nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

October 7, 2011

Municipality of Wawa
40 Broadway Avenue
P.O. Box 500
Wawa, ON P0S 1K0

Attn: Mr. Chris Wray, CAO/Clerk-Treasurer

Re: **Adaptive Phased Management Initial Screening – The Municipality of Wawa**

Dear Mr. Wray,

Further to the Municipality of Wawa's request to Learn More about the Adaptive Phased Management program and request for an initial screening, I am pleased to attach a report outlining the findings from the initial screening, as described in the Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel (May, 2010). As you know, the purpose of the initial screening in Step 2 of the process is to determine whether, based on readily-available information and five screening criteria, there are any obvious conditions that would exclude the Municipality of Wawa from further consideration in the site selection process.

As the report indicates, the review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Municipality of Wawa from further consideration in the NWMO site selection process. The initial screening suggests that the Wawa area contains portions of lands that are potentially suitable for hosting a deep geological repository for Canada's used nuclear fuel. It is important to note that this initial screening has not confirmed the suitability of your community. Should your community choose to continue to explore its potential interest in the project, your area would be the subject of progressively more detailed assessments against both technical and social factors. Several years of studies would be required to confirm whether a site within your area could be demonstrated to safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for the long-term management of Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future. The NWMO expects that the selection of a preferred site would take between seven to ten years. It is important that any community which decides to host this project base its decisions on an understanding of the best scientific and social research available and its own aspirations. Should the Municipality of Wawa continue to be interested in exploring the project, over this period there would be ongoing engagement of your community, surrounding communities and others who may be affected. By the end of this process, Wawa as a whole community would need to clearly demonstrate that it is willing to host the repository in order for this project to proceed.

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The next evaluation step would be to conduct a feasibility study as described in Step 3 of the site selection process. This feasibility study would focus on areas selected in collaboration with the community. As your community considers whether it is interested in advancing to the feasibility study phase, the NWMO encourages you to continue community discussion and further learning about the project. Support programs are available to assist your community to reflect on its long-term vision and whether this project is consistent with achieving that vision. Programs and resources are also available to engage your community residents in learning more about this project and becoming involved. We would be very pleased to provide further information about these programs.

Once again, I thank you for taking the time to learn about Canada's plan for the safe, secure management of Canada's used nuclear fuel.

Sincerely,

Kathryn Shaver,
Vice President, APM Public Engagement and Site Selection

c. Mayor Linda Nowicki

SUMMARY REPORT
Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel

Municipality of Wawa, Ontario

Revision: 0 (Final)

Prepared for:
Nuclear Waste Management Organization
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October, 2011

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Client:	Nuclear Waste Management Organization	
Document ID:	10-214-1_Wawa Summary Report_R0.docx	
Revision Number:	0	Date: October, 2011
Prepared by:	Anthony West	
Reviewed by:	Kenneth Raven	
Approved by:	 Kenneth Raven	

EXECUTIVE SUMMARY

On May 3, 2011, the Municipality of Wawa expressed interest in learning more about the Nuclear Waste Management Organization (NWMO) site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). This report summarizes the findings of an initial screening, conducted by Geofirma Engineering Ltd., to evaluate the potential suitability of the Wawa area against five screening criteria using readily available information (Geofirma, 2011). The purpose of the initial screening is to identify whether there are any obvious conditions that would exclude the Municipality of Wawa from being further considered in the site selection process. The initial screening focused on the Municipality of Wawa and its periphery, which are referred to as the "Wawa area" in this report.

The review of readily-available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Municipality of Wawa from being further considered in the NWMO site selection process. The initial screening indicates that the Wawa area contains portions of lands that are potentially suitable for hosting a deep geological repository. Examples of these formations include the Whitefish Lake-Brule Bay Batholith and the Western Batholith that are respectively present in the southern and northwestern parts of the Municipality and extend well beyond its boundaries. The Wawa Gneiss Domain, outside of the southern boundary of the Municipality, is also potentially suitable. The rocks of the Michipicoten Greenstone Belt within and outside of the municipality are likely unsuitable for hosting a deep geological repository due to their compositional heterogeneity, spatial variability and potential for natural resources.

