ACTA GEOGRAPHICA SLOVENICA

GEOGRAFSKI ZBORNIK

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GEOSCAPES 1

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GEOGRAFSKI INŠTITUT ANTONA MELIKA
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RESEARCH CENTRE OF
THE SLOVENIAN ACADEMY OF SCIENCES AND ARTS
ANTON MELIK GEOGRAPHICAL INSTITUTE

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Contents

Acta geographica Slovenica, 59-3, 2019, 7–70

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Aleš Smrekar, Mateja Breg Valjavec, Katarina Polajnar Horvat, Jernej Tiran

BOJAN ERHARTIČ

Green spaces improve quality of urban life.

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The geography of urban environmental protection in Slovenia: The case of Ljubljana

ABSTRACT: This paper uses findings from sustainability studies to present the development of environmental urban geography in Slovenia in recent decades. Modern European cities, of which Ljubljana is no exception, depart significantly from sustainable development concepts. Compared to other similar cities, Ljubljana has an effective green space system, which its residents also perceive as offering a better-quality living environment. The major, poorly addressed problems are primarily inherited issues, such as gravel pits, illegal dumping sites, and unregulated gardens in suburbanized water protection areas on which residents depend. These, however, show a large gap between claimed and actual environmental awareness.

KEY WORDS: urban green spaces, environmental degradation, environmental protection, quality of urban life

Geografija varstva mestnega okolja v Sloveniji: primer Ljubljane

POVZETEK: Z rezultati trajnostno naravnanih študij, želimo predstaviti razvoj okoljske urbane geografije v Sloveniji v zadnjih desetletjih. Sodobna evropska mesta, med katerimi Ljubljana ni izjema, bistveno odstopajo od konceptov trajnostnega razvoja. V primerjavi z drugimi primerljivimi mesti ima Ljubljana učinkovit sistem zelenih površin, kar kot večjo kakovost bivalnega okolja dojemajo tudi prebivalci. Eden od večjih, slabo reševanih problemov so predvsem pretekla bremena, kot so gramoznice, divja odlagališča odpadkov in neurejeni vrtički na suburbaniziranih vodovarstvenih območjih, od katerih so odvisni prebivalci. Ti pa izkazujejo veliko razliko med deklarativno in dejansko okoljsko ozaveščenostjo.

KLJUČNE BESEDE: urbane zelene površine, degradacija okolja, varovanje okolja, kakovost življenja v mestu

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1 Introduction

Humans act upon the natural environment – the human habitat – introducing not only positive impacts but also numerous negative ones, which are understood as environmental pollution or degradation (Polajnar Horvat 2015a). Although there is a widespread belief that people in the past were more respectful of the environment and that they interacted with it rationally and responsibly, the current generation is not the first to degrade the environment (Plut 2014). With ongoing innovations, but especially industrialization and a growing population, negative environmental impacts have been continually on the rise and increasingly more natural resources are being used. Human actions are having ever more impact on the environment, with many negative effects. The level of economic and technological development is not the only factor in environmental impacts; people's relationship with the environment also matters. Especially since the 1980s, people have enjoyed a better standard of living than ever before in history and have used goods and services not available in the past. This affects the method of production and consumption of these goods, which have become the main sources of negative environmental impacts (Polajnar Horvat 2015a). Our production and consumption have increased our ecological footprint and surpassed the environment's carrying capacity (Meadows et al. 2004; Polajnar Horvat 2015a). Today it is commonly believed that the key to economic progress is growth and the dominant forms of awareness and people's environmental behavior are personal gain and fulfilling ones' own desires as much as possible (Mohorič 2011).

During the industrial revolution, cities became the locus of the greatest concentration of industries, which brought population increases and also environmental problems. All of these processes intensified throughout the twentieth century. Tertiarization, globalization, and the information revolution drastically changed cities' appearance and function in the second half of the twentieth century (Relph 2016). At the start of the twenty-first century Earth's surface has now been reshaped by anthropogenic processes more than ever before (Ellis and Ramankutty 2008; Smrekar and Breg Valjavec 2014), although Perko et al. (2019) did not identify this in their Slovenian typology, because they based it on natural elements.

The 2030 Sustainable Development Agenda points the way to ultimately including sustainable development concepts in all aspects of global society in order to end poverty, protect the planet, and improve the lives and prospects of everyone, everywhere. City systems are the subject of one of the goals, whose aim is for cities to become inclusive, safe, resilient, and sustainable (Sustainable … 2015). Modern European cities unfortunately depart significantly from sustainable development concepts, because in order to meet their material and energy needs, as well as emissions and waste disposal, they require very extensive land, which would otherwise be used for production and other quality-of-life activities (Plut 2003). This creates conflicts, in which humans benefit but the environment suffers (Cieślak 2019).

Although the share of urban population in Slovenia has stagnated in recent decades at 49.8% (Pelc 2015), on the global level this has already exceeded half of the world's population. Projections show that more than two-thirds of the world's population will be urban by 2050 (World … 2018). Urban life means encountering a range of positive and negative impacts of actions by various actors and activities (residents, business, traffic, services), which have different interests and change with time and place. These actions and their impacts are also reflected in quality of life, which affects people's decisions about where to live and work, in which mention must also be made of the following factors: economically competitive cities (Florida 2002), changes in land use, and mobility patterns (Marans and Stimson 2011). Efforts toward good quality of urban life have become an important component of urban planning and spatial documents at the local, national, and international levels. The Leipzig Charter on Sustainable European Cities (2007) offers guidelines for comprehensive urban development policy within EU member states. It is the foundation of national urban policies, offers strategies for remediation of degraded areas (Smrekar 2007), and is a good basis for further actions that improve the quality of the urban environment (Podobnik 2007). Last but not least, modern urban planning arose precisely for the purpose of protecting and improving the human environment, especially cities (Mušič 1980). Harvey even writes that the »qualities of urban living in the twenty-first century will define the qualities of civilization itself« (Harvey 1996, 403).

Central European cities' historical development is closely tied to gravel plains, because most cities arose along large rivers or their tributaries, which created these plains (Šifrer 1969; Galluser and Schenker 1992). The natural processes that shaped these areas before significant human settlement gained a competitor, as human inhabitants changed how these landscapes looked and functioned. They did this primarily with intensive agriculture, utilizing and extracting mineral resources (gravel, sand, and clay), and uncontrolled

industrial development, all of which led to changes in land use and in some places also permanent degradation (e.g., backfilling gravel pits with waste). Land use is affected by numerous interdependent factors stemming from the relationship between humans and their needs on the one hand and the environment and its characteristics on the other (Gabrovec and Kumer 2019). The technological, economic, and spatial development that Ljubljana and its surrounding areas have experienced in the past century have contributed to a greater intensity and extent of anthropogenic impacts on the natural environment, which in certain periods has been reflected as degradation of various landscape characteristics in the city itself or on its periphery. Landscape degradation of Slovenian cities in riverine gravel plains (Ljubljana, Maribor, Celje, Kranj, Novo Mesto, and Murska Sobota) arises from unclosed material cycles, which create environmental impacts in cities and changes in the landscape dynamics of peri-urban areas (Urbanc and Breg 2005; Breg et al. 2007). In the past, cities faced the problems of air polluted by sulphur dioxide from industry and coal burning, whereas today the problem is particulate, nitrogen oxide, and ozone, which are generated by traffic and also extend to the urban periphery (e.g., ozone). Landscape elements that are under constant pressure from urbanization include groundwater (e.g., wastewater seepage from the sewer system and agricultural fertilizers from nearby farms) and soil (along areas with more traffic, i.e., the bypass and arterial roads).

In the 1990s Slovenian cities experienced major functional changes in the shift from an industrial to a post-industrial society (Bole 2008). Of all Slovenian cities, Ljubljana has the most pronounced post-industrial character with its emphasis on tertiary and quaternary activities (Rebernik 2007). Considering its central functions, Slovenia's capital is also the strongest economic center because companies located in Ljubljana represent one-third of Slovenian capital, create one-third of its added value, and employ one-fourth of all workers in Slovenia (Pichler-Milanović 2001; Ravbar et al. 2005; Nared et al. 2017).

Ljubljana faces numerous environmental challenges, such as limited self-cleaning capacity due to its location in a poorly ventilated plain; the Ljubljanica River has a karst catchment area and its landscape-forming elements are relatively highly susceptible to environmental pollutants, especially its air (traffic, heating) and water (Plut 2007); the city is also threatened by earthquakes (Kilar and Kušar 2009) and floods (Natek 2011). However, Ljubljana has met these challenges with relative success, as acknowledged when it was named the 2016 Green Capital of Europe, which the European Commission determined in 2014 based on high environmental standards and commitments to ambitious goals for further environmental improvements and sustainable development. The most positive changes in Ljubljana are those involving traffic regulation, conserving and protecting green spaces and heritage, revitalizing degraded areas, and waste and wastewater treatment (Ljubljana, Zelena prestolnica … 2015). Other indicators of Ljubljana's achievements include being named to the Global Top 100 Sustainable Destinations and World's Best Sustainable Destination lists (Kozina et al. 2019).

This issue presents findings from past geographical studies focusing on sustainable development in the urban and peri-urban environment. It shows how Slovenian geographers, and especially those in the Environmental Protection Department of the Anton Melik Geographical Institute of the Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU), have contributed to sustainable urban development in Slovenia in recent decades with their research, which analyzed the situation, drew attention to problems, and proposed potential solutions. An outline of the development of environmental thinking in Slovenia helps explain what happened in Slovenian urban areas, using the case of Ljubljana, as the driver of Slovenian development. It seeks to determine how environmentally oriented Ljubljana residents claim to be and how much they are actually willing to do in order to improve the quality of their living environment. Thus, it determines objective standards for quality of urban life and also how residents perceive it. It also examines the effectiveness of Ljubljana's green space system, of which it can be proud, and the reasons for unbuilt land degradation and its remediation.

2 Building environmental awareness in Slovenia

The conservation movement began in the early twentieth century in Slovenia, but awareness of the importance of environmental protection began to really take hold in the 1960s, shortly after the environmental movement's beginnings in western Europe (Polajnar Horvat et al. 2014). People became concerned with improving the quality of their living environment and this led to greater promotion of environmental protection (Polajnar Horvat et al. 2014). The history of Slovenian environmentalism can be roughly divided into four periods.

2.1 Before the Second World War

The conservation movement in Slovenia emerged in the 1920s. In 1920, the Slovenian Museum Society's Section for the Protection of Nature and Natural Monuments submitted a memorandum to the regional government, which is considered the first nature conservation program in Slovenia (Spomenica 1920). Although environmental protection was still in its infancy at the time, the Triglav Lakes Valley was protected under this memorandum in 1924 (Erhartič 2012). Compared to environmentalist movements in the West at that time, which emphasized the issue of industrial pollution, in Slovenia the main focus was the importance of nature conservation rather than environmental protection. Slovenia did not yet have significant industrial development and its direct, visible consequences at the time, but the beauty and rarity of its natural environment were very highly prized (Smrekar et al. 2016a; Polajnar Horvat et al. 2017). The first example of industrial pollution in Slovenian cities was caused by the Celje zinc plant in the early 1930s. Individuals were already calling attention to the fact that factory gases were causing environmental damage, primarily in the surrounding forests due to sulphur dioxide emissions (Špes 1998).

2.2 The »flower power« era

The second wave of the environmental protection movement came to Slovenia from the United States (Carson 1962; Hardin 1968; Meadows et al. 1972) and western Europe (Barnes and Barnes 1999) during the 1960s (Smrekar 2006a). What was probably the first European »ecological« film, the twelve-minute documentary *Strupi* (Poisons) by director Mako Sajko released in 1964, had a big impact in Europe and even the United States. The film shows polluted water and air and how these lead to illness and even death in animals and humans (Cingerle 2014). They did not have trouble showing the film in communist Yugoslavia, even though the filmmaker showed that factory smokestacks billowing thick smoke were not only symbols

Figure 1: The first articles to raise awareness of environmentalism among the public were published in the magazine *Tovariš*.

of the proletarian revolution, but also of extensive pollution. He filmed it in Trbovlje, and it is practically unbelievable how enthusiastically the factory directors cooperated with him; not only did they cheerfully show him their effluents running into the river, they even asked how much smoke he needed so that it would be visible (Butala 2017). The first general-interest articles were published in the magazine *Tovariš* (Comrade; Figure 1), for which Drago Kralj wrote a series of articles called »Strupi« (Poisons) and Željko Kozinc wrote »*Zrak, ki ga diham in kruh, ki ga jem*« (The air that I breathe and the bread that I eat). Both used their writing to raise awareness of the issue of industrial pollution, something that was not well understood at the time (Merljak Zdovc 2008; Ščuka 2009). Because the general mindset of that time was positively inclined toward industry and urbanization, and their positive effects were emphasized, the authorities were not fans of such articles. However, people enjoyed reading them, because they discussed examples from their local environments.

In the early 1970s, due to influences from other countries, environmental protection gained prominence in society and legal regulations but environmental conditions visibly deteriorated. At this point there was a shift, and society began to open to new ideas; people began to think critically about unlimited economic growth (Toš 2012). In 1970, representatives of the Natural Science Society (*Prirodoslovno društvo*) took part in the United Nations Conference on the Human Environment in Stockholm, which is seen as the beginning of institutional regulation of environmental protection. The *Green Book on Environmental Threats in Slovenia* (Zelena knjiga o ogroženosti okolja v Sloveniji; Peterlin 1972), was published on this occasion. It described acute environmental degradation and was first to also address the problematic attitude toward the environment. Throughout the country, environmental protection institutions at both the policy level (the Environmental Protection Community and Republican Committee for Environmental Protection) and civil-society level (the Association of Environmental Protection Societies) were founded (Smrekar 2006a; Bahor 2009). A significant milestone was also achieved in the business world, where environmental topics were now addressed through environmental impact assessments (Anko 2009).

2.3 Environmental protection movement development in the 1980s

The concept of »sustainable development« was first used in the well-known Brundtland Report (*Our Common Future*; WCED 1987), when environmental societies and organizations in Slovenia also gained more prominence and legitimacy as shapers of policy (Drevenšek 2002). The trigger for the environmental movement's formation was pollution in the Krupa River in White Carniola. Analyses in 1983 indicated that the level of polychlorinated biphenyls in the Krupa's karst spring was 400 times higher than the maximum permitted level (Plut 1988). The pollution came from capacitors being disposed of in karst dolines near the largest karst spring in White Carniola, which was also a source of drinking water. In answer to this highly hazardous waste disposal, which seriously threatened human health, in 1984 Dušan Plut published an article in the White Carniola youth bulletin *Razmerja* (Relationships), in which he called attention to the ecological catastrophe and the inadequate regulation that had allowed it (Polajnar Horvat et al. 2017).

A globally significant milestone that affected change in people's thinking was the Chernobyl nuclear accident in 1986. This increased people's awareness of how dangerous nuclear power plants were, and it sparked questions about whether to build more of them. This gave rise to the anti-nuclear movement, which called attention to the problematic nature of the Krško nuclear power plant and the senselessness of building the planned power plant near Dol pri Ljubljani. At that time, environmental activist Vane Gošnik organized an environmental protest in Velenje against the disposal of nuclear waste at Velunski Graben. Leo Šešerko, politician and environmentalist, held numerous round tables to warn of the dangers of nuclear radiation (Pesek 2009).

Public warnings about air pollution caused by the Šoštanj coal-fired power plant also began around this time. There was visible damage to the vegetation in its vicinity. The main initiator behind this was again Vane Gošnik (Pesek 2009). At this time there was a shift in informing the general public about environmental issues: many articles, especially in the weekly *Mladina* (Youth; Figure 2), pointed to the link between sociopolitical conditions and pollution.

In 1988, in order to shed light on the issue of environmental degradation and highlight growing environmental problems, the Council for the Study and Protection of the Environment at the Slovenian Academy of Sciences and Arts published the volume *Slovenija 88 – okolje in razvoj* (Slovenia 88: Environment and Development) with over forty contributions (Lah 1989). These articles assessed the environmental situation

Figure 2: The weekly *Mladina* has been a staunch supporter of the environmental movement since the 1980s.

and compared it to the findings of the *Green Book on Environmental Threats in Slovenia* (Peterlin 1972). At that time, the idea of coming together and forming a Green Party began to mature. The individuals involved believed that change could only be achieved by incorporating environmental protection into public discussion. At the beginning of 1989, Dušan Plut published the »*Osnutek zelenega manifesta*« (Draft Green Manifesto; Plut 1989), emphasizing that Slovenia needed a Green Party to combat the multifaceted economic, technological, sociopolitical, and moral/ethical crisis, and that they would no longer passively and irresponsibly accept further poisoning of the population and the country (Pesek 2009). That same year, the Greens of Slovenia political party was founded. The party was formed at a time when the first democratic parties were being established in Slovenia since the Second World War, and it immediately became actively involved in political life (Vodopivec 2007). In 1990, it participated in the first multi-party parliamentary elections since the Second World War and, with 8.8% of votes, became proportionately the strongest Green Party in Europe (Pesek 2009). In 1994, it merged with the Liberal Democrats, and subsequent attempts by »green« parties to gain parliamentary seats have been unsuccessful due to their fragmentation and lack of political power.

2.4 Environmentalism following Slovenia's independence and accession to the European Union

Slovenia's independence brought a marked shift to environmental protection, because the economic, political, and legislative contexts for solving environmental problems all changed at the same time. The establishment of democracy has meant more shared decision-making on environmental issues. The right to a healthy living environment was enshrined in the Constitution of the Republic of Slovenia (Ustava 1991). People began to recognize the environment as valuable. In 1993, the first Environmental Protection Act (Zakon 1993) was adopted, which laid the foundations for modern environmental protection. It was amended in 2004 (Zakon 2004) when, instead of addressing increasingly serious environmental problems by seeking technical solutions to reduce environmental impacts, the concept of sustainability was introduced as a way to approach environmental problems (Smrekar 2006a). This means that environmental protection is not

merely or primarily cleaning up polluted areas, but also preventive management and prudent decision-making regarding new encroachments on the environment and exploiting natural resources. One of the fundamental principles applied in this act is the principle of integrity, which is based on the recognition that environmental protection cannot be successfully implemented only partially, without consensus or cooperation (Špes 2008). After the law was adopted, the number of legal acts dealing with environmental protection increased dramatically. This was further boosted by Slovenia's accession to the European Union, when Slovenia committed itself to systematically integrating EU environmental policy and principles into national law, the economy, and everyday life (Plut 2004).

Environmental issues have thus come to the forefront of public debate and become the subject of public policy. Concern for the environment has become a positive value, but often only at the claimed level. People have begun to support environmental protection in principle because this has become socially desirable. However, when faced with restrictions that interfere with their lifestyles, this enthusiasm quickly fades (Smrekar 2006a). Principled support for environmental protection has often not been manifested in actual behavior, which is far from achieving a transition to an environmentally-friendly society. In the past year (2019), the global climate change movement led by the young activist Greta Thunberg from Sweden has led to increased interest in the environment among Slovenian youth, leading to increased media pressure on state institutions (Prezelj 2019).

2.5 Development of urban environmental issues in Slovenian geography

The Environmental Protection Department of the Anton Melik Geographical Institute (ZRC SAZU) has a rich foundation that dates from long before its creation in 2005. Darko Radinja, a professor at the Department of Geography (Faculty of Arts, University of Ljubljana) was undoubtedly a key figure in the environmental education of the students that were later hired by the institute, because he served as advisor to their undergraduate, master's, and doctoral theses (Lampič 2019). Radinja's understanding of environmental processes in the landscape is evidenced by his statement that »destructive environmental change is also based on the belief that the essential components of the natural environment are virtually inexhaustible. It is true that these materials have not run out yet, but even now there is already a lack of good air, good water, and good soil, because the regeneration capacity of the geosphere and individual landscapes is exceeded« (1972, 37). Thus, even before the advent of climate change at the global level, Radinja (1972) warned of exceeding the planet's regenerative capacity and drew attention to the interconnectedness of the local, regional, and global geographical environment (Plut 2009).

In the 1960s and 1970s, individual environmental studies primarily concerned with nature conservation were conducted by institute members (Orožen Adamič 1970). The first more urban topics that are the subject of this issue began to emerge toward the end of the 1970s. Špes (1977, 1978, 1979) was primarily concerned with the societal challenges of pollution in the industrial town of Celje, whereas Černe (1977) used factor analysis to examine the industrially degraded Velenje Basin. For the next decade, Špes (1981) focused on environmental problems in Celje and narrow, poorly ventilated industrial valleys such as the Mežica Valley (Špes 1987). In the 1990s, the environmental group grew stronger with the additions of Irena Rejec Brancelj, Igor Šebenik, Barbara Lampič, and Aleš Smrekar. Under Špes's leadership, they first began to explore sustainable urban development (Špes et al. 1995), environmental degradation as a spatial factor in differentiating urban landscapes (Špes 1998), and the impact of the urban environment on population health (Špes et al. 1997). Šebenik focused on using geographic information systems to inventory illegal dumping sites in cities and remediate them (Šebenik and Šimec 1993), so he was probably the first geographer in Slovenia to tackle environmental issues with this very new digital tool, which was not yet widely used.

The new millennium brought a comprehensive assessment of impacts on gravel plains, especially in cities, under the leadership of Irena Rejec Brancelj (Kladnik et al. 2002; Andjelov et al. 2005). In addition to these, studies were conducted of diffuse and uncontrolled pollution sources such as illegal dumping sites (Smrekar 2008) and options to remediate them (Breg Valjavec et al. 2005), private wells (Smrekar 2007; 2009), and community gardening (Jamnik et al. 2009). Smrekar surveyed 600 Ljubljana residents to determine environmental awareness in different demographic groups (Smrekar 2006a). After the 2005 establishment of the Environmental Protection Department (Oddelek 2019), headed by Aleš Smrekar, the department was joined by Mateja Breg Valjavec, Katarina Polajnar Horvat, and Jernej Tiran, most of whom were advised

by Smrekar during their doctoral studies and who began to focus more heavily on environmental urban issues. In the 2010s, they continued their research by studying environmental risks from past urban and suburban degradation (Breg Valjavec et al. 2018), environmental behavior and social influences (Polajnar Horvat 2015a; Polajnar Horvat 2017; Polajnar Horvat and Smrekar 2017), and also began tackling the issue of the (over-) congestion of protected areas in cities using the case of an urban landscape park (Smrekar et al. 2011), and the opportunities for recreation not only in protected areas, but within all the green spaces in an urban environment (Smrekar et al. 2018). In order to provide a comprehensive understanding of the urban environment and the impact of its characteristics on the population, research on the quality of the residential environment was carried out on the case of Ljubljana (Tiran 2015; 2017).

3 Methods

Research on the urban environment reflects its complex, dynamic system, and therefore it consists of multiple work phases and methods that aim to analyze, present, and interpret the findings as objectively as possible. Our research on urban environmental protection to date has made use of various methods, from field data collection, measurement of phenomena, statistical analysis, spatial analysis, and presenting complex phenomena and their causal relationships, to analyzing the interdependence and combined effects of phenomena in the urban environment. This issue explains in more detail the most relevant methods used to research green space, urban degradation due to waste disposal, community gardening, quality of the residential environment, and environmental awareness.

Our green space research has relied on contemporary approaches that address the role and importance of green spaces in cities by going beyond the anthropocentric perception of cities and green spaces. We have put green spaces in the context of ecosystem services (Escobedo et al. 2019) and determined how they are valued by visitors (users) of urban green spaces. As part of the urban ecosystem, green spaces affect biodiversity, bioclimate, and other cultural ecosystem services (Smrekar et al. 2018) and they build and connect ecological corridors, thereby allowing the survival, reproduction, and migration of plant and animal species. They also support the population's quality of life, which is why examining people's relationships with green spaces, visitor profiles, visitors' priorities, and movement patterns offers valuable information for planning new urban green spaces and improving the status and function of existing ones. In short, because we understand the city as an ecosystem, our research is a comprehensive analysis of the urban landscape. The methods in development and frequent use in our research within and outside the urban environment are outlined below. Following is a brief summary of some essential methods most commonly used in the study of illegal dumping sites over the last two decades.

Combined methodological approaches are used to examine environmental impacts and consequences of anthropogenic degradation in the past and today, because they have proven effective (Breg Valjavec 2013; Breg Valjavec et al. 2018). Tried and tested field and desk research methods are primary, but these are supplemented and improved with the development and availability of high-resolution remote sensing data (high-resolution aerial and satellite images, unmanned aerial images (UAV), lidar terrain and vegetation data), and the ever-growing accessibility and diversity of noninvasive geophysical methods (georadar, electrical tomography).

Integral study of secondary sources offers basic data on prior production of hazardous substances and hazardous waste, potential storage locations, illegal disposal based on past research, and the like (Smrekar and Breg Valjavec 2014). This desk research thus determines the locations of former sources of pollution, locates them in the land cadaster (lots), determines their continuity in these areas, and determines the occurrence and danger of such current activities and current environmental risk (e.g., to groundwater) in these areas. Determining the dumping locations requires a spatial approach (Smrekar et al. 2005; Urbanc and Breg 2005; Breg Valjavec et al. 2007).

Field inventory is a basic method that can be used for an initial capture of dumping site data or as a field check. Inventories of illegal dumping sites, analysis of their condition, and preparation of remediation proposals have been carried out in several work stages (Breg Valjavec, Janža and Smrekar 2018; Smrekar et al. 2005; Smrekar 2006b).

Spatial historical-geographical analysis of archival aerial images was used to further cross-reference the producers' locations with dumping sites that are not related to the producer's location (Smrekar and

Breg Valjavec 2014). By analyzing archival aerial images or a time series of aerial images from the second half of the twentieth century, we determined the locations of once-active gravel pits (Urbanc and Breg 2005; Breg Valjavec 2013). Further photogrammetric analysis, which enables three-dimensional analysis of objects, also determined the depth and volume of each gravel pit and compared it with the current state of the surface on a digital terrain model (Breg Valjavec 2013). The method makes it possible to deduce the presence of a dumping site even if the terrain of a former pit is now flattened.

Laser remote sensing (Breg Valjavec 2014) is a more modern method that produces high-resolution earth-surface data. A digital terrain model with a resolution of 1 m provides visual and automatic algorithm-supported detection of the consequences of waste disposal, which were detected as micro-relief changes (Zakšek et al. 2011; Breg Valjavec 2013; 2014).

Objective and subjective assessments of the quality of the residential environment are the two different methods employed to study residential environment quality. Objective assessment includes measurements with various indicators that aim to evaluate the environmental characteristics or conditions that enhance quality of life. The objective assessment does not necessarily correspond to the residents' opinions; therefore, subjective assessments that measure quality of life through the perception and evaluation of the residential environment, usually with the level of residents' satisfaction with their home, neighborhood, or city (Tiran 2015; 2016), are also important and much more frequently used. Both types of research are important: if the concept is measured in only a subjective way – that is, by interviewing the population – there is a risk that people's satisfaction with their residential conditions may reflect ignorance of the situation, which is characteristic of people with lower social status (Felce and Perry 1995). Objective assessments are also important from the point of view of environmental protection in urban areas, in order to identify potentially unhealthy living conditions that residents may not even recognize or simply become accustomed to and are not aware of the potential adverse effects on their health. The quality of Ljubljana's residential environment was objectively measured at the building scale using partial indices and a synthetic index using the method of aggregating standardized unweighted indicators (Tiran 2017).

