powiat

Olecko Powiat

Slavsk Municipal District

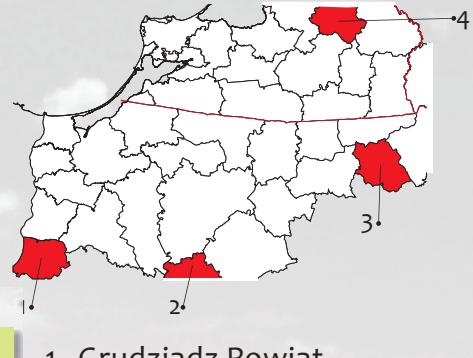
Suwalki Powiat

Szczytno Powiat

Vilkaviskis District Municipality

Yantarniy Municipal Unit

DESCRIPTION OF THE MUNICIPAL UNITS



Powiat Grudziądzki belongs to the Kuyavian-Pomeranian Voivodship. Only 3% of the area of the Nogat River catchment covers

less than 7% of the area of two municipal sub-unit of this powiat - Gmina Grudziądz (10.4 ths.inh.) and Gmina Rogóźno (4 ths.inh.).



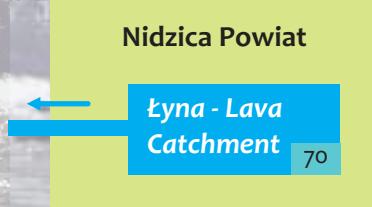
- 1 - Grudziadz Powiat
- 2 - Nidzica Powiat
- 3 - Olecko Powiat
- 4 - Slavsk Municipal District



Nidzica Town

Powiat Nidzicki belongs to Warmińsko-Mazurskie Voivodship. It is the very southern powiat, with an area covering the very upstream part of the Łyna River catchment to a small extent. Its total population (by 30.06.05) is 33.9 ths. inh. (14.8 ths. - in cities, 19.1 ths. - in villages). It

is composed of the urban-rural gmina of Nidzica (there are no urban gminas in the powiat); rural gminas of Janowiec Kościelny, Janowo, and Kozłowo. There is a WWTP (MB) in the city of Nidzica (14.5 ths. of inh.), but the city doesn't belong to the Łyna River catchment.



Slavsk Municipal District
Polessk Canal

Powiat Olecki belongs to Warmińsko-Mazurskie Voivodship. Its area covers a small part of the upstream of the Węgorapa-Angrapa River catchment. Its total population (by 30.06.08) is 46.20 ths. (23.74 ths. - in cities, 22.46 ths. - in villages). It is composed of the urban-rural gmina of

Olecko (there are no urban gminas in the powiat); rural gminas of Kowale Oleckie, Świętajno, and Wieliczki Dubeninki. The main city Olecko (22.38 ths. inh.) is facilitated by a WWTP (MB), but it doesn't belong to the Węgorapa-Angrapa River catchment.



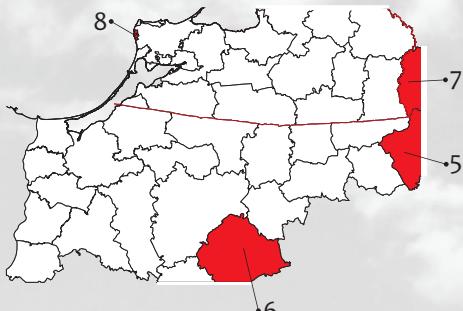
Slavsk Municipal District

Pregolya Catchment

<5

The **Slavsk Municipal District** covers less than 2% of the proper Pregolya River catchment. The urban population of the district equals 4.4 ths. inh., all these people live in the City of Slavsk, which doesn't

belong to the Pregolya River catchment. Rural population equals 16 ths., The Krasnoe Village (500 inh.) is the closest settlement to the border with the Pregolya River catchment.



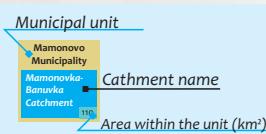
- 5 - Suwałki Powiat
- 6 - Szczytno Powiat
- 7 - Vilkaviskis District Municipality
- 8 - Yantarniy Municipal Unit

Powiat Szczycieński belongs to Warmińsko-Mazurskie Voivodship. Its area covers a small part of the upstream of the Łyna River catchment. Its total population (by 30.06.05) is 69.5 ths. inh. (28.4 ths. - in cities, 41.1 ths. - in villages). It is composed of the urban gmina of

