🏆 *reviewed paper*

Geosystem Services and Subsurface Planning – Case Studies in Two Swedish Municipalities

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DOI: 10.48494/REALCORP2026.8184

1 ABSTRACT

The strategic significance of geological resources for sustainable development and the security of European societies is well established. Nevertheless, the subsurface resources are often not systematically assessed in spatial planning at the municipal level. In cities, there is a variety of increasing demands and land-use conflicts, but these issues are also relevant for smaller municipalities. The absence of strategic prioritisation results in suboptimal utilisation of subsurface resources. Accordingly, a multidisciplinary research project (UNDER) is developing novel methods to incorporate subsurface considerations into spatial planning. This work is being carried out in close collaboration with spatial planners at the City of Malmö (a medium-sized city) and at the municipality of Askersund (a small municipality) in Sweden.

The geosystem services concept has been put forward as a concept that could support the efficient use of subsurface resources and improve systematic planning of the subsurface (e.g., Lundin Frisk, 2025). Geosystem services, analogous to ecosystem services, describe goods and services delivering benefits to humans either derived from the subsurface (van Ree & van Beukering, 2016) or the geosphere (Gray, 2011), often referred to as abiotic nature in this context). Similar to the classification of ecosystem services, geosystem services are categorised into supporting, provisioning, regulating, and cultural services. For instance, groundwater as a supply resource constitutes a provisioning geosystem service, whereas water quality regulation is considered a regulating service. The service perspective is holistic in the sense that it takes into account potentially conflicting uses of the subsurface and highlights a broader range of services and goods than typically included in spatial planning. In order to operationalise the concept, an indicator-based framework for assessing different geosystem services has been developed (Lundin Frisk et al., 2025).

The City of Malmö in southern Sweden (≈370,000 inhabitants) is currently developing a climate resilience plan. To support this effort, the research project has developed seven thematic GIS maps of geosystem services, including stormwater infiltration and retention capacity and access to subsurface space (Lundin-Frisk et al., 2026). The municipality of Askersund (≈11,500 inhabitants) is simultaneously preparing its comprehensive plan. Within Askersund municipality, diverse subsurface resources, such as a zinc mine and mineral resources, groundwater reserves, and geological construction materials (gravel and sand) are present, alongside underground transport infrastructure. Five thematic GIS maps of geosystem services have been developed, including maps for erosion resistance and the access to bedrock with quality suitable for aggregate production (Gustafsson, in prep.).

The thematic maps were presented in workshops with urban planners in Malmö and Askersund. Workshop feedback supported the relevance of geosystem services in supporting planning decisions and suggested future development needs for such maps. In Malmö, maps on stormwater infiltration and geoenergy were viewed as particularly valuable. In Askersund, participants emphasised that geosystem services provide a useful framework for communicating with non-experts, including decision-makers.

Keywords: Subsurface planning, Geosystem services, Strategic planning, Case study, Resilience

2 ABSTRACT (DEUTSCH)

Die strategische Bedeutung geologischer Ressourcen für eine nachhaltige Entwicklung und für die Sicherheit europäischer Gesellschaften ist längst anerkannt. Trotzdem spielen unterirdische Verhältnisse eine untergeordnete Rolle in der räumlichen Planung auf der kommunalen Ebene. In den größten Städten gibt es eine Vielfalt von steigenden Ansprüchen und Nutzungskonflikten, aber diese Fragen sind auch für kleinere

Gemeinden relevant. Das Fehlen einer strategischen Priorisierung führt zu einer suboptimalen Nutzung der unterirdischen Ressourcen. Deshalb entwickelt ein interdisziplinäres Forschungsprojekt neue Methoden, um unterirdische Fragestellungen in die Raumplanung einzubeziehen. Diese Arbeit wird in engem Austausch mit Malmö (mittelgroße Stadt) und Askersund (kleine Gemeinde) in Schweden betrieben.