Research into residential preferences is also very important from the subjective perspective, because it helps authorities and planners build housing or design its surroundings so that residents are happy with it. At the same time, it is a good alternative to research on housing satisfaction, which often shows no major differences between residents of different areas (McCrea et al. 2014; Tiran 2017).

Subjective quality of the residential environment was also assessed with a questionnaire. This asked people how satisfied they were with their home, neighborhood, the city, and its individual elements, whether they planned to move away in the future, and whether they were satisfied with personal aspects of their lives or life in general. The relationship between their desired and actual residential environments was also used to determine the level of housing deprivation, which indicates how many people have included elements they also assessed as problematic in their residential preferences. In the original survey the questionnaire was sent out to the residents of four selected urban areas in Ljubljana, but this issue is limited to the historical city centre area ($n = 113$). The relationship between quality of the residential environment and quality of life at the citywide level was analyzed with the Quality of Life in Ljubljana (Kos et al. 2010) survey findings. Structural equation modeling and multiple linear regression analysis were used (see Tiran 2016). The particular areas of interest were the impact of the residential environment on quality of life compared to other domains of life. This survey also indirectly sought to answer the question of how much and in what ways city authorities and urban planners can improve the population's quality of life by improving residential conditions.

The subjective method of direct surveying answers many questions about how local residents evaluate the types of freely accessible public areas and how much and in what ways they use them. Of all urban green spaces used for recreation, one or two spaces were selected to represent »hot spots« where people spend most of their free time.

In order to assess environmental awareness and knowledge, Smrekar (2006a, 2011) conducted an extensive survey on drinking water provision in Ljubljana. The survey covered several levels, such as setting environmental priorities, knowledge of the issue, a hypothetical willingness to pay for environmental costs, and the extent of commitment to environmental action reflected in actual environmentally-friendly actions taken. Similarly, a comprehensive survey was used to assess active environmental action among 302 community gardeners as direct users of space and water in the Ljubljana area. We also used the multi-level approach to collecting information in this survey. The latest Polajnar Horvat (2015a) study, in addition

to a large-scale, multilevel environmental awareness study on water use among 408 individuals in Ljubljana, also included an actual six-month measurement of changes in household behavior that offered insight into actual behaviors. Socio-geographical factors were also measured in these surveys. The dimensions of environmental action were measured by individual statements using a 5-point Likert scale (5 – strongly agree, 1 – disagree).

The Polajnar Horvat (2015a) study assessed claimed environmental awareness at the first, hypothetical level, and actual willingness to carry out environmentally-friendly actions was assessed at the second level. The final, third level examined the extent of committed environmental actions, as measured by indicators of actual environmentally-friendly practices. This method views the individual as both the causer and the receiver of environmental changes and an active or passive landscape modifier (Smrekar 2011). The advantage of this questionnaire over most comparable ones is in determining the active function of the environmentalist body as measured by indicators of actual behavior. The three-level question structure largely succeeded in eliminating the bias toward the socially more desirable answers, which can be observed to a greater extent at lower levels. Method verifications by sociologists indicate that respondents often report a higher frequency of desired behaviors (such as visiting libraries and voting) than actual ones, or a lower frequency of behaviors that could damage their reputation (such as drinking alcohol; Malnar 2002). In addition, the questionnaire used a method of transitioning from examining the general attitude toward the environment to assessing the specific attitude toward groundwater and active willingness to protect it. Past research (Kaiser and Shimoda 1999; Stern 2000; Kollmuss and Agyeman 2002) has shown that attitudes toward the environment, environmental awareness, and action itself is predicted more successfully if specific environmental topics are examined and measured, rather than general ones.

The *k*-means clustering method was used to divide respondents into groups according to their characteristics by similarity; that is, each group contains the individuals most similar in the factors studied, and the groups are as different as possible from one other (Polajnar Horvat 2015). The groups thus obtained were analyzed according to the social factors studied, their motivation for environmentally-friendly behaviors, and the behaviors themselves.

4 Ljubljana's development and environmental challenges

Ljubljana, the capital of the Republic of Slovenia (Nared et al. 2017), located in the southern part of the Ljubljana Plain in central Slovenia (Perko et al. 2015), has developed into a political, administrative, economic, transport, and gravitational center, resulting from heavy urbanization in Slovenia and especially in the Ljubljana Plain (Gabrovec and Kumer 2019). Its economic and employment strengths have been growing in recent decades, which is reflected in the increasing concentration of jobs, daily mobility flows, and the expansion of its functional region (Ravbar 2009; Kozina 2010; Bole 2011; Nared et al. 2017).

Ljubljana is at the junction of the Ljubljana Plain in the north and the Ljubljana Marsh in the south, and between the Polhov Gradec Hills in the west and Sava Hills in the east. The city developed along the 1.5 km wide Ljubljana Gate (elevation 298 m), where the Ljubljanica River broke through a low barrier of carbonaceous shale between Rožnik and Šiška hills (394 m and 429 m, respectively) in the west and Castle and Golovec hills (366 m and 450 m, respectively) in the east. It is particularly noteworthy that the Ljubljana Gate is the lowest natural barrier between the Alps and the Mediterranean (Ogrin 2010) and is one of the major transport junctions of the fifth and tenth Pan-European corridors (Pak 2010).

The Sava and Ljubljanica rivers filled the sinking Ljubljana Plain, 60 km long and 20 km wide, with their deposits, forming the plain relief (Šifrer 1969) with the Ljubljana Plain, 20 km long and up to 6 km wide, in the eastern part. A well-permeable gravel embankment with intermediate, less permeable layers of conglomerate and loam was formed in the Pleistocene (Gams 1992). The total thickness of the Holocene and Pleistocene gravel and conglomerate layers varies greatly, because the Quaternary substrate is at various depths. In the carbonate gravel aquifers there is a large amount of groundwater, estimated at up to 100 million m^3, which is one of the largest reservoirs of groundwater in Slovenia and a natural resource of regional importance (Figure 3). The estimated groundwater flow velocity is from a few meters to several dozens of meters per day (Bračič Železnik et al. 2005). The annual groundwater level regime from 1974 to 1990 indicates a small average annual fluctuation, ranging from 20 to 70 cm. Dynamic groundwater reserves are estimated at 3–4 m^3/s (Andjelov et al. 2005).

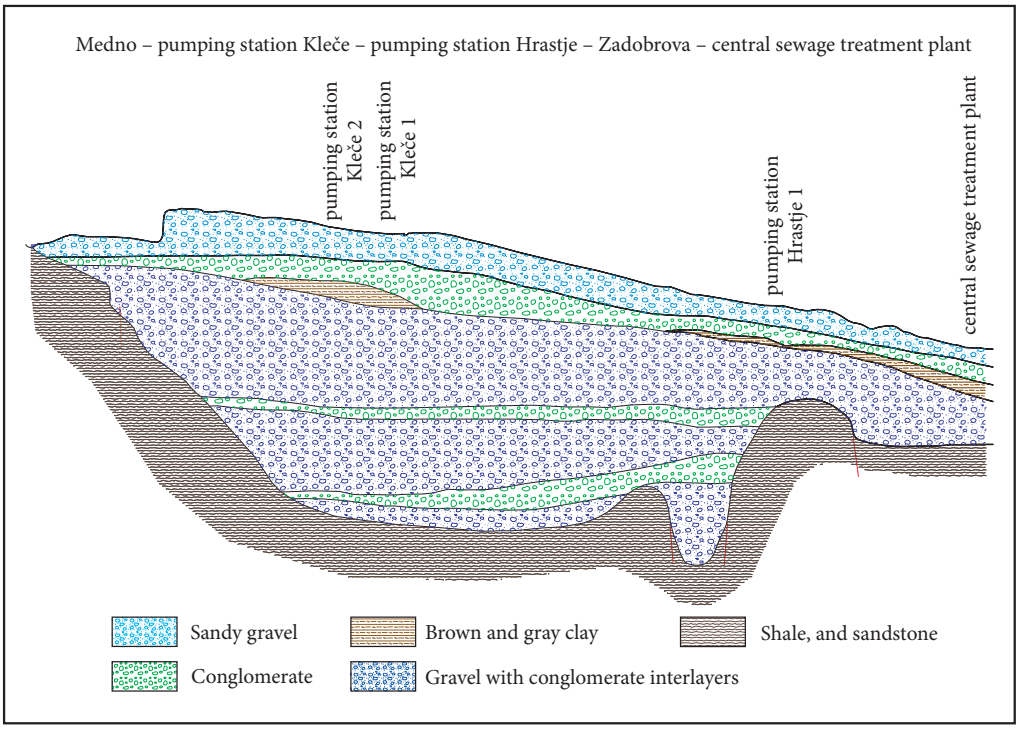


Figure 3: Hydrogeological profile of the Ljubljana Plain (Bračič Železnik et al. 2005).

The Ljubljana Marsh is the southern and youngest part of the Ljubljana Plain, measuring 163 km². It is characterized by an extensive bottom with more recent deposits of loam, clay, and lake chalk. This wide tectonic depression is located at the junction of two tectonic units: the older Dinaric and the younger Alpine thrust structures (Gams 1992; Pavšič 2008; Verbič and Horvat 2009). Despite the unstable soils of the Ljubljana Marsh, reflected in subsidence and greater earthquake and flood risk, Ljubljana has been expanding rapidly to the south over the last few decades (Gašperič 2004).

The main water supply for the Ljubljana Plain and Marsh is the Sava River, which is generally followed by groundwater, whereas the precipitation infiltration throughout the Ljubljana Plain is smaller (Auersperger et al. 2005). A larger surface watercourse in the Ljubljana Plain is the Ljubljanica River. Its flow is slow, and a bed full of fine-grained sediment severely restricts the exchange of water between the river and the aquifer (Ristić 2013).

Due to a sinking groundwater level, which mainly results from erosion of the Sava riverbed due to a smaller inflow of sediments after the construction of hydroelectric power plants, numerous springs and surface outflows in the northeastern and southern parts of the Ljubljana Plain have dried up (Bračič Železnik et al. 2005). Groundwater level fluctuation is greatest in Brod to the north (6 m), decreasing to 2 to 3 m to the east (Auersperger et al. 2005). The largest anthropogenic impact is extraction, which averages nearly 1 m³/s for drinking water supply alone, and water losses due to soil sealing are also not insignificant, at 0.5 m³/s (Smrekar 2004). The difference in surface and underground inflows and outflows from the Ljubljana Plain is 2.6 m³/s, which can be attributed to several factors in the final balance, in particular water leakage from the aquifer into the Ljubljanica and Sava rivers, industrial water extraction, and groundwater runoff in the area between Podutik and Rožnik Hill (Andjelov et al. 2005).

Between 1,400 and 1,500 mm of precipitation falls annually in the Ljubljana Plain and Marsh, with an average annual air temperature between 8 and 10 °C. Because Ljubljana lies in a plain wind is reduced, heat inversions are more frequent and more pronounced, and there is a greater number of days with fog, most often in September and October (Komac et al. 2020). In anticyclone weather, only local winds are common.

Ljubljana most commonly has northeast winds (in anticyclone weather and after cold fronts) and southwest winds (before cold fronts). However, northeast winds are present only in the northern and eastern parts of the city, because cooler air flows into the city from the surrounding area there (Jernej 2000).

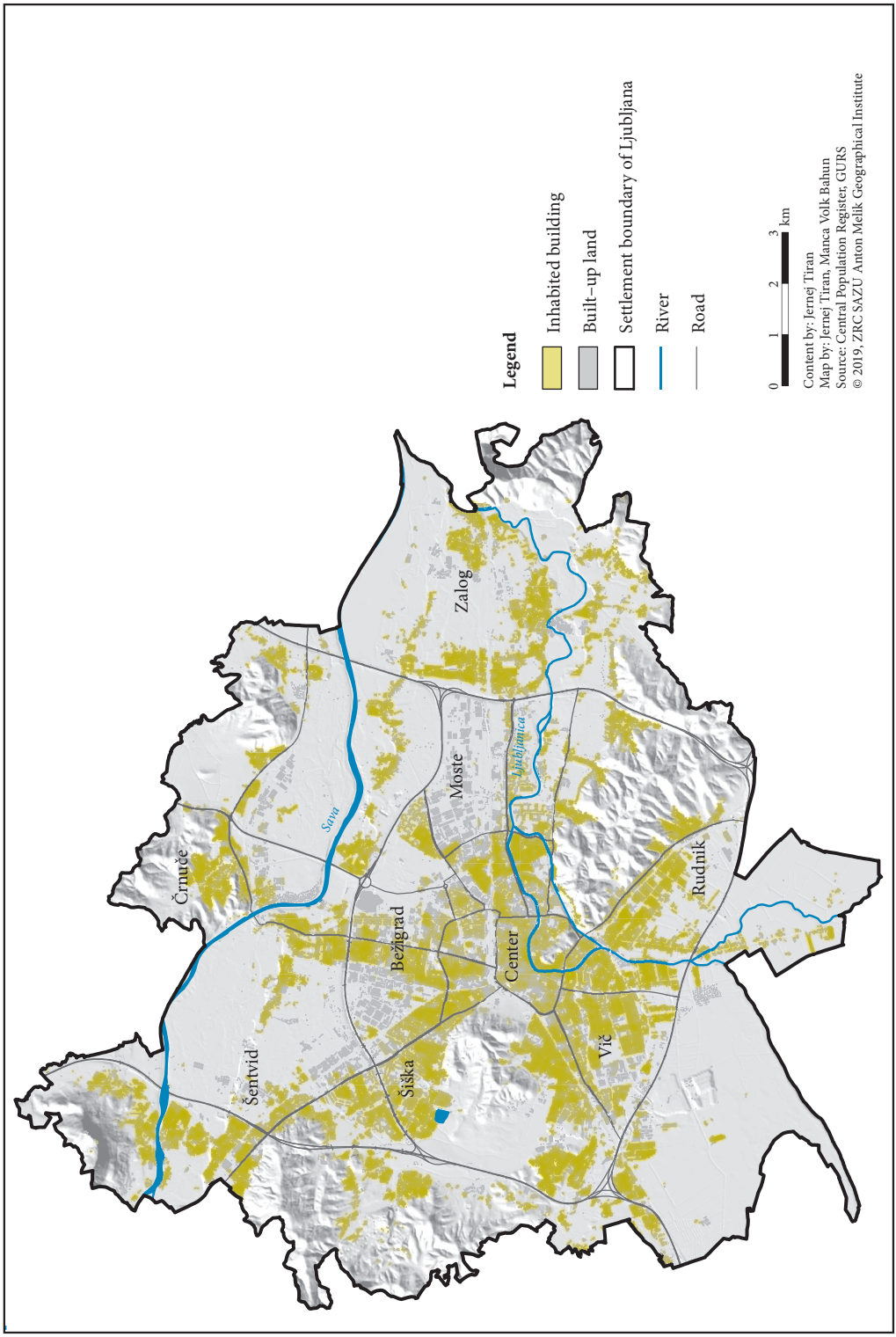
The beginnings of the settlement that developed into the core of today's Ljubljana date back to the Bronze Age, from which traces of human settlement have been found in the elevated area between the Ljubljanica riverbed and Castle Hill (Tičar et al. 2017). The first major settlement was the Roman town of Emona, in the southern part of today's newer downtown area, followed by the medieval development of the city, which developed from three city squares on both sides of the Ljubljanica below Castle Hill. A breakthrough occurred after 1857, when the Vienna–Trieste railway line was built through the city and Ljubljana became increasingly the political, economic, and cultural center for Slovenians within Austria-Hungary. After the severe earthquake of 1895 and the ambitious reconstruction afterward, the city became completely modern in character. After the end of the First World War, when the new southern Slavic state was formed, Ljubljana's role further increased, and by 1931 it already had a population of 60,000. After the Second World War there was a major economic and spatial development and expansion of the city along its thoroughfares, which significantly increased the population (Figure 4). The population was already 267,008 at the time of Slovenia's independence in 1991 (Gams 1992), this number climbed to 294,113 by 2019 (Population 2019). The number of jobs increased from 142,000 in 1997 (Pak 2010) to a whopping 267,000 in 2017 (Internet 1).

Due to the long history and size of its built-up area, Ljubljana has a very diverse functional and morphological structure compared to other Slovenian cities (Tiran et al. 2016). Since Slovenia became independent, Ljubljana has undergone a rapid spatial and functional transformation due to new political, economic, and social conditions such as investment centralization (Ravbar 2009; Foški and Zavodnik Lamovšek 2019). From a spatial point of view, more intensive »internal development« of the city is noticeable, especially in the form of housing construction and rehabilitation and reuse of certain degraded urban areas (Nastran and Regina 2016). There are two conflicting processes taking place in the functional transformation of the city: on the one hand there is increasing functional heterogeneity, including through a mixed land use system, and on the other there is a spatial concentration of certain activities (notably trade). In the downtown area and in the local supply centers, shops are disappearing at the expense of suburban shopping center development (Rebernik 2007), in recent years also due to the rapid development of tourism and the accompanying touristification.

Due to its concentration of population, jobs, services of general interest such as education, health, administration, and the courts (Nared et al. 2017), and business (especially service) activities, Ljubljana is also the traffic hub of Slovenia. Traffic flows were further increased by the construction of the freeway network with Ljubljana at its crossroads (Kozina 2010; Bole 2011). Centralization and suburbanization are also typical (Bole et al. 2012). Ljubljana attracts 127,660 commuters daily (Persons 2018), mostly by car and often alone in a vehicle (Celostna … 2017), whereas poor public transport provision in conjunction with traffic and environmental problems increases the potential for social exclusion especially for young people (Gabrovec and Rasputnik 2018). Due to the intersection of the fifth and tenth Pan-European corridors, the Ljubljana beltway faces increasing freight transport pressures (Celostna … 2018). The latest available information on travel habits shows that most trips are carried out by car and on foot (Figure 6).

Due to the high proportion of commuting routes by car and poor self-cleaning capabilities of the Ljubljana Plain (Plut 2007), traffic is a major air pollutant. Levels of nitrogen oxides, black carbon, and particulate matter exceed acceptable values in Ljubljana's downtown, especially along corridors and also directly adjacent to arterial roads and the beltway (Ogrin 2007; Ivančič and Vončina 2014; Ogrin et al. 2018). Traffic is also one of the main sources of noise. The first noise studies conducted in the 1990s show that the main source of noise in Ljubljana is traffic, especially road traffic (Špes et al. 2002). The situation has not changed significantly since then. More than half of the population are exposed to values above 55 decibels – which, according to the World Health Organization, can cause anxiety or sleep disorders – due to road noise in Ljubljana, and one-sixth of the population experiences values above 65 decibels, which is the limit value for road and rail noise indicators (Novelacija … 2014). The residents' perceptions largely agree with the results of measurements and modeling (Lampič and Cigale 2005).

Figure 4: Index map of Ljubljana with inhabited buildings (Tiran 2017). ➤ p. 20
Figure 5: Morphological structure of Ljubljana (Tiran et al. 2016). ➤ p. 21


Legend
Inhabited building
Built–up land
Setlement boundary of Ljubljana
River
Road
0
1
2
3
km
Content by: Jernej Tiran
Map by: Jernej Tiran, Manca Volk Bahun
Source: Central Population Register, GURS
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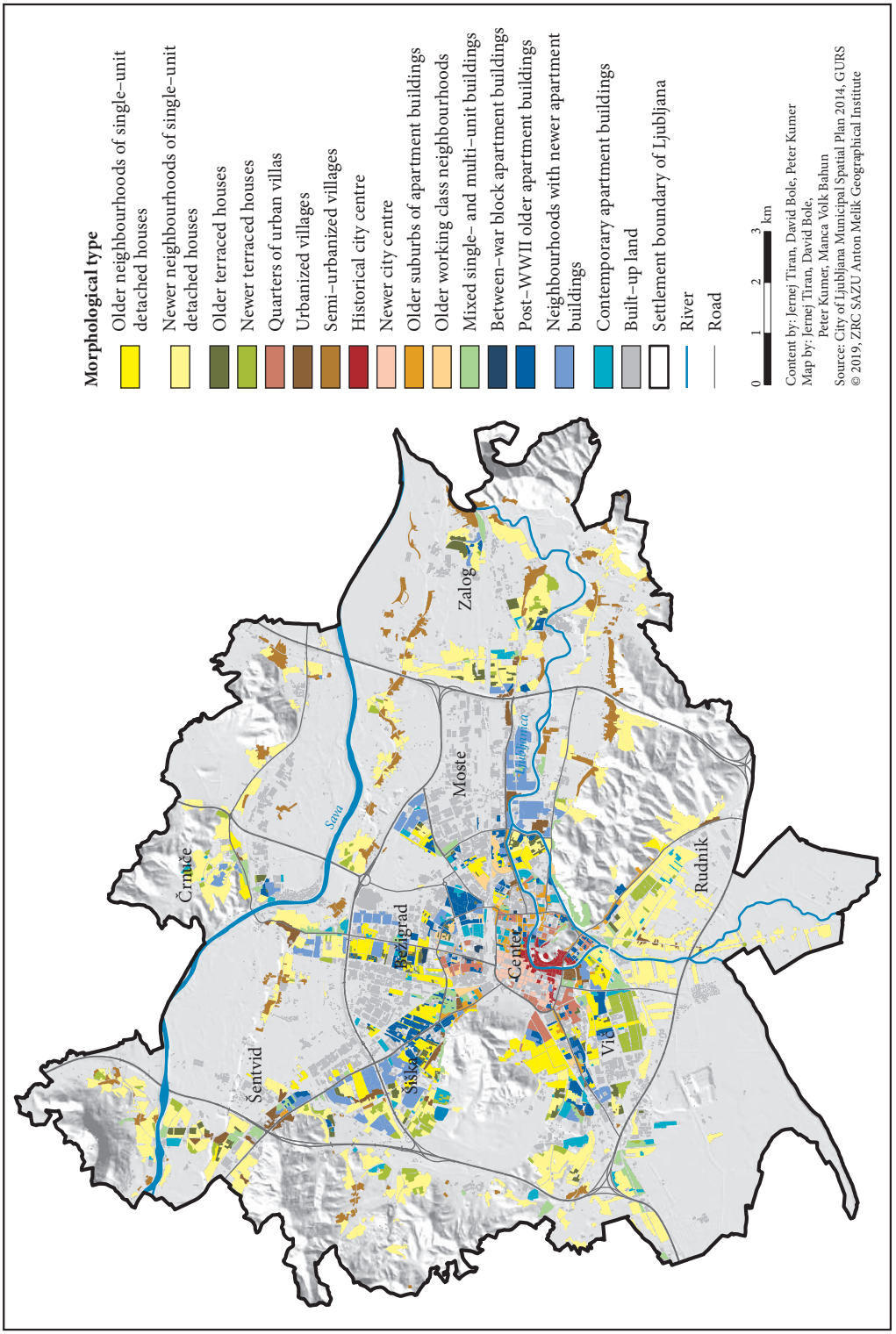
Morphological type
Older neighbourhoods of single–unit detached houses
Newer neighbourhoods of single–unit detached houses
Older terraced houses
Newer terraced houses
Quarters of urban villas
Urbanized villages
Semi–urbanized villages
Historical city centre
Newer city centre
Older suburbs of apartment buildings
Older working class neighbourhoods
Mixed single– and multi–unit buildings
Between–war block apartment buildings
Post–WWII older apartment buildings
Neighbourhoods with newer apartment buildings
Contemporary apartment buildings
Built–up land
Settlement boundary of Ljubljana
River
Road
0 1 2 3 km
Content by: Jernej Tiran, David Bole, Peter Kumer
Map by: Jernej Tiran, David Bole,
Peter Kumer, Manca Volk Bahun
Source: City of Ljubljana Municipal Spatial Plan 2014, GURS
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Šentvid
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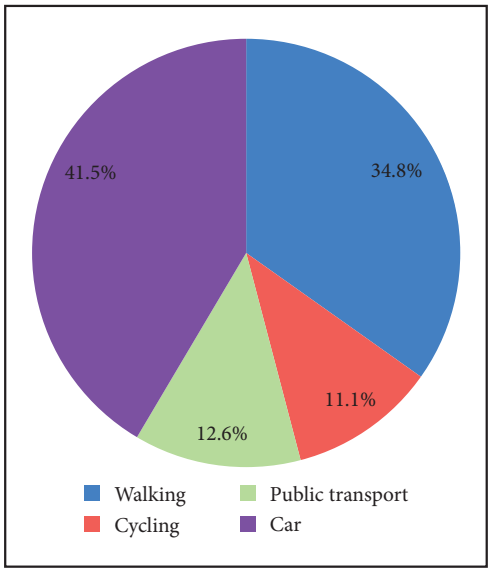


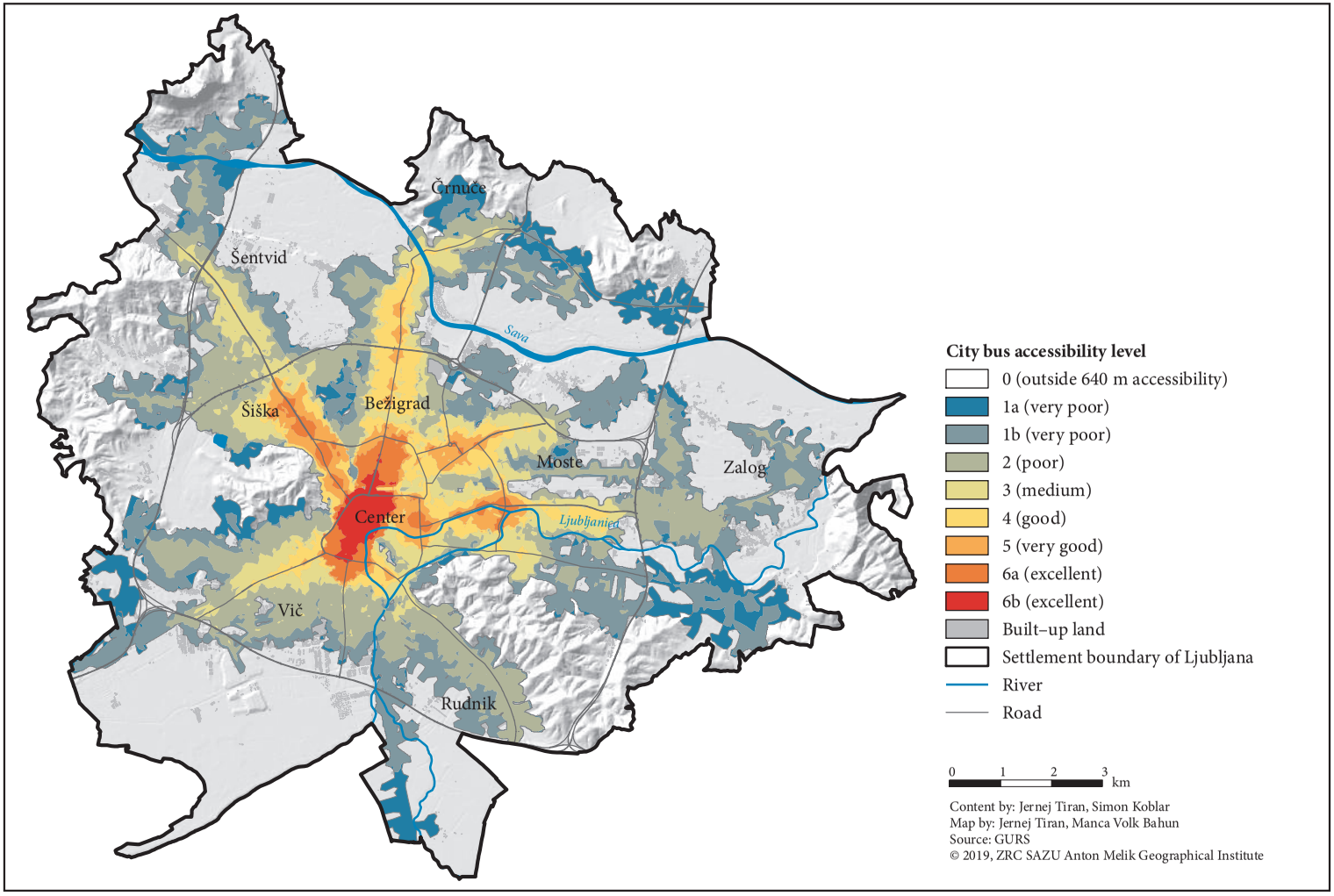
Figure 6: Proportions of completed routes in Ljubljana by travel mode (Klemenčič et al. 2014).

