

# **COST-OPTIMIZED PUMPING IN THE PHOSPHATE INDUSTRY**

**by Eric Coffin**



# Thank You

- **Bob Andrews**
- **Francine Neuman**



# Thank You

## Florida Institute of Phosphate Research

- **Gary Albarelli**
- **Karen Stewart**
- **Malysavanh Birdy**



# Thank You

- **George Mcquien**
- **Mark Thompson**
- **Terry Tarte**



# **COST-OPTIMIZED PUMPING IN THE PHOSPHATE INDUSTRY**



# COST- **OPTIMIZED**

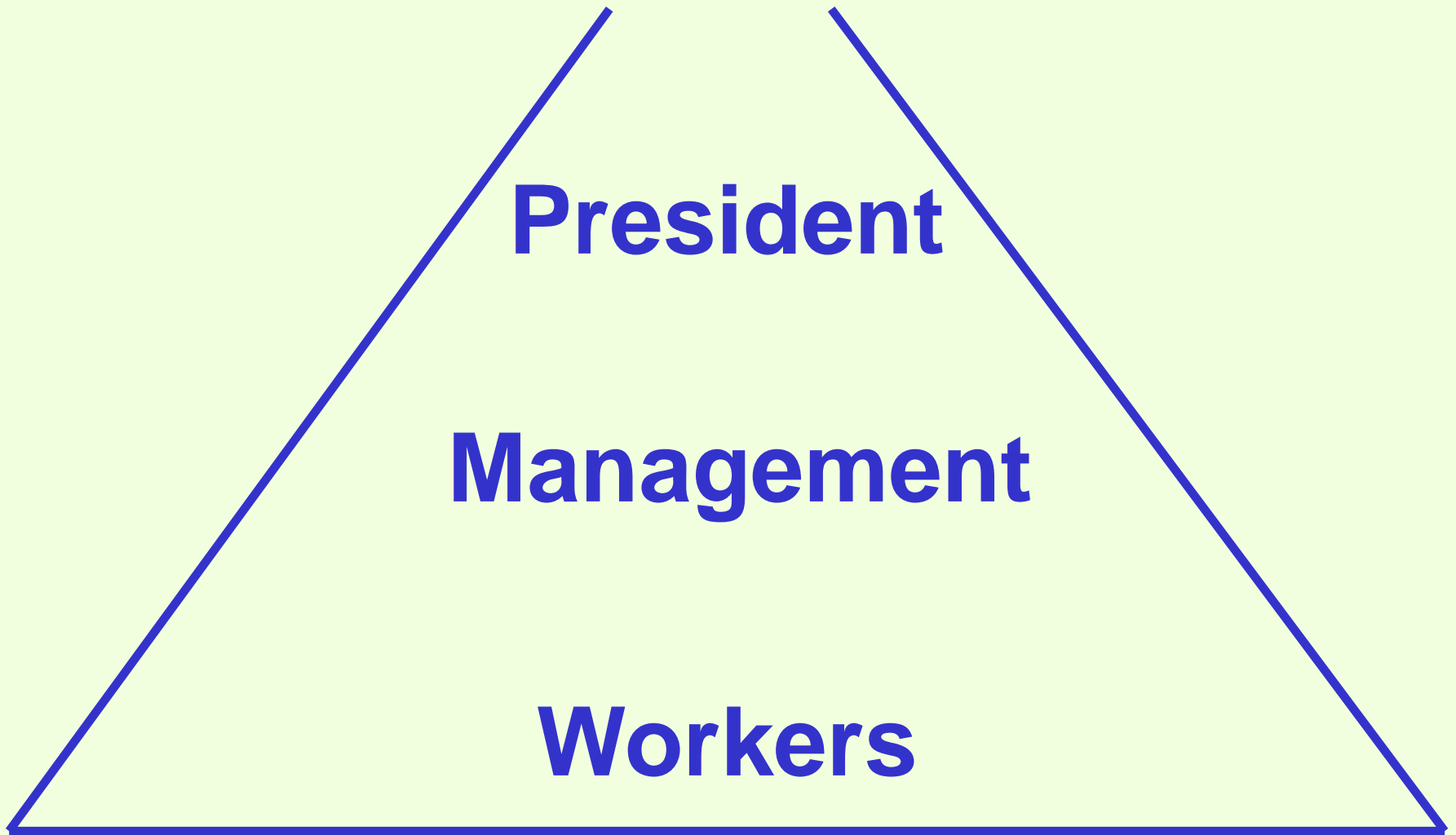
## PUMPING IN THE PHOSPHATE INDUSTRY



COST-OPTIMIZED  
PUMPING IN THE  
PHOSPHATE INDUSTRY

# Corporate Profits







**Stockholders**

**Board of Directors**

**President**

**Eng**

**Const**

**Oper**

**Main**





# Engineering



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# Engineering Material Specification Drawings Pumps



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# Construction



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**Construction  
Bids  
Right of Way  
Permits  
Trencher  
Cranes  
Welders  
Weather**



# Operations



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# Operations Workers Inspection Safety Schedules Training



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# Maintenance



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**Maintenance  
Staff  
Accidents  
Inspection  
Equipment  
Access  
Spare Parts**



# Stockholders



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# Stockholders WSJ Investment Profit



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**Stockholders**  
**Board of Directors**



