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1. Introduction

The Estonian Land Board (ELB) is responsible for the organisation, co-ordination and supervision of the activities in the fields of geodesy, cartography and geoinformatics as well as for the maintenance of the Land Cadastre, co-ordination of land reform, land consolidation and land assessment according to valid legal acts in Estonia. ELB, established in 1990, is a government agency under the jurisdiction of the Ministry of the Environment and the costs in connection with the Board's activities are financed from state budget. ELB employs today 211 people and the total budget for 2002 is equivalent to 4.3 million Euros.

ELB’s organization chart is presented in Figure 1.1. The present report is concentrating on the Land Board's activities in the fields of geodesy, cartography and geoinformatics as well as on other aforementioned activities that handle spatial data. The following ELB’s departments and bureaus under these are directly involved in managing spatial data:

- Department of Geodesy and Geoinformatics, Bureaus of Geodesy, Cartography, Geoinformatics, Technical Supervision and Archives of Geodetic and Cartographic Data;
- Department of Land Cadastre, Bureaus of Central Land Cadastre, Cadastral Map, Real Estate Valuation, Central Land Cadastre Archive and Local Cadastral Offices in all counties (in total 15 counties).

The main tasks of these departments are to supervise, organise and co-ordinate the activities with the aim of providing the society with high-quality services in the related fields. The Department of Geodesy and Geoinformatics maintains several spatial databases (geodetic network, topographic maps, special maps), but it has very small production capabilities and majority of the works (building and measuring of geodetic networks, cartographic production, software development) are outsourced through public procurements. The copyright and ownership of data and publications produced by ELB’s order belong to the Land Board. The Department of Land Cadastre registers land and maintains Land Cadastre including cadastral maps; all actual land surveying works are carried out by private surveyors or companies at landowners’ own expense.

For providing these services ELB uses modern technology. ELB owns a set of high-precision GPS instruments (Ashtec and Leica) and analytic (Leica) as well as soft photogrammetric (LH Socet Set, with aerophotoscanner) stations, which are given to subcontractors for performing works ordered from them. ELB’s main building and local offices are connected via Virtual Private Network (VPN), which functions through the governmental Wide Area Network (WAN). Main software technologies for cartographic and geoinformatic projects include a database platform from Oracle with Spatial Option and GIS software from Intergraph (GeoMedia, GeoMedia Pro and GeoMedia WebEnterprise). The central office as well as all local cadastral offices are equipped with A1/A0 inkjet plotters to produce cadastral maps on demand. ELB also owns a wide photoplotter (Scantext Largo) for making different photographic products (orthophotos, printing originals).
The major milestone for ELB in 2001 was the full-scale launch of the Cadastral Information System (CIS). CIS now manages in an integrated way both textual and map data. CIS can be divided into two parts, cadastral data registration tool and public services system working over Internet. Since the end of the year 2000, free public access to the textual part of the cadastral database covering the whole country has been provided via ELB’s home pages (http://www.maaamet.ee, the interface is only in the Estonian language at the moment). In July 2001, access to the cadastral maps for 9 counties was added to the service and the full coverage (15 counties) was achieved at the end of the same year. This public service is free for everyone and includes also almost all large scale digital spatial data available from ELB as backdrop maps (raster and vector maps, orthophotos), so everybody can use these pages also just as an Estonian web atlas. The service experienced an average load of 30 000 hits per day during the first couple of months it was active, and after steadily increasing load we have today reached an average of 60 000 hits/day. The demand for the service was so high that our existing servers ‘choked’ under the heavy load and in the beginning of 2002 we had to change these for new Xeon-based multi-processor rack servers working in cluster mode.

Shortly after the successful launch of the service described above, a project called “Family of Universal Services” was initiated in the end of 2001. Universal Services are software components for building different web applications based on Intergraph WebEnterprise. Using these components it is possible to create new web applications more rapidly. In 2002, some new intranet CIS applications (registration of cadastral restrictions – easements) as well as targeted Internet applications (registration of buildings in Buildings Register and data exchange with CIS) are under development or implementation phase.

