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Integrating Expanded Cemeteries into the Landscape: A Framework for Sustainable Design

Abstract

Cemeteries are long-lasting landscape structures whose expansion has become increasingly necessary due to demographic pressures and changing burial practices. In Poland, the absence of coherent strategies has resulted in monotonous, environmentally poor and socially alienating cemetery extensions. This study develops a framework for sustainable cemetery expansion grounded in Environmental Sustainable Design (ESD). A comparative analysis of 34 expanded cemeteries in France, Germany, the Netherlands and Slovenia identifies key spatial and landscape features that support sustainable development. These findings are synthesised into three design principles – Accessibility, Identity and Coherence – which form the basis of a three stage planning process: diagnosis, evaluation and design guidance. The framework is applied to three Polish cemeteries representing rural, suburban and urban contexts. The results demonstrate that ESD principles provide a clear structure for integrating new cemetery areas with their landscape setting, improving spatial quality and strengthening social and ecological functions. The study offers practical guidance for municipalities and designers seeking to develop cemetery expansions that are environmentally responsible, culturally meaningful and spatially coherent.

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1 Introduction

Cemeteries are long-lasting components of the cultural landscape and play an important role in shaping the social, ecological and spatial quality of human environments (Klaver, 2015; Lai et al., 2019; Klingemann, 2022; Długożima et al., 2025; Page and Besco, 2025). As urbanisation intensifies and demographic pressures grow, the provision of burial space has become a critical planning challenge in many countries (Canning and Szmigin, 2010; Neckel et al., 2017; Scalenghe and Pantani, 2020; Puzdrakiewicz, 2023). Poorly planned cemetery expansions may generate environmental risks, degrade landscape quality and diminish the social and cultural functions of burial grounds (Nguyen and Nguyen, 2018; Franco et al., 2022; Gao et al., 2023; Sallay et al., 2023; Pathak and Mishra, 2025). At the same time, cemeteries are increasingly recognised as multifunctional spaces that support regeneration, contemplation, education and community identity (Francis et al., 2000; Worpole, 2003; Säumel et al., 2023; Moesch et al., 2024; Długożima et al., 2025). Their permanence and symbolic significance require long term, sensitive planning approaches that balance functional needs with environmental and cultural considerations (Davies and Bennett, 2016; Rugg, 2000).

In Poland, the demand for burial space has intensified due to demographic trends (Szukalski, 2023), the COVID 19 pandemic and the limited availability of land within existing cemeteries. Yet cemetery expansions are often carried out without coherent design strategies, resulting in monotonous, grid like layouts with limited vegetation, weak spatial identity and poor integration with the surrounding landscape (Pilarczyk and Nowak, 2019; Długożima, 2020; Długożima and Nejman, 2022; Jaszczak et al., 2025). Such spaces frequently fail to support ecological functions, social needs or aesthetic expectations, despite legal requirements that cemeteries be maintained as park like areas (Act on Cemeteries and Burial of the Deceased, 1959; Act on Nature Conservation, 2004). This situation highlights the need for planning tools that integrate environmental, social and cultural dimensions of cemetery design (Oyeleke and Oloukoi, 2024; Page and Besco, 2025).

Environmental Sustainable Design (ESD) provides a useful framework for addressing these challenges (Huang et al., 2023). ESD emphasises holistic, long term and landscape integrated approaches that balance ecological processes, cultural values and community needs (Antrop, 2006; UNESCO, 2011). In landscape architecture, sustainable design requires attention to natural systems, spatial coherence, user experience and the distinctiveness of place (Thompson and Sorvig, 2008; Chen and Wu, 2009; de Jonge, 2009; Kilbane, 2025). Research shows that cemeteries with diverse vegetation, coherent spatial organisation and strong landscape identity are more attractive, socially meaningful and environmentally resilient (Capels and Senville, 2006; Harvey, 2006; Cheng, 2013; Okumus and Terzi, 2023). However, Polish practice lacks comprehensive tools for analysing and designing cemetery expansions in accordance with these principles.

A review of international examples indicates that countries such as France, Germany, the Netherlands and Slovenia have developed more integrated approaches to cemetery enlargement. These include park like layouts, multifunctional buildings, diverse burial forms, landscape based screening, and spatial continuity between old and new cemetery areas (CAUE, 2016; Dekker and Emaar, 2014; Mathijssen, 2025). Yet these practices have not been systematically synthesised or adapted to the Polish context (Kubiak et al., 2023).

1.2 Goals of the study

This gap motivates the present study. To support sustainable cemetery expansion, the study adopts three core design principles: Accessibility, Identity and Coherence as an interpretive and operational framework. These principles reflect key dimensions of sustainable landscape design: 1) Accessibility referring to physical, functional and social access for diverse users, including circulation systems, entrances and connections to public space (Moonen, 2009; Wilkinson et al., 2017). 2) Identity understood as the distinctiveness of place, cultural meaning and the relationship between cemetery design and local landscape character (Uzzell et al., 2002; Stobbelaar and Pedroli, 2011; Enache and Craciun, 2013; Kaymaz, 2013). 3) Coherence describing the spatial and

visual integration of cemetery components and their fit within the broader landscape structure (Kaplan and Kaplan, 1989; Kuiper, 1998; Krause, 2001).

These principles provide a clear lens through which to analyse European case studies and to guide the development of cemetery expansions in Poland. The study pursues two main objectives:

- I. to identify landscape, spatial and functional features of sustainably expanded cemeteries in selected European countries, and
- II. to apply these features – interpreted through the “Accessibility – Identity – Coherence” framework – to the expansion concepts of three Polish cemeteries requiring development.

To achieve these aims, the study addresses the following **research questions (RQ)**:

RQ1. What features characterise sustainably expanded cemeteries in France, Germany, the Netherlands and Slovenia?

RQ2. How can these features be interpreted through the principles of Accessibility, Identity and Coherence?

RQ3. How can this framework guide the expansion of cemeteries in Poland?

RQ4. How does an ESD based approach enhance the integration of expanded cemetery areas with existing burial grounds and their landscape context?

By linking international case studies with local design applications, the study contributes to the development of practical, evidence based guidelines for sustainable cemetery expansion. It positions cemeteries not only as functional burial grounds but as meaningful public landscapes that can support ecological resilience, cultural continuity and social well being.

2 Theoretical background. Landscape cemetery design and sustainable development

2.1 Cemetery as landscape elements in the context of contemporary research shift

Cemeteries are increasingly recognised as complex landscape structures shaped by natural, cultural and social processes (Goyvaerts and Vande Keere, 2020; Clayden et al., 2020; Puzdrakiewicz, 2020; Klingemann, 2022; Sallay et al., 2022; Grabalov and Nordh, 2022; Säumel et al., 2023; Długożima et al., 2024; Moesch et al., 2024; Długożima et al., 2025). As long lasting elements of the built environment, they require planning approaches that balance ecological performance, spatial quality and cultural meaning (Francis et al., 2000; Worpole, 2003). Their permanence and symbolic significance impose long-term responsibilities on designers and municipalities, making cemetery expansion a task that must be approached with sensitivity, foresight and interdisciplinary knowledge (Davies and Bennett, 2016; Rugg, 2000). In many European contexts, cemeteries are legally defined as park-like areas or green spaces, emphasising their dual role as burial grounds and public landscapes (Act on Nature Conservation, 2004; CAUE, 2016; Klingemann, 2022; Długoński et al., 2022; Długożima et al., 2025; Jaszczak et al., 2025).

