Attachment 2.05.4(2)(e)-9

Flood and Sideroll Irrigation Designs - Irrigated Pasture

Note: In this attachment are the irrigation designs for both Lloyd and Benson fields to be replaced as irrigated pasture (IP) in the post-mine condition. Details of the irrigation layouts can be seen on Map 2.05.4-5

The irrigation design worksheets are from the Colorado Irrigation Guide and National Engineering Handbook Sec. 15, Chap. 11.

SIDEROLL SPRINKLER IRRIGATION DESIGN WORKSHEET

Project Name: BENSON - EAST - 20 Shares Section 6

Designer: Ross Gubka Reviewed by: _____

Need 20 Shares of WATER TO OPERATE This S. de Roll

PRELIMINARY DATA:

Design Crop: GRASS

Soil Name: _____

Town: _____

Sprinkler Lateral Slope - 0 -

Minimum Pressure 35 psi available for sideroll
(check Rainbird sprinkler model and gpm chart. Stay out of grayed out area because of insufficient pressure to mist the water stream properly)

FIELD DIMENSIONS

Length 900 FT (L) (manifold or mainline direction)
basically: (8) x 60ft x (17) x(18)

WIDTH ~~1320~~ 1400 Actual ft (W) (sideroll direction)

Soil Information:
Design Group _____

Max Sprinkler App. Rate _____ inch/hr (1)

Root Depth: 3' grass & 5'Alfalfa Ft (2)

Moisture Extraction: 3' grass & 5'Alfalfa ft (3)

AVERAGE WATER HOLDING CAPACITY (CIG 2-C)

	Soil Depth in feet	AWC inches
1st		
2nd		
3rd		
4th		

TOTAL AVAILABLE WATER (TAW) Recommendation from NRCS **4.0" (grass) & 7.6" on Morgan Prime Farmland soils** (4)

Management Allowance
Deficiency (Table CO 684.2) 50 % (5)

IRRIGATION NET APPLICATION:

= % OF Total TAW

(4) x (5) (Decimal) = (4.0) x (50%)

Net. App. = ( ) in. 2.0 in. (6)

DAILY PEAK CONSUMPTIVE USE RATE: .21 for grass & .25 for alfalfa in/day (7) (CO683.52)

IRRIGATION FREQUENCY:

= (Net Application) (6)
Daily Peak Consumptive Use (7)

= (2.0) (Round down to next whole number
(.21)

= 9.5

= (rounded down) days return period ___9___ days (8)

IRRIGATION GROSS APPLICATION

DESIGN FIELD EFFICIENCY (70% FOR SIDE ROLL SPRINKLERIRRIGATION)
(CO685.69) ___70___% (9)

GROSS APP.

= NET App. ____X 100 (6) = (2.0) x 100
Field Eff. % (9) (70) %

= ___2.9___ in. (10)

MAX HOURLY WATER APPLICATION RATE:

MAX APP Rate w/cover
(CIG Table 6-D-1, CIG Sec 2-C) ___.50___in/hr (10A)

SET TIME ___10___HR (11)

Normally 11 or 23 hrs/set..... **(11hr for flood & 23hr for sprinkler)**

CHECK POSSIBLE HOURLY APPLICATION RATES

= Gr. App. In. (10) = (2.9)
Set time (11) (10)

= Hourly App. Rate = ___.29___ in/hr* (12)

USE _____ in. Gross App. On _____ hr. Sets

Sideroll Spacing:

Sprinkler set spacing: _____60_____ft (Sm)

Spacing of Nozzle Along Lateral: _____40_____ft (s1)

Q = Total flow rate, gpm

Number of CCC ditch shares:_____ whatever IT TAKES

Note: 1 share of CC water equals 450gpm/35 shares = 12.86gpm

Q = # CCC ditch shares x 12.86gpm =_____=_____(13)

Required Sprinkler Head Capacity:

Flow at Nozzle = $\frac{\text{Hourly App. Rate (12) x (Sm) x (s1)}}{\text{96.3 (conversion factor)}}$

$$= \frac{(.29) \times (60) \times (40)}{96.3}$$

=_____7.22_____gpm (14)

Selection
(see chart)

Make Rainbird_____ Model 30 PSH

Size 13/64 X O inch

Flow 7.08 gpm (14)

PSI @ Nozzle 35 psi (DP)

Dia. 2x51 ft.

1400 FT / 40 FT/nozzle + 1 = 36 nozzles

36 nozzle x 7.08 gpm = 255 gpm

255 gpm x 35 shares / 449 = 19.9 shares ⟹ USE 20 Shares

36 nozzle for 1400' System

Number of Nozzles (33nozzles for a full 1320ft side roll system)

= (13)/(14)

= ( )/( )

=_____(Round down)

=_____ .... Use = _____(15)

1400

Number of 1280ft sideroll systems = # of nozzles (15) /33
= ( )/33
=_____ (15a)

Total area of system(s): = $\frac{[(15) \times 40ft] \times [(8) \times 60ft]}{43560}$

= $\frac{[(36) \times 40ft] \times [(9) \times 60ft]}{43560}$

= 17.9 acres (16) 5ef

$\frac{29.6}{17.9} = 1.65$

NEED 29.6AC

SYSTEM EFFICIENCY (maintenance, cleaning head gate, checking water, farmer needed time off) ... =_____ ?/(8) .....(n out of total potential /shifts-days of irrigation). (17)

$\frac{15}{18} = 83\%$ $\frac{14}{18} = 78\%$ $\frac{6 day}{7} = 86\%$

NUMBER OF SETS PER DAY:

= 24/ (11)

= 24/2

=_____ (rounded down) = 2 (18)

NET EFFECTIVE ACREAGE WATERED.

= (16) x (17)% x (18)

= (17.9) x (15/18) x (2)

= 29.8 ACRES

Good — STOP here

NUMBER OF SIDE ROLL SYSTEMS (full or parcel)

= Number of Nozzles(15) /33
= ( )/33
= _____ (round up) _____ (19)

DETERMINE SIDEROLL HEADLOSS: This system is under a Diesel Pump so sideroll pressure is no problem

Spec. Allows a variation of up to +/- 10% of the design pressure without special desing.

MULTIPLE OUTLET FACTOR = _____(F)
(Table CO685.72)
use # outlets per sideroll

LATERAL SIZE = Use 5 in. Dia Aluminum Pipe
(sideroll pipe)

FLOW PER SIDEROLL(s) = {# HEADS (15)} X {NOZZLE FLOW (16)}

= (_____) X (_____)

= _____(20a)

SIDEROLL HEADLOSS PER 100LF =
(Table CO685.73)
for 40 ft pipe lengths
SIDEROLL LENGTH SRL = _____FT/100FT (18)

TOTAL SIDEROLL HEADLOSS
WITH 5" LATERAL = (Sideroll Lenght {SRL} x {Headloss {18}) x (F)
(2.31) x (100)

= (_____) x (_____) x (_____)
2.31 x 100

= _____ (19)

PRESSURE GAIN (or LOSS) DUE TO FIELD SLOPE =
Note" Look at most restrictive conditions
in an entire field

= (S)% X (SRL) = (_____) x (_____)
2.31 x 100 2.31 x 100

= _____+/- psi (20)
pressure due to elevation change

PRESSURE VARIATION:

= Sideroll Headloss (19) + Elev pressure Gain/Loss (20)
(DP)

= (_____) +/- (_____) x 100
( )

=_____( )%*

*PRESSURE VARIATION MUST NOT EXCEED +/-10% OF DP. If flow control nozzles are used, then +/-10% pressure limit can be dealt with easily.

REQUIRED PRESSURE AT MAINLINE AT BEGINNING OF SIDEROLL (MPS)

For Level Laterals = (DP) + 0.75 (19) + 1

= _____ + 0.75( ) + 1 =__ (MPS)_____

MANIFOLD LENGTH (ML)* =Field Length (L) - (1)(Sm)

= ( ) - (1x 60) =_____ft (ML)

NUMBER SETS $= \frac{ML}{Sm} + 1 = \frac{(\quad)}{(\quad 60 \quad)} + 1 =$ _____ sets per field

* Use multiples of 60ft. Note this lenght may be shorter if 60 ft swing lines are used.

MAINLINE CAPACITY
(Manifold)

MAINLINE CAP.= (#HEAD REQ'D {15}) X (NOZZLE FLOW (GPM) {16}) X (#SIDEROLLS {15a})

= (____) X (_____) X (_____)

= _____GPM = _____GPM = _____CFS
449

TOTAL SIDEROLL PRESSURE REQURIED:

TOTAL PRESSURE REQUIRED = MPS + (SWING LINE LOSS + RISER, HYDRANT AND STUB VALVE LOSS)

= ( ) + (2ps i)

Total = ( ) psi req. at beginning of sideroll riser (22)

Main Line Head Loss per 100ft.

siderolls (15a)= _____
gpm per sideroll (20a) = _____gpm

Mainline material & Diameter _____ (21) _____
Length of Mainline Pipe _____ (L)
Hazen Williams "C" factor_____ _____
Friction Loss ft/100 (chart) _____ (24) _____

Total Main line Head Loss = {(L) x (24)}/(2.31 x100)
= { ( ) x ( )}/(2.31x 100)

= _____psi (25) _____

Mainline pressure losses are found by using the pipeline computer program. Mainline losses should be checked at the beginning set and last set and any restrictive sets in between.

Total = (22) + (25) or (22) + (25)

= ( ) + ( ) or (22) + (25)

= _____ or _____psi at beginning of system.

FRICTION LOSS IN VARIOUS PIPE

Values in this table are Friction Loss Constants (C) for Various Pipe Materials - use these values to plug in to the next 11 pages of tables ("Des" in the column head below is for "Design or In-service.)