ELB cooperates with many national and international institutions and organisations within the scope of the related fields. Most natural cooperation is with different institutions within the Ministry of Environment (unification of registers having spatial component). Other national bodies include:

**Figure 1.1. Organization Chart of Estonian Land Board**
the Ministry of Justice, real-time link between the Land Cadastre and the Title Book;
the Ministry of Agriculture, organising aerial photography for agricultural land registration;
the Ministry of Finance, real-time link with the Buildings Register is at the testing phase;
the Ministry of Transport and Communication, cooperation in building up the National Information Infrastructure, integration of road registers with ELB’s Land Information System;
the Army Headquarters and the Border Guard, cooperation in defence mapping;
nationwide utilities companies like the Estonian Energy and the Estonian Telephone. Cooperation with them started in 2001, they get up-to-date map and property boundaries information and ELB gets information about utilities’ networks as restrictions to cadastre as well as for map data production.

ELB’s international cooperation include bilateral, regional as well all pan-European contacts:
- Bilateral with the National Land Survey of Finland, the Finnish Geodetic Institute, the National Survey and Cadastre of Denmark;
- Regional: within the framework of the Baltic Council of Ministers, MapBSR (Digital Map of the Baltic Sea Region) Project;
- Pan-European: ELB has been a partner in several EU PHARE projects, the aims of which have been accelerating the land reform and setting up cadastral and land information systems. ELB was an active member of CERCO and has also been an active member of EuroGeographics since summer 2001. ELB has been granted a role of the Baltic Sub-regional Coordinator in EuroGeographics’ EuroGlobalMap Project.

The National Land Board has set itself the following objectives for the coming years:
- We will capture, maintain and deliver data to the community about the nation's most important geospatial features;
- We will make land-related data available for the public;
- We will become recognised as the best know-how centre in our fields of activity;
- We will ensure good and timely execution of land-related national programmes;
- We will remain an effective and well-functioning government agency.

2. Cartography

Cartography has been one of the main activities of the Land Board since the establishment of the agency. In the field of cartography ELB is responsible for the organisation of production of national topographic databases and maps. Also the production of national thematic maps falls within the cognisance of ELB.

In the field of cartography the Land Board has the following tasks:
- Strategic planning of map production;
- Development of guidelines and specifications;
- Outsourcing of mapping works, i.e. organisation of public procurement;
• Contract management;
• Quality control of cartographic works and produced spatial data;
• Dissemination of spatial data.

In addition to organising the production of maps, ELB is participating in the development of GI standards for the Estonian society.

2.1 General Overview of Mapping Projects

A short overview of the mapping projects the Land Board is engaged in follows.

Estonian Basic Map – topographic digital database in scale 1:10 000
Estonian Basic Map is a main mapping product of the ELB and its detailed description is given in Part 2.2.

Estonian Base Map – GI digital database in scale 1:50 000
The aim of the Base Map Project was to produce in short time a digital map containing the main spatial data of Estonia using SPOT satellite data as a source. The accuracy and content corresponds to the scale 1:50 000. The Base Map contains so called “base information” about the Estonian territory, which can be used for creation of geographic information systems and production of thematic maps. The Base Map is in TM-Baltic projection (Transverse Mercator Baltic, common TM projection for the Baltic countries). Digital maps of similar aim, content and design are produced also in Latvia and Lithuania.

The international project started in 1993 and the digital database was completed in 1996, the last sheets of paper map were printed in 1998. SPOT images (orthorectified panchromatic and multispectral data as well as plots on film and paper) and some equipment for all Baltic States were provided by Sweden as technical aid.

In the production of the Base Map ArcInfo GIS software was used. After completion the data has been also re-projected into Lambert-EST (L-EST) projection and converted to MicroStation and MapInfo file formats as well as loaded into Oracle Spatial for using as a backdrop map in CIS.

