

Irrigating Orchards Efficiently for Water and Energy Savings

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Keys to Reducing Water and Energy Costs

- Pumping hours
- Unit energy cost
- Horsepower (kW) demand

Means of Reducing Pumping Hours

- Manage orchard floor vegetation

Manage Orchard Floor Vegetation

- Normal and wet years generally encourage orchard floor vegetation
 - Helps soil tilth and infiltration rates
 - Important BMP to control runoff
- Dry years are the exception
 - Consumes winter rainfall, reduces reserve
 - Increases in-season water use up to 25%

Means of Reducing Pumping Hours

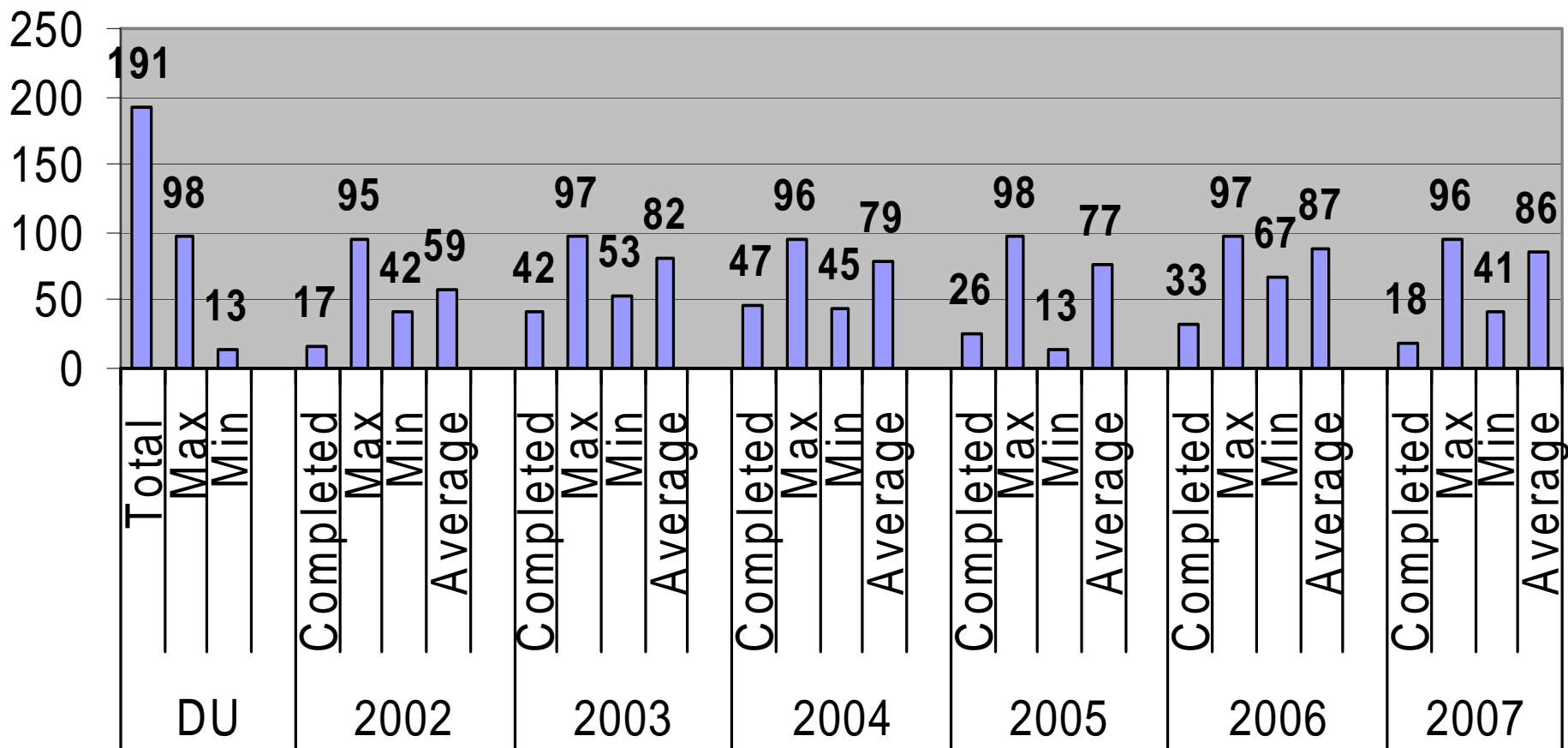
- Manage orchard floor vegetation
- Irrigation system maintenance and improvements