**President**

**Eng      Const      Oper      Main**



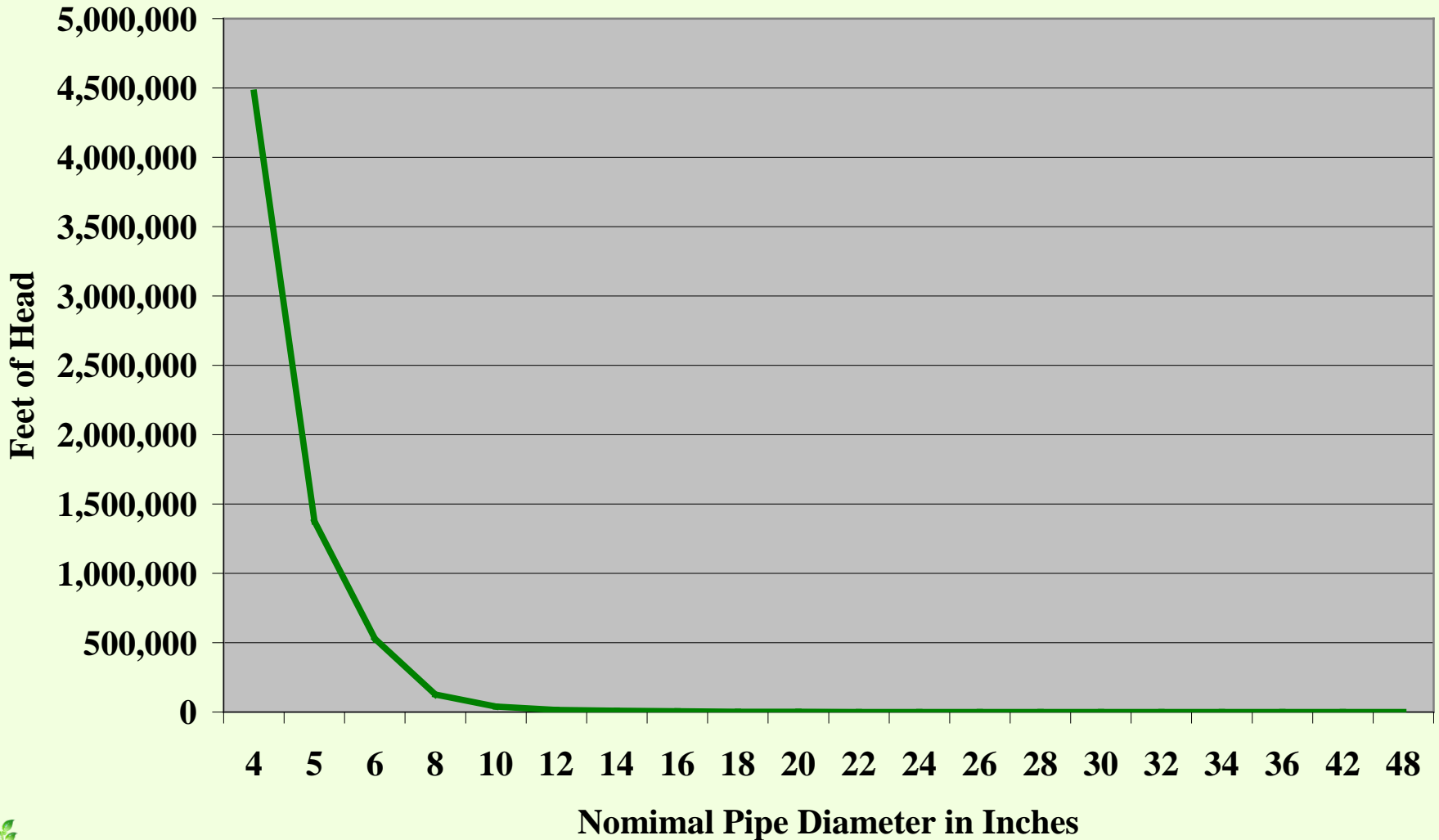


# Head Loss in Pipes

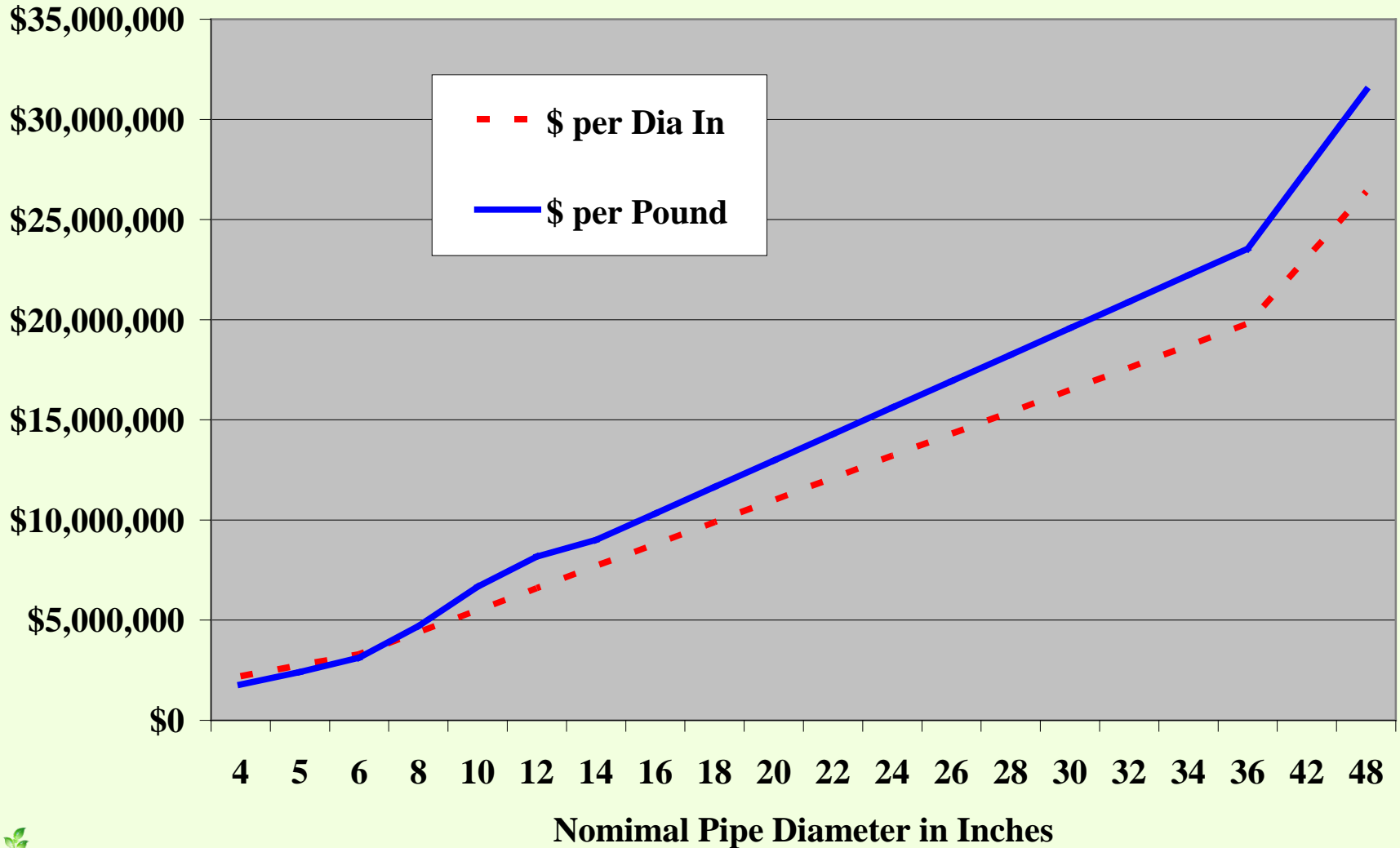
$$h = f * \frac{L}{D} * \frac{V^2}{2g}$$



## Head Loss in Feet of Water for 1,000 GPM of clean water flowing in a 5,000 foot long Steel Pipe



## Installed Steel Pipe Pricing "Capital Cost" for 5,000 feet of pipe vs. Pipe Diameter

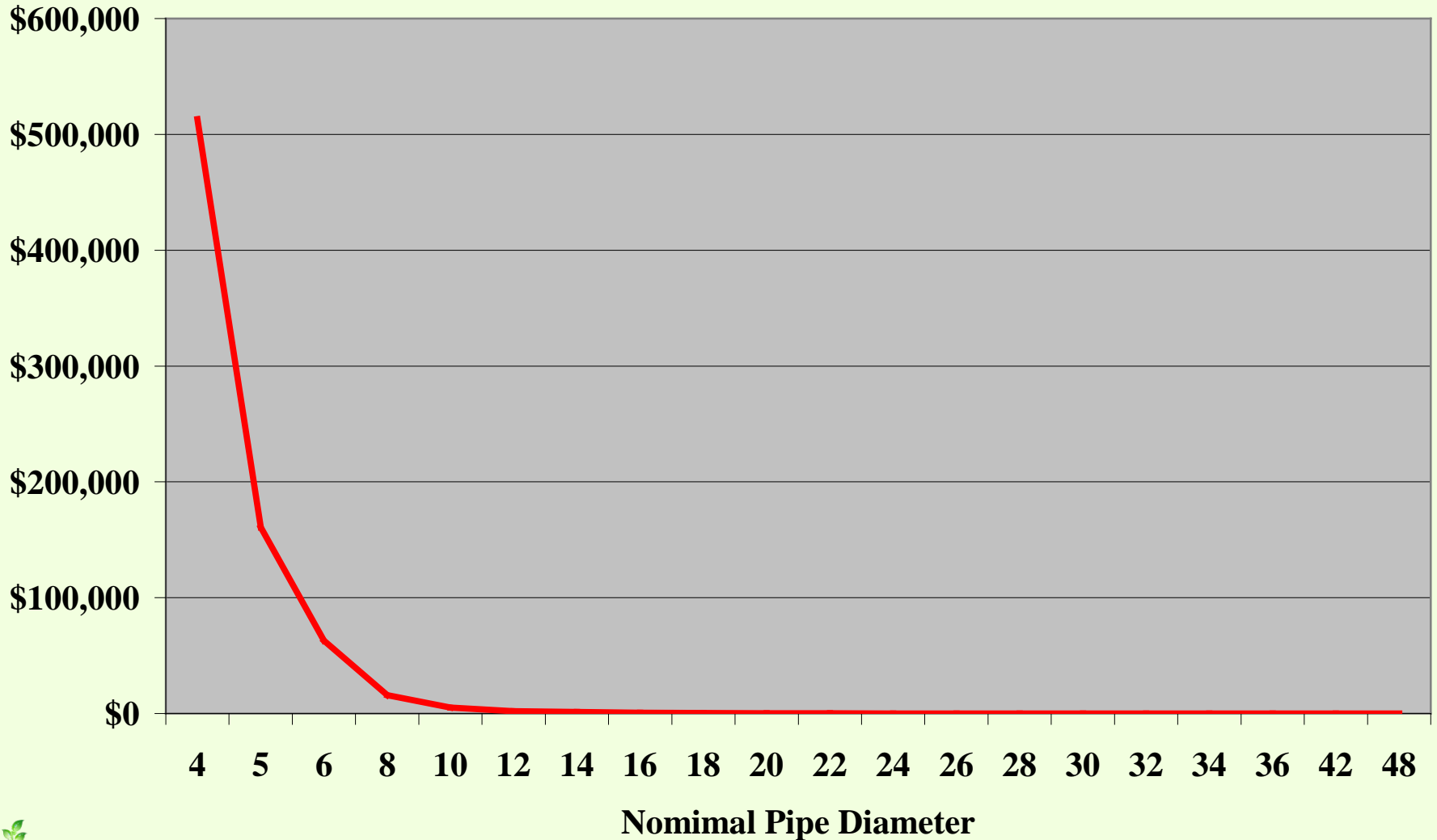


# Head Loss in Pipes

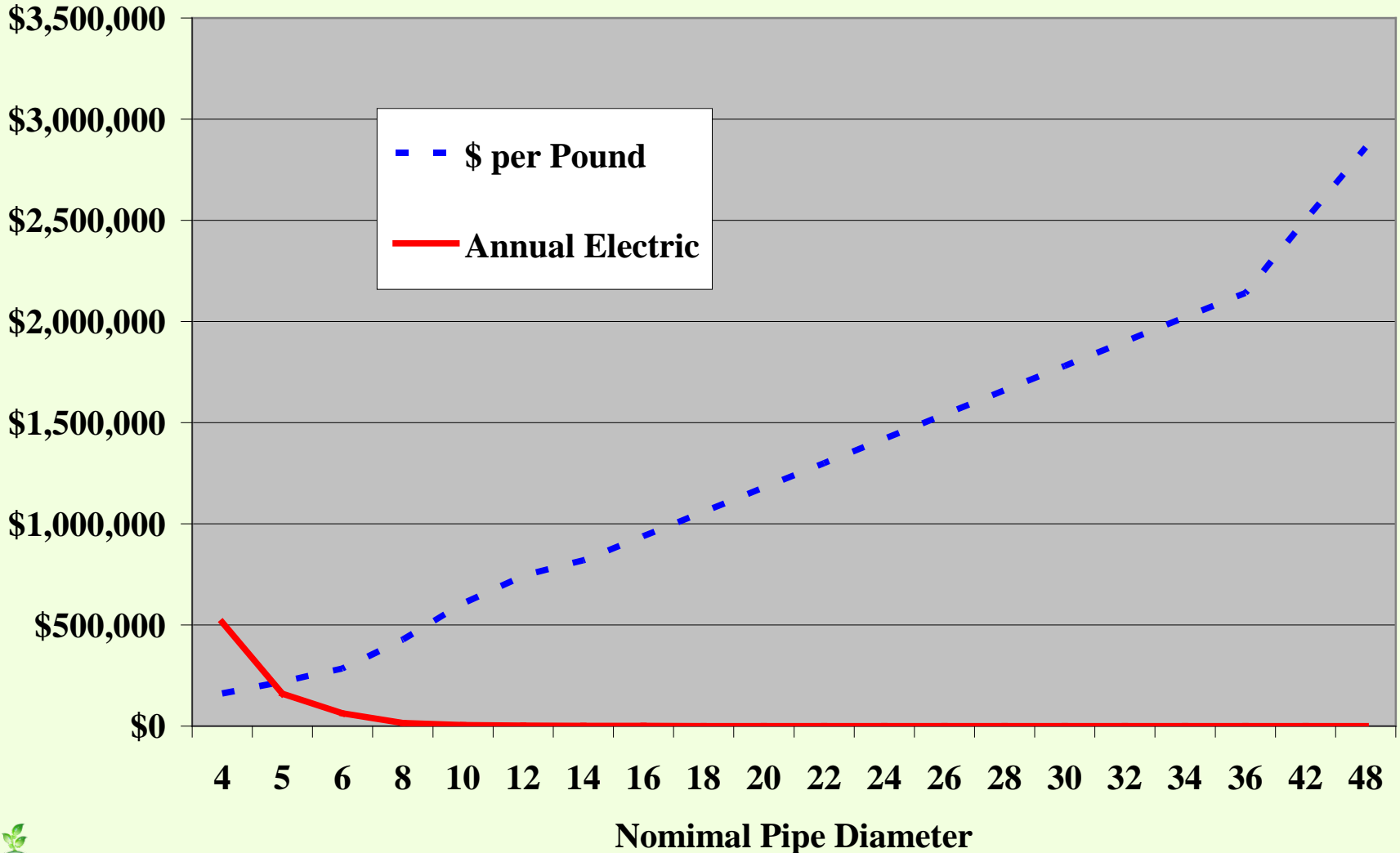
$$h = f * \frac{L}{D} * \frac{V^2}{2g}$$



