CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Environmental Sciences

Enhancing urban sustainability through landscape architecture: a case study of Imperial Island in Prague

Bachelor Thesis

Supervisor: doc. Peter Kumble, Ph.D.

Advisor of thesis: Shima Yazdanmehr, Ph.D candidate

Author of thesis: Kazakova Mariia

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BACHELOR THESIS ASSIGNMENT

Mariia Kazakova

Environmental Engineering

Thesis title

Enhancing urban sustainability through sustainable landscape architecture: a case study of Imperial Island in Prague

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Objectives of thesis

This BEE thesis aims to analyze sustainable landscape architecture methods and practices applicable to urban environments. After analyzing the definition of sustainable landscape architecture and reviewing relevant literature, the Imperial Island located in Prague was chosen as a working site. The role of sustainable landscaping in urban growth will be studied in terms of the environment, social and economic advantages. The practical part of the study included a site analysis of the location, a public survey, and a proposed master plan that incorporates sustainable landscape architecture principles and practices. The public survey provides insights into the community's perceptions and expectations for a proposed design. The findings suggest that sustainable landscape architecture is an effective way to promote urban sustainability and enhance the quality of life in urban environments.

Methodology

This research will begin with a review of current definitions of sustainable landscape design, followed by an examination of basic principles and the most typical approaches employed in urban areas. The literature review will be used to establish a theoretical foundation for practical research.

A site analysis of the Imperial Island is conducted to identify potential areas for sustainable landscape architecture interventions, followed by a public survey to understand community expectations and perceptions of sustainable landscape architecture. Based on the findings, a master plan is proposed that incorporates sustainable landscape architecture principles.

The proposed extent of the thesis

50+ pages

Keywords

Sustainability, urban planning, landscape architecture, urban ecology, sustainable practices, green stormwater management, green infrastructure

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Recommended information sources

Cadenasso, M. L. (2008). Urban Principles for Ecological Landscape Design and Maintenance: Scientific Fundamentals. Cities and the Environment (CATE), Vol. 1: Iss. 2, Article 4

J. Morgan Grove, M. L. (2015). Expanding the Landscape: Applying Patch Dynamics to Social-Ecological Systems. B M. L. J. Morgan Grove, The Baltimore School of Urban Ecology: Space, Scale, and Time for the Study of Cities (стр. 38–76). Yale University Press

nternational Federation of Landscape Architects. (2020-2022). A Landscape Architectural Guide to the United Nations 17 Sustainable Development Goals. https://www.iflaeurope.eu/

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The Bachelor Thesis Supervisor

doc. Peter Kumble, Ph.D.

Supervising department

Department of Landscape and Urban Planning

Electronic approval: 29. 3. 2023

prof. Ing. Petr Sklenička, CSc.

Head of department

Electronic approval: 29. 3. 2023

prof. RNDr. Vladimír Bejček, CSc.

Dean

Prague on 29. 03. 2023

Declaration:

I hereby declare that I have independently elaborated the bachelor/final thesis with the topic of: "Enhancing urban sustainability through landscape architecture: a case study of Imperial Island in Prague" and that I have cited all of the information sources that I used in the thesis as listed at the end of the thesis in the list of used information sources.

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Prague, 20.03.2023

Kazakova Mariia

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Abstract

This BEE thesis aims to analyze sustainable landscape architecture methods and practices applicable to urban environments. After analyzing the definition of sustainable landscape architecture and reviewing relevant literature, the Imperial Island located in Prague was chosen as a working site. The role of sustainable landscaping in urban growth will be studied in terms of the environment, social and economic advantages. The practical part of the study included a site analysis of the Imperial Island, a public survey, and a proposed master plan that incorporates sustainable landscape architecture principles and practices. The public survey provides insights into the community's perceptions and expectations for the proposed design. The findings suggest that sustainable landscape architecture is an effective way to promote urban sustainability and enhance the quality of life in urban environments.

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Key words

“sustainability”, “urban planning”, “landscape architecture”, “urban ecology”, “sustainable practices”, “green stormwater management”, “green infrastructure”

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1 INTRODUCTION

As the world continues to develop and urbanize, the need for sustainable design practices becomes increasingly urgent. Sustainable landscape architecture (SLA) is a critical aspect of creating livable and healthy urban environments. It is a philosophy that aims to balance the built environment with the natural environment, while also considering social and economic factors.

The objective of SLA is to form a design that maximizes the quality of the built environment whereas minimizing or eliminating negative impacts. This could be accomplished through the utilize of naturally inviting materials, energy-efficient systems, and land use planning. The result is a design that not only benefits the environment but also enhances the well-being of individuals and communities.

The importance of SLA in urban areas cannot be overstated. As urban populations continue to grow, cities face a range of environmental, social, and economic challenges. Air and water pollution, heat islands, limited access to green space are just a few of the issues that plague urban areas. Sustainable landscape architecture can help address these issues by incorporating green spaces into cities, reducing the impact of buildings on the natural environment, and promoting sustainable alternatives.

This thesis aims to explore the principles and practices of SLA and their application in urban environments. By examining a case study, this paper will demonstrate the impact that sustainable design can have on the environment, society, and the economy. This research will contribute to the growing body of knowledge on sustainable design practices and help inform future efforts to create more natural and sustainable urban environments in Imperial Island, Prague.

2 OBJECTIVES OF THE THESIS

The objective of this BEE thesis is to analyze the concept of sustainable landscape architecture as well as sustainable methods in urbanized environments. The thesis comprises an analysis of the definition of sustainability in the field of landscape design, as well as detailed study of current practices. The research is based on a literature review.

Various practices and methods are reviewed and evaluated for their applicability to urban environments. A site analysis of the Imperial Island is conducted to identify potential areas for sustainable landscape architecture interventions, followed by a public survey to understand community expectations and perceptions of sustainable landscape architecture. The feasibility and applicability of the proposed master plan are evaluated, and potential challenges and limitations are identified. The study concludes with recommendations for future research and implementation of master plan for Imperial Island.

3 LITERATURE REVIEW

This chapter presents a theoretical analysis of the definition of sustainable landscape (SLA), with a progressive clarification of the fundamental principles, as well as a study of approaches applied in urban areas. It aims to combine environmental, social, and economic advantages. The concept of urban ecology and the model of Boland Sustainable Park were highlighted as fundamental for urban sustainability. By incorporating ecological concepts into landscape design, a framework for transforming landscapes to increase efficiency was established. These initiatives mean to create multifunctional landscapes, driven by a rapidly expanding knowledge base on ecological services offered by landscapes.

Permeable pavements, green stormwater infrastructures, and vertical greening systems are studied in considerable detail. This is an example of repurposing formerly disused pavements and vertical areas for landscaping purposes.

3.1 SUSTAINABLE LANDSCAPE ARCHITECTURE

The modern city dweller tends to develop and optimize the environment around to a level in which this area will save time and human resources. Therefore, in the literature can be found such definition as "landscape design is the art of developing a property for its greatest use and enjoyment" (Williams, 2006). It is an integration of architecture, nature science and philosophy into a design that adapts the area to human needs. However, with the development of sustainable planning, design becomes an essential part of the urban environment, while combining the city and nature. SLA is an important and growing field of study that focuses on the design, planning, management, and stewardship of land resources. Guided by the main definition of sustainability - it is achieved in a way that meets current needs while preserving natural ecosystems for future generations.

This idea is further supported by architect Jason F. McLennan, author of The Philosophy of Sustainable Design, who argues that design should combine art with environmental, physical, and biological sciences, focusing on open space. The goal of sustainable approach is to "eliminate negative environmental impacts completely through skillful, sensitive design" (McLennan, 2004). It requires the use of renewable resources, minimizing the impact on the environment, and integrating economic and social aspects.

There are many definitions for the term and purpose of SLA. It could focus on the aesthetic, social, or economic aspects of planning. However, it remains important to follow formal definitions and guidelines when designing urban spaces. The American Society of Landscape Architects (ASLA) highlights the importance of sustainable architecture approach in their climate mission (American Society of Landscape Architects, 2022). It pointed out that sustainable landscapes can “respond to the environment, regenerate, and actively contribute to healthy communities”. In addition to sequestering carbon, purifying

air and water, increasing energy efficiency, and restoring natural habitats, such landscapes also provide economic, social, and environmental benefits. It is crucial to recognize the value of sustainable architecture and understand that it can make a major contribution to the well-being of our planet and its inhabitants.

Furthermore, the International Federation of Landscape Architects (IFLA) has developed guidance and encouragement to the global professional community of landscape architects in their obligations to maintain and move toward sustainability. Landscape architecture, according to the authors, can have a significant impact on all 17 Sustainable Development Goals (International Federation of Landscape Architects, 2020-2022). It is an important tool for climate change mitigation. A good example of this is the use of native plants and trees in planting to improve soil flush capacity and reduce the risk of flooding.

3.1.1 Principles and applications of urban ecology concept

As reviewed in the previous section, SLA is the design of the urban space minimizing the negative impact on the environment while maintaining social and economic benefits. It aims to create a balance between the City and Nature.

The concept of urban ecology is a fundamental principle to guide sustainable planning. According to the (Cadenasso, 2008), it is the basis for organic landscape design and maintenance. Urban ecology includes five main principles that describe the structure of cities and ecological processes in it. According to the concept, the city is a dynamic heterogeneous ecosystem where human and natural processes interact.

The importance of this approach is expressed in the potential to transform the environmental functions of the city into ecosystem services. According to the (EASAC, 2009), ecosystem services are divided into four types: supporting, regulating, providing and cultural services. Ecosystem services can be called as benefits that people get from the environment and properly functioning ecosystems (agro-ecosystems and forestry, water ecosystems, etc.) free of charge. Every day the urban resident requires a great number of them: clean drinking water; decomposition and recycling of waste; production of food, medicine and building materials, and so on. The ecological functions of urban environments indicate perspectives and approaches to landscape design and practice that can improve the ecological resilience and function of urban systems.

The concept of urban ecology suggests that the interaction of human and natural processes should be considered as goals of SLA (Cadenasso, 2008). Design that meets only obvious urban planning criteria, such as recreation or economic benefits, misses an opportunity to contribute to ecosystem services. Key biological processes that affect the health and well-being of the city's residents must be supported. Sustainable projects

should focus on the restoration, preservation and creation of natural objects that can occur in the city.

However, city dynamics and constant transformation should be taken into account. It is an additional challenge for sustainable landscape architecture. In parallel to the development of the social structure of the city, events such as changes in economic features (manufacturing introduction, investments cut, etc.); upgrading of city technologies and infrastructure have an impact on the demands and potential approaches (J. Morgan Grove, 2015). Moreover, sustainable urban planning must also be prepared for climate change (Dizdaroglu, Developing Design Criteria for Sustainable Urban Parks, 2021), be able to adapt or prevent events such as floods, temperature extremes, heat island effects and so on.

This concept forms the basis for the theoretical framework of the urban ecology. Understanding the structure of the city as well as the principles of interaction between the city and nature is essential to developing a sustainable design plan.

Table 1 summarizes the general implications of the five principles of urban ecology for landscape design. It suggests that these principles should be considered to create a successful and sustainable landscape design. Specifically, the principles include the integration of natural and built environments, consideration of different spatial and temporal scales, understanding of ecological processes, recognition of the role of social systems, and the integration of ecological and cultural values. Each of these principles should be applied to create a sustainable urban landscape.

Table 1. A summary of the general implications of each of the five principles of urban ecology (Cadenasso, 2008)

Principle	**Summary of Implication for Landscape Design**
Cities are ecosystems	Design affects all four components of human ecosystems (Fig. 1)
Cities are heterogeneous	Design should enhance heterogeneity, and its ecological functions
Cities are dynamic	Design must accommodate internal and external changes projects can experience
Human and natural processes interact in cities	Design should recognize and plan for feedbacks between social and natural processes
Ecological processes remain important in cities	Remnant ecological processes yielding ecological services should be maintained or restored

3.1.2 Concept of Sustainable Park: A Fifth Model for Urban Parks

Various historical periods are regarded as the start of the development of a sustainable strategy. However, a solid definition of the concept of sustainable park began to arise in the late 1990s as one of the approaches to SLA. An important result is the (Boland, 2004) definition of "three general attributes of this new kind of park: (1) self-sufficiency regarding material resources and maintenance, (2) solving larger urban problems outside of park boundaries, and (3) creating new standards for aesthetics and landscape management in parks and other urban landscapes".

The concept of a sustainable park will be considered as the main one in this diploma research. Firstly, because of its apparent fundamentality and presence in many research papers as a reference. Secondly, due to its detailed approach and accurate answers to the question "How to define a sustainable urban space?"

To summarize the article's definition, a sustainable park is a public space that is self-sufficient from its design to its final stage. Moreover, a sustainable park has natural attributes, improving the overall ecological state of its surroundings. The use of native species of flora and fauna, the restoration of natural systems, or waste recycling are examples of the ecological opportunities available within an urban park. Such a plan is expected to play a major role in the integration of large urban landscapes and to serve as a link between the industrial and residential parts of the city.

	Pleasure Ground 1850–1900	**Reform Park 1900–1930**	**Recreation Facility 1930–1965**	**Open Space System 1965–?**	**Sustainable Park 1990–present**
Social Goal	Public health & social reform	Social reform; children's play; assimilation	Recreation service	Participation; revitalize city; stop riots	Human health; ecological health
Activities	Strolling, carriage racing, bike riding, picnics, rowing, classical music, non-didactic education	Supervised play, gymnastics, crafts, Americanization classes, dancing, plays & pageants	Active recreation: basketball, tennis, team sports, spectator sports, swimming	Psychic relief, free-form play, pop music, participatory arts	Strolling, hiking, biking, passive & active recreation, bird watching, education, stewardship
Size	Very Large, 1000+ acres	Small, city blocks	Small to medium, follow formulae	Varied, often small, irregular sites	Varied, emphasis on corridors
Relation to City	Set in contrast	Accepts urban patterns	Suburban	City is a work of art; network	Art-nature continuum; part of larger urban system; model for others
Order	Curvilinear	Rectilinear	Rectilinear	Both	Evolutionary aesthetic
Elements	Woodland & meadow, curving paths, placid water bodies, rustic structures, limited floral displays	Sandlots, playgrounds, rectilinear paths, swimming pools, field houses	Asphalt or grass play area, pools, rectilinear paths, standard play equipment	Trees, grass, shrubs, curving & rectilinear paths, water features for view, free-form play equipment	Native plants, permeable surfaces, ecological restoration green infrastructure, resource self-sufficiency
Promoters	Health reformers, transcendentalists, real estate interests	Social reformers, social workers, recreation workers	Politicians, bureaucrats, planners	Politicians, environmentalists, artists, designers	Environmentalists, local communities, volunteer groups, landscape architects
Beneficiaries	All city dwellers (intended), upper middle class (reality)	Children, immigrants, working class	Suburban families	Residents, workers, poor urban youth, middle class	Residents, wildlife, cities, planet

Figure 1. A Comparison of the Sustainable Park to Prior Park Types. Based on study of urban parks (Cranz 1982) (Boland, 2004)

3.1.2.1 Principle I: Resource Self-sufficiency.

According to presented concept the sustainable park differs from other urban park models in emphasizing self-sufficiency in material resources and the maintenance of natural processes. The sustainability of the park can be ensured through various strategies that aim to reduce the need for resources. The basic principles underlying existing practices are the use of native species, as well as natural adaptation to environmental conditions, such as the practice of "dry gardening" for example. Sustainable Park is designed to be as like the natural conditions of the region as feasible. The need to use native species is also expressed by (Peter M Vitousek, 1997). According to this study invasive species not only require additional investments in their maintenance, but also bring significant damage to the ecosystem and contribute to climate change.

