Stantec

APPENDIX B

DEWATERING CALCULATIONS

APPENDIX B.1 - PROJECTED DEWATERING RATES IN AQUIFER (SAND)

Dupuit Forcheimer Equation - Well or Point Source Excavation

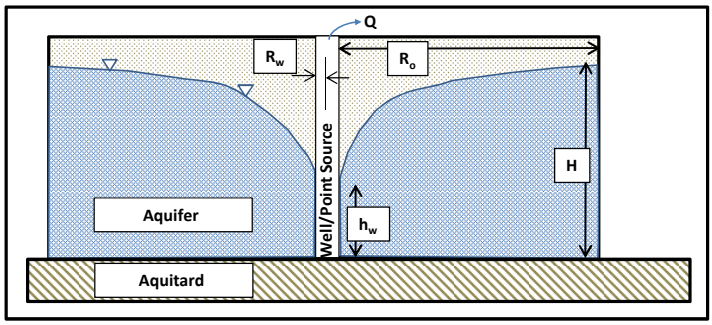
Dupuit Forcheimer Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer:

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{ln\frac{R_o}{r_w}}$$

Where:

Q = pumping rate in m3/s
K = hydraulic conductivity in m/s
H = hydraulic head of the original water table (m)
h_w = hydraulic head at maximum dewatering (m)
R_o = radius of influence of Well or Point Source (m)
r_w = equivalent radius of the well (m)

Conceptual Drawdown



The term r_w is calculated as follows:

$$r_w = \sqrt{\frac{ab}{\pi}}$$

Where:

a = length of excavation area (m)
b = width of excavation area (m)

The equivalent radius of influence (R_o) is approximated using the Sichart and Kryieleis method:

$$R_o = 3000(H - h_w)\sqrt{K}$$

Calculations: LVM BH211

K =	1.00E-04	m/s	Q=	0.000887626 m^3/s
H =	1.9	m		77 m^3/day
h_w =	1	m		**76,691 L/day**
R_o (set value) =	27.0	m	Note: Model designed for use in coarse soils; R_o requires manipulation when calculation used for fine-grained materials	
R_o (model) =	27.0	m		
r_w =	10.7	m		
a =	19.0	m		
b =	19.0	m		

Base of Aquifer	243	m AMSL	Anticipated dewatering elevation minus 1 m
Static Water Level	244.9	m AMSL	
Elevation requiring dewatering	244	m AMSL	

Equations obtained from Powers, J.P., A.B. Corwin, P.C. Schmall, and W.E. Kaeck, 2007. Construction Dewatering and Groundwater Control, New Methods and Applications. John Wiley & Sons, Inc., 3rd Edition.

Source: Waterloo Hydrogeologic, Inc. (WHI). Six Conservation Authorities FEFLOW Groundwater Model – Conceptual Model Report. December 2004.

Hydraulic Conductivity
Upper Unconfined Aquifer (HU-I) - Aquifer 1
Literature values: $6x10^{-3}$ to $1x10^{-7}$
Studies (Middlesex-Elgin, Oxford): $1x10^{-4}$ to $6x10^{-4}$

Assumption: Depth of excavation is 3.0 m BGS
Calculated Dewatering Rate (based on 19 m x 19 m excavation)

Calculated Dewatering Volumes

Location	GS Elev.	Unit (m BGS)		Unit (m AMSL)		Static Water Level		Parameters (m AMSL)				Q (L/day) Middlesex-Elgin Values		
	(m AMSL)	Top	Bottom	Top	Bottom	(m BGS)	(m AMSL)	Base	SWL	Dewater	R_o	K = $1x10^{-4}$ m/s	R_o	K = $6x10^{-4}$ m/s
LVM BH211	247.0	0.4	13.7	246.6	233.3	2.1	244.9	243.0	244.9	244.0	27.0	76,691	66.1	233,598
LVM BH212	225.0	2.4	5.6	222.6	219.4	1.6	223.4	221.0	223.4	222.0	42.0	94,612	102.9	342,791
LVM BH213	225.0	0.2	2.2	224.8	222.8	1.7	223.3	221.0	223.3	222.0	39.0	90,163	95.5	319,411
LVM BH220	242.0	0.3	3.1	241.7	238.9	1.8	240.2	238.0	240.2	239.0	36.0	86,038	88.2	296,766
											AVERAGE =	**86,876**		**298,142**
											MAXIMUM =	**94,612**		**342,791**

APPENDIX B.2 - PROJECTED DEWATERING RATES IN AQUITARD (SILT AND CLAY)

