# Enabling Sustainable Human Settlements

**Presentation to the Portfolio Committee on Human Settlements**

**16 April 2013**

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**Executive Director : Built Environment**

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# Layout of the Presentation

- URBAN/RURAL DESIGN AND PLANNING
  - ✓Urban & rural spatial dynamics: Challenges and lessons learned
  - ✓Population dynamics and the movement of people
- ALTERNATIVE BUILDING TECHNOLOGY
  - ✓ Unit cost of the alternative technology/(Low cost housing demonstration model)
  - ✓ CSIR low cost housing model vs standard RDP housing model - Costing
  - ✓ Findings on the contributions of an alternative technology
- ALTERNATIVE TECHNOLOGIES FOR WATER AND SANITATION
  - ✓ Water value chain (includes sanitation)
  - ✓ CSIR's water and wastewater technologies
- CONCLUSIONS

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# Designing sustainable human settlements

Current initiatives focus on a range of areas related to integrated planning and design aimed at creating well-functioning, sustainable settlements

- Housing options and urban development (medium-density mixed housing, social housing)

- Appropriate technologies, (particularly sanitation), focusing on user acceptability issues and decision-making processes

- The relationship between crime and the physical environment, and the role of planning, design and management in creating safer communities

- Examples of support: Guidelines for Human Settlement Planning and Design (the Red Book)

# Human settlements are more than just housing

- Guidelines for provision of social facilities in a range of SA settlements has been published and should be applied to new township approval and used to support capital budget requests to retro existing settlements.

- Accessibility analysis can be used to test sufficiency and accessibility of facilities in settlements.

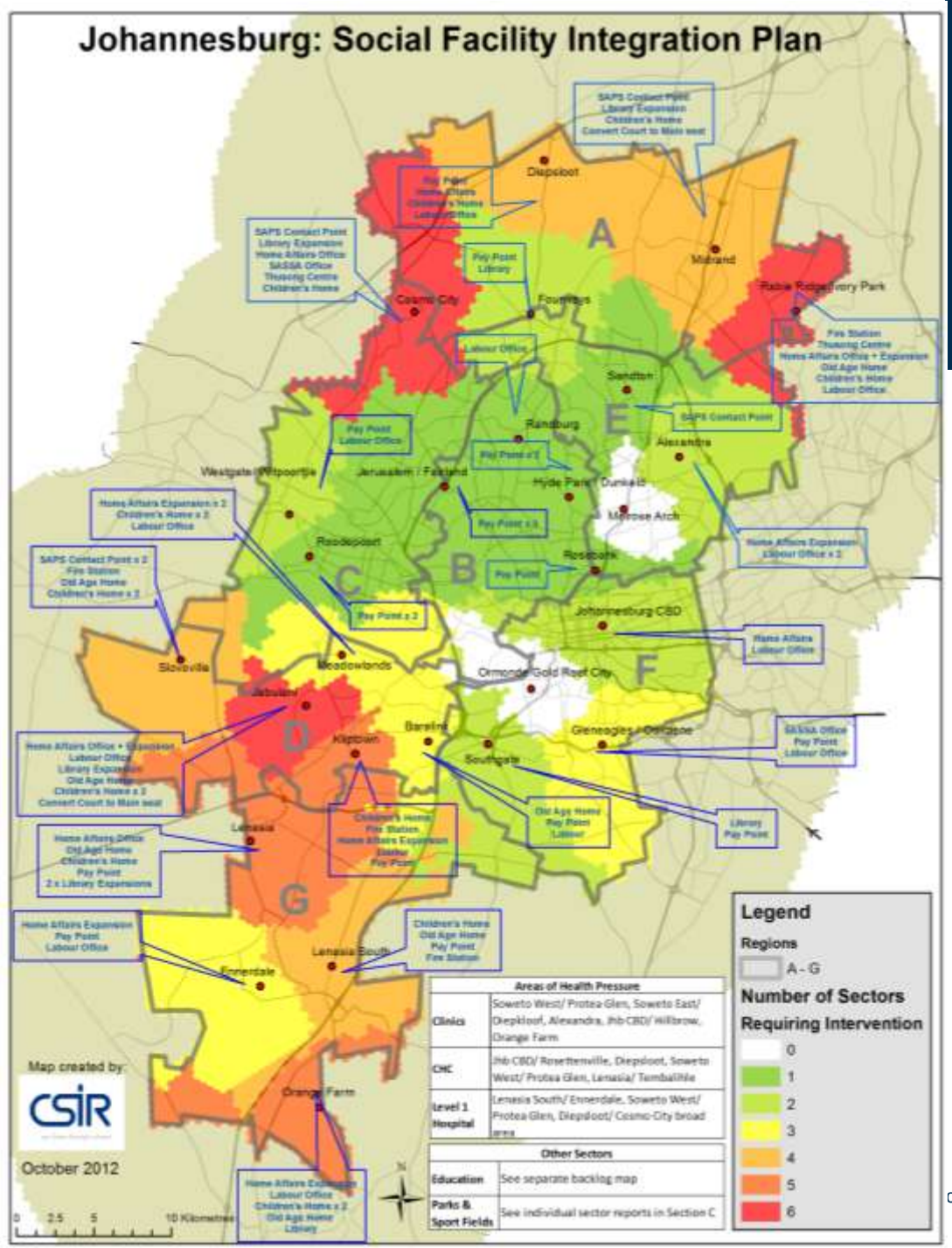
- DPSA project highlighted large backlogs in 2 of our biggest metros. Capital and manpower requirements are huge including basic education and health sectors. Thus alternative building technologies ie for schools as tested by CSIR are appropriate. Also critical need to increase the recruitment and/ or training opportunities for key professionals.

# Publication

- Forward planning – providing an equitable basis for allocation of scarce land and capital resources together with location guidelines
- Land use management – provide guidance on the number of facilities required, & scale and site requirements
- Plan implementation –a yardstick to measure sufficiency of facilities on a broad scale
- Improving quality of life – ensuring that a full range of facilities and open spaces is accessible to all.

GUIDELINES FOR THE PROVISION OF SOCIAL FACILITIES IN SOUTH AFRICAN SETTLEMENTS

First Edition: August 2012




# Integrated facility plan to meet extensive backlog of facilities

The Government Programme of Action (Outcome 12) requires government departments to develop geographic access norms and to set targets for reducing the distances people have to travel to reach services, where this is appropriate.

