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Date: October 25, 2010
To: Mr. Sandeep Janwadkar
From: Don Grigg
cc:
Email: Don_Grigg@golder.com

Project No.: 08382734.12
Company: FDEP
Address: 3319 Maguire Blvd
Suite 232
Orlando, FL 32803-3767

RE: RESPONSE TO 1ST REQUEST FOR ADDITIONAL INFORMATION CLARIFICATION

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3	Copies	Response to 1st Request for Additional Information Clarification – J.E.D. Solid Waste Management Facility Modification of GCCS System – Intermediate Modification

Notes:

Please advise us if enclosures are not as described.

ACKNOWLEDGEMENT REQUIRED:

☐ Yes ☐ No

document3

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Golder Associates

October 25, 2010 083-82734.12

Mr. Sandeep Janwadkar
Permitting Engineer
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, FL 32803-3767

RE: RESPONSE TO FIRST REQUEST FOR ADDITIONAL INFORMATION CLARIFICATION
J.E.D. SOLID WASTE MANAGEMENT FACILITY
MODIFICATION OF GCCS SYSTEM – INTERMEDIATE MODIFICATION
ADDITION OF HORIZONTAL GAS COLLECTORS (CELL 7 THROUGH 10)
AND GCCS/LEACHATE SUMP CONNECTIONS
MODIFICATION OF PERMIT NUMBER S049-0199726-012
PERMIT APPLICATION NO. S049-199726-015

Dear Mr. Janwadkar:

Golder Associates Inc. (Golder), on behalf of Omni Waste of Osceola County, LLC (Omni), has prepared the following clarifications to our Response to the First Request for Additional Information (RAI), dated September 24, 2010 submitted to the Florida Department of Environmental Protection (FDEP). A summary of associated correspondence follows:

- Solid Waste Permit Modification Application, Golder, July 21, 2010;
- First Request for Additional Information, FDEP, August 24, 2010;
- Response to the First Request for Additional Information, Golder, September 24, 2010 (RAI-1).

These clarifications are in response to a phone call between Omni, FDEP and Golder which took place on October 21, 2010. The format of this response includes the comment in italics followed by the responses in bold text. Responses may include references to attachments that follow. Note that revisions made to RAI-1 are shown via underline and strikethrough for the clarifications requested.

Comment 9 *Exhibit 2, Engineering Design Narrative, Appendix A, Design Calculations: Provide the source/reference used for the following constants used in your design calculations: $P_{landfill}$, Intrinsic Waste Permeability (Ki), Gas Generation Rate (GGR), Waste Density, and Dynamic Viscosity.*

Response 9 **The landfill pressure is based on Golder's experience for landfill sites under steady state conditions and represents the generation of landfill gas under nominal cover conditions. We have measured this pressure in passive landfill vents. The intrinsic waste permeability was estimated using data from a paper entitled "Gas permeability and tortuosity for packed layers of processed municipal solid waste and incinerator residue", by Kallel et. al published in Waste Management and Research in 2004.**

The graph on the following page is from a presentation from Dr. Mort Barlaz regarding the gas production and recovery at a Delaware landfill. During the first 8 to 10 years after waste placement, the gas generation rate tends to range between 4 and 8 cubic meters per year per ton of wet waste and decreases thereafter. Using a value of 6 cubic meters per year per ton of wet waste yields 0.1 cubic feet of gas per year per pound of waste as used in the calculations. The graph below illustrates different cells in the landfill that Dr. Barlaz analyzed for his

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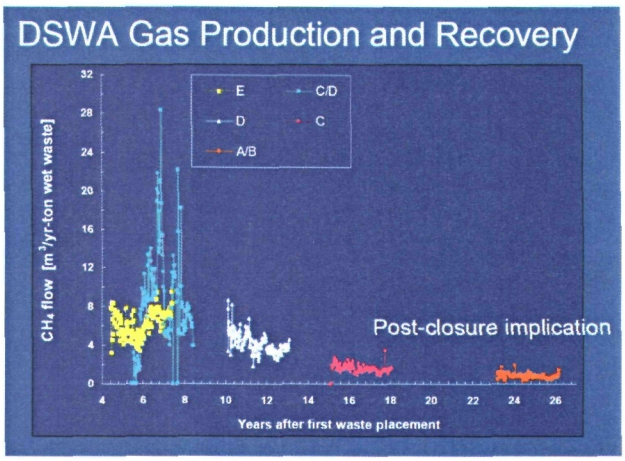
presentation. Please note that a value of 6 cubic meters per year per ton of wet waste was used as a conservative estimate for the average of the values from this graph.



The waste density is based on typical values measured using aerial surveys and waste acceptance values at modern solid waste landfills. The dynamic viscosity is based on a gas consisting of 50 percent methane and 50 percent carbon dioxide. Note that the calculation is not sensitive to this value and fluctuations would be expected under operating conditions.

Comment 10 *Exhibit 2, Engineering Design Narrative, Appendix A, Design Calculations, LFG Extraction Well Horizontal Design and Spacing Calculations: The longest perforated pipe length is Well HGC-8; it is approximately 1005 feet long. Provide the basis for using 400, 500, and 600 feet H values in the calculations for well pressure and well ROI. Provide the revised calculations using H value of 1005 feet or explain why this H value of 1005 was not used in the design calculations related to well pressure and well ROI.*

Response 10 **The calculation presented uses the H value (for vertical wells total well depth) to estimate the associated radius of influence. In converting that calculation to estimate the zone of influence for HGCs, some compromises were required. The H value still represents total depth, but we have conservatively estimated it to be high (greater than the total waste thickness at the facility). We looked at three separate scenarios to illustrate variations in the zone of influence associated with various waste depths and then extrapolated this data to estimate ROI's for different pipe lengths. Note that these devices are temporary in nature, due to this the spacing (ROI) is not deemed critical. A revised calculation is provided for a well length of 1,005 feet. This calculation indicates an average flow of about 154 cfm with corresponding radii of influence values of 30 feet in the vertical direction and 90 feet in the horizontal direction at very low pressures (1-inch of water). Although these values are less than the spacing included with the design, the effects on the performance of the horizontal collection system are expected to be minimal for the following reasons:**

- **The design pressure value is very low, which is considered conservative and represents conditions towards the remote end of the well.**
- **The longest horizontal wells are deep within the landfill and any gas not intercepted by these wells will likely be intercepted by horizontal or vertical wells located at higher elevations than these wells.**

Comment 17 *Exhibit 3, Drawings, Drawing No. 32B of 40: Clarify why only two rows of horizontal gas collectors are recommended as part of this permit application located at approximate elevations of 95 feet NGVD and 180 feet NGVD of waste in Cells 7 through 10. The Department Solid Waste Permit Nos SC49-0199726-006 and SO49-0199726-007 issued on April 04, 2008, in the modified Specific Condition No. A states that the final maximum top elevation for Cells 1-21 has been modified from 178 feet NGVD to 330 ft NGVD.*

b. Additionally, the Sections C-32B and D-32B show final covers for Cells 7 and 8 and Cells 9 and 10 at elevations of approximately 220 feet NGVD elevations instead of 330 feet NGVD. Clarify this discrepancy and if necessary submit the revised drawing.

Response 17b **Sections C-32B and D-32B (as shown on Drawings Nos 29B and 32B) are cut roughly parallel to the contours of the final cover system. Omni and Golder acknowledge that the permitted final cover elevation is 330 feet NGVD, it is not at the locations shown in the application package. ~~No revisions to the drawings were made in support of this comment.~~ Drawing 32B has been revised to indicate the top of waste for clarification.**

Golder has prepared these clarifications on behalf of, and with input from, Omni staff. We hope these clarifications and the changes made to the application, as attached, are satisfactory to FDEP. If you have any questions on the contents of these responses, please don't hesitate to call Mike Kaiser at (904) 673-0446 or either of the undersigned.

Sincerely,

GOLDER ASSOCIATES INC.

Don E. Grigg, P.E.
Senior Project Engineer

Kevin S. Brown, P.E.
Senior Consultant and Associate
Florida Professional Engineer No. 57819

10/25/10
Date

cc: Mr. Mike Kaiser, Omni Waste of Osceola County, LLC

Attachments: Attachment 1 Additional ROI Calculation – 1,005 feet
Attachment 2 Revised Drawing 32B (under separate cover)

FN: G:\Projects\083\083-82\083-82734\083-82734.12\250_Final_Reports\Oct Clarification\RAI1 Clarification-JED Horizontal Mod.docx

ATTACHMENT 1

LFG HORIZONTAL EXTRACTION WELL VERTICAL DESIGN AND SPACING

Equations and Input

Gas Interception Equation

$$Q = \pi (ROI)^2 (GGR)(\gamma_{waste})(H)$$

Steady State Radial Flow Equation

$$\frac{Q}{H} = \pi \frac{k_i}{\mu} P_w \frac{\left[1 - \left(\frac{P_{Landfill}}{P_w}\right)^2\right]}{\ln\left(\frac{R_w}{ROI}\right)}$$

Constant Parameters:

k_i =	5.00E-13	m^2 (Intrinsic Waste Permeability (LFG))
P_{atm} =	30	Inches Hg (Atmospherk Pressure)
	101,592	Pa (Absolute)
$P_{landfill}$ =	3	Inches water (Landfill Pressure)
	102,338	Pa (Absolute)
R_w =	4	Inches (well radius)
	0.1016	meters
GGR =	0.1	ft^3/lb-yr (gas generation rate)
	2.02E-11	m^3/N-S
γ_{waste} =	1501.2	lbs/yd^3 (waste unit weight)
	8737.0	N/m^3
μ =	1.32E-05	kg/m-s (gas viscocity)

Q = Well Flow
H = Well Depth
k_i = Intrinsic Permeability of waste
μ = Dynamic Viscosity of LFG
$P_{Landfill}$ = Landfill Pressure (absolute pressure)
P_w = Wellhead Pressure (absolute pressure)
R_W = Radius of Extraction Well
ROI = Well Radius of Influence

Determine Well ROI based on assumed flows using gas interception equation

H =	1005	ft	
	306.324	m	
Q (cfm)	Q (cu. m/s)	ROI (m)	ROI (ft)
30	1.42E-02	9.1	30.0
60	2.83E-02	12.9	42.4
90	4.25E-02	15.8	51.9
120	5.66E-02	18.3	60.0
150	7.08E-02	20.4	67.0
180	8.50E-02	22.4	73.4
210	9.91E-02	24.2	79.3
240	1.13E-01	25.8	84.8
270	1.27E-01	27.4	89.9
300	1.42E-01	28.9	94.8
330	1.56E-01	30.3	99.4
360	1.70E-01	31.7	103.9

Determine Well Pressure given ROI and Flows using Steady State Radial Flow Equation

H =	1005	ft					
	306.324	m					
Pressure (Pa, Absolute)	Pressure (in. water, guage)	ROI (m)	$(\pi k_i)/\mu$	$\ln(R_w/ROI)$	Q/H	Q/H	Q (cfm)
101468.0163	-0.5	9.1	1.19E-07	-4.499184636	4.62E-05	4.62E-05	30
100473.0916	-4.5	12.9	1.19E-07	-4.845758226	9.25E-05	9.25E-05	60
99438.73227	-8.7	15.8	1.19E-07	-5.04849078	1.39E-04	1.39E-04	90
98383.61936	-12.9	18.3	1.19E-07	-5.192331816	1.85E-04	1.85E-04	120
97316.83042	-17.2	20.4	1.19E-07	-5.303903592	2.31E-04	2.31E-04	150
96243.82634	-21.5	22.4	1.19E-07	-5.39506437	2.77E-04	2.77E-04	180
95168.28627	-25.8	24.2	1.19E-07	-5.47213971	3.24E-04	3.24E-04	210
94092.87112	-30.1	25.8	1.19E-07	-5.538905407	3.70E-04	3.70E-04	240
93019.60082	-34.4	27.4	1.19E-07	-5.597796924	4.16E-04	4.16E-04	270
91950.06298	-38.7	28.9	1.19E-07	-5.650477182	4.62E-04	4.62E-04	300
90885.53815	-43.0	30.3	1.19E-07	-5.698132272	5.08E-04	5.08E-04	330
89827.07958	-47.3	31.7	1.19E-07	-5.741637961	5.55E-04	5.55E-04	360

LFG HORIZONTAL EXTRACTION WELL HORIZONTAL DESIGN AND SPACING

Equations and Input

Gas Interception Equation

$$Q = \pi(ROI)^2(GGR)(\gamma_{waste})(H)$$

Steady State Radial Flow Equation

$$\frac{Q}{H} = \pi \frac{k_i}{\mu} P_w \frac{\left[1-\left(\frac{P_{Landfill}}{P_w}\right)^2\right]}{\ln\left(\frac{R_w}{ROI}\right)}$$

Constant Parameters:

k_i =	5.00E-12	m^2 (Intrinsic Waste Permeability (LFG))
P_{atm} =	30	inches Hg (Atmospheric Pressure)
	101,592	Pa (Absolute)
$P_{landfill}$ =	3	inches water (Landfill Pressure)
	102,338	Pa (Absolute)
R_w =	4	inches (well radius)
	0.1016	meters
GGR =	0.1	ft^3/lb-yr (gas generation rate)
	2.02E-11	m^3/N-S
γ_{waste} =	1501.2	lbs/yd^3 (waste unit weight)
	8737.0	N/m^3
μ =	1.32E-05	kg/m-s (gas viscocity)

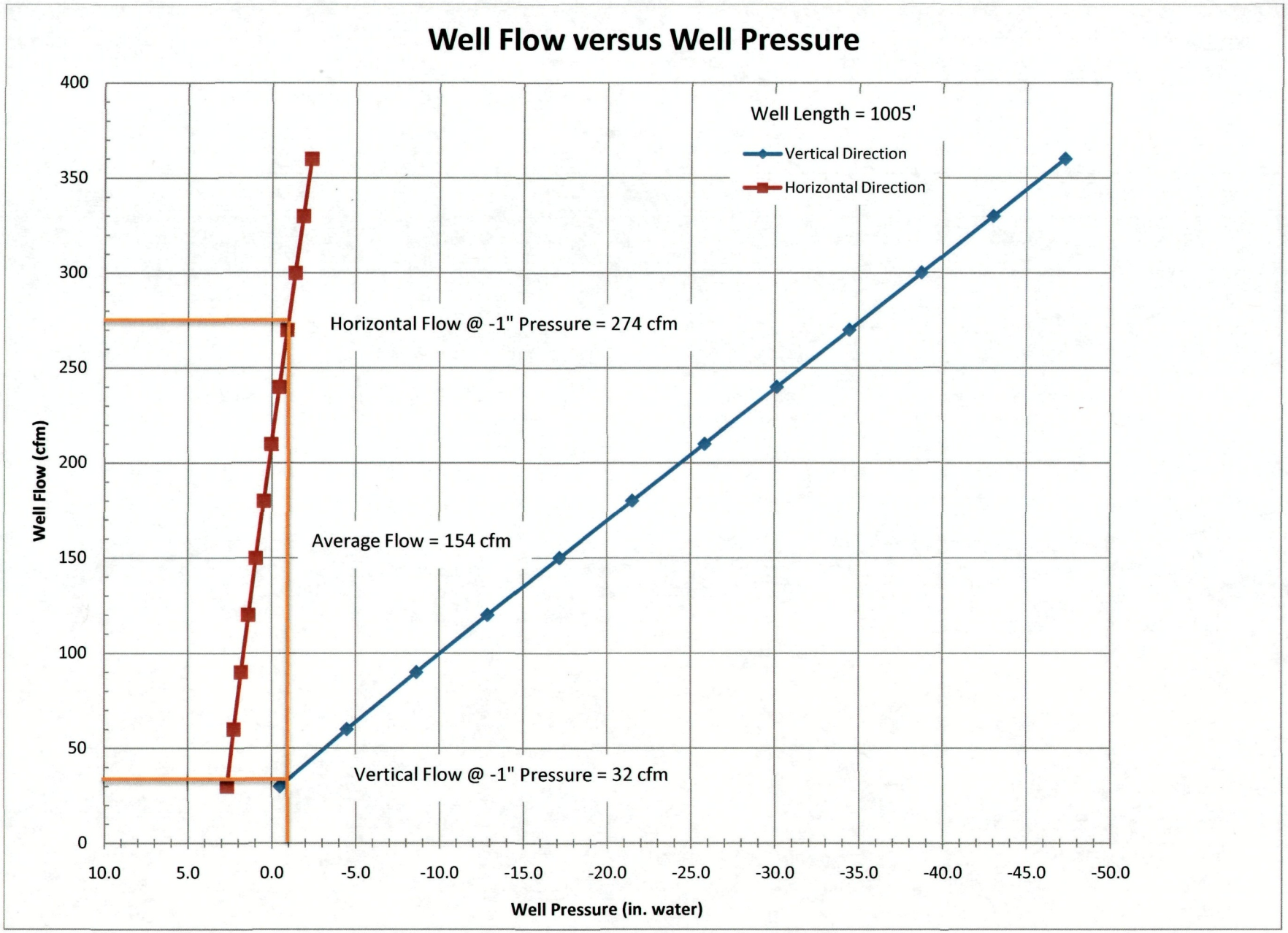
Q = Well Flow
H = Well Depth
k_i = Intritusic Permeability of waste
μ = Dynamic Viscosity of LFG
$P_{Landfill}$ = Landfill Pressure (absolute pressure)
P_w = Wellhead Pressure (absolute pressure)
R_w = Radius of Extraction Well
ROI = Well Radius of Influence

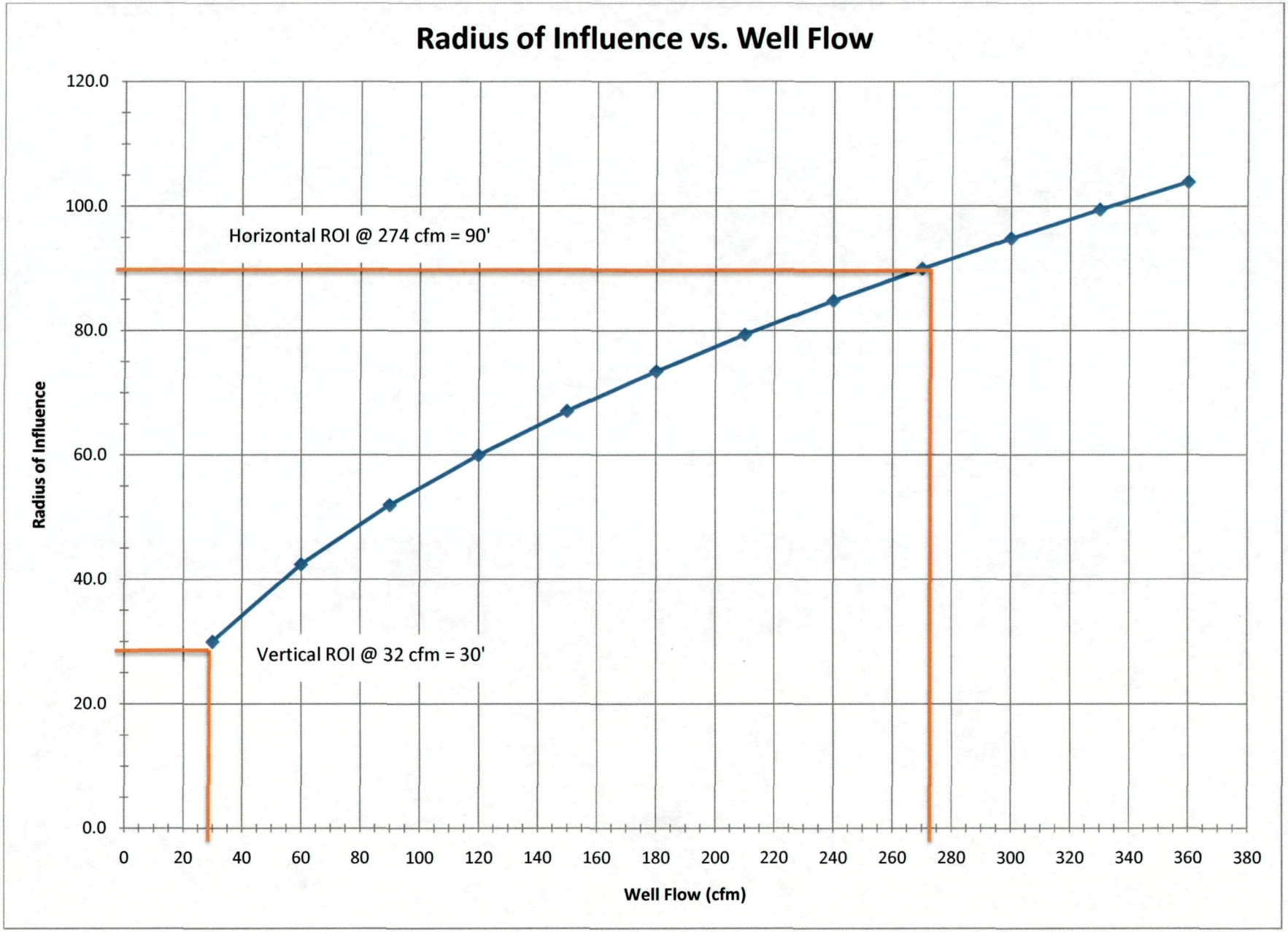
Determine Well ROI based on assumed flows using gas interception equation

