Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek Your knowledge hub
WIEN

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

DIPLOMARBEIT

from house to habitat

Nurturing Ecologically Sensitive Housing to Combat Urban Sprawl and Soil Sealing

Ausgeführt zum Zwecke der Erlangung des akademischen Grades

einer Diplom - Ingenieurin unter der Leitung von

Univ.Prof. Arch. Dipl.-Ing Michael Ulrich Hensel, PhD

unter Mitbetreuung von Assistant Prof. Milica Vujovic, PhD

E 259/1 Digitale Architektur und Raumplanung

E 259 Institut für Architekturwissenschaften

Eingereicht an der Technischen Universität Wien

Fakultät für Architektur und Raumplanung

von

Stefanie Tischberger, BSc.

01425877

[redacted]

Wien, am 30.05.2023

ABSTRACT

This master thesis identifies and addresses ecological consequences of suburban residential developments in Austria. Existing research shows that the ongoing expansion of settlement areas impacts the environment on multiple levels. Urban sprawl jeopardizes food security and degrades intact ecosystems (Robinson et al., 2005; Sonderegger et al., 2020). Furthermore, soil sealing contributes significantly to rising temperatures (Stolte et al., 2016) and flooding events (Morabito et al., 2018; Ferreira et al., 2022). In this context it is important to consider the underlying preferences of the general population that lead to suburban sprawl. Recent research shows that the majority of Austrians wish to own a detached house (Raiffeisen Immobilien Vermittlung GmbH, 2021). From a planner's perspective it is necessary to gain an in-depth understanding of prevailing housing aspirations and the related environmental consequences, in order to identify implications and develop guidelines for future designs. The research presented in this master thesis focuses on the comparison of population density and plot coverage ratios of four different data sets to evaluate the relationship between building typology and urban sprawl, as well as construction method and soil sealing. Additionally, a survey was conducted that identifies the motivations of (future) homeowners and establishes criteria for future design. The results confirm the assumption that plot size and population density are directly related to urban sprawl. Furthermore, the study revealed that soil sealing could be reduced by up to 30% related to plot size in existing settlements, and by around 40 to 70% in newly constructed houses. Research further highlighted the impact of residents' preferences and habits on biological diversity, not only on the individual plot, but also on larger scales. The survey results indicate a willingness amongst a majority of respondents to facilitate interconnected, shared green spaces and to accept related constraints. Eventually, the results were synthesized into a framework for designing residential settlements that seeks to balance the needs of human and non-human stakeholders. By establishing an overarching argument for decision-making processes, the step-by-step approach can assist planners and policy makers in the ecological optimization of existing developments, as well as in the planning of new residential areas. Finally, the study emphasizes the need to raise public awareness of the impact and potential of individual choices on each property, and on the larger scale of the settlement area.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

KURZFASSUNG

In der vorliegenden Masterarbeit werden die ökologischen Auswirkungen von suburbanen Wohngebieten in Österreich behandelt. Aktuelle Forschungsergebnisse belegen die negativen Auswirkungen der fortschreitenden Ausdehnung von Siedlungsflächen auf die Umwelt. Die Zersiedelung der Landschaft gefährdet die Ernährungssicherheit und belastet intakte Ökosysteme (Robinson et al., 2005; Sonderegger et al., 2020). Darüber hinaus trägt die Bodenversiegelung erheblich zu Temperaturanstieg (Stolte et al., 2016) und Überschwemmungen (Morabito et al., 2018; Ferreira et al., 2022) bei. Ein wesentlicher Treiber des Bodenverbrauchs sind die Bedürfnisse und Vorstellungen der Bevölkerung: Studien zu diesem Thema zeigen, dass sich die Mehrheit der Österreicher:innen ein Einfamilienhaus wünscht (Raiffeisen Immobilien Vermittlung GmbH, 2021). Aus planerischer Sicht ist es daher notwendig, ein umfassendes Verständnis der vorherrschenden Wohnwünsche und der damit verbundenen Umweltauswirkungen zu erlangen, um in weiterer Folge entsprechende Schlussfolgerungen für zukünftige Bauvorhaben ziehen zu können. In der vorliegenden Masterarbeit werden Bevölkerungsdichte und Bodennutzung anhand von vier Datensätzen verglichen, um die Zusammenhänge zwischen Gebäudetypologie und Zersiedelung sowie Konstruktionsweise und Bodenversiegelung zu erfassen. Zudem wurde eine Umfrage durchgeführt, in der die Beweggründe der (künftigen) Hausbesitzer:innen ermittelt und Kriterien für eine zukunftsorientierte Gestaltung erarbeitet wurden. Die Hypothese, dass Grundstücksgröße und Bevölkerungsdichte in direktem Zusammenhang mit der Zersiedelung stehen, konnte durch die Ergebnisse belegt werden. Darüber hinaus zeigte die Studie, dass die Bodenversiegelung im Verhältnis zur Grundstücksgröße in bestehenden Siedlungen um bis zu 30 % und im Neubau um ca. 40 bis 70 % reduziert werden kann. Weitere Forschungsergebnisse unterstreichen die Relevanz der Vorlieben und Gewohnheiten der Bewohner:innen für die biologische Vielfalt, nicht nur am einzelnen Grundstück, sondern auch in größerem Maßstab. Die Ergebnisse der Umfrage zeigen, dass ein Großteil der Befragten bereit ist, zusammenhängende, gemeinschaftlich genutzte Grünflächen zu fördern und die damit verbundenen Einschränkungen in Kauf zu nehmen. Die Ergebnisse wurden in einem Leitfaden für die Gestaltung von Siedlungen zusammengefasst, der darauf abzielt, die Bedürfnisse von Bewohner:innen mit dem Schutz von Tier- und

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Pflanzenwelt in Einklang zu bringen. Die Etablierung einer umfassenden Argumentation für Entscheidungsprozesse und der „step-by-step approach" können Planer:innen und politische Entscheidungsträger:innen bei der ökologischen Optimierung bestehender Siedlungen sowie bei der Planung neuer Wohngebiete unterstützen. Abschließend betonen die Studienergebnisse die Notwendigkeit, das Bewusstsein der Öffentlichkeit für die Auswirkungen und das Potenzial individueller Entscheidungen, sowohl auf der Ebene des einzelnen Grundstücks als auch im gesamten Siedlungsgebiet, zu schärfen.

Own Photograph.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

acknowledgements

I'm extremely grateful for the guidance and expertise I received from both of my thesis supervisors Univ.Prof. Arch. Dipl.-Ing Michael Ulrich Hensel, PhD and Assistant Prof. Milica Vujovic, PhD. Your positive and constructive approach to teaching and your extensive knowledge of scientific research have been a source of encouragement and motivation to me throughout the whole process. I deeply appreciate all the work and dedication you put into every meeting and feedback. Furthermore, I would like to thank my academic colleague Maximilian Michel from Data Science master's program at TU Vienna for the cooperation in data analysis and representation.

I would like to extend my thanks to my friend Viktoria Kalt, for sharing expertise, for being patient with my endless questions, and for devoting hours of time to proofreading. Additionally, I would like to thank my go-to person and brainstorming mastermind Lukas Schneeweiß for consistent encouragement and countless hours of conversation. Special recognition is owed to my family and friends for their unwavering support. Thank you for always being there, ready to listen, and providing a much-needed break. Lastly, this thesis would not be complete without a shout-out to my dog for providing emotional support and taking me on walks.

TABLE OF CONTENTS

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

GLOSSARY

Term	Definition
Brownfield	abandoned sites such as former industrial areas (Naumann et al., 2018)
Evapotranspiration	water exchange from earth to atmosphere: combination of evaporation (soil) and transpiration (through plants) (Babaeian & Tuller, 2023)
Land Cover	physical surface or type of land (Verheye, 2009)
Land Degradation	negative human interference with land (Johnson et al., 1997)
Land Recycling	the reuse of built land (Naumann et al., 2018)
Land Take	"urbanization" or the "increase of artificial surfaces" (Naumann et al., 2018, p. 2); used as synonym for land consumption and land conversion; these terms are used as umbrella terms for land cover change and land use change in this master thesis
Land Use	human-determined use of land (Verheye, 2009)
Productive land	used in this thesis as synonym to healthy soil describing a stable, resilient and fertile condition of soil
Resilience (Ecology)	an ecosystem's ability to withstand and recover from disturbance or damage (Folke et al., 2004)
Soil Sealing	covering the soil with a layer entirely or partially impervious to water and air (Morabito et al., 2018)
Urban Sprawl	a structure of human settlement identified by a diffuse network of individual buildings (Robinson et al., 2005)

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

1 INTRODUCTION

1.1 Problem Statement and Motivation

Land cover and land use change take place at a rapid pace. According to the Environment Agency Austria the annual land take is almost five times above the target of the 2030 government program (*Bodenverbrauch in Österreich*, 2021). The consequences of extensive conversion of productive land to human settlement have been recognized for decades. Cropland and connected natural areas are being fragmented for the sake of housing, commercial and industrial development, as well as related infrastructure (Robinson et al., 2005). The ongoing expansion of conventional housing settlements is covering soil with an entirely or partially impervious layer, such as asphalt, concrete or pavement (Morabito et al., 2018). In Austria, almost half of the area affected by land take loses its biological functions through sealing (*Bodenverbrauch in Österreich*, 2021). This development impacts negatively on the environment. Sealed, as well as compressed soil has been shown to restrict water infiltration (Ferreira et al., 2022), to create heat islands (Rodríguez-Rojas et al., 2018; Jorgan et al., 2021) and to play a significant role in global warming and natural disasters, such as recent flooding events (Morabito et al., 2018; Sonderegger et al., 2020; Ferreira et al., 2022). In Austria the majority of all areas affected by land use change are either grassland or have previously been used for agricultural purposes (Aust et al., 20; Sonderegger et al., 2020). The continuing loss of cropland jeopardizes food security and puts pressure on the remaining farmland (Morabito et al., 2018; Stolte et al., 2016). Additionally, the fertility of soils in Austria is threatened by the widespread use of pesticides and fertilizers, contaminating air and water qualities (Umweltbundesamt, 2022). Healthy soil plays a crucial role in meeting climate targets and has been shown to hold considerable amounts of carbon (Ferreira et al., 2022), currently retaining around 40 years of the national greenhouse gas emissions (Umweltbundesamt, 2022). Ongoing construction slowly exposes these stocks, with the effect that settlement areas are characterized by the lowest carbon storage potential (Umweltbundesamt, 2022). The ability of healthy soils to bind and store carbon also plays a significant role in supporting food chains, providing habitat and nutrition for a wide range of species, from microorganisms to mammals (Geisen et al., 2019; Stolte et al., 2016). Hence, the condition of soil is directly related to the flora and fauna above ground.

In general, land take is slowly decreasing. However, the share related to housing has recently been rising (*Bodenverbrauch in Österreich*, 2021). In 2020 almost 68% of all designated building areas were used for the construction of residential buildings. Semi-detached and detached houses accounted for more than two thirds of this area (STATISTIK AUSTRIA, 2021). These building typologies frequently constitute a diffuse network of low-density developments occurring especially in peripheral zones and rural areas. Its spatial pattern is characterized by the need for individual infrastructure and transportation (Robinson et al., 2005). In particular, the extensive use of cars is claiming a considerable amount of land for road networks and adjacent parking areas, as well as driveways and garages (Robinson et al., 2005; Stolte et al., 2016). Still the majority of the Austrian population seeks the qualities that in their view only owning a freestanding house can provide (Raiffeisen Immobilien Vermittlung GmbH, 2021). These desires and expectations directly relate to the dwelling types that are closely linked with negative environmental consequences.

In response to this challenge, new solutions in the field of architecture that combine ecological sensitivity with the wishes of the population are required. Therefore, the design of new settlement areas needs to address both the protection and appreciation of green infrastructure as a valuable resource, as well as the management of sociological needs and desires.

1.2 Structure and Contents

This master thesis examines the correlation between the prevalent land use practice in Austria and its consequences for domestic biodiversity and ecosystems. The considerable impact caused by the construction of residential buildings, as well as the intentions and desires of dwellers nourishing certain construction decisions, are of particular interest to this research. The conceptual framework is based on these topics and led to the formulation of a set of design guidelines.

A literature review served to examine the relation between land take, urban sprawl and soil sealing in the context of housing. Furthermore, their roles are studied with focus on their impact on biodiversity and ecosystems, and the consequences on (micro) climate, food production, water and air quality. The study of existing settlements served to establish correlations between selected typologies and urban

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

sprawl, as well as construction types and soil sealing. The findings served to define the influence of the choice of construction method and materials on the degree of soil sealing, as well as the effect of certain building typologies on land take and urban sprawl. A survey served to verify existing desires and expectations of homeowners.

The formulation of design guidelines was supported by literature review, study and survey, in order to connect the ecological sensitivity with the desires of the population. The research focused specifically on finding an architectural response to the challenges of diminishing biodiversity and natural resources, while taking into account the desires of future dwellers.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Figure 1. Orthophoto of a Residential Area in the Outskirts of Vienna; source: Google Earth.

2 STATE OF THE ART

2.1 Land Take and Housing

Land take is frequently referred to as "urbanization" or the "increase of artificial surfaces" (Naumann et al., 2018, p. 2) and is adopted in this master thesis as an umbrella term for both land use change and land cover change (see Glossary). In Austria, land take is converting mostly agricultural land and grassland into built environments at an alarming pace. The land affected can frequently no longer fulfill its ecological functions (Aust et al., 20). According to the Austrian Environment Agency land take in Austria amounts to 42 km² per year (three-year average; *Bodenverbrauch in Österreich*, 2021). Although the rate of land conversion is on a slow but steady decline, numbers still exceed the target in the 2030 government program by almost a factor of five (*Bodenverbrauch in Österreich*, 2021).

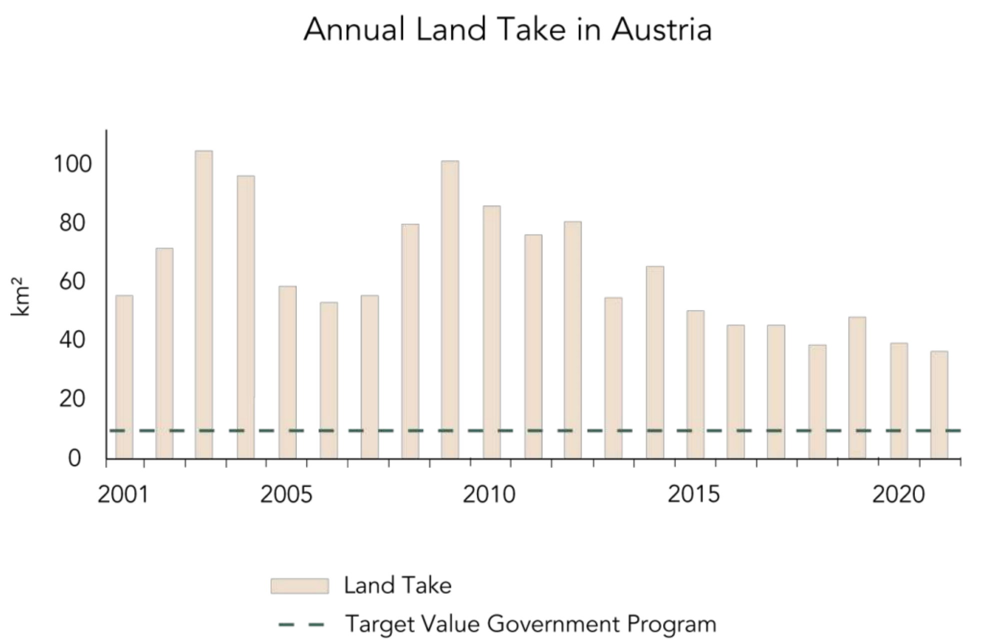


Figure 2. Annual Land Take in Austria; own presentation; source: *Flächeninanspruchnahme*, 2021.

On an international level, two primary policy targets address the issue of land take. Target 15.3 of the Sustainable Development Goals of the United Nations (2017) stipulates to "halt and reverse land degradation until 2030" (Naumann et al., 2018, p. 2). The term land degradation refers to the reduced or lost biological or economic productivity of soils due to various pressures, such as land use and cultivation practices. The goal encapsulates the idea of "Land Degradation

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Neutrality”, describing a condition in which resilience and stability of natural resources ensure food security and ecosystem functions (United Nations Statistics Division, 2022). Another target on an international level is the “Roadmap to a Resource Efficient Europe”, initiated by the European Union in 2011. This entails the goal of “no net land take by 2050” for the first time. Meeting this target requires either construction on previously developed land only, or the compensation of any new land take by way of land recycling (*Land take in Europe*, 2019).

While these targets emphasize the necessity of effective land use practices, they do not offer practical guidelines (Naumann et al., 2018). In consequence, there is a wide range of different spatial planning legislations among European states. Austria set an annual land take target of 9 km² by 2030. While quantitative targets can serve as an instrument to supervise trends, the protection of arable land, forests and grassland by law can be a useful tool for providing meaningful land use policies. Austria’s spatial planning legislation enforces strategies to ensure the highest level of forest conservation, making it a challenging and protracted matter to convert forest soils into areas zoned for construction development. This legislation, in turn, demands adequate afforestation elsewhere (Naumann et al., 2018). Experts have recently been proposing to establish a similar approach towards the handling of cropland (Aust et al., 2020). In Poland the law stipulates the collection of fees for the transformation of agricultural land (Naumann et al., 2018). The French “Solidarity and Urban Renewal Act” supports urban recycling and densification over the enlargement of constructed areas, forming the legal basis for regional and urban planning. In result, land recycling accounts for more than 45% of the total land take from 2006 to 2012 within the urban agglomeration of Nantes, whereas in Vienna it only adds up to around 5% (Naumann et al., 2018). According to the 13th environmental control report, a study in 2004 already concluded that Austria’s brownfield stock (i.e. formerly developed sites) amounts to 8.000 to 13.000 ha. However, no precise records exist on this matter to date (Umweltbundesamt, 2022). Several European countries are pursuing the same target of reducing land consumption, yet individual governments selected particular approaches that prove to be effective in some ways, while other aspects continue to be overlooked. It can therefore be said that the common goal of

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

reducing land take would be approached more adequately through a combination of several measures.

Contrary to the mentioned downward trend in general land take in Austria, the share of land conversion related to housing has been rising until the year 2019 (*Bodenverbrauch in Österreich*, 2021).

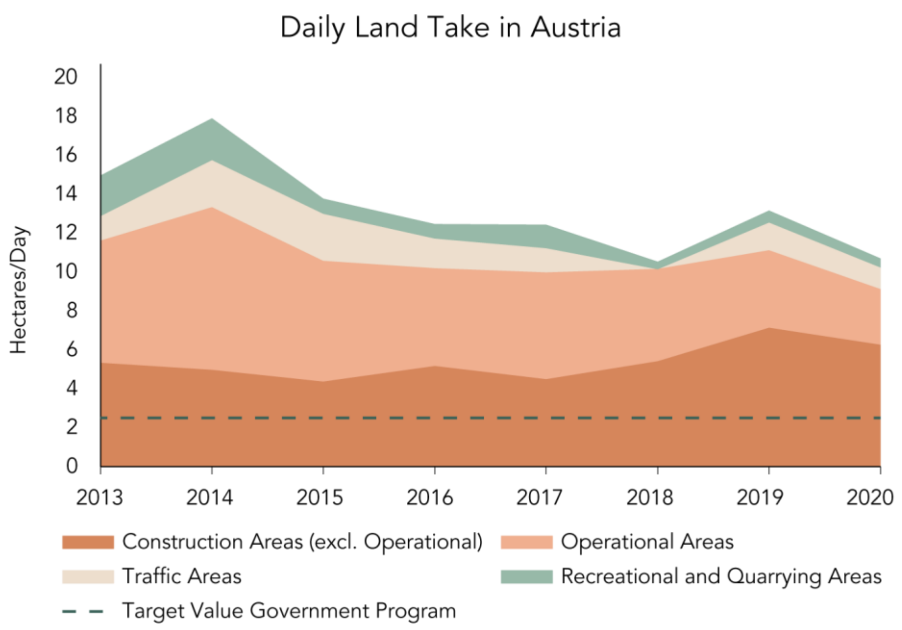


Figure 3. Daily Land Take in Austria; own presentation; source: Umweltbundesamt, 2022.

This augmentation, however, does not necessarily correspond with population growth (Morabito et al., 2018; Herburger, 2022), but is caused by rising spatial requirements due to changing lifestyles and related infrastructure (Gentile et al., 2009). In 2020 almost 68% of all designated building areas were used for the construction of residential buildings. Semi-detached and detached houses accounted for more than two thirds of this area (STATISTIK AUSTRIA, 2021). Their low-density pattern occupies a much larger area compared to higher density developments (Gentile et al., 2009). The following calculations are based on data provided by Statistics Austria to provide a more detailed insight into regional variations. Due to the mountainous landscape, less than 39% of Austria's total land area is suitable for current forms of permanent settlement and agricultural production (STATISTIK AUSTRIA, 2022; see Table A1). By January 2022, an average of 45% of this area in each federal state has already been claimed by residential, industrial, and commercial development, leaving a continually decreasing amount of land for the cultivation of agricultural produce (STATISTIK AUSTRIA, 2022; see Table A1). The continuing growth of settlements will eventually lead to the saturation of available space in some regions, whilst putting national food security under pressure. Mountainous provinces such as Tyrol and Vorarlberg are particularly affected due to the limited space available, already showing a settlement rate of more than 55% and 60% (STATISTIK AUSTRIA, 2022; see Table A1).

2.1.1 Urban Sprawl

"Urban sprawl" can be described as a structure of human settlement identified by a diffuse network of individual buildings (Robinson et al., 2005). It consists mostly of residential construction but can also include commercial development or other typologies (Robinson et al., 2005). As a uniform definition of urban sprawl is yet to be established, there is no shared method of measurement or quantification either. In literature, density of buildings (Wang et al., 2020) or inhabitants (Bueno-Suárez et al., 2020) per selected area is frequently used to describe the phenomenon. Settlement structures that fall into the definition of urban sprawl usually show a particularly low density (Herburger, 2022). Furthermore, urban sprawl originates in and cannot easily be separated from private transport (Robinson et al., 2005). The related extensive use of cars requires individual infrastructure requiring a considerable amount of land for road networks and parking areas, as well as driveways and garages (Stolte et al., 2016). Compared to multi-storied buildings, these housing typologies occupy a significantly larger area thereby impacting environment, land and resources (Robinson et al., 2005). Urban sprawl was already recognized and brought into the political discourse in the late 1960s (Herburger, 2022).

Vorarlberg, the westernmost province of Austria, is known for its mountainous landscape. The social and economic center of the region is concentrated within the Alpine Rhine Valley, which is home to over two thirds of the local population (Herburger, 2022). The region has been characterized by intensive housing development for decades. However, the area consumed by the construction of settlements does not necessarily correspond with population growth (Morabito et al., 2018; Herburger, 2022), but derives from rising spatial requirements due to

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

changing lifestyles, as well as required infrastructure (Gentile et al., 2009). In the second half of the twentieth century, the Alpine Rhine Valley experienced an economic revival, resulting in a construction boom. During these decades the population grew by 73%, and the total settlement area tripled (Herburger, 2022). This ongoing expansion of settlement areas affects the land and its resources negatively, with impact on soil fertility (Umweltbundesamt, 2022), food security (Schreefel et al., 2020) and water supply (Morabito et al., 2018). It also threatens intact ecosystems and biodiversity (Stolte et al., 2016). Urban sprawl does not only degrade natural habitats but also segregates remaining natural areas (Robinson et al., 2005; Stolte et al., 2016).

In order to work on solutions in the field of residential construction, it is essential to find a way to measure urban sprawl to facilitate environmental evaluation of different settlements and their housing typologies. A mixed-methods study should consider this parameter as one of the crucial coefficients. However, land and its resources are not only threatened by the loss of natural areas on a big scale, but also by the treatment of soils within a settlement and the individual plot of land.

2.1.2 Soil Sealing

The term "soil sealing" describes the loss of productive land by covering the ground with a layer entirely or partially impervious to water and air (Morabito et al., 2018). This layer can consist of concrete, asphalt, pavement, or other materials. In result, the soil can no longer fulfill important functions such as storing and evaporating water, filtering pollutants and binding carbon (*Bodenverbrauch in Österreich*, 2021; Stolte et al., 2016). Additionally, the soil loses its role as habitat for various species of flora and fauna (Geisen et al., 2019). The imperviousness encourages water runoff, thereby significantly contributing to water pollution and flooding events (Morabito et al., 2018). The latter account for 35% of all natural disasters in Austria, while causing 69% of the related economic damage (Sonderegger et al., 2020). Furthermore, soil sealing has been identified as the main reason for declining soil quality in Europe (Morabito et al., 2018). It prohibits evapotranspiration processes and therefore negatively impacts microclimate and creates Urban Heat Islands in areas with high soil-sealing rates (Rodríguez-Rojas et al., 2018; Stolte et al., 2016). This phenomenon increasingly occurs in the

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

periphery as a result of the rising amount of impermeable surfaces (Jorgan et al., 2021). According to the Environment Agency Austria between 40 and 60% of the areas affected by land take have been sealed in the years 2019 to 2021, resulting in loss of productive soils of approximately 15 to 21 km² per year (*Bodenverbrauch in Österreich*, 2021).

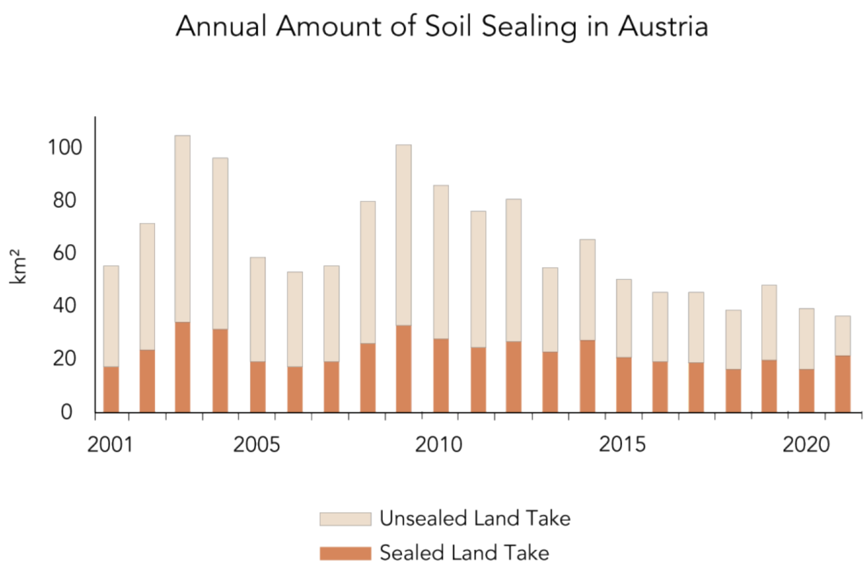


Figure 4. Annual Amount of Soil Sealing in Austria; own presentation; source: *Flächeninanspruchnahme*, 2021.

To be more descriptive such areas are frequently described in terms of the equivalent number of soccer fields. Therefore, in Austria the average area of land being covered with a water- and airtight layer amounts to around 2.150 to 3.000 soccer fields per year, or 6 to 8 soccer fields per day (*Bodenverbrauch in Österreich*, 2021; Football pitch, 2023; see Table A2). Contrary to the slow but continuous decline of land take in general, the sealed area has remained rather stable over the course of the last 20 years (*Bodenverbrauch in Österreich*, 2021). Apart from the national goal of mitigating land take in general, there is no quantitative target specifically addressing the rate of soil sealing to this day. However, ÖROK is currently working on precise measurements and goals as part of the ÖREK 2030 Implementation Pact "Soil Strategy for Austria" (*Bodenstrategie Für Österreich - oerok.gv.at,* 2021; *ÖREK 2030 - Punkt 2,* 2023).

TU Bibliothek Your knowledge hub
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

The expansion of settlements examined in the previous chapter shows a strong correlation between residential construction and land consumption. However, not only the settlement areas on a bigger scale have been constantly growing over the previous decades, also the living space is also at an all-time high. According to Statistics Austria, the average living space per person amounts to 46,3 m² in 2021 (STATISTIK AUSTRIA, 2023). This figure has risen by 3,4 m² within the past ten years, continuing a trend that started in the 1970s. Since then, the average living space per person has doubled (STATISTIK AUSTRIA, 2021). Owners of houses show the highest demand for space with more than 50 m² per person. Apartment owners, on the other hand, occupy around 10 m² less (STATISTIK AUSTRIA, 2023). The space required by tenants is the lowest and varies from 29 to 36 m² per person, depending on the type of rental arrangement (STATISTIK AUSTRIA, 2023). Similarly to the trend of houses and apartments growing larger, cars have increased in size and quantity over the past decades. Whereas in 1990 one in three inhabitants owned a car this figure has risen to more than one in two by 2020 (excluding other motorized vehicles; STATISTIK AUSTRIA, 2023; STATcube - Statistische Datenbank von Statistik Austria, 2023; see Table A3). In a conventional construction, this causes the sealing of not only the individual building footprints, but also the garages, driveways as well as road networks and adjacent parking areas (Robinson et al., 2005).

These developments are key drivers of the almost unchanged annual sealing rate and clearly demonstrate the need for political action to protect as much soil as possible. However, planners are equally challenged when it comes to making appropriate suggestions to minimize the existing level and rate of soil sealing.

