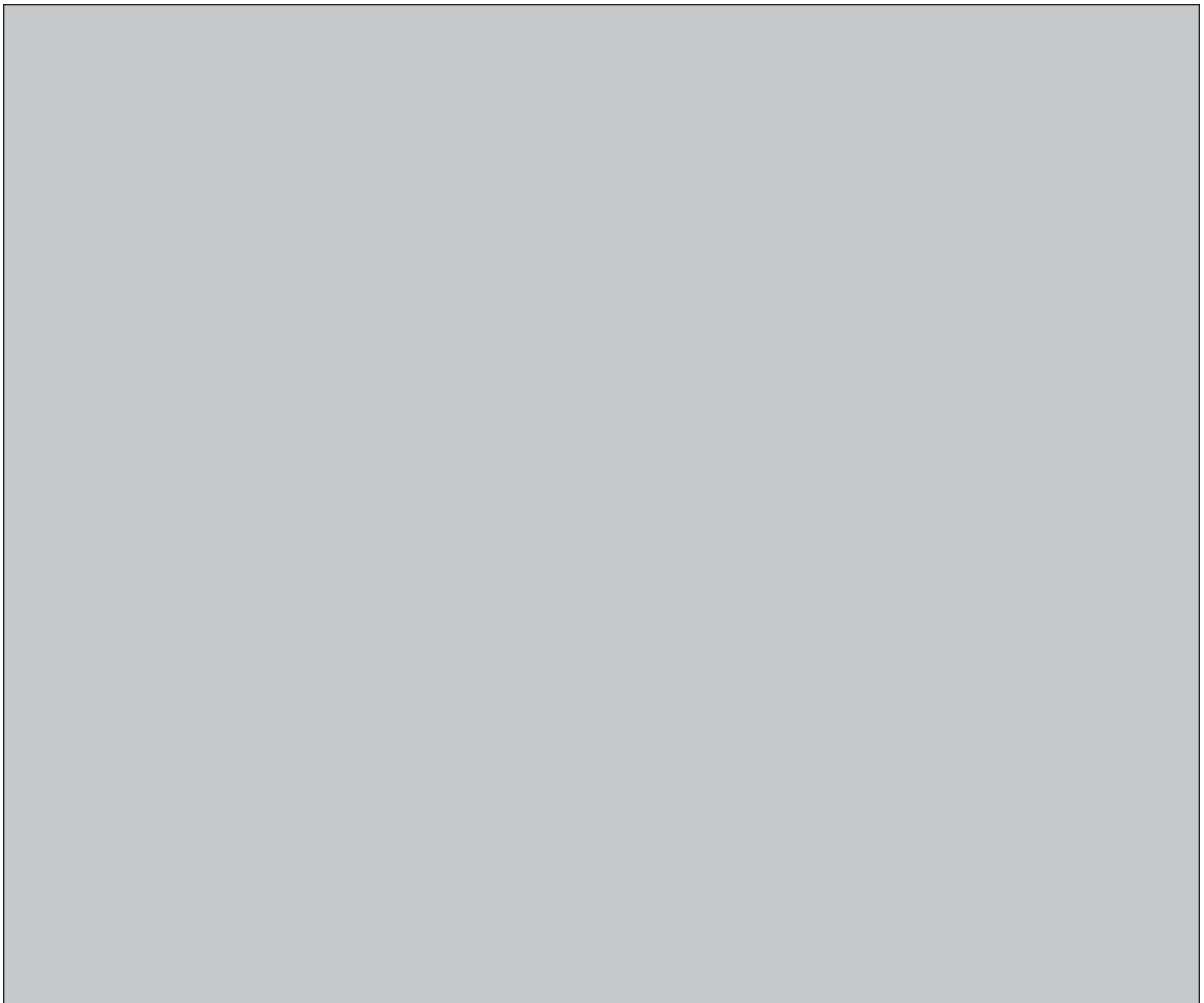


NWMO BACKGROUND PAPERS**5. ECONOMIC FACTORS****5-1 AN EXAMINATION OF ECONOMIC REGIONS AND THE NUCLEAR FUEL WASTE
MANAGEMENT ACT**

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NWMO Background Papers

NWMO has commissioned a series of background papers which present concepts and contextual information about the state of our knowledge on important topics related to the management of radioactive waste. The intent of these background papers is to provide input to defining possible approaches for the long-term management of used nuclear fuel and to contribute to an informed dialogue with the public and other stakeholders. The papers currently available are posted on NWMO's web site. Additional papers may be commissioned.

The topics of the background papers can be classified under the following broad headings:

1. **Guiding Concepts** – describe key concepts which can help guide an informed dialogue with the public and other stakeholders on the topic of radioactive waste management. They include perspectives on risk, security, the precautionary approach, adaptive management, traditional knowledge and sustainable development.
2. **Social and Ethical Dimensions** - provide perspectives on the social and ethical dimensions of radioactive waste management. They include background papers prepared for roundtable discussions.
3. **Health and Safety** – provide information on the status of relevant research, technologies, standards and procedures to reduce radiation and security risk associated with radioactive waste management.
4. **Science and Environment** – provide information on the current status of relevant research on ecosystem processes and environmental management issues. They include descriptions of the current efforts, as well as the status of research into our understanding of the biosphere and geosphere.
5. **Economic Factors** - provide insight into the economic factors and financial requirements for the long-term management of used nuclear fuel.
6. **Technical Methods** - provide general descriptions of the three methods for the long-term management of used nuclear fuel as defined in the NFWA, as well as other possible methods and related system requirements.
7. **Institutions and Governance** - outline the current relevant legal, administrative and institutional requirements that may be applicable to the long-term management of spent nuclear fuel in Canada, including legislation, regulations, guidelines, protocols, directives, policies and procedures of various jurisdictions.

Disclaimer

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1. INTRODUCTION

In Canada's Nuclear Fuel Waste Management Act, the Nuclear Waste Management Organisation (NWMO) is required to review a minimum of three long-term strategies including deep geologic disposal, on-site storage at the reactor sites and centralised storage. The Act further requires that economic regions should be selected in association with each of these options. Economic Regions are Statistics Canada's method for dividing up this vast country into sub-provincial sized units. The purpose of this report is to provide an overview of economic regions and to highlight the implications of the use of these regions for NWMO and the management of nuclear fuel waste and to provide recommendations to NWMO regarding the use of the economic region approach.

This report is divided into two major parts. Sections 1 through 4 review and describe regions as stipulated by Statistics Canada and the Act. They also outline how the choice of particular management options affects the selection of economic regions. Since the Act, particularly in Sections 8(2)(c) and 12(c) requires the designation of economic regions prior to actual site selection, this appears to suggest a two staged siting process. This report, therefore, assesses the implications of this staged approach for the actual site selection process. In order to facilitate the discussion about site selection, the voluntary siting model, as endorsed by Atomic Energy Canada Limited (AECL) and the Environmental Assessment Panel during the evaluation of the deep geologic disposal concept, is briefly described.

The second part of this report, encompassing sections 5 and 6, begins with a broader discussion of the idea of regions. It explains that there is no unambiguous way in which to divide up space; regionalization always implies human choice. The report therefore evaluates the implications of using economic regions as the preferred strategy for partitioning space in Canadian NFW (nuclear fuel waste) management. The implications for the site selection stage are also noted. The report concludes by providing recommendations concerning the use of economic regions as part of Canada's future NFW management strategies.

2. ECONOMIC REGIONS

As set out in the Nuclear Fuel Waste Act, *economic regions* are the broad –based geographic parameters within which NWMO will propose a waste management option for Canada. An economic region is a grouping of complete census divisions created as a standard geographic unit for analysis of regional economic activity.

Within the Province of Quebec, economic regions are designated by law. In all other provinces, economic regions are created by agreement between Statistics Canada and the provinces concerned. Prince Edward Island and the three territories (Yukon, Northwest Territories and Nunavut) each consist of one economic region. In Ontario, there is one exception where the economic region boundary does not respect census division boundaries: the census division of Halton is split between the economic region of Hamilton-Niagara Peninsula and the economic region of Toronto.

There is a total of 76 economic regions in Canada (Map 1). The distribution of economic regions by territory/province is as follows:

Table 1: Number of Economic Regions by Province/Territory

Province/Territory	# of Economic Regions
Yukon Territory	1
Northwest Territories	1
Nunavut	1
British Columbia	8
Alberta	8
Saskatchewan	6
Manitoba	8
Ontario	11
Quebec	17
New Brunswick	5
Nova Scotia	5
Prince Edward Island	1
Newfoundland and Labrador	4

Economic regions were created in the 1950s in response to the requirement for a geographic unit suitable for the presentation and analysis of regional economic activity. Ideally, each region was to represent a community of economic interest, particularly with regard to dynamic types of production, market relationships and labour supply and demand. Thus, economic regions should be the best combination of structural, functional, production and marketing forces allowing for the availability of statistics. The latter criterion resulted in the use of the basic census units (e.g. census district, census metropolitan area,).

Structural Factors: These involve the location of key natural resources (raw material and power) as organized for productive use by the distribution of the human and capital resources required for economic activity. These factors tend to stress the homogeneity of an area based on a common interest.

Functional Factors: Those activities and relations that tend to tie an area together, principally transportation factors and a single labour market orientation. Local transportation, as in commuting links, is considered the basic internal unifying tie, while major transport links with the outside are considered as the export connections.

