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April 26, 2011

Mr. Craig Laing
Aggregate Resources Officer
Midhurst District MNR
2284 Nursery Road
Midhurst, Ontario
L0L 1X0

Dear Mr. Laing:

Re: **The Highland Companies Proposed Melancthon Quarry Application**

The Grand River Conservation Authority has received notice of a complete application by the Ministry of Natural Resources and a set of reports in support of a proposed quarry in Melancthon Township by the Highland Companies.

Given the volume of the material provided, we have not been able to undertake a comprehensive review to provide comments, but due to the timelines provided are offering preliminary comments, trusting that any further comments would be considered. We request additional time to complete and coordinate a review. Coordination of commenting timelines with the municipal approvals process may be appropriate for this application.

The Membership of the GRCA has provided a formal request for extension of the commenting time frame under separate cover. The notification is also provided below:

Please be advised that the members of the Grand River Conservation Authority at their General Meeting held April 14, 2011 passed Motion No. CW49-11 as follows:

> "WHEREAS the Township of Melancthon passed a Motion on March 24, 2011 requesting that the Minister of Natural Resources authorize a 120 day extension of the date for final comments with respect to The Highland Companies application under the *Aggregate Resources Act* for a Class A, Category 2 Licence for a dolostone quarry on 2,316 acres located in the Township of Melancthon;
>
> THEREFORE BE IT RESOLVED that the Grand River Conservation Authority supports the Township of Melancthon's request for the extension;
>
> AND THAT a copy of this Motion be circulated to the Minister of Natural Resources, the Premier of Ontario, all Grand River watershed municipalities and Members of Provincial Parliament and Conservation Ontario".

We do not agree with some of the information in the plans and reports relating to the jurisdictional boundary between the Conservation Authorities. The reports suggest that 2 hectares of the proposed licenced area is within the Grand River Conservation Authority. Our information suggests the licence limit is coincident with, or outside, our watershed boundary, as shown on the

attached sheet. The area in question is characterized as an internally drained depression area that does not directly drain to either watershed. As such, we believe the application is within the jurisdictional area of the Nottawasaga Valley Conservation Authority. However we have an interest in reviewing and commenting on the proposal as it has a potential to impact ground water resources within our watershed. Clarification on the jurisdictional boundary should be done in the near term by advising the applicant, and requesting additional clarification on the rational for these statements.

Conceptually, we have difficulty with the premise of perpetual pumping to maintain required mitigation measures for the proposed operation. As such, an analysis of the operation without pumping/recharging should be considered. The reports predict less than 1 m of drawdown within 100 m, but that is with the groundwater management system active. The reports have not presented the base case (unmitigated) scenario, which would likely have significant impacts extending some kilometres from the quarry. As impacts could extend upgradient without mitigation, impacts to groundwater could extend into the Grand River watershed. We are not able to determine what potential impacts could arise without this analysis. We are attaching preliminary technical comments from our technical review of the hydrogeological report for your consideration. As noted above, these are preliminary in nature due to the limited review time allotted.

The Study Area identified in the reports has been expanded from the Aggregate Resources Act minimum of 120 metres adjacent to the Proposed Licence Area to 500 metres surrounding the Proposed Licenced Area. While recognizing, and appreciating that the report has gone beyond the minimum requirement, the potential for impacts appears to be predicated on the mitigation measures functioning as intended and does not provide analysis for potential impacts that may arise from failure of the mitigation measures proposed. The area of potential influence to ground water from the proposal, with and without mitigation measures functioning, should be considered before scoping the study area boundary.

We have not undertaken review of the potential impacts to natural features in the vicinity of the proposed licenced area as there is insufficient information provided in the hydrogeological analysis to allow for consideration of potential impacts. We would anticipate undertaking a review, and providing comments once the hydrogeological model, including existing, during excavation, mitigated and unmitigated states are available.

We recommend that this application not be approved at this time, and that the commenting period be extended to allow sufficient time to resolve the technical questions outlined above and in the attached technical memorandum attached.

