

DOCUMENT OF THE INTER-AMERICAN DEVELOPMENT BANK

URUGUAY

**INTEGRATION OF INE AND CADASTRAL SPATIAL DATA BASE TO
SUPPORT RURAL INFRASTRUCTURE PLANNING AND
MANAGEMENT**

(TC-0004017-UR)

PLAN OF OPERATIONS

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ABBREVIATIONS

DNC	<i>Dirección Nacional de Catastro</i>
DNT	<i>Dirección Nacional de Topografía</i>
DNV	<i>Dirección Nacional de Vialidad</i>
DTM	Digital Terrain Model
GIS	Geographic Information System
INE	<i>Instituto Nacional de Estadística</i>
IPTI	<i>Instituto de Planificación de Transporte Interurbano</i>
JCF	Japan Trust Fund for Consulting Services
MTOP	<i>Ministerio de Transporte y Obras Públicas</i>
NCGD	National Clearinghouse of Geographic Data
NSDI	National Spatial Data Infrastructure

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EXECUTIVE SUMMARY

Requester:	<i>Ministerio de Transporte y Obras Públicas (MTOP)</i>		
Executing agency:	<i>Ministerio de Transportes y Obras Públicas (MTOP), through the Dirección Nacional de Topografía (DNT).</i>		
Amount and Source:	IDB: (JCF)	US\$	350,000
	Local:	US\$	70,000
	Total:	US\$	420,000
Terms:	Execution Period:	18	Months
	Disbursement Period:	24	Months
Objectives:	<p>The objective of the program is to enhance and expand existing Geographic Information System (GIS) capabilities and spatial databases of the <i>Dirección Nacional de Topografía</i> (DNT), and to develop specific GIS-based applications to improve the tools already used for planning and decision making within the <i>Dirección Nacional de Vialidad</i> (DNV). The focus will be on the digital conversion and georeferencing of cadastral databases and socio-economic statistics from the census and other sources. Also, specific applications will be developed for the <i>Instituto de Planificación de Transporte Interurbano</i> (IPTI), the <i>Instituto Nacional de Estadística</i> (INE), and the <i>Dirección Nacional de Catastro</i> (DNC), including GIS user training. Furthermore, the new digital databases and applications complement other GIS efforts currently under development and supported by both, the MTOP and the Bank.</p>		
Description:	<p>The program supported by this technical cooperation consists of two phases.</p> <p>Subprogram “A” includes the participation of the <i>Dirección Nacional de Catastro</i> (DNC) and focuses on the conversion of a sample of microfilms of survey plats that form the base for the national cadastre, which are archived in DNT. These data will be digitally integrated into the National Clearinghouse of Geographic Data at DNT. The availability and dissemination of the new digital</p>		

database will enhance infrastructure management, planning and decisions by the project participants, primarily IPTI, DNT, DNV and DNC. In addition, Subprogram A will develop prototype GIS applications to georeference the rural highway network in a sample area within three departments, and will create links between highway and parcel data. This digital union will allow DNT and DNV to calculate affected parcels and areas for several applications such as highway land expropriation/acquisition; to estimate right of way costs; to automatically generate expropriation plans with the corresponding update of the cadastral database; and to benefit infrastructure planning studies in general.

Subprogram “B” includes the participation of the *Instituto Nacional de Estadística* (INE) and concerns the dissemination and use of digital spatial data and transportation models to enhance infrastructure management, planning and decisions by the project participants. To facilitate the accuracy and expansion of the spatial databases, considerable existing cartographic data and socio-economic statistics from the census and other sources, must be digitally converted and georeferenced. Among the key information to be converted to a spatial database are census data for social, economic and agricultural production characteristics; and rural land use, particularly forest plantations, irrigation systems and property maps.

**Environmental/
social review:**

The Committee for Environmental and Social Impact approved the project Profile. The program has positive environmental and social implications. This project will contribute to the improvement of the quality of environmental impact assessments for the highway projects currently being developed with Bank participation, as well as for future projects.

**Benefits and
beneficiaries:**

Direct beneficiaries will be all highway users of the Uruguayan road network. The tools enhanced and developed through this program will contribute to improve the effectiveness, efficiency and equity of government strategic planning, decision-making, and operation management in the highway and infrastructure sectors. Therefore, the program will contribute in the long run to reduce travel times, to decrease vehicle-operating costs, and to expand the road network geographical coverage.