Um unterirdische Ressourcen effizienter zu nutzen und die Planung des unterirdischen Raums zu verbessern, wird der Begriff Geosystemdienstleistungen entwickelt (z.B. Lundin Frisk, 2025). Geosystemdienstleistungen ähneln den Ökosystemdienstleistungen und beschreiben Vorteile für den Menschen, unterscheiden sich jedoch durch ihre Fokussierung auf unterirdische Ressourcen und dass sie potenziell konfliktierende Nutzungen berücksichtigt. Ein indikatorbasiertes System zur Bewertung verschiedener Geosystemdienstleistungen ist entwickelt worden (Lundin Frisk et al., 2025). Ähnlich wie Ökosystemdienstleistungen werden auch Geosystemdienstleistungen in unterstützende, bereitstellende, regulierende und kulturelle Dienste aufgeteilt.

Die mittelgroße Stadt im südlichen Schweden Malmö (etwa 370.000 Einwohner) arbeitet derzeit an der Entwicklung eines Klimaresilienzplans. Zur Unterstützung wurden im Forschungsprojekt verschiedene thematische Karten zu Geosystemdienstleistungen mit GIS entwickelt, z.B. für Kapazität des Bodens Regenwasserversickerung (Lundin-Frisk et al., 2026). Die kleine Gemeinde Askersund (etwa 11.000 Einwohner) entwickelt derzeit ihren Masterplan. Innerhalb der Gemeinde gibt es eine Vielfalt unterirdischer Ressourcen inkl. eine Zinkgrube, Grundwasserressourcen, Baustoffen (Kies und Sand), gleichzeitig gibt es auch unterirdische Transportinfrastruktur. Für Askersund wurden thematische Karten entwickelt, beispielsweise zur Erosionsbeständigkeit und zum Zugang zu Gebirgsarealen für Gesteinskörnungen (Gustafsson, 2026).

Die thematischen Karten wurden in verschiedenen Workshops mit Stadtplaner(innen) in Malmö und Askersund präsentiert. Die Rückmeldungen aus den Workshops unterstreichen, dass Geosystemdienstleistungen einen wesentlichen Beitrag zur planerischen Entscheidungsunterstützung leisten. Für Malmö wurden besonders die thematischen Karten zur Regenwasserversickerung und Geoenergie als wichtig beachtet. In den Workshops mit Askersund haben die Teilnehmenden zum Ausdruck gebracht, dass Geosystemdienstleistungen ein wichtiger Begriff in der Kommunikation mit Nicht-Fachleuten, z. B. Entscheidungsträgern, sein kann.

3 INTRODUCTION

This paper presents results from an ongoing research project aimed at investigating the role of geosystem services to support integration of the subsurface in spatial planning. The research is case study-driven, focusing on planning cases in the cities of Malmö and Gothenburg, and the rural municipality of Askersund. For Malmö and Askersund, a similar approach for the dialogue with municipal planning professionals was used, and this paper presents results from this process.

3.1 Background: Geosystem services and subsurface planning

The subsurface plays a significant yet often overlooked role in urban development by providing critical services – such as stormwater infiltration to mitigate flooding, geothermal energy, and groundwater resources (Erlström et al., 2016). However, its potential is frequently neglected in planning, primarily due to limited awareness and understanding of subsurface data and functions (Dick et al., 2017; Finesso & van Ree, 2022). The concept of geosystem services bridges this gap by framing geological information in terms of societal benefits, extending the ecosystem services framework to include the subsurface and abiotic nature (van Ree & van Beukering, 2016; Gray, 2011; Lundin-Frisk, 2025). Lundin-Frisk et al. (2025) identify 39 such services, some of which were applied in the two case studies presented in this paper.

Geosystem services are defined, in this paper, as the contributions provided by the subsurface to human wellbeing, although there are alternative definitions (e.g., Fox et al., 2020; Gray, 2011; Lundin-Frisk et al., 2022; van Ree & van Beukering, 2016). As a parallel to ecosystem services, geosystem services are divided into provisioning, regulating, supporting, and cultural services, and many identified services are presented in Figure 1 (Lundin-Frisk, 2025). For a systematic description, presentation, and analysis of different geosystem services in a certain geophysical setting, indicators and capacity classes for assessing and visualise the potential for delivering different services have been developed (Lundin-Frisk et al., 2025).

