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June 8, 2017

Att: Mr. Colin Jackson

Poplar Woods Ltd.
611 Wonderland Road North, Suite 101
London, Ontario
N6H 5N7

RE: Wastewater Impact Assessment for Phases II Poplar Woods Development

1. Introduction

The subject property is identified as part of Lots 5 and 6, Concession 8 (Lobo) in the Municipality of Middlesex Centre. A key plan and concept lot layout is depicted on the accompanying drawing 1 in Appendix A.

Poplar Woods Ltd. retained BOS Engineering & Environmental Services Inc., (BOS) to conduct an assessment of the potential impacts of sewage systems serving ten (10) proposed lots planned in Phase II of Poplar Woods Development. The portion of the property to be developed is approximately 3.63ha in size including a new road connecting the dead-end of Bowling Green Drive to Ilderton Road. A preliminary plan was provided by MHBC Planning on Nov 24, 2016. The plan does not yet reflect existing topography and anticipated grading and drainage of the property is yet to be determined. Proposed lot sizes vary in size from 0.246 ha to 0.489 ha. Approximately 0.55ha is designated as road allowance leaving the total lot area at 3.08ha. The development abuts a wetland near its southern boundary. The wetland and appropriate setbacks have been addressed by others.

The lots are to be serviced with on site wastewater treatment systems and private on-site wells.

2. Shallow Soils

Shallow soils were examined in 2015 in the context of initial development concepts. A report entitled “Proposed Sewage System Envelopes for Poplar Hill Lot Divisions Phase 2 and Phase 3- BOS Engineering June19, 2015” was prepared. That report confirmed that soils under the lots were suitable for in-ground filter beds that meet Ontario Building Code requirements with adequate minimum setbacks for onsite wells. However, the study recommended hydrogeological assessment to verify confinement and quality of the supply aquifer and to provide background groundwater quality data for the shallow groundwater regime. Such assessment was subsequently carried out by JFM Environmental Limited.

The soils and currently proposed concept plan for Phase II only are presented on the attached sketch entitled “Poplar Woods Phase II – Soil Tests and Septic System Sizing and Concept Layout – Oct 2016”. The sketch accompanies this report as Appendix B.

3. Hydrogeology

Groundwater quality was tested during a February 9 2016 hydrogeological study by JFM Environmental. *(Draft Hydrogeological Assessment Poplar Woods Development Phase 2 – JFM Environmental Limited)* The average Nitrate plus Nitrite concentration was documented as 0.804 mg/L in the area of Phase II.

A critical part of the hydrogeological assessment and a subsequent draft *(Hydrogeological Assessment –April 15, 2017 JFM Environmental Limited)* confirmed that the domestic supply aquifer is hydrogeologically separated from the shallow aquifer.

- The shallow aquifer consists of sand and gravel having a maximum depth ranging from 4.57m to 7.01m below ground surface.

- Below that aquifer is a confining layer of clay to silty clay ranging from 19.8 to 21.0 meters below ground surface.

- Below the confining layer is the deep aquifer comprised of black fine-textured sand ranging to a depth of 24.7 to 27.7m below ground surface.

- Below the deep aquifer is a lower confining layer of grey silty clay to silt.

3. Application of Procedure D5-4

MOECC recommends Procedure D5-4 for assessment of multi-lot developments. Conservation Authorities such as the St. Clair Region Conservation Authority, similarly recommend that procedure in assessment of subdivisions.

Due to potential wetland impacts at this site, the SCRCA typically recommends that currently documented groundwater nitrate concentrations be conservatively used as the concentration of the infiltrated precipitation used to dilute the sewage effluent. Phase II single home lots are proposed to be approximately 0.245ha to 0.489ha in size. Procedure D5-4 was applied in a spreadsheet format as outlined in a table in Appendix A.

Phase II lot sizes result in nitrate concentrations that are compliant with Ontario Drinking Water Guidelines only by using enhanced treatment technology based on the documented background nitrate concentration of groundwater in this area as the rainfall dilution concentration. The options for Phase II are:

1. Increase the minimum lot size to at least 0.52 ha or
2. Employ 50% nitrate reduction measures.

The proponent desires to maintain the currently proposed lot sizes as outlined on Drawing 1 in Appendix A. Nitrate reduction of 50% at the source results in concentrations of less than 10 mg/L at the subdivision boundary. There is a precedent in Phase I of allowing use of tertiary treatment for lot sizing.

