Center Pivot Irrigation Water Management Plan Help Sheet

The "Plan Summary" on page 1 is based on the data entered/derived throughout the plan.

1. Any System issues.
2. MAD (%).
3. MAD (inches)
   *(**Note**: This is the "checking account balance at field capacity" and therefore when it gets to zero it is the amount required to fill the rooting zone. You may want to see if you can leave a little room for rainfall by not completely filling the rooting zone in which case the irrigation depth would be slightly less than the MAD in inches.)*
4. Any recommended adjustments to MAD throughout the growing season depending on plant growth stage.
5. Any issues regarding application depth or residue management from the CPNozzle simulation.
6. Weather tracking to account for rainfall.
7. Rain gauge needs both for measuring rainfall and irrigation events.
8. Methods of determining soil moisture.
9. Method used to determine when and how much to irrigate.
10. Any additional information based on "Additional Recommendations in Section 6 (top of page 9).

The "System Description" on page 2 is a short site specific description so everyone knows which particular pivot the plan is for and any other site specific details.

The italicized bolded text are intended as guidance based on the input to the previous field.

Also, the "References" section is where you can get some of the required materials/information.

The WEB Soil Survey (WSS) is the recommended method to obtain soils data. The steps to use the WSS are as follows:

1. Use the web browser to go to Web Soil Survey, the click "Start WSS" on the home page.
2. Locate your fields using the methods available in the WSS (address, state and county, map, etc.).
3. Select VIEW each time to retrieve the requested data.
4. Zoom into your location using the magnifying glass with the + symbol.
5. Use the Area of Interest (AOI) tool to select the specific field of interest.
6. Select the SOIL DATA EXPLORER tab and soil series identifications will appear.
7. Select the SOIL PROPERTIES AND QUALITIES tab and under that the SOIL PHYSICAL PROPERTIES sub menu.
8. One at a time select WATER CONTENT, 15 BAR (PWP) and WATER CONTENT, One-Third bar (Fc) as shown on WSS input screen.
9. Under Aggregation Method be sure to select WEIGHTED AVERAGE and select the correct depth units and enter your managed root zone depth (inches).
10. The WSS will provide a depth weighted summary of Fc and PWP along with the area and % area of each within the AOI

Use the TAB KEY to navigate through the different fields.

Center Pivot Irrigation Water Management Plan

Client _____ Contract No. _____ CIN _____

Farm _____ Tract _____ Operator Field No. _____

County _____ Location T _____ R _____ S _____

Planner _____ Plan Date _____

Irrigation Water Management: The process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner. For information on Irrigation Water Management, see Wisconsin NRCS Conservation Practice Standard 449.

Plan Summary

Resource Concern

Objective

System Description

Plan Developed By

(print) (sign) (date)

Landowner Approval

(print) (sign) (date)

Certified by NRCS Representative **Engineering Job Class** _____

(print) (sign) (date)

Section 1: System Information and Evaluation

1) Water Source: _____

2) Water Quantity or Quality Concerns or Restrictions: _____

3) Sprinkler Design Package Available? ☐ Yes ☐ No

Note: most of the system information is contained in the sprinkler design package, if available from the landowner or supplier

4) System Capacity (gpm): 1 Power Source: ☐ Electric ☐ Diesel ☐ Other

5) Flow Meter? ☐ Yes ☐ No

6) Center Pivot Wetted System Length (ft.): _____

7) End Gun? ☐ Yes ☐ No If Yes: End Gun Radius (ft.) _____

End Gun Capacity (gpm) _____

8) Acres Irrigated by Center Pivot: 1

9) Age of Sprinkler Package (years): _____

Note: if sprinkler package is more than 10 years old, uniformity may be affected

10) System Pressure at Pivot Point (psi): _____ Working Pressure Gauge? ☐ Yes ☐ No

11) Mounting Height of Sprinklers (ft.): _____

12) Wetted Diameter of Last Sprinkler in Outer Span (ft.): _____

13) Pressure Regulators? ☐ Yes ☐ No If Yes, Rated Outlet Pressure (psi):