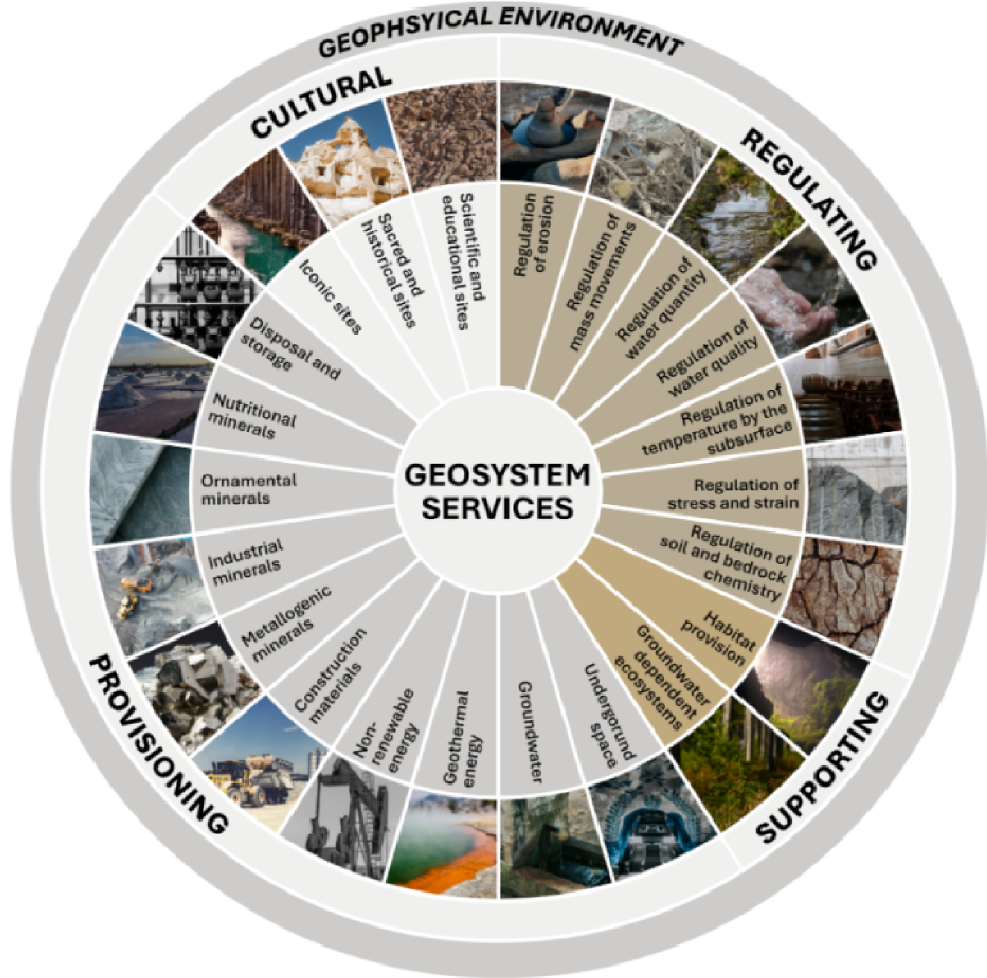

Fig. 1: Geosystem services are systematically divided into provisioning, supporting, cultural, and regulating services (from Lundin-Frisk, 2025)

Previously and in parallel with the ongoing development of the geosystem services concept, other related concepts and definitions – such as nature-based solutions (NBS), geodiversity, geoheritage, geodesign, and geoconservation – have been proposed or established. Steinitz (2012) introduced geodesign as an iterative, collaborative, and multidisciplinary approach applicable across scales, from landscape architecture to comprehensive planning. While geodesign may incorporate georesources and the underground, its primary focus remains on surface planning rather than the subsurface. NBS leverage natural processes and systems to address environmental and societal challenges, such as maintaining biodiversity, flood mitigation, and climate adaptation. Furthermore, NBS generally connects to ecosystem services, but already in its current useage extends to geosystem services such as regulation of water quantity (Kabisch et al., 2022). Previously established or proposed concepts insufficiently include the subsurface, and only ecosystem services have been successfully implemented in Sweden. Therefore, the inclusion of geosystem services in spatial planning is considered important.