The subdivision agreement should therefore specify that all proposed sewage systems in the Phase 2 development shall include Level IV treatment as defined by the Ontario Building Code (OBC), including effluent recirculation for denitrification. When employing Level IV treatment systems, monitoring and reporting of basic parameters (SS and BOD) is an OBC requirement but nitrogen parameters should be added to the list of monitored parameters in this development.

Domestic wells should of course be advanced to the deeper confined aquifer that is hydrogeologically separated from the overburden.

Sincerely,
BOS Engineering & Environmental Services Inc.

Art W. Bos P. Eng.

Encls/ Appendices A & B

APPENDIX A - SEWAGE IMPACT ASSESSMENT – PHASE II

MOE Procedure D5-4 outlines a predictive method to gauge the effects of the combined effluent discharges from all of the individual sewage systems in a development based on nitrogen as an indicator of groundwater impact potential. Phase II lots are proposed to be approximately 0.245 ha to 0.489 ha in size, as identified on Drawing1 of this Appendix.

A1. CONTAMINANT ATTENUATION PREDICTIVE ASSESSMENT FACTORS

There is an existing wetland near the proposed southern development boundary. Attenuation will be assessed based on Procedure D5-4 using background nitrate plus nitrite concentrations of 0.804 mg/L in the area of phases II. This concentration was the average documented by the draft Hydrogeological report completed by JFM Environmental.

A1.1 Nitrates and Maximum Acceptable Concentration

Residential sewage systems for treatment of domestic waste generally produce nutrients and bacteria in their effluent waters for treatment and uptake by natural decomposition processes in soil and vegetation. Bacteria and phosphorus are adequately removed where soils exist that reasonably treat the effluent such as those at this site. However, nitrate is the most transportable potential contaminant that remains in solution after effluent treatment by conventional systems and can be transmitted to groundwater and laterally to off-site properties. Nitrate is considered the critical parameter for analysis of domestic sewage system impacts on groundwater, particularly in sandy soils. In the Ontario Drinking Water Objectives, the maximum acceptable concentration of nitrates in groundwater is set at 10 mg/L as N. This parameter has been found in conventional septic tank effluent at concentrations of 40 mg/L, in studies conducted by MOE.

It is to be shown that sufficient dilution of this effluent takes place to ensure that the average effluent concentration is below the Drinking Water Quality Objective of 10 mg/L for downstream ecosystems and wells. Precipitation and infiltration through the soil to groundwater normally provide dilution and provide the basis for the following impact calculations.

A1.2 Estimated Effluent Flow per Lot

The average daily design sewage load per residence is 1000 L/day, based on Procedure D-5-4. This average flow rate is considered a realistic and conservative average daily flow rate and not a peak design flow used to design the sewage system, (which can periodically be 2 to 3 times this amount). In contrast, the average daily design flow standard for sewage treatment plants in the City of London is only 750 L/day for low density residential developments.
In a given year an annual load estimate of the total effluent volume from a single residence is:

(1 x 1000 L/day) x 365 days/year = 365,000 L/year

A1.3 Precipitation Recharge Estimation

The recharge capacity of the property is based on topography, soils and vegetative cover on the site. The amounts of infiltration and runoff are directly dependent on the total precipitation in conjunction with these factors.

A1.4 Surplus Water Estimation

The mean annual precipitation for London Airport is 990 mm. Evaporation/evapotransporation for this area was estimated to be 570mm/yr based on stormwater balance calculations conducted in the region.