It is important to note that the intent of this initial screening is not to confirm the suitability of the Wawa area to host a deep geological repository, but rather to provide early feedback on whether there are known reasons to exclude it from further consideration. Should the community of Wawa remain interested in continuing with the site selection process, more detailed studies would be required to confirm and demonstrate whether the Wawa area contains sites that can safely contain and isolate used nuclear fuel. The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

The five initial screening criteria are defined in the site selection process document (NWMO, 2010) and relate to: having sufficient space to accommodate surface and underground facilities, being outside protected areas and heritage features, absence of known groundwater resources at repository depth, absence of known economically exploitable natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

1 INTRODUCTION

In May 2010, the NWMO published and initiated a nine-step site selection process to find an informed and willing community to host a deep geological repository for Canada's used nuclear fuel (NWMO, 2010). The site selection process is designed to address a broad range of technical and social, economic and cultural factors as identified through dialogue with Canadians and Aboriginal peoples, and draws from experiences and lessons learned from past work and processes developed in Canada to site facilities for the management of other hazardous material. It also draws from similar projects in other countries pursuing the development of deep geological repositories for used nuclear fuel. The suitability of potential candidate sites will ultimately be assessed against a number of site evaluation factors, both technical and social in nature.

The site evaluation process includes three main phases over a period of several years, with each step designed to evaluate the site in progressively greater detail upon request of the community. These are: Initial Screenings (Step 2) to evaluate the potential suitability of the community against a list of initial screening criteria; Feasibility Studies (Step 3) to determine if candidate sites within the proposed areas may be potentially suitable for developing a safe used nuclear fuel repository; and Detailed Site Evaluations (Step 4), at one or more selected sites, to confirm suitability based on detailed site evaluation criteria. It is up to the communities to decide whether they wish to continue to participate in each step of the process.

2 OBJECTIVE OF THE INITIAL SCREENING

The overall objective of the initial screening is to evaluate proposed geographic areas against a list of screening criteria, using readily available information. Initial screening criteria 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 safety factors outlined in Section 6 of the Site Selection Document (NWMO, 2010).

For cases where readily available information is limited and where assessment of some of the criteria is not possible at the initial screening stage, the area would be advanced to the feasibility study stage for more detailed evaluation, if the community remains interested in participating in the siting process.

3 INITIAL SCREENING ASSESSMENT

This section provides a summary evaluation of each of the five initial screening criteria for the Wawa area, based on readily available information. The intent of this evaluation is not to conduct a detailed analysis of all available information or identify specific potentially suitable sites, but rather to identify any obvious conditions that would exclude the Municipality of Wawa from being further considered in the site selection process.

The Municipality of Wawa is approximately 422 km^2 in size. It is located along the northeast shore of Lake Superior at Michipicoten Bay approximately 170 km north of Sault Ste. Marie.

Screening Criterion 1: The site must have enough available land of sufficient size to accommodate the surface and underground facilities.

The review of readily available information shows that the Wawa area contains sufficient land to accommodate the repository surface and underground facilities. Surface facilities will require a land parcel of about 1 km by 1 km (100 ha) in size, although some additional space may be required to satisfy regulatory requirements. The underground footprint of the repository is about 1.5 km by 2.5 km (375 ha) at a typical depth of about 500 m.

Review of available mapping and satellite imagery shows that developed areas and large water bodies occupy only a small portion of the Wawa area. Although the Municipality has a large range in topographic elevations, most of the Municipality is unconstrained by topography. Locally, there may be areas where topography may be unfavourable for the development of the repository's facilities and a more detailed assessment would be required during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process. The review of available geological information also suggests that the lands at the periphery of the Municipality are accessible and contain a number of geological formations with potentially sufficient volumes of rock at depth to accommodate the repository's underground facilities (see screening criterion 5).

