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Original Contribution

STRUCTURE AND CONTENT OF SPECIALIZED MAPS AND REGISTERS

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ABSTRACT: *The article examines the content and main components of specialized maps and registers as part of the cadastre system in the Republic of Bulgaria. It presents their key structural elements, thematic content, and the interrelation between maps and registers. Emphasis is placed on their role in territorial management, spatial planning, and the maintenance of up-to-date spatial information.*

KEY WORDS: *Specialized cadastre, Maps, Registers, Thematic content, Spatial data.*

1. Introduction

The cadastre is a fundamental component of the information infrastructure of every state. In addition to the basic cadastre, which contains data on land parcels, buildings, and individual properties, an important role is also played by the specialized cadastre. It covers specific objects or activities such as technical infrastructure, forests, water resources, agriculture, transport, and ecology [4,9].

To be usable and integrated within the national geospatial system, specialized cadastres are developed through specialized maps and registers that have standardized content and structure, in accordance with the regulatory requirements (Regulation No. RD-02-20-5 and related legislative acts).

2. Core components of specialized maps

Specialized maps are thematic plans created on a cadastral basis. They contain spatially distributed objects specific to the respective thematic field [3].

Their main elements include:

2.1. General data

General data constitute an introductory and mandatory element in the content of every specialized map, as they provide the essential information necessary for its proper interpretation, use, and integration with other

cartographic and cadastral materials. They ensure the identifiability of the map and provide information about its spatial, thematic, and temporal characteristics.

The general data include the following main components:

2.1.1. Title and scope of the map

The title of the map clearly defines the type of specialized cadastre and the territorial scope for which it has been prepared. For example:

- Specialized Map of the Technical Infrastructure – Shumen, Dobruzhanski District";
- Forestry Specialized Map of the Land Area of Velino Village".

The title must be unambiguous and specific in order to avoid confusion when multiple maps are used for different territories or thematic domains.

The scope describes the geographical or administrative unit covered by the map — such as a land parcel, neighborhood, settlement, municipality, or a defined area based on property boundaries, hydrographic basin, forest district, etc. For larger objects (e.g., highway routes or watershed zones), the scope may also be determined by thematic boundaries, not solely by administrative ones.

2.1.2. Type of specialized map

This element indicates the thematic orientation of the map — for example, forestry, water, agricultural, transport, environmental, and so on. Defining the type is important because it determines which thematic elements will be represented and which regulatory requirements apply during the map's creation.

For example:

- Water cadastre – for water bodies, sanitary protection zones, and hydraulic engineering facilities;
- Forestry cadastre – for forest compartments, plantations, and infrastructure;
- Agricultural cadastre – for land use, soil types, irrigation systems, etc.

The clear designation of the type of specialized cadastre is essential both for the proper use of the map by professionals and for its registration and archiving within the respective institutional repositories.

2.1.3. Scale and coordinate system

The scale of the map determines the level of detail and is selected according to the map's purpose and the size of the territory.

- For urbanized areas and technical infrastructure, larger scales (1:500, 1:1000, 1:2000) are typically used, allowing for detailed representation of linear objects and facilities.
- For larger territories (e.g., forested or agricultural areas), smaller scales (1:5000, 1:10000) are applied, providing a more generalized depiction of objects.

The coordinate system used for map production in Bulgaria is BGS2005 — the national coordinate system based on ETRS89 and the UTM projection.

Indicating the coordinate system is essential to ensure integration with other geospatial datasets and to maintain accuracy in geodetic activities.

2.1.4. Date of compilation or update

Indicating the date of creation or last update plays a crucial role in assessing the currency and reliability of the information contained in the map.

- For maps produced through geodetic surveys, the date of the fieldwork is recorded.
- For periodically updated maps, both the date of creation and the date of the most recent update are indicated, allowing users to trace the temporal dynamics of the data.

This element is also important from a legal perspective, as in many cases — particularly in design and construction — the use of maps that are current as of a specific date is a mandatory requirement.

