ANNEX O

DATA SETS AND SPATIAL ANALYSIS

CONTENTS

O.1 DETAILS OF DIGITAL DATA SETS ACQUIRED BY THE STUDY TEAM

SUMMARY OF DIGITAL DATA SETS

Table 1.1 Water Management Data (SAZP GIS 1)

Data set	SAZP GIS - Water Management Data	**Status**	already obtained
Contact person	Mrs. M. Supoková/ Mr. R. Navrátil	**Source**	SAZP GIS Lab.
Origin	digitized from water management maps in 1996	**Format**	PC Arc/Info coverages
Spatial coverage	whole Slovakia	**Scale**	1:50 000
Temporal coverage	representative for 1994	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- Basins, sub-Basins, small watersheds, - Water Conservation Areas, - Mineral Water Protection Areas, - Water Basins of Public Water Supply		

Table 1.2 Administrative Boundaries of Slovakia (SAZP GIS 2)

Data set	SAZP GIS – Administrative Boundaries of Slovakia	**Status**	already obtained
Contact person	Mr. R. Navrátil	**Source**	SAZP GIS Lab.
Origin	digitized from paper maps in 1995	**Format**	PC Arc/Info coverages
Spatial coverage	Hron river basin area, also available for whole Slovakia	**Scale**	1:10 000
Temporal coverage	if necessary, then updated (last update 1998)	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- Land Technical Unit (Cadaster UTJ) - Land Administrative Unit (ZUJ) - District Boundaries (OKRES) - Regions of Slovakia (KRAJ)		

Table 1.3 Forest Management Units (SAZP GIS 3)

Data set	SAZP GIS – Forest Management Units	**Status**	already obtained
Contact person	Mr. R. Navrátil	**Source**	SAZP GIS Lab.
Origin	digitized from paper maps in 1995	**Format**	PC Arc/Info coverages
Spatial coverage	whole Slovakia	**Scale**	1:25 000
Temporal coverage	None	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- Forest Management Regions, - Forest Management Districts		

Table 1.4 Protected Natural Areas of Slovakia (SAZP GIS 4)

Data set	SAZP GIS – Protected Nature Areas of SK	**Status**	already obtained
Contact person	Mrs. Záhradná/ Mr. R. Navrátil	**Source**	SAZP GIS Lab.
Origin	digitized from paper maps	**Format**	PC Arc/Info coverages
Spatial coverage	Hron river basin area + 60 km buffer zone, also available for whole Slovakia	**Scale**	1:50 000
Temporal coverage	annually updated	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- National Park core zone, - National Park buffer zone, - Landscape Protected Area, - National Nature Reserve, - Nature Reserve, - National Nature Monument, - Nature Monument, - Protected Site		

Table 1.5 Caves of the Republic of Slovakia (SAZP GIS 5)

Data set	SAZP GIS – Caves of the Republic of Slovakia	**Status**	already obtained
Contact person	Mr. R. Navrátil	**Source**	SAZP GIS Lab.
Origin		**Format**	PC Arc/Info coverage
Spatial coverage	Hron river basin area, also available for whole Slovakia	**Scale**	1:50 000
Temporal coverage	1999	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- ID code, cadaster, okres information		

Table 1.6 Protected Trees of the Republic of Slovakia (SAZP GIS 6)

Data set	SAZP GIS – Protected Trees of the Republic of Slovakia	**Status**	already obtained
Contact person	Mr. R. Navrátil	**Source**	SAZP GIS Lab.
Origin	digitized from paper maps in 1995	**Format**	PC Arc/Info coverages
Spatial coverage	Hron river basin area, also available for whole Slovakia	**Scale**	1:10 000
Temporal coverage	1999	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	-		

Table 2.1 Program of Village Renewal in 1998 (SAZP BB 1)

Data set	SAZP BB – Program of village renewal in 1998	**Status**	partially obtained
Contact person	Mrs. A. Krsakova	**Source**	SAZP BB CUPER
Origin	digitized from statistics data by The Center for Physical Planning and Environmental Regionalization (CUPER)	**Format**	ArcInfo coverage
Spatial coverage	whole Slovakia	**Scale**	1:500 000
Temporal coverage	None	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- Municipalities of SR integrated into program of village renewal in 1998		

Table 3.1 Catalogue of Waste (SAZP BA 1)

Data set	SAZP BA – Catalogue of Waste	**Status**	already obtained
Contact person	Mr. A. Jancárik	**Source**	SAZP BA Center for Waste Management
Origin	digitizing data from District Environmental Authorities to create Regional Waste Information System (RWIS)	**Format**	PC Arc/Info coverages
Spatial coverage	whole Slovakia	**Scale**	aggregated for Cadasterss
Temporal coverage	annual data from 1997	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- Type of Waste (Category of Waste) - Quantity of Waste		

Table 4.1 CORINE Land Cover (SAZP RS 1)

Data set	SAZP RS – CORINE Land Cover	**Status**	already obtained
Contact person	Ms. N. Machkova	**Source**	SAZP RS Lab.
Origin	Satellite imagery, Phare CORINE Program	**Format**	PC Arc/Info coverages
Spatial coverage	Hron river basin area, also available for whole Slovakia	**Scale**	1:100 000
Temporal coverage	representative for 1989-1990	**Projection**	Gauss-Krueger
Attributes/ Main items	- Land Cover Categories		

Table 4.2 Land Cover Map of the Study Area as of 1998 (SAZP RS 5)

Data set	SAZP RS – Simulation results of the project DANUBE (1997)	**Status**	already obtained
Contact person	Ms. N. Machkova	**Source**	SAZP RS Lab.
Origin	Landsat images of 1998 purchased by JICA, the images processed by SAZP RS Laboratory, land cover classification is done by the Slovak Academy of Science based on CORINE methodology	**Format**	ArcView shape file
Spatial coverage	Study area - Hron river basin	**Scale**	1:50 000
Temporal coverage	1989	**Projection**	Gauss-Krueger
Attributes/ Main items	- CORINE land cover categories		

Table 4.3 Soil Characteristics (SAZP RS 2)