Ljubljana has one of the best public transport systems in Slovenia. It was introduced in 1901 and has been modernized several times since then (Ogrin and Dovečar 2014). However, the proportion of routes using public transport remains at a similar level, indicating its non-competitiveness compared to cars (Klemenčič et al. 2014). Accessibility is best in downtown and suburban Ljubljana and along most arterial roads, where it is at a relatively high level, and worst on the less densely populated outskirts and also in more recently built areas. This is a concern for sustainable mobility. Modern residential areas are significantly less accessible compared to older residential neighborhoods built before 1991. Of the overall population, 93.1% live 640 m (or about eight minutes' walk) from the nearest bus stop, and 78.6% live 400 m (or about five minutes' walk) from the nearest bus stop (Figure 7; Tiran et al. 2017). Gaps in acceptable accessibility (outside the radii listed above) occur in individual parts of the urban periphery.

Ljubljana is characterized by the appearance of an urban heat island. The intensity of the Ljubljana heat island was calculated by comparing weather stations in the city and at the Brnik airport outside the city. The distance between the two stations is 17 km and the altitude difference is 65 m. From 1980 to 2011, the heat island effect was greatest at maximum temperatures (3.74 °C) and lower at average temperatures (1.54 °C) and minimum temperatures (0.79 °C). In addition, these differences increased over the period observed (Komac et al. 2017). Satellite thermal imaging of central Ljubljana (Cedilnik et al. 2016) indicates that year-round hot spots occur mainly in the area of large groups of industrial plants and shopping centers, and are more pronounced in the northern part of the capital than in the south. The most prominent are shopping malls, industrial plants, and warehouses. Large parking areas, which absorb a large amount of heat, contribute to this. Among the »mitigating circumstances« that reduce the heat capacity of these surfaces is the fact that most of them are not enclosed by taller buildings, which allows them to be better ventilated and to cool faster. The heat island also affects air pollution, because city warming causes the air to rise above the city and especially downtown, which triggers air inflows from the outskirts, increasing the concentration of air pollutants in the downtown area, especially nitrogen oxides and dust particles. In Ljubljana, approximately 54% of total NOx emissions were due to traffic in 2011 (Ogrin et al. 2018).

In practice, Ljubljana is torn between a sustainable transport paradigm that places walking, cycling, and public transport at the forefront, and »old« traffic planning that adapts to traffic demand or increases in car traffic. Proof of this is the current spatial plan, which, as a solution to the congestion, envisages the expansion of existing roads, the elimination of bottlenecks, and the construction of many new roads

Figure 7: Access to public bus transport in Ljubljana using the PTAL (Public Transport Accessibility Level) method (Tiran et al. 2015). ►


Črnuče
Šentvid
Sava
Šiška
Bežigrad
Moste
Zalog
Center
Ljubljanica
Vič
Rudnik
City bus accessibility level
0 (outside 640 m accessibility)
1a (very poor)
1b (very poor)
2 (poor)
3 (medium)
4 (good)
5 (very good)
6a (excellent)
6b (excellent)
Built–up land
Settlement boundary of Ljubljana
River
Road
0 1 2 3 km
Content by: Jernej Tiran, Simon Koblar
Map by: Jernej Tiran, Manca Volk Bahun
Source: GURS
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and even tunnels (Odlok o občinskem … 2010). From the sustainable mobility perspective, some of the measures implemented are problematic: the completion of the »inner beltway« (the Fabiani Bridge) was carried out expressly in favor of motor traffic. There is a tendency to expand activities to the urban periphery in the vicinity of the beltway (shopping centers, higher education institutions). The number of urban public transport passengers is stagnant or declining (Tiran et al. 2017), and accessibility is decreasing, especially due to the reduced frequencies of public transport on city arterial roads (Bole et al. 2016). Although urban public transport has seen some improvements (increased travel speed on *Slovenska cesta*, updating the fleets, extended lines to the surrounding countryside, dedicated bus lanes on some arterial roads), these measures are incomplete. The city bus, with a few exceptions, remains uncompetitive compared to car travel, with longer travel times and also an outdated and dysfunctional route network (Koblar 2017). The construction of new parking garages in the urban core is also problematic because of its car-friendliness, and parking lots also occupy certain undeveloped, degraded land in the core that is slated for development in the future. Data show that after the closure of *Slovenska cesta* in the downtown area and the introduction of yellow bus lanes on arterial roads such as *Celovška cesta* and *Dunajska cesta*, the amount of traffic on these roads decreased, and the amount of traffic on parallel roads such as *Bleiweisova cesta* did not increase as much as it decreased on *Slovenska cesta* (Koblar 2016). Measures to limit car traffic were therefore effective despite predictions to the contrary.

In 2007, a systematic closure of the downtown area to motor traffic was begun, at which time it was closed, including the former main route through it. Traffic was diverted to the adjacent roads of the »inner beltway,« which avoids the downtown area. At the same time, downtown streets were completely closed, with some allowing restricted motor traffic. Driving and parking on these streets is only allowed for vehicles with permits. In 2013, a part of *Slovenska cesta* between *Šubičeva cesta* and *Gosposvetska cesta* was closed to private vehicles.

Currently, twenty-one streets in or near the historical city centre are intended for pedestrians and cyclists only. Also, in view of limiting the detrimental effects of motor traffic, the introduction of one-way streets and regulation and the expansion of paid parking areas toward the city's outskirts were positive measures.

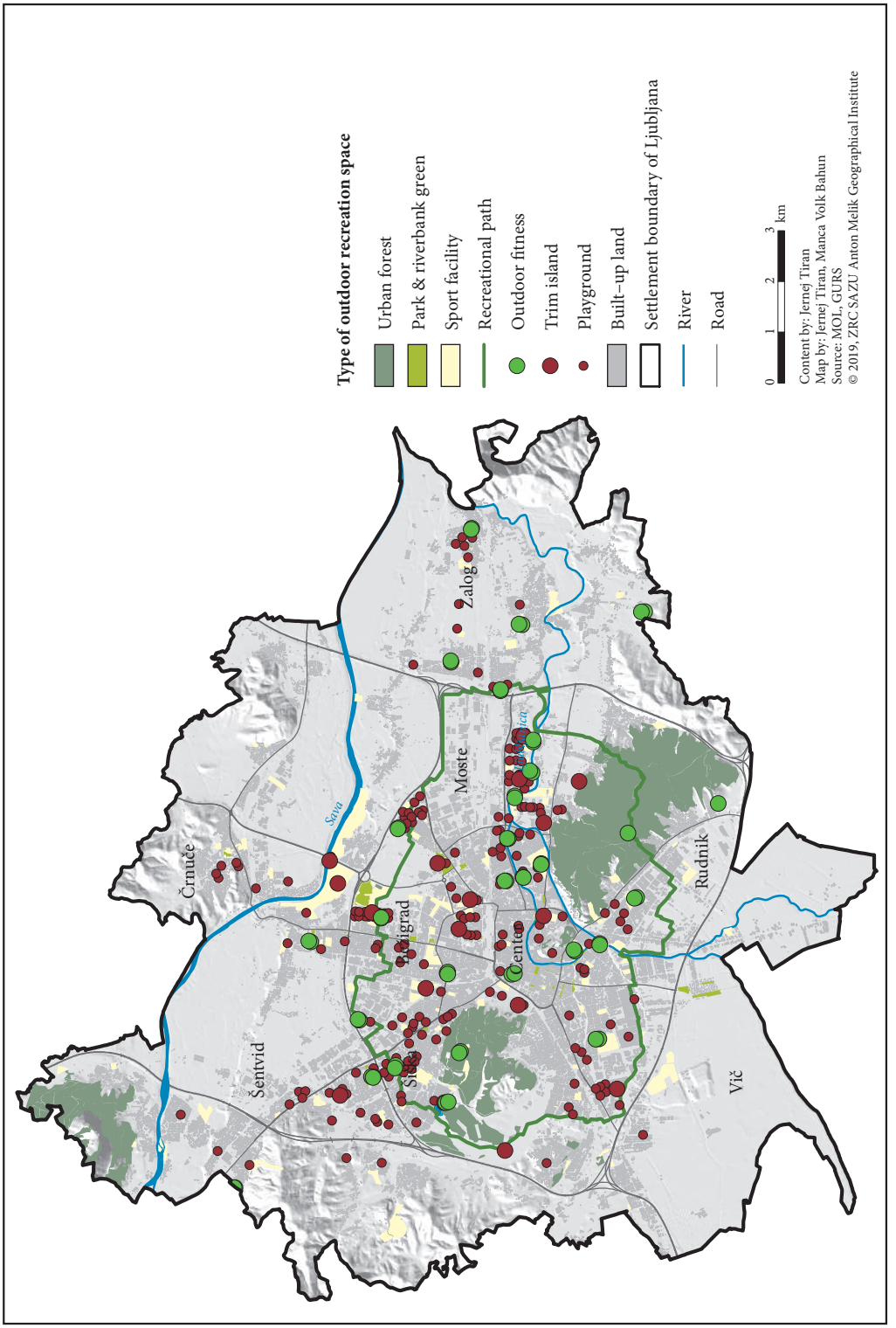
Ljubljana has also undertaken a systematic promotion of bicycle commuting, including the introduction and designation of new bicycle lanes, the provision of secure bicycle parking through the installation of stands and the introduction of a bicycle rental system at several accessible points throughout the city core called *BicikeLJ*, which complements public transport system. For those with difficulty walking, access to all major destinations in the city's pedestrian zone is provided with three free electric vehicles, the »Cavaliers« (Mobilna … 2012; Internet 1).

Cycling is not only important from the perspective of maintaining a healthy environment, but also for maintaining the healthy lifestyle of the residents and visitors to the city. Accordingly, the development and operation of functional green urban areas, which play an important role in recreation, is also important for modern sustainable cities. Green urban areas in Ljubljana have a rich continuity, based on the natural and cultural heritage of urban gardens (initially private and later public), parks, and later also urban forests, so their role is wider, offering cultural ecosystem services that enrich the emotions and senses, and thus are »places of senses.«

5 Green spaces in Ljubljana

Modern European cities are sustainable (LEIPZIG … 2007), smart, and green, or at least striving for it. Green cities have a functioning and effective system of green urban areas such as parks, gardens, markets, cemeteries, community gardens, and forests, and also protected grasslands or forested areas in the wider urban and suburban system (Smrekar and Tiran 2013; Wood et al. 2017). The green environment is of paramount importance for human health and wellbeing within a predominantly built-up environment (Ward Thompson et al. 2012; Wolch et al, 2014) and provides cultural ecosystem services (Millennium … 2005). In order for people to develop more awareness of the importance of the environment, they need to have enough free time that they feel the need for a quality environment. Therefore, people need to change their

Figure 8: Recreation areas in Ljubljana. ►


Type of outdoor recreation space
Urban forest
Park & riverbank green
Sport facility
Recreational path
Outdoor fitness
Trim island
Playground
Built–up land
Settlement boundary of Ljubljana
River
Road
0
1
2
3
km
Content by: Jernej Tiran
Map by: Jernej Tiran, Manca Volk Bahun
Source: MOL, GURS
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Črnuče
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lifestyles so that spatial values become an integral part of them. This is the only way to maintain a healthy environment, which is especially true of the urban environment (Smrekar 2007).

Most of the urban green areas in Slovenian cities are poorly designed, offer few activity and recreation options, have indistinct typologies and purposes, are poorly managed and maintained, and also used inappropriately (Šuklje Erjavec 2006). As a result, green spaces are increasingly exposed to construction pressures and, as a result, our cities are losing important potential for planning solutions that can increase the quality of life.

However, the urban green space situation is improving, especially in larger cities such as Ljubljana, Maribor, Celje, Velenje, and Koper. Urban green spaces have been consistently maintained in Ljubljana for the past two centuries through spatial and socioeconomic development, with changes to their shape, size, purpose, protection, and popularity. Residents' attitudes toward different types of green spaces are emphasized here. Particular attention is paid to recreation and sports, which are the most common cultural ecosystem services and indicate changes in services over time (Figure 8; Ribeiro and Šmid Hribar 2019). They are seen in various land-use types in Ljubljana, which is also consistent with the European perspective (Kenward and Sharp 2008). They are especially prominent at Tivoli, Rožnik, and Šiška Hills Landscape Park, which extends into the downtown area. The promotion of healthy lifestyles, the desire for physical activity in a quality environment, and good transport accessibility significantly increases the amount of leisure time spent in protected and other unspoiled areas (Mavri 2018).

5.1 Green infrastructure in Ljubljana

The deliberate planning of urban green spaces in Europe only began after the industrial revolution in the first half of the nineteenth century and the emergence of the first environmental problems of rapidly growing industrial cities (Smrekar and Tiran 2013).

The cornerstone of Ljubljana's green system is green wedges, which are connected by pointedly circular and transverse connections and a network of public parks. These green wedges descend from the periphery into the city, with Rožnik and Šiška hills and Castle Hill extending right into the downtown area, comprising a green belt along with the surrounding area (Smrekar and Tiran 2013). Ljubljana has a good structure of parks both small and large, including small public green spaces between apartment buildings, which are often characterized by management difficulties due to ownership issues (Simoneti and Vertelj Nared 2017).

The extensive green spaces in Ljubljana were not created from complex plans, but are a response to natural conditions (its position along the river, between hills) and also owe much to certain individuals' efforts (Smrekar and Tiran 2013). At the beginning of the nineteenth century there were extensive urban green areas in Ljubljana on Castle, Golovec, Šiška, and Rožnik hills. The first green spaces in the built-up downtown were public parks. The aristocracy had houses with gardens, and the workers were given a public park – an informal communal environment that nurtured a sense of community, where people interacted with each other, relaxed, and enjoyed their leisure time. Many parks were privately owned and closed to the public, such as the Zois Gardens in Ljubljana, which were opened to the public in 1789 (Smrekar and Tiran 2013). The development of Tivoli Park was also important for the city. Figure 9 (top) shows the green areas of the narrow (medieval) core of Ljubljana on the Franciscan Cadaster of 1826 and the land cover of the parks of that time in today's city (aerial photo from 2016; Figure 9, bottom). Green urban parks that have been preserved in whole or in part since the beginning of the nineteenth century are Star (*Zvezda*) Park (49), Miklošič Park (15), Foerster Park (5), Slovenian Reformation Park (14), and the Knafelj Passage (17).

The main functions of green areas in the nineteenth century and the first half of the twentieth century were walking and sitting; that is, moderate recreation in the fresh air, relaxation, and enjoyment of the outdoors. The recreational aspect of green spaces in cities was first highlighted by the Athens Charter (1933), which had a major impact on urban planning development in Slovenia after the Second World War. In the 1950s and 1960s, the design and construction of new housing developments (e.g., *Litostroj*

Figure 9: Green urban parks in 1826 and a comparison with the situation in 2016, when most had been built-up. A part of Ljubljana where the site of a beautiful city park from 1826 is now densely built-up is highlighted as an example. ►


Year 1826
S. Peter Vorstadt
Polana Vorstadt
Stadt Laibach
Vorstadt
Year 2016
Content by: Mateja Breg Valjavec
Map by: Mateja Breg Valjavec, Manca Volk Bahun
Source: GURS
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and *Savsko naselje*) took into account the importance of green spaces, but these were limited to ornamental plantings with an aesthetic touch but without useful value to the residents (Jančar 1970). In the 1970s, urban planning (*Generalni* 1965) considered green urban areas to be just as important as the built environment. Numerous well-planned neighborhoods of apartment buildings were created at that time, with many green spaces and a 33-kilometer green belt along the route once traced by the barbed wire that surrounded Ljubljana during the Second World War (Trail of Remembrance and Comradeship; Smrekar and Tiran 2013).

5.2 Evaluation of urban green spaces

Green areas in Ljubljana are very heterogeneous and diverse, as seen in the previous subsection. This subsection presents how the residents, visitors, and other users perceive and experience urban green spaces. Direct surveying was implemented to provide information on how the local residents evaluate the selected types of freely accessible urban green spaces and how much they use these areas. Smrekar, Polajnar Horvat and Tiran (2018) compiled an inventory and typology of recreation spaces in the City of Ljubljana that are believed to have a certain cultural ecosystem value. They evaluated urban green spaces and their restorative capacities. The typology consists of the following recreation spaces:

- Large urban parks (Tivoli Park),
- Small urban parks (Star Park, Argentina Park, Toscanini Park),
- Green spaces in housing developments (Šiška, Nove Fužine),
- Urban forests (Rožnik and Golovec hills),
- Riverbank green spaces (Ljubljanica and Gradaščica rivers),
- Sport facilities (green spaces; Kodeljevo Park and Svoboda Sport Center) and
- Playground green spaces (Šmartno Street and Kodeljevo parks).

The types of green spaces in Ljubljana described here play different roles in people's minds and perceptions in terms of recreation, and they see them as represent different cultural ecosystem services. Recreational and sports green spaces (Figure 10) matter most to the middle generation; that is, to active

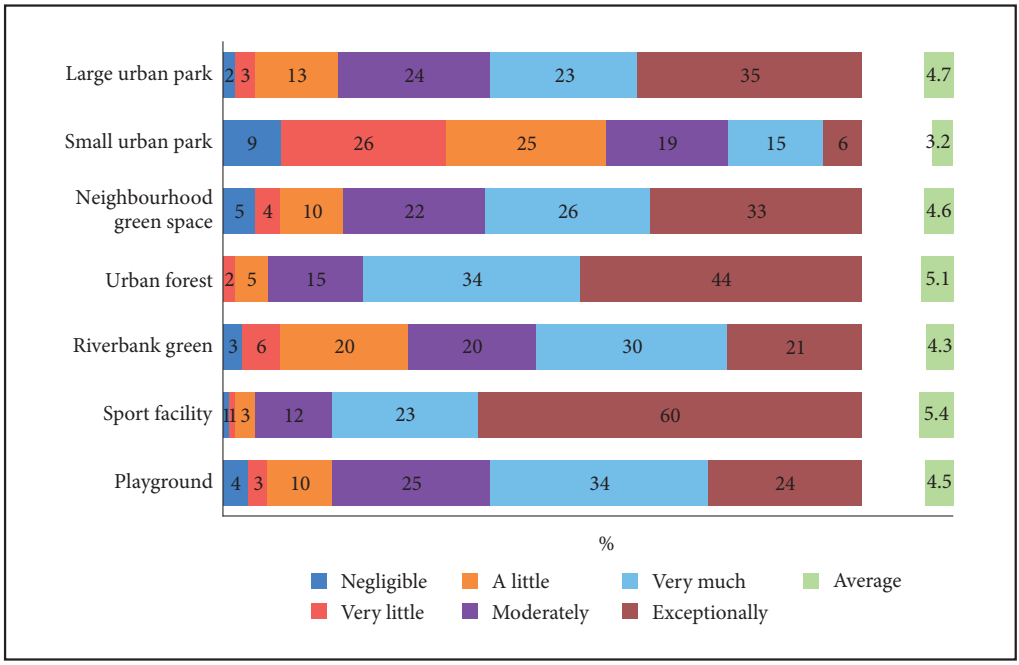


Figure 10: Assessment of recreation and sports values of different types of urban green spaces among Ljubljana residents.

urban residents that are aware of a healthy lifestyle. Residents generally do not recognize small urban parks as valuable spaces suitable for recreation and sports, but their functions are seen as more aesthetic. However, residents are most likely to satisfy their aesthetic needs in well-maintained and well-equipped children's playgrounds, the large and beautifully landscaped urban park, and waterfront areas, of which there are many in Ljubljana. Residents gave urban forests a surprisingly low rating, because 13% of them evaluated them as negligible or less valuable areas. A »wilder« and »more unkempt« natural environment obviously does not seem inviting to urban residents, which is probably a consequence of their greater alienation from more pristine natural environments. On the other hand, residents relax the most precisely in the urban forests, followed by the large urban park, waterfront areas, and green sports areas. The most people (51%) also determined that sports areas were exceptionally valuable to them. This is in line with the findings of Beiling et al. (2014), that more natural areas are more attractive than ones showing greater human intervention.

From the natural heritage protection point of view, residents see Tivoli Park (Figure 11), a large urban park, as most important, closely followed by the Ljubljanica waterfront; surprisingly, the urban forests are not ranked the highest and, even more surprisingly, the sports areas have the same score and even the highest share of people answering »extremely valuable« (32%). This aligns with the Plieninger et al. (2015) study findings that residents only rarely have contact with more natural areas, and thus they feel better in a more urbanized natural setting. There is a positive correlation between attributing more importance to natural heritage and education.

The green areas that evoke the most emotion are the waterfront areas. It is interesting that only one-tenth of the respondents rated this space »extremely valuable« but as many as 46% rated it »very valuable.« Green spaces in housing developments are most perceived as »extremely valuable« (by 27% of respondents).

Residents draw inspiration most often from sports facilities, but just behind these are waterfronts, green areas in housing developments, and playgrounds (each at 4.2). Surprisingly, urban forests only appear on the list after that (4.1), followed by the large urban park (4.0). People with a primary school education are least likely to draw inspiration from public outdoor spaces (3.7), whereas people with higher education levels are significantly more likely to, and at relatively similar levels (from 4.0 to 4.1).

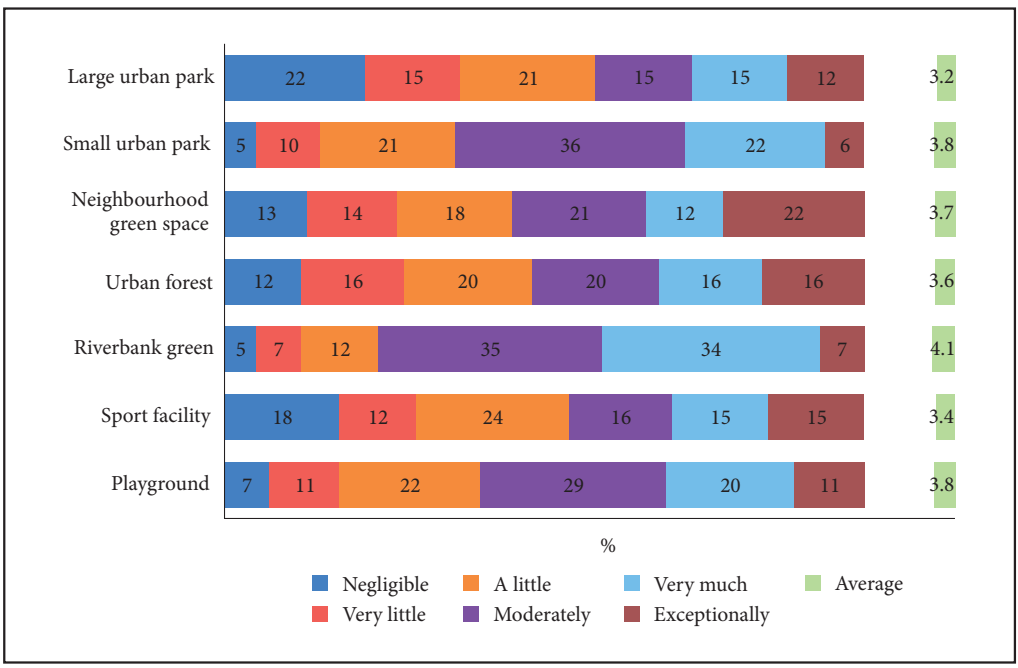


Figure 11: Ljubljana residents' rankings of the wellbeing benefits of various types of urban green spaces.

Residents mostly seek out waterfront areas for mental relaxation, although these were given the highest rating of »extremely valuable« by only 7% of respondents, placing waterfronts only in sixth place on the list of nine. This is followed by small urban parks and playgrounds, each at 3.8 (Figure 11). People have the greatest sense of »escape« from everyday life in the urban forests (4.7), which is unsurprising, because they gave similar answers on the recreation survey as well. The other place mentioned as offering a sense of escape is sports facilities (4.6). One of the reasons for this is an increasingly greater emphasis on recreation and sports activity. In recent years recreation as a way to spend leisure time has grown considerably. A third place offering escape is green spaces in housing developments (4.4).

Respondents report the feeling of »fascination« most in waterfront areas (4.26) and least in small urban parks (3.63) and green spaces in housing developments (3.82), which is probably because they are used every day. They have the strongest feeling of »coherence« in the old part of the city (4.53), at sports facilities (4.48), and at playgrounds (4.42). They feel the least coherence in small urban parks (3.72) and urban forests (3.76), probably due to their alienation from nature.

The greatest sense of »compatibility« is characteristic of sports facilities (4.86) and the large urban park (4.78), and the least in small urban parks (3.97). The greatest sense of »novelty« is felt in urban forests (4.4) and the least in green spaces in housing developments (3.59) and small urban parks (3.79).

The feel of »dissatisfaction« is very low in all the urban green spaces selected. Residents feel it the least in the large urban park (1.3), where 73% rank it as insignificant, and they feel it the most in green spaces in housing developments (1.9).