Production Factors: The homogeneity of production is stressed, as are certain functional relationships such as that of a forest hinterland to a pulp industry. In general, the regions are uniform and in many of them, production is closely integrated.

Marketing Factors: Generally, these refer to the internal consumption and marketing relationships.

An example of the application of these criteria for the designation of Northwestern Ontario is as follows:

Structural Factors: The western portion of the Canadian Shield in Ontario separated from northeastern Ontario by a broad nonproductive gap.

Functional Factors : Functionally tied together by transportation factors, including lake shipment. Thunder Bay is the primary urban centre.

Production Factors: Manufacturing, mining, forestry and trapping.

Marketing Factors: Thunder Bay constitutes the dominant marketing centre, although the northwestern fringes have some ties with Winnipeg.

Map 1 Economic Regions of Canada



3. SITING PROCESSES

Whatever solution is proposed and implemented for the management of NFW, it will have to be located somewhere. The processes and procedures involved in siting a facility or facilities generally begin at a broad geographical scale and eventually will be honed into a single place.

The selection of a NFW management strategy for Canada implies that 1) a particular technology or set of technologies are selected; and 2) the selection and implementation of a siting strategy.

There are two basic approaches to facility siting: the “technical” and “voluntary” approaches. Each approach differs in its commitment to public participation and the sharing of decision making power among the proponent, local governments and community residents. As well, different criteria are emphasized in the siting process in order to situate most effectively a facility. The two approaches are best thought of as extremes on a continuum. Siting methodologies can exhibit characteristics of both approaches.

The “Technical” Siting Approach

A major distinguishing characteristic of the technical approach is that the balance of decision making power lies with the proponent. Essentially, the approach entails using a top-down process where environmental data are used to reduce a generalized study area down to a specific site. This progressive narrowing and short listing of environmental criteria occurs under a logically staged approach. From a strictly technical perspective, this approach to siting has a great deal of merit. Criteria selected are based on the optimal requirements deemed necessary for a facility to operate safely and within strictly defined engineering, technological, geological and biophysical constraints.

The application of the technical approach generally exhibits seven sequential stages:

1. goal identification
2. project characterization
3. selection of site specific evaluation criteria
4. area and site screening
5. site assessment and selection
6. final detailed design
7. site decision

Facility siting using this approach usually leads to an imposed decision. Once the facility design has been completed, a site is announced to the prospective host community or region. A process of education and defense of the project begins in order to demonstrate the environmental and technical credibility of the decision. The decision in the United States to site a NFW repository in Yucca Mountain, Nevada, exhibits many of the characteristics of the Technical siting approach.

The “Voluntary” Siting Approach

The voluntary siting approach has become the emergent process in Canada for siting hazardous facilities. It has been endorsed by the Environmental Assessment Panel that evaluated the deep geologic disposal concept as the best procedure by which to situate/locate a NFW management facility.

Essentially, this approach attempts to overcome the social and political constraints that lead to conflictive siting problems. A basic principle is relied on – only communities that volunteer to investigate a facility are considered as potential hosts. Instead of fighting with communities that may not want a facility, interested communities are supported. The focus is therefore primarily, but not exclusively, on social and political aspects rather than on technical and engineering aspects to find the optimal or ideal site.

The application of the voluntary approach generally exhibits seven sequential stages:

1. establish general environmental and safety criteria
2. initiate broad public consultation
3. invitation to communities to participate
4. consultation with interested communities
5. site investigation
6. community referendum on whether or not to accept the facility
7. site decision

In this approach, communities are able to withdraw from the siting process at any time and for any reason. This “opt-out” provision protects communities from imposed decisions and reinforces the voluntary and cooperative nature of the approach. Volunteer communities must confirm that they can provide potential sites that meet basic environmental criteria and the majority of the population must support the initiative. Siting efforts of the proponents are focused on developing positive relations with willing communities.

4. ECONOMIC REGIONS AND THE ACT

This section of the report provides examples of how the choice of a management strategy has implications for economic regions. It is important to note that this discussion does not presuppose a particular economic region selection process. Further, these examples are only illustrative since no selection process criteria are yet available.

A. Section 12(2): Economic Regions and Methods to Manage Nuclear Fuel Waste

As stipulated in section 12(2) of the Act, NWNNO is required to consider at minimum three waste management strategies:

1. deep geologic disposal in the Canadian Shield
2. storage at nuclear reactor sites
3. centralized storage, either above or below ground

1. *Deep Geologic Disposal in the Canadian Shield*

The potential economic regions under consideration on the Shield are depicted in Map 2. As shown, this is a vast area. A total of 21 economic regions fall on the Canadian Shield (Table 2). There is incongruity between the boundaries of the Shield and economic regions.

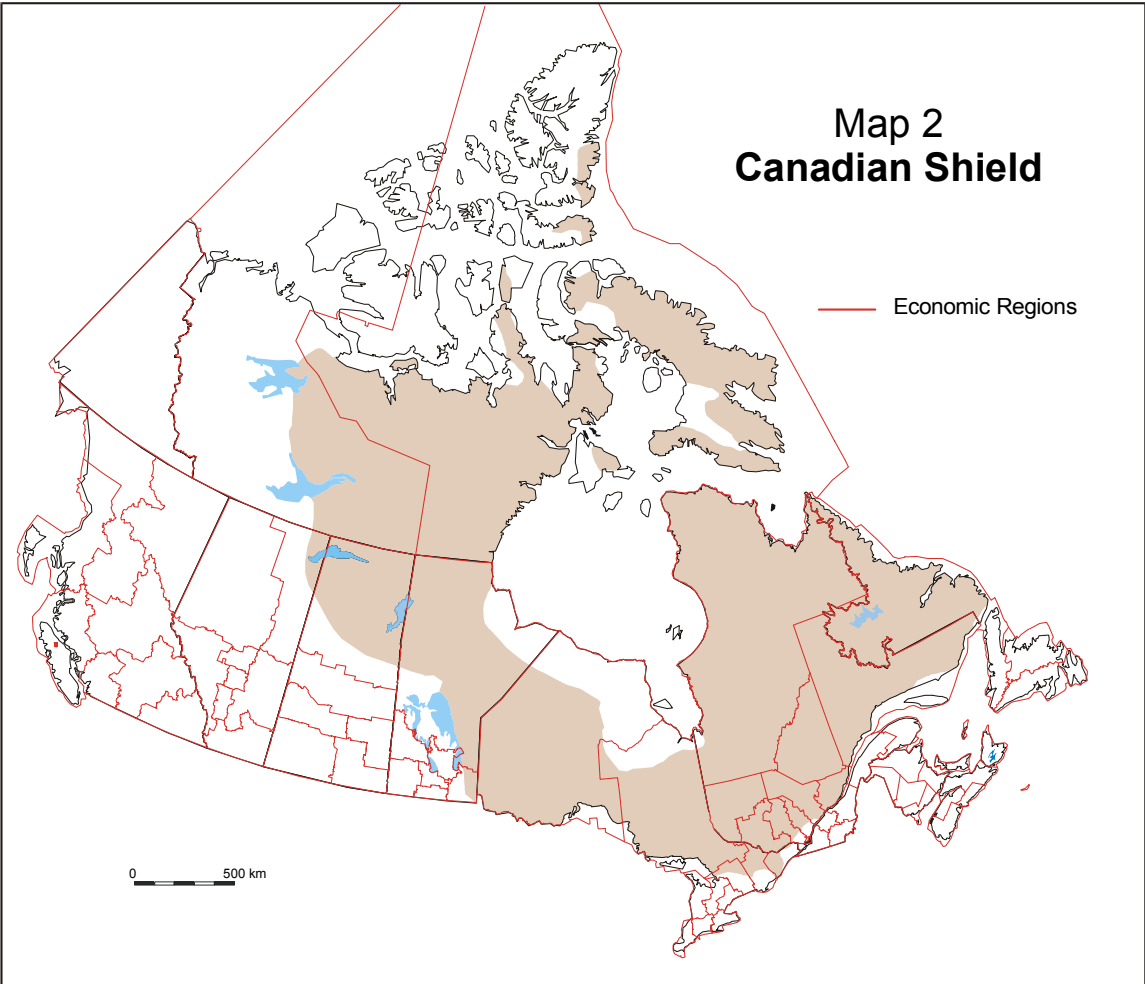
Table 2: Economic Regions on the Canadian Shield

Province/Territory	ER # ¹	ER Name
Northwest Territories	10	Northwest Territories
Nunavut	10	Nunavut
Alberta	80	Wood Buffalo-Cold Lake
Saskatchewan	60	Northern
Manitoba	10	Southeast
	80	North
Ontario	10	Ottawa
	15	Kingston-Pembroke
	20	Muskoka-Kawartha
	90	Northeast
	95	Northwest
Quebec	20	Capitale-Nationale
	50	Lanaudiere
	55	Laurentides
	60	Abatibi-Temiscamingue
	70	Maurice
	75	Saguenay-Lac St. Jean
	80	Cote-Nord
	90	Nord du Quebec
Newfoundland/Labrador	30	West Coast-Northern Pen.-Labrador

¹ Each economic region is assigned a code that is not unique between provinces and territories. A two digit province/territory code must precede the economic region code.

Map 2 Canadian Shield

— Economic Regions



As depicted in the map and table, the Canadian Shield falls within six provinces and two territories. In Alberta, the Shield covers only a relatively small portion of the northeast section of the province. Approximately one-third of Saskatchewan and Manitoba are on the Shield. In Manitoba, the AECL's underground research laboratory was situated on the Shield in the southeastern portion of the province. For the Provinces of Quebec and Ontario and the territory of Nunavut, the majority of their land consists of the Canadian Shield. For Newfoundland and Labrador, the Shield is situated only in Labrador.

