

The volunteer process of site selection for radwaste disposal in Canada:

why it may be suitable for Canada, but is inappropriate for the UK

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Quick summary

Canada has asked for volunteer communities **WITHOUT** going to a national search.

The relevant question is:

- Can volunteerism work as a process ?

Answers:

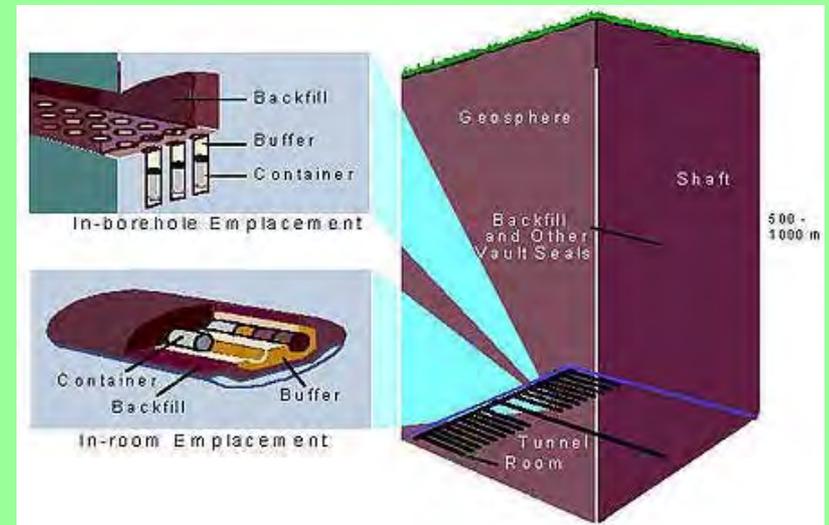
- Only if most of your country is fundamentally suitable,
- Only if tough exclusion criteria are applied early on in the acceptance process,
- Only if the assessment of exclusion specifically includes hydrogeology and deep flow, not just rock type and resource as practised by the NDA, and
- The assessment should be undertaken by an independent arms-length body, not by the developer

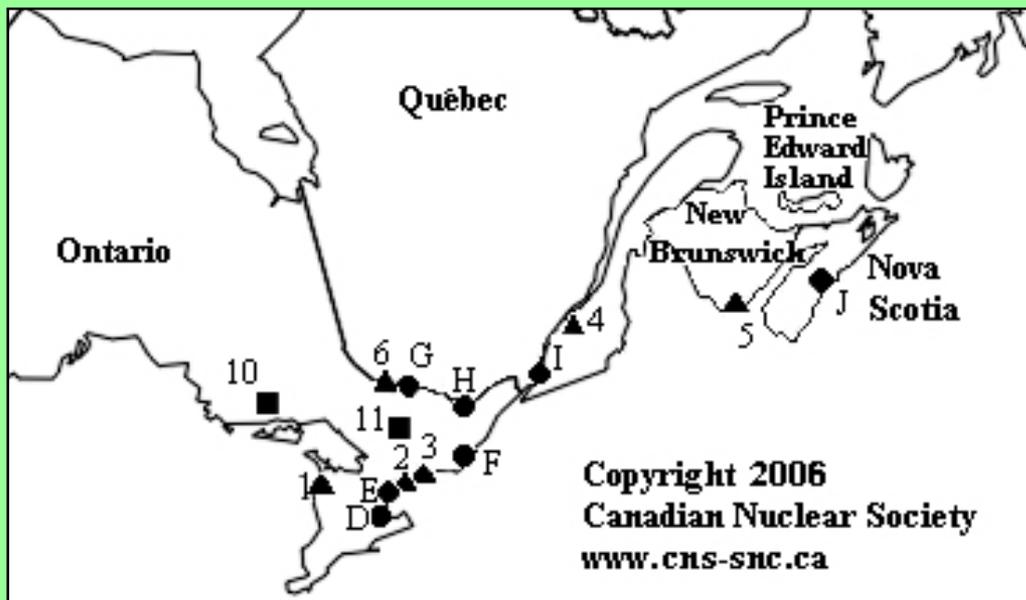
Brief history of site search in Canada

In the 1970s and 80s Atomic Energy of Canada Limited (AECL) began to develop the concept of deep geological disposal of nuclear fuel wastes. In September 1988, the federal Minister of Energy, Mines and Resources referred the concept, along with a broad range of nuclear fuel waste management issues, for public review.