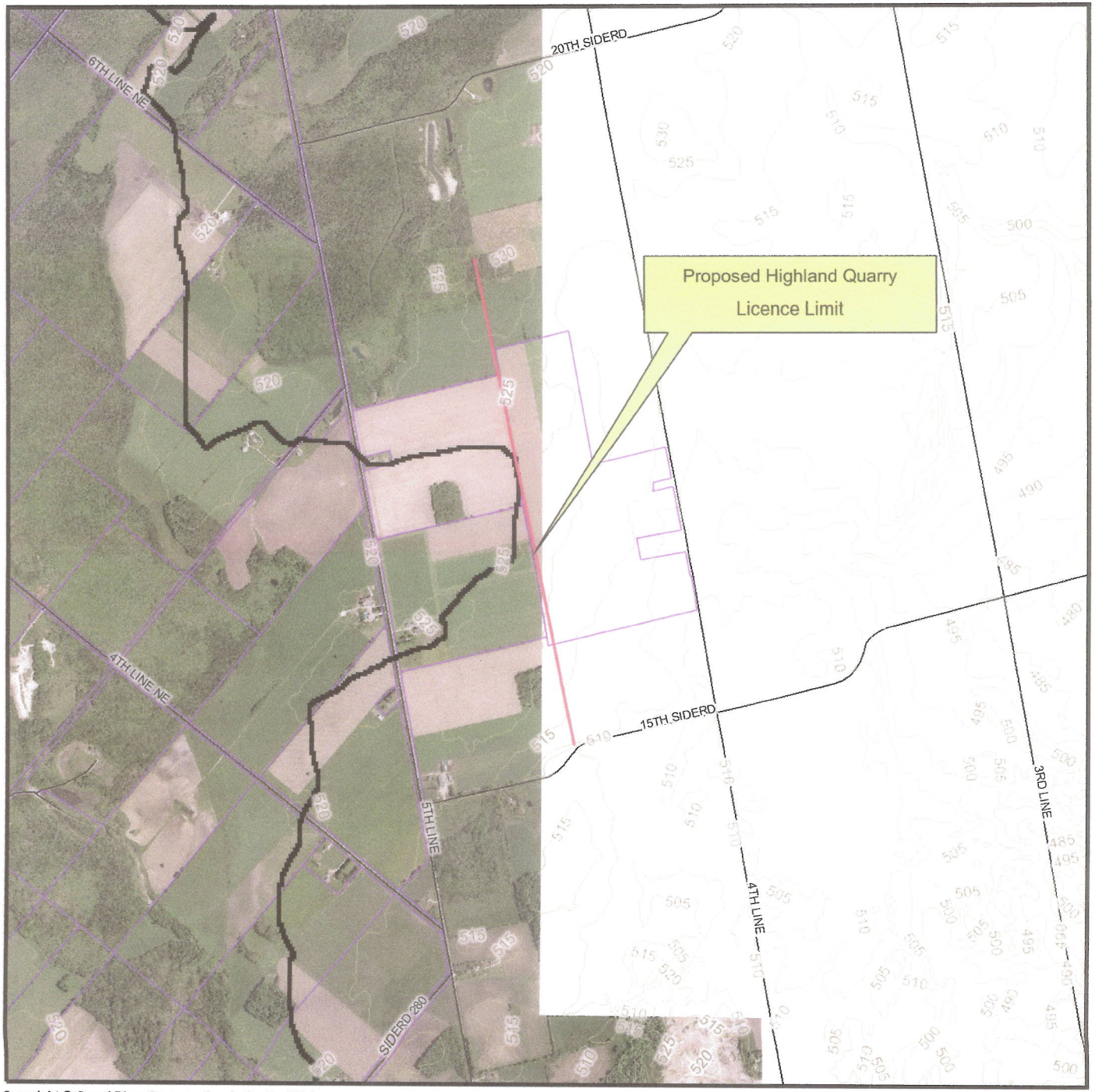
We trust these comments will be helpful. If you wish to discuss them further, or require clarification on the points provided, please contact me.

Yours truly

Fred Natolochny
Supervisor of Resource Planning
Resources Planning

Encl.

cc. Nottawasaga Valley Conservation Authority
Township of Melancthon
The Highland Companies




**Grand River Conservation Authority**
Map created: April 7, 2011

LEGEND

- WATERSHED BOUNDARY (GRCA)
- UTILITY LINE (NRVIS)
- ROADS-ADDRESSED (MNR)
- RAILWAY (NRVIS)
- MUNICIPAL BOUNDARY (GRCA)
- PARCELS-PIN (Teranet)
- CONTOUR 5m (NRVIS)
- PARKS (GRCA)
- BUILT-UP (MNR)
- BUILT-UP PERVIOUS
- BUILT-UP IMPERVIOUS

**GRCA Disclaimer**

This map is for illustrative purposes only. Information contained hereon is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.

