Appendix I

The purpose of this appendix is to provide guidelines and procedures for the evaluation of sideroll or rectangular move sprinkler systems in New Mexico.

Guidelines for the evaluation of center-pivot sprinkler systems are found in Engineering Tech Note NM-1(Rev.1).

Successful operation of sprinkler irrigation systems requires that the frequency and quantity of water application be accurately scheduled. Irrigation hardware efficiency must be known to manage the quantity of application. Since system performance changes with time, periodic field checks are recommended. Data from the field evaluation of a lateral move sprinkler system is presented in Figure 1. The procedure for collecting the data follows:

(1) Information required. The desired information includes:

(a) Duration of normal irrigations.

(b) Spacing of sprinklers along lateral lines.

(c) Spacing of lateral lines along the main lines.

(d) Measured depths of water caught in catch containers at a test location.

(e) Duration of the test.

(f) Water pressures at the sprinkler nozzles at the test location and along laterals throughout the system.

(g) Rate of flow from the tested sprinklers.

(h) Additional data specified on Form NM-ENG-226 A.

(2) Equipment needed. The equipment the evaluator needs is:

(a) A pressure gauge (0-100 psi) with pitot attachment.

(b) A stopwatch or watch with an easily visible second hand.

(c) A large container of known volume clearly marked (5 gallon or larger).

(d) A 4-foot length of flexible hose having diameter appreciably larger than the outside diameter of nozzles.

(e) 50 catch containers such as 1-quart oil cans, plastic

freezer cartons, or vials.

(f) A 500-ml graduated cylinder to measure volume of water caught in containers.

(g) A soil probe or auger.

(h) A 50- to 100-foot tape for measuring distances in laying out catch container grid.

(i) A shovel for smoothing spots to set containers and for checking soil, root, and water penetration profiles.

(j) Form NM-ENG-226A for recording data.

(k) Manufacturers' sprinkler performance charts showing the relationship between discharge, pressure, and wetted diameter plus recommended operating pressure ranges.

(l) Sling psycrometer

(m) Wind gauge

(3) Field procedure. The information obtained from the following field procedure should be entered on form NM-ENG-226A.

(a) Choose a location along a lateral for the test. It should be a location at which the pressure is typical for the entire system. Loss of pressure due to friction in a lateral that has only one size of pipe is such that about half of the pressure loss occurs in the first 20 percent of the length and over 80 percent of the pressure loss occurs in the first half of the lateral's length. On a flat field the most representative pressure is about 40 percent of the distance from the inlet to the terminal end.

(b) Set out catch containers on a 10' x 10' grid on both sides of the lateral between two adjacent sprinklers. The grid pattern should be continued perpendicular to the lateral for a distance equal to the lateral move (see Figure 2).

For solid set or block move systems where several adjacent laterals operate simultaneously, the catch containers should be placed in the area between two adjacent laterals. Caution should be exercised to allow for any water that could enter the test container area from adjacent blocks. These tests cannot be used to study other lateral spacings.

Each container should be located within a foot of its correct grid position and set carefully in an upright position with its top parallel to the ground; any surrounding vegetation that would interfere with a container should be removed. Under windy conditions, it may be necessary to fasten containers to short stakes with rubber bands, weigh them down

with a known depth of water or a stone (which is later subtracted from the total depth shown after the catch); or they may be set in shallow holes. The most accurate means for measuring the catch can be achieved volumetrically by using a graduated cylinder. These measurements can be converted to depths if the area of the container opening is known. For 1-quart oil cans, 200 ml corresponds to 1.00 inches in depth. Other suitable catch containers may be square or cylindrical plastic freezer containers with sides tapered slightly for nesting or any similar container of adequate volume.

Determine and record the container grid spacing and the ratio of volume to depth of catch. Also indicate the position of the lateral and record the location and position numbers of the sprinklers on the lateral.

(c) Determine the soil texture profile, estimate the available soil moisture capacity in the root zone, and check the soil moisture deficit in the catch area on the side of the lateral that was not irrigated during the previous set.

