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NOVEL BUSINESS MODELS IN SUPPORT OF TRENCHLESS CITIES

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What are the Essential Features of Cities?

We have many aspirations (needs) for cities

- **Sustainability** – ensuring we meet the needs of people today without compromising the ability of future generations to meet their own needs
- **Resilience** – ensuring that our engineering interventions continue to function, and deliver their benefits, no matter how the future develops
- **Liveability** – putting people at the centre of our thinking … embracing our responsibility of looking after people's health and wellbeing … and for this we need planetary wellbeing
- **Adaptability** – making sure that, wherever possible, our systems are able to respond to contextual change
- **Smart** – delivering all of the above

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… surely the application of trenchless technologies is all about delivering on these principles

How do we Enable Change to Happen?

First – Compile a rigorous Evidence Base

Second – Make the Business Case for change

Comprehensive, accessible, transparent

Third – Create the Business Models to implement change

Balance the (multiple) forms of value against the cost

Fourth – Engineer all of the Forms of Governance

To enable the business models to work

The 'hard' systems of governance

- *Legislation, Regulation, Taxation*
- *Codes and Standards*

… and the 'soft' systems of governance

- *Citizen and societal attitudes and behaviours*
- *Societal norms, social acceptability, practice norms*

… and avoidance of risk

The information on this, and the subsequent slides, is taken from Rogers (2018), Leach and Rogers (2019) and UKCRIC (2019)

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… is the evidence base for TT not strong enough?

Is the case for change not compelling?

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… we fall short on the Business Models:

Robust, transparent and comprehensive articulation of all the positive consequences of TT and all the negative consequences of TT

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… we might need some help here

- ***Incentivise TT***
- ***Tax or legislate against trenching***
- ***Make trenching socially unacceptable***

An 'Engineering Cities' Methodology

Assemble an appropriately-broad, multi-disciplinary, multi-sectoral group of people who are able to represent the views of all stakeholders

… *all relevant disciplines* (urban professionals, sectors) *and communities of interest*

Understand deeply *the aspirations of the city and its citizens*, and the context in which the city exists (past and present)

Diagnose fully the problem

… the *Urban Living Partnership* funded five programmes on diagnostics

Establish the baseline performance of the city in terms of its sustainability, resilience and liveability – this is what the *Liveable Cities* programme set out to do

Map the systems in which the intervention is planned and all other infrastructure and urban systems with which the system interacts, *and establish all the (inter)dependencies*

Apply ingenuity to solve of the problem, yielding a number of alternatives

… this is what engineers do

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… no disturbance from utility streetworks

… (huge) adverse consequences of utility streetworks

… utility streetworks impacts on very many urban systems

… what are the TT options

An 'Engineering Cities' Methodology

Assess the impact of the intervention on the city's infrastructure and urban systems using one of the many sustainability / resilience / liveability assessment frameworks

… the *Liveable Cities* programme has produced such tools

… iteration between engineering solutions and their impacts is necessary

Conduct a futures analysis to explore whether the interventions are vulnerable to future contextual change (i.e. whether they are resilient)

… they will continue to deliver their benefits into the far future

… the *Designing Resilient Cities Methodology* is most appropriate

Make the case for change – establish a compelling 'business case' for the intervention

… the *Liveable Cities Methodology* was designed for this

Develop a suite of alternative 'business models' that capture the different forms of value that might be generated by the intervention (social, economic, environmental, political …)

… identify all of the consequences of the intervention – positive and negative

An 'Engineering Cities' Methodology

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… trenching will usually result in earlier road and buried utility failures

… surely the comprehensive, transparent business models would be compelling, if only …

An 'Engineering Cities' Methodology

Understand all of the dimensions of governance (formal and informal) *relevant to the intervention and the context* in which it is to be implemented

… and engineer changes to all of these systems of governance so that the business models can work (i.e. are able to deliver their benefits)

Influence policy by drawing on research findings

… seek to shape local and national government policy

… and make the case for the intervention to policy-makers

Influence practice by implementing the tools and case studies

… this enables the research findings to be translated to practice

Inform the public so they can understand the problems and appreciate what we are doing on their behalf

… yet by meeting citizen aspirations we will address the informal forms of governance

… and if we co-create the solutions we will be even closer to getting full 'citizen buy in'

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… this is a task for us all !

