Water reuse: An integral part of sustainable water resource planning

Collaborative Science and Technology Network for Sustainability Workshop

November, 2007

Acknowledgments

- Partners
  - Illinois Institute of Technology
  - Illinois Waste Management and Research Center
  - Chicago Metropolitan Agency for Planning
- Sponsor
  - US EPA Science to Achieve Results Program
- Work conducted by
  - Yi Meng
  - Shihui Luo
  - Feng Huang

Decision support for sustainable growth

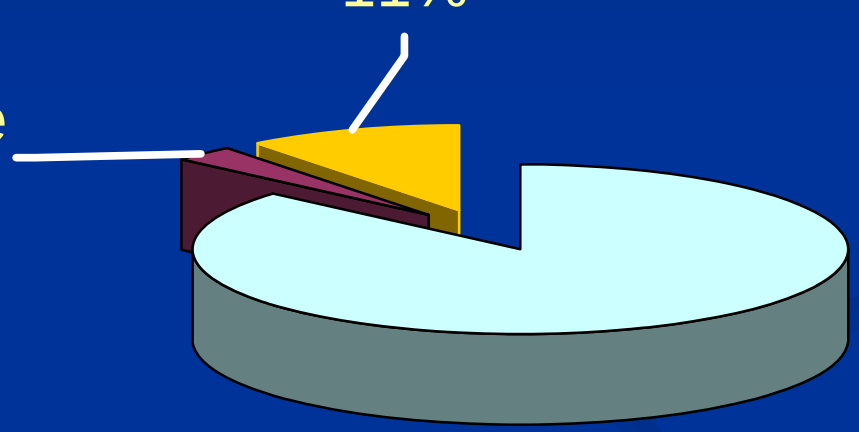
What do decision-makers need to know?

- Demonstrate need for efficient water use
- Water reuse education
- Identify potential barriers and incentives
- Provide tool for economic assessment

NE Illinois: Limited water sources

Minimum flow requirements

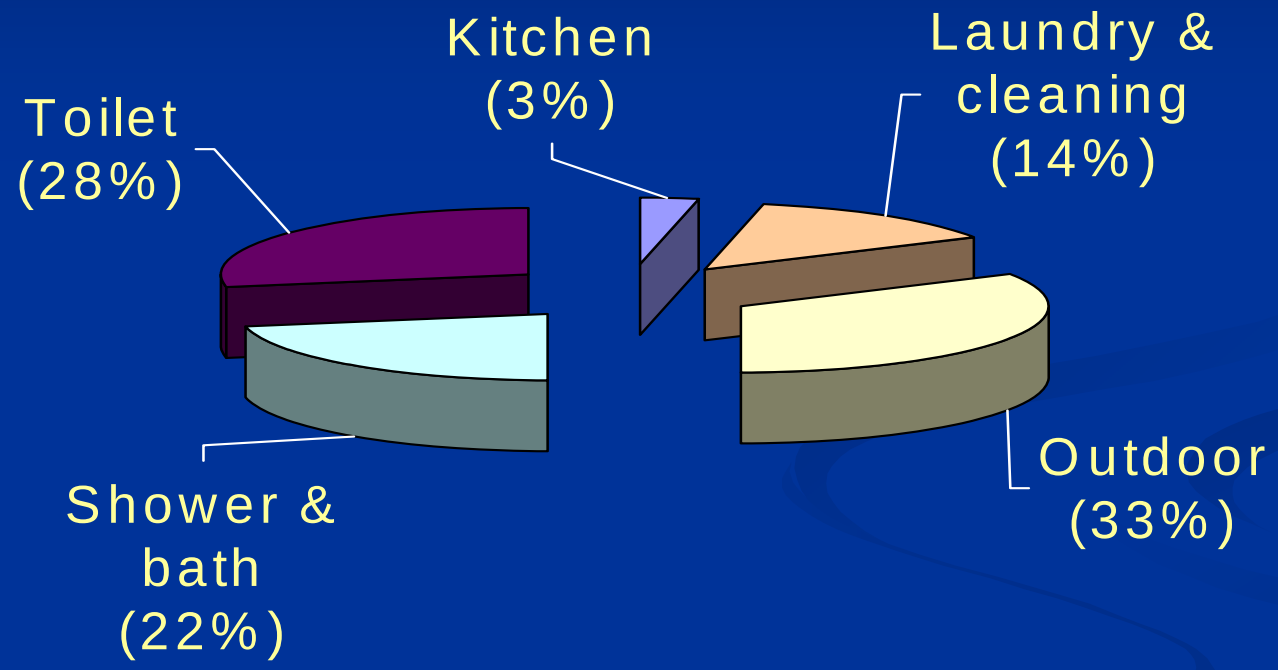
Unknown resources
Falling water table



Limited by
Supreme Court decree

Northeastern Illinois regional non-cooling water source allocation (NIPC, 2001)