Data set	SAZP RS – Soil Characteristics	**Status**	raster format obtained
Contact person	Ms. N. Machkova/ Mr. R. Navrátil	**Source**	SAZP RS Lab.
Origin	VUPOP-Soil Fertility ReSAZPrch Institute (HPGL form), Lesoproject Zvolen (paper maps digitized by SAZP)	**Format**	PC Arc/Info coverages
Spatial coverage	Hron river basin area, ONLY forests and agricultural lands	**Scale**	1:5 000 (VUPOP), 1:10 000 (Lesoproject)
Temporal coverage	None	**Projection**	Gauss-Krueger
Attributes/ Main items	- parent materials, - soil types, - soil texture, - soil hydraulic properties - width of the main soil horizons, - depth of the soils		

Table 4.4 Hydrology, Meteorology, Pollution Sources (SAZP RS 3)

Data set	SAZP RS – Hydrology, Meteorology, Pollution Sources	**Status**	already obtained
Contact person	Ms. N. Machkova	**Source**	SAZP RS Lab.
Origin	Slovak Hydro-Meteorological Institute	**Format**	raster images, PC Arc/Info coverages
Spatial coverage	Hron river basin area	**Scale**	100 m x 100 m raster
Temporal coverage	data of 1989-1990, + long term monthly averages from 1930	**Projection**	Gauss-Krueger
Attributes/ Main items	- temperature - precipitation - monitoring stations - water pollution sources - digital elevation model		

Table 4.5 Simulation results of the project DANUBE (SAZP RS 4)

Data set	SAZP RS – Simulation results of the project DANUBE (1997)	**Status**	already obtained
Contact person	Ms. N. Machkova	**Source**	SAZP RS Lab.
Origin	Slovak Hydro-Meteorological Institute	**Format**	raster images
Spatial coverage	Hron river basin area	**Scale**	100 m x 100 m raster
Temporal coverage	eutrophication model simulations for 1989-1990	**Projection**	Gauss-Krueger
Attributes/ Main items	- mean summer phosphorous load in runoff - peak summer phosphorous load in runoff - mean summer in-river phosphorous concentration - peak summer in-river phosphorous concentration - Phosphorous concentration in rivers and LANDCOVER export		

Table 5.1 Endangered Landscape Areas (SAZP KE 1)

Data set	SAZP KE - Endangered Landscape Areas	**Status**	already obtained
Contact person	Mr. P. Bohus	**Source**	SAZP KOSICE
Origin	digitized from analysis of monitoring data by SAZP Center of Landscape Revitalization in Endangered Areas, KOSICE	**Format**	ArcView shape files
Spatial coverage	whole Slovakia	**Scale**	1:500 000
Temporal coverage	None	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- quality of the environment in the Slovak Republic - pollution of underground water - carbon dioxide content of the air - analysis of air pollution indicator - plan of water flows pollution - contamination of soil - selected characteristics of geological area - plan of surface and underground water pollution - cumulative characteristics of air pollution from stationary sources - plan of air and water pollution		

Table 6.1 Geochemical Atlas of Slovakia: Soils (VUPOP 1)

Data set	VUPOP – Geochemical Atlas of Slovakia: Soils	**Status**	already obtained
Contact person	Mr. P. Sefcik	**Source**	VUPOP
Origin	-	**Format**	Excel 5.0 or dBASE
Spatial coverage	whole Slovakia	**Scale**	1:1 000 000, some areas 1:50 000 (e.g. ZV, BB)
Temporal coverage	reference years 1995-1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- total chemical element content of 36 elements from A and C horizons - risk elements content: 12 chemical elements - soil texture data		

Table 6.2 Soil Types and Pedogeochemical Data (VUPOP 2)

Data set	VUPOP – soil types and pedogeochemical data	**Status**	already obtained
Contact person	Mr. P. Sefcik	**Source**	VUPOP
Origin	field survey by the Soil Fertility ReSAZPrch Institute	**Format**	hardcopies, 25% digital
Spatial coverage	whole Slovakia, but only agricultural and forested areas	**Scale**	for Hron basin 1:50 000
Temporal coverage	compiled between 1991-1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- name of soil categories and sub-types using national soil classification system with possible transfer to FAO classification scheme		
Action needed	order should be made when digital data is available	**Ref.num.**	VUPOP 2

Table 7.1 Borehole Database (GSSR 1)

Data set	GSSR – Borehole Database	**Status**	already obtained
Contact person	Mr. M. Gedeon	**Source**	GSSR
Origin	archive of Geological Survey of Slovak Republic	**Format**	MS Access, dBASE
Spatial coverage	entire Hron basin, also available for whole Slovakia	**Scale**	point data
Temporal coverage	compiled between 1997-1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- name of the borehole, depth, geological profile, casing - pumping test information - estimated and computed hydraulic parameters - chemical analysis		

Table 7.2 Geological Units (GSSR 2)

Data set	GSSR – Geological Units	**Status**	already obtained
Contact person	Mr. J. Lexa	**Source**	GSSR
Origin	field surveys and published maps of Geological Survey of Slovak Republic	**Format**	hardcopy maps
Spatial coverage	entire Hron basin, also available for whole Slovakia	**Scale**	1:50 000
Temporal coverage	compiled between 1976-1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- name of the geological unit, age - GIS layer with the regions describing lithology of the geological unit		

Table 7.3 Hydrogeology (GSSR 3)

Data set	GSSR – Hydrogeology	**Status**	already obtained
Contact person	Mr. M. Gedeon	**Source**	GSSR
Origin	field surveys and published maps of Geological Survey of Slovak Republic	**Format**	MapInfo
Spatial coverage	entire Hron basin, also available for whole Slovakia	**Scale**	1:50 000
Temporal coverage	compiled between 1976-1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- name of the geological unit, age - GIS layer with the regions describing lithology of the geological unit		

Table 7.4 Tectonics (GSSR 4)

Data set	GSSR – Tectonics	**Status**	already obtained
Contact person	Mr. J. Lexa	**Source**	GSSR
Origin	field surveys and published maps of Geological Survey of Slovak Republic	**Format**	hardcopy maps
Spatial coverage	entire Hron basin, also available for whole Slovakia	**Scale**	1:50 000
Temporal coverage	compiled between 1976-1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- tectonic lines, types		

Table 7.5 Geochemical Atlas of Slovakia: Groundwater (GSSR 5)

