# Tools for Irrigation Stewardship

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- Irrigation System Uniformity
- Preventing Irrigation Runoff (comparing irrigation application rate to soil infiltration rate)
- Irrigation Scheduling
- Record keeping
- Avoiding water use conflicts

# Irrigation Scheduling

## Right to Farm GAAMPs

- Irrigation scheduling for each unit or field
- Irrigation scheduling is the process of determining when it is necessary to irrigate and how much water to apply
- Irrigation water is applied to replace the water used by the plant.

# Irrigation Scheduling

- Method to determine the appropriate amount of water to be applied to a crop at the correct time to achieve healthy plants and conserve water
- Can measure soil moisture
- Or estimate evapotranspiration (ET) using weather data and pan evaporation
- Potential ET measured by weighing lysimeter

# Primary Factors

- Know available soil water for each unit
- Known depth of rooting for each crop
- Know allowable soil moisture depletion at each stage of plant growth
- Use evapotranspiration data to estimate crop water use
- Measure rainfall in each field
- Use container capacity for nursery crops

# *Determining irrigation requirements*

- The plant water requirement includes the water lost by evaporation into the atmosphere from the soil and soil surface

- and by transpiration, which is the amount of water used by the plant.

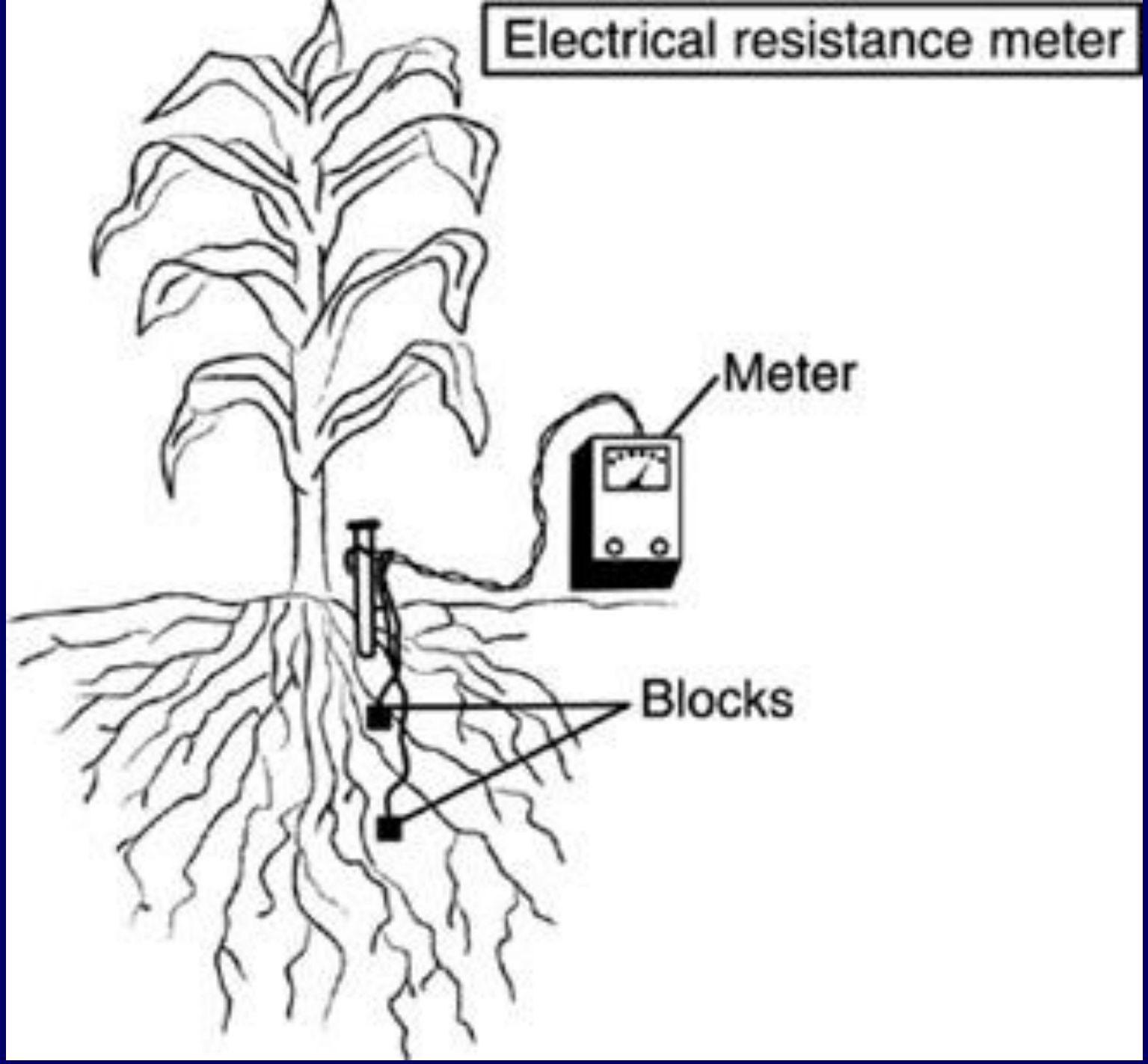
- The combination of these is **evapotranspiration (ET).**

