HARDEN

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Our File: 9506

July 16, 2015

James Dick Construction Ltd.
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Bolton, Ontario L7E 5T4

Attention: Mr. Greg Sweetnam

Dear Mr. Sweetnam;

Re: Proposed Hidden Quarry
Peer Review on Behalf of the Concerned Residents Coalition
Hunter and Associates May 15 2015

We are pleased to respond to the issues raised by Hunter and Associates Peer Review dated May 15, 2015 regarding the proposed Hidden Quarry.

In summary Mr. Hunter does not use any hydrogeological terms including transmissivity, storativity, porosity or hydraulic conductivity. Mr. Hunter's analysis is mainly statistical, a comparison of one water level or chemical parameter to another or to a standard without any analysis or evaluation of what the measured value represents in either the local or regional hydrogeological context.

There are two areas where the site plans could be improved upon in recognition of Mr. Hunter's comments.

1) A range of water levels for the proposed quarry pond elevations could be shown instead of one value. We recommend showing a range of 347.6 m AMSL to 349.6 m AMSL to reflect seasonal water level changes.

2) A review of the quarry floor elevation relative to high groundwater level should be done to ensure that the working floor is not below the water table. There will be no dewatering, therefore, if the quarry floor is below the high water table, an elevation adjustment will need to be made. I have attached a figure of high groundwater elevations for Rob Stovel to consider.

The following responses address hydrogeological issues raised in the Hunter and Associates May 15 2015 Peer Review. Responses are organized by the same section numbering system.

1.0 SITE PLANS

1.4 Recommendations and Operational Pit Floor (Top of Bedrock)

Due to the sloping water table, the proposed quarry floor elevation of 349 m AMSL will be below the seasonal high water table in portions of Phases 1 and 3. I have attached a figure showing the high water table applicable for Phases 1 and 3 and the quarry floor should be raised to this elevation. The proposed quarry floor of 354 m AMSL in Phase 2 will allow the quarry to operate in dry conditions.

2.0 GROUNDWATER

2.1 Applicant's Mixed Season Bedrock Contour Water Levels (September 2012, Fig 3.17)

The use of November 2011 data for two of the private residential water wells was carefully considered by the project hydrogeologists and deemed to be useful in terms of being reasonably representative of bedrock groundwater elevations and fitting with the overall pattern of groundwater flow established from on-site dedicated groundwater monitors. We expect that the November data used for these two wells are approximately 1.5 metres lower than would have occurred in May of the same year when all other values on Figure 3.17 were obtained. When looking at Figure 3.17 then, the use of November data provides a conservatively high estimate of overall water level change occurring in the bedrock. In efforts to recreate this water level change within the groundwater model, the model will therefore over predict the potential impact of the quarry activity on upgradient wells.

The calibration of the regional groundwater model was achieved by including static water levels from bedrock wells including dedicated groundwater monitors on-site. The purpose being to obtain a reasonable representation of the groundwater flow system in the vicinity of the site. The convergence of groundwater flow along the Tributary B corridor is reasonable given the significant groundwater discharge at the Brydson Spring. Measured static water levels obtained from level-surveyed wells east of the site corroborate this pattern of groundwater flow.

- **Monitor M3**

The water level in monitor M3 has been measured for many years and has a relatively narrow range of seasonal water levels. However, the well has been tested on several occasions and found to respond to the addition and withdrawal of slugs of water, thereby confirming the functioning of the well screen.

The water level in W1 has been measured on three occasions and found to have a range of 0.62 m and found to maintain similar seasonal water level change relative other on-site monitors. A pumping test was performed on W1 and W1 was found to be functioning. The groundwater model is not intended to represent extreme conditions (wet or dry). The main purpose of the model is to provide an estimate of water level change occurring post extraction. With only small natural changes in aquifer transmissivity occurring between spring and fall ("wet and dry") seasons of approximately 4%, the model reasonably predicts potential water level change.

- **Tributary B Corridor Water Levels**

The water levels in the Tributary B corridor are adequately represented by M3, M11, M15 (I, II, III and IV) and sporadically by water levels obtained in W1.

- **Wet and Dry Bedrock Levels in Vicinity of TP8**

We concur that there are no bedrock water levels in the vicinity of TP8. This is a relatively small site and there are nine monitoring locations along the northern property boundary. These are M13S, M13D, TP1, M14S, M14D, M2, M3, SW4 and TP8. These monitors provide adequate background information for overburden and bedrock groundwater systems.