Screening Criterion 2: Available land must be outside of protected areas, heritage sites, provincial parks and national parks.

The review of readily available information shows that the Wawa area contains sufficient land outside of protected areas, heritage sites, provincial parks and national parks to accommodate the repository's facilities.

There are seven protected areas in the Wawa area including four Ontario provincial parks, two conservation reserves, and a forest reserve. With the exception of the Magpie River Terraces Conservation Reserve, these protected areas border Lake Superior and are outside the Municipality boundaries. These protected areas occupy a small portion of land within the Wawa area. Known archaeological sites are small and generally concentrated around the shoreline of Lake Superior or within the protected areas discussed above. There are no National Historic Sites in the Wawa area.

The absence of locally protected areas would need to be confirmed in discussion with the community and Aboriginal peoples in the area during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Screening Criterion 3: 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.

The review of available information did not identify any known groundwater resources at repository depth (typically 500 m) for the Wawa area. The Ontario Ministry of the Environment Water Well Records indicate that no potable water supply wells are known to exploit aquifers at typical repository depths in the Wawa area or anywhere else in Northern Ontario. Water wells in the Wawa area source water from overburden or shallow bedrock aquifers at depths of up to 117 m.

Experience in similar geological settings across the Canadian Shield suggests that the potential for deep groundwater resources at repository depths is low throughout the Wawa area. Active groundwater flow is generally confined to localized shallow fractured systems, in the upper 300 m. At greater depth, permeability tends to decrease as fractures become less common and interconnected. Groundwater at such depths is also generally saline. The absence of groundwater resources at repository depth would need to be confirmed during subsequent site evaluation stages, if the community remains interested in continuing with the site selection process.

Screening Criterion 4: 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.

Based on the review of available information, the Wawa area contains sufficient land, free of known economically exploitable natural resources, to accommodate the required repository's facilities.

The Wawa area has a negligible potential for oil and gas resources. While there has been historic mining of iron and gold, there are currently no operating mines within the Wawa area. The potential for economically exploitable natural resources, such as iron, base metals, gold and diamonds, in the Wawa area is associated with specific geological units such as the rocks of the greenstone belts. The natural resource potential of the large granitic batholiths in the area is limited, except in localized areas along their margins.

Extraction of sand and gravel has occurred in the Wawa area in the past and continues today. However, the risk that these resources pose for future human intrusion and breaching of the repository is negligible, as quarrying operations are typically limited to the near surface.

Screening Criterion 5: Available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe, considering the safety factors outlined in Section 6 of the Site Selection Document.

Based on the review of available geological and hydrogeological information, the Wawa area comprises portions of land that do not contain obvious known geological and hydrogeological conditions that would make the area unsuitable for hosting a deep geological repository.

The safety-related geoscientific factors outlined in Section 6 of the Site Selection Document (NWMO, 2010) relate to: safe containment and isolation of used nuclear fuel; long-term resilience to future geological processes and climate change; safe construction, operation and closure of the repository; isolation from future human activities; and amenability to site characterization and data interpretation

activities. At this early stage of the site evaluation process, where limited data at repository depth exist, these factors are assessed using readily available information, with the objective of identifying any obvious unfavourable hydrogeological and geological conditions that would exclude the Municipality of Wawa from further consideration. They would be gradually assessed in more detail as the site evaluation process progresses and more site specific data is collected during subsequent evaluation phases, provided the community remains interested in continuing in the site selection process.

Safe Containment and Isolation

The geological and hydrogeological conditions of a suitable site should promote long-term containment and isolation of used nuclear fuel and retard the movement of any potentially released radioactive material. This requires that the repository be located at a sufficient depth, typically around 500 m, in a sufficient rock volume with characteristics that limit groundwater movement. The review of readily available information indicates that the Wawa area contains areas with no obvious geological and hydrogeological conditions that would fail the containment and isolation requirements.