In the short-term, the project will benefit and strengthen the technical and institutional capacity at the *Dirección Nacional de Topografía* (DNT) and the *Dirección Nacional de Vialidad* (DNV), as well as other departments of the *Ministerio de Transporte y Obras Públicas* (MTOP). Among the tools that will be improved thanks to this project are the Highway Inventory System, the Bridge

Inventory System, the Maintenance Management System, the Planning Management System, the Traffic Sign Information System, and the Traffic Accident Analysis System.

The program will also facilitate collaboration among agencies with regard to exchange of data and information, and thereby reduce cost of data management and elimination of redundant data collection and maintenance. The program will provide the ability to integrate diverse and disparate data, increase technical capacity in the application of GIS and related geospatial technologies. It will make available and readily accessible geospatial databases, not only for transportation applications, but also for the benefit of other essential sectors such as health, education, environment and natural resources. Other agencies that will benefit directly in the short-term are the *Instituto de Planificación de Transporte Interurbano* (IPTI), the *Instituto Nacional de Estadística* (INE), and the *Dirección Nacional de Catastro* (DNC). Indirect short-term beneficiaries will be the Uruguayan GIS community as a whole, including other government agencies, universities, private sector and NGOs.

Risks:

Full development of the entire demographic and cadastral databases is an on-going process that requires continued government support, interagency collaboration, awareness to and demonstration of benefits. Benefits from GIS typically accrue in the medium to long-term. To be sustainable, this project will require periodic updates and maintenance of the spatial databases, staff will require continued training to stay abreast of the latest technological advances and equipment will have to be maintained and replaced, all of which results in future costs. These recurrent costs are typical of operations involving introduction of information systems technology and imply commitment for continued funding from the several agencies involved. In addition, there is risk of lack of inter-agency cooperation, thereby not gaining the full benefits that result from sharing of data.

The risk of lack of funding is mitigated by MTOP's strategy to continue supporting all processes of technological development to consolidate the highway planning process. The "*Plan Quinquenal de Transporte y Obras Públicas 2000-2004*" makes the required financial commitment, by providing DNT with enough resources to achieve the desired sustainability. During the next four years DNT has an assigned budget of US\$ 885,000 to continue the development of the National Spatial Data Infrastructure, providing for personnel training and other technological development.

Another factor that contributes to mitigate the risk of lacking the necessary support is the existing "technological" culture at MTOP.

The prevalent “technical” institutional environment translates into an organization wide willingness to introduce, develop, enhance, and use state-of-the-art knowledge, methods and analytical tools. This “technological” culture becomes a built-in safeguard mechanism to ensure sustainable institutional support for this program in the long-term.

On the other hand, the risk of lack of coordination between agencies is mitigated by the existence of the National Clearinghouse of Geographic Data, implemented by MTOP in 1997. The NCGD is a self-financed operation, with 100 % of total management costs covered by charging a user access fee, and has public access through the Internet, which is already working to integrate and coordinate the exchange of digital geographic data between all agencies and GIS users in Uruguay. NCGD’s successful operation is then another built-in mechanism to promote the sustainable growth of GIS applications in Uruguay.

In addition, to counteract the risk of failing institutional support and to raise awareness, the program includes sample areas to be analyzed with prototype applications designed to illustrate the use of GIS in topic areas important for Uruguay and to focus on delivery of short and medium-term products. Furthermore, seminars will be provided for all GIS users and providers to foster cooperation, raise managerial awareness to GIS, and solidify continued budgetary and human resources support to ensure project sustainability.

**Bank’s country
and sector
strategy:**

The program is consistent with the Bank’s Country Strategy for supporting modernization of the State through financing operations that contribute to improved public sector efficiency, particularly improved planning and analytical capabilities to support the integration of Mercosur corridors.

By strengthening the Uruguayan GIS system the program will contribute to understanding socio-economic consequences of present and future projects in multiple sectors, including health, education, environment, natural resources and infrastructure.