The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to:

*http://grims.grandriver.ca/docs/SourcesCitations1.htm*

0 300 600 900 1200 m.

NAD 1983, UTM Zone 17 Scale 1:25,529

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THIS MAP IS NOT TO BE USED FOR NAVIGATION

GRAND RIVER CONSERVATION AUTHORITY

# MEMORANDUM

**TO:** **Fred Natolochny** **DATE:** April 19, 2011
**FROM:** **Gregg Zwiers**
**CC:**
**RE:** **GRCA Hydrogeological Comments**
**Proposed Melancthon Quarry Application,**
**Hydrogeologic and Hydrologic Assessment,**
**Volumes 1 through 4**

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The Grand River Conservation Authority (GRCA) reviewed the report *Proposed Melancthon Quarry Application, Hydrogeologic and Hydrologic Assessment, Volumes 1 through 4* (January, 2011), prepared by GENIVAR Inc. Although the proposed quarry lies within the Nottawasaga Valley Watershed, a small portion of the identified area of interest appears to extend into the Grand River watershed and hydrogeologic impacts related to the proposed quarry are likely to extend into the Grand River watershed. The legislated 45 day timeline available for review was not sufficient to thoroughly examine the substantive and detailed documentation provided as part of this application. Nonetheless, our preliminary comments on the hydrogeologic work conducted in support of this application are provided below.

1. We note that there do not appear to be any monitoring wells or flow gauges related to the project within the Grand River watershed. This means that baseline conditions cannot be established for areas within the Grand River watershed and, consequently, there is no way of assessing whether impact is occurring to any wetlands, surface water courses, or groundwater resources within the Grand River watershed. Note that there are a number of wetlands within the Grand River watershed immediately upgradient (to the northwest) of the quarry in an area where impacts could occur in the absence of mitigation. It is critical that baseline conditions in upgradient areas, including within the Grand River watershed, be established.
2. Will the impacts of the proposed quarry, in its unmitigated state, cause the groundwater flow divide to move further into the Grand River watershed?
3. We note that it may be appropriate for the proponent to make use of the stratigraphic nomenclature described by Brunton and proposed for use (Brunton, 2009 – as referenced in report). While not officially adopted, it has come into relative widespread use and provides a strong basis for interpretation of the carbonate bedrock in the study area.
4. The statement on page 18 (Volume 2) that groundwater movement in this case can be simulated as an equivalent porous medium is not supported by other comments within the report, including:
    a. page 12 (Volume 2) "fractures and joints are common",
    b. page 17 (Volume 2) presence of "visible dissolution features", sinking streams, and "springs and seeps within the Pine River",
    c. page 21 (Volume 2) bedrock below interface aquifer also "contains localized zones, beds, or fractures of moderate to high bulk hydraulic conductivity",
    d. statement on page 34 (Volume 2) that tracer moved some 70 m in a period of 2.2 hours (although not a natural gradient test) clearly indicates that preferential movement along a fracture was occurring,
    e. page 74 (Volume 2) "most groundwater movement occurs in this deeper dolostone through the secondary porosity features".
5. The statement on page 21 (Volume 2) that there were no continuous zones of high hydraulic conductivity that would be indicative of horizontal fractures is misleading. The boreholes drilled as part of this project are generally located a number of kilometers

apart. There is every likelihood that there are locally to regionally extensive horizontal fracture zones or sets (including solution-enhanced conduits) with higher hydraulic conductivity/transmissivity, but the drilling program was not designed to detect them. Consider that it appears that only 9 of the boreholes drilled within the study area (of approximately 72 $km^2$) were cored (or 1 cored borehole for every 8 $km^2$); clearly the drilling program would be unable to detect discrete horizontal fracture sets that could be extensive. While a hydraulic testing program in the absence of a cored borehole could be expected to detect discrete fracture sets and possibly comment on their connectivity, details on the packer testing program used in this case are not clear. Table A2 and Table B2 seem to contradict each other in terms of packer spacing or were there two series of packer tests in these boreholes?

