

**“Ground conditions,
the greatest unknown,
and how they should
be considered.**

Michael de Freitas



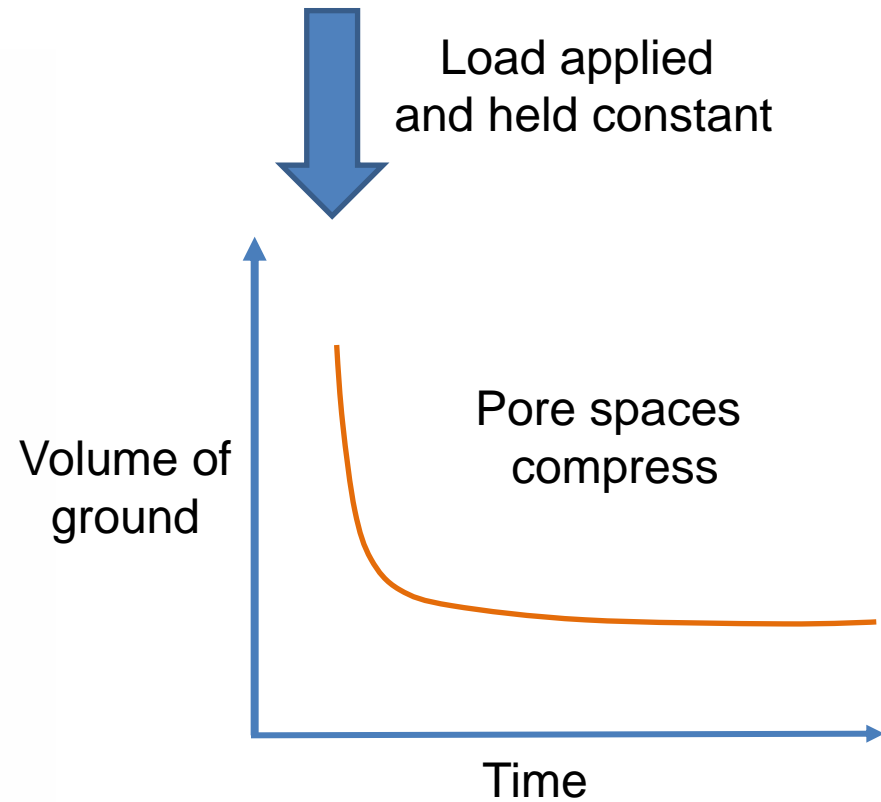
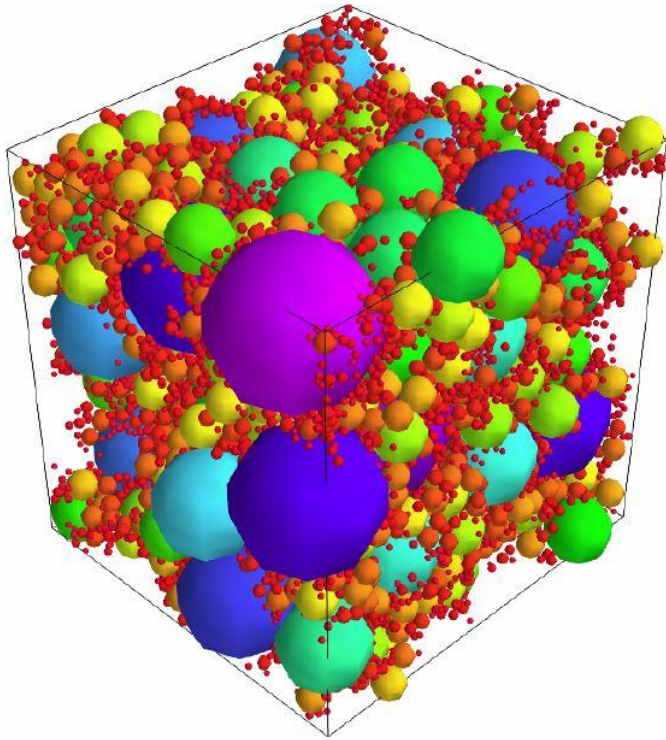
Lecture outline and structure

- 1 The nature of geological materials.**
- 2 Ground response to excavation.**
- 3 BIA & associated studies.**
- 4 Things that can go wrong.**
- 5 Damage to neighbouring properties.**
- 6 Qualifications needed.**
- 7 Questions & Answers.**



Bagshot Sands

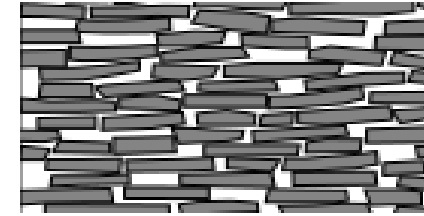
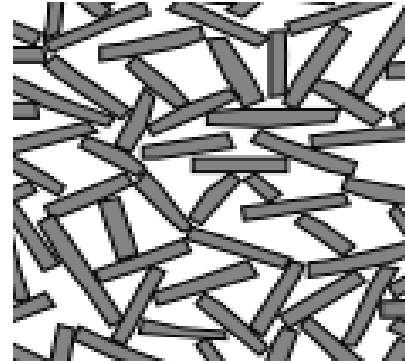
Granular materials will settle under load