The same is true of »fear,« for which rankings range from 1.2 (shopping centers and small urban parks) and 1.5 (urban forests). Residents are bothered more by noise, surprisingly least of all in green spaces in housing developments (1.6) and more logically in urban forests (1.8).

Residents most often visit green spaces in housing developments, at 46% daily and 38% several times a week, and sport facilities (37% daily and 38% several times a week). They least often visit shopping centers (6% once a year or less and 31% a few times a year) and urban forests (4% once a year or less and 23% a few times a year; Figure 12).

Residents spend the longest in urban forests (48% of respondents spend more than 60 minutes and 39% of respondents spend from 41 to 60 minutes). On the other hand, they spend the least time in small urban parks (34% of respondents spend 20 minutes or less and 36% of respondents spend from 21 to 40 minutes), which they pass through on the way to various errands or are directly adjacent to their homes (Figure 13).

Ljubljana residents most often go for walks in selected urban green spaces, because 65% of respondents do this. More than nine-tenths of these walks are in urban forests (91%). More than half (53%) sit on benches or the ground, generally in waterfront areas (73%) and small urban parks (68%), and the least in urban forests (27%). Residents also enjoy sitting at cafes, bars, and restaurants and sports facilities (68%). They frequently conclude their sports activities by sitting at a nearby cafe, bar, or restaurant.

More pristine natural settings, in this case urban forests, have greater recreation capacity than less natural areas (Paracchini 2014). Thus the 18% of residents that run most often do this in urban forests (44%) and significantly fewer at sports facilities (28%). Dog walkers make up 16%, most often also in urban forests (27%) and sports facilities (24%). Another fifth of the population are involved with all other sports.

Among the outdoor green spaces within a ten-minute walking distance, green spaces in housing developments (81%) are visited most frequently, followed by urban forests (57%) and outdoor sports facilities (56%). Urban forests are mostly used only by residents living nearby, whereas others obviously do not recognize them as having significant ecosystem value.

Green recreational spaces are often a good way to improve degraded areas, something that has also taken place in Ljubljana. A golf course has been built on disused and remediated landfill sites of the city waste disposal area.

The new recreational area on the right bank of the Sava River is a revitalized area where large amounts of construction waste were dumped at the beginning of the twenty-first century. Nevertheless, Ljubljana has a heritage of degraded areas that are the result of past human activity and the destruction of the natural balance, and they will need to be addressed in the further urban and suburban development of Ljubljana. This topic is discussed in the next section.

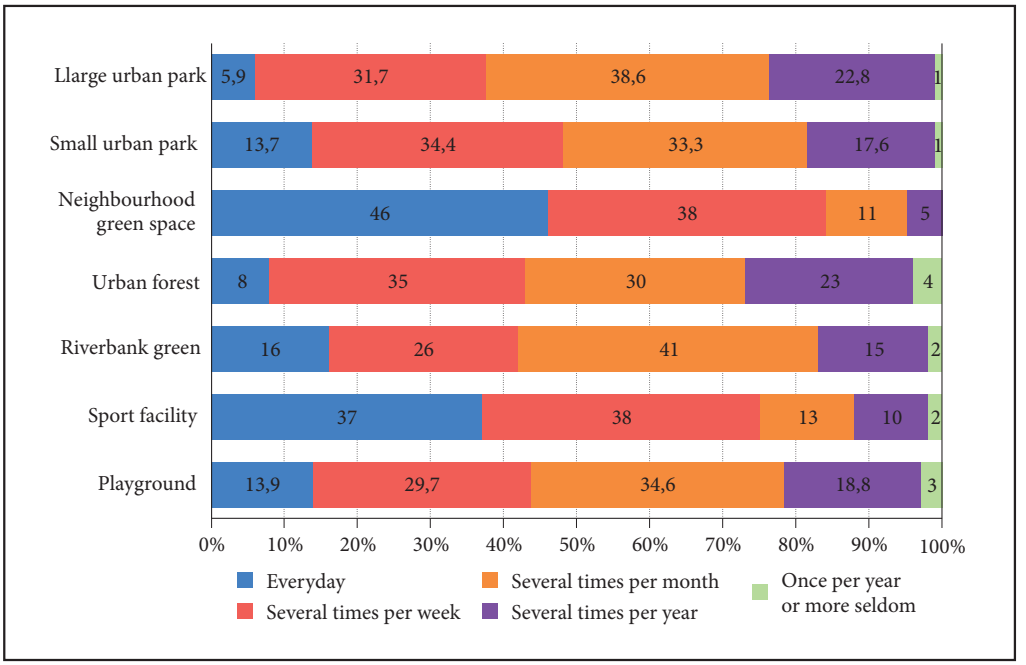


Figure 12: Frequency of visits to urban green spaces by Ljubljana residents.

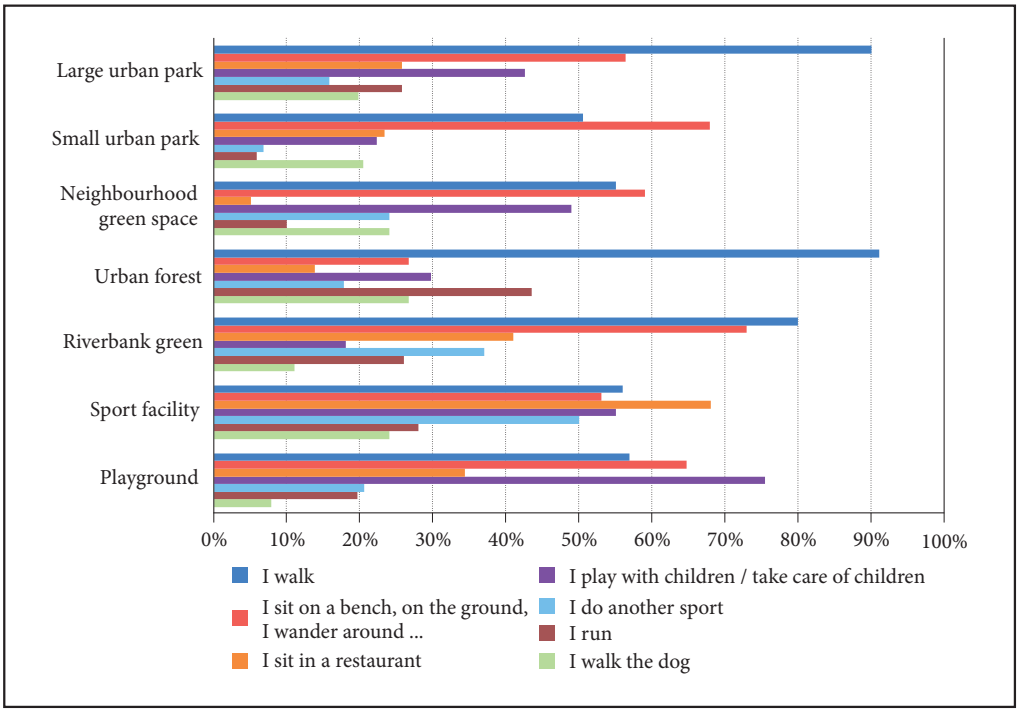


Figure 13: Types of recreation among Ljubljana residents by selected urban green spaces.

6 Anthropogenic degradation of urban and peri-urban Ljubljana

Degradation is caused by various human activities in the landscape that have varying impact on different landscape elements. In cities, soil is permanently degraded through construction, and air is frequently polluted by industry and traffic (Ogrin 2007; Ogrin and Vintar Mally 2013). In most western European industrialized cities, industry and mining have caused the longest-lasting effects even in peri-urban areas, in the form of disused mines, polluted watercourses, polluted aquifers, and devastated agricultural land. The effects of anthropogenic degradation in urban areas differ from those in peri-urban spaces.

During the communist era, from the mid-twentieth century to the 1990s, Slovenia was characterized by ineffective implementation of environmental regulations and »industocracy« (Breznik 1988). This means that industry had such powerful influence on policy and management, both in Slovenia and Ljubljana, that it was able to pollute the environment for many years without consequences (Smrekar and Breg Valjavec 2014). In the 1970s and 80s, industry in Ljubljana was characterized by:

- Great heterogeneity (almost all industrial sectors were represented);
- Fragmented capacities;
- Actual and technological obsolescence of facilities and equipment;
- Insufficient automation of technological processes;
- A considerable focus on imported raw materials.

Landscape changes that have taken place over the past half-century result from changes in mindset more than from official measures (Urbanc and Breg 2005). In recent decades, Ljubljana has also expanded into former agricultural land. Many vacant areas have emerged in the immediate vicinity of the water utilities in the Ljubljana Plain north of the city, which are now being used for squatter gardens, illegal extraction of water and gravel, and illegal dumping. The area is easily accessible, crisscrossed with trails, and the unregulated ownership further promotes illicit and undesirable activity. The main reason for these environmentally-unfriendly conditions is undoubtedly the lack of a mature attitude toward the living environment (Smrekar 2006a).

Groundwater monitoring in the Ljubljana Plain shows that groundwater contains pollutants originating from past or contemporary industrial production (Cr^{6+}, tetrachloroethylene, trichloroethylene; Janža et al. 2005), so this area has been thoroughly examined in the last two decades. The study focused on an analysis of the situation and a search for sources of pollution, both those impacting the environment in the past (Smrekar and Breg Valjavec 2014) and those created by modern production facilities and warehouses.

This section focuses on the issue of illegal dumping sites in Ljubljana and their potential producers, as well as past and current locations.

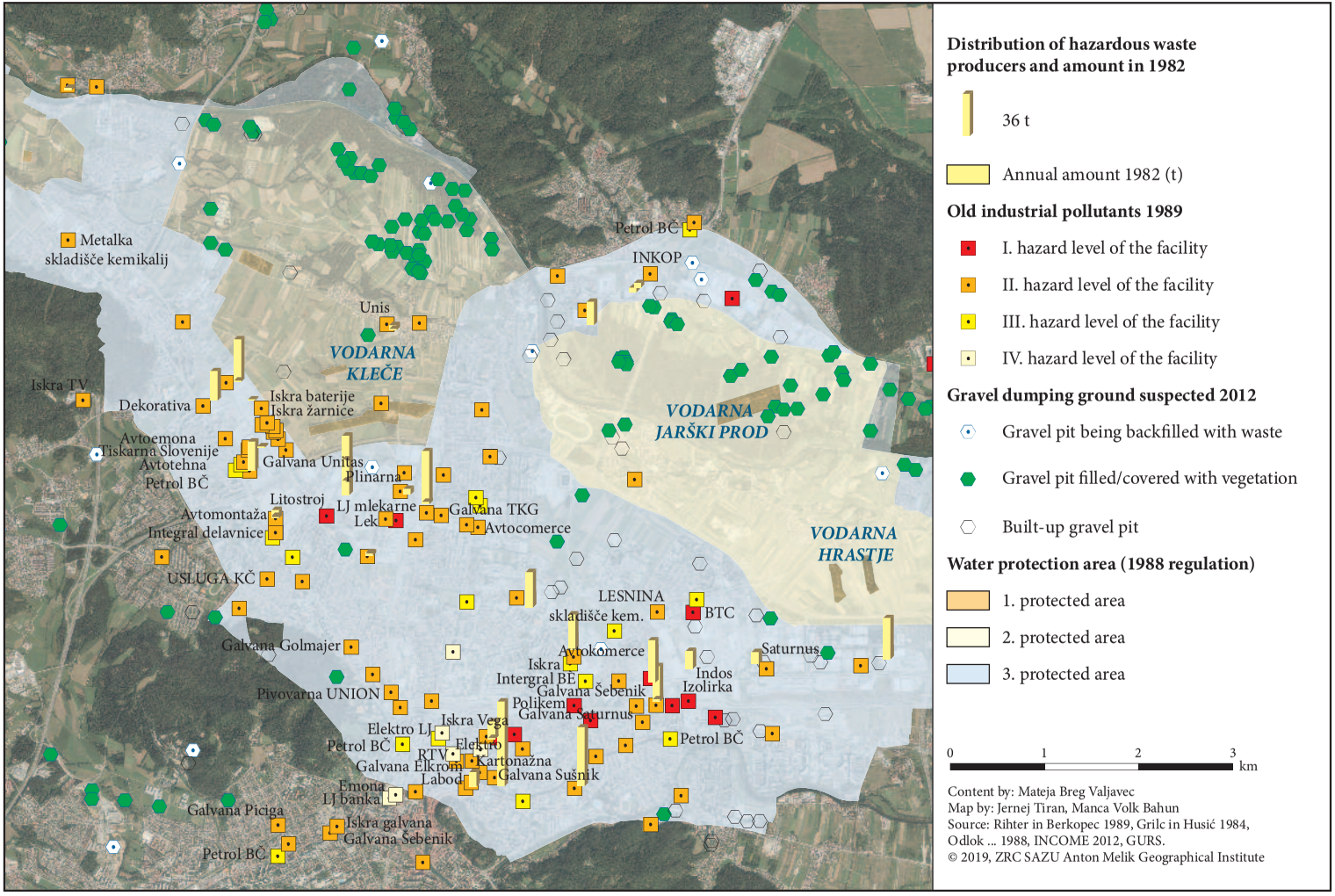
6.1 Sources of hazardous industrial waste

In the Ljubljana area, which is now almost entirely a water protection area for drinking water, at least 170 plants were operating in the 1980s (Figure 14) that produced or stored environmentally hazardous substances (Grilc and Husić 1984; Rihtar and Berkopec 1989). These plants mainly engaged in machinery and metalworking activities (metal processing, electroplating, painting, machine-making, machinery and vehicle servicing), food production (breweries, dairies), chemical production (pharmaceuticals, paints, chemical treatment equipment, production and storage of chemicals), and other activities (textile industry, petroleum product storage).

Today's land use in known areas of hazardous activity from the 1980s is quite diverse. It encompasses 309 business units (Figure 15) located on the grounds of the 170 former plants. Their primary activities have the potential to pollute groundwater used as drinking water. We found that 76% of sites (130 out of 170) still have activities that produce, store, or sell hazardous substances. These tend to be larger areas, whereas smaller ones have more often been transformed.

At the Ljubljana urban regional level, Bole (2008) notes the decentralization of business activities from the city to suburbanized areas. Our study findings can only partially confirm this, because despite the

Figure 14: Former hazardous waste producers (as of 1989), quantity of waste generated (as of 1982), and the condition of gravel pits as potential sites for industrial waste disposal on the Ljubljana Plain at that time (Smrekar and Breg Valjavec 2014). ►


Metalka
skladišče kemikalij
Unis
VODARNA
KLEČE
Iskra TV
Dekorativa
Iskra baterije
Iskra žarnice
Avtoemona
Tiskarna Slovenije
Avtotehna
Petrol BČ
Galvana Unitas
Plinarna
Litostroj
LJ mlekarne
Lek
Galvana TKG
Avtomontaža
Integral delavnice
Avtocomerce
USLUGA KČ
Galvana Golmajer
Pivovarna UNION
Elektro LJ
Petrol BČ
RTV
Elektro
Galvana Elkrom
Kartonažna
Galvana Sušnik
Labod
Emona
LJ banka
Galvana Piciga
Iskra galvana
Galvana Šebenik
Petrol BČ
Petrol BČ
INKOP
VODARNA
JARŠKI PROD
VODARNA
HRASTJE
LESNINA
skladišče kem.
BTC
Avtokomerce
Saturnus
Iskra
Intergral BE
Galvana Šebenik
Indos
Izolirka
Polikem
Galvana Saturnus
Iskra Vega
Petrol BČ
Distribution of hazardous waste producers and amount in 1982
36 t
Annual amount 1982 (t)
Old industrial pollutants 1989
I. hazard level of the facility
II. hazard level of the facility
III. hazard level of the facility
IV. hazard level of the facility
Gravel dumping ground suspected 2012
Gravel pit being backfilled with waste
Gravel pit filled/covered with vegetation
Built-up gravel pit
Water protection area (1988 regulation)
1. protected area
2. protected area
3. protected area
0
1
2
3
km
Content by: Mateja Breg Valjavec
Map by: Jernej Tiran, Manca Volk Bahun
Source: Rihter in Berkopec 1989, Grilc in Husić 1984,
Odlok ... 1988, INCOME 2012, GURS.
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intensive relocation of shopping and service activities to shopping and industrial zones on the outskirts (BTC, Vič, Rudnik), a large amount of preserved old and new (post-Fordist) production remains at the sites of old pre-transition companies. The main industrial area in Ljubljana is the industrial zone between the Kamnik and Upper Carniola railway lines and between the Upper Carniola railway line and Celovec Street (*Celovška cesta*). The area lies above groundwater in the Ljubljana Plain and is a threat to Ljubljana's drinking water supply. The areas have good transport connections and accessibility and well-maintained municipal infrastructure. Individual degraded urban areas remain within the built-up urban space (Koželj 1998; Špes et al. 2012), which over time have either renewed their original industrial role, or their use has completely changed into a tertiary or quaternary activity or residential area (including parks, parking lots, and playgrounds).

Former producers of hazardous waste also left traces of hazardous substances in production sites in Ljubljana due to improper waste handling and disposal, which also affected the transformation or continuity of activities in these areas (Urbanc and Breg 2005; Smrekar 2007; Breg Valjavec 2013). The larger the area, the more difficult it is to convert to other uses; conversely, the smaller the area, the more often its intended use changes (Elliott and Frickel 2011). Areas with »traditional« production of environmentally hazardous substances have a greater negative impact on environmental pollution than smaller areas. Areas that may be contaminated by past production of hazardous substances limit future land use planning, especially if they are above drinking water sources (Smrekar and Breg Valjavec 2014).

6.2 Waste dumping sites

Fieldwork was carried out in Municipality of Ljubljana territory for the first time in 1996 in order to inventory illegal dumping sites (Kobal et al. 1999). This fieldwork identified 457 landfills with a total volume of 32,782 m^3. A few years later (Berden et al. 2004), 278 illegal dumping sites with an estimated total volume of 100,000 m^3 were recorded in Ljubljana's city districts. In both studies, the lower limit of the recorded landfills was 1 m^3 of waste. Comparing data from the two studies reveals that the number of landfills decreased by almost four-tenths between 1996 and 2004, but there was more than three times as much waste.

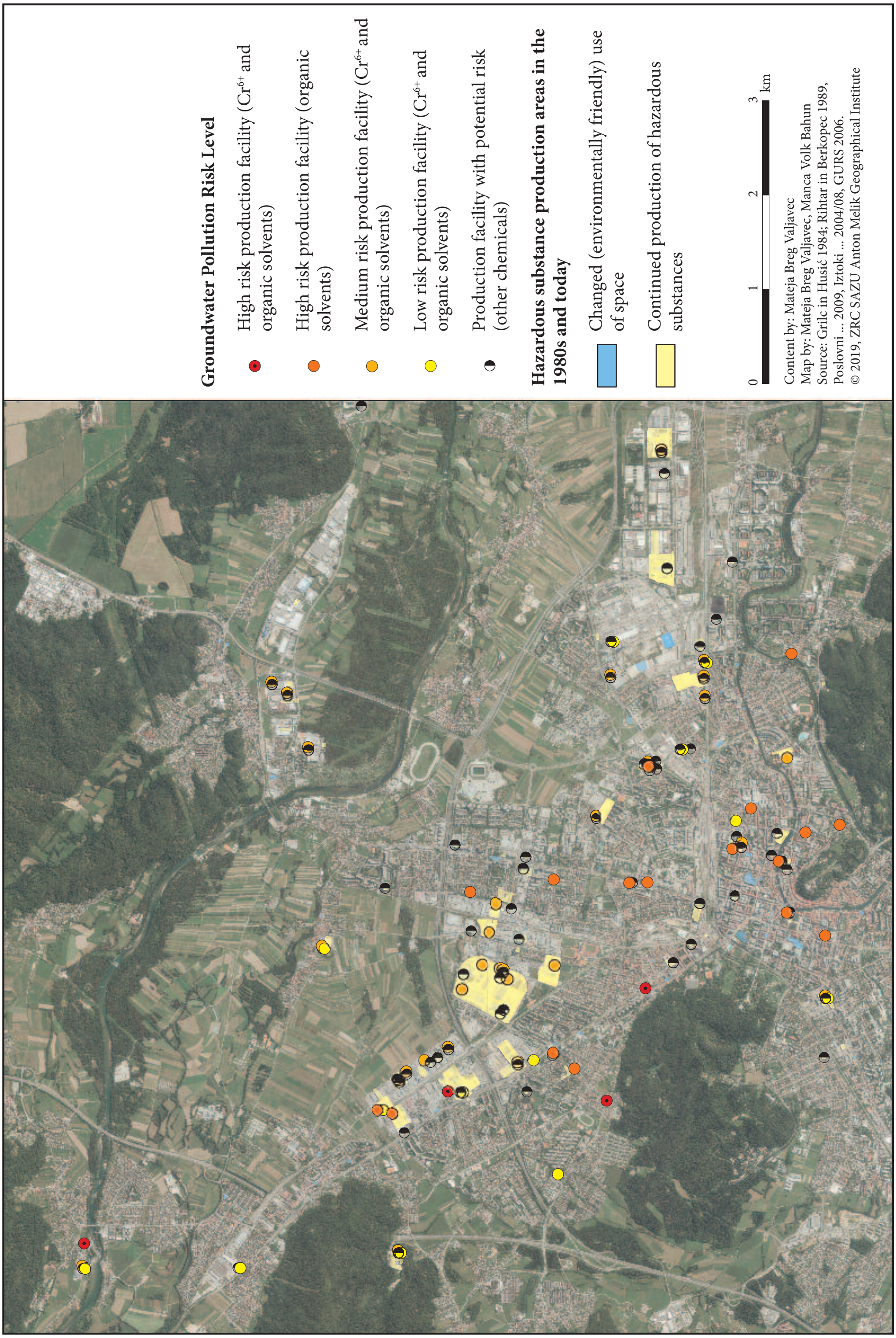
The first thorough examination of illegal dumping sites in Slovenia (Šebenik 1994) was innovative, because its quantitative parameters were much more accurate than in previous studies. Šebenik analyzed 3,501 landfills ranging in size from 1 to 10,000 m^3. The average dumping site was 135 m^2 and had 47 m^3 of waste. Large sites up to 1,000 m^3 accounted for 39% of the waste, which means that smaller landfills are also important in terms of volume and not just because they are so numerous (Breg et al. 2007).

Snaga, the company responsible for waste management in Ljubljana, disposed of 36,499 m^3 of waste from all illegal dumping sites in the City of Ljubljana from 2000 to 2005, following orders from the inspection services (Breg et al. 2007). In a survey conducted in 2006/2007 (Breg et al. 2007), as many as 1,445 illegal dumping sites were discovered and inventoried in the Municipality of Ljubljana water protection areas. Their total area is 120,816 m^2, which means that 0.28% of the total area is covered with waste. It is therefore one of the areas most polluted with illegal waste in Slovenia. The volume of waste is 209,422 m^3. The average dumping site measures 83.6 m^2 and has 145.5 m^3 of waste material.

6.3 Illegal dumping sites' impact on groundwater

Most industrial areas in Ljubljana are located on the Ljubljana Plain with its water-bearing layers of gravel/sand and conglomerate, which make it one of the largest groundwater reservoirs in Slovenia (Bračič Železnik et al. 2005). The largest number of dumping sites recorded a decade ago (760 sites, or 52.6% of all sites, with a total area of 57,340 m^2 or 47.5% and a volume of 118,975 m^2 or 56.8%) are in a designated area with a strict water protection regime. Dumping sites closer to the pumping stations (Water Protection Area I) represent a greater threat, but in these locations there is significantly less waste (71 sites with a total area of 8,589 m^2 or 7.2% and a volume of 10,249 m^3 or 4.9%). The remaining 831 dumping sites are within a defined area with a less stringent regime.

Figure 15: Areas of continuous and modified production of hazardous substances and their risk of groundwater contamination (Smrekar and Breg Valjavec 2014). ►


Groundwater Pollution Risk Level
High risk production facility (Cr^{6+} and organic solvents)
High risk production facility (organic solvents)
Medium risk production facility (Cr^{6+} and organic solvents)
Low risk production facility (Cr^{6+} and organic solvents)
Production facility with potential risk (other chemicals)
Hazardous substance production areas in the 1980s and today
Changed (environmentally friendly) use of space
Continued production of hazardous substances
0 1 2 3 km
Content by: Mateja Breg Valjavec
Map by: Mateja Breg Valjavec, Manca Volk Bahun
Source: Grilc in Husić 1984; Rihtar in Berkopec 1989, Poslovni ... 2009, Iztoki ... 2004/08, GURS 2006.
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Four thematic groups were used to determine the priority order of remediation (Figure 16; Breg et al. 2007). Due to the great weight given to the area's vulnerability in this methodology, it is not surprising that fifty-eight illegal dumping sites in the first priority group are located near pumping stations. Some of them are also downstream of the pumping stations, but pumping out drinking water leads to the formation of depression cones (Bračič Železnik et al. 2005), which means that they are in the stations' catchment areas. Some of the most polluted illegal dumping sites are in former gravel pits, where the groundwater is close to the surface. If hydroelectric power plants were built, the groundwater would rise still further and permanently flood the waste-filled gravel pits (Breg Valjavec, Janža and Zorn 2018). This increased moisture would change the conditions for waste decomposition and the rate of decomposition products' leaching into groundwater.

Analysis of the soil beneath the illegal dumping site in the water protection area of the Jarški Prod pumping station, a dumping site with weathered metal barrels whose contents have already leaked out, did not indicate increased presence of hazardous substances (Breg Valjavec et al. 2008). Despite this, groundwater monitoring indicates that it contains pollutants originating from past or current industrial production (Smrekar and Breg Valjavec 2014). Old gravel pits backfilled with waste are particularly hazardous to water protection areas. Of the eighty-seven gravel pits inventoried on the Ljubljana Plain, only fifteen were empty. Gravel pits started being used this way more frequently after 1958 (Breg Valjavec et al. 2005). A comprehensive approach to the problem, which threatens Ljubljana's water supply (groundwater), has never been undertaken by either the city or the state.

These studies of degradations in Ljubljana's urban and peri-urban areas, carried out in the first decades of the twenty-first century as part of geographical research, provide a very precise assessment of the extent of degradation. They have been published in the form of online lists and interactive maps INCOME (Internet 2) and scholarly volumes (Smrekar 2008; Breg Valjavec 2013). The potential threats due to past industrial activities and unregulated waste disposal in gravel pits, and their impact on groundwater, have been professionally assessed. It is crucial that in the future all these findings be taken into account in planning and implementing spatial development, such as the planned construction of hydroelectric power plants on the Sava River and other development projects in water protection areas.