The European Landscape Convention defines landscape as an area shaped by the interaction of natural and human factors and perceived by people (Council of Europe, 2000). Cemeteries exemplify this definition: they combine vegetation, topography, built structures and symbolic elements, forming distinctive cultural landscapes (Ariès, 1981; Francis et al., 2002; Palánová and Juraka, 2018). Their spatial organisation, vegetation patterns and architectural features influence user experience, ecological processes and the relationship between the cemetery and its surroundings (Capels and Senville, 2006; Harvey, 2006). Well-designed cemeteries often exhibit a strong relationship with the local landscape, whether through topographic integration, visual connections or the use of regionally characteristic materials and vegetation (Cheng, 2013; Enache and Craciun,

2013). Conversely, poorly planned expansions – characterised by monotonous grids, minimal greenery and weak spatial identity – can disrupt landscape coherence and diminish both social and ecological value.

Although strategic documents such as the European Green Deal (European Commission, 2019) and the 2030 Agenda for Sustainable Development (UN, 2015) emphasise green transformation and climate adaptation, cemeteries are not explicitly mentioned in these frameworks. Meanwhile, contemporary research increasingly highlights their role as elements of green – blue infrastructure, providers of ecosystem services and contributors to climate adaptation (Quinton et al., 2020; McClymont and Sinnett, 2021; Straka et al., 2022; Säumel et al., 2023; Stumpe et al., 2024; Jaszczak et al., 2025; Iswoyo et al., 2025).

In recent years, scientific research has undergone a clear shift from micro scale, thanato architectural perspectives toward meso and macro scale approaches, in which cemeteries are understood as integral components of urban ecological networks. This shift reframes cemeteries not as isolated points on the urban map but as nodes within green infrastructure, essential for building sustainable and resilient cities (Lai et al., 2020; Długożima and Kosiacka Beck, 2020; Rae, 2021; Allam, 2023; Sallay et al., 2023; Nwambuonwo and Agwu, 2024; Stumpe et al., 2024). Such a perspective underscores the need for planning tools that integrate cemeteries into broader territorial systems, ensuring ecological connectivity, spatial coherence and multifunctionality.

Environmental Sustainable Design (ESD) provides a conceptual foundation for integrating ecological, social and cultural dimensions in landscape planning. ESD emphasises long term thinking, multifunctionality, resource efficiency and the integration of natural and built systems. Applied to cemetery design, ESD requires attention to ecological processes (soil, water, vegetation, biodiversity), social needs (rituals, accessibility, comfort, safety), cultural values (identity, symbolism, memory) and spatial quality (coherence, legibility, integration with surroundings). Landscape architecture plays a central role in implementing ESD principles, bridging ecological knowledge, spatial design and cultural interpretation. Sustainable cemetery design must therefore

consider both environmental performance and the experiential qualities that shape users' perceptions and emotional connections to the site (Thompson and Sorvig, 2008; Weisenhorn et al., 2018).

Taken together, the literature demonstrates a clear contemporary shift: cemeteries are no longer viewed solely as burial grounds or heritage sites but as multifunctional landscape infrastructures whose sustainable development requires integrated, landscape based approaches. Their ecological, cultural and social functions position them as essential – though still under-recognised – components of strategies for climate adaptation, green infrastructure and resilient urban planning.

2.2 *Three design principles for sustainable cemetery expansion*

A synthesis of literature on landscape perception, sustainable design and cemetery planning suggests that three principles: Accessibility, Identity and Coherence are particularly relevant for guiding cemetery expansion.

Accessibility encompasses physical access, circulation systems and the ability of diverse users to move comfortably through the cemetery (Wilkinson et al., 2017). It includes: multiple entrances and connections to public space (Moonen, 2009); clear and legible path systems (Dian, 2004); inclusive design for people of all ages and abilities. Accessibility also relates to social openness: cemeteries that are easy to enter and navigate are more likely to function as meaningful public landscapes.

Identity refers to the distinctiveness and recognisability of a place, shaped by its physical features, cultural meanings and historical context (Kaymaz, 2013; Stobbelaar and Pedrolí, 2011). In cemetery design, identity is expressed through: the relationship between the cemetery and local landscape character; the use of materials, vegetation and forms that reflect regional traditions; the preservation of symbolic and historical elements. Identity contributes to a sense of belonging and supports the cultural continuity of burial practices (Enache and Craciun, 2013; Worpole, 2003).

Coherence describes the degree to which spatial elements fit together and form a unified whole

(Kaplan and Kaplan, 1989; Kuiper, 1998; Krause, 2001). In cemetery expansion, coherence involves: visual and spatial integration between old and new areas; continuity of layout, vegetation structure or design motifs; clear relationships between cemetery boundaries, entrances and surrounding landscape. Coherence enhances legibility, supports ecological connectivity and strengthens the cemetery's role as a landscape element.

Although many European countries have developed innovative approaches to cemetery expansion – such as park like layouts, multifunctional buildings, diverse burial forms and landscape integrated designs (CAUE, 2016; Dekker and Emaar, 2014) – these practices have not been systematically analysed or translated into a framework applicable to the Polish context. Existing Polish guidelines focus primarily on sanitary and legal requirements, with limited attention to landscape integration, ecological performance or spatial quality. There is therefore a need for a structured, evidence based approach that can guide sustainable cemetery expansion in Poland. The “Accessibility – Identity – Coherence” framework offers a clear and operational lens for analysing international examples and for developing design recommendations that align with ESD principles.

3 Methods

3.1 Research design and analytical framework

3.1.1 Overall research design

The study follows a three stage, multi scale research design grounded in ESD (Fig. 1). The stages include: 1) Diagnosis, focused on identifying spatial, landscape and functional features of expanded cemeteries; 2) Evaluation, which interprets these features through the “Accessibility – Identity – Coherence” framework; 3) Design Guidance, which applies the identified principles to expansion concepts for three Polish cemeteries. This structure ensures a coherent progression from empirical observation to conceptual synthesis and practical application. To capture the complexity of cemetery landscapes, the study employs a three scale analytical approach: 1) macro scale – the cemetery within the wider settlement and landscape structure (visibility, access, ecological links, topography); 2) meso scale – the relationship between cemetery and its vicinity (boundaries, transitions, spatial continuity, view corridors); 3) micro scale – the internal organisation of the cemetery and relations between old and new cemetery sections

