Irrigation System Evaluation & Basic Irrigation Scheduling Tools

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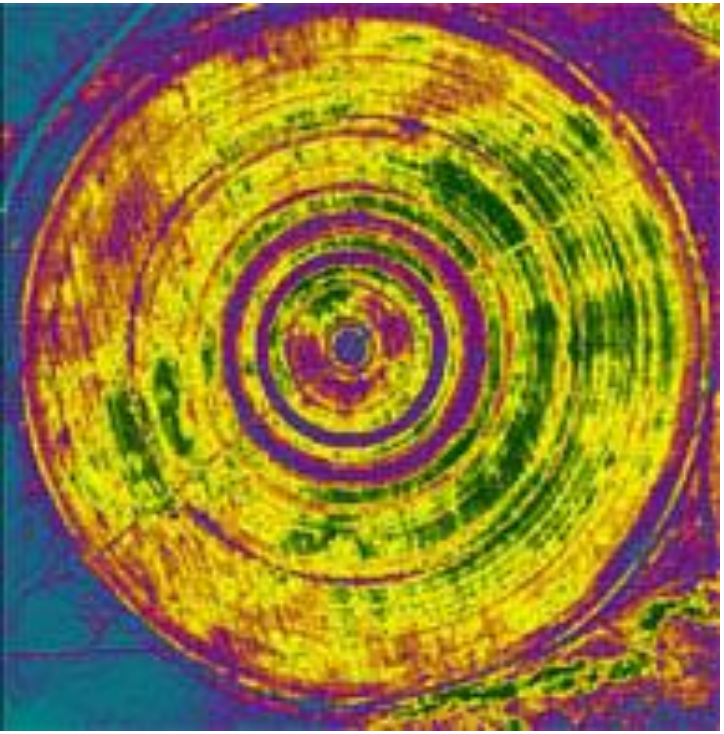
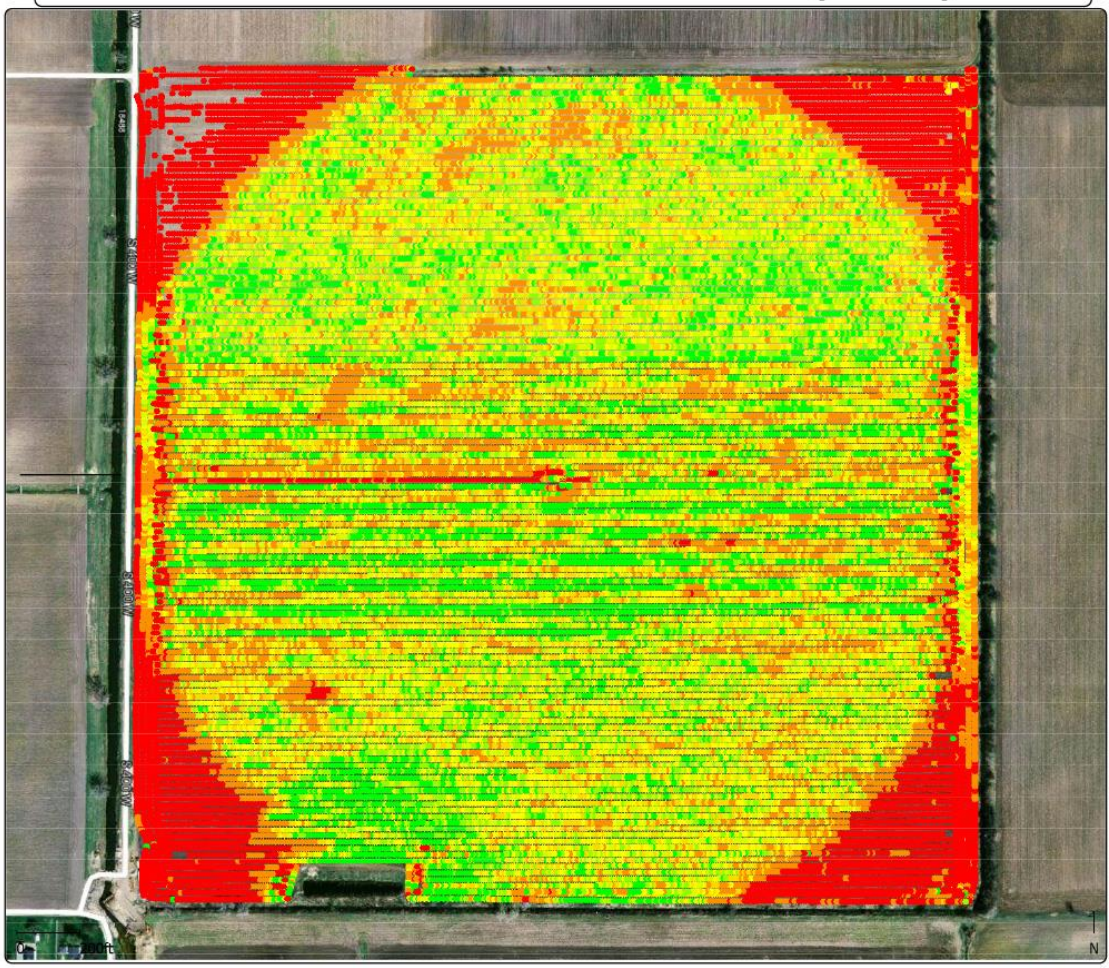
http://msue.anr.msu.edu/resources/irrigation

https://engineering.purdue.edu/ABE/Engagement/Irrigation

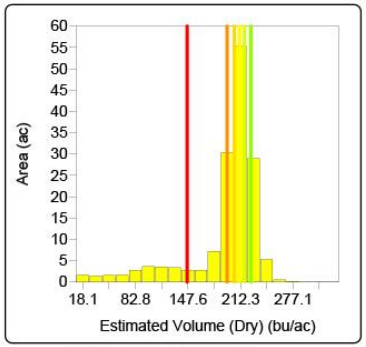
Have you seen yield map patterns that match the irrigation system configuration?