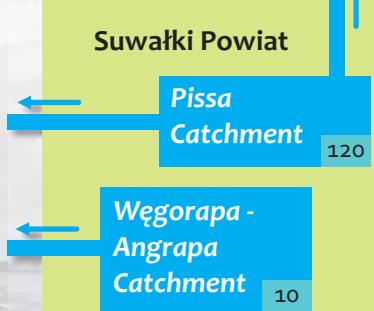
Szczytno; the urban-rural gmina of Pasym; rural gminas of Dzierzutny, Jedwabno, Rozogi, Szczytno, Świątajno, and Wielbark. The main cities Szczytno (25.7 ths. inh.) and Pasym (2.5 ths.) are facilitated by a WWTP (MB). Only Pasym belongs to the Łyna River catchment.

Powiat Suwalski belongs to Podlaskie Voivodship. Its area covers a tiny part of the upstream of the Węgorapa-Angrapa River catchment, the very south-eastern part of the Vistula Lagoon catchment. Its total population (by 30.06.12) is 36.12 ths. inh. (36.12 ths. - in villages). It is composed of rural gminas of

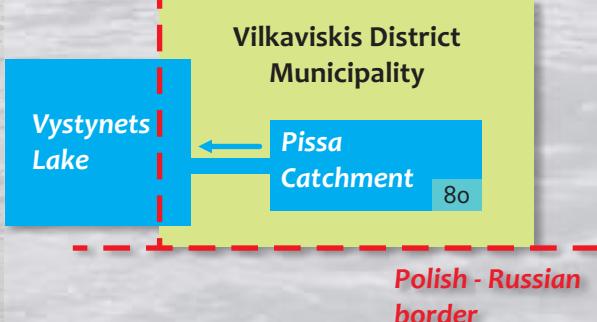
Bakałarzewo, Filipów, Jeleniewo, Przerośl, Raczki, Rutko-Tartak, Suwałki, Szypiszki, and Wiżajny. The main city Suwałki (treated as powiat – 69.4 ths. of inh.) is facilitated by a WWTP (MB) and doesn't belong to the Węgorapa-Angrapa River catchment.



Polish - Lithuanian border



Russian - Lithuanian border



The area of **Vilkaviskis District Municipality** covers 6% of the area of the Pissa River catchment. Most of this area is within the

Vystyts National Park in Vistycio Seniunija, the main settlement is the Vystyts settlement with 570 inh.

The **Yantarniy Municipal Unit** covers less than 2% of the Primorskaya River catchment. Total population of the unit is of 6.2 ths. of inh., but only 250-300 persons are living in

the Pokrovskoe Village related to the Primorskaya River catchment, and 5.6 ths. inh. live in the Yantarniy settlement.

Yantarniy Municipal Unit



TABLES

Municipal units on the Russian and Lithuanian parts of the Vistula Lagoon catchment

Municipal units	Catchments →	PM	NL	GR	PR	DM	IN	GL	WA	PS	LL	BM	PH
	Area	120	190	200	1750	420	1250	570	2200	1400	7040	490	1260
	Number	3	2	3	10	2	5	3	10	7	15	3	8
BGR	1010	3			20 2 <2							17 36	81 65
BLT	40	1	40 35 30										
LDN	30	1											30 99 2
MMV	110	1										110 100 22	
CHR	1150	6			430 33 24			250 19 20	270 21 47	120 9 5	30 2 2	50 4 <2	
GRV	520	2											140 16 11
KGD	200	3			10 6 6	180 89 10							<10 5 <2
GSV	640	4						250 39 20	20 3 3	130 21 6	240 37 17		
GVR	720	4						550 69 31	90 11 21			80 10 <2	<10 <2 <2
KRZ	510	1							510 39 41				
NMN	210	1							210 30 17				
NSV	770	3							30 3 3	20 2 <2	720 68 52		
OZK	850	4							280 33 49	420 50 19	30 3 2	120 14 2	
PLS	390	2						60 7 4	330 39 79				
PRK	1250	3						70 6 4				1080 86 15	100 8 8
SVT	80	3			<10 3 <2	80 95 40		<10 2 <2					
SLV	<10	1						<10 <2 <2					
YNT	<10	1											
ZLK	420	4			80 10 70 22	180 13 99 54	110 13 54	50 6 3					
VLK	80	1									80 6 6		

Legend

- 850 Area of a municipal unit or a catchment, km²
- 5 Number of administrative units or sub-catchments contributing to the area
- 40 Share of sub-catchments in a municipal unit, %
- 60 Share of a municipal unit in a catchment, %

