United States Department of Agriculture

NRCS Natural Resources Conservation Service

IRRIGATION WATER MANAGEMENT IMPLEMENTATION WORKSHEET

NRCS – NY - 449

Contract Holder: _____ County: _____ Program: _____

Practice Location (Address): _____

Prepared by: _____ Date: _____ Job Class: _____

Tracts # _____ Fields # _____ Total Acres: _____

Eng. Design Approval by: _____ Date: _____ Design JAA Level: _____

Eco. Design Approval by: _____ Date: _____ Design JAA Level: _____

INDEX	
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1	Cover sheet, Design Approvals, Index, List of included references
2	End of Year Certification Approvals, System Evaluation
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6	Crop rotations
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8	Example: How long do I need to Irrigate?
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References Included	
Contract Holder IWM Plan Soils Map Including:	
Basic Title Information Legend Soil - Symbol, Boundary, Texture	Irrigation System Components Tract/Field/Block/Zone Crops
NRCS Irrigation Guide page 3-7, Maximum Allowable Depletion (MAD) for crop growth stages; page 3-8, Rooting depth and moisture extraction patterns	
NRCS National Engineering Handbook Section 15, tables 11-1 and 1-4, available water holding capacity of soil by texture – in/ft and in/in given	
USDA NRCS Program Aid Number 1619, "Estimating Soil Moisture by Feel and Appearance", April 1998 *	
ATTRA Soil Moisture Monitoring: Low-Cost Tools and Methods (National Sustainable Agriculture Information Service Publication 2006)*	
NRCS Conservation Practice Standard Code 449, Irrigation Water Management	
Additional References Suggested or Included for this Plan	

*Separate electronic file

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

End of Plan Year Review and Approvals (to be completed by NRCS)

Eng. Construction Approval by: _____ Date _____ Construction JAA Level: _____

Eco. Application Approval by: _____ Date: _____ Application JAA Level: _____

Comments, Concerns, Suggestions: _____

System Evaluation: (to be completed by contract holder/operator)

Working as designed? ☐ yes ☐ no

Meets crop needs? ☐ yes ☐ no

Comments, Concerns, Suggestions: _____

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

Irrigation Water Management Overview:

Irrigation Water Management (IWM) is the act of timing and regulating irrigation water application in a way that will satisfy the water requirement of the crop without wasting water, soil, and plant nutrients. The plan is to meet the peak water requirements of the crop without causing erosion, runoff, and excessive losses to deep percolation.

This involves applying water:

* according to crop needs
* in amounts that can be held by the soil and available to crops
* at rates consistent with soil intake rates to prevent runoff and soil erosion
* to maintain, protect or improve water quality

The net results of proper irrigation water management typically:

* conserve water
* prevent excessive soil erosion
* prevent leaching or runoff of agrichemicals
* reduce labor
* minimize pumping cost
* maintain or improve quality of ground water and downstream surface water
* increase crop yield and product quality

To maintain high distribution uniformity, emission uniformity, and application efficiency it is recommended that a good operation, maintenance and management program is followed.

Applied irrigation should always be considered supplemental to rainfall events. Irrigation is needed when the available soil moisture is at the maximum allowable depletion (MAD) for the crop being irrigated. **Crop appearance is not a good method for monitoring water need** – if the crop appears stressed due to lack of moisture, yields will be affected. Monitor applications based on rainfall and soil moisture readings. Monitoring of soil-water contents of fields to determine irrigation need should be done at several locations in each crop and soil management area, and at different depths. Measurements should be taken several times per week in the spring and fall, and more frequently during the hot weather or critical growth periods of the crop. To accurately predict moisture levels, measurements should be taken and recorded regularly, regardless of the time of year or stage of the crop growth (refer to record keeping sheets). Comparison of yearly records and yields can assist with management and improvement of the irrigation system.

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

(To be completed by NRCS)

Narrative - Managing your irrigation system:

Benchmark Condition:
Planned Management/Objectives:

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

Irrigation System Description: (to be completed by NRCS)

Source of irrigation water supply: (well,municipal,pond,etc.)		Supply Flow Rate: (GPM or CFS)		Water Tested:	☐ no ☐ yes (report attached)

Description of pipeline conveyance system: (system type, age, and condition)	
Description of irrigation delivery system: (system type, age, and condition)	
Zone/Acres Irrigated: (list all)	

Application efficiency (%):	☐	90% (new micro-irrigation)	☐	80% (> 5 yr. old micro-irrigation)	☐ 70% (sprinkler)

Your delivery system net application rate (list all that apply):	

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

Crop/Field Information: (to be completed by contract holder)

CROP ROTATION	YEAR #:	YEAR #:	YEAR #:	YEAR #:	YEAR #:
Field # _____ Block # Zone #					
Field # _____ Block # Zone #					
Field # _____ Block # Zone #					
Field # _____ Block # Zone #					
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Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

(to be completed by NRCS and contract holder)

Soils Available Water Capacity Information

References: USDA program aid 1619, Estimating Soil Moisture by Feel and Appearance" (or Soil Physical Properties from County soil survey)
NRCS Irrigation Guide page 3-7, Maximum Allowable Depletion (MAD) for crop growth stages

Use as many continuation sheets as necessary to complete this information, especially on irrigated acres where crops or soil moisture properties change

Tract/Field/Zone/Block:			Crop:	
Growth Stage	Root Depth At Crop Growth Stage	MAD % at Crop Growth Stage:	Predominant USDA Soil Texture at Root Depth Zone	Available Water Capacity (AWC) (in/in or in/ft, circle one):
Establishment				
Vegetative				
Flowering yield formation				
Ripening maturity				

Tract/Field/Zone/Block:			Crop:	
Growth Stage	Root Depth At Crop Growth Stage	MAD % at Crop Growth Stage:	Predominant USDA Soil Texture at Root Depth Zone	Available Water Capacity (AWC) (in/in or in/ft, circle one):
Establishment				
Vegetative				
Flowering yield formation				
Ripening maturity				

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

Tract/Field/Zone/Block:			Crop:	
Growth Stage	Root Depth At Crop Growth Stage	MAD % at Crop Growth Stage:	Predominant USDA Soil Texture at Root Depth Zone	Available Water Capacity (AWC) (in/in or in/ft, circle one):
Establishment				
Vegetative				
Flowering yield formation				
Ripening maturity				

Tract/Field/Zone/Block:			Crop:	
Growth Stage	Root Depth At Crop Growth Stage	MAD % at Crop Growth Stage:	Predominant USDA Soil Texture at Root Depth Zone	Available Water Capacity (AWC) (in/in or in/ft, circle one):
Establishment				
Vegetative				
Flowering yield formation				
Ripening maturity				

Tract/Field/Zone/Block:			Crop:	
Growth Stage	Root Depth At Crop Growth Stage	MAD % at Crop Growth Stage:	Predominant USDA Soil Texture at Root Depth Zone	Available Water Capacity (AWC) (in/in or in/ft, circle one):
Establishment				
Vegetative				
Flowering yield formation				
Ripening maturity				

Irrigation Water Management Plan Worksheet

Year _____

Contract Holder: _____

Example: ***How Long Do I Need To Irrigate?***

Given: AWC for soil = 1.24 in/ft (this information is recorded on sheet 7 for your farm)
Net system application rate (in/hr) = delivery rate X efficiency = 0.022 in/hr x 0.90 (90%, new micro) = 0.02 in/hr
Depth of field sample (consider rooting depth of crops, top 40% is where roots get most of the water)
Soil Moisture Deficit (SMD) (from field determination)

Find: Approximate Irrigation Run Time Required to increase Available Soil Moisture in root zone to near 100% (field capacity)

Look at 2 potential soil moisture findings

#1 – soil moisture down to **sample depth of 9"** is found to be depleted by 15% (SMD = 15%; 85% moisture available)

a) find inches of water depleted
15% of 1.24 in/ft = 0.15 X 1.24 = 0.19 in/ft depleted
for 9" depth, water needed is 9/12 of 0.19 in/ft = 9/12 X 0.19 = 0.14" needed to replenish 9" of soil

b) find length of time to irrigate to refill 9" of soil to field capacity

0.14" ÷ 0.02 in/hr = **7 hours of irrigation time needed**

#2 – soil moisture down to **sample depth of 12"** is found to be depleted by 30% (SMD = 30%; 70% moisture available)

a) find inches of water depleted
30% of 1.24 in/ft = 0.30 X 1.24 = 0.37 in/ft depleted
for 12" depth, water needed is 12/12 of 0.37 in/ft = 12/12 X 0.37 = 0.37" needed to replenish 12" of soil

b) find length of time to irrigate to refill 12" of soil to field capacity

0.37" ÷ 0.02 in/hr = 18.5 hours = 18 + (0.5 X 60 min/hr) =**18 hours 30 minutes of irrigation time needed**

Irrigation Application Record

Year _____

Contract Holder: _____

(to be completed by contract holder)

Tract/Field/Block/Zone:		Crop:	

date	beg. soil moisture (% depletion & smd**, or meter reading)	depth of soil moisture determin-ation	irrigation req'd? yes/no	how long do I need to irrigate?	irrigation start time	irrigation end time	A. net system application rate (in/hr) (= delivery rate x efficiency)	B. total time irrigated (min)	C. total inches irrigated (= A x B/60)	D. rainfall inches	total inches applied (= C + D)	end. soil moisture (% depletion & smd**, or meter reading)

* If using hand method refer to USDA NRCS Program Aid Number 1619, "Estimating Soil Moisture by Feel and Appearance", April 1998

** smd is soil moisture deficit or depletion, inches, as defined in USDA NRCS Program Aid Number 1619

fertilizer or chemical applied/ other notes	

Sheet 9 - Irrigation Application Record Sheet Page _____ *of* _____

Soil Moisture Observations & Measurements

Year _____

Contract Holder: _____

(to be completed by contract holder)

Tract/Field/Block/Zone:	

soil moisture monitoring method *					
observe soil moisture below at 6" - 9" deep at least 3 times per week & record below			observe deep soil moisture at 18" - 24" deep at least once every 2 weeks & record below		
date	depth (inches)	soil moisture (% depletion & smd**, or meter reading)	date	depth (inches)	soil moisture (% depletion & smd**, or meter reading)

* If using hand method refer to USDA NRCS Program Aid Number 1619, "Estimating Soil Moisture by Feel and Appearance", April 1998

** smd is soil moisture deficit or depletion, inches, as defined in USDA NRCS Program Aid Number 16

notes	

Sheet 10 – Soil Moisture Records Page _____ *of* _____

Irrigation System Maintenance Record

Year _____

Contract Holder: _____

(to be completed by contract holder)

date	maintenance performed, notes

Sheet 11 - Maintenance Record Sheet Page _____ *of* _____

(c) Irrigation related management

Determining when to irrigate a specific crop requires

(MAD) of the available soil water. MAD is defined as the percentage of the available soil water that can be depleted between irrigations without serious plant moisture stress. MAD is expressed as:

- a percentage of the total Available Water Content (AWC) the soil will hold in the root zone,
- a soil-water deficit (SWD) in inches, or
- an allowable soil-water tension level.

Different crops tolerate different soil-water depletion levels at different stages of growth without going into moisture stress. Some crops have critical growth periods during only one stage of growth, while others have critical periods during several stages of growth.

MAD should be evaluated according to crop needs, and, if needed, adjusted during the growing season. Values of MAD, during the growing season are typically 25 to 40 percent for high value, shallow rooted crops; 50 percent for deep rooted crops; and 60 to 65 percent for low value deep rooted crops.

Recommended MAD values by soil texture for deep rooted crops are:

- Fine texture (clayey) soils 40%
- Medium texture (loamy) soils 50%
- Coarse texture (sandy) soils 60%

Table 3–2 displays adapted irrigation methods for various crops, and table 3–3 lists recommended MAD levels by crop development stages for a few crops. Caution: Medium to fine textured soils can reduce MAD values given in this table.

Table 3–3 Recommended Management Allowable Depletion (MAD) for crop growth stages (% of AWC) growing in loamy soils 1/,2/

Crop	Crop growth stage			
	Establishment	Vegetative	Flowering yield formation	Ripening maturity
Alfalfa hay	50	50	50	50
Alfalfa seed	50	60	50	80
Beans, green	40	40	40	40
Beans, dry	40	40	40	40
Citrus	50	50	50	50
Corn, grain	50	50	50	50
Corn, seed	50	50	50	50
Corn, sweet	50	40	40	40
Cotton	50	50	50	50
Cranberries	40	50	40	40
Garlic	30	30	30	30
Grains, small	50	50	40 3/	60
Grapes	40	40	40	50
Grass pasture/hay	40	50	50	50
Grass seed	50	50	50	50
Lettuce	40	50	40	20
Milo	50	50	50	50
Mint	40	40	40	50
Nursery stock	50	50	50	50
Onions	40	30	30	30
Orchard, fruit	50	50	50	50
Peas	50	50	50	50
Peanuts	40	50	50	50
Potatoes	35	35	35	50 4/
Safflower	50	50	50	50
Sorghum, grain	50	50	50	50
Spinach	25	25	25	25
Sugar beets	50	50	50	50
Sunflower	50	50	50	50
Tobacco	40	40	40	50
Vegetables				
1 to 2 ft root depth	35	30	30	35
3 to 4 ft root depth	35	40	40	40

For medium to fine textured soils:
1/ (Most restrictive MAD) Some crops are typically not grown on these soils.
2/ Check soil moisture for crop stress point approximately one-third of the depth of the crop root zone.
3/ From boot stage through flowering.
4/ At vine kill.

(d) Rooting depth and moisture extraction patterns

The soil is a storehouse for plant nutrients, an environment for biological activity, an anchorage for plants, and a reservoir for water to sustain plant growth. The amount of water a soil can hold available for plant use is determined by its physical properties. It also determines the frequency of irrigation and the capacity of the irrigation system needed to ensure continuous crop growth and development.

The type of root system a plant has is fixed by genetic factors. Some plants have tap roots that penetrate deeply into the soil, while others develop many shallow lateral roots. The depth of the soil reservoir that holds water available to a plant is determined by that plant's rooting characteristics and soil characteristics including compaction layers and water management. The distribution of the plant roots determines its moisture extraction pattern. Figure 3–1 shows typical root distribution for several field and vegetable crops. Typical rooting depths for various crops grown on a deep, well drained soil with good water and soil management are listed in table 3–4.

For annual crops, rooting depths vary by stage of growth and should be considered in determining the amount of water to be replaced each irrigation. All plants have very shallow roots early in their development period; therefore, only light and frequent irrigations are needed. Because roots will not grow into a dry soil, soil moisture outside the actual root development area is needed for the plant to develop a full root system in the soil profile. Excess moisture in this area will also limit root development.

For most plants, the concentration of moisture absorbing roots is greatest in the upper part of the root zone (usually in the top quarter). Extraction is most rapid in the zone of greatest root concentration and where the most favorable conditions of aeration, biological activity, temperature, and nutrient availability occur. Water also evaporates from the upper few inches of the soil; therefore, water is diminished most rapidly from the upper part of the soil. This creates a high soil-water potential gradient.

Table 3–4 Depths to which the roots of mature crops will extract available soil water from a deep, uniform, well drained soil under average unrestricted conditions (depths shown are for 80% of the roots)

Crop	Depth (ft)	Crop	Depth (ft)
Alfalfa	5	Peas	2 - 3
Asparagus	5	Peppers	1 - 2
Bananas	5	Potatoes, Irish	2 - 3
Beans, dry	2 - 3	Potatoes, sweet	2 - 3
Beans, green	2 - 3	Pumpkins	3 - 4
Beets, table	2 - 3	Radishes	1
Broccoli	2	Safflower	4
Berries, blue	4 - 5	Sorghum	4
Berries, cane	4 - 5	Spinach	1 - 2
Brussel sprouts	2	Squash	3 - 4
Cabbage	2	Strawberries	1 - 2
Cantaloupes	3	Sudan grass	3 - 4
Carrots	2	Sugar beets	4 - 5
Cauliflower	2	Sugarcane	4 - 5
Celery	1 - 2	Sunflower	4 - 5
Chard	1 - 2	Tobacco	3 - 4
Clover, Ladino	2 - 3	Tomato	3
Cranberries	1	Turnips	2 - 3
Corn, sweet	2 - 3	Watermelon	3 - 4
Corn, grain	3 - 4	Wheat	4
Corn seed	3 - 4		
Corn, silage	3 - 4		
Cotton	4 - 5	Trees	
Cucumber	1 - 2	Fruit	4 - 5
Eggplant	2	Citrus	3 - 4
Garlic	1 - 2	Nut	4 - 5
Grains & flax	3 - 4		
Grapes	5	Shrubs & misc. trees	
Grass pasture/hay	2 - 4	for windbreaks	
Grass seed	3 - 4	< 10 ft tall	2 – 3+
Lettuce	1 - 2	10 – 25 ft tall	3 – 4+
Melons	2 - 3	> 25 ft tall	5+
Milo	2 - 4		
Mustard	2	Other	
Onions	1 - 2	Turf (sod & lawn)	1 - 2
Parsnips	2 - 3	Nursery stock	1 - 3
Peanuts	2 - 3	Nursery stock	pots

NEH 15, Chapter 11, Table 11-1-Range in available water-holding capacity of soils of different texture*

	Inches of water per foot of depth	
	Range	Average
1. Very coarse texture-very coarse sands	0.40 to 0.75	0.6
2. Coarse texture-coarse sands, fine sands, and loamy sands	0.75 to 1.28	1.0
3, Moderately coarse texture-sandy loams	1.25 to 1.75	1.5
4. Medium texture-very fine sandy loams, loams, and silt loams	1.50 to 2.30	2.0
5. Moderately fine texture clay loams, silty clay loams, and sandy clay loams	1.75 to 2.50	2.2
6. Fine texture-sandy clays, silty clays, and clays	1.60 to 2.50	2.3
7, Peats and mucks	2.00 to 3.00	2.5

*Chapter 1, Section 15, Soil-Plant-Water Relationships

NEH 15, Chapter 1, Table 1 -4.-Ranges in available water content by soil textural classes

Textural class	Inches of water per inch of soil depth or cm of water per cm of soil depth
Very coarse sand	0.03 - 0.06
Coarse sand-loamy sand	0.06 - 0.10
Sandy loam-fine sandy loam	0.10 - 0.14
Very fine sandy loam-silt loam	0.12 - 0.19
Sandy clay loam--clay loam	0.14 - 0.21
Sandy clay--clay	0.13 - 0.21
Peat and muck	0.17 - 0.25