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TECHNICAL MEMORANDUM

Date: January 9, 2014

To: Mahrez Ben Belfadhel, Director Geoscientific Site Evaluations, Nuclear Waste Management Organization

From: Kenneth Raven, P.Eng., P.Geo., Principal and Senior Geoscientist

RE: **Interim Results of Geoscientific Preliminary Assessment, Sedimentary Sites, Southern Ontario**

1.0 INTRODUCTION

As previously discussed, our ongoing desktop geoscientific preliminary assessment of the Municipalities of Arran-Elderslie, Brockton and South Bruce, the Township of Huron-Kinloss and the Town of Saugeen Shores (henceforth collectively termed the Communities) has identified that two of these communities have very limited potential to satisfy the geoscientific evaluation factors outlined in the site selection process (NWMO, 2010). These include the Municipality of Arran-Elderslie and the Town of Saugeen Shores.

While recognizing that Phase 1 preliminary assessments are still in progress for the five communities in Bruce County, we felt it important to bring these early findings to your attention. This Technical Memorandum provides a brief summary of these findings. We would be pleased to discuss this Memorandum with you.

While the assessment for the three other communities is still ongoing, interim findings indicate that the Municipality of Brockton, the Township of Huron-Kinloss and the Municipality of South Bruce appear to contain areas that have the potential to satisfy NWMO's geoscientific evaluation factors. We are continuing with our geoscientific evaluations as part of the broader Phase 1 assessments in progress.

2.0 SCOPE OF THE ASSESSMENT

The desktop geoscientific preliminary assessment is being conducted using available geoscientific information and a subset of key geoscientific characteristics and constraints that can be realistically assessed at this early stage of the site evaluation process. The desktop geoscientific preliminary assessment is being conducted using the following review and interpretation activities:

- Assembly and detailed review of available geoscientific information such as geology, structural geology, natural resources, hydrogeology and overburden deposits (surficial deposits);
- Interpretation of available geophysical surveys;

- Interpretation of available borehole geophysical data and selected 2-D seismic reflection surveys to provide information on the geometry and potential structural features of the subsurface bedrock geology;
- Terrain analysis studies to help assess overburden (surficial deposits) type and distribution, bedrock exposures, accessibility constraints, watershed and subwatershed boundaries, groundwater discharge and recharge zones;
- Assessment of land use and protected areas including parks, conservation reserves, heritage sites and source water protection areas; and
- The identification and evaluation of general potentially suitable areas based on systematic assessment of key geoscientific characteristics and constraints that can be realistically assessed at this stage of the assessment.

Based on available information on the sedimentary rocks underlying the five Communities, the key geoscientific characteristics and constraints that can be realistically assessed at this stage of the assessment include the following:

- **Bedrock and structural geology** – Based on available information, it was determined that the Ordovician Cobourg Formation (limestone) within the sedimentary sequence in the area of the five communities is the preferred host rock for a used fuel deep geological repository. The Cobourg Formation has a number of favourable containment and isolation characteristics (NWMO, 2011; Intera Engineering Ltd., 2011). These include: sufficient volume, very low hydraulic conductivity and high geomechanical strength. These favourable characteristics are also complemented by the presence of 200 m of overlying very low permeability Ordovician shale formations, which acts as a barrier.
- **Minimum depth of top of the Cobourg Formation-** For the specific sedimentary sequence in the area of the five communities, it was determined that a minimum depth of 500 m is preferred in order to maintain the integrity of a repository within the Cobourg Formation. This would protect the 200 m thick Ordovician shale caprock barrier under the most conservative assumptions of future bedrock removal rates due to glacial erosion.
- **Protected areas** – All known protected areas within the Communities were excluded from further consideration. These include exclusion areas identified by the Communities for future development, Conservation Areas and Reserves, First Nation Reserves, Provincial Parks, Provincially Significant Wetlands, and built-up areas.
- **Source water protection areas -** Land-based water protection zones (IPZs, Intake Protection Zones) 1 and 2, and groundwater protection areas (WHPAs, Well Head Protection Areas) A, B and C were excluded from further consideration, given that they provide the highest level of protection for municipal groundwater supplies through land use planning and controls. The consideration of WHPAs D and E would need to be further assessed in collaboration with the Communities in future studies.
- **Natural resources** – There are no known oil and gas pools within the Communities. Discretionary mineral occurrences such as limestone, dolostone, marl and gypsum are not considered as siting constraints due to the shallow depth associated with these occurrences (typically less than 20 m). Deeper discretionary salt occurrences of the Silurian Salina Formation known to be present beneath the Township of Huron-Kinloss are also not

considered a siting constraint due to the thin nature of the deposits and their occurrence approximately 400 m above the Cobourg Formation.

- **Surface constraints** – Built-up areas were excluded from further consideration. Other surface features such as overburden, the limited extents of wetlands outside protected areas, the relatively flat topography and the ease of accessibility within the Communities were not found to be significant siting constraints.

3.0 INTERIM ASSESSMENT FINDINGS

The assessment of the key geoscientific characteristics and constraints discussed above indicates that the Municipality of Arran-Elderslie and the Town of Saugeen Shores have limited potential to satisfy the geoscientific evaluation factors outlined in the site selection process (NWMO, 2010). The following sections provide a brief description of how these characteristics and constraints were assessed for each of the two communities.

3.1 Municipality of Arran-Elderslie

The Municipality of Arran-Elderslie contains several protected areas that comprise about 5% of the municipality. These include several conservation areas, provincially significant wetlands, well head protection areas and built-up areas associated with Chesley, Paisley and Tara. There are no natural resource constraints for siting a deep geological repository in the municipality such as known oil and gas resources.

