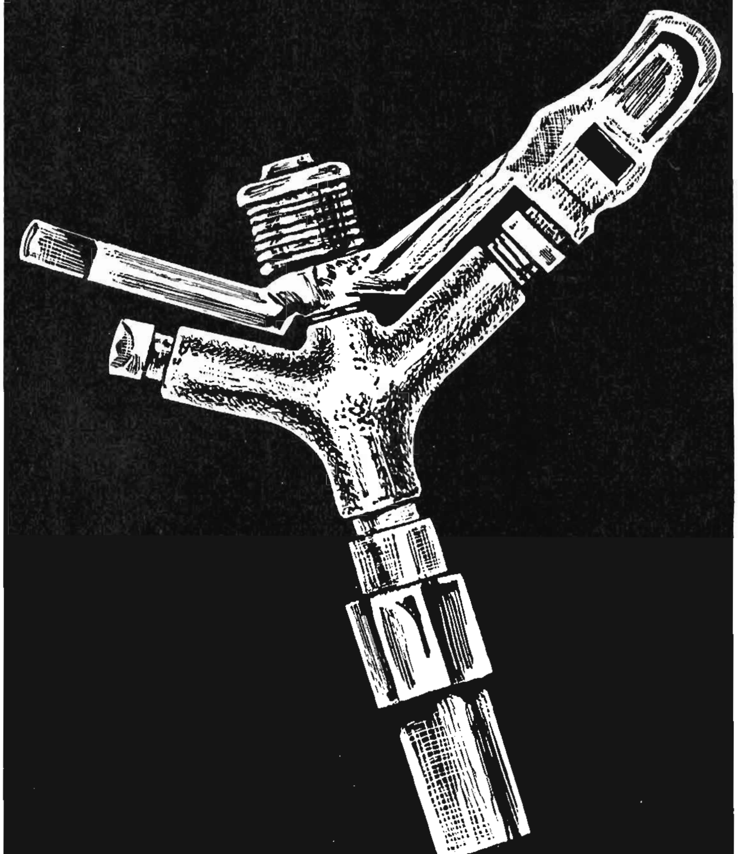
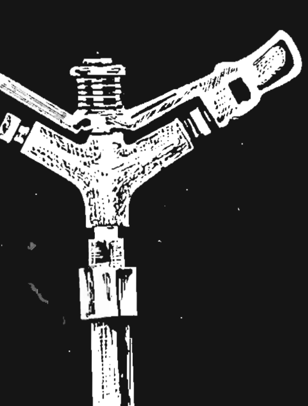
Buying a Sprinkler System?

Here's How!





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By John Wolfe

Agricultural Experiment Station
Oregon State College • Corvallis

Before buying . . .

Make sure an irrigation system is practical for your farm. Check the following list:

WHAT	WHERE
1. Availability of water.	1. Stream measurement or well test. Get a water right from the State Engineer, State Office Building, Salem, Oregon.
2. Availability of power.	2. Power Company.
3. Suitability of soil.	3. County Agent, or other qualified farm adviser, or local experience.
4. Quality of irrigation water.	4. Analysis by Oregon State College or other qualified testing laboratory.
5. Length of growing season sufficient to support high crop income.	5. County Extension Agent, or other qualified farm adviser, or local experience.
6. Best method of irrigation for your field (sprinkler vs. some gravity method).	6. Irrigation engineer, irrigation specialist, or any farm adviser qualified in irrigation engineering.

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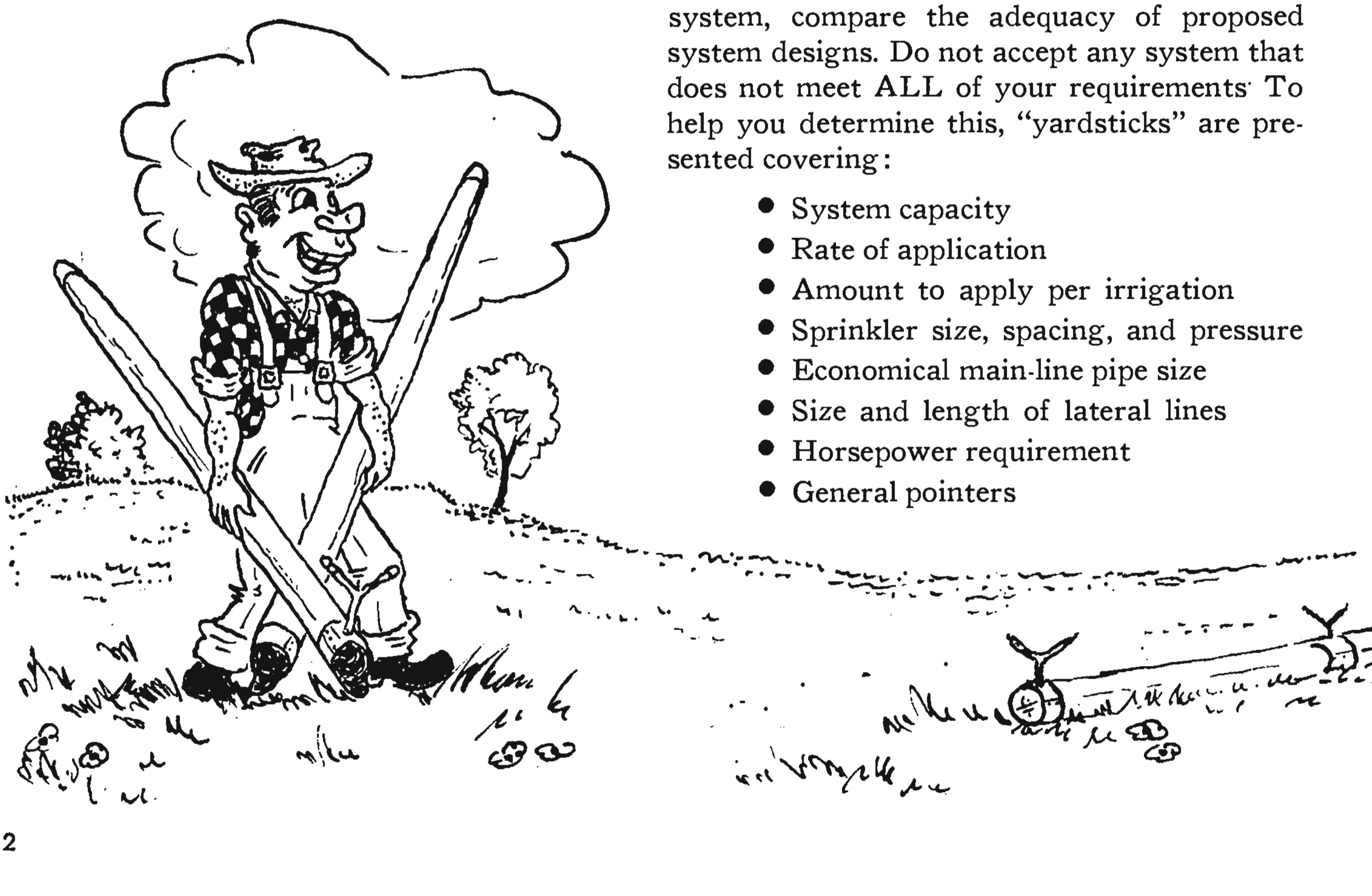
If your decision favors buying a sprinkler system, compare the adequacy of proposed system designs. Do not accept any system that does not meet ALL of your requirements. To help you determine this, "yardsticks" are presented covering:

- System capacity
- Rate of application
- Amount to apply per irrigation
- Sprinkler size, spacing, and pressure
- Economical main-line pipe size
- Size and length of lateral lines
- Horsepower requirement
- General pointers



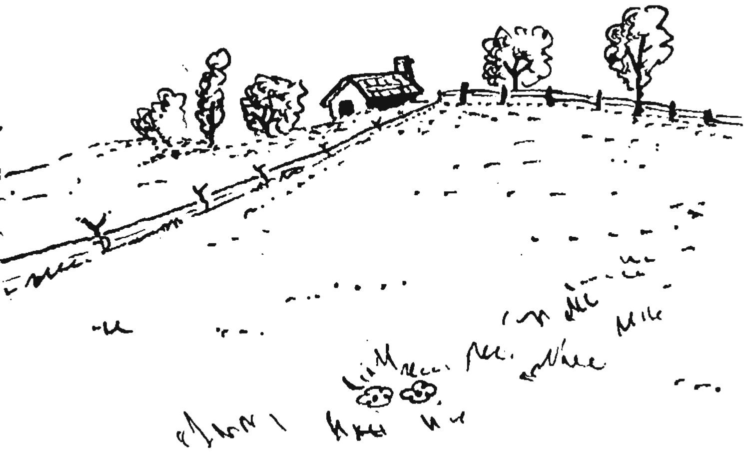
1. *Figure your . . .* System Capacity

The capacity of a sprinkler system should not be lower than the lowest of the pair of values listed in Table 2. The figures in the inches per day column are the exact equivalent of those in the gpm per acre column. A system with a lower capacity might get by during a cool season but would be inadequate for the hottest month in a hot, dry season.

There is one exception to this recommendation. If you have a deep-rooted crop growing on a deep, fine-textured soil, the required capacity would be slightly smaller than the figures shown.

Capacities should not be higher than the highest figure recommended in Table 2, unless

- **System cannot be operated 24 hours a day (except for moving time), 7 days a week during peak use.**
- **Shape of field does not permit all sprinklers to be in operation during period of peak use.**
- **System is so small that the excess capacity per acre does not increase cost excessively.**
- **More acreage will be covered by the system in the next year or two.**



2. *Determine your . . .* Application Rate

To obtain the most benefit from uniform distribution of your sprinkler system, and to prevent erosion from irrigation water, make sure each drop is absorbed where it falls. This means there must be no free water standing or running on the surface during an irrigation.

Recommended maximum rates of application are shown in Table 1. Check the proposed sprinkler selection by a 24-hour trial set with a line of three sprinklers. If runoff occurs, smaller nozzles can be tried until no runoff or puddling takes place. This trial is not a sure method. Soil infiltration capacities show considerable variation with different crops. They vary during a season with the same crop. It is better to be safe and select a rate on the low side.

TABLE 1. Don't Apply Water Too Fast

Soil texture and profile description	Maximum application rate	
	Individual sprinkler discharge	Sprinkler spacing on lateral
	(gpm)	*(feet)*
Coarse sandy soils, uniform in texture to 6 feet	16	40
	12	30
	7	20
Coarse sandy soils over finer textured subsoils	12	40
	9	30
	6	20
Sandy loam soils, uniform in texture to 6 feet	9	40
	7	30
	5	20
Sandy loam soils over finer textured subsoils	8.5	40
	6	30
	4	20
Silt loam soils, uniform in texture to 6 feet	7.5	40
	5	30
	3	20
Silt loam soils over finer textured or more compact subsoils	7	40
	5	30
	3	20
Fine textured clay or clay loam soils	5	40
	4	30
	2	20

It is possible that these rates can be increased as much as 25% on flat lands in forage crops. On sloping land in row crop, they may have to be decreased.

