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Geographical Information Systems (GIS) Capabilities in Ukraine

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For the New Independent States of the former Soviet Union

A USAID Project Consortium Led by CH2M HILL

PREFACE

Under the 1992 Freedom Support Act, the United States Congress initiated a program to provide various forms of assistance to new independent states (NIS) of the former Soviet Union. Cooperative Agreements were signed between representatives of the U.S. government and each country in which assistance was to be undertaken. The U.S. Agency for International Development (USAID) was given the responsibility to coordinate all U.S. government assistance to the NIS under the Act.

Through competitive bidding, USAID awarded a multi-year contract to a team managed by CH2M HILL International Services, Inc. (CH2M HILL) to support implementation of an environmental assistance program to republics of the former Soviet Union. Under this contract, termed the Environmental Policy & Technology (EPT) Project, CH2M HILL is to assist USAID's missions in Moscow, Kyiv, and Almaty undertake a program to promote environmental improvements in the NIS. The USAID mission in Kyiv supports environmental, and other, assistance programs to Ukraine, Belarus, and Moldova. CH2M HILL established an office in Kyiv from which to perform services in these countries under the EPT Project.

This report was prepared as a contractually required deliverable under a contract between USAID and CH2M HILL. Although work on this report was conducted in cooperation with the assisted governments and USAID, the findings and recommendations are those of the CH2M HILL team. They do not necessarily represent official positions of the governments of the assisted countries nor of the United States of America.

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Clark Atlanta University/HBCUMI Environmental Consortium
Consortium for International Development
Ecojuris
Environmental Compliance, Inc.
Harvard Institute for International Development
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BACKGROUND

As part of a United States government bilateral assistance program, the U.S. Agency for International Development (USAID) is supporting environmental management in Ukraine. Under direction from USAID, a consortium led by CH2M HILL International Services, Inc. (CH2M HILL), is implementing part of USAID's Environmental Policy & Technology (EPT) Project by undertaking various tasks that have been agreed to by representatives of the governments of both countries.

USAID authorized CH2M HILL to perform a series of tasks in Ukraine under Delivery Order No. 5. Activity Implementation Plan #5 required that CH2M HILL prepare an evaluation of Geographical Information Systems (GIS) capabilities in Ukraine.

In August 1994, CH2M HILL retained a subcontractor, Dr. Stanley A. Morain, to undertake the GIS evaluation. A copy of Dr. Morain's report follows. This report was initially submitted as a draft to USAID in October 1994, for review and comment. No comments have been received by CH2M HILL from USAID concerning the document. It is hereby re-submitted as a final report.

PRELIMINARY REPORT

Environmental Policy and Technology Project

Dr. Stanley A. Morain

to

International Resources Group (IRG)

August 8-26, 1994

for

United States Agency for International Development
Project # CCN-003-Q-00-3165-00

Major Findings & Conclusions

Geographic Information Systems technology is a user driven, science-oriented, component of the Information Age. It has compelling applications for environmental protection, resource management, economic forecasting, and for complex inter-related social issues; and, has been adopted worldwide as a government and business tool. Operational agencies, academic institutions, and the private sector in the Ukraine are aware of the value of GIS and are struggling to keep abreast of its evolution in resource management and planning.

Despite economic difficulties, GIS is "on the move" in the Ukraine. US/AID has an opportunity to make significant contributions to its rational development. It is in the best interests of the United States to foster this development because GIS is the only way rapid progress can be made toward understanding and managing critical environmental and social issues in Ukraine.

To build the GIS infrastructure Ukraine needs assistance in expanding the base of trained personnel, up-grading and expanding the equipment base, and preparing the physical facilities to adequately house GIS activities. The consultant sees this as a Phased effort with Phases 1 & 2 being short term and low-cost to expedite the creation of a centralized National GIS facility, and a longer term, more expensive Phase 3 to stimulate the spread of technology to other governmental and academic laboratories. A cost-estimate is given for Phases 1 & 2 (12 months, $350,000), while Phase 3 is scoped but not priced.

With additional equipment and training, there will be no absence of talent to deliver quality GIS products to address environmental and social issues. There is already some movement toward commercial suppliers of equipment and products in anticipation of a robust domestic growth in the technology; and there is even evidence that future quantum leaps in data models and data structures may originate in Ukraine.

Ukraine is not yet a "backward" country in its level of GIS developments, but if it is not nurtured, the Ukrainian scientific community believes it will become a backward nation within a few years because technology will continue to evolve in the West. Recognizing this Rudenko et al.(1993) have proposed the concept of a multi-purpose National GIS (NGIS) of Ukraine. This concept was deferred for implementation In 1993 by the State Committee on Science and Technology for economic reasons. Nevertheless, it should be reviewed and, if appropriate, adopted by US/AID as an infrastructural model for the technology.

In Ukraine, the tangible infrastructure of GIS technology lags well behind the intellectual infrastructure, but both need assistance to achieve their potential as national environmental and economic planning and management tools. In recognizing this, the Cabinet of Ministers of Ukraine created the National Commission on GIS which has membership representing all the major players. This Commission is guided by a 15-member Council.

To facilitate infrastructure development and optimize acquisition and allocation of US/AID resources, EPT should coordinate with Ukraine's National Commission on GIS. This would be facilitated if a GIS coordinator were identified in the United States to expedite equipment purchases; assist with training schedules, programs of instruction, and location of training centers; and provide general "State-side" support for needs identified by EPT/Ukraine.

At this juncture it appears necessary to nurture equipment and expatriate training in this technology through 2000. This timeframe could be shortened if efforts to educate high-level decision-makers were stepped up. Part of the reason local policy and decision-making personnel remain unconvinced of the utility of GIS technology is that output products are not easily generated for use or display in their offices. These capabilities disappeared with the break-up of the Soviet Union. Moscow has the equipment, but Ukraine retains the knowledge.

One way to promote better understanding of the technology by the GOU might be for the National Commission to identify a small number of critical issues about which there are on-going programs for data collection and continuing needs for information. With these datasets and assistance from US/AID the first steps toward building a national GIS could be started.

All of the current capability for GIS is housed in small laboratories or offices scattered throughout the operational agencies and educational institutions of Ukraine. Moreover, most of the available literature consists of operator manuals for hardware and software, and there is limited access to scientific and analytical literature. These entities all need physical renovation to make them suitable for GIS project activities. In the short term, a single, centralized laboratory having a full complement of GIS skills and equipment should be created. In the longer term it can then provide services and support to more specialized laboratories. The proposed NGIS model would create a central GIS facility to serve other GIS laboratories. If this element of the model is adopted, EPT/USAID should urge the "center's" location in a modern office building, independent of other organizational missions and objectives.

In the short term, equipment may be the missing ingredient that would best stimulate GIS infrastructure development in Ukraine. Planners, however, should be determined to pace the infusion of new equipment to optimize their short and medium-term needs. In Kiev, there are several hardware and software resellers of American made equipment who are anxious to market their product lines. This may be an excellent opportunity to promote private enterprise in the region.

Training is required at all levels from administrators to technicians and from study tours through long term, degree-oriented university instruction. To develop Ukraine's GIS infrastructure, training should be provided for all of the main sectors: educational, administrative, and applications. None of the facilities visited had a skill mix approaching that described in Section 2.3. Training in Phase 2 would provide skilled personnel to operate the centralized center, training during Phase 3 would expand these skill to existing labs.

While everyone agrees that data and information should be shared, there seem to be few infrastructural mechanisms (MOUs, Technical Agreements, etc.) to stimulate sharing. This situation is politely recognized and most hope that efforts of the National Commission on GIS will break the grid-lock.

These findings and conclusions aim to create an efficient capability in Ukraine for government ministries and academic units to address their urgent environmental, economic, social, and natural resource issues; and, to help set the stage for further evolution of Ukraine's land reform and democritization.

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1.0 Introduction

1.1 EPT Project Background

Under the 1992 Freedom Support Act, the United States Congress initiated a program to provide various forms of assistance to newly independent states (NIS) of the former Soviet Union. The U.S. Agency for International Development (USAID) was given responsibility to coordinate all U.S. government assistance to the NIS under the Act.

USAID awarded a contract to a team managed by CH2M HILL International Services, Inc. (CH2M HILL) to support implementation of an environmental assistance program to republics of the former Soviet Union. Under this contract, termed the Environmental Policy & Technology (EPT) Project, CH2M HILL is to assist USAID's missions in Moscow, Kiev, and Almaty undertake a program to promote environmental improvements in the NIS. The USAID mission in Kiev supports environmental, and other assistance programs to Ukraine, Belarus, and Moldova. These western republics of the former Soviet Union are termed WESTNIS. CH2M HILL has established an office in Kiev from which to perform services in the WESTNIS region under the EPT Project.

Concern was expressed regarding the technologies necessary to protect, plan, and manage environments in Ukraine. USAID/Kiev offered to arrange an initial review of GIS technology and infrastructure as one of most useful information technologies available for resource assessments and environmental management. Assistance from the EPT Project Kiev regional office was requested from USAID/Kiev. In response, consultant services were arranged by CH2M-Hill to review the current infrastructure for GIS technology in Ukraine.

1.2 Report Purpose and Organization

This report describes the infrastructure for GIS technology in Ukraine, but with almost sole emphasis on Kiev. Developments in the technology have been so rapid and pervasive in Western Europe and North America as tools for resource management and environmental protection that its importance for Ukraine's near term economic decision-making seems natural. Fundamental reforms being considered and implemented by Ukraine's Government, along with other fundamental changes in science and environment perspectives stimulated in part by the Chernobyl NPP accident have accelerated national needs for complex spatial data processing, analysis, and sharing. In light of these fundamental changes and the urgencies they generate, it seems appropriate for the United States to step up the pace of its financial aid to develop the infrastructure for spatial analytical technologies.

Subsumed under the rubric of "spatial analytical technologies" are Geographic Information Systems (GIS), Land Information Systems (LIS), remote sensing (RS), and Global Positioning Systems (GPS). This report deals with GIS technology because it often drives adoption of the others. The aim of Section 2.0 is to introduce readers to GIS technology and to suggest a few of the many ways it is being used by government and private organizations around the world. Section 3.0 is a review of Ukraine's GIS situation, current GIS infrastructure, and data issues; Section 4.0 is a summary of consultant observations; Section 5.0 suggests a set of Phased assistance activities including an estimate of costs for Phases 1 & 2; and, Section 6.0 lists the contacts and published sources upon which the report is based.

1.3 **Report Preparation**

1.3.1 Preparation Team

This report has been written by Dr. Stan Morain, serving as consultant to CH2M-Hill. He was assisted by Dr. Victor Chabanyuk, Vice President and Director of R&D for *Intelligent Systems*, who served as technical Counterpart throughout the consultancy. Additional technical assistance was provided by Ms. Svetlana Volskaya, Programme Officer, United Nations Office, Ukraine. Mr. Ties van Kempen has supplied information of EPT Project Background.

1.3.2 Methodology

Data and information for this report were gathered during a three-week period in August, 1994. Dr. Chabanuk arranged a series of on-site meetings with Directors, Deputy Directors, and other key personnel at laboratory, Enterprise, State Committee, Ministry, and corporate offices in Kiev. In all cases, the topics of the meetings focused on facilities, equipment, personnel training, general level of GIS development, and current GIS activities. Most of the meetings lasted between 1.5 and 2.5 hours and included demonstrations of technical capability. The number of meetings and shortness of time prevented travel to other cities in Ukraine, but there are many organizations around the country involved in the rudimentary procedures of GIS.

In addition to organizational briefings, Dr. Morain was supplied by Dr. Chabanuk with key published papers describing Ukraine's present state of GIS technical development and plans for a national multi-purpose infrastructure (see especially, Rudenko et al., 1993; Volskaya et al., 1993; Prister et al., 1994; and Chabanyuk, 1994)[1]. As further background, these were supplemented by documents brought to Kiev by Morain, such as Chambers (1989), Morrison and Wortman (1992), Aranoff (1989), Gilbert (1994), and Clayton (1994); and those provided by CH2M-Hill (i.e.,IDRC, 1994).

Lastly, several lengthy discussions with Dr. Chabanuk were held to review the ideas he and his colleagues have generated about GIS infrastructure in Ukraine. Based on these inputs a briefing of all interested Ukrainian parties was held at Main Administration of Geodesy, Cartography and Cadastre on August 23rd. Dr. Morain presented his basic findings and obtained feedback from participants. This report includes feedback suggestions from that briefing. A list of persons attending that meeting is given in Appendix A.

2.0 Description of GIS Technology

2.1 **Definition of GIS**

Geographic Information System (GIS) technology (and its companion, Land Information System technology-LIS) consists of electronically manipulating point, line and area

[1] Where necessary, parts of these documents were translated from Ukrainian.

data (and the attributes that characterize these points, lines, and areas) in such ways that they may be scaled, combined, sorted, and presented in graphic (map) form to assist in managing complex economic, environmental, social, and natural resource situations. GIS is considered the basis for "spatial data analysis" of natural and environmental systems, while LIS is the basis for many municipal and cadastral systems. Differences between GIS and LIS are often blurred because there are many overlapping applications. As a general proposition, however, GIS deals more with object and relational databases tied to a digital map base, and LIS deals more with civil engineering, land survey, and municipal infrastructures managed with autocad softwares.

The basis for GIS consists of two primary elements: (1) a geodetically controlled digital map base of a particular area (civil unit, drainage basin, ecosystem, region, or nation); and (2) digital datasets that characterize the physical, social, economic, and environmental properties of that area. Thus, it is possible to store a wide variety of data about an area and to relate such seemingly unrelated attributes as transportation net (line data), emissions from industrial plants (point data), and agricultural crop types (area data). Three-dimensional GISs are possible when soil or geologic properties at depth are incorporated (e.g., well log data, bathymetry, etc.) or when atmospheric profile data (e.g., temperature, moisture content, trace gas concentrations, etc.) are included. Lastly, the element of time (4th dimension) can be used to animate or "visualize" the GIS to reconstruct past conditions, or predict future conditions, in the interactons between attributes.

The power of GIS technology stems from the fact that attribute data are all keyed to a digital map base and are stored as files by precise coordinates for retrieval and presentation. Once an attribute has been "captured" in digital form as a data layer, it can be maintained, up-dated, corrected, or replaced by more refined attributes, without editing all of the other layers or attributes. To be effective, however, it is necessary to record the quality of data in each attribute file, such as: (a) when and how the data were collected; (b) by what procedures and within what accuracies they were collected; (c) by whom and for what purpose they were collected; and, (d) by what set of data capture and cartographic standards they were digitized. These data about the data (called "metadata") are necessary because the intent of GIS applications is to relate selected attributes about a place to address complex management questions in a modeling (analytical) framework. If the pedigree of the data cannot be verified, or if their integrity is in question, then modeled results cannot be trusted. In a traditional analog system one might compare two maps from different sources (say, vegetation with soils or geology) and make an informed yet casual interpretation of their correlation. GIS analyses are scientific, procedurally, and repeatable, thereby eliminating casual interpretations of data; and, since there may be many point, line, and area attributes being modeled to address a single question, those datasets (attributes) must be understood and managed. Some examples of these complexities are given in Section 2.2.