3.2 Aim and objectives

This study is part of a collaborative effort of researchers from the UNDER-project, property developers, and civil servants from the Malmö municipality, as well as civil servants of the Askersund municipality, to explore the role of the subsurface in urban planning.

Primary Aim: To explore how geosystem services can enhance urban climate resilience planning in Malmö and for the development of an updated comprehensive plan for the municipality of Askersund. The two municipalities have been studied individually by Gustafsson (2026) and Lundin-Frisk et al. (2026), whereas this paper presents a combined discussion and joint conclusions of the two different studies.

4 CASE STUDIES

The two municipalities for the case studies, the city of Malmö and the municipality of Askersund, were selected because of the importance of the underground, ongoing planning processes, and their openness to exchange with the research project.

4.1 Case study 1: City of Malmö

Malmö is located in the south of Sweden and is the country's third-largest city, and currently has approximately 365,000 inhabitants. The city's rapid population growth, coupled with its coastal location, makes it vulnerable to the impacts of emerging climate change (Malmö stad, 2016; Persson et al., 2012; Sonesson et al., 2024). The surrounding areas comprise a flat landscape with a mixture of suburbs and agricultural land. The municipality is densely populated, considering its 334 km² area. Consequently, civil servants in Malmö are working to improve the city's climate resilience, particularly in response to four anticipated effects of climate change: (1) rising sea levels, (2) more frequent and intense rainfalls, (3) more frequent and severe heatwaves, and (4) more prolonged periods of drought.

4.2 Case Study 2: Municipality of Askersund

The municipality of Askersund has a population of about 11,500 and is located on the northern shore of Lake Vättern, about halfway between the two largest cities in Sweden: Gothenburg and Stockholm. The administrative centre is Askersund town, which has a small-town character. The municipality covers about 1,020 km², and approximately 4,700 inhabitants live in Askersund town, approx. 4,000 in smaller communities and 2,500 in rural areas. Demographic trends indicate a growing proportion of elderly citizens relative to the working-age population (Statistics Sweden, 2025).

Within the municipality of Askersund, there are important geosystem services that may be relevant for spatial planning. These include those assigned as national interest (for mineral resources), and there is an active underground mine, there is underground transport infrastructure with rail tunnels, groundwater resources, a planned drinking water tunnel, as well as areas prone to instability and erosion. A significant share of the coastal area along Lake Vättern is subject to environmental protection, whereas there is a preference to establish new housing in the vicinity of the lake.

5 METHODS

As a part of the UNDER-project, geosystem service maps were developed as presented in Lundin-Frisk et al. (2026) and in Gustafsson (2026). The process to select the geosystem services to be mapped was similar for the two cases, with feedback from the two different municipalities.

Repeated exchange between UNDER-project researchers, property developers, and Malmö municipality civil servants occurred (Lundin-Frisk et al., 2026). For the Askersund case, the exchange was limited to the UNDER-project and civil servants of the municipality (Gustafsson, 2026).

Methodological Steps:

- Exchange with stakeholders/municipality:
  - Malmö: Introduce the geosystem services concept at a workshop, investigate current subsurface use, and match uses with geosystem services. A discussion focusing on what services are assessed to be of the highest importance.
  - Askersund: Workshop/meeting/webinar with civil servants involved in spatial planning to discuss and select the most important geosystem services for the comprehensive plan.
- Map Development: This work with the development of thematic maps is presented in more detail in Lundin-Frisk et al. (2026) and Gustafsson (2026). A selection of geosystem services is presented in Table 1, and indicators are based on Lundin-Frisk et al. (2025).

