The implementation of a Water Geodatabase for the the City of Cape Town

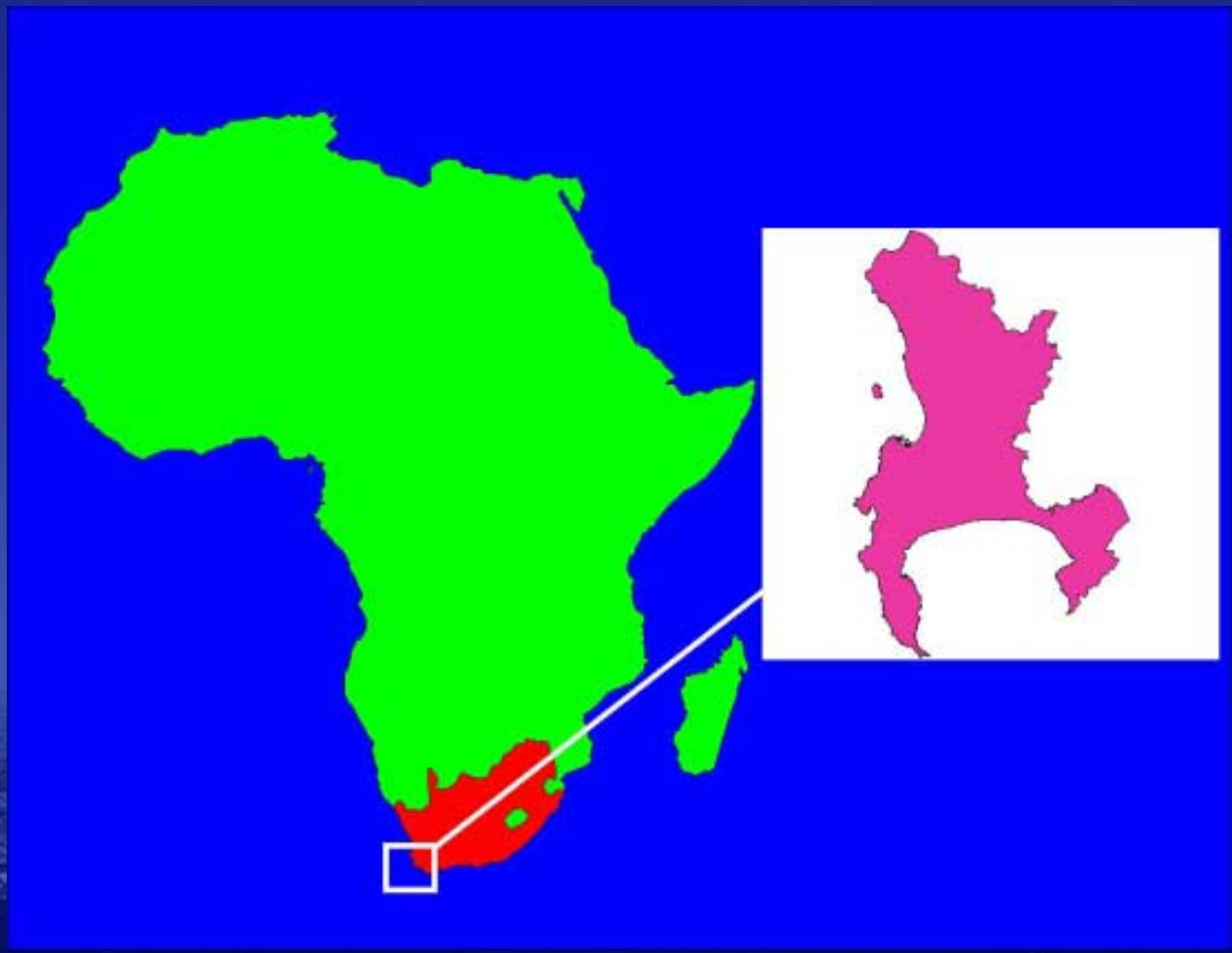
Topics

- Introduction to the City of Cape Town
- History of Water Information Systems in the City
- Driving forces for a Metropolitan wide integrated Spatially enabled Water Information Management System
- Implementation of the City of Cape Town Water Geodatabase Projects
- Summary of experiences & conclusions

View of Cape Town from Tableview

CITY OF CAPE TOWN ESRI 2004 PJ LE ROUX , SOUTH AFRICA

City of Cape Town
Where are we located



Cape Town in a nutshell

Cape Town covers an area of 2 500 km²

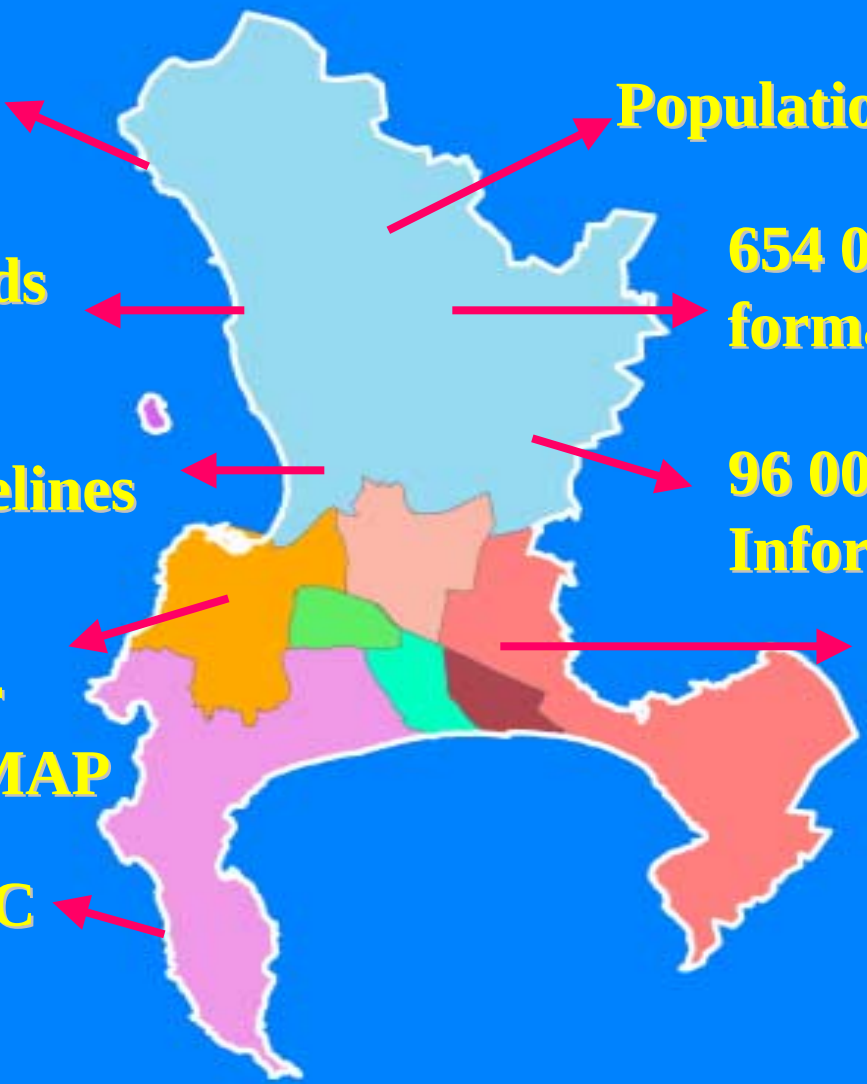
Annual turnover
R 1 Billion
($ 154 million)