Grain Harvest 2012 - Good South(CORN)



Grower : [redacted]
Farm : Good
Field : Good South
Year : 2012
Operation : Grain Harvest
Crop / Product : CORN
Op. Instance : Harvest - 1
Area : 152.77 ac
Avg. Yield : 187.77 bu/ac
Avg. Moisture : 18.55 %



Estimated Volume (Dry)
(bu/ac)
225.46 - 399.32 (21.80 ac)
217.56 - 225.46 (22.02 ac)
211.28 - 217.56 (22.04 ac)
204.93 - 211.28 (22.17 ac)
195.98 - 204.93 (22.32 ac)
146.88 - 195.98 (21.48 ac)
10.00 - 146.88 (20.95 ac)

Irrigation System Uniformity

An 1” application should be 1” everywhere in the irrigated field

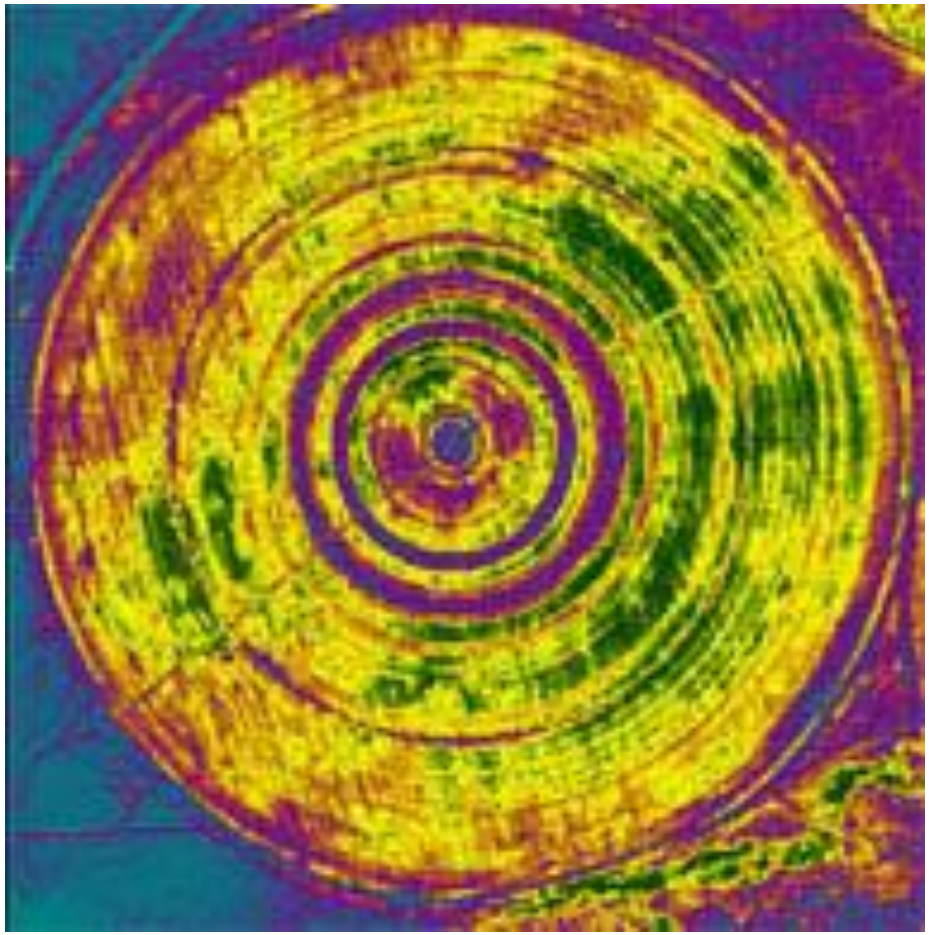
- 10% or less deviation from the average is ideal
- Over applied area will likely be over applied each application
- Under applied areas will likely be under applied each application

A 30% deviation on a field in an 8” irrigation application year will have areas receiving as little as 5.6” and as great as 10.4”

Repair all visible system leaks and problems first.

Low Uniformity
= Under Application in areas
= Reduced Yields
= Reduced Income

Even with adequate scheduling a 30% deviation in application uniformity can result in a 40% yield reduction in low application areas of the field.



30% x 40% =12%, 150 acres x 200 bu. = 30,000 12% x 30,000 3,600 bu. X $3.5/bu. = $12,600

Water savings
= Energy Savings
= Reduced Expenses
= Increase Profitability

A 30% deviation on a field in an 8” irrigation application year will have areas receiving as little as 5.6” and as great as 10.4”

- To over apply by 30% to make up for lack of uniformity will take an additional 2.4”of water.
- With average energy cost nearing $3.00/acre.
- A typical 140 acre irrigated field with a 30% deviation will cost over $1000/ year more than uniform system to irrigate.

Stick with the Plan!!!!

Make sure the system is within it’s design.

- Has the system changed in length or coverage area?
- Is the water supply flow and pressure what was designed for?
- Sprinkler height?
- End drive changes?
- Tire changes?

Irrigation System Uniformity

Irrigation System Uniformity

Basic system evaluation

Collect enough uniform container to place every 10 feet the length of the system or across the application pattern.

Spread the container every ten feet from the center point to the outside edge of the application area.

Run the system at standard setting over the container.

Measure and record the water volume caught by each container.

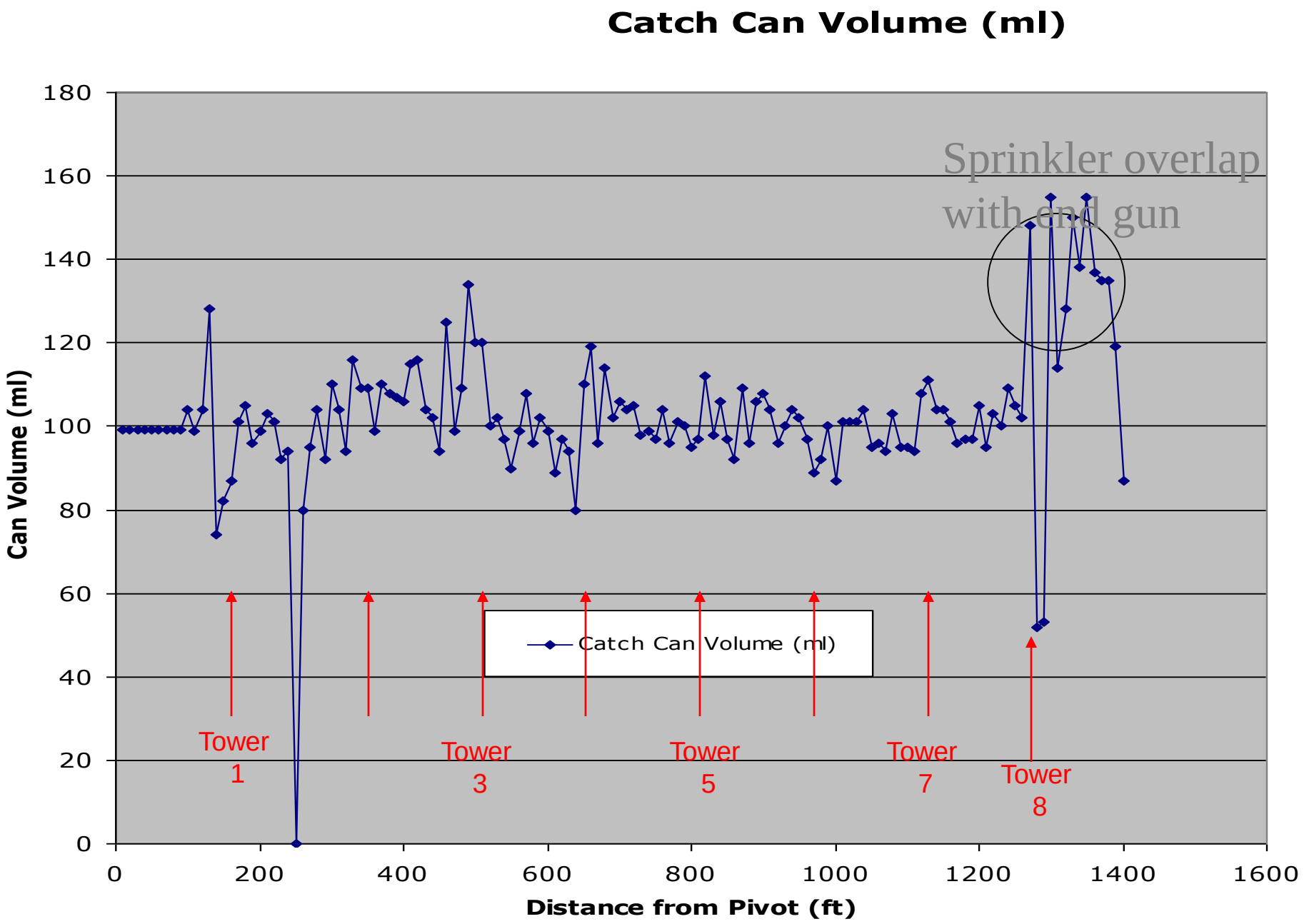
Note sample point varying greater than 50% of the average.