TABLE 2. Use These Suggested Capacities

Agricultural section	Corn, alfalfa, Ladino pasture, small grains, orchards with cover		Grass hay, pole beans		Grass pasture, legume seed, peas	
	Gpm/acre	*Inches/day*	*Gpm/acre*	*Inches/day*	*Gpm/acre*	*Inches/day*
Coastal area			4.2 – 5.3	.22 – .28	4.2 – 5.3	.22 – .28
Columbia River below Hood River	5.5 – 6.9	.29 – .37	5.1 – 6.4	.27 – .34	5.1 – 6.4	.27 – .34
Tualatin Valley	5.5 – 6.8	.29 – .36	5.1 – 6.4	.27 – .34	5.1 – 6.4	.27 – .34
Willamette Valley	5.4 – 6.8	.29 – .36	5.1 – 6.4	.27 – .34	5.1 – 6.4	.27 – .34
Umpqua River Valley area	5.5 – 6.8	.29 – .36	5.1 – 6.4	.27 – .34	5.1 – 6.4	.27 – .34
Medford-Grants Pass	6.0 – 7.5	.32 – .40	5.3 – 6.7	.28 – .36	5.7 – 7.1	.30 – .38
Lake Creek-Little Butte Creek	5.9 – 7.4	.31 – .39	5.2 – 6.5	.28 – .34	5.5 – 6.9	.29 – .37
Hood River Valley	5.4 – 6.8	.29 – .36	5.1 – 6.3	.27 – .33	5.1 – 6.3	.27 – .33
Columbia River above Hood River	6.5 – 8.2	.34 – .43	5.8 – 7.2	.31 – .38	6.1 – 7.7	.32 – .41
East slope of Mt. Hood	5.7 – 7.1	.36 – .38	5.0 – 6.3	.27 – .33	5.3 – 6.7	.28 – .36
Madras-Redmond area	5.7 – 7.1	.30 – .38	5.0 – 6.3	.27 – .33	5.3 – 6.7	.28 – .36
Klamath area	5.7 – 7.2	.30 – .38	5.0 – 6.3	.27 – .33	5.4 – 6.7	.29 – .36
Lakeview area	5.7 – 7.2	.30 – .38	5.1 – 6.4	.27 – .34	5.4 – 6.8	.29 – .36
Columbia Basin wheat land	6.0 – 7.5	.32 – .40	5.3 – 6.6	.28 – .35	5.7 – 7.1	.30 – .38
Pendleton-Heppner area	6.2 – 7.8	.33 – .41	5.5 – 6.9	.29 – .37	5.8 – 7.3	.31 – .39
Hermiston area	6.6 – 8.3	.35 – .44	5.8 – 7.3	.31 – .39	6.2 – 7.8	.33 – .41
Milton-Freewater area	6.3 – 7.9	.33 – .42	5.6 – 7.0	.30 – .37	6.0 – 7.5	.32 – .40
Dayville-Canyon City	6.0 – 7.6	.32 – .40	5.3 – 6.7	.28 – .36	5.7 – 7.1	.30 – .38
Harney Valley	5.8 – 7.2	.31 – .38	5.1 – 6.4	.27 – .34	5.4 – 6.8	.29 – .36
Wallowa Valley	5.6 – 7.0	.30 – .37	5.0 – 6.2	.27 – .33	5.3 – 6.6	.28 – .35
Grand Ronde Valley	6.0 – 7.5	.32 – .40	5.3 – 6.6	.28 – .35	5.6 – 7.0	.30 – .37
Baker Valley	5.6 – 7.1	.30 – .38	5.0 – 6.2	.27 – .33	5.3 – 6.6	.28 – .35
Pine and Eagle Valleys	6.2 – 7.7	.33 – .41	5.4 – 6.8	.29 – .36	5.8 – 7.3	.31 – .39
Malheur area	6.4 – 8.1	.34 – .43	5.7 – 7.1	.30 – .38	6.1 – 7.6	.32 – .40
Jordan Valley	6.0 – 7.5	.32 – .40	5.3 – 6.6	.28 – .35	5.6 – 7.0	.30 – .37

Suggested capacities are adjusted to include expected water losses. They should be adequate for a hot, dry season. For shallow, sandy soils, select the higher figure. For deep, medium to fine textured soils, select the lower figure. For other, compute averages between pairs of figures.

3. *Know the . . .* Amount to Apply Each Irrigation

One irrigation should supply enough water to fill the soil in the root zone and little more. In areas of low annual rainfall, some additional water will be required for leaching. Thus, assuming that we remove 50 per cent to 75 per cent of the available moisture before irrigation, and that our irrigation efficiency is 75 per cent, the figures of Table 3 will indicate how much water to apply for each irrigation. Crop roots' effective root zone also is shown in Table 3, assuming roots are not restricted for depth either by compact layer or a gravel layer in the subsoil.

To find the correct amount of water to apply per irrigation, read in the column your crop is listed, or the column containing the depth to a restrictive layer (whichever gives the shallower root zone), and read the figures opposite the profile description which most nearly describes your soil. The usual depth of application should be within this range.

To check the amount of application of a proposed system design, find the theoretical application rate of the proposed system from Table 4. Multiply this value by the proposed length of set in hours.