The Base Map database is distributed first of all to state agencies, local governments and research establishments for whom it is free of charge. It is planned to extend the database to make it correspond to the content of a topographic map. The Base Map has already been used in all counties for general planning, in the Estonian Defence Mapping Project at the scale 1:50 000 corresponding to NATO standards, in CORINE Land Cover Project, in the digital textbook “Estonian Geography for Schools” developed by the Institute of Geography of Tartu University.

Estonian Soil Map – GI digital database in scale 1:10 000
The digital map was produced at the scale 1:10 000 in the coordinate system of Lambert-EST. The available maps at the scale 1:5000 were reduced and generalised to correspond the scale 1:10 000. Graphic data, i.e. the digital soil map, is in DGN format and the soil database in MS Access. The designed GIS-interface allows different queries, calculations of soil areas according to soil properties, making of soil explications, etc. ELB mostly needs the Estonian Soil Map for land valuation purposes. Other users include the Ministry
of Agriculture, agricultural advisers, forest managers, etc. The project was initiated in
1997 and the works were outsourced through public tendering. To date maps and data
cover the whole Estonia except the land of towns and settlements, the total covered area is
43300 km². Loading data (graphical and attributes) into Oracle Spatial for using as a
backdrop map in CIS is underway. Updating of the database has been started in coopera-
tion with the Estonian Agricultural University.

Maps of urban areas – topographic digital databases 1:2000
The Land Board has produced topographic digital city maps at the scale of 1:2000 mainly
for the needs of the land cadastre.

These maps are in the same co-ordinate system as the Basic Map (L-EST). The following
products are made:

- Digital orthophotos 1:2000;
- Vector maps digitised by analytic photogrammetric method.

In 2001 the Land Board organised the production of orthophotos for 30 urban areas, to-
tally 200 km².

MapBSR - digital database 1:1000 000
The purpose of the MapBSR project is to provide basic map data sets for the Baltic Sea
region in the nominal scale of 1:1 million. The elements included in the database are
boundaries, hydrography, transport, settlements, geographical names, elevation and na-
tional parks. The MapBSR Project provides the first uniform, reliable map data sets for
the Baltic Sea Drainage area and the countries within its sphere of influence. The data
was produced by the National Mapping Agencies of the participating countries each being
responsible of their own area. First version of the data was ready in 2000, with the second
and final version issued 2002. In 2001 a new project - EuroGlobalMap (see below) was
initiated, in which the MapBSR database will be enlarged to cover all of Europe and the
data content will be redesigned to comply with GlobalMap specification.

EuroGlobalMap – digital database 1:1000 000
EuroGlobalMap is a response of the European National Mapping Agencies under Euro-
Geographics to the Global Mapping Initiative. ELB has been granted a role of the Baltic
(Estonia, Latvia and Lithuania) Sub-regional Coordinator in the Project.

Models of spatial data
The aim of the project is to create preconditions for maintaining spatial data of different
Estonian state registers and databases in the same system and allowing cross-reference
between them. Three models of spatial data will be created: reality-, data- and presenta-
tion models that must set uniform requirements both for producers and consumers.

The models are developed in co-operation with the Institute of Geography of Tartu Uni-
versity. In 1999, in the first stage of the project, a detailed analysis of current situation
and a preliminary list of features were compiled. In 2000, i.e. in the second stage, the
principles for creation of models were defined. In 2001 the reality model for the Estonian
National Topographic Database (ENTD) was created. ENTD is the Land Board’s GIS-
database that contains topographic data collected during basic mapping. The reality model
of ENTD complies with ISO 15046/10 standard and contains the following information:
• Name of feature in Estonian and its English equivalent;
• Shortened name of feature;
• Is it a feature causing restrictions?
• Code of feature;
• Basic Map code of feature;
• Definition of feature;
• Guidelines helping to identify the feature in nature, selection criteria of features to be mapped, references to additional materials;
• Feature attributes, definition, references to additional materials, data type, measurement unit, definition of attribute value;
• Relations to other features, name of feature relation, name of related feature, description and conditions of feature relation.