  - Development of thematic maps based on geosystem services indicators (e.g., erosion regulation, temperature regulation, groundwater provisioning).
  - To further assess the accessibility of different and suitability of geosystem services, further aspects were included, such as depth, contamination, conflicts of interest, nature protection, etc.
  - For Malmö and Askersund, seven resp. five thematic maps for geosystem services were developed.
- Stakeholder/municipality feedback:
  - Webinar and Workshop 1: Introduce the concept of geosystem services and their potential applications in spatial or climate resilience planning. In the Askersund case, a focused discussion was held to identify and prioritize the most relevant geosystem services..
  - Workshop 2: Two different workshops to test maps with urban planners and civil servants at the Askersund and Malmö municipalities, respectively, assess usefulness, and gather improvement suggestions.

Section	Geosystem service	Indicator [unit]
Regulating services	Regulation of erosion	Soil eroded kg, ml-2t-1]
		Landscape index [-]
		Soil erodibility [-] *
	Regulation of water quantity	Reduced flood risk area [m2, m2person-1]
		Storage and permeability capacity [-] *
		Quantity of water filtered [l3/t]
		Water Retention Index (WRI) composed of sub-indicators [-]
		Permeability index [-] *
	Regulation of water quality	Quantity of water filtered [l3/t]
		Biochemical degradation capacity [-]
Provisioning services	Construction materials	Thermal conductivity (λ) [W/(K m)]
	Groundwater for drinking	Groundwater level [m]
		Current groundwater extraction [l3/h]
		Number of springs [-]
		Potential extraction capacity [l3/h]
		Hydraulic conductivity in rocks [log10(K)]
		Number of wells [-];

Table 1: Examples of indicators for geosystem services based on Lundin-Frisk et al. (2025), the services were systematically divided into provisioning, supporting, cultural, and regulating services.

6 RESULTS AND DISCUSSION

The participants in the stakeholder/municipality exchange in the workshops with the city of Malmö and the municipality of Askersund both gave a positive response to the geosystem services concept. The positive response primarily underscored the geosystem services concept for its communicative value in planning dialogues and for fulfilling its purpose to highlight resources and conflicts of interest. They also pointed out that some of the services in the developed maps are already presented under different nomenclature in the current planning process.

6.1 Development of geosystem services potential maps

For the city of Malmö, seven thematic geosystem services maps were developed and included accessibility and suitability. Highlighting the role of the subsurface in providing beneficial services for climate resilience, the following thematic geosystem service potential maps were created, based on previously elaborated indicators for geosystem services (Lundin-Frisk et al., 2025): regulation of erosion, temperature by the subsurface, groundwater quantity and provisioning, underground space (deep and shallow), and construction material. Additionally, the maps were developed further to indicate accessibility of the services (how easily accessible it is due to, e.g. above-ground constructions or depth) and suitability (how suitable it is to make use of certain geosystem services due to, e.g. contamination), thus also providing information about potential conflicts of interest or areas where there is currently untapped potential (Lundin-Frisk, 2025).

For the municipality of Askersund, the selection of five prioritised geosystem services themes was influenced by municipal preferences, risk perspectives, data availability, and assessment by researchers. Despite limited prior experience with the geosystem services concept among participants, the webinar and workshop 2 confirmed the importance of four thematic areas: Bearing capacity, infiltration and retention of storm water, resistance to erosion, and provision of rock aggregate. Drinking water supply (provision of groundwater) was assessed as less important for the comprehensive plan by the municipality planners, but Gustafsson (2026) emphasised the societal importance and potential risks from climate change. The outcomes reflect a balance between practical planning needs and broader research considerations. The resulting geosystem services potential map for provisioning of groundwater on a municipal scale is shown in Figure 2, and additional maps were delveloped for each selected theme (Gustafsson, 2026).