6. The statement on page 22 (Volume 2) that groundwater movement through bedrock is typically slower than through a porous material (despite the following statement on secondary porosity) is completely misleading in this depositional environment. Groundwater movement through the carbonate bedrock in southern Ontario can be exceptionally fast (on the order of 10s or more metres/day) compared to movement through a porous medium (a few m to 10 or so metres/year), particularly if solution-enhanced features are present (100s or more metres/day). The groundwater moving through the bedrock within the setting of the proposed quarry would be expected to move very fast.
7. The discussion included on the Dundalk Municipal water supply is out of date.
8. Note that as part of this work in support of the proposed quarry, only water wells within 500 m have been inventoried. While this is consistent with (or in excess of) the requirements under the Aggregate Resources Act, the dewatering impacts of a quarry can easily extend for several kilometers, so it would be advisable to extend the inventory to a radius of 2 to 3 km.
9. The assumption on page 62 that agricultural water use is continuous and 100% consumptive is not credible. See the Water Budget for the Grand River Watershed for a thorough and carefully considered discussion on the actual agricultural use as compared to permitted volumes and the degree of consumption (although the definition used is slightly different). The assumption that industrial (aggregate) use is 0% consumptive is, similarly, not credible.
10. A base case has not been presented. It is essential that the impacts of the proposed quarry in the absence of mitigation efforts be presented. At present it is not possible to assess possible impacts to nearby wetlands, streams, springs, etc. in the absence of mitigation or in the case the proposed mitigation fails or is less than completely effective.
11. A number of important details on the proposed water management system are not provided in the report; we calculate the following based on the figures and statements in the text:
    a. the length of the recharge system (wells and force mains) will be approximately 27 km,
    b. the number of recharge wells required will be, at minimum, 535, with the potential to add more to address problem areas,
    c. there will be 16 sumps with high-lift pumps, plus about 38 km of basal trenching.
12. The planned rehabilitation use, as indicated on page 63, is intended to be agricultural. This means that the quarry must be dewatered at a rate possibly exceeding 600,000 $m^3$/day (600,000,000 litres/day) perpetually, which would seem challenging. With regard to the proposed water management system we provide the following comments:
    a. Who will be responsible for the system? "Authorities" are referenced on page 69, but it's unclear who this refers to. It would seem unreasonable to ask a public agency to assume responsibility for this exceptionally large and highly complex system, especially prior to its implementation (in our opinion the approach is unproven in this setting).
    b. The figure of 600,000 $m^3$/day is a steady state calculation. While the storativity in bedrock systems is generally low, there will be an initial rate that will be somewhat higher as groundwater is removed from storage. Has the dewatering

rate required during initial stages through complete quarry excavation been considered?

c. It is indicated on page 72 that there will be little upward movement of groundwater into the proposed quarry. While the permeability of the underlying rock is believed to be somewhat low, the dewatering will create an enormous upward gradient into the quarry. It seems unreasonable to discount this component of groundwater flow. While the numerical model may not have quantified any significant component of upward flow, it's important to keep in mind that the model would appear to extend to the top of the Cabot Head Formation (is this the case? It's quite difficult to reconcile the modelling report with the actual geology – Layer 5 appears to end at the top of the Cabot Head – a cross section of the model layers would be helpful), which means that the base of the quarry essentially occurs at or very near the base of the model. Aside from representing a poor boundary choice (likely interference in the area of interest by the boundary condition at the base of the model – i.e. no flow), the simulation is effectively pre-constrained from indicating that there is any upward flow here.

d. On page 73 it is indicated that a similar system is operating at the Milton Quarry and that the Milton Quarry is situated in the same setting as the proposed quarry. In attempting to confirm this in the short time frame available, we were only able to determine that a similar system is *proposed* for the Milton Quarry expansion and that, if such a system is currently operating there, it is doing so on a very small or pilot scale (our understanding is that there is a short length of recharge wells operating with the intent of protecting 16 Mile Creek). It would be helpful if this discussion could be expanded to thoroughly discuss the actual, current operation of the Milton system, how successful that system has been, any problems they may have encountered in its operation and how they have dealt with them, and any other items that may inform the review of this proposal. Although the application indicates that the hydrogeologic setting is the same, in our opinion, the hydrogeological setting is markedly different. Our understanding is that the Milton Quarry is located adjacent to the Niagara Escarpment, which would be the dominating influence on the local groundwater flow. While the actual rocks can be said to be similar, the hydrogeological setting is obviously completely different. In a general sense, we're not aware of any similar recharge systems in operation in a fractured rock environment; it would be most helpful if the proponent could provide additional examples.