Evaluations Completed 2002 - 2007

DU Average, Maximum, Minimum

Source: Tehama County RCD Mobile Irrigation Lab



Free Assistance in Evaluating Irrigation System Performance

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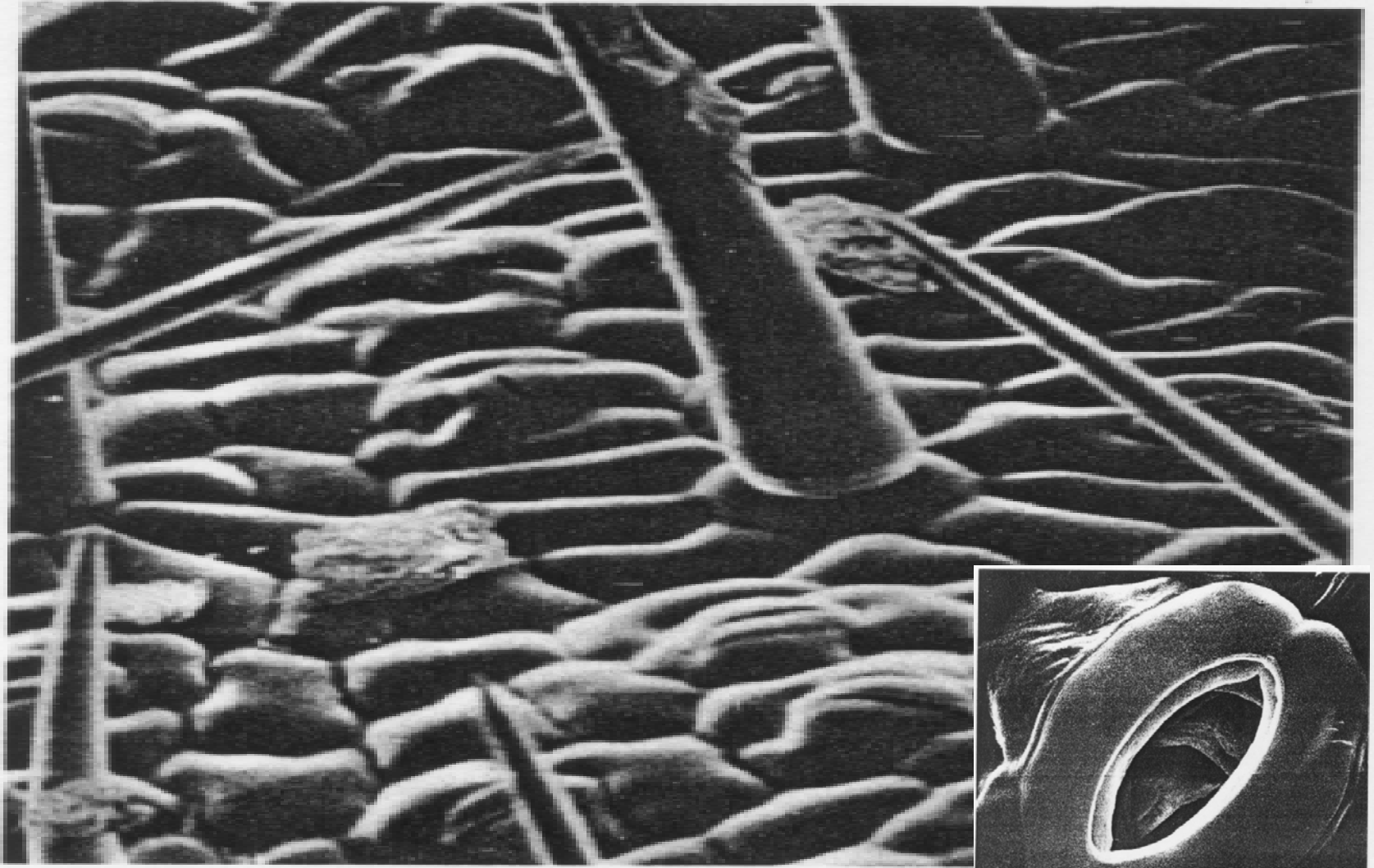
Means of Reducing Pumping Hours

- Manage orchard floor vegetation
- Irrigation system maintenance and improvements
- Utilize crop stress

Why Allow Crop Stress?

