



PERMANENT SPRINKLERS FOR HILLY PASTURES

WATER REQUIREMENTS

Irrigated pastures in the Sierra foothill areas use about 9 inches depth of water per month from mid-June to mid-September. An application of 3 inches depth of water every 10 days is usually required. This is equivalent to a continuous flow of 5.63 gallons per minute for each acre irrigated.

Plastic irrigation pipe has materially changed cost factors in sprinkler irrigation.

PROPER IRRIGATION

Sprinklers are a practical means of uniformly applying irrigation water on hilly ground with a 5 to 12 percent slope. Sprinkler spacings of 40 x 60 feet provide at least 80 percent coefficient of uniformity where winds are only moderate.

SPRINKLER REQUIREMENTS

Sprinklers should apply water uniformly over the entire pasture. The water precipitation rate should always be less than the rate at which the soil can absorb water. Otherwise, runoff and soil erosion occur. Most soils cannot take water at a rate higher than 0.3 inch per hour. The sprinklers, therefore, should be designed to apply 3 inches depth of water over a 12- to 24-hour period.

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If the sprinklers are spaced at 40-foot intervals along the buried plastic lateral lines and the lines are spaced 60 feet apart, a sprinkler discharge of 7.5 gallons per minute (gpm) will apply 0.3 inch depth of water per hour. This will require a sprinkler with a single $\frac{3}{16}$ -inch nozzle operated at 55 pounds per square inch (psi) or a sprinkler with $\frac{1}{64}$ -inch and $\frac{3}{32}$ -inch nozzles operated at 45 psi. Brass impulse sprinklers are recommended. The water must be screened to at least the sprinkler orifice size.

LATERAL LINES

The lateral lines should be large enough in diameter to prevent excessive friction losses. Each lateral line should be no more than $\frac{1}{8}$ mile (660 feet) long to keep pipe sizes reasonable. A typical lateral line with 7.5-gpm sprinklers spaced at 40 feet would use $1\frac{1}{2}$ -inch pipe to the last three sprinklers, 2-inch pipe for the next three sprinklers, $2\frac{1}{2}$ -inch pipe for the next four sprinklers, and 3-inch pipe to the first six sprinklers.

Main-line pipes should also be of adequate size to carry the flow without too much friction loss. Total friction loss in the complete pipeline system should not exceed about 10 psi.

Where freezing occurs, lateral lines should have drains at low points.

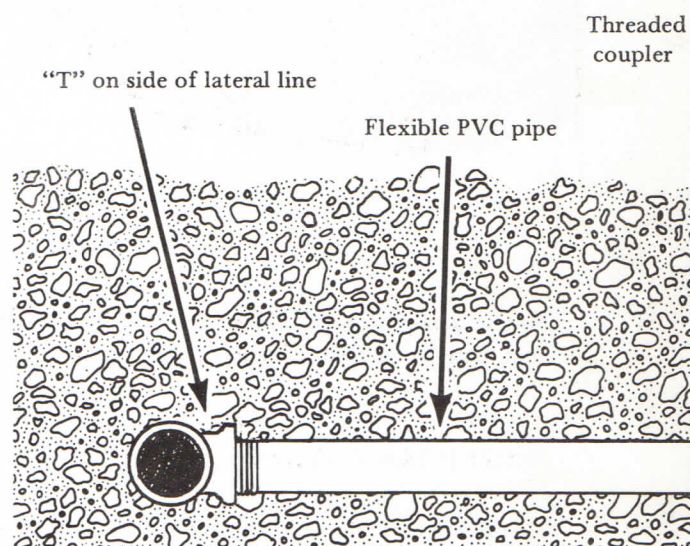
PLASTIC PIPES

Plastics being used that are well proven for most conditions are the polyvinyl chloride (PVC), Class I, 125 psi type. With automatic valves, 160-psi pipe must be used, but most systems rely on manual, slow-closing valves and so a 125-psi pressure rating is adequate. Schedule 80 PVC or galvanized iron risers must be used in pastures grazed by animals. For flexibility, a system of elbows should be designed at the risers in pastures.

COSTS

As shown in Table 1, the initial cost of a permanent system is about \$500 per acre, exclusive of the water source. Wells and/or pumps and reservoirs are quite variable in cost. Water development can often cost \$200 to \$300 per acre irrigated. Of the sprinkler cost, \$75 to \$100 per acre is for installation and can be partially saved if the grower installs his own system.

SPRINKLER AND RISER DESIGN



BOOSTER PUMP

Total water use—42 inches depth of water per year

Pressure at pump discharge

60 psi = 139 feet of lift

Assume overall pump efficiency at 60 percent.

Kilowatt-hours (kw.-hr.) per acre-foot (ac.-ft.) = 1.

In selected areas of study, electric power costs for the booster pump will vary from 3.0 to 4.0 cents per horsepower-hour of operation and usually total about \$35 to \$40 per acre per year. (See energy cost figures.)

Annual capital costs, of depreciation and interest, are about \$45 to \$50 per acre.