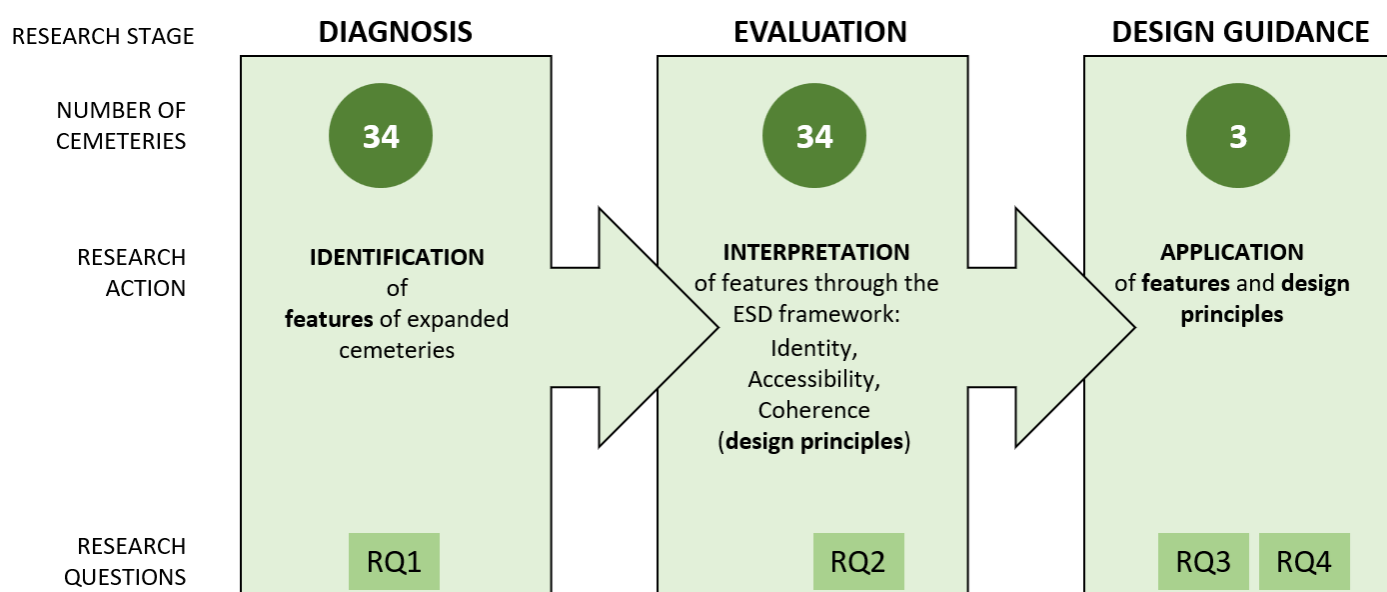


Figure 1. Research flowchart. Own elaboration

(path systems, vegetation, built elements, burial forms, user experience). This multi scale approach enables a comprehensive assessment of both spatial integration and internal design quality

3.1.2 Operationalisation of the „Accessibility – Identity – Coherence“ framework

The three principles were translated into observable criteria used across scales: 1) Accessibility – number and location of entrances; clarity and hierarchy of circulation; connections to public transport and parking; inclusivity for users of different ages and abilities; 2) Identity – relationship with local landscape character (materials, vegetation, topography); preservation or reinterpretation of historical elements; distinctiveness of spatial composition and architectural expression; 3) Coherence – spatial continuity between old and new areas; visual linkages (axes, view corridors); consistency of layout, vegetation structure and design motifs; integration with surrounding land uses.

Data were collected through analysis of architectural and landscape documentation, orthophotos and satellite imagery, municipal planning documents and photographic surveys. Analytical tools included GIS based visibility and connectivity analyses, topographic modelling, vegetation structure assessment and comparative spatial mapping.

3.2 Spatial scope and rationale for case study selection

3.2.1 European case studies

The spatial scope of the study was shaped by the legal, cultural and professional conditions that influence cemetery planning in Poland. Cemeteries in Poland occupy a hybrid position in the planning system: they are legally classified as construction objects requiring certified architectural design, yet they are simultaneously recognised as green areas under the Act on Nature Conservation (2004). The Act on Cemeteries and Burial of the Deceased (1959) further requires that cemeteries be maintained in a park like form. This dual classification highlights the need for interdisciplinary approaches that integrate technical, ecological and landscape considerations.

To identify relevant international reference points,

the study focused on countries whose legal frameworks, burial traditions and professional practices show strong parallels with the Polish context. The selection of France, Germany, the Netherlands and Slovenia was guided by three main criteria.

(1) Legal and institutional similarities with Poland

All four countries, like Poland, require interment to take place within officially designated cemeteries, ensuring that burial landscapes are planned and maintained within a formalised legal structure. France, Germany and the Netherlands also classify cemeteries as park like areas, aligning closely with the Polish requirement that burial grounds be maintained in a landscaped form (van der Breemer, 2021). Slovenia follows the same principle, with the exception of allowing ash burial or scattering outside cemeteries under specific conditions and municipal approval (Dziewulak, 2012). Comparable cremation rates in France (41.3%) and Poland (approx. 40%) indicate similar demographic and cultural pressures shaping cemetery development (ICS, 2024; Kuźniar, 2025).

(2) Cultural parallels in burial traditions and landscape perception

Poland shares with the selected countries a cultural understanding of cemeteries as meaningful public landscapes that combine commemoration, identity and everyday use. In all four contexts, cemeteries are perceived not only as functional burial grounds but also as culturally embedded spaces reflecting local identity, religious traditions and community values. This cultural proximity strengthens the relevance of the selected examples for informing Polish practice.

(3) Professional practice and the role of landscape architects

A key motivation for selecting these countries was the prominent role of landscape architects in cemetery design – an aspect still underdeveloped in Poland (Długożima and Kosiacka-Beck, 2020). In France, Germany and the Netherlands, landscape architects typically lead or co lead cemetery expansion projects, shaping spatial structure, vegetation systems, circulation networks and the integration of new areas with the surrounding landscape. Their involvement is supported by professional standards and

municipal expectations. In Poland, by contrast, the participation of landscape architects depends largely on the initiative of the lead architect or commissioning authority, which often results in expansions prioritising technical or capacity driven solutions over landscape integration, ecological continuity or spatial identity.

The cemeteries included in the study were chosen based on their relevance to the research aims. All sites underwent expansion after 2000, ensuring that

the analysis focused on contemporary design approaches. Only cemeteries with clearly identifiable old and new sections were included, allowing for an assessment of spatial continuity and integration. The final sample comprised 34 cemeteries: 11 in France, 9 in Germany, 9 in the Netherlands and 5 in Slovenia (Tab. 1). These sites represent a diverse range of landscape settings, design strategies and planning traditions, providing a robust basis for identifying features of sustainable cemetery expansion.

Table 1. Cemeteries selected for the research. Own elaboration based on websites of architecture, landscape design studios and cemetery area by Google Maps Area Calculator Tool.

L.p.	Location	Cemetery area [ha]		Expansion of cemeteries	
		Original	Expanded	Year	Authors/consultants of project
France					
1.	Auvers-le-Hamon	0.5	1.0	2014-2015	Lorraine BAPTS Architecture
2.	Châteaubourg	0.43	0.38	2019	Dominique Vignaux
3.	Liernais	0.4	0.5	2015	Atelier Correia et Associés
4.	Noisy-le-Grand	0.7	0.5	2007	Atelier de l’Ile Bernard Cavalié Paysagistes
5.	Gerland	0.2	0.26	2014-2016	Mayot&Toussaint paysagistes
6.	Arradon	0.7	0.6	1998-2000	Atelier Philippe Madec
7.	Saint-Marc-Jaumegarde	0.25	0.6	2016	Frédéric Gimmig, David Mossé, Reliefs Paysagistes
8.	Reux	0.4	0.35	2014	Zenobia (Atelier de Paysage et d’Urbanisme)
9.	IFs	1.13	0.52	2010	Bureau d’études Neill Ingénierie Services
10.	Audrieu	0.35	0.32	2008	SCPA Daligaux - Van Nieuwenhuyse Architectes
11.	Melesse	1.0	0.33	2015	Atelier Bouvier Environment
The Netherlands					
12.	Emst	1.3	0.9	2012	Buro Stad+Land
13.	Nijkerk	4.0	0.6	2015	Bureau Maris
14.	Logik, Zuiderparklaan	0.8	0.8	2014	Adviesburo R.I.E.T.
15.	Bodegruven Vredenhof	1.4	0.4	2019	Multi-Tuin en Landschap (MTL), Ada Wille
16.	Lentfert, Rijssen-Holten	9.5	5.0	2013	Het instituut
17.	Hoflaan, Zoetermeer	8.0	2.2	2017	Ada Wille
18.	Emmeloord	4.5	2.0	2000, 2017	Gemeente Noordoostpolder
19.	De Walakker	2.0	1.2	2007	Ank Bleeker en Anneke Nauta landschapsarchitecten BNT
20.	Hoevelaken	2.1	0.8	2012	SLAG
Germany					
21.	Karlskron	0.5	0.3	2006	Mutter Thomas Landschaftsarchitekt
22.	Bohmte	2.0	0.26	2017	Brendenfels landscape + environment
23.	Olching	2.0	3.0	2016	Michael Heintz
24.	Gorxheimertal	0.5	0.6	2003	Hans D. Bretschweider Wald-Michelback
25.	Leerstetten	0.5	0.4	2010	Lack of data
26.	Bodenheim	0.65	0.3	2015	Gutschker – dongus
27.	Herrsching	0.27	0.25	2015	Monika Treiber
28.	Argelsried, Gilching	1.2	0.8	2009	Freiraum Plan
29.	Nehren	0.6	0.5	2010	Grüllmeier
Slovenia					
30.	Polje-Ljubljana	0.95	0.67	2019	MISEL Iztok Čančula
31.	Sostro-Dobrunje	0.72	0.67	2018	Lack of data
32.	Dolenji Logatec	1.2	0.25	2020	Lack of data
33.	Dolenjske Toplice	0.2	0.7	2001	Simić Suzana
34.	Krško	1.9	0.25	2016	Kostak GIP