- Assure maximum use of moisture reserve
- Reduce the rate of crop water use

How Does Crop Stress Reduce Crop ET?



Microscopic view of leaf surface

Tools to Manage Crop Stress



Additional Information

Management strategies

- <http://ucmanagedrought.ucdavis.edu>
- <http://ceteama.ucdavis.edu>

Soil moisture monitoring

- <http://www.irrigate.net/>
- <http://www.irrometer.com/>
- <http://www.puresense.com/>

Pressure chamber

- <http://www.pmsinstrument.com>
- <http://www.soilmoisture.com/>

Means of Reducing Pumping Hours

- Manage orchard floor vegetation
- Irrigation system maintenance and improvements
- Allow crop stress
- Use practices that favor water infiltration not evaporation

Practices that Favor Water Infiltration

- Longer intervals between irrigations
 - Alternate check irrigation with flood irrigation systems
- Longer set times (within limits)
- Minimize irrigation in mid afternoon
- Soil and water amendments

Ways to Reduce Energy Unit Cost

- Compare energy sources and costs

2009 Agricultural Electric Rates

Source: <http://www.pge.com/tariffs/electric.shtml>

Rate	Description	“Average” Total Rate (\$/kWh)	
		35 hp and less	Greater than 35 hp
AG-1	Agricultural Power w/o TOU	0.27875	0.21768
AG-R	Split Week TOU Power	0.20077	0.18510
AG-V	Short Peak TOU Power	0.20558	0.18654
AG-4	Time Of Use (TOU) Power	0.20021	0.17422
AG-5	Large TOU Power	0.16231	0.11698
AG-ICE	Ag Internal Combustion Engine Conversion Incentive Rate	NA 2009	NA 2009

Electric Rate Analysis Tool

Source: <http://www.pge.com/mybusiness/myaccount/rates/tools/>

Service ID: #####	Name: Farmer XXXXXXXX	D.A. Code: FULL SERVICE
Old Account:	Service Address:	City:
Account:	Supply: AG PUMP	Voltage: SECONDARY
NAICS:	Meter Code: TOUG-COMPLEX TOU/TOT-KW,KWH XOVER	RTM: N
Meter No:	Rate Schedule: AG5B	FTA: No

Rates are effective **01/01/09** unless otherwise noted.

Estimated Costs for Bundled Rates

					** Best **			
FROM	TO	AG1B Bills	AG4B Bills	AG4C Bills	AG5B Bills	AG5C Bills	AGRB Bills	AGVB Bills
12/20/07	01/22/08	\$21.90	\$28.12	\$77.44	\$39.61	\$180.53	\$28.15	\$28.14
01/22/08	02/21/08	\$18.92	\$24.84	\$69.78	\$35.48	\$163.61	\$24.84	\$24.84
02/21/08	03/21/08	\$65.58	\$65.04	\$117.44	\$140.54	\$251.92	\$62.65	\$62.02
03/21/08	04/23/08	\$910.48	\$886.21	\$649.78	\$559.81	\$681.46	\$706.42	\$697.79
04/23/08	05/21/08	\$1,948.49	\$1,473.41	\$1,365.89	\$1,245.45	\$1,351.53	\$1,675.58	\$1,621.73
05/21/08	06/20/08	\$1,824.21	\$1,394.53	\$1,318.21	\$1,228.00	\$1,373.81	\$1,535.14	\$1,531.11
06/20/08	07/22/08	\$2,134.28	\$1,803.98	\$1,499.70	\$1,371.39	\$1,516.58	\$1,880.95	\$1,793.78
07/22/08	08/20/08	\$2,215.30	\$1,649.12	\$1,541.23	\$1,387.75	\$1,527.92	\$1,911.70	\$1,842.95
08/20/08	09/19/08	\$2,210.77	\$1,634.61	\$1,511.54	\$1,373.83	\$1,514.77	\$1,877.51	\$1,812.58
09/19/08	10/20/08	\$1,293.89	\$1,017.03	\$1,020.29	\$936.42	\$1,145.04	\$1,139.88	\$1,104.05
10/23/07	11/21/07	\$837.37	\$624.81	\$587.88	\$499.41	\$603.54	\$643.99	\$636.12
11/21/07	12/20/07	\$19.24	\$24.70	\$68.04	\$34.80	\$158.64	\$24.72	\$24.71
12 Month Total		\$13,500.23	\$10,216.38	\$9,827.03	\$8,912.28	\$10,469.35	\$11,540.51	\$11,179.80