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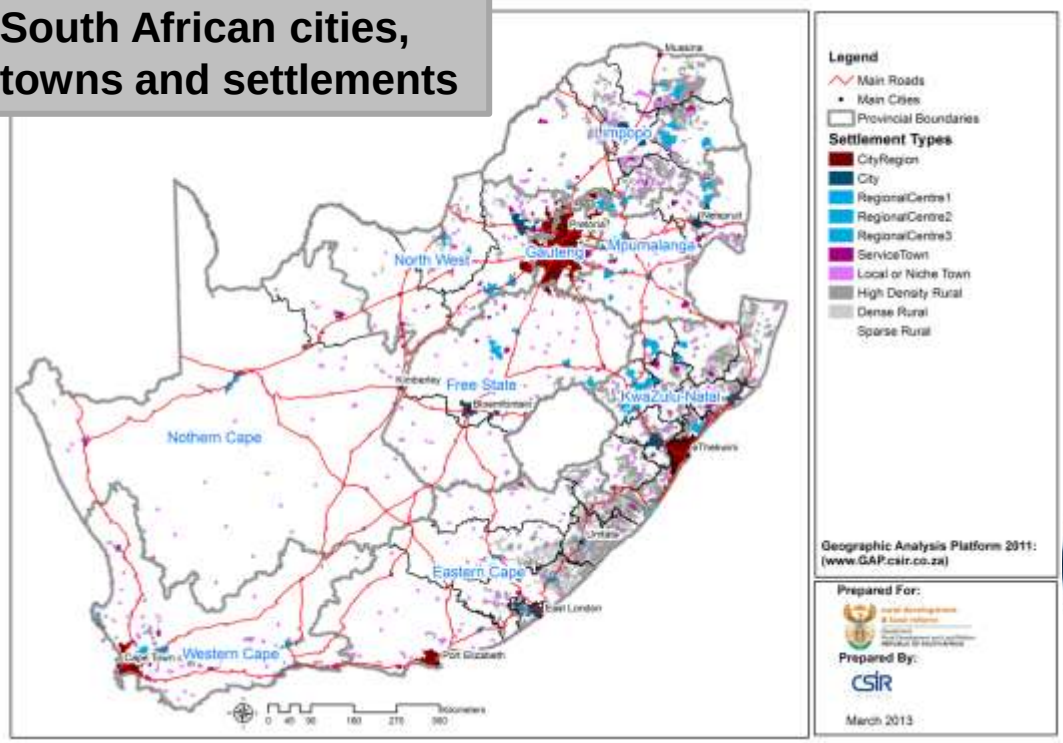
## Human settlements play a critical role in realising South Africa's development vision

According to recent spatial dynamics research conducted by CSIR (using the unique Geospatial Analyses Platform and innovative spatial analyses tools), it is estimated that even though the network of city regions, cities and towns in South Africa covers only 6.7% of the land area, these areas house more than 77% (three quarters) of the population and acts as the economic and job creation engines of the country - generating 86% of total economic activity.

In addition to the 'formal' towns and cities, large and growing dense rural settlements in traditional rural districts are now estimated to house 12% of the national population.

For close to 90% of South Africa's population, their quality of life, and access to services and economic opportunities are thus dependent on the quality and sustainability of the country's human settlements.

**South African cities, towns and settlements**



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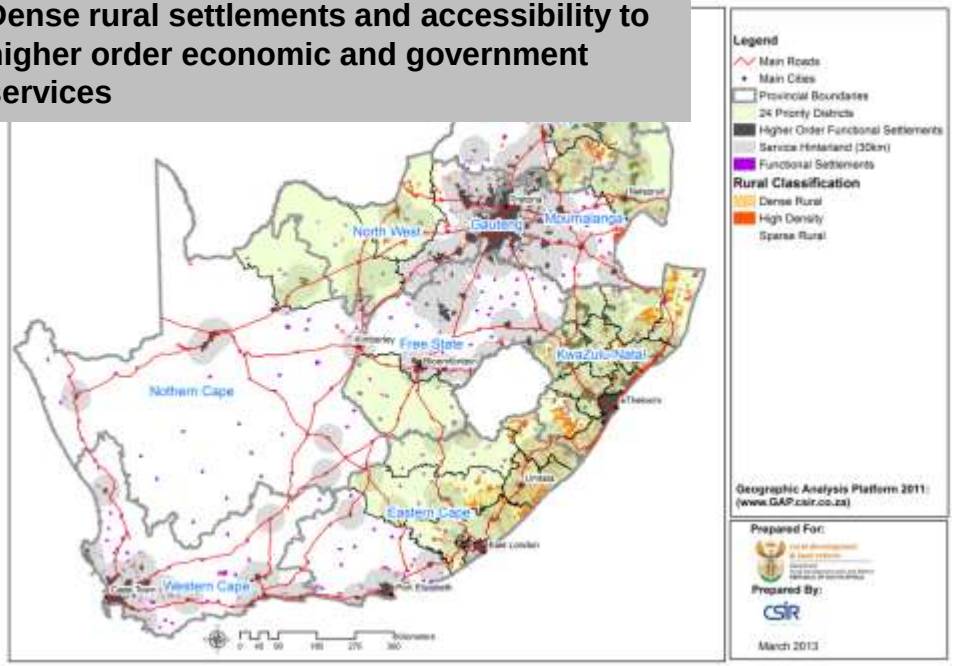
In recent studies conducted by CSIR, BE in collaboration with DRDLR (Rural Infrastructure) and Meraka (CSIR) the unique development dynamics and challenges and changes across South Africa's settlement landscape clearly points to:

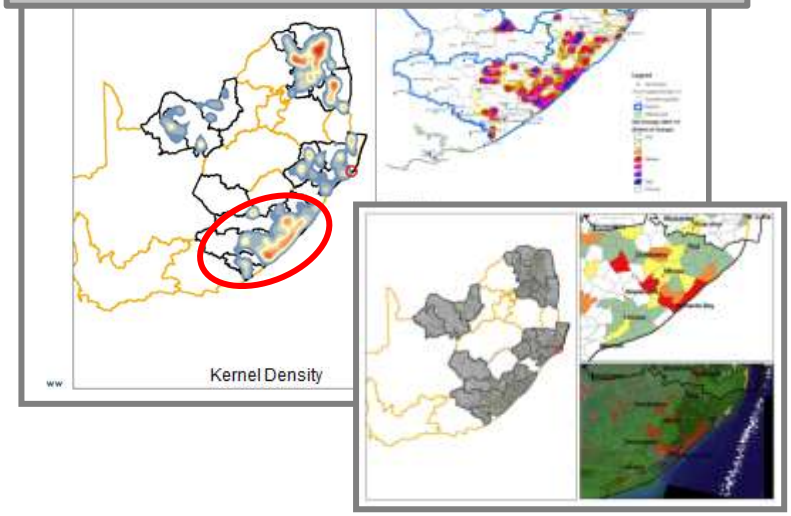
- The **important role that regional towns and service centres (estimated to house 20% of the national population)** play in providing access to government services and economic opportunities and the investment priorities related thereto.
- The tremendous amount of **settlement related change that occurred in high density and growing settlements in rural districts (housing more than 6million/12% of the national population).** Given the unique contexts of typography, limited agriculture activities, being largely located on tribal land and often in areas with limited access to higher order government facilities and economic opportunities, these areas are faced with unique challenges in terms of sustainability of governance, service delivery and livelihoods.

In this context, CSIR's unique spatial analyses platforms and capabilities, including i.e. change detection technologies, innovative migration analyses and recent investment in regional land use modelling assist diversified governance and prioritisation of investment.