7 Community gardening in Ljubljana

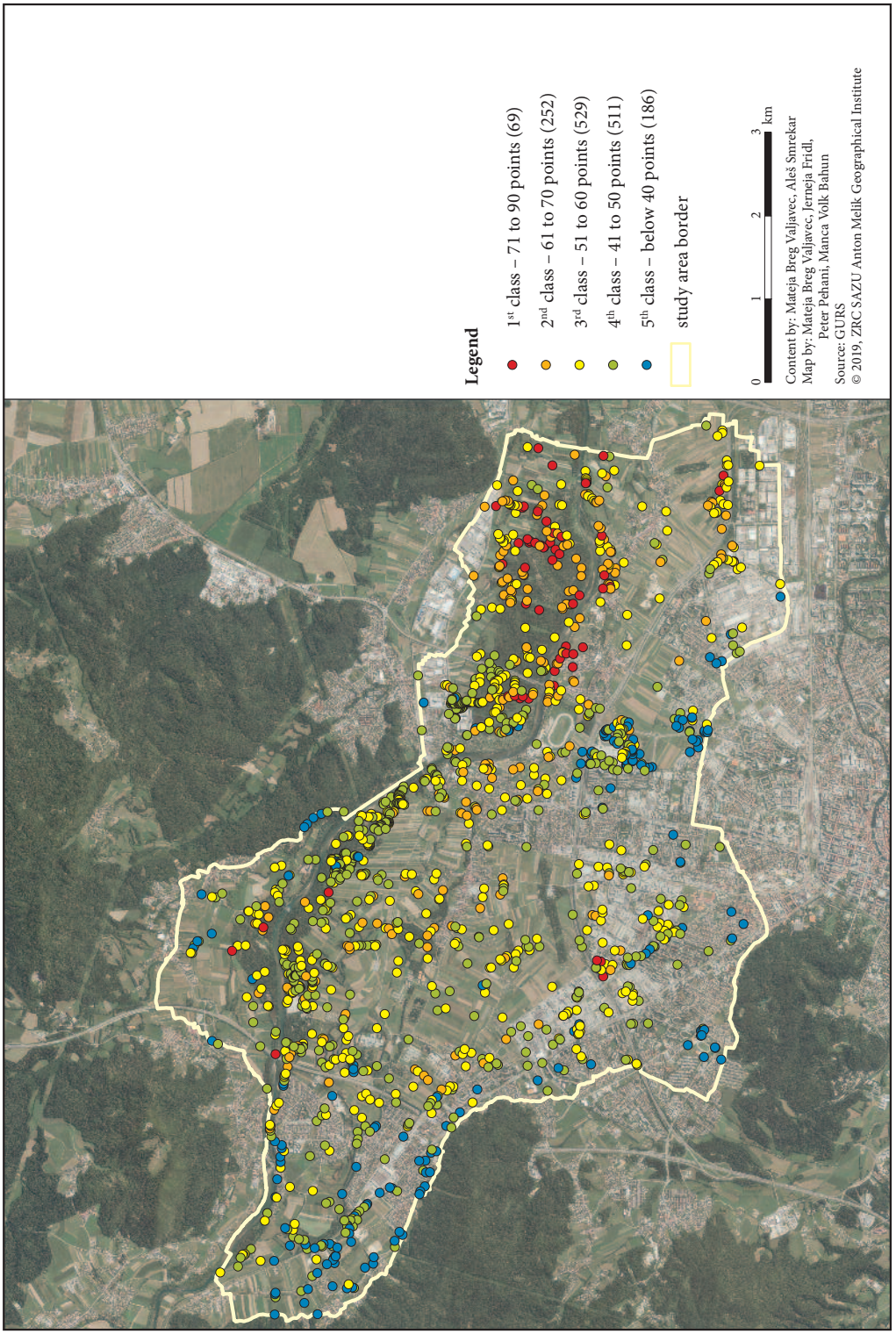
The practice of urban community gardening, which does not include gardening in the yards next to individual houses but rather various community garden-plot areas, goes back to the origins of cities. In the earliest settlements there was no great distinction between urban and rural food production. In European cities there was a completely different way of organizing agricultural production in the fifteenth century, through the gardening movement with the onset of industrialization in the nineteenth century, the alienation from nature on the one hand and the desire for recreation on the other in the twentieth century, to the establishment of community gardens and urban farming laboratories in recent years (Lohrberg et al. 2016). Urban gardening has been experiencing a resurgence across Europe in recent times, closely linked to increasing public awareness of maintaining or establishing sufficient green spaces, food security, and urban quality of life (Bell et al. 2016).

The contemporary literature (Lohrberg et al. 2016) divides urban gardening into two types: individual cultivation (garden plots, private yards) and collective cultivation (educational, community, therapeutic, horticulture). Falling somewhere in between are »squatter gardens,« where food is produced on idle land. Gardening is farming in miniature, so it may not seem to fit in a modern city at first glance, but in fact it is quite the opposite; it contributes to sustainable development in modern cities (Pearson et al. 2010) and also helps in the fight against poverty and social exclusion (Scheromm 2015; Kozina et al. 2019).

Garden-plot areas are present in Slovenia's largest cities such as Ljubljana, Maribor, Celje, Koper, and Velenje. They have been thoroughly studied only in Ljubljana (Goriup 1984; Simoneti et al. 1997; Jamnik et al. 2009) and Velenje (Lovšin 2014; Kozina 2016).

This section presents a study (Jamnik et al. 2009) that examined the garden plots' locations and their role in environmental protection, health, and administrative planning, as well as who the gardeners are and what they do.

Figure 16: Illegal dumping sites on the Ljubljana Plain by remediation priority in 2005. ►


Legend
1st class – 71 to 90 points (69)
2nd class – 61 to 70 points (252)
3rd class – 51 to 60 points (529)
4th class – 41 to 50 points (511)
5th class – below 40 points (186)
study area border
0
1
2
3
km
Content by: Mateja Breg Valjavec, Aleš Smrekar
Map by: Mateja Breg Valjavec, Jernej Fridl,
Peter Pehani, Manca Volk Bahun
Source: GURS
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7.1 Garden-plot areas as spaces for leisure activities

In Ljubljana, tenants on smaller parcels of land emerged at the beginning of the twentieth century, when they cultivated garden beds and produced food on them (Vastl 2000). These are some of the forerunners of community gardening. Until the end of the Second World War, this development typically offered private outdoor space for people with limited housing space and ensured minimal subsistence for the socially disadvantaged through producing vegetables and fruits and raising small animals.

People's reasons for gardening changed after the Second World War, because the need to grow food declined and leisure and recreation took center stage. The first detailed data for Ljubljana come from 1984, when community gardening in Ljubljana was already in full swing (Figure 18). Garden plots in 289 areas occupied exactly two square kilometers of territory. These spontaneously growing garden-plot areas were distributed throughout the flat part of Ljubljana. By 1995, the total garden area had grown by one-third, increasing to 267 ha, and the number of garden-plot areas had increased to 378, an increase of just under one-third.

By 2005, the surface area and number of gardens had declined significantly because of the more urban way of life, and they had shrunk to a lower amount than in 1984 (Figure 19). The greatest decline took place in the compact inner part of the city and the peripheral areas that tend to be used for new construction. Also thanks to the interventions by the city authorities, the number of garden-plot areas decreased to 218 by 2008, and the garden area was reduced to only 130 hectares. Precise data for the past decade are not available, but we estimate that the surface area has further shrunk a bit, and that the number is no longer declining so dramatically.

In 2006, a survey in Ljubljana (Jamnik et al. 2009) covered 302 community garden plots with a total sample of 551 respondents. It found that in 2005 there were garden-plot areas of varying size, from only a few dozen square meters to a few dozen hectares. A rental structure for garden plots was typical. Only 7% of the 302 gardeners surveyed also owned the land. Among the 93% that were tenants, under half of the respondents actually paid rent for their land, whereas the rest (half of all gardeners surveyed) used

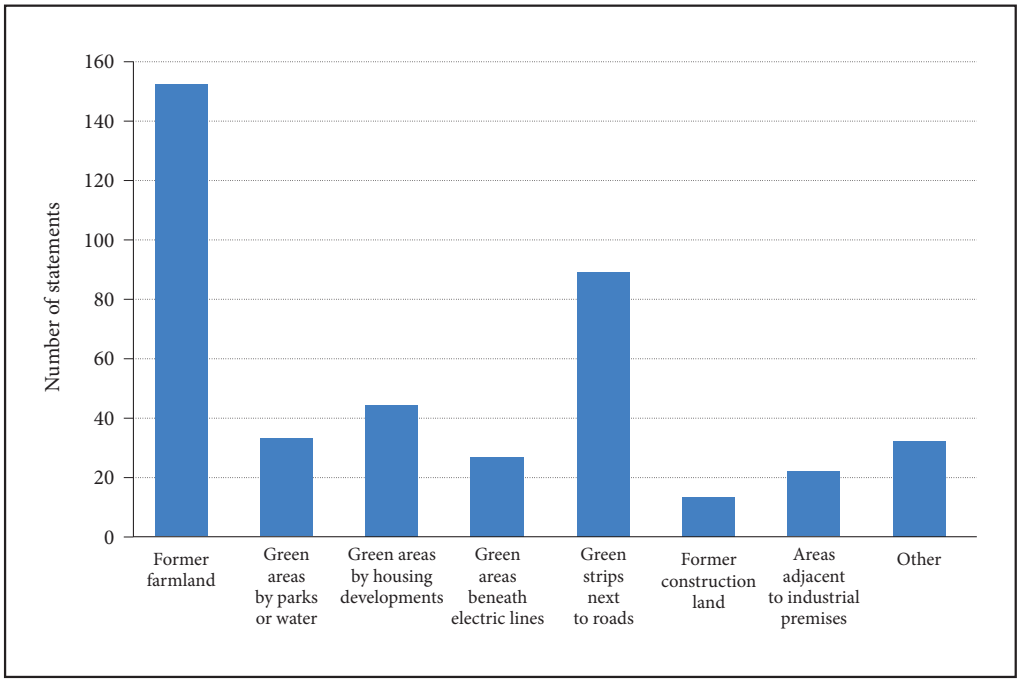


Figure 17: Locations of Ljubljana garden-plot areas.

»nobody's land,« which was mostly owned by the municipality or the state, and for which they did not pay rent. As many as three-quarters of gardeners did not have a signed lease, and 91% said they did not want to rent additional land for gardening. Only one-third would be willing to buy the land they were using.

Municipal infrastructure in garden-plot areas was relatively poor. Only 15% of garden-plot areas were reportedly connected to the public water supply system, but many had access to wells, and most did not have electricity. Shared facilities were available in only a handful of garden-plot areas.

Two-thirds of gardeners had a shack on their plot. The average structure measured 14 m² and occupied around 7% of the garden area (Figure 20). They were built without plans, makeshift, using a great variety of materials. They were reminiscent of emergency shelters and did not contribute to the attractive appearance of the garden-plot areas. Quite often, these were not just simple sheds for storing tools and garden produce, but actual vacation homes. The dominant building material used for walls was wood; 93% of structures were wooden. The rest were mostly made of sheet metal; only four structures were masonry.

A few percent of Ljubljana residents are actively engaged in community gardening. The precise number is unknown, but in the 1990s it was estimated at around 12,000 (Simoneti et al. 1997). Considering that there was a sharp decrease in garden-plot areas around the start of the twenty-first century, we estimate that the number of active gardeners has fallen below 10,000.

This reduction in gardener numbers does not mean that the need for this type of leisure activity is dwindling, because the activity passes from generation to generation. As Goriup (1984) determined, as many as 89% of gardeners come from families that had gardens, and so they were attached to them from childhood. The presence of many immigrants among them means that they had certain contact with gardening even in their former homes, before moving to the Slovenian capital. The same study also revealed the gardeners' persistence and perseverance. Over time only about one in every six gardeners gave up gardening, mainly for health reasons.

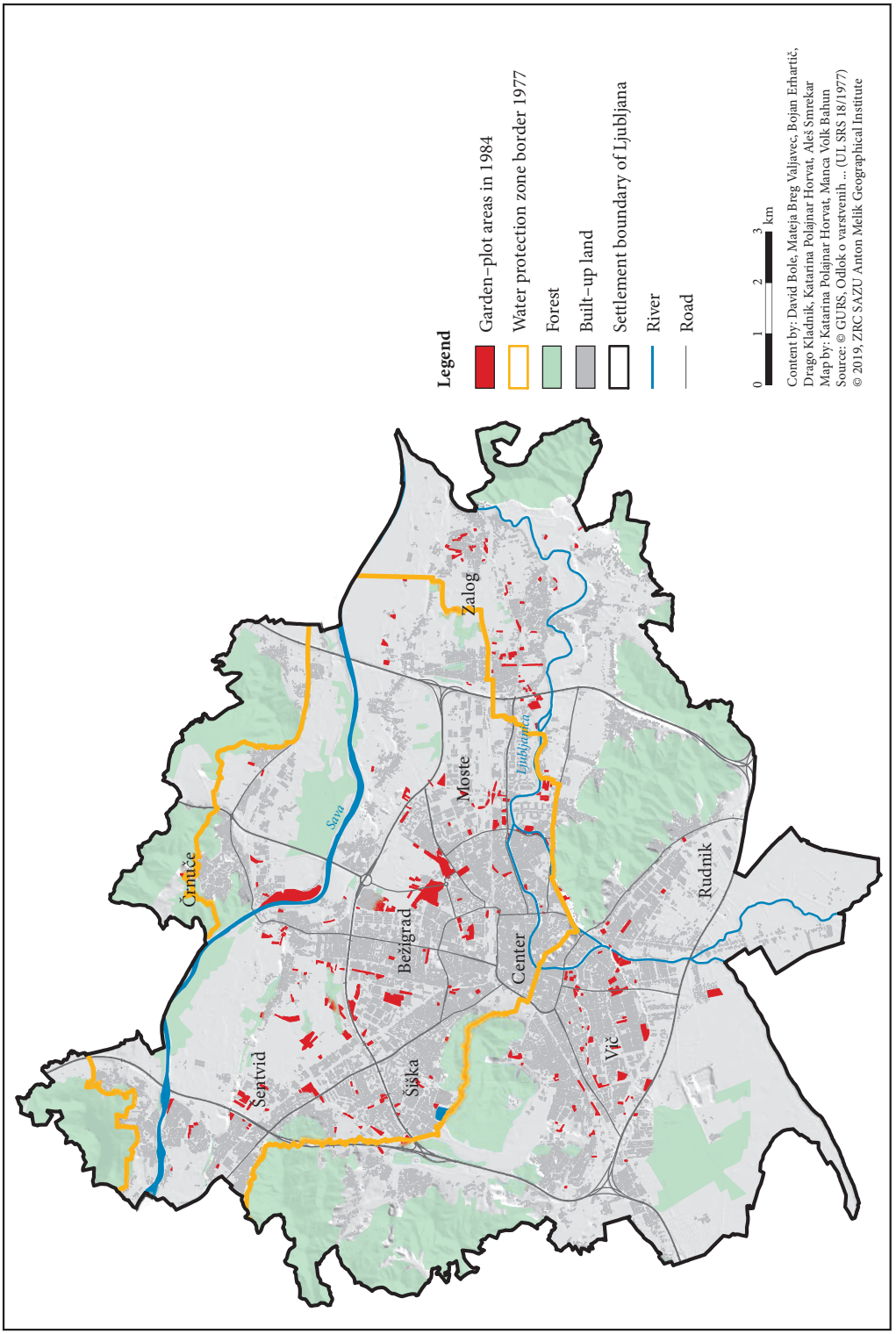
There were marginally more women than men among gardeners. They were mostly older, with the Ljubljana community gardener's average age being 60.6 years. The gardeners' education level was lower than that of the overall population of Ljubljana; this gap was most evident in the highest educational category. Garden plots were most often visited by two persons (54%), usually spouses. Gardeners spent an average of an hour and a half per day at their gardens. Interestingly, this time was significantly shorter than the two to three hours mentioned in a study from the 1980s (Goriup 1984). This reduction of the time spent gardening was certainly the result of changes in working hours that have occurred in parallel with recent sociopolitical changes.

The need to make a »gardening« escape into nature was felt especially keenly by residents of high-rise buildings or apartment buildings in high-density housing developments, which provided people with almost no individuality other than inside their homes. These accounted for nearly three-fifths of the surveyed population of gardeners. Another nearly one-quarter came from high-rises or apartment buildings in low-density residential areas.

The gardeners surveyed in 2006 reported that gardening primarily provided them with recreation and relaxation (29%), followed by satisfying the need for direct contact with nature (22%), and satisfying the need for physical activity (20%). One-fifth of respondents considered gardening an opportunity to produce healthy food. It was interesting that only just under one-tenth of the respondents still considered community gardening an opportunity to produce food for existential reasons. A similar proportion used the garden for leisure time (Figure 21).

The main problems gardeners reported were polluted produce along roadsides and garden damage caused by passersby. The respondents were also bothered by theft of their produce, damage by wild animals, a lack of nearby water, noise from nearby freeways, rail lines, and factories, odors from nearby illegal dumping sites, and lack of municipal infrastructure. Some were also disturbed by the unkempt appearance. They also mentioned damage to garden structures, vandalism, disruptive partying on garden plots, dogs running across the gardens, waste accumulation, improper use of protective substances, unregulated parking, and access difficulties due to poorly maintained access roads and the distance of their garden plot from home, which was related to heavy traffic and delayed access on the one hand and the poor mobility of elderly gardeners on the other.

Figure 18: Garden plots in Ljubljana in 1984. ➤ p. 40
Figure 19: Garden plots in Ljubljana in 2005. ➤ p. 41


Legend
Garden–plot areas in 1984
Water protection zone border 1977
Forest
Built–up land
Settlement boundary of Ljubljana
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km
Content by: David Bole, Mateja Breg Valjavec, Bojan Erhartič, Drago Kladnik, Katarina Polajnar Horvat, Aleš Smrekar
Map by: Katarina Polajnar Horvat, Manca Volk Bahun
Source: © GURS, Odlok o varstvenih ... (UL SRS 18/1977)
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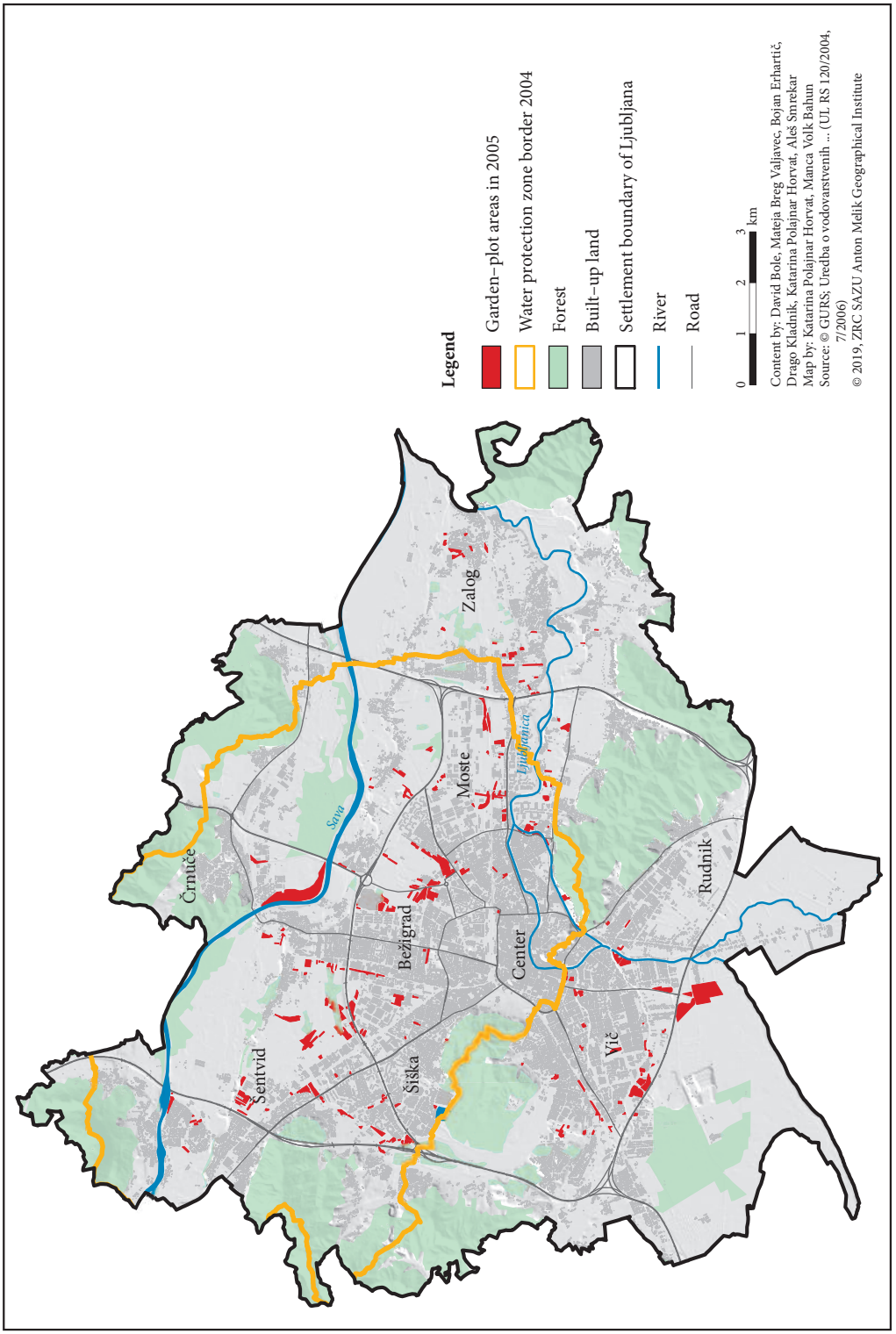
Legend
Garden–plot areas in 2005
Water protection zone border 2004
Forest
Built–up land
Settlement boundary of Ljubljana
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Content by: David Bole, Mateja Breg Valjavec, Bojan Erhartič, Drago Kladnik, Katarina Polajnar Horvat, Aleš Smrekar
Map by: Katarina Polajnar Horvat, Manca Volk Bahun
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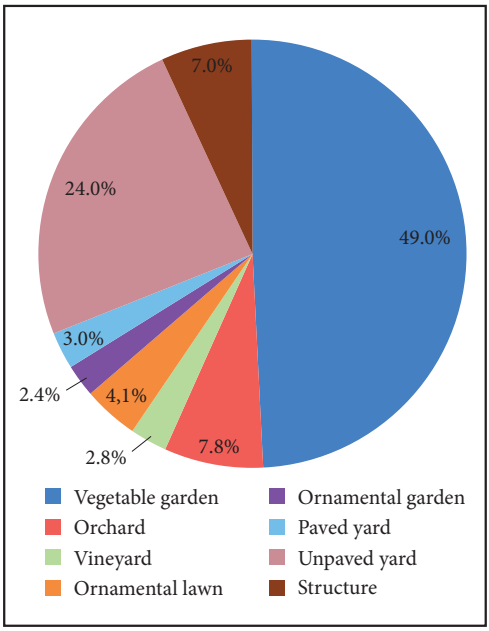


Figure 20: Proportion of Ljubljana garden plots by specific land use.

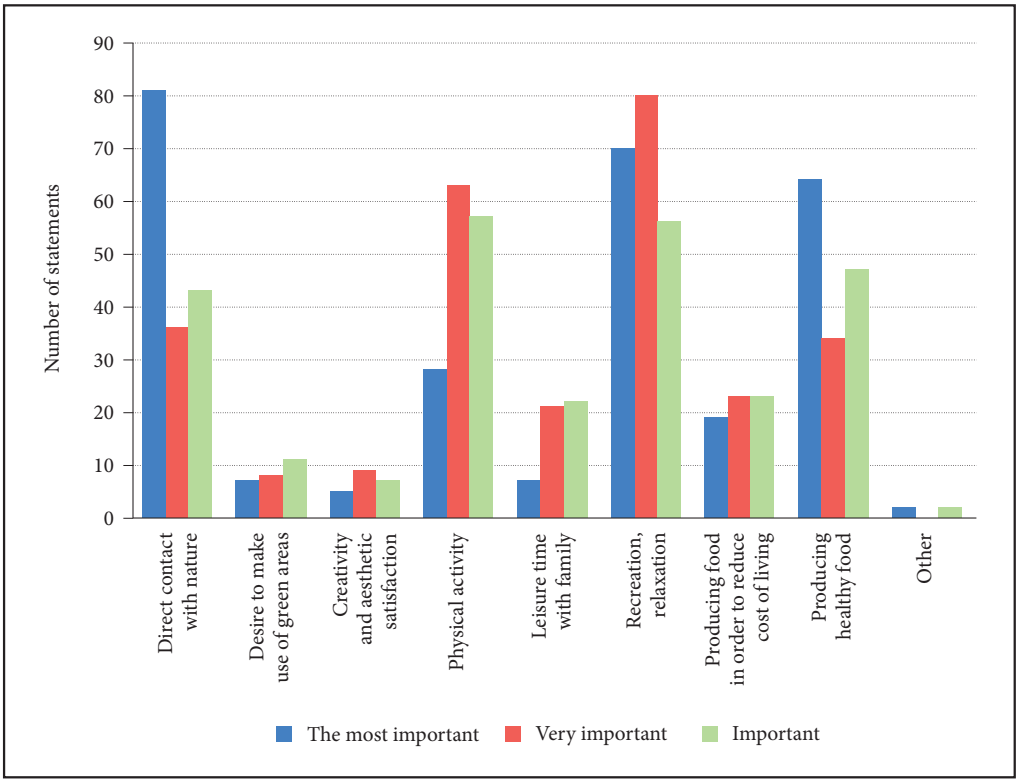


Figure 21: Ljubljana community gardeners' main reasons for gardening.

Soil fertility analyses at Ljubljana garden-plot areas indicated that the great majority of gardens were overfertilized. This is in line with expectations, because the survey results indicated that the gardeners lacked basic understanding of fertilizers. Phosphorus and potassium inputs were too high, whereas the concentration of nitrogen in the soil, which is the most exposed to leaching, was generally acceptable. However, the results for residual pesticides in soil and plant specimens from garden plots were very favorable, because residues were not found in any plant samples and only one soil sample.

Heavy-metal contamination of soil in Ljubljana is proportional to the city's size, level of industrialization, and traffic load. Analyses of the heavy metal content in garden plot soil indicated that they were most contaminated with lead and cadmium. The lead content in soil was most often elevated directly adjacent to roads, so it can be concluded that the main source of lead contamination in Ljubljana garden-plot soil was traffic from when leaded gasoline was still in use. Elevated levels of copper were also detected, which in some locations is connected with many years' use of copper preparations to prevent plant diseases. The high copper content in soil can be connected with the same source of pollution that also caused contamination with cadmium, zinc, nickel, and arsenic.

Community gardening in Ljubljana has already been through several phases of life. In 2009, however, the city authorities hoped for a new era and hence sought an agreement with the gardeners within the framework of the newly adopted ordinance on renting and managing garden plots (Odlok o urejanju … 2009). The ordinance defines garden plots as special urban green spaces, which shall no longer be located in designated water protection areas, downtown, and more exposed locations, where they might reflect poorly on the Ljubljana cityscape. That is why there are now to be no garden plots near cultural monuments or cemeteries, which did happen in the past.