2.1.5. Data sources

This component of the general data contains a description of all sources used in the creation of the map, specified by type, temporal coverage, and accuracy. The most commonly used sources include:

- Cadastral map and cadastral registers (CMCR) – the main source for property boundaries, buildings, and administrative units;
- Geodetic surveys – used for accurately determining the location of objects, especially in technical infrastructure mapping;
- Archival plans and documentation – useful for tracing old networks, historical forest maps, or legacy data;
- Remote sensing data – orthophotos, satellite imagery, drone data, and LiDAR technologies;
- Specialized institutional registers – such as those of Water and Sewerage (W&S) companies, Electricity Distribution, the Forestry Agency, Irrigation Systems, and others.

Listing the sources ensures transparency regarding data quality and origin, while also facilitating future updates and verification.

The general data section forms a fundamental part of the content of specialized maps. It provides the necessary contextual, spatial, and temporal framework, enabling the correct use of the map as part of a unified geoinformation system. The strict documentation of these elements is a prerequisite for the accuracy, reliability, and interoperability of specialized cadastral data.

2.2. Basic cadastral base

It serves as a background layer and includes land parcels, buildings, administrative and transportation boundaries, as well as relief information when necessary. This foundation ensures compatibility with the cadastre system and enables the integration of data from various specialized registers [19].

2.3. Specialized thematic elements

The specialized thematic elements constitute the core component of specialized maps, as they provide the means to visualize and record objects characteristic of a specific thematic domain. Unlike the basic cadastral foundation, which has universal content, the thematic elements are strictly function-oriented — they represent infrastructure networks, natural resources, land use, or other specific objects necessary for territorial management and activity planning.

Depending on the purpose of the specialized cadastre, the thematic elements can be divided into several main groups:

2.3.1. Specialized maps of technical infrastructure

Technical infrastructure is among the most commonly developed and practically applied types of specialized cadastre. Its content includes both underground and above-ground facilities, which are essential for the proper functioning of urbanized areas.

Main thematic elements:

- Underground networks and facilities: water supply, sewerage, electricity, gas transmission, and telecommunication networks. These are represented using different types of lines, color schemes, and symbols, indicating parameters such as diameter, depth, material, and other technical attributes.
- Above-ground facilities: power lines (including high-voltage transmission lines), transformer stations, reservoirs, manholes, poles, and others.
- Easements and protection zones: a crucial component that shows restrictions on land parcels located near engineering networks. Easements ensure the safe operation and maintenance of the networks and are represented as zones with precisely defined widths and regulatory regimes.

Specialized maps of technical infrastructure enable coordination between different networks help prevent construction conflicts, and support more efficient management of technical resources.

2.3.2. Specialized maps of waters, water bodies, and facilities

Specialized maps of waters, water bodies, and facilities contain both spatial and attribute information about all water features and installations, as well as their adjacent zones.

Main thematic elements:

- Water bodies: rivers, lakes, reservoirs, ponds, canals, and other surface waters. They are represented as linear or polygonal features in accordance with the hydrographic system.
- Hydraulic engineering structures: dikes, sluices, water intakes, treatment plants, and similar facilities.
- Canals and drainage systems: linear features essential for regulating water flow in agricultural and urbanized territories.
- Sanitary protection zones: delineate the restrictions and regimes around water sources and facilities used for drinking water supply.

These elements are key for water resource management, environmental protection, and flood prevention [17].

2.3.3. Specialized maps of forest territories

Specialized maps of forest areas contain spatial information about forest territories and serve as an important tool for the management, planning, and conservation of forest resources.

Main thematic elements:

- Forest compartments and sub-compartments: the basic units of forest management division, represented as polygonal features with unique identifiers.
- Roads and clearings: forest roads, firebreaks, and management boundaries — essential for access, protection, and territorial organization.
- Stand characteristics: tree species composition, age classes, site productivity, yield, and other parameters represented in attribute form.
- Protected zones and special regimes: reserves, protected areas, or sections subject to specific restrictions on logging and access.

These data enable sustainable forest resource management, forest planning, and monitoring of changes in forest cover and condition.

2.3.4. Specialized maps of agricultural territories

Specialized maps of agricultural territories focus on representing land use, soil characteristics, and irrigation systems.