An example of how the economic regions and the siting criteria of the Canadian Shield can be used to locate potentially suitable areas for a geologic disposal facility has been undertaken for Ontario at the University of Guelph, Department of Geography. Ontario was selected for study because it produces the majority of NFW in Canada.

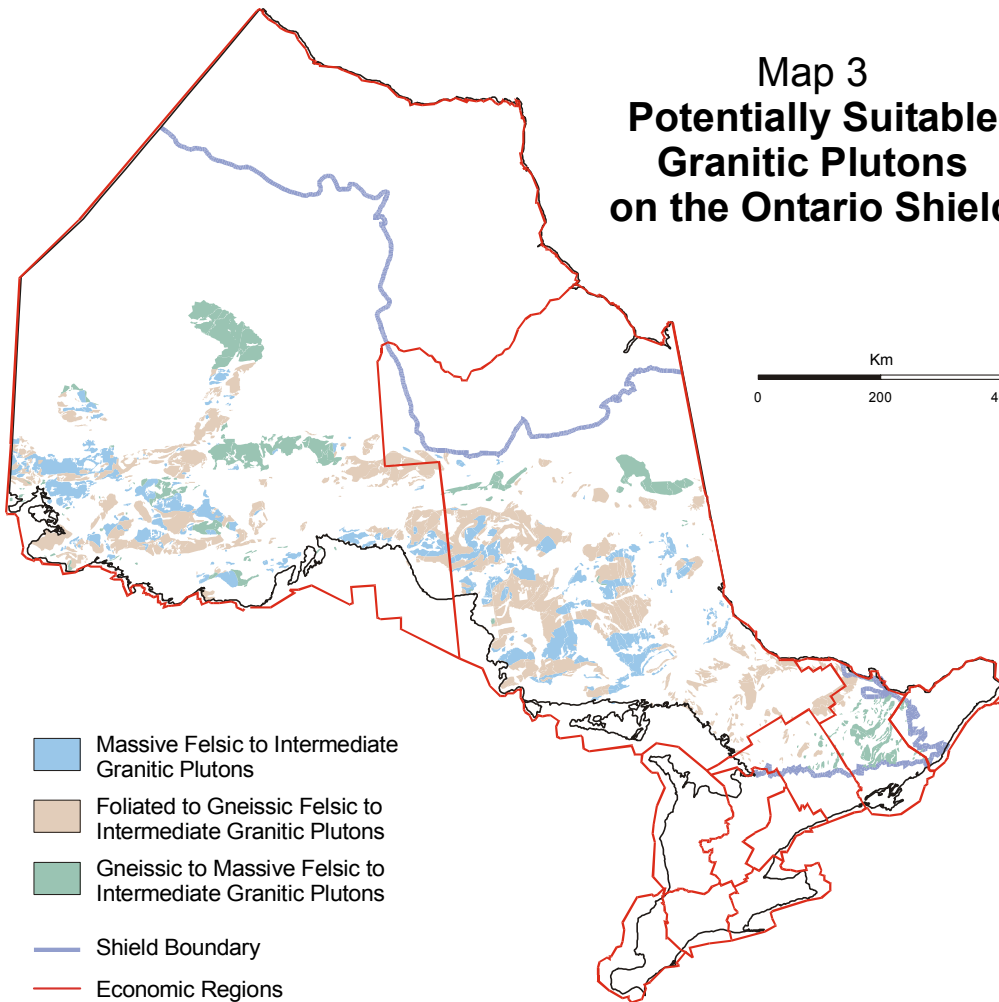
On the basis of the Environmental Impact Statement (EIS) submitted to the Environmental Assessment Panel in 1994 by the AECL, siting criteria can be identified and mapped. Through a series of overlay analysis, the inclusionary criteria (e.g. granitic plutons on the Shield; location of facility within 25 km of an existing transportation system) can be kept while exclusionary criteria (e.g. faults and earthquake zones, water bodies, mineral resources, parks, Indian reserves, populated areas) can be deleted. The remaining areas are then subject to a final siting criteria of being at least 5 km² in area.

The resultant analysis is presented in Table 3 and Map 3.

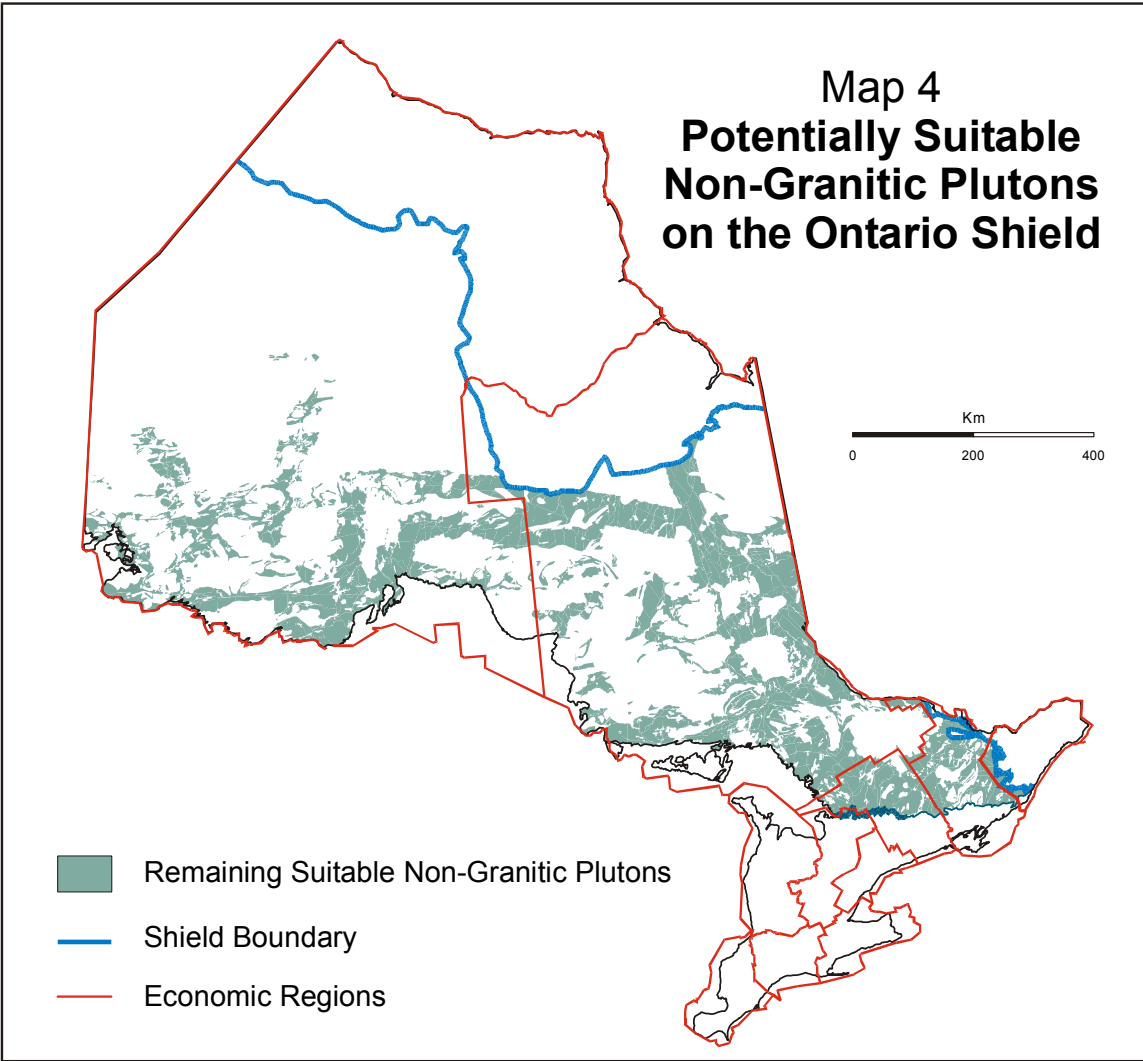
Table 3: Siting Criteria for a Geologic NFW Disposal Facility in Ontario: Results of Overlay Analysis

Criteria	Remaining Area (km²)	% of Ontario	% of Shield
Ontario	978,843.59	100.00	N/A
Shield	652,059.27	66.62	100.00
Granitic Plutons	281,090.08	28.72	43.11
Faults and Earthquakes	280,749.84	28.69	43.06
Lakes	267,621.51	27.34	41.04
Rivers	265,444.93	27.12	40.71
Mines	265,433.00	27.12	40.71
Parks	250,676.42	25.61	38.44
Areas Beyond 25 km of Transportation Routes	127,006.71	12.89	19.48
Indian Reserves	126,219.24	12.89	19.48
Settlements	126,217.24	12.89	19.36
Final Areas Greater than 5 km ²	124,789.93	12.75	19.14

Map 3 Potentially Suitable Granitic Plutons on the Ontario Shield



Map 4
**Potentially Suitable
Non-Granitic Plutons
on the Ontario Shield**



As shown in Map 3 and detailed in the table, a vast area is potentially suitable for the construction of a NFW disposal facility on the Ontario portion of the Shield (124,790 km²). Potentially suitable areas fall within each of the five economic regions of Ontario located on the Shield noted in Table 2.