Evaluating Irrigation System Uniformity

Pivot Extensions (cornering arm or Z-arm)

- Some center pivot irrigation systems are designed to expand the wetted area to allow coverage of corner or odd-shaped fields, often referred to as cornering arms or Z-arm.
- These systems require two separate evaluations if the extension accounts for 30 percent or more of the irrigated portion of the field.

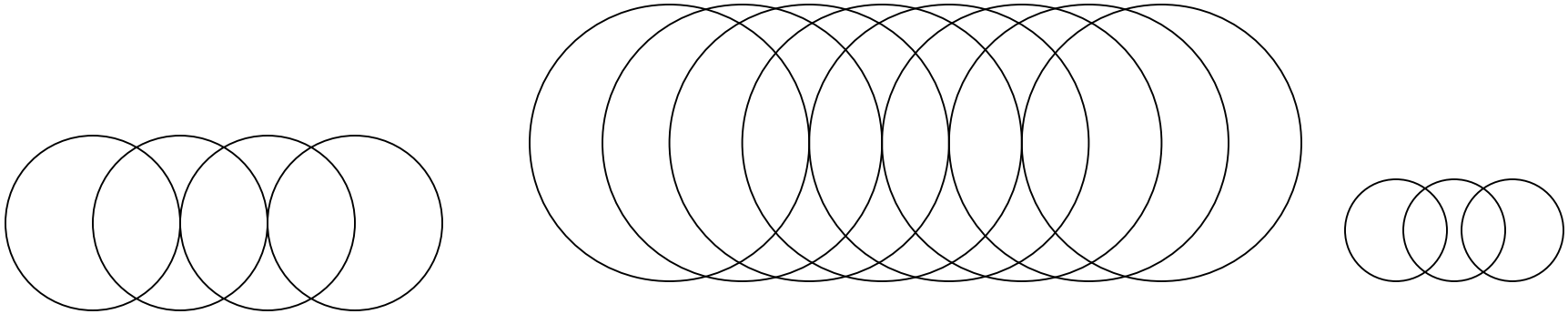
•One evaluation will evaluate the system while extended, and a second when the arm is not deployed.



http://web1.msue.msu.edu/stjoseph/anr/anr.htm

Irrigation System Uniformity

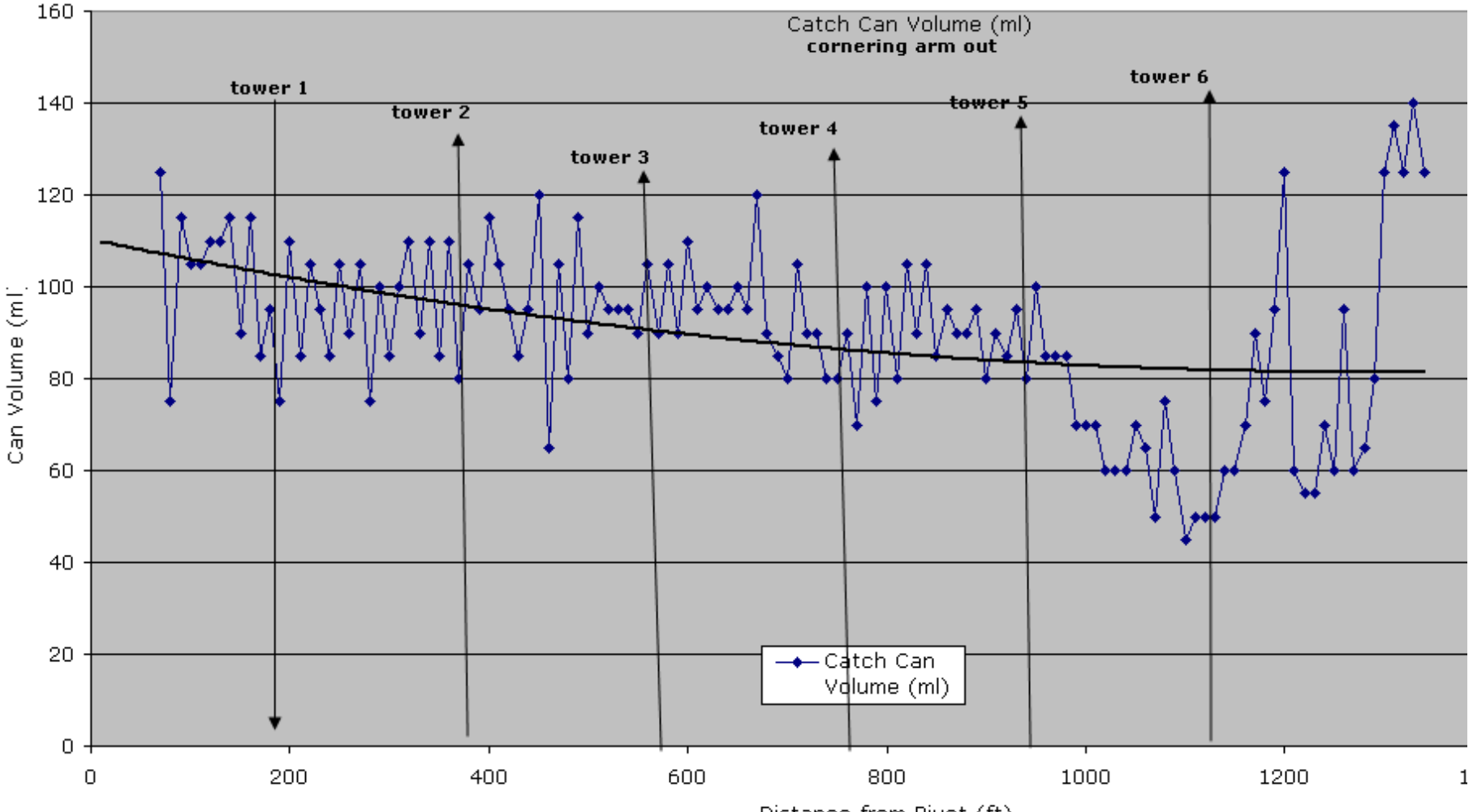
- Most systems are designed to have 90% or better uniformity
- Changes in **volume** and **pressure** from design parameters will cause reduction in uniformity
- Some sprinklers can perform well over a large change in pressure over others
- Multiple overlaps tends to reduce potential problems