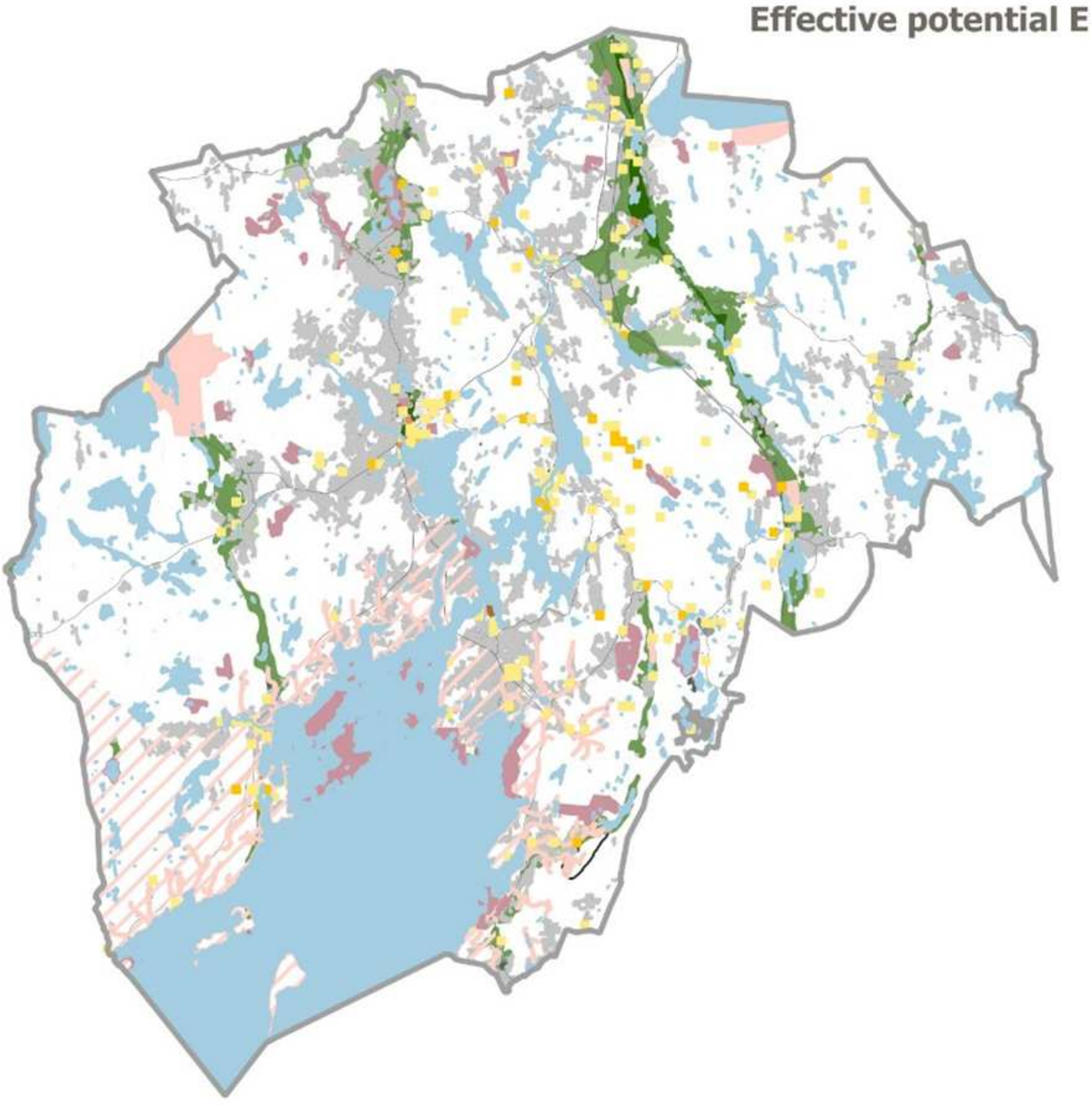

Fig. 2: Example map presenting a geosystem services potential map for groundwater provisioning on a municipal scale for Askersund (from Gustafsson, 2026).