Municipal units of Russia:

BLT	Baltiysk Municipal District
BGR	Bagrationovsk Municipal District
LDN	Ladushkin Municipal Unit
MMV	Mamonovo Municipal Unit
CHR	Chernyakhovsk Municipal District
GRV	Gurievsk Municipal Unit
KGD	Kaliningrad City
GSV	Gusev Municipal District
GVR	Gvardeisk Municipal Unit
KRZ	Krasnoznamensk Municipal District

Municipal units of Lithuania:

NMN	Neman Municipal District
NSV	Nesterov Municipal District
OZK	Ozersk Municipal District
PLS	Polessk Municipal District
PRK	Pravdinsk Municipal District
SVT	Svetliy Municipal Unit
SLV	Slavsk Municipal District
YNT	Yantarniy Municipal Unit
ZLK	Zelenogradsk Municipal District

VLK	Vilkaviskis district municipality
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Municipal units on the Polish part of the Vistula Lagoon catchment

Municipal units	Catchments →	WA	PS	LL	BM	PH	PL	EL	BD	NG	SW
	Area	2200	1400	7040	490	1260	2330	1510	330	1540	750
	Number	10	7		3	8	6	7	2	7	2
BRT	1350	3		1080		9	10	10	6		
BRN	1150	5			210	40	710	50	140		
ELBp	1290	4			18	43	3	62	30	13	43
ELBm	80	1					80	940	190	80	
GZK	280	2	260		20		6	4	71	62	
GLD	730	2	550	180	2	<2			14	57	6
GRZ	20	1							80		
ILW	250	2						30		220	
KTN	1160	2	60		1100		2	2		15	14
KWZ	650	1	5	3	93	16				650	
LDZ	930	2			490		47	440			
MLB	480	3			53	7		5	30	120	330
MRG	290	1			290					24	8
NDZ	70	1			27	4				67	44
NDG	480	2			70					11	4
OLC	60	1	60		8	<2				79	56
OLTp	2700	2			2160		19	540			
OLTm	90	1			77	31	23				
OST	560	3			90		24	420	50		
SZM	720	2			5	<2	18	3	3	390	
SWL	130	2	10	120	9	8	22	330		53	25
SZT	170	1			170						
WGZ	720	2	570		9	2					
			80	26	20	2					

Municipal units of Poland:

BRT Bartoszyce Powiat
 BRN Braniewo Powiat
 ELBp Elbląg Powiat
 ELBm Elbląg City
 GZK Giżycko Powiat
 GLD Gołdap Powiat
 GRZ Grudziądz Powiat
 ILW Iława Powiat
 KTN Kętrzyn Powiat
 KWZ Kwidzyn Powiat
 LDZ Lidzbark Powiat
 MLB Malbork Powiat

Sub-catchments:

MRG	Mrągowo Powiat	PM	Primorskaya	PL	Pasłęka
NDZ	Nidzica Powiat	NL	Nelma	EL	Elbląg
NDG	Nowy Dwór Gdański Powiat	GR	Graevka	BD	Bauda
OLC	Olecko Powiat	PR	Pregolya	NG	Nogat
OLTp	Olsztyn Powiat	DM	Deyma	SW	Szkarrawa
OLTm	Olsztyn City	IN	Instruch		
OST	Ostróda Powiat	GL	Golubaya		
SWL	Suwałki Powiat	WA	Węgorapa-Angrapa		
SZM	Sztum Powiat	PS	Pissa		
SZT	Szczytno Powiat	LL	Łyna Lava		
WGZ	Węgorzewo Powiat	BM	Banówka-Mamonovka		
		PH	Prokhladnaya		

CONCLUSIONS

The water resources of the South-Eastern Baltic are essentially transboundary. They are shared between Poland (Warmińsko-Mazurskie and Pomorskie Voivodeship), Russia (Kaliningrad Oblast) and Lithuania (Vilkaviskis District Municipality). The countries have different legislative frameworks for water management, which poses real challenges for an international cooperation towards sustainable development of water resources in the region.

The water quality in a shared basin depends on all stakeholders within the basin. Administrative units (as well as countries) need to coordinate their activities in order not to limit their neighbours in water consumption taking potential upstream-downstream conflicts into account (see, for example, [Dombrowsky, 2009; Moellenkamp, 2008]).