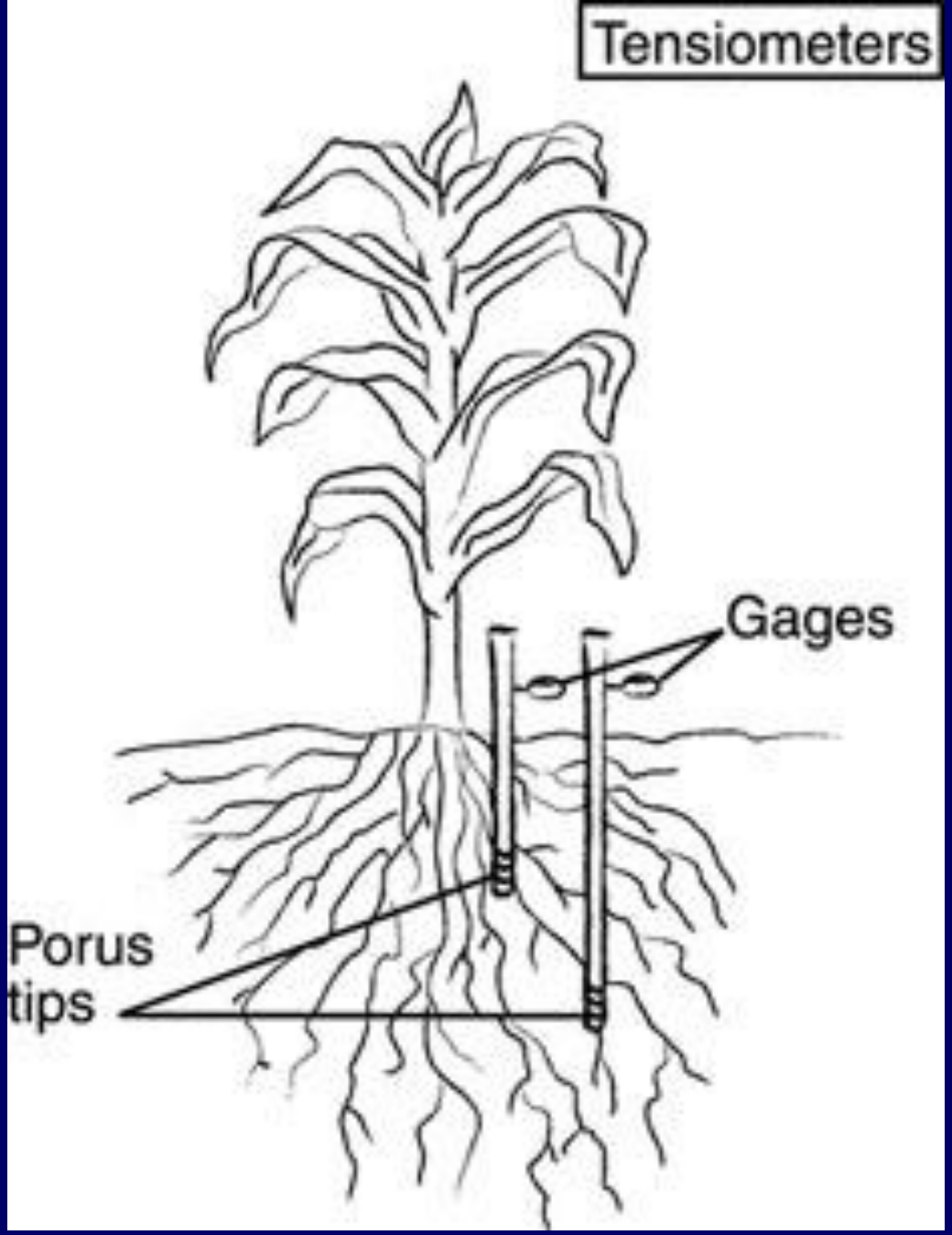
# Methods to Estimate Soil Moisture

- Feel an Appearance
- Electrical resistance – electrodes on blocks in soil
- Tensiometers – measures soil moisture tension

