# 지방자치단체의 GIS 활용에 관한 국제세미나

4th Annual

International Seminar on

Application of GIS to Urban & Regional Planning

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September 16~17, 1999

KOREA RESEARCH INSTITUTE

FOR HUMAN SETTLEMENTS

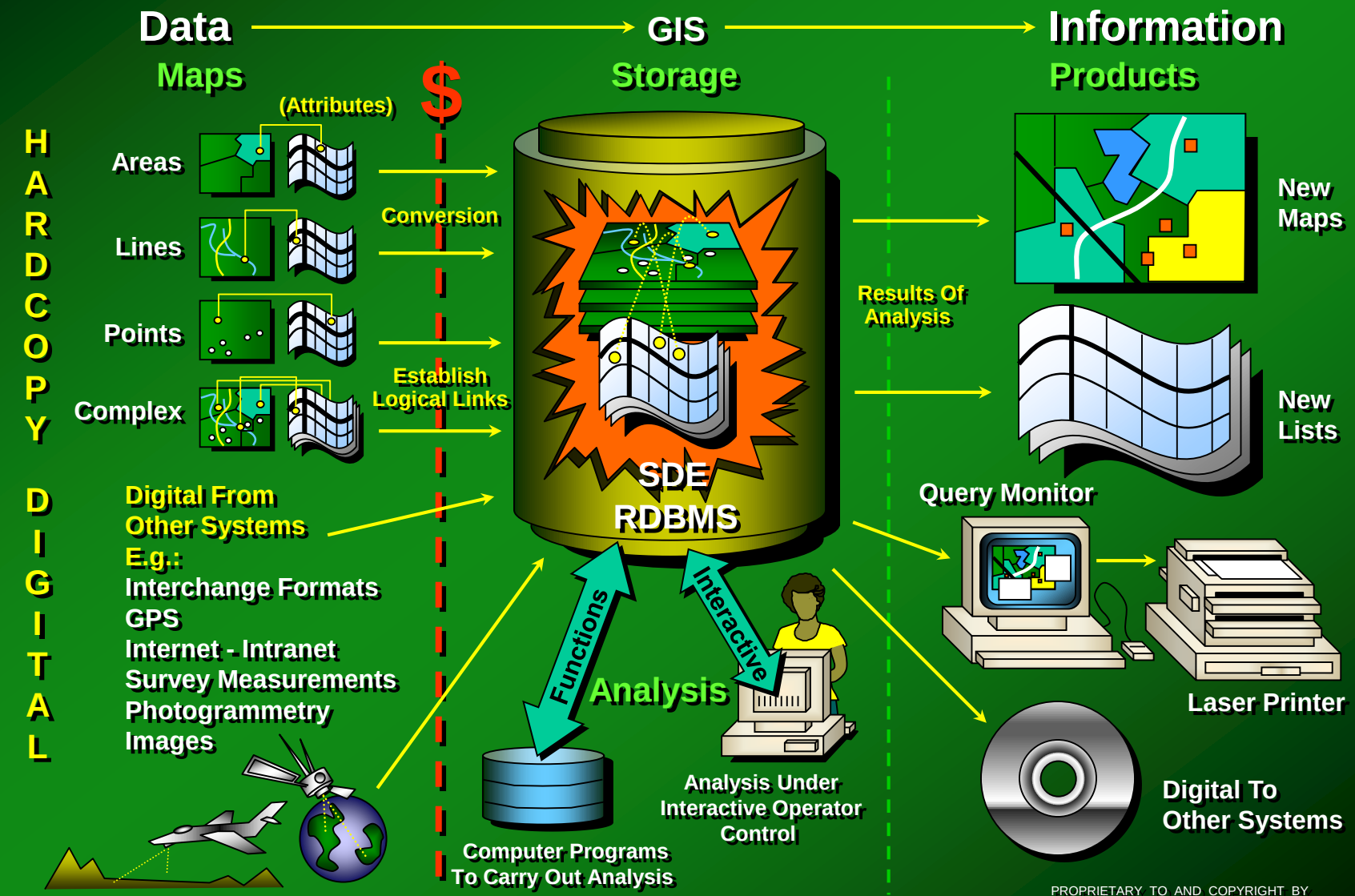
# Modern GIS Planning Methods

Dr. R. F. Tomlinson

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# Parts of a Geographic Information System

GISPLAN®




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# Knowing What You Want To Get Out Of It



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1. Organizational Strategic Business Plan Review

2. Develop Project Proposal for GIS Planning Process

3. Project Proposal Approval and Commitment of Resources

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# 4. Requirements: Study Preparation

a. Identify In-house GIS Team
b. Initial Visits - Briefing by Departments
c. Technology Seminar (3 Days): for Key Personnel

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# 5. Requirements: Needs Assessment for All Participating Departments

a. Initial Identification of Current and Potential Information Requirements

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# 5. Requirements: Needs Assessment for All Participating Departments

a. Initial Identification of Current and Potential Information Requirements

b. Information Product Descriptions

- Map Output Requirements
- List Output Requirements
- Document Retrieval Requirements
- Data Requirements
- Functions Utilized
- Frequency of Use
- Logical Linkages
- Error Tolerance
- Current Cost
- Benefit Analysis

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# 5. Requirements: Needs Assessment for All Participating Departments

a. Initial Identification of Current and Potential Information Requirements

b. Information Product Descriptions
   - Map Output Requirements
   - List Output Requirements
   - Document Retrieval Requirements
   - Data Requirements
   - Functions Utilized
   - Frequency of Use
   - Logical Linkages
   - Error Tolerance
   - Current Cost
   - Benefit Analysis

c. Create Master Input Data List - Data Source and Data Volume Evaluation

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# 6. Requirements: System Scope - Determine the Following

a. Information Product Priorities

b. Data Handling Load

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# Preliminary Data Handling Load Estimates - 1999-2000

Number of workstations, all locations, plus data storage requirements

**Workstation Types:**

A = Multi-user UNIX Workstation ($20,000)
plus 4 x-Terminals ($2500 each) used
by 4 people @ $7500 per person

B = High End NT Pentium III 500 Mhz 21" screen ($3500)

C = Standard Pentium II 400 Mhz 17" screen ($2000)

**Workstation Requirements by Location:**

| Processing Complexity (from PD) | x Data Volume to Be Handled (from PD) | = Type |
|---|---|---|
| H | H | = A or B |
| H | L | = B or C |
| L | H | = C |
| L | L | = C |

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# Preliminary Data Handling Load Estimates - 1990-2000 (Cont'd.)

## Data Storage Estimates :

Enterprise Network Mass Storage

- 1000-3000 GB, RAID1, Full Mirror
- Server and Disk Subsystem, Very Secure

$250 - $220 per GB

Work Group Server

- 20-100 GB, RAID5

$260 - $120 per GB

Personal Computer

- <20 GB, No Security

$20 per GB

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# 6. Requirements:

## System Scope - Determine the Following

a. Information Product Priorities
b. Data Handling Load
c. Data Availability Requirements
d. Multiple Data Use Potential

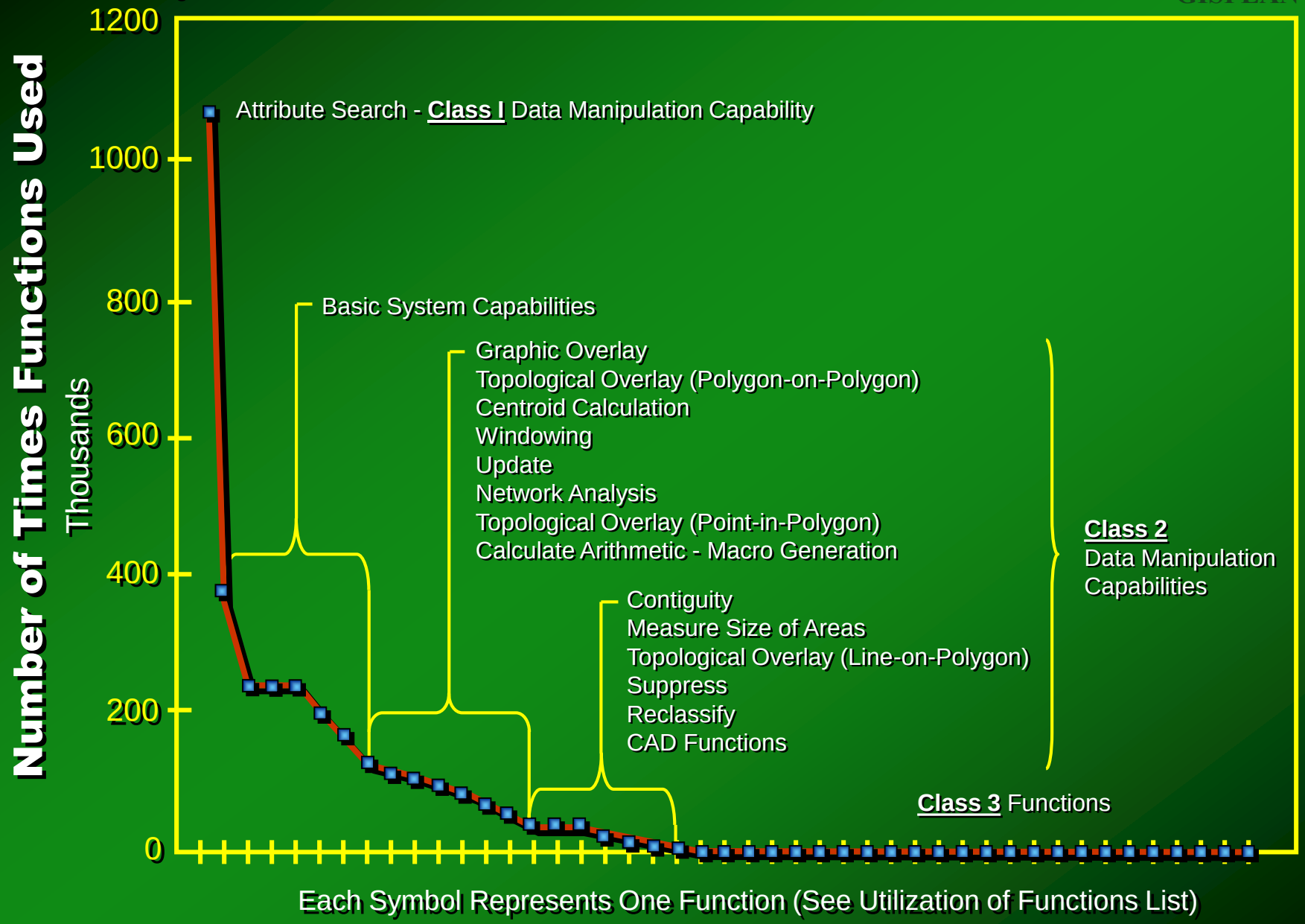
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# 8. Conceptual System Design: Technology

a. System Function Utilization Requirements

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# 8. Conceptual System Design: Technology

a. System Function Utilization Requirements
b. System Interface Requirements
c. Data Communication Requirements

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# Communications

## Range of Options :

| | | |
|---|---|---|
| **Low Speed** | **Modem Speeds** | **28.8K** |
| **Medium Speed** | **56K (53)K**<br>**Frame Relay - Time Share 56K**<br>**ISDN 128K** | |
| **High Speed** | **T1**<br>**Fractional T1**<br>**Digital Service Line**<br>**Business synch.**<br>**T3** | **1.540 MBS**<br>**Time Share T1**<br>**2.2 MBS**<br>**6.0 MBS**<br>**45 MBS** |
| **Networks** | **Fast Ethernet**<br>**Fibre-optic (FDDI)**<br>**ATM**<br>**Giga-Net (Fibre-optic)** | **100 MBS**<br>**100 MBS**<br>**150-600 MBS**<br>**1000 MBS** |

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# Communications (Cont.)

## Recommendations :

1) Cooperative processing between 2 machines mounting disks as if they were local Ethernet 100 or faster.

2) Remote (50 miles) use of central workstation: needs 56k (single user) or T1 (multiple users) or make workstation and storage local.

3) Internet: non-mission critical applications, non-time sensitive small packets - of questions and answers. Speeds and reliability are improving.

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# 8. Conceptual System Design: Technology

a. System Function Utilization Requirements
b. System Interface Requirements
c. Data Communication Requirements
d. Hardware and Software Requirements

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# 1999-2000 Estimates of Technology Life-Cycles

**Definitions:**

| | |
|---|---|
| **Current** | **Length of time between major releases with significant functional improvement** |
| **Useful** | **Current Software will run with this equipment** |
| **Obsolete** | **New releases of software cannot run with this equipment** |
| **Non-functional** | **After this point the infrastructure is no longer functional. Cost of maintenance greater than residual value of equipment** |

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# 1999-2000 Estimates of Technology Life-Cycles

(Months)

| Technology | Current | Useful | Obsolete | Non-functional |
|---|---|---|---|---|
| Network Infrastructure | 24-36 | 37-84 | 85-120 | 120+ |
| Wide Area Networks* | 12-24 | 25-60 | 61-84 | 84+ |
| Computer | | | | |
| • Server | 12-18 | 19-48 | 49-72 | 72+ |
| • Workstation | 6-12 | 13-48 | 49-72 | 72+ |
| • Desktop | 6-12 | 13-36 | 37-60 | 60+ |
| • Laptop | 6-12 | 13-24 | 25-48 | 48+ |
| OS Software | 18-36 | 37-60 | 61-72 | 72+ |
| Vendor Software | 12-18 | 19-36 | 37-60 | 60+ |
| Internet Products (Browsers, Associated) Products | 9-12 | 13-24 | 24-36 | 36+ |
| Data | Variable – depends on rate of decay of validity | | | |

* Internet bandwidth increasing at 300% per year

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# 9. Implementation Strategy

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a. Institutional Interaction Requirements - Local, Provincial, Federal (Data Sources, Information Recipients), Partnership, Multi-agency Cases
b. Legal Review (as Necessary)
c. Existing Hardware and Software
d. System Requirements Definition (Draft RFP)
e. Security Review
f. Department Staffing
g. Training Program by Personnel Category

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# 9. Implementation Strategy, (Cont.)

h. Cost model

i. Cost - Benefit Analysis

j. Department Budgeting

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# Benefit Categories

- **Savings**
  - Decrease in person-hours now used
  - Minimize current expenditure
- **Benefits to Agency**
  - Benefits that accrue to agency acquiring GIS as a result of new information produced by GIS
  - Beneficial changes in operating procedures
  - Increases in effectiveness of planned expenditure
  - Increases in revenue
  - Minimize risk of investments
  - Reduction in liability
  - Development of better policy options
- **Future and External**
  - Benefits that accrue to agencies other than those acquiring GIS (e.g., other parts of company, other departments of government), or to the public good

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# 9. Implementation Strategy, (Cont.)

k. Management Issues - Migration Strategy

l. Alternative Implementation Strategies, Including Pilot Project

m. Risk Analysis

n. GIS Strategy Recommendations

o. GIS Committee Review and Approval

p. System Procurement Procedures

q. Selection Criteria

r. Benchmark Test Design, Monitoring and Evaluation Methodology

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# Planning Time Determinants



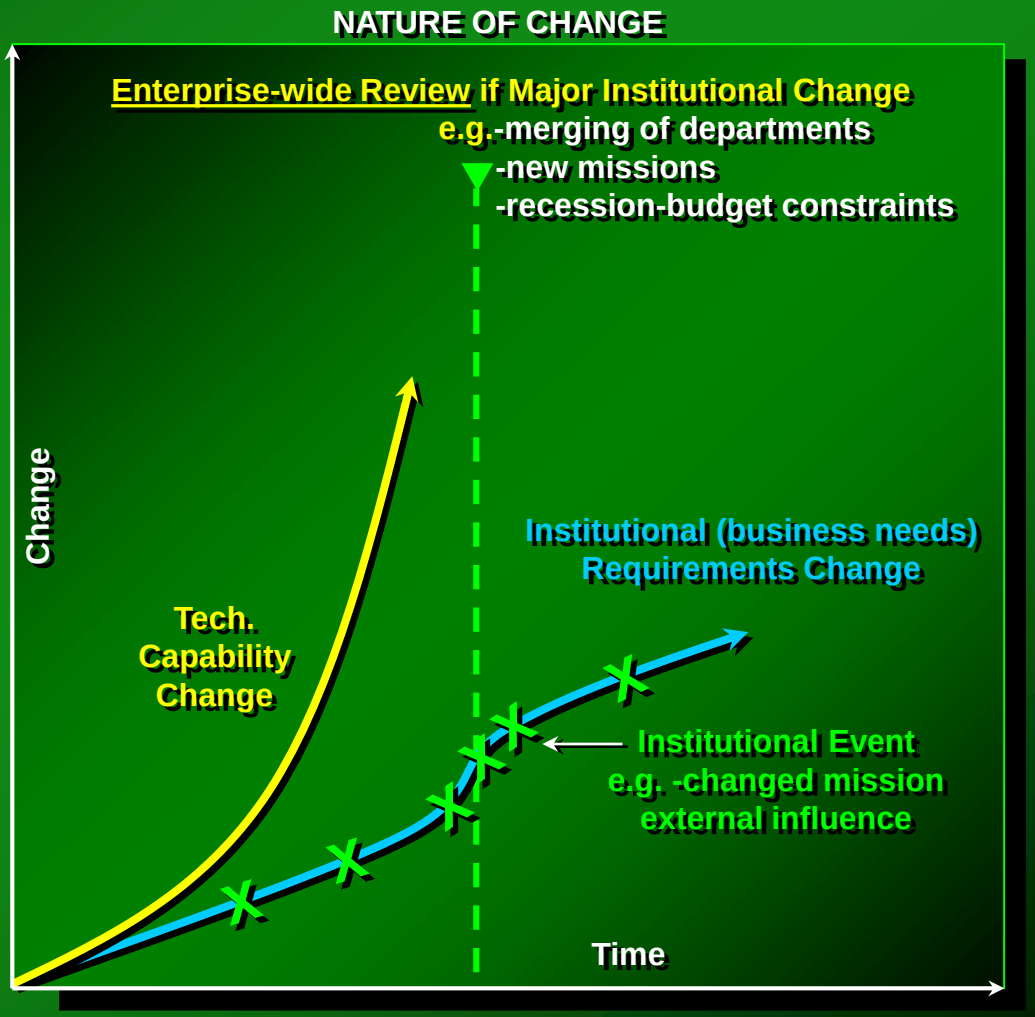
**MINIMIZE TOTAL COSTS/TIME**

**e.g. Funds wasted on:**

- maintenance
- out of date training
- over-capacity

**MAXIMIZE**

- Support for business




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# Planning Approach

1) **Start with enterprise-wide planning**

2) **Acquire technology** to minimize expenditure according to technology life-cycle table. Purchase equipment where you will use at least 50% of its capacity in the first year

3) **Add information products** incrementally to meet adjustments in business needs - to use remaining part of existing technology life-cycle, or add new technology with full knowledge of the new technology life-cycle

4) **Enterprise-wide review** if major institutional change occurs

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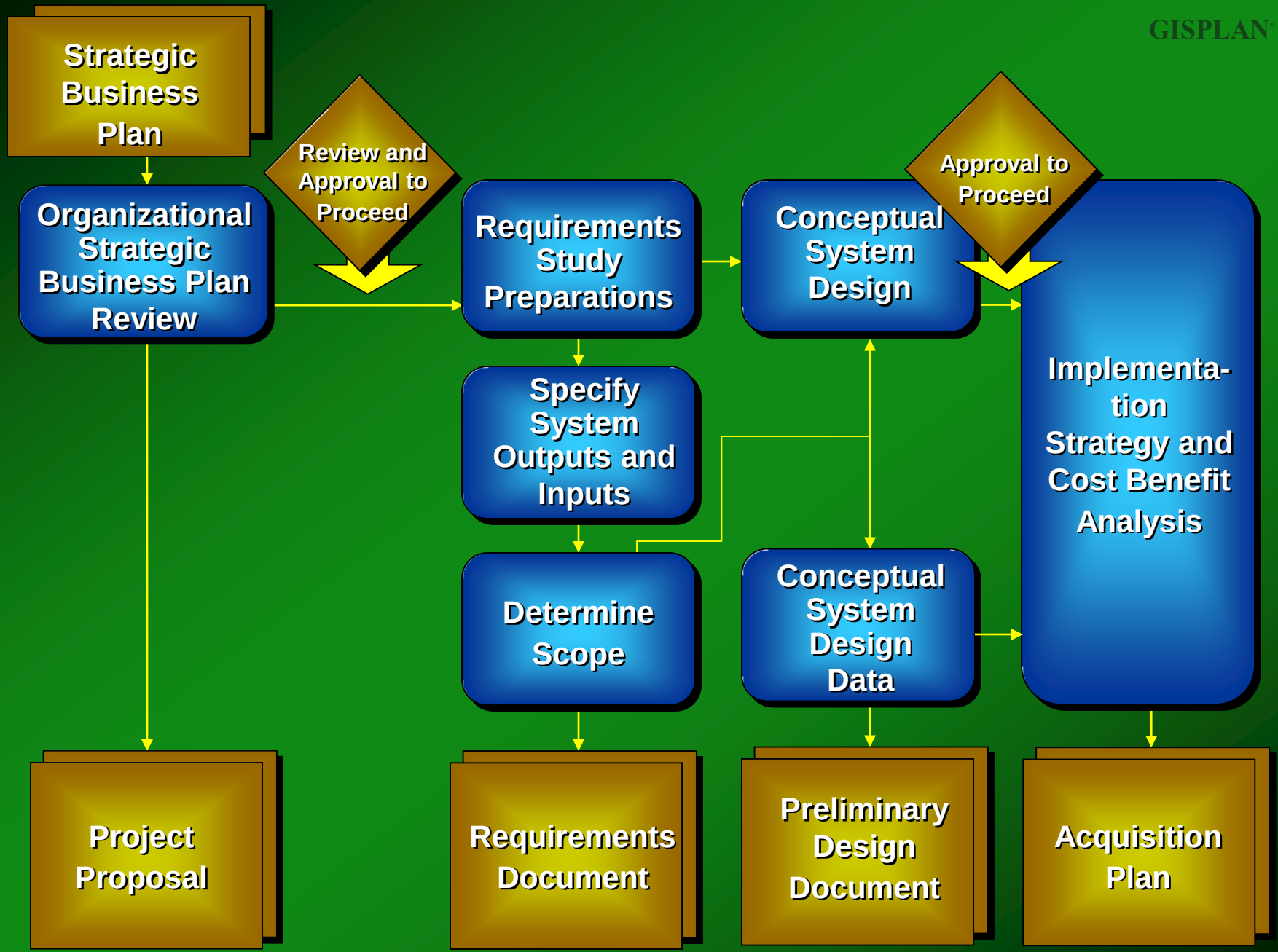
# Planning Approach- Operational Outcomes

A) **Continuous technology acquisition budget**

B) **Information product design should not exceed the life of the technology to be used.**

e.g. *If technology to be used has one year until obsolete, the information product design should probably wait and take advantage of the new technology. Alternatively, the design could go forward with the full understanding that its benefit cycle will be limited and it may have to be abandoned or require significant adaptation effort when the new technology is acquired.*

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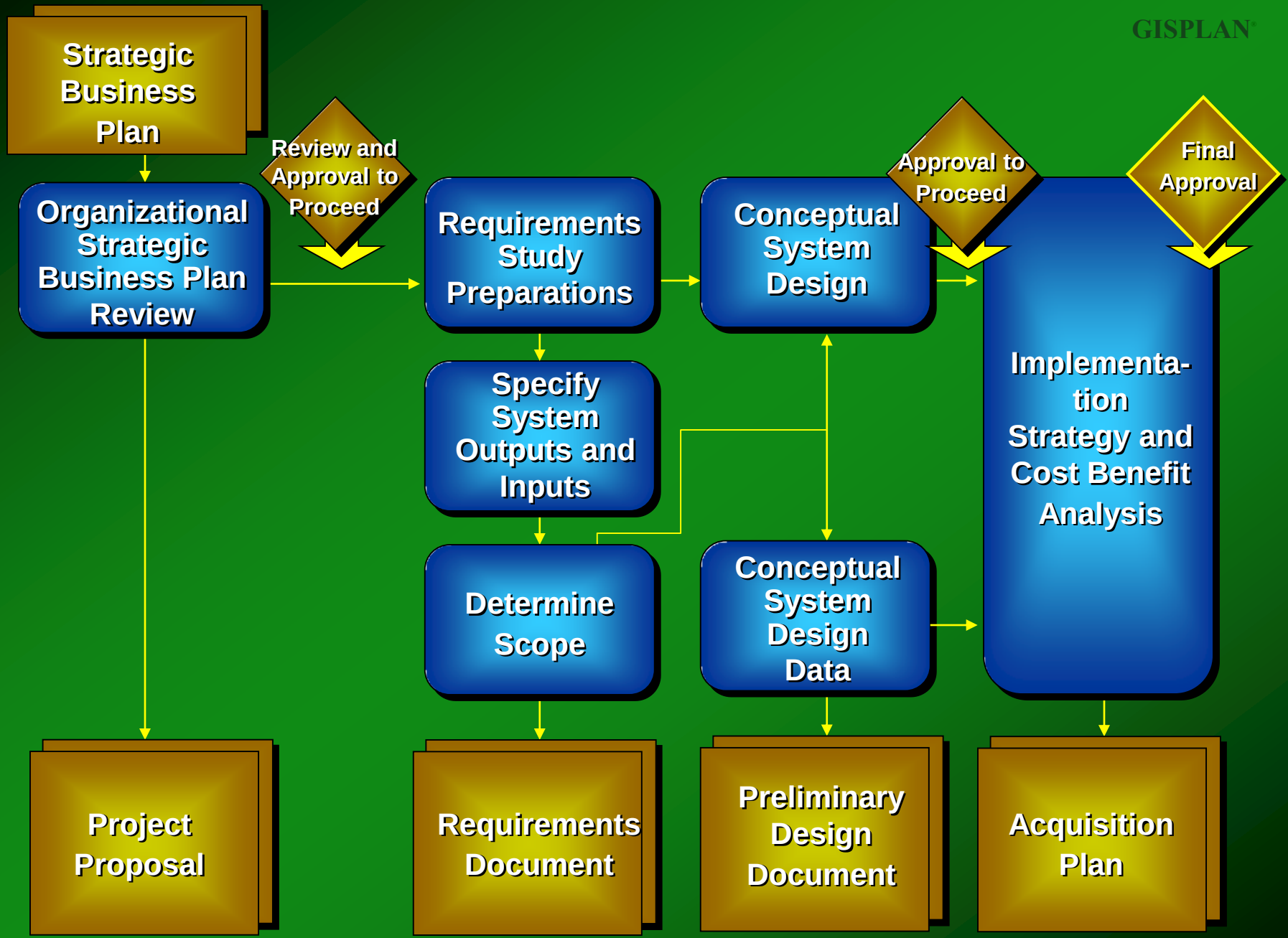
# 10. Final GISPLAN® Report

a. Strategic Business Plan Considerations
b. Resultant Information Requirements
c. Conceptual System Design
d. Recommendations
e. Timing
f. Funding Alternatives

**Executive Summary**

**Presentation**

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# Can you afford to plan…..

## GIS Cost Waterfall

Cost of a change

| | |
|---|---|
| $1 | - in the requirements stage |
| $10 | - in the design |
| $100 | - in construction |
| $1000 | - in implementation |

(Moody, 1996)
*Database Programming & Design*
October , 57-64

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# 지역정보화와 GIS

# Regional Informatization and GIS

김 성 태(Seang-Tae, Kim)
(한국지역정보화학회 회장 -President of KARIS)

# 정보정책·지역정보화·GIS

산업사회 → 패러다임의 변화 → 정보·지식기반사회

공업(산업)정책 → 국가핵심정책 변화 → 정보정책

- Drucker 단절의 시대(The Age of Discontinuity)

지식기술, 지식경제, 지식사회의 도래

Toffler 제3의 물결이 도래하는 시대

**지식자본**이 가장 중요한 생산적 요소로 작용

# 지역정보화정책의 중요성

우리나라의 경쟁력 회복

정보정책의 성공적 수립과 추진
사이버 코리아 21 :
창조적 지식기반국가 건설을 위한 정보화 비젼

지역정보화정책의 성공적인 집행

NIIAC (미 국가정보기반 자문위원회)
국가정보정책의 성공적 추진을 위해서는
"정보고속도로를 이웃 즉 지역사회에 실현하는 것이 최상의 방법"

GIS관련 기술발전과 환경의 변화

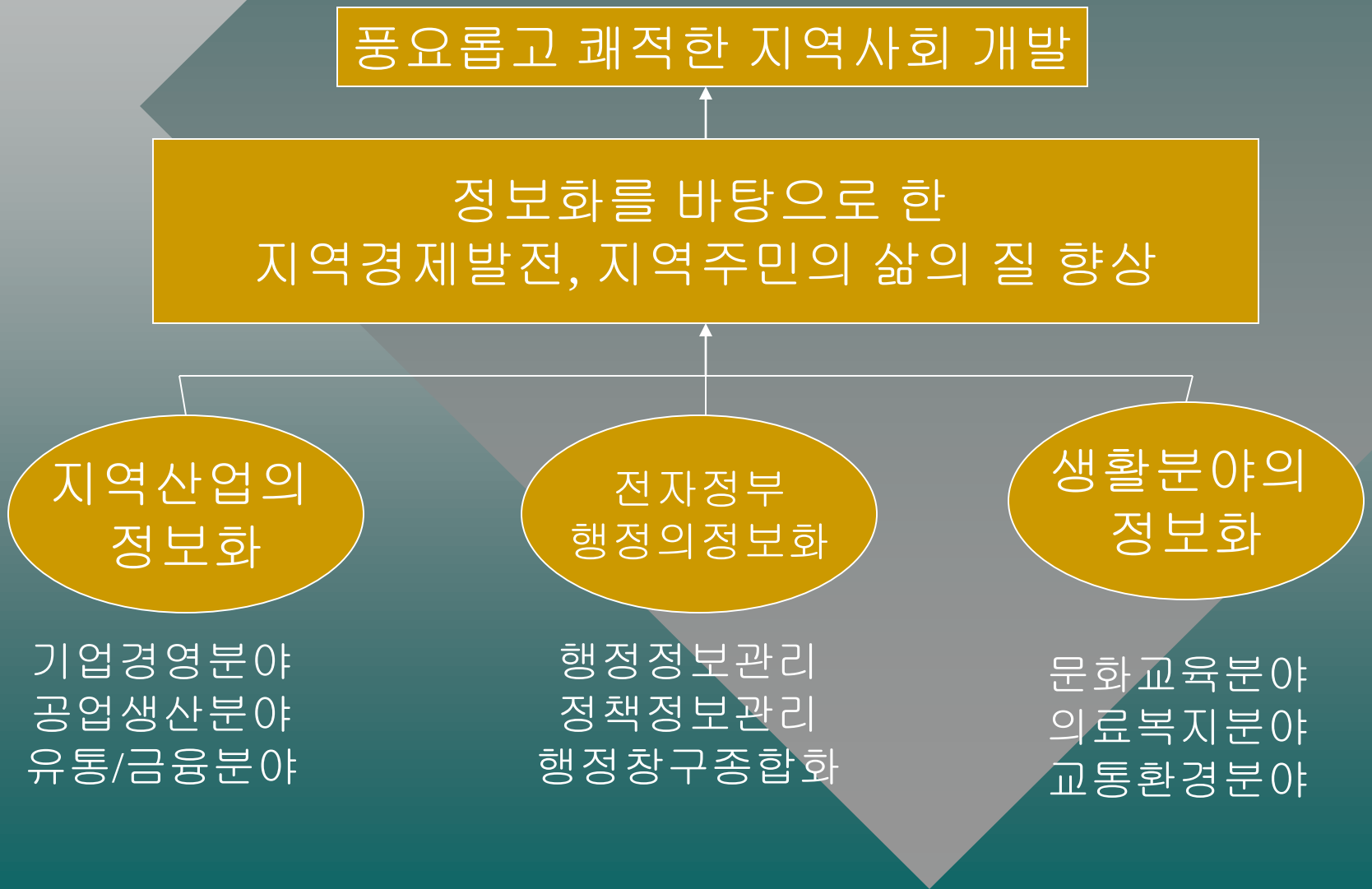
GIS → 지역정보화 추진의 전략적 수단으로 등장

# 지역정보정책의 개념

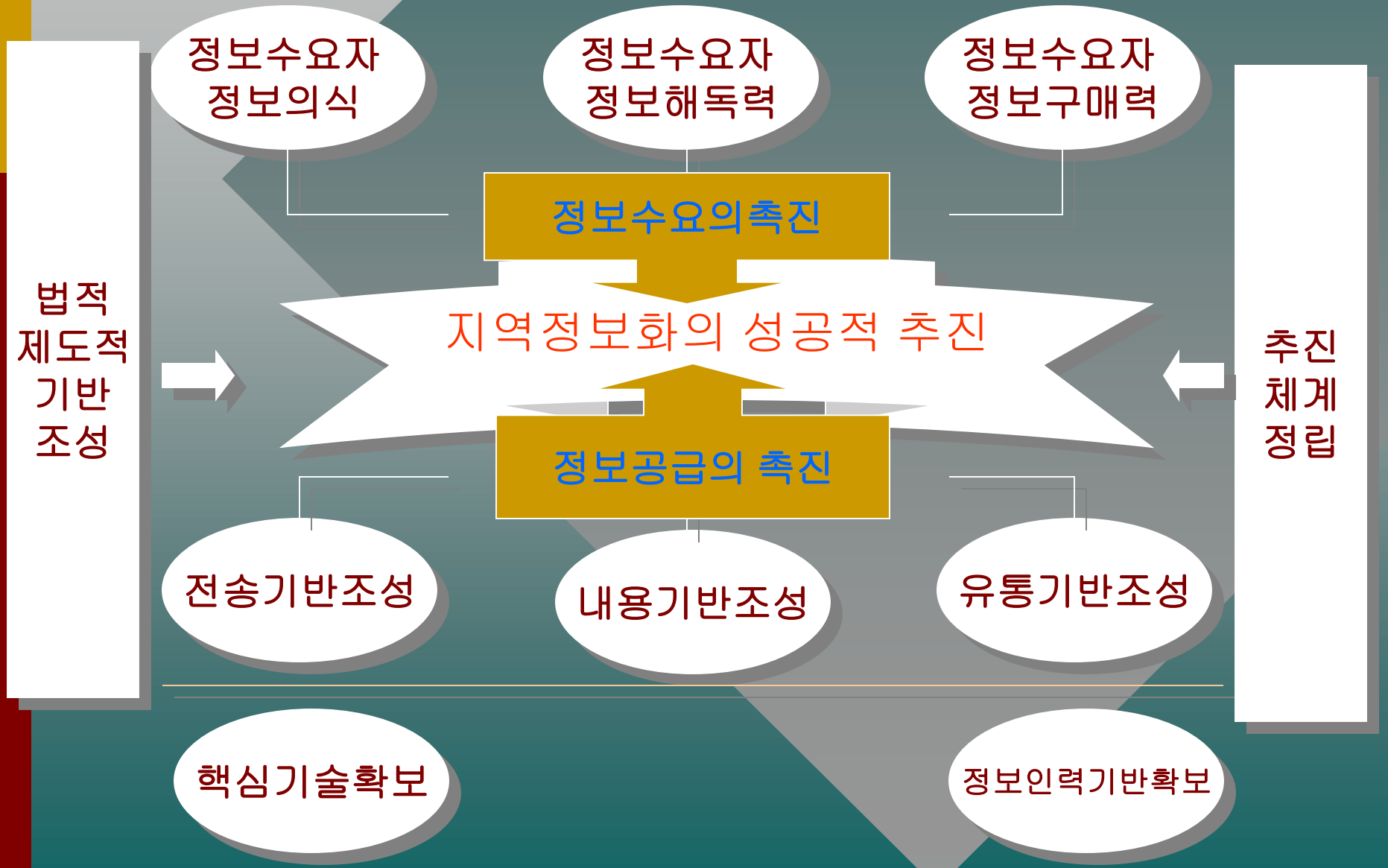
지역의 생활, 산업, 행정 등 전반적인 지역사회 개발과 관련된 제반 분야의 **당면 문제 해결** 또는 미래지향적인 **목표의 효율적 달성**을 위하여 **국가 및 지역사회**가 **정보화를 주된 수단**으로 활용하는 것

정보정책을 둘러싼 다양한 이행관계자들의 **역할 분담**과 **협조 및 조정**방안 모색

# 지역정보화 정책체계


풍요롭고 쾌적한 지역사회 개발
정보화를 바탕으로 한
지역경제발전, 지역주민의 삶의 질 향상
지역산업의
정보화
전자정부
행정의정보화
생활분야의
정보화
기업경영분야
공업생산분야
유통/금융분야
행정정보관리
정책정보관리
행정창구종합화
문화교육분야
의료복지분야
교통환경분야

# 지역정보화 하위 정책 요소



# 지역정보화 추진의 장애요소

## 지역정보화 정보통신기반 순환 일반 모형



# 기술환경의 변화와 GIS 활용분야의 확산(1)

- INTERNET GIS
  - Client/Server 개념
  - Interactive 시스템
  - Cross platform GIS Tool 제공
  - Distributive Computing Environment에서 GIS 데이터와 분석 기능 처리
- GIS – CALS의 연계
- EC(Electronic Commerce)활성화에 기여
  - 제품의 생산, 판매, 유통분야 에서 공간적으로 지역성 특징 파악 연결
  - 상품의 공급과 수요를 효율적으로 연결
  - 공공/민간 부문 생산성 향상, 비용절감

# 기술환경의 변화와 GIS 활용분야의 확산(2)

- Open GIS
  - 상호 이질적인 다양한 형태의 지리자료들
  - 사용자들의 자유로운 접근 및 처리를 지원
- 특징
  - **Interoperable**
  - **Supportive Information Community**
  - **Ubiquitous**
  - **Reliable**
  - **Easy to Use**
  - **Portable**
  - **Cooperative**
  - **Scalable**
  - **Extensible**
  - **Compatible**
  - **Implementable**

# GIS 활용 범위의 확장

## 전통적 GIS

**목적 /분야**

행정관리분야

자원 및 시설물
관리 정보시스템
토지정보시스템
지역계획시스템
등

**사용자**

행정관련
전문가/관리인

## Open GIS

| 적용영역의 확장 | 사용자 범위의 확산 |
| --- | --- |
| **•생활분야**<br>•생활편의정보시스템<br>•지역문화정보시스템<br>•관광 및 위락정보시스템 | 일반인,<br>주부<br>학생<br>등으로 확산 |
| **•산업분야**<br>•마케팅 경영정보시스템<br>•부동산 유통정보 시스템<br>•전자상거래 시스템 | 다양한 분야의<br>기업인에게 확산 |

# GIS 정책

- 특징 ( 장기적/연속적/범위확장성)
  - 다양한 사용자들의 만족도를 높일 수 있도록 분석과 반영이 이루어져야 함
  - 정책추진체계 가변적 신축적으로 이루어져야 함
  - 다양한 이해관계자의 역할분담의 적절성, 조정의 신축성 보장
- 정책적 관점의 GIS 전략

**정책내용관련 기준**

- GIS정책수립과정의 합리성
- 타 정보정책과의 연계성
- 기본계획의 적절성
- 법/제도적 기반의 충실성

**정책자원관련 기준**

- 추진기구 및 인력의 적정성
- 예산 확정 및 분담의 합리성
- 관련기술 개발과 표준화

**조직관계관련 기준**

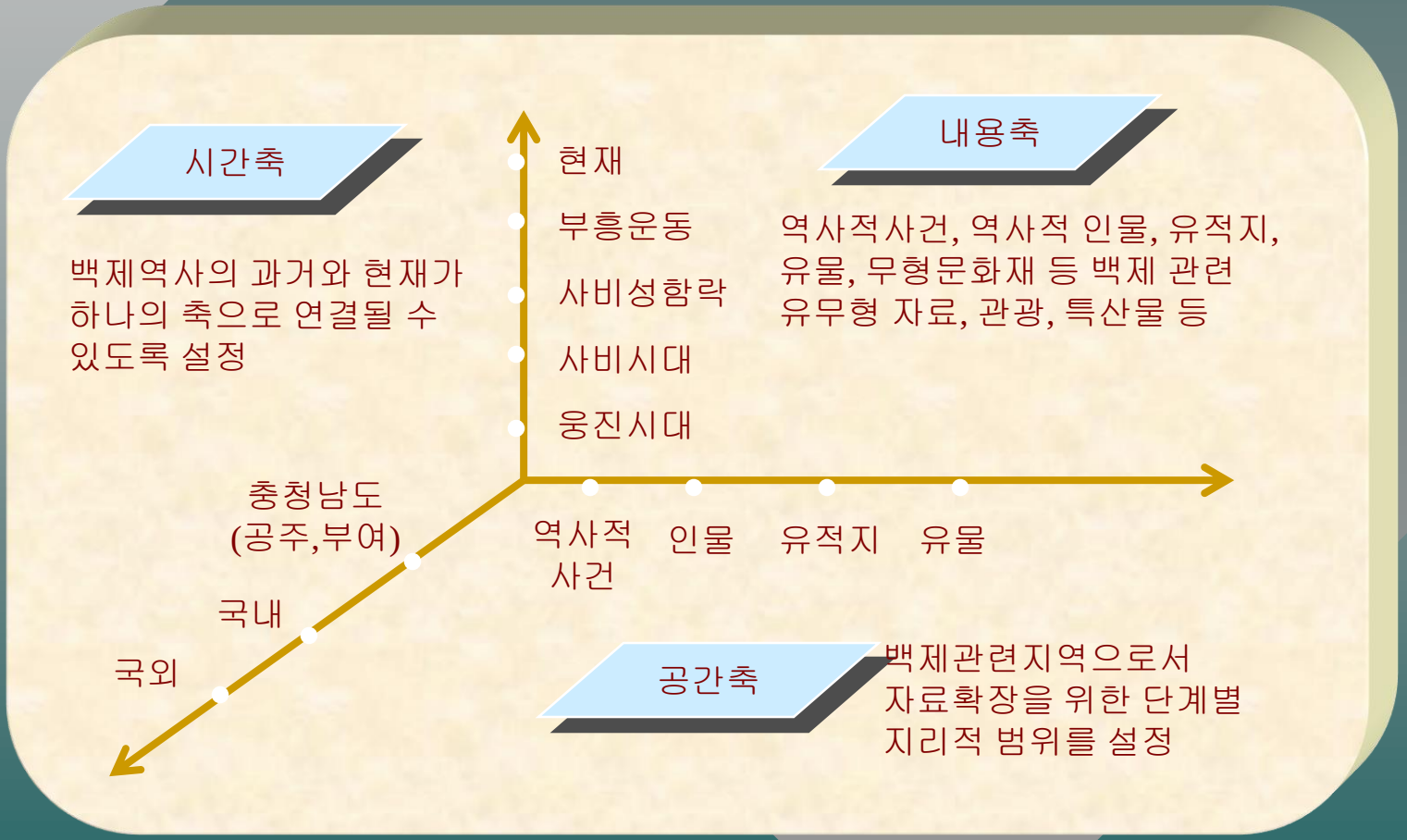
- 업무분담과 수행의 적절성
- 조정기능의 원활성
- 평가 및 보상체계의 적절성
- 중앙/지방/민간 조직간 역할 및 협조관계의 적절성

# 지역정보화정책의 성공적 추진을 위한 GIS정책 과정의 역할 분담 방안

- **GIS 응용서비스의 성격에 따른 역할 분담 기준**

| | 공익성 ⟷ 상업성 | |
|---|---|---|
| 전국단위의 보편적 수요정보 | 중앙정부주도 | 전국적 민간정보산업체 |
| 지역고유 필요정보 | 지방정부주도 | 지역민간 정보산업체 |

# Web GIS 활용예시
# (충남도 사이버백제 역사문화관)



# GIS관련 정보통신기반의 성격에 따른 역할분담 방안 제시 기준

| | 낮은 배제성<---------<br>Exclusion Not Feasible | ---------> 높은 배제성<br>Exclusion Feasible |
|---|---|---|
| 높은<br>소비<br>경합성<br>**Alternate Use** | **집합재**<br>**(Common Pool Resources)**<br><서비스 지역관련 공공기관이 세금을 바탕으로 GIS 관련 시스템 공급> | **사유재**<br>**(Private Goods)**<br><민간기업이 시장경제 원리를 바탕으로 GIS 관련 시스템 공급 |
| 낮은<br>소비<br>경합성<br>**Joint Use** | **공유재**<br>**(Public Goods)**<br><중앙정부 차원의 공공기관이 세금을 바탕으로 GIS 관련 시스템 공급> | **톨재**<br>**(Toll Goods)**<br><공공기관이 사용료를 바탕으로 GIS 관련 시스템 공급> |

# 재정적 등가성(Fiscal Equivalancy)의 원칙

| 응용서비스/정보재화 | 수요범위 | 재원부담 및 지원주체 |
|---|---|---|
| 특정 지역 정보시스템 | - 국가적 수요기능<br>- 범광역적 수요기능<br>- 광역적 수요기능<br>- 기초지역 수요기능 | - 국가적 지원<br>- 해당 광역자치단체 공동지원<br>- 광역자치단체 지원<br>- 기초자치단체 지원 |

# 지역간 형평성의 원칙

- **수직적 형평성**
  - GIS시스템에 기여할 능력이 있는 해당지역/예상이용자에게 시스템 사용허가
  - 민간의 정보통신 SOC 투자 유도 가능
- **수평적 형평성**
  - 지역적 빈부격차, 소외지역, 주민을 대상으로 GIS시스템 도입
  - 보편적 서비스 제공 가능

# 지역정보화와 GIS

끝.

# GIS를 기반으로 한 지방자치단체 정보화 전략

# Informatization Strategies for Local Government Utilizing GIS

1999. 9. 16

최 병 남

# GIS를 기반으로 한 지방자치단체 정보화 전략

## 차 례


I. 머리말

II. 지방자치단체 정보화란?

III. 지방자치단체 정보화 현황과 문제

IV. 지방자치단체 정보화 전략

V. 맺는 말

# GIS를 기반으로 한 지방자치단체 정보화 전략

## I. 머리말

목 적

❍ 지방자치단체 중심의 정보화 추진전략



최 병 남

# GIS를 기반으로 한 지방자치단체 정보화 전략

## II. 지방자치단체 정보화란?

정보화란?

- 정보화촉진기본법
- 한국전산원
- 기타

본 연구에서는

- 정보기술을 활용하여 바람직하지 못한 상태를 변화 시키는 과정

# GIS를 기반으로 한 지방자치단체 정보화 전략

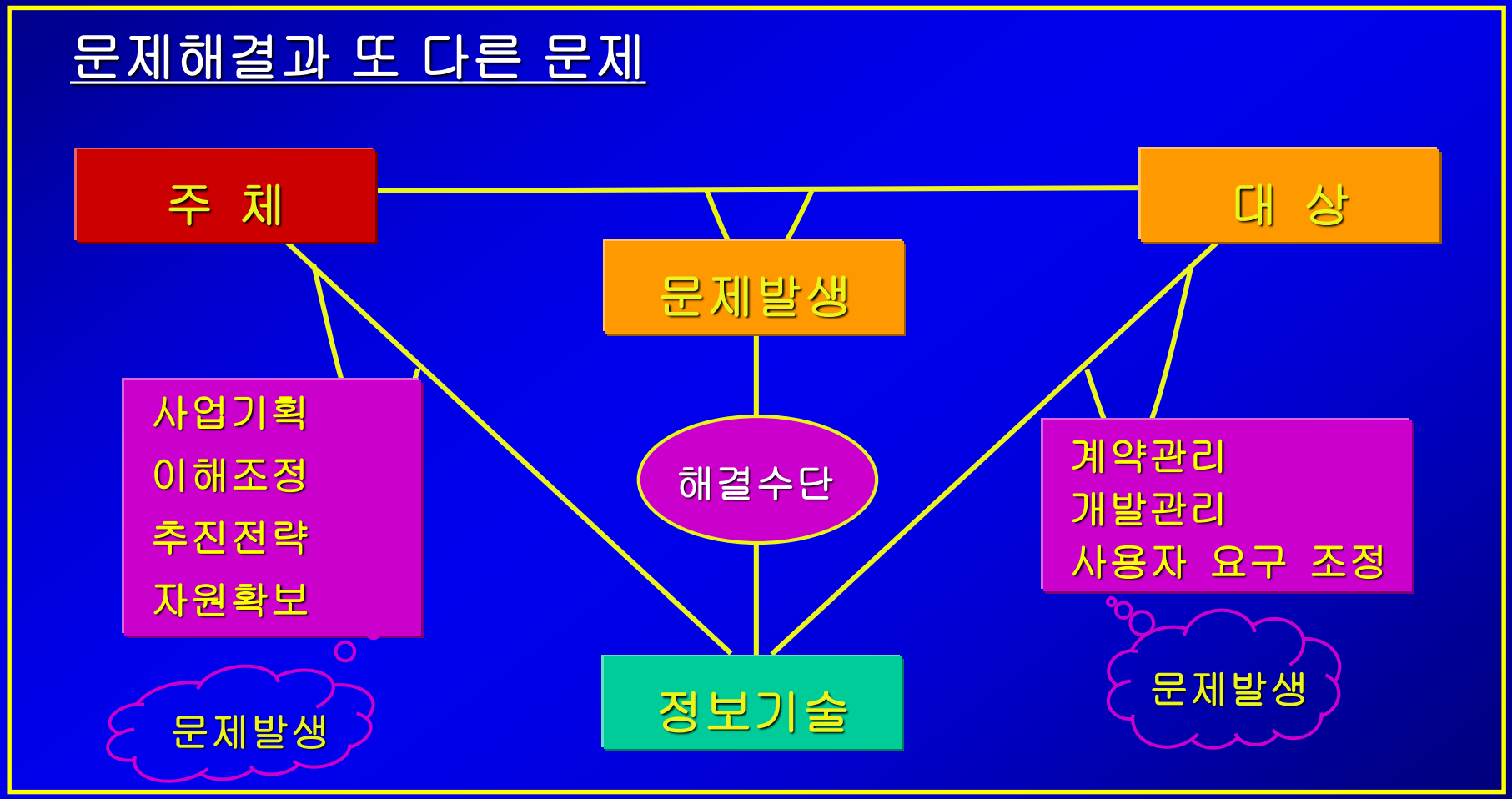
## II. 지방자치단체 정보화란?

지방자치단체 정보화란?

- 지방자치단체가
- 공공업무처리에 있어서 문제 해결
- 정보기술을 활용
- 경영 수단, 방법, 절차, 조직 등을 변화 시키는 과정

# GIS를 기반으로 한 지방자치단체 정보화 전략

## II. 지방자치단체 정보화란?



# GIS를 기반으로 한 지방자치단체 정보화 전략

## III. 지방자치단체 정보화 현황과 문제

현황

❍ 중앙정부에서 추진하는 지방자치단체 정보화 사업

- 행정전산망 사업
- 부처별 소관업무 정보화

❍ 지방자치단체 자체적으로 추진하는 정보화 사업

정보시스템 발전단계

❍ 1 - 3단계

# GIS를 기반으로 한 지방자치단체 정보화 전략

## III. 지방자치단체 정보화 현황과 문제

지방자치단체 정보화 추진의 문제

- 정보화 마인드 결여
- 정보기술 중심의 정보화
- 예산 부족
- 추진전략 미비
- 추진체계 미비

⇒ 정보화를 추진할 수 있는 사람 부재

# GIS를 기반으로 한 지방자치단체 정보화 전략

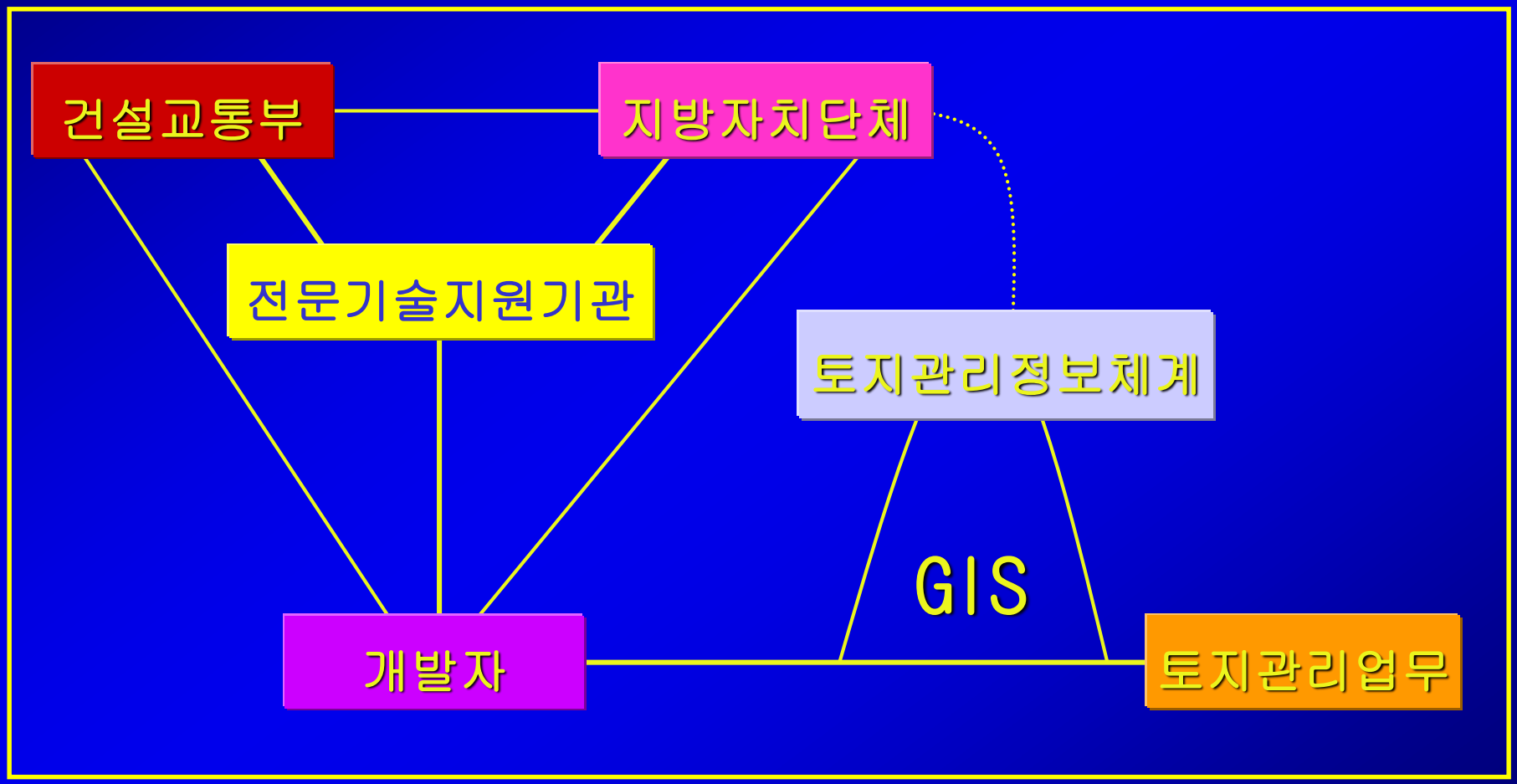
## IV. 지방자치단체 정보화 전략

토지관리정보체계 추진전략

- 사람 중심의 정보화
- 전문기관 기술지원
- GIS기술을 기반으로 한 통합인프라 구축
- 제도 정비
- 성과 관리 및 평가

# GIS를 기반으로 한 지방자치단체 정보화 전략

## IV. 지방자치단체 정보화 전략



# GIS를 기반으로 한 지방자치단체 정보화 전략

## IV. 지방자치단체 정보화 전략

**전문기술지원기관이 하는 역할은**

지방자치단체 정보화를 추진함에 있어서

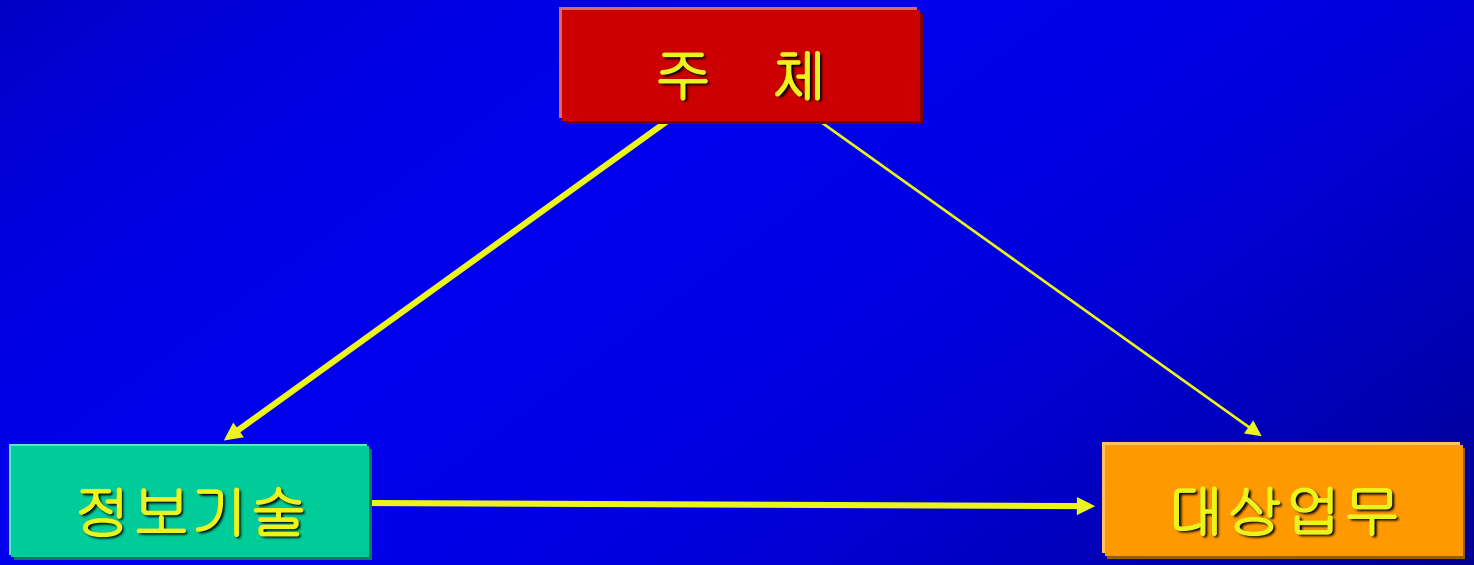
담당자들이 자기의 역할을 할 수 있도록 지원

- ❍ 사업추진계획 수립 지원
- ❍ 담당자 역할에 적합한 교육, 워크샵

# GIS를 기반으로 한 지방자치단체 정보화 전략

## V. 맺는 말

- 사람(조직)에 의한 정보화
- 사람을 위한 정보화



4th GIS seminar , KRIHS, KOREA

# APPLICATION OF GIS TO URBAN & REGIONAL PLANNING : GIS-based Decision Support System for Community Facility Location Planning Using AHP

*17th September 1999*

**Akira Ohgai**

Dept. of Architecture and Civil Engineering,
Toyohashi Univ. of Technology,
Toyohashi, JAPAN

DAP - 1

# 1. Applying GIS to urban & regional planning

Urban & regional planning is spatial planning based on map. That is ...

Planning process is a series of work as follows:

1) Analysis on the present conditions about urban activities or urban land use;
2) Definition of problems and targets or goals;
3) drawing up the alternatives and evaluating them;
4) Implementation;
5) Monitoring.

All of the work need maps,
Planners have to manage and deal with a diversity of information about urban activities and land use.

In order to reduce the load of planners and raise the quality of planning, GIS is very useful.

Because GIS has the function of dealing with geographic information based on maps.

DHP- 1

# 1. Background of system development

**The past studies on facility location planning**

These have focused on various methods of solving optimum location problems that are almost based on mathematical programming techniques.

From the standpoint of providing a useful decision support tool for application in real planning area, it is not important to get the optimum location, but the following aspects are indispensable.

The first requirement:
Decision-makers can choose several sites in real planning area, for example possible to build a facility.

The second requirement:
The support system enables them to evaluate the alternative set from various criteria such as users' convenience or services' efficiency and impartiality.

The third:
To provide a GIS-based system that has an interactive interface and provides visual presentation and easy operational functions for end-users.

**PURPOSE**

I attempt to develop a GIS-based decision support system that is useful for actual community facility location planning, using an analytical hierarchy process (AHP).

# 5. Application to the Toyohashi-Hamamatsu region

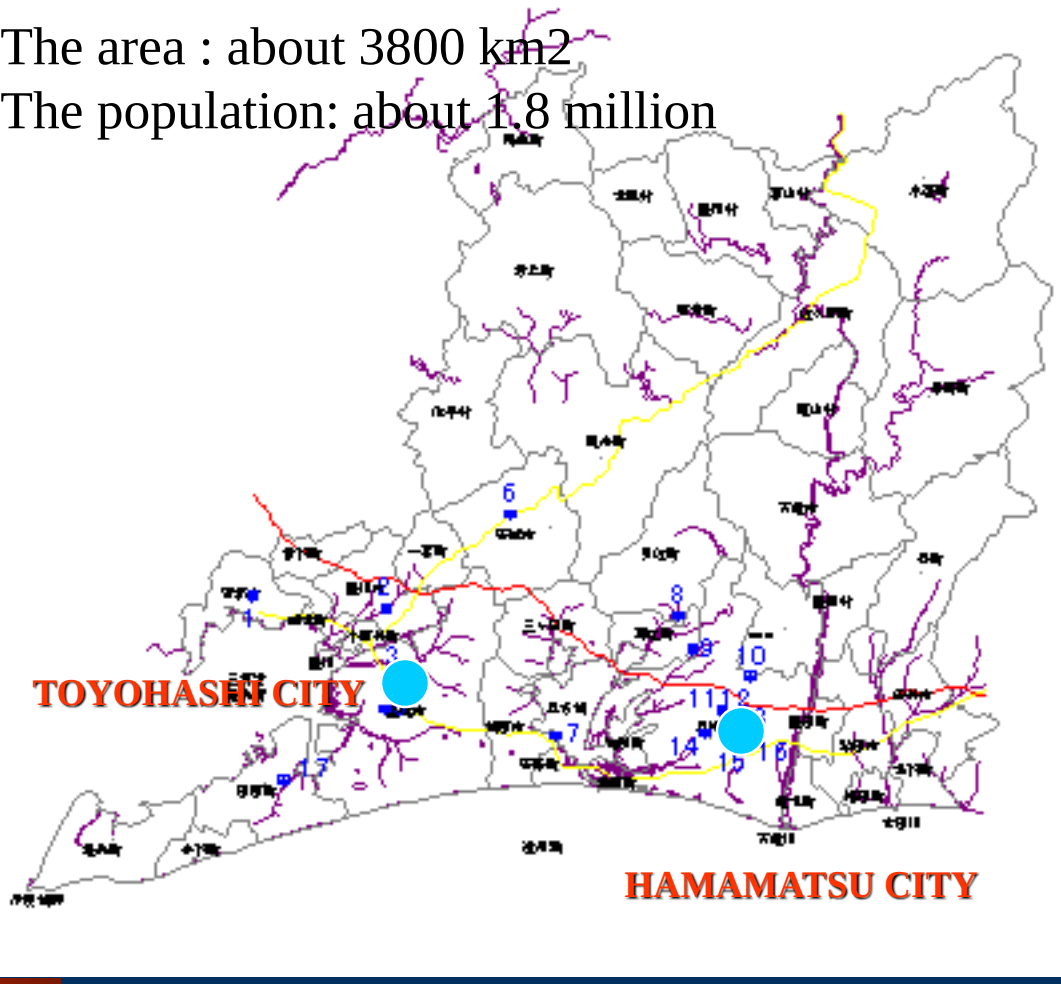
## Outline of the region

1) Most of the population is partially distributed in the southern developed area.

2) Th northern area has a problem on depopulation and aging.

3) In the region, there are 17 general hospitals with more than 100 beds, but most of them are located at densely populated area in the south.

The area : about 3800 km2
The population: about 1.8 million



The values of four indexes, which were calculated based on the Tij estimated for existing 17 facilities.

| | |
|---|---|
| 1) Average distance | 15,168 meters |
| 2) Maximum distance | 72,214 meters |
| 3) Rate of users within 5 km | 32.7 % |
| 4) Rate of users within 3 km | 21.6 % |

**PLAN 1** : Relocating Toyohashi general hospital in the center of the city to the suburb.

**PLAN 2** : Rebuilding Toyohashi general hospital in the present site, increasing the number of beds to 900.

**PLAN 3** : Building a new facility with 500 beds in the northern area.

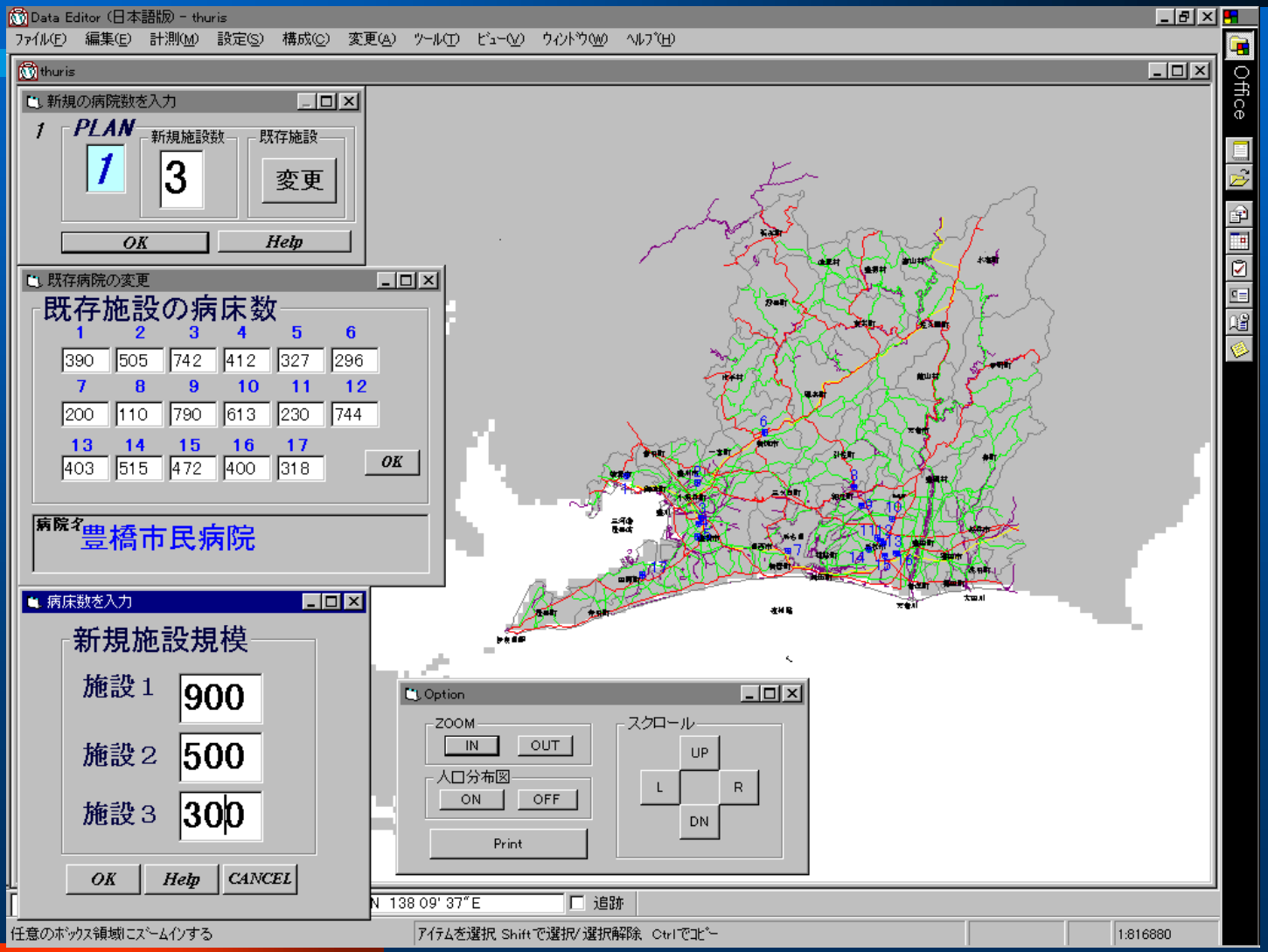
**PLAN 4** : Building a new facility with 500 beds in the area where there is no general hospital in the densely populated area.

# STEP 1 Setting the alternatives

## This panel is for setting a first facility-locating plan.

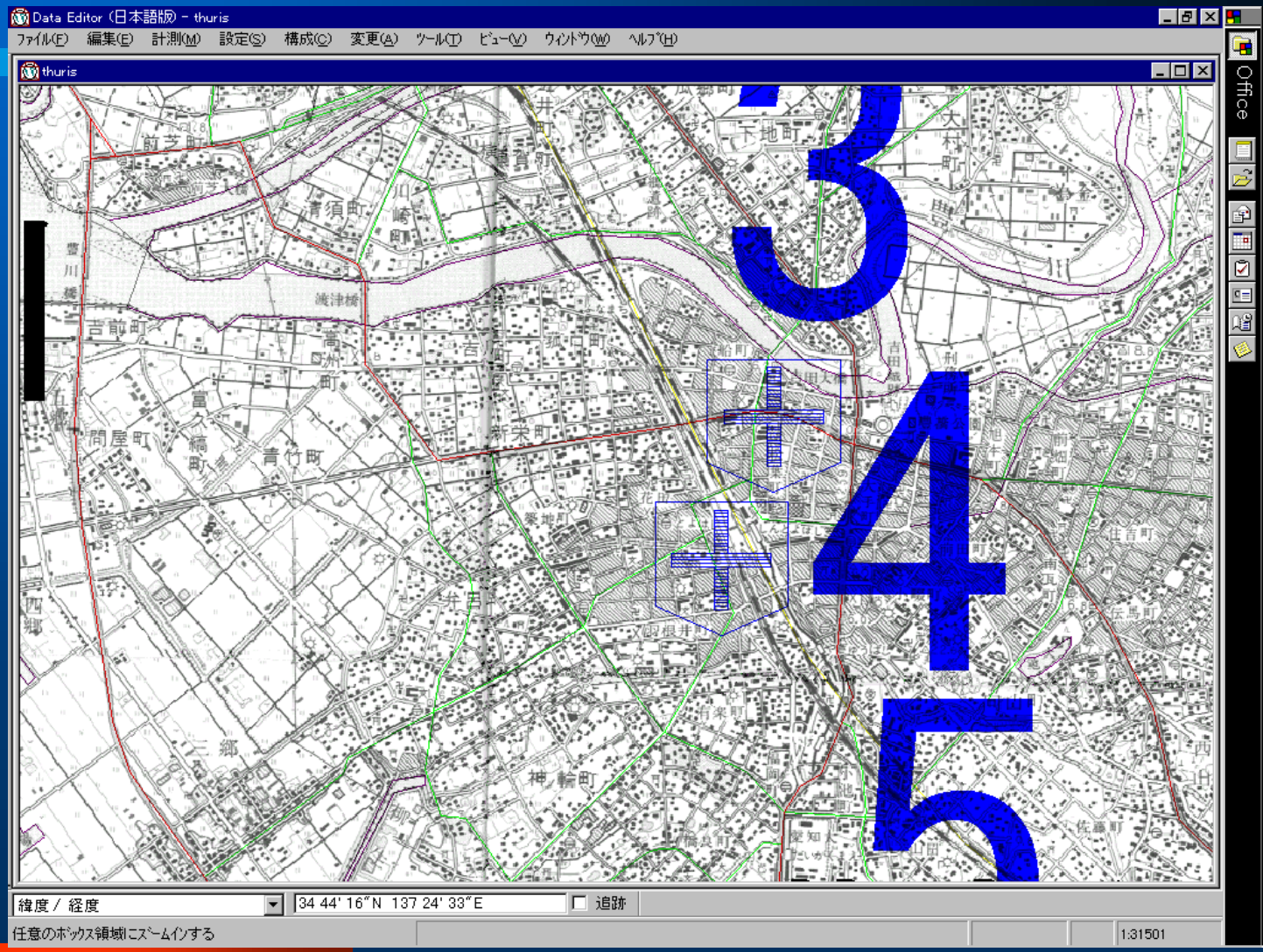
A user first inputs the number of new facilities and the number of their beds.