Pipe material or surface coating	C Range High	C Range Low	C New, Clean	C Des
Acrylonite butadiene styrene (ABS)	150	120	140	130
Aluminum	150	130		
Asbestos cement	160	140	150	140
Asphalt lining	140	130		
Brass	150	120	140	130
Brick sewer				100
Cast iron, asphalt coated	140	90	130	100
Cast iron, bitumastic enamel lined	150	140		
Cast iron, bituminous lined	160	130	150	140
Cast iron, cement lined	150	100	140	120
Cast iron, new, unlined	150	110	130	120
Cast iron, old, unlined	120	60		80
Cast iron, sea-coated	140	100	130	120
Cement lining	140	130		
Concrete	150	90	120	100
Concrete lined, steel forms	140			
Concrete lined, wooden forms	120			
Concrete, old	110	100		
Concrete, steel forms	140			
Concrete, wooden forms	120			
Copper	150	120	140	130
Ductile iron, cement-lined	140	100		120
Fiber	150	140		
Galvanized iron	150	120	140	130
Glass	120	110		130
Lead	150	120	140	130
Plastic	150	120	140	130
Polyethylene	150	140	150	140
Polyvinyl chloride (PVC)	150	120	140	130
Steel, coal-tar enamel lined	150	140		
Steel, corrugated			60	60
Steel, interior riveted, no projecting rivets	140	100	130	110
projecting girth and horz. rivets			120	110
projecting girth rivets			130	100
Steel, welded and seamless	150	100	140	100
Tin	150	120	140	130
Vitrified clay	140	100		110
Wrought iron, plain	150	80	130	100

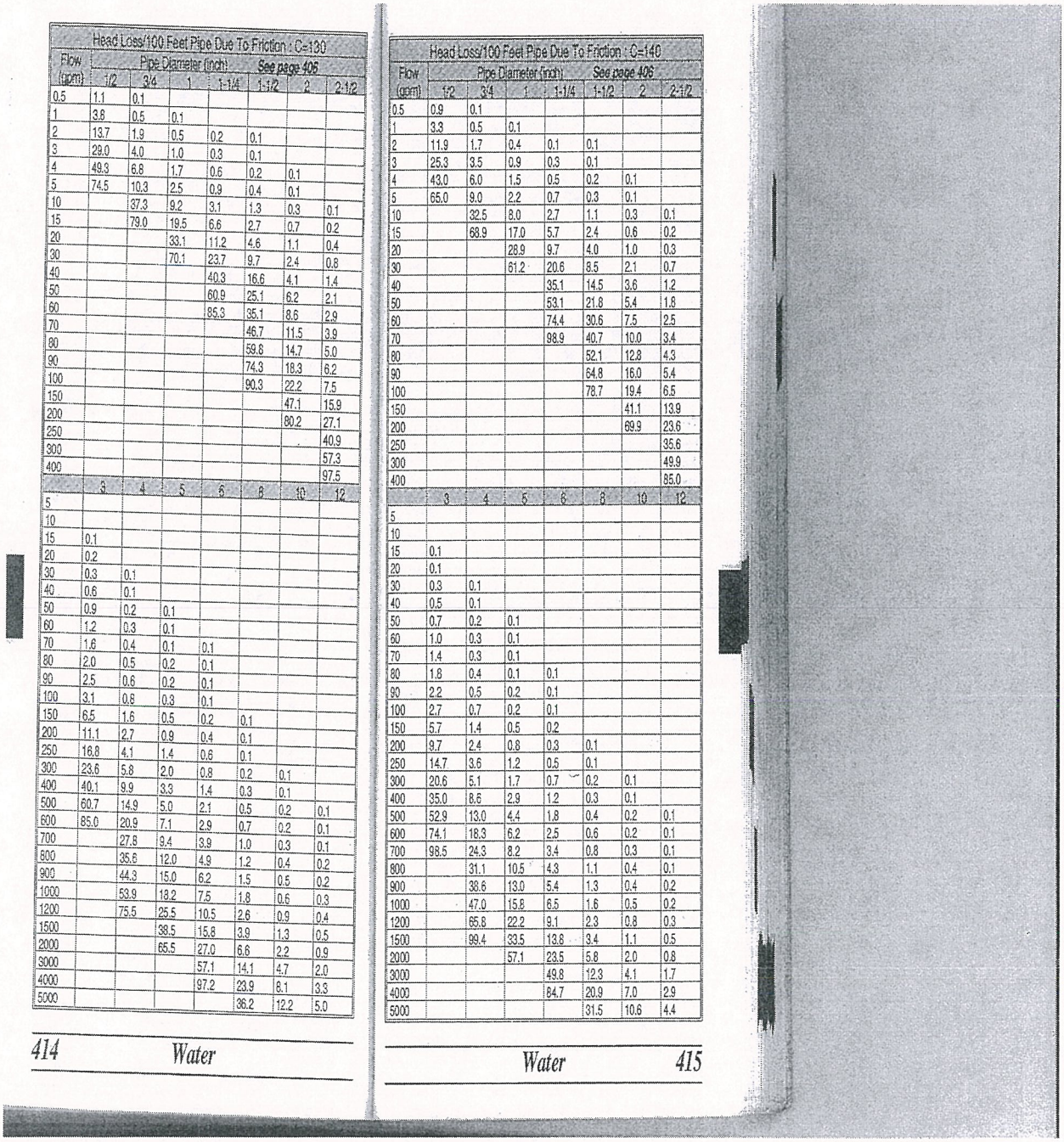
Notes:

1. Values shown above are used in the Hazen-Williams equation for flow in pipes. Feet of Head Loss values shown on the next 11 pages were developed using the Hazen-Williams equation and the constants from the above table.
2. Feet of Head Loss values are subject to the following conditions:
   a) Pipes carrying clear water at approximately 60° F (15.6°C).
   b) Pipes are flowing full.
   c) Velocities of water are generally less than 10 feet per second.

Head Loss/100 Feet Pipe Due To Friction ; C=60

Flow (gpm)	Pipe Diameter (inch) See page 406						
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	4.4	0.6	0.2	0.1			
1	15.9	2.2	0.5	0.2	0.1		
2	57.2	7.9	2.0	0.7	0.3	0.1	
3		16.8	4.1	1.4	0.6	0.1	
4		28.6	7.1	2.4	1.0	0.2	0.1
5		43.3	10.7	3.6	1.5	0.4	0.1
10			38.4	13.0	5.3	1.3	0.4
15			81.3	27.4	11.3	2.8	0.9
20				46.7	19.2	4.7	1.6
30				98.9	40.7	10.0	3.4
40					69.3	17.1	5.8
50						25.8	8.7
60						36.1	12.2
70						48.1	16.2
80						61.6	20.8
90						76.5	25.8
100						93.0	31.4
150							66.4
200							
250							
300							
400							

Flow (gpm)	3	4	5	6	8	10	12
5	0.1						
10	0.2						
15	0.4	0.1					
20	0.7	0.2	0.1				
30	1.4	0.3	0.1				
40	2.4	0.6	0.2	0.1			
50	3.6	0.9	0.3	0.1			
60	5.0	1.2	0.4	0.2			
70	6.7	1.6	0.6	0.2	0.1		
80	8.5	2.1	0.7	0.3	0.1		
90	10.6	2.6	0.9	0.4	0.1		
100	12.9	3.2	1.1	0.4	0.1		
150	27.3	6.7	2.3	0.9	0.2	0.1	
200	46.5	11.5	3.9	1.6	0.4	0.1	0.1
250	70.3	17.3	5.8	2.4	0.6	0.2	0.1
300	98.5	24.3	8.2	3.4	0.8	0.3	0.1
400		41.3	13.9	5.7	1.4	0.5	0.2
500		62.5	21.1	8.7	2.1	0.7	0.3
600		87.5	29.5	12.1	3.0	1.0	0.4
700			39.3	16.2	4.0	1.3	0.6
800			50.3	20.7	5.1	1.7	0.7
900			62.5	25.7	6.3	2.1	0.9
1000			76.0	31.3	7.7	2.6	1.1
1200				43.8	10.8	3.6	1.5
1500				66.2	16.3	5.5	2.3
2000					27.8	9.4	3.9
3000					58.8	19.8	8.2
4000						33.8	13.9
5000						51.0	21.0



Head Loss/100 Feet Pipe Due To Friction : C=130

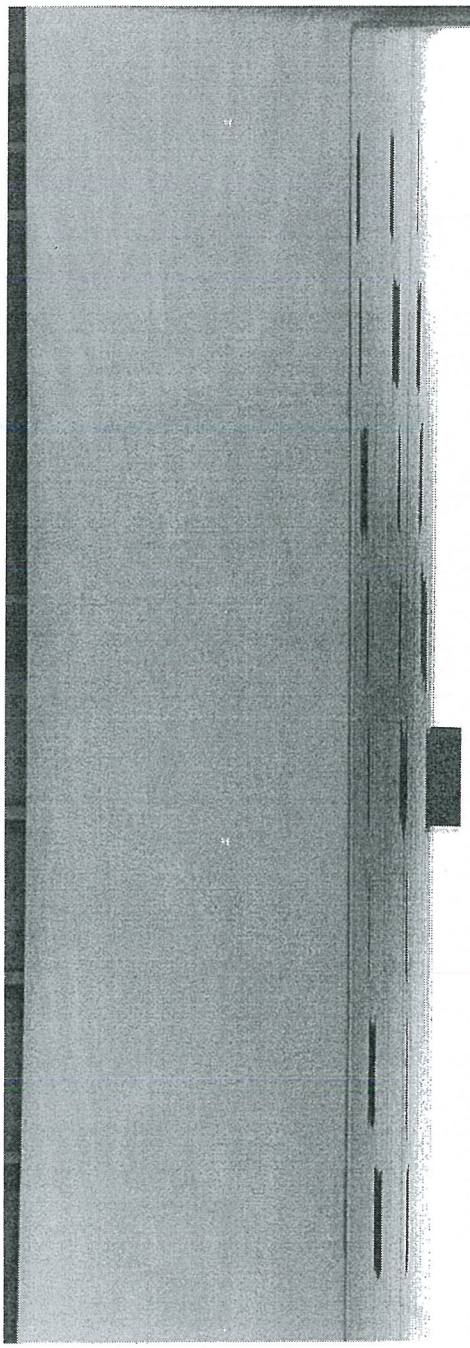
Flow (gpm)	Pipe Diameter (inch) See page 406							
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	1.1	0.1					
1	3.8	0.5	0.1				
2	13.7	1.9	0.5	0.2	0.1		
3	29.0	4.0	1.0	0.3	0.1		
4	49.3	6.8	1.7	0.6	0.2	0.1	
5	74.5	10.3	2.5	0.9	0.4	0.1	
10		37.3	9.2	3.1	1.3	0.3	0.1
15		79.0	19.5	6.6	2.7	0.7	0.2
20			33.1	11.2	4.6	1.1	0.4
30			70.1	23.7	9.7	2.4	0.8
40				40.3	16.6	4.1	1.4
50				60.9	25.1	6.2	2.1
60				85.3	35.1	8.6	2.9
70					46.7	11.5	3.9
80					59.8	14.7	5.0
90					74.3	18.3	6.2
100					90.3	22.2	7.5
150						47.1	15.9
200						80.2	27.1
250							40.9
300							57.3
400							97.5