Importantly, only 5% of the municipality area has the top of Cobourg Formation at depths greater than the minimum preferred depth of 500 m. The depth of the top of the Cobourg Formation decreases from 545 m over a small area near the southern boundary of the municipality to about 343 m in the northern part of the municipality.

Based on this preliminary evaluation, the Municipality of Arran-Elderslie does not contain sufficient land areas that have the potential to meet the geoscientific site evaluation factors outlined in the site selection process document (NWMO 2010).

3.2 Town of Saugeen Shores

The Town of Saugeen Shores contains several protected areas that occupy about 25% of the town. These include the Saugeen Bluffs Conservation Area, MacGregor Point Provincial Park, provincially significant wetlands, water intake protection zones at Southampton, and built-up areas at Port Elgin and Southampton. The land west of Highway 21 was excluded as it is preserved for future expansion.

There are no natural resource constraints for siting a deep geological repository in the town. There are two known dry oil and gas exploration wells and no known oil and gas pools within the town.

The depth of the Cobourg Formation decreases from 584 m near the southern boundary of the town to about 400 m in the northern part. The area where the depth of the Cobourg Formation is greater than the preferred 500 m represents about 40% of the town, and is mostly located in the southern portion of the town. However, this area contains a number of constraints that greatly reduce the prospect for finding areas that are large enough for hosting the repository's surface and underground facilities.

These include the excluded areas west of Highway 21, the presence of a provincial park and a conservation area, built-up areas, and the Saugeen River and its tributaries.

Based on this preliminary evaluation, the Town of Saugeen Shores has very limited potential to contain areas that would meet the geoscientific site evaluation factors outlined in the site selection process document (NWMO, 2010).

3.3 Other Communities

Based on work to date, the Municipality of Brockton, the Municipality of South Bruce and the Township of Huron-Kinloss appear to contain large areas that have the potential to meet the geoscientific site evaluation factors outlined in the site selection process document (NWMO, 2010). As mentioned earlier, the geoscientific preliminary assessment is still ongoing. More detailed descriptions of the methodology and results will be provided in a final Phase 1 report, once the assessment is completed.

The following sections discuss some of the characteristics and constraints relevant each of the three communities. It is important to note that the desktop preliminary assessment is still ongoing.

3.3.1 Municipality of Brockton

The Municipality of Brockton contains several protected areas that comprise about 15% of the municipality. These include the large Greenock Swamp Wetland Complex Conservation Area in the western third of the municipality, several smaller conservation areas, provincially significant wetlands, municipal water well head protection areas, municipal water intake protection zones, and built-up areas associated with Walkerton.

There are no natural resource constraints for siting a deep geological repository in the municipality. There are six known dry oil and gas exploration wells and no known oil and gas pools.

The top of the Cobourg Formation within the municipality is at depths of about 404 to 691 m. A large area of the municipality (about 70%) has the top of Cobourg Formation at depths more than the preferred 500 m. This area is generally free of unfavourable geoscientific features and surface constraints.

3.3.2 Municipality of South Bruce

The Municipality of South Bruce contains several protected areas that comprise about 8% of the municipality. These include several small conservation areas, provincially significant wetlands, municipal water well head protection areas, and built-up areas associated with Mildmay and Teeswater.

There are no natural resource constraints for siting a deep geological repository in the municipality. There are three known dry oil and gas exploration wells and no known oil and gas pools.

The top of the Cobourg Formation within the municipality is at depths varying from 433 to 717 m. A large area of the municipality (about 95%) has the top of Cobourg Formation at depths more than the preferred 500 m. This area is generally free of unfavourable geoscientific features and surface constraints.

3.3.3 Township of Huron-Kinloss

The Township of Huron-Kinloss contains several protected areas that comprise about 15% of the township. These include dispersed provincially significant wetlands in the southeastern third of the township, municipal water well head protection areas, municipal surface water intake protection zones, and built-up areas. The land west of Highway 21 was also excluded at it is preserved for future expansion. There are no national, provincial or municipal parks within the township.

There are no natural resource constraints for siting a deep geological repository in the township. There are eight known dry oil and gas exploration wells and no known oil and gas pools within the township.

The top of the Cobourg Formation within the township is at depths of about 683 to 809 m. Therefore, the Cobourg Formation is at depths greater than the preferred 500 m within the entire township. Protected areas and surface constraints discussed above represent a small area of the township.

4.0 SUMMARY OF INTERIM FINDINGS

The findings to date of the preliminary geoscientific assessment of the Municipalities of Arran-Elderslie, Brockton and South Bruce, the Township of Huron-Kinloss and the Town of Saugeen Shores support the following conclusions:

- The Municipality of Arran-Elderslie does not contain sufficient land areas that have the potential to meet the geoscientific site evaluation factors outlined in the site selection process document.

- The Town of Saugeen Shores has very limited potential to contain areas that would meet the geoscientific site evaluation factors outlined in the site selection process document.

The Municipality of Brockton, the Municipality of South Bruce and the Township of Huron-Kinloss appear to contain large areas that have the potential to meet the geoscientific site evaluation factors outlined in the site selection process document (NWMO, 2010). As mentioned earlier, the geoscientific preliminary assessment is still ongoing. More detailed descriptions of the methodology and results will be provided in a final Phase 1 report, once the assessment is completed.

5.0 REFERENCES

Intera Engineering Ltd., 2011. Descriptive Geosphere Site Model, Report NWMO DGR-TR-2011-24 R000, prepared for the Nuclear Waste Management Organization, March, Toronto, Canada, (available at www.nwmo.ca).

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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).