



Harden Environmental Services Ltd.
4622 Nassagaweya-Puslinch Townline Road
R.R. 1, Moffat, Ontario, L0P 1J0
Phone: (519) 826-0099 Fax: (519) 826-9099

Groundwater Studies

Geochemistry

Phase I / II

Regional Flow Studies

Contaminant Investigations

OMB Hearings

Water Quality Sampling

Monitoring

Groundwater Protection
Studies

Groundwater Modelling

Groundwater Mapping

File: 1728

December 9, 2020

Township of Wilmot
60 Snyder's Road West
Baden, ON N3A 1A1

Attention: Mr. Andrew Martin, Manager of Planning

**Re: Zone Change Application 11/19 – Follow-Up Comments from
Hydrogeology and Source Water Protection Jackson Harvest Farms
Ltd. (Hallman Pit) 1894-1922 Witmer Road Township of Wilmot**

Dear Mr. Martin;

We are pleased to provide a response to the two comments requiring a response regarding our hydrogeological analysis of the Hallman Pit.

ROW Comment 1

Harden did not provide an assessment of the water balance at the beginning of operations. Regional staff required that this scenario be evaluated (i.e., where aggregate washing is occurring but there is minimal enhanced recharge due to a small open pit area) to assess potential impacts to nearby private well owners prior to approval of the zone change.

Harden Response

The wash plant will not be installed right at the beginning of the mining operation and may never be installed. An area of approximately 18 hectares in Phase 1 will be stripped of vegetation prior to the development of the wash pond and siltation ponds.

ROW Comment 2

The report did not include an evaluation of the potential radius of influence of pumping resulting from the wash pond, and whether this radius could extend to nearby private wells. The report rationalized

expected drawdowns based on historical monitoring at the existing Germet Pit; however, hydrogeological conditions may differ at the Germet Pit site and the proposed Jackson Harvest Farms property. Prior to zone change approval, the Region recommends that an additional assessment be undertaken to evaluate the radius of influence of pumping in the shallow aquifer, and that the proponent confirm whether this radius may extend to neighbouring private wells.

Harden Response 2

Our water well survey found that none of the local wells within 500 metres of the wash pond obtain water from the unconfined water table aquifer. The nearest private well is approximately 350 metres from the proposed wash pond. We provide the following analysis to confirm that the area of influence is significantly less than 350 metres.

The estimate of the area of influence of the wash pond and the estimated volume of groundwater recharge to the wash pond are related as shown by the Dupuit-Forchheimer discharge formula (Bear, 1979);

$$Q = k (H^2 - h^2) / 0.733 \text{ Log } (R/R_e)$$

Where

Q – groundwater inflow into the wash pond (m³/s)

k – hydraulic conductivity (m/s)

H – initial thickness of saturated soils above impermeable datum (m)

h – dewatered thickness of saturated soils above impermeable datum (m)

R – estimated radius of influence (m)

R_e – equivalent radius of excavation

Estimate of Radius of Influence from Edge of Excavation

The radius of influence is estimated using the Siechartd empirical formula of
 $R_x = 3000 h \sqrt{k}$.

Equivalent Radius of Excavation

Groundwater Flow into the wash pond using Equation (1) is radial and since the washpond is rectangular, an equivalent circle of the same area of excavation is required. This is determined using;

$$R_e = \sqrt{L \times W / \pi}$$

For the purpose of the estimate, we assumed that horizontal flow prevails.

Radius of Influence from Center of Wash Pond

The radius of influence(R) used in Equation 1 is the sum of R_x and R_e .

Base of Aquifer

The geological data for Well 6504927 shows that the saturated sand near the south end of the proposed pit has a thickness of 10 metres.