Siting criteria can be altered and a variety of siting scenarios can subsequently be mapped. For example, Map 4 depicts the remaining suitable non-granitic plutons on the Ontario portion of the Canadian Shield. Again, potentially geologically suitable areas can be found in each of the five economic regions in Ontario located on the Shield.

As shown in Table 3, the “remaining area” of potentially suitable siting regions is sensitive to a number of factors, most notably the presence of the Shield in Ontario, the presence of granitic plutons and the transportation requirement (25 km from existing transportation corridors). The first two criteria are fixed. However, the transportation buffer could be extended and thus greatly increase the potentially suitable area. Similarly, if both granitic and non-granitic plutons are included, the remaining potentially suitable area also increases. The main point is that the specification of criteria is to some degree malleable even with the imposition of strict requirements such as geology, park boundaries, water bodies and the like. Indeed, it is the inclusion of “non physical” criteria such as social, economic or political constraints, that can have a major impact on siting. The use of GIS technologies to develop scenarios is highly useful and insightful.

The consideration of geology as the major siting criteria does not take into account social or political aspects of NFW management. Further, it does not take into account the transportation of NFW from the reactor sites (none of which are located on the Shield) to the potential disposal facility.

2. *Storage at Nuclear Reactor Sites*

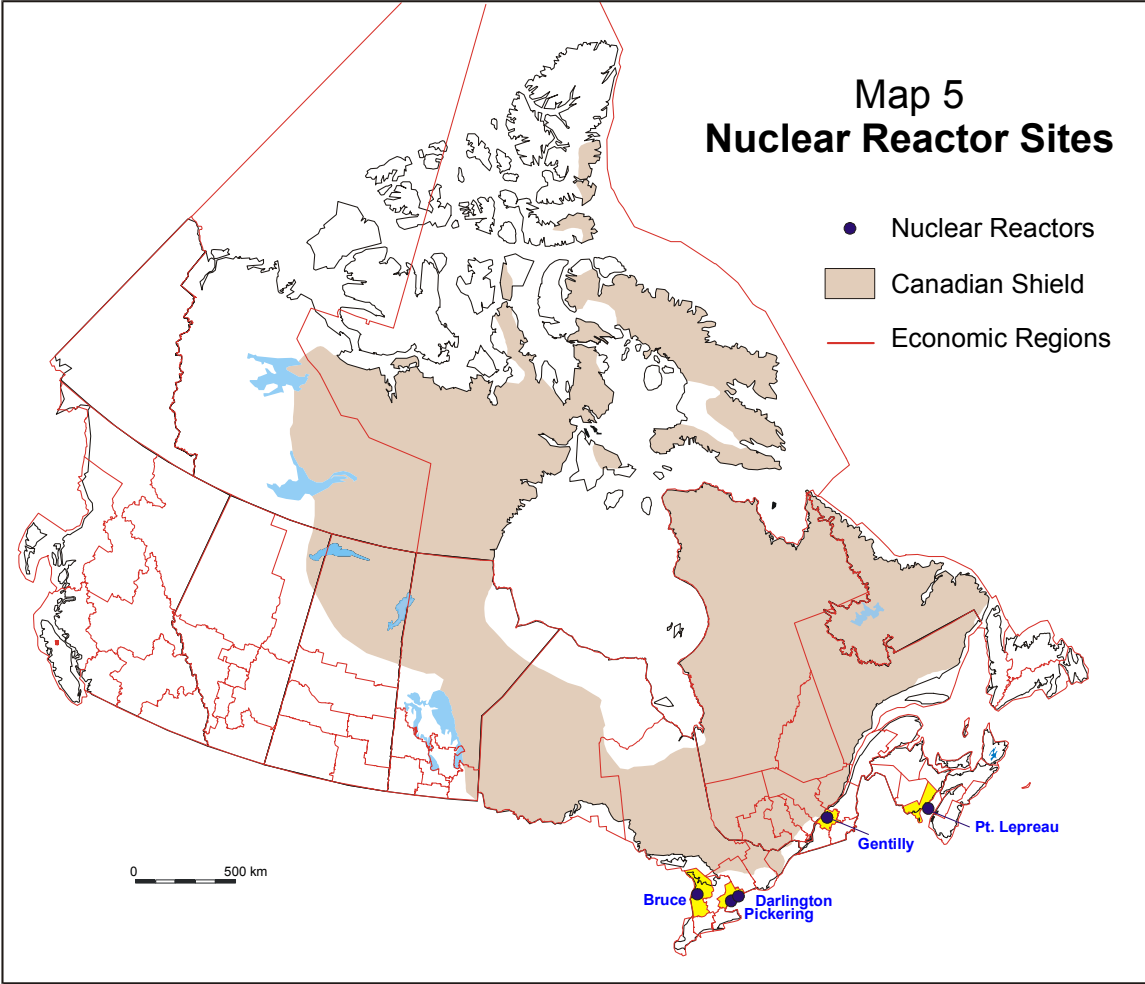
The potential economic regions to be considered under this management option are those where nuclear generating facilities are currently located. The majority of nuclear reactors in Canada are located in the Province of Ontario in Pickering, Darlington and Bruce reactor stations. Reactors are also located in the Province of Quebec (Gentilly) and New Brunswick (Point Lepreau). These power stations and their respective economic regions are depicted in Map 5. The specific economic regions are presented in Table 4 and Maps 6 – 8.

Table 4: Economic Regions and Nuclear Generating Facilities

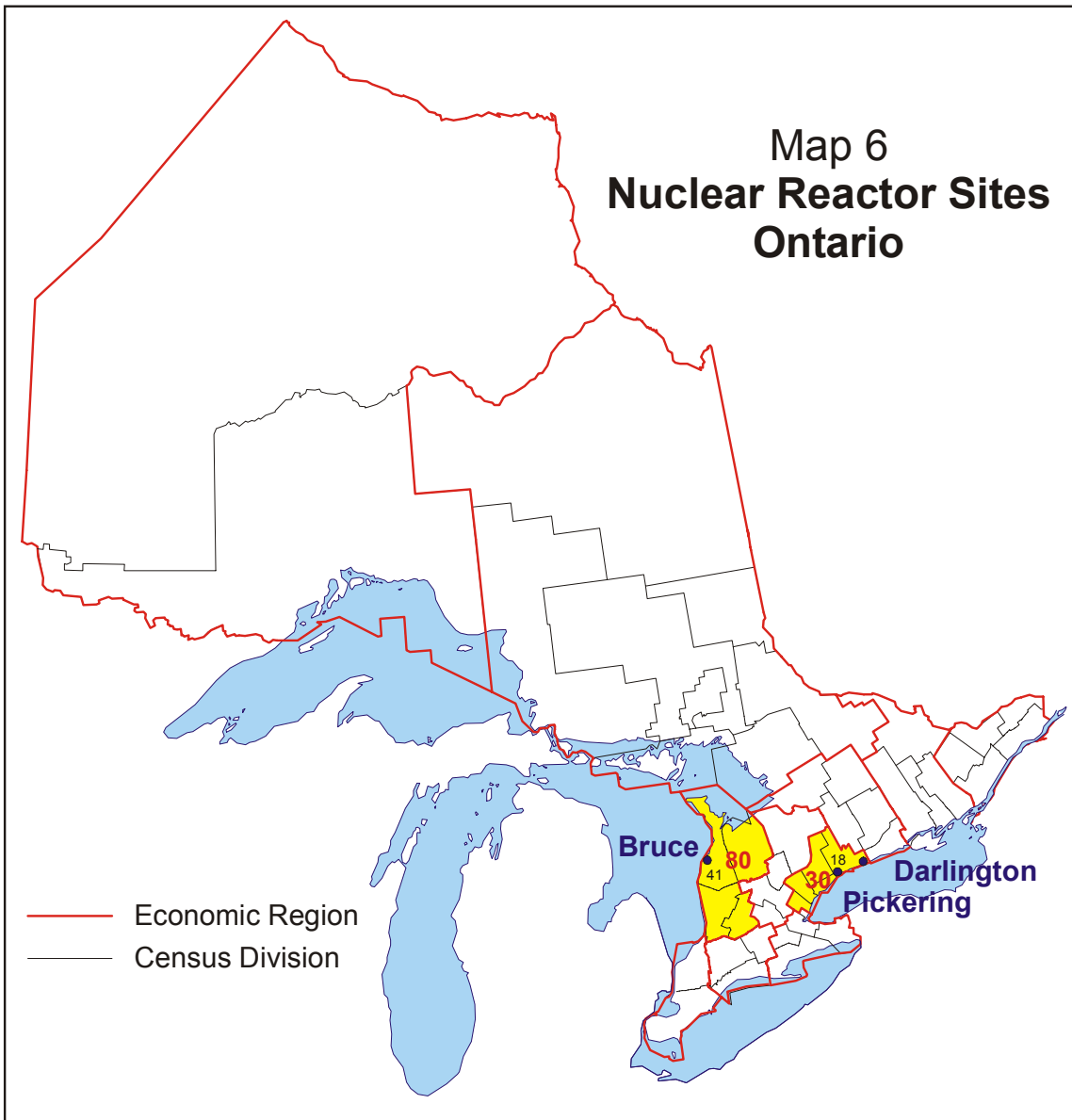
Province	Generating Facility	Economic Region	Census Division
Ontario	Bruce	Stratford-Bruce Peninsula	Bruce County
Ontario	Pickering	Toronto	Durham Regional Municipality
Ontario	Darlington	Toronto	Durham Regional Municipality
Quebec	Gentilly	Centre-du-Quebec	Becancour
New Brunswick	Point Lepreau	Saint John-St. Stephen	Charlotte County

From a geographical perspective, the on-site storage option is the most straightforward in that the siting regions are specified (reactor sites) and transportation of NFW is not a major consideration as the NFW is already there. However, the above does not consider the social and political aspects of NFW management.

