DEPARTMENT OF PETROLEUM AND NATURAL GAS ENG

OIL AND GAS PROPERTIES EVALUATION

PNGE – 241

FINAL PROJECT
(OIL FIELD SELECTION)

WEST VIRGINIA UNIVERSITY

SUBMITTED TO: SHAHAB MOHAGHEGH

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1. - OBJECTIVE

The purpose of this project is to select the most profitable oil field based on production data. For this particular project two different fields were studied, one in Texas and another in Louisiana.

2. - EXECUTIVE SUMMARY

This project has been designed in order to select the best oil field for a future investment. The study is based on two relatively newly drilled oil wells. The first oil well is in Texas and the second well is in Louisiana. It is important to take into consideration the fact that only enough resources are available to invest in one of the two wells. As engineers we are asked to make an evaluation of the two wells for the final investment decision. The decision will be based on the highest profit over a three year period. We were provided with the production data from each well and also have been told that the time value of money is approximately 15.5%.

The data provided was used to perform a decline curve analysis and generate a monthly net cash flow for the next three years of each well in order to select the most profitable field for future investment. Also, a net present value profile was considered in order to make this decision. Based on this study we were able to choose the best well to invest in.

3. – METHODOLOGY:

The method used to evaluate the two oil fields was decline curve analysis. A net cash flow for three years was made for each well in order to estimate the profits and losses from each one. The time value of money used was approximately 15.5% for the evaluation.

In order to get the production rate per month, q, we used Fetkovich type curve matching techniques (see appendix A) to determine the parameters of decline for each field. Using this matching technique and the given data we were able to obtain the initial production rate, qi, initial nominal decline rate, Di, and the hyperbolic exponent, b. According to this technique we identified that both fields experience hyperbolic decline because the semi-log graph of production rate versus time displayed upward concavity. Therefore the hyperbolic exponent, b, has values between 0-1.

After all the field parameters were obtained we were able to calculate the cumulative production per month, Np, using the following equation.

$$\mathbf{Np = qi^{b} * [qi^{1-b} - q^{1-b}] * f / Di * (1 - b)}$$

Where;

qi = initial production rate, BPD.

q= current production rate, BPD.

b= hyperbolic exponent

f= time conversion factor

Di= Initial nominal decline, %/ year

Next, the production for each month of the three year period was calculated by subtracting the previous cumulative month's production from the next month production (see column 4 from calculation tables).

Now in order to obtain the profit for each month, we need to consider the given oil prices for each field. The price of oil for the Louisiana field was $18.95 per barrel and for Texas the price was $17.00 per barrel. It was also given that the oil prices for both fields will increase 5% per year. Then the profit of each field was calculated by multiplying the monthly production by the current oil prices (see column 5 from calculation tables).

The next step was to calculate the cost of production per barrel for each field. For this part the production cost for Louisiana was $4.93 per barrel and for Texas $5.51 per barrel, both production costs were assumed to be constant. These costs were determined by multiplying monthly production by the cost per barrel from each field (see column 6 from calculation tables).

Now the Net Cash Flow was calculated for both fields. This was done by subtracting the operating costs from the profits. (see column 7 from calculation tables). For this calculation, the initial investment was considered. The initial investment for Louisiana was $100,000 and for Texas $1,000,000.

Then the last calculation was the Net Present Value, this was performed considering the given time value of money as 15.5 %. However, a net present value profile was constructed using various discount percentage rates (see "Net Present Profile" graph).