(d) Check and record the make and model of the sprinkler and the diameter of the nozzles.

(e) Obtain the normal sprinkler spacing, duration, and frequency of irrigation from the operator and record them. The standard way of expressing the sprinkler grid spacing is -by -foot; this indicates the sprinkler spacing on the lateral and the spacing between laterals in that order.

(f) Check and record the size and length of the lateral pipe and the height and erectness of the risers.

(g) Before starting the test, stop the rotation of the sprinklers at the test site to prevent water from entering the containers. A short piece of wire or stick wedged behind the impact arm facilitates this. If double nozzle sprinklers are used, buckets placed over the sprinkler heads will keep water from entering the catch containers.

(h) Turn on the water to fill the lateral lines. Measure and record the pressure at the sprinklers to be tested at several places along the line and at both ends to observe the differences in pressure. Pressures should be checked at both the beginning and end of the test period and recorded.

Also record how long it takes each sprinkler in the test area to fill the larger container of known volume. Do this by slipping a short length of hose over the sprinkler nozzle and collecting the flow in the container. To improve accuracy, measure the nozzle output several times and compute the average. (If the sprinkler has two nozzles, each can be measured separately with one hose.) Often the measured sprinkler discharge rate is greater than what the manufacturer specified at the given pressure. This occurs because sprinkler nozzles often erode during use and become enlarged, or because the hose fits too tightly and creates a syphoning action. You can check nozzle erosion with a drill bit that has the diameter specified for the nozzle.

(i) Note the wind speed and direction and record the wind direction by drawing an arrow relative to the direction of water flow in the lateral.

(j) Empty all catch containers before starting the test; start the test by releasing all sprinklers surrounding the test site so they are free to rotate and note the starting time.

(k) Outside the catchment area, set a container to check the volume of rainfall that may fall during the test.

(l) While the test is in progress, check sprinkler pressure at selected locations throughout the system.

(m) Record pumping plant power usage data and compute cost/hour.

(n) Terminate the test by either stopping the sprinklers surrounding the test site in a position such that the jets do not fall into the containers, or by deflecting the jets to the ground. Note the time, check and record the pressure, and turn off the water. It is most desirable for the duration of the test to be equal to the duration of an irrigation to get the full effect of wind and evaporation. Ideally minimum duration test should apply an average of about 0.5 inch of water in the containers.

Measure the depth of water in all the containers and observe whether they are still upright; note any abnormally low or high catches, catch depths or volumes are recorded above the line at the proper grid point, which is located relative to the sprinkler and direction of flow in the pipe line.

(4) Utilization of field data. The general procedure for utilizing the data is:

(a) Assuming that the test is representative and that the next set would give identical results, the right-hand side of the catch pattern may, as if it were a subsequent set, be overlapped (or superimposed) on the left-hand side to simulate different lateral spacings. For lateral spacings that are whole units of the container spacings, the summation of the catches of the two sets represents a complete irrigation (see Figure 1.). For very close lateral spacings, water may overlap from as many as four lateral positions. The above concept of overlapping is not suggested where winds are likely to change appreciably between subsequent lateral sets.

(b) After superimposing the catch volumes, compute the average can catch. Determine also the number of cans that represent 25 percent of the catch area. This figure is equal to 1/4 of the total number of superimposed catch containers. The 25 percent criteria is used by the SCS as the indicator area, so that only 1/8 of the sprinkled area will have an application lower than the management objective. Calculate the average catch in the low 25 percent of the area.

(c) Pattern efficiency is calculated by dividing the average of the low 25 percent catch by the average for the entire catch.

(d) Application efficiency is calculated by dividing the average catch at the test area by the inches applied through the measured nozzle discharge.

(e) The system efficiency is calculated by multiplying the pattern efficiency by the application efficiency.