Note: if no, refer to Figure 1 of Appendix to determine if field elevation changes are excessive. Uniformity may be affected

14) Available System Uniformity Check: CPED or Manufacturer's Value: _____ Date _____

Catch Can Value: _____ Date _____

On-Site Visual Check? ☐ Yes ☐ No Date _____

If yes, provide a description of visual observations:

Note: for on-site visual check, sunrise or sunset provides good light angle for visualizing sprinkler pattern, also check for varying crop heights, crop color, and crop response

15. Use of Fertigation/Chemigation? ☐ Yes ☐ No

Note: if yes, the following are required: back-flow preventer installed and NRCS 590 plan and 595 plan followed for irrigated acreage. Recommended current system uniformity check (within the last 5 years)

Section 2: Crop Information MAD (in.) column will automatically populate upon completion of section 3

Year	Crop	Emergence Date	[1]Rooting Depth (in.)	Residue (%)	[2]MAD (%)	[3]MAD (in.)
						0.00
						0.00
						0.00
						0.00

[1]See Table 1 in Appendix for recommended crop rooting depths.
[2]MAD – Management Allowable Depletion is the fraction in percent of total available soil moisture allowed to be depleted before irrigation begins. Typical values are 50% for field crops and 35% for potatoes and vegetables. Contact UW Extension for more specific recommendations.
[3]MAD (in.) = (AWC(%)/100) × Rooting Depth (in.) × (MAD(%)/100). See section 3 for AWC(%) value.

ET – Evapotranspiration is water lost from the soil surface by evaporation and water lost from the crop by transpiration. ET varies throughout the growing season with a peak value of 0.3 inches per day, or 5.66 gpm per acre for most crops in Wisconsin. In the absence of rainfall, irrigation is used to replace the water lost by ET. Assuming an irrigation application efficiency of 90% for a center pivot in good working order, then the gross irrigation requirement is 5.66/0.9 or 6.3 gpm per acre.

Peak Demand System Capacity = (6.3 gpm/acre) x (acres irrigated by center pivot).

Peak Demand System Capacity = 6.3 gpm.

(System Capacity)/(Peak Demand System Capacity) × 100 = 15.9 %.

Note: If system capacity from Section 1 is less than Peak Demand System Capacity, then MAD may have to be adjusted accordingly to keep up with crop demand. If system capacity from Section 1 is less than 80% of Peak Demand System Capacity, other strategies may have been taken.

Note: Assumes 24 hour/day operation. Off-peak electric use and/or maintenance downtime also affects the ability of the system to keep up with crop demand.

Section 3: Soils Information

Place Web Soil Survey Soils Map in the box below:

Section 3: Soils Information (cont.)

Place the following items in the box below: 1) Field Capacity Moisture (%) @ ⅓ bar (based on rooting depth), 2) Permanent Wilting Point Moisture (%) @ 15 bar (based on rooting depth), 3) Saturated Hydraulic Conductivity (Ksat for subsoil - 12” to 36” depth).

***Table in Section 2 must have the “Rooting Depth” column already filled in for this table to calculate.**

	Soil Types & Texture	Rooting Depth (in.)	Field Capacity (% moisture)	Permanent Wilting Point (% moisture)	[1]AWC (%)
Predominant Soil Managed for AWC					0.00
					0.00
					0.00
					0.00

[1]AWC - Available Water Content (%) = Field Capacity (%) minus Permanent Wilting Point (%)

	Soil Types & Texture	Maximum Field Slope	Maximum Application Rate (in./hr.)
Runoff Indicator Soil			

Section 4: Potential Irrigation Runoff Evaluation

Place CPNozzle Input and Output in box below

Note: weighted average percent runoff should be less than 5%
Note: see Table 2 in Appendix for intake family

On-Site Irrigation Runoff Evaluation

[1]Over Application Water Inefficiency Visual Observation	Yes	No
Excess ponding of water?		
Runoff during irrigation, which carries sediment?		
Rills caused by the irrigation? (*they should appear even when precipitation has not occurred*)		
Yellowing of plants because of lack of O_2 or N deficiency?		
Sediment deposition at the bottom of slope?		

