

APPENDIX 9E

**MILORGANITE® AND GLASS FURNACE TECHNOLOGY
SENSITIVITY ANALYSIS**

Summary of Capital and Operating Costs

Milorganite® Capital Investment	\$36,266,250
Glass Furnace Capital Investment	\$79,350,000
Debt Service Rate	2.85%
General Interest Rate	3.0%
Electrical Power Interest Rate	0.0%
Natural Gas Interest Rate	0.0%
Discount Rate	5.125%

Milorganite®				Glass Furnace		
<u>Year</u>	<u>Debt Payment</u>	<u>Annual O&M</u>	<u>Total Annual</u>	<u>Debt Payment</u>	<u>Annual O&M</u>	<u>Total Annual</u>
1 2008	\$2,403,981	\$14,053,455	\$16,457,436	\$5,259,874	\$10,915,553	\$16,175,427
2 2009	\$2,403,981	\$14,043,166	\$16,447,147	\$5,259,874	\$10,958,657	\$16,218,531
3 2010	\$2,403,981	\$14,032,567	\$16,436,548	\$5,259,874	\$11,003,055	\$16,262,928
4 2011	\$2,403,981	\$14,021,651	\$16,425,632	\$5,259,874	\$11,048,784	\$16,308,657
5 2012	\$2,403,981	\$14,010,407	\$16,414,388	\$5,259,874	\$11,169,043	\$16,428,916
6 2013	\$2,403,981	\$13,998,826	\$16,402,807	\$5,259,874	\$11,144,398	\$16,404,272
7 2014	\$2,403,981	\$13,986,898	\$16,390,879	\$5,259,874	\$11,194,368	\$16,454,242
8 2015	\$2,403,981	\$13,974,611	\$16,378,592	\$5,259,874	\$11,245,836	\$16,505,710
9 2016	\$2,403,981	\$13,961,956	\$16,365,938	\$5,259,874	\$11,298,849	\$16,558,723
10 2017	\$2,403,981	\$13,948,922	\$16,352,903	\$5,259,874	\$11,633,978	\$16,893,852
11 2018	\$2,403,981	\$13,935,496	\$16,339,477	\$5,259,874	\$11,409,692	\$16,669,566
12 2019	\$2,403,981	\$13,921,668	\$16,325,649	\$5,259,874	\$11,467,621	\$16,727,495
13 2020	\$2,403,981	\$13,907,424	\$16,311,406	\$5,259,874	\$11,527,287	\$16,787,161
14 2021	\$2,403,981	\$13,892,754	\$16,296,735	\$5,259,874	\$11,588,743	\$16,848,617
15 2022	\$2,403,981	\$13,877,643	\$16,281,624	\$5,259,874	\$10,980,553	\$16,240,427
16 2023	\$2,403,981	\$13,862,079	\$16,266,060	\$5,259,874	\$11,717,241	\$16,977,115
17 2024	\$2,403,981	\$13,846,048	\$16,250,029	\$5,259,874	\$11,784,396	\$17,044,270
18 2025	\$2,403,981	\$13,829,536	\$16,233,518	\$5,259,874	\$11,853,565	\$17,113,439
19 2026	\$2,403,981	\$13,812,529	\$16,216,510	\$5,259,874	\$11,924,809	\$17,184,683
20 2027	\$2,403,981	\$13,795,012	\$16,198,993	\$5,259,874	\$12,901,247	\$18,161,120
Total	\$48,079,623	\$278,712,650	\$326,792,273	\$105,197,479	\$228,767,673	\$333,965,152
NPV			\$201,757,046			\$204,658,021

Base Case Analysis Assumptions

Key Assumptions			
Cost of Capital	annual rate	2.85%	
Life of Investments	years	20	
Nominal Milorganite Production	Tons / year	42,000	
Chaff	Tons / year	4,200	
Milo to Landfill	Tons / year	0	
Capital Cost Escalation Factor		0%	
General Inflation Rate		3.0%	
Electrical Energy Inflation Rate		0.0%	
Natural Gas Inflation Rate		0.0%	
Milorganite Revenue Inflation		0.0%	
Discount Rate		5.13%	
Natural Gas Cost			
2008 All-in Burner Tip		\$9.25	
2009 All-in Burner Tip		\$9.25	
2010 All-in Burner Tip		\$9.25	
2011 All-in Burner Tip		\$9.25	
Electric Cost Structure - Milorganite Case			
1st Year Escalation Factor		8%	
Tariff - ?		Future (2008) Current	
On-peak demand rate	\$/Kw	11.2104	
Customer demand rate	\$/Kw	0.8208	
On-peak energy rate	\$/KwHr	0.066204	
Off-peak energy rate	\$/KwHr	0.033696	
Facilities charge	\$/month	567	
Electric Cost Structure - Glass Furnace Case			
Transmission Service Schedule ?			
On-peak demand rate	\$/Kw	10.21	9.4498
Customer demand rate	\$/Kw	0	
On-peak energy rate	\$/KwHr	0.0651	0.0603
Off-peak energy rate	\$/KwHr	0.0337	
Facilities charge	\$/month	567	
Interruptible Rate			
On-peak demand rate	\$/Kw	4.85	4.4918
Customer demand rate	\$/Kw	0	
On-peak energy rate	\$/KwHr	0.0592	0.0548
Off-peak energy rate	\$/KwHr	0.0305	0.0282
Facilities charge	\$/month	864	
Chemicals			
19% Aq Ammonia	\$/ton of Milorga	\$0.60	
	\$/ton anhydrou:	\$310	
50% Aq Sodium Hydroxide	\$/ton of Milorga	\$5.40	
	\$/ton anhydrou:	\$270	
O&M			
Glass Furnace System C	\$/dry ton	\$8	
O2 System		0	Included in \$8/dry ton