Figure 2 The Dry Garden at Cambridge Botanic Garden, designer - Howard Rice. Source: gapphotos.fr

Fertilizer application, pesticide use, or mechanical cultivation are necessary practices to maintain artificial landscapes. These expend more resources than the use of native tree and plant species. There is limited study analyzing the economic impact of urban parks with different agricultural approaches. However, (Nazanin Hosseinpour, 2021) has identified the financial benefits of using urban agriculture practices in park design, showing long-term financial profitability. By choosing perennial plants, the annual costs of purchasing, planting, and maintaining annual flower beds are removed. Therefore, by implementing cost-effective and sustainable solutions, urban parks can save resources, which is one of their main concerns.

(Boland, 2004) identified systematic strategies for increasing resource self-sufficiency. It includes sustainable design, construction and maintenance practices, plant selection, composting, water harvesting, public-private partnerships, and community management. For example, composting is an increasingly important practice in maintaining an artificial landscape. It allows organic waste to be recycled into ecological fertilizer, reducing the cost of maintaining urban parks. It is a way of adapting a natural process within an urban environment. (Clarice Araújo Carvalho, 2022) underlined that it contributes to the

sustainable development of cities parks by "enhancing urban garden contribution and decentralize organic waste management".

3.1.2.2 Principle II: An Integrated Part of the Larger Urban System

Green infrastructure, including sustainable parks, can help solve problems in the urban environment. It applies to internal park functions, like creating biodiversity, maintaining clean water resources, or purifying the soil. It also affects problems beyond the park's boundaries by providing ecosystem services: urban air pollution control, lower air temperatures during summer, or meet social urban issues (accessible infrastructure, reclamation, health, and social well-being) (Tony Gore, 2013). However, green infrastructure must be integrated into the overall urban space, being a part of it, not an addition.

An important task of sustainable park planning is its integration into the city's infrastructure. Primarily it applies to the water system and roads. The common park landscape, which is mostly represented in cities, rarely acts as part of the urban infrastructure system. This is reflected in the separation of the stormwater systems, looped bikeways, and paths that are not connected to the city's central road network. Sustainable Parks changes this situation by using green space in urban runoff treatment and changes in road connectivity. An example of the application is the design of Jackson Bottom Park in Hillsboro, Oregon (Kazmi, 2012). It was based on a system of ponds that collected and treated urban wastewater as it passed through the park system. Water quality improvement involves creating a biodiversity-rich ecosystem. In this park, the pond system reduced the temperature value of the flow, which had a positive effect on the chemical quality of urban stream and reduced the need for urban water treatment. Economically, it functions as a critical trigger for the creation and application of natural systems in urban systems.

Moreover, according to the (Chris Pittner, Gordon Allerton, 2010) wetlands is the most sustainable concept for urban runoff treatment. It consists of a combined system of deep and shallow places. Thus, it allows a slowing down of the water flow, a purification through vegetation and sedimentation.

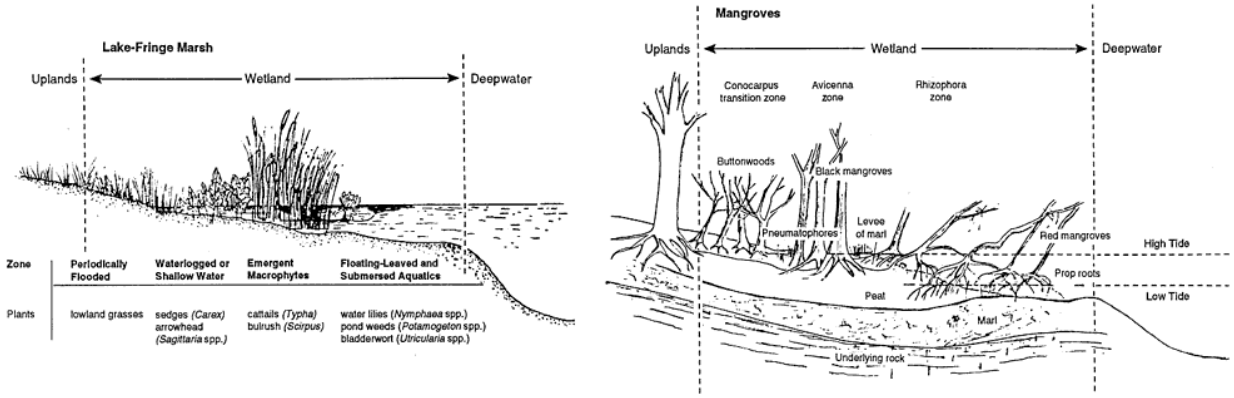


Figure 3 Zonation of vegetation in two common kinds of wetlands in urban environment (National Research Council, 1995).

One of the most important goals of sustainable design is to improve people's quality of life and health. This is not a new task. People in ancient Egypt already created therapeutic gardens that served medical and educational purposes. However, the increased interest in the natural and ecological approach in modern society has led to the development of the "Biophilia" hypothesis. It suggests that in every living organism there is a positive response to natural occurrences and their absence causes a mental disconnection with the environment around us. It leads to stress tension, increased exhaustion, and other psychological reactions of the body. Some recent studies show that the condition of modern cities has "potentially undesirable effects on health or quality of life due to the visual absence of plants and may be ameliorated by adding elements of Nature" (Bjørn Grinde, 2009). By integrating recreational activities into park planning and increasing green spaces, this problem can be addressed.

Urban isolation is a social problem solved by the creation of a sustainable park and the integration of society. This results in an improvement in the social well-being of the city. For example, participation in urban park design can create a sense of belonging and community. Sustainable Park is a place where people can meet, relax, spend time together and appreciate nature. The importance of this aspect is particularly evident in relation to sensitive members of the population, such as children and the elderly. By interviewing 91 older adults, (Byoung-Suk Kweon, 2007) shows that the attributes of open green spaces can play a role in the formation and maintenance of social connections. Green infrastructure is important for developing a sense of community and belonging, and therefore special attention should be given to keeping it in residential areas.

A sustainable park can also be integrated into the educational system, creating a community-nature connection. For example, seasonal plant care activities in the park can be used as learning activities for nearby schools and kindergartens. Larger outdoor green spaces in the city are often used for observation or research purposes among university

students. The term "Citizen Science" encompasses a wide range of initiatives at different scales (Michael J.O. Pocock., 2014).

3.1.2.3 Principle III: New Modes of Aesthetic Expression.

An important aspect of the stylistic transformation of a sustainable park is to change toward multifunctional materials. Just to name few, it can include the use of drought-tolerant, low-maintenance native flora; multifunctional pathways like permeable pavement or natural lumber, which is a natural protection against pests; park infrastructure made from recycled materials; rainwater collection spots for further irrigation, etc (Boland, 2004).

Therefore, a sustainable park is stylistically flexible. It can be a naturalistic or formalistic appearance that is created from long-lasting materials and technology. In this way, a definition of the sustainable park changes the approach to the stylistics of urban green space. It creates a new style of design in which the focus moves from the final visual solution of the park to the materials used in its creation. Such a park should be integrated into the environment and be not only part of the surrounding landscape, but also a tool that integrates natural, social, and financial needs (Dizdaroglu, Developing Design Criteria for Sustainable Urban Parks, 2021).

3.2 SUSTAINABLE PRACTICES IN LANDSCAPE ARCHITECTURE

This chapter will review the most used sustainable practices in landscape architecture. Most of the information, along with the techniques chosen, were obtained from the book “Green infrastructure” (Dover, 2015). A few examples of green infrastructures were also collected from the EPA website (EPA, 2022).

3.2.1 Permeable pavements

The ability of soil and vegetation cover to hold and filter water is lost in the modern urban landscape. The common use of impermeable surfaces (such as paved streets, roads, or parking lots) increases the pressures on urban drainage systems. It leads to urban flooding, reduced groundwater recharge, and degradation of the aquatic environment. Numerous pollutants accumulate in urban areas and can be transported by such impermeable surfaces. Permeable pavements have become widespread as a solution to the problem and as an alternative to traditional urban pavements. As defined by the (EPA, 2021) : " Permeable pavements are a stormwater control that allows stormwater to infiltrate through the surface of the pavement to the ground below."

Figure 4 Installations of the three test pavement types: permeable pavers, permeable concrete, and permeable asphalt (Upper Midwest Water Science Center , 2019)

A porous urban surface called permeable pavement is made from paving stones with open pores, concrete, or asphalt with a rock pool underneath. A permeable pavement collects surface runoff and silt, storing it in a reservoir where it slowly seeps into the ground or drains through a drainage tile. The basis of the permeable pavement is simple. It allows for technological and design variability when choosing a working approach.

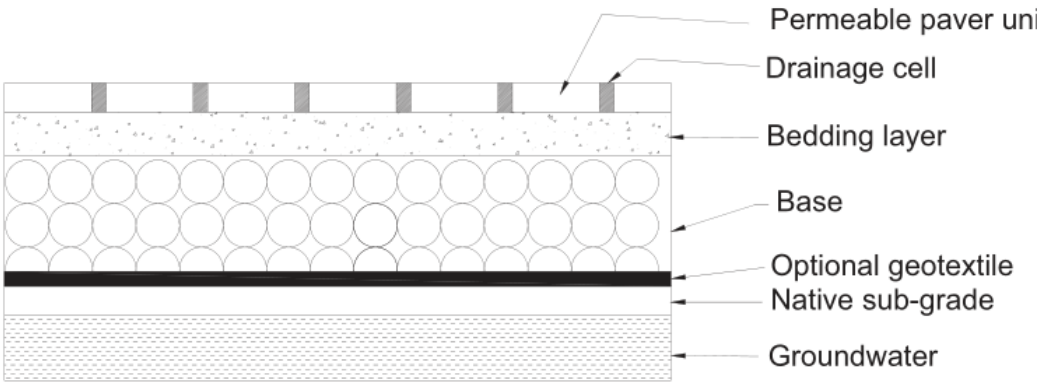


Figure 5 Typical schematic layout of a permeable pavement system. (Miklas Scholz, 2007)

Permeable pavements can be made from a range of materials, including permeable concrete, permeable asphalt, and permeable paving stones. Each material has its own unique characteristics and can be used in different applications. Summarizing the data in Chapter 4. Permeable pavements (Dover, 2015), the materials that can be used are:

- loose gravel: *a cheap and simple option, but one that has a tendency to disperse and act as an possible pollutant;*
- open concrete blocks or plastic blocks: *a version of permeable pavement in which plants reach the top layer and directly interact with the water masses. Not suitable for areas with heavy rainfall*
- permeable asphalt: *similar to classic asphalt in appearance but allows water to seep through pores in its structure. Typically used in pedestrian and vehicle areas, found an application in large open spaces in parks*
- porous concrete: *creates drainage paths due to its porous structure but allows less infiltration. Typically used in high-traffic areas, as a more resistant and long-lasting material.*
- permeable blocks: *they do not differ in appearance from the classic block pavement, but have the capability of infiltrating through the pores in the structure, as well as through the edges*

There is a variability in the colors, structures, and texture of permeable pavements, which allows the creation of various design solutions in an urban environment, enhancing the aesthetic appeal of the area. Existing restrictions cover the technological aspects of the environment, its structure, the techniques, as well as the natural aspects of the topography, like temperature and rainfall variations.

An important benefit is the overall effect on the runoff load. Such pavements significantly reduce the amount of stormwater runoff as well as increase infiltration into the soil. On the one hand, it decreases the quantity of water entering drainage systems and rivers by allowing water to permeate through the pavement. Furthermore, the water infiltrates into the soil, which reduces the need to irrigate the surrounding vegetation, as well as recharging the groundwater storage of the area. The quantity and quality of running water depends on the catchment area and the material composition (structure). As shown in Table 2, the percentage of runoff varies from 20-55%, which is however significantly different from the 95% of water that enters urban drainage systems when using impermeable pavements. Infiltration accounts for 42 to 15% of the total water, which is notably different from the water incapacity in conventional pavement to reach the soil.

Table 2 Effect of different proportions of sealed surface on runoff, evapotranspiration, and infiltration. Data from (EPA, 1993), cited in (Dover, 2015)

Source	*Land cover*	*Runoff(%)*	*Evapotranspiration(%)*	*Infiltration (%)*
1	Natural vegetation	10	40	50
2	10-20% sealed surface	20	38	42
3	35-50% sealed surface	30	35	35
4	75-100% sealed surface	55	30	15
5	100%	95	not given	not given

Permeable pavements can contribute to improvements in water quality in several ways. One of the main ways is to filter stormwater runoff through the pavement into the soil. When water is filtered through the soil, it is cleaned through natural processes such as sedimentation, filtration, and biological activity. In addition, permeable pavements can reduce the number of pollutants entering drainage system by reducing total runoff. Permeable pavements have proven to be a pollutant control technology (Miklas Scholz, 2007). Harmful pollutants such as hydrocarbons and heavy metals in surface runoff can pose a threat to soil and groundwater. However, by passing through certain pores in the permeable pavement structure, many pollutants can be removed. The most important target pollutants are hydrocarbons, heavy metals, and nutrients. The recent focus has been on fecal coliforms entering drainage systems via dog droppings. Research (Kiran Tota-Maharaj, 2010) has found that permeable pavements can remove up to 98.6 % of all coliforms that are most frequently found in urban drainage. This not only safeguards the environment but also provides a chance to utilize the water for non-drinking purposes.

Another advantage of permeable pavements is the cooling of the surrounding space and the reduction of the "heat island" effect that often occurs in urban areas. One of the reasons is the increased evaporation of water from the surface of the pavement, which cools both the surface and the air. As shown in Table 2, the possible evaporative capacity varies from 38-30% depending on the type of pavement.

In addition, the thermal absorption capacity of vegetation and porous surfaces is lower than that of standard materials like asphalt (Takashi Asaeda, 2000). A study conducted in Tokyo analyzed 4 types of materials (grass, ceramic, block, and asphalt) for daytime heating absorption and compared it to the air temperature for 30 hours from August 9 to 10, 1994. The above study shows that grass surfaces can in some cases have similar or almost similar cooling capacity as porous materials, which are the basis for permeable pavements.