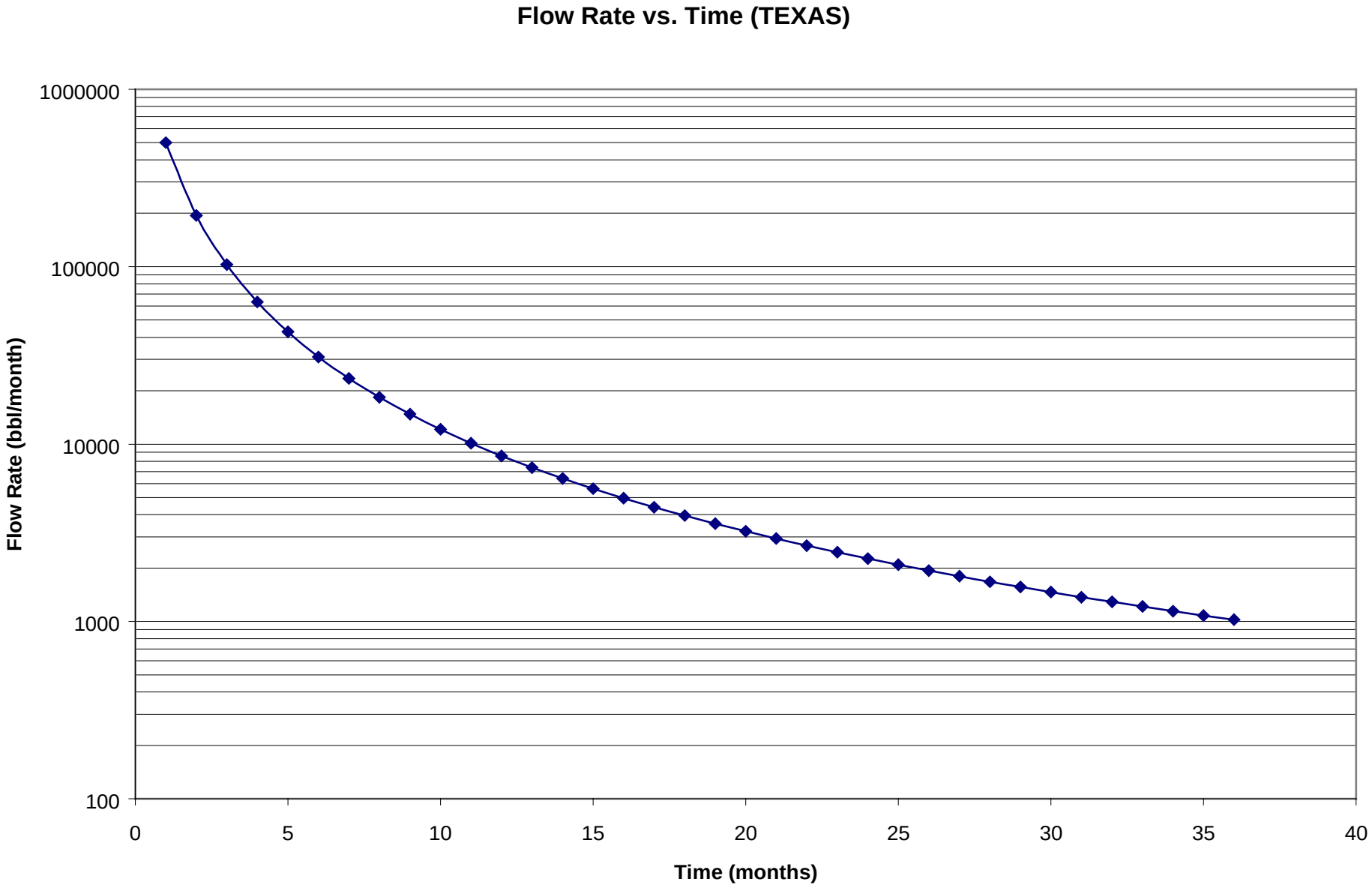
4. – DATA AND RESULTS:

The data to be use it for this project was given in order make the anlysis; the values given were the following:

Data for Texas			Data for Louisiana	
Time (day)	Rate (BOPD)		Time (day)	Rate (BOPD)
1	92800		1	93000
2	81390		2	81500
4	69980		4	70000
6	58800		6	53000
8	50100		8	43000
10	41800		10	38500
20	25000		20	18000
30	15000		30	9000
40	10500		40	5000
50	8000		50	2900
70	4800		70	1100
100	2600		100	370
120	2000		120	200

The results obtained from this project are presented in the following tables.

Net Present Value ($)		
Discount Rate%	**Texas**	**Louisiana**
0	21527342.4	18234072.47
5	21289870.1	18140245.14
10	21061688.5	18047443.8
15	20842081.1	17955649.32
15.5	20820566.6	17946524.53
20	20630404.3	17864843.17
30	20228585.6	17686124.57
50	19498148.6	17339791.58
75	18693634.2	16926421.42
100	17981311.2	16533148.95

