WATER-REEL
KIFCO

Most Trusted Traveling Irrigation Systems Since 1964

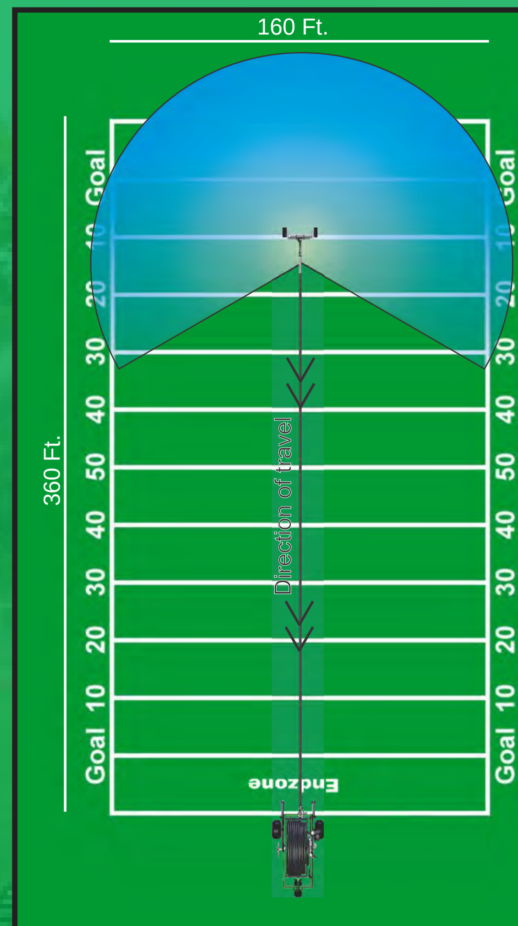
Football Field Layouts

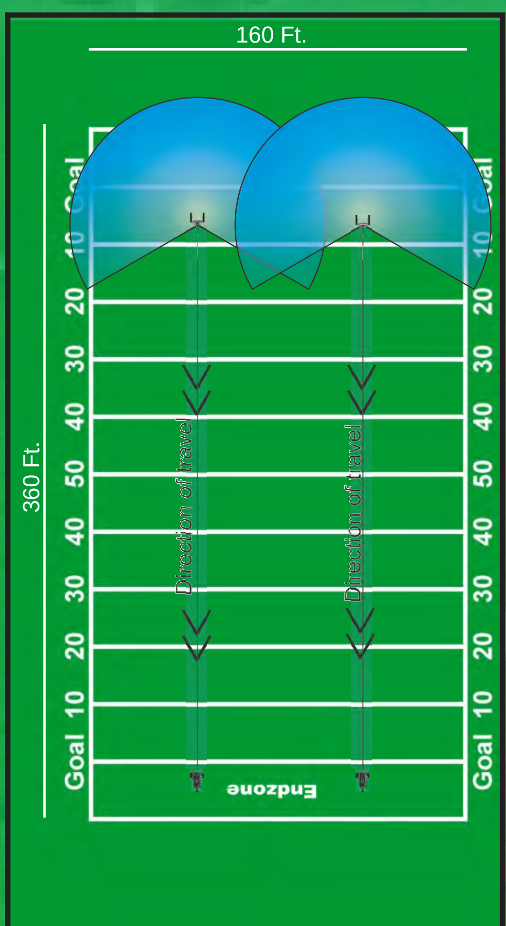
One Pass Irrigation

Model	B140	T180	T200S
Required Supply Pressure	106 PSI	87 PSI	80 PSI
Required Supply Pressure (With 5Hp Booster Pump)	56 PSI	37 PSI	30 PSI
Required Supply Pressure (With 9Hp Booster Pump)	33 PSI	14 PSI	7 PSI
Flow	53 GPM	53 GPM	53 GPM

The B140, T180 or T200S can irrigate a football **field in a single pass with 53 GPM and a minimum pressure of 80 to 106 PSI. The T200S requires less pressure due to shorter hose and larger diameter.**

All performance data based on Nelson SR75 with a .50" nozzle.





Two Pass Irrigation

Model	B110	B140
Required Supply Pressure	55 PSI	50 PSI
Flow	14 GPM	14 GPM

The B110 and B140 can irrigate a football field in two passes.

All performance data based on Sime K1 with 8mm nozzle.

All data contained herein are representative samples. Graphics may not be to scale as field dimensions and sprinkler performance vary. Please refer to model specific spec sheets for more detailed data.

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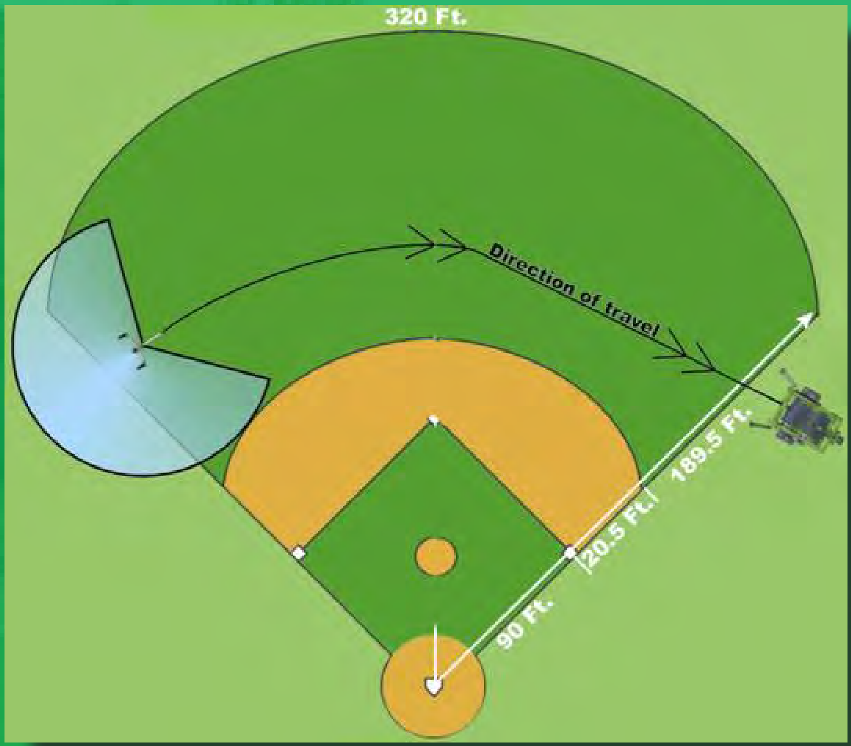
Baseball Field Layouts

One Pass Irrigation



Kifco Water-Reels will follow the curve of a baseball field if pulled out along an arc. Note: The Water-Reel must be pulled out along an arc after a straight pull out of a minimum of 20% of the total tube length.

Model	B140	T180	T200S
Required Supply Pressure	90 PSI	81 PSI	77 PSI
Required Supply Pressure (With 5Hp Booster Pump)	40 PSI	31 PSI	27 PSI
Flow	42 GPM	42 GPM	42 GPM

The B140, T180 and T200S can all irrigate a baseball field in 1 pass with 35-40 GPM and a minimum pressure of 55 to 90 PSI. The T200S optimizes pressure and flow for the fastest application of water.

All performance data based on SR75 w/ a .45" nozzle

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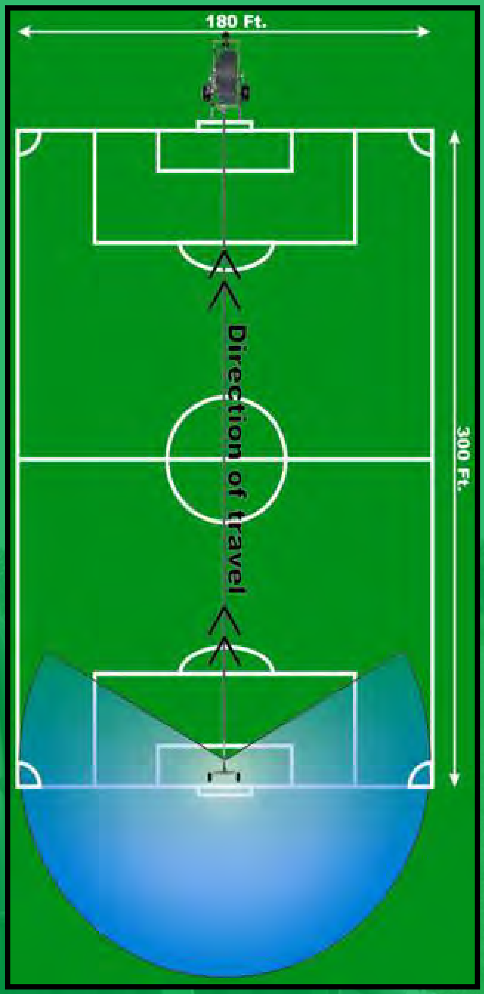
Soccer Field Layouts

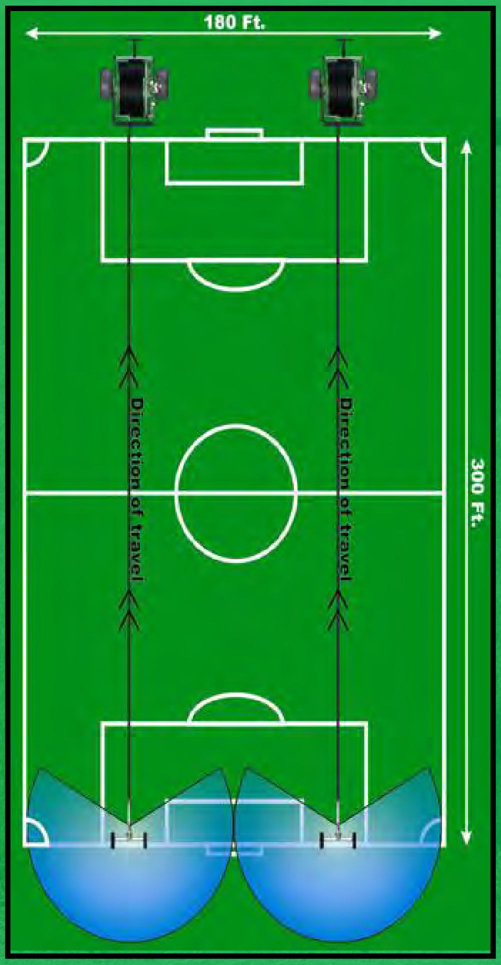
One Pass Irrigation

Model	T200S
Minimum Inlet Pressure	104 PSI
Minimum Inlet Pressure (With 5 or 9Hp Booster Pump)	56 or 29 PSI
Flow	61 GPM

The T200S can all irrigate a soccer field in a single pass with 61 GPM and a minimum pressure of 29 to 104 PSI. The T200S requires less pressure due to shorter hose and larger diameter.

All performance data based on Nelson SR75 w/ a .50” nozzle.





Two Pass Irrigation

Model	B140	T180	T200S
Minimum Inlet Pressure	53 PSI	55 PSI	53 PSI
Flow	27 GPM	27 GPM	27 GPM

The B140, T180 and T200S can all irrigate a soccer field in 2 passes with less than 30 GPM and a minimum pressure of 55 PSI. The T200S requires less pressure due to shorter hose and larger diameter

All performance data based on SR75 w/ a .40” nozzle.

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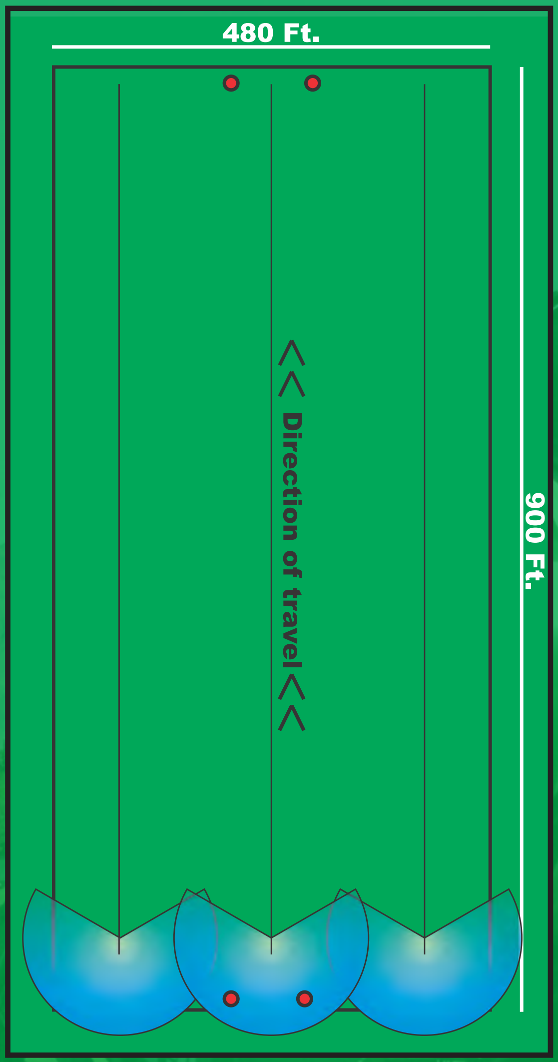
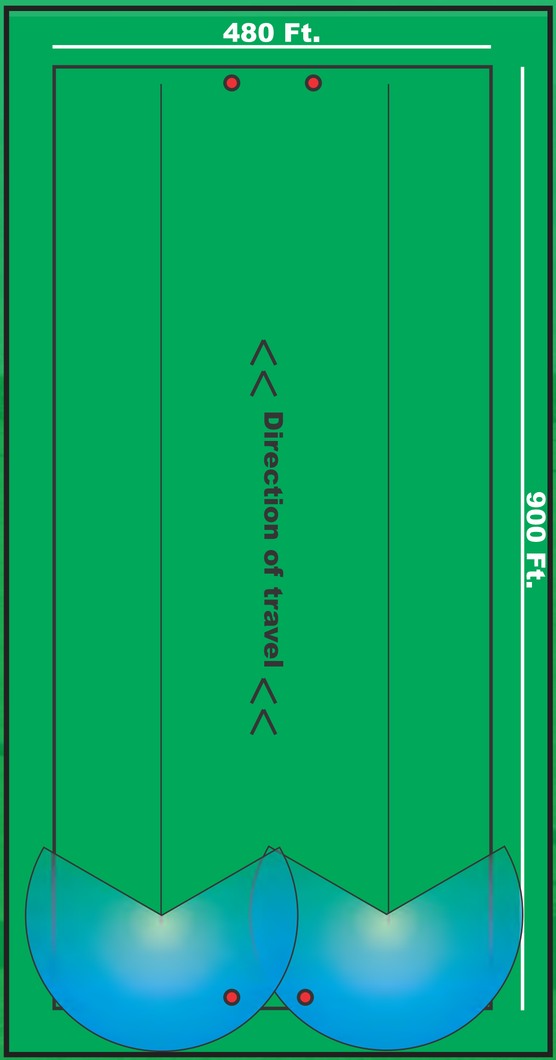
Polo Field Layouts

Polo Field Dimensions: 900 ft. x 480 ft.

Model	T30/980	T37/1220
Minimum Inlet Pressure	71 PSI	106 PSI
Flow	100 GPM	260 GPM
Irrigated Width (70% of Wetted)	172 Ft.	238 Ft.
Passes Necessary	3	2
Nelson SR 150 Nozzle*	.86”	1.18”



T30/980



T37x1220

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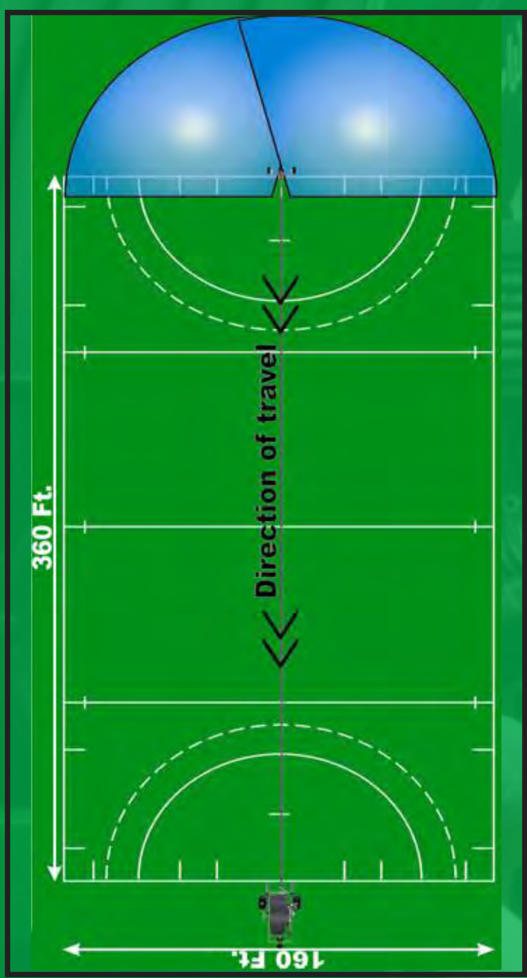
Synthetic Turf Field Layouts

One Pass Irrigation

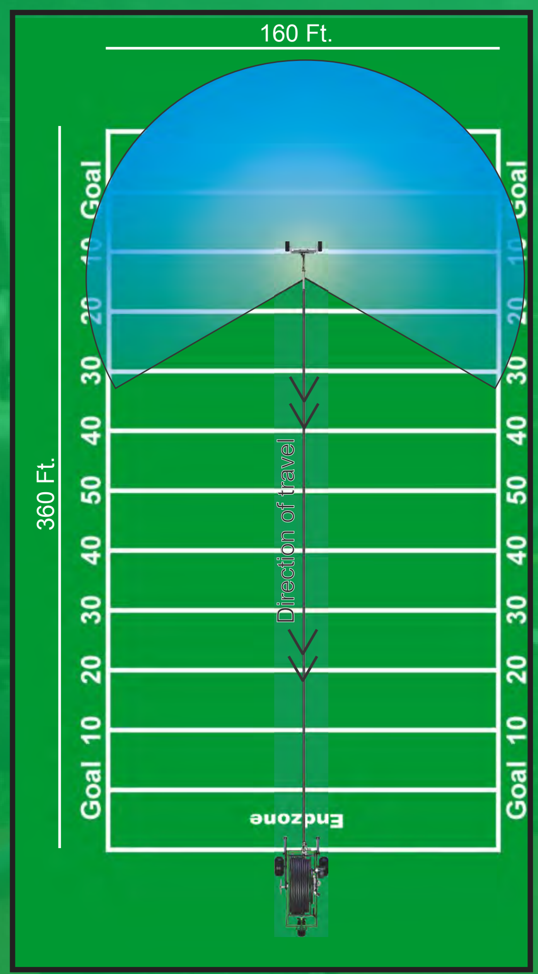
Model	E200SST
Minimum Inlet Pressure	98 PSI
Minimum Inlet Pressure (With 5 or 9Hp Booster Pump)	70 or 40 PSI
Flow	106 GPM

Note: The E200SST is specifically designed for application of water to cool and condition all types of synthetic turf. The machine will apply .1” to .2” of water to the playing surface in less than 30 minutes. The machine is equipped with a dual gun, gun cart for speed of water application.

All performance data based on Nelson SR75 with a .50” nozzle.