Flow (gpm)	3	4	5	6	8	10	12
5							
10							
15	0.1						
20	0.2						
30	0.3	0.1					
40	0.6	0.1					
50	0.9	0.2	0.1				
60	1.2	0.3	0.1				
70	1.6	0.4	0.1	0.1			
80	2.0	0.5	0.2	0.1			
90	2.5	0.6	0.2	0.1			
100	3.1	0.8	0.3	0.1			
150	6.5	1.6	0.5	0.2	0.1		
200	11.1	2.7	0.9	0.4	0.1		
250	16.8	4.1	1.4	0.6	0.1		
300	23.6	5.8	2.0	0.8	0.2	0.1	
400	40.1	9.9	3.3	1.4	0.3	0.1	
500	60.7	14.9	5.0	2.1	0.5	0.2	0.1
600	85.0	20.9	7.1	2.9	0.7	0.2	0.1
700		27.8	9.4	3.9	1.0	0.3	0.1
800		35.6	12.0	4.9	1.2	0.4	0.2
900		44.3	15.0	6.2	1.5	0.5	0.2
1000		53.9	18.2	7.5	1.8	0.6	0.3
1200		75.5	25.5	10.5	2.6	0.9	0.4
1500			38.5	15.8	3.9	1.3	0.5
2000			65.5	27.0	6.6	2.2	0.9
3000				57.1	14.1	4.7	2.0
4000				97.2	23.9	8.1	3.3
5000					36.2	12.2	5.0

Head Loss/100 Feet Pipe Due To Friction : C=140

Flow (gpm)	Pipe Diameter (inch) See page 406							
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	0.9	0.1					
1	3.3	0.5	0.1				
2	11.9	1.7	0.4	0.1	0.1		
3	25.3	3.5	0.9	0.3	0.1		
4	43.0	6.0	1.5	0.5	0.2	0.1	
5	65.0	9.0	2.2	0.7	0.3	0.1	
10		32.5	8.0	2.7	1.1	0.3	0.1
15		68.9	17.0	5.7	2.4	0.6	0.2
20			28.9	9.7	4.0	1.0	0.3
30			61.2	20.6	8.5	2.1	0.7
40				35.1	14.5	3.6	1.2
50				53.1	21.8	5.4	1.8
60				74.4	30.6	7.5	2.5
70				98.9	40.7	10.0	3.4
80					52.1	12.8	4.3
90					64.8	16.0	5.4
100					78.7	19.4	6.5
150						41.1	13.9
200						69.9	23.6
250							35.6
300							49.9
400							85.0

Flow (gpm)	3	4	5	6	8	10	12
5							
10							
15	0.1						
20	0.1						
30	0.3	0.1					
40	0.5	0.1					
50	0.7	0.2	0.1				
60	1.0	0.3	0.1				
70	1.4	0.3	0.1				
80	1.8	0.4	0.1	0.1			
90	2.2	0.5	0.2	0.1			
100	2.7	0.7	0.2	0.1			
150	5.7	1.4	0.5	0.2			
200	9.7	2.4	0.8	0.3	0.1		
250	14.7	3.6	1.2	0.5	0.1		
300	20.6	5.1	1.7	0.7	0.2	0.1	
400	35.0	8.6	2.9	1.2	0.3	0.1	
500	52.9	13.0	4.4	1.8	0.4	0.2	0.1
600	74.1	18.3	6.2	2.5	0.6	0.2	0.1
700	98.5	24.3	8.2	3.4	0.8	0.3	0.1
800		31.1	10.5	4.3	1.1	0.4	0.1
900		38.6	13.0	5.4	1.3	0.4	0.2
1000		47.0	15.8	6.5	1.6	0.5	0.2
1200		65.8	22.2	9.1	2.3	0.8	0.3
1500		99.4	33.5	13.8	3.4	1.1	0.5
2000			57.1	23.5	5.8	2.0	0.8
3000				49.8	12.3	4.1	1.7
4000				84.7	20.9	7.0	2.9
5000					31.5	10.6	4.4



Head Loss/100 Feet Pipe Due To Friction , C=150

Flow (gpm)	Pipe Diameter (inch) See page 406						
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	0.8	0.1					
1	2.9	0.4	0.1				
2	10.5	1.5	0.4	0.1			
3	22.2	3.1	0.8	0.3	0.1		
4	37.9	5.3	1.3	0.4	0.2		
5	57.2	7.9	2.0	0.7	0.3	0.1	
10		28.6	7.1	2.4	1.0	0.2	0.1
15		60.6	14.9	5.0	2.1	0.5	0.2
20			25.4	8.6	3.5	0.9	0.3
30			53.8	18.2	7.5	1.8	0.6
40			91.7	30.9	12.7	3.1	1.1
50				46.7	19.2	4.7	1.6
60				65.5	26.9	6.6	2.2
70				87.1	35.8	8.8	3.0
80					45.9	11.3	3.8
90					57.0	14.1	4.7
100					69.3	17.1	5.8
150						36.1	12.2
200						61.6	20.8
250						93.0	31.4
300							44.0
400							74.8

Flow (gpm)	3	4	5	6	8	10	12
5							
10							
15	0.1						
20	0.1						
30	0.3	0.1					
40	0.4	0.1					
50	0.7	0.2	0.1				
60	0.9	0.2	0.1				
70	1.2	0.3	0.1				
80	1.6	0.4	0.1	0.1			
90	2.0	0.5	0.2	0.1			
100	2.4	0.6	0.2	0.1			
150	5.0	1.2	0.4	0.2			
200	8.5	2.1	0.7	0.3	0.1		
250	12.9	3.2	1.1	0.4	0.1		
300	18.1	4.5	1.5	0.6	0.2	0.1	
400	30.8	7.6	2.6	1.1	0.3	0.1	
500	46.5	11.5	3.9	1.6	0.4	0.1	0.1
600	65.2	16.1	5.4	2.2	0.5	0.2	0.1
700	86.7	21.4	7.2	3.0	0.7	0.2	0.1
800		27.4	9.2	3.8	0.9	0.3	0.1
900		34.0	11.5	4.7	1.2	0.4	0.2
1000		41.3	13.9	5.7	1.4	0.5	0.2
1200		57.9	19.5	8.0	2.0	0.7	0.3
1500		87.5	29.5	12.1	3.0	1.0	0.4
2000			50.3	20.7	5.1	1.7	0.7
3000				43.8	10.8	3.6	1.5
4000				74.6	18.4	6.2	2.6
5000					27.8	9.4	3.9

Head Loss/100 Feet Pipe Due To Friction , C=160

Flow (gpm)	Pipe Diameter (inch) See page 406						
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.7	0.1						
2.6	0.4	0.1					
9.3	1.3	0.3	0.1				
19.7	2.7	0.7	0.2	0.1			
33.6	4.7	1.1	0.4	0.2			
50.8	7.0	1.7	0.6	0.2	0.1		
	25.4	6.3	2.1	0.9	0.2	0.1	
	53.8	13.3	4.5	1.8	0.5	0.2	
	91.6	22.6	7.6	3.1	0.8	0.3	
		47.8	16.1	6.6	1.6	0.6	
		81.3	27.4	11.3	2.8	0.9	
			41.5	17.1	4.2	1.4	
			58.1	23.9	5.9	2.0	
			77.3	31.8	7.8	2.6	
			98.9	40.7	10.0	3.4	
				50.6	12.5	4.2	
				61.5	15.2	5.1	
					32.1	10.8	
					54.6	18.4	
					82.5	27.6	
						39.0	
						66.4	

Flow (gpm)	3	4	5	6	8	10	12
0							
5	0.1						
0	0.1						
0	0.2	0.1					
0	0.4	0.1					
0	0.6	0.1					
0	0.8	0.2	0.1				
70	1.1	0.3	0.1				
90	1.4	0.3	0.1				
90	1.7	0.4	0.1	0.1			
100	2.1	0.5	0.2	0.1			
150	4.5	1.1	0.4	0.2			
200	7.6	1.9	0.6	0.3	0.1		
250	11.5	2.8	1.0	0.4	0.1		
300	16.1	4.0	1.3	0.5	0.1		
400	27.3	6.7	2.3	0.9	0.2	0.1	
500	41.3	10.2	3.4	1.4	0.3	0.1	
600	57.9	14.3	4.8	2.0	0.5	0.2	0.1
700	77.0	19.0	6.4	2.6	0.6	0.2	0.1
800	98.5	24.3	8.2	3.4	0.8	0.3	0.1
900		30.2	10.2	4.2	1.0	0.3	0.1
1000		36.7	12.4	5.1	1.3	0.4	0.2
1200		51.4	17.3	7.1	1.8	0.6	0.2
1500		77.7	26.2	10.8	2.7	0.9	0.4
2000			44.6	18.4	4.5	1.5	0.6
3000			94.4	38.9	9.6	3.2	1.3
4000				66.2	16.3	5.5	2.3
5000					24.6	8.3	3.4

UN CARTS

Factory made, new B78 x 13 tires on ball bearing spindles. Trailer hitch mounted for towing. Wide wheels and tall risers makes it adaptable to most any type of crop. Easily disassembled for shipping or storage. List price does not include Big Gun Sprinkler.

SIZE	WEIGHT	PRICE
inch	225#	$ 795.00

SPRINKLERS

30H/ST. Bore Drive Nozzle (1/8" Spreader)
Stream Height 9'

Part #	Size	List Price
100345002	30H	$ 21.10

(Two Outlet with Nozzles)

PSI at Nozzle	Nozzle 9/64"X 1/8"X20 degrees		Nozzle 5/32"X 1/8"X20 degrees		Nozzle 11/64"X 1/8"X20 degrees		Nozzle 3/16"X 1/8"X20 degrees	
	DIA.	GPM	DIA.	GPM	DIA.	GPM	DIA.	GPM
25	80	5.2	82	5.8	83	6.6	85	7.4
30	81	5.6	85	6.4	88	7.2	91	8.1
35	82	6.1	87	6.9	90	7.7	94	8.7
40	83	6.5	88	7.3	92	8.3	96	9.3
45	84	6.9	89	7.9	93	8.8	98	9.9
50	85	7.3	90	8.2	95	9.3	100	10.4
55	86	7.6	91	8.6	96	9.7	101	10.9
60	87	7.9	92	9.0	97	10.1	102	11.4
65	88	8.2	93	9.4	98	10.5	103	11.8
70	89	8.5	94	9.7	99	10.9	104	12.3
75	90	8.8	95	10.0	100	11.3	105	12.7
80	91	9.1	96	10.3	101	11.6	106	13.1

NOTE: Rainbird sprinkler performance data represents ideal test conditions and may be adversely affected by wind and other factors. The shaded area of the chart denotes nozzle/pressure combinations that result in marginal water distribution.