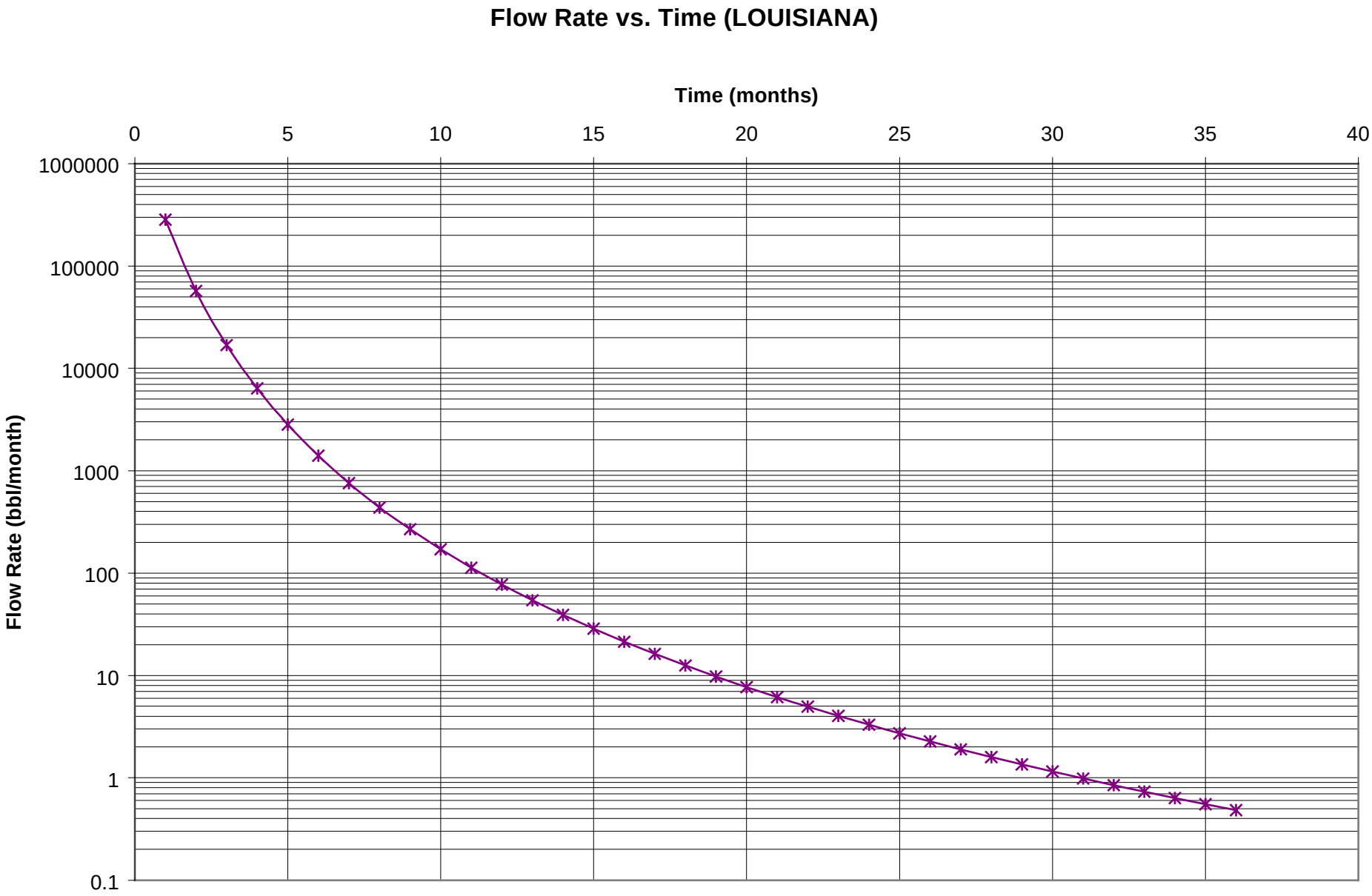

Flow Rate vs. Time (TEXAS)
1000000
100000
10000
1000
100
Flow Rate (bbl/month)
0
5
10
15
20
25
30
35
40
Time (months)

Project TEXAS

qi (bbl/day) = 104500 b= 0.5
qi (bbl/month) = 3176800 Di (1/day)= 0.1
Di (1/month) = 3.04

Price of oil ($/bbl) = 17 Production Cost ($/bbl) = 5.51
*Note: The price of oil is assumed to increase 5% each year