3.2.2. Polish case studies

The three Polish case studies were selected to test whether the design principles identified in European cemetery expansions can be effectively applied in the Polish planning context. Each site represents a distinct landscape setting within the Mazovia region: suburban (Antoninów), rural agricultural (Helenów) and historic urban (Czerwińsk nad Wisłą), and each contains clearly defined land reserves for future development. Together, they provide a robust basis for evaluating how the „Accessibility – Identity – Coherence“ framework can guide sustainable cemetery expansion under diverse spatial, cultural and administrative conditions.

Antoninów is one of the largest municipal cemeteries in the Warsaw metropolitan area, located within a transitional suburban – forest landscape. Established in 1999, it has already reached capacity for cremation burials, creating an urgent need for expansion. The surrounding land reserves consist of forested and semi open areas that offer opportunities for landscape integrated development but also require careful ecological consideration. The existing layout is functional yet weakly connected to the surrounding landscape, with limited visual permeability and few elements reinforcing spatial identity. This makes Antoninów a critical test case for assessing how the framework can support the integration of large scale cemetery expansions into suburban and peri forest environments.

Helenów is situated in an open agricultural landscape on the outskirts of Wołomin. Its axial relationship with the nearby parish church gives it a potentially strong landscape presence, yet the existing spatial structure is fragmented and lacks clear compositional order. The surrounding land reserves – open fields with dispersed tree stands – provide favourable conditions for expansion but require a coherent spatial

concept to ensure visual integration and functional clarity. The site currently does not operate as a landmark or meaningful public space, making it an ideal context for testing how the framework can strengthen spatial structure, enhance visibility and integrate new burial areas into a predominantly agricultural landscape.

The **cemetery in Czerwińsk** occupies a prominent hill overlooking the town and forms part of a historically layered cultural landscape that includes the monastery and parish church. Archaeological research confirms that earlier ecclesiastical structures once occupied this site, and the cemetery's spatial form developed gradually during the eighteenth and nineteenth centuries (Kosiacka-Beck et al., 2021). The surrounding topography, long distance views and strong cultural context create both opportunities and constraints for expansion. The site requires a design approach that respects its historical significance while improving accessibility, spatial legibility and ecological continuity. Czerwińsk therefore provides a valuable setting for testing how the framework can guide sensitive expansion in heritage rich environments.

Together, the three case studies (Tab. 2, Fig. 2-3) demonstrate the adaptability of the „Accessibility – Identity – Coherence“ framework across varied Polish landscapes. Antoninów tests ecological integration at a metropolitan scale. Helenów examines spatial coherence in an agricultural setting, and Czerwińsk explores identity – driven design in a culturally significant landscape. Their combined analysis provides a comprehensive basis for evaluating the framework's practical relevance and for developing context – specific guidelines for sustainable cemetery expansion in Poland.

Table 2. Polish research objects – cemeteries for development.

L.p.	Location	Administrative unit (commune, district)	Landscape type in which burial site is located	Type of cemetery	Date of foundation	Area [ha]
1.	Antoninów	Piaseczno, Piaseczno	Rural, forest, open, suburban	Communal	1999	42,3
2.	Czerwińsk	Czerwińsk, Płońsk	Urban (small town)	Religious (Roman-catholic)	18th century	1,9
3.	Helenów	Wołomin, Wołomin	Rural, agricultural, forest	Religious (Roman-catholic)	1998	0,6



Figure 2. Characteristics of three selected cemeteries for the purposes of study in the region of Mazovia (Poland). Own elaboration based on <https://polska.e-mapa.net/>



Figure 3. Landscape context of the three cemeteries selected for expansion. Owns elaboration

4 Results

4.1 Features of sustainably expanded cemeteries in Europe

The analysis of 34 expanded cemeteries in France, Germany, the Netherlands and Slovenia revealed a consistent set of spatial, landscape and functional strategies that support sustainable development. Although the case studies varied in scale, context and design language, several recurring patterns emerged across the three analytical scales (macro, meso and micro).

Landscape setting and visibility (macro scale). Many cemeteries were deliberately positioned or expanded to strengthen their relationship with the surrounding landscape. Some sites were designed as visible landmarks with clear arrival zones and framed views (e.g., Karlskron, Bohmte), while others were integrated into woodland or topographic depressions to minimise visual impact (e.g., Saint Marc Jaumegarde, Dolenjske Toplice). In several Dutch

and German examples, vegetation belts or natural landforms were used to mediate between the cemetery and adjacent land uses, enhancing ecological continuity and reducing noise or visual disturbance (e.g., Argelsried, Karlskron, de Walakker).

Relationship between old and new cemetery areas (meso scale).

Three main strategies were identified: 1) Continuity of layout, where the expanded area extends the spatial logic of the historic cemetery (e.g., Argelsried, Arradon). 2) Contrasting composition, where the new section introduces a distinct spatial structure while maintaining functional links (e.g., Olching, Liernais). 3) Axial or linear connections, where a main path, water feature or landscape axis links the old and new parts (e.g., Hoevelaken, Dolenjske Toplice). These strategies varied in form but shared a common goal: to maintain legibility and spatial coherence despite functional enlargement.

Internal organisation and landscape design (micro scale).

The internal layouts of expanded cemeteries demonstrated a wide range of design approaches, including grid systems softened by vegetation, concentric or radial layouts, meandering paths integrated with landform, and hybrid systems combining formal and informal circulation. Vegetation played a central role in shaping spatial identity, with many cemeteries incorporating diverse planting structures, ecological gradients, meadows, or park like

arrangements. Built elements – such as pavilions, columbaria, shelters and multifunctional buildings – were often designed using natural materials and subdued forms to blend with the landscape.

Synthesis through the ESD framework. When interpreted through the three design principles (Tab. 3), the European case studies revealed the following patterns:

Accessibility was enhanced through multiple entrances, clear circulation hierarchies, and strong connections to surrounding public spaces and transport networks.