[1]Typically occurs at the steepest part of the field and/or the outer end of the center pivot

Section 5: Irrigation Scheduling Information and Documentation

1) Method used for weather forecasting: ☐ Local Weather Forecast ☐ Internet Weather Site

2) Method used to determine rainfall amount:

   ☐ In field rain gauges ☐ In field weather station ☐ Local rainfall data

   Note: Recommend installing a minimum of three rain gauges in field irrigated by center pivot. Typically placed on access road to pivot point. Install at ~25%, ~50%, and ~75% of system wetted length. Install per manufacturer's recommendations to avoid interference with collecting rainfall or irrigation water.

3) Method used to determine irrigation depth applied:

   ☐ In field rain gauges ☐ Center pivot manufacturer's calibration chart

   Note: Recommend use of rain gauges.

4) Method used to determine soil moisture:

   ☐ Soil moisture sensors ☐ Wisconsin Irrigation Scheduling Program (WISP)

   Note: See Table 1 in Appendix for recommended placement of sensors in crop root zone.

   Recommend using both soil moisture sensors and WISP. May require trail and error to get agreement between both methods.

   Recommend plotting sensor readings to visualize sensor response.

   Soil Moisture Field Capacity can be determined after a good soaking rain for calibration of moisture sensors.

   If deep sensor indicates an increase in moisture content after an irrigation event, this indicates possible loss of water below the root zone. Adjust irrigation scheduling accordingly to prevent deep percolation.

5) Method used to determine when and how much to irrigate:

   ☐ Paper Copy of "Checkbook" Moisture Balance using crop ET and MAD

   ☐ Use of Computerized "Checkbook" Irrigation Scheduling software using crop ET and MAD

   ☐ Use of moisture sensors and MAD

   Note: Recommend tracking crop ET as a check even if using soil moisture sensors.
   Note: See Section 7: References for irrigation scheduling information, software programs, and forms.

Section 6: Additional Recommendations

Recommend on-site verification of soils. Also, check for root inhibiting layers and evidence of actual rooting depths. In addition, information on tillage, residue management, and field slopes can be obtained.

Recommend promoting crop residue management to reduce evaporation losses, to maintain good infiltration, to provide surface storage of applied water, and to increase organic matter for increased available water content, and to reduce runoff.

Recommend optimizing use of rainfall to reduce unnecessary irrigations during the growing season. This can be accomplished by not filling the root zone to field capacity (i.e. applying less than the full MAD amount indicated by irrigation scheduler).

Full rooting depth takes time to develop. Recommend lower MAD values until full rooting depth is established.

Section 7: References

http://fyi.uwex.edu/cropirrigation/wisconsin-irrigation-scheduling-program-wisp/

The Wisconsin Irrigation Scheduling Program (on-line with automated ET values)

UW-Extension Irrigator Scheduler Excel Spreadsheet & Quick Guide (ET values will need to be obtained from UW-Extension and entered in spreadsheet.)

Irrigation Management in Wisconsin Publication A3600-01 (Overview of Irrigation Water

Management with example and form for manual paper copy of “Checkbook” scheduling method. ET values will need to be obtained from UW-Extension and entered on paper copy.)

Methods to Monitor Soil Moisture Publication A3600-02

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/ndcsmc/?cid=stelprdb1042198

CPNozzle Software program

http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Web Soil Survey

CPNozzle User’s Guide 2012 USDA NRCS-Nebraska

Uniformity of Water Distribution Test Procedure for Center Pivot and Lateral Move Irrigation Systems