for Your Sprinkler Irrigation System

Mint, onions, sugar beets, potatoes		Hops, deciduous orchards, vegetable seed, small truck, bush beans, sorghum		Strawberries		Tomatoes	
Gpm/acre	*Inches/day*	*Gpm/acre*	*Inches/day*	*Gpm/acre*	*Inches/day*	*Gpm/acre*	*Inches/day*
4.2 – 5.3	.22 – .28						
4.8 – 6.0	.25 – .32	4.5 – 5.6	.24 – .30	4.1 – 5.1	.22 – .27	4.8 – 6.0	.25 – .32
4.8 – 6.0	.25 – .32	4.4 – 5.6	.23 – .30	4.1 – 5.1	.22 – .27	4.8 – 6.0	.25 – .32
4.7 – 5.9	.25 – .31	4.4 – 5.5	.23 – .29	4.1 – 5.1	.22 – .27	4.7 – 5.9	.25 – .31
4.8 – 6.0	.25 – .32	4.4 – 5.6	.23 – .30	4.1 – 5.1	.22 – .27	4.8 – 6.0	.25 – .32
5.3 – 6.7	.28 – .36	5.0 – 6.2	.27 – .33	4.3 – 5.3	.23 – .28	5.0 – 6.2	.27 – .33
5.2 – 6.5	.28 – .34	4.8 – 6.1	.25 – .32	4.2 – 5.2	.22 – .28	4.8 – 6.1	.25 – .32
4.7 – 5.9	.25 – .31	4.4 – 5.5	.23 – .29	4.1 – 5.1	.22 – .27	4.7 – 5.9	.25 – .31
5.8 – 7.2	.31 – .38	5.4 – 6.7	.29 – .36			5.4 – 6.7	.29 – .36
5.0 – 6.3	.27 – .33						
5.1 – 6.3	.27 – .33						
5.1 – 6.4	.27 – .34						
5.8 – 7.3	.31 – .39	5.4 – 6.8	.29 – .36			5.4 – 6.8	.29 – .36
5.6 – 7.0	.30 – .37	5.2 – 6.5	.28 – .34	4.5 – 5.6	.24 – .30	5.2 – 6.5	.28 – .34
		4.9 – 6.1	.26 – .32				
5.0 – 6.2	.27 – .33						
		5.1 – 6.4	.27 – .34			5.1 – 6.4	.27 – .34
5.7 – 7.1	.30 – .38	5.3 – 6.6	.28 – .35				

Operation 24 hours a day, 7 days a week during the peak use is assumed, except time required to change pipe. Pairs of figures in "inches per day" column are given as average daily requirements between irrigations during period of peak demand. Multiply days of use by these figures.

TABLE 3. Apply the Right Amount of Water

Soil texture and profile description	Amount of water to apply per irrigation for crops with root zone depth— 1 to 2 feet: Beans[1], Ladino clover[1], mint, onions, potatoes[1], strawberries, truck crops, vegetable seed	2 to 4 feet: Corn, cranberries, grass-clover mixture, grass seed, sugar beets, tomatoes, grain	4 to 6 feet: Alfalfa, hops, orchard
	Inches	*Inches*	*Inches*
Coarse sandy soils, uniform in texture to 6 feet	1.0–1.5	1.5–2.5	2.0–3.5
Coarse sandy soils over finer textured subsoils	1.5–2.0	2.0–3.0	2.5–4.0
Sandy loam soils, uniform in texture to 6 feet	2.0–3.0	2.5–4.0	3.5–6.0
Sandy loam soils over finer textured subsoils	2.0–3.5	3.0–4.5	4.0–7.0
Silt loam soils, uniform in texture to 6 feet	2.5–4.5	3.5–5.5	4.5–8.5
Silt loam soils over finer textured or more compact subsoils	2.5–4.5	4.0–6.0	5.0–9.0
Fine textured clay or clay loam soils	2.5–4.0	3.5–5.0	4.5–8.0

[1] **These crops will root deeper than 2 feet but seem to respond to light, frequent applications. A soil auger can be used after an irrigation to determine if a quantity suggested here was adequate.**

4. *Use the . . .* Best Sprinkler Size, Spacing, Pressure

For each sprinkler nozzle size, there is a recommended pressure range for most uniform coverage. Except for a few special cases, pressures that are either higher or lower aren't profitable. Also, for each sprinkler nozzle size at recommended pressure, there is a maximum spacing that will give uniform coverage.

Offsets are often necessary to eliminate "dry" strips between sprinkler sets. By using offset pipes, the sprinklers can be set in the center of the space between the sets of the previous irrigation. It is nearly always desirable and frequently necessary to offset the 60-foot spacing. The 40-foot spacing on the lateral also can be offset easily on systems with an even number of laterals in rotation. In this case, every other lateral could have the first sprinkler 10 feet from the main line and, on the alternate laterals, 30 feet from the main. All other sprinklers on all laterals would have the conventional 40-foot intervals. (See back page.)

Table 4 reports the recommended pressure and spacing of several of the common sizes of sprinklers, and the theoretical rates of application at these conditions. Pressures indicated are near the best for uniform distribution, but a variation of 5 pounds per square inch below or 10 pounds per square inch above is permissible. In general, a pressure lower than this range is a more serious error than one higher. Divide the Table 3 value by the application rates to check the proposed time length of set.

In the column headed "offsets recommended," the single offset applies to the longer spacing and the double offset to both the longer and the shorter spacings.

TABLE 4. Use the Best Spacing and Pressure

Sprinkler nozzle size	Recommended average pressure[1]	Discharge at recommended average pressure	Minimum permissible pressure on last sprinkler	Maximum spacing at recommended pressure[2]	Offsets recommended	Theoretical rate of application at these conditions
Inches	*Lbs./sq. in.*	*gpm*	*Lbs./sq. in.*	*Ft.*		*In./hr.*
1/8	25	2.21	24	30 x 40	Double	0.18
				or 20 x 50	Single	0.21
5/32	30	3.78	28	30 x 50	Single	0.24
				or 20 x 50	Single	0.36
3/16	35	5.84	33	30 x 50	Single	0.38
				or 20 x 50	Single	0.57
5/32	30	3.89	28	30 x 50	Single	0,24
11/64	32	4.82	30	30 x 60	Single	0.26
3/16	35	5.93	33	30 x 60	Single	0.32
5/32 x 3/32	30	5.19	28	40 x 50	Double	0.25
11/64 x 3/32	35	6.50	33	40 x 60	Double	0.26
3/16 x 3/32	35	7.57	33	40 x 60	Single	0.31
3/16 x 1/8	35	8.52	33	40 x 60	Single	0.34
13/64 x 5/32	40	11.8	38	40 x 60		0.48
7/32 x 3/16	45	15.9	42	40 x 60		0.64
7/32 x 3/16	45	16.2	42	60 x 60	Double	0.44
				or 40 x 80	Single	0.49
1/4 x 3/16	45	18.8	42	60 x 80	Double	0.38
				or 40 x 80	Single	0.57
1/4 x 7/32	45	21.1	42	60 x 80	Double	0.43
				or 40 x 80	Single	0.64
9/32 x 7/32	55	26.8	52	60 x 80	Double	0.54

[1] Permissible variation from 5 pounds below to 10 pounds above.