The authors hope, that the Atlas will help in coordinating actions of all stakeholders. The administrative structure of the international transboundary Vistula Lagoon catchment, located in the south-eastern part of the Baltic Region, is presented. This catchment includes areas of local administrative units (LAU¹, levels 1 and 2) within the territories of Warmińsko-Mazurskie, Pomorskie Voivodships (both in Poland) and Kaliningrad Oblast (Russia) as well as the Vilkaviskis District Municipality (Lithuania). In total 43 municipal units are fully or partly covered by the Vistula Lagoon catchment: 23 in Poland, 19 in Russia and 1 in Lithuania.

17 river sub-catchments were identified within the Vistula Lagoon catchment and presented in the Atlas, eight of them comprising the Pregolya River catchment, while the remaining nine are catchments of the separate rivers discharged directly to the Vistula Lagoon.

The atlas focuses on transboundary characteristics of the catchments in a general perspective, considering the sharing of catchment area between different administrative units in three different countries. The catchments boundaries do not coincide with national borders nor with internal boundaries between administrative units in the area, which is a good example of “spatial misfit” (Young, 2002).

The catchment-administrative structural scheme and the corresponding map presented in the Atlas illustrate the interrelation in terms of spatial coverage of sub-catchments and administrative units. The maximum number sub-catchments within an administrative unit can reach five for the Braniewo Powiat (Poland) and even six for the Chernyakhovsk Municipal District (Russia).

Any river sub-catchment (among 17 revealed) belongs to not less than two administrative units, and is shared either internationally or by national administrative units. In average, each sub-catchment is shared by 6 administrative units, 3 Polish and 3 Russian. The international Łyna-Lava river sub-catchment is the one with the largest number of administrative units (15 units). In Poland the Łyna-Lava sub-catchment is shared by 11 national administrative units. In Russia the most shared sub-catchment is the catchment of the proper Pregolya River (10 national administrative units).

¹<http://ec.europa.eu/eurostat/web/nuts/local-administrative-units>. Directly related to EU countries, but has clear equivalent in Russian Federation.

Kaliningrad Oblast of Russia is neighboured by territory of the EU countries - Poland and Lithuania, where the Water Framework Directive is the main legislation act concerning surface, ground and coastal waters. In the Russian Federation, the National Water Code plays the same role. These two basic documents are in agreement with each other in general, still having some differences [Kessler et al., 2006], that gives a room for cooperation to harmonize approaches for the practical water management of the shared river basin.

On the other hands the needs for cooperation between stakeholders within the catchment is very high nowadays. Diffusive sources [Veivo, 2004] and especially agricultural soils, where nutrients were deposited in the past [Raateoja and Pitkanen, 2004] and are still accumulating, are the main sources of nutrients for the Baltic Sea [Gustafsson et al., 2012]. This has led to adoption of the Baltic Sea Action Plan with heavy reduction targets for nitrogen and phosphorus [HELCOM, 2007, 2013] for countries around the Baltic Sea. A challenge in this regard relates to how these targets should be fulfilled in practice and what the Maximum Allowable Inputs [Wulff et al., 2014] are within the national areas, and especially within transboundary areas considering interests of all stakeholders. Authors hope the present Atlas contains useful basic information for national and local environmental authorities to help them in developing actions for implementation of the HELCOM Baltic Sea Action Plan.

WNIOSKI

Zasoby wodne południowo-wschodniego Bałtyku są w głównej mierze transgraniczne. Podzielone są pomiędzy Polskę (województwo warmińsko – mazurskie i województwo pomorskie), Rosję (Obwód kaliningradzki) i Litwę (okręg miejski Vilkaviskis). We wszystkich wymienionych krajach występuje różne prawodawstwo dotyczące zarządzania gospodarką wodną, co stanowi istotne wyzwanie dla współpracy międzynarodowej zmierzającej do zrównoważonego rozwoju gospodarki wodnej w regionie.

Jakość wody we wspólnej zlewni Zalewu Wiślanego zależy jest od wszystkich interesariuszy w zlewni. Jednostki administracyjne (a także wszystkie kraje) powinny koordynować działania dla ograniczenia zużycia wody z uwzględnieniem możliwych konfliktów wzdłuż biegu rzek (od źródła do ujścia) (dla przykładu warto zwrócić uwagę na publikację: Dombrowsky, 2009; Moellenkamp, 2008).