- **Wet Season Monitor M15**

The water levels in each of the monitors vary from season to season and higher water levels in the spring are a normal occurrence. The water levels in M2 were 0.64 meters higher in April 2014 than shown on Figure 3.17 and the water levels in M4 were 0.82 meters higher in April 2014 than shown on Figure 3.17. Therefore a higher water level in M15 compared to the interpolated potentiometric contours shown on Figure 3.17 is expected.

- **Distorted Data in Tributary B Corridor**

The model calibration was conducted on a regional scale and the addition of one or two more data points will not significantly improve the overall accuracy of the model. The model is a reasonable tool to understand the potential impacts of the mining on bedrock groundwater levels. Several variations of the model have been developed with each providing similar results. The nature of groundwater flow in the aquifer is understood adequately to allow for the development of the groundwater model. Multi-level groundwater monitor M15 was installed at the request of the Township of Guelph/Eramosa in the Tributary B corridor and the water levels obtained and aquifer characteristics estimated from in-situ testing proved that the model was using reasonable estimates of aquifer characteristics.

2.2 Groundwater Modelling

The model has been used as a tool to assist in the predictions of change to the water levels in the bedrock groundwater system. The understanding of groundwater flow in this area is based on;

- monitoring groundwater levels for seventeen years
- conducting pumping tests in the Gasport Aquifer in several places east of Rockwood

- observing drilling of bedrock wells
- obtaining streamflow measurements in Tributary A, Tributary B and Tributary C
- working as a professional hydrogeologist in Wellington County for twenty five years with knowledge of other groundwater models, monitoring the water level changes in other quarries and gravel pits, reviewing the monitoring results of other gravel pits and quarries.

Seasonal variation occurs in all of the on-site monitoring wells and when water levels at one well are elevated, they are elevated in all wells. Therefore, during a relatively wet year, all of the water levels in the area will be high and during a dry year, all of the water levels will be lower. The predicted final water levels in the east and west ponds are based on a reasonably calibrated groundwater model using regional groundwater data obtained at different times of the year. As such, the model likely represents average groundwater condition (not dry and not wet season conditions). The final pond levels will also fluctuate seasonally by the same amount as the existing groundwater does (approximately one and a half metres).

The groundwater model uses estimates of transmissivity and saturated thickness in order to calculate groundwater flux and re-calculate groundwater levels. The model is not sensitive to minor changes in transmissivity or saturated thickness, therefore minor seasonal changes will not influence the usefulness of the model to predict water level change.

2.2.2 Adversely Affected Groundwater Model

The groundwater model is a tool to understand groundwater flow in the bedrock aquifer on a regional scale and how the removal of the aquifer rock via quarrying will alter the groundwater flow pattern and level at a local scale. Water levels from 330 wells were used to calibrate the model to industry standards. The regional groundwater pattern is similar to that of other calibrated models and potentiometric maps of water levels obtained from water wells.

The underestimation of predicted water levels at specified locations north of the proposed quarry and overestimation of predicted water levels elsewhere does not translate into an underestimation of predicted drawdown. Drawdown is a function of transmissivity, saturated thickness and time. The transmissivity estimate used in the model has been proven to be a reasonable estimate through the testing conducted in M15 and is similar to other groundwater models prepared for this area. The reviewer is confusing an underestimation of modelled baseline conditions with an underestimation of predicted drawdown conditions.

2.3 Predicted Maximum Lake Water Levels (Post-Extraction)

The bedrock surface and groundwater levels in Phase 1 are higher than the 349 m AMSL quarry floor shown on the site plans. This means that the quarry will have to operate at least temporarily as high as at the 354 m AMSL water level. Noise predictions may need to be updated.

All groundwater and ecological assumptions for worst case scenario are based on the maximum potential impact and therefore are not affected by proposed elevation of pit floor. In order to remain dry during Phase 1, the pit floor will need to be raised to 354 m AMSL.

2.4 Drainage Ditch 'Tributary B'

The peer reviewer is of the opinion that historically, water seasonally retained in Tributary B would have been of benefit to the Brydson Spring. The quarry will provide a similar if not greater benefit through the storage of water in the future ponds.

2.5 Guelph Limestone Quarry not Valid as an Analogue for Hidden Quarry

No volumetric balance/mass balance was prepared for the Guelph Limestone Quarry as an analogue for the Hidden Quarry. The Guelph Limestone Quarry is used as a local example of subaqueous extraction and the potential impact on water quality that can occur from blasting. No analogy was made between the Guelph Limestone Quarry and the proposed Hidden quarry.