London Clay

Clay settles under load



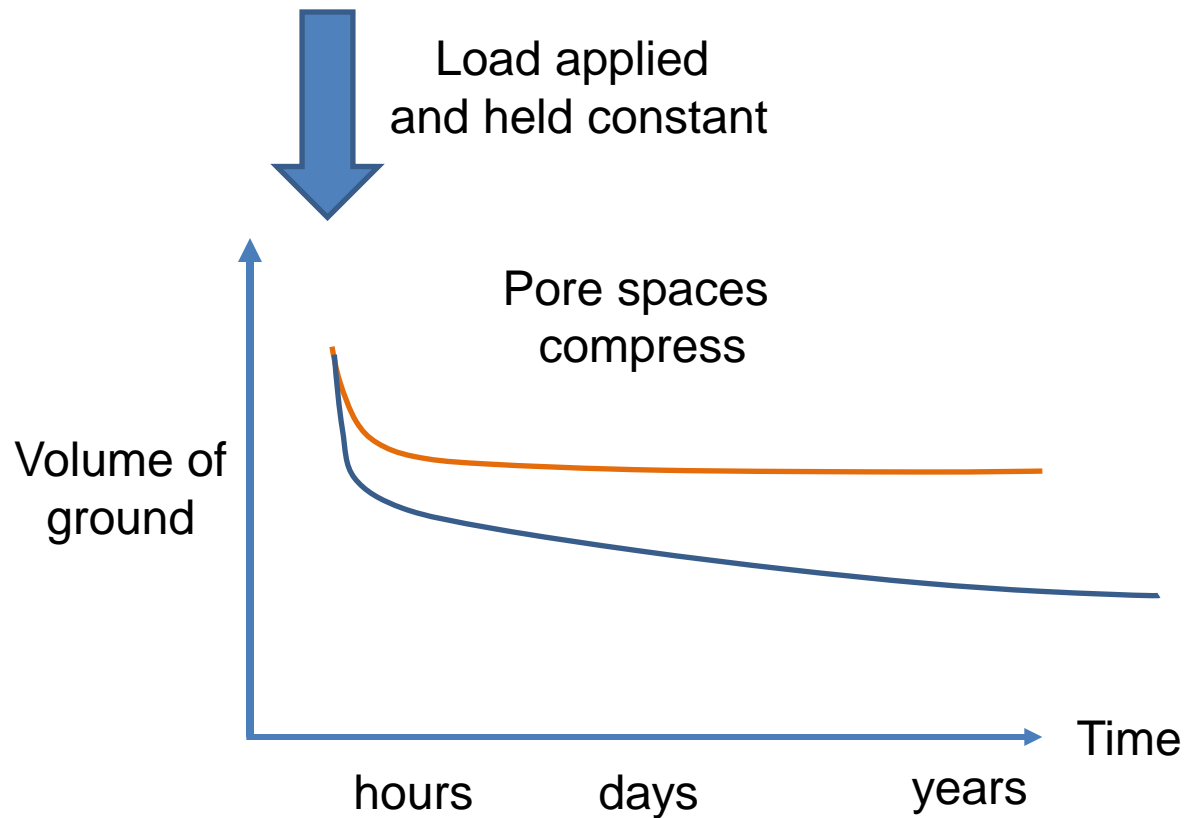
Load applied
and held constant

Volume of
ground

Pore spaces
compress

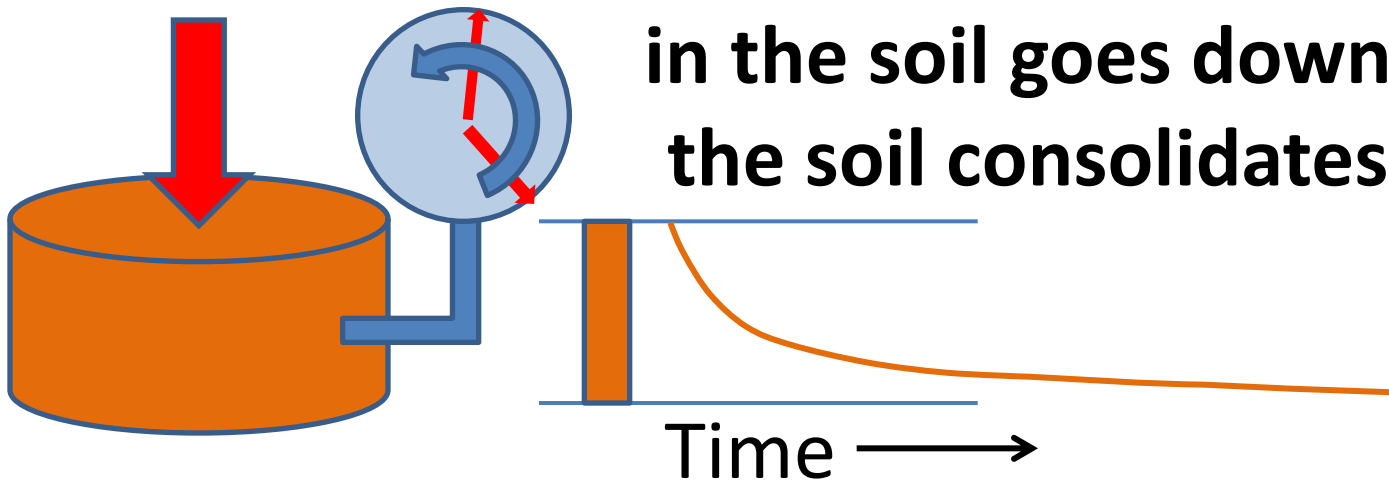
Time

Rates & amounts differ for a given load

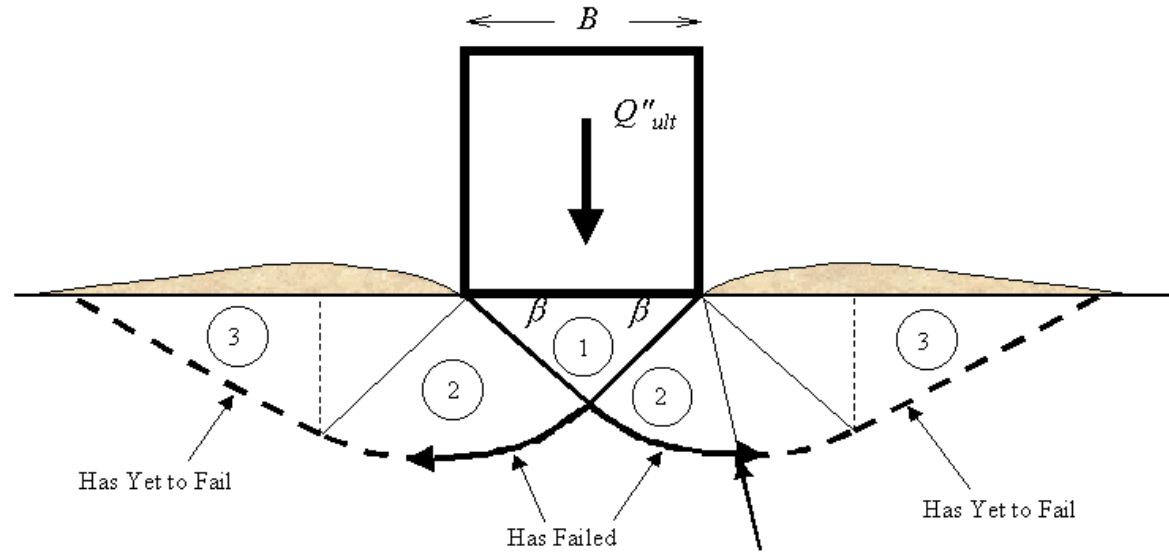


Pores are filled with water & air which escape when squeezed

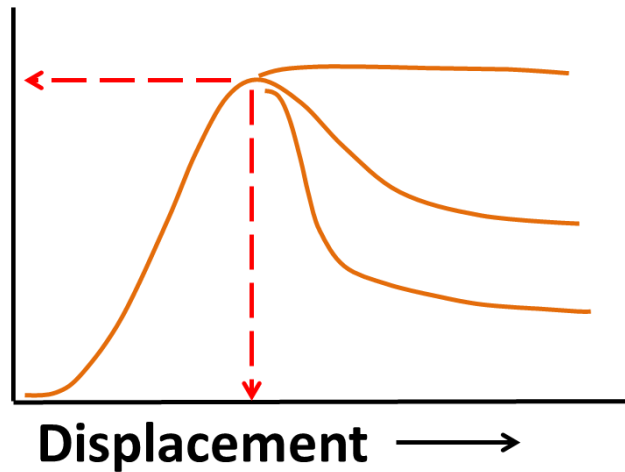
When pore pressure in the soil goes down the soil consolidates



Loads can exceed strength

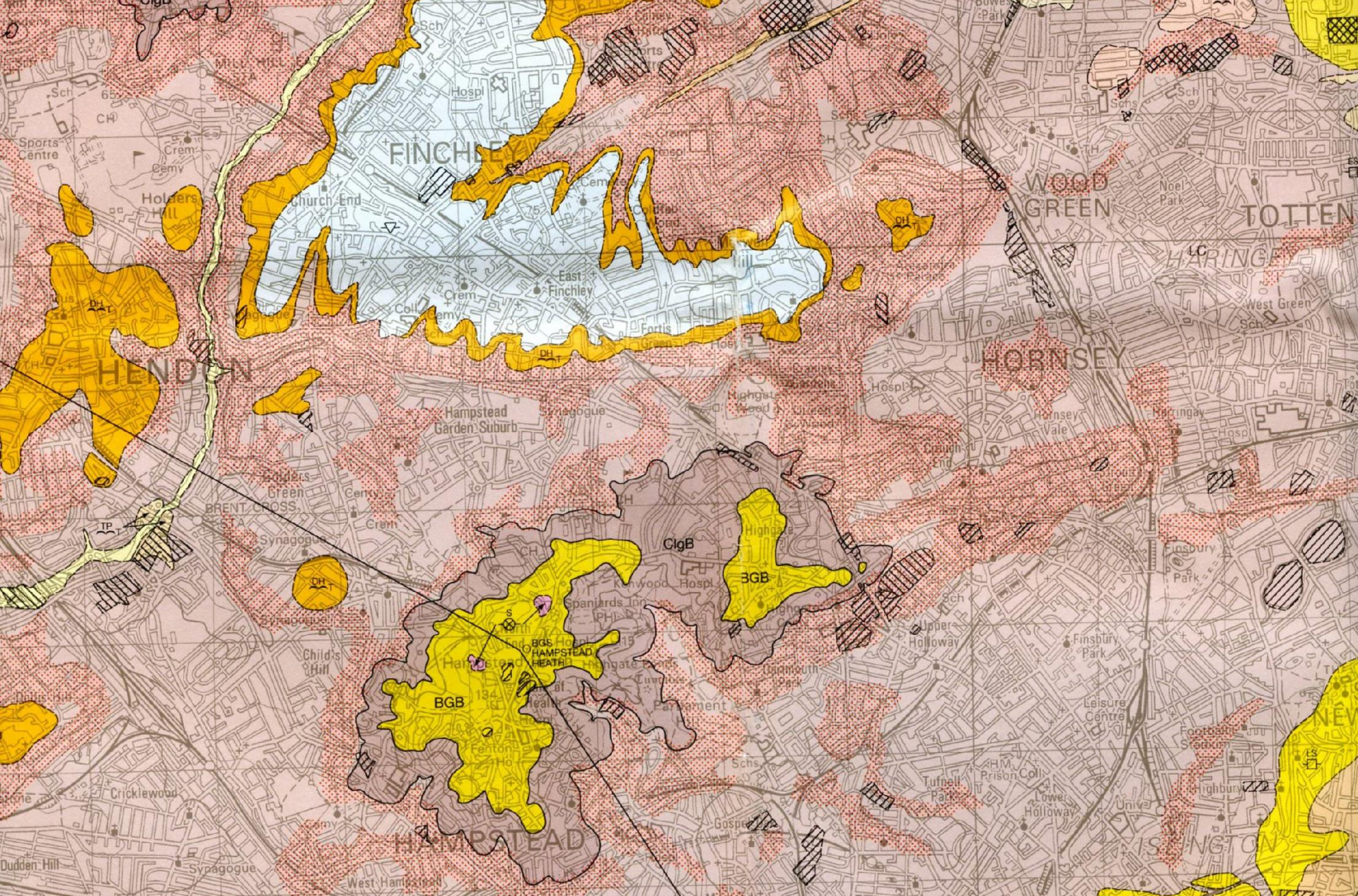


Soil Strength



What must be known?