Successful garden-plot management also depends to a large extent on ownership status, which may prove to be very problematic. That is, the municipality controls only a small portion of the land at the planned locations of new garden plots, and it therefore has relatively limited levers for regulating them uniformly and harmoniously. The general attractiveness of the garden-plot areas is also what their further destiny and the whole project of »regulated community garden plots« in Ljubljana depend on.

8 Ljubljana's quality of residential environment

The spatial impact of community gardening in Ljubljana confirms the thesis that various actors and activities in cities have intersecting interests that need to be continually coordinated. Among other things, these activities and their impacts reflect on the quality of the residential environment. Because this quality affects people's decisions about where to live and work, it is a factor in cities' economic competitiveness (Florida 2002), and also built-up land and mobility flows (Leitmann 1999; Marans and Stimson 2011).

The »residential environment« is a multifaceted concept, because it describes a variety of activities that intersect and change within the space and have a specific spatial relationship with the residents (Drozg 1994; Pacione 2003; van Kamp et al. 2003). Cities are a dynamic and also contradictory spatial phenomenon (Mira et al. 2005). The term is closely tied to related terms, such as »quality of life« (Kahneman et al. 1999), »livability« (Kaal 2011), »residential wellbeing« (Perlaviciute and Steg 2012) or »living environment» (Kozina 2016).

The range of aspects within »residential environment« that lend themselves to analysis are often too broad and inconsistent, especially in relation to »non-spatial« areas of life such as financial status, health, and family life (Marans and Stimson 2011). Nevertheless the »residential environment« is not defined solely from the viewpoint of the »physical environment,« but in its broader sense: as characteristics of the home and its immediate and more distant surroundings, all of which are important for meeting basic human needs and performing basic human functions (Tiran 2015).

Past research (Krevs 1998) shows that the standard of living in Ljubljana as a whole is high on the Slovenian scale, especially in terms of leisure activities, services, supply, education, employment, and transport, and residents' wages and wealth. Quality of life is also high, with three-quarters of the population satisfied with the residential environment and only one-tenth dissatisfied (Kos et al. 2010). According to an EC survey on the quality of life in European cities, 71% of people are very satisfied with living in Ljubljana, which ranks it twentieth among the eighty-three European cities included in the survey. Its sports infrastructure, educational institutions, streets and roads, public spaces, safety, cleanliness, and green spaces

are particularly highly ranked (Quality of Life 2016). However, less is known about the quality of the residential environment in individual parts of the city, as such research in Ljubljana is relatively rare (Krevs 2002; Rebernik 2002; 2013), but no less important for deciding on future spatial development. This is true of both objective and subjective research.

8.1 Objective quality of residential environment in Ljubljana

In choosing the residential environment factors to study we looked to various social theories and prior research on quality of living factors and residential preferences.

The Housing Conditions Index (Figure 22) combines the indicators of housing age, infrastructure connections, and size. The highest quality of housing is in areas with low population density and a predominance of detached, semi-detached, row, or atrium single-unit detached houses. They are distinguished by their size (usually between 30 and 40 m² per person) and above-average number of rooms (usually more than 1.3 per person). These include the older districts with large homes just outside the downtown area. The worst housing conditions are found in housing built without permits and urbanized rural settlements on the periphery, areas with large, older apartment buildings and workers' housing more than sixty years old with less than 20 m² of usable floor area per person, and the historical city centre, where space per person exceeds 35 m² per but more than three-quarters of the buildings are from the nineteenth century or even older.

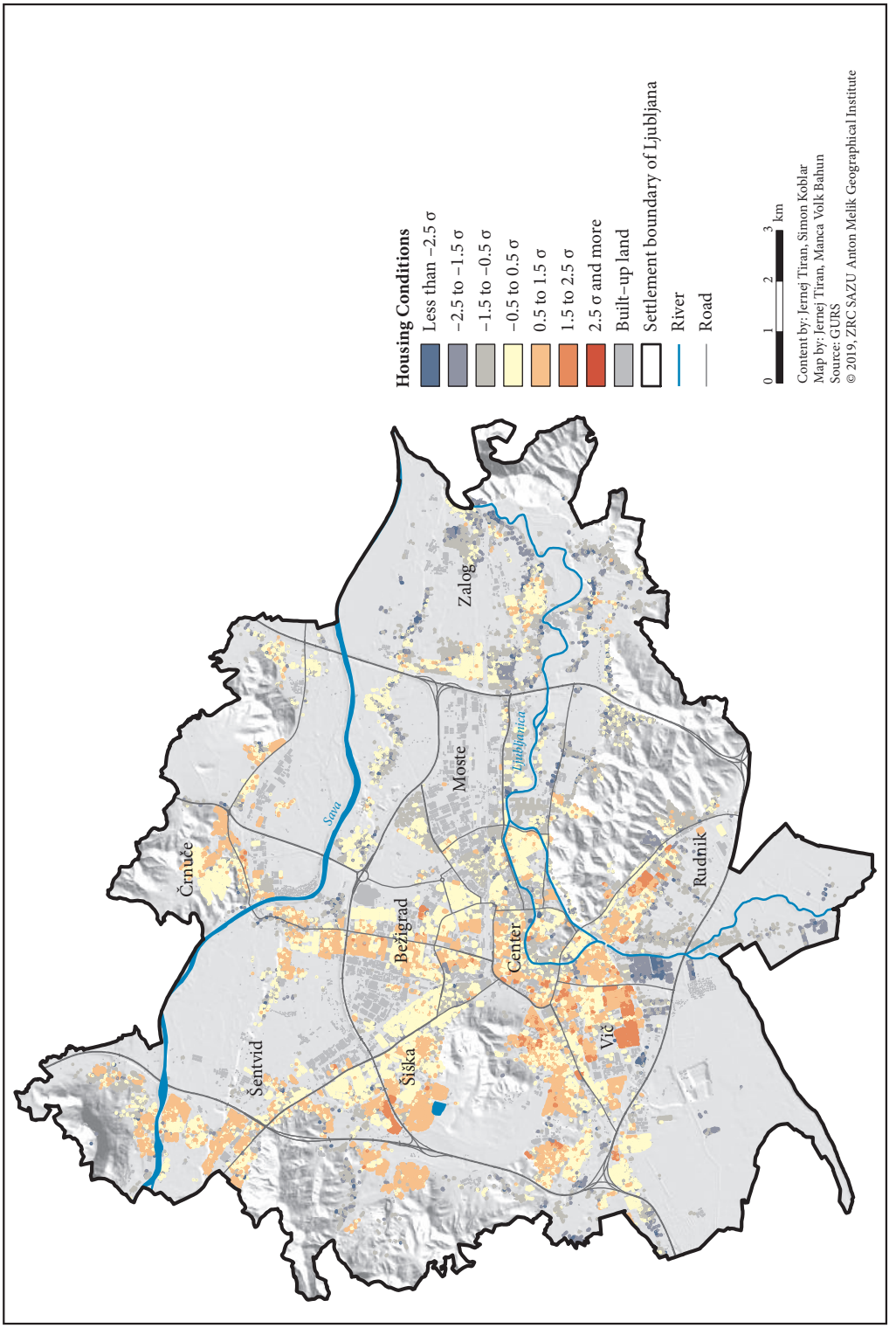
The Safety Index (Figure 23) covers a variety of topics such as local flood risk, local road traffic safety, and crime rate. In terms of safety, residents of Ljubljana areas outside the beltway live in the best possible residential environment. The area inside the beltway is the most problematic in terms of safety, as areas along arterial roads. Particular emphasis should be placed on flood risk due to river flooding in the populated floodplains of the Ljubljanica and Ižica rivers in the south and floods of small waterways from the surrounding area, especially on the eastern periphery. Floods have affected Ljubljana twice in the last decade, in 2010 and 2014 (e.g., Golob and Polajnar 2015).

The Aesthetic Value Index consists of land cover, diversity of cultural heritage, and distance from degraded urban areas. Areas close to larger protected areas, such as Tivoli, Rožnik, and Šiška Hills Landscape Park and the Ljubljana Marsh Landscape Park, have a high index. The historical city centre is a special case; although its aesthetic value index is reduced by a relative lack of greenery, it is also a »heritage hot spot«. Individual areas in the Bežigrad, Šiška, and Moste neighborhoods, and the downtown area score low due to their proximity to degraded urban areas. These areas expanded after the 2008 financial crisis but have been shrinking in recent years.

The Urban Accessibility Index (Figure 24) combines indicators for walking accessibility to supplies, services, primary education institutions, green spaces, and leisure activities. Residents of the urban core have the best walking distance to urban amenities, despite the increasing touristification in the historical city centre (Daugul 2018) and the relocation of some activities to the periphery (Rebernik 2007). The downtown area particularly stands out for its good accessibility to leisure activities, especially cultural institutions. Most of the area inside the beltway also has above-average accessibility to urban amenities. The accessibility index steadily decreases from the center toward the periphery, and is below average in most urbanized rural settlements on the periphery, as well as in some housing developments containing single-unit detached houses or social housing. These areas have no basic infrastructure (preschool or primary school, and services such as ATM, pharmacy, post office, and health center), and in some places there is even no grocery store. At the periphery, the index is above average only in some well-equipped neighborhood centers (Črnuče, Šentvid, and Zalog).

Environmental pollution (Figure 25) were measured by noise level and air pollution (sulfur dioxide, dust particles, nitrogen oxides, and nitrogen dioxide). Areas under the most environmental pollution occur in a narrow band along the arterial roads and the beltway. It is noteworthy that respondents rank even the wider urban core (Špes et al. 2002) as one of the noisiest areas due to services, leisure activities, and a large number of pedestrians. Areas with the fewest environmental pollution are the urban areas in the far east

Figure 22: Housing Conditions Index in Ljubljana (Tiran 2017). ➤ p. 45
Figure 23: Aesthetic Value Index in Ljubljana (Tiran 2017). ➤ p. 46
Figure 24: Urban Accessibility Index in Ljubljana (Tiran 2017). ➤ p. 47


Housing Conditions
Less than –2.5 σ
–2.5 to –1.5 σ
–1.5 to –0.5 σ
–0.5 to 0.5 σ
0.5 to 1.5 σ
1.5 to 2.5 σ
2.5 σ and more
Built–up land
Settlement boundary of Ljubljana
River
Road
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1
2
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Map by: Jernej Tiran, Manca Volk Bahun
Source: GURS
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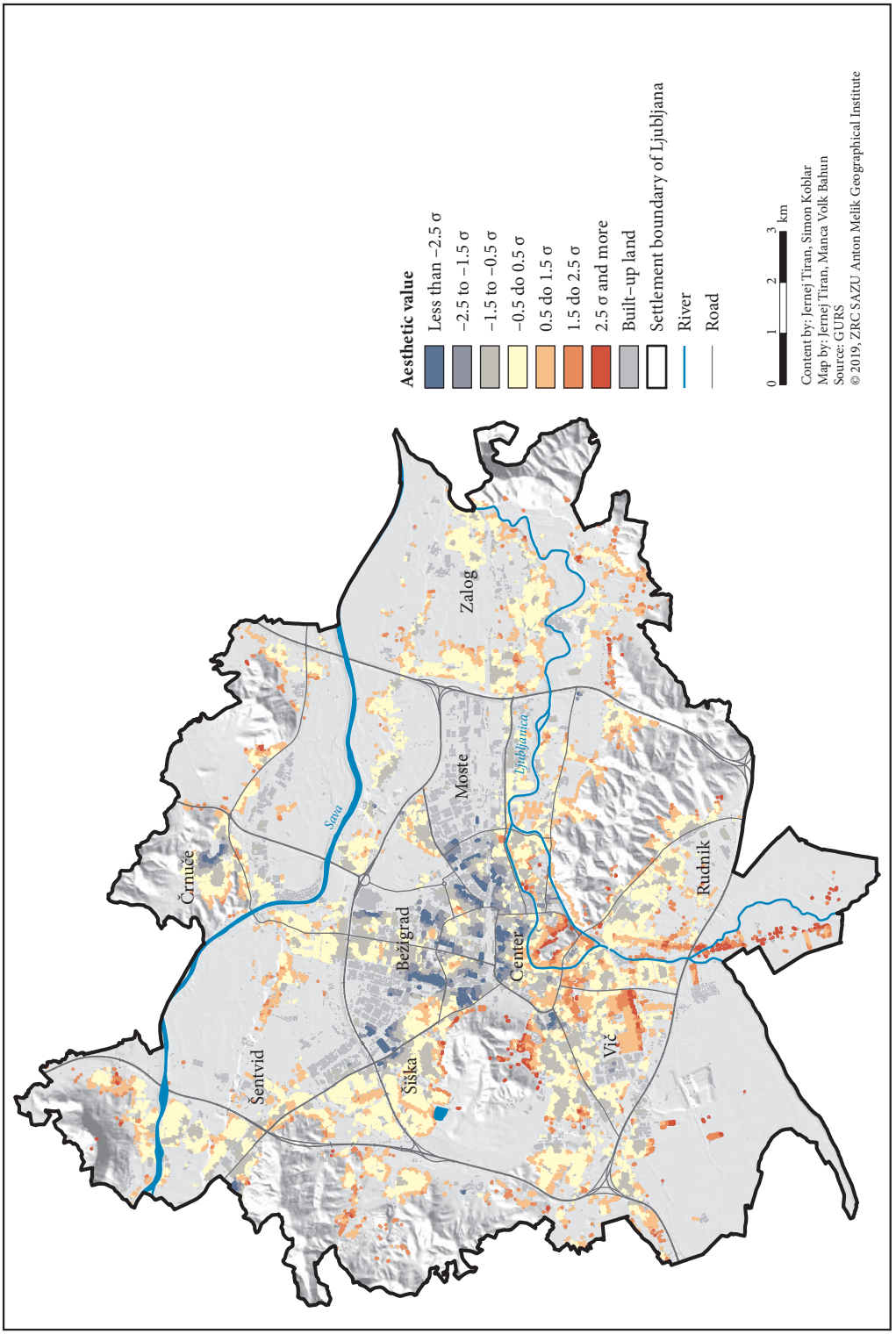
Aesthetic value
Less than –2.5 σ
–2.5 to –1.5 σ
–1.5 to –0.5 σ
–0.5 do 0.5 σ
0.5 do 1.5 σ
1.5 do 2.5 σ
2.5 σ and more
Built–up land
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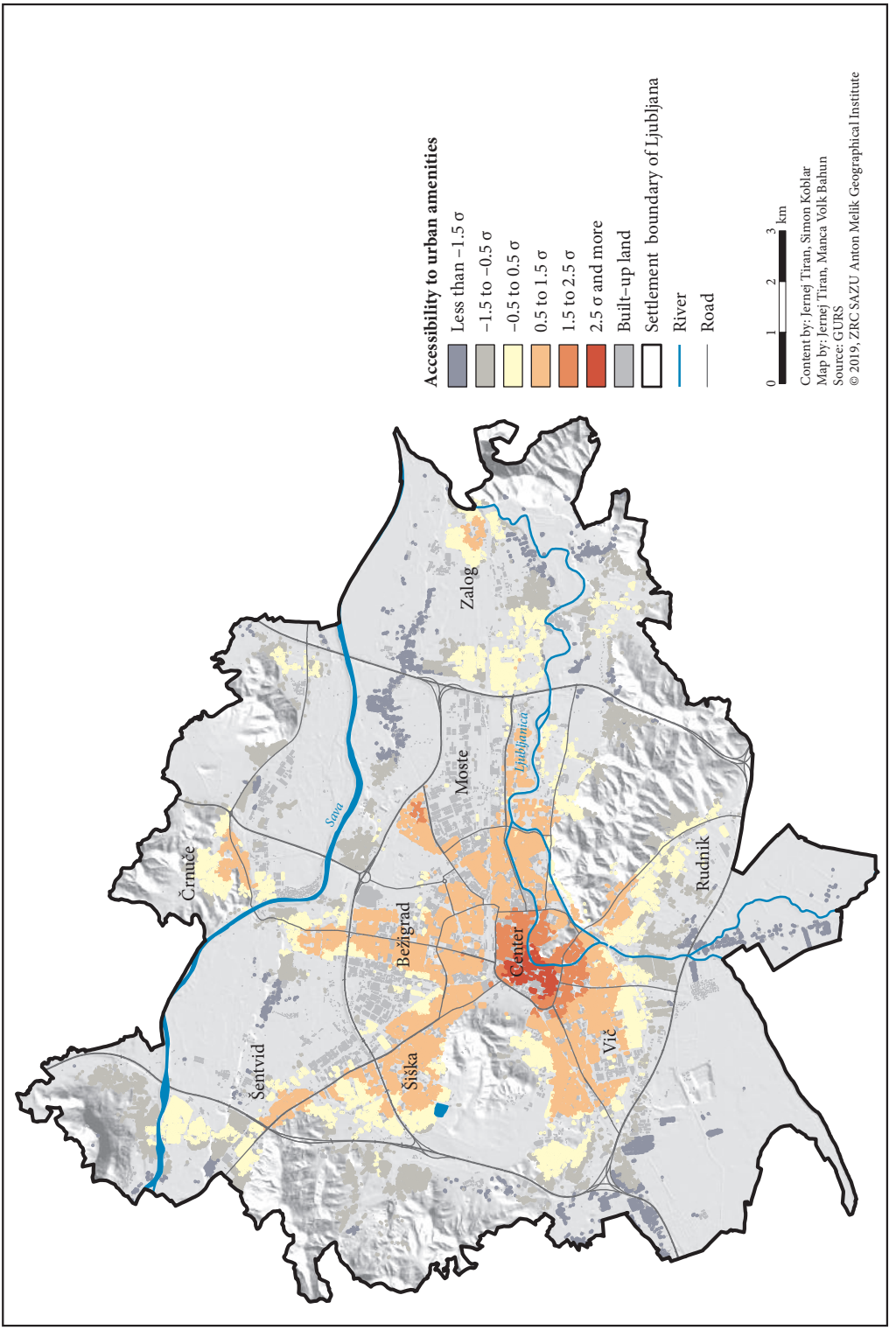
Accessibility to urban amenities
Less than –1.5 σ
–1.5 to –0.5 σ
–0.5 to 0.5 σ
0.5 to 1.5 σ
1.5 to 2.5 σ
2.5 σ and more
Built–up land
Settlement boundary of Ljubljana
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(Zalog), north (Črnuče), and northeast (Šentvid), and within the Ljubljana beltway Rožna Dolina to the southwest of the downtown area and Rudnik and Galjevica in the southeastern part of the city. In general, there is much less air pollution outside the beltway, because there are many larger compact residential areas with a very favorable index value there. The city does not have issues with noise from railways and industrial plants.

The Social Environment Index (Figure 26) combines indicators for educational structure, official unemployment, and average income per capita, in which Murgle in the south, Koseze in the northwest, and the western part of the downtown stand out. With the exception of the downtown, these are mostly well-planned, compact neighborhoods of single-unit detached houses, primarily semi-detached or atrium houses with a uniform urban design. Socially disadvantaged areas of the city include the eastern part of Ljubljana, the large apartment buildings in Dravlje and Šiška, and areas of substandard single-unit detached houses in the south, such as in Rakova Jelša.

The Urban Mobility Index (Figure 27) combines indicators for public bus accessibility, distance from the nearest freeway interchange, and pedestrian access to the nearest *BicikeLJ* bicycle rental point. Residents in the broader urban core, Bežigrad, Šiška, and Dravlje have the best mobility conditions, whereas residents in the far eastern part of Ljubljana have the worst.

The synthesis of all indexes and indicators – that is, the quality of the residential environment as a whole – is shown in Figure 28. It shows that the best residential conditions are enjoyed by inhabitants of Murgle, Trnovo, parts of the city west of downtown, and large parts of Rožna Dolina, Bežigrad, and Koseze. The worst residential conditions are in southern parts of town where the housing was built without permits (Rakova Jelša and Sibirija), in most urbanized rural settlements at the northeastern periphery, and in large parts of Moste and Šiška near the industrial zones located there.

The historical city centre is a special case that is typified by »bipolar« residential conditions: it has above-average access to urban amenities, a great concentration of cultural heritage, and very good mobility conditions, but its overall score is reduced by the higher crime rate and very old housing stock. An accumulation of unfavorable residential conditions in some urban areas due to not implementing appropriate measures could lead to increased social degradation and differentiation and jeopardize the implementation of sustainable urban development.

8.2 Subjective quality of residential environment in Ljubljana

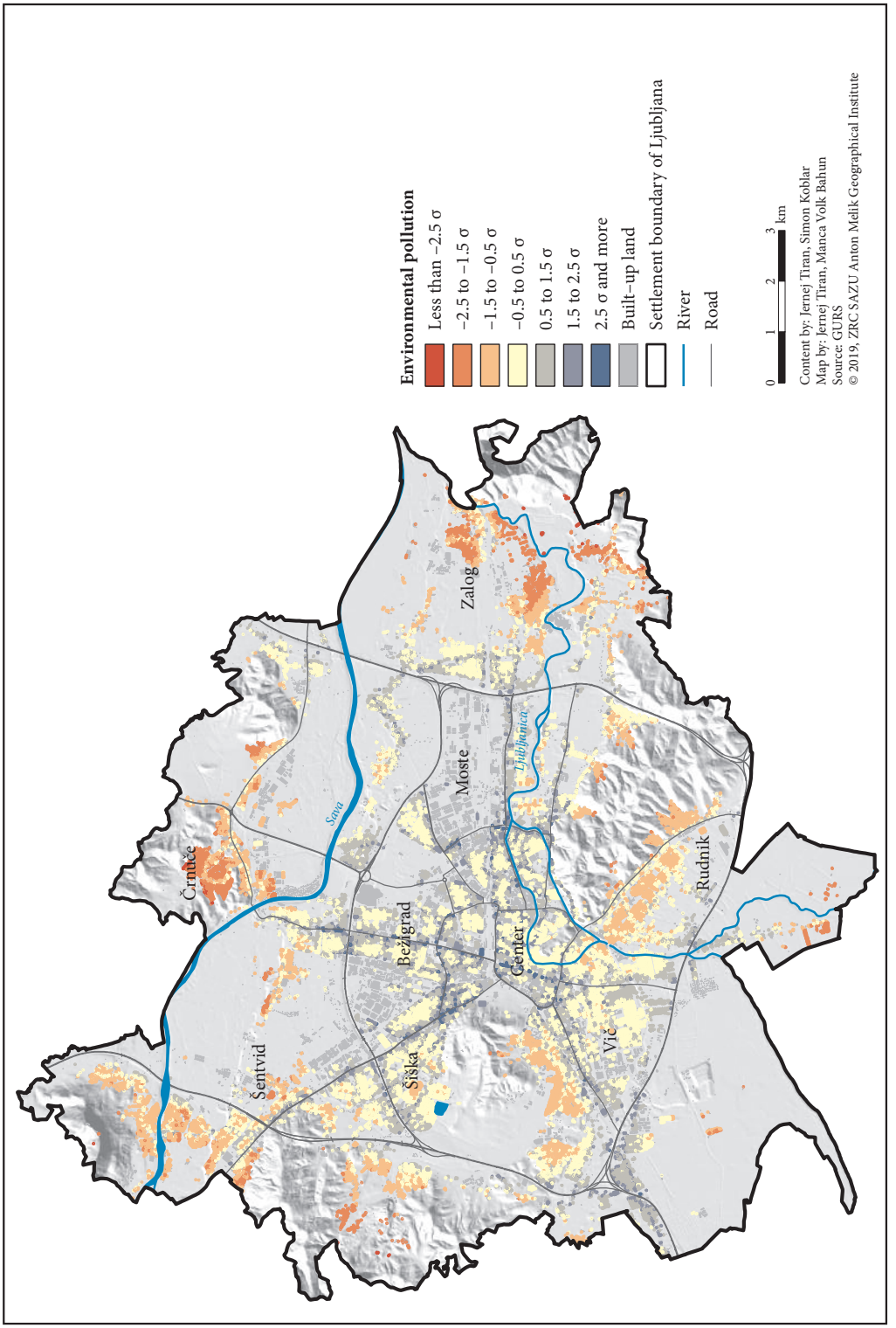
The subjective quality of the residential environment was measured with a questionnaire. We focused on Ljubljana inhabitants' residential preferences and the quality of life in the historical city centre (see section 3).

Ljubljana residents considered factors related to the city's aesthetic value, safety, environmental impact, and housing conditions to be the most important. The least significant factors were proximity to a bicycle rental point, the socioeconomic characteristics of their neighbors, and proximity to a freeway or highway interchange (Figure 29). The respondents' residential preferences are very similar to those of Slovenians in general (Hočevar et al. 2004; Mandič and Cirman 2006; Kozina 2016).

Presented in greater detail below are the survey results for the historical city centre, with its characteristic compact medieval layout and buildings from the sixteenth to nineteenth centuries. We focused on this area for two reasons: 1) its »bipolar« residential conditions mentioned above, measured objectively, and 2) its rapid spatial, social, and economic transformation (Uršič and Kos 2004; Rebernik 2007; Uršič 2016; Daugul 2018).

