



NUCLEAR WASTE SOCIÉTÉ DE GESTION  
MANAGEMENT DES DÉCHETS  
ORGANIZATION NUCLÉAIRES

January 7, 2013

The Township of Manitouwadge  
1 Mississauga Drive  
Manitouwadge, ON P0T 2C0

Attn: Mayor MacEachern

**Re: Adaptive Phased Management Initial Screening – The Township of Manitouwadge**

Dear Mayor MacEachern,

Further to the Township of Manitouwadge'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 Township of Manitouwadge 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 Township of Manitouwadge from further consideration in the NWMO site selection process. The initial screening suggests that the Manitouwadge area comprises geological formations 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 Township of Manitouwadge 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, Manitouwadge 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,

A handwritten signature in blue ink that reads "Kathryn Shaver". The signature is written in a cursive style with a long, sweeping tail on the letter 'v'.

Kathryn Shaver,  
Vice President, APM Engagement and Site Selection

# **SUMMARY REPORT**

## **Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel**

### **Township of Manitouwadge, Ontario**

Revision: 0 (Final)

**Prepared for:**  
**Nuclear Waste Management Organization**  
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**Document ID: 10-214-6\_Manitouwadge Summary Rpt\_R0**

**January 4, 2013**

Title:	SUMMARY REPORT Initial Screening for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel, Township of Manitouwadge, Ontario	
Client:	Nuclear Waste Management Organization	
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Revision Number:	0	Date: January 4, 2013
Prepared by:	Dru Heagle,	
Reviewed by:	Kenneth Raven	
Approved by:	 Kenneth Raven	

## EXECUTIVE SUMMARY

On September 12, 2012, the Township of Manitouwadge 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. (2013), to evaluate the potential suitability of the Manitouwadge area against five screening criteria using readily available information. The purpose of the initial screening is to identify whether there are any obvious conditions that would exclude the Township of Manitouwadge from further consideration in the site selection process. The initial screening focused on the Township of Manitouwadge and its periphery, which are referred to as the "Manitouwadge 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 Township of Manitouwadge from further consideration in the NWMO site selection process. The initial screening indicates that the Manitouwadge area contains portions of land with geological units that are potentially suitable for hosting a deep geological repository. Examples of these units include the metasedimentary rocks of the Quetico Subprovince, the Black-Pic Batholith and other smaller granitic intrusions including the Fourbay, Rawluk Lake and Everest Lake plutons.

It is important to note that the intent of this initial screening was not to confirm the suitability of the Manitouwadge 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 Township of Manitouwadge remain interested in continuing with the site selection process, more detailed studies would be required to confirm and demonstrate whether the Manitouwadge 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 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 (NWMO, 2010) for the Manitouwadge 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 Township of Manitouwadge from further consideration in the site evaluation process.

The Township of Manitouwadge is approximately 352 km<sup>2</sup> in size and the Manitouwadge area is 2,371 km<sup>2</sup>. It is located 60 km northeast of Lake Superior, 400 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 Manitouwadge area contains sufficient land to accommodate the repository surface 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 the Township of Manitouwadge contains limited constraints that would prevent the development of the repository's surface facilities. These would mainly include permanent water bodies such as Manitouwadge, Wowun and Rabbitskin lakes, which account for less than 1% of the Township area. Residential and industrial infrastructure occupies a small portion of the Township, with developments limited mainly to roadways and the settlement area. The areas at the periphery of the Township are largely undeveloped, with few natural or physical constraints such as major infrastructure or permanent water bodies. Although the Manitouwadge area has a range in topographic elevations, most of the area is unconstrained by topography.

The review of readily available information also suggests that the Manitouwadge area has the potential to contain sufficient volumes of host rock to accommodate underground facilities associated with a deep geological repository (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 Manitouwadge area contains sufficient land outside of protected areas, heritage sites, provincial parks and national parks to accommodate the repository's facilities.

The Manitouwadge area was screened for federal, provincial and municipal parks, conservation areas, nature reserves, national wildlife areas, and archaeological and historic sites using available data from the Ontario Ministry of Natural Resources (Land Information Ontario) and the Ontario Ministry of Tourism and Culture. There is only one protected area within the Manitouwadge area, the Isko Dewabo Lake Complex Conservation Reserve, which is located approximately 10 km southwest of the Township and occupies less than 1% of the Manitouwadge area. There is only one known

archaeological site in the Manitouwadge area. It is a small and localized site located northeast of the Township. There are no known National Historic Sites in the Manitouwadge area.

The absence of locally protected areas or heritage sites 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 Manitouwadge 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 Manitouwadge area or anywhere else in Northern Ontario. Water wells in the Manitouwadge area source water from overburden or shallow bedrock aquifers at depths of up to 49 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 Manitouwadge 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 less 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 Manitouwadge area contains sufficient land, free of known economically exploitable natural resources, to accommodate the required repository's facilities.