He can change the number of the beds for existing facility if need be.



# STEP 2 Choosing a site of a new facility

A user selects a site by clicking a mouse on the screen of SIS, where a raster-formatted map is displayed.

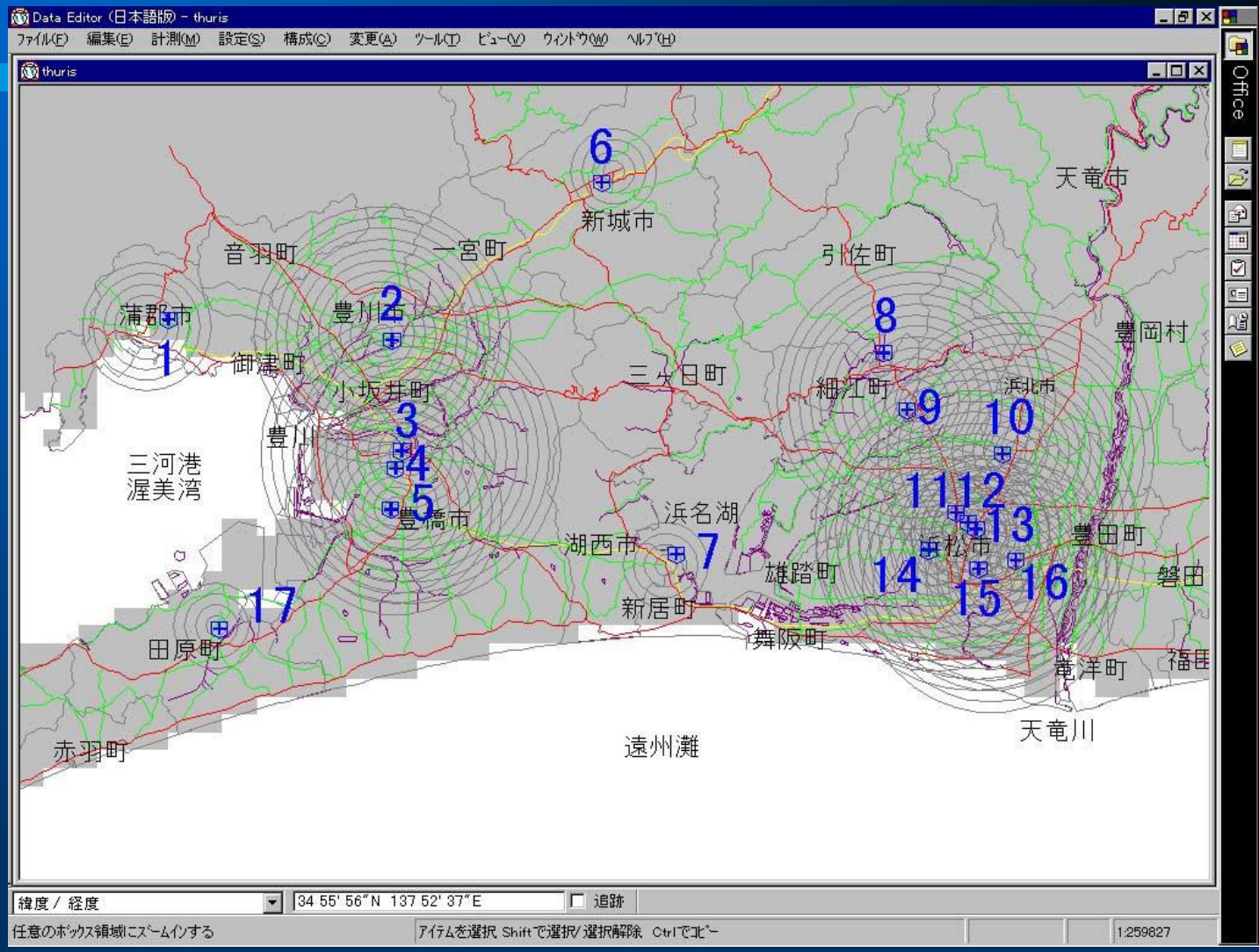


# STEP 3 Estimating the facility-selecting behaviour and calculating the values of four indexes

1. The system first executes the shortest path searching for the new facility,

2. and gets the shortest distance data for existing facilities from EXCEL.

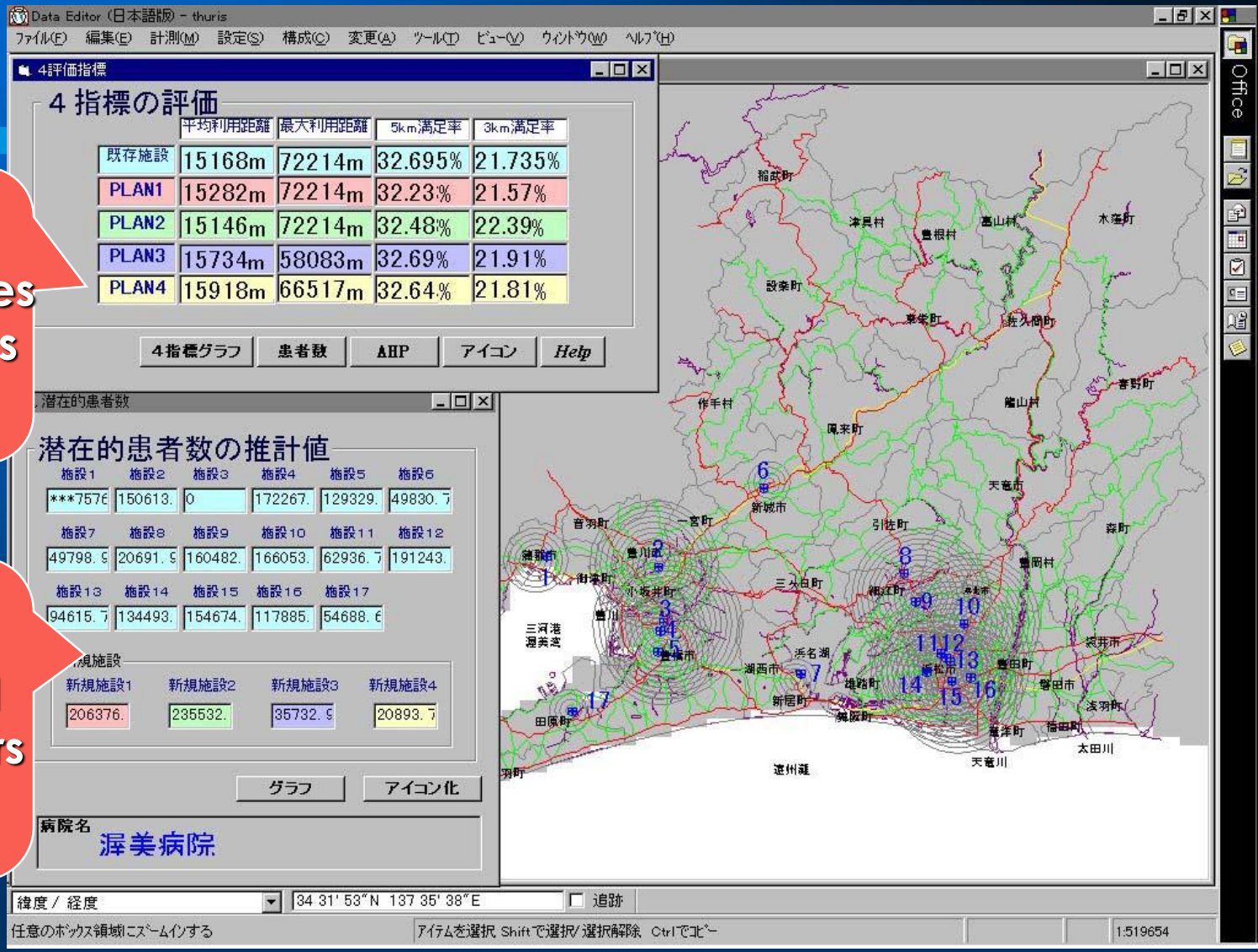
3. The number of facility-users for each node i and each facility j is estimated.



# STEP 4-1 Displaying the results of estimation

This panel shows the values of four indexes by plan.

This shows the estimated number of users by facility.



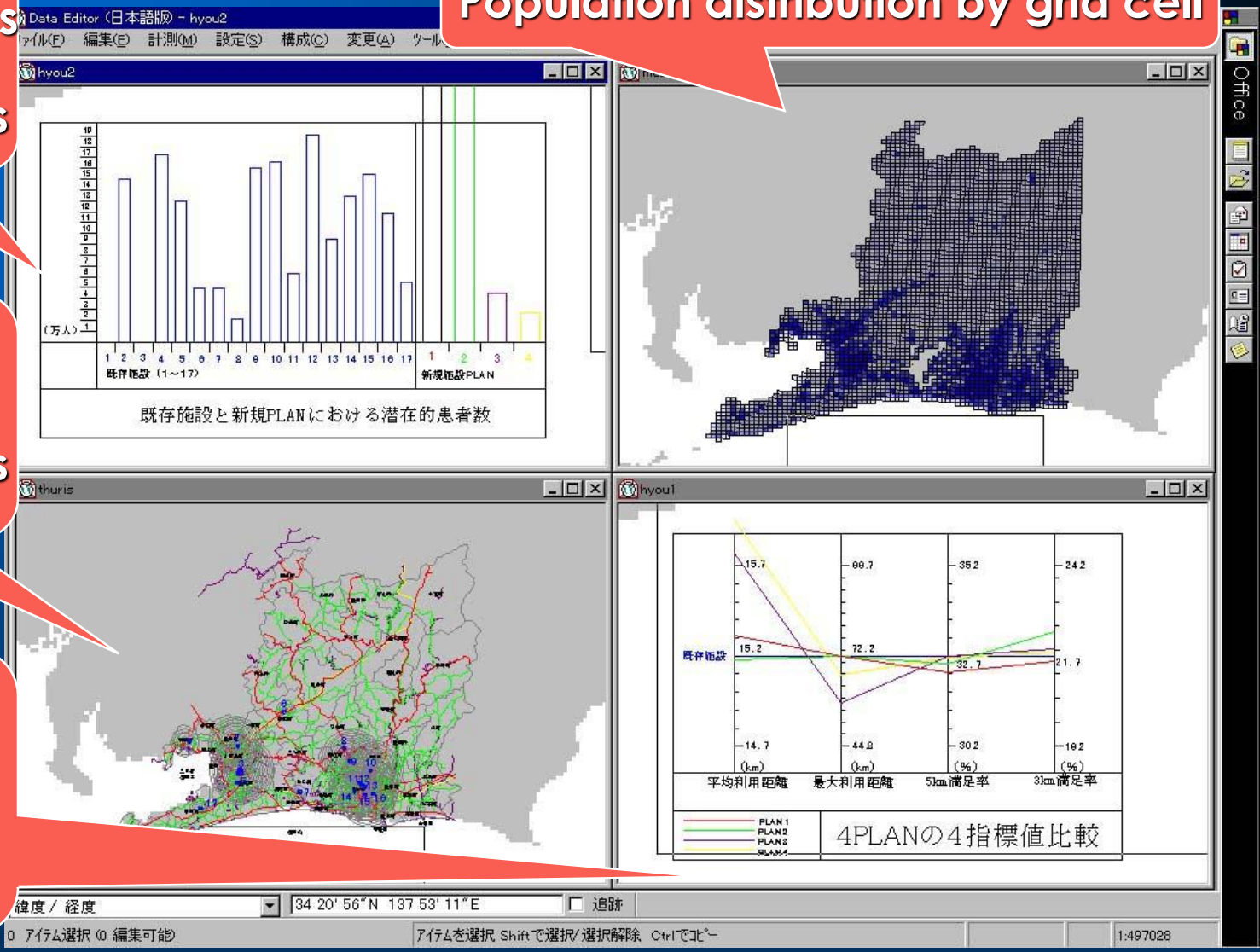
# STEP 4-2 Displaying the various information

This graph shows the estimated number of users

Population distribution by grid cell

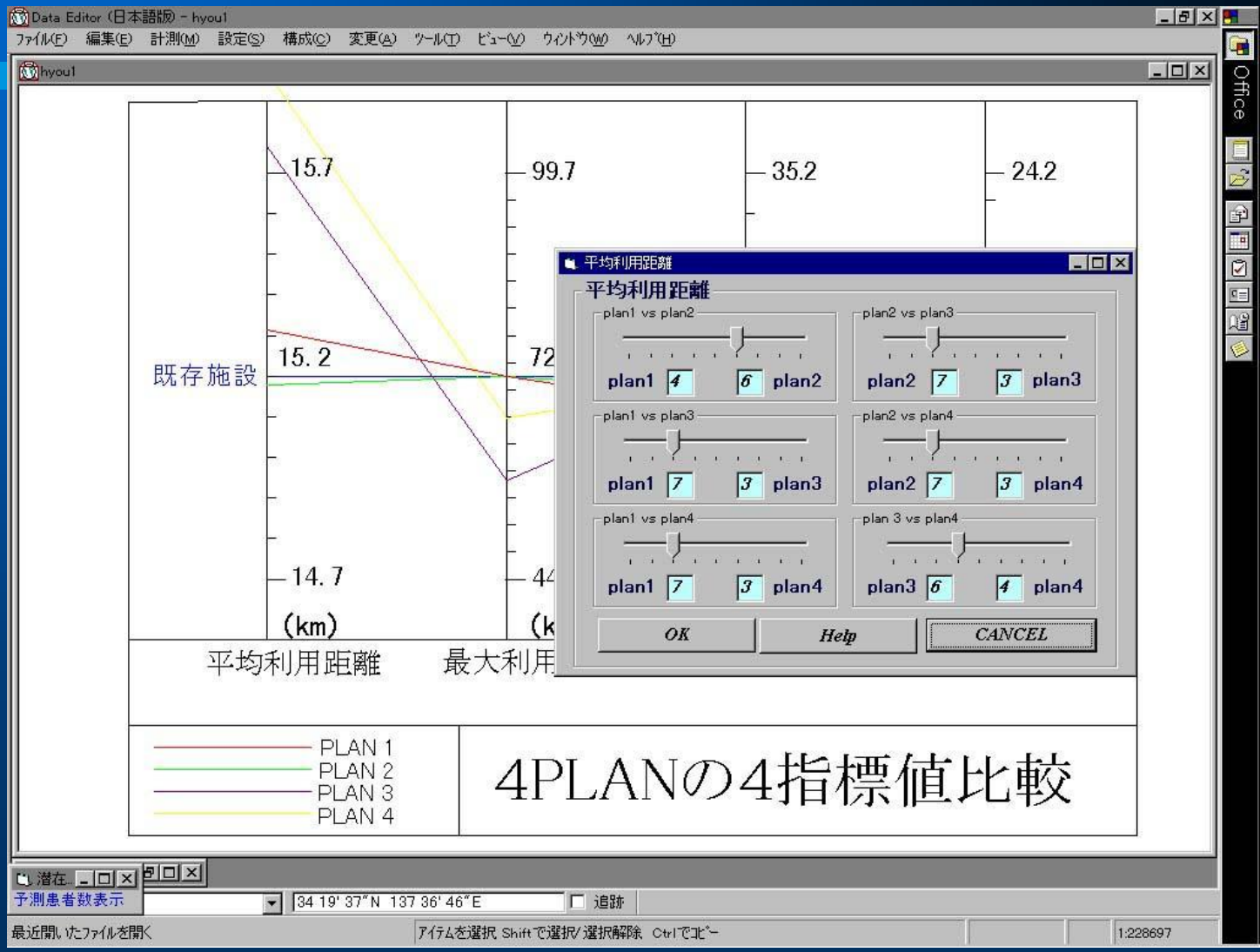
Mapping the estimated number of users

Comparison of four values for each index by plan



# STEP 5 Multicriteria evaluation using AHP (1)

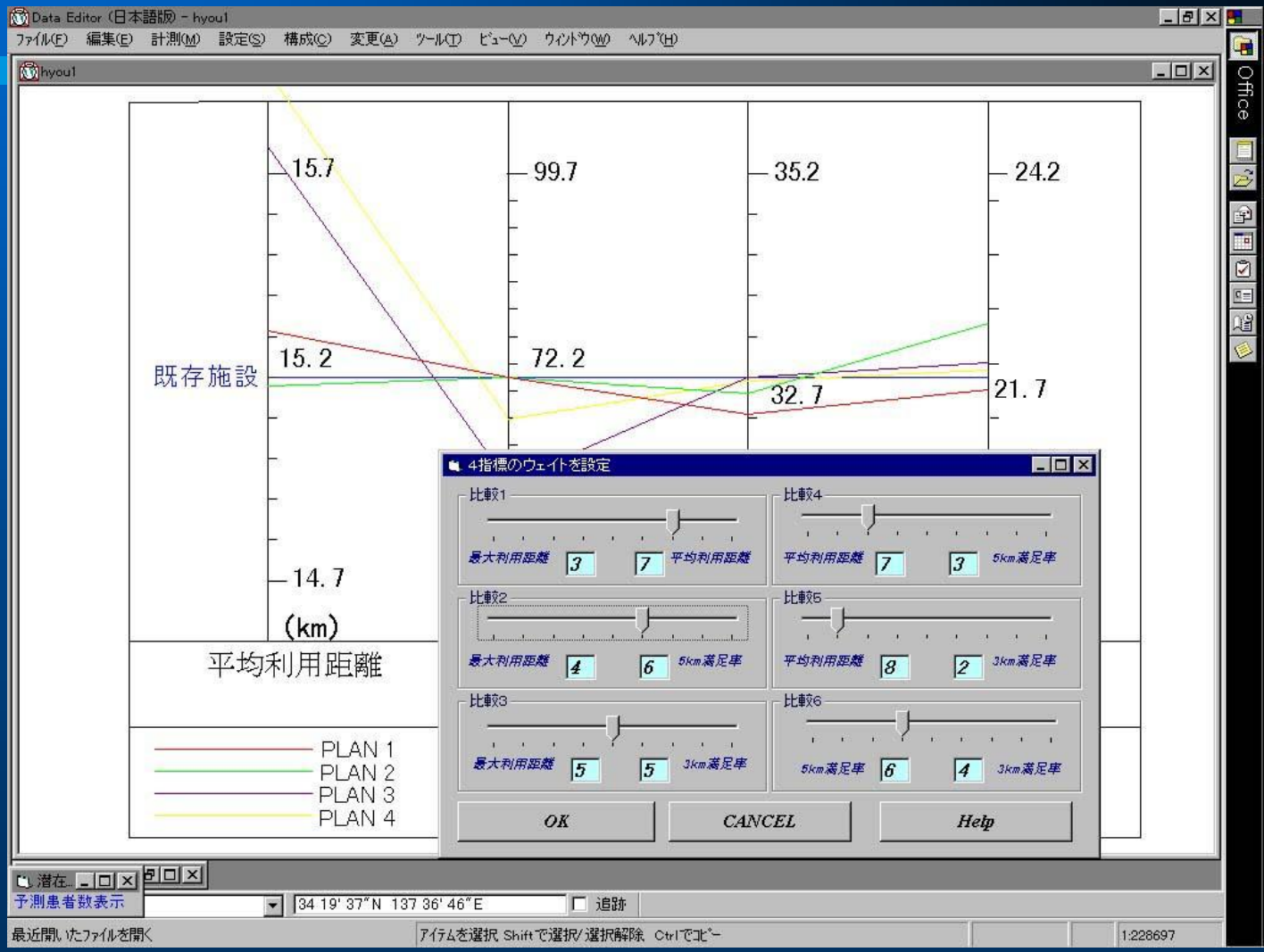
A user carries out a pairwise comparison between the alternatives by index, moving a scroll bar on the panel in turn.



# STEP 6 Multicriteria evaluation using AHP (2)

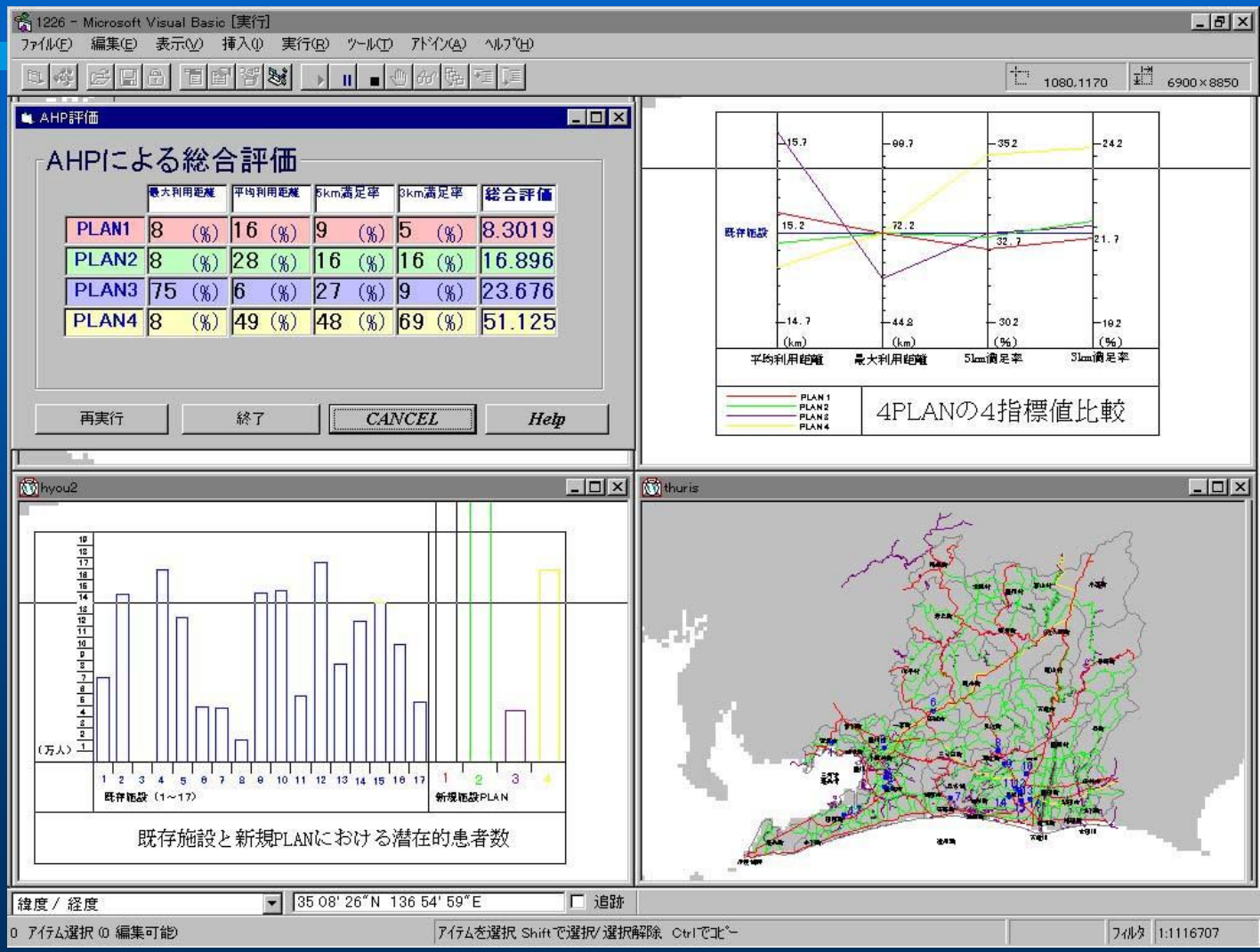
Next, a user sets the weight of each index by moving a scroll bar again.

Following this procedure, when ‘OK’ button is clicked, the result of evaluation is finally displayed.



# STEP 6 The result of multicriteria evaluation

Considering a diversity of information given in a series of procedures as well as the result, a user can determine the most desirable location plan.



# Land Information Service

## A Basic Need

## for

## Investment

## and

## Facility Management

**Dr. Ing.**
**Friedrich Rokahr**
**Berlin**
**Germany**

# Structure

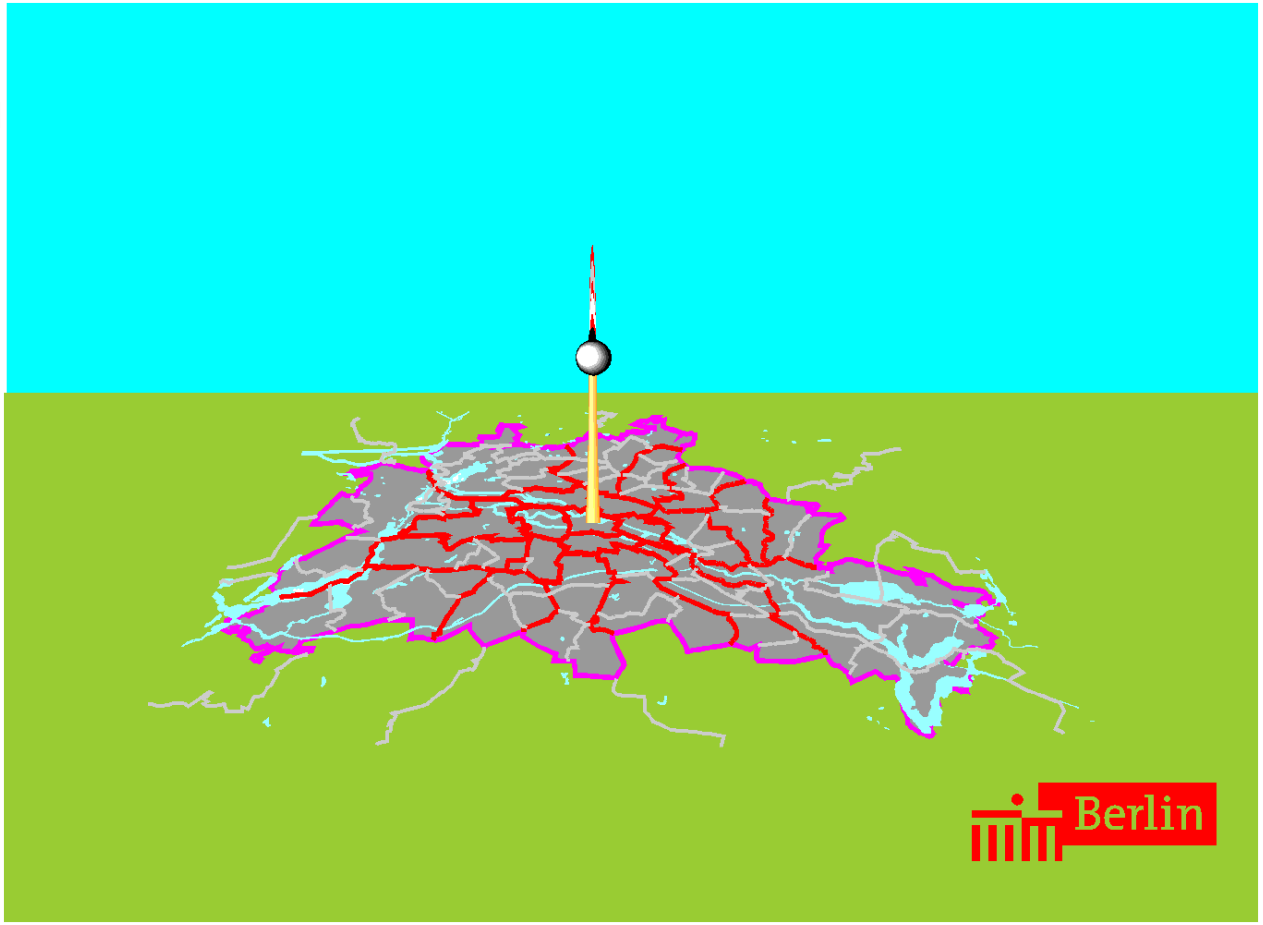
- **1 Preface**
  - Statistic Information
- **2 Definition**
  - GIS LIS Land Information Service
- **3 GIS Berlin - Concept and Experience**
- **4 Launch of the Geo Information Management with GIS Berlin**
- **5 Property Market Database**
- **6 BLIS - Berlin Land Information Service**
- **7 Locational Factors by BLIS for Building Investments**

# Germany and Berlin



# Berlin `s Administration Districts

Charlottenburg
Friedrichshain
Hellersdorf
Hohensch´hsn
Köpenick
Kreuzberg
Lichtenberg
Marzahn
Mitte
Neukölln
Pankow
Prenzl.Berg



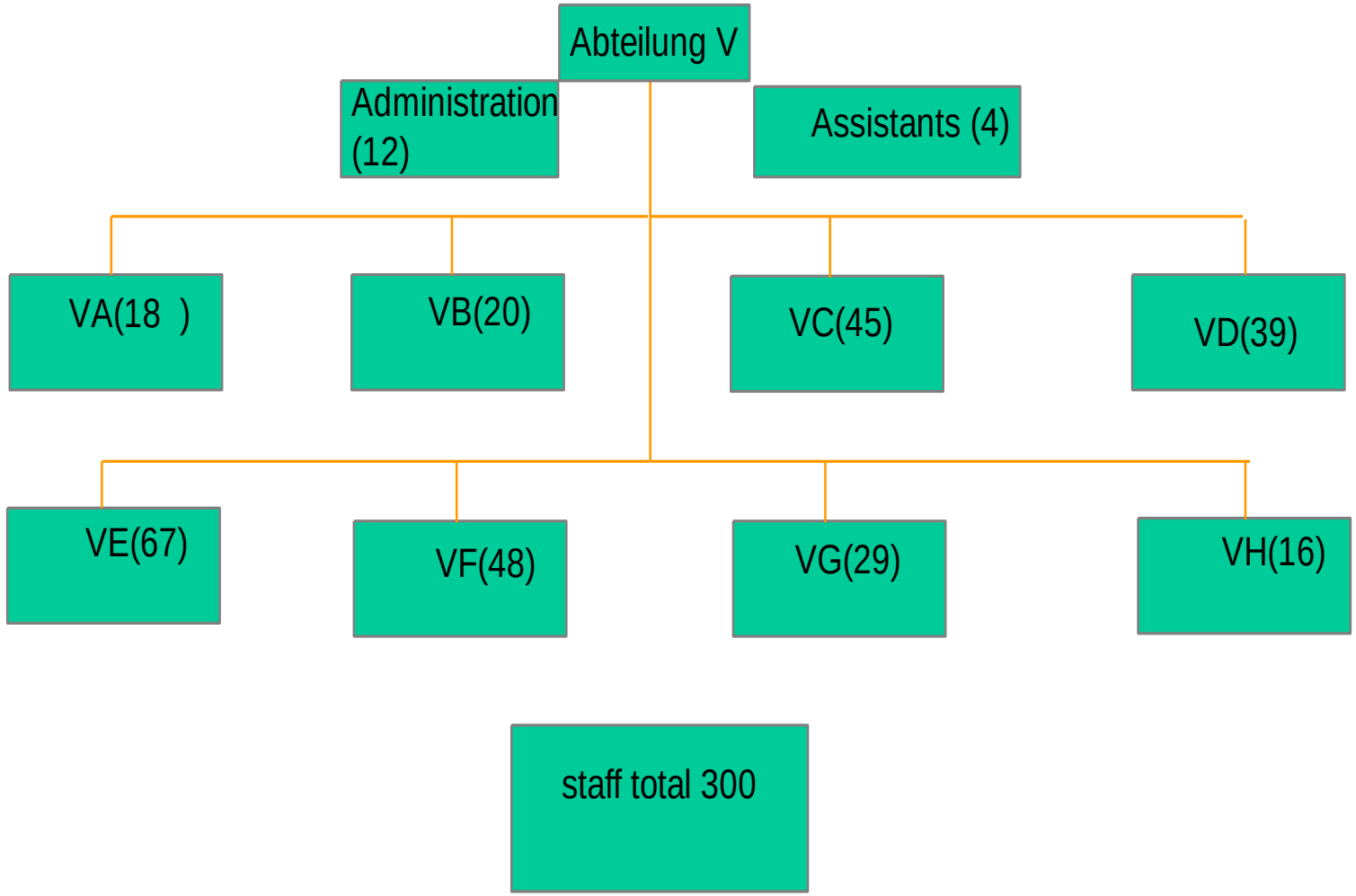

Reinickendorf
Schöneberg
Spandau
Steglitz
Tempelhof
Tiergarten
Treptow
Wedding
Weißensee
Wilmersdorf
Zehlendorf

# Berlin Statistic

| | | |
|---|---|---|
| **Total Space:** | **890,2 sq. km** | **100 %** |
| **Buildings and free space** | **380,2 sq. km** | **42,7%** |
| **Water and woods** | **212,2 sq. km** | **23,8%** |
| **Transport** | **110,3 sq. Km** | **12,4%** |
| **Recreation, sport, green** | **97,8 sq. km** | **11,0%** |
| **Other** | **89,6 sq. Km** | **10,1%** |

# Department of Geoinformation, Surveying, Valuation





# Definitions

GIS = geographic data about the earth spatially referenced

**LIS** = data about land, information about the soil spatially / functionally referenced

**Land Information Service** = activity associated with the management of land

**FM** = facility management = administrative activity with economic approach, administration of immovable properties

# GIS Definition by Law

**Surveying Act of Berlin ( 1974, updated 1996)**
Sect. 6a

The products of the Land Surveying and Mapping Agency and the documents of the Real Estate Register form the Official Base Information System, which is to be used as the basis for all spatial and territory related information systems of all the Berlin administration.

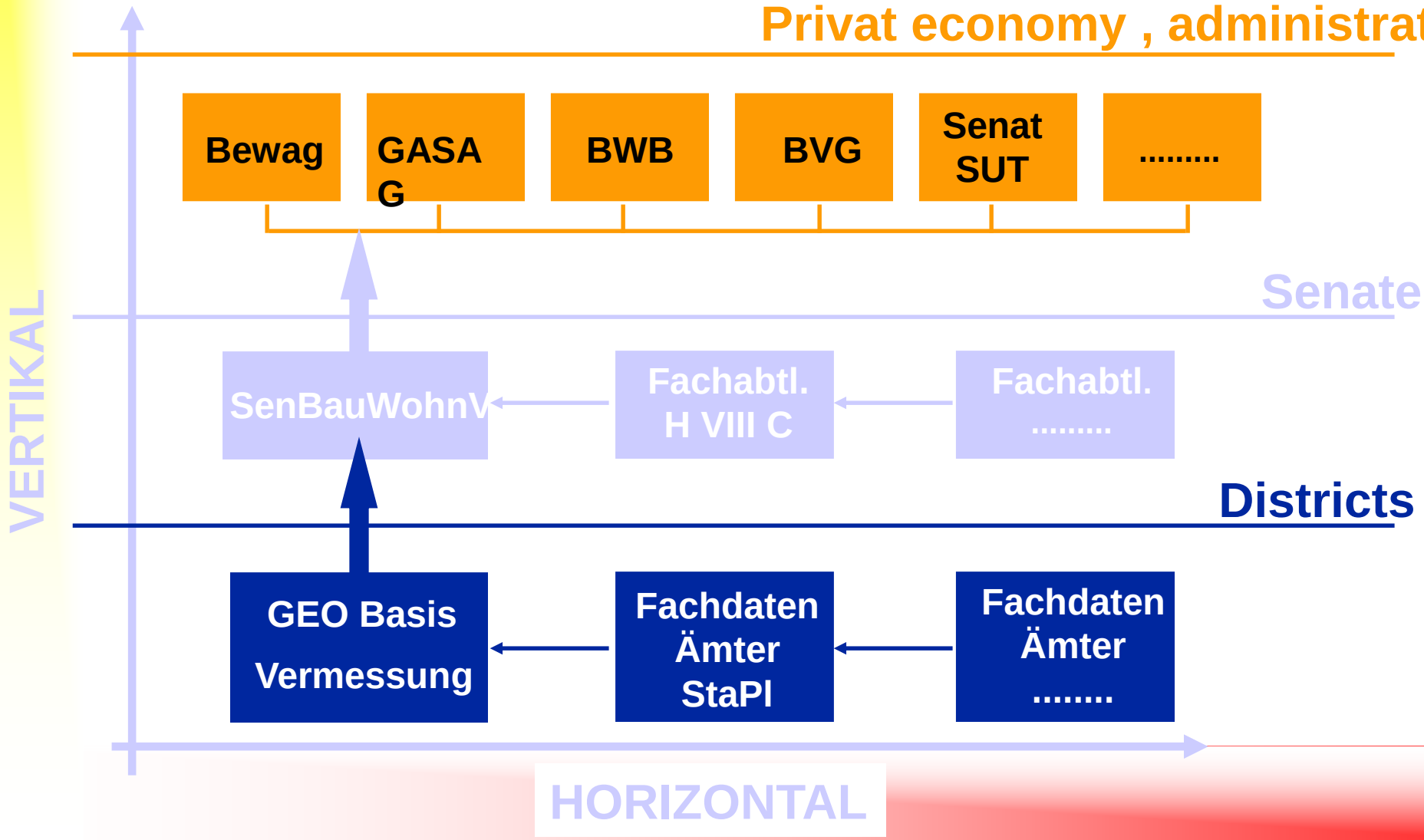
# GIS - New Vision



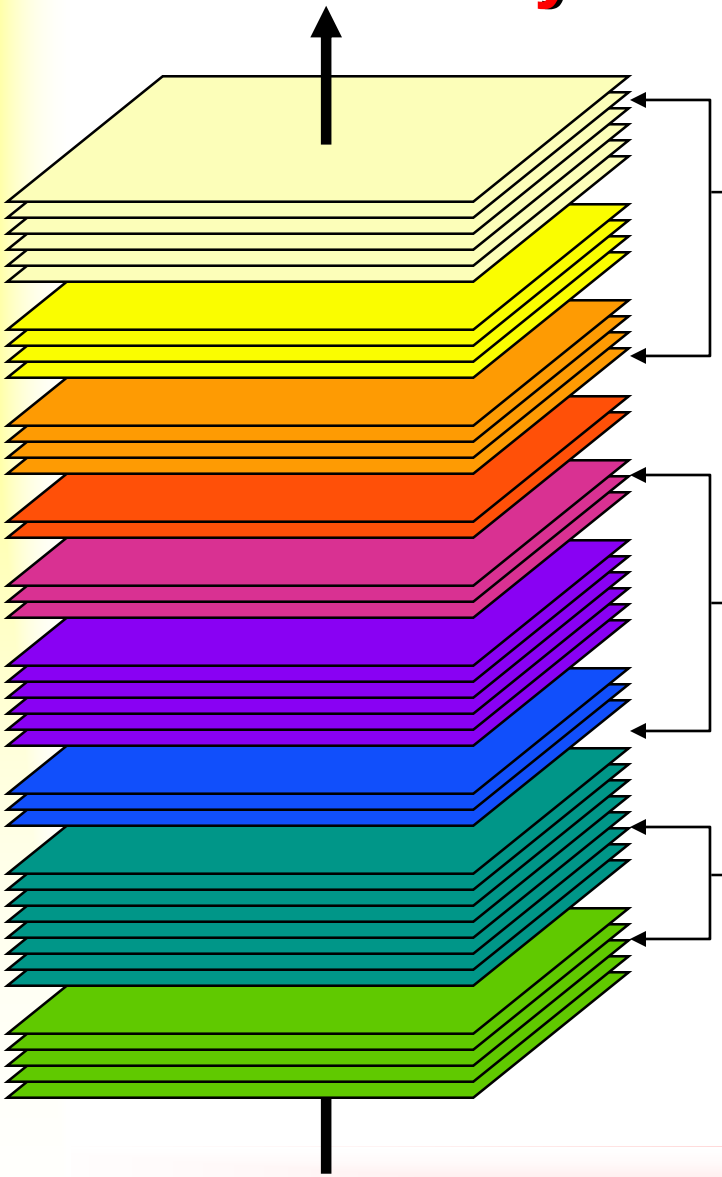
- Increased utilisation of existing data archives
- improved process orientation
- extended user orientation
- organised data transfer within public administration
- compliance on national regulation and European standards

# Utilisation/process/user orientation/ means





# Layer Design of GIS Berlin



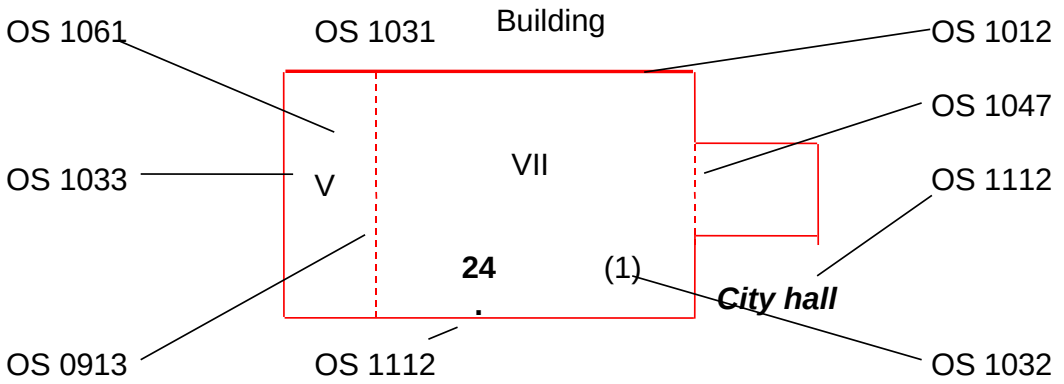
**New Customer 700-999**
- electricity
- gas
- water
- master plan
- applications of more than one districts etc.

**Specific district applications 200-699**
- locally binding plan
- park
- environmental damages

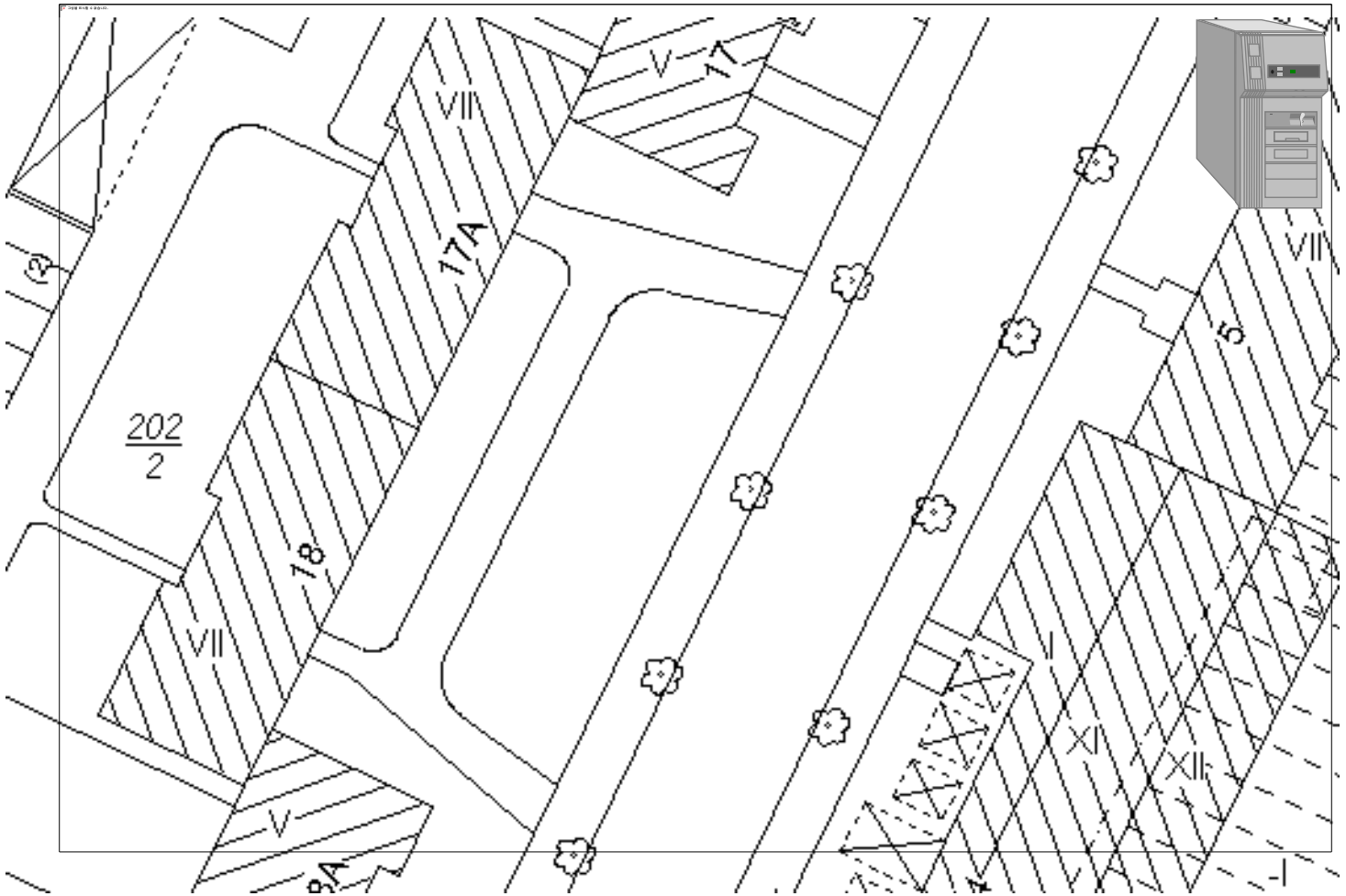
**Official Base Information 000-199**
- data
- maps (digital, raster data)

# GIS - Object Forming

Example of object forming



# GIS - Digital Map of Berlin (1:500)



# GIS - Quality Model

- Quality parameters
- completeness
- precision
- consistency
- accuracy
- legal reliability
- trustworthiness

# Contents of BASIS GIS

points/coordinates of the Berlin Coordinate Register

boundaries of
- parcels (349 504)
- cadastre sections (fields) [Flur](1617)
- numbering districts
- local districts
- statistic block, statistic areas (15847)
- waters

buildings (541 910) represented by
- outlines
- features (geometry, text)
- nature of usage

# Contents of BASIS GIS

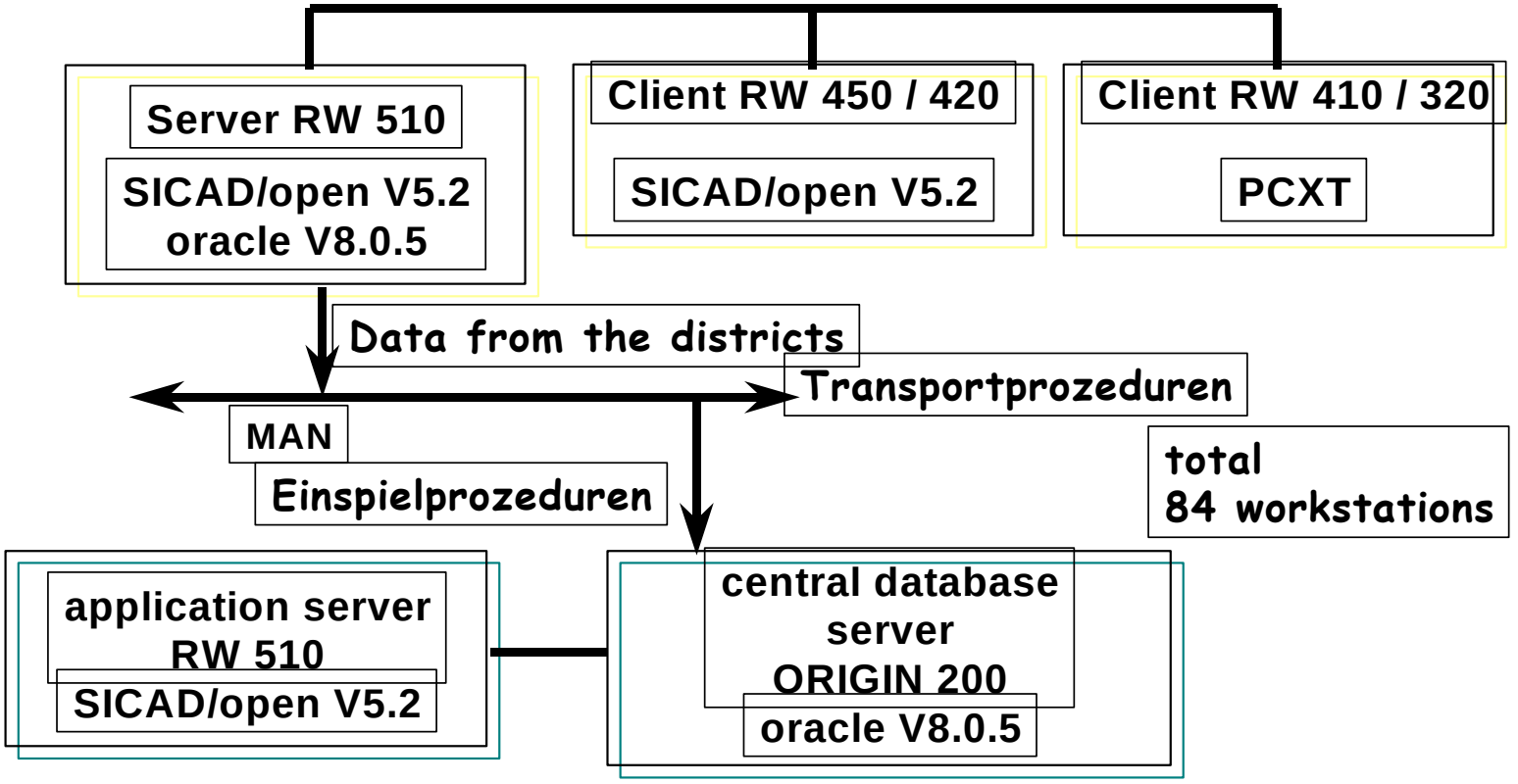
Topography

| | |
|---|---|
| bridges | (1 193) |
| staircases | (1 518) |
| edges of kerb (stones) | |
| street trees | (412 000) |

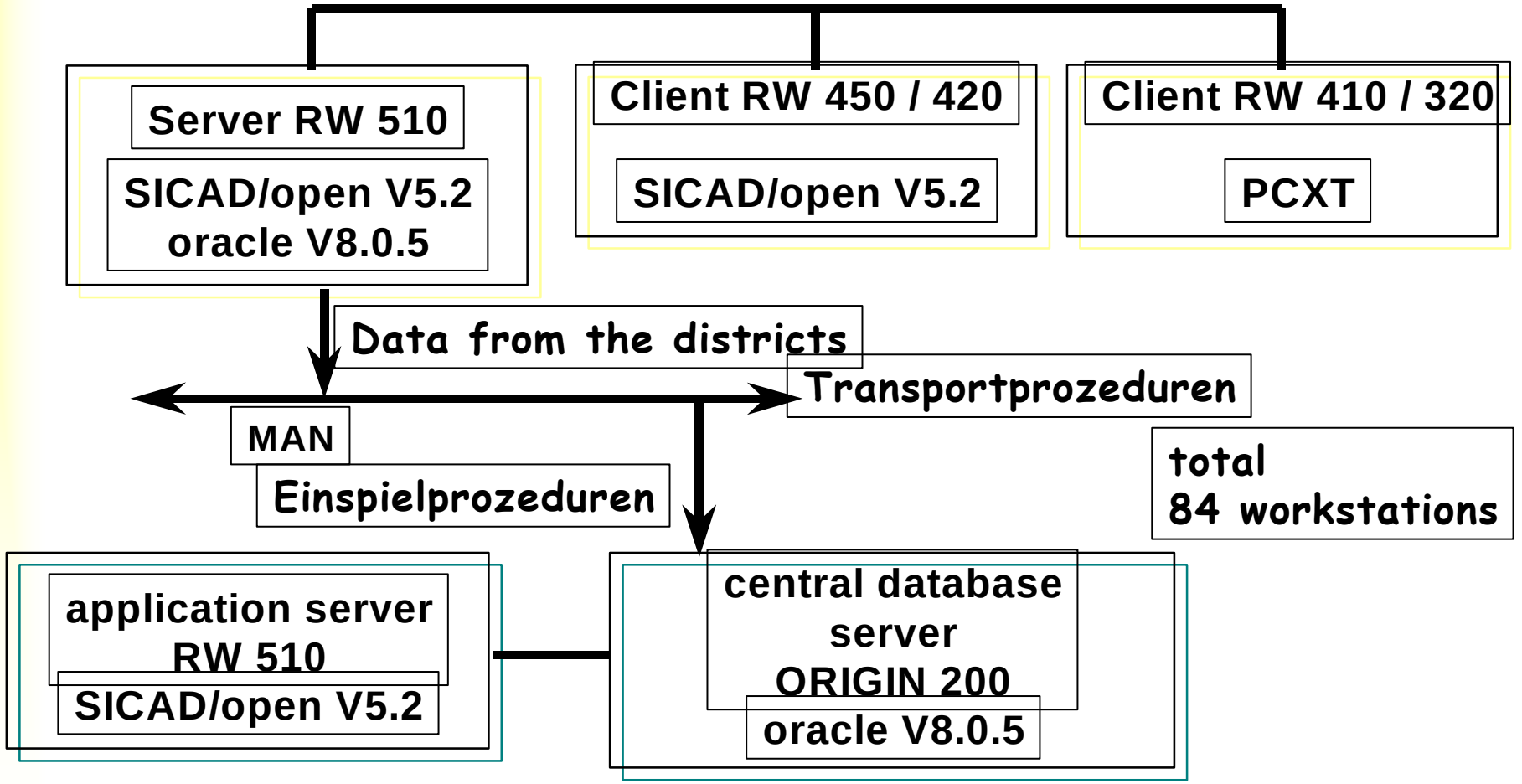
Lettering

- parcel numbers
- property numbers
- street names
- explanation lettering

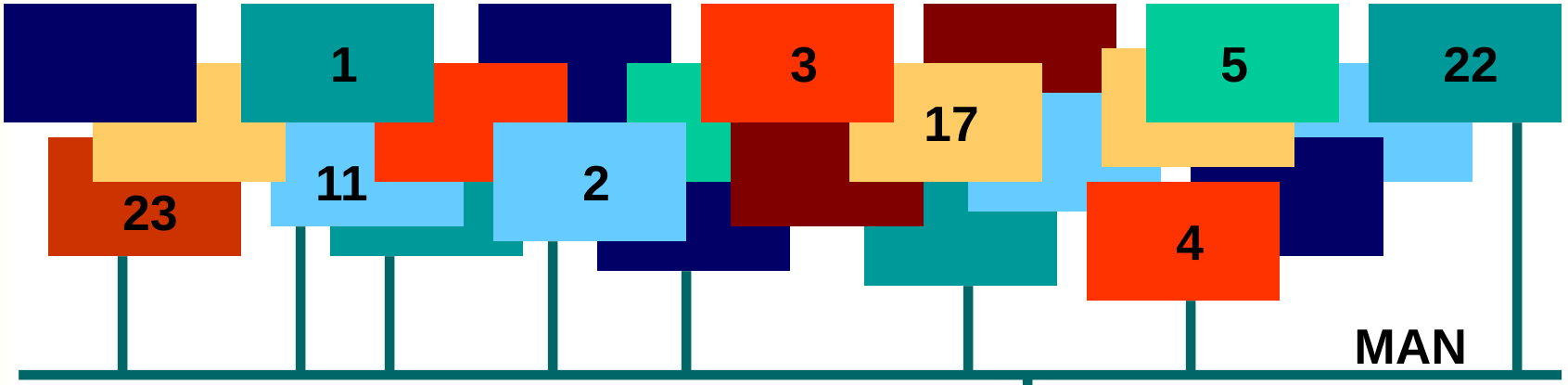
# GIS Berlin Hardware



# Secondary user process



# Difference update supply GIS




23 x secondary user process(BZSN)

**Central data base server**
GIS POOL “Berlin”

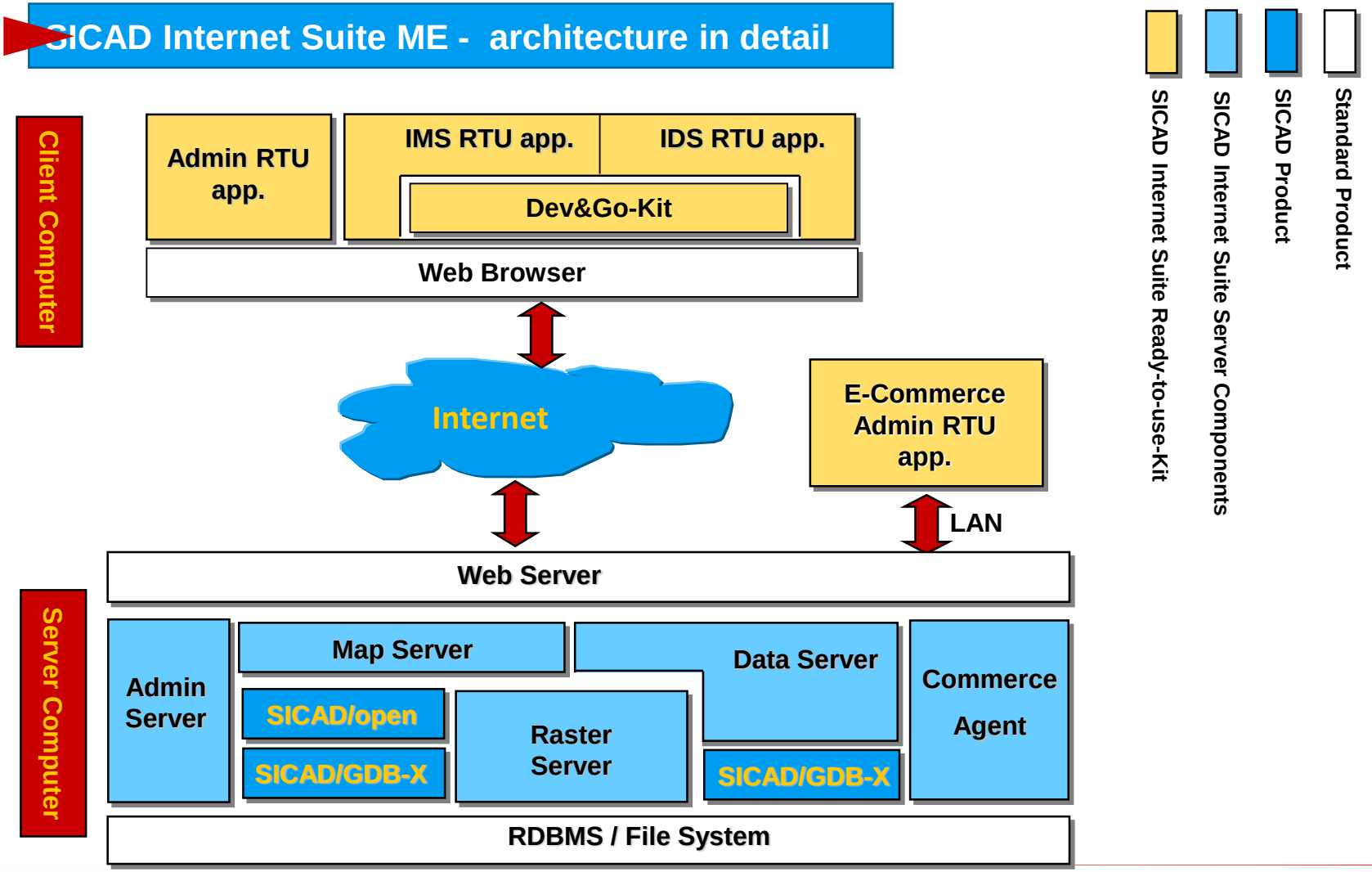
5 BZSN- Contracts

GASAG | Bewag | BWB | BVG | SenSUT

# SICAD Internet Suite ME - Pilot Project SBauWV Berlin



## SICAD Internet Suite ME - architecture in detail



# SICAD Internet Suite ME - Pilot Project SBauWV Berlin

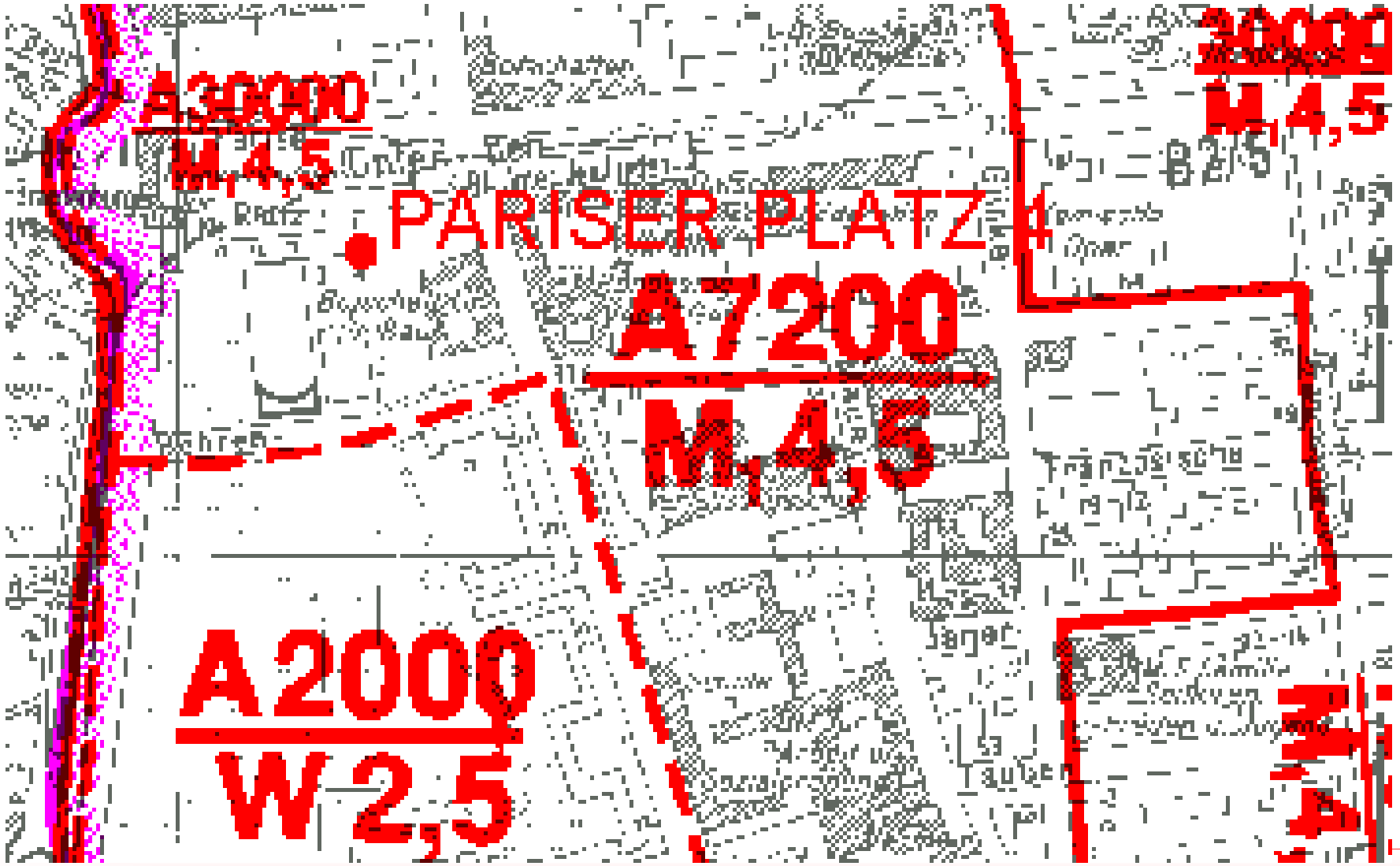


## SICAD Internet Map Server ME - Highlights

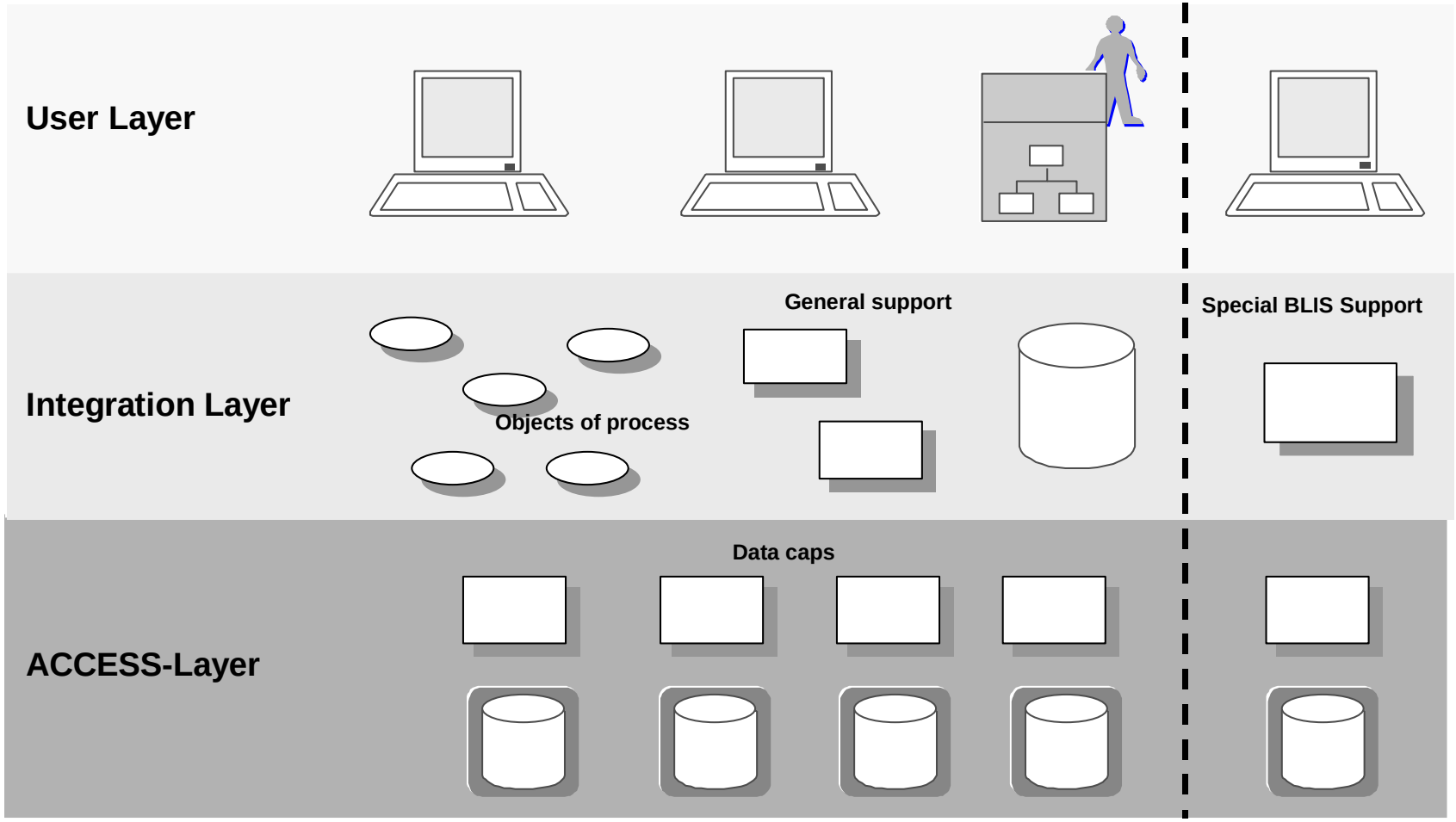
- Presentation of vector-, raster- and alpha data
- Dynamic and seamless presentation of actual data sources (operational database)
- Initiating via alpha data (e.g. address selection) or graphical images (e.g. overview maps)
- Various navigation methods (pan, center, logical zoom)
- Switching (on/off) of thematic layers in the tree-view (as with MS-Explorer)
- Print/plot mechanisms including the creation of map legends
- Configurable queries and display of alpha data
- „ready to use“ applications
- Administration tool for easy configuration

# Property Market



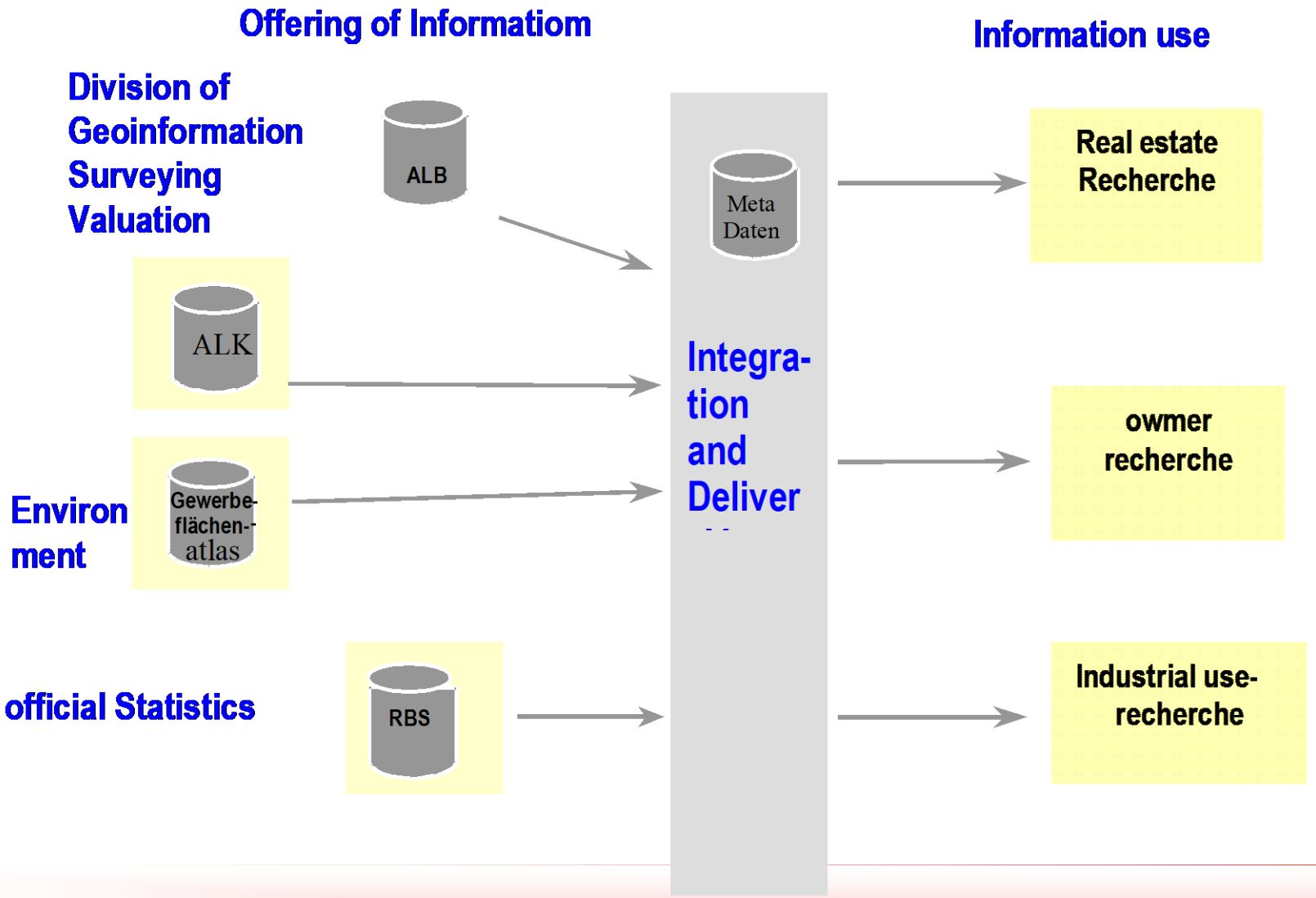


# Berlin Land Information Service BLIS

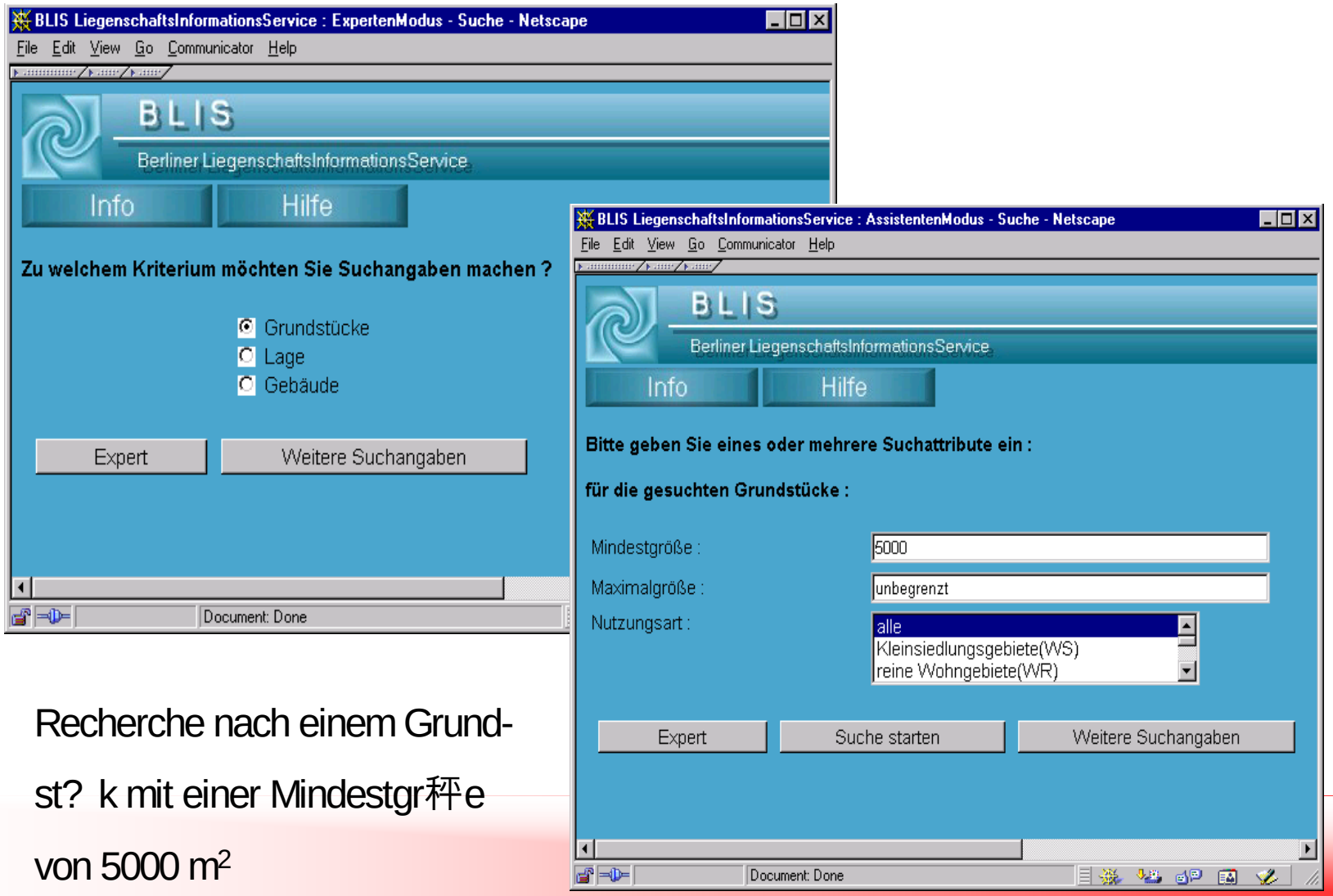


# Berlin Land Information Service BLIS





# BLIS-Startapplikation: Assistentenmodus




Recherche nach einem Grund-

st? k mit einer Mindestgr秤e

von 5000 m²

# Locational Factors for Investment

## Benefit Analysis

- **Property information**
  - 1.1 affiliation to district
  - 1.2 size of  the property
  - 1.3 geometric quality
  - 1.4 area concentration number
- **Environment information**
  - 2.1 distance to shopping center
  - 2.2 distance to recreation zone
  - 2.3 land use in the neighbourhood