2.2 Estonian Basic Map 1:10 000

The Estonian Basic Map is a seamless digital topographic database covering the whole territory of Estonia, which contains information on utilities (roads, electric power lines, etc.), settlement, hydrography, relief, place names and land use. The accuracy and content corresponds to the mapping scale of 1:10 000. The used projection is L-EST. Digital data are in MicroStation DGN format.

The fundamentals of the Estonian Basic Map Project were developed and approved in 1991. As source materials are used aerial photographs, fieldwork materials, existing cartographic and statistic data. Contractors are chosen through public tendering procedure.

The project provides users with the products described as follows.

1. Digital orthophotos 1:10 000.

The majority of orthophotos have been produced on the basis of aerial photography made within the Basic Map Project in the years 1991-2000. Digital orthophotos have been made by two methods:

• Up to 1996 by scanning analog orthophotos;
• Since 1996 directly in digital form.

Estonia is covered by 2050 tiles of 5 by 5 km. By the end of 2001 the whole territory of Estonia was covered by orthophotos (Figure 2.1). In spring 2002, new aerial photographing was performed in co-operation with the Estonian Agricultural Registers and Information Board and with funding provided by EU PHARE program. The total area of 23 000 km² was photographed over areas where orthophotos were originally made using analog methods (Figure 2.2).
2. Digital vector and raster map 1:10 000.

The vector map will be completed as a result of stereomapping and extensive fieldworks with digital processing of already available information. The digital vector map consists of aforementioned tiles, which include 3-4 files each with different information in DGN format. All already completed vector maps contain a file with topographic information (points, lines, texts) and a map frame file (frames, coordinate grids, frame texts). Since 1999 a file with closed areas has been included too.

Mainly considering the needs of the land reform and land cadastre, ELB has produced from the vector map also a raster map (black-and-white, TIFF or CIT format).
By the end of 2001, 67% of the Estonian territory was digitally mapped. By the end of 2002, 85% of the Estonian territory will be covered by digital Basic Map (Figures 2.3 and 2.4). The digital map covering the whole Estonia is expected to be ready by the end of 2003, however this depends on the processing of aerophotos taken in 2002 (see above).

3. Printed paper map 1:20 000.

The first Basic Map sheets that were produced by manual technology were printed in 1994. The production has been fully digital since 1996. As the works above, ELB procures also compilation and publishing of printed maps through public tendering from mapping companies. The publisher is responsible for the following works:

- Generalisation of data from the scale 1:10 000 to 1:20 000;
- Adding of height contour lines;
- Editing of geographic names;
- Editing map layout to make the information on map correct and readable;
- Preparations for printing and organisation of printing.

In 1997 a strategic decision was made on concentrating resources to complete orthophoto and vector database coverage and to produce printed maps only over areas where there is the highest demand. By the end of 2001, altogether 80 sheets of the Estonian Basic Map had been printed (Figure 2.5). Ten sheets in South-Estonia will be printed in the second half of 2002. A new printed map sheet layout has been designed to meet the needs of Estonian Armed Forces. Plotter maps are available from the digital data where it is completed.
3. Geodesy

In the field of geodesy the Land Board is responsible for the planning and co-ordination of works necessary for the development of national and local networks as well as for the creation of geodetic database.

The National Geodetic Network, measured exclusively by GPS technique, is divided into first order, second order and densification networks according to the classification of geodetic networks in Estonia (Fig. 3.1). The average distance between adjacent points is 70-110 km in the first order and 15 km in the second order network with the number of points in networks being 13 and 199, respectively. The first and second order geodetic networks were completed in 1998 and are the densification of EUREF network in Estonia.
(results of EUREF-Estonia-1997 campaign). The Densification Network was established area by area during the period of 1992 - 2001 by private companies working under contract with the ELB. The network consists of 3922 points established mainly in pairs with the average distance between the pairs being 5 km.

