

ICA: CYPRUS NATIONAL REPORT

Department of Lands and Surveys

The Cypriot Cadastral, Valuation, Mapping and Land Registration Authority

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International Cartographic Association Association Cartographique Internationale

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1. INTRODUCTION

The Department of Lands and Surveys (DLS) is the Cadastral, Valuation, **Mapping** and Land Registration Authority of Cyprus. It is one of the oldest departments in Cyprus Government and probably the most important pillar of socio-economic development in our country, as it deals with the land, which is one of the leading factors for progress, prosperity and development in the Cypriot economy.

It is divided into eleven (11) branches, which independently or in cooperation are dealing with all matters related to the legal, fiscal and spatial aspects of land in Cyprus. These branches are:

- Administration, responsible for all personnel administrative matters, the preparation of annual budgets and control of expenditure.
- Registration undertakes all the work associated with the investigation and registration of title etc.
- Tenure is responsible for Land Tenure matters including General Registration.
- Management of State Lands is responsible for the Management of State Lands and the steering of acquisition and requisition uses.
- Valuation is responsible for the carrying of Land Valuations for all purposes.
- Survey concentrates on cadastral surveys, which effectively support the registration system and the production and maintenance of cadastral plans.
- Cartography of the Department is the Mapping organization of the Republic of Cyprus. The main activities of this Branch concentrate on GIS applications, the production and maintenance of topographical maps, and other thematic mapping both in digital form.
- Photogrammetry, Geodesy and Hydrography. Main activities focus on the areas of geodesy, the establishment and maintenance of the geodetic and leveling networks, air survey (aerial photography), hydrography, sea surveying and photogrammetry.
- Land Information System Technical and Operational Support. It is responsible for both automated systems and manual processes engaged in information processing regarding input and output data, infrastructure, central help desk, trainings, legal and fiscal upgrade etc.
- Land Consolidation
- Operational and Legal Transformation

2. SURVEYING AND MAPPING ACTIVITIES

2.1 Survey

Survey Branch carries out the full range of tasks related to land surveys and land mapping, including the collection, verification, processing, analysis, finalization, storage and management of all relevant land measurements and data. These tasks include field survey work and updating the official cadastral plans. Also updating the geographical databases of the Land Information System, which store the cadastral boundaries of properties and all geospatial information related to these boundaries. Field survey work can be undertaken by the Department and by Private Licensed Surveyors, while the control and the supervision of such work, including that of private licensed surveyors, the update of the cadastral plans and the entry of the data into LIS databases are carried out solely by the Survey Branch.

Survey Branch actively participates and contributes in the ongoing upgrade procedures of the geographical part of the LIS. The goal remains to have all the staff working in a single environment and making maximum use of advances in technology through the new system incorporated in August 2022. Systems runs on esri, ArcGIS Pro platform. For this reason, the staff were educated and trained in the use of the new system implemented by the upgrading of the geographical part of the LIS.

Survey Branch also:

- Works continuously in monitoring and upgrading of the quality of the data stored in the geographical databases of the LIS.
- Contributes to the efforts of the Management to review and simplify the procedures and reduce the number of stages in the processing procedure of cases and also to reduce the number of field visits.
- Supports the expansion of the applications of the online service platform, DLS Portal, to the Survey Sector, in order to automate the exchange of data and information with private licensed surveyors, other government departments and citizens.
- Increases the efforts to replace the cadastral background with a new digital background, through the publication and adoption of new cadastral plans of high accuracy and credibility, via the re-survey project.
- Enforces the utilization of the plots resulting from the sporadic re-survey, so as to expedite the process and adopt a larger number of plots.
- Continues the assignment of survey cases to private Licensed Surveyors, through tenders, and to provide them continuous training and support from the Survey Branch.



Figure1: Cadastral Plans: old cadastral plan (on the left), new cadastral plan after resurvey (on the right).

2.2 Geodesy

The DLS has the responsibility for the extension, checking and the maintenance of all the Geodetic networks in Cyprus. It also has the responsibility to establish, maintain and renew the geodetic reference systems in Cyprus.