# Locational Factors for Investment

- Traffic affiliation
  - 3.1 pedestrian zone
  - 3.2 frequency of pedestrians
  - 3.3 accessibility by (car, bus, lorry)
  - 3.4 car park
  - 3.5 distance to closest railway station, metro
- asking BLIS
- start working your property assessment
- give quality points

# Locational Factors for Investment

- **Example:(benefit analysis)**
  - 1.1 very nice district 70 pt x0.12 = 8.4
  - 1.2 size better than 800sqm 50 pt x0.10= 5.0
  - 1.3 geometric quality 80 pt x0.05= 4,0
  - etc
  - weights (sum) 0,27 17,4
- **Alternative** **0.20** **10.3**

# THE USE OF GEOGRAPHIC INFORMATION SYSTEMS FOR FOREST FIRE MANAGEMENT IN INDONESIA

**KUSTANTA BUDI PRIHATNO**

**FORESTRY AND ESTATE CROPS PLANNING AND PROGRAMMING AGENCY**

# INTRODUCTION

- *Forest is an important natural resource*
- *Forests cover 60 % of Indonesia' total land*
- *Fire is one of the greatest threat to tropical forest of Indonesia*
- *Forest fires are mostly caused by human*
  - *Land clearing*
  - *Agricultural practices*
- *Boosted by long dry season as an impact of El Nino, a big Fires occurred, in 1997/1998.*
  - *Forestry sector loss = USD 6.1 billion*
  - *Total loss = USD 9.2 billion*
- *Land preparation using fire is not allowed*

- ***Several projects related to fire management***
  - ***Forest Fire Prevention Management Project (FFPMP) by JICA***
  - ***Forest Fire Prevention and Control Project by EU (terminated)***
  - ***Tropical Forest Management Project Supported by ODA - UK (terminated)***
  - ***Integrated Forest Fire Management by GTZ***

- ***Forest Fire Management within Ministry of Forestry and Estate Crops***
  - ***Coordinated by DG of Nature Protection and Conservation***
  - ***Mapped by Forestry and Estate Crops Planning and Programming Agency***

# FIRE DETECTION

- Objectives :
  - to detect and monitor forest fires
- Using NOAA and HIMAWARI (GMS 5)

- NOAA
  - Contains Advanced Very High Resolution Radiometer (AVHRR)
  - Characteristic spectral of NOAA - AVHRR

| Band Number | Band Width (μm) | Remarks |
|---|---|---|
| 1 | 0.58 – 0.68 | Visible |
| 2 | 0.72 – 1.10 | Near IR |
| 3 | 3.55 – 3.93 | Mid-IR |
| 4 | 10.3 – 11.3 | Far IR |
| 5 | 11.5 – 12.5 | Far IR |

- Fire detection :

- Identifying High Ground Temperature (HOT SPOTS)
- Mainly using channel 3
- Two observations :
  - Day time (threshold 315 K)
  - Night time (threshold 310 K)
- Implemented daily
  - Out put is Latitude and Longitude coordinates

| No. | Long. | Lat. | Province | Hour | Date |
|---|---|---|---|---|---|
| 1 | 104.26 | -4.70 | Lampung | 15 | 10 |
| 2 | 105.10 | -4.10 | Lampung | 15 | 10 |
| 3 | 105.80 | -4.60 | Lampung | 15 | 10 |
| 4 | 105.50 | -4.30 | Lampung | 15 | 10 |
| 5 | 105.60 | -4.20 | Lampung | 15 | 10 |
| 6 | 103.24 | -2.39 | South Sumatera | 15 | 10 |
| 7 | 103.14 | -2.49 | South Sumatera | 15 | 10 |
| 8 | 103.21 | -2.41 | South Sumatera | 15 | 10 |
| 9 | 103.14 | -2.43 | South Sumatera | 15 | 10 |
| 10 | 100.51 | -2.06 | West Sumatera | 15 | 10 |
| 11 | 100.54 | -2.08 | West Sumatera | 15 | 10 |
| 12 | 100.55 | -2.11 | West Sumatera | 15 | 10 |

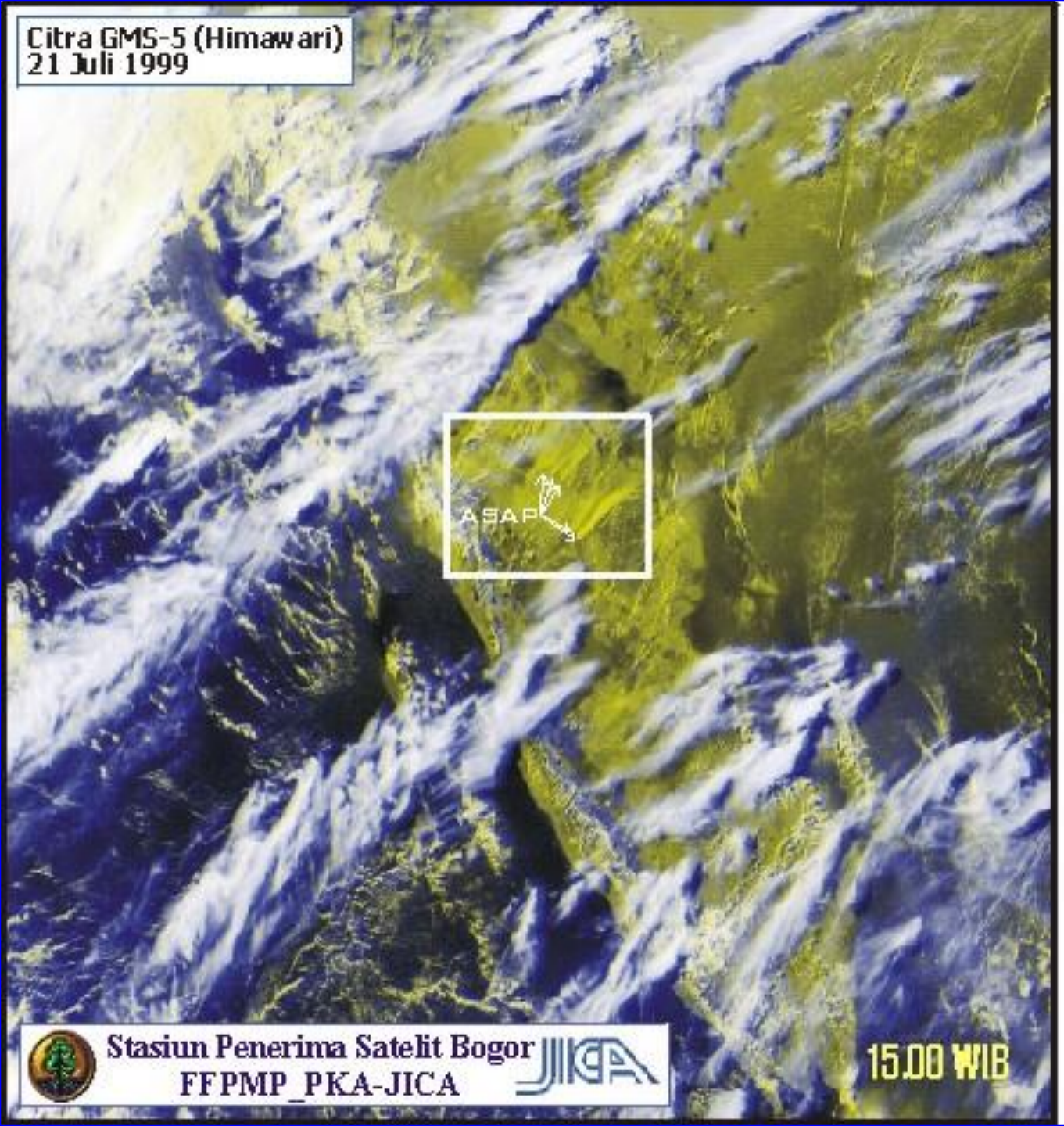
An example of hot spots coordinate list distributed by FFPMP-JICA

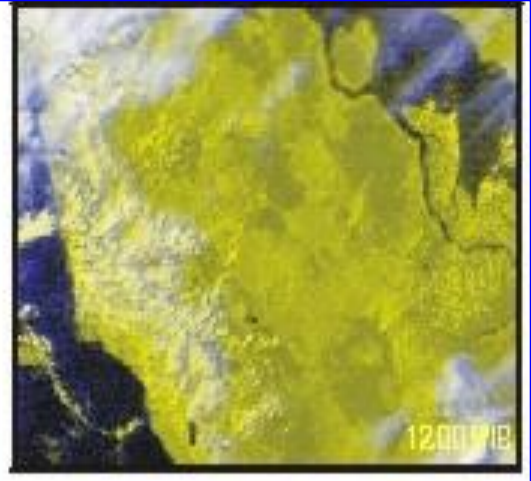
- HIMAWARI (GMS 5)

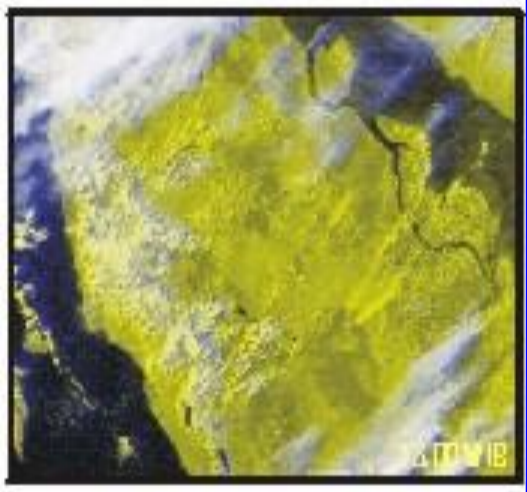
- Contains Visible and Infra red Spin Scan Radiometer (VISSR)
- Characteristic spectral of HIMAWARI -VISSR

| Band Number | Band Width (μm) | Scan Resolution (km) | Remarks |
|---|---|---|---|
| 1 | 0.5 – 0.75 | 1.25 | Visible |
| 2 | 6.5 – 7.0 | 5.0 | Mid IR |
| 3 | 10.5 – 11.5 | 5.0 | Far IR |
| 4 | 11.5 – 12.5 | 5.0 | Far IR |

- Use to detect smoke
- Only channel 1 and 2
- Visual interpretation


Citra GMS-5 (Himawari)
21 Juli 1999
ASAP
Stasiun Penerima Satelit Bogor
FFPMP_PKA-JICA
JICA
15.00 WIB


12.00 WIB





# FIRE MAPPING

- Using GIS software Arc/Info and Arcview
- Based on 1 : 250,000 scale of GIS data base library

## Fire Distribution

---

* Importing hot spot coordinates (text file) into various thematic layers
* Thematic layers :

  Administrative boundaries, forest land use, land cover, forest concessionaire, estate crops, industrial plantation forest,

* In addition to the occurrence of hot spot, the frequency of hot spot is also taken into consideration in determining fires

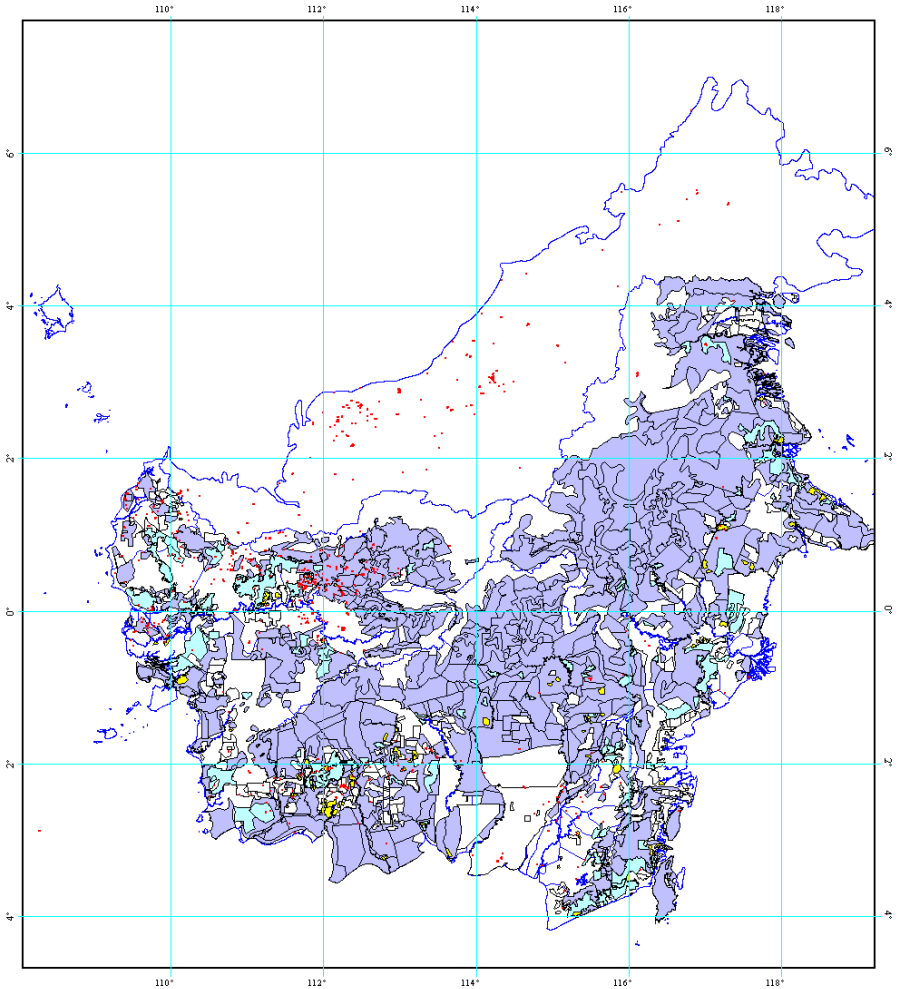
# Fire Distribution (Continued)

Outputs :

*Hotspot Coordinates and Fire distribution maps*

- Distributed to regional offices
- Posted in Ministry of Forestry and Estate Crops (http://mofrinet.cbn.net.id)

Peta Sebaran Titik Panas
PULAU KALIMANTAN
24 - 26 Juli 1999
Skala 1: 5.000.000

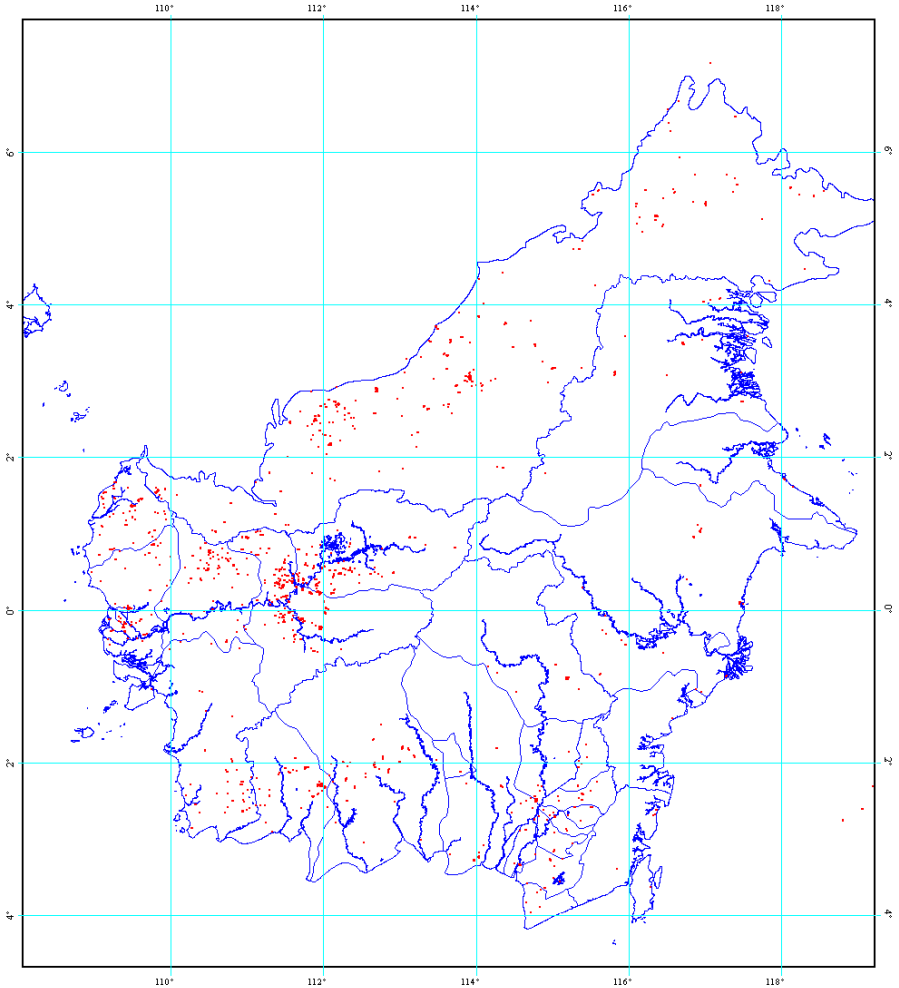



Legenda:

- Atse77o85x.txt
- Atse77q76x.txt
- Areal Transmigrasi
- Areal HTI
- Areal Perkebunan dan Budidaya Pertanian
- Areal HPH
- Base line

Proyek Inventarisasi Hutan Nasional
Badan Planologi Kehutanan dan Perkebunan
Departemen Kehutanan dan Perkebunan
1999

Peta Sebaran Titik Panas
PULAU KALIMANTAN
Bulan Juli 1999
Skala 1: 5.000.000



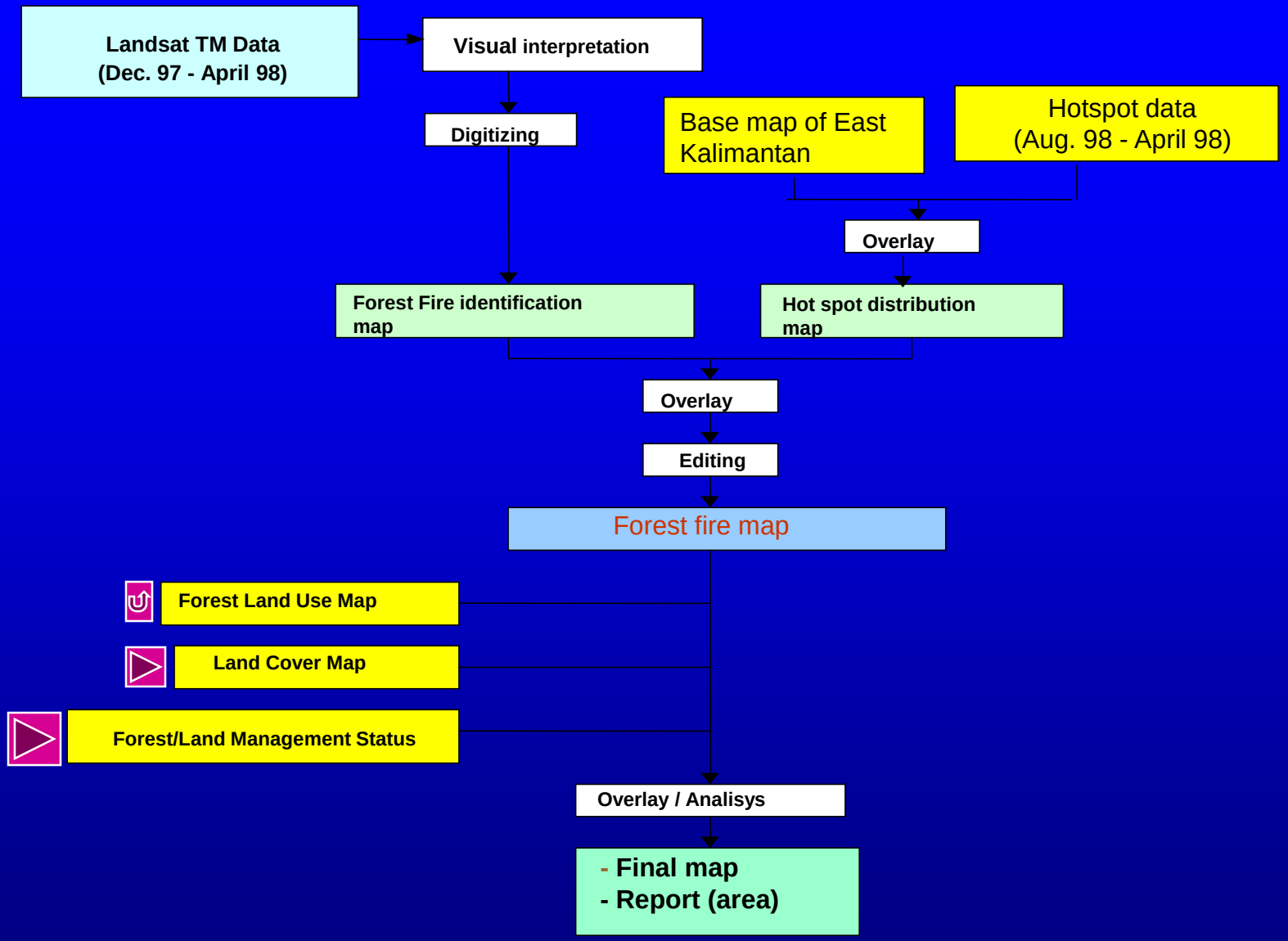

Legenda:
Juli 1999
Base line

Sumber : FFPMP - JICA

Proyek Inventarisasi Hutan Nasional
Badan Planologi Kehutanan dan Perkebunan
Departemen Kehutanan dan Perkebunan
1999

# ASSESSMENT OF 1997/1998 FIRES (East Kalimantan)

- Objectives :
  - to assess the extent of burned area
  - to assess the distribution of burned area
- Material used :
  - Hard copies of Landsat TM data taken from December 1997 to March 1998
  - Hot spots data gathered from August 1997 to April 1998
  - Forest Land Use Maps
  - Land Cover Maps
  - Forest/Land Management Status




# METHODOLOGY

## *FOREST LAND USE CLASSES :*

*PROTECTION FOREST*

*CONSERVATION FOREST*

*PRODUCTION FOREST*

*LIMITED PRODUCTION FOREST*

*CONVERTIBLE PRODUCTION FOREST*

*NON FORESTRY PURPOSES AREA*

# LAND COVER CLASSES :

- LOWLAND FOREST
- HILLY FOREST
- MANGROVE FOREST
- SWAMP FOREST
- UNPRODUCTIVE DRYLAND
- UNPRODUCTIVE WETLAND
- AGRICULTURE
- ESTATE CROPS
- SETTLEMENT

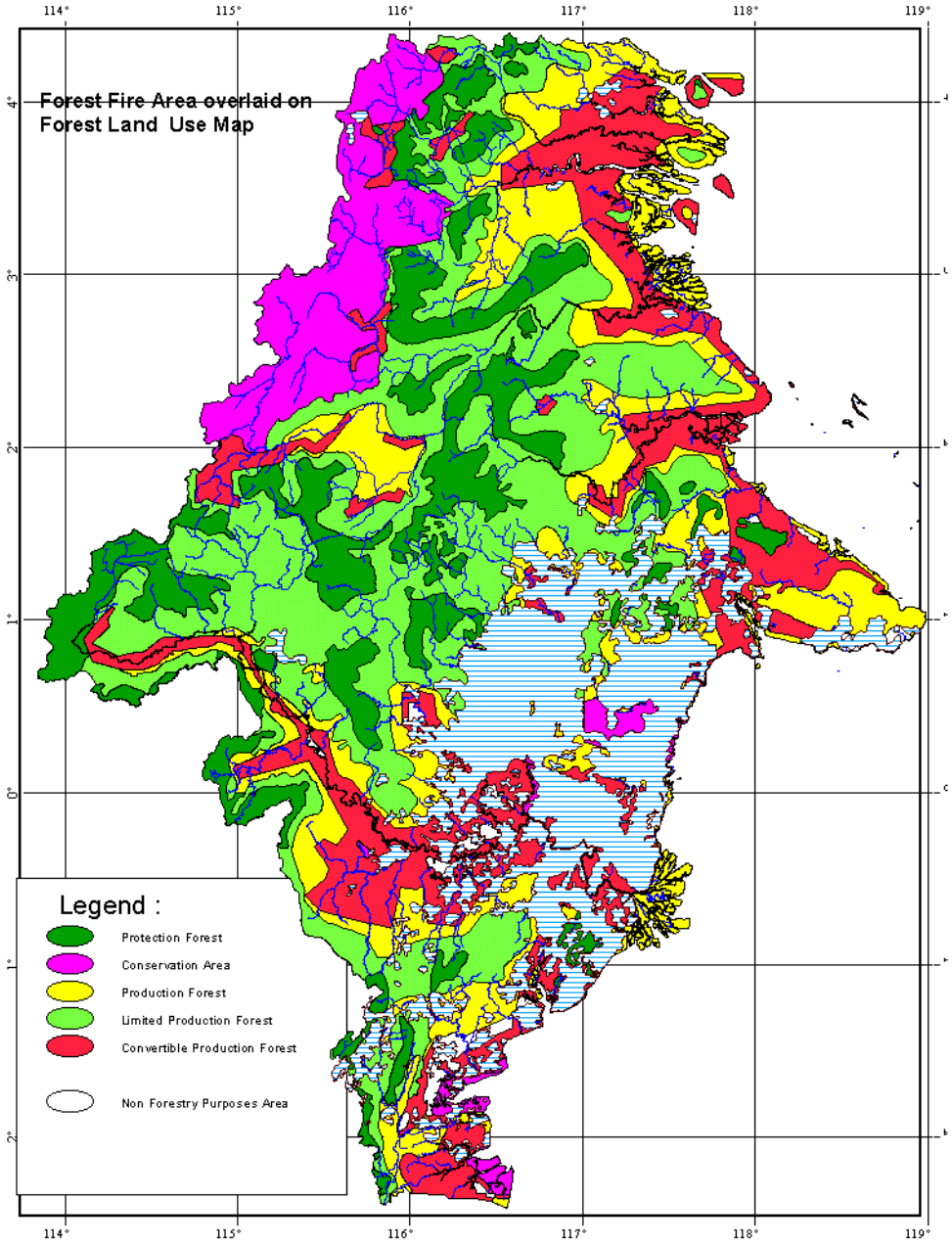
# FOREST/LAND MANAGEMENT STATUS :

FOREST CONCESSIONAIRE

INDUSTRIAL PLANTATION FOREST

ESTATE CROPS

OTHERS

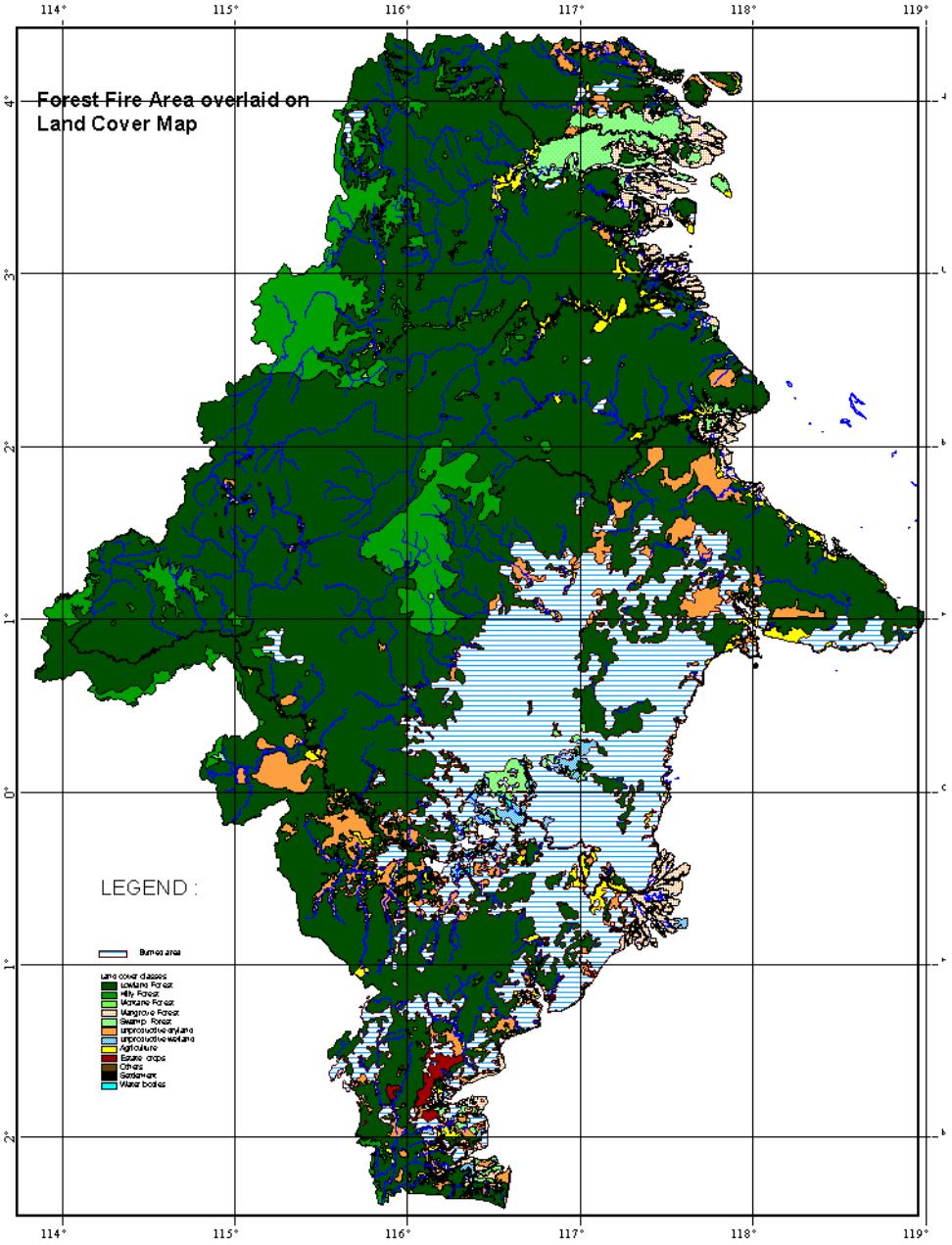

Forest Fire Area overlaid on
Forest Land Use Map
114°
115°
116°
117°
118°
119°
4°
3°
2°
1°
0°
1°
2°
Legend :
Protection Forest
Conservation Area
Production Forest
Limited Production Forest
Convertible Production Forest
Non Forestry Purposes Area

# Fire distribution by mean of forest land use categories

| **Area distribution :** | | |
|---|---|---|
| •Protection forest | 81,207 ha | (2.5%) |
| •Conservation forest | 206,271 ha | (6.3%) |
| •Production forest | 1,009,863 ha | (31.0%) |
| •Limited Production forest | 357,806 ha | (11.0%) |
| •Convertible Production forest | 1,483,250 ha | (45.5%) |
| •Non forestry purposes area | 121,920 ha | ( 3.7%) |

Factors :

- Increasing accessibility
- Land preparation using fire


Forest Fire Area overlaid on
Land Cover Map
114°
115°
116°
117°
118°
119°
4°
3°
2°
1°
0°
1°
2°
LEGEND :
Burned area
Land cover classes
Lowland Forest
Hilly Forest
Montane Forest
Mangrove Forest
Swamp Forest
unproductive-dryland
unproductive-wetland
Agriculture
Estate crops
Others
Settlement
Water bodies

# Fire distribution by mean of land cover classes

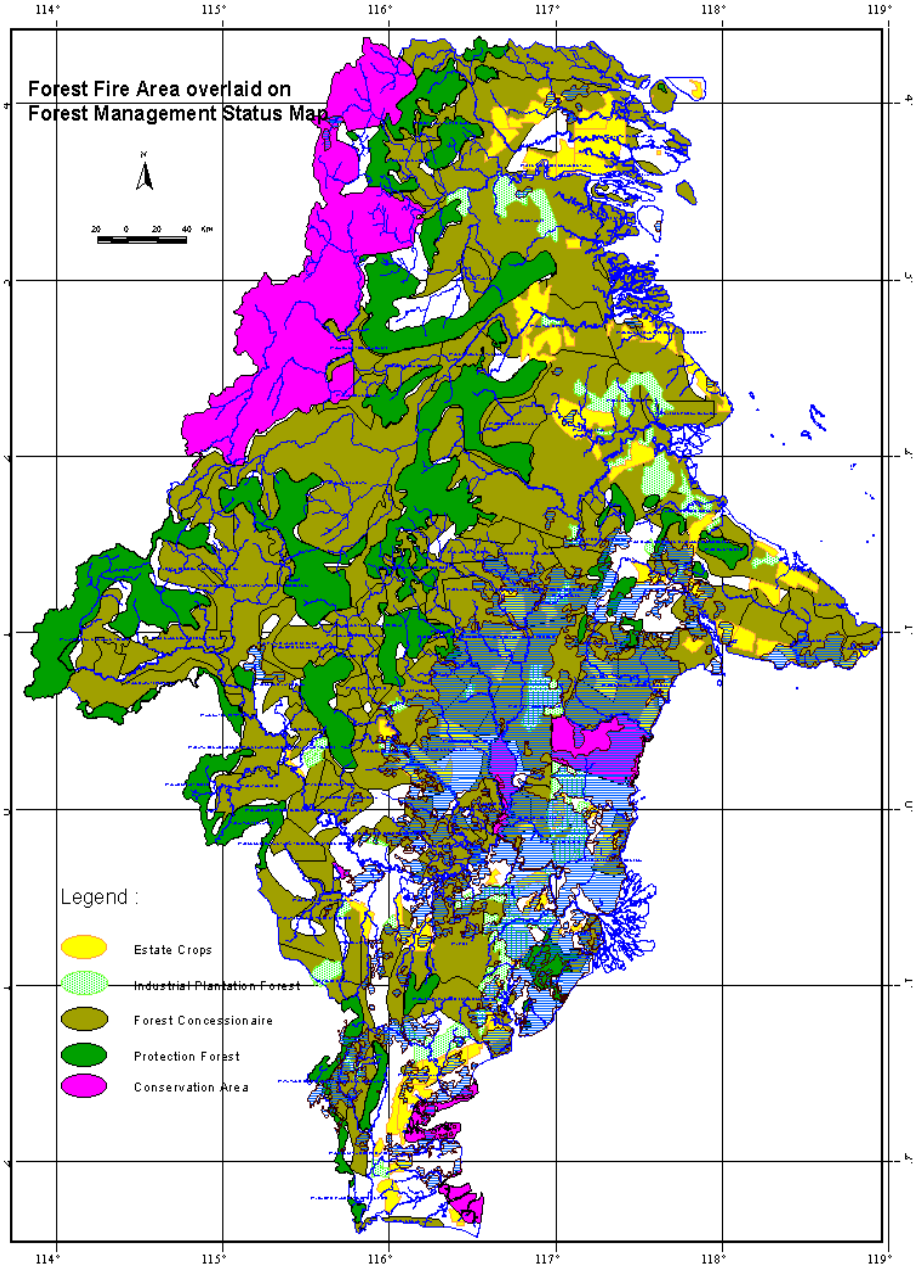
**Two kind of data used :**

- *Curent land cover derived from 1997/1998 Landsat TM data*
- *Past Land cover taken from GIS data base*

**Area distribution :**

| | | |
|---|---|---|
| Lowland forest | 1,879,159 ha | (57,6 %) |
| Hilly forest | 7,310 ha | (0.2%) |
| Mangrove forest | 34,317 ha | (1.1%) |
| Swamp forest | 155,735 ha | (4,8%) |
| Unproductive dryland | 584,835 ha | (17.9%) |
| Unproductive wetland | 301.741 ha | (9.3%) |
| Agriculture | 280.236 ha | (8.6%) |
| Estate crops | 7,612 ha | (0.2%) |
| Settlement | 9,372 ha | (0.3%) |

Remarks : 70% of East Kalimantan is Lowland forest


Forest Fire Area overlaid on
Forest Management Status Map
20 0 20 40 Km
114°
115°
116°
117°
118°
119°
Legend :
Estate Crops
Industrial Plantation Forest
Forest Concessionaire
Protection Forest
Conservation Area

# FIRE DISTRIBUTION BY MEAN OF FOREST/LAND MANAGEMENT STATUS

**Area distribution :**

| | | |
|---|---|---|
| Forest concessionaire | 1,536,931 ha | (47.14%) |
| Industrial Plantation Forest | 295,285 ha | (9.06%) |
| Estate crops | 320,794 ha | (9.84%) |
| Others | 1,107,307 ha | (33,96%) |

## The fires distributed in :

*11 Forest concessionaire companies*

*15 industrial plantation forests companies*

*10 estate crops companies*

## ROLE OF LOCAL GOVERNMENT

**Organization :**

National Center for Forest Fire Management (PUSDALKARHUTNAS)

Provincial or District Center for Forest Fire Management (PUSDALKARHUTDA)

- Field validation of hotspot
- Fires suppression
- Improving community participation

# ROLE OF LOCAL GOVERNMENT (Cont'd)



# DISCUSSION :

- *Forest fire management regime should be developed and established*
- *Forest fire detection using NOAA - AVHRR is effective*
- *NOAA AVHRR weakneses :*
  - No information on the number, the size, the extent of fire
  - Not capable to penetrate cloud and haze
  - Possible false detection

- *Need field information*
- *Use cumulative observations*
- *Supported with other remote sensing data*

# Assessment of burned area :

- Use of GIS combined with remote sensing data for assessing burned area is very useful
- Problems :
  - Occurrence of cloud and haze hampers burned area identification
  - If time difference between Hotspots and Landsat TM is long then burned area identification become difficult
  - If hotspots occurred after the date of Landsat TM caused no burned area information

## FIRE DETECTION :

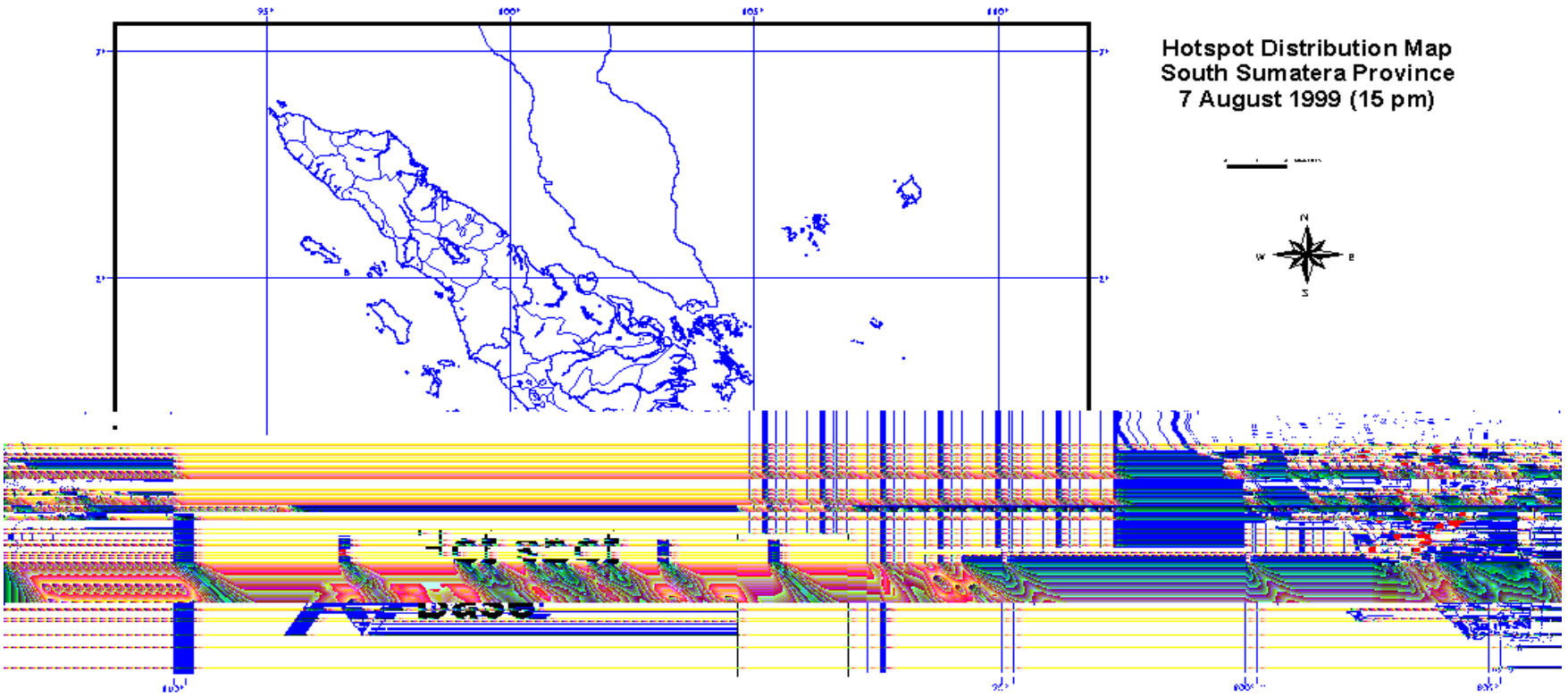
- Coordinated by headquarter since the NOAA coverage is very large
- Data dissemination needs good communication network

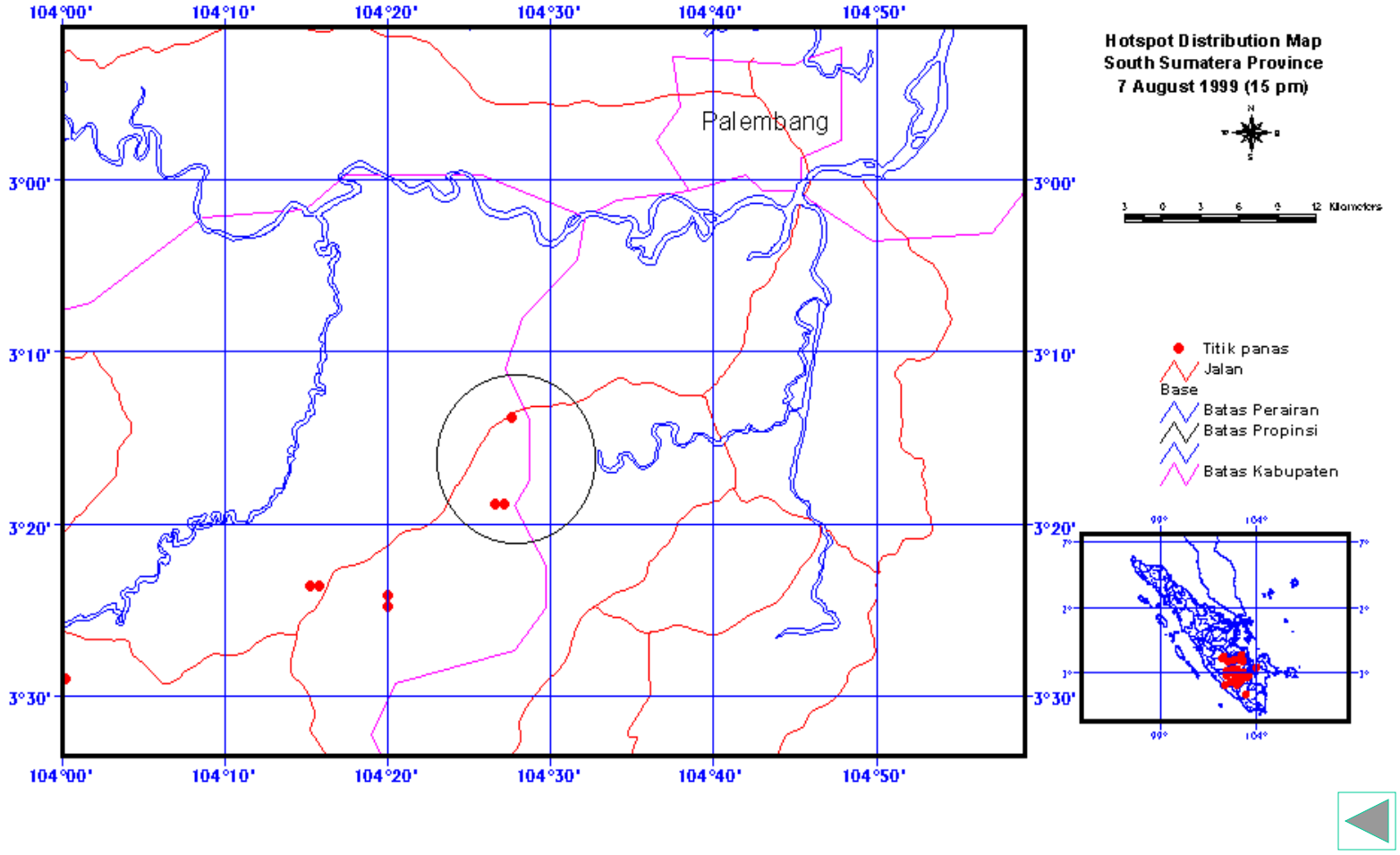
## FIRE MAPPING :

**Local Government** :

- Improve its role by conducting local fire mapping

  e.g Provincial or District fire distribution map, fire danger map
- At Provincial level with scale of 1 : 250,000 to 1 : 100,000
- At district level with scale of at least 1 : 50,000

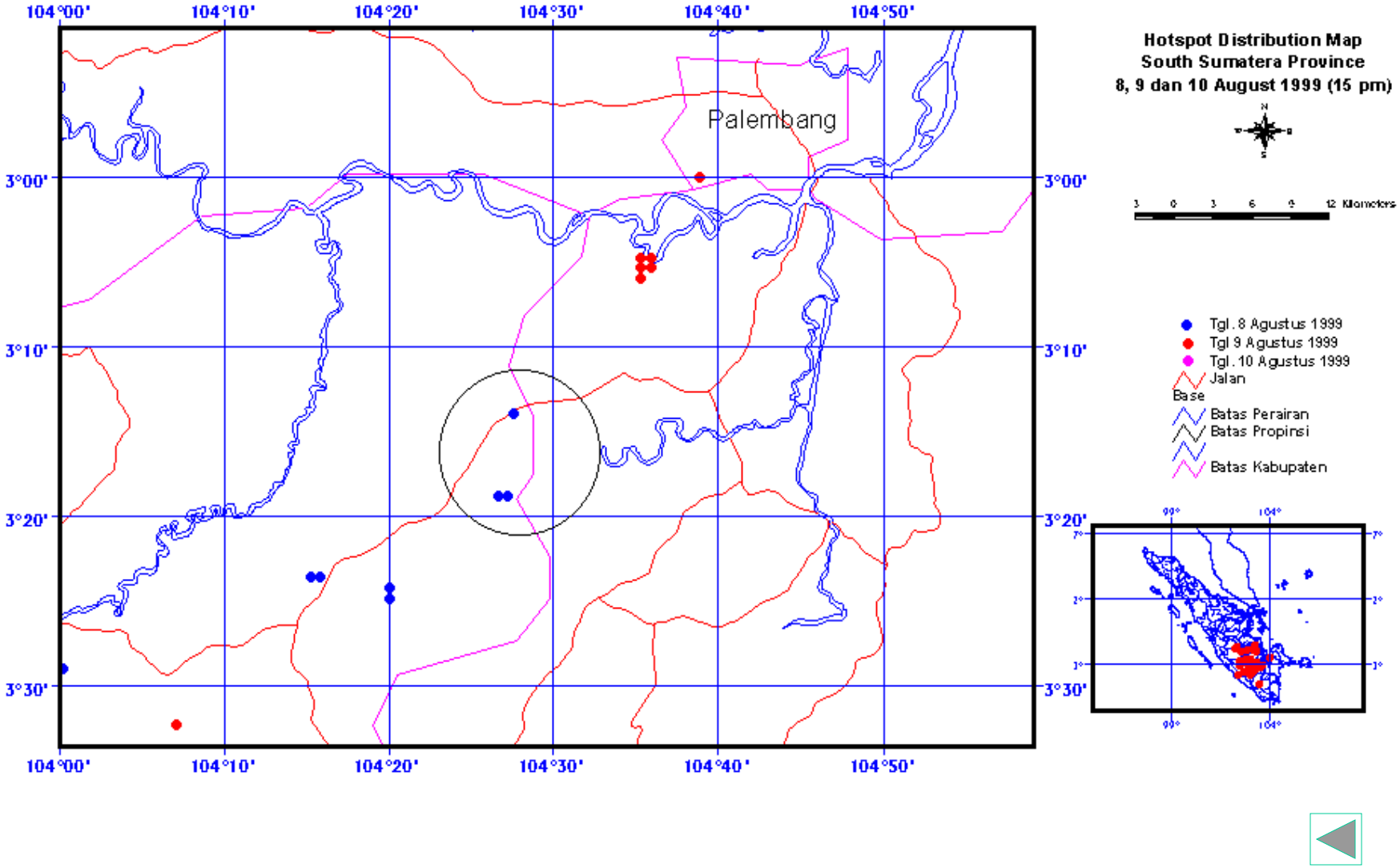

Hotspot Distribution Map
South Sumatera Province
7 August 1999 (15 pm)
N
W
E
S

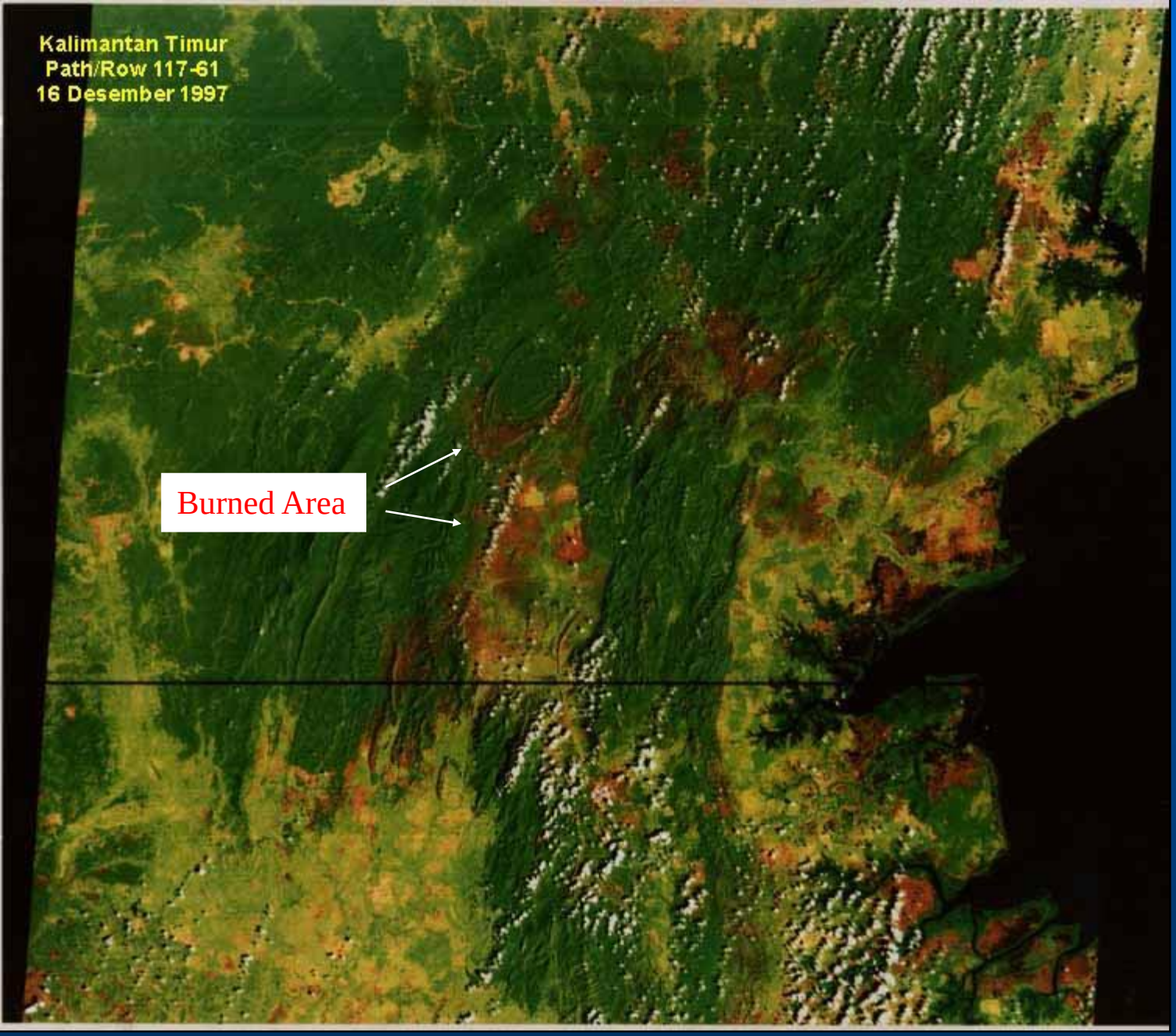

Hotspot Distribution Map
South Sumatera Province
7 August 1999 (15 pm)
Palembang
104°00'
104°10'
104°20'
104°30'
104°40'
104°50'
3°00'
3°10'
3°20'
3°30'
Titik panas
Jalan
Base
Batas Perairan
Batas Propinsi
Batas Kabupaten
Kilometers



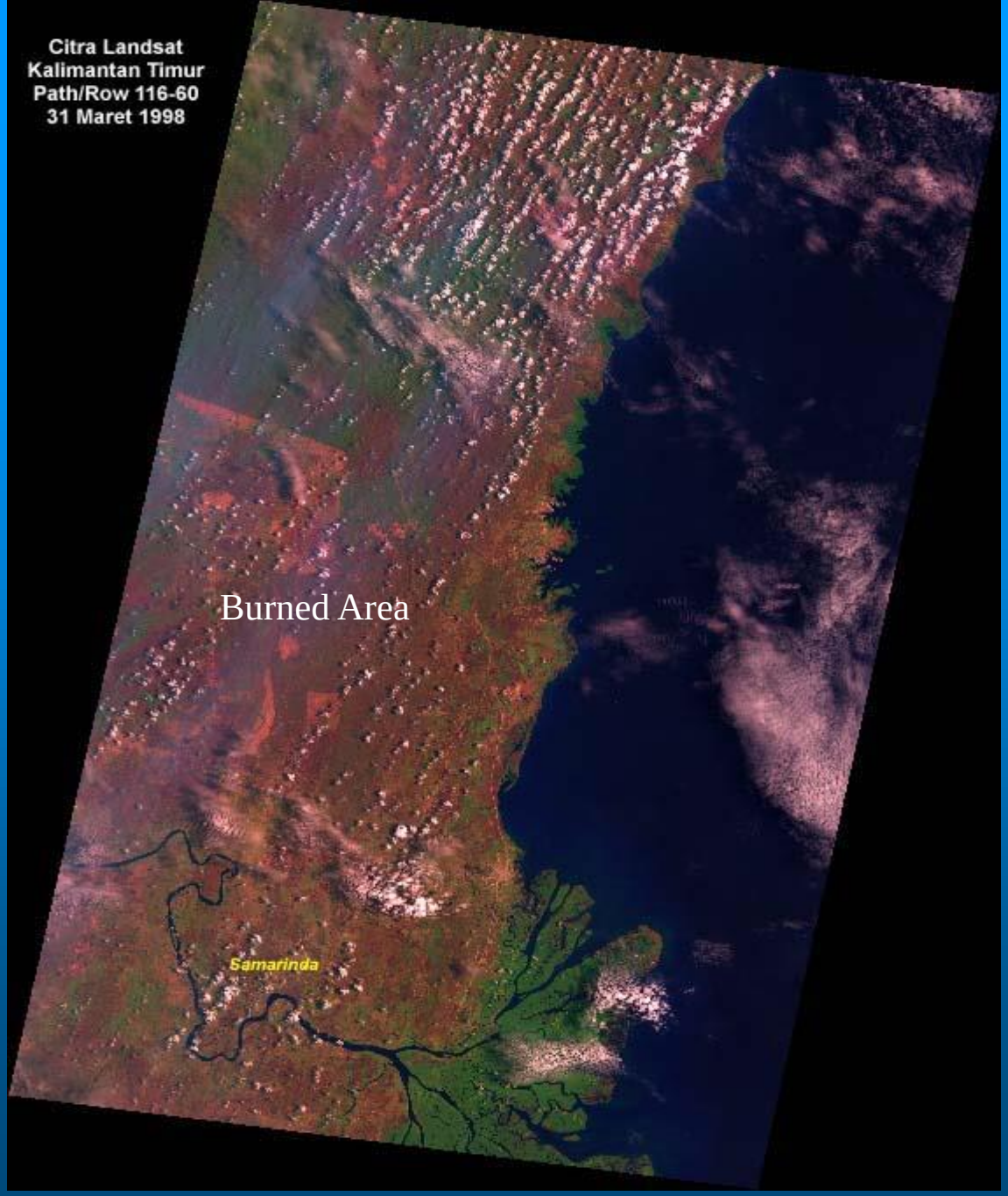
Photograph of fires which burned secondary forest in South Sumatera

Taken on 7 August 1999


Hotspot Distribution Map
South Sumatera Province
8, 9 dan 10 August 1999 (15 pm)
Palembang
104°00'
104°10'
104°20'
104°30'
104°40'
104°50'
3°00'
3°10'
3°20'
3°30'
3 0 3 6 9 12 Kilometers
Tgl. 8 Agustus 1999
Tgl 9 Agustus 1999
Tgl. 10 Agustus 1999
Jalan
Base
Batas Perairan
Batas Propinsi
Batas Kabupaten

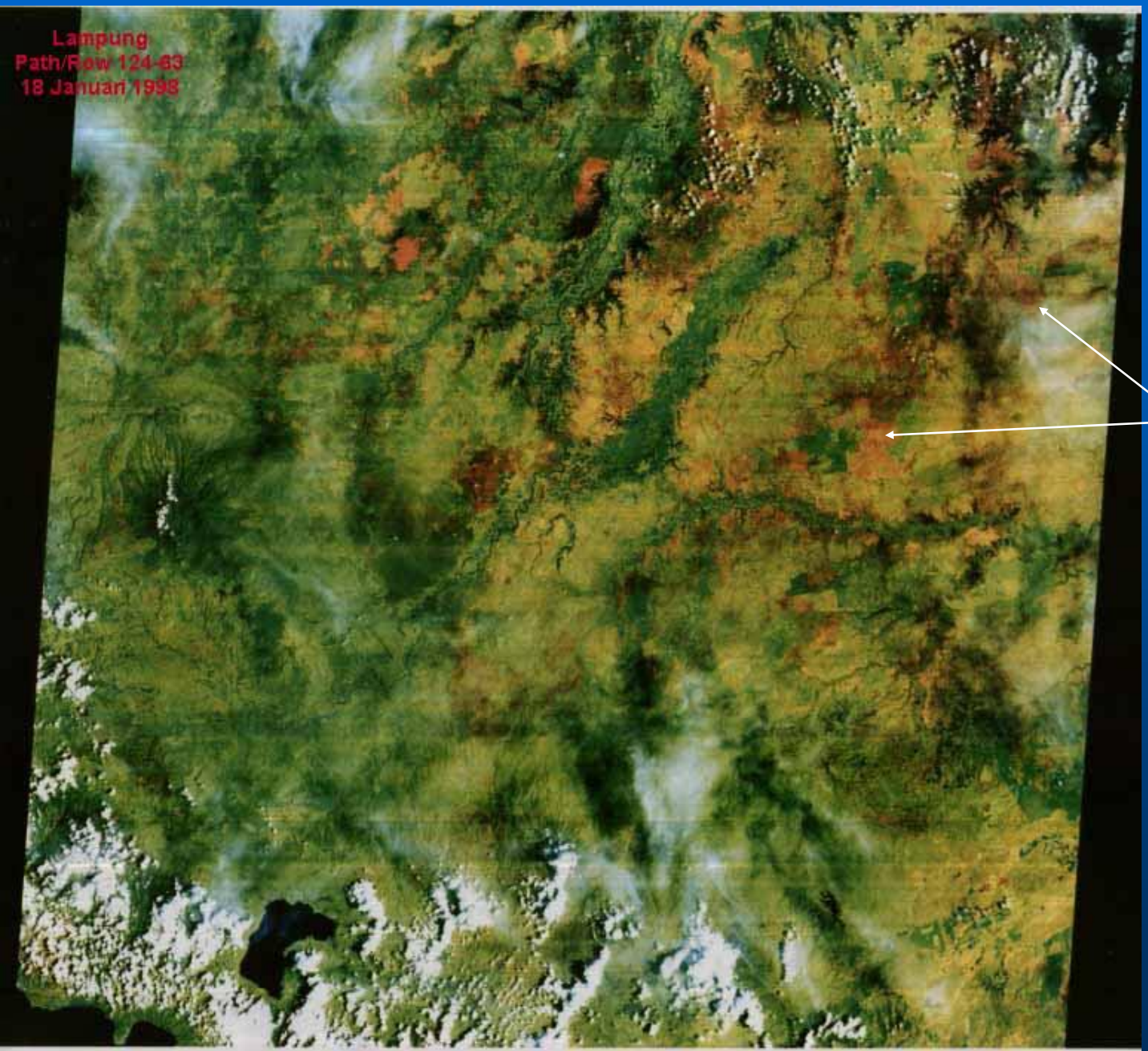


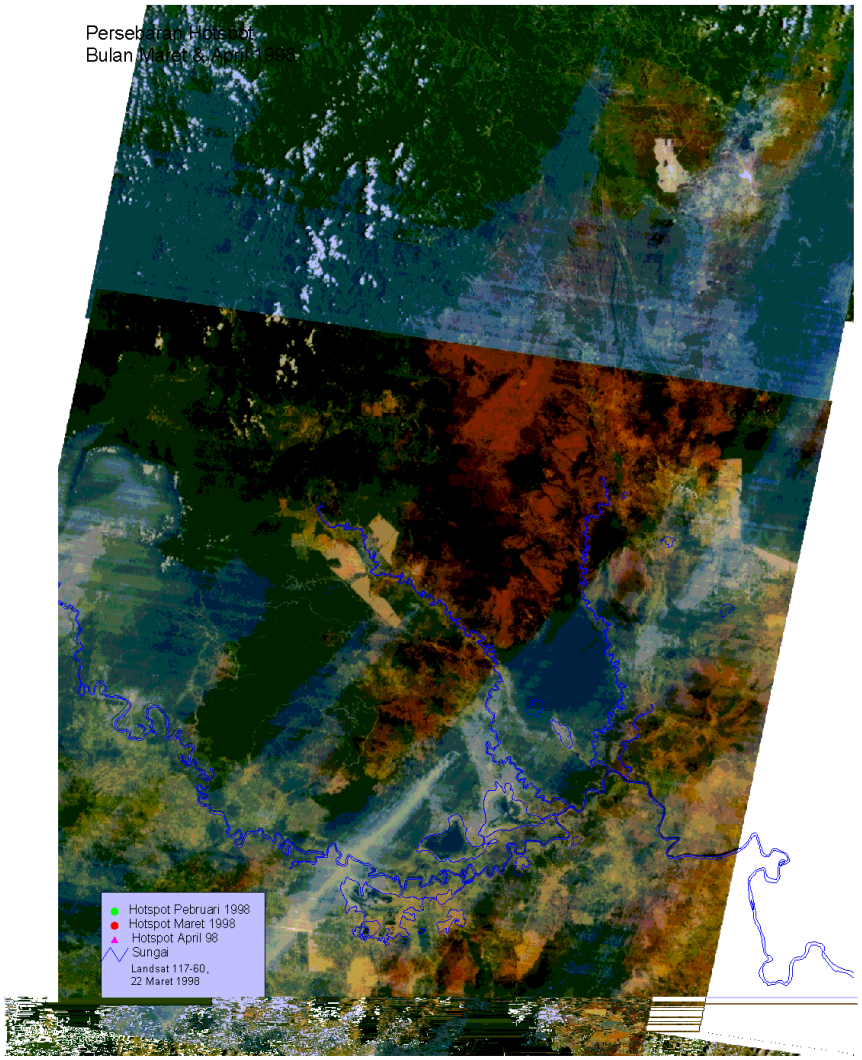

**Landsat TM data of East Kalimantan (Path/Row 117-61) 16 December 1997**

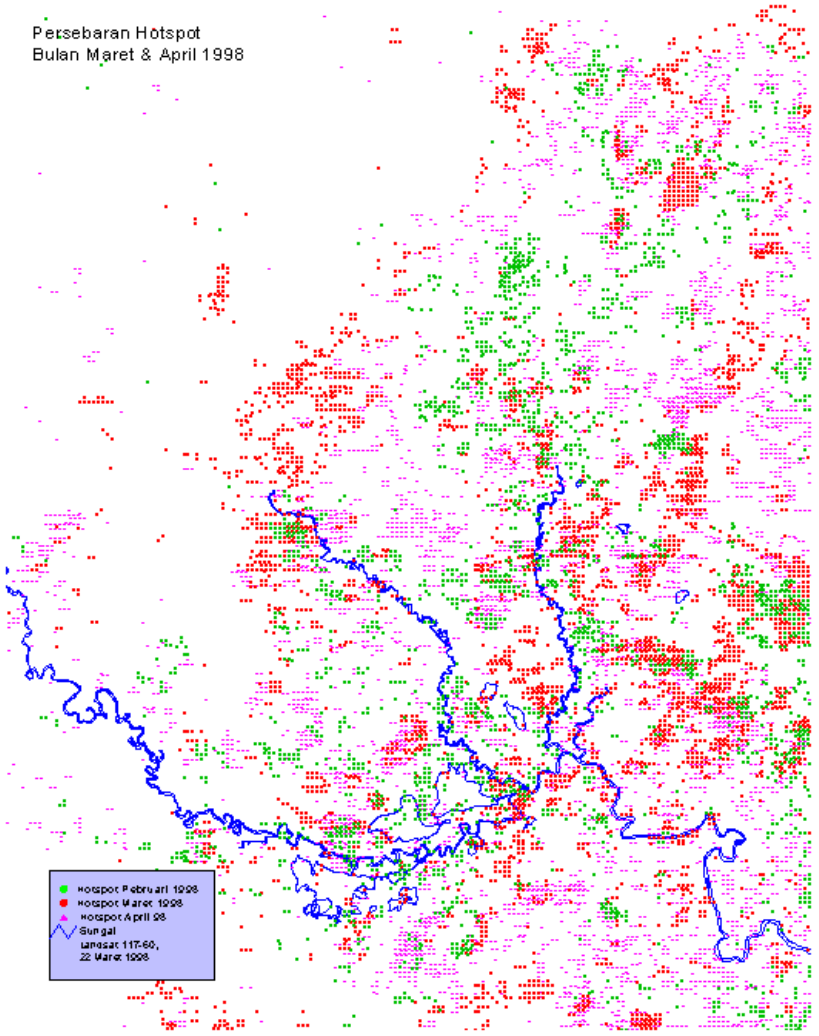



Landsat TM data of East Kalimantan (Path/Row 116-60) 31 March 1998

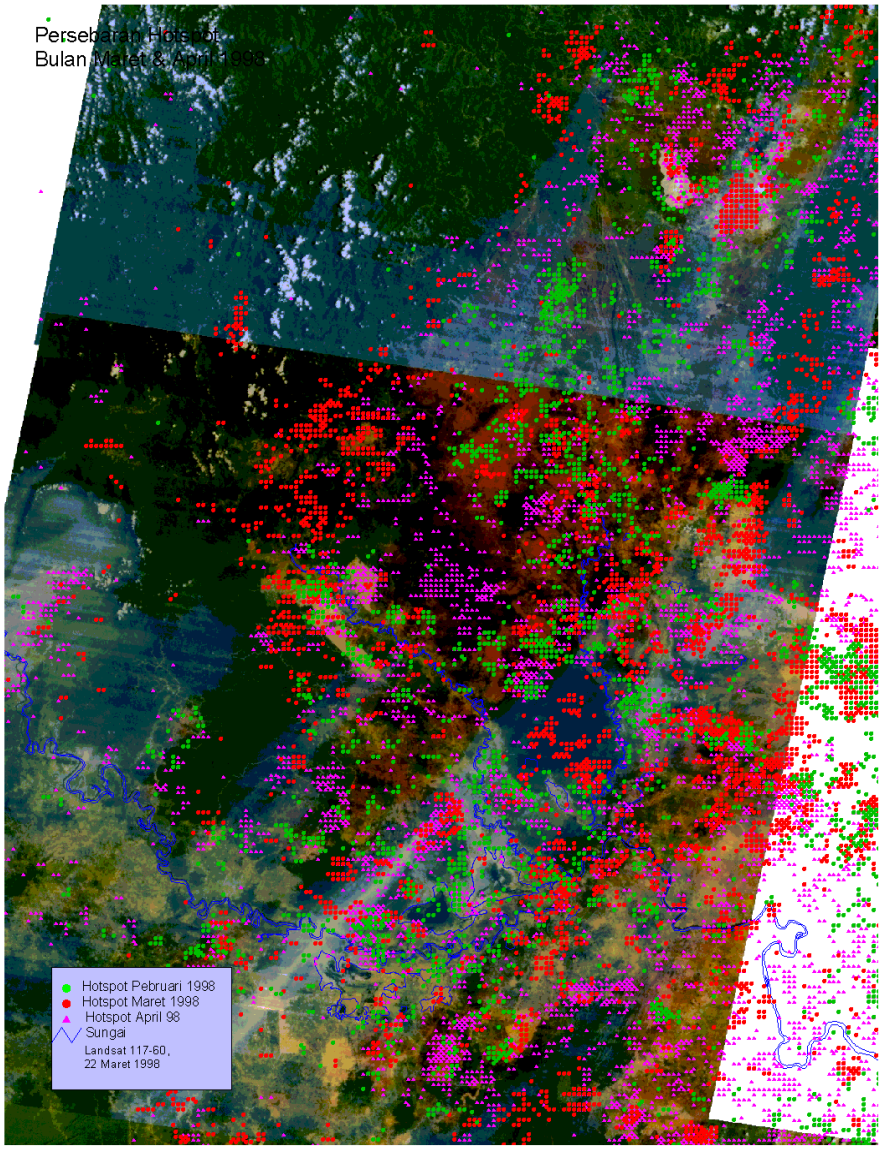
# Landsat TM of Lampung (Path/Row 124-63) 18 January 1998