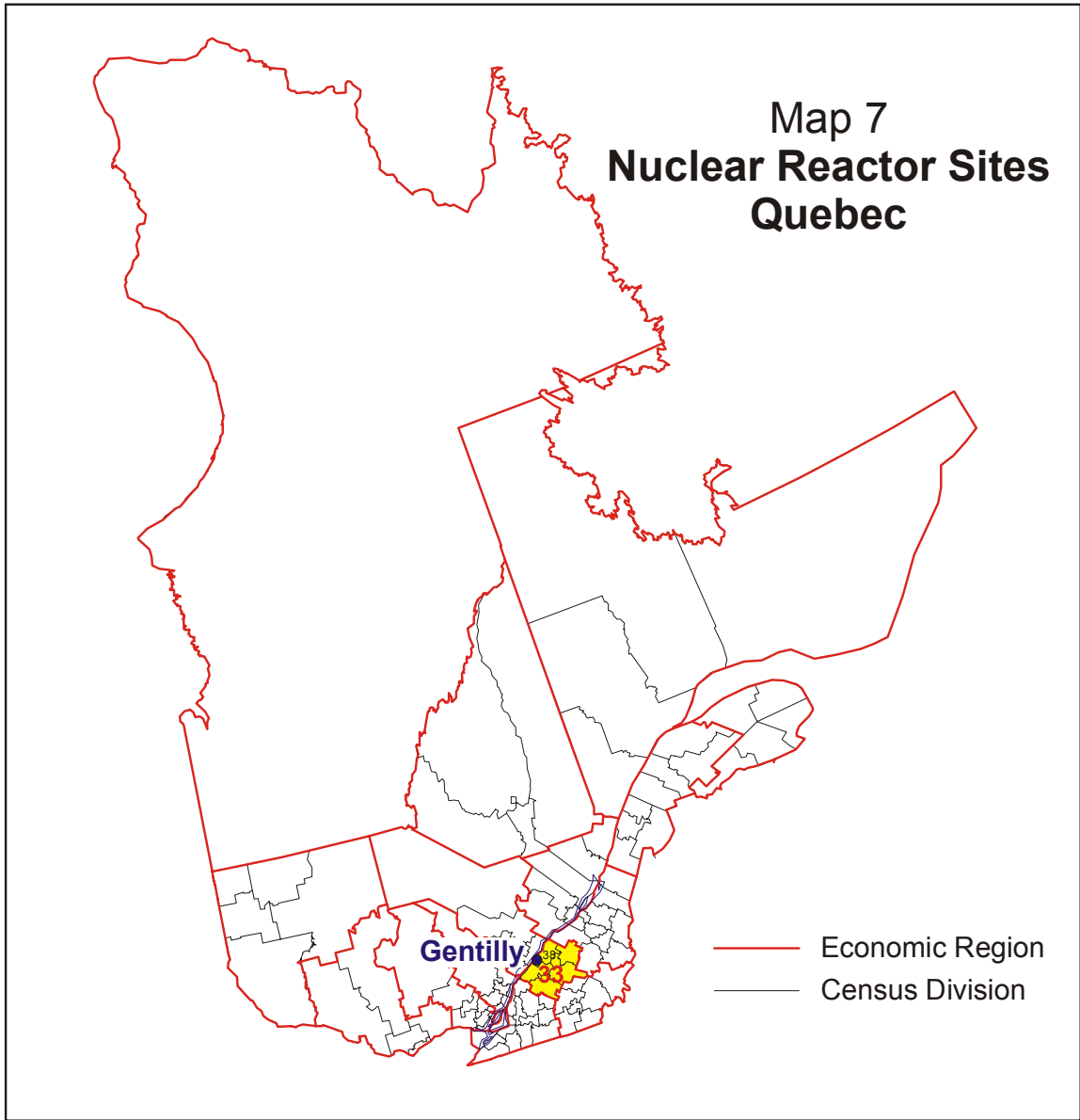
Map 5 Nuclear Reactor Sites



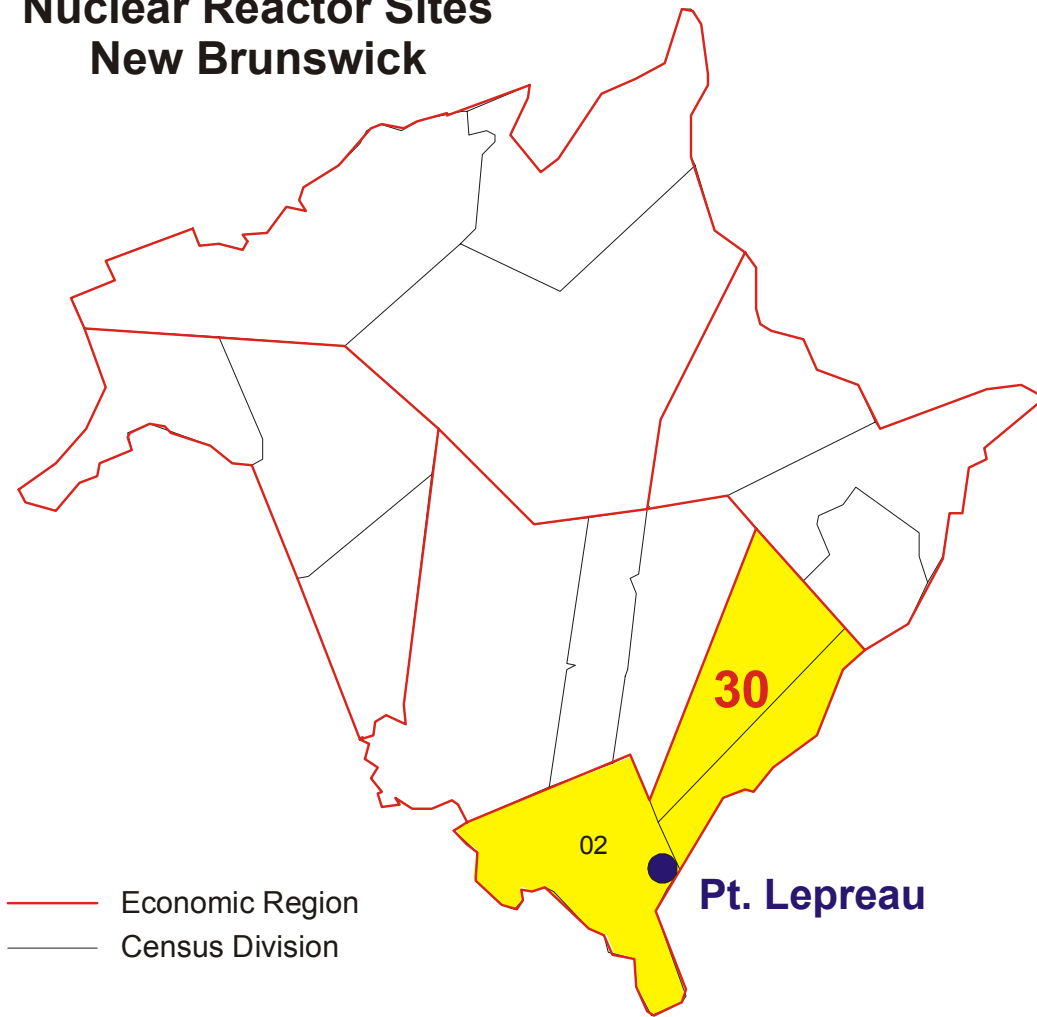
Map 6 Nuclear Reactor Sites Ontario



Map 7 Nuclear Reactor Sites Quebec



Map 8
Nuclear Reactor Sites
New Brunswick

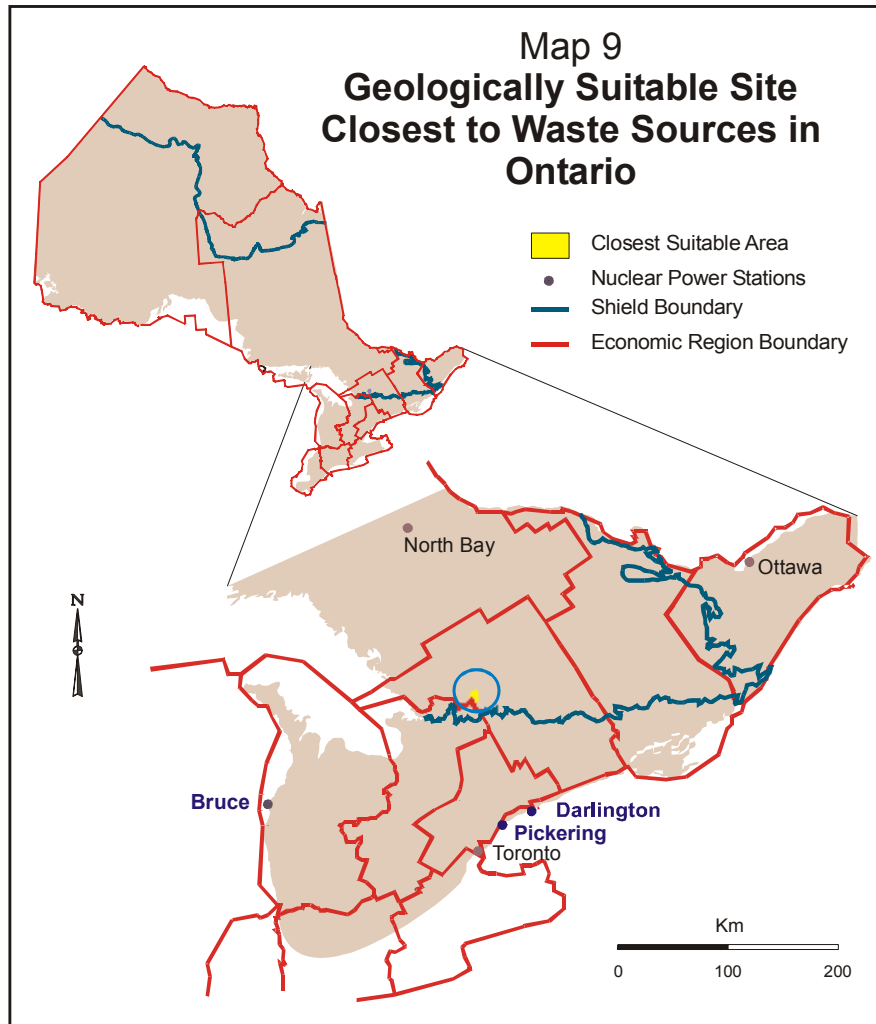


3. *Centralized Storage, Either Above or Below Ground*

In the absence of specific siting criteria, all of Canada is theoretically available for the construction of a centralized storage facility. It will be incumbent on NWMO, through its various consultation mechanisms, to outline specific criteria required for a centralized storage facility. Criteria could include:

- Minimizing transportation distance
- Maximizing distance from populated areas
- Specifying required geologic or hydrologic conditions
- Obtaining support from a potential host region and/or community
- Minimizing costs

Once siting criteria have been identified, mapping techniques will be useful to demonstrate various siting scenarios and possibilities. For example, on the basis of criteria outlined by the AECL in its EIS to the Environmental Assessment Panel in 1994, it is possible to identify the most geologically suitable site closest to NFW sources in Ontario (Map 9).



B. Section 8(2)(c) Representation on the Advisory Council

The appointed Advisory Council membership is to reflect a broad range of scientific and technical disciplines, expertise in matters related to nuclear energy, traditional aboriginal knowledge and ...

“includes representatives nominated by local and regional governments and aboriginal organizations that are affected because their economic region is specified for the approach that the Governor in Council selects under section 15 or approves under subsection 20(5).”

A question to emerge from section 8(2)(c) is “why is local representation sought *after* the decision is made of where to locate the facility or facilities for NFW management?”

An important point here is not that potentially affected communities are excluded from participation in the waste management processes, nor are they excluded from consultation meetings with NWMO. The point is that participation on the Advisory Council is potentially restricted to those communities and interests located within an economic region that was selected prior to their having representation on the Advisory Council. The distinction that emerges here is between participation and consultation and empowerment. The Advisory Council may be perceived by the public as being influential in NWMO’s consultation and decision making processes (as it should be). Clearly, NWMO is free, with the advice from the existing Council, to carry out broad consultations with economic regions and communities in preparing its study approaches. The ability of local communities and regions to directly influence the decision of NWMO and subsequent decisions is potentially limited unless they have representation on a decision making organization (i.e. the Advisory Council). This issue may be one of perception.

The challenge for NWMO is to ensure that representation on the Advisory Council will continue to evolve in a manner reflecting the need for appropriate representation at the various stages of its deliberations prior to decisions being made.

Several other issues emerge related to representation and siting for each management option (section 12(2)) NWMO may recommend to the Governor in Council. These are summarized below:

1. *Deep Geological disposal in the Canadian Shield*

Under this option, geologic criteria dominate in the initial stages of the site selection process. The broad region under consideration is the Canadian Shield. In essence, Canada is divided into two regions: Shield and non-Shield. Parts of both regions benefit from the nuclear industry. The Shield in terms of mining and refining uranium; the non-shield in terms of the generation and (primarily) the use of the resultant electricity.

As specified in the Act in section 12(3):
“...a detailed technical description of each proposed approach and must specify *an economic region* for its implementation” (emphasis added).

A strict interpretation means that only one region is to be selected. This raises a number of issues:

- i. Communities/residents/ local government etc. may feel unfairly singled out because their region was selected. This would be beyond the potential feelings of “environmental injustice” and the unequal distribution of risk in that a region that does not (obviously) benefit from the use of nuclear power is responsible for managing the resultant wastes.
