MEMORANDUM

Draft Work Plan

Date: April 20, 2012
To: Chris Prucha; Waste Management
From: David Harding (WESA Inc.) and Bernie Kueper (B. Kueper and Associates, Ltd.)
Project No.: KB9657-00 (WESA)
Re: Proposed Scope of Work for Hydrogeologic Investigation
WM Beechwood Road Environmental Centre
Town of Greater Napanee, Ontario

The purpose of this document is to provide details of the investigation that will be completed to support the development of a hydrogeologic conceptual model in the area of the proposed landfill for the Beechwood Road Environmental Centre (BREC). The following sections of the memorandum provide an overview of the proposed scope of work for this investigation.

Objective of Hydrogeologic Investigation

The principal objective of the BREC Hydrogeologic Investigation is to provide additional characterization of overburden geology, bedrock geology, groundwater flow and groundwater quality in areas north and northeast of the Waste Management (WM) Richmond Landfill, in order to prepare an overall site conceptual model that integrates the conceptual model of the existing site with the additional site-specific data from the areas to the north and northeast.

New monitoring wells will be installed in both overburden and bedrock in areas where data gaps have been identified where a proposed landfill footprint may be located, north and northeast of the existing landfill. Target intervals for screening the bedrock monitoring wells will be identified based on the hydraulic properties of the bedrock.

Proposed Scope of Work

The proposed scope of the Hydrogeologic Investigation to study the site-specific conditions at the proposed WM BREC facility is provided below. The proposed locations of boreholes to be drilled as part of this investigation are shown on the accompanying figure in relation to existing monitoring wells north of Marysville Creek and the existing landfill site.

Task 1: Drilling and Logging Boreholes

New boreholes will be drilled using two techniques. The first technique will use diamond coring with an HQ-size triple tube core barrel to prevent excessive mechanical breaking of core. Fracture frequency (FF), fracture orientation relative to the core axis, weathering, fracture infilling, lithology, and rock quality designation (RQD) will be recorded on the borehole logs, and the rock core will be photographed using a digital camera with depth intervals noted on the photographs. The second technique will use air-rotary drilling with a water well drill rig. This technique does not provide a core sample; however, observations of rock lithology will be recorded as the borehole is advanced. Approximately 25% of the boreholes will be cored, and the other 75% will be drilled with air-rotary techniques.

The boreholes will be drilled to a depth of approximately 30 metres (m) below the bedrock surface, which coincides with the thickness of the intermediate bedrock groundwater flow zone defined in the

existing landfill Site Conceptual Model Report. The separation distance between proposed borehole locations will be approximately 200 m across the investigation area. Note that these boreholes will not be instrumented as monitoring wells until after completion of the packer testing and aquifer interference testing; a determination as to which boreholes are instrumented would be made at that time.

Shallow boreholes will be drilled adjacent to 50% of the intermediate bedrock holes using air-rotary techniques. The shallow boreholes will target the shallow groundwater flow zone, which extends to a depth of approximately 2 m below the bedrock surface. The boreholes will be instrumented with 50 mm diameter PVC standpipe piezometers.

Downhole geophysical logging will be completed in all of the intermediate bedrock boreholes (cored and air-rotary drilled). The geophysical logging will be continuous through the bedrock profile and will include the following parameters: acoustic televiewer (ATV), optical televiewer (OTV), three-arm caliper, natural gamma, fluid temperature and resistivity.

A total of four rock core samples will be selected from the most representative portions of the geologic profile and submitted to PTS Laboratories in Santa Fe, California for measurement of matrix porosity using mercury injection porosimetry.

Task 2: Hydraulic Testing

The hydraulic testing program will use similar investigative techniques to those that have been used successfully at the site to characterize the three-dimensional groundwater flow regime. The results of these investigations culminated in the completion of the Site Conceptual Model Report (B. Kueper and Associates Ltd. and WESA Inc., October 2009).

Hydraulic testing of the intermediate bedrock boreholes will be conducted to observe the hydraulic characteristics of the bedrock throughout the vertical profile, and to determine the location(s) of permeable intervals. The tests will be conducted using an inflatable straddle packer system, with a packer test interval of approximately 3 m. Water will be injected into the test section, and the rate of decline of the water pressure will be measured (i.e., falling-head tests) using a pressure transducer. This will provide a bulk rock hydraulic conductivity of the test interval. In the cored boreholes, the exact positioning of the straddle packer assembly will be informed by the downhole geophysical logging results and boring log observations.

The shallow monitoring wells will be hydraulically tested using slug test procedures, where a slug of known volume is introduced to the well and the rate of decline of the water level is measured using a pressure transducer. This will provide an estimate of the bulk rock hydraulic conductivity of the aquifer formation at the location of the monitoring well.