Residential satisfaction in the historical city centre increases with the spatial level considered (home: 4.0, neighborhood: 4.1, whole city: 4.2). Although it scored relatively high, the downtown area was rated worse than any other Ljubljana area surveyed in the original study (three representative neighborhoods: single-unit detached houses, modern multi-family housing, and a housing development with large apartment buildings; Tiran 2015). The most problematic aspects reported by the residents include the unfavorable

Figure 25: Environmental Pollution Index in Ljubljana (Tiran 2017). ► p. 49
Figure 26: Social Environment Index in Ljubljana (Tiran 2017). ► p. 50
Figure 27: Urban Mobility Index in Ljubljana (Tiran 2017). ► p. 51
Figure 28: Overall Quality of Residential Environment in Ljubljana (Tiran 2017). ► p. 52


Environmental pollution
Less than –2.5 σ
–2.5 to –1.5 σ
–1.5 to –0.5 σ
–0.5 to 0.5 σ
0.5 to 1.5 σ
1.5 to 2.5 σ
2.5 σ and more
Built–up land
Settlement boundary of Ljubljana
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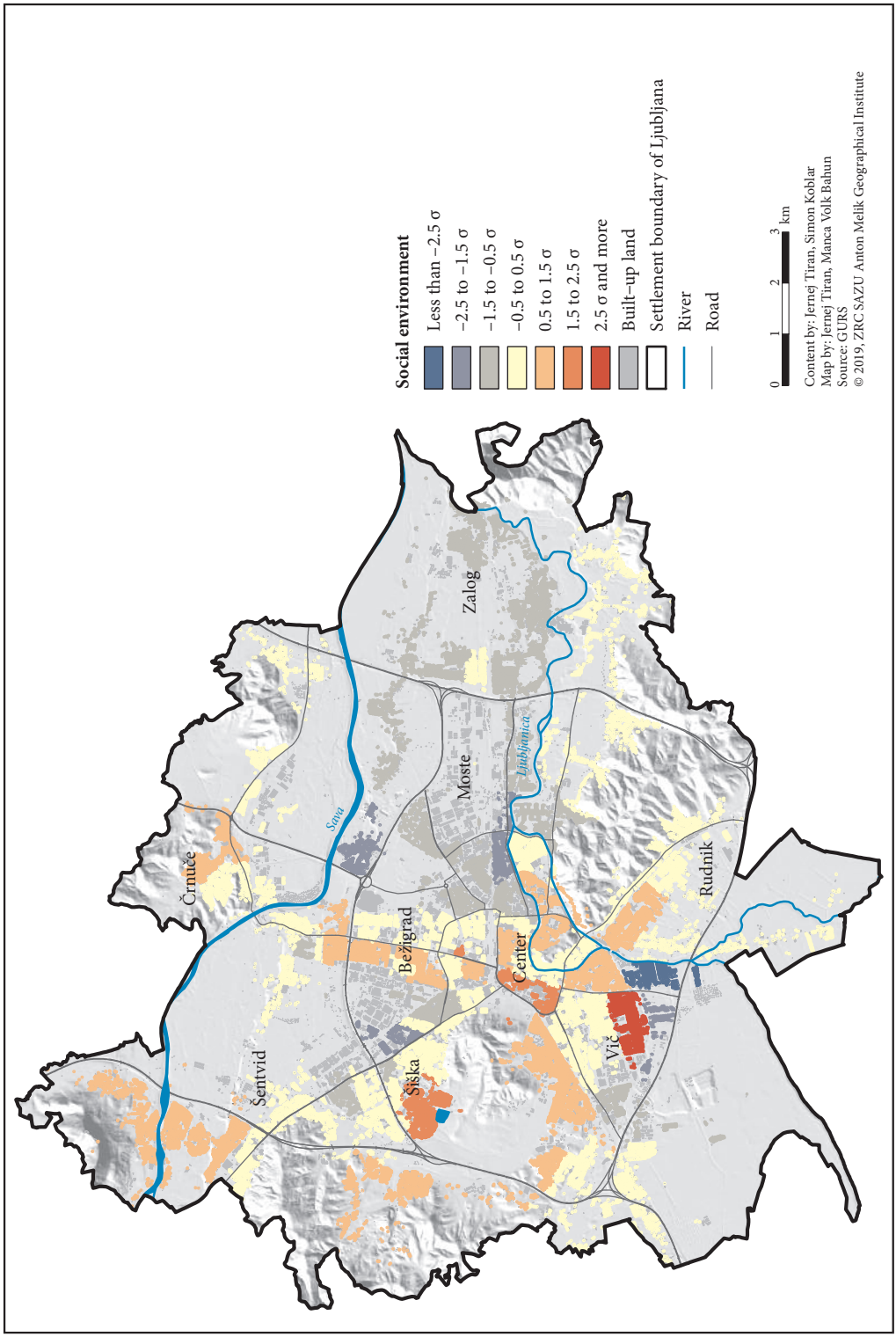
Social environment
Less than –2.5 σ
–2.5 to –1.5 σ
–1.5 to –0.5 σ
–0.5 to 0.5 σ
0.5 to 1.5 σ
1.5 to 2.5 σ
2.5 σ and more
Built–up land
Settlement boundary of Ljubljana
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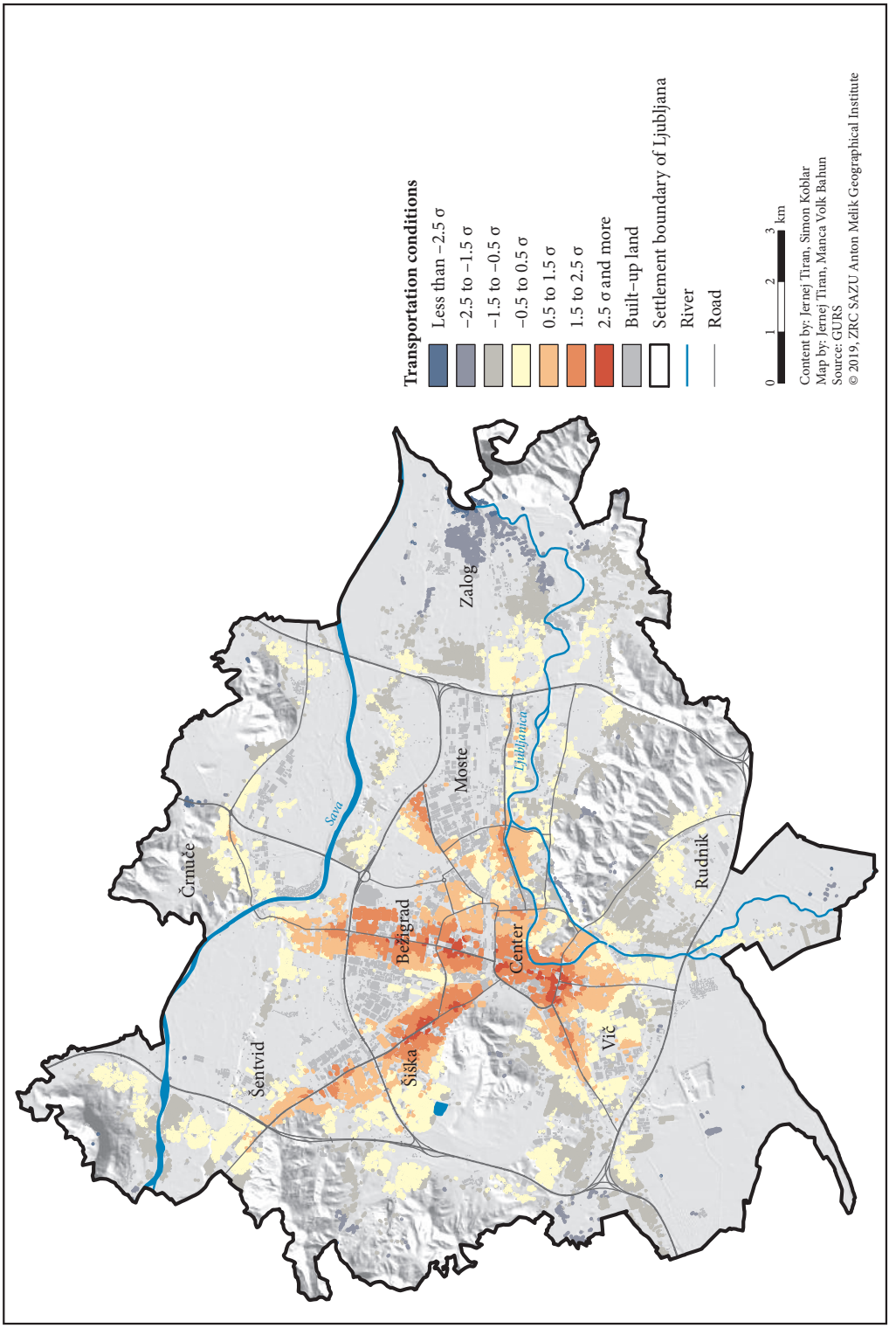
Transportation conditions
Less than −2.5 σ
−2.5 to −1.5 σ
−1.5 to −0.5 σ
−0.5 to 0.5 σ
0.5 to 1.5 σ
1.5 to 2.5 σ
2.5 σ and more
Built−up land
Settlement boundary of Ljubljana
River
Road
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Content by: Jernej Tiran, Simon Koblar
Map by: Jernej Tiran, Manca Volk Bahun
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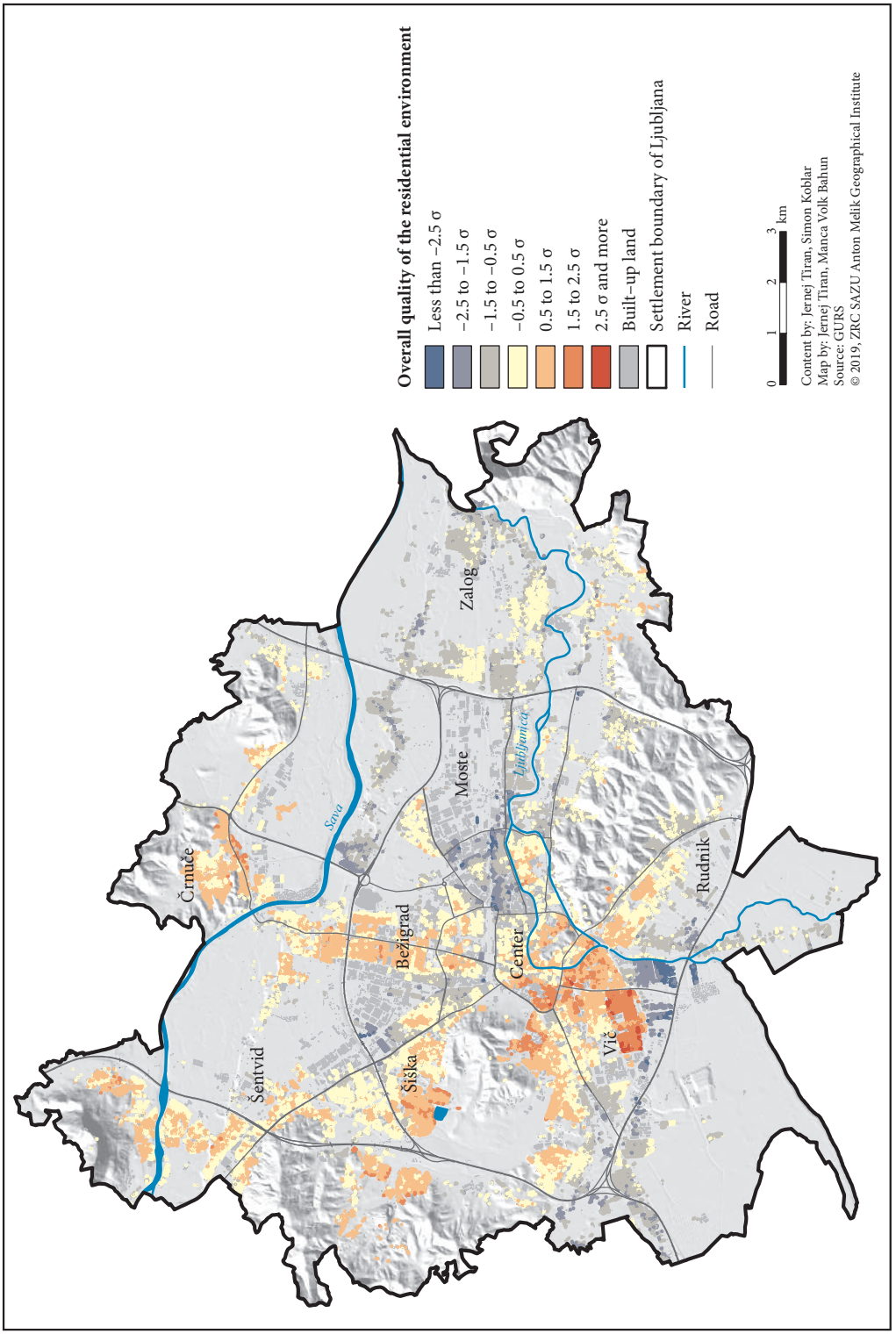
Overall quality of the residential environment
Less than −2.5 σ
−2.5 to −1.5 σ
−1.5 to −0.5 σ
−0.5 to 0.5 σ
0.5 to 1.5 σ
1.5 to 2.5 σ
2.5 σ and more
Built−up land
Settlement boundary of Ljubljana
River
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Map by: Jernej Tiran, Manca Volk Bahun
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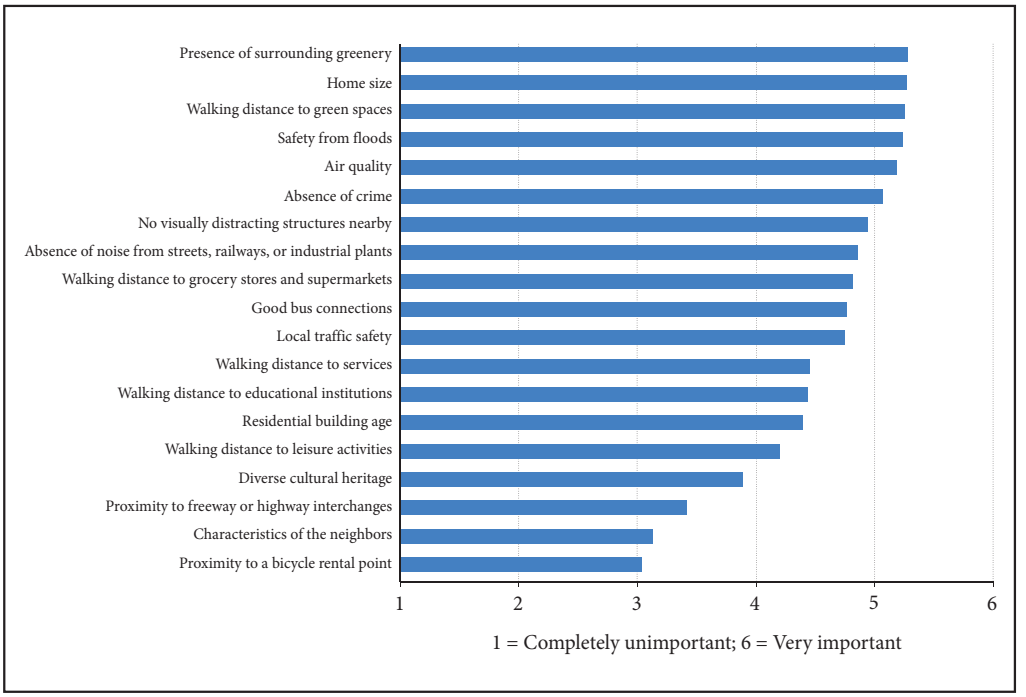

Figure 29: Ljubljana residents' rankings for the importance of various residential environment factors (Tiran 2017).

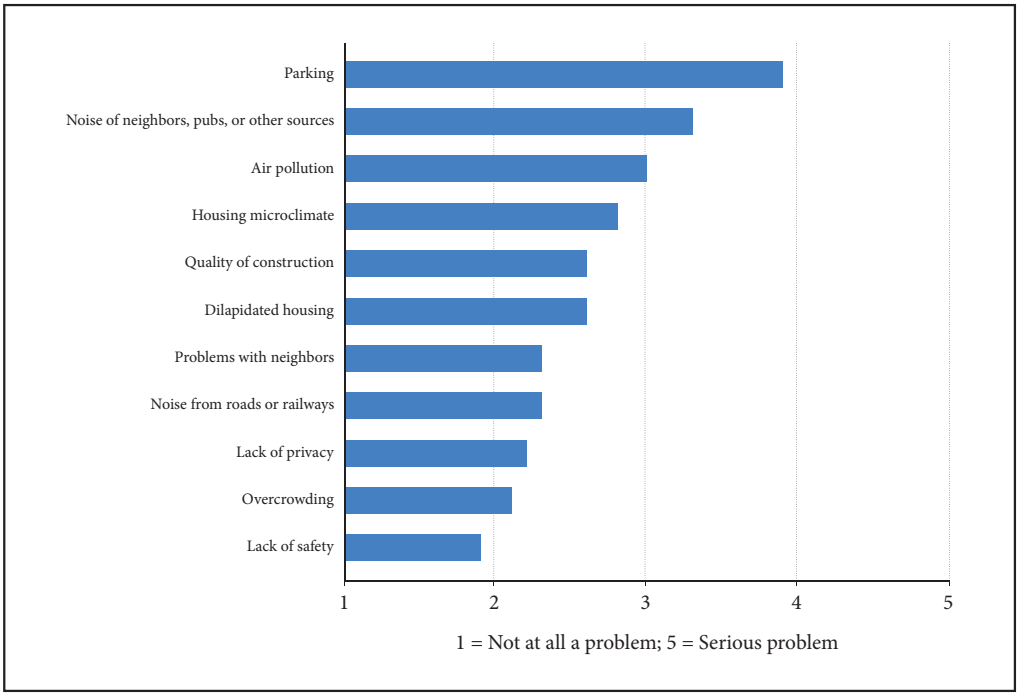

Figure 30: Problems in the residential environment in the historical city centre of Ljubljana (Tiran 2015).

housing microclimate (2.8) and dilapidated housing (2.6); most problematic at the level of the surrounding area are parking (3.9) and the noise of neighbors, pubs, or other sources (3.3; Figure 30). At the same time, as many as one-quarter of the residents are seriously considering moving out in the next five years, which is 10% more than in the other three Ljubljana neighborhoods. In can be concluded that the area is characterized by a high level of residential deprivation based on the ratio between residential preferences and residential environment scores.

In the light of these findings indicating the continuing flight from the historical city centre, which has been gaining new momentum recently with touristification and rising real estate prices, our research confirms the finding that maintaining or even enhancing the residential function of urban centers is one of the key strategic and sustainable tasks for policy-makers in Slovenian cities (Strategija 2004; Cork 2006; Nacionalno 2016). The historical city centres represent what is potentially a very high-quality residential environment because of their great cultural, historical, and experiential value and central location.

8.3 The impact of residential quality on quality of life

Structural modeling results (see section 3 and Tiran 2016) indicate that satisfaction with one's home and neighborhood and assessed quality of urban life have a statistically significant impact on Ljubljana residents' quality of life, because together they explain a high 39% of variance in quality of life. Satisfaction with one's home has by far the greatest impact ($\beta = 0.53$).

The regression analysis results, in which the dependent variable is illustrated by the composite variable of »happiness and life satisfaction in general,« significantly relativize the importance of residential satisfaction for quality of life, because the standardized regression coefficient values of individual residential quality variables are not statistically significant (Table 1); the only exception is »satisfaction with one's home,« which even has a negative value ($\beta = -0.10$). Ljubljana residents' perception of their quality of life is primarily affected by the socioeconomic areas of life described by »living standard« ($\beta = 0.29$), »family life« ($\beta = 0.25$), and »social life« ($\beta = 0.20$).

Table 1: Regression model results: impact of individual domains of life on quality of life.

	B	*SEB*	β
Constant	–3.278	0.16	
Home	–0.10	0.03	–0.10**
Neighborhood	0.05	0.03	0.05
City	0.04	0.03	0.04
Living standard	0.30	0.04	0.29**
Family life	0.25	0.03	0.25**
Health	0.11	0.03	0.10**
Social life	0.22	0.04	0.20**
Work	0.06	0.03	0.07*

Adjusted $R^2 = 0.44$**
$n = 849$
*$p \leq 0.05$, **$p \leq 0.01$

B = multiple regression coefficient, *SEB* = standard error of the multiple regression coefficient, β = standardized multiple regression coefficient

We found that the results obtained were highly dependent on the definition of »quality of life« and the inclusion of variables in the model. The regression analysis results even caused us to have doubts about whether the city authorities and urban planners can have much impact on the Ljubljana residents' quality of life. However, most socioeconomic determinants of quality of life are at least indirectly related to the quality of the residential environment, which ultimately has a significant effect on residents' desire to move to another location. In this light, the greatest effort should be invested in renovating the existing building stock and building new, high-quality housing, which will help stop the processes of socio-geographical differentiation and migration from Ljubljana to its surroundings, and consequently to improve its residents' quality of family and social life.

9 Ljubljana residents' environmental awareness and behavior

One of the important measures to ensure a quality living environment is appropriate environmental behavior or raising awareness of one's responsibility to the environment, which is also a prerequisite for a quality lifestyle (Špes 1998). Environmental awareness and related environmentally friendly behavior are modern concepts that form the basis of a sustainable society (Polajnar Horvat 2015a). Environmental awareness is a person's perception, understanding, and awareness of environmental problems, which is expressed through concern and willingness to solve them (Rojšek 1987; Gardner and Stern 2002). It signifies, above all, a cognitive or conscious component of human activity in the environment, which is not necessarily reflected in environmentally friendly behavior (Rojšek 1987; Kirn 2004). These two concepts are essential components of seeking balance between material well-being, social security, and a healthy environment, or essential components of contemporary sustainability-based paradigms of social development (Gardner and Stern 2002).

Although almost everyone has already come face-to-face with information about environmental pollution and the need to protect the environment, people usually do not think about their own negative attitude toward the environment or tend to attribute it to the social mindset and widely accepted social behavior (Malačič 2007). They feel alienated from the environment and often act on the notion that »it makes no sense to take care of the environment to the best of my ability unless others do so too« (Smrekar 2011). They are not aware of their role and the importance of their own actions, and often even environmentally conscious people are caught in the trap of collective environmental apathy (Polič 2002). At the same time, people are often oriented too much toward the short term to think about long-term topics and therefore tend not to be active enough (Špes 1998; Kirn 2004). Ljubljana residents' environmental awareness has been studied several times so far, mainly from the point of view of their attitude toward water as a key environmental component. Smrekar (2006a; 2011) examined environmental awareness related to water, later a large-scale study of community gardeners' awareness (Smrekar 2009) was conducted, in which their attitudes to water were also studied, and Polajnar Horvat (2015a) published the findings of a study that measured environmental behavior regarding water. This section presents the level of environmental awareness related to water in Ljubljana, the extent to which residents differ in environmental awareness, and what their actual behavior is. The aim is to use these findings to determine how different people's awareness and behavior are, whether and how environmental awareness has changed over the past ten years, and what future solutions are possible.

9.1 From words to actions: claimed and actual environmental awareness in Ljubljana

In 2010, we surveyed 408 people in Ljubljana, using the statement »Someone like me is able to do something for the environment« to determine how people on a hypothetical level support environmental protection and how many feel able to act in environmentally friendly ways (Figure 31). The feeling of their own capability for environmentally friendly action is a basic condition for active environmental engagement. Just under two-thirds of the respondents (60.2%) felt capable of acting in environmentally friendly ways (the answers »Completely agree – 5,« »Mostly agree – 4,« and »Somewhat agree – 3«) with a median value for the statement of 3.73. These respondents were aware, at least at the claimed level, that not only other living beings but also they themselves were involved in contributing to human environmental impacts. Only one-tenth felt incapable or powerless to do anything for the environment (the answers »Disagree –2,« and »Completely disagree –1«).

People's hypothetical willingness to protect the environment has increased over the years. In 2004, 56% of respondents were willing to do something for the environment (the answers »Completely agree« and »Mostly agree«). In the past few years there has been a social shift, in which the general economic crisis has led to the realization that the current social system based on constant growth and a lack of environmental balance needs to change. Awareness and understanding of the connection between environmental pressures and the environment's condition have increased, as has people's sensitivity to the environment's condition and their awareness of the importance of a healthy environment for quality of life now and in the future (Polajnar Horvat 2015a).

Because only environmentally active individuals can change current mindsets and help remedy environmental degradation and prevent new degradation, this study (Polajnar Horvat 2015a) examined how many people were willing to pay higher prices for various articles in order to protect drinking water. This

leads to the second level of the study, which examines actual willingness to take environmental action (Figure 32). The median value of answers was 3.08, which indicates a reduction in willingness when the question centers on the costs of environmental protection to the individual. Only a bit more than one-third (35%) answered »completely willing« and »somewhat willing.« Individuals' actual environmental attitudes gave way to their hypothetical ones in one-fourth (25.2%) of respondents.

Actual willingness to take environmental action was measured in two time periods within six years. Between 2004 and 2010, actual willingness to behave in environmentally friendly ways increased in one-third of respondents. One of the reasons was that the past decade has seen considerable positive changes regarding environmental protection, including at the legislative level (Toš 2012).

Research to date indicates that education has significant impact on individuals' environmental attitudes (Gardner and Stern 2002). Only one-fifth of people with a vocational education and a good fourth of those with primary and secondary school education are willing to take environmentally friendly action. In contrast, nearly a third of people with higher education are willing to do so. Study findings from 2004 (Smrekar 2006a) were not much different; the main difference was only among those with higher education, among whom nearly half demonstrated willingness to behave in environmentally friendly ways.

Further research (Smrekar 2011, Polajnar Horvat 2015a) explored whether respondents were really willing to actively participate in groundwater protection as a source of drinking water, thereby contributing to a healthy living environment. Respondents were presented with an (imaginary) »Healthy Drinking Water Foundation,« whose purpose was to improve groundwater quality as a source of drinking water in Ljubljana. The most burning issues in need of resolution were presented (watertight drainage and treatment of household and industrial wastewater, illegal dumping sites, and seepage from manure pits). The funds for these programs were to be collected through a permanent additional monthly charge on people's electric bills, whereby the charge was to be listed as an independent item on the bill. The power company, as a neutral organization, was to credit the funds to the »Healthy Drinking Water Foundation.« Most respondents did not question the reality of this fund, which facilitated the study, in which we examined whether respondents would be willing to spend €2.00 or more per month in order to solve the problems listed above (Smrekar 2011).

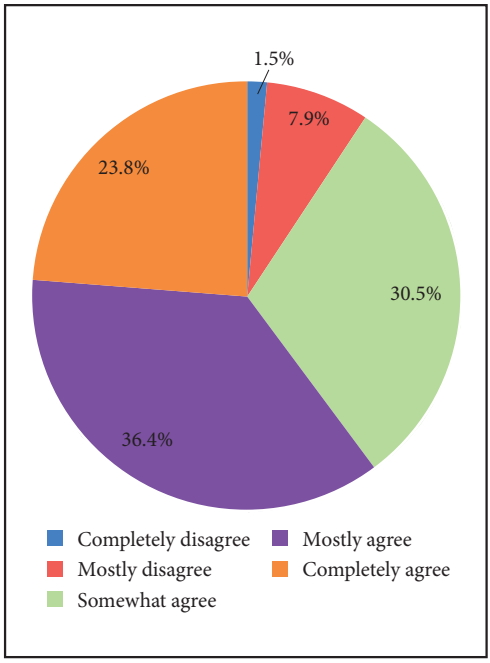

Figure 31: Agreement with the statement »Someone like me is able to do something for the environment« (Anketa 2010; $n = 408$).

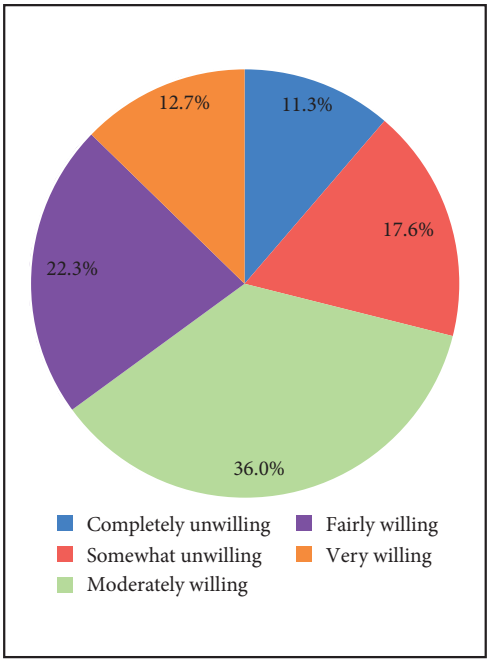

Figure 32: Respondents' willingness to pay higher prices for various articles in order to protect drinking water (Anketa 2010; $n = 408$).