30WSH ST. Bore Nozzles
Stream Height 9'

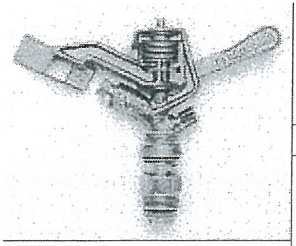
Part #	Size	List Price
100345001	30WSH	$ 18.30

(One Outlet with Nozzle)

PSI at Nozzle	Nozzle 9/64"		Nozzle 5/32"		Nozzle 11/64"		Nozzle 3/16"	
	DIA.	GPM	DIA.	GPM	DIA.	GPM	DIA.	GPM
25	80	2.9	82	3.5	83	4.3	85	5.1
30	81	3.1	85	3.9	88	4.7	91	5.6
35	82	3.4	87	4.2	90	5.1	94	6.0
40	83	3.6	88	4.5	92	5.4	96	6.4
45	84	3.8	89	4.7	93	5.7	98	6.8
50	85	4.1	90	5.0	95	6.1	100	7.2
55	86	4.2	91	5.2	96	6.3	101	7.6
60	87	4.4	92	5.8	97	6.6	102	7.9
65	88	4.6	93	5.8	98	6.9	103	8.2
70	89	4.8	94	5.9	99	7.2	104	8.5
75	90	5.0	95	6.1	100	7.4	105	8.8
80	91	5.1	96	6.3	101	7.7	106	9.1

NOTE: Rainbird sprinkler performance data represents ideal test conditions and may be adversely affected by wind and other factors. The shaded area of the chart denotes nozzle/pressure combinations that result in marginal water distribution.

All prices subject to change without notice



RAIN BIRD

PERFORMANCE DATA — 30PSH

30PSH

3/4" Full Circle, Brass Impact Sprinkler

Bearing: 3/4" Male NPT, Brass
Trajectory Angle: 27°
Operating Range: 25-100 psi
Flow Rate: 5.89-23.4 GPM
Radius: 47-68 ft.

FEATURES

- Heavy duty brass construction
- High pressure spoon
- Stainless steel springs and fulcrum pin
- Chemically resistant washers
- Dual nozzle ports
- Two-year warranty

BENEFITS

- High pressure spoon allows for larger nozzles and pressures
- Exceptionally wide range of flow rates
- Corrosion and grit resistant
- Built to last

Straight Bore Nozzle (SBN-3) with Spreader (LAN-1-20) (Stream Height: 10 ft.)

PSI @ Nozzle	NOZZLE SIZE 13/64" x 1/8-20" Rad.	GPM	7/32" x 1/8-20" Rad.	GPM	15/64" x 1/8-20" Rad.	GPM	1/4" x 1/8-20" Rad.	GPM
25	47	8.30	48	9.24	49	10.30	50	11.30
30	49	9.15	50	10.20	51	11.30	52	12.40
35	51	9.94	52	11.10	52	12.20	54	13.50
40	52	10.70	53	11.90	54	13.00	56	14.50
45	53	11.30	54	12.70	55	13.80	57	15.40
50	53	11.90	55	13.30	56	14.50	58	16.20
55	54	12.50	56	13.90	57	15.30	59	17.00
60	55	13.00	57	14.40	58	15.30	60	17.70
65	56	13.50	58	14.90	59	16.00	61	18.40
70	57	14.00	59	15.40	60	17.20	62	19.10
75	58	14.50	60	15.90	61	17.80	63	19.80
80	59	15.00	61	16.40	62	18.40	64	20.50
85	60	15.43	62	16.81	63	18.90	65	21.20
90	61	15.87	63	17.25	64	19.30	66	22.00
95	62	16.29	64	17.67	65	19.80	67	22.70
100	63	16.71	65	18.08	66	20.20	68	23.40

Brass Straight Bore Nozzle and Vane (SBN-3V) with Plug (Stream Height: 10 ft.)

PSI @ Nozzle	NOZZLE SIZE 13/64" Rad.	GPM	7/32" Rad.	GPM	15/64" Rad.	GPM	1/4" Rad.	GPM
25	47	5.89	48	6.83	49	7.90	50	8.90
30	48	6.51	50	7.58	51	8.70	52	9.80
35	51	7.08	52	8.26	52	9.40	54	10.60
40	52	7.60	53	8.87	54	10.00	56	11.40
45	53	8.07	54	9.41	56	10.60	57	12.40
50	53	8.49	55	9.88	56	11.10	58	12.80
55	54	8.87	56	10.30	57	11.60	59	13.40
60	55	9.20	57	10.60	58	12.10	60	14.00
65	56	9.47	58	10.95	59	12.60	61	14.60
70	57	9.78	59	11.29	60	13.10	62	15.10
75	58	10.18	60	11.71	61	13.60	63	15.60
80	59	10.52	61	12.10	62	14.00	64	16.10
85	60	10.84	62	12.52	63	14.40	65	16.60
90	61	11.17	63	12.94	64	14.80	66	17.10
95	62	11.50	64	13.38	65	15.20	67	17.50
100	63	11.83	65	13.83	66	15.60	68	18.00

PART NUMBERS AND ORDERING INFORMATION

Ordering Example	MAKE YOUR SPRINKLER CHOICE FROM CHART 1	CHOOSE NOZZLE SIZE(S) FROM CHART 2	ADD THEM TOGETHER TO CREATE THE PART NUMBER
To order a 30PSH sprinkler with a 13/64" Brass Straight Bore Nozzle and a 1/8" Brass 20° Low Angle Spreader Nozzle the part number would be:	A08714-	+ 13-08	= A08714-13-08

Chart 1	PART NUMBER: FIRST HALF
SPRINKLER ONLY/PLUG	
Sprinkler without Nozzle	A08713
SPRINKLER WITH COMBINATION NOZZLES INSTALLED	
Sprinkler with **SBN-3** and **LAN-1-20**	A08714-
Sprinkler with **SBN-3V** and **LAN-1-20**	A10803-

Chart 2	PART NUMBER: SECOND HALF				
NOZZLE	1/8"	13/64"	7/32"	15/64"	1/4"
Brass Straight Bore Nozzle (105842-) SBN-3	–	13	14	15	16
Brass Straight Bore Nozzle with Vane (106131-) SBN-3V	–	13	14	15	16
Brass 20° Low Angle Spreader Nozzle (100226-) LAN-1-20	08	–	–	–	–
Brass Plug (100225)					

Rain Bird Agri-Products Co. / 633 W. Foothill Blvd. / Glendora, CA 91741-2469 / Phone: (800) 435-5624 / Fax: (626) 852-7310

SIDEROLL SPRINKLER IRRIGATION DESIGN WORKSHEET

Project Name: Benson - South - 12 Shares Section 6

Designer: Ross Gubka Reviewed by: _____

PRELIMINARY DATA:

Design Crop: GRASS

Soil Name: _____

Town: Nucla

Sprinkler Lateral Slope - 0 -

Minimum Pressure 35 psi available for sideroll
(check Rainbird sprinkler model and gpm chart. Stay out of grayed out area because of insufficient pressure to mist the water stream properly)

FIELD DIMENSIONS

Length 1297 FT (L) (manifold or mainline direction)
basically: (8) x 60ft x (17) x(18)

WIDTH ~~1320~~ 800 ft (W) (sideroll direction)

Soil Information:
Design Group _____

Max Sprinkler App. Rate _____ inch/hr (1)

Root Depth: 3' grass & 5'Alfalfa Ft (2)

Moisture Extraction: 3' grass & 5'Alfalfa ft (3)

12 shares of CCC water to operate a 800' x 1320 sideroll

AVERAGE WATER HOLDING CAPACITY
(CIG 2-C)

	Soil Depth in feet	AWC inches
1st		
2nd		
3rd		
4th		

TOTAL AVAILABLE WATER (TAW)

Recommendation from NRCS **4.0" (grass) & 7.6" on Morgan Prime Farmland soils** (4)

Management Allowance
Deficiency (Table CO 684.2) 50 % (5)

IRRIGATION NET APPLICATION:

= % OF Total TAW

(4) x (5) (Decimal) = (4.0) x (50%)

Net. App. = ( ) in. 2.0 in. (6)

DAILY PEAK CONSUMPTIVE USE RATE: .21 for grass & .25 for alfalfa in/day (7)
(CO683.52)

IRRIGATION FREQUENCY:

= (Net Application) (6)
Daily Peak Consumptive Use (7)

= (2.0) (Round down to next whole number
(.21)

= 9.5

= (rounded down) days return period ___9___ days (8)

IRRIGATION GROSS APPLICATION

DESIGN FIELD EFFICIENCY (70% FOR SIDE ROLL SPRINKLERIRRIGATION)
(CO685.69) ___70___% (9)

GROSS APP.

= NET App. ____X 100 (6) = (2.0) x 100
Field Eff. % (9) (70) %

= 2.9 in. (10)

MAX HOURLY WATER APPLICATION RATE:

MAX APP Rate w/cover
(CIG Table 6-D-1, CIG Sec 2-C) _____in/hr (10A)

SET TIME ___10___HR (11)

Normally 11 or 23 hrs/set..... **(11hr for flood & 23hr for sprinkler)**

CHECK POSSIBLE HOURLY APPLICATION RATES

= Gr. App. In. (10) = (2.9)
Set time (11) (10)

= Hourly App. Rate = .29 in/hr* (12)

USE _____ in. Gross App. On _____ hr. Sets

Sideroll Spacing:

Sprinkler set spacing: 60 ft (Sm)

Spacing of Nozzle Along Lateral: 40 ft (s1)

Q = Total flow rate, gpm

Number of CCC ditch shares: Whatever it takes

Note: 1 share of CC water equals 450gpm/35 shares = 12.86gpm

Q = # CCC ditch shares x 12.86gpm = = (13)

Required Sprinkler Head Capacity:

Flow at Nozzle = $\frac{\text{Hourly App. Rate (12)} \times \text{(Sm)} \times \text{(s1)}}{96.3 \text{ (conversion factor)}}$

$= \frac{(.29) \times (60) \times (40)}{96.3}$

= 7.22 gpm gpm (14) ⇐

Selection
(see chart)

Make Rainbird Model 30PSH
Size 13/64 inch
Flow 7.08 gpm (14)
PSI @ Nozzle 35 psi (DP)
Dia. 2x51 ft.

STOP HERE - WE ONLY NEED TO KNOW the quantity of water TO OPERATE A 800FT Long Sideroll

Conclusion: $\frac{800 \text{ FT}}{40 \text{ FT/sprinkler}} + 1 = 21$ Nozzles

21 Nozzle x 7.08 gpm = 149 GPM

$149 \text{ gpm} \times \frac{35 \text{ shares}}{449 \text{ gpm}} = 11.6 \text{ shares}$ ⇒ USE 12 Shares

Number of Nozzles (33nozzles for a full 1320ft side roll system)

= (13)/(14)

= ( )/( )

=_____(Round down)

=_____ .... Use = _____(15)

Number of 1280ft sideroll systems = # of nozzles (15) /33
= ( )/33
=_____ (15a)

Total area of system(s): = $\frac{[(15) \times 40ft] \times [(8) \times 60ft]}{43560}$

= $\frac{[(\quad) \times 40ft] \times [(\quad) \times 60ft]}{43560}$

= _____acres (16)

SYSTEM EFFICIENCY (maintenance, cleaning head gate, checking water, farmer needed time off) ... =_____ ?/(8) .....(n out of total potential /shifts-days of irrigation). (17)

NUMBER OF SETS PER DAY:

= 24/ (11)

= 24/____

=_____ (rounded down) = _____ (18)

NET EFFECTIVE ACREAGE WATERED.