New materials have been developed for surfaces that are normally covered by asphalt or concrete. These are characterized by a high degree of water permeability. Different types of Sustainable Drainage Systems (SuDS) have an average infiltration rate of more than 70%, while maintaining safety for both pedestrians and motorized traffic (Rodríguez-Rojas et al., 2018). These systems fully absorb water from regular rain events without generating runoff and enable pollutant filtering capacities of soil, as well as evapotranspiration, thereby contributing to a more pleasant microclimate in cities. Furthermore, SuDS improve oxygen balance and carbon storage potential significantly, when compared to sealed surfaces (Rodríguez-Rojas et al., 2018). While these findings suggest that

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

the targeted application of already available solutions in the field of material technology instead of conventional materials forms a useful approach for reducing environmental impacts, such systems cannot replace more prudent measures for protecting soil.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

2.2 The Effects of Land Take and Soil Sealing on Ecosystem Services and Biodiversity

The prevalent land use practice is already leading to various negative consequences on multiple levels in Austria. In order to secure the quality of life, it is essential to protect ecosystem services and the resources they depend on (Sonderegger et al., 2020). The World Economic Forum stated in 2020 that approximately more than 50% of the global gross domestic product builds upon ecosystem services (Herweijer et al., 2020). Among these are food security, clean drinking water and protection against natural disasters. Further, Ecosystem Services enable identification, inspiration and recreation through diverse landscapes (Sonderegger et al., 2020). One essential element that links all these services is healthy and fertile soil (Ferreira et al., 2022). Soils fulfill a number of services that are essential for human life, as well as the life of animals and plants. They provide habitat for various species (Geisen et al., 2019) and form the basis for domestic agriculture (Ferreira et al., 2022) and the filtration and storage of water (Sonderegger et al., 2020). The agricultural use of soil ecosystems is a particularly significant resource for society as only "functioning" soils manage to secure food supply for the population (Schreefel et al., 2020). Therefore, the basic needs of humanity strongly rely on the fertility and availability of soils. This availability, however, is threatened by constantly changing land uses (Stolte et al., 2016), as the majority of all areas affected through land take are either cropland or grassland (Aust et al., 2020). Additionally, the impermeability of sealed soil has been shown to represent the main cause for the decline in soil quality in Europe (Morabito et al., 2018). Austria's spatial planning legislation enforces strategies to ensure the highest level of forest conservation, making it a challenging and protracted matter to convert forest soils into areas zoned for construction development. This legislation, in turn demands adequate afforestation elsewhere (Naumann et al., 2018). Experts have recently been proposing to establish a similar approach towards the handling of cropland (Aust et al., 2020). A more conscious treatment of agricultural land, similar to forests, could play a significant role in securing domestic food production. A study by the Environment Agency examined the development of different types of land use in Austria over the course of the last 20 years and found that forest and settlement areas increased at a similar rate, while grassland and arable land steadily declined throughout the study

TU Bibliothek Your knowledge hub
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

period (Sonderegger et al., 2020). This development does not only put pressure on the remaining arable land but leads to a significant loss of habitat for various species (Ferreira et al., 2022; Cardoso, et al., 2020). Fertile soils play a significant role in supporting food chains, providing habitat and nutrition for a wide range of animals and plants, from microorganisms and tiny invertebrate animals to insects and mammals (Geisen et al., 2019; Stolte et al., 2016). The biodiversity of soils is thus directly related to the flora and fauna above ground. In turn, domestic agriculture strongly depends on a variety of non-human stakeholders (Cardoso, et al., 2020). Insect pollination has been shown to affect weight, quality and storability of crops, as well as their seed production. It is essential for 88% of all flowering plant species worldwide (Powney et al., 2019). The pollination through insects alone has been calculated to a total profit share of 10% in Austrian agricultural plant products, such as fruits and vegetables (Umweltbundesamt, 2022). Further, the fertility of soils is directly related to the achievement of climate targets, as they manage to store large amounts of carbon (Ferreira et al., 2022; Stolte et al., 2016). Currently, the carbon stock in Austria's soils amounts to 836 mt, equivalent to about 40 years of the national greenhouse gas emissions (Umweltbundesamt, 2022). Above all moors store the highest amount of carbon, followed by forest and grassland soils and vegetation (Stolte et al., 2016), frequently referred to as carbon sinks. Settlement areas, however, show the lowest storage potential (Umweltbundesamt, 2022). The most fertile soils in Austria are located in the foothills of the Alps and along the Danube River, as well as in Burgenland and southeastern Styria. However, many of these regions are characterized by a particularly high settlement activity (Sonderegger et al., 2020), which is historically consequential, because settlements and cities clearly developed where fertile soils and thus food was available. Yet the ongoing expansion increases the pressure on the remaining land and jeopardizes food safety (Morabito et al., 2018). Further, fertile soils are not only the basis for the growth of plant foods, but also for the production of timber and firewood. Since trees and soils are closely connected via their nutrient cycles, forest soils can only remain fertile in the long run if lumber extraction and reforestation are carried out cautiously and sustainably (Sonderegger et al., 2020). Forests are significant ecosystems, as they not only provide humans with wood products and various species of flora and fauna with habitat (Cardoso, et al., 2020), they additionally

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

hold a protective function, as they manage to shield settlements, as well as transportation infrastructure from avalanches (Getzner et al., 2017).

Urban sprawl and soil sealing are already heavily affecting ecosystem services and biodiversity. Yet the findings show that our quality of life depends on them. To enable the development of possible solutions, the following chapter of the thesis draws a more precise picture of the issues related to the state of national biodiversity.

2.2.1 Biodiversity Decrease

According to IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services), land use changes represent one of the main drivers of biodiversity decrease, as roughly 75% of the earth's land surface have yet been transformed considerably (Brondizio et al., 2019). The UN Convention's Global Biodiversity Outlook 5 comes to the bitter conclusion that none of the 20 Aichi Biodiversity goals committed to in 2010 have been thoroughly met and therefore predicts the extinction of a million species within the upcoming decades (Secretariat of the Convention on Biological Diversity, 2020). These alarming global forecasts correspond to findings obtained on a regional level.

In Austria, aside from arable land, grassland is particularly affected through land take (Aust et al., 2020; Sonderegger et al., 2020), leading to a significant loss of habitat (Cardoso, et al., 2020). Land use changes and soil sealing contribute to global warming, such as higher temperatures, droughts and natural disasters (Stolte et al., 2016; Morabito et al., 2018; Ferreira et al., 2022). These phenomena impede domestic species from continuing to occupy their natural habitat (Dullinger et al., 2020; Cardoso, et al., 2020). Invasive alien species are transmitting diseases and changing competitive conditions (Cardoso, et al., 2020). These developments aggravate the conservation of biodiversity. However, various species have shown increasing resilience and adaptability to changing circumstances within interconnected natural areas (Umweltbundesamt, 2022). Yet these vast, contiguous green areas and habitat corridors are being scattered through the construction of roads and railway lines, as well as the continuing dispersal of human settlement (Stolte et al., 2016).

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek Your knowledge hub

During the reporting period of 2013 to 2018 less than 20% of all habitat types in Austria showed a favorable conservation status, while the majority were either in an insufficient or poor condition (Umweltbundesamt, 2022). A similar picture is drawn regarding the evaluation of species conservation. Within the same investigation period less than 15% of species assessments are in favorable condition, while the majority shows an insufficient or poor state of preservation (Umweltbundesamt, 2022). The habitat types and species in wetland, as well as grassland and forest ecosystems show particularly worrying conservation statuses. Among the species specifically concerned are fish, reptiles, amphibians, lower plants such as algae and fungi, as well as birds and insects (Umweltbundesamt, 2022). Above all insects play a significant role in maintaining biodiversity, ecosystems, and food security. Besides supporting food chains, degrading organic substances and providing other indispensable services, insects pollinate plants (Cardoso, et al., 2020). Pollination is essential for 88% of all flowering species worldwide (Powney et al., 2019) and has been shown to affect weight, quality and storability of crops, as well as their seed production (Sonderegger et al., 2020). Therefore, domestic agriculture strongly depends on the stability of the various insect populations. In Austria around 40.000 insect species are known and, while in the past decades primarily fastidious insects were considered endangered, studies now show that also the populations of widespread and previously frequent species are also declining (Umweltbundesamt, 2022).

In order to sustain habitat types and species diversity, planners are challenged to incorporate the exigencies of flora and fauna into the designing of architecture on the scale of an individual building, as well as in the bigger context of settlement areas. To begin with, planners need to learn to identify the constraints, as well as the qualities that our built environment creates for the living conditions of species, to be able to steer in a positive direction. Therefore, established approaches for creating habitat through architectural planning are highlighted within the following section.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

2.2.2 The Construction of Settlement Areas and Biodiversity

Rich and varied green spaces benefit the quality of life in cities and towns, not only by providing recreational space for humans, but also by offering habitat for wildlife (Goddard et al., 2010). Effects of urbanization on biodiversity have been shown to be much more intense in core areas, rapidly decreasing towards the outbounds (Łopucki et al., 2020). The targeted examination of this phenomenon and its drivers could yield valuable information on species richness within typologies of constructed areas and constitute an approach towards the designing of sustainable settlements. A study investigating the correlation of "urbanity" and species richness in cities ranging from 1.300 to 1.700.000 inhabitants in Poland sets human population density (i.e. the number of people per selected area) as a decisive parameter. Łopucki et al. (2020) found that wildlife poverty begins to emerge around 1.000 people per km^2 and identifies the rather spacious arrangement of individual buildings with gardens as reason for increased species richness in peripheral zones. The higher proportion of green and unpaved areas and the unhindered mobility of ground-dwelling fauna form the basis of this argument. Areas characterized by higher population density, multifamily housing, big roads and car parks could, however, form a barrier that hinders the migration of terrestrial fauna (Łopucki et al., 2020). This reasoning presumably withstands as long as fences or walls do not prevent animals from migrating suburban settlements (Taucher et al., 2020) and a variety of fauna (Goddard et al., 2010) and substrates (Donovan et al., 2005) is provided. The findings suggest that increased permeability of settlements (i.e. organizing the built structure in a way, that allows animals to move freely), combined with varied green spaces and unsealed surfaces (Jorgan et al., 2021), offers a significant potential for increasing species richness in settlement areas. These measures can be enhanced by ecological corridors, providing an increased connectivity of urban green areas (Goddard et al., 2010). An open river flowing through an area of high building density and green belts have the potential to impact urban biodiversity positively (Łopucki et al., 2020). However, the suitability and acceptance of green spaces as habitats has been shown to be highly dependent on the level of design and maintenance (Donovan et al., 2005; Taucher et al., 2020). Donovan et al. (2005) have found the "disturbance" to considerably impact the diversity of habitats and associated species within a study carried out in the UK. Abandoned urban spaces,

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

as well as spaces that are rarely intervened, such as former industrial areas, have been shown to offer a wide range of habitat (Donovan et al., 2005). A big variety of local green and dead plant material (Taucher et al., 2020), sheltered spaces (Chiquet et al., 2013) and waters (Łopucki et al., 2020) allow various insect, mammal, bird and bat species to colonize the urban environment. Heavily designed and maintained open spaces on the other hand, such as parks that are mowed and pruned on a regular basis, can only provide a small fraction of the same habitat (Donovan et al., 2005). The study area in Birmingham Eastside was divided into four "designed" and four "natural" open spaces. The heavily managed sites only accommodated 18%, the derelict land however managed to host 82% of all insect species recorded. The paper shows that heavily designed and regularly "disturbed" open spaces have a very limited potential to maintain and facilitate urban biodiversity, when compared to naturally evolved and variegated habitat (Donovan et al., 2005).

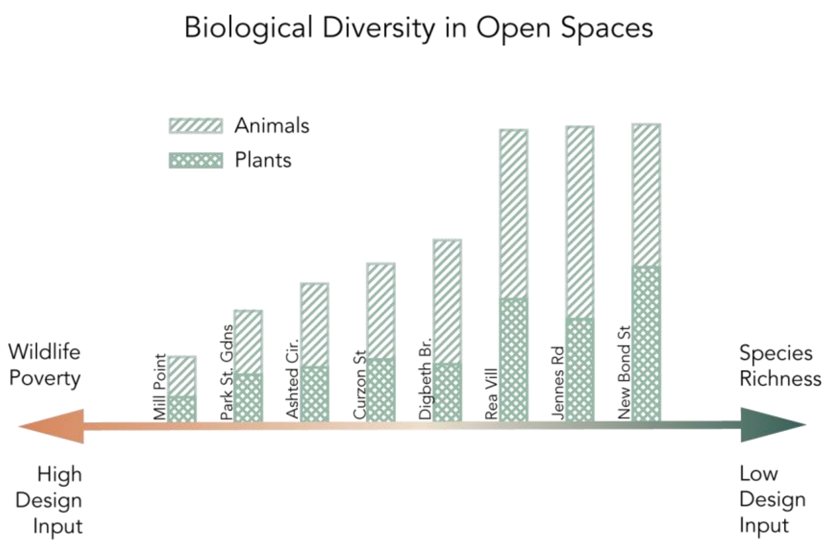


Figure 5. Biological Diversity in Open Spaces. own presentation; source: Donovan et al., 2005

Thus, the sustainable planning of settlement areas requires the incorporation of the variety and qualities of different habitats into newly constructed areas. The necessity for various substrates with rare "disturbance" could be replicated in the form of brown or green roofs (Donovan et al., 2005). Brown roofs attempt to imitate the conditions characteristic of brownfields (i.e. abandoned land), while green roofs are covered with vegetation of different sizes (Bates et al., 2015). By

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

moving these habitat types on top of buildings aesthetic and safety concerns can be eliminated while making space for more human-centered open space activities on a ground level (Donovan et al., 2005). Additionally, the incorporation of bird and bat habitat into facades and roofs can help to secure and enhance the local wildlife population (Chiquet et al., 2013). These engineering measurements can then be supplemented by an adaptation of habits (Goddard et al., 2010), such as the renunciation of pesticide use (Powney et al., 2019) and limiting frequent mowing to certain areas, while allowing wildflowers and other flora to thrive (Donovan et al., 2005).

2.3 Land- and Homeownership as Ideal of the Middle-class

Around 65% of the population seeks to live in a detached house (Raiffeisen Immobilien Vermittlung GmbH, 2021). According to a survey conducted in 2020 the main reason Austrians opt for property ownership is to ensure family safety through value investment (Wienerberger Traumhausstudie, 2020). An average of 155 m² living space is desired, while the most decisive features are a terrace and/or plenty of garden space (Wienerberger Traumhausstudie, 2020). This desire for land and home ownership requires a steady supply of building land. In 2020, residential construction accounted for 68% of this land, with two-thirds used to build detached or semi-detached houses. (STATISTIK AUSTRIA, 2021). In Austria, municipalities are responsible for the enforcement of building regulations and spatial planning within their municipal borders. This represents a considerable challenge, as especially small communities frequently lack corresponding expertise (Herburger, 2022). However, owning the autonomy within the administration of spatial development is seen as a valuable good in many regions, frequently resulting in rather feeble cross-regional planning (Herburger, 2022). Additionally, this thinking has been shown to root in the ideals of governing political parties (Herburger, 2022). Rural, as well as peripheral regions, are frequently run by the conservative Austrian People's Party (ÖVP), characterized by a liberal economic stance and traditional social values (Die neue Volkspartei, 2019; Amt der niederösterreichischen Landesregierung, 2023). Within the discourse of housing, these ideals have shown to establish the concept of individual land ownership and the "self-financed single-family home" (Herburger, 2022, p. 34) throughout the bulk of the society (Herburger, 2022). As a result, Austrians show reluctance when

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

questioned on environmental protection measures concerning the construction of detached houses (Raiffeisen Immobilien Vermittlung GmbH, 2021). Unsurprisingly, the least popular proposals include the abolition of housing subsidies for single-family houses and a limitation of living space per person. The majority consider measures to reduce individual commuting more useful, including the construction of settlements well connected to public transportation, local infrastructure and high-speed internet access (Raiffeisen Immobilien Vermittlung GmbH, 2021). While political measurements to reduce the environmental impact of private transport and commuting are certainly necessary, they can only complement changes in the field of housing construction. However, the results might imply a willingness to live in a more compact settlement for better public accessibility and proximity to infrastructure. In contrast to this assumption a further survey found that more than half of respondents seek to live in a rural area with less than 5.000 habitants (Wienerberger Traumhausstudie, 2020). However, there was a strong willingness among participants to consider "sustainable construction methods" (Wienerberger Traumhausstudie, 2020) and/or the renovation of existing buildings, provided that adequate funding was available (Raiffeisen Immobilien Vermittlung GmbH, 2021).

These surveys show that many dwellers are open to certain measures as long as the ideal concept of the single-family home remains untouched. They also provide a first insight into the population's wishes and expectations. Yet the surveys focused on the individual house, questions regarding the entire property, its context within the neighborhood, and residents' decisions on a larger scale remain unanswered. In order to develop an adaptable solution that has the potential to mitigate the environmental impact, it is essential to identify and incorporate the needs of the population regarding their individual piece of land, as well as the qualities they seek in their community and infrastructure. A survey was designed to provide answers to these persistent questions and will be presented in the next section of the thesis.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

3 RESEARCH AIMS AND QUESTIONS

The previous review of existing literature on the relationship of biodiversity loss and housing developments has shown that the consequences of the ongoing expansion of settlements are manifold. Urban sprawl jeopardizes food security, shatters and segregates intact ecosystems (Robinson et al., 2005; Sonderegger et al., 2020) and accelerates climate change through decreased carbon storage potentials (Umweltbundesamt, 2022; Sonderegger et al., 2020; Stolte et al., 2016). Soil sealing significantly contributes to rising temperatures (Stolte et al., 2016), flooding events (Morabito et al., 2018; Ferreira et al., 2022), as well as water pollution (Rodríguez-Rojas et al., 2018) and has been identified as the main reason for declining soil quality in Europe (Morabito et al., 2018). Additionally, affected areas lose their role as habitat for various species of flora and fauna (Geisen et al., 2019; Cardoso, et al., 2020). Still the majority of the Austrian population seeks the qualities that in their view only owning a house within a plot can provide (Raiffeisen Immobilien Vermittlung GmbH, 2021). The research objectives and questions addressed in this master thesis are presented below.

3.1 Research Aims

While there has been a lot of research done on the negative environmental consequences of urban sprawl and soil sealing, little has focused on linking them to one of the main drivers, the housing desires of the population. The negative consequences resulting from residential construction in peripheral zones and rural areas have reached the public discourse decades ago (Herburger, 2022), still the majority of the population continues to dream of the conventional detached house (Raiffeisen Immobilien Vermittlung GmbH, 2021). While the influence of political agendas and policies cannot be denied (Herburger, 2022), from a planner's perspective precise definitions of the typologies' issues, as well as the desires of the population are required to work on adequate alternatives. The main objective is to mitigate the environmental impact resulting from the construction of new housing settlements by offering an ecologically sensitive alternative to the prevailing housing practice in peripheral areas. A comprehensive approach that involves non-human stakeholders in the planning and implementation of residential development forms the basis for a sustainable reduction of the effects

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

on biodiversity and ecosystem services. On the other hand, the incorporation of housing desires plays a decisive role in creating an alternative, that can have the potential to supersede the “social imaginary of the single-family home” (Herburger, 2022, p. 34).

3.2 Research Questions

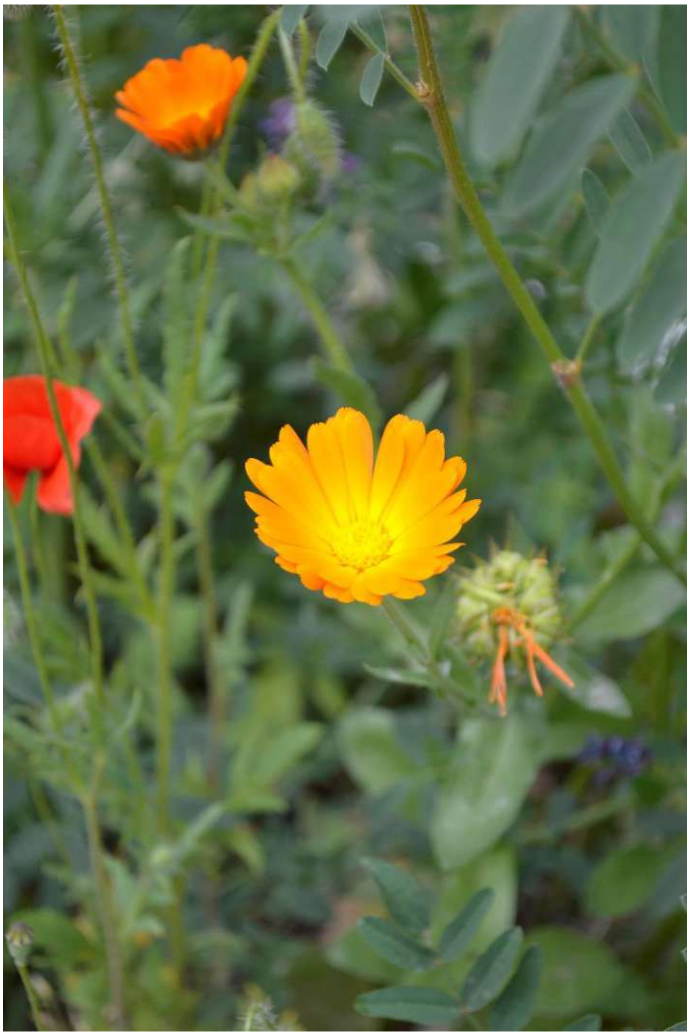
The previous background research served to identify important parameters, as well as gaps in literature. The following research questions provide a starting point for further investigation.

i. What is the relation between building typology and urban sprawl, as well as construction method and soil sealing? How does altering individual parameters improve environmental outcomes? In what way can this knowledge be beneficial to the development of an environmentally conscious typology?
ii. What are the desires that convince people to become land- and homeowners? How can planners incorporate these ideas into the development of an adequate alternative?
iii. How can the impact of settlement construction on biological diversity be mitigated? In what way can we include non-human stakeholders into the architectural planning of residential developments?

The following chapter seeks to find answers to these questions through a mixed-methods study on existing settlements and a survey discussing housing desires. The findings will eventually form the framework for the design of a possible alternative to the prevailing housing practice.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub



Own Photograph.

4 METHODOLOGY

To address the issues of land take and soil sealing through the construction of settlements, precise definitions of typologies' issues, as well as individual strengths of certain construction methods are required. A mixed methods study analyzing environmental impact of existing housing developments has the potential to inform decision-making processes prior to development, as well as to ecologically optimize already developed settlements and plots. In order to support planners with practical guidance, a framework to highlight the relationship between building typology (i.e. density, see 2.1.1) and urban sprawl, as well as construction type and soil sealing was developed for this study. The quantitative analysis was further supported through qualitative observations to capture habits and patterns of inhabitants strongly influencing environmental outcomes. Previous research clearly indicated a growing urgency for solutions in urban agglomerations. The study therefore focused on peripheral areas in and around Vienna. However, knowing that rural areas are dealing with similar issues, the results can also provide valuable information for those settings. Building dimensions and plot sizes are dependent on town or city planning regulations and may therefore affect the accuracy of results on a national scale. However, establishing a classification of typologies and types of construction is effective in testing causal relationships between variables. Irrespective of the municipality, they generate indicators that can inform planning decisions. Previous surveys have shown that the majority of Austrians seek to live in a conventional detached house (Raiffeisen Immobilien Vermittlung GmbH, 2021). Yet the collection of data is frequently restricted to the individual property itself and, usually, little attention is given to understanding the wider context of the settlement area or the residents' decisions therein. In order to develop an adoptable and user-oriented solution, it is essential to identify the wishes and needs of the population regarding their individual piece of land, as well as the qualities they seek in their community and infrastructure. To this end a mixed-methods survey was conducted in April 2023 which collected the responses from 20 participants. In spite of the difficulty involved in comparing different types of data consistently, a purely quantitative survey would not fully capture the participants' individual perspectives, while a purely qualitative survey would not be sufficiently generalizable.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

4.1 Data Collection

4.1.1 Quantitative Data

The first stage consisted of gathering data on plots and houses in and around Vienna (see Appendix B). Sites of interest for analysis were identified using maps. All units in the sample were measured manually and arising ambiguities were resolved by double-checking different sources and/or on-site inspections. Four different datasets were defined with a sample size of 41 units each.

i. Conventional detached house
ii. Conventional semi-detached house
iii. Conventional row house
iv. Detached house constructed on columns

The typologies of detached, semi-detached and row house were studied in order to develop a method for evaluating their impact on urban sprawl. By juxtaposing the conventional detached house with its equivalent built on columns, the effect on soil sealing was investigated. This type of construction was initially established in the Danube regions in and around Vienna to prevent flood damage (Grossmann, 2014).

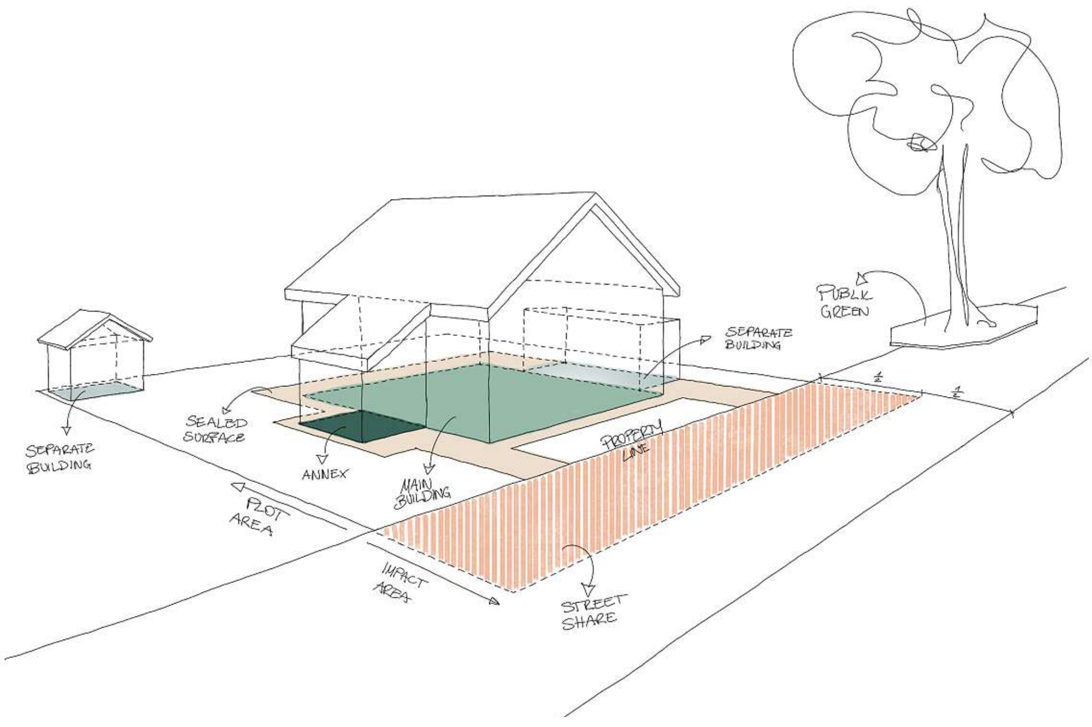


Figure 6. Parameters for data collection using the conventional detached house as an example.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Forming the basis of the analysis, the following parameters were collected:

i. Plot size
ii. Street share
iii. Main building
iv. Annex(es)
v. Separate building(s)
vi. Other sealed surface
vii. Public green

The "Geodatenviewer der Stadtvermessung Wien", "NÖ Atlas", Google Maps, Google Street view and on-site visits served as source of area estimation. Houses were excluded from the sample if they did not meet the requirement of having only one unit per plot (i.e. they were too large). Besides descriptive statistics, additional analytical methods were applied using RStudio in collaboration with a colleague from Data Science master's program. This included the calculation of key metrics, statistical tests to determine significance and a visual analysis of the data. The results of the study were presented using charts and graphs.

Furthermore, a mixed-methods survey was conducted to better understand the desire of becoming a homeowner. The questions were based on both research and study findings and specifically designed to identify the individual preferences and needs of (future) settlers. Besides examining the choices made by residents within their individual properties, the questionnaire specifically addressed their intentions in the wider context of the settlement. The survey consisted of nine multiple choice questions and three questions measured on a five-point Likert scale (see Appendix C). 20 participants responded via google docs over the course of two weeks in April 2023. Participation was open to anyone wishing to live in a house on the outskirts of a city or a town in Austria.

4.1.2 Qualitative Data

During the quantitative analysis, a number of observations highlighted the necessity for complementary qualitative evaluation to obtain a more in-depth understanding and allow broader conclusions. Depending on the construction type (conventional vs. on columns) studied, separate buildings and sealed surfaces

TU Bibliothek Your knowledge hub WIEN
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

appeared to be arranged in different patterns. Furthermore, considerable discrepancies were observed in the amount of variegated vegetation on each plot. Complementing the quantitative analysis, the investigation therefore focused on capturing these characteristics within two site visits. Qualitative observations were documented photographically and subsequently classified according to their attributes. The records were documented and stored in a database, grouped in two categories:

i. Use of Space
ii. Level of Maintenance

To strengthen the quantitative survey, remove any possible distortion and verify findings, supplementary qualitative data was collected. Four open-ended questions served to gain insights into the individual respondents' positions. They were considered to be a useful complement to the previous Likert scale and/or multiple-choice questions. These included individual qualities that play a role in the decision to become a homeowner, necessary facilities on the property and common amenities within the settlement. The open-ended questions further helped to identify motivations and therefore set up clear conditions, under which participants would opt for certain "constraints", such as smaller individual plots.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

4.2 Data Analysis

4.2.1 Quantitative Data

The analysis adopted the measurement of urban sprawl by the number of inhabitants per selected area as described by Bueno-Suárez et al. (2020). Therefore, the total floor area was calculated from the raw data collected and multiplied by 0.75 ("Ausbauverhältnis", 2016) to obtain the habitable area. Subsequently, the result was divided by the average habitable area per person provided by Statistics Austria (STATISTIK AUSTRIA, 2023). In order to obtain a comparable value for different typologies, the figure was then extrapolated to 1000 m² of land. Detached houses on columns were considered outliers in habitable area calculations, as they are not designated for permanent residence. Consequently, they are not directly comparable with conventional dwellings in this assessment. Outliers in conventional semi-detached dwellings were accepted for analysis as they do not affect comparability and highlight the influence of individual property characteristics on the results of the study.