Identity was strengthened through the use of local materials, regionally characteristic vegetation, and the preservation or reinterpretation of historical elements.

Coherence was achieved through spatial continuity, visual linkages, consistent vegetation structures and the integration of expanded areas into the broader landscape setting.

These recurring features formed the basis for the design guidelines applied to the Polish case studies.

Table 3. Key features of sustainably expanded cemeteries in Europe, synthesised through the “Accessibility – Identity – Coherence” framework.

Design principle	Identified features	European good practices
Accessibility	Multiple entrances improving openness	Bohmte (GER), Ifs (FR), Hoflaan (NL), Dolenji Logatec (SLO)
	Clear hierarchy of circulation routes	
	Integration with surrounding roads – local mobility (parking, bikes) and public transport	
	Inclusive design for diverse users	
Identity	Use of local materials and colours	Karlskron (GER), Saint Marc Jaumegarde (FR), Dolenjske Toplice (SLO), Emst (NL)
	Regionally characteristic vegetation	
	Landscape-integrated forms (e.g. terracing, landform based design)	
	Preservation or reinterpretation of historical elements	
Coherence	Distinct spatial motifs, symbolic elements/ distinct architectural expression using natural materials	Argelsried (GER), Arradon (FR), Hoevelaken (NL), Gerland (FR)
	Spatial continuity between old and new cemetery areas; consistent layout logic	
	Axial or linear connections	
	Vegetation based transitions	
	Consistent material palette	
	Integration of built elements into landscape; visual linkages with landscape or religious landmarks	

4.2 Application of features and the ESD principles to the three Polish cemeteries

The three Polish cemeteries: Antoninów, Helenów and Czerwińsk were used as testing grounds for the applicability of the European design principles. For each site, a preliminary expansion concept was developed for designated reserve areas adjacent to the existing cemeteries. The aim was to verify whether the features identified in the European cases could be effectively implemented within the Polish planning, landscape and cultural context (Tab. 4). Across all three sites, the concepts addressed three interconnected layers of design intervention – site layout, the natural environment and the built environment – and translated them into coherent spatial strategies. In each case, the proposed solutions introduced landscape based spatial structures that responded to existing topography and vegetation, complemented by ecological and regionally grounded planting strategies. Accessibility was improved through a more diversified circulation system and mobility infrastructure, while spatial and visual coherence was strengthened by vegetation based transitions and the consistent use of materials. The concepts also incorporated symbolic and cultural references adapted to the local context and integrated multifunctional, user oriented design features that enhance everyday use and support the social role of the cemetery. These concepts provided a practical means of testing the universality and adaptability of the “Accessibility – Identity – Coherence” framework.

4.3. Design solutions proposed in the expansion concepts

The **expansion concept for Antoninów** (Appendix 2) focused on integrating the new cemetery area with the surrounding birch forest and the existing cemetery. Concrete was selected for columbaria, benches and water features due to its texture, colour and durability, which harmonise with the subdued tones of the forest. Trasston (a natural volcanic tuff aggregate) in earth toned colours was used for primary surfaces, while secondary paths with dark aggregate created a camouflaged, park like effect. The forest’s light and moisture conditions are expected to support moss growth, further strengthening ecological integration. Accessibility was enhanced through diverse burial forms and seating options.

The **concept for Helenów** (Appendix 3) responded to the rural landscape by introducing a broad parkway functioning as both a circulation route and a viewpoint axis leading to a symbolic gate. An organically shaped path, reminiscent of a river, symbolised the course of life and stages of mourning. This path connected key functional elements, including the main entrance, ceremonial square, technical areas and burial zones. Open areas played an important role, with agricultural fields interpreted as a contemporary expression of the “God’s Acre” idea.

The **expansion concept for Czerwińsk** (Appendix 4) drew on the site’s unique cultural and topographic

Table 4. Application of the “Accessibility – Identity – Coherence” framework to the three Polish cemeteries selected for expansion.

Design principle	Antoninów Designed by Rej & Długozima, 2014	Helenów Designed by Sierzan & Długozima, 2015	Czerwińsk Designed by Długozima et al., 2020
Accessibility	• clear but uniform circulation • potential for additional entrances • diverse seating and columbaria	• meandering paths • improved entrance zone • bike shed and parking	• concentric layout • need for improved access due to slope • parking and bicycle stands
Identity	• Integration with birch forest • polygonal layout responding to existing trees • Mazovian materials and colours	• “Nature – Culture” gradient • rural landscape references • wooden elements and earth tone palette	• hilltop setting • symbolic references • water and vegetation linked to local religious landscape
Coherence	• vegetation based transitions • mineral surfaces • integration with Protected Landscape Area	• preservation of forest vegetation • mineral aggregate surfaces • coherent fencing	• terraced layout potential • meadow plantings • columbaria and outdoor chapel integrated into landscape

Note: Detailed design elements (e.g., specific plant species, symbolic references, material palettes) are provided in Supplementary Material (Table in Appendix 1 and Figures in Appendix 2-4).

setting on a hill overlooking the Vistula River and adjacent to the monastery complex. Visual and spatial links were established between the new cemetery area, the monastery hill and the historic cemetery section containing the 1839 wooden belltower. Historical and compositional analysis enabled the reconstruction of former view axes and the creation of new ones, accentuated by portals inspired by the Romanesque architecture of the nearby basilica.

4.4. Evaluation of the implementation of ESD principles in the Polish concepts

To assess the applicability of the European design principles, the expansion concepts were evaluated against the key features of sustainably expanded cemeteries identified earlier. The assessment is summarised in Table 5.

The analysis of the evaluation table (Tab. 5) reveals a differentiated degree of implementation of ESD principles across the three Mazovian cemetery expansion concepts, with each project demonstrating distinct strengths shaped by its specific landscape context. Accessibility is rated lowest in Czerwińsk, primarily due to the challenging hilltop topography that limits inclusive circulation. In contrast, Identity emerges as the strongest dimension in Czerwińsk, which receives maximum scores for the use of local materials, integration with landform, and the

reinterpretation of historical elements. The project draws directly on the unique setting of the monastery and Romanesque basilica, incorporating portals inspired by regional architectural heritage.

Across all three concepts, the integration of built elements with the surrounding landscape and the consistent material palette are evaluated very highly. Czerwińsk also leads in axial and visual connections, owing to the reconstruction of historical view corridors toward the Vistula River and the monastic complex. Antoninów and Helenów, meanwhile, achieve strong Coherence through vegetation – based transitions that link new burial quarters with adjacent forests or agricultural fields.

The application of the “Accessibility – Identity – Coherence” triad, together with the associated key features proves to be an exceptionally effective tool not only for final evaluation but also for the verification and optimisation of design proposals at every stage of development. The table functions as an operational instrument, enabling precise calibration of design decisions in line with ESD principles. By grounding the assessment in concrete features identified in European case studies – such as circulation hierarchy, use of local materials, or visual linkages – the framework shifts the evaluation away from subjective aesthetic impressions toward measurable indicators of sustainable design. This approach allows designers

Table 5. Assessment of the implementation of ESD based design principles in the expansion concepts for the three Polish cemeteries.