- ii. Communities/residents/local governments etc. located adjacent to the selected economic region may feel excluded from the decision making process insofar as they would not have representation on the Advisory Council.
- iii. Communities in other economic regions may be denied the opportunity to volunteer for hosting the facility.
- iv. A further consideration with the geologic disposal option which directly affects communities in a variety of economic regions relates to the issue of transportation of NFW. It should be resolved as early as possible if the selection of an economic region (on the Shield) for constructing a disposal facility automatically involves other regions as potential transportation corridors. If adjacent regions do in fact become part of the locational strategy, communities/residents/local government etc. may demand to become involved in the decision making process.

2. *Storage at Nuclear Reactor Sites*

Under this scenario, the location of current nuclear reactor sites is the key inclusionary criteria. As noted above, four economic regions would be affected; two in Ontario (Toronto and Stratford-Bruce Peninsula), one in Quebec (Centre-du-Quebec) and one in New Brunswick (Saint John-St. Stephen; see Table 4 and Maps 5-8).

The nuclear generating facilities are located in heavily populated areas relative to regions on the Canadian Shield. The selection of this management option has its own unique characteristics:

- i. Communities/residents/local governments etc. may feel singled out as they are producing nuclear power and dealing with the wastes as well. This sentiment, for example, was voiced by some participants at the CEEA environmental assessment of the *Bruce Used Fuel Dry Storage Facility* completed in 1999.
- ii. Communities/residents/local governments etc. in these regions have experience with the nuclear industry and may therefore be more receptive to listening to plans for continuing to store NFW at the reactor sites.

- iii Following from the point (i) above, it may be extremely difficult to get a community or region to “volunteer” to host a NFW storage facility. Alternatively, the compensation that communities may ask for may not be guaranteed by the government, thus derailing a siting process. The latter occurred during the low level nuclear waste siting process in the 1990s where Deep River was willing to host a disposal facility but the federal government was unwilling to guarantee long term employment prospects. The consequent result was that a facility was built and is currently operating in Port Hope, the site of historic high quantities of low level waste.
- iv The selection of communities/residents/local governments etc. from economic regions with nuclear generating facilities exclusively may make communities/residents/local governments etc. from adjacent regions feel excluded from the decision making process and would prevent them from volunteering to host a facility.
- v The selection of this management option, although perhaps the easiest to implement, is generally regarded as an interim solution.

3. *Centralized Storage, Either Above or Below Ground*

The appointment of representatives nominated by local and regional governments and aboriginal organizations that are affected because their economic region is selected is initially difficult to envisage under this management option. As noted above, without initially specifying and applying siting criteria, there are no limiting factors by which to select economic regions.

5. DISCUSSION: REGIONS AND NFW MANAGEMENT

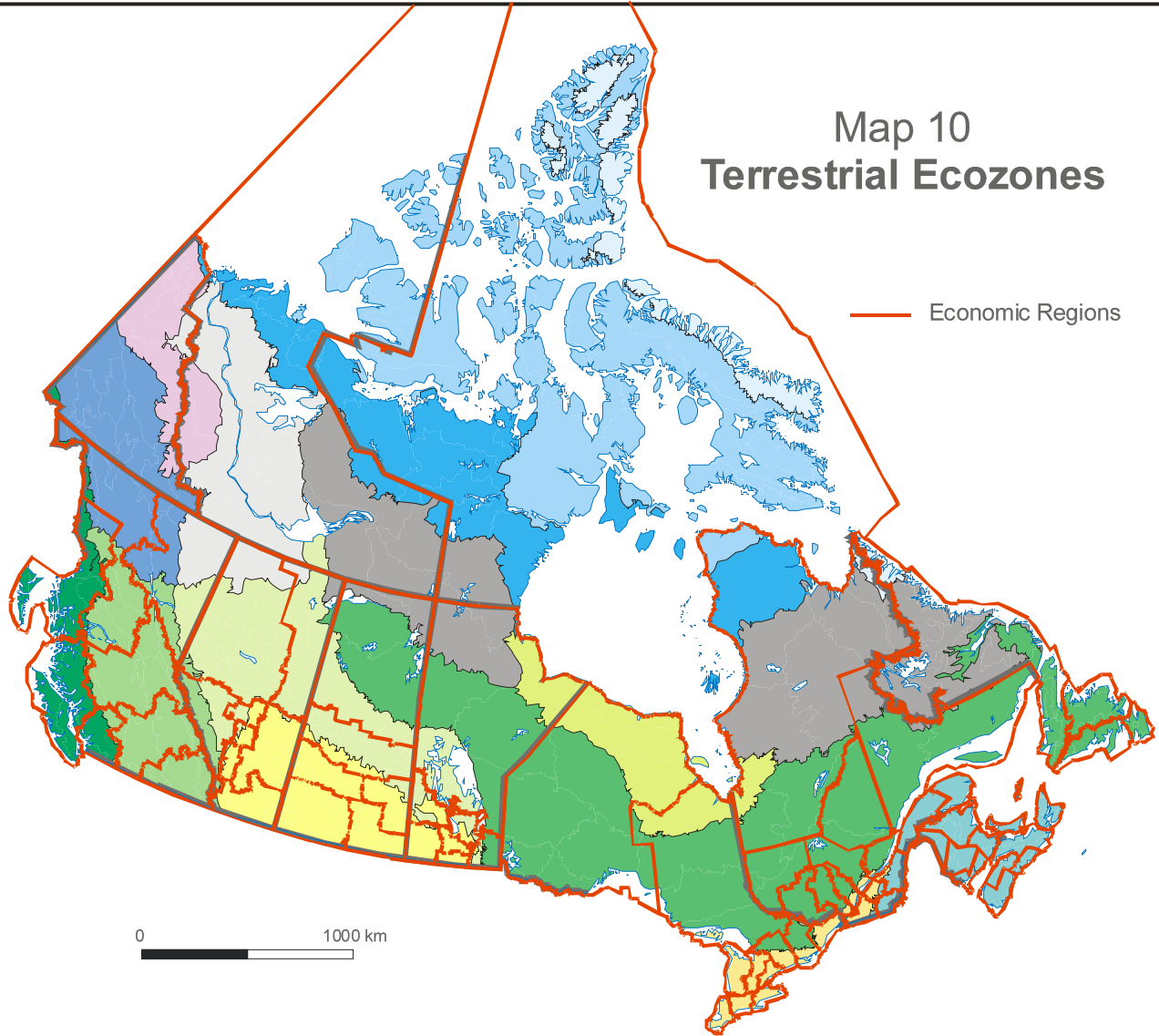
Regions are a logical way to organize geographic information. Regions are areas of the earth's surface that have distinctive characteristics which can be biophysical (eg. Ecozones or geological provinces; Maps 10 and 11) or human (eg. Economic Regions). An important aspect of regions is a *sense of place* or bond between people and a region. The biophysical and human characteristics combine to form a psychological bond between people who live in a certain place and the place itself. This sense of place is not confined to a particular scale such as a neighbourhood or town but may extend over vast areas such as First Nations Treaty areas (Map 12). People develop a strong sense of "spatial empathy"; they imbue it with meaning and it becomes part of their community and identity.
