To enable the evaluation of soil sealing of different construction types, the values of "building coverage ratio" (BCR) and "surface coverage ratio" (SCR) were calculated for each plot. BCR includes all property areas covered by main building, annex(es) and separate building(s). SCR refers to all sealed plot areas, such as paths, driveways, and terraces. Both ratios describe the relation of areas to plot size.

The quantitative data gathered in the survey through Likert scale and multiple-choice questions was analyzed through descriptive statistics methods. This process evaluated and removed outliers, such as incomplete or inconsistent responses. By measuring frequency and percentages the responses gathered were summarized. To support the interpretation and communication of results, findings were subsequently visualized in tables and charts.

4.2.2 Qualitative Data

Qualitative observations were carefully analyzed regarding their influence on the environmental evaluation of the property and settlement area. Common patterns regarding the arrangement of built structures were considered key aspects. The

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

aim of this investigation was to find out whether the design of the main building could (unconsciously) encourage a more environmentally sensitive approach among residents. Therefore, the spatial distribution of main building, separate buildings and sealed surfaces on plot were examined for conventional and on column detached houses. Further, factors such as garden care regimes, as well as vegetation and substrate diversity were investigated. The occurrence and amount of wild grasses, forbs and flowers (mowing), the shape and size of trees and hedges (pruning), the presence of low maintenance areas (such as a pile of dead wood, a pond or a feral part of the plot) were carefully studied on the photographs collected. Additionally, the overall amount of variegated green and the connectivity between plots (i.e. fences, walls and street width) were assessed.

The open-ended questions collected in the survey were evaluated through content analysis. The first step consisted of reading the responses and taking notes. Subsequently inductive coding helped to identify themes that emerge directly from the data. These were categorized, connected to the quantitative findings and interpreted.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

5 RESULTS AND DISCUSSION

5.1 Quantitative Data

5.1.1 Quantitative Analysis of Housing Typologies and Construction Types and their Effect on Urban Sprawl and Soil Sealing

The analysis of three different housing typologies showed that the number of inhabitants was reversed proportional to land consumption. Figure 7 illustrates the estimated number of inhabitants per 1000m² by typology in a boxplot diagram. The box represents the middle 50% of the data, with the median marked by the horizontal line. The vertical lines indicate the range of the data. Beyond these lines, outliers are displayed as single points. Detached Houses showed the lowest, and Row Houses the highest population density. In the case of semi-detached houses, the high number of outliers indicates a wide variation in the estimated number of occupants. The fact that some of the houses within the study area had a converted attic, thus offering a higher amount of habitable area related to plot size explains the density similar to row houses. Others had much larger plots than the average semi-detached house, resulting in a density closer to that of detached houses.

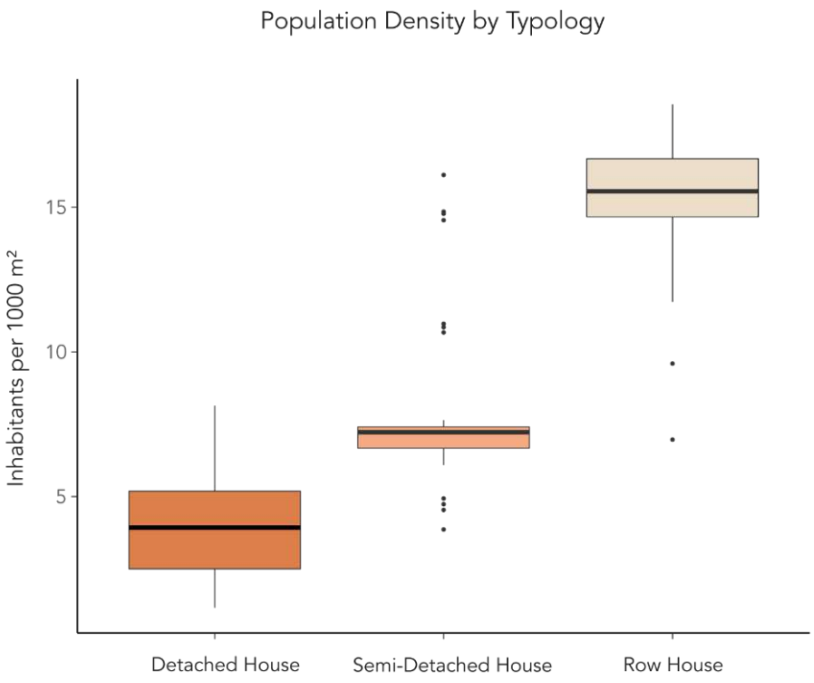


Figure 7. Inhabitants per 1000 m² by typology.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

In line with this argument, Figure 8, compares the size of the plots and the impact areas by typology. The total amount of land occupied by each building typology, including plot size and street share, is shown in the grey bar on the left. Detached houses accounted for the largest share of land take, while row houses had the smallest effect.

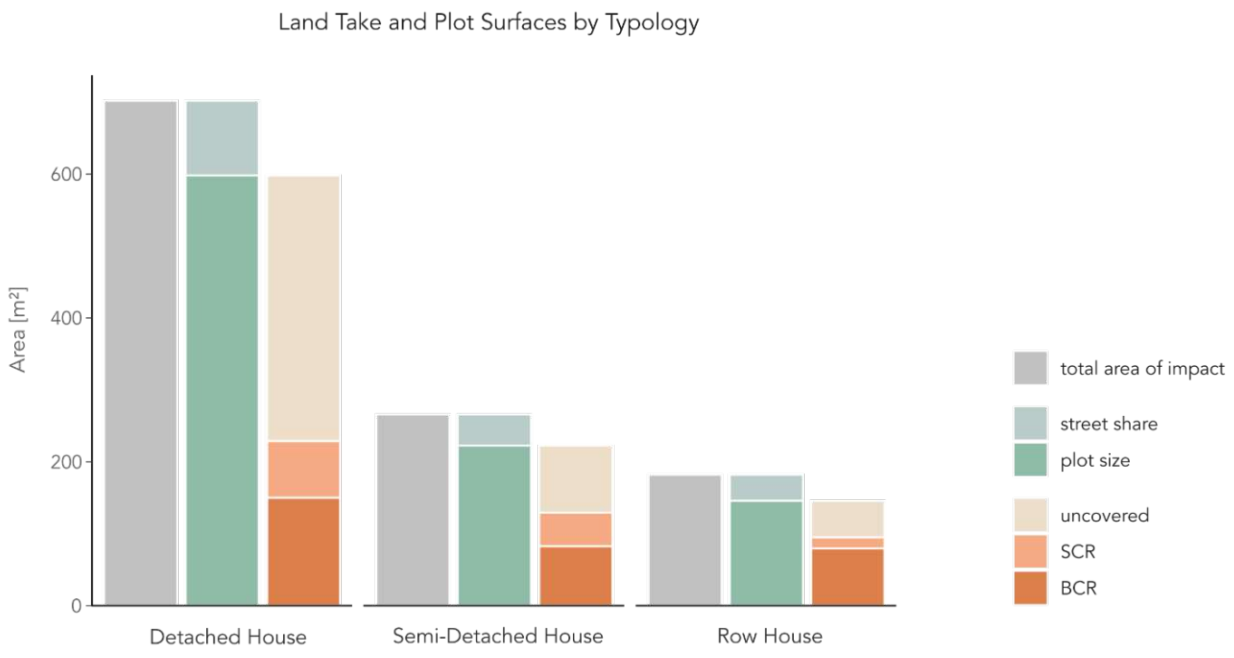


Figure 8. Land Take and Plot Surfaces by Typology.

In other words, these two diagrams indicate that the smaller the plot size, the greater the number of residents in a given area. As settlement structures that are considered drivers of urban sprawl usually show a particularly low density (Herburger, 2022), the findings obtained in the sample area led to the assumption that the higher the number of inhabitants, the lower the impact of housing on urban sprawl.

Figure 9 illustrates land take and plot surfaces of two different construction types. Building coverage ratios (BCR) and surface coverage ratios (SCR) of conventional detached houses and their equivalents built on columns were compared in order to analyze soil sealing on plots.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

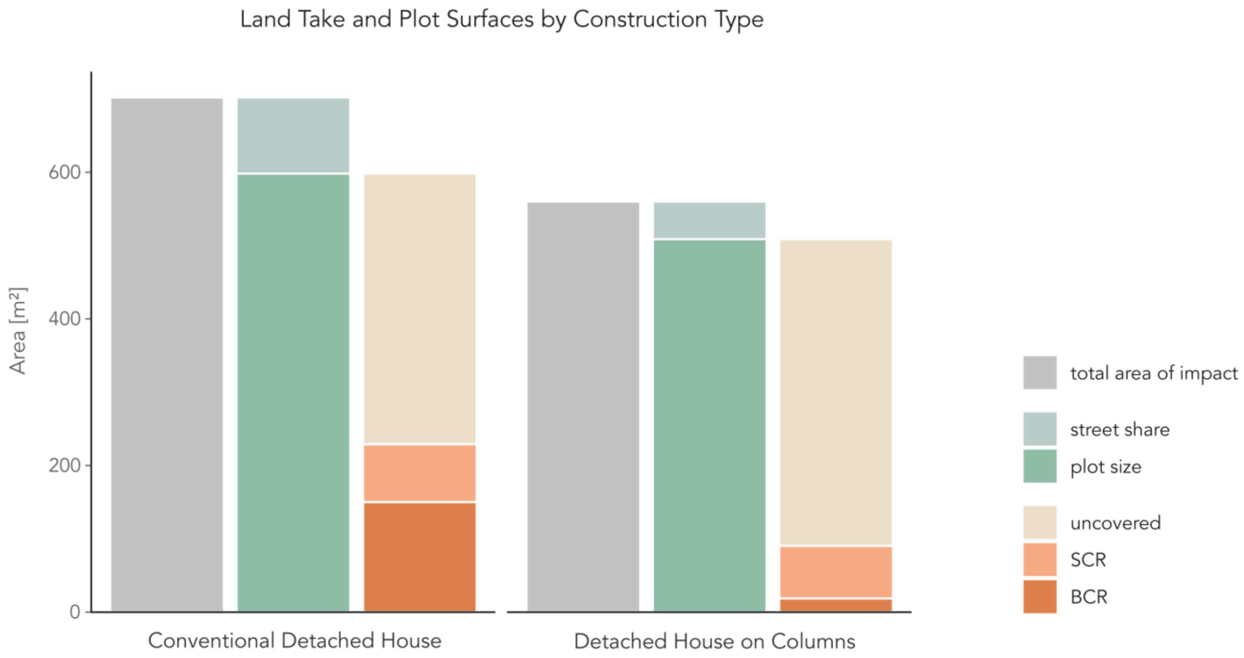


Figure 9. Land Take and Plot Surfaces by Construction Type.

Given that the type of construction of a building cannot be changed once it is built, BCR can be considered as the invariable component in existing settlements. However, a comparison of the two types showed that BCR could be almost completely avoided by using a column structure. That means that around 14 to 48% of the total plot area is covered by buildings in a conventional construction, compared to 1 to 9% when constructed on columns. Unlike BCR, SCR could be modified within the study area, as land covered with a layer of a particular material could either be uncovered or replaced by a material open to evapotranspiration. SCR can therefore be thought of as "room for intervention". The study showed that soil sealing could be reduced by up to 30% related to plot size in a conventional construction, as well as to a very similar extent when constructed on columns.

The study trends identified in the study area provide input for further research to support the development of new settlements and the ecological enhancement of already developed sites. Figure 10 summarizes the results of the study with regard to both the correlation between urban sprawl and building typology, as well as between soil sealing and construction type.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

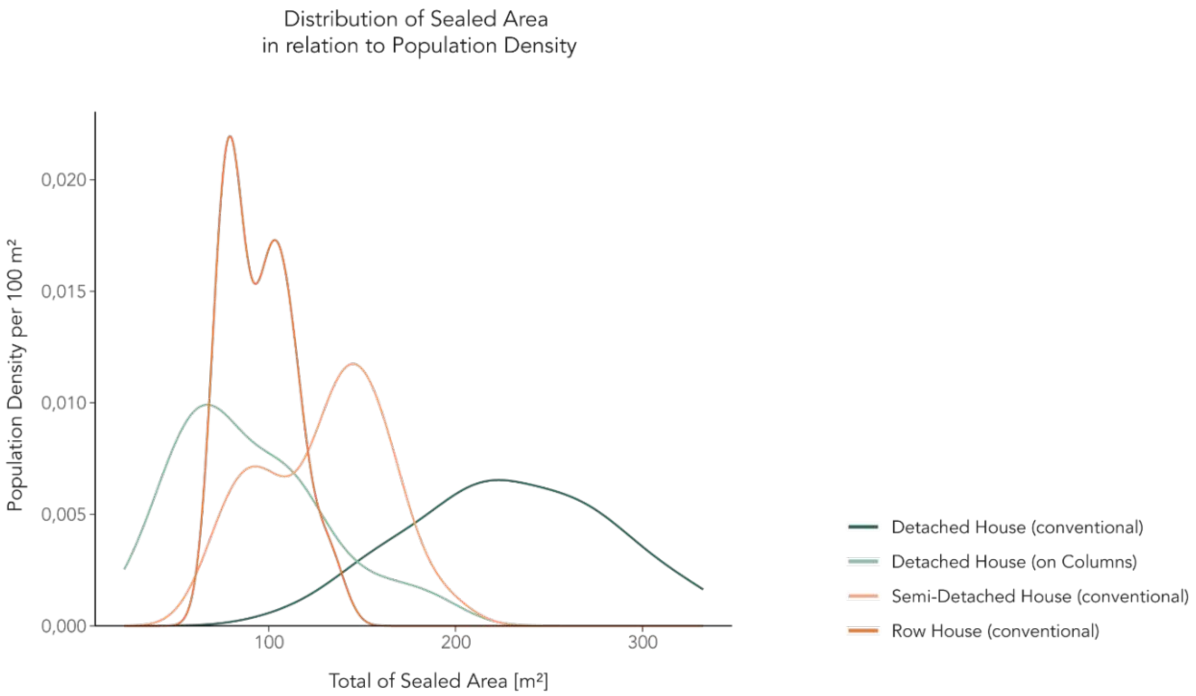


Figure 10. The Correlation of Urban Sprawl and Building Typology, as well as Soil Sealing and Construction Type.

Acquiring evidence, that the effects of urban sprawl can be mitigated by increasing population density while reducing plot size has the potential to inform the design of settlements and their regulatory frameworks. Furthermore, the results imply that soil sealing could be significantly reduced in future settlements. Reducing BCR by raising buildings off ground constitutes an approach to housing that leaves soil in its natural condition and increases settlement permeability (see 2.2.2). In addition, the SCR analysis revealed that there is significant potential for unsealing and the targeted application of permeable materials in existing settlements.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

5.1.2 Quantitative Analysis of Survey on the Desires of Potential Homeowners

The most common motivations in the selected sample for becoming a homeowner (Figure 12) were found to be the ability to adapt one's home to individual preferences, being close to nature, putting down roots and enjoying peace and quiet. The ability to give children more freedom as they grow up was also considered a key quality by many of the respondents. In response to the effects of urban sprawl, planners are challenged to incorporate these desires in new typologies, contesting assumptions that higher density is incompatible with individuality and connection to nature.

Respondents expressed the desire for multiple shared facilities (Figure 13) such as a water cistern, a wildflower meadow, a forest for the children to build forts in, a summer kitchen/barbecue area, a play area, and a swimming pond. When asked if they would consider living on a smaller individual plot to accommodate several of the abovementioned community areas within their neighborhood, 55% agreed (Figure 11). For the majority of respondents, this indicated both a desire for a sense of community in their settlement and a consequential willingness to reduce the size of their private property. An additional qualitative question focusing on the individual's position served to better understand the factors that determine whether participants would adopt such a 'constraint'.

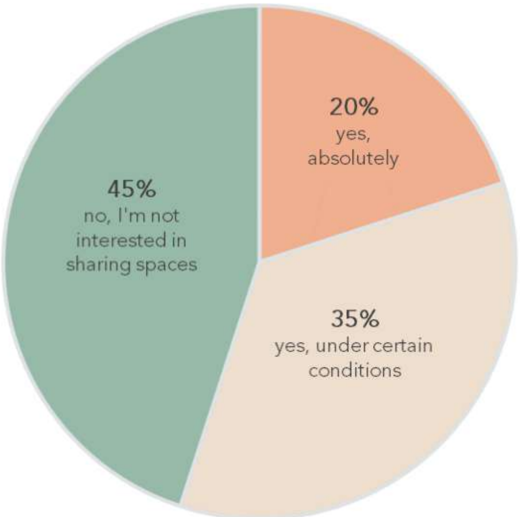


Figure 11. Survey Question 4: Would you consider a smaller individual plot if it meant more space for several of the community areas

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

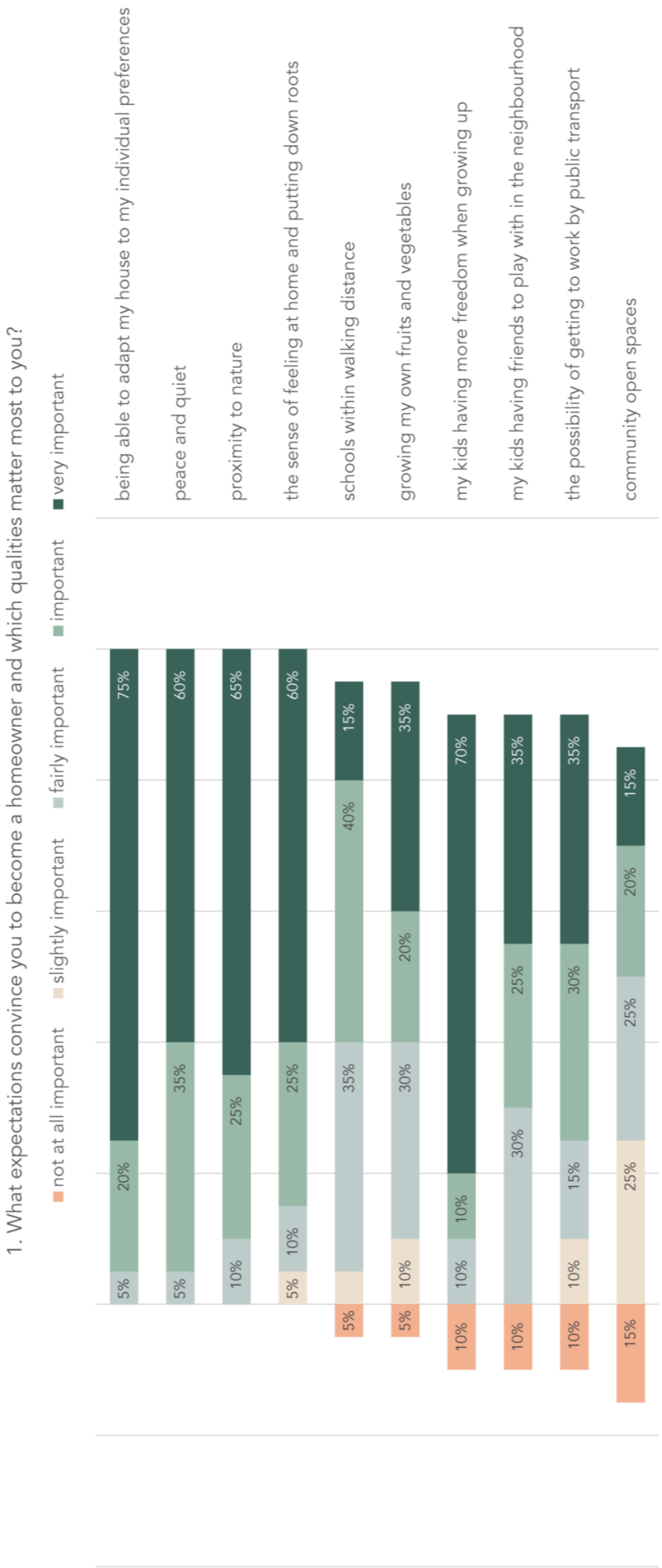


Figure 12. Survey Question 1: What expectations convince you to become a homeowner and which qualities matter most to you?

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

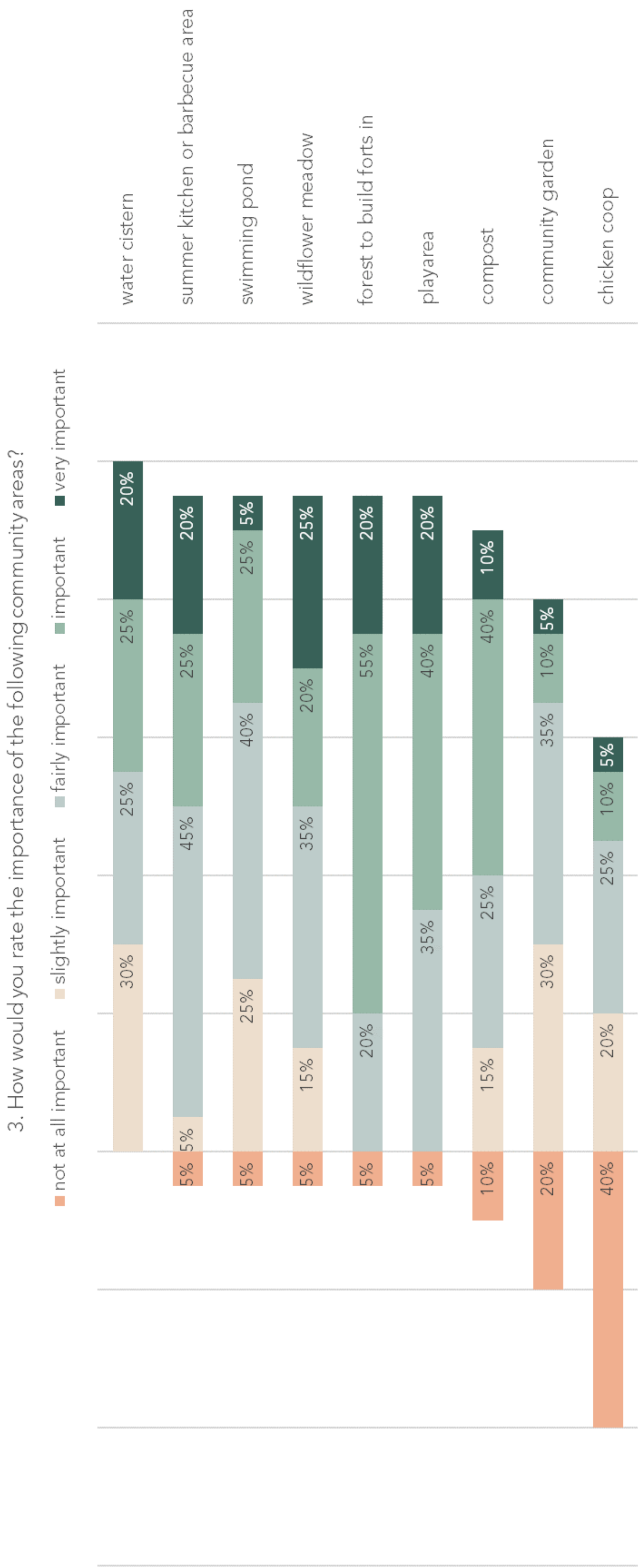


Figure 13. Survey Question 3: How would you rate the importance of the following community areas?

The survey revealed that 85% of respondents desired a living space of less than 150m², 35% even seeking homes of less than 120m² (Figure 15). However, the majority expressed that their home should be suitable for four or more people (Figure 14). These results contradict previous research conducted by Wienerberger Österreich GmbH (see 2.3) and Statistics Austria (see 2.1.2), both suggesting significantly higher spatial requirements. Considering that most respondents were below the age of 30, the results of the survey may indicate a trend among young adults contradicting the prevailing belief that more living space equals a better quality of life. This indicates a previously unrecognized potential for developing new housing solutions to tackle urban sprawl which is in line with the earlier findings.

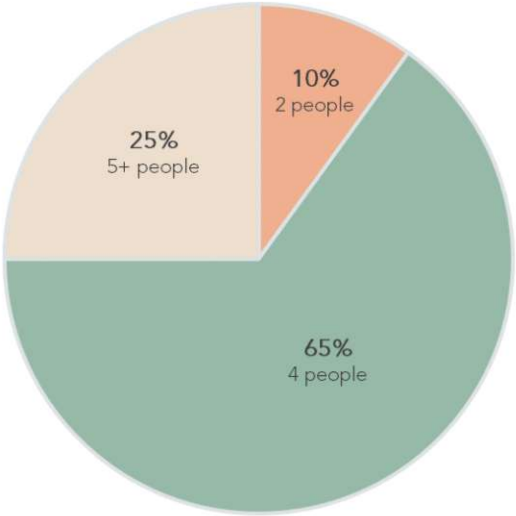


Figure 14. Survey Question 5:
How many people do you want your house to accommodate?

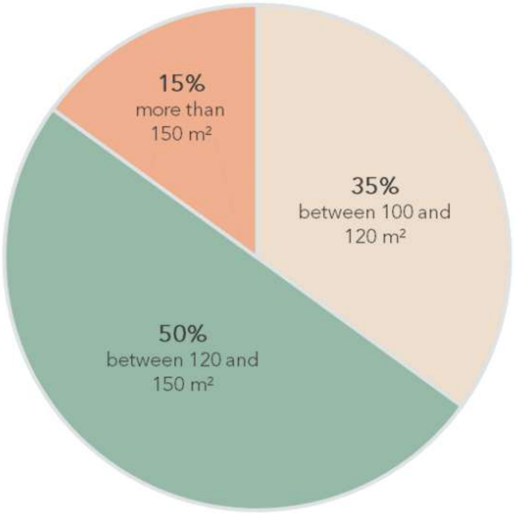


Figure 15. Survey Question 6:
How much living space should your house provide?

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

When asked if respondents would opt for a terrace or a garden, 80% chose the garden (Figure 16). 87% of this group explained that they would prefer to create enclosure by planting bushes or trees rather than by using fences or walls (Figure 17). This finding supports measures that have been shown to be effective in enhancing biodiversity and addressing wildlife poverty in suburban areas (see 2.2.2).

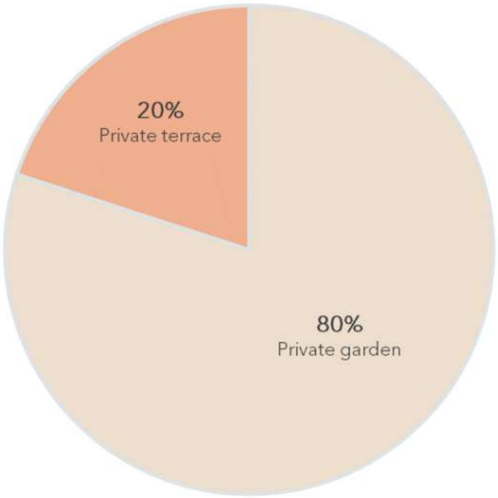


Figure 16. Survey Question 7:
If you had to choose, would you rather have a garden or terrace of your own (in addition to the choice of community areas)?

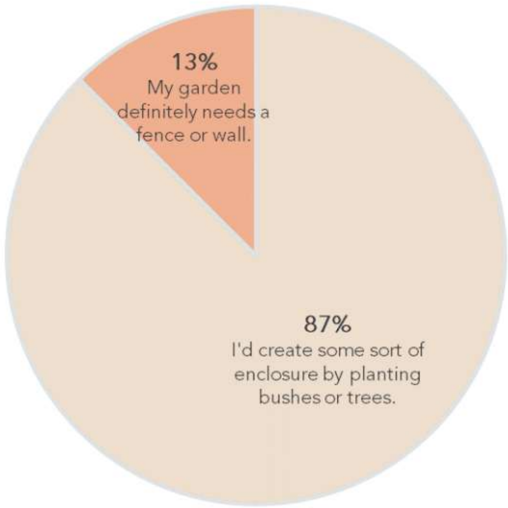


Figure 17. Survey Question 7.1:
If you decided to have a garden: How would you rate your preferred degree of separation between your garden and the area that you share with your neighbors?

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

The survey further revealed that 63% of the respondents who had decided to have a garden would like to have a garden shed (Figure 18). As the analysis of plot surfaces showed, in the context of a conventional construction, this results in additional soil being sealed. However, 90% of the same group of respondents stated that the extension could be part of their main building (Figure 19). This result suggests a call to action for planners to include these areas in the planning of housing developments and to develop solutions that are environmentally responsible.

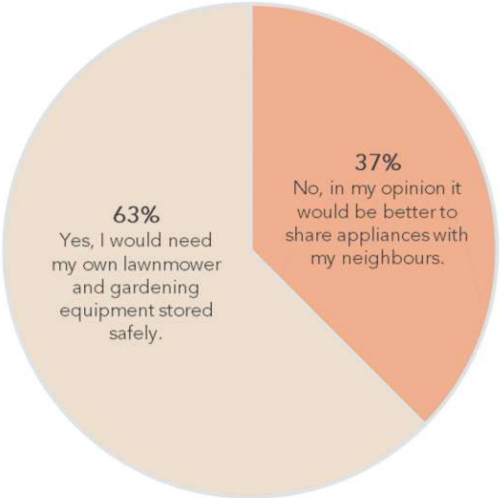


Figure 18. Survey Question 7.2:
If you decided to have a garden: Will you need a garden shed of your own?