Data set	GSSR – Geochemical Atlas of Slovakia: Groundwater	**Status**	already obtained
Contact person	Mr. K. Marsina	**Source**	GSSR
Origin	new field surveys by Geological Survey of Slovak Republic	**Format**	dBASE IV table
Spatial coverage	entire Hron basin, also available for whole Slovakia, 1sample per square kilometer	**Scale**	1:1 000 000 (points)
Temporal coverage	samples were taken between 1991 and 1994	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- measurements of pH, conductivity, temperature, etc. - type of well, rock material - chemical analysis of elements and compounds		

Table 7.6 Geochemical Atlas of Slovakia: Rocks (GSSR 6)

Data set	GSSR – Geochemical atlas: Rocks	**Status**	already obtained
Contact person	Mr. K. Marsina	**Source**	GSSR
Origin	new field surveys by Geological Survey of Slovak Republic and archive	**Format**	dBASE IV table
Spatial coverage	entire Hron basin, also available for whole Slovakia	**Scale**	1:1 000 000 (points)
Temporal coverage	samples were taken between 1991 and 1994	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- chemical analysis of all major and 26 trace elements		

Table 7.7 Stiavnica Region: Rocks, River Sediments, Water (GSSR 7)

Data set	GSSR – Stiavnica Region (rocks, river sediments, water)	**Status**	already obtained
Contact person	Mr. K. Marsina	**Source**	GSSR
Origin	new field surveys by Geological Survey of Slovak Republic	**Format**	dBASE IV table
Spatial coverage	Stiavnica region	**Scale**	1:1 000 000 (points)
Temporal coverage	samples were taken between 1996 and 1997, 3 times per year	**Projection**	local system and/or JTSK
Attributes/ Main items	- chemical analysis of rock samples - chemical analysis of river sediment samples - chemical analysis of river water samples		

Table 7.8 Old Environmental Load Database (GSSR 8)

Data set	GSSR Geofond – Old environmental load database	**Status**	already obtained
Contact person	Mr. Caudt	**Source**	GSSR Geofond
Origin	catalogue of Geofond, Geological Survey of Slovak Republic based on data reported from okres offices on landfill sites	**Format**	dBASE IV tables
Spatial coverage	entire Hron basin, available for whole Slovakia	**Scale**	1:50 000 (points)
Temporal coverage	annually updated	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- description of landfill sites based on the required form		

Table 7.9 Landfill suitability maps (GSSR 9)

Data set	GSSR Geofond – Landfill suitability maps	**Status**	already obtained
Contact person	Mr. Caudt	**Source**	GSSR Geofond
Origin	Geofond, Geological Survey of Slovak Republic	**Format**	ArcView shape files
Spatial coverage	study area, also available for whole Slovakia	**Scale**	1:50 000
Temporal coverage	compiled in 1992	**Projection**	not known
Attributes/ Main items	- landfill suitability categories		

Table 8.1 Groundwater Quality Data (SHMU BA 1)

Data set	SHMU BA – Groundwater Quality Data	**Status**	already obtained
Contact person	Mr. R. Chriastel/ Mr. M. Vydareny	**Source**	SHMU BA
Origin	sampling by ground water quality monitoring network, laboratory analysis by private and/or state laboratories	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	compiled from 1982, samples collected 1-4 times per year	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- location, ID code, name of monitoring stations - results of laboratory analysis		

Table 8.2 Suface Water Quality Data (SHMU BA 2)

Data set	SHMU BA – Surface Water Quality Data	**Status**	already obtained
Contact person	Mrs. J. Adamková/ Mr. M. Vydareny	**Source**	SHMU BA
Origin	sampling and laboratory analysis by Hron River Basin Authority	**Format**	MAGIC, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	compiled from 1967, digital form from 1995, samples collected once per month	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- location, ID code, name of monitoring stations - weather conditions, discharge - results of laboratory analysis		

Table 8.3 Wastewater Effluents (SHMU BA 3)

Data set	SHMU BA – Waste Water Effluents	**Status**	already obtained
Contact person	Mrs. J. Adamková/ Mr. M. Vydareny	**Source**	SHMU BA
Origin	collected by Slovak Hydro-Meteorological Institute	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	compiled from 1982, samples collected inregularly, but once per five years	**Projection**	locations are given in river kms from the river mouths
Attributes/ Main items	- location, ID code, name of location - quantity of waste water discharge to recipient - results of laboratory analysis		

Table 8.4 Critical loads - Acidity and Toxicity of Groundwaters(SHMU BA 5)

Data set	SHMU BA Critical loads - acidity and toxicity of groundwaters	**Status**	already obtained
Contact person	Mr. R. Chriastel	**Source**	SHMU BA
Origin	data compiled and modeled for groundwaters by Slovak Hydro-Meteorological Institute	**Format**	dBASE tables
Spatial coverage	Hron river basin, available for whole Slovakia	**Scale**	1:50 000 (points)
Temporal coverage	calculated for 1995	**Projection**	JTSK
Attributes/ Main items	- critical loads, exceedances of critical loads of acidity, toxicity		

Table 9.1 Air Pollution Sources (SHMU BA 4)

Data set	SHMU BA – Air Pollution Sources	**Status**	already obtained
Contact person	Mrs. K. Magulová	**Source**	SHMU BA
Origin	reported data by organizations	**Format**	available as ASCII text
Spatial coverage	districts overlapping with Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	annual data for 1993-1997	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- location, ID code, name of pollution source - emissions, consumption, installed energy output		

Table 10.1 Surface Water Level Data (SHMU BB 1)

Data set	SHMU BB – Surface Water Level Data	**Status**	already obtained
Contact person	Miss. J. Podolinská/ Mrs. Veselová	**Source**	SHMU BB
Origin	state monitoring network of the Slovak Hydro-Meteorological Institute	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	from 1988 in digital form, daily data	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- location, ID code, name of monitoring stations - water level in the surface stream - water discharge - water temperature (only for selected stations) - suspended sediment concentration (only for selected stations)		

Table 10.2 Groundwater Level Data (SHMU BB 2)