**Dense rural settlements and accessibility to higher order economic and government services**




**MODIS (remote sensing) Settlement related change detection 23 Priority Rural Districts (2001-2012): Example**



# Sustainable Human Settlements: Investment Potential Atlas 2009

- **Aim:**
  - Spatial interpretation of current policy ,
  - Relates to establishment of sustainable human settlements ; settlement locality
- **Objective:**
  - Guide housing / settlement investment decisions by various stakeholders
  - from dysfunctional space economy to integrated, sustainable settlements
- **Method:**
  - Outcomes of multi-disciplinary research and specialist technical competencies / platforms,
  - Applied to address investment locality decisions,
  - Packaged in useable format to support decisions making
- **Use & Impact:**
  - Contribute to distribution of national housing fund (since 2005),
  - New edition (2009): input into allocation formula,
  - Uses an integrated investment framework,
  - More direct use by lower sphere decision makers,
  - Includes a housing response typology with detailed density, dwelling type, delivery models and level of formality,
  - Quantitative index for Quality of Place and Quality of Life

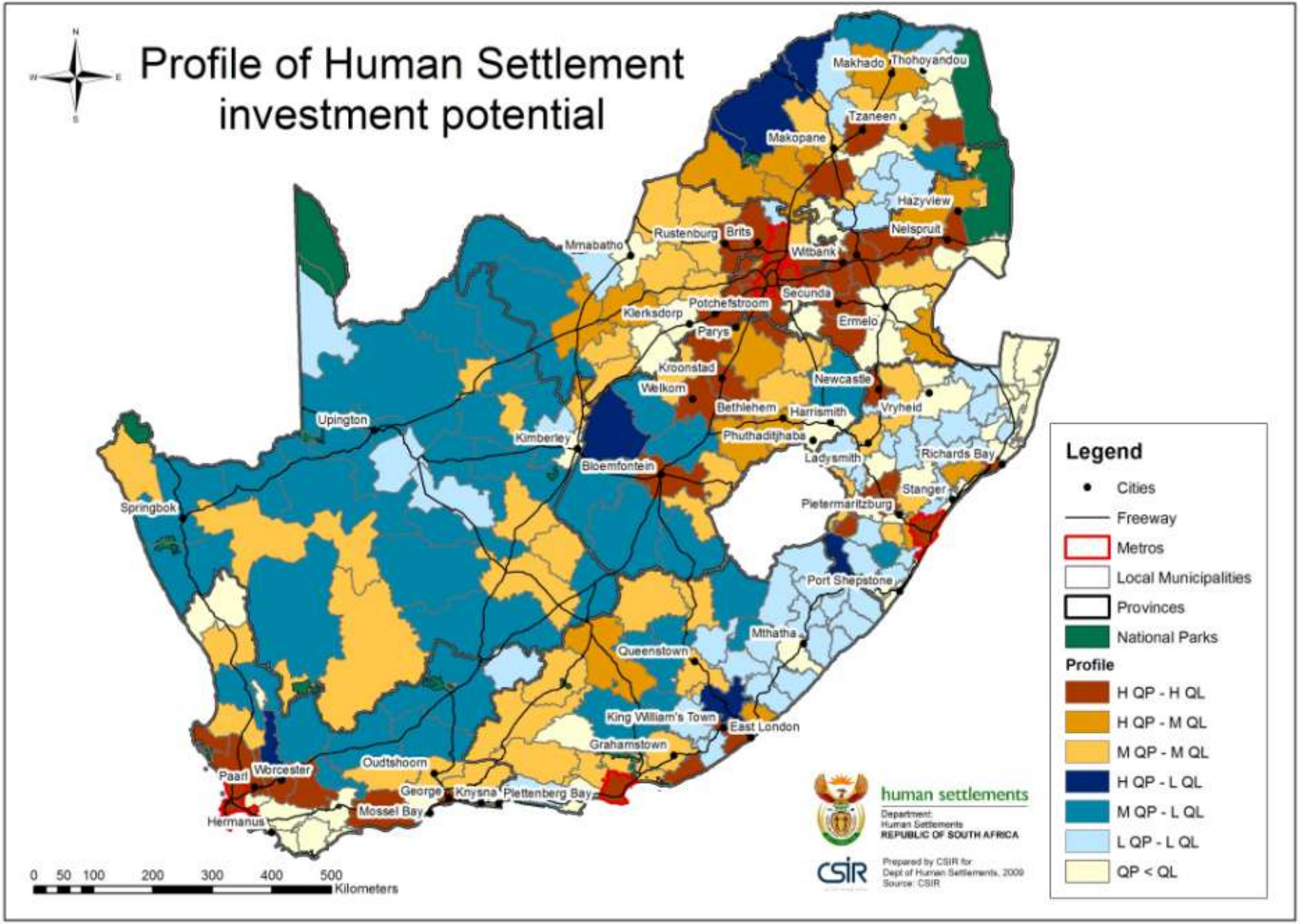
# Delivery mechanisms of Human Settlements Atlas

- Glossy A3 Atlas with full page maps, easily navigation with explanations

- Complemented by electronic map viewer product for desktop use

- Distributed to; DoHA, PCAS, Metro's, Provinces, HDA, Habitat for humanity, UN library, HSRC, GCRO and DBSA.

# Profile of Human Settlement investment potential



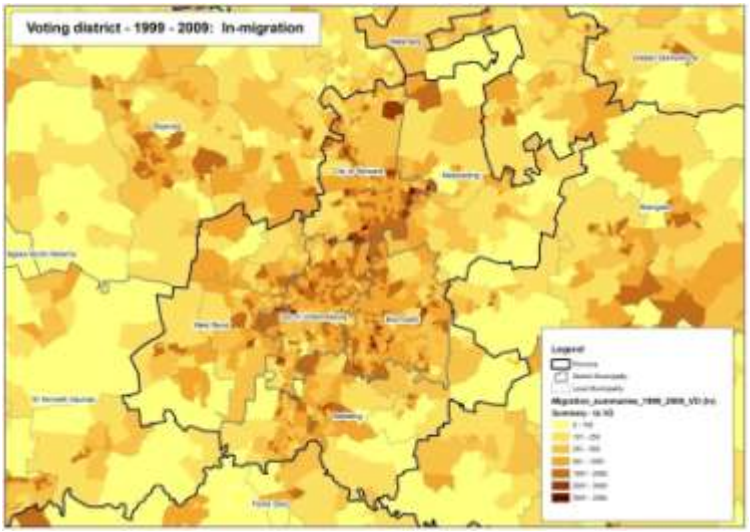
# Envisaged Human settlements Atlas 2013/2014 ??

- Last version 2009
- New census 2011 data now available
- All platforms (including GAP) have been updated to reflect a new 2011 picture
- More data input due to current household surveys conducted
- Greater environmental analysis needed- climate change impact, community risk and vulnerability

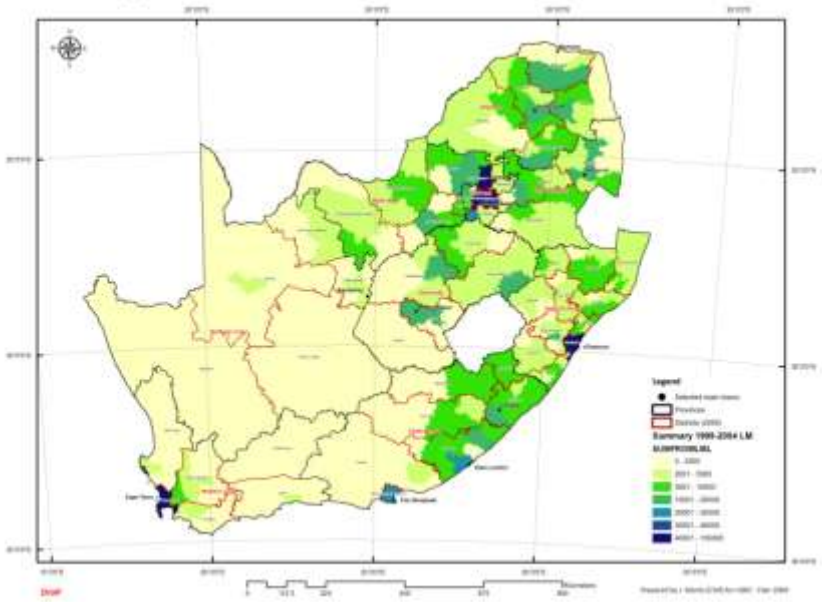
# Migration proxy development and analysis