The 'AECL' concept was as follows:

- the waste form is either used Canada Deuterium Uranium (CANDU) fuel or the solidified high-level wastes from reprocessing;
- the waste form is sealed in a container designed to last at least 500 years and possibly much longer;
- the containers of waste are emplaced in rooms in a disposal vault or in boreholes drilled from the rooms;
- the disposal rooms are between 500 and 1000 metres below the surface;
- the geological medium is plutonic rock of the Canadian Shield;
- each container of waste is surrounded by a buffer;
- each room is sealed with backfill and other vault seals; and
- all tunnels, shafts and exploration boreholes are ultimately sealed in such a way that a disposal facility would be passively safe-that is, long-term safety would not depend on institutional controls.





▲ CANDU reactors [# of reactors x net MW(e)]

1. Bruce A: 4 x 770 (2 shut and being refurbished)
Bruce B: 2 x 795 + 1 x 825 + 1 x 849
Douglas Point: 1 x 208 (decom) - large prototype CANDU
2. Pickering A: 4 x 515 (2 shut)
Pickering B: 4 x 516
3. Darlington: 4 x 881
4. Gentilly-1: 1 x 250 (decom) - Boiling water CANDU
Gentilly-2: 1 x 635 CANDU 6
5. Point Lepreau: 1 x 633 CANDU 6
6. Nuclear Power Demonstration: 1 x 22 (decom) - 1st Canadian PHWR, prototype for CANDU reactors

Currently, there are nuclear power plants are operating in Ontario, Quebec and New Brunswick, comprising 19 operating reactors, and two new ones projected (*Le Monde*, 10 Jan 2013). They are all of the CANDU type. The map and table shown above date from 2006, and may be out of date. The square and circle symbols denote, respectively, uranium mines and research reactors.

The Nuclear Waste Management Organization (NWMO) of Canada was established in 2002 under the Nuclear Fuel Waste Act (NFWA) to investigate approaches for managing Canada's used nuclear fuel. Contrary to the Seaborn report (para. 6.1.2) recommendation that:

"The agency must be at arm's length from the producers and current owners of the wastes.",

the NWMO is run by and for the nuclear industry.

21 communities in Canada responded to the Nuclear Waste Management Organisation (NWMO) call for volunteers.

The NWMO site selection process was designed between 2008-09, and the call for volunteers made in May 2010 closed on 30 September 2012.

The screening process includes not just the environmental, economic and future intrusion risk, factors that were partly addressed by the BGS screening report of West Cumbria, **but also the likely suitability of the geology.**



Communities Involved in the Nuclear Waste Management Organization's Siting Process

Saskatchewan

1. English River First Nation (Step 3)
2. Pinehouse (Step 3)
3. Creighton (Step 3)

Northern Ontario

4. Ear Falls (Step 3)
5. Ignace (Step 3)
6. Nipigon (Step 3)
7. Schreiber (Step 3)
8. Hornepayne (Step 3)
9. White River
10. Wawa (Step 3)
11. Blind River
12. Elliot Lake
13. Township of the North Shore
14. Spanish
20. Manitouwadge (considering)

