Ground Source Renewable Energy Mapping for Glasgow

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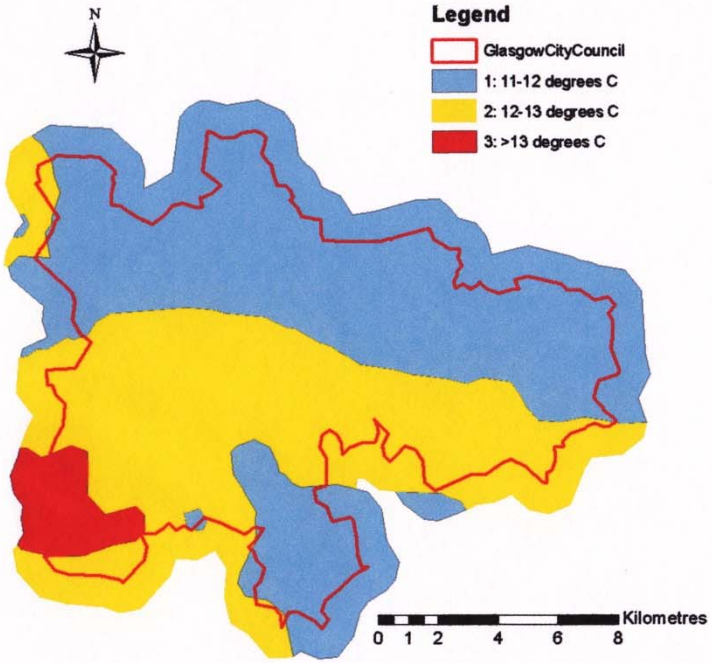
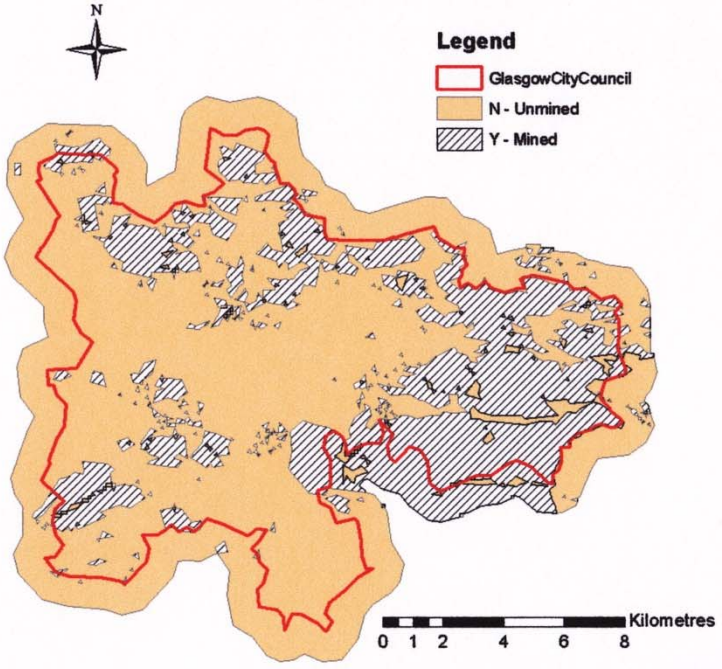
Mine-workings below Glasgow

Temperature at 100m depth



Aquifer potential of mine workings

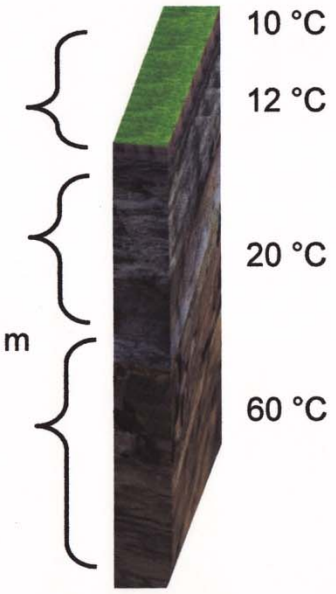


BGS' Geology Maps

Potential contribution to the Earth's heat store to Scotland's renewable energy mix?

Outline

1. Ground source heat pumps 1-100m+ depth
2. Disused mine workings - up to 100s m depth
   - Temperature increase ~2.5 °C per 100 m due to geothermal gradient
3. Direct use
4. Engineered Geothermal Systems



Estimate of Thermal Potential for Glasgow

Thermal potential in Glasgow's abandoned mines

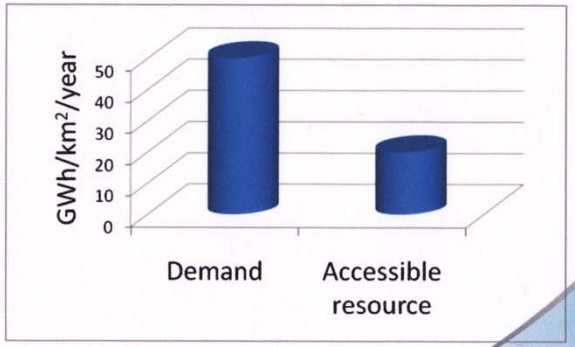
Potential heat that can be extracted?