The surplus water that is available for runoff or infiltration is:

990mm/yr - 570mm/yr = 0.42 m/yr

A1.5 MOE Infiltration Factors

Surplus water may either infiltrate the ground to recharge groundwater or it may leave the site as surface water. MOE has compiled a set of factors to quantify the percentage of surplus water that will infiltrate to the subsurface. These factors are presented in the following table:

Area Characteristic	Infiltration Factor "I"
TOPOGRAPHY	
Flat	0.30
Rolling	0.20
Hilly land	0.10
SOIL	
Tight Impervious Clay	0.10
Medium (combinations of clay and loam)	0.20
Open Sandy Loam	0.40
VEGETATIVE COVER	
Cultivated Lands	0.10
Woodland or grassland	0.20

Source: Hydrologic Cycle Component Values, Stormwater Management Planning & Design Manual MOE, 2003

The soil overburden is described as medium and the area is generally grassed. The average slope of the tableland can be considered rolling. Therefore, the percentage of surplus water that is estimated to infiltrate is the sum of the factors for each of the categories in the above table:
I = 0.20 + 0.40 + 0.20 = 0.80

Based on the above chart, 80% of the surplus water is expected to infiltrate. Since the Conservation Authority generally assumes that infiltration is not this high, we have conservatively

reduced the infiltration percentage on these sandy soils to only 55% to conform to SCRCA policies.

A1.6 Volume of Water Available for Dilution

The amount of water available for dilution may then be calculated by multiplying the estimated depth of annual surplus water by the area of the property and then by the percentage that is estimated to infiltrate (Infiltration Factor):

0.42 m/year x Lot Area m^2 x 0.55 (m^3/yr)

= 231 x Lot Area (L/year)

A2. IMPACT CALCULATION

The native sandy soils on the site are classified under the unified classification system as "SP – Poorly Graded Sand" with little or no fines. The estimated hydraulic conductivity of the sand on which the filter beds will be based is 10^{-1} to 10^{-3} m/s.

Following is a mass balance calculation of the nitrogen load at the property boundary based on various lot sizes in each phase and various treatment efficiencies.

The nitrate concentration at the property boundary can be expressed by the following relationship:

$$C_o = [Q_E (N_E) + D_W (N_B)]/[D_W + Q_E]$$

Where: C_o = Nitrate Concentration at the property boundary (mg/L);
N_E = Nitrate Concentration of the sewage effluent (from the tank) (mg/L);
Q_E = Yearly volume of effluent produced (L/year);
D_W = Dilution Water available (L/yr);
N_B = Background Nitrate Concentration, (mg/L)
(measured average concentration in groundwater – not that of precipitation)

The values for the variables are:
N_E = **40 mg/L** (conventional) (Also considered 50% tertiary treatment to **20 mg/L**)
Q_E = 365,000 L/year (from section 1.2);
DW = 231 x Lot Area L/year (from section 1.6);
N_B = 0.804 mg/L

See following tables for calculations of varying lot sizes and treatment efficiencies in Phase II.

Phase II D5-4 Nitrate Calculations - Varying Treatment Efficiencies and Lot Sizes

Revised - May 5, 2017

PHASE II - WITH NO PRETREATMENT

	Lot Size (m^2)	Mean Annual Precip. (mm/yr) [1]	Evapo. (mm/yr) [2]	Infiltration (%) [3]	Dilution Volume (L/yr)	Background NO_3+NO_2 (mg/L)	Septage Conc. (mg/L)	Reduction Effic. (%)	Treated Conc. (mg/L)	No. of Houses (#)	Sewage Volume (L/yr)	Concentration at Lot Boundary (mg/L)	OWQG (mg/L)
Smallest Lot	2450	990	570	55	565950	0.804	40	0	40	1	365000	**16.17**	**10**
Ten Lots	30820	990	570	55	7119420	0.804	40	0	40	10	3650000	**14.09**	**10**
Largest Lot	4890	990	570	55	1129590	0.804	40	0	40	1	365000	**10.38**	**10**