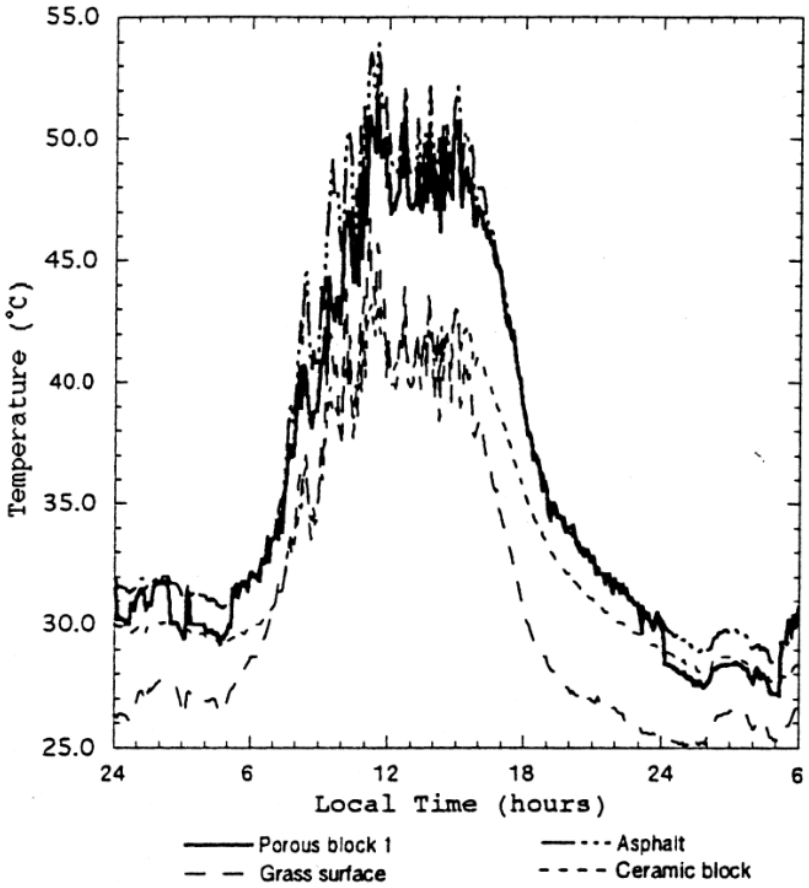


Figure 6 Surface temperature of four samples. (Takashi Asaeda, 2000)

There are several methods to incorporate permeable pavements into more extensive metropolitan systems. One method is to link them to other sustainable infrastructure components, such green roofs, bioswales, and rain gardens. Together, these components can control stormwater runoff and enhance water quality. For instance, permeable pavements can be utilized to collect runoff from the street and direct it to neighboring bioswales or rain gardens, where it can be cleaned up and absorbed into the ground.

By linking permeable pavements to other forms of transportation infrastructure, such as bike lanes and pedestrian walkways, they may also be integrated into larger urban systems. To make urban environments more livable, permeable pavements may also be connected with other urban systems like public transit and green areas.

3.2.2 Green stormwater infrastructure

This comparatively new kind of stormwater management measure (SCM) tries to manage stormwater by employing vegetated systems that rely on a mix of detention, infiltration, and evapotranspiration. Green stormwater infrastructure has roots in both landscape ecology and landscape architecture. Even though adaption strategies vary globally, a significant portion of current investments are connected to urban drainage infrastructure, which is the most expensive capital investment in urban infrastructure and the most cost-effective in terms of socioeconomic gain (Nadia Schou Vorndran Lund, 2019). Therefore, it is a mandatory part of sustainable urban environments and landscape design. It should be noted that this infrastructure is most effective in combined form and greatly depends on the conditions and demands of the landscape.

3.2.2.1 Downspout disconnection

Downspout disconnection is a technique used in sustainable landscape design to reduce the amount of stormwater runoff. It redirects roof water to a more natural area, such a rain garden, green roof, or permeable pavement, as opposed to a storm sewer system. This lessens the quantity of water that goes into the sewer system and runs the risk of producing floods or water contamination by allowing the water to be absorbed by the soil and taken up by plants.

By introducing downspout disconnection into new construction projects and retrofitting old structures, downspout disconnection may be included into larger urban networks (Ellis, 2012). It may also be carried out on a smaller scale in a neighborhood or town by engaging the general population via outreach and education programs and collaborating with local authorities to put policies and rewards for drainage disconnection in place. Cities with combined sewer systems (carrying both wastewater and stormwater in the same pipe network) may find downspout separation to be particularly advantageous.

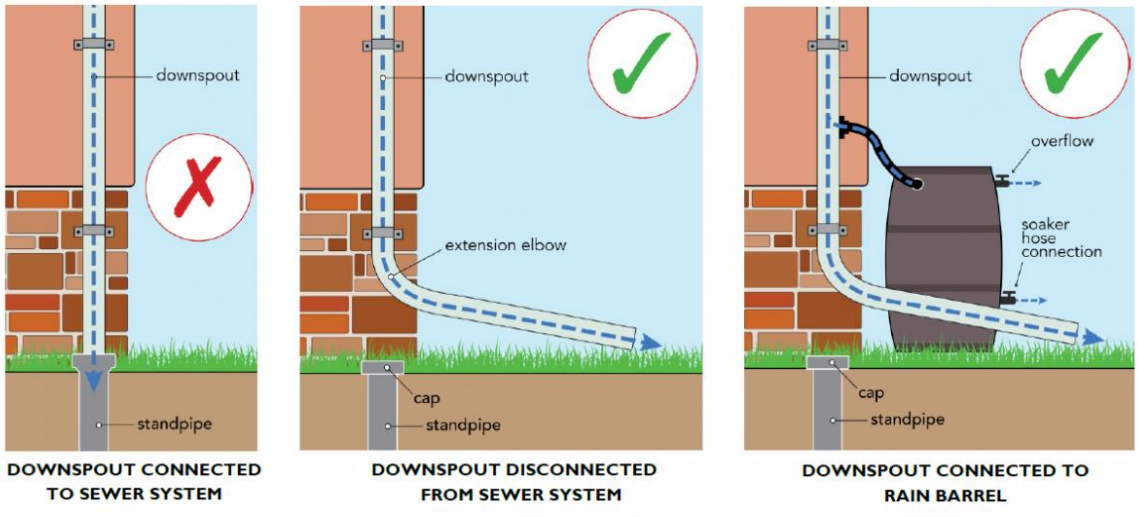


Figure 7 Process of disconnecting the downspout from a pipe or the paved area (EPA, 2022)

3.2.2.2 Rainwater harvesting system

Rainwater harvesting systems are sustainable landscaping techniques that collect and store rainwater for later use. It involves collecting, storing, and distributing runoff. The main components of a rainwater harvesting system include the collection area, delivery system, filtration, storage, and distribution. These systems can include various components such as gutters, downspouts, cisterns, and filtration systems. Impermeable surfaces such as roofs, roads and walkways can be used as collection points, and water is transported to storage via a combination of pipes and open channels (Seymour, 2005). The spectrum of technologies includes ground-level pits, aquifers, nets that catch dew and fog, backyard rain barrels, commercial building cisterns, and more.

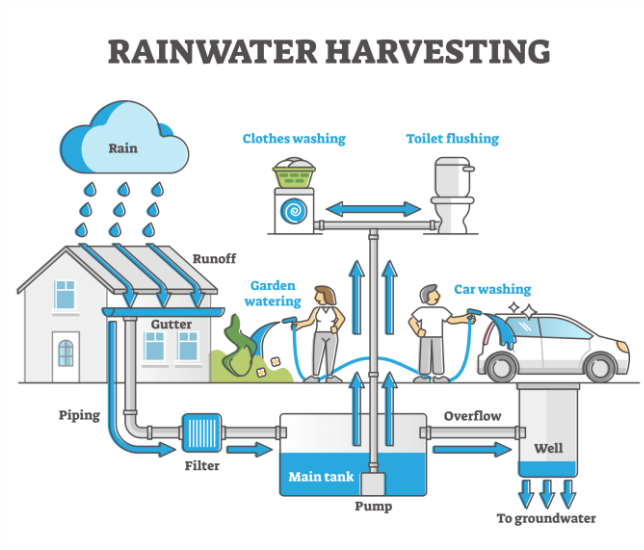


Figure 8. Left -Rainwater harvesting system (SA Clean water, 2023)

Figure 9. Right - Adaptation of rainwater harvesting system to the architecture of the building and its surroundings (EPA, 2022)

Using a rainwater harvesting system has many benefits, such as reducing water stress on landscapes, keeping green spaces healthy, and providing groundwater recharge. Rainwater harvesting systems also help reduce stormwater runoff and improve water quality by allowing rainwater to soak into the ground rather than run off into drains and storm sewers. In addition, by reducing the amount of water that must be treated in municipal wastewater treatment plants, rainwater harvesting systems reduce the energy required to pump and treat the water, thereby reducing greenhouse gas emissions (Ellis, 2012).

Rainwater harvesting systems can be integrated into new projects or remodeled into existing buildings. They are also often seen in residential and commercial landscapes. They can be designed as simple and affordable for individual homes, or more complex and extensive for commercial ones. One interesting example of the use of this technology is at the Malayer University campus in Iran (Iman Saeedi, 2018). It has significantly reduced water consumption and improved the environmental and social impact of the

university site. It is crucial to consider the local environment, laws, and regulations before implementing a rainwater collecting device.

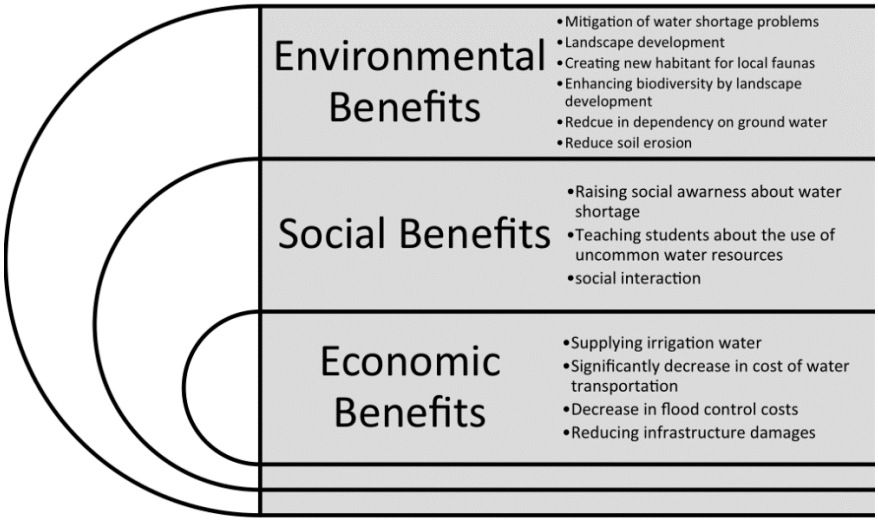


Figure 10 Benefits earned by using rainwater harvesting for landscape irrigation in the Malayer University (Iman Saeedi, 2018)

3.2.2.3 Rain gardens

Rain gardens and other bioretention techniques are planted depressions that handle the on-site stormwater runoff from impermeable surfaces. They're employed to gather stormwater and pass it through a filter made of dirt, sand, and/or gravel. Design elements used in bioretention techniques are inspired by volume reduction and pollutant removal processes seen in living systems. Stormwater that has been filtered soaks into the soil, hydrates vegetation, and may assist resupply the groundwater table in the area. Through these procedures, bioretention techniques enable pollution removal via filtration and plant absorption while reducing peak flows in downstream sewage systems (EPA.gov, 2021). Application of bioretention techniques is effective in filtering stormwater from light to moderate storms and are well suited to small sites in urban environments. Stormwater discharges from heavier storms are typically diverted beyond bioretention practices to a larger stormwater control or the storm drain system by designers.

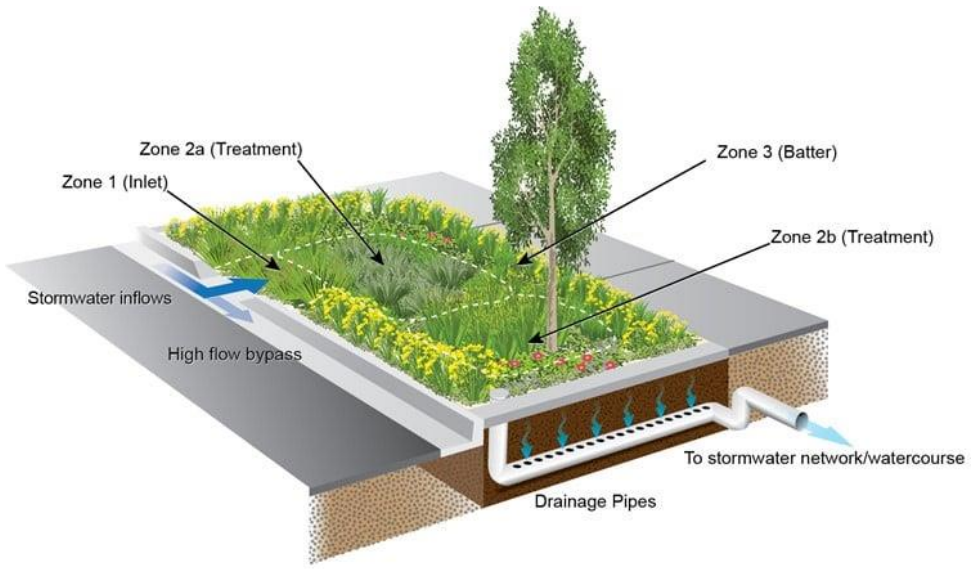


Figure 11 Major zones within the rain garden system (Water Sensitive SA, 2016)

3.2.2.4 Planter boxes

Urban rain gardens with vertical walls and either open or closed bottoms are called planter boxes. To manage roadway and sidewalk runoff, specialized planters are put in the sidewalk area. It is typically rectangular, with four concrete sides serving as the planter's framework and curbs. The planter has a permeable fabric lining, is filled with gravel or stone, and is then covered in soil, plants, and occasionally trees. Runoff can enter the planter through an inlet at street level since the top of the soil in the planter is lower in elevation than the sidewalk. These planters provide storage, infiltration, and runoff evapotranspiration, which regulate rainwater. The current combined sewer line is linked to an overflow pipe that receives any extra runoff (P.M.F.van de Wouw, 2017).

Figure 12 Example of planter box (Philadelphia Water Department, 2020)

3.2.2.5 Bioswales

Rain gardens situated in long, narrow areas, such the space between the sidewalk and the curb, are known as bioswales. Swales are commonly short, vegetated waterways. They are commonly used as components of sustainable urban drainage systems that frequently lead to retention ponds. It acts as infiltration structures and can clear contaminants in addition to diverting excess water away from sealed surfaces because they are covered in plants. In comparison to an asphalt-surfaced area without a swale, (Rushton, 2001) showed that a permeable-surfaced parking space with a swale could reduce runoff by 50%. A swale could even cut runoff by 32% when used in conjunction with a sealed parking area.

