# Techniques to help reduce service damages

# when excavating

Jeremy Blom BEng(Hons), CMIOSH









- ✓ Review of PAS 128 and the different survey categories
- ✓ Planning to avoid damages
- ✓ Equipment
- ✓ On-Site techniques
- ✓ Incident investigation and learning





#### A robust methodology for delivering utility surveys

# **Survey Categories**

#### Type D:

Desktop utility records search where underground utilities are identified through the collation and analysis of existing paper/online utility records.

#### Type C:

Site reconnaissance, where existing records are supported and validated by the visual inspection of physical evidence observed during a site visit.

#### Type B:

Detection, where underground utilities are detected and located by geophysical techniques

#### Type A:

Verification, where underground utilities are observed and located at a manhole or inspection chamber, or are excavated and exposed

- A Type D survey is a prerequisite for survey types C, B or A.
- Survey types C, B or A are independent of each other, i.e. a Type B survey does not require a Type A or C.











# **Survey Accuracy and Sub-Categories**



	Survey Type	Quality Level	Post-		ation Accuracy	Supporting Data
	stablish with client prior to survey)	(Practitioner to determine post survey)	processing	Horizontal	Undefined	
D	Desktop utility records search	QL-D	-	Undefined	Undefined	-
C	Site reconnaissance	QL-C	-	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar)
В	Detection <sup>3</sup>	QL-B4	No	Undefined	Undefined	A utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route
	, r	QL-B3	No	+/- 500mm	Undefined (No reliable	Horizontal location only of the utility detected by one of the geophysical techniques
	ſ	QL-B3P	Yes		depth measurement possible)	used
	Ţ	QL-B2	No	+/- 250mm or +/-	+/- 40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical
		QL-B2P	Yes	40% of detected depth whichever is greater		techniques used 4)
	1	QL-B1	No	+/- 150mm or +/-	+/- 15% of detected depth	Horizontal and vertical location of the utility detected by multiple 5) geophysical
		QL-B1P	Yes	15% of detected depth whichever is greater		techniques used
A	Verification	QL-A	-	+/- 50mm	+/- 25mm	Horizontal and vertical location of the top and/or bottom of the utility. Additional attribution is recorded specified in 9.2.5

1) Horizontal location is to the centreline of the utility.

2) Vertical location is to the top of the utility.

3) For detection, it is a requirement that a minimum of GPR and EML techniques are used (see 8.2.1.1.2)

4) Electronic depth readings using EML equipment are not normally sufficient to achieve a QL-B2 or higher.

5) Some utilities can only be detected by one of the existing detection techniques. As a consequence, such utilities cannot be classified as QL-B1

6) P = Post-processing. Using data recorded during scanning to help understand complex utility networks, thereby improving confidence in data interpretation.

# Use of PAS 128



The type of survey required will depend on:

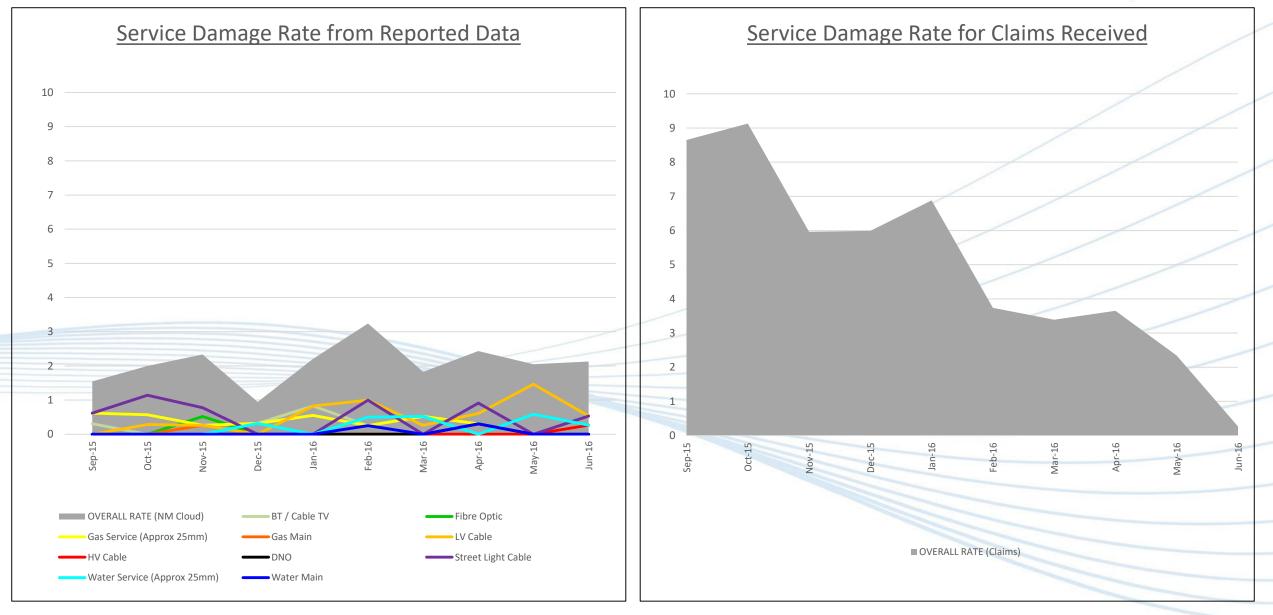
- What the information is for Design or construction
- The location
- What services are expected
- What is being constructed
- Method of excavation
- Access restrictions
- Time v Risk





# Service Damage Rate v Rate of Claims Received







#### No Action

#### 1 EQUIPMENT

Cable locators with data download facility and depth indicator as a minimum. i.e. Radiodetection eCAT4+ and Genny 4 (or equivalent).

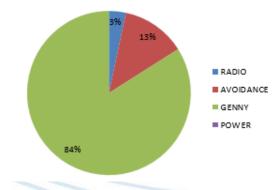
Data downloaded at least weekly and post incident.

#### Benefit

- Enables Site Manager and safety team to monitor CAT & Genny usage, compliance with standard set in training and thus identify training needs.
- 2. Enables reasonably accurate assessment of service depth, thus reducing risk of shallow strikes.
- 3. Enhances post incident investigation and causal identification.



#### Usage Analysis





# NoActionBenefit2EQUIPMENT<br/>Where applicable consider use of the<br/>eSafe ground probing radarWill locate services that are difficult to find<br/>with CAT and Genny.Is simple to use, meaning that with<br/>minimal training it can be used by the gang<br/>negating the need for external, specialist<br/>GPR surveyors.





#### No Action Benefit **PLANNING OF WORK** 3 • Ensure all available Utility Plans are Gang has all available service information attached to Permit to Break Ground. and real time visibility of work area. • Where possible attach photo of Safe System of work developed to sprayed up services to Permit to Break minimise risk of service damage. Ground. Always investigate viability of alternative digging techniques, such as Vacuum Excavation.



#### **Vacuum Excavation**







#### Benefit No Action SETTING STANDARDS 4 Pre-Start Site Induction for all operatives Enables Site Manager to set the Health, and Supervisors by Site Management. Safety, Environmental and Quality Including reference to Standards standards they require right from start, thereby improving behaviours and culture. Booklet.

NORTH MIDLAND CONSTRUCTION PLC

HEALTH, SAFETY AND ENVIRONMENTAL **STANDARDS GUIDE** 



North Midland Construction site; you should keep it with you while on site and use it as a quick reference. More detailed information the Safety Team or the QESH Portal

#### A Promise From Our Directors

"Your health and wellbeing is of prime importance to NM Group. We do not want you to put yourself at the risk of injury or ill health. You have our direct authority to stop any activity that puts yourself or others at risk and to help put it right"

> Doc Ref: HSESG Issue: H June 2017



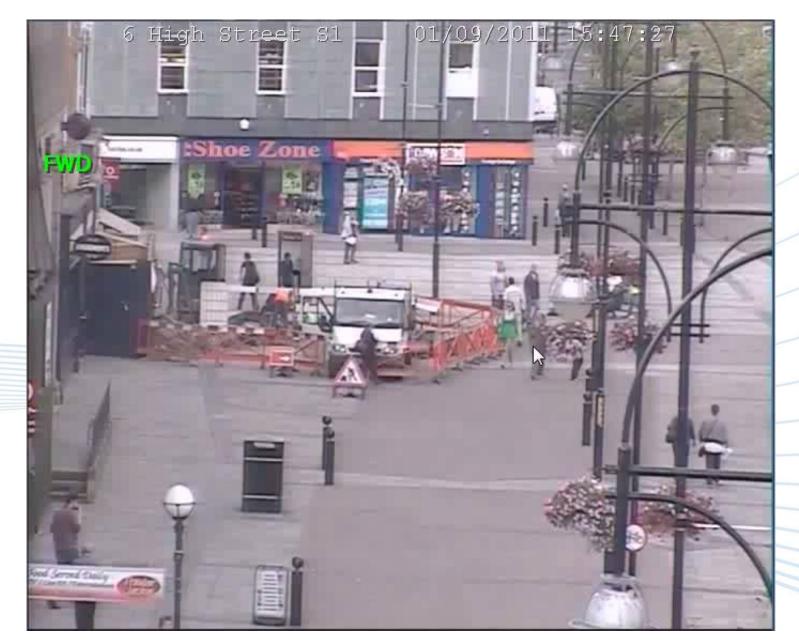
# NoActionBenefit5BUY-IN<br/>All digging gangs receive "Preventing<br/>Injury and Customer Disruption" toolbox<br/>talk and a copy of "Preventing Damage<br/>to Buried Services" poster.Explains the reasoning behind the<br/>standards expected, by giving a clear<br/>understanding of the potential for injury,<br/>cost to the business and disruption caused<br/>by service damages. Making the need for

compliance personal.

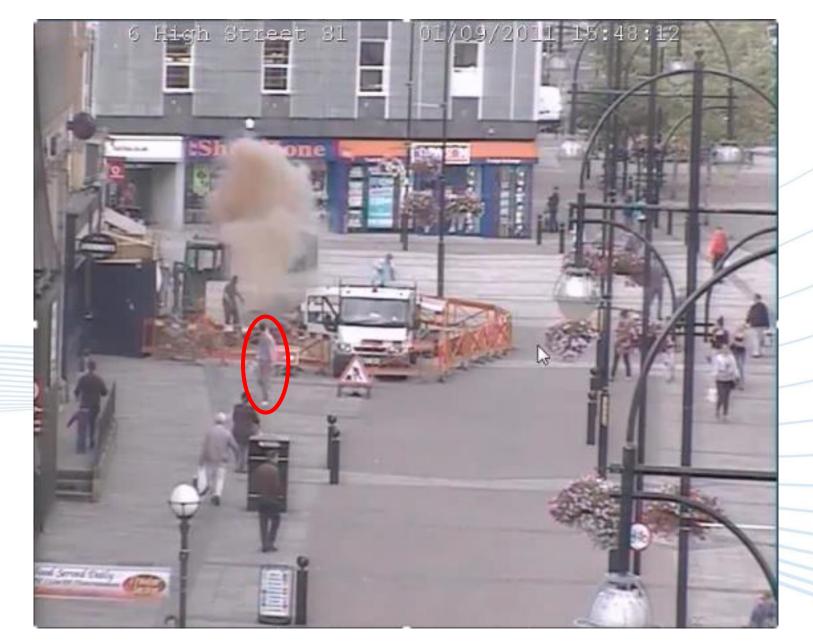
	There are five key	steps to avoid damage to undergro		
1. Planning     C. Avientic     G. Avientic     G. Aviettic     G. Aviettic     G. Aviettic     Construction     G. Aviettic     Construction     Construc	rking? rrough hard surfaces?	<ul> <li>√ Support exposed services at × Do NOT use services as a 3 × Do not handle or attempt to a EXTREME</li> </ul>	4. Protecting Services cardion progresses to prevent adjusterit services bains dama imanimum in controls to prevent damage due to defection. TEP or Hash HOLD affort the position of exposed electricity cables unless specific if CARE ENOLID BE TARKIN WHERE JOINT S HAVE DESIVUE CARE ENOLID BE TARKIN WHERE JOINT S HAVE DESIVUE to however slight, futtom your supervision timmediativity and keep	ally authorised. POSED
🕴 Ensure you have all the Service Drawings,"	The Plane, Trial Hole Records, Pholographs etc. v posts, bollards, signs etc. that may indicate a ser Tool (CAT) to trace all services; TEST Genry Known service	th you. vice. S BACKFILLING + Backfill around the service w + Extract ground support as backfills	with SAND and correct marker tape. Do not encase in concrete actiful progresses. for the services once the backfill is in place.	EMERGENC CONTACTS NMC Site Manager
Y Ensure General and CA1 operators is receive Annu position of services with walargeood of dig area so they are not lost, include 500m Remember that not all cables and pipes are HORLIGHT any services indicated as being Rick Assess the Texanol and ensure all rel the Controls. Obtain Formit to Encavate and Break Grout	sant or crayon in AKD solatids the Disclusion zones (Fpositide, a shown on plane, g shattow, g shat	r Covers, Street Service drawings only indica ad Signs, Service drawings only indica dignal, Service source with not be con- signs of Service route will not be con- vice may be marining at Services may be evaning at Services may be evaning at Services may be evaning at	isistent and may change suddenly. ipe, tiles, sand or other protection in place. concrete.	NMC H&S Manager. Gas: Electricity:
SAFE DIGGING: Get your Permit to Excavate and Break Gro ONLY HAND DIGGING is permitted within 5 Do NOT use Excavators or Hand Held powe	00mm of a burled service. er tools within 500mm of any service.	<ul> <li>Some HV cables are split into</li> <li>Damage to ANY service can</li> </ul>	I be present with a live service inside.	
Consider using Air Picks or Vacuum excav Hand tools used for excavating near burled AVOID using picks and crowbars near burl Wear FIRE RETARDANT overalls when dig	I services MUST be of the INSULATED type. ad services.	Inspect site location. Look for Indi Mark the location of services on t		BT: Cable TV:
digging trial holes to at least 500mm beyon As services may deviate in line and level, e within the whole area where the excavator	d where the excavator will dig. nsure trial holes confirm that no services are pres Mill dig.	ent Plans should be available on site Atways assume that there will be	and used before digging more services than you expect to find	Other:
300mm as the dg progresses. • If a service is found to be BEINEATH or EMI Supervisor and Implement the following ap 1) NEVER auto thesis the concrete or terms services are present. 2) Ersäs and remove the surfacing on each confirm If can be removed without damp 3) Get at least 300mm clicerance between t	o above the service until you have proved it is safe an a side of the service; then excavate beneath surfar	Cable locator <u>and</u> Genny must all auti your Cable locator <u>and</u> Genny must all Table care, ONLY use hand tools w disator and to Observe A service is po	wy to used, in all mode, before starting work and through within 500mm of a service "SAFE DIGGING PRACTICE" and rem sittively located only when it has been sat herare as other services may be adiacent	ember: fely exposed.



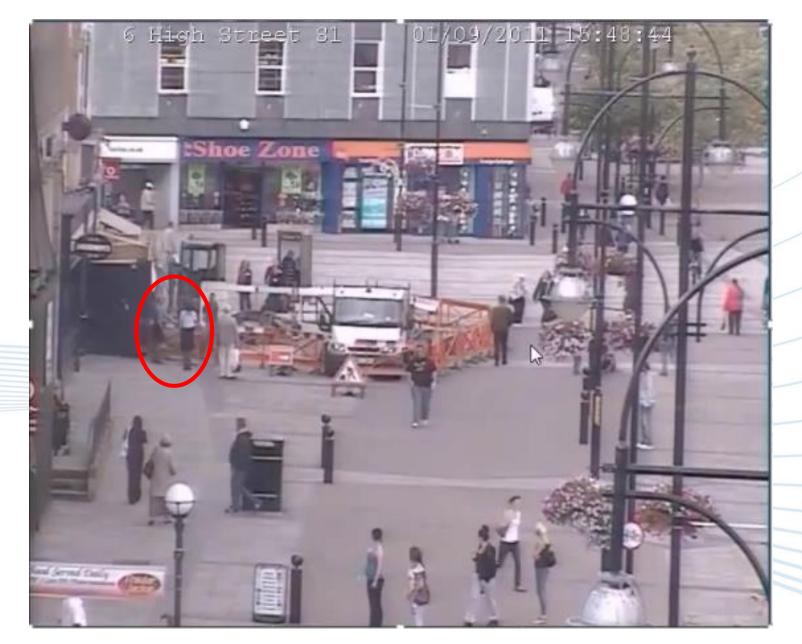
#### When it Goes Wrong



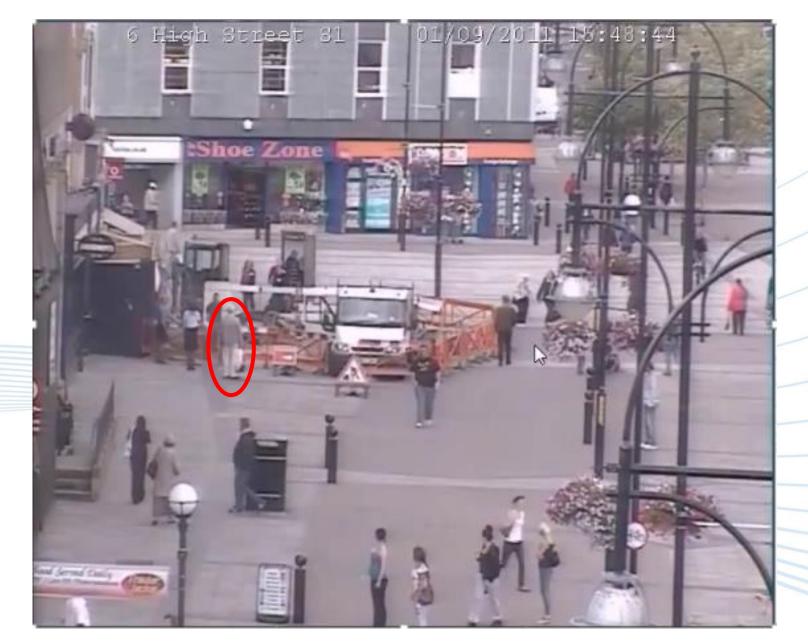


















Νο	Action	Benefit	
	TRAINING Make RadioDetection approved CAT, Genny and Safe Dig training compulsory for ALL digging gangs (Direct and Sub- Contract) and their Manager / Supervisor.	Recognised high level of competency in use of locating equipment and safe excavation around services.	

Refresher training every 3 years.



No	Action	Benefit						
6	TRAINING Make RadioDetection approved CAT, Genny and Safe Dig training compulsory for ALL digging gangs (Direct and Sub- Contract) and their Manager / Supervisor. Refresher training every 3 years.	Recognised high level of competency in use of locating equipment and safe excavation around services.	Title Series Revision	CECA A form should be used in t 1) Induction: - To an 2) Post incident refi	impetency Assessment to following circumstance tens new starters within esh: - With all gang men	I ssue Date 08 Document Dwner H8 ces: I two weeks of induction	(A Systychian Status)	
7	COMPETENCY ASSESSMENT Manager / Supervisors assess service avoidance competency of all digging gangs within 3 days of start on site and annually thereafter.	Helps maintain a consistent high level of competency in service location and avoidance practices.	Crew/ID Operative Operative Does ICOPC	Construction     Construction	Construction     C	Af Californition date     array cal bination date     array cal bination date     with of ausessment     Af given (difference)     Af given (difference)     works powdents     works     w	CRAMENTS	208
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7	<b>COMPETENCY ASSESSMENT</b> Manager / Supervisors assess service avoidance competency of all digging gangs within 3 days of start on site and annually thereafter.	Helps maintain a consistent high level of competency in service location and avoidance practices.	Converting Convertence Converting Converting Converting Converting Converting Conve
8	<b>COMPLIANCE VERIFICATION</b> In addition to their daily site visits, Site Manages to complete a minimum of 1 weekly site inspection of their site.	Allows them to drive the standard of Health, Safety, Environment and Quality they expect, thereby improving compliance whilst enhancing their understanding of SHEQ site issues.	1         Down't steek CAT.6         • Down't class         • Owen't class           diam         • Down't fetters         • Owen't class of the



#### No Action

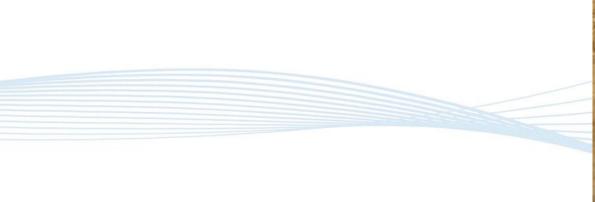
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#### VISIBLE FELT LEADERSHIP

Senior Leaders complete regular site tours, focusing on service avoidance.

#### Benefit

Demonstrates the importance management place on compliance with Standards and training and will further enhance compliance.







Νο	Action	Benefit
10	REPORTING	
	Promote an open reporting culture, with	1. H&S Team aware of damages thus
	a clear expectation that when a service	enabling prompt response and correct
	damages occurs:	level of investigation.
	hour.	<ol> <li>Allows learning's to be gained and preventative actions taken.</li> </ol>
	2. Details are uploaded to the reporting system within 24 Hours.	<ol> <li>Can notify insurance company in a timely manner.</li> </ol>
	completed and uploaded within 24	<ol> <li>Can notify client within required timeframe.</li> </ol>
	hours.	5. Learnings can be shared quickly.

# Investigation

Operational Form         Panel Approval         28/03/2017           Series         SIF         Isue Data         29/03/2017           Revision         C         Doc unent Dwner         HES Manager             Even of Executed information         Insustigation byc         Project/tostract/larg Code:           Was ut ity damaged by a Subcontractor?         Yes         Max         Project/tostract/larg Code:           Was ut ity damaged by a Subcontractor?         Yes         Max         Project/tostract/larg Code:           Was ut ity damaged by a Subcontractor?         Yes         Max         Project/tostract/larg Code:           Was ut ity damaged by a Subcontractor?         Yes         Max         Project/tostract/larg Code:           Was ut ity damaged by a Subcontractor?         Yes         Max         Project/tostract/larg Code:           Was ut ity damaged by a Subcontractor?         Yes         Max         Name of Subcontractor could gamage           Utant         Utant         Utant         Utant         Utant	Panel Approval         28/03/2017           Issue Date         29/03/2017           Document Dwner         HES Manager           Vests of regetimere         Egailficatione           Mail         Mascin           Mail         Mascin           Mail         Mascin           Mail         Mascin           Mail         Mascin           Mail         Mascin           ATTADI         Mascin           Mattriation         ATTADI           Mail         Mascin	Dnal Form         Panel Approval         28(05)/2017           ka investigation Form         Panel Approval         28(05)/2017           Issue Data         29(05)/2017           Occument Dwner         H85 Manager           drukture?         Yes         An           drukture?         Yes         An           drukture?         Yes         An           drukture?         Yes         No           annical plant sum off mechanical plant         Yes         No           whice grants use off mechanical plant         Yes         No           satire         Metical:         Mittorio           whice grants use the plant use off mechanical plant         Yes	Strike Investigation Form Panel Approval 28, SF Issue Date 29,	Nos Adamser	Panel Approval RADIA 28/05/2017 Issue Data Document Dwner HSS Manager 3gestese
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#### Benefit

#### 11 **REPORTING**

Action

No

Use the following reporting categories:

- Damage to underground cable
- Damage to underground pipeline
- High Potential Near Miss
- Latent Damage
- Uncharted service found, not damaged
- Good Practice / Initiative around services

Enables collection of Intelligent Data which will allow better routine monitoring and tracking improvements.

Promoted pride in using innovation and good practice.

# **Incident Category Definitions**



Damage to underground cable	<ul> <li>HV, LV, Street Light, Fibre Optic, Telecommunications, etc. cable damaged by our works due to ground penetration or reinstatement.</li> <li>For example whilst: <ul> <li>Inserting "pin" into the ground,</li> <li>Cutting the surface,</li> <li>Hand excavating,</li> <li>Mechanically excavating,</li> <li>Reinstating,</li> <li>Etc.</li> </ul> </li> </ul>
Damage to underground pipeline	<ul> <li>Water or gas main, water or gas service, sewer, pumping main, culvert, duct, etc. damaged by our works due to ground penetration or reinstatement. For example whilst: <ul> <li>Inserting "pin" into the ground,</li> <li>Cutting the surface,</li> <li>Hand excavating,</li> <li>Mechanically excavating,</li> <li>Reinstating,</li> <li>Etc.</li> </ul> </li> </ul>
High Potential Near Miss	Underground cable or pipe very nearly but not actually damaged due to ground penetration or reinstatement. For example whilst:
Latent Damage	Existing underground service found with pre-existing damage. Damage NOT caused by our work e.g. old/corroded cable pot end, leaking pipe joint, perished pipe
Uncharted service found, not damaged	Unknown service located, and exposed without damage, through use of correct service location techniques and safe dig practices.
Good Practice / Initiative around services	<ul> <li>Exceptional workmanship used to locate / prevent damage to underground service. For example:</li> <li>Getting assistance of utility owner to locate known service we are unable to locate,</li> <li>Stopping and reviewing / changing work method to prevent damage to service</li> </ul>



# NoActionBenefit12FEEDBACK<br/>Normalise reporting feedback on<br/>damage rates by either:<br/>• Hours worked,<br/>• Turnover,<br/>• Meters laid,<br/>• Services crossed, etc.Enable benchmarking of gangs, sites, sub-<br/>contractors, divisions, peer contractors.



No	Action	Benefit	
13	FEEDBACK		
	Introduce a 5 x 5 style risk rating system	Will enable:	
	for Service Damage Severity to highlight:	✓ Future iterations of Improvement Plan	
	1. Services posing highest risk.	to focus on known high risk areas.	
	2. Work methods posing highest risk.	✓Identification of those lacking	
	3. Teams/individuals of concern.	understanding of their accountability and	
	4. Causes resulting from non-	responsibility.	
	compliance with procedures.		

	1	2			3	4
	Strike Type	Proximity of			SEVERITY -	
		people	LIKELIHOOD	RATING	SERVICE	SEVERITY - SAFETY
_	Direct contact	1m	Almost Certain			
	with breaker etc		(>90%)	5	3 phase	Fatal accident
	Contact with	2m				Major injury (RIDDOR)
	non-insulated		Probable			resulting in lost time.
	hand tools		(50% - 90%)	4	LV cable	Irreversible disability
	Contact with	3m				
	insulated hand		Possible		Street light cable	Injury resulting in over
	tools		(10% - 50%)	3	gas main	7 days lost time
	Contact with	4m	Remote		Water main / Gas	Injury resulting in 1 to
	small machine		(1% - 10%)	2	service	7 days lost time
	Contact with	5m	Unlikely		Water service /	Injury requiring First
	large machine		(<1%)	1	BT / Comms	Aid but no lost time

_	RISK RANKING	ACTION REQUIRED
_	High	
	(12 – 25)	Group level review
	Medium	
	(7 – 11)	Divisional investigation
	Low	
	(1 – 6)	Local investigation



Νο	Action	Benefit
14	ACCOUNTABILITY Use Just Culture process for ALL service damages not reported within the required timeframes.	Brings ownership and accountability and will improve quality of data.



Νο	Action	Benefit
14	ACCOUNTABILITY Use Just Culture process for ALL service damages not reported within the required timeframes.	Brings ownership and accountability and will improve quality of data.
15	ACCOUNTABILITY Use Just Culture and post incident refresher training following service damages. Intensity of training dependant on Just Culture findings, incident severity, cause of damage and if repeat offenders	Brings ownership and accountability, and helps refresh good practice while ironing out bad habits for the gang.
	of damage and if repeat offenders.	



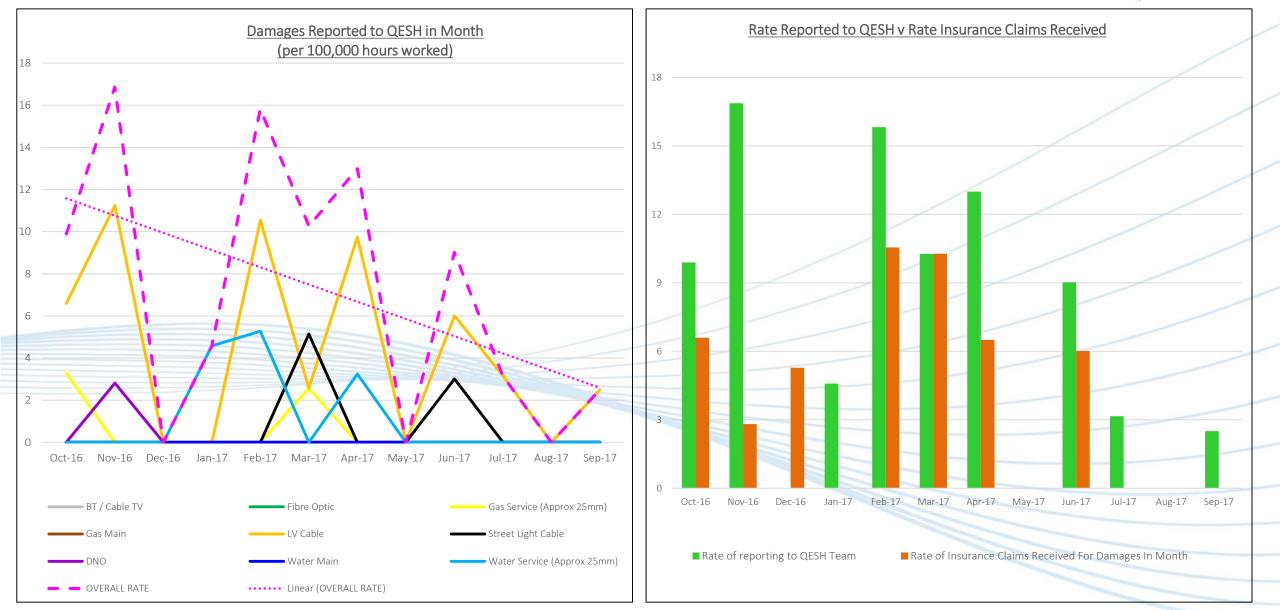
Νο	Action	Benefit
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15	ACCOUNTABILITY Use Just Culture and post incident refresher training following service damages. Intensity of training dependant on Just Culture findings, incident severity, cause	Brings ownership and accountability, and helps refresh good practice while ironing out bad habits for the gang.
16	<ul> <li>of damage and if repeat offenders.</li> <li>ACCOUNTABILITY <ul> <li>Hold "Explanation meeting" where site</li> <li>team justify their actions / in-actions to</li> <li>the H&amp;S team and management.</li> </ul> </li> <li>For significant damages, meeting to <ul> <li>include Directors.</li> </ul> </li> </ul>	Drives accountability for their actions, enforces understanding of their responsibilities and embeds good practice.



#### No Action Benefit **H&S LEADERSHIP** 17 To reinforce good practice and identify 1. Further demonstrates the importance of opportunities for improvement, enhance safe working. regular contact of the H&S Team with 2. Highlights personal responsibilities at all the whole site, through: levels. 3. Enables accurate communication of • Face to face meetings • Site visits current trends. • Stand Downs, etc. 4. Sets clear expectations at the top. 5. Gives the opportunity for 2-way discussions and continual improvement

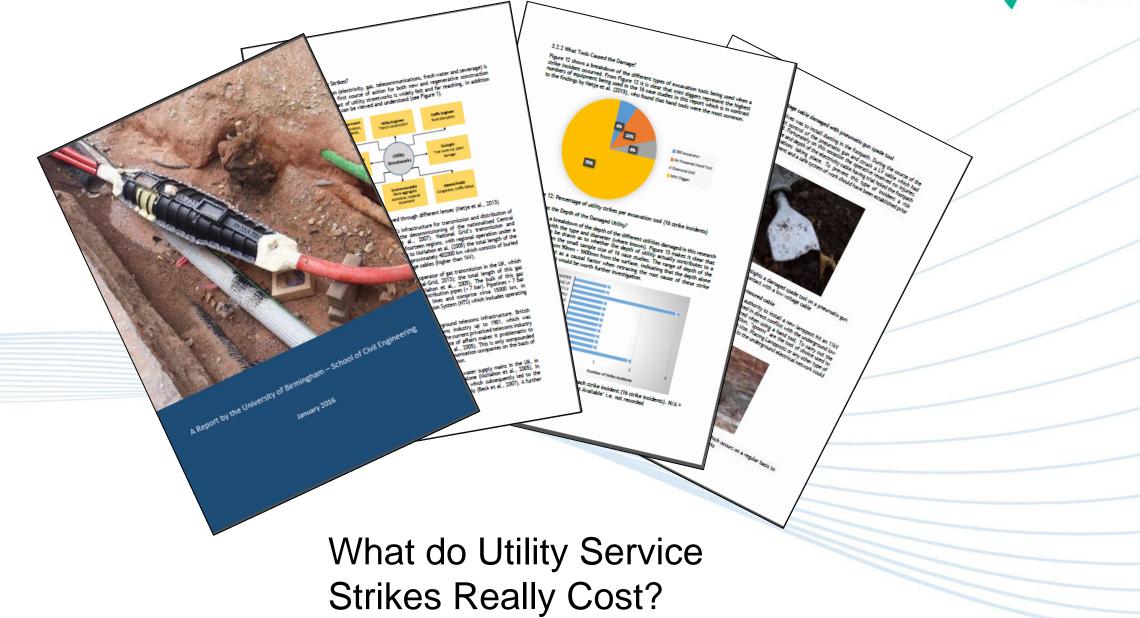
# Service Damage Rate v Rate of Claims Received





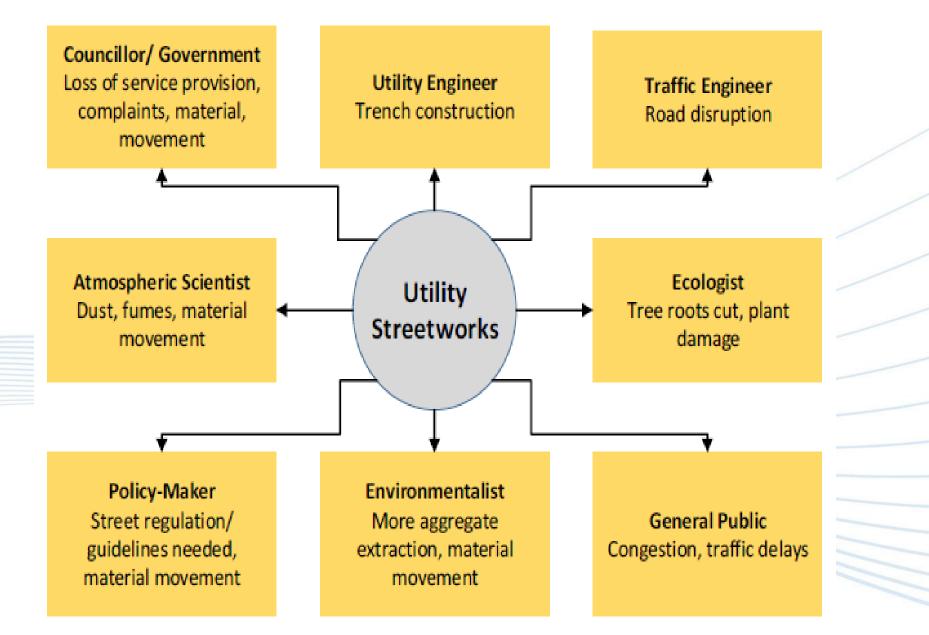
#### **The True Cost of Service Damages**





#### **Street Works Viewed From Different Lenses**





# **Decision Making**



				•
Office	UTILITY	On Site		
Sequence, Planning and Programming	Competence and training	Equipment	Physical Site Considerations	Excavation Technique
Missed opportunities to design out risk	No training for operatives on how to interpret utilities on drawings and	Equipment not available / improper use (e.g.CAT and Genny)	Poor ground conditions (e.g. collapsible ground)	Genny is not used as much as it should be
Service location activities not programmed or resourced	ed No training for operatives on how to use CAT and Genny properly ( <i>Should</i>	PPE not available	Adverse weather conditions	Rushing / work pressures
Wrong timing of utility survey i.e. commissioned to close to excavation		Poor PPE	Previous incorrect cover	Chasing management measure
activities			Inadequate tools (e.g. Excavators & drilling machines – poor visibility)	Utility encased in concrete
Poor utility strike reporting structure	Training received does not develop competent operators	uning machines poor visioner,	No marking tape on existing services	Cutting corners / laziness
Use of generic method statements				Did yet CAT seen at avery donth
Inconstant working practices				Did not CAT scan at every depth (against safe system of work)
Poor work to dig permits application				Performance related pay / chasing bonus
system				Inappropriate tools made available
True cost of utility strikes not quantified / understood				
Laborious management procedures				
Lack of faith in the system				
Inaccurate statutory drawings				
"Them - US" hierarchy in organisation				

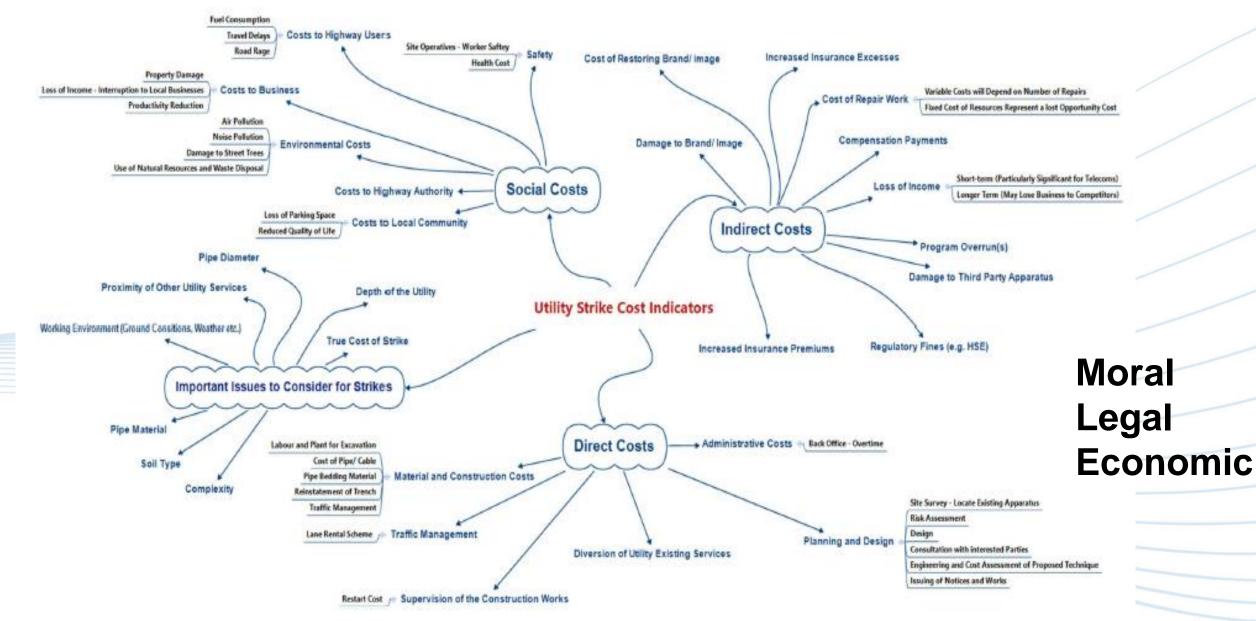
# **Current UK Industry Thinking**



Yes, 57%	No, 43%	6	Q1. Direct cost of utility strikes measured on a regular basis?	
Yes, 29% No, 71%			Q2. Tally of other costs (indirect and/or social) incurred during service strikes kept?	
Yes, 86% No, 14%		No, 14%	Q3. Company has an adequate permit to dig system?	
Yes, 29%	Yes, 29% No, 71%		Q4. Company has a specific utility strike implementation plan with actions and targets?	
14%	4% No, 86%		Q5. 'Service location' - separate exercise/ item on your programme?	
Yes, 57%	Yes, 57% No, 43%		Q6. Formal training for operatives on safe digging techniques provided?	
14% No, 86%		Q7. Formal training for subcontractors on safe digging techniques provided?		
Yes, 29%	29% No, 71%		Q8. Are Operatives acknowledged or praised for avoiding service?	
Yes, 43% No, 57%		Q9. Dedicated service survey co-ordinator to the main dig team?		
Yes, 86	5%	No, 14%	Q10. You have a dial before you dig system?	
Yes, 100%			Q11. Formal escalation process for utility strikes in place?	
Yes, 86% 💦 💦 No, 14%			Q12. Do you measure the number of utility services successfully avoided or similar?	
14% No, 86%		Q13. Genny is used as much as it should be?		
No, 100%			Q14. A number of services would still be damaged if the genny was used?	
Yes, 43% No, 57%		Q15. Supervisors praised/ rewarded for their performance in avoiding services?		
Yes, 43%	Yes, 43% Q16. Supervisors discipline		Q16. Supervisors disciplined/ removed from the site for damaging services?	
Yes, 71%	N	lo, 29%	Q17. Operatives disciplined or removed from site for poor working practice?	

#### **Examples of Utility Strike Costs**





#### **Costs of a Typical Water Service Strike**



	Min (£)	Max(£)	Average (£)
Direct Cost	750	10,000	5,375
Indirect Cost	2,000	25,000	13,500
Social Cost (Traffic Delays)	41,128	602,698	224,799
Social Costs (Loss of Business income)	70,500	414,779	210,593
TOTAL	£114,378	£1,052,477	£454,267

Typically the Real Cost of a Utility Strike is 29 times that of the direct repair cost

#### **Case Studies Used to Generate Report**





Failure to avoid hazard at planning stage



Pneumatic spade following contact with LV cable



Cable strike causing serious burns to operative



Excavator contact with HV cable





