OR652.0907 State Supplement

Effective irrigation water management (IWM) requires knowledge of many factors including crops grown, soils, climate, irrigation water supply, and the irrigation system. Refer to the proper chapter in this guide for detailed information on individual details.

The worksheets included in this supplement are designed supplement those in Chapter 9 in order to assist planners, irrigation system designers, and irrigators with various elements of IWM by answering basic questions:

- How much water should be applied?
- When to apply water?
- What is the amount actually applied?
- How well does an existing irrigation system function?
- What capabilities are needed in the design of a new irrigation system?

Individual worksheets can be selected for the needed use, and if necessary, appropriate modifications should be made if required for specific situations.

The Worksheets in this section are available as MS Word .doc files for electronic fill-in. (The .doc files are "Read Only" so that they can be edited but must be saved using a different file name.)

The files can be downloaded from the NRCS Oregon Engineering web site:

http://www.or.nrcs.usda.gov/technical/engineering/engineering.html

Irrigation Water Flows, Volumes, and Relationships

Water Flow Rates:

1 cubic foot per second (cfs)
= 448.8 gallons per minute
1 cfs for 1 hour = 0.99 acre-inch
1 cfs for 24 hr = 1.98 acre-ft
1,000 gpm = 2.23 cfs
1,000 gpm for 24 hr = 4.42 ac-ft
1 gpm/acre = 0.053 ac-in/ac/day
1 cfs = 40 miner's inches in OR, No CA
1 cfs = 50 miner's inches in ID, WA
1 miner's inch = 11.22 gpm in OR
1 miner's inch = 9 gpm in ID, WA
1 cfs = 28.32 liters/sec
1 cubic meter/sec = 35.3 cfs
1 liter/sec = 15.85 gpm

Q x **T** = **D** x **A** *where Q = cfs T = hr; D = inches depth; A = acres*

Gpm for 5 ft/s velocity in PVC pipe

6"	8"	10"	12"	14"
480	800	1250	1750	2150

Water Volumes & Weights:

1 cubic foot = 7.48 gallons
= 62.4 lb = 28.3 liters
1 acre-foot = 43,560 cubic feet
(1 acre covered 1 ft deep)
12 acre-in = 1 acre-ft = 325,829 gal
1 million gallons = 3.07 acre-ft
1 acre-ft = 1,234 cubic meters
1 cu meter = 1,000 liters = 35.3 cu ft

Pressure and Pressure Head:

1 psi = 2.31 ft of pressure head
1 atmosphere (sea level)
= 14.7 psi = 33.9 ft of head

Lengths and Areas:

1 mile = 5,280 ft = 1.61 km
1 meter = 3.28 ft = 39.37 inches
1 acre = 43,560 square ft
1 hectare = 2.47 acres

Pump Power Requirement

$$Horsepower = \frac{Pump\ Head\ in\ ft \times gpm}{39.6 \times \%\ Pump\ Efficiency}$$

Conservation Practice Worksheet **OR IWM-W9.1**

Natural Resources Conservation Service, Oregon **February 2007**

Irrigation System Inventory

Client: _____ **Date:** _____

This form is used to identify and evaluate those components of an irrigation system that directly affect irrigation system operation and water management. Other aspects not directly affecting irrigation water management, such as energy-use efficiency, may also be noted.

ITEM	OK	Needs attention	Comments
Irrigation water supply			
Adequate water supply for area irrigated			
Suitable quality of irrigation water supply			
Inflow controlled by valve and/or gate			
Inflow is measured easily and accurately			
Type of water measuring device:			
Source of irrigation water:			
Type of delivery schedule if applicable:			
Irrigation water conveyance			
Adequate capacity in ditch and/or pipe			
Ditch or pipe free of leaks			
Adequate water control devices			
Irrigation water application			
Adequate water control for uniform application			
Uniformity of application throughout field			
Wet and/or dry spots			
Excessive runoff (There should be no runoff from sprinkler-irrigated areas.)			
Overall system condition			
General maintenance			

NOTES: _____

Conservation Practice Worksheet **OR IWM-W9.2**

Natural Resources Conservation Service, Oregon **February 2007**

Irrigation Water Application – How Much, When, System Capacity

Client: _____

NOTE: • This worksheet pertains to **each** crop irrigated and months throughout the growing season.
• A computerized version of this worksheet is available at NRCS field offices.
Make additional copies of this sheet as needed.

Field ID:	
Crop:	
Soil Map Unit Name:	
Managed Root Zone Depth (in):	

	AWC (in/in)	**AWC in soil layer** (in)
Depth _____ in		
Depth _____ in		
Depth _____ in		
Total Available Water Capacity (in): Sum of depth x AWC for all depth zones in the managed root zone		

IRRIGATION REQUIREMENT HOW MUCH water to apply?	Month	Month	Month	Month	Month	Month
Effective Rooting Depth (in) :						
Total Available Water Capacity (in): From above						
Management-Allowed Deficit (%:):						
Maximum Net Irrigation Requirement (in): Total Available Water Capacity x MAD						
IRRIGATION TIMING WHEN to apply water?						
Daily Crop Water Use (in/day):						
Maximum Irrigation Frequency (days): Net Irrigation Requirement / Daily Water Use						
Actual Irrigation Period (days) :						
Desired Net Irrigation Application (in): Daily crop water use x Actual Irrigation Period						
SYSTEM CAPACITY						
System Application Efficiency (%): (Water Required / Water Applied)						
GROSS Irrigation Requirement (in): (Net Irrigation Application / Application Efficiency)						
Irrigated Acres:						
Gross Application Requirement (acre-in): Gross Irrigation Requirement x Acres						
Required System Flow Rate (gpm or cfs)						

Compare **Irrigation Timing** and **System Capacity** with **documented** system operation

Conservation Practice Worksheet **OR IWM-W9.3**

Natural Resources Conservation Service, Oregon **February 2007**

Measuring Irrigation Water Applications

Client:_____ **Field ID:**_____

USING A TOTALIZING FLOWMETER TO MEASURE THE VOLUME OF WATER USED

Read the flow meter before and after each irrigation. The difference between the two readings is the volume of water that was applied measured in acre-feet or acre-inch. Divide the volume by field acreage to find the Gross Irrigation Depth and then complete the previous page.

Final Flowmeter reading *(Acre-in)*	Subtract	**Initial Flowmeter reading** *(Acre-in)*	Equals	**Water Volume** *(Acre-in)*	Divide by	**Field Area** (acres)	Equals	**Gross Irrigation Depth** (inches)	*If t flowmeter reads acre-ft instead of acre- inch then multiply the final Gross Irrigation Depth by 12 to convert to inches*
{Example} **2504**	-	**2367**	=	**137**	÷	**32**	=	**4.28**	
	-		=		÷		=		
	-		=		÷		=		
	-		=		÷		=		
	-		=		÷		=		
	-		=		÷		=		
	-		=		÷		=		

OR

MEASURING THE FLOW RATE OF WATER USED

Record the flow rate, duration of irrigation, and area of the field irrigated. The flow rate in gpm or cfs can be entered in the appropriate column.

Flow rate *(gpm)*	**Divide by Conversion factor**	**Flow rate** *(cfs)*	Multiply by	**Duration of irrigation** (hr)	Divide by	**Field Area** (acres)	Equals	**Gross Irrigation Depth** (inches)
{Example} **820**	÷ 449	**1.83**	X	**36**	÷	**28**	=	**2.35**
	÷ 449		X		÷		=	
	÷ 449		X		÷		=	
	÷ 449		X		÷		=	
	÷ 449		X		÷		=	
	÷ 449		X		÷		=	
	÷ 449		X		÷		=	

Conservation Practice Worksheet **OR IWM-W9.4**

Natural Resources Conservation Service, Oregon **February 2007**

Irrigation Applications by Center-Pivot Sprinkler

Client:_____ **Field ID:**_____

DEPTH APPLIED AS RELATED TO PIVOT SPEED

Obtain a percent timer chart for your system if you do not already have one. The Percent Timer Chart will tell you the depth of water that the pivot applies during one full revolution for a particular speed. Note the depth of water applied in a single revolution and record that depth as the gross application for an irrigation.

Pivot speed (%)	**Gross depth of water applied per revolution** (in)
{Example} **25%**	**0.90 inch**

OR

DEPTH APPLIED AS RELATED TO THE TOTAL FLOW RATE OF THE PIVOT IN GPM

Obtain the total flow rate for your system in gpm and the total area irrigated by the pivot. This information is normally included in the pivot design and/or nozzling package information.

Pivot flow rate (gpm)	Divide by	**Total area irrigated by the pivot** (acres)		**Application rate** (gpm/acre)	Multiply by	**Time to complete one irrigation** (hr)	**Multiply by conversion factor**	**Gross Depth of Water Applied per irrigation** (in)
{Example} **900** gpm	÷	**130** acres	=	**6.9** gpm/acre	x	**60** hr	x ***0.0022***	**0.91** inch
	÷		=		x		x ***0.0022***	
	÷		=		x		x ***0.0022***	
	÷		=		x		x ***0.0022***	
	÷		=		x		x ***0.0022***	
	÷		=		x		x ***0.0022***	
	÷		=		x		x ***0.0022***	

Conservation Practice Worksheet **OR IWM-W9.5**

Natural Resources Conservation Service, Oregon **February 2007**

Irrigation Applications by Hand-Line & Wheel-Line Sprinkler

Client:_____ **Field ID:**_____

From tables below		Multiply	Number of hours per set (hr)		Gross Irrigation Depth (in)
Sprinkler Discharge (gpm)	Gross Application Rate (in/hr)				
{Example} **6.1 gpm**	*{40x60 spacing}* **0.24 in/hr**	**x**	**11.5 hr**	**=**	**2.76 in**
		x		**=**	
		x		**=**	
		x		**=**	
		x		**=**	
		x		**=**	

Sprinkler Discharge in gpm

Sprinkler Nozzle Diameter	Pressure in psi										
(in)	20	25	30	35	40	45	50	55	60	65	70
3/32	1.15	1.29	1.41	1.52	1.62	1.72	1.81	1.90	1.98	2.06	2.14
7/64	1.57	1.75	1.92	2.07	2.21	2.34	2.47	2.59	2.70	2.81	2.92
1/8	2.05	2.29	2.50	2.70	2.89	3.06	3.22	3.38	3.53	3.67	3.81
9/64	2.59	2.90	3.17	3.42	3.65	3.87	4.08	4.28	4.47	4.65	4.82
5/32	3.20	3.58	3.91	4.22	4.51	4.78	5.04	5.28	5.51	5.74	5.95
11/64	3.87	4.33	4.73	5.11	5.46	5.79	6.10	6.39	6.67	6.94	7.20
3/16	4.61	5.15	5.63	6.08	6.50	6.89	7.25	7.60	7.94	8.26	8.57
13/64	5.41	6.04	6.61	7.14	7.62	8.08	8.51	8.93	9.32	9.69	10.06
7/32	6.28	7.01	7.67	8.28	8.84	9.37	9.87	10.35	10.81	11.24	11.66
15/64	7.20	8.05	8.80	9.50	10.15	10.76	11.34	11.88	12.40	12.91	13.39
1/4	8.20	9.15	10.02	10.81	11.55	12.24	12.90	13.52	14.11	14.68	15.23
17/64	9.25	10.33	11.31	12.20	13.04	13.82	14.56	15.26	15.93	16.58	17.20
9/32	10.37	11.59	12.68	13.68	14.62	15.49	16.32	17.11	17.86	18.58	19.28

Gross Application Rate

Sprinkler discharge	(in/hr for sprinkler discharge & spacing)								
(gpm)	30X30	30X40	30X50	40X40	40X50	40X60	60X60	60X80	80X80
2	0.21	0.16	0.13	0.12	0.10	0.08	0.05	0.04	0.03
3	0.32	0.24	0.19	0.18	0.14	0.12	0.08	0.06	0.05
4	0.43	0.32	0.26	0.24	0.19	0.16	0.11	0.08	0.06
5	0.53	0.40	0.32	0.30	0.24	0.20	0.13	0.10	0.08
6	0.64	0.48	0.38	0.36	0.29	0.24	0.16	0.12	0.09
7	0.75	0.56	0.45	0.42	0.34	0.28	0.19	0.14	0.11
8	0.86	0.64	0.51	0.48	0.38	0.32	0.21	0.16	0.12
9	0.96	0.72	0.58	0.54	0.43	0.36	0.24	0.18	0.14
10	1.07	0.80	0.64	0.60	0.48	0.40	0.27	0.20	0.15
11	1.18	0.88	0.71	0.66	0.53	0.44	0.29	0.22	0.17
12	1.28	0.96	0.77	0.72	0.58	0.48	0.32	0.24	0.18
13	1.39	1.04	0.83	0.78	0.63	0.52	0.35	0.26	0.20
14	1.50	1.12	0.90	0.84	0.67	0.56	0.37	0.28	0.21
15	1.60	1.20	0.96	0.90	0.72	0.60	0.40	0.30	0.23
16	1.71	1.28	1.03	0.96	0.77	0.64	0.43	0.32	0.24
17	1.82	1.36	1.09	1.02	0.82	0.68	0.45	0.34	0.26
18	1.92	1.44	1.15	1.08	0.87	0.72	0.48	0.36	0.27
19	2.03	1.52	1.22	1.14	0.91	0.76	0.51	0.38	0.29
20	2.14	1.60	1.28	1.20	0.96	0.80	0.53	0.40	0.30