## Annual Electric Cost for Operating at 1,000 GPM of Waterflow through 5,000 Feet of Clean Steel Pipe



## Pipe Capital Cost & Annual Electric Cost vs. Diameter for Flowing 1,000 GPM for a Distance of 5,000 feet



# **Incremental Investment and Incremental Return (IIIR)**



$$y = ax + \frac{b}{x} + c$$

$y$  = the total cost

$x$  = the variable of design

$a, b, c$  are coefficients





$$x = \sqrt{\frac{b}{a}}$$

***X = Minimum cost point***



# The **a** and **b** of optimized pipes & pumping

• **a**

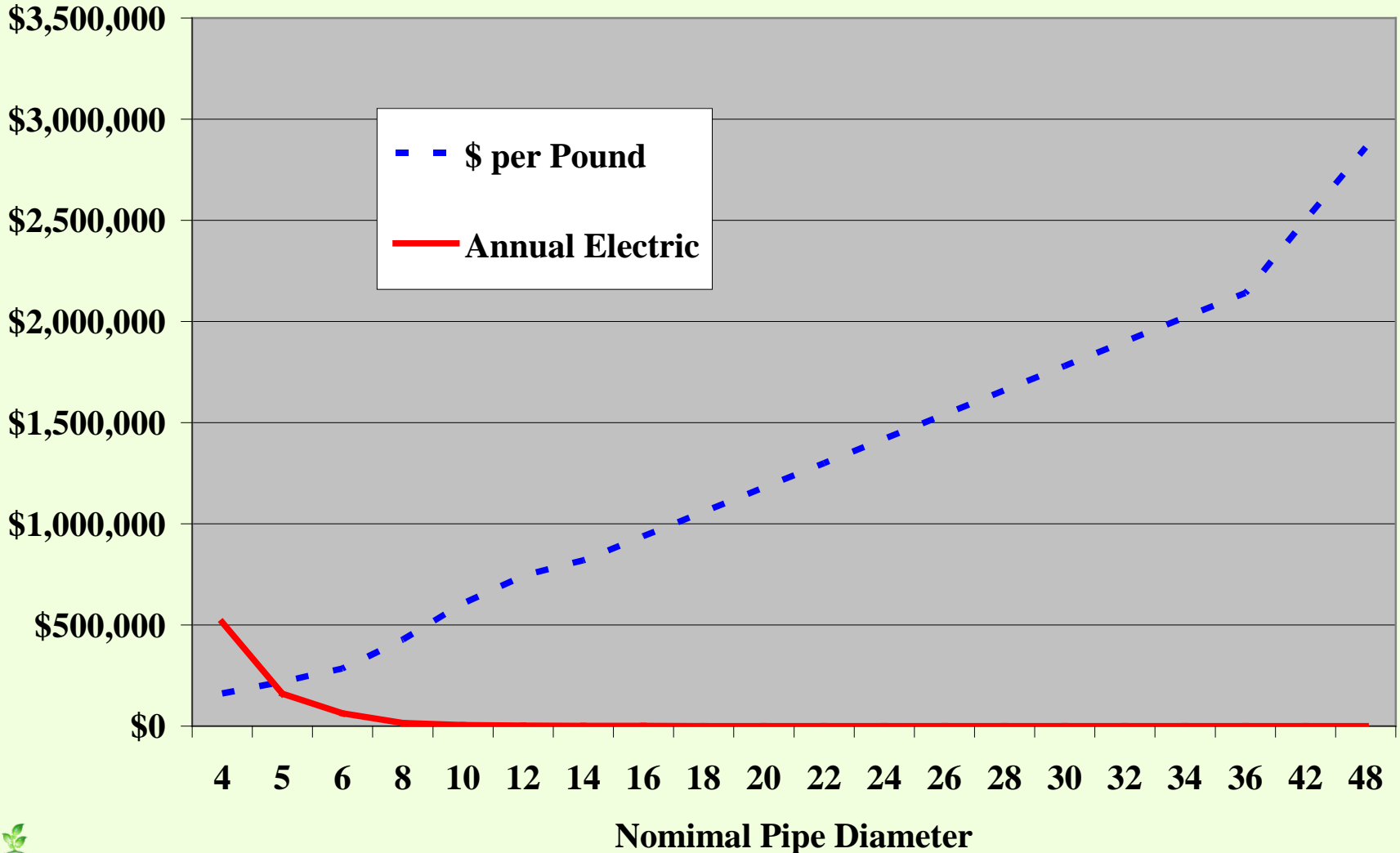
- Annual Cost
- Energy
- Maintenance

• **b**

- First Cost
- Capital
- (A/P, i, n)