**Special
contractual
conditions:**

None

**Exceptions to
Bank policy:**

None

I. FRAME OF REFERENCE

A. Background

- 1.1 The *República Oriental del Uruguay*, through the *Ministerio de Transportes y Obras Públicas* (MTOP), *Dirección Nacional de Topografía* (DNT), has requested funding to support development systems, databases and applications that will strengthen analytical capabilities among various agencies. The development and dissemination and use of spatial digital data through integration of spatial and statistical data and application developments will support infrastructure planning, development and management responsibilities among the participating directorates and institutions.
- 1.2 Highway planning and management at MTOP is usually carried out with state-of-the-art analysis tools, and MTOP's professional and technical staff are internationally recognized as an experienced and knowledgeable team, with sound technical capabilities, always taking advantage of the latest technological advances. MTOP's technical competence and excellence has allowed this agency to share its unique products, carrying out technology transfer both inside Uruguay and to other Latin American countries. According to the Bank's experience in project preparation and execution, MTOP could be recognized as one of the top highway agencies within Latin America.
- 1.3 In Uruguay, the principal public institutions and many private firms have already developed and successfully implemented geographic information systems. The most ambitious projects have successfully involved multi-institutional cooperation to integrate geographic information of different divisions or departments. Since approximately 1995 the MTOP has been developing a basis for future GIS solutions to support implementation of projects related to transportation and infrastructure. Recognizing the growing demand for geographic information, the lack of knowledge on information availability, and the lack of coordination among institutions that produce geographic information, the MTOP initiated the National Clearinghouse of Geographic Data in 1997.
- 1.4 The Clearinghouse is a public service provided by MTOP, and is part of a future National Geographic Information System. The Clearinghouse is a distributed network, electronically connected, of producers, administrators and users of geographic information. Since 1997, the databases have public access through the Internet. The central Node of the Clearinghouse resides in MTOP, within the *Dirección Nacional de Topografía*, which provides the general coordination for the current ten agencies collaborating in this effort. An operator is contracted for daily operations and maintenance, and for processing inquiries and data delivery. Users pay transaction expenses and fees if the data are not free of charge. This mechanism is designed to provide financial sustainability of the Clearinghouse. MTOP only provided the initial investment, and the concessionaire covers 100 % of total management costs by charging a user access fee, and besides a reasonable profit, the operator pays DNT a monthly fee of US\$6,500. In addition to the

Clearinghouse, the DNT is also developing a National Spatial Data Infrastructure, with the goal of establishing a National Geographic Information System.

- 1.5 MTOP's "*Plan Quinquenal de Transporte y Obras Públicas 2000-2004*" reflects the commitment and strong "technological" culture existing within the highway planning and management staff. This Plan sets as objectives to support and to consolidate the planning process to maintain permanent, reliable and systematic highway information and databases; to continue all processes of technological development; and to advance tool development, taken advantage of the latest scientific and technological advances. The budget for this five-year plan provides the necessary economic and human resources required to fulfill these objectives. The following table summarizes the resources already included in the *Plan Quinquenal* to support these technological development efforts. It is worth noting that 60% of this budget is devoted to the sustainable development of the National Spatial Data Infrastructure (NSDI).

INVESTMENT PLAN 2000-2004						
<i>Dirección Nacional de Topografía</i> (thousand of US dollars)						
Description	2000	2001	2002	2003	2004	Total
936-Training/Technological Development	6.9	36.0	36.0	44.0	50.0	172.9
937-Micrographic System Development	8.7	90.0	84.0	69.0	93.0	344.7
A. National Spatial Data Infrastructure	-	215.0	240.0	190.0	240.0	885.0
B. Management Automation	-	-	20.0	19.0	20.0	59.0
Total by Year	15.6	341.0	380.0	322.0	403.0	1,461.6

- 1.6 The proposed project will complement the GIS development initiated through another Bank's Technical Cooperation, "Spatial Information System for National Infrastructure Management and Planning (TC-9811911-UR/ATN/JF-7544-UR)". The expected spatial data products and applications developed through the execution of that operation are required to develop this project, and together they will significantly enhance MTOP's management and technical tools. In addition, both projects provide data and analytical capabilities, which strengthen the existing National Geographic Data Clearinghouse. Thus, the project financed through this Technical Cooperation will add very valuable digital information and new tools for all GIS users in Uruguay, beyond MTOP's highway applications.

