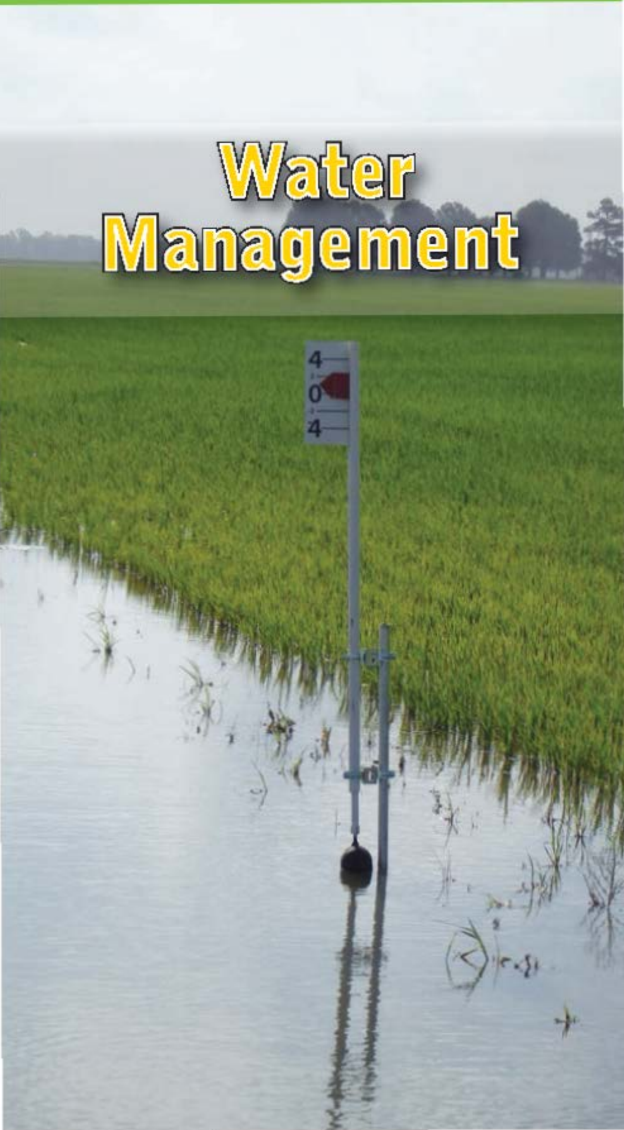
Water Management



Determining Water Needs

Recommended pumping rates for different soil textural groups

Soil Textural Group	(GPM/Acre)	
	Minimum	Desired
Silt Loam with pan	10	10
Sandy Loam	15	25
Silt Loam without pan	10	15
Clay and Silty Clay	15	20

General guide for irrigable acreage for different soil textural groups at various pump capacities

Pump Capacity (GPM)[1]	Irrigable Acreage			
	Silt Loam - with pan	Silt Loam - no pan	Clay and Silty Clay	Sandy Loam
400	40	27	20	16
600	60	40	30	24
800	80	53	40	32
1000	100	67	50	40
1200	120	80	60	48
1400	140	93	70	56
1600	160	107	80	64
1800	180	120	90	72
2000	200	133	100	80
2200	220	147	110	88
2400	240	160	120	96
2600	260	173	130	104
2800	280	187	140	112
3000	300	200	150	120

[1]GPM = gallons per minute

Determining Pump Flow

Hours of operating time to pump one acre-inch of water

Pump Capacity (GPM)[1]	Surface Acres							
	20	40	60	80	120	160	200	240
	Time (Hours)							
400	23	45	68	91				
800	11	23	34	45	68	91		
1200		15	23	30	45	60	76	91
1600		11	17	23	34	45	57	68
2000			14	18	27	36	45	54
2400			11	15	23	30	38	45
2800				13	19	26	32	39
3200				11	17	23	28	34
3600					15	20	25	30
4000					14	18	23	27
4400						17	21	25
4800							19	23

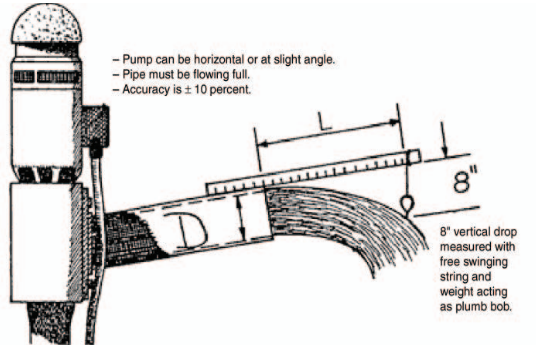
[1] GPM = gallons per minute

Water Volume and Flow Conversions and Equivalents

Volume	equals
1 gallon (gal)	8.33 pounds (lb)
1 cubic foot (ft^3)	7.48 gal
1 acre-foot (ac-ft)	325,851 gal
1 acre-inch (ac-in)	27,154 gal
1 ac-in	3,630 ft^3