A GIS is not just an "electronic atlas," though that is one of its fundamental uses. If one were interested merely in an electronic atlas, maps of all subject matters, vintages, reliabilities, scales, and sources could be converted from hardcopy to digital format and regenerated for viewing on a monitor. With such an approach, there would be much data redundancy since each individual map would be shown on its own map base, contain its own coordinate system, titling, and other ephemerous data. The objective of a GIS, however, is to "relate" numerous attributes about the same place to create new maps and reports derived

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from their interaction. To do this, the datasets must be interoperable, but there need be only one map base and one coordinate system to which all attributes are tied.

GIS is such a compelling technology for environmental monitoring, resource evaluations, and economic development that it has driven the development of both Global Positioning System (GPS) technology and remote sensing. In many instances the digital map base for a GIS can be enhanced by using a satellite or aerial image that has been geometrically corrected using "x,y,z" control points from a geodetic base. These "image-based" GISs may also include a time-series of such geometrically corrected images to portray the rates of change in many area-extensive phenomena (e.g. seasonal and annual cropping patterns) by using spectral properties as pixel-specific attributes. Since digital image files are stored in picture element ("raster") format, and since most other attribute data are stored in point, line, and area (vector) format, there is a requirement for GIS software systems to handle both raster and vector data, and to be able to convert from one to the other.

GPS technology has become a critical operating procedure for data collection because attribute standards require locational accuracies more advanced than can be achieved by "dead reckoning" or by pencil-plotting field sample sites on a paper map. Inexpensive hand-held GPS devices are commonly available and are being used worldwide for this purpose. They typically achieve locational accuracies on the order of one meter using three satellite transmitters, and can record elevation if signals are received from four satellites.

2.2 **Sample Applications**

The scenarios below are typical of the questions that can be addressed by a robust GIS. They are selected examples that *could* be relevant to Environmental Policy and Technology (EPT) Project applications in Ukraine, and are already relevant applications in the United States, Europe, Canada, and Australia. Further examples of these applications are routinely described in monthly trade magazines like *GIS World*, *Geo Info Systems*, *Earth Observation Magazine*, and *GPS World*, as well as in numerous scientific journals. "GPS-Based GIS Prepares Newark for the Future" (Farkas, 1990), "Corvallis Converts to GIS" (McVey, 1990), "Crystal River Uses GIS to Untangle Utilities Records" (Whitcomb, 1990), and "Building a GIS Data Base Puts Fort Pierce Electric Services on Track (Radice, 1990) are typical of GIS use by municipalities in just one issue of *Geo-Info Systems*. Environmental sensitivity assessments, economic assessments, integrated remote sensing and GIS applications, utilities management, cost effectiveness, and data issues are other popular topics (see, for example, Clayton, 1994; Corbley, 1994; Gilbert, 1994; Tosta, 1990; Finkle et al., 1990; Norton and Stonecker, 1990; and EOM Airborne, 1994).

2.2.1 Environmental Protection (Example)

The spread of environmental contaminants is a dynamic process that requires knowledge of biogeochemical interactions in the effected ecosystems. The only way the dynamics of such contaminants can be monitored, and their effects modeled, is to create an ecosystem-wide GIS, including in the case of radionuclides such ephemeral attributes as frequency of dust storms and other atmospheric events. Three dimensional and 4-dimensional approaches are required as advanced capabilities in these GIS applications because chemical flows in physical and biophysical systems (air, water, soil, vegetation, human, and wildlife populations) occur at different rates at different times, and at all scales of geographic reference, from local to global. Since our knowledge of ecosystem parameters and biogeochemical flows is restricted to local levels (and to far lesser extent to global levels through global change research modeling), we must first approach these problems from a very local perspective.

The Chernobyl NPP accident has caused an incredible amount of biogeochemical data to be collected by a wide variety of Ministries, State Committees, and other organizations (Prister et al., 1994). While some of these data have been converted to digital format by their originating agencies, other datasets are still in tabular form, and all of them need to be in a consistent format for transfer and sharing. Most importantly, conceptual models have been created by Ukraine's Institute of Geography to monitor future landscape changes, but the advanced hardware and software systems required to test these models are not locally available. What once would have taken hours to generate on a high-speed mainframe computer can now be done in the U.S. "on-the-fly" with desk top workstations using robust software.

2.2.2 Sustainable Resource Management (Example)

A ministry of forests needs to provide a sustainable supply of fuel wood to its rural population. Since it does not want to strip the land of forest, it has decided to make only certain lands available for wood removal. If wood can be removed only from soil types a,b,c on slopes less than 15% and aspects from 240°-280°; and if only mature specimens of species x,y,z can be harvested, how much wood is present in the region, and how long will it last at current rates of consumption? If a tree planting program is initiated at the same time cutting is permitted, will the trees mature rapidly enough to sustain production? What will be the effect on the ecosystem if there is a consistent program for cutting only mature trees?

The answers to these questions can be modeled in a GIS containing the relevant attributes. Demographic data, fuel wood consumption data, species reproduction rates, amount of land available meeting the soil/slope/aspect requirements, population growth rate, and a variety of ecosystem data are needed to create the models. Once these are created they can be used to predict future situations or to model alternative management plans. In fact, most of the data types required are usually being collected for other reasons by one or more ministries, but the data are not being shared and there is no incentive for sharing (see Section 3.2.1.2).

2.2.3 Economic Development (Examples)

There are so many of these applications that two examples are selected from the references to this report. They are intended to show how deeply GIS technology has penetrated into everyday life in America.

(a) "The regional wastewater treatment facility of Crystal River, Florida (population 3998) recently installed a PC-based computerized utilities management system that has capabilities usually found only in larger cities and private operations. The system has resolved the numerous discrepancies found on existing paper maps, increased the utility department's efficiency

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in handling requests for information, and saved the city money by reducing personnel costs and facilitating revenue collection (Whitcomb, 1990)."

(b) "The city of Newark, New Jersey, developed its geographic information system (GIS) after the state mandated preparation of new tax maps and a revaluation of all property in the city. The city chose an open computing environment that uses stand-alone, networked personal computers and workstations as the basis of its new GIS, rather than making the GIS fit its existing, older mainframe computer system. Global positioning system (GPS) technology was used to construct the locational framework of the GIS (Farkas, 1990)."

2.3 **Required Skill Mixes**

Traditionally, Geographers are trained as "spatial analysts" and as cartographers, as integrators of biogeochemical datasets, and as modelers of social and economic data. In many parts of the world, Geographers have also played a central role in the development of image processing applications for both aerial and spacecraft image-sets. Geography and Geographers are therefore at the heart of developing and applying GIS technology. Other key contributors to the technology have been Civil Engineers (especially in urban land information systems---utilities, transportation, surveying, emergency response networks, etc.); Computer Programmers trained in Earth and social sciences; System Analysts; and virtually all of the physical and natural sciences (among others: geodesy, geology, forestry, agronomy, biology, hydrology, meteorology, and their allied subdisciplines). Each of these fields of endeavor has produced specialty groups who focus their attention on developing GIS applications in their "primary discipline." Thus, there are GISs that focus specifically on mineral and hydrocarbon exploration, weather prediction, human health, economic development, land reform, wet lands monitoring, landscape right-of-way optimization, and virtually every other application imaginable.

Whatever other, more traditional, training a GIS team may possess, its individuals should have the following theoretical/conceptual training combined with applied (on-the-job) skill mixes and functions. Not all of these individuals need be present on all GIS teams, but there should be at least one complete GIS "Center" where all these skills reside. Smaller teams can then access these skills when necessary.

2.3.1 Team Leader: The team leader or group director is usually a senior-level person, often with a PhD in natural, physical, or engineering sciences. This person should have management skills and systems integration background as well as technical ability. Most importantly, the leader should be someone who ***uses*** GIS technology and is sympathetic to user needs.

2.3.2 GIS Modelers and Analysts are usually career professionals who have served for a few years as GIS technicians and who have practical experience in traditional discipline applications (hydrology, geology, environmental science, economics, etc.). Individuals should be trained in commercial softwares such as ARC/INFO[2], MAPINFO, SPANS, etc.

2.3.3 Database Manager is responsible for retrieving and preparing datasets for capture into digital format. This person must understand data formats and structures and prepare the dataset for inclusion in the database. This person is directly responsible for preparing data dictionaries, ensuring data quality, and facilitating data transfer standards and metadata. Most often, this person is a senior GIS professional with traditional education and 4-5 years' continuous on-the-job experience working with a wide variety of datasets (see item 2.3.4, below), ***or***, a Masters degree in Geography with 2-3 years' on-the-job experience.

2.3.4 Data Input Technicians are usually individuals with traditional educations in natural, physical, or engineering sciences. They should also have formal training in cartography, geodesy, aerial and/or satellite image interpretation, or related experience such that they are conversant with geographic coordinate systems and the fundamentals of spatial data.

2.3.5 GPS Specialist is a required element for those applications based on field data collection and reduction. Training in Differential GPS (DGPS) is suggested. Usually, such training is found in Geography, Civil Engineering (Surveying), or Geodesy curricula.

2.3.6 Image Processing Specialists are like the GIS modelers and analysts. They are usually discipline-oriented, career professionals who have four-year university degrees plus 2-5 years' on-the-job training with one or more commercial image processing softwares, ***or*** they have an MA or PhD degree in a specialized aspect of the topic and in-depth knowledge of at least one commercial processing software (e.g. EASI/PACE, ERDAS, ER-Mapper, Image Works).

2.3.7 System Analyst/Programmer can be one or two individuals, usually with an MA or PhD in electrical engineering, computer science, or systems integration and with training in software design. Analyst/programmers must be fluent in major operating systems [UNIX, X-Windows, Paradox, Oracle, etc.] and software languages [especially C++], and they must be able to create and maintain local and widearea networks.

2.3.8 Telecommunications Specialist is usually an electrical engineer with practical experience in telemetry and land-line telecommunications. This person should coordinate with the System Analyst and Database Manager to expand data networking to external sources and nodes.

2.3.9 Mathematician/Statistician is preferably someone with background in sampling strategies, coordinate systems, fuzzy logic, fractals, data models, and data structures.

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[2] Trade-marked, Copyrighted, or Registered products, processes, services, or vendors are given as examples only, and do not represent an endorsement.

3.0 GIS in Ukraine

3.1 Players and Projects

3.1.1 Organizations in Kiev with Current GIS Capabilities

In the government sector there are several organizations developing in-house GIS capabilities. To provide direction and coordination, the government recently created a National Commission on GIS that consists of some 60 individuals representing all the major Ministries and State Committees in Ukraine. From this number, a GIS "Council" of some twelve people has been named.

The relationship between the State Commission on GIS and the concept for a Multi-Purpose GIS (see Section 3.1.2.1-A) is somewhat circular. Authors of the Multi-Purpose concept (Rudenko et al., 1993) argued successfully for the creation of the Commission. The Commission is now, in turn, recommending the adoption of the Multi-Purpose concept--which was also approved *as a concept* by former Prime Minister Kuchma, now President Kuchma. The State Committee on Science and Technology is a member of the Commission Council, so it seems that much of the political acceptance for a future GIS infrastructure has already been done.

For this report, four government organizations were visited (items 1-4). In the private sector, five organizations were visited (items 5-9), and in the academic sector four Institutes within the Ukrainian Academy of Science and three universities were visited (items 10-13). Section 6.1 lists the individuals with their complete addresses and telephone numbers (where, known):

(1) Main Administration of Geodesy, Cartography, and Cadastre
  (a) Ukrainian Institute for Geoinformatics
  (b) Ukrainian Enterprise of Geodesy and Cartography
(2) State Committee of Geology
(3) Ukrainian National Space Agency
(4) State Committee on Urban Development and Architecture
(5) Intelligent Systems
(6) "ECOMM" resellers for ESRI (ARC/INFO), hosted by Institute of Public Administration and Local Government
(7) VISICOM representative for Intergraph
(8) Planning and Development Collaborative International (PADCO), contractor to US/AID
(9) Academy for Educational Development (AED), contractor to US/AID
(10) Ukraine National Academy of Science
  (a) Institute of Geography
  (b) Institute of Applied Informatics
  (c) Institute of Cybernetics, 4i Computer Systems Department
  (d) Institute for Strategic Studies
(11) Kiev Topographic College, Kiev Slavonic University,
(12) Department of Geography, Kiev State University

(13) Environmental Education Information Center, hosted by The University of Kiev-Mohyla Academy

3.1.2 **Current, Planned or Proposed GIS Activities**

The activities listed in 3.1.2.1 show the breadth of GIS applications in Ukraine. The order of presentation is based on their importance in context of developing a viable GIS infrastructure for Ukraine--not necessarily in priority of importance for the specific problems they address. Section 3.1.2.2 lists other projects that were mentioned by name during meetings, but about which no detailed information is available. They may all be very important, but they are presented here without ranking. The important point to make is that all of these activities are progressing in the absence of widespread data sharing--not because of data sharing. The primary means of displaying maps and spatial data analyses is still based on traditional techniques while GIS continues to be only a peripheral "toy". The need for data and processing equipment will starve or accelerate these efforts as explained in Section 3.2.1.2. US/AID assistance to establish a central GIS facility under the direction of, and in cooperation with, the National Commission should accelerate the pace of GIS development and use (see Section 5.4.1 and 5.4.2).

From another perspective, the activities listed below show how GIS will be employed by the Ministry of Environment and other organizations. The opportunities are real, near term, and numerous.

3.1.2.1 Important Activities for GIS Infrastructure

(A) Multi-purpose National GIS of Ukraine. The premise of NGIS is to create a nationwide object-oriented GIS developed by the State so as to link other information systems in Ukraine and around the world (Appendix-B, Figure 1). NGIS objectives are to: (i) embrace Ukraine as a single (unified) geosystem from which to derive data on its natural, cultural, economic, demographic, and environmental resources; (ii) incorporate all of the relevant facilities and organizations into this unified whole, while each retains its legal autonomy; and, (iii) provide an information system that can fulfill industrial, managerial, and scientific needs.

This concept fits well with US/AID's desire to indentify or create a single facility in Ukraine for GIS technology. It is endorsed also by the scientific and technical GIS community by whom it was conceived. If created, it would single-handedly provide the focus around which data sharing and data standards could evolve in satellite organizational agencies. In 1992, the concept was submitted to the State Committee on Science and Technology but has apparently been deferred for economic reasons. Nevertheless, it should be reviewed, and if appropriate, adopted by US/AID as an infrastructural model for the technology.

(B) Training program for mayors of cities and towns. This project is sponsored by Ukrainian Institute of Public Administration and Local Government, and is aimed at introducing local authorities to GIS technology. A series of oneweek executive training sessions is planned for September, 1994. Training will be conducted by the local ESRI (ARC/INFO) reseller, for which a training center equipped with DECstations has been created near the State Committee of Geology headquarters.

(C) Donets Oblast. The atlas of Donets Oblast is based on data from some 30 contributing sources. The most recent atlas contains 100+ highly detailed maps of all important environmental and economic aspects of the Oblast. The first atlas was completed in 1993 based on 1991 data. Only five copies of the atlas were made, and the only known copy in Kiev is in Professor Rudenko's office at the Institute of Geography. The atlas is a masterpiece of traditional cartography. For environmental planning, energy conservation, and economic projections, it would better serve Ukraine's planners if it were converted into an electronic atlas; and if English language overlays were created, it might serve international planners as well. These two versions could be created by a map scanning process at fairly low cost, but further study of the prospects is required.