Electric Rate Analysis Tool

Source: <http://www.pge.com/mybusiness/myaccount/rates/tools/>

Usage and Demand Values

FROM	TO	kWh	On kWh	Part kWh	Off kWh	TOU kWh est?	Max Demand	Max dmd est?	On Demand	Part Demand	Off Demand	TOU dmd est?
12/20/07	01/22/08	8	0	3	5	N	0	N	0	0	0	N
01/22/08	02/21/08	0	0	0	0	N	0	N	0	0	0	N
02/21/08	03/21/08	47	0	34	13	N	29	N	0	29	11	N
03/21/08	04/23/08	6340	0	2288	4052	N	29	N	0	29	29	N
04/23/08	05/21/08	10755	733	3117	8905	N	29	N	29	29	29	N
05/21/08	06/20/08	9192	739	1765	6688	N	29	N	29	29	29	N
06/20/08	07/22/08	10981	971	1955	8055	N	29	N	29	29	29	N
07/22/08	08/20/08	11481	962	2606	7913	N	29	N	28	29	29	N
08/20/08	09/19/08	11462	832	2038	8582	N	29	N	28	29	29	N
09/19/08	10/20/08	6141	455	1449	4237	N	28	N	28	28	28	N
10/23/07	11/21/07	5899	1	1862	4036	N	29	N	0	29	29	N
11/21/07	12/20/07	7	0	2	5	N	0	N	0	0	0	N
Total		72,303	4,693	17,119	50,491							

Breakeven Diesel Fuel Costs

(1200 hours annual operation)

Source: Jim Thompson, UC Davis

Electric Rate (\$/kWh)	35 hp	75 hp
0.10	1.00	1.20
0.12	1.30	1.45
0.14	1.55	1.75
0.16	1.85	2.00
0.18	2.10	2.30
0.20	2.40	2.60
0.22	2.65	2.85

Ways to Reduce Energy Unit Cost

- Compare energy sources and costs
- When rainfall is low, winter irrigate?

Benefits of Winter Irrigation

- Build up soil moisture reserve
- Pumping lifts may be less
- Deeper infiltration, less evaporation
- Reserve may help at harvest
- Extent of winter irrigation depends on several factors

Ways to Reduce Energy Unit Cost

- Compare energy sources and costs
- When rainfall is low, winter irrigate?
- When more than one source of water is available, look for opportunities to save by coordination

Steps to Reduce Horsepower Requirements

- Reduce pressure requirements
 - PG&E rebate programs

PG&E Rebate Program

- <http://www.pge.com/mybusiness/>
 - Energy savings rebates
 - Incentives by industry
 - Agriculture and Food Processing

Rebates:

- Sprinkler (>50 psi) to drip \$44.00 per acre
- High to low pressure - \$1.15 per nozzle