Hockey Field



Football Field

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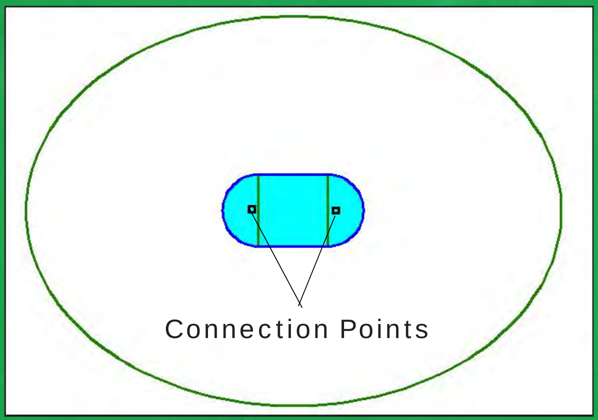
Cricket Field Layouts

Featured Models for Cricket Field Irrigation

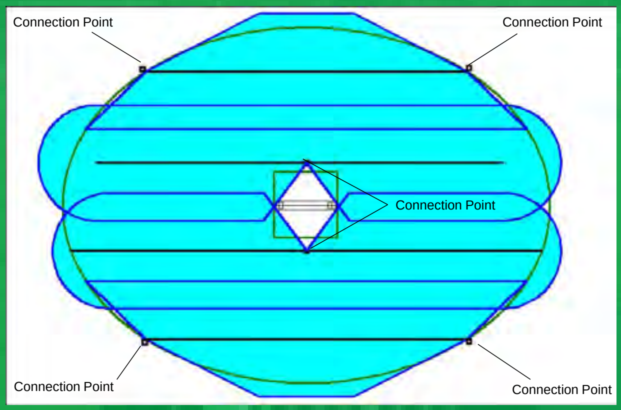
Model	E110	B140	T200L	T23x600
Required Minimum PSI	23	81	60	74
Minimum Flow (GPM)	3	18	28	74

Kifco has a wide range of models to choose from and application designs for **your cricket field irrigation. Below are** several sample application designs as **examples. For a detailed layout of your sports field complex, contact Kifco or your local Authorized Kifco Dealer.**

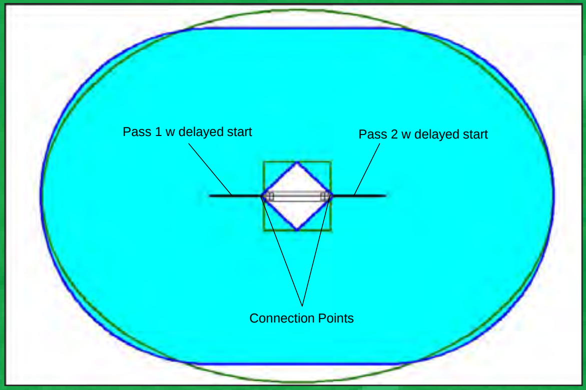
Pitch coverage with an E110 Water-Reel



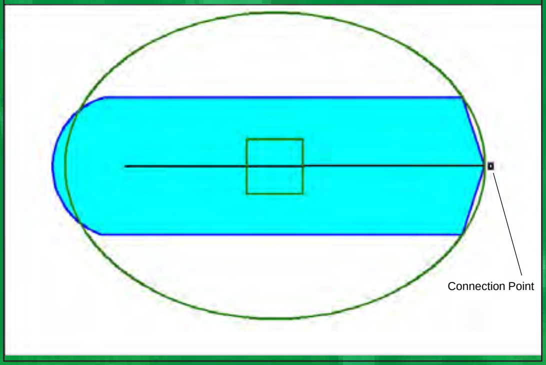
Complete Coverage with B140 Leaving Pitch Area Dry for More Frequent Light Coverage



The T23x660 w/ computer control op- tion for delayed start is an excellent system to easily manage and irrigate up **to 5 fields in the general area.**



The T200L can cover the entire outfield and infield with fewest moves & connection points. Central pass shown.



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Common Water Reel Applications with Suggested Models

Please refer to model specific spec sheets for further information.

Sports Fields (Natural Grass)

No In-Field Obstructions

B110/E110
B140/E140
T180
T200S

Sports Fields (Synthetic Turf)

Quickly Cools Playing Surfaces

E180 ST
E200SST
E200LST
E210LST

Indoor & Outdoor Horse Arenas

Improves Footing

E110
B110
E180 ST
E200SST
E200LST
E210LST

Pastures & Paddocks

Quickens Re-Growth

B-Series Water-Reels
(perfect for smaller areas)
Ag-Rain Water-Reels
(for more acreage)

Common Water Reel Applications with Suggested Models

Please refer to model specific spec sheets for further information.

Ranches & Hobby Farms

Increases Property Values

B-Series Water-Reels
Ag-Rain Water-Reels

Polo Fields

Lowers Labor Costs

T30x980
T37x1220
T40x1250

Vegetables & Produce

High Quality

B-Series Water-Reels
(perfect for smaller areas)
Ag-Rain Water-Reels
(for more acreage)

Agricultural Irrigation

Increased Production

Ag-Rain Water-Reels

Common Water Reel Applications with Suggested Models

Please refer to model specific spec sheets for further information.

Slurry & Waste Disposal

Passes Large Solids

Engine Drive
Ag-Rain Water-Reels

Food Plots

Attracts Game

B110
E110
B140
E140
T200S
T200L
T200LSC

Dust Suppression (Construction, Mining, Feed Lots, etc.)

Healthier Environment

B110
E110
E140
T180
T200S
T200L
T210
E180 ST
E200SST
E200LST
E210LST

Composting or Waste Water Reuse

Increased Production

Engine Drive B-Series and
Ag-Rain Water-Reels

Common Water Reel Applications with Suggested Models

Please refer to model specific spec sheets for further information.

Golf Courses, Parks & Recreation

Excellent For Hard To Reach Areas

B110/E110
B140/E140
T200S
T200L
T200LSC

Residential Landscape, Gardens & Nurseries

Beautifies Overall Landscape

B110
E110
B140
E140
T180
T200S
T200L
E200SST

Hydroseeding, Reclamation and Establishment

Quickly Establishes New Landscaping

B-Series and Ag-Rain Water-Reels

Cemeteries

Increases The Value Of Burial Plots

B110/E110
B140/E140
T180
T200S

Introducing REEL-DESIGN KIFCO®

A first of its kind tool to aid in the design and quotation of Kifco® Water-Reels®.

Exclusively for You, the Dealer!

Selling Water-Reels® Has Never Been Easier!

With Kifco Reel Design, you will be able to create designs of your customer's actual property, prepare quotations and bill of materials all in one report and without ever leaving your computer!

Designs

Reel Design utilizes state of the art Satellite Imagery which allows you and your customer to select the actual field or area of land to be irrigated. Handing over a complete design of your customer's actual property is sure to impress!

Bill of Materials

As items are selected during your design, they are automatically compiled into a Bill of Materials. From the pipe in the ground to the nozzle on the end of your sprinkler, you will easily be able to show your customer exactly what's needed for the job.

Quotations

With up to date pricing included, professional quotations are simply added to the final report. Your logo is included to give your reports that personal touch.

Manage with Less Guess Work

With allowances for pipe type & diameter, friction loss and even head gain or loss due to elevation changes, Reel Design can precisely select the right equipment needed for any project!

Leading the Way

At Kifco we recognize that the ability to effectively stand apart from the rest is highly dependent on keeping our dealers supplied with marketing and training materials to aid in the sale. Kifco Reel-Design is just one more tool that will allow us to continue to lead the competition in traveling irrigation sales & service.

Get Started Today

Simply watch the training video by copying & pasting the following link in your web browser:

https://youtu.be/JEdOtDaDf3k

WATER-REEL® KIFCO

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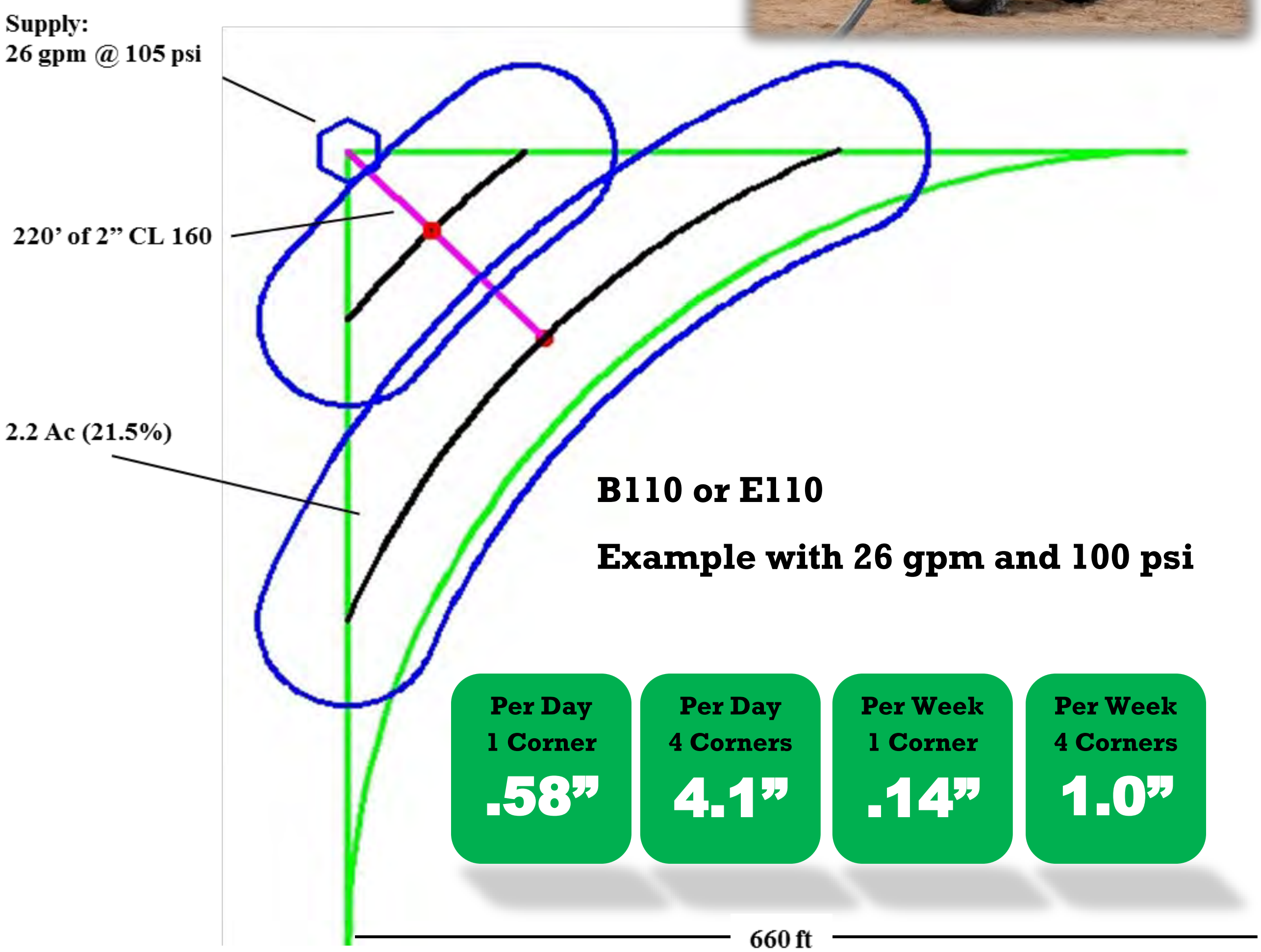
Since 1964

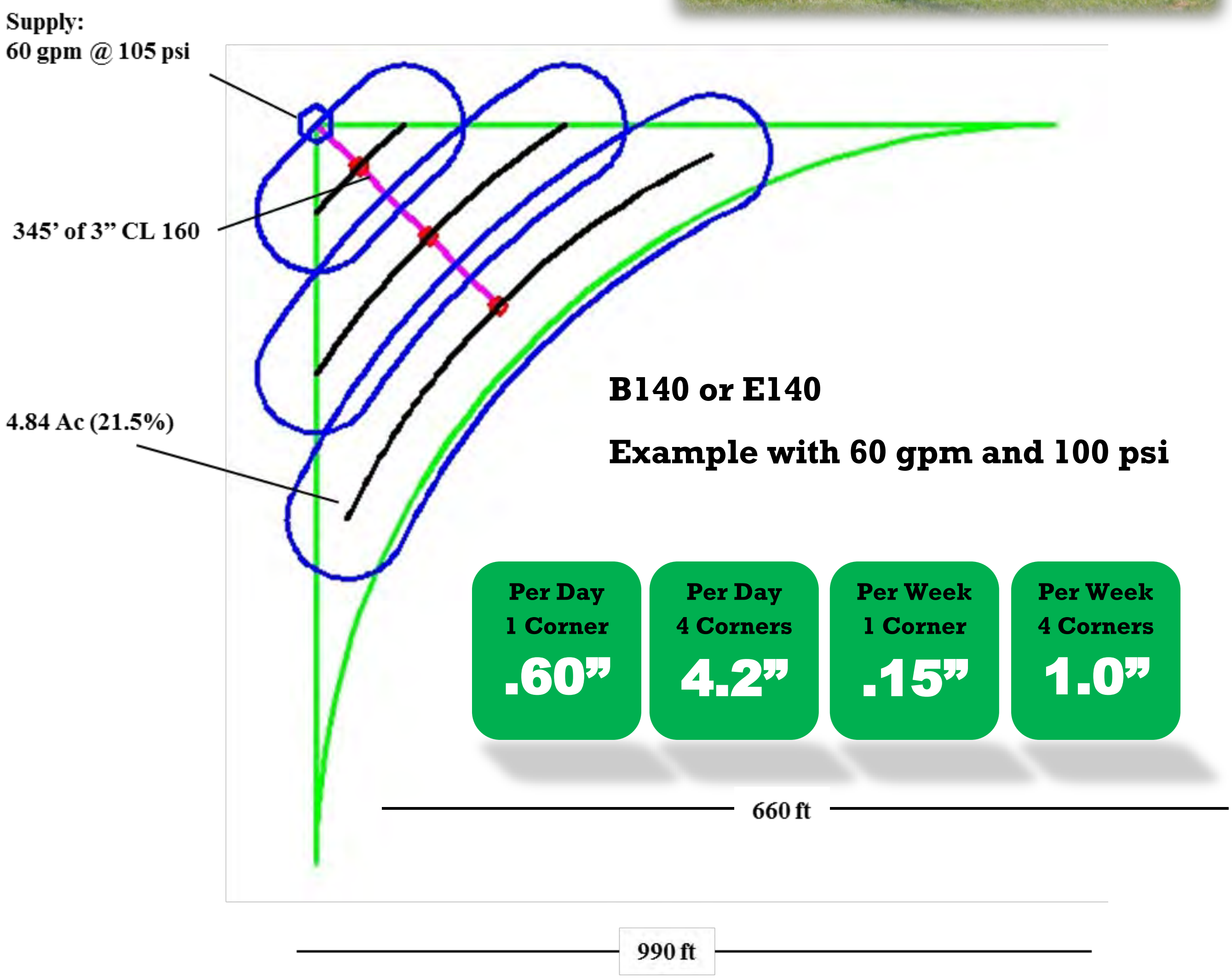
Ag Layouts

Lost Corners



Ag Layouts

Lost Corners



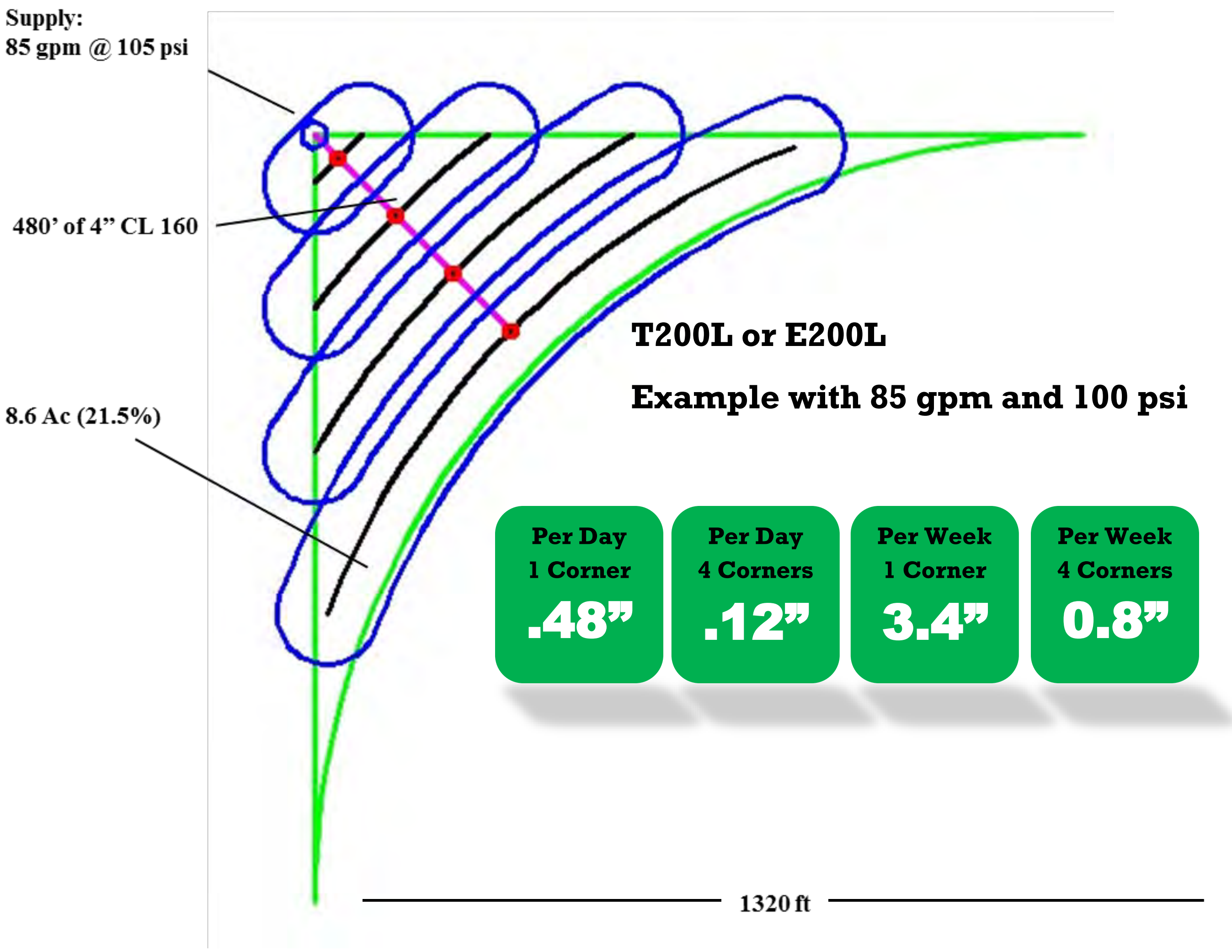
B140 or E140

Example with 60 gpm and 100 psi

Per Day 1 Corner	Per Day 4 Corners	Per Week 1 Corner	Per Week 4 Corners
.60"	4.2"	.15"	1.0"