Autorzy mają nadzieję, że Atlas pomoże w koordynacji działań wszystkich interesariuszy. W Atlasie przedstawiono strukturę administracyjną w transgranicznej zlewni Zalewu Wiślanego położonego w południowo-wschodnim rejonie Bałtyku. Zlewnia ta obejmuje lokalne jednostki administracyjne (LAU¹, poziomy 1 i 2) w granicach województw: warmińsko-mazurskiego oraz pomorskiego (oba w Polsce) i Obwodu kaliningradzkiego (Rosja), a także okręgu miejskiego Vilkaviskis (Litwa). W sumie w zlewni Zalewu Wiślanego znajdują się całkowicie lub w części 43 jednostki miejskie: 23 w Polsce, 19 w Rosji i 1 na Litwie.

W zlewni Zalewu Wiślanego zidentyfikowano 17 podzlewni i opisano je w Atlasie, z czego osiem obejmuje zlewnię rzeki Pregoły, a pozostałych dziewięć dotyczy zlewni rzek bezpośrednio wpływających do Zalewu Wiślanego.

W Atlasie główną uwagę zwrócono na transgraniczną charakterystykę zlewni, biorąc pod uwagę podział obszaru zlewni pomiędzy jednostki administracyjne trzech różnych krajów. Granice poszczególnych podzlewni nie pokrywają się z granicami państw, a także z granicami jednostek administracyjnych, co stanowi dobry przykład przestrzennego niedopasowania [Young, 2002].

Przedstawiony w Atlasie schemat strukturalny podziału zlewniowo-administracyjnego oraz odpowiadająca mu mapa odzwierciedlają zależności między położeniem przestrzennym podzlewni a granicami jednostek administracyjnych. Maksymalna liczba podzlewni w granicach jednostki administracyjnej występuje w okręgu miejskim Czerniahowsk (Rosja) - sześć oraz pięć w powiecie braniewskim (Polska).

Każda podzlewnia należy do nie mniejszej niż dwóch jednostek administracyjnych i jest dzielona albo przez państwa, albo jednostki administracyjne. Przeciętnie w każdej podzlewni znajduje się 6 jednostek administracyjnych, 3 w Polsce i 3 w Rosji. Transgraniczna podzlewnia rzeki Łyna-Ława obejmuje najwięcej jednostek administracyjnych (15 jednostek). W Polsce podzlewnia ta obejmuje 11 lokalnych jednostek administracyjnych. W Rosji najwięcej jednostek administracyjnych (10 lokalnych jednostek administracyjnych) obejmuje zlewnia rzeki Pregoły.

¹<http://ec.europa.eu/eurostat/web/nuts/local-administrative-units>. Directly related to EU countries, but has clear equivalent in Russian Federation.

Obwód kaliningradzki graniczy z terytorium państw Unii Europejskiej – Litwą i Polską, gdzie Ramowa Dyrektywa Wodna jest podstawowym aktem prawnym dotyczącym zasobów wód powierzchniowych, podziemnych i przybrzeżnych. W Federacji Rosyjskiej taką samą rolę odgrywa National Water Code (Krajowy Kodeks Wodny). Te dwa podstawowe dokumenty generalnie są zgodne, aczkolwiek z nieznacznymi różnicami.(Kessler et al. 2006), co stanowi podstawę dalszej współpracy celem zharmonizowania wysiłków dla praktycznego zarządzania wodami wspólnej zlewni.

Z drugiej strony istnieje obecnie znaczna potrzeba współpracy pomiędzy interesariuszami w ramach zlewni. Rozproszone źródła zanieczyszczeń (Vivo, 2004), szczególnie pochodzące z gleb wykorzystywanych rolniczo, w których biogeny odkładane były w przeszłości (Raateeoja i Pitkainen, 2004) i nadal podlegają akumulacji, stanowią główne źródło dopływu biogenów do Bałtyku(Gustafsson et al., 2012). Doprowadziło to do przyjęcia Bałtyckiego Planu Działań(Baltic Sea Action Plan) zakładającego znaczącą redukcję azotu i fosforu (HELCOM, 2007, 20013) we wszystkich krajach wokół Bałtyku. Wyzwanie związane z tym planem polega na określeniu sposobu jego praktycznej realizacji, a także wyznaczeniu maksymalnych dopuszczalnych wielkości zrzutu biogenów przez poszczególne państwa (Wolff et al., 2014), a w szczególności z obszarów transgranicznych z uwzględnieniem potrzeb wszystkich interesariuszy. Autorzy mają nadzieję, że Atlas zawiera pozytyczne podstawowe informacje dla władz krajowych i lokalnych odpowiedzialnych za ochronę środowiska i będzie pomocny w realizacji zadań związanych z wdrażaniem Bałtyckiego Planu Działań HELCOM.