## Pipe Capital Cost & Annual Electric Cost vs. Diameter for Flowing 1,000 GPM for a Distance of 5,000 feet



# The $a$ and $b$ of optimized pipes & pumping

•  $a$

- Annual Cost
- Energy
- Maintenance

•  $b$

- First Cost
- Capital
- **( $A/P, i, n$ )**



# The $a$ and $b$ of optimized pipes & pumping

•  $a$

•  $b$

• **Annual  
Cost**

• Energy

• Maintenance

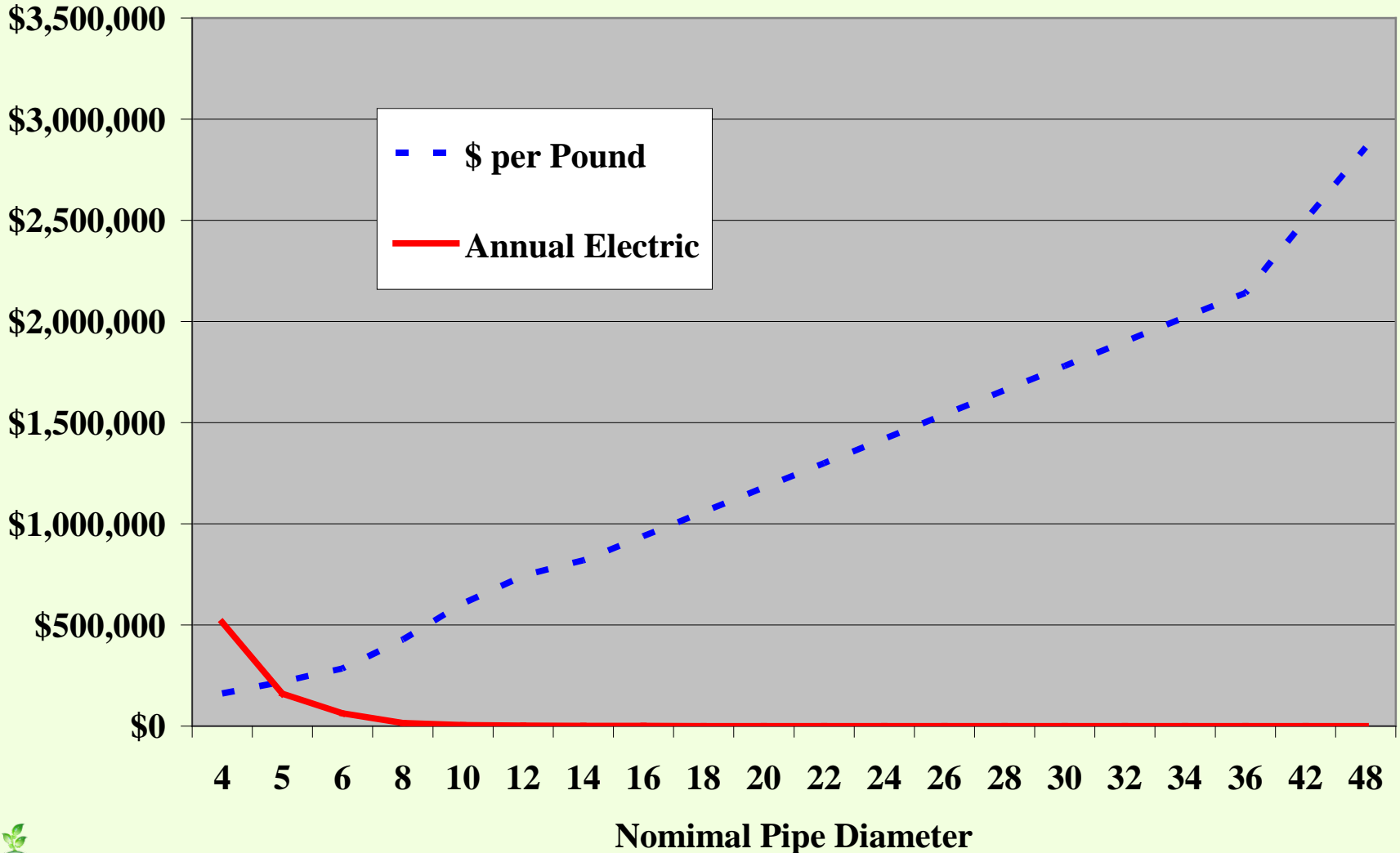
• First Cost

• Capital

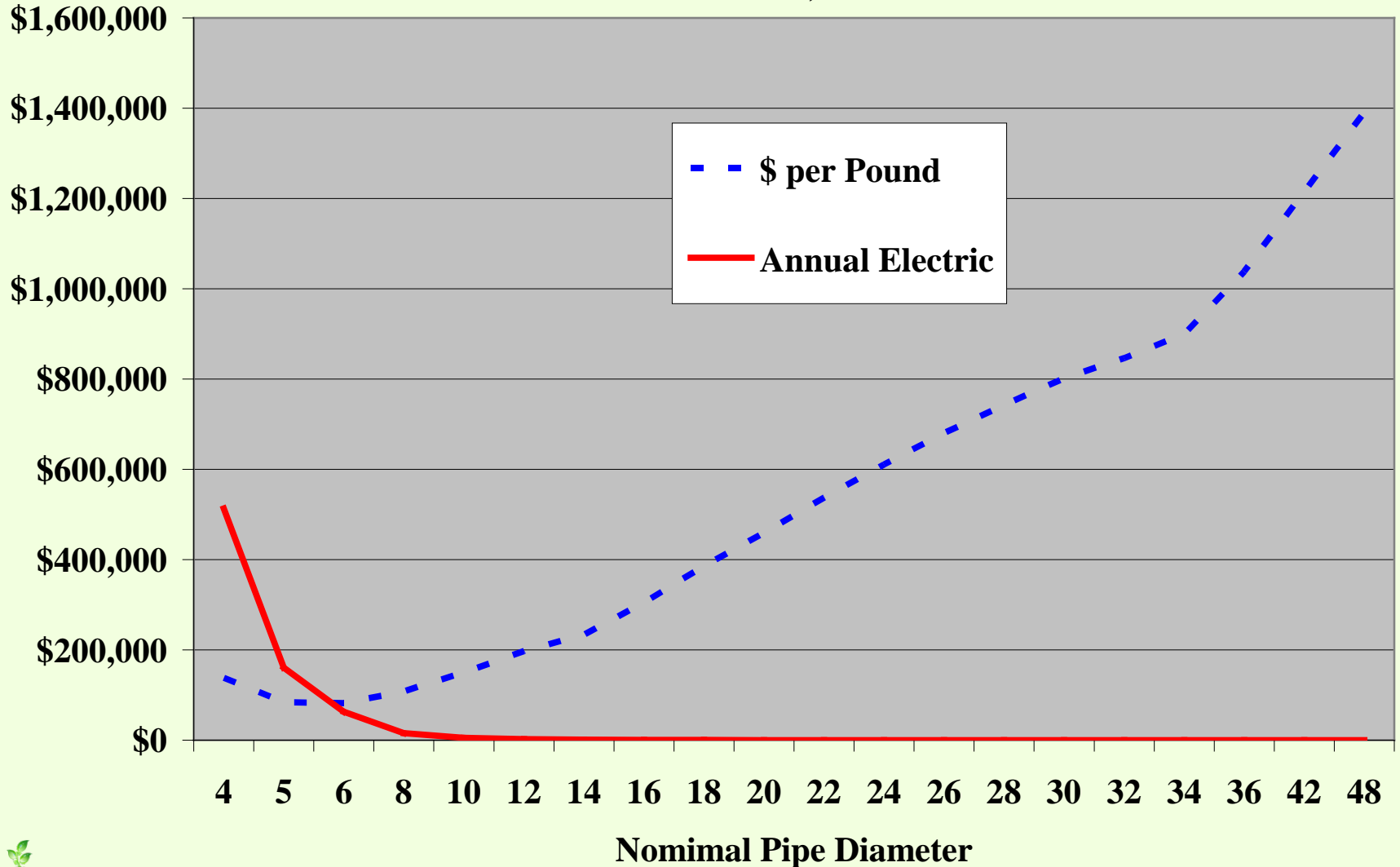
• **( $A/P, i, n$ )**



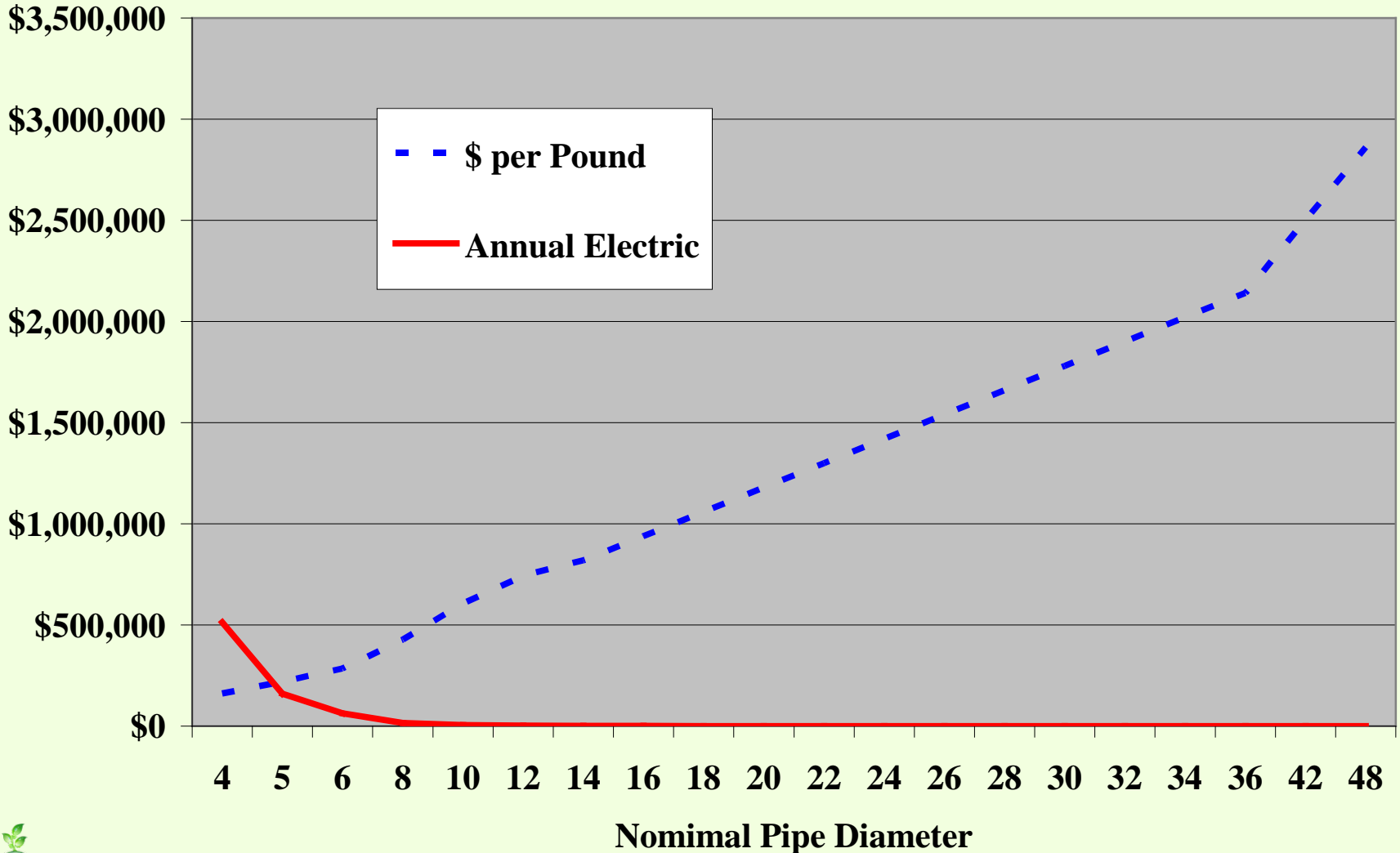
# Pipe Capital Cost & Annual Electric Cost vs. Diameter for Flowing 1,000 GPM for a Distance of 5,000 feet