10 351 km of roads
(6500 miles)

17 600 km of pipelines
11 000 miles)

Moderate, winter
rainfall 515mm MAP

Avg. temp 16,7 ° C
(62 ° F)



Population of 3 100 000

654 000 consumers on
formal properties

96 000 consumers on
Informal sites

25 000 Employees
serving customers

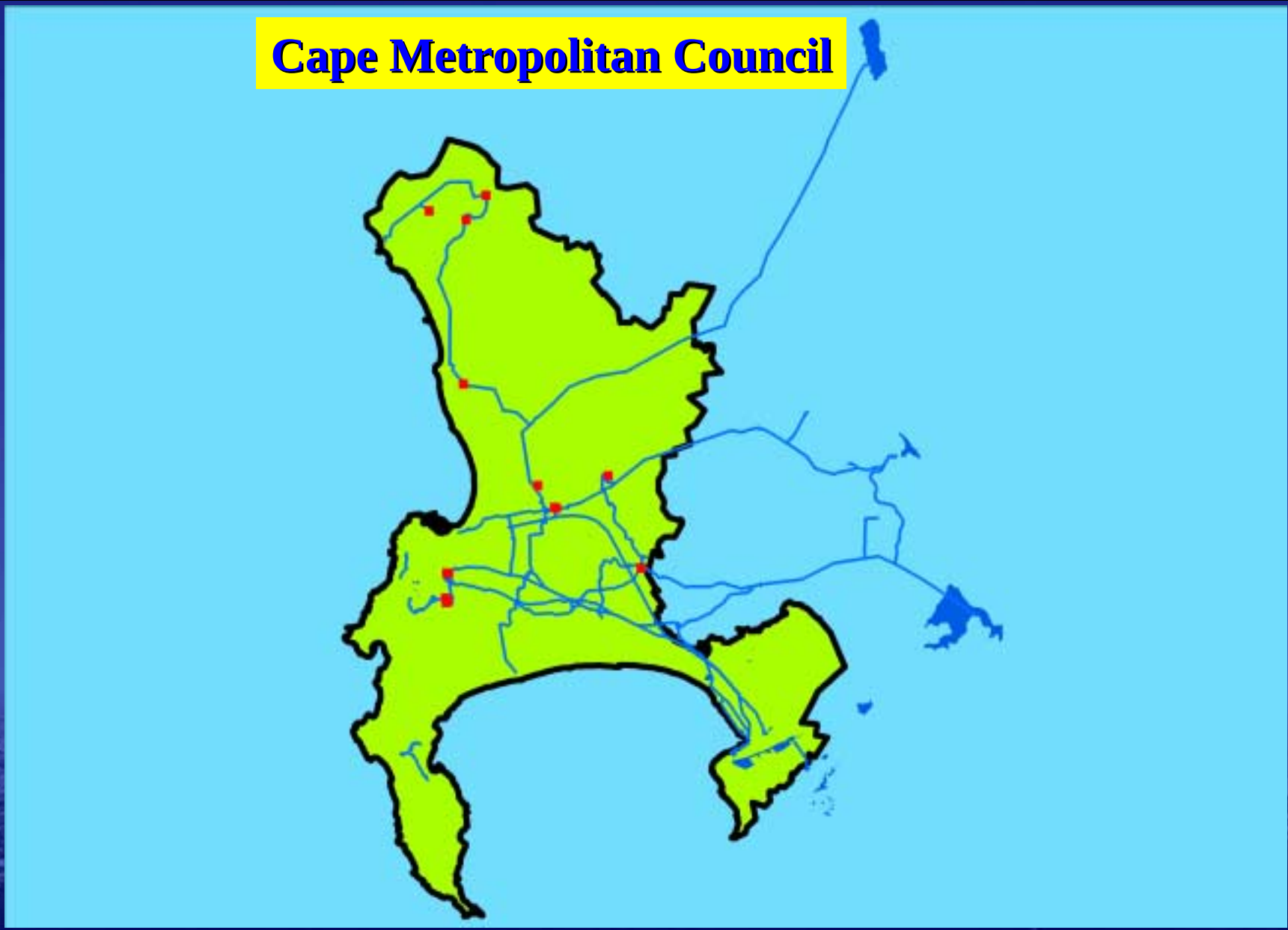
Challenges managing Water in the City of Cape Town

- Cape Town's Population increase 2.6% per annum and currently represents 750 000 households
- 69% of households in the city have piped water in their dwellings
- 15% has piped water on site & 14% of households make use of communal taps
- Not all informal households have been supplied with water due to unsustainable land occupation
- 67% of consumers earn less than R2500/month ($385)

Challenges: Service delivery in High Income area Vs

Within 100 meter an Informal settlement

Bulk water supply in the Cape Metro



Challenges

- The water demand of the city is approximately 850Ml/day
- The City makes use of 5 large storage dams with a total capacity 780million m3 plus a number of smaller dams
- The water supply and waste infrastructure includes 33 Treatment plants, 131 Reservoirs, 690 Pump stations, 17 600km of pipelines and a replacement value of over R12 billion, excluding the 5 major storage dams
- The strategy of the city is to concurrently follow all possible water demand measures to reduce usage and eliminate wastage, while exploring all possible alternative sources of additional supply
- An ISO 9001 Quality Management System has been implemented to improve communication, revenue income & management

Challenges

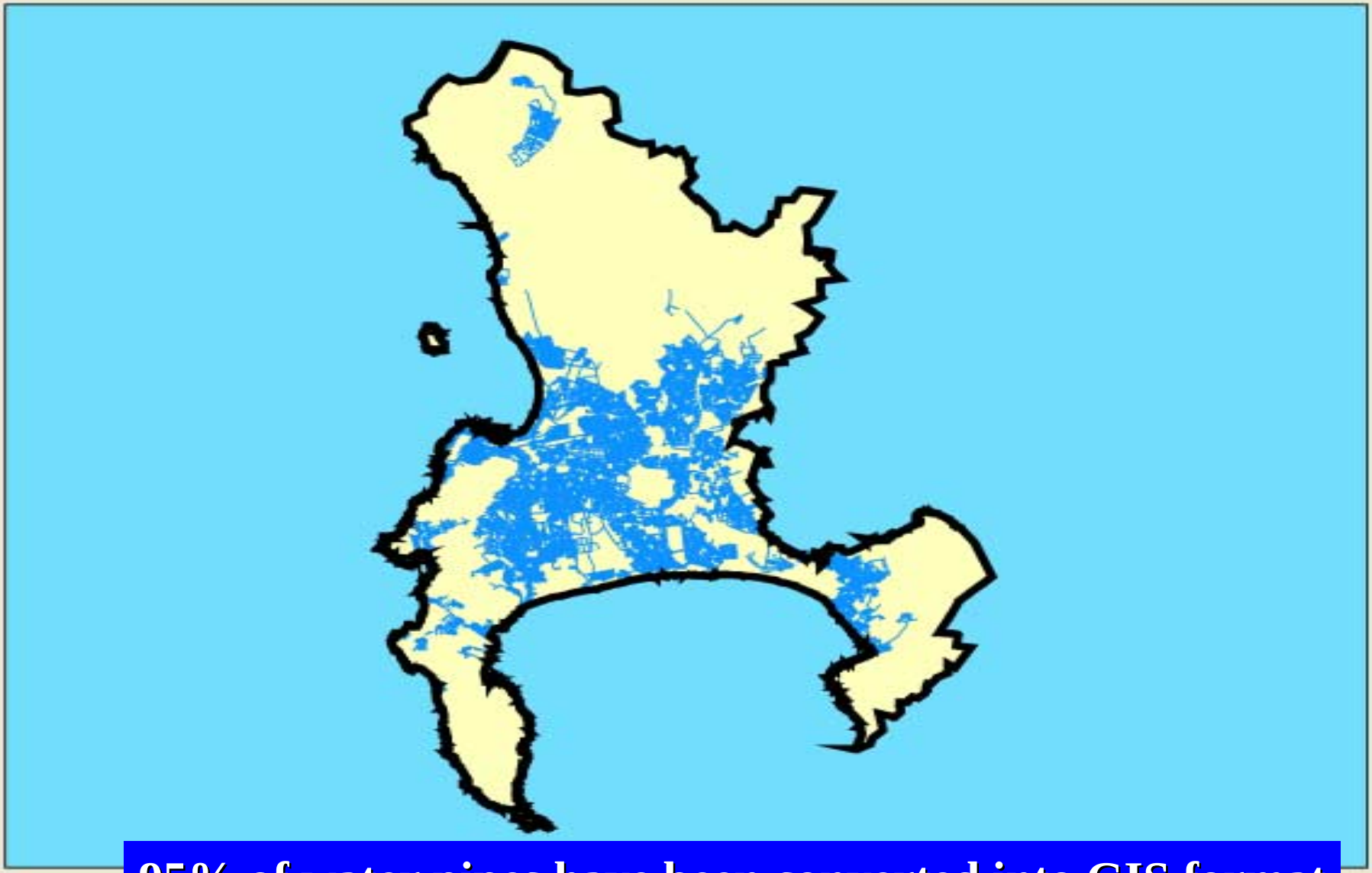
- The most important measure planned to increase future supply capacity is the implementation of the Berg River dam, near Franschoek (approximately 50km from Cape Town) in 2006/07