6.2 Feedback from the municipalities and stakeholders

Preliminary results indicate that the city of Malmö is already considering the subsurface in its plans to some extent, for example, through stormwater parks that can delay and store incoming stormwater. Although the concept of geosystem services was new to workshop participants, it was positively received. It was recognised to potentially have a high communicative value for facilitating dialogue and improving the understanding of the contributions of the subsurface to enhance the city's climate resilience. The feedback from participants during the second workshop suggests that such maps may serve as a valuable basis for discussion in the early stages of planning, e.g. in the comprehensive planning process. The information provided by the maps can foster better collaboration among stakeholders from diverse backgrounds by offering a shared point of reference (Lunding-Frisk et al., 2026).

The webinar and the workshop gathered representatives from the municipality of Askersund, including a comprehensive planner, a GIS/map engineer, a land and development engineer, spatial planning architects, an environment inspector, and two relevant supervisors. As a first step, the group explored the relevance and practical application of nine pre-selected geosystem services for comprehensive planning. The discussion revealed that participants did not identify any missing aspects, though some, particularly those new to the geosystem services concept, acknowledged the need for more time to fully assess its scope. Some of the services, such as groundwater provisioning, geological construction materials, and mineral resources, were deemed less relevant to current municipal planning. For mineral resources and construction material, this was related to the limited influence that the municipality exercises regarding these services and the permitting process. Participants also highlighted challenges in integrating complex map materials, preferring simplified, user-friendly formats. The most useful geosystem servicesand maps were those related to regulating erosion, infiltrating stormwater, and preventing harmful emissions, as these directly addressed pressing issues like buildability, stormwater management, and contamination (Gustafsson, 2026).

6.3 Discussion

The discussions in workshop 2 in both case studies highlighted the advantage of geosystem services maps to facilitate optimised subsurface use (e.g., geothermal energy, stormwater management) and resolving conflicts of interest. In the Malmö case, the workshop also facilitated stakeholder collaboration and innovative planning strategies. The scalability and applicability of geosystem services' potential maps to other urban contexts were also discussed and considered important in exchanges with both Askersund and Malmö.

During the workshop with the municipality of Askersund, data transparency, resolution, and scale stood out as key themes, especially regarding the stormwater infiltration and retention map, revealing that no single map can serve all users effectively. Too low a resolution of the maps developed within the project could miss critical details, while excessive detail may lead to overconfidence in uncertain data. Balancing these challenges requires aligning technical limitations (like data quality and availability) with user preferences. It was concluded that the purpose of each map must be defined and consistently communicated, from selecting geosystem services and through the development process.

The discussions at the Workshop 2 with the municipality of Askersund provided detailed comments on the five geosystem services potential maps, whereas the discussions at the Workshop 2 with Malmö held a more general character. The participants at the two Workshops (with Malmö and Askersund, respectively) had different backgrounds, and their overview may differ, with participants from Askersund likely working with a municipal-wide perspective. The workshops focusing on geosystem services maps were conducted earlier in Malmö than in Askersund, allowing insights and experiences from Malmö to be integrated into the Askersund case. Therefore, the maps for Askersund had been further developed at the time of the workshops and issues that were discussed in Malmö had been addressed.

The similarities between geosystem services and the established concept of ecosystem services facilitated communication with workshop participants. It is crucial to operationalize both ecosystem and geosystem services in spatial planning. While some geosystem services already align with Nature-based Solutions (NBS), more could be integrated – such as those vital for climate resilience. Expanding the scope of the NBS concept should also be considered as a potential path forward alongside the implementation of geosystem services in spatial planning.

7 CONCLUSIONS

The integration of geosystem services in spatial planning offers a promising concept for enhancing urban climate resilience as well as comprehensive planning. The use of maps in stakeholder engagement was deemed a critical instrument for effective planning. The exchange with the Askersund and Malmö municipalities indicates that the geosystem services potential maps should be further developed, as well as the indicators. Furthermore, there is a need for adaptivity for each mapping case regarding the indicators for geosystem services.