Flow	equals
1 cubic foot per second (cfs)	448.83 gallons per minute (GPM)
1 cfs	1 ac-in per hour
1 GPM	0.00223 cfs
1 GPM	0.00221 ac-in per hour
1 liter/second (L/s)	15.83 GPM
1 cubic meter/minute (m^3/min)	264.2 GPM
1 cfs for 1 hour	1 ac-in
542 GPM for 1 hour	1 ac-in

Plumb-bob method for flow estimation
GPM = D × D × L



Pump Flow Calculated From Yardstick and 8-Inch Plumb Bob Measurements

Length (L)	Inside Diameter of Pipe (D) – Inches										
	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"	14"
Inches	Flow (GPM)										
	64	100	144	196	256	324	400	484	476	676	784
4	96	150	216	294	384	486	600	726	864	1014	1176
6	128	200	288	392	512	648	800	968	1152	1352	1568
8	160	250	360	490	640	810	1000	1210	1440	1690	1960
10	192	300	432	388	768	972	1200	1452	1728	2028	2352
12	224	350	504	686	896	1134	1400	1694	2016	2366	2744
14	256	400	576	784	1024	1296	1600	1936	2304	2704	3136
16	288	450	648	882	1152	1458	1800	2178	2592	3042	3428
18	320	500	720	980	1280	1620	2000	2420	2880	3380	3920
20	352	550	792	1078	1408	1782	2200	2662	3168	3718	4312
22	384	600	864	1176	1536	1944	2400	2904	3456	4056	4704
24	416	650	936	1274	1664	2106	2600	3146	3744	4394	5096
26	448	700	1008	1372	1792	2268	2800	3388	4032	4732	5488
28	480	750	1080	1470	1920	2430	3000	3630	4320	5070	5880
30	512	800	1152	1568	2048	2592	3200	3872	4608	5408	6272

General Rice Irrigation Water Quality

Water Quality Variable	Level Considered to Cause Concern[1]	Concern
Calcium (Ca)	> 60 ppm (> 3 meq/L)	Together cause soil pH increase near water inlet; cause Zn or P deficiency.
Bicarbonate (HCO_3)	> 305 ppm (> 5 meq/L)	
Electrical Conductivity (EC) [after lime deposition]	> 770 ppm (> 1,200 µmhos/cm)	Causes high soil salinity – can injure/kill seedling rice.
Chloride (Cl)	> 100 ppm (> 35 meq/L)	Contributes to measured EC. High Cl alone problem for soybeans.
Sodium Adsorption Rate (SAR)[2]	> 10	Causes sodic soil – poor physical condition.

[1] Lower levels can cause injury in some cases.
[2] SAR = Na √[(Ca + Mg)/2], where Na, Ca and Mg are in meq/L -

Water Quality Sampling and Analysis

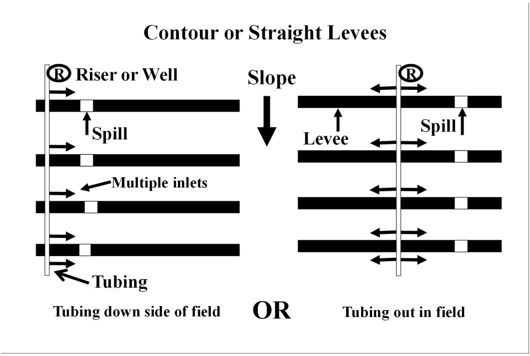
For information on the analysis of irrigation waters, contact your local Extension office or the AWRC Water Quality Laboratory (**479-575-7317** or **awrc@uark.edu**).

- Prior to collecting an irrigation water sample, run the well long enough to remove any residue or contaminants from the pipe.
- Using a plastic bottle (minimum 500 mL), and after rinsing the bottle three times with irrigation water, fill the bottle completely with irrigation water and cap tightly.
- Submit samples through the nearest county Extension office or directly to the AWRC.
- For assistance with interpreting the results of the water quality analysis, consult with your local Extension office and specialists (see **Contacts**).

Multiple-Inlet (MI) Irrigation

- Cross tubing perpendicular over levees to keep tubing from rolling. Use small diameter PVC tubing through pipe if necessary.
- Set levee gates higher when using MI compared to traditional cascade irrigation. Higher gate settings with MI allow for rainfall capture and can reduce pumping by 25%.