- Master planning has shown that new infrastructure totaling some R2,8 billion will be required within the next 10-12 years, based on a predicted demand of twice the current figure.

Water GIS in Cape Town before 2000

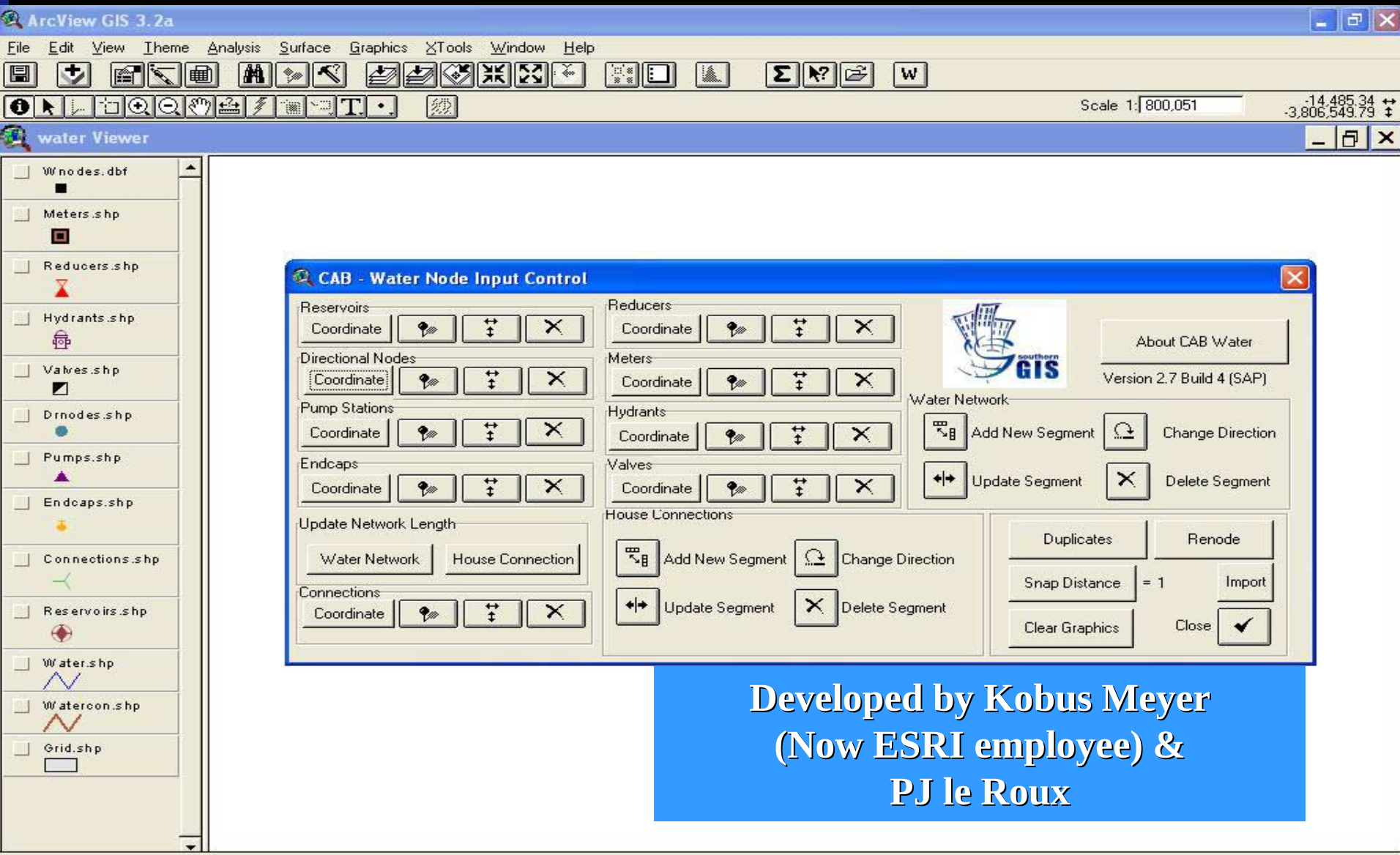
- No uniform GIS standards for the capturing Civil Engineering networks
- No standardised GIS software
- Turnaround time to capture and maintain GIS data from CAD-based to an automated GIS workflow very long
- No automated tools in the existing GUI of Arcview 3.2 GIS to create network topology
- There was scope to design a standardised database and built an automated application based on the design
- Due to various competency levels it was also important to define automated procedures for attributes input purposes