Though there was less of a benefit from heavy rain events, runoff reduction worked best during "minor storms." There are a variety of small structures that have been used or proposed to assist minimize runoff. One early example was the installation of little sunken vegetated islands in parking lots, where water would run off the surface of the lot into basins for infiltration (Susan D. Bitter, 1994).

3.2.3 Vertical greening system

A Vertical Greening System (VGS) is an advanced technique to urban gardening that involves growing plants on vertical surfaces such as walls, buildings, and other structures. It`s self-sustaining, live vertical gardens (Gabriel Pérez, 2016). The basic idea behind a "green wall" is straightforward: instead of growing plants in vacant areas on the ground or on rooftops where they take up room, the walls are used. This system serves to create a green and sustainable urban environment while maximizing limited urban space. Given that a significantly larger part of the public can see green walls, they are far more attractive than green roofs from an aesthetic standpoint.

Figure 13 Example of green wall (Ardoin, 2022)

For thousands of years, people have thought of growing plants on walls. The oldest examples of intentionally planted vegetation, according to (Köhler, 2008), were vines growing in palace gardens in the Mediterranean around 2,000 years ago. Stanley Hart White, a professor of landscape architecture, was the one to patent vertical gardens as we know them today. He first conceived the notion in 1938, but it wasn't until much later that it truly caught on (Hindle, 1938). Patrick Blanc, a French botanist, popularized green wall systems as a form of urban agriculture in the 1980s and 1990s. His huge living wall designs aimed to increase biodiversity in large cities. Living green walls have become increasingly common in both residential and commercial settings, both indoors and outdoors, since Patrick Blanc's rise to prominence. Most of the earliest published research on green walls was done in German, and the first ecological publications—rather than just botanical ones—only appeared towards the end of the 1970s (Köhler, 2008). Since the publication of that study, a boom of research specifically focused on green walls have

been published in English. He also monitored the number of green wall publications from the 1850s to 2005 and demonstrated an increase in writings in the 1980s and 1990s.

By merging modern technology and design principles, vertical gardening systems provide urban dwellers several advantages, including energy savings, air purification, reduced noise pollution, improved urban aesthetics, and increased biodiversity (Wilmers, 1988). Vertical green systems have been demonstrated to enhance urban hydrology. It can keep 45-75% of the total precipitation. Due to the significant water loss through evaporation (about 23%), which is essential for urban areas, drainage system systems are not overloaded (Lau, 2018). The type of substrate, and biological factors all have a significant impact on efficiency of VGS regarding the reduction of rainwater runoff. According to all the variables, an average runoff decreases of 4 to 87% is expected.

There are several divisions for Vertical Greening Systems; for instance, the (Dover, 2015) book focuses on different types of planting and grounding technologies (i.e., direct, and indirect greening, free-standing etc.). However, (Welina Pochodyła, 2021) presented a categorization based on the type of material and kind of attachment that most likely provides a better understanding of the constructional and ecological behavior of such a system after its installation:

- Modular green walls: *preplanted panels that are simple to install and maintain. They come in a range of shapes and materials and are well-liked for their adaptability and capacity to fit into any area.*

- Trellised green walls *are structures that allow plants to grow on a grid of metal or wooden beams. These systems may be found in both residential and commercial environments and are frequently used for ornamental purposes.*

- Hydroponic green walls: *plant-growing systems that utilize a contained water-based system. These technologies are well recognized for their high yields and effective use of space and are frequently employed in commercial and industrial areas*.

- Felt green walls *are made of a porous substance that enables plants to grow through the surface. The simplicity of installation and upkeep of these systems, as well as their capacity to produce lush, dense green walls, are the key reasons why they are so popular.*

- Plants grow directly into the wall *to create natural green walls, which don't require any further support. It is possible to employ these systems, which are frequently seen in natural settings, to prevent erosion and generate habitat.*

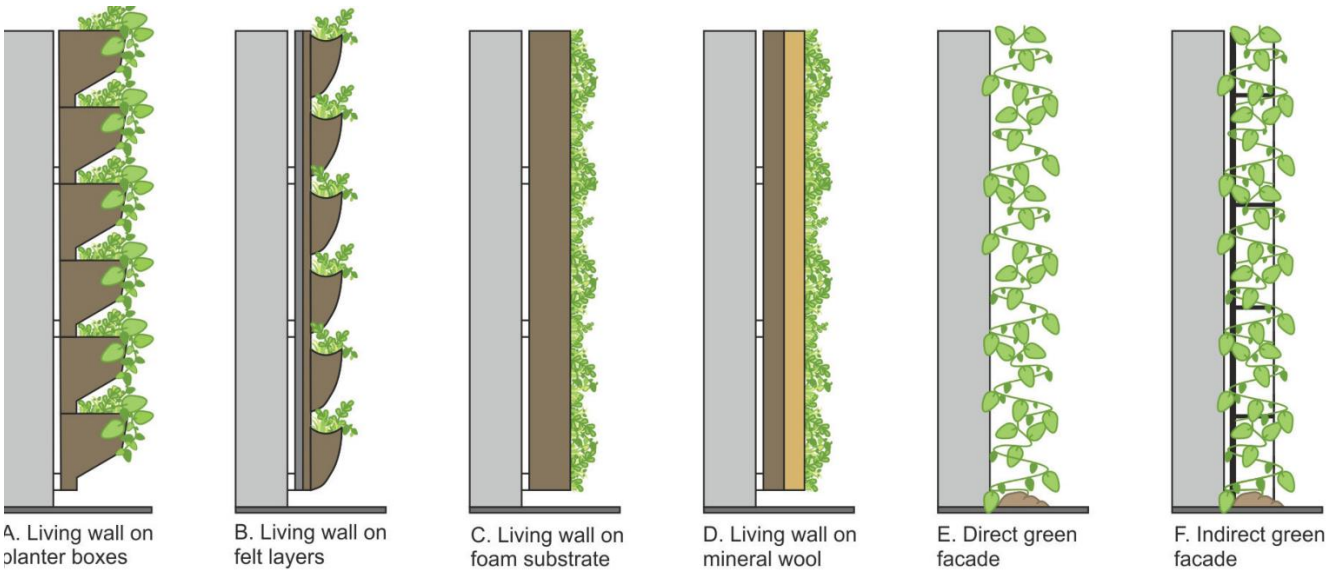


Figure 14 Types of vertical greening systems (Welina Pochodyła, 2021)

The choice of system will rely on the unique requirements of the urban area. Each of these forms of green walls has benefits and drawbacks. Depending on the type of vertical garden, they are built on various building technologies. The building's interior or external walls are where the structures are fixed. They can cover whole walls, but even tiny vacant areas can be transformed into living walls by plants.

Despite the apparent environmental and aesthetic advantages of adding vertical vegetation to cities, there are several difficulties that builders must overcome. The high expense of green walls and facades is one of the most typical explanations for their limited use (Dover, 2015). Initiation costs will vary depending on the kind of wall utilized and can range from zero if natural colonization of pre-existing structural walls is employed to several hundreds of euros per square meter for the most elaborate living wall systems (Katia Perini, 2013). Much of the technology is still rather new and has a small output. A maintenance budget must be considered.

Such methods also have demanding environmental criteria. Only a few species of plants can adapt to the challenging circumstances of high-altitude wall vegetation (Steven W. Peck, 1999). Any kind of vertical greening system must also include the needs for appropriate sun, mineral, and water input throughout the whole wall cover.

4 METHODOLOGY

The methodology for this Bachelor thesis work includes a literature review, site analysis, data collecting, and public landscape perception survey. It is an important part of the research process. This methodology covers the methodical technique used to gather, evaluate, and interpret data to investigate the concept of sustainable landscape architecture and the possibilities for sustainable design practices application on a case study area (Imperial Island, Prague 7).

Overall, this chapter will give a planned and methodical approach to the study process, so that the data obtained will be rigorous and dependable, and the findings reached will be valid and useful.

4.1 THEORETICAL RESEARCH

The literature review section of the thesis is a fundamental component that serves as the theoretical basis for this research. The literature review focuses on the definition of sustainable landscape architecture (SLA), concepts applicable to sustainable urban green public spaces, and sustainable practices for landscape design.

Literature research was conducted using relevant academic resources such as academic journals, articles, conferences, books, and other research publications and reviews relating to sustainable architecture and urban green space design. Materials were searched using Google Scholar, as well as Národn technická knihovna (NTK - Prague) and Czech University of Life Sciences scientific databases. “Sustainability”, “urban planning”, “landscape architecture”, “urban ecology”, “sustainable practices”, “green stormwater management”, and “green infrastructure” were used as keywords.

The identified sources were studied and critically examined in Chapter 3 - Literature review - to develop a core theme - the study of sustainable landscape design within public urban areas and the search for efficient ways to implement sustainable planning. This synthesis aims to provide a complete overview of the field of research and to serve as the scientific foundation for proposed designs for a case study area – Imperial Island, Prague.

The literature review defines sustainable landscape architecture and explores concepts such as urban ecology and the “Sustainable Park: A Fifth Model for Urban Parks” (Boland, 2004) and its relationship to urban public spaces. Moreover, approaches of sustainable landscape architecture and their application to the design of urban green areas are investigated. The sustainable practices are categorized as permeable pavement, green stormwater infrastructure, and vertical greening systems. The major insight was the understanding of sustainability as a balance of environmental, economic, and social elements, as well as the necessity of social awareness and acceptance of sustainable change. “Toward an Urban Ecology” (Orff, 2016) and “Green Infrastructure: integrating

plants and increasing biodiversity in buildings and urban environments" (Dover, 2015) books were important sources in shaping the work.

The material gathered and processed is organized in a clear, simple, and professional manner, with dataset obtained from various scientific sources. Headings, subheadings, and tables are used to arrange the material based on relevant subjects. The figures represent the potential applications of the landscape practices (figure № 4, 9, 12, 14) investigated, as well as its technological aspects (figure № 5, 7, 8, 11).

4.2 SITE DESCRIPTION, CHARACTERISTICS

Císařský Ostrov (Imperial Island in English) is the largest island in Prague, situated on the Vltava River in the northern part of the city. The island covers an area of about 66 hectares and is connected to the mainland by three bridges. The island used to have a rich social life in restaurants and a gardening colony, but the construction of the sewage treatment plant in the 1960s caused the decline of the island as a holiday destination. The island is now seen by the citizens of Prague only as a link between Troja and Stromovka. Only hobby clubs with dogs and horses operate here.

The island was donated by the Czech Estates to the personal property of Rudolf II, and before that, it belonged to the property of the office of the highest commander of Prague. A part of the Royal Game Preserve was located on the present-day area of the island. Due to floods, the shape of the river floodplain changed, and in the 18th century, another river arm divided the island across. The Vltava riverbed in this area was significantly influenced by the construction of the Podbaba lock and navigation canal between 1899 and 1902 (Dana Fialová, 2015). The right side of Imperial Island is probably the last natural section of the Vltava riverbed in Prague with rapids. In 2002, Prague's equestrian area was damaged by floods, resulting in the loss of several amenities and trees. It was rebuilt with new stables and riding arenas. However, in 2013, another flood caused significant damage to the entire complex, with the Vltava River creating a new riverbed and splitting the island in two ((IPR), 2018).

In 1967, the Central Wastewater Treatment Plant was launched on the island, and it constitutes the larger part of the island. The central sewage treatment plant was built on the island in 1967, and the original construction and technology had to be upgraded in this century to meet European Union standards (Central wastewater treatment plant, n.d.).

4.3 SITE ANALYSIS

A visual assessment, a review of the number and quality of park furniture, and a study of the island for indications such as existing circulation, pedestrian and cycling pathways were all part of the site analysis. The primary goal is to identify the primary planned uses of the site, as well as the internal and external interactions of the Imperial Island in terms of spatial planning. This section is split into core design components such as purpose, context, spatial organization, the role of form and media represented on the island.

I. Purpose

An analysis of activities on the island was done to discover the primary purpose for which Imperial Island is used. Island: 660 000 m^2. Most of the island territory (67.96 %) is allocated to wastewater treatment plants, while the other side of the island (4.77%) is dedicated to the private sector. The planned redevelopment area is – 184 000 m^2 approximately, that is located between the wastewater treatment plant and the private sector and is the primary public area. This area's main designated use is for hobby clubs, such as a racetrack and training facility for horses and ponies, and a dog training center. Residents utilize this place as a route between Stromovka and Troja, as well as for walking, running, and social gathering. This site is part of a cycling path and a kayak rafting route that passes by this island. There are a green space and a pedestrian bridge between Stromovka and Troja for pedestrians and bicycles, in addition to the recreational and restaurant zones. Near the bridge there is a descent to the water, which is not marked by navigation and is not equipped for comfortable use. This spot is used for fishing and recreation near the water.

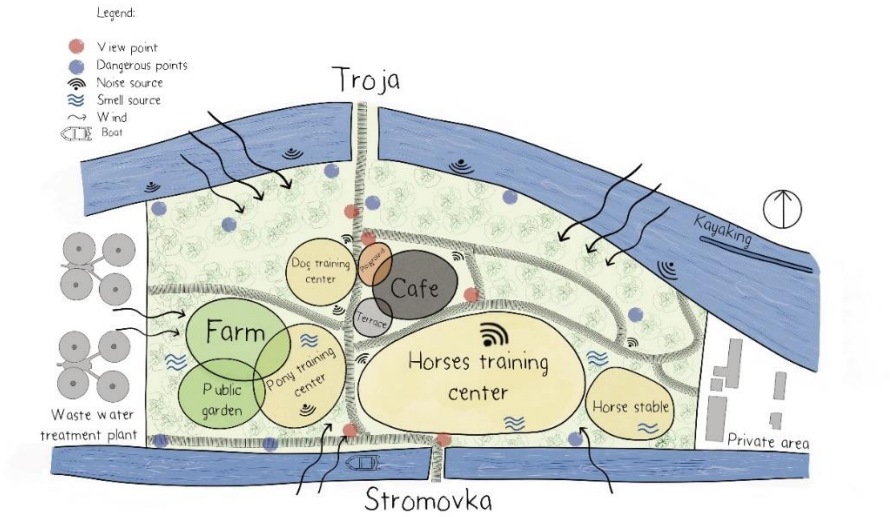


Figure 15. Analysis of the Imperial Island based on visual and sensitivity studies. It is presented in the format of a relationship diagram, designed by the author in the Procreate program for IOS.

The presented relationship diagram shows the main usage places of the island, as well as viewpoints and places of possible danger, which are mainly associated with intersecting bicycle and pedestrian paths. In addition, sources of noise were found in the form of sounds from animal farms, as well as the noise of cars passing on the island. In addition, the running river is a constant source of sound, which at the same time has a calming effect. Moreover, both pleasant odor sources (from the existing vegetation and the restaurant located on the island) and unpleasant odor from the training centers for animals were detected. The assessment of noise and sense pollution is subjective. The island is located on a wind-blown terrain.

