

# Designing the Underworld

## Trees, People and the Built Environment

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# Overview



1. Background

2. Use of Underground Space

3. Physical Interdependencies

4. Mapping the Underworld Initiative

5. Summary

# Uses for Underground Space



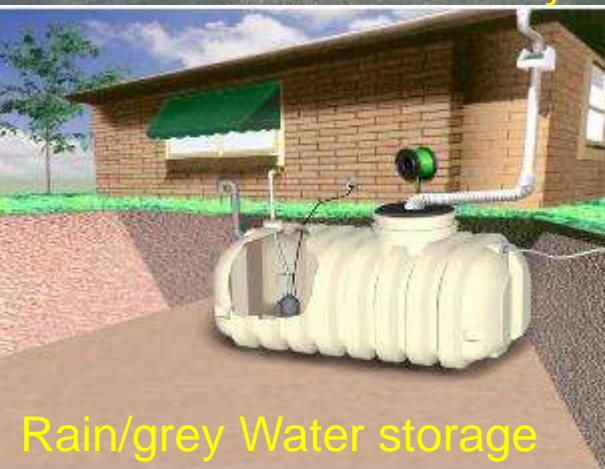
Food delivery



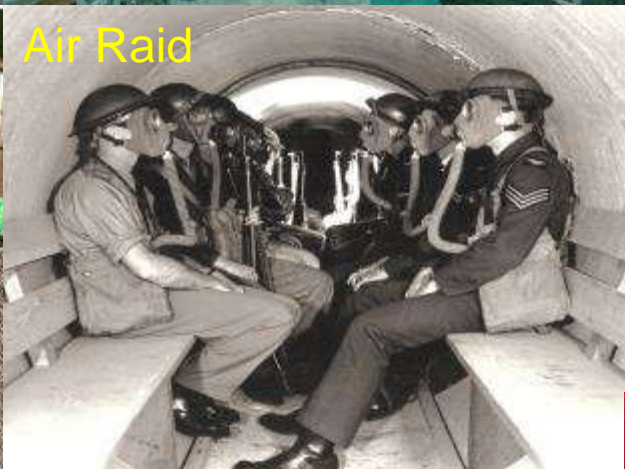
Operating theatres



Cinema/Theatres



Rain/grey Water storage



Air Raid



PWC



Living



Retail/offices

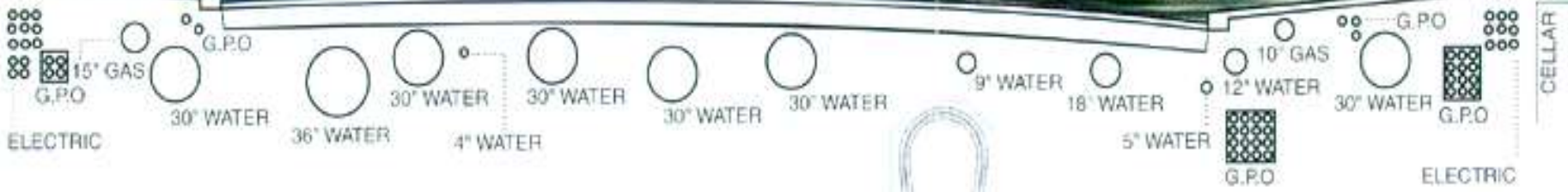


Gas, Water, Com's

# Use of Underground Space



# Use of Underground Space



27+

## Environmental Impact

Example: Damages to tree roots (from utilities) and vice versa



UNIVERSITY OF BATH

UNIVERSITY OF BIRMINGHAM

British Geological Survey

EPSRC  
Engineering and Physical Sciences Research Council

UNIVERSITY OF LEEDS

Newcastle University

The University of Sheffield

UNIVERSITY OF Southampton

UKWIR

## Social Impact

Examples: Loss of utility provision, traffic delays, losses to local businesses, reduced quality of open space



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# Physical Interdependencies

Surface urban transport infrastructures – roads, cycle ways, pedestrian areas, tramways – are vital to a city's function

Since the *utility services infrastructure* that supports city living is typically buried beneath the *surface transport infrastructure* ...