- 1 The vertical profile = “what’s there?”
- 2 Its mechanical properties
= stiffness, strength & permeability
- 3 Existing pore pressures
- 4 Intended changes in load *
* amount, sequence & rate



Geological Maps



WARNING!

Basement 10m x 15m x 7m

5 BH's each 15m deep

Volume of ground seen <0.01%

JUDGEMENT is important

Use the right people!





Ground response to excavation

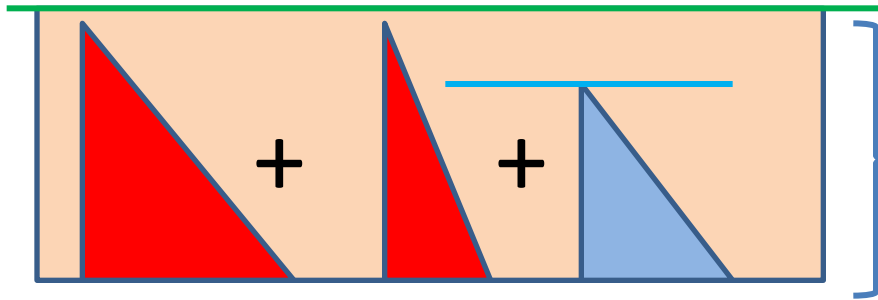
A question of

1 DESIGN &

2 CONSTRUCTION SEQUENCE

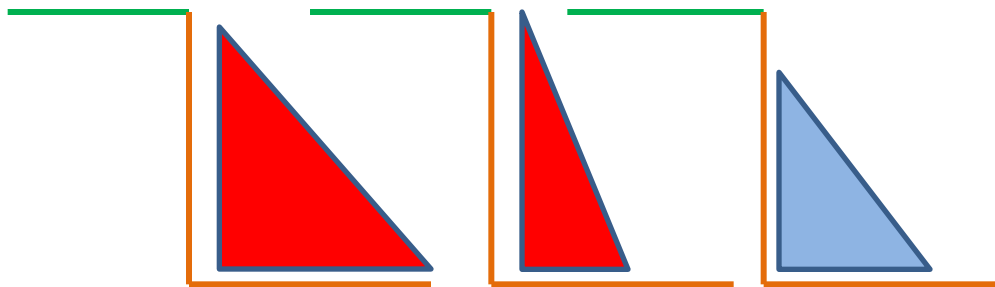
= SUPPORT

**= adequate &
timely**



These will be in some sort of balance

STRESS Vertical + Horizontal + Water

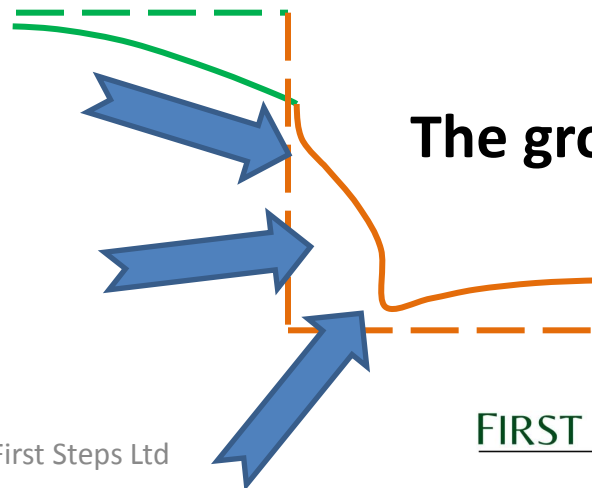


Excavation upsets that balance

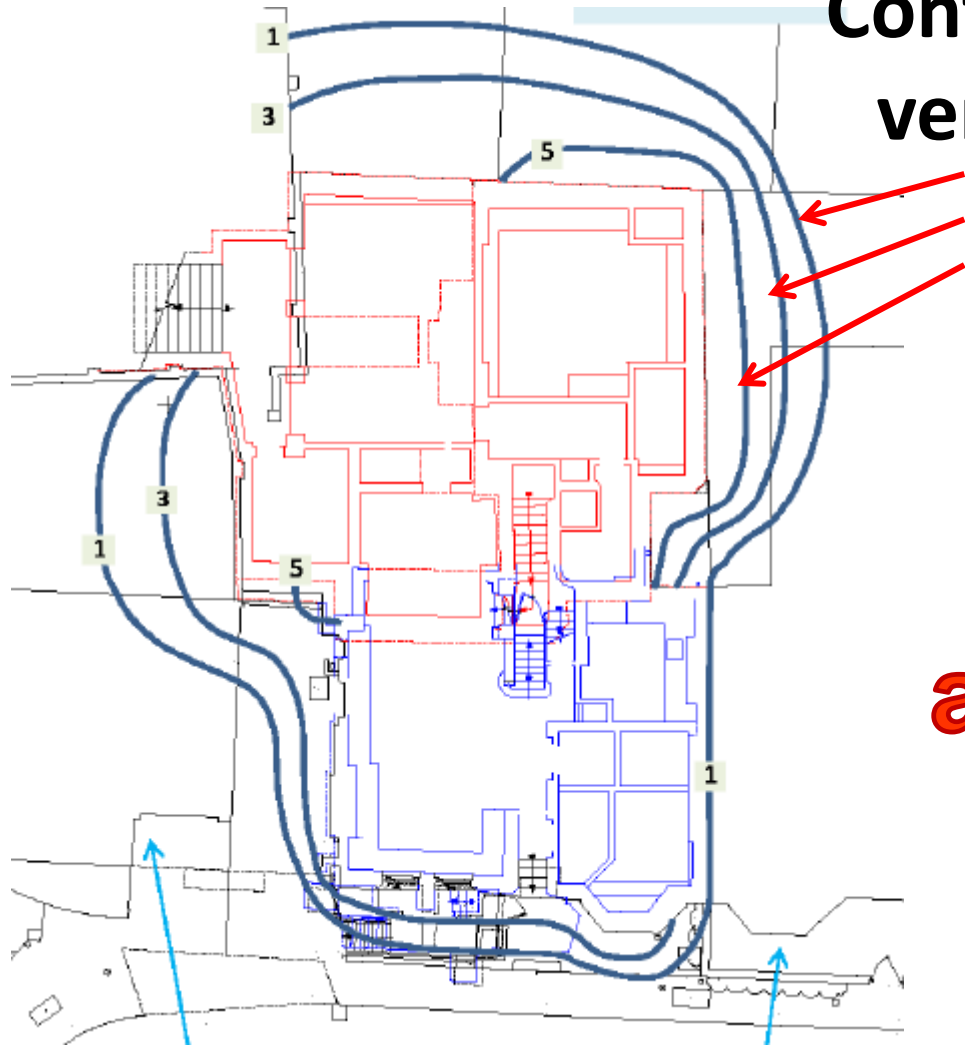
The ground moves



The ground drains

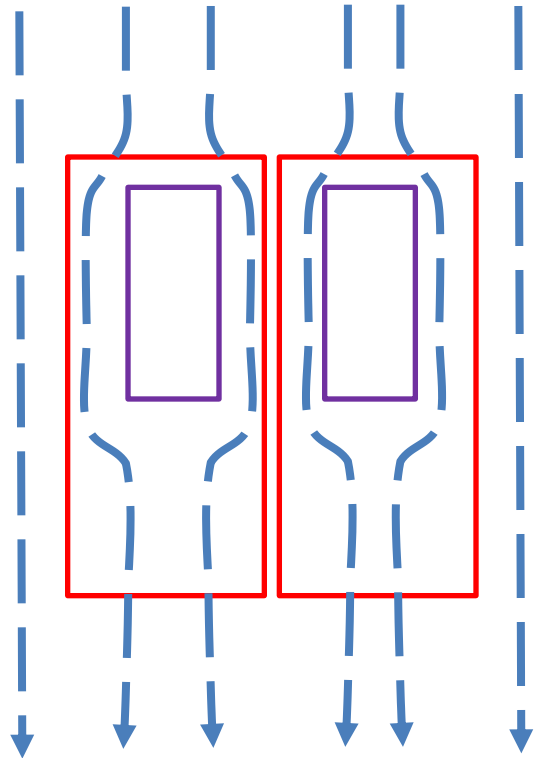


Contours of predicted vertical settlement

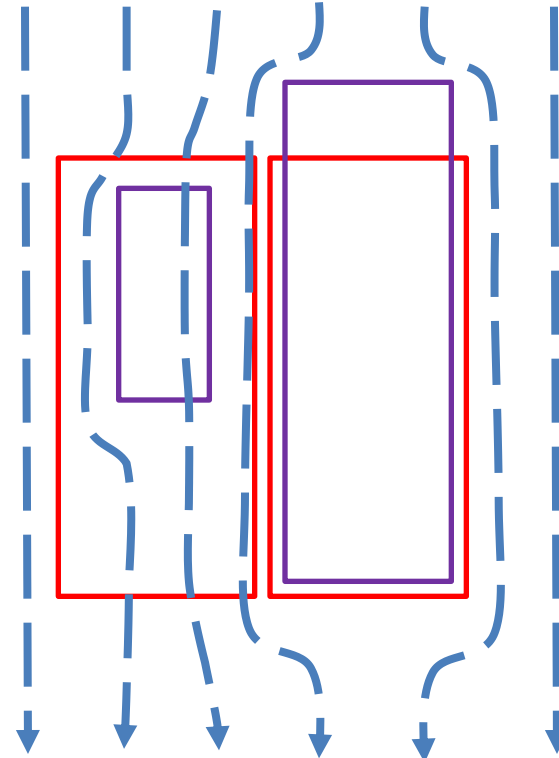


But what has been assumed?

BEFORE



AFTER



Ground water flow

Basement Impact Assessment & associated studies

THE BASEMENT IMPACT ASSESSMENT

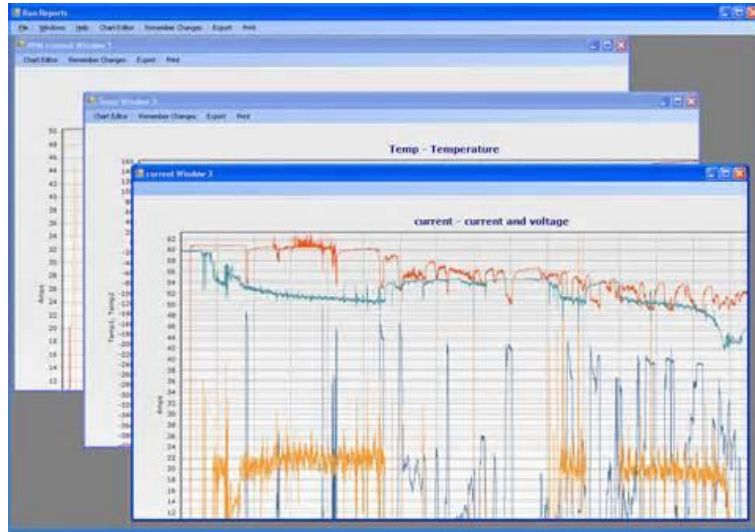
5 KEY STAGES

1. Screening to identify whether there are matters of concern; this is a “light touch” that considers the project at a variety of scales and is expected to draw on existing data.

2. Scoping to put any matters for concern into perspective; *“Is there a problem, if so how big is it and can it be solved?”* To answer that further data is normally required of a site specific nature; this is the next step.

3. Site investigation to acquire the data, existing or new, required to answer the questions raised by scoping and to solve any problems that materialise. The site investigation also provides base line conditions against which “change” can be measured. The Site Investigation should provide what is needed for assessing the impact of the development.

Factual



Interpretative



Council deadline

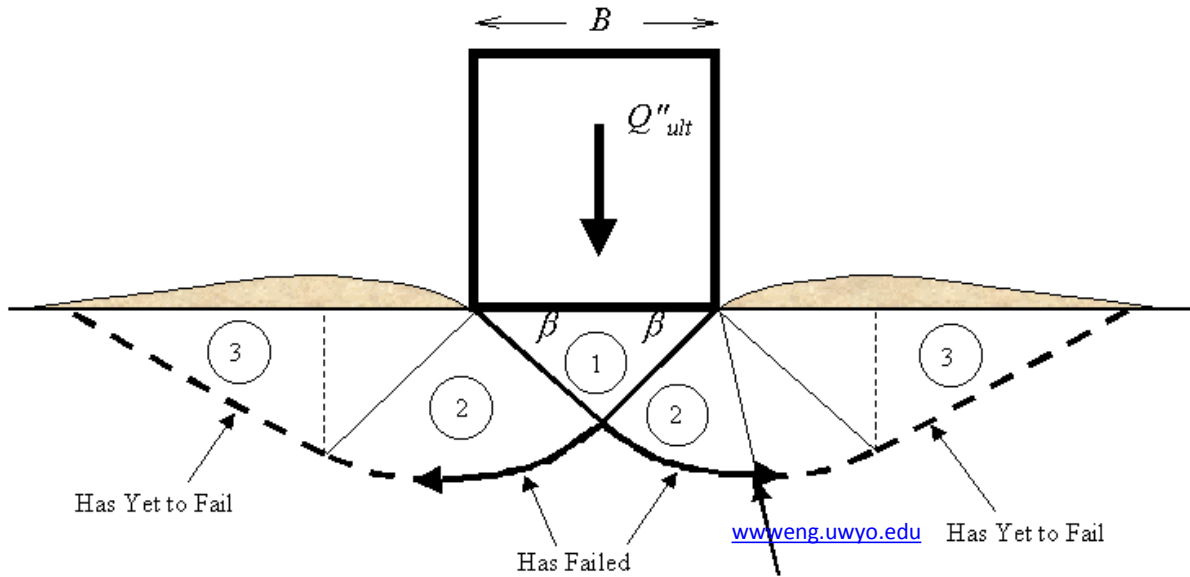
THE BASEMENT IMPACT ASSESSMENT

5 KEY STAGES

4. *Impact assessment* here predictions are made based on relevant facts of the impact the works will have, in the short and long term, on surrounding ground. They are normally based on a mix of theory, empiricism, modelling and experience. They are often judgements based on best endeavours. They can be linked to observation and monitoring, and with basements this is often associated with tracking ground movement and water levels.

5. *Decision* in an ideal world the decision will be obvious but in ground engineering, where so much of the ground is not seen and not tested and not instrumented, the decision invariably involves a substantial element of judgement. This is not the same as “*trusting to luck*”; the judgement is centred on the adequacy and relevance of the factual data upon which the decision has to be made.