The source area for the Brydson Spring incorporates a much larger area than just the proposed Hidden Quarry, therefore, flow in the creek will be greater than that predicted to flow through the quarry.

3.0 DRY OPERATIONAL QUARRY FLOOR AND ACTUAL OPERATIONAL DRAWDOWNS

The assumption made by the reviewer that the quarry needs to operate at the elevation of the bedrock/overburden contact is incorrect.

3.1 Top of Bedrock

No dewatering is required for the operation of the quarry. The quarry does not need to operate at the overburden/bedrock contact. Drilling efforts including that for M3, M15 and M11 in the Tributary B corridor do not corroborate the peer reviewer's supposition that there is a depression in the bedrock surface beneath the Tributary B corridor.

3.2.1 Phase 1 Operations (Fig 3.1)

There will be no active dewatering of the quarry. The quarry floor in Phase 1 will remain above the high bedrock water level. The site plan will be revised.

The hydraulic barrier will be installed in the vicinity of TP2, thereby maintaining overburden water levels beneath the wetland and allowing overburden water levels to decline in the active quarry area.

Full drawdown of the quarry will occur passively over the lifetime of the quarry.

3.2.1.1 Dewatering (Phase 1)

There will be no dewatering of the quarry. Where necessary, the site plans will be revised to show the pit floor above the water table.

3.2.1.2 Wash Water and Silt Ponds

Silt ponds require the retention of water, not the exfiltration of water. Therefore, the ponds can be established in the water table or above. The purpose of the silt ponds is not to infiltrate water. Therefore, mounding of water is not an issue for the silt ponds. Excess water is returned to the source pond in order to maintain water levels and loss of water is not desired.

There will be no dewatering of the quarry and therefore, no loss of baseflow to Brydson Spring.

3.2.2 Phase 2 (Fig 3.2)

The peer reviewer has incorrectly assumed that the quarry must operate at the bedrock/overburden contact. Therefore, the assumed pit floor elevation of 351 m AMSL is incorrect.

Two sets of mini piezometers confirm that Tributary B is a losing stream to the east and to the west.

There will be no dewatering of Phase 2. The ultimate lake level depends entirely on existing groundwater levels. The predicted drawdown at the north end of Phase 2, is approximately 1.4 metres. This is less than on the west side because the quarry excavation has less length in the direction parallel with groundwater flow.

3.2.3 Phase 3 (Fig 3.3)

There will be no dewatering of the quarry. The pit floor will be adjusted to remain above the water table.

4.0 ADAPTIVE MANAGEMENT

4.1 Groundwater Monitor - Trigger Levels

A discussion on trigger levels should occur once additional groundwater monitors have been installed and seasonal data obtained. I have not reviewed Mr. Hunter's suggestions at this time.

4.2 Groundwater Quality

Baseline water quality samples will be obtained prior to quarry activities commencing. Details of water quality triggers can be developed after additional samples are obtained and prior to commencement of active quarrying. A detailed groundwater quality monitoring program has been presented to hydrogeologists representing the Ministry of the Environment and Climate Change and the Township of Guelph Eramosa. Through their comments a stringent protocol for water quality testing has been developed.

5.0 DOMESTIC WATER WELL INTERFERENCE

5.1.1 W5 (MOE 67-07545)

The peer reviewer is confusing predicted water level at baseline conditions with drawdown. There cannot be a four metre drawdown at Well W5 when there is a maximum predicted drawdown of 2.54 m in the quarry. Well W5 is a high producing well which according to the well record had about 1.5m of drawdown at a pumping rate of 1.1 L/s. Water was "found at" a depth of 18.8 m, significantly below the final water elevation in the quarry. The large volume of water stored in the quarry ultimately becomes a positive recharge boundary, thereby improving the overall productivity of the aquifer.

5.1.2 W7 (No MOE Well Record)

The owner has categorically refused entry to both Guelph/Eramosa Township (during pumping test of TW2) and Harden Environmental. The well house is unsafe. Inspection was not allowed in 1998 for the same reason. Nonetheless, James Dick Construction Ltd. is responsible for well replacement if the quarry interferes with the functioning of the well.