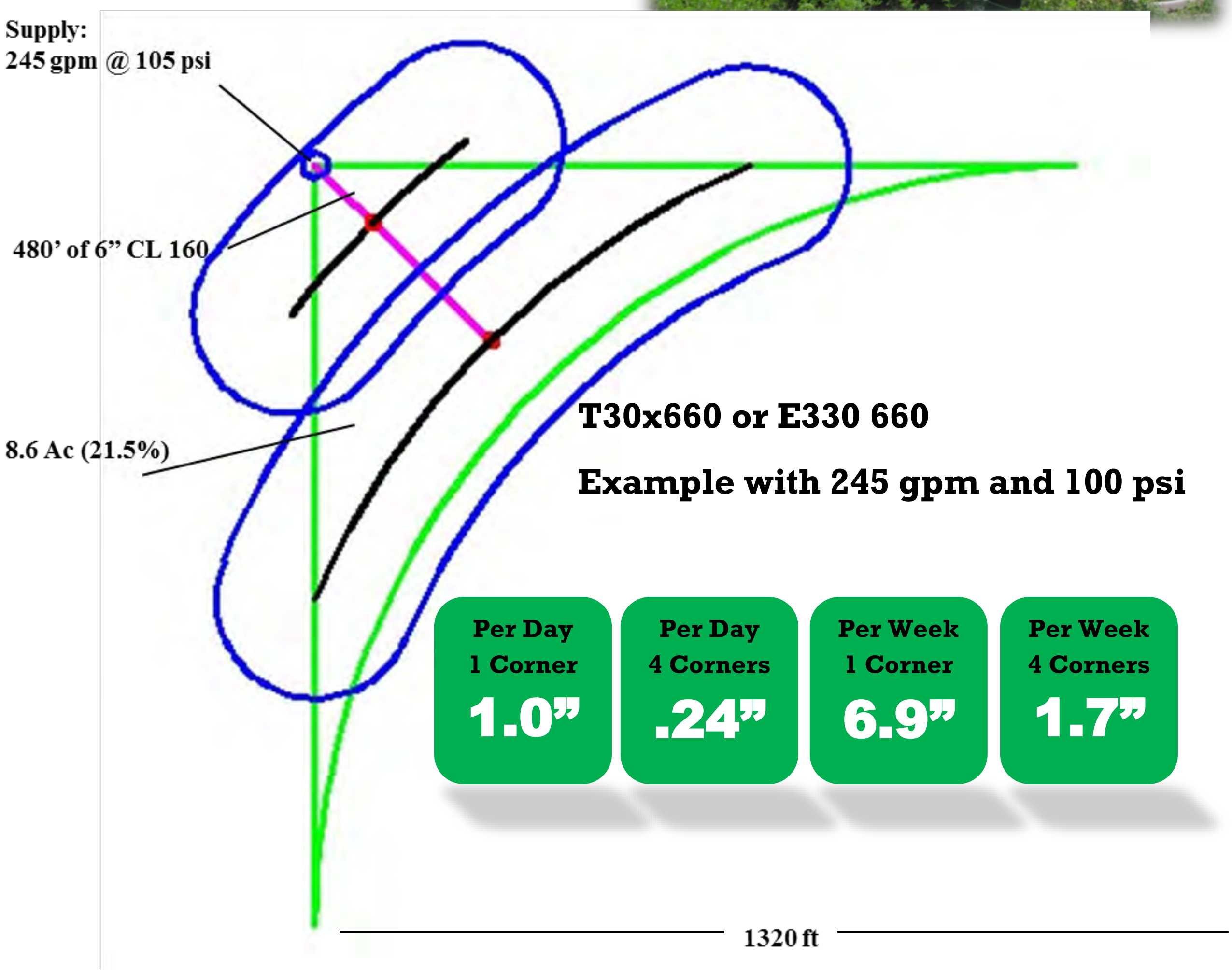
Ag Layouts

Lost Corners



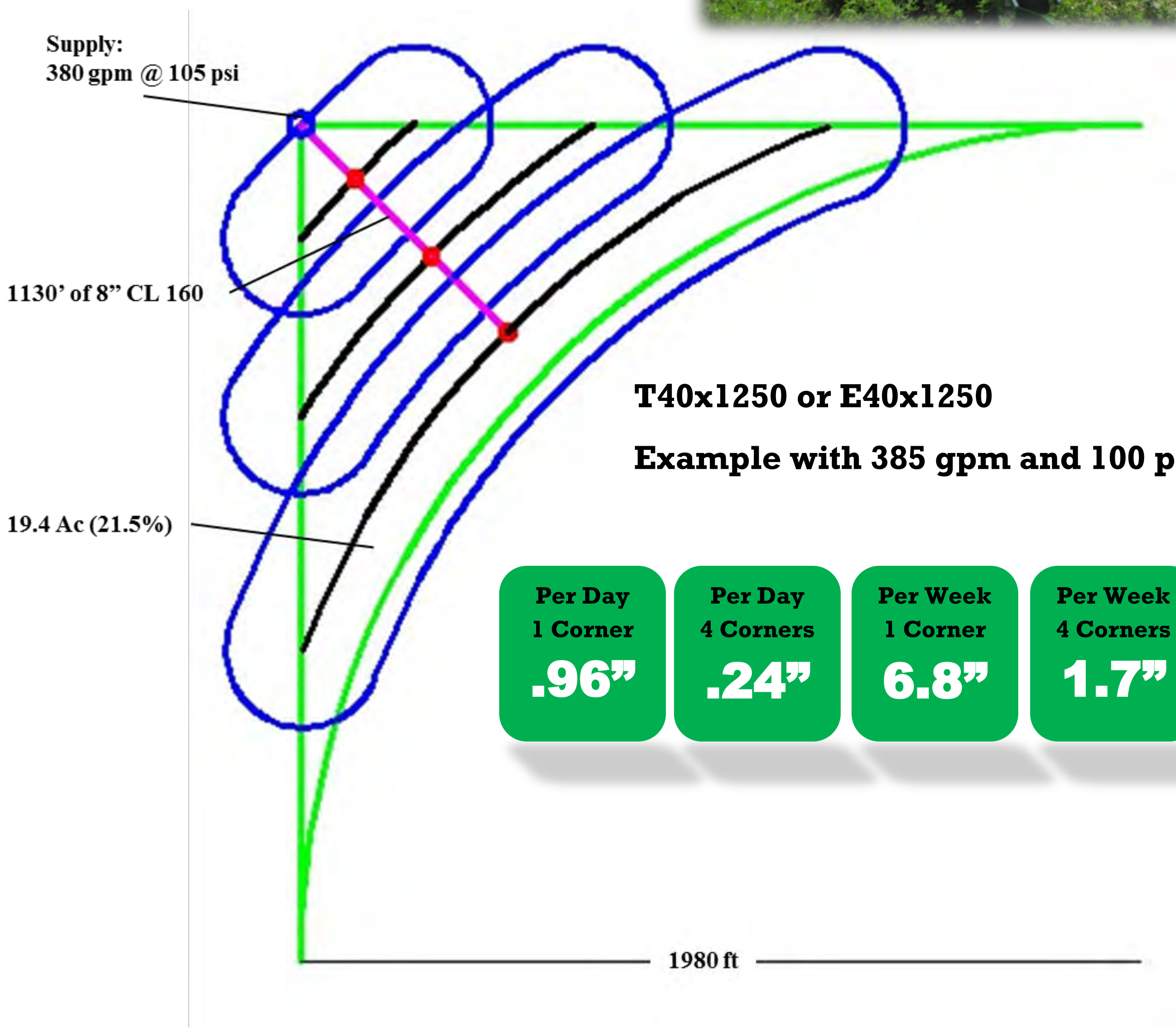
Ag Layouts

Lost Corners



Ag Layouts

Lost Corners



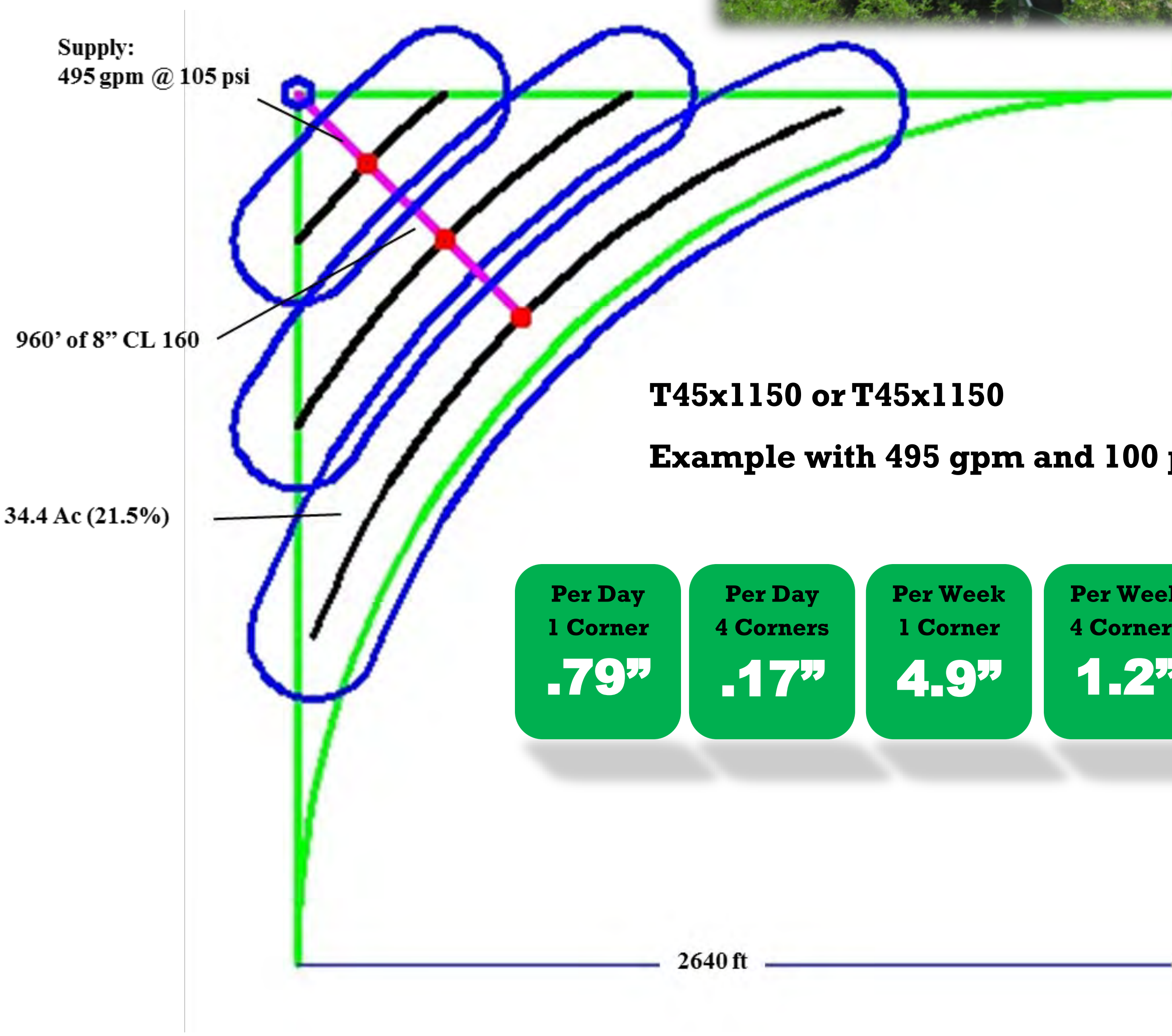
T40x1250 or E40x1250

Example with 385 gpm and 100 psi

Per Day 1 Corner	Per Day 4 Corners	Per Week 1 Corner	Per Week 4 Corners
.96"	.24"	6.8"	1.7"

Ag Layouts

Lost Corners

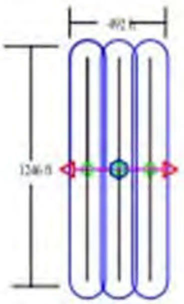


T45x1150 or T45x1150

Example with 495 gpm and 100 psi

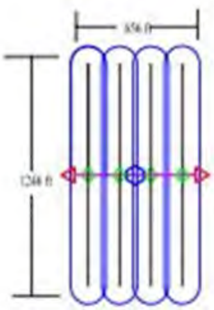
Per Day 1 Corner	Per Day 4 Corners	Per Week 1 Corner	Per Week 4 Corners
.79"	.17"	4.9"	1.2"

Ag Layouts



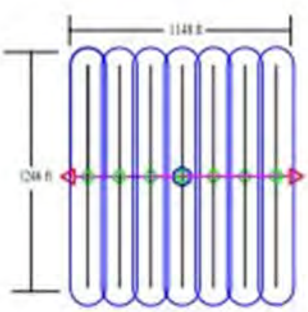
14.1 Ac, .35"/day

Water-Reel 2014 MSRP : $772/Ac



118.8 Ac, .27"/day

Water-Reel 2014 MSRP : $579/Ac



32.8 Ac, .15"/day

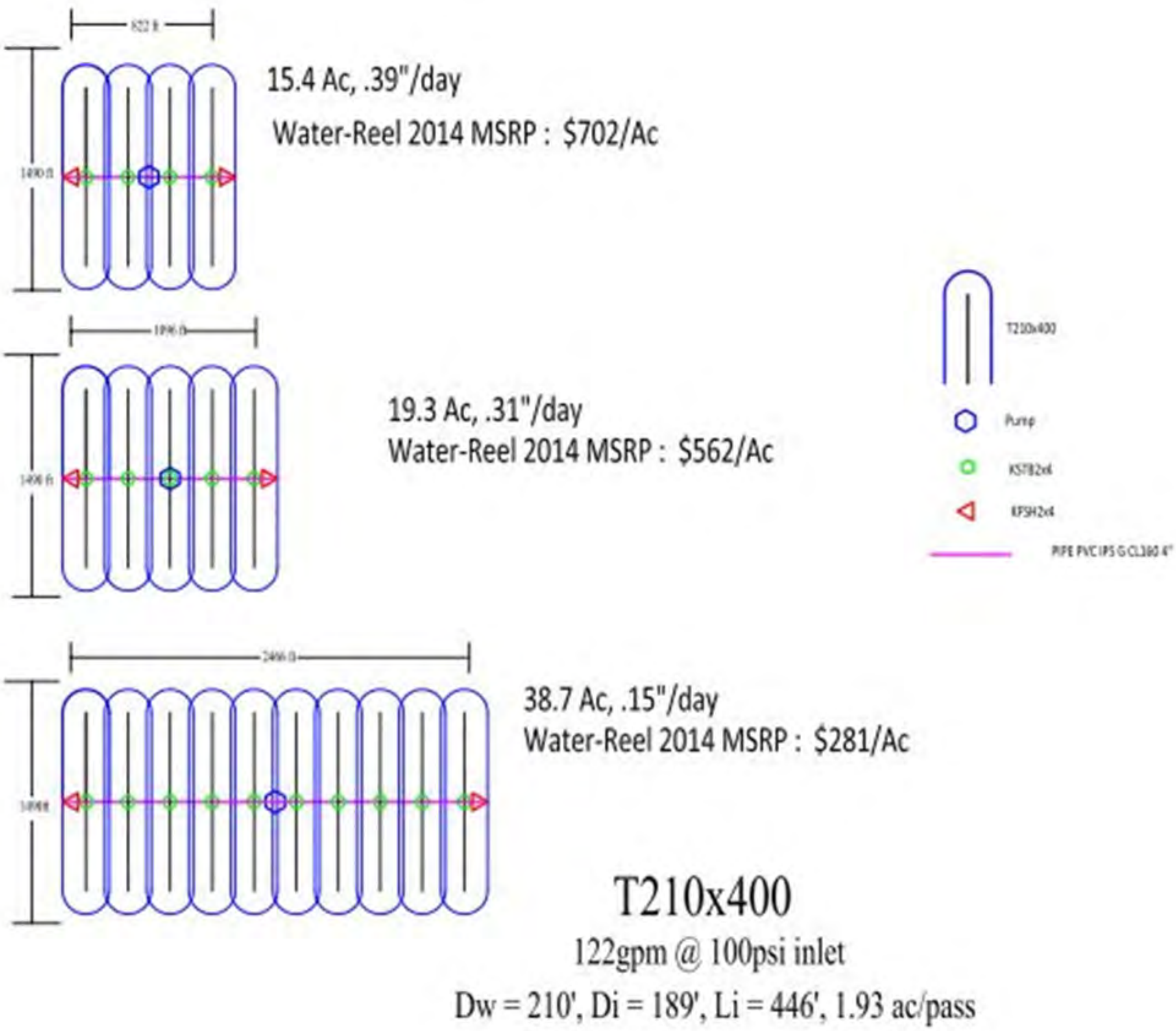
Water-Reel 2014 MSRP : $331/Ac

T200L

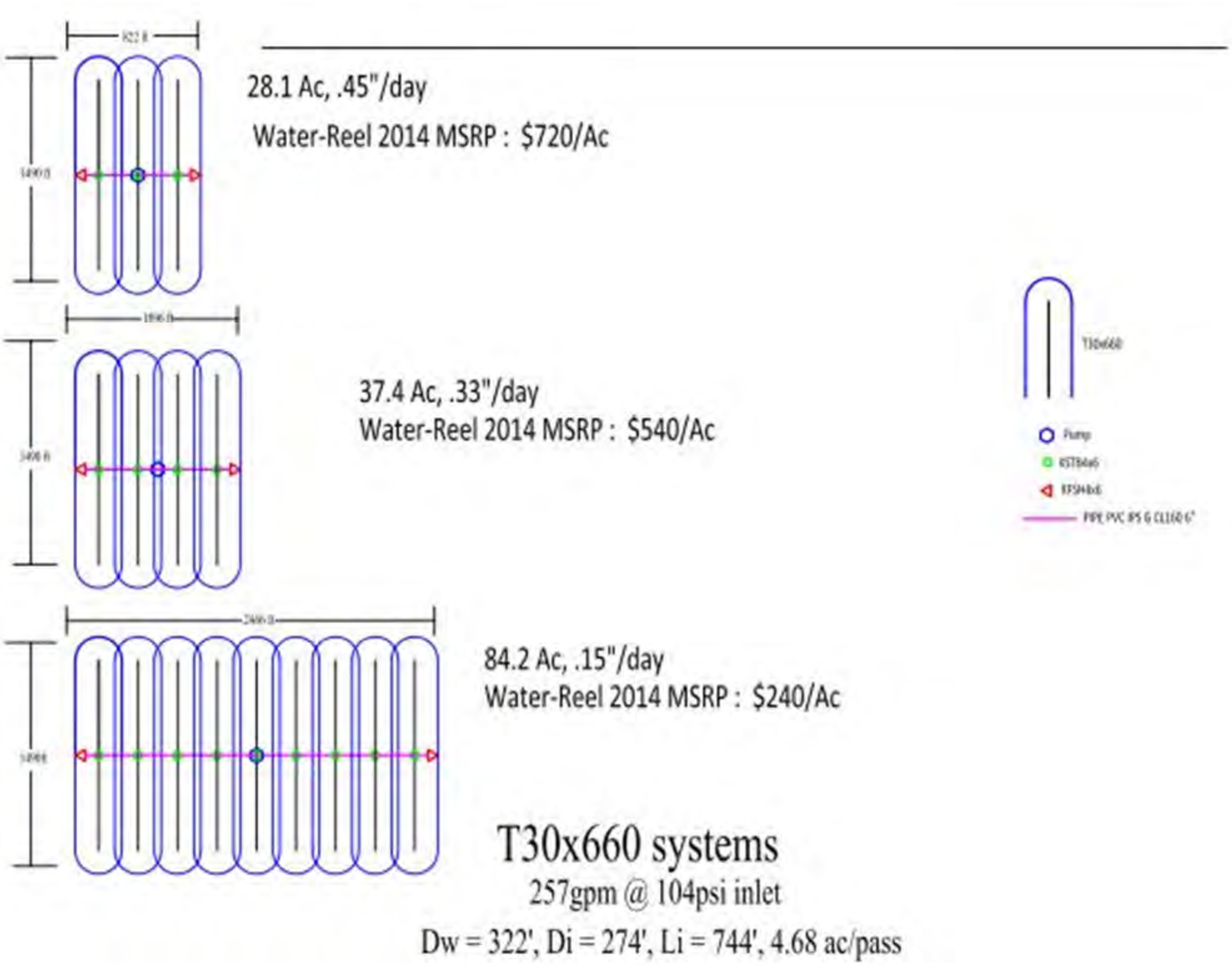
100gpm @ 104psi inlet

Dw = 184', W = 164', Li = 623', 2.34 ac/pass

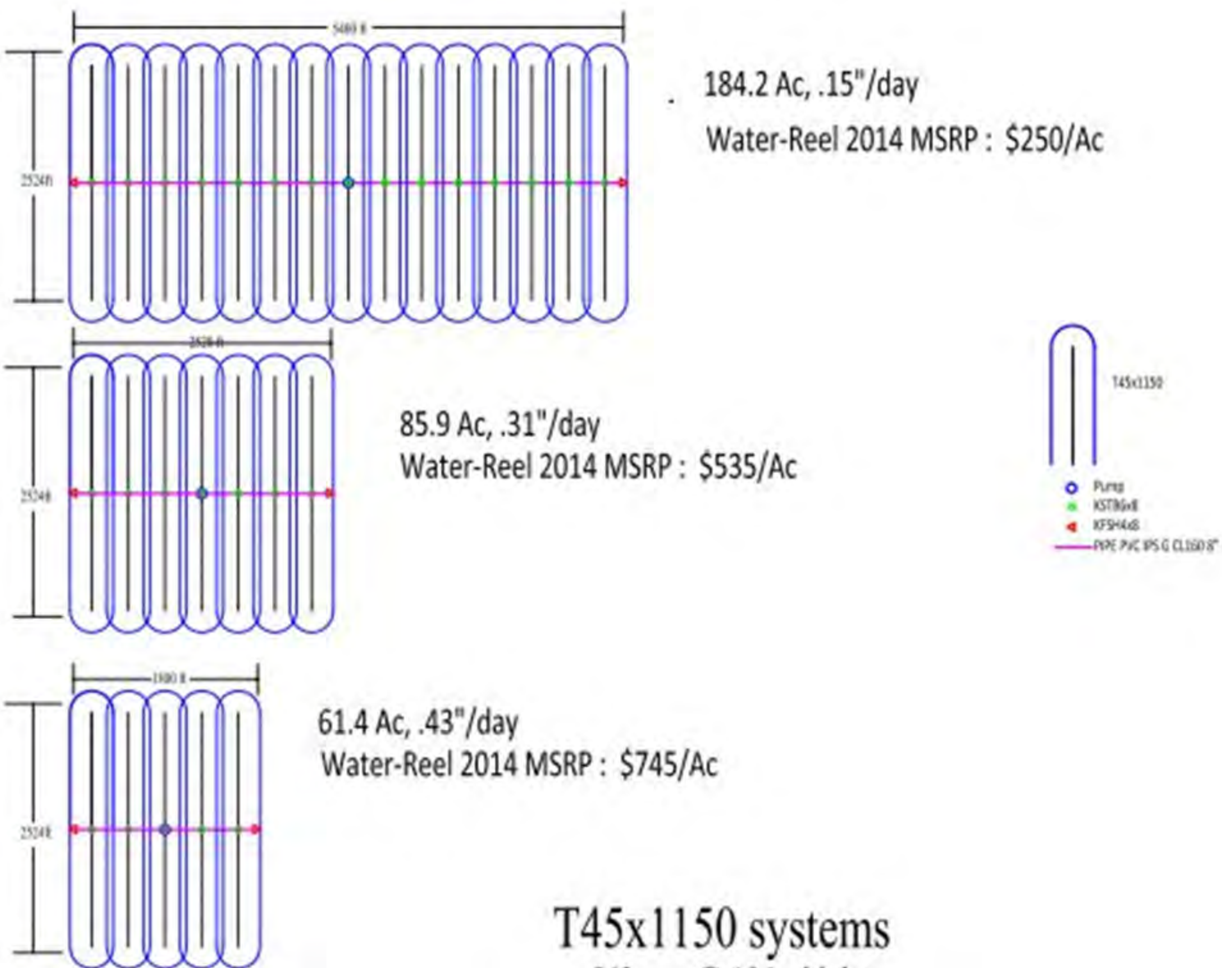
Ag Layouts


15.4 Ac, .39"/day
Water-Reel 2014 MSRP : $702/Ac
19.3 Ac, .31"/day
Water-Reel 2014 MSRP : $562/Ac
38.7 Ac, .15"/day
Water-Reel 2014 MSRP : $281/Ac
T210x400
Pump
T210x400
122gpm @ 100psi inlet
Dw = 210', Di = 189', Li = 446', 1.93 ac/pass

Ag Layouts


28.1 Ac, .45"/day
Water-Reel 2014 MSRP : $720/Ac
37.4 Ac, .33"/day
Water-Reel 2014 MSRP : $540/Ac
84.2 Ac, .15"/day
Water-Reel 2014 MSRP : $240/Ac
T30x660 systems
257gpm @ 104psi inlet
Dw = 322', Di = 274', Li = 744', 4.68 ac/pass

Ag Layouts



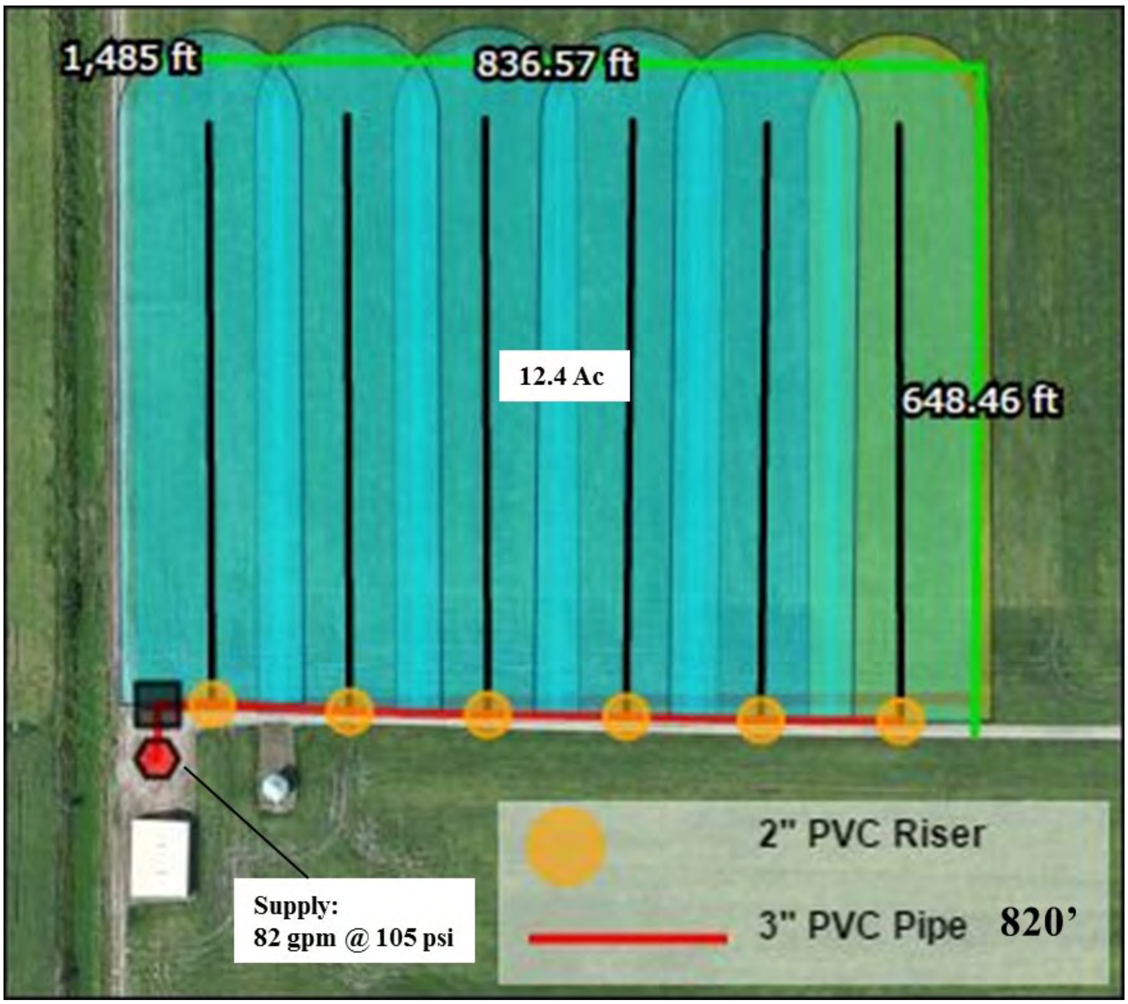
T45x1150 systems

542gpm @ 104psi inlet

Dw = 424', Di = 360', Li = 1262', 6.14ac/pass

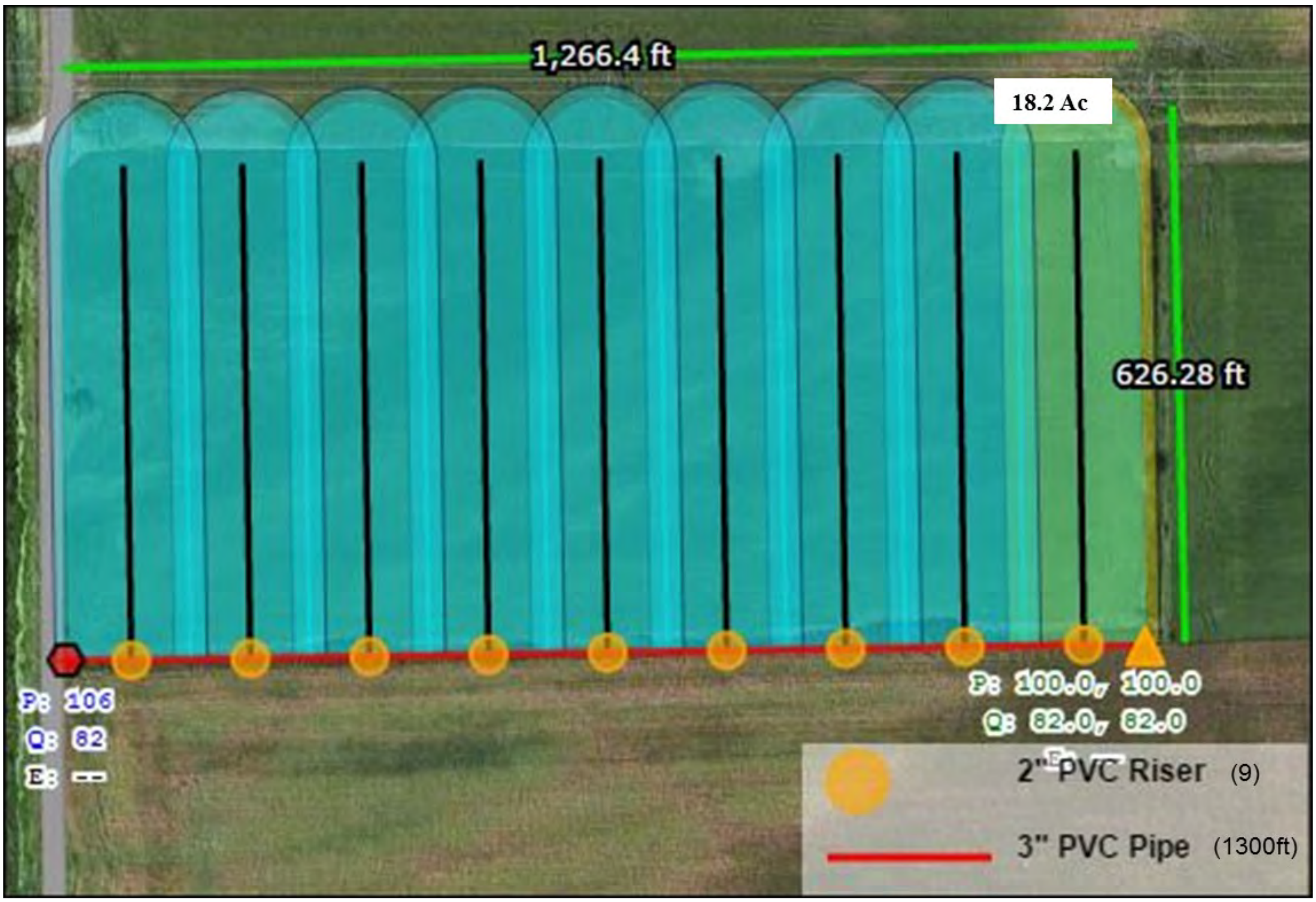
Ag Layouts

T200L or E200L
82 gpm w 100 psi @ the inlet.
Gives .32”/day (2.25”/wk)



Ag Layouts

T200L 82 gpm w 100 psi @ the inlet.
Gives .22"/day (1.5"/wk)

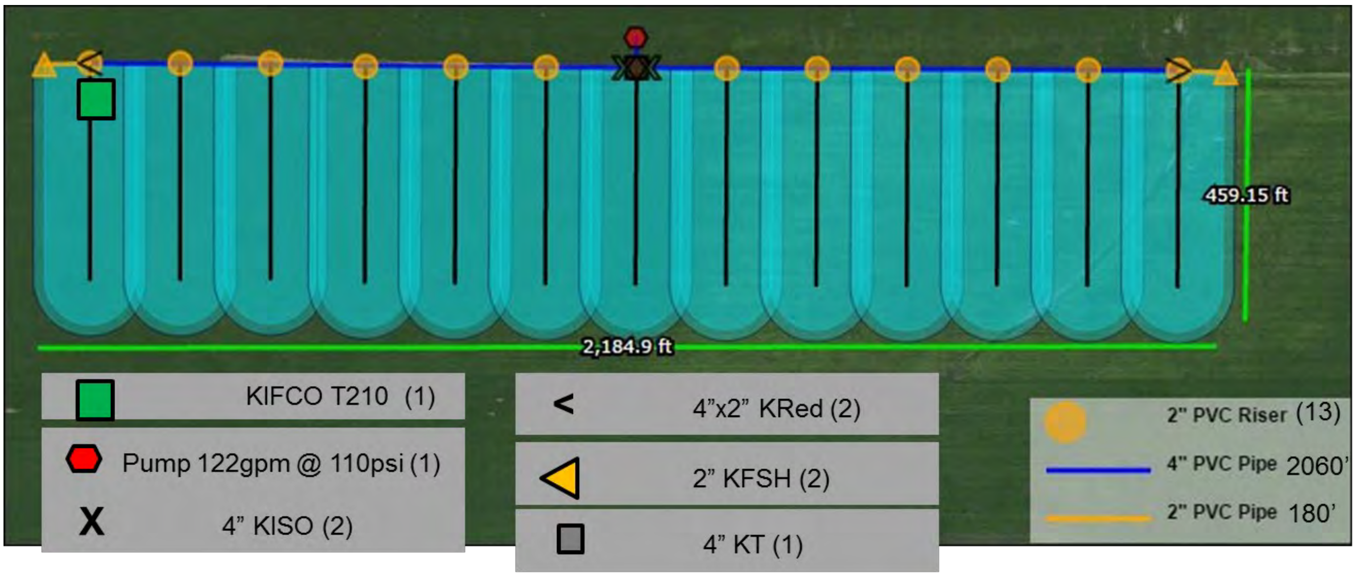


Pump: Model ####

2"x3" KFLSH (1)

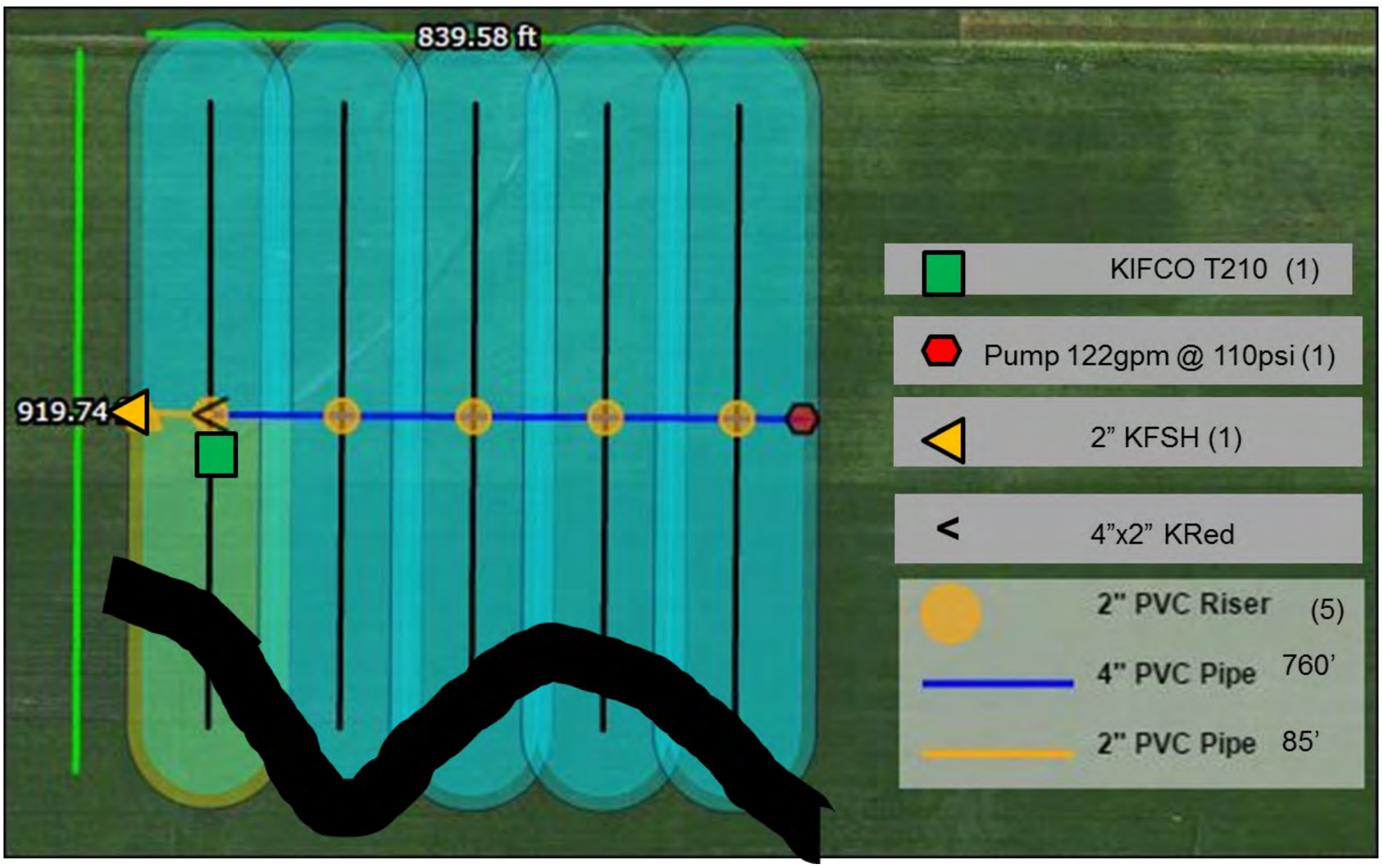
Ag Layouts

23 Ac, .25'/day, 1.75"/wk



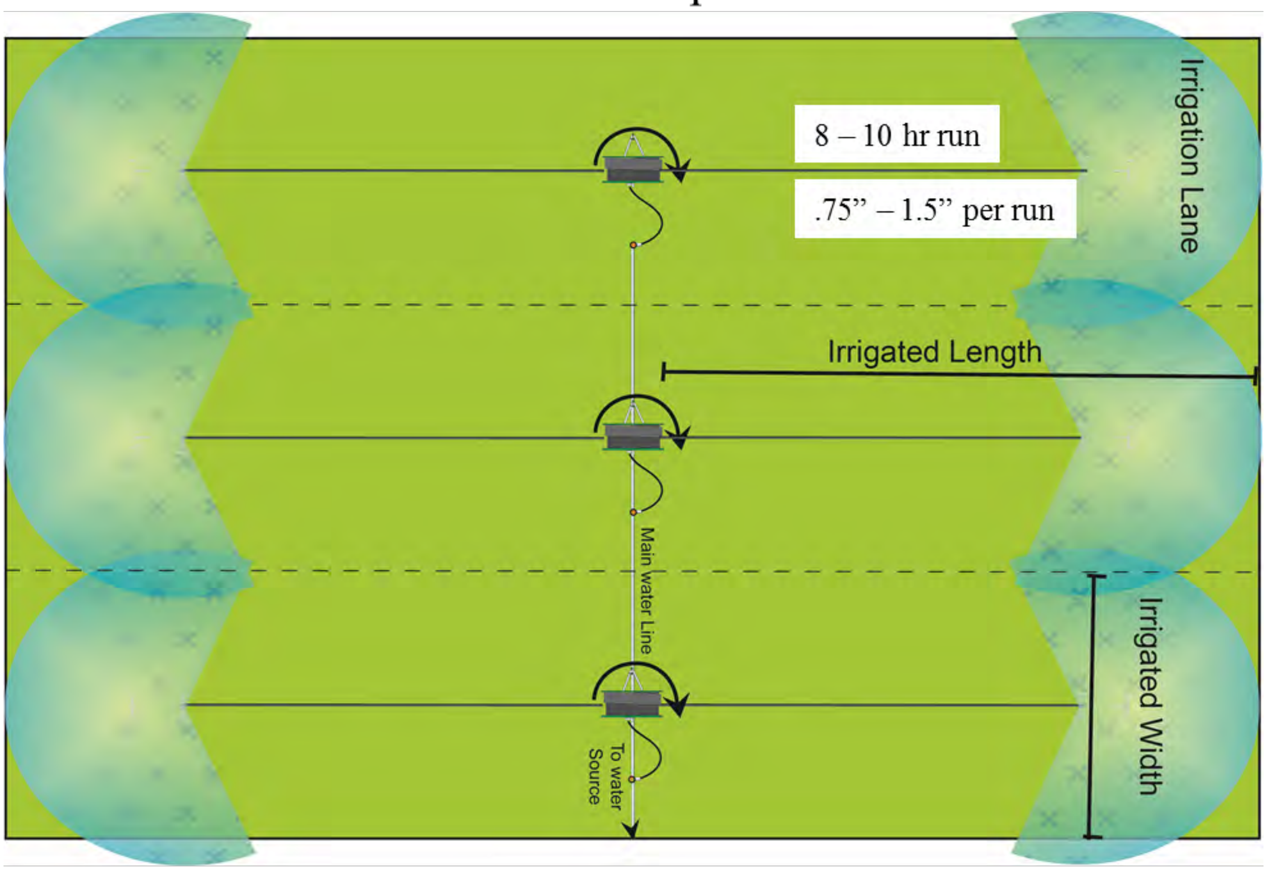
Ag Layouts

17.7 Ac, .32'/day, 2.24"/wk



Ag Layouts

Cost-Effective Operation

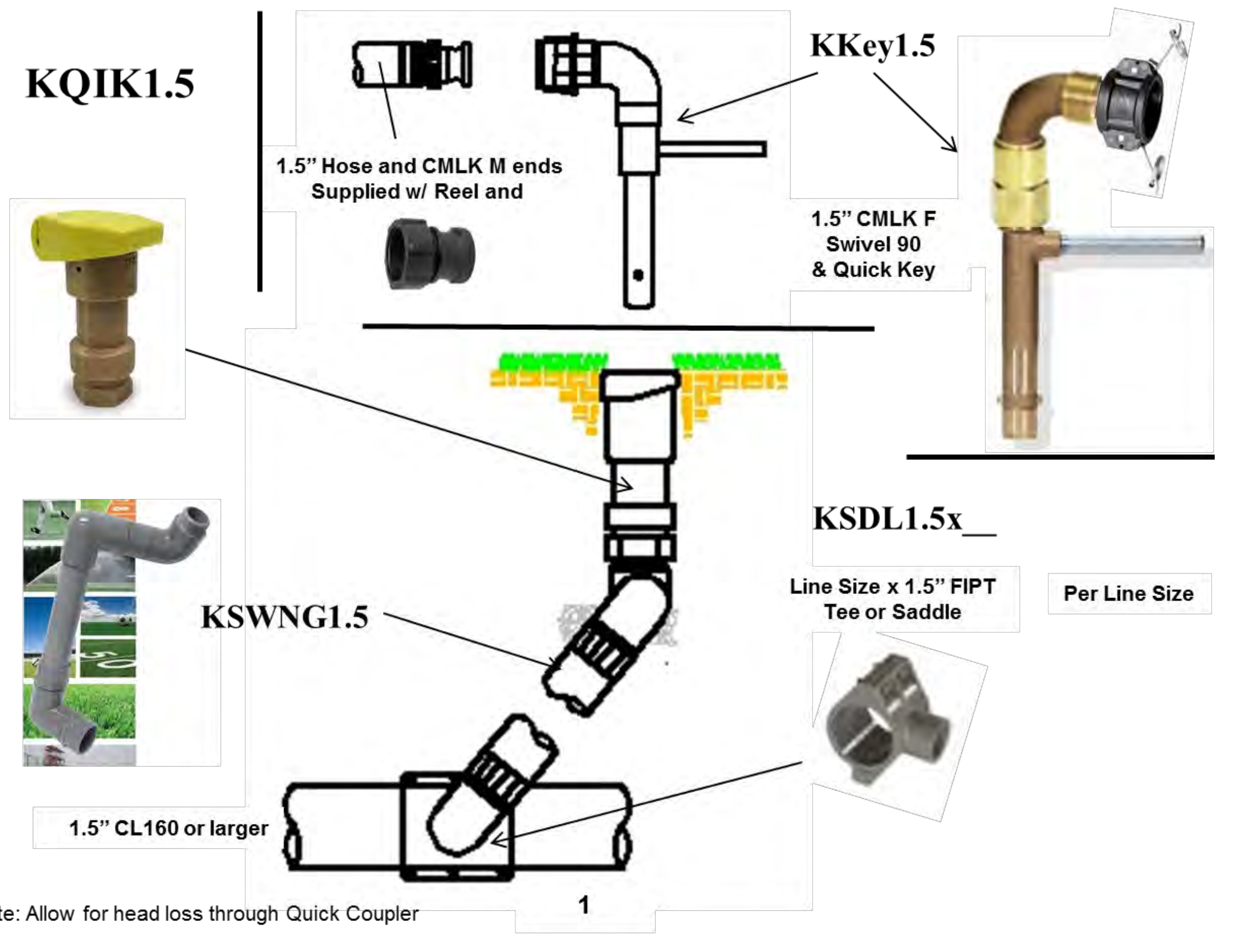


20 – 23 hrs /day operation w two 30 minute visits per day

Details in Installation - For Water-Reel Models B110 & E110

KSTB1.5Q Details

Isolation valve and French drain
recommended for use in freezing temperatures.



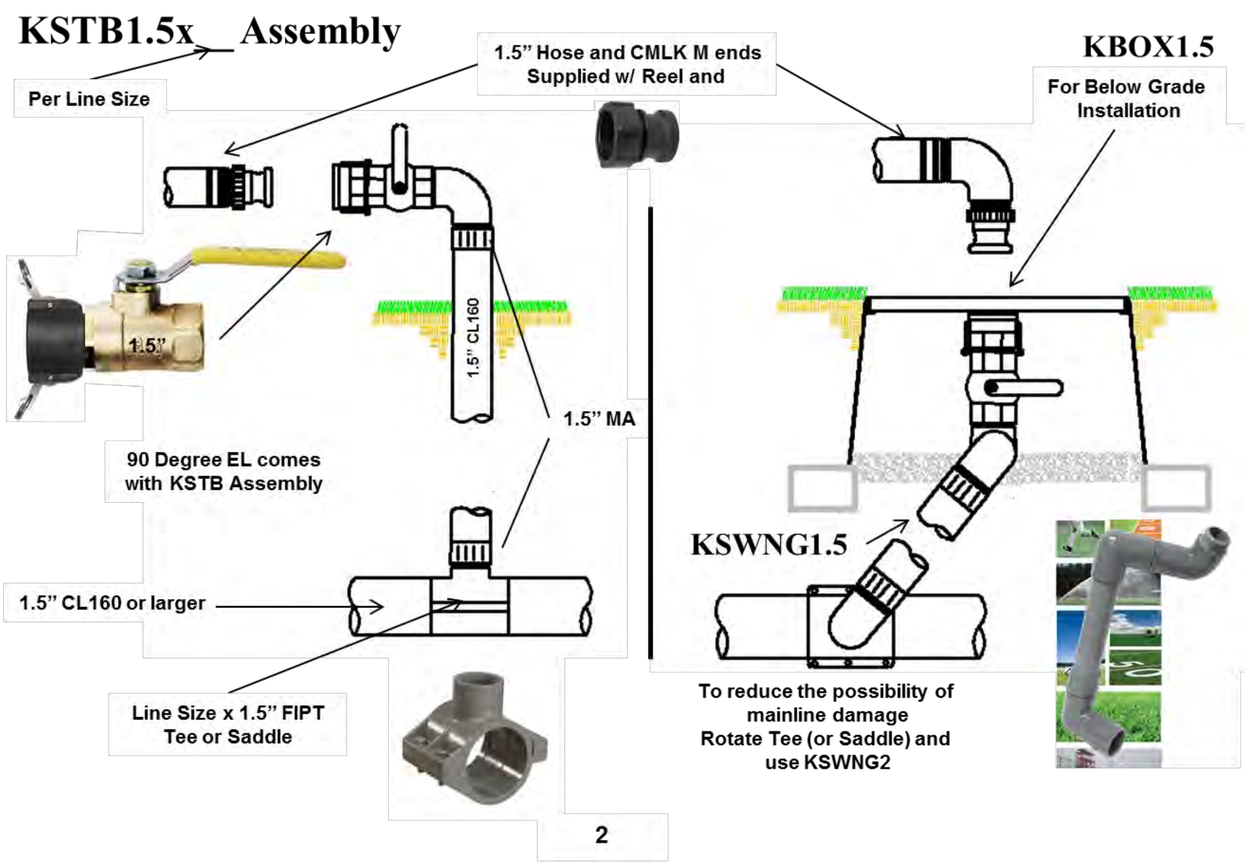
KSTB1.5Q

Note: Allow for head loss through Quick Coupler

Details in Installation - For Water-Reel Models B110, E110, B140 & E140

KSTB1.5 Details

Isolation valve and French drain
recommended for use in freezing temperatures.

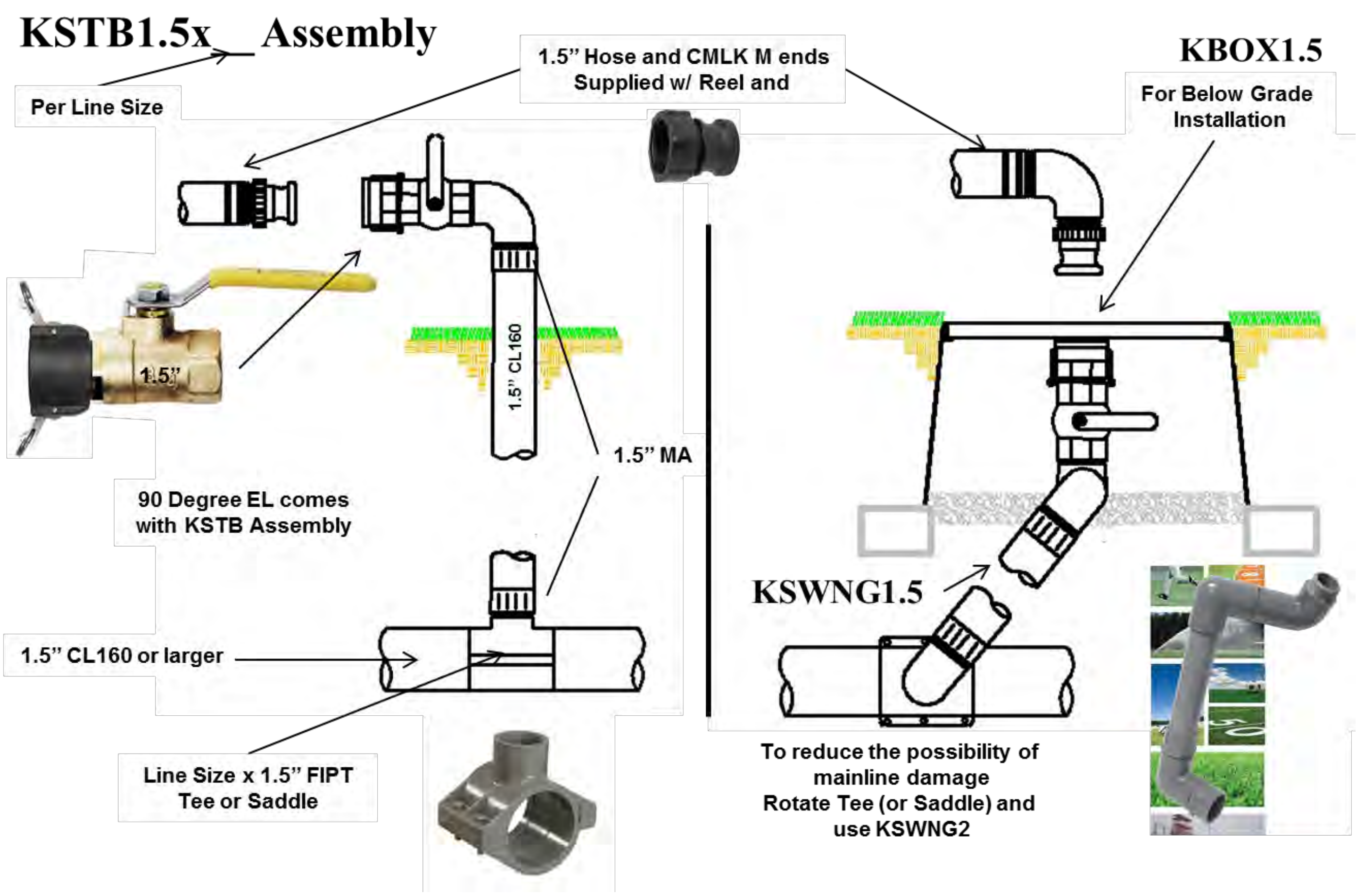


KSTB1.5

Details in Installation - For Water-Reel Models B110, E110, B140 & E140

KSTB1.5 Details

Isolation valve and French drain
recommended for use in freezing temperatures.

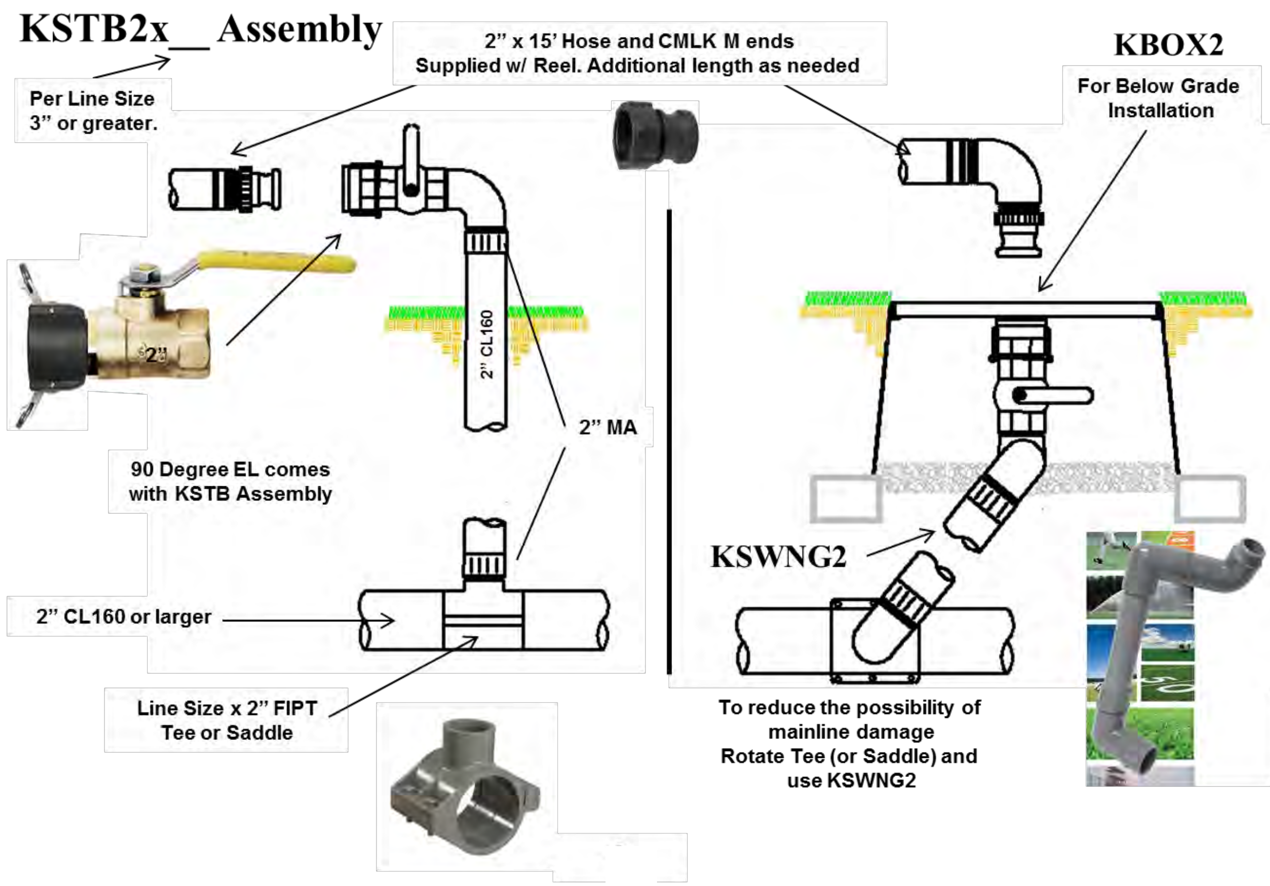


KSTB1.5

Details in Installation - For Water-Reel Models T180, T200S, T200L & T210

KSTB2 Details

Isolation valve and french drain
recommended for use in freezing temperatures.



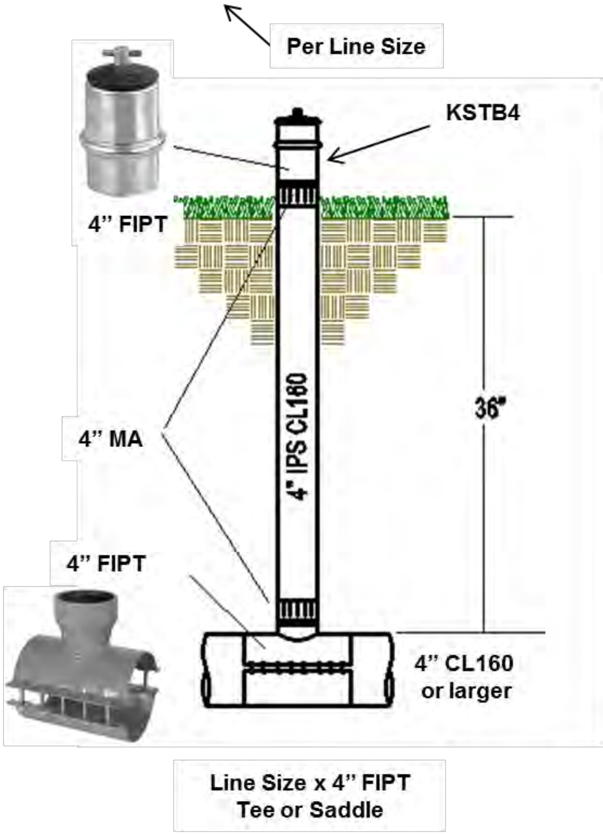
KSTB2

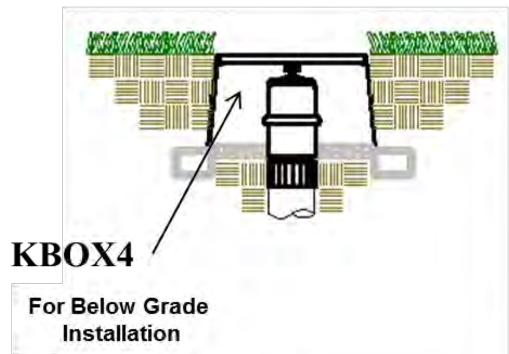
Details in Installation - For Water-Reel Models T200L, T210, T23x600, T27x980, T30x660, T30x980, T30x1200 & T33x1120

STUB4 Details

Isolation valve and French drain
recommended for use in freezing temperatures.

KSTB4x__ Assembly





KSWNG4x__ ← Per Line Size

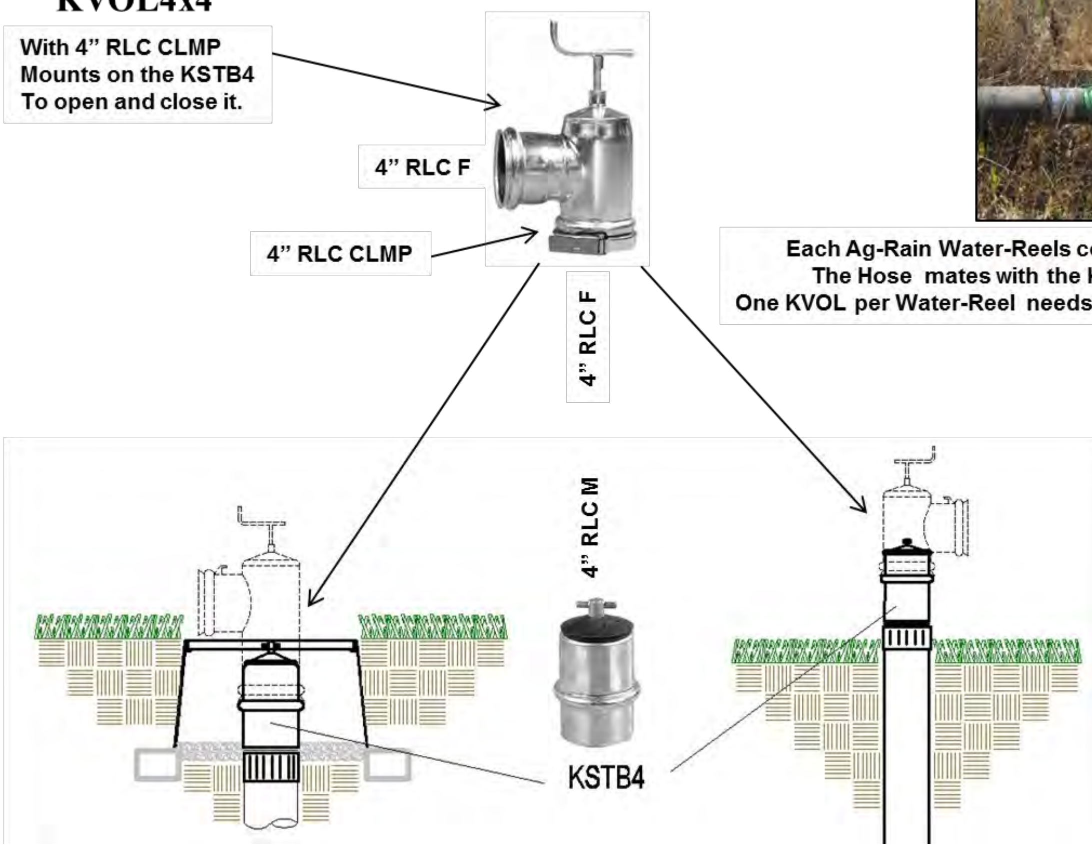
KSTB4

Details in Installation - For Water-Reel Models T23x600, T27x980, T30x660, T30x980, T30x1200 & T33x1120

KVOL4x4 Details

Isolation valve and French drain
recommended for use in freezing temperatures.

KVOL4x4



Each Ag-Rain Water-Reels come with a 30’ Hose .
The Hose mates with the KVOL and the Reel
One KVOL per Water-Reel needs to be ordered separately.

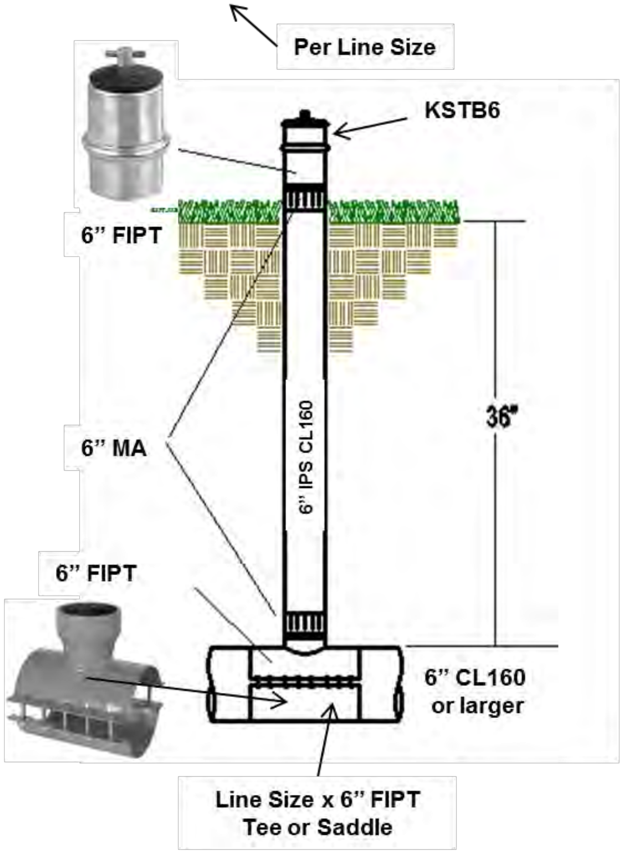
KVOL6x6

Details in Installation - For Water-Reel Models T37x1080, T37x1220, T40x1240, T40x1320, T41x1575, T45x1150, T45x1320

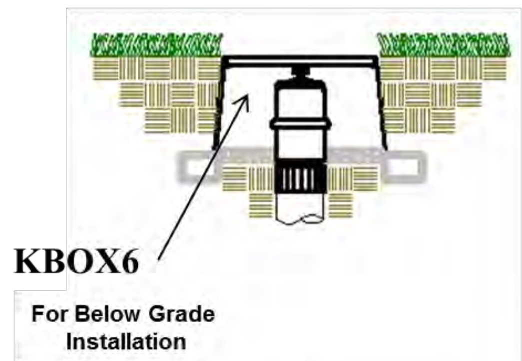
KSTB6 Details

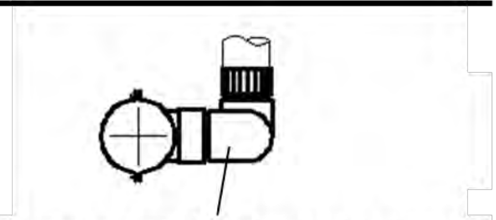
Isolation valve and French drain
recommended for use in freezing temperatures.

KSTB6x__ Assembly



Options





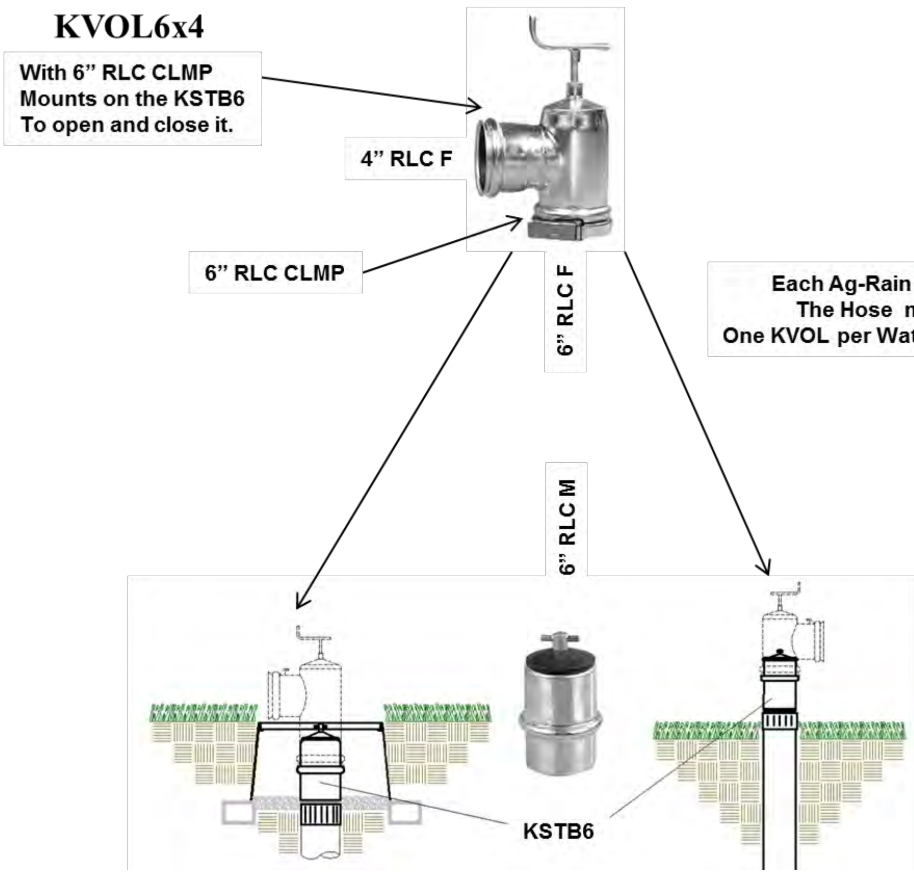
KSWNG6x__ ← Per Line Size

KSTB6

Details in Installation

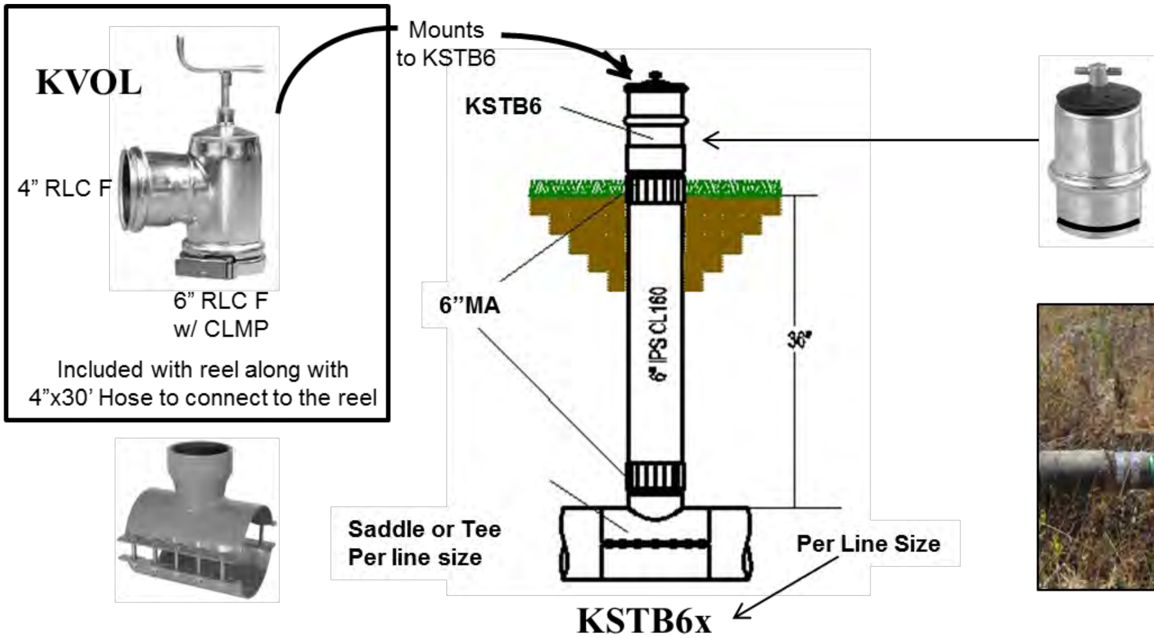
VOL6x4 Details

Isolation valve and French drain
recommended for use in freezing temperatures.



Each Ag-Rain Water-Reels come with a 30' Hose .
The Hose mates with the KVOL and the Reel
One KVOL per Water-Reel needs to be ordered separately.

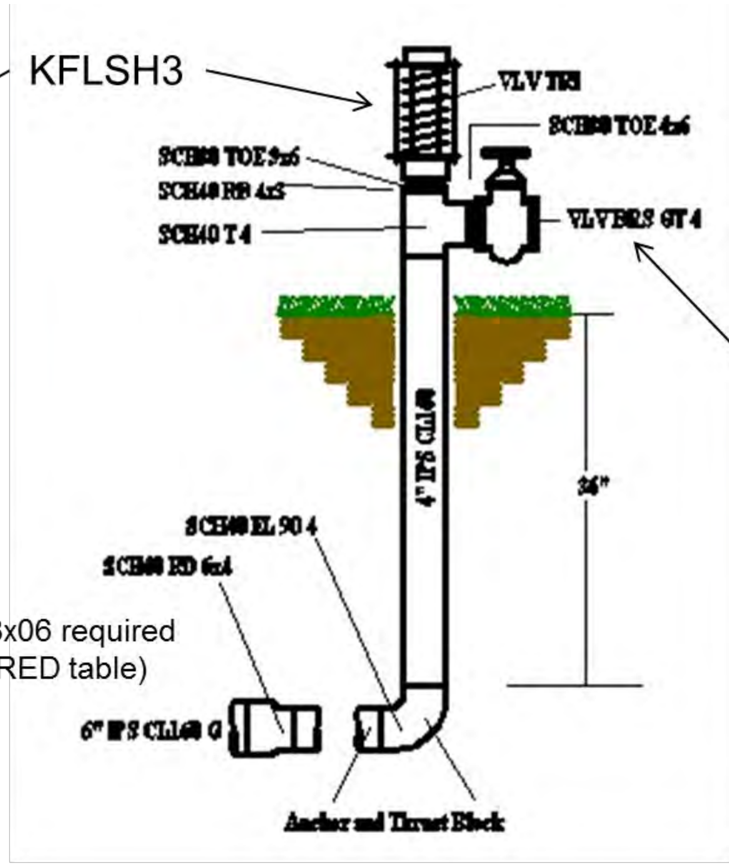
Details in Installation



Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA	
KSTB6x06	**3**	3	0	0	0	Tee
KSTB6x08	**41**	10	5	12	14	Saddle
KSTB6x10	**32**	11	5	2	14	Saddle
KSTB6x12	**8**	2	6	0	0	Saddle
KSTB6x15	**0**	0	0	0	0	Saddle
Total	**84**	26	16	14	28	

KSTB

Details in Installation



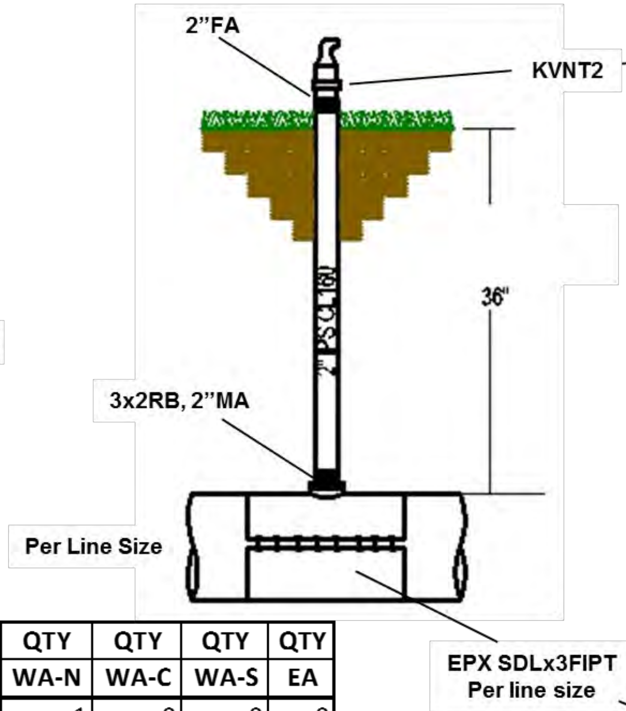
KVNT

Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KFLSH3x06	8	3	1	2	2

Details in Installation

KVNT2x__

Per Line Size



Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KVNT2x06	**1**	1	0	0	0
KVNT2x08	**8**	3	1	0	4
KVNT2x10	**4**	0	1	0	3
KVNT2x12	**1**	0	1	0	0
KVNT2x15	**0**	0	0	0	0
Total	**14**	**4**	**3**	**0**	**7**