We don't use water very efficiently



Domestic water use (USEPA, 2006)

The Illinois Diversion

54%

2 WPPs

Users

Reuse

N.B. Chicago River

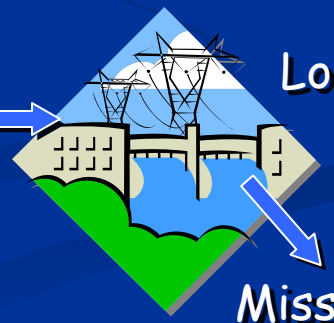
Combined Sewer System

16%

30%

7 WWTPs

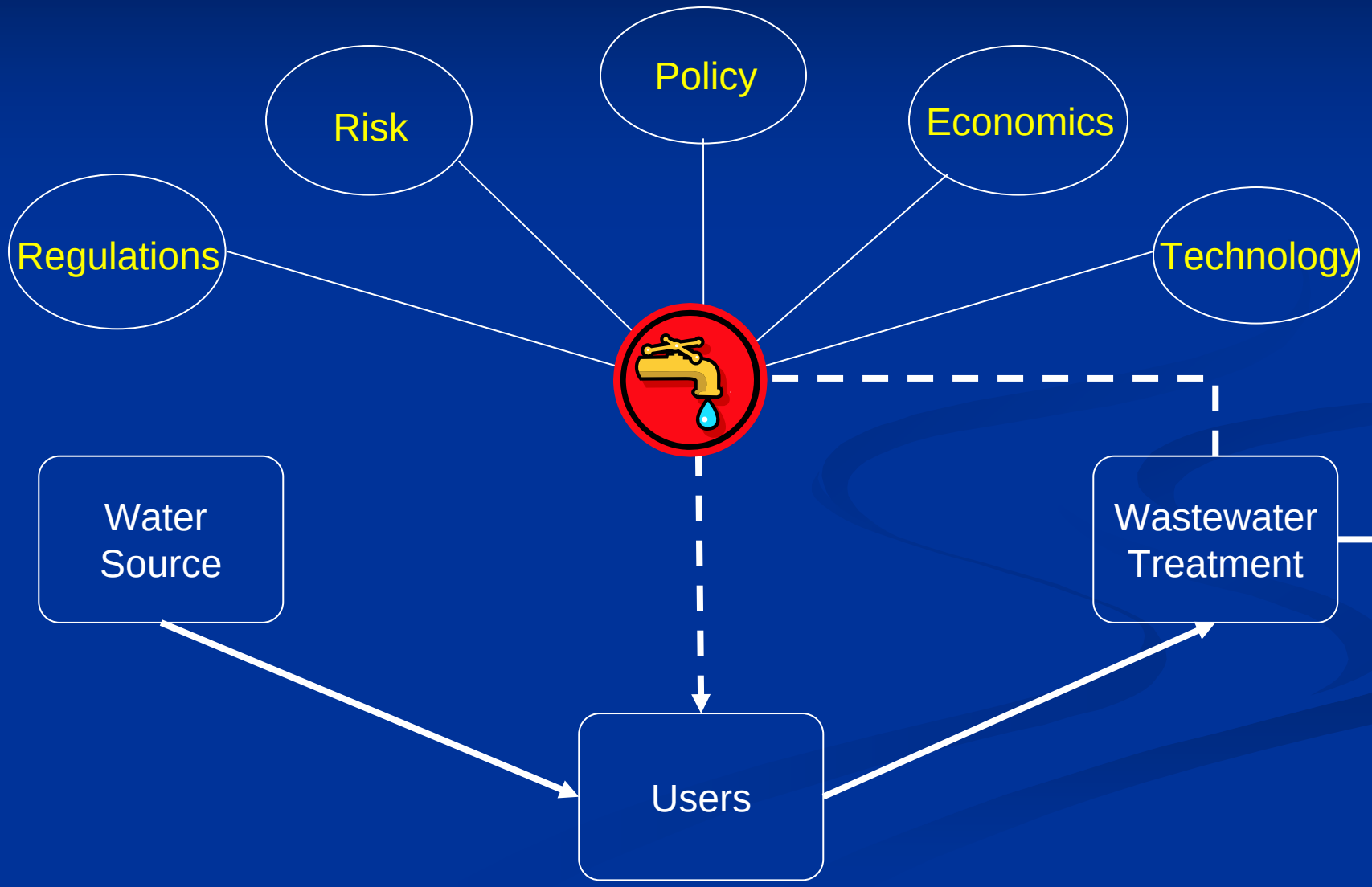
Chicago Sanitary & Ship Canal, Cal-Sag Channel