Potential resources assume mine workings up to 300m deep, extract 10°C (no allowance for renewing thermal resource naturally, or artificially)

- Annual heating demand c.50GWh per km^2 per year
(from 2007 estimate Glasgow's electricity/gas use)
- Accessible resource estimated equivalent to 20GWh per km^2 per year
(based on borehole yield 60 l/s/km^2)

Equivalent to:

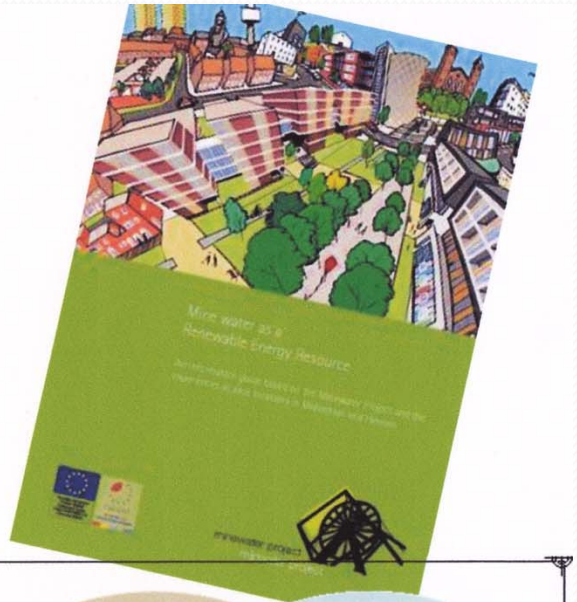
- **40% of heating demand**
- **Estimated to be 1% of total resource, i.e. could last 100 years**