Design principle	Key features of sustainably expanded cemeteries (from European cases)	Antoninów	Helenów	Czerwińsk
Accessibility	Multiple entrances / openness	●●●○○	●●●●○	●●●○○
	Clear hierarchy of circulation	●●●○○	●●●●○	●●●●○
	Integration with local mobility (parking, bikes)	●●●○○	●●●●○	●●●○○
	Inclusive design for diverse users	●●●●○	●●●○○	●●○○○
Identity	Use of local materials and colours	●●●●○	●●●●○	●●●●●
	Regionally characteristic vegetation	●●●●●	●●●●○	●●●●○
	Integration with topography / landform	●●●●○	●●●●○	●●●●●
	Preservation / reinterpretation of historical elements	●○○○○	●○○○○	●●●●●
Coherence	Distinct spatial motifs / symbolic elements	●●●○○	●●●●○	●●●●●
	Continuity between old and new areas	●●●○○	●●●○○	●●●●○
	Axial / visual connections	●●○○○	●●●○○	●●●●●
	Vegetation based transitions	●●●●○	●●●●○	●●●●○
	Consistent material palette	●●●●○	●●●●○	●●●●○
	Integration of built elements into landscape	●●●●○	●●●●○	●●●●●

where: ●●●●● = fully implemented ●●●●○ = strongly implemented ●●●○○ = moderately implemented ●●○○○ = partially implemented ●○○○○ = minimally implemented

to detect critical weaknesses early in the process. For example, despite Antoninów's strong landscape identity, the low accessibility score clearly signals the need for additional entrances and improved circulation. In Helenów, the lower coherence rating indicates the necessity of reinforcing axial or material connections between the new and existing sections. In Czerwińsk, the steep terrain requires adjustments to path geometry – such as meandering routes – to ensure mobility for users with limited physical capacity. The evaluation table (Tab. 5) thus serves as a design checkpoint, where low scores provide explicit guidance for targeted corrections. The triad and its assessment matrix together form a methodology of a “living project,” supporting the creation of cemeteries that function not only as burial grounds but as sustainable, multifunctional public spaces that respect and enhance the cultural and natural landscape.

5 Discussion

5.1 *Landscape identity as a driver of meaningful cemetery expansion*

The European case studies showed that landscape identity is central to the success of cemetery expansions. Cemeteries that used local materials, regionally characteristic vegetation and spatial forms responding to topography or cultural context exhibited stronger legibility and a clearer sense of place. These findings align with broader landscape research emphasising the importance of place specific design in creating meaningful environments (Kaymaz, 2013; Stobbelaar and Pedroli, 2011).

The Polish concepts confirmed the relevance of this principle. Antoninów and Helenów demonstrated that even in relatively ordinary settings, identity can be strengthened through material palettes, vegetation strategies and symbolic motifs. Czerwińsk, situated within a culturally rich landscape, showed how historical references and reconstructed view axes can reinforce spatial identity and restore the cemetery's role as a landscape landmark. The results indicate that identity based strategies are both trans-

ferable and adaptable, supporting the universality of the framework.

5.2 *Accessibility as a foundation for social openness and everyday use*

Accessibility emerged as a key dimension of sustainable cemetery expansion. European cemeteries frequently incorporated multiple entrances, clear circulation hierarchies and strong connections to surrounding public spaces. These features enhanced openness and supported diverse forms of use, echoing contemporary approaches to inclusive landscape design (Moonen, 2009; Wilkinson et al., 2017).

The Polish concepts revealed both opportunities and limitations. Helenów demonstrated how circulation hierarchies and symbolic pathways can improve legibility and user experience. Antoninów and Czerwińsk, however, showed that accessibility remains constrained by existing layouts, topography and regulatory frameworks. The evaluation suggests that improving accessibility requires not only design interventions but also changes in planning practice, including stronger integration of cemeteries into local mobility networks.

5.3 *Coherence as a prerequisite for integrating new and old cemetery areas*

Coherence proved to be the most critical dimension for successful expansion. European examples demonstrated a range of strategies – continuity of layout, axial connections, vegetation based transitions – that maintained spatial unity despite functional enlargement. These strategies resonate with landscape perception research emphasising the importance of order, legibility and visual continuity (Kaplan and Kaplan, 1989; Krause, 2001).

The Polish concepts confirmed that coherence is both essential and challenging. Antoninów and Helenów showed partial coherence, achieved through material consistency and vegetation transitions. Czerwińsk demonstrated strong coherence due to its axial organisation and integration with the cultural landscape. The results indicate that coherence is highly dependent on site conditions but can be significantly improved through landscape based design strategies.

5.4. Contribution to Environmental Sustainable Design (ESD)

The study demonstrates that the “Accessibility – Identity – Coherence” framework operationalises ESD principles in a way that is both analytically robust and practically applicable. By linking ecological, social and cultural dimensions, the framework aligns with the holistic perspective advocated in sustainable landscape design (Antrop, 2006; UNESCO, 2011).

A key contribution of the study is the verification of the “Accessibility – Identity – Coherence” framework through its application to real expansion concepts. The evaluation table demonstrated that many of the design principles identified in the European case studies were successfully incorporated into the Polish expansion concepts, confirming both the flexibility of the framework across diverse landscape settings and the usefulness of the triad as a clear structure for translating ESD principles into spatial solutions. This confirms that the framework is not only descriptive but also prescriptive, offering a practical tool for guiding cemetery expansion in planning and design practice.

The findings indicate that sustainable cemetery expansion requires a shift from capacity – driven approaches toward landscape integrated design, and that the „Accessibility – Identity – Coherence“ framework offers municipalities a structured tool for evaluating existing cemeteries and preparing expansion strategies. The results also highlight the central role of landscape architects, whose expertise bridges ecological, spatial and cultural dimensions, and demonstrate that integrating cemeteries into wider green infrastructure networks can strengthen ecological connectivity while supporting everyday use.

The study is based on a purposive sample of contemporary European expansions and three Polish design applications. Therefore, findings are context – sensitive and not statistically generalisable. Data availability varied across sites (differences in documentation detail and temporal coverage). The analytical workflow prioritises transferable qualitative and spatial criteria. Subsequent research should develop quantitative indicators and validate them through longitudinal monitoring.

6 Conclusions

This study demonstrates that sustainable cemetery expansion is achieved when design is grounded in landscape thinking and structured analysis. The “Accessibility – Identity – Coherence” framework, applied across macro, meso and micro scales and tested on 34 European examples and three Polish case studies, provides a transferable methodology for diagnosing site conditions, evaluating design options and producing landscape integrated expansion concepts. Key findings indicate that successful expansions combine territorial integration, clear spatial hierarchies, continuity between old and new areas, and the use of vegetation and materials that reinforce local identity.

The proposed three stage workflow: Diagnosis, Evaluation, Designing translates these insights into actionable steps. Diagnosis requires multi scale mapping (macro: landscape exposure, topography, ecological links, access; meso: boundaries, transitions, view corridors; micro: path hierarchy, vegetation structure, architectural detail, user needs). Evaluation interprets diagnostic outputs through Accessibility (inclusivity and legibility), Identity (cultural and landscape meaning) and Coherence (spatial and ecological integration). Designing integrates these results into site specific concepts that reinforce ecological continuity at the territorial level, ensure compositional consistency between old and new areas, and shape inclusive, identity forming internal spaces.

Table 6 summarises integrated analytical requirements, methods and expected design outcomes across scales. The framework is intended as a practical toolkit for planners, landscape architects and municipalities; it supports evidence based decision making and can be embedded in local planning procedures. Future work should operationalise quantitative indicators for spatial coherence, ecological performance and user experience, and test the framework in participatory planning processes.