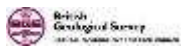
... streetworks to install, replace, repair or maintain the utility infrastructure comes into conflict with the city's movements

In particular, using traditional (i.e. open cut) techniques disrupts, and often significantly damages, the transport infrastructure ...

... and the ground on which it bears

... and the ground in which the utility infrastructure is buried

... if the ground properties change, or the ground moves, the adjacent / overlying infrastructure responds accordingly





# Physical Interdependencies

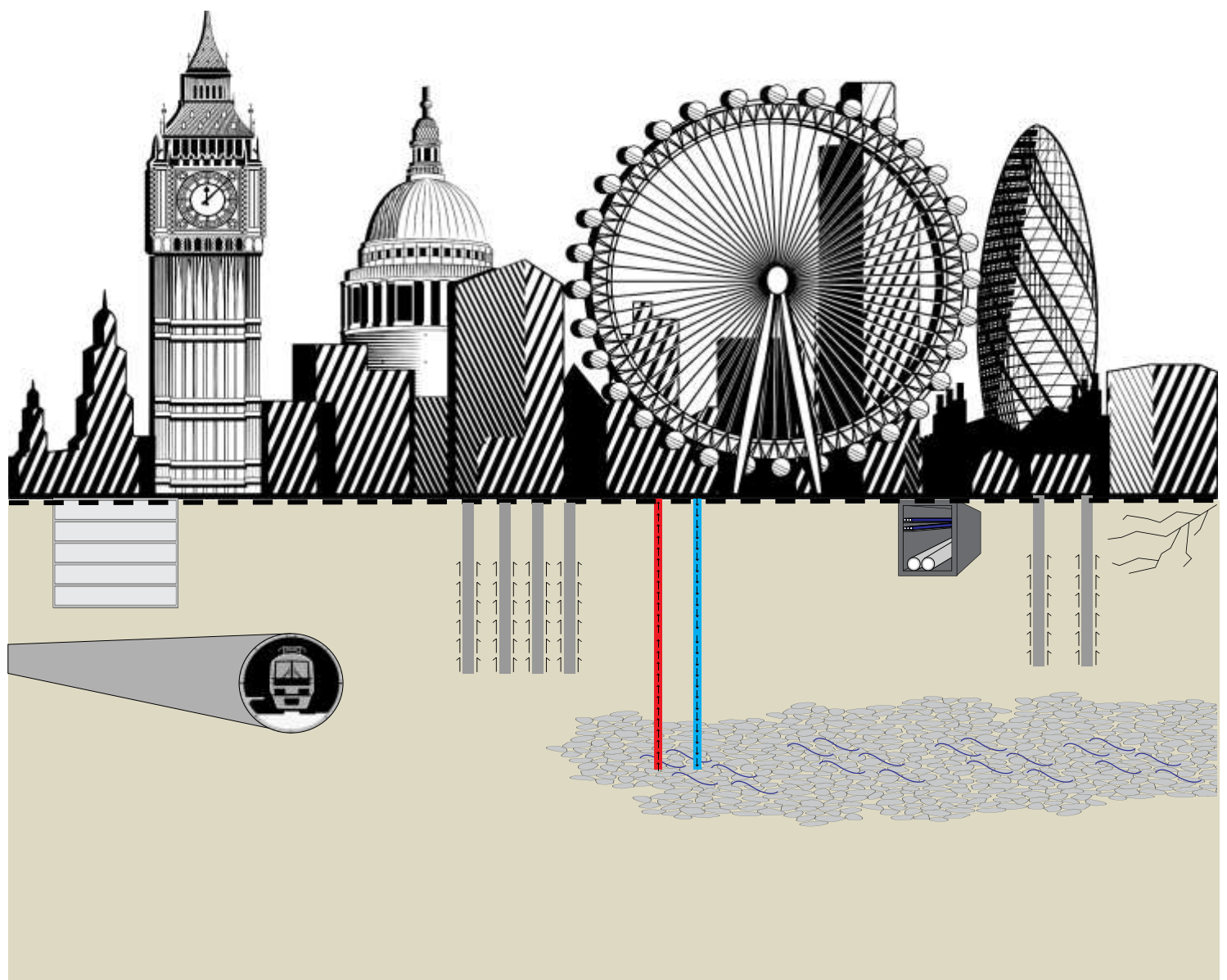
A leaking water pipe can erode and weaken the soil  
...leading to road failure