Main thematic elements:

- Permanent land use types: the main characteristic of agricultural land, reflecting its purpose — arable land, meadows, perennial crops, vineyards, pastures, etc.
- Irrigation systems: canals, irrigation facilities, and pumping stations that are important for the management of water resources in agriculture.
- Soil types and productivity: spatial differentiation of soil units and assessment of their quality, which is crucial for land evaluation and crop planning.
- Erosion control and protective structures: elements related to anti-erosion measures and soil conservation.

These elements support agricultural planning, land evaluation, and the sustainable use of soil resources.

2.3.5. Specialized maps of mineral resources

Specialized maps of mineral resources contain spatial and attribute information about the location, type, distribution, and characteristics of mineral resources and deposits within the country’s territory. They are prepared in accordance with the Law on Mineral Resources (LMR) and the Regulation on Specific Requirements for the Management of Mining Waste (2009).

Main thematic elements:

- Mineral resources and deposits: showing the boundaries, geological formations, and types of minerals — metallic, non-metallic, energy, and construction materials.
- Mining areas: delineating the territories allocated for the exploration and extraction of mineral resources, indicating their status and boundaries.
- Mining and processing facilities: including shafts, mines, quarries, beneficiation plants, and other installations related to resource exploitation.
- Mining waste facilities and sites: showing the locations of tailings ponds, waste heaps, and other areas designated under the Mining Waste Management Regulation.
- Restricted and protective zones: representing areas with special regimes for environmental protection, safety, and groundwater preservation.

These maps serve as a key instrument for planning and managing exploration, extraction, and conservation activities related to mineral resources, ensuring their sustainable and responsible use.

2.3.6. Specialized maps of the maritime space and inland sea waterways

Specialized maps of the maritime space and inland waterways contain spatial and attribute information on the aquatorial boundaries, zones, objects, and activities within the marine environment. They are prepared and maintained in accordance with the Law on the Maritime Spaces, Inland Waterways, and Ports of the Republic of Bulgaria (LMSIWPRB).

Main thematic elements:

- Maritime spaces and boundaries: include internal waters, territorial sea, contiguous zone, exclusive economic zone, and continental shelf, as defined by international and national legislation.
- Inland waterways: show the main navigation routes, fairways, and port approaches, indicating depths, navigation aids, and facilities ensuring the safety of shipping.
- Ports and coastal facilities: include port terminals, quays, breakwaters, lighthouses, and other elements of maritime infrastructure.
- Zones with different designations: represent areas and water spaces with specific regimes — such as those for fishing, aquaculture, energy facilities, military and protected zones, as well as recreation and tourism areas.
- Elements of marine environment protection: depict marine protected areas, ecologically sensitive zones, and facilities related to monitoring and management of marine resources.

These maps serve as a primary tool for spatial planning and management of the maritime space, ensuring safe navigation and the preservation of marine and coastal ecosystems.

2.3.7. Specialized maps of cultural monuments

Specialized maps of cultural heritage monuments contain spatial and attribute information on the location, boundaries, characteristics, and protection regimes of immovable cultural properties. They are prepared and maintained in accordance with the Cultural Heritage Act (CHA).

Main thematic elements:

- Immovable cultural properties: include individual sites and ensembles — archaeological, architectural, historical, artistic, and ethnographic monuments registered under the CHA.
- Boundaries of immovable cultural properties: depict the precise spatial outlines of the sites and their adjacent areas, as determined during their declaration and categorization.
- Protection zones: represent areas with specific preservation regimes, established to safeguard the monuments from adverse impacts and unauthorized construction.
- Historic settlements and cultural landscapes: depict complex territories of high cultural value, combining architectural, archaeological, and natural elements.
- Infrastructure and accessibility: include elements of transport and tourism infrastructure that ensure access and sustainable management of cultural sites.

These maps serve as a key instrument for the preservation, planning, and management of cultural heritage, supporting territorial planning, cultural tourism, and the long-term safeguarding of national identity [18,20].

Each type of specialized cadastre includes thematic elements strictly defined by its purpose and regulatory framework. Their accurate representation on maps ensures precision, comparability, and practical applicability. Modern GIS technologies enable the integrated visualization of multiple thematic layers, facilitating territorial management and informed decision-making.