There are two Geodetic systems in use:

- The old geodetic system, 1913-15, which is used for all the survey works that are based on the plans in use.
- The new geodetic system established in 1993, based on GNSS measurements. It consists of three orders of points. The first order control points are 40 and the distances between them are 5-31km, the second order control points are 416 and the distances between each other are 1-13km. Approximately 25000 3rd order control points have been established and measured and consist the 3rd order control network. The reference ellipsoid that was chosen is WGS84 and the projection is a Local Transverse Mercator.

The DLS has also the responsibility of elevation networks. It manages the elevation points, the extension and establishment of new points, the maintenance and the establishment of new elevation reference systems.

In 2008 a system of 7 permanent reference stations was created in Cyprus (CYPOS). It provides services for real time measurements (RTK) as well as data for post processing. The services provided are unlimited both for RTK measurements and post processing data.



Figure 2: The contribution of the EGM08 geodynamic model to the gravity field of the region of Cyprus

2.3 Photogrammetry

The Branch operates a photogrammetric section with five (5) digital photogrammetric workstations. A Digital Terrain Model (DTM) of the free area of Cyprus has been completed at a spacing of 1m. A Digital Surface Model (DSM) also covers the city areas at a spacing of 50cm (Lidar Survey 2019). The country has also been covered with ortho-photomaps (1963,1993,2008,2014,2019), as well as with ortho-rectified satellite imagery. The latest digital colour aerial photography was flown in 2019 using a pixel size of 10cm covering almost 60% of the island (free areas).

The new aerial photography is currently being used as a basic tool during the updating procedure of cadastral and topographical maps. Further to this the Department has also competed the collection and processing of a new series of satellite images, covering the whole island. These images are mainly used for medium scale topographical maps. All digital ortho photos and satellite images are stored in separate layers of the Land Information System, and they are being accessed by GIS applications and a variety of users.



Figure 3: Orthoimages of 1963 (left) and 2019 (right)

2.4 Hydrography

<u>General information</u>: The Department of Lands and Surveys, according to the legislation, is responsible to process and evaluate information and data of hydrography and nautical cartography for the purpose of:

(a) Contributing to the safety of mariners;

(b) Implementing, exploiting, promoting and developing sciences related to hydrography and marine cartography.

The Director of DLS is the Hydrographer of Cyprus. The DLS has established a Hydrographic Unit which deals with all aspects of Hydrography and Nautical Cartography. It also represents the Republic of Cyprus to the International Hydrographic Organization and its subordinate organs. DLS has bilateral agreements with the Hellenic Navy Hydrographic Service (Memorandum of Understanding) and the United Kingdom Hydrographic Office (Exchange of Letters).

<u>Hydrographic activities:</u> Upon the establishment of the Cyprus National Hydrographic Committee in 2007, a resurvey program was planned, the implementation of which began in 2012. Four Hydrographic Surveys have been conducted as follows:

• 2012 with MBES, • 2014 with LiDAR, • 2018 with MBES, • 2022 with MBES

Data retrieved are S-44 compliant. So far, all coastal areas controlled by the Republic of Cyprus, from 0-250 m depth, have been resurveyed. Waters beyond 250 m depth have not been adequately surveyed. DLS collects data from various activities carried out in the Exclusive Economic Zone of the Republic of Cyprus.



Figure 4: Hydrographic Surveys commenced

DLS, has an MBES system which has been installed on the survey vessel "ALKYON", operated by the Department of Fisheries and Marine Research, and used for the conduct of small-scale hydrographic surveys and in urgent occasions.



Figure 5: PYTHEAS network locations

Oceanographic activities: In 2017 DLS established a new Tide Gauge Network named PYTHEAS, in order to monitor the sea level. Pytheas is fully operational since 2018 and consists of 5 stations, Stations are positioned approximately 40km apart and are equipped with, Sea Level sensor, sea water thermometer, Meteorological sensor and GNSS receiver.