II. Context

To determine the focus of future development, it is necessary to analyze the context of the site. It includes the physical, economic, social and cultural background. Firstly, Imperial Island is located in the city of Prague, the capital of a central European country. It is a temperate climate zone. Due to historical development, Prague is dominated by Post Soviet Europeanisation. However, it is being challenged by an ecological paradigm recently. The restoration and installation of natural green areas in cities has resulted in a rethinking of public spaces.

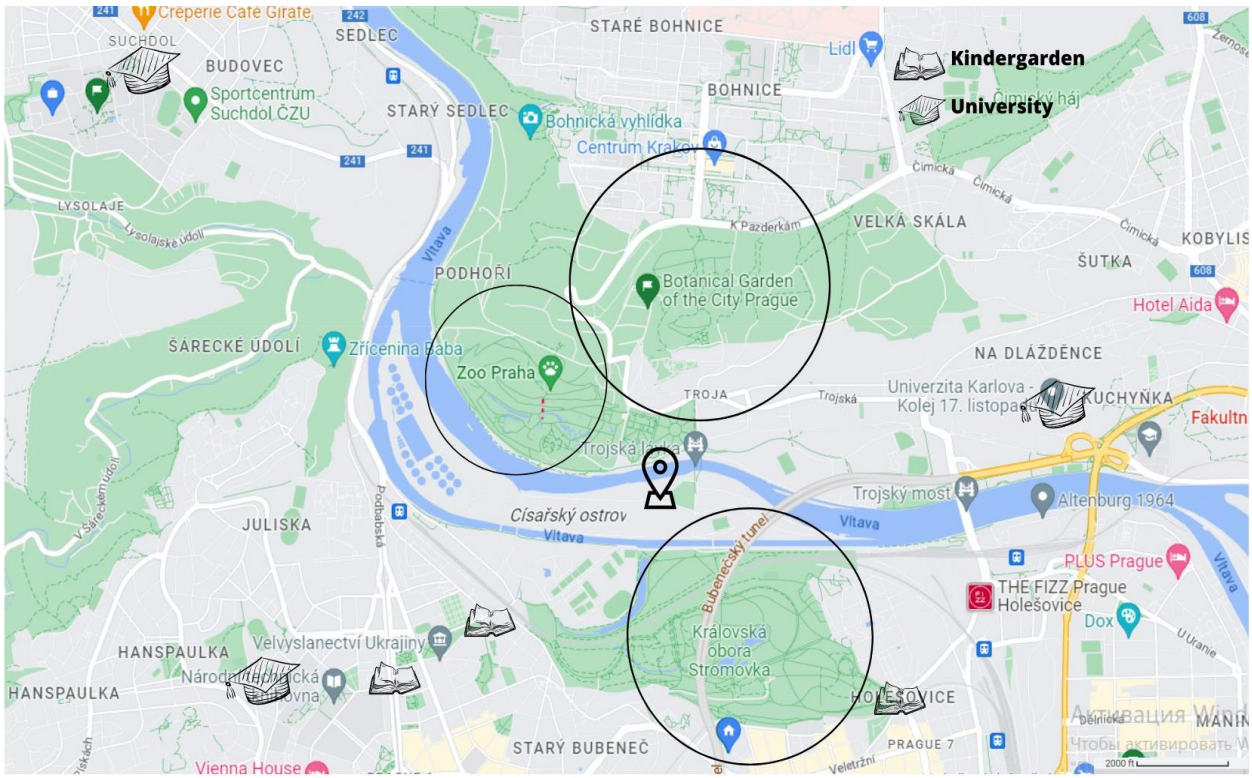


Figure 16. A map of the study location, with significant areas highlighted and marked kindergartens and universities. Source: google maps, design – canva.com

Imperial Island is located between two large public spaces: the largest garden in Prague - Stromovka Park on one side of the Vltava River, and the Botanical Garden of the City Prague and the Zoo Praha on the other side. The island is located between the two largest natural public spaces of Prague and serves as a passageway between them. It is part of the municipal district of Prague 6 and Prague 7. In addition to these central residential areas, there are 3 children's educational facilities within walking distance. There are 3 universities nearby - CULS, CTU and Charles University (Faculty of Humanities). Thus, the main users of the island are residents of all ages and different social groups, tourists, as well as possible excursions from local educational institutions.

III. Spatial organization

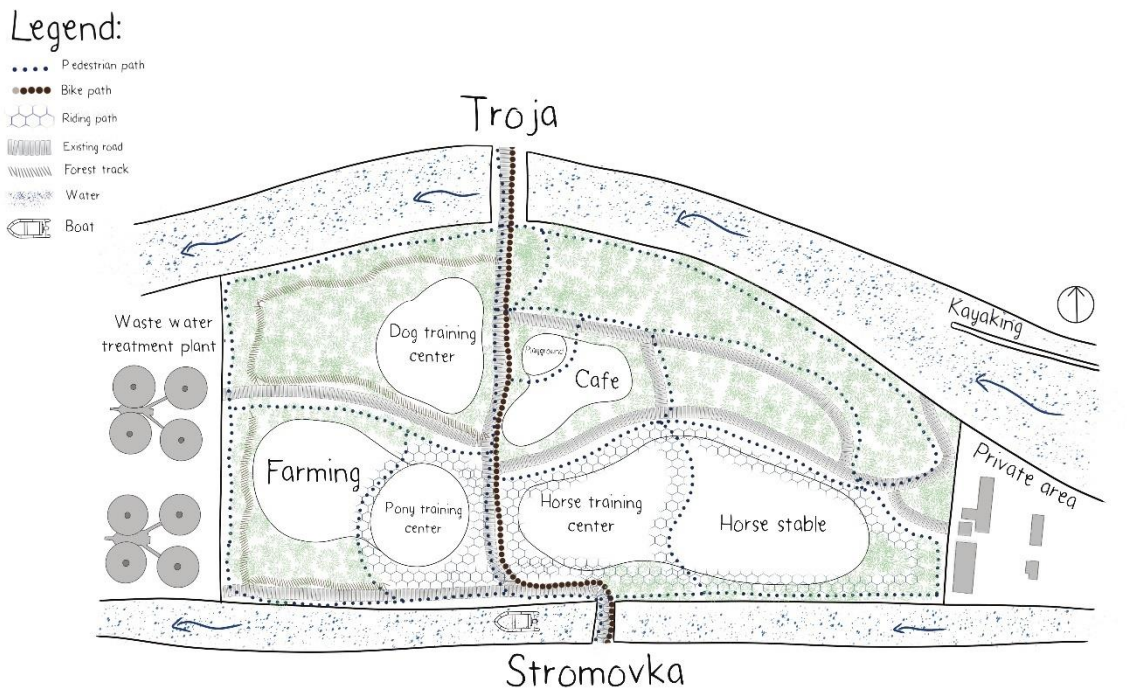


Figure 17. Circulation diagram of Imperial Island. It is presented in the format of a relationship diagram, designed by the author in the Procreate program for IOS.

In terms of spatial organization, the island was analyzed for the presence and position of corridors, roads, and gateways. The island is located between two canals of the Vltava River. Above is a diagram of the circulation on Imperial Island, which marks the main pedestrian routes and types of movement. Roads used by motor vehicles split in two directions and lead to the private area as well as to the water treatment plant. In the study area, there is only one bridge leading from Stromovka Park to the territory of the island from the side of Za Elektrarnou Street. However, the area of the wastewater treatment plant is also connected to the territory of Prague 6 by a bridge from Mlynska St. There is no vehicular access to the Troja side by the island.

The bridge Trojská lavka, which connects the Imperial Island to Troja, is part of the A310 bicycle route and the main crosswalk from the island to the Troja district.

Pedestrian and bicycle roads on the island are connected, and there is intense cyclist traffic in the area. Thus, on Saturday, February 25, 2023, from 13:00 to 14:30, 31 cyclists were seen crossing the island in both directions. In addition, there are additional pedestrian routes used by locals for walking, as well as the main horseback riding route, which connects the Island and Stromovka Park.

IV. Role of the form

The direct access to the water of the Vltava River, which is used for numerous water activities including fishing, relaxation near the water, and kayaking, is a fundamental feature of this location. This island is a unique region in Prague where you can witness how natural processes, especially those associated with water, still occur daily. It offers a more intimate and closer encounter with the Vltava River, an important natural element of Prague. The river is crucial to the construction of the Imperial Island and the options for exploiting this space. Water is the dominant form on the study area.

Apart from its historical significance, the Vltava River provides considerable environmental benefits, such as pollution absorption and natural cooling of the area, as well as a favorable influence on the population's mental health and a relaxing effect.

Nonetheless, there are potential hazards related to the water surface that must be considered while developing landscape design. Any infrastructure built on this island should take into account the possibility of flooding every five years.

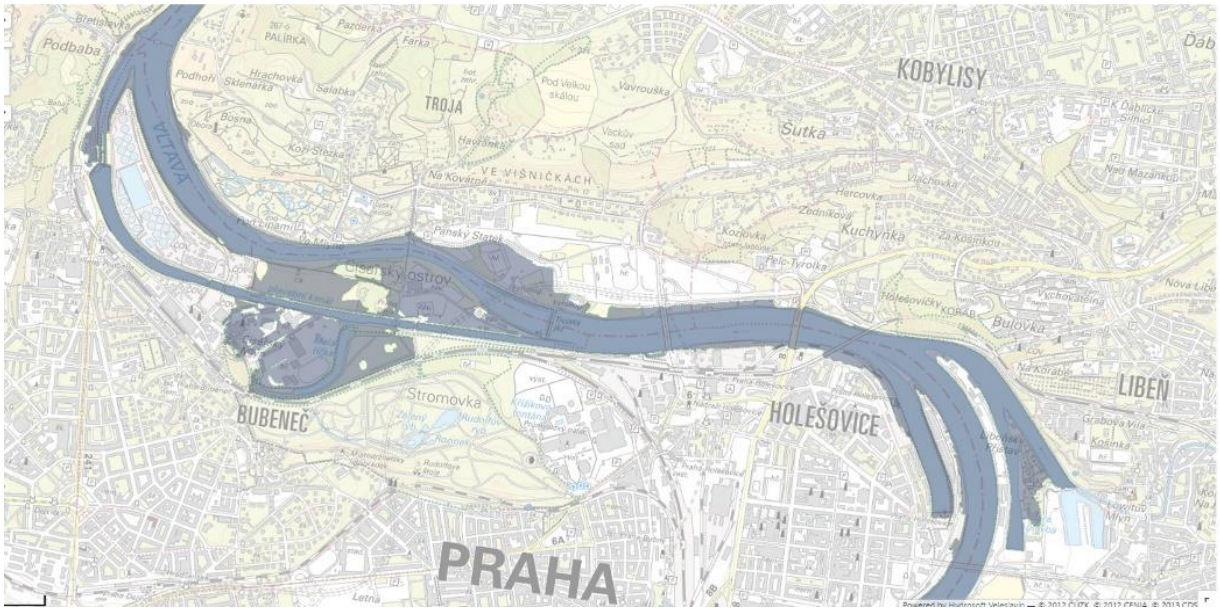


Figure 18. Map - possible boundaries of the Vltava River flooding in 5 years. Source: geoportal.gov.cz

This island has previously been flooded. June 2013 was a month of much above-normal precipitation in the Czech Republic, with average precipitation reaching 146 mm, 174% of the long-term average between 1961 and 1990 (Jan Daňhelka, 2014). The consequences of the 2013 flood are seen below, along with an image of Imperial Island in 2001. As seen on the map, the island has been naturally divided into two parts.

Figure 19 Comparison map - right map of the Imperial Island in 2001, left - of Imperial Island in 2013 after flood event. Source: mapy.cz

Anti-flooding measures have been taken to prevent flooding, such as the creation of artificial structures to control the water level, a canal lock, a spillway keeping the water at a high level for boat navigation, and a separate spot for smooth rafting on the river.

V. Media and materials

Table 3. Media presented in Imperial Island, Prague. Visual assessment, February 2023

Type of Furniture	Imperial Island
Pet waste station	0
Trashcans	2
Benches	0*
Lunch Tables	0*
Bio Waste Container	0
Toilets	1
Playground	1
Working out furniture	4
Bicycle parking	1
Recycle bins	3
Speed bumps	2
Car Stoppers	1

The types of media and materials present and used on the site were analyzed for a detailed site analysis. The forms of furniture were chosen according to the purpose of the territory's usage by visitors, and in reference to Stromovka Park, an example of designed green space. The table above displays all the categories and quantities discovered in the site.

Despite the presence of several farms and animal training centers on the Imperial Island, not a single pet waste station was discovered. There are two trash cans and no containers for biowaste or separate waste collection. Although the high number of people that pass through the island on a regular basis, no serious waste contamination was discovered.

As for benches and lunch tables, there are no public facilities at the spot. During the summer, however, a café with a summer terrace opens, likely serving as the main resting spot.

In general, the furniture is in good condition. Visually, the site has a large presence of gray color in the pavements (asphalt and stone are the main materials), as well as insufficient night lighting and navigation for people.

VI. SWOT analysis

To comprehensively evaluate the location, data presented in previous parts were analyzed and integrated into a SWOT analysis. Landscape architects utilize the SWOT analysis to evaluate site`s strengths, weaknesses, opportunities, and threats. It helps to develop comprehensive design concept and to improve strengths, focus on possibilities, and prevent threats presented on Imperial Island. Overall, a SWOT analysis contributes to the creation of a successful and sustainable project that serves the demands of both nature and society.

Table 4. SWOT analysis - summarization of Imperial Island site analysis

Strengths	Weaknesses
• Waterfront area • Diverse nature of users and high flow • Naturally evolving area, dynamic • Historical and cultural value • Unique recreational activities such as fishing on the Vltava River, kayaking • Existing river and untouched shore	• Insufficient navigation • The signs are not informative enough • Collision sites • Combined path for pedestrians, bicycles, and cars • Barriers for people with disabilities • Lack of drinking water points and toilets • Poorly organized areas near water
Opportunities	**Threats**
• Educational use - histroical aspects, cultural values, environmental values • Public activites near the river • Research area for environmental scientists and dendrological studies • Encouraging a healthy lifestyle • River reconnection	• Flood risks • Dangerous collision points for pedestrians and cyclists • Insufficient number of street lights on pathways. • Threats related to animal activities on the site

The placement of Imperial Island between two canals of the Vltava River is one of its strengths. This island is a rare region in Prague that allows visitors to witness how natural processes still occur daily and could be developed as a study area. Furthermore, the island is located between two important natural locations in Prague and has a large load capacity. These elements serve as the foundation for an ecologically sensitive design that creates an equilibrium between cultural and historical value and recreational options.

The waterfront area presents a unique set of opportunities and challenges for sustainable landscape. There are several weaknesses and threats on Imperial Island that need to be considered when developing a sustainable landscape design concept.