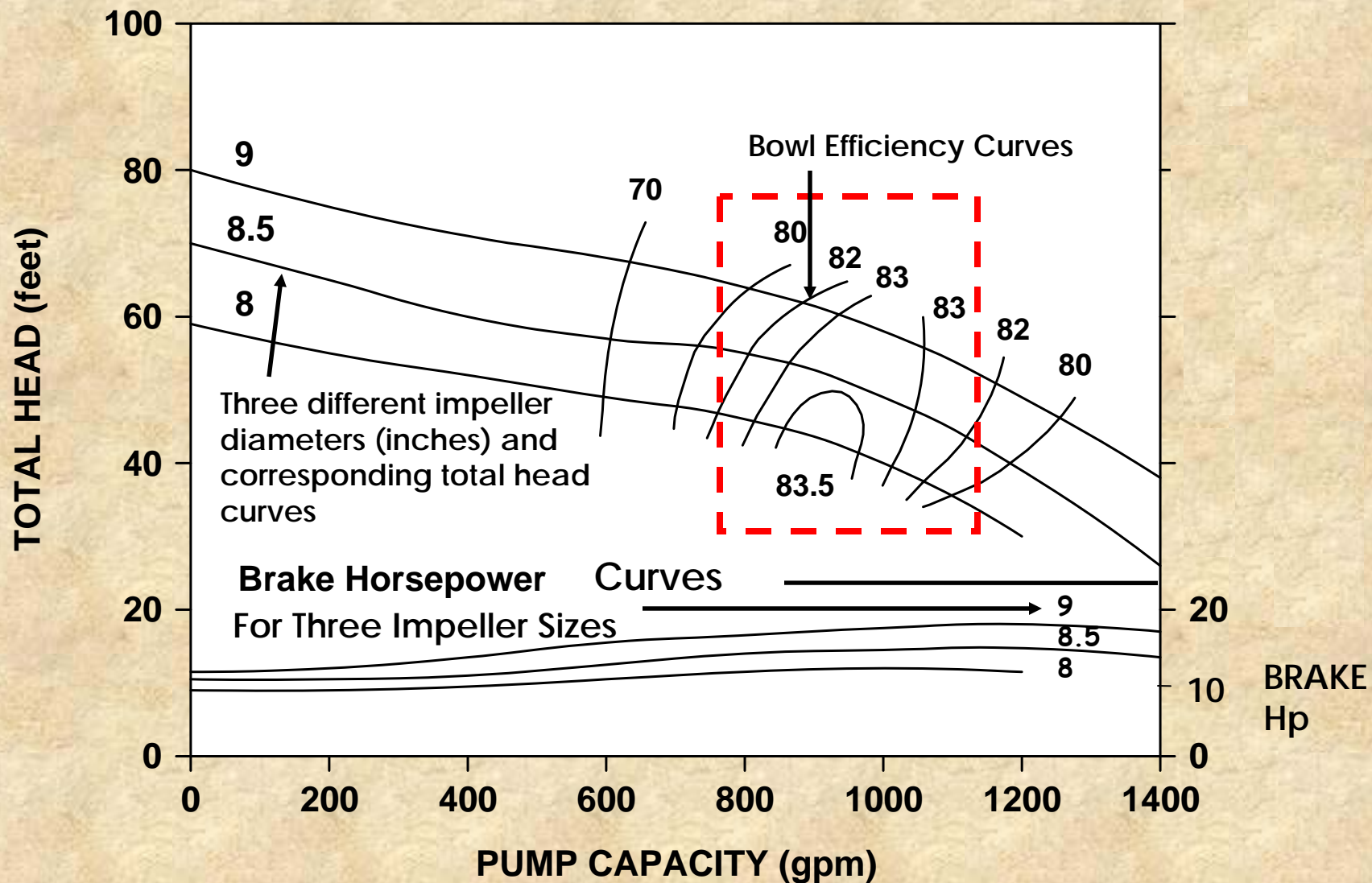
Steps to Reduce Horsepower Requirements

- Reduce pressure requirements
- Operate efficient pumps

An Efficiently Operating Pump

- Provides enough total head to lift and pressurize water
- Delivers enough flow capacity (gpm)
- Operates efficiently over expected range of groundwater conditions
- Operates at a high bowl efficiency
- Operates at a low brake horsepower