e. The potential clogging of recharge wells is discussed on page 77, but the conclusions are not supported in the text. Bacterial growth and chemical precipitation will be minimized by limiting atmospheric exposure – how? Groundwater, potentially quite old and of significantly varying geochemistry over the depth of the quarry, will be mixed and transferred internally along the basal trenches to the sumps. It seems there will be a significant opportunity for interaction of this mixed groundwater with the atmosphere prior to being conveyed to the groundwater management system for recharge. Further, the mixing of groundwater alone can be sufficient to cause clogging problems due to chemical precipitation. The groundwater will also be mixed with rainwater and snow melt, further complicating the geochemical issues.

f. On page 77 it is indicated that the service life of the recharge wells will be suitable for continuous operation; what does this mean? Does this mean that the recharge wells are anticipated to last indefinitely, or to last indefinitely with maintenance, or that a replacement program will be in place?

g. On page 79 a potential hydraulic barrier is discussed if eventually required, but there are no details on what is actually being proposed (e.g. grout curtain?).

h. Has the increased hydraulic conductivity that will develop near the quarry face (due to blasting effects, stress release, freeze-thaw cycles, dissolution due to the addition of acidified (from atmospheric exposure) water, etc.) been accounted for in the design of the groundwater management system? The permeability on the

quarry side is likely to increase with time, causing an increase in the volumes of water requiring handling at the proposed quarry.

i. Has the impact of partial or complete failure of the various components of the groundwater management system been considered? Are there contingency plans or back up plans in place or proposed?
j. The monitoring program is only briefly discussed; presumably a detailed Adaptive Management Plan will be developed in concert with MNR, MOE, Conservation Authorities, and local municipalities?
k. How has the likely anisotropy or significant heterogeneity been accounted for? It's highly likely, particularly with 27 km of recharge wells, that there will be sections of the perimeter in which it is difficult or impossible to counteract the impacts of the quarry dewatering due to heterogeneity or where, despite high injection rates, dewatering impacts will be observed at locations beyond the recharge wells.
l. Will the proposed construction of the recharge wells (over both the interface aquifer and deeper into the dolostone below) provide sufficient recharge to the lower units to prevent dewatering within those zones? It's certainly possible that a successful implementation of the groundwater management system within the interface aquifer will not mitigate impacts within the units underlying it.
m. The uniform provision of water to the 27 km perimeter of the quarry and injection into 535 or more recharge wells will be enormously challenging and require considerable ongoing expertise.
n. The groundwater management system has only been evaluated in a conceptual sense through the use of a highly simplified (over simplified in our opinion) numerical model using the equivalent porous medium approach; actual implementation of the system is likely to be exceptionally complex, extremely costly, and challenging. At this stage, we consider this approach, in this setting, unproven. It would be helpful if the proponent could provide examples of groundwater management systems, similar in scale and size and in similar geologic and hydrogeologic settings.

13. It is difficult to understand the construction of the numerical model with the figures provided (a cross section or series of cross sections to provide an understanding of the layering would be helpful). As we understand it, the numerical model is constructed as an equivalent porous medium of 5 layers with layer 1 being overburden, layer 2 the interface aquifer, layer 3 the lower interface aquifer and transition zone below, layer 4 the dolostone below the transition zone (up to 100 m in thickness), layer 5 the dolostone with shale sitting on the Cabot Head Formation (is this correct?) (up to 3 m thick). On this basis, we make the following comments:
    a. The thickness of layer 4 would preclude any understanding of the vertical movement of groundwater or for representing vertical heterogeneities (aside from adjusting the $K_h$:$K_v$ ratio) in the volume of rock between the transition zone and the zone that is 3 m above the base of the model.
    b. As noted above, the base of the quarry appears to be at or very near the base of the model. If this is the case, the results will, obviously, be highly influenced by the boundary of the model.
    c. The southeast extent of the model domain is within a couple of hundred metres of the quarry face, although the figures seem to indicate that the Escarpment is a little further off; is this the case? If so, in our opinion this boundary of the model will unduly influence the results in this area of the model.
    d. On page 21 (Volume 3), there is a reference to WMC (2003) which is missing from the list of references.
    e. A base case has not been provided. A base case would have been produced as part of the modelling exercise and it is critical to include an assessment of the unmitigated impacts of the quarry dewatering in this document. There are a number of wetlands to the north and northwest of the proposed quarry and it's

important to understand the potential impacts on those in the absence of mitigation.

f. Figure H-19 provides the calibration statistics against the MOE water well records, which don't seem to represent a particularly well-calibrated model. Has calibration against streamflows or spring discharge locations been attempted?

Report prepared by Gregg Zwiers, M.Sc., P.Geo., Senior Hydrogeologist with the Grand River Conservation Authority.