Water Reticulation distribution



95% of water pipes have been converted into GIS format

The development of a civil capturing tool



Developed by Kobus Meyer (Now ESRI employee) & PJ le Roux

Civil As-built application continues

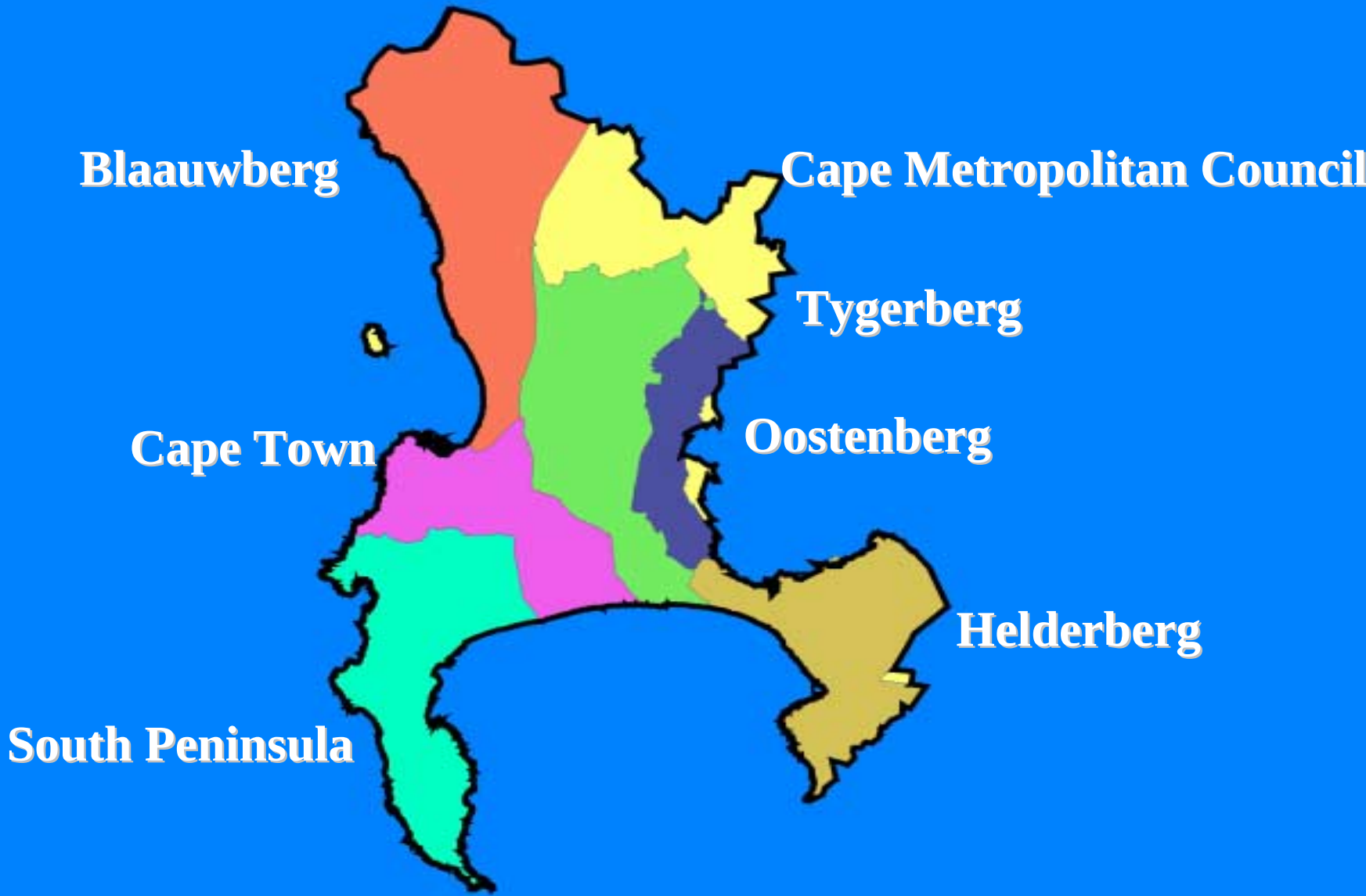
- Once converted as dialogues it would enable the user to limit spelling mistakes to the minimum – only numeric info like reservoir levels had to be typed in

- There was also a need to build various quality control tools such as finding spatial duplicates, move or delete features as well as switching pipe directions

- An import function was also o import features from a database file and create a spatial network on the fly

❖ Although the application provided brand new functionality in a stand alone environment, the amalgamation process where various local councils were integrated in one system would require new challenges to capture and maintain their infrastructure in a multi-user and wide area network environment.

Changes in Cape Town after December 2000



Changes in Cape Town continue

- The City of Cape Town has undergone significant changes in political structure over the last decade
- Prior to December 2000 the area consisted of 6 Metropolitan Local Councils and the Cape Metropolitan Council as the Bulk Water Provider
- In December 2000, these councils were amalgamated as the City of Cape Town through a massive restructuring process
- Part of the challenge of the restructuring process was to integrate the 7 local authorities information systems, including GIS
- Core the success of this integration was to integrate the various billing and financial systems
- To address this an ambitious SAP implementation was undertaken

Changes in Cape Town continue

- Part of this plan was to ensure that the whole business processes were standardised, and optimised and that all the information systems were integrated including GIS

- This process put pressure on the various GIS's to become robust and reliable & fully integrated in the City's Information Technology Architecture

- To achieve these objectives the City decided to implement ESRI Geodatabase technology to address a multi-user capturing environment and an effective management platform to their many users in the City.

Geodatabase Project

- Initially the City concentrated on the Electricity & Property Geodatabase, but this has now been expanded into Water as well.

- Water Services, designed as a new entity, used this integration process to examine their business requirements and implement a totally integrated spatial and non-spatial information system.

Business Objectives

- Maintain a consistent supply of potable water to clients
- Provide high quality service
- Continuously improve efficiency and cost effectiveness (e.g. improve data management)
- Preserve intellectual capital (e.g. institutional knowledge)

Project Objectives

Pilot Project for the Migration of Corporate Water GIS, Data Capture Tools and Data to the Geodatabase Environment

Project Goals

- User requirements analysis
- Conceptual design of water geodatabase system
- Physical design of water geodatabase
- Conversion and loading of a subset of the existing available water data
- Documenting procedures and rules for the capture and maintenance of water data
- Implementation, testing pilot project
- Pilot project analysis and documentation

Project Deliverables

- Water User Requirements Document
- Conceptual Design Document
  - System Strategy
  - Data (content, structure, behaviour, rules)
  - Business workflows
  - Applications
    - Data Maintenance Tools
    - Modelling Tools
    - Query, Display and Reporting Tools
- Pilot Project
- Pilot Project Outcome Analysis
- Recommendation & Implementation Plan

Project Risks

- In The City of Cape Town band width of the IT networks is still a major problem
- Buy in or support from all levels to be successfully implemented
- New technology such as Mobile or Geodatabase technology will require additional training to be successfully integrated with operational and other business processes

Project Phases

- Project Planning and Management
- User Requirements analysis
  - User Groups
    - Executive Management
    - Engineering/Scientific
    - Operational
    - Water modelling specialists
  - Requirements
    - Business Requirements
    - Application Requirements
    - Data Requirements
    - Operational Requirements

Project Phases

- Conceptual Design
  - Computer System Strategy
    - Integration with Cities IT and GIS Strategy
  - Computing Systems
    - Hardware
    - Software
    - Communications (LAN/WAN)
  - Applications
  - Database
    - Content
    - Structure

Project Phases

- **Business Workflows**
  - SAP and GIS
  - Data Maintenance
  - Query and Reporting
  - Modelling
- **Pilot Project**
- Develop physical geodatabase
- Populate geodatabase with pilot project area data
- Test query, display and reporting options
- Test data maintenance options
- Test operational options

Project Phases

- **Pilot Project Evaluation and Analysis**
- **Recommendation and Implementation Plan**