Data set	SHMU BB – Groundwater Level Data	**Status**	already obtained
Contact person	Mrs. Kolacná/ Mrs. Veselová	**Source**	SHMU BB
Origin	state monitoring network of Slovak Hydro-Meteorological Institute	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	mainly from 1960's and 1980's weekly or daily data	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- location, ID code, name of monitoring stations - water level of groundwater - water temperature (only for selected stations)		

Table 10.3 Yield of Springs (SHMU BB 3)

Data set	SHMU BB – Yield of Springs	**Status**	already obtained
Contact person	Mrs. Kolacná/ Mrs. Veselová	**Source**	SHMU BB
Origin	state monitoring network of Slovak Hydro-Meteorological Institute	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	mainly from 1970's, weekly or daily data	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- location, ID code, name of monitoring stations - yield of springs - water temperature - code describing whether the resource is utilized or not		

Table 10.4 Register of Withdrawal of Underground Water (SHMU BB 4)

Data set	SHMU BB – Register of Withdrawal of Underground Water	**Status**	already obtained
Contact person	Mrs. Ruzicková/ Mrs. Veselová	**Source**	SHMU BB
Origin	reported data from organizations	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	1988 hardcopy, from 1989 digital	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- withdrawal of underground water for public drinking water pipelines, industry and agriculture		

Table 11.1 Meteorological Data Including Rain-Gauge Data (SHMU BB 5)

Data set	SHMU BB – Meteorological Data Including Rain-Gauge Data	**Status**	already obtained
Contact person	Mr. Kamensky/ Mr. Sramo	**Source**	SHMU BB
Origin	state monitoring network of Slovak Hydro-Meteorological Institute	**Format**	INGRES, available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	monthly 1961-1997	**Projection**	geographic (lat/long)
Attributes/ Main items	- location, ID code, name of monitoring stations (rain-gauges) - air temperature, precipitation, air humidity, snow cover, atmospheric phenomena, wind direction and velocity, cloudiness, state of ground - sunshine duration and soil temperature (only in selected stations)		

Table 11.2 SHMU BB – Air Quality Data (SHMU BB 6)

Data set	SHMU BB – Air Quality Data	**Status**	already obtained
Contact person	Mr. J. Kluka	**Source**	SHMU BB
Origin	state monitoring network of Slovak Hydro-Meteorological Institute	**Format**	available as ASCII text
Spatial coverage	Hron river basin	**Scale**	1:50 000 (points)
Temporal coverage	daily 1993-1997	**Projection**	geographic (lat/long)
Attributes/ Main items	- location, ID code, name of monitoring stations (rain-gauges) - concentrations of SO2, NO, NO2, NOx, O3, total suspended particulate, CO, H2S		

Table 12.1 Tree Species Composition of Slovakia (LVU 1)

Data set	LVU – Tree Species Composition Map of Slovakia	**Status**	already obtained
Contact person	Mr. T. Bucha	**Source**	LVU
Origin	Landsat TM data classified by Forest ReSAZPrch Institute	**Format**	Arc/Info coverage
Spatial coverage	whole Slovakia	**Scale**	raster 30m x 30m
Temporal coverage	1990-1993	**Projection**	Gauss-Krueger
Attributes/ Main items	- name of tree species		

Table 12.2 Crown Condition (LVU 2)

Data set	LVU – Crown Condition	**Status**	obtained only for 1997
Contact person	Mr. T. Bucha	**Source**	LVU
Origin	government organizations, field survey by Forest ReSAZPrch Institute	**Format**	FOXPRO, ASCII text is available
Spatial coverage	whole Slovakia, monitoring plots by regular 16km x 16km grid	**Scale**	approx. 1:50 000 (point)
Temporal coverage	annual 1987-1997	**Projection**	geographic (lat/long)
Attributes/ Main items	- code of monitoring plot - number of tree, tree species - defoliation, discoloration, easily identifiable damage		

Table 12.3 Soil Condition (LVU 3)

Data set	LVU – Soil Condition	**Status**	obtained only for 1993
Contact person	Mr. P. Pavlenda	**Source**	LVU
Origin	government organizations, field survey by Forest ReSAZPrch Institute	**Format**	FOXPRO, ASCII text is available
Spatial coverage	whole Slovakia, monitoring plots by regular 16km x 16km grid	**Scale**	approx. 1:50 000 (point)
Temporal coverage	every five years, 1988, 1993, 1998	**Projection**	geographic (lat/long)
Attributes/ Main items	- code of monitoring plot - pH(CaCl2), COx, Ntotal, Stotal, P, K, Ca, Mg, Humus, ECV CaCO3, Al, Fe, Mn, Zn, Cu, Pb, Cd, Exchangeable acidity, base saturation, exchangeable H, Al, Fe, Ca, Mg, K, Na		

Table 12.4 Foliar Condition(LVU 4)

Data set	LVU – Foliar Condition	**Status**	obtained only for 1995, 97
Contact person	Mrs. B. Mankovska	**Source**	LVU
Origin	government organizations, field survey by Forest ReSAZPrch Institute	**Format**	FOXPRO, ASCII text is available
Spatial coverage	whole Slovakia, monitoring plots by regular 16km x 16km grid	**Scale**	approx. 1:50 000 (point)
Temporal coverage	every two years, 1990, 1992, 1993, 1995, 1997	**Projection**	geographic (lat/long)
Attributes/ Main items	- code of monitoring plot - N, S, P, K, Ca, Mg, Na, Zn, Cu, Fe, Mn, Cd, Co, Cr, Pb, V)		

Table 12.5 Deposition (LVU 5)

Data set	LVU – Deposition	**Status**	ordered but not received
Contact person	Mr. J. Mindas	**Source**	LVU
Origin	government organizations, field survey by Forest ReSAZPrch Institute	**Format**	FOXPRO, ASCII text is available
Spatial coverage	5 intensive monitoring plots, plot area: 0.25 ha	**Scale**	-
Temporal coverage	every two weeks since 1995	**Projection**	geographic (lat/long)
Attributes/ Main items	- code of monitoring plot - pH, NH4, SO4, NO3, Cl, Ca, Mg, K, Na, Fe, Mn, Conductivity		

Table 12.6 Forest Regions (LVU 6)

