

## **Attachment B-16**

Input Parameters

Iterations

Pressure in USDW, psi	97.9	97.9	97.9	97.9	97.9	97.9	101.7
Pressure in Injection Zone or Interval, psi	1282	1282	1282	1282	1282	1282	1282
Depth of Pressure Measurement, ft.	2850	2850	2850	2850	2850	2850	2850
Compressibility of Liquid	0.00000317	0.00000317	3.17E-06	3.17E-06	3.17E-06	3.17E-06	3.17E-06
Specific Gravity	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Measured Viscosity of Reservoir Fluid	1.325	0.65	1.325	1.325	1.325	1.325	1.325
Compressibility of Formation, cu ft/cu ft/psi	7.00E-09	7.00E-08	7.00E-08	7.00E-08	4.30E-05	7.00E-09	7.00E-09
Original Temperature at Midpoint, deg F	100	100	100	100	100	100	100
Injection Interval Net Thickness, ft	296	296	296	296	296	296	296
Injection Interval Net Porosity*	0.06	0.06	0.06	0.06	0.06	1	1
Orig Avg Hor Perm, kh/net thickness, md**	10	10	10	10	10	10	10
Open Hole Diameter, ins.	7.875	7.875	7.875	7.875	7.875	7.875	7.875
Date of first Injection							
Maximum Injection Rate, gpm	35	35	35	35	35	35	35
Maximum Specific Gravity	1.193	1.193	1.193	1.193	1.193	1.193	1.193
Injectate viscosity at wellhead conditions	2.4	2.4	2.4	2.4	2.4	2.4	2.4

using 20-year ZEI

835 feet

827 feet

827 feet

219 feet

205 feet

186 feet

highest values

lowest values

\*max injection 39 at 6% porosity and 58 at 10% porosity  
(10% is conservative value; 6% is unlikely for any injection zone.)

\*\* using 100 md results in 0 value result

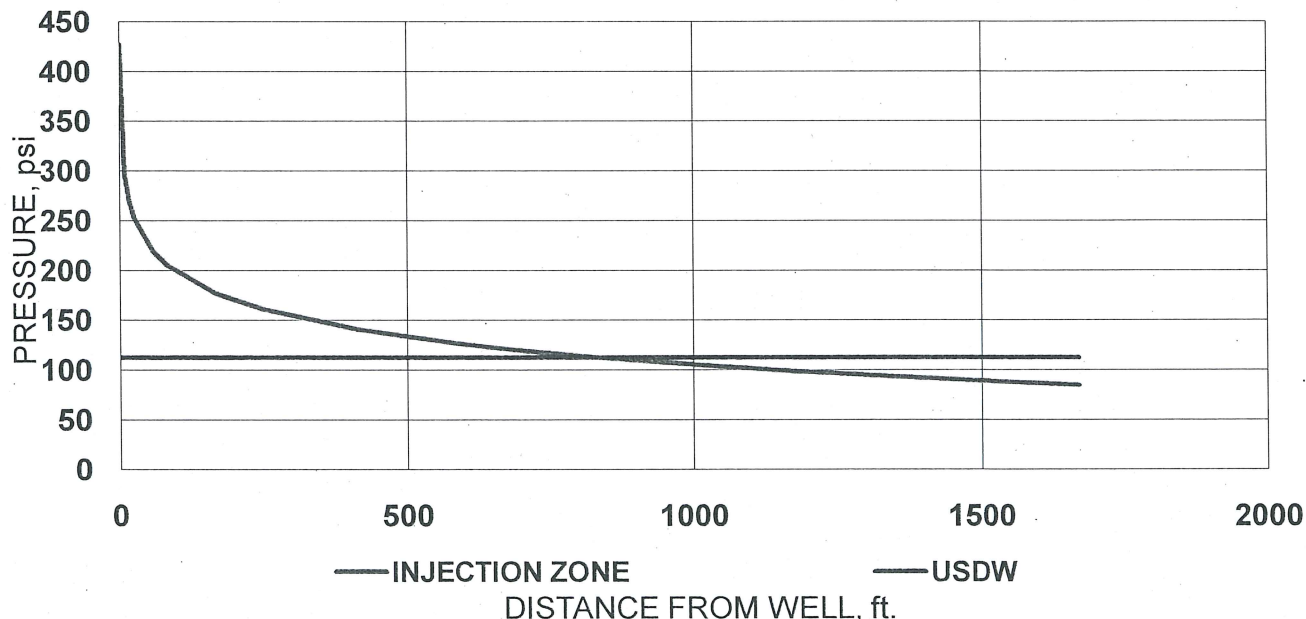
(1/4 mile = 1320 feet)

