Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	**Laetitia Amber Ruiter**
Student number	5437067

Studio		
Name / Theme	Metropolitan Ecologies of Places	
Main mentor	Kristel Aalbers	Environmental Technology and Design
Second mentor	Remon Rooij	Spatial Planning and Strategy
Argumentation of choice of the studio	My graduation project is a mix of design, planning and technology. Technology: Firstly, in my research I investigate the whole flow system, and which leverage points are present in this system. With this information, I am going to look for available solutions within these leverage points. These solutions include also technical solutions, such as novel techniques for water purification or precision agriculture. Planning: After this, I will look at the bigger picture and see how these (technology-based) solutions could fit together spatially. Here, the planning trajectory becomes more relevant. The scenarios with spatial strategies are the end products which align with the planning trajectory. Working with the scenarios, different scales are used to create a coherent spatial plan for the rural areas of the Province of Utrecht. Design: For the creation of integrated solutions and scenarios, a design-based approach is also required. This is where design plays a role. Additionally, the outcomes (conclusion maps, scenarios, strategies) are visualized.	

Graduation project	
Title of the graduation project	From fields to faucet: safeguarding the drinking water quality in the rural areas of the Province of Utrecht with integrated solutions
Goal	
Location:	Rural areas of the Province of Utrecht, Netherlands

The posed problem,	The quality of groundwater and surface water is under pressure in the Netherlands, which has significant consequences for drinking water quality. The Water Framework Directive (WFD) is a European directive that sets standards and requirements for the quality and quantity of groundwater and surface water. Like all other member states, the Netherlands has an obligation to meet these goals by 2027 (Environmental Information Point, 2025). However, the Netherlands has repeatedly failed to meet these goals (in 2015 and later in 2021), resulting in delays (Slagter et al., 2024). Despite slight improvements in water quality in recent years, most groundwater bodies and surface water bodies in the Netherlands still do not meet the desired water quality as defined by the WFD (Gaalen et al., 2020). This is also the case in the province of Utrecht. The poor water quality is already having a negative impact on the residents of the Netherlands, farmers, industry, and nature, and this situation is expected to worsen in the future (Van Driezum et al., 2020). As the quality of groundwater and surface water continues to decline, drinking water sources are also at risk. Due to increasing and ongoing pollution, it is becoming increasingly difficult and costly to purify the water and convert it into high-quality drinking water (Vewin, 2024). The decline in water quality is primarily due to current agricultural practices and further urbanization. Despite measures taken to improve water quality, the situation continues to deteriorate due to an excess of pesticides and nutrients (As et al., 2024). Pesticides can cause serious health issues, including cancer, reproductive problems, and neurological damage (Abanyie et al., 2023). These consequences of unsustainable agriculture call for a new approach to farming, where water quality is not compromised. Furthermore, research has shown that urbanization is an increasing source of multiple pollutants to rivers (Strokal et al., 2021). Population growth, along with the associated urbanization and infrastructure development, poses a risk to the further deterioration of water quality (F. Swartjes et al., 2022).

	The city of Utrecht is set to become the fastest-growing municipality in the Netherlands in the coming years, and it is increasingly clear that agricultural sustainability must be achieved. Various plans exist for urbanization, agriculture, and water quality, but a clear, integrated future vision with corresponding action perspectives to safeguard drinking water quality are lacking. The Province of Utrecht wishes to gain more insight into future scenarios and available considerations for rural areas, with the goal of identifying integrated solutions that can ensure the protection of drinking water quality from groundwater abstractions.
research questions and	RQ: "How could the drinking water quality from groundwater abstractions be spatially safeguarded in the rural areas of the province of Utrecht by 2030, while exploring integrated solutions between groundwater quality, agriculture and urbanization?" SQ1. How is the safeguarding of drinking water quality organized spatially and administratively in the province of Utrecht, and how has this evolved over time? SQ2 A. How do agriculture and urbanization affect the groundwater quality in the rural areas of the Province of Utrecht, and what are the consequences for drinking water quality? B. Are there other (external) factors that influence groundwater quality in the rural areas of the Province of Utrecht, and what are the consequences for drinking water quality? SQ3. What spatial trends and policies exist for urbanization and agriculture in the Province of Utrecht, and how do they affect the rural areas and each other? SQ4. What are the bottlenecks and challenges for safeguarding the drinking water quality in the rural areas of the province of Utrecht, looking at the trends, policies and influences of urbanization and agriculture on water quality? SQ5. Which solutions and alternatives could be used to safeguard the drinking water quality and which considerations are possible between agriculture, urbanization and water quality?