Time (month)	Flow Rate (bbl/month)	Np (bbl)	Np (bbl/month)	Profit($/month)	Operating Cost ($/month)	Net Cash Flow ($)	NPV@ 5%	NPV@ 10%	NPV@ 15%	NPV@ 15.5%	NPV@ 20%
0	0	0	0	0	-1000000	-1000000	-1000000	-1000000	-1000000	-1000000	-1000000
1	500251.9526	1260634.92	1260634.921	21430793.65	6946098.413	14484695.24	14424592.77	14364987.01	14305871.8	14299987.07	14247241.22
2	194637.7806	1572673.27	312038.3467	5304651.894	1719331.29	3585320.603	3555628.635	3526303.988	3497340.63	3494463.935	3468732.645
3	102763.8321	1714100.72	141427.4521	2404266.686	779265.2611	1625001.425	1604857.01	1585044.185	1565556.16	1563624.961	1546386.295
4	63375.78601	1794802.26	80701.54046	1371926.188	444665.4879	927260.6999	911966.0059	896985.3632	882311.065	880860.1945	867935.6256
5	42952.94754	1846976.74	52174.4843	886966.2331	287481.4085	599484.8246	587150.168	575118.8106	563382.087	562224.2945	551931.614
6	31019.07544	1883478.26	36501.51668	620525.7836	201123.3569	419402.4267	409068.59	399030.5928	389278.795	388318.9961	379803.9099
7	23446.81806	1910446.74	26968.47453	458464.0669	148596.2946	309867.7723	300978.729	292379.9181	284060.722	283243.7855	276010.9536
8	18343.32647	1931185.41	20738.67494	352557.474	114270.0989	238287.3751	230491.3472	222981.0925	215745.019	215036.061	208772.0502
9	14741.36715	1947629.43	16444.01746	279548.2968	90606.5362	188941.7606	182001.828	175343.9717	168955.631	168331.1551	162824.8536
10	12104.86206	1960987.65	13358.22653	227089.851	73603.82817	153486.0228	147234.9198	141262.7283	135555.928	134999.345	130101.7045
11	10117.24901	1972054.18	11066.52175	188130.8698	60976.53485	127154.3349	121469.5328	116060.8652	110913.86	110413.0183	106014.8589
12	8581.826669	1981372.14	9317.9653	158405.4101	51341.9888	107063.4213	101852.4563	96915.13973	92236.0582	91781.78757	87800.72499
13	7371.148756	1989325.63	7953.484832	141969.7043	43823.70142	98146.00283	92981.64079	88108.74218	83509.7536	83064.27793	79168.24484
14	6399.698307	1996193.9	6868.269666	122598.6135	37844.16586	84754.44768	79961.56509	75457.9076	71224.9334	70815.8477	67245.35851
15	5608.360991	2002184.87	5990.978079	106938.9587	33010.28921	73928.66949	69458.57629	65275.6231	61360.2912	60982.76802	57694.46105
16	4955.214643	2007456.56	5271.682133	94099.52607	29046.96855	65052.55752	60865.55151	56963.72577	53326.5964	52976.69992	49935.22618
17	4409.860497	2012131.15	4674.591459	83441.45754	25756.99894	57684.4586	53747.73983	50094.34568	46702.8387	46377.31799	43553.48207
18	3949.821059	2016304.65	4173.506902	74497.0982	22996.02303	51501.07517	47787.23253	44354.94641	41181.8376	40877.97629	38247.3872
19	3558.186337	2020053.55	3748.893081	66917.74149	20656.40087	46261.34061	42747.23195	39512.98622	36535.2941	36250.79945	33792.87222
20	3222.037405	2023439.49	3385.942922	60439.08117	18656.5455	41782.53566	38448.44458	35392.58691	32590.735	32323.65404	30020.85798
21	2931.367179	2026512.76	3073.267756	54857.82944	16933.70533	37924.12411	34753.11528	31858.76596	29215.9417	28964.5976	26801.88145
22	2678.326933	2029314.75	2801.992089	50015.55878	15438.97641	34576.58237	31554.00176	28806.55545	26308.2138	26071.15595	24035.5023
23	2456.690848	2031879.87	2565.116228	45787.32467	14133.79042	31653.53425	28766.61679	26153.35144	23786.8248	23562.79007	21642.86555
24	2261.469369	2034236.93	2357.059842	42073.51819	12987.39973	29086.11845	26323.67667	23833.44303	21587.6319	21375.51354	19561.39115
25	2088.625904	2036410.26	2173.33005	40733.63845	11975.04857	28758.58988	25919.25807	23370.31041	21081.0283	20865.30124	19024.0497
26	1934.866479	2038420.53	2010.27666	37677.6103	11076.6244	26600.9859	23875.19408	21438.3078	19258.6972	19053.77742	17308.30473
27	1797.481625	2040285.44	1864.909366	34953.06379	10275.6506	24677.41318	22056.8256	19723.69497	17645.492	17450.55605	15793.48047
28	1674.226192	2042020.2	1734.759584	32513.73151	9558.52531	22955.2062	20432.3714	18195.57225	16211.3919	16025.70406	14450.43194
29	1563.227042	2043637.98	1617.77491	30321.14625	8913.939752	21407.20649	18975.43643	16828.30577	14931.5218	14754.42202	13255.04004
30	1462.911455	2045150.21	1512.237662	28343.11439	8332.42952	20010.68487	17663.95407	15600.48947	13785.1341	13616.02809	12187.21335
31	1371.951114	2046566.92	1416.701451	26552.52694	7806.024995	18746.50195	16479.36278	14494.1379	12754.8176	12593.16838	11230.11278
32	1289.217905	2047896.86	1329.94133	24926.42537	7327.976728	17598.44865	15405.9597	13494.05291	11825.8772	11671.198	10369.54444
33	1213.748769	2049147.77	1250.914324	23445.26171	6892.537923	16552.72379	14430.38904	12587.32273	10985.8437	10837.69196	9593.48002
34	1144.717551	2050326.5	1178.727924	22092.30811	6494.79086	15597.51725	13541.23407	11762.92287	10224.0836	10082.05569	8891.675346
35	1081.41229	2051439.11	1112.614771	20853.18234	6130.507387	14722.67495	12728.68953	11011.39583	9531.48586	9395.212866	8255.364661
36	1023.216792	2052491.03	1051.91217	19715.46385	5796.036058	13919.42779	11984.29667	10324.59224	8900.2096	8769.353267	7677.014058
					Total NPV ($) =	22659864.73	22398180.35	22147057.75	21905674.3	21882042.47	21673291.7