Dupuit Forcheimer Equation - Well or Point Source Excavation

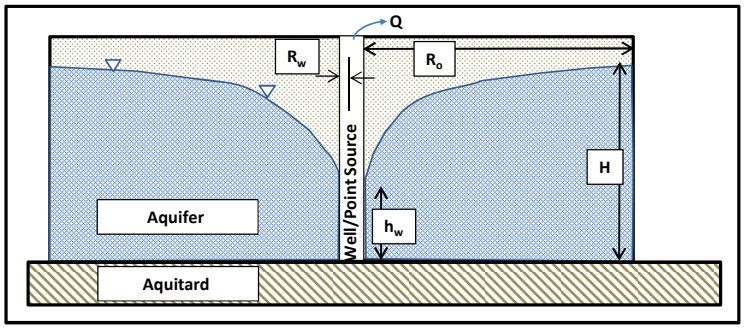
Dupuit Forcheimer Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer:

$$Q = \frac{\pi K\left(H^2 - {h_w}^2\right)}{ln\frac{R_o}{r_w}}$$

Where:

Q = pumping rate in m3/s
K = hydraulic conductivity in m/s
H = hydraulic head of the original water table (m)
h_w = hydraulic head at maximum dewatering (m)
R_o = radius of influence of Well or Point Source (m)
r_w = equivalent radius of the well (m)

Conceptual Drawdown



The term r_w is calculated as follows:

$$r_w = \sqrt{\frac{ab}{\pi}}$$

Where:

a = length of excavation area (m)
b = width of excavation area (m)

The equivalent radius of influence (R_o) is approximated using the Sichart and Kryieleis method:

$$R_o = 3000(H - h_w)\sqrt{K}$$

Calculations: LVM BH203

K =	1.00E-06	m/s	Q=	5.07756E-05 m^3/s
H =	2.7	m		4 m^3/day
h_w =	1	m		**4,387 L/day**
R_o (set value) =	15.82	m	Note: Model designed for use in coarse soils; R_o requires manipulation when calculation used for fine-grained materials	
R_o (model) =	5.10	m		
r_w =	10.7	m		
a =	19.00	m		
b =	19.00	m		

Base of Aquifer	242.0	m AMSL	Anticipated dewatering elevation minus 1 m
Static Water Level	244.7	m AMSL	
Elevation requiring dewatering	243.0	m AMSL	

Equations obtained from Powers, J.P., A.B. Corwin, P.C. Schmall, and W.E. Kaeck, 2007. Construction Dewatering and Groundwater Control, New Methods and Applications. John Wiley & Sons, Inc., 3rd Edition.

Source: Waterloo Hydrogeologic, Inc. (WHI). Six Conservation Authorities FEFLOW Groundwater Model – Conceptual Model Report. December 2004.

Hydraulic Conductivity
Aquitard 1 (HU-II & HU-IV)
Literature values: $1x10^{-6}$ to $1x10^{-11}$
Studies (Middlesex-Elgin, Oxford): $1x10^{-6}$ to $6x10^{-8}$

Assumption: Depth of excavation is 3.0 m BGS
Calculated Dewatering Rate (based on 19 m x 19 m excavation)

Calculated Dewatering Volumes

Location	GS Elev. (m AMSL)	Unit (m BGS) Top	Unit (m BGS) Bottom	Unit (m AMSL) Top	Unit (m AMSL) Bottom	Static Water Level (m BGS)	Static Water Level (m AMSL)	Parameters (m AMSL) Base	SWL	Dewater	Q (L/day) Middlesex-Elgin Values R_o	Q (L/day) Middlesex-Elgin Values K = $1x10^{-6}$ m/s	Q (L/day) Middlesex-Elgin Values R_o	Q (L/day) Middlesex-Elgin Values K = $6x10^{-8}$ m/s
LVM BH203	246.0	0.3	28.6	245.7	217.4	1.3	244.7	242.0	244.7	243.0	15.8	4,387	12.0	929
LVM BH240	238.0	0.3	24.1	237.7	213.9	2.1	235.9	234.0	235.9	235.0	13.4	3,154	11.4	710
LVM BH241	254.0	0.3	13.7	253.7	240.3	1.8	252.2	250.0	252.2	251.0	14.3	3,600	11.6	791
LVM BH244	253.0	0.3	13.7	252.7	239.3	2.6	250.4	249.0	250.4	250.0	11.9	2,456	11.0	578
LVM BH251	239.0	0.3		238.7	206.5	1.3	237.7	235.0	237.7	236.0	15.8	4,387	12.0	929
Well 3006345	224.7	0.3	24.4	224.4	200.3	2.1	222.6	220.7	222.6	221.7	13.4	3,154	11.4	710
											AVERAGE =	**3,523**		**775**
											MAXIMUM =	**4,387**		**929**