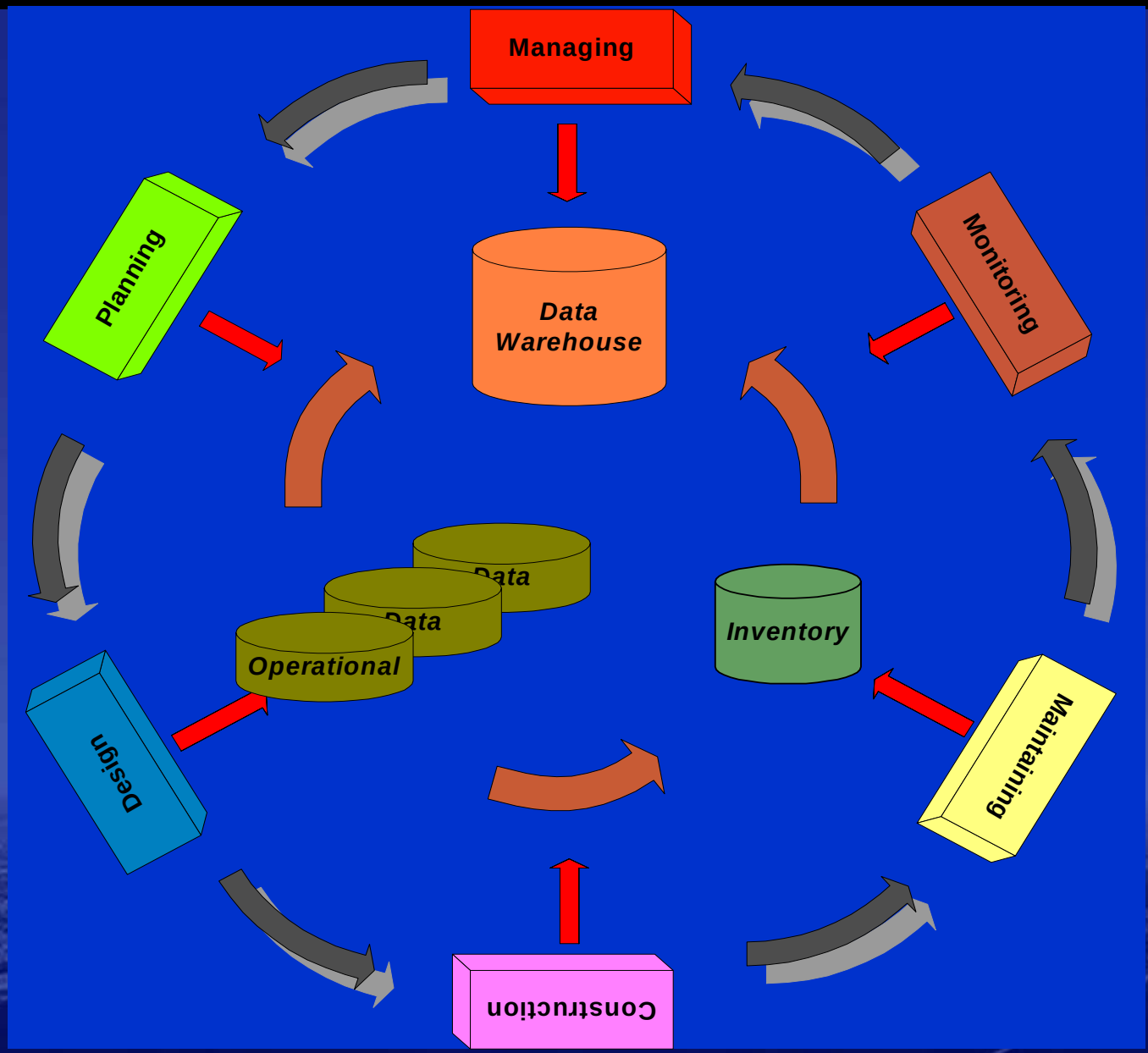
Business Requirements

- Integrated with existing systems
- Adhere to common standards
  - Data
  - Metadata
  - Tools
  - Management systems
- Optimise use of resources
- Capture and validation at source

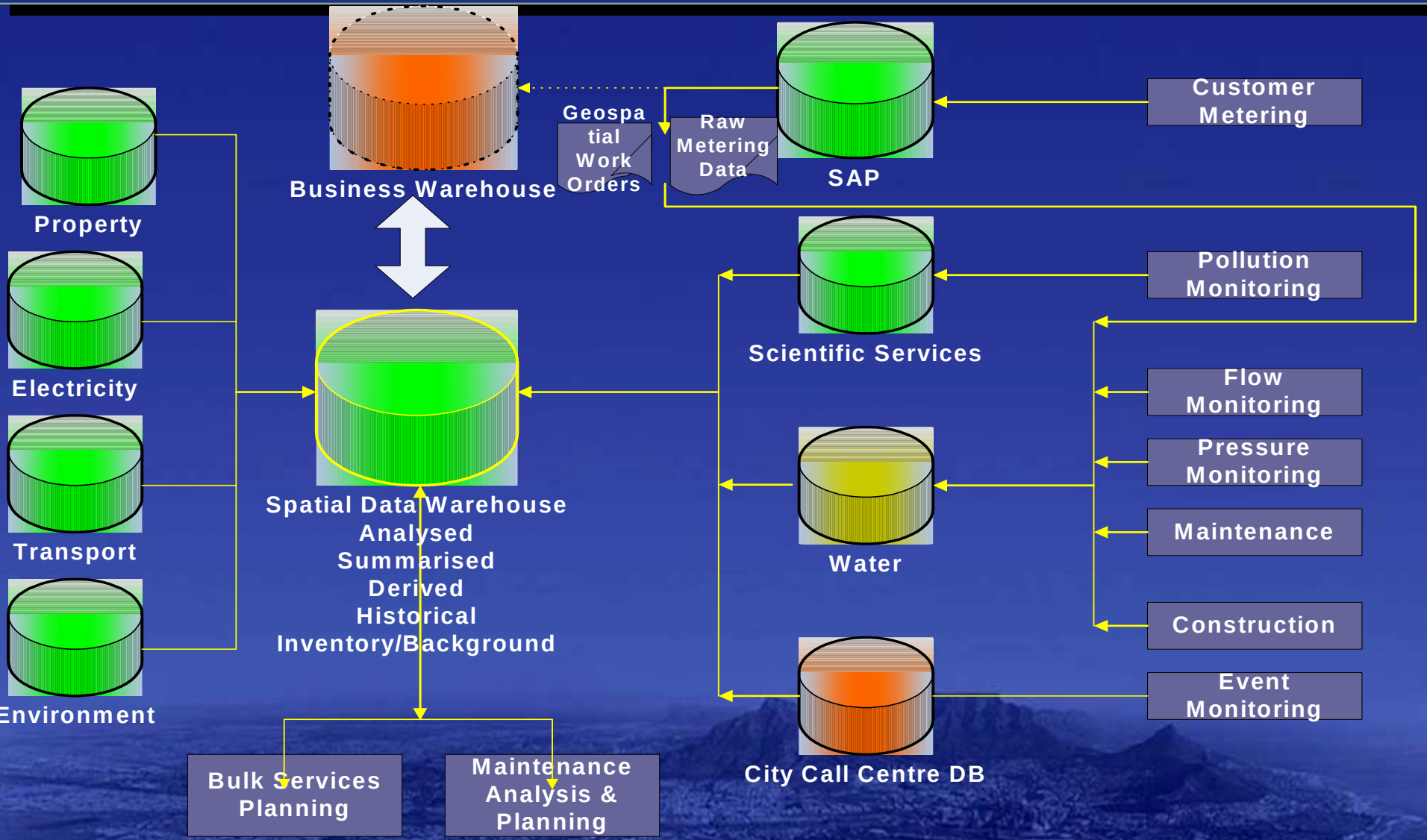
Key Business Processes

- Policy and Strategy
- Planning and Design
- Construction and Development
- Maintenance
- Monitoring
  - Usage (metering / consumption)
  - Flow
  - Pressure
  - Environment (e.g. Pollution)
  - Events (Call Centre)
- Management & Finances
  - Billing
  - Budgeting
  - Costing
  - Asset management
  - Debt Management (non payment)
  - Performance Monitoring

Business Process Information Integration



Water Information System Conceptual design



Water Information System Conceptual Design
January 2004

Mapping of Geodatabase & Tests

- The biggest challenge was to map the shape file themes to the applicable feature classes, domains and rules of the ESRI Model
- Mostly it was found that the same feature had simply a different naming convention - detailed documentation that existed simplified this process
- The project team decided to adopt the ESRI naming convention and add additional subtypes & domains if required
- The Personal Geodatabase has then been translated into a Multi-User Environment to test the model on the City's WAN running on SDE on a Microsoft Sequel Server machine
- Users were provided with appropriate settings and passwords to enable them to access the database from their desktop PCs loaded with Arcgis 8.3 in a versioning environment as well as to test the Geodatabase on ArcIms Web environment.