B. Relationship to Bank's strategy for Country and Region

- 1.7 The Program lies within the Bank's global country and sector strategies for supporting modernization of the State through financing operations that contribute

- to improved public sector efficiency, particularly improved planning and analytical capacities and methodologies to support the inter-oceanic studies and the integration of Mercosur corridors.
- 1.8 The Bank has supported actions for strengthening the planning and control capabilities at MTOP. Strengthening of the GIS system, development of analytical tools and methodologies, and diffusion of spatial data of broad infrastructure management and planning application, will contribute to the understanding of socio-economic impacts and consequences of present and future projects, not only in the transport sector, but also in other sectors, such as health, education, environment and infrastructure in general.
 - 1.9 The Bank has provided continued support for efforts to develop a highway network consistent with the requirements of the country's strategic position in MERCOSUR. The country needs to improve and consolidate the different means of transport available to it, in a framework of sustained economic growth and greater competitiveness for efficient service provision along the Argentina-Brazil corridor.
 - 1.10 The Bank has supported several GIS initiatives in the region, promoting the overall awareness of GIS technologies and seeking to strengthen the capabilities of each country's Transport ministry and highway department. Recently, the Bank completed similar complementary projects in Argentina, Bolivia, Chile and Perú.
 - 1.11 All spatial data compiled will be made available and distributed on a Data CD to interested government and non-government organizations, thus enabling the benefits to reach other areas of the government and the public sector.

C. The Program Strategy

- 1.12 In planning processes where funds are limited and decisions must be made swiftly, geographic information technologies (comprising Geographic Information Systems, Remote Sensing, and Global Positioning Systems technologies) offer supporting tools for better and speedier decision-making. A GIS-based Spatial Information System for National Infrastructure Management and Planning provides analytical capabilities to support decisions related to maintenance, upgrading and corridor selection as well as support for regional analysis of multi-modal transportation solutions. Satellite imagery provides needed data to quickly update regional maps and transportation networks. GPS technology provides the means to capture geo-referenced data of existing pavement conditions and the possibility of developing tracking systems much needed for highway safety.
- 1.13 Furthermore, a GIS-based system can support various transportation planning and management related activities such as regional analysis of multi-modal transportation solutions, corridor selection, decisions that relate to maintenance and upgrading, social and environmental impact analysis, and concession studies.
- 1.14 In developing countries, and to a certain extent even in more developed countries, fully operational GIS systems integrated into decision-making process were until

- recently often limited or nonexistent. The private sector often has a key role in real estate development, marketing and commodity transport, but it is primarily the public sector that carries out and consolidates comprehensive planning activities, including transportation and related infrastructure planning.
- 1.15 Increasingly, Geographic Information Systems are being successfully implemented due to decreasing costs of computer power and wider availability of digital spatial data, as well as a refocus on planning processes, which recognize the growing need to incorporate environmental and social variables. Spatial data, stored in digital format, includes polygons such as urban parcels, lines such as highways or rivers, and points such as highway markers or light posts. Spatial data in a GIS enables a user to visualize the content of the database by producing a graphic output such as a map. More importantly, application tools in a GIS facilitate analyses critical to planning processes, such as shortest path and route optimization algorithms, which will find the shortest path from an urban parcel to the hospital through the highway network, or an optimal path given user defined constraints or objectives.
 - 1.16 The main objectives for bringing GIS technologies into planning processes are to provide the means for visualizing the spatial and temporal dimensions of the problem being analyzed, and to provide a number of additional analytical tools that transform existing data into valuable information, which in a context can be transformed into knowledge. For example, if there is a need for infrastructure management, the possibility of presenting a visual display of the distribution of past projects provides a further insight into understanding what is being managed. Today it is possible to link images, videos, and designs to objects on the map, by zooming on to that object one can have access to much more than just the location of the object. In addition, with Internet capabilities being incorporated into GIS systems, the data being accessed can literally be stored on a computer on the other side of the world.
 - 1.17 The main components of a GIS are spatial data, personnel, hardware and software. Until recent years, spatial data was often the bottleneck of any GIS system, but is becoming less of an issue with the wide commercial availability of a number of spatial data sets and the conversion of hard-copy maps to digital formats being done by the national mapping agencies.
 - 1.18 The program supported through this Technical Cooperation considers all four components of a GIS: existing and relevant spatial data will be incorporated; hardware and software will be specified and provided; and above all, to assure proper technology transfer, personnel will receive adequate training through a series of workshops with the provision of training materials and user manuals.