## Annual Cost of Pipe & Annual Cost of Electricity for pumping 1,000 GPM over a Distance of 5,000 Feet

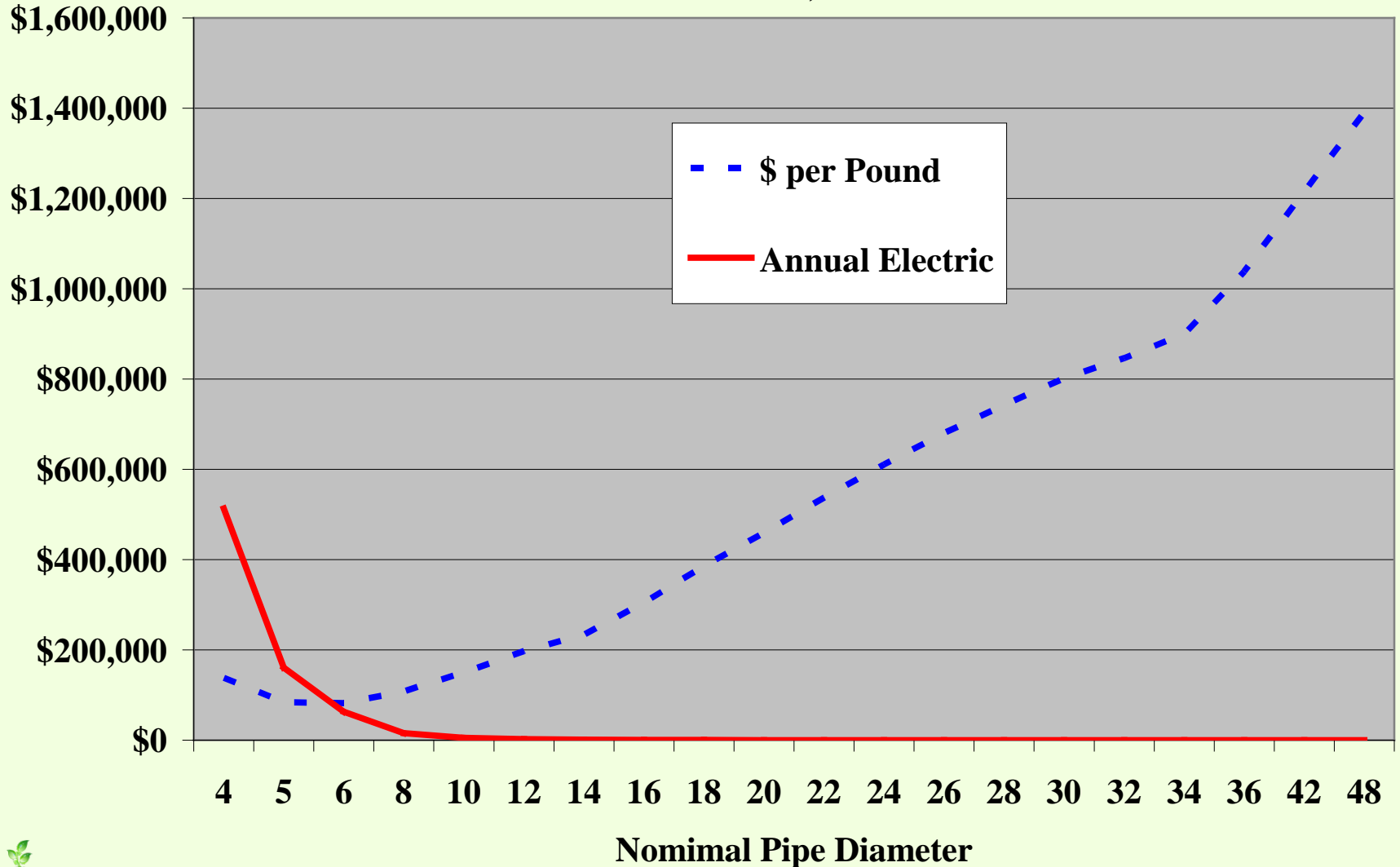


## Pipe Capital Cost & Annual Electric Cost vs. Diameter for Flowing 1,000 GPM for a Distance of 5,000 feet





## Annual Cost of Pipe & Annual Cost of Electricity for pumping 1,000 GPM over a Distance of 5,000 Feet

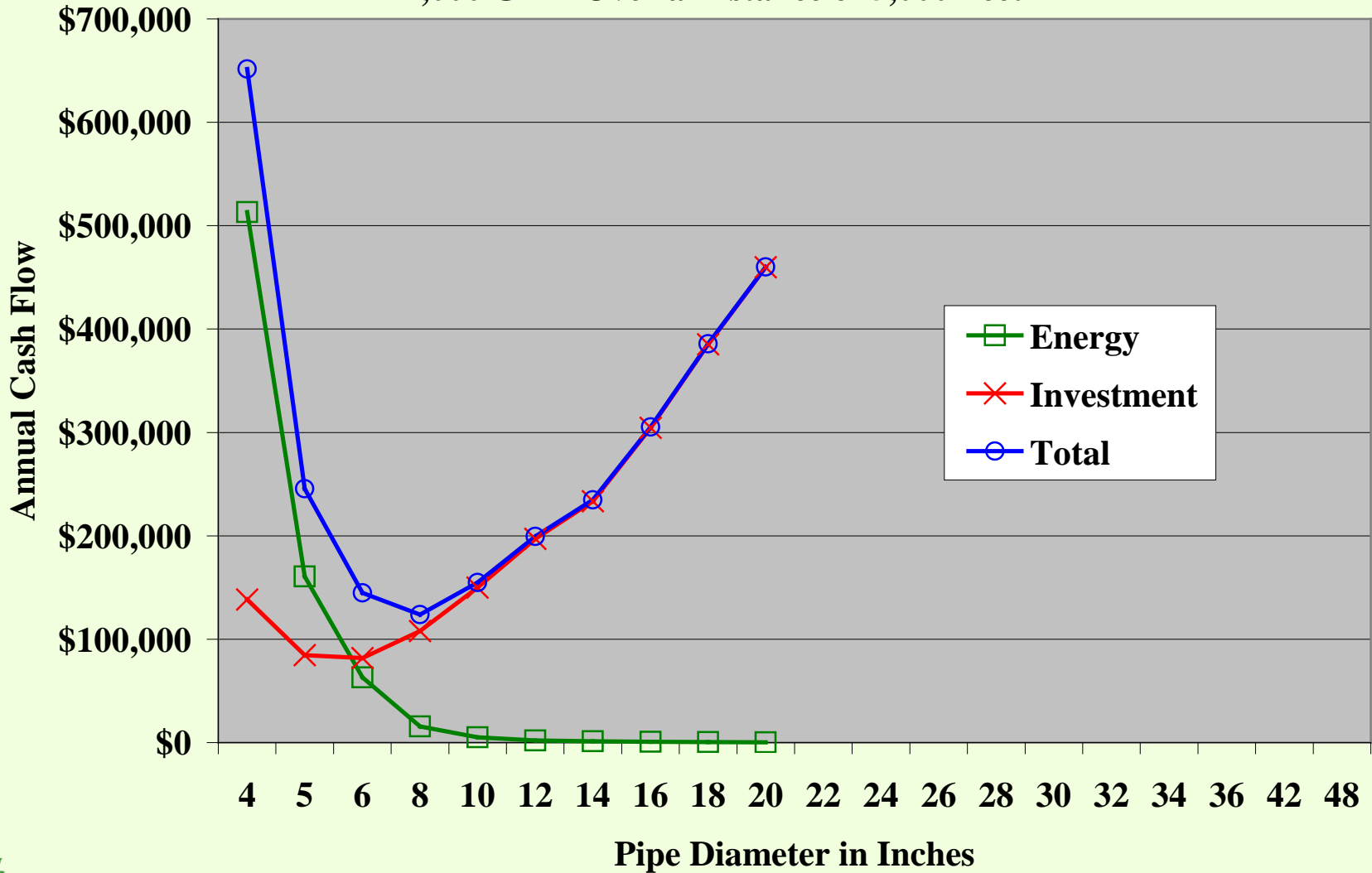


$$y = ax + \frac{b}{x} + c$$

$$x = \sqrt{\frac{b}{a}}$$



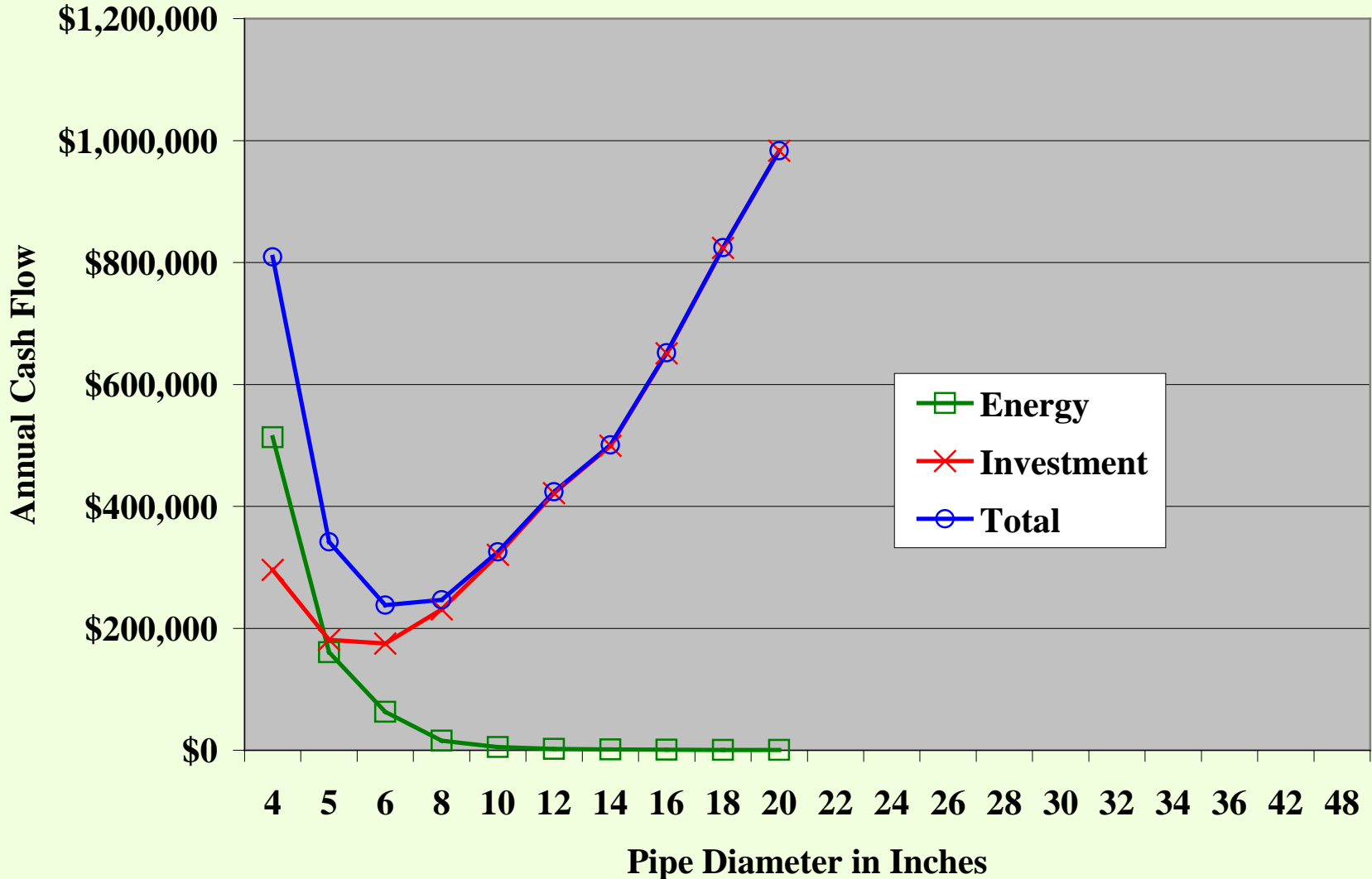
## Optimized Pipe Sizing - Annual Loan Payment & Annual Pumping Cost for 1,000 GPM Over a Distance of 5,000 Feet



- **Short Life**
- **Cheap Energy**
- **Few Hours of Operation**



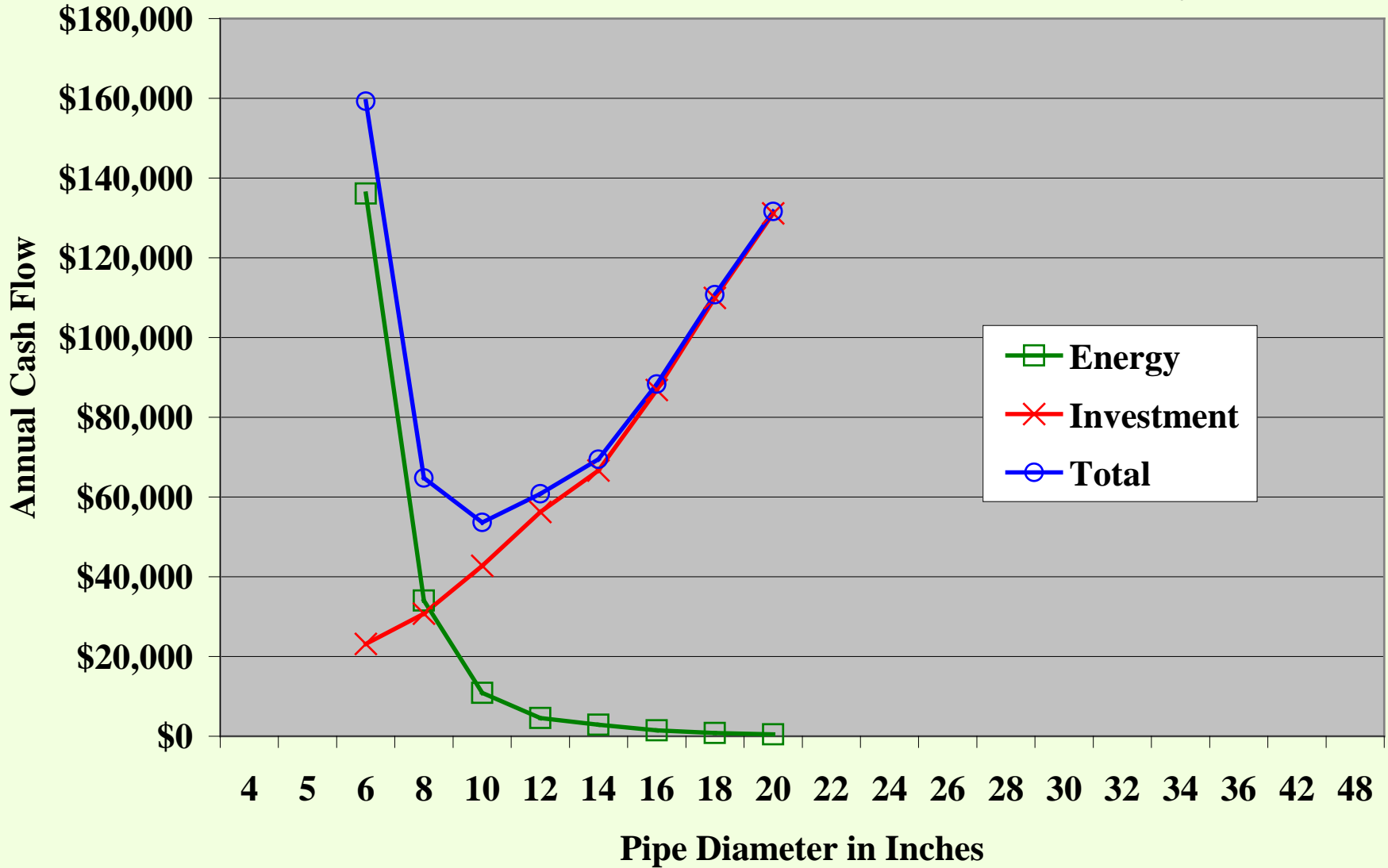
## Optimized Pipe Sizing - Annual Loan Payment & Annual Pumping Cost for 1,000 GPM Over a Distance of 5,000 Feet for a 4-Year Project