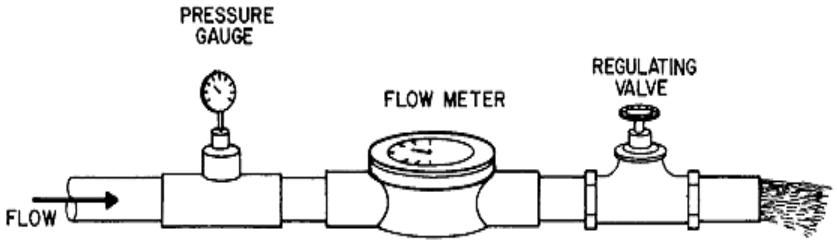
Water supply over or under design

supply over design yield tail up, supply under design yield tail down

Example of Water supply under volume for sprinkler design

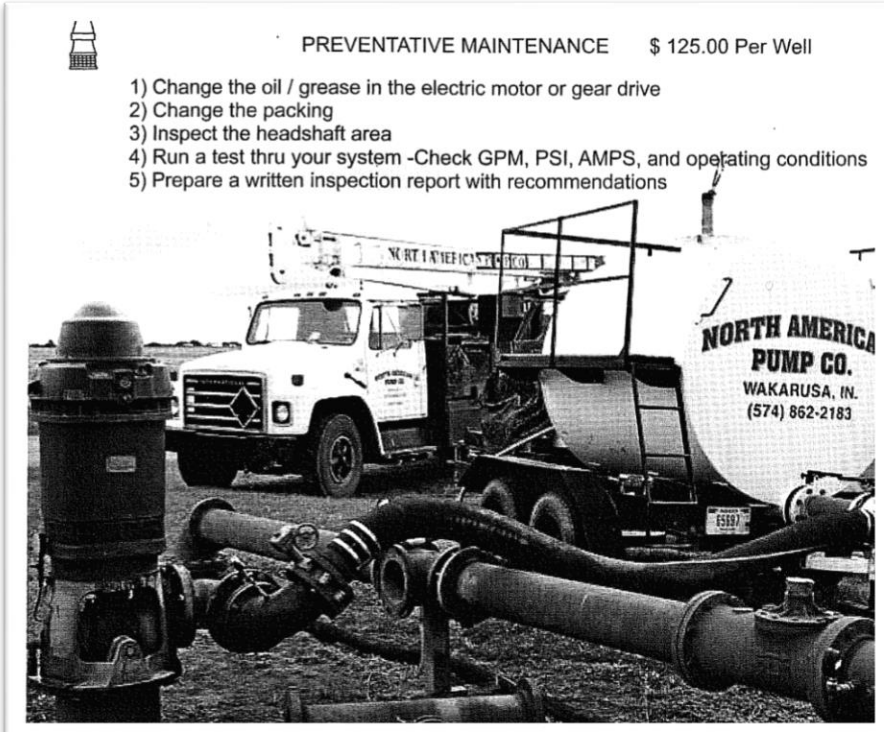


Measure flow at desired pressure and match to sprinkler package

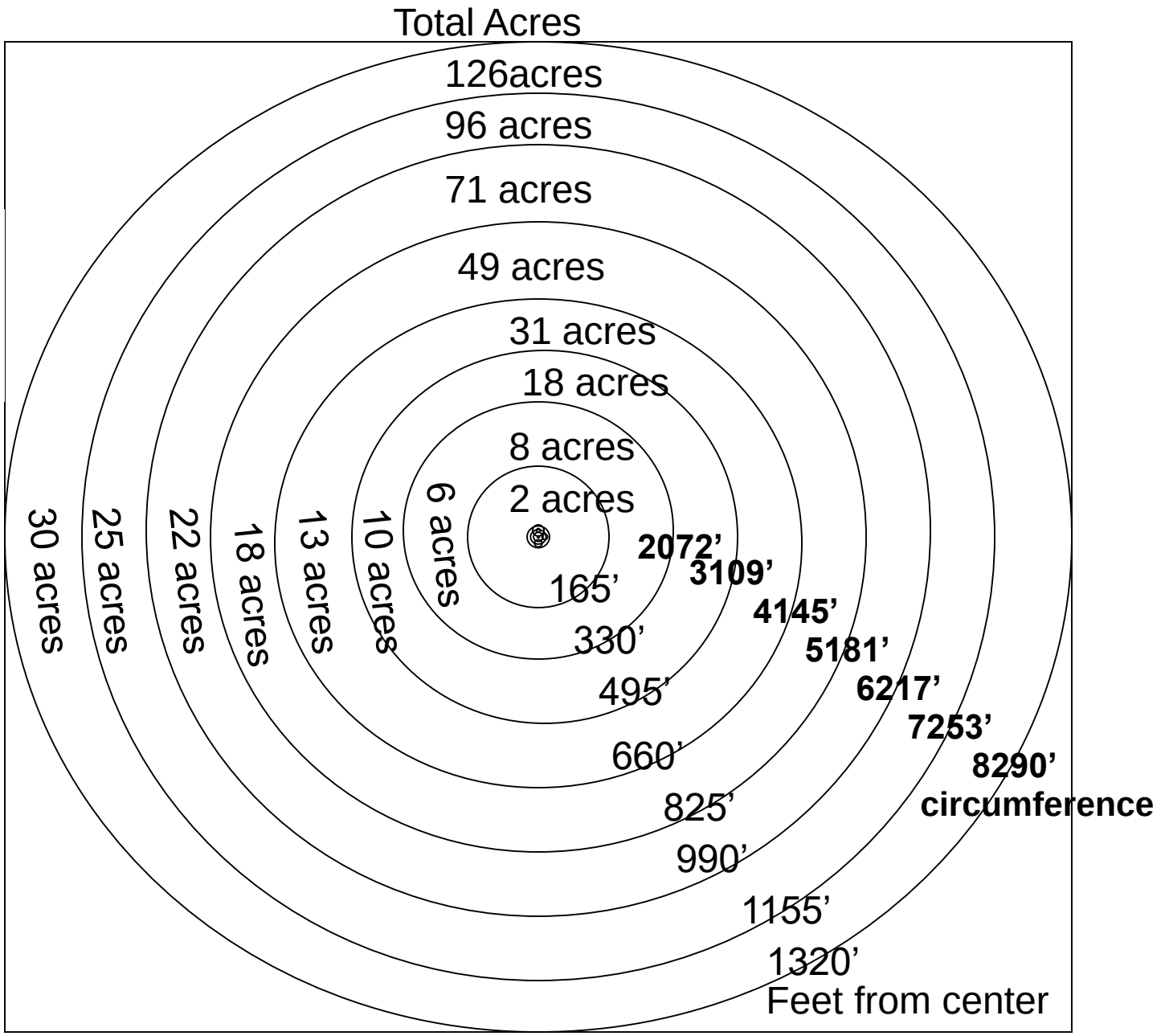


Poor performance:

Ask dealer to measure flow at peak water use season and compare to design parameters.



Over and under application issue affect the majority of the application area