Data collection continues by all the organizations involved in the first atlas, but none of the data have yet been captured digitally. A longer term objective should be to capture these data, but before that can happen, there must be infusions of equipment for accurately locating field data collection sites and additional personnel training. When this is accomplished, routine up-dating of all datasets will be much easier and more reliable: and, more importantly, can be used to build a time-series of data to measure rates of change.

(D) Laboratory for Landscape-Ecological Problems of Chernobyl has an on-going project within the Ukrainian Academy of Science, Institute of Geography. Dr. Vassili Davydchuk and his staff have been collecting ecosystem data (in the field as well as from other organizations in Ukraine) and has spent considerable time formulating models for the flow of radionuclides through soils, vegetational communities, and the hydrologic system. Appendix-B (Figures 2 & 3) are examples of the detailed datasets (maps) his laboratory produces. Some of these are being digitized and analyzed at Main Administration of Geodesy, Cartography and Cadastre with the help of the Canadian firm Photosur Geomat. There is a group of six individuals drawn from several organizations to analyze and overlay the datasets using SPARCstation equipment and Canadian Spatial Analysis System (SPANS) software. They also have a 40" x 60" digitizing tablet that is non-functioning for lack of space, and a 36" Cal-Comp plotter that is partly disfunctional for the same reason. What is needed, aside from more space to operate the equipment, is access to advanced visualization and animation software to process the data as a time-series (perhaps under item 5.4.2.3 (d).

(E) Canadian Chernobyl Project - (Radioecological Geographical Information System). This project is co-sponsored by Canada. The Belorusian-Canadian-Ukrainian project was started in 1993. It is a pilot project to insert GIS into the Chernobyl Disaster After Effects (ECDA) established by the Ministry of

Chernobyl. According to Prister et al. (1994), the project originally had four "global" and six "local" aims. Global aims are to: (i) design GIS tools for calculating radio isotope levels in milk and potatoes; (ii) define optimal economic management recommendations for agricultural commodities in the radiated landscapes; (iii) create and test a full-scale radioecological GIS (RGIS) in lands impacted by the NPP disaster; and, (iv) develop principles of integration of RGIS with an associated decision support system. Goal (iii) has been dropped and goal (iv) has been set aside for Chernobyl Ministry under the name Organizational Technical System (OTS) "Inform-Chernobyl".

At the local level, GIS technology will be used to: (i) organize data in the integrated radioecological data bank (IRDB); (ii) classify and characterize natural resources in the polluted territory; (iii) create a Land Information System (LIS) as a subsystem of RGIS; (iv) integrate RGIS with spatial analytical tools to provide statistics; (v) integrate RGIS with models of radionuclide migrations in the hydrosphere and lithosphere; and (vi) integrate RGIS with economic models to address agricultural economics (global goal ii).

Pieces of these activities are being conducted by different institutions. All of the elements need to be standardized and integrated, and an overall conceptual framework needs to be developed.

(F) State Committee on Urban Development and Architecture has three projects in progress (Appendix-B, Figure 4). The Committee has responsibility for coordinating between national and local authorities, urban design, village and rural development, and related issues. They have a project in the Chernobyl region to regenerate social and economic infrastructures affected by the Chernobyl accident (Oblasts covering roughly one-third of Ukraine). A second project involves border region development, and a third project involves economic development and environmental protection in the Bila Tchervka area; namely, military airports, the development of a rubber plant, and containment of pesticides and oil contamination in the water supply of Bila Tcervka. The lastter project is described as a feasibility study to develop a new model for urban design.

The Chernobyl regional study was first proposed in 1992, but apparently has not yet been funded. As currently proposed, the effort would be headquartered in Ukraine and coordinate the Ukrainian, Russian, and Belorussian Committees of Construction and Architecture. The proposal reads like a duplication of item (D), above, but contains specific ideas about the creation of a GIS to represent the data. While the proposal recognizes the need for a broad interdisciplinary approach coupled with sophisticated data management and processing techniques, it appears to be very underscoped in terms of time, data processing needs, and equipment.

(G) Environmental Education and Information Center has a cooperative agreement with US/EPA and Ministry of Environmental Protection (MEP) to conduct training in environmentally related topics. MEP and Kiev Mohyla

Academy (UKMA) are founders of the Center which has five goals: "(i) to introduce modern methods of environmental education and information resource management in MEP and the University; (ii) to satisfy the needs of the government citizens of Ukraine for current and comprehensive environmental information; (iii) to cooperate with international databases on the environment and environmentally sound technologies; (iv) to develop a broader understanding of the environmental data and their application; and (v) to encourage technology transfer and applications to various projects promoting environmental sustainability." The Center is involved with environmental education, information development (including database development and GIS implementation), and outreach & information dissemination. It is housed in about 100 sq. meters of space but has only desktop PC capability and no input/output devices. If up-graded, it could evolve into a local training facility for data capture technicians and database managers.

(H) Commission on Geographic Names. This organization has responsibility for cataloging and maintaining place names and their various spellings in Ukraine. This function provides an important database for GIS development because some places have a string of different names to which data are referenced. Each "place" or "feature" must be accurately geolocated, and its various names attached as a variable attribute.

(I) Environmental Management Development in Ukraine--Dnipro River Basin. This project is sponsored by Canada/IDRC in cooperation with Ukraine Ministry of Environmental Protection. According to the "Program Summary"...

"...the Environmental Management Information System for the Dnipro river basin will be designed and reviewed with the large number of institutions who will use this system. A pilot information system will be tested in Zaporizhzhia and after modification, manuals will be produced and training courses provided. Other information technologies **such as remote sensing or GIS**, which can add a powerful new dimension to environment management, and which are already used in some institutions **might** be incorporated into this activity (IDRC, 1994, p.7) (emphasis added)."

Since this project is scoped at only $5M, and has several major goals, it is questionable that adequate attention will be payed to these "other information technologies".

3.1.2.9 Other Projects

The following are projects about which little is known by the consultant. They are listed here without priority, even though they may be very important to EPT if more were known.

(A) Implementation Plan for a "Torrens" Land Registration System in Ukraine UMA Engineering (Alberta, Canada). This is a pilot project for Kosov district of Ivano-Frankovska Oblast, and is designed as a parcel-based LIS.

(B) Land Information System (LIS) for Agriculture Using SPOT Images This is a joint effort between IGN/France and Main Administration for Geodesy, Cartography and Cadastre, Enterprise for Geoinformatics. It is the only project reviewed during the consultancy that is attempting to merge satellite imagery and GIS for resource monitoring.

(C) GIS of Odessa region. This project is being conducted by Odessa University in collaboration with University of Utrecht They are using Oracle, Intergraph and Idrisi software, but are apparently having problems using their equipment. The team is therefore advocating a training program for their scientists and technicians.

(D) Land Reform in Ukraine. This **might** be a World Bank Project, but at the moment is only in the idea stage. It is scoped at $10M

(E) Chernobyl GIS training center. This project has been proposed by the Committee on Urban Development and Architecture as part of the "TEXAS Program" for funding by the Commission of the European Communities (CEC).

(F) Ukraine National Space Agency (Priroda) plans to launch its own Earth resource satellite fairly soon. Its Research and Production Centre of Aerospace Information carries out the following tasks: (i) storing and disseminating aerospace information; (ii) implementing aerial resource surveys; (iii) serving as a repository for aerospace data for the Ukraine; (iv) projecting Ukraine's future needs for aerospace resource data; (v) developing GIS/RS technologies; (vi) implementing geodetic, topographic, cartographic, and cadastral surveys; (vii) providing technical assistance in GIS technology, publications, marketing and consulting; (viii) creating hardware/software systems for exploiting aerospace data; and (ix) improving the expertise of aerospace specialists.

None of the above tasks were explained during consultant's meeting with Mr. Uruskiy, nor were any laboratories visited that would confirm work in progress. Many of these functions appear to be redundant with other organizational mandates.

3.2 **Infrastructure**

A technology's tangible infrastructure is based on its physical facilities and the scientific legacy of its development (data & literature). Its intellectual infrastructure is manifested in its practitioners and their means to practice (equipment). In Ukraine, the tangible infrastructure of GIS technology lags well behind the intellectual infrastructure, but both need assistance to achieve their potential as national environmental and economic planning and management tools.

3.2.1 Tangible Infrastructure

Figure 5 in Appendix-B is a current organizational chart for Ukraine's Main Administration for Geodesy, Cartography and Cadastre. Although there are many organizations involved in GIS, this appears to be the focal point for the technology in Ukraine. It is roughly equivalent to U.S. Geological Survey, which is generally regarded as the focal point in America. The diagram shows the main Enterprises involved in GIS. The Enterprise currently developing GIS activities is the Aero-Geodetic Enterprise (UkrAGP), and in particular the Research and Production Centre of Geographic Information Technology. The plan is to elevate the R&P Centre to higher status. It might possibly even serve as a short-term focal point of US/AID assistance, though there seems to be widespread agreement that a separate, centralized, facility needs to be established.

Consultant had no time to produce a functional chart of all organizations visited in Kiev, but their number and range of GIS responsibilities indicate widespread activity, geographically and topically.

3.2.1.1 Physical Plant

All of the current capability for GIS is housed in small laboratories or offices scattered throughout the operational agencies and educational institutions of Ukraine. Those visited are generally configured into several offices on different floors (without direct communications between them), or more rarely, as adjacent small offices; but almost never as a single, coherent laboratory with open work space. Total space devoted to GIS activities is typically under 40-50 square meters, and in many cases this is shared space with other functions (aerial photogrammetry, cartography, etc.).

Almost all of the office space is furnished with traditional desks and chairs. Scientific equipment has been gradually moved into these spaces as circumstances permitted, but only two offices (Intelligent Systems and the DEC/ESRI Training Center) appeared to have been designed for form and function. Similarly, electrical wiring appears to be outdated and few surge suppressors were seen. Lighting (both natural and artificial) is suboptimum for efficient GIS activities. One must recognize that GIS activities require large work areas for map layouts, digitizing, map displays, etc., and that manipulating the data requires more than just desktop PCs for input and output.

3.2.1.2 Scientific Literature & Data

No GIS libraries were visited and none were seen to be co-located with a GIS laboratory. Discussions often emphasized the need for technical literature in repositories where staff and technicians can gain access to technology reports and new technology developments. Most of the available literature consists of operator manuals for hardware and software, but there is limited access to scientific and analytical literature. The first edition of Ukraine's National *Journal of Geodesy and Cartography* appeared on August 18, 1994. Produced under the auspices of the Main Administration for Geodesy, Cartography and Cadastre, this Journal is the first to be widely available to Ukrainian GIS specialists. It will be an important focal point for GIS technologists in Ukraine and will bring much needed international attention and respect to local efforts.

Data represent the essence of GIS technology. As is typical throughout the world, data are highly prized resources that are often jealously guarded, and often only available to their collecting agencies. Since every operational organization (whether government, university, or corporation) collects and processes data, each shares in the creation of this guarded cultural environment. Each endeavors to gain access to other people's data, and some are more successfully than others. In Section 3.1.2 it was suggested that data drive the technology, and that in Ukraine, activities are progressing in spite of data sharing.

It is proper for data collection agencies to retain basic custody of their data and to serve their constituencies by providing oppropriately analysed and reduced datasets. This ensures data integrity and accuracy. While everyone agrees that data and information should be shared, there seem to be few infrastructural mechanisms (MOUs, Technical Agreements, etc.) to stimulate sharing. This situation is politely recognized and most people hope that efforts of the National Commission on GIS will break the grid-lock.

US/AID could impact this situation significantly by financing the creation of a GIS clearinghouse for data sharing. US/AID should be aware, however, that there is no desire in the world community for creating centralized GIS repositories for collecting, processing, and disseminating everyone's data. Instead, most everyone agrees that institutional autonomy must be maintained, but that their data should move between agencies via servers that can perform platform and software conversions. When this structure evolves, according to Rudenko et al. (1993) the "age of the information system" will have begun in Ukraine. It is a win-win structure because no agency collects all the information it requires to monitor and plan resources. By sharing their data with others, however, they gain equal access to quality checked datasets needed for their own work. This stage of understanding and development is just now taking form in North American and Western Europe (see Kottman, 1992; Morrison and Wortman, 1992). It could follow quickly in Ukraine, if its GIS infrastructure is designed efficiently from the beginning (Rudenko et al., 1993; Volska et al., 1993). The concept of the multi-purpose National GIS of Ukraine is viable, and in their view should be endorsed to keep Ukraine from slipping two or three generations into "technological backwardness."

3.2.2 Intellectual Infrastructure

This part of Ukraine's GIS infrastructure is already taking shape in the sense that some people estimate the existence of over 100 "collectives" throughout the country[3]. Some of these people have served as data capture technicians, but it is apparent in brief conversations that many are software and computer specialists lacking in the fundamentals of data preparation. Some lab directors have little or no training in either computers or GIS.

3.2.2.1 Personnel and Training

None of the facilities visited had a skill mix approaching that described in Section 2.3. Most GIS activities are being carried out using individuals having some background in traditional cartography, earth and biological sciences, geography, and (more rarely) computer

[3] "Collective, in this regard, refers to groups as small as three or four people.

science, mathematics, and statistics. As has been discovered by personnel at Odessa University, there are growing needs for GIS training among existing professional and technical levels. Most of their project personnel have traditional educations in a related discipline but need technical training for specific GIS requirements. Their traditional, disciplinary, backgrounds will then be directly related to their Institute, Enterprise, or State Committee missions and objectives.

Kiev Topographical Technical Secondary School at Kiev Slavonic University has a "professional track in cartography". Appendix-B, Figure 6 & 7 shows the program curriculum and calendar for 1994-95. These indicate the absence of GIS coursework, even though this college produces many of the personnel for the Main Administration for Geodesy, Cartography, and Cadastre. It is clear from their curriculum that no directly related GIS instruction is offered. Neither are there faculty to offer the required courses, or the equipment to sustain the instruction. Nevertheless, there are a few desktop computers and the rudiments of computer cartography.

Although the curriculum for Kiev State University, Department of Geography has not been reviewed, the experiences of Odessa University and evidence from Kiev Slavonic University are probably symptomatic of a widespread absence of GIS training infrastructure in Ukraine. Curriculum modernization and concomitant instructional up-grades are therefore required if growing demands for GIS products and services are to be sustained.

3.2.2.2 Equipment

It is arguable that equipment is "tangible", not "intellectual." It is categorized as intellectual here because it provides the scientific means for practicing the technology. In this sense, Ukraine has only the barest means to practice GIS. During the course of many office visits, organizations demonstrated their capabilities on fledgling, in-house systems, many of which are clones for IBM 360, IBM PC XT, DEC/PDP-11 and similar technology. More powerful desktop technology such as SPARCstations, Hyundai, Compaq, and HP are seen, but all have been acquired in the absence of an overall planning objective. The systems ususally consist of a computer, terminal, and monitor operating off the hard drive or diskettes. Storage capacities for data are typically constrained to internal hard drive capacity, so applications are limited to small datasets or small geographic areas[4]. There is a general sense of frustration from those personnel who are better versed in GIS concepts but who have little technical capability to show-off their talents. Probably none of the current applications would be convincing to government administrators in search of problem solutions, though they are certainly convincing as demonstrations of ideas. Planned activities are limited by the same infrastructural constraints.

Data capture and data output devices are present in rare instances. Digitizing tablets are usually "page-size" instruments, and printers are usually page-size black & white dot matrix, or color ink-jets. Only one 36" x 48" tablet was seen and it was not operational for lack of space. One 36" Cal-Comp plotter was also seen.