Central Ontario

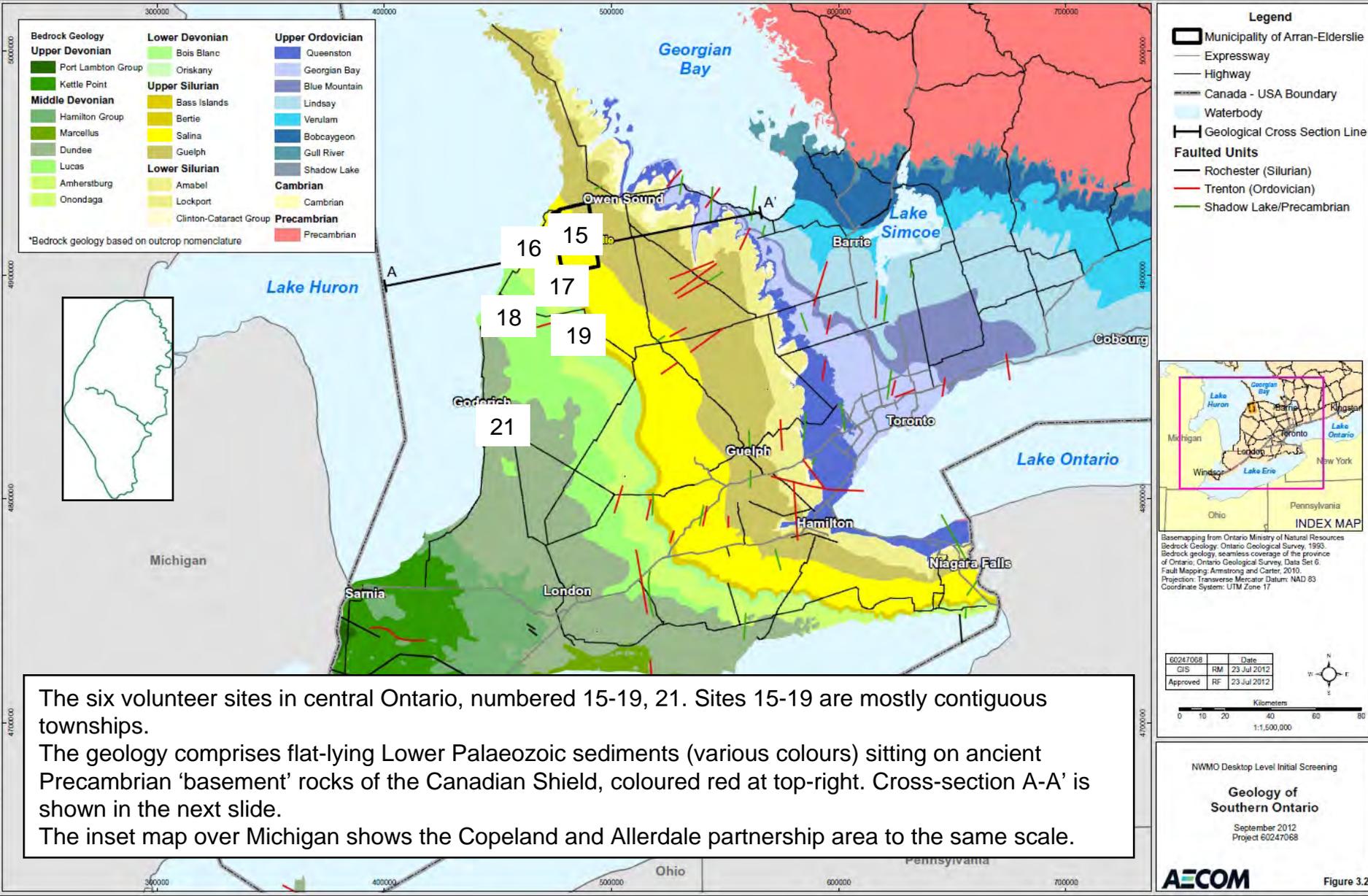
15. Aaran-Elderslie
16. Saugeen Shores
17. Brockton ((Step 3)
18. Huron Kinloss
19. South Bruce
21. Central Huron

The English River First Nation community proposed:

- 3 sites in the Athabasca basin – rejected.
- 3 sites in the Western Canada Sedimentary Basin – rejected.
- 7 sites within the Canadian Shield – passed.

So there are in fact 27 localities which have passed the initial screening. Some of the townships had parts of their areas screened out. One township (Red River, discussed below) was rejected completely on geological criteria.

All except the 6 Central Ontario sites are situated in the ancient hard crystalline rocks of the Canadian Shield. All 27 sites are situated in very low relief terrain.