May 2016 – Florence (Italy)

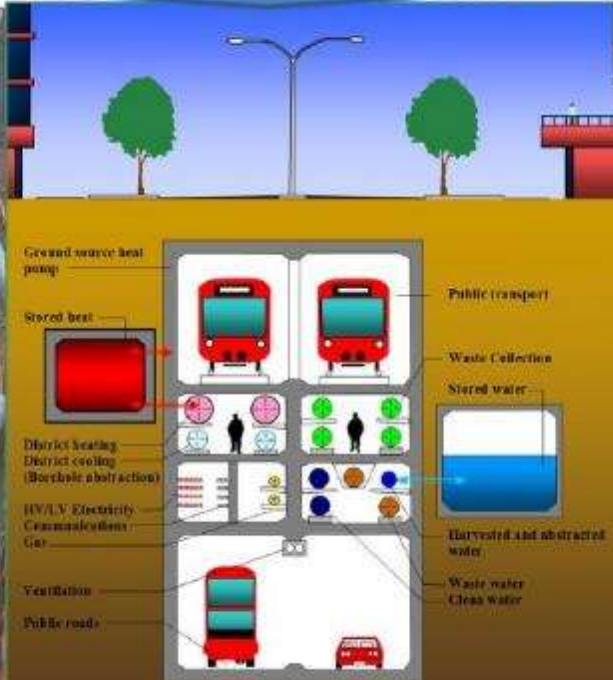
# Physical Interdependencies

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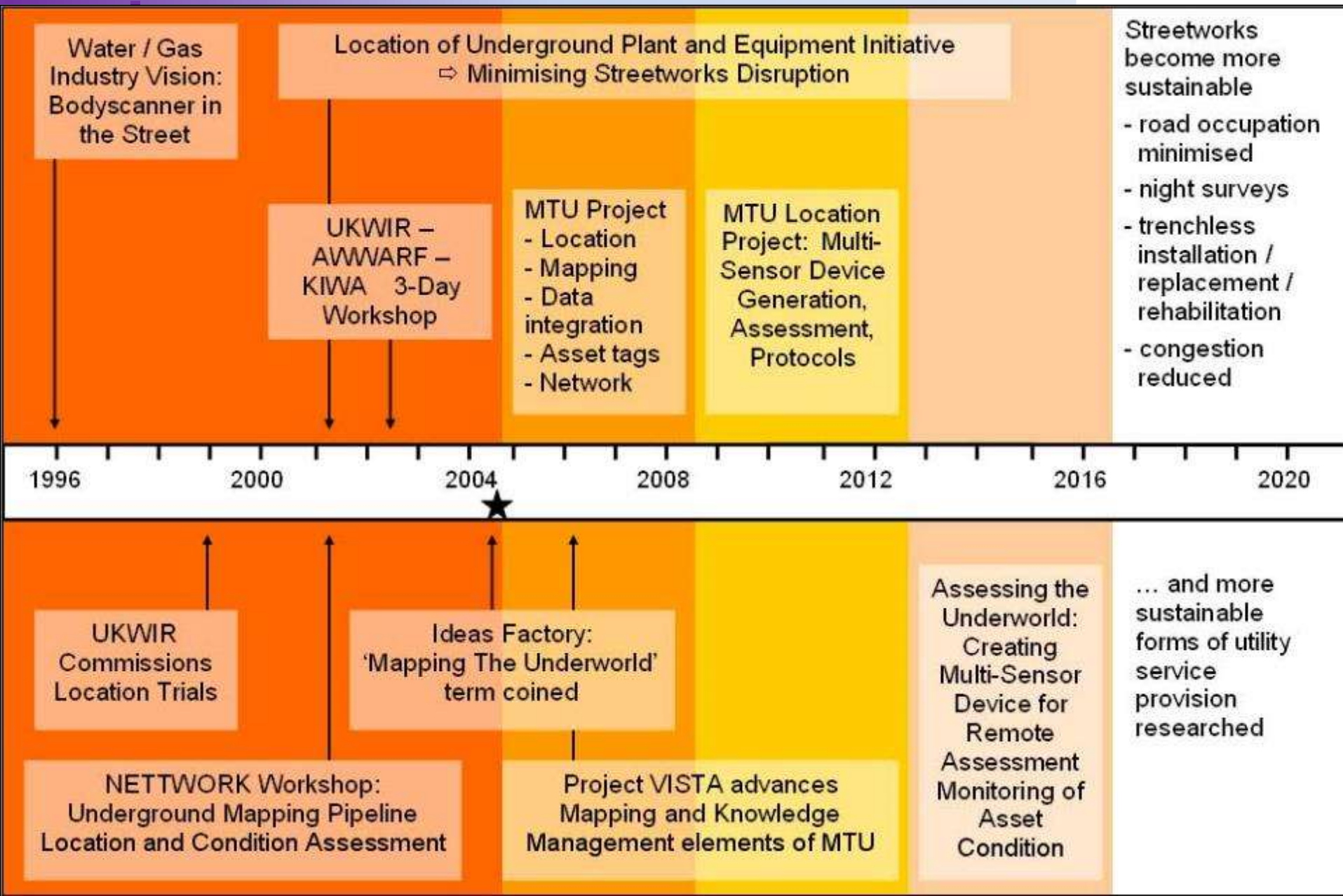




## From confusion to management for ST and LT



# Mapping the Underworld Initiative



# Mapping the Underworld Initiative

Are we going to dig trenches or use trenchless technologies?

How can we carry out streetworks in the most sustainable manner – i.e. economically, socially and environmentally cost effective?

- Streetworks become more sustainable
- road occupation minimised
  - night surveys
  - trenchless installation / replacement / rehabilitation
  - congestion reduced

Do we know what is buried beneath the streets ... and where it is?

We need a map of the underworld before we start

**MTU Project**  
 - Location  
 - Mapping  
 - Data integration  
 - Asset tags  
 - Network

**MTU Location Project: Multi-Sensor Device Generation, Assessment, Protocols**

1996

2000

2004

2008

2012

2016

2020

What condition is the road surface, and road foundation, in?  
 What is the condition of the adjacent pipes and cables?  
 What is the condition of the adjacent ground?  
 What will happen to the road, pipes and cables when we excavate, when we reinstate and in the long term?

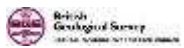
**Assessing the Underworld: Creating Multi-Sensor Device for Remote Assessment Monitoring of Asset Condition**

... and more sustainable forms of utility service provision researched

# Summary

- Underground space is crowded
- Currently it is a free for all – first serve
- Proactive management of underground space is needed – possibly a masterplan?
- Mapping the Underworld Initiative tries to address many challenges

➔ Vital to view Underground Space as a holistic system, combined with surface use





# Thank You

## Any Questions?

More information can be found at  
[www.mappingtheunderworld.ac.uk](http://www.mappingtheunderworld.ac.uk)  
[www.assessingtheunderworld.org](http://www.assessingtheunderworld.org)