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[4] The single exception to this is Intelligent Systems, a joint stock company with excellent equipment for software development and graphics display & printing.

Electronic field equipment was not seen. Several references were made to the need for GPS units and IBM-compatible 486 lap-top computers. The need here is for acquiring accurate locational data for field sample sites, data recordings at those sites, and for word processing at field stations.

3.3 **Digital Base, Data Sharing, and Data Standards**

Infrastructures for GIS data sharing are just now being developed in the United States, primarily through the Federal Geographic Data Committee (FGDC) headed by Secretary of Interior Bruce Babbitt. Image-based GIS is expected to be a frequent traveler on the often-referred-to Information Superhighway (or Infobahn), presently characterized by the Internet (which at this time is little better than a cow path). Developers of GISs (especially public agencies who have been directed by President Clinton in his Executive Order of April 13, 1994 to make Federal data available on the Internet to the public) want their systems to travel these future highways through servers accessible by the public, and they recognize that for this to happen, they must adhere to spatial data transfer standards and metadata standards. This does not equate to a universal hardware/software system, but it does require that systems and methodologies be compatible with recognized systems and procedures.

3.3.1 Digital Map Base (DMB) of Ukraine

An accurate GIS must be tied to a geodetically correct digital base map. It is uncertain at this time whether a geodetically correct base map exists for Ukraine, even though the consultant has been advised that the Main Administration for Geodesy, Cartography, and Cadastre has digital maps of the nation in several standard scales (1:1M, 1:500,000, 1:200,000). More information needs to be obtained to determine the accuracy and scales of those being used by current projects.

If the digital base map being used in Ukraine by the organizations and projects listed in Section 3.2.1, was prepared from a 1:1M scale (or smaller) map, **or** if no DMB is being used, then an important first step for EPT might be to provide the DMB. The best of these would be digitized from the largest scale map series available, preferably 1:50,000 or 1:100,000. Failing this possibility, the Ukrainian 1:200,000 map series should be digitized. Depending on the urgency and immediate uses for a digital base map, other sources might be obtained at low cost. The sections below describe some of these options. Further detail and ordering information is given in Appendix C for all of the items below.

3.3.1.1 DMA has Digital Terrain Elevation Data (DTED) and Digital Feature Analysis Data (DFAD) available on CD-ROM. These are usually developed at fairly large scales, and are reportedly available to US/AID by request.

3.3.1.2 DMA also produces Tactical Pilot Charts (TPC) at 1:500,000 (possibly 1:250,000) scale, but in raster format. They are available in CD-ROM format for the Ukraine but would have to be ordered directly by US/AID because they may be based on copyrighted material developed by the Ukrainian government. In other words, it may be that Ukrainian-produced maps have already been converted into a digital map base by DMA, thereby avoiding the need to digitize them locally. This is one of the questions for further study during a proposed second visit to Ukraine by the consultant (see Section 5.5).

The maps from which the TPCs may have been produced could be the 1992 set of maps showing 16 of the "Regions of the Ukraine" at 1:200,000 scale. These are available in paper form for $225 from *Four One Company Ltd., London.* If acquired, they would have to be digitized for use as a digital map base. However, they have apparently been produced by The Main Administration for Geodesy, Cartography, and Cadastre, so there should be no dispute as to the quality of information they contain.

3.3.1.3 The Digital Chart of the World (DCW) is another global database developed in vector format by DoD/Defense Mapping Agency. It is based on DMA's 1:1,000,000 "Operational Navigation Charts" and contains 17 thematic layers including political boundaries, cities, transportation networks, drainage, land cover, and elevation contours.

3.3.1.4 The Relational World Data Bank II (RWDB2) is provided by the United States Geological Survey, EROS Data Center, as a global coverage on five 9-track (6250bpi) computer tapes for $230. The data were compiled by the CIA usually at 1:3,000,000 and are questionable as to their completeness and accuracy. RWDB2 is topologically structured to establish the relationships among polygons, lines, and point features, together with their names and attributes. Use of these data should be explored as a "last resort" DMB for the country.

3.3.2 Data Standards and Data Dictionaries

One of the most fundamental requirements for a GIS is that data capture adhere to strict standards. These are fairly well established already by the international community, but there is little evidence that these standards are being followed in Ukraine. Clearly, there is need for training for data capture technicians as well as a need for the National Commission to address this issue on a national scale.

Data dictionaries are respositories about data that contain information on all the objects in a database, and their relationaships. Like standards, these dictionaries, if they exist in any of the organizations visited, were not revealed.

3.3.3 Metadata and Data Transfer Standards

Once data have been entered into a GIS and its dictionary prepared, it is necessary to prepare metadata about the various elements. This information alerts potential remote users about the existence of various datasets and describes them so users can determine their appropriateness for use in their problem solutions. Data transfer standards are also required so that potential users can actually gain access to these datasets via some form of platform server. The GIS community in Ukraine appreciates the need for metadata and data transfer standards as is evidenced in their published materials (Chabanuk, 1994a,b; Rudenko et al., 1993; Volska et al., 1993).

4.0 Observations

The infrastructure for GIS in the Ukraine is just beginning to take shape. Almost all of the organizations visited have indicated their desire to participate in this development, but have indicated their belief that, at present, there is little potential to advance their capabilities or to provide state-of-the-art applications to those in need of problem solutions. Some of the reasons cited for this situation are: (1) reorganization and government reforms following independence; (2) newness of the technology in Ukraine; (3) lack of money to acquire the technology; (4) shortage of trained personnel qualified to practice the technology; (5) democtritization of the formerly closed Ukrainian society; (6) inflation and the inadequacy of salaries and wages to keep qualified people from relocating (usually to Western Europe or North America); and, (7) little understanding of the technology at policy and decision-making levels. There are no doubt elements of truth in all of these views, but there are important activities and a few recent events that provide a positive outlook.

Despite these hurdles, GIS is "on the move" in the Ukraine. US/AID has an opportunity to make significant contributions to its rational development. Many of the costly mistakes made in North America and Europe during the pioneering stages of GIS technology can be avoided in Ukraine by partnering with those who have a vision of its potential and realistic experience with its application to local, regional and national problems of Ukraine.

One of the continuing dilemmas for developing GIS technology is **user** inertia. Information about, and answers to, pressing environmental, economic, social and engineering issues often are not asked until the information and answers are needed. There is no time to create a GIS specifically for these responses, and once the "crisis" is over, there is no perceived need for a GIS until the next "crisis." Somehow the vision and value of GIS must be instilled at the highest levels of Ukraine's policy and economic planning levels.

4.1 **Facilities**

One of the first needs, is for organizations to allocate adequate and suitable space for GIS that allows for its growth in personnel numbers and equipment. This space should not be simply carved out of existing facilities by reassigning office functions and moving furniture, but should be carefully selected in context of organizational objectives, designed, and renovated for power, lighting, and furniture.

Several articles have been published that describe GIS infrastructure in Ukraine (Volska et al., 1993; Rudenko et al., 1994; Chabanyuk, 1994b). There is concurrence that a "central" GIS facility should be created with a full complement of professional and technical skills for the creation of a National GIS. The general feeling is that this facility should be located in Kiev and should be under the direction of the National Commission or be incorporated into the Research and Production Center of Geographic Information Technology.

None of the facilities visited had libraries available for general use[5]. These materials tend to be rather expensive for the present Ukrainian economy. Although the Environmental Education Information Center is being developed with co-sponsorship of EPA and the Ukrainian Ministry of Environmental Protection, few Ukrainians have experience with electronic information search and retrieval techniques. One can hope that as these techniques filter through the population, more information will become available. Still, there is a difference between retrieving the citation and abstract about technical information, and being able to retrieve the entire article.

4.2 **Training**

Training is required at all levels from administrators to technicians and from study tours through long term, degree-oriented university instruction. To develop Ukraine's GIS infrastructure, training should be provided for all of the main sectors: educational, administrative, and applications. It seems there are several mechanisms for this training and all should be exploited. Aside from EPT-sponsored training there are opportunities through US/AID's contract with the Academy for Educational Development (AED) and other AID-sponsored projects. Administrators at the local level have similar opportunities through the Executive Training Program.

Considering the infusion of GIS technology in Ukrainian government, educational, and private sector organizations, long term training is probably not a high priority, ***except*** for training young faculty members, and other key personnel, who can then modernize their institutional curricula or significantly enhance their parent laboratory's capability. The driver for long-term training should be a desire to ensure the coterie of personnel for "next-generation" GIS systems that will evolve by 2000.

4.3 **Equipment**

In the short term, equipment may be the missing ingredient that would best stimulate GIS infrastructure development in Ukraine. Planners, however, should be determined to pace the infusion of new equipment so as to optimize their immediate and medium-term needs. As explained earlier, the kernel of GIS infrastructure already exists in the form of PC-based hardware and software. What is needed to "quick-start" this kernel are input and output devices, together with a few well-placed workstations and more robust software. In the foreseeable future (1995-2000), the infrastructure would best migrate toward upper and higher-end workstations, increased storage capacity, improved networking capability, and faster data transfer.

Since GIS is a "user-driven" technology, applications dictate the capabilities resident in the system. The technology is not hardware limited except at the cutting edge of its development. USAID's participation in developing Ukraine's GIS infrastructure should

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[5] Libraries and reading rooms no doubt exist in each of the facilities, but none were seen to be co-located with the GIS laboratory, and many reported the virtual absence of GIS literature and information.

therefore be focused on critical and immediate user needs, rather than more advanced evolutionary trends.

Part of the reason local policy and decision making personnel remain unconvinced of the utility of GIS technology is that output products are not easily generated for use or display in their offices. Data capture limitations aggravate this situation by imposing size limitations on input maps and tabular datasets. In many applications, the data themselves are of limited use because their geolocations are not known to within any useable limits of accuracy.

There are numerous vendors for digitizing tablets, inkjet & electrostatic printers and plotters, conversion softwares, and hand-held GPS units. It is a highly competitive industry with many technical and service niches. Outside the United States, however, maintenance and spare parts are equally important considerations. In Kiev, there are several hardware and software resellers of American made equipment who are anxious to market their product lines. This may be an excellent opportunity to promote private enterprise in the region.

As the infrastructure evolves, considerably more sophisticated environmental questions will be asked (see, for example, Section 2.2.1). One can expect some consolidation of existing GIS activities as redundancies are eliminated, but these will be offset by new organizations with legitimate needs for in-house GIS development. Overall, there will be a net expansion of the technology and a concomitant need to link these "nodes" with a multi-purpose GIS facility. At this juncture it appears necessary to nurture equipment and expatriate training in this technology at least through 2000, or until the Ukrainian economy can finance its own needs. The gradual increase in size and complexity of GIS applications requires a similar migration to high-end data management and presentation equipment.

5.0 Suggested Assistance and Implementation

5.1 Facilities

It is suggested that the Concept of the Multi-Purpose National GIS of Ukraine described and supported by most of the current major players in Ukraine's GIS community be reviewed and, if appropriate, adopted as an infrastructural model for the technology (see Section 3.1.2.1-A).

An equally important suggestion is to identify a small number of critical issues about which there are continuing needs for information, and to begin the process of systematic GIS development. As time and resources permit, this core-level GIS could be expanded to include new datasets so that, in time, resource planners and managers would migrate automatically to the GIS as their first (preferred) source of information. There are a few additional suggestions (below) which must be undertaken to firmly plant GIS as a management and planning technology in Ukraine.

To expedite infrastructure development and optimize the acquisition and allocation of US/AID resources, it is suggested that EPT work closely with Ukraine's National Commission on GIS (see Section 3.1.1). This Commission has representatives from all of the major interest groups working with GIS, and through its Council can coordinate and recommend specific individuals for study tours and training, and identify specific equipment needs. Furthermore, the National Commission could identify, and if necessary, relocate GIS activities into suitable space in their respective organizations. As soon as the space is identified and renovations underway, proper office furniture might then be procured. To prepare adequate space, electrical wiring, and working environments might require working with local office architects and designers. In any case, organizations wanting to have serious GIS programs will have to participate in these preparations.

It is suggested that if a central GIS facility is created as a "service center" to other GIS laboratories, EPT/USAID should urge that it be located in a modern office building, independent of other organizational missions and objectives. EPT/USAID should also recognize that any such center would require equipment having higher capabilities than that supplied, on average, to other organizations, because it will be expected to receive and disseminate datasets across the network. It will perhaps also serve as the respository for most data, at least until data sharing capabilities over copper or fiber-optic land-lines are developed.

It is suggested that multiple subscriptions be entered immediately for *Photogrammetric Engineering and Remote Sensing* (American Society for Photogrammetry and Remote Sensing), *Cartography and Geographic Information Systems* (Journal of the American Congress on Surveying and Mapping), *GeoInfo System, GIS World, GPS World*, and *Proceedings of IEEE*, among others. If possible, negotiations should be made with the publications departments of these Societies and publishers to acquire publications dating from 1992. It is recommended that journal subscriptions should be in quantities sufficient to be available at several locations in Ukraine, but the "main library" for books and other informational materials should be housed at the central GIS facility.

5.2 **Training**

As with training, it is suggested that EPT/USAID coordinate with the National Commission on GIS to determine the types and timing of equipment purchases.

5.2.1 Study Tours

As used here, the term Study Tour includes groups to the United States to visit a variety of relevant facilities to learn how Americans are using and developing GIS technology, and individuals who might confine their interest to only two or three installations specializing in a given processing technique.

5.2.1.1 Upper-level Administrators

It is commonly agreed among those contacted that an important step in generating government and institutional support for GIS will be to organize a study tour to the United States of mid-to-top level administrators to learn first hand about the state-of-the-technology. Current equipment and applications are inadequate in Ukraine to make a convincing case for this technology. Funds for the study tour could be proposed from AED. The selected individuals should visit counterpart organizations in the United States including private, government, and educational laboratories. The study tour would best be organized by the American Society for Photogrammetry and Remote Sensing, working with the American Congress on Surveying and Mapping, both headquartered in Bethesda, MD. A requirement

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of AED is to provide Ukrainian or Russian interpreters, so any proposal would need to include costs for interpreter('s) services and traveling hosts. ASPRS/ACSM have access to technically and language-qualified Society members, and through their auspices could create an agenda free of institutional and organizational bias.

5.2.1.2 Senior-Level GIS Professional

Study tours for smaller groups of GIS developers and application specialists should also be arranged for practicing professionals to acquire up-to-date information on techniques, trends in the technology, spatial data transfer standards, use of the Internet and other telecommunications linkages, and to provide an opportunity for Ukrainian technologists to establish contact with American scientists. These study tours should be scheduled to coincide with major regional, national, or international GIS conferences to expedite their opportunities to meet American and International GIS specialists. A few suggested meetings and technical exhibits include: (1) annual meeting of ASPRS/ACSM (1995 will be in Charlotte, NC); (2) annual GIS/LIS meeting (1995 will be in Nashville, TN); 18th Congress of ISPRS (1996 meeting will be in Vienna, Aust.)

5.2.2 Technical Training

"Training" means daily classroom instruction and hands-on experience in a specific aspect of GIS technology, the aim of which is to provide a small coterie of individuals in each of the major skill mixes identified in Section 2.3. It is not expected that each GIS facility in Ukraine have a complete complement of these skill mixes, but rather that the allocation of skills will have more or less equal representation. The allocation of these skills would be at the discretion of the National Commission.