[2] When wind averages above 4 mph, the spacings indicated for small- and medium-sized sprinklers must be reduced. Larger sprinklers are even more susceptible to wind. In addition, their higher application rates mean shorter lengths of set. This increases the probability of a high wind lasting through an entire set. Large sizes should therefore be selected with extreme caution.

5. *Here's How to . . .* Use the Information

Example 1

A proposed Willamette Valley sprinkler system for Ladino clover-grass pasture mixtures on Willamette silt loam specified 6.2 gpm sprinklers (11/64-inch by 3/32-inch nozzles) at 32 pounds per square inch (psi) average pressure at 40-foot by 60-foot spacing. Total system capacity proposed is 5.5 gpm per acre. Operating schedule calls for 24-hour sets. Double offsets are indicated. Evaluate the system.

Solution

1: *System capacity*

Table 2 indicates a range of 5.4 to 6.8 gpm per acre for Ladino clover pasture in the Willamette Valley. Since Willamette silt loam is a deep, medium-fine textured soil, 5.5 gpm per acre is adequate capacity.

2: *Application rate*

In Table 1 we find that the profile description which fits Willamette silt loam is a silt loam soil over finer textured or more compact subsoil. Maximum recommended application rate is to have sprinklers, each of which are discharging 7 gpm, spaced 40 feet apart on the lateral. The design rate can therefore be considered safe, since specifications call for 6.2 gpm sprinklers spaced 40 feet apart. To make sure, a 24-hour trial set should be made in critical areas of the field.

3: *Amount to apply per irrigation*

In Table 4, the closest figure is 0.26 inches per hour at 35 psi. Since the sprinkler is operating at 32 psi we can assume it will apply water at 0.25 inches per hour. In 24 hours it would apply a total of 6 inches.

From Table 3 we see that the effective root zone of the column containing clover-grass mixtures is 2 to 4 feet. Since this soil has no restrictive layer, we may use this column. Reading down to the correct soil description we see that 6 inches is the maximum amount recommended per irrigation for a 4-foot depth on this soil. Nevertheless, the proposed system does fall within the recommended range, and therefore could be considered satisfactory.

4: *Sprinkler size, spacing, and pressure*

From Table 4 we find that the recommended average pressure for this sprinkler is 35 pounds per square inch and that the maximum permissible spacing is 40 feet by 60 feet. This spacing is recommended only if double offsets are used. The proposed spacing meets these requirements.

The proposed pressure is 3 psi less than that recommended, but 5 psi below is permissible.

Example 2

A proposed sprinkler system for corn in the Hermiston area on a loamy fine sand over finer textured subsoil specified 8.52 gpm sprinklers (3/16-inch by 1/8-inch nozzles) at 35 psi average pressure at 40-foot by 60-foot spacing. Total system capacity proposed is 77 gpm for 10 acres or 7.7 gpm per acre. Operating schedule calls for three 7.5 hour sets per day, allowing one-half hour moving time. No offsets are indicated. Evaluate the system.

Solution

1: *System capacity*

Table 2 indicates a range of 6.6 to 8.3 gpm per acre for corn in the Hermiston area. Because this soil is quite sandy, the system capacity should be near the upper limit. However, since corn roots 3 to 4 feet deep the 7.7 gpm proposed should be ample.

2: *Application rate*

Table 1 suggests 12 gpm maximum per sprinkler for these conditions. The 8.52 gpm sprinklers proposed should be safe. However, some of these soils seal up somewhat with cropping. It might be advisable to make a trial run.

3: *Amount to apply per irrigation*

From Table 4 the proposed application rate is found to be 0.34 inches per hour. Multiplying this by 7.5 hours length of set gives 2.55 inches applied.

Table 3 suggests a range of 2 to 3 inches per irrigation. Because corn is one of the deeper rooted crops in the 2- to 4-foot column, a 3-inch application would be better, but the 2.55 inches should be satisfactory.

4: *Sprinkler size, spacing, and pressure*

From Table 4 it appears that a 3/16-inch by 1/8-inch sprinkler would be satisfactory on a 40-foot by 60-foot spacing if a single offset were used. However, winds in the Hermiston area are known to exceed 4 mph for days. Under these conditions, the proposed spacing does not give satisfactory distribution.

A much better spacing would be 30 feet by 50 feet. The same discharge on the lateral would be achieved if the discharge per sprinkler were reduced to 6.48 gpm. An 11/64-inch by 3/32-inch sprinkler at 35 psi would do. Reducing the lateral movement to 50 feet increases the amount applied per irrigation to 3.1 inches, almost exactly the amount recommended in Table 3. This change would increase the time it takes to cover the acreage once, but not excessively, since the system capacity and amount applied at each irrigation conform to recommendations.

6. *There's an . . .* Economical Main Line Pipe Size

Irrigation main line, suction line, and supply line should be selected on a basis of economy. The objective is to select the pipe size that will have the lowest total cost for a period covering the entire length of life of the pipe. If the size selected is too small, the cost of power to force the necessary quantity of water through it will be too great. If the size is too large, the cost of interest and depreciation, computed for the life of the pipe, will be excessive. The most economical selection will be a compromise between these two factors.