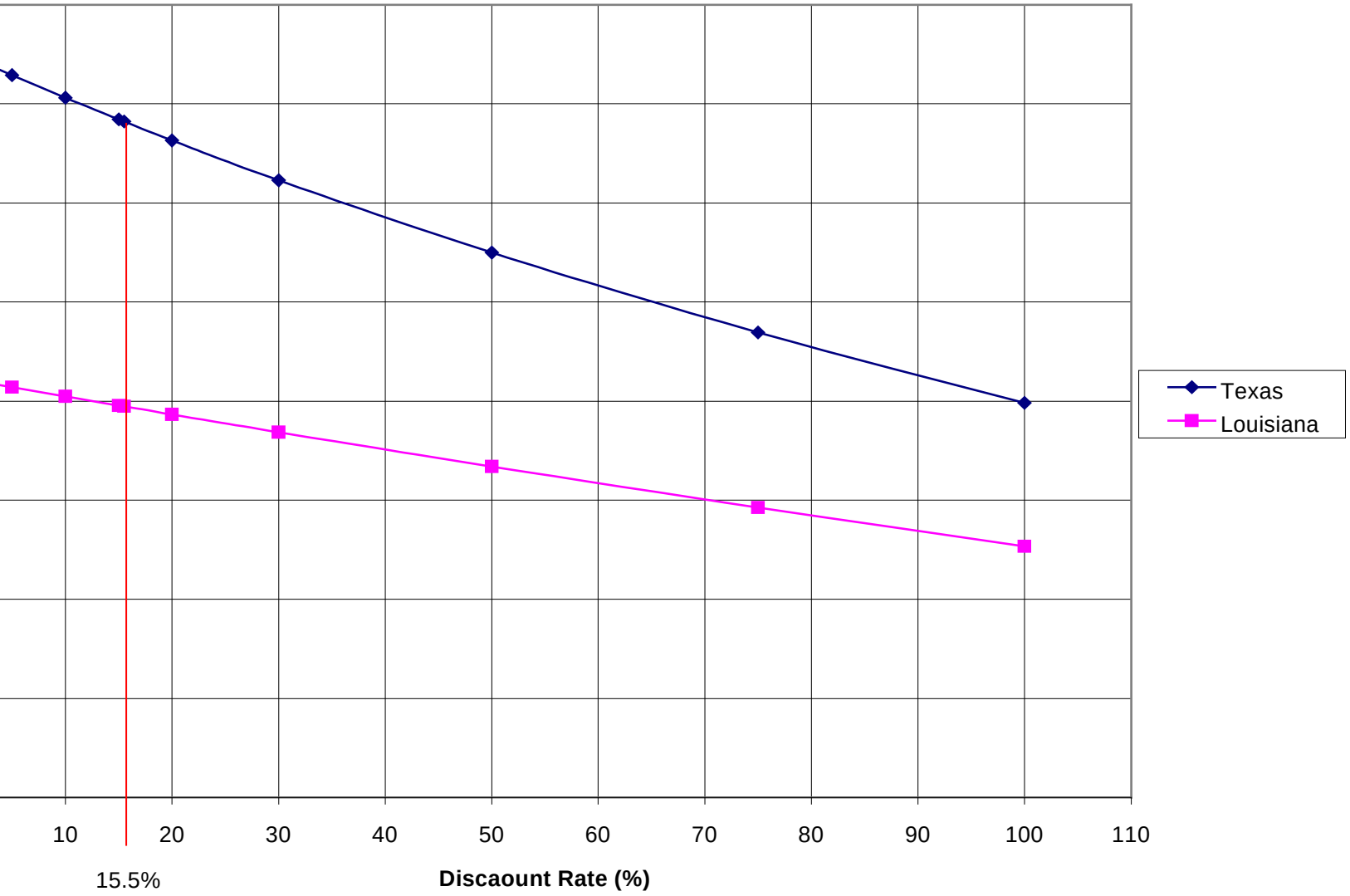

Flow Rate vs. Time (LOUISIANA)
Time (months)
0
5
10
15
20
25
30
35
40
Flow Rate (bbl/month)
1000000
100000
10000
1000
100
10
1
0.1

Project LOUISIANA

qi (bbl/day) = 100000 b= 0.2
qi (bbl/month) = 3040000 Di (1/day)= 0.1
Di(1/month) = 3.04
Price of oil ($/bbl) = 18.95 Production Cost ($/bbl) = 4.93
*Note: The price of oil is assumed to increase 5% each year