2.5 Mapping With UAV Technology

The task is to acquire GIS data and imagery from UAV technology for large or unreachable areas complex in landscape or difficult to access environments and to create ortho-mosaic maps, 3D clouds and digital surface models. The results achieved by using this technique were up to centimeter level of accuracy. The high- resolution geospatial information produced is definitely suitable for cadastral mapping. The images produced can also be used by planners to examine the existing social and environmental conditions of the sites and consider the impact of different scenarios.

In the past two years, the Department has surveyed the two Reception centers for asylum seekers. Also, pilot projects have run for areas identified to be resurveyed due to inaccurate existing cadastral plans. A study was then carried out comparing the results of the products produced by the UAV technology to the ones carried out by standard survey methods.



Figure 13: Asylum seekers Survey, 3D cloud-points, DSM and ortho with section DSM

2.6 Mapping And Map Production

The Cartographic Branch of the Department is currently working on the major project of maintaining the Cartographic Database (TDS) and the creation of a newly designed Topographic Map Series at scale 1:25k.

• New Topographic Map Series at scale 1:25k – THE PROGRESS

New Grid created based on international standards

31 sheets (scale 1:50k)

89 sheets (scale 1:25k)

Uniform in size and orientation

Encoded name

Topographic Data Store Entity Catalogue – TDS V. 7.0

TDS was selected instead of a custom-made database schema due to lack of resources and expertise. Originally 1 million rows of data were migrated to the TDS. The database is still being developed and enhanced in terms of new data collected and updated.

Cartographic Workflow

- 1. TDS Development (completion & update of data): per map sheet
- 2. Data Preparation: extract AOI (per map sheet), marginalia information
- 3. *Create Template Layout*, using the Rapid Graphic: select product type, scale and version using mxd template
- 4. First Output: map document, production pdf
- 5. Map Evaluation (

- 6. Enhance Cartography: annotation, notes, legend, marginalia info, custom symbology
- 7. Print and Publish Map

The Production Environment:

- The TDS is sitting on an enterprise SDE database, where multi user editing (versioning) environment is applied. Data editing (collection and processing) mainly include interpretation of aerial photographs and satellite images, sometimes scanning and digitization of existing maps and data transfer and generalization from the digital cadastral database (parcel fabric).
- The software framework includes ArcGIS Pro (v.2.9.4) for data editing and ArcMap Desktop Application (v.10.8.1), Production Mapping and Defense Mapping extensions for map design and composition. Also, many peripherals support the map production process, such as scanners and high-quality plotters.

Additionally, cartographic work expands to the creation of ad hoc maps for a variety of applications and uses and revision of existing thematic maps, like street name maps and tourist maps.



Figure 14: tables in cross reference



Figure 15: 25k map sheet and representation rules

- Existing Cartographic Products include:
- ✓ The Topographic Map of Cyprus at scale 100k

- ✓ Administrative Map of Cyprus at scale 250k
- ✓ General Use Map of Cyprus, at scale 350k
- ✓ Street Name Maps at scales 5 & 10k
- ✓ Tourist Maps (including detailed town maps)



Figure 16: Topographic map of Cyprus, 100k

Figure 17: Administration and Road Map, 250k



Figure 18: Tourist Map

2.7 Planning Zones Update: The planning zones database is continuously updated with information coming from the Department of Housing and Planning. Mass updating is carried out in parallel, for the population of all zoning characteristics and attributes of each property. The update planning zones workflow was designed in the new GIS system, on ESRI's platform, ArcGIS Pro.





2.8 Postal Code Areas Update: Postal code areas are maintained in collaboration with the Cyprus Post Department, which is the competent authority. Editing is done on a GIS environment,

on a multi user editing environment, using ArcGIS Pro.



Figure 20: postal codes areas

2.9 EuroGeographics Databases

The Cartography Branch is also involved in the continuous updating of the Eurogeographics databases based on each year's Production Plan:

- 1. EuroRegional Map (ERM),
- 2. EuroBoundary (EBM),
- 3. Euroglobal (EGM),

The EuroDEM dataset for Cyprus has also been delivered. Complete datasets from Cyprus are already included on the EuroGeoNames on-line system, through the server that was installed for this purpose.