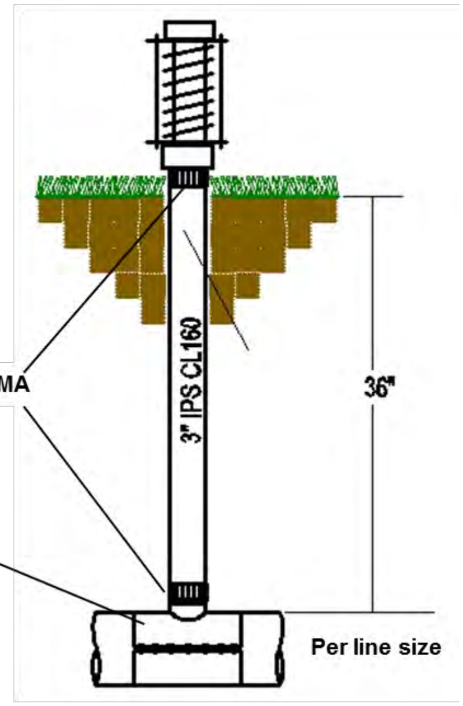
Details in Installation

KTAV

KTAV__

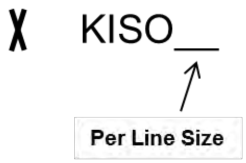
Per Line Size

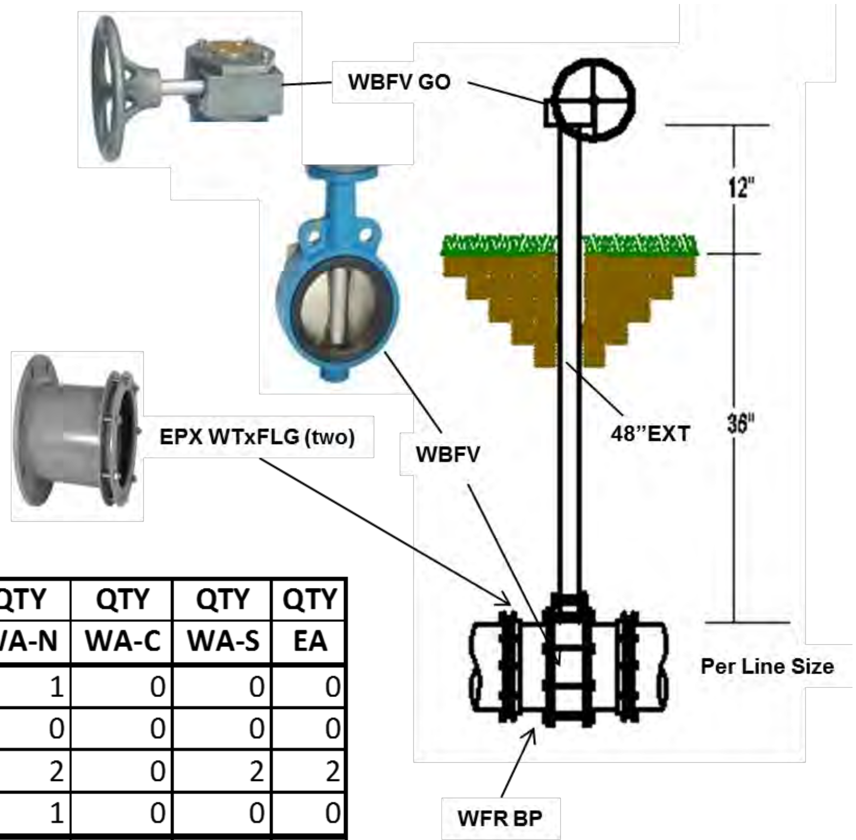
EPX SDLx3FIPT
Per line size



Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KTAV06	0	0	0	0	0
KTAV08	**0**	0	0	0	0
KTAV10	**5**	3	0	2	0
KTAV12	**4**	1	1	0	2
KTAV15	**0**	0	0	0	0
Total	**9**	4	1	2	2

Details in Installation





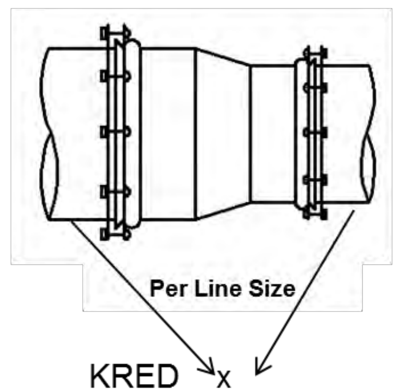
Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KISO6	1	1	0	0	0
KISO8	0	0	0	0	0
KISO10	6	2	0	2	2
KISO12	1	1	0	0	0
Total	8	4	0	2	2

Details in Installation

Spare Repair Couplers

Field Assemblies	QTY TTL
KCPLG06	1
KCPLG08	3
KCPLG10	3
KCPLG12	2
KCPLG15	1
Sub-Total	10

Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KRED08x06	7	2	1	2	2
KRED10x08	8	3	1	2	2
KRED12x10	4	1	1	0	2
KRED15x12	0	0	0	0	0
Sub-Total	19				



Details in Installation

Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KT06	1	1	0	0	0
KT10	2	0	0	1	1
KT12	1	1			
KT15	0	0	0	0	0
KT15x06	0	0	0	0	0
Sub-total	4				

Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KL90-08	1	0	0	0	1
KL90-10	2	1	1	0	0
KL90-12	5	1	2	1	1
KL90-15	0	0	0	0	0
Sub-Total	8				

Field Assemblies	QTY TTL	QTY WA-N	QTY WA-C	QTY WA-S	QTY EA
KL22-06	1	1	0	0	0
KL22-08	0	0	0	0	0
KL22-10	3				3
KL45-08	0	0	0	0	0
KL45-10	4	0	0	0	4
Sub-Total	8				

Efficiency Tables

Net PET (in.day)	Cool Humid	Cool Dry	Warm Humid	Warm Dry	Hot Humid	Windy Hot Humid	Hot Arid	Windy Hot Arid
Max Yield	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45
90% Yield	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.44
50% Yield	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.43
20% Yield	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.42
Sustain only	0.06	0.11	0.16	0.21	0.26	0.31	0.36	0.41

Decrease by reliable beneficial precipitation
in Peak Use frequency window divided by # of days in frequency

Efficency (%)	Subsurface Dri	Surface Drip	Pivot	Water-Reel	Solid Set Perminate	Solid Set Temp	Surface
Well Managed	95%	90%	80%	80%	75%	70%	65%
Managed	90%	85%	75%	75%	70%	65%	60%
Poorly Managed	80%	75%	70%	72%	65%	60%	55%
Not Managed	65%	65%	65%	65%	60%	55%	50%

Devide Net PET by Effiency to get Gross PET

Crop	Factor @ PET	Crop	Factor @ PET	Crop	Factor @ PET
Safflower	1.2	Coffee	0.9	Castor beans	0.8
Potatoes	1.2	Tea	0.9	guar	0.8
Sweet Corn	1.2	peas	0.9	cotton	0.8
Barley	1.1	Almonds	0.9	Flax	0.8
Cantalope	1.1	Apples	0.9	Sugar Beets	0.8
Surgum	1.1	Apricots	0.9	Grapes	0.7
Wheat	1.1	Bananas	0.9	Soybean	0.7
Berries	1.1	Cherries	0.9	Citrus	0.6
onions dry	1.1	Peaches	0.9	Broccli	0.6
Sugar Cane	1.1	Pears	0.9	Cabbage	0.6
Alfalfa	1.0	Pecans	0.9	Carrots	0.6
Pumpkin	1.0	Plums	0.9	Caulflower	0.6
sesbania	1.0	Strawberries	0.9	Onions Green	0.6
Turf Grass	1.0	Walnuts	0.9	Lettus	0.4
Bermuda Grass	0.9	Blue Panic Grass	0.8	non production pasture	0.3

Design PET (design depth) = (Net PET (reference PET) x Crop Factor) ÷ Efficiency

Less beneficial precipitation

Common Water Reel Applications with Suggested Models

Efficiency Tables

Design PET			Operating Hours per Day								
Gross Application			22	20	18	16	14	12	10	8	6
in/day	in/wk	in/2 wks	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac
0.02	0.14	0.28	0.41	0.45	0.50	0.57	0.65	0.75	0.91	1.13	1.51
0.04	0.28	0.56	0.82	0.91	1.01	1.13	1.29	1.51	1.81	2.26	3.02
0.04	0.28	0.56	0.82	0.91	1.01	1.13	1.29	1.51	1.81	2.26	3.02
0.06	0.42	0.84	1.23	1.36	1.51	1.70	1.94	2.26	2.72	3.39	4.53
0.08	0.56	1.12	1.65	1.81	2.01	2.26	2.59	3.02	3.62	4.53	6.03
0.10	0.7	1.4	2.06	2.26	2.51	2.83	3.23	3.77	4.53	5.66	7.54
0.12	0.84	1.68	2.47	2.72	3.02	3.39	3.88	4.53	5.43	6.79	9.05
0.14	0.98	1.96	2.88	3.17	3.52	3.96	4.53	5.28	6.34	7.92	10.56
0.16	1.12	2.24	3.29	3.62	4.02	4.53	5.17	6.03	7.24	9.05	12.07
0.18	1.26	2.52	3.70	4.07	4.53	5.09	5.82	6.79	8.15	10.18	13.58
0.20	1.4	2.8	4.11	4.53	5.03	5.66	6.46	7.54	9.05	11.31	15.08
0.22	1.54	3.08	4.53	4.98	5.53	6.22	7.11	8.30	9.96	12.44	16.59
0.24	1.68	3.36	4.94	5.43	6.03	6.79	7.76	9.05	10.86	13.58	18.10
0.26	1.82	3.64	5.35	5.88	6.54	7.35	8.40	9.80	11.77	14.71	19.61
0.28	1.96	3.92	5.76	6.34	7.04	7.92	9.05	10.56	12.67	15.84	21.12
0.30	2.1	4.2	6.17	6.79	7.54	8.48	9.70	11.31	13.58	16.97	22.63
0.32	2.24	4.48	6.58	7.24	8.04	9.05	10.34	12.07	14.48	18.10	24.13
0.34	2.38	4.76	6.99	7.69	8.55	9.62	10.99	12.82	15.39	19.23	25.64
0.36	2.52	5.04	7.40	8.15	9.05	10.18	11.64	13.58	16.29	20.36	27.15
0.38	2.66	5.32	7.82	8.60	9.55	10.75	12.28	14.33	17.20	21.49	28.66
0.40	2.8	5.6	8.23	9.05	10.06	11.31	12.93	15.08	18.10	22.63	30.17
0.42	2.94	5.88	8.64	9.50	10.56	11.88	13.58	15.84	19.01	23.76	31.68
0.44	3.08	6.16	9.05	9.96	11.06	12.44	14.22	16.59	19.91	24.89	33.18
0.46	3.22	6.44	9.46	10.41	11.56	13.01	14.87	17.35	20.82	26.02	34.69
0.48	3.36	6.72	9.87	10.86	12.07	13.58	15.51	18.10	21.72	27.15	36.20
0.50	3.5	7	10.28	11.31	12.57	14.14	16.16	18.85	22.63	28.28	37.71

Enter the left side of chart a the calculated Design PET
Follow the row to the right to the column noting the operating hours available read the gpm/ac at the intersection.
Multiply this value by the total number of acres to be irrigated to get required system flow.

If you have a know flow and you wish to determine the number of acres you can irrigate.
Divide the flow by the gpm/ac to determine the number of acres that can be irrigated.ame value

If you have a know flow and acreage and wish to determine how much water can be applied,
Devide the flow by the acres. Enter the chart at the available operating hours column.
Follow it down until you finde the gpm/ac value calculated.
Read the resulting application on the left side of that row.

Efficiency Tables

Head Loss & Velocity CL160 PVC

Pipe	1		1.5		2		3		4		6		8		10		12	
Dia	1.1		1.754		2.193		3.23		4.154		6.115		7.961		9.924		11.774	
GPM	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'
1	0.28	0.02																
2	0.57	0.06																
3	0.85	0.14																
4	1.14	0.23																
5	1.44	0.36	0.66	0.05	0.42	0.02												
10	2.88	1.30	1.32	0.20	0.84	0.07	0.39	0.01										
15	4.61	3.11	1.99	0.42	1.27	0.14	0.58	0.02										
20	5.77	4.71	2.65	0.71	1.69	0.24	0.78	0.04	0.47	0.01								
25			3.31	1.08	2.12	0.37	0.97	0.06	0.54	0.02								
30			3.97	1.50	2.54	0.51	1.17	0.08	0.70	0.02								
35			4.64	2.00	2.96	0.68	1.36	0.10	0.82	0.03								
40			5.30	2.56	3.39	0.86	1.56	0.13	0.94	0.04								
45					3.81	1.08	1.75	0.16	1.06	0.05								
50					4.24	1.31	1.95	0.20	1.18	0.06								
55					4.66	1.56	2.15	0.24	1.30	0.07								
60					5.09	1.83	2.34	0.28	1.41	0.08								
65							2.54	0.32	1.53	0.09								
70							2.73	0.37	1.65	0.11								
75							2.93	0.42	1.77	0.12								
80							3.12	0.47	1.89	0.14								
85							3.32	0.53	2.00	0.16								
90							3.51	0.59	2.12	0.17								
95							3.71	0.65	2.24	0.19								
100							3.91	0.72	2.36	0.21	1.09	0.03						
110							4.30	0.86	2.60	0.25	1.20	0.04						
120							4.69	1.01	2.83	0.30	1.30	0.05						
130							5.08	1.17	3.07	0.34	1.41	0.05						
140									3.31	0.39	1.52	0.06						
150									3.54	0.45	1.63	0.07						
160									3.78	0.50	1.74	0.08						
170									4.01	0.56	1.85	1.09						
180									4.25	0.63	1.96	0.10						
190									4.49	0.69	2.07	0.11						
200									4.72	0.76	2.18	0.12	1.28	0.03				
225									5.31	0.95	2.45	0.14	1.44	0.04				
250											2.72	0.18	1.60	0.05				
275											3.00	0.21	1.77	0.06				
300											3.27	0.25	1.93	0.07				
325											3.54	0.29	2.09	0.08				
350											3.81	0.33	2.25	0.09				
375											4.09	0.37	2.41	0.10				
400											4.36	0.42	2.57	0.12				
425											4.63	0.47	2.73	0.13				
450											4.90	0.52	2.89	0.14	1.86	0.05		
475											5.18	0.58	3.05	0.16	1.96	0.05		
500													3.21	0.18	2.07	0.06		
550													3.54	0.21	2.27	0.07		
600													3.86	0.25	2.48	0.08		
650													4.18	0.29	2.69	0.10		
700													4.50	0.33	2.89	0.11	2.06	0.05
750													4.82	0.37	3.10	0.13	2.20	0.06
800													5.15	0.42	3.31	0.14	2.35	0.06
850													5.47	0.47	3.52	0.16	2.50	0.07
900													5.79	0.52	3.72	0.18	2.65	0.08
950															3.93	0.20	2.79	0.09
1000															4.14	0.22	2.94	0.09
1050															4.34	0.02	3.09	0.10
1100															4.55	0.26	3.23	0.11
1150															4.76	0.28	3.38	0.12
1200															4.97	0.30	3.53	0.13
1250															5.17	0.33	3.68	0.14
1300															5.36	0.35	3.82	0.15
1350															5.59	0.38	3.97	0.16
1400															5.79	0.40	4.12	0.18
1450															6.00	0.43	4.27	0.19
1500															6.21	0.46	4.41	0.20
1550															6.42	0.49	4.56	0.21
1600															6.62	0.52	4.71	0.23
1650																	4.85	0.24
1700																	5.00	0.25
1750																	5.15	0.27
1800																	5.30	0.28
1850																	5.44	0.30
1900																	5.59	0.31
1950																	5.74	0.33
2000																	5.89	0.34
2100																	6.18	0.37
2200																	6.47	0.41
2300																	6.77	0.44
2400																	7.06	0.48
2500																	7.36	0.52