University of Wisconsin-Madison Biological Systems Engineering

Appendix

Figure 1. Elevation change that requires pressure regulators

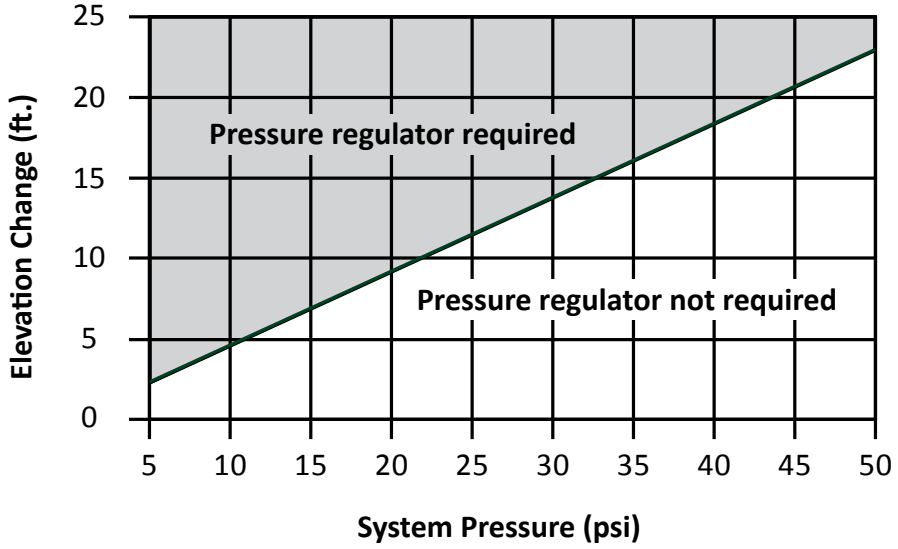

Table 1. Roof Zone/Irrigation Management Range and Senor Placement Depths by Crop Type

Crop Type	Irrigation Management Depth (in.)	Shallow Sensor Depth (in.) @ 25%	Deep Sensor Depth (in.) @ 75%
Broccoli & Cauliflower	12-18	3-4	9-13
Blueberry & Strawberry	12-18	3-4	9-13
Potato*	16	4	12
Tomato & Cantaloupe	12-24	3-6	9-18
Dry, Snap & Green Bean	18-24	4-6	13-18
Soy Bean	30-36	7-9	22-27
Small Grains	30-36	7-9	22-27
Sweet Corn & Asparagus	34-30	6-7	18-22
Field Corn	30-36	7-9	22-27
Established Alfalfa	36-48	9-12	27-36

*Measured from the top of the hill.
From Wisconsin Irrigation Scheduler Quick Guide by the University of Wisconsin Extension

Table 2. NRCS Intake Family Descriptions

NRCS Intake Family	Soil Texture	Description
0.1	Clay, silty clay, silty clay loam	Slowly permeable subsoils
0.3	Silt loam, loam, very fine sandy loam, clay loam, silty clay loam, sandy clay loam	Slow to moderately slow permeable subsoils
0.5	Silt loam, loam, very fine sandy loam	Moderately slow permeable subsoils
1.0	Fine sandy loam, loamy fine sand, silt loam, loam, very fine sandy loam	Moderate, moderately slow, moderately permeable, medium textured, moderately rapidly permeable subsoils underlain by bedrock or mixed sand & gravel
1.5	Fine sandy loam, loam, sandy loam	Moderately rapid, moderate subsoils under-lain by bedrock or mixed sand & gravel
2.0	Loam fine sand or loamy sand	Moderately rapid to rapidly permeable subsoils
3.0	Loamy sand, loamy find sand, find sandy loam, fine sand	Rapidly permeable subsoils

From CPNozzle User's Guide 2012
USDA NRCS Nebraska

Ksat (µm/sec)	Permeability (in/hr)	Permeability Class	Texture[1]
705.00 (max)	100.00	Very Rapid[2]	S, VFS, FS, COS
141.14	20		
		Rapid	LS, LVFS, LFS, LCOS
100	14.17		
42.34	6.0		
		Moderately Rapid	SL, VFSL, FSL, COSL, L, SIL, SI (<20% clay)
14.11	2.0		
10.00	1.417	Moderate	SCL, L, SIL (20-27% clay)
4.23	0.6		
		Moderately Slow	CL, SICL, SCL (27-35% clay)
1.41	0.20		
1.00	0.1417	Slow	C, CL, SC, SICL, SIC (35-60% clay)
0.42	0.06		
0.10	0.01417	Very Slow	C (>60% clay)
0.01	0.001417		
0.00	0.00	Impermeable	Bedrock, cemented pans