Persebaran Hotspot
Bulan Maret & April 1998
Hotspot Pebruari 1998
Hotspot Maret 1998
Hotspot April 98
Sungai
Landsat 117-60,
22 Maret 1998


Persebaran Hotspot
Bulan Maret & April 1998
Hotspot Pebruari 1998
Hotspot Maret 1998
Hotspot April 98
Sungai
Landsat 117-60,
22 Maret 1998

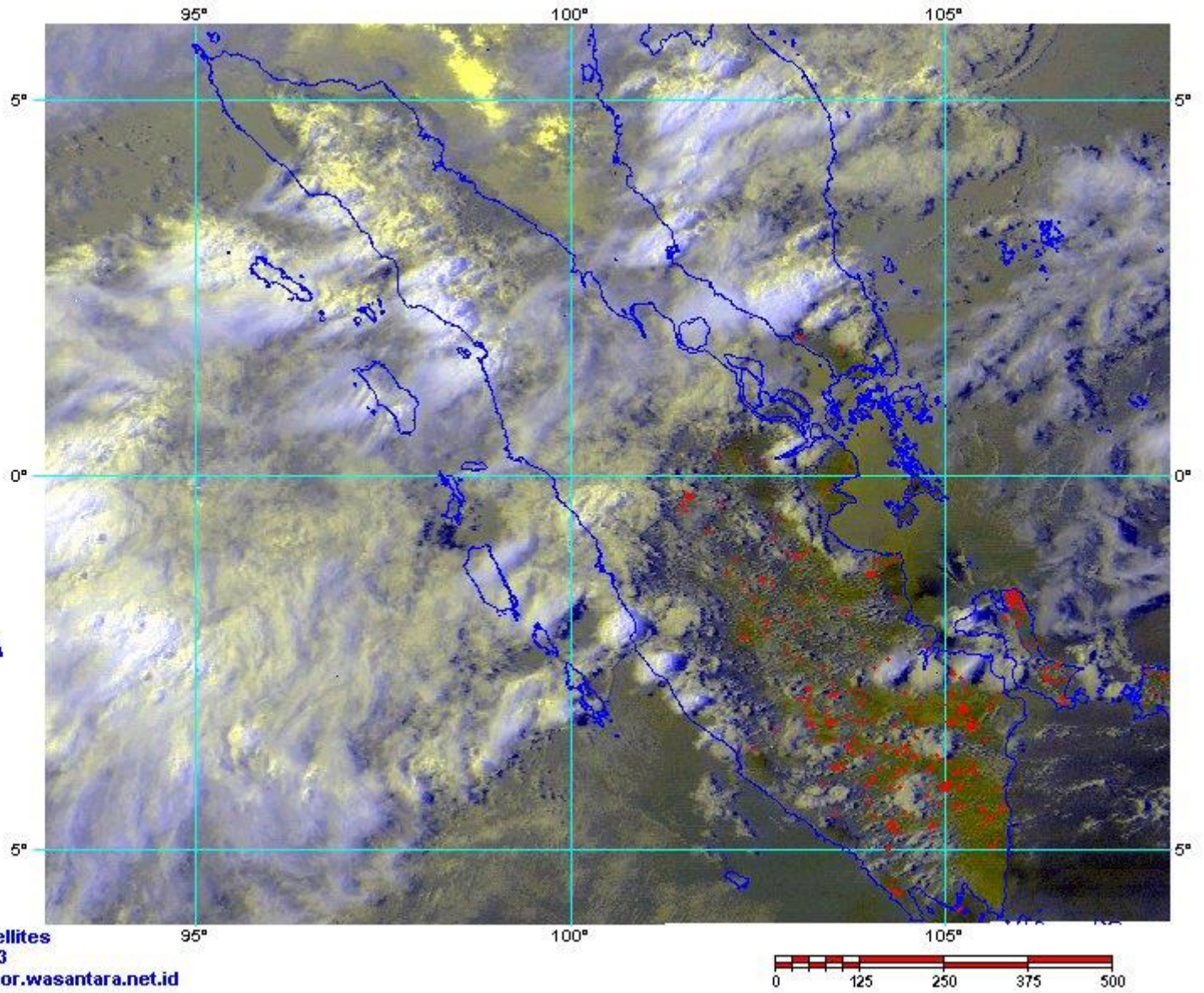
**Overlaying**




LANDSAT DATA
overlaid with
HOT SPOTS

# Hot Spot and smoke/haze in Sumatra

## 27 August 1999

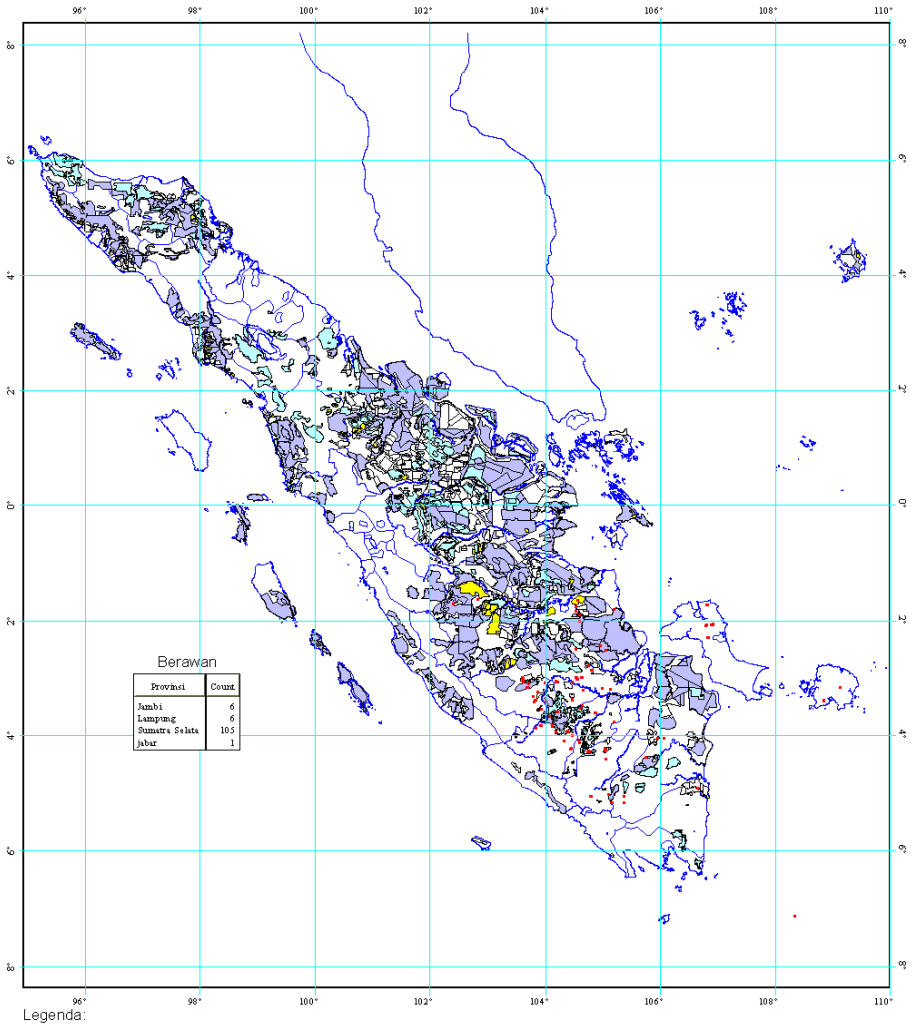



GMS-5 GMT08
NOAA14 GMT08:31

Source: FFPMP-JICA/PKA
Threshold Temp.:315K

POSKO Receiving Station of Satellites
Jl.Ir.H.Janda NO. 100 Bogor 16123
pongi@indo.net.id ; linhut@bogor.wasantara.net.id

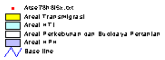
Peta Sebaran Titik Panas
PULAU SUMATERA
17 Agustus 1999
Skala 1: 6.500.000




Berawan

| Provinsi | Count |
|---|---|
| Jambi | 6 |
| Lampung | 6 |
| Sumatra Selata | 10.5 |
| jabar | 1 |

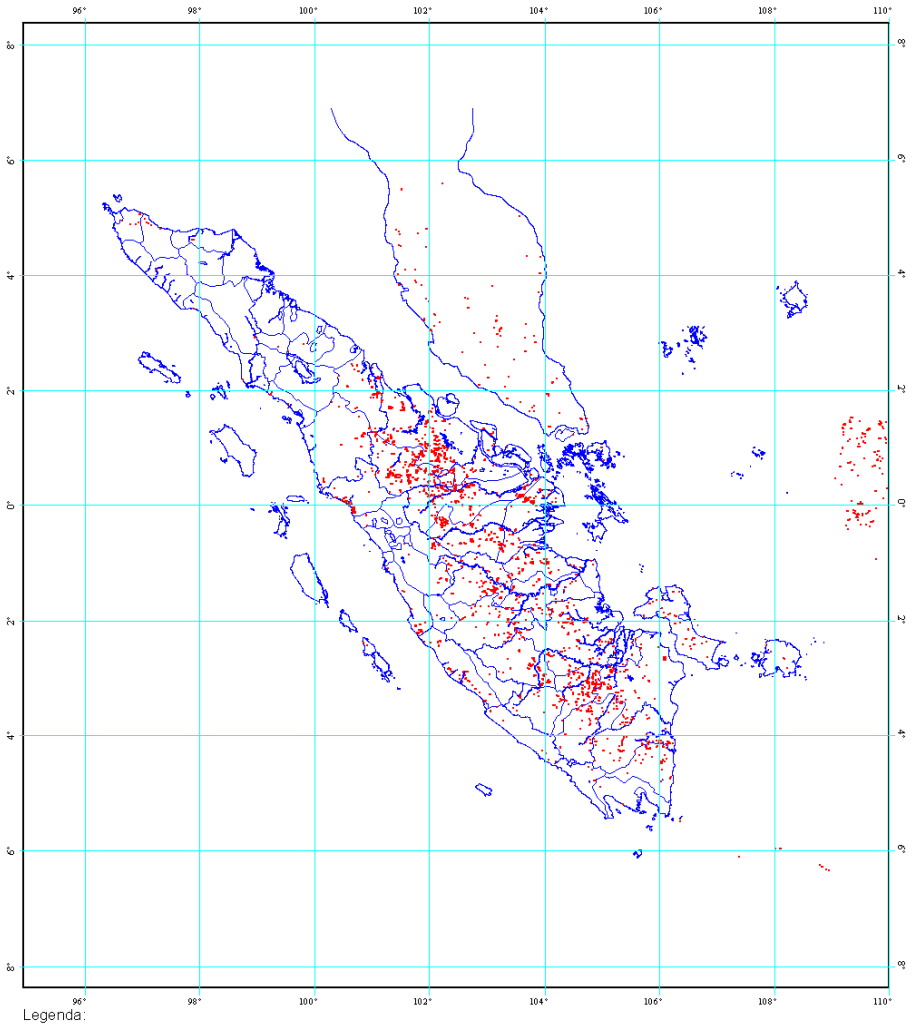
Legenda:




Sumber: FFPMP- JICA

Proyek Inventarisasi Hutan Nasional
Badan Planologi Kehutanan dan Perkebunan
Departemen Kehutanan dan Perkebunan
1999

Peta Sebaran Titik Panas
PULAU SUMATERA
Bulan Juli 1999
Skala 1: 6.500.000




Legenda:

Juli 1999
Base line

Sumber: FFPMP- JICA

Proyek Inventarisasi Hutan Nasional
Badan Planologi Kehutanan dan Perkebunan
Departemen Kehutanan dan Perkebunan
1999


Tg Ca


Tg Gb

*Disasters & Hazards - and GIS*

# GIS and Hydrological Modelling

## Operational tools in Flood and Environmental Management

Sten Lindberg, DHI

# *Danish Hydraulic Institute - a Consulting and Research Organisation*

- **to develop and apply advanced methods and technologies within hydraulic and hydrological engineering**
- **to provide specialised consulting services**
- **to contribute to the technological development through international research collaboration and through transfer of know-how and technology**



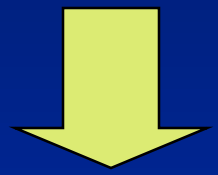
# *Man's interpretation and representation of nature*




- Measurements and data
  - costly but important
  - no or only little information about future
- Simulation Model representation
  - in-expensive but "dangerous"
  - some information about the future

# *Physical based simulation models - process models*

- Represent a physical system, e.g. a river
- Water movements is calculated from physical laws
- Equations may be solved in both time and place domain



- What is the effect of a given rainstorm?
- What if a hydro-dam collapses and the reservoir is emptied?
- What will be the oxygen content 5km downstream of a pollution site?

# *Environmental hazards*

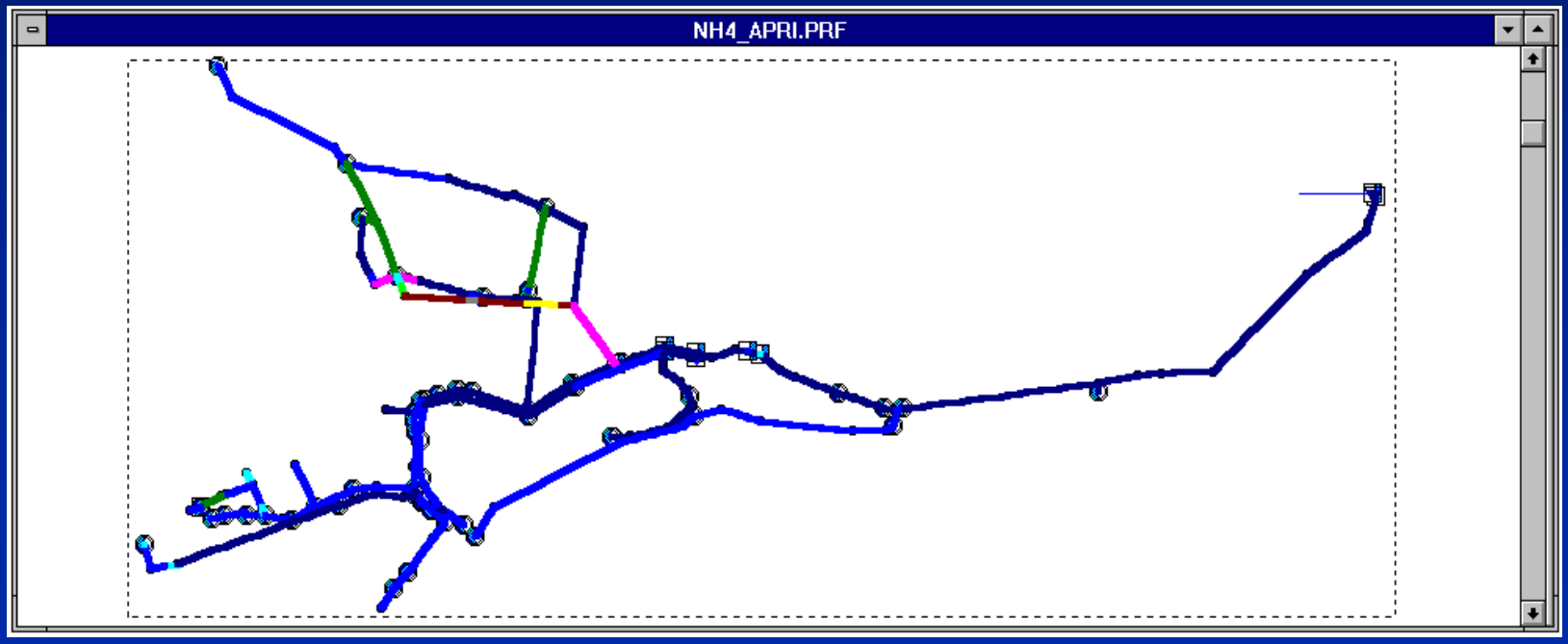
- Spill of chemicals into drains
- Sewer overflows
- Virus in water supply
- Toxic substances in the river
- …

- Air pollution
- Noise
- ….



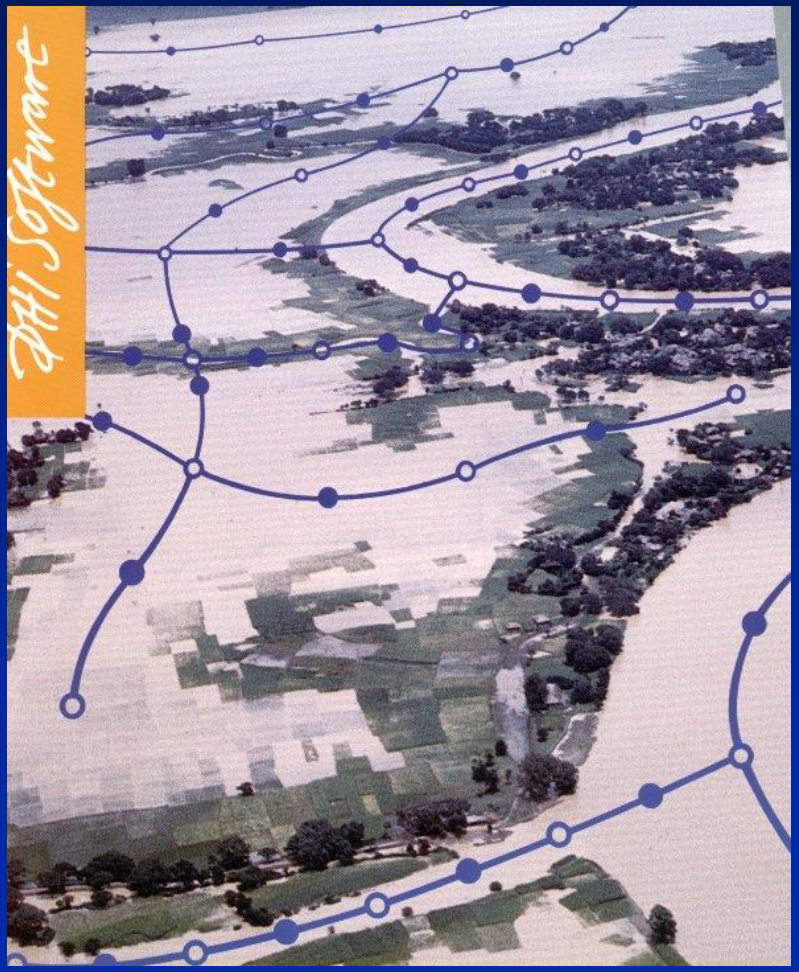
# *Spills into the drain*

- Where and how fast?
- Where can we trap it?
- Who shall be alerted?



# *Floods - an increasing problem*

- Flood studies (where, when, why)
- Flood forecasting (where, when)



# *Urban flooding*



- Local rainfall
- River overtopping
- Storm surges
- Snowmelt and rain

Model predictions =>

into GIS and Digital Elevation Models (DEM) to produce

- Flood inundation maps

ArcView

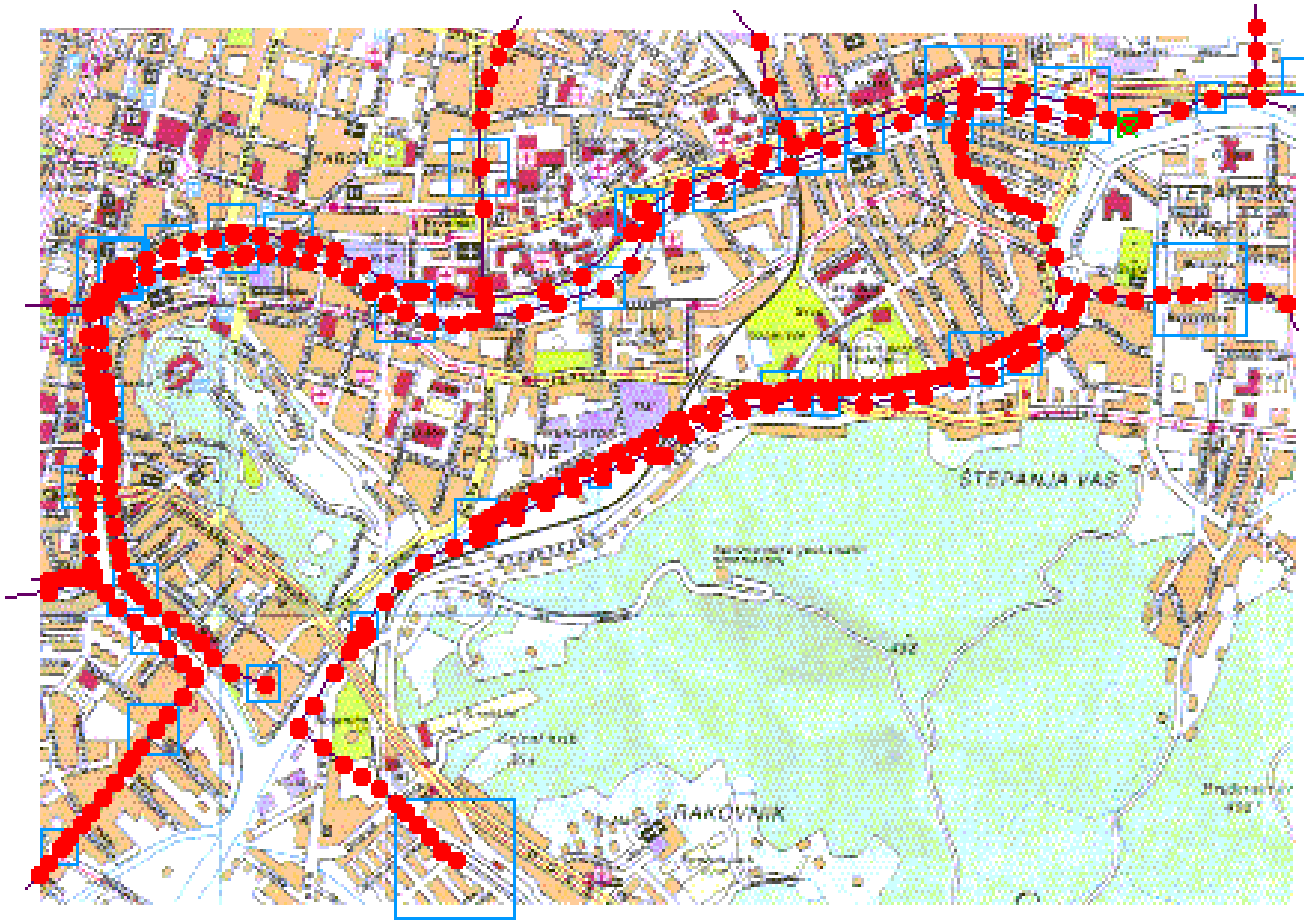
File Edit View Theme Graphics Window Help Setup Tools Verify

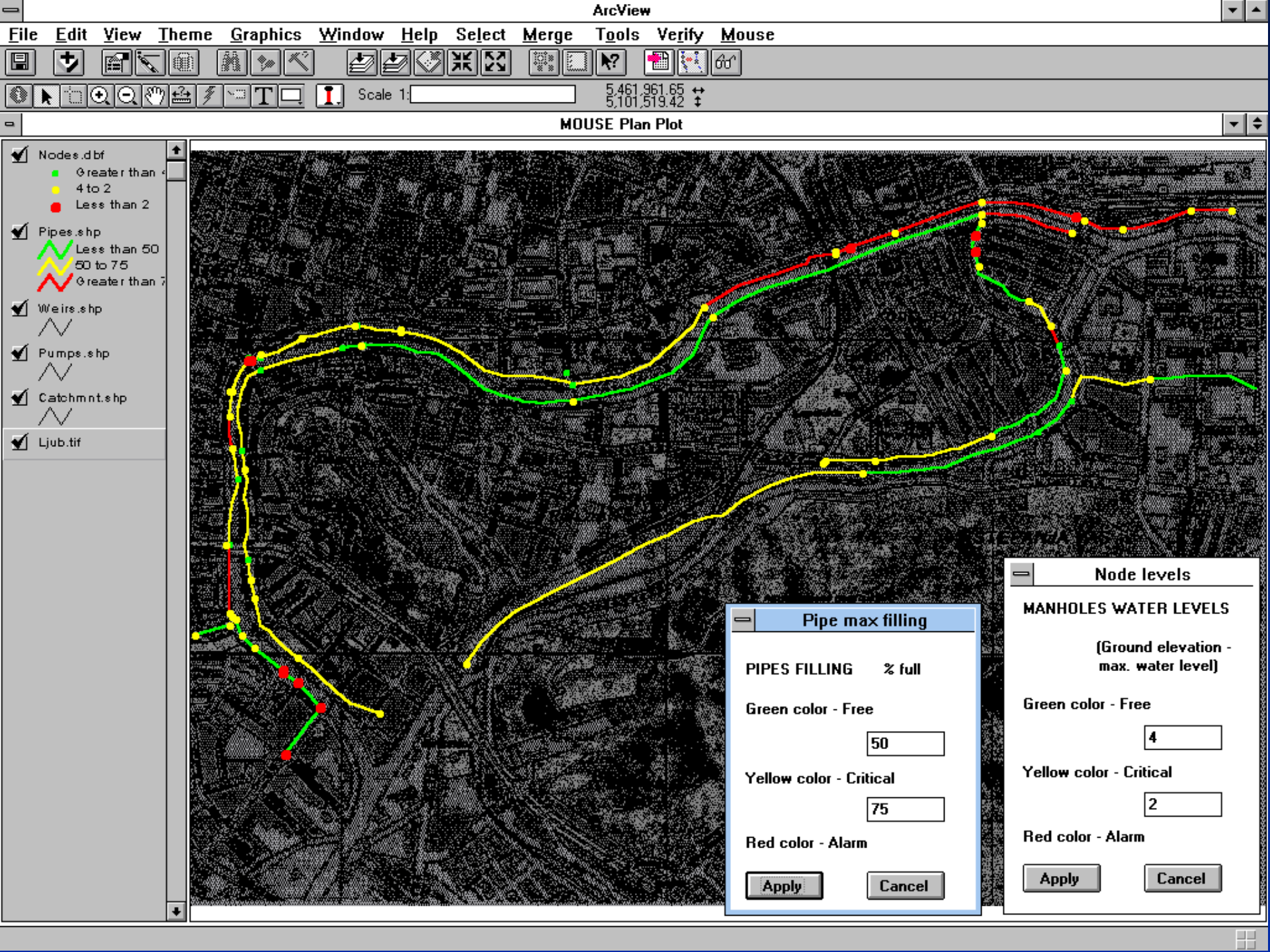
Scale 1:

5,461,700.29
5,101,452.10

View1

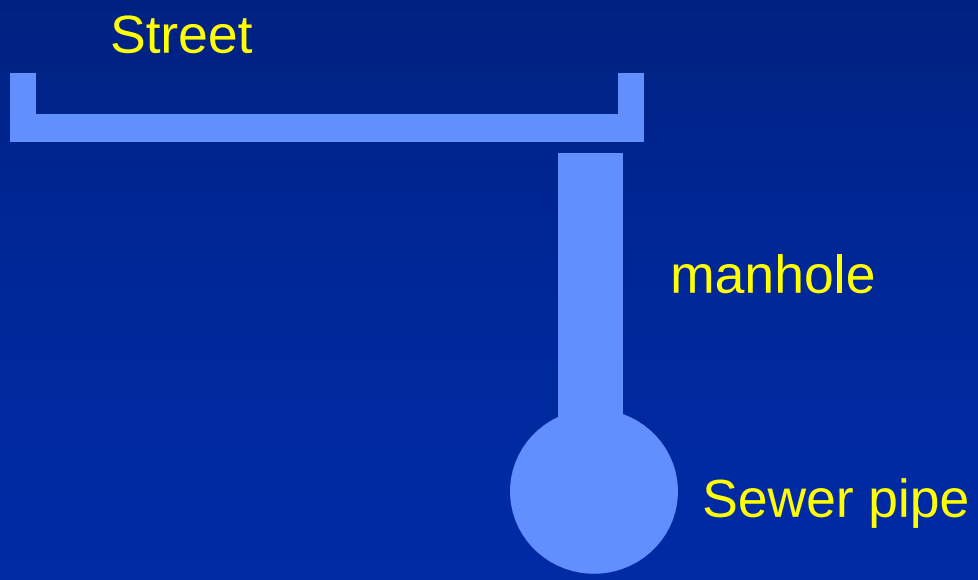
- Nodes.dbf
  - Manholes
  - Outlets
  - Structures
- Pipes.shp
  - Pipes
- Weirs.shp
- Pumps.shp
- Catchmnt.shp
- Ljub.tif




ArcView
File Edit View Theme Graphics Window Help Select Merge Tools Verify Mouse
Scale 1:
5,461,961.65
5,101,519.42
MOUSE Plan Plot
Nodes.dbf
Greater than
4 to 2
Less than 2
Pipes.shp
Less than 50
50 to 75
Greater than 7
Weirs.shp
Pumps.shp
Catchmnt.shp
Ljub.tif
Pipe max filling
PIPES FILLING % full
Green color - Free
50
Yellow color - Critical
75
Red color - Alarm
Apply
Cancel
Node levels
MANHOLES WATER LEVELS
(Ground elevation - max. water level)
Green color - Free
4
Yellow color - Critical
2
Red color - Alarm
Apply
Cancel

*Street and pipe flow hydraulic model concept*

When pipe is full, the storm-water starts to flow on the street



ArcView GIS Version 3.0a

File Edit View Theme Graphics Window Help BRS Tool Statistics Tool EM Tool Graph Tool

Scale 1: 20,329

743,794.82
4,323,187.00

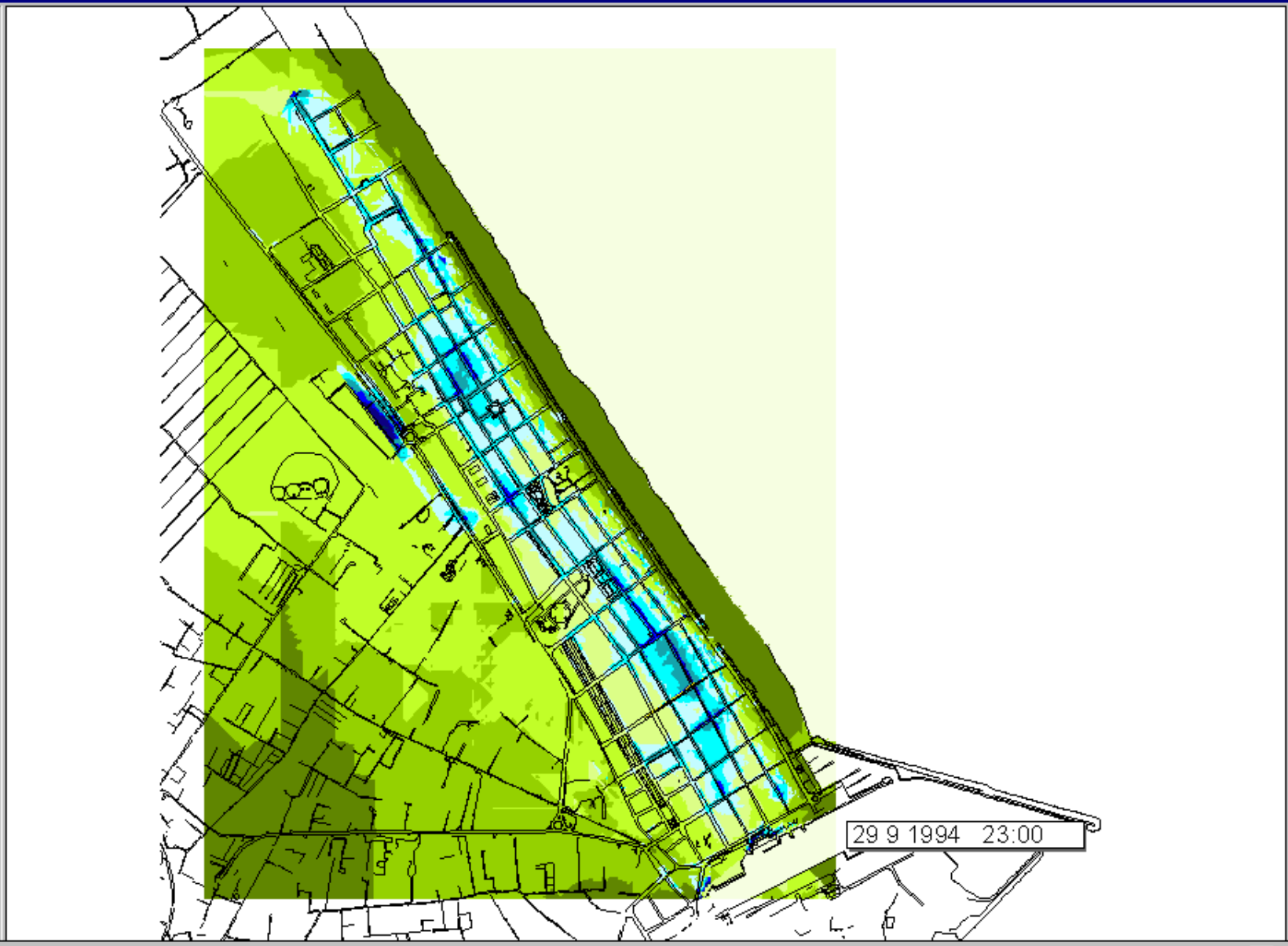
MIKE 11 GIS FLOOD MANAGEMENT

Gandia.dxf

FLOODMAP
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7

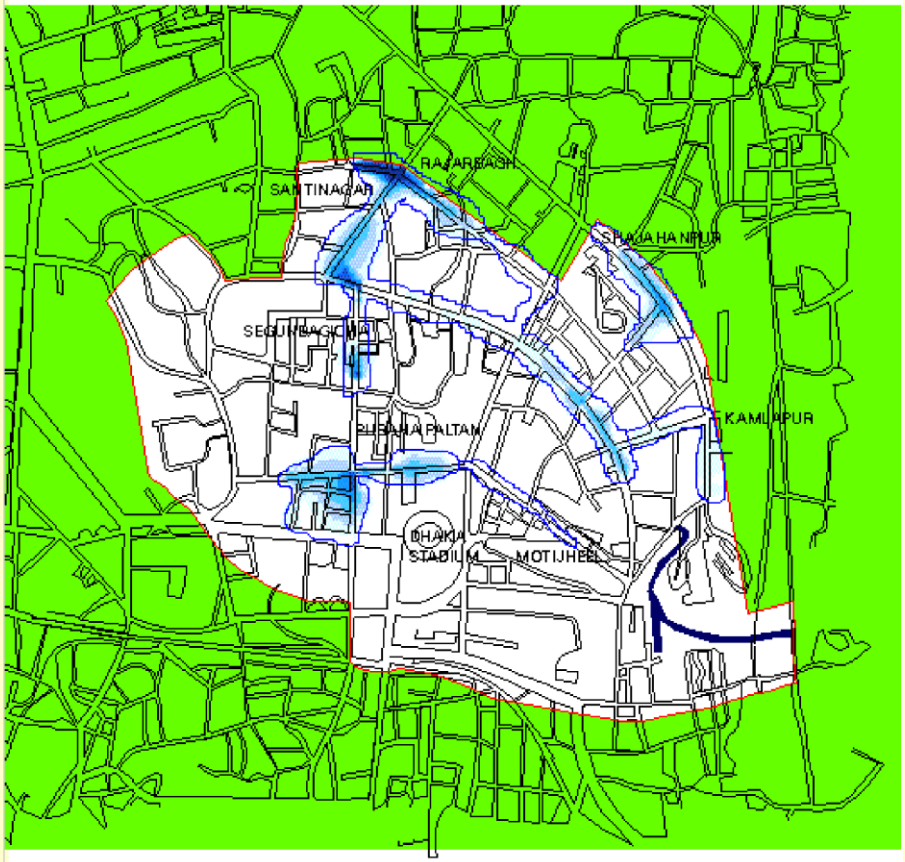
DEM
- 0 - 0.764
- 0.764 - 1.753
- 1.753 - 2.169
- 2.169 - 2.618
- 2.618 - 3.431

Dem5result.bil




Selects features in active themes using selected graphics

# Flood Depth Map




**Flood Depth (m)**

- Flood Free
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1.0
- Above 1.0 m
- Outside the Model Area

**Date:**
October 06, 1996
Maximum Flooding

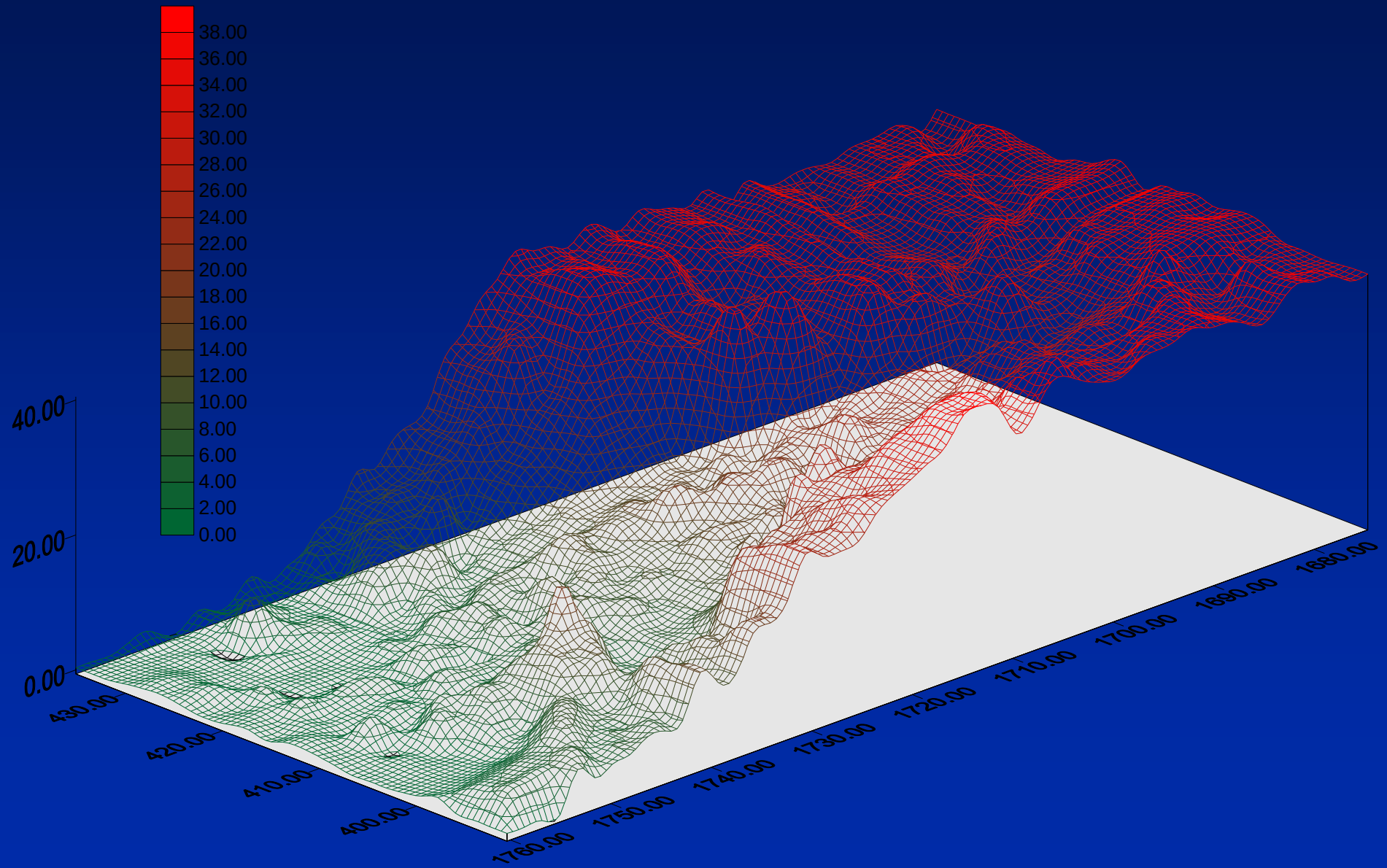
STORM WATER DRAINAGE MODEL FOR DHAKA CITY

SWMC

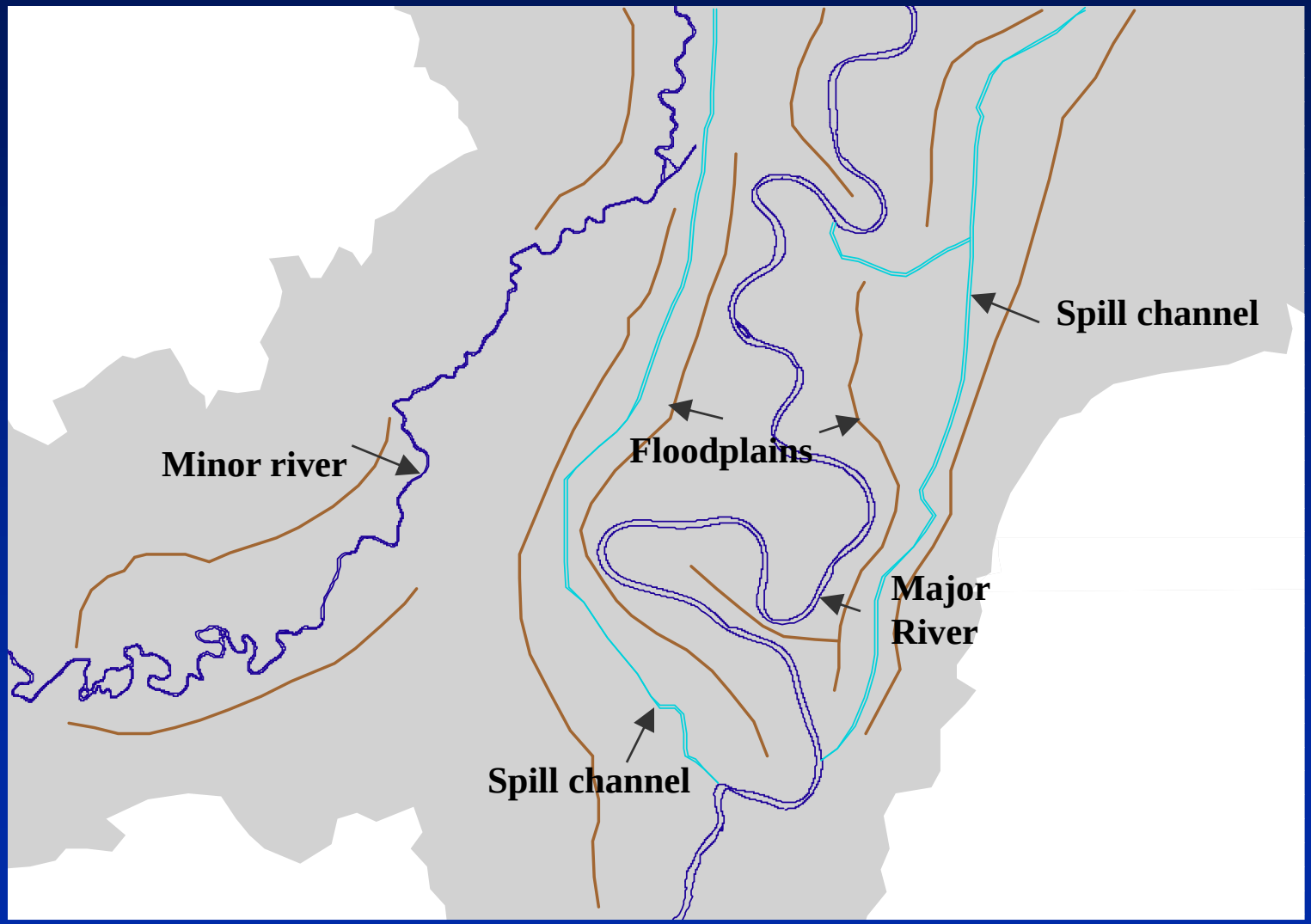
# *River Flood Mapping*

- Fully integrated GIS based flood modelling
- Leverages full power of GIS for modelling
- Pre-processing: Floodplain schematization
- Post-processing: Flood depth maps
  Comparison maps
  Duration maps
- Analysis with other GIS data

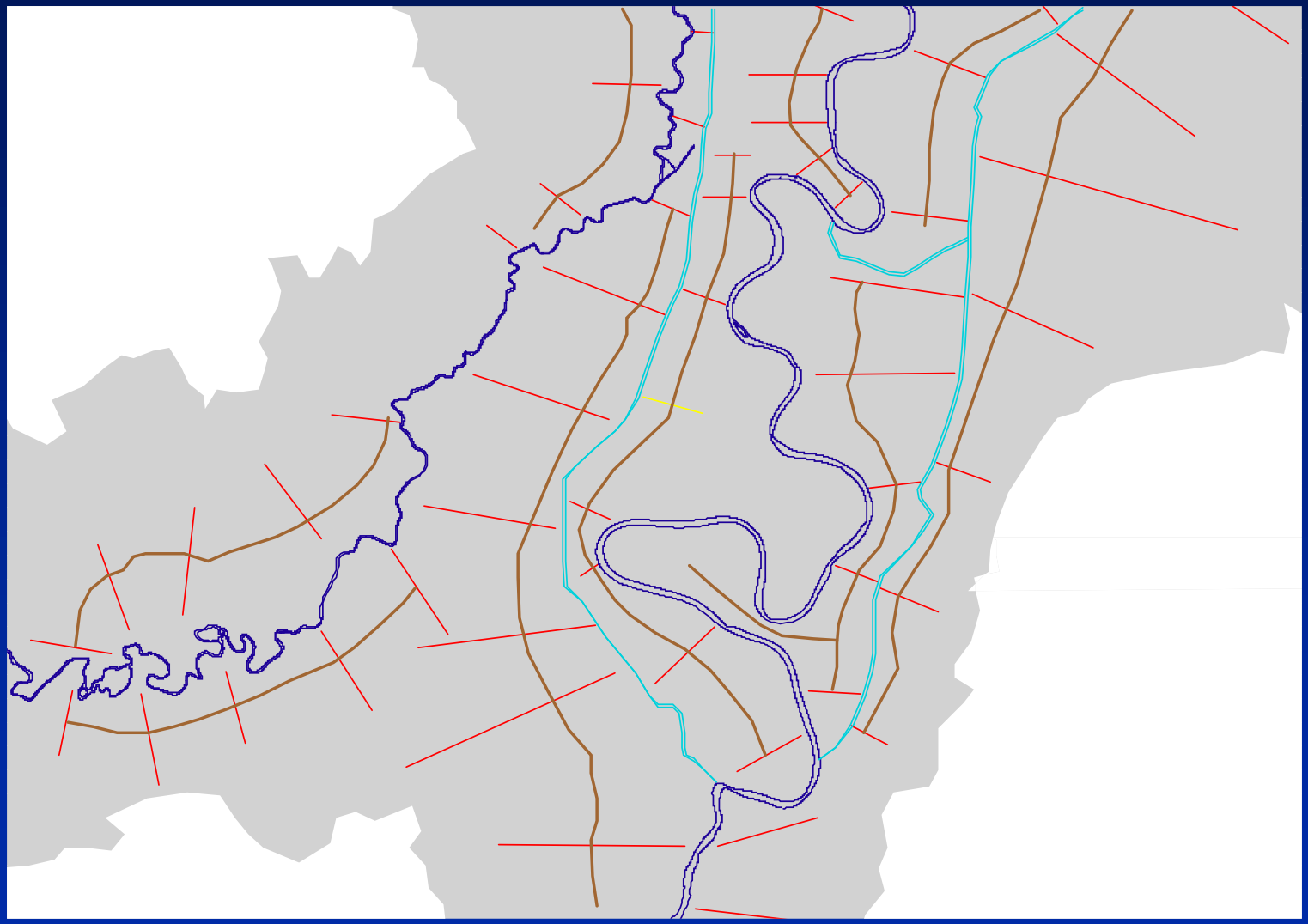
# *Digital Elevation Model*



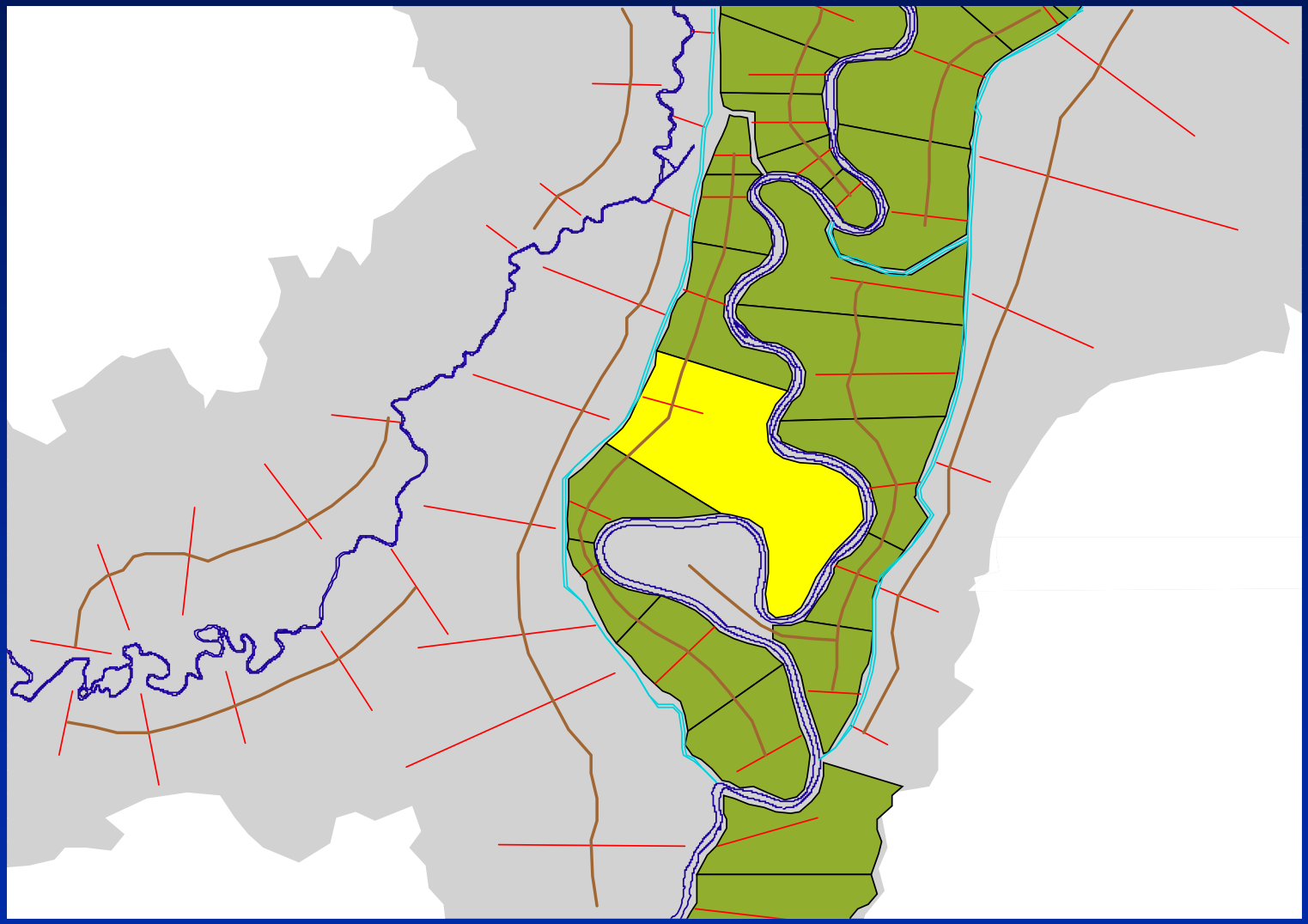
# *Typical Model Schematic*



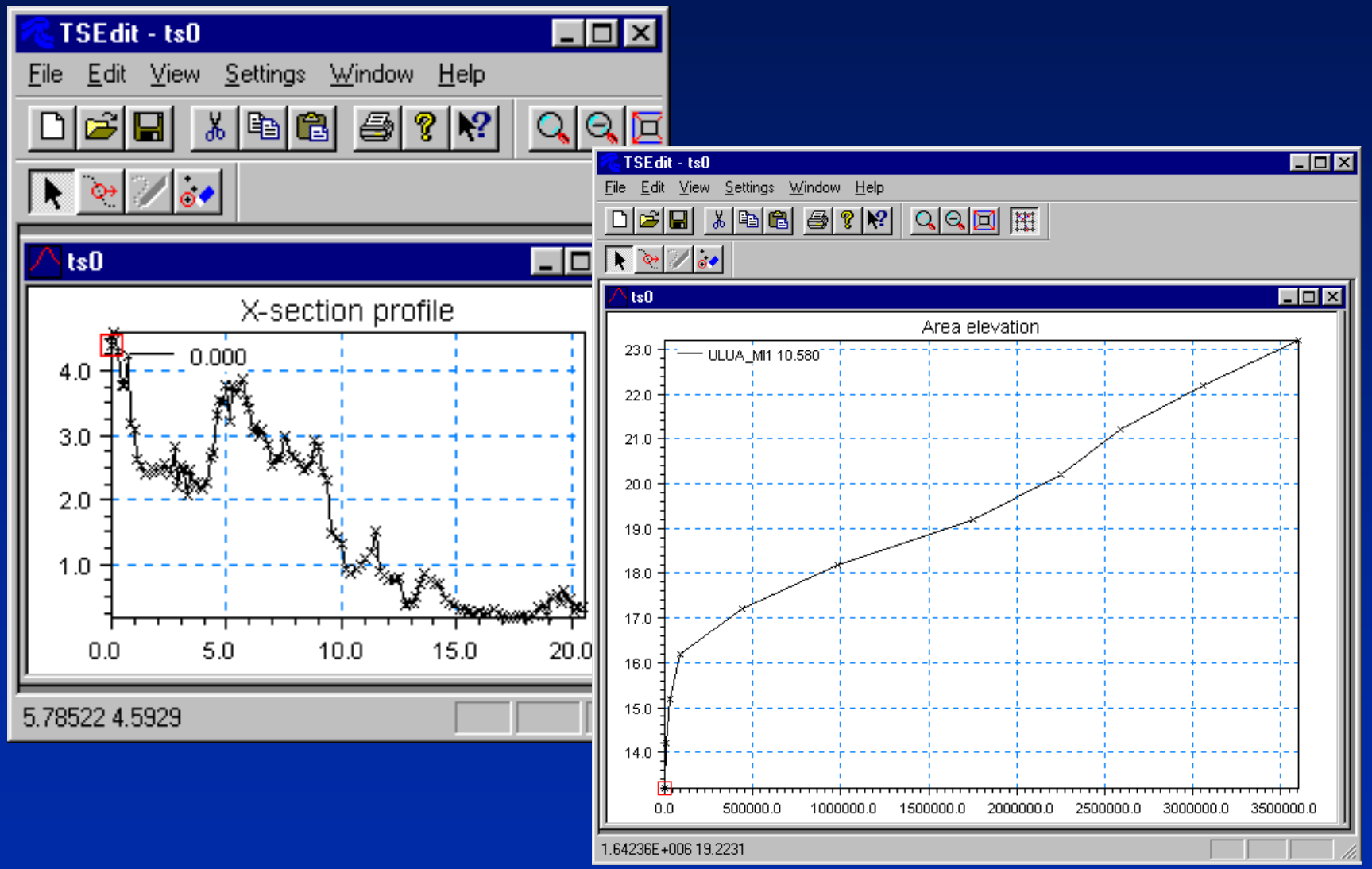
# *Floodplain Sections ...*



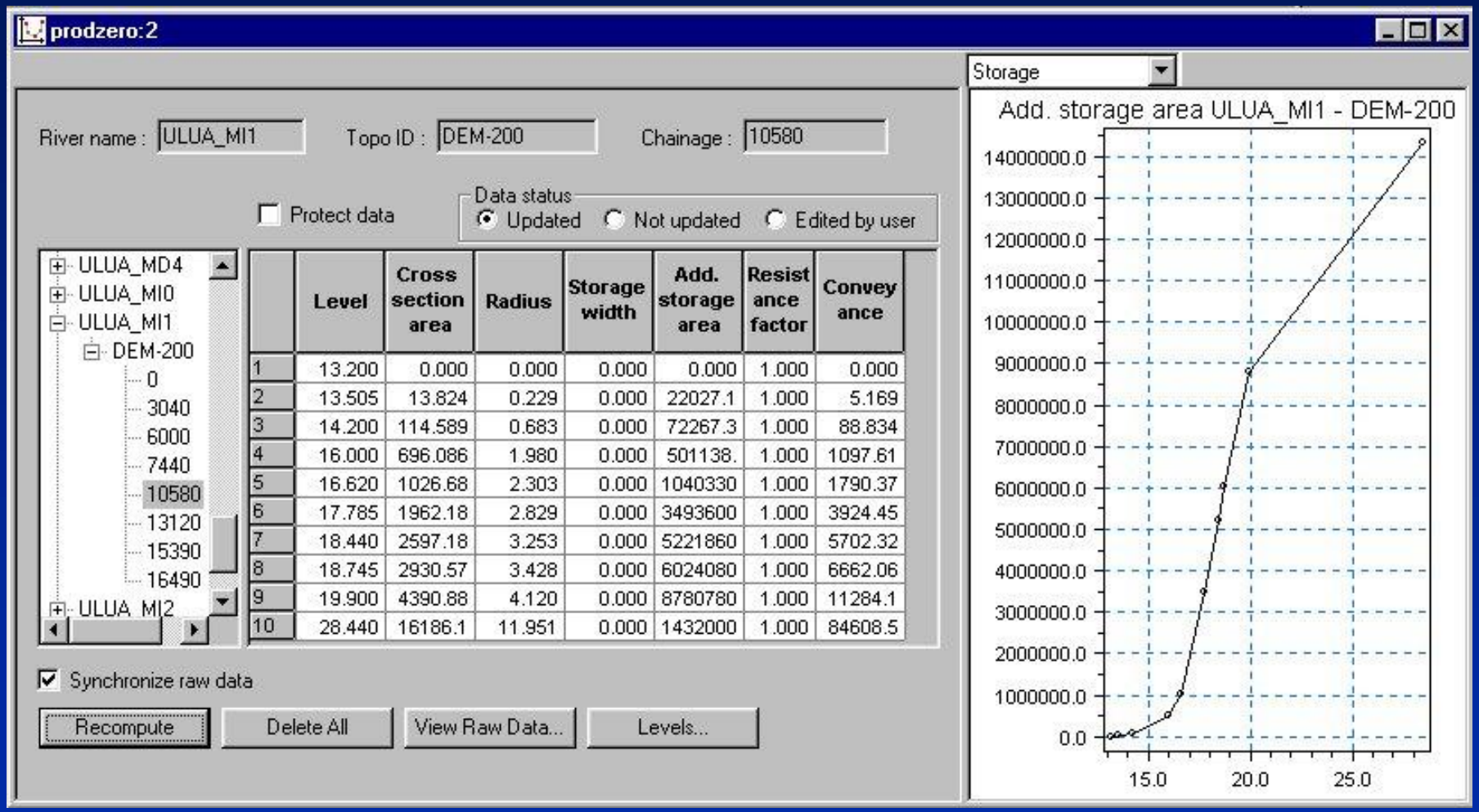
# … and storage



# … extracted from DEM

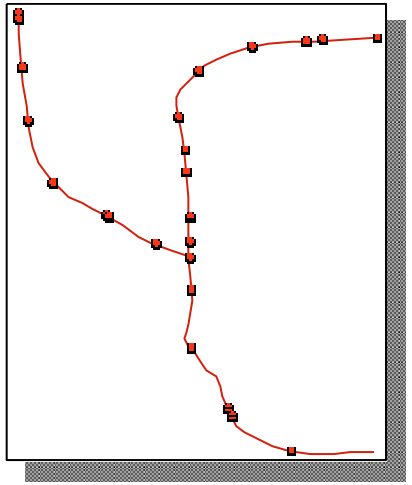


# … and imported to the river flood model

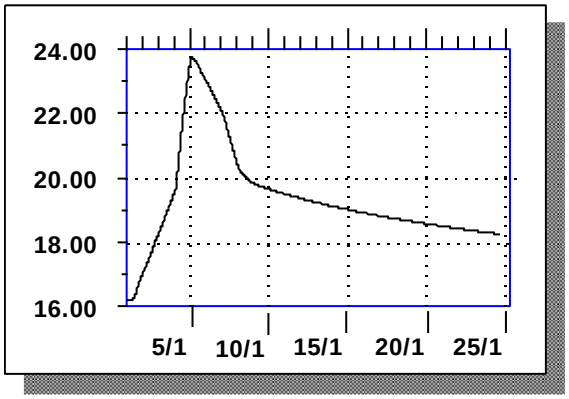



| | Level | Cross section area | Radius | Storage width | Add. storage area | Resistance factor | Conveyance |
|---|---|---|---|---|---|---|---|
| 1 | 13.200 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 0.000 |
| 2 | 13.505 | 13.824 | 0.229 | 0.000 | 22027.1 | 1.000 | 5.169 |
| 3 | 14.200 | 114.589 | 0.683 | 0.000 | 72267.3 | 1.000 | 88.834 |
| 4 | 16.000 | 696.086 | 1.980 | 0.000 | 501138. | 1.000 | 1097.61 |
| 5 | 16.620 | 1026.68 | 2.303 | 0.000 | 1040330 | 1.000 | 1790.37 |
| 6 | 17.785 | 1962.18 | 2.829 | 0.000 | 3493600 | 1.000 | 3924.45 |
| 7 | 18.440 | 2597.18 | 3.253 | 0.000 | 5221860 | 1.000 | 5702.32 |
| 8 | 18.745 | 2930.57 | 3.428 | 0.000 | 6024080 | 1.000 | 6662.06 |
| 9 | 19.900 | 4390.88 | 4.120 | 0.000 | 8780780 | 1.000 | 11284.1 |
| 10 | 28.440 | 16186.1 | 11.951 | 0.000 | 1432000 | 1.000 | 84608.5 |

# Flood Mapping



MIKE11
River Model




+

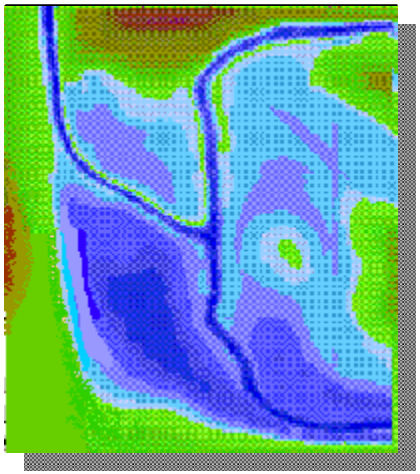


Digital Elevation
Model

+

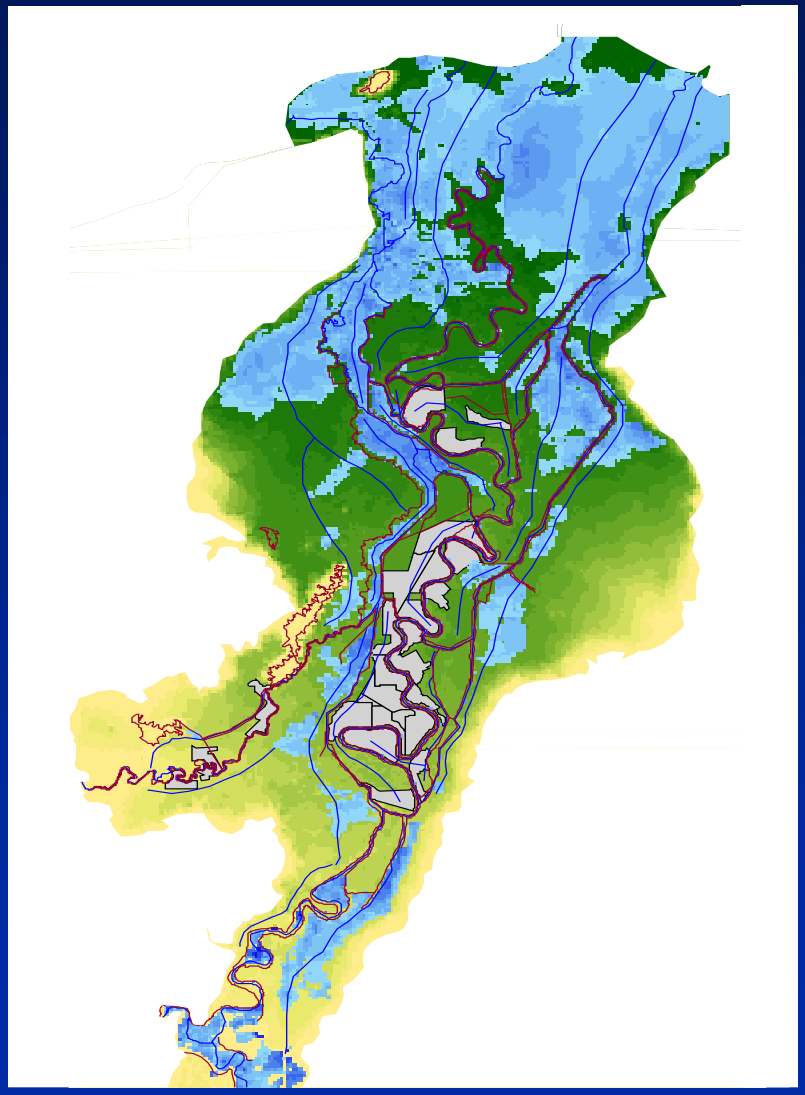
MIKE11-GIS

=



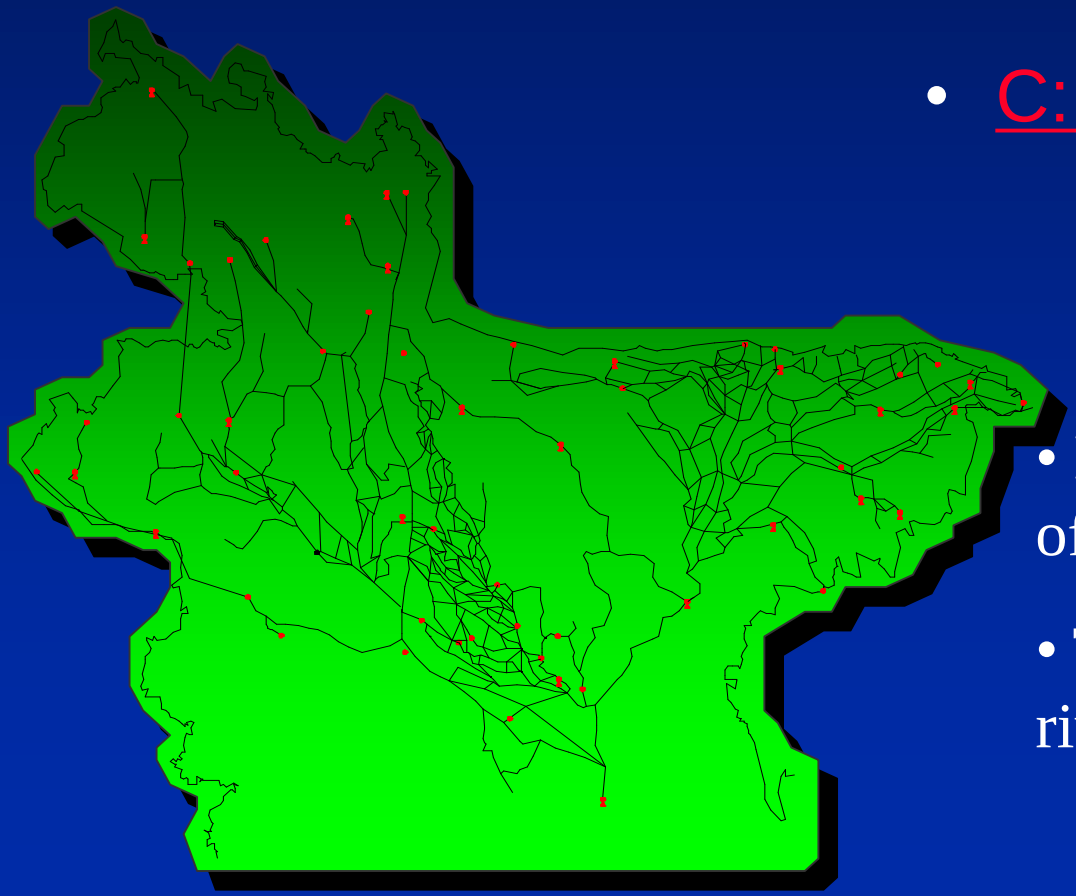
Flood Map

# *35 year Flood*



# *Animation of floods from Bangladesh*

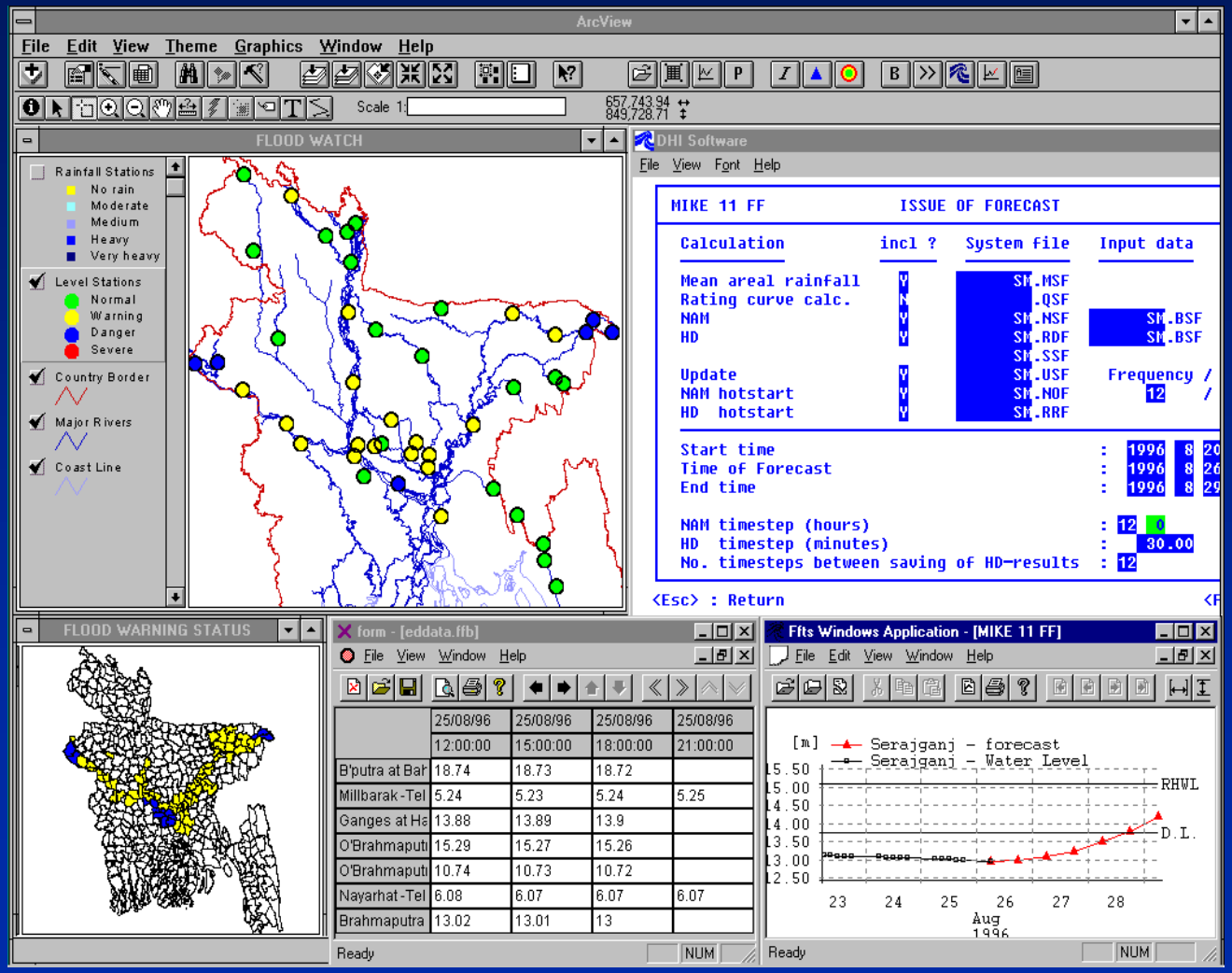
- A: Monsoon flood in 1988
- B: Predicted effects from protection levees
- C: Difference B-A