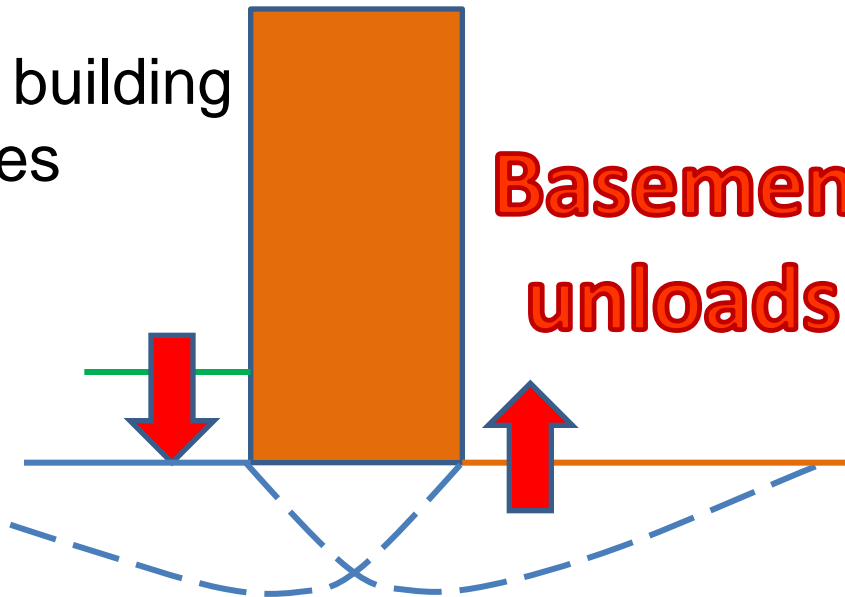
Things that can go wrong



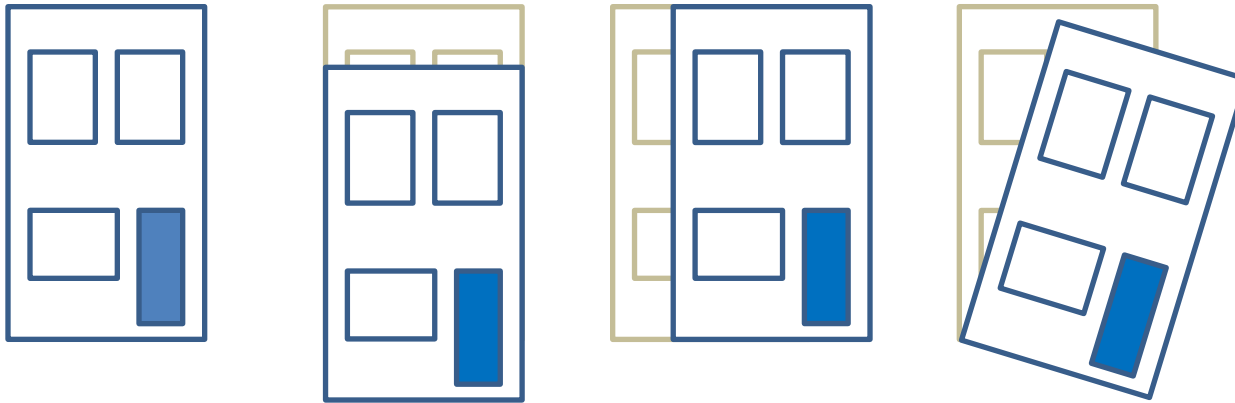
www.weng.uwyo.edu

Existing building
± piles

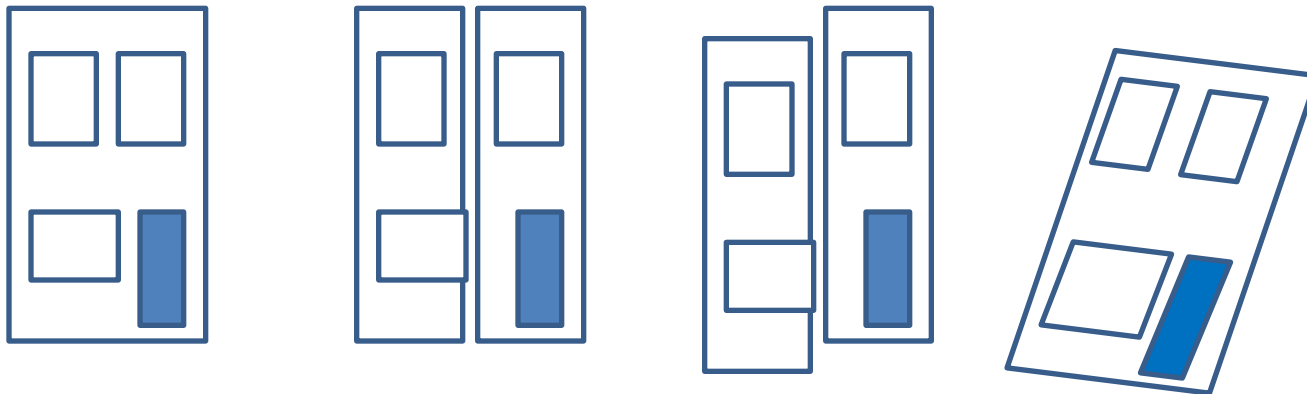
**Basement excavation
unloads the ground**



(C) First Steps Ltd



Rigid body displacements; usually requires raft foundations.

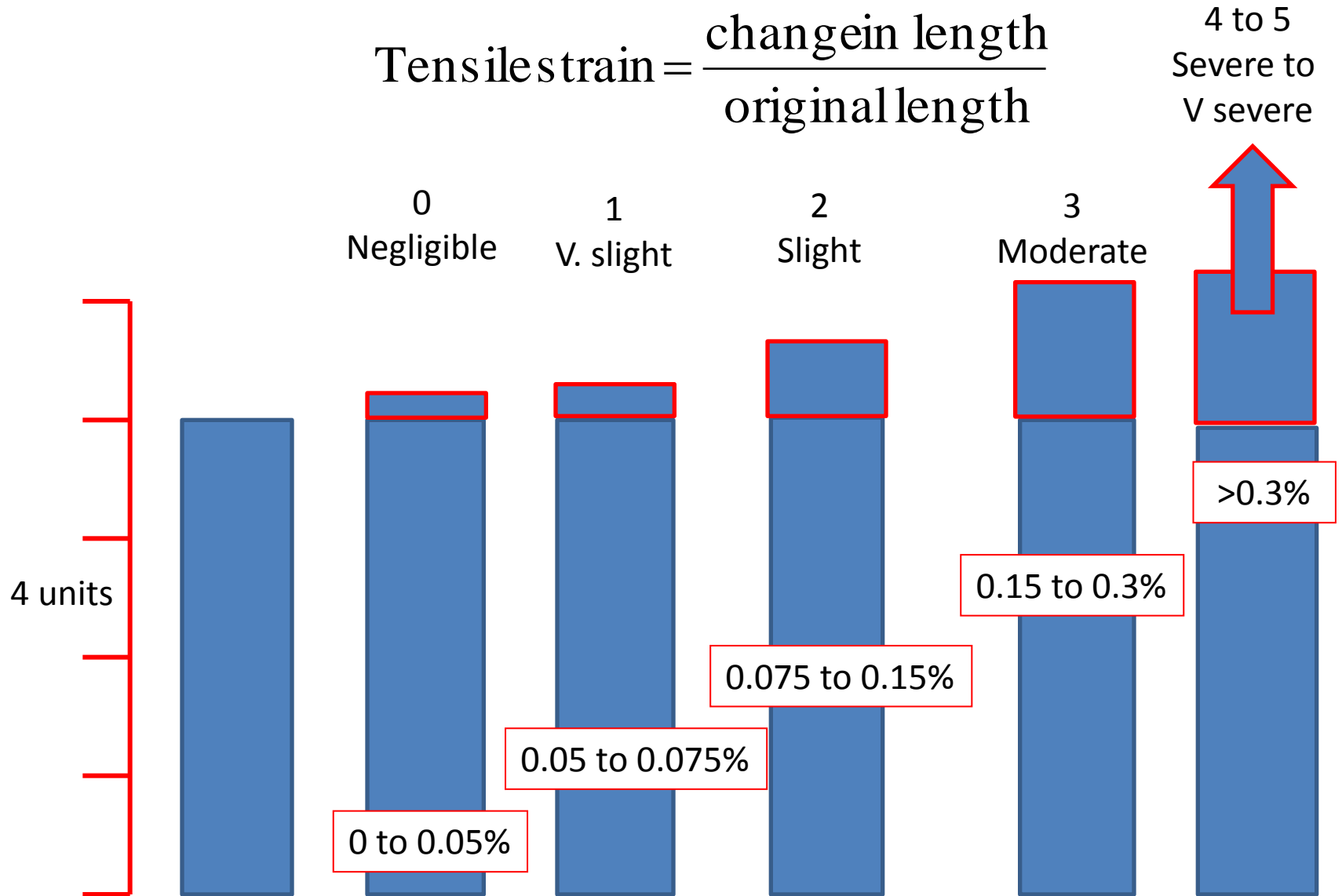


Distortions; the more usual case.

Category of damage	Description of damage Table from BRE Classification of damage (based on nature of repair)
0 “Negligible”	Hairline cracking like that from shrinkage and thermal movement (e.g. as between summer and winter). Irritation rather than a problem. No action required.
1 “Very slight”	Fine cracks up to 1mm, rarely visible in external brickwork & normally restricted to internal wall finishes . Easily treated.
2 “Slight”	Cracks up to 5mm, doors & windows may stick slightly. External repointing where needed for water tightness; easing & adjusting on doors & windows
3 “Moderate”	Several cracks of up to 3mm or individual cracks from 5 to 15mm. Doors & windows sticking, service pipes may fracture. Can be patched, some repointing may be required & some brickwork may have to be replaced
4 “Severe”	Extensive damage; typical cracks 15 to 25mm depending on number. Frames distorted & floor sloping noticeably. Extensive repair work
5 “Very severe”	Structural damage; danger of instability. Walls require shoring, major repair requiring part or complete rebuilding

From CIRIA C580. Table 2.5. *NOTE that when assessing damage account must be taken of its the location within the building & that crack width should not be used on its own.*

$$\text{Tensile strain} = \frac{\text{change in length}}{\text{original length}}$$







THE HEATH AND HAMPSTEAD SOCIETY

An review of structural damage in three residential properties adjacent to new basements in the London Borough of Camden and the relevance of contemporary and proposed planning controls

Report reference G1016-RP-01-E1.