= (16) x (17)% x (18)

= ( ) x ( ) x ( )

= _____ ACRES

NUMBER OF SIDE ROLL SYSTEMS (full or parcel)

= Number of Nozzles(15) /33
= ( )/33
= _____ (round up) _____ (19)

DETERMINE SIDEROLL HEADLOSS:

Spec. Allows a variation of up to +/- 10% of the design pressure without special desing.

MULTIPLE OUTLET FACTOR = _____(F)
(Table CO685.72)
use # outlets per sideroll

LATERAL SIZE = Use 5 in. Dia Aluminum Pipe
(sideroll pipe)

FLOW PER SIDEROLL(s) = {# HEADS (15)} X {NOZZLE FLOW (16)}

= (_____) X (_____)

= _____(20a)

SIDEROLL HEADLOSS PER 100LF =
(Table CO685.73)
for 40 ft pipe lengths
SIDEROLL LENGTH SRL = _____FT/100FT (18)

TOTAL SIDEROLL HEADLOSS
WITH 5" LATERAL = $\frac{\text{(Sideroll Lenght \{SRL\} x \{Headloss \{18\}) x (F)}}{\text{(2.31) x (100)}}$

= $\frac{(\quad\quad) \times (\quad\quad) \times (\quad\quad)}{2.31 \times 100}$

= _____ (19)

PRESSURE GAIN (or LOSS) DUE TO FIELD SLOPE =
Note" Look at most restrictive conditions
in an entire field

= $\frac{(S)\% \text{ X (SRL)}}{2.31 \times 100} = \frac{(\quad\quad) \times (\quad\quad)}{2.31 \times 100}$

= _____ +/- psi (20)
pressure due to elevation change

PRESSURE VARIATION:

= $\frac{\text{Sideroll Headloss (19) + Elev pressure Gain/Loss (20)}}{\text{(DP)}}$

= $\frac{(\quad\quad) +/- (\quad\quad)}{(\quad\quad)} \times 100$

= _____ ( )%*

*PRESSURE VARIATION MUST NOT EXCEED +/-10% OF DP. If flow control nozzles are used, then +/-10% pressure limit can be dealt with easily.

REQUIRED PRESSURE AT MAINLINE AT BEGINNING OF SIDEROLL (MPS)

For Level Laterals = (DP) + 0.75 (19) + 1

= _____ + 0.75( ) + 1 = __ (MPS)_____

MANIFOLD LENGTH (ML)* =Field Length (L) - (1)(Sm)

= ( ) - (1x 60) = _____ft (ML)

NUMBER SETS $= \frac{ML}{Sm} + 1 = \frac{(\quad\quad)}{(\quad 60 \quad)} + 1 =$ _____ sets per field

* Use multiples of 60ft. Note this lenght may be shorter if 60 ft swing lines are used.

MAINLINE CAPACITY
(Manifold)

MAINLINE CAP.= (#HEAD REQ'D {15}) X (NOZZLE FLOW (GPM) {16}) X (#SIDEROLLS {15a})

= (____) X (_____) X (_____)

= _____GPM = _____GPM = _____CFS
449

TOTAL SIDEROLL PRESSURE REQURIED:

TOTAL PRESSURE REQUIRED = MPS + (SWING LINE LOSS + RISER, HYDRANT AND STUB VALVE LOSS)

= ( ) + (2ps i)

Total = ( ) psi req. at beginning of sideroll riser (22)

Main Line Head Loss per 100ft.

siderolls (15a)= _____
gpm per sideroll (20a) = _____gpm

Mainline material & Diameter _____ (21) _____
Length of Mainline Pipe _____ (L)
Hazen Williams "C" factor_____ _____
Friction Loss ft/100 (chart) _____ (24) _____

Total Main line Head Loss = {(L) x (24)}/(2.31 x100)
= { ( ) x ( )}/(2.31x 100)

= _____psi (25) _____

Mainline pressure losses are found by using the pipeline computer program. Mainline losses should be checked at the beginning set and last set and any restrictive sets in between.

Total = (22) + (25) or (22) + (25)

= ( ) + ( ) or (22) + (25)

= _____ or _____psi at beginning of system.

FRICTION LOSS IN VARIOUS PIPE

Values in this table are Friction Loss Constants (C) for Various Pipe Materials - use these values to plug in to the next 11 pages of tables ("Des" in the column head below is for "Design or In-service.)

Pipe material or surface coating	C Range High	C Range Low	C New, Clean	C Des
Acrylonite butadiene styrene (ABS)	150	120	140	130
Aluminum	150	130		
Asbestos cement	160	140	150	140
Asphalt lining	140	130		
Brass	150	120	140	130
Brick sewer				100
Cast iron, asphalt coated	140	90	130	100
Cast iron, bitumastic enamel lined	150	140		
Cast iron, bituminous lined	160	130	150	140
Cast iron, cement lined	150	100	140	120
Cast iron, new, unlined	150	110	130	120
Cast iron, old, unlined	120	60		80
Cast iron, sea-coated	140	100	130	120
Cement lining	140	130		
Concrete	150	90	120	100
Concrete lined, steel forms	140			
Concrete lined, wooden forms	120			
Concrete, old	110	100		
Concrete, steel forms	140			
Concrete, wooden forms	120			
Copper	150	120	140	130
Ductile iron, cement-lined	140	100		120
Fiber	150	140		
Galvanized iron	150	120	140	130
Glass	120	110		130
Lead	150	120	140	130
Plastic	150	120	140	130
Polyethylene	150	140	150	140
Polyvinyl chloride (PVC)	150	120	140	130
Steel, coal-tar enamel lined	150	140		
Steel, corrugated			60	60
Steel, interior riveted, no projecting rivets	140	100	130	110
projecting girth and horz. rivets			120	110
projecting girth rivets			130	100
Steel, welded and seamless	150	100	140	100
Tin	150	120	140	130
Vitrified clay	140	100		110
Wrought iron, plain	150	80	130	100

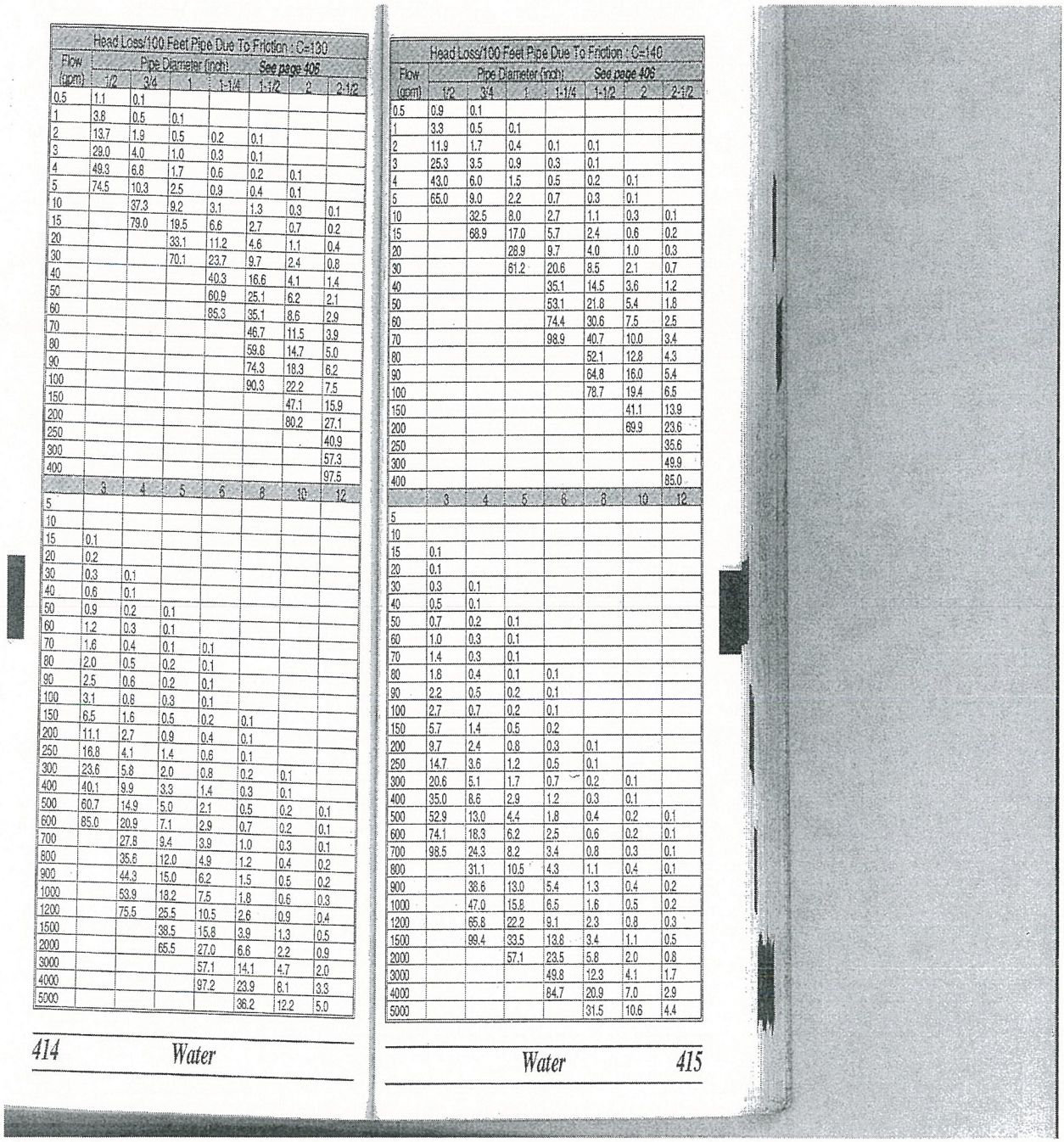
Notes:

1. Values shown above are used in the Hazen-Williams equation for flow in pipes. Feet of Head Loss values shown on the next 11 pages were developed using the Hazen-Williams equation and the constants from the above table.
2. Feet of Head Loss values are subject to the following conditions:
   a) Pipes carrying clear water at approximately 60° F (15.6°C).
   b) Pipes are flowing full.
   c) Velocities of water are generally less than 10 feet per second.