II. THE PROGRAM

A. Project Objectives

- 2.1 The objective of the program is to enhance and expand existing Geographic Information System (GIS) capabilities and spatial databases of the *Dirección Nacional de Topografía* (DNT), at the *Ministerio de Transporte y Obras Públicas* (MTOP), and to develop specific GIS-based applications to improve the tools already used for planning and decision making within the *Dirección Nacional de Vialidad* (DNV). The focus will be on the digital conversion and georeferencing of cadastral databases and socio-economic statistics from the census and other sources.
- 2.2 In addition, specific applications will be developed for the *Instituto de Planificación de Transporte Interurbano* (IPTI), the *Instituto Nacional de Estadística* (INE), and the *Dirección Nacional de Catastro* (DNC), including specific GIS user training.
- 2.3 The DNT has converted a significant amount of needed spatial data to digital format and established the backbone of a National Spatial Data Infrastructure (NSDI). The present development focus is on enhancement and expansion of spatial databases through conversion of considerable existing cartographic data from multiple sources and scales.
- 2.4 This initiative provides further consolidation of databases and applications to contribute to other sectors such as health, education, environment and natural resources. These sectors will benefit from the availability and coordination of cadastral, census, socio-economic and spatial data.
- 2.5 Strengthening of the GIS system will contribute to the understanding of socio-economic consequences of highway projects and of other infrastructure projects, including ones which the bank is presently involved. Furthermore, the systems, databases and applications will provide the MTOP and the Bank with additional analytical tools and spatial data to support the studies of inter-oceanic and other integration corridors. The tools and methodologies developed for other Bank supported GIS projects in Chile, Argentina and Bolivia will be incorporated into this project.

B. Description

- 2.6 An international consulting firm with expertise in developing GIS solutions for transportation and environmental planning, also employing local experts, will be contracted to carry out the tasks of this program. The project has two subprograms named "A" and "B", which will facilitate the coordination of activities between the secondary beneficiaries.

- 2.7 Subprogram “A” includes the participation of the *Dirección Nacional de Catastro* (DNC) and focuses on the conversion of a sample of microfilms of survey plats that form the base for the national cadastre, and which are archived in the *Dirección Nacional de Topografía* (DNT). These data will be digitally integrated into the National Clearinghouse of Geographic Data. The availability and dissemination of the new digital database will enhance infrastructure management, planning and decisions by the project participants.
- 2.8 In addition, Subprogram “A” will include the development of prototype GIS applications to georeference the rural highway network in a sample area. It will also create links between highway and parcel data in order to calculate affected parcels and areas for applications such as expropriation/acquisitions, and to generally benefit infrastructure planning studies.
- 2.9 Subprogram “A” provides for creation of a spatial database for rural property parcels in the following departments: San José, Canelones and Colonia. This subprogram will be coordinated with DNC, and the activities include the following tasks:
- a. Digitize (scan) and georeference parcels survey plats, including their corresponding identification numbers. The survey plats on microfilm archived by DNT will be the source materials for this conversion task;
 - b. Create polygon topology to the georeferenced parcels in the project analysis areas and construct parcel layer in the GIS;
 - c. Georeference highway layout and develop GIS “buffer” algorithms for project analysis areas;
 - d. Incorporate land values from available and most recent appraisals (valuation) in three Departments (San José, Canelones and Colonia) to benefit infrastructure planning studies;
 - e. Program union of parcels and highway buffers to calculate the area and values of affected parcels for expropriation/acquisitions applications;
 - f. Create a GIS application to automatically generate expropriation plans and update of cadastral database;
 - g. Coordinate with related GIS projects in Uruguay and Mercosur;
 - h. Acquire software and hardware for microfilm scanning;
 - i. Prepare Terms of Reference for subsequent needs and for completing the digitalization of the remaining survey plats at DNT, including interface to property registry; and
 - j. Provide project supervision and data quality control.
- 2.10 Subprogram “B” includes the participation of the *Instituto Nacional de Estadística* (INE) and concerns the dissemination and use of digital spatial data and transportation models to enhance infrastructure management, planning and

decisions by the project participants. To facilitate the accuracy and expansion of the spatial data bases, considerable existing cartographic data and statistical, of multiple sources and scales, must be digitally converted and georeferenced.

2.11 Subprogram “B” specific information responds to the infrastructure management and planning needs, particularly in rural areas countrywide. The information requirements include:

- a. census data for social, economic, and agricultural production characteristics, georeference for use in GIS;
- b. property maps and attribute data which presently lack cartographic control for use in GIS;
- c. specifications for digital terrain models (DTM’s) countrywide, from existing topographic maps, and technical criteria for dynamic segmentation applications for the rural transportation network layers in the GIS;
- d. rural land use, particularly forest plantations, irrigation systems, and related land use data which is fundamental for planning transportation of agricultural, forestry or mineral products.