- **40-Year Life**
- **8,760 Hours of Operation**
- **Expensive Energy**
- **Low Finance Cost**



## Optimized Pipe Sizing - Annual Loan Payment & Annual Pumping Cost for 1,000 GPM Over a Distance of 5,000 Feet 40-Years, 1% Money



- **Optimization**
- **Capital**
- **Operation and  
Maintenance**





- **Project Life**
- **Interest Rate**
- **Hours of Operation**
- **Pump Efficiency**
- **Motor Efficiency**





- **Water**
- **50,000 Feet**
- **13,000 GPM**
- **80% Pump Efficiency**
- **96% Motor Efficiency**



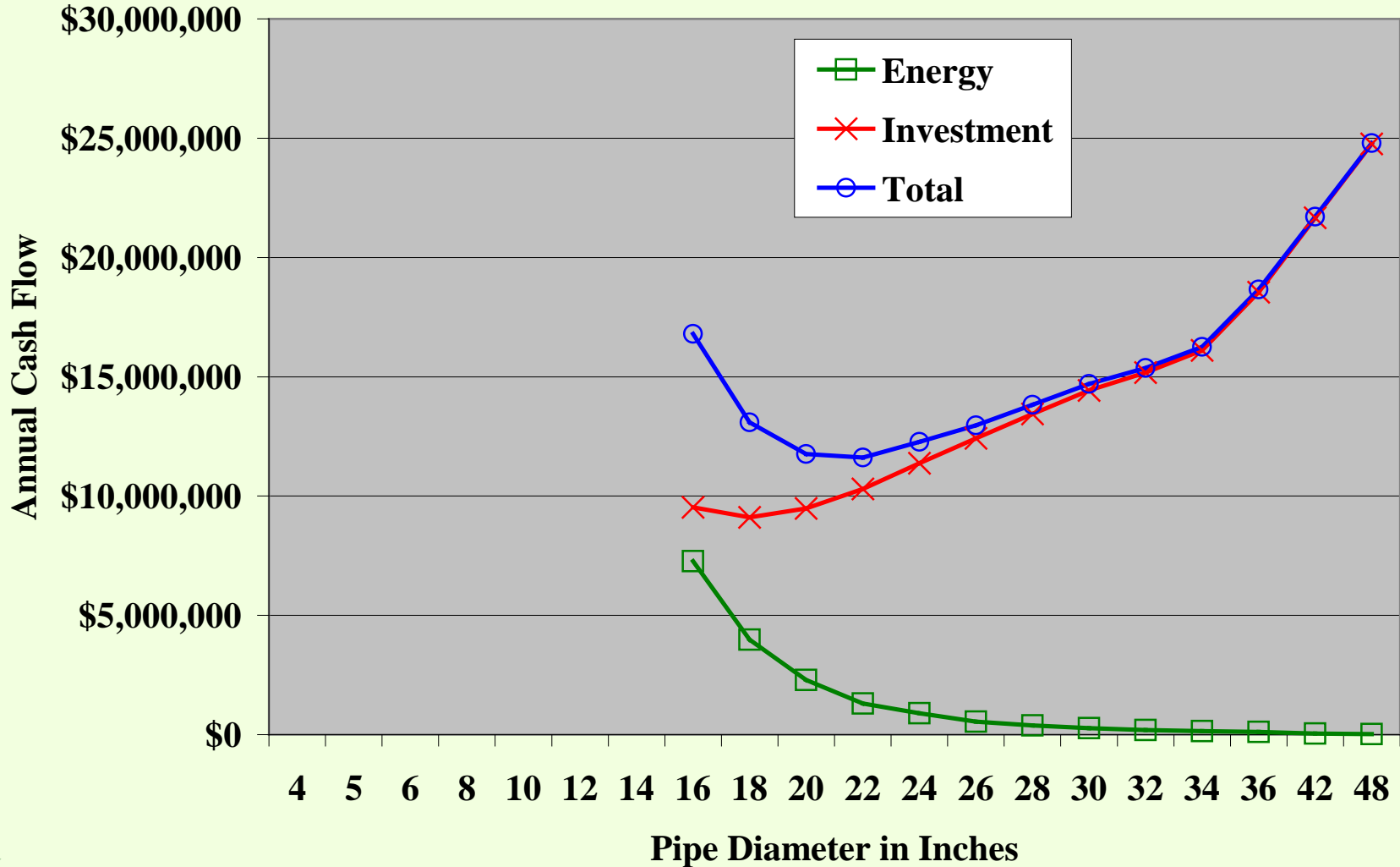
- **7,280 Hours**
- **\$0.07 per kWh**
- **5-Year Project Life**



- **12% Loan Interest Rate**
- **Maintenance is 4% of Capital**



## Optimized Pipe Sizing - Annual Loan Payment & Annual Pumping Cost for 13,000 GPM Over a Distance of 50,000 Feet



- **Engineering Optimization**
- **Test for Corporate Profits**



- **XYZ Pipe Company**
- **\$21,000,000 sales**
- **28% tax bracket**





- **Sales to Increase**  
**2% per year**
- **Operating Expense**  
**\$14,000,000**



# **Engineers present Management with 3 new pipeline proposals**



Pipe Diameter	20	22	24
Energy	\$2,521,000	\$1,425,000	\$967,000
Investment	\$6,572,000	\$7,135,000	\$7,880,000
Total	\$9,093,000	\$8,560,000	\$8,848,000



<b>Sales</b>	<b>\$21,000,000</b>



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<b>Gross Profit</b>	<b>\$7,000,000</b>



<b>Sales</b>	<b>\$21,000,000</b>
<b>Operating Expense</b>	<b>\$14,000,000</b>
<b>Gross Profit</b>	<b>\$7,000,000</b>
<b>Less Depreciation</b>	<b>\$0</b>



<b>Sales</b>	<b>\$21,000,000</b>
<b>Operating Expense</b>	<b>\$14,000,000</b>
<b>Gross Profit</b>	<b>\$7,000,000</b>
<b>Less Depreciation</b>	<b>\$0</b>
<b>Adjusted Gross Profit</b>	<b>\$7,000,000</b>





<b>Sales</b>	<b>\$21,000,000</b>
<b>Operating Expense</b>	<b>\$14,000,000</b>
<b>Gross Profit</b>	<b>\$7,000,000</b>
<b>Less Depreciation</b>	<b>\$0</b>
<b>Adjusted Gross Profit</b>	<b>\$7,000,000</b>
<b>Taxes at 28%</b>	<b>\$1,960,000</b>



<b>Sales</b>	<b>\$21,000,000</b>
<b>Operating Expense</b>	<b>\$14,000,000</b>
<b>Gross Profit</b>	<b>\$7,000,000</b>
<b>Less Depreciation</b>	<b>\$0</b>
<b>Adjusted Gross Profit</b>	<b>\$7,000,000</b>
<b>Taxes at 28%</b>	<b>\$1,960,000</b>
<b>Net Profit</b>	<b>\$5,040,000</b>



<b>Sales</b>	<b>\$21,000,000</b>
<b>Operating Expense</b>	<b>\$14,000,000</b>
<b>Gross Profit</b>	<b>\$7,000,000</b>
<b>Less Depreciation</b>	<b>\$0</b>
<b>Adjusted Gross Profit</b>	<b>\$7,000,000</b>
<b>Taxes at 28%</b>	<b>\$1,960,000</b>
<b>Net Profit</b>	<b>\$5,040,000</b>
<b>Cash on the books</b>	<b>\$5,040,000</b>



# XYZ Pipe Company

Sales	\$21,000,000	\$21,420,000	\$21,848,400	\$22,285,368	\$22,731,075
Operating Expense	\$14,000,000	\$14,000,000	\$14,000,000	\$14,000,000	\$14,000,000
Gross Profit	\$7,000,000	\$7,420,000	\$7,848,400	\$8,285,368	\$8,731,075
Less Depreciation	\$0	\$0	\$0	\$0	\$0
Adjusted Gross Profit	\$7,000,000	\$7,420,000	\$7,848,400	\$8,285,368	\$8,731,075
Taxes at 28%	\$1,960,000	\$2,077,600	\$2,197,552	\$2,319,903	\$2,444,701
Net Profit	\$5,040,000	\$5,342,400	\$5,650,848	\$5,965,465	\$6,286,374
Cash on the books	\$5,040,000	\$5,342,400	\$5,650,848	\$5,965,465	\$6,286,374



# 20-Inch Pipe Company

Sales	\$21,000,000	\$21,420,000	\$21,848,400	\$22,285,368	\$22,731,075
Operating Expense	\$16,521,057	\$16,521,057	\$16,521,057	\$16,521,057	\$16,521,057
Gross Profit	\$4,478,943	\$4,898,943	\$5,327,343	\$5,764,311	\$6,210,018
Less Depreciation	\$1,314,402	\$1,314,402	\$1,314,402	\$1,314,402	\$1,314,402
Adjusted Gross Profit	\$3,164,541	\$3,584,541	\$4,012,941	\$4,449,909	\$4,895,617
Taxes at 28%	\$886,072	\$1,003,672	\$1,123,624	\$1,245,975	\$1,370,773
Net Profit	\$2,278,470	\$2,580,870	\$2,889,318	\$3,203,935	\$3,524,844
Net Profit + Depreciation	\$3,592,871	\$3,895,271	\$4,203,719	\$4,518,336	\$4,839,246