	SQ6. Which future scenarios are possible to safeguard the drinking water quality in the rural landscapes in the province of Utrecht, where integrated solutions are used for water quality, agriculture and urbanization? SQ7. Which development strategies, including relevant stakeholders, are possible and in line with the scenarios and which interventions fit within the relevant time context?
design assignment in which these result.	Advice of possible interventions of how to safeguard drinking water quality in the rural areas of the province of Utrecht, integrated with groundwater quality, urbanization and agriculture.

The design outcomes include:

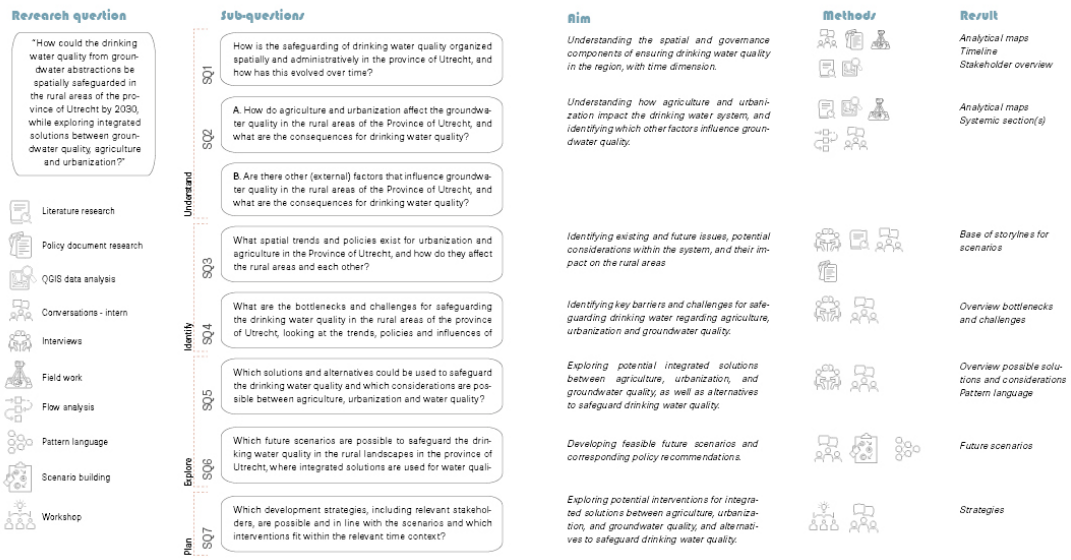
Conclusion map with bottlenecks and challenges: A conclusion map with the identified key barriers and key challenges in the focus area.

Pattern language: A complete set of patterns and a pattern field with integrated solutions for groundwater quality, urbanization and agriculture.

Scenarios with strategies: Future scenarios will be created, where the conclusion maps, trend analyses and the identified bottlenecks and challenges come together. Within these scenarios, possible strategies will be made.

Process

Method description



Methods

Literature research

For sub-questions 1 through 5, a literature review is conducted. The literature review forms the scientific foundation of this study. It involves reviewing scientific reports, articles, and books relevant to each sub-question. Literature is sourced using Google Scholar, the TU Delft library, and websites of research institutions and governmental organizations.

Policy document research

To answer sub-questions 1, 3, and 4, policy research is conducted. This primarily focuses on provincial policies related to groundwater quality, urbanization, and agriculture, as well as policies from water authorities. Additionally, national and international policies on these three themes are examined at a high level. For this policy research, documents are sourced from the websites of governmental bodies and the European Union.

Conversations - intern

During the research, an internship is carried out within the Province of Utrecht as a graduate trainee. During this period, conversations are held with professionals about groundwater, agriculture, and urbanization. These discussions take place throughout the research period and serve as a significant source of knowledge for all sub-questions. This method is particularly important for quickly gaining an understanding of the situation at the start of the research and for building a network with other actors who are crucial for the study (e.g., for interviews).

Interviews

Sub-questions 3, 4, and 5 are partially answered through interviews. These interviews are conducted either in person or online. In sub-question 1, the key stakeholders are identified, forming the basis for the selection of the interview list. Recruitment of participants will primarily rely on the internal network.

QGIS data analysis

Open data in QGIS and internal data from the Province of Utrecht are analyzed and used to assess the area. This information provides a better understanding of the region and is utilized for creating base maps.

Fieldwork

To gain insight into the production of drinking water, a visit is made to one of the drinking water production sites within the focus area. During the research it will become clear which areas need integrated solutions the most. These areas will be visited to get a better understanding of the landscape, agricultural practices and other important features.

Pattern language

Pattern language is used as a method to create solutions for different scales and create different designs. It forms a basis for the workshop, but is adjustable during the use of it. New patterns could be created if necessary.