- Model covers northern part of country: 82,000 $km^2$
- Total length of modelled rivers: 7300 km

# FLOOD WATCH

*- a management system for real-time flood forecasting and warning*




## Components

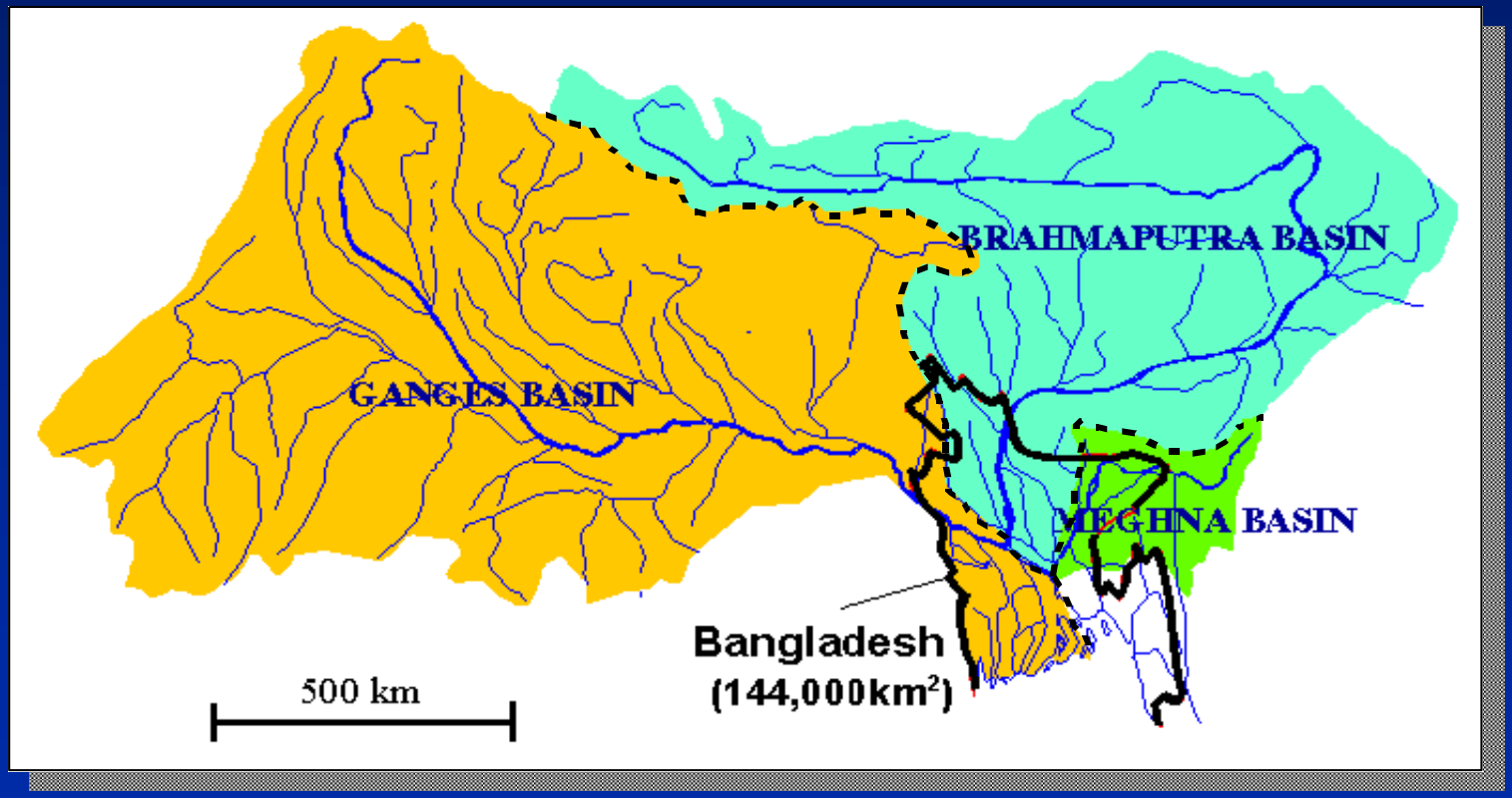
- database management
- editing and presentation
- forecast calculation

## Strengths

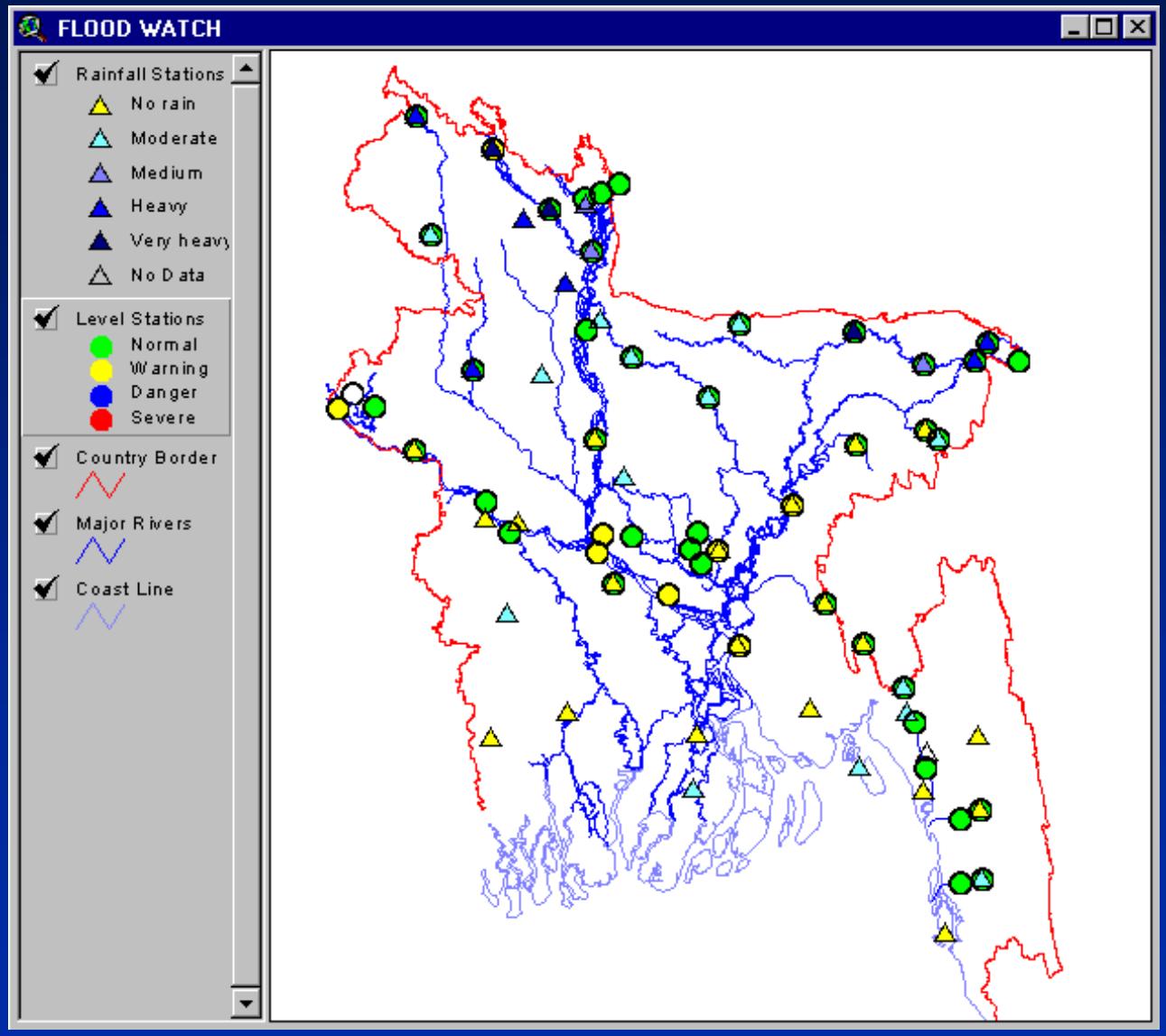
- fast real-time operation
- build in time series
- data base
- telemetric data link
- GIS data presentation
- dissemination of
- forecasts and warnings
- flood mapping link
- using MIKE 11 GIS

# Real-time application from Bangladesh

| Basin Areas ($km^2$) | |
|---|---|
| Ganges | - 1,087,300 |
| Brahmaputra | - 552,000 |
| Meghna | - 82,000 |



# Real-time hydrometric network




## Station Network

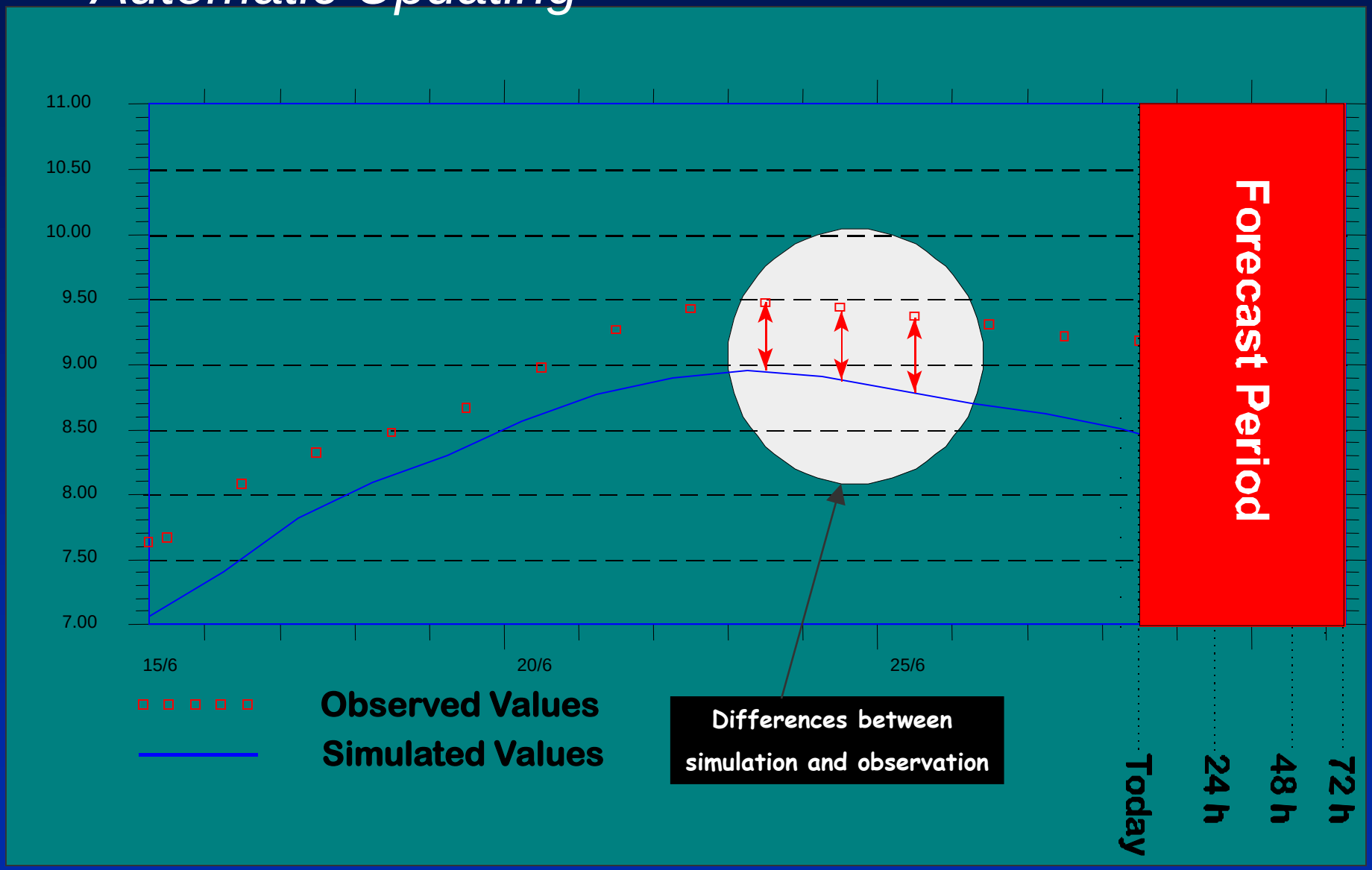
60 Water Level and Rainfall stations

## Data Collection

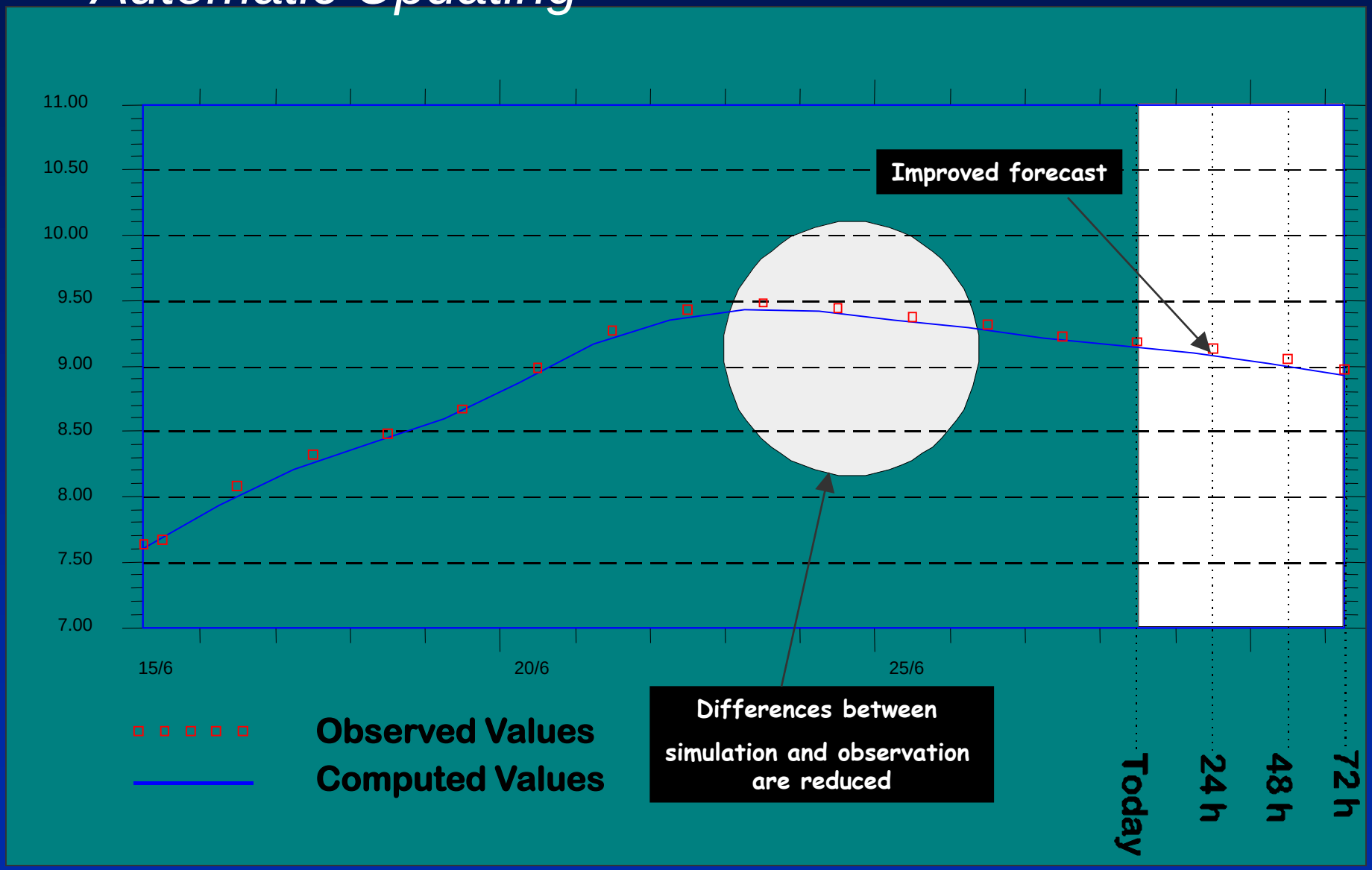
Daily procedure :

1) Data entered into a databox in the field
2) Data transmitted to the Flood Forecasting and Warning Centre in Dhaka via HF radios
3) Data transferred automaticly to the Flood Watch data base
4) Quality check in Flood Watch.

# Automatic Updating

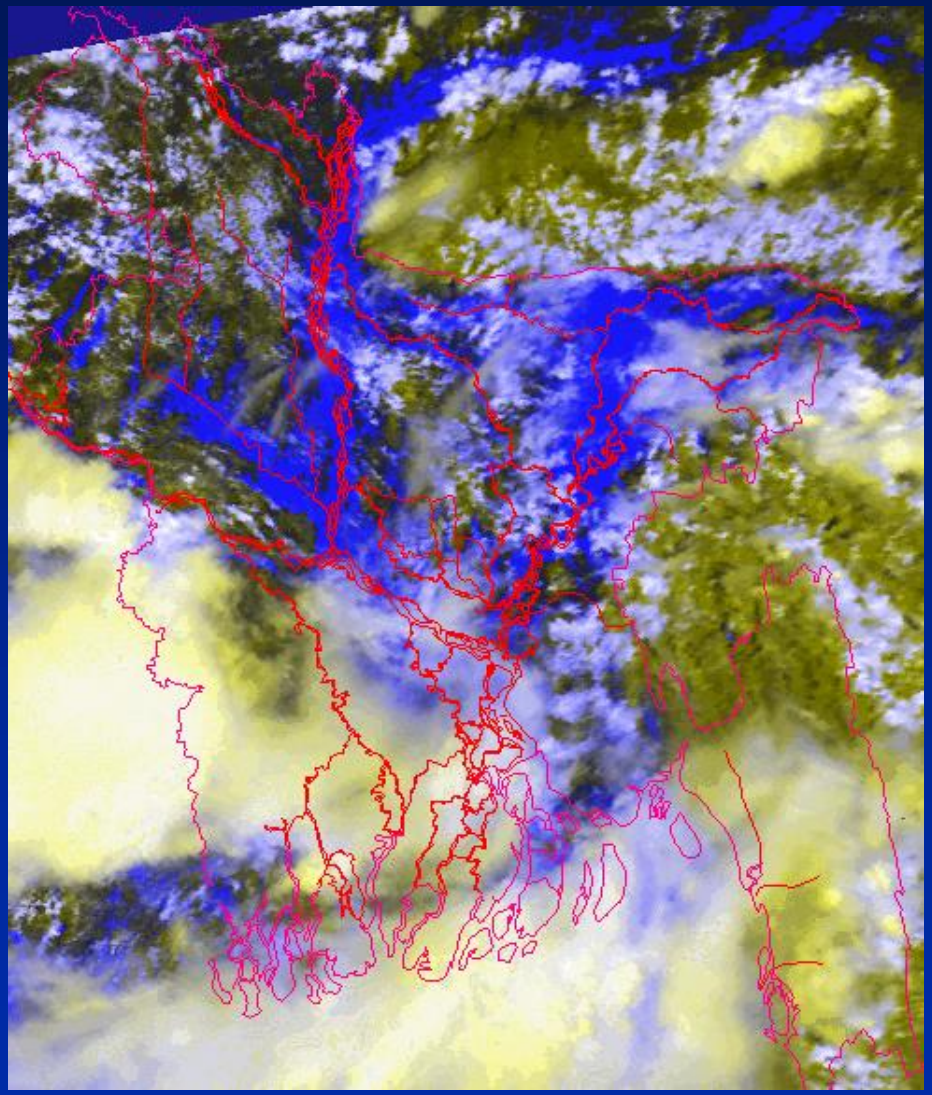


# Automatic Updating

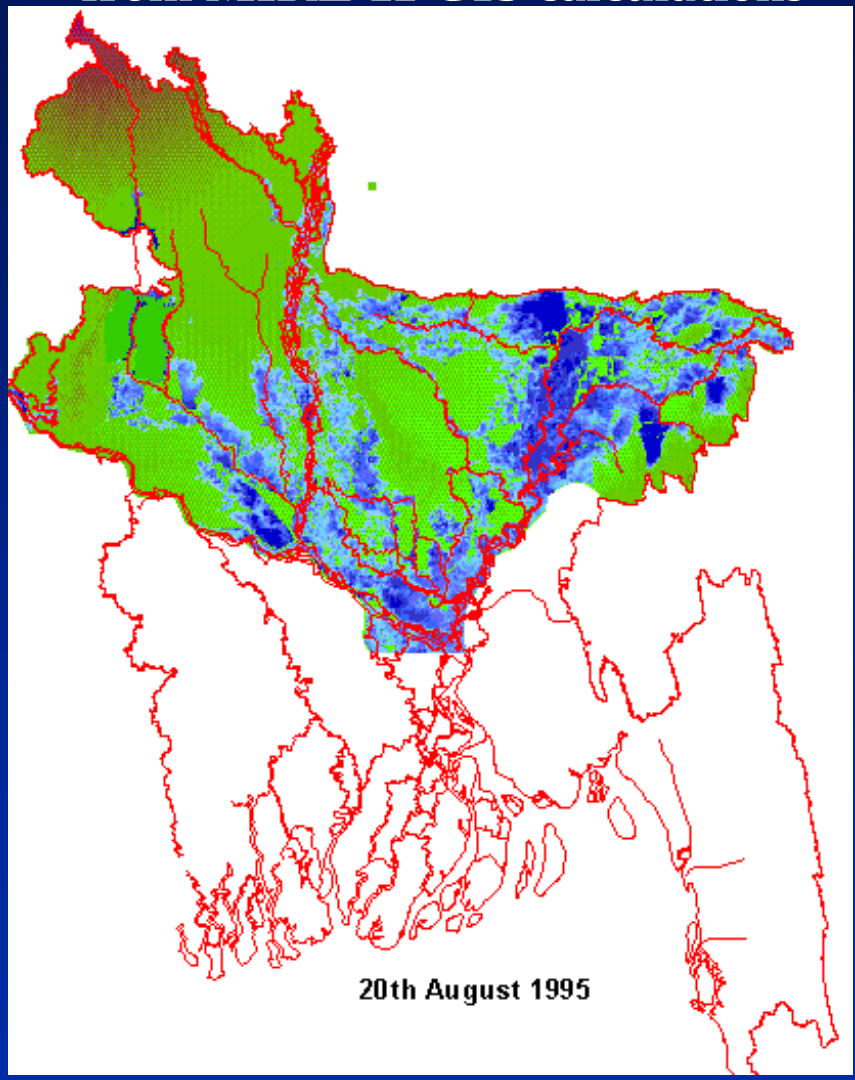


# Flood maps showing flood extent

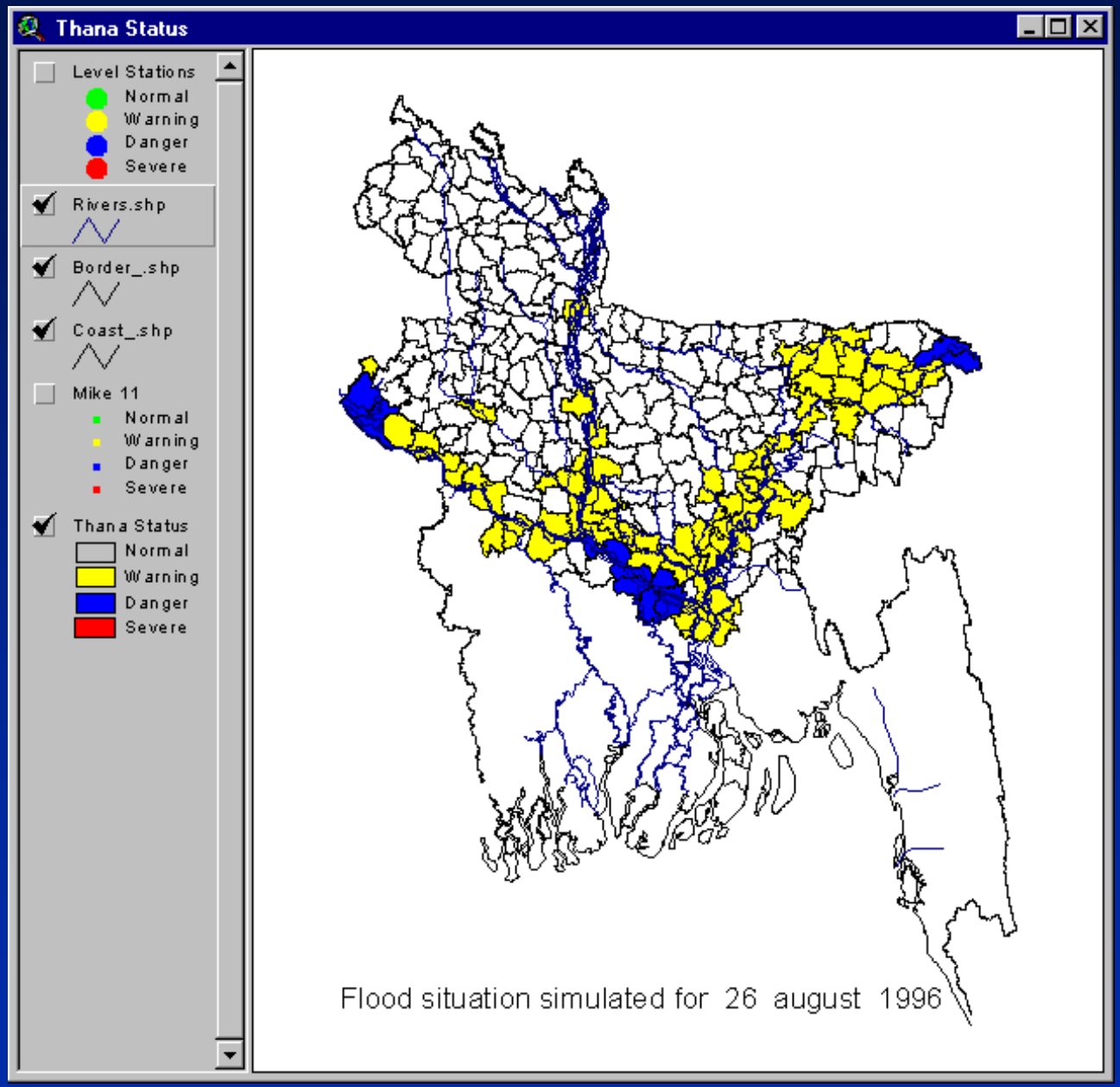
**a) Flood map based on data from NOAA**



**b) Forecasted flood map from MIKE 11 GIS calculations**



# Preparation of flood warning map for TV




**Warning status based on results from MIKE 11 GIS**

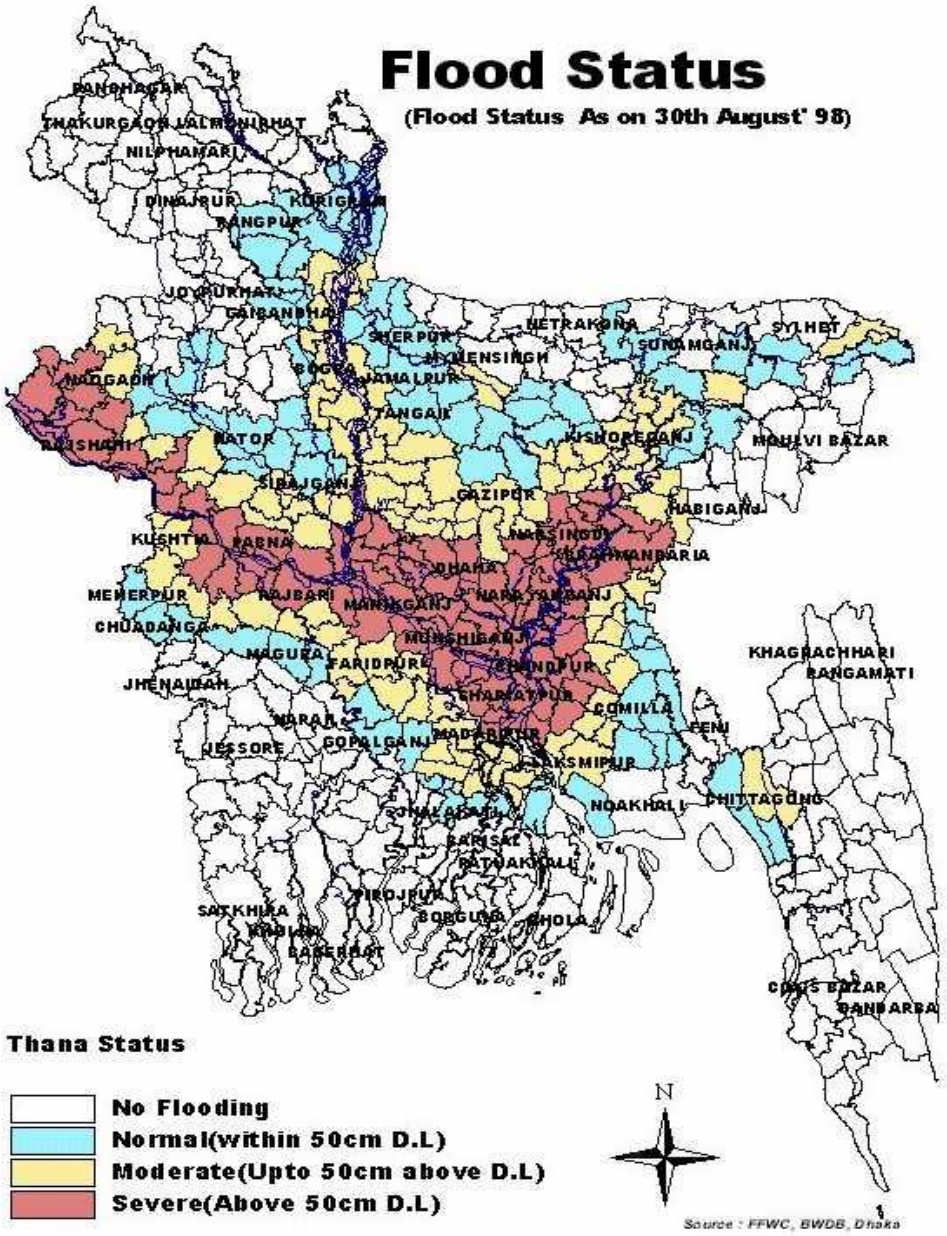
**Yellow: areas with flood warnings**

**Blue: area flooded**

**Red: severe flooding (no areas here)**

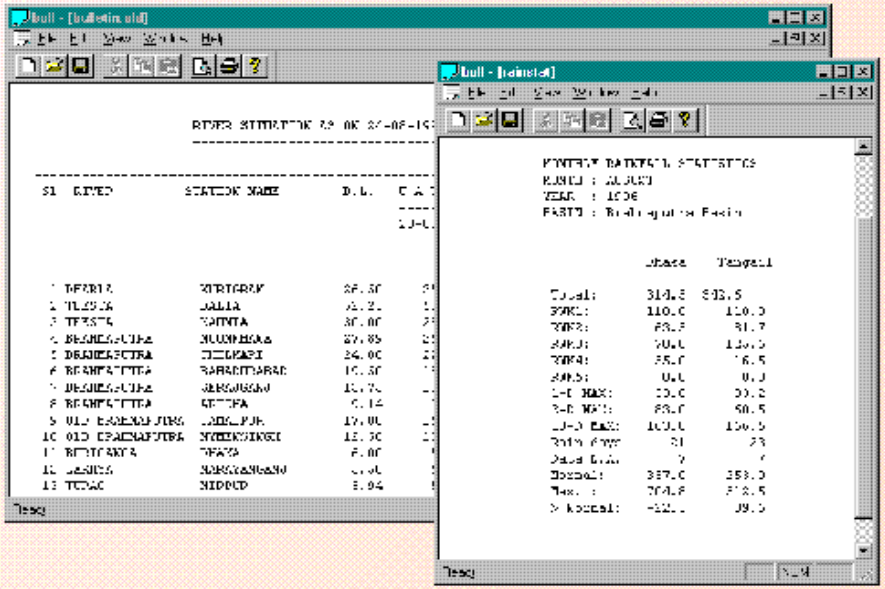
# www.ffwc.net

*30 august 1998*

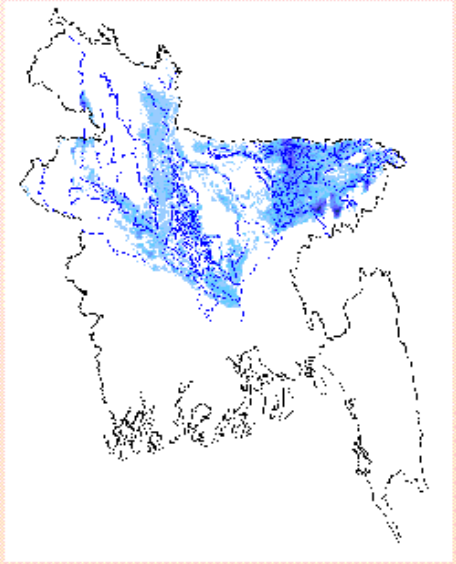


# Dissemination of Flood Warnings

**Water Level Forecasts**



**Inundation Forecasts**



**To..**



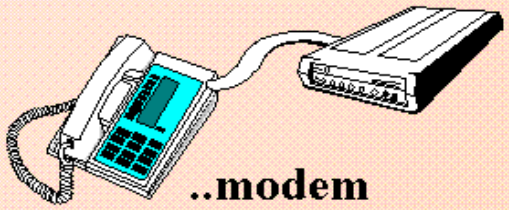
**..fax**

➤**Newspapers**



➤**Radio**

**Via..**



**..modem**



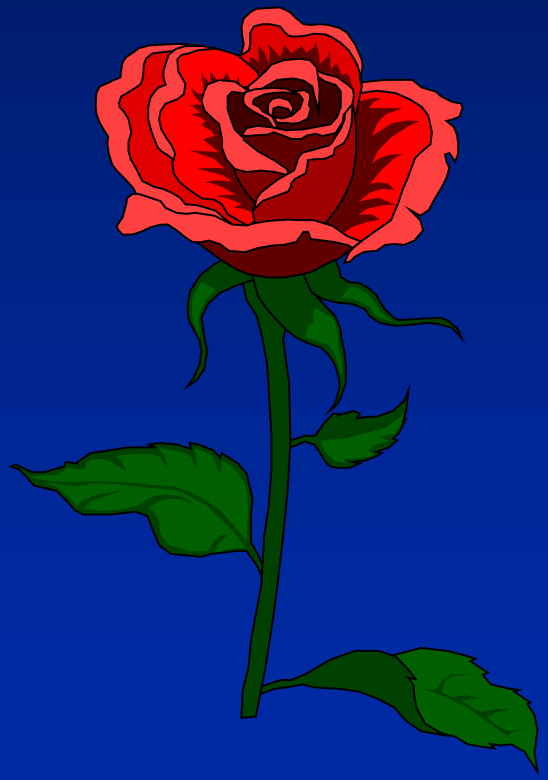
➤**Television**

➤**Prime Minister's Office**



**..Wireless LAN**

# *GIS & Hazards …….*



- Thanks for your attention

GIS를 기반으로 한

# 통합정보시스템 구축방안

# A Case of Developing The Integrated Information System Utilizing GIS

1999. 9.

SK 씨앤씨주식회사

# 목 차


Ⅰ 개요

Ⅱ 토지관리정보체계

Ⅲ 건물행정관리시스템

Ⅳ 지하시설물관리시스템

Ⅴ 통합시스템 구축사례

Ⅵ 향후발전방향


SK 씨앤씨주식회사

# Ⅰ 개 요

SK 씨앤씨주식회사

# 1. 추진배경

## 본 연구(GIS를 이용한 통합정보시스템 구축)의 추진배경

### 시스템간 호환문제

- ▶ 독립적 단위시스템 구축
  - GIS Tool, DBMS 등
- ▶ 업무표준 부정확, 불이행

### 공통자료 관리·이용문제

- ▶ 필요자료 개별구축
- ▶ 데이터의 이중관리
- ▶ 유지관리비용 증가
- ▶ 자료의 유일성 상실
- ▶ 사고발생원인 잠재

### 서비스 수준저하문제

- ▶ 행정처리시간 지연
  - 업무시스템간 호환문제
- ▶ 자료의 신뢰성 문제
  - 업무오류의 원인 잠재

## 2. 기대효과

### 본 연구(GIS를 이용한 통합정보시스템 구축)의 기대효과

| 품 질 | 비 용 | 시 간 | 서 비 스 |
|---|---|---|---|
| ▶ 자료의 표준화 | ▶ 자료보관비 절감 | ▶ 검색시간 단축 | ▶ 인력 재배치 |
| ▶ 관리오류 최소화 | ▶ 관리인건비 절감 | ▶ 업무협조시간 단축 | ▶ 공사 안전도 증가 |
| ▶ 업무 정확도 향상 | ▶ 관리업무비 절감 | ▶ 시설점검시간 단축 | ▶ 시설안전성 증대 |
| ▶ 자료의 신뢰성 | ▶ 제작비용의 절감 | ▶ 업무처리시간 단축 | ▶ 행정력의 일관성 유지 |

# II 토지관리정보체계

SK 씨앤씨주식회사

# 1. 개요 및 목적

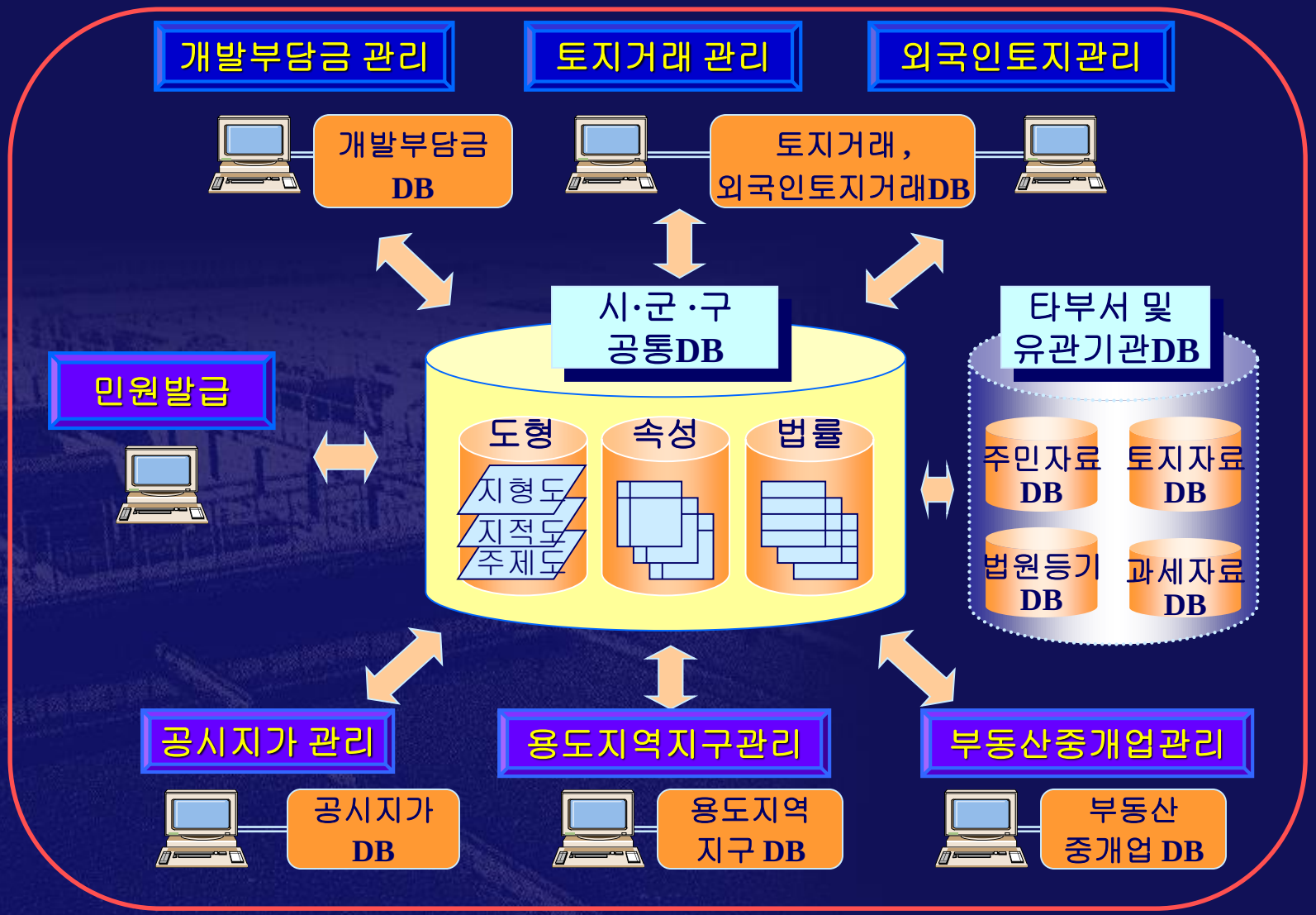
## 개발 목적

- 토지관련 신속 · 정확한 민원처리를 통한 서비스의 질적 수준 제고
- 토지정보의 전산화를 통한 합리적인 정책수립
- 토지행정업무의 전산화를 통한 행정생산성 제고

## 사업 개요

- 주관기관 : 건설교통부 토지관리과
- 시범지역 : 대구광역시 남구청
- 사업기간 : 1998년 4월 ~ 1998년 12월
- 사 업 자 : 국토연구원(학술), SKC&C(기술)

## 2. 시스템 구성 및 기능


개발부담금 관리
토지거래 관리
외국인토지관리
개발부담금 DB
토지거래, 외국인토지거래DB
시·군·구 공통DB
타부서 및 유관기관DB
민원발급
도형
속성
법률
지형도
지적도
주제도
주민자료 DB
토지자료 DB
법원등기 DB
과세자료 DB
공시지가 관리
용도지역지구관리
부동산중개업관리
공시지가 DB
용도지역 지구 DB
부동산 중개업 DB

# III 건축행정관리시스템

SK 씨앤씨주식회사

# 1. 개요 및 목적

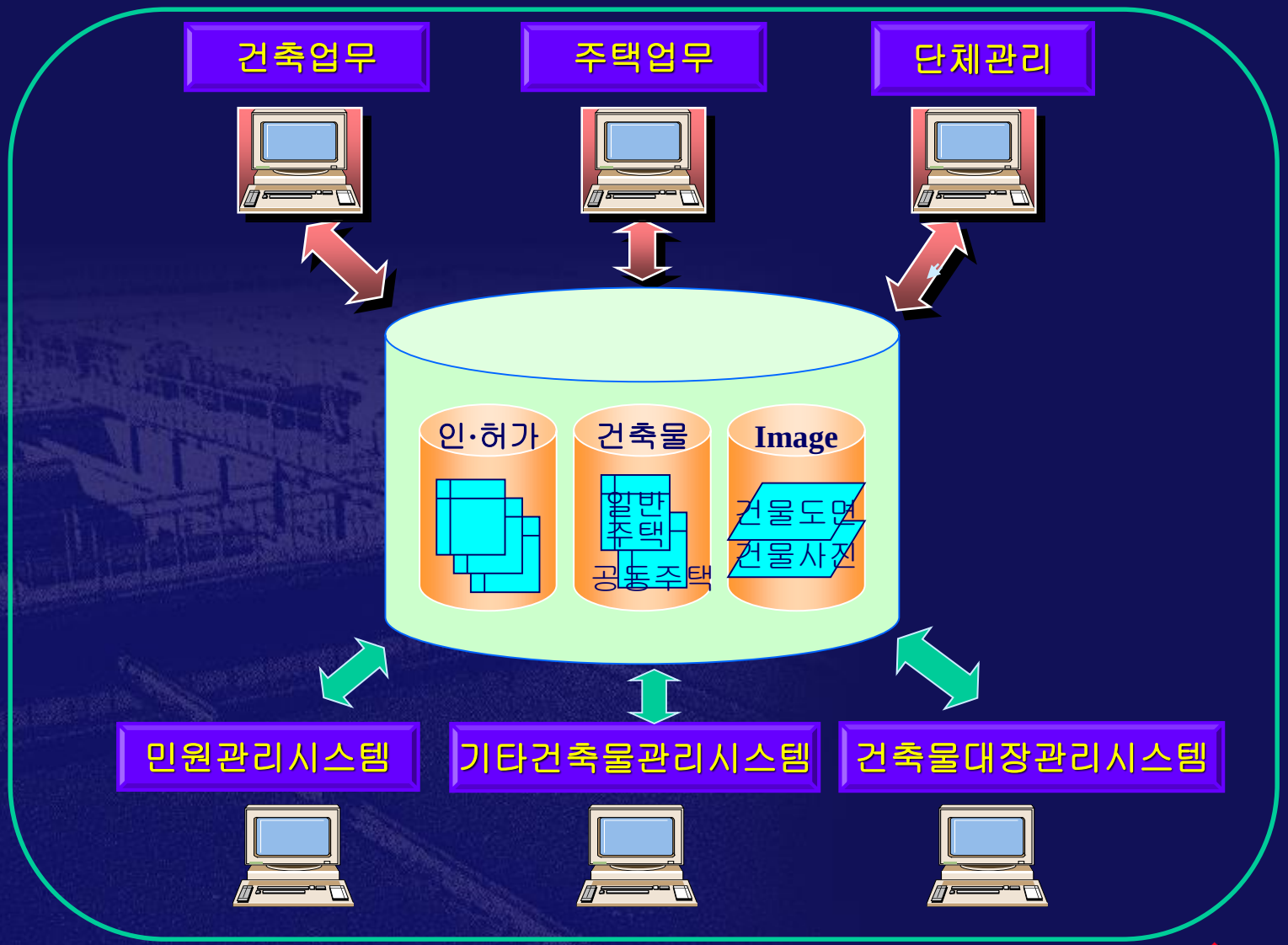
## 개발 목적

- 건축행정의 국가표준시스템 개발
- 업무절차 간소화로 행정의 생산성 향상
- 업무절차의 투명성 확보
- 민원서비스의 수준 제고

## 사업 개요

- 주관기관 : 건설교통부 건축과
- 시범지역 : 서울 은평구, 경기도 고양시, 충청북도 청주시
- 사업기간 : 1997년 10월 ~ 1998년 9월
- 사 업 자 : LG전자(주)

## 2. 시스템 구성 및 기능


건축업무
주택업무
단체관리
인·허가
건축물
Image
일반
주택
공동주택
건물도면
건물사진
민원관리시스템
기타건축물관리시스템
건축물대장관리시스템

# Ⅳ 지하시설물관리시스템

SK 씨앤씨주식회사

# 1. 개요 및 목적

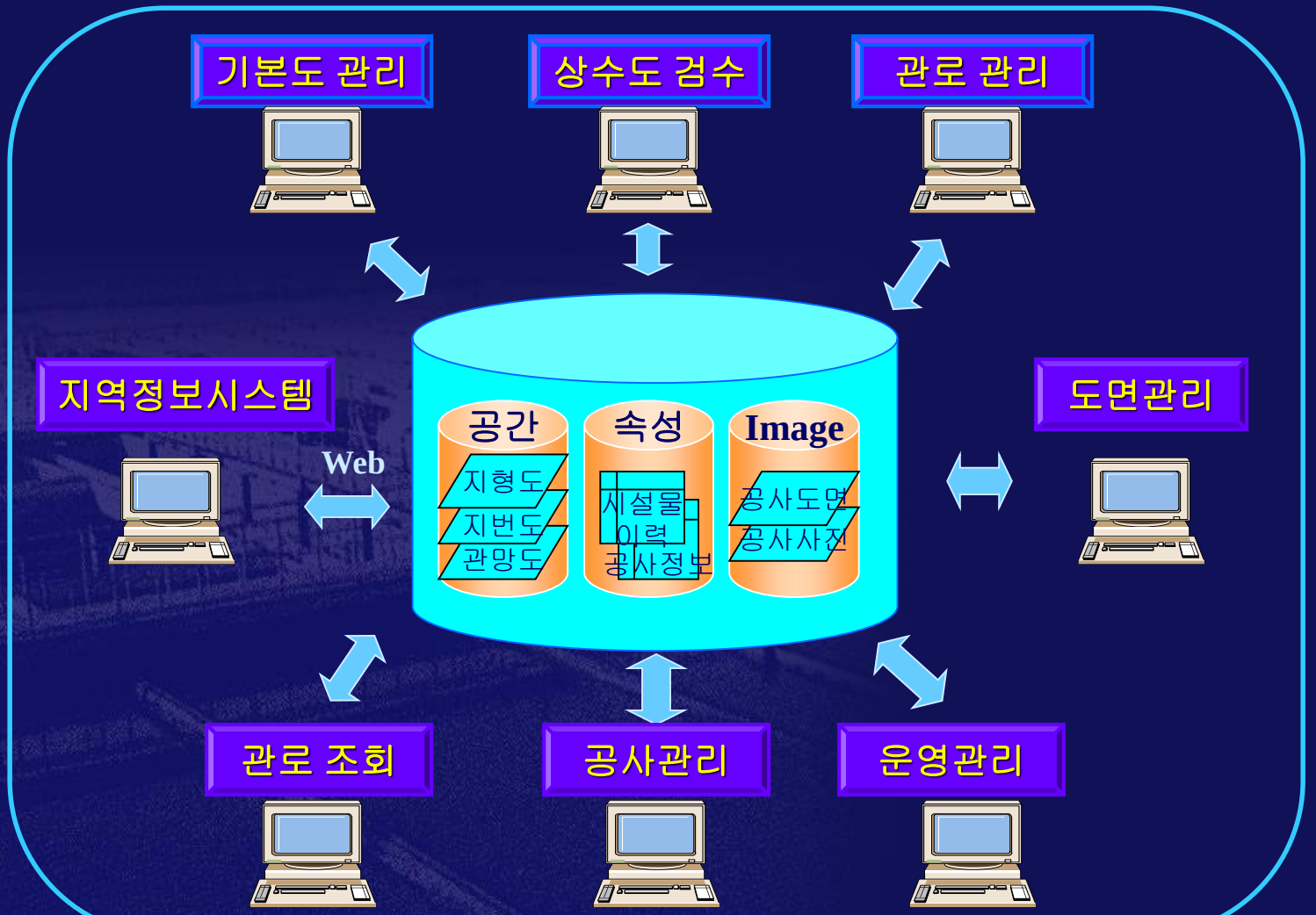
## 개발 목적

- 지하시설물의 체계적, 종합적 관리
- 재난사고의 예방 및 신속한 대처
- 관리업무의 생산성 향상 및 민원서비스 제고
- 누수, 누전 등 재정손실, 환경오염 차단

## 사업 개요

- 주관기관 : 전주시 상수도 사업소
- 대상지역 : 전주시
- 사업기간 : 1998년 12월 ~ 1999년 8월
- 사 업 자 : SKC&C(주)

## 2. 시스템 구성 및 기능




※ 지하시설물관리시스템의 구축대상중 지방자치단체가 관리주체인 상수도관리시스템

# V 통합시스템구축

SK 씨앤씨주식회사

# 1. 대상 및 주안점

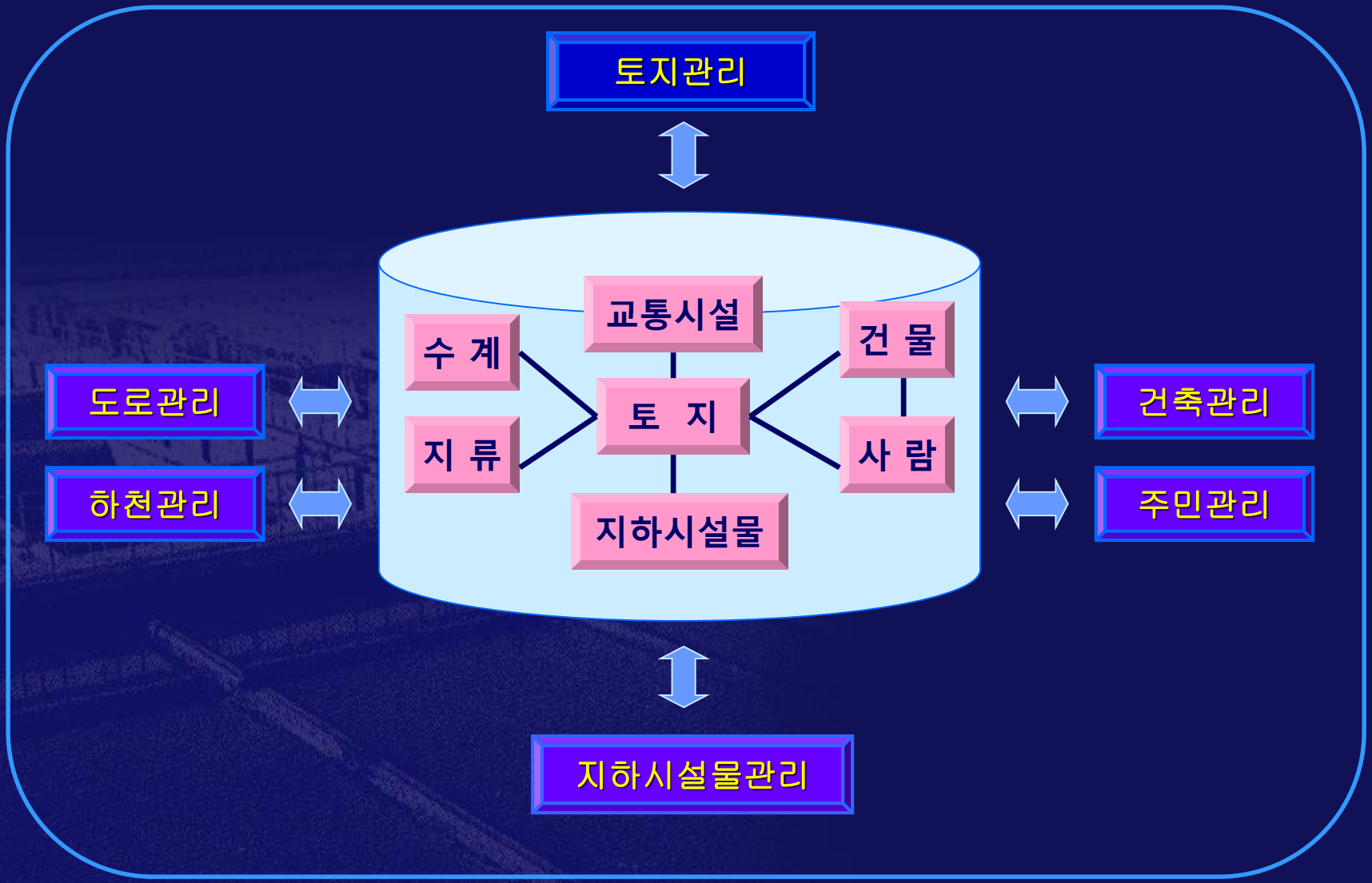
## 개발 대상

- 건설교통부 주관부문
  - 토지관리정보체계, 건축행정관리시스템, 상수도관리시스템, 도시가스관리시스템
- 행정자치부 주관부문
  - 새주소관리시스템

## 사업 주안점

- 중복구축 된 데이터베이스의 단일 통합
- 자료유지 갱신, 관리의 일관성 유지
- 각 하부시스템의 기능향상에 필요한 데이터베이스 상호공유
- 향상된 기능을 수행할 수 있도록 응용프로그램 상호지원

## 2. 시스템 구성 및 기능

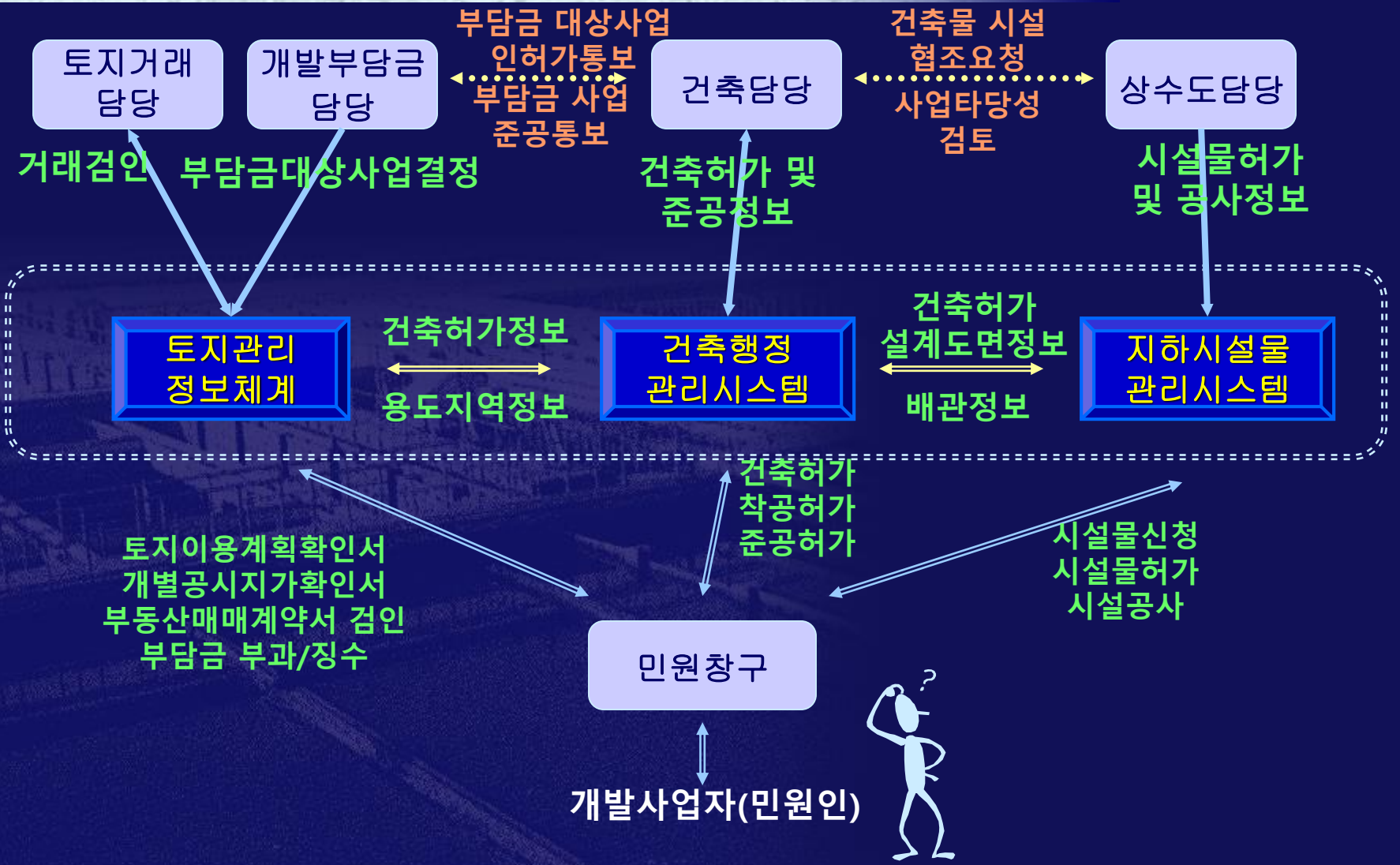


# 2. 업무처리(가정) 사례

▶ 밀레니엄市 신지식氏의 주유소 건축사업

| 민 원 인 | 시 군 구 |
|---|---|
| ▶ 토지에 대한 지가 및 규제사항 파악 | ▶ 공시지가확인서, 토지이용계획확인서 발급 |
| ▶ 토지거래 계약, 토지거래 검인신청 | ▶ 부동산매매계약서 검인 |
| ▶ 토지매입, 건축허가 신청 | ▶ 신청서(건축주, 설계자, 건축물내역) 접수 |
| | ▶ 용도지역지구 사항 및 법률 조회 |
| | ▶ 건축허가 처리, 허가증 교부 |
| ▶ 착공신고 | ▶ 개발부담금 대상사업 통보 |
| | ▶ 개발부담금 부과대상사업 결정(연접사업확인) |
| | ▶ 개발부담금 산정 |
| | ▶ 개발부담금 부과/징수 |
| ▶ 상수도 등 시설물 신청 | ▶ 배관확인, 건축설계도면 조회 |
| ▶ 준공검사 | ▶ 신청접수(공사비 산정) |

# 3. 처리 PROCESS


토지거래 담당
개발부담금 담당
부담금 대상사업 인허가통보
부담금 사업 준공통보
건축담당
건축물 시설 협조요청
사업타당성 검토
상수도담당
거래검인
부담금대상사업결정
건축허가 및 준공정보
시설물허가 및 공사정보
토지관리 정보체계
건축허가정보
용도지역정보
건축행정 관리시스템
건축허가 설계도면정보
배관정보
지하시설물 관리시스템
건축허가 착공허가 준공허가
토지이용계획확인서 개별공시지가확인서 부동산매매계약서 검인 부담금 부과/징수
시설물신청 시설물허가 시설공사
민원창구
개발사업자(민원인)

# 4. 통합시스템의 효과

| | |
|---|---|
| 민 원 인 | ▶ 민원제출서류의 감소(건축허가신청시 토지이용계획확인서 등)<br>▶ 민원방문회수의 감소<br>▶ 민원처리시간의 단축 |
| 업무담당자 | ▶ 업무처리시간의 단축<br>▶ 업무담당자간 협의·통보사항 전산처리<br>▶ 업무처리절차 간소화 |
| 지방자치단체 | ▶ 각종문서관리를 전산처리 및 DB화(관리, 검색 효율성)<br>▶ 주민의 신뢰를 얻는 자치행정<br>▶ 일관된 행정처리 |

# VI 향후 발전방향

SK 씨앤씨주식회사

**도시종합 정보시스템 (UIS)**

- ▶ 물적자원, 공공서비스, 자치발전 정책수립 지향
- ▶ 지방자치종합행정, 도시경영 등 타 시스템과의 연계 추진

**기술개발**

- ▶ 상이한 컴퓨팅환경 및 GIS 데이터 포맷에서 통합가능한 OPEN GIS
- ▶ GIS기능의 컴포넌트化를 통한 시스템 개발촉진 및 비용절감

**관심과 투자**

- ▶ 각 개별시스템 주관부서간 협조체제 및 제도적 뒷받침
- ▶ 「정보화전략계획」을 바탕으로 한 종합적·체계적 추진

# 감사합니다.

SK 씨앤씨주식회사

LAND VICTORIA

# Developing a Common Geospatial Infrastructure between State & Local Governments

## A Case Study from Victoria, Australia

**Steve Jacoby**
**Director, Land Information Group**

**Land Victoria**
**Department of Natural Resources & Environment**
**State Government of Victoria**

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# State of Victoria, Australia







- Capital - Melbourne
- Population - 4.8M
- Area - 227,420 km$^2$
- Land Parcels - 2.4M
- Local Govt.s - 78

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# Developing a common Geospatial Infrastructure between State & Local Governments

- Land Victoria
- Background
  - Priority Geospatial Datasets
  - Content & Quality Requirements
- “The Problem”
- Property Information Project
  - Proposal / Stages / Progress
- Benefits
  - Local / State Government
- Future Steps

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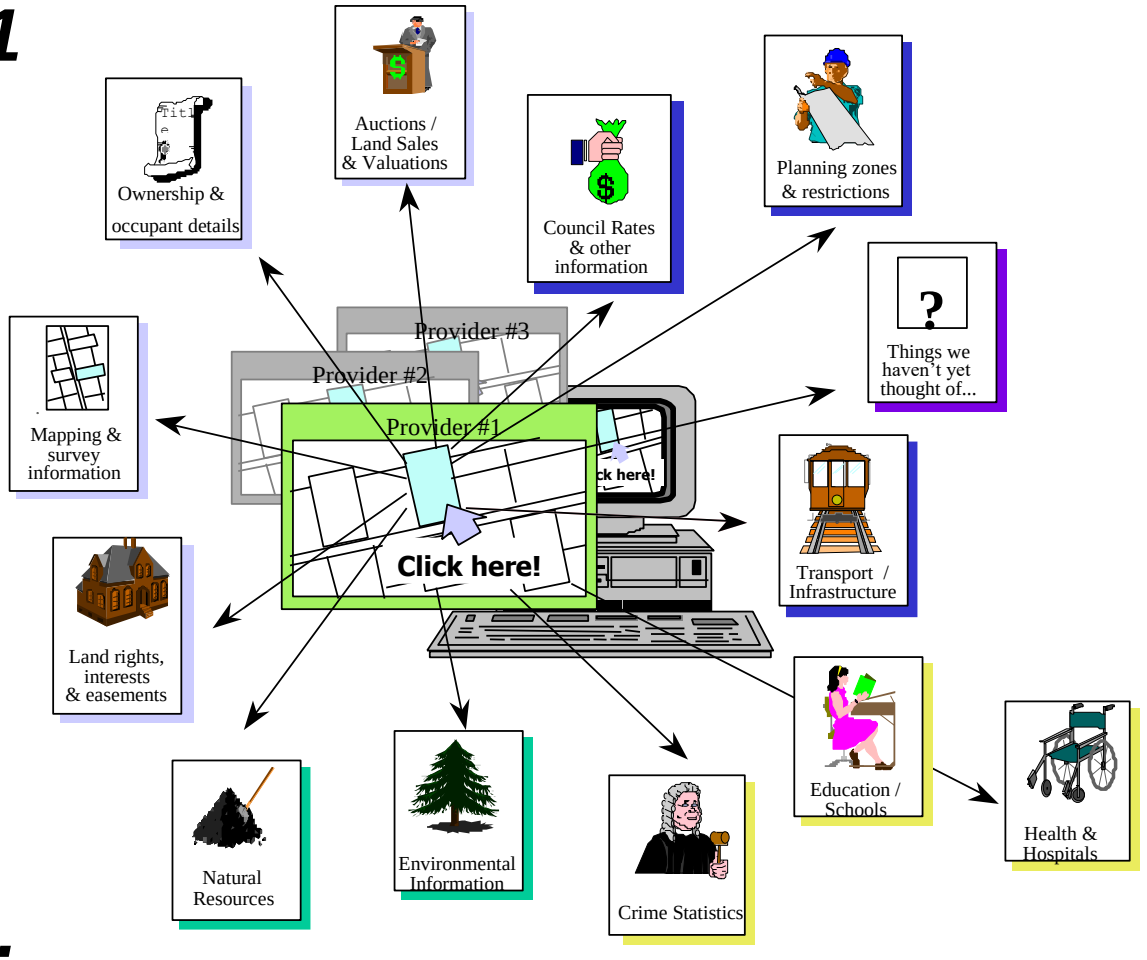
# Land Victoria

- **State Government Agency (3 major businesses)**
  - **LAND REGISTRY**
  - **CROWN LAND MANAGEMENT**
  - **LAND INFORMATION GROUP**
- **Responsibilities include:**
  - **Land Titles / Surveying / Valuations / Geodesy / Mapping / GIS / Remote Sensing**
- **Staff: 800**
- **Budget: US$30M**
- **Revenue: US$60M**

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# Land Victoria's *Vision*

- ***By the year 2001 customers will be able to point to a piece of land on an electronic map and have all the information relevant to that piece of land at their fingertips...***



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# Background

- **1993 Tomlinson Associates Study**
  - **To Develop a Strategic Framework for GIS Development in Victoria**
  - **Major Investigation (over 18 months)**
  - **Covered approx. 40 State Agencies & Reviewed 270 Datasets**
  - **Set Requirements for the most important (Framework) datasets**

# 1993's Priority Geospatial Datasets

- **State Digital Cadastral Mapbase**
- **Digital Road Centreline Network**
- **Digital Topographic Mapbase (1:100,000 scale)**
- **Planning Zones & Controls Layer**
- **Digital Topographic Mapbase (1:25,000 scale)**

  - **Top 5 Datasets based upon Frequency of Use and Aggregated Benefits (Tomlinson Associates, 1993)**

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# Content & Quality Requirements

## For the State Digital Cadastral Mapbase

- authoritative State-wide coverage of land units
- clear, current and correct parcel and property land units
- land unit key linkages established to various agency databases
- dataset maintenance established
- support for communication of land information between agencies
- the ability to perform topologic (spatial) analyses

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# Parcel & Property Information

**PROPERTY INFORMATION**
- Street Address
- Local Government Property Number






**PARCEL INFORMATION**
- Lot / Plan Number

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# "The Problem(s)"

- **Custodianship of the Mapbase**
  - **No Single Custodian (State custodian 900K land units, Melbourne Water custodian 1.5M land units)**
- **Mapbase(s) Technical Structure**
  - **CAD format (spaghetti)**
  - **Mixture of 'Property' land units and 'Parcel' land units**
  - **2 Technical Standards Implemented**
- **Maintenance and Access Issues**
  - **No Maintenance in Rural Areas**
  - **Metro Maintenance in 'Areas of Interest' only**
  - **Local Government is custodian for all Property & Street Address data (State has access to Parcel data via State Land Titles Office)**

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# Establishing the Geospatial Infrastructure - the solutions

1) Resolved Custodianship
   - State-wide Mapbase formed by Agreement between State & Melbourne Water in 1994

2) Technical Re-engineering by Outsourcing
   - Contract let to the Private Sector to Manage & Maintain the New Cadastral Mapbase
   - State retained Custodianship & all I.P. Rights
   - State sets Standards & Monitors Quality
   - Output based Contract….

# 2) Outsourcing & Re-engineering (cont…)

## Requirements of the Cadastral Mapbase Contract

- All spatial data to be stored in a single database, not in a proprietary GIS
- Land parcels and properties and their relationship correctly modelled
- Allowance for ‘Proposed’ Parcels & Properties
- Topologically structured (polygonised)
- All data uniquely identified
- Data never deleted (only retired)
- Capable of incremental or ‘change-only’ updates

- **Progressively established from 1995...**

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# Establishing the Geospatial Infrastructure - the solutions (cont…)

**3) Establish a Secure Supply of Property Information from Local Government**

- **Include Local Governments' Property Information in the Mapbase**
- **Establish correct relationships (match) between these properties and the land parcels**
- **Ensure On-Going Maintenance of all Property Details (including Street address, Road Name, Suburb / Locality Names)**

**BUT HOW?**

# Prescriptive or Co-operative?

## 1) Prescriptive

- Legislate - Requiring Local Government to provide Property Information to the State
- Unlikely to succeed - Recent Major Reforms in Local Government (210 into 78)

## 2) Co-operative

- Persuade Local Government to participate in an exchange of data and ongoing services for mutual benefit
- Property Information Project

- Still Unlikely to succeed...