# 22-Inch Pipe Company

Sales	\$21,000,000	\$21,420,000	\$21,848,400	\$22,285,368	\$22,731,075
Operating Expense	\$15,424,923	\$15,424,923	\$15,424,923	\$15,424,923	\$15,424,923
Gross Profit	\$5,575,077	\$5,995,077	\$6,423,477	\$6,860,445	\$7,306,152
Less Depreciation	\$1,427,032	\$1,427,032	\$1,427,032	\$1,427,032	\$1,427,032
Adjusted Gross Profit	\$4,148,045	\$4,568,045	\$4,996,445	\$5,433,413	\$5,879,121
Taxes at 28%	\$1,161,453	\$1,279,053	\$1,399,005	\$1,521,356	\$1,646,154
Net Profit	\$2,986,593	\$3,288,993	\$3,597,441	\$3,912,058	\$4,232,967
Net Profit + Depreciation	\$4,413,624	\$4,716,024	\$5,024,472	\$5,339,089	\$5,659,998



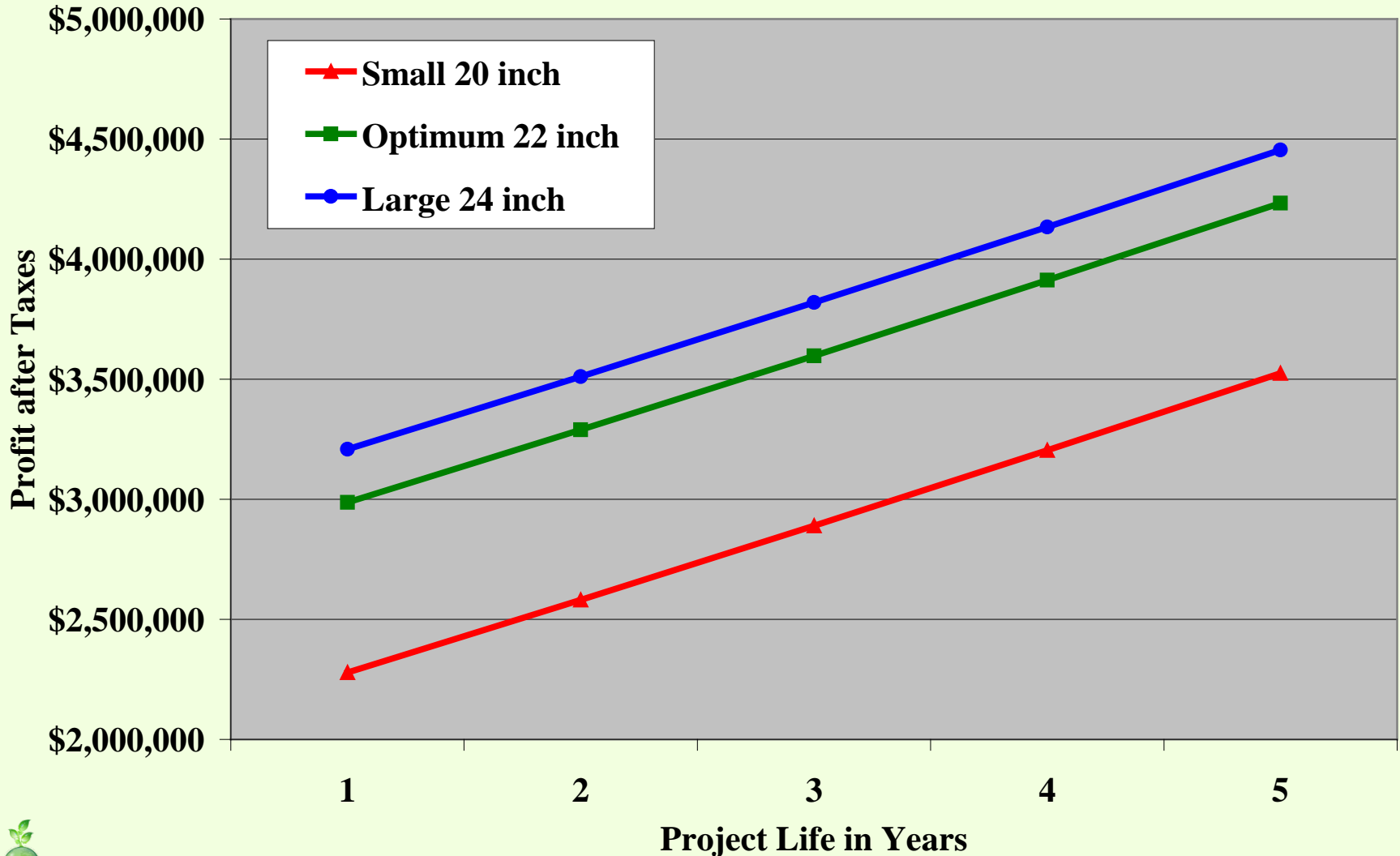
# 24-Inch Pipe Company

Sales	\$21,000,000	\$21,420,000	\$21,848,400	\$22,285,368	\$22,731,075
Operating Expense	\$14,967,888	\$14,967,888	\$14,967,888	\$14,967,888	\$14,967,888
Gross Profit	\$6,032,112	\$6,452,112	\$6,880,512	\$7,317,480	\$7,763,187
Less Depreciation	\$1,576,081	\$1,576,081	\$1,576,081	\$1,576,081	\$1,576,081
Adjusted Gross Profit	\$4,456,030	\$4,876,030	\$5,304,430	\$5,741,398	\$6,187,106
Taxes at 28%	\$1,247,688	\$1,365,288	\$1,485,240	\$1,607,592	\$1,732,390
Net Profit	\$3,208,342	\$3,510,742	\$3,819,190	\$4,133,807	\$4,454,716
Net Profit + Depreciation	\$4,784,423	\$5,086,823	\$5,395,271	\$5,709,888	\$6,030,797



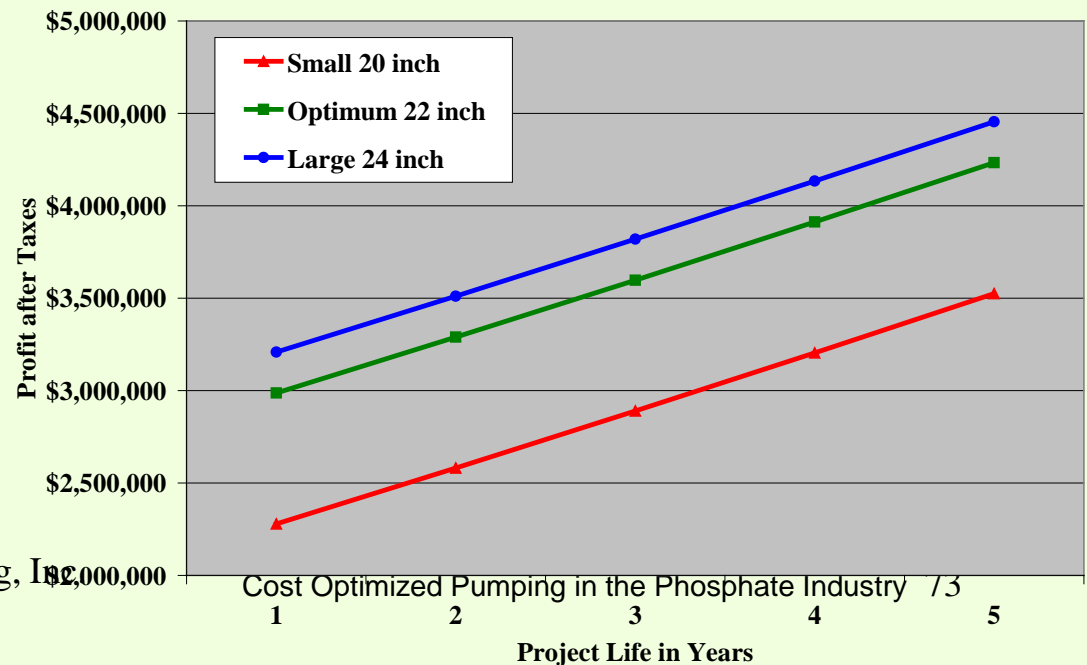


## Profit vs. Pipe Size for Pumping 13,000 GPM a Distance of 50,000 Feet



- **20-inch Red 8% ROI**
- **22-inch Green 38% ROI**
- **24-inch Blue 45% ROI**

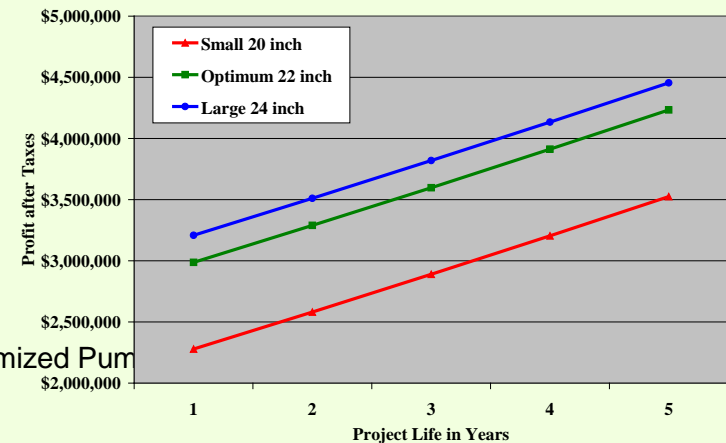
Profit vs. Pipe Size for Pumping 13,000 GPM a Distance of 50,000 Feet



- **20-inch Red 8% ROI**
- **22-inch Green 38% ROI**

**30%**  
**Increment**

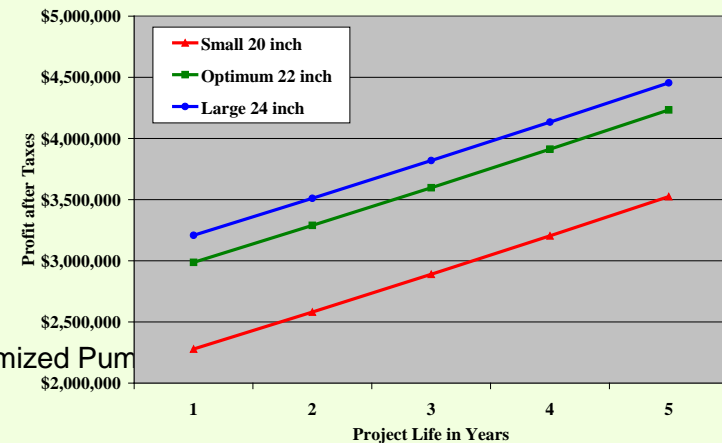
Profit vs. Pipe Size for Pumping 13,000 GPM a Distance of 50,000 Feet