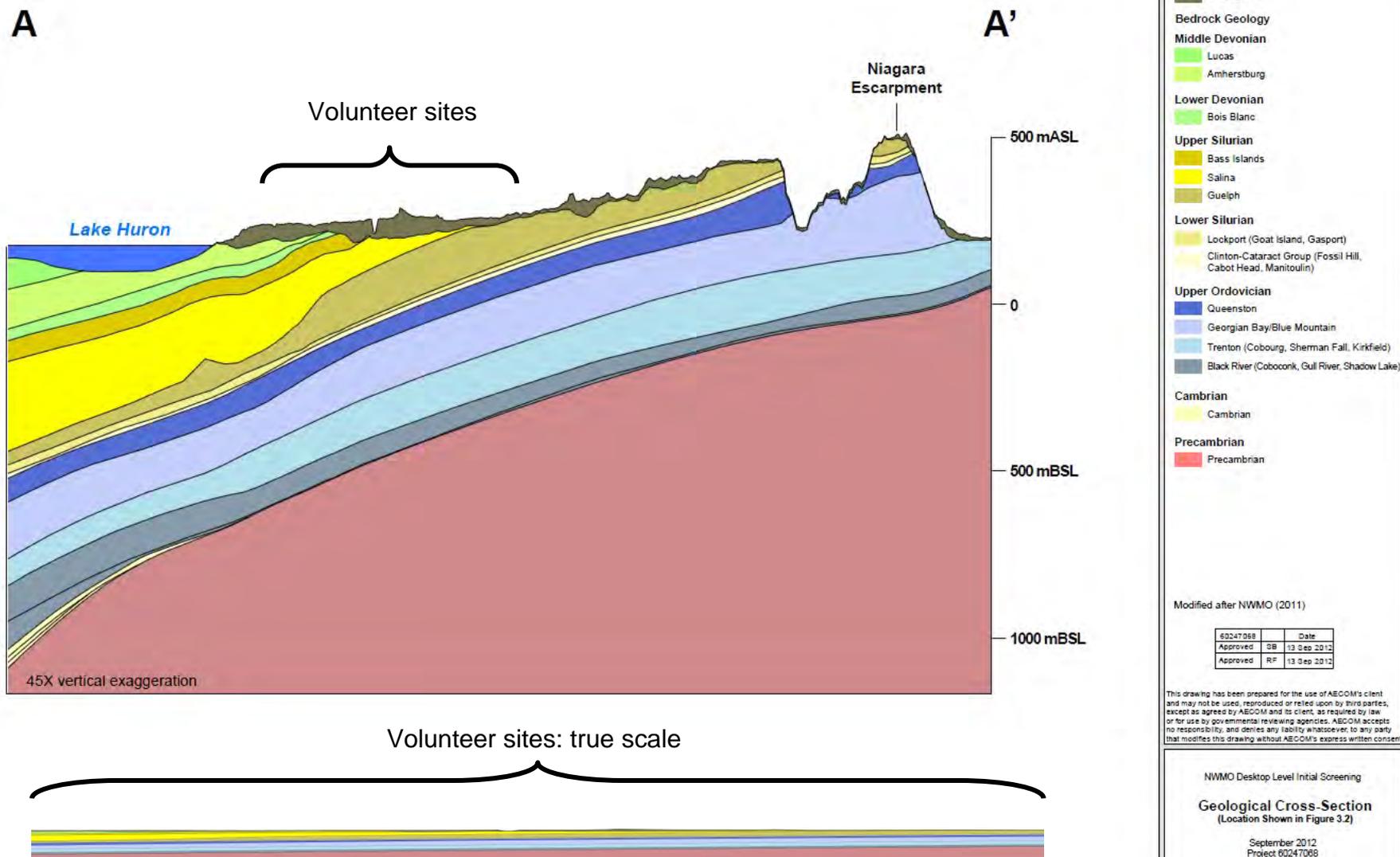
The six volunteer sites in central Ontario, numbered 15-19, 21. Sites 15-19 are mostly contiguous townships.

The geology comprises flat-lying Lower Palaeozoic sediments (various colours) sitting on ancient Precambrian 'basement' rocks of the Canadian Shield, coloured red at top-right. Cross-section A-A' is shown in the next slide.

The inset map over Michigan shows the Copeland and Allerdale partnership area to the same scale.