The framework developed in this study demonstrates that sustainable cemetery expansion is not a matter of adding new burial plots but of designing landscape integrated, culturally sensitive and eco-

logically resilient environments. By combining multi scale analysis, ESD principles and insights from exemplary European projects, the study offers a practical methodology that can support future planning processes, inform design competitions and guide municipal decision making. It also opens avenues

for further research, including the development of quantitative indicators for spatial coherence, ecological performance and user experience in burial landscapes (Fig. 4).

Table 6. Integrated analytical and design recommendations for sustainable cemetery expansion.

Dimension	Macro scale (landscape & settlement)	Meso scale (old – new cemetery relationship)	Micro scale (internal organisation)
Accessibility	- analyse regional access, public transport, pedestrian permeability - identify barriers - ensure legible approach routes	- assess entrance hierarchy - integrate circulation systems - ensure intuitive wayfinding and functional continuity	- provide barrier free paths - design resting places and orientation points - ensure micro mobility and comfort
Identity	- assess landscape character, topography, vegetation and cultural landmarks - reinforce symbolic presence in the landscape	- reinterpret historical structures - maintain continuity of materials and vegetation - respect local burial traditions	- use detail, vegetation and small architecture to express local identity - incorporate symbolic and contemplative elements
Coherence	- integrate new areas with ecological networks - maintain visual continuity - ensure compatibility with surrounding land uses	- ensure spatial continuity through consistent layout, vegetation structure and view corridors - design clear transitions	- maintain material and compositional consistency - organise graves, paths and greenery into a harmonious spatial system
Analytical tools & methods	- landscape visibility analysis - topographic modelling - ecological connectivity mapping - transport accessibility assessment	- spatial continuity analysis - boundary and transition mapping - view corridor analysis - vegetation structure assessment	- micro scale functional analysis - user experience mapping - material and detail inventory - symbolic and cultural assessment
Design outcomes	- landscape integrated extension - improved territorial accessibility - strengthened ecological performance	- seamless integration of old and new areas - enhanced legibility - reinforced cultural continuity	- inclusive, comfortable and identity forming internal spaces - coherent spatial rhythm - improved everyday usability

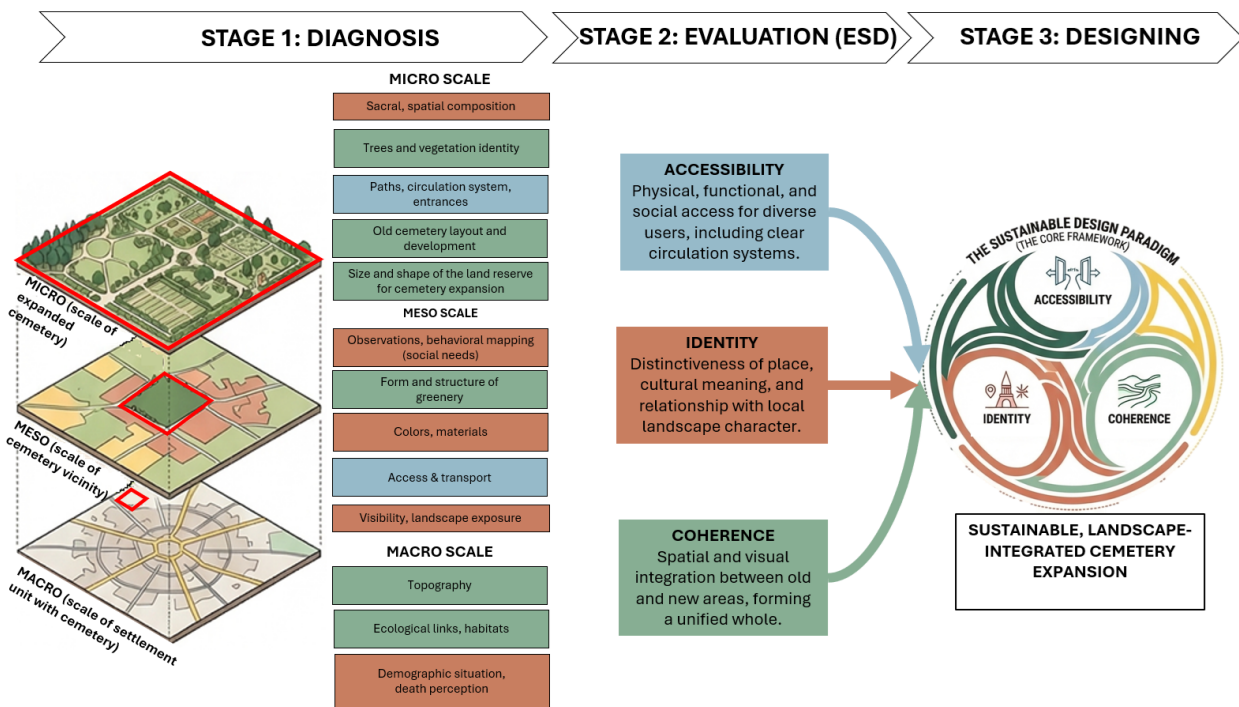


Figure 4. Flowchart presenting the procedure for designing the expansion of a cemetery. Own elaboration

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Declaration of Competing Interest

The author declares that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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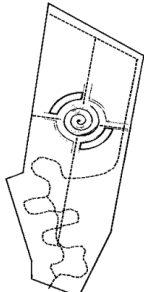
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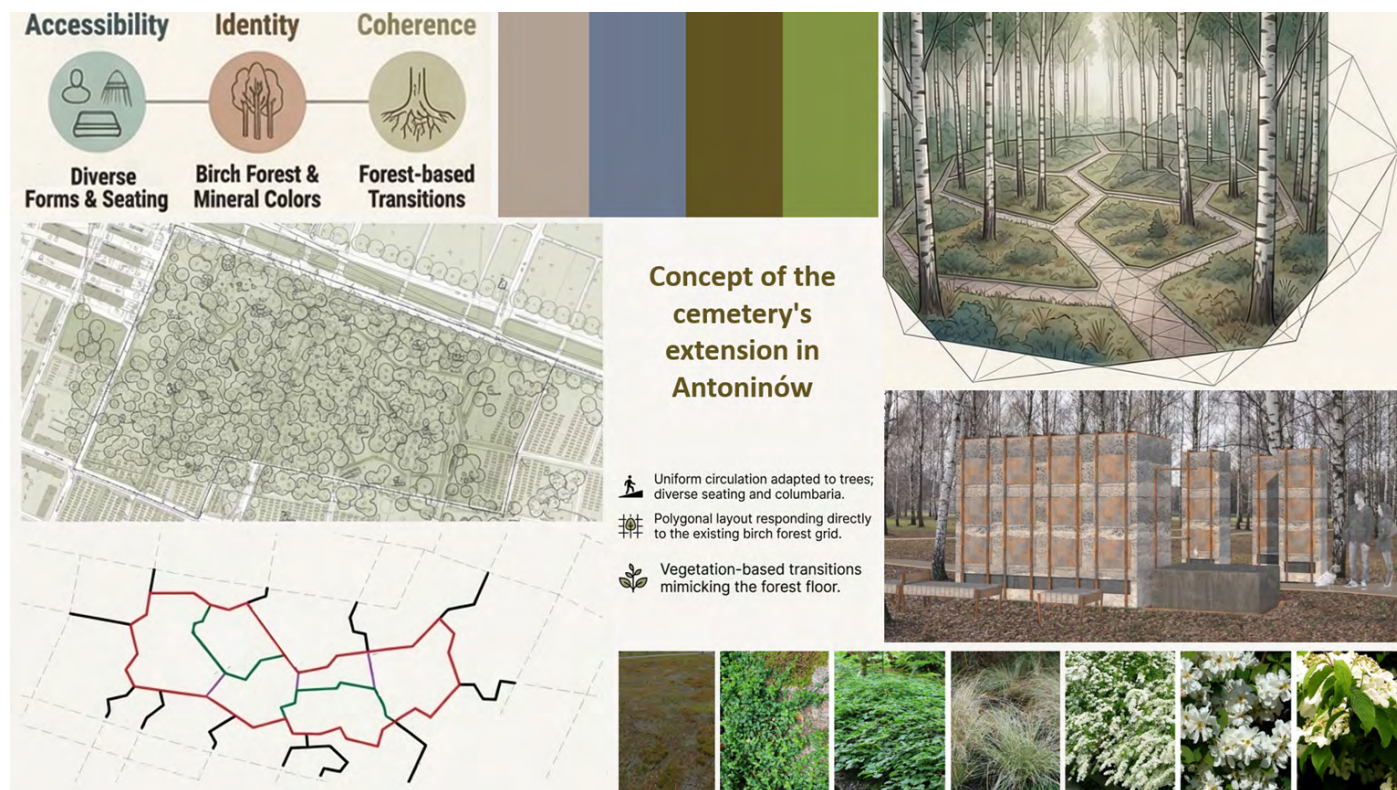
Appendix 1