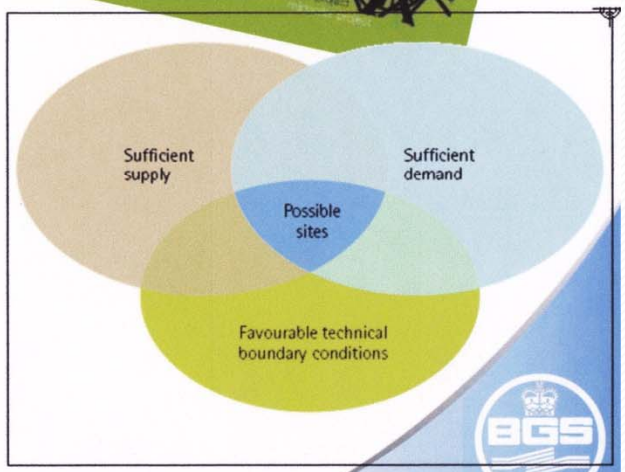


Examples

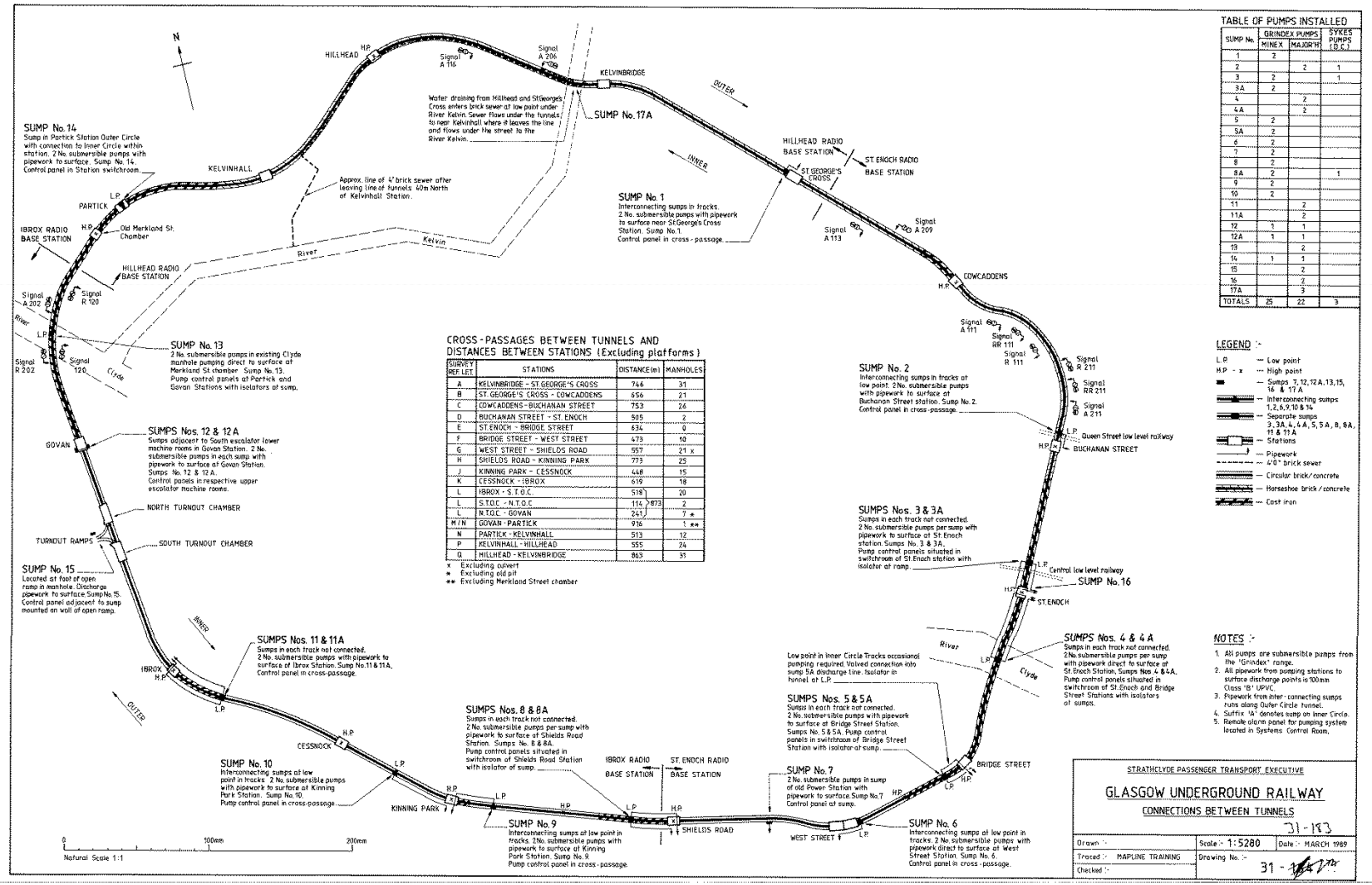
Disused and flooded mines

- Working example - Heerlen, Netherlands; heats 800 houses and office complex
- Small local examples (Shettleston, and Lumphinans) & Scottish National Minewater Potential Study (PB Power 2004)
- Need to establish favourable conditions (model geology, mines, groundwater) - identify suitable sites
- Match supply & demand to sources
- Develop schemes on range of scales





Glasgow Underground Subway



CROSS-PASSAGES BETWEEN TUNNELS AND DISTANCES BETWEEN STATIONS (Excluding platforms)

SURVEY REF LET	STATIONS	DISTANCE (m)	MANHOLES
A	KELVINBRIDGE - ST.GEORGE'S CROSS	746	31
B	ST.GEORGE'S CROSS - COWCADDENS	656	21
C	COWCADDENS - BUCHANAN STREET	753	24
D	BUCHANAN STREET - ST.ENOCH	505	2
E	ST.ENOCH - BRIDGE STREET	634	9
F	BRIDGE STREET - WEST STREET	473	10
G	WEST STREET - SHIELDS ROAD	557	21 x
H	SHIELDS ROAD - KINNING PARK	773	25
J	KINNING PARK - CESSNOCK	448	15
K	CESSNOCK - IBROX	619	18
L	IBROX - S.T.O.C.	518	20
L	S.T.O.C. - N.T.O.C.	114 > 873	2
L	N.T.O.C. - GOVAN	241	7 *
M/N	GOVAN - PARTICK	916	1 **
N	PARTICK - KELVINHALL	513	12
P	KELVINHALL - HILLHEAD	555	24
Q	HILLHEAD - KELVINBRIDGE	863	31

x Excluding culvert
* Excluding old pit
** Excluding Merkland Street chamber

TABLE OF PUMPS INSTALLED

SUMP No.	GRINDEX PUMPS MINEX	GRINDEX PUMPS MAJORITH	SYKES PUMPS (D.C.)
1	2		
2		2	1
3	2		1
3A	2		
4		2	
4A		2	
5	2		
5A	2		
6	2		
7	2		
8	2		
8A	2		1
9	2		
10	2		
11		2	
11A		2	
12	1	1	
12A	1	1	
13		2	
14	1	1	
15		2	
16		2	
17A		3	
TOTALS	25	22	3

LEGEND :-
L.P — Low point
H.P - x — High point
— Sumps 7, 12, 12A, 13, 15, 16 & 17A
— Interconnecting sumps 1, 2, 6, 9, 10 & 14
— Separate sumps 3, 3A, 4, 4A, 5, 5A, 8, 8A, 11 & 11A
— Stations
— Pipework
— 4'0" brick sewer
— Circular brick/concrete
— Horseshoe brick/concrete
— Cast iron

NOTES :-
1. All pumps are submersible pumps from the 'Grindex' range.
2. All pipework from pumping stations to surface discharge points is 100mm Class 'B' UPVC.
3. Pipework from inter-connecting sumps runs along Outer Circle tunnel.
4. Suffix 'A' denotes sump on Inner Circle.
5. Remote alarm panel for pumping system located in Systems Control Room.

STRATHCLYDE PASSENGER TRANSPORT EXECUTIVE

GLASGOW UNDERGROUND RAILWAY

CONNECTIONS BETWEEN TUNNELS

31-183

Drawn :-	Scale :- 1:5280	Date :- MARCH 1969
Traced :- MAPLINE TRAINING	Drawing No. :-	
Checked :-	31 - [illegible]	

Glasgow Underground Railway
Sump Locations