It includes unclear navigation, dangerous collision points for pedestrians and bicyclists, insufficient street lighting, poorly organized areas near water, and flood risk. The focus of future design should be on eliminating the daily risk of bicycle and pedestrian collisions on the island. Since this site is part of the bike path, high-speed crossing of the island has been observed. Also, during a personal investigation of Imperial Island, a bike was seen hitting a dog's front feet that was walking on a leash with its owner and moving toward the Trojska lavka bridge. It clearly shows the main danger present at the site daily. However, an important aspect is also the possibility of flooding, which limits the ability to build new facilities on the island in a longtime perspective.

Addressing these weaknesses and threats will require careful planning and design to ensure safe use of the area. It is also important to consider the opportunities the area offers, including the potential for educational uses, public events near the river, opportunities for research by environmental scientists and dendrological studies, promotion of healthy lifestyles, and reconnection of the river. Overall, a well-designed landscape architecture project on the island can help create a vibrant and sustainable space that meets community needs while preserving the unique historical, cultural, and ecological values of the area.

Figure 20. Pictures of Imperial Island: 1. Horse passage sign 2. Entrance to the island from Stromovka Park (barrier for people with disabilities) 3. A man-made bench discovered on an island 4. Combined road for pedestrians, cyclists, and cars. Bridge from Stromovka Park side 5. Sign indicating a kayaking route 6,7. Waterfront area, access to the water.

4.4 PUBLIC LANDSCAPE PERCEPTION SURVEY

A public landscape perception survey was done to evaluate the data collected during the site analysis and to create a holistic picture of the demands and attitudes of Prague residents toward Imperial Island. It took place on Saturday, February 25, 2023, from 12:00 to 15:30. This period was chosen to reach the highest number of responders as lunchtime on a weekend, when people go for a walk, cycling or passing to Stromovka Park or the Troja neighborhood.

30 people were interviewed over the course of 3.5 hours. The gender ratio was about being equal (12 males and 10 women), and most respondents (67.9%) were between the ages of 26 and 50. 60 percent of respondents are living near Imperial Island, 4 tourists who were visiting for the first time were questioned. The survey was conducted in three languages: Czech, Russian, and English. All responses were entered into Google forms in English.

Figure 21. Survey results – overview of the activity and main audience question. Source: Google forms

The study's major purpose was to determine the island's main target audience, as well as their motivations for visiting the island and personal opinions of the present design. It was discovered that the majority of respondents (43.3%) visit the island several times in a month, with a much lower number of persons visiting the island every week. Yet, the main reason for visiting the island is to pass by to Stromovka Park or the Troja neighborhood (50% of responders). However, 26% of respondents stated that they visit the island for sports or recreation, primarily during the summer.

Furthermore, respondents were asked to rate the presence of specific park furniture on the island. The findings supported the conclusions that the island lacked benches and waste bins, as well as separation of pedestrian and cycling pathways and clear navigation of the island. In addition, respondents were questioned - "What's the reason you're not spending time on the island?" to better understand their personal attitude toward the island and the primary reasons for not spending free time on the island, preferring Stromovka Park. The key takeaway reached from the 27 replies is that visitors are unaware of the activities available on the island.

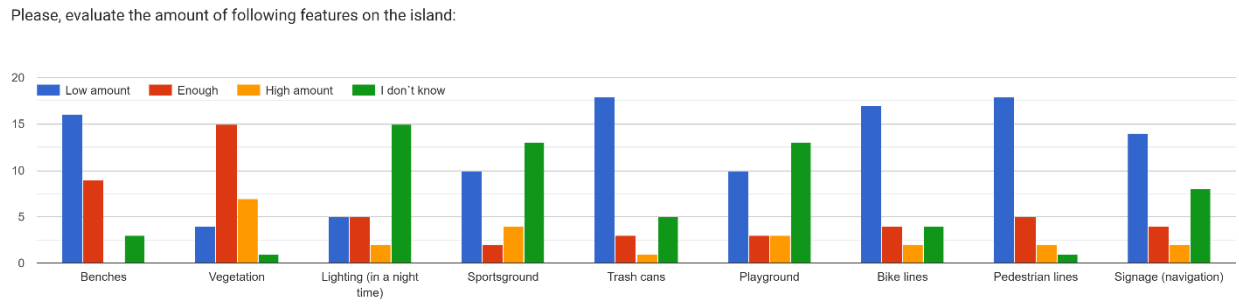


Figure 22. Survey results - evaluation of park features on the Imperial Island. Source: Google Form

The final part of the survey included questions such as:

- *"Is there anything you would like to change in Císařský ostrov? It could be smell, circulation (direction, accessibility, design, road material), color or texture, vegetation, etc."*
- *"Is there anything you really like in Císařský ostrov? It could be water accessibility, location, nature, design, sport centers, etc."*
- *"If you have a power to add something right now in a design of this island, what would it be? Where would you put it? What would change? "*

The answers served as the basis for the proposed design concept, as well as to support the SWOT analysis presented above. A detailed breakdown of each question is presented in Appendix I.

The feedback received about Imperial Island points towards several areas that require improvement to make the island more accessible, functional, and enjoyable for visitors. Improving the circulation and road material, adding more vegetation, benches, trash bins, and separate paths for pedestrians and cyclists are suggested by many respondents. Some people also recommended adding public spaces, food courts, and more information about available activities to create a more engaging environment. Additionally, there are concerns about navigation, lighting, and recreation in the waterfront area, and a need for better sidewalk infrastructure and toilets. Lastly, several people suggested incorporating areas for dogs or organizing park competitions to make the space more interactive. Overall, the feedback highlights the need to address various issues on the island to enhance visitors' experience and make Imperial Island a more desirable destination.

However, the respondents generally appreciate the natural beauty of Imperial Island, particularly its water accessibility and calm atmosphere. Many people mentioned enjoying walks by the river and appreciating the island's location and views, especially of the nearby forest in Troja. Some people mentioned specific amenities they liked, such as the bar and street food bus, public garden, food court. Additionally, the location and good connections to other areas of the city were also appreciated. Overall, the respondents' positive feedback focused on the natural environment and peaceful ambiance of Imperial Island.

5 RESULTS

As a result, the developed landscape design project for Imperial Island in Prague is presented. This chapter discusses the creation and development of a conceptual idea based on a literature review of the principles of sustainable landscape architecture, as well as a site analysis and conducted public landscape perception survey of the site. It includes the development of a masterplan and detailed plans for planting, circulation, and pavements to be possibly applied. In addition, a core strategy for implementing the principles of sustainability within Imperial Island is presented.

5.1 CONCEPT

In his book "Design with Nature" (McHarg, 1969), Ian McHarg introduced the concept of shifting baselines, which suggests that our standards and understanding of pre-industrial ecosystems have been constantly deteriorating over generations. To bridge this gap in perception, it is the designer's primary responsibility to visualize the history and interconnectedness of the earth's landscape. This includes addressing issues like water quality and loss of biodiversity, which require new forms of design as starting points for planning.

The proposed concept is based on history of the Imperial Island's regional landscape character. The main goal and purpose of the developed design is to create a system for restoring the structure and functions of the existing ecosystem, as well as reconnecting nature with society. Being the primary defining structure, the river acts as a fundamental working tool. Observing water move across a landscape may reveal hidden possibilities in an urban scene - meditative, calming, and informative. Water is also a key component in establishing the location character, which will be essential in the project's design (Orff, 2016).

"Water is life. It's the briny broth of our origins, the pounding circulatory system of the world."

-Barbara Kingsolver

The concept is based on the site analysis of Imperial Island, the viewpoint of residents, and the history of it. Thus, the primary purpose of the developed master plan is to allow deeper, more personal access to the Vltava River. Release the river and allow it to naturally regenerate within the island's space, thereby restoring and uniting natural "flow" and society.

The major conceptual approach is to link two Vltava River channels by creating an extra river flow crossing the island and developing the natural wetland system. Furthermore, the island's central position and benefits in the form of open environment serve as the

foundation for the creation of a public educational institution. Developed Island's design aims to serve not only for natural processes, but also as a foundation for educational orientation. The structure and planting of the island will serve as an example of sustainable development concepts in the urban context, which visitors will be able to learn by example from the site.

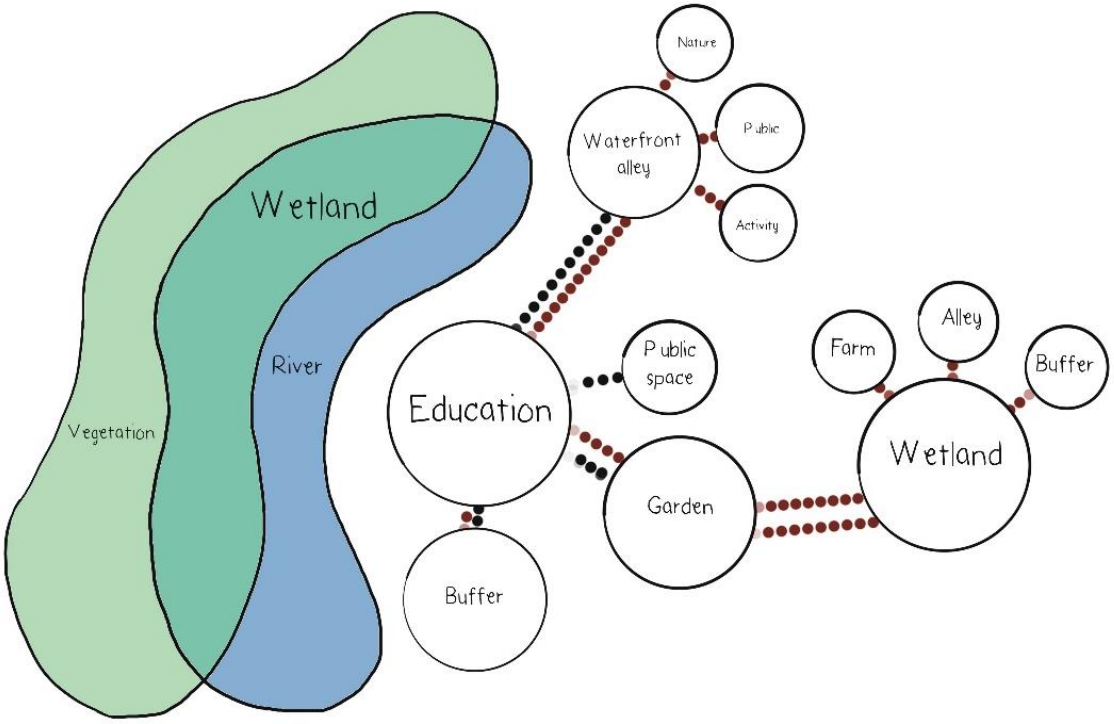


Figure 23. Bubble diagram of proposed concept design for Imperial Island, Prague. It is designed by the author in the Procreate program for IOS.

It is planned to develop the waterfront area for recreation purposes. Thus, the connection between society and nature is maintained. Increased local vegetation, as well as the construction of natural buffer zones that will act as an obstacle to wind patterns, is an important part of the design concept. A strategy includes establishing the urban green infrastructure in order to repair and reconstruct the local coastal environment using measures such as adaptive flood control, stormwater management, water quality improvement and biodiversity restoration.

Examples of sustainable park were explored for the development of the concept and further design. The Seoul River Project (Reinventing the Urban Park ~ Cheonggyecheon Stream, Seoul, 2009), Shaheyuan Park (Holmes, Shaheyuan Park: Infusing Sustainability with Lumber Industry Heritage, 2020), and Weiliu Wetland Park (Holmes, Weiliu Wetland Park | Xianyang, China | Yifang Ecoscape, 2019) are all examples of sustainable landscape development that prioritize ecological, social, and economic sustainability.

The three parks mentioned have one thing in common: they all promote sustainable landscape development by revitalizing underused or degraded natural areas. Each project aims to protect or improve the natural environment while also providing possibilities for recreation and education. They include cultural and historical components to help the community develop a feeling of place and identity. As a distinguishing aspect of their terrain, all three parks have a strong link to water. The Seoul River Project and the Weiliu Wetland Park entail the repair and preservation of deteriorated waterways. Each park also incorporates water as a design feature, providing peaceful and visually beautiful landscapes that give a reprieve from urban environments.

5.2 PROPOSED MASTER PLAN

Figure 24 Masterplan of sustainable landscape development for Imperial Island, Prague. It was designed by the author in the Procreate program for IOS. Source of reference pictures: pinterest.com.

5.3 DETAILED (FOCUS) ELEMENTS

An adaptive landscape was built based on the existing topography to restore flood resilience and reuse coastline areas: the lowest regions were planned as floodable natural wetlands, while places with less danger of flooding were used as balancing ponds. Ponds for balancing and attenuation only hold run-off until the flood peak has past, and hence have limited water capacity (Orff, 2016). These are typically smaller urban flood storage basins that are mostly dry. The site's highest points were designed for recreation and education. Bioengineering methods like as tree cover, crushed stone, retaining walls, and grass slope can be utilized to protect from flooding and restore biodiversity (Siobhan Vernon, 2022). This assists in protecting the environment.

The historical flooding of the island, way water moved through the Imperial Island, were taken into account while considering the construction of an extra water channel through the island (figures 18, 19). Letting water into the site, especially during floods, relieves river pressure and restores the land's historical floodplain role. The unpredictable water level in the river, as well as the necessity to preserve the island's wildlife, spurred the development of a water stream with vegetation coverage, creating a wetlands.

Figure 25. Developed dendroplan with proposed vegetation. It`s designed by the author in the Procreate program for IOS.

The proposal preserves existing old trees along the riverside to establish a continuous green corridor along the embankment and planting native species to promote the stability and diversity of plant communities. The project will modify the terrain and choose native trees, shrubs, and aquatic plants to reestablish hiding places and habitats for aquatic life, amphibians, and birds.

Furthermore, by forming a vegetation buffer zone, a windbreak is formed in two areas. Windbreaks are made up of trees or shrubs that are firmly fused throughout the height of the plant with a combination of trees, shrubs, and bushes. Windbreaks may also serve to minimize noise, sight, and smell, as well as providing habitat for wildlife (Siobhan Vernon, 2022).