To select the most economical pipe size, the designing engineer must give consideration to the cost of electricity per kilowatt-hour, and the pressure required to overcome the friction in the pipe. In addition, he must estimate the number of hours that water will be pumped through the pipe during the year and the expected efficiency of the pump and motor combined. These figures will give him the total annual cost of pumping a certain quantity of water against the friction in the pipe. Interest and depreciation computed for the expected length of life of the pipe can then be added to obtain the total annual cost. If the pipe is to be buried or moved frequently, these costs should also be added in.

Table 5 gives suggested permissible capacities for common pipe sizes based on typical though not necessarily average Willamette Valley conditions in 1954. The assumptions made for computing the table were 15-, 20-, and 25-year life of pipe, respectively, for aluminum, steel, and asbestos-cement; interest at 5 per cent; electricity at 1.8 cents per kilowatt-hour; 2,600 hours per year operation; and over-all pump and motor efficiency at 60 per cent. In the case of steel, the friction factor was based on 15-year-old pipe. For aluminum, the friction factor used included the loss in the couplers. For asbestos-cement the friction factor for new, smooth pipe was used. The true values for any proposed system will not all agree with these assumed values. The table will be useful to the extent that deviations will compensate for each other.

If the suction lift of a centrifugal pump is near the 15-foot maximum, it would be advisable to select the suction pipe one size larger than the table indicates.

If a proposed sprinkler system has two or more laterals to be rotated in sequence around the main line with equal intervals, the main line can be tapered. For example, if a system has two laterals and a center main, and one lateral is started at each end of the main, the laterals will meet in the center but on opposite sides. Never will the last half of the main be required to carry water for both laterals at once, and therefore it can be reduced in size.

No conclusions can be drawn from these figures on the relative merits of the three classes of pipe because computation was based only on comparison of sizes within each class. The figures will serve only as a check for a selected size for a proposed pipe line.

TABLE 5. Use Right Sized Main, Supply Line

	Suggested Capacities		
Pipe size	Portable aluminum	Buried steel	Buried asbestos cement
Inches	*gpm*	*gpm*	*gpm*
3	20–80		20–120
4	50–180	40–160	90–180
5	140–220		
6	180–400	130–400	140–390
7	360–650		
8		300–750	350–800

EXAMPLE

Proposed is a 4" aluminum main line through which 150 gpm would be pumped for a Willamette Valley irrigation system. Is this the most economical size?

SOLUTION

From Table 5, it appears that 150 gpm might call for either a 5" or 4" pipe. However, since it is farther within the range for 4", a careful computation might show 4" more economical. If the system might soon be expanded, however, 5" would be a better choice.

7. *Determine your . . .* Size and Length of Lateral Lines

If laterals have too many sprinklers for the size of pipe, the last sprinklers do not get enough water. Table 6 shows the maximum sprinklers recommended for each size of pipe when the lateral is on level land. The first figure in each entry represents approximately the 20 per cent permissible loss specified by the American Society of Agricultural Engineers. The second figure represents this lateral length reduced by 10 per cent. In the author's opinion, the latter set of figures more nearly represent maximums that should be recommended. A 10 per cent reduction in length of lateral reduces the pressure loss in the lateral about 25 per cent. Even then, the pipe size for the first few sprinklers on a lateral is too small for power economy, as indicated by Table 5. The extra cost of labor for moving the larger pipe should not be overlooked, especially on hand-moved systems.

Table 6 assumes that the lateral is laid out on the level. If instead, it is laid uphill from the main, its size must be increased to obtain equal performance. For every 10 foot gain in elevation, pressure on the sprinklers is reduced by 4 1/3 psi. To use the Table, insert the proposed lateral pipe size and sprinkler size. If the corresponding table value is less than the proposed number of sprinklers per lateral, the pipe size is too small.

TABLE 6. Use the Right Sized Lateral Line

Average discharge per sprinkler	Sprinkler spacing on lateral	Maximum number sprinklers per lateral								
		All 2″	Half 2″ Half 3″	All 3″	Half 3″ Half 4″	All 4″	Half 4″ Half 5″	All 5″	Half 5″ Half 6″	All 6″
gpm	*Ft.*									
2.21	20	23–21	39–35	50–45						
2.21	30	21–19	34–31	44–40						
3.78	20	18–16	28–26	37–33	52–46	62–56				
3.78	30	15–13	25–22	32–29	45–41	53–48				
5.84	20	13–12	22–20	28–25	42–38	49–44				
5.84	30	12–11	19–17	25–22	36–32	43–39				
5.19	40	11–10	18–16	23–21	33–30	39–35				
6.20	40	10– 9	16–14	21–19	29–26	35–31				
7.57	40	9– 8	15–13	19–17	27–24	31–28				
8.52	40	8– 7	13–12	17–15	24–22	29–26	39–35	43–39		
11.8	40	7– 6	11–10	14–13	21–19	25–22	33–30	37–33		
15.9	40	5– 4	9– 8	12–11	17–15	21–19	27–24	31–28	40–36	43–39
16.2	40	–	–	12–11	17–15	21–19	27–24	31–28	39–35	41–37
16.2	60	–	–	10– 9	15–13	18–16	23–21	27–24	33–30	37–33
18.8	40	–	–	11–10	16–14	19–17	25–22	28–25	35–31	38–34
18.8	60	–	–	9– 8	13–12	16–14	21–19	25–22	31–28	33–30
21.1	40	–	–	10– 9	14–13	17–15	23–21	25–23	31–29	35–31
21.1	60	–	–	9– 8	13–12	15–14	19–18	22–20	27–24	31–28
26.8	60	–	–	8– 7	11–10	14–13	18–16	20–18	25–22	28–25

EXAMPLE

Proposed is a lateral with 12 sprinklers, with an average discharge of 7.57 gpm. Six sprinklers would be on 3-inch pipe and 6 on 2-inch pipe, all at 40-foot spacing. Is this pipe too small?