2.4. Attribute information

Attribute information represents the non-spatial data that provide detailed descriptions of each object depicted in a specialized map. While the cartographic representation shows the location and shape of objects, attribute information supplies identification, legal, technical, and descriptive characteristics, enabling the full and effective use of spatial data in cadastral and thematic applications [10].

Each object—whether linear, polygonal, or point—is linked to a unique record in an attribute database, with the spatial and attribute components connected through an identifier. This ensures the ability to perform efficient querying, analysis, updating, and integration of data within Geographic Information Systems (GIS) [9,18].

2.4.1. Object identifier

Each object in a specialized map must have a unique identifier, which serves as an unambiguous link between the spatial element and its corresponding record in the register.

- The identifier may be numeric, alphanumeric, or composite (e.g., a cadastral parcel code combined with an object code).
- In certain specialized cadastres (e.g., technical infrastructure), identifiers are generated according to the internal coding systems of the respective utility companies.
- In the forest cadastre, for instance, the identifier may include the compartment number, sub-compartment, and stand category.

The unique identifier ensures interoperability and enables automated data processing.

2.4.2. Name and classification

Each object is assigned a name (for example, “Main Water Pipeline F300,” “Irrigation Channel No. 2,” “Forest Compartment 45”), which facilitates easier identification and handling by specialists.

In addition, objects are classified by type, category, or functional purpose in accordance with the applicable legal regulations or the internal classification systems of the respective institutions.

- In engineering networks, this may include the type of network (water supply, sewerage, gas, etc.) and subtype (main, distribution, service, etc.);
- In the forest cadastre, attributes such as stand type, age group, and productivity are used;
- In the agricultural cadastre, attributes include land use type, soil classification, and land category.

2.4.3. Technical characteristics

The attribute information also contains specific technical parameters for each object, which vary depending on the type of specialized cadastre:

- Linear objects (water pipelines, canals, power lines, etc.): length, diameter/section, material, pressure, laying depth, year of construction, and others.
- Areal objects (forest compartments, agricultural parcels, water bodies): area, boundaries, surface type, land category, site productivity, etc.
- Point objects (manholes, hydraulic facilities, control points): coordinates, elevation, functional purpose, capacity, construction type, and similar attributes.

Specifying these parameters is essential for the operation, maintenance, and analysis of the respective objects, as well as for engineering design and investment planning.

2.4.4. Legal regime and ownership

An important component of the attribute information concerns the legal status of the objects. Depending on the type of cadastre, this may include:

- Ownership – state, municipal, private, or mixed;

- Type of property right – ownership right, right to build, easement, concession, etc.;
- Restrictions and encumbrances – protected areas, sanitary protection zones, and regimes governing access and use.

This information is particularly important for the issuance of construction and reconstruction permits, for expropriation procedures, and in the resolution of property disputes.

2.4.5. Additional data and metadata

In addition to the main identification, technical, and legal data, objects may include supplementary attributes that support their management:

- Date of entry/update, responsible person or institution;
- Historical data related to the object (e.g., previous routes, former land categories, reconstructions);
- Links to documents, drawings, photos, reports, or specialized registers;
- Codes based on standardized systems (INSPIRE, institutional internal codes, etc.).

Metadata are essential for ensuring data traceability and for facilitating their integration across different GIS environments and registry systems.

Attribute information is an integral component of the content of specialized maps and registers. It provides the necessary descriptive and legal context, without which spatial data cannot be effectively used in territorial management. The standardization of attributes, the unique identification of objects, and their regular updating are prerequisites for a high-quality and sustainable specialized cadastre.

2.5. Legend, symbology, and metadata

The legend, symbols, and metadata are an integral part of the content of every specialized map, as they ensure the unambiguous interpretation of the presented information, standardized visual representation, and data traceability. They play a crucial role both in enabling accurate understanding by users and in ensuring the interoperability of maps within Geographic Information Systems (GIS).

2.5.1. Legend and conventional signs

The legend is an explanatory element of the map that presents all symbols, lines, hatchings, color schemes, and textual designations used to visualize the various thematic objects.