PHASE II - MIN REQUIRED LOT SIZE TO AVOID PRETREATMENT

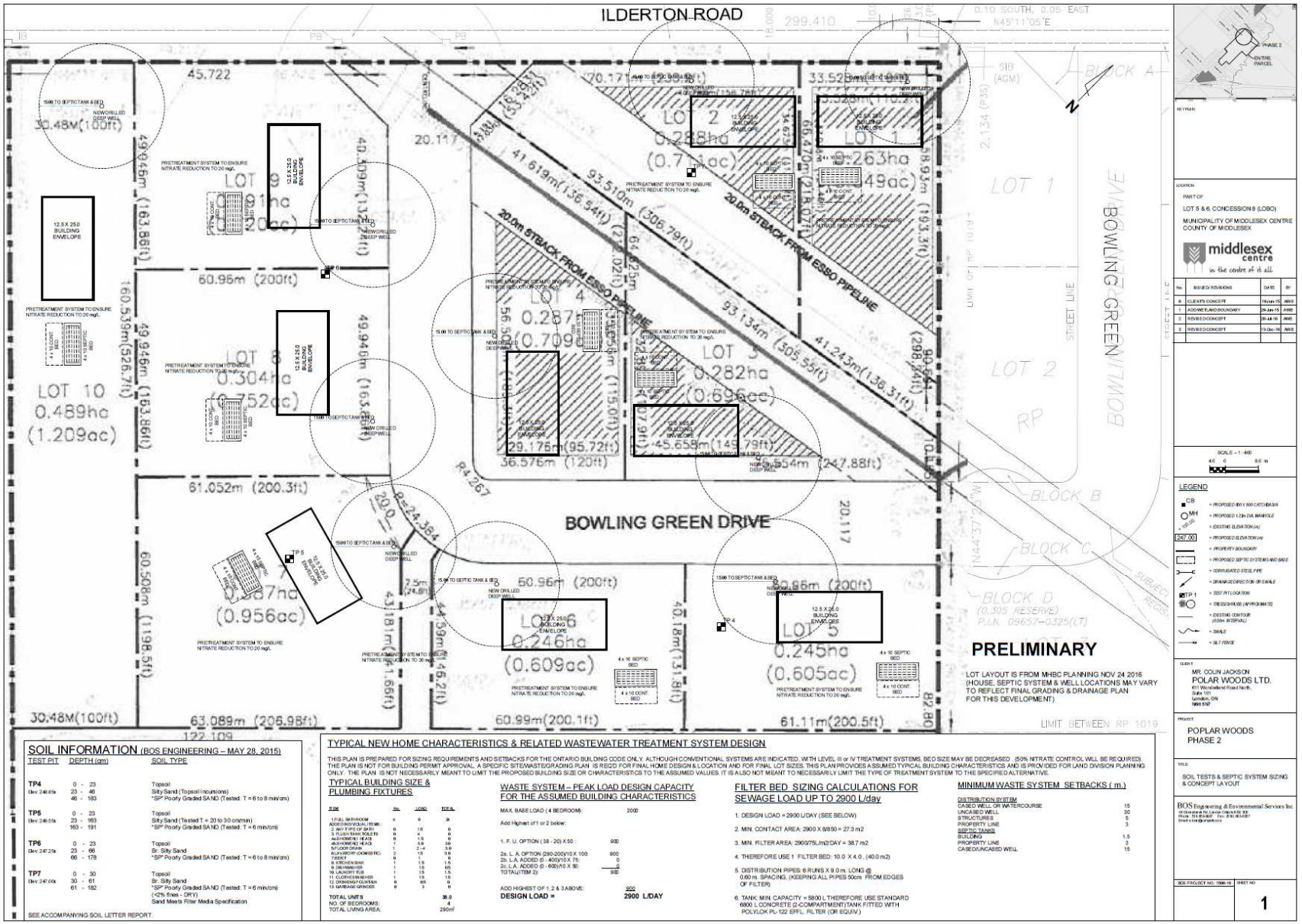
	Lot Size (m^2)	Mean Annual Precip. (mm/yr) [1]	Evapo. (mm/yr) [2]	Infiltration (%) [3]	Dilution Volume (L/yr)	Background NO_3+NO_2 (mg/L)	Septage Conc. (mg/L)	Reduction Effic. (%)	Treated Conc. (mg/L)	No. of Houses (#)	Sewage Volume (L/yr)	Concentration at Lot Boundary (mg/L)	
	5200	990	570	55	1201200	0.804	40	0	40	1	365000	**9.94**	**10**