- **22-inch Green 38% ROI**
- **24-inch Blue 45% ROI**

**7%**  
**Increment**

Profit vs. Pipe Size for Pumping 13,000 GPM a Distance of 50,000 Feet



# **COST-OPTIMIZED PUMPING IN THE PHOSPHATE INDUSTRY**

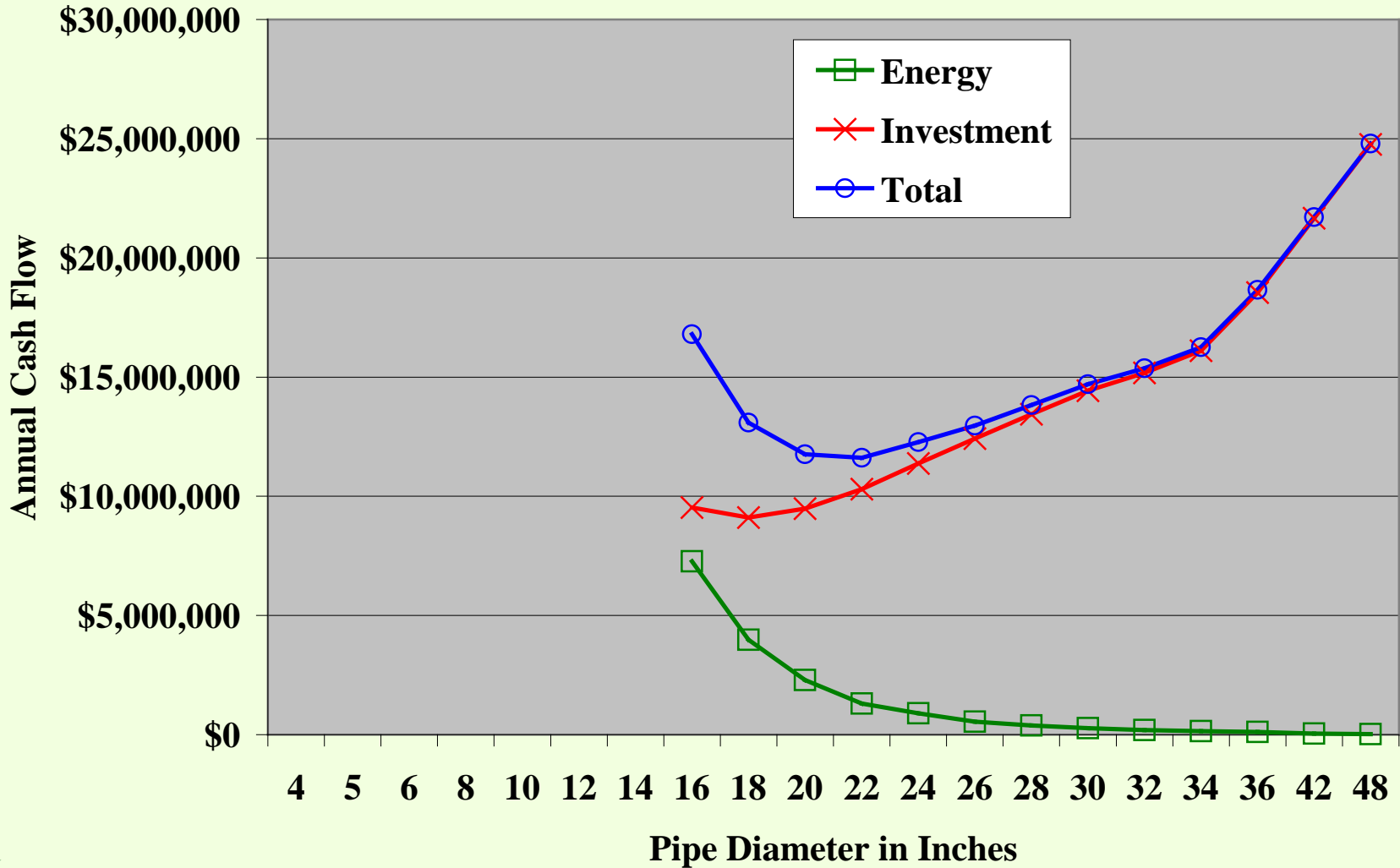


# COST- **OPTIMIZED**

## PUMPING IN THE PHOSPHATE INDUSTRY



## Optimized Pipe Sizing - Annual Loan Payment & Annual Pumping Cost for 13,000 GPM Over a Distance of 50,000 Feet



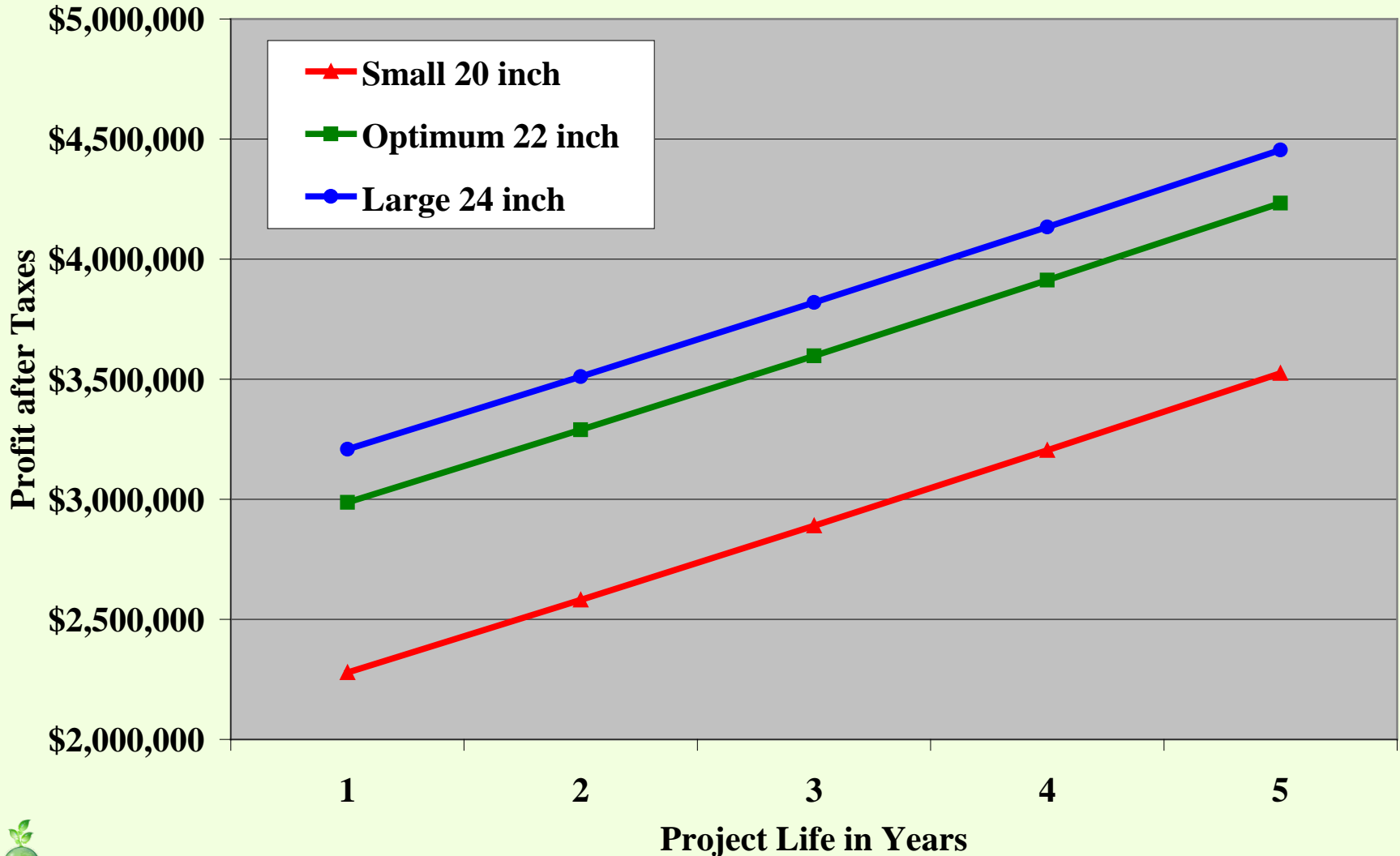


COST-OPTIMIZED  
PUMPING IN THE  
PHOSPHATE INDUSTRY

# Corporate Profits



## Profit vs. Pipe Size for Pumping 13,000 GPM a Distance of 50,000 Feet



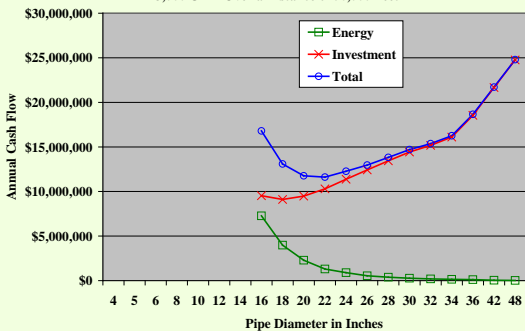
# Stockholders

President

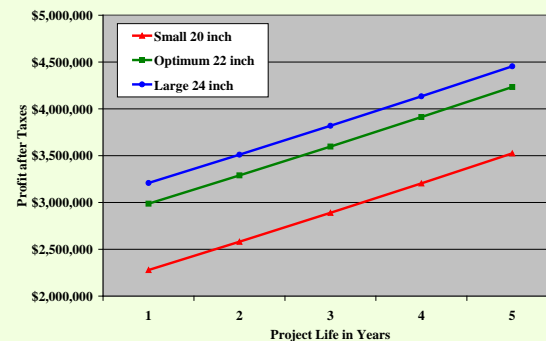


Board of Directors

Optimized Pipe Sizing - Annual Loan Payment & Annual Pumping Cost for 13,000 GPM Over a Distance of 50,000 Feet



Profit vs. Pipe Size for Pumping 13,000 GPM a Distance of 50,000 Feet



Eng

Const

Oper

Main



# Thank You!

- **Questions?**



**For more information on the**

**COST-OPTIMIZED**

**PUMPING**

**Model, please contact**

**Eric Coffin**

**(727) 742-7276**

**[www.GEEintl.com](http://www.GEEintl.com)**