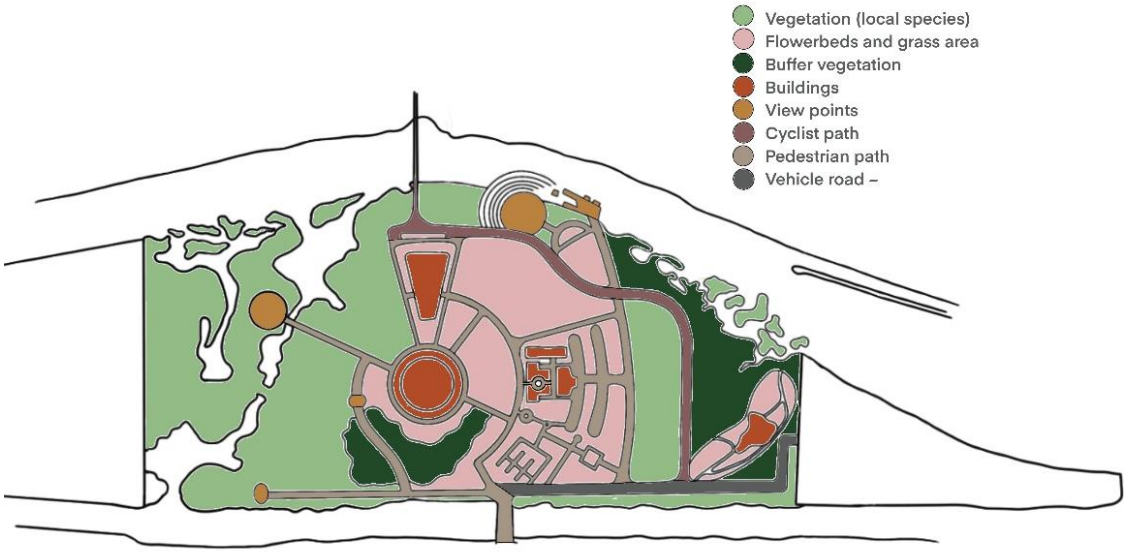


Figure 26. Site zoning plan – Imperial Island, proposed design. It`s designed by the author in the Procreate program for IOS.

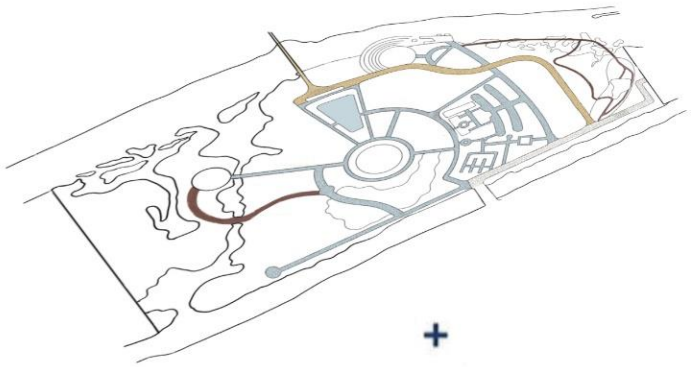
One of the creative components is represented by two colorful bridges that cross the wetland zone. The constructions rise and fall in the terrain to generate boardwalks and bridges that represent the connection of water and local culture. It is intended to build observation platforms, wooden flooring, and a designed waterfront area. Based on the previously discussed landscape projects, it is suggested to build a green pier and a stone exit to the river (Holmes, Weiliu Wetland Park | Xianyang, China | Yifang Ecoscape, 2019). This site is being developed as a place for rest and recreation of nature, as well as chances for fishing and direct interaction with the Vltava River.

It should be mentioned that most of the proposed area is designed naturally that respects to environmental principles. These zones will be restricted for visitors; nevertheless, thematic spots, bridges, and viewing platforms will allow visitors to experience natural sights and processes. Furthermore, these components will serve as models for the educational community center. The prospect of holding open classes on the study of local flora and fauna, sustainable development, and natural processes is expected, with monitoring the water surface, buffer zone, and wetlands as examples. The establishment of an open community garden and farm, in addition to being an educational center, seeks to inspire people to reconnect with nature inside the urban environment.

One of the significant issues addressed is the dangerous circulation that exists on the island. The island's vehicle access is severely confined to one road going to a private area. A bridge from Mlynska St connects the wastewater treatment plant area to the territory of Prague 6. It is also proposed to build a separate bike route that will cover the island territory, from Troja to the bridge that connects Imperial Island to Stromovka Park. The project area is dominated by pedestrian roads. It involves the creation of both short and fast tracks and designed the use of permeable pavements only.

Overall strategy. Creating integrated green infrastructure

In order to restore and reconstruct the local riparian ecosystem, a plan was developed to create a piece of urban Gren infrastructure through strategies including adaptive flood control, water quality improvement and biodiversity restoration.



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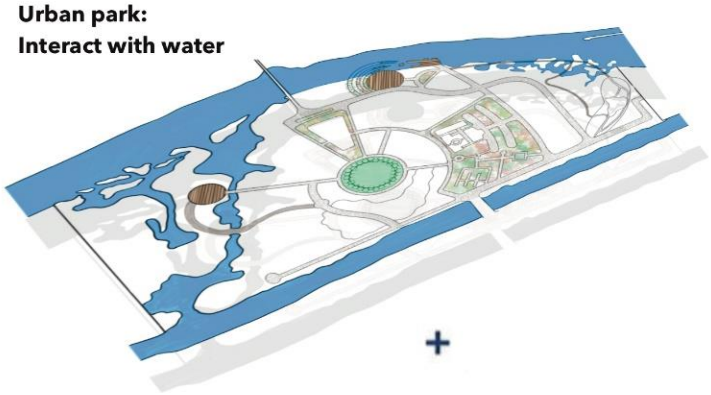
Urban park:
Interact with water



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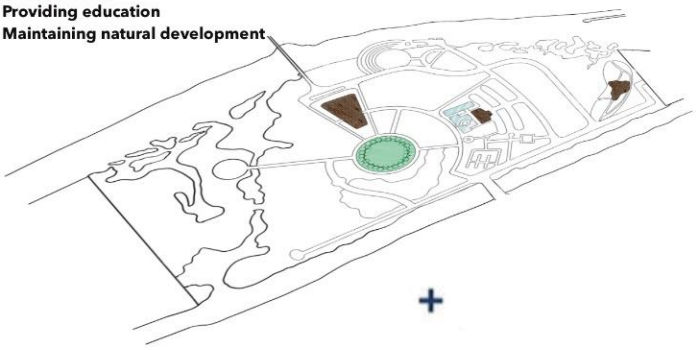
Wetland Park:
Providing education
Maintaining natural development



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Floodable Park:
Adaptive flood management

S1 Safety

Creating resilient, flood adaptive landscape. Separation of cyclists, pedestrians and vehicles

Building adaptive landscape for flood management, the lowest areas were designed to be floodable natural wetlands. Different roads were created for pedestrians, cyclists and vehicles with few points of connection.

S2 Experience

Returning of rural lifestyle and the taste of nature

The highest areas were used for reacreational and leisure spaces. Using water as a main theme, with a touch of local culture, the design gave nearby residents and island visitors opportunities to return and experience the restored natural riparian area.

S3 Education

Providing public education for sustainability and using outdoor educational spaces as public gardens and exhibition parks

Creating an educational space and outdoor garden to explore ecology and sustainable design through practices used in island improvement. Opportunities for indoor classes as well as real study examples and gardening.

S4 Environment

Assisting natural recovery process. Purifying water, cooling the environment and surve as a natural absorption.

Areas of lower flood risk were used for constructed wetlands. Creating a buffer belt of constructed and natural wetlands to collect and purify stormwater run-off, reusing treated water for irrigation, aquatic playground and replenishing the natural riparian wetlands. Using existing trees and wild reed ponds as a foundation, the design applied local trees, shrubs and aquatic plants to restore shelters for aquatic life, amphibians and birds.

6 DISCUSSION AND RECOMMENDATION

The presented results of the literature review, the site analysis of Imperial Island and the conducted work on the sustainable landscape design of the territory is a theoretical bachelor thesis work. For the possible further implementation of this project, it is necessary to consider a detailed geological analysis as well as the further impact of the creation of an additional canal on the territory of the island. Changes such as the connection of two riverbanks can significantly affect the entire river flow. Future work requires a detailed study of the flood prevention tools and the elaboration of several scenarios of the Vltava River behavior.

A detailed study is needed to examine and elaborate the master plan, taking into account the technological requirements for the arrangement of pathways, pavement design as well as the soil and water cover. A detailed list of vegetation that is native to the island is needed. The creation of a planting strategy, considering technological and climatic requirements, is necessary in the future development of the site. In-depth work with dendrologists, planners, geologists is necessary for the successful implementation of this theoretical thesis work.

According to the “Toward an Urban Ecology” book (Orff, 2016), when creating a sustainable landscape design for a park, several key aspects must be considered. First, it is necessary to analyze the ecological features of the original site, including biodiversity, hydrological regime, soil composition, etc. This will help identify potential threats to the proposed park's ecosystem and develop a strategy to minimize them. Second, it is necessary to maximize the conservation and restoration of natural processes. This will help to increase the park's resilience to climate change and maintain biodiversity (American Society of Landscape Architects, 2022). This is a key factor in the development of the presented conceptual project, but the technological features are not considered.

According to the (Boland, 2004) article, social and economic aspects such as the park's accessibility to the public, its role in developing tourism and increasing the economic prosperity of the region must be considered. Sustainable park space change can affect visitors, but there are also significant obstacles that landscape architects face when implementing these projects. Factors such as prohibiting automobile access, or restricting the natural area can significantly affect the perception of the proposed design. Public opinion regarding the innovations must be heard before final approval and implementation of new landscape planning.

It is important to consider the principles of sustainable landscape design, such as increasing green space, creating a public area, using renewable materials. However, in the further development of the project, the economic issue of the proposed changes must be taken into careful consideration.

As discussed by (Clarice Araújo Carvalho, 2022), (Dover, 2015) and in (Gabriel Pérez, 2016) article, sustainable alternatives are often more expensive and harder to maintain. The sustainable topic is relevant in today's world, but a limited number of possible sustainable technologies have been introduced. Furthermore, proposed landscape changes can have both positive and negative impacts on the economic situation. The landscaping project could adversely affect tourist activity, reducing the navigability of the canal. The project assumes a minimum amount of expenses (financial and physical) for its maintenance, due to its ecological and natural processes basis. However, it is necessary to analyze the quality and quantity of measures to maintain the proposed design in a future. It may include an analysis of reclamation work, replacement or modification of pavements, and evaluation and maintenance within the necessary limits of river flow (Tony Gore, 2013).

In summary, creating a sustainable landscape design for a park requires a comprehensive approach that considers environmental, social, and economic aspects as well as sustainable design principles. A Landscape and Visual Impact Assessment (LVIA) as part of the Environmental Impact Assessment (EIA) should be conducted as a primary recommendation. This analysis covers the topics discussed above and provides recommendations for further implementation.

The Landscape and Visual Impact Assessment (LVIA) assists in determining the importance of development-related changes, as well as their influence on the landscape as an environmental resource and on people's perspectives. LVIA is a requirement of the European Commission's Environmental Impact Assessment Regulation - EIA Directive 2014/52/EU on 'the evaluation of the environmental consequences of certain private and public undertakings'. The landscape baseline can use current landscape character assessments and landscape designation declarations, but more data may be necessary depending on the nature or extent of the projected development (Siobhan Vernon, 2022).

7 CONCLUSION AND CONTRIBUTION OF THE THESIS

The thesis presents a conceptual design for the sustainable development of Imperial Island in Prague based on a literature review of sustainable landscape architecture, site analysis, and public perception surveys. The proposed design aims to restore the ecosystem's structure and functions and reconnect nature with society by linking two Vltava River channels and creating a natural wetland system. The design also includes an educational institution and public access to the river.

The thesis highlights the importance of interdisciplinary collaboration, public participation, and engagement in the design and development process, which can help ensure the project's long-term sustainability. The successful implementation of a sustainable landscape design project requires careful consideration of economic, environmental, and social aspects as well as sustainable design principles. Collaboration between various experts, such as dendrologists, planners, geologists, and landscape architects, is essential.

Additionally, an LVIA and EIA should be conducted as part of the future analysis, and the project's economic impact should be evaluated. In conclusion, the proposed design strategy and concepts have broad applicability and relevance, and can help improve the ecological, social, and economic sustainability of case study area. The paper emphasizes that sustainable landscape architecture is an effective way to promote urban sustainability and enhance the quality of life in urban environments.

8 BIBLIOGRAPHY

International Federation of Landscape Architects. (2020-2022). *A Landscape Architectural Guide to the United Nations 17 Sustainable Development Goals.* https://www.iflaeurope.eu/.

Philadelphia Water Department. (2020). *Stormwater planter*. Source: archive.phillywatersheds.org: http://archive.phillywatersheds.org/what_were_doing/green_infrastructure/tools/stormwater-planter

Upper Midwest Water Science Center . (2019). *Evaluating the potential benefits of permeable pavement on the quantity and quality of stormwater runoff.* USGS.

(IPR), P. I. (2018). *Anti-flood protection*. Source: Follow-up projects of the Císařský ostrov concept: http://en.iprpraha.cz/cisarskyostrovprojects

American Society of Landscape Architects. (2022). *Landscape Architecture: A Solution to the Climate Crisis*. Source: asla.org/climateaction.aspx: https://www.asla.org/climateaction.aspx

Ardoin, J. (2022). *Green Walls: How to Create a Living Landscape*. Source: lawnstarter: https://www.lawnstarter.com/blog/landscaping/green-walls/

Bjørn Grinde, G. P. (2009). Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being? *International Journal of Environmental Research and Public Health*.

Boland, G. C. (2004). Defining the Sustainable Park: A Fifth Model. *Landscape Journal*, 102–120.

Byoung-Suk Kweon, W. C. (2007). Green Common Spaces and the Social Integration of Inner-City Older Adults. *Environment and Behavior* .

Cadenasso, M. L. (2008). Urban Principles for Ecological Landscape Design and Maintenance: Scientific Fundamentals. *Cities and the Environment (CATE)*, Vol. 1: Iss. 2, Article 4.

Central wastewater treatment plant. (б.д.). Source: Official website of Prague wastewater treatment organisation : https://www.pvk.cz/

Chris Pittner, Gordon Allerton. (2010). *Sustainable urban drainage systems for Roads.* Scottish Environment Protection Agency .

Clarice Araújo Carvalho, S. M.-R. (2022). Urban Gardens and Composting: Effective Government for Strengthening Urban Resilience and Community Waste Management. B S. D. Seria, *Water-Energy-Food Nexus and Climate Change in Cities* (стр. 217–241). Springer.

Dana Fialová, E. S. (2015). *Císařský ostrov*. Source: Bubeneč - historie a současnost pražské čtvrti: https://www.bubenec.eu/cisarsky-ostrov-popis/

Dizdaroglu, D. (2021). Developing Design Criteria for Sustainable Urban Parks. *Journal of Contemporary Urban Affairs* , 6.

Dizdaroglu, D. (2021). Developing Design Criteria for Sustainable Urban Parks. *Journal of Contemporary Urban Affairs*.

Dover, J. W. (2015). *Green Infrastructure. Incorporating plants and enhancing biodiversity in buildings and urban environments .* London: Routledge.

EASAC. (2009). *Ecosystem services and biodiversity in Europe.* The Royal Society for teh European Academies Science Advisory Council, London.

Ellis, J. (2012). Sustainable surface water management and green infrastructure in UK urban catchment planning. *Journal of Environmental Planning and Management* .