# Property Information Project Proposal

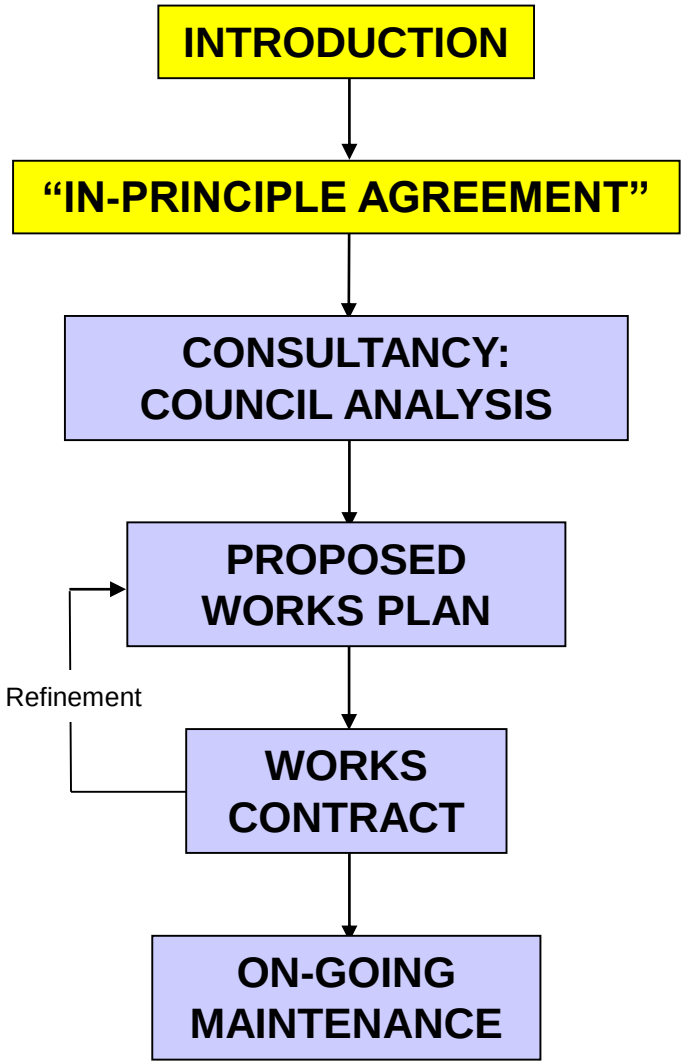
**Land Victoria provides:**

- **Products**
- **Cadastral Map Base**
- **Funding**
- **data reconciliation (matching Property & Parcel Data)**
- **new addressing - locality definitions, road naming, property numbering**
- **migration of data into Cadastral Mapbase**
- **Services**
- **on-going maintenance**

**Local Government agrees to:**

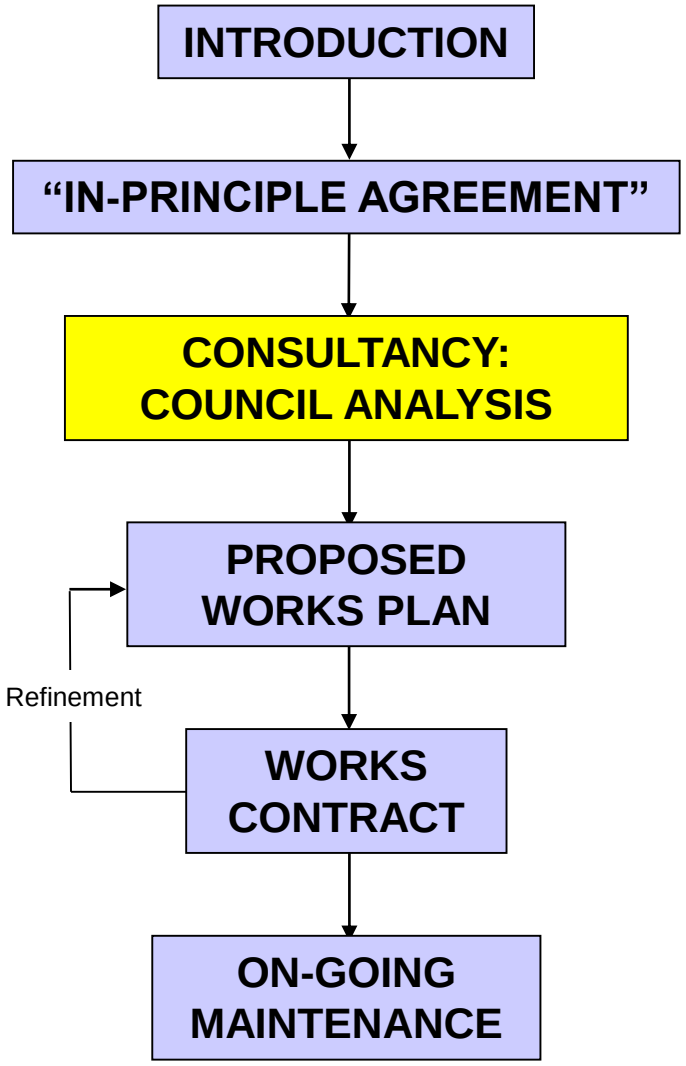
- **adoption of Cadastral Mapbase**
- **supply Land Victoria with all (proposed) plans submitted by Developers**
- **supply of all relevant property changes (CPN, street addressing, road names, localities, etc)**

# Project Stages




- PIP Commenced in July 1997
- 2 Year Establishment
- Major initial focus on communications
- 'Face-to-face' meetings
- Formal presentations to every Local Government
- Establish Contact Officers
- Asked for "In-Principle" Agreement to the Project
- Proceed to next stage...

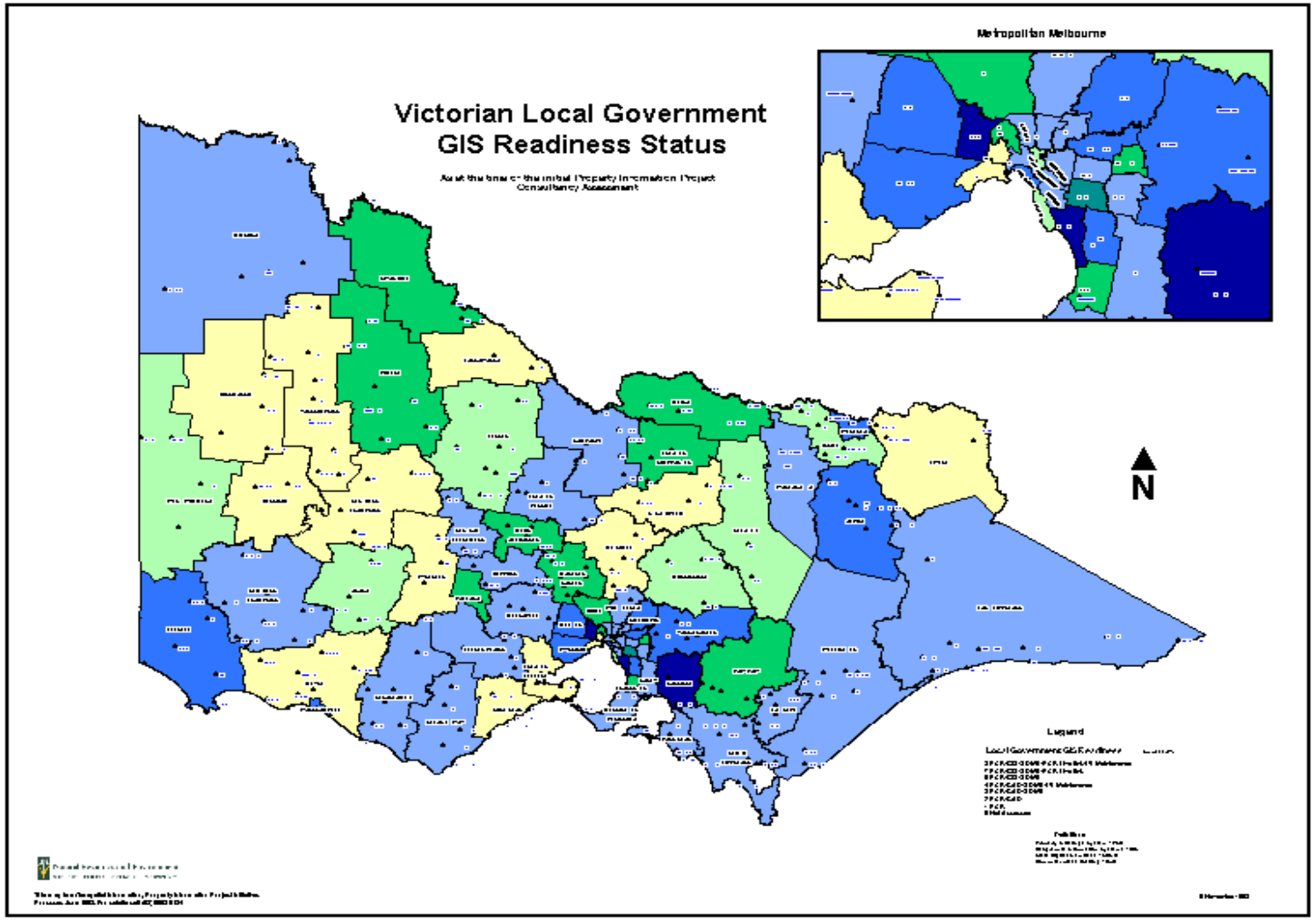
# Project Stages



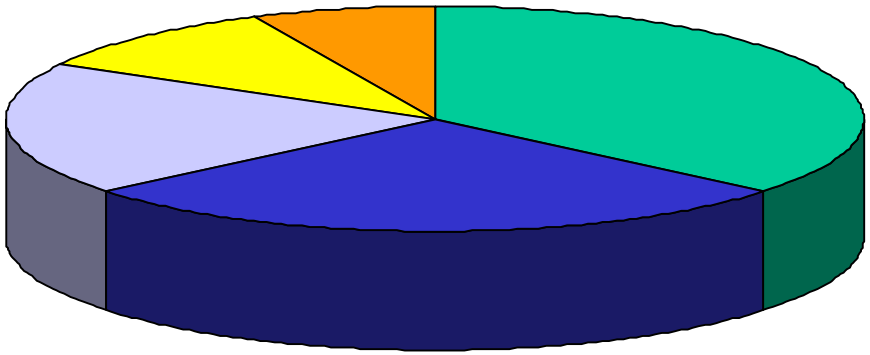

- State funded a brief 'fact finding' consultancy
- Determine each Local Government's GIS status, directions, capabilities, etc
- Task took between 2 & 7 days
- Conducted by a panel of independent consultants
- Significant variations were found:
  - understanding
  - utilisation
  - and plans for GIS

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# Victorian Local Government ‘GIS Readiness’

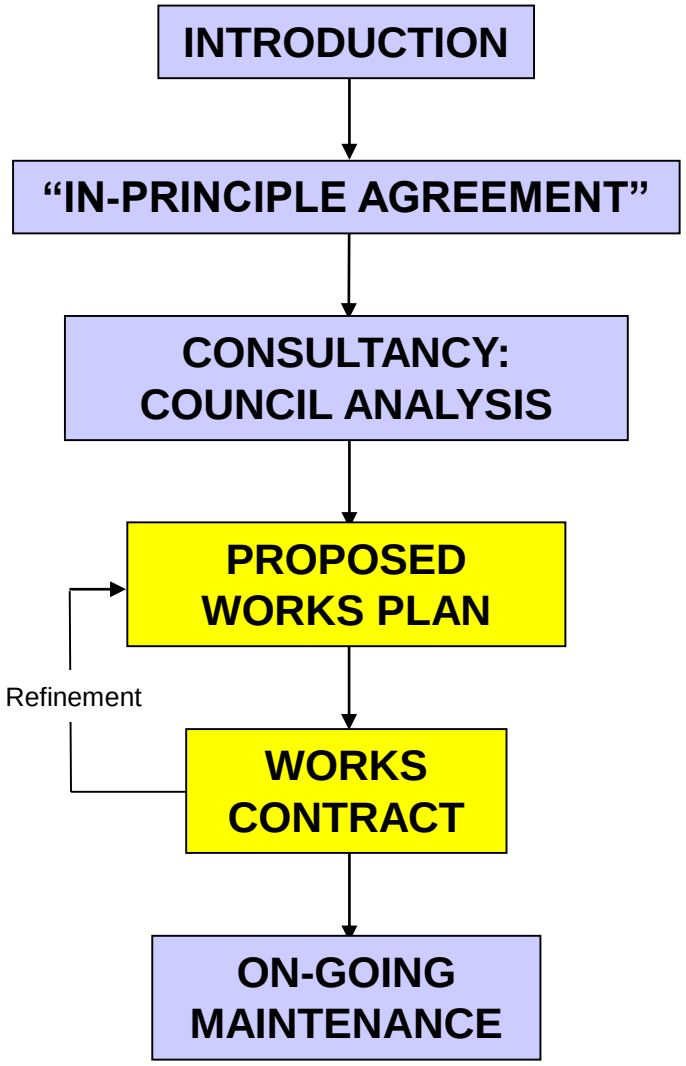


# Location of GIS units in Local Government Departments



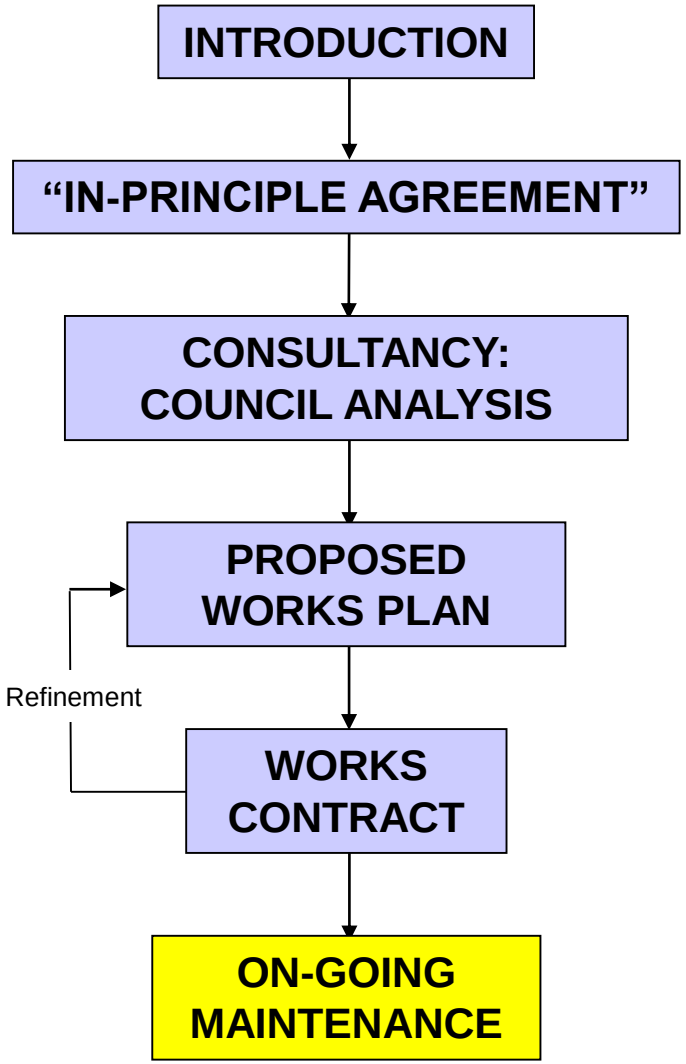
| | |
|---|---|
| IT | 36% |
| GIS | 28% |
| Engineering | 19% |
| Planning | 10% |
| Other | 7% |

# Project Stages




- **The Analysis Stage led to preparation of a draft Work Plan, covering:**
  - **MATCHING OF PROPERTY & PARCEL RECORDS**
  - **AUTOMATIC PASS**
  - **MANUAL RECONCILIATION**
  - **BASIC ADDRESSING, ALLOCATION OF NUMBERS, NAMING OF ROADS**
  - **ESTABLISHING MAINTENANCE LOOP (HW/SW)**
- **Plan was refined and funding agreed**
- **Contract entered into between State & Local Govt.**

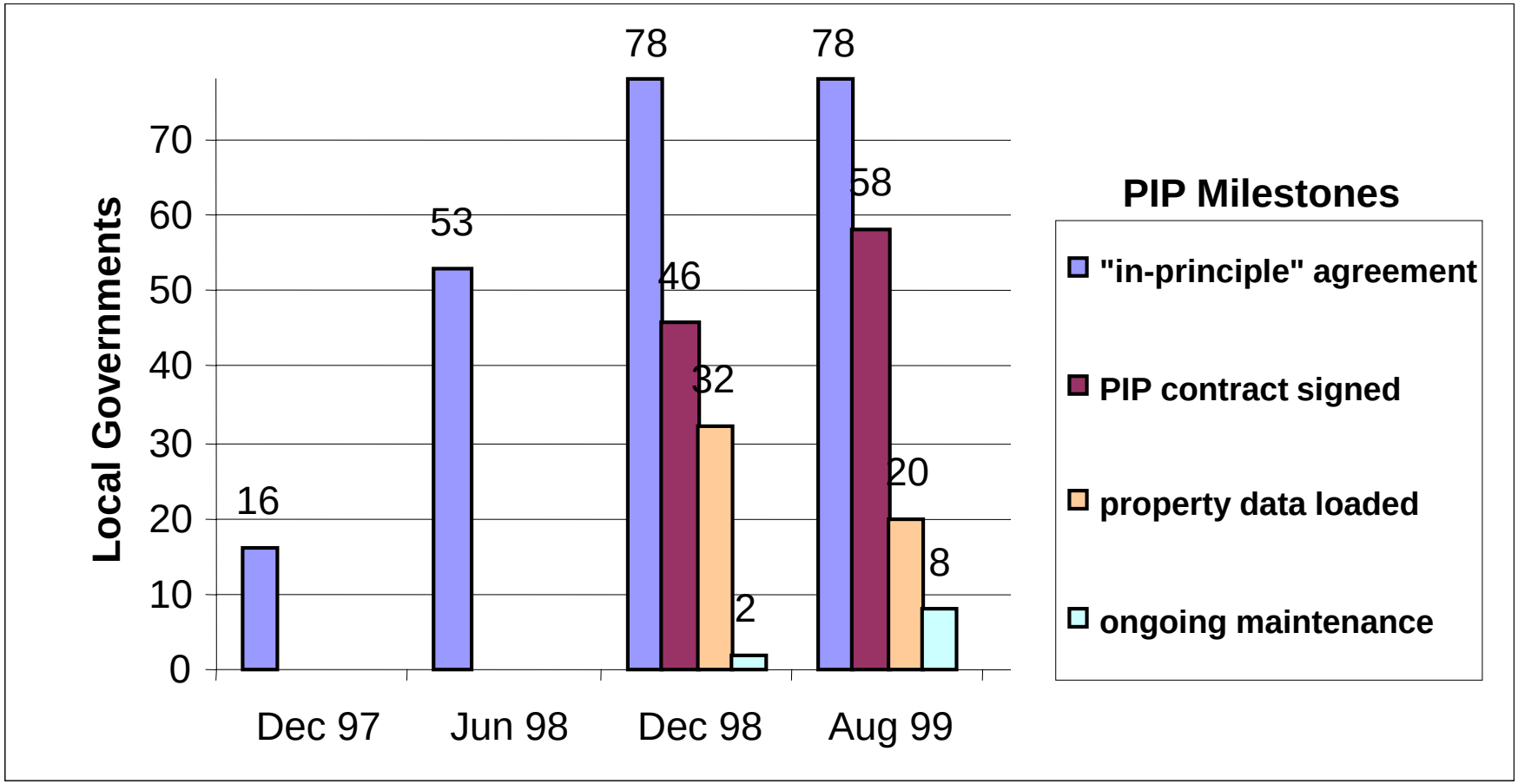
# Project Stages




- **Contract also covered On-going Maintenance**
- **3 Year term (rolling)**
- **Specified data formats, frequencies, quality, service levels, etc. <u>both ways</u>**
- **Supply from Local Government of changes as they occur**
- **Supply of Mapbase to Local Government typically every 2 - 4 weeks**

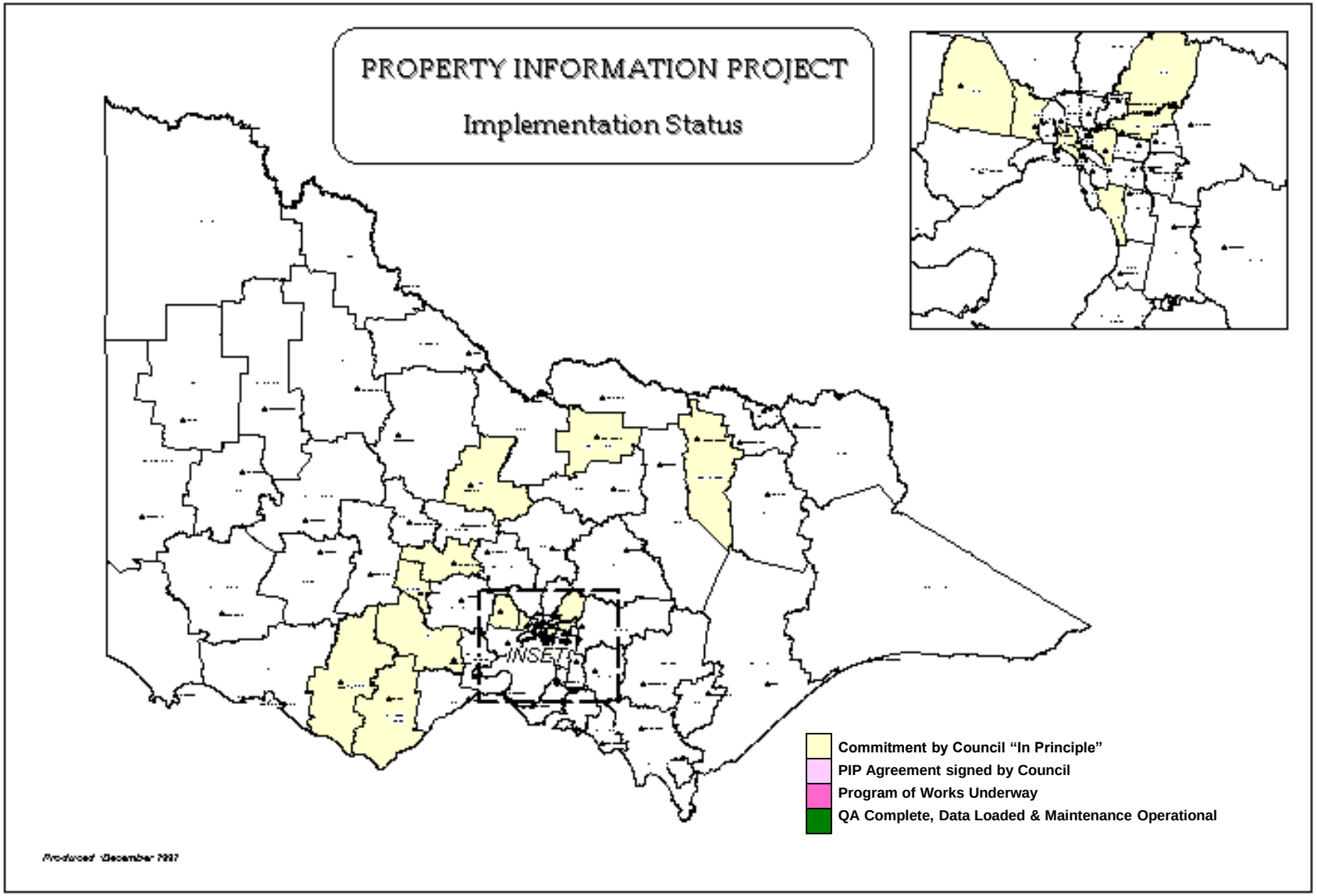
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# Progress to Date



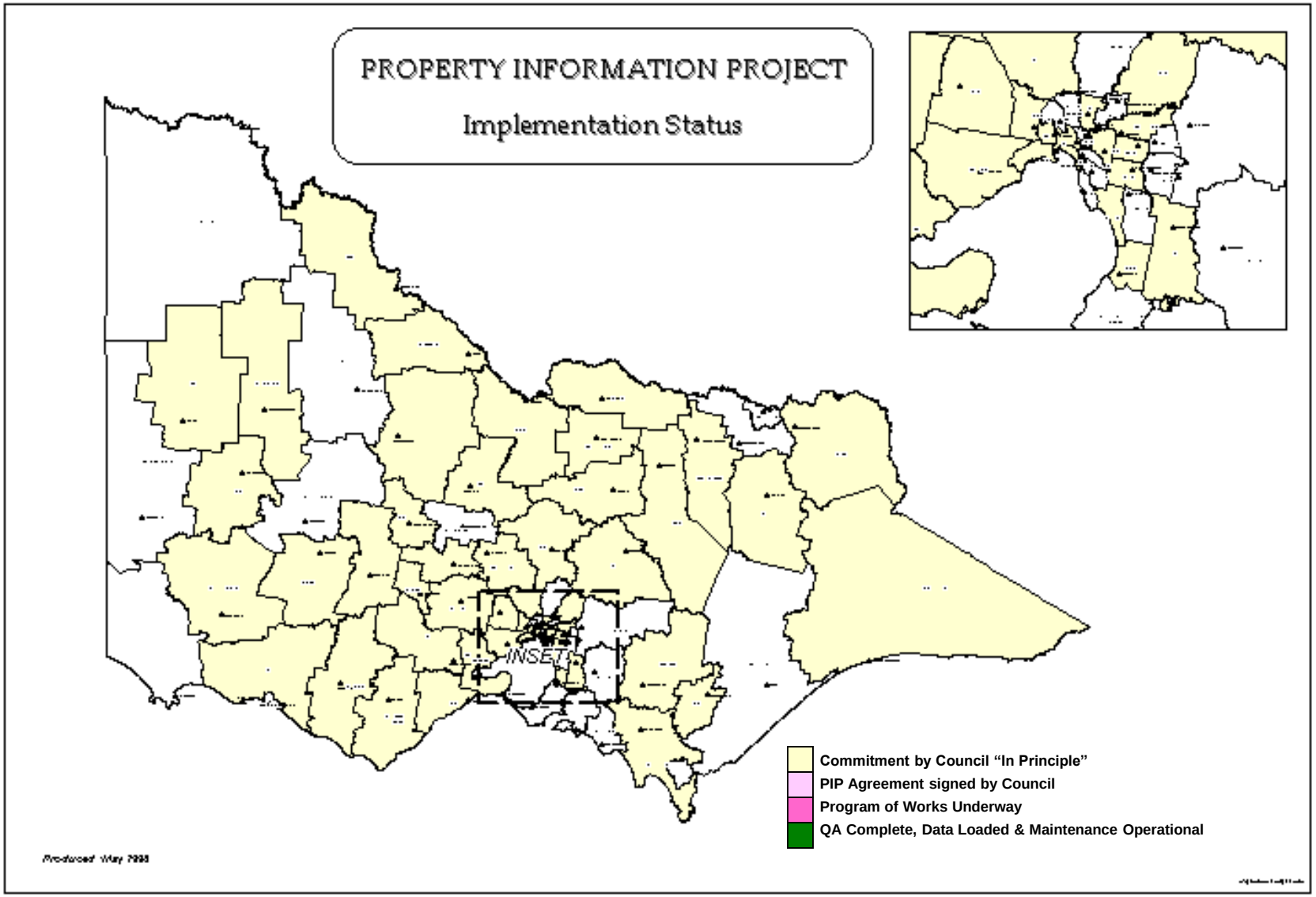
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# PIP December 1997



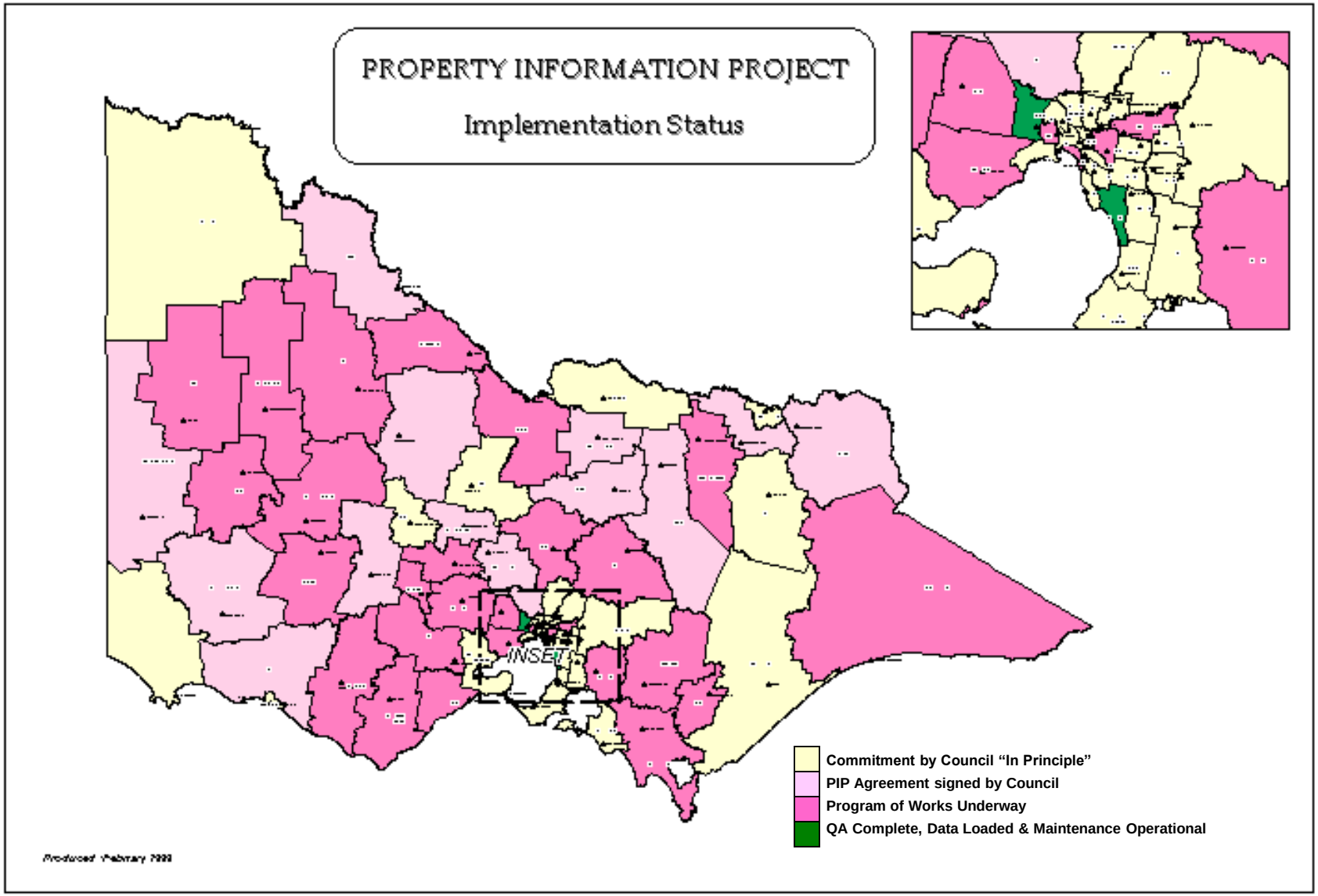
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# PIP June 1998



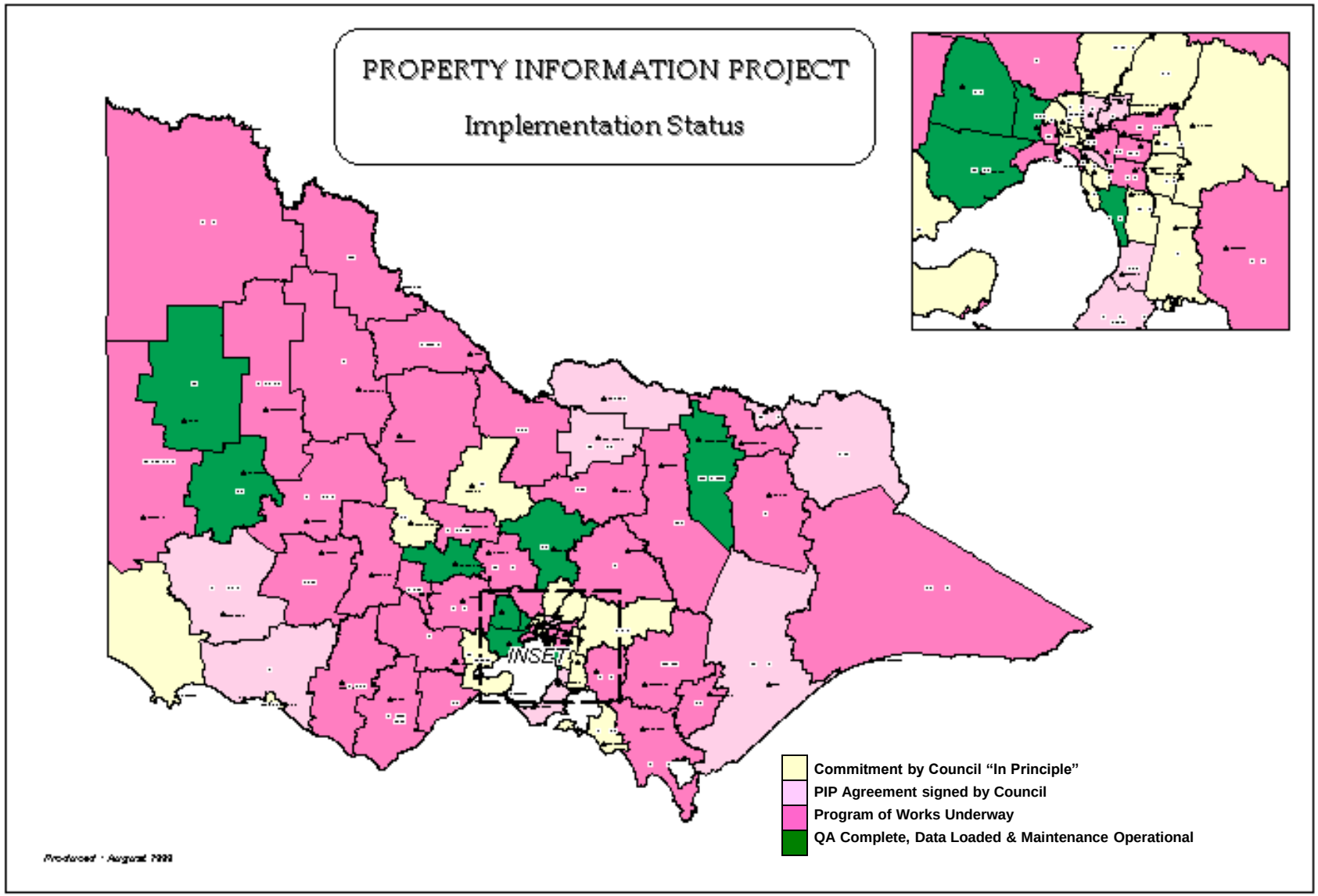
LAND VICTORIA

# PIP December 1998



LAND VICTORIA

# PIP August 1999



LAND VICTORIA

# Common Geospatial Infrastructure

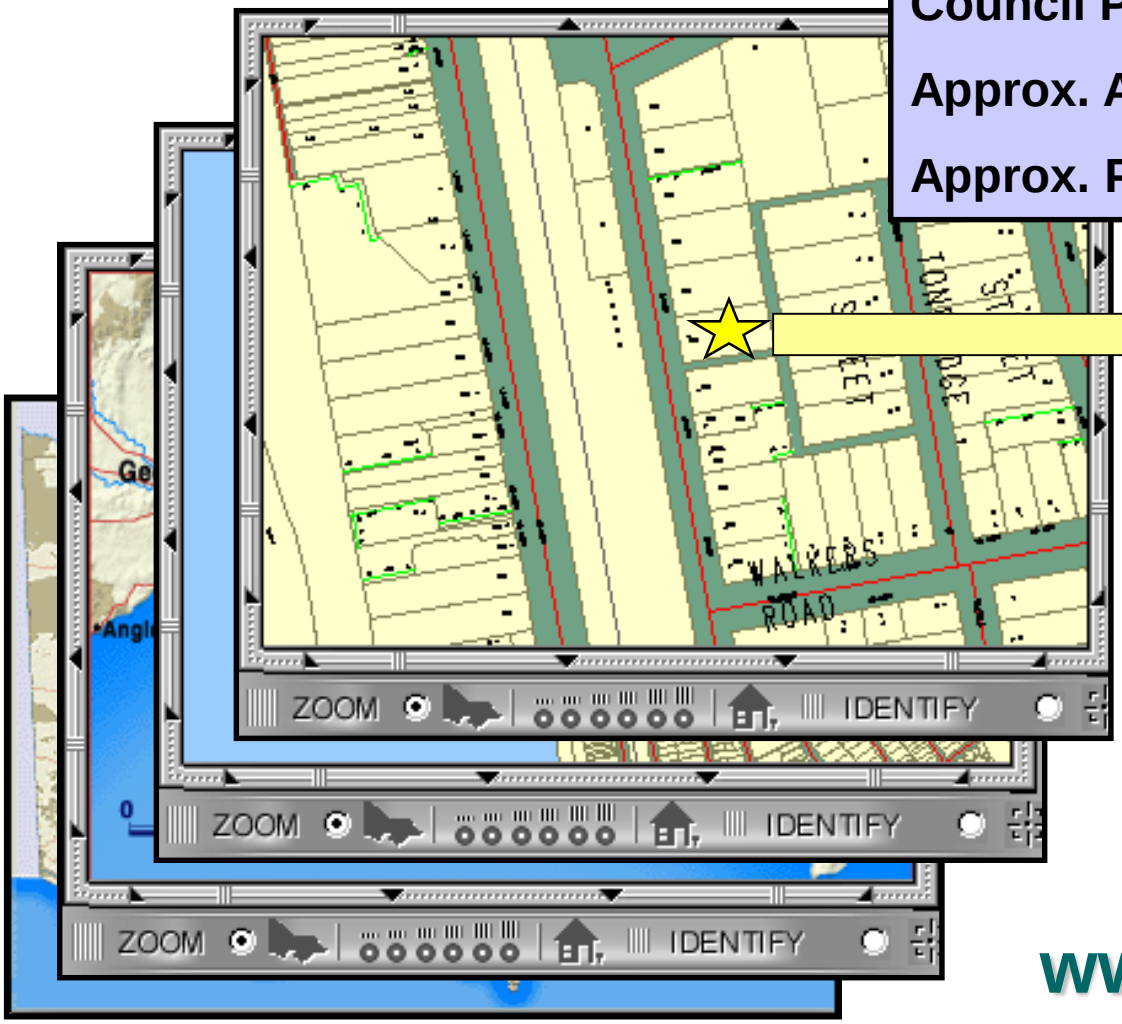
**Address:** 529 Station St. CARRUM

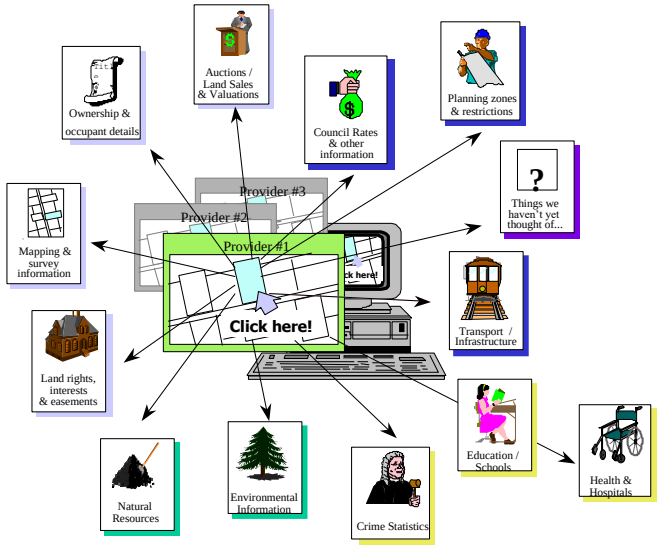
**Parcel Description:** Lot 1 on Plan 5149

**Council Prop. No:** 127350005

**Approx. Area:** 748 square metres

**Approx. Perimeter:** 115 metres




**www.land.vic.gov.au**

LAND VICTORIA

# Benefits of PIP to Local Government

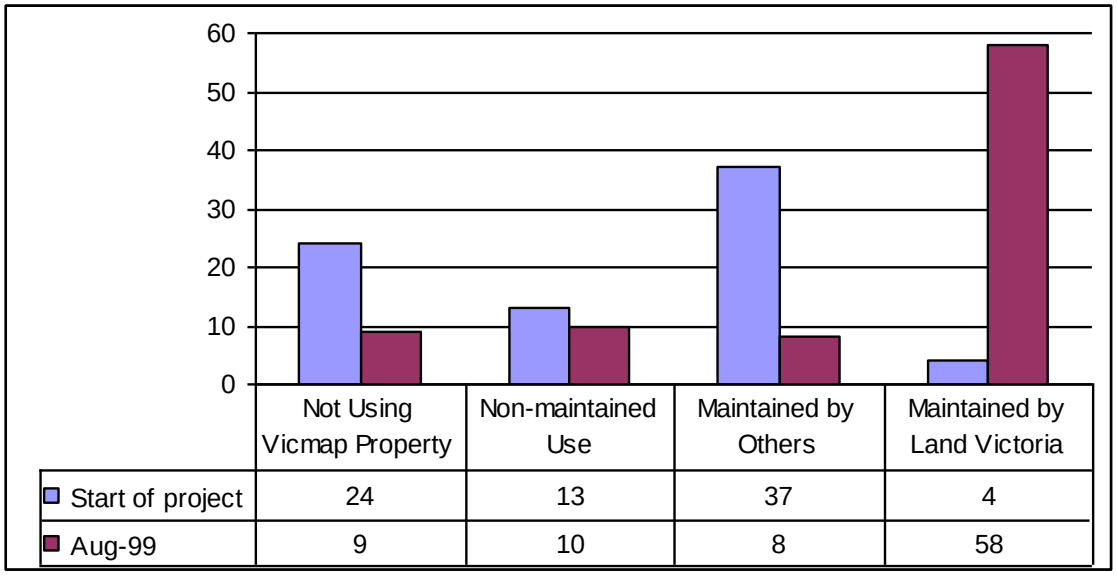
- no licence fees / free on-going maintenance
- capital funding US$10,000-US$25,000 ea.
- structured and well supported approach
- vendor independent approach
- more accurate property rating database
- ease of integration with others (neighbours & State Departments)

- GIS Benefits...
  - ADMINISTRATION / OPERATIONS / SERVICE DELIVERY / DECISION MAKING

LAND VICTORIA

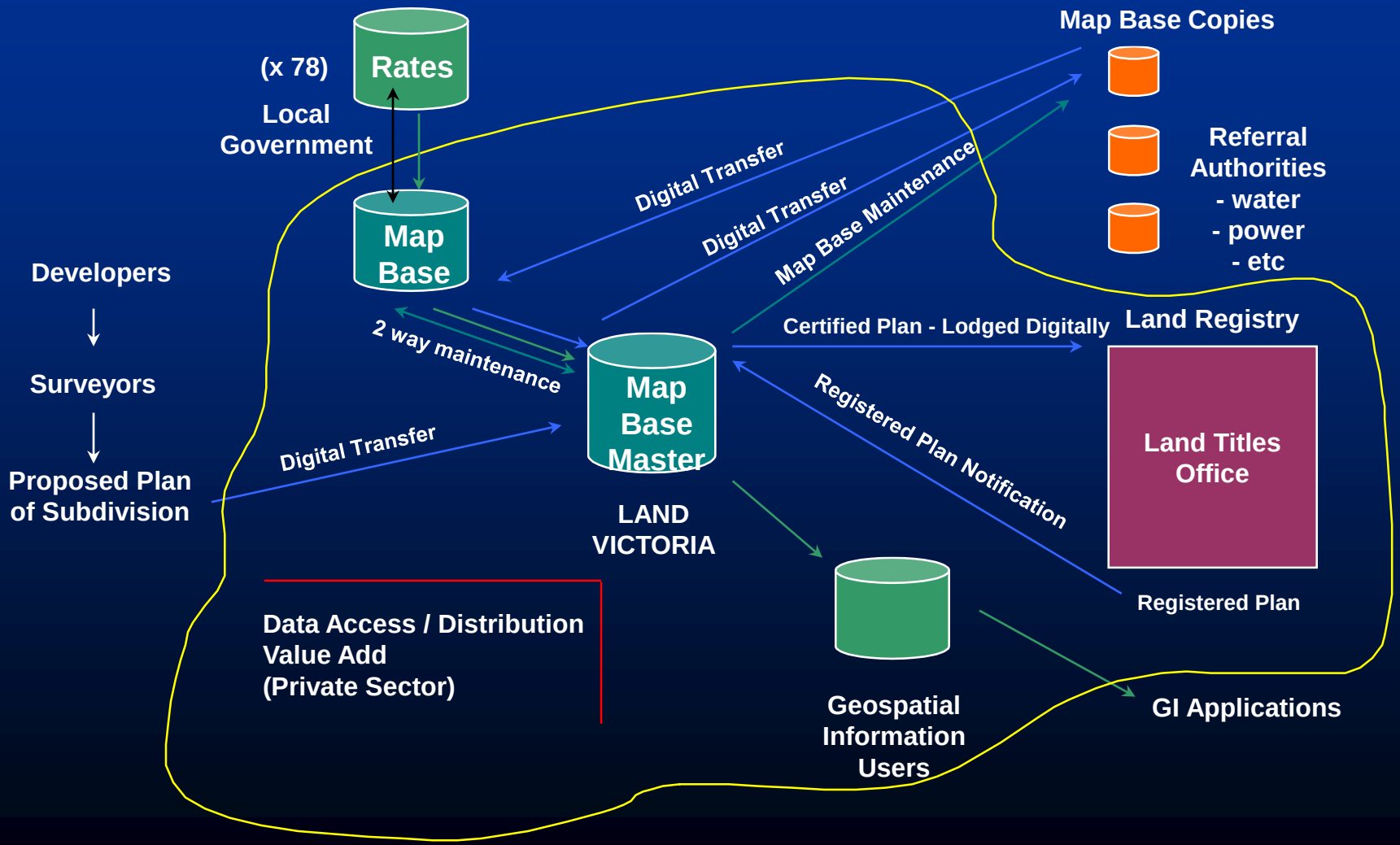
# Additional Benefits of PIP to State Government

- **Current, secure, higher quality data generated through PIP - especially for Emergency Services**
- **Decrease the amount of duplicative maintenance**
- **Growing Victoria's geospatial information industry**
- **Increased take-up of GIS technology**




| | Not Using Vicmap Property | Non-maintained Use | Maintained by Others | Maintained by Land Victoria |
|---|---|---|---|---|
| Start of project | 24 | 13 | 37 | 4 |
| Aug-99 | 9 | 10 | 8 | 58 |

# Future Developments for the Property Information Project



# Summary & Conclusions

- **Victoria's Geospatial Information Strategy is dependent upon participants accessing common Framework data**
- **Local & State Government are key custodians of that information**
- **Institutional barriers in establishing data infrastructure remain the most difficult to resolve**
- **PIP has demonstrated that a Co-operative approach between Local & State Government can be successful**

# The end.

# GIS IN LOCAL ECONOMIC DEVELOPMENT: EXAMPLES FROM THE IRISH BORDER CORRIDOR AND THE CITY OF BRISTOL

***Victor Mesev***
***School of Environmental Studies, University of Ulster, Coleraine BT52 1SA, Northern Ireland***

## ABSTRACT

Rarely is data awareness more important in GIS than when it has direct social and economic implications to the development and sustainability of a region. This paper will demonstrate how information awareness and data availability can help aid local economic development in two regions: the Irish border corridor, and the city of Bristol in England.

The Irish border corridor has suffered particularly severe economic and social deprivation, where problems of peripherality both within national boundaries and within Europe have been exacerbated by the consequences of 30 years of politically motivated violence. It is imperative for the development of this region that the tendency towards economic isolation be addressed and effectively countered. The provision of advanced telecommunications technology is a key infrastructural requirement for the promotion of economic development, and can strengthen the economic and social cohesion of outlying areas by bringing information and services to business and individuals. Thereby allowing small and medium sized enterprises to fulfil their competitive potential in a wider market. An advanced region-based telecommunications service is supported by a GIS and associated multimedia environments. Data on the Irish border corridor are accessed, interrogated, and continually updated to provide a convenient, accurate, and reliable service for existing and potential businesses.

Bristol in southwest England represents a city-wide example of GIS in local government using a new generation of precise, high-resolution digital urban data from the British national mapping service, the Ordnance Survey. The ADDRESS-POINT data set contains digital records of every UK (domestic and non-domestic) mail delivery point at a resolution of 10 cm. It provides a considerably enhanced and disaggregate means of representing micro-scale spatial distributions of the amount of space filled within an urban fabric, and when coupled with the UK Population Census, the density of population and households. This paper will illustrate how such precise urban information can greatly aid local planning of service provision, house building, and general urban sustainability.

**Keywords: GIS, Data Awareness, Local Economic Development**

## 1. INTRODUCTION

The scale and rapidity of change in today's economic activities and urban systems is without precedent in history. Europe's populations are static (by global standards) yet are changing their residential preferences, economic fortunes, and social cohesian. Increasingly, the development of modern society is being facilitated by advanced communications technology and associated services, creating what we now call the "information society". In such a society, data, knowledge, and awareness-based activities are important strategic resources on which the competitiveness of firms and the comparative advantages for cities and regions increasingly depend. In effect, information and knowledge have become key strategic resources for local economic development. The innovation of GIS has revolutionised the handling of geographical data, information, and awareness over the last 10 years. This paper will address the data-rich world of GIS to two separate applications that deal with regional economic development and local urban planning. The first is set in the so-called "border" region of Ireland. This is primarily along the international frontier between the United Kingdom and the Republic of Ireland, and includes all six UK Ulster counties, along with all Republic of Ireland counties that front the international border. The objectives of project "Border" are to develop GIS and telecommunications at various sites along the border in order to promote awareness of the economic potential of the region to new and existing businesses. The second application is centred around the English city of Bristol, where the advent of a new, highly precise and detailed digital data

set, named ADDRESS-POINT is currently being researched as a means to locate individual residential and business addresses for a variety of maintenance and planning purposes at the local government level.

## 2. PROJECT "BORDER"

The Schools of Environmental Science and Information & Software Engineering within the University of Ulster, together with the Local Government Computer Services Board (Republic of Ireland), are collaborating with appropriate Information Providers in Northern Ireland and the Republic of Ireland to establish Project BORDER, a Geographical Information Systems-based Teleservice for SMEs, Small Partnerships, Community Groups, Development Agencies, Co-operatives, Government Departments and Local Authorities, to promote the co-ordination and development of economic and environmental opportunities throughout the entire border corridor.

The provision of advanced telecommunications technology is a key enabling infrastructural requirement for the promotion of economic development. As such, it can strengthen the economic and social cohesion of outlying areas by bringing information and services to business and individuals, thus enabling them to fulfil their competitive potential in a wider market. It could be argued that a principal long-term benefit of the diffusion of telecommunications infrastructure is the equalising effect of reducing the locational disadvantage of peripherality [2]. For peripheral, economically disadvantaged areas, it could equally be argued that failure to introduce telecommunications infrastructure and to make effective use of that service can only result in widening regional disparities, as core regions capitalise on the benefits of such services to enhance their economic advantage.

In the context of European border regions, the Irish border corridor has suffered particularly severe economic and social deprivation, where problems of peripherality (both within national boundaries and within Europe) have been exacerbated by the consequences of 30 years of politically motivated violence. It is imperative for the development of this region that the tendency towards economic isolation be addressed and effectively countered. In Europe, recognition of the disadvantages of having wide economic regional disparities between and within member states led to a major policy initiative in order to redress the imbalance. A key objective was to strengthen the overall competitiveness of the single European market in response to other growing continental markets. A key focus of the European Union (EU) Regional Development Policy (typified by the cross-border INTERREG programmes) was to introduce structural changes in the poorer, less favoured, regions, and in particular, to introduce equitable provision of, and access to, an advanced telecommunications service. It has been recognised that the lack of telecommunications infrastructure and services in the less favoured regions will make it difficult to attract new industries and for indigenous industry to compete in core markets [1].

A number of preconditions which could facilitate sustainable and successful adoption of these technologies in less favoured regions have been identified; namely, the development of a critical mass of adopters to stimulate a cumulative self-sustained mechanism; a clear identification of the usefulness of these technologies for business and other purposes; and the proper integration and management of these technologies into established business and social structures. Project BORDER aims to provide the opportunity for these preconditions to be directly addressed by providing the physical and organisational mechanism to support entrepreneurial initiatives and to develop the business and economic potential of the border region.

The key to success in identifying and developing entrepreneurial and business potential is knowledge and information; however, assembling the information required can be a difficult process. Fundamental problems in this respect are the availability, awareness and accessibility of data. In a cross-border context such problems are exacerbated by the difficulty of finding comparable data sources at similar spatial scales. These problems have been manifested for some years now by the approaches made to the University of Ulster by a variety of groups, ranging from local governments, to environmental protection agencies and community groups requesting advice on the availability of information on the economic, social and environmental characteristics of their own local and neighbouring cross-border areas. In a direct response to the growing number of requests, particularly those of an environmental and cross-border nature, the Schools of Environmental Studies and

Information and Software Engineering at the University of Ulster collaborated with the Local Government Computer Services Board to develop the BORDER Telematic Information Service.
The principal objectives of BORDER are:-

- to address the shortfall in realising the potential for economic development in the border corridor;
- to identify current socio-economic, infrastructural and environmental resources and to conduct an audit of secondary (and subsequently primary) data sources;
- to establish a Geographical Information Systems-based Teleservice to provide economic and environmental information to user groups in the border region using advanced telecommunications and database technology to facilitate higher levels of SME and small Partnership business opportunities in the border corridor and beyond to the rest of Europe;
- to promote the border corridor as an area for inward investment, through exposure and utilisation of advanced telematics technology;
- to facilitate greater levels of interaction between the two national governments on issues of the physical environment, its protection and use in the border region;
- to provide a service that will facilitate more efficient and cost-effective integrated Spatial Planning;
- to facilitate the flow of information and ideas between groups and communities along the border corridor to enhance business opportunities in a manner compatible with protection of the local environment.

### *2.1 The "BORDER" Technical Architecture*

The Project Management Team will collate and maintain a distributed multimedia database of spatially referenced data to which all associated partners will have access (conceptual user-group access is illustrated in figure 1).

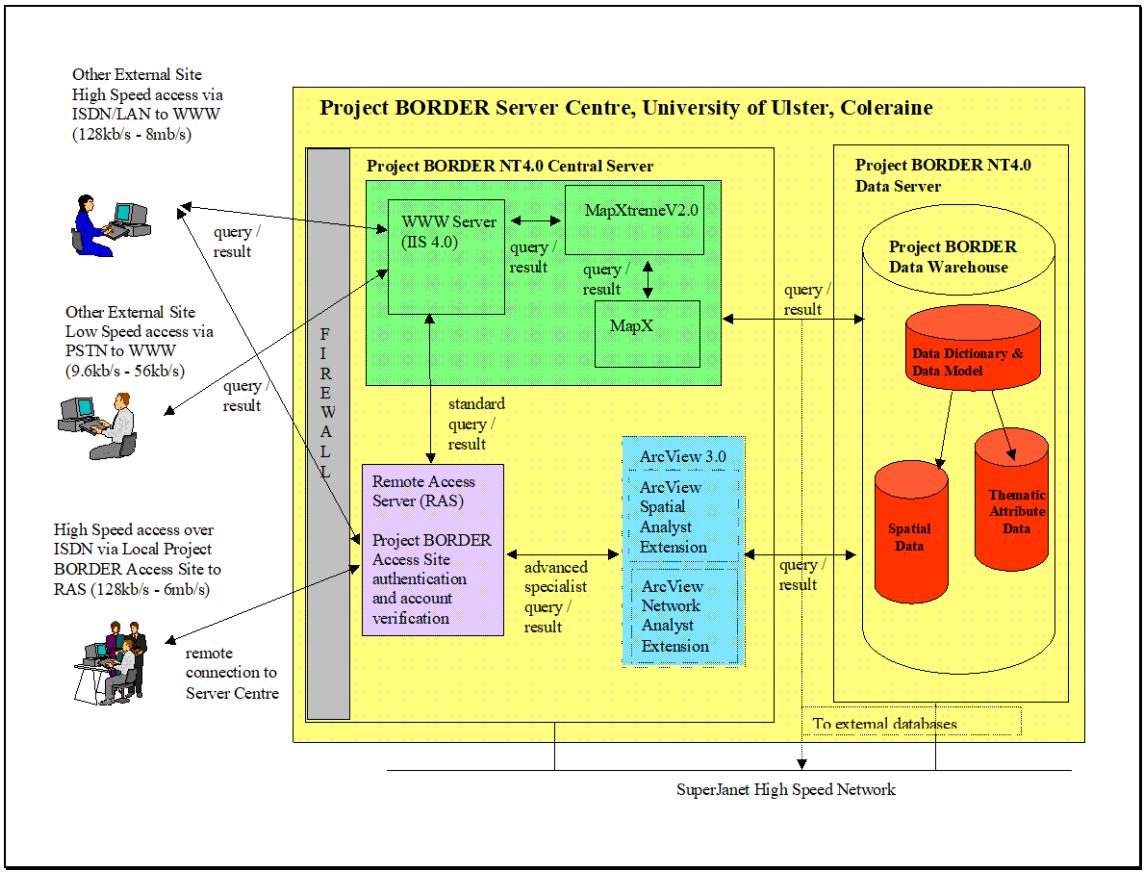


Figure 1 : Conceptual Architecture of BORDER

Advanced telecommunications facilities (the Euro-ISDN service) will support the delivery software technology for client-server access, which will be realised at each site by a GIS compliant front-end and associated software facilities provided by the latest desktop multimedia workstations. This will permit the retrieval, integration and processing of a variety of spatial and aspatial datasets and related data in a user friendly environment. Whilst initially there will be a central source for the validation, entry and maintenance of the respective datasets, access sites are provided at eight strategic geographical locations (figure 2) throughout the border region.

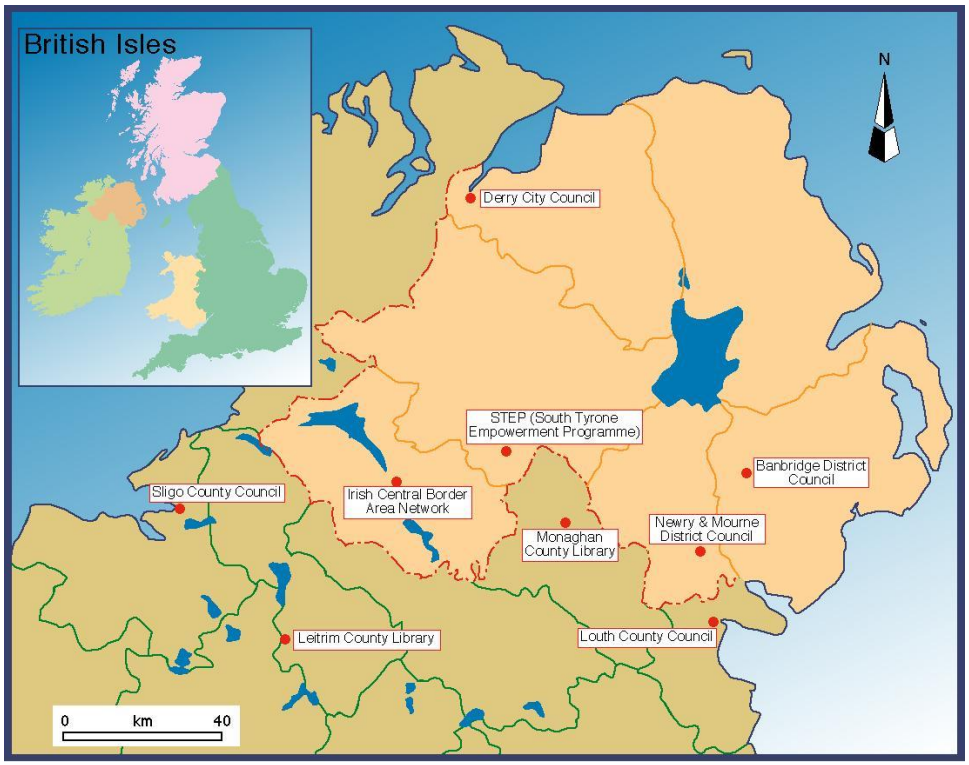



Figure 2: Geographical coverage of BORDER Access Sites

As can be viewed in figure 1, access to the BORDER servers is provided through a variety of means (e.g. over standard telephone lines via a modem from the home or office, via standalone multimedia using CD ROMs, or via point-to-point ISDN connections). There are also facilities for real-time desktop file exchange, shared whiteboard, remote applications sharing and video conferencing mover ISDN. These tools are being used for software development and test; data feeds and overall project management. The central servers are currently located at and managed by the University of Ulster at Coleraine.

In regard to detailed spatial queries, the software provided to each BORDER Access Site will enable experienced users to launch queries against the data, but steps have also been taken to provide a level of technical support to the inexperienced users. This comes in the form of on-site personnel who have been trained in the BORDER technology and who are made aware of the systems and data which are available to address a specific request. In effect, each BORDER Access Site will provide a local bureau service to all users, not just in terms of assisting with the technology and the means to use it to gain access to knowledge, but also in ensuring that more detailed queries or data requirements are fed back to the main BORDER central control at the University for subsequent processing.

Currently, the GIS Engine is provided by MapInfo's MapXtreme 2.0 environment which is being further enhance by the BORDER software development team to provide additional query processing capability. The implications of the various telecommunications services (e.g. PSTN, ISDN, SMDS and Novell LAN) are being examined to ensure that performance aspects of the service are met. For complex queries not available on the Internet service, additional functions such as network analysis are provided at the University of Ulster BORDER Office using ESRI software products. Such queries are received via e.mail or through remote BORDER Access Site operatives and they are analysed, processed and the relevant resultant data returned to the user using a combination of paper and electronic media.

### *2.2 Data Issues of the "BORDER" Project*

The first phase of the project (June 1998 – August 1999) will use only secondary data already in existence. The procedure for data procurement consists of secondary data audits at the national (UU and LGCSB) and local (Nexus and border site representatives) levels. A metadatabase is being compiled detailing data sources organised under the main functional sectors of Economic Activity, Social Infrastructure, Environment and Tourism. Data is then collected on a selective basis depending on its usefulness, form, nature and ownership status.

The question of the freedom or charging for information has become an important problem in recent years, with the availability of computer-based information over networks [7]. With the introduction of distributed GIS, certain data ownership issues arise which are being investigated as part of BORDER, these include data Security, Copyright, data standards and who pays for data (users or Local Authorities).

Data may come free of charge, be purchased or leased from the owning organisation (costed in a substantial budget for the purchase of data). In certain circumstances special permission and royalty agreements need to be put in place to facilitate the provision of information on the Internet. In addition to royalties BORDER is being offered as test bed for organisations interested in pursuing the Internet as a route to business in the future.

Data integrity and security are serious issues especially for commercially purchased or leased data from sources such as Census and Ordnance Survey. Such issues must be addressed and accommodated for in the technical architecture and delivery mechanisms provided by the service. For example, the need to provide adequate security mechanisms to prevent unauthorised access to data and potential corruption of data structures and items determined that a thin client / thick server architecture be used (hence the adoption of the MapXtreme internet GIS software as opposed to say Activemaps). Using such a system allows certain controls on the server side about how information can be accessed, distributed and viewed. For example, with the census data, users are denied access to certain types of raw count data at the most detailed level of spatial aggregation (for reasons of commercial sensitivity and data protection legislation) but are allowed to classify such variables by say quartiles, quintiles, natural breaks or standard deviations.

Currently the question of charging for information is not a problem as this is costed into the development phase of the project. However, it is an issue that is being investigated with respect to the long-term viability of the system. We are currently investigating how a charging system could be put into operation, possibly along the lines of an electronic dedicated charge card i.e. a C-SET, once BORDER becomes commercial. The C-SET (Chip Secure Electronic Transaction) initiative is one of the ISIS (Information Society Initiatives in support of Standardisation) projects (GI2000 1998). Other simple methods include 'pay-per-hit', 'pay-per-theme' or just have 'credits' allocated per user group.

Given the cross-border nature of the project and the fact that information is being procured from a variety of different sources in effectively two countries, data comparability is a main issue across all types of map and thematic data (Census data being a classic example) [11]. The problem is being addressed in BORDER with the provision of a data-dictionary to explain how each item of information was collected, ownership, accuracy, date created and most recent update. This will hopefully allow the client to make an informed decision before undertaking data comparisons between different regions.

Part of the data audit process and the user needs studies are tailored towards identifying the data or information deficit in respect to what users would like but does not already exist. This is an activity that will develop the data issue and strategy for the second phase of the project. It is envisaged that a substantial component of Phase II will involved the actual collection and generation of primary data in addition to the procurement of more secondary data.

## 3. "ADDRESS-POINTS" IN BRISTOL

The discussion now switches to the city scale, and how the introduction of a very precise and highly detailed digital data set of delivery points can help planning and sustainability for Bristol local council. Delivery points will also be viewed as a means of developing urban models in order to refine conceptions of urban land use and the density at which urban space is filled. This is essentially the use of scale-independent techniques that utilise fractal geometry, along with the spatial data analysis of density gradients to reveal the way urban land is filled and how density changes with distance from the historical seed of initial development.

### *3.1 ADDRESS-POINTS*

Recent years have seen a proliferation in the number of fine scale digital datasets that have become available. In the UK, the national mapping agency, Ordnance Survey (GB) is engaged in creating and updating a rolling programme of digital data products, including 1:10 000 and 1:50 000 maps, road centrelines, and digital records of each mail delivery point. It is this lattermost product, marketed as ADDRESS-POINT, which provides the data infrastructure to the research reported here. The ADDRESS-POINT file comprises the precise (within 0.1 m) geographical co-ordinates of all business and domestic mail delivery points (including post office boxes) in the UK. It is a commercial data product, and as such is very frequently updated in consultation with the UK Post Office to account for new building, demolitions, redevelopment and property reconfiguration.

As such, ADDRESS-POINT may be used to discern at least three geographies: built environment, industrial/commercial/service, and residential. The structure of the data file does not allow these geographies to be discriminated in any fully automated way, although Longley and Mesev (1999) describe a procedure which they have successfully used to manually sift the observations. The dataset is thus geographically exhaustive, and offers the same degree of detail as the digital analogue models of the recent past. The definition of the elemental unit as 'dimensionless' mail delivery points allows the widest range of modelling assumptions to be tested in order to devise plausible measures of urban density and space-filling. In the empirical section of this paper, we will illustrate these properties with respect to the creation of urban density gradients for Bristol and environs, UK.

### *3.2 The Urban Morphology of Bristol, UK*

The study area for the empirical analysis reported here is the city and environs of Bristol, in the south west of England. The purpose of our analysis is to use the ADDRESS-POINT product as a framework for creating fine scale estimates of the distribution of population and non-residential activities, and to use these estimates to derive separate density profiles of residential and non-residential activities at much finer scales than has hitherto been possible. The same approach is then used in a preliminary analysis of the density gradient extant between the centre of Bristol and its nearest city neighbour, Bath.

Recent years have seen the popularisation of fractal dimensions as means of summarising the space-filling properties of cities (e.g. Frankhauser 1994; Batty and Longley 1994), and we also present a preliminary assessment of the usefulness of fractal techniques for summarising 'dimensionless' ADDRESS-POINT data.

Figure 2 shows the study area for the first set of empirical analyses, together with the mosaic of small areas that comprise its census geography (the shading on this map is explained below). The intention was to define the study area to include all of the built structures that comprise the continuous built morphology of Bristol. For reasons that we explore in our conclusions, this is by no means a straightforward and clearly defined task, and for purposes of this analysis we have defined 'greater Bristol' using a circle of radius 9.06 km centred upon Bristol Bridge. The procedure by which

population characteristics are ascribed to ADDRESS-POINT co-ordinates has been described by Longley and Mesev (1999), and may be briefly summarised as follows.

First, population counts for each of the UK Census Enumeration Districts (ED) in the study area were extracted. Next the 325 ADDRESS-POINT tiles (each covering 1 km$^2$) that together cover the study area were joined using ArcView software. As stated above, the address-points are almost dimensionless, and so an early decision was required in order to assign each a measure of space-filling. We took the essentially arbitrary decision to make each of dimension 10 m x 10 m for a first set of analyses, and 20 m x 20 m for a second set. These same dimensions were used irrespective of whether or not a point pertained to a residential or a non-residential address. In practice, this amounts to a geographically invariant assumption that each address fills either 100 m$^2$ (in the first set of analyses) or 400 m$^2$ (in the second set of analyses). This means that either 6.23% of the total area is deemed covered with urban land in the first set of analyses, or 16.43% covered in urban land in the second set. As a point of reference with the paper by Longley and Mesev (1997), comparable statistics are available for Bristol from a national survey conducted by Mesev (1998) utilizing Landsat TM data. In this survey, Bristol, like all other settlements, is defined within a circular area where the radius is measured from the initial point of development to the furthest extent of contiguous pixels classified as urban. Bristol was classified as having 77.23 km$^2$ (29.95%) of available land occupied at the pixel resolution of 30 m. This represents a substantially greater amount of filled space even if address-point cell size is increased to 30 m (64.03 km$^2$ land occupied, 24.83%). The main reason for this difference is that satellite images of urban areas are frequently misclassified, and tend to over-predict the amount of built land. This is because as the spectral values of most pixels represent mixed land covers, any proportion that is artificial (concrete, Tarmac, brick, metal) will dominate a pixel and be classified as built. Address-points are far more discriminatory, and only indicate the location of a mailing property. However, because address-points are virtually dimensionless, they do not reflect the underlying physical urban structure. There is much scope for examining ways in which both these data sets may be harmonized to produce more representative urban models.

The principal distinction developed in this paper is between residential and non-residential development, although this distinction is not explicitly made within the ADDRESS-POINT file. Thus individual non-residential addresses could only be identified in a time-consuming, manual way. This sifting led to the creation of separate built, residential and non-residential files. The residential dataset is shown in Figure 3(a), while that for non-residential addresses is shown in Figure 3(b). Each of the datasets was reformatted for further analysis using the raster-to-raster and raster-to-pixel conversion routines in ERDAS Imagine (version 8.3). The endpoint of the analysis was a set of six rectangular ASCII arrays of spatially referenced cells – one for each of the three land uses at cell resolution 10m, and one for each land use at cell resolution 20m. Each was then fed into a series of purpose-written (C++) programs to obtain space filling dimensions and density profiles.

The Census geography depicted in Figure 2 is the finest spatial scale for which reliable population counts are available. In order to generate population density profiles that were unconstrained by the geometry and configuration of Census Enumeration Districts (EDs), average population figures were generated for each ED and each residential address-points within an ED was assigned the mean ED value. This was achieved by performing a point-in-polygon search in ArcView for every address-points. Table 1 and Figure 2 illustrate that average 'pseudo household size' shows considerable and spatially systematic variation across the study area. (Note that spurious values of average household size below unity arise, typically in the city centre, where non-residential addresses have not been removed in the manual sifting procedure.) Population estimates can thus be derived for any convenient zonal scheme – here we will reaggregate population into radial distance bands. The 'non-residential' dataset comprised the remaining non-domestic addresses, and no attempt was made to identify the different functions of addresses within it.

There are three principal outputs from the analysis. Calculation of simple straight line radial distance measures enables calculation of fine scale density profiles for built, residential and non-residential land uses; the population data enable the creation of detailed population profiles; and (following Fotheringham et al. 1989) the three datasets at each (10m and 20m) scale can be use to derive fractal space-filling dimensions. The different operations carried out in the analysis are summarised in Figure 4.

## 4. EMPIRICAL ANALYSIS OF BRISTOL

Fractal dimensions and density gradients were generated using the exact same techniques as the ones outlined in Longley and Mesev (1997). Instead of using occupied *pixels* as the units of analysis we have instead used rasterised address-point *cells* at 10 m and 20 m spatial resolution. Briefly, gradients are derived from a series of concentric rings at 10 m and 20 m width, radiating out from the city centre. There are two types of gradients; both based on the principles of space-filling where one measures the cumulative number of cells $N(r)$ occupied at each ring $r$, and the other on the density of occupied cells $p(r)$ as a proportion of the total area of each ring. The Fractal dimension $D$ of a settlement is calculated as,

$$D = \frac{1}{\log_e r'} \log_e \left[ \frac{N(r')}{4} \right] \quad (1)$$

for cumulative gradients, and as,

$$D = 2 + \frac{\log_e p(r')}{\log_e r'} \quad (2)$$

for density measures. In both, $r'$ is the mean radial distance, and used to represent the whole settlement. Fractal dimension of empirically represented settlements should fall between 1 and 2. This is where space is filled beyond a line ($D = 1$) but less than a complete sphere ($D = 2$).