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FIG. 1- SAMPLE EVALUATION

SPRINKLER IRRIGATION SYSTEM EVALUATION SHEET FOR LATERAL MOVE SYSTEMS

Name ED JONES Date 8/25/81 Field Office ESTANCIA

Technician L. SALDIVAR, J. WHITEHEAD

Pump Pressure 50 Gaged Area Pressure 40

1st Nozzle Pressure 42 Last Nozzle Pressure 40

Nozzle Size 3/16 x 3/32 Sprinkler Head Type RB 30

Discharge in GPM at Gaged Area (measured volumetrically) $\frac{5 \text{ GAL}}{34 \text{ SEC}} = 8.8$ GPM

Discharge in GPM at 1st Sprinkler 9.1

Discharge in GPM at last Sprinkler 8.8

Average Discharge of Lateral - 1st -3/4 (1st - last) $9.1 - \frac{3}{4}(9.1-8.8) = 8.9$ GPM

Spacing of Sprinkler Heads on Lateral 40'

Spacing of Laterals 60'

Application Rate of Lateral = $\frac{96.3 \times 8.9}{40 \times 60} = .36$ "/HR

Application Rate at Gaged Area $\frac{96.3 \times 8.8}{40 \times 60} = .35$ "/HR

Lateral Length 1280 Total Number of Laterals 2

Total Sprinkler Heads $33 \times 2 = 66$

Total GPM = Total Heads X Avg. Discharge $66 \times 8.9 = 587$

Main Line Type and Size 6" SURFACE ALUMINUM

Lateral Size 5" DIA.

Time Started 9:24 AM Time Stopped 3:21 PM

Duration of Test (Min. three hrs.) 5.95 HRS.

Temperature 70° START - 95° STOP Humidity 64%

Wind - Velocity and Direction 0-7 MPH FROM NORTH (8 MPD FROM WEATHER STATION)

Using 1 Gal. Plastic Jugs, 1" - 183.9 cc. Using 50 ML Cylinders, 1" = 13.5 ML

Using standard 1 quart oil cans, 1" - 200 cc.

No. of Cans 24 (COMPOSITE) Total Catch 8745 cc.

Average Catch 364.4 cc 1.82 inches

No. of Cans in low 25% of Cans $.25 \times 24 = 6$

Total Catch in low 25% 2045 c.c.

Average Catch in low 25% $\frac{2045}{6}$ = 340.8 cc 1.70 inches

Pattern Efficiency = $\frac{\text{Avg. of low 25\%}}{\text{Avg. Catch}}$ = $\frac{1.70}{1.82}$ = 93%

% Catch = $\frac{\text{Avg. Catch (inches)}}{\text{Inches applied from nozzles (at gaged area)}}$ = $\frac{1.82}{.35 \times 5.95}$ = 87%

System efficiency = (% Catch) x Pattern uniformity= .93 x .87 = 81%

Field application efficiency - $\frac{\text{inches needed}}{\text{inches applied at nozzle}}$ = $\frac{1.50}{.35 \times 5.95}$ = 72%

Field app. efficiency should not exceed system efficiency.

Minimum irrigation frequency = $\frac{\text{net irrigation}}{\text{peak daily use}}$ = $\frac{.35 \times 5.95}{.25}$ = 8.3 days

Net system irrigation rate = system efficiency (.81) X gross application rate (.36) = .29 "/hr.

Type of Power -- Electric Motor HP

Electric Meter Kh Factor

Hp = .08 X Meter RPM x Kh

Cost/KW-HR Cost/HR =

Type of Power -- Internal Combustion

Engine Type CHRYSLER V-8

Engine RPM 1600

Gear Head RPM 1400

Fuel Cost $3.10/mcF Fuel Consp. 300 FT^3/HR

Cost/HR = $.93/HR

Observations: DURING PEAK USE PERIODS, WATER LEVEL DROPS AND PUMP MUST BE RUN AT 1400 RPM TO DEVELOP NEEDED HEAD.

Recommendations: PUMP SHOULD PROBABLY BE RUN AT 1760 RPM FOR MAXIMUM EFFICIENCY, IF WATER IS AVAILABLE.

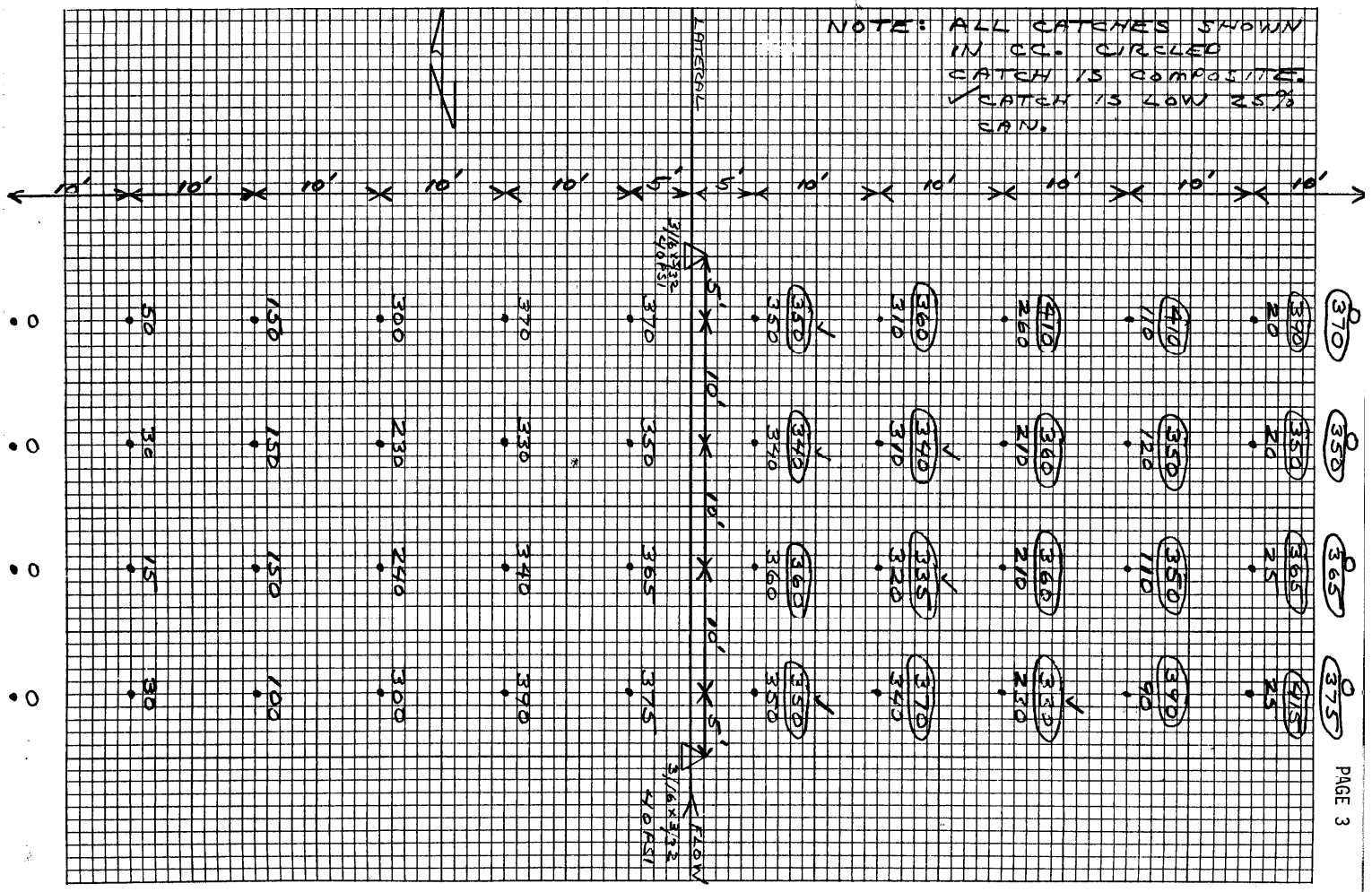
This system meets SCS specifications

Signed

Date No. of Systems Acres Irrigated

NAME ED JONES
DATE 8/25/81
LOCATION ESCONDIDO

CAN CATCH WORKSHEET FOR SPRINKLER EVALUATION



AME _____
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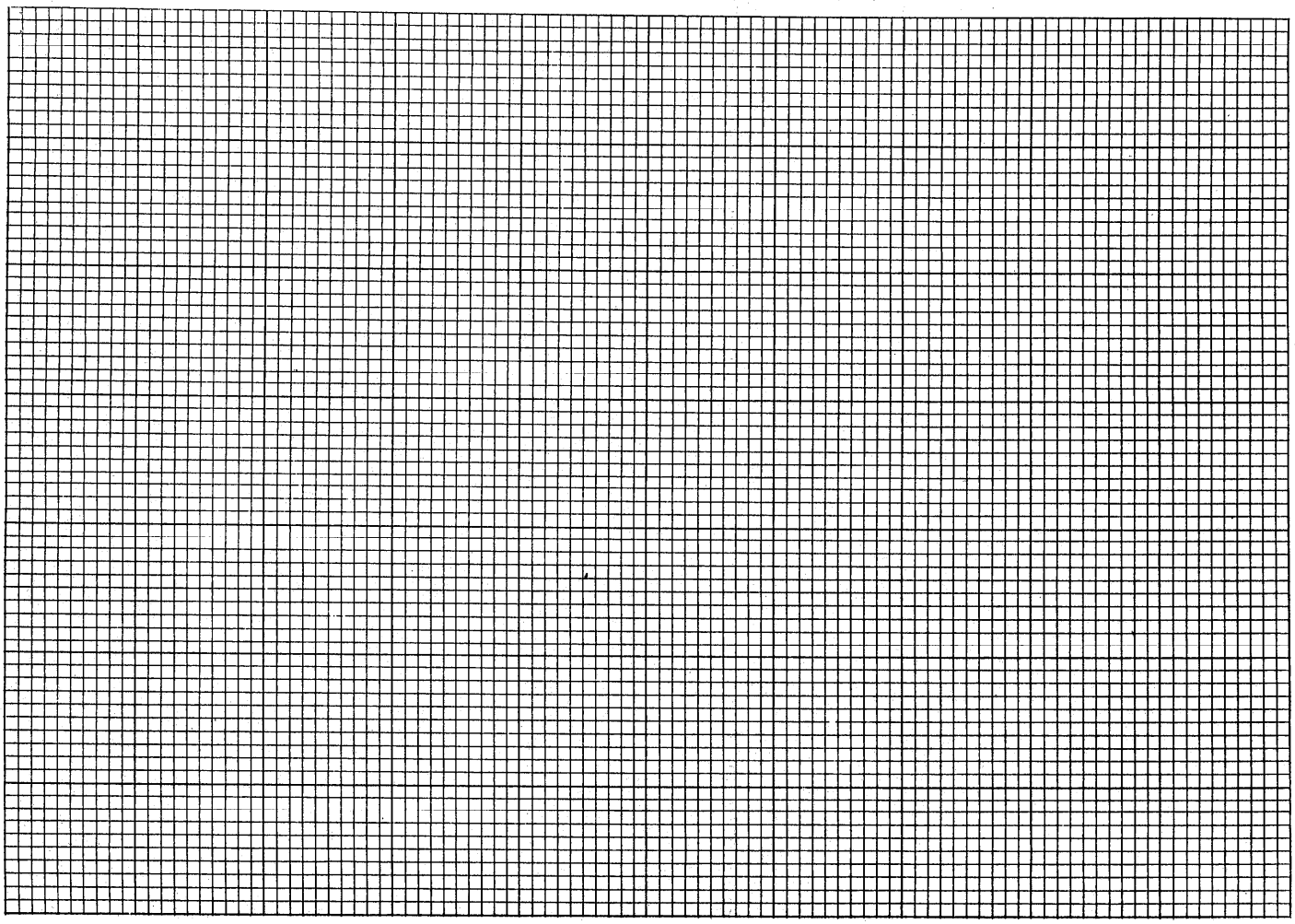
CAN CATCH WORKSHEET FOR SPRINKLER EVALUATION



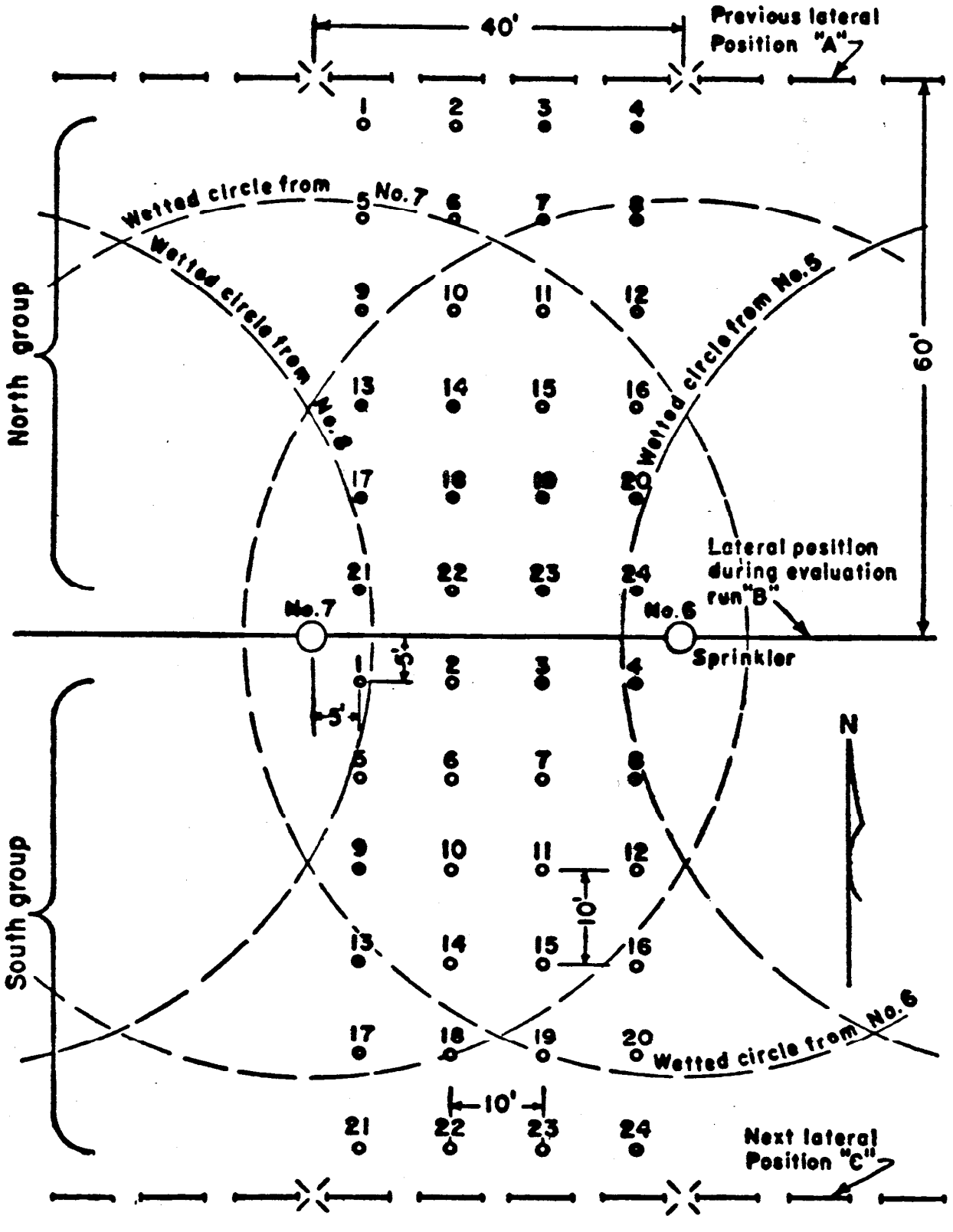


Figure 2 – Typical Catch Can Layout