Head Loss/100 Feet Pipe Due To Friction - C=60

Flow (gpm)	Pipe Diameter (inch) See page 406						
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	4.4	0.6	0.2	0.1			
1	15.9	2.2	0.5	0.2	0.1		
2	57.2	7.9	2.0	0.7	0.3	0.1	
3		16.8	4.1	1.4	0.6	0.1	
4		28.6	7.1	2.4	1.0	0.2	0.1
5		43.3	10.7	3.6	1.5	0.4	0.1
10			38.4	13.0	5.3	1.3	0.4
15			81.3	27.4	11.3	2.8	0.9
20				46.7	19.2	4.7	1.6
30				98.9	40.7	10.0	3.4
40					69.3	17.1	5.8
50						25.8	8.7
60						36.1	12.2
70						48.1	16.2
80						61.6	20.6
90						76.5	25.8
100						93.0	31.4
150							66.4
200							
250							
300							
400							

	3	4	5	6	8	10	12
5	0.1						
10	0.2						
15	0.4	0.1					
20	0.7	0.2	0.1				
30	1.4	0.3	0.1				
40	2.4	0.6	0.2	0.1			
50	3.6	0.9	0.3	0.1			
60	5.0	1.2	0.4	0.2			
70	6.7	1.6	0.6	0.2	0.1		
80	8.5	2.1	0.7	0.3	0.1		
90	10.6	2.6	0.9	0.4	0.1		
100	12.9	3.2	1.1	0.4	0.1		
150	27.3	6.7	2.3	0.9	0.2	0.1	
200	46.5	11.5	3.9	1.6	0.4	0.1	0.1
250	70.3	17.3	5.8	2.4	0.6	0.2	0.1
300	98.5	24.3	8.2	3.4	0.8	0.3	0.1
400		41.3	13.9	5.7	1.4	0.5	0.2
500		62.5	21.1	8.7	2.1	0.7	0.3
600		87.5	29.5	12.1	3.0	1.0	0.4
700			39.3	16.2	4.0	1.3	0.6
800			50.3	20.7	5.1	1.7	0.7
900			62.5	25.7	6.3	2.1	0.9
1000			76.0	31.3	7.7	2.6	1.1
1200				43.8	10.8	3.6	1.5
1500				66.2	16.3	5.5	2.3
2000					27.8	9.4	3.9
3000					58.8	19.8	8.2
4000						33.8	13.9
5000						51.0	21.0



Head Loss/100 Feet Pipe Due To Friction : C=130

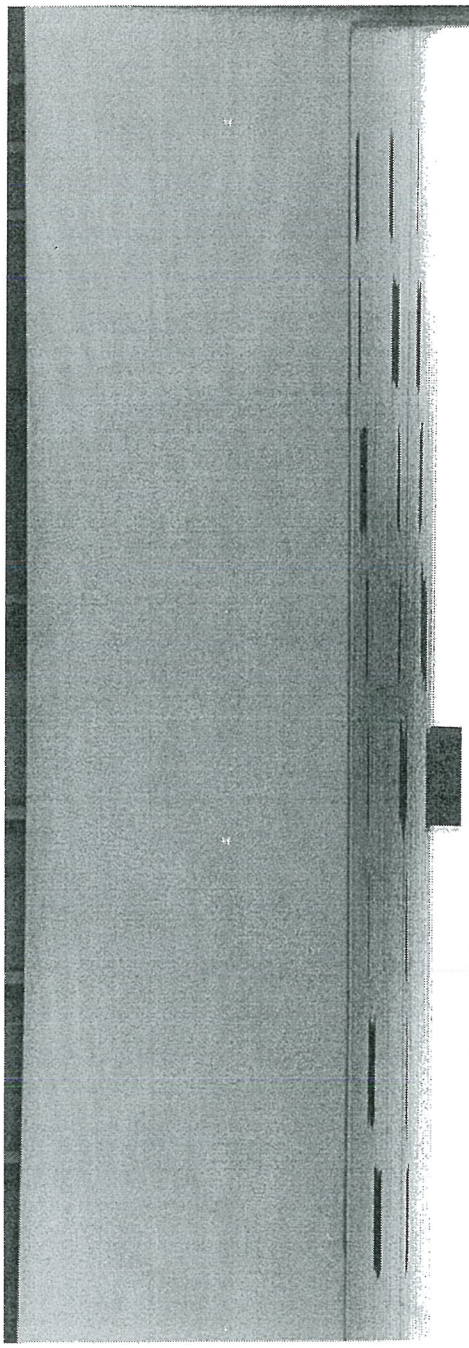
Flow (gpm)	Pipe Diameter (inch) See page 406							
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	1.1	0.1					
1	3.8	0.5	0.1				
2	13.7	1.9	0.5	0.2	0.1		
3	29.0	4.0	1.0	0.3	0.1		
4	49.3	6.8	1.7	0.6	0.2	0.1	
5	74.5	10.3	2.5	0.9	0.4	0.1	
10		37.3	9.2	3.1	1.3	0.3	0.1
15		79.0	19.5	6.6	2.7	0.7	0.2
20			33.1	11.2	4.6	1.1	0.4
30			70.1	23.7	9.7	2.4	0.8
40				40.3	16.6	4.1	1.4
50				60.9	25.1	6.2	2.1
60				85.3	35.1	8.6	2.9
70					46.7	11.5	3.9
80					59.8	14.7	5.0
90					74.3	18.3	6.2
100					90.3	22.2	7.5
150						47.1	15.9
200						80.2	27.1
250							40.9
300							57.3
400							97.5

	3	4	5	6	8	10	12
5							
10							
15	0.1						
20	0.2						
30	0.3	0.1					
40	0.6	0.1					
50	0.9	0.2	0.1				
60	1.2	0.3	0.1				
70	1.6	0.4	0.1	0.1			
80	2.0	0.5	0.2	0.1			
90	2.5	0.6	0.2	0.1			
100	3.1	0.8	0.3	0.1			
150	6.5	1.6	0.5	0.2	0.1		
200	11.1	2.7	0.9	0.4	0.1		
250	16.8	4.1	1.4	0.6	0.1		
300	23.6	5.8	2.0	0.8	0.2	0.1	
400	40.1	9.9	3.3	1.4	0.3	0.1	
500	60.7	14.9	5.0	2.1	0.5	0.2	0.1
600	85.0	20.9	7.1	2.9	0.7	0.2	0.1
700		27.8	9.4	3.9	1.0	0.3	0.1
800		35.6	12.0	4.9	1.2	0.4	0.2
900		44.3	15.0	6.2	1.5	0.5	0.2
1000		53.9	18.2	7.5	1.8	0.6	0.3
1200		75.5	25.5	10.5	2.6	0.9	0.4
1500			38.5	15.8	3.9	1.3	0.5
2000			65.5	27.0	6.6	2.2	0.9
3000				57.1	14.1	4.7	2.0
4000				97.2	23.9	8.1	3.3
5000					36.2	12.2	5.0

Head Loss/100 Feet Pipe Due To Friction : C=140

Flow (gpm)	Pipe Diameter (inch) See page 406							
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	0.9	0.1					
1	3.3	0.5	0.1				
2	11.9	1.7	0.4	0.1	0.1		
3	25.3	3.5	0.9	0.3	0.1		
4	43.0	6.0	1.5	0.5	0.2	0.1	
5	65.0	9.0	2.2	0.7	0.3	0.1	
10		32.5	8.0	2.7	1.1	0.3	0.1
15		68.9	17.0	5.7	2.4	0.6	0.2
20			28.9	9.7	4.0	1.0	0.3
30			61.2	20.6	8.5	2.1	0.7
40				35.1	14.5	3.6	1.2
50				53.1	21.8	5.4	1.8
60				74.4	30.6	7.5	2.5
70				98.9	40.7	10.0	3.4
80					52.1	12.8	4.3
90					64.8	16.0	5.4
100					78.7	19.4	6.5
150						41.1	13.9
200						69.9	23.6
250							35.6
300							49.9
400							85.0

	3	4	5	6	8	10	12
5							
10							
15	0.1						
20	0.1						
30	0.3	0.1					
40	0.5	0.1					
50	0.7	0.2	0.1				
60	1.0	0.3	0.1				
70	1.4	0.3	0.1				
80	1.8	0.4	0.1	0.1			
90	2.2	0.5	0.2	0.1			
100	2.7	0.7	0.2	0.1			
150	5.7	1.4	0.5	0.2			
200	9.7	2.4	0.8	0.3	0.1		
250	14.7	3.6	1.2	0.5	0.1		
300	20.6	5.1	1.7	0.7	0.2	0.1	
400	35.0	8.6	2.9	1.2	0.3	0.1	
500	52.9	13.0	4.4	1.8	0.4	0.2	0.1
600	74.1	18.3	6.2	2.5	0.6	0.2	0.1
700	98.5	24.3	8.2	3.4	0.8	0.3	0.1
800		31.1	10.5	4.3	1.1	0.4	0.1
900		38.6	13.0	5.4	1.3	0.4	0.2
1000		47.0	15.8	6.5	1.6	0.5	0.2
1200		65.8	22.2	9.1	2.3	0.8	0.3
1500		99.4	33.5	13.8	3.4	1.1	0.5
2000			57.1	23.5	5.8	2.0	0.8
3000				49.8	12.3	4.1	1.7
4000				84.7	20.9	7.0	2.9
5000					31.5	10.6	4.4



Head Loss/100 Feet Pipe Due To Friction : C=150

Flow (gpm)	Pipe Diameter (inch) See page 406						
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
0.5	0.8	0.1					
1	2.9	0.4	0.1				
2	10.5	1.5	0.4	0.1			
3	22.2	3.1	0.8	0.3	0.1		
4	37.9	5.3	1.3	0.4	0.2		
5	57.2	7.9	2.0	0.7	0.3	0.1	
10		28.6	7.1	2.4	1.0	0.2	0.1
15		60.6	14.9	5.0	2.1	0.5	0.2
20			25.4	8.6	3.5	0.9	0.3
30			53.8	18.2	7.5	1.8	0.6
40			91.7	30.9	12.7	3.1	1.1
50				46.7	19.2	4.7	1.6
60				65.5	26.9	6.6	2.2
70				87.1	35.8	8.8	3.0
80					45.9	11.3	3.8
90					57.0	14.1	4.7
100					69.3	17.1	5.8
150						36.1	12.2
200						61.6	20.8
250						93.0	31.4
300							44.0
400							74.8