MICHIGAN STATE UNIVERSITY EXTENSION

PURDUE UNIVERSITY

Center Pivot Percent Timer , Water Applied Estimator Chart

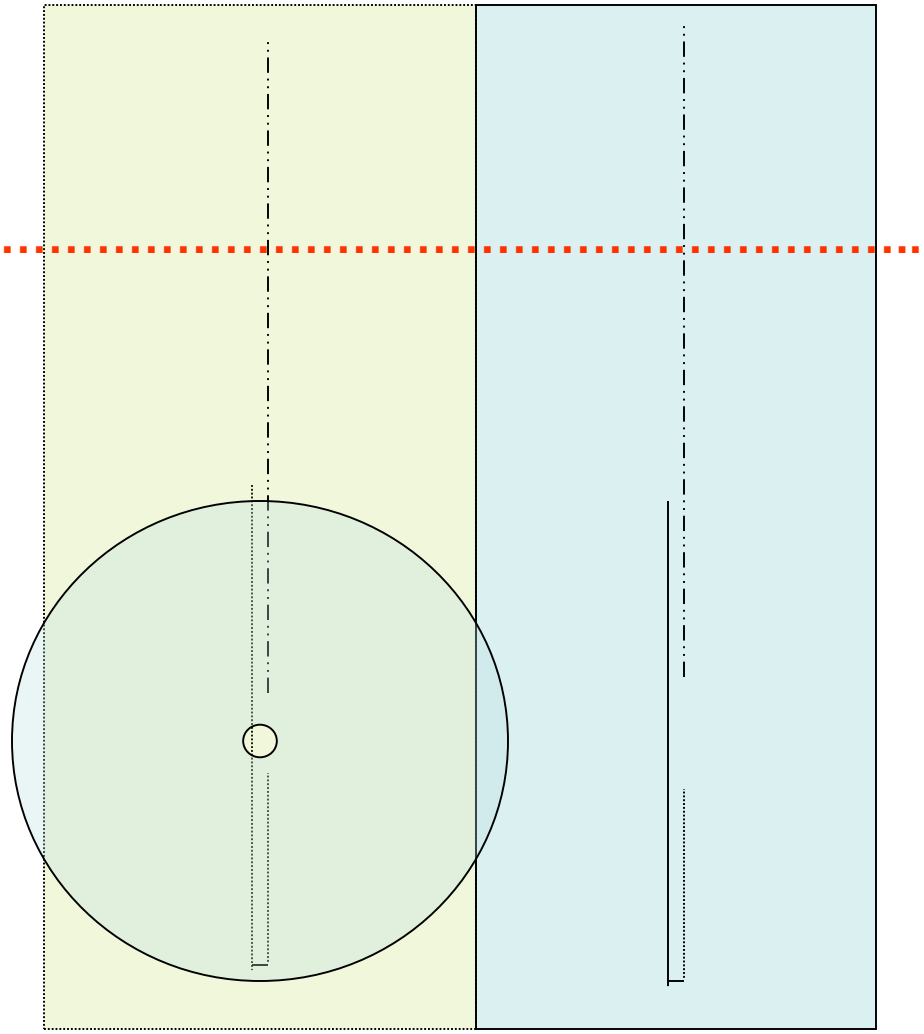
MSU Extension, St. Joseph County **V 1.0**

7/24/2007

	% Timer Setting	Hours to Run Circle	Water Applied
Measured	40	72	1.25
Estimated	5	576.00	10.00
	10	288.00	5.00
	15	192.00	3.33
	20	144.00	2.50
	25	115.20	2.00
	30	96.00	1.67
	35	82.29	1.43
	40	72.00	1.25
	45	64.00	1.11
	50	57.60	1.00
	55	52.36	0.91
	60	48.00	0.83
	65	44.31	0.77
	70	41.14	0.71
	75	38.40	0.67
	80	36.00	0.63