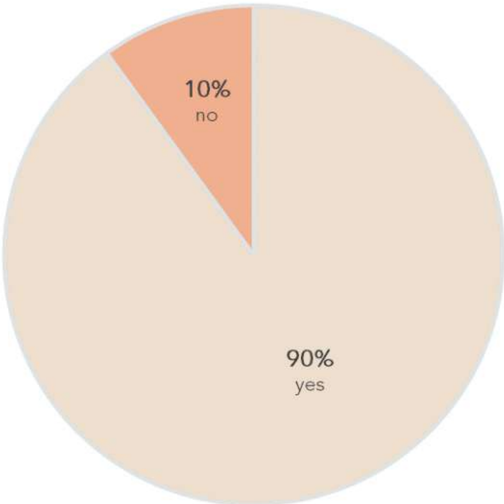


Figure 19. Survey Question 7.3:
If yes, can it be attached to or integrated into your main building?

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Good public connectivity could reduce reliance on private cars, with none of the participants stating that they needed to use a car every day, 15% not requiring a car at all, 40% using it a few times a week, and 45% using it only a few times a month (Figure 20). If additionally car sharing were available, 20% would not need a car at all and 70% would require only one car for their family. 10% of participants still expressed the need for two cars per family (Figure 21). These findings directly imply that with better public accessibility and car sharing within the development, the requirement for private cars could be significantly reduced. Previous research found that roughly one in two Austrians owns a car, claiming a significant amount of land, both in settlements and on individual plots (see 2.1.1). In terms of settlement design, this finding implies that young adults would be willing to opt for public transport regularly, and thereby reduce the amount of land take and soil sealing for parking and commuting. The results therefore show preferences not only for individual properties, but also for the whole settlements and infrastructure areas.

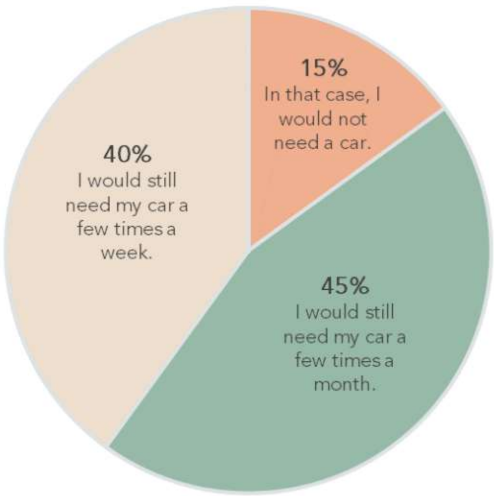


Figure 20. Survey Question 8:
If public transportation (travel time to work and leisure in around 30 minutes) and local supply were available within walking distance, how often would you need your car per week?

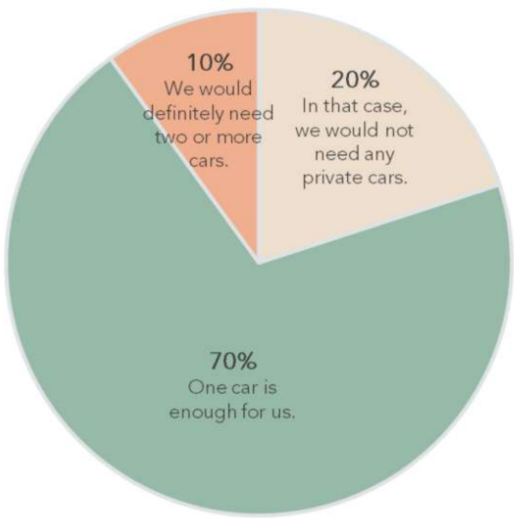


Figure 21. Survey Question 9:
If additionally there was car sharing available within your settlement, how many cars would you and your family/spouse need?

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

The responses collected highlight a clear desire and willingness among young adults to adopt housing concepts that prioritize shared facilities over large plot or building sizes. While the majority of respondents expressed a preference for shared spaces, planners should also provide solutions for those who opted for privacy and individual space. Yet almost 90% of participants chose bushes and trees over fencing and walls. The implementation of transitional spaces with varying degrees of enclosure can serve as a crucial element in the design of settlements, creating a balance between privacy and community. These structures can further support the needs of non-human stakeholders through the provision of food and habitat, while at the same time enhancing the residents' connection with nature.

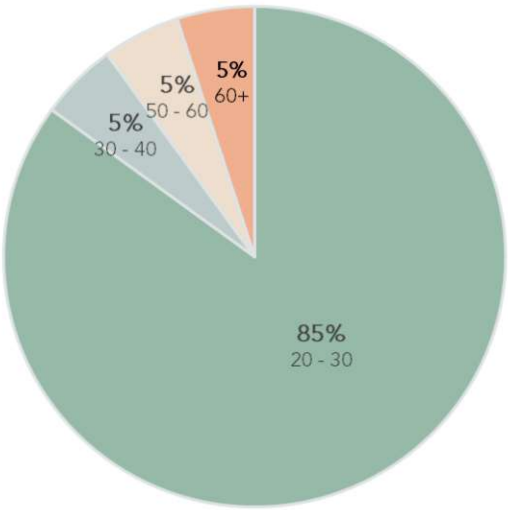


Figure 22. Survey Question 10: Please select your age group from the following options.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

5.2 Qualitative Data

5.2.1 Qualitative Analysis of Use of Space and Maintenance Practices on Individual Properties

The use of space: Figures 23 and 24 show examples of houses within the study areas that are built on columns. In this type of construction, the main building's footprint is usually still sealed, although the volume itself is raised off ground. However, residents typically use the space underneath as a covered outside area, either to cool off in the summer or to provide shelter on rainy days, to store gardening equipment, or to park their cars and bicycles. Additional terraces are usually situated on the above-ground level. The study found that in conventional houses, all these functions are usually distributed around the main building, not only claiming a significant amount of land, but also sealing intact green spaces. This suggests that altering the structural concept of the main building has the potential to encourage residents to make more environmentally conscious decisions regarding the arrangement of auxiliary functions on their property.

Figure 23. Detached House on Columns

Figure 24. Detached House on Columns

The level of maintenance: Heavily designed and regularly "disturbed" open spaces have a very limited potential to maintain and facilitate urban biodiversity, when compared to naturally evolved and variegated habitat (Donovan et al., 2005). Figures 25 to 29 show different treatments of properties within the study areas. Fences or walls prohibit cross-settlement migration of ground-dwelling fauna (Taucher et al., 2020). Frequent mowing or pruning, covering the ground with gravel or pavement, and pesticide use negatively affect habitat availability (Donovan et al., 2005). Rich, varied green, blooming wildflowers, an area of dead plant material (Taucher et al.,2020) or waters (Łopucki et al., 2020), in turn, have

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

the potential to provide a variety of habitat structures and nutrition for several animal species.

Figure 25.
High Maintenance Lawn

Figure 26.
Low Maintenance Lawn

Figure 27.
Low Maintenance Greenery

Figure 28.
Low Maintenance "Hedge"

Figure 29.
Pile of Dead Wood

The qualitative analysis made visible that, in order to mitigate the effects of soil sealing and biodiversity decrease, landowners ought to learn about the impact of their daily habits, both on their individual plot of land and in the larger context of the settlement area. However, planners are responsible for providing practical solutions, while considering all auxiliary areas as part of the design and discussing (possibly changing) needs thoroughly. The qualitative analysis suggested that changing the structural concept of building volumes could be a possible approach

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

to encourage inhabitants to adopt a more environmentally conscious practice. Further, defining areas on each property that are 'biodiversity-centered' and others as 'human-centered' could help enhance feasibility and acceptance by residents (Donovan et al., 2005). Including the needs of non-human stakeholders in the design of building envelopes could reduce the dependence of habitat availability on the willingness of residents. Research identified multiple possibilities, such as brown or green roofs (Bates et al., 2015) and habitat facades (Chiquet et al., 2013).

5.2.2 Qualitative Analysis of Survey on the Desires of Potential Homeowners

Complementing the quantitative survey findings, additional motivations for choosing land and home ownership were collected through open-ended questions. Above all, participants cited safety in their neighborhood and for their children as a key factor. Affordable housing after mortgage repayment was another priority.

Understanding the factors that determine participants' attitudes towards considering a smaller individual plot to accommodate shared facilities was another focus of the qualitative section of the survey. The respondents emphasized the importance of a fair distribution of costs and repair work, as well as equitable usage of common facilities. When asked if there were any additional shared spaces considered to be valuable in their settlement, sports facilities were identified as most important.

The qualitative results of the survey aligned with the wish for community mentioned in the previous chapter and revealed the desire for a peaceful and harmonious, yet well-organized, neighborhood. All findings presented formed the initial point to elaborate concrete implications for design. These are presented in the following chapter in the form of a design guideline.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

6 SIX POINT GUIDELINE FOR DESIGN

This section seeks to provide an approach to an environmentally friendly housing concept for suburban areas by altering selected elements of conventional buildings. The guideline is one of several possible outcomes and was developed from the individual findings of literature review, analysis, and survey.

Figure 30 shows a diagrammatic illustration of a conventional single-family home. The main building is located towards the center of the site. Auxiliary buildings such as a garage and garden shed, as well as sealed surfaces for paths, driveway and terrace, are organized around the main structure (see 5.1.1 and 5.2.1).

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

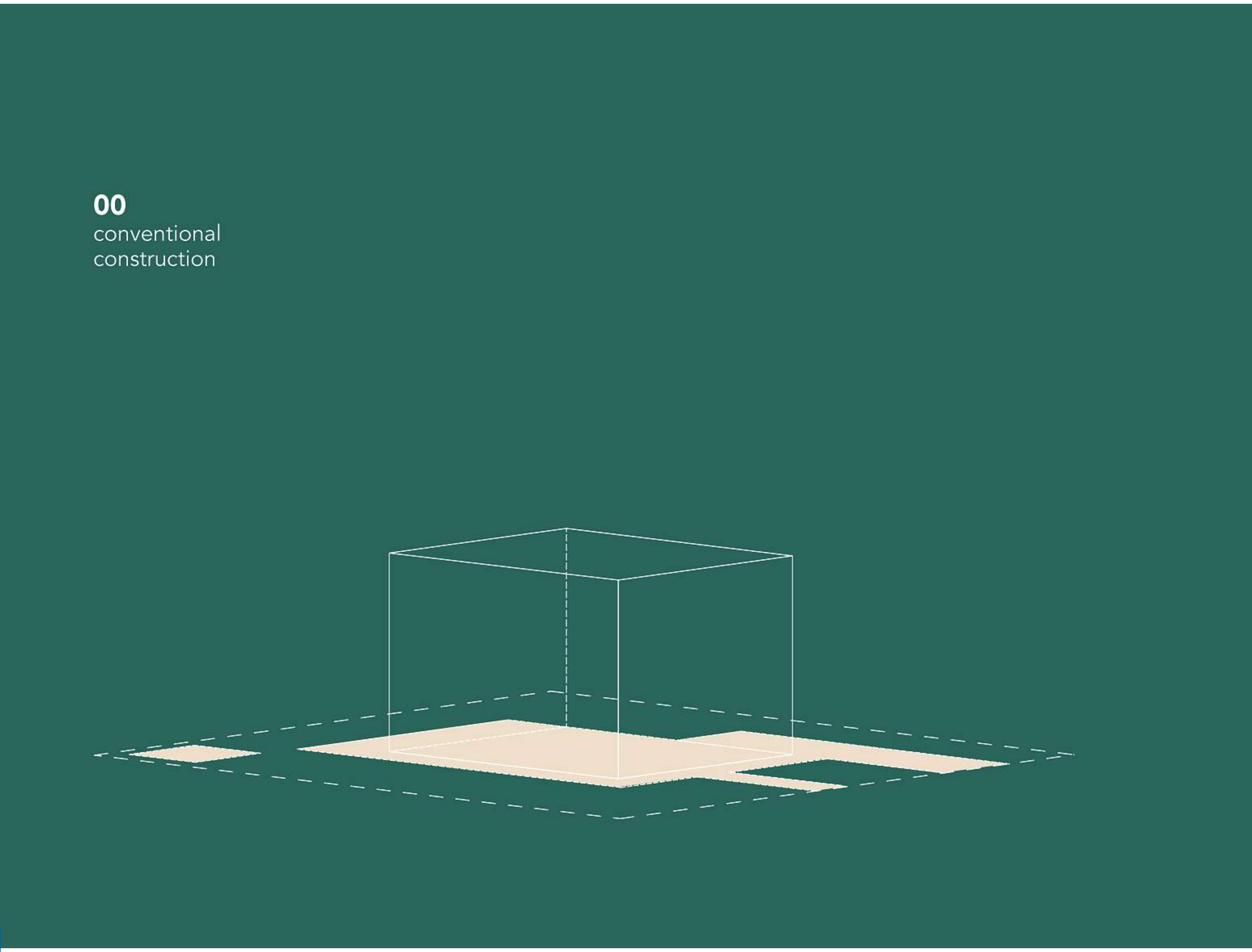


Figure 30. Schematic Illustration of a Conventional Single-family Detached House.

In order to address the environmental issues associated with suburban housing developments, the suggested 6-point design guideline has been developed based on research methodology. The influence of the selected case study area on the results cannot be denied, as building dimensions and plot sizes are determined by town or city planning regulations. This may limit the accuracy of results on a national level. However, the established research methodology is effective in testing causal relationships between building, surface and site parameters. These generate indicators that can help to build an overarching argument for planning decisions.

Each of the six operations is presented on the following pages in the form of schematic illustrations and associated with the study findings.

01	**protect soil** lift built structure off ground as much as possible	SOIL SEALING
02	**prevent spreading of built structures** use space underneath for auxiliary functions	
03	**provide habitat** include low-disturbance areas in building envelope	BIODIVERSITY
04	**improve space efficiency** use leftover spaces to create more habitable area	URBAN SPRAWL
05	**enhance settlement permeability** decrease individual plot areas for interconnected community space	BALANCE
06	**reconcile the needs of human and non-human stakeholders** individual privacy + habitat and nutrition through transitional zones	

Figure 31. Guideline for Design.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Wien Bibliothek Your knowledge hub

The first measure, following the results of the quantitative study in section 5.1.1, is to lift the main building's structure off the ground. The study results imply that by adapting the construction method, soil sealing could be reduced by up to 40% related to plot size in future developments. The concept is suitable for accessibility as the specific height of the building is an individual decision during the planning process. The main objective of this measure is to reduce BCR (building coverage ratio) by positioning the main building volume on pillars and therefore preserving soil in its natural state and improving settlement permeability for ground-dwelling fauna (see 2.2.2).

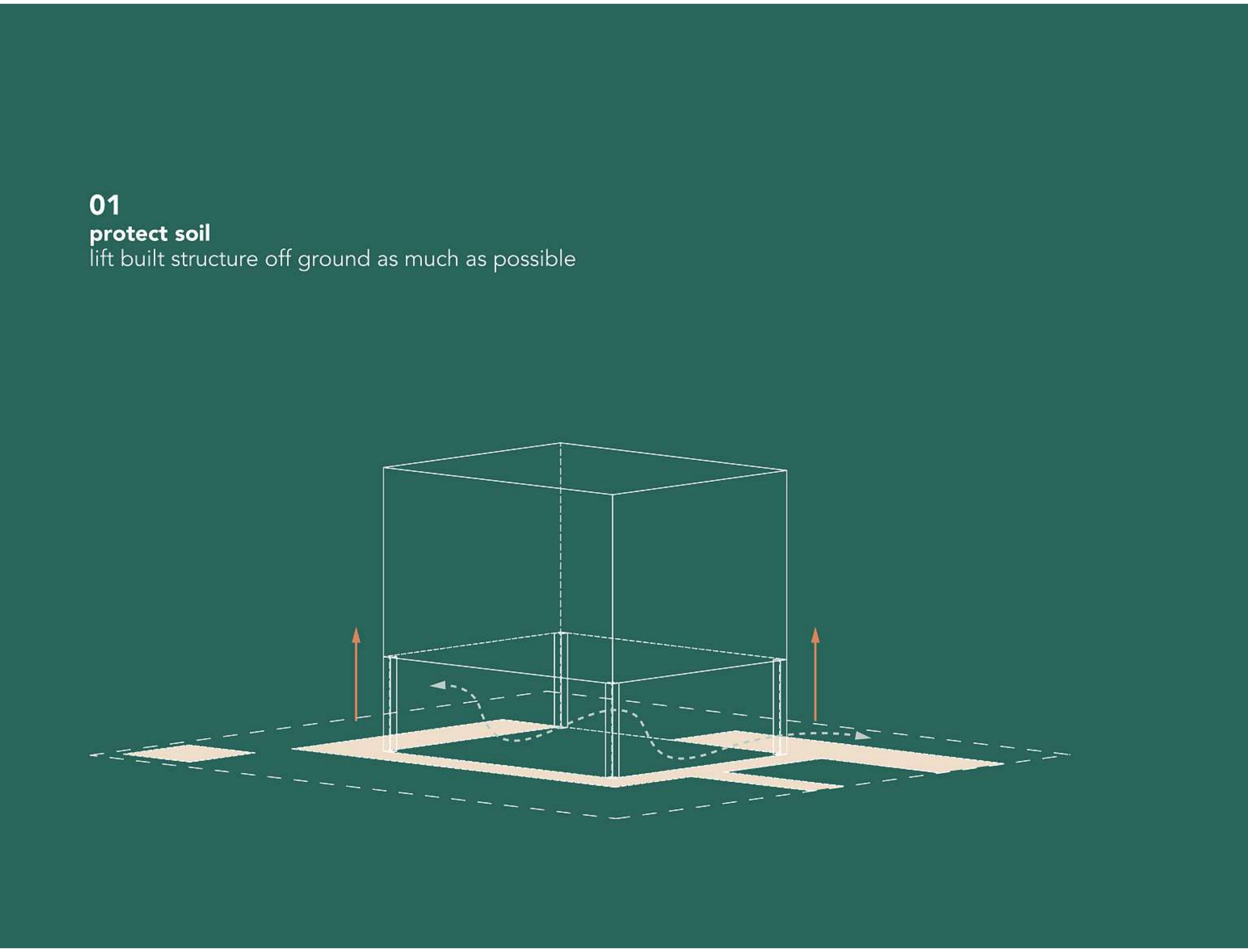


Figure 32. Measure 01: Protect Soil.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

In line with the results of the qualitative survey in Section 5.2.1, raising the main building volume to the above-ground level creates space below for auxiliary functions. The covered area resulting from this measure provides an outdoor space which may serve as a shelter from sun or rain or as a storage space for gardening equipment and parking space for cars or bicycles. Furthermore, the central passage replaces conventional circulation around the building, minimizing sealed areas. The study findings in section 5.1.1 suggest that there is a big potential for reducing SCR (surface coverage ratio) in new and existing settlements. The targeted application of new solutions in the field of material technology (see 2.1.2) can supplement a more prudent approach towards the treatment of soil. SuDS (sustainable drainage systems) manage to maintain safety for pedestrians and motorized traffic while completely absorbing water from regular rain events without creating runoff, thus reducing the risk of flooding.

02
prevent spreading of built structure
use space underneath for auxiliary functions

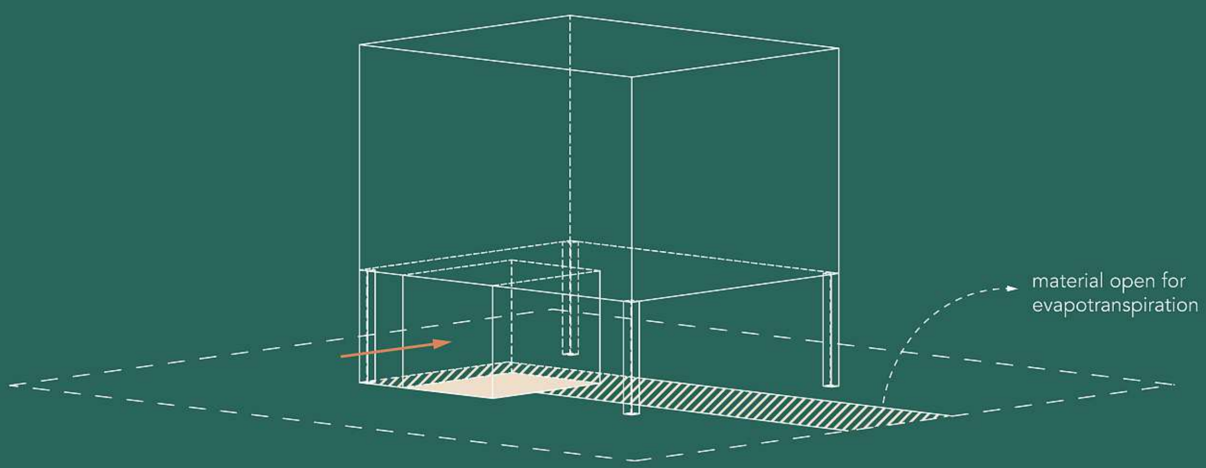


Figure 33. Measure 02: Prevent Spreading of Built Structure.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

To incorporate non-human stakeholders in the planning of residential settlements, it is necessary to provide a variety of habitat and sources of nutrition. Previous studies found that availability and acceptance strongly depend on the "level of disturbance" (see 2.2.2). Providing a non-human centered area on top of buildings could increase feasibility while making space for more human-centered open space activities at ground level (see 5.2.1). Brown or green roofs, in combination with bird and bat boxes in facades and roofs have been shown to enhance the local wildlife population (see 2.2.2). These engineering measurements can then be supplemented by an adaptation of habits, such as the renunciation of pesticide use and limiting frequent mowing to certain areas, while allowing wildflowers and other flora to thrive (see 5.2.1).

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

03
provide habitat
include low-disturbance areas in building envelope

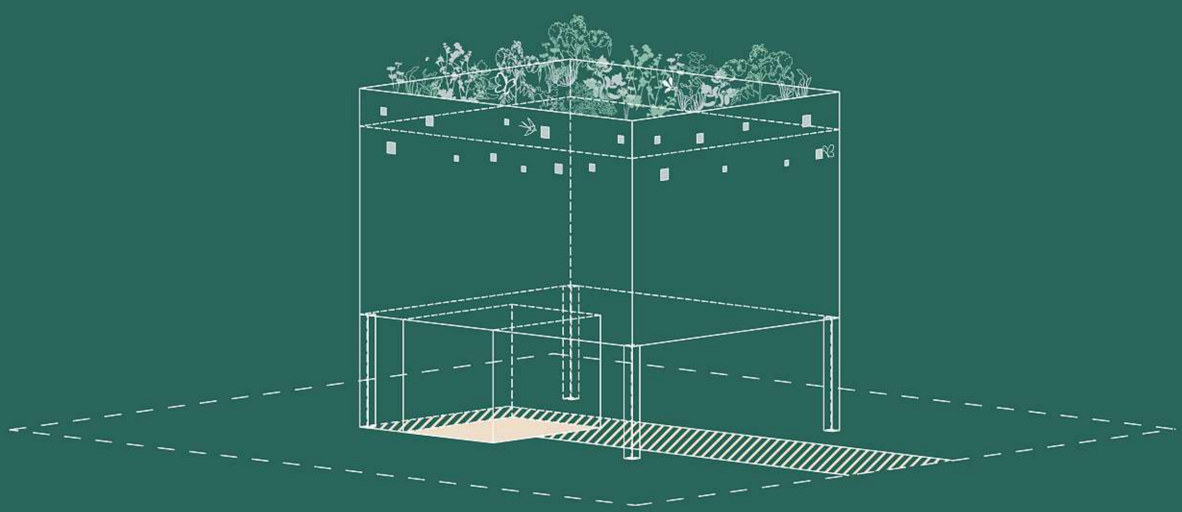


Figure 34. Measure 03: Provide Habitat.

The results of the quantitative analysis in Section 5.1.1 confirmed the assumption that plot size and population density are directly related to urban sprawl. Therefore, the measure presented on this page aims to increase the number of habitants within a case study area that was part of the analysis (see 4.1.1). Based on the results of the survey in section 5.1.2, the majority of units offer a living space between 100 and 150 m².

The following calculations are based on data provided by Statistics Austria and analysis methodology (see Table A4). At present, this settlement area provides housing for approximately 86 inhabitants. This number could increase to as many as 151 residents by the addition of 26 units.

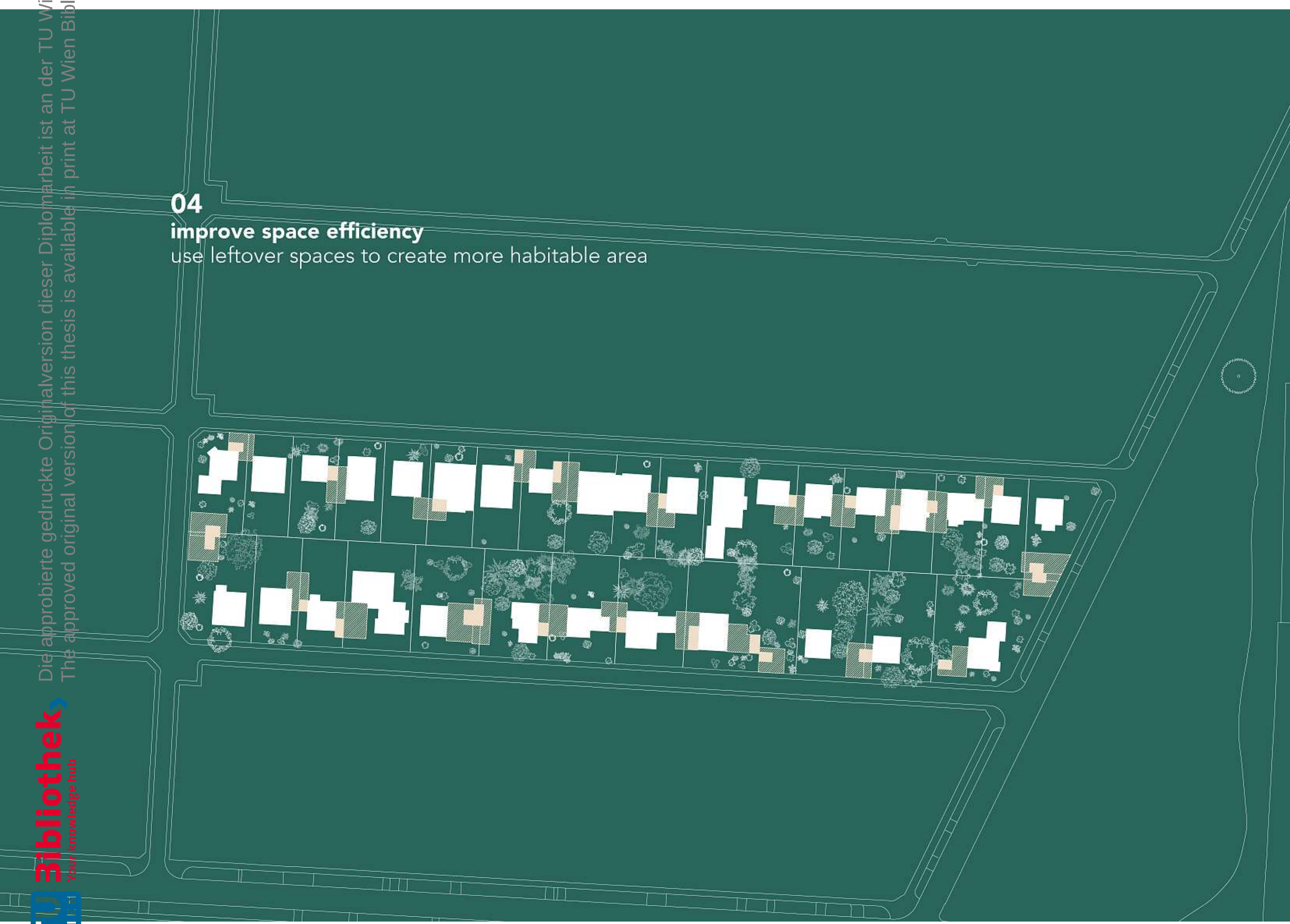


Figure 35. Measure 04: Improve Space Efficiency.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

In line with the survey findings presented in section 5.1.2, measure 05 suggests to dissolve the sharp separations between plot areas to facilitate a large, interconnected community space. The majority of respondents expressed a willingness to support housing concepts that prioritize shared facilities over large plot or building sizes and chose bushes and trees over fencing and walls. However, planners should also provide solutions for those who chose individual space. Creating privacy on individual properties while maintaining permeability for ground-dwelling fauna (see 2.2.2) will be subject of the following measure.