H =	1005	ft	
	306.324	m	
Q (cfm)	Q (cu. m/s)	ROI (m)	ROI (ft)
30	1.42E-02	9.1	30.0
60	2.83E-02	12.9	42.4
90	4.25E-02	15.8	51.9
120	5.66E-02	18.3	60.0
150	7.08E-02	20.4	67.0
180	8.50E-02	22.4	73.4
210	9.91E-02	24.2	79.3
240	1.13E-01	25.8	84.8
270	1.27E-01	27.4	89.9
300	1.42E-01	28.9	94.8
330	1.56E-01	30.3	99.4
360	1.70E-01	31.7	103.9

Determine Well Pressure given ROI and Flows using Steady State Radial Flow Equation

H =	1005	ft					
	306.324	m					
Pressure (Pa, Absolute)	Pressure (in. water, guage)	ROI (m)	$(ak_i)/\mu$	$\ln(R_w/ROI)$	Q/H	Q/H	Q (cfm)
102250.8098	2.6	9.1	1.19E-06	-4.499184636	4.62E-05	4.62E-05	30
102150.0952	2.2	12.9	1.19E-06	-4.845758226	9.25E-05	9.25E-05	60
102044.413	1.8	15.8	1.19E-06	-5.04849078	1.39E-04	1.39E-04	90
101935.5533	1.4	18.3	1.19E-06	-5.192331816	1.85E-04	1.85E-04	120
101824.3688	0.9	20.4	1.19E-06	-5.303903592	2.31E-04	2.31E-04	150
101711.3627	0.5	22.4	1.19E-06	-5.39506437	2.77E-04	2.77E-04	180
101596.8685	0.0	24.2	1.19E-06	-5.47213971	3.24E-04	3.24E-04	210
101481.1236	-0.4	25.8	1.19E-06	-5.538905407	3.70E-04	3.70E-04	240
101364.3063	-0.9	27.4	1.19E-06	-5.597796924	4.16E-04	4.16E-04	270
101246.555	-1.4	28.9	1.19E-06	-5.650477182	4.62E-04	4.62E-04	300
101127.9807	-1.9	30.3	1.19E-06	-5.698132272	5.08E-04	5.08E-04	330
101008.6744	-2.3	31.7	1.19E-06	-5.741637961	5.55E-04	5.55E-04	360


Well Flow versus Well Pressure
Well Length = 1005'
Vertical Direction
Horizontal Direction
Horizontal Flow @ -1" Pressure = 274 cfm
Average Flow = 154 cfm
Vertical Flow @ -1" Pressure = 32 cfm
Well Flow (cfm)
400
350
300
250
200
150
100
50
0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
Well Pressure (in. water)


Radius of Influence vs. Well Flow
Horizontal ROI @ 274 cfm = 90'
Vertical ROI @ 32 cfm = 30'
Radius of Influence
Well Flow (cfm)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380

ATTACHMENT 2

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