2.12 Subprogram “B” provides for creation of a spatial database of socioeconomic data for rural areas, with the INE. The activities will include the following tasks:

- a. Georeference INES’s digital urban cartography for integration to DNT’s base maps at 1:50,000 scale;
- b. Create a spatial database for the Inn’s rural census cartography, referenced to DNT’s base maps, 1:50,000 scale;
- c. Design database structure and methodology that will permit the integration of agricultural production data following the current agricultural census to the spatial databases;
- d. Coordinate this project with other GIS-based projects in Uruguay and throughout the region, specifically in the Mercosur area of influence;
- e. Provide seminars, training and workshops with participants from all participating directorates, institutions, and other government agencies;
- f. Acquire hardware and software; and
- g. Prepare Terms of Reference for subsequent needs.

2.13 A supervisory consultant will also be hired to provide the required analysis of reports, evaluate the products delivered, coordinate with local counterparts and

support the Bank's staff in the task of integrating this project with other GIS-related projects in the Region.

C. Cost and Financing

- 2.14 The total cost of the Project will be the equivalent of US\$420,000, of which the Bank will provide non-reimbursable financing of up to US\$350,000 from the Japan Trust Fund for Consulting Services, in accordance with the estimated budget. The following table presents a summary of the budget (see Annex II for the detailed estimated budget by subprogram).

BUDGET SUMMARY (in US\$ equivalent)				
ITEM		TOTAL COST	JCF	LOCAL
Salary Cost		107,050		
	Salaries National/International Professionals Subprogram A		50,650	
	Salaries National/International Professionals Subprogram B		56,400	
Overhead		107,050		
	100% Consultant Total Salaries Subprogram A		50,650	
	100% Consultant Total Salaries Subprogram B		56,400	
Direct Costs		70,700		
	Per diem and travel expenses local/international Subp. A		21,000	
	Per diem and travel expenses local/international Subp. B		11,700	
	Digital scanner and GIS hardware & software Subprogram A		28,000	
	GIS hardware & software Subprogram B		10,000	
Total Estimated Budget Consulting Firms (A)		284,800	284,800	0
Administration Costs		65,200		
	Specialized Supervisory Consultants		30,000	
	Contingencies (10%)		35,200	
Total Project Administration Costs (B)		65,200	65,200	0
Local Administration Costs		70,000		
	Office Support and Other Costs			40,000
	Counterpart Professional Staff			30,000
Total Local Administration Costs (C)		70,000	0	70,000
TOTAL PROJECT COSTS TO BE FINANCED BY JCF (A+B)		350,000	350,000	0
TOTAL ESTIMATED BUDGET (A + B + C)		420,000	350,000	70,000

- 2.15 The Bank's contribution, which amounts to 83.3% of the total project cost, will be used to finance a total of 28 person/months of consulting services and general support including computer equipment, data conversion and database development.

III. PROGRAM EXECUTION

- 3.1 The beneficiary agency will be the *Ministerio de Transportes y Obras Públicas*, MTOP, through the *Dirección Nacional de Topografía* (DNT). Currently, DNT provides GIS support activities throughout MTOP, and has developed, maintains, and is responsible for the operation of the National Clearinghouse of Geographic Data. DNT also interacts with other Uruguayan agencies, including the *Dirección Nacional de Catastro* (DNC) and the *Instituto Nacional de Estadística* (INE), in the coordination of spatial databases to meet the planning and management requirements of MTOP.
- 3.2 As the executing agency, MTOP will be responsible for coordinating and supervising the work of the consulting firm. DNT will have the responsibility for day-to-day supervision of the project and general administrative oversight of the project. Also, DNT will provide logistic support and arrange for the coordination within the MTOP, and the cooperation of other institutions involved. Counterpart personnel will be identified and assigned to participate in the training programs and to collaborate with the consultants throughout the project.
- 3.3 The hardware acquired by the consulting firm for this program, as specified in Terms of Reference (see Annexes III and IV), will be donated to the beneficiaries (MTOP or INE). Any software license purchased by the Consultant for the purposes of this program shall be registered in the name of MTOP or INE, depending on the component in execution.
- 3.4 The Bank will be hiring the consulting firm to carry out the project, following the Bank's policies for procurement, and complying with the contracting conditions set by the donor, consistent with its responsibilities for administering the Japanese Trust Fund for Consultancy Services (JCF).
- 3.5 The Finance and Basic Infrastructure Division 1 (RE1/FI1) will make the call for proposals, review the qualifications and technical proposals, and make the selection of the consulting firm. The Country Office (COF/CUR) and the local counterparts, *Dirección Nacional de Topografía* and *Dirección Nacional de Vialidad*, will be involved in the review of the proposals and the selection of the consulting firm.
- 3.6 The Finance and Basic Infrastructure Division 1 (RE1/FI1), as the unit with basic responsibility (UBR) for the administration of this operation, will be responsible for processing disbursement requests from JCF's contribution in accordance with a schedule to be negotiated with the consulting firm that will be hired, and upon acceptance by the Bank of the reports indicated in the Terms of Reference (see Annexes III and IV for details).
- 3.7 In the execution of this Technical Cooperation, the Finance and Basic Infrastructure Division 1 (RE1/FI1) will be monitoring activities and will be responsible for technical supervision, in coordination with the Country Office in