Comparison of multiple-inlet irrigation setup with tubing placed along the edge in a side-inlet design (left) and down the middle of the field in a traditional multiple-inlet setup (right).



Suggested Pipe Sizes for Multiple Inlet

< 1200 gpm – 12 in
< 2200 gpm – 15 in
> 2200 gpm – 18 in

MI Gate Calculations:

$$\frac{\text{total flow in gpm}}{\text{field area in acres}} = \text{gpm/acre}$$

gpm/acre × paddy* area = flow rate needed in paddy

*a paddy is the area between any two levees

$$\frac{\text{flow rate needed in paddy}}{\text{75 gpm per hole}} = \text{Number of holes}$$

- Round up for number of holes and punch.
- Use blue gate in last hole to regulate.

Example MI Gate Calculation:

Pump flow rate = 1200 gpm; Area of field = 80 acres

$$\frac{\text{total flow in gpm (1200)}}{\text{field area in acres (80)}} = \text{15 gpm/acre}$$

15 gpm/acre × 11 paddy acres = 165 gpm for paddy

$$\frac{\text{flow rate needed in paddy (165)}}{\text{75 gpm per hole}} = \text{2.2 holes}$$

- Punch 3 holes, install blue gate in last hole.
- Close gate to choke down flow.
- Repeat steps for remaining paddies.

Keys to Water Management Success

- Keep acreage within limits of pumping capacity and select fields that hold water adequately.
- Establish a smooth field surface that provides a good seedbed, drainage and water control.
- Contact county CES for water quality testing if no recent history.
- Use multiple-inlet irrigation to improve water management.
- For multiple-inlet irrigation and intermittent flooding, set levee gates higher than levee irrigation to store rainfall.
- Accurate levee survey, proper levee construction and correct gate installation.
- Establish a levee base early on clay soils.
- Seed longer-season cultivars on fields with good water-holding capacity.
- Service and repair pumps before the season begins.
- Analyze differences in energy costs (diesel vs. electric).
- Timers/pump control technology to manage irrigation pumps.
- Use flow meters to monitor water use.
- Flush if necessary for stand establishment and herbicide activation.
- Operate irrigation system so no water leaves the field during pumping or small rain events.
- Use surface water when possible.

Critical Water Management Situations

Situation	Rice Stage	Recommended Practice
After dry-seeding, no moisture for germination	Rice not germinated	Flush quickly – water off in 2 days. Use multiple water inlets if possible to reduce flush time.
Soil surface is crusted	Rice germinated but not emerged	Flush to soften crust before rice emerges/loses penetrating power.
Residual herbicides have been applied, soil surface is dry	Rice has germinated and may be emerged	Flush to activate herbicides.
Barnyardgrass is drought stressed and less than 4-leaf	Rice may or may not be emerged	Flush and apply herbicide before grass gets too large
Barnyardgrass too large, drought stressed, or not controlled	Rice is 6" to 8" tall	Flood, treat with Clincher, Ricestar or Regiment, and maintain flood.
Seedling rice has tipburn and dying before flooding (salinity)	Rice has emerged but may be less than 8" tall	Dilute salts by flushing and don't let soil surface dry.
Rice is chlorotic within 2-4 days post-flood (high pH, Zn deficient)	Rice is 6" to 10" tall	Drain, apply zinc and, after recovery, add N; reflood to shallow depth.
History of straighthead	Rice is about 2-3 weeks prior to internode movement (consider DD50 drying time frame)	Drain before first DD50 drying date to dry soil thoroughly until rice plants are drought stressed; then reflood before 1/2-inch IE.

Not enough water; severe drought stress	Rice can be in various stages	Flush quickly, then close gates and raise flood to desired depth as water becomes available.
Nitrogen applied on dry soil	Rice is 3 weeks old	Flood within 7 days to place N below soil surface.
Nitrogen applied into flood	Rice is at internode elongation.	Prefer low flood with little water movement. Delay pumping for 24 hours after N application.
Sprangletop/large barnyardgrass	Rice is tillering to IE stage	Apply Clincher into flood. Flood must be maintained for suppression
Drought, pumping flow rate is low	Rice near heading	Use multiple inlets; clean out algae in flow pattern to ensure sufficient water as heads emerge.
Preparation for harvest	Rice is 10-14 days after heading; heads dropping and some ripening	Consider ceasing pumping for harvest 10-14 days after heading if adequate flood on the field to prevent drought stress during grain fill. If not, continue pumping 5-7 days.