Biosolids Disposal Option
Economic Evaluation
Glass Furnace Option

Capital Investment	Qty	Unit Cost	Cost	
Two New Turbine Generators	0	\$33,900,000	\$0	
Sludge Agglomeration	0	\$3,000,000	\$0	
SSWWTP sludge Handling Equipment	0	\$1,200,000	\$0	
add'l equipment	0	\$700,000	\$0	
Interplant Sludge pumping & pipeline upgrades	0	\$2,700,000	\$0	
Glass Furnace & O2 System Complete	1	\$66,200,000	\$66,200,000	
inc Conveyance of Dried Sludge to Glass Furnace				
inc Chaff handling & Conveyance				
Transmission Line (outside the "fence")	1	\$7,000,000	\$7,000,000	Reflects a \$2.2MM reduction per Glass Furnace
Transmission Line (inside the "fence")	1	\$6,400,000	\$6,400,000	
Generator Plug-in	0	\$400,000	\$0	
Replacement locomotive	0	\$2,616,250	\$0	
Capital Sub-Total			\$79,600,000	
Reimbursements				
Sale of Used GE Frame 5	1	(\$250,000)	(\$250,000)	
Sub-Total			(\$250,000)	
Net Capital Investment			\$79,350,000	
Capital Escalation Factor			0%	
Assumed Capital Investment			\$79,350,000	
Overhauls and Major Maintenance (expressed as net present values)				
D&D Equipment Replacement (over 20 years)	0	\$49,000,000	\$0	
SSWWTP digester & digested sludge equipment (over 20 years)	0	\$6,500,000	\$0	
Transmission Line & Substation (inside the "fence")	0	\$1	\$0	
Sub-Total			\$0	
PV of Energy Costs (from Below)				
PV of O&M Costs (from Below)				
O&M Sub-Total			\$0	
Miscellaneous & Contingency	0%		\$0	
Grand Total			\$79,350,000	

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Fuel Consumption, MMBtu											
Base Case		0	0	0	0	0	0	0	0	0	0
Additional ISS Pumps (4&5)							0	0	0	0	0
Additional PAC											
Supplemental		0	0	0	0	0	0	0	0	0	0
Glass Furnace Use		121,379	121,379	121,379	121,379	121,379	121,379	121,379	121,379	121,379	121,379
Fuel Use		121,379	121,379	121,379	121,379	121,379	121,379	121,379	121,379	121,379	121,379
Fuel Pricing (\$/MMBtu)											
Inflation Rate	0.0%	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25
Total		\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25
Fuel Cost (\$)		\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756	\$1,122,756
Off-Peak Power Purchases (MWh)											
Base Case		88,044	88,044	88,044	88,044	88,044	88,044	88,044	88,044	88,044	88,044
Additional ISS Pumps (4&5)		0	0	0	0	0	0	0	0	0	0
Additional PAC		0	0	0	0	0	0	0	0	0	0
Annual Off-Peak Purchase		88,044	88,044	88,044	88,044	88,044	88,044	88,044	88,044	88,044	88,044
O2 plant - interruptible		9,758	9,758	9,758	9,758	9,758	9,758	9,758	9,758	9,758	9,758
On-Peak Power Purchases (MWh)											
Base Case		41,940	41,940	41,940	41,940	41,940	41,940	41,940	41,940	41,940	41,940
Additional ISS Pumps (4&5)							0	0	0	0	0
Additional PAC		0	0	0	0	0	0	0	0	0	0
Annual on-peak Purchase		41,940	41,940	41,940	41,940	41,940	41,940	41,940	41,940	41,940	41,940
O2 plant interruptible		5,489	5,489	5,489	5,489	5,489	5,489	5,489	5,489	5,489	5,489
Max Demand for Demand Charge (MW)											
Base Case		13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Annual Frequency (# of months per year)		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Additional ISS Pumps (1, 2 and 3)		9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Annual Frequency (# of months per year)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Additional ISS Pumps (4&5)		6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Annual Frequency (# of months per year)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Additional PAC		4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Annual Frequency (# of months per year)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Option 1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max Demand		33.3	49.3	49.3	49.3	49.3	49.3	49.3	49.3	49.3	49.3
Annual Frequency (# of months per year)		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
O2 Plant		2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Electric Energy - Interruptible											
ON Peak Demand		\$11,099	\$11,099	\$11,099	\$11,099	\$11,099	\$11,099	\$11,099	\$11,099	\$11,099	\$11,099
Customer Demand		0.0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Off-Peak Energy		\$297,493	\$297,493	\$297,493	\$297,493	\$297,493	\$297,493	\$297,493	\$297,493	\$297,493	\$297,493
On Peak Energy		\$325,076	\$325,076	\$325,076	\$325,076	\$325,076	\$325,076	\$325,076	\$325,076	\$325,076	\$325,076
Facility and Other		\$10,368	\$10,368	\$10,368	\$10,368	\$10,368	\$10,368	\$10,368	\$10,368	\$10,368	\$10,368
		\$644,036	\$644,036	\$644,036	\$644,036	\$644,036	\$644,036	\$644,036	\$644,036	\$644,036	\$644,036

Electric Energy Cost

ON Peak Demand	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661	\$2,006,661
Customer Demand	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Off-Peak Energy	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738	\$2,966,738
On Peak Energy	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758	\$2,731,758
Facility and Other	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804
	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961	\$7,711,961

Total Electric (Firm + Uninterruptible) * Inflation factor	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998	\$8,355,998
Inflation Factor	0.0%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