SOLUTION

Under the column "Half 2", Half 3" ", and opposite 7.57 gpm, read 13 sprinklers maximum. Thus the 12 sprinklers are satisfactory, assuming relatively level land. Had the land elevation raised 10 feet from the main line to the end sprinkler, the maximum permissible friction loss would be 10 feet less. If this were the case, 7 sprinklers on 3-inch pipe and 5 on 2-inch would bring the total pressure variation up to the 20 per cent maximum recommended by ASAE. If all 12 were on 3-inch, the variation would about correspond to the lower set of figures in the table above.

8. *Figure your . . .* Horsepower Requirements

The best made pump on the market is not satisfactory if it is not selected to fit the job at a high operating efficiency. It must be capable of delivering the required quantity of water at the required pressure and should have a guaranteeed efficiency at these conditions of at least 60 per cent. An inefficient pump is not cheap no matter how low its first cost may be. Unless your system is to be expanded in the near future, an oversized pump and motor is an extravagance. An undersized unit would not operate the sprinklers satisfactorily.

The approximate horsepower requirement of typical sprinkler systems is shown in Table 7. Assumptions had to be made to compile this table which may not fit any system exactly, but several small deviations will tend to balance each other. The actual power requirement must be computed accurately from engineering data to make a pump selection. This table will serve only as a rough check on a selection.

The example at the bottom of Table 7 shows 9.7 HP, which would require a 10 HP pump and motor. If instead a dealer recommends a $7\frac{1}{2}$- or a 15-HP pump, it would be well to question his selection by requesting guaranteed pump performance curves. A qualified, unbiased observer can tell from these if the $7\frac{1}{2}$ HP selection would provide adequate capacity and pressure, or if the 15 HP selection would be as efficient as it should be. Perhaps the curves would indicate that the 15 HP selection had a trimmed impeller, and thus was actually only a $10\frac{1}{2}$ or 11 HP pump that would operate efficiently.

TABLE 7. Estimate Your Horsepower Needs

Static lift, ft., plus length of supply line in hundreds of feet	Acres irrigated									
	10	20	30	40	50	60	70	80	90	100
Ft. + (ft./100)	*HP*	*HP*	*HP*	*HP*	*HP*	*HP*	*HP*	*HP*	*HP*	*HP*
0	2.5	5.0	7.5	10.0	12.4	14.7	17.0	19.3	21,8	24.3
10	2.8	5.5	8.2	10.9	13.5	16.0	18.5	21.0	23.7	26.3
20	3.0	6.0	9.0	11.8	14.6	17.3	20.0	22.7	25.5	28.3
30	3.3	6.5	9.7	12.8	15.7	18.6	21.5	24.4	27.4	30.3
40	3.5	7.0	10.4	13.7	16.8	19.9	23.0	26.0	29.2	32.3
50	3.8	7.5	11.1	14.6	17.9	21.2	24.5	27.7	31,1	34.4
60	4.0	8.0	11.8	15.5	19.0	22.5	25.9	29.3	32.9	36.4
70	4.3	8.5	12.5	16.5	20.2	23.8	27.4	31.0	34.7	38.4
80	4.5	8.9	13.2	17.4	21.3	25.1	28.9	32.7	36.6	40.4
90	4.8	9.4	13.9	18.3	22.4	26.4	30.4	34.4	38.5	42.5
100	5.0	9.9	14.6	19.2	23.5	27.7	31.9	36.0	40.3	44.5

The figures in this table were computed with the following assumptions: (1) Capacity of system is 6 gpm/acre, (2) Fields are rectangular, with length twice the width, (3) Single, center main line extends the length of field, (4) Friction loss in main line is 1.25 ft./100 ft. length, computed for four-fifths of the length of main line, (5) Friction loss in lateral is 12 ft., (6) Pressure on last sprinkler is 75 ft. or 32 psi, (7) Friction loss in supply line is 1 ft./100 ft., (8) Pump efficiency ranges from 60 per cent for small acreages to 75 per cent for large acreages.

EXAMPLE

A 30-acre field is situated 1,000 feet from a creek. The water in the creek is 20 feet lower than the highest point of the field. Figure the system's approximate horsepower requirement.

SOLUTION

Find the figure to enter in column 1 above as follows:

Static lift = 20 ft.
Length of supply line/100 = 1,000/100 = 10 hundred ft.
Total 30 ft. + hundreds of ft.

To find HP, enter at 30 in the first column and read across to 9.7 HP under 30 acres.

9. *Consider some . . .* General Pointers for System Operation

Place main line up and down the slope. Put laterals across the slope.

●

A system with a center main line saves cost compared to one with the main line along the field edge.

●

Rotate laterals in sequence around the field with uniform intervals between. Do not bunch in one place, especially at the far end of the main line.

●

If possible, put laterals at right angles to the wind. Twenty-four hour sets are best to reduce the ill effect of the wind. They are practical on deep, fine textured soils in pasture or a deeper rooted crop.

●

Sets less than 12 hours in length are susceptible to wind and should not be used if they can be avoided. An exception would be at the start of the first irrigation, or any other time when the soil would not hold the full amount of a normal set. Very coarse textured soils will usually require shorter sets.

●

Where there is a choice of well location, it is most economical to have it in the center of the area it will serve.

●

Tapered main lines are recommended on almost all multiple lateral systems.

●

Offsets are recommended on most irrigation systems that are easily adapted to them.

●

Tapered laterals usually have a lower first cost for equal performance, but may have a slightly higher labor cost—especially if several pipe sizes frequently are placed in one pile, and thus require sorting.

●

Except during the period of peak moisture use by the crop, do not operate a well-designed system continuously. Frequency of irrigation can be determined with a soil auger, or an instrument for measuring moisture tension.

●

Provide tapped openings for fertilizer injection. Certain oil soluble insecticides can also be applied through sprinkler systems with reasonably uniform distribution.