PHASE II - WITH 50% PRETREATMENT

	Lot Size (m^2)	Mean Annual Precip. (mm/yr) [1]	Evapo. (mm/yr) [2]	Infiltration (%) [3]	Dilution Volume (L/yr)	Background NO_3+NO_2 (mg/L)	Septage Conc. (mg/L)	Reduction Effic. (%)	Treated Conc. (mg/L)	No. of Houses (#)	Sewage Volume (L/yr)	Concentration at Lot Boundary (mg/L)	
Smallest Lot	2450	990	570	55	565950	0.804	40	50	20	1	365000	**8.33**	**10**
Ten Lots	30820	990	570	55	7119420	0.804	40	50	20	10	3650000	**7.31**	**10**
Largest Lot	4890	990	570	55	1129590	0.804	40	50	20	1	365000	**5.49**	**10**

1. Note that mean annual precipitation is based on London Airport weather station
2. Evaporation is based on regional stormwater balance calculations in this area.
3. Infiltration was estimated to be 80% of surplus water but 55% was used for conformance to SCRCA practices

APPENDIX B – PROPOSED LOT LAYOUT – PHASE II


ILDERTON ROAD
BOWLING GREEN DRIVE
20.0m SETBACK FROM ESSO PIPELINE
LOT 10
0.489ha
(1.209ac)
LOT 9
0.287ha
(0.956ac)
LOT 8
0.304ha
(0.752ac)
LOT 7
0.287ha
(0.709ac)
LOT 6
0.246ha
(0.609ac)
LOT 5
0.245ha
(0.605ac)
LOT 4
0.282ha
(0.696ac)
LOT 3
0.288ha
(0.71ac)
LOT 2
0.263ha
(0.649ac)
LOT 1
BLOCK A
BLOCK B
BLOCK C
BLOCK D
(0.305 RESERVE)
P.LN. 09657-0325(LT)
BOWLING GREEN DRIVE
PRELIMINARY
LOT LAYOUT IS FROM MHBC PLANNING NOV 24 2016
(HOUSE, SEPTIC SYSTEM & WELL LOCATIONS MAY VARY
TO REFLECT FINAL GRADING & DRAINAGE PLAN
FOR THIS DEVELOPMENT)
LIMIT BETWEEN RP 1019
LEGEND
SOIL INFORMATION (BOS ENGINEERING – MAY 28, 2015)
TEST PIT DEPTH (cm) SOIL TYPE
TP4 0 - 23 Topsoil
Elev 246.85± 23 - 46 Silty Sand (Topsoil incursions)
46 - 183 *SP Poorly Graded SAND (Tested: T = 6 to 8 min/cm)
TP5 0 - 23 Topsoil
Elev 246.55± 23 - 163 Silty Sand (Tested T = 20 to 30 cm/min)
163 - 191 *SP Poorly Graded SAND (Tested: T = 6 min/cm)
TP6 0 - 23 Topsoil
Elev 247.25± 23 - 66 Br. Silty Sand
66 - 178 *SP Poorly Graded SAND (Tested: T = 6 to 8 min/cm)
TP7 0 - 30 Topsoil
Elev 247.00± 30 - 61 Br. Silty Sand
61 - 182 *SP Poorly Graded SAND (Tested: T = 6 min/cm)
(<2% fines - DRY)
Sand Meets Filter Media Specification
SEE ACCOMPANYING SOIL LETTER REPORT.
TYPICAL NEW HOME CHARACTERISTICS & RELATED WASTEWATER TREATMENT SYSTEM DESIGN
THIS PLAN IS PREPARED FOR SIZING REQUIREMENTS AND SETBACKS FOR THE ONTARIO BUILDING CODE ONLY. ALTHOUGH CONVENTIONAL SYSTEMS ARE INDICATED, WITH LEVEL III or IV TREATMENT SYSTEMS, BED SIZE MAY BE DECREASED (50% NITRATE CONTROL WILL BE REQUIRED).