- Through StepSA Initiative (living labs) **a need for added migration data was identified to support regional analysis and planning**
- **Independent Electoral Data** from IEC was identified as a possible and very usable data source
- IEC was approached and anonomised voter registration data obtained for 1999, 2000, 2004, 2006, 2009 and 2011
- Due to **spatial unit difference of voter districts** a process was applied to standardise the data to a single period in order to then trace the movement of people over different time periods
- CSIR (Johan Maritz) and HSRC (Pieter Kok) processed the data spatially to create data at voting district level indicating the following:
  - **Movement between different election periods**
  - **Data described age and gender movements spatially**
  - **Data could be aggregated to Local and District Municipalities to map major movement trends**
- Information was mapped and placed on the **StepSA portal** (http://stepsa.org)
- **Data also compared** with earlier Census data – findings remain constant and confirmed the validity of the IEC data for migration analyses
- Contributes significantly to **understanding population movement in time and spatially within South Africa**

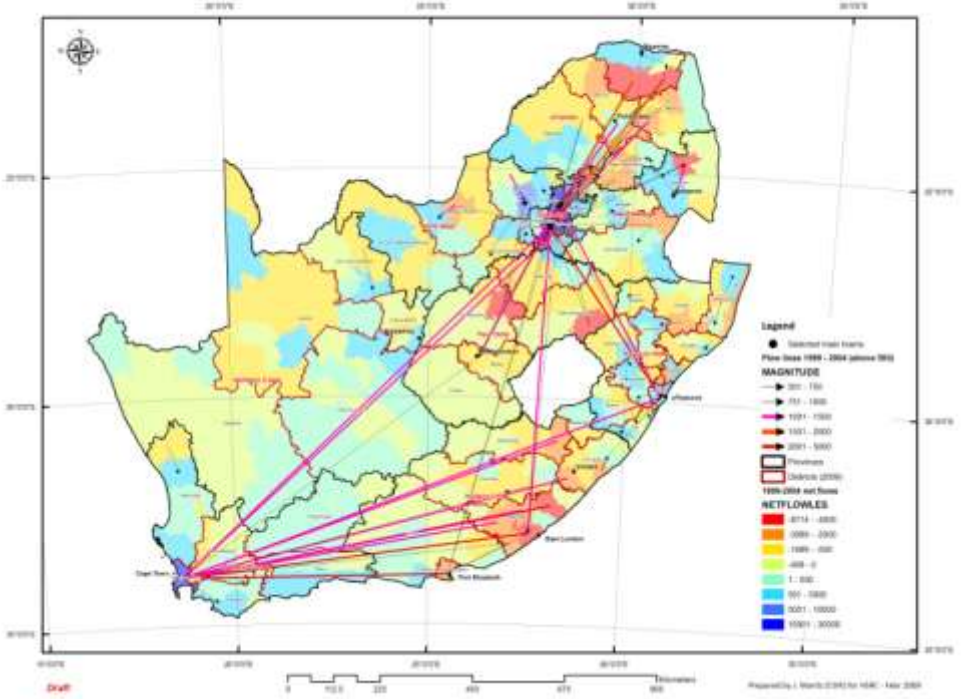
# Examples of spatial migration data using IEC data:




IEC Data comparison 1999 - 2004 LM: From LM.



IEC Data comparison 1999 - 2004 LM: Net Flow lines.



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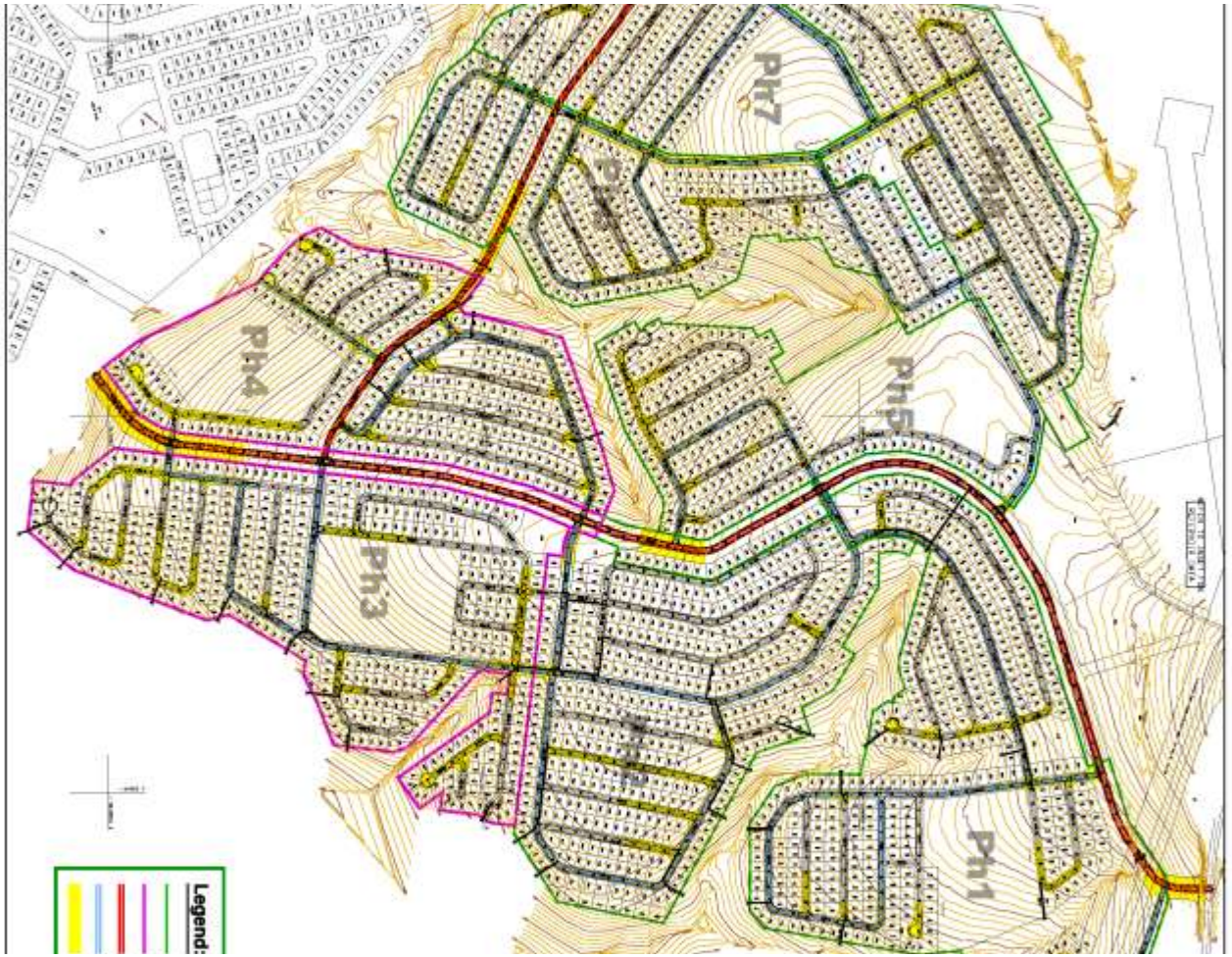
# Lessons from Innovative Housing Project




