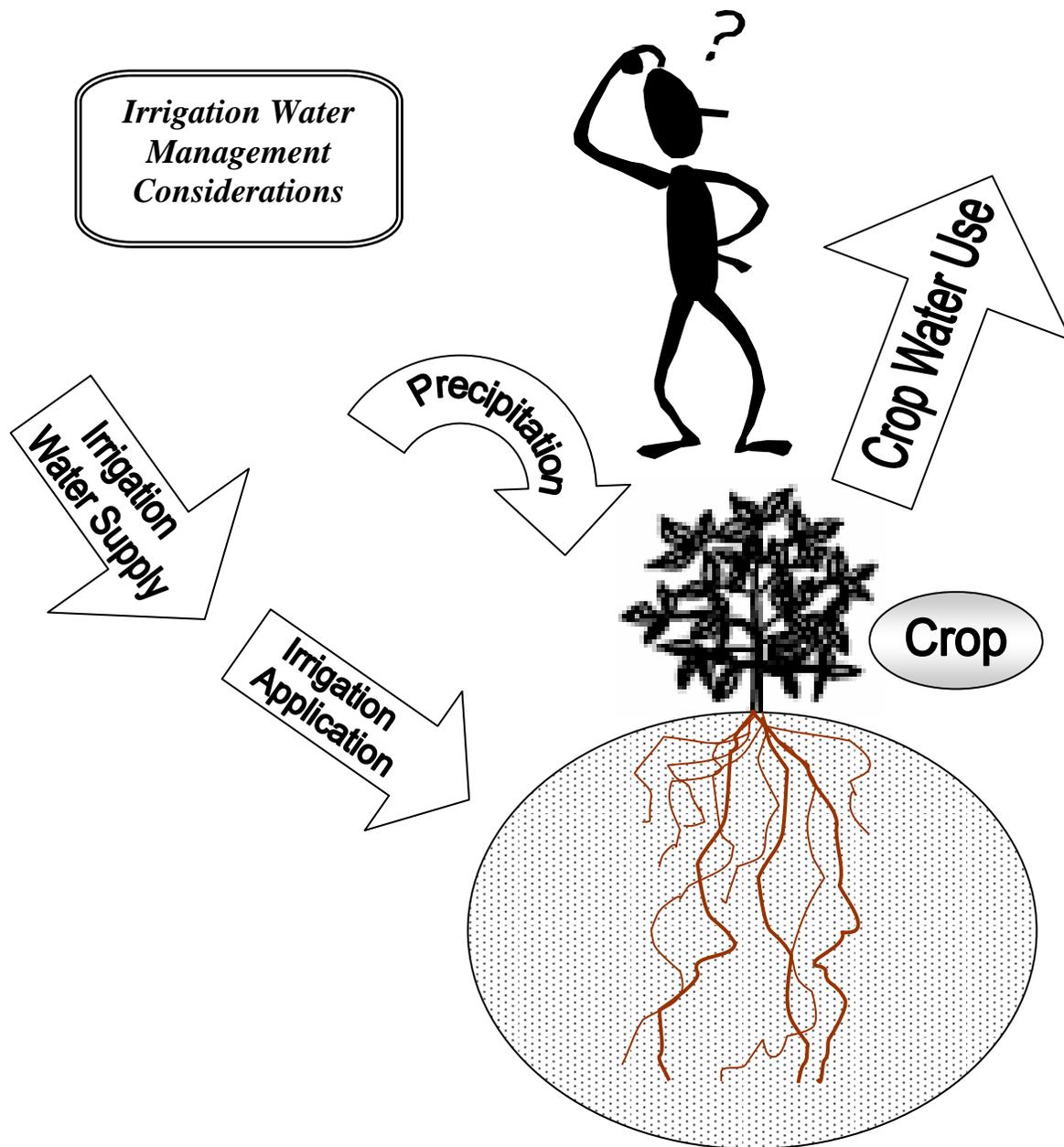


OR652.1005 State Supplement

A key element for effective irrigation system design and management is an Irrigation Water Management (IWM) Plan. The IWM Plan includes factors related to the irrigation system including agronomic and management aspects. Irrigation water management must be considered in irrigation system design to assure that the system will supply crop water needs and function effectively and economically as a

component of a production system. Likewise, for effective irrigation system operation, an IWM Plan assists the irrigator or decision maker in the management of the irrigation system and water application. The IWM Plan should also provide guidance for appropriate record keeping of irrigation activities and associated conservation measures.



(a) IWM Plan Components

The IWM plan includes the following elements that meet specifications listed in the Irrigation Water Management Job Sheet (449 OR-JS), and the accompanying 449 OR-IWM Plan Worksheet (449 OR-IWM-Plan) provides a format for developing an IWM Plan. These items are contained in Section OR652.1005(c).

(1) Statement of Objective(s) for the IWM Plan Describe the principal objective(s) of IWM for the cooperator. Typical objectives may be to maximize crop yield and quality and to document water savings. Other objective(s) may include maximizing net return, frost protection, crop cooling, dust control, and other purposes. All pertinent objectives should be noted, including associated sub objectives and site-specific information that might influence IWM objectives.

(2) Irrigation System Description including Plan Map

One or more conservation plan maps may be used along with narrative descriptions to describe the irrigation system. Components should be described including any limiting conditions that might affect system operations and water management. The IRRIGATION SYSTEM INVENTORY WORKSHEET (Section OR652.0907) can be used to obtain and organize information about existing systems.

The following elements should be included in describing the irrigation system and its operation:

- (i) Irrigation Water Supply:
 - Description of irrigation water source (well, stream, irrigation district, etc.).
 - Supply flow rate (gpm or cfs) including seasonal variability.
 - Annual volume available (acre-ft).
 - Water delivery schedule including water rights and/or historical water use information.
- (ii) Method of water measurement
- (iii) Irrigation water conveyance:
 - Description of water conveyance (pipeline, unlined ditch, lined ditch, etc.).
 - Methods of water control (valves, gates, etc.).
 - Water conveyance losses (% loss in conveyance).
- (iv) Irrigation application:
 - Description of application system including system type and age.
 - Field layout and area irrigated (acres).
 - System capacity (gpm or cfs).
 - Application efficiency (%).
- (v) Other pertinent information including:
 - Irrigation system configuration.
 - System component sizing.
 - System operation.
 - Factors affecting IWM.
 - On-site observations.

- (3) Soils Information
- (i) Soils Map and Soil Description.
 - (ii) Soil physical properties affecting irrigation operations and water management:
 - Available Water Holding Capacity throughout the soil profile.
 - Intake family characteristics and/or allowable sprinkler application rate.
 - Presence of any field-specific conditions and anomalies that may affect irrigation system operation including inhibiting or differing soil layers at depth, high water table, possible erosion and/or salinity problems.
- (4) Crop Information
- (i) Crop(s) grown including expected crop mix and rotation.
 - (ii) Managed root zone as affected by maximum effective rooting depth and seasonal variation in rooting depth for each crop.
 - (iii) Management allowed deficit for each crop along with seasonal variations.
 - (iv) Crop consumptive water use (CU) including peak daily (design) CU, total seasonal use, and seasonal variation including planting and harvest dates for each crop.
- (5) Description of Irrigation Scheduling and System Management
- (i) Net and gross application with corresponding frequency shall be identified for the design (peak water use) period for each crop grown (Refer to IRRIGATION WATER APPLICATION – HOW MUCH, WHEN, SYSTEM CAPACITY WORKSHEET, Section OR652.0907.) This information should be related to the system capacity and water supply.
 - (ii) Description of system operation that corresponds to design (peak water use) period; e.g., hours per set and sets per day and days per cycle for periodic-move, solid-set, or microirrigation systems; cycle time for “continuous move” systems, and hours per set and sets per day and days per cycle for surface systems.
 - (iii) Guidance for seasonal adjustment of application depths and irrigation frequencies throughout the irrigation season. (Inefficient irrigations normally occur early and late in the irrigation season when crop water use rates are less than peak.)
 - (iv) A method for estimating crop consumptive use and rainfall shall be identified.
 - (v) A method for monitoring soil moisture levels shall be identified and an appropriate method specified. (Assessing soil moisture provides opportunity to “calibrate” consumptive use and rainfall estimates, and account for errors in other estimates such as irrigation application efficiency. At a minimum, soil moisture assessment should include using the “feel and appearance” method but might also utilize soil moisture and/or plant monitoring instruments where appropriate.)

(b) **Minimum Requirements to Document IWM Plan Implementation for NRCS Cost-Share Assistance**

(1) Record Keeping

The detail of IWM may be specified as *Irrigation Application Cycle Records* or *Detailed Records* with the associated level of record keeping as appropriate for the level of detail.

a) **Irrigation application cycle** records and procedures should include dates and amounts for:

- i) All precipitation events.
- ii) All irrigations including gross and estimated net application for each irrigation.

NOTE: If irrigation water applications are summarized for multiple irrigations, report the total number of irrigations.

- iii) Total crop consumptive use between irrigations derived from current or historic data.
- iv) Measured or estimated soil moisture level at the time of each irrigation.
- v) Dates and notes on all unusual events including extreme weather such as hail or frost, irrigation system mechanical problems, water source problems, runoff observations, etc.
- vi) Dates and notes on irrigation system maintenance.
- vii) IWM and O&M Review Notes as described in Sections (2) and (3).

b) **Detailed** records and procedures should include dates and amounts for:

- i) All precipitation events.
- ii) All irrigations including gross and net applications for each irrigation.
- iii) Actual daily crop consumptive use derived from current data.
- iv) Weekly, or more frequent, measurements of soil moisture status.
- v) Dates and notes on all unusual events including extreme weather such as hail or frost, irrigation system mechanical problems, water source problems, runoff observations, etc.
- vi) Dates and notes on irrigation system maintenance.
- vii) IWM and O&M Review Notes as described in Sections (2) and (3).

Record sheets for reporting Irrigation Application Cycle Records (Form OR-449-IWM Irrigation Application Cycle Record) and Detailed Records (Form OR-449-IWM Detailed Record) are located in Section OR652.1005(c).

(2) Notes from a review of IWM and a comparison of IWM implementation to the IWM Plan:

- i) Follow-up is performed and documented to determine if adjustments need to be made in the IWM plan so that planned goals are met and if any additional resource concerns require attention.
- ii) The quantity of water “conserved” and/or the improved uniformity of water application throughout the entire irrigation season should be estimated compared to previous years.
- iii) Crop response, both yield and quality, should be reviewed in relation to the IWM plan.
- iv) Irrigation induced soil erosion should be addressed and adjustments made to minimize any detrimental effects of erosion including alterations to system hardware and/or operation and management practices.
- v) Impacts on non-point source pollution of surface and groundwater resources should be reviewed.

(3) Notes from a review of the irrigation system Operation and Maintenance Plan. An Operation and Maintenance review of irrigation system components should be completed during follow-up to ensure that the system is performing per design specifications.

A record sheet for reporting review notes (Form OR-449-IWM Review Notes) is included in Section OR652.1005(c).

(c) **OR 449–Job Sheet, worksheets and record sheets**

Following are copies of the Oregon IWM Job Sheet that includes specifications (OR 449-IWM Job Sheet). The accompanying worksheets and record sheets are suitable for

- developing an IWM Plan (Worksheet OR 449-IWM Plan),
- reporting irrigation application cycle records (Worksheet OR 449-IWM Irrigation Cycle Record),
- reporting detailed records (Worksheet OR 449-IWM Detailed Record), and
- reviewing the implementation and effectiveness of the IWM Plan (Worksheet OR 449-IWM Review Notes).

The Job Sheet and Worksheets in this section are available as MS Word .doc files for electronic fill-in. (The .doc files are “Read Only” meaning 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>

Conservation Practice Job Sheet

OR 449-IWM Job Sheet

Natural Resources Conservation Service, Oregon

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IRRIGATION WATER MANAGEMENT

Page 1

Client _____

Date _____

**Definition**

Irrigation water management (IWM) is the process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner.

Purpose

IWM is applied as part of a conservation management system to support one or more of the following:

- Manage soil moisture to promote desired crop response
- Optimize use of available water supplies
- Minimize irrigation induced soil erosion
- Decrease non-point source pollution of surface and groundwater resources
- Manage salts in the crop root zone
- Manage air, soil, or plant micro-climate.

Where used

This practice is applicable to all irrigated lands.

An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, etc.) must be available and capable of applying irrigation water to meet the intended purpose(s).

Conservation Management Systems

IWM is generally one of several components of a resource management system used to manage water supplied to a crop through an irrigation system that is

part of an overall resource management plan for the irrigated cropland.

Irrigation Water Management Planning

IWM components of the conservation plan will contain the following information:

- field map(s) and soil survey information
- crop rotation or sequence
- recommended irrigation water application rates, timing, and method of application
- locations of designated sensitive areas
- guidelines for irrigation system operation and maintenance

IWM is most effective when used in conjunction with other conservation practices such as irrigation system design, cover crop, residue management, conservation buffers, nutrient management, pest management, and conservation crop rotation.

IWM requires knowledge, skills, and desire to determine when irrigation water should be applied. The main factors influencing IWM are

- **irrigation interval** (time between irrigations),
- **irrigation set time** (time water is applied), and
- **application rate** (rate at which water is applied).

These parameters define the timing and duration of irrigation and the amount of water applied. System design and maintenance are also important factors influencing IWM.

Conservation Practice Job Sheet

OR 449-IWM Job Sheet

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IRRIGATION WATER MANAGEMENT

Page 2

Water Rights

Under Oregon law all water is publicly owned and anyone planning to store or divert surface or groundwater for the purpose of irrigation must obtain a permit or water right from the Oregon Water Resources Department. These permits or water rights must be obtained prior to the use of the water. It is the responsibility of the landowner to file for the necessary permits or water rights. The landowner should complete a *Producer Self-Certification of Irrigation History* (OREGON BULLETIN NO. OR210-2007-2).

Operation and maintenance

The operation and maintenance (O&M) aspects applicable to this standard consist of evaluating available field soil moisture, crop evapotranspiration rates and changes in soil intake rates and adjusting the volume, application rate, and/or frequency of water application to achieve the intended purpose(s). A review of the effectiveness of the IWM Plan is useful in evaluating the effectiveness of the Plan and its implementation.

Other necessary O&M items are addressed in the physical component standards considered companions to this standard such as Irrigation System and Irrigation Water Conveyance.

IWM Plan Specifications

An IWM Plan shall be developed to assist the irrigator or decision-maker in the proper management and application of irrigation water. Factors to be included in the IWM Plan include the following:

- Statement of objective(s) for the IWM Plan
- Description of the irrigation system and its components including water supply, water conveyance and application systems, and any water measurement devices.
- Soils information including available water capacity, depth, and limiting conditions related to irrigation water management.
- Crop information including crops grown, irrigation water requirements, and physical characteristics including rooting depth.
- Description of irrigation scheduling and system management including methods for measuring and/or estimating crop water use and soil moisture levels.
- IWM record keeping requirements of appropriate detail for the IWM objectives. The detail of IWM may be specified as **Detailed or By Irrigation Cycle** with the associated level of record keeping as appropriate for the level of detail.
- IWM review requirements regarding the effectiveness of the IWM Plan and its implementation.

Worksheets

IWM Worksheets and Record Sheets for developing an IWM Plan and associated reporting are contained in the Oregon Supplements to Part 652, *Irrigation Guide*, Chapters 2, 9, and 10.

The Job Sheet and Worksheets 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

$$Q \times T = D \times A$$

where:

- Q = flow rate (acre-in/hr or cfs)
- T = time (hr)
- D = gross depth applied (in)
- A = area (acres)

$$Q = \frac{453 \times A \times D}{F \times H}$$

where:

- Q = flow rate (gpm)
- A = area (acres)
- D = gross application depth (in)
- F = irrigation period (days)
- H = hours of operation per day

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

$$Q \times T = D \times A \quad \text{where } Q = \text{cfs}$$

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



Natural Resources
Conservation Service

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 =

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

Conservation Practice Job Sheet

OR 449-IWM Job Sheet

Natural Resources Conservation Service, Oregon

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IRRIGATION WATER MANAGEMENT

Landowner/Operator: _____
 Job Location: _____
 County: _____ SWCD: _____ Farm/Tract No.: _____
 Referral No.: _____ Prepared by: _____ Date: _____

PLAN APPROVAL AND ACCEPTANCE:

Practice Code	PRACTICE	LEAD DISCIPLINE	CONTROLLING FACTOR	UNITS	JOB CLASS				
					I	II	III	IV	V
449	Irrigation Water Management	CED-WME & BCSD-Agron	Area	Acres	40	320	640	2000	All

Number of Acres: _____ Job Class: _____

Plan Prepared by: /s/ _____ Date: _____

Job title: _____

Plan acceptance by landowner/operator by: /s/ _____ Date: _____

PRACTICE CERTIFICATION:

Year 				
Suitability of IWM Plan:*				
Irrigation records including*				
Individual irrigation application amounts:				
Application timing:				
Total seasonal amount applied:				
Review of IWM Plan and Implementation:				
Practice meets specification*				
Contract item number:				
Approved by: /s/				
Date:				

* Note **A** for **Acceptable** or **U** for **Unacceptable**

Conservation Practice Worksheet

449 OR-IWM-Plan

Natural Resources Conservation Service, Oregon

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IRRIGATION WATER MANAGEMENT PLAN



Landowner/Operator: _____

Job Location: _____

County: _____ SWCD: _____ Farm/Tract No.: _____

Referral No.: _____ Prepared by: _____ Date: _____

IWM PLAN OBJECTIVE(s):

<p>IWM Objectives::</p>	<ul style="list-style-type: none"> •
<p>Site-specific information influencing IWM objectives:</p>	<ul style="list-style-type: none"> •

Conservation Practice Worksheet

449 OR-IWM-Plan

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IRRIGATION WATER MANAGEMENT PLAN

Page 2

IRRIGATION SYSTEM DESCRIPTION including descriptions of irrigation water supply and system components and limiting conditions that may affect system operations and associated irrigation water management.

For existing irrigation systems, include an inventory of the system. The **IRRIGATION SYSTEM INVENTORY** form, **OR IWM-W9.1** found in Section OR652.0907 may be used to assist in documenting this information.

Field ID: _____

Description of irrigation water supply (well, stream, irrigation district, etc.):	
Supply flow rate (gpm or cfs):	
Annual volume available (acre-ft):	
Water delivery schedule:	
<hr/>	
Method(s) of water measurement:	
<hr/>	
Description of water conveyance (pipeline, unlined ditch, lined ditch, etc.):	
Methods of water control (valves, gates, etc.):	
Water conveyance losses (% loss in conveyance):	
<hr/>	
Description of application system (system type, age, and condition):	
Field layout and area irrigated (acres):	
System capacity (gpm or cfs):	
Application efficiency (%):	

Include a plan map of the irrigation system showing components.

Conservation Practice Worksheet

449 OR-IWM-Plan

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IRRIGATION WATER MANAGEMENT PLAN

BASIC SOILS & CROP INFORMATION

Attach a soil survey map of the area of interest along with the following information:

- Brief map unit description that contains the percent of area for each soil type when more than one soil type is present.
- Soil physical properties including Available Water Holding Capacity throughout the soil profile.
- Intake rate characteristics.

(Refer to Part 652, Chapter 2 for soils guidelines and information.)

Note any site specific conditions that affect irrigation system operation and management such as soil variability and anomalies, and/or conditions that affect irrigation system operations and management.

SOILS INFORMATION

Map unit name and symbol:	
Percent of area for this soil (%):	
Available Water Holding Capacity In the managed root zone (in):	
Intake family characteristics and/or allowable sprinkler application rate:	
Site-specific soil conditions affecting irrigation operations:	

Map unit name and symbol:	
Percent of area for this soil (%):	
Available Water Holding Capacity in the managed root zone (in):	
Intake family characteristics and/or allowable sprinkler application rate:	
Site-specific soil conditions affecting irrigation operations:	

CROP ROTATION INFORMATION

	Year #1	Year #2	Year #3	Year #4
Field #1				
Field #2				
Field #3				
Field #4				

Conservation Practice Worksheet

449 OR-IWM-Plan

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IRRIGATION WATER MANAGEMENT PLAN

Description of Irrigation Scheduling and System Management

Include worksheet(s) (hand- or computer-generated) that include irrigation system operations information including the following:

- (i) Net and gross application with corresponding frequency for the design (peak water use) period for each crop grown. This information should be related to the irrigation system capacity.
- (ii) Description of system operation that corresponds to design (peak) period such as
 - hours per set and sets per day and days per cycle for periodic-move, solid-set sprinkler systems,
 - hours per day operation for micro irrigation systems;
 - cycle time for continuous-move systems, and
 - hours per set and sets per day and days per cycle for surface systems.
- (iii) Guidance for seasonal adjustment of application depths and irrigation frequencies throughout the irrigation season. (Inefficient irrigations normally occur early and late in the irrigation season when crop water use rates are less than peak.)
- (iv) Methods used for estimating actual consumptive use and rainfall.
- (v) A method for monitoring soil moisture levels. (Assessing soil moisture provides opportunity to “calibrate” consumptive use and rainfall estimates, and account for errors in other estimates such as irrigation application efficiency. At a minimum, soil moisture assessment should include using the “feel and appearance” method but should include soil moisture and/or plant monitoring instruments where appropriate.)

YEAR: _____

	Field #1	Field #2	Field #3	Field #4
Crop:				
Method for estimating ET:				
Method for monitoring soil moisture:				
Other:				

Specify the record sheet(s) (hand- or computer-generated) to be used in recording the implementation of the IWM Plan. Record sheet forms are available in Section OR652.1005(c) for reporting *Irrigation Cycle* (**Worksheet OR 449-IWM Irrigation Cycle Record**) and *Detailed* (**Worksheet OR 449-IWM Detailed Record**) alternatives.

IWM Review

A review of IWM should be conducted including comparison of IWM implementation to the IWM Plan. A worksheet for review notes is available in Section OR652.1005, **Worksheet OR 449-IWM Review Notes**

Include all supporting worksheets and record sheets as components of the IWM plan.

Conservation Practice Worksheet

OR 449-IWM Irrigation Cycle Record

Natural Resources Conservation Service, Oregon

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IRRIGATION APPLICATION CYCLE WATER MANAGEMENT RECORD

Page 2

Client: _____ Date: _____

NOTE: Make additional copies of this sheet as needed.

RECORD OF CROP WATER USE FROM CURRENT OR HISTORIC DATA AND SOIL MOISTURE STATUS								
March Average Daily ET	April Average Daily ET	May Average Daily ET	June Average Daily ET	July Average Daily ET	August Average Daily ET	September Average Daily ET	October Average Daily ET	November Average Daily ET

Date	Crop Water Use				Soil Moisture	Observations	
	Irrigation start date	Number of days between the start of this irrigation and the start of the previous irrigation	Multiply by <u>Average Daily ET</u> (<i>Evapotranspiration</i>) for the current month (see above)	Equals If another method of determining crop water use such as AgriMet or evaporation pan is used, 1. enter the value and 2. note the method used <i>Method</i> _____	<u>Soil Moisture Status</u> at the time of irrigation Note 1. soil moisture status (% depletion, meter reading, etc.) and 2. method used (soil probing, resistance block, neutron probe, etc.) <i>Method</i> _____	Compare <u>Total Net Depth Applied</u> (from p. 1) to <u>Crop Water Use</u> and note differences between the two values Note observations pertaining to soil moisture status, unusual weather, etc.	
Start date (mo/day)	Days between irrigations	X	Average Daily ET (in/day)	=	Crop water use (inches)	Soil moisture status (% depletion or reading)	Observations
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
		X		=			
SEASONAL TOTAL				=		Compare seasonal crop water use with seasonal total water applied	

Conservation Practice Worksheet

OR 449-IWM Review Notes

Natural Resources Conservation Service, Oregon

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Irrigation Water Management Review Notes

Page 1

Client: _____ Date: _____

NOTE: Make additional copies of this sheet as needed.

Tract/Field ID: _____

Review of IWM and relation of IWM implementation to the IWM Plan

<p>Description of how well IWM goals were met throughout the irrigation season including</p> <ol style="list-style-type: none"> Any adjustments needed in the IWM Plan: Additional resource concerns requiring attention: 	<hr/> <hr/> <hr/> <hr/>
<p>Estimation of water "conserved" and/or the improved uniformity of application throughout the irrigation season compared to previous years:</p>	<hr/> <hr/> <hr/> <hr/>
<p>Description of crop response (yield and quality) in relation to the IWM Plan and its implementation:</p>	<hr/> <hr/> <hr/> <hr/>
<p>Observations of soil erosion, if present, and adjustments made and/or needed to minimize erosion:</p>	<hr/> <hr/> <hr/> <hr/>
<p>Notes on any non-point source pollution impacts on surface and groundwater resources:</p>	<hr/> <hr/> <hr/> <hr/>

Irrigation System Operation and Maintenance Plan

<p>Notes from a review of the irrigation system operation and maintenance plan, including needed adjustments to ensure that the system is performing per design specifications:</p>	<hr/> <hr/> <hr/> <hr/> <hr/>
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