Sample Pump Curve



Steps to Reduce Horsepower Requirements

- Operate efficient pumps
- Maintain efficient pumping plants

Electrical Pumping Plant Efficiency

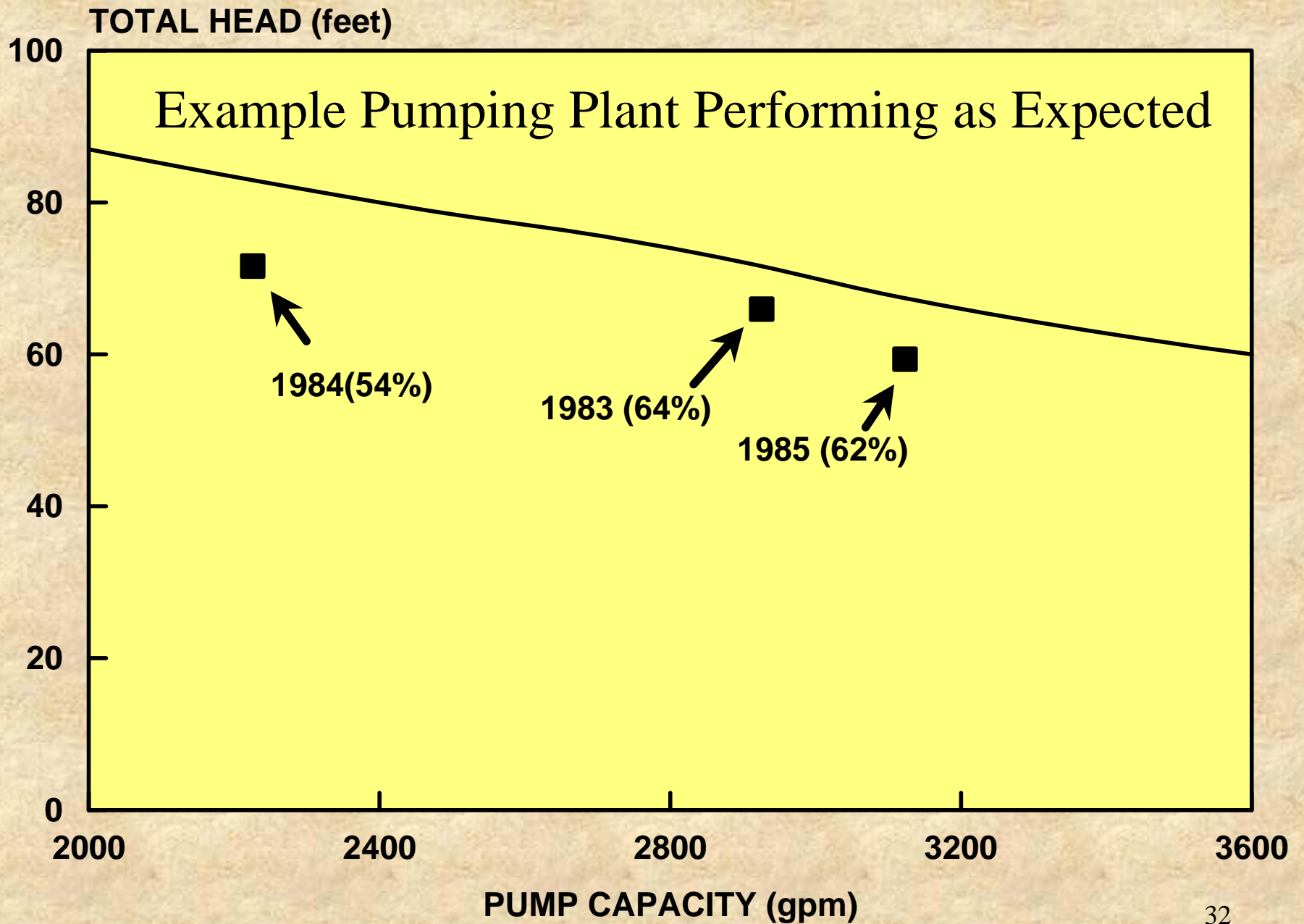
$$\begin{array}{l} \% \\ \text{Efficiency} \end{array} = \frac{\text{gpm} \times \text{total head}}{3960 \times \text{Input Horsepower}}$$

Maintaining Efficient Pumps

- Have on record pump performance curves
- Conduct pumping plant efficiency tests
- Compare and assess need to repair or replace