The Cartography Branch also provides cartographic support, GIS support and expertise and also map products to other Government Ministries and Departments such as:

- 1. Ministry of Defense
- 2. Ministry of Agriculture, Natural Resources and Environment
- 3. Ministry of Communications and Public Works
- 4. Ministry of Foreign Affairs
- 5. Ministry of Interior
- 6. Ministry of Education
- 7. Ministry of Commerce, Industry and Tourism
- 9. Department of Planning and Housing
- 10. Department of Forestry
- 11. Statistical Service of Cyprus
- 14. Water Development Department
- 15. Department of Geological Survey
- 16. Cyprus Police
- 17. Mines Service, etc.

2.10 Special Projects

✤ INSPIRE Directive: DLS has undertaken a leading and coordinating role for the implementation of the INSPIRE directive. DLS officers have already participated in

several meetings and conferences in Europe and in Cyprus for this purpose. DLS, with the support of the Department of Environment of Cyprus, has drafted the new law, covering all aspects of INSPIRE directive. The law (N43(I)/2010) was approved by the Parliament in 2010. Na π áp ω λ εκτικό aπό το DLS PORTAL γιa το implementation An INSPIRE Geoportal is up and running since 2016.

Strategic Plan for Developing a Key Address Register. This project took part under the European Commission's Directorate General for Structural Reform Support

3. LAND INFORMATION SYSTEM

The redesign and automation of the Department's processes, together with the upgrade of its systems based on the latest flexible and stable technologies that provide enhanced unified functionality, are expected to lead to more efficient processes and to the provision of new services, thus contributing to improved productivity, new areas of growth and a more citizen-friendly approach. The above is in line with the overall approach of the Republic of Cyprus regarding e-Government.

3.1 Architecture of the LIS

The Land Information System (LIS) collects data from all over Cyprus and has the main database along with the district servers. The LIS is based on a complex architecture, composed of a network of SUN servers connected to mainframe computers and workstations or Unix emulators running on personal computers and through Sunray servers/terminals. Applications are based on Oracle with Oracle forms.

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Figure 21: Oracle form, land register records

The main objectives and tasks of the Department are met by using the LIS.

With regards to the provision of services in relation to all rights these are:

The computerisation of land transactions, automation of methods and procedures, digitisation of existing cadastral plans and topographic maps, automatic update of plans, the gradual collection of digital land data from the re-survey programme, the automation of valuation and re-valuation methods, the automated case control and monitoring, the provision of services to Government Departments and other organisations by extending the system to a National Land Information System

LIS also Interconnects with other Horizontal Applications like:

- The DLS-PORTAL,
- the Government Data Warehouse (GDW) and
- the National Open Data Portal.

3.2 DLS Portal

The DLS PORTAL is one of the most important keys to the success of the new vision of change in the Department, shifting the focus to the citizen and the daily increasing needs for information and services. Using the Web Platform, the Department is no longer perceived as a closed box, offering a wealth of information to the public. It is the first and largest electronic library of geographic and descriptive data for all immovable property in Cyprus.



Figure 21: DLS Portal Front end

It is undoubtedly an integrated dynamic solution that covers both the development of specialised web applications and the supply of off-the-shelf software and data processing equipment. It contributes to reducing the time needed to serve citizens and organised bodies, while at the same time increasing the efficiency and effectiveness of the DLS and the public sector in general. It has become an essential tool for certain specialised teams to carry out their work, and in particular it provides instant information and easy access/transparency to everyone, from anywhere, at any time of the day. It enables access to the Department's data, online submission and processing of applications to all citizens via the Internet on a 24-hour basis. Citizens, specialised groups and organisations can use this platform to navigate the site and properties, submit applications to the Department, export data and catalogues, purchase maps, subscribe to services and other features.

The redesign and automation of the Department's procedures, as well as the upgrade of its systems to the latest flexible and stable technologies that provide enhanced unified functionality, led to more efficient procedures and new services/prospects of services. This has contributed to the enhancement of productivity and new areas of development, more friendly service and two-way communication with citizens.