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Project Information and Cost Data*	Unit	Open-Cut Trenching Scenario	Trenchless (Pipe-Jacking) Scenario
Project duration	days	300	200
Construction duration			
Pipe length			
Pipe diameter			0
Trench depth			cut trench
Road closure			
Travel distance increase			
Direct contract costs			
Direct cost per metre of			
Increased fuel cost			
Traffic diversion cost			
Delay (time) costs to idli routes			
Lost business revenue			
Total indirect costs (crite			
Indirect costs per metre			
Indirect costs per construc			
Total Indirect costs as % of direct			
True total costs	£	7,058,174	6,131,030
True total costs per metre of placed pipe	£/m	2,823	2,452

Project information and impact / cost quantification data for a sewer system upgrade project in Kessel-Dorp, Belgium

Created by Hojjati et al. (2019) adapted from Michielsen (2005, 2006) and Matthews et al. (2015)

Project Information and Cost Data*	Unit	Open-Cut Trenching	Trenchless (Pipe-Jacking)
Project duration	days	300	200
Construction duration	days	216	144
Pipe length	metres	2500	2500
Pipe diameter	millimetres	1200 and 1600	600, 1200 and 1600
Trench / installation depth	metres	2.9 to 4.4	Deeper than open-cut
Road closure	months	8	1
Travel distance increase	kilometres	11.7	11.7
Direct contract costs	£	4,321,620	5,586,897
Direct cost per metre of placed pipe	£/m	1,728	2,235
Increased fuel cost	£	434,841	53,757
Traffic diversion cost	£	1,428,168	382,380
Delay costs – idling vehicles on diverted routes	£	431,464	53,340
Lost business revenue	£	442,081	54,656
Total indirect costs	£	2,736,554	544,133
Indirect costs per metre of placed pipe	£/m	1,095	218
Total Indirect costs as % of direct contract costs	%	63	10
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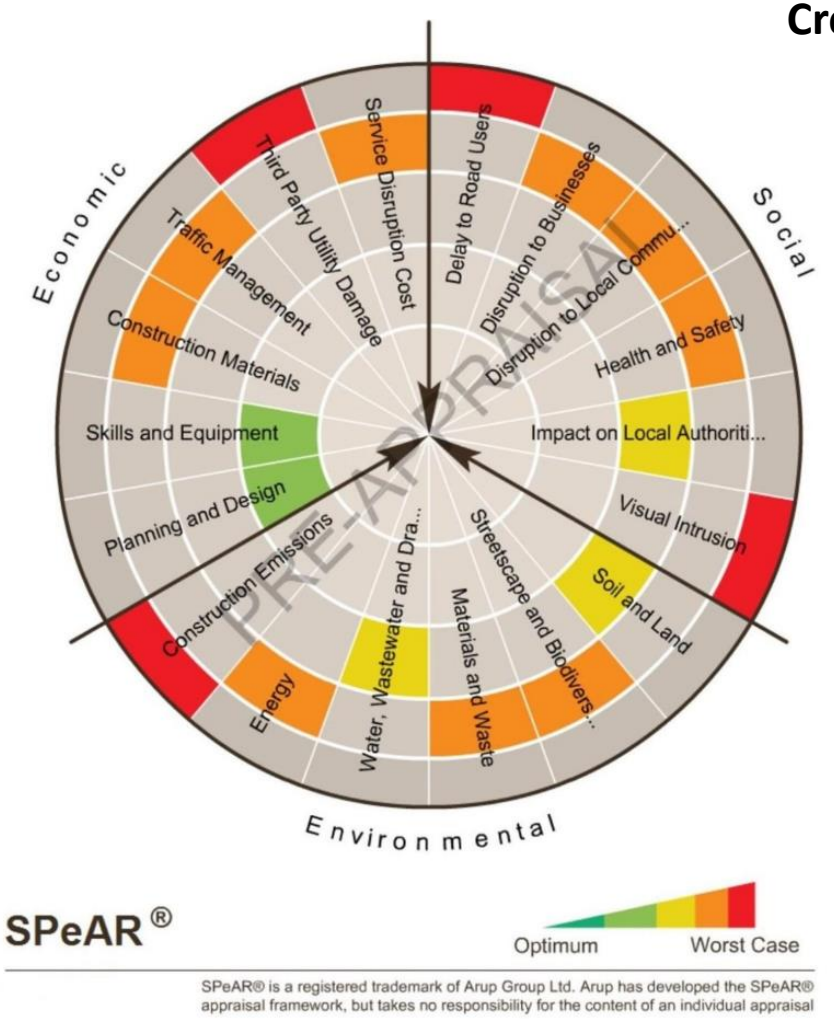
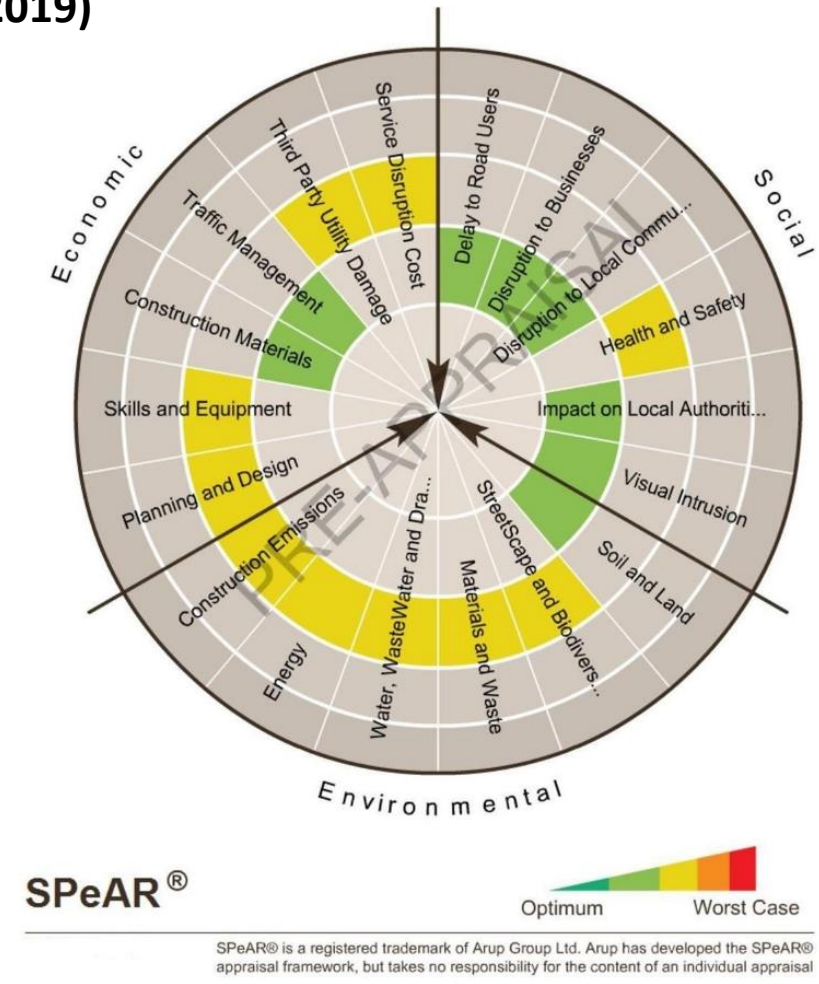
Created by Hojjati et al. (2019)

Impacts of Trenching versus Pipe Jacking – construction phase

Created by Hojjati et al. (2019)