# Challenge 1: Poor urban design & planning

Poor orientation

Poor use of infrastructure resources (roads, services)

No supporting social infrastructure

## Poor urban design & planning

No variation in house design

No variation in types (single, semi-detached, row houses)

Poorly integrated into existing communities


## Urban design & planning

Mix of housing types

Correct orientation

Integrates into existing community

## Challenge 2: One-size-fits-all (No)

Only 1 house design (house plan and type)

Difficult to expand

## Variations on a theme

CSIR/DST House

## Mdantsane, Buffola City

## Mthimkulu Village, Kleinmond

More than 1 house plan (match beneficiary needs)

Mix housing types

## Kleinmond

Semi-detached


## Challenge 3: Poor construction quality

Poor building skills

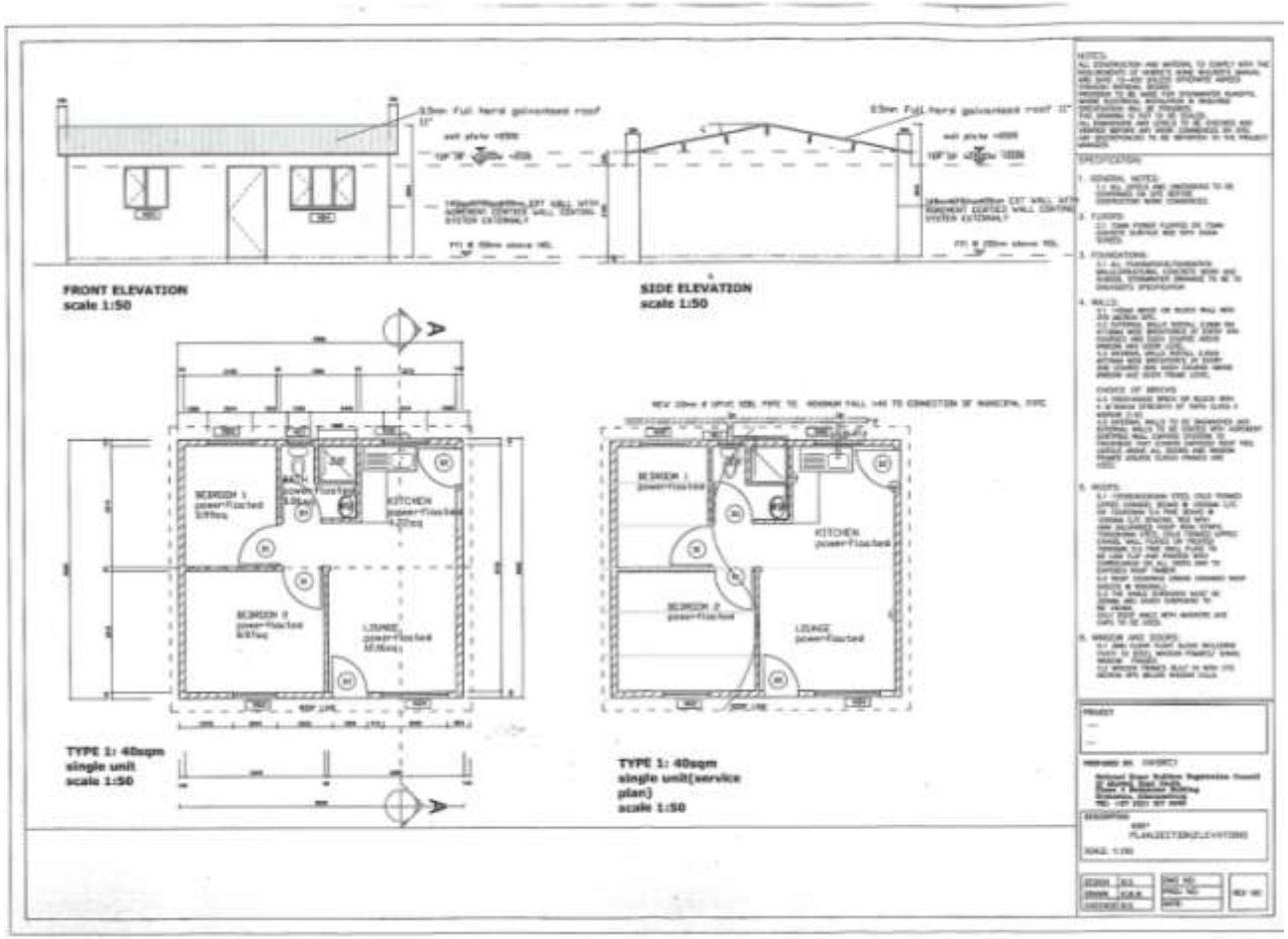
Poor supervision

Treating masonry block like a brick

## Good building quality

Local training in block laying

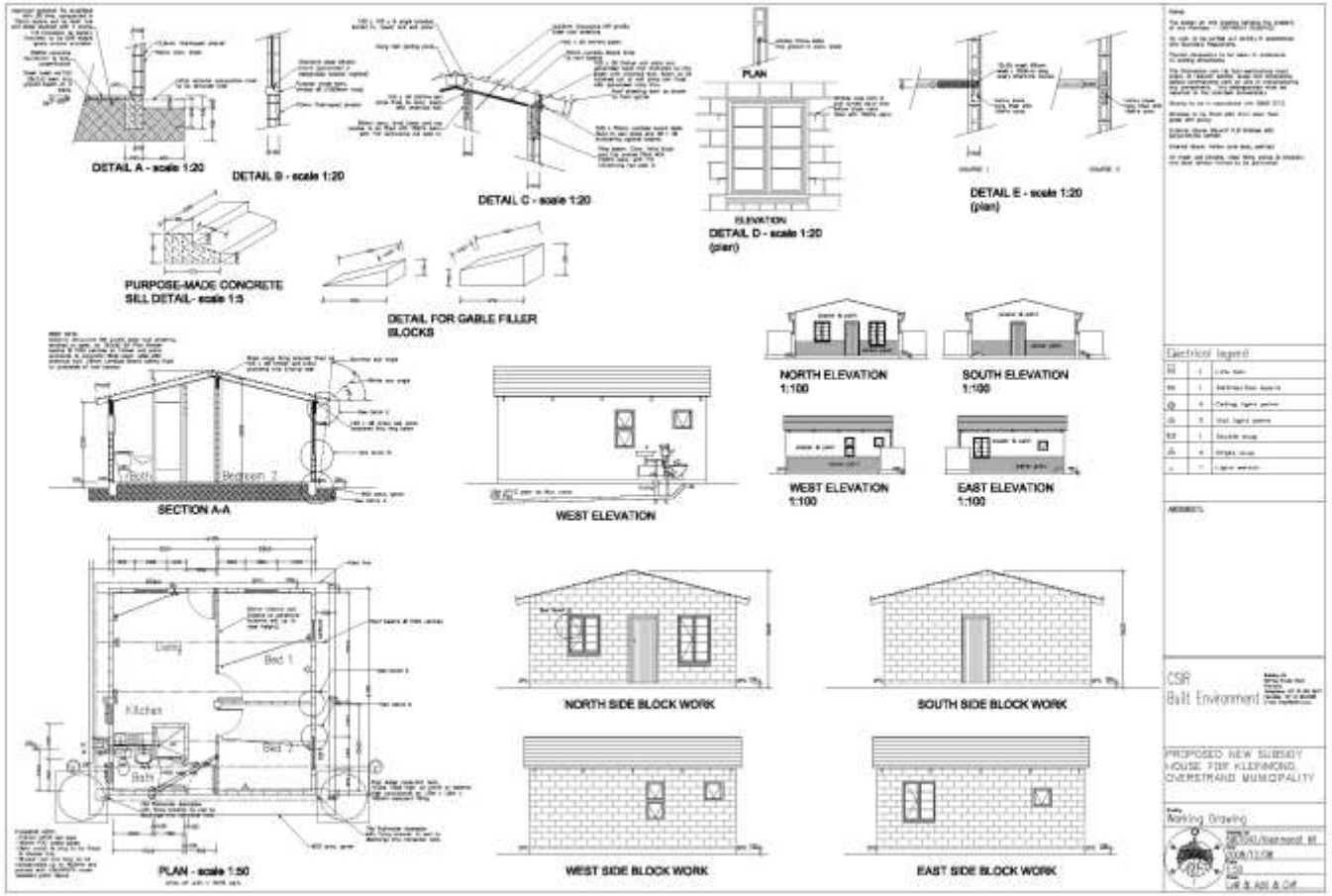
Modular use of block (material mass reduction 33%)