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Figure 22: e-cadastre login page and electronic applications dashboard

3.3 Upgrade and expansion of the LIS

The maintenance, upgrade and expansion of the LIS is the largest IT and strategic project of the Government. The DLS main objective is the expansion of the LIS with a view to establish a National Land Information System, which will directly support organisations that manage land-related data.

In order to upgrade and operate a modern, integrated and reliable Land Information System, the Department is in the process of implementing the DLS IT Strategy, which aims to the development and implementation of a new governance model of information technologies in the Department of Lands and Surveys.

The upgrade and expansion of the existing Land Information System intends to create an integrated and modern Land Information System, with upgraded, enriched and redesigned functions, developed to serve in an efficient and reliable manner, the operational processes of the Department of Lands and Surveys and to provide services to all the departments of the wider public sector, other organisations and the citizen.

Consequently, the upgrade (Phase A) of the Geographical Subsystem of the Land Information System (LIS) was completed in 2022. The upgrade, which is a project of huge strategic importance for the Republic of Cyprus, includes the latest in GIS technologies to support spatial procedures. As part of the above upgrade, the Department intends to install at the same time a specialised Data Analytics and Dashboards platform. In this way, the Department enters a new business intelligence environment for faster decision-making by the Management, based on on-line real-time data.

In addition, the assessment of the tenders for the B Phase of the LIS upgrade, which concerns the Legal and Valuation Part, is currently underway and is expected to be awarded in 2023. This project will include the development, set-up, configuration and implementation of a new information system for the DLS that will replace and improve all the functions of the existing old system. It will also include the migration of data from the old system to the new one, the supply, configuration

and installation of the software system, the supply of new computer equipment (servers, peripheral equipment, network equipment, etc.) and user training.

Operating with the new systems is expected to deliver many benefits to the citizens, organisations, professional groups, other services of the wider public sector and to the Department of Lands and Surveys itself.

Main benefits are: Open, flexible and interoperable architecture, Unified communication through programming interfaces with Internet services and software, Faster processing of tasks/services, Workflow models, Workflow integration within the software to achieve full automation, Reduction of backlog of cases, Minimise the need for multiple manual checks, New redesigned and flexible procedures, Improved service to the public while reducing the need for the public to visit the DLS offices, Easier and faster future system upgrade process, Avoiding commitments in terms of technologies and specialised personnel, Building multi-skilled workforce, Maintenance of and easier access to historical data, Implementation of modern system security standards, Flexible tools enabling the production of specialised reports and statistics, Automation of workflows and faster delivery of e-services, Compatibility with local and European requirements, Effective interoperability with external systems, Reliable and secure data

Additional and general future benefits: Operational development of information technologies and enhanced performance through increased productivity, efficiency and cost rationalisation, Business continuity, Strengthening the IT environment of the DLS, Smooth system upgrade and transition to the new status, while preserving seamless performance of the daily tasks and transactions, Providing the latest, flexible and stable technological support which offers widely integrated functionality and enables the development of more efficient procedures and new services, Increased efficiency and effectiveness of services, and increase of their value, Risk mitigation, and reduction of the associated costs, Redesign of business processes and provision of mechanisms for publishing services and optimising their availability, Confronting challenges and laying down principles regarding the use of open and shared data, and the establishment of principles among stakeholders to ensure smooth and optimal access to information and online services, Introduction of integrated end-to-end processes supported by a service-oriented architecture, Setting standards for data integrity and quality, Lay the bases for the launch of a National Integrated Land Information System along with a National Geospatial Data Infrastructure

3.4 Constant digital transformation

By using the integrated Land Information System, modern technology (artificial intelligence), satellite images and other geographic data, the Department managed to collect new data in cooperation with other public sector departments and in combination with its existing data, to analyse and utilise them in various projects of the Department, such as the General Valuation.

Some of the examples are listed below:

- ✓ detection of non-registered buildings
- ✓ tracing of new building permits
- \checkmark tracing of town planning permissions through the department of town planning and housing
- ✓ automatic/algorithmic detection of the shape of a parcel
- \checkmark automatic/algorithmic detection of access to the parcel