In summary, the assumptions used for the Dupuit equation are as follows;

Initial saturated thickness of aquifer (H) = 10 m

Saturated thickness of aquifer during pumping (h) = 9 m

Length of Excavation (L) 120 m

Width of Excavation(W) 50 m

Hydraulic Conductivity (k) = 8×10^{-5} m/s

Initial saturated thickness above datum = 10 m

Final saturated thickness above datum = 9 m

Estimated area of influence from edge of wash pond = 27 metres

The hydraulic conductivity is variable at the site. The following table provides an estimate of the area of influence for a range of hydraulic conductivity. It is found that under site conditions the area of influence is expected to be 27 metres from the edge of the wash pond. However, the sensitivity analysis shows that the maximum extent of the area of influence from the edge of wash pond could be as much as 67 metres. This does not extend beyond the property boundary.

The equivalent well analysis provided also shows that for a drawdown of one metre, there is more than sufficient inflow of water to replace the 300 m³/day estimated consumption of water.

k (m/s)	Area of Influence (m)	Volume of Inflow (m3/day)
5.00E-04	67	2772
1.00E-04	30	986
8.00E-05	27	861
5.00E-05	21	651
1.00E-05	9.5	263

In addition, all of the requested changes to the site plan notes will be made. These include;

High Water Table Delineation

The site plan note will include a statement regarding maintaining a 1.5 m separation from the high water table.

Fuel Storage and Asphalt Recycling

The site plan notes will include siting the fuel storage on concrete surface and low-permeability liner beneath any asphalt storage should it occur. The notes will state that over and above the 1.5 metre separation from the water table, the asphalt recycling will be underlain by a one metre thickness of clay or silt and runoff will be captured in the recycling area. Should recycling occur, a groundwater monitor designated M12 will be installed and water quality therefrom tested on a regular basis.

Groundwater Monitoring Program

We have revised the monitoring program to include BTEX/PHC's

Parameter	Location	Frequency
Water Levels	SG1, MW1, MW2, MW3, MW7S, MW8, MW11	Once daily at 6 pm with data logger
Water Quality (general chemistry, anions, ICP metals, nutrients, PAH, TPH), BTEX, PHC's	MW12	Annually

A trigger level and contingency plan will be developed and added to the ARA site plan notes.

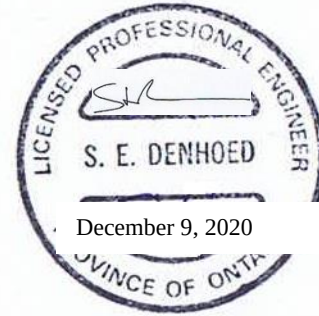
An additional year of monitoring will occur before any on-site activity to provide for an adequate water level base prior to the zone change approval.

Respectfully submitted,

Harden Environmental Services Ltd.

A handwritten signature in black ink, appearing to read 'S. Denhoed', with a long horizontal line extending to the right.

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



Project: **Hallman Pit**
 Location: Wilmot Township
 Date: 08-Dec-20
 Project #: 1728

ESTIMATE OF DEWATERING REQUIREMENTS SEASONAL HIGH WATER TABLE

PARAMETERS	Units	
Initial Water Level	353	metres above datum
Lowest Water Level during Dewatering	352	metres above datum
Aquifer Bottom Elevation	343	metres above datum
Initial Head above datum (H)	10	metres
Dewatering head above datum (h)	9	metres
Hydraulic Conductivity (k)	8.00E-05	m/s
	6.912	m/day
Length of Site (L)	120	metres
Width of Site (W)	50	metres
Equivalent Radius r_e (Equation 1)	43.7	metres
Estimated Radius of Influence from Edge of Wash Pond (R_x) (Equation 2)	26.83	metres
Radius of Influence from Center of Wash Pond (R)	70.55	metres
Estimated Volume of Inflow to Wash Pond (Equation 3)	861.95	m ³ /day
	598.58	L/min
	131.84	Imp. Gall/min

Equation 1 $Re = \sqrt{L \times W / \pi}$

Equation 2 $R_x = 3000 h \sqrt{k}$

Equation 3 $Q = \frac{k(H^2 - h^2)}{.733 \text{ Log } (R/r_e)}$