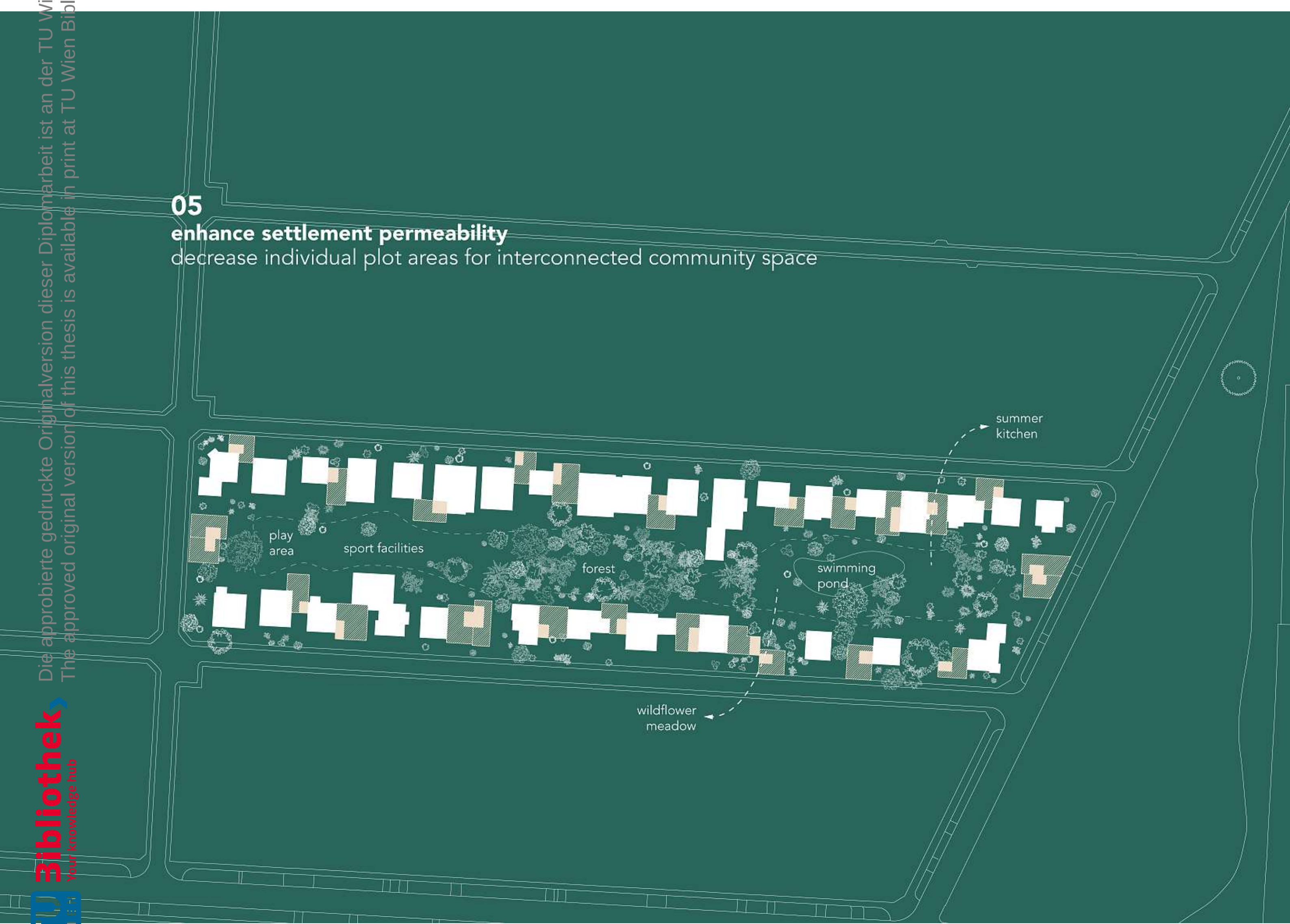


Figure 36. Measure 05: Enhance Settlement Permeability.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

In order to provide residents with individual privacy while maintaining habitat, nutrition and mobility for non-human stakeholders, transitional zones can serve as mediators between privacy and community. These can provide different degrees of enclosure depending on the needs of the residents, from a built element such as a habitat wall or vertical garden, to a hedge, dense shrubs and trees, a loose arrangement of vegetation, or a connecting path to neighbors and community space. They also enhance residents' connection with nature, which the survey identified as a key motivation for homeownership (see 5.1.2).

06
reconcile the needs of human and non-human stakeholders
individual privacy + habitat and nutrition through transitional zones

Figure 37. Measure 06: Reconcile the Needs of Human and Non-human Stakeholders.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

For efficient use of space, the building itself is directly adjacent to its neighbors (see measure 04). Yet, the concept adopts the conventional idea of maintaining a "gap" to the property line and transforms it into a green zone in collective ownership. The transitional area can therefore be considered as an extension of the community space, connecting shared and private green. Simultaneously, it could be a valuable instrument to balance the needs of human and non-human stakeholders, enhancing individual privacy and supporting habitat and nutrition.

A possible outcome of the guideline is presented below. The concept is based on research and proposes to reconcile the needs and desires of future homeowners with measures to sustain biodiversity in residential areas.

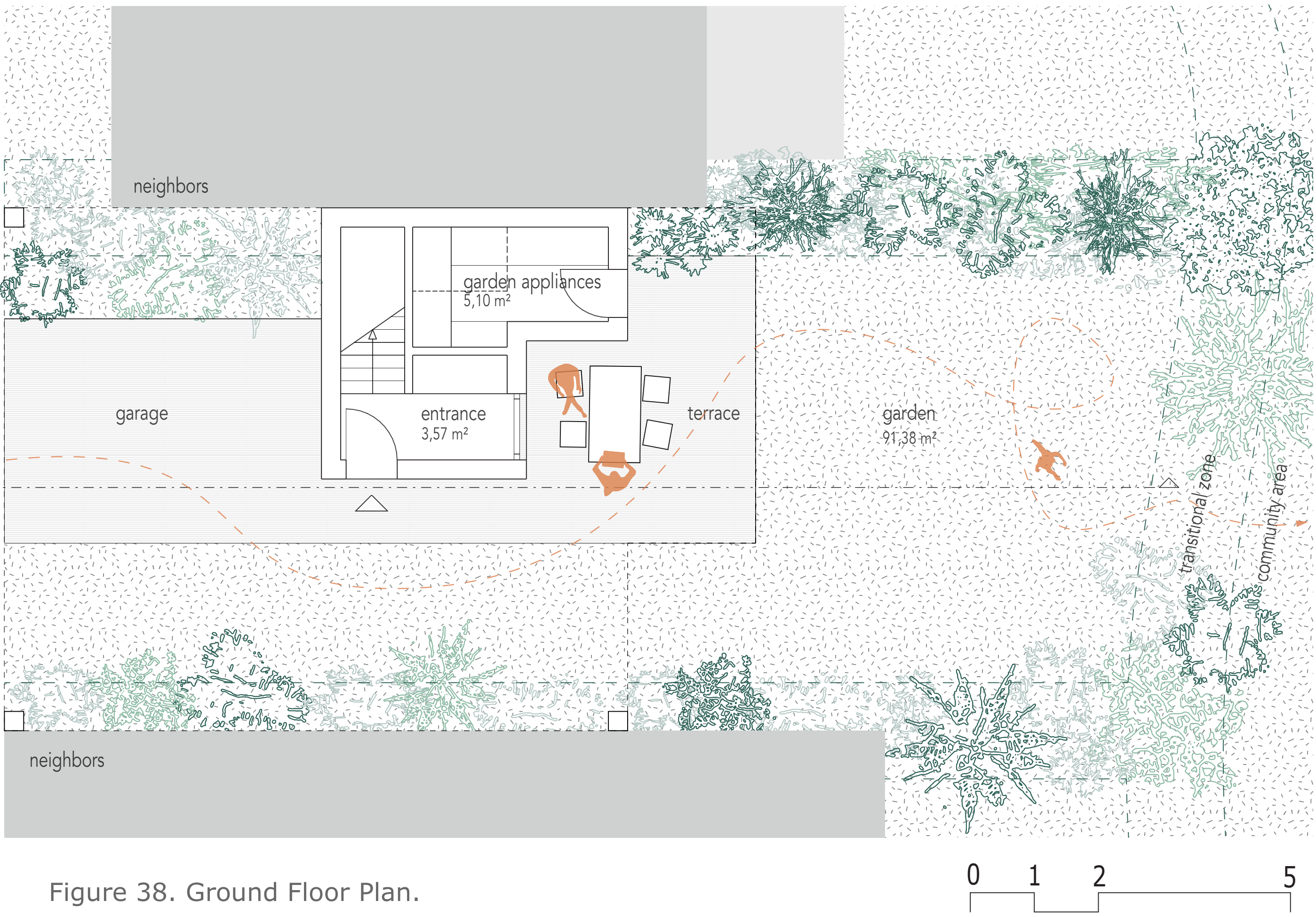


Figure 38. Ground Floor Plan.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

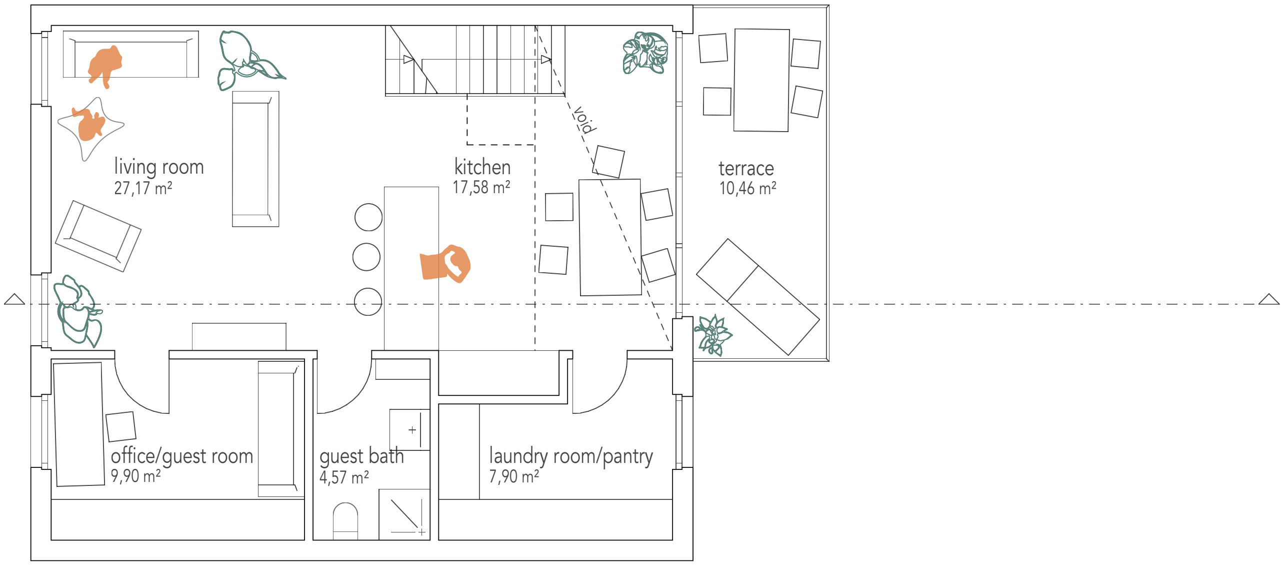


Figure 39. First Floor.

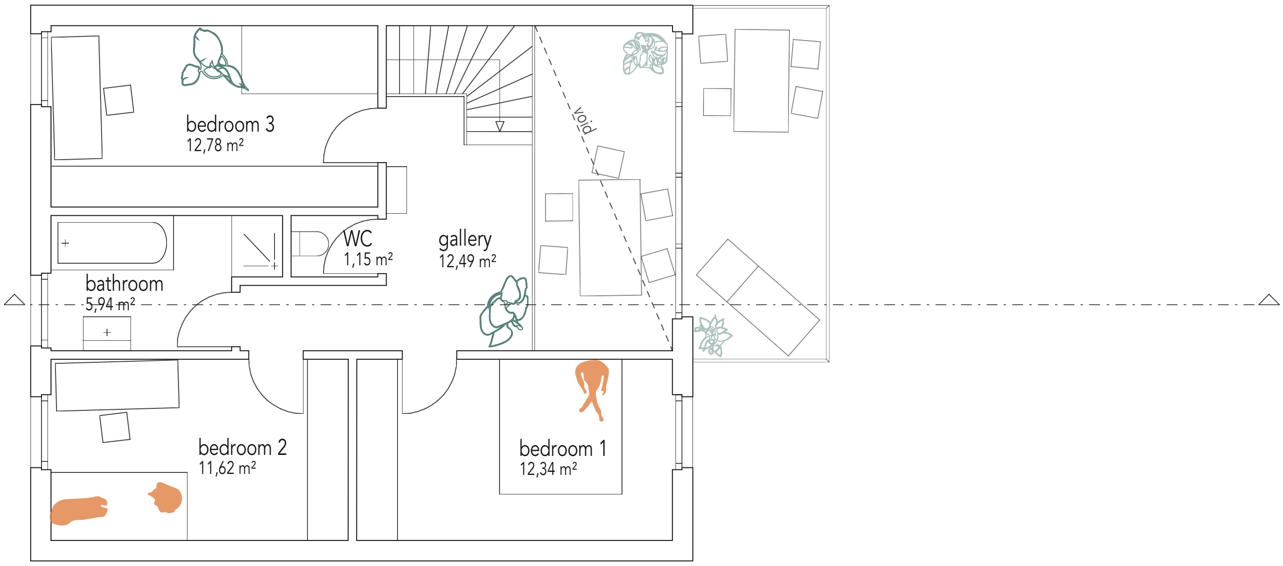
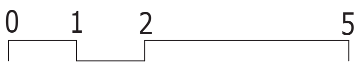


Figure 40. Second Floor.



Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek Your knowledge hub WIEN

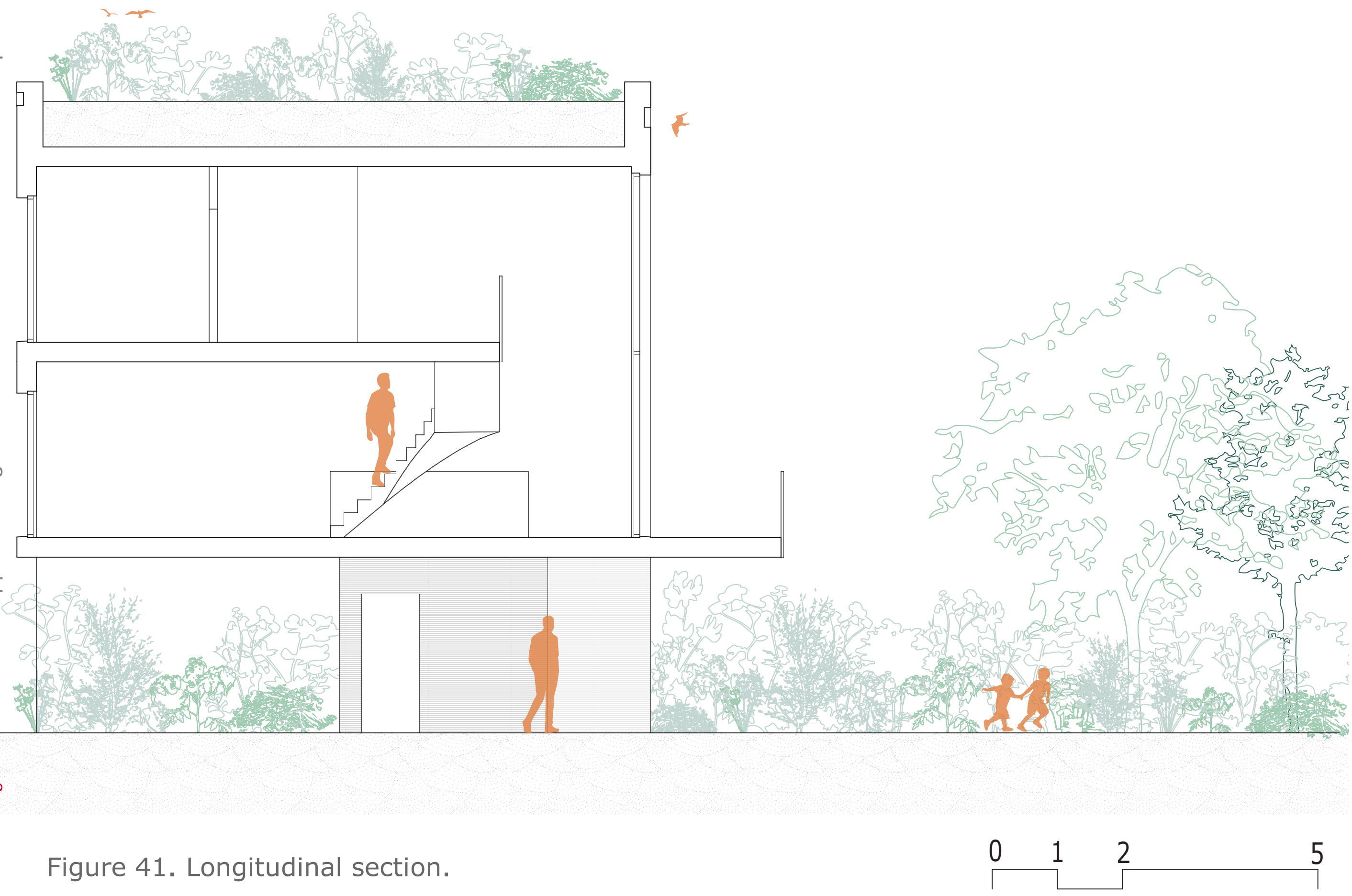


Figure 41. Longitudinal section.

7 CONCLUSION

The research presented in this master thesis aimed at identifying and addressing ecological consequences of suburban housing settlements in Austria. As a first step the thesis elaborated clear definitions of issues, such as the effect of soil sealing and urban sprawl on biodiversity in Austria, as well as potentials related to specific typologies and construction methods. The study was conducted on a selected sample of properties representing four dwelling types, bearing in mind that the results are not entirely generalizable. Following, the research focused on housing desires of the population, which have been identified as one of the main drivers of sprawling growth of settlement areas and the related loss of valuable land and soil resources.

The research questions included:

i. What is the relation between building typology and urban sprawl, as well as construction method and soil sealing?
ii. What are the desires that convince people to become land- and homeowners?
iii. How can the impact of settlement construction on biological diversity be mitigated?

The key findings of this master thesis are the following:

i. Research confirmed the presumption that plot size and population density directly correlate with urban sprawl. Within the study area, the detached house typology had the largest plot sizes and, therefore, the lowest population density. The row house, in contrast, had the least effect on urban sprawl. The research further found that by adapting the conventional construction method, soil sealing could be significantly reduced, not only by the structure of the building itself, but also by having an impact on the spatial organization habits of residents.
ii. The survey revealed that proximity to nature, adaptability of one's home, and putting down roots are key motivations for becoming a homeowner. In addition, the majority of respondents expressed a desire for community spaces within the development and set clear conditions for design.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

iii. Research provided possibilities to incorporate non-human stakeholders into planning processes. The combination with analysis and survey findings allowed for the creation of a step-by-step approach that has the potential to enhance biodiversity in settlement areas.

A mixed-methods approach, including quantitative and qualitative data, was selected to analyze the environmental impact of housing developments. Four datasets were defined that are based on conventional detached, semi-detached, row houses and detached houses constructed on columns. Data was collected manually for 41 units in each dataset. Additionally, site visits served to capture individual characteristics of plot maintenance and use of space. Qualitative observations were documented photographically, analyzed and classified. The results confirmed the assumption that plot size and population density directly correlate with urban sprawl, identifying row houses as the typology with the least negative impact. Furthermore, raising the building volume off ground, and centering all outbuildings underneath, reduces soil sealing significantly. The targeted combination of these findings informed the development of practical guidance for planners. This research demonstrates that the environmental impact can be reduced by rethinking building design, while considering the question of user acceptability. Taking into account the wishes of the population is a key element to improve feasibility. The mixed-methods survey focused on understanding the desires that convince Austrians to become land and homeowners, both at the level of the individual plot and in the larger context of the settlement. The aim was to enable the incorporation of these findings into the development of more environmentally sensitive housing developments. Besides identifying motivations, desires and needs, the survey revealed a willingness to accept certain constraints for interconnected, shared green spaces and set clear conditions. These results provide an overarching argument that can inform decision-making processes of planners and policy makers. Furthermore, recent research has shown that designing new settlements with variegated green spaces and low-maintenance areas has the potential to increase species richness in suburban areas. Combining building elements such as green roofs, habitat facades and transitional zones with adapted gardening habits can help to mitigate negative impacts on biodiversity. Synthesizing all findings enabled the development of a framework for designing residential settlements that can meet the needs of

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

residents as well as non-human stakeholders. The proposed 6-point guideline is applicable to the ecological improvement of existing developments as well as to the planning of new residential areas.

Future studies should focus on assessing acceptance of more in-depth designs and developing solutions in collaboration with all stakeholders and municipalities. Action should be taken to raise public awareness of the impact as well as the potential of individual and collective choices. Furthermore, a longer-term research agenda could transfer evidence to different fields of architecture, providing an overarching argument for further eco-sensitive planning challenges. Related research questions could be:

i. What impact would an action research agenda have on the outcomes of the project? How would multiple precise planning and survey phases inform each other?
ii. In which way could an interdisciplinary approach in collaboration with sociologists facilitate the development of a framework to support community organization?
iii. How would interdisciplinary research collaborating with spatial and/or urban planners inform future legislation regarding area and building regulations?
iv. In which way could an interdisciplinary approach in collaboration with biologists inform the precise design of habitat within building envelopes, sites and settlements?
v. How would a comparable methodology inform the design of public building typologies on a larger scale? In what ways would a surface analysis inform the design of schools or hospitals? How can the needs, preferences and expectations of employees, students, patients, or visitors be addressed in creating a more ecologically sensitive built environment?

This study provides a solid foundation for the implementation of sustainable measures in suburban housing developments, ensuring a harmonious coexistence of human settlements and environment. Yet, reflecting on the implications for design, intriguing analogies to architectural concepts of the past emerge. In 1998, Lacaton & Vassal chose a column structure for a project at Cap Ferret, thus preserving the vegetation and dunes characteristic of this location (House in Lège

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Wien Bibliothek Your knowledge hub

Cap-Ferret, 2000). Le Corbusier advocated a similar approach in his “Les Cinq Points d’une Architecture Nouvelle” (Le Corbusier's Five Points of Architecture, 2023): a column structure and a roof garden. His work "Vers une architecture" was first published precisely 100 years ago and in 1931 he implemented the principles in his project Villa Savoye (Le Corbusier's Five Points of Architecture, 2023). Whilst his intention was primarily aesthetic, he also encouraged the column structure to facilitate freedom of movement on the ground floor and to enlarge the garden underneath the building volume (Le Corbusier's Five Points of Architecture, 2023). The concept of ascending buildings on pillars has further been realized on a large scale by Lúcio Costa and Oscar Niemeyer in the design of Brasilia Superquadra in Brazil. The intention was to create a sense of complete freedom for the local community, resulting in a park-like district entirely devoid of fenced or other impassable areas (*Brasilia Superquadra*, 2014). While individual intentions may differ, all of these projects share the column structure and have proven effective in their own context and purpose. In particular, they demonstrate that even on a large scale, the approach of modifying conventional construction methods can be useful in preserving and enhancing interconnected green spaces, thus providing habitat for non-human stakeholders, and expanding open spaces for residents.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

REFERENCE LIST

Amt der niederösterreichischen Landesregierung. (2023). *Niederösterreich weiterbringen. Arbeitsübereinkommen. Volkspartei Niederösterreich und FPÖ Niederösterreich.*

Ausbauverhältnis. (2016, June 17). In *Wikipedia*. https://de.wikipedia.org/w/index.php?title=Ausbauverh%C3%A4ltnis&oldid=155376288

Aust, G., Heinrich, F., Horvath, D., Musil, A., Foldal, C., & Jandl, R. (2020). Conversion of agricultural soils in Austria - a case study for a community in Upper Austria. *Die Bodenkultur: Journal of Land Management, Food and Environment, 71(2),* 69-76. https://doi.org/10.2478/boku-2020-0007

Babaeian, E., & Tuller, M. (2023). *Proximal sensing of evapotranspiration.*

Bates, A. J., Sadler, J. P., Greswell, R. B., & Mackay, R. (2015). Effects of recycled aggregate growth substrate on green roof vegetation development: A six year experiment. *Landscape and Urban Planning, 135,* 22-31. http://dx.doi.org/10.1016/j.landurbplan.2014.11.010

Bodenstrategie für Österreich - oerok.gv.at. (2021). oerok.gv.at. https://www.oerok.gv.at/bodenstrategie

Bodenverbrauch in Österreich. (2021). https://www.umweltbundesamt.at/news210624

Brasilia Superquadra. (2014). *Domus.* https://www.domusweb.it/en/photo-essays/2014/11/25/brasilia_superquadra.html

Brondizio, E. S., Diaz, S., Settele, J., Ngo, H. T., Gueze, M., Aumeeruddy-Thomas, Y., Bai, X., Geschke, A., Molnár, Z., Niamir, A., Pascual, U., Simcock, A., & Jaureguiberry, P. (2019). IPBES global assessment report on biodiversity and ecosystem services. Chapter 1. Assessing a planet in transformation: Rationale and approach of the IPBES

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Global Assessment on Biodiversity and Ecosystem Services. https://doi.org/10.5281/zenodo.5517203

Bueno-Suárez, C., & Coq-Huelva, D. (2020). Sustaining What Is Unsustainable: A Review of Urban Sprawl and Urban Socio-Environmental Policies in North America and Western Europe. *Sustainability, 12(11),* 4445. https://doi.org/10.3390/su12114445

Cardoso, P., Barton, P.S., Birkhofer, K., Chichorro, F., Deacon, C., Fartmann, T., Fukushima, C.S., Gaigher, R., Habel, J.C., Hallmann, C.A., & Hill, M.J. (2020). Scientists' warning to humanity on insect extinctions. *Biological conservation, 242,* 108426. https://doi.org/10.1016/j.biocon.2020.108426

Chiquet, C., Dover, J. W., & Mitchell, P. (2013). Birds and the urban environment: the value of green walls. *Urban ecosystems, 16,* 453-462. https://doi.org/10.3390/ani10091606

Die neue Volkspartei. (2019). *Unser Weg für Österreich. 100 Projekte.*

Donovan, R. G., Sadler, J. P., & Bryson, J. R. (2005). Urban biodiversity and sustainable development. *Engineering Sustainability, 158(2),* 105-114. https://doi.org/10.1680/ensu.2005.158.2.105

Dullinger, I., Gattringer, A., Wessely, J., Moser, D., Plutzar, C., Willner, W., Egger, C., Gaube, V., Haberl, H., Mayer, A., & Bohner, A. (2020). A socio-ecological model for predicting impacts of land-use and climate change on regional plant diversity in the Austrian Alps. *Global Change Biology, 26(4),* 2336-2352. https://doi.org/10.1111/gcb.14977

Ferreira, C. S., Seifollahi-Aghmiuni, S., Destouni, G., Ghajarnia, N., & Kalantari, Z. (2022). Soil degradation in the European Mediterranean region: Processes, status and conse-quences. *Science of the Total Environment, 805,* 150106. https://doi.org/10.1016/j.sci-totenv.2021.150106

Flächeninanspruchnahme. (2021). https://www.umweltbundes-amt.at/umweltthemen/boden/flaecheninanspruchnahme

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L., & Holling, C. S. (2004). Regime shifts, resilience, and biodiversity in ecosystem management. *Annu. Rev. Ecol. Evol. Syst., 35,* 557-581. https://doi.org/10.1146/annurev.ecolsys.35.021103.105711

Football pitch. (2023, May 21). In *Wikipedia.* https://en.wikipedia.org/w/index.php?title=Football_pitch&oldid=1156203614

Geisen, S., Wall, D. H., & Van der Putten, W. H. (2019). Challenges and Opportunities for Soil Biodiversity in the Anthropocene. *Current Biology, 29(19),* 1036-1044. https://doi.org/10.1016/j.cub.2019.08.007

Gentile, A. R., Barceló-Cordón, S., & Van Liedekerke, M.V. (2009). Soil Country Analyses - Austria. *European Commission, Joint Research Centre-Institute for Environment and Sustainability, EUR 23959EN.*

Getzner, M., Gutheil-Knopp-Kirchwald, G., Kreimer, E., Kirchmeir, H., & Huber, M. (2017). Gravitational natural hazards: Valuing the protective function of Alpine forests. *Forest Policy and Economics, 80,* 150-159. https://doi.org/10.1016/j.forpol.2017.03.015

Goddard, M. A., Dougill, A. J., & Benton, T. G. (2010). Scaling up from gardens: biodiversity conservation in urban environments. *Trends in ecology & evolution, 25(2),* 90-98. https://doi.org/10.1016/j.tree.2009.07.016

Grossmann, G. (2014). *Hochwasser 2013: Ein Kaleidoskop* (Vol. 2). LIT Verlag Münster.

House in Lège Cap-Ferret. (2000). *Architecture and Urbanism Magazine, 362,* 72-97.