Edition	Date	Detail
E1	11/02/11	Preliminary report modified to address expanded brief.

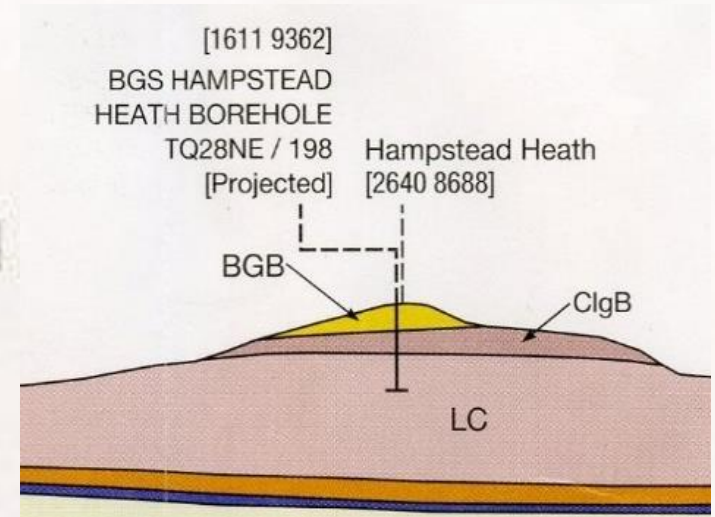


Eldreds

Eldred Geotechnics
Consulting Environmental & Geotechnical Engineers
66 Warren Road, Chislehead,
Dorington, Kent BN16 8HY
Telephone: 01680 869406
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Email: mail@eldreds-geo.co.uk

[1611 9362]
BGS HAMPSTEAD
HEATH BOREHOLE
TQ28NE / 198
[Projected]

Hampstead
[2640 8688]



BGB

ClgB

LC

Apron aquifer

British Geological Survey
Sheet 256 North London

REDACTED



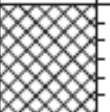

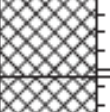



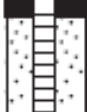



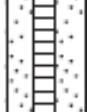

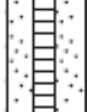


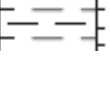

Borehole No

BH01

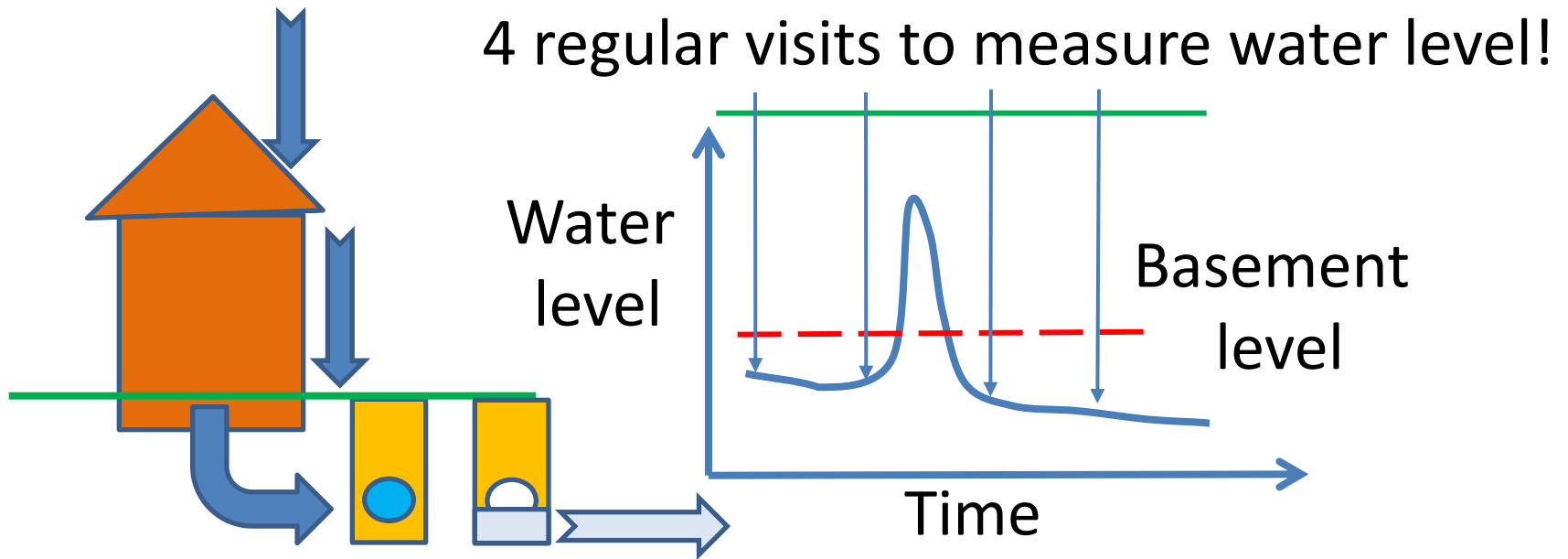
Job No 09/2188	Date Started 13/03/09 Date Completed 16/03/09	Ground Level (mOD) 75.82	Co-Ordinates E 526916.0 N 185663.9	Final Depth 25.00m
Client Ringline Properties Limited			Method/ Plant Used Cable Percussion	Sheet 1 of 3

PROGRESS			STRATA				SAMPLES & TESTS			Field Records	Instrument/ Backfill	
Date	Casing	Water	Level (mOD)	Legend	Depth (Thickness)	Strata Description	Depth (m)	Type No	Test Result			
13/03/09	1.20	Dry	75.22	[Redacted]	(0.60)	Dark brown sandy CLAY with brick fragments and a toothpaste tube. (MADE GROUND)	0.20			... Occasional roots of live appearance encountered between ground level and 0.60m depth		
					(0.45)	... with occasional pockets of brown mottled bluish grey clay, with brick and charcoal fragments at 0.50m	0.50	B01				
13/03/09			Dry		74.77		1.05	Brown slightly gravelly slightly sandy CLAY with brick fragments and a clay smoking pipe stem. Gravel is subrounded to rounded fine to medium flint. (MADE GROUND)	1.00	T02		... Roots of live appearance (<5mm) encountered between 1.05m and 1.30m depth
					74.52		1.30	Dark brown sandy CLAY with frequent brick fragments. (MADE GROUND)	1.00	T03		
13/03/09	2.70	Dry				Dark brown sandy CLAY with frequent brick fragments. (MADE GROUND)	1.00	J04				
							... with a siltstone nodule (120mm) at 1.10m	1.20	V05			
							Firm, brown occasionally mottled grey slightly sandy CLAY with extremely to very closely spaced partings of orangish brown silty sand.	1.20	B06			
							... becoming brown occasionally mottled bluish grey with black flecks below 2.20m	1.20	B07			
							... with light grey sand at 2.70m	1.20	B08			
							... becoming very closely fissured at 3.70m	1.70-1.70	U09	N8	32 blows	1, 2 / 1, 1, 2, 4
							... with occasional selenite crystals below 4.20m	2.00	T10			
							... becoming brown extremely to very closed fissured below 4.70m	2.00	T11			
							... with pyrite nodules (25mm) at 5.00m	2.00	J12			
								2.20	V13			
								2.20	D14			
								2.20	D15			
						2.70-3.15	U16	N10	28 blows	1, 1 / 2, 2, 3, 3		
						3.20	D17					
						3.20-3.65	D18					
						3.20		N9		1, 2 / 2, 2, 2, 3		
						3.50	T19					
						3.50	T20					
						3.50	J21					
						3.50	V22					
						3.70-4.15	U23	28 blows				
						4.20	D24					
						4.20-4.65	D25					
						4.20		N12	34 blows	1, 2 / 2, 3, 3, 4		
						4.70-5.15	U26					
						5.00	T27					
						5.00	T28					
						5.00	J29					
						5.00	V30					
						5.20	D31					