Pump testing will be completed in the intermediate bedrock holes to observe hydraulic connections across the site. The number of tests will be determined by ensuring that there is overlap in the responsive wells in adjacent pump tests. Results of these tests may warrant the drilling of additional boreholes and additional hydraulic testing to further define connections. These tests will consist of aquifer interference testing similar to that completed for the Site Conceptual Model development, which was a step-discharge pumping test followed by a constant-discharge pumping test of duration long enough to observe drawdown effects in adjacent observation wells. Water level monitoring will be completed in up to 25 observation wells for each test. Pneumatic straddle packers will be installed in the intermediate bedrock observation wells to isolate discrete monitoring zones in the bedrock. The

locations of the isolated zones will be selected on the basis of the packer testing results, which will provide hydraulic conductivity profiles in the boreholes.

Field measurements of pH, temperature and conductivity will be collected from the pumping boreholes during the aquifer interference testing as a preliminary indicator of general groundwater quality.

Task 3: Monitoring Well Installation and Groundwater Sampling

The results of the hydraulic testing program will be used to determine the specific boreholes and the intervals in the boreholes that will be instrumented as monitoring wells. The boreholes will be instrumented in the intermediate bedrock flow zone with single-screen 50 mm diameter PVC standpipe piezometers.

The groundwater levels will be measured in the new monitoring wells as part of a regularly-scheduled site-wide monitoring event in order to obtain representative groundwater elevations across the entire Waste Management property.

Once the monitoring wells have been installed in the cored bedrock boreholes, a preliminary round of geochemical sampling/testing will be conducted from the shallow and intermediate bedrock monitoring wells. The analytical test suite will include the Inorganic and General Parameters and VOCs specified in the EMP for the existing landfill. These lists include all parameters specified in the Comprehensive Groundwater List in Schedule 5 of O. Reg. 232/98.

Task 4: Reporting

On completion of the work described above, a technical report will be prepared summarizing the observations and results of the hydrogeologic investigation. Information gathered from previous investigations in the area north and northeast of the existing landfill, including geophysical surveys, test pitting and trenching excavations, borehole drilling and groundwater geochemical analyses, will be included in the report. The report is to provide an interpretation of the site-specific characteristics of fracture occurrence, the groundwater flow regime, and geochemistry of the groundwater.

The Hydrogeologic Investigation Report outlined above will serve as an appendix to the Geology and Hydrogeology Existing Conditions Report. It will provide site-specific technical data that will be integrated with existing information to prepare an overall site conceptual model.

Other information to be included in the Existing Conditions Report is outlined below and in the Approved Terms of Reference (TOR) for the BREC Environmental Assessment (WM, February 2012). Much of the regional geologic and hydrogeologic information was compiled for the Site Conceptual Model Report, completed in October 2009. This information will be reviewed and updated where applicable:

- Compile and interpret information from defined background sources;
- Compile and review published geologic and hydrogeologic maps and reports, water well data, regional groundwater and wellhead protection studies, regional and local topographic and drainage mapping, previous subsurface investigation findings, properties and interpretation;
- Compile and review current conceptual geologic and hydrogeologic model of the existing landfill site. On the basis of the current model and the results obtained from the Hydrogeologic Investigation described above, prepare a conceptual model of the geologic and hydrogeologic conditions in the area of proposed new landfill development envelopes.

COUNTY ROAD 111

JOHNSONSIDE ROAD

M45-1
M45-2
M45-3

M62-1
M62-2
M62-3
M62-4

M69-1
M69-2
M69-3
M69-4

M90-1
M90-2

M61-1
M61-2
M61-3
M61-4

M93

M92

M60-1
M60-2
M60-3
M60-4

M59-1
M59-2
M59-3
M59-4

M94-1
M94-2

S2
S3
S4
S5
S6
S7
S8
S9

Marysville Creek

BEECHWOOD ROAD

DESERONTO ROAD
(COUNTY ROAD 10)

DRAFT

Notes:

1. Site plan shows the locations of existing monitoring wells north of Marysville Creek.

2. Proposed Borehole locations are approximate; final locations may vary depending on site accessibility.

WASTE MANAGEMENT OF CANADA
Beechwood Road
Environmental Centre - BREC
Figure 1:
Site Plan and Proposed Borehole Locations (200m Spacing)

LEGEND

- M52-2 Active / M52-2 Abandoned Shallow Monitoring Well
- M52-2 Active / M52-2 Abandoned Intermediate Monitoring Well
- M52-2 Active / M52-2 Abandoned Deep Monitoring Well
- Surface Water Monitoring Location
- Proposed New Borehole
- Approximate boundary of lands owned/optioned by Waste Management

Project : K-B9657-00-00
Data Source: WM Canada, WESA, HPA Ltd. Base Mapping(2009)
Date: March 2012

0 20 40 80 120 160
Meters

Prepared by:
WESA Geomatics

WESA
A Better Environment For Business

Units: Metres
UTM NAD 83 Zone 18

Scale: 1:4500

WASTE MANAGEMENT