Regions are intellectual concepts and represent a framework for data collection or analysis. The challenge is to divide a large spatial unit into a series of areas that are distinguishable from one another on some verifiable basis. The creation of regions is often done on the basis of biophysical and/or human criteria that logically divide a large spatial unit into a series of regions. Towards the margins of a region, its core characteristics become less distinct and merge with those characteristics from the neighbouring area. Thus, boundaries between regions are best considered transition zones rather than finite limits.

The important point here is that regions are generally best thought of as human constructs imposed on space. As such, regions are malleable and ever changing. A significant challenge, particularly in the context of siting a NFW management facility, is determining how best to select a region or regions for consideration. Although the economic regions used by Statistics Canada may at first glance appear to be neutral spaces, their selection as potential siting/management areas will suddenly infuse them with new meaning. Indeed, the relevance of the regions themselves may be challenged by residents living within and without the regions on a variety of grounds. The regions will have become politicized.

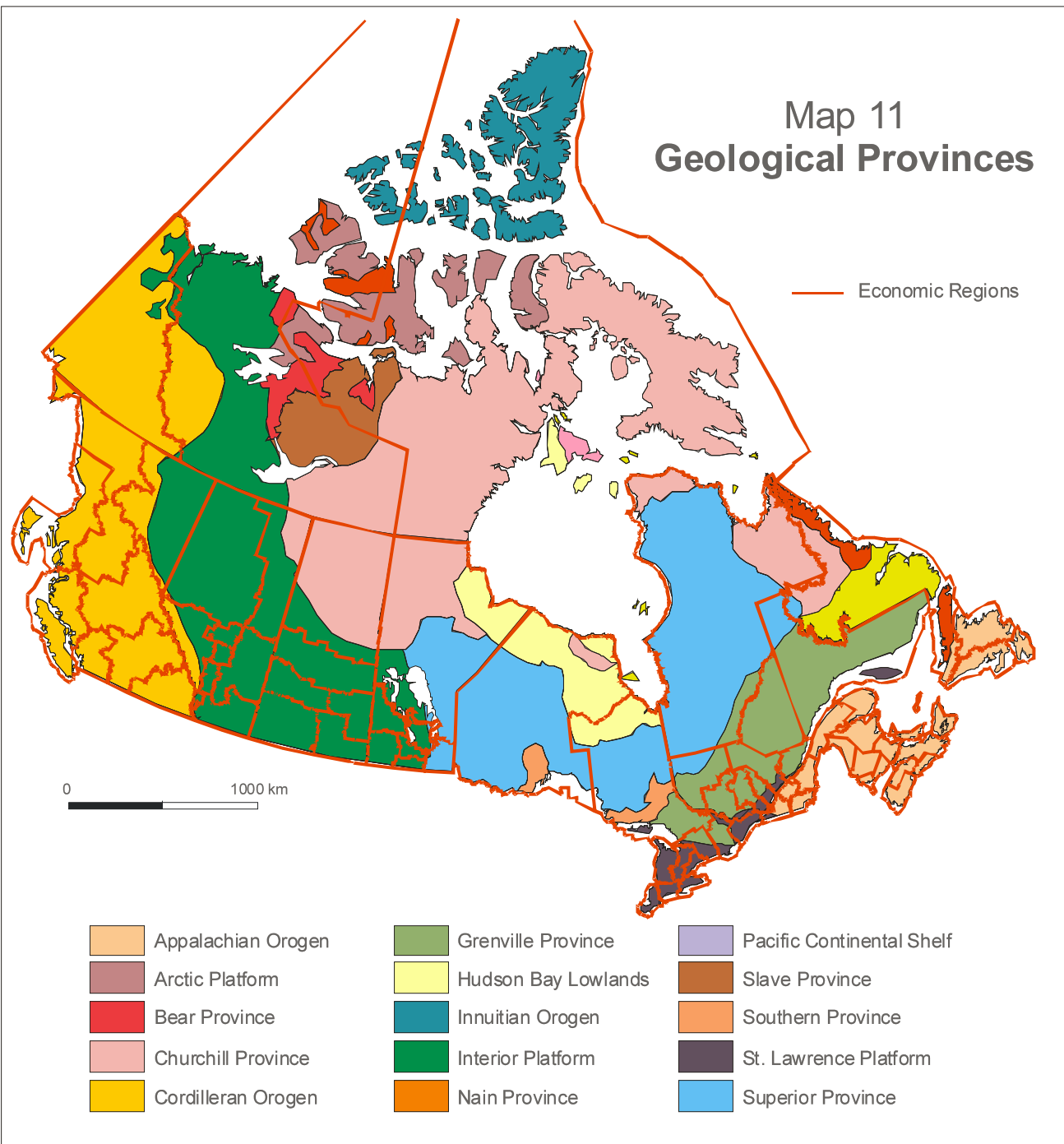
Map 10 Terrestrial Ecozones

— Economic Regions

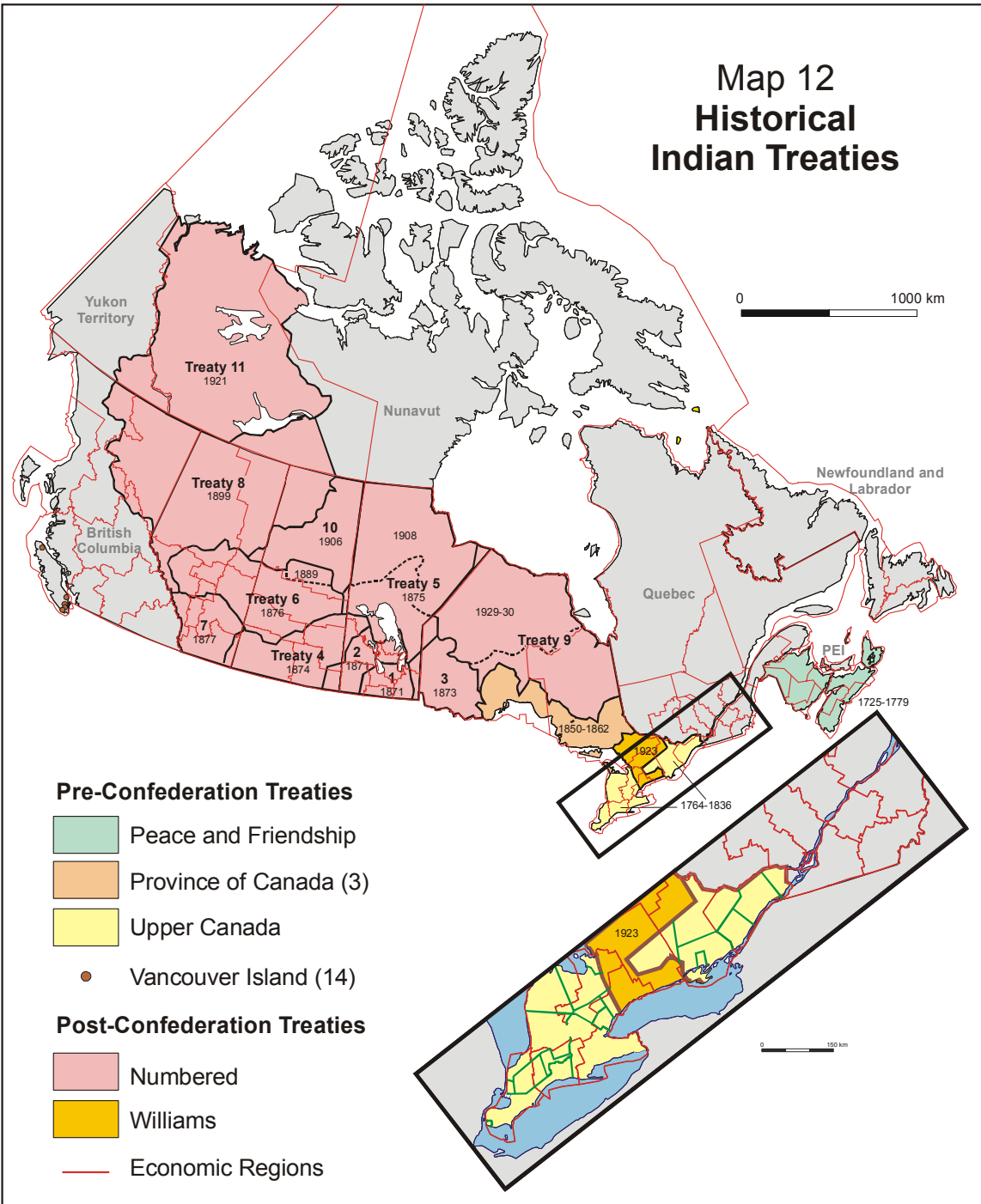


- | | | |
|---|---|--|
|  Arctic Cordillera |  Boreal Shield |  Taiga Cordillera |
|  Northern Arctic |  Atlantic Maritime |  Boreal Cordillera |
|  Southern Arctic |  Mixedwood Plains |  Pacific Maritime |
|  Taiga Plains |  Boreal Plains |  Montane Cordillera |
|  Taiga Shield |  Prairies |  Hudson Plains |

Map 11 Geological Provinces



Map 12 Historical Indian Treaties



Several within and between region implications associated with the way regions are defined within the NFW Management Act can be identified.

1. *Within-region implications of the Act's economic region approach*

- i. Economic regions, as defined by Statistics Canada, are just one of many ways of dividing up space in this country. Ecozones and Indian treaties are just two of many other ways in which Canada can be subdivided (see Maps 10 and 12). This means that the legislation's definition of what constitutes the size, scale and limits of a particular parcel of Canadian space may conflict with other ideas about that area. This may lead to differences of opinion regarding what should or should not be included in a particular region.
- ii. The predominant way in which space is divided in Canada consists of the national, provincial and municipal levels. Located between the provincial and municipal levels, arguably, economic regions are not a predominant scale for most Canadians. By invoking this economic region division, the Act increases the importance of this way of thinking about space in Canada. For people interested in NFW management it will now become important to identify within which economic region particular places are located, to be aware of the neighbouring regions and to pinpoint the exact places on the ground where the boundaries are to be found. This may cause some anxiety among interested participants and NWMO may be called upon to provide clear, concise information regarding the extent and boundaries of any economic regions chosen.
- iii. Since economic regions are less important to the way people and communities organise and understand space, they may not have close ties or relationships with other communities within a particular economic region. Communities may need information and support as they try to understand what this different organisation of space means for them. They may also resist the organisation of space into economic regions by arguing that it is of little relevance to how they understand their communities and live their daily lives. For instance, due to employment patterns, rivers and other natural barriers or some other factor, communities may argue that they are more closely allied with people in a neighbouring economic region.
- iv. Economic regions do not have legal governance or control of space the way municipalities do. Thus, if the NWMO approach to site selection includes voluntary siting, an economic region could not come forward to host a management facility. The choice of economic region will have to be undertaken using some other type of siting mechanism.
- v. Communities within economic region(s) chosen for further investigation may develop a number of tactics to promote or protect their particular places. Conceivably, they could develop alliances with neighbouring communities to either take advantage of the benefits that could accrue to a host community or to prevent the imposition of risks and costs. Communities may also compete with their neighbours to deal with those same risks and benefits.

2. *Between-region implications of the Act's economic region approach*
 - i. Partitioning space into economic regions may create a set of tensions between the regions, particularly once NWMO announces which region(s) are to be considered for the establishment of a management facility. Regions may argue over the exact location of the boundary between regions and regions may argue that they should or should not be included among the NFW management options in order to control the perceived costs and benefits that may result from the project.
 - ii. Defining the economic region(s) within which a management approach will be implemented will not mean that the problem of finding a facility location is now a 'local' concern. First, citizens within the economic region will have affiliations that extend beyond the boundaries of their municipality or economic region. These communities of interest may widen the number and range of participants beyond those located in place-bound communities and bounded economic regions. Second, Canadian citizens from outside the economic region, such as members of provincial or national organisations (e.g. Greenpeace, Campaign for Nuclear Phaseout) may wish to participate in decision-making, perhaps through the environmental assessment or regulatory processes. It can also be argued that since the management of nuclear waste is within federal jurisdiction, the problem of choosing a waste management facility site is, by definition, a national rather than a local issue.