Lockport

Mississippi River

Water reuse: Barriers & Incentives



Water reuse regulations

- Federal
  - There are no water reuse regulations
  - *Guidelines for Water Reuse* (USEPA, 2004)
- States (2004 data)
  - 25 states have regulations
  - 16 states have guidelines
  - 9 states without regulations or guidelines

Illinois reuse regulations

- State level
  - IEPA (land application)
  - Dept. of Public Health (cross-connections)
- Regional (CMAP)
  - "…recommended alternative is to evaluate a no-discharge system, such as land application."
- Municipal
  - Chicago's Water Agenda 2003
  - Village of Richmond Reuse Ordinance

Water reuse risks

- Human health risks
  - Pathogenic organisms
    - Bacteria, viruses, protozoa
  - Chemical contaminants of concern
    - Pharmaceuticals
    - Pesticides, herbicides
    - Disinfection by-products
- Ecosystem risks
  - Chemical contaminants of concern
  - Nutrients

"…there have not been any confirmed cases of infectious disease resulting from the use of properly treated reclaimed water in the U.S."

USEPA (2004)

- Are there unconfirmed cases?
- What about non-infectious disease?
- How long does it take to see effects?
- What about ecosystem risks?
- What about incidental reuse?

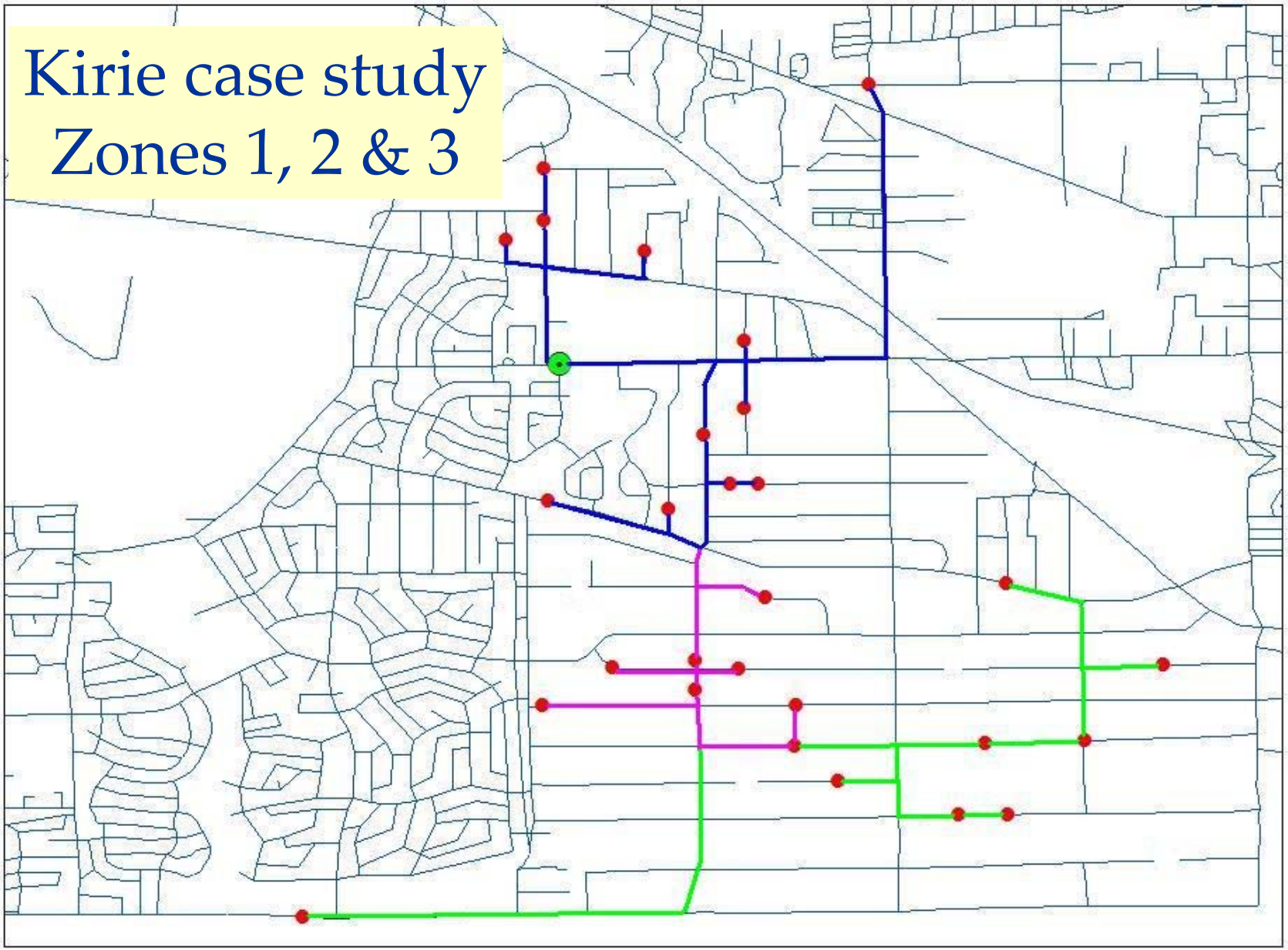
Water reuse policy

- IL Executive Order 2006-1
  - Governor orders water supply study
- The mission statement
  - "To consider the future water supply needs of northeastern Illinois and develop plans and programs to guide future use that provide adequate and affordable water for all users, including support for economic development, agriculture and the protection of our natural ecosystems."

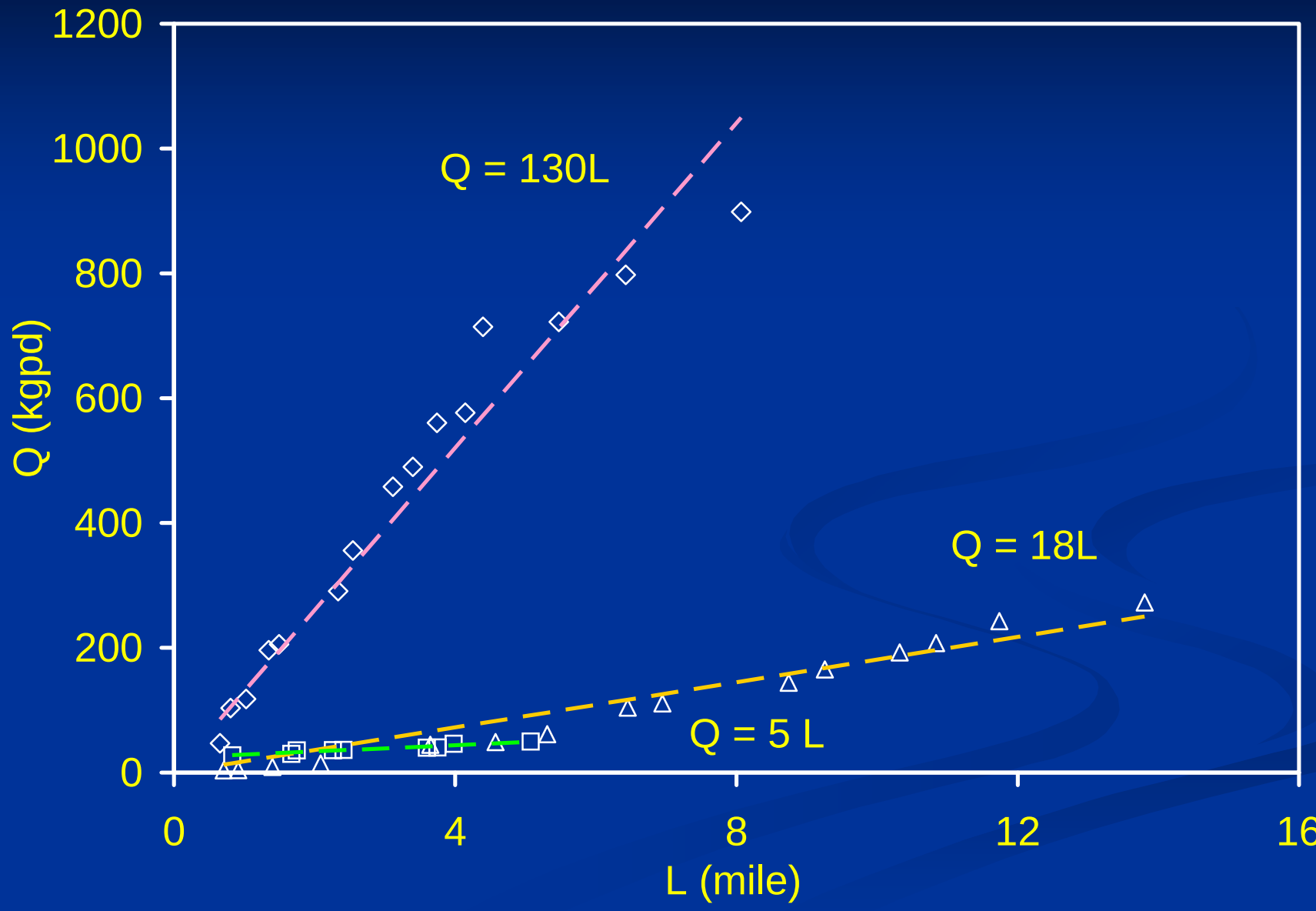
Water reuse economics

- Objective:
  - Minimize cost
- Constraints:
  - Demand
  - Mass balance
  - Capacity
  - Water withdrawal
  - Water quality

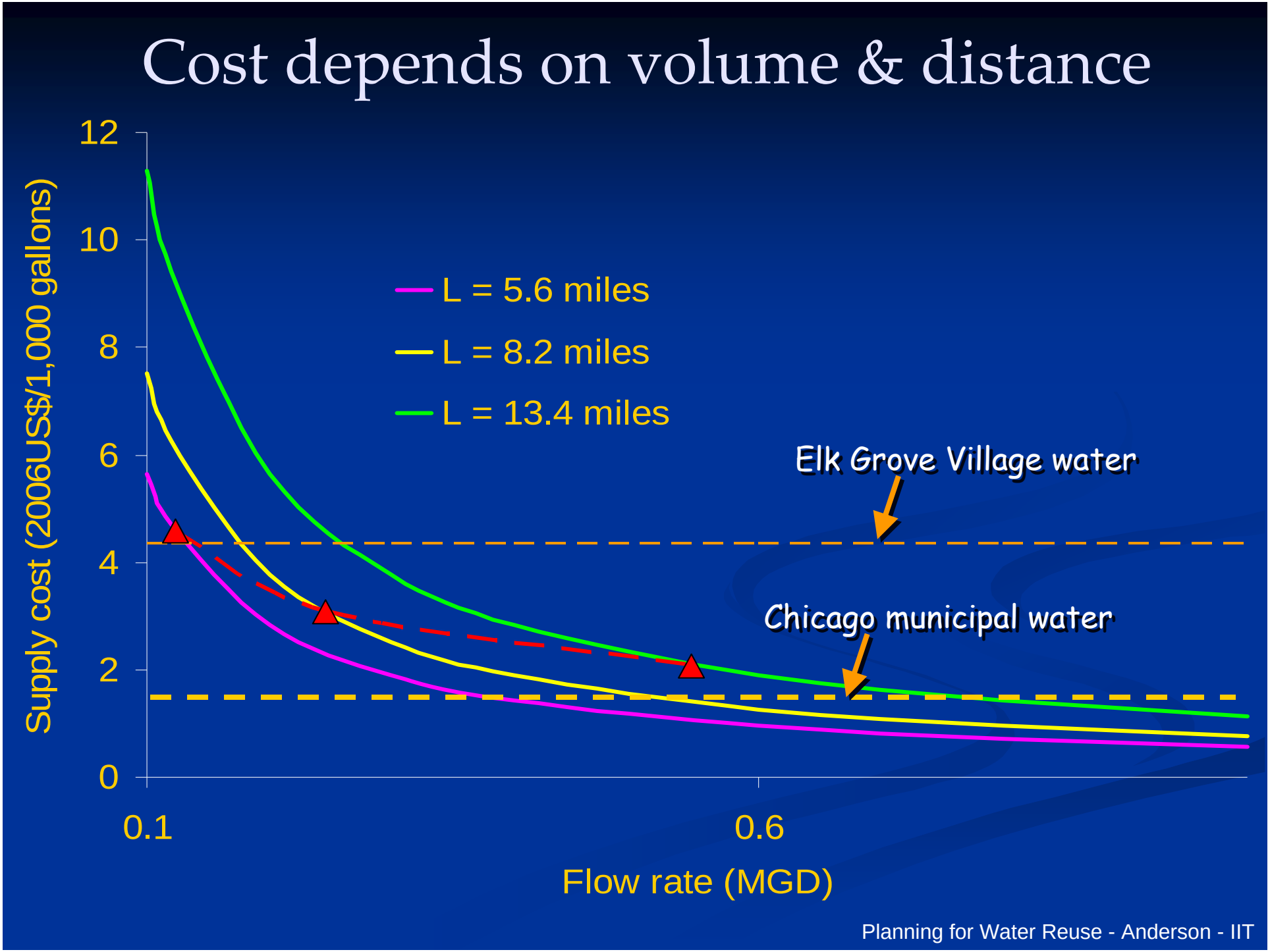
Kirie case study
Zones 1, 2 & 3



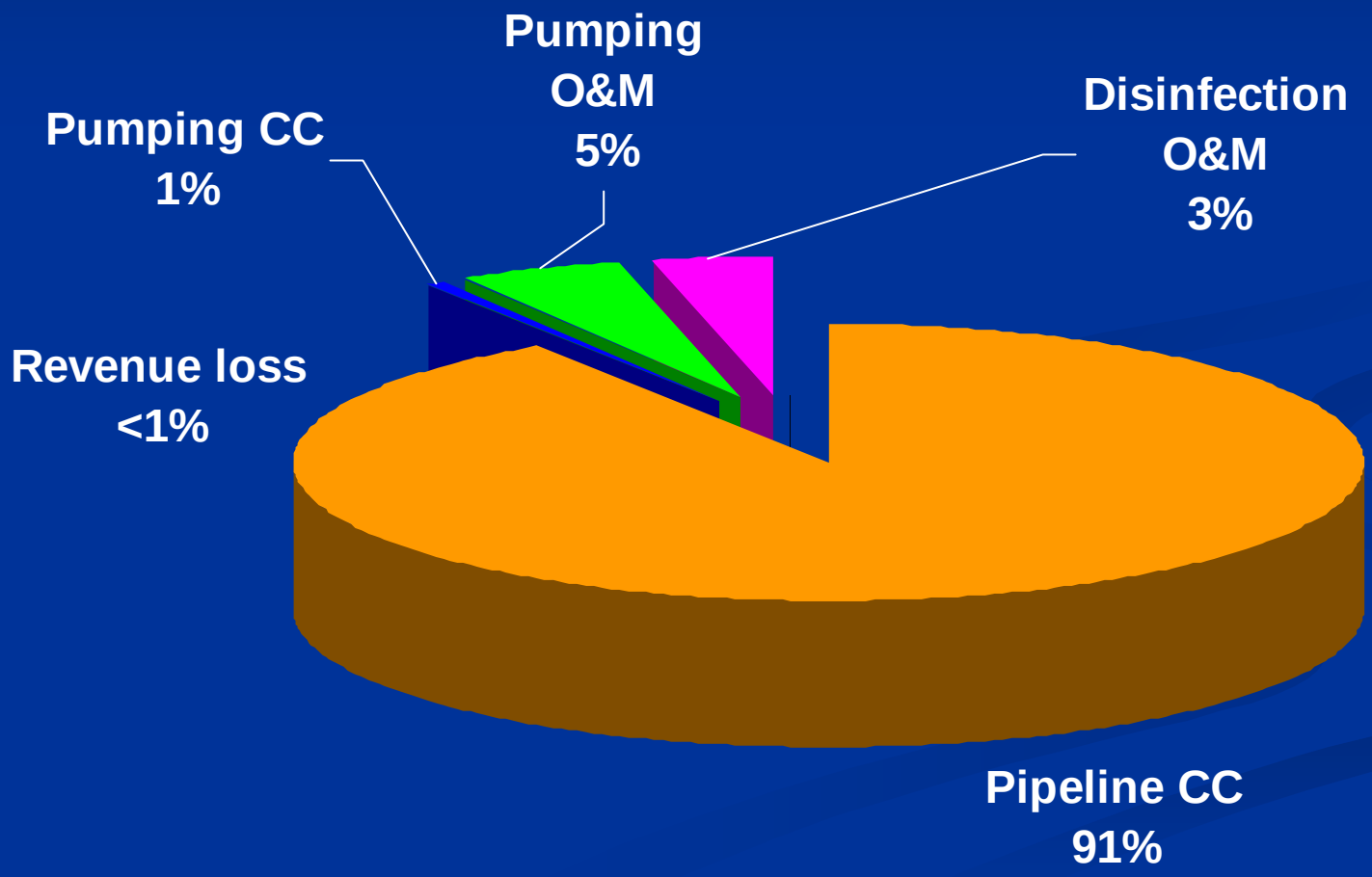
User clusters determine demand



Cost depends on volume & distance



Pipeline costs dominate



Surprises

- Water use data are limited
  - Quantity and quality
- Chicago is different
  - Water is cheap
  - WRD is revenue-neutral
- System inertia
  - Change is hard

Feedback and response

- Feedback
  - Chicago is an unusual case study
- Response
  - Partnership in Aurora, IL
  - Rationale
    - Rapid growth in western suburbs
    - Recent drought and watering restrictions
    - Limited water sources

Collaborative efforts

- Regional Water Supply Planning Group
  - NE Illinois water resources planning
  - Facilitated by CMAP
- Reuse workshops
  - Commerce & industry
  - Golf course & park district irrigation
  - Facilitated by ILWMRC

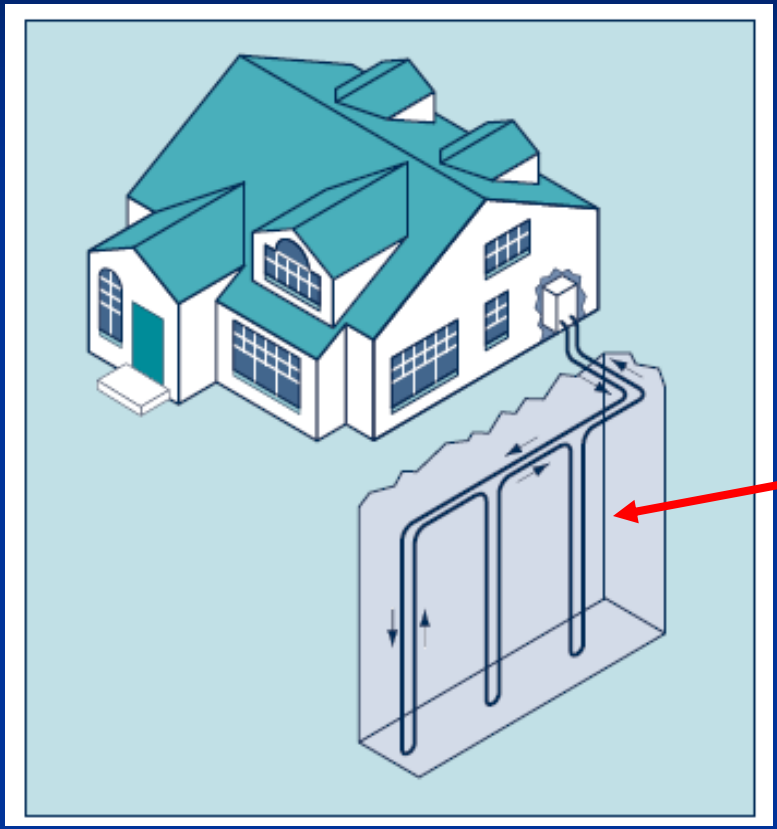
Future efforts

- CMAP's regional planning tool
  - Identify potential reuse sites
- Great Lakes regional water reuse
  - Growth in SE Wisconsin
- Can we get more value from water?

Geothermal heat pumps

- "…the most energy efficient, environmentally clean, and cost-effective space conditioning systems available." (USEPA, 1993)
- Benefits (USDOE, 1998):
  - Less energy consumption
  - Lower operating costs
  - Reduced carbon emissions

Domestic geothermal heat pump



Ground loop represents about 60% of initial costs

USDOE (1998)

Dual-purpose distribution system

- Integrated infrastructure
  - Non-potable water supply
  - Ground loop for heat pump system
- Issues
  - Economics
  - Regulations
  - Technology
  - Risk
  - Policy