The Municipality of Wawa is dominated by rocks of the Michipicoten Greenstone Belt, which extends beyond the Municipality boundaries to the north, northwest, and southwest. These rocks are heterogeneous, fractured and variable in composition, and are arranged in layers of varying thickness. Past tectonic events have deformed these layers, making them difficult to characterize from a stratigraphic point of view. These events created numerous regional folds, faults and smaller scale shear zones within the Greenstone belt rocks in the Wawa area. Although these Greenstone belt rocks may have sufficient thickness and lateral extent, they are unlikely to be suitable for hosting a deep geological repository due to their structural complexity and heterogeneity. Within the Michipicoten Greenstone Belt are the Hawk Lake Granitic Complex and the Jubilee Stock. While these intermediate to felsic granitic intrusions may contain sufficient volume to host a repository, their potential suitability may be affected by proximity to faults and the potential for mineral resources at their margins.

About 25% of the Municipality of Wawa is underlain by granitoid (gneissic) terrane, including the Whitefish Lake-Brule Bay Batholith of the Wawa Gneiss Domain in the south, and the Western Batholith in the northwest. Both the Wawa Gneiss Domain and the Western Batholith extend well beyond the Municipality boundaries to the south, east and northwest, respectively. The thickness of the various plutons which make up the granitoid terrane is uncertain, although their likely origin as mid-crustal intrusions suggests a thickness of at least 10 km. Relative to the greenstone belts, the Wawa Gneiss Domain (including the Whitefish Lake-Brule Bay Batholith) and the Western Batholith are more homogeneous in compositional structure, and are cut by a sparse network of mapped faults occurring with a spacing of 5 to 15 km. Faults have also been mapped at a local scale with spacing between 250 m and 3 km. The extent to which these minor faults extend to depth and their potential impact on siting the repository would need to be evaluated during subsequent site evaluation stages, if the community remains interested in continuing in the site selection process.

Based on the geologic characteristics described above, and available experience from other similar granitic rocks in the Canadian Shield, the Wawa Gneiss Domain (including the Whitefish Lake-Brule Bay Batholith) and the Western Batholith may be potentially suitable rocks for hosting a deep geological repository.

From a hydrogeological point of view, the review of readily available information did not reveal the existence of deep fracture systems or deep aquifers in the Wawa area. The presence of active deep groundwater flow systems in crystalline rocks is controlled by the frequency and interconnectivity of fractures at depth. Experience from other areas in the Canadian Shield, particularly for granitic intrusions, indicates that active groundwater flow tends to be generally limited to shallow fractured systems, typically less than 300 m. In deeper rock, fractures are less common and less likely to be interconnected, leading to very slow groundwater movement.

Long-term Stability

A suitable site for hosting a repository is a site that would remain stable over the very long-term in a manner that will ensure that the performance of the repository will not be substantially altered by future geological and climate change processes, such as earthquakes or glaciation. A full assessment of this geoscientific factor requires detailed site specific data that would be typically collected and analyzed through detailed field investigations.

At this early stage of the site evaluation process, the long-term stability factor is evaluated by assessing whether there is any evidence that would raise concerns about the long-term hydrogeological and geological stability of the Wawa area. The review did not reveal any obvious geological or hydrogeological conditions that would clearly fail to meet the long-term stability requirement for a potential repository within the Wawa area.

The Municipality of Wawa is located in the Superior Province of the Canadian Shield, where large portions of land have remained tectonically stable for the last 2.5 billion years. There is also no evidence to suggest that the faults and shear zones identified in the Wawa area have been tectonically active within the past billion years. The geology of the Wawa area is typical of many areas of the Canadian Shield, which has been subjected to numerous glacial cycles during the last million years. Glaciation is a significant past perturbation that could occur in the future. However, findings from studies conducted in other areas of the Canadian Shield suggest that deep crystalline formations, particularly the plutonic intrusions, have remained largely unaffected by past perturbations such as glaciation.