Constant Values
Variable Values

### CALCULATION OF INJECTION INDUCED PRESSURE EFFECTS

Facility Name		Operator	
		West Bay Exploration Company	
Well Name		USEPA Permit Number	Well Class
West Bay #22		MI-075-2D-0009	Class II
County	State	Date	Analyst
Jackson	Michigan	October 25, 2012	
<b>Well and Operational Information</b>			
Reference Elevation of Well, ft.	Injection Rate, gpm	Minimum Injectate Specific Gravity	Date of First Injection
	-35.0	1.193	10/25/2012
Radius of Well Bore, ft.	Duration of Additional Inj., months	Viscosity of Injectate, cp	Current Cum. Injected Volume, gals
0.328125	240	2.4	
<b>Lowermost Underground Source of Drinking Water Information</b>			
Name of Lowermost USDW	Hydrostatic Pressure in USDW, psi	Specific Gravity of Water in USDW	
Marshall Sandstone	97.9	1.00	
Depth to Base of USDWs, ft	Depth of Pressure Measurement, ft	Pressure at Base of USDW, psi	<==Assumes psig
226	226	112.60	
<b>Injection Zone Information</b>			
Formation at Top of Injection Zone	Porosity of Effective Injection Zone	Specific Gravity of Connate Fluid	Pressure at Top of IZ, psi
Niagara Dolomite	0.06	1.2	1184.3
Depth to Top of Injection Zone, ft	Permeability of Active IZ, md	Viscosity of Connate Fluid, cp	Measured Pressure in IZ, psi
2662	10	#REF!	1282
Effective Thickness of IZ, ft	Compressibility of IZ, psi	Compress. of Connate Fluid, psi	Depth of Pressure Measurement, ft
296	7.00E-09	3.170000E-06	2850
<b>Calculation of Critical Pressure and Cone of Endangering Influence</b>			
CRITICAL PRESSURE RISE, psi	Feet to Potential Conduit	ZONE OF ENDANGERING INFLUENCE RADIUS, ft.	
187	1,320	835	
Plume Radius, Volume X 3	Max Safe Injection Rate, gpm	Viscosity to use	Specific Gravity to use
1627	39	0.70	1.19