5.1.3 W31 (No MOE Well Record)

The water quality presented by Mr. Hunter clearly identifies that the well water quality is being compromised by nearby farming activities. In 2012 the water sample exceeded the Ontario Drinking Water Standard for nitrate and in 2014 the nitrate concentration is 96.3% of the drinking water standard. Nitrate is an indicator of anthropogenic contamination of well water, in this case, barnyard wastes. The resident has been aware of the elevated nitrate issue for some time and should be taking measures to reduce nitrate concentrations through treatment methods. The presence of nitrate in the well is an indication that there may be other undetected contamination in the well.

5.1.4 Domestic Well W24

There is opportunity to lower the pump in the well. James Dick Construction Ltd. will make this adjustment to the well if necessary or provide the residence with a new well if necessary.

5.2 Water Quality Impacts on Downgradient Domestic Wells

The potential mitigation for these wells include deepening or replacement as agreed to by James Dick Construction Ltd.

5.3 Drawdown Impacts on Allen Wetlands, Allen Springs, De Grandis Ponds and Brydson Springs

The minor differences in observed static water levels in M15-II and M15-III compared to M15-IV do not have any relationship to the distance to potential areas of recharge. Greater hydraulic potentials (than occur in any of the M15 multi-level piezometers) occur within the proposed Hidden Quarry site boundaries and can be the source of greater hydraulic potentials observed in M15.

5.3.1 Allen Wetlands

The elevation of the Allen Wetlands is higher than Tributary C (a losing stream), the proposed Hidden Quarry site and depressions immediately west of the wetland. There is no groundwater discharge to the Allen Wetland from these areas. The water levels in TP8 confirm that the water table on the site is at least four metres below that of the wetland. Any drawdown in the bedrock aquifer at the site cannot have an impact on support hydrology for the Allen Wetland. The greatest direct impact to the wetland comes from (a) water retained by the De Grandis ponds and (b) channelization of Tributary B through portions of the Allen Wetland. In the absence of the De Grandis ponds, the spring discharge water would flow from the De Grandis spring for a longer period of time. Provided with a complete application, the GRCA was prepared to issue a permit to Ms. De Grandis to deepen the ponds and thereby allow alteration of the surface water flow to the wetland (delay flow from the ponds in the fall). Although this would potentially have a direct impact to the hydro-period of the Allen wetland the GRCA has deemed this acceptable.

5.3.2 Allen Springs and Farm Pond

The Allen Spring is located immediately downgradient from a prominent topographical feature rising some twenty metres above the Allen Farm. The quaternary geology unit where the spring is found is identified as kame and esker deposits, a relatively permeable formation. The other prominent geological formation identified in this area is the Wentworth Till, a geological formation that is less permeable. The source area for the Allen Spring is north and east of the spring (away from the proposed quarry). Two measurements on the Allen property confirm that there are six to eight metres of overburden overlying bedrock beneath the Allen property. The bedrock well on the Allen Farm has a static water level approximately six metres below that of the Allen Spring confirming that flowing artesian conditions are not prevalent in the area. Therefore, it is not likely that the Allen Spring has a bedrock source. The emergence of groundwater to the ground surface signifies that the preferential flow path (the path of least resistance) is not to remain in the subsurface, suggesting that greater resistance to groundwater flow occurs in the subsurface. The resistance to groundwater flow cannot be affected by the quarry, therefore, groundwater originating from the north and northeast of the Allen Spring will continue to follow the same flow path.

5.3.3 De Grandis Farm Ponds (W31)

The water quality of Tributary B is more reflective of shallow groundwater than surface water and consistently contains elevated nitrate concentrations consistent with farming activities occurring on the De Grandis farm. The spring discharge observed by Ms. De Grandis also confirms that this is groundwater discharge. However, there are no chemical parameters suggestive that the water in Tributary B is of a bedrock origin and in fact, the elevated nitrate and low sulphate concentration suggest a shallow overburden source.

5.3.4 Brydson Springs

There will be no reduction in groundwater levels upgradient of the Brydson Spring, therefore there is no potential for loss of groundwater discharge to the Brydson Spring or associate creek flow.

6.0 PROPOSED MONITOR WELL LOCATION DEFICIENCIES AND NEW MONITOR WELLS RECOMMENDED

6.1 New Groundwater Monitoring Wells

Evaluation by hydrogeologists from the Ministry of the Environment and Climate Change, Halton Region, the Township of Guelph-Eramosa and the Grand River Conservation Authority resulted in the addition of four monitoring wells at the site. In addition, James Dick Construction has agreed to modify/replace monitoring well M3.