Evaluation & Conclusion

- The pilot project was very successful to indicate an integrated approach to capture, store, manage of the City's Water spatial data and to be integrated to the City's ERP program to address informed decision-making

- The project team recommends that the model need to be tested for capturing purposes

- This will enable refinement of rules if applicable and give direction to future application development

- User training focusing on data capture, populating and maintaining the Geodatabase

- Other issues to be addressed include meta-data, standardised symbology and setting user profiles

Evaluation & Conclusion

- The City want to apply the lessons learned from the Water GDB to the implementation of a Sewer and Stormwater Geodatabase for the City

- The development of an in-house capturing and maintenance tool (dockable toolbar of existing ArcEditor functionality) is crucial for the City's as-built conversion process that can be extended to Consulting firms providing data to the City

- This is one of the areas where the City can save thousands of rands and a common data model internally & externally will promote a healthy data sharing environment

- The City is not currently utilising the Enterprise version of SAP and only a batch monthly download is possible to develop a spatial reporting environment – when the City migrate to enterprise version of SAP, more seamless integrations between sap and the geodatabase will be possible

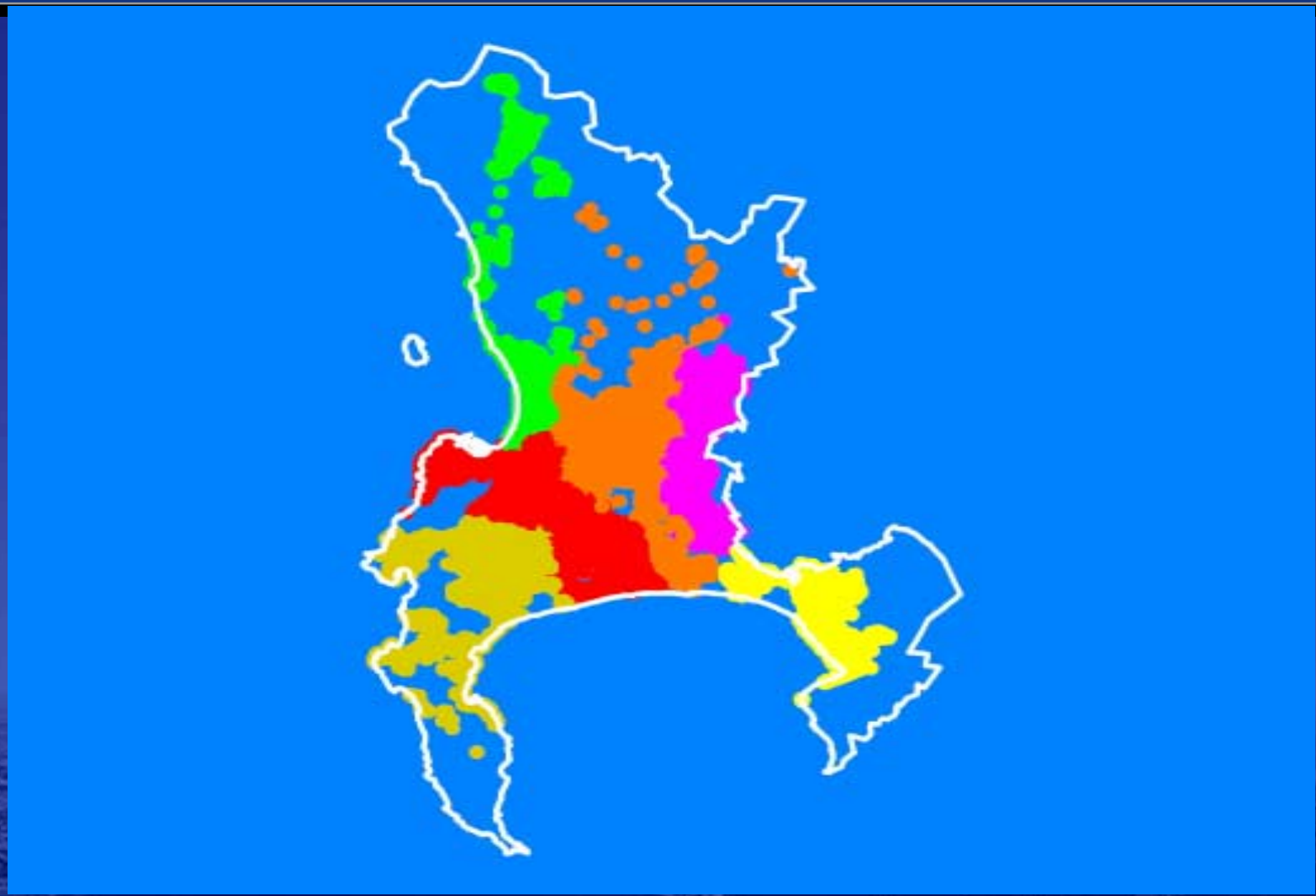
Evaluation & Conclusion

- Water Services is currently implementing a Technical Operations Centre (TOC) that will attempt to integrate the notification and work order process of SAP with mobile GPS/GIS technology, geocoding of alarms and other telemetry technologies

- The current GIS Production environment (Water Geodatabase) as well as the Warehouse server environments (reporting portal) of the City, will form a major part of this process