TOTAL ENERGY	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753	\$9,478,753
---------------------	--------------------	--------------------	--------------------	--------------------	--------------------	--------------------	--------------------	--------------------	--------------------	--------------------	--------------------

Impactable Changes to Cash Flow

	0	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
O&M Glass Furnace											
1 Glass Aggregate	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Glass Furnace Chemicals (cooling water, air emission, 1 etc)	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200	\$277,200
1 Operations & Maintenance Staff	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000	\$790,000
1 Annual Glass Furnace System Maintenance	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600	\$369,600
1 Major Maintenance Activities - Glass Furnace refractory filler retubing	\$0	\$0	\$0	\$0	\$0	\$65,000	\$0	\$0	\$0	\$0	\$215,000
						\$65,000					\$150,000
1 Rebate - NG Conservation Program	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1 Emission Reduction Credit	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1 Turbine Capacity Contract	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1 Major Maintenance Activities - O2 system	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total O&M Glass Furnace	\$1,436,800	\$1,436,800	\$1,436,800	\$1,436,800	\$1,436,800	\$1,501,800	\$1,436,800	\$1,436,800	\$1,436,800	\$1,436,800	\$1,651,800

O&M Milorganite

o Chaff	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o Dust Agent	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o Turbine Operation & Maintenance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o D&D Facility Impacts	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o MMSD Milo Revenue	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o MMSD Milo Marketing Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o MMSD Other Support & Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
o Other	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total O&M Milorganite	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Glass Furnace Existing Fuel & Power

Taken From Table 1: Provided by Minergy on 3/21/2006

From MMSD Data

	ELECTRIC			Oxygen Plant			Melter Plant			Base Plant w/o Turbines			TOTAL ELECTRIC USE		
	Electric Use (kwh)	Peak Demand (kw)	Customer Demand (kw)	Electric Use (kwh)	Peak Demand (kw)	Customer Demand (kw)	Electric Use (kwh)	Peak Demand (kw)	Customer Demand (kw)	Electric Use (kwh)	Peak Demand (kw)	Customer Demand (kw)	Electric Use (kwh)	Peak Demand (kw)	Customer Demand (kw)
January	1,229,547	2,288		335,331	685										
February	1,299,144	2,288		354,312	685										
March	1,230,273	2,288		335,529	685										
April	1,392,930	2,288		379,890	685										
May	1,439,361	2,288		392,553	685										
June	1,392,930	2,288		379,890	685										
July	1,230,273	2,288		335,529	685										
August	1,229,547	2,288		335,331	685										
September	1,183,149	2,288		322,677	685										
October	1,229,547	2,288		335,331	685										
November	1,183,149	2,288		322,677	685										
December	<u>1,206,348</u>	2,288		<u>329,004</u>	685										
	15,246,198			4,158,054											
On Peak	5,488,631 kwh			1,496,899 kwh						40,443,176 kwh			47,428,706 kwh		
Off Peak	9,757,567 kwh			2,661,155 kwh						85,383,056 kwh			97,801,777 kwh		
Peak Demand	2,288 kwe			685 kwe						22,100 kwe			25,073 kwe		
Customer Demand	2,288 kwe			685 kwe						22,100 kwe			25,073 kwe		
Frequency										12 months			12 months		
Given	36% onpeak			36%											
	64% offpeak			64%											

NATURAL GAS

	Melter Start-up (Dtherms)	NOX Reheat (Dtherms)	Direct Fire (Dtherms)	Base Plant w/o Turbines (Dtherm)	Direct Fire (Dtherms)
January	240	460	11,954		
February	120	460	8,685		
March	240	460	16,963		
April	120	460	8,613		
May	120	460	13,030		
June	120	460	5,033		
July	240	460	10,840		
August	240	460	9,487		
September	240	460	8,634		
October	240	460	7,885		
November	240	460	7,939		
December	<u>240</u>	460	<u>4,396</u>		
	2,400	5,520	113,459	(1,627,134)	222,808
				Diff in Use	109,349
				Diff in Economic Analysis	0

Biosolids Disposal Option
Economic Evaluation
Milorganite, Replace Turbines

Capital Investment				
	<u>Qty</u>	<u>Unit Cost</u>	<u>Cost</u>	
Two New Turbine Generators	1	\$33,900,000	\$33,900,000	
Sludge Agglomeration	0	\$3,000,000	\$0	Improvement is common to both alternatives and has been deleted from evaluation
SSWWTP sludge Handling Equipment	0	\$1,200,000	\$0	Improvement is common to both alternatives and has been deleted from evaluation
	0	\$700,000	\$0	Improvement is common to both alternatives and has been deleted from evaluation
Interplant Sludge pumping & pipeline upgrades	0	\$2,700,000	\$0	Improvement is common to both alternatives and has been deleted from evaluation
Glass Furnace & O2 System Complete	0	\$66,200,000	\$0	
inc Conveyance of Dried Sludge to Glass Furnace				
inc Chaff handling & Conveyance				
Transmission Line (outside the "fence")	0	\$7,000,000	\$0	
Transmission Line (inside the "fence")	0	\$6,400,000	\$0	
Generator Plug-in	0	\$400,000	\$0	
Replacement locomotive	1	\$2,616,250	\$2,616,250	
Capital Sub-Total			\$36,516,250	
Reimbursements				
Sale of Used GE Frame 5	1	(\$250,000)	(\$250,000)	
Sub-Total			(\$250,000)	
Net Capital Investment			\$36,266,250	
Capital Escalation Factor			0%	
Assumed Capital Investment			\$36,266,250	
Overhauls and Major Maintenance (expressed as net present values)				
D&D Equipment Replacement (over 20 years)	0	\$49,000,000	\$0	Improvement is common to both alternatives and has been deleted from evaluation
SSWWTP digester & digested sludge equipment (over 20 years)	0	\$6,500,000	\$0	Improvement is common to both alternatives and has been deleted from evaluation
Transmission Line & Substation (inside the "fence")	0	\$1	\$0	
Sub-Total			\$72,532,500	
PV of Energy Costs (from below)				
PV of O&M Costs (from below)				
O&M Sub-Total				
Miscellaneous & Contingency	0%		\$0	
Grand Total			\$36,266,250	