The concept of the National Geodetic Network aims at creating the integrated georeference based on GPS, levelling, gravimetric networks and network of sea level stations. According to that, 126 points of the first and second order were planned to be included directly into a high precision levelling network. From those points 5 have been included and 23 have been connected by first order levelling so far.

In the possession of ELB there are a great number of data, the majority of them being reports of geodetic works maintained as hard copies (catalogues of coordinates and heights, schemes of traverse and levelling lines, technical reports). Digital information dates back to the beginning of 1990’s, when the establishment of national geodetic network was started. This information includes mainly measurement results; in the last couple of years also sketches and general schemes of networks have been digitally stored.

In the field of geodesy there is close co-operation with the Finnish Geodetic Institute, the National Survey and Cadastre of Denmark and the Committee of Senior Officials on Geodesy, Cartography and Land Reform of the Baltic Council of Ministers. Estonia has also participated in the measuring campaigns organised by EUREF as well as in annual symposiums. Reports on gravimetry have been presented at several conferences.

Future priorities in the field of geodesy are connected with the maintenance of geodetic database and design of permanent GPS network.

Currently the following projects are ongoing:
- Improvement of local networks;
- Densification of gravimetric network;
• Completion of the geodetic database.

3.1 Local Geodetic Networks

During the Soviet era almost all bigger settlements, totally ca 160, had their own local geodetic networks. In connection with transferring to the uniform cadastral information system, it is necessary to transform the existing local networks to the national coordinate system. This work was started in 2000, when transformation parameters were determined and coordinates recalculated for local networks in 41 towns and settlements. In 2001 and 2002, these works have been continuing and the local geodetic networks of another 46 towns and settlements have been transformed into L-EST coordinate system. At the same time the reconstruction of geodetic networks has also been started. In 2000 and 2001, networks in 12 settlements were reconstructed and works in 8 settlements will be finished in 2002. A contract to reconstruct networks in another 17 settlements was signed in mid 2002 with the deadline of works being 2003.

3.2 Levelling Networks

Two high precision levelling campaigns were carried out in Estonia during 1933-1943 and 1950-1990, respectively. Preparations for the third campaign started in 2001 with test measurements to choose the best measuring methodology; the actual reconstruction works started in 2002. Works are carried out in cooperation with the Finnish Geodetic Institute.

3.3 Gravimetric Network

The main activities in 2000-2001 included checking, correcting and digitising of gravimetric data measured in Estonia in the years 1949-1998. In 2000 new values were calculated for the points of first, second and third order gravimetric network.

Main works in 2001 included gravimetric re-measurements of first order gravimetric network points as well as of first order horizontal network points. The project has continued in 2002 with re-measurements of second order gravimetric network points and of first order horizontal network points as the year before. Measurements are performed with two LaCoste&Romberg gravity meters, which are borrowed from NIMA (National Imagery and Mapping Agency, USA).

High precision gravity measurements on Finnish geodynamic profile in cooperation with the Finnish Geodetic Institute will be carried out in the autumn of 2002. At the moment preparations are underway to deliver gravimetric data for the Unified European Gravity Network 2002 Project (UEGN2002). Data for 7 first order and 70 second order points (average distance between the points 50 km) have been prepared.

4. Geoinformatics

The year 2001 was a major milestone in the development process of (geo)information systems at the Estonian Land Board. The Cadastral Information System (CIS) was fully functional by the end of that year. In 2002 new development projects have been initiated. Main goals are to develop cadastral restrictions (servitudes) registration and managing
subsystem under CIS as well different public services by creating links between different databases and registers. One of the priorities is also the creation of the Estonian National Topographic Database (ENTD) that together with CIS forms a basis for the National Land Information System.