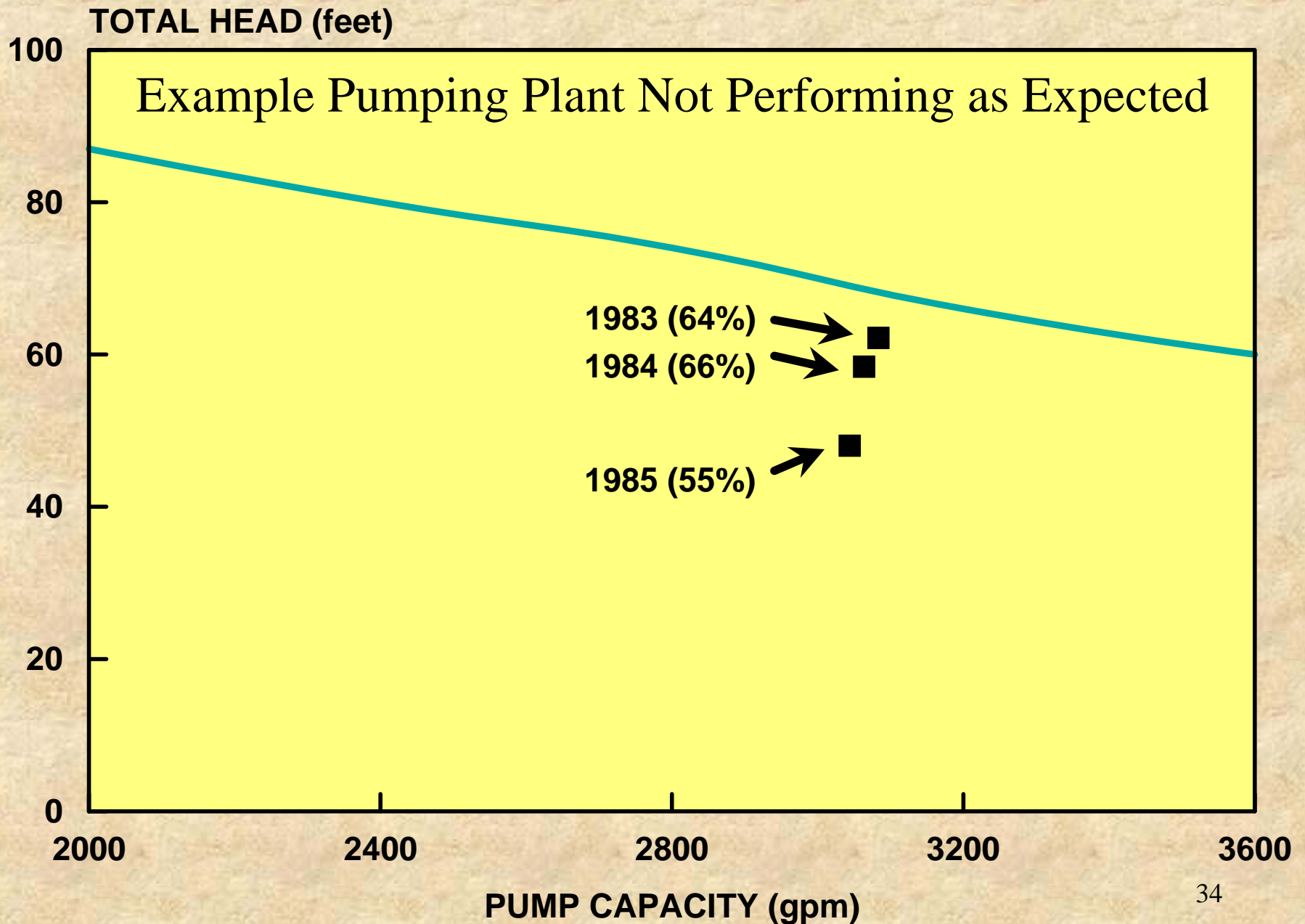
<http://www.pumpefficiency.org>

- Pump testing rebates



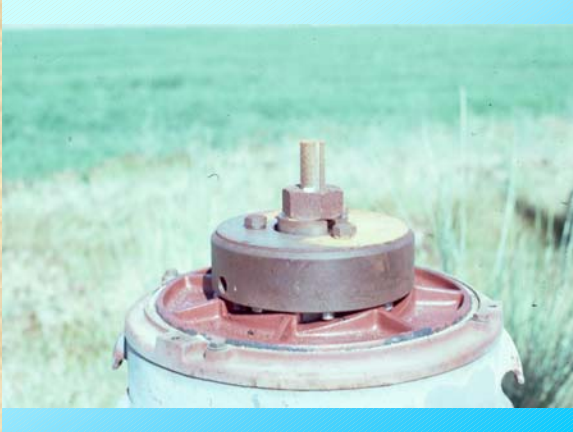
Possible Reasons for Isolated Year of Lower Pumping Plant Efficiency

- Declining groundwater level requiring more lift
- Change in irrigation system requiring more water or pressure
- Declining well efficiency