		NEW TURBINE										
		2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Fuel Consumption, MMBtu												
Base Case			1,216,651	1,216,651	1,216,651	1,216,651	1,216,651	1,216,651	1,216,651	1,216,651	1,216,651	1,216,651
Additional ISS Pumps (1 - 3)			104,329	104,329	104,329	104,329	104,329	104,329	104,329	104,329	104,329	104,329
Additional ISS Pumps (4&5)			0	0	0	0	0	0	0	0	0	0
Additional PAC			0	0	0	0	0	0	0	0	0	0
Sludge Drying			234,657	234,657	234,657	234,657	234,657	234,657	234,657	234,657	234,657	234,657
Fuel Use	1,642,000		1,555,637	1,555,637	1,555,637	1,555,637	1,555,637	1,555,637	1,555,637	1,555,637	1,555,637	1,555,637
Fuel Pricing (\$/MMBtu)												
	0.0%		\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25
Total			\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25	\$9.25
Fuel Cost (\$)			\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639	\$14,389,639
Off-Peak Power Purchases (MWh)												
Base Case			0	0	0	0	0	0	0	0	0	0
Additional ISS Pumps (4&5)			0	0	0	0	0	0	0	0	0	0
Additional PAC			0	0	0	0	0	0	0	0	0	0
Glass Furnace Use												
Annual Off-Peak Purchase			0	0	0	0	0	0	0	0	0	0
On-Peak Power Purchases (MWh)												
Base Case			0	0	0	0	0	0	0	0	0	0
Additional ISS Pumps (4&5)										0	0	0
Additional PAC			0	0	0	0	0	0	0	926	926	926
Annual on-peak Purchase			0	0	0	0	0	0	0	926	926	926
Max Demand for Demand Charge (MW)												
Base Case			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Additional ISS Pumps (4&5)			0.0	0.0				0.0	0.0	0.0	0.0	0.0
Additional PAC			0.0	0.0						0.6	0.6	0.6
Customer Demand			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max On PeakDemand			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
Annual Frequency (# of months per year Max On Peak)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electric Energy Cost												
ON Peak Demand			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Customer Demand			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Off-Peak Energy			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
On Peak Energy			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Facility and Other			\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804
			\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804
Total Electric (Firm + Uninterruptible) * Inflation factor			\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804	\$6,804
Inflation Factor	0.0%		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TOTAL ENERGY			\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443	\$14,396,443

Impactable Changes to O&M	Initial	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
O&M Glass Furnace											
0 Glass Aggregate	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Glass Furnace Chemicals (cooling water, air emmision, 0 etc)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Operations & Maintenance Staff	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Annual Glass Furnace System Maintenance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Major Maintenance Activities - Glass Furnace	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
refractory											\$150,000
filler						\$65,000					\$65,000
retubing											
0 Rebate - NG Conservation Program	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Emission Reduction Credit	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Turbine Capacity Contract	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
0 Major Maintenance Activities - O2 system	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total O&M Glass Furnace	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
O&M Milorganite											
1 Chaff	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222	\$202,222
1 Dust Agent	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928	\$212,928
1 Turbine Operation & Maintenance	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994	\$1,553,994
1 D&D Facility Impacts	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1 MMSD Milo Revenue	0.0% (\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)	(\$5,836,133)
1 MMSD Milo Marketing Cost	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000	\$3,184,000
1 MMSD Other Support & Costs	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000	\$340,000
1 Other	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1
Total O&M Milorganite	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)
Total O&M		(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)	(\$342,988)
Inflation Factor	3.0%	1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30
Total Milorganite O&M		(\$342,988)	(\$353,278)	(\$363,876)	(\$374,792)	(\$386,036)	(\$397,617)	(\$409,546)	(\$421,832)	(\$434,487)	(\$447,521)

Milorganite Existing Fuel & Power

Common Inputs

Pump Electrical Load	3.2	Mwe/pump/hr
Plant baseload req't	12.5	Mwe
Add'l PAC	4.1	Mwe
Avg dispatch load	0.0	Mwe
Direct Fire Efficiency	99%	
Heat Req'd per Dryer	19	mmBtu/hr/dryer
Average #dryers req'd	7.1	
Total output heat req'd	135	mmBtu/hr