Central Ontario sites on a geology map

The central Ontario sites have very simple and predictable geology



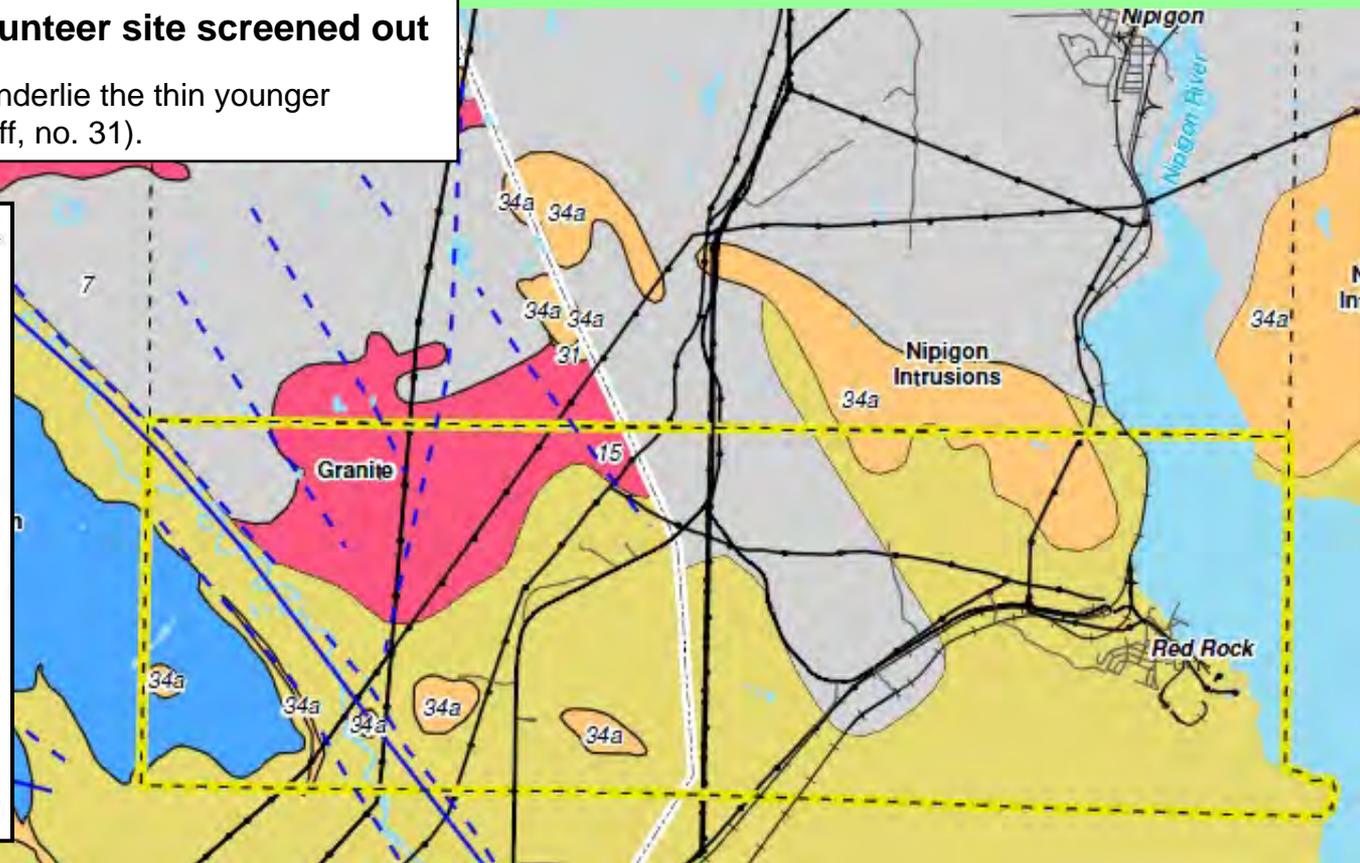
The six volunteer sites in central Ontario are located in the bracketed geological zone. The main diagram has a x45 vertical exaggeration. Note that the topographic relief in the volunteer zone is a few tens of metres at maximum. The lower cross-section shows the zone with no vertical exaggeration. The geological setting is called a 'foreland basin'; this is the same setting as the Swiss clay site.

Red Rock Township – a volunteer site screened out

The metasediments (grey, no.7) underlie the thin younger sediments of the Sibley Group (buff, no. 31).

LEGEND

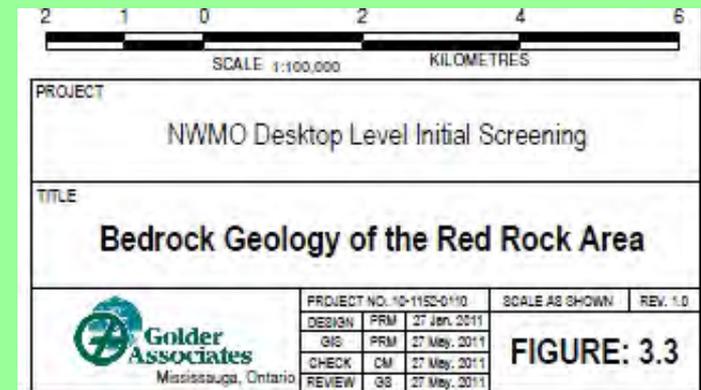
- Township of Red Rock
- Municipal Boundary, Lower Tier
- Main Road
- Local Road
- Railway
- Utility Line
- Water Area, Permanent
- Geological Fault
- Lineament / Fault (Hart, 2005)
- Geological Contact
- Revised Mapping (Hart, 2005)
- 34 Mafic and related intrusive rocks (Keweenawan age)
- 34a Logan and Nipigon sills (1109 Ma): diabase sills
- 31 Sibley Gp.
- 15 Massive granodiorite to granite
- 15a Potassium feldspar megacrystic units
- 11 Gneissic tonalite suite
- 10 Mafic and ultramafic rocks
- 10a Gabbro
- 10b Anorthosite
- 7 Metasedimentary rocks (Paragneisses and Migmatites)



The township is marked by the yellow rectangle. Here is the summary conclusion from the screening:

“The review of readily available information and the application of the five initial screening criteria show that the Red Rock area is unlikely to contain geological formations that would be potentially suitable for hosting a deep geological repository. The various geological formations within the area considered for this screening are either not amenable to site characterization or are unlikely to meet the containment and isolation function of a deep geological repository. Therefore, the Township of Red Rock is not considered a suitable candidate for continuing in the NWMO site selection process.”

Details are provided next, as they are instructive for the UK process.



Why was Red Rock screened out? – extracts from the report

“Initial screening criteria (NWMO, 2010) require that:

- 1) The site must have enough available land of sufficient size to accommodate the surface and underground facilities.*
- 2) This available land must be outside of protected areas, heritage sites, provincial parks and national parks.*
- 3) This available land must not contain known groundwater resources at the repository depth, so that the repository site is unlikely to be disturbed by future generations.*
- 4) This available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations.*
- 5) This available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the outlined safety factors in Section 6 of the site selection document (NWMO, 2010).”*

Item 5 above leads to:

“6.5 Screening Criterion 5: Unsafe Geological or Hydrogeological Features

The site should not be located in an area of known geological or hydrogeological features that would make the site unsafe, as per the following five geoscientific safety-related factors identified in the site selection process (NWMO, 2010):

- 1) Safe containment and isolation of used nuclear fuel. Are the characteristics of the rock at the site appropriate to ensuring the long-term containment and isolation of used nuclear fuel from humans, the environment and surface disturbances?*
- 2) Long-term resilience to future geological processes ...*
- 3) Safe construction, operation and closure of the repository. ...*
- 4) Isolation of used fuel from future human activities. ...*
- 5) Amenable to site characterization and data interpretation activities. Can the geologic conditions at the site be practically studied and described on dimensions that are important for demonstrating long-term safety?*

...

Since the geology of the Red Rock area does not satisfy the safety-related factors 1 and 5, the other safety-related factors (2, 3 and 4) are not discussed.”

Why was Red Rock screened out (continued)?

Screening criterion 5, items 1 & 5:

“Safe Containment and Isolation and Amenability to Site Characterization

...

*An approximately 500 m deep geological repository in these areas would necessarily have to be developed in the underlying metasedimentary rocks. One of the key criteria in assessing the suitability of a site relates to having a host rock that is **amenable to site characterization** in order to develop a good understanding of the geoscientific characteristics of the site and a robust safety case. Because of the nature of the **structural characteristics of these metasedimentary rocks (e.g. fracture geometry and frequency)**, the presence of the overlying 200 m thick sedimentary rocks would greatly reduce the ability to adequately characterize them at repository depth. Therefore, all the areas within and outside the Township that are covered by the sedimentary rocks of the Sibley Group are excluded from further consideration.*

...

*Similarly to the sedimentary rocks of the Sibley Group, the Hele Intrusion has an estimated maximum thickness of approximately 130 m and does not extend to repository depth. A deep geological repository in this area would necessarily have to be developed in the underlying metasedimentary rocks, which would be **difficult to adequately characterize due to the overlying Hele intrusion**. Therefore, the area of the Hele Intrusion is also excluded from further consideration.”*

Comment: comparison with the coastal plain of West Cumbria

The metasedimentary rock in which the Red Rock repository would have to be sited is hidden by overlying sediments or intrusives. The fact that its structure is known to be fractured was sufficient to rule it out. On this basis the complex metavolcanics of the Borrowdale Volcanic Group in West Cumbria would have been immediately ruled out, as not “*amenable to site characterisation*”. This of course proved to be the case at Longlands Farm, but only after £400M had been wasted.

Transport

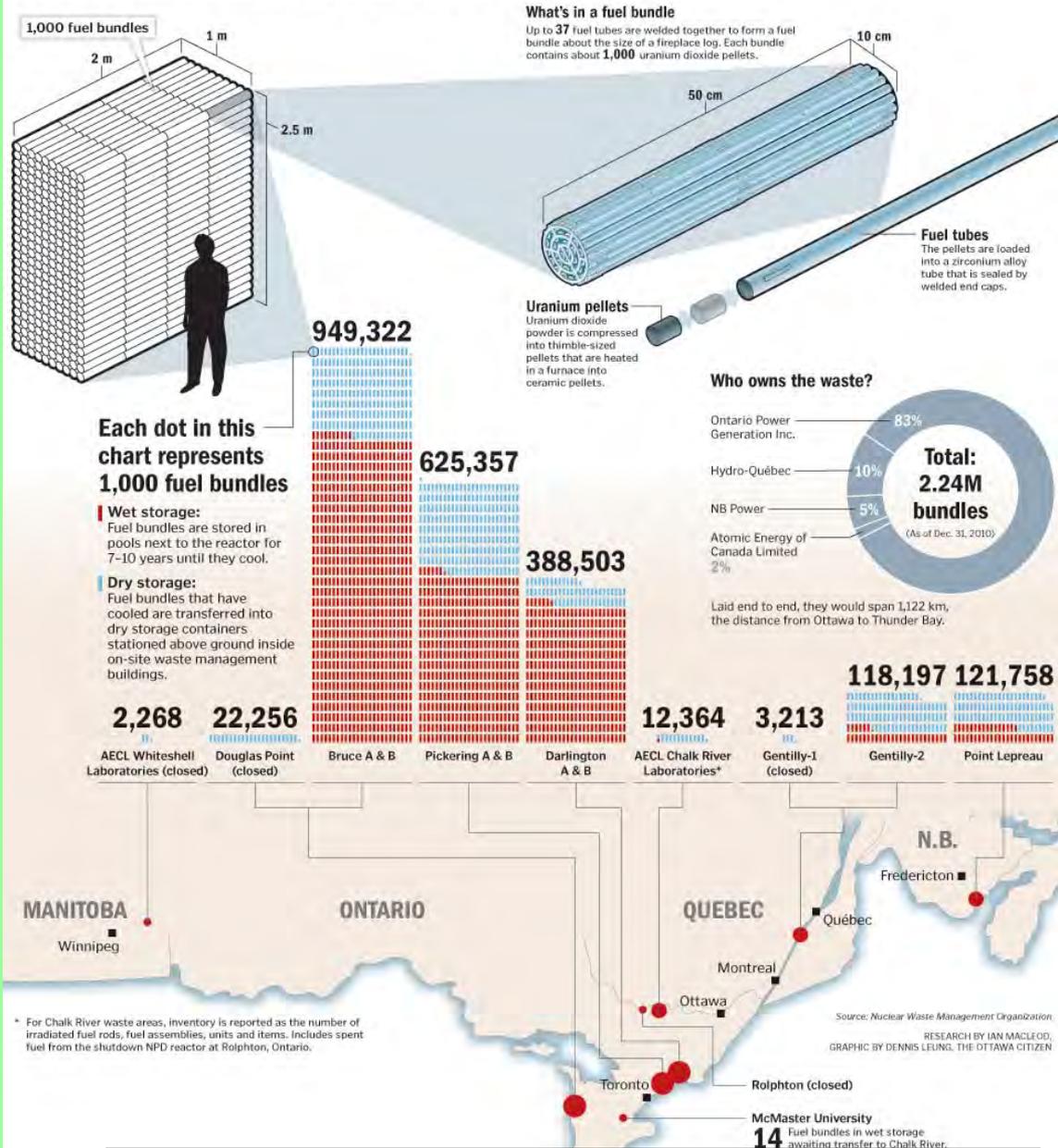
Even if a repository were to be sited in southern Ontario, for example at the Bruce nuclear power plant, where 42% of Canada's spent fuel is currently stored, the majority has to be transported several hundred kilometres.

Pickering to Bruce, for example, is about 200 km.

This is not considered to be an issue by the NWMO, which is looking for just one national site.

Where Canada's used nuclear fuel is stored

Once a reactor has used up a fuel bundle, it stays dangerously radioactive for more than 100,000 years. Without a long-term storage facility, Canada's spent fuel — growing by 85,000 bundles a year — is stored at the reactor sites. Here's where Canada's used fuel and other nuclear waste is stored:



Source: <http://radiofreethinker.com/tag/nuclear-waste-management-organization/>

Comparisons with the UK version of voluntarism

Canada is 60 times the area of England and Wales, but with half the population.