The study underscores that integrating the concept of geosystem services into spatial planning could enhance spatial planning, examplified by Malmö's climate change resilience plan and the comprehensive plan in Askersund. This can be achieved by

- enabling more effective planning and subsequently new or optimised uses of the subsurface, such as harnessing deep and shallow geo-energy for heating and cooling buildings, and improved utilisation of the subsurface for storing and delaying stormwater flow.
- improving the management of conflicts of interest, which is a key advantage of a more holistic perspective, as that provided by geosystem services.
- fostering better collaboration among various stakeholders in spatial planning processes, thus facilitating the implementation of innovative strategies that integrate the subsurface more effectively into climate resilience initiatives.
- A stronger connection between the concept of Nature-based solutions and the subsurface, and thereby geosystem services, should be considered for enhanced utilization of geosystem services.

8 REFERENCES

Erlström, M., Mellqvist, C., Schwarz, G., Gustafsson, M., & Dahlqvist, P. (2016). Geologisk information för geoenergianläggningar – en översikt. (SGU-rapport 2016:16) Geological Survey of Sweden. Uppsala, Sweden (in Swedish). Fox, N., Graham, L. J., Eigenbrod, F., Bullock, J. M., & Parks, K. E. (2020). Incorporating geodiversity in ecosystem service decisions. Ecosystems and People, 16(1), 151-159. https://doi.org/10.1080/26395916.2020.1758214

Gray, M. (2011). Other nature: geodiversity and geosystem services. Environmental Conservation, 38(3), 271-274. https://doi.org/10.1017/S0376892911000117

Gustafsson, A., 2026. Mapping of Geosystem Services for Comprehensive Planning. -A Case Study of Askersund Municipality. Master's thesis. Chalmers University of Technology.

Kabisch, N., Frantzeskaki, N., Hansen, R., 2022. Principles for urban nature-based solutions. Ambio 51, 1388–1401 (2022). https://doi.org/10.1007/s13280-021-01685-w

Lewis, M. A., Cheney, C. S., & ÓDochartaigh, B. É. (2006). Guide to Permeability Indices. (British Geological Survey Open Report, CR/06/160N). Keyworth, Nottingham, United Kingdom.

Lundin-Frisk, E., Volchko, Y., Taromi Sandström, O., Söderqvist, T., Ericsson, L. O., Mossmark, F., Lindhe, A., Blom, G., Lång, L.-O., Carlsson, C., & Norrman, J. (2022). The geosystem services concept – What is it and can it support subsurface planning? Ecosystem Services, 58, 101483. https://doi.org/10.1016/j.ecoser.2022.101493

Lundin Frisk, E., 2025. Geosystem Services to support planning and Management of the subsurface. Diss. Chalmers University of Technology.

Lundin-Frisk, E., Ericsson, L. O., Lindgren, P., Melgaço, L., Mossmark, F., Taromi Sandström, O., Svahn, V., Söderqvist, T., Volchko, Y., Melo Zurita, M., & Norrman, J. (2025). Geosystem services from the subsurface: A literature review and a proposed set of indicators tailored to a Swedish setting. Environmental and Sustainability Indicators, 26, 100609. https://doi.org/10.1016/j.indic.2025.100609

Lundin-Frisk, E., Ericsson, L. O., Lindgren, P., Melgaço, L., Mossmark, F., Taromi Sandström, O., Svahn, V., Söderqvist, T., Volchko, Y., Melo Zurita, M., & Norrman, J. 2026. Mapping Geosystem Services Potential for Urban Climate Resilience: a Case Study from Malmö, Sweden. Sustainable Cities and Society 139, 107221, https://doi.org/10.1016/j.scs.2026.107221

Malmö stad. (2016). Skyfallsplan för Malmö. City of Malmö. Malmö, Sverige (in Swedish).

Persson, G., Sjökvist, E., Åström, S., Eklund, D., Andréasson, J., Johnell, A., Asp, M., Olsson, J., & Nerheim, S. (2012). Klimatanalys för Skåne län. (Rapport 2011-52) Swedish Meteorological and Hydrological Institute (SMHI). Norrköping, Sweden (in Swedish).

van Ree, C. C. D. F., & van Beukering, P. J. H. (2016). Geosystem services: A concept in support of sustainable development of the subsurface. Ecosystem Services, 20, 30-36. https://doi.org/10.1016/j.ecoser.2016.06.004