EPA. (1993). *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* EPA.gov.

EPA. (2021). *Stormwater Best Management Practice——Permeable Pavements.* EPA .

EPA. (31 March 2022 r.). *What is Green Infrastructure?* Source: EPA.gov: https://www.epa.gov/green-infrastructure/what-green-infrastructure#permeablepavements

EPA.gov. (2021). Stormwater Best Management Practice Bioretention (Rain Gardens) Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment Subcategory: Filtration Description. *EPA*.

Gabriel Pérez, J. C. (2016). Green facade for energy savings in buildings: The influence of leaf area index and facade orientation on the shadow effect. *Applied Energy* .

Hindle, R. L. (1938). A vertical garden: origins of the Vegetation-Bearing Architectonic Structure and System.

Holmes, D. (12 march 2019 r.). *Weiliu Wetland Park | Xianyang, China | Yifang Ecoscape*. Source: worldlandscapearchitect.com: https://worldlandscapearchitect.com/weiliu-wetland-park-xianyang-china-yifang-ecoscape/?v=928568b84963

Holmes, D. (3 November 2020 r.). *Shaheyuan Park: Infusing Sustainability with Lumber Industry Heritage*. Source: worldlandscapearchitect.com: https://worldlandscapearchitect.com/shaheyuan-park-infusing-sustainability-with-lumber-industry-heritage/?v=928568b84963

Iman Saeedi, M. G. (2018). Rainwater harvesting system: a sustainable method for landscape development in semiarid regions, the case of Malayer University campus in Iran. *Environment, Development and Sustainability*.

J. Morgan Grove, M. L. (2015). Expanding the Landscape: Applying Patch Dynamics to Social-Ecological Systems. B M. L. J. Morgan Grove, *The Baltimore School of Urban Ecology: Space, Scale, and Time for the Study of Cities* (стр. 38–76). Yale University Press.

Jan Daňhelka, J. K. (2014). *FLOODS IN THE CZECH REPUBLIC.* Prague: CZECH HYDROMETEOROLOGICAL INSTITUTE.

Katia Perini, P. R. (2013). Cost–benefit analysis for green façades and living wall systems. *Building and Environment*.

Kazmi, N. (2012). ROLE OF WETLANDS TO ENHANCE STORM WATER INFILTRATION AND TO REDUCE WATER TEMPERATURE JACKSON BOTTOM WETLANDS AS AN EXAMPLE. *Academia*.

Kiran Tota-Maharaj, M. S. (2010). Efficiency of permeable pavement systems for the removal of urban runoff pollutants under varying environmental conditionsEfficiency of permeable pavement systems for the removal of urban runoff pollutants under varying environmental conditions. *Environmental Progress; Sustainable Energy*.

Köhler, M. (2008). Green facades—a view back and some visions. *Urban Ecosyst*, 423–436.

Lau, J. T. (2018). Green Wall for Retention of Stormwater. *Pertanika Journal of Science and Technology*, 283-297.

McHarg, I. (1969). *Design With Nature .* Minnesota: American Museum of Natural History.

McLennan, J. F. (2004). *The Philosophy of Sustainable Design: The Future of Architecture.* Ecotone Publishing.

Michael J.O. Pocock., D. S. (2014). *A Strategic Framework to Support the Implementation of Citizen Science for Environmental Monitoring.* Scottish Environment Protection Agency.

Miklas Scholz, P. G. (2007). Review of permeable pavement systems. *Building and Environment*, 3830–3836.

Nadia Schou Vorndran Lund, M. B.-N. (2019). Integrated stormwater inflow control for sewers and green structures in urban landscapes. *Nature Sustainability*.

National Research Council. (1995). Ecology of Wetland Ecosystems. B N. R. Council, *Wetlands: Characteristics and Boundaries* (стр. 20-42). The National Academies Press.

Nazanin Hosseinpour, F. K. (2021). A cost-benefit analysis of applying urban agriculture in sustainable park design. *Elsevier BV, Land Use Policy* .

Orff, K. (2016). *Toward an Urban Ecology: SCAPE.* The Monacelli Press.

P.M.F.van de Wouw, E. H. (2017). Precipitation collection and evapo(transpi)ration of living wall systems: A comparative study between a panel system and a planter box system. *Elsevier*, 221-237.

Peter M Vitousek, C. M. (1997). INTRODUCED SPECIES: A SIGNIFICANT COMPONENT OF HUMAN-CAUSED GLOBAL. *New Zealand Journal of Ecology* , Vol. 21, No. 1 (1997), pp. 1-16.

Reinventing the Urban Park ~ Cheonggyecheon Stream, Seoul. (14 October 2009 r.). Source: https://ideasinspiringinnovation.wordpress.com/2009/10/14/reinventing-the-urban-park-cheonggyecheon-stream-seoul/

Rushton, B. T. (2001). *Low-Impact Parking Lot Design Reduces Runoff and Pollutant Loads.* Journal of Water Resources Planning and Management.

SA Clean water. (2023). *Rainwater harvesting system* . Source: SA clean water : https://sacleanwater.com/rainwater-harvesting-systems/

Seymour, R. M. (2005). CAPTURING RAINWATER TO REPLACE IRRIGATION WATER FOR LANDSCAPES: RAIN HARVESTING AND RAIN GARDENS. *Proceedings of the 2005 Georgia Water Resources Conference, held April 2.* Athens, Georgia: Institute of Ecology, The University of Georgia.

Siobhan Vernon, S. I. (2022). *Landscape Architect's Pocket Book, 3rd edition .* New York: Routledge.

Steven W. Peck, C. C. (1999). *GREENBACKS FROM GREEN ROOFS:BENEFITS, BARRIERS AND OPPORTUNITIES.* Environmental Adaptation Research Group, Environment Canada .

Susan D. Bitter, J. K. (1994). Bioretention as a Water Quality Best Management Practice. *Watershed Protection Techniques*, 26-28.

Takashi Asaeda, T. C. (2000). Characteristics of permeable pavement during hot summer weather and impact on the thermal environment. *Building and Environment*, 363-375.

Tony Gore, E. O. (2013). *Green Infrastructure's contribution to economic growth: a review.* Natural England. Department for Environmental Food & Rural affairs .

Water Sensitive SA. (5 December 2016 r.). *A guide to raingarden plant selection and placement – fact sheet.* Source: watersensitivesa: https://www.watersensitivesa.com/raingarden-plant-selection-and-placement-fact-sheet/

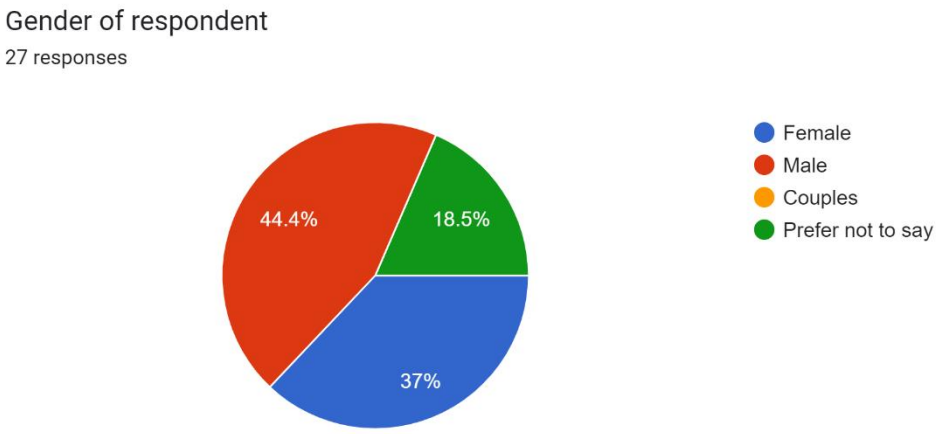
Welina Pochodyła, K. G.-L. (2021). Blue-green infrastructure as a new trend and an effective tool for water management in urban areas. *Landscape Online*.

Williams, J. A. (2006). *Residential Landscape Design.* Source: www.aces.edu.: https://www.aces.edu/wp-content/uploads/2019/09/ANR-0813-Residential-Landscape-Design_091919L-G.pdf

Wilmers, F. (1988). Green for melioration of urban climate. *Energy and Buildings*, 289-299.

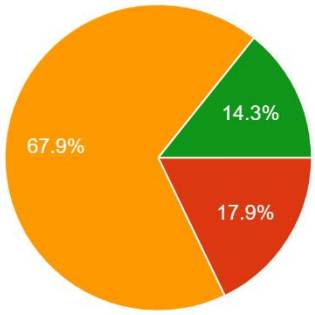
9 APPENDICES

9.1 APPENDIX I - PUBLIC LANDSCAPE PERCEPTION SURVEY



Age range

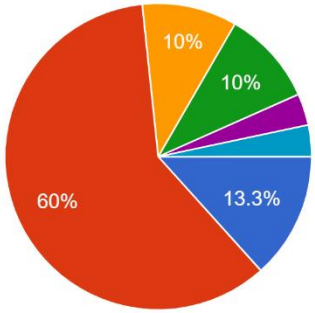
28 responses



- 0 - 14
- 15 - 25
- 26 - 50
- 50 +

Do you live/work nearby?

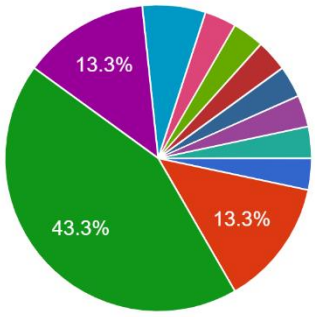
30 responses



- Yes, I live/work in an island
- Yes, Prague 6 or Prague 7
- Other Prague district
- Tourist / visiting
- Troja
- First time in prague, tourist from Germany

How often are you visiting this island?

30 responses



- Every day
- Few times a week
- Weekends and holidays
- Few times a month
- Rarely
- Tourist / first time
- 4 times per year
- In summer every day/ winter every week

1/2

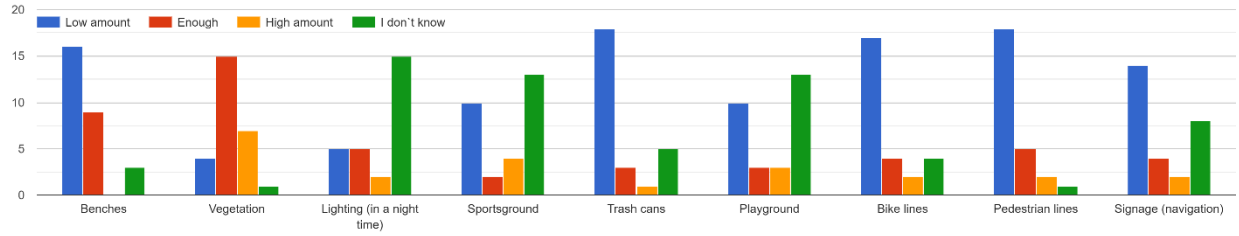
What's your main activity on the island?

30 responses

What's the reason you're not spending time on the island?

27 responses

Please, evaluate the amount of following features on the island:



Is there anything you would like to change in Císařský ostrov? It could be smell, circulation (direction, accessibility, design, road material), color or texture, vegetation, etc.

28 responses

- Add more circulation and navigation (struggled to find their way), add more vegetation
- Park and benches
- Sidewalk and add more activities and car side is bad
- Benches and food area
- Nothing all cool
- Add more natural design, waterfront area organized, bring back the house competition
- River side and area for dogs (park)
- Toilets and sidewalk
- Have a problem with navigation on a island,

Is there anything you would like to change in Císařský ostrov? It could be smell, circulation (direction, accessibility, design, road material), color or texture, vegetation, etc.

28 responses

- Cyclotrons čišník, cesty
- More benches and trash bins, pedestrian lime
- Circulation, road material, more vegetation
- No toilet, road material
- All cool
- All cool / separate cyclists and walking people
- Nothing
- Nothing
- Design, the activity on island

Is there anything you would like to change in Císařský ostrov? It could be smell, circulation (direction, accessibility, design, road material), color or texture, vegetation, etc.

28 responses

- Part near the water a park , benches near the water and public space
- All cool
- Signs for cars - separate roads for security
- Add more food courts
- Area near the water looks bad and lamps and lightning, parking
- Finish the all the reconstruction
- Area near the river, add some food courts near and toilets
- Give a reason to stay at the island, more information about possible activities, organised public space
- Here is enough space , could add more cycling roads, and make better sidewalk on the way to another bridge

Is there anything you really like in Císařský ostrov? It could be water accessibility, location, nature, design, sport centers, etc.

27 responses

- Nature, water accessibility
- Water accessibility
- Calm place
- It's calm and silent
- Going to the water side
- Nature, river
- Calmness
- Bar , Bus with street food in summer time,
- Bus with burger (reason for first visit to this island) good connection to stromovka

Is there anything you really like in Císařský ostrov? It could be water accessibility, location, nature, design, sport centers, etc.

27 responses

- Walk by the river
- Location and nature
- Area near the water
- Bridge
- It's calm in here
- Nature ,
- Water accessibility, location and view on a Troja (forest)
- Nature
- Food court, beer garden

Is there anything you really like in Císařský ostrov? It could be water accessibility, location, nature, design, sport centers, etc.

27 responses

- Location, view on a forest
- River and silent and beautiful
- Calm
- All this area is cool
- River, nature
- Nature, location
- Nature is good, it's cool that you're in the city but feeling like on a farm
- Nature
- View

If you have a power to add something right now in a design of this island, what would it be? Where would you put it? What would change?

20 responses

Comfortable riverfront area, more benches

Entering to the water for recreation with kids

Add access to water, benches, trash bins, more visual pleasure

Football ground /cozy bar with scene, singers / open space - recreation site

Wifi, make it more public area(no private restrictions), pleasure view for a river. That the reason of choosing stromovka over the island

More clean circulation

More public space, visual design and water road

Food shop/ bar

Playground for kids, safe plays for visitors with kids (no cars or bikes)

If you have a power to add something right now in a design of this island, what would it be? Where would you put it? What would change?

20 responses

Lightning after the bridge on the way to stromovka is too dark. More food and public space

No separating for bikes and pedestrians

View points, playgrounds, food stands , public gardens, cause there is some farms ans people are qalkinh by and stopping there

Visual design, public space with clarified activity and clear

Beer garden

Public space for concerts (like Naplavka- to add a vibe), more mixed design of public and green area

Organise the river side and add more lightening

Food court

Public activity, concerts and nature

If you have a power to add something right now in a design of this island, what would it be? Where would you put it? What would change?

20 responses

by and stopping there

Visual design, public space with clarified activity and clear

Beer garden

Public space for concerts (like Naplavka- to add a vibe), more mixed design of public and green area

Organise the river side and add more lightening

Food court

Public activity, concerts and nature

Cocking roads, signs for cyclists

Maps with directions to city center with distance, more pedestrian lines with more space, no cars, coffee place or organized public activity