

Institutional Resistance and Other Barriers

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The Journey to Date

- **Rainwater harvesting was believed to be forbidden in urban areas, it was claimed:**
 - rainwater tanks were health hazards, unreliable and not economically viable
 - Water authority projects 'proved' that rainwater harvesting was not hygienic or beneficial
 - Publications from water authorities and health officials 'claimed' that rainwater harvesting was unsafe and had no benefits
- **Early projects challenged this view:**
 - Publications by Mitchell, Clarke, Macalister and Coombes
 - Figtree place
 - Maryville

Water Quality from Rainwater Tanks

- Over 3.2 million Australians drink rainwater with no widespread adverse health effects
- BUT <5% of domestic water used for drinking/cooking → No need to drink rainwater to reap system benefits in urban areas
- Rainwater treatment chain
 - The processes of flocculation, settlement and biofilms in tanks act to improve the quality of rainwater
- Rainwater used in hot water systems has been found to be compliant with drinking water guidelines
 - Microbial heat death and microbial shock phenomena

Roof Water Quality Results from Figtree Place

Item	Roof	Tank surface	Tank supply	HWS
Fecal Coliforms (CFUs/100 ml)	113	119	0	0
Total Coliforms (CFUs/100 ml)	310	834	127	0
HPC (CFUs/ml)	1318	3256	351	3
Pseudomonas (CFUs/100 ml)	49,825	6,768	4,433	0
Ammonia (mg/L)	0.39	0.1	0.11	0.18
Nitrate (mg/L)	0.25	0.06	<0.05	<0.05
Lead (mg/L)	0.015	<0.01	<0.01	<0.01
Zinc (mg/L)	0.55	0.25	0.17	0.15

Treatment Chain!

Applying Logic to the Rainwater quality debate

- **Notable failures in centralised water supply systems**
 - Sewage contamination at Sunbury in Victoria impacting thousands of people
 - Cryptosporidium outbreak at Milwaukee in USA that impacted on 400,000 people
 - About 100 deaths
- **Analysis of health publications indicates that it is over 1000 times more likely to contract illness from drinking mains water compared to rainwater**

Applying Logic to the Rainwater quality debate

- Epidemiological studies by Heyworth found that consumption of mains water more likely to cause gastrointestinal illness than rainwater
 - No relationship between Coliform bacteria and illness
- Disparity between apparent faecal contamination of rainwater and low prevalence of illness
 - Due to limited sources of contamination
 - birds and small animals?
 - Enteric pathogens are usually species specific
 - Most bacteria in tanks are environmental species
 - Bacillus Spp.
 - A natural rainwater treatment train exists



Applying Logic to the Rainwater quality debate

- Two well researched cases do show illness resulting from consumption of rainwater
 - Access of frogs and mice to an open tank in North Qld causes gastrointestinal illness in construction workers (Salmonella)
 - Underground tank contaminated with septic tank overflows results in isolated outbreak of gastrointestinal illness (cryptosporidium)
- Results are instructive
 - Modern sealed tanks located above ground will eliminate this risk pathway
 - Simple design standards required

Past Hot Water Research

- *Legionella Spp.* are present in all waters.
- Has been a serious problem in mains water systems with low temperature storage hot water systems
- Illness caused by inhalation of aerosols rather than ingestion
- Research has established that *Legionella Spp.* is eliminated by exposure to heat
 - 90% reduction in 4.8 minutes at 60°C
 - 90% reduction in 0.16 minutes at 66°C
- Resulted in ASNZ 3500.4.2 requiring storage hot water systems to be set at a minimum of 60°C
- Instantaneous hot water systems more efficient for elimination of bacteria

D-values of bacteria grown at 37°C exposed to instantaneous heat: results of laboratory studies

Bacteria	55°C	60°C	65°C	55°C	60°C	65°C
	N	N	N	S	S	S
E. Coli O157:H7	223	67	3	232	69	3
E. Coli O3:H6	401	51	<2	225	41	3
Shigella Sonnei	354	54	3	305	39	4
Pseudomonas aeruginosa	304	49	5	116	45	<2
Salmonella typhimurium	77	4	<2	34	6	<2
Klebsiella pneumoniae	22	<2	<2	19	<2	<2

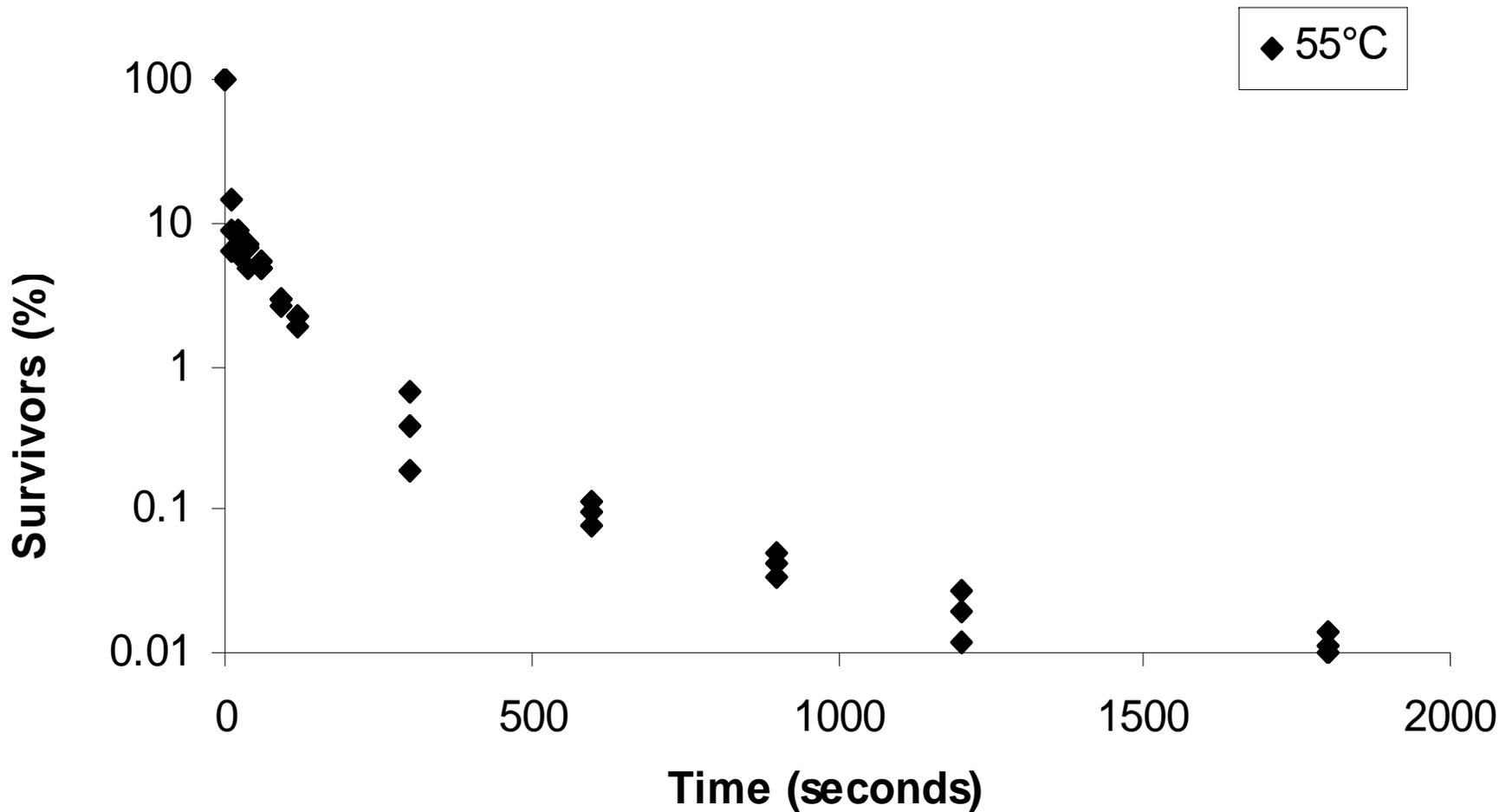
Average *E. coli* concentrations in Cold and Hot water samples

From field studies of urban rainwater tanks
no treatment measures, old storage hot water services and
overhanging trees

System	N	Cold Water	Hot water	Hot water Temp	Reduction %
1	10	0.3	0	66.3°C	100
2	8	1429	0.1	50.7°C	99.99
3	8	113	1.3	65.4°C	98.89
4	4	7	0	60°C	100
5	5	8	0	69.2°C	100

Inactivation of Heterogeneous Bacterial Population at 55°C:

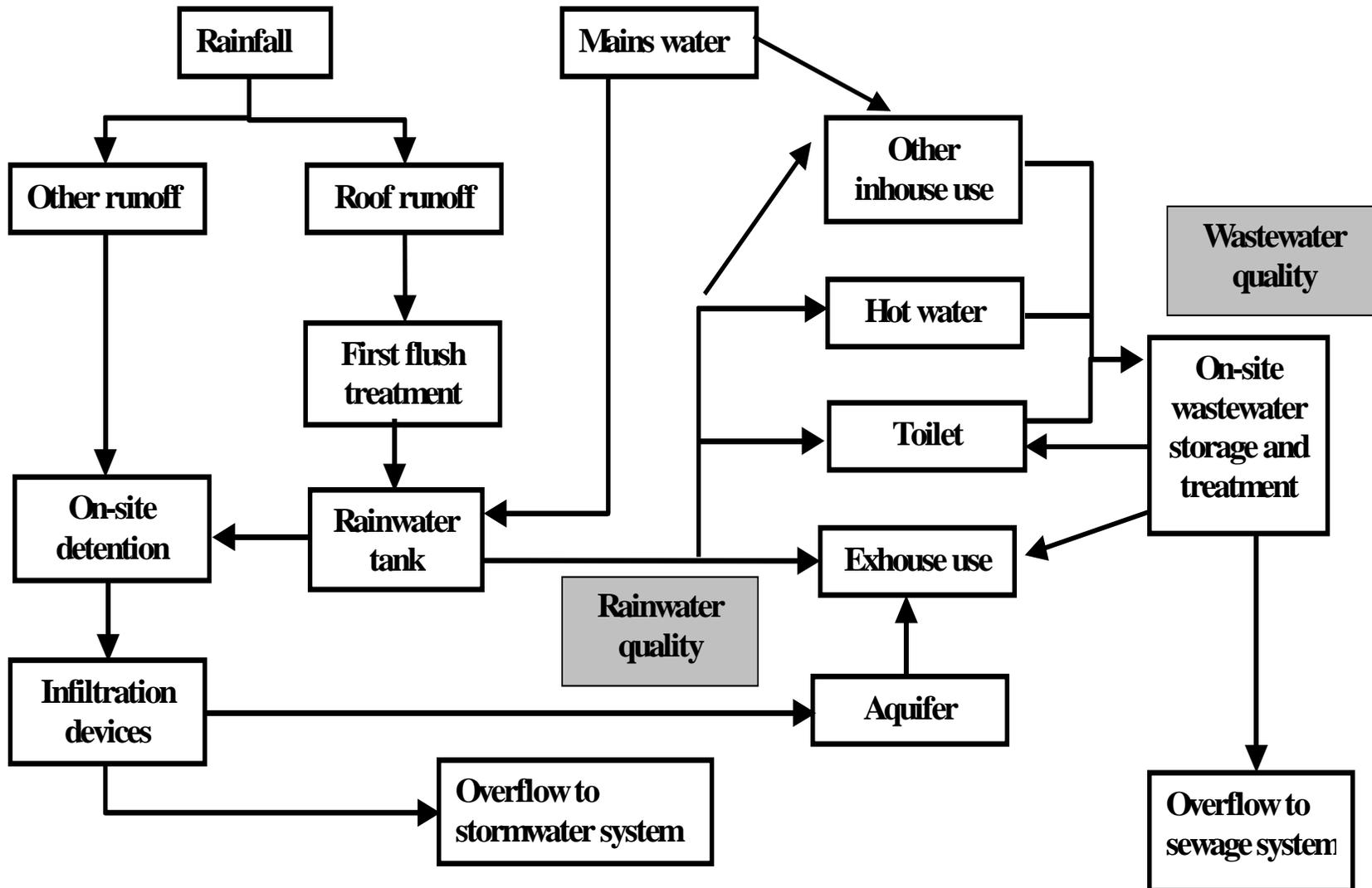
bacteria sourced from rainwater tanks



The Journey to Date

- **It was claimed that rainwater tanks will not improve the security of regional water supplies or reduce requirement for trunk infrastructure**
- **LGAs claim that rainwater harvesting will not reduce requirement for stormwater infrastructure**
 - **Private infrastructure cannot be reliable**
- **Research from the University of Newcastle (Coombes) showed that widespread adoption of tanks will improve regional water security**
 - **Efficient dual water supply systems were created**
 - **PURRS model was created to reveal infrastructure benefits**
 - **Partnerships with industry were initiated to explore benefits and implementation methods**

PURRS: probabilistic Urban Rainwater and wastewater Reuse Simulator



The journey to Date

- In response to community support, State Governments create rainwater policies
 - 5 star rating in Victoria
 - BASIX in NSW
 - LGA planning policies
- Capacity building policies and demonstration projects were created
 - Improved understanding of rainwater harvesting
 - Aided the development of sensible guidelines

The Paradigm Curve

Implementation
of idea

Business
as usual

Strong
resistance to
implementation

Incremental
improvement
of established
idea

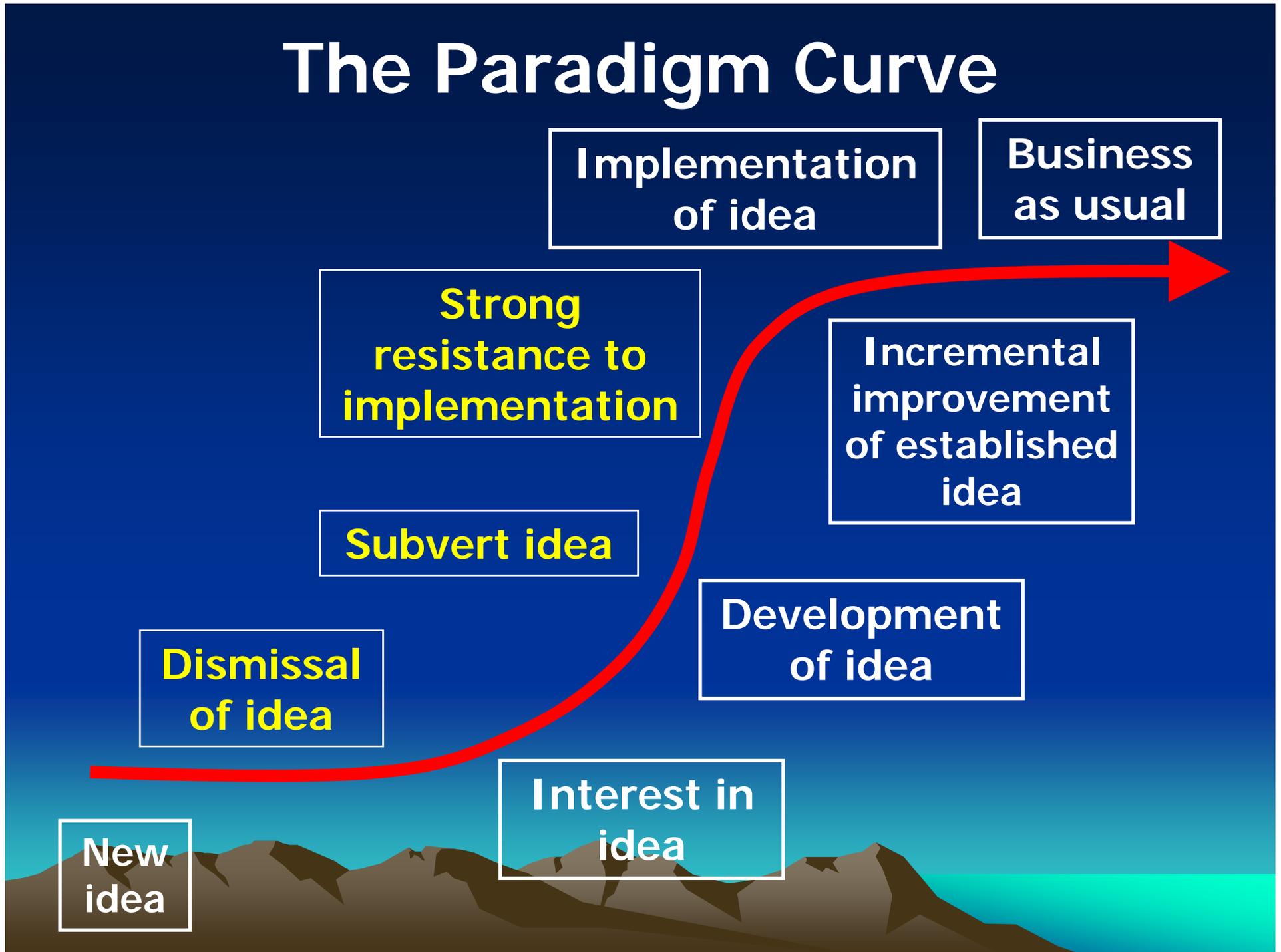
Subvert idea

Development
of idea

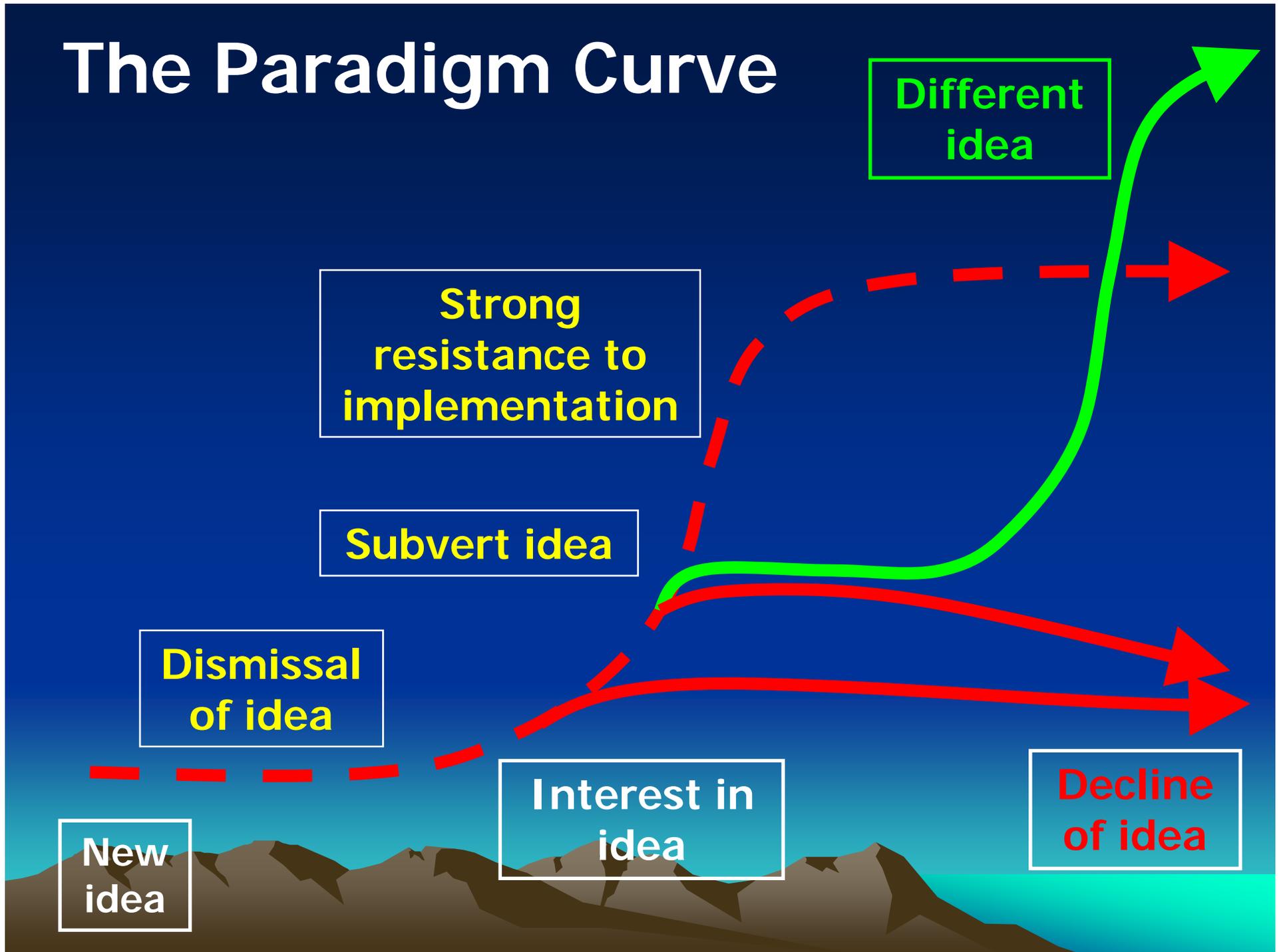
Dismissal
of idea

Interest in
idea

New
idea



The Paradigm Curve



Conclusions

- **Consistent messages required from Government and Institutions on permitted uses of rainwater**
 - efficient approval processes
 - Consistent design rules
 - Demonstration projects
- **Consider treatment train or methods for rainwater**
 - Roof to end use treatment train, Filters, UV and so on
 - Appropriate end uses for a given treatment method
- **Rainwater guidelines**
 - An agreed set of solutions based on research rather than assumptions and ongoing research needs should be defined
 - Simple “agreed” drawings and guidelines required
 - Acknowledgement of systems benefits

