

February 18th, 2010
Project Number W-B8202-00

Mr. Jeremy Vink
Senior Planner
Township of Woolwich
24 Church Street West
PO Box 158
Elmira, ON N3B 2Z6

**Re: Hunder Development Ltd.
Hydrogeological Assessment Report
Technical Review**

Dear Mr. Vink:

WESA Inc. (WESA) was retained by the Township of Woolwich to conduct a technical review of the hydrogeological aspects of the Hunder Developments Ltd. Hunsberger Pit application. The application is for an aggregate operation within an 88.3 ha property in the Township of Woolwich. An annual production rate of 500,000 tonnes, all above the water table, is being requested. In completing this review, WESA has reviewed the following documents:

- Hunder Development Ltd. – Hunsberger Pit Planning Summary Report, IBI Group, April 3, 2009.
- Hydrogeological Assessment Report, Proposed Hunsberger Pit. AMEC Geomatrix Limited prepared for IBI Group, February, 2009.
- Site Plans – 4 sheets (Existing Conditions, Operational Plan, Rehabilitation Plan and Cross Sections) prepared by IBI Group dated March, 2009.
- Vulnerability Scoring of Wellhead Protection Areas, Regional Municipality of Waterloo. Stantec Consulting Ltd, prepared for the Regional Municipality of Waterloo, November, 2009.
- Regional Municipality of Waterloo draft Guidelines for Hydrogeological Studies for Mineral Aggregate Resource Extraction Projects (i.e. the Guidelines).
- Regional Municipality of Waterloo Official Policies Plan.
- Township of Woolwich OPA 13.
- Letter of Objection from Conestogo-Winterbourne Residents Association dated May 20, 2009.

The AMEC Geomatrix report concludes that there will be, on average, no impacts to the groundwater flow to the southwest woodlot/wetland, groundwater will not be impacted by site operations other than normal seasonal variations, private wells will not be subject to interference during aggregate operations and that geochemical monitoring will ensure that groundwater contamination is prevented.

The review of this information is summarized in the comments provided below.

Water Level Data

- The majority of the groundwater monitors have not been monitored for two years. It is WESA's opinion that two years of data, covering all seasons, is required to determine seasonal fluctuations.
- One of the water levels for MP5 is lower than the bottom of the well.
- Most of the water levels for MW3, MP3 and MP5 are reported as dry. This means that the water level in those monitors was lower than the bottom of the well. The lowest water levels were not used in calculating the average water level. The average water level, therefore, would be lower for those monitors than what is presented in the report.
- Ten of the twelve monitoring wells are screened over both the sand/gravel unit and the clay till unit. The water levels therefore represent an average water level for the two units. There could potentially be significant differences in water levels between the two units and more seasonal fluctuation within the sand/gravel than in the till.
- The groundwater data presented in the report has been supplemented with other "as deemed appropriate" data from historic exploratory boreholes and test pits that were excavated on/around the property. This other data has not been presented and it is not known if it is appropriate. Using data from different time periods is not appropriate.
- If the woodlot/wetland southwest of the site is not related to groundwater flow, will surface water flow to the wetland be maintained? How will this be monitored?
- Based on these issues, the reliability of the groundwater contour map in Figure 3 is a concern.
- The amount and quality of the water level data collected to date, including a lack of seasonal data, does not appear to be adequate to determine the depth of excavation so that it will remain the required 1.5 metres above the water table.

- The report concludes that groundwater flow to the woodlot/wetland northwest of the site will be maintained. Presumably this means that the wetland functions and seeps will also be maintained. Will there be any effect on surface water flow in this area?

Groundwater Model

- The concerns expressed with respect to the water level data also raise a concern for the groundwater model. Incorrect water level data raises concerns on the reliability of the model.
- The model results are not well presented. For example the initial potentiometric surface figure (Slide 4 of Appendix C) is not legible and therefore could not be compared to the observed heads (Figure 3 of the report). Due to this the model results reported could not be confirmed.
- The source of the hydraulic conductivity (K) values is not provided. Are these values field measured or published values? If field measured were they measured in the on-site monitoring wells that are screened across multiple units? If so then they would not provide a representative K value for each unit defined in the model.
- What values of recharge were used in the model and how were they obtained? The source of the data is provided but the details and values are not. For example was the data a monthly average for one specific year or was it an average for a month over many years? This could have a large impact on the variation of recharge over time in the model.
- What is the source of the precipitation data used in the model and does the model take into account evapotranspiration?
- What were the boundary conditions used in the model?
- Was the hydraulic conductivity and recharge values varied spatially over the study area? For example was a different recharge value assigned for the wetland areas versus the open field versus treed areas? What evidence is there to conclude that the hydraulic conductivity of layer 1 is uniform across the study area? This could also have a significant impact on groundwater levels and surface water runoff properties within the model.
- No details were provided with respect to the sensitivity of the model to input parameters including hydraulic conductivity, recharge, and specific storage. Was a sensitivity analysis completed? What were the results?