Herburger, J. (2022). The Myth of Urban Densification: Tracing the Pathway of a Discourse on the Case of the Alpine Rhine Valley in Austria. *European Journal of Spatial Development 19(4),* 25-43. https://doi.org/10.5281/zenodo.6798752

Herweijer, C., Evison, W., Mariam, S., Khatri, A., Albani, M., Semov, A., & Long, E. (2020). Nature risk rising: Why the crisis engulfing nature matters for business and the economy. *In World Economic Forum.*

Johnson, D. L., Ambrose, S. H., Bassett, T. J., Bowen, M. L., Crummey, D. E., Isaacson, J. S., ... & Winter-Nelson, A. E. (1997). *Meanings of environmental terms. Journal of environmental quality*, *26(3),* 581-589. https://doi.org/10.2134/jeq1997.00472425002600030002x

Jorgan, N., Küzmič, F., & Šilc, U. (2021). Urban structure and environment impact plant species richness and floristic composition in a Central European city. *Urban Ecosystems, 25(1),* 149-163. https://doi.org/10.1007/s11252-021-01140-4

Land take in Europe. (2019). European Environment Agency. https://www.eea.europa.eu/data-and-maps/indicators/land-take-3/assessment

Le Corbusier's Five Points of Architecture. (2023, May 18). In *Wikipedia.* https://en.wikipedia.org/w/index.php?title=Le_Corbusier%27s_Five_Points_of_Architecture&oldid=1155555359

Łopucki, R., Klich, D., Kitowski, I., & Kiersztyn, A. (2020). *Urban size effect on biodiversity: The need for a conceptual framework for the implementation of urban policy for small cities. Cities Cities, 98*, 102590. https://doi.org/10.1016/j.cities.2019.102590

Morabito, M., Crisci, A., Georgiadis, T., Orlandini, S., Munafò, M., Congedo, L., Rota, P., & Zazzi, M. (2017). Urban Imperviousness Effects on Summer Surface Temperatures Nearby Residential Buildings in Different Urban Zones of Parma. *Remote Sensing of Urban Agriculture and Land Cover, 10(1),* 26. https://doi.org/10.3390/rs10010026

Naumann, S., Frelih-Larsen, A., Prokop, G., Ittner, S., Reed, M., Mills, J., Morari, F., Verzandvoort, S., Albrecht, S., Bjuréus, A., Siebielec, G., & Mitursk, T. (2018). Land take and soil sealing – drivers, trends and policy (legal) instruments: insights from European

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

cities. *International Yearbook of Soil Law and Policy 2018,* 83-112. https://doi.org/10.1007/978-3-030-00758-4_4

ÖREK 2030 - Punkt 2. (2023). https://www.oerek2030.at/kapitel-7/punkt-2

Powney, G. D., Carvell, C., Edwards, M., Morris, R. K., Roy, H. E., Woodcock, B. A., & Isaac, N. J. (2019). Widespread losses of pollinating insects in Britain. *Nature communications*, *10(1),* 1018. https://doi.org/10.1038/s41467-019-08974-9

Raiffeisen Immobilien Vermittlung GmbH. (2021). *Trotz Klimawandel: Österreicher halten dem Einfamilienhaus die Treue* [Presseinformation].

Robinson, L., Newell, J. P., & Marzluff, J. M. (2005). Twenty-five years of sprawl in the Seattle region: growth management responses and implications for conservation. *Landscape and Urban Planning 71(1),* 51-72. https://doi.org/10.1016/j.landurbplan.2004.02.005

Rodríguez-Rojas, M. I., Huertas-Fernández, F., Moreno, B., Martínez, G., & Grindlay, A. L. (2018). A study of the application of permeable pavements as a sustainable technique for the mitigation of soil sealing in cities: A case study in the south of Spain. *Journal of Environmental Management, 205,* 151-162. https://doi.org/10.1016/j.jenvman.2017.09.075

Schreefel, L., Schulte, R. P. O., De Boer, I. J. M., Schrijver, A. P., & Van Zanten, H. H. E. (2020). Regenerative agriculture–the soil is the base. *Global Food Security*, *26,* 100404. https://doi.org/10.1016/j.gfs.2020.100404

Secretariat of the Convention on Biological Diversity. (2020). Global Biodiversity Outlook 5. *UN Convention on Biological Diversity (CBD).*

Sonderegger, G., Färber, B., Götzl, M., Schwarzl, B., & Weiss, M. (2020). *Erfassung und Darstellung von Ökosystemleistungen in Österreich im Rahmen des österreichischen Programms für die ländliche Entwicklung 2014-2020.* Umweltbundesamt.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

STATcube - Statistische Datenbank von Statistik Austria. (2023). *Bevölkerung zu Jahresbeginn ab 1982.* https://statcube.at/statistik.at/ext/statcube/jsf/tableView/tableView.xhtml

STATISTIK AUSTRIA. (2021). *Wohnbautätigkeit in Österreich. Wohnungsbestand mit Ende 2020 auf geschätzte rund 4,9 Mio. angewachsen.* Pressemitteilung: 12.659-250/21.

STATISTIK AUSTRIA. (2021). *Wohnfläche pro Person in Hauptwohnsitzwohnungen in Österreich bis 2021.* Cited according to de.statista.com, https://de.statista.com/statistik/daten/studie/512938/umfrage/wohnflaeche-pro-person-in-hauptwohnsitzwohnungen-in-oesterreich/#:~:text=Wohnfl%C3%A4che%20pro%20Person%20in%20Hauptwohnsitzwohnungen%20in%20%C3%96sterreich%20bis%202021&text=Die%20durchschnittliche%20Wohnfl%C3%A4che%20pro%20Person,um%203%2C4%20Quadratmeter%20angestiegen.

STATISTIK AUSTRIA. (2022). *Dauersiedlungsraum.* https://data.statistik.gv.at/web/meta.jsp?dataset=OGDEXT_DSR_1

STATISTIK AUSTRIA. (2023). *Kfz-Statistik.* https://www.statistik.at/statistiken/tourismus-und-verkehr/fahrzeuge/kfz-bestand

STATISTIK AUSTRIA. (2023). *Mikrozensus 2022.* Durchschnittliche Wohnfläche in Quadratmeter und durchschnittliche Wohnraumanzahl pro Wohnung und pro Person nach Rechtsverhältnis 2022 (Tabelle). https://www.statistik.at/statistiken/bevoelkerung-und-soziales/wohnen/wohnsituation

Stolte, J., Tesfai, M., Oygarden, L., Kvaemo, S., Keizer, J., Verheijen, F., Panagos, Pl, Ballabio, C., & Hessel, R. (2016). *Soil threats in Europe: status, methods, drivers and effects on ecosystem services: deliverable 2.1 RECARE project.* European Commission DG Joint Research Centre. https://doi.org/10.2788/828742

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU Bibliothek WIEN Your knowledge hub

Taucher, A. L., Gloor, S., Dietrich, A., Geiger, M., Hegglin, D., & Bontadina, F. (2020). Decline in distribution and abundance: urban hedgehogs under pressure. *Animals, 10(9),* 1606.

Umweltbundesamt. (2022). *13. Umweltkontrollbericht. Umweltsituation in Österreich.* Umweltbundesamt.

United Nations Statistics Division. (2022). *SDG Indicators*. https://unstats.un.org/sdgs/metadata/?Text=&Goal=15&Target=15.3

Verheye, W. (2009). Land cover, land use and the global change. *Encyclopedia of land use, land cover and soil sciences-land cover, land use and the global change*, 45-80.

Wang, X., Shi, R., , & Zhou, Y. (2020). Dynamics of urban sprawl and sustainable development in China. *Socio-Economic Planning Sciences, 70*, 100736. https://doi.org/10.1016/j.seps.2019.100736

Wienerberger Traumhausstudie. (2020). *Online Interviews Marketagent.com.* Wienerberger Österreich GmbH.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

APPENDICES

Appendix A. Calculations

Table A1 calculates the occupation rate of the permanent settlement area for Austria in total and for the federal provinces. The area of permanent settlement is the sum of all land surfaces suitable for development. It includes the category of already developed settlement areas (urban, industrial and commercial areas) as well as areas suitable for permanent settlement (arable land, grassland, recreational areas, etc.).

Permanent Settlement Areas of the Austrian Federal Provinces				
Federal Province	Total Land Area	Permanent Settlement Area	Existing Settlement Area	**Occupation Rate**
Burgenland	3.965,20 km²	2.484,71 km²	482,69 km²	**19,43%**
Carinthia	9.536,50 km²	2.455,28 km²	1.078,87 km²	**43,94%**
Lower Austria	19.179,56 km²	11.615,61 km²	2.618,39 km²	**22,54%**
Upper Austria	11.982,52 km²	6.842,31 km²	2.678,40 km²	**39,14%**
Salzburg	7.154,56 km²	1.496,06 km²	730,74 km²	**48,84%**
Styria	16.399,34 km²	5.229,58 km²	2.451,98 km²	**46,89%**
Tyrol	12.648,37 km²	1.572,95 km²	868,35 km²	**55,21%**
Vorarlberg	2.601,67 km²	567,30 km²	344,21 km²	**60,68%**
Vienna	414,82 km²	320,54 km²	248,34 km²	**77,48%**
				Average = 46,02%
Austria	83.882,56 km²	32.584,34 km²		
Total Area Suitable for Permanent Settlement = 38,85%				

Table A1. Area of Permanent Settlement in Austria; Source: STATISTIK AUSTRIA, 2022.

Table A2 served to calculate the rate of soil sealing to the dimension of soccer fields.

Soil Sealing in Austria			
Annual Soil Sealing Rate	Size of one Soccer Field	Soccer Fields/Year	Soccer Fields/Day
15 - 21 km²	0,007 km²	2.143 - 3.000	5,87 - 8,22

Table A2. Soil Sealing in Austria in the Dimension of Soccer Fields; Source: Bodenverbrauch in Österreich, 2021 and Football pitch, 2023.

Table A3 shows the number of private cars per inhabitant in Austria.

Private Cars in Austria			
Year	Inhabitants	Cars	**Number of Cars per Inhabitant**
1990	7.644.818	2.991.284	**0,39**
2020	8.901.064	5.091.827	**0,57**

Table A3. The Number of Private Cars per Inhabitant in Austria; Sources: STATISTIK AUSTRIA, 2023 and STATcube - Statistische Datenbank von Statistik Austria, 2023.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

Table A4 was used for the calculation of the estimated number of inhabitants within the case study area of the design guideline.

average number of inhabitants per 1000m²:	4,1
settlement area	19.255 m²
estimated number of inhabitants before measure	78,95
added habitable area	3.525 m²
average habitable area per person	54,6
estimated number of inhabitants after measure	143,51

Table A4. Estimated Inhabitants Case Study Area (Design Guideline); Sources: Appendix B, STATISTIK AUSTRIA, 2023 and Ausbauverhältnis, 2016.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Appendix B. Quantitative Analysis Data of Residential Settlements

This Appendix consists of the individual data collected on conventional detached houses, detached houses on columns, conventional semi-detached houses and row houses. Furthermore, it calculates the typologies' impacts on urban sprawl and the construction methods' effects on soil sealing. Detached houses on columns were considered outliers in population density (i.e. inhabitants per 1000 m²) calculations, as they are not designated for permanent residence. Consequently, they are not directly comparable with conventional dwellings in this assessment and were removed from the analysis sample using strikethrough.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Data Collected on Conventional Detached Houses:

		PLOT	BUILT				COVERED						
nr.	adress	plot size	floors	main building	annex	seperate buildings	other sealed area	open for infiltration	property line 1	property line 2	steet width 1	steet width 2	green
1	Haaderstraße 23, 2103 Langenzersdorf	844,08 m²	1	99,93 m²	0,00 m²	35,03 m²	119,03 m²	0,00 m²	32,06 m	30,43 m	12,00 m	10,00 m	
2	Haaderstraße 25, 2103 Langenzersdorf	637,95 m²	3	152,20 m²	0,00 m²	34,65 m²	145,56 m²	0,00 m²	22,12 m		12,00 m		
3	Haaderstraße 27, 2103 Langenzersdorf	642,36 m²	2,5	146,52 m²	11,19 m²	64,13 m²	57,05 m²	16,97 m²	22,12 m		12,00 m		
4	Haaderstraße 29, 2103 Langenzersdorf	645,51 m²	2	133,40 m²	0,00 m²	59,32 m²	59,39 m²	40,63 m²	22,24 m		12,00 m		
5	Haaderstraße 31, 2103 Langenzersdorf	650,62 m²	1,5	125,67 m²	24,52 m²	46,70 m²	40,84 m²	0,00 m²	22,55 m		12,00 m		
6	Haaderstraße 33, 2103 Langenzersdorf	654,54 m²	1	132,27 m²	0,00 m²	32,61 m²	96,69 m²	0,00 m²	22,75 m		12,00 m		
7	Haaderstraße 35, 2103 Langenzersdorf	660,98 m²	2	107,70 m²	15,91 m²	51,23 m²	110,55 m²	0,00 m²	22,83 m		12,00 m		
8	Haaderstraße 37, 2103 Langenzersdorf	665,39 m²	2	150,14 m²	0,00 m²	36,19 m²	76,66 m²	0,00 m²	21,71 m		12,00 m		
9	Haaderstraße 39, 2103 Langenzersdorf	748,95 m²	1	124,92 m²	0,00 m²	0,00 m²	59,70 m²	13,71 m²	23,90 m	30,43 m	12,00 m	10,00 m	
10	Schrammelgasse 4, 2103 Langenzersdorf	643,47 m²	2	113,69 m²	0,00 m²	21,74 m²	21,97 m²	0,00 m²	21,89 m		9,00 m		
11	Schrammelgasse 6, 2103 Langenzersdorf	642,10 m²	1	94,76 m²	23,34 m²	27,20 m²	106,38 m²	0,00 m²	22,12 m		9,00 m		
12	Schrammelgasse 8, 2103 Langenzersdorf	640,64 m²	1	99,76 m²	6,51 m²	0,00 m²	5,21 m²	0,00 m²	21,18 m		9,00 m		
13	Schrammelgasse 10, 2103 Langenzersdorf	648,22 m²	1	145,34 m²	6,30 m²	57,94 m²	110,87 m²	0,00 m²	21,61 m		9,00 m		
14	Schrammelgasse 14, 2103 Langenzersdorf	654,15 m²	1	140,72 m²	0,00 m²	13,16 m²	138,20 m²	0,00 m²	21,60 m		9,00 m		
15	Schrammelgasse 16, 2103 Langenzersdorf	657,83 m²	1	134,05 m²	0,00 m²	24,75 m²	71,01 m²	0,00 m²	21,24 m		9,00 m		
16	Schrammelgasse 18, 2103 Langenzersdorf	830,12 m²	1	152,47 m²	0,00 m²	12,00 m²	102,95 m²	0,00 m²	28,36 m	28,42 m	9,00 m	10,00 m	
17	Karl-Benz-Weg 66, 1210 Wien	577,90 m²	2,5	91,44 m²	39,66 m²	32,42 m²	73,88 m²	0,00 m²	18,67 m	30,03 m	6,00 m	7,95 m	
18	Karl-Benz-Weg 68, 1210 Wien	485,28 m²	2	120,81 m²	0,00 m²	34,20 m²	45,71 m²	0,00 m²	14,98 m		6,00 m		
19	Karl-Benz-Weg 70, 1210 Wien	497,43 m²	1,5	72,42 m²	52,25 m²	15,16 m²	79,38 m²	0,00 m²	14,99 m		6,00 m		
20	Karl-Benz-Weg 72, 1210 Wien	492,32 m²	1	131,41 m²	0,00 m²	14,78 m²	136,95 m²	0,00 m²	14,99 m		6,00 m		
21	Karl-Benz-Weg 74, 1210 Wien	491,51 m²	1,5	110,38 m²	0,00 m²	26,77 m²	53,82 m²	0,00 m²	15,06 m		6,00 m		
22	Karl-Benz-Weg 76, 1210 Wien	491,21 m²	1	153,13 m²	0,00 m²	48,27 m²	119,87 m²	0,00 m²	14,98 m		6,00 m		
23	Karl-Benz-Weg 78, 1210 Wien	491,59 m²	2	143,84 m²	0,00 m²	0,00 m²	65,43 m²	0,00 m²	15,16 m		6,00 m		
24	Karl-Benz-Weg 80, 1210 Wien	491,10 m²	1,5	60,63 m²	20,25 m²	0,00 m²	100,18 m²	0,00 m²	14,93 m		6,00 m		
25	Karl-Benz-Weg 82, 1210 Wien	509,29 m²	1,89	165,01 m²	0,00 m²	14,06 m²	122,69 m²	0,00 m²	15,66 m		6,00 m		
26	Karl-Benz-Weg 84, 1210 Wien	472,02 m²	3	63,18 m²	104,49 m²	7,70 m²	34,86 m²	0,00 m²	14,38 m		6,00 m		
27	Karl-Benz-Weg 86, 1210 Wien	494,91 m²	2	117,03 m²	0,00 m²	34,29 m²	98,53 m²	0,00 m²	15,00 m		6,00 m		
28	Karl-Benz-Weg 88, 1210 Wien	487,26 m²	1,5	165,29 m²	67,16 m²	2,44 m²	36,19 m²	0,00 m²	14,88 m		6,00 m		
29	Karl-Benz-Weg 90, 1210 Wien	487,26 m²	1,5	85,25 m²	0,00 m²	0,00 m²	69,14 m²	0,00 m²	14,88 m		6,00 m		
30	Karl-Benz-Weg 92, 1210 Wien	496,40 m²	1	95,14 m²	0,00 m²	0,00 m²	35,53 m²	23,72 m²	15,13 m		6,00 m		
31	Karl-Benz-Weg 94, 1210 Wien	540,80 m²	1,5	84,59 m²	15,09 m²	21,26 m²	82,21 m²	0,00 m²	16,82 m		6,00 m		
32	Karl-Benz-Weg 94A, 1210 Wien	440,39 m²	1,5	115,22 m²	13,16 m²	7,94 m²	89,00 m²	0,00 m²	13,08 m		6,00 m		
33	Karl-Benz-Weg 96, 1210 Wien	522,63 m²	1,5	78,43 m²	9,13 m²	29,02 m²	47,46 m²	0,00 m²	15,95 m		6,00 m		
34	Karl-Benz-Weg 96A, 1210 Wien	462,58 m²	2	83,30 m²	0,00 m²	29,77 m²	96,65 m²	6,07 m²	14,15 m		6,00 m		
35	Karl-Benz-Weg 98, 1210 Wien	584,85 m²	1,5	84,69 m²	0,00 m²	30,53 m²	62,55 m²	0,00 m²	25,39 m	30,40 m	6,00 m	13,24 m	
36	Kravoglgasse 55, 1210 Wien	772,15 m²	2,5	118,08 m²	7,28 m²	46,19 m²	50,77 m²	0,00 m²	23,79 m	31,32 m	8,04 m	7,95 m	
37	Kravoglgasse 57, 1210 Wien	525,30 m²	2	116,08 m²	0,00 m²	38,59 m²	64,43 m²	0,00 m²	15,00 m		8,04 m		
38	Kravoglgasse 59, 1210 Wien	517,65 m²	2	89,84 m²	10,85 m²	0,00 m²	42,01 m²	0,00 m²	14,83 m		8,04 m		
39	Kravoglgasse 63, 1210 Wien	786,30 m²	1,3	89,41 m²	0,00 m²	24,49 m²	55,49 m²	2,56 m²	22,37 m		8,04 m		
40	Kravoglgasse 65, 1210 Wien	766,56 m²	1,5	103,47 m²	0,00 m²	30,28 m²	113,38 m²	0,00 m²	22,18 m		8,04 m		
41	Kravoglgasse 67, 1210 Wien	771,76 m²	2	109,74 m²	0,00 m²	17,84 m²	81,20 m²	0,00 m²	22,23 m		8,04 m		117,95 m²

Table B1. Data Collection: Conventional Detached Houses.

TU Bibliothek Your knowledge hub
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

URBAN SPRAWL			
habitable area	adjoining area	inhabitants per 1000 m^2	area of impact
74,95 m^2	101,22	1,15	1188,59 m^2
342,45 m^2	140,14	8,14	770,67 m^2
283,12 m^2	157,99	6,69	775,08 m^2
200,10 m^2	144,54	4,70	778,95 m^2
159,77 m^2	129,28	3,72	785,92 m^2
99,20 m^2	123,66	2,30	791,04 m^2
173,48 m^2	119,20	3,98	797,96 m^2
225,21 m^2	139,75	5,18	795,65 m^2
93,69 m^2	93,69	1,64	1044,50 m^2
170,54 m^2	101,57	4,21	741,98 m^2
88,58 m^2	91,47	2,19	741,64 m^2
79,70 m^2	74,82	1,98	735,95 m^2
113,73 m^2	152,46	2,79	745,47 m^2
105,54 m^2	115,41	2,57	751,35 m^2
100,54 m^2	119,10	2,44	753,41 m^2
114,35 m^2	123,35	1,90	1099,84 m^2
201,20 m^2	92,90	4,89	753,26 m^2
181,22 m^2	116,26	6,26	530,23 m^2
120,66 m^2	65,69	4,07	542,39 m^2
98,56 m^2	109,64	3,36	537,28 m^2
124,18 m^2	102,86	4,24	536,68 m^2
114,84 m^2	151,05	3,92	536,14 m^2
215,76 m^2	107,88	7,36	537,08 m^2
83,40 m^2	45,47	2,85	535,90 m^2
233,90 m^2	134,30	7,70	556,26 m^2
220,52 m^2	53,16	7,84	515,17 m^2
175,55 m^2	113,49	5,95	539,92 m^2
236,32 m^2	125,80	8,14	531,88 m^2
95,91 m^2	63,94	3,30	531,88 m^2
71,36 m^2	71,36	2,41	541,79 m^2
106,48 m^2	79,39	3,30	591,26 m^2
139,49 m^2	92,37	5,33	479,63 m^2
95,08 m^2	80,59	3,05	570,47 m^2
124,95 m^2	84,80	4,53	505,03 m^2
95,28 m^2	86,42	2,02	862,26 m^2
226,86 m^2	123,20	4,19	992,27 m^2
174,12 m^2	116,00	5,45	585,60 m^2
142,90 m^2	67,38	4,53	577,25 m^2
87,17 m^2	85,42	1,82	876,22 m^2
116,40 m^2	100,31	2,49	855,71 m^2
164,60 m^2	95,68	3,50	861,14 m^2

Table B2. Urban Sprawl: Conventional Detached Houses; Sources: STATISTIK AUSTRIA, 2023 and Ausbauverhältnis, 2016.

SOIL SEALING					
built	BCR	covered	SCR	BCR+SCR	street share
134,96 m^2	15,99%	119,03 m^2	14,10%	30,09%	344,51 m^2
186,85 m^2	29,29%	145,56 m^2	22,82%	52,11%	132,72 m^2
221,84 m^2	34,54%	65,54 m^2	10,20%	44,74%	132,72 m^2
192,72 m^2	29,86%	79,71 m^2	12,35%	42,20%	133,44 m^2
196,89 m^2	30,26%	40,84 m^2	6,28%	36,54%	135,30 m^2
164,88 m^2	25,19%	96,69 m^2	14,77%	39,96%	136,50 m^2
174,84 m^2	26,45%	110,55 m^2	16,73%	43,18%	136,98 m^2
186,33 m^2	28,00%	76,66 m^2	11,52%	39,52%	130,26 m^2
124,92 m^2	16,68%	66,56 m^2	8,89%	25,57%	295,55 m^2
135,43 m^2	21,05%	21,97 m^2	3,41%	24,46%	98,51 m^2
145,30 m^2	22,63%	106,38 m^2	16,57%	39,20%	99,54 m^2
106,27 m^2	16,59%	5,21 m^2	0,81%	17,40%	95,31 m^2
209,58 m^2	32,33%	110,87 m^2	17,10%	49,44%	97,25 m^2
153,88 m^2	23,52%	138,20 m^2	21,13%	44,65%	97,20 m^2
158,80 m^2	24,14%	71,01 m^2	10,79%	34,93%	95,58 m^2
164,47 m^2	19,81%	102,95 m^2	12,40%	32,21%	269,72 m^2
163,52 m^2	28,30%	73,88 m^2	12,78%	41,08%	175,36 m^2
155,01 m^2	31,94%	45,71 m^2	9,42%	41,36%	44,95 m^2
139,83 m^2	28,11%	79,38 m^2	15,96%	44,07%	44,96 m^2
146,19 m^2	29,69%	136,95 m^2	27,82%	57,51%	44,96 m^2
137,15 m^2	27,90%	53,82 m^2	10,95%	38,85%	45,17 m^2
201,40 m^2	41,00%	119,87 m^2	24,40%	65,40%	44,93 m^2
143,84 m^2	29,26%	65,43 m^2	13,31%	42,57%	45,49 m^2
80,88 m^2	16,47%	100,18 m^2	20,40%	36,87%	44,80 m^2
179,07 m^2	35,16%	122,69 m^2	24,09%	59,25%	46,97 m^2
175,37 m^2	37,15%	34,86 m^2	7,39%	44,54%	43,15 m^2
151,32 m^2	30,58%	98,53 m^2	19,91%	50,48%	45,01 m^2
234,89 m^2	48,21%	36,19 m^2	7,43%	55,63%	44,63 m^2
85,25 m^2	17,50%	69,14 m^2	14,19%	31,69%	44,63 m^2
95,14 m^2	19,17%	47,39 m^2	9,55%	28,71%	45,39 m^2
120,94 m^2	22,36%	82,21 m^2	15,20%	37,56%	50,46 m^2
136,32 m^2	30,95%	89,00 m^2	20,21%	51,16%	39,24 m^2
116,58 m^2	22,31%	47,46 m^2	9,08%	31,39%	47,84 m^2
113,07 m^2	24,44%	99,69 m^2	21,55%	45,99%	42,45 m^2
115,22 m^2	19,70%	62,55 m^2	10,70%	30,40%	277,41 m^2
171,54 m^2	22,22%	50,77 m^2	6,58%	28,79%	220,12 m^2
154,67 m^2	29,44%	64,43 m^2	12,26%	41,71%	60,30 m^2
100,69 m^2	19,45%	42,01 m^2	8,12%	27,57%	59,60 m^2
113,89 m^2	14,48%	56,77 m^2	7,22%	21,70%	89,92 m^2
133,74 m^2	17,45%	113,38 m^2	14,79%	32,24%	89,15 m^2
127,57 m^2	16,53%	81,20 m^2	10,52%	27,05%	89,38 m^2

Table B3. Soil Sealing: Conventional Detached Houses.