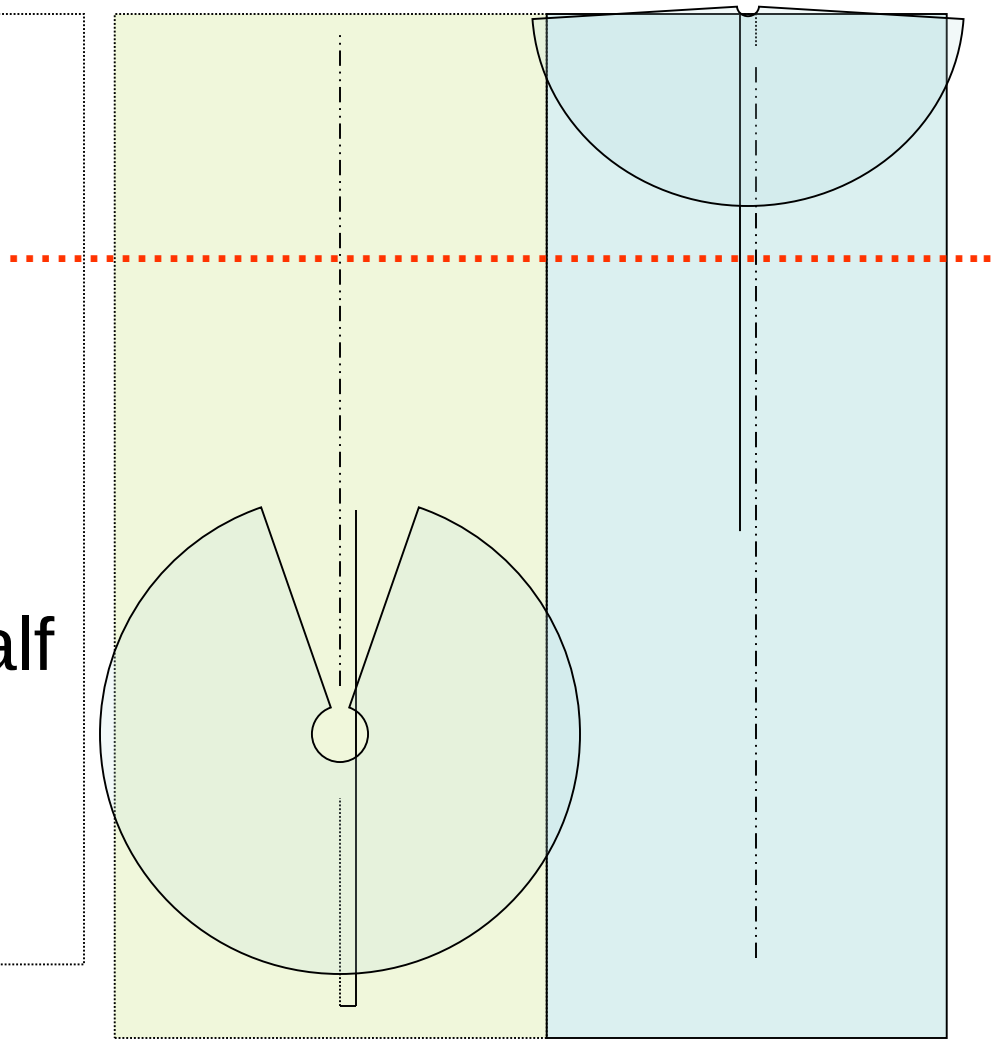
Improving Traveler Uniformity

- Check traveler uniformity by placing catch can every 10’ across the width of the coverage pattern.
- Traveler lane spacing should be adjusted to create an even application between lanes.
- Spacing will be narrower further from pump or additional pressure will need to be provided.



Improving traveler uniformity

- Measure traveler forward speed at the beginning middle and end of the run.
- Traveler forward travel speed may be reduce as more hose is being pulled in the second half of the run.
- Adjust speed accordingly.



Greatest improvement needed

Pivots

- End gun stop adjustment
- Water supply over or under design
- End gun orifice, too little or too much
- Wrong sprinkler or tip
- Leaks, plugs and **no turn sprinklers**

Trickle/Drip

- Follow a good design
- Line length matched to design
- Supply pressure issues at manifold

Big Gun Travelers

- Traveler lane gap spacing
- Water supply over or under design (pressure at gun)
- Gun orifice, tip wrong
- Wind differences

Most system apply within 85% of the expected application

MSU Extension Irrigation System Evaluation Tool, 1-23-07

Farm Name [redacted] Farm

System Uniformity Coefficient = 79

System Identification: Cornering Arm System on [redacted] Farm-Behind House

Cornering Arm Extended

Good System uniformity coefficient are 85 or greater

Deviation from desired application = -0.04

Application is 4 % under expectation

System Settings

Application rate (in)	0.5	Wind speed (mph)	4 mph
Percent timer Setting (%)	19	Wind Condition (variable or steady)	steady
Operating Pressue (psi)			

Rate of application calculator

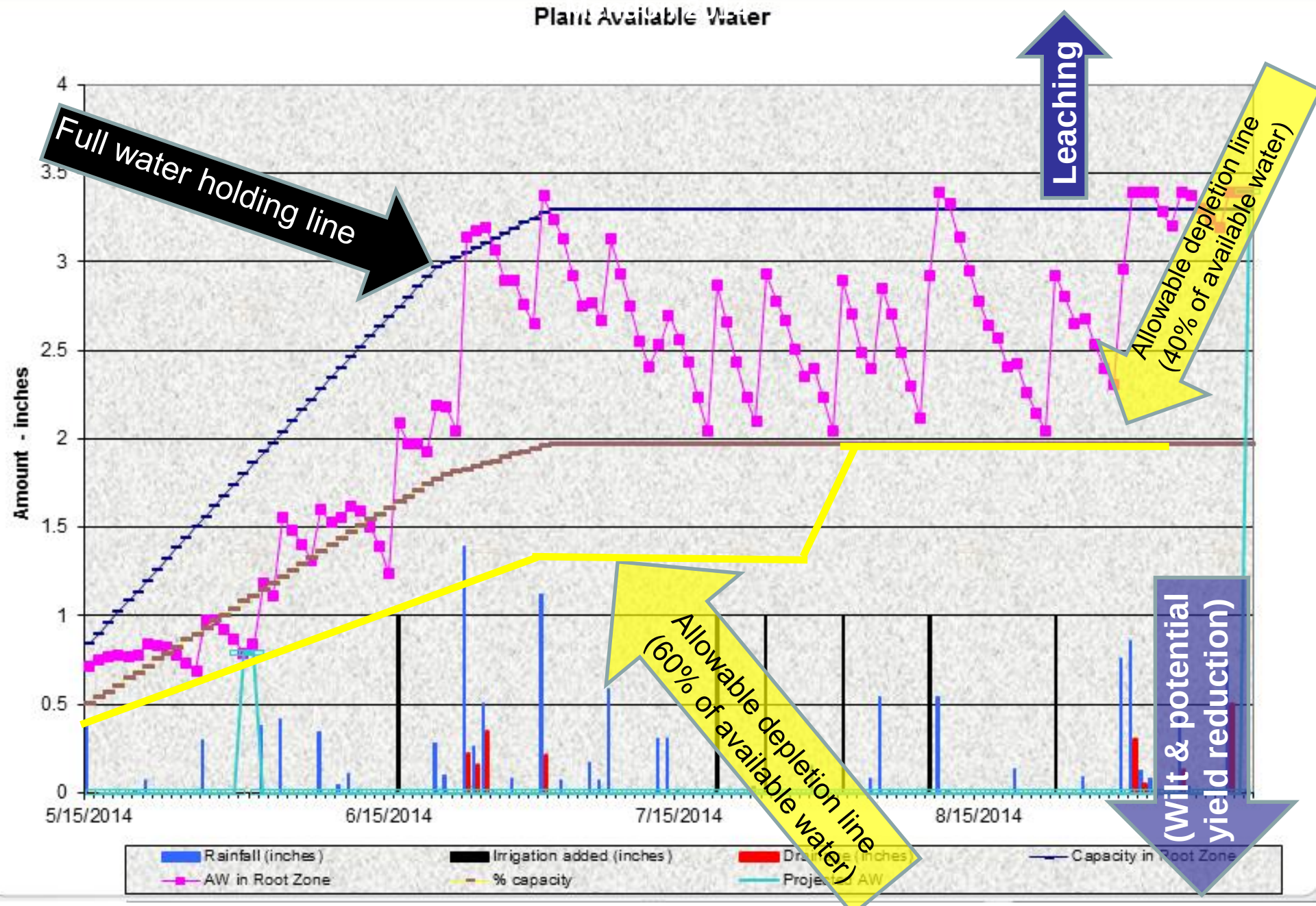
Time from start to end of application at highest rate section of system (min.)	22	Inches/Hour	1.25
Rate of application for the highest rate section of system (minute /one inch)	48.00		
Average Application (cm)			1.164
Average Application (in)			0.46
Length of evaluation area (ft)	1340		
Catch Can Spacing Distance (ft)	10		
Average catch, collected only (ml)			88.95
number of cans data collected from	129	*70% average catch can (ml)*	*59.94*
number of cans set	134	Evaluation area, full circle (acres)	122.82
catch can openning area (sq cm)			76.977
Diameter of catch can (cm)	9.9	catch can openning area (sq in)	11.767