Table. Polish cemeteries whose expansion concept is based on the triad: “Accessibility – Identity – Coherence”.

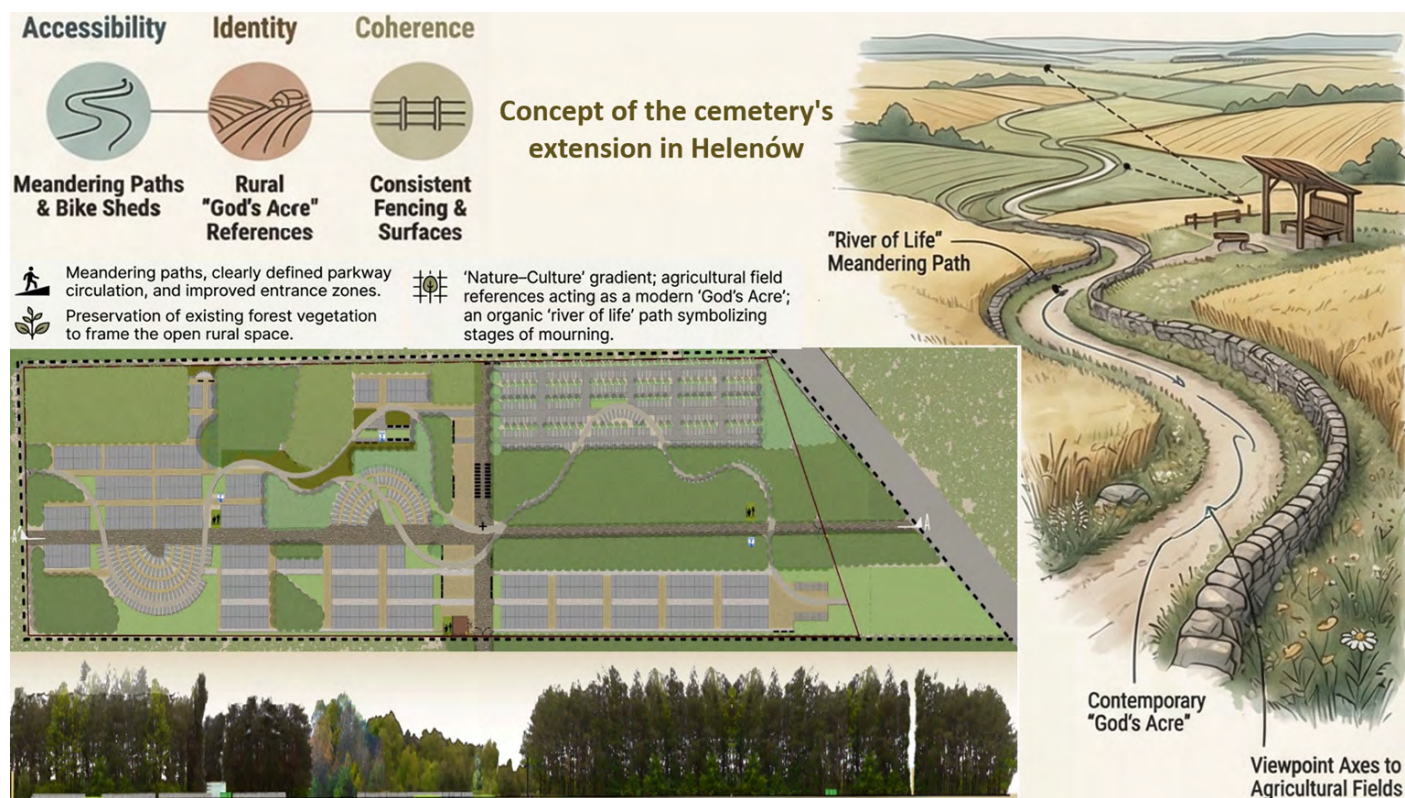
CEMETERIES			
LAYERS	ANTONINÓW	HELENÓW	CZERWIŃSK
Expanded cemetery layout			
Site conditions (context) Site topos	Lowland area, no permanent land development elements, covered with 486 birch trees ('Betula pendula')	Forest, rural area	Cemetery hill overlooking monastery and sanctuary. Small-town landscape
Identity	1 Incorporated in birch-tree forest, emphasis on genius loci, polygonal (does not collide with trees)	Idea of 'Nature – Culture' path (gradient)	Patio, archetypes, sacrum, God's Meadow, references to the Gethsemane's
	2 Ascetism	Christian symbolism, God's Acre idea	Christian symbolism
	3 Colour, materials linked with Mazovian (regional) landscape, water feature - encourages relaxation and an atmosphere of tranquillity	Colour, materials linked with Mazovian (regional) landscape and surrounding forest landscape (wood, colours of the Earth and nature)	Water element, landscaping elements (pergola, gazebo), markers that help to tell the history of cemetery (series of monuments to commemorate a place)
Accessibility	1 Polygonal	Regular, meandering paths	Regular, concentric rings around the central point, divided into four sections by two intersecting paths, meandering paths
	2 Ecumenism, universal means of expression readable for different groups of users	Comprehensible message of meanings referring to Christian symbolism	
	3 Landscaping elements for different types of users (e.g different types of benches), columbariums as a react on socio-cultural needs in the aspect of commemoration	Roofed bike shed, car park, square with cross	Car park, bicycle stands
Coherence	1 Moss, Trasston surface (camouflage of parkways)	Surfaces of mineral aggregates	
	2 Inclusion in Protected Landscape Area, environmental gradient	Preservation of forest area and the already existing plants	Flower meadows, climbers, plants and trees associated with Holy Mary (e.g. rose, linden tree, 'Scilla siberica')
	3 Landscaping elements (paths, water tap, benches, lamps, waste bins) incorporate materials that connect to the landscape (concrete, corten, wood)	Elaborating exemplary tombstone forms, fence corresponding with surrounding, corten, wood	Fence, wall columbariums, outdoor "chapel" integrate into and highlight the cemetery landscape

where 1, 2, 3 mean cemetery layers: 1 – site layout, 2 – natural environment, 3 – built environment (Długozima, 2020).
Own elaboration based on Rej (2014), Sierzan (2015), Długozima et al. (2020)

Appendix 2



Appendix 3



Appendix 4