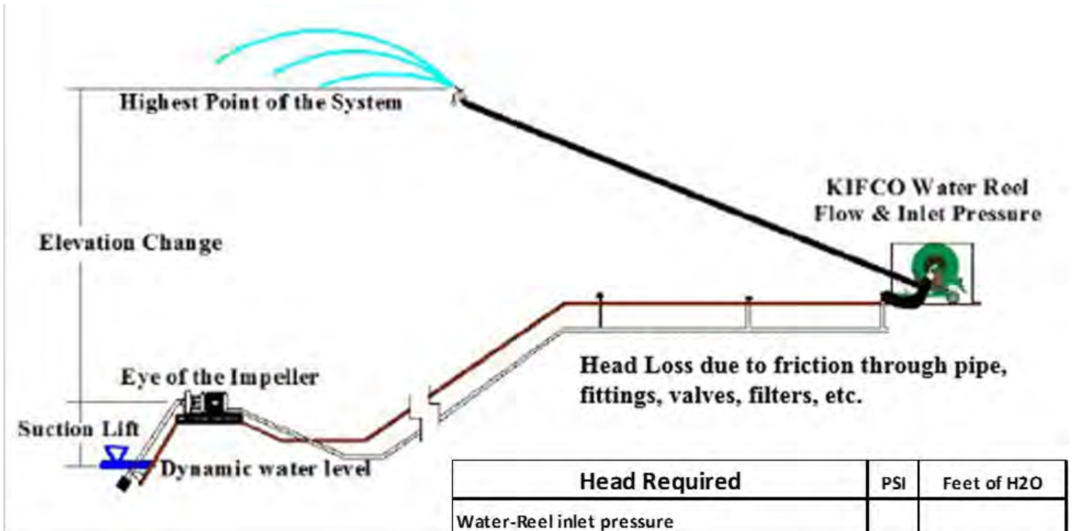
Efficiency Tables

Head Loss & Velocity MDPE SDR12

Pipe	1		1.5		1.8		2		2.1		2.3		2.7		3		3.3		3.7		4		4.5	
ID (in)	1.2	1.3	1.4	1.7	1.8	2.2	1.9	2.3	2.1	2.5	2.3	2.8	2.7	3.2	3.0	3.5	3.3	3.9	3.7	4.3	4.0	4.7	4.5	5.3
GPM	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'	FPS	PSI/C'
1	0.29	0.02																						
2	0.57	0.07	0.42	0.03																				
3	0.86	0.16	0.62	0.07	0.38	0.02																		
4	1.14	0.27	0.83	0.12	0.50	0.04	0.45	0.03																
5	1.43	0.40	1.04	0.19	0.63	0.05	0.57	0.04	0.46	0.03														
10	2.86	1.45	2.08	0.67	1.26	0.20	1.13	0.15	0.93	0.09	0.77	0.06												
15	4.29	3.07	3.12	1.42	1.89	0.42	1.70	0.32	1.39	0.20	1.16	0.13	0.84	0.06										
20	5.71	5.22	4.16	2.42	2.52	0.71	2.26	0.55	1.85	0.34	1.54	0.22	1.12	0.10	0.91	0.06								
25	7.14	7.90	5.20	3.65	3.15	1.08	2.83	0.83	2.31	0.51	1.93	0.33	1.40	0.15	1.13	0.09	0.94	0.06						
30	8.57	11.07	6.24	5.12	3.78	1.51	3.39	1.16	2.78	0.71	2.31	0.46	1.68	0.21	1.36	0.13	1.12	0.08						
35			7.29	6.81	4.41	2.01	3.96	1.54	3.24	0.95	2.70	0.61	1.96	0.28	1.59	0.17	1.31	0.11	1.04	0.06				
40			8.33	8.73	5.04	2.57	4.52	1.97	3.70	1.21	3.09	0.78	2.24	0.36	1.81	0.21	1.50	0.13	1.19	0.08	1.02	0.05		
45			9.37	10.85	5.67	3.19	5.09	2.46	4.16	1.51	3.47	0.97	2.52	0.44	2.04	0.27	1.69	0.17	1.34	0.10	1.15	0.07	0.91	0.04
50			10.41	13.19	6.30	3.88	5.65	2.98	4.63	1.83	3.86	1.18	2.80	0.54	2.27	0.32	1.87	0.20	1.49	0.12	1.28	0.08	1.01	0.04
55			11.45	15.74	6.93	4.63	6.22	3.56	5.09	2.19	4.24	1.41	3.08	0.64	2.49	0.39	2.06	0.24	1.64	0.14	1.40	0.10	1.11	0.05
60			12.49	18.49	7.56	5.44	6.78	4.18	5.55	2.57	4.63	1.65	3.36	0.76	2.72	0.45	2.25	0.29	1.79	0.16	1.53	0.11	1.21	0.06
65			13.53	21.44	8.19	6.31	7.35	4.85	6.01	2.98	5.01	1.92	3.64	0.88	2.95	0.53	2.44	0.33	1.94	0.19	1.66	0.13	1.31	0.07
70			14.57	24.60	8.81	7.24	7.91	5.57	6.48	3.42	5.40	2.20	3.92	1.01	3.17	0.60	2.62	0.38	2.09	0.22	1.79	0.15	1.41	0.08
75			15.61	27.95	9.44	8.23	8.48	6.32	6.94	3.89	5.78	2.50	4.20	1.14	3.40	0.69	2.81	0.43	2.24	0.25	1.91	0.17	1.51	0.10
80			16.65	31.50	10.07	9.27	9.04	7.13	7.40	4.38	6.17	2.81	4.48	1.29	3.63	0.77	3.00	0.49	2.38	0.28	2.04	0.19	1.61	0.11
85					10.70	10.37	9.61	7.97	7.86	4.90	6.56	3.15	4.76	1.44	3.85	0.86	3.18	0.54	2.53	0.31	2.17	0.21	1.71	0.12
90					11.33	11.53	10.17	8.87	8.33	5.45	6.94	3.50	5.04	1.60	4.08	0.96	3.37	0.60	2.68	0.35	2.30	0.24	1.81	0.13
95					11.96	12.75	10.74	9.80	8.79	6.02	7.33	3.87	5.32	1.77	4.31	1.06	3.56	0.67	2.83	0.38	2.42	0.26	1.91	0.15
100					12.59	14.02	11.30	10.78	9.25	6.62	7.71	4.25	5.60	1.95	4.53	1.17	3.75	0.73	2.98	0.42	2.55	0.29	2.01	0.16
110					13.85	16.72	12.43	12.86	10.18	7.90	8.48	5.07	6.16	2.33	4.99	1.39	4.12	0.88	3.28	0.50	2.81	0.34	2.22	0.19
120					15.11	19.65	13.56	15.10	11.10	9.28	9.26	5.96	6.72	2.73	5.44	1.64	4.50	1.03	3.58	0.59	3.06	0.40	2.42	0.23
130							14.69	17.52	12.03	10.76	10.03	6.91	7.28	3.17	5.89	1.90	4.87	1.19	3.87	0.68	3.32	0.47	2.62	0.26
140							15.82	20.09	12.95	12.35	10.80	7.93	7.84	3.63	6.35	2.18	5.25	1.37	4.17	0.78	3.57	0.54	2.82	0.30
150							16.95	22.83	13.88	14.03	11.57	9.01	8.40	4.13	6.80	2.47	5.62	1.56	4.47	0.89	3.83	0.61	3.02	0.34
160											12.34	10.16	8.95	4.65	7.25	2.79	5.99	1.75	4.77	1.00	4.08	0.69	3.22	0.39
170											13.11	11.36	9.51	5.21	7.71	3.12	6.37	1.96	5.07	1.12	4.34	0.77	3.43	0.43
180											13.88	12.63	10.07	5.79	8.16	3.47	6.74	2.18	5.36	1.25	4.59	0.86	3.63	0.48
190													10.63	6.40	8.61	3.83	7.12	2.41	5.66	1.38	4.85	0.95	3.83	0.53
200													11.19	7.04	9.07	4.21	7.49	2.65	5.96	1.52	5.10	1.04	4.03	0.59
225													12.59	8.75	10.20	5.24	8.43	3.30	6.71	1.89	5.74	1.29	4.53	0.73
250															11.33	6.37	9.37	4.01	7.45	2.30	6.38	1.57	5.04	0.89
275															12.47	7.60	10.30	4.78	8.20	2.74	7.01	1.87	5.54	1.06
300															13.60	8.93	11.24	5.62	8.94	3.22	7.65	2.20	6.04	1.24
325															14.73	10.36	12.18	6.51	9.69	3.73	8.29	2.55	6.55	1.44
350															15.87	11.88	13.11	7.47	10.43	4.28	8.93	2.93	7.05	1.65
375																			11.18	4.86	9.56	3.33	7.56	1.88
400																			11.92	5.48	10.20	3.75	8.06	2.12
425																			12.67	6.13	10.84	4.20	8.56	2.37
450																			13.41	6.82	11.48	4.67	9.07	2.63
475																			14.16	7.54	12.11	5.16	9.57	2.91
500																					12.75	5.67	10.07	3.20
550																					14.03	6.77	11.08	3.81
600																							12.09	4.48
650																							13.10	5.20
700																							14.10	5.96

Add 15 PSI for Turbine loss
Add 15 PSI for HPSV loss

Efficiency Tables



Head Required	PSI	Feet of H2O
Water-Reel inlet pressure		
Turbine Loss		
HPSV Loss		
Elevation gain or Loss		
Lift gain or loss		
Head loss due to flow through pipe		
Headloss due to fittings		
Head loss due to screens and filters		
Head loss due to valves, etc.		
TDH		

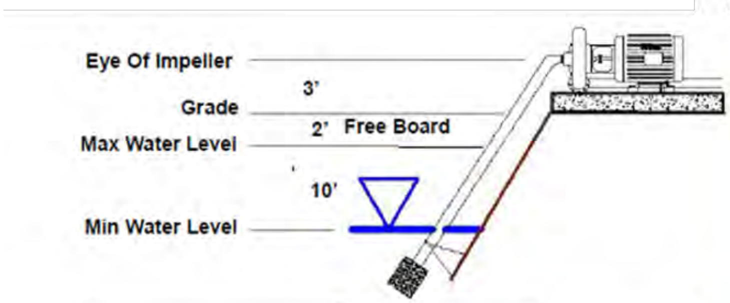
HP = (TDH x Q) ÷ (EFF x 3960)

HP = Horse Power
Required at pump shaft

TDH = Total Dynamic Head
in ft of H_2O

Q = Total system flow in GPM

EFF = Pump efficiency at this performance poin



	PSI	Feet of Water
Lift		
Entrance Loss		
Exit Loss		
Fitting Loss		
Filter /screen Loss		
Head loss through Pipe		
NPSH Losses		

Elevation ABSL (ft)	Pressure (PSI)	Pressure Ft of H_2O
0	14.7	33.9
500	14.43	33.3
1000	14.17	32.7
1500	13.91	32.1
2000	13.66	31.5
2500	13.41	31.0
3000	13.17	30.4
3500	12.93	29.9
4000	12.69	29.3
4500	12.46	28.8
5000	12.23	28.2
5500	12	27.7
6000	11.77	27.2
6500	11.55	26.7
7000	11.34	26.2
7500	11.13	25.7
8000	10.91	25.2
8500	10.71	24.7
9000	10.5	24.2
9500	10.3	23.8
10000	10.1	23.3
10500	9.91	22.9
11000	9.72	22.4
11500	9.53	22.0
12000	9.34	21.6
12500	9.16	21.2
13000	8.99	20.8
13500	8.81	20.3
14000	8.63	19.9
14500	8.46	19.5
15000	8.29	19.1

Efficiency Tables

BHP = Horse Power Required at the Pump Shaft

CHP = Continuous Horse Power provided by the drive engine or electric motor

IHP = Intermitent Horse Power of drive engine or electric motor

Engine CHP < IHP, The relation ship between CHP & IHP is not constant.

Increase BHP by the transfer loss percentage below.

Power plants for Irrigation Pumps should be sized using CHP not IHP

CHP should be provided by MFG as per standard testing.

Published engine CHP typically need to be derated for:

Accessories: - 10 % w/o fan, -15% w fan

Elevation: -3% per 1000' > 3000'ABSL for non-turbo; 0% for engine with turbo

Temperature: -1% per 10 °F > 85 °F w Turbo; -1% per 5 °F > 85°F wo Turbo

All horsepowers should be at the required RPM

Transfer Loss	
SAE Couple	1.0%
Close Coupled	0.5%
Frame & Coupling	2.0%
PTO	3.0%
Belts & Pulleys	3-7%
VHS Motor	0.5%
RAG	3.0%
Extended PTO shaft	+
Vertical Shaft	+

+ Consult MFG

The drive Engine (or motor) CHP after de-rating should be greater than the BHP plus transfer loss.

Specifying Water-Reels: Consumptive Use Method

To size a machine inquire what depth of water is to be applied and how many hours a day they will run. Use the corresponding gpm/acre figure multiplied by the total acres to determine the required flow. If the referenced depth used was a net value, divide by the efficiency. If the crop has a crop factor other than one, multiply by the crop factor. It is important to discuss operating hours with the client. Flow rate and capital cost of the system increase dramatically with a decrease in operating hours.

PET Crop Factor = 1			Operating Hours per Day								
	Gross ET		22	20	18	16	14	12	10	8	6
in/day	in/wk	in/2 wks	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac	gpm/ac
0.02	0.14	0.28	0.41	0.45	0.50	0.57	0.65	0.75	0.91	1.13	1.51
0.04	0.28	0.56	0.82	0.91	1.01	1.13	1.29	1.51	1.81	2.26	3.02
0.04	0.28	0.56	0.82	0.91	1.01	1.13	1.29	1.51	1.81	2.26	3.02
0.06	0.42	0.84	1.23	1.36	1.51	1.70	1.94	2.26	2.72	3.39	4.53
0.08	0.56	1.12	1.65	1.81	2.01	2.26	2.59	3.02	3.62	4.53	6.03
0.10	0.7	1.4	2.06	2.26	2.51	2.83	3.23	3.77	4.53	5.66	7.54
0.12	0.84	1.68	2.47	2.72	3.02	3.39	3.88	4.53	5.43	6.79	9.05
0.14	0.98	1.96	2.88	3.17	3.52	3.96	4.53	5.28	6.34	7.92	10.56
0.16	1.12	2.24	3.29	3.62	4.02	4.53	5.17	6.03	7.24	9.05	12.07
0.18	1.26	2.52	3.70	4.07	4.53	5.09	5.82	6.79	8.15	10.18	13.58
0.20	1.4	2.8	4.11	4.53	5.03	5.66	6.46	7.54	9.05	11.31	15.08
0.22	1.54	3.08	4.53	4.98	5.53	6.22	7.11	8.30	9.96	12.44	16.59
0.24	1.68	3.36	4.94	5.43	6.03	6.79	7.76	9.05	10.86	13.58	18.10
0.26	1.82	3.64	5.35	5.88	6.54	7.35	8.40	9.80	11.77	14.71	19.61
0.28	1.96	3.92	5.76	6.34	7.04	7.92	9.05	10.56	12.67	15.84	21.12
0.30	2.1	4.2	6.17	6.79	7.54	8.48	9.70	11.31	13.58	16.97	22.63
0.32	2.24	4.48	6.58	7.24	8.04	9.05	10.34	12.07	14.48	18.10	24.13
0.34	2.38	4.76	6.99	7.69	8.55	9.62	10.99	12.82	15.39	19.23	25.64
0.36	2.52	5.04	7.40	8.15	9.05	10.18	11.64	13.58	16.29	20.36	27.15
0.38	2.66	5.32	7.82	8.60	9.55	10.75	12.28	14.33	17.20	21.49	28.66
0.40	2.8	5.6	8.23	9.05	10.06	11.31	12.93	15.08	18.10	22.63	30.17
0.42	2.94	5.88	8.64	9.50	10.56	11.88	13.58	15.84	19.01	23.76	31.68
0.44	3.08	6.16	9.05	9.96	11.06	12.44	14.22	16.59	19.91	24.89	33.18
0.46	3.22	6.44	9.46	10.41	11.56	13.01	14.87	17.35	20.82	26.02	34.69
0.48	3.36	6.72	9.87	10.86	12.07	13.58	15.51	18.10	21.72	27.15	36.20
0.50	3.5	7	10.28	11.31	12.57	14.14	16.16	18.85	22.63	28.28	37.71

Sometimes the term Supplemental Watering is used to justify values below the calculated required flow. In this case the producer should be advised without precipitation the system cannot sustain production.

Metric to US Conversions

- Millimeters (mm) x 0.03937 = inches (") (in)
- Centimeters (cm) x 0.3937 = inches (") (in)
- Meters (m) x 39.37 = inches (") (in)
- Meters (m) x 3.281 = feet (') (ft)
- Meters (m) x 1.094 = yards (yds)
- Kilometers (km) x 0.62137 = miles (mi)
- Kilometers (km) x 3280.87 = feet (') (ft)
- Liters (1) x 0.2642 = gallons (U.S.) (gals)
- Liters (1) x 0.0353 = cubic feet
- Bars x 14.5038 = pounds per square inch (PSI)
- Kilograms (kg) x 2.205 = Pounds (P)
- Kilometers (km) x 1093.62 = yards (yds)
- Square centimeters x 0.155 = square inches
- Square meters x 10.76 = square feet
- Square kilometers x 0.386 = square miles
- Cubic centimeters x 0.06102 = cubic inches

Cubic meters x 35.315 = cubic feet

US to Metric Conversions

- Inches (") (in) x 25.4 = millimeters (mm)
- Inches (") (in) x 2.54 = centimeters (cm)
- Inches (") (in) x 0.0254 = meters (m)
- Feet (') (ft) x 0.3048 = meters (m)
- Yards (yds) x 0.9144 = meters (m)
- Miles (mi) x 1.6093 = kilometers (km)
- One mile = 5,280 feet (ft)
- Feet (') (ft) x 0.0003048 = kilometers (km)
- Gallons (gals) x 3.78 = liters (l)
- Cubic feet x 28.316 = liters (l)
- Pounds (P) x 0.4536 = kilograms (kg)
- Square inches x 6.452 = square centimeters
- Square feet x 0.0929 = square meters
- Square miles x 2.59 = square kilometers
- Acres x 4046.85 = square meters
- Cubic inches x 16.39 = cubic centimeters
- Cubic feet x 0.0283 = cubic meters

Useful Irrigation Formulas

<u>Water Measurement</u>

- 1 cubic foot = 7.48 gallons = 62.4 pounds of water
- 1 acre-foot = 43,560 cubic feet = 325,851 gallons = 12 acre-inches
- 1 acre-foot covers 1 acre of land 1 foot deep; 1 acre-inch = 27,154 gallons
- 1 cubic meter = 1,000 liters = 264.18 gallons
- 1 acre-inch = 450 gallons per minute (GPM)
- 1 gallon = 128 ounces = 3,785 milliliters = 8.33 pounds
- 1 pound = 454 grams

Useful Irrigation Formulas Continued:

Water Measurement

- 1 cubic foot = 7.48 gallons = 62.4 pounds of water
- 1 acre-foot = 43,560 cubic feet = 325,851 gallons = 12 acre-inches
- 1 acre-foot covers 1 acre of land 1 foot deep; 1 acre-inch = 27,154 gallons
- 1 cubic meter = 1,000 liters = 264.18 gallons

1 acre-inch / hour = 450 gallons per minute (GPM) or 1 cubic foot per second (cfs)

- 1 gallon = 128 ounces = 3,785 milliliters = 8.33 pounds

1 pound = 454 grams

Pressure

- 1 pound per square inch (psi) = 2.31
- Feet of head x .433 = psi

A column of water 2.31 feet deep exerts a pressure of 1 psi

feet of head = psi x 2.31

- Total Dynamic Head (TDH) includes: Pumping Lift, Elevation Change, Friction Loss and Irrigation System Operating Pressure

TDH = Lift + Elevation + Friction + System Pressure

Area/Length

1 acre = 0.405 hectare (ha) = 43,560 feet^2

Horsepower

Water Horsepower (WHP) – power required to lift a given quantity of water against a given total dynamic head

$$WHP = \frac{Q \times H}{3{,}960}$$

where: Q = flow rate, GPM; H = total dynamic head, feet

Brake Horsepower (BHP) – required power input at the pump

$$BHP = \frac{WHP}{E}$$

where: E = pump efficiency

Power Unit Horsepower

Electric Units: approximate name plate horsepower = BHP

Useful Irrigation Formulas Continued:

Internal combustion units:

20% for continuous duty
5% for right-angle drive
3% for each 1,000 feet above sea level
1% for each 10ºabove 60ºF

Approximate Engine
Horsepower Required = BHP / (0.80 x 0.95 x 0.91 x 0.96)

	0.80	0.95	0.91	0.96
	cont. duty	drive	3,000' elevation	100ºF

<u>Nebraska Performance Criteria (NPC)</u>

Energy source	WHp-hours per unit of fuel
Diesel	12.5 WHp-hrs per gallon
Propane	6.89 WHp-hrs per gallon
Natural Gas:	
925 BTU/ft³	61.7 WHp-hrs per 1,000 ft³ (MCF)
1,000 BTU/ft³	66.7 WHp-hrs per 1,000 ft³ (MCF)
Electric	0.885 WHp-hrs per kilowatt-hour

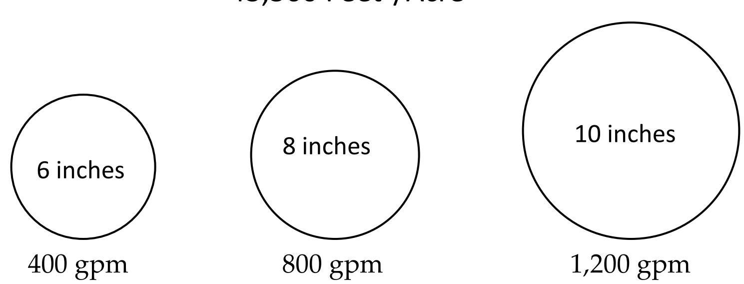
<u>Water Application</u>

Average Application (inches) = $\frac{Q\,T}{A}$

Where: Q = Flow Rate, Acre-Inches/Hour or GPM/450
T = Length of Application, Hours
A = Area Irrigated, Acres

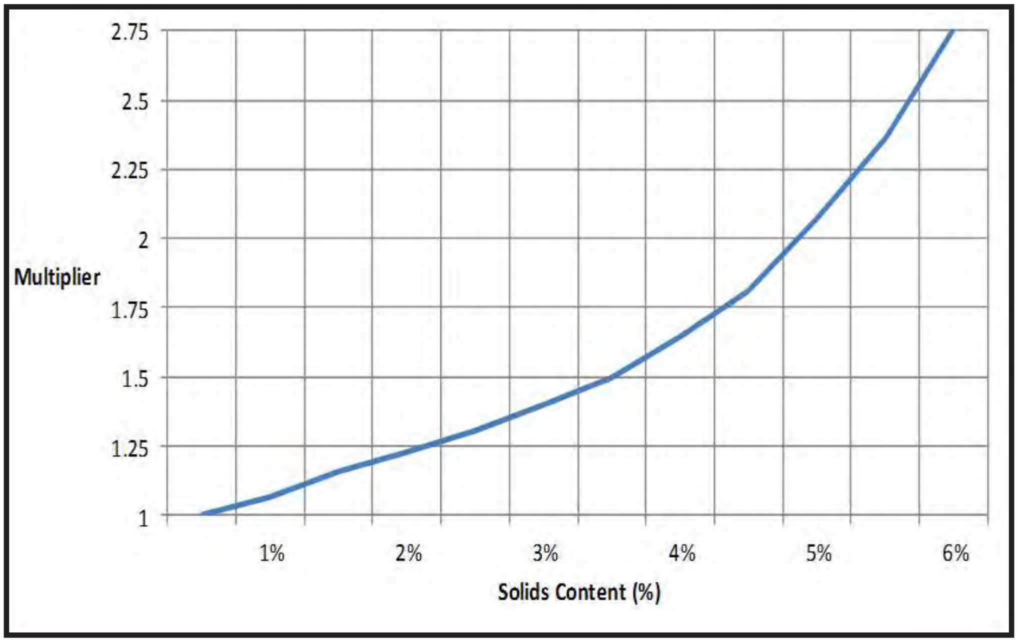
Set Size (Acres) is computed by the formula:

$$\frac{\text{No. of Rows x Width of Row (Feet) x Length of Run (Feet)}}{\text{43,560 Feet}^2\text{/Acre}}$$



Wastewater Friction Loss In Pipelines

The information contained in this bulletin gives a guide to the additional friction loss of water in pipelines due to solids content up to 6%



To Find Wastewater Friction Loss:

1. Calculate the standard friction loss for water.
2. Establish the solids content of wastewater.
3. Find the multiplier from graph above.
4. Friction loss for water x multiplier = wastewater friction loss.

Guide To Flow Characteristics