Use an eccentric tapered reducer on the suction side of a centrifugal pump, and a tapered reducer on the discharge. There should be no elbows, tees, or pipe other than a short nipple before the pipe size is enlarged on either the suction or discharge side. Because of cost, a gate valve of the smaller size is often permitted.

●

Individual regulating valves can be used on sprinklers on steep, undulating land or at the beginning of long laterals. When all sprinklers on a lateral are thus equipped, additional pressure must be provided at the pump to overcome the loss through the regulating valves.

●

Close sprinkler spacings give more uniform coverage during windy conditions. In general, spacings greater than 40 by 60 feet are not recommended.

●

Mount a pressure gauge for each valve-opening elbow, and adjust the valve to the correct pressure for each lateral setting. A single, portable pitot gauge often can be used instead of the mounted gauges.

●

Initial investment in a system can be reduced by increasing the distance between main line valve tees. An offset is required on the lateral, however, to maintain the correct interval between settings.

●

Use extreme caution so that electric wiring is completed according to code. Unfortunately, irrigation water and pipes are both good conductors, and therefore, are potential hazards.

●

Never lift metal irrigation pipe up on end in the field. Several deaths have resulted from contact with power lines.

●

Avoid changing pipes at night, if possible. If night changes are necessary, use a miner's cap that has an electric light. Also, place phosphorescent tape on each coupler.

●

A centrifugal pump will not operate efficiently if the suction lift is more than 15 feet including friction loss in the suction pipe.

The time it takes to cover the entire acreage once can be determined from the proposed system layout. This time will be satisfactory if the system complies with the "yardsticks" presented in this bulletin.

●

Save labor on hand-moved systems by permitting a flow of water through the lateral while it's being coupled.

●

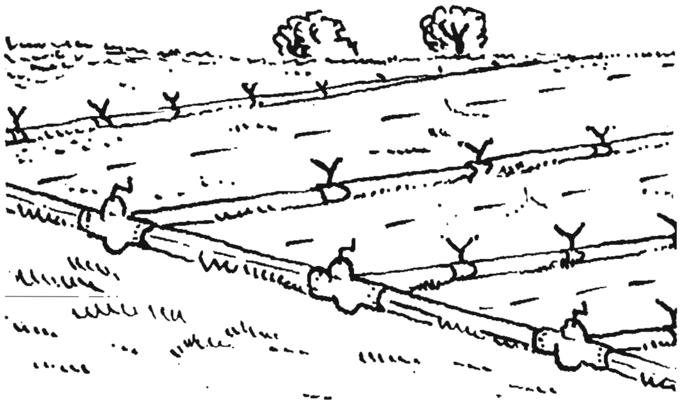
Most dented aluminum pipes can be fully reclaimed by using high internal pressure.

Protect pumps and motors or engines by automatic shut-off switches in case of lost prime, overheating, low oil pressure, undervoltage, or overloading. A time clock can be used to shut off a pump automatically if the next set is not made immediately.

●

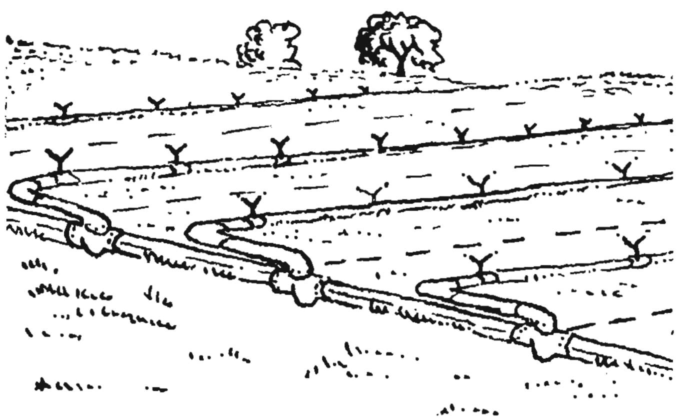
The reputation of a dealer and his ability to give continued service should be investigated before purchasing a system.

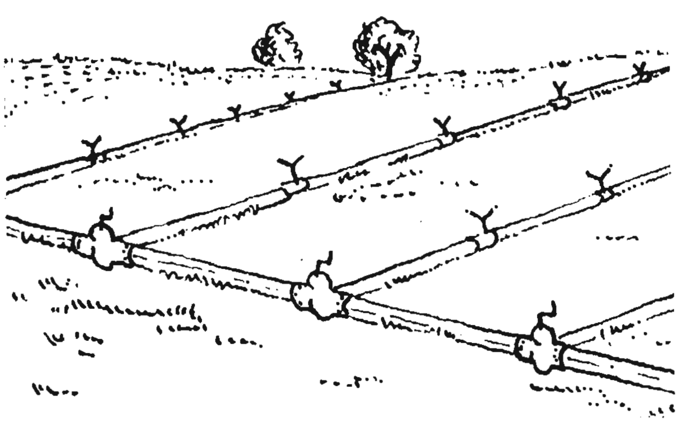
Irrigation Offset Prevents "Dry Strips"



◀ **THE CONVENTIONAL irrigation main line has valves spaced at 60-foot intervals. Usually, when a lateral is moved from one valve to the next, it is placed straight out from the valve. When sprinklers smaller than 10 gpm are used, a "dry" strip shows up half-way between the lateral sets.**

THESE "DRY" STRIPS can be prevented by using a 30-foot offset on the second, fourth, sixth, etc. irrigations. This places the lateral directly on the "dry" strip left from the previous irrigation. Thus, the total of any two successive irrigations gives a more uniform distribution of water on the field. ▶





◀ **FOR THE THIRD IRRIGATION (and fifth, etc.) the lateral is again placed where it was for the first irrigation. For sprinklers smaller than 7 gpm, the 40-foot spacing also should be offset by having the first sprinkler 10 feet from the main on the first irrigation, and 30 feet on the second, fourth, etc.**