The main functions of the legend are:

- to ensure clarity and unambiguous interpretation when reading and analyzing the map;
- to link graphic elements with their corresponding real-world objects or categories;
- to serve as a reference tool for both specialists and non-specialists when using the map.

Depending on the type of specialized cadastre, the legend contains different groups of symbols, for example:

- Technical infrastructure: various types of lines representing water supply, sewerage, and electrical networks, differentiated by color, thickness, and hatching;
- Water bodies and hydrological objects: blue lines and areas for rivers, canals, and reservoirs, with distinct contour types for sanitary protection zones;
- Forest areas: hatchings and colors indicating different forest types, age classes, or protected territories;
- Agricultural areas: color-coded zones for different land-use types, soil boundaries, and irrigation systems.

The legend should be clearly structured and prominently placed, usually in the lower or side section of the map sheet. For digital maps (in GIS environments), the legend can be dynamic, displaying automatically depending on the active data layers.

2.5.2. Graphic and text annotations

In addition to the legend, maps employ various notations and design elements that facilitate orientation and data interpretation:

- Labels and captions – used for parcels, compartments, routes, objects, and other identifiers;
- Numerical codes or numbers – for identifying objects, compartments, buildings, or network segments;
- Symbols and pictograms – point representations for hydraulic structures, poles, manholes, survey points, etc.;
- Auxiliary elements – arrows indicating flow direction, water currents, route profiles, and similar features.

To ensure that the map is readable and professionally designed, the notations must be harmonized in terms of:

- Size and legibility – avoiding overlap and ensuring placement that does not obscure important features;
- Color and contrast – making elements distinguishable from the background and other graphics;
- Uniformity and standardization – applying established symbols and fonts in accordance with regulatory requirements (e.g., Regulation No. RD-02-20-5 and the technical specifications of the Geodesy, Cartography, and Cadastre Agency – GCCA).

2.5.3. Metadata

Metadata represent “data about data” — that is, information describing the origin, quality, structure, and currency of the spatial data used in a specialized map. They are essential for:

- assessing the reliability of the map;
- enabling integration with other geospatial databases;

- supporting data reproduction and updating in the future.

Typically, metadata include:

- Data origin – sources (geodetic surveys, archives, cadastral maps, remote sensing, etc.), methods of collection, and responsible institutions;
- Quality and accuracy – type of measurements, coordinate precision, mapping methods, and the presence of verification or validation procedures;
- Date of creation and update – indicating stages of data integration when multiple sources are combined;
- Author/organization and contact information – identifying the entity responsible for creating or maintaining the data;
- Scope and usage constraints – licenses, copyrights, access rights, and terms of use;
- Thematic classification and keywords – facilitating data search and indexing in geoportals.

In modern GIS environments, metadata are stored in separate metadata files (e.g., in XML format) compliant with standards such as INSPIRE, ISO 19115, and ISO 19139. This enables data exchange between different institutions and countries [21].

The legend, notations, and metadata are mandatory elements for the correct representation and use of specialized maps. While the legend and notations ensure the clarity and standardization of visual content, metadata provide the essential information on the origin, quality, and applicability of spatial data. In the context of digital transformation and geospatial data integration, well-structured metadata are a key factor for the reliability and sustainability of specialized cadastral systems.

3. Content of specialized registers

Specialized registers are an integral part of specialized maps. They store tabular and textual data that complement the spatial objects.

They typically contain:

- a unique identifier corresponding to the object represented in the map;
- the name and classification of the object;
- technical parameters (dimensions, capacities, material, etc.);
- ownership and legal status;
- dates of creation, update, and the responsible institutions;
- additional notes or links to other registers.

The register and the map are closely interrelated — the spatial information provides visualization and localization, while the register contains detailed descriptive data about the objects. In maintaining specialized cadastres, updates must be performed simultaneously in both components to ensure consistency and reliability.

4. Conclusion

Specialized maps and registers represent an important tool for territorial management and the maintenance of up-to-date spatial information. Their content must be clearly structured, harmonized with the cadastral base, and compliant with the regulatory framework. Modern technologies — including GIS, remote sensing, and web-based databases — enable the integration and efficient use of these data by state and municipal authorities, designers, investors, and citizens alike.

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