5.2.2.1 Data Capture Technicians

AED might also provide funds for short term group training in data capture and editing. AED's general philosophy is that larger groups (15-20+) are more cost efficient than smaller groups (2-14). Localities that might host such training include: (1) Forestry Remote Sensing & GIS Laboratory, Ft. Collins, CO; (2) National Center for Geographic Information and Analysis (NCGIA), University of California, Santa Barbara; (3) Earth Data Analysis Center (EDAC), University of New Mexico, Albuquerque; and, (4) Environmental Sciences Research Institute (ESRI) Training Center, Redlands, CA.

5.2.2.2 Professional (staff) Training

By reference to Section 2.3 it is suggested that short term (30 day) group training be undertaken as soon as possible to fortify the technical backgrounds and experience levels of persons now employed as Team Leaders (2.3.1), GIS Modelers and Analysts (2.3.2), Database Managers (2.3.3), Image Processing Specialists (2.3.6) and System Analyst/Programmers (2.3.7).

5.2.4 Long Term Training

Long Term needs will be most urgent in computer science, artificial intelligence, cybernetics, object-oriented and samantic databases, and systems integration; and in environmental database management for these new systems. Using existing mechanisms for identifying and placing MA and PhD candidates, it is suggested that in Phase 3 USAID/EPT inaugurate a three-year program for at least two Masters and two PhD students each year, 1995-1997, so that by 2000 at least a dozen GIS theoreticians and experts will be available in Ukraine to guide future developments. By this time, their expertise should find its way into local educational curricula and/or ensure timely modernization of evolving GIS laboratories.

5.3 **Equipment**

5.3.1 Software

GIS is a "user driven" technology. Therefore, it is suggested that the selection of softwares be based on what users are trying to accomplish and that this decision should precede the selection of hardware. All of the currently popular softwares are compatible with a range of platforms, but not all platforms will carry popular, commercial softwares. MAPINFO is the more popular commercial software in Ukraine. ARC/CAD, ARC/INFO, SPANS and Intergraph are known, but not widely used. ARC/INFO, in particular, is regarded as pricy and not user friendly, notwithstanding its worldwide stature in the industry. There are also several so-called "home-grown" softwares being employed. For compatibility in the early stages of GIS infrastructure development, it is suggested that EPT/USAID provide the most recent version of either MAPINFO or ARC/INFO (or both) as the baseline operating software(s). These are interoperable accepting either vector or raster data.

5.3.2 Quick-Start Hardware

It is suggested for Phase 2 that EPT/USAID procure as quickly as possible digitizing tablets (40" x 60"), and a printer/plotter (36"). GPS units should also be acquired for accurately locating field data collection sites (e.g., Trimble Navigation Pathfinder with associated PFINDER software). To support this, there will eventually need to be a network of GPS Base Stations to facilitate data collection. Specifications for this equipment will probably vary between organizational needs and objectives, so procurement should be coordinated by the National Commission working directly with these organizations. The Base Station may or may not be a vital element of GPS data collection, and may represent internal security problems for the Government. This question needs further study.

A small number of desk-top Workstations would significantly boost the GIS infrastructure in the short-term. It is suggested that these be in SPARCstation or DECstation class with appropriately priced options. All necessary peripherals like external storage drives should also be purchased.

5.3.3 Mid-Term Hardware

For field data collection efficiency, it is suggested in Phase 3 that IBM-compatible lap-tops be procured. These will serve a dual role in recording data at field sample sites (including GPS readings that must be taken on-site), and in providing field station word processing capability. The latter will reduce time and errors in transcribing field notes into computer files.

It is suggested that EPT/USAID monitor the evolving GIS equipment base and its applications to assess future equipment procurement and allocation. This may lead to such needs as data visualization using Silicon Graphics Incorporated (SGI) *INDIGO* harware, using Autometric Inc. *WINGS* software. It is not presently foreseen that *Virtual Reality* capabilities will be required under USAID sponsorship, but one can expect the technology to move in this direction over the next half decade.

To gain some insight into these possible future needs, it is suggested that existing datasets from the Laboratory for Landscape-Ecological Problems of Chernobyl be processed during a study tour using *INDIGO/WINGS* visualization and animation technology.

5.4 Installed Infrastructure

Distilling the above narrative to manageable terms, it seems best to suggest a phased approach. Phase 1 might focus on quick turn-around activities; Phase 2 on creating a centralized facility to expedite data transfers and provide technical assistance to other organizations conducting projects; and Phase 3 on up-grading these companion facilities. Training and equipment are required for all three phases, but cost estimates in Section 5.4.2 are given only for Phases 1 and 2. Phase 3 is un-priced. All of the actions, of course, are predicated on an MOU being signed between US/AID and GOU.

5.4.1 Phase 1 Activities

5.4.1.1 Electronic Atlas of Donets (Probably requires external contractor) Est. $20,000

5.4.1.2 Electronic Atlas of Ukraine (Probably requires external contractor) Est. 10,000

Total Phase 1 (Est.) $30,000

5.4.2 Phase 2 Equipment and Training Costs

The aim of Phase 2 is to create an efficient capability in Ukraine for government ministries and academic units to address their urgent environmental, economic, social, and natural resource issues; and, to help set the stage for further evolution of Ukraine's land reform and democritization. Phase 2 assistance would accomplish the following:

5.4.2.1 Prepare space for a centralized facility (GOU expense) No Cost

(a) ± 150 Sq meters of space
(b) modern electrical wiring, wall power, and lighting
(c) GIS-compatible laboratory furniture
(d) office desks, worktables, and bookcases
(e) adequate space for digitizing tablets and printer/plotter

5.4.2.2 Equip the central facility with:

(a) 2 (40" x 60") digitizing tablets @ $10,000	20,000
(b) 6 PCs for data editing (existing equip or GOU expense)	NC
(c) 2 workstation for image and data processing @ $20,000	40,000
(d) 1 (36") electrostatic or inkjet printer/plotter@ $20,000	20,000
(e) Peripherals: 3 sets @ $5,000	15,000
(f) Software/Licenses:	25,000
(g) 2 GPS Units: @ $1,000	2,000

5.4.2.3 Train ± 23 people in GIS technology:

(a) ± 6 Ministry, Enterprise, State Committee policy makers — 80,000

6 people @ $10,000 plus $20,000 (group costs)
($2000 int. air; 3000 dom. air; 100/day lodging; 75/day meals each for 20 days; plus 20,000 group fees for tour buses and interpreter)

(b) ± 4 technicians for data capture (AED funding?) — 58,000

4 people @ $12,000 plus $10,000 (group costs)
($2000 int. air; 4000 training fee; 100/day lodging; 75/day meals; 250 book allowance each for 30 days; plus 10,000 group interpreter fee)

(c) ± 4 prof. staff (30 days of training) — 32,000

4 people @ $8,000
($2,000 int. air; 100/day lodging; 75/day meals; 750 book allowance each for 30 days)

(d) ± 5 lab directors for applications-oriented study tours — 80,000

5 people @ $12,000 plus $20,000 (group costs)
(as for technician training except est. 2 separate groups)

5.4.2.4 U.S./Kiev Equipment and Training Coordination

(a) 1 (U.S.-based) & 1 (Kiev-based) coordinator @ $1000/mo x 6 mos. — 6,000

Total Phase 2 $378,000

Estimated Total Phases 1 & 2 $408,000
Less AED $58,000
Total Phase 1 & 2 EPT Project Costs $350,000

5.4.3 Phase 3 Equipment and Training Costs

These actions are suggested in the mid to longer term (15-36 months), but are not priced. The aim of this assistance would be to expand GIS capabilities to existing government and academic laboratories that could be served by the central GIS facility.

5.4.3.1 Renovate space for ± 6 existing laboratories (GOU expense)

(a) ± 150 Sq meters of space
(b) modern electrical wiring, wall power, and lighting
(c) GIS-compatible laboratory furniture
(d) office desks, worktables, and bookcases
(e) adequate space for digitizing tablets and printer/plotter

5.4.3.2 Equip renovated facilities with:

(a) 2 (40" x 60") digitizing tablets
(b) 6 PCs for data editing (existing equip or GOU expense)
(c) 2 workstations for image and data processing
(d) 1 (36") electrostatic or inkjet printer/plotter
(e) Peripherals
(f) Software/Licenses
(g) 2 GPS Units

5.4.3.3 Train ± 45 people in GIS technology:

(a) ± 12 technicians for data capture
(b) ± 20 prof. staff (30 days of training)
(c) ± 6 lab directors for applications-oriented study tours
(d) ± 6 long-term MA and Phd students

5.4.3.4 U.S./Kiev Equipment and Training Coordination

(a) 1 (U.S.-based) & 1 (Kiev-based) coordinator

5.5 Implementation

It is suggested that a senior-level GIS coordinator be retained by CH2M-Hill on a "while actually employed" basis in the United States to facilitate equipment purchases, training schedules, programs of instruction, and training venues based on needs identified to EPT/Ukraine by the Commission. This should probably not exceed two working days/month

Following Embassy and USAID-level negotiations with GOU, inauguration of infrastructure-building might be signalled by EPT/USAID contacting Mr. Anatoly Bondar, Chairman of the National Commission on GIS and Director General of the Main Administration for Geodesy, Cartography and Cadastre. At that time also, it would be appropriate for the GIS consultant to return to Kiev to work directly with the Commission on equipment and training needs, and to plan a physical layout for the centralized facility.

The first task of the newly established central facility following personnel training would probably be the creation of a digital map base for Ukraine--if that need has not already been satisfied.

Beginning with approval to proceed, consultant recommends that Dr. Victor Chabanuk, be retained on a "while-actually employed" basis to interface with U.S. Consultant, CH2M-Hill, and US/AID-Ukraine on equipment and training matters. His Resume is included ad Appendix D.

6.0 Sources

6.1 Organizational Contacts

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2. Tchereminskiy M.D., Main Administration of Geodesy, Cartography and Cadastre, Cabinet of Ministres, Ukraine.

3. Lemetyuk B.D., Main Administration of Geodesy, Cartography and Cadastre, Cabinet of Ministres, Ukraine.

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31. Leschinskyi O.L., professor of Kiev Topographic College and Kiev Technical College of Radioelectronic Equipment Building.

32. Rybin S.Y., student of Kiev Technical College of Radioelectronic Equipment Building.

33. Troyan V.I., student of Kiev Technical College of Radioelectronic Equipment Building.

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35. Kononov V.I., Centre of aero-geodetic information processing.

36. Seredinin E.S., ECOMM.

37. Mantsevich Yu.N., State Committee on Urban Development and Architecture.

38. Kachura O.V., Kiev Slovanian University, prorector.

39. Polovitsa S.G., Public Limited Company "Kievproject", Kiev General Plan Administtration.

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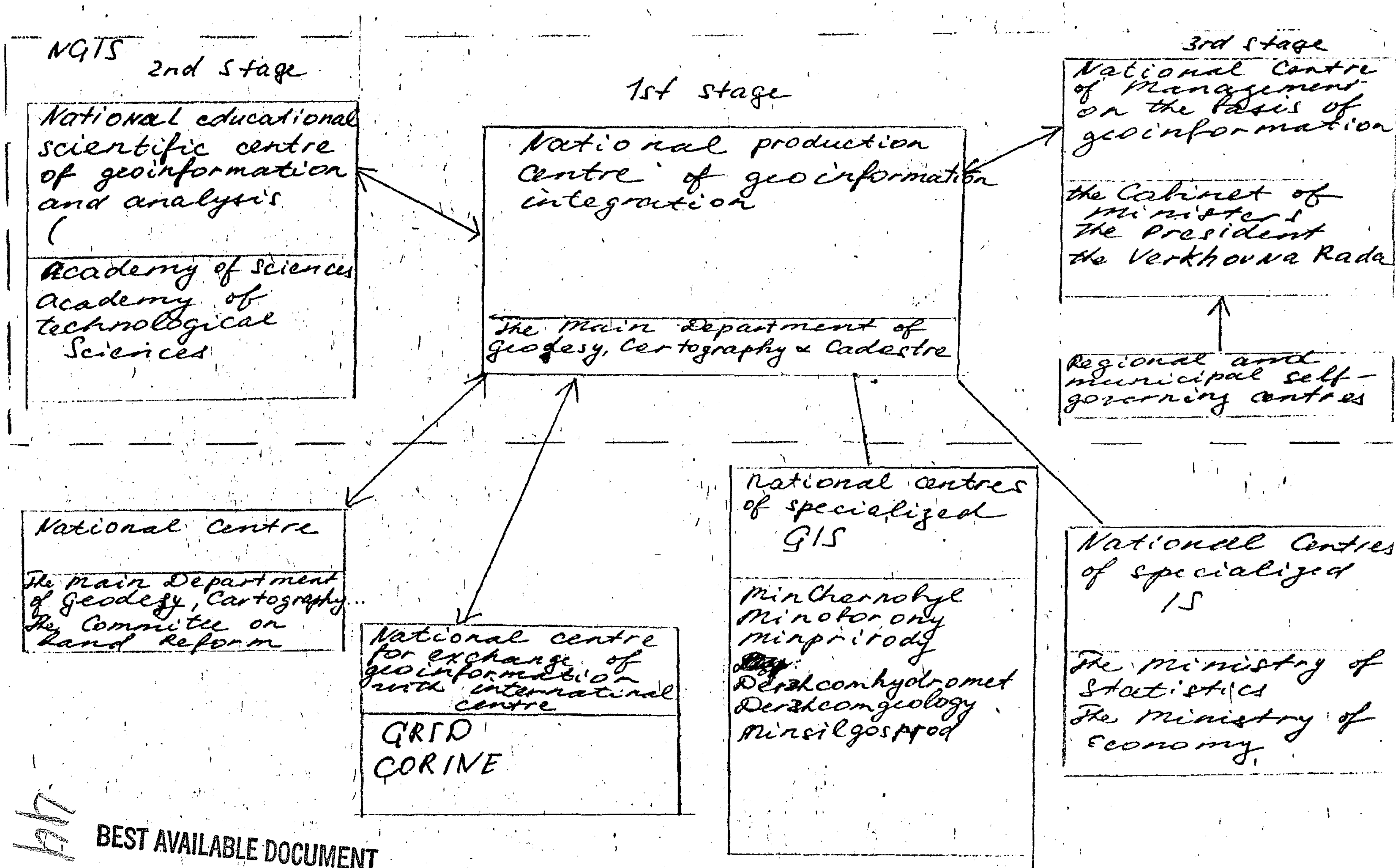
APPENDIX-B