Potential for Human Intrusion

The site should not be located in areas where the containment and isolation functions of the repository are likely to be disrupted by future human activities such as exploration or mining. This factor has already been addressed in previous sections, which concluded that the potential for groundwater resources at repository depths and known economically exploitable natural resources is low throughout the granitic intrusive rocks in the Wawa area.

Amenability to Construction and Site Characterization

The characteristics of a suitable site should be favourable for the safe construction, operation, closure and long-term performance of the repository. This requires that the strength of the host rock and in-situ stress at repository depth are such that the repository could be safely excavated, operated and closed without unacceptable rock instabilities; and that the soil cover depth over the host rock should not adversely impact repository construction and site investigation activities. Similarly, the host rock

geometry and structure should be predictable and amenable to site characterization and interpretation activities.

From a constructability perspective, limited site specific information is available on the local rock strength characteristics and in-situ stresses for the Wawa area. However, available information from geologically similar settings suggests that crystalline rock formations within the Canadian Shield, particularly within plutonic intrusions, generally possess geomechanical characteristics that are good to very good and amenable to the type of excavation activities involved in the development of a deep geological repository for used nuclear fuel.

In terms of predictability the review of readily-available information on the bedrock geology and Quaternary geology for the Wawa area did not indicate any obvious conditions which could make the granitoid terrane difficult to characterize, although conditions such as thick overburden cover may exist in localized areas. Because of their compositional variability and high degree of deformation, the rocks of the greenstone belts are not amenable to characterization.

The degree to which factors such as geologic variability and overburden thickness might affect the characterization and data interpretation activities would require further assessment during subsequent site evaluation phases, provided the community remains interested in continuing in the site selection process.

4 INITIAL SCREENING FINDINGS

This report presents the results of an initial screening to assess the potential suitability of the Wawa area against five initial screening criteria using readily-available information. The initial screening focused on the Municipality of Wawa and its periphery, which are referred to as the "Wawa area" in this report. As outlined in NWMO's site selection process (NWMO, 2010), the five initial screening criteria relate to: having sufficient space to accommodate surface and underground facilities, being outside protected areas and heritage sites, absence of known groundwater resources at repository depth, absence of known economically exploitable natural resources and avoiding known hydrogeologic and geologic conditions that would make an area or site unsuitable for hosting a deep geological repository.

The review of readily available information and the application of the five initial screening criteria did not identify any obvious conditions that would exclude the Municipality of Wawa from further consideration in the NWMO site selection process. The initial screening indicates that the Wawa area contains portions of lands with geological formations that are potentially suitable for hosting a deep geological repository. Examples of these formations include the Whitefish Lake-Brule Bay Batholith and the Western Batholith that are respectively present in the in the southern and northwestern parts of the Municipality and extend well beyond its boundaries. The Wawa Gneiss Domain, outside of the southern boundary of the Municipality, is also potentially suitable. The rocks of the Michipicoten Greenstone Belt within and outside of the municipality are likely unsuitable for hosting a deep geological repository due to their compositional heterogeneity, spatial variability and potential for natural resources.

It is important to note that at this early stage of the site evaluation process, the intent of the initial screening was not to confirm the suitability of the Wawa area, but rather to identify whether there are

any obvious conditions that would exclude it from further consideration in the site selection process. Should the community of Wawa remain interested in continuing with the site selection process, several years of progressively more detailed studies would be required to confirm and demonstrate whether the Wawa area contains sites that can safely contain and isolate used nuclear fuel.

The process for identifying an informed and willing host community for a deep geological repository for Canada's used nuclear fuel is designed to ensure, above all, that the site which is selected is safe and secure for people and the environment, now and in the future.

5 REFERENCES

Geofirma Engineering Ltd., 2011. Initial Screening for Siting a Deep Geologic Repository for Canada's Used Nuclear Fuel – Municipality of Wawa, Ontario. Final Report Reference No. 10-214-1, October.

NWMO, 2010. Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel, Nuclear Waste Management Organization. (Available at www.nwmo.ca)

6 REPORT SIGNATURE PAGE

Respectfully submitted,

Geofirma Engineering Ltd.

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