Definition of Base Operating Modes

Mode	Description	Electrical Req'ts (Mwe)				Operating Time			Incidents	Heat Req'd	Annual		
		Plant	Pumps	Dispatch	Total	Days/yr	Hrs/day	Hrs/yr	Months/yr	mmBtu/hr			
1	Off Peak, 0 Pumps	12.5	0.0	0.0	12.5	na	na	2179.4	12.0	135	27,243	MwHr	2179.4
2	Off Peak, 1 Pump	12.5	3.2	0.0	15.7	300.3	8.6	2569.3	12.0	135	40,338	MwHr	2569.3
3	Off Peak, 2 Pumps	12.5	6.4	0.0	18.9	88.8	7.3	643.8	6.0	135	12,168	MwHr	643.8
4	Off Peak, 3 Pumps	12.5	9.6	0.0	22.1	30.9	8.3	254.9	3.0	135	5,634	MwHr	254.9
5	On Peak, 0 Pumps	12.5	0.0	0.0	12.5	na	na	2865.8	12.0	135	35,822	MwHr	2646.3
6	On Peak, 1 Pump	12.5	3.2	0.0	15.7	9.0	6.6	64.4	2.0	135	1,011	MwHr	59.5
7	On Peak, 2 Pumps	12.5	6.4	0.0	18.9	12.5	9.7	131.4	2.0	135	2,483	MwHr	121.3
8	On Peak, 3 Pumps	12.5	9.6	0.0	22.1	5.6	8.5	51.0	2.0	135	1,128	MwHr	47.1
	Total							8760			125,826	MwHr	
											onpeak	40,443	MwHr
											offpeak	85,383	MwHr
											customer Demand	22.1	Mwe
											Peak Demand	22.1	Mwe

Definition of Future Operating Modes

Mode	Description	Incremental Electrical Req'ts (Mwe)				Operating Time			Incidents	Heat Req'd
		Plant	Pumps	Dispatch	Total	Days/yr	Hrs/day	Hrs/yr	Months/yr	mmBtu/hr
13	Off Peak, 4th Pump	0.0	3.2	0.0	3.2	na	na	339.9	2.0	135
14	Off Peak, 4th, 5th Pump	0.0	6.4	0.0	6.4	na	na	63.7	1.0	135
15	On Peak, 4th pump	0.0	3.2	0.0	3.2	na	na	339.9	2.0	135
16	On Peak, 4th & 5th pump	0.0	6.4	0.0	6.4	na	na	36.0	1.0	135
17	Added PAC off peak	4.1	0.0	0.0	4.1	231.4	12.0	2777	7.0	
18	Added PAC on peak	4.1	0.0	0.0	4.1	128.6	12.0	1543	7.0	
	Total									

Base Case Operating Strategy

Use Existing Frame 5 for heat generation off peak, power generation on peak, no direct firing of dryers req'd

Mode	Description	Pwr Req'd (Mwe)	Op Hrs (Hrs/yr)	Sources of Power (Mwe)			Heat Rates (Btu/kwh)		Annual Consumption of Gas Fuel (MMBtu)				Energy Purchases (MWhr)	Energy Sales (MWhr)	Generated Power (MWhr)	Exhaust Heat (mmBtu/hr)			Effective HR (Btu/kwh)
				GT1 (Frame 5)	GT2 (Frame 5)	Purchased	GT1 (Frame 5)	GT2 (Frame 5)	GT1 (Frame 5)	GT2 (Frame 5)	direct fire	Total				Req'd	Produced	Excess	
1	Off Peak, 0 Pumps	12.5	2179	8.0	0.0	4.5	20,905	0	364,486	0	13,493	364,486	9,807	0	17,435	135	129	-6	20,905
2	Off Peak, 1 Pump	15.7	2569	8.0	0.0	7.7	20,905	0	429,691	0	15,907	429,691	19,784	0	20,554	135	129	-6	20,905
3	Off Peak, 2 Pumps	18.9	644	8.0	0.0	10.9	20,905	0	107,675	0	3,986	107,675	7,018	0	5,151	135	129	-6	20,905
4	Off Peak, 3 Pumps	22.1	255	8.0	0.0	14.1	20,905	0	42,636	0	1,578	42,636	3,595	0	2,039	135	129	-6	20,905
5	On Peak, 0 Pumps	12.5	2866	12.5	0.0	0.0	16,805	0	601,998	0	0	601,998	0	0	35,822	135	150	15	16,805
6	On Peak, 1 Pump	15.7	64	15.5	0.2	0.0	15,436	45,534	15,404	586	0	15,990	0	0	1,011	135	164	29	15,819
7	On Peak, 2 Pumps	18.9	131	16.0	2.9	0.0	15,202	33,439	31,951	12,739	0	44,689	0	0	2,483	135	166	31	18,000
8	On Peak, 3 Pumps	22.1	51	16.0	6.1	0.0	15,202	24,285	12,411	7,559	0	19,969	0	0	1,128	135	166	31	17,709
9	On Peak, 0 Pumps, Dispatch	12.5	0	9.0	3.5	0.0	19,600	31,336	0	0	0	0	0	0	0	135	133	-1	#DIV/0!
10	On Peak, 1 Pump, Dispatch	15.7	0	12.5	3.2	0.0	16,805	32,363	0	0	0	0	0	0	0	135	150	15	#DIV/0!
11	On Peak, 2 Pumps, Dispatch	18.9	0	12.5	6.4	0.0	16,805	23,663	0	0	0	0	0	0	0	135	150	15	#DIV/0!
12	On Peak, 3 Pumps, Dispatch	22.1	0	15.0	7.1	0.0	15,658	22,345	0	0	0	0	0	0	0	135	162	27	#DIV/0!
			8760		max>	0.0					0	0	0	0	0			137	
	Off-Peak Total								944,487	0	34,965	944,487	40,203	0	45,180				20,905
	On-Peak Total								661,763	20,884	0	682,647	0	0	40,443				16,879
	Annual Total								1,606,250	20,884	34,965	1,627,134	40,203	0	85,623				19,003