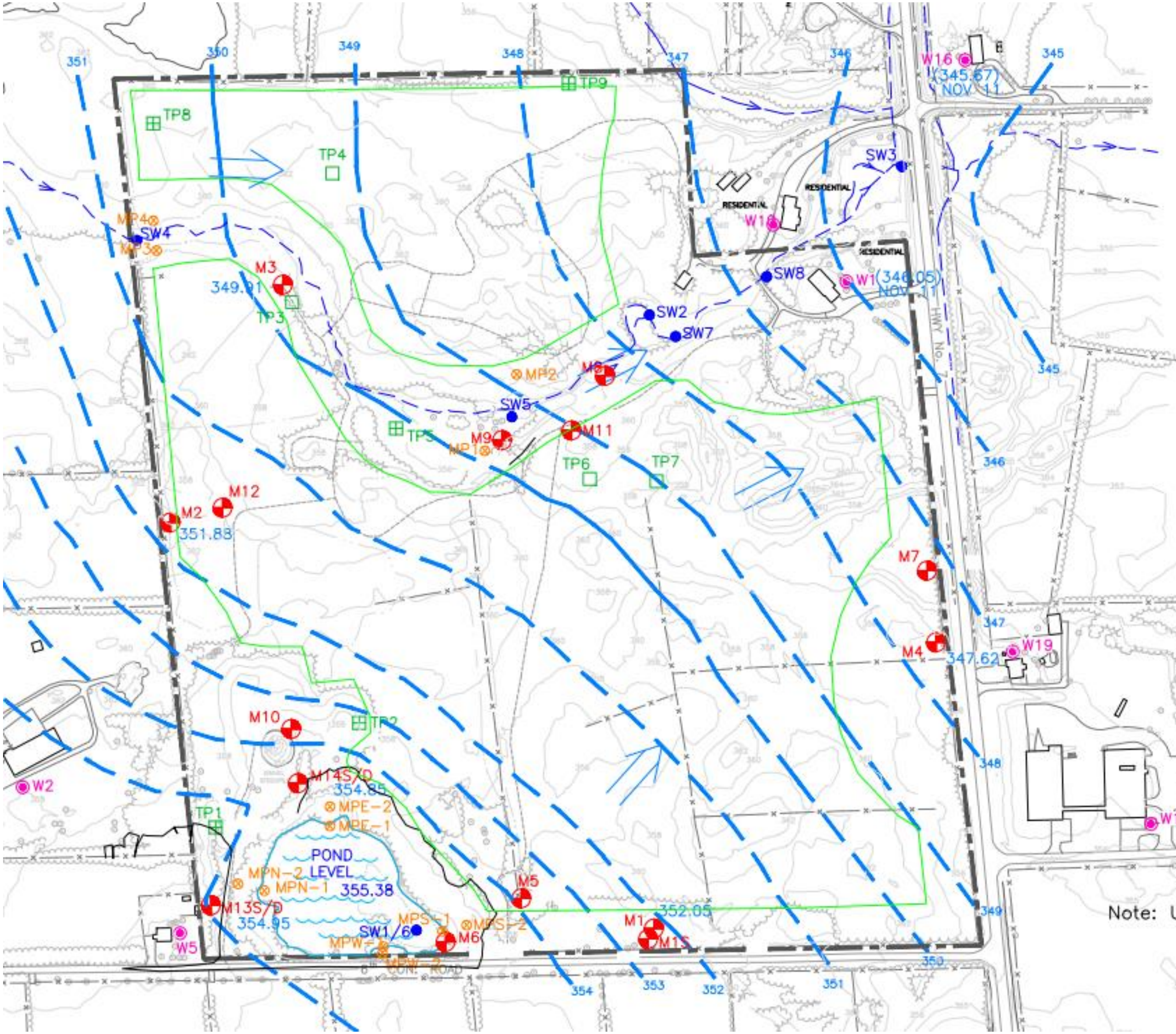
The purpose of the existing and additional monitoring wells is to provide verification of water level change during extraction and verification of the maintenance of water quality standards. Detailed contingency and mitigation plans will be invoked should water levels or water quality changes exceed threshold values.

In addition to the on-site monitoring network, James Dick Construction Limited has agreed to 1) off-site streamflow monitoring of Tributary A and B and 2) include select private wells where accessible and with owner permission.

Where needed, trigger levels will be developed for the monitoring wells and included on the site plans prior to commencement of quarry activities.

Sincerely,
Harden Environmental Services Ltd.

Stan Denhoed, M.Sc., P.Eng
Senior Hydrogeologist



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TP8
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CON. ROAD
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