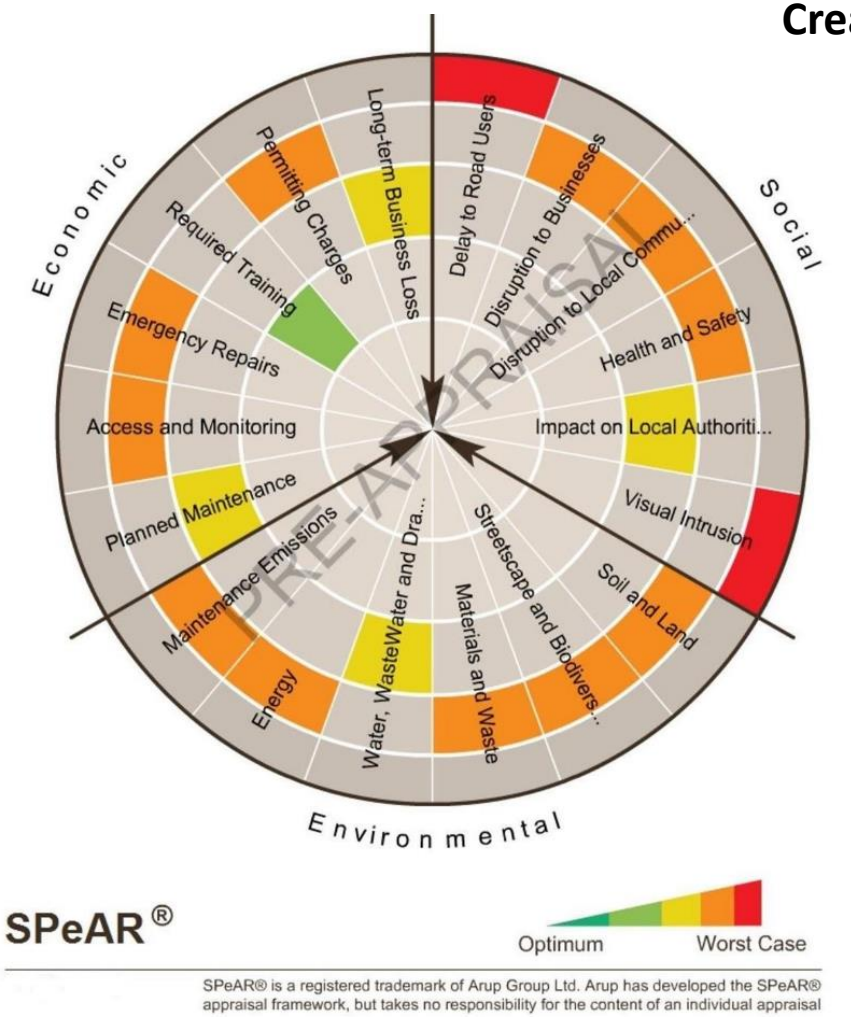
Open-Cut Trenching



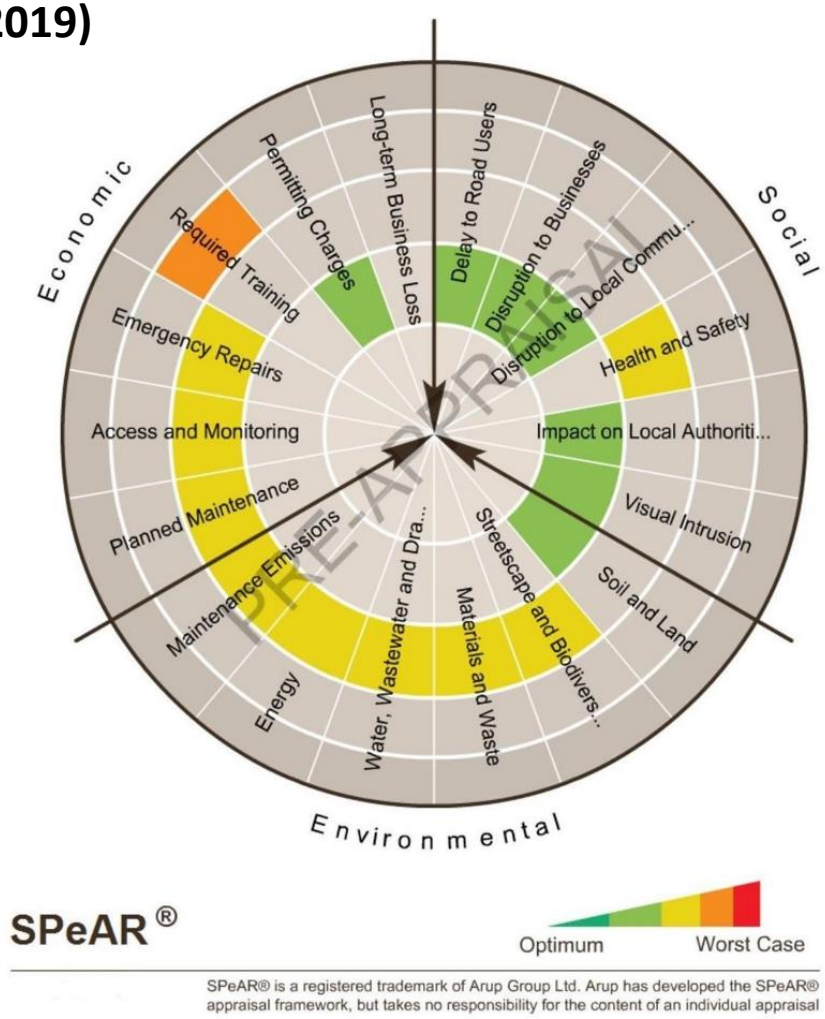
Pipe Jacking

Impacts of Trenching versus Pipe Jacking – operation and maintenance

Created by Hojjati et al. (2019)



Open-Cut Trenching



Pipe Jacking

Pipebots

In collaboration with

The University Of Sheffield.

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Engineering and Physical Sciences Research Council

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EPSRC Grand Challenge: Balancing the impact of City Infrastructure Engineering on Natural Systems using Robots:

National Buried Infrastructure Facility

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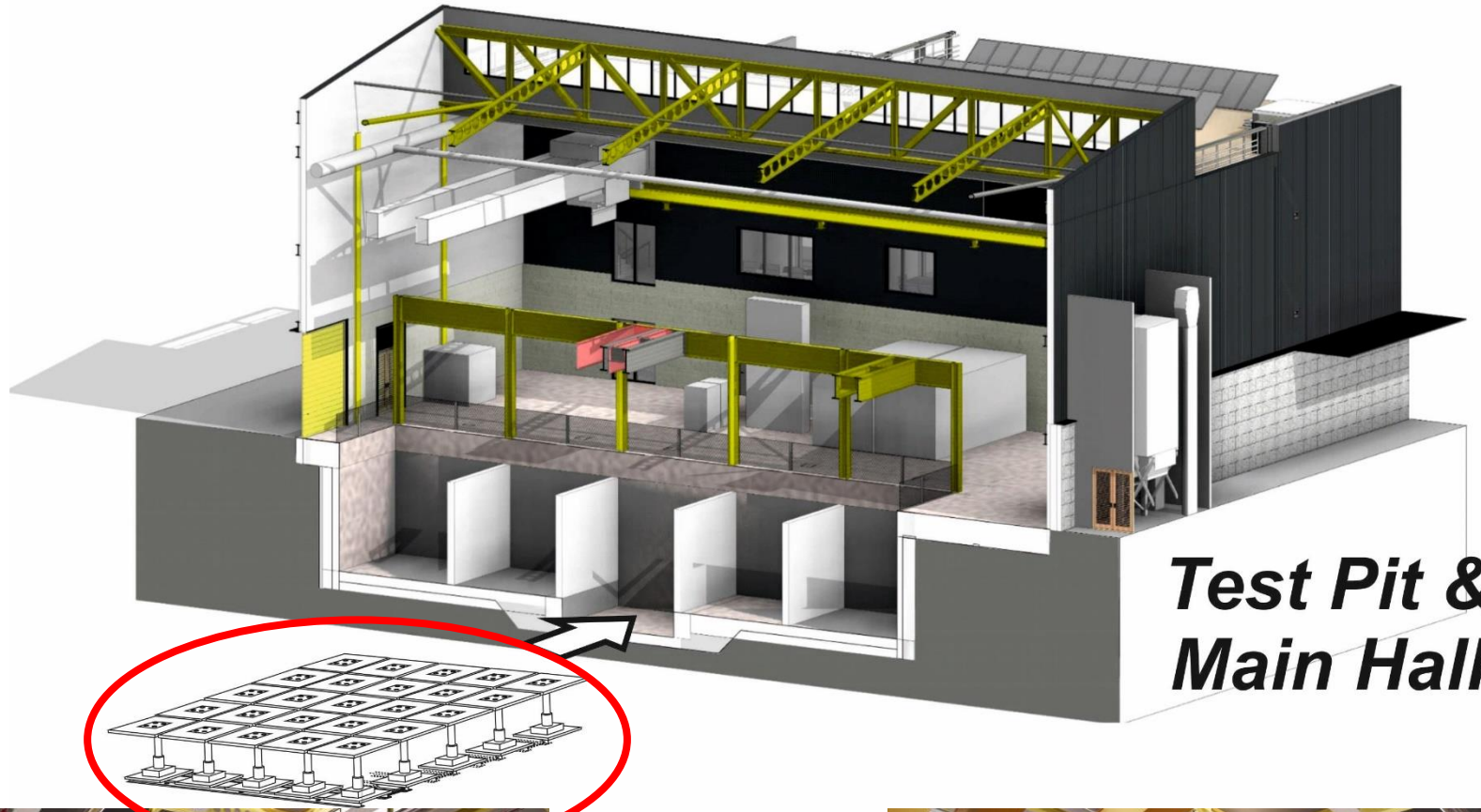
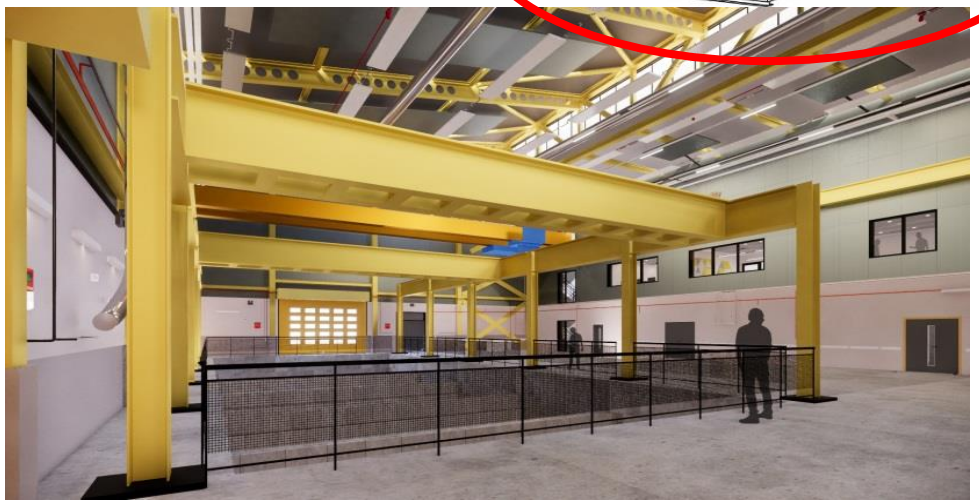
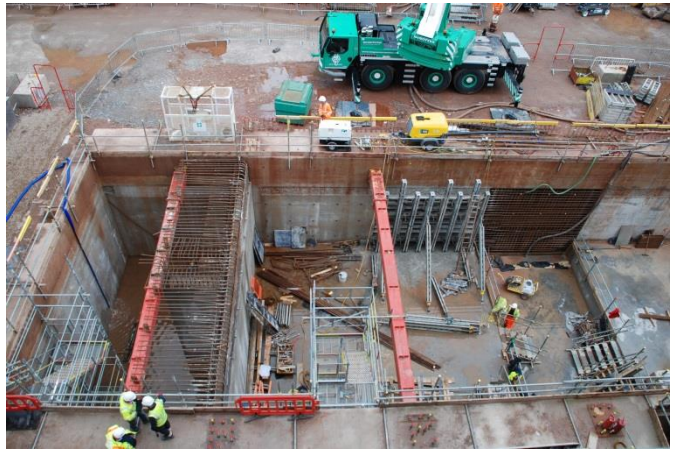
Opening Spring 2020


Test Pit &
Main Hall





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Prof. David Chapman – Buried Infrastructure

Prof. Nicole Metje – Sensors

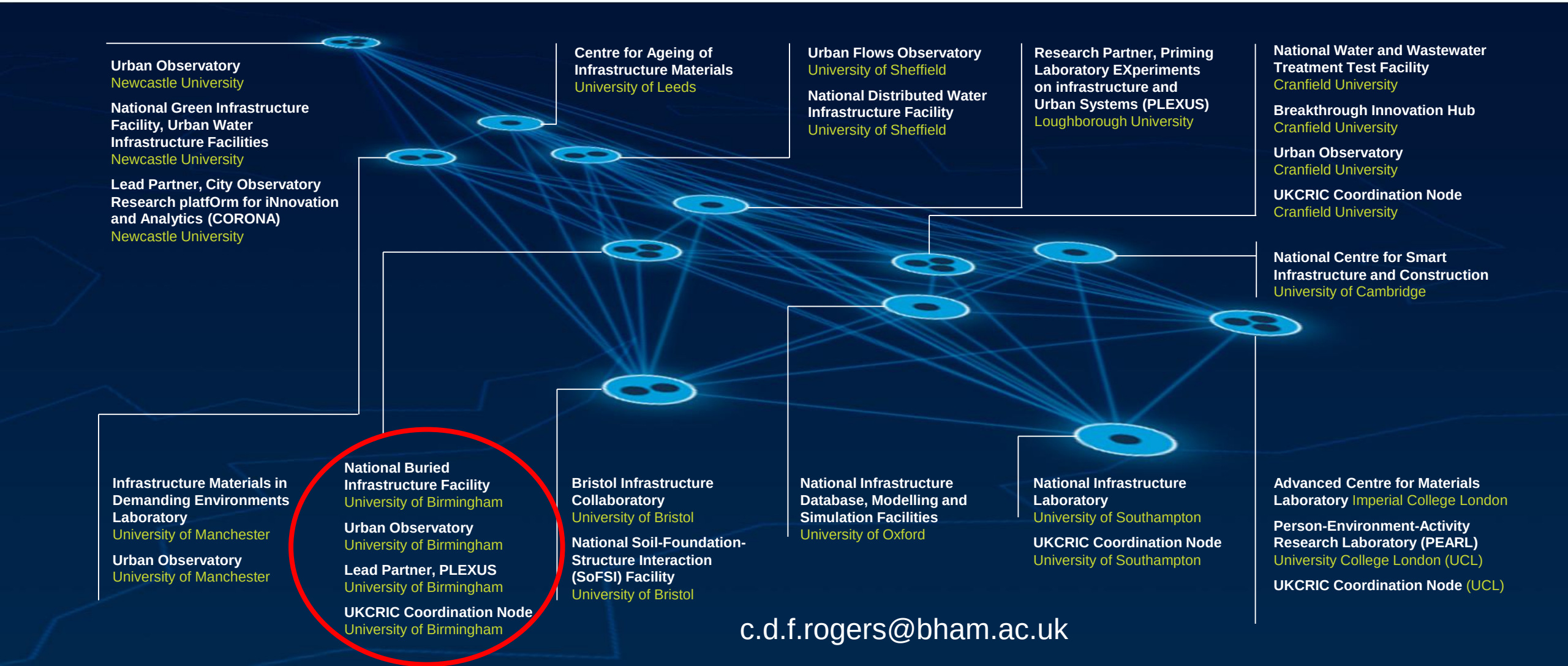
Prof. Ian Jefferson – Geostructures

Prof. Nigel Cassidy – Geo-environmental





UK Research Facilities and Programmes



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