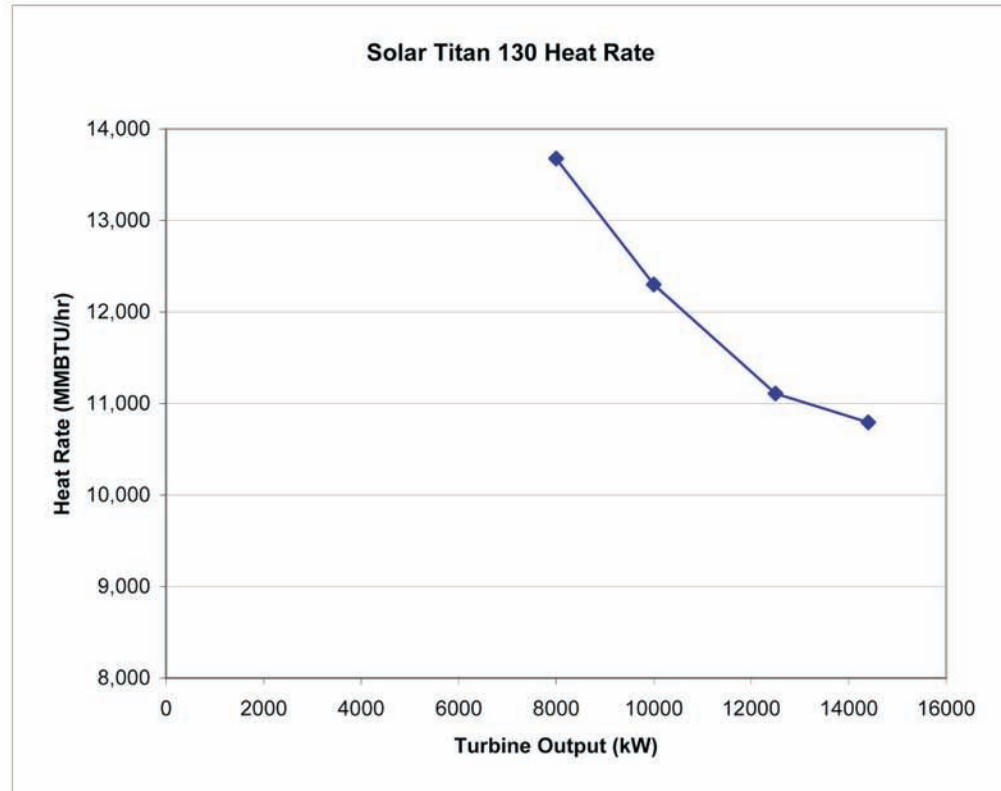
Incremental Additions

	Mode	Description	Pwr Req'd (Mwe)	Op Hrs (Hrs/yr)	Sources of Power (Mwe)			Heat Rates (Btu/kwh)		Annual Consumption of Gas Fuel (MMBtu)				Energy Purchases (MWhr)	Energy Sales (MWhr)	Generated Power (MWhr)	Exhaust Heat (mmBtu/hr)			Effective HR (Btu/kwh)
					GT1 (Frame 5)	GT2 (Frame 5)	Purchased	GT1 (Frame 5)	GT2 (Frame 5)	GT1 (Frame 5)	GT2 (Frame 5)	direct fire	Total				Req'd	Produced	Excess	
	13	Off Peak, 4th Pump	25.3	340	8.0	0.0	3.2	0	0	0	0	0	0	1,088	0	0	135	129	0	0
	14	Off Peak, 4th, 5th Pump	28.5	64	8.0	0.0	6.4	0	0	0	0	0	0	408	0	0	135	279	144	0
	15	On Peak, 4th pump	25.3	340	16.0	9.3	0.0	0	19,263	0	53,335	0	53,335	0	0	1,088	135	316	181	6,202
	16	On Peak, 4th & 5th pump	28.5	36	16.0	12.5	0.0	0	16,805	0	4	0	4	0	0	230	135	316	181	4
		Off-Peak Total							0	0	0	0	0	1,496	0	0				#DIV/0!
		On-Peak Total							0	53,339	0	53,339	0	0	1,318	0				40,466
		Annual Total					max>	0.0		0	53,339	0	53,339	1,496	0	1,318				40,466
	17	Added PAC off peak	4.1	19.8	2777	16.0	0.0	3.8	15,202	0	337,738	0	337,738	10,553	0	44,434	0	166	166	7,601
	18	Added PAC on peak	4.1	16.6	1543	16.0	0.0	0.6	15,202	0	82,089	0	82,089	926	0	24,686	0	166	166	3,325
		Off-Peak Total							337,738	0	0	0	337,738	10,553	0	44,434				7,601
		On-Peak Total							82,089	0	0	0	82,089	926	0	24,686				3,325
		Annual Total					max>	0.6		419,827	0	0	419,827	11,479	0	69,120				6,074

New Turbine Heat Rate Versus Turbine Output

Solar Titan 130

<u>Output</u>	<u>Heat Rate</u>	<u>Exhaust Energy</u>
14400	10,793	68.7
12500	11,111	63.4
10000	12,302	59.5
8000	13,678	55.5



<u>Turbine Operating Scenarios</u>	<u>Total Load</u>	<u>No. of Turbines</u>	<u>Load Each (MW)</u>	<u>Heat Rate (BTU/kWh)</u>	<u>Operating Hours (hr)</u>	<u>Total NG Required Dtherm</u>
Base Plant	12.5	1	12.5	11,111	8760	1,216,651
+3 ISS Pumps	9.6	2	11.05	11,802	800	104,329
+2 New ISS Pumps	6.4	2	14.25	10,818	0	0

Turbine Waste Heat Versus Natural Gas Drying

The purpose of this spreadsheet is to evaluate at what Milorganite Production level it becomes beneficial to go off of the turbines and dry with natural gas only while buying electric power.

