Deliverable 1.3.1

Catalogue of current regulations

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MARGIN

MARGIN enables 5 cities in the Alpine Space to manage groundwater sustainability tackling effects of climate change and urbanization to foster cities' climate-resilience. User-oriented, transnational tools and procedures will be established including risk analysis to monitor impacts on groundwater quantity, ecosystem and infrastructure, strategies and measures to cope with it and concepts to implement groundwater sustainability management into policy instruments at different administrative levels.

Deliverable Information

Work Package: WP1 – City Groundwater Management Evaluation

Title: Catalogue of current regulations

Code: Deliverable 1.3.1

Description: Catalogue of existing national and regional regulations, which play a role for groundwater management, focusing on the pilot cities, based on review and city factsheets.

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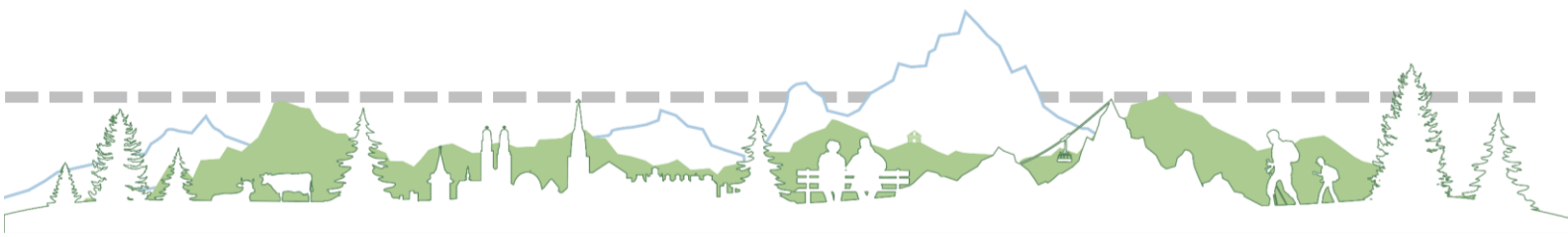


1 Introduction

Groundwater is an important resource underpinning water security, ecosystem health, thermal use and socioeconomic development, particularly in densely populated urban areas. As cities demands on groundwater commonly intensify, ensuring the sustainability of groundwater demands a robust regulatory framework. This deliverable "Catalogue of Current Regulations" aims to address the complex matrix of legal provisions governing groundwater management within the pilot cities of Munich, Milan, Ljubljana and Linz by systematically compiling and analysing existing national, regional and municipal regulations. Their coherence and alignment with overarching European Union directives are instrumental in harmonizing management practices and supporting the long-term sustainability of groundwater resources. This approach reflects the growing recognition that sustainable groundwater management in urban contexts cannot be achieved without clear, effective, and well-coordinated regulation. By cataloguing the regulatory landscape and its nuances within each pilot city, this deliverable provides valuable insights into how laws and policies shape actual groundwater management on different scales and highlights where significant gaps or inconsistencies may exist.

This deliverable is closely connected to other foundational elements of sustainable groundwater management addressed within the MARGIN project. Notably, it complements Deliverable D.1.2.1, which catalogues current strategies and measures, by analysing the regulatory environment that enables—or constrains—the adoption of specific management interventions. Similarly, the interplay with D.1.1.1, which catalogues current data handling practices, is critical, since data-driven management relies on regulatory clarity regarding reporting obligations, data sharing protocols, and the use of monitoring information. Together, these deliverables form a comprehensive framework for understanding and evaluating groundwater management in urban contexts.

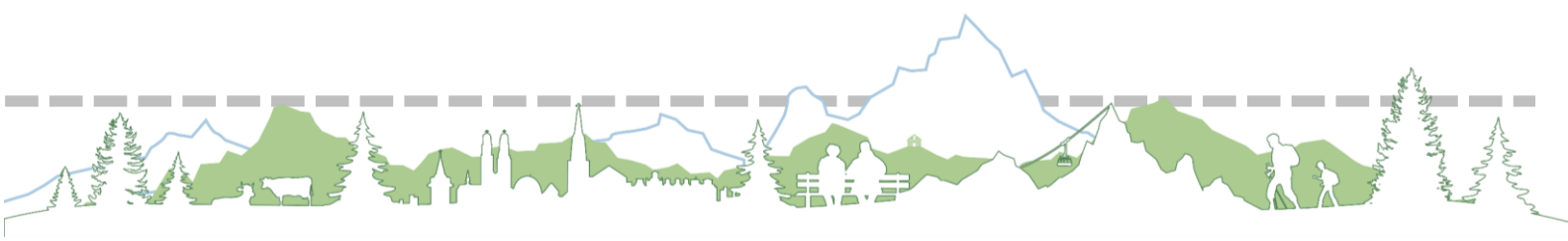
In order to compare current regulations and policies valid for the countries of the involved project partner cities, a total of 34 regulation elements have been identified. The regulation elements and their general description can be found in Table 1. Management of these regulation elements on EU level and in the project partner cities is listed in the corresponding section. Additionally, in each city section there is a glossary of the legislative levels in the country of origin and a list of legal instruments including abbreviations and translation.

Table 1: List of regulation elements that are relevant in the context of groundwater issues. These regulation elements are the basis for the description and comparison of the legal framework in the project partner cities. The topics column refers to the topics listed in the city fact sheets.

Regulation element	**Description**
Groundwater in general	
Protection	Sustainable use for the protection and improvement of groundwater bodies
Outline of groundwater bodies	Catalogue of groundwater bodies
Groundwater management	
Aquifer sustainability planning	Long-term aquifer management planning
Climate change adaptation	Regulatory frameworks addressing climate change
Data management and information sharing	Standardized data collection, processing, and sharing protocols
Quantity	Quantity of groundwater in general and depletion prevention management
Private use	Private use of groundwater through private wells
Public water supply	Water supply managed through public entities
Monitoring of groundwater usage	Monitoring of groundwater usage (e.g. wells, actual extraction, heat pumps)
Registration of installations	Registry of installations using groundwater (e.g. wells, heat pumps)
Discharge into surface waters	Discharge of extracted groundwater into surface waters
Thermal use	
Temperature difference	The maximum temperature difference between extracted and infiltrated/reinjected water at geothermal installations)
Minimum/maximum infiltration temperature	Minimum and maximum temperatures that can be infiltrated/reinjected after thermal groundwater use
Permits for groundwater heat pumps	Permit requirements for geothermal use of groundwater
Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	Distance requirements to prevent adverse effects of geothermal groundwater use on various neighbouring installations

Regulation element	Description
Minimum distance to neighbouring thermal groundwater installations	Distance requirements to prevent adverse effects of geothermal groundwater use on existing neighbouring groundwater heat pumps
Minimum distance between pumping and reinjection site	Distance requirements between the pumping and reinjection site of geothermal groundwater use
Rainwater management	
Flood risk	Flood risk related to heavy rainfall events
Sponge city	Sponge city concepts promote water retention and a natural rainwater management
Infiltration of rainwater	Infiltration of rainwater into the groundwater
- minimum distance to MHGW	Minimum distance of infiltration system to mean highest groundwater level
- minimum distance to buildings	Distance requirements between infiltration systems and (neighbouring) buildings
- types of infiltration systems	Permitted or recommended infiltration systems
Drainage of rainwater into sewers	Drainage of rainwater into sewer systems instead of on-site infiltration
Construction in groundwater	
Backwash	Changes of the groundwater level due to constructed object in the groundwater
Ground breakings affecting groundwater	Groundwork (drilling, excavation, etc.) affecting groundwater, aquifers and/or aquitards
Dewatering during construction	Temporary water management during construction
Groundwater extremes	
Groundwater flooding	High groundwater levels causing issues (flooded basements, flooded terrain)
Low groundwater levels	Low groundwater levels causing issues (water supply, dry groundwater heat pumps, etc.)
Drinking water	Groundwater that is used as drinking water

Regulation element	Description
- Protection	Protection of drinking water (protection zones)
- Construction	Construction in designated drinking water protection zones
- Thermal use	Thermal groundwater uses in designated drinking water protection zones
Re-use of water	Re-use of treated wastewater in context of groundwater recharge
Ecology	Groundwater ecosystem monitoring



2 EU Regulations

Groundwater plays a critical role in the European Union's water policy, particularly as a source of drinking water and a vital ecological resource. The EU has established a robust legal framework to ensure the sustainable management, pollution prevention and quality monitoring of groundwater across all Member States. These laws are binding and must be transposed into national legislation.

First, we can mention the **Water Framework Directive (WFD) - Directive 2000/60/EC** which represents the cornerstone of EU water law. This Directive requires Member States to achieve "good status" for all water bodies, including groundwater, establishes River Basin Management Plans (RBMPs), water monitoring and public participation. It mandates integrated water resource management. Furthermore, there is **Groundwater Directive – Directive 2006/118/EC** which is more specific to groundwater protection. The Directive aims to prevent or limit pollutants from entering groundwater. It is interesting that it requires a Member State to set threshold values for pollutants (e.g., nitrates, pesticides). Linked to the WFD, there is also the **Environmental Quality Standards Directive (EQSD)**. It sets out environmental quality standards (EQSs) for the presence in surface water[1] of certain substances or groups of substances identified as priority pollutants because of the significant risk they pose to or via the aquatic environment. Despite its focus on pollution control for surface water, it supports an integrated water management approach that includes groundwater.

A Watch List mechanism was established in 2013 to improve the available information on identifying the substances of greatest concern. Member States must monitor the substances on the list at least once per year for up to four years. The watch list was established in 2015 and updated in 2018, 2020, 2022 and again in 2025.

The Nitrate Directive - Directive 91/676/EEC aims to reduce water pollution from nitrates used for agricultural purposes and prevent any further pollution and it is connected to the WFD as well. It is also focusing on surface water but its aim to reduce nitrate pollution is protecting groundwater from nitrate infiltration as well.

The **Drinking Water Directive – Directive 2020/2184** ensures the safety and quality of drinking water sources. It sets strict chemical and microbiological standards, strengthens protection of water catchments, including groundwater and

[1] https://eur-lex.europa.eu/EN/legal-content/summary/environmental-quality-standards-applicable-to-surface-water.html#keyterm_E0001

encourages risk-based approaches and public access to information. In addition, with **Urban Wastewater Treatment Directive – Directive 91/271/EEC** which protects groundwater indirectly by regulating sewage and stormwater, prevents leaching of pollutants into groundwater from untreated or poorly treated wastewater, encourages risk-based approaches and management of sewer systems, especially in urban areas.

The Water Reuse Regulation – Regulation EU 2020/741 on minimum requirements for water reuse sets out harmonised parameters to guarantee the safety of water reuse in agricultural irrigation, with the aim of encouraging this practice and helping to address droughts and water stress. It created minimum requirements for water quality and monitoring along with rules on risk management, for the safe use of reclaimed water for agricultural irrigation in the context of integrated water management.

Lastly, **Industrial Emissions Directive – Directive 2010/75/EU** applies to large-scale industrial activities as it requires permits that include groundwater protection measures (under IPPC regime), and it mandates monitoring and remediation in case of contamination.

Together, a comprehensive EU legal framework for groundwater protection is formed. They require Member States to monitor groundwater quality, quantity, prevent and reduce pollution and manage water sustainability.

2.1 List of relevant EU level regulations

Table 2: List of relevant regulations and their abbreviations (if official abbreviation is available).

Name in English	Abbreviation
Water Framework Directive	WFD
Groundwater Directive	GWD
Drinking Water Directive	DWD
Urban Wastewater Treatment Directive	UWWTD
Industrial Emissions Directive	IED
Environmental Quality Standards Directive	EQSD
Nitrates Directive	ND
Infrastructure for Spatial Information in the European Community (INSPIRE) Directive	INSPIRE
Water Reuse Regulation	Water Reuse

2.2 List of relevant EU level regulation elements.

Table 3: EU level regulation elements.

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Groundwater in general	WFD 2000/60/EC	Good chemical status, sustainable quantitative status (balance abstraction/recharge)	Directive	EU
Protection	GWD 2006/118/EC	Pollution prevention; reversal of upward trends; threshold values for pollutants	Directive	EU
Outline of groundwater bodies	WFD + GIS under RBMP	Definition of groundwater bodies; analysis in River Basin Management Plan (RBMP)	Directive + RBMP process	EU / Member State
Groundwater management	WFD 2000/60/EC	Integrated catchment planning via RBMPs	Directive	EU / Member State
Aquifer sustainability planning	WFD Annex V requirements	Plans to prevent over-abstraction; ensure long-term supply	Directive + RBMP	EU / Member State
Climate change adaptation	WFD Article 4 exemptions	Flexible objectives; shifting baselines, exemptions under Article 4(4), 4(5), 4(7)	Directive	EU / Member State

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Data management and information sharing	WFD + INSPIRE + FAIR principles	Monitoring, reporting, trans-boundary coordination	Directive, Open data regulations	EU/ Member State
Quantity	WFD quantitative status	Balance abstraction and recharge; no deterioration	Directive	EU
Private use	WFD / National transposition	Member states define abstraction rules and permits	National legislation	Member State
Public water supply	Drinking Water Directive 2020/2184	Drinking-water quality standards; microbiological/chemical requirements	Directive	EU
Monitoring of groundwater usage	WFD + GWD	Trend monitoring; detect significant upward trends; quality and quantity monitoring	Combined Directives	EU / Member State
Registration of installations	WFD implementation at the national level	Abstraction installations to be registered	National regulation	Member State
Discharge into surface waters	WFD and GWD	Controls on point source discharges to groundwater or into aquifers	Directive + national laws	EU / Member State

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Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Thermal use	Varies (e.g. national licensing)	Permit regimes, temperature limits, distances	National law, sometimes based on EU general environmental acquis	Member State
Temperature difference	National transpositions	Limits on allowed temperature change from injections	National regulation	Member State
Minimum/maximum infiltration temperature	National rules	Defined in permits where infiltration allowed	National Regulation	Member State
Permits for groundwater heat pumps	National licensing schemes	Environmental impact assessments required	National Regulation	Member State
Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	National spacing rules	Permitted buffer zones versus buildings, wells, public infrastructure	National regulation	Member State
Minimum distance to neighbouring thermal	National transposition of WFD/GWD	Buffer zone to prevent thermal/hydraulic interference	National legislation or national technical standards	Member State

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Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
groundwater installations				
Minimum distance between pumping and reinjection site	National regulation	Avoid hydraulic interference	National regulation	Member State
Rainwater management	WFD + national planning	Sustainable urban drainage, infiltration systems	RBMP, national guidelines	Member State
Flood risk	Floods Directive 2007/60/EC	Preliminary risk assessments, hazard & risk maps, management plans	Directive	EU / Member State
Sponge city				
Infiltration of rainwater	National standards	Separation of infiltration systems from groundwater bodies	National regulation	Member State
minimum distance to MHGW	National transposition of WFD/GWD	Maintain buffer to prevent hydraulic or thermal interaction near zones with high groundwater	National legislation, permitting guidelines, technical standards	Member State
minimum distance to buildings	National spacing rules	Prevent structural damage and contamination	National regulation	Member State
types of infiltration systems	National guidelines	Allowed: infiltration trenches, basins, soakaways, infiltration wells	National technical standards	Member State
Drainage of rainwater into sewers	WFD + urban runoff rules	Combined sewer overflow controls	National legalisation	Member State

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Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Construction in groundwater	WFD + national planning	Dewatering, site contamination, groundwater level control	National permitting regimes	Member State
Backwash	National standards	Waste water from filters, polls discharge thresholds	National environmental law	Member State
Ground breakings affecting groundwater	National environmental assessments	Baseline studies; impact mitigation	National EIA-type	Member State
Dewatering during construction	WFD + national law	Authorisations required; restoring levels post-work	National permitting regimes	Member State
Groundwater extremes	WFD + Floods Directive	Adaptation to floods and droughts; integrate both protections	Directive / RBMP / national law	EU / Member State
Groundwater flooding	Floods Directive	Risk assessment and planning; emergency management	Directive + national plans	EU / Member State
Low groundwater levels	WFD quantitative status	Abstraction reduction when recharge below threshold	Directive	EU / Member State
Drinking water				
- Protection	Drinking Water Directive / WFD	Source protection zones; chemical & microbial limits; risk assessments	Directive + RBMP + national law	EU / Member State

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Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
- Construction	National transposition	Well construction standards, protection zones	National regulation	Member State
- Thermal use	National licensing	Thermal remediation, reinjection limits	National law	Member State
Re-use of water	Water Reuse Regulation + WFD + national rules	Re-use under quality standards/permits	Directive/National law	Member State
Ecology	WFD ecological status + GWD	Maintain dependent ecosystems; no chemical deterioration	Directive	EU

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3 Pilot cities

3.1 Linz

The Austrian Water Rights Act (WRG) establishes the fundamental national legal framework for groundwater protection, extraction permits, environmental quality objectives, and monitoring requirements for Austria. This comprehensive federal legislation is complemented by specialised decrees including the Drinking Water Decree (TWV), General Wastewater Emissions Decree (AAEV) and Quality Objective Decrees for both groundwater and surface water chemistry. Especially the National Water Management Plan Decree (NGPV) implements EU Water Framework Directive requirements through integrated planning and monitoring programs for Austria's groundwater bodies.