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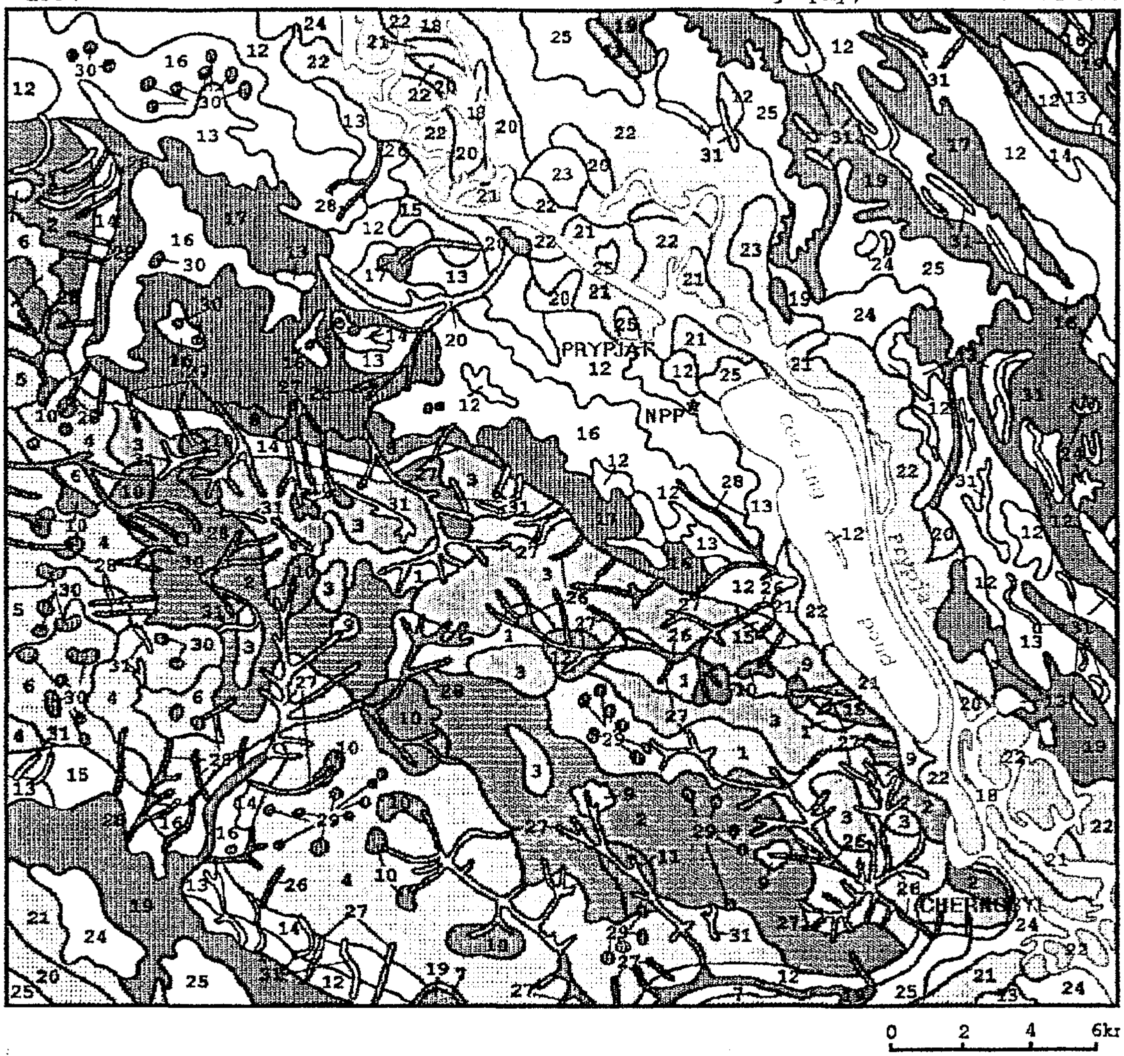
BALANCE1.TIF

1994 Institute of Geography, Ac. Sci.of Ukraine



Long-term balance of Cs-137
in natural landscapes of Chernobyl zone

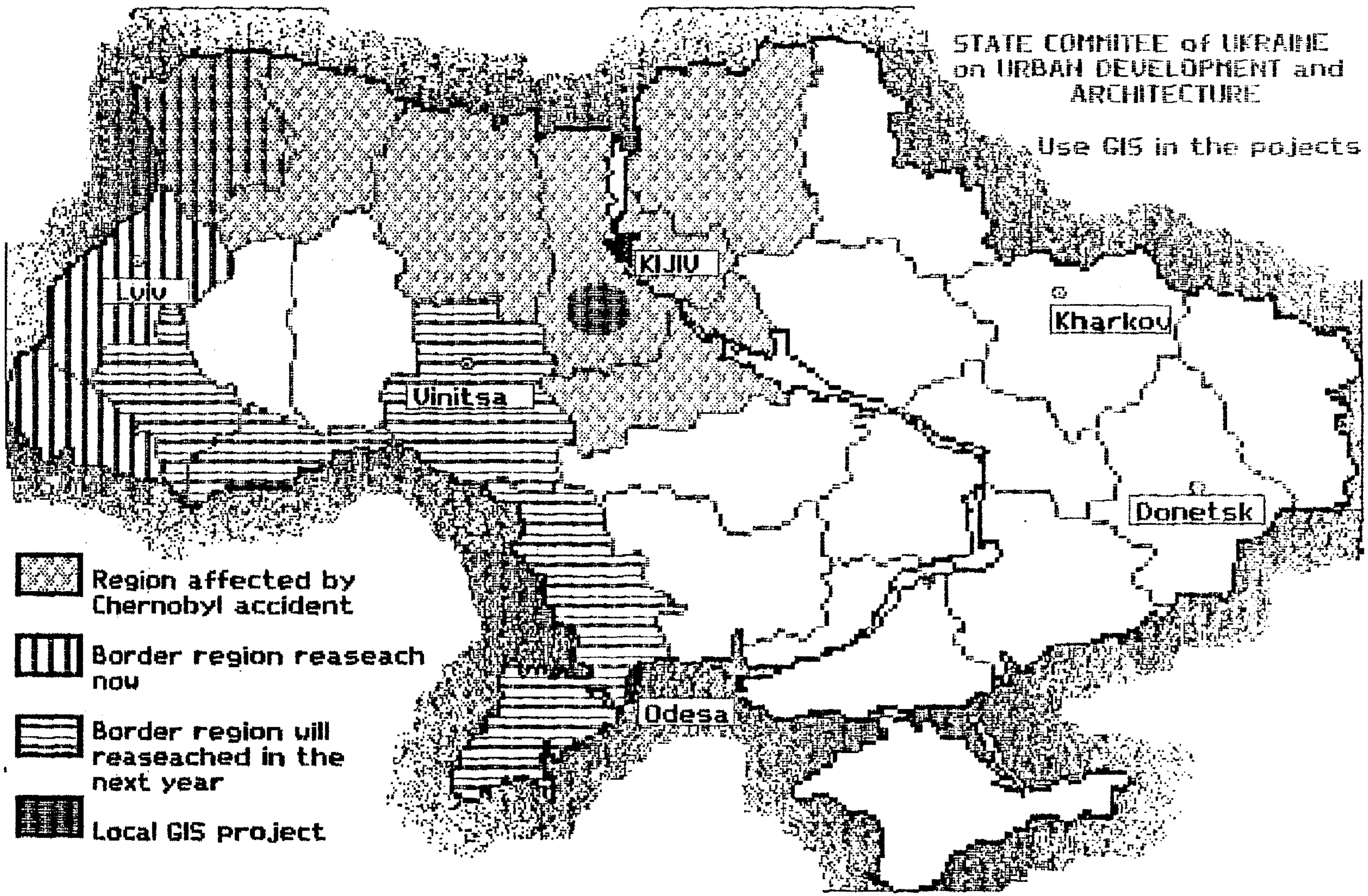
(qualitative evaluation)

Degree \ Balance	Negative	Neutral	Positive
Strong			
Average			
Slight			

1993 Institute of Geography, Ac. Sci.of Ukraine

Natural Landscapes of Chernobyl nuclear accident zone

Worked out by V.Davydchuk
Ju.Fomenko


STATE COMMITEE of UKRAINE
on URBAN DEVELOPMENT and
ARCHITECTURE
Use GIS in the pojects
KIJIV
Lviv
Vinitsa
Kharkov
Donetsk
Odesa
Region affected by
Chernobyl accident
Border region reaseach
now
Border region will
reaseached in the
next year
Local GIS project

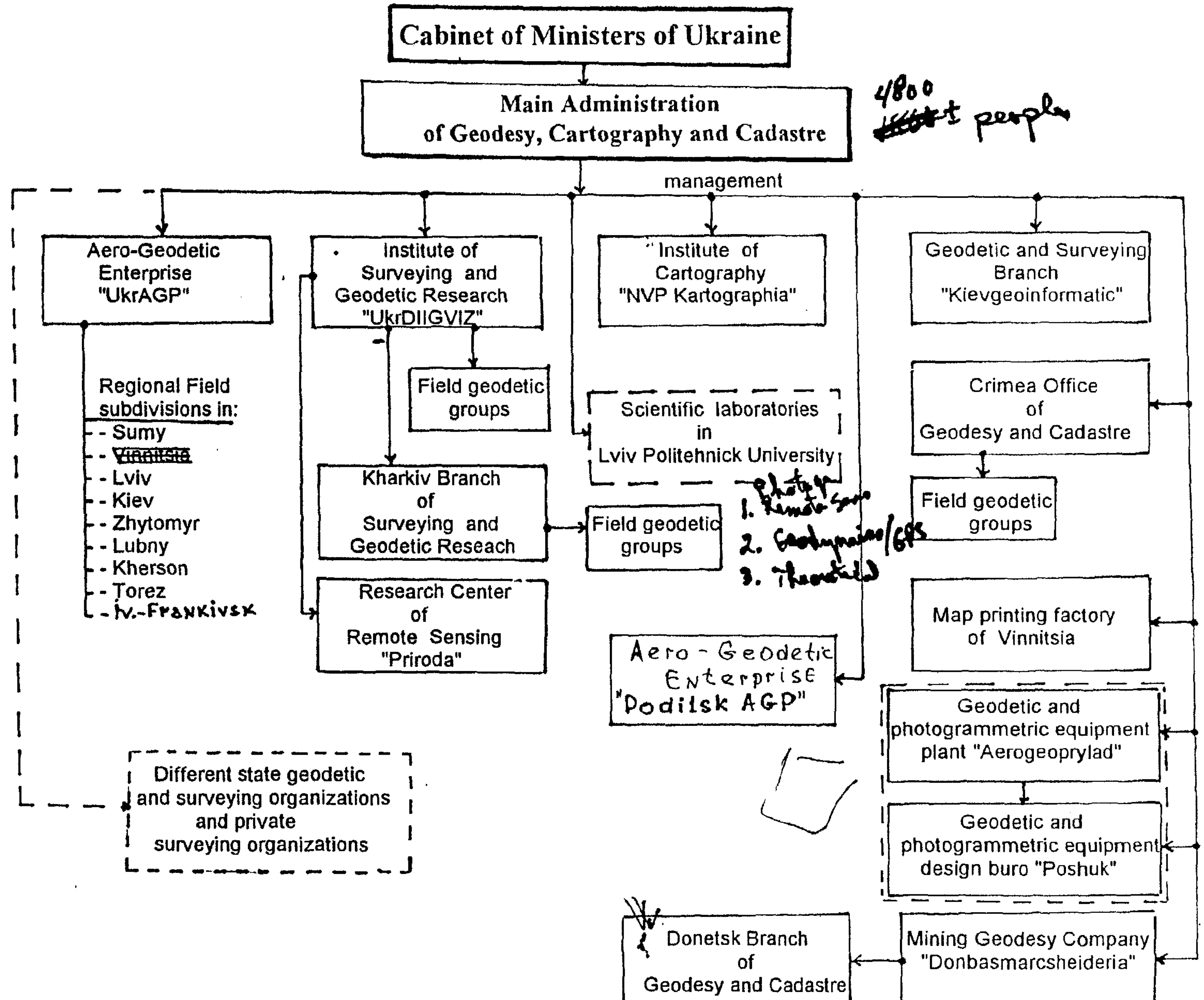


Fig 1. Organization chart of Geodetic Service of Ukraine

REMARKS TO THE CURRICULUM

1. Classes for the 1-3 years of studying begin on the 1st of October; for the 4th year - on the 15th of October.
2. Those students who have secondary education begin studying from the 2nd year.
3. The schedule is recommended, so the changes are possible.
4. Physical training is obligatory, so it should be planned in the main curriculum.
5. Tests are carried out at the cost of time planned for the subject.
6. Tutorials could be individual or for the group.
7. Field classes can be organized in a concentrated way or they may be interchanged with theoretical classes under the condition of strict keeping to the amount of hours established for theory and practical classes.
8. Technological field classes are held as a rule in a concentrated way.
9. Pre-conscription training for girls is held for 70 hours at the 1st and 2nd years of studying, of which the civil defence is 35 hours. Pre-conscription training for boys is concluded with a 5 days' assembly.
Those having secondary education are exempted from pre-conscription training and use this time for optional subjects.
10. Optional subjects could include: "Basics of scientific and technical creative work", "Basics of ethics and aesthetics" and others.
11. Studying of regulatory documents is carried out at the expense of time given for the corresponding subjects.
12. The educational establishment has the right to make changes to the list of labs and studies.
13. The Curriculum is revised in accordance with the regulatory documents of the Ministry of education of Ukraine issued in 1992, 1993.

DIRECTOR OF THE TECHNICUM

DEPUTY DIRECTOR

APPROVED by the Ministry of education

„ЗАТВЕРДЖУЮ"
НАЧАЛЬНИК ГОЛОВНОГО УПРАВЛІННЯ
ГЕОДЕЗІЇ, КАРТОГРАФІЇ ТА КАДАСТРУ
А. БОНДАР

Individual Curriculum

ІНДИВІДУАЛЬНИЙ НАВЧАЛЬНИЙ ПЛАН

Kiev Topographical Technical Secondary School

КИЇВСЬКОГО ТОПОГРАФІЧНОГО ТЕХНІКУМУ

СПЕЦІАЛЬНІСТЬ 3004 "КАРТОГРАФІЯ"

КВАЛІФІКАЦІЯ СПЕЦІАЛІСТА
МОЛОДШИЙ СПЕЦІАЛІСТ
КАРТОГРАФ

ТЕРМІН НАВЧАННЯ:
3 РОКИ 6 МІСЯЦІВ НА БАЗІ
НЕПОВНОЇ СЕРЕДНЬОЇ ОСВІТИ
2 РОКИ 6 МІСЯЦІВ НА БАЗІ
СЕРЕДНЬОЇ ОСВІТИ

I. ГРАФІК НАВЧАЛЬНОГО ПРОЦЕСУ

Курси	бересень				27.IX-3.X	жовтень 4-10	11-17	18-24	25-31	листопад 1-7	8-14	15-21	22-28	29.XI-5.XII	грудень 6-12	13-19	20-26	27.XII-2.I	січень 3-9	10-16	17-23	24-30	лютий 31-6	7-13	14-20	21-27	березень 28.II-6.III	7-13	14-20	21-27	28.III-3.IV	квітень 4-10	11-17	18-24	25.IV-1.V	травень 2-8	9-15	16-22	23-29	30.V-5.VI	червень 6-12	13-19	20-26	27.VI-3.VII	липень 4-10	11-17	18-24	25-31	серпень 1-7	8-14	15-21	22-28
I	////	////	////	////							14								⁚⁚	=	=						25																				⁚⁚	⁚⁚	=	=	=	=
II	=	=	=	=							14								⁚⁚	=	=						12							⁚⁚	⁚⁚	○	○	○	○	○	○	○	○	○	○	○	○	○	○	=	=	=
III	=	=	=	=							12						⁚⁚	=									12				○	○	○	○	⁚⁚	⁚⁚	X	X	X	X	X	X	X	X	X	X	X	X	X	=	=	=
IV	=	=	=	=	=	=					16												○	○	○	○	⁚⁚	‖‖	‖‖																							