Cost to run with turbines

- Cost for fuel
- Cost for turbine maintenance
- Assume a demand charge for a relatively infrequent failure (once per year)

Costs to not run a turbine

- Costs for fuel to run dryers (1,800 BTU/lb. water evaporated)
- Costs to run boilers for building heat
- Costs to buy electricity (include all charges)

Assumptions

Electrical Rates

Facilities Charge	\$6,300 /year	Turbine Heat Rate	Percent	Output	Heat Rate	#REF!
Customer Charge	NA /month		Loaded (%)	MW	BTU/kWh	
On Peak Energy Charge	\$0.0613 /kWh		100	17900	15040	
Off Peak Energy Charge	\$0.0331 /kWh		80%	14320	16426	
On-Peak Demand Charge	\$10.38 /kW		70%	12530	17267	
Customer Demand Charge	\$0.76 /kw		60%	10740	18388	
			50%	8950	20207	

Fuel Cost

Natural Gas Cost	\$7.01 \$/Dtherm (2005 cost per Dtherm, does not include daily administration and meter charges)
	\$/kW-hr Cost to produce Electricity assuming 24% efficient turbines

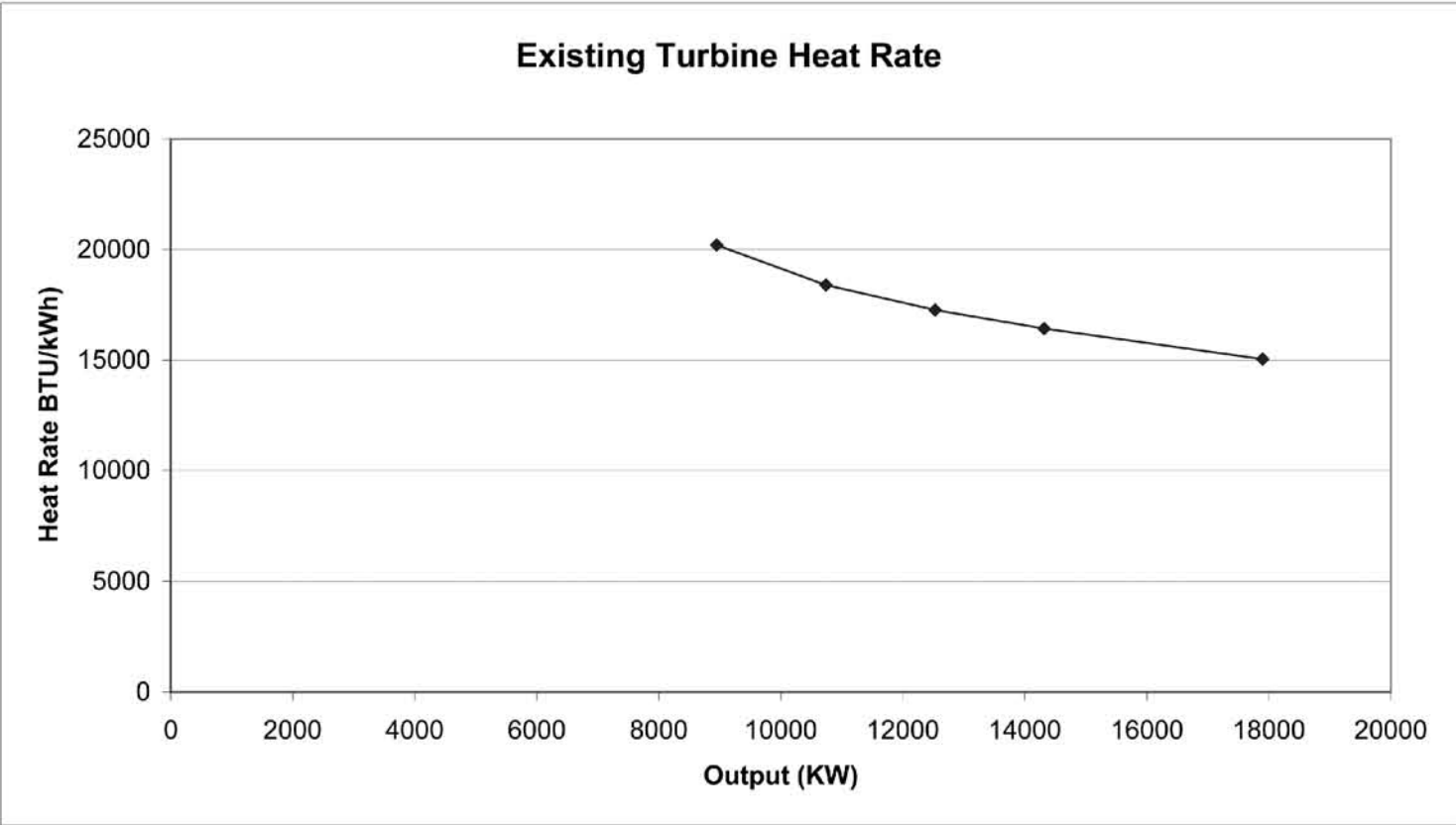
Turbine Maintenance

Maintenance Cost	\$5.00 \$/MW-hr (rule-of-thumb from Bryan Eskra)
------------------	--

Milo Production (t/year)	0	45,000	Scale the plant power according
Plant Power Requirements	8	12	to the Milorganite Production

Water to Evaporate in Dryers

Assume cake solids	17.0%
Assumed % of Milo that is product	95.0% The rest is Chaff
Cake to Dryers per ton finished Product	1.05 tons
Water in Cake per ton finished product	5.14 tons
Finished product Moisture	5.00%
Water in finished product	0.055 tons
Water to Evaporate per ton finished	5.08 tons
	10,168 pounds
Heat of Evaporation	1850 BTU/lb. water evaporated
Heat Required to Evaporate Water	18,810,494 BTU/ton of Finished product
	18.8 Dtherm/ton of finished product