A distinctive feature of Austria's system is the extensive network of technical guidance documents that translate legal requirements into practical implementation standards. The Austrian Association for Gas and Water (ÖVGW) provides crucial technical guidelines covering water loss control, emergency supply, technical monitoring, and protection zones. Similarly, the Austrian Water and Waste Management Association (ÖWAV) publishes detailed rule sheets addressing thermal groundwater use, deep drilling, groundwater protection during mining, and numerical modelling. These technical documents establish industry best practices that are widely adopted and often referenced in permit conditions.

Upper Austria has developed a comprehensive state-level regulatory framework that builds upon federal foundations while addressing regional characteristics. The state's Water Supply Act (WVG) establishes public water supply through municipalities and cooperatives, while the Regional Program for Deep Groundwater (RPTG) specifically protects deep aquifers for municipal drinking water supply. Spatial planning integration occurs through the Spatial Planning Act (ROG) and Building Act (BauO), which prohibit development in flood-prone areas and require flood-protected construction in hazard zones. The state has created specialised guidelines including the Groundwater Priority Guideline (LVGW) and Drinking Water Protection Areas Guideline (TWSG-LL) that provide detailed frameworks for identifying, zoning, and protecting groundwater catchment areas.

On municipality level, Linz has implemented specific municipal ordinances that address local groundwater management and protection needs.

3.1.1 Regulation Glossary for Austria

Table 4: List of the different levels of legal instruments and their regulation levels in Austria.

English term	German term	Remark	Example
Act	Gesetz	Binding on the country level	WRG
Decree	Verordnung	Binding on the country level	TWV
Ordinance	Verordnung	Binding on the state or municipal level	Kanalordnung Linz
Technical guidance	Richtlinie	the Gas Industry Act (GWG) states the compliance ("state of the art") with ÖVGW set of rules, therefore they can be considered as binding	ÖVGW Technical guidance
Rule Sheet	Regelblatt	Not automatically binding; but binding if 1) referenced in legislation; 2) incorporation in individual water-law permits; 3) recognition by courts as state of the art	ÖWAV rule sheets
Guideline & Information sheet	Leitfaden & Merkblatt	Externally not binding, some may be binding on administration level	Groundwater Priority Guideline
Standard	Standard	Several German standards or adaptions are also in use in Austria	ÖNORM B 2506

3.1.2 List of relevant regulations in Linz, Austria

Table 5: List of relevant regulations in Linz, Austria, their abbreviations (if official abbreviation is available; project abbreviations are marked in brackets) and their English translation. OÖ – Oberösterreich (Upper Austria).

Name in German	Abbreviation	English translation
Federal		
Acts		
Wasserrechtsgesetz	WRG	Austrian Water Rights Act
Lebensmittelgesetz	LMG	Food Act
Umweltförderungsgesetz	UFG	Environmental Support Act
Gemeinde-Wasserversorgungsgesetz	GemWVG	Municipal Water Supply Act
Gaswirtschaftsgesetz	GWG	Gas Industry Act
Mineralrohstoffgesetz	MinRoG	Mineral Raw Materials Act
Umweltinformationsgesetz	UIG	Environmental Information Act
Decrees		
Trinkwasserverordnung	TWV	Drinking Water Decree
Allgemeine Abwasseremissionsverordnung	AAEV	General Wastewater Emissions Decree
Qualitätszielverordnung Chemie Grundwasser	QZV Chemie GW	Quality Objective Decree for Groundwater Chemistry
WRG-Gefahrenzonenplanungs-verordnung	WRG-GZPV	WRG Hazard Zoning Ordinance
Qualitätszielverordnung Chemie Oberflächengewässer	QZV Chemie OW	Quality Objective Decree for Surface Water Chemistry
Qualitätszielverordnung Ökologie Oberflächengewässer	QZV Ökologie OG	Quality Objective Decree for Surface Water Ecology
Gewässerzustands-überwachungsverordnung	GZÜV	Decree on the Monitoring of the Quality of Water Bodies
Nationale Gewässerbewirtschaftungsplan Verordnung	NGPV	National Water Management Plan Decree

Technical guidance		
ÖVGW Richtlinie W 72: Schutz- und Schongebiete	W72	ÖVGW Technical guidance W 72: Protection and Conservation Zones
ÖVGW Richtlinie W 59: Technische Überwachung von öffentlichen Trinkwasserversorgungsanlagen	W59	ÖVGW Technical guidance W 59: Technical monitoring of public drinking water supply facilities
ÖVGW Richtlinie W 63: Wasserverluste in Trinkwasserversorgungssystemen – Ermittlung, Bewertung und Maßnahmen	W63	ÖVGW Technical guidance W 63: Water losses in drinking water supply systems – determination, assessment, and measures
ÖVGW Richtlinie W 74: Trinkwassernotversorgung	W74	ÖVGW Technical guidance W 74: Emergency Drinking Water Supply
ÖVGW Richtlinie W 77: Bereitstellung von Löschwasser	W77	ÖVGW Technical guidance W 77: Provision of firefighting water
Rule Sheets		
ÖWAV Regelblatt 35: Einleitung von Niederschlagswasser in Oberflächengewässer	RB35	ÖWAV Rule Sheet 35: Discharge of stormwater into surface water bodies
ÖWAV Regelblatt 45: Oberflächenentwässerung durch Versickerung in den Untergrund	RB45	ÖWAV Rule Sheet 45: Surface Water Drainage through Infiltration into the Subsoil
ÖWAV Regelblatt 207: Thermische Nutzung des Grundwassers und des Untergrunds - Heizen und Kühlen ÖWAV-Arbeitsbehelf 43: Leitfaden zur Anwendung der	RB207 AB43	ÖWAV Rule Sheet 207: Thermal Use of Groundwater and Subsurface - Heating and Cooling

Thermalfahnenformel des ÖWAV-Regelblatts 207		ÖWAV Guideline 43: Guidelines for Application of the Thermal Plume Formula of ÖWAV Regulation Sheet 207
ÖWAV Regelblatt 213: Tiefbohrungen zur Wassergewinnung	RB213	ÖWAV Rule Sheet 213: Deep drilling for water extraction
ÖWAV Regelblatt 217: Schutz des Grundwassers beim Abbau von Sand und Kies	RB217	ÖWAV Rule Sheet 217: Protection of groundwater during sand and gravel extraction
ÖWAV Regelblatt 218: Brunnen in gespannten Grundwässern – Neuerrichtung, Sanierung und Rückbau	RB218	ÖWAV Rule Sheet 218: Wells in confined groundwater – new construction, rehabilitation, and decommissioning
ÖWAV Regelblatt 219: Tiefengrundwasserbewirtschaftung zum Zweck der Trinkwasserversorgung	RB219	ÖWAV Rule Sheet 219: Deep groundwater management for the purpose of drinking water supply
ÖWAV-Regelblatt 222: Numerische Modellierung von Porengrundwasserleitern	RB222	ÖWAV Rule Sheet 222: Numerical modelling of porous aquifers
Standard		
Regenwasser-Sickeranlagen für Abläufe von Dachflächen und befestigten Flächen, ÖNORM B 2506	ÖNORM B2506	Rainwater Infiltration Systems for Runoff from Roof Surfaces and Paved Areas, ÖNORM B 2506
Wasserversorgung - Anforderungen an Wasserversorgungssysteme und deren Bauteile außerhalb von Gebäuden, ÖNORM B 2538	ÖNORM B2538	Water Supply - Requirements for Water Supply Systems and Their Components Outside of Buildings, ÖNORM B 2538
Technische Überwachung von öffentlichen	ÖNORM B2539	Technical surveillance of water supply systems, ÖNORM B 2539

Trinkwasserversorgungsanlagen, ÖNORM B 2539		
Gewässerschutz an Straßen, RVS 04.04.11	RVS 04.04.11	Water Protection on Roads, RVS 04.04.11
Bemessung von Regen-rückhalteräumen, DWA-A 117	DWA-A 117	Dimensioning of Rainwater Retention Areas, DWA-A 117
Anlagen zur Versickerung von Niederschlagswasser, DWA-A 138	DWA-A 138	Facilities for the Infiltration of Precipitation Water, DWA-A 138
State		
Acts		
OÖ. Raumordnungsgesetz	ROG	Spatial Planning Act Upper Austria
OÖ. Wasserversorgungsgesetz	WVG	Upper Austrian Water Supply Act
OÖ. Abwasserentsorgungsgesetz	AEG	Upper Austrian Sewage Disposal Act
OÖ. Umweltinformationsgesetz	UIG	Upper Austrian Environmental Information Act
OÖ. Bodenschutzgesetz	BSG	Upper Austrian Soil Protection Act
OÖ. Bauordnung	BauO	Upper Austrian Building Act
OÖ. Straßengesetz	STG	Road law Upper Austria
OÖ. Landes-Verfassungsgesetz	LVG	Upper Austrian Provincial Law
OÖ. Bautechnikgesetz	BTG	Upper Austrian Building Technical Act
Ordinance		
OÖ. Verordnung für Regionalprogramm Trinkwassernutzung aus Tiefengrundwässern	(RPTG)	Upper Austrian Regulation for the Regional Program for Drinking Water Use from Deep Groundwater
Verordnung des Landeshauptmanns von Oberösterreich über die Geschäftseinteilung des Amtes der	LGBl-31/2022	Ordinance of the Governor of Upper Austria on the Organization of the Office of

Oberösterreichischen Landesregierung		the Provincial Government of Upper Austria
Technical guidance		
Kiesleitplan für den OÖ. Zentralraum	KLP-Z	Gravel Management Plan for the Upper Austrian Central Region
Guidelines & Information sheets		
Leitlinie Vorrang Grundwasser	(LVGW)	Groundwater Priority Guideline
Leitfaden für Trassenauswahlverfahren der OÖ Abteilung Raumordnung	(LTVRO)	Technical guidance for Route Selection Procedures of the Upper Austrian Department of Spatial Planning
Trinkwasser-Schutzgebiete Leitlinie für Oberösterreich	(TWSG-LL)	Drinking Water Protection Areas Guideline for Upper Austria
Leitfaden zur Verbringung von Niederschlagswässern von Dachflächen und befestigten Flächen in Oberösterreich	(LFNW)	Guideline for the Management of Stormwater from Roofs and Paved Surfaces in Upper Austria
Leitfaden zum Weg zu einem Trinkwasser-Schutzgebiet	(LWTWSG)	Guideline to Establishing a Drinking Water Protection Area
Merkblatt zu Einreichunterlagen für Wasserversorgungsanlagen	(MEWVA)	Information Sheet for Application Documents for Water Supply Installations
Merkblatt Heizen und Kühlen mit Grundwasser	(MHKG)	Information Sheet for Heating and Cooling with Groundwater
Municipal		
Ordinance		
Kanalordnung Linz	(KOL)	Linz Sewer System Ordinance
Grundwasserschongebiets- verordnung Scharlinz	GWSG-VO Scharlinz	Groundwater Protection Area Ordinance Scharlinz

Grundwasserschongebiets-verordnung Urfahr	GWSG-VO Urfahr	Groundwater Protection Area Ordinance Urfahr
Grundwasserschongebiets-verordnung St. Georgener Bucht	GWSG-VO St. Georgener Bucht	Groundwater Protection Area Ordinance St. Georgener Bucht
Verordnung des Gemeinderates der Landeshauptstadt Linz über die Verwendung von Auftau- und abstumpfenden Streumitteln	Winterdienst-VO	Ordinance of the Municipal Council of the State Capital Linz on the Use of De-icing and Gritting Materials
Verordnung über Grabungs- und Aufbrucharbeiten auf gemeindeeigenen Verkehrs- und Grünflächen der Stadt Linz	(GA-VO)	Ordinance on Excavation and Break-up Works on Municipal Traffic and Green Areas of the City of Linz
Bebauungsplanänderung, Ediktalverordnung Nr. 2 and Nr. 3	BBV/B-Ediktal2 and 3	Amendment to the zoning plan, Edictal Ordinance No. 2 and No. 3
Verordnung über den Schutz der öffentlichen Parkanlagen, Grünanlagen und Spielplätze	Grünanlagen verordnung	Ordinance on the Protection of Public Parks, Green Areas and Playgrounds

3.1.3 Regulation elements in Linz, Austria

Table 6: List of regulation elements and the current regulations in Linz, Austria.

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Groundwater in general				
Protection	Obligatory	WRG protects groundwater through protection zones, environmental quality objectives, discharge restrictions, monitoring requirements, and preventive measures against contamination and deterioration.	WRG §§ 30, 32, 33, 34, 35, 59	Federal
	Obligatory	LVG establishes important constitutional principles for environmental and water protection that provide the framework for groundwater regulation in the province.	LVG §§ 10	State
	Obligatory	BSG takes a comprehensive approach to groundwater protection through soil protection measures.	BSG §§ 1, 14, 18	State
	Obligatory	STG designates that roads for public use must be carried out with the greatest	BSG §§ 11, 13	State

	Recommended	possible consideration for the protection of nature including water. RB217 addresses groundwater protection during sand and gravel mining operations. It aims to balance different usage interests between the construction industry's raw material needs and environmental protection requirements.	RB217	Federal
Outline of groundwater bodies	Obligatory	WRG requires groundwater body inventories detailing hydrogeology, anthropogenic pressures, socioeconomic factors, then identifying groundwater bodies' spatial boundaries per Annex B and updating delineations using monitoring results. Implementation of the EU Water Framework Directive.	WRG §§ 55d	Federal
	Obligatory	NGPV describes groundwater body designation and management by establishing a systematic approach to groundwater management by defining how Austria's aquifers are divided into manageable units	NGPV section 1.3	Federal
	Obligatory	GZÜV provides the detailed technical framework for groundwater body	GZÜV Annex 13 lists all current	Federal

		designation and monitoring. This regulation specifies: 1) Criteria for groundwater body delineation and designation; 2) Parameters to be monitored in each groundwater body 3) Frequency and methods for monitoring programs 4) Data processing and reporting requirements.	groundwater bodies	
	Obligatory	The UIG establishes the right of public access to environmental information, including data on groundwater levels and spring discharges. This legal framework directly requires that such information be actively published and made easily accessible through eHYD, Austria's official portal for hydrological data.	UIG §§ 4, 5, 12	Federal
Groundwater management				
Aquifer sustainability planning	Obligatory	NGPV implements EU Water Framework Directive requirements through integrated planning, monitoring, and measures for groundwater protection, sustainable abstraction, and quality	NGPV Section 1.3, 2.2, 4.1.3, 6.5 and 6.7	Federal

	Relevant for Funding	maintenance across Austria's groundwater bodies UFG directly supports Austrian aquifer sustainability by funding water management, protection measures, and ecological improvement projects	UFG §§ 7,16,17,18,22	Federal
Climate change adaptation	Obligatory	NGPV covers risk analysis and sustainability assessments taking account the following aspects related to climate change: Impact assessment of rising temperatures on groundwater resources, Evaluation of increased evaporation and water demand, Assessment of thermal impacts from groundwater heat pumps.	NGPV section 2.2.4	Federal
	Relevant for Funding	With climate change threatening groundwater resources, the UFG specifically supports climate adaptation measures for water systems, addressing challenges identified in studies like "Austria's Water Treasure" that project varying groundwater availability scenarios through 2050.	UFG §§ 16,18,	Federal

Data management and information sharing	Obligatory	WRG mandates the Wasserinformationssystem (WISA) as Austria's central hydro-data system, collects groundwater status, uses monitoring networks and electronic registers, supports planning, EU reporting, and ensures public access.	WRG §§ 59	Federal
	Obligatory	Upper Austria operates its own Water-Information-System WIS OÖ. It mirrors the federal WISA database, holds the water-book, monitoring and permit data, and is anchored administratively in the province's water-management tasks while relying on the WRG for data duties and public access.	WVG §§ 11 AEG §§ 37 UIG §§ 59 LGBl-31/2022 §§ 1	State
Quantity	Obligatory	WRG regulates groundwater extraction permits, establishes environmental objectives, limits extractions protecting water bodies, sets 300-liter-per-minute permit thresholds.	WRG §§ 10, 30c, 55e, 99	Federal
	Obligatory Recommended	ÖVGW W 59,63,74,77 and ÖWAV RB207, RB213, RB218, RB219, RB222 establish comprehensive guidance for water loss	W59 W63 W74	Federal

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		control, emergency supply, technical monitoring, deep groundwater management, numerical modelling, well construction, and deep drilling - ensuring sustainable groundwater quantity management nationwide	W77 RB213 RB218 RB219 RB222	
Private use	Obligatory	Private groundwater use is regulated through exemptions in WRG, allowing landowners to use groundwater without permits if extraction uses hand-operated pumps or quantity is proportionate to property size.	WRG §§ 10	Federal
Public water supply	Obligatory	WRG provides detailed regulations for water cooperatives (Wassergenossenschaften) and water associations (Wasserverbände). These entities serve as crucial intermediaries between individual users and public authorities in Austria's water management system.	WRG §§ 73-86, 87-97	Federal
	Obligatory	WVG establishes public water supply managed through municipalities and cooperatives as non-profit operators, with	WVG §§ 1, 3, 4, 5, 9, 10, 11	State

		mandatory connection obligations, territorial zones, and subsidized infrastructure development.		
	Obligatory	Secures quality and quantity of deep groundwater aquifers for municipal drinking water supply and emergency disaster response situations	RPTG	State
Monitoring of groundwater usage	Obligatory	WRG controls groundwater extraction via permits, mandatory meters, test-pumping, reinjection rules and nationwide monitoring programmes ensuring quantitative and chemical integrity.	WVG §§ 10, 32, 56-57, 59c-59g, 55e, 103	Federal
Registration of installations	Obligatory	WRG regulates registration of water rights, permits, and authorisations. Articles cover the water book as registry, the management of the registry, notification procedures and inspections/updates.	WVG §§ 114, 124, 125, 126	Federal
	Obligatory	MEWVA is a guideline detailing submission requirements for water supply system permits. It assists applicants and planners in obtaining	MEWVA ÖNORM B2538	State Federal

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		water rights permits for drinking and utility water supply facilities, specifying necessary technical reports, plans, and documentation. determination of current and future water demand. It refers for example to ÖNORM B2538 for determination of current and future water demand.		
Discharge into surface waters	Obligatory Obligatory	Under WRG, the discharge of extracted groundwater into surface waters is possible, but subject to strict regulations. Any activities affecting water bodies that could impair their quality require water rights permits, see QZV ChemieOW. The QZV ChemieOW is the central regulatory framework for ensuring the good chemical status of surface water. It establishes threshold values for pollutants, assessment and monitoring criteria.	WVG §§ 32 QZV Chemie OG	Federal Federal

Thermal use				
Temperature difference	Recommended	The maximum allowable temperature change is 6 °K between extracted and reinjected groundwater.	RB207 AB43 MHKG	Federal State
Minimum/maximum infiltration temperature	Recommended	Groundwater temperatures at the injection point must not fall below 5 °C or exceed 20 °C.	RB207 AB43 MHKG	Federal State
Permits for groundwater heat pumps	Obligatory	In Upper Austria, permits for geothermal installations are governed primarily by the WRG at the state level and—when drilling exceeds 300 m—by the MinRoG.	WRG, see registration section	Federal
Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	Recommended	a. ≥ 1 m all building structures; b. according to protection zones, prohibited in I and II; Zone III requires special conditions. C. ≥ 1.5 m to other wells; D. ≥ 1 m for general installations.	RB207 AB43 MHKG	Federal State
Minimum distance to neighbouring thermal groundwater installations	Recommended	5-10 m; depending on thermal interaction, numerical modelling might be required.	RB207 AB43 MHKG	Federal State

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Minimum distance between pumping and reinjection site	Recommended	Pumping/Reinjection Separation Formula: a = 0.6×Q/(J×kf×H) with Q = flow rate (m^3/s), J = groundwater gradient, kf = permeability coefficient (m/s), H = aquifer thickness (m); also, minimum 8 m vertical separation.	RB207 AB43 MHKG	Federal State
Rainwater management				
Flood risk	Obligatory	The WRG-GZPV establishes standardized hazard zone planning for flood risk areas, creating color-coded zones to guide building restrictions and land-use decisions.	WRG-GZPV §§ 1,2,8,9,10	Federal
	Obligatory	ROG prohibits building land designation in HQ30 areas, conditionally allows HQ100 construction with flood protection, considering WRG-GZPV hazard zone classifications.	ROG §§ 2,21,30	State
	Obligatory	BauO requires like ROG flood-protected construction in HQ100 areas and hazard zones, with mandatory building site permits considering current hazard conditions and WRG-GZPV classifications.	BauO §§ 5,28	State

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	Obligatory	The BTG establishes comprehensive flood protection requirements through its central provision regarding Flood-Protected Design of Buildings.	BTG §§ 47	State
Sponge city	Regulation to be expected	A revision of RB45 is expected in Fall 2025 that is most likely going to consider the sponge city concept. The legal instruments may be mentioned as foundation for sponge city implementation.	RB45	Federal
	Obligatory	According to AAEV, uncontaminated or slightly contaminated rainwater should be directed to natural surface and underground drainage before entering the sewage system. This regulation provides the legal foundation for sponge city principles by prioritizing natural water cycle restoration.	AAEV §§ 3	State
	Obligatory	The Grünanlagenverordnung prohibits vehicle traffic on green spaces, preventing soil compaction to maintain natural permeability for effective stormwater absorption and water retention.	Grünanlagenver-ordnung	Municipal

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	Obligatory	BBV/B-Ediktal 2 and 3 regulate green roofs for new buildings over 100 m², tree planting for large lots, increased green-space ratios and native soil preservation.	BBV/B-Ediktal2 and 3	Municipal
Infiltration of rainwater	Obligatory	RB45 helps clarify when water law permits are required for infiltration, based on factors such as area size, land use, and potential impact on groundwater.	RB45	Federal
	Obligatory	RB35 applies to the drainage of stormwater from roof surfaces, traffic areas, and other sealed surfaces, except for heavily trafficked roads with very high traffic volumes.	RB35	Federal
	Obligatory	It sets out the state-of-the-art standards for managing surface water by allowing it to infiltrate into the ground, rather than discharging it directly into surface waters or sewer systems.	ÖNORM B 2506	Federal
	Obligatory	LFNW prioritizes infiltration of stormwater into groundwater with appropriate pre-treatment based on surface contamination levels]. It categorizes surfaces into five types (F1-F5), see AAEV, requiring different treatment approaches,	LFNW	State

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	Obligatory	promotes blue-green infrastructure concepts, and mandates water rights permits for larger or more contaminated areas while emphasizing natural water cycle restoration. A fundamental principle established by the KOL is that uncontaminated or only slightly contaminated rainwater must not be discharged into the public sewer system.	KOL	Municipal
minimum distance to MHGW	Obligatory	The required distance from the lowest point of the infiltration system to the highest relevant groundwater level must be at least 1 m of undisturbed soil. Determination of MHGW: Use long-term gauge records; where data are lacking, Linz authorities accept hydrographic maps from DORIS or a local groundwater level adjusted for seasonal fluctuation)	ÖNORM B 2506	Federal Comment for municipality
minimum distance to buildings	Obligatory	Buildings with basements: 1.5 × foundation or basement depth (horizontal measure); Buildings without basements / other structures: ≥ 6 m	DWA-A 138 used in Upper Austria	State

		recommended; Property boundary (neighbouring parcel): ≥ 1 m, and no surface runoff onto neighbouring land		
types of infiltration systems	Obligatory	The pollution potential of the source area dictates the system type: F1 – Low Pollutant Load - Infiltration shaft; gravel infiltration trench; F2 – Low/Moderate Load - Swale with gravel infiltration trench; soil-filter swale; technical filters; F3 – Moderate Load - Soil filter (≥ 30 cm), swale, technical filters; infiltration shaft not allowed; F4/F5 – High Load - Only area-wide soil filters or certified technical filter systems; point infiltration prohibited	RB45	Federal
Drainage of rainwater into sewers	Obligatory	If infiltration is not possible (e.g., due to impermeable ground), the water must be retained and discharged in a controlled (restricted) manner into a surface water body or a stormwater sewer. The design is carried out according to DWA-A 117	AAEV §§ 3;4 LFNW DWA-A 117	State

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Construction in groundwater				
Backwash	Obligatory Obligatory	The WRG permits planned changes to the groundwater level caused by water-use structures but (1) the affected land must remain usable in its customary manner and (2) the landowner receives adequate compensation for any anticipated deterioration in soil quality or groundwater conditions. LVGW states within zones I (Kernzone) and II (Randzone), any constructed object that may lower the water table (e.g., wells, drainage, backwash return lines) triggers a water-rights procedure that 1) requires a permit under WRG; 2) Must demonstrate that the land remains usable in its pre-existing manner; 3) is subject to spatial planning reviews.	WRG §§ 10 LVGW	Federal State
Ground breakings affecting groundwater	Obligatory	Excavations affecting groundwater require WRG permits and must protect quantity and quality.	WRG §§ 10,40,56	Federal

Dewatering during construction	Obligatory	Groundwater dewatering (Bauwasserhaltung) during construction is governed by WRG requiring a water-use permit (Bewilligung). The district administrative authority issues permits and may impose additional requirements when dewatering affects protected groundwater zones or sensitive areas.	WRG §§ 40	Federal
Groundwater extremes				
Groundwater flooding	Obligatory	Under the WRG, municipalities must produce danger-zone plans identifying areas subject to inundation, including where high groundwater contributes to surface flooding. These plans inform regional water-management programs, which in turn feed into land-use and building rules at the state level, ensuring that areas of groundwater-driven flooding are treated identically to surface floodplains.	WRG §§ 3,9,10,32,39,55	Federal
	Obligatory	BauO plot approval is refused when high groundwater threatens building	BauO §§ 5	State

	Obligatory	suitability, preventing development on sensitive sites and indirectly safeguarding aquifers from sealing or contamination under law. The ROG integrates natural-hazard avoidance and site-suitability principles into spatial planning, thereby prohibiting development on sites prone to groundwater flooding.	ROG §§ 2,18,21	State
Low groundwater levels	Obligatory	The WRG is enabling emergency orders for temporary use of public and private water bodies and equitable redistribution of scarce groundwater in the public interest.	WRG §§ 25,71	Federal
	Obligatory	The GemWVG establishes binding legal foundations for municipalities to restrict water withdrawals, ensure minimum supply, and thus safeguard the public interest (drinking-water and utility-water supply) in cases of water scarcity, particularly during groundwater drought.	GemWVG §§ 4,5	Federal

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Drinking water				
Protection	Obligatory	The TWV is connected to groundwater quality protection by considering comprehensive quality parameters and monitoring systems specifically designed to safeguard groundwater-derived drinking water.	TWV §§ 3–10,13–17,18–23,41–49	Federal
	Obligatory	LMG defines water as a foodstuff, safeguarding groundwater resources through hygiene standards, monitoring, protected zones, use restrictions, and water supply oversight.	LMG §§ 3,11,12	Federal
	Obligatory	QZV Chemie GW sets pollutant thresholds, defines good chemical status, prohibits deterioration and limits contaminant inputs, thereby safeguarding groundwater quality for safe public drinking-water supply.	QZV Chemie GW	Federal
	Obligatory	The WRG regulates protection areas (Schutzgebiete) by enabling water authorities to impose land use restrictions, prohibitions, and compensation requirements, while	LMG §§ 34,35	Federal

			conservation areas (Schongebiete) require notifications or permits for activities affecting water quality or quantity.		
		Obligatory	ÖVGW W 72 defines drinking water protection: Schutzzone I for capture protection, Schutzzone II 60-day bacteriological safeguard, Schutzzone III chemical barrier; Schongebiete overlay the catchment with regulatory restrictions enforced.	ÖVGW W 72	Federal
		Obligatory	Those guidelines mandate identifying, zoning and prioritizing groundwater catchment areas, defining protective zones and integrating drinking-water safeguarding measures into spatial planning.	LVGW TWSG-LL LTVRO LWTWSG KLP-Z RVS 04.04.11	State
		Obligatory	These three ordinances establish groundwater protection zones, protecting water supply infrastructure through strict regulatory frameworks that restrict industrial activities and control land use to prevent contamination.	Groundwater Protection Area Ordinance Scharlinz Groundwater Protection Area Ordinance Urfahr	Municipal

	Obligatory	Both ordinances establish critical protective barriers against groundwater contamination that could compromise drinking water safety. These ordinances specifically prohibit activities near unsealed soil areas and mandate proper restoration procedures to prevent pollutant infiltration into groundwater systems.	Groundwater Protection Area Ordinance St. Georgener Bucht Winterdienst-VO GA-VO	Municipal
	Obligatory	Establishes the Austrian standard for technical surveillance of public drinking water supply systems. The standard mandates self-monitoring and technical inspections per § 134 WRG for all system components. It requires operators to maintain facilities according to state-of-the-art technology, ensuring proper operation and preventing water contamination through trained personnel, systematic maintenance	ÖNORM B 2539	Federal

		documentation, and periodic inspections every five years.		
Construction	Obligatory	Zone I: absolute ban Zone II: prohibited construction of new buildings, public streets, and parking areas; existing building maintenance allowed with limited expansions Zone III: authorization required, some constructions like buildings with wastewater infiltration systems are strictly prohibited.	WRG §§ 34,35	Federal
Thermal use	Obligatory	Zone I: thermal groundwater uses are prohibited Zone II: Strict authorization required, prohibited based on system type Zone III: protection areas apply notification and authorization procedures for thermal installations based on system type and capacity	WRG §§ 10,34,35	Federal

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Re-use of water	Prohibited with exceptions	Re-use of treated wastewater for groundwater recharge is prohibited due to water quality protection concerns. Limited exceptions exist like household wastewater from individual properties in scattered locations outside protection zones, substances in minimal quantities for scientific purposes and cases involving geothermal water, mine water, and construction dewatering	WRG §§ 32	Federal
Ecology	Regulation gap	QZV Ökologie OG focuses exclusively on surface waters and QZV Chemie GW addresses chemical status of groundwater. Direct regulatory connections exist where groundwater pollution impacts surface waters. The QZV Chemie GW specifically requires that pollutant concentrations from groundwater bodies entering connected surface waters must not exceed 50% of pollutant loads in those surface waters	QZV Ökologie OG	Federal

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3.1.4 Regulation gaps in Linz, Austria

A regulatory gap concerns the differences between permitted and actual groundwater extraction rates. The current system allows water extraction permits to be granted for extraordinarily long periods, like multiple decades. This long duration is likely to prevent sustainable water management over time, particularly as climate change could lead to water scarcity as a stress factor. Furthermore, often the extraction rates permitted are higher, than the amounts withdrawn. To improve the information about actual used amounts of water, the Austrian Court of Audit recommends establishing a digital reporting registry for actual water withdrawals to address this critical information deficit. Particular attention is paid to regions projected to face significant climate-induced challenges in water management and the overexploitation of groundwater. A disadvantage is that, in the current planning stage, geothermal plants are expected to be excluded from the extraction register, with the justification that they do not cause an overall quantitative change in groundwater, as the extracted water is reinjected into the aquifer.

Austria faces a regulatory gap in subsurface management characterised by the lack of comprehensive groundwater and underground space management systems. This regulatory gap has created uncoordinated subsurface development, particularly challenging in urban areas and the space-constrained Alpine regions where available surface area is often limited.

Another major regulatory gap involves the integration of innovative urban water management approaches, specifically the sponge city concept, into Austrian stormwater regulations. The ÖWAV Rule Sheet 45 (RB45), which governs surface water drainage through infiltration into the subsurface, is expected to undergo revision in Fall 2025. This revision represents a significant opportunity to incorporate sponge city principles into Austrian water management frameworks. Currently, RB45 focuses primarily on traditional stormwater infiltration approaches, categorizing infiltration systems based mainly on pollutant loads.

The fourth regulatory gap concerns the absence of specific ecological protections for groundwater ecosystems. The Quality Objective Decree for Surface Water Ecology (QZV Ökologie OG) focuses exclusively on surface waters with no provisions extending ecological criteria to groundwater-dependent ecosystems and the Quality Objective Decree for Groundwater Chemistry (QZV Chemie GW) addresses chemical status of groundwater leaving no equivalent regulation for groundwater ecology. This creates a significant regulatory void where groundwater ecosystems lack also ecological protection mechanisms. However, further research should be conducted to provide better criteria for ensuring groundwater ecosystem quality.

Finally, Austria does not have an explicit climate protection law that specifically addresses groundwater as a resource. While Austria has a Climate Protection Act (Klimaschutzgesetz, KSG) that was enacted in 2011, this law focuses on setting emission ceilings for various sectors (energy, transport, buildings, agriculture, waste management and fluorinated gases) without specifically addressing groundwater resources in the context of climate protection.

3.2 Ljubljana

The most important legislation regulating groundwater in Slovenia at the national level is the Water Act (ZV-1). The protection of groundwater used as drinking water is additionally governed by the Drinking Water Regulation and the regulations on water protection zones. Besides these, several other regulations directly or indirectly address the quality of groundwater and soil, such as Environmental Protection Act, the Regulation on the Status of Groundwater, the Soil Protection Ac and the regulations concerning the handling of hazardous substances.

At the level of the City of Ljubljana, groundwater and water management are addressed through the Municipal Spatial Plan (OPN MOL) and local environmental regulations. The Public Utility Company VO-KA SNAGA, which is responsible for drinking water supply, sewage, wastewater management, plays a key role in the water management and participates in the protection of water resources.

At the municipal level, emphasis is also placed on implementing blue-green infrastructure principles (modern urban water management approaches), such as sustainable stormwater retention, the use of groundwater for energy purposes (e.g., geothermal heat pumps), and the prevention of negative impacts of construction projects on the groundwater table.

As part of the water rights permitting system managed by the Slovenian Water Agency (DRSV), groundwater extraction and reinfiltrating at constructions sites as well as the final state of buildings in relation to water regimes are assessed. A water permit is only granted if it can be demonstrated that the intervention will not negatively affect neighbouring properties or the groundwater balance, including assessments of the waterproofing of basement structures and safe distance from the highest recorded groundwater level (HHW), with the prescribed safety margin.

3.2.1 Regulation Glossary for Slovenia

Table 7: List of the different levels of legal instruments and their regulation levels in Slovenia.

English term	Slovenian term	Remark	Example
Constitution	Ustava	Binding	Constitution of the Republic of Slovenia
Act/Law	Zakon	Binding	Water Act
Decree	Uredba	Binding, depending on the legal status and who was issued by	Decree on water protection zones
Regulation	Pravilnik	Binding, depending on the legal status and who was issued by	Drinking water regulation
Decision	Odločba	Binding	ARSO's water permit decision
Ordinance	Odlok	Binding on the municipality level	Odlok o občinskem prostorskem načrtu MOL
Spatial plan	Prostorski načrt	Binding on the municipality level	OPN MOL
Guidelines	Smernice	Not binding	Guidelines for groundwater monitoring
Consent	Dovoljenje/ soglasje	Not binding	Water consent for construction by ARSO
Agreement	Pogodba	Binding between parties	Concession agreement for water use

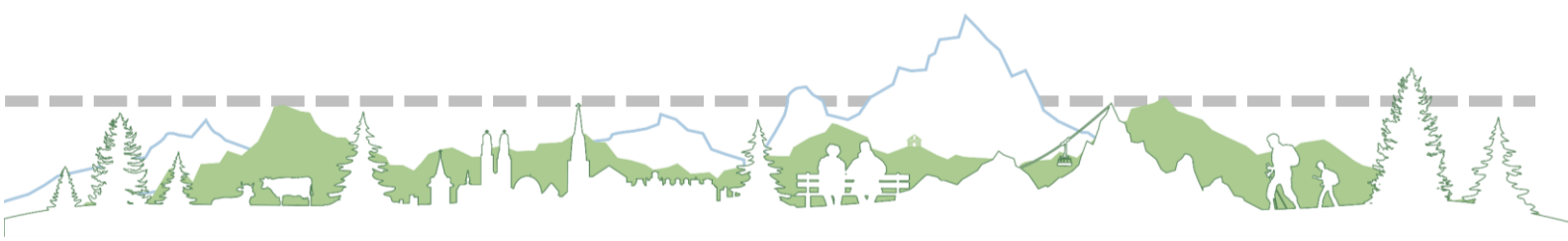
3.2.2 List of relevant regulations in Ljubljana, Slovenia

Table 8: List of relevant regulations in Ljubljana, Slovenia, their abbreviations (if official abbreviation is available) and their English translation.

Name in Slovenian	Abbreviation	English translation
State		
Zakon o vodah	ZV-1	Water Act
Zakon o varstvu okolja	ZVO-2	Environmental protection act
Zakon o varstvu tal		Soil Protection Act

Zakon o urejanju prostora	ZUreP-3	Spatial Planing Act
Zakon o graditvi objektov	GZ-1	Building Act
Uredba o odvajanju in čiščenju komunalne odpadne vode		Regulation on Technical Standards for the Drainage and Treatment of Stormwater
Uredba o vodovarstvenem območju		Decree on Water Protection Zones
Uredba o stanju podzemne vode		Decree on the Status of Groundwater
Pravilnik o pitni vodi		Drinking water regulation
Pravilnik o evidentirani posebni rabi vode		Regulations on recorded special water use
Pravilnik o vsebini vloge za pridobitev vodnega dovoljenja in o vsebini vloge za pridobitev dovoljenja za raziskavo podzemnih voda		Regulation on the content of the application for obtaining a water permit and on the content of the application for obtaining a permit for groundwater research
Smernice za vrtanje v plitvi geotermiji do globine 300 m		Guidelines for drilling for shallow geothermal energy use to a depth of 300 m
Okoljske presoje		Environmental Assessments
Muncipal		
Odlok o občinskem prostorskem načrtu MOL	OPN MOL	Municipal Spatial Plan of Ljubljana
Odlok o oskrbi s pitno vodo		Ordinance on Drinking Water Supply
Odlok o odvajanju in čiščenju komunalne odpadne in padavinske vode		Ordinance on the discharge and treatment of municipal wastewater and stormwater
Lokalni okoljski akcijski načrt		Local Environmental Action Plan (LEAP)

Vodno soglasje in vodno dovoljenje	/	Water Consent and Permit (issued by ARSO)
Občinski prostorski načrt Mestne občine Ljubljana	RBMP	River Basin Management Plan OPN MO



3.2.3 Regulation elements for Ljubljana, Slovenia

Table 9: List of regulation elements and the current regulations in Ljubljana, Slovenia.

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Groundwater in general				
Protection	Binding	Establishes protected zones, prohibits harmful activities near sources	Decree on Water Protection Zones, Environmental Protection Act Art. 5	National
Outline of groundwater bodies	Not directly binding, but operationally binding through RBMPs and linked regulations	Outline of groundwater bodies	River Basin Management Plan OPN MOL	National /Municipal
Groundwater management				
Aquifer sustainability planning	Binding indirectly (through RBMP measures, not as	Ensures long-term sustainable use of aquifers	River Basin Management Plan OPN MOL	National /Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
	a stand-alone obligation)			
Climate change adaptation	Not strictly binding	Targets resilience measures related to water resources	Local Environmental Action Plan (LEAP)	National /Municipal
Data management and information sharing	Binding	Obligation to report and monitor groundwater status	Decree on the Status of Groundwater	National
Quantity	Binding	Sustainable use must not exceed recharge rates	RMBP	National
Private use	Partly binding	Allowed up to 15 m^3/day without permit (for personal needs)	Regulations on recorded special water use	National
Public water supply	Binding	Must follow strictly safety and monitoring protocols	Drinking water regulation	National /Municipal
Monitoring of groundwater usage	Binding	Required for all public and commercial uses	Monitoring programs, user reporting, Water act Art. 55	National
Registration of installations	Binding	All water-related installations must be declared	Water Act	National
Discharge into surface waters	Binding	Must meet quality standards	Water Act	National

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Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Thermal use				
Temperature difference	Not specified	New water use must follow the general principles of water protection defined in the Water Act (it must not degrade groundwater or natural processes, nor restrict or prevent existing uses...).	Water Act	National
Minimum/maximum infiltration temperature	Recommended	In general, re-injected water should not cause a significant change in groundwater temperature (> 3 °C), except in the vicinity of the reinjection point. Re-injected water should not exceed 20 °C.	Guidelines for drilling for shallow geothermal energy use	National
Permits for groundwater heat pumps	Binding	A research permit is required for groundwater investigations using boreholes deeper than 30 m, or when conducted in protected or endangered areas. A water permit is obligatory for large-scale heat pumps (> 16 kW). For small-scale	Water Act/ Building Act/ Regulation on the content of the application for obtaining a water permit and on the	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		heat pumps, the thermal use of groundwater must be registered through a simplified procedure.	content of the application for obtaining a permit for groundwater research	
Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	Not specified	In water protection areas, restrictions are based on distance or travel time (specific). Must follow the general principles of water protection defined in the Water Act.	Decree on Water Protection Zones/ Water Act	National/ Municipal/ Case-specific
Minimum distance to neighbouring thermal groundwater installations	Recommended	The temperature impact on neighbouring water rights should be less than 1 °K, and the hydraulic impact should not exceed 10 cm. Must follow the general principles of water protection defined in the Water Act.	Guidelines for drilling for shallow geothermal energy use/ Water Act	National
Minimum distance between pumping and reinjection site	Not specified			Case-specific

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Rainwater management				
Flood risk	Binding	Construction in flood zones requires adaptation measures	Flood Risk Maps, LEAP	National / Municipal
Sponge city	Not binding	Encourages retention systems, green roofs, permeable surfaces	Municipal planning principles	Municipal
Infiltration of rainwater	Binding	Priority method for stormwater handling where soil allows	Water Act Art. 92 + Municipal ordinances	National / Municipal
minimum distance to MHGW	Conditionally binding	Typically, ≥ 30 cm clearance from HHW (high groundwater)	Construction planning standards	National / Municipal
minimum distance to buildings	Binding, where defined in regulations/ permits	Required to protect foundations and prevent moisture damage	Construction technical guidelines and municipals building codes	Municipal
Types of infiltration systems	Conditionally binding	The requirement that stormwater from impervious surfaces must be infiltrated at the point of origin whenever hydrogeological conditions allow, without	Regulation on Technical Standards for the Drainage and Treatment of Stormwater + Water Act	National / Local practice

MARGIN is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme. **See more about MARGIN at www.alpine-space.eu/project/margin.**

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		deteriorating the chemical status of groundwater		
Drainage of rainwater into sewers	Binding	When planning, building, reconstructing or maintaining facilities in the agglomeration, it is necessary to ensure the planning and implementation of measures to reduce the amount of rainwater discharged into the public sewer system.	Regulation on the discharge and treatment of municipal wastewater	National
Construction in groundwater				
Backwash	Binding	Groundwater quality research is carried out to determine the general state of groundwater quality (water from your own well/borehole),	Regulations on operational monitoring of groundwater status	National / Municipal
Ground breakings affecting groundwater	Binding on a given case	A risk analysis has been carried out when the intended construction is in a water protection area.	Water Act, Building Act	National
Dewatering during construction	Binding	Requires plan for safe dewatering and possible reinfiltrating	Regulation on the discharge and	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
			treatment of municipal wastewater	
Groundwater extremes				
Groundwater flooding	Binding	Flood-prone areas require special construction rules	Flood Risk Mapping and Adaptation, Environmental Protection Act	National / Municipal
Low groundwater levels	Binding	Restrictions during drought periods possible	River Basin Management Plan, Water Act	National
Drinking water				
Protection	Binding	Strict control on land use pollution and monitoring near wells	Drinking Water Regulation + Protection Zones	National
Construction	Binding	Must not endanger water source integrity	Building Act + Water Act	National / Municipal
Thermal use	Binding	Sustainable and regulated extraction and reinjection	Water Act	National

MARGIN is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme. **See more about MARGIN at www.alpine-space.eu/project/margin.**

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Re-use of water	Binding	Encouraged where safe and feasible (e.g., irrigation, cooling)	Water Act	National
Ecology	Binding	Groundwater abstraction must not harm protected habitants	Environmental Assessments, Natura 2000 rules	National / EU- Level

3.2.4 Regulation gaps in Ljubljana, Slovenia

There are several regulatory gaps in Ljubljana, Slovenia.

Firstly, we have weak enforcement of water protection zones as regulations exist but enforcement at the municipal level is inconsistent. There are land-use violations and pollution risks that remain near critical water catchment areas.

Secondly, we have limited integration of groundwater data in spatial and construction planning. Groundwater levels and flow are not systematically included in early project design states which results in issues like groundwater flooding, unstable foundations and unplanned dewatering. There is also a lack of unified permitting framework for groundwater-related activities such as dewatering, infiltration, geothermal systems which require separate permits from multiple bodies (e.g., ARSO, Municipality, VO-KA SNAGA).

Thirdly, in the catchment areas of well fields used for drinking water supply, water protection area decrees apply, setting the restrictions and conditions for the construction of wells and for activities that may pose a risk to groundwater. Although technical guidelines for drilling associated with shallow geothermal energy exist, they are not legally binding (e.g., distances between geothermal wells, buildings and drinking water wells.). These gaps can increase risk of contamination, thermal interference and legal disputes. There are traces of insufficient regulation of geothermal groundwater use in urban settings. Current regulations do not fully address the cumulative impacts of geothermal systems, reinjection temperatures, or the long-term monitoring of thermal impacts on groundwater, all of which pose a risk of unsustainable groundwater use and potential conflicts between systems in densely populated areas.

Lastly, in the current applicable legislation several aspects are not properly addressed. One of these, currently the most problematic environmental problem, is climate change. In the Water Act (Zakon o vodah; ZV-1), there are no explicit mechanisms to manage groundwater during droughts or protection of recharge areas. The collection and management of groundwater data are currently fragmented across institutions. Key stakeholders, including ARSO (Environmental Agency), VO-KA SNAGA (Water supply company) and local authorities operate without an integrated digital groundwater information system. This limits data interoperability and reducing the effectiveness of decision-making, particularly in situations requiring urgent responses (pollution, flooding).

3.3 Milan

National regulations in the fields of environmental and energy law share the common objective of environmental protection and sustainable development. Legislative Decree 152/2006 (D.Lgs. 152/2006) represents the fundamental legal framework, while the other decrees cited below constitute its evolution or integration. All of these establish regulatory and control instruments for the management of natural resources and production activities. A central focus of the legislation concerns the promotion of renewable energy sources and the improvement of its efficiency. The regulations are aimed at supporting Italy's alignment with European environmental, energy, and climate targets. They address the integrated management of water resources and wastewater, setting out principles for water conservation and quality of both surface and groundwater. They also establish criteria for the protection of water resources in cases of environmental emergencies, with specific attention to the use of water for energy production (hydroelectric and geothermal applications).

Regulations at the regional level govern the organisation of the integrated water service, which includes the activities of abstraction and drinking water distribution, as well as the treatment of wastewater. They define regional and local planning frameworks to ensure the efficient, equitable, and sustainable use of water resources. A common principle is the protection of the quality of surface and groundwater, the prevention of pollution, and compliance with national environmental standards. Furthermore, they establish forms of regional participation and oversight to ensure the proper functioning of the service and the effectiveness of infrastructure investments.

At the municipal level, regulations are all based on the assumption that water is a fundamental resource for the city and its territory. The Territorial Governance Plan of Milan (PGT) addresses the issue by incorporating it into urban planning, focusing both on the protection of the minor water network and on the prevention of hydraulic risk, as well as on the enhancement of green and blue spaces as elements that improve urban quality and resilience to climate change. The Hydraulic Police Regulation (RPI) is more technical and operational, regulating the use of watercourses and adjacent areas, with particular attention to hydraulic safety and maintenance. Overall, establish that water is not only a resource to be regulated and protected, but also a strategic resource for the future of the city and its territory, with the capacity to influence safety, quality of life, and environmental sustainability.

3.3.1 Regulation Glossary for Italy

Table 10: List of the different levels of legal instruments and their regulation levels in Italy.

English term	Italian term	Remark	Example
Legislative Decree	Decreto legislativo	Binding on the country level	Decreto Legislativo 3 aprile 2006, n. 152
Regional Law	Legge regionale	Binding on the regional level	Legge Regionale 12 dicembre 2003, N. 26
Regional Regulation	Regolamento regionale	Technical effect on the regional level. Subordinate to regional law	Regolamento Regionale 24 marzo 2006, N. 2
Manual	Manuale	Not binding	Manuale SIPIUI
Territorial Governance Plan	Piano di Governo del Territorio	Binding on the municipal level	PGT Comune di Milano
Technical Guidance	Linee guida	Not binding	Linee guida SUDS
Regulation	Regolamento	Technical effect on the municipal level	Regolamento di Polizia Idraulica (RPI)

3.3.2 List of relevant regulations in Milan, Italy

Table 11: List of relevant regulations in Milan, Italy, their abbreviations (if official abbreviation is available) and their English translation.

Name in Italian	Abbreviation	English translation
National		
Decreto Legislativo 3 aprile 2006, n. 152	D.Lgs. 152/2006	Legislative Decree No. 152 of April 3, 2006
Decreto-Legge 4 novembre 2009, n. 152	D.L. 152/2009	Legislative Decree No. 152 of September 30, 2009
Decreto Legislativo 11 febbraio 2010, n. 22	D.Lgs. 22/2010	Legislative Decree No. 22 of February 22, 2010

Decreto Legislativo 3 marzo 2011, n. 28	D.Lgs. 28/2011	Legislative Decree No. 28 of 2011
Decreto Ministeriale n. 485148 del 30 settembre 2022	D.M. n. 485148	Ministerial Decree of September 30, 2022
Piano Nazionale di Adattamento ai Cambiamenti Climatici del 21 dicembre 2023	PNACC	National Climate Change Adaptation Plan of December 21, 2023
Decreto-Legge 14 aprile 2023, n. 39, Decreto Siccità	D.L. 39/2023	Legislative Decree No. 39 of April 14, 2023, Drought Decree
Regional		
LEGGE REGIONALE 12 dicembre 2003, N. 26	L.R. n. 26/2003	Regional Law No. 26 of December 12, 2003
Regolamento Regionale 24 marzo 2006, N. 2	RR 2/2006	Regional Regulation No. 2 of March 24, 2006
Regolamento Regionale 15 febbraio 2010, n. 7	RR 7/2010	Regional Regulation No. 7 of February 15, 2010
Legge Regionale 12/2005	L.R. n. 12/2005	Regional Law 12/2005
Legge Regionale 04/2006	L.R. n. 4/2006	Regional Law no. 4/2006
Regolamento Regionale 7/2017	RR 7/2017	Regional Regulation 7/2017
Regolamento Regionale 6/2019	RR 6/2019	Regional Regulation 6/2019
Regolamento Regionale 3/2025	RR 3/2025	Regional Regulation 3/2025
Legge Regionale n. 38 del 10 Novembre 2015	L.R. n. 38/2015	Regional law, November 10, 2015, No. 38

Deliberazione di Giunta Regionale 6203/2017	DGR 6203/2017	Regional Council Resolution 6203/2017
Legge Regionale del 29 aprile 1980 n. 44	L.R. n. 44/1980	Regional Law No. 44 of April 29, 1980
Programma di tutela e uso delle acque	PTUA	Water Use and Protection Program
Municipal		
Piano di Governo del Territorio di Milano	PGT	Milan's Territorial Governance Plan
Regolamento di Polizia Idraulica	RPI	Hydraulic Police Regulations
PIANO ARIA-CLIMA del COMUNE di MILANO, approvato dal Consiglio Comunale il 21/2/2022	PAC	AIR-CLIMATE PLAN of the MUNICIPALITY OF MILAN, approved by the City Council on February 21, 2022
Piano Territoriale Metropolitano	PTM	Metropolitan Territorial Plan

3.3.3 Regulation elements for Milan, Italy

Table 12: List of regulation elements and the current regulations in Milan, Italy.

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Groundwater in general				
Protection	Binding	This decree regulates water resources (both surface and groundwater), sets quality objectives, and outlines protection criteria.	Legislative Decree No. 152 of April 3, 2006 – Environmental Regulations	National
	Binding	Defines measures to prevent and control groundwater pollution and establishes criteria for the classification and chemical/quantitative assessment of groundwater bodies.	Legislative Decree No. 152 of September 30, 2009 – Implementation of Directive 2006/118/EC	National
	Binding	While focused on groundwater protection, it impacts geothermal	Legislative Decree No. 22 of February 22, 2010	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		plant installation and operation as well.	– Implements Directive 2006/118/EC	
Outline of groundwater bodies	Binding Binding	Lombardy's main quantitative and qualitative water protection plan includes detailed cartography. Adopts a simplified model based on regional classification for defining multiple hydro-structures as part of its water protection planning.	Water Use and Protection Program Milan's Territorial Governance Plan	Regional Municipal
Groundwater management				
Aquifer sustainability planning	Binding Binding	Discipline for use of surface & groundwater, domestic use, water saving/reuse; contains technical definitions used in permits and planning.	Regional Regulation No. 2 of March 24, 2006	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
	Binding	Operative plan that includes recharge areas, abstraction controls, and groundwater quality targets.	Water Use and Protection Program	Regional
	Binding	Hydraulic & hydrologic invariance for new developments—manage stormwater locally to reduce runoff/pollution and protect receiving waters & aquifers.	Regional Regulation 7/2017 Regional Regulation 6/2019	Regional
	Binding	Regional regulation of wastewater discharges (domestic/urban and stormwater first flush), relevant to protect groundwater from infiltration systems and industrial areas.	Metropolitan Territorial Plan	Regional
		Maps and protects groundwater recharge zones and hydro-morphological belts used by local plans to constrain land uses and projects.		Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Climate change adaptation	Binding	The actions in this decree include strengthening drought management, groundwater recharge protection, and monitoring networks. Use it as the national adaptation framework your local plans must align to.	National Climate Change Adaptation Plan of December 21, 2023	National
Data management and information sharing				
Quantity	Not binding	Establishes procedures for using water resources, including for domestic, agricultural, and industrial purposes.	Regional Regulation No. 2 of March 24, 2006 Regulation of the Use of Surface and Groundwater	Regional
Private use	Binding	Art. 4: Private individuals may use groundwater for personal/family needs—potable, hygiene, gardening, livestock watering, and even heat pump systems—without needing a concession, provided:	Regional Regulation No. 2 of March 24, 2006	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		Use isn't for economic/commercial activity. Maximum flow ≤ 1 l/s. Annual volume ≤ 1,500 m^3/year. Article 22: For uses exceeding those domestic thresholds—or other purposes—private individuals must apply for a concession. This involves authorization for drilling wells and abstraction, with technical controls. Article 22(5): For temporary or short-term excavations, a licence is required, with annual fees, usage monitoring (flow/volumes), and eventual site closure obligations.		
Public water supply	Binding	Governs the use of surface and groundwater, water-saving measures, and water reuse.	Regional Law No. 26 of December 12, 2003	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
			Regulation of Local Public Services of Economic Interest	
Monitoring of groundwater usage	Binding Binding	It frames the Water Framework obligations (monitor groundwater status, pressures and measures) and requires authorities to set monitoring programs used for status assessment and reporting. Contains detailed provisions on wells, concessions, authorisations and technical/monitoring requirements tied to concessions and licenses (drilling notices, completion reports, testing, instruments and hydrogeological data).	Legislative Decree No. 152 of April 3, 2006 Regional Regulation No. 2 of March 24, 2006	National Regional
Registration of installations	Binding	Article 22: mandates that any entity planning to derive groundwater via bored wells must apply for a	Regional Regulation No. 2 of March 24, 2006	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		concession. The application requires detailed design and execution plans and is submitted via the SIPIUI electronic portal. The authorization defines: Safety and environmental precautions during drilling (limits on depth, stratigraphy, hydrological assessments). Obligations to install monitoring instruments (piezometers, flow meters, sampling devices). Requirements for notifications, completion reporting, and potential revocation if public interest is compromised.		
Discharge into surface waters	Binding	These regulations govern water discharges into natural and artificial watercourses. In high-risk flood zones, a maximum runoff discharge	Hydraulic Police Regulations	Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		of 10 litres per second per hectare of impermeable surface is enforced for projects reducing soil permeability. Moreover, discharges from urban drainage systems must be mitigated to ensure compatibility with the receiving system's hydraulic capacity.		
	Binding	Approval of the implementation procedures and content of the preliminary investigations required by Regional Law 38/2015 for the purpose of issuing the authorization for the discharge into groundwater of extracted groundwater used for thermal exchange via heat pump.	Regional law, November 10, 2015, No. 38 and Legislative Decree April 3, 2006, No. 152	Regional
	Binding	Regulatory act defines the procedures and content of the preliminary investigations required to obtain authorization for the	Regional Council Resolution (D.G.R.) 6203/2017	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		discharge into groundwater of water extracted for thermal exchange using heat pumps. In practice, it sets out how preliminary investigations must be conducted to assess the environmental impact of such water withdrawals and discharges, and how to obtain authorization to proceed with the installation of geothermal systems that use this type of thermal exchange.		
Thermal use				
Temperature difference	Binding	The temperature of the re-injected water must remain within a maximum increase of 5 °C above the annual average groundwater temperature evaluated during the design phase.	Regional Council Resolution 6203/2017	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Minimum/maximum infiltration temperature	Binding	The temperature of the re-injected water must generally not exceed 21 °C. In the presence of shallow unconfined aquifers with very low groundwater depth—such that they are almost immediately affected by seasonal variations in air temperature—the temperature of the re-injected water may reach up to 23 °C.	Regional Council Resolution 6203/2017	Regional
Permits for groundwater heat pumps	Binding Not binding	Promotes the use of renewable energy sources, including geothermal. Provides simplified administrative procedures (PAS) for small-scale geothermal installations. Includes specific rules for the use of groundwater in geothermal systems and for the installation of geothermal probes (e.g., closed-loop systems).	Legislative Decree No. 28 of 2011 – Implementation of Directive 2009/28/EC Regional Regulation No. 7 of February 15, 2010 – Regulation on Groundwater Use	National Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
	Not binding	Energy transition, through the increased use of eco-sustainable and/or renewable energy sources aimed at overcoming dependence on fossil fuels and reducing climate-altering emissions, to improve air quality and achieve a 'zero-emissions' Milan."	AIR-CLIMATE PLAN of the MUNICIPALITY OF MILAN, approved by the City Council on February 21, 2022	Municipal
	Not binding	It sets out provisions for the installation of heat production systems using geothermal energy, intended for the heating and air conditioning of buildings, with particular emphasis on simplifying the installation process. This decree applies to "small-scale local uses of geothermal heat" and defines the requirements for system implementation, installer qualification, and inspection	Ministerial Decree of September 30, 2022	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
	Binding	procedures. (Only for borehole heat exchangers) The installation of private wells for domestic use requires prior notification to the Metropolitan City of Milan via the SIPIUI platform (by the Lombardy Region).	DGR n. x/7568 of 18 Decembre 2017	Regional
Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	Binding	a) Not specified b) The area immediately surrounding the abstraction well for drinking purposes must extend at least 200 m in radius from the point of abstraction. c) Not specified d) Not specified	Regional Regulation No. 7 of February 15, 2010	Regional
Minimum distance to neighbouring thermal groundwater installations	Not binding	In the case of existing or planned geothermal systems located in the immediate proximity, interference must be assessed through quantitative and qualitative	Regional Council Resolution No. X/6203 – 08/02/2017	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		modelling (thermal plume analysis), based on the average and maximum design flow rates.		
Minimum distance between pumping and reinjection site	Not binding	No minimum distance is specified; it is only required to report the actual designed distance between the extraction and injection wells.	Regional Council Resolution No. X/6203 – 08/02/2017	Regional
Rainwater management				
Flood risk	Binding	This law establishes the principle of hydraulic and hydrological invariance, meaning that the flow and volume of stormwater runoff discharged into water bodies from urbanized areas must not exceed pre-development levels. This principle applies to all projects that modify soil permeability, both in urban redevelopment and new land transformations.	Regional Law 12/2005 – Territorial Governance	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Sponge city	Binding	It states that stormwater runoff from urbanized areas must not exceed the flow rates and volumes that existed prior to development. This principle encourages the use of Sustainable Urban Drainage Systems (SuDS), such as detention basins, green roofs, infiltration wells, and permeable pavement. It regulates: the discharge of wastewater and the collection and treatment of first flush rainwater and water used to wash external areas.	Regional Law 4/2006 (art. 58bis of LR 12/2005)	Regional
	Not binding	This regulation outlines the criteria and methods for ensuring hydraulic and hydrological invariance. It promotes the adoption of Sustainable Urban Drainage Systems (SuDS), with a preference for stormwater infiltration into the	Regional Regulation 7/2017 – Hydraulic and Hydrological Invariance	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
	Not binding	soil, provided the water does not come from potentially polluted surfaces. Design must consider the hydrogeological characteristics of the site, excluding areas with shallow groundwater or low-permeability soils. Provisions for the application of the principles of hydraulic and hydrological invariance in urban and peri-urban contexts, updating the criteria and methods established by Regional Regulation no. 7/2017	Regional Regulation 3/2025	Regional
Infiltration of rainwater	Binding	Milan's Rules Plan (Piano delle Regole) defines how stormwater must be managed, specifying areas where infiltration is allowed, restricted, or prohibited. It particularly highlights zones with shallow groundwater tables or drinking water protection areas,	Milan's Territorial Governance Plan – Rules Plan	Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		where infiltration might be incompatible or subject to stricter regulation.		
minimum distance to MHGW	Binding	Sets rules for stormwater management (infiltration, retention, controlled discharge) across Lombardy. It requires new interventions to respect hydraulic invariance and provides technical attachments (methods and good practice) for infiltration works and connections to the receptor; it therefore governs how and where you may locate infiltration basins or outfalls relative to watercourses and the need to avoid increasing risk to the channel. For works near watercourses, you must follow the regulation and obtain necessary clearances.	Regional Regulation 7/2017 – Hydraulic and Hydrological Invariance	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
minimum distance to buildings	Binding	Requires that the design of infiltration structures must assess and ensure no interference with existing buildings' foundations or underground levels, including underground floors. Specifically: The project must verify that infiltration does not compromise the stability of the ground or impact building foundations or underground structures. Soil investigations and hydrogeological assessments are required, especially near buildings. This means your design must include a site-specific geotechnical/hydrogeological study to determine safe distances from	Regional Regulation 7/2017 – Hydraulic and Hydrological Invariance	Regional