- Uruguay (COF/CUR) and the *Ministerio de Transportes y Obras Públicas* (MTOP). RE1/FI1 will process and authorize disbursement requests upon previous approval by the Country Office (COF/CUR) as the unit responsible for the field supervision of this operation.
- 3.8 The study will cover a period of 12 months. It is envisaged that an international expert firm in developing GIS applications for regional transportation and environmental planning, also employing local experts, will carry out the study.
- 3.9 A supervisory consultant will also be hired by the Bank to provide the required analysis of the reports, evaluate the products delivered, and coordinate with local counterparts. The supervisory consultant will also provide support and coordinate with the Bank's staff (COF/CUR and RE1/FI1) and DNT in the task of integrating this Project with other GIS-related projects in Uruguay and in the Region.
- 3.10 As the executing agency, MTOP, through DNT will assure close coordination of this project in a timely and efficient manner with the complementary project TC-9811911-UR/ATN/JF-7544-UR (Spatial Information System for National Infrastructure Management and Planning), financed by the Japan Special Fund.

IV. VIABILITY AND RISKS

A. Environmental and Social Impact

- 4.1 The Committee for Environmental and Social Impact approved the Profile on February 23, 2001, and its recommendations are included in this final version. The proposed project has positive environmental and social implications. It will contribute to the quality of the environmental impact assessments for highway projects (for both direct and indirect impacts) currently being developed with Bank participation, as well as to future projects, and other essential sectors such as health, education, environment and natural resources.
- 4.2 The execution of the Project will facilitate the viability, usefulness and significant value of geospatial approaches to transportation and infrastructure projects, and will contribute to addressing relationships to the crucial areas of environment and sustainable development. It will exemplify the general goals of other Bank initiatives in the use of GIS for environmental studies and will promote regional integration.

B. Benefits and Beneficiaries

- 4.3 The direct beneficiaries will be all highway users of the Uruguayan road network. The tools developed through this program will contribute to improve the effectiveness, efficiency and equity of government strategic planning, decision-making, and operation management within the highway and infrastructure sectors. Therefore, the program will contribute in the long run to reduce travel times, to

decrease vehicle-operating costs, and to expand the geographical coverage of the highway network.

- 4.4 In the short-term, the project will provide the following major benefits: (a) improve and upgrade analytical tools that will contribute to improving effectiveness, efficiency and equity of government strategic planning, management decisions, and operations in the area of highway planning and infrastructure management; (b) reduce cost in data management resulting from elimination of redundant data collection and maintenance efforts; (c) provide organizational structure that will contribute to the collaboration among agencies with regard to exchange of data and information; (d) contribute to increasing flow of information from government to the private sector; (e) provide the ability to integrate diverse and disparate data; (f) increase technical capacity in the application of GIS; and (g) make available and readily accessible geographic referenced digital data bases, for both the public and private sectors, through financially sustainable mechanisms.
- 4.5 The direct short-term beneficiaries of this program will be the *Dirección Nacional de Topografía* (DNT) and *Dirección Nacional de Vialidad* (DNV), as well as other departments of the *Ministerio de Transporte y Obras Públicas*, (MTOP) in addition to the *Instituto de Planificación de Transporte Interurbano* (IPTI), the *Instituto Nacional de Estadística* (INE), and the *Dirección Nacional de Catastro* (DNC). Indirect beneficiaries will be the GIS community as a whole, who will benefit from the various workshops, and more specifically on the discussion of the National Spatial Data Infrastructure and the National Clearinghouse of Geographic Data. All spatial data compiled will be made available and distributed on a Data CD to interested government and non-government organizations, thus enabling the benefits to reach other areas of the government and the public sector.
- 4.6 The consolidation of database development and application designs is an important initiative that will contribute to and benefit other sectors such as health, education, environment and natural resources through availability and coordination of spatial data.