	Milorganite Production tpy	Turbine Output MW	Turbine Heat Rate BTU/kWh)	Turbine Fuel Dtherm	Exhaust Heat Dtherm	Dryer Heat Req'd Dtherm	Dryer Fuel Dtherm
Base Case	42,000	12.5	11,111	1,216,651	555,384	790,041	234,657

Estimates of Operation & Maintenance Costs

Glass Furnace Related	Annual Cost	Unit Prices	Quantity
Glass Aggregate Sales/Disposal	\$0	0	13505 tons/year
Glass Furnace Chemical Costs			
19% Aq Ammonia	\$27,720	\$0.60	46,200 tons/year milo & chaff
50% Aq Sodium Hydroxide	\$249,480	\$5.40	46,200 tons/year milo & chaff
Cooling Water	\$0		
Total	\$277,200		
Glass Furnace O&M Cost			
O&M Staff	\$790,000	\$115,000 \$100,000	4 on 12, 2 6 relief Operators 1 operator, 24x7x365 1 Maintenance Tech
Glass Furnace System Maintenance	\$369,600	\$8	46,200 tons/year milo & chaff
Oxygen Sytem Maintenance	\$0	\$0.00	50,000 to be provided

Milorganite® Related	Annual Cost	Unit Prices	Quantity
Chaff disposal	\$202,222	\$16.25	12,444 cu yds/year
Dust Agent	\$212,928	\$5.07	42,000
Sludge Agglomerator Maintenance	\$1		
Substations and new Electric Distribution O&M	\$1		

Dust Agent
2005 Milorganite® Sales
38,515 tons to all but Sunniland
5,547 tons to Sunniland
44,062 tons sold
1 gal/ton applied to all but Sunniland
3 gal/ton applied to Sunniland
55156 gallons applied
\$4.05 cost per gallon (2006 1st Quarter bill from UWS)
\$223,381.80 cost of dust agent
\$5.07 Cost per ton

Turbine Maintenance Cost	Basis	Annualized Cost	
	new turbine	Frame 5	Difference
Estimated Maintenance			
Routine Maintenance	1 manyear + misc materials	100,000	100,000 0
Major overhaul	2,000,000	333,333	250,000 83,333
period (yrs)	6		
Hot Gas Path Inspection	750,000	250,000	200,000 50,000
period (yrs)	3		
Combustor Inspection	150,000	50,000	33,333 16,667
period (yrs)	3		
Boroscope	10,000	10,000	10,000 0
period (yrs)	1		
Unplanned maintenance	75,000	75,000	75,000 0
period (yrs)	1		
Total		818,333	668,333 150,000
Actual Maintenance	\$ 340,994 UW Maintenance	Frame 5	
	\$ 163,000 MMSD Maintenance		
	\$ 503,994		
Operation	\$1,050,000		



Base Case Analysis¹

	<u>Milorganite</u>	<u>Glass Furnace</u>	
Base	\$201,757,046	\$204,658,021	Natural gas at \$9.25/Dtherm, Electric at 2008 rates, General Inflation at 3%, NG and Electric inflation at 0%

Milorganite Sales Analysis²

	<u>Milorganite</u>	<u>Glass Furnace</u>	
T1	\$202,463,871	\$206,720,637	More Milorganite Made and sold
T2	\$209,234,357	\$204,658,021	Less Milorganite sold (same amount made as base case)
T3	\$216,711,668	\$204,658,021	Lowest Milorganite sold (same amount made as base case)
S1	\$210,965,835	\$204,658,021	Sales price of Milorgate dropped by 10%

Energy Rates Analysis²

Nymex Gas Prices through 2011, Base case Electric Rates through 2011, vary inflation rates after 2011

	<u>Milorganite</u>	<u>Glass Furnace</u>	
E1	\$219,766,853	\$211,798,420	Inflate NG 1.5% per year, inflate Electric 0.5%
E2	\$259,226,904	\$228,079,838	Inflate NG 3.0% per year, inflate Electric 1.5%
E3	\$199,036,384	\$223,383,455	Inflate NG 0.5% per year, inflate Electric 1.5%
E4	\$219,798,053	\$250,114,292	Inflate NG 1.5% per year, inflate Electric 3.0%
E5	\$247,646,836	\$213,973,764	NG hedged at \$9.60/Dtherm thru 2010, Inflate NG 3.0% and Elec at 1%
E6	\$220,275,526	\$225,040,645	NG hedged at \$9.60 thru 2010, Inflate NG 1%, Elec at 3.0%

Credit Analysis²

An emission credit of \$500,000 per year applied Glass Furnace process

	<u>Milorganite</u>	<u>Glass Furnace</u>
C1	\$201,757,046	\$196,889,662

Combined Estimate Analysis²

An estimate that is a combination of individual sensitivity analyses provided above

Natural Gas hedged at \$9.60/Dtherm thru 2010, NG inflates at 3% per year after 2010, Electricity at 2008 values through 2011, Electricity inflates at 1% per year after 2011, Milorganite production is 42,00 tons per year with 39,000 tpy sold and the rest (3,000 tpy) to landfill.

Glass Furnace receives an annual emission credit of \$500,000 per year.

	<u>Milorganite</u>	<u>Glass Furnace</u>
Combine 1	\$255,124,148	\$221,742,123

Notes:

1) Base Case Analysis documentation provided in Table 9-E-1, Sensitivity Base Case

2) All other analyses listed above were variations on the Sensitivity Base Case as noted after each analysis. The documentation for each of these analyses is included in the project files.