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		buildings, even if no fixed numeric setback is mandated in law.		
distance from trees	Binding	Requires that the design of infiltration structures must assess and ensure no interference with existing trees: Specifically: ARTICLE 46, Underground Works Near Public and Private Trees. 46.1. The minimum distance from the clear edge of any excavation to the trunk line must not be less than: a. 5 meters for monumental or valuable specimens with a circumference greater than 250 cm, and for Platanus species with a circumference greater than 120 cm; b. 3.00 meters for first-size trees not included in the previous point; c. 2.50 meters for second-size trees; d. 2.00 meters for third-size trees;	Municipal Regulation for the use and protection of public and private green spac - December 11, 2017	Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		e. 1.50 meters for fourth-size trees; f. 1 meter for shrubs.		
types of infiltration systems	Binding	Applies to new buildings, expansions, refurbishments, and infrastructure—aims to maintain hydrological and hydraulic invariance: both the peak flow rates and total volume discharged must not exceed pre-development levels. Supports use of natural-based solutions and sustainable urban drainage systems (SuDS). The regulation defines these approaches and encourages their inclusion in building codes and municipal planning.	Regional Regulation 7/2017 – Hydraulic and Hydrological Invariance	Regional
Drainage of rainwater into sewers	Binding	Assigns to the Regions the responsibility to regulate the discharge of stormwater runoff and first flush water from separate sewer systems. The Regions may require	Legislative Decree no. 152/2006 (Environmental Code) – Article 113	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
	Not binding	specific permits or impose technical conditions for these discharges. It is also prohibited to discharge directly into groundwater. Further regulates the discharge of stormwater runoff throughout the Lombardy Region, especially for industrial or potentially polluted areas.	Regional Regulation no. 6/2019	Regional
Construction in groundwater				
Backwash	Binding	Milan's urban planning document that integrates environmental considerations into land-use planning. It includes provisions for water management, including groundwater, and may influence the design and implementation of systems involving backwashing.	Milan's Territorial Governance Plan	Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Ground breakings affecting groundwater				
Dewatering during construction				
Groundwater extremes				
Groundwater flooding	Binding	Mandatory runoff control for developments: post-development peak flows/volumes must not exceed pre-development. Relevant when choosing dewatering/stormwater solutions around high water table.	Regional Regulation 7/2017 – Hydraulic and Hydrological Invariance	Regional
	Binding	Includes the Geological, Hydrogeological. Seismic component with maps of geological feasibility and prescriptions. It classifies areas by constraints (including shallow water table) and	Milan's Territorial Governance Plan	Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		governs what is allowed for underground levels		
Low groundwater levels	Binding	It introduces regulations to address water scarcity and strengthen water infrastructure. The measure includes actions such as the appointment of a Special Commissioner to manage the phenomenon, the enhancement of infrastructure, the reuse of wastewater, and the promotion of rainwater harvesting for agriculture.	Legislative Decree No. 39 of April 14, 2023, Drought Decree	National
	Binding	These regional documents define long-term objectives and actual measures to ensure quantitative safeguards for groundwater, including low-level extremes.	Water Use and Protection Program	Regional
	Binding	Includes hydrogeological characterization and policies that	Milan's Territorial Governance Plan	Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		aim to preserve aquifer recharge areas, crucial to preventing low groundwater levels and ensuring long-term sustainability. It also addresses infrastructure siting and limits for extraction near recharge zones, reinforcing balanced water use.		
Drinking water				
- Protection	Binding	It establishes that drinking water must be wholesome and clean, meaning free from microorganisms, parasites, in line with Directive (EU) 2020/2184. A) The absolute protection zone is the area immediately surrounding the water abstraction well, which extends for a minimum radius of ten metres from the abstraction point. It's used exclusively for water	Legislative Decree No. 152 of April 3, 2006	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		abstraction and associated infrastructure. B) The protection zone consists of the portion of land surrounding the absolute protection zone. In this area, the installation of several hazardous facilities is forbidden (e.g. cemeteries, other types of wells, quarries, etc.). The Regions shall regulate, within the protection zones, other facilities (sewers, residential constructions, railways and roads). In the absence of regional regulations, the protection zone extends for a radius of 200 m from the abstraction point. In these two zones is forbidden the infiltration of any type of surface water.		

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Construction	Binding	A) The absolute protection zone is the area immediately surrounding the water abstraction well, which extends for a minimum radius of ten metres from the abstraction point. It's used exclusively for water abstraction and associated infrastructure. B) The protection zone consists of the portion of land surrounding the absolute protection zone. In this area, the installation of several hazardous facilities is forbidden (e.g. cemeteries, other types of wells, quarries, etc.). The Regions shall regulate, within the protection zones, other facilities (sewers, residential constructions, railways and roads). In the absence of regional regulations, the protection	Legislative Decree No. 152 of April 3, 2006	National

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		zone extends for a radius of 200 m from the abstraction point. In these two zones is forbidden the infiltration of any type of surface water.		
Thermal use	Binding	The drilling of geothermal wells is prohibited within the protection zone of a drinking water abstraction point.	Regional Law No. 44 of April 29, 1980	Regional
Re-use of water				
Ecology				

3.3.4 Regulation gaps in Milan, Italy

Gaps related to groundwater in general and quantity management

At the regional level, a groundwater well registry is available. However, there is no active monitoring of actual extraction volumes, which limits the ability to perform detailed groundwater budget analyses. There are no clearly defined regulations for groundwater management during droughts or for addressing flooding of underground structures. This gap is largely due to insufficient study of groundwater fluctuation dynamics and their underlying causes.

Gaps concerning geothermal installations:

Although technical guidelines exist, there are no specific binding rules governing the spatial arrangement of geothermal wells and their interaction with other existing wells. For example, there is no clear definition of the required separation between plants, between extraction and injection wells, or of the maximum allowable discharge/thermal potential. In addition, coordination between subsurface and surface water priorities is weak, and there is no specific regulation indicating where reinjection should occur, whether back into aquifers or into surface water systems. Such regulatory instruments are essential to prevent poor design practices and disputes between designers and permitting authorities, and to ensure a sustainable use of the resource in the future.

Current regulations only require designers to demonstrate, through numerical modelling, that no negative impacts occur beyond the system. However, this requirement needs to be standardized through regulations that specify the sources of input parameters, the types of analyses to be carried out, and the distances at which impacts must be assessed.

Data collection is not mandatory such as the extracted volumes and energy, and the temperature difference between intake and discharge is essential to evaluate the status of the resource and the cumulative impacts of multiple systems. Moreover, no monitoring of actual extraction volumes or thermal energy is in place for these systems. This limits the ability to assess the status of the resource, reducing the sustainability of existing systems and constraining the optimal development of new installations by preventing full use of the resource potential.

3.4 Munich

The most important legislature dealing with groundwater on a federal level are the Water Resources Act (WHG) and the Groundwater Protection Decree (GrwV). The protection of groundwater that is used as drinking water is regulated in the Drinking Water Decree (TrinkwV) and the Drinking Water Catchment Area Decree (TrinkwEGV). Besides these rules, there are several rules that directly or indirectly deal with the quality of groundwater and soils (e.g., Federal Environment Protection Act, Federal Soil Protection Act, Decree for installations for handling substances hazardous to water).

In addition, there are extensive technical guidance documents that translate legal requirements into practical implementation standards. They establish industry best practices that are widely adopted and often referenced in permit conditions. Examples are the German Association for Water, Wastewater and Waste e. V (DWA), German Association for the Gas and Water sector (DVGW), Association of German Engineers (VDI) or the German Institute for Standardisation (DIN).

In Bavaria the Bavarian Water Act (BayWG) regulates the topic water and groundwater. The implementation of the WHG and the BayWG is regulated in the Administrative Rule for the Enforcement of the Water Act (VVWas). Additionally, there is a collection of guidelines published by the Bavarian State Office for environment (LFU) dealing with (ground-)water management and water supply, protection of groundwater and soil, protection of surface water and wastewater management as well as watercourse development and hydraulic engineering.

On a municipal level the focus is on the implementation of sponge city principles, the implementation of thermal use of groundwater and the prevention of adverse effects of construction projects and buildings interacting with the groundwater table. The implementation of Sponge city concepts is set in several municipal decisions and therefore part of the “Munich building code”.

As part of the Munich Water Law Permit, the groundwater backwash of construction sites and the final state of a building/construction object is reviewed. The Munich Water Law stipulates that no neighbours may be adversely affected and that third parties are not adversely affected if their buildings (usually the underground components) are a) located outside the range of the backwash, b) located above the HHW (usually HW40) + 30 cm safety surcharge + backwater or c) are demonstrably watertight up to the HHW + 30 cm safety surcharge + backwater.

3.4.1 Regulation Glossary for Germany

Table 13: List of the different levels of legal instruments and their regulation levels in Germany.

English term	German term	Remark	Example
Act	Gesetz	Binding on the country level	WHG, BAYWG
Decree	Verordnung	Binding on the country level	VAwS
Rules	Vorschrift	Binding on the country level	VVWas
Standard	Standard	Binding on the country level if referenced by laws	DIN
Voluntary Standard	Freiwilliger Standard	Not binding	
Technical guidance	Richtlinie	Not binding; can become binding if referenced in legislature	VDI, DWA
Ordinance	Anordnung	Binding on the municipal level	
Decision	Beschluss	Binding	Policy decision I
Approval	Erlaubnis	Binding	
Guidelines	Leitfaden	Not binding	

3.4.2 List of relevant regulations in Munich, Germany

Table 14: List of relevant regulations, their abbreviations (if official abbreviation is available) and their English translation.

Name in German	Abbreviation	English translation
Federal		
Rules		
Grundwasserverordnung	GrwV	Groundwater protection decree
Umweltinformationsgesetz	UIG	Environmental information act
Wasserhaushaltsgesetz	WHG	Water resources act
Nationale Wasserstrategie	NWS	National water strategy
Baugesetzbuch	BauGB	German federal building code
Trinkwasserverordnung	TrinkwV	Drinking water decree
Trinkwassereinzugsgebiete verordnung	TrinkwEGV	Drinking water catchment area decree
Bundesnaturschutzgesetz	BNatSchG	Federal environment protection act

Name in German	Abbreviation	English translation
Bundes-Bodenschutzgesetz	BBodSchG	Federal soil protection act
Bundes-Bodenschutz- und Altlastenverordnung	BBodSchV	Federal soil protection and contamination decree
Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen	AwSV	Decree for installations for handling substances hazardous to water
Gesetz über die Umweltverträglichkeits-prüfung	UVPG	Environmental impact assessment act
Bundes-Klimaanpassungs-gesetz	KanG	Federal climate adaptation act
Regulations		
DWA-Regelwerk (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V.)	DWA	Set of rules by the German Association for Water, Wastewater and Waste e. V.
DVGW-Regelwerk (Deutscher Verein des Gas- und Wasserfaches)	DVGW	Set of rules by the German Association for the Gas and Water sector
Richtlinie VDI 4640 Thermische Nutzung des Untergrunds (Verein Deutscher Ingenieure)	VDI 4640	Association of German Engineers Guideline 4640 -- Thermal use of the underground - Fundamentals, approvals, environmental aspects
Deutsches Institut für Normung --Planung und Ausführung von Entwässerungsanlagen	DIN 1986-100	German Institute for Standardisation -- Planning and execution of drainage systems

State		
Rules		
Bayerisches Wassergesetz	BayWG	Bavarian water act/law
Bayerisches Umweltinformationsgesetz	BayUIG	Bavarian environmental information act
Bayerisches Naturschutzgesetz	BayNatSchG	Bavarian environment protection act
Verwaltungsvorschrift zum Vollzug des Wasserrechts	VVWas	Administrative rule for the enforcement of the water act
Verwaltungsvorschrift zum Vollzug der Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen und über Fachbetriebe (VVAwS)	VVAwS	Administrative rule for the enforcement of the decree for installations for handling substances hazardous to water and on specialist companies
Verordnung über Pläne und Beilagen in wasserrechtlichen Verfahren	WPBV	Decree on plans and annexes in water law proceedings
Niederschlagsfreistellungs-verordnung	NWFreiV	Precipitation exemption decree
Verordnung über die Kompensation von Eingriffen in Natur und Landschaft	BayKompV	Decree on the compensation of interventions in nature and landscape
Verordnung über das Landesentwicklungsprogramm Bayern	LEP	Decree on the regional development in Bavaria
Verordnung über den Abfallwirtschaftsplan Bayern	AbfPV	Decree on the waste management plan
Verordnung zur Eigenüberwachung von Wasserversorgungs- und Abwasseranlagen	EÜV	Decree on the self-monitoring of water supply and wastewater systems
Bayerische Bauordnung	BayBO	Bavarian building code
Bestattungsverordnung	BestV	Burial decree

Verordnung über Sachverständige und Untersuchungsstellen für den Bodenschutz und Altlastenbehandlung in Bayern	VSU	Decree on experts and investigation facilities for soil protection and contaminated site remediation in Bavaria
Verordnung über den Erlass des Kostenverzeichnisses zum Kostengesetz	KVz	Decree on the issuance of the cost schedule under the costs act
Regulations		
Handlungsanleitung zur Hochwasserrisikomanagement-Planung in Bayern	stmuv_wasser_001	Guidelines for flood risk management planning in Bavaria
Technische Regeln zum schadlosen Einleiten von gesammeltem Niederschlagswasser in das Grundwasser	TRENGW	Technical rules for the harmless discharge of collected rainwater into the groundwater
Sammlung von Schriftstücken (Merkblätter, Schreiben, Hinweise) der Bayerischen Wasserwirtschaft	Slg Wasser	Collection of documents (leaflets, letters, information) from the Bavarian Water Management Authority
Schutz von Grundwasser und Boden (Merkblätter Bayerisches Landesamt für Umwelt LFU)	Merkblätter LFU	Protection of groundwater and soil (guidelines by the Bavarian State Office for Environment, LFU)
Leitfaden Erdwärmesonden in Bayern	-	Technical Rules for implementation of Borehole Heat Exchangers
Municipal		
Rules		
Entwässerungssatzung 210	EWS 210	Drainage statutes
Entwässerungsabgaben-satzung 211	EAS 211	Drainage fee statutes
Wasserversorgungsverord-nung 225	WVO 225	Water supply decree
Wasserschutzgebiet-Verordnung Trudering		Water protection area decree Trudering

Wasserschutzgebiet-Verordnung Karlsfeld		Water protection area decree Karlsfeld
Wasserschutzgebiet-Verordnung Ober- und Unterschleißheim		Water protection area decree Ober- and Unterschleißheim
Überschwemmungsgebiet sverodnung Isar 371	ÜgVO 371	Flood protection area decree Isar
Überschwemmungsgebiet sverodnung Würm/Würmkanal 370	ÜgVO 370	Flood protection area decree Würm/Würmkanal
Überschwemmungsge-bietsverordnung Hachinger Bach 375	ÜgVO 375	Flood protection area decree Hachinger Bach
Überschwemmungsgebiet sVO Gröbenbach 376	ÜgVO 376	Flood protection area decree Gröbenbach
Bekanntmachung zur vorläufigen Sicherung des vom Wasserwirtschaftsamt München ermittelten Überschwemmungsge-biets am Schwebelbach		Announcement on the provisional protection of the flooding area on the Schwebelbach determined by the Munich Water Management Office
Regulations		
Merkblatt Bauvorhaben im Grundwasser		Information sheet for construction projects in groundwater
Leitfaden Grundstücksentwässerung - Planung und Bau in München		Guideline property drainage - planning and construction in Munich
Wasserwirtschaftliche Anforderungen an Tiefgaragen mit wasserdurchlässigem Bodenbelag		Water management requirements for underground car parks with water-permeable flooring
Merkblatt Wärmepumpen-/Kühl-wasseranlagen bis 50 kW Heizleistung		Information sheet for heat pump/cooling water systems up to 50 kW heating capacity
Antragsunterlagen für die Begutachtung von Grundwasser-		Application documents for the assessment of groundwater heat pumps with more than 50 kJ/s

wärmepumpen mit mehr als 50 kJ/s		
Merkblatt Autowaschen auf Privatgrundstücken sowie auf öffentlichen Straßen und Plätzen		Leaflet Car washing on private property and on public roads and squares
Grüne Stadt der Zukunft		Green city of the future
Beschlussvorlage – Prinzipien der Schwammstadt auf den öffentlichen Flächen umsetzen		Decision bill – Implementing the principles of the sponge city in public spaces
Grundsatzbeschluss I → Umsetzung Klimaziele München (Schwammstadt)		Policy decision I – Implementation of the climate goals of Munich
Grundsatzbeschluss II → Klimaneutrales München 2035 und klimaneutrale Stadtverwaltung 2030 (Thermische Nutzung oberflächennahe Geothermie)		Policy decision II – Climate-neutral Munich 2035 and climate-neutral city administration 2030
Klimafahrplan → Klimaneutrales München bis 2035		Roadmap climate – Climate-neutral Munich until 2035

3.4.3 Regulation elements in Munich, Germany

Table 15: List of regulation elements and the current regulations in Munich, Germany

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
Groundwater in general				
Protection	Obligatory	Groundwater management should prevent deterioration of groundwater quantity and quality and reverse man-made trends of increasing pollutants.	WHG §§ 47, 48 GrwV	Federal
Outline of groundwater bodies	Obligatory	State ministry publishes catalogue of all bodies of water and divides them into planning units.	GrwV § 2 BayWG Art. 3	Federal State
Groundwater management				
Aquifer sustainability planning	Obligatory	Groundwater management should prevent deterioration of groundwater quantity and quality	WHG § 47; WHG § 48	Federal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		and reverse man-made trends of increasing pollutants.		
Climate change adaptation	Obligatory	The requirements of climate protection are to be considered for building projects both through measures that counteract and adapt to climate change. The responsible water supervision authority analyses the natural water cycle in respect to climate change.	BauGB §1 BayWG Art. 58	Federal State
Data management and information sharing	Obligatory	Monitoring of properties of water bodies with measurement methods and procedures to guarantee comparability. Free access to environmental information from responsible authority.	WHG §§ 23, 88, 100 GrwV §§4-12 UIG § 1, BayUIG Art. 1	Federal Federal/State

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		The responsible authority collects the data that is required for water management.	BayWG Art. 58	State
Quantity	Obligatory	Groundwater management should prevent deterioration of groundwater quantity and quality and reverse man-made trends of increasing pollutants. From 2026, introduction of water extraction fee (Wassercent) for groundwater.	WHG § 47 GrwV §§ 4, 9, 12 Key point paper: Wassercent	Federal State
Private use	Allowed (if no negative impact on groundwater resource)	Groundwater extraction for private households is allowed if no negative impact on groundwater resource is created. Drilling notification required (WHG § 49, BayWG Art. 30).	WHG § 46 BayWG Art. 29	Federal State
Public water supply	Obligatory	The public water supply is a task of general interest. It also includes the provision of drinking water	WHG §§ 50, 51 BayWg Art. 31, 32	Federal State Municipal

Regulation element	Legal regulation	Legislative condition	Legal instrument	Regulation level
		from the pipe network in public places. Protection of bodies of water of interest for public water supply, from adverse effects, recharge groundwater and prevent harmful run-off of precipitation water.	Water protection decrees in Munich	
Monitoring of groundwater usage	Obligatory	Permits and authorisations are entered into the water register. In Munich, many groundwater uses are only registered in the water rights permit decision.	WHG § 87 BayWG Art. 53	Federal State
Registration of installations	Obligatory	Permits and authorisations are entered into the water register.	WHG § 87 BayWG Art. 53	Federal State
Discharge into surface waters	Not allowed (Federal), Allowed (State)	Common use allows discharge of groundwater and spring water into surface waters on a state level.	WHG § 25 BayWG Art. 29	Federal State

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Thermal use				
Temperature difference	Obligatory	Maximum temperature difference of ± 6 °K if maximum groundwater temperature of 20 °C is not exceeded.	VDI 4640 Slg Wasser Leaflet 3.7/2 LFU	Federal State
Minimum/maximum infiltration temperature	Obligatory	Minimum of 0 °C, even under peak load Maximum of 20 °C as long temperature difference of ± 6 °K is not exceeded.	VDI 4640 Slg Wasser Leaflet 3.7/2 LFU	Federal State
Permits for groundwater heat pumps	Obligatory	Water law authorisation is required. Requirements vary depending on the maximum heating capacity. For installations < 50 kW expert opinion by a private water management expert is sufficient. For installations > 50 kW the water management office acts as official expert.	WHG §§ 8-15 BayWG Art. 15, 70 Information sheet for heat pump/cooling water systems up to 50 kW heating capacity Application documents for the assessment of groundwater heat	Federal State Municipal

			pumps with more than 50 kJ/s	
Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	Obligatory	a) 1.5 m (Construction act); 3 m recommended (VDI 4640) b) not allowed (WHG § 52) c) not regulated d) not regulated.	WHG § 52 VDI 4640 Slg Wasser Leaflet 3.7/2 LFU	Federal State
Minimum distance to neighbouring thermal groundwater installations	Recommended	Distance ≥ 6 m.	VDI 4640 Slg Wasser Leaflet 3.7/2 LFU	Federal State
Minimum distance between pumping and reinjection site	Recommended	Distance ≥ 10 m Extraction well upstream of injection well.	VDI 4640 Leaflet 3.7/2 LFU	
Rainwater management				
Flood risk	Obligatory (> 800m^2 drainage area)	Proof of 'safety against flooding or controlled, damage-free flooding' depending on surface sealing; < 70 %, based on 30-year rainfall event;	DIN 1986-100	Federal

		> 70 %, based on 100-year rainfall event.		
Sponge city	Recommended (Federal) Obligatory (Municipal)	Implementation of sustainable urban water management, enhancing infiltration, retention and groundwater recharge. Roof greening, façade greening, decentralised water management, tree pits with 36 m^3 substrate volume in public spaces etc.	Set of DWA rules DIN 1986-100 EWS 210 Decision bill -- Implementing the principles of the sponge city in public spaces; Policy decision I -- Implementation of the climate goals of Munich	Federal Municipal
Infiltration of rainwater	Allowed (Federal/State) Obligatory (Municipal)	No authorisation is required for the discharge of precipitation water into the groundwater by means of harmless infiltration Precipitation water can be	WHG § 46 DWA-A138-1 BayWG Art. 18 NWFreiV TRENGW	Federal State Municipal

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		infiltrated if outside protection areas, uncontaminated by uses, and not mixed with wastewater or hazardous substances.	EWS 210	
minimum distance to MHGW	Recommended	> 1 m.	DWA-A138-1	Federal
minimum distance to buildings	Recommended	> 1.5 * depth of building pit filling.	DWA-A138-1	Federal
types of infiltration systems	Recommended	Preference to use surface infiltration > infiltration basins > basin-trench elements > infiltration trenches > infiltration shafts.	DWA-A138-1	Federal
Drainage of rainwater into sewers	Not recommended (Federal) Prohibited (Municipal)	Precipitation water should be infiltrated, trickled or discharged directly or via a sewerage system into a body of water without mixing with wastewater. Discharge of precipitation is prohibited if proper infiltration is possible; MSE may authorize	WHG § 55 EWS 210	Federal Municipal

		exceptions if discharge is necessary for operational reasons.		
Construction in groundwater				
Backwash	Prohibited/ Permission required	No negative effect on neighbour (if their buildings are outside backwash range, above HHW plus safety surcharge, or watertight up to HHW plus surcharge).	Munich Water Law Permit Information sheet for construction projects in groundwater	Municipal
Ground breakings affecting groundwater	Allowed	Notification of excavation and drilling works that affect movement, quantity or nature of groundwater is necessary.	WHG § 49 BayWG Art.30	Federal State
Dewatering during construction	Permission required	Pumping, raising, lowering and diverting groundwater for a temporary purpose and reintroducing it without adversely changing its properties. Discharge in surface water only as exception. No negative effect on neighbour (if their buildings are outside backwash range, above HHW plus	BayWG Art. 70 Munich Water Law Permit	State Municipal

		safety surcharge, or watertight up to HHW plus surcharge).	Information sheet for construction projects in groundwater	
Groundwater extremes				
Groundwater flooding	Obligatory	Risk maps for groundwater floodings only for extreme events or events with a low probability (200-year recurrence). In designated flood areas, soil's natural water infiltration and retention must be maintained or improved, particularly by unsealing soils or sustainable afforestation, to reduce flooding risks. Preservation and restoration of the infiltration capacity of soils, decentralised infiltration of rainwater and measures for natural water retention and water storage.	WHG § 74 WHG § 78 BayWG Art. 44	Federal State

Low groundwater levels	Obligatory	Preservation and restoration of the infiltration capacity of soils, decentralised infiltration of rainwater and measures for natural water retention and water storage.	BayWG Art. 44	State
Drinking water				
- Protection	Obligatory	Ground- and surface water quality protection in drinking water catchment areas, reducing contamination and treatment efforts for untreated water Division into three protection zones: I) extraction area, II) narrow protection zone, III) wider protection zone	WHG §§ 50, 51, 52 TrinkwV TrinkwEGV Slg Wasser Water protection areas (Munich) WVO 225	Federal State Municipal
- Construction	Prohibited	Prohibited in protection zone I and II, prohibited in protection zone III unless connected to a collective drainage system.	WVO 225	Municipal

- Thermal use	Prohibited	Prohibited in protection zone I and II, in protection zone III special permission possible.	WVO 225	Municipal
Re-use of water	Permission required	The use of treated wastewater to recharge groundwater is not envisaged. However, permission can be obtained for irrigation purposes if water is treated in a way that hygiene and quality standards are met.	WHG §§ 57, 61, 93 DIN EN 16941-2 VDI 2070 DWA-M 1200-1	Federal
Ecology	Not specifically regulated	Groundwater management should prevent deterioration of groundwater quantity and quality and reverse man-made trends of increasing pollutants.	WHG §§ 47, 48 GrwV	Federal

3.4.4 Regulation gaps in Munich, Germany

Inadequate recording of groundwater extractions: Permits of groundwater extractions are issued without mandatory monitoring. There are many water rights for which the actual extraction quantities are unknown as they are often only estimated (e.g., irrigation in agriculture). This particularly affects smaller extractions, which can collectively amount to a significant quantity. A review is not possible (too many uses, no staff). In the light of the implementation of the water extraction fee in Bavaria (Wassercent), this leads to concerns that citizens will bear the costs while large companies and agriculture can utilize generous free quantities. This does not lead to the conservation of groundwater resources.

When climate adaptation measures like the implementation of sponge city concepts are passed as a resolution in Munich, they become legally binding in the Municipality. However, during the process of passing the resolution, their phrasing becomes softened and offer too much leeway for exceptions which affects the overall effectiveness.

Data protection: The collection and processing of data on water extractions, such as those from irrigation or other uses, may include personal data subject to data protection laws. Such data often cannot be utilized in planning, calculations, or groundwater modelling.

Permits of construction water retention are issued without mandatory monitoring. Often, only random checks are conducted regarding the actual quantity of groundwater extracted or infiltrated. Supervising compliance with water law regulations and approving water management projects poses significant challenges for authorities.

The designation of water protection areas often takes a long time, resulting in delays in the protection of drinking water (conflicts with landowners, farmers, lengthy procedures, etc.).

4 Comparison of regulations

Table 16: Comparison of the implementation of regulation elements in the pilot cities.

Regulation element	Comparison
Groundwater in general	
Protection	All cities have obligatory regulations to identify protected zones and regulate activities near these areas. Linz has several layers of regulations on that topic from the Federal to the State level. We observe the interconnection of groundwater protection with links to geothermal use or to soil quality and their monitoring.
Outline of groundwater bodies	All cities have obligatory regulations. All are granting a definition of groundwater body designation. Most of them are also dividing the identified groundwater bodies into planning units for further monitoring and activities. Linz provided a detailed technical framework for groundwater body designation and monitoring based on the Federal regulation. This regulation specifies: 1) Criteria for groundwater body delineation and designation; 2) Parameters to be monitored in each groundwater body 3) Frequency and methods for monitoring programs 4) Data processing and reporting requirements.
Groundwater management	
Aquifer sustainability planning	Milan presented a regional regulation while Linz and Munich must follow Federal regulations. Ljubljana presented State/Municipal regulations with a reference to the River Basin Management Plan (RBMP) required by the EU Water Framework Directive. These RBMPs are the main aspect here to monitor groundwater quantity and quality and promoting restauration to maintain or create 'good' or 'high status'.
Climate change adaptation	We see a main layer of regulation at the National / Federal level first (Linz, Munich, Milan) and a second local level (Ljubljana, Munich - State level).

	A direct reference to fighting drought is established in the regulation in Milan while Munich has a reference to "climate protection (measures) are to be considered for building projects both through measures that counteract and adapt to climate change" and another obligation is that "the responsible water supervision authority analyses the natural water cycle in respect to climate change".
Data management and information sharing	Nothing from Milan here. Ljubljana, Linz and Munich have all Federal regulation with some additional one at the State level for Munich and Linz. Obligation to monitor and report groundwater status in all cities with ensured public access as well.
Quantity	A mix of binding and non-binding regulations deal with groundwater quantity. Milan has regional non-binding requirements to "Establishes procedures for using water resources, including for domestic, agricultural, and industrial purposes." while the pilot cities have binding requirements with the same purpose of monitoring groundwater extraction. In Munich a water extraction fee (Wassercent) for groundwater will be introduced in 2026.
Private use	A small private use either with or without permit is allowed in all cities here but with differences in the permit requirement: - Linz: Without permits if extraction uses hand-operated pumps or quantity is proportionate to property size. - Ljubljana: Allowed up to 15 m^3/day without permit (for personal needs) - Munich: Groundwater extraction for private households is allowed if no negative impact on groundwater resource is created but a drilling notification is required - Milan: Private individuals may use groundwater for personal/family needs—potable, hygiene, gardening, livestock watering, and even heat pump systems—without needing a concession, provided: Use is not for economic/commercial activity - Maximum flow ≤ 1 l/s - Annual volume ≤ 1,500 m^3/year. Otherwise, a permit is required, as well as an excavation permit.

Public water supply	Is regulated across all cities under national requirements in Linz, Munich, and Ljubljana, while Milan requires only regional reporting. Additionally, Linz, Munich and Ljubljana have state and/or municipal regulations. Strict processes and monitoring are in place due to the sensitive nature of the water end users (citizens and drinking water in most cases).
Monitoring of groundwater usage	It is a binding regulation in all cities with Federal/national requirements. Permit obligation is stated by Linz and Munich and Milan (at the regional level here). Ljubljana regulation is binding for all public and commercial uses and included monitoring and reporting obligations.
Registration of installations	It is mandatory in all four cities to register installations.
Discharge into surface waters	It is allowed in all four cities with strict monitoring and requirement to avoid negative impact on the receiving water bodies, especially regarding the chemical status of the water.
Thermal use	
Temperature difference	Linz and Munich set a maximum temperature difference of ± 6 °K between extracted and reinjected groundwater, while Milano allows an increase of + 5 °C above the annual average. Ljubljana does not define a limit, leaving flexibility for local assessment and project-specific considerations.
Minimum/maximum infiltration temperature	Linz specifies 5-20 °C and Munich 0-20 °C as acceptable injection temperatures, while Milano permits up to 23 °C in shallow aquifers affected by seasonal variations. Ljubljana recommends that temperature changes remain below 3 °C, with a maximum of 20 °C.
Permits for groundwater heat pumps	All four cities require permits, although procedures differ. Linz and Munich mandate obligatory permits depending on drilling depth or system capacity. Milano offers simplified administrative procedures for small-scale installations, whereas Ljubljana differentiates requirements based on borehole depth and heat pump size, with larger systems requiring full water permits and for smaller system just registration.

Minimum distance to installations; a. next building, b. drinking water well, c. other uses well, d. other public installations	Minimum distances to buildings, wells, and public installations vary. Linz and Munich define clear separation requirements, ensuring safety and resource protection. Milano specifies only a radius of 200 m around drinking water wells, while other distances are not defined. Ljubljana does not specify formal distances, instead relying on water protection rules and local regulations.
Minimum distance to neighbouring thermal groundwater installations	Linz recommends 5-10 m between installations, while Munich requires at least 6 m separation. Milano does not impose binding distances but requires quantitative and qualitative modelling to assess thermal interference. Ljubljana suggests that temperature impacts on neighbouring groundwater should remain below 1 °K, with hydraulic effects under 10 cm.
Minimum distance between pumping and reinjection site	Linz uses a formula-based calculation, including a minimum vertical separation of 8 m, to determine safe distances. Munich requires at least 10 m, with extraction wells positioned upstream of reinjection. Milano does not define a minimum distance but requires reporting of the designed separation, while Ljubljana provides no formal guidance.
Rainwater management	
Flood risk	All project partners have measures in place to deal with rainwater flood risk. In Linz, the 30-year flood (HQ30) and 100-year flood (HQ100) are taken in consideration dealing with rainwater flood risk, construction is prohibited in HQ30 risk areas but conditionally allows construction in HQ100 areas with flood protection measures. Adaptation measures are required in Ljubljana for construction in flood areas. Milan focuses on maintaining a pre-urbanisation, natural water cycle to manage storm water runoff. In Munich, 'safety against flooding or controlled, damage-free flooding' needs to be demonstrated for construction sites with > 800 m^2 drainage area for 30-year rainfall event if surface sealing < 70 % or 100-year rainfall event if surface sealing > 70 %.

Sponge city	All cities promote sponge city concepts on regional or municipal levels. Linz is likely to foresee an implementation of sponge city concepts into federal legislation in fall 2025. On a municipal level green roofs for buildings over 100 m^2 and tree planting for large plots, increased green-space ratios and native soil preservation. Ljubljana encourages retention systems, green roofs and permeable surfaces in their municipal planning standards. In Milan the use of 'sustainable urban drainage systems' is promoted through the requirement of keeping pre-urbanisation amount of runoff. In Munich the implementation of sponge city concept is recommended on a federal level and mandatory on municipal level through Roof greening, façade greening, decentralised water management and large volume tree pits.
Infiltration of rainwater	For Linz federal laws govern when water law permits for infiltration are required and set the standards to promote infiltration rather than discharging into surface waters as well as appropriate treatments for contaminated rainwater prior infiltration. In Ljubljana, infiltration is the prioritised method for dealing with rain- and stormwater, if the soil conditions allow infiltration. Municipal regulations in Milan govern areas where infiltration is allowed, or infiltration is not possible or subject to stricter rules due to shallow groundwater or drinking water protection areas. In Munich harmless infiltration is allowed on a federal level and does not need authorisation. On municipal level infiltration of rainwater is preferred if rainwater is uncontaminated and infiltration occurs outside of protection areas.
minimum distance to MHGW	In Linz the lowest point of an infiltration system needs to be at least 1 m above the relevant water level (MHGW). Ljubljana requires ≥ 30 cm clearance from high groundwater levels (HHW). In Milan there are no specific minimum distances. In Munich ≥ 1 m distance to MHGW is recommended.

- minimum distance to buildings	Both, Linz and Munich follow the recommendations of DWA-A 138: 1.5 x basement depth for buildings with basements, ≥ 6 m for buildings without basements and ≥ 1 m to neighbouring plots. In Ljubljana there are no specific distances but there is a requirement to protect foundations and prevent moisture damage. For Milan there are no specific distances foreseen.
- types of infiltration systems	In Linz the pollution potential of the water source dictates the allowed infiltration systems. For Ljubljana the provisions state that the water needs to be infiltrated at the point of origin without deteriorating the chemical status of the groundwater. Milan does not have specific rules for possible infiltration systems. In Munich there is a preference to use surface infiltration > infiltration basins > basin-trench elements > infiltration trenches > infiltration shafts.
Drainage of rainwater into sewers	In Linz discharge into surface water or stormwater sewer is allowed if infiltration is not possibly. In Ljubljana it is only allowed if infiltration is not possible. In Milan rainwater may be discharged into dedicated sewer systems, however, specific permits or technical conditions can be demanded e.g., industrial or polluted areas. Discharge into sewers is prohibited in Munich if proper infiltration is possible.
Construction in groundwater	
Backwash	All four cities have regulations in place. It is strictly monitored and requires permits in Linz and Munich. In Milan, it is a regional text regulating this issue. In Ljubljana, it requires hydrological study and mitigation measures.
Ground breakings affecting groundwater	No information from Milan. It is allowed in Linz, Ljubljana and Munich with permit requirement and monitoring requirements (Assessment of hydrological impacts).
Dewatering during construction	No information from Milan. It is allowed in Linz, Ljubljana and Munich under strict requirements.

	In Linz, it is possible in sensitive areas under strict conditions and additional requirement can be decided by the local authorities
Groundwater extremes	
Groundwater flooding	Linz and Munich have national regulations as well as local state regulation, but Milan has only regional and municipal regulations. Ljubljana presents both national and municipal level of regulation. Special construction rules apply in areas prone to flooding and permit is required to build there. Strong link with rainwater infiltration requirements, soil quality regulations are noted here.
Low groundwater levels	All four cities must comply with national regulations on that topic. Milan has some regional and municipal requirements as well. In all cities, extractions can be stopped below a certain level of groundwater if necessary. Linz even offer a hierarchy in such event with preference to "safeguard the public interest (drinking-water and utility-water supply) in cases of water scarcity, particularly during groundwater drought."
Drinking water	
- Protection	In all the pilot cities, drinking water major guidelines are regulated at national or federal level, giving strict insights on the protection of this resource.
- Construction	Linz and Munich establish three distinct types of protection zones around drinking water extraction sites, whereas Milan defines only two. In Linz and Munich, the threshold limits are not strictly quantified. By contrast, in Milan, the absolute protection zone has a fixed radius of 10 m. In the absence of regional regulations, the protection zone extends up to 200 m. In Linz and Munich, Protection Zones I and II (the areas closest to the extraction site) prohibit any type of installation, with limited exceptions in Zone II (Linz). A similar principle applies in Milan, although regional authorities retain discretion to authorise certain infrastructure, such as sewers, residential buildings, railways, or roads within the protection zone. Ljubljana does not prescribe an absolute threshold; instead, it requires that any

	construction near an extraction well must not compromise the integrity of the water resource.
- Thermal use	In both Linz and Munich, the drilling of geothermal wells is prohibited within Protection Zone I. In Linz, special permits are required for drilling activities in Zones II and III, whereas in Munich, such permits may be requested only for activities in Zone III. In Ljubljana, since no absolute threshold is defined, geothermal systems must instead comply with regulatory requirements and demonstrate long-term sustainability. In Milan, the drilling of geothermal wells is entirely prohibited within the protection zone of a drinking water abstraction well.
Re-use of water	In Munich the re-use of water for groundwater recharge is not envisaged, but it is possible to obtain permission, for irrigation if water treatment ensures hygiene and quality standards. Regulations are set at the federal level, mainly through WHG provisions and technical standards. In Ljubljana water re-use is explicitly encouraged where it is safe and feasible, for example in irrigation or cooling. The framework is provided by state-level regulation with additional oversight from EU rules. In Linz, water re-use is generally prohibited, particularly for groundwater recharge, due to concerns about water quality. Only limited expectations are allowed, such as household wastewater usage outside protection zones, minimal scientific purposes or specific cases involving geothermal and mining water. The framework is on federal level. For Milano there was no data available on the given subject.
Ecology	In Munich, ecological protection of groundwater is not specifically regulated but federal laws require that groundwater management prevent deterioration in both quality and quantity and reverse man-made trends of increasing pollutants. The emphasis is therefore more on maintaining status and reversing pollutions rather than on proactive ecological safeguards. In Ljubljana, ecological considerations are strongly embedded in legislation. Groundwater abstraction

	must not harm protected habitats and is tied to environmental impact assessments as well as Natura 2000 rules. This framework ensures that ecological values and biodiversity are directly considered when managing groundwater, reflecting both state and EU-level commitments. In Linz there is a regulatory gap. The QZV Ökologie OG addresses only surface waters, leaving groundwater without a direct ecological regulation. Instead, the QZV Chemie GW regulates groundwater mainly through chemical status, setting limits so that pollutant concentrations from groundwater inflows do not exceed 50 % of pollutant loads in connected surface waters. This means groundwater ecology is protected only indirectly, through its effects on surface water quality. For Milano there was no data available on the given subject.

5 Conclusions

Deliverable 1.3.1 provides a systematic analysis of groundwater management regulations across the pilot cities Linz (Austria), Ljubljana (Slovenia), Milan (Italy), and Munich (Germany). The primary purpose of this approach was to address the complex matrix of legal provisions governing groundwater management in urban contexts, systematically compiling and analysing existing national, regional, and municipal regulations to assess their coherence and alignment with overarching European Union directives.

This methodological approach reflects the growing recognition that sustainable groundwater management in densely populated urban areas cannot be achieved without clear, effective, and well-coordinated regulatory frameworks. The analysis employed a standardized framework of 34 regulation elements, as shown in Table 1, ranging from general groundwater protection to specific technical requirements for geothermal use, rainwater management, construction activities, and drinking water protection. This systematic cataloguing provides valuable insights into how binding and non-binding regulations (laws to guidelines) shape actual groundwater management practices on different administrative scales and highlights significant gaps or inconsistencies that may exist across jurisdictions (see Section 3.1.13.1 to 3.4 for details).

Linz demonstrates a regulatory framework with the Austrian Water Rights Act at its core, characterized by extensive technical guidance documents and rule sheets that translate legal requirements into practical implementation standards. The Austrian system's distinctive feature lies in its comprehensive network of technical guidelines provided by organizations such as the Austrian Association for Gas and Water (ÖVGW) and the Austrian Water and Waste Management Association (ÖWAV). These documents establish industry best practices that are widely adopted and often referenced in permit conditions, creating a robust bridge between legal requirements and practical implementation.

Ljubljana's regulatory framework reflects a centralized approach, with the Water Act (ZV-1) serving as the primary legislative instrument governing groundwater management. The Slovenian system emphasizes integrated water resource management through the Municipal Spatial Plan (OPN MOL) and local environmental regulations, with the Public Utility Company VO-KA SNAGA playing a crucial role in water management and resource protection. The regulatory approach prioritizes blue-green infrastructure principles and sustainable

stormwater retention, demonstrating a forward-looking perspective on urban water management.

Milan's regulatory framework represents a multi-layered approach with Legislative Decree 152/2006 serving as the fundamental legal foundation, complemented by regional regulations that govern integrated water service organization. The system emphasizes the protection of surface and groundwater quality, pollution prevention, and compliance with national environmental standards. Regional participation and oversight mechanisms ensure proper service functioning and effective infrastructure investments, while municipal-level regulations through the Territorial Governance Plan (PGT) integrate water management considerations into urban planning processes.

Munich's regulatory system operates within a federal structure that balances national environmental standards with regional implementation flexibility. The approach emphasises technical precision and comprehensive monitoring requirements, consistent with the country's tradition of detailed environmental regulation.

The comparative analysis, see Chapter 4, reveals significant variations in regulatory approaches across the four pilot cities, reflecting different national legal traditions, administrative structures, and regional priorities. These differences manifest across multiple dimensions of groundwater management, from basic protection measures to complex technical requirements for specific uses.

The identified regulatory gaps highlight common challenges across different governance systems, see Table 16. The upcoming revisions to various regulations and ongoing European policy developments present opportunities to address these gaps and improve regulatory coherence across the region.

Table 17: Comparison of gaps in the pilot cities.

Regulation gap	Linz	Ljubljana	Milan	Munich
Lack of specific climate protection legislation addressing groundwater resources and drought management mechanisms	x	x	x	x
Geothermal regulation Inconsistencies: Technical guidelines exist but may lack legal binding force	x	x	x	x
Fragmented data collection and management across institutions without integrated digital systems	X	Separate permits required from multiple bodies (ARSO, Municipality, VO-KA SNAGA)	x	
Sponge City integration: Lack of integration of modern urban water management approaches into existing regulatory frameworks	x	x		
Coordination difficulties between municipal and regional levels			x	x
Lack of comprehensive groundwater and underground space management systems	x			
Protection for groundwater ecosystems	x			
Weak Enforcement of groundwater protection zones		x		
Technical standards vary on a regional level undermining national coherence			x	
Extraction Permits vs. Actual Use Disparity	x			

6 References

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