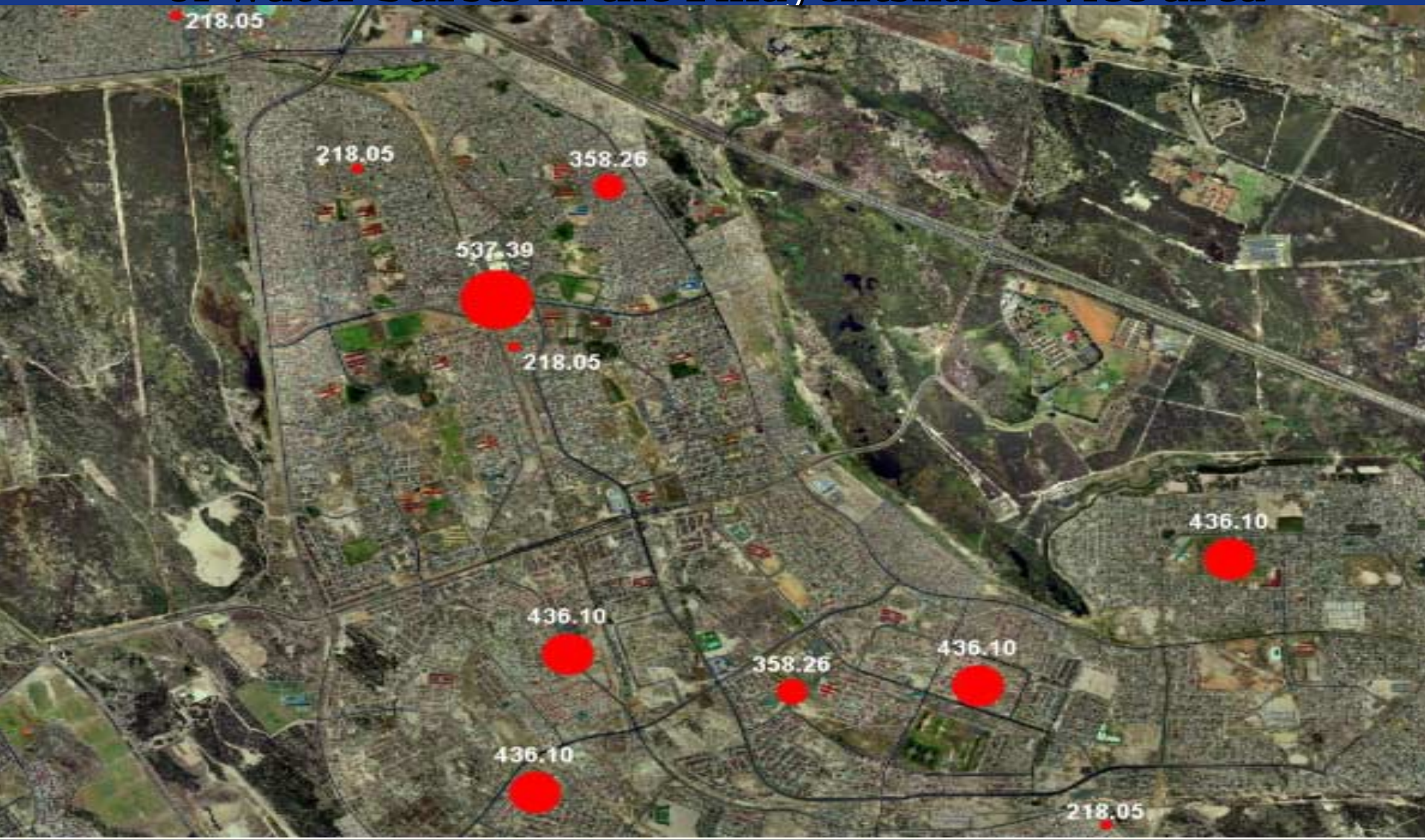
- There are great expectations form all the users
- The Geodatabase Project team is positive that the new technology will improve efficiencies
- Good Management support
- Have integrated well with IT and have good IT support

Informed decision-making through the Geodatabase & the City's ERP program



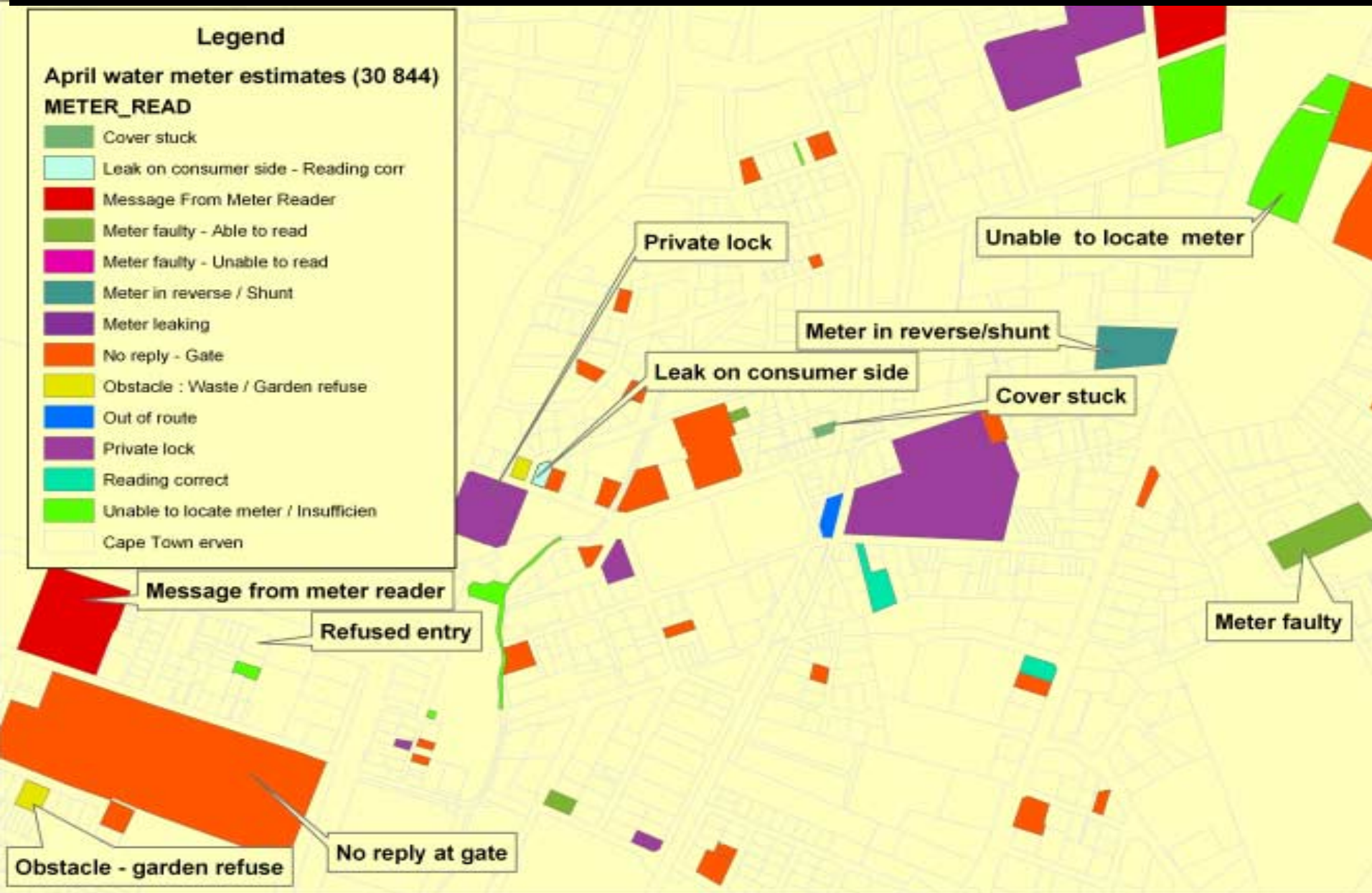
More than 500 000 meters geocoded from SAP for reporting

Linking GIS to SAP to extract monthly maintenance costs of water bursts in the Khayelitsha service area