- The report states “base case simulation results indicate that there is no significant surface water runoff within the proposed excavated area”. What evidence is this statement based on? No supporting information (figure, values etc.) are provided in the report to support this claim. Was a sensitivity analysis completed on this to confirm that this is always the case? If the hydraulic conductivity and recharge were not varied spatially across layer 1 of the model then this statement may not be able to be uniformly made across the site.
- The report states the observation wells were simulated in the numerical model to evaluate the potential impacts to groundwater beneath the sensitive features. Were the sensitive features identified in the model (drains, higher recharge areas for discharging ponds or lower recharge for wetlands)? If not then the nature of the sensitive features was not taken into account and therefore the full impacts of the proposed on-site activities on the sensitive features cannot be assessed. Water level data for MP4 indicates that at times the pond may be recharged by groundwater and other times it may exfiltrate from the pond. Was this considered in the model?
- MP5 was drilled to determine potential impacts to the woodlot/wetland southeast of the site. Since the report indicates that MP5 was not likely installed within the wetland, how can any conclusions that there will be no impacts to the wetland be determined?
- Were the seasonal variations in groundwater levels obtained as a result of the modeling compared to the field data collected? Since there is not two years of data, this may be hard to do but would help verify the validity of the model.
- The results of the model cannot be confirmed. Given the scale and clarity of Slides 8-10, it is difficult to compare the simulated base case versus proposed excavation results
- The report notes that “groundwater flow changes were reported for ...areas, and are attributed to seasonal variable changes in groundwater flow”. As noted above the groundwater flow is greatly affected by recharge, hydraulic conductivity and surface features (wetlands, ponds etc). The validity of the model is depended on the issues raised in the preceding points and the model results may therefore not be representative or predictive of site conditions.

Private Wells

The report provides a database of 61 private wells (two properties indicated they were on a municipal supply) although there is only information on 14 of these wells. The distance criterion for choosing these wells is not known but the Region’s Guidelines requires a door-to-door survey for wells within 1 km of a proposed aggregate extraction operation.

Figure 10 from the AMEC Geomatrix report indicates wells from the MOE database but there has been no correlation between the database in the report and the MOE database (i.e. the street address has not been correlated to the MOE database – 31 wells are shown in Figure 10).

The report indicates that there are two shallow wells (<8.5 m) but the location of these wells is not shown on any figure. Since only 23% (14 of 61) of the wells have known well depths, it is not known if there are more shallow depth wells. A door-to door survey would provide this type of additional data.

Aquifer Vulnerability

The Stantec report identifies that portions of the proposed extraction area are within Well Head Protection Area D (WHPA D) for the Region's municipal wells C5 and C6. The proposed extraction area also currently has a low vulnerability score using the Intrinsic Susceptibility Index (ISI) method. However, the Region has taken the position that for any licensed aggregate extraction above the water table, the ISI will be increased to high since the extraction process will removed the overburden soils to within 1.5 m of the groundwater table. A high ISI for those portions of the proposed extraction area within the WHPA D will represent a long term concern for the municipal supply wells. This concern would also be applicable to private wells in the vicinity of the site especially shallow wells that are completed in the same aquifer unit as the sand and gravel unit identified at the site.

The removal of the overburden material – both the upper silt and the sand/gravel unit – will allow potential water quality threats from agricultural operations (principally nitrates) to infiltrate more readily into the shallow overburden aquifer. This may impact the potential for denitrification. The AMEC Geomatrix report concludes that water quality at the site is good but reports that nitrate concentrations up to 103 mg/L have been detected and that seven of the nine monitoring wells sampled were above the drinking water limit and Site Condition Standard (Table 2) of 10 mg/L. More sampling, including private wells and all monitoring locations on the site, is required to delineate the extent of nitrate impacts. Would the source of the nitrates at MW1 (103 mg/L) continue during and after extraction operations? The progressive rehabilitation to agricultural operations may have to consider mitigative measures to reduce nitrate loading to the groundwater and surface water.

Although the upper silt/topsoil will be used successively to infill the previously excavated phase, it is not known if the hydraulic properties of the upper unit will be maintained. The soil will be reworked and ripped to allow for infiltration but the protective nature of the extracted material will be lost. As stated in the paragraph above, this creates a potential water quality concern for the shallow dug wells off site, the municipal aquifer and the private drilled wells.

The Region has expressed concerns on whether the silt aquitard beneath the sand and gravel unit at the proposed extraction site is continuous. A continuous aquitard would provide greater protection not only for the municipal wells but also private wells completed in the same aquifer.

The Region comments that additional investigation is required to determine the continuity of the aquitard. WESA is in agreement with this evaluation.

Monitoring Program

- No off site geochemical sampling program has been conducted to date. This data must be collected in order to establish background conditions. At least one year (two sets) of data is required prior to extraction.
- A minimum of two sets of samples (early spring and later summer) for water quality analysis should be collected on an annual basis as stipulated in the Region's aggregate guidelines. Only annual sampling is proposed. The list of wells to be monitored should be confirmed by the proponent. It is assumed that the same analytical parameter list will be used in the sampling but this should be confirmed with the modifications noted below.
- Field monitoring of temperature should be included in the monitoring program.
- Any potential impacts from refueling operations will be more readily apparent by monitoring for BTEX (benzene, toluene, ethylbenzene, xylenes) than the Petroleum Hydrocarbon (PHC) fractions F1-F4 that has been conducted to date.
- In order to maintain wetland functions, the seeps that have been identified to date should be monitored. There appears to be limited monitoring to date and therefore more background monitoring, prior to any excavation on the site, should be completed to determine seasonal fluctuations. Inspection of the seeps should be included as part of the proposed monitoring program.
- The report suggests that sufficient background water level data has been collected. We do not agree with this statement, however, if the proponent feels that the data is sufficient then trigger levels in the monitoring wells should be established. These trigger levels would indicate that water levels are lower than anticipated and that contingency measures are required. The trigger levels would have to take seasonal fluctuations into account. Contingency measures could range from increased monitoring to halting of operations depending on the magnitude of the drop in water levels.
- The Township of Woolwich should be copied on all environmental monitoring reports since presently the proponent proposes to only include the MNR and the Region.
- The IBI planning report indicates that clean inert fill material will be tested at the source before being imported for backfill and that the testing results would be provided to the MNR if requested. The Region and the Township should be provided a copy of all testing that is conducted.

Since refueling activities are proposed for the site, the detailed design of the operation should be provided to the Township for review.

Respectfully submitted,

WESA Inc.



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