4.1 Cadastral Information System

The new Cadastral Information System was set up in the spring of 2001 and was implemented in the county cadastral offices during that year. CIS constitutes one part of the Estonian National Land Information System (NLIS) and consists of Land Register (i.e. the Estonian name for cadastral register), cadastral maps and archive. CIS can be divided, based on its technological architecture, into two parts with the following components started initially:

1. Data Registration Application - tool for data registration (LAN-WAN application)
   - Alphanumerical data registration
   - Spatial data registration
   - Management Information (LAN-WAN-Intranet)
   - Summaries and views of alphanumerical data
   - Maps (Thematic maps)

2. Public Services System (Web application)
   - Land information service for public user
   - Cadastral unit (CU) data for public user.

CIS is built around Oracle DBMS with Oracle Spatial and Intergraph Geomedia 4 product family software as GIS engine.

Data Registration Application

The main feature of the new CIS is integrated alphanumerical and GIS data and functionality. Integration of different data and development of registration tools for different types of data was one of the major tasks in 2001 in the fields of cadastre, IT and GIS. Graphical data of cadastral and administrative boundaries were reviewed and transferred into a central database covering the whole Estonia. As a result a dataset was formed that would serve as basis for the cadastral index map in the Public Service System and for the development of the map of administrative boundaries. Both alphanumerical and spatial data are stored in Oracle Database (spatial data in Oracle Spatial Cartridge) and data have been consolidated into a central register. Thanks to the central database, data quality checks and procedures are now more efficient and easier to conduct. Special tools were developed for quality checks and spatial analysis. In addition to that, a central management of classifiers is now possible. The main advantage of one central database is the possibility to query both spatial and alphanumerical data using SQL, which provided us with the basis for developing different public services. To avoid possible network problems, local offices work with local copies of the central database with replication time (time when changes are transferred into the central database and vice versa) set to two hours. The system is set up in such a way that it does not depend on administrative division, i.e. one county cadastral office is able to serve some other region when needed.

Public Services System

The Public Service System is a tool for achieving one of ELB’s main objectives, i.e. to provide the society with land related information. It also enables public access to spatial
data maintained by ELB. The Public Service System is a group of services based on the Land Board's datasets and map server and offered via Internet. Internet map server is based on Intergraph Geomedia Web Enterprise 4 technology.

The Land Information Service is available for everyone and is designed especially for the public. Everyone can use this service free of charge. For users the service is a web map application (Figure 4.1). First, using navigation tools it is possible to see administrative boundaries and the Estonian Base Map at the scale 1:50 000 as a topographic background map. Zooming further the user can choose for displaying either the Estonian Basic Map or digital orthophotos, both at the scale 1: 10 000. Also the cadastral and geodetic information is available. It is possible to display on the screen geodetic points and the parcel boundary layer, and by clicking in the point or parcel the alphanumerical information is displayed in a pop-up window or as a tool tip. The service is accessible through the Land Board’s home page http://www.maaamet.ee/teenus/maainfo.php

Cadastral Unit Data Service is also designed for public usage and is free of charge. Using different queries it is possible to get alphanumeric data from the cadastre. The service is suitable in cases when graphical cadastral data are of no interest. The service is accessible through the ELB’s home page http://www.maaamet.ee/teenus/kiirp2ring.php. It is also possible to query information by mobile phone using WAP protocol, the address is wap.maaamet.ee/ky.

![Figure 4.1. Land Information Service and Cadastral Unit Data Service Web pages](image)

4.2 Land Information System Development

Two new layers were added into CIS and land information public service in the beginning of 2002: land price zones and productivity zones. Land valuation for the whole country was done in the second half of 2001. Land price zones (ca 1000 areas) and productivity
zones (ca 5000 areas) were created and edited directly in digital format by valuators in ELB’s county cadastral offices and it took just some weeks to feed all spatial information into CIS’ Oracle Spatial database. Using this information every landowner can see directly in the Internet the exact taxable value of his/her land.

CIS development in 2002 has been targeted, in addition to CIS internal development, to creating new web-based public services. The following main goals have been defined:

- creating universal software “building blocks” called “Family of Universal Services” which will enable easy and quick set-up of new applications;
- making geospatial data managed by ELB accessible to the public;
- providing framework, so that geospatial data from other public as well as private sector institutions would be accessible to the public.