# Challenge 4: Poor technical documentation

Poor design (location on site, ease of expandability)

Ignores block dimensions wastes material




# Design & technical documentation skill

Complete design and construction documentation

All technical details included

All construction problems worked out beforehand







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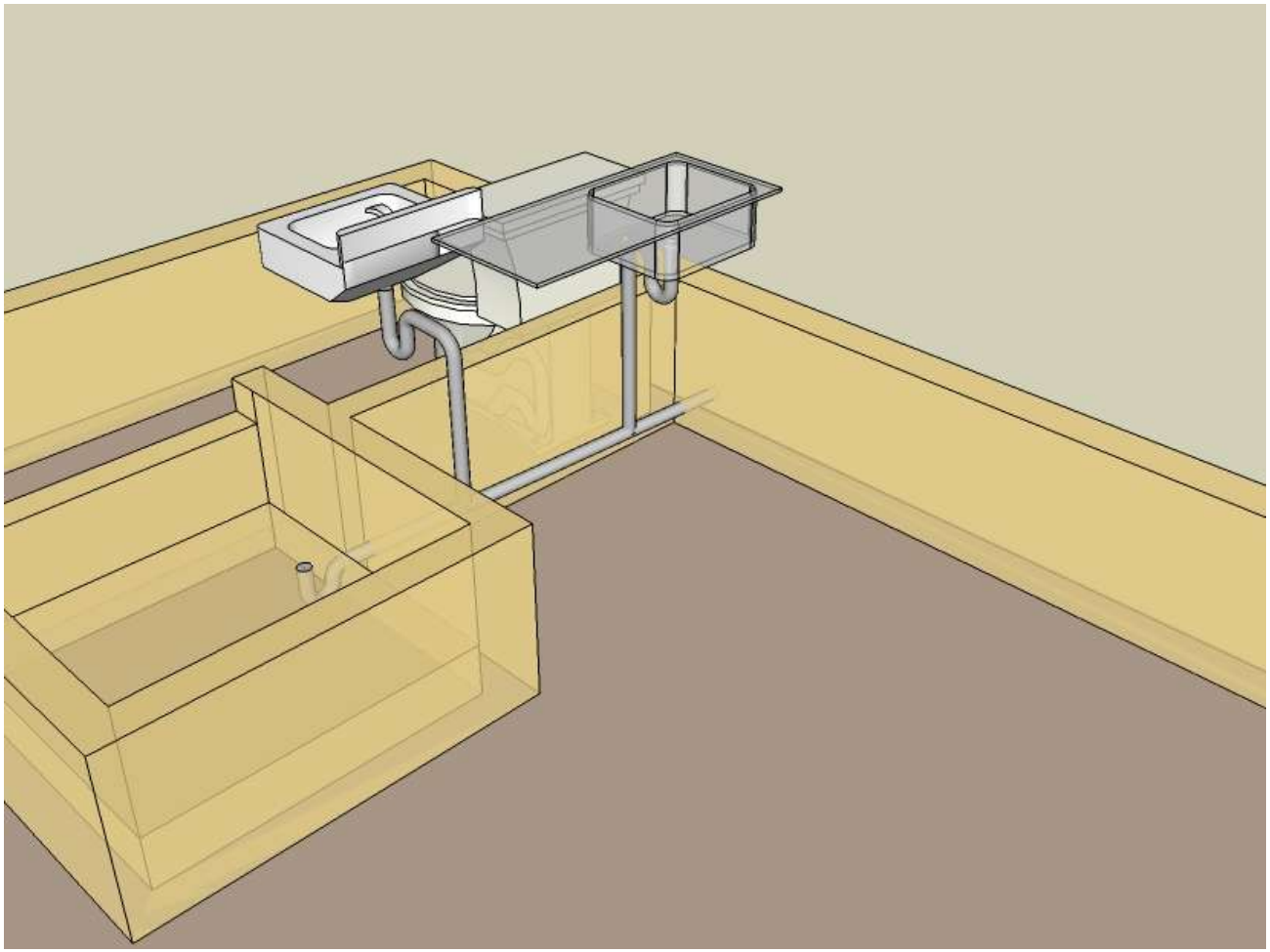
# Challenge 5: Inadequate service design and provision

Poor service design wasteful of piping

Inadequate or no service provision



## Service design & provision

Comprehensive service design (material reduction 26%)

## Service design and provision

Off-grid electricity for lighting and cellphone charging

Solar water heating

Rain water harvesting (22,000l for free)

# Challenge 6: Alternative building technology (ABT)

Agrément SA certified systems

Generally performs better than standard brick house (SBH)

## IDT Alternative Building Technology Study

Savings of up to 53% versus conventional school building

DHS is not exploiting available technology

Caution: not without its own challenges (performance, logistics, thermal comfort)

## Light frame steel

Insulated panel system

## Imison System

Insulation panels with high strength reinforced mortar coat

## Danish precast concrete technology

Structurally insulated panels (high strength concrete)

Walls and roof

# Kleinmond costing per house

| Item | Cost |
|---|---|
| Standard subsidy top structure (inc. geotech and SCCCA) | R75,000 |
| Tiled roof, wooden trusses, insulated ceiling | 10,255 |
| Reinforced ring beam | 928 |
| Blocks for gable | 600 |
| Steel additional | 304 |
| Sit-bath | 613 |
| Fire-proof party wall | 1,300 |
| ABT services (PVP, SWH, RWT) | 25,084 |