Possible Corrective Actions

- Impeller adjustment

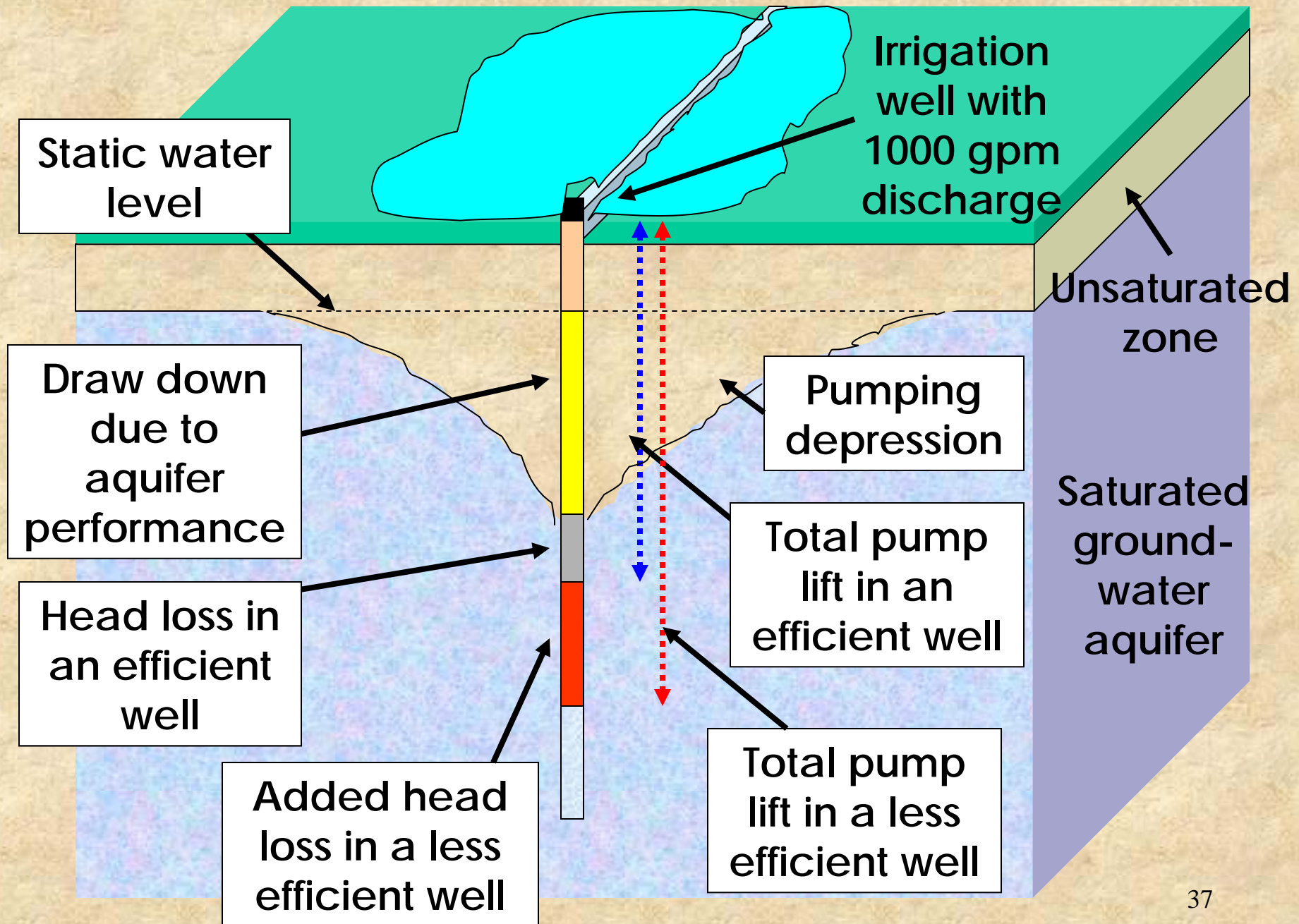


- Pump repair
- Pump replacement



Steps to Reduce Horsepower Requirements

- Operate pumps that perform efficiently
- Maintain efficient pumping plants
- Well efficiency



Keys to Reducing Water and Energy Costs

- Pumping hours
- Unit energy cost
- Horsepower or kilowatt demand

THANK YOU!