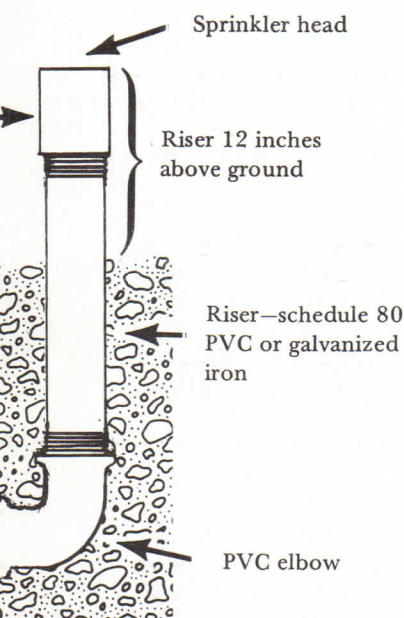
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For 40 Acres

Assume pump will be operating 80 percent of time during peak water-use period.

$$\text{Flow required} = 40 \times \frac{5.63}{0.80} = 282 \text{ gpm}$$

Horsepower required:

Assume pump efficiency at 67 percent.

$$\text{Horsepower} = \frac{282 \text{ gpm} \times 139 \text{ ft.}}{0.67 \times 3,960} = 15 \text{ horsepower}$$

Total acre-feet pumped:

$$3.5 \text{ feet} \times 40 \text{ acres} = 140 \text{ acre-feet}$$

$$\text{Energy used} = 140 \times 237 = 33,200 \text{ kw.-hr.}$$

Energy Cost (PG&E Schedule) for 40 Acres

Standby:

$$\begin{aligned} \text{Power use: } 15,000 \text{ kw.-hr.} \times .01702 &= \$255.30 \\ 15,000 \text{ kw.-hr.} \times .01032 &= 154.80 \\ 3,200 \text{ kw.-hr.} \times .00642 &= 20.54 \end{aligned}$$

Energy cost adjustment:

$$33,200 \text{ kw.-hr.} \times .02444 = 811.40$$

Less fuel collection balance adjustment:

$$33,200 \text{ kw.-hr.} \times .00042 = 13.94$$

$$\text{Total energy cost} \quad \$1,362.50$$

$$\text{Cost per acre} \quad 34.06$$

$$\text{Cost per acre-foot} \quad 9.73$$

$$\text{Cost per hp.-hr.} \quad .0338$$

$$x \frac{139}{0.60} = 237 \text{ kw.-hr./ac.-ft.}$$

TABLE 1.

SOLID-SET UNDERGROUND IRRIGATION SYSTEM USING PLASTIC PIPE: SAMPLE INSTALLATION COSTS.

	Cost	Cost per acre	Life (years)	Depreciation (per acre)	Interest @ 8% (per acre)
40 Acres					
Booster pump—15 hp.—300 gpm	\$ 1,500	\$ 37.50	15	\$ 2.50	\$ 1.50
Plastic pipe—mains, laterals, risers, and fittings	11,000	275.00	20	13.75	11.00
Sprinkler heads—704 @ \$5.00	3,520	88.00	10	8.80	3.52
Installation of 18" ditches	4,000	100.00	20	5.00	4.00
Total	\$20,020	\$500.50	—	\$30.05	\$20.02
80 Acres					
Booster pump—30 hp.—600 gpm	\$ 2,500	\$ 31.25	15	\$ 2.08	\$ 1.25
Plastic pipe—mains, laterals, risers, and fittings	20,000	250.00	20	12.50	10.00
Sprinkler heads—1,408 @ \$5.00	7,040	88.00	10	8.80	3.52
Installation	8,000	100.00	20	5.00	4.00
Total	\$37,540	\$469.25	—	\$28.38	\$18.77
100 Acres					
Booster pump—40 hp.—750 gpm	\$ 3,000	\$ 30.00	15	\$ 2.00	\$ 1.20
Plastic pipe—mains, laterals, risers, and fittings	24,000	240.00	20	12.00	9.60
Sprinkler heads—1,760 @ \$5.00	8,800	88.00	10	8.80	3.52
Installation	10,000	100.00	20	5.00	4.00
Total	\$45,800	\$458.00	—	\$27.80	\$18.32
150 Acres					
Booster pump—50 hp.—1,125 gpm	\$ 3,600	\$ 24.00	15	\$ 1.60	\$.96
Plastic pipe—mains, laterals, risers, and fittings	36,000	240.00	20	12.00	9.60
Sprinkler heads—2,640 @ \$5.00	13,200	88.00	10	8.80	3.52
Installation	15,000	100.00	20	5.00	4.00
Total	\$67,800	\$452.00	—	\$27.40	\$18.08
160 Acres					
Booster pump—60 hp.—1,200 gpm	\$ 3,800	\$ 23.75	15	\$ 1.58	\$.95
Plastic pipe—mains, laterals, risers, and fittings	38,000	237.50	20	11.88	9.50
Sprinkler heads—2,816 @ \$5.00	14,000	88.00	10	8.80	3.52
Installation	16,000	100.00	20	5.00	4.00
Total	\$71,800	\$449.25	—	\$27.26	\$17.97