Page 1

catch can number	Distance from center point	catch volume in ml	Data adjustment	Comments	Water volume (cm)	Water volume (in)	% applied of average	Deviation from average (%)	Area covered per catch can (acres)	Area covered per catch can (% of total)	Weighted Deviation
1	10		88.95		1.156	0.455	99.26%	-0.74%	0.01623	0.01%	0.0001
2	20		88.95		1.156	0.455	99.26%	-0.74%	0.02885	0.02%	0.0002
3	30		88.95		1.156	0.455	99.26%	-0.74%	0.04327	0.04%	0.0003
4	40		88.95		1.156	0.455	99.26%	-0.74%	0.05770	0.05%	0.0005
5	50		88.95		1.156	0.455	99.26%	-0.74%	0.07212	0.06%	0.0006
6	60		88.95		1.156	0.455	99.26%	-0.74%	0.08655	0.07%	0.0007
7	70	125	0.00		1.624	0.639	139.48%	39.48%	0.10097	0.08%	0.0011
8	80	75	0.00		0.974	0.384	83.69%	-16.31%	0.11539	0.09%	0.0008
9	90	115	0.00		1.494	0.588	128.32%	28.32%	0.12982	0.11%	0.0014
10	100	105	0.00		1.364	0.537	117.16%	17.16%	0.14424	0.12%	0.0014

Data Entry | Uniformity Graph

MSU Excel Irrigation Schedule Checkbook Method -



Average water use for CORN in inches/day –adapted From * Irrigation Scheduling Checkbook Method, Jerry Wright, University of Minnesota, 2002

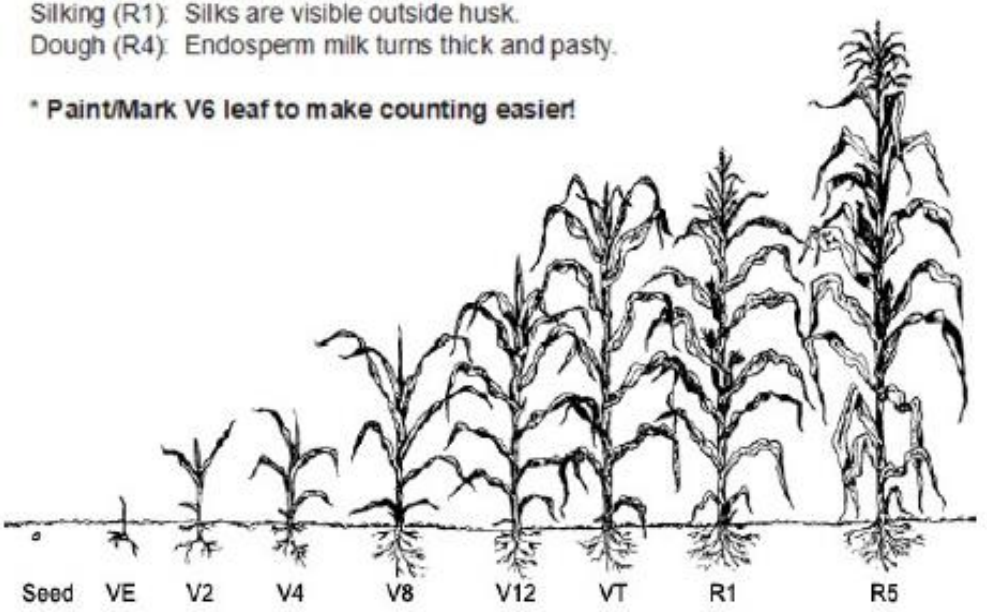
	Week after emergence																	
Temperature	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
50-59	.01	.02	.03	04	.05	.06	.08	.09	.09	.10	.10	.10	.09	.07	.06	.05	.04	.03
60-69	.02	.03	.04	.06	.08	.09	.11	.12	.13	.15	.14	.14	.13	.11	.09	.07	.06	.04
70-79	.03	.04	.05	.07	.10	.12	.15	.16	.17	.19	.19	.18	.17	.14	.11	.09	.07	.05
80-89	.03	.05	.07	.09	.13	.15	.18	.20	.22	.24	.23	.22	.21	.17	.14	.11	.09	.06
90-99	.04	.06	.08	.11	.15	.18	.21	.24	.26	.28	.27	.26	.25	.20	.17	.13	.11	.07
Corn growth stages		3 leaf			8 leaf			1st tassel	silk		blis-ter ker-nel			ear-ly dent	dent			

Crop Stage	K_c	Rooting Depth	% Growing Sea-son
V2	0.2	6	10
V4	0.20	10	15
V6	0.39	15	20
V8	0.56	20	27
V10	0.76	23	34
V12	1.0	26	50
V14	1.1	28	55
V16-VT	1.2	30	60
Silking	1.2	30	65
Blister	1.2	30	70
Dough	1.2	30	75
Begin Dent	1.2	30	80
Full Dent	1.0	30	85
Black Layer	0.66	30	90
Full Maturity	0.11	30	100