ЗАКЛЮЧЕНИЕ

Трансграничные водные ресурсы Юго-Восточной Балтики делят между собой Республика Польша (Варминьско-Мазурское и Поморское воеводства), Российская Федерация (Калининградская область) и Литовская Республика (Вилкавишский район). Эти страны имеют различные системы природоохранного законодательства, что усложняет международную кооперацию по обеспечению устойчивого использования водных ресурсов в регионе.

Качество вод в пределах водного бассейна зависит от водопользователей. Административные единицы и страны должны координировать свою деятельность, чтобы не ограничивать своих соседей в водопотреблении и водопользовании, принимая во внимание возможные конфликты при водопользовании в пределах одного водосбора (см., например, [Dombrowsky, 2009; Moellenkamp, 2008]).

Авторы надеются, что данный атлас окажется полезным для координации действий водопользователей. В нем представлено административное деление трансграничного водосбора Калининградского/Вислинского залива, расположенного в Юго-Восточной Балтике. На водосборе, в пределах Варимнско-Мазурского и Поморского воеводств (оба - Польша), Калининградской области (Россия) и Вилкавишского района (Литва) расположены соответственно 23, 19 и 1 муниципальное образование различного уровня (уровни 1 и 2 по классификации местных административных образований LAU¹).

В атласе представлены 17 речных водосборных бассейнов (частных водосборов), находящихся в пределах водосбора Калининградского/Вислинского залива, восемь из них составляют водосборный бассейн реки Преголи, а остальные девять – это водосборы отдельных рек, впадающих напрямую в залив.

В атласе приводятся общие характеристики этих водосборных бассейнов с учетом того, что их территории могут быть разделены между административными единицами трёх вышеупомянутых стран. Границы этих бассейнов не совпадают ни с государственными границами, ни с границами административных образований внутри одной страны, что хорошо иллюстрирует известный принцип «пространственного» несоответствия ("spatial misfit") [Young, 2002].

Структурная схема бассейново-административного деления и соответствующие карты иллюстрируют пространственное переплетение частных водосборов и административных единиц. Максимальное число частей водосборов в пределах одной административной единицы может достигать пяти для Бранёвского повята (Польша) и даже шести для Черняховского городского округа (Россия).

¹<http://ec.europa.eu/eurostat/web/nuts/local-administrative-units>. Directly related to EU countries, but has clear equivalent in Russian Federation.

Любой частный водосбор (из выделенных 17-ти) принадлежит не менее чем двум административным единицам из одной или двух стран. Формально, средний частный водосбор в пределах водосбора Калининградского/Вислинского залива делится между шестью административными единицами, по 3 из Польши и России. Максимальное число административных образований (15 единиц) встречается в пределах водосбора реки Лыны-Лавы, который в Польше делится 11-ю административными образованиями. На территории России максимальное число административных образований (10 единиц) встречается в пределах водосборного бассейна, образованного основным руслом реки Преголи.

Калининградская область России граничит с территорией стран Евросоюза – Польшей и Литвой, в которых основным законом, касающимся поверхностных, подземных и береговых водных объектов, является Рамочная водная директива ЕС. В Российской Федерации аналогичным актом является Водный кодекс. Эти два основных документа в целом очень похожи, хотя и имеют некоторые различия [Kessler et al., 2006]. Это создает возможность для гармонизации подходов к практическим задачам водного управления в пределах трансграничных водосборов.

С другой стороны, необходимость сотрудничества между водопользователями сегодня очень высока. Диффузные источники [Veivo, 2004], особенно сельскохозяйственные земли, где биогены накапливались ранее [Raateoja and Pitkanen, 2004] и накапливаются до сих пор, являются основным источником биогенного загрязнения Балтийского моря [Gustafsson et al., 2012]. Это ведет к необходимости странам Балтийского региона применять строгие меры по ограничению выноса азота и фосфора, предписанные Планом действий Хелком по Балтийскому морю [HELCOM, 2007, 2013]. Вызов заключается в том – как эти ограничения можно выдержать на практике, и каков максимально возможный вынос [Wulff et al., 2014] с национальной территории в пределах трансграничного водосбора и с учетом интересов водопользователей. Авторы надеются, что настоящий атлас содержит полезную базовую информацию для государственных и местных природоохранных органов, которая поможет им при планировании мероприятий по исполнению требований Плана действий Хелком по Балтийскому морю.

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