# Findings of what technology can contribute

| Innovative technology | Per house | National |
|---|---|---|
| Energy reduction (heating cooling) | 11.12 GJ | 23.3 million GJ |
| $CO_2$ reduction | 0.885 ton | 1.94 million ton |
| Material weight reduction | 18.8 ton | 39.4 million ton |
| Water from materials | 19.73 m3 | 41.4 million $m^3$ |
| Water, through tanks | 22 m3 | 46.2 million $m^3$ |
| Electricity (SWH) | 1762.95 kWh/annum | 3.7 billion kWh/annum |
| Electricity (PV) | 36 kWh/annum | 75.6 million kWh/annum |
| $CO_2$ reduction (SWH) | 2.11 ton/kWh/annum | 4.4 million t/kWh/annum |
| $CO_2$ reduction (PV) | 0.04 ton/kWh/annum | 90 300 ton/kWh/annum |

## Decent sustainable human settlements

Must do things differently by understanding that housing delivery is a R12b property development

# Bokaap

Variations on a theme


8295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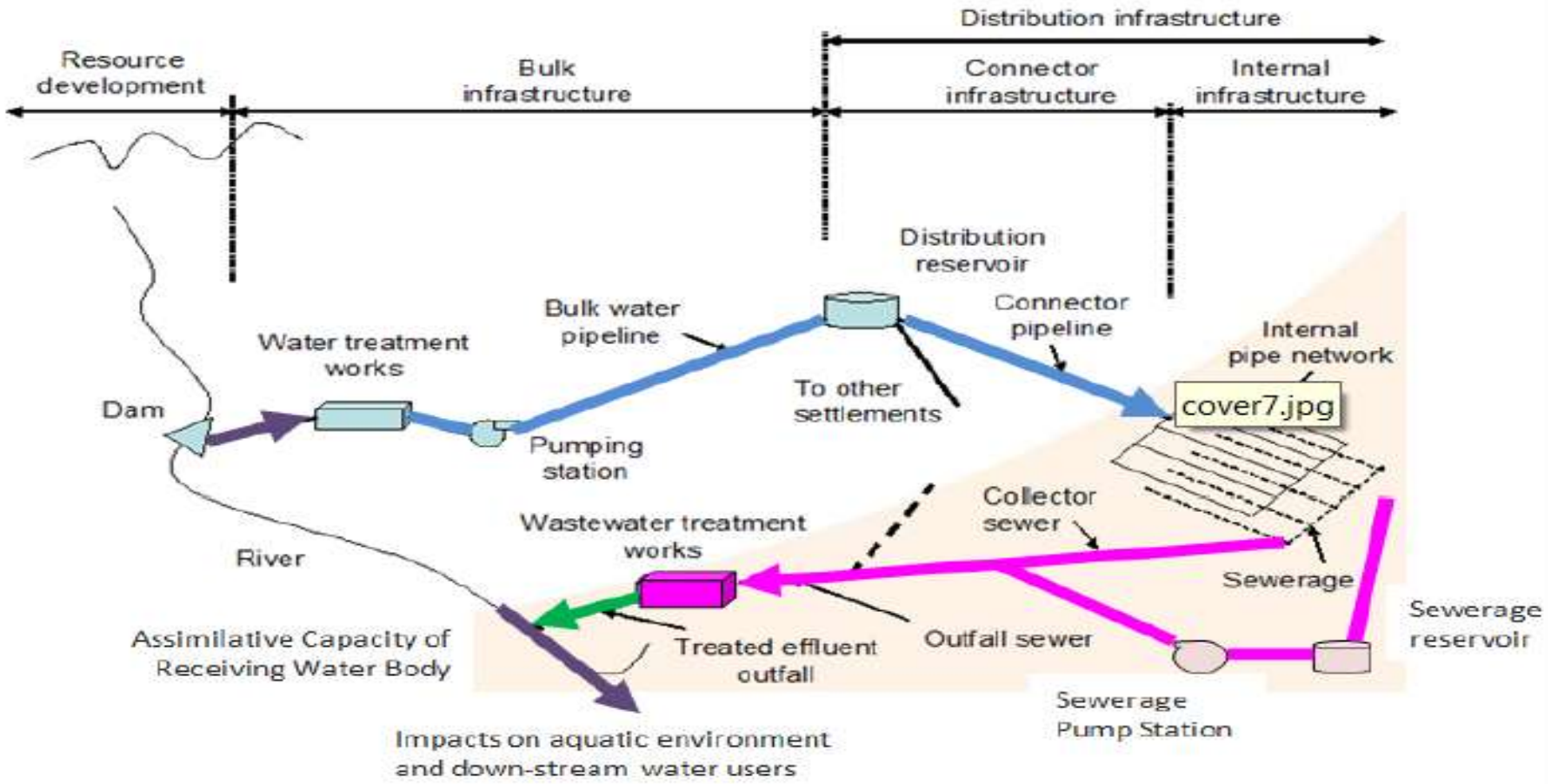
# Water Value Chain in South Africa




Both urban and rural sanitation are components of the water value chain


# Technological option for treating potable water at household level in rural areas

# The SanTech Centre

## Background

- First open-air exhibition centre for on-site sanitation technologies in Africa, located at the CSIR, Pretoria
- Officially opened on 27 May 2011 - jointly funded by the CSIR and the Water Research Commission

## Purpose

- To display full-scale, albeit non-working examples of some on-site technologies and products available in South Africa
- It allows visitors to acquaint themselves with sanitation systems to assist with decisions regarding appropriate options

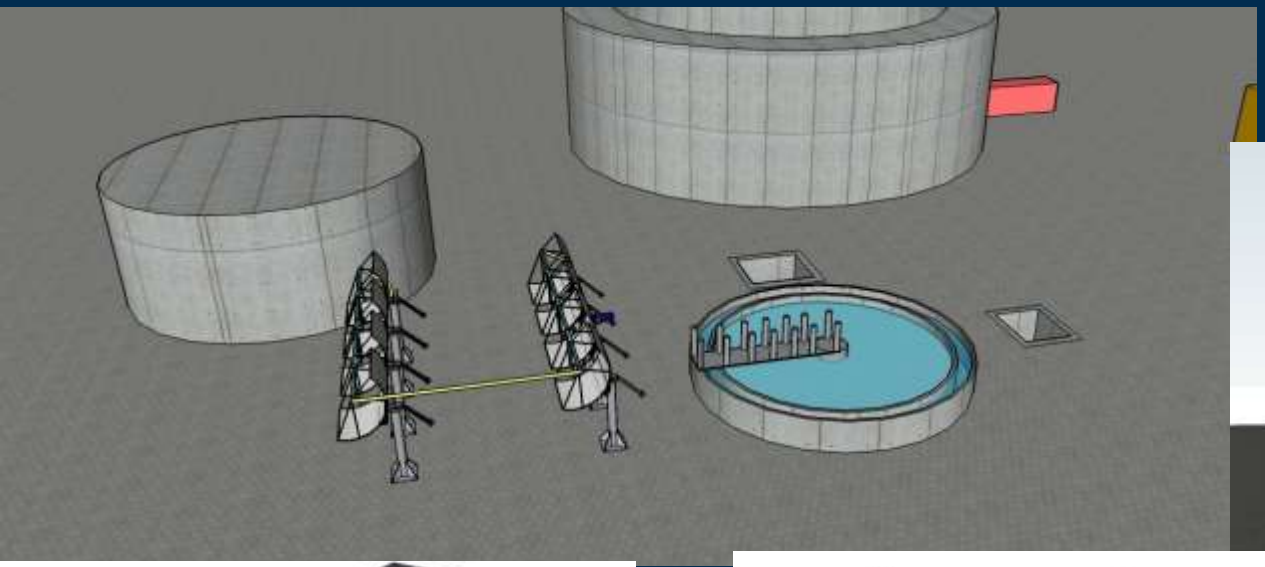
## Exhibits

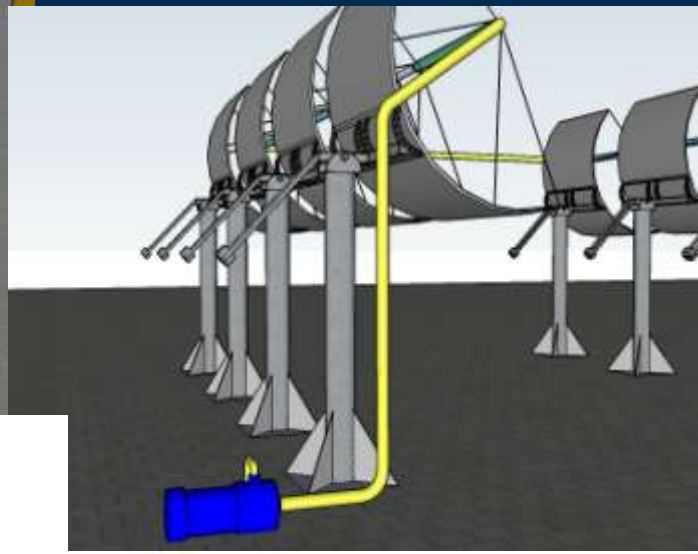
- A comprehensive range of sanitation technologies and products, including conventional and alternative approaches (dry sanitation, urine diversion and/or separation technologies, water-borne systems and ecological sanitation)
- Examples provided by commercial suppliers, as well as exhibits constructed by the CSIR
- The products and technologies exhibited are not endorsed or promoted by the CSIR, and exhibits are not being tested on this site

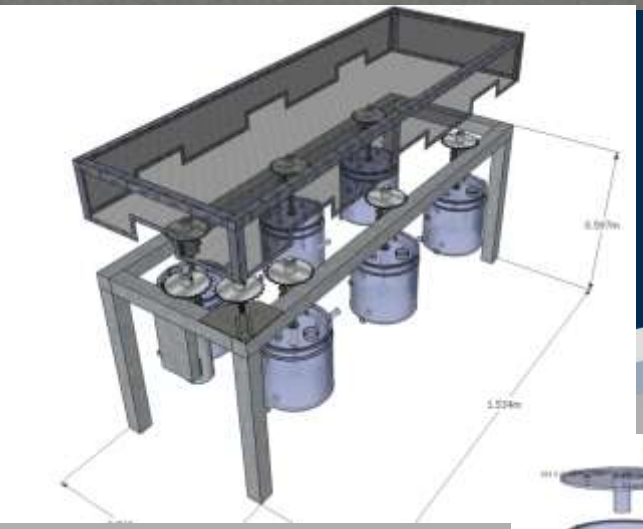
# The SanTech Centre

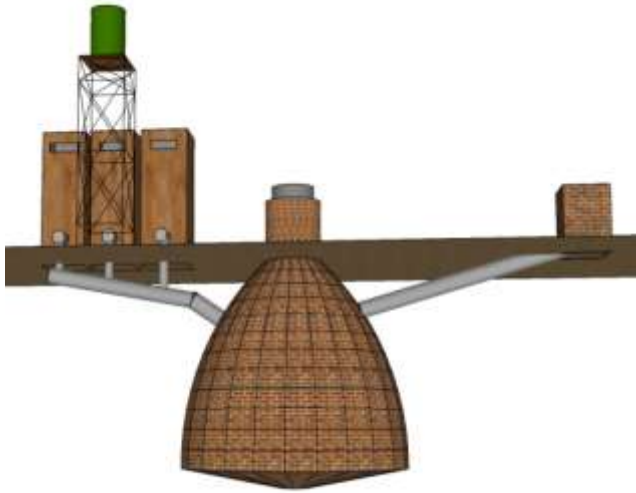
# Examples of exhibits

# The wastewater treatment technology – ERWAT Plant as a pilot









# CSIRs patented AD

This is an automated two-stage continuous flow anaerobic digester facilitated by three hopper tanks.

- 1st stage – Control of the loading rate, temperature, mixing and pH
- 2nd stage – Stratification/settling of the stabilised sludge

*Summary of benefits resulting from the waste to energy project*

| Item | Description | Objective | Component | No. | Economic benefit |
|---|---|---|---|---|---|
| Job creation | Unskilled | | Seven permanent jobs related to the community garden programme | 7 | R35000/month. Nationwide rolout at 350 wastewater treatment works with digesters can creat 10000 jobs |
| | Semi-skilled | | Three permanent technical assistant jobs at ERWAT for basic monitoring and maintenance of systems | 3 | R15000/month |
| | Skilled | Sustainability of the waste water infrastructure | Training of seven technicians for the operation and maintenance of the wastewater treatment works | 7 | Trained staff will ensure long-term sustainability of the infrastructure and continued development in the surrounding areas. This will also be part of the overall infrastructure skills development at local government level |
| Reduction in electricity usage by ERWAT | Free energy from the grid | Operational efficiency | Freed energy can be used to provide additional 750 indigent households with electricity | 750 households | A total of 900MWh per annum will be freed from the grid. Potential energy savings for the full rollout of the project is 1500GWh/year |
| Increase in biogas production | Increase in biogas production | Operational efficiency | The CSIR process will increase biogas production from as low as 30% up to 72% | from 30% to 72% | Increase in biogas production for generation of electricity |
| Reduction in retention time | Reduction in retention time | Operational efficiency | The CSIR process will reduce retention time from 30 to 16 days | Reduction from 30 to 16 days | Increase in existing sludge handling capacity of plant |
| Stabilization of the sludge | Stabilization of the sludge | Stabilization of the sludge for safe use by the surrounding communities | Sludge from 2-stage digestion process results in a significant reduction in obnoxious odours and pathogenic bacteria and depending on the classification of the sludge is suitable for various beneficial uses. | | Depending on its classification, the final sludge would be safe for productive use by the local communities |

# Benefits of the wastewater treatment technology – ERWAT Plant as a pilot

# Conclusions

- CSIR will:
  - ✓ Continue discussions with DHS to update ‘Red Book’ and Human Settlements Atlas;
  - ✓ Continue engagements with the DHS, provinces, municipalities, SALGA, MISA, NHBRC, CoGTA, NT and other stakeholders on the appropriate mechanism or model for rolling-out CSIR’s low cost housing model;
  - ✓ Work with other partners such as Water Affairs, municipalities, MISA, SALGA, CoGTA, NT, DBSA, etc to prepare for the rollout of the waste-to-energy and rural water treatment (‘AmaDrum’) technologies (SIP 6)
  - ✓ Continue exploring, in partnership with relevant departments such NT and DST, innovative financing mechanism for practical and creative R & D based solutions in infrastructure (i.e. water, human settlements, energy, transport, etc.)
- It is crucial to treat sanitation as an integral part of the water value chain