Time (month)	Flow Rate (bbl/month)	Np (bbl)	Np (bbl/month)	Profit($/month)	Operating Cost ($/month)	Net Cash Flow ($)	NPV@ 5%	NPV@ 10%	NPV@ 15%	NPV@ 15.5%
0	0	0	0	0	-100000	-100000	-100000	-100000	-100000	-100000
1	282776.5304	1063032.6	1063032.623	20144468.21	5240750.831	14903717.37	14841876.2	14780546.2	14719720.86	14713665.86
2	56888.542	1198164.1	135131.4358	2560740.709	666197.9785	1894542.73	1878853	1863357.37	1848052.655	1846532.563
3	16925.83573	1230346	32181.92802	609847.536	158656.9052	451190.6309	445597.423	440096.282	434685.3235	434149.1164
4	6384.651368	1240990.1	10644.094	201705.5814	52475.38344	149230.1979	146768.722	144357.788	141996.1559	141762.6577
5	2824.66376	1245307.7	4317.632362	81819.13326	21285.92754	60533.20571	59287.7091	58072.8383	56887.71822	56770.80967
6	1401.338283	1247321.8	2014.071238	38166.64995	9929.371202	28237.27875	27541.5283	26865.696	26209.1327	26144.5119
7	757.8736382	1248362.1	1040.31106	19713.89459	5128.733527	14585.16106	14166.7628	13762.0255	13370.44944	13331.99707
8	438.4335454	1248942.9	580.7604984	11005.41144	2863.149257	8142.262187	7875.87248	7619.24763	7371.991534	7347.766486
9	267.7201382	1249287.5	344.6914373	6531.902736	1699.328786	4832.57395	4655.07091	4484.78254	4321.387601	4305.415345
10	170.8863191	1249502.5	214.9710508	4073.701412	1059.80728	3013.894132	2891.14574	2773.87413	2661.813811	2650.884596
11	113.1896483	1249642.2	139.6682251	2646.712866	688.5643498	1958.148516	1870.60383	1787.31155	1708.04881	1700.335959
12	77.36238795	1249736.1	93.91597257	1779.70768	463.0057448	1316.701935	1252.61574	1191.89496	1134.350042	1128.763268
13	54.31850732	1249801.1	65.02729493	1293.880601	320.584564	973.2960369	922.081999	873.758351	828.1510188	823.7333177
14	39.0404105	1249847.3	46.17582421	918.7834622	227.6468134	691.1366489	652.05272	615.327299	580.809186	577.4732654
15	28.6398686	1249880.8	33.51846813	666.9337195	165.2460479	501.6876717	471.353152	442.967195	416.3973439	413.8354323
16	21.39339744	1249905.6	24.80555202	493.5684713	122.2913715	371.2770999	347.380431	325.111382	304.3530462	302.356068
17	16.23956521	1249924.3	18.67461206	371.5780934	92.06583744	279.512256	260.436734	242.734073	226.3003957	224.7230726
18	12.50617812	1249938.6	14.27546039	284.0459731	70.37801972	213.6679534	198.259942	184.020054	170.855442	169.5947804
19	9.756834329	1249949.6	11.06332526	220.1325144	54.54219353	165.5903208	153.011732	141.4349	130.7763891	129.7580535
20	7.701833704	1249958.3	8.68077835	172.7257872	42.79623726	129.9295499	119.561655	110.058971	101.3461596	100.5156283
21	6.14496335	1249965.2	6.888271439	137.059381	33.9591782	103.1002028	94.479525	86.6109714	79.42621185	78.74290986
22	4.950889839	1249970.7	5.522147645	109.8769328	27.22418789	82.65274488	75.427491	68.8599253	62.88782568	62.32115651