Flow (gpm)	3	4	5	6	8	10	12
5							
10							
15	0.1						
20	0.1						
30	0.3	0.1					
40	0.4	0.1					
50	0.7	0.2	0.1				
60	0.9	0.2	0.1				
70	1.2	0.3	0.1				
80	1.6	0.4	0.1	0.1			
90	2.0	0.5	0.2	0.1			
100	2.4	0.6	0.2	0.1			
150	5.0	1.2	0.4	0.2			
200	8.5	2.1	0.7	0.3	0.1		
250	12.9	3.2	1.1	0.4	0.1		
300	18.1	4.5	1.5	0.6	0.2	0.1	
400	30.8	7.6	2.6	1.1	0.3	0.1	
500	46.5	11.5	3.9	1.6	0.4	0.1	0.1
600	65.2	16.1	5.4	2.2	0.5	0.2	0.1
700	86.7	21.4	7.2	3.0	0.7	0.2	0.1
800		27.4	9.2	3.8	0.9	0.3	0.1
900		34.0	11.5	4.7	1.2	0.4	0.2
1000		41.3	13.9	5.7	1.4	0.5	0.2
1200		57.9	19.5	8.0	2.0	0.7	0.3
1500		87.5	29.5	12.1	3.0	1.0	0.4
2000			50.3	20.7	5.1	1.7	0.7
3000				43.8	10.8	3.6	1.5
4000				74.6	18.4	6.2	2.6
5000					27.8	9.4	3.9

Head Loss/100 Feet Pipe Due To Friction : C=160

Flow (gpm)	Pipe Diameter (inch) See page 406						
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
	0.7	0.1					
	2.6	0.4	0.1				
	9.3	1.3	0.3	0.1			
	19.7	2.7	0.7	0.2	0.1		
	33.6	4.7	1.1	0.4	0.2		
	50.8	7.0	1.7	0.6	0.2	0.1	
		25.4	6.3	2.1	0.9	0.2	0.1
		53.8	13.3	4.5	1.8	0.5	0.2
		91.6	22.6	7.6	3.1	0.8	0.3
			47.8	16.1	6.6	1.6	0.6
			81.3	27.4	11.3	2.8	0.9
				41.5	17.1	4.2	1.4
				58.1	23.9	5.9	2.0
				77.3	31.8	7.8	2.6
				96.9	40.7	10.0	3.4
					50.6	12.5	4.2
					61.5	15.2	5.1
						32.1	10.8
						54.6	18.4
						82.5	27.6
							39.0
							66.4

Flow (gpm)	3	4	5	6	8	10	12
0							
5	0.1						
0	0.1						
0	0.2	0.1					
0	0.4	0.1					
0	0.6	0.1					
0	0.8	0.2	0.1				
0	1.1	0.3	0.1				
0	1.4	0.3	0.1				
0	1.7	0.4	0.1	0.1			
100	2.1	0.5	0.2	0.1			
150	4.5	1.1	0.4	0.2			
200	7.6	1.9	0.6	0.3	0.1		
250	11.5	2.8	1.0	0.4	0.1		
300	16.1	4.0	1.3	0.5	0.1		
400	27.3	6.7	2.3	0.9	0.2	0.1	
500	41.3	10.2	3.4	1.4	0.3	0.1	
600	57.9	14.3	4.8	2.0	0.5	0.2	0.1
700	77.0	19.0	6.4	2.6	0.6	0.2	0.1
800	98.5	24.3	8.2	3.4	0.8	0.3	0.1
900		30.2	10.2	4.2	1.0	0.3	0.1
1000		36.7	12.4	5.1	1.3	0.4	0.2
1200		51.4	17.3	7.1	1.8	0.6	0.2
1500		77.7	26.2	10.8	2.7	0.9	0.4
2000			44.6	18.4	4.5	1.5	0.6
3000			94.4	38.9	9.6	3.2	1.3
4000				66.2	16.3	5.5	2.3
5000					24.6	8.3	3.4

UN CARTS

Factory made, new B78 x 13 tires on ball bearing spindles. Trailer hitch mounted for towing. Wide wheels and tall risers makes it adaptable to most any type of crop. Easily dissasembled for shipping or storage. List price does not include Big Gun Sprinkler.

SIZE	WEIGHT	PRICE
inch	225#	$ 795.00

SPRINKLERS

30H/ST. Bore Drive Nozzle (1/8" Spreader)
Stream Height 9'

Part #	Size	List Price
100345002	30H	$ 21.10

(Two Outlet with Nozzles)

PSI at Nozzle	Nozzle 9/64"X 1/8"X20 degrees		Nozzle 5/32"X 1/8"X20 degrees		Nozzle 11/64"X 1/8"X20 degrees		Nozzle 3/16"X 1/8"X20 degrees	
	DIA.	GPM	DIA.	GPM	DIA.	GPM	DIA.	GPM
25	80	5.2	82	5.8	83	6.6	85	7.4
30	81	5.6	85	6.4	86	7.2	91	8.1
35	82	6.1	87	6.9	90	7.7	94	8.7
40	83	6.5	88	7.3	92	8.3	96	9.3
45	84	6.9	89	7.9	93	8.8	98	9.9
50	85	7.3	90	8.2	95	9.3	100	10.4
55	86	7.6	91	8.6	96	9.7	101	10.9
60	87	7.9	92	9.0	97	10.1	102	11.4
65	88	8.2	93	9.4	98	10.5	103	11.8
70	89	8.5	94	9.7	99	10.9	104	12.3
75	90	8.8	95	10.0	100	11.3	105	12.7
80	91	9.1	96	10.3	101	11.6	106	13.1

NOTE: Rainbird sprinkler performance data represents ideal test conditions and may be adversely affected by wind and other factors. The shaded area of the chart denotes nozzle/pressure combinations that result in marginal water distribution.

30WSH ST. Bore Nozzles
Stream Height 9'

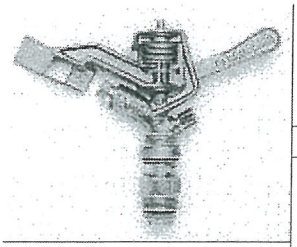
Part #	Size	List Price
100345001	30WSH	$ 18.30

(One Outlet with Nozzle)

PSI at Nozzle	Nozzle 9/64"		Nozzle 5/32"		Nozzle 11/64"		Nozzle 3/16"	
	DIA.	GPM	DIA.	GPM	DIA.	GPM	DIA.	GPM
25	80	2.9	82	3.5	83	4.3	85	5.1
30	81	3.1	85	3.9	86	4.7	91	5.6
35	82	3.4	87	4.2	90	5.1	94	6.0
40	83	3.6	88	4.5	92	5.4	96	6.4
45	84	3.8	89	4.7	93	5.7	98	6.8
50	85	4.1	90	5.0	95	6.1	100	7.2
55	86	4.2	91	5.2	96	6.3	101	7.6
60	87	4.4	92	5.8	97	6.6	102	7.9
65	88	4.6	93	5.8	98	6.9	103	8.2
70	89	4.8	94	5.9	99	7.2	104	8.5
75	90	5.0	95	6.1	100	7.4	105	8.8
80	91	5.1	96	6.3	101	7.7	106	9.1

NOTE: Rainbird sprinkler performance data represents ideal test conditions and may be adversely affected by wind and other factors. The shaded area of the chart denotes nozzle/pressure combinations that result in marginal water distribution.

All prices subject to change without notice



RAIN BIRD

PERFORMANCE DATA — 30PSH

30PSH

3/4" Full Circle, Brass Impact Sprinkler

Bearing: 3/4" Male NPT, Brass
Trajectory Angle: 27°
Operating Range: 25-100 psi
Flow Rate: 5.89-23.4 GPM
Radius: 47-68 ft.

FEATURES

- Heavy duty brass construction
- High pressure spoon
- Stainless steel springs and fulcrum pin
- Chemically resistant washers
- Dual nozzle ports
- Two-year warranty

BENEFITS

- High pressure spoon allows for larger nozzles and pressures
- Exceptionally wide range of flow rates
- Corrosion and grit resistant
- Built to last

Straight Bore Nozzle (SBN-3) with Spreader (LAN-1-20) (Stream Height: 10 ft.)

PSI @ Nozzle	NOZZLE SIZE 13/64" x 1/8-20" Rad.	GPM	7/32" x 1/8-20" Rad.	GPM	15/64" x 1/8-20" Rad.	GPM	1/4" x 1/8-20" Rad.	GPM
25	47	8.30	48	9.24	49	10.30	50	11.30
30	49	9.15	50	10.20	51	11.30	52	12.40
35	51	9.94	52	11.10	52	12.20	54	13.50
40	52	10.70	53	11.90	54	13.00	56	14.50
45	53	11.30	54	12.70	55	13.80	57	15.40
50	53	11.90	55	13.30	56	14.50	58	16.20
55	54	12.50	56	13.90	57	15.30	59	17.00
60	55	13.00	57	14.40	58	15.30	60	17.70
65	56	13.50	58	14.90	59	16.00	61	18.40
70	57	14.00	59	15.40	60	17.20	62	19.10
75	58	14.50	60	15.90	61	17.80	63	19.80
80	59	15.00	61	16.40	62	18.40	64	20.50
85	60	15.43	62	16.81	63	18.90	65	21.20
90	61	15.87	63	17.25	64	19.30	66	22.00
95	62	16.29	64	17.67	65	19.80	67	22.70
100	63	16.71	65	18.08	66	20.20	68	23.40

Brass Straight Bore Nozzle and Vane (SBN-3V) with Plug (Stream Height: 10 ft.)

PSI @ Nozzle	NOZZLE SIZE 13/64" Rad.	GPM	7/32" Rad.	GPM	15/64" Rad.	GPM	1/4" Rad.	GPM
25	47	5.89	48	6.83	49	7.90	50	8.90
30	48	6.51	50	7.58	51	8.70	52	9.80
35	51	7.08	52	8.26	52	9.40	54	10.60
40	52	7.60	53	8.87	54	10.00	56	11.40
45	53	8.07	54	9.41	56	10.60	57	12.40
50	53	8.49	55	9.88	56	11.10	58	12.80
55	54	8.87	56	10.30	57	11.60	59	13.40
60	55	9.20	57	10.60	58	12.10	60	14.00
65	56	9.47	58	10.95	59	12.60	61	14.60
70	57	9.78	59	11.29	60	13.10	62	15.10
75	58	10.18	60	11.71	61	13.60	63	15.60
80	59	10.52	61	12.10	62	14.00	64	16.10
85	60	10.84	62	12.52	63	14.40	65	16.60
90	61	11.17	63	12.94	64	14.80	66	17.10
95	62	11.50	64	13.38	65	15.20	67	17.50
100	63	11.83	65	13.83	66	15.60	68	18.00

PART NUMBERS AND ORDERING INFORMATION

Ordering Example	MAKE YOUR SPRINKLER CHOICE FROM CHART 1	CHOOSE NOZZLE SIZE (S) FROM CHART 2	ADD THEM TOGETHER TO CREATE THE PART NUMBER
To order a 30PSH sprinkler with a 13/64" Brass Straight Bore Nozzle and a 1/8" Brass 20° Low Angle Spreader Nozzle the part number would be:	A08714-	+ 13-08	= A08714-13-08

Chart 1	PART NUMBER: FIRST HALF
SPRINKLER ONLY/PLUG	
Sprinkler without Nozzle	A08713
SPRINKLER WITH COMBINATION NOZZLES INSTALLED	
Sprinkler with **SBN-3** and **LAN-1-20**	A08714-
Sprinkler with **SBN-3V** and **LAN-1-20**	A10803-