Теоретичне навчання ☐ Навчальна практина ⊡ Виробнича практина ☒ Екзаменаційна сесія ⁚⁚ Державні екзамени ‖‖ Канікули =

II. ЗВЕДЕНІ ДАНІ З БЮДЖЕТУ ЧАСУ

Курси	Теор. нав.: тижнів	Теор. нав.: годин	Екзаменац. сесія в тижнях	Практика: навч. в тижн.	Практика: вироб. в тижн.	Канікули в тижнях	Всього тижнів в навч. р.
I	39	1393	3			6	48
II	26	1014	3	14		9	52
III	24	936	3	4	13	8	52
IV	16	560	3	4		6	29
	105	3903	12	22	13	29	181

III. ПЛАН НАВЧАЛЬНОГО ПРОЦЕСУ

N п/п	Назва предметів	Розподіл за семестрами: екзамени	Розподіл за семестрами: курсові проекти	Кількість контр. робіт	Кількість годин: всього	занять на уроках	з них: лаборат./практич.	курсове проектув.	самост. робота	1 курс: 1 семестр 14 тижнів	2 семестр 25 тижнів	2 курс: 3 семестр 14 тижнів	4 семестр 12 тижнів	3 курс: 5 семестр 12 тижнів	6 семестр 12 тижнів	4 курс: 7 семестр 16 тижнів
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Соціально-гуманітарний та природничо-математичний цикл															
1.	Всесвітня історія				100	78			22	2	2					
2.	Історія України	4			70	66			4			3	2			
3.	Українська мова	2,3			100	95			5	2	1	3				
4.	Українська література			2	200	195			5	5	5					
5.	Світова література			2	140	128			12	2	4					
6.	Іноземна мова				230	217			13	3	3	2	3	3		
7.	Математика	1,2		3	280	273			7	7	7					
8.	Основи інформатики та обчислювальної техніки				70	64	28		6	1	2					
9.	Фізика	1,2		2	160	142	36		18	3	4					
10.	Хімія			1	90	78	18		12	2	2					
11.	Біологія			1	50	42	10		8	3						
12.	Географія країн світу			1	50	42			8	3						
13.	Філософія	4			70	66			4			3	2			
14.	Основи економічної теорії	6			80	72			8					3	3	
15.	Основи соціології				40	32			8							2
16.	Правознавство				60	52			8			2	2			
17.	Українська та зарубіжна культура				60	42			18			3				
	РАЗОМ:	9		12	1850	1684	92		166	33	30	16	9	6	3	2
	Спеціальний цикл															
18.	Обчислювальна техніка та основи програмування				80	66	30		14			3	2			
19.	Фізична та економічна географія України та СНД	4,5		2	216	200	34		16			4	7	5		
20.	Геодезія	3,5		3	196	190	96		6			5	6	4		
21.	Фотограмметрія	6		2	108	108	44							5	4	
22.	Картографічне креслення			4	386	386	380					7	8	8	8	
23.	Складання та редагування карт	5,7	6	3	228	228	108	20					3	3	4	7
24.	Математична картографія	6		2	84	84	34							4	3	
25.	Тематичне картографування			1	64	64	30									4
26.	Оформлення карт			1	96	96	92									6
27.	Видання карт			2	60	60	18									
28.	Автоматизація картографічних процесів	7		1	48	48	14									3
29.	Техніка безпеки	6			48	48									4	
30.	Основи підприємництва та управлінської діяльн.				80	80										
31.	Економіка, організація і планування картогр. робіт	7	7		100	100	16	12							3	4
32.	Основи державного кадастру				32	32										2
	РАЗОМ:	11		21	1826	1790	896	32	36			19	26	29	31	31
33.	Фізичне виховання				288	288				4	4	2	2	2	2	2
34.	Допризивна підготовка юнаків				140	137	86		3		1	2	2	2	3	
	РАЗОМ:	20		33	4104	3899	1074	32	205	37	35	39	39	39	39	35
	Факультативні предмети															
35.																
36.																
	Всього по навчальному плану															

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Консультації на навчальну групу на весь період навчання до 200 годин	Всього			1 сем.	2 сем.	3 сем.	4 сем.	5 сем.	6 сем.	7 сем.
		Предметів вивчається	33	11	10	11	10	9	9	8
		Курсових проектів	2						1	1
		Екзаменів	20	2	3	2	3	2	4	3

Tutorials: up to 200 hrs per group

N п/п	V. ПРАКТИКА	семестр	тижнів
	А. НАВЧАЛЬНА		
1.	Теодолітні ходи	4	3
2.	Нівелювання IV класу	4	2
3.	Мензульна зйомка	4	4
4.	Комбінована зйомка	4	3
5.	Дешифрування аерознімків	4	1
6.	З геоморфології	4	I
7.	З складання карт	6	4
8.	З складання карт	7	4
	Б. ВИРОБНИЧА технологічна	6	I3
	Всього:		35

VI. ДЕРЖАВНІ ЕКЗАМЕНИ

/перелік предметів, що виносяться на державні екзамени/

1. Картографія
2. Економіка, організація і планування картографічного виробництва

N п/п	VII. ПЕРЕЛІК НЕОБХІДНИХ ЛАБОРАТОРІЙ, КАБІНЕТІВ ТА МАЙСТЕРЕНЬ Найменування
	Лабораторії
1	Фізики
2	Хімії
3	Геодезії
4	Фотограмметрії
5	Технічних засобів навчання
	Кабінети
I	Історії
2	Суспільних наук
3	Української мова і літератури
4	Світової літератури
5	Іноземної мови
6	Математики
7	Географії
8	Картографічного креслення і оформлення карт
9	Складання і редагування карт
10	Видання карт
II	Автоматизації картографічних процесів
12	Техніки безпеки
13	Економіки, організації і планування картографічного виробництва
14	Правознавства
15	Фізичного виховання
16	Допризивної підготовки юнаків
I7	Методичний
18	Інформатики, обчислювальної техніки та програмування
	Полігони / господарства/
I	Навчальний геодезичний полігон
2	Спортивно-оздоровчий комплекс

ПОЯСНЕННЯ ДО НАВЧАЛЬНОГО ПЛАНУ

I. Початок занять на I–3 курсах – I жовтня; на 4 курсі – I5 жовтня.

2. Групи студентів, зарахованих на базі загальної середньої освіти, приступають до навчання з 2 курсу.

3. Графік навчального процесу має рекомендувальний характер. При обов"язковому збереженні загальної тривалості теоретичного навчання можливі зміни графіка практик, екзаменаційних сесій та зимових канікул в навчальних групах.

4. Заняття з фізичного виховання являються обов"язковими і плануються в основному розкладі.

5. Контрольні роботи, передбачені навчальним планом проводяться за рахунок часу, відведеного на вивчення предмету.

6. Форми проведення консультацій, передбачених навчальним планом – групові, індивідуальні.

7. Навчальну практику можна проводити концентровано або шляхом чергування її з теоретичними заняттями при обов"язковому зберіганні на протязі навчального року об"єму годин, встановлених як на теоретичне навчання, так і на навчальну практику.

8. Технологічна практика по спеціальності проводиться, як правило, концентровано.

9. Допризивна військова підготовка для дівчат проводиться на I та 2 курсах в об"ємі 70 годин, в тому числі цивільна оборона – 35 годин. Завершується допризивна військова підготовка для юнаків п"ятиденними польовими заняттями /зборами/ за рахунок часу, відведеного на предмет в строки, погоджені з військовими комісаріатами.

Особи, з середньою освітою від занять з допризивної підготовки молоді звільняються.

Студенти, звільнені від вивчення допризивної військової підготовки, використовують резерв часу, що утворився, для вивчення факультативних предметів.

I0. В перелік факультативних предметів можуть бути включені: "Основи науково-технічної творчості", "Основи етики та естетики" і інші, виходячи з можливостей навчального закладу та особливостей підготовки спеціалістів і визначаються навчальним закладом.

II. Вивчення директивних документів проводиться за рахунок часу, визначеного навчальним планом на відповідні предмети.

I2. Навчальному закладу надається право вносити необхідні зміни в перелік кабінетів та лабораторій з урахуванням підготовки спеціалістів та факультативних предметів, що вивчаються.

I3. Навчальний план скоректовано згідно директивним документам Міністерства освіти України 1992, 1993 років.

Директор технікуму В.М.Катющенко

Заступник директора по навчальній роботі В.І.Хіхлуха

ПОГОДЖЕНО:

Головний спеціаліст ВК та НЗ ГУГІК України В.Д.АНТОНЕНКО

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„Затверджую"
Директор технікуму
[signature] В. Катющенко

ГРАФІК SCHEDULE OF KIEV

учбового процесу TOPOGRAPHICAL TECHNICAL SECONDARY S…

Київського топографічного технікуму на 1994-95 навч. рік 1994-1995

№	курс	група	Класний керівник	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
				жовтень					листопад				грудень					січень				лютий				березень					квітень				травень					червень				липень				серпень				вересень			
				26-2	3-9	10-16	17-23	24-30	31-6	7-13	14-20	21-27	28-4	5-11	12-18	19-25	26-1	2-8	9-15	16-22	23-29	30-5	6-12	13-19	20-26	27-5	6-12	13-19	20-26	27-2	3-9	10-16	17-23	24-30	1-7	8-14	15-21	22-28	29-4	5-11	12-18	19-25	26-2	3-9	10-16	17-23	24-30	31-6	7-13	14-20	21-27	28-3	4-10	…-17	[illegible]
1		ПГ-11	Костенко Ю.Л.																																																				
2	1	АГ-12	Ковальова Т.М.							12																	16															11										6			
3		АГ-13	Кривошокова А.Ю.																																																				
4		ЗВ-14	Войтюк Л.І.																																																				
5		ПГ-21	Опанасенко Ф.Ф.																																			а							13										
6	2	АГ-22	Пономаренко І.І.							12																14																											4		
7		АГ-23	Косішна О.В.																																									14											
8		ЗВ-24	Фурса Л.А.																																																				
9		ДПГ-21	Овчаренко В.Ф.																																																				
10	2п	ДАГ-22	Шевченко О.І.							12																14																		14									4		
11		ДК-23	Косянчук В.Д.																																			г							13										
12		ПГ-31	Паньков А.І.																															пг		п																			
13	3	АГ-32	Гончаренко Е.Ю.							12														12							п		сп			а						13													
14		ЗВ-33	Терехова Г.І.																															зк	ф																				
15		ДАГ-31	Ковальчук Н.В.																														а	п		сп																			
16	3п	ДАГ-32	Гончаренко О.С.							12														12							сп		п	а								13													
17		ДК-33	Пономаренко Г.А.																																ок																				
18		ПГ-41	Кавуренко Ю.А.																	3				пг																															
19		АГ-42	Незгода Л.І.																			оп		ф	ок																														
20	4	АГ-43	Макаренко К.І.								13								оп	ф		ок		3																															
21		К-44	Марчук Г.Л.																	3				ск																															
22		ПГі-45	Шаблій Я.М.					9						пг								7																																	
23		ДАГ-41	Денисюк Б.М.					9		оп	ф		ок									7																																	
24	4п	ДАГ-42	Ануфрієва О.І.					9					оп		ф	ок						7																																	
25		ДК-44	Садовська В.Л.								13									3				ск																															

Умовні позначення

THEORETICAL		- теоретичне навчання
EXAMS		- екзамени
STATE EXAMS		- державні екзамени
VACATION		- канікули
FIELD CLASS		- учбова практика в Синяві
" "		- учбова практика в Києві
PRACTICUM		- виробнича практика

а	- визначення азимута	AZIMUTH DETERMINATION
оп	- обчислювальна практика	COMPUTER
г	- геоморфологія	GEOMORPHOLOGY
ск	- складання карт	MAP COMPOSITION
сп	- спостереження пунктів триангуляції	TRIANGULATION
ок	- оновлення планів і карт	MAP REVISION
пг	- прикладна геодезія	APPLIED GEODESY
ф	- фотограмметрія	PHOTOGRAMMETRY
п	- полігонометрія	FIELD MEASUREMENT
зк	- земельний кадастр	LAND CADASTRE

Заступники директора
[signature] В. Хіхлуха
[signature] В. Герштейн

APPENDIX-C

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U.S. Department of the Interior
U.S. Geological Survey

Information Update

Relational World Data Bank II

Area of Coverage

Global

Product/Price

Five 9-track computer tape set (6250 BPI) for $230

One 8mm computer tape for $230

Contents

Relational World Data Bank II (RWDB2) is a digital representation of cartographic features of the world for use in automated mapping systems. Listed are feature classes contained in RWDB2:

Linear Features: Coasts, islands, lakes, rivers, international boundaries, provincial boundaries, railroads and roads, law of the sea and other ocean lines, oil and gas, special linear features.

Point Features: Cities, airfields, ports, elevation points, miscellaneous points.

RWDB2 is normally derived from 1:3,000,000-scale maps. However, Europe, Central America, parts of Asia, and parts of the Middle East are at 1:2,000,000 scale, and Northeast U.S.S.R. and the Antarctic are at approximately 1:4,000,000 scale.

RWDB2 is topologically structured to establish the relationships among polygons, lines, and point features, together with their names and attributes. The data are structured as 727 regional panels. Each panel varies in size from approximately 20 degrees of latitude and longitude over the oceans to 5 degrees or less over land masses.

Data Format

The data are distributed as TAR files containing ASCII flat files to allow users to load RWDB2 into most relational data base packages. The distribution format is 7 schema tables, 7 feature tables and 21 attribute tables per panel. Five coordinate files containing topological and coordinate information are also provided for each panel.

Documentation

Technical Guide and Distribution Format document and the the User's Guide will be provided with the purchase of the data set.

Ordering and Technical Information

Sioux Falls - ESIC
EROS Data Center
Attn: Customer Services
Sioux Falls, SD 57198
(605) 594-6151
FAX: (605) 594-6589

RWDB2 is distributed, without modification, by the U.S. Geological Survey on behalf of the Central Intelligence Agency (CIA). RWDB2 has been designed and created specifically for the expressed and sole use of the CIA. No guarantee of completeness, usability, accuracy, or reliability exists or is implied. The attributes, structure, and format of the data base may be modified at any time without notice.

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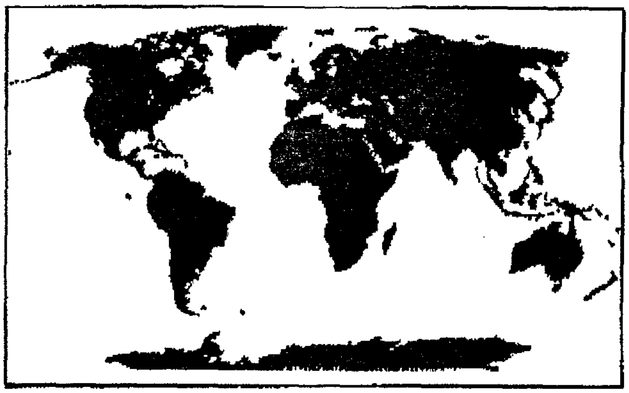
DIGITAL CHART OF THE WORLD

The DCW database

- Has been developed in accordance with the Vector Product Format (VPF), which is also known as the Vector Relational Format (VRF) of the Digital Geographic Information Exchange Standard (DIGEST).
- Can be accessed directly from the four optical Compact Discs (CDs) that store the database or transferred to magnetic media.
- Is the first Defense Mapping Agency (DMA) database to support Geographic Information System (GIS) applications.
- Is generally based on the DMA's 1:1,000,000-scale Operational Navigation Chart (ONC) series base maps.
- Has worldwide coverage composed of four regions:
  1. North America
  2. Europe/Northern Asia
  3. South America/Africa/Antarctica
  4. Southern Asia/Australia
- Contains more than 1500 megabytes (MB) of vector data, organized into 17 thematic layers, including political boundaries and ocean coastlines, cities, transportation networks, drainage, land cover, and elevation contours.
- Contains a worldwide index by place name with more than 100,000 entries.