THE PLAN IS NOT FOR BUILDING PERMIT APPROVAL. A SPECIFIC SITE/WASTE/GRADING PLAN IS REQ'D FOR FINAL HOME DESIGN & LOCATION AND FOR FINAL LOT SIZES. THIS PLAN PROVIDES ASSUMED TYPICAL BUILDING CHARACTERISTICS AND IS PROVIDED FOR LAND DIVISION PLANNING ONLY. THE PLAN IS NOT NECESSARILY MEANT TO LIMIT THE PROPOSED BUILDING SIZE OR CHARACTERISTICS TO THE ASSUMED VALUES. IT IS ALSO NOT MEANT TO NECESSARILY LIMIT THE TYPE OF TREATMENT SYSTEM TO THE SPECIFIED ALTERNATIVE.
TYPICAL BUILDING SIZE & PLUMBING FIXTURES
ITEM No. COST TOTAL
1.FULL BATHROOM 4 6 24
ADDED INDIVIDUAL ITEMS:
2. ANY TYPE OF BATH 0 15 0
3. PUSH TANK TOILET 0 4 0
4. WATER SAVING TOILET 0 4.5 0
5. SHOWERHEAD 0 3.9 0
6.FLOOR DRAIN 1 2.4 2.4
7.LAVATORY (DOMESTIC) 2 15 30
8.BIDET 0 1 0
9. KITCHEN SINK 1 1.5 1.5
10. DISHWASHER 1 15 15
11. LAUNDRY TUB 1 15 15
12. CLOTHES WASHER 1 15 15
13. DRINKING FOUNTAIN 0 65 0
14. GARBAGE GRINDER 0 3 0
TOTAL UNITS 30.9
NO. OF BEDROOMS: 4
TOTAL LIVING AREA: 290m²
WASTE SYSTEM – PEAK LOAD DESIGN CAPACITY FOR THE ASSUMED BUILDING CHARACTERISTICS
MAX. BASE LOAD (4 BEDROOM): 2000
Add Highest of 1 or 2 below:
1. F. U. OPTION (38 - 20) X 50 : 900
2a. L.A. OPTION (290-200)*10 X 100: 900
2b. L.A. ADDED (0 - 400)*10 X 75: 0
2c. L.A. ADDED (0 - 600)*0 X 50: 0
TOTAL(ITEM 2): 900
ADD HIGHEST OF 1, 2 & 3 ABOVE: 900
DESIGN LOAD = 2900 L/DAY
FILTER BED SIZING CALCULATIONS FOR SEWAGE LOAD UP TO 2900 L/day
1. DESIGN LOAD = 2900 L/DAY (SEE BELOW)
2. MIN. CONTACT AREA: 2900 X 9/850 = 27.3 m2
3. MIN. FILTER AREA: 2900/75L/m2/DAY = 38.7 m2
4. THEREFORE USE 1 FILTER BED: 10.0 X 4.0 , (40.0 m2)
5. DISTRIBUTION PIPES: 6 RUNS X 9.0 m. LONG @ 0.60 m. SPACING, (KEEPING ALL PIPES 50cm FROM EDGES OF FILTER)
6. TANK: MIN. CAPACITY = 5900 L THEREFORE USE STANDARD 6900 L CONCRETE (2-COMPARTMENT) TANK FITTED WITH POLYLOK PL-122 EFFL. FILTER (OR EQUIV.)
MINIMUM WASTE SYSTEM SETBACKS (m.)
DISTRIBUTION SYSTEM
CASED WELL OR WATERCOURSE 15
UNCASED WELL 30
STRUCTURES 5
PROPERTY LINE 3
SEPTIC TANKS
BUILDING 1.5
PROPERTY LINE 3
CASED/UNCASED WELL 15
LOCATION
PART OF
LOT 5 & 6, CONCESSION 8 (LOBO)
MUNICIPALITY OF MIDDLESEX CENTRE
COUNTY OF MIDDLESEX
middlesex centre
in the centre of it all
No. ISSUES/REVISIONS DATE BY
0 CLIENTS CONCEPT 19-Nov-15 AWE
1 ADD WETLAND BOUNDARY 24-Jan-16 AWE
2 REVISED CONCEPT 08-Jul-16 AWE
3 REVISED CONCEPT 13-Dec-16 AWE
SCALE – 1 : 400
CLIENT
MR. COLIN JACKSON
POLAR WOODS LTD.
611 Wonderland Road North,
Suite 101
London, ON
N6H 5N7
PROJECT
POPLAR WOODS
PHASE 2
TITLE
SOIL TESTS & SEPTIC SYSTEM SIZING & CONCEPT LAYOUT
BOS Engineering & Environmental Services Inc.
BOS PROJECT NO. 1566-16
SHEET NO
1