As expected, more space is filled by address-points represented by 20 m cells than 10 m. Consistently higher proportion of occupied cells and higher fractal dimensions are demonstrated in each of the three land uses (Table 2). However, fractal dimensions from either 20 m or 10 m are substantially lower than those generated from both idealised computer models of urban growth: 1.71 from diffusion limited aggregation (Batty and Longley 1994), and Landsat TM classifications: 1.66 built, 1.6 residential, and 1.19 non-residential (Longley and Mesev 1997). Moreover, the differences in dimensions of the three land uses are remarkably consistent between ADDRESS-POINT and Landsat. More research is needed to determine whether fractal dimensions of urban form are much lower than predicted by growth models or high-resolution imagery.

The cumulative counts (Figure 5) are very similar to those generated using satellite data in Longley and Mesev (1997). They all, as expected, increase with distance from the city centre, and level off at the periphery. The main difference is that the residential profile based on address-points has a much shallower gradient at the beginning, near the city centre. This is where address-points have an advantage over classified imagery. Classification accuracy is low when differentiating between pixels that represent residential and non-residential land use. Most residential address-points can be filtered from the city centre. Beyond the city centre the cumulative gradient rapidly increases towards the periphery and 'levels off' at the 'complete' point. In contrast, the non-residential cumulative plot is generally shallower and there is less of a city centre break point. The heavy clustering of commercial/industrial activities in the centre doesn't seem to have been reflected in the plot. The reason for this may be that the 20 m cells have under-represented some non-residential buildings, in particularly large department shops and business towers. In terms of comparing 20 m against 10 m, the 10 m plots are consistently slightly higher than 20 m. This can simply be attributed to the higher number of grid cells generated at the 10m resolution. Address-points close together may be represented by one 20 m cell, the same points would be represented by multiple 10m cells.

Turning to the density plots in Figure 6. These measure the amount of space-filling at incremental rings. Densities are generally lower than those produced by the 97 paper. This is simply another indication of less space-filling by the use of address-points. Where the satellite image takes into account all space taken up by buildings, roads, gardens, etc., as areas, address points indicate the location of a delivery point represented by arbitrary grid cells. The shape of the density plots can be considered similar to ones produced from satellite imagery. Both indicate instability around the city

centre, a trough at the edge of the centre, followed by a peak, and then a general downward trend. The main difference is that in the residential plot, as in the cumulative, there is much less density in the centre, but a much steeper peak up to $r = 210$. This reflects the rapid rise in high density terraced housing just beyond the commercial centre. The gradient then falls at a very similar rate to that generated by image classification giving support to their general similarity in representing urban morphologies. Lastly, unlike the cumulative plots, the differences between 10m and 20m are much more apparent in the density plots. 20m cells produce a much more filled urban structure than 10m, but the 10m plot has a shallower gradient. The non-residential plot is different. As expected its highest density is in the city centre, with a much lower and flatter peak between $r = 300$ and $r = 500$ representing business parks, and industrial estates, including a major regional commercial centre.

The next set of plots represent the results from the point-in-polygon analysis between population numbers (aggregated to census enumeration districts) and residential address-points (Figure 7). The cumulative count plot supports findings in the space-filling cumulative in Figure 5(a). However, although generally similar the population density plot has many differences with its corresponding space-filling plot in Figure 5(b). Remember, these plots are measuring different aspects of the Bristol urban morphology, and population density does not necessarily mirror space-filling. Maximum peaks in the two plots are similar (2 km for population, and r = 225 for space-filling) but the pop density profile trails off much sharper than space-filling. This is to be expected because many households in the suburbs of Bristol will be decreasing whilst at the same time properties will be increasing in size.

## 5. EMPIRICAL ANALYSIS OF THE BRISTOL-BATH TRANSECT

The final part of our analysis looks at inter-city changes. Taking the historical centres of Bristol (bridge) and its nearest city neighbour Bath (Roman pump rooms) a 18 km directional transect was constructed and address-point density, population density, and average household size calculated within a 1 km buffer zone (Figure 8),

The rather erratic peaks and troughs are the result of a narrow transect where extreme values are over-emphasised. Nevertheless, the plots still reveal many interesting aspects of urban spatial interaction. First, despite the two settlements being very close (18 km between centres), and that they lie within the more economically vibrant southern part of England, they still very much exist as independent entities separated by a sizeable distance. Both the address-point density and population density plots support this. Although the growing demand for new houses in the UK is most acute in southern areas such as the south-west, there is no evidence as yet to suggest that prime areas such as the transect are being flooded with new development. Both settlements still exhibit high densities (most notably close to the Bath centre), and the only indication of urban sprawl can be found by a small increase in address- point density between 6 km and 9 km.

## 6. CONCLUSIONS

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Tables and Figures

Table 1: Census and ADDRESS-POINT statistics of the study area

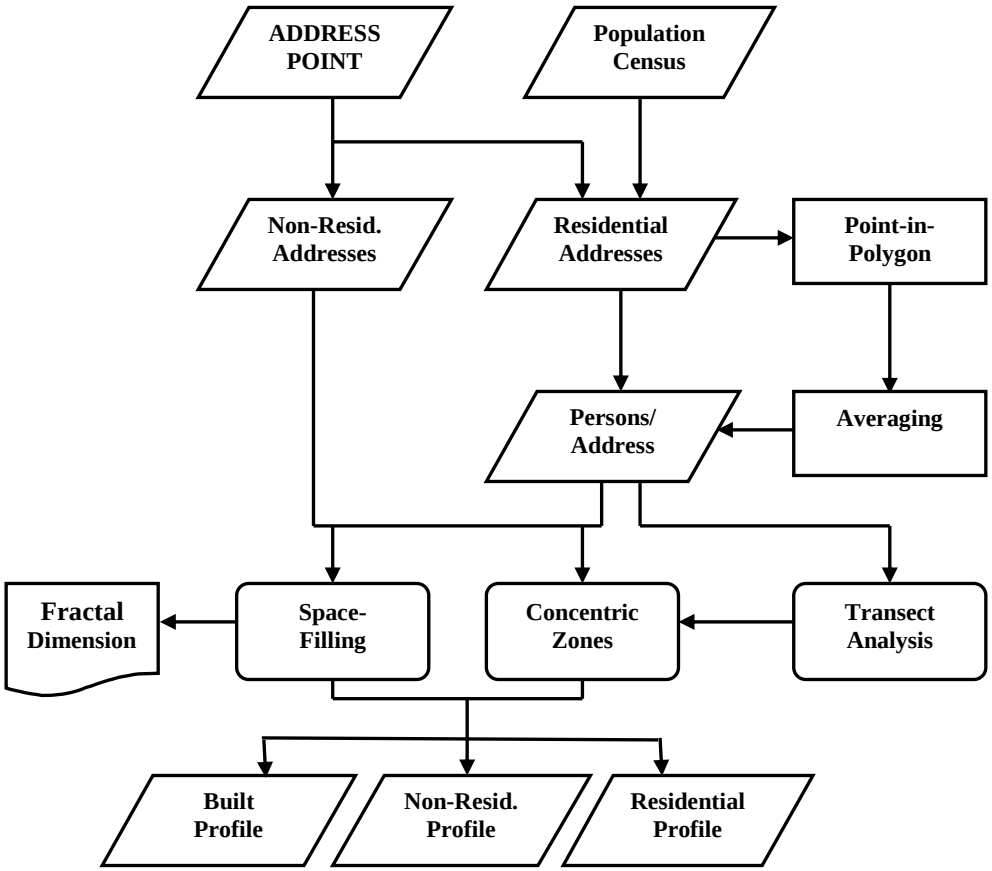
| **Basic Statistics** | |
|---|---|
| **Total study area** | **257.30 km²** |
| **Total study area population** | **482,671** |
| **Number of EDs (some partly outside study area)** | **1,155** |
| **Total number of ADDRESS-POINTS** | **247,696** |
| **Number of residential ADDRESS-POINTS:** | **231,203** |
| **Number of non-residential ADDRESS-POINTS** | **16,493** |
| ***Derived Statistics*** | |
| **Mean** | **2.09 persons/ADDRESS-POINT** |
| **Range in ED average household size** | **0.17¤ - 3.93** |
| **Standard deviation of ED mean household size** | **0.62** |

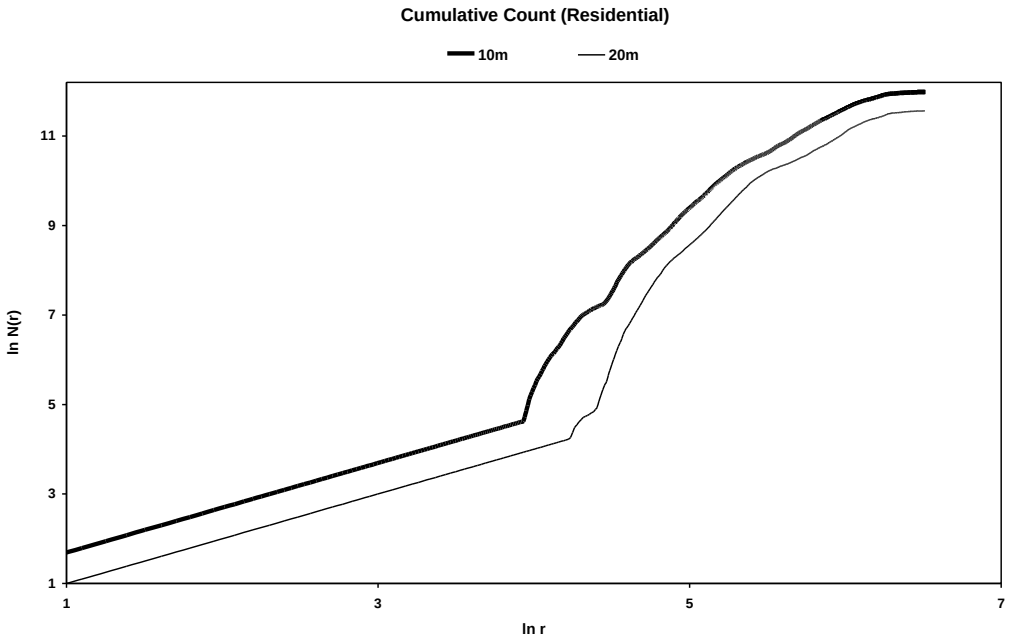
¤ the lower bound is set by a very small number of City centre enumeration districts, in which small numbers of non-domestic properties were likely not identified.

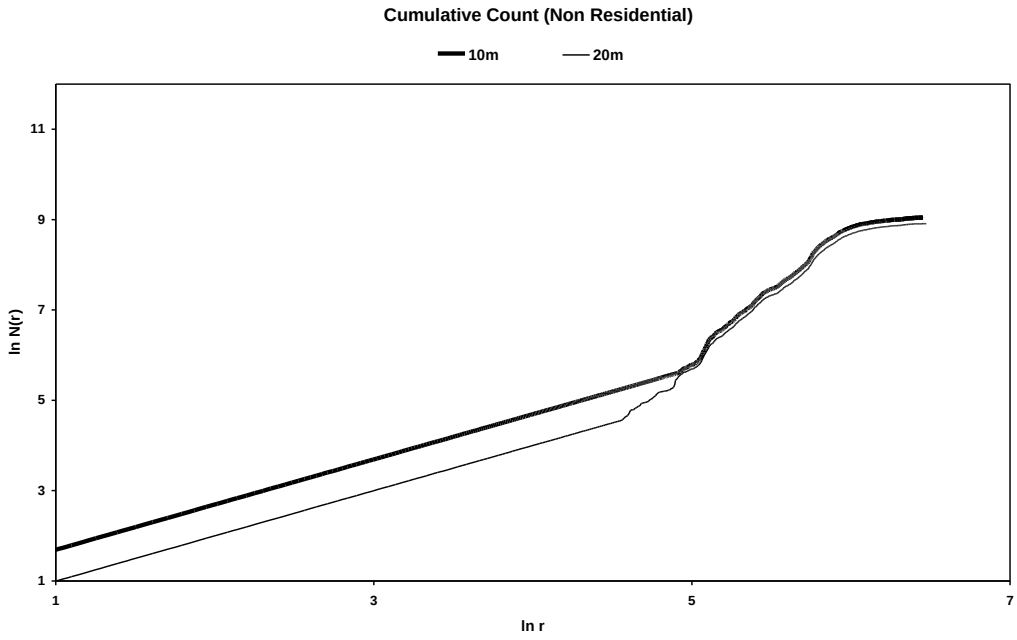
Table 2: Space-filling and fractal dimensions of urban land use

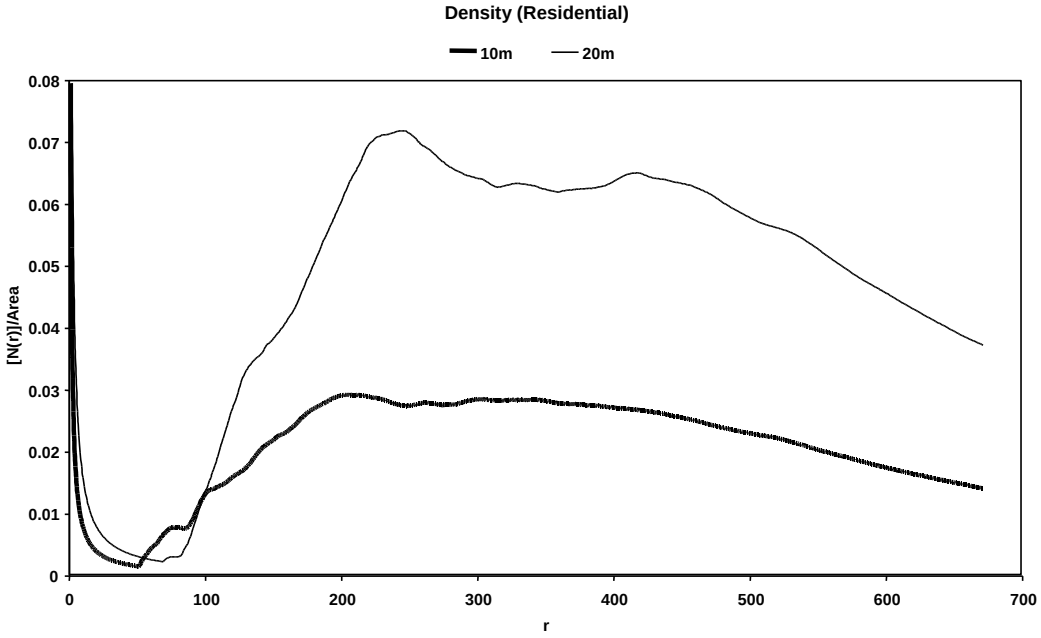
| Land-use | Spatial Dimensions | | | | Fractal Dimensions | |
|---|---|---|---|---|---|---|
| | Spatial Resolution | Number of Occupied cells† | Occupied area ($km^2$) | Percent Occupied | Density $p(r')$ | Count $N(r')$ |
| **Built-up** | **20m** | **105,904** | **42.36** | **16.43** | **1.578898** | **1.587047** |
| **Built-up** | **10m** | **160,710** | **16.07** | **6.23** | **1.479334** | **1.495399** |
| **Residential** | **20m** | **102,219** | **40.89** | **15.86** | **1.553049** | **1.563011** |
| **Residential** | **10m** | **156,444** | **15.64** | **6.06** | **1.480110** | **1.495890** |
| **Non-residential** | **20m** | **7,432** | **2.97** | **1.15** | **1.155580** | **1.206122** |
| **Non-residential** | **10m** | **8,488** | **0.85** | **0.33** | **1.059813** | **1.114579** |

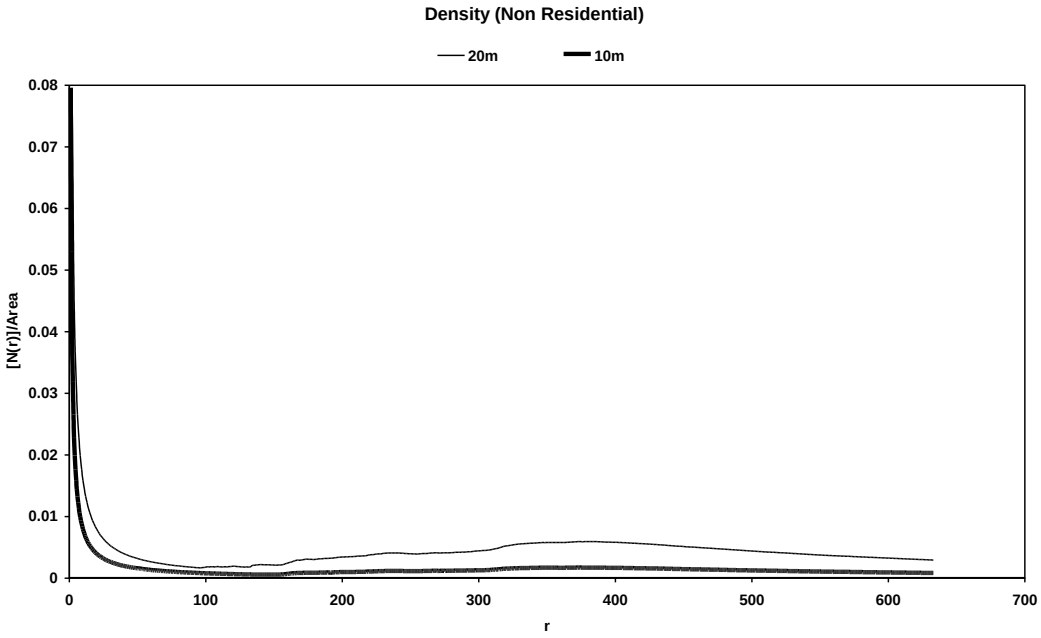
† once rasterised, residential plus non-residential no longer necessarily add up to total number of built.

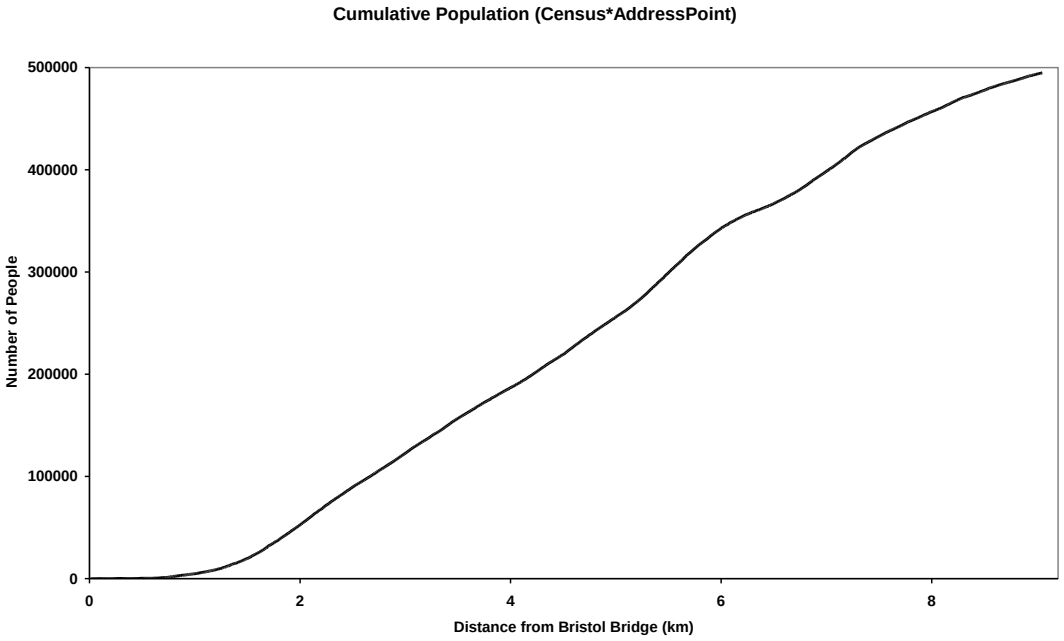

ADDRESS POINT
Population Census
Non-Resid. Addresses
Residential Addresses
Point-in-Polygon
Persons/ Address
Averaging
Fractal Dimension
Space-Filling
Concentric Zones
Transect Analysis
Built Profile
Non-Resid. Profile
Residential Profile

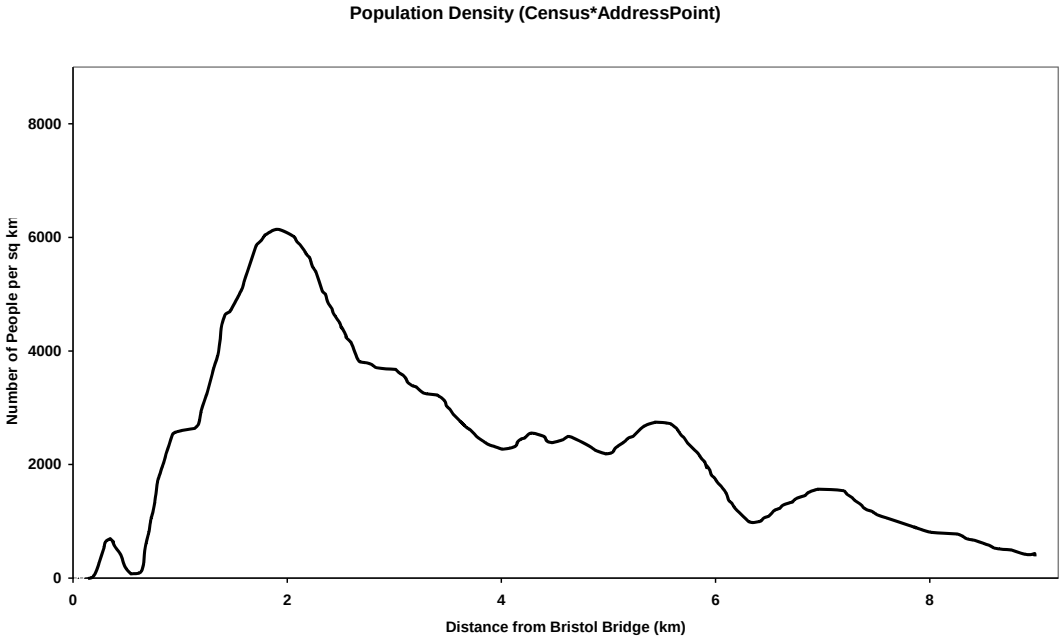

Cumulative Count (Residential)
10m
20m
ln N(r)
11
9
7
5
3
1
1
3
5
7
ln r

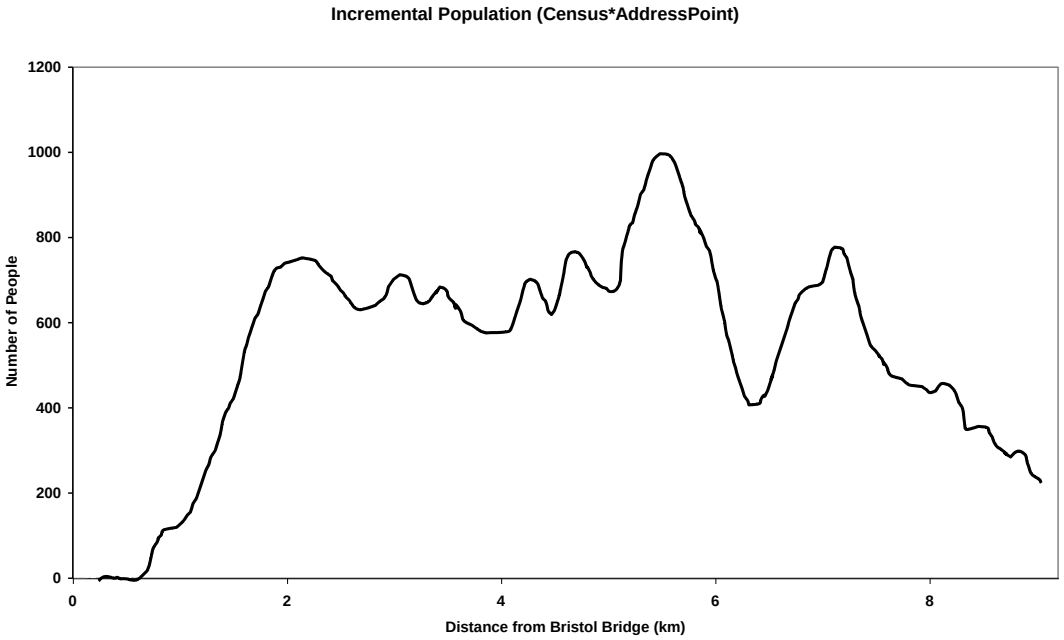

Cumulative Count (Non Residential)
10m
20m
ln N(r)
11
9
7
5
3
1
1
3
5
7
ln r

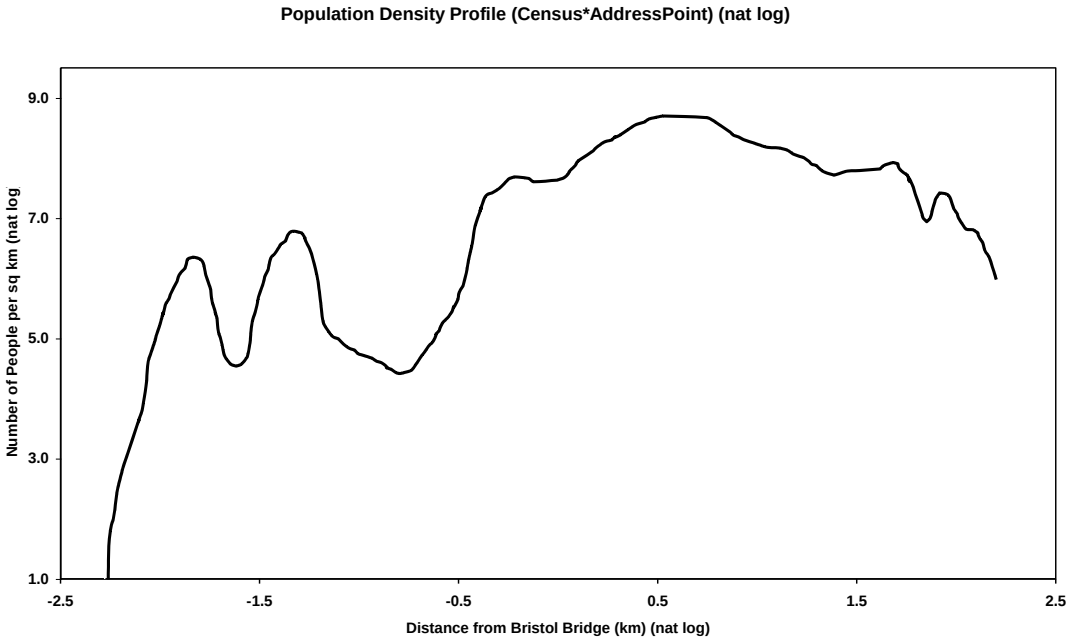

Density (Residential)
10m
20m
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
[N(r)]/Area
0
100
200
300
400
500
600
700
r


Density (Non Residential)
20m
10m
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
[N(r)]/Area
0
100
200
300
400
500
600
700
r

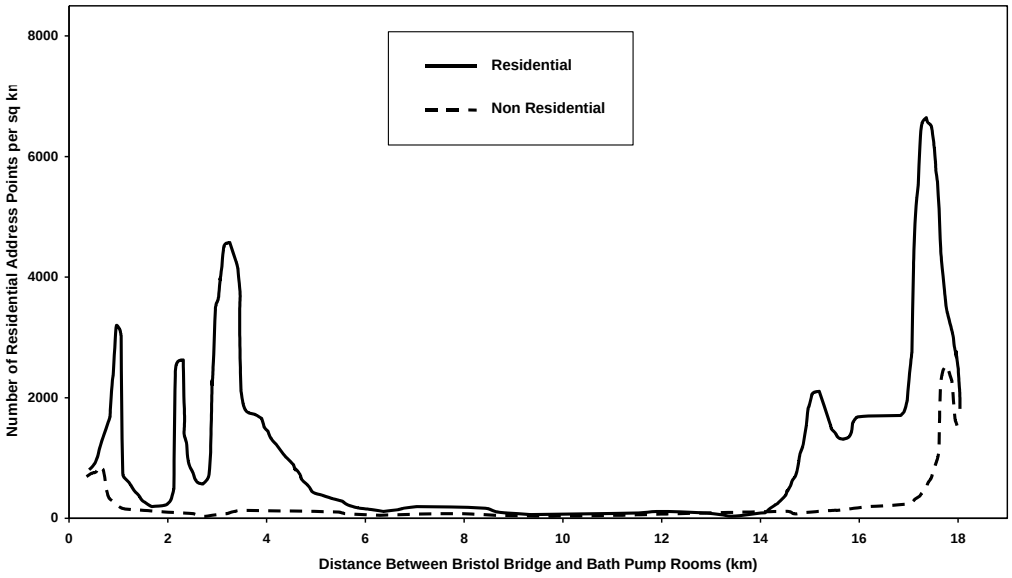

Cumulative Population (Census*AddressPoint)
500000
400000
300000
200000
100000
0
Number of People
0
2
4
6
8
Distance from Bristol Bridge (km)


Population Density (Census*AddressPoint)
8000
6000
4000
2000
0
Number of People per sq km
0
2
4
6
8
Distance from Bristol Bridge (km)

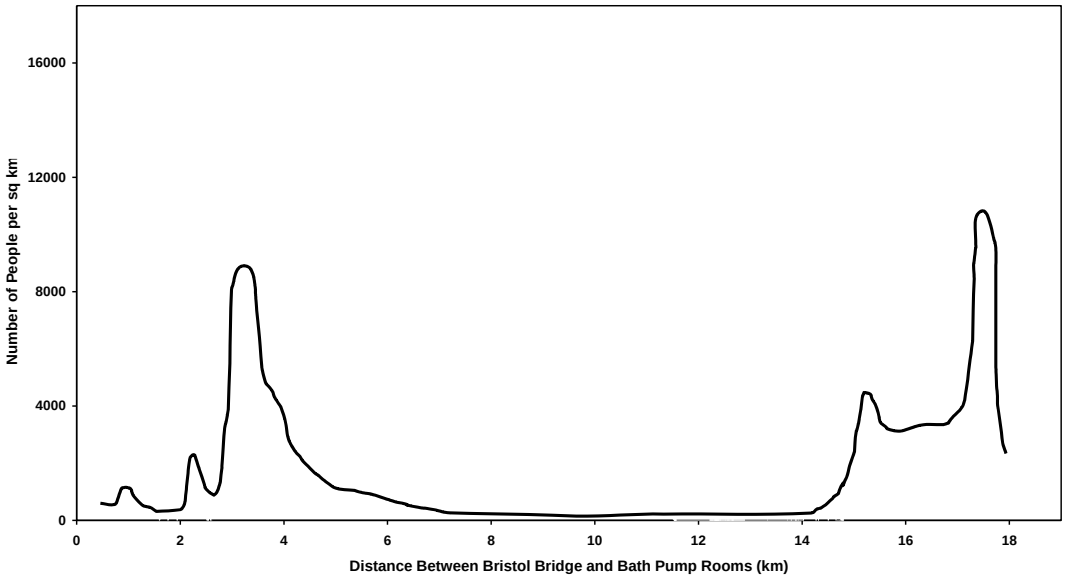

Incremental Population (Census*AddressPoint)
1200
1000
800
600
400
200
0
Number of People
0
2
4
6
8
Distance from Bristol Bridge (km)


Population Density Profile (Census*AddressPoint) (nat log)
9.0
7.0
5.0
3.0
1.0
Number of People per sq km (nat log
-2.5
-1.5
-0.5
0.5
1.5
2.5
Distance from Bristol Bridge (km) (nat log)

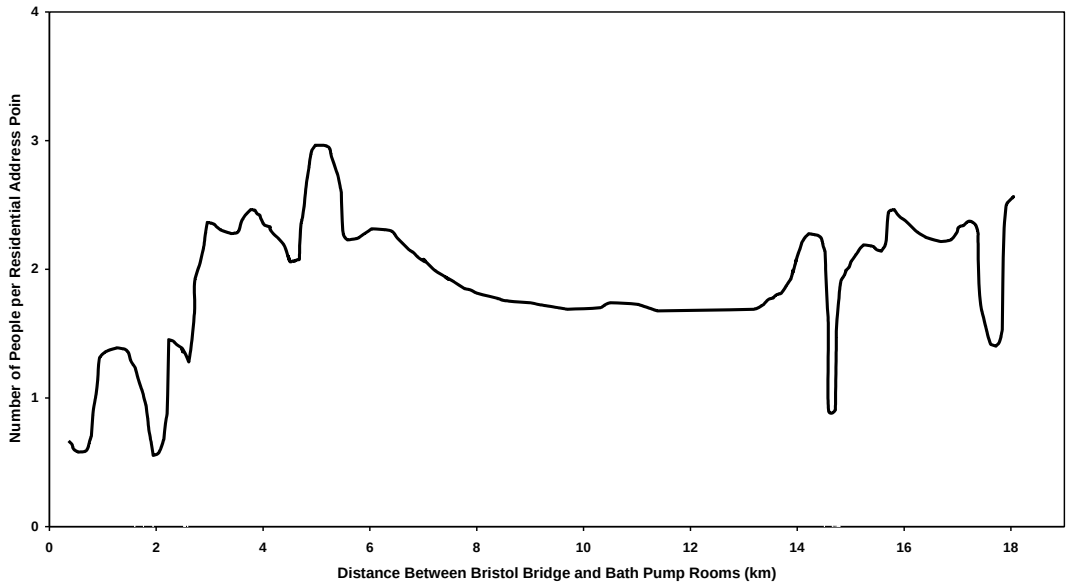
**Address Point Density Along Bristol - Bath Transect**




**Population Density Along Bristol - Bath Transect**




**Average Household Size Along Bristol - Bath Transect**



# 지방자치단체의
# GIS 데이터베이스 구축전략

# GIS Database
# Building strategies
# in Local Governments

**Eui-Joon kim (Managing Director, KOGIIC)**

# 사회 구조의 대변화




정보

정보

정보

패러다임의 변화



# GIS 발전 단계

1. 초기 단계 (과거)

NGIS 구축 | 지방자치제실시

2. 과도기 (현재)

GIS 정보화 근로사업 | IMF

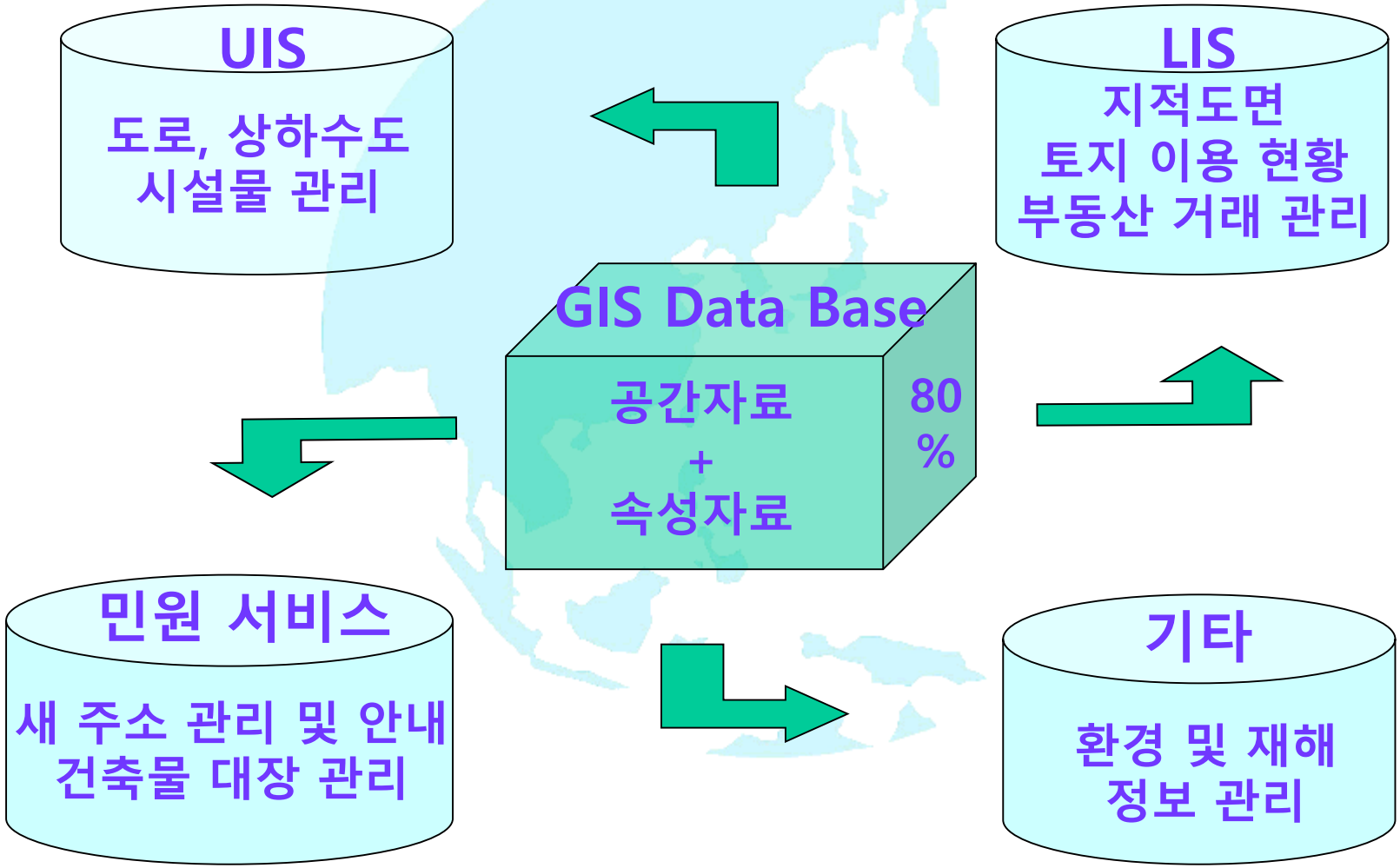
3. 도약기 (미래)

다양한 DB | 포괄적인 DB | 고품질의 DB

# GIS 도입의 배경 및 효과



# GIS Data Base 구도



# 특 성

- 전국 237개 시군구 - 전체공무원의 약 40% (20 여만명)
- 위임업무(기관위임, 단체위임) 약 85% 차지
  - 지방자치제 이후 년간 100여건씩 증가 (위임증가 + 자체증가)
- 대민업무의 전초기지 - 민원사무가 약 65% 차지
- GIS 관련업무가 약 80% 차지 - GIS 도입 당위성

# GIS 구축 현황

1. 기초 단계

1) NGIS 구축 기본 계획 - 수치지형도

(1/5000, 1/25000 98년 완료 1/1000 추진중)

2) 지방자치단체 - 수치지형도

(1/1000 추진중)

3)국토 연구원 - 토지특성도(주제도)

(1차 완료 + 2차 착수 = 전국 약 50%)

4) 기타 국토 기본 지질도 (자원 연구소), 임상도 (산림청) 등

## 2. 활용 단계

### 1) 도시 종합 정보 관리 시스템

창원, 울산, 광주, 청주 (6단계 착수) 대구에 이어 과천,
서울 (시정개발 연구원의 기초 연구 완료)
부산 (서구의 시범 사업 성공) 등 대도시로 확산

### 2) 지하시설물 관리 시스템

광주, 여수 등 약 20개 시가 정보화 근로 사업으로 추진중

### 3) 토지관리 정보 시스템

건교부 (국토 연구원) 주관
시범사업완료 - 대구 남구청
99년 중 12개 지자체의 선정 우선순위에 따라 시행

### 4)지적 도면 전산화

행자부 (지적공사) 주관
시범사업 완료 - 대전 유성구
99년 중 전국 사업으로 확대

### 5) 기타

송배전망도 (한국전력), 통신 선로 (한국통신), 가스관망도 (가스공사),
토양도 (농업진흥청), 해도 (해양수산부)등이 구축 중

# GIS 구축상의 문제점

1. 정보화 마인드 결여
2. DB 표준화 (일관성, 호환성) 미비
3. 데이터의 공유 의식 결여
3. NGIS와 연계성 결여
4. 중장기적 마스터플랜(Masterplan) 미흡
5. 중앙정부와 지자체간 사업 중복 현상
6. CIO 제도 미 활성화
7. DB의 관리 및 갱신 소홀

# 효과적인 GIS 구축을 위한 단계

제 1단계 수요 조사 (Needs Assessment)

제 2단계 개념 설계 (Conceptual Design)

제 3단계 상세 설계 (Physical Design)

제 4단계 시범 연구 (Pilot Study)

제 5단계 구축 (Implementation)

제 6단계 운용 및 관리 (Operation)

자료 : 서울시정개발연구원
[서울시지리정보시스템 구축에 관한연구]

# 효과적 GIS 구축 전략

1. 마스터플랜 (Masterplan) 수립
2. 정치적 지지 확보
3. 전문인력 확충
4. 재원조달 방안
5. 중앙정부의 효율적인 예산지원
   (재정자립도, 사업의 우선순위)
6. 관계 기관간의 상호 협조
7. 법적 제도적 보완
8. 전문기구에 의한 검수 및 감리체계 확립

# GIS 구축의 기대 효과

1. 정보의 공동 활용
2. 행정서비스의 질 향상
3. 업무처리의 효율성 제고
4. 효과적인 계획 수립 및 정책 결정
5. 의사결정의 객관성과 합리성 확보
6. 경쟁력 제고 → 정보화 사회 구현
7. 삶의 질 향상

# 광해방지 시스템 구축

한동훈 장은미
삼성SDS
GIS 사업팀

# 용어 정의

- Emergency: 계획되고 예측가능한 행동으로부터의 벗어남
- Disaster: emergency가 그것을 다룰 수 있는 통제 범위를 넘었을 때
- Risk: 나타날 수 있는 emergency의 포텐셜이나 가능성
- Harzard: emergency를 일으킬 수 있는 물리적 특성

SAMSUNG SDS

# 광해란 무엇인가?

- 광산의 존재로 인하여 주변환경에 악영향을 미치는 것을 말하며,

  주로 경제성이 사라진 폐광으로 인해 지속적으로 환경에 영향을 미치는 것을 말한다

SAMSUNG SDS

# 광해에는 어떤종류가 있는가?

- 지반침하: 지하에 있는 갱도로 인하여 지반이 가라앉는 현상
- 침출수: 탄광에서 흘러나오는 오염된 폐수
- 주위 경관의 훼손: 침출수나 폐석으로 말미암은 주위경관의 훼손

SAMSUNG SDS

# 광해의 실제적 보기 (sink-hole)



SAMSUNG SDS

# 광해의 실제적 보기(trough)



SAMSUNG SDS

# 광해의 실제적 보기(trough)



SAMSUNG SDS

# 광해의 실제적 보기(침출수)



SAMSUNG SDS

# 광해의 실제적 보기(경관훼손)



SAMSUNG SDS

# 현재 상황

- 문화일보 99/8/3: 전국의 금속광산 906개 중 99%인 894개가 휴폐광산,
  이중에 150여개소가 붕괴위험

- 중앙일보 99/1/15: 동강 인근 65개의 폐광산에서 흘러나온 폐수로 오염,
  카드늄이 환경기준치의 20배,
  비소가 10배 황산이온이 4배로 검출

SAMSUNG SDS

# 광해 방지를 위한 요소

- Data 이용성을 향상 시켜야 한다
- Data 통합성을 높여야 한다
- 분석과 모의 방법(Analysis and Simulation methods ) 을 활용한다

SAMSUNG SDS

# 광해 방지를 위한 요소

- Data 이용성을 향상 시켜야 한다

  - 광산갱도의 위치정보와 지반안정성에 대한 정보는 이 지역에 도로, 건물, 지하 매설물을 건설할 때 반드시 필요하다

  - 이러한 자료를 검색하는데 많은 시간과 노력이 필요하다

SAMSUNG SDS

# 광해 방지를 위한 요소

- Data 통합성을 높여야 한다

- 광해는 상당히 다양한 환경적 위험요소들을 포함한다

- 광해에 관한 데이터가 여러 부서에 흩어져 있기 때문에 통합적 위험성을 파악하기 어렵다

SAMSUNG SDS

# 광해 방지를 위한 요소

- 모의와 분석방법을  활용한다. (Analysis and Simulation methods)

- 불가피 하게 광해위험 지역에 도로나 철도등을 건설하게 될 때가 있다

- 위험을 방지하기 위한 필요하고 충분한 조건이 설정되어야한다

SAMSUNG SDS

# 광해 방지를 위한 최선의 선택

데이터의 이용성 향상

데이터의 통합성 향상

**Analysis & Simulation**

**SOLUTION**

**GIS SYSTEM**

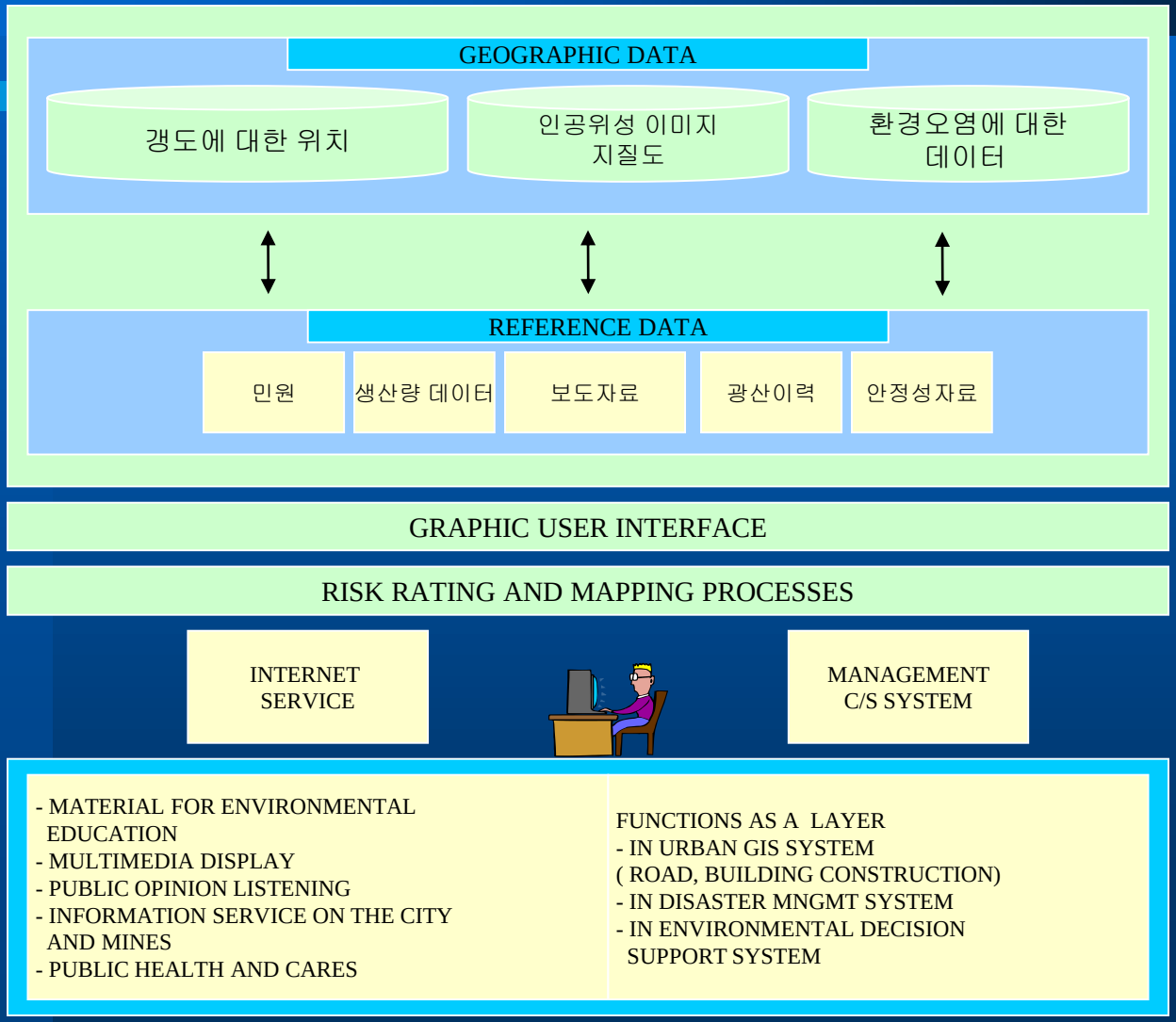
SAMSUNG SDS

# 시스템 구축을 위한 요소

- 광산에 대한 GIS 시스템의 구축
- 광해에 대한 Risk Evaluation 방법
- GIS 시스템과 Risk Evaluation의 Mapping

SAMSUNG SDS

# 시스템 구성 요소




SAMSUNG SDS

# 광산지역 GIS를 위한 속성 데이터

| geographical data | types of data | attributes |
|---|---|---|
| pits | line | id number, depth, width, slope, etc. fractureness |
| gates | point | id number, elevation, surrounding land uses |
| soil | polygon | texture, depth, color, conductivity etc. |
| main geological formation | polygon | name of formation, |
| fault | line | discrepance |
| stability test point | point | stress and strain test, rating of risk |
| mine deposit | polygon | main element, pH, depth |
| water quality test point | points | pH, COD, BOD, conductivity TN, TP |
| sinking point | points | the depth of sinking, the mean diameter of sinking or fractured |

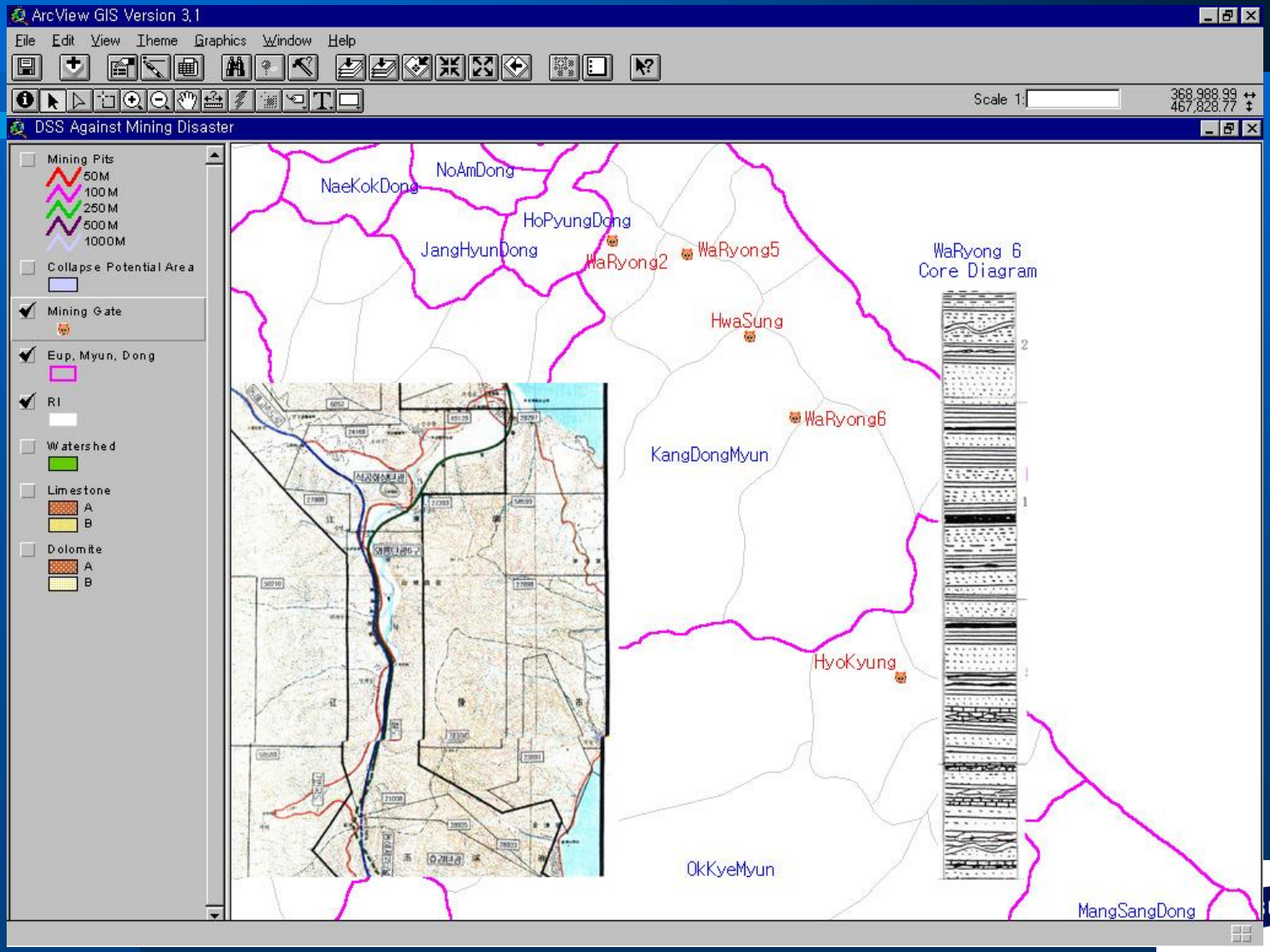
SAMSUNG SDS

# 토양관계 데이터 베이스의 예

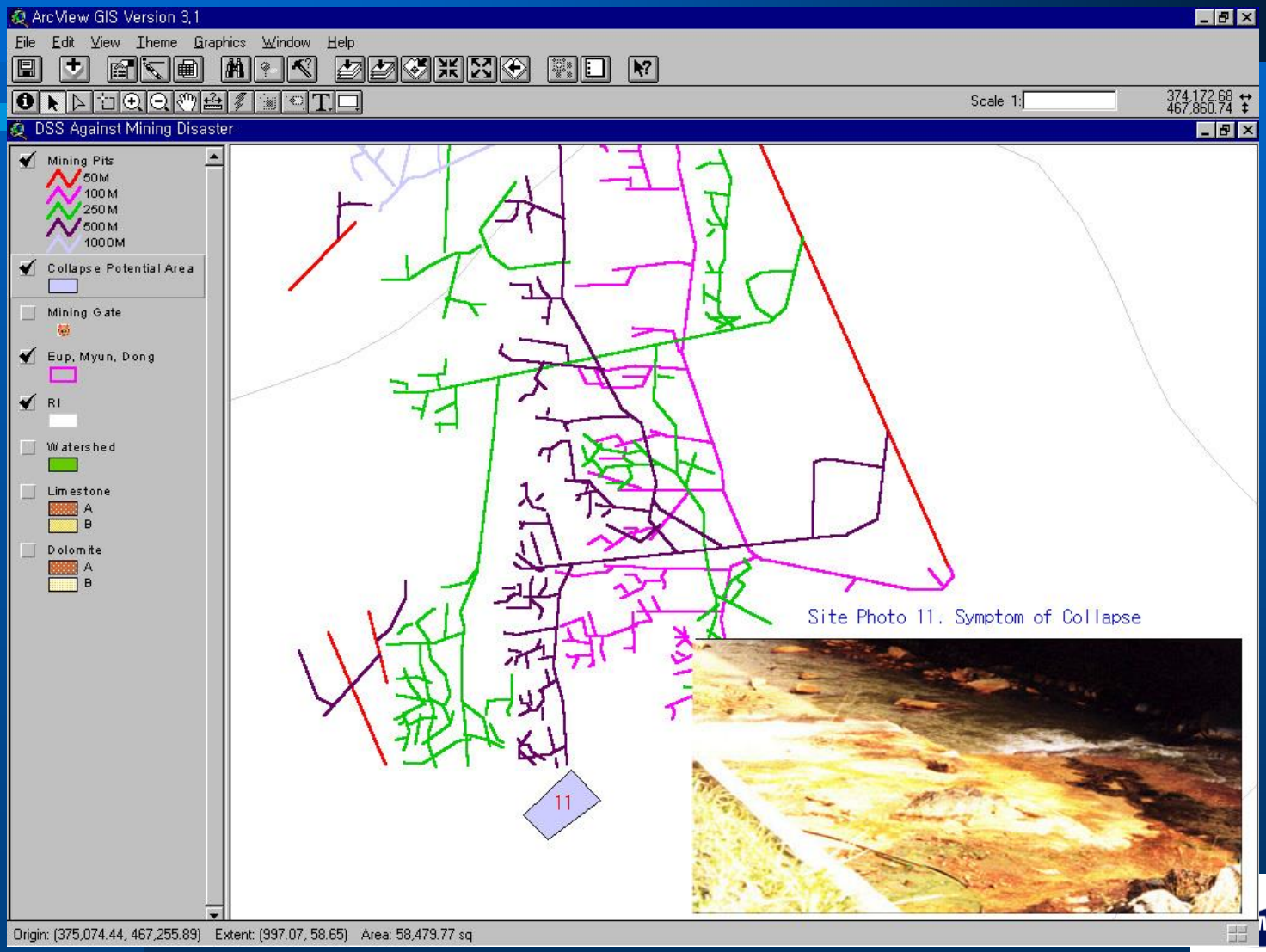
| 토양통 | 표토자갈 | 표토토성 | 침식 | 경사 | 유효토심 | 배수등급 | 심토토성 | 구분 | 토양유형 | 지형 | 모재 | 신분류 | 토색 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 가곡 | 88 | SiL | 1 | 0~2% | >100 | 약간불량 | 미사식양질 | P | 보통답 | 곡간지 | 반암 충적붕적층 | Haplaquepts | 회갈색 |
| 가곡 | 88 | SiL | 1 | 2~7% | >100 | 약간불량 | 미사식양질 | P | 보통답 | 곡간지 | 반암 충적붕적층 | Haplaquepts | 회갈색 |
| 가곡 | 88 | SiL | 1 | 7~15% | >100 | 약간불량 | 미사식양질 | P | 보통답 | 곡간지 | 반암 충적붕적층 | Haplaquepts | 회갈색 |
| 가천 | 88 | SL | 1 | 0~2% | 50-100 | 약간불량 | 사양질/사력질 | P | 사질답 | 하성평탄지 | 하성 충적층 | Haplaquepts | 암회갈색 |
| 가파 | 88 | LfiS | 1 | 2~7% | <20 | 매우양호 | 사질 | C | 사질전 | 해안대지 | 충적층(패사) | Udipsamments | 백색 |
| 가파 | 88 | LfiS | 1 | 7~15% | <20 | 매우양호 | 사질 | C | 사질전 | 해안대지 | 충적층(패사) | Udipsamments | 백색 |
| 가포 | 88 | L | 1 | 0~2% | <20 | 불량 | 사양질sk | P | 염해답 | 하해혼성평탄지 | 하해혼성 충적층 | Fluvaquents | 암오리브회 |
| 각화 | 잔돌이 있는 | L | 침식이 있 | 2~7% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | L | 침식이 있 | 7~15% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | L | 침식이 있 | 15~30% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | L | 침식이 심 | 15~30% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | SiCL | 침식이 있 | 2~7% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | SiCL | 1 | 7~15% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | SiCL | 침식이 있 | 7~15% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |
| 각화 | 잔돌이 있는 | SiCL | 1 | 15~30% | 50-100 | 양호 | 식질gr | C | 중점전 | 산록경사지 | 산성암 붕적층 | Hapludalfs | 황적색 |

SAMSUNG SDS

# 강릉지역 GIS 구축예

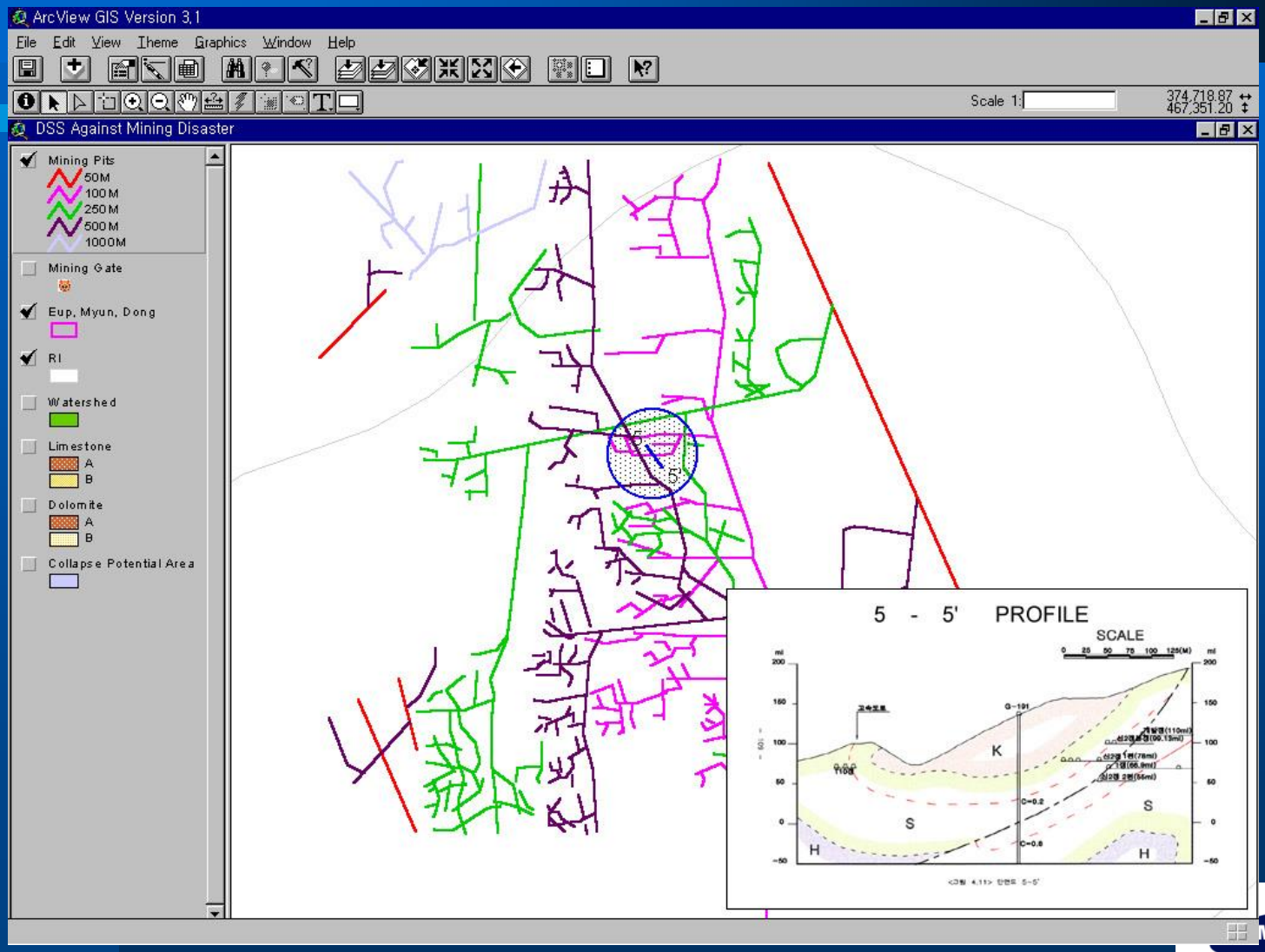

ArcView GIS Version 3.1
File Edit View Theme Graphics Window Help
Scale 1:
368,988.99
467,828.77
DSS Against Mining Disaster
Mining Pits
50M
100M
250M
500M
1000M
Collapse Potential Area
Mining Gate
Eup, Myun, Dong
RI
Watershed
Limestone
A
B
Dolomite
A
B
NaeKokDong
NoAmDong
HoPyungDong
JangHyunDong
WaRyong2
WaRyong5
WaRyong 6
Core Diagram
HwaSung
WaRyong6
KangDongMyun
HyoKyung
OkKyeMyun
MangSangDong