CARE!
Standpipes
can join
Strata
that are
separate

PROGRESS			STRATA				SAMPLES & TESTS			Field Records	Instrument/ Backfill
Date	Casing	Water	Level (mOD)	Legend	Depth (Thickness)	Strata Description	Depth (m)	Type No	Test Result		
13/03/09		Dry	75.22		(0.60) 0.60	Dark brown sandy CLAY with brick fragments and a toothpaste tube. (MADE GROUND)	0.20 0.50			... Occasional roots of live appearance encountered between ground level and 0.60m depth	
13/03/09	2.20	Dry	74.77		(0.45) 1.05	... with occasional pockets of brown mottle bluish grey clay, with brick and charcoal fragments at 0.50m	0.99			... Roots of live appearance (<5mm) encountered between 1.05m and 1.30m depth	
			74.52		1.30	Brown slightly gravelly slightly sandy CLAY with brick fragments and a clay smoking pipe stem. Gravel is subrounded to rounded fine to medium flint. (MADE GROUND)	1.00 1.00 1.00 1.00 1.00	T02 T03 J04 V05 B06			
						Dark brown sandy CLAY with frequent brick fragments. (MADE GROUND)	1.20-1.70 1.20 1.20	B07 D08	N8	1, 2 / 1, 1, 2, 4	
13/03/09	2.70	Dry				... with a siltstone nodule (120mm) at 1.10m	1.70-2.15 2.00 2.00	U09 T10 T11	32 blows		
						Firm, brown occasionally mottled grey slightly sandy CLAY with extremely to very closely spaced partings of orangish brown silty sand.	2.00 2.00 2.00	J12 V13 D14			
						... becoming brown occasionally mottled bluish grey with black flecks below 2.20m ... with light grey sand at 2.70m	2.20-2.65 2.20 2.70-3.15	D15	N10	1, 1 / 2, 2, 3, 3	
						... becoming very closely fissured at 3.70m	3.20 3.20-3.65 3.20	D17 D18	N9	1, 2 / 2, 2, 2, 3	
					(6.40)	... with occasional selenite crystals below 4.20m	3.50 3.50 3.50 3.50	T19 T20 J21 V22			
						... becoming brown extremely to very closed fissured below 4.70m ... with pyrite nodules (25mm) at 5.00m	3.70-4.15 4.20 4.20-4.65	U23 D24 D25	28 blows		
							4.20 4.70-5.15 5.00 5.00 5.00 5.00 5.20	U26 T27 T28 J29 V30 D31	N12	1, 2 / 2, 3, 3, 4	
							5.20-5.65 5.20 5.70-6.15 6.20 6.20-6.65 6.20	D32 U33 D** D	40 blows	2, 2 / 3, 3, 4, 5	
							6.20 6.70-7.15	U			

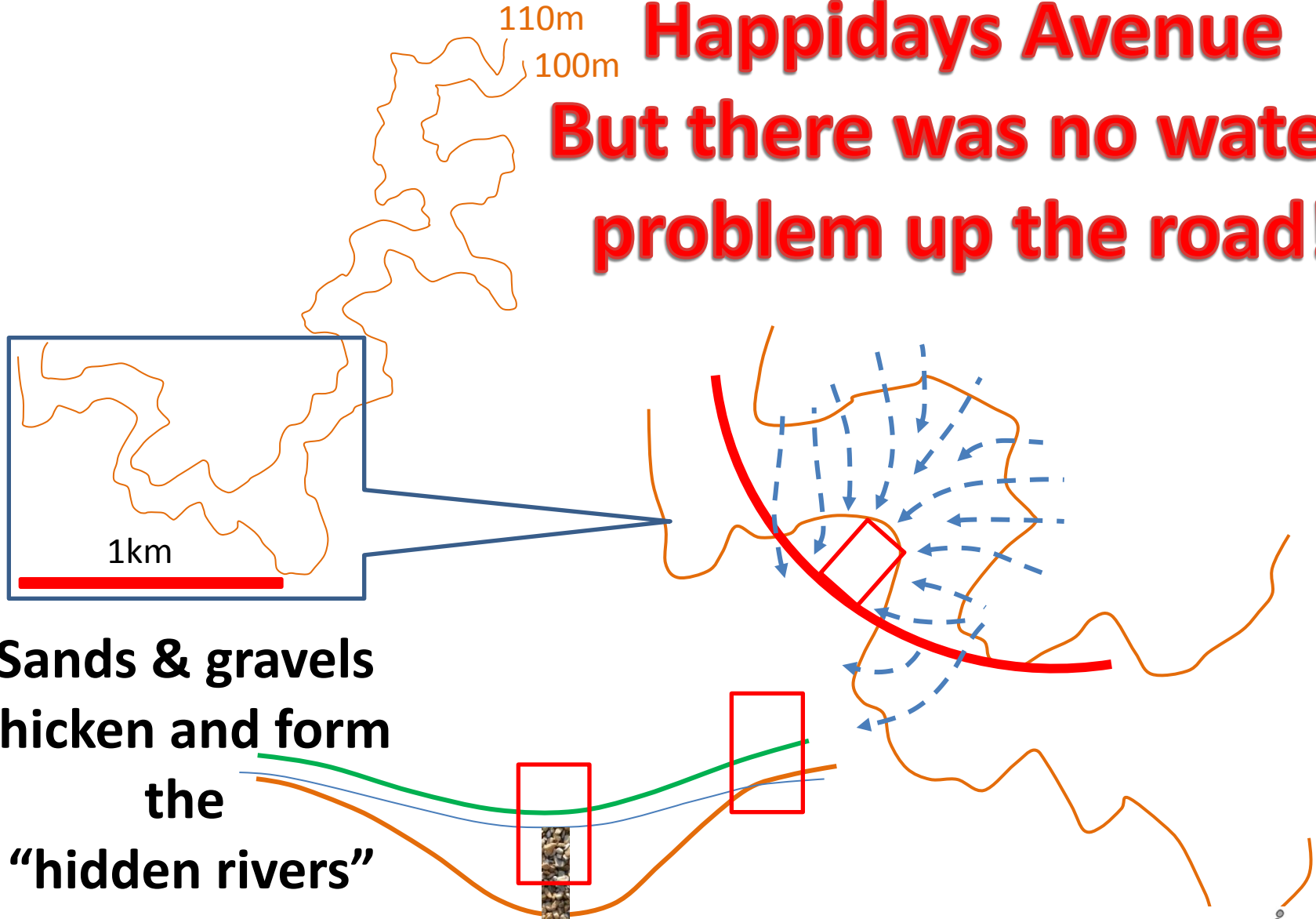
Should link water levels to rainfall



**Requires TIME &
CONTINUOUS MEASUREMENT**

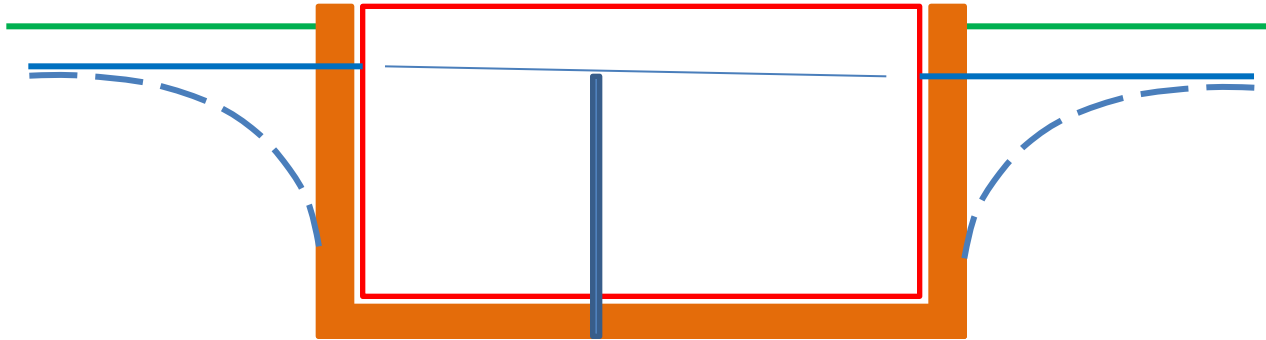
Happidays Avenue

But there was no water problem up the road!



**Sands & gravels
thicken and form
the
"hidden rivers"**

Granular drain; great idea?