The Manitouwadge area has a negligible potential for oil and gas resources. There are currently no active mines within the Manitouwadge area. There are, however, six past producing mines, four of which have mineral reserves remaining. These mines exploited base metals and are all located in the Manitouwadge Greenstone Belt within the Township of Manitouwadge. Metallic mineral potential in the Manitouwadge area is mostly associated with the rocks of the Manitouwadge Greenstone Belt, and the tonalite intrusion surrounding the Loken Lake Pluton. The mineral potential of the remaining granitic intrusions and metasedimentary and migmatized rocks in the Manitouwadge area is considered low.

There is potential in the Manitouwadge area for industrial minerals, dimension stone, and aggregate extraction. However, the risk that these resources pose for future human intrusion is negligible, as development of these non-metallic resources would be limited to very shallow depths.

**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 Manitouwadge 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 Township of Manitouwadge 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 Manitouwadge area contains areas with no obvious geological and hydrogeological conditions that would fail the containment and isolation requirements.

The bedrock geology in the southern half of the Township comprises granitic rocks of the Black-Pic Batholith, which extends well beyond the Township boundaries and dominates the bedrock geology in the southern part of the Manitouwadge area. There are other smaller granitic intrusions in the Manitouwadge area, including the Fourbay, Rawluk Lake, and Everest Lake plutons at the periphery of the Township. The granitic rocks of these intrusions appear to have favorable geological characteristics and sufficient rock volume (lateral extent and thickness) to potentially host a deep geological repository. Similarly, the metasedimentary rocks of the Quetico Subprovince that dominate the bedrock geology in the northern sector of the Manitouwadge area, and a belt of migmatized rocks that runs north of the Township warrant further considerations as potentially suitable host rocks.

The central part of the Township of Manitouwadge is underlain by rocks of the Manitouwadge Greenstone Belt that extend to the east beyond the Township boundaries. This greenstone belt includes a series of heterogeneous metavolcanic and metasedimentary rocks that have undergone several phases of deformation. While these 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, lithological heterogeneity, and potential for natural resources (see Criterion 4).

Other intrusions within the Manitouwadge area such as the Nama Creek Pluton, the Faries-Moshkinabi Intrusion and the Dotted Lake Pluton would also be likely unsuitable due to their limited lateral extent to potentially host the repository's facilities.

There are several sets of faults and dykes mapped within the Manitouwadge area. The extent to which these faults and dykes extend to depth, their frequency of occurrence, 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 with the site selection process.

From a hydrogeological point of view, the review of readily available information did not reveal the existence of known deep fracture systems or deep aquifers in the Manitouwadge 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 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 Manitouwadge 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 Manitouwadge area.

The Township of Manitouwadge 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. The geology of the Manitouwadge 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 have remained largely unaltered 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 under Screening Criteria 3 and 4, which concluded that the potential for deep groundwater resources at repository depths is low, and that the potential for economically exploitable natural resources is mostly limited to the Manitouwadge Greenstone Belt.

### ***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 Manitouwadge area. However, available information from geologically similar settings suggests that crystalline rock formations within the Canadian Shield 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 of the geological formations and amenability to site characterization activities, the review of the bedrock and Quaternary geology for the Manitouwadge area did not indicate any obvious conditions which would make the rock mass unusually difficult to characterize, although such conditions may exist in localized areas.

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, if the community remains interested in continuing in the site selection process.

## **4 INITIAL SCREENING FINDINGS**

This report summarizes the results of an initial screening conducted to assess the potential suitability of the Manitouwadge area against five initial screening criteria using readily available information. The initial screening focused on the Township of Manitouwadge and its periphery, which are referred to as the "Manitouwadge 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 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 Township of Manitouwadge from further consideration in the NWMO site selection process. The initial screening indicates that the Manitouwadge area contains large portions of land with geological units that are potentially suitable for hosting a deep geological repository. Examples of these units include the metasedimentary rocks of the Quetico Subprovince, the Black-Pic Batholith and other smaller granitic intrusions including the Fourbay, Rawluk Lake and Everest Lake plutons.

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 Manitouwadge 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 Manitouwadge 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 Manitouwadge 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.

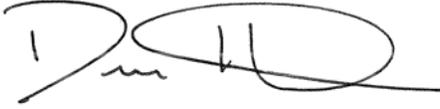
## 5 REFERENCES

Geofirma Engineering Ltd., 2013. Initial Screening for Siting a Deep Geologic Repository for Canada's Used Nuclear Fuel – Township of Manitouwadge, Ontario. Final Report Reference No. 10-214-6, December.

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](http://www.nwmo.ca))

## 6 REPORT SIGNATURE PAGE

Respectfully submitted,  
Geofirma Engineering Ltd.



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Senior Geoscientist



Kenneth Raven, P. Eng., P.Geo.  
Principal