Chart 2	PART NUMBER: SECOND HALF				
NOZZLE	1/8"	13/64"	7/32"	15/64"	1/4"
Brass Straight Bore Nozzle (105842-) SBN-3	–	13	14	15	16
Brass Straight Bore Nozzle with Vane (106131-) SBN-3V	–	13	14	15	16
Brass 20° Low Angle Spreader Nozzle (100226-) LAN-1-20	08	–	–	–	–
Brass Plug (100225)					

Rain Bird Agri-Products Co. / 633 W. Foothill Blvd. / Glendora, CA 91741-2469 / Phone: (800) 435-5624 / Fax: (626) 852-7310

FLOOD IRRIGATION DESIGN WORKSHEET GATED

Project Name: Benson - West - Flood IRRIGATION Section 36

Designer: Ross Gubka Reviewed by: _____

PRELIMINARY DATA:

A) $\frac{900' \text{ LONG} \times 600^{FT}}{43560} = 12.4 \text{ Ac}$

Design Crop: GRASS

Soil Name:= _____

B) 2 sets/day

Town: _____

C) 15 out of 18 sets (6 days/wk)

D) 155 gpm = 12 Shares

Root Depth: 3' ft. (2)

Moisture Extraction: 3' ft (3)

AVERAGE WATER HOLDING CAPACITY (CIG 2-C)

	Soil Depth in feet	AWC inches
1st		
2nd		
3rd		
4th		

TOTAL AVAILABLE WATER (TAW)* Recommendation from NRCS **4.0" (grass) & 7.6" on Morgan Prime Farmland soils** (4)

total only to moisture extraction depth.

Management Allowance
Deficiency (Table CO 684.2) 50 % (5)

IRRIGATION NET APPLICATION:

= % OF Total TAW

(4) x (5) (Decimal) = (4.0) x (50)

Net. App. = ( ) in. (6) 2.0 in.

DAILY PEAK CONSUMTIVE USE RATE: .21 in/day

(CO683.52)

IRRIGATION FREQUENCY:

= (Net Application) (6) / Daily Peak Consumptive Use) = (2.0) / (.21)

= days return period (7) 9.5 days (round down) = 9 (7)

IRRIGATION GROSS APPLICATION

DESIGN FIELD EFFICIENCY (50-60% For Corrugate flood irrigation)
(CO685.69) 55 % (8)

GROSS APPLACATION.

= NET App. X 100 (6) / Field Eff. % (8) = (2.0) x 100 / (.55) %

= 3.6 in. (9)

MAX HOURLY WATER APPLICATION RATE:

MAX APP Rate w/cover
(CIG Table 6-D-1, CIG Sec 2-C) .50 in/hr (10)

SET TIME: 10 HR (11)

Normally 11 or 23 hrs/set..... **(11hr for flood irrigation is recommended by NRCS)**

CHECK POSSIBLE HOURLY APPLICATION RATES

= Gr. App. In. (9) = (3.6) / Set time (11) (9)

= Hourly App. Rate = .40 in/hr* (12)

USE _____ in. Gross App. On _____ hr. Sets

Gross Irrigation Application (inches) = $\frac{Q \times T}{450 \times A}$

= $\frac{(14) \times (11)}{450 \times (15)}$

= $\frac{(155) \times (9)}{450 \times (.83)}$

= 3.7 (13)

Gross Application (9): 3.6 inch

Q = Total flow rate, gpm

Number of CCC ditch shares: 44 - (20+12) = 12 shares

Note: 1 share of CC water equals 450gpm/35 shares = 12.86gpm

Q = # CCC ditch shares x 12.86gpm = 12 x 12.9 = 155gpm (14)

T = length of application, hours (NRCS recommends **11 hr sets** for flood irrigation) 9 (11)

A = area being irrigated, acres

450 is a conversion constant:
450 gpm = 1 acre-inch/hr

the area being irrigated, A, is determined using the following formula:
A = Set size or area (acres) =

= $\frac{N \times R \times L}{43560}$

= $\frac{(19) \times (20) \times (21)}{43560}$

= $\frac{(24) \times (2.5) \times (600)}{43560}$

= .83 (15)

N = number of wetting furrows = Q (total gpm) /corrugate flood rate (start with 7gpm per gate, then round up to the next even number of sections of pipe)
flow per gate: 7 (7gpm 1st try) (16) $\frac{155}{24\text{ gates}} = 6.45\text{ gpm/gate}$

*gated pipe comes in 30ft lengths @ **2.5ft** spacings per gate = **12 gates** per pipe section

N= 1st Estimated number of gates = (14) /(16) (Not final number)
$= \frac{155}{7} = 22$ (17) ⇒ USE 24 gates = 2 pipes @ 12 $\frac{\text{gate}}{\text{pipe}}$ = 60 Ft

Estimated Number of 30ft gated pipe:

= (17)/12 = $\frac{22}{12} = 1.8$ Rounded up to whole number = 2 (18)

Net number of Gates

N = (18) x 12
= 2x12 = 24 (19)

R = width between wetting furrows , feet (30inch or **2.5ft)** (20)

L = row length, feet (NRCS recommends 400-600ft)... use: 600 (21)

NUMBER OF SETS PER DAY:

= 24/ (11)

= 24/ 9

= 2.7 (rounded down) = 2 (22)

SYSTEM EFFICIENCY (maintenance, cleaning head gate, checking water, farmer needed time off) ... = (23) $\frac{15}{18} = 83\%$ basically $\frac{6\text{ days}}{\text{wk}}$ =

NET EFFECTIVE ACREAGE WATERED.

= (15) x (22) x (7) x (23)

= (.83) x (2)x(9)x($\frac{15}{18}$)

= 12.5 @ $\frac{15}{18}$ ACRES

12.81 @ $\frac{6\text{ day}}{\text{wk}}$

FLOOD IRRIGATION DESIGN WORKSHEET

24 Share @ 25.5 Ac

Project Name: LLOYD

Designer: Ross Gubka Reviewed by: _____

24 Share Water
2 Sets/day - 6 day/week

PRELIMINARY DATA:

Design Crop: GRASS

25.5 Ac

Soil Name: _____

1960 FT X 600 FT = 25.5 Ac

Town: Nucla

62 JOINT @ 30 FT each

Root Depth: _____ ft. (2)

Moisture Extraction: _____ ft (3)

AVERAGE WATER HOLDING CAPACITY (CIG 2-C)

	Soil Depth in feet	AWC inches
1st		
2nd		
3rd		
4th		

TOTAL AVAILABLE WATER (TAW)* Recommendation from NRCS **4.0" (grass) & 7.6" on Morgan Prime Farmland soils** (4)

total only to moisture extraction depth.

Management Allowance
Deficiency (Table CO 684.2) 50 % (5)

IRRIGATION NET APPLICATION:

= % OF Total TAW

(4) x (5) (Decimal) = (4.0) x (50%)

Net. App. = ( ) in. (6) 2.0 in.

DAILY PEAK CONSUMTIVE USE RATE: **.21 for grass & .25 for alfalfa in/day**
(CO683.52)

IRRIGATION FREQUENCY:

= (Net Application) (6) / Daily Peak Consumptive Use) = (2.6) / (.21)

= days return period (7) 9.5 days (round down) = 9 (7)

IRRIGATION GROSS APPLICATION

DESIGN FIELD EFFICIENCY (50-60% FOR CORRUGATE FLOOD IRRIGATION)
(CO685.69) 55 % (8)

GROSS APPLACATION.

= NET App. X 100 (6) / Field Eff. % (8) = (2.0) x 100 / (55) %

= 3.64 in. (9)

MAX HOURLY WATER APPLICATION RATE:

MAX APP Rate w/cover
(CIG Table 6-D-1, CIG Sec 2-C) 1.0 in/hr (10)

SET TIME: 9 HR (11)

Normally 11 or 23 hrs/set..... **(11hr for flood irrigation is recommended by NRCS)**

CHECK POSSIBLE HOURLY APPLICATION RATES

= Gr. App. In. (9) / Set time (11) = (3.64) / (9)

= Hourly App. Rate = 0.40 in/hr* (12)

USE 0.40 in. Gross App. On 9 hr. Sets

Gross Irrigation Application (inches) = $\frac{Q \times T}{450 \times A}$

= $\frac{(14) \times (11)}{450 \times (15)}$

= $\frac{(\quad) \times (\quad)}{450 \times (\quad)}$ $\frac{310 \times 9}{450 \times 1.65} =$

= 3.76 (13)

Gross Application (9): 3.64

Q = Total flow rate, gpm

Number of CCC ditch shares: 24

Note: 1 share of CC water equals 450gpm/35 shares = 12.86gpm

Q = # CCC ditch shares x 12.86gpm = 24 x 12.9 = 310 gpm (14)

T = length of application, hours (NRCS recommends **11 hr sets** for flood irrigation) 9 (11)

A = area being irrigated, acres

450 is a conversion constant:
450 gpm = 1 acre-inch/hr

the area being irrigated, A, is determined using the following formula:
A = Set size or area (acres) =

= $\frac{N \times R \times L}{43560}$

= $\frac{(19) \times (20) \times (21)}{43560}$ $\frac{48 \times 2.5 \times 600}{43560} = 1.65$

= $\frac{(\quad) \times (\quad) X (\quad)}{43560}$

= 1.65 (15)

N = number of wetting furrows = Q (total gpm) /corrugate flood rate (start with 7gpm per gate, then round up to the next even number of sections of pipe)
flow per gate: 7 (7gpm 1st try) (16) $\frac{310gpm}{7}$ = 44 GATES Round up to 48 GATES

*gated pipe comes in 30ft lengths @ **2.5ft** spacings per gate = **12 gates** per pipe section

N= 1st Estimated number of gates = (14) /(16) (Not final number)
= $\frac{310}{7}$ = 44 (17)

Estimated Number of 30ft gated pipe:

= (17)/12 = $\frac{44}{12}$ = 3.67 Rounded up to whole number = 4 pipes (18)

Net number of Gates

N = (18) x 12
= 4 X 12 = 48 gate (19)

R = width between wetting furrows , feet (30inch or **2.5ft)** (20)

L = row length, feet (NRCS recommends 400-600ft)... use: 600FT (21)

NUMBER OF SETS PER DAY:

= 24/ (11)

= 24/9

= 2.67 (rounded down) = 2 sets/day (22)

SYSTEM EFFICIENCY (maintenance, cleaning head gate, checking water, farmer needed time off) ... = (23)

$\frac{6 day}{WEEK}$ = 86%

NET EFFECTIVE ACREAGE WATERED.

= (15) x (22) x (7) x (23)

= (1,65) x (2)x(9)x(6/7)

= 25.5 ACRES