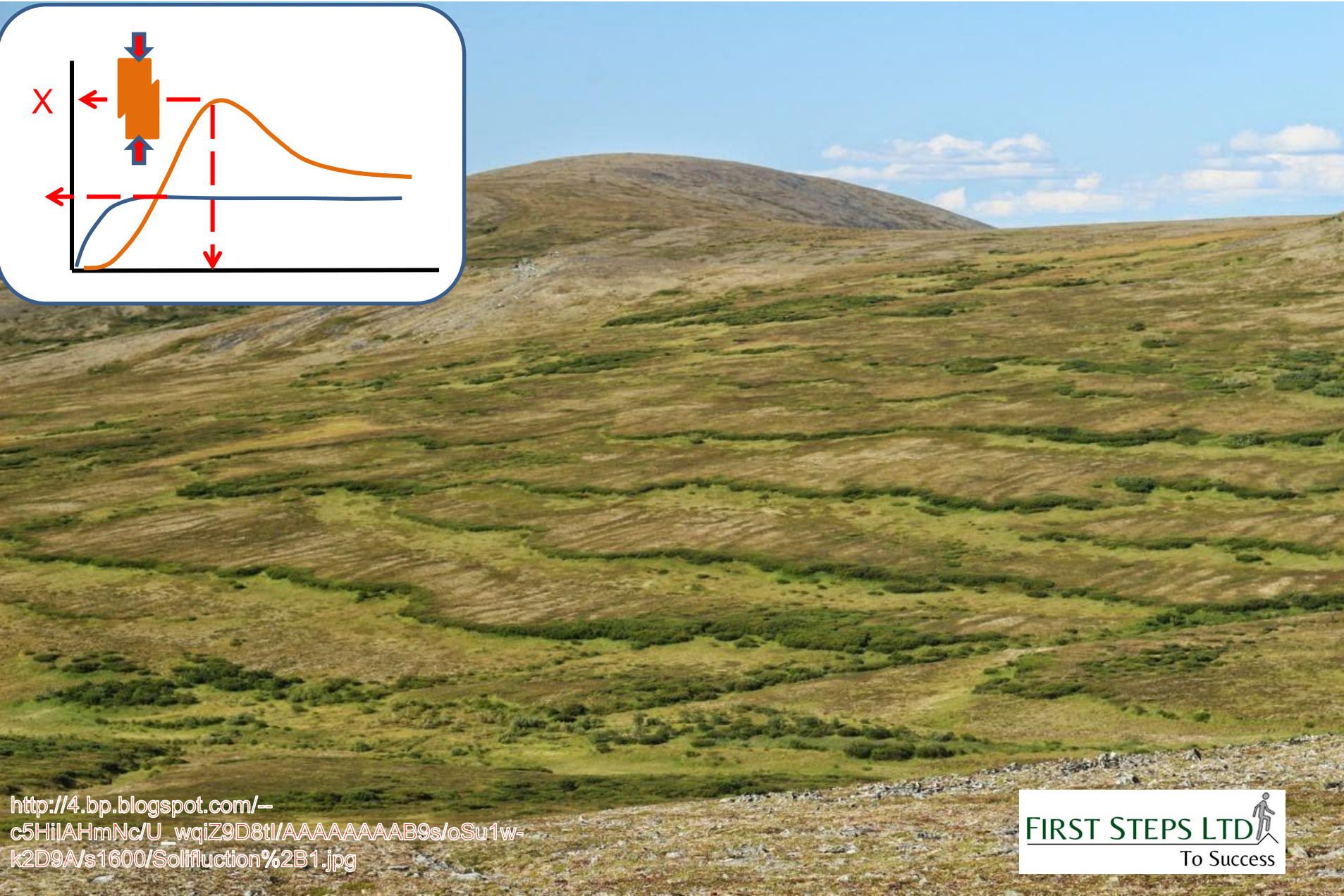
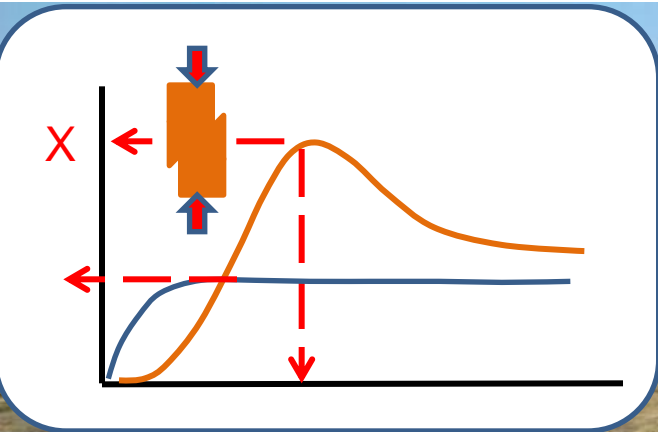
How will you know it is functioning?

How can it be inspected?

How can it be maintained?

**Chemical & bio-chemical reactions
that block pores in the drain.**

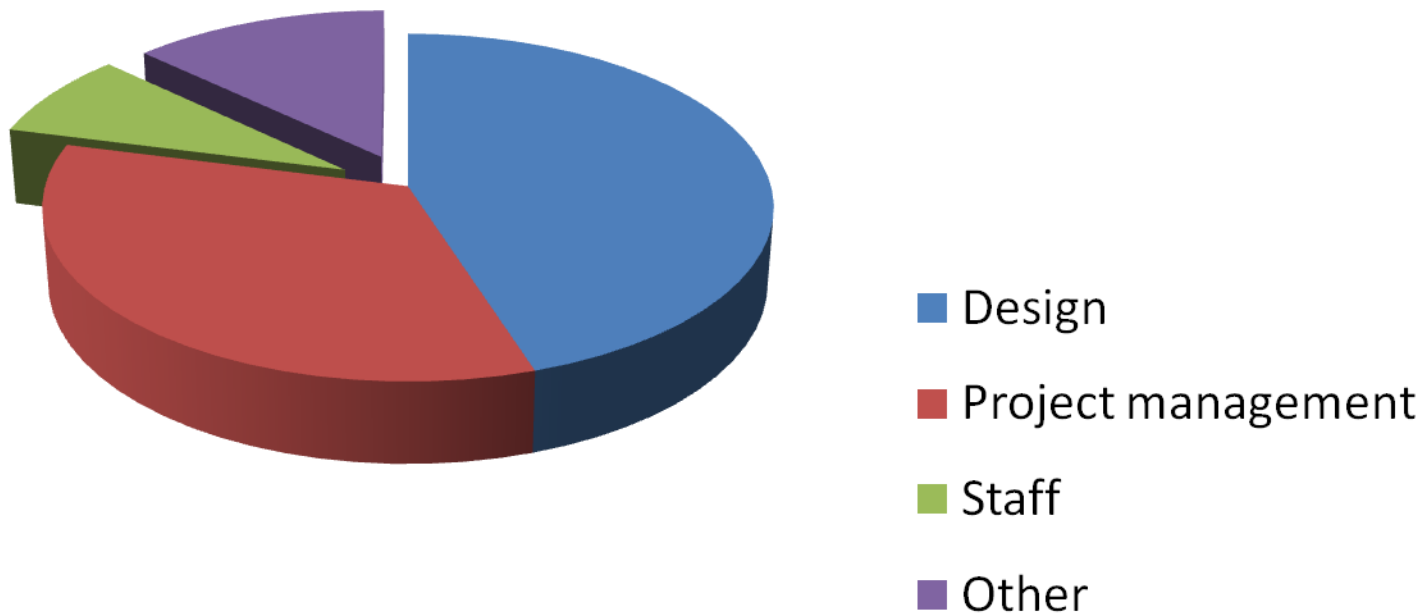
Palaeo-landslides our glacial inheritance



http://4.bp.blogspot.com/--c5HilAHmNc/U_wqiZ9D8tI/AAAAAAAAAB9s/oSu1w-k2D9A/s1600/Solifluction%2B1.jpg

Damage to neighbouring properties

CLAIMS associated with ground engineering



Ref; Int. State of the Art Report on Integrating Geotechnical Risk Management in Project Risk Management (ISSMGE TC304) 2013

Qualifications needed

- 1. Chartered Geologist CGeol
speciality Engineering Geology.**
- 2. Chartered Engineer CEng or MICE or MStructE
speciality Ground Engineering.**
- 3. Chartered Member Institⁿ of Water & Environmental
Management C.WEM speciality Flood Risk.**
- 4. Specialist or Advisor grade on UK Register of
Ground Engineering Professionals RoGEP.**

QUESTIONS AND ANSWERS!



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