23	4.024711566	1249975.2	4.468632495	88.91461507	22.0303582	66.88425687	60.7841694	55.2623117	50.26181563	49.78842775
24	3.298864315	1249978.9	3.647362541	72.57339617	17.98149733	54.59189884	49.4070564	44.7331229	40.51794729	40.11982123
25	2.724573391	1249981.9	3.000741556	62.69261787	14.79365587	47.898962	43.1699038	38.9244958	35.1115745	34.75226968
26	2.2661747	1249984.3	2.486934452	51.95796717	12.26058685	39.69738032	35.6296065	31.9929743	28.7402816	28.43447426
27	1.897280327	1249986.4	2.075176884	43.35537365	10.23062204	33.12475161	29.6071093	26.4753235	23.68572973	23.42406518
28	1.598150555	1249988.2	1.742585757	36.40675511	8.590947782	27.81580732	24.7587803	22.0483548	19.6440385	19.41903255
29	1.353867634	1249989.6	1.47195882	30.75271566	7.256756985	23.49595868	20.826915	18.4702837	16.38842602	16.19404616
30	1.153050279	1249990.9	1.250236182	26.12040315	6.163664377	19.95673878	17.6163344	15.5584327	13.74797127	13.57932113
31	0.986937901	1249991.9	1.067411145	22.30075393	5.262336947	17.03841698	14.9778479	13.1735065	11.59266415	11.44574356
32	0.848730889	1249992.9	0.915750158	19.1321957	4.514648278	14.61754742	12.7964317	11.208372	9.822759053	9.69428009
33	0.733110354	1249993.7	0.789228035	16.48884807	3.890894213	12.59795386	10.9826864	9.57996478	8.361110461	8.248355071
34	0.635885063	1249994.3	0.683114887	14.27189239	3.367756394	10.904136	9.46660007	8.22339278	7.147598932	7.048308051
35	0.553729487	1249994.9	0.593671099	12.40319923	2.926798518	9.47640071	8.19295155	7.08759784	6.135038614	6.047325105
36	0.483987739	1249995.4	0.517920067	10.82058027	2.553345932	8.267234334	7.11789237	6.13213594	5.286145343	5.208425195
					Total NPV ($) =	17425198.38	17336276.1	17248315	17161297.64	17152647.14

Net Present Value Profile



5. CONCLUSIONS

From the results of the Net Present Value calculations for each field, we conclude that the oil well in Texas would be the most profitable investment. Despite higher initial investment, higher production costs, and lower oil prices the Texas field will yield greater returns over a three year period because the production rates in Texas are much larger than the production rates in Louisiana. Inspection of the Net Present Value Profile will show that the Texas oil field will be the best investment even if the discount rate changes from 15.5%. Investing in the Louisiana field will result in considerable profit over three years, but this project was designed to recommend the largest profit between the two fields.

6. REFERENCES:

1. Thompson, Robert and Wright, John. *Oil Property Evaluation*. Thompson-Wright Associates, 1985.
2. Mohaghegh, Shahab, Ph.D. *PNGE 241 Class notes*. Fall 1999.

APPENDIX: