Integrating social and technical factors in decision support for non-potable water reuse networks

Sarah Bell, Martin Shouler, Siraj Tahir, Luiza Campos, Lazaros Papageoriou, Songsong Liu, Damien McLeod

Lucy Rees, Simon Woolf, Alexa Bruce, Han Sheng Quek, Harrison Williams, Amalia Ouriachi, Tanjian Xiong

University College London, BioNano Consulting and Arup
(funded by UK Technology Strategy Board)
• Water reuse
• WReN framework
• Social and institutional factors
• GIS and optimisation
• Case study: Central London retrofit
Water Reuse Networks

• ‘Greywater’ reuse
  – District scale
  – Matching supply of high quality ‘wastewater’ to non-potable demand
  – Variable quality, quantity and treatment
  – Treatment, storage, blending
WReN

- Decision making framework to evaluate feasibility of non-potable networks
- Planning, appraisal and conceptual design
- New development and retrofit
- Social and technical evaluation
Layout
- nodes, links

Node properties/attributes
- supply, demand, supply-demand, buffer, treatment-pumping

Link properties/attributes
- distance
- gravity, pumped
- material

Central supply core

Individual recirculation

Direct supply/demand relationship
- One to many
- Many to one

Legend:
- supplier
- user
- Supplier/user
- buffer
- Central treatment/pumping
Rapid Appraisal of Social and Institutional Viability

Viable?

Maybe

Detailed characterisation of supply and demand

Scenario 1
Scenario 2
Scenario N

Least cost network optimisation for each scenario

Risk assessment of optimised networks for each scenario

Conceptual design of reuse network alternatives

Do not proceed
WReN Rapid Appraisal

- Early stage evaluation
  - Does not replace detailed stakeholder engagement
- Identify major obstacles before technical development
- International research and experience of reuse schemes and water management
- Qualitative scoring system
  - 9 indicators
  - Score out of 5
WReN Rapid Appraisal

- Public acceptability
  - History of reuse
  - Proposed end use
  - Proposed source

- Planning and regulatory environment
  - Local planning authorities
  - Water reuse standards
  - Water infrastructure planning and management
WReN Rapid Appraisal

- Institutional capacity
  - Water reuse commercial structure
  - Customer and public engagement
  - Technical skills and management

- Non-feasible system
  - Any element scoring 1 or 2
  - Average score 3 or less
Case Study

• Hypothetical central London Retrofit (UCL)
• Water reuse network at London Olympic Park
• Local government encouraging district heating networks and water recycling
• Owned by a Water Services Company (WaSCo)
Rapid Apraisal

- Public acceptability (3.5)
- Planning and regulation (3.7)
- Institutional capacity (3.7)

- Average score above 3
- No elements less than 2

- Scheme warrants further investigation
Monthly greywater supply and reuse water demand in UCL Bloomsbury
Location of greywater supply, water demand, hubs and plants in Bloomsbury

- 6 suppliers
- 7 hubs
- 2 treatment plants
- 13 demands
Optimisation

• Least cost pathways between nodes
  – GIS
• Least cost network optimisation
  – GAMS
• 5 suppliers are selected in the network
• 2 hubs are selected as supply hubs
• 1 plant is selected
• 3 hubs are selected as delivery hubs
Risk Assessment

- Hazards
  - Social
  - Environmental
  - Economic
  - Strategic
- No high or extreme risks
- Moderate social, strategic, economic risks
  - Critical Control Points
Case Study Results

- Rapid appraisal justified further investigation
- Supply and demand estimates based on metering and benchmarking
- GIS identified sites for nodes, treatment and least cost pipe pathways
- GAMS optimised network layout and treatment
- Risk assessment identified Critical Control Points
Conclusions

- Decision support system addressing social and institutional factors
- Integrating GIS and GAMS techniques into decision making and design framework
- Feasibility stage of planning
  - Water infrastructure considerations in master planning
- Stakeholder and public engagement needed throughout