Scenario building

Sub-question 6 is answered through the scenario building. These scenarios are developed based on trend and policy analyses. The variables for each theme (groundwater quality, urbanization, and agriculture) are incorporated into the scenarios, forming specific narratives. An overview of the characteristics of these narratives is created following the trend and policy analyses. An example of such a narrative overview is shown below. The scenarios depict potential future outcomes for groundwater quality, agriculture, and urbanization, serving as a starting point for developing a strategy or stra-

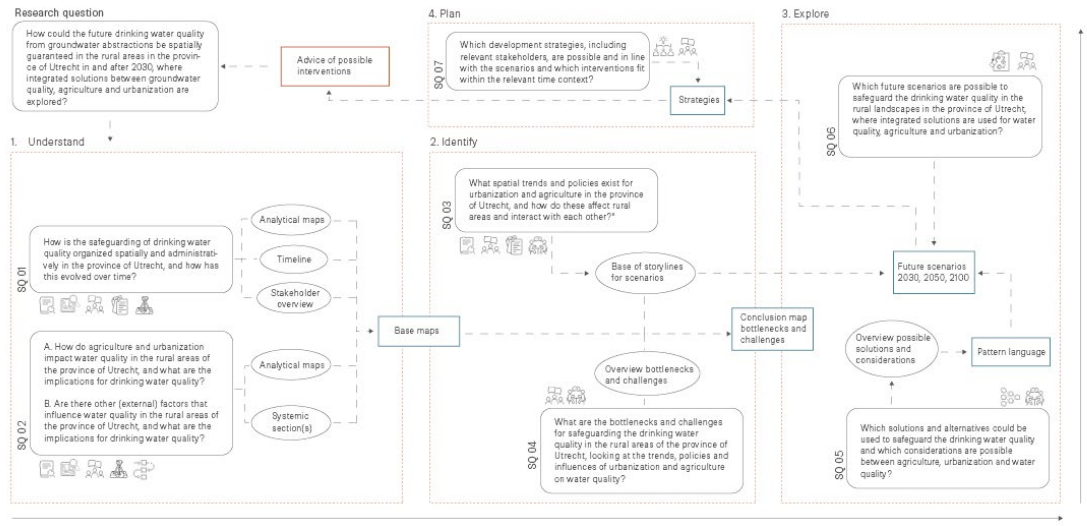
Flow analysis

The various impacts of urbanization and agriculture on groundwater quality are analyzed using a flow analysis. To develop integrated solutions, it is essential to approach the problem from a systemic perspective.

Workshop

After the scenarios have been developed, a workshop is organized for internal staff, professionals, and interview participants. During this workshop, the pattern language method is used to design one or more strategies in response to the scenarios. The participants are required to collaborate to achieve this. The outcome of the workshop is one or more strategies that can then be further elaborated.

Methodological framework



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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Due to the increased pressure on land use in the province of Utrecht, it is no longer feasible to address spatial planning in a sectoral manner. This also applies for safeguarding the drinking water quality. The drinking water quality is closely linked to groundwater quality and is influenced by land use on the surface. The distribution of these functions is connected to urbanism and the broader built environment. Urbanists are responsible for ensuring the integration and coherence of the built environment in different scales. This is exactly what this research is addressing.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

This topic has much societal relevance and is currently a more discussed topic (news articles, reports and research). As mentioned before, groundwater is a vital source of drinking water in the Netherlands. This is also the case for the province of Utrecht.

Contamination from agricultural activities – toxic substances and nutrients – and other substances like PFAS form a serious risk for the groundwater quality, and therefore the drinking water quality. These substances can cause significant health problems, including cancers, reproductive issues and neurological damage (Abanyie et al., 2023). There are several visions, programs and strategies created about each topic: (drinking)water quality, agriculture and urbanization. However, an integrated approach regarding safeguarding drinking water quality is lacking. It is necessary – as well for Utrecht as for the whole of the Netherlands - to get insight into the possibilities of (re)arranging space/functions and exploring integrated solutions to safeguard the drinking water quality. In this way, the drinking water quality could be assured, which is vital for all (natural) processes in the Netherlands.

This research is not only relevant for the Province of Utrecht and the Netherlands, but also for regions outside the Dutch territory. By contributing to the exploration of integrated solutions for groundwater quality, agriculture and urbanization, the research could serve as a model for other regions facing similar challenges. The Province of Utrecht has several landscape types, and this makes it more practical to use the research for other regions.

Executing this investigation for the province of Utrecht makes it valuable for the professionals working at the province of Utrecht. Integrated working is not yet the standard within the organization and this research could help the professionals with doing so. Finally, the province would like to use the research for re-rewriting their environmental vision, where they work in an integrated manner.