TU WIEN Bibliothek Your knowledge hub
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Data Collected on Detached Houses Constructed on Columns:

	PLOT	BUILT					COVERED						
adress	plot size	floors	main building	main building 2	annex	seperate buildings	other sealed area	open for infiltration	property line 1	property line 2	steet width 1	steet width 2	green
Inselweg 6, 3420 Klosterneuburg	281,78 m^2	1	15,60 m^2	38,64 m^2	0,00 m^2	0,00 m^2	45,95 m^2	0,00 m^2	17,61 m		3,30 m		
Inselweg 4, 3420 Klosterneuburg	300,62 m^2	1	16,27 m^2	45,71 m^2	0,00 m^2	0,00 m^2	44,09 m^2	0,00 m^2	20,28 m		3,30 m		
Inselweg 2, 3420 Klosterneuburg	315,69 m^2	1	11,18 m^2	39,04 m^2	0,00 m^2	0,00 m^2	93,96 m^2	0,00 m^2	20,26 m	14,27 m	3,30 m	4,20 m	
Strandwiesenweg 1, 3420 Klosterneuburg	327,44 m^2	1	10,75 m^2	47,04 m^2	0,00 m^2	0,00 m^2	46,11 m^2	0,00 m^2	19,97 m	16,64 m	3,80 m	4,20 m	
Strandwiesenweg 3, 3420 Klosterneuburg	329,17 m^2	1	11,37 m^2	37,86 m^2	0,00 m^2	0,00 m^2	34,33 m^2	0,00 m^2	20,69 m		3,80 m		
Strandwiesenweg 5, 3420 Klosterneuburg	354,17 m^2	1	25,25 m^2	59,60 m^2	0,00 m^2	0,00 m^2	47,20 m^2	0,00 m^2	22,67 m		3,80 m		118,87
Donaulände 7, 3420 Klosterneuburg	743,73 m^2	1	11,85 m^2	23,70 m^2	0,00 m^2	0,00 m^2	59,87 m^2	0,00 m^2	25,11 m	19,86 m	3,15 m	3,50 m	
Donaulände 8, 3420 Klosterneuburg	641,67 m^2	1	17,77 m^2	35,93 m^2	0,00 m^2	6,17 m^2	56,85 m^2	0,00 m^2	20,34 m	19,75 m	3,15 m	3,50 m	
Donaulände 12, 3420 Klosterneuburg	973,43 m^2	2	0,00 m^2	76,99 m^2	0,00 m^2	22,65 m^2	0,00 m^2	0,00 m^2	30,28 m	30,18 m	3,15 m	3,50 m	
Donaulände 13, 3420 Klosterneuburg	654,74 m^2	1,2	19,04 m^2	38,07 m^2	0,00 m^2	5,23 m^2	84,42 m^2	0,00 m^2	20,11 m	19,97 m	3,15 m	3,50 m	
Donaulände 14, 3420 Klosterneuburg	527,85 m^2	2	18,77 m^2	37,54 m^2	10,34 m^2	0,00 m^2	63,12 m^2	0,00 m^2	13,58 m	16,59 m	3,15 m	3,50 m	
Dreiföhrenweg 1, 3400 Klosterneuburg	418,59 m^2	1	9,19 m^2	27,56 m^2	0,00 m^2	0,00 m^2	30,86 m^2	10,42 m^2	19,57 m	20,38 m	3,63 m	2,91 m	
Dreiföhrenweg 3, 3400 Klosterneuburg	283,00 m^2	2	12,18 m^2	24,35 m^2	0,00 m^2	0,00 m^2	42,39 m^2	0,00 m^2	13,90 m		3,63 m		
Dreiföhrenweg 4, 3400 Klosterneuburg	454,24 m^2	1	22,52 m^2	67,55 m^2	0,00 m^2	0,00 m^2	58,50 m^2	0,00 m^2	16,66 m		3,63 m		
Dreiföhrenweg 5, 3400 Klosterneuburg	438,53 m^2	1	22,42 m^2	44,83 m^2	0,00 m^2	0,00 m^2	38,73 m^2	0,00 m^2	16,61 m		3,63 m		
Dreiföhrenweg 6, 3400 Klosterneuburg	396,48 m^2	1	16,37 m^2	32,74 m^2	0,00 m^2	0,00 m^2	16,37 m^2	0,00 m^2	15,99 m		3,63 m		
Dreiföhrenweg 9, 3400 Klosterneuburg	383,30 m^2	1,8	28,30 m^2	56,59 m^2	0,00 m^2	0,00 m^2	89,61 m^2	0,00 m^2	14,08 m		3,63 m		
Dreiföhrenweg 11, 3400 Klosterneuburg	389,42 m^2	1	17,47 m^2	34,93 m^2	0,00 m^2	0,00 m^2	68,84 m^2	0,00 m^2	15,54 m		3,63 m		
Dreiföhrenweg 12, 3400 Klosterneuburg	304,82 m^2	1	15,06 m^2	45,19 m^2	0,00 m^2	0,00 m^2	52,00 m^2	0,00 m^2	15,88 m		3,63 m		
Greifensteinerweg 17, 3422 St. Andrä-Wördern	793,54 m^2	1	12,77 m^2	51,09 m^2	0,00 m^2	0,00 m^2	60,84 m^2	0,00 m^2	26,23 m		3,50 m		
Greifensteinerweg 19, 3422 St. Andrä-Wördern	964,82 m^2	1	33,25 m^2	66,49 m^2	15,13 m^2	0,00 m^2	132,73 m^2	27,10 m^2	39,79 m		3,50 m		
Greifensteinerweg 20, 3422 St. Andrä-Wördern	521,32 m^2	1	23,50 m^2	46,99 m^2	0,00 m^2	0,00 m^2	23,50 m^2	0,00 m^2	23,51 m		3,50 m		
Greifensteinerweg 22, 3422 St. Andrä-Wördern	518,31 m^2	1	15,73 m^2	47,20 m^2	0,00 m^2	0,00 m^2	31,47 m^2	0,00 m^2	23,84 m		3,50 m		
Greifensteinerweg 25, 3422 St. Andrä-Wördern	451,45 m^2	1	13,00 m^2	64,99 m^2	0,00 m^2	8,46 m^2	78,80 m^2	0,00 m^2	15,62 m		3,50 m		
Greifensteinerweg 26, 3422 St. Andrä-Wördern	433,74 m^2	1	23,69 m^2	47,37 m^2	0,00 m^2	0,00 m^2	76,47 m^2	0,00 m^2	33,38 m		3,50 m		
Greifensteinerweg 27, 3422 St. Andrä-Wördern	528,64 m^2	1	0,00 m^2	28,91 m^2	0,00 m^2	3,91 m^2	115,14 m^2	0,00 m^2	15,83 m		3,50 m		
Greifensteinerweg 28, 3422 St. Andrä-Wördern	401,72 m^2	1	8,96 m^2	44,80 m^2	0,00 m^2	0,00 m^2	57,05 m^2	0,00 m^2	23,07 m		3,50 m		
Greifensteinerweg 31, 3422 St. Andrä-Wördern	693,24 m^2	1	0,00 m^2	51,33 m^2	0,00 m^2	6,81 m^2	121,62 m^2	0,00 m^2	16,81 m		3,50 m		
Greifensteinerweg 32, 3422 St. Andrä-Wördern	469,54 m^2	1	11,39 m^2	56,97 m^2	0,00 m^2	0,00 m^2	158,01 m^2	0,00 m^2	22,82 m		3,50 m		
Greifensteinerweg 33, 3422 St. Andrä-Wördern	477,92 m^2	1	9,37 m^2	37,46 m^2	13,79 m^2	0,00 m^2	144,35 m^2	0,00 m^2	16,33 m		3,50 m		
Greifensteinerweg 34, 3422 St. Andrä-Wördern	414,46 m^2	1	19,77 m^2	59,31 m^2	0,00 m^2	0,00 m^2	52,46 m^2	0,00 m^2	18,39 m		3,50 m		
Greifensteinerweg 35, 3422 St. Andrä-Wördern	473,73 m^2	1	10,10 m^2	40,40 m^2	0,00 m^2	14,00 m^2	109,71 m^2	0,00 m^2	15,83 m		3,50 m		
Greifensteinerweg 37, 3422 St. Andrä-Wördern	542,37 m^2	1	12,75 m^2	50,99 m^2	0,00 m^2	0,00 m^2	90,19 m^2	24,32 m^2	19,70 m		3,50 m		
Schneiderweg 39, 3422 St. Andrä-Wördern	621,55 m^2	1	14,03 m^2	70,16 m^2	0,00 m^2	0,00 m^2	133,54 m^2	0,00 m^2	21,80 m		3,00 m		
Schneiderweg 41, 3422 St. Andrä-Wördern	888,01 m^2	1	16,22 m^2	48,65 m^2	0,00 m^2	0,00 m^2	102,58 m^2	0,00 m^2	20,11 m		3,00 m		
Schneiderweg 43, 3422 St. Andrä-Wördern	683,04 m^2	1	23,85 m^2	47,69 m^2	0,00 m^2	0,00 m^2	85,81 m^2	0,00 m^2	20,73 m		3,00 m		
Treppelweg 4, 3422 St. Andrä-Wördern	347,31 m^2	1	11,59 m^2	34,78 m^2	0,00 m^2	0,00 m^2	37,42 m^2	0,00 m^2	24,40 m		6,29 m		
Treppelweg 5, 3422 St. Andrä-Wördern	764,89 m^2	1	42,53 m^2	85,06 m^2	0,00 m^2	8,51 m^2	143,21 m^2	0,00 m^2	12,43 m	29,50 m	6,29 m	2,50 m	
Treppelweg 7, 3422 St. Andrä-Wördern	333,49 m^2	1,5	30,69 m^2	50,77 m^2	0,00 m^2	0,00 m^2	54,50 m^2	37,33 m^2	28,98 m		6,29 m		
Treppelweg 10, 3422 St. Andrä-Wördern	427,14 m^2	1	16,55 m^2	66,18 m^2	0,00 m^2	0,00 m^2	49,64 m^2	0,00 m^2	13,65 m		6,29 m		
Treppelweg 16, 3422 St. Andrä-Wördern	592,18 m^2	1	28,09 m^2	56,17 m^2	0,00 m^2	9,48 m^2	56,13 m^2	0,00 m^2	22,92 m		6,29 m		

Table B4. Data Collection: Detached Houses on Columns.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

URBAN SPRAWL			
habitable area	adjoining area	~~inhabitants per 1000 m²~~	area of impact
28,98 m²	11,70	~~1,71~~	310,84 m²
34,28 m²	12,20	~~1,88~~	334,08 m²
29,28 m²	8,39	~~1,41~~	379,09 m²
35,28 m²	8,06	~~1,61~~	400,33 m²
28,40 m²	8,53	~~1,41~~	368,48 m²
44,70 m²	18,94	~~2,06~~	397,24 m²
17,78 m²	8,89	~~0,36~~	916,01 m²
26,95 m²	17,96	~~0,70~~	708,27 m²
115,49 m²	16,99	~~1,97~~	1073,94 m²
34,26 m²	18,20	~~0,87~~	721,36 m²
64,07 m²	14,08	~~1,72~~	680,93 m²
20,67 m²	6,89	~~0,78~~	483,76 m²
36,53 m²	9,13	~~2,17~~	308,23 m²
50,66 m²	16,89	~~1,92~~	484,48 m²
33,62 m²	16,81	~~1,31~~	468,68 m²
24,56 m²	12,28	~~1,06~~	425,50 m²
76,40 m²	21,22	~~3,42~~	408,86 m²
26,20 m²	13,10	~~1,15~~	417,63 m²
33,89 m²	11,30	~~1,86~~	333,64 m²
38,32 m²	9,58	~~0,84~~	839,44 m²
61,22 m²	24,93	~~1,08~~	1034,45 m²
35,24 m²	17,62	~~1,15~~	562,46 m²
35,40 m²	11,80	~~1,16~~	560,03 m²
48,74 m²	16,09	~~1,86~~	478,79 m²
35,53 m²	17,76	~~1,32~~	492,16 m²
21,68 m²	2,93	~~0,71~~	556,34 m²
33,60 m²	6,72	~~1,39~~	442,09 m²
38,50 m²	5,11	~~0,98~~	722,66 m²
42,73 m²	8,55	~~1,54~~	509,48 m²
38,44 m²	7,02	~~1,39~~	506,50 m²
44,48 m²	14,83	~~1,82~~	446,64 m²
30,30 m²	18,08	~~1,11~~	501,43 m²
38,24 m²	9,56	~~1,21~~	576,85 m²
52,62 m²	10,52	~~1,47~~	654,25 m²
36,49 m²	12,16	~~0,73~~	918,18 m²
35,77 m²	17,88	~~0,92~~	714,14 m²
26,09 m²	8,70	~~1,13~~	424,05 m²
63,80 m²	38,28	~~1,39~~	840,86 m²
57,12 m²	23,02	~~2,46~~	424,63 m²
49,64 m²	12,41	~~1,93~~	470,07 m²
42,13 m²	28,17	~~1,16~~	664,26 m²

Table B5. Urban Sprawl: Detached Houses on Columns; Sources: STATISTIK AUSTRIA, 2023 and Ausbauverhältnis, 2016.

SOIL SEALING					
built	BCR	covered	SCR	BCR+SCR	street share
15,60 m²	5,54%	45,95 m²	16,31%	21,84%	29,06 m²
16,27 m²	5,41%	44,09 m²	14,67%	20,08%	33,46 m²
11,18 m²	3,54%	93,96 m²	29,76%	33,30%	63,40 m²
10,75 m²	3,28%	46,11 m²	14,08%	17,37%	72,89 m²
11,37 m²	3,45%	34,33 m²	10,43%	13,88%	39,31 m²
25,25 m²	7,13%	47,20 m²	13,33%	20,46%	43,07 m²
11,85 m²	1,59%	59,87 m²	8,05%	9,64%	172,28 m²
23,94 m²	3,73%	56,85 m²	8,86%	12,59%	66,60 m²
22,65 m²	2,33%	0,00 m²	0,00%	2,33%	100,51 m²
24,27 m²	3,71%	84,42 m²	12,89%	16,60%	66,62 m²
18,77 m²	3,56%	63,12 m²	11,96%	15,51%	153,08 m²
9,19 m²	2,19%	36,07 m²	8,62%	10,81%	65,17 m²
12,18 m²	4,30%	42,39 m²	14,98%	19,28%	25,23 m²
22,52 m²	4,96%	58,50 m²	12,88%	17,84%	30,24 m²
22,42 m²	5,11%	38,73 m²	8,83%	13,94%	30,15 m²
16,37 m²	4,13%	16,37 m²	4,13%	8,26%	29,02 m²
28,30 m²	7,38%	89,61 m²	23,38%	30,76%	25,56 m²
17,47 m²	4,48%	68,84 m²	17,68%	22,16%	28,21 m²
15,06 m²	4,94%	52,00 m²	17,06%	22,00%	28,82 m²
12,77 m²	1,61%	60,84 m²	7,67%	9,28%	45,90 m²
33,25 m²	3,45%	146,28 m²	15,16%	18,61%	69,63 m²
23,50 m²	4,51%	23,50 m²	4,51%	9,01%	41,14 m²
15,73 m²	3,04%	31,47 m²	6,07%	9,11%	41,72 m²
21,46 m²	4,75%	78,80 m²	17,46%	22,21%	27,34 m²
23,69 m²	5,46%	76,47 m²	17,63%	23,09%	58,42 m²
3,91 m²	0,74%	115,14 m²	21,78%	22,52%	27,70 m²
8,96 m²	2,23%	57,05 m²	14,20%	16,43%	40,37 m²
6,81 m²	0,98%	121,62 m²	17,54%	18,53%	29,42 m²
11,39 m²	2,43%	158,01 m²	33,65%	36,08%	39,94 m²
9,37 m²	1,96%	144,35 m²	30,20%	32,16%	28,58 m²
19,77 m²	4,77%	52,46 m²	12,66%	17,43%	32,18 m²
24,10 m²	5,09%	109,71 m²	23,16%	28,25%	27,70 m²
12,75 m²	2,35%	102,35 m²	18,87%	21,22%	34,48 m²
14,03 m²	2,26%	133,54 m²	21,48%	23,74%	32,70 m²
16,22 m²	1,83%	102,58 m²	11,55%	13,38%	30,17 m²
23,85 m²	3,49%	85,81 m²	12,56%	16,05%	31,10 m²
11,59 m²	3,34%	37,42 m²	10,77%	14,11%	76,74 m²
51,04 m²	6,67%	143,21 m²	18,72%	25,40%	75,97 m²
30,69 m²	9,20%	73,17 m²	21,94%	31,14%	91,14 m²
16,55 m²	3,87%	49,64 m²	11,62%	15,49%	42,93 m²
37,57 m²	6,34%	56,13 m²	9,48%	15,82%	72,08 m²

Table B6. Soil Sealing: Detached Houses on Columns.

TU Bibliothek Your knowledge hub
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Data Collected on Conventional Semi-detached Houses:

		PLOT	BUILT				COVERED						
nr.	adress	plot size	floors	main building	annex	seperate buildings	other sealed area	open for infiltration	property line 1	property line 2	steet width 1	steet width 2	green
1	Memlinggasse 2, 1220 Wien	361,09 m^2	2	76,47 m^2	0,00 m^2	26,50 m^2	36,23 m^2	14,81 m^2	7,64 m	14,04 m	8,60 m	4,60 m	
2	Memlinggasse 2A, 1220 Wien	218,54 m^2	2	74,48 m^2	0,00 m^2	17,61 m^2	64,52 m^2	13,11 m^2	7,65 m	7,19 m	8,60 m	4,60 m	
3	Memlinggasse 2B, 1220 Wien	234,26 m^2	2	75,66 m^2	0,00 m^2	27,72 m^2	50,30 m^2	13,93 m^2	7,83 m	8,27 m	8,60 m	4,60 m	
4	Memlinggasse 2C, 1220 Wien	229,43 m^2	2	74,22 m^2	0,00 m^2	24,54 m^2	62,81 m^2	13,03 m^2	8,22 m	7,60 m	8,60 m	4,60 m	
5	Memlinggasse 2D, 1220 Wien	228,36 m^2	2	75,01 m^2	0,00 m^2	30,09 m^2	43,55 m^2	26,02 m^2	7,93 m	7,85 m	8,60 m	4,60 m	
6	Memlinggasse 2E, 1220 Wien	233,84 m^2	2	76,85 m^2	0,00 m^2	23,69 m^2	32,04 m^2	13,02 m^2	8,00 m	8,20 m	8,60 m	4,60 m	
7	Memlinggasse 2F, 1220 Wien	232,50 m^2	2	76,40 m^2	0,00 m^2	24,42 m^2	34,93 m^2	13,04 m^2	8,10 m	8,05 m	8,60 m	4,60 m	
8	Memlinggasse 2G, 1220 Wien	221,61 m^2	2	73,02 m^2	0,00 m^2	24,21 m^2	21,77 m^2	12,74 m^2	7,80 m	7,60 m	8,60 m	4,60 m	
9	Memlinggasse 2H1, 1220 Wien	231,28 m^2	2	75,59 m^2	0,00 m^2	23,69 m^2	79,61 m^2	12,86 m^2	7,90 m	8,30 m	8,60 m	4,60 m	
10	Memlinggasse 2H2, 1220 Wien	227,43 m^2	2	75,24 m^2	0,00 m^2	24,96 m^2	36,43 m^2	12,79 m^2	8,10 m	7,80 m	8,60 m	4,60 m	
11	Memlinggasse 2J, 1220 Wien	221,36 m^2	2	74,77 m^2	0,00 m^2	23,11 m^2	37,48 m^2	12,86 m^2	7,92 m	8,04 m	8,60 m	4,60 m	
12	Memlinggasse 2K, 1220 Wien	233,70 m^2	2	76,12 m^2	0,00 m^2	22,62 m^2	46,26 m^2	12,64 m^2	7,85 m	8,00 m	8,60 m	4,60 m	
13	Memlinggasse 2L, 1220 Wien	243,29 m^2	2	70,93 m^2	0,00 m^2	17,20 m^2	45,14 m^2	12,60 m^2	8,61 m	9,05 m	8,60 m	4,60 m	
14	Memlinggasse 2M, 1220 Wien	323,90 m^2	2	68,82 m^2	0,00 m^2	23,37 m^2	38,45 m^2	43,45 m^2	11,50 m	11,40 m	8,60 m	4,60 m	61,203
15	Grossmannstraße 1/16, 1220 Wien	200,87 m^2	2,5	86,84 m^2	0,00 m^2	0,00 m^2	42,71 m^2	0,00 m^2	2,90 m				
16	Grossmannstraße 1/17, 1220 Wien	192,50 m^2	2,5	90,32 m^2	0,00 m^2	3,57 m^2	34,78 m^2	0,00 m^2					
17	Grossmannstraße 1/18, 1220 Wien	197,56 m^2	2,5	89,92 m^2	0,00 m^2	3,95 m^2	33,72 m^2	0,00 m^2	21,75 m		1,35 m		
18	Grossmannstraße 1/19, 1220 Wien	288,01 m^2	2,5	90,98 m^2	0,00 m^2	0,00 m^2	36,72 m^2	0,00 m^2					
19	Grossmannstraße 1/20, 1220 Wien	196,57 m^2	2,5	90,80 m^2	0,00 m^2	4,31 m^2	60,14 m^2	0,00 m^2	21,46 m		1,35 m		
20	Grossmannstraße 1/21, 1220 Wien	284,08 m^2	2,5	90,74 m^2	0,00 m^2	5,75 m^2	46,66 m^2	0,00 m^2					
21	Grossmannstraße 1/22, 1220 Wien	209,27 m^2	2,5	92,43 m^2	0,00 m^2	0,00 m^2	56,01 m^2	0,00 m^2	22,28 m	9,35 m	1,35 m	15,68 m	
22	Grossmannstraße 1/23, 1220 Wien	307,98 m^2	2,5	85,90 m^2	0,00 m^2	8,33 m^2	32,91 m^2	0,00 m^2		13,07 m		15,68 m	150,5215
23	Eduard-Gaertner-Gasse 8/1, 1220 Wien	181,68 m^2	2	52,55 m^2	0,00 m^2	5,83 m^2	45,49 m^2	0,00 m^2	10,13 m	17,97 m	2,50 m	20,00 m	
24	Eduard-Gaertner-Gasse 8/2, 1220 Wien	181,06 m^2	2	52,64 m^2	0,00 m^2	5,82 m^2	26,54 m^2	0,00 m^2	10,00 m		2,50 m		
25	Eduard-Gaertner-Gasse 8/3, 1220 Wien	183,32 m^2	2	52,80 m^2	0,00 m^2	5,83 m^2	21,67 m^2	6,38 m^2	10,13 m		2,50 m		
26	Eduard-Gaertner-Gasse 8/4, 1220 Wien	189,59 m^2	2	52,99 m^2	0,00 m^2	5,92 m^2	52,90 m^2	0,00 m^2	10,04 m		2,50 m		
27	Eduard-Gaertner-Gasse 8/5, 1220 Wien	183,79 m^2	2	49,09 m^2	0,00 m^2	5,92 m^2	29,28 m^2	0,00 m^2	10,25 m		2,50 m		
28	Eduard-Gaertner-Gasse 8/6, 1220 Wien	181,19 m^2	2	48,97 m^2	0,00 m^2	5,43 m^2	13,56 m^2	0,00 m^2	9,96 m		2,50 m		
29	Eduard-Gaertner-Gasse 8/7, 1220 Wien	183,16 m^2	2	49,73 m^2	0,00 m^2	10,55 m^2	39,98 m^2	0,00 m^2	10,20 m		8,12 m		
30	Eduard-Gaertner-Gasse 8/8, 1220 Wien	179,79 m^2	2	49,18 m^2	0,00 m^2	5,27 m^2	23,95 m^2	0,00 m^2	9,95 m		8,12 m		
31	Eduard-Gaertner-Gasse 8/9, 1220 Wien	181,66 m^2	2	49,66 m^2	0,00 m^2	5,27 m^2	25,81 m^2	0,00 m^2	10,12 m		2,50 m		
32	Eduard-Gaertner-Gasse 8/10, 1220 Wien	179,89 m^2	2	50,09 m^2	0,00 m^2	5,28 m^2	18,95 m^2	0,00 m^2	10,04 m		2,50 m		
33	Eduard-Gaertner-Gasse 8/11, 1220 Wien	181,79 m^2	2	49,53 m^2	5,79 m^2	9,75 m^2	37,35 m^2	0,00 m^2	10,17 m		2,50 m		
34	Eduard-Gaertner-Gasse 8/12, 1220 Wien	178,96 m^2	2	49,31 m^2	0,00 m^2	5,51 m^2	41,98 m^2	0,00 m^2	10,04 m		2,50 m		
35	Eduard-Gaertner-Gasse 8/13, 1220 Wien	181,65 m^2	2	51,03 m^2	0,00 m^2	5,51 m^2	36,32 m^2	0,00 m^2	10,20 m		2,50 m		
36	Eduard-Gaertner-Gasse 8/14, 1220 Wien	186,58 m^2	2	48,82 m^2	0,00 m^2	6,56 m^2	44,71 m^2	0,00 m^2	10,46 m		2,50 m		203,734
37	Mittelfeldweg 38A, 1220 Wien	239,23 m^2	2	62,51 m^2	11,10 m^2	19,57 m^2	48,58 m^2	0,00 m^2	8,67 m		12,00 m		
38	Mittelfeldweg 40, 1220 Wien	244,34 m^2	2	64,01 m^2	11,30 m^2	18,53 m^2	74,41 m^2	0,00 m^2	8,67 m		12,00 m		
39	Mittelfeldweg 40A, 1220 Wien	236,80 m^2	2	63,56 m^2	11,23 m^2	22,55 m^2	96,33 m^2	8,72 m^2	8,66 m		12,00 m		
40	Mittelfeldweg 42, 1220 Wien	235,40 m^2	2	63,86 m^2	11,33 m^2	18,18 m^2	72,56 m^2	7,85 m^2	8,52 m		12,00 m		
41	Mittelfeldweg 42A, 1220 Wien	301,43 m^2	2	67,61 m^2	19,22 m^2	2,96 m^2	69,23 m^2	0,00 m^2	12,21 m	25,15 m	12,00 m	7,40 m	13,16 m^2

Table B7. Data Collection: Conventional Semi-detached Houses.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

URBAN SPRAWL			
habitable area	adjoining area	inhabitants per 1000 m^2	area of impact
114,71 m^2	77,23	4,93	426,23 m^2
111,72 m^2	69,07	7,64	267,97 m^2
113,49 m^2	77,54	7,24	286,95 m^2
111,33 m^2	74,07	7,22	282,26 m^2
112,52 m^2	78,83	7,35	280,51 m^2
115,28 m^2	75,41	7,35	287,10 m^2
114,60 m^2	75,62	7,34	285,85 m^2
109,53 m^2	72,92	7,36	272,63 m^2
113,39 m^2	74,46	7,30	284,34 m^2
112,86 m^2	75,15	7,38	280,20 m^2
112,16 m^2	73,41	7,50	273,91 m^2
114,18 m^2	74,06	7,32	285,86 m^2
106,40 m^2	66,10	6,47	301,13 m^2
103,23 m^2	69,14	4,73	399,57 m^2
162,82 m^2	65,13	14,85	200,87 m^2
169,35 m^2	70,42	16,11	192,50 m^2
168,60 m^2	70,40	14,55	212,23 m^2
170,59 m^2	68,24	10,85	288,01 m^2
170,24 m^2	71,33	14,77	211,05 m^2
170,14 m^2	72,37	10,97	284,08 m^2
173,30 m^2	69,32	10,67	297,54 m^2
161,07 m^2	70,68	7,19	410,39 m^2
78,82 m^2	43,78	3,86	374,06 m^2
78,96 m^2	43,85	7,47	193,56 m^2
79,20 m^2	43,97	7,40	195,98 m^2
79,48 m^2	44,18	7,20	202,14 m^2
73,64 m^2	41,26	6,86	196,60 m^2
73,46 m^2	40,80	6,95	193,64 m^2
74,59 m^2	45,21	6,08	224,60 m^2
73,78 m^2	40,84	6,14	220,19 m^2
74,49 m^2	41,20	7,02	194,32 m^2
75,13 m^2	41,52	7,15	192,44 m^2
78,64 m^2	44,46	7,41	194,50 m^2
73,96 m^2	41,12	7,07	191,51 m^2
76,55 m^2	42,41	7,21	194,41 m^2
73,23 m^2	41,54	6,72	199,65 m^2
102,09 m^2	61,55	6,42	291,26 m^2
104,49 m^2	61,90	6,46	296,35 m^2
103,76 m^2	64,58	6,58	288,77 m^2
104,28 m^2	61,53	6,67	286,50 m^2
115,82 m^2	52,92	4,53	467,75 m^2

Table B8. Urban Sprawl: Conventional Semi-detached Houses; Sources: STATISTIK AUSTRIA, 2023 and Ausbauverhältnis, 2016.

SOIL SEALING					
built	BCR	covered	SCR	BCR+SCR	street share
102,97 m^2	28,52%	43,64 m^2	12,08%	40,60%	65,14 m^2
92,09 m^2	42,14%	71,08 m^2	32,52%	74,66%	49,43 m^2
103,38 m^2	44,13%	57,27 m^2	24,45%	68,58%	52,69 m^2
98,76 m^2	43,05%	69,33 m^2	30,22%	73,26%	52,83 m^2
105,10 m^2	46,02%	56,56 m^2	24,77%	70,79%	52,15 m^2
100,54 m^2	43,00%	38,55 m^2	16,49%	59,48%	53,26 m^2
100,82 m^2	43,36%	41,45 m^2	17,83%	61,19%	53,35 m^2
97,23 m^2	43,87%	28,14 m^2	12,70%	56,57%	51,02 m^2
99,28 m^2	42,93%	86,04 m^2	37,20%	80,13%	53,06 m^2
100,20 m^2	44,06%	42,83 m^2	18,83%	62,89%	52,77 m^2
97,88 m^2	44,22%	43,91 m^2	19,84%	64,05%	52,55 m^2
98,74 m^2	42,25%	52,58 m^2	22,50%	64,75%	52,16 m^2
88,13 m^2	36,22%	51,44 m^2	21,14%	57,37%	57,84 m^2
92,19 m^2	28,46%	60,18 m^2	18,58%	47,04%	75,67 m^2
86,84 m^2	43,23%	42,71 m^2	21,26%	64,49%	0,00 m^2
93,89 m^2	48,78%	34,78 m^2	18,07%	66,84%	0,00 m^2
93,87 m^2	47,51%	33,72 m^2	17,07%	64,58%	14,68 m^2
90,98 m^2	31,59%	36,72 m^2	12,75%	44,34%	0,00 m^2
95,11 m^2	48,38%	60,14 m^2	30,59%	78,98%	14,49 m^2
96,49 m^2	33,97%	46,66 m^2	16,43%	50,39%	0,00 m^2
92,43 m^2	44,17%	56,01 m^2	26,76%	70,93%	88,28 m^2
94,23 m^2	30,60%	32,91 m^2	10,69%	41,28%	102,40 m^2
58,38 m^2	32,13%	45,49 m^2	25,04%	57,17%	192,39 m^2
58,46 m^2	32,29%	26,54 m^2	14,66%	46,95%	12,50 m^2
58,62 m^2	31,98%	24,86 m^2	13,56%	45,54%	12,66 m^2
58,90 m^2	31,07%	52,90 m^2	27,90%	58,97%	12,55 m^2
55,01 m^2	29,93%	29,28 m^2	15,93%	45,86%	12,81 m^2
54,40 m^2	30,02%	13,56 m^2	7,48%	37,50%	12,45 m^2
60,28 m^2	32,91%	39,98 m^2	21,83%	54,74%	41,44 m^2
54,45 m^2	30,29%	23,95 m^2	13,32%	43,61%	40,41 m^2
54,93 m^2	30,24%	25,81 m^2	14,21%	44,44%	12,65 m^2
55,36 m^2	30,78%	18,95 m^2	10,53%	41,31%	12,55 m^2
65,07 m^2	35,79%	37,35 m^2	20,55%	56,34%	12,71 m^2
54,82 m^2	30,63%	41,98 m^2	23,46%	54,09%	12,55 m^2
56,54 m^2	31,13%	36,32 m^2	19,99%	51,12%	12,76 m^2
55,38 m^2	29,68%	44,71 m^2	23,97%	53,65%	13,08 m^2
93,18 m^2	38,95%	48,58 m^2	20,31%	59,26%	52,03 m^2
93,83 m^2	38,40%	74,41 m^2	30,45%	68,86%	52,01 m^2
97,34 m^2	41,10%	100,69 m^2	42,52%	83,63%	51,97 m^2
93,37 m^2	39,66%	76,49 m^2	32,49%	72,15%	51,10 m^2
89,78 m^2	29,79%	69,23 m^2	22,97%	52,75%	166,33 m^2

Table B9. Soil Sealing: Conventional Semi-detached Houses.