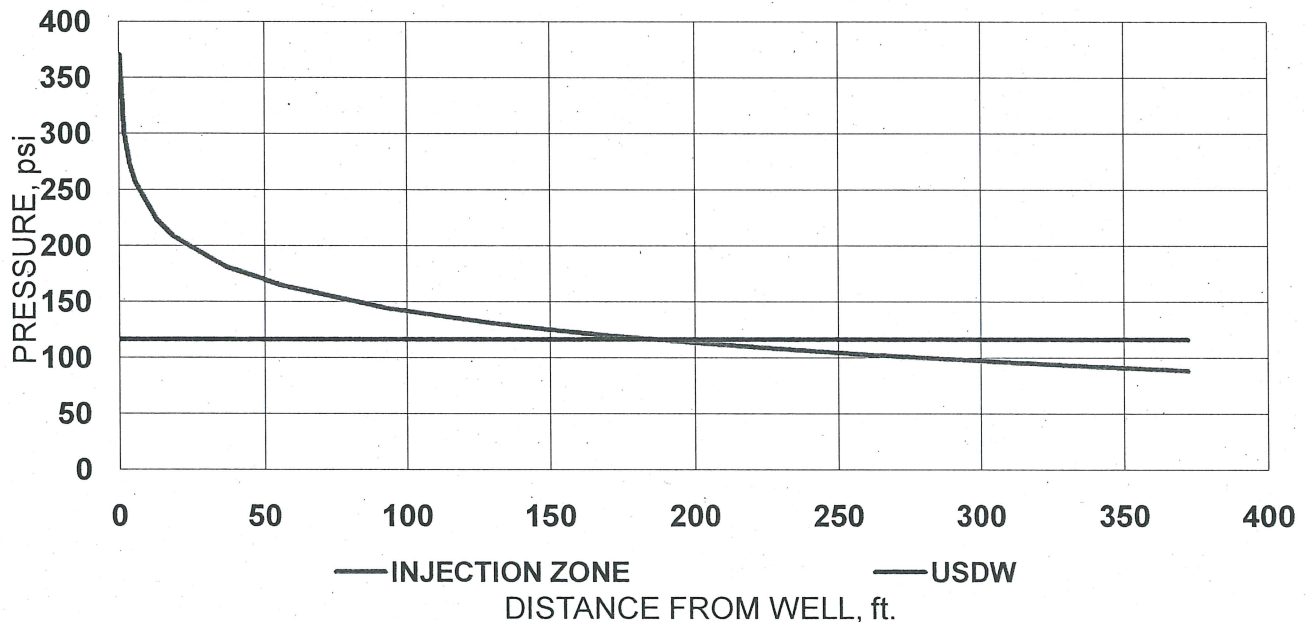
### RELATIONSHIP OF PRESSURES AT THE BASE OF USDWS



### CALCULATION OF INJECTION INDUCED PRESSURE EFFECTS

Facility Name		Operator	
West Bay #22		West Bay Exploration Company	
Well Name		USEPA Permit Number	Well Class
West Bay #22		MI-075-2D-0009	Class II
County	State	Date	Analyst
Jackson	Michigan	October 25, 2012	
<b>Well and Operational Information</b>			
Reference Elevation of Well, ft.	Injection Rate, gpm	Minimum Injectate Specific Gravity	Date of First Injection
	-35.0	1.193	10/25/2012
Radius of Well Bore, ft.	Duration of Additional Inj., months	Viscosity of Injectate, cp	Current Cum. Injected Volume, gals
0.328125	240	2.4	
<b>Lowermost Underground Source of Drinking Water Information</b>			
Name of Lowermost USDW	Hydrostatic Pressure in USDW, psi	Specific Gravity of Water in USDW	<==Assumes psig
Marshall Sandstone	101.7	1.00	
Depth to Base of USDWs, ft	Depth of Pressure Measurement, ft	Pressure at Base of USDW, psi	
226	226	116.40	
<b>Injection Zone Information</b>			
Formation at Top of Injection Zone	Porosity of Effective Injection Zone	Specific Gravity of Connate Fluid	Pressure at Top of IZ, psi
Niagara Dolomite	1	1.2	1184.3
Depth to Top of Injection Zone, ft	Permeability of Active IZ, md	Viscosity of Connate Fluid, cp	Measured Pressure in IZ, psi
2662	10	#REF!	1282
Effective Thickness of IZ, ft	Compressibility of IZ, psi	Compress. of Connate Fluid, psi	Depth of Pressure Measurement, ft
296	7.00E-09	3.170000E-06	2850
<b>Calculation of Critical Pressure and Cone of Endangering Influence</b>			
CRITICAL PRESSURE RISE, psi	Feet to Potential Conduit	ZONE OF ENDANGERING INFLUENCE RADIUS, ft.	
190	1,320	186	
Plume Radius, Volume X 3	Max Safe Injection Rate, gpm	Viscosity to use	Specific Gravity to use
399	60	0.70	1.19

### RELATIONSHIP OF PRESSURES AT THE BASE OF USDWS



Values used

Parameter	Source, range of value	Value	low value	high value
Depth to Base of USDWs, ft	permit 226 x (0.4333 to 0.45)	226	97.9	101.7
Pressure in USDW, psi	226 (using USDW base)	226		
Depth of Pressure Measurement, ft.	226 (using USDW base)	226		
Specific Gravity, USDW	1.0 (assume pure H2O)	1		
Depth to Top of Injection Zone, ft		2662		
Pressure in Injection Zone or Interval, psi	midpoint of formation depth (see below) x (0.4333 to 0.45)		1235	1282
Depth of Pressure Measurement, ft.	2662 + (370/2)	2850		
Compressibility of Liquid	from SOP default is 3.17e-6 psi/cubic ft ; varies with temperature and pressure	0.00000317		
Specific Gravity	Baseline: 1.2	1.2		
Measured Viscosity of Reservoir Fluid	per SOP Appendix A: .65 - 1.325 (higher is more conservative)	1.325	0.65	1.325
Compressibility of Formation, cu ft/cu ft/psi	FOT SOP: default is 7e-7 ft/cu ft/psi; range for sound rock is 7e-6 to 7e-9 ZEI SOP: 4.3E-5 for limestone. per discussion with West Bay Exp. Co.		7.00E-07	7.00E-09 4.30E-05
Original Temperature at Midpoint, deg F		100		
Injection Interval Net Thickness, ft	80% of thickness (common conservative value per Bill, based on well records)	296		
Injection Interval Net Porosity	per SOP 6%*	0.06	0.6	0.1
Orig Avg Hor Perm, kh/net thickness, md	10 md from literature survey (low)	10	10	100
Open Hole Diameter, ins.	from permit	7.875		
Date of first Injection	date of analysis (automatic)			
Maximum Injection Rate, gpm	from permit	35		
Maximum Specific Gravity	from permit	1.193		
Injectate viscosity at wellhead conditions	taken from <a href="http://www.csgnetwork.com/specifi_c_gravity_viscosity_liquids.html">http://www.csgnetwork.com/specifi_c_gravity_viscosity_liquids.html</a>	2.4		

\*6% is unlikely for any injection zone; 10% is conservative value.