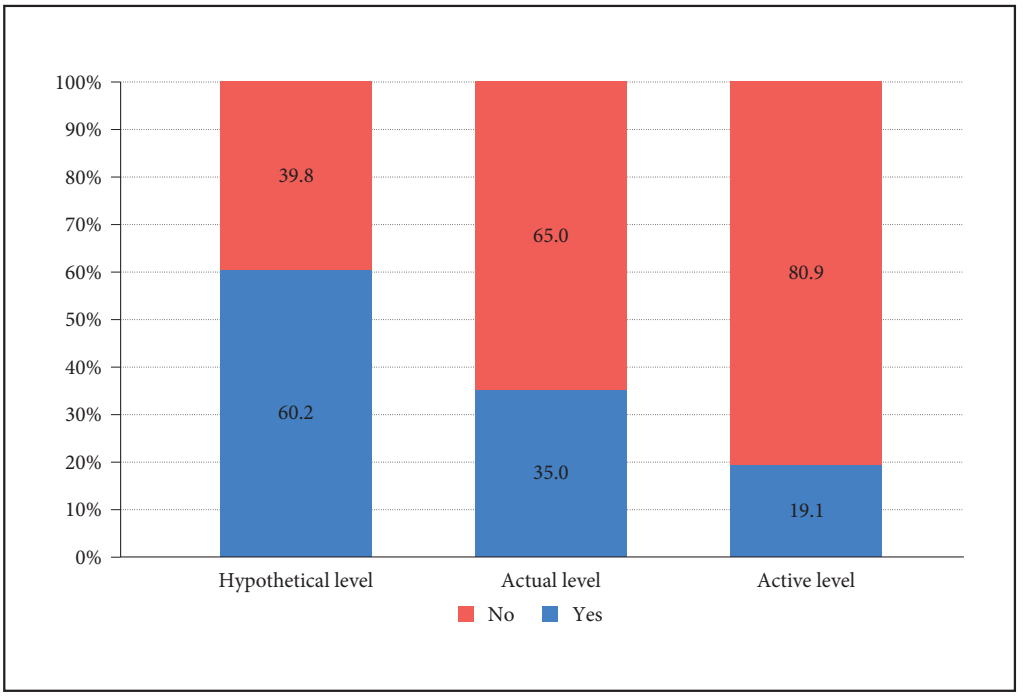

Figure 33: Willingness to behave in environmentally friendly ways at the hypothetical, actual, and active levels (Anketa 2010; $n = 408$).

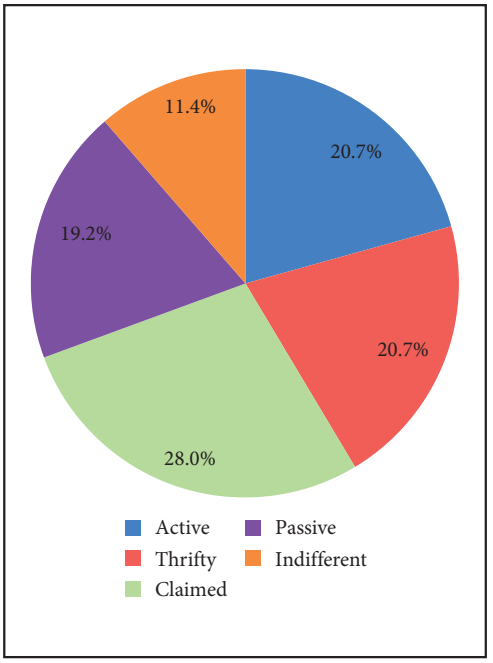

Figure 34: Segmentation of participants by environmental attitude (Anketa 2010; $n = 386$).

Only one-fifth (19.1%) of respondents expressed willingness to contribute €2.00 to the »Healthy Drinking Water Foundation,« indicating a further significant decline in zeal compared to the hypothetical statements of support mentioned above (Figure 33). Almost exactly the same proportion (20.9%) was also observed in 2004 (Smrekar 2006a), when the respondents expressed their willingness to contribute SIT 500 (€0.84), which is close to the same amount.

Despite the fact that lifestyles across Slovenia are pretty similar, with regard to their level of environmental awareness and action, Slovenians are not a homogeneous group that is easy to identify and describe (Gilg, Barr and Ford 2005; D'Souza et al. 2006; Culiberg and Rojšek 2007), because they differ in education and economic status (Vukovič 2011). Therefore, in order to improve people's environmental awareness and sustainability-oriented behavior, it is crucial to fine-tune the categories and define them more precisely, and then ways to promote environmental awareness and behavior can be tailored to the individual group. Therefore, in her study Polajnar Horvat (2015b) divided respondents into groups based on their attitudes, norms (personal and subjective), claimed behavioral control, values, and intention and behavior. The participants were divided into five groups: claimed (28.7% of participants), active (20.7%), thrifty (20.7%), passive (19.2%), and indifferent (11.4%; Figure 34; Polajnar Horvat 2016).

The »active« group is characterized by high environmental awareness, which is why they mostly agree or strongly agree with the survey statements. This group, which we consider the »environmental body« of the area studied, is characterized by personal responsibility for environmental action and positive feelings when engaging in environmentally friendly behavior. People in the »thrifty« group are mostly neutral or moderately positive, because rather than believing that one of the goals of human life is environmental protection, members of this group are guided by values such as wealth, money, power, fame, and influence. »Claimed« people feel capable of acting in an environmentally friendly manner and are sure that they are well-informed about how to act appropriately. At the claimed level they express very high support for environmental protection, which is reflected in their very high level of environmental awareness. »Passive« people are aware of the need for environmentally friendly action on a claimed level and so they do care about the environment, but they do not put this belief into practice. The »indifferent« group has negative feelings toward the need for environmentally friendly behavior. They do not feel capable of this kind of action, are unaware of the consequences of inappropriate environmental behavior, and do not feel responsible for them. They largely have no feelings of guilt over behaving environmentally inappropriately, do not have any sense of moral responsibility, believe that they cannot contribute to protecting the environment, and they are markedly uninformed about the environment (Polajnar Horvat 2015a; 2016).

The question about the »Foundation,« with which we measured Ljubljana residents' actual environmental attitudes, was key for determining actual environmental behavior. This question raised concern among the respondents that the »Foundation« would really come to life based on the survey, and that thus it would also depend on their answers how much they would actually have to contribute to a fund for resolving the most urgent groundwater pollutants in their environment. Likewise, we also found that education had a significant impact on willingness to actively participate in environmental protection. The most environmentally active group are those with university degrees, followed by graduates of vocational higher education programs and then secondary schools. Better-educated people are more likely to have post-materialist values, which, rather than the desire for economic security and comfort, are reflected in protecting the environment and caring for others (Duch and Taylor 1993; Warwick 1998). On the other hand, the reason less-educated people are less willing to sacrifice their own financial resources is that they have less capacity for additional financial expenditures.

10 Discussion

Slovenia has a long tradition of environmental protection and an institutional and administration system of environmental protection, which has the support of NGOs and other professional bodies and individuals. Ljubljana has adopted an environmental protection program (Program 2014) that identifies challenges and measures to deal with them. Despite this, the way toward sustainable development requires systematic changes to the development model, which take into consideration environmental limits. Natural capital must come to be understood as development potential and not an obstacle to development, and so it is

necessary to establish mechanisms for aligning priorities and various policies. Slovenia's regulations are mostly good; better monitoring is needed, which is one of the most important policy implementation levers. It is very important to involve all relevant stakeholders in environmental decision-making processes, educate the stakeholders, because successful development of a sustainable society is seen only with broad inclusion (Smrekar et al. 2016b). Maintaining a healthy environment and natural resources should be in everyone's interest, so the starting point for planning development is awareness of the scarcity of natural resources and space (Multiannual … 2019).

Major environmental problems in Ljubljana are traffic and uncontrolled activities in riparian areas located above large quantities of drinking water in aquifers. The challenge is to raise residents' environmental awareness; for example, through social impact methods.

A major current environmental problem in Ljubljana is traffic. Since the turn of the third millennium, the City of Ljubljana has begun to address transport issues more decisively, especially downtown, but traffic throughout the municipality remains one of the key environmental pollutants. A modern, user-friendly, and environmentally-friendly approach to transport management and planning is exemplified by the integrated transport strategy (Celostna … 2017), which builds on the transport policy adopted in 2012, which has never been implemented in practice. Also important is the recently adopted integrated transport strategy at the regional level (Celostna … 2018), which focuses on improving public transport (modern regional rail, modernizing and electrifying lines, additional trains) in relation to the Park and Ride collection points. Although the situation is improving compared to the past with regard to both nitrogen oxides (Ogrin and Vintar Mally 2013) and PM10 particles (Poročilo … 2017), the direct impact of transport measures is difficult to assess. The closure of *Slovenska cesta* to car traffic and the replacement of the bus fleet with cleaner vehicles contributed to an impressive 72% reduction in black carbon emissions in this section (Titos et al. 2015).

A combination of (un)favorable natural and social trends have caused part of the Ljubljana Plain, which should be strictly protected because of its water pumping function, to become a degraded landscape. Economic exploitation based on an egocentric attitude to the environment has reduced the value of this delicate riparian area. So far, groundwater analyses still indicate its suitability, but the area is under hidden threat due to uncontrolled activities in the past and present. The riparian landscape is under great pressure from certain groups of people that see this landscape as a place for harmful activities such as community gardening (Jamnik et al. 2009), gravel extraction (Breg Valjavec 2013), and illegal dumping (Smrekar et al. 2017). The water protection area is easily accessible, crisscrossed with trails, and the unregulated ownership further promotes illicit and undesirable activity. To achieve a successful and long-term solution to the problem, remediation of the degraded spaces will not be enough; it will be necessary to restore the cultural and social value of the area and place it durably within the population's value system and memory. In the long run, areas whose primary function will remain supplying drinking water should also be given a new purpose, and today's degraded areas should be turned into green (peri)urban spaces through remediation.

Such a change is made possible by the use of various social impact techniques based on a bottom-up approach; that is, engaging the individual from the beginning, step by step. The approach should therefore be applied across the entire population, making use of targeted techniques that are tailored to different groups (Kozina 2018). Interaction between individual groups or mutual awareness raising enables the transfer of knowledge between younger and older people. The case of a creative spatial planning project of an urban community garden called »Beyond the Construction Site« demonstrates the potential of a participatory process for physical and social changes to public space, as an example of how the bottom-up initiative contributed to the sustainable environmental and social development of the urban environment (Poljak Istenič 2019). However, this is far from sufficient for spatial changes; support from city authorities and earmarked funds are also necessary to address the negative situation. In the last decade, steps have been taken toward addressing environmental problems in Ljubljana based on environmental studies on garden plots (Jamnik et al. 2009), private wells (Smrekar and Kladnik 2004), and illegal dumping sites and gravel pits (Smrekar et al. 2005; Smrekar et al. 2006), in which geographers have played the main role.

With residents' increased environmental awareness and education and the activity of civil initiatives (such as Jane's Walk) come new challenges in environmental protection in Ljubljana. With the city's socioeconomic development, the development of tourism, and the spread of cosmopolitanism on the one hand,

and the impact of European Union recommendations and legislation on the other, the city administration and the residents are becoming ever more aware that green spaces are more than just grass, trees, shade, or public space. They offer diverse types of ecosystem services, act as bio-corridors and, as outdoor classrooms, emphasize their conservation and educational importance.

Various formal measures will be able to become effective when Ljubljana residents recognize green spaces as an even greater value and when they gain a special place in their consciousness as public spaces. People should perceive them as an »outdoor room,« as Ward Thompson (2002) puts it, where they can relax and enjoy various activities. Of course, activities like community gardening, for example, need to be coordinated with the most important function: supplying quality drinking water.

10.1 Looking ahead to geographic research in areas with the greatest concentration of people and activities

Geography, as a crossroads between natural sciences, social sciences, and humanities (Urbanc 2017), plays an important role on the way to increasingly sustainable cities due to its basic connection of interdisciplinarity and sustainability with its comprehensive view, breadth, and openness (Smrekar 2007; Brečko Grubar and Kovačič 2017) and emphasis on the spatial approach. This will also prompt and guide research at the Department of Environmental Protection. A prominent research topic that will have a greater role to play in the transition to the third decade of the twenty-first century is innovative sustainable management of protected areas (including protected areas in cities) and urban areas, which, from the perspective of geography and heritage, are undoubtedly a »place of sense.« The superiority of Ljubljana's urban space is achieved through its rich cultural heritage, which testifies to the continuous settlement of Ljubljana from prehistoric times, as well as through its status as Slovenia's capital, spanning several decades.

The city is also characterized by natural heritage. It contains the Tivoli, Rožnik, and Šiška Hills Landscape Park, which is largely landscaped as a park. At Ljubljana's periphery, however, is the Ljubljana Marsh Landscape Park, which aside from the UNESCO world heritage site with prehistoric pile dwellings (UNESCO) also contains a wealth of natural heritage and great biodiversity, with numerous protected species of plants and animals. All of this landscape diversity opens up new opportunities for geographical research, also in developing new methods and research approaches for the ongoing development of basic geography, as well as numerous challenges connected with related disciplines such as history, archeology, botany, forestry, and others. Accordingly, the research topics also address a number of applied areas for which they provide expert support.

The next section touches on topics that represent new research challenges, but current spatial processes are calling for even more intensive research.

The interpretation of natural and cultural heritage that the department has begun to develop in recent years is an important topic of ongoing research. Heritage can also be preserved through the integration of heritage and its professional interpretation within the context of sustainable tourism (Skowronek et al. 2018). Heritage interpretation is an intensely evolving professional discipline. It presents a set of different knowledge, techniques, and tools that explain how to extract key facts about particular heritage from an extensive body of knowledge. Interpretation reveals ways of bringing heritage closer to the public in an interesting way (Smrekar et al. 2014; Smrekar et al. 2016c).

In the future, we will upgrade our research methods and applications in environmental psychology. Numerous past awareness-raising activities among urban locals and visitors have confirmed their usefulness and success, as well as some of the weaknesses that will be addressed in the future.

With urban growth and development, the pressures of construction, and the pressures of increasing traffic and population, we can also expect many new dimensions of anthropogenic land degradation and degradation of landscape elements. Throughout its post-industrial development, Ljubljana has at various times faced the degradation of various landscape elements.

In the future, increasing anthropogenic pressures will primarily affect air (dust particles), groundwater (waste management and sewage), and nature in and around the city (biodiversity). Accordingly, special attention will be paid to the further spatial and functional development of green infrastructure in urban areas, as well as protection of environmental components in the urban environment (linking physical and social topics). As pointed out in our presentation of urban green spaces, exploring these areas opens up

new opportunities in the context of ecosystem services research and environmental assessment. Research on the quality of green urban areas is closely linked to the study of the quality of urban life, which has been part of Slovenian geography for several decades (Špes 1977; 1998; Krevs 2002; Rebernik 2002; Tiran 2017) and will undoubtedly also be relevant in the future.

11 Conclusion

Even in the environmental movement's infancy, in Slovenia the environmental mentality was quite insightful and sensitive to the issues of sustainable development of society, although of course there was no such theoretical basis at the time. The first questions on this topic appeared in the media in the 1960s, and not long after that (the 1970s), Slovenian geographers began exploring environmental issues, along with others, of course, such as biologists, hydrologists, geologists, and so on. The idea spread more and more among the public in the 1980s, when the first environmental movements emerged, and when Slovenia gained its independence, at which time it had the most powerful Green Party of any European country. Joining the European Union has permeated society even more with the sustainable paradigm. Today, environmental protection is an important branch of Slovenian geography.

This issue has presented the most important aspects of quality living environment experienced not only in Ljubljana, but also in increasingly more Slovenian cities.

An important aspect of residents' satisfaction is urban green areas, which are quite extensive in Ljubljana, conveniently distributed, and suitable for maintaining a quality environment, both in terms of physical geography (especially air quality and reducing the thermal island effects) and recreation and relaxation in the natural environment. In particular, all this is emphasized in the Tivoli, Rožnik, and Šiška Hills Landscape Park, which extends into the downtown area.

In the future, green spaces will be a great asset to modern, sustainable cities. In Ljubljana, residents feel above-average wellbeing along riverbanks and in city parks; certain other types of urban green spaces in Ljubljana still need to be made meaningful and inviting to residents and visitors.

One of the major challenges facing Ljubljana is the unregulated and insufficiently controlled activities in water protection areas, where proper use is a prerequisite for maintaining good drinking water. It is absurd that designated water protection areas, which were protected early enough, but not effectively monitored, have been degraded through illicit excavation of gravel for construction materials, illegal dumping, and the spontaneous development of garden plots. These very plots are one of the biggest insufficiently controlled activities, which has already grown difficult to manage due to the unregulated conditions of the past decades. The prohibition of garden plots in some current locations, especially near the pumping stations, is necessary, despite the resistance of the affected people. Some of this has already happened and the city has set up new and well-maintained community gardens, which remain difficult for some residents to accept.

Ljubljana's quality of the residential environment is quite high, but it differs significantly within the city, with an accumulation of unfavorable residential conditions in some urban areas. This can lead to increased social degradation and differentiation and jeopardize the implementation of sustainable urban development. Ljubljana residents' quality of life is influenced by their satisfaction with socioeconomic areas of life, such as material and financial status, family life, and social life, more than the residential environment. However, this does not diminish the responsibility of urban planners and city authorities in spatial planning. Of course, residents with increased environmental awareness, which is achieved through social impacts, can exert the greatest pressure on spatial decision-makers, who will subsequently have to change some inappropriate practices.

In the past, predominantly natural processes such as earthquakes, floods, and fires caused landscape changes; today, human beings largely direct these processes in the (urban) environment. Hence, geographers' work will have to be more actively involved in the »construction« of modern, sustainable cities.

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Guidelines for contributing authors in Acta geographica Slovenica

EDITORIAL POLICIES

1 Focus and scope

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We accept original research papers and review papers.

Papers presenting new developments and innovative methods in geography are welcome. Submissions should address current research gaps and explore state-of-the-art issues. Research based on case studies should have the added value of transnational comparison and should be integrated into established or new theoretical and conceptual frameworks.

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1 The papers

Research papers must be prepared using the journal's template and contain the following elements:
- **Title:** this should be clear, short, and simple.
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- **Key words:** include up to seven informative key words. Start with the research field and end with the place and country.
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Research papers should have the following structure:
- **Introduction:** present the background of the research problem (trends and new perspectives), state of the art (current international discussion in the field), research gap, motivation, aim, and research questions.
- **Methods:** describe the study area, equipment, tools, models, programs, data collection, and analysis, define the variables, and justify the methods.
- **Results:** follow the research questions as presented in the introduction and briefly present the results.
- **Discussion:** interpret the results, generalize from them, and present related broader principles and relationships between the study and previous research. Critically assess the methods and their limitations, and discuss important implications of the results. Clarify unexpected results or lacking correlations.
- **Conclusion:** present the main implications of the findings, your interpretations, and unresolved questions, offering a short take-home message.

Review papers (narratives, best-practice examples, systematic approaches, etc.) should have the following structure:
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  - **Literature review:** use subheadings to indicate the content of the various subsections. Possible structure: methodological approaches, models or theories, extent of support for a given thesis, studies that agree with one another versus studies that disagree, chronological order, and geographical location.
  - **Conclusions:** provide implications of the findings and your interpretations (separate from facts), identify unresolved questions, summarize, and draw conclusions.
- **Acknowledgement:** use when relevant.
- **Reference list:** see the guidelines below.

2 Paper submission

2.1 Open journal system

Author(s) must submit their contributions through the *Acta geographica Slovenica* Open Journal System (OJS) using the Word document template.

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Do not use contractions or excessive abbreviations. Use plain text, with sparing use of **bold** and *italics*. Do not use auto-formatting, such as section or list numbering and bullets.

If a text is unsatisfactory, the editorial board may return it to the author(s) for professional copyediting or reject the paper. See the section on the peer-review process for details. Author(s) may suggest reviewers when submitting a paper.

2.2 Language

Papers are published in English.

Papers are submitted in English or Slovenian and copyedited/translated after acceptance by a professional chosen by the editorial board.

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All papers should have English and Slovenian abstracts.

2.3 Supplementary file submission

Supplementary files (figures) can be submitted to the OJS packed in one zip file not exceeding 50 MB.

2.4 Submission date

The journal publishes the submission date of papers. Please contact the editor with any questions.

3 Citations

Examples for citing publications are given below. Using "gray literature" is highly discouraged.

3.1 Citing papers

- de Kerk, G. V., Manuel, A. R. 2008: A comprehensive index for a sustainable society: The SSI – the Sustainable Society Index. Ecological Economics 66-2,3. DOI: https://doi.org/10.1016/j.ecolecon.2008.01.029
- Fridl, J., Urbanc, M., Pipan, P. 2009: The importance of teachers' perception of space in education. Acta geographica Slovenica 49-2. DOI: https://doi.org/10.3986/AGS49205

- Gams, I. 1994a: Types of contact karst. Geografia fisica e dinamica quaternaria 17.
- Gams, I. 1994b: Changes of the Triglav glacier in the 1955-94 period in the light of climatic indicators. Geografski zbornik 34.
- Perko, D. 1998: The regionalization of Slovenia. Geografski zbornik 38.
- van Hall, R. L., Cammeraat, L. H., Keesstra, S. D., Zorn, M. 2016: Impact of secondary vegetation succession on soil quality in a humid Mediterranean landscape. Catena, In press. DOI: https://doi.org/10.1016/j.catena.2016.05.021 (25. 11. 2016).

3.2 Citing books

- Cohen, J. 1988: Statistical power analysis for the behavioral sciences. New York.
- Fridl, J., Kladnik, D., Perko, D., Orožen Adamič, M. (eds.) 1998: Geografski atlas Slovenije. Ljubljana.
- Luc, M., Somorowska, U., Szmańda, J. B. (eds.) 2015: Landscape analysis and planning. Heidelberg. DOI: https://doi.org/10.1007/978-3-319-13527-4
- Nared, J., Razpotnik Visković, N. (eds.) 2014: Managing cultural heritage sites in Southeastern Europe. Ljubljana.

3.3 Citing parts of books or proceedings

- Gams, I. 1987: A contribution to the knowledge of the pattern of walls in the Mediterranean karst: a case study on the N. island Hvar, Yugoslavia. Karst and man, Proceedings of the International Symposium on Human Influence in Karst. Ljubljana.
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- Zorn, M., Komac, B. 2013: Land degradation. Encyclopedia of Natural Hazards. Dordrecht. DOI: https://doi.org/10.1007/978-1-4020-4399-4_207

3.4 Citing expert reports, theses, and dissertations

- Breg Valjavec, M. 2012: Geoinformatic methods for the detection of former waste disposal sites in karstic and nonkarstic regions (case study of dolines and gravel pits). Ph.D. thesis, University of Nova Gorica. Nova Gorica.
- Holmes, R. L., Adams, R. K., Fritts, H. C. 1986: Tree-ring chronologies of North America: California, Eastern Oregon and Northern Great Basin with procedures used in the chronology development work including user manual for computer program COFECHA and ARSTAN. Chronology Series 6. University of Arizona, Laboratory of tree-ring research. Tucson.
- Hrvatin, M. 2016: Morfometrične značilnosti površja na različnih kamninah v Sloveniji. Ph.D. thesis, Univerza na Primorskem. Koper.
- Šifrer, M. 1997: Površje v Sloveniji. Elaborat, Geografski inštitut Antona Melika ZRC SAZU. Ljubljana.

3.5 Citing online material with authors and titles

- Bender, O., Borsdorf, A., Heinrich, K. 2010: The interactive alpine information system GALPIS. Challenges for mountain regions, Tackling complexity. Internet: http://www.mountainresearch.at/images/Publikationen/Sonderband/bender-borsdorf-heinrich.pdf (4. 8. 2014).

3.6 Citing online material without authors

- Internet: http://giam.zrc-sazu.si (18. 11. 2016).
- Internet 1: http://giam.zrc-sazu.si/ (22. 7. 2012).
- Internet 2: http://ags.zrc-sazu.si (23. 7. 2012).

3.7 Citing sources without authors

- Popis prebivalstva, gospodinjstev, stanovanj in kmečkih gospodarstev v Republiki Sloveniji, 1991 – končni podatki. Zavod Republike Slovenije za statistiko. Ljubljana, 1993.
- WCED – World commission on environmental and development: Our common future – Brundtland report. Oxford, 1987.

3.8 Citing cartographic sources

- Buser, S. 1986: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm (Udine). Savezni geološki zavod. Beograd.
- Digitalni model višin 12,5. Geodetska uprava Republike Slovenije. Ljubljana, 2005.
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3.9 Citing official gazettes

- 1999/847/EC: Council Decision of 9 December 1999 establishing a Community action programme in the field of civil protection. Official Journal 327, 21. 12. 1999.
- Zakon o kmetijskih zemljiščih. Uradni list Republike Slovenije 59/1996. Ljubljana.
- Zakon o varstvu pred naravnimi in drugimi nesrečami. Uradni list Republike Slovenije 64/1994, 33/2000, 87/2001, 41/2004, 28/2006 in 51/2006. Ljubljana.

3.10 In-text citations

Please ensure that every reference cited in the text is also in the reference list (and vice versa). In-text citations should state the last name of the author(s) and the year, separate individual citations with semicolons, order the quotes according to year, and separate the page information from the name of the author(s) and year information with a comma; for example: (Melik 1955), (Melik, Ilešič and Vrišer 1963; Kokole 1974, 7–8; Gams 1982a; Gams 1982b).

For sources with more than three authors, list only the first followed by *et al.*: (Melik et al. 1956). Cite page numbers only for direct citations: Perko (2016, 25) states: »Hotspots are …« To cite online material with authors, cite the name: (Zorn 2010). To cite online material without authors, cite only Internet followed by a number: (Internet 2).

3.11 Works cited list

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Include the Digital Object Identifier (DOI) in the reference if available. Format the DOI as follows: https://doi.org/… (for example: https://doi.org/10.3986/AGS.1812).

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Number all tables in the paper uniformly with their own titles. The number and the text are separated by a colon, and the caption ends with a period. Example:

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Content by: Drago Perko
Map by: Jerneja Fridl
Source: Statistical Office of the Republic of Slovenia, 2002
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Since 2003 (from volume 43 onward) the name of the joint journal has been *Acta geographica Slovenica*. The journal continues the numbering system of the journal *Geografski zbornik / Acta geographica*.

Those interested in the history of the journal are invited to read the paper »The History of *Acta geographica Slovenica* in volume 50-1.«

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Contents

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