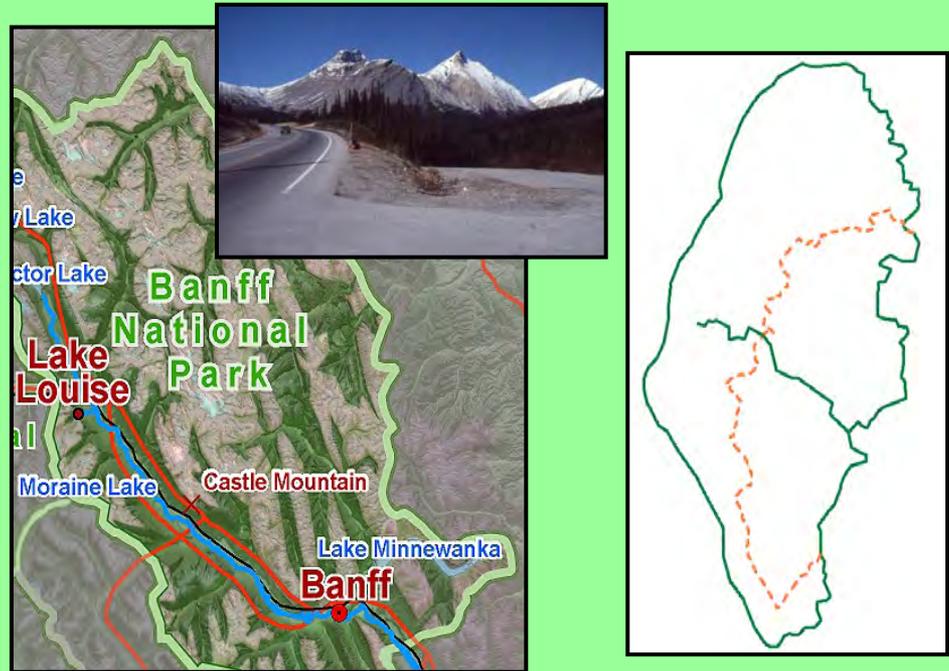
The Canadian process has produced 21 volunteer communities which have completely or partially passed an initial geological suitability test, **which includes the likelihood of the rocks being amenable to characterisation**. One community was completely rejected.

The geology of most of Canada, excluding the Rockies, is, in principle, reasonably promising; the ancient rocks of the Canadian Shield are similar to those of Finland and Sweden.

The analogy with England and Wales would be if 42 communities had come forward from areas of potentially suitable geology, such as in eastern England, and only two others were from geologically unsuitable areas.

If that were the case in England, the MRWS 'voluntary' process could be considered a success.

Another comparison of the current UK process with Canada would be, hypothetically, that only Red Rock in Canada had volunteered, but was not excluded because the geological screening criteria discussed above were not applied.



Part of Banff National Park, Alberta (left), in the Rockies (photo), at the same scale as the MRWS Partnership area (right).

The Lake District National Park within the eastern half of the partnership area is outlined in orange.

A converse analogy between the UK and Canada would be as follows:

- In the whole of Canada only the town of Banff, Alberta (population 6700) volunteered.
- It is surrounded by (but not part of) the Banff National Park.
- It proposes a chunk of the National Park for investigation.
- The complexity of the geology and the extreme topography are not a hindrance, because these criteria do not form part of the initial screening.
- So Banff National Park goes forward for site characterisation.

Conclusions

- Canada is a huge country, 60 times the size of England and Wales.
- A limited geological search was tried in the 1970s and 1980s, but aborted.
- Canada is blessed with 8 million sq km of low relief hard rock at the surface – the Canadian Shield.
- It is therefore reasonable for Canada to permit voluntarism before a systematic geological survey.
- The Canadian initial screening process has robust criteria for checking the geology.
- The Canadian volunteer process has thrown up a good variety of sites for comparison and sifting.
- The Canadian site search process is not linked either to reprocessing or to 'new build'.
- Transport of high-level waste overland over long distances is not considered an issue.
- The Canadian process has evaluated 27 localities for geological suitability (equivalent to MRWS Stage 4) in under 2.5 years.

In contrast:

- The UK voluntarist process has only yielded two contiguous communities.
- The geology of these two communities is *a priori* unsuitable.
- The UK initial screening excluded any test for geological suitability.
- The UK initial screening postponed the all-important groundwater risk to the site investigation stage.
- The UK has carried out in the past three national geological suitability surveys, but these are now being ignored (or hidden, as in the 2006 exercise, completed but never published).
- Siting at or near Sellafield, to reduce alleged transport risks, is given a spuriously high importance.
- The UK is seeking a site search quick fix to remove one of the obstacles to 'new build'.
- The UK claims that not enough is known to evaluate the geology of Copeland and Allerdale in MRWS Stage 4, and that £40M must be spent on surface studies first (i.e. Stage 5).

Therefore it is wrong and invalid to claim, as the NDA is trying to do, that the Canadian volunteer process in site search has any applicability or relevance to the UK.