Data Collected on Conventional Row Houses:

		PLOT	BUILT				COVERED						
nr.	adress	plot size	floors	main building	annex	seperate buildings	other sealed area	open for infiltration	property line 1	property line 2	steet width 1	steet width 2	geen
1	Hermann-Plackholm-Gasse 1, 1220 Wien	285,91 m²	2,5	94,64 m²	0,00 m²	3,43 m²	16,20 m²	0,00 m²	28,35 m	11,11 m	10,85 m	4,85 m	
2	Hermann-Plackholm-Gasse 2, 1220 Wien	156,68 m²	2,5	83,12 m²	0,00 m²	3,14 m²	16,64 m²	0,00 m²	6,02 m		10,85 m		
3	Hermann-Plackholm-Gasse 3, 1220 Wien	157,32 m²	2,5	83,56 m²	0,00 m²	0,00 m²	16,81 m²	0,00 m²	6,05 m		10,85 m		
4	Hermann-Plackholm-Gasse 4, 1220 Wien	152,73 m²	2,5	80,90 m²	0,00 m²	0,00 m²	16,47 m²	0,00 m²	5,85 m		10,85 m		
5	Hermann-Plackholm-Gasse 5, 1220 Wien	171,60 m²	2,5	92,47 m²	0,00 m²	0,00 m²	16,03 m²	0,00 m²	5,88 m		10,85 m		
6	Hermann-Plackholm-Gasse 6, 1220 Wien	219,46 m²	2,5	96,30 m²	0,00 m²	0,00 m²	14,77 m²	0,00 m²	9,24 m		10,85 m		
7	Hermann-Plackholm-Gasse 7, 1220 Wien	153,21 m²	2,5	81,09 m²	0,00 m²	0,00 m²	17,54 m²	0,00 m²	5,87 m		10,85 m		
8	Hermann-Plackholm-Gasse 8, 1220 Wien	153,49 m²	2,5	81,39 m²	0,00 m²	0,00 m²	17,87 m²	0,00 m²	5,93 m		10,85 m		
9	Hermann-Plackholm-Gasse 9, 1220 Wien	226,69 m²	2,5	93,20 m²	18,50 m²	6,77 m²	18,50 m²	0,00 m²	8,80 m		10,85 m		
10	Grossmannstraße 1/7, 1220 Wien	162,63 m²	2,5	90,00 m²	0,00 m²	0,00 m²	14,74 m²	0,00 m²	8,48 m	21,74 m	9,85 m	10,84 m	
11	Grossmannstraße 1/8, 1220 Wien	156,24 m²	2,5	89,03 m²	0,00 m²	3,04 m²	12,38 m²	0,00 m²	7,23 m		9,85 m		
12	Grossmannstraße 1/9, 1220 Wien	153,11 m²	2,5	80,49 m²	0,00 m²	6,40 m²	23,99 m²	8,16 m²	7,19 m		9,85 m		
13	Grossmannstraße 1/10, 1220 Wien	153,17 m²	2,5	89,18 m²	0,00 m²	0,00 m²	15,80 m²	0,00 m²	7,12 m		9,85 m		
14	Grossmannstraße 1/11, 1220 Wien	187,51 m²	2,5	89,74 m²	0,00 m²	0,00 m²	40,13 m²	0,00 m²	8,91 m		9,85 m		
15	Grossmannstraße 1/12, 1220 Wien	182,46 m²	2,5	89,43 m²	0,00 m²	0,00 m²	28,26 m²	0,00 m²	8,80 m		9,85 m		
16	Grossmannstraße 1/13, 1220 Wien	149,43 m²	2,5	79,36 m²	0,00 m²	0,00 m²	36,28 m²	0,00 m²	7,19 m		9,85 m		
17	Grossmannstraße 1/14, 1220 Wien	151,35 m²	2,5	88,77 m²	0,00 m²	0,00 m²	7,86 m²	30,67 m²	7,19 m		9,85 m		
18	Grossmannstraße 1/15, 1220 Wien	175,75 m²	2,5	89,32 m²	0,00 m²	2,42 m²	36,26 m²	0,00 m²	8,40 m		9,85 m		150,5215
19	An der Neurisse 9/1, 1220 Wien	94,14 m²	2,5	65,64 m²	0,00 m²	0,00 m²	6,79 m²	0,00 m²	17,73 m	5,52 m	3,20 m	8,14 m	
20	An der Neurisse 9/2, 1220 Wien	97,17 m²	2,5	68,00 m²	0,00 m²	0,00 m²	7,71 m²	0,00 m²	5,72 m	5,72 m	3,20 m	8,14 m	
21	An der Neurisse 9/3, 1220 Wien	98,75 m²	2,5	70,04 m²	0,00 m²	0,00 m²	11,12 m²	0,00 m²	5,62 m	5,62 m	3,20 m	8,14 m	
22	An der Neurisse 9/4, 1220 Wien	93,72 m²	2,5	65,96 m²	0,00 m²	0,00 m²	8,64 m²	0,00 m²	5,52 m	5,52 m	3,20 m	8,14 m	
23	An der Neurisse 9/5, 1220 Wien	96,45 m²	2,5	65,64 m²	0,00 m²	0,00 m²	7,61 m²	0,00 m²	5,57 m	5,57 m	3,20 m	8,14 m	
24	An der Neurisse 9/6, 1220 Wien	175,46 m²	2,5	69,33 m²	16,61 m²	4,61 m²	0,00 m²	0,00 m²	5,68 m	14,16 m	6,50 m	3,20 m	
25	An der Neurisse 9/7, 1220 Wien	112,95 m²	2,5	69,25 m²	0,00 m²	2,61 m²	16,25 m²	0,00 m²	5,68 m		6,50 m		
26	An der Neurisse 9/8, 1220 Wien	110,24 m²	2,5	67,56 m²	0,00 m²	0,00 m²	14,84 m²	0,00 m²	5,54 m		6,50 m		
27	An der Neurisse 9/9, 1220 Wien	108,35 m²	2,5	66,35 m²	0,00 m²	0,00 m²	12,63 m²	0,00 m²	5,44 m		6,50 m		
28	An der Neurisse 9/10, 1220 Wien	109,69 m²	2,5	67,14 m²	0,00 m²	0,00 m²	9,25 m²	0,00 m²	5,50 m	19,95 m	6,50 m	2,00 m	
29	An der Neurisse 9/11, 1220 Wien	169,81 m²	2,5	72,17 m²	0,00 m²	10,39 m²	23,27 m²	0,00 m²	5,87 m	19,58 m	7,50 m	2,00 m	
30	An der Neurisse 9/12, 1220 Wien	147,31 m²	2,5	68,88 m²	18,58 m²	9,84 m²	0,00 m²	0,00 m²	5,60 m		7,50 m		
31	An der Neurisse 9/13, 1220 Wien	134,75 m²	2,5	67,85 m²	0,00 m²	0,00 m²	11,68 m²	0,00 m²	5,52 m		7,50 m		
32	An der Neurisse 9/14, 1220 Wien	123,57 m²	2,5	67,34 m²	0,00 m²	0,00 m²	9,59 m²	0,00 m²	5,48 m		7,50 m		
33	An der Neurisse 9/15, 1220 Wien	115,98 m²	2,5	68,78 m²	0,00 m²	0,00 m²	19,39 m²	0,00 m²	5,60 m		7,50 m		
34	An der Neurisse 9/16, 1220 Wien	148,56 m²	2,5	68,00 m²	0,00 m²	0,00 m²	12,38 m²	0,00 m²	5,62 m		6,00 m		
35	An der Neurisse 9/17, 1220 Wien	137,00 m²	2,5	67,61 m²	0,00 m²	0,00 m²	9,48 m²	0,00 m²	5,58 m		6,00 m		
36	An der Neurisse 9/18, 1220 Wien	127,01 m²	2,5	67,92 m²	0,00 m²	0,00 m²	12,38 m²	0,00 m²	5,61 m		6,00 m		
37	An der Neurisse 9/19, 1220 Wien	113,32 m²	2,5	66,08 m²	9,98 m²	0,00 m²	0,00 m²	0,00 m²	5,45 m		6,00 m		
38	An der Neurisse 9/20, 1220 Wien	149,66 m²	2,5	64,48 m²	14,41 m²	0,00 m²	0,00 m²	38,73 m²	5,65 m		5,00 m		
39	An der Neurisse 9/21, 1220 Wien	132,95 m²	2,5	67,28 m²	0,00 m²	5,09 m²	12,60 m²	0,00 m²	5,48 m		5,00 m		
40	An der Neurisse 9/22, 1220 Wien	127,36 m²	2,5	68,63 m²	0,00 m²	0,00 m²	7,26 m²	0,00 m²	5,59 m		5,00 m		
41	An der Neurisse 9/23, 1220 Wien	110,33 m²	2,5	65,26 m²	0,00 m²	0,00 m²	13,83 m²	0,00 m²	5,39 m		5,00 m		192,34 m²

Table B10. Data Collection: Conventional Row Houses.

TU Bibliothek Your knowledge hub WIEN
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

URBAN SPRAWL			
habitable area	adjoining area	inhabitants per 1000 m^2	area of impact
177,45 m^2	73,55	6,96	466,65 m^2
155,85 m^2	64,70	15,08	189,34 m^2
156,68 m^2	62,67	15,09	190,14 m^2
151,69 m^2	60,68	15,06	184,47 m^2
173,38 m^2	69,35	15,60	203,50 m^2
180,56 m^2	72,23	12,27	269,59 m^2
152,04 m^2	60,82	15,05	185,05 m^2
152,61 m^2	61,04	15,05	185,66 m^2
188,63 m^2	74,98	12,59	274,43 m^2
168,76 m^2	67,50	9,59	322,23 m^2
166,92 m^2	69,05	15,94	191,82 m^2
150,91 m^2	65,16	14,66	188,52 m^2
167,22 m^2	66,89	16,27	188,22 m^2
168,26 m^2	67,30	13,32	231,37 m^2
167,69 m^2	67,08	13,60	225,80 m^2
148,80 m^2	59,52	14,75	184,83 m^2
166,45 m^2	66,58	16,32	186,78 m^2
167,47 m^2	68,80	14,13	217,11 m^2
123,07 m^2	49,23	15,55	144,99 m^2
127,50 m^2	51,00	18,01	129,63 m^2
131,32 m^2	52,53	18,41	130,63 m^2
123,67 m^2	49,47	18,12	125,03 m^2
123,07 m^2	49,23	17,61	128,03 m^2
142,45 m^2	55,46	12,05	216,59 m^2
129,85 m^2	53,90	18,10	131,40 m^2
126,67 m^2	50,67	18,09	128,23 m^2
124,40 m^2	49,76	18,08	126,01 m^2
125,88 m^2	50,35	15,63	147,52 m^2
135,32 m^2	61,92	11,72	211,40 m^2
143,09 m^2	59,04	15,57	168,32 m^2
127,22 m^2	50,89	14,99	155,45 m^2
126,27 m^2	50,51	16,05	144,12 m^2
128,97 m^2	51,59	17,24	136,97 m^2
127,50 m^2	51,00	14,12	165,41 m^2
126,77 m^2	50,71	15,10	153,74 m^2
127,35 m^2	50,94	16,22	143,83 m^2
131,39 m^2	49,56	18,56	129,68 m^2
131,72 m^2	48,36	14,73	163,79 m^2
126,14 m^2	54,27	15,76	146,63 m^2
128,68 m^2	51,47	16,68	141,32 m^2
122,36 m^2	48,94	18,10	123,80 m^2

Table B11. Urban Sprawl: Conventional Row Houses; Sources: STATISTIK AUS¬TRIA, 2023 and Ausbauverhältnis, 2016.

SOIL SEALING					
built	BCR	covered	SCR	BCR+SCR	street share
98,07 m^2	34,30%	16,20 m^2	5,67%	39,97%	180,74 m^2
86,26 m^2	55,05%	16,64 m^2	10,62%	65,68%	32,66 m^2
83,56 m^2	53,11%	16,81 m^2	10,69%	63,80%	32,82 m^2
80,90 m^2	52,97%	16,47 m^2	10,78%	63,75%	31,74 m^2
92,47 m^2	53,89%	16,03 m^2	9,34%	63,23%	31,90 m^2
96,30 m^2	43,88%	14,77 m^2	6,73%	50,61%	50,13 m^2
81,09 m^2	52,93%	17,54 m^2	11,45%	64,38%	31,84 m^2
81,39 m^2	53,03%	17,87 m^2	11,64%	64,67%	32,17 m^2
118,47 m^2	52,26%	18,50 m^2	8,16%	60,42%	47,74 m^2
90,00 m^2	55,34%	14,74 m^2	9,06%	64,40%	159,60 m^2
92,06 m^2	58,93%	12,38 m^2	7,92%	66,85%	35,58 m^2
86,88 m^2	56,75%	28,07 m^2	18,33%	75,08%	35,42 m^2
89,18 m^2	58,22%	15,80 m^2	10,32%	68,54%	35,05 m^2
89,74 m^2	47,86%	40,13 m^2	21,40%	69,26%	43,86 m^2
89,43 m^2	49,02%	28,26 m^2	15,49%	64,50%	43,34 m^2
79,36 m^2	53,11%	36,28 m^2	24,28%	77,39%	35,40 m^2
88,77 m^2	58,65%	23,20 m^2	15,33%	73,98%	35,43 m^2
91,73 m^2	52,19%	36,26 m^2	20,63%	72,83%	41,36 m^2
65,64 m^2	69,72%	6,79 m^2	7,21%	76,94%	50,84 m^2
68,00 m^2	69,98%	7,71 m^2	7,93%	77,91%	32,46 m^2
70,04 m^2	70,93%	11,12 m^2	11,26%	82,19%	31,89 m^2
65,96 m^2	70,38%	8,64 m^2	9,22%	79,60%	31,31 m^2
65,64 m^2	68,05%	7,61 m^2	7,89%	75,94%	31,58 m^2
90,55 m^2	51,61%	0,00 m^2	0,00%	51,61%	41,13 m^2
71,86 m^2	63,62%	16,25 m^2	14,39%	78,01%	18,45 m^2
67,56 m^2	61,28%	14,84 m^2	13,46%	74,75%	18,00 m^2
66,35 m^2	61,24%	12,63 m^2	11,66%	72,89%	17,67 m^2
67,14 m^2	61,21%	9,25 m^2	8,43%	69,64%	37,83 m^2
82,56 m^2	48,62%	23,27 m^2	13,70%	62,32%	41,58 m^2
97,30 m^2	66,05%	0,00 m^2	0,00%	66,05%	21,01 m^2
67,85 m^2	50,35%	11,68 m^2	8,67%	59,02%	20,70 m^2
67,34 m^2	54,50%	9,59 m^2	7,76%	62,26%	20,54 m^2
68,78 m^2	59,31%	19,39 m^2	16,72%	76,02%	21,00 m^2
68,00 m^2	45,77%	12,38 m^2	8,33%	54,10%	16,85 m^2
67,61 m^2	49,35%	9,48 m^2	6,92%	56,27%	16,74 m^2
67,92 m^2	53,47%	12,38 m^2	9,75%	63,22%	16,82 m^2
76,06 m^2	67,12%	0,00 m^2	0,00%	67,12%	16,36 m^2
78,90 m^2	52,72%	19,37 m^2	12,94%	65,65%	14,13 m^2
72,36 m^2	54,43%	12,60 m^2	9,48%	63,91%	13,69 m^2
68,63 m^2	53,89%	7,26 m^2	5,70%	59,59%	13,96 m^2
65,26 m^2	59,15%	13,83 m^2	12,54%	71,68%	13,47 m^2

Table B12. Soil Sealing: Conventional Row Houses.

TU WIEN Bibliothek Your knowledge hub
Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

Descriptive statistics of all four datasets, provided by a colleague from Data Science master's program and basis of graphs used in section 5.1.1.

```
   address              type             plot.size         floors       main.building    main_building_2       annex
 Length:164         Length:164         Min.   : 93.72   Min.   :1.000   Min.   :  0.00   Min.   : 0.000   Min.   :  0.000
 Class :character   Class :character   1st Qu.:181.53   1st Qu.:1.000   1st Qu.: 47.25   1st Qu.: 0.000   1st Qu.:  0.000
 Mode  :character   Mode  :character   Median :303.12   Median :2.000   Median : 69.07   Median : 0.000   Median :  0.000
                                       Mean   :368.88   Mean   :1.837   Mean   : 68.88   Mean   :11.998   Mean   :  3.746
                                       3rd Qu.:519.06   3rd Qu.:2.500   3rd Qu.: 89.94   3rd Qu.: 5.925   3rd Qu.:  0.000
                                       Max.   :973.43   Max.   :3.000   Max.   :165.29   Max.   :85.060   Max.   :104.490

 seperate.buildings other.sealed.area open.for.infiltration property.line.1 property.line.2 steet.width.1    steet.width.2
 Min.   : 0.00      Min.   :  0.00    Min.   : 0.000       Min.   : 0.000  Min.   : 0.000  Min.   : 0.000  Min.   : 0.000
 1st Qu.: 0.00      1st Qu.: 21.75    1st Qu.: 0.000       1st Qu.: 7.822  1st Qu.: 0.000  1st Qu.: 3.500  1st Qu.: 0.000
 Median : 4.13      Median : 44.40    Median : 0.000       Median :13.990  Median : 0.000  Median : 6.000  Median : 0.000
 Mean   :10.34      Mean   : 51.55    Mean   : 3.233       Mean   :13.962  Mean   : 4.083  Mean   : 6.316  Mean   : 1.690
 3rd Qu.:18.27      3rd Qu.: 71.40    3rd Qu.: 0.000       3rd Qu.:20.427  3rd Qu.: 5.534  3rd Qu.: 8.600  3rd Qu.: 2.125
 Max.   :64.13      Max.   :158.01    Max.   :43.450       Max.   :39.790  Max.   :31.323  Max.   :12.000  Max.   :20.000

     green          habitable.area   adjoining.area    inhabitants.per.1000.m. area.of.impact        built             BCR
 Min.   :  0.000   Min.   : 17.77   Min.   :  2.933   Min.   : 0.3554         Min.   : 123.8   Min.   :  3.91   Min.   :0.0074
 1st Qu.:  0.000   1st Qu.: 73.40   1st Qu.: 40.169   1st Qu.: 1.9800         1st Qu.: 198.9   1st Qu.: 53.56   1st Qu.:0.1316
 Median :  0.000   Median :113.44   Median : 60.746   Median : 6.3396         Median : 376.6   Median : 84.41   Median :0.3059
 Mean   :  6.148   Mean   :110.78   Mean   : 59.417   Mean   : 7.1606         Mean   : 427.6   Mean   : 82.73   Mean   :0.3078
 3rd Qu.:  0.000   3rd Qu.:151.10   3rd Qu.: 74.859   3rd Qu.:12.1009         3rd Qu.: 560.6   3rd Qu.:101.36   3rd Qu.:0.4760
 Max.   :203.734   Max.   :342.45   Max.   :157.988   Max.   :18.5556         Max.   :1188.6   Max.   :234.89   Max.   :0.7093

    covered            OCR             BCR.OCR         street.share
 Min.   :  0.00   Min.   :0.0000   Min.   :0.0233   Min.   :  0.00
 1st Qu.: 23.25   1st Qu.:0.0948   1st Qu.:0.2808   1st Qu.: 29.05
 Median : 45.83   Median :0.1351   Median :0.4570   Median : 43.24
 Mean   : 53.16   Mean   :0.1498   Mean   :0.4576   Mean   : 58.74
 3rd Qu.: 74.01   3rd Qu.:0.1993   3rd Qu.:0.6413   3rd Qu.: 65.15
 Max.   :158.01   Max.   :0.4252   Max.   :0.8363   Max.   :344.51
```

Table B13. Descriptive Statistics of all Data Sets.

Appendix C. Survey Data

This Appendix contains all survey questions and answers collected. Outliers, such as incomplete or inconsistent responses, were removed using strikethrough.

The following survey is part of a master thesis project in the field of architecture. It serves to better understand the desire of becoming a homeowner and therefore specifically focuses on learning from your individual expectations. Please note that even if you already are a homeowner, it is important to relate the answers to your desired housing concept, not your current home or development. The survey is completely anonymous and there are no right or wrong answers. It takes about 5 minutes to complete the questionnaire.

participant	timestamp	00. Please select the language you are most comfortable using.
1	09.04.2023 12:03:09	German
2	09.04.2023 13:31:11	German
3	11.04.2023 18:21:33	German
4	11.04.2023 18:25:25	German
5	11.04.2023 18:28:29	German
6	11.04.2023 18:52:47	German
7	11.04.2023 20:21:54	German
8	11.04.2023 21:40:55	German
9	11.04.2023 23:11:27	German
10	12.04.2023 13:37:00	German
11	12.04.2023 15:51:20	German
12	13.04.2023 19:52:16	German
13	13.04.2023 20:54:39	German
14	13.04.2023 21:09:16	German
15	14.04.2023 07:12:18	German
16	14.04.2023 10:55:08	German
17	17.04.2023 20:59:23	German
18	18.04.2023 08:41:19	German
19	18.04.2023 09:16:33	German
20	21.04.2023 12:27:21	German

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

1. What expectations convince you to become a homeowner and which qualities matter most to you?										
proximity to nature	growing my own fruits and vegetables	community open spaces	peace and quiet	my kids having more freedom when growing up	my kids having friends to play with in the neighbourhood	schools within walking distance	the possibility of getting to work by public transport	the sense of feeling at home and putting down roots	being able to adapt my house to my individual preferences	1.1. Are there any other factors that play a role in your decision?
very important	fairly important	fairly important	ziemlich wichig	very important	fairly important	ziemlich wichig	ziemlich wichig	very important	very important	~~proximity to shops~~
ziemlich wichig	not at all important	fairly important	ziemlich wichig	not at all important	not at all important	ziemlich wichig	very important	very important	ziemlich wichig	
ziemlich wichig	very important	slightly important	very important	very important	very important	slightly important	slightly important	slightly important	very important	
ziemlich wichig	very important	fairly important	very important	very important	very important	ziemlich wichig	very important	ziemlich wichig	very important	
fairly important	slightly important	not at all important	ziemlich wichig	very important	fairly important	very important	very important	ziemlich wichig	very important	
very important	very important	very important	very important	very important	very important	fairly important	fairly important	very important	ziemlich wichig	
very important	very important	fairly important	ziemlich wichig	very important	fairly important	fairly important	ziemlich wichig	very important	very important	
very important	ziemlich wichig	ziemlich wichig	very important	very important	ziemlich wichig	ziemlich wichig	ziemlich wichig	very important	very important	
very important	ziemlich wichig	slightly important	very important	very important	fairly important	fairly important	slightly important	fairly important	very important	~~being noisy~~
very important	ziemlich wichig	very important	very important	very important	very important	ziemlich wichig	ziemlich wichig	very important	very important	
very important	very important	not at all important	very important	very important	very important	very important	very important	very important	very important	
fairly important	ziemlich wichig	slightly important	ziemlich wichig	ziemlich wichig	fairly important	fairly important	not at all important	very important	very important	
very important	slightly important	ziemlich wichig	very important	very important	very important	ziemlich wichig	not at all important	very important	ziemlich wichig	affordability after mortgage
ziemlich wichig	fairly important	fairly important	ziemlich wichig	very important	ziemlich wichig	ziemlich wichig	fairly important	ziemlich wichig	ziemlich wichig	safety for children
very important	fairly important	ziemlich wichig	very important	very important	very important	fairly important	ziemlich wichig	very important	very important	
very important	very important	slightly important	very important	ziemlich wichig	ziemlich wichig	very important	very important	very important	very important	
very important	fairly important	not at all important	very important	not at all important	not at all important	not at all important	very important	very important	very important	safety in neighborhood
ziemlich wichig	fairly important	very important	fairly important	fairly important	ziemlich wichig	fairly important	fairly important	fairly important	fairly important	
very important	very important	slightly important	very important	fairly important	fairly important	fairly important	ziemlich wichig	ziemlich wichig	very important	
very important	fairly important	ziemlich wichig	ziemlich wichig	very important	ziemlich wichig	ziemlich wichig	very important	ziemlich wichig	very important	

Picture yourself in the following situation:
You have decided to buy a house in the suburbs of a city or a town. Which are the qualities that you wish to find?

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

2. On a scale from 1-5: How important is neighbourhood community to you?	3. How would you rate the importance of the following community areas?									3.1. Can you think of any other common areas that you consider meaningful in your settlement?
	playarea	forest to build forts in	community garden	wildflower meadow	swimming pond	summer kitchen or bar	chicken coop	water cistern	compost	
3	important	very important	important	fairly important	important	important	fairly important	important	very important	
2	fairly important	not at all important	fairly important	very important	important	slightly important	not at all important	very important	important	
2	very important	fairly important	not at all important	important	slightly important	important	fairly important	important	important	
2	very important	very important	fairly important	very important	important	important	slightly important	very important	important	
3	fairly important	fairly important	not at all important	slightly important	fairly important	important	not at all important	slightly important	slightly important	
3	important	important	slightly important	fairly important	fairly important	fairly important	slightly important	fairly important	fairly important	
2	fairly important	very important	slightly important	fairly important	fairly important	fairly important	fairly important	fairly important	fairly important	
2	important	important	fairly important	important	important	fairly important	not at all important	important	important	
3	very important	important	very important	very important	important	very important	slightly important	slightly important	slightly important	
2	important	important	fairly important	important	slightly important	fairly important	fairly important	fairly important	important	
2	important	fairly important	fairly important	fairly important	fairly important	fairly important	slightly important	slightly important	fairly important	
2	important	important	important	fairly important	fairly important	very important	important	important	important	
1	very important	important	slightly important	not at all important	slightly important	important	not at all important	slightly important	not at all important	sport facilities
4	fairly important	important	slightly important	slightly important	not at all important	not at all important	not at all important	very important	not at all important	~~a pool car~~
2	fairly important	important	fairly important	slightly important	slightly important	fairly important	not at all important	slightly important	slightly important	
2	fairly important	important	fairly important	very important	very important	very important	very important	very important	very important	
4	not at all important	important	not at all important	important	fairly important	fairly important	not at all important	slightly important	important	
3	important	fairly important	not at all important	fairly important	slightly important	very important	not at all important	fairly important	fairly important	
2	important	very important	slightly important	very important	fairly important	fairly important	fairly important	fairly important	fairly important	sport facilities
3	fairly important	important	slightly important	fairly important	fairly important	fairly important	important	important	important	

Your neighborhood.

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.

4. Would you consider a smaller individual plot if it meant more space for several of the community areas mentioned above?	4.1. Which are the specific conditions?
no	
yes	
yes, under certain conditions	if I like my neighbors
yes, under certain conditions	if I still have enough privacy
no	
no	
yes	
yes, under certain conditions	
no	
yes	
no	
yes, under certain conditions	
yes, under certain conditions	undo agreements
no	
yes, under certain conditions	fair sharing of expenses
yes, under certain conditions	fair sharing of work
no	
no	
no	
yes	

Your property.

5. How many people do you want your house to accommodate?	6. How much living space should your house provide?	7. If you had to choose, would you rather have a garden or terrace of your own (in addition to community areas)?	7.1. If you decided to have a garden: How would you rate your preferred degree of separation between your garden and the area that you share with your neighbours?	7.2. If you decided to have a garden: Will you need a garden shed of your own?	7.3. If yes, can it be attached to or integrated into your main building?	7.4. Are there any other built structures that should be part of your private garden? What would those be?
4	between 100 and 120 m²	Private garden	bushes or trees	yes	yes	
2	between 100 and 120 m²	Private terrace	~~bushes or trees~~	~~yes~~	~~yes~~	~~a pavillon~~
4	between 100 and 120 m²	Private garden	fence or wall	yes	yes	
5+	between 120 and 150 m²	Private terrace				
4	between 120 and 150 m²	Private garden	bushes or trees	yes	yes	a pool
4	between 120 and 150 m²	Private garden	bushes or trees	yes	yes	
5+	more than 150 m²	Private garden	bushes or trees	no, I would share appliances		
5+	between 120 and 150 m²	Private garden	bushes or trees	no, I would share appliances	~~yes~~	
5+	more than 150 m²	Private garden	bushes or trees	yes	no	a garage
4	between 100 and 120 m²	Private garden	bushes or trees	yes	yes	
4	between 100 and 120 m²	Private garden	bushes or trees	yes	yes	
4	more than 150 m²	Private garden	bushes or trees	yes	yes	
5+	between 120 and 150 m²	Private garden	bushes or trees	no, I would share appliances	~~yes~~	~~no~~
4	between 120 and 150 m²	Private terrace	~~fence or wall~~			
4	between 120 and 150 m²	Private garden	bushes or trees	yes	yes	covered seating area
4	between 120 and 150 m²	Private garden	bushes or trees	no, I would share appliances	~~yes~~	
2	between 120 and 150 m²	Private terrace		~~yes~~	~~yes~~	~~raised garden bed~~
4	between 100 and 120 m²	Private garden	fence or wall	yes	yes	
4	between 100 and 120 m²	Private garden	bushes or trees	no, I would share appliances	~~yes~~	
4	between 120 and 150 m²	Private garden	bushes or trees	no, I would share appliances	~~yes~~	
	none:	none:	none:			
	less than 80 m²	I don't need any private outside spaces	I don't need a separation			
	between 80 and 100 m²					

8. If public transportation (travel time to work and leisure in around 30 minutes) and local supply were available within walking distance, how often would you need your car per week?	9. If additionally there was car sharing available within your settlement, how many cars would you and your family/spouse need?
I would not need a car	no private cars needed
a few times a week	one car
a few times a month	one car
a few times a month	one car
a few times a week	one car
a few times a month	one car
I would not need a car	no private cars needed
a few times a month	one car
a few times a week	one car
a few times a week	one car
a few times a month	one car
a few times a week	one car
a few times a month	one car
a few times a week	two or more cars
a few times a week	one car
a few times a month	one car
a few times a month	one car
a few times a week	two or more cars
a few times a month	no private cars needed
I would not need a car	no private cars needed
none:	
once a day	
more than once a day	

The accessibility of your home.

10. Is there anything else you would like to comment on or you think should be covered?	11. Please select your age group from the following options:
	20 - 30
~~pool & e-charging~~	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	20 - 30
	60+
	30 - 40
	20 - 30
	20 - 30
	50 - 60
	20 - 30
	20 - 30
	20 - 30

Many thanks!
I very much appreciate your time and effort in answering my questions. If you are interested in finding out about the results of my thesis, you are more than welcome to contact me at: stefanie.tischberger@gmail.com

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar
The approved original version of this thesis is available in print at TU Wien Bibliothek.
TU WIEN Bibliothek Your knowledge hub