The VPFVIEW software

- Runs on a PC-class computer.
- Permits you to display geographic features for any area of the world at will.
- Allows you to change the colors and symbols used in the display.
- Gives you full zoom capability.
- Allows you to print hard copy graphics of the features.
- Allows you to save data to a hard disk.
- Allows online display of the database structure and content.



Preferred hardware and software environment to support VPFVIEW

- IBM PC/386 compatible computer (80386 processor) with 80387 math coprocessor
- Video Graphics Array (VGA) and compatible monitor
- Microsoft or compatible mouse
- High-density floppy drive (5-1/4 inch or 3-1/2 inch)
- 30 MB hard drive with at least 20% free disk space
- 1 MB Random Access Memory (RAM)
- MS-DOS Version 3.1 or higher
- CD drive (ISO 9660 compatible)
- Microsoft MS-DOS CD-ROM Extensions Version 2.0 or higher
- Printer capable of reading PostScript formatted files (optional)
- Line printer (optional)

VPFVIEW can also operate on the following (although this is not recommended):

- *IBM PC/286 compatible computer (80286 processor) with 80287 math coprocessor*
- *Enhanced Graphics Adapter (EGA) and compatible monitor*
- *Arrow key interface*

47000CC0012

U.S. Department of the Interior
U.S. Geological Survey

Digital Chart of the World

General

The Digital Chart of the World (DCW) is a comprehensive 1:1,000,000-scale vector base map of the world. It consists of cartographic, attribute, and textual data stored on compact disc read only memory (CD-ROM) with software that permits the data base to be queried and displayed on personal computers (PC). The primary source for the data base is the Defense Mapping Agency (DMA) Operational Navigation Chart series. This is the largest scale, unclassified map series in existence that provides consistent, continuous global coverage of essential base map features.

The DCW data base is based on the vector product format (VPF) military standard (MIL-STD-600006) and the vector relational format of the International Digital Geographic Exchange Standard. The DCW is described by military specification (MIL-D-89009).

Access to the data base is direct from the four optical CD-ROM's that store the data base. The data base also can be transferred to a magnetic media. The DCW is the first DMA data base to support geographic information system applications. The DCW has worldwide coverage composed of four regions: disc 1—North America; disc 2—Europe and northern Asia; disc 3—South America, Africa, and Antarctica; and disc 4—southern Asia and Australia. The data base contains more than 1,500 megabytes of vector data and is organized into 17 thematic layers, including political boundaries and ocean coastlines, cities, transportation networks, drainage, land cover, and elevation contours. The data base also contains a worldwide index by place name with more than 100,000 entries.

Price

$200 per package.

Software

The software in the package, VPFVIEW, runs on a PC and operates with any VPF data base. The software functions include display of geographic features for any area in the world; variations in colors and symbols used in the display; zoom capability; hard-copy print of the graphics used for the geographic features; saving data to a hard disc; and online display of the data base structure and content.

The following operating software is required to support the VPFVIEW software:

- MS-DOS version 3.1 or higher and
- Microsoft MS-DOS CD-ROM Extensions version 2.0 or higher.

Hardware

The following hardware is required to support VPFVIEW software:

- IBM PC/386 compatible computer (80386 processor) with an 80387 math coprocessor, or an IBM PC/286 compatible computer (80286 processor) with an 80287 math coprocessor;

Hardware, continued

- Virtual graphics array (VGA) and compatible monitor or an enhanced graphics adapter, compatible monitor, and an arrow key interface;
- Microsoft or compatible mouse;
- High-density floppy drive (for either a 5 1/4-inch or a 3 1/2-inch disc);
- Thirty-megabyte hard drive with at least 20 percent free memory;
- One megabyte of random access memory (RAM);
- CD-ROM drive (ISO 9660 compatible); and
- Printer capable of reading postscript formatted files (optional).

Contents

The DCW package contains:

- One copy of the VPFVIEW Users Manual for the DCW;
- One copy of the installation instructions for the software;
- One 5 1/4-inch disc and one 3 1/2-inch disc containing executable and source code for the VPFVIEW software;
- Two 5 1/4-inch discs and two 3 1/2-inch discs that provide the DCW data base with a default symbol selection; and
- Four CD-ROM's for the DCW data base (discs 1-4).

Ordering Information

To order the DCW package by mail, write to:

USGS Map Sales
Denver Federal Center
Box 25286, MS 306
Denver, CO 80225
303-236-7477

Payment (check, money order, purchase order, or Government account) must accompany order. Make all drafts payable to Dept. of the Interior—U.S. Geological Survey.

The DCW package can also be purchased over-the-counter from any Earth Science Information Center by check, money order, purchase order, Government account, credit card, or cash.

Missing or defective material will be replaced free if reported to the office that took the order, by telephone or in writing, within 90 days of purchase.

The MIL-STD-600006 and MIL-D-89009 are available on request from:

Standardization Document Order Desk
Building 40
700 Robbins Avenue
Philadelphia, PA 19111-5094

The use of Standard Form (SF) 344 should be limited to routine (Priority 09 - 15) Requisitions. Requisitions received by mail with priority designators 01 through 08 will be downgraded to 09.

Users may obtain Standard Form (SF) 344 through their local supply source using National Stock No. 7540-00-965-2379.

b. Procedures for Digital DMA Products

(1) DoD Activities and Contractors Sponsored by DoD Activities.

(a) Approval of the pertinent Military Department Headquarters is required prior to DMA accepting requests for digital data. Procedures for obtaining that approval are specified in U.S. Air Force Regulations 96-3 and 96-9; U.S. Army Regulation 115-11; and OPNAVINST 3140.55.

(b) Requests for data related to fielded systems and operational requirements are controlled by DMA release and distribution policies as defined in DMA Instruction 8660.10. All requests for available data will be forwarded to:

Director
DMA Combat Support Center
ATTN: PMSR, Stop D-17
6001 MacArthur Blvd.
Bethesda, MD 20816-5001

(c) Commitments of digital data as Government Furnished Materials (GFM) must be coordinated with HQ DMA at the following address, prior to inclusion in contracts:

Director
Defense Mapping Agency
ATTN: PR, Stop A-13
8613 Lee Highway
Fairfax, VA 22031-2137
Message: HQ DMA FAIRFAX VA//PR//

(d) Requisitions will be prepared on one of the following standard forms listed in order of preference and forwarded through Command channels:

DMA Form 8660-6, "DMA Digital Product Request"
DD Form 173, "Joint Messageform"

(e) For Digital Terrain Elevation Data (DTED) and Digital Feature Analysis Data (DFAD) requests should be submitted indicating full one degree cells of data required by either southwest corner coordinates of each cell, geographic coordinates delineating areas required, or a graphic or diagram indicating areas required. All other digital products should be requested by either DMA stock number or geographic boundaries.

(f) Requests for data related to DoD weapon system development are controlled by DMA release and distribution policies as defined in DMA Instruction 8660.10. That is, all requests for data (for proposed, prototype, or developing systems) must be submitted through the pertinent Military Departments to HQ DMA/PR (see address above in paragragh 1.b.(1)(c)).

(g) Requests for Terrain Contour Matching, Probablistic Vertical Obstruction Data, Digitized Point Positioning Database, Relocatable Target Assessment Data, and Interim Terrain Data will always be submitted through the appropriate Military Department to HQ DMA/PR (see address above in paragraph 1.b.(1)(c)).

(2) DMA Policy on Response Time to Requests. DMA policy is to provide digital data in a timely manner that is consistent with DMA mission and validated priorities. The standard response time to routine requests is six to eight weeks for data on tape and two weeks for data on CD ROM. Requests for more than 100 cells should be broken up and prioritized for incremental monthly shipments. Validated priority requests can be furnished in a shorter time period. To assist in prioritizing the processing of digital data, user requests for data should include:

(a) Intended use;

(b) Mission or plan being supported ;

(c) Priority and due dates;

(d) Need to receive future editions;

(e) Point of contact with telephone number;

(f) Completed DMA Form 8660-6.

(3) Order Form. Requests for DMA Form 8660-6 (see following sample) to order digital data should be forwarded to:

Director
Defense Mapping Agency
ATTN: IMR, Stop D-2
6005 MacArthur Blvd.
Bethesda, MD 20816-5002

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UKRAINE

LATEST SERIES

We have obtained a limited number of the latest edition of Ukrainian topographic sheets presented in a unique format. Each sheet is double-sided, folded, and contains one half of the particular *oblast* on one side and the second half on the reverse. Unlike previous series (in which multiple sheets were used), the entire *oblast* is depicted on one sheet, which is cut to the appropriate size to offer complete coverage.

These maps are very convenient to use and were printed in a limited run of only 5000 copies. You may purchase the currently available titles as a set (for a 20% discount) or by the individual sheet.

SET:

50. REGIONS OF THE UKRAINE, Topographic maps, 1992
1: 200k, 17 sheets 225.00
double-sided, folded, various sizes (when unfolded)
Includes the following regions: Cherkassy, Chernigov, Chernovitsy, Dnepropetrovsk, Ivano-Frankovsk, Khmelnitsky, Lvov, Nikolaev, Odessa, Poltava, Rovno, Sumi, Ternopol, Vinnitsa, Volinsk, Zaporozhe and Zhitomir.

SINGLE SHEETS:

51. CHERKASSY REGION, Topographic map, 1992 .... 18.50
52. CHERNIGOV REGION, Topographic map, 1992 .... 18.50
53. CHERNOVITSY REGION, Topographic map, 1992 .... 9.50
54. DNEPROPETROVSK REGION, Topographic map, 1992 .... 18.50
55. IVANO-FRANKOVSK REGION, Topographic map, 1992 .... 14.00
56. KHMELNITSKY REGION, Topographic map, 1992 .... 18.50
57. LVOV REGION, Topographic map, 1992 .... 14.00
58. NIKOLAEV REGION, Topographic map, 1992 .... 18.50
59. ODESSA REGION, Topographic map, 1992 .... 18.50
60. POLTAVA REGION, Topographic map, 1992 .... 18.50
61. ROVNO REGION, Topographic map, 1992 .... 14.00
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63. TERNOPOL REGION, Topographic map, 1992 .... 14.00
64. VINNITSA REGION, Topographic map, 1992 .... 14.00
65. VOLIN' REGION, Topographic map, 1992 .... 18.50
66. ZAKARPATIA REGION, Topographic map, 1992 .... 14.00

PREVIOUS SERIES:

67. KIEV REGION, Topographic map, 1992
1: 200k, multiple of 3 sheets 14.00
single-sided, folded, city and town index on obverse
68. ZHITOMIR REGION, Topographic map, 1991
1: 200k, multiple of 4 sheets 18.50
single-sided, folded, city and town index on obverse
69. KHARKOV REGION, Political-Administrative map, 1991
1: 400k 9.50
double-sided, folded, with city and town index

Customer Inquiries may be directed to:

Mr. Sergei Partserniak, Manager
Cartographic Division
(519) 433-1351

Orders may be sent to:

Four One Company Ltd.
523 Hamilton Road
London, ON N5Z 1S3 Canada
or faxed to: *(519) 433-5903*

APPENDIX-D

Chabanyuk Victor Savich, Ph. D.

Personal Data

Date of birth: [redacted]
Citizenship: Ukrainian

Language: Ukrainian, Russian, English
Place of birth: [redacted]

Education

1977-1982: Kiev State University, Faculty of Cybernetics,
1985-1989: Ph. D. in Mathematical Cybernetics, Kiev State University

Career Summary

Glushkov's Institute of Cybernetics of the Ukrainian Academy of Sciences (1982-1990)
1982: Engineer/Programmer
1990: Head of the Department of the Mathematical Modelling in the Geoecoinformation Systems
Joint Venture 4i Computer Systems (1991-1993)
1991: Technical Director
Joint Stock Company Intelligent Systems (1993 to present)
1993: Director Research & Development, Vice President

Selected Projects

1986: System of the Runoff Modelling from the Watersheds of the Chernobyl Zone
1989: Integrated Radioecological Databank of the Chernobyl Zone
1991: Cartographic System of Mogilev Region of Belorus
1993: Conception of the Multipurpose GIS of Ukraine
1994: Canadian-Ukrainian Chernobyl GIS Project

Last Selected Publications

[1990a]: Morozov, A.A., Chepurnoy, N.D., Buka, N.N., Chabanyuk, V.S. et al. CHESS - Chernobyl Simulation System // Informatik fur den Unmeltschutz, 5. Symposium Wien, Osterreich, 19.-21. September, 1990. Proceedings. Informatik-Fachberichte 256.- Berlin etc.: Springer-Verlag, 1990, pp. 566-572.

[1990b]: Beletsky, J.A., Buka, N.N., Chabanyuk, V.S., Chepurnoy, N.D. Conception and logical Structure of the Integrated Radioecological Data Bank // Systems Analysis and Methods of the Mathematical Modelling in Ecology. Kiev, Institute of Cybernetics, pp. 15-20. (Russian)

[1991]: Chepurnoy, N.D., Buka, N.N., Chabanyuk, V.S. About Conception of the National Ecological Decision Support System Development // Computer Decision Support Systems in Ecology. Kiev, Institute of Cybernetics, pp. 3-16. (Russian)

[1992]: Morozov, A.A., Chepurnoy, N.D., Buka, N.N., Chabanyuk, V.S. Monitoring and Maps of Radioactive Pollution // Ukrainian Academy of Sciences Reports, No. 1, pp. 139-145. (Ukrainian)

[1994a]: Rudenko, L.G., Chabanyuk, V.S. Conceptual Basis of the Multipurposes GIS of Ukraine // Ukrainian Geographic Journal, No. 3, pp. 1-10 (Ukrainian).

[1994b]: Chabanyuk, V.S. The main directions of geographic information systems development in nineties // Geodesy and Cartography, 1994. (in preparation, Ukrainian)

[1994c]: Rudenko L.G., Chabanyuk V.S. Conception of the Multipurpose GIS of Ukraine // Proc. of 1-st Ukrainian GIS Conference, Vinnitsa, 22-25, November, 1993, pp. 4-33. (Ukrainian)

[1994d]: Prister B.S., Tabachnyi L.J., Chabanyuk V.S. Liquidation of the Chernobyl After-Effects and GIS // The Canadian Conference on GIS, Ottawa, Canada, June 6-10, 1994, Proceedings, v. 2, pp. 1025-1035.

[1994e]: Chabanyuk V.S. Semantic Modelling in the Chernobyl GIS Project // Ibid, pp. 1036-1047.

Fields of the Scientific Research

Similarity of Information Systems and Semantic Data Models, Hybrid Semantic Data Models in GIS, Methodology of the GIS Design, Object-Oriented Databases in GIS