Corn Growth Stages

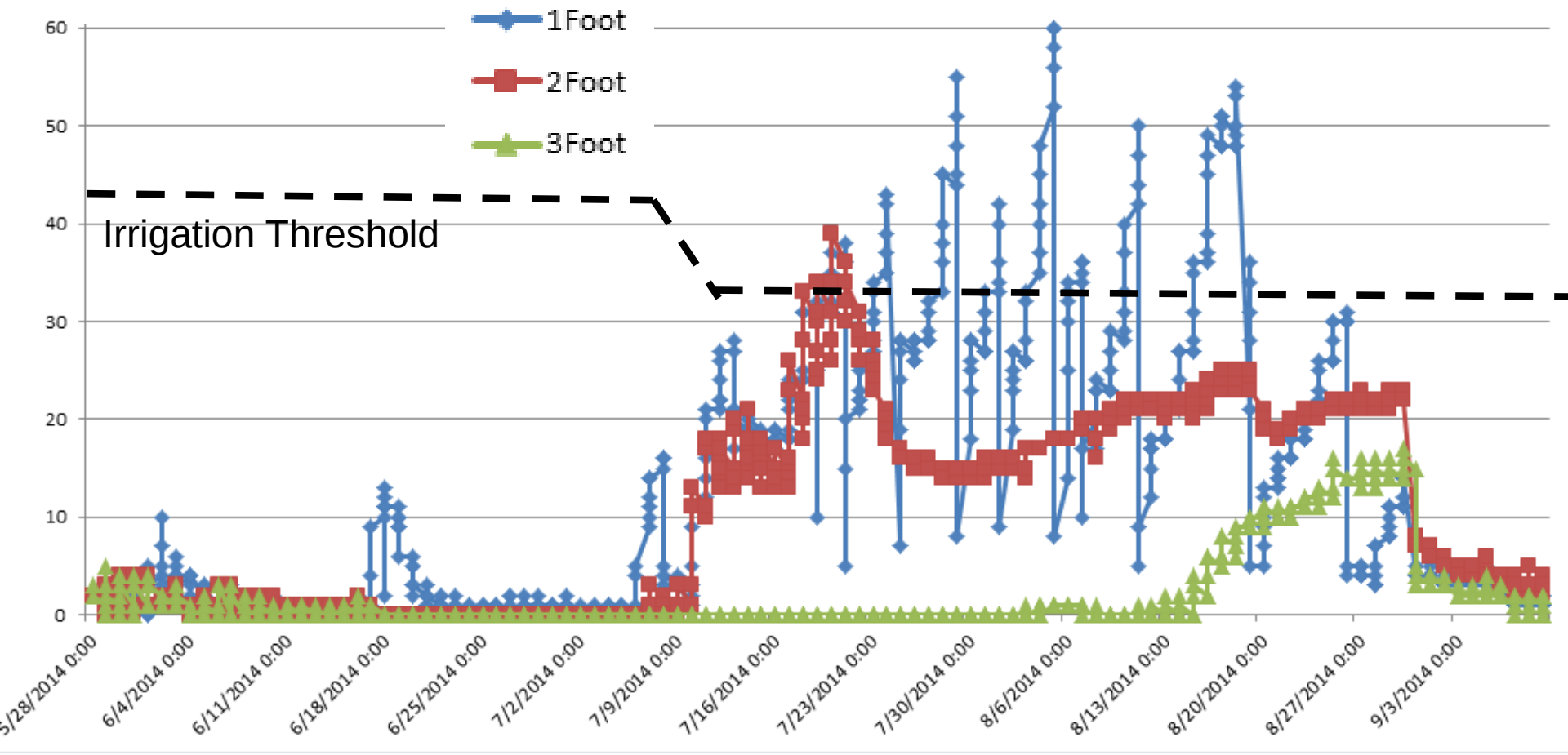
2 leaf (V2): Two collars visible.
4 leaf (V4): Four collars visible.
6 leaf (V6): Growing point above ground, tassel forms.*
8 leaf (V8): Ear formation begins.
Silking (R1): Silks are visible outside husk.
Dough (R4): Endosperm milk turns thick and pasty.

*** Paint/Mark V6 leaf to make counting easier!**



http://msue.anr.msu.edu/uploads/235/67987/resources/SoilWaterBalanceSheet.03.05.15.pdf

Watermark Soil Moisture, 2014 Soybean, Constantine MI



Cost Share Opportunities

- Natural Resources Conservation Service **(NRCS)**
  - Administers USDA Farm Bill Programs
  - Every County is covered by a local NRCS office
- Environmental Quality Incentives Program **(EQIP)**
  - Covers Entire State of Michigan
  - Cutoff Deadline: **March 17th**
- Regional Conservation Partnership Program **(RCPP)**
  - Covers St. Joseph River Watershed (MI & IN)
  - Cutoff Deadline: **March 17th** (MI)

Program Eligibility

- **Land Eligibility**
  - Written Control of Land
  - Owned, Leased, other
  - **Land under contract must have been irrigated at least 2 out of the last 5 years.**
- **Individual or Entity Eligibility**
  - Farm Service Agency (FSA) records
  - Individual or Business Entity
  - Signatory Authority

Irrigation Conservation Practices

- Irrigation System – Sprinkler (442)
  - *Physical system*
- Irrigation System – Micro (441)
  - Drip Irrigation outside or in SHT
- Irrigation Water Management (449)
  - *Management of system (any type)*

Irrigation System – Sprinkler (442)

Replace sprinkler packages and install pressure regulators on existing Center Pivot irrigation system or existing Linear-Move irrigation system.

Contract Unit = linear feet of lateral pipe (pipe where nozzles are attached)

Irrigation System – Sprinkler (442)

Scenario 1

Coefficient of Uniformity (CU) for retrofitted system must be greater than or equal to 85%.

- Only eligible for existing Center Pivot or existing Linear-Move system with CU less than 85% OR nozzles that are at least 8 years old. (Existing CU documented by in-field system evaluation.)
- Flow measurement with flow meter required for retrofit design.
- Post-retrofit CU ≥ 85% documented by in-field system evaluation, Center Pivot Evaluation and Design (CPED) , or manufacturer computer model.
- Only eligible with Irrigation Water Management (contract or conservation plan).

Irrigation System – Sprinkler (442)

- **Other scenarios for systems meeting uniformity standard.**
- Scenario 2
  - **VRI System Retrofit**
    - Used to address resource concerns related to varying field conditions. Ex: Different Soil Types, Slope, Crops etc.
- Scenario 3
  - **Fertigation Retrofit**
    - Used to address excess nutrients in surface or groundwater

Irrigation Water Management (449)

Payment Rate determined by level of management and size of field. Above or below 30 acre field size. An Irrigation Water Management Plan will be developed.

Can be used with any type of irrigation system.

- Basic - Checkbook Method Irrigation Scheduling

  Record rainfall, irrigation amounts, and soil moisture
- Intermediate

  Basic + using a computer irrigation scheduler
- Advanced

  Computer Scheduler with automatic sensors etc.