C. Risks

- 4.7 Recurrent Costs: Benefits from GIS implementation typically accrue in the medium to long-term, but costs for equipment, training and data are immediate. This Project is intended to put the necessary demographic and cadastral databases in place for a multi-agency GIS application development. However, the full development of such a system is an on-going process that requires continued government support, awareness to and demonstration of the benefits. To be sustainable this project will require periodic updates and maintenance of the databases developed, staff will require continued training to stay abreast of the latest technological advances and equipment will have to be maintained and replaced, all of which will result in future costs.

- 4.8 These recurrent costs are typical of all operations that involve the introduction of information systems technology and imply a commitment for continued funding from the various agencies involved. The risk of lack of funding is mitigated by MTOP's strategy to continue supporting all processes of technological development to consolidate the highway planning process. The "*Plan Quinquenal de Transporte y Obras Públicas 2000-2004*" makes the required financial commitment, by providing DNT with enough economic and human resources required to achieved the desired sustainability for this program. During the next four years DNT has an assigned budget of US\$ 885,000 to continue the development of the National Spatial Data Infrastructure. Also, DNT has a provision of US\$ 172,900 for personnel training and other technological development (see the table on paragraph 1.5 for a budget summary).
- 4.9 Another factor that contributes to mitigate the risk of lacking the necessary support is the existing "technological" culture at MTOP. The prevalent "technical" institutional environment translates into an organization wide willingness to introduce, develop, enhance, and use state-of-the-art knowledge, methods and analytical tools. In fact, the five-year plan sets specific objectives to support and to consolidate the planning process in order to maintain permanent, reliable and systematic highway information and databases; to continue all processes of technological development; and to advance tool development, taken advantage of the latest scientific research and cutting-edge technologies. Therefore, the existing "technological" culture among MTOP's professional staff becomes a built-in safeguard mechanism to ensure sustainable institutional support for this program in the long-term.
- 4.10 In addition, to counteract the risk of failing institutional support and to raise awareness, the program includes two sample prototypes with the secondary beneficiaries. The two sample projects have been designed to illustrate the use of GIS in topic areas important for Uruguay, and to focus on the delivery of short and medium-term products and applications. Also the program financed with this Technical Cooperation will include seminars to raise managerial awareness to GIS and to solidify continued budgetary and human resources support to ensure the sustainability of the project.
- 4.11 Lack of Inter-agency Coordination: Exchange and integration of diverse geographic and socioeconomic census data is critical to the successful use of GIS. Without cooperation and collaboration between MTOP's directorates and other public sector agencies there is a risk that groups will adopt GIS technology but remain isolated in their use, thereby not gaining the full benefits, which result from inter-agency cooperation and sharing of data. However, the risk of lack of coordination between agencies is mitigated by the existence of the National Clearinghouse of Geographic Data, successfully implemented by MTOP in 1997. The NCGD is a self-financed operation, with 100% of total management costs covered by charging user fees, has public access through the Internet, which is already working to integrate and coordinate the exchange of digital geographic data between all agencies and GIS users in Uruguay. The NCGD resides in MTOP, within the DNT, which will be also responsible for the execution of this

program. NCGD's successful and self-financed operation is then another built-in mechanism to promote the sustainable growth of GIS applications in Uruguay.

- 4.12 Furthermore, the program is aimed to foster more cooperation between agencies, and the seminars financed by this program should promote more ongoing user groups throughout the country and at the Mercosur level.

Future Bank loans to Uruguay should include specific institutional strengthening components that will build upon the capabilities and databases developed during this program, and the complementary Technical Cooperation TC-9811911-UR (Spatial Information System for National Infrastructure Management and Planning), recently approved by the Bank (as ATN/JF-7544-UR).