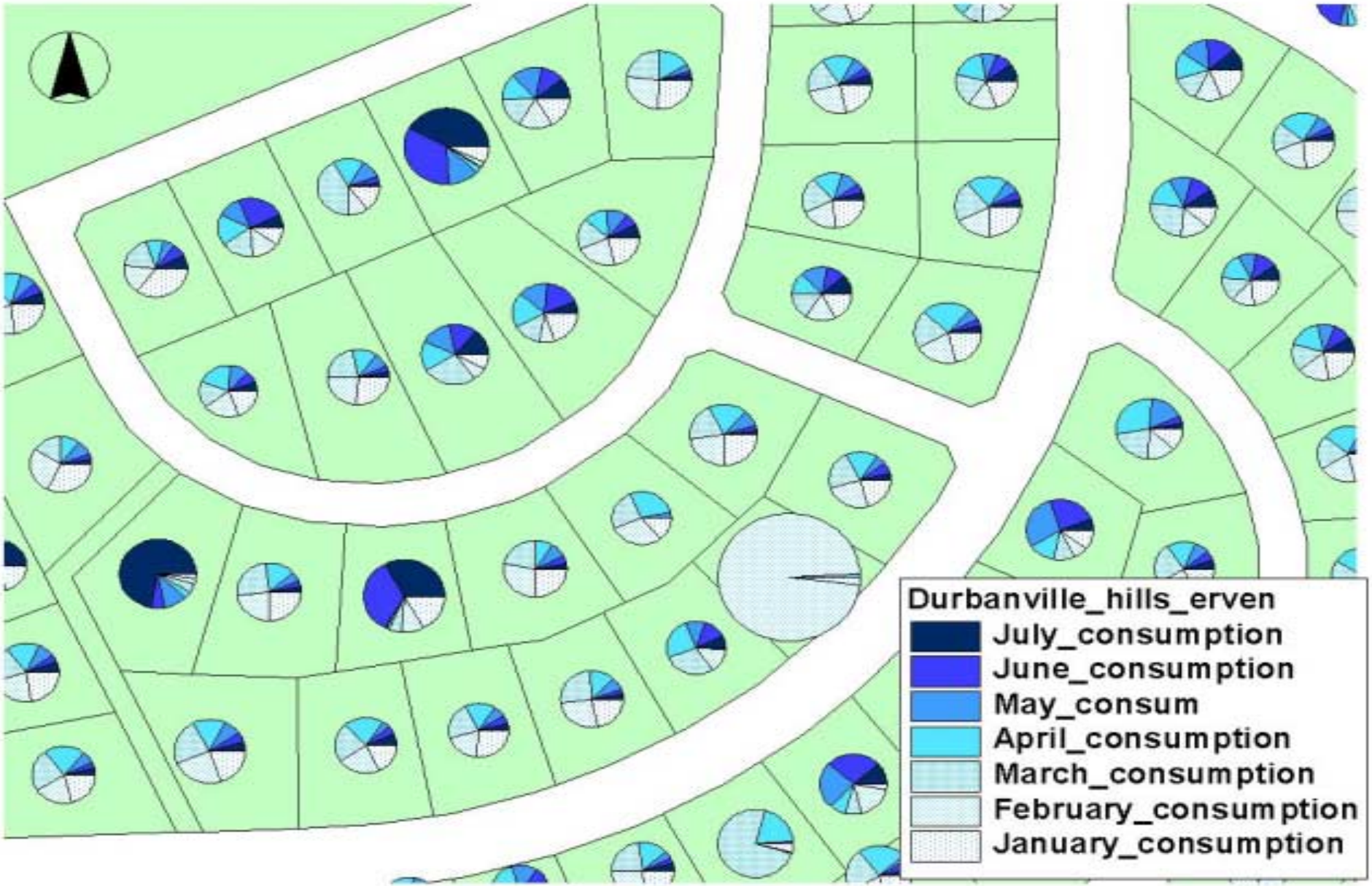
Bursts have been captured with mobile GIS devices

Certain problems of meter readings estimates

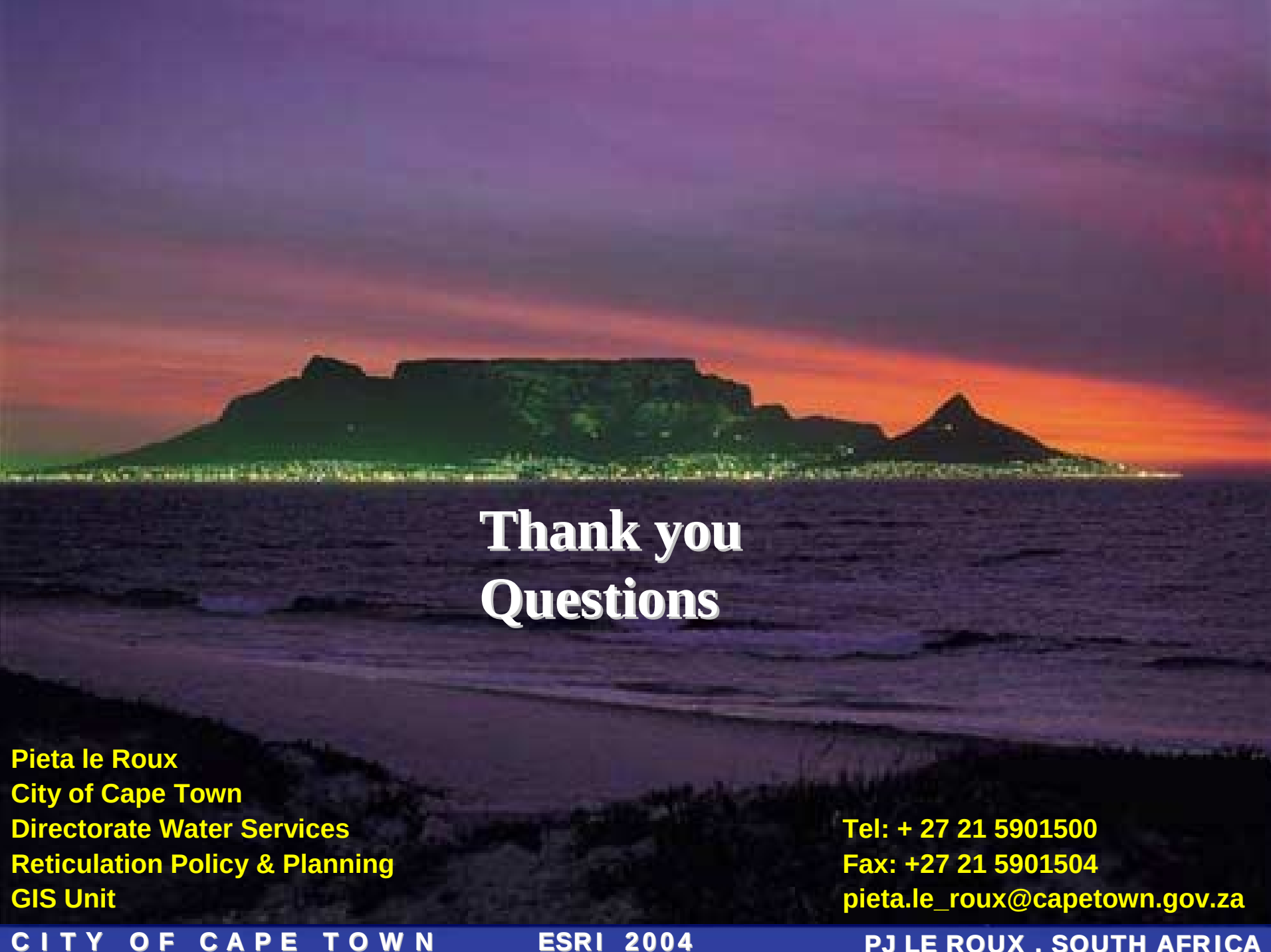


Linking SAP to GIS enable monthly reporting of water consumption patterns based on City's tariff structure

Time-spatial consumption patterns



3D-Spatial Consumption Patterns



Thank you
Questions

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