**Family of Universal Services**

In 2001 ELB started developing of software components called “Family of Universal Services” based on Integraph’s WebEnterprise. Using these components it is possible to create new applications with relatively fewer resources (time, money, human). These components are usable in LAN, WAN as well as in Internet and targeted for different applications. In 2002, within ELB the existing applications (CIS and Public Services) are extended as well as new applications (servitudes management) are under development using these components.

ELB is cooperating with the following institutions to set up new (GIS based) applications:

- Buildings Register, to manage spatial data registered in that system and to enable data exchange with CIS;
- Estonian Energy, Ltd. (biggest energy company in Estonia), for registering objects causing restrictions (power lines, transformers, etc) and to enable data exchange with CIS;
- Estonian Geological Survey, to manage geological data in their LAN and to enable public access to certain data.

The following components of the Universal Services will be ready by the end of 2002:

- Presentation Service – serves map window from Public Services System, so developers can include it into their Internet application map window requiring background maps.
- Registration Service – enables inclusion of users’ data into the system and data editing over Internet. Parts of Registration Service are:
  - Spatial Data Editor allows adding, editing and deleting spatial data;
  - Universal Import Service allows importing of file-based spatial data into LIS; all formats supported by Geomedia WebEnterprise are also supported here (DGN, SHP and MIF);
- Extraction Service – enables export of data through Internet, the user can define the area of interest, data layers and format of the data (DGN, SHP or XML);
- Analysis Automata – performs some spatial analysis and display of results, these tools are mainly developed for helping to find inconsistencies in input data;
- Printing Service – tools for enabling printing of maps with final design over the Internet;
Potential users of Universal Services are those to whom spatial characteristics of their data are of importance. From the users’ point of view the following advantages of the services could be listed:

- the user has no need to deal with managing of background data (maps), the most up-to-date general purpose map data is available from ELB’s databases via Presentation Service;
- users, who need only the standard GIS functionality available via Universal Services, e.g. map window, some analysis, import/export, map print, do not need to acquire expensive desktop GIS software licenses;
- data management through Universal Services (adding, editing and erasing data) is managed in a better way, e.g. trying to digitise or import non-standard data into the system is prohibited.

New design of the Public Services System

Universal Services components are used in redesigning of Public Services System (see above). The most remarkable changes of the system are in the administration segment: Universal Services allow rapid addition of new data layers with their specific legends and creation of new applications. The following new applications are at development and testing phase with planned availability by the end of 2002:

- New design of Land Information Service (see p. 4.1, Fig. 4.2), to have similar look-and-feel as well as administration of this existing service with other new services a complete redesign was needed. Cadastral maps, geodetic points, land price zones and productivity zones maps and attribute information can be displayed on top of different background layers (orthophotos, Basic Map).
- Soil Map (Fig. 4.3) application, data from Soil Map (see p. 2.1) is displayable with other data layers in LIS.
- Forest data Protected areas applications, data from forest and protected areas databases is displayable with other data layers in LIS. Forest and protected areas data are managed by other state agencies; with these applications also data exchange with different institutions will be tested.

Cadastral restrictions and Estonian National Topographic Database

A system for registration of cadastral restrictions (servitudes) is under development and is expected to be operational in the autumn of 2002. The system is based to great extent on Universal Services. What makes the system unique is that it has means for cross-referencing data with the owners or managers of cadastral restrictions (power lines, gas pipes etc). So far data management and exchange principles, XML schemas for data exchange and software for data quality checking have been developed. In the first stage data models for storing in Oracle database the following restrictions are created: buildings, power lines, roads, gas pipes, coastlines, railroads, and protected areas. Restrictions will be available via LIS as well as via Public Service. Restrictions database is also part of the Estonian National Topographic Database.
Figure 4.2. New Design of Land Information Service

Figure 4.3. Thematic Soil Map