6. CONCLUSION

Economic regions are required in the decision making and planning process for NFW management as specified in the Act. The specification of management strategies and hence select regions, however, is not a neutral process. The selection of one region or series of regions on the basis of limited criteria means that other regions are not selected.

Economic regions are an artifact of the Government of Canada; they are a way of dividing up space for the enumeration of statistical data. There are many other ways to formulate legitimate planning regions that do not correspond with economic regions. A reading of the *Act* seems to give NWMO little room to maneuver; the requirement to use economic regions is clearly spelled out. A prudent strategy may be for NWMO to select initially a particular management strategy (i.e. geologic disposal on the Shield, centralized storage or on-site storage) in the spirit of the Act and with full participation from the Advisory Committee and stakeholder and public groups. Once a management strategy has been selected, the next stage of identifying possible regions/locations would commence. Again, full and open consultation with the Advisory Committee, stakeholder groups and the public would occur. This strategy would avoid the requirement of selecting a management approach **and** identifying a region or regions at the same time.

A proposed solution may involve more than one management option and hence may involve numerous economic regions and locations. For example, a management strategy can be envisioned that progresses from on-site storage of NFW to centralized storage on the Canadian Shield to ultimately the construction of a disposal facility (perhaps with a retrievability option) either adjacent to the centralized storage facility or in a different location. This is similar to the situation in Oskarshamn in Sweden where the implementing organization has developed the trust and confidence of the Swedish people by successfully operating a central underground storage facility for over a decade. If this type of management solution is deemed acceptable or worthy of pursuing, the geographical implications are broad based and distributed differently than if a single management option is proposed. For example, a staged or stepwise approach to NFW management is gaining credence in a number of countries. This approach implies that decision making under conditions of uncertainty is inevitable for some of the issues surrounding NFW management. Further, it can be expected that some, but not all, uncertainties in predicting the future behaviour of a repository system or storage facility can be reduced or eliminated by further research and development or that technological and engineering innovations can eradicate or reduce risk. The staged approach allows for new innovations to be incorporated into a management process. This, coupled with a thoughtful and cautious and broad based geographic approach, may increase the flexibility of Canada's NFW management process.

The selection of economic regions may be potentially useful because they tend to be large and theoretically allow for widespread participation by communities, local governments etc.. Therefore, the potential to invoke an inclusive and broad-based management and siting process is greater than if relatively small regions were selected. However, it is important to keep in mind that the selection of a region of any scale will not "reduce" the issues associated with NFW management. For example, although siting a facility (geologic or otherwise) implies that a process is required to find a specific suitable location on engineering, geologic, biophysical,

social, political etc grounds., this does not preclude “larger scale” considerations from entering into the siting process. For example, throughout the EA process for the deep geologic disposal concept and reflected in the Panel Report, concerns were expressed about Canada’s commitment to nuclear energy as a viable long term strategy, risks imposed on unborn generations, potential new breakthroughs such as transmutation, importation of NFW from abroad, weapons production and nuclear fuel waste. Although these issues may seem to transcend local concerns, in reality they do not and should not be overlooked. These types of issues can be said to “transcend scale”; they will be added onto regional and local concerns.

Transportation of NFW must be factored into the selection of economic regions for two of the management options; geologic disposal and centralized storage. Consideration of a geologic disposal facility or a centralized storage facility as requiring only one location is false and may be perceived in some quarters as misleading. Provision has to be made in the decision making process for transporting the waste to the disposal or storage site. This in turn will likely involve economic regions other than the potential host region for the facility.

The consideration of First Nations and NFW management was underscored in the EA Panel report. As depicted in Map 12, historical Indian treaties and economic regions do not coincide. Moreover, First Nations’ submissions to environmental assessments related to nuclear fuel waste (i.e. the geologic disposal concept; Bruce used fuel dry storage) have been uniformly negative. They do not want nuclear fuel waste to be located on or transported through “their” land.

The use of economic regions does not fit easily into the concerns expressed by First Nations. Clearly, First Nations should be actively involved in the NWMO decision making process, including and especially in selecting the region(s) for a management option. NWMO may also find itself in a unique position with respect to First Nations: a truly innovative collaboration is possible based, for example, on the 2002 agreement between the Grand Council of the Cree and the Quebec government. Under this agreement, the Cree receive financial compensation, increased control over logging in the province and employment guarantees in exchange for allowing Hydro Quebec to construct hydro dams. It is rightly conceived as a nation-to-nation agreement spanning a 50 year time frame. It reflects a common willingness to pursue development in northern Quebec. An analogous framework may be appropriate for managing NFW.