Data set	LVU – Forest Regions	**Status**	already obtained
Contact person	Mr. J. Vladovic	**Source**	LVU
Origin	LESOPROJECT (Forest Management Institute Zvolen)	**Format**	Arc/Info coverage + database dbf, ascii
Spatial coverage	whole Slovakia	**Scale**	-
Temporal coverage	updated every 10 years	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- total and forest area, forest categories, tree species compositions, stand characteristics, volume - health condition, ecological orders, forest vegetation zones, geobiocenological units and brief description of forest regions		

Table 12.7 Calculated Deposition of Sulfur and Nitrogen (LVU 7)

Data set	LVU – Calculated Deposition of Sulfur and Nitrogen	**Status**	already obtained
Contact person	Mr. J. Mindas	**Source**	LVU
Origin	calculated an mapped by Forest ReSAZPrch Institute	**Format**	Arc/Info grid + database
Spatial coverage	whole Slovakia, calculated on a network of 250m x 250m cells	**Scale**	approx. 1:100 000 (raster)
Temporal coverage	1990-1995	**Projection**	Gauss-Krueger
Attributes/ Main items	- deposition of sulfur and nitrogen		

Table 12.8 Calculated Critical Load of Sulfur and Nitrogen (LVU 8)

Data set	LVU – Calculated Critical Load of Sulfur and Nitrogen	**Status**	already obtained
Contact person	Mr. J. Mindas	**Source**	LVU
Origin	calculated an mapped by Forest ReSAZPrch Institute	**Format**	Arc/Info grid + database
Spatial coverage	whole Slovakia, calculated on a network of 250m x 250m cells	**Scale**	approx. 1:100 000 (raster)
Temporal coverage	1990-1995	**Projection**	Gauss-Krueger
Attributes/ Main items	- critical loads of sulfur and nitrogen		

Table 12.9 Forest Management Districts (LVU 9)

Data set	LVU – Forest Management Districts (LHC)	**Status**	already obtained
Contact person	Mr. J. Vladovic	**Source**	LVU
Origin	LESOPROJECT (Forest Management Institute Zvolen)	**Format**	Arc/Info coverage
Spatial coverage	whole Slovakia	**Scale**	1:25 000
Temporal coverage	updated every 10 years	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- code of forest management districts		

Table 12.10 Forest Health Condition Map (LVU 10)

Data set	LVU – Forest Health Condition Map	**Status**	already obtained
Contact person	Mr. T. Bucha	**Source**	LVU
Origin	Landsat TM scene of 1990, and Landsat TM image of 1998 purchased by JICA, Image processing is done by SAZP RS, interpretation and classification are carried out by Forest ReSAZPrch Institute	**Format**	Arc/Info coverage
Spatial coverage	study area –entire Hron basin	**Scale**	raster 30m x 30m
Temporal coverage	representative for 1990	**Projection**	Gauss-Krueger
Attributes/ Main items	- categories of forest health		

Table 13.1 Basic Map of the Slovak Republic, ZM 200 (IGC 1)

Data set	IGC – Basic Map of the Slovak Republic 1:200 000 (ZM 200)	**Status**	already obtained
Contact person	IGC	**Source**	IGC
Origin	digitized by the Institute of Geodesy and Cartography (IGC)	**Format**	AutoCad DXF
Spatial coverage	Hron basin area, map sheets: 35, 36, 37, 45, 46	**Scale**	1:200 000
Temporal coverage	none	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- roads (cesty), forest (lesy), text (popis), settlements (sidla), waters (vody)		

Table 13.2 Basic Map of the Slovak Republic, ZM 50 (IGC 2)

Data set	IGC – Basic Map of the Slovak Republic 1:50 000 (ZM 200)	**Status**	already obtained
Contact person	IGC	**Source**	IGC
Origin	digitized by the Institute of Geodesy and Cartography (IGC)	**Format**	AutoCad DXF
Spatial coverage	Hron basin area, map sheets: 35, 36, 37, 45, 46	**Scale**	1:50 000
Temporal coverage	none	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- topography (polohopis), water (voda), text (popis), elevation contours (viska), additional elevation (dodatok)		

Table 13.3 Map of Administrative Division of Slovak Republic (IGC 3)

Data set	IGC – Map of Administrative Division of Slovak Republic	**Status**	already obtained
Contact person	IGC	**Source**	IGC
Origin	digitized by the Institute of Geodesy and Cartography (IGC)	**Format**	ArcInfo coverage
Spatial coverage	whole Slovakia	**Scale**	1: 10 000
Temporal coverage	None	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- topography (polohopis), water (voda), text (popis), elevation contours (viska), additional elevation (dodatok)		

Table 14.1 Evaluation of Ecological Capacity of Ziarska Region (CU 1)

Data set	CU - Evaluation of ecological capacity of Ziarska valley region	**Status**	already obtained
Contact person	ESPRIT Company	**Source**	Comenius University
Origin	project carried out by Comenius University, Faculty of Natural Sciences, Department of Economic Geology	**Format**	tables: dBASE, GIS: ArcView shape files
Spatial coverage	Ziarsak Valley Region (around Ziar nad Hronom)	**Scale**	1: 10 000
Temporal coverage	completed in 1998	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- geological map, geochemical types of rocks, soil associations, soil pollution, pollution sources, potential health risk, potential erosion, modeled sunshine exposition, ground-, surface water quality - microclimate: temperature inversion, air circulation, suitability for industry and waste disposal sites, suitability for winter recreation, suitability for settlements and summer recreation - representative animal species, actual vegetation, present landscape structure, interests of land use, land use limits, ecological landscape capacity, ecological landscape optimization and revitalization		

Table 15.1 Immovable Cultural Monuments (SPU 1)

Data set	SPU – Immovable Cultural Monuments	**Status**	already obtained
Contact person	Mr. Luboslav Skoviera	**Source**	SPU
Origin	Slovak Institute for Monuments (SPU)	**Format**	tables: dBASE files
Spatial coverage	Okreses within the Study Area, national level also available	**Scale**	locations only
Temporal coverage	annual updates	**Projection**	none
Attributes/ Main items	- location: name, cadaster, obec/mesto, address, ID-code - description: name of cultural monument, monument object; dominant style, type, categories - ownership, utilization, construction-technical state, etc.		

Table 16.1 Hydroecological Plan (HEP 1)

Data set	PH – Hydroecological Plan (HEP)	**Status**	already obtained
Contact person	Povodie Hrona	**Source**	Povidie Hrona
Origin	digitized by Study Team (M.Bel University BB) from hardcopy paper maps	**Format**	Intergraph Microstation, DXF is also available
Spatial coverage	Okreses within the Study Area, national level also available	**Scale**	1:50 000
Temporal coverage	completed in 1993	**Projection**	Slovak Civil (JTSK)
Attributes/ Main items	- Hydroecological Map A: mineral, geothermal, mining wells/ springs, categories by CO2, H2S concentrations, protection zones - Hydroecological Map B: pollution sources (amount, treated/ untreated, sufficiently/ insufficiently treated), monitoring locations by type - Hydroecological Map C: landfills by type (agricultural, oil, agrochemical, industrial, and solid waste), protection zones of water reserves/ resources, planned reservoirs by categories		

Table 17.1 Nitra Kraj Statistical Data (KSSU 1)

Data set	KSSU – Nitra Kraj Statistical Data	**Status**	already obtained
Contact person	Nitra Kraj Statistical Office	**Source**	KSSU Nitra
Origin	Nitra Kraj Statistical Office (KSSU Nitra)	**Format**	T602 document file
Spatial coverage	old okreses such as Nitra, Levice, Nove Zamky	**Scale**	obec/mesto
Temporal coverage	annually updated, last complete year available: 1997	**Projection**	none
Attributes/ Main items	- population data, land use data, data on public water supply/ sewerage systems, etc.		

Table 18.1 Nitra Kraj Territorial Plan (NR TR)

Data set	NR TR - Nitra Kraj Territorial Plan	**Status**	already obtained
Contact person	Nitra Kraj Office - AUREX	**Source**	AUREX
Origin	Map appendices of the Nitra Territorial plan prepared by AUREX	**Format**	ArcView shape files
Spatial coverage	Nitra Kraj	**Scale**	1:50 000
Temporal coverage	1998	**Projection**	Gauss/Krueger
Attributes/ Main items	- all layers of the territorial plan		

Table 18.2 Banska Bystrica Kraj Territorial Plan (NR TR)

Data set	BB TP – Banska Bystrica Kraj Territorial Plan	**Status**	already obtained
Contact person	Nitra Kraj Office - AUREX	**Source**	BB Kraj Office - hardcopy
Origin	Map appendices of Banska Bystrica Territorial Plan, digitized by SAZP GIS Laboratory on the request of study team	**Format**	ArcView shape files
Spatial coverage	cadasters of the study area that are part of Banska Bystrica Kraj	**Scale**	1:50 000
Temporal coverage	1998	**Projection**	JTSK
Attributes/ Main items	- all layers of the territorial plan		

Table 19.1 Tourist Sites in the Study Area (VKU)

Data set	VKU – Tourist sites in the Study Area	**Status**	already obtained
Contact person	Cartographic Institute	**Source**	tourist maps
Origin	Published tourist maps digitized by the study team	**Format**	ArcView shape files
Spatial coverage	digitized for the study area	**Scale**	1:100 000
Temporal coverage	1998	**Projection**	JTSK
Attributes/ Main items	- location of tourist sites - description of tourist sites		

O.2 SPATIAL ANALYSIS OF ENVIRONMENTAL DATABASE COVERING THE STUDY AREA

(1) Introduction

The term spatial analysis can have very broad and very specific meaning. In either case it refers to data manipulation techniques that aim at deriving additional information (data, indicator, index) on geographically referenced, spatially distributed phenomenon. However, it is never a generic problem solving tool, it always relies on the expert knowledge about the specific field concerned in analysis (e.g. determining forest health condition map requires the expert of forest ecology, etc.).

The methodology of spatial analysis greatly depends on the problem to be solved. Different techniques exist for spatial data manipulation, as it was highlighted in the tentative plan. Some question can be answered by employing various techniques, some can be solved by only one method.

Regarding to this issue, the Study team was asked to "include all necessary information (algorithms, flow-charts, source-code or name of software used, etc.) related to the spatial analysis and/or modelling" into the Progress Report (2), so that "the Slovak side will be able to use the methodology". Therefore, where appropriate the detailed descriptions are given.

REMP incorporates spatial analysis as a tool to assist in a) describing the Hron environment, b) identifying the locations of "environmental issues" and c) assessing the severity of these issues.

Based on these principles evaluation maps were prepared to study the state of the environment in the Hron basin. The contents of the spatial analysis are given in the following chapters.

(2) Forest Health Condition

The Forest Health Condition map of the river Hron basin was prepared by the counterpart organization of Forest Research Institute with the technical assistance of JICA.

The forest classification was carried out on the base of LANDSAT TM scene of 23rd July 1990. Satellite image, as of 10th May 1998, purchased by JICA, was used to determine forest health training plots. The image was used for the calculation of "Tasseled Cap" transformation coefficients optimized for forest health condition assessment. Then the coefficients were

applied on the base scenes to classify forest health conditions. The map is representative for the year of 1990.

To describe the forest condition, the following categories were assigned to each cell representing a 30 m x 30 m area forest cover (forest stand):

Explanation of categories:

- healthy forest stands
- healthy forest stands with first symptoms of damage
- slightly damaged forest stands
- slightly - moderate damaged forest stands
- moderate - severe damaged forest stands

More detailed description of the evaluation method can be obtained from Forest Research Institute.

(3) Air Quality

Air quality evaluation maps were prepared by the counterpart organization of Slovak Hydro-Meteorological Institute with the assistance of JICA.

Ambient air quality is assessed taking into account the following pollution sources:

- long-range air pollution
- natural background air quality,
- local heating and hot water production
- road transport
- railway transport
- combustion processes, technologies

The U.S. EPA ISCST3 model was applied to calculate the concentrations of SO2, NOx, CO and dust (TSP).

Model simulations were carried out for:

- the year of 1990 as a baseline condition,
- the year of 1998 to evaluate present conditions with classification of contributions of different types of sources,
- 4 future scenarios in Banska Bystrica to evaluate the impacts of proposed air quality improvement projects. The scenarios are as follows:
  - a) do nothing,
  - b) construction of a ring road (bypass road) to reduce traffic volume in the center of BB,
  - c) reduction of air pollution from the Cement factory,

d) the combination „b" and "d".

Air quality evaluation maps were prepared for the simulation cases to present the spatial distribution of air quality in the Hron basin. The concentrations of SO2, NOx, CO, and dust (TSP) were mapped, as well as, the IZO air pollution index is calculated for the basin. These results are given in "Air Auality and Pollution Sources (Ref.8 - 11)," which was prepared by the SHMU and the Study Team in co-operation.

More information on modelling and evaluation method can be found in the above document, and for further details, SHMU may be consulted.

(4) Groundwater Quality

The groundwater quality evaluation map was prepared to assess the status of groundwater quality along the Hron Basin. The flowchart of the process of spatial analysis is given in Figure O.2-1. The detailed steps of analysis are described below.

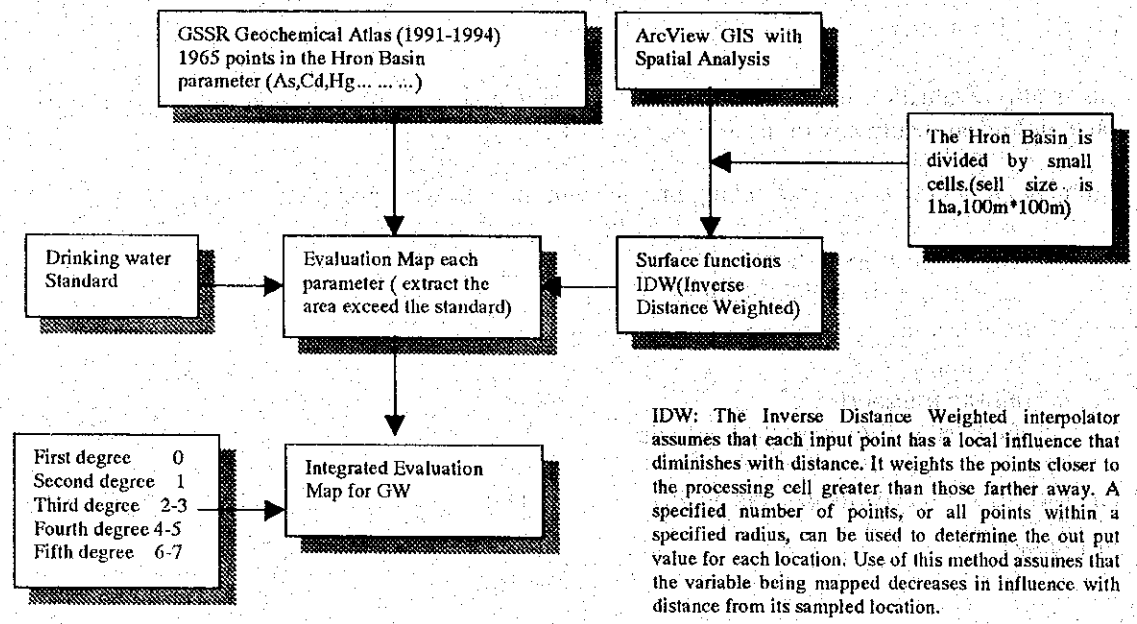
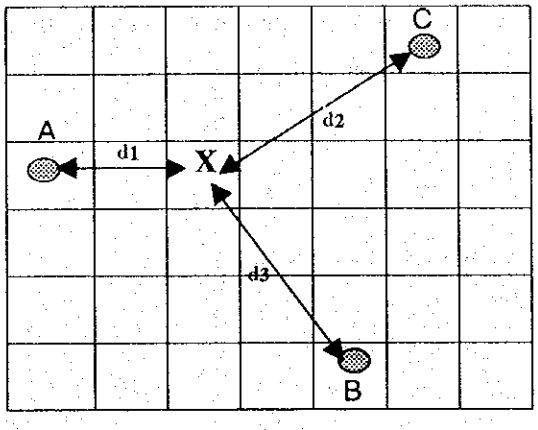


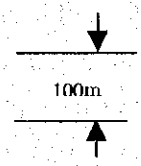
Figure O.2-1 Groundwater Quality Evaluation Map – Spatial Analysis

We used Geochemical Atlas of GSSR compiled from 1991 to 1994 as the data related to groundwater pollution. The number of the sampling points in the Hron basin is 1965 points and the statistical sampling density was 1 sample per about 3 km^2. The parameter of groundwater quality consists of 32 items such as As, Cd, Hg and so on.

We grasped the distribution of groundwater pollution in the Hron basin by the following

technique. At first we divide the Hron basin into small cells, the area of a cell is 1 ha, 100 m *100 m. When there is a sampling point for groundwater quality in a cell, the analysed value of the sample becomes the data of the cell. When there is not a sampling point in the cell, we estimate the quality from the values of neighbouring sampling points as shown below:





$$X = \frac{A * d1^{-2} + B * d2^{-2} + C * d3^{-2}}{d1^{-2} + d2^{-2} + d3^{-2}}$$

Where,

X: the value of groundwater pollution we want to know
A, B, C: the value of actual sampling points around X
(we selected 12 points in this special analysis)
d1,d2,d3: the distance from the cell (X) to each sampling points (A,B,C)

The interpolation mentioned above was done by using "Spatial Analysis" which is an extension of "ArcView" GIS software. The interpolation was enforced for only parameters that have an environmental standard of the drinking water among parameters of Geochemical Atlas.

IDW: The Inverse Distance Weighted interpolator assumes that each input point has a local influence that diminishes with distance. It weights the points closer to the processing cell greater than those further away. A specified number of points, or all points within a specified radius, can be used to determine the output value for each location. Use of this method assumes that the variable being mapped decreases in influence with distance from its sampled location.

Each parameter in evaluation maps has two kinds of area, one is the area where the parameter value is less than the environmental standard; other is the area exceeding the environmental

standard. The area that exceeds the environmental standard is different among the parameters because the pollution sources are not same among the parameters. But, in a specified area, several parameters exceed an environmental standard. That means these areas are the most polluted areas.

After making each evaluation map, we made an integrated groundwater pollution map according to the following classification as an index by the number of parameter that exceeded an environmental standard here.

First degree (high level of environment)
The number of the parameter exceed the standard is 0
Second degree (suitable level of environment)
The number of the parameter exceed the standard is 1
Third degree (slightly affected environment)
The number of the parameter exceed the standard is 2
Fourth degree (affected environment)
The number of the parameter exceed the standard is 3-4
Fifth degree (heavily affected environment)
The number of the parameter exceed the standard is 5-7

The integrated evaluation map is shown in the Main Report and Map Volume as a "Groundwater Pollution Evaluation Map".

(5) Soil Contamination

Soil contamination evaluation map was prepared by the same technique of spatial analysis as that in the previous section – groundwater pollution. The IDW interpolation method was applied in the similar way.

The unique characteristics of the analysis are summarized follows:

- Number of sampling points: 1416 points in the Hron basin
- Parameters: As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn
- Classification system: First degree (high level of environment)
  No parameter exceeding the standard.
  Second degree (suitable level of environment)
  One parameter exceeding the standard.
  Third degree (slightly affected environment)
  2 - 3 parameters exceeding the standard.
  Fourth degree (affected environment)
  4 - 5 parameters exceeding the standard.
  Fifth degree (heavily affected environment)
  6 - 7 parameters exceeding the standard.

The integrated evaluation map is shown in the the Main Report and Map Volume as a "Soil Contamination Evaluation Map ".

(6) Land Cover / Land Use Changes and Territorial Development

The land cover map of the study area was prepared by the counterpart organization of Slovak Environmental Agency with the assistance of JICA. In 1998 JICA purchased cloud free LANDSAT TM satellite images for the summer period with intensive vegetation occurrence. Image processing (atmospheric correction, geographic correction, etc.), as well as, the pre-processing works for land cover interpretation were carried out by the Remote Sensing (RS) Department of SEA. SEA managed the final steps of visual interpretation to involve the same personnel who worked on the classification of CORINE land cover map of 1990.

The application of the CORINE methodology was selected to obtain comparable results for land cover change analysis.

The land cover map was finally prepared in the beginning of July.

The territorial plan of Nitra Kraj was available in digital form. However, the territorial plan of Banska Bystrica Kraj was prepared only on paper maps.

The digital version of the Banska Bystrica territorial plan (only those areas that are part of the study area) was created by the counterpart organization of Slovak Environmental Agency with the assistance of JICA. The digitalization (scanning, geo-referencing and vectorization) of the paper maps was finished in mid-July.

Since the land cover map of 1998 and the territorial plan of Banska Bystrica Kraj was obtained by the end of the working period in Slovakia, spatial analysis of land cover change and territorial development will be done in the next stage of study.

(7) DRASTIC Analysis Method for Groundwater Vulnerability

We evaluated the vulnerability of groundwater to pollution using the GIS digital data contained in Annes O.1. Groundwater Vulnerability Map indicates the areas where the risk of groundwater pollution is high according to such conditions as topography, meteorology and geological features, but high vulnerability dose not mean that the groundwater is presently polluted.

Used digital data sets consisted of seven attributes shown in Figure O.2 - 2.

Data values for each attribute are divided into ten classes, and each class has a weight according to the degree of the importance.

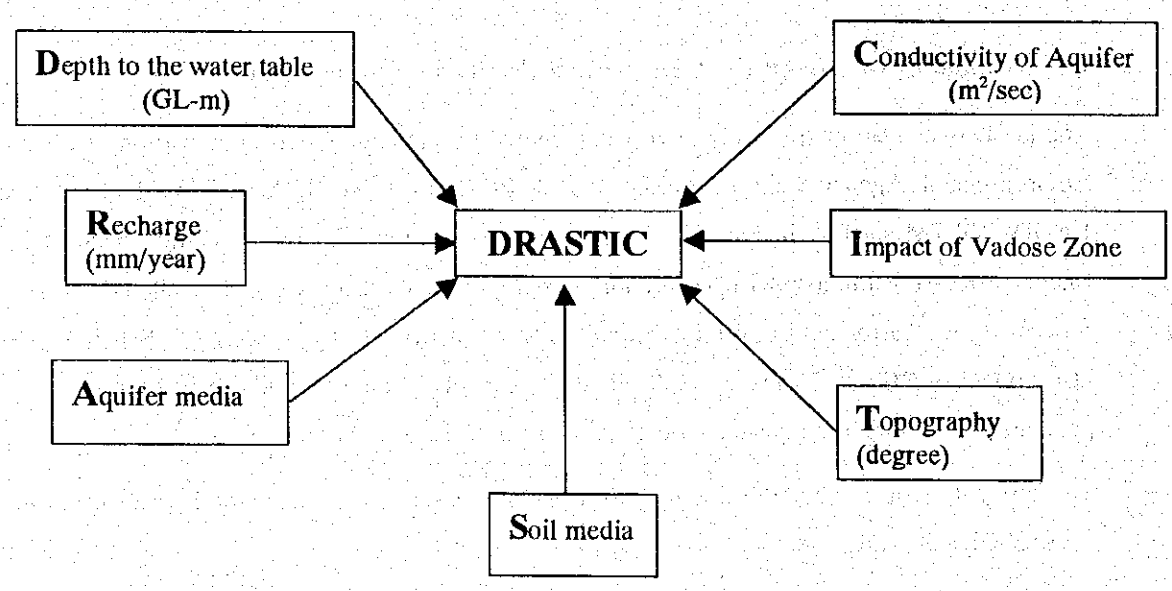


Figure O.2-2 Seven digital data which were used for groundwater vulnerability

A procedure of analysis is as follows:

First we converted all digital data into raster data (100 m *100 m), because polygon data, point data and raster data are coexisting in the data we use. This conversion was done by using Spatial Analysis of ArcView.

Secondly, we used overlay method by using map operation of Spatial Analysis of ArcView identically and calculated synthesis point of vulnerability. Highest score will be 70 points because we have ten points for each of seven attributes.

Through the analysis, vulnerability scores ranged from 26 points to 65 points and these were classified into five categories as follows:

First degree :	very low vulnerability
Second degree :	low vulnerability
Third degree :	medium vulnerability
Forth degree :	high vulnerability
Fifth degree :	very high vulnerability