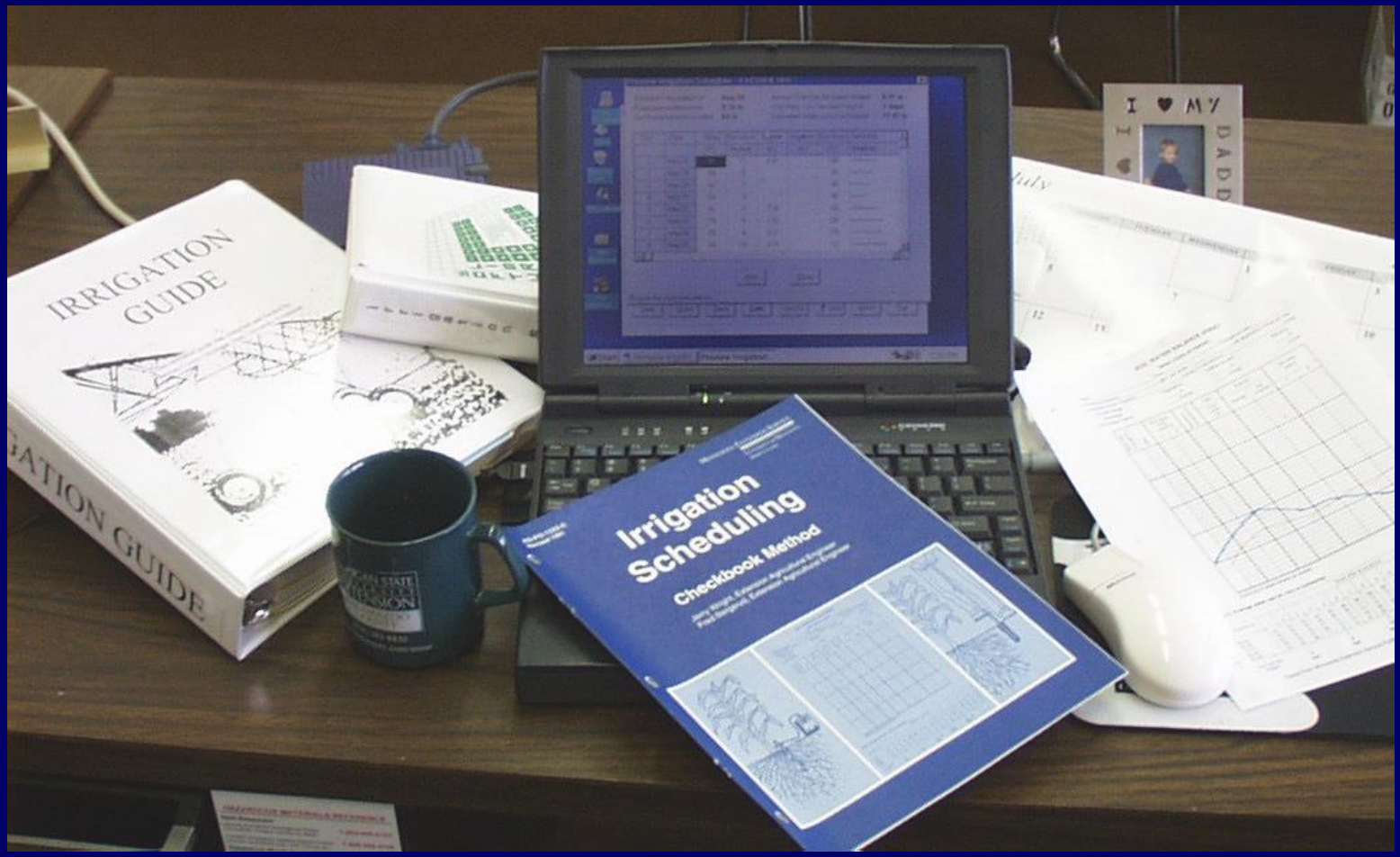
Table 12. Guide for judging soil water deficit based on soil feel and appearance for several soil textures.

| Moisture deficiency | SOIL TEXTURE CLASSIFICATION | | | | Moisture deficiency |
|---|---|---|---|---|---|
| | Coarse (loamy sand) | Sandy (sandy loam) | Medium (loam) | Fine (clay loam) | |
| in./ft. | | | | | in./ft. |
| .0 | (field capacity) Leaves wet outline on hand when squeezed. | (field capacity) Appears very dark, leaves wet outline on hand, makes a short ribbon. | (field capacity) Appears very dark, leaves wet outline on hand, will ribbon out about one inch. | (field capacity) Appears very dark, leaves slight moisture on hands when squeezed, will ribbon out about two inches. | .0 |
| .2 | Appears moist, makes a weak ball. | Quite dark color, makes a hard ball. | Dark color, forms a plastic ball, slicks when rubbed. | Dark color, will slick and ribbons easily. | .2 |
| .4 | Appears slightly moist, sticks together slightly. | Fairly dark color, makes a good ball. | Quite dark, forms a hard ball. | Quite dark, will make thick ribbon, may slick when rubbed. | .4 |
| .6 | Appears to be dry, will not form a ball under pressure. | Slightly dark color, makes a weak ball. | Fairly dark, forms a good ball. | Fairly dark, makes a good ball. | .6 |
| .8 | Dry, loose, single-grained flows through fingers. (wilting point) | Lightly colored by moisture, will not ball. | Slightly dark, forms weak ball. | Will ball, small clods will flatten out rather than crumble. | .8 |
| 1.0 | | Very slight color due to moisture, loose, flows through fingers. (wilting point) | Lightly colored, small clods crumble fairly easily. | Slightly dark, clods crumble. | 1.0 |
| 1.2 | | | Slight color due to moisture, powdery, dry, sometimes slightly crusted but easily broken down in powdery condition. (wilting point) | Some darkness due to unavailable moisture, hard, baked, cracked sometimes has loose crumbs on surface. (wilting point) | 1.2 |
| 1.4 | | | | | 1.4 |
| 1.6 | | | | | 1.6