# 강릉 효경탄광 갱도 GIS 구축예




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# 효경탄광 속성데이터 구축예



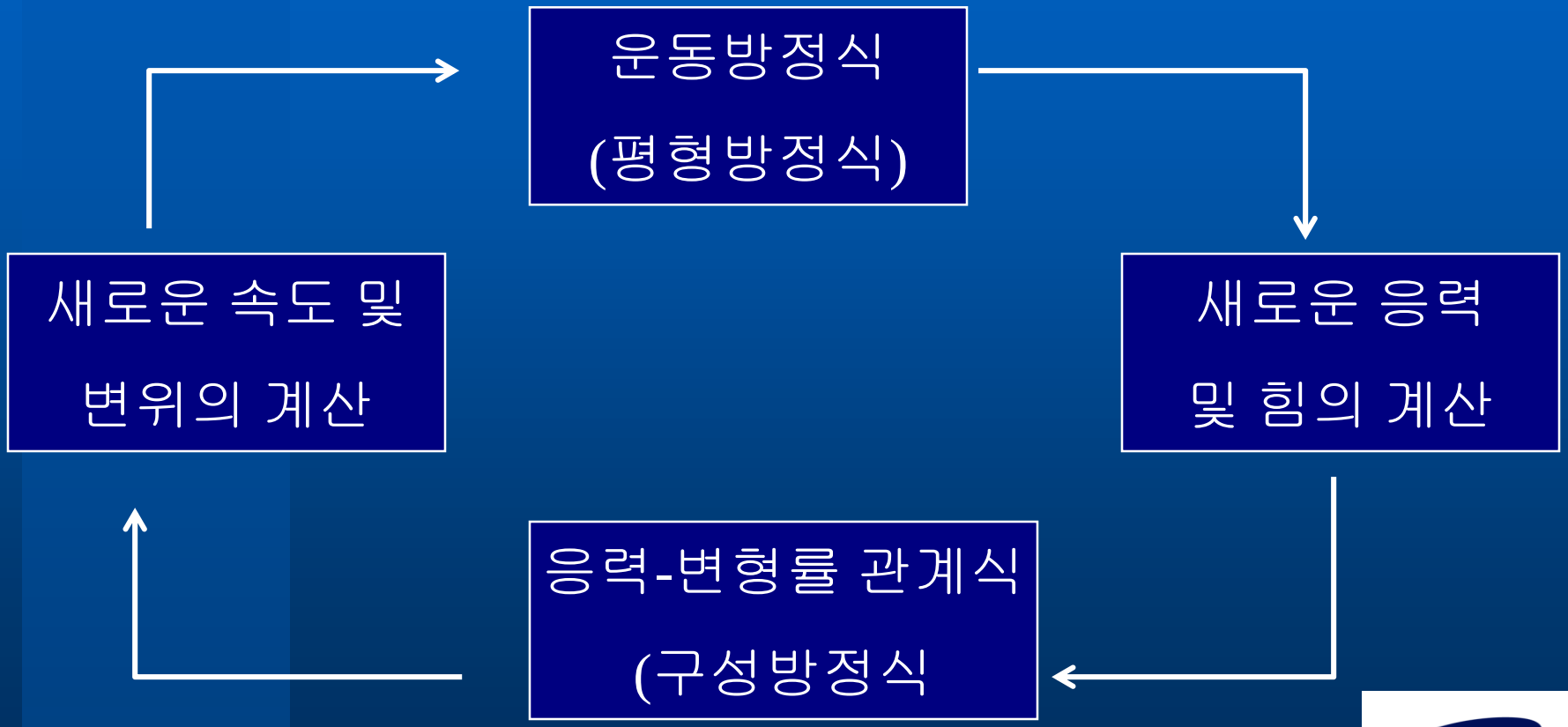
# 지반침하를 위한 평가방법

- 지반침하 평가 모델링을 통한 지반침하 정도를 평가한다 - FLAC 모델

  - 채굴공동의 붕괴 여부및 공동의 붕괴가 지상에 미치는 영향의 조사를 위해 만들어진 모델

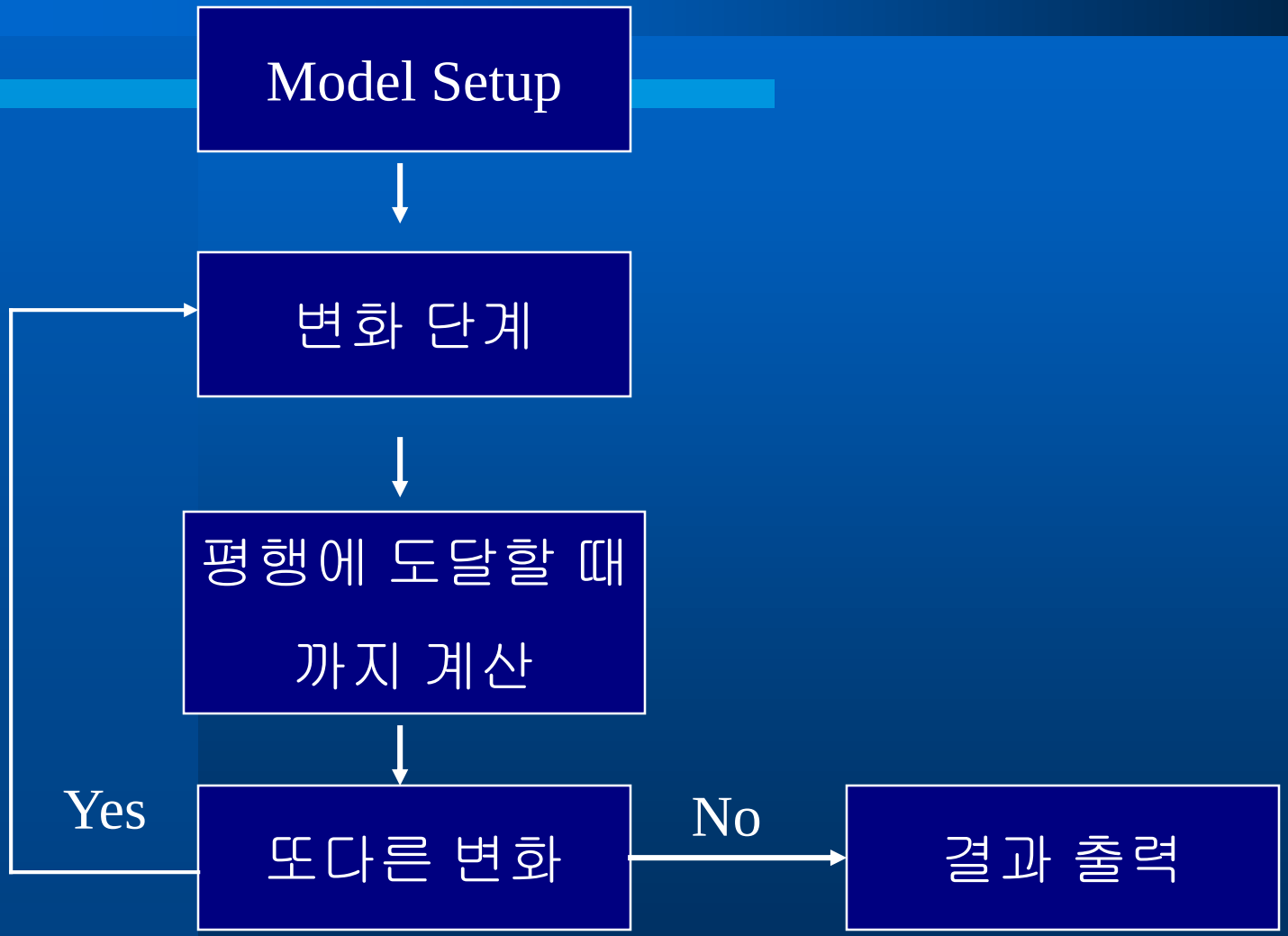
SAMSUNG SDS

# Analysis & Simulation(FLAC)




SAMSUNG SDS

# Analysis & Simulation



# 침출수를 위한 평가방법

- 생활 환경 기준 8개 종목

  **-pH, BOD, COD, SS(suspended solids), DO(Disolved Oxygen), 대장균 수, 총 질소, 총 인**

- 건강 보존 기준 9개 항목

  **-Cd, As, CN, Hg, 유기인, Pb, 6가크롬, PCB, 음이온 계면활성제**

- 이외에 수량을 측정, 현재 수질 5등급 기준방법에 의거 평가치를 설정한다

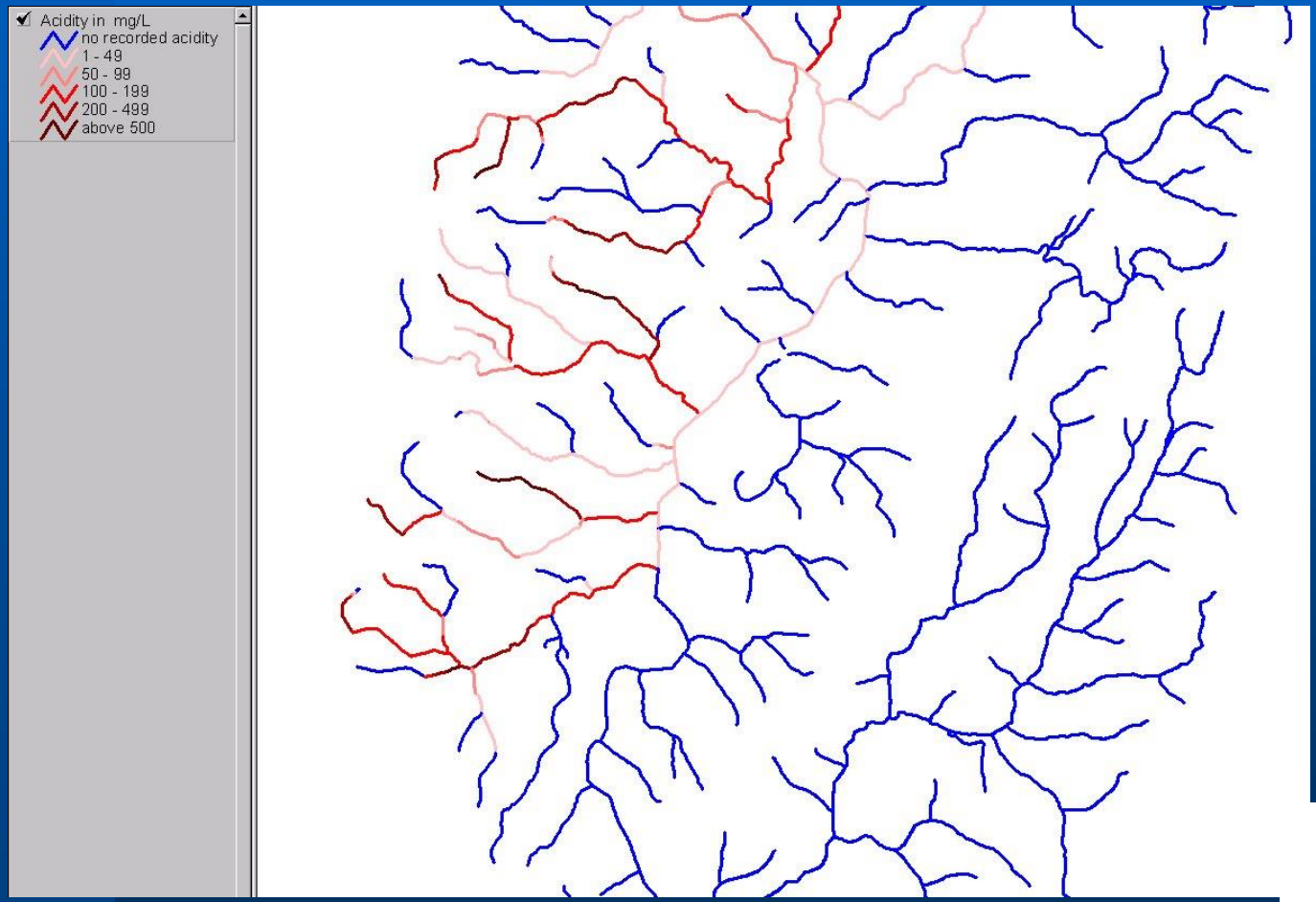
SAMSUNG SDS

# 경관 훼손에 대한 평가방법

- 복원이 필요한 넓이를 몇 개의 등급으로 나눈다
- 복원에 대한 우선순위를 정한다
- 이에 따라 평가를 실시한다

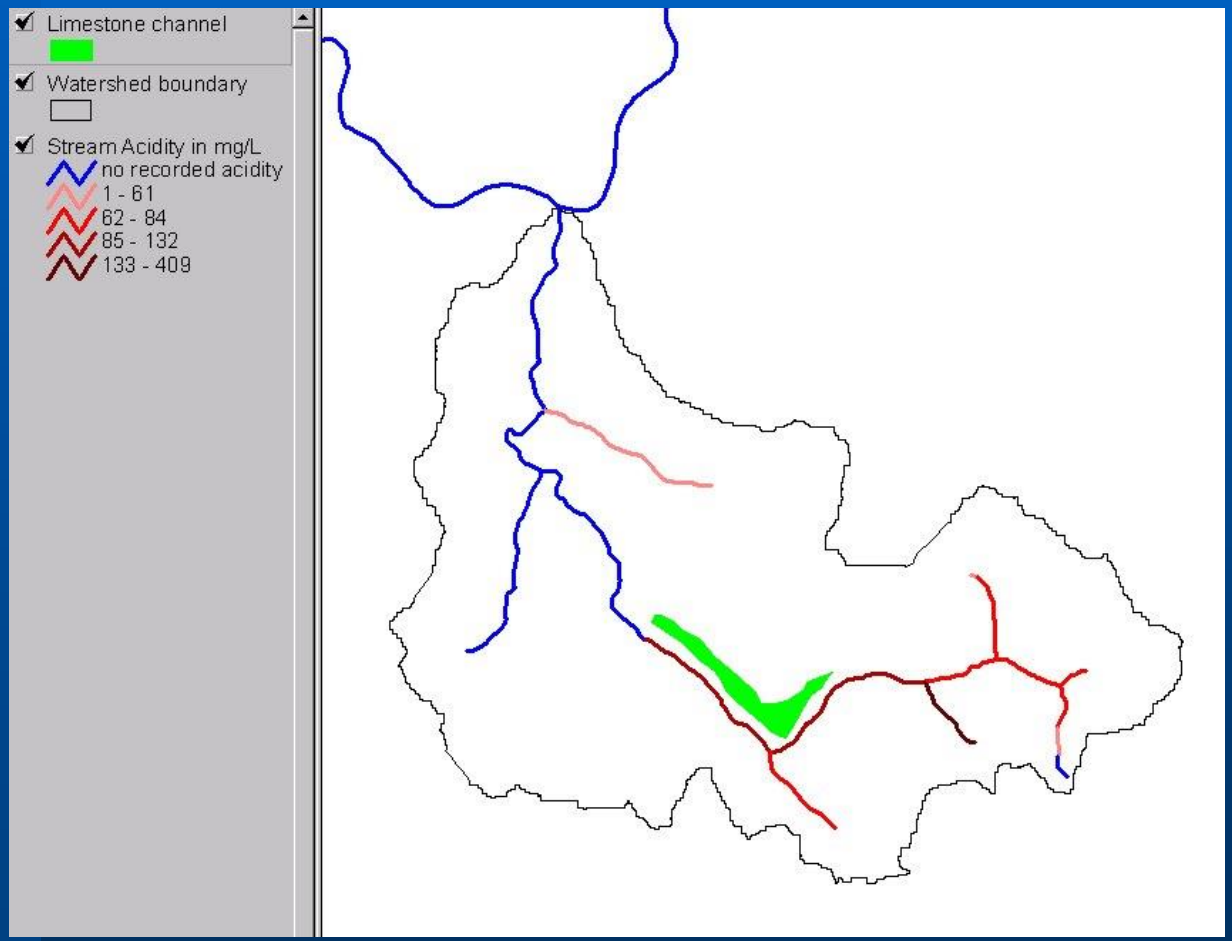
SAMSUNG SDS

# Acidity in mg/l



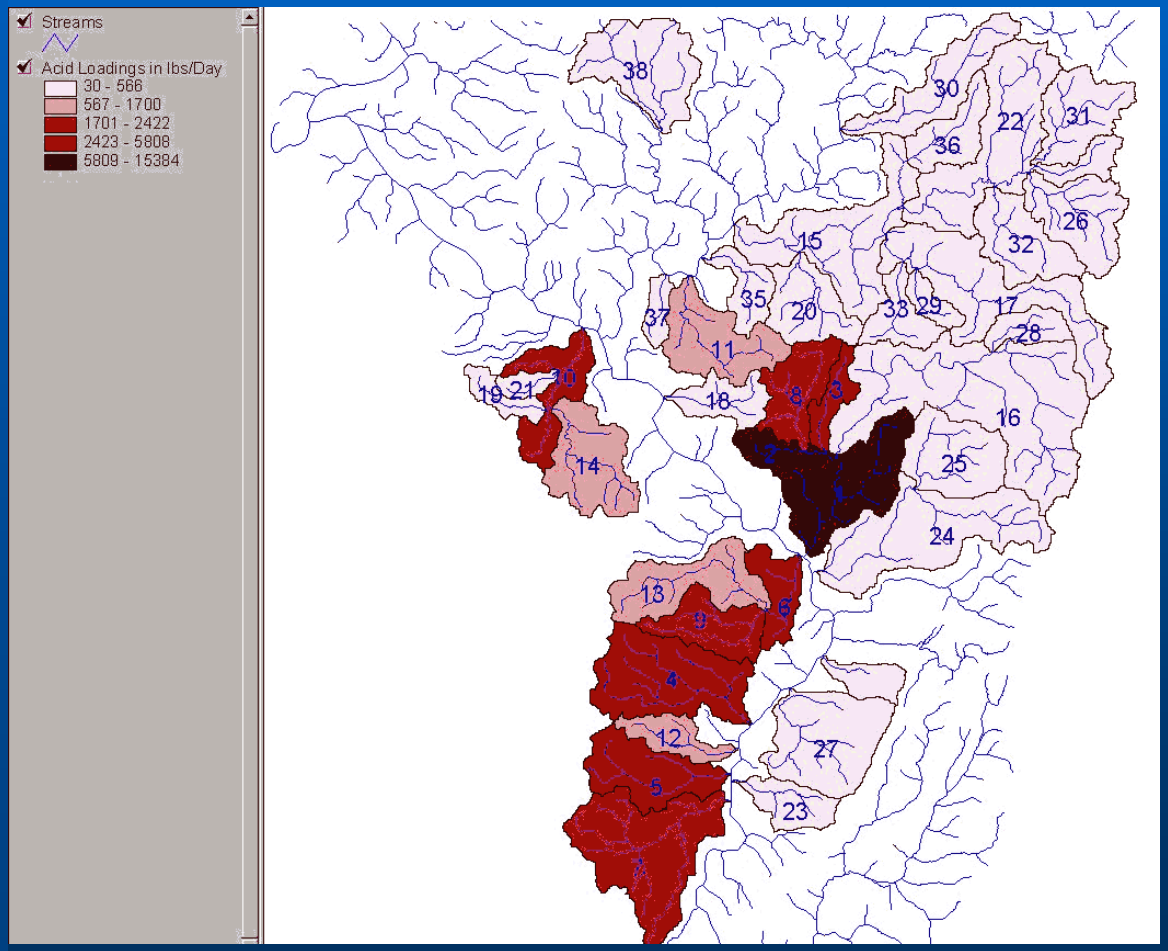

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# Limestone Channel




SAMSUNG SDS

# West Virginia Acid Loading




SAMSUNG SDS

부산광역시

# GIS를 이용한 부산시 도시정보시스템 구축 전략



# - 목 차 -


1. 구축목적
2. 추진 전략
3. 추진 일정
4. 기대효과
5. 시범사업 개요
6. 시범사업 성공요인
7. 시범 사업 특징
8. 시범 사업 추진 현황
9. 시범 시스템 구성도
10. 데이터베이스 구축
11. 응용 시스템 개발
12. 미래상

# 1. 구축목적

◆ 부산광역시는 도시경쟁력 기반 강화, 도시안전 강화, 지역경제 활성화, 지역정보 고도화, 물류 유통체계 국제화, 삶의 질 향상, 시정 개혁 및 행정 여건을 개선하기 위해 의사결정지원에 필수적인 공간정보를 구현하는 도시정보시스템(UIS)구축

◆ 이러한 도시정보시스템(UIS)을 통해

- ➲ 도시 행정의 선진화
- ➲ 친환경적 도시개발
- ➲ 고도정보화와 첨단기술산업시대 진입
- ➲ 정보 인프라 구축을 통한 첨단해양정보산업 도시건설

# 2. 추진 전략

◆ '96~ '97년에 부산광역시 UIS구축 마스터플랜을 수립

- ➲ 시정전반에서 지리정보를 활용할 수 있는 체계 지향
- ➲ 유관기관 및 관련 부서간 통합관리체계 구축
- ➲ NGIS구축계획 및 부산광역시 시정전산화기본 계획과 연계
- ➲ 기본계획에 의한 체계적, 종합적인 전산화 추진

**추진방법**

- ➲ 하향 및 상향식 복합 추진
- ➲ 전담 추진조직 구성
- ➲ 기본계획에 근거한 주관 부서별 자체 추진계획 수립
- ➲ 단위사업은 계획에 의한 시범사업 실시 후 본격 추진
- ➲ 변동자료 직접 갱신체계 구축



## ◆ 시스템구축 방향

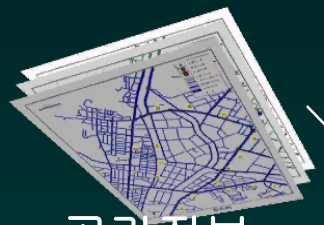
➲ 부산광역시 도시정보시스템은 효율적인 도시기반시설관리, 데이터 통합관리체계 확립, 기술환경 변화에 유연한 체계를 최대한 만족시킬 수 있도록 기능 통합적인 시스템으로 설계




- ❑ 전사적 데이터관리
- ❑ 표준화된 데이터 교환체계의 준수
- ❑ 업무중심의 시스템
- ❑ 사용하기 편리한 시스템
- ❑ 표준화된 시스템 개발환경
- ❑ 개방적인 체계 구성

## ◆ 응용시스템

➲ “공간자료시스템 + 속성자료시스템” 형태가 아닌 “통합정보시스템”을 구축함은 물론, 특정 업무만을 위한 개별시스템 형태가 아니라 Enterprise GIS 구축 개념을 토대로 조직 전반에 걸친 업무 혁신(renovation), 자료 공유 및 업무의 유기적인 연계를 고려하여 시스템을 설계하고 구축



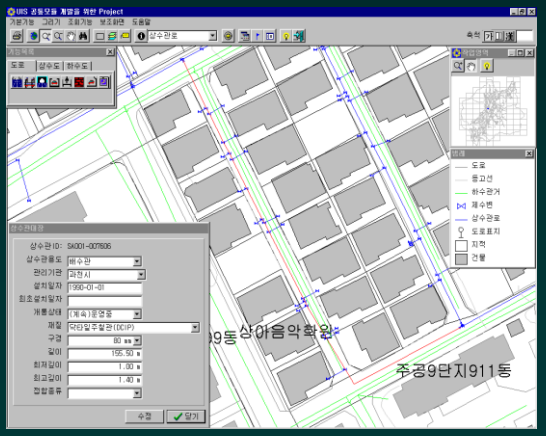
공간정보
(지도/도면)

| 연도 | 자본금 | 매출액 | 순이익 | IS매출액 | GIS순이익 | 기타 |
|---|---|---|---|---|---|---|
| '94년도 | 698.77 | 1,361.87 | 28.70 | '95년도 | '95년도 | '95년도 |
| '95년도 | 806.81 | 2,063.85 | 55.27 | '95년도 | '95년도 | '95년도 |
| '96년도 | 1,140.60 | 3,060.32 | 99.24 | '95년도 | '95년도 | '95년도 |

속성정보
(대장/조서)

통 합

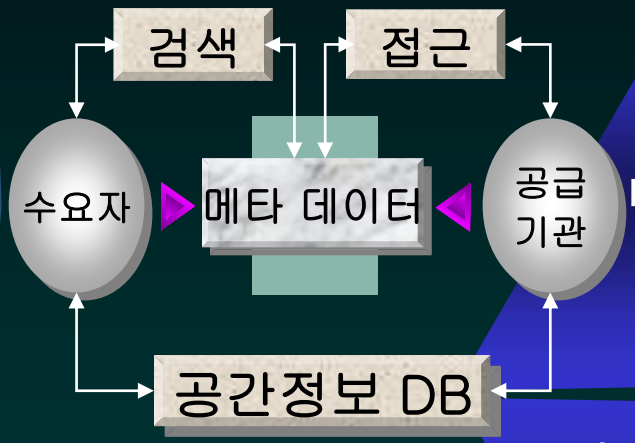
도시공간정보
통합
데이터베이스

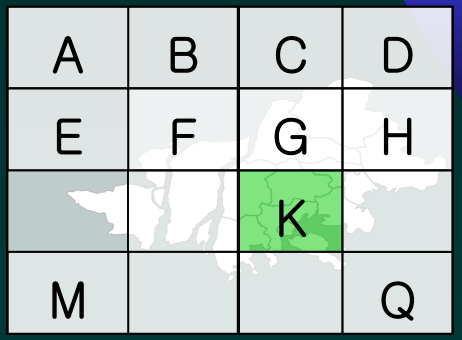


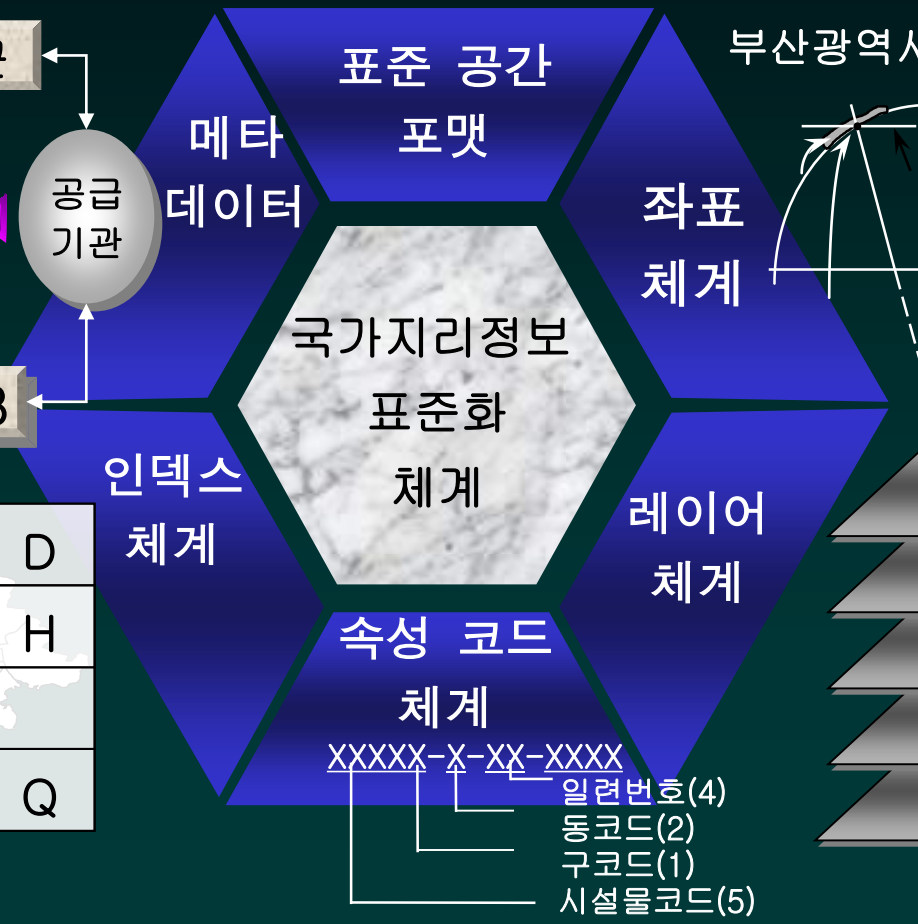
공간정보와 속성정보의
일원화된 테이블조회

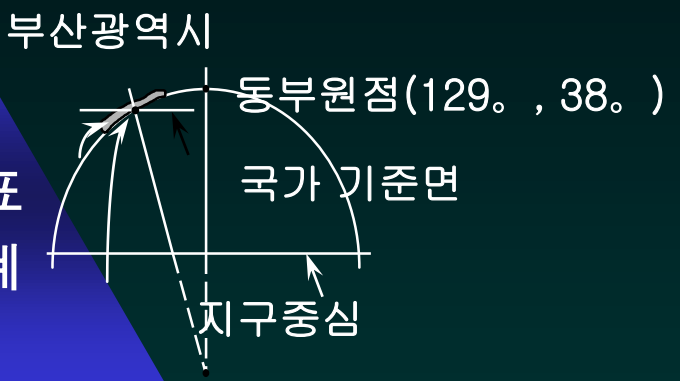
## ◆ 데이터베이스

➲ 타 시스템과의 호환성과 자료의 정확성 등을 위해 데이터베이스를 이루는 요소들을 표준화하고, 표준화에 대한 안은 국가지리정보체계를 기본으로 함



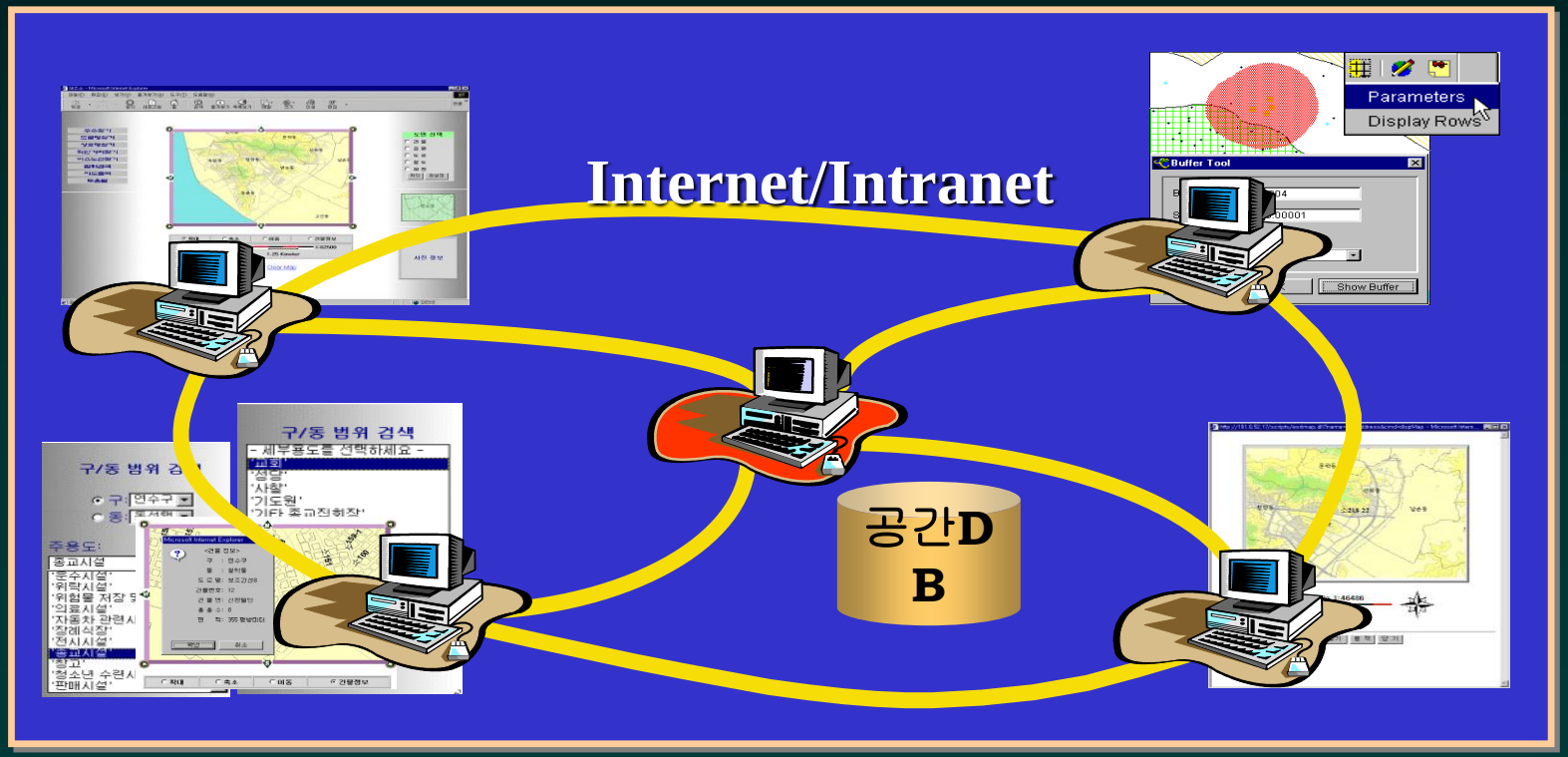



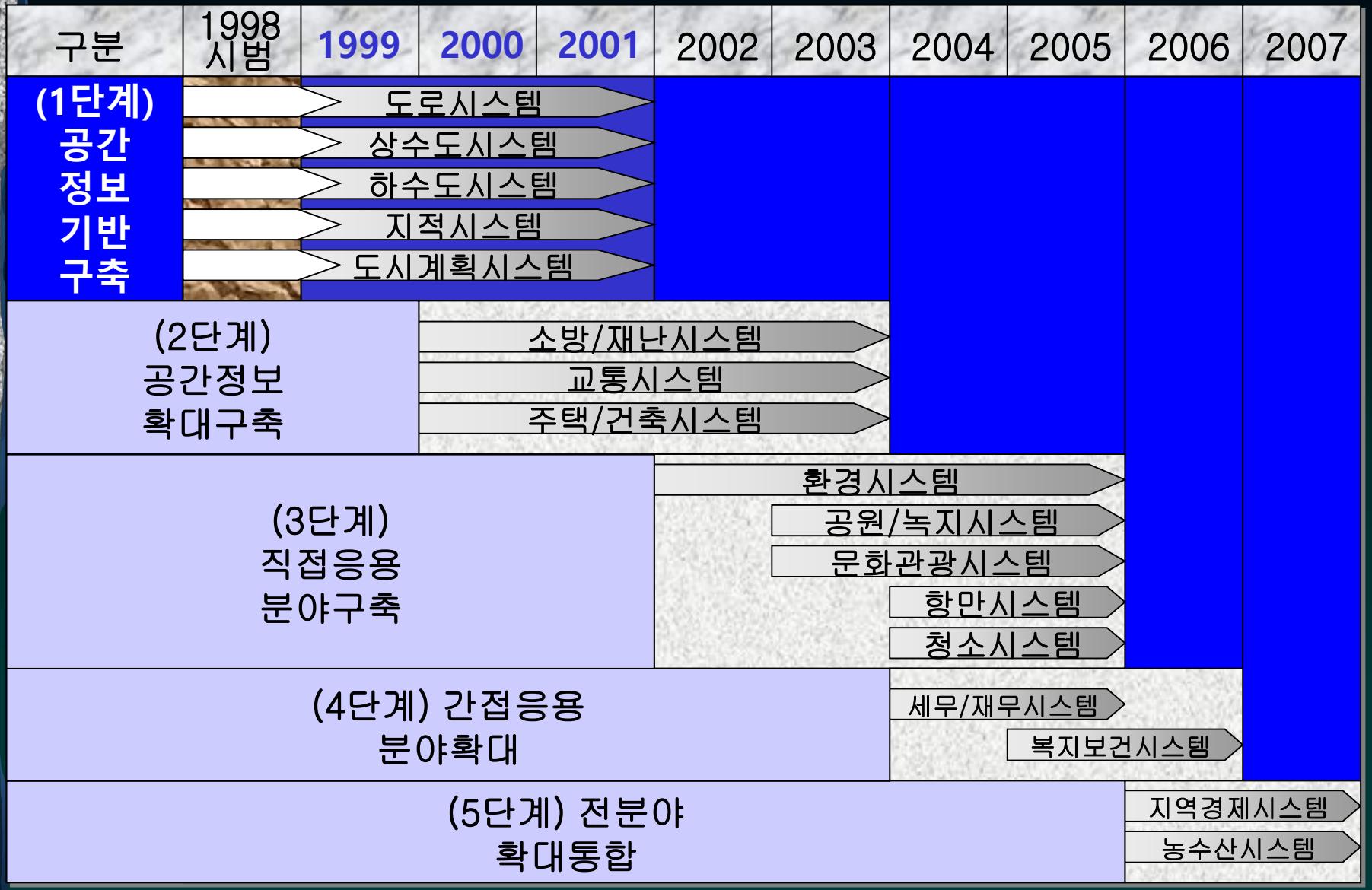



## ◆ Internet/Intranet

➲ 지도상에 정보를 표시하고 버퍼, 공간검색 등 GIS만의 기능을 Web-Browser상에서 구현하여 생활지리정보, 관광안내, 교통정보 등의 공간정보를 제공함으로써 대민서비스의 질적 향상을 고려한 시스템과 청내 공간정보를 제공하는 Intranet을 개발



# 3. 추진 일정


구분
1998 시범
1999
2000
2001
2002
2003
2004
2005
2006
2007
(1단계) 공간정보 기반 구축
도로시스템
상수도시스템
하수도시스템
지적시스템
도시계획시스템
(2단계) 공간정보 확대구축
소방/재난시스템
교통시스템
주택/건축시스템
(3단계) 직접응용 분야구축
환경시스템
공원/녹지시스템
문화관광시스템
항만시스템
청소시스템
(4단계) 간접응용 분야확대
세무/재무시스템
복지보건시스템
(5단계) 전분야 확대통합
지역경제시스템
농수산시스템

# 4. 기대효과

❍ 컴퓨터를 통한 대량정보의 유기적인 분석과 신속한 업무처리로 **인력, 비용, 시간 등의 절감**

❍ 신속하고 정확한 업무처리로 **행정서비스의 질 향상**

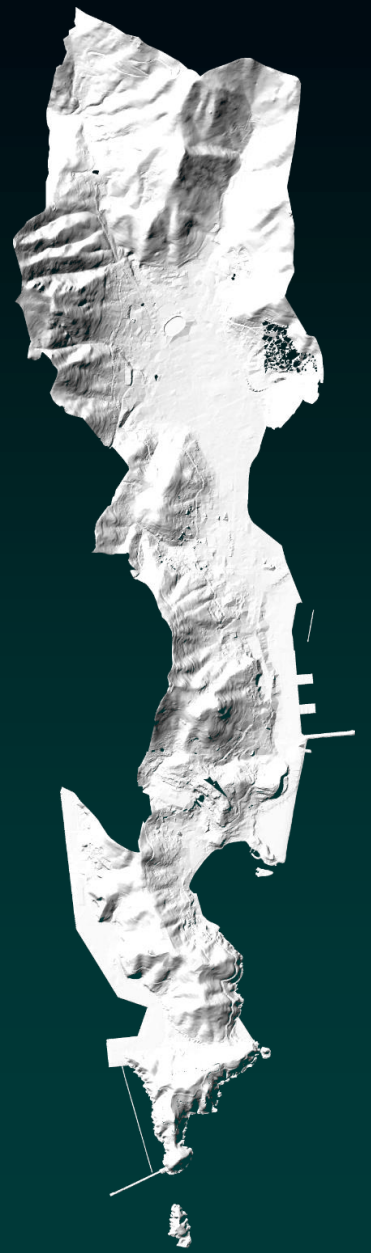
❍ 도시시설물에 대한 통합관리와 재난관련 정보의 즉시 제공으로 재해의 예방과 재난발생시 **신속한 대응 가능**

❍ 과학적인 분석과 합리적인 의사결정을 가능케 하므로 대시민 설득력과 수용성 증대 등 **행정의 신뢰성 확보**

# 5. 시범사업 개요

## ◆ 대상지역 및 기간

- 대상지역 : 부산광역시 서구(13.34㎢)
- 사업기간 : 1998. 6. 15 ~ 1999. 7. 2



## ◆ 사업내용

- 도로, 상하수도, 도시계획, 지적 등 5개분야 **응용시스템 개발 및 DB 구축**
- 시스템 구축·운영을 위한 **장비(H/W,S/W 등) 도입 및 네트워크 구성**

## ◆ 사업자

- (주)LG-EDS시스템, 중앙항업(주), 아키정보기술(주)

# 6. 시범사업 성공요인

◆ 시범사업은 기존 UIS와 차별, 당면 과제, 장기 프로젝트임을 고려하여 **사업관리 및 품질관리**를 시범사업의 주요 성공요소로 도출

**시범사업의 특징**

❍ 현업부서에서 파견된 각 분야의 **감독관들의 적극적인 참여**

❍ 철저한 감리수행, 전문가로 구성된 자문위원단 **실질적인 활용**, 제도개선 및 발전방향에 대한 **연구가 병행**되었고, 현업 요구사항의 적극적인 수용, 오류처리 즉시 조치, **개선사항을 반영한 통합시스템 구현**

❍ 무엇 보다도 주관기관의 추진력과 참여기관의 책임감을 통하여 **상호간의 신뢰**가 형성되었고, 이는 부산시 도시정보시스템의 주요 성공 요인으로 작용

# 7. 시범 시스템 특징

## ◆ 부산광역시 특성을 반영한 통합운영모델로 개발

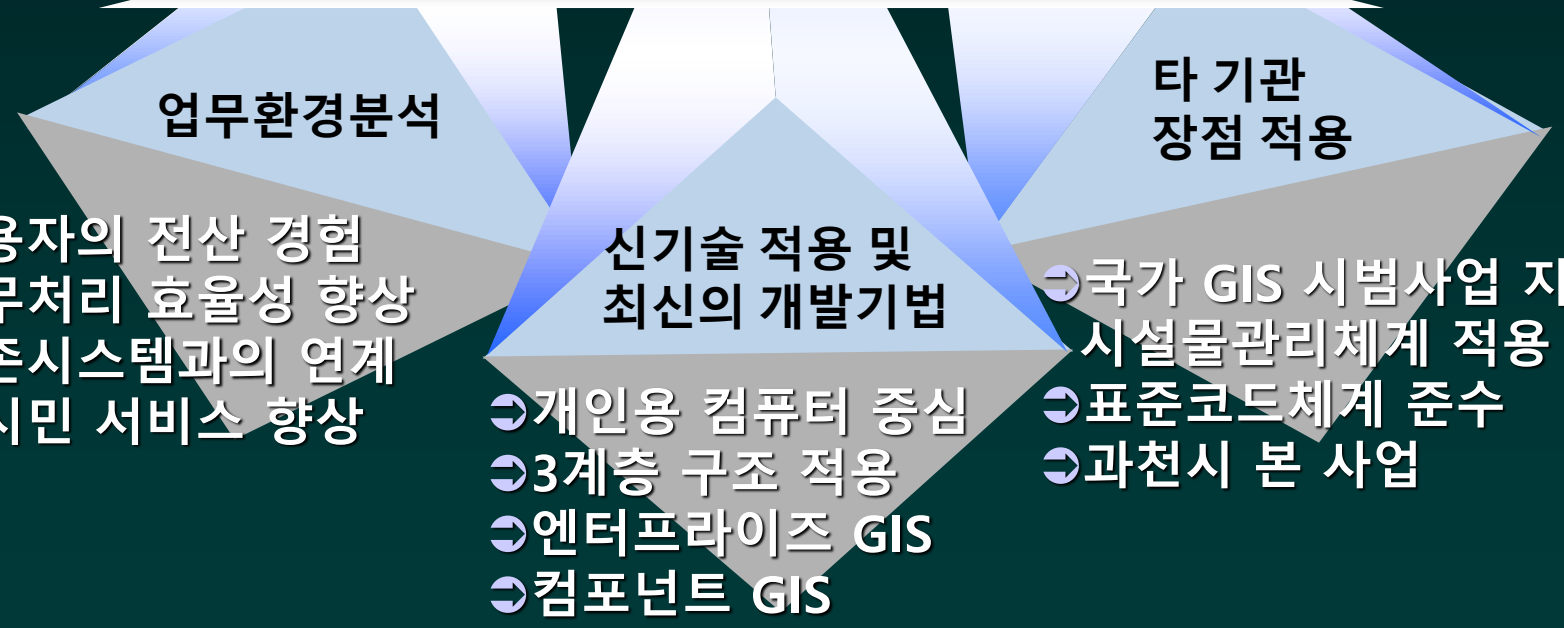
사용하기 쉬운 시스템

업무 중심으로 개발

사무자동화 (OA)와 연계

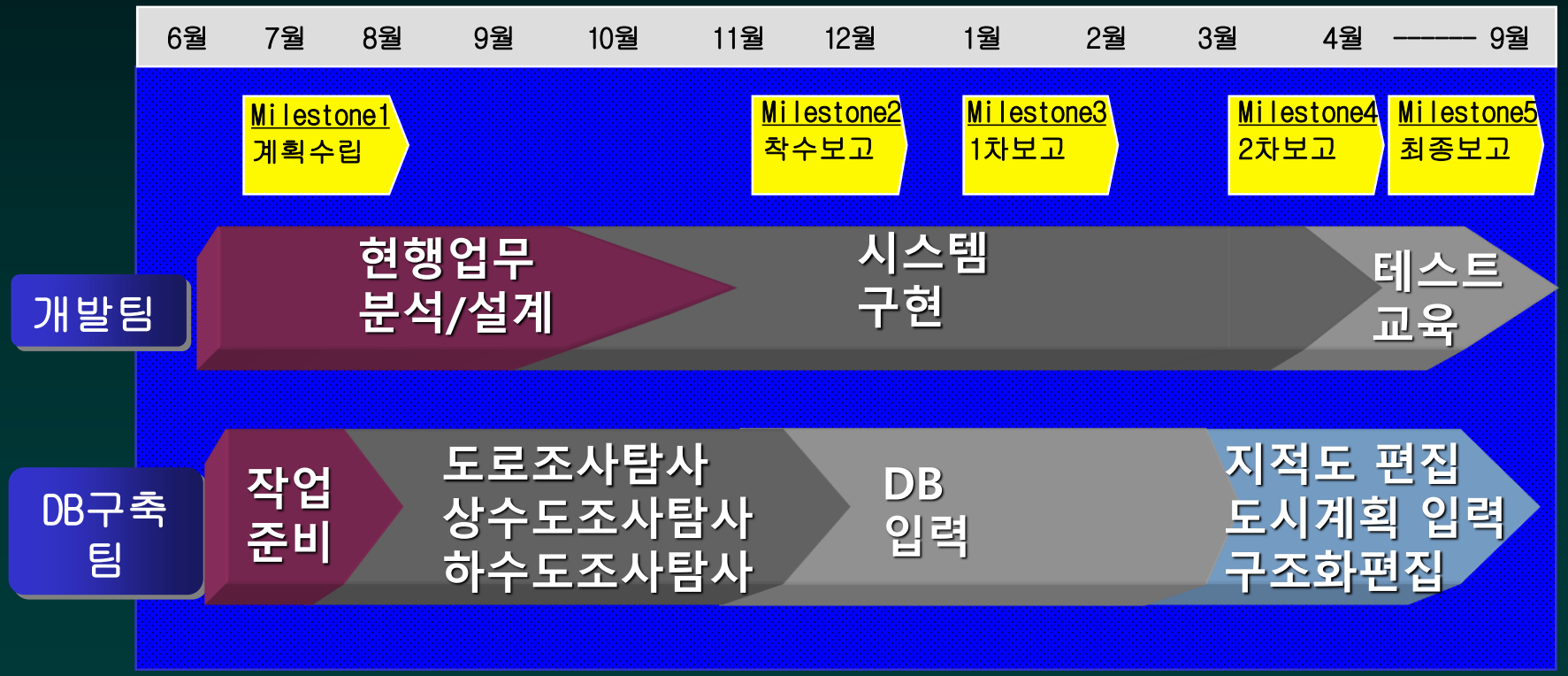
유지보수가 용이하도록 설계

기존 정보시스템과 GIS의 통합시스템

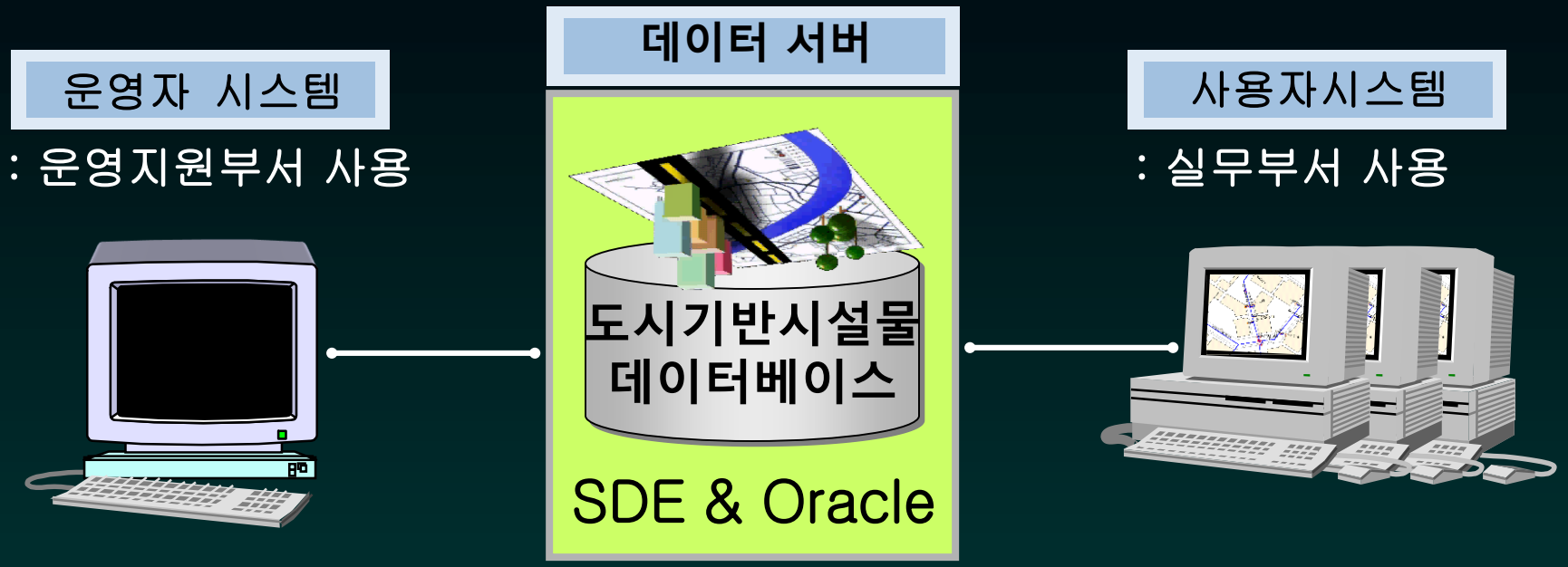


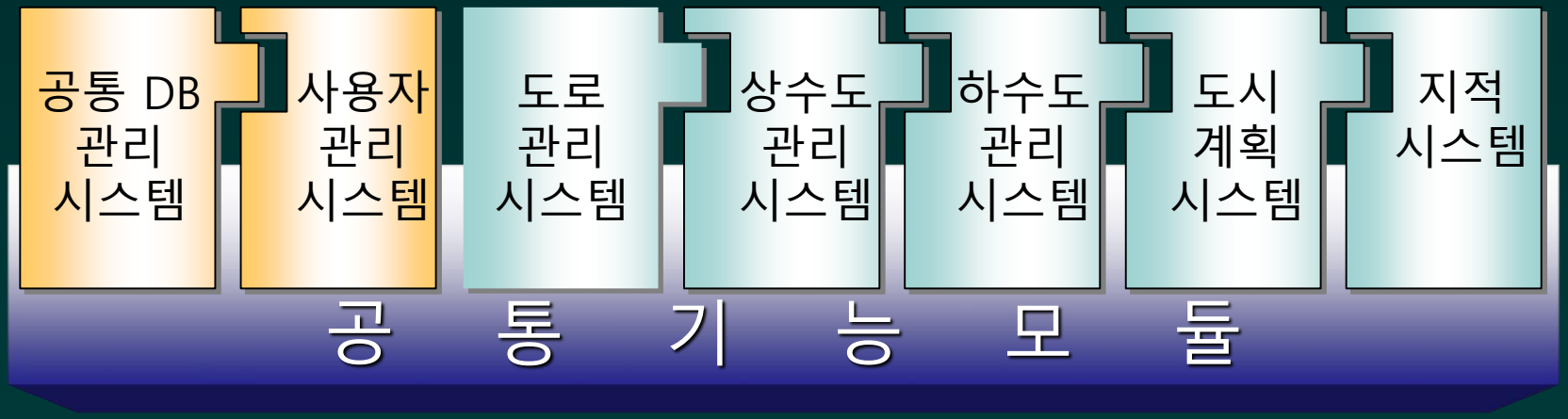
# 8. 시범사업 추진 현황

◆ 시범사업 전체 일정은 5개의 Milestone으로, 4단계에 걸친 감리 및 자문을 받아 고품질의 시스템으로 개발되었고, DB는 감독관의 3회 이상에 걸친 전수검사와 감리의 10% 샘플 검수를 받았으며, 최종으로 측량협회의 성과심사를 수행



# 9. 시범시스템 구성도


운영자 시스템
: 운영지원부서 사용
데이터 서버
도시기반시설물
데이터베이스
SDE & Oracle
사용자시스템
: 실무부서 사용


공통 DB 관리 시스템
사용자 관리 시스템
도로 관리 시스템
상수도 관리 시스템
하수도 관리 시스템
도시 계획 시스템
지적 시스템
공 통 기 능 모 듈

# 10. 데이터베이스 구축

## ◆ 데이터베이스 구축목표

### 정확성

- 탐사단계로 부터 각 분야별 **데이터 전수검수** 실시
- 사업자, 감독관, 감리팀,성과심사 등을 통한 **입체적인 데이터 검수** 실시

### 범용성

- 안정성이 검증된 Arc/Info, SDE 및 Oracle DBMS를 사용
- 향후 다양한 종류의 데이터에 **유연하게 대처**

### 호환성

- NGIS 표준 레이어코드 및 심볼코드 사용
- 향후 데이터와의 연계를 고려한 **범용성 있는 데이터베이스 설계**

## ◆ 데이터베이스 구축량

| 구 분 | 내 용 |
|---|---|
| 기본도 신규제작 | • 1/1,000 39매 (제작면적 : 5.4㎢) |
| 도 로 | • 도로연장 103㎞에 대한 시설물도 작성<br>• 도형자료 25개 레이어, 속성 36종 25,000여건<br>• 이미지 7,200여건 |
| 지적/도시계획 | • 지적도 203매, 43,630필지<br>• 지적승인도 및 도시계획결정도 입력(이력포함)<br>• 도시계획시설 8,500여건, 지적승인고시 3,200여건 |
| 상수도 | • 탐사연장:159㎞, 입력연장:468㎞<br>• 도형자료 19종, 속성자료 45종 190,000여 건<br>• 이미지 250여건 |
| 하수도 | • 조사/탐사연장 : 265㎞<br>• 도형자료 18종, 속성자료 24종 110,000여 건 |

☞ 전체적으로 캐비넷 5개 분량의 정보가 입력됨

# ◆ 데이터베이스 구축과정

**기본도제작**



항공필름 입수



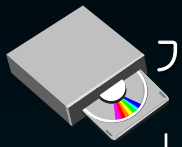
측량



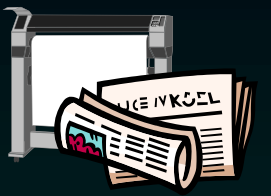
수치도화



정위치 및
도면제작편집



기존데이터
(NGIS)

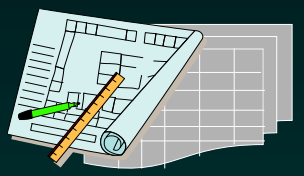


조사도면 출력

**시설물DB구축**



시설물
조사/탐사



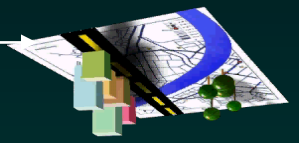
시설물원도 및
대장/조서 작성



정위치 입력
대장자료 입력



검수



구조화 편집

**지적및도시계획**

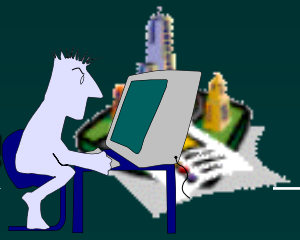
단위지적도 입력
(대한지적공사)



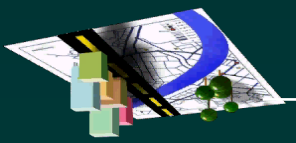
검수

연속지적 편집
중복/누락지번 수정

지적과의
위상관계 설정



도시계획시설
입력



구조화
편집

데이터변환

최종DB

## ◆ 데이터베이스 구축성과

### 정확성

- ❍ 일반적으로 **표본검수를 배제하고 초기단계부터 매 단계별 감독관 밀착검수로 3~5회에 걸친 전수검수 실시**
- ❍ 사업자-감독관 **상호 교환검수 실시**

### 활용성

- ❍ 정확한 관로 유수방향 입력으로 **단수지역 실제예측**
- ❍ 기존 MIS데이터(부동산관리, 세입민원, 구역유량계,수도전 정보 등)와의 연계에 의한 **실질적인 정보관리시스템 구현**

### 편의성

- ❍ 용도에 따라 선택적으로 사용할 수 있도록 **단위 및 연속도면의 데이터 이원화**
- ❍ 단위 및 연속도면과의 **데이터 갱신 자동화 구현**

# 12. 응용시스템 개발

## ◆ 업무분석 및 정의

### 업무분석

❍ 5개 업무관련 데이터베이스로 구축되는 시설물에 대한 **현행 업무처리 절차의 조사 및 문제점 도출, 개선방안 제시**

❍ 수작업 혹은 전산화된 현행 시스템에 대한 분석작업을 수행하여 **신규시스템의 기능 구현**

### 요구분석

❍ 사용자들의 요구사항 분석을 실시하여 구축될 **시스템의 주요기능 및 기능에 대한 우선순위를 결정**

## ◆ 설계

### 시스템 및 DB설계

❍ 데이터베이스 설계

– 업무정의 및 분석단계를 통해 도시정보시스템에 적절한 **레이어, 테이블, 코드, 심볼 설계 및 데이터 간의 관계도** 등 구체적인 데이터베이스를 설계

❍ 응용시스템 설계

– 업무분석 및 데이터베이스 설계 결과를 바탕으로 고객의 요구사항 반영여부에 대한 기술적 검토를 거쳐, Client/Server방식의 시스템 환경에 **전체 5개 업무에 공통된 기반 및 공통된 인터페이스, 유연한 확장성이 제공되도록 설계**

## ◆ 개발내용 및 기능



# 공통사항

| 개 발 내 용 | 세부기능 |
|---|---|
| ❑ 도형정보 기능설계 | ➲도형정보의 확대, 축소, 화면이동 기능 |
| ❑ 속성정보 기능설계 | ➲속성별 도형정보의 검색 기능 |
| ❑ 데이터베이스 설계 | ➲화면, 위치도 등의 프린터, 플로터 출력기능 |
| ❑ 입출력 양식 설계 | ➲도형정보와 속성정보의 기능 연계 및 일관성 유지 |
| ❑ 코드 설계 | ➲속성정보의 집계 및 통계처리 |
| | ➲규정된 대장에 대한 시설물 속성정보의 출력 |
| | ➲확장 및 갱신이 용이한 논리적, 물리적 레이어 분류 |
| | ➲업무별 상관관계를 고려한 속성정보 설계 |

# 도로관리시스템

| 개 발 내 용 | 세부기능 |
| --- | --- |
| ❑ 도로현황관리 | ➲도로노선정보 관리 |
| ❑ 도로시설물관리 | ➲도로구간정보 관리, 도로대장 관리 및 출력 |
| ❑ 도로공사관리 | ➲교차로 및 광장정보 관리 |
| ❑ 도로포장관리 | ➲도로종류별,노선별,차선별 통계, 도로시설물 통계 |
| ❑ 굴착/점용관리 | ➲안전점검시설물/보수시설물/일반시설물/기전시설물/조경시설물 정보 및 이력 관리 |
| ❑ 보상관리 | ➲시설물별 현황 통계관리, 도로 종.횡단도 작성 |
| | ➲시설물 도면 및 사진자료 관리 |
| | ➲시설물별 대장 관리 |



# 상수도관리시스템

| 개 발 내 용 | 세부기능 |
|---|---|
| ❑ 관로유지관리 | ➲상수관로 정보 및 보수이력 관리 |
| ❑ 관로시설물관리 | ➲누수관리 및 차단제수변 위치조회 |
| ❑ 상수사업장관리 | ➲노후관 현황관리 및 분포도 조회 |
| ❑ 수용가시설관리 | ➲폐관 및 관철거 현황관리 |
| ❑ 민원관리 | ➲종합계획 수립 지원 |
| ❑ 공사관리 | ➲변류정보 및 보수이력 관리 |
| | ➲소화전 정보 및 보수이력 관리 |
| | ➲상수맨홀 정보 및 보수이력 관리 |
| | ➲구역유량계 정보 및 보수이력 관리 |
| | ➲시설물 대장 및 현황사진 관리 |



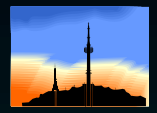
# 하수도관리시스템

| 개 발 내 용 | 세부기능 |
|---|---|
| ❑ 하수관거관리 | ➲ 하수관거/측구/심도/관말 유지관리 |
| ❑ 하수부속시설관리 | ➲ 불량하수관거 관리 |
| ❑ 공사관리 | ➲ 하수폐관 정보 관리 |
| ❑ 하수기타관리 | ➲ 하수맨홀유지관리 |
| | ➲ 하수물받이 유지관리 |
| | ➲ 집수정 유지관리 |
| | ➲ 토구 유지관리 |
| | ➲ 침사지 유지관리 |
| | ➲ 펌프장 유지관리 |



# 도시계획시스템

| 개 발 내 용 | 세부기능 |
| --- | --- |
| ❑ 도시계획 시설관리 | ➲ **도시계획시설 결정관리** |
| ❑ 도시계획 구역관리 | ➲ **도시계획시설 결정조서 및 사유서 관리** |
| ❑ 도시계획 도면작성 | ➲ 지적승인도 및 결정도 작성 |
| | ➲ 도시계획시설 편입필지 정보조회 |
| | ➲ 연차별 집행계획 관리 |
| | ➲ 심의위원회 및 의견청취 관계서류 입력/조회 |
| | ➲ 용도지역/지구/구역 결정관리 |
| | ➲ 도시계획 관련 이미지 입력/조회 |
| | ➲ 도시계획 결정조서 및 사유서 입력/조회 |



# 지적시스템

| 개 발 내 용 | 세 부 기 능 |
|---|---|
| ❑ 지적관리 | ➲신규등록/등록전환/분할/합병 등 지적공부 유지관리 |
| ❑ 지가관리 | ➲부동산관리시스템(국가행정망) 연계 |
| ❑ 창구민원관리 | ➲지적정보조회 |
| | ➲소유자/공유지/토지이동연혁/소유권변동연혁 조회 |
| | ➲지적정보통계관리 |
| | ➲개별지가자동산정프로그램 (ALPA) 연계 |
| | ➲지가현황도 및 변동률도 조회 |
| | ➲표준지 분포현황/미산정필지현황도 조회 |
| | ➲지적도등본, 토지이용계획확인원 발급 |

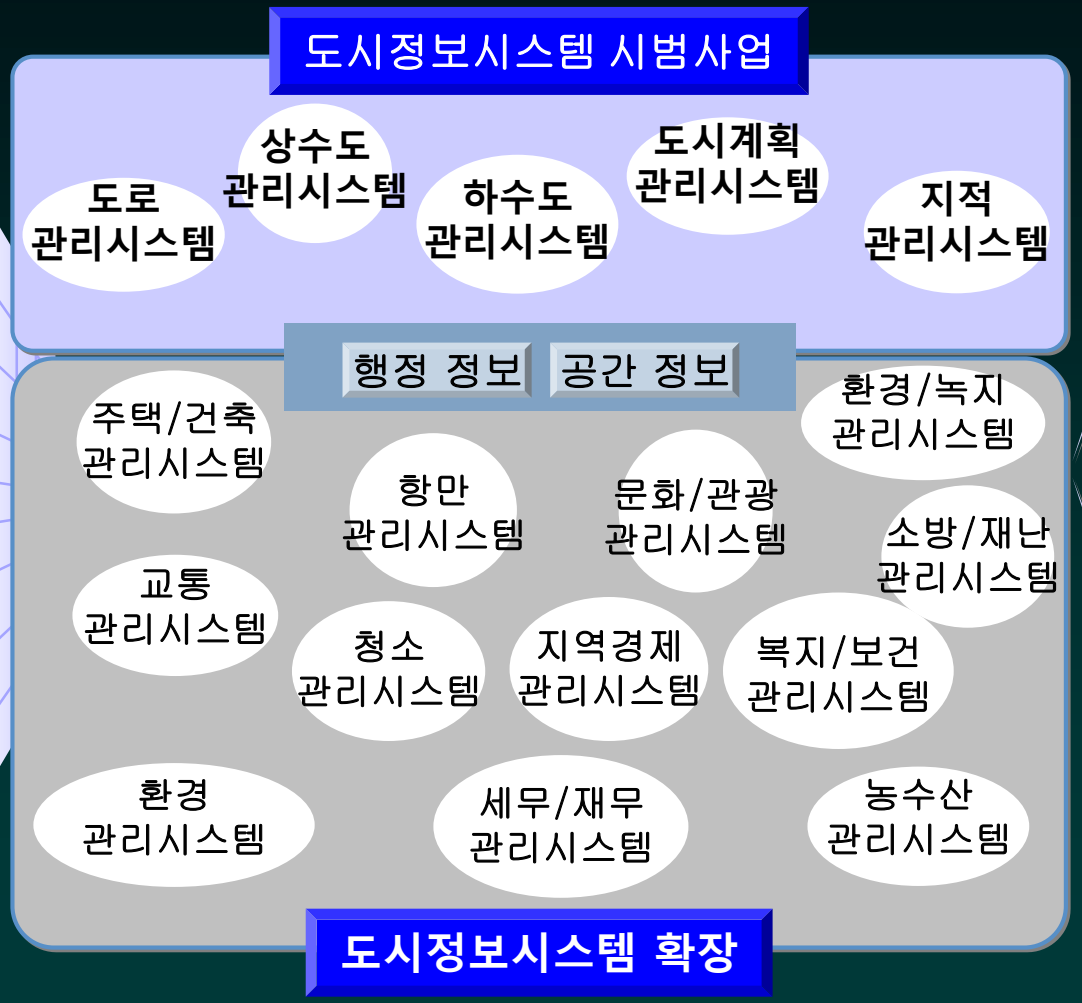
## ◆ 시범사업의 기대효과

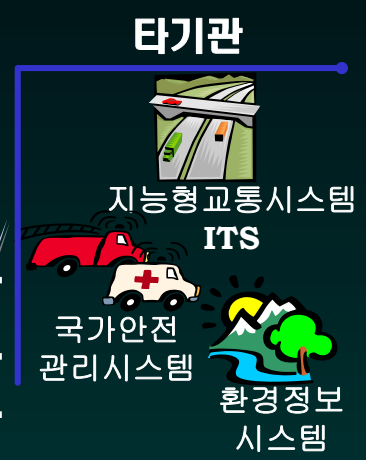
- ❍ **업무처리시간단축(50% 이상)** 및 **유지보수공사비용 절감(20~30%)** 가능
- ❍ 불법점용물에 대한 점용료 부과로 **지방재정확충** 기여
- ❍ 상수도 관망관리에 의한 누, 도수 방지 효과
- ❍ 통계산출작업에 들어가는 시간과 노력 대폭 절감
- ❍ 해당 시설물에 대한 정확한 정보 및 **합리적유지보수계획 수립 가능**
- ❍ **지적열람도(필름) 재구축 비용(년간 약 5,000만원) 절감**
- ❍ 도면 검색 시간 단축**(약 5분~24시간에서 2초)**

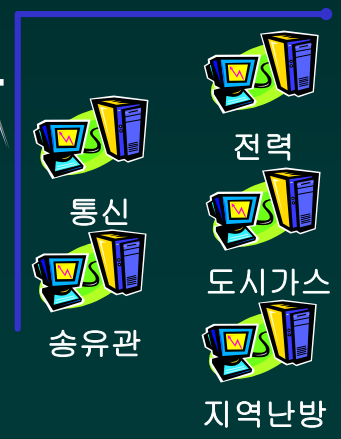
# 14. 미래상

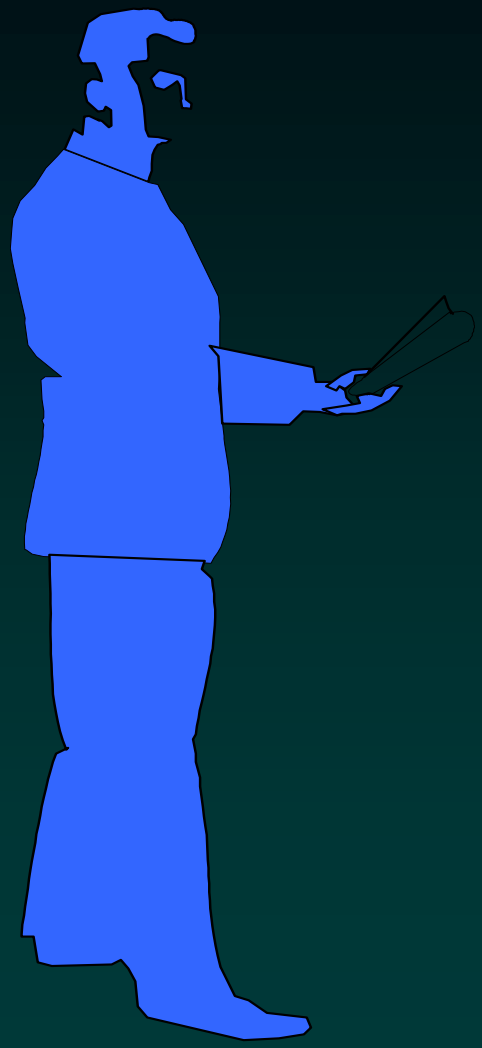
◆ 2007년까지 총 17개분야의 도시정보화를 통해 첨단해양 정보산업도시 부산건설

- 관련기관 간의 초고속통신망 연결
- 정보의 공유
- 공간정보 기반 데이터 베이스
- 공간정보 유통기구





# 감사합니다.

# 서울시 지하시설물 통합정보관리 현황과 향후 정책방안

**1999. 9. 17**

서울시 지리정보담당관
이 종 상

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III. 지하시설물 통합정보관리의 향후 정책방안

IV. 결 론

# I. 지하시설물 통합정보관리의 필요성

■ <u>서울시 지하시설물 관리의 문제점</u>

- 지하시설물이 공동구의 부재로 무질서하게 산재함

- 지하시설물 통합정보의 미비로 사고발생 가능성 상존

- 각 관리기관별로 사용하는 도면의 상이와 사업추진에 대한 입장차이 등으로 통합의 어려움

# I. 지하시설물 통합정보관리의 필요성

## ■ 지하시설물 관련 사고 사례

- ‘94년 말 서울 아현동 도시가스 폭발사고
  : 70여명 사상자, 집50채, 차량 30여대 전소

- ‘95년 4월 대구 도시가스 폭발사고
  : 303명 사상자, 5백40억원 피해

- ‘97년 4월 서울 공덕동 지하철공사장 가스폭발
  : 공덕동 일대 전화 4,000여선 끊겨 하루종일 전화불통,
  교통 2시간 두절

- ‘98년 1월 부산 당감동 상수도관 파열
  : 1만세대 12시간 단수

# I. 지하시설물 통합정보관리의 필요성

## ■ 지하시설물 통합정보관리의 필요성

- 도로굴착관련 사업시 신속.정확한 지하시설물 정보 제공으로 대시민 서비스 향상
- 체계적인 시설물 관리로 재난발생 최소화
- 사고발생시 단시간 내에 정보의 획득으로 신속한 대처 가능
- 도로 이중굴착에 따른 자원낭비 최소화

# II. 지하시설물 통합정보관리의 추진현황

## ■ 단계별 추진계획

| | |
|---|---|
| 1단계계획<br>(1998-2001년) | - 서울시 관리 상,하수도는 조사/탐사 및 측량을 실시하여 지하시설물도 DB 구축 및 응용시스템 개발<br>- 유관기관 관리 가스,통신, 전기,난방등 시설물은 기존 시설물도면을 활용, 이격법등으로 이기하여 1/1,000수치지형도에 약식의 지하시설물도 구축 |
| 2단계계획<br>(2002년 이후) | - 1단계사업의 통합정보를 바탕으로 여타 지하시설물에 대한 조사/탐사 및 측량을 직접 실시하여 정식의 지하시설물도 및 DB구축<br>- 지하시설물 데이터의 지속적인 갱신을 위한 법적/제도적 장치 마련<br>- 네트워크를 통한 데이터 공유 |

# II. 지하시설물 통합정보관리의 추진현황

## ■ 서울시 상수도 관리시스템

- '98년부터 상수도 GIS 구축사업 실시하여 2000년 완료 예정 (현공정 : 45%)
- 도시정보화 공공근로사업의 한 분야로 추진
  (공공근로 인력관리 : 사업소 직영)
- 시설물에 대한 조사/탐사 및 상수관망도, DB 구축과 응용 시스템 개발
- 현안문제 : GIS S/W 선정 미결

# II. 지하시설물 통합정보관리의 추진현황

## ■ 서울시 하수도 관리시스템

- '98년부터 1/1,000 수치지형도에 정위치 편집을 시작으로 2000년까지 DB 구축 및 응용시스템 구축 예정 (현공정 : 16%)

- 도시정보화 공공근로사업의 일환으로 추진(사업자 대행)

- 현재 하수도관리 전산시스템 구축을 위한 기본계획 수립중이며 응용시스템 개발은 2000년에 추진

# II. 지하시설물 통합정보관리의 추진현황

## ■ 서울시 지하시설물도 수치지도화 협의회 구성과 운영

- 서울시 지하시설물도 수치지도화 협의회 구성
  (협약체결 : 1999. 3. 20)
- 실무협의회는 서울시 지리정보담당관이 주축이 되어 상/하수도와 도로관련부서 및 타유관기관의 실무자 15명으로 구성
- 협의회의 주요기능
  - 지하시설물도의 통합관리 및 자료의 공동활용방안 검토
  - 시설물도구축 비용부담 협의, 데이터의 정확도 검증
  - 기술적 사항(이격법등에 의한 도면이기작업) 검토

# II. 지하시설물 통합정보관리의 추진현황

## ■ 유관기관 지하시설물도구축 현황

| 기 관 | | 사용 기본도 | 구축 현황 |
|---|---|---|---|
| 한국전력 | | 1/600 지적도 | •강동지점 DB구축완료<br>•강서지점 DB진행중(1/1,000지형도) |
| 한국통신 | | 1/5,000 지번약도 | •'92~'96 : 기본도 및 시설도DB구축 |
| 가스공사 | | 1/1,000 수치지도 | •서울지역 가스배관 DB 구축중 |
| 지역난방 | 한국지역난방공사 | 1/1,200항측도 | •'94~'98 : 배관136km에 대한DB구축 및 시스템개발 완료<br>•'99년 : 나머지 73km DB구축 완료예정 |
| | 서울에너지 | 1/1,000 수치지도 | • 2000년 구축예정 |

# II. 지하시설물 통합정보관리의 추진현황

## ■ 유관기관 지하시설물도구축 현황

| 기 관 | | 사용 기본도 | 구축 현황 |
|---|---|---|---|
| 도시가스 | 강 남 | 1/1,000 수치지도 | • 2000년 구축예정 |
| | 극 동 | 1/1,200 항측도 | •사업기간 : '96~'97<br>•시설물관리프로그램 및 DB구축을 완료 하여 현재 운영중임 |
| | 대 한 | 1/1,200 항측도 | •사업기간 : '95~'96<br>•사업내용 : DB구축 및 응용시스템 개발<br>•'99.3~'99.12 : 1차 1/1,000수치지형도 구조화편집 작업과 탐사 및 데이터 변환작업 |
| | 서 울 | 1/1,200 항측도 | •DB구축 및 시설물관리시스템 개발완료 현재 분석시스템 개발 |
| | 한 진 | 1/1,200 항측도 | •사업기간 : '93~'96<br>•사업내용 : 기초자료 정비 및 탐사, 관망 및 시설물 전산입력과 응용프로그램 개발, H/W,S/W 구입 |

# II. 지하시설물 통합정보관리의 추진현황

## ■ 타시도 지하시설물통합도 구축사례

| 시도 | 주관부서 | 사업지역 | 조사탐사내용 |
|---|---|---|---|
| 부산광역시 | 정보통신담당관 | 13.34km² (서구) | •상수도 - 468km<br>•하수도 - 265km<br>•타기관 시설물 제외 |
| 대구광역시 | 도로과 | 446.7km² (전역) | •상수도 - 234km<br>•하수도 - 2410km<br>•타기관 시설물 - 2460km |
| 과 천 시 | 총무과<br>지리정보계 | 57.11km² (전역) | •상수도 - 41.50km<br>•하수도 - 22.00km<br>•타기관 시설물 - 126.4km |

*서울은 지리정보담당관실에서 주관하고 있음

# III. 지하시설물 통합정보관리의 향후 정책방안

## ■ 지하시설물 통합정보관리시스템의 개발추진

- 기본방향은 지하시설물을 한 곳에서 관리하는 것이 아닌 각 기관의 정보를 한번에 볼 수 있는 DB를 구축하고 서로 공유하는 체제 구성
- 사업주관은 정보화기획단(CIO) 산하의 지리정보담당관(4급)이 맡고
- '99년 서울시 도로관리확대사업과 병행하여 지하시설물 통합정보관리시스템 구축예정 (예산 : 4억원 확보)

# III. 지하시설물 통합정보관리의 향후 정책방안

## ■ 정확한 지하시설물 통합정보 DB의 단계별 구축

- 단기적으로는 각 지하시설물 유관기관에서 1/1,000 수치지형도에 지하시설물 정보를 이기한 약식의 지하시설물 통합정보 DB 구축
  (지하시설물의 정확한 위치확인 : 종단 줄파기방법 병행)
- 장기적으로는 모든 지하시설물에 대한 탐사 및 측량을 통해 보다 정확하고 완벽한 데이터베이스 구축

# III. 지하시설물 통합정보관리의 향후 정책방안

## ■ 법적/제도적 장치 마련

-기 보유하고 있는 지하시설물 도면의 전산화는 이미지 또는 벡터형식으로 입력시키고 이미지데이터는 압축형태로 저장하는것이 바람직함

- 새로운 지하시설물의 데이터를 지속적으로 갱신하기 위해서는 도로굴착관련 각종 인허가의 준공도면을 수치화일로 제출토록하고 수집된 데이터는 일정한 기간단위로 일괄 정리

# III. 지하시설물 통합정보관리의 향후 정책방안

## ■ 기본도(Base Map) 상의 데이터 이기지침 마련

- 측량작업과정상의 착오 등으로 1/1,000 수치지형도의 도형 정보와 실제 도로나 건물 등의 현황이 서로 일치하지 않는 문제가 가끔 발생함.

- 지하시설물의 경우, 도로선이나 건물 모서리 등을 기준으로 상대적인 위치를 측정함.

- 따라서 수치지형도상의 상대기준점을 통하여 지하시설물 위치정보를 표기할 수 있는 표준적인 이기지침이 필요함.

# III. 지하시설물 통합정보관리의 향후 정책방안

## ■ 정확한 지하시설물 DB를 위한 가상도근점의 검토

- 지하시설물 DB의 갱신 및 유지관리 방법으로 가상도근점 설치 고려.
- 식별가능한 지점에 일정간격으로 표시물을 설치해 이를 기준점으로 사용함.
- 이 기준점을 기준으로 지하시설물의 상대적 위치를 측량함으로써 정확도를 높일 수 있을 것으로 기대함.

# III. 지하시설물 통합정보관리의 향후 정책방안

## ■ 통일된 GIS S/W 선정 모색

- 각 시스템간의 데이터 공유 및 제공 과정에서 데이터가 누락되거나 손실되는 일을 방지해야 함.
- 정보공유를 위한 S/W의 통합문제는 기술발전과 더불어 해결해야 하는 문제임.
- 서울시 정보화위원회에서는 지하시설물 통합정보의 효율적인 관리를 위해 'GIS S/W 서버부분 단일화 원칙'을 천명함.

# IV. 결 론

- 서울시 지하시설물 통합정보의 효율적 구축을 위해서는 과거의 경험에 비추어 볼 때 정책결정자의 지속적인 관심과 추진의지 필요

- 지하시설물 통합정보 구축은 기술적인 문제, 제도적인 문제, 비용부담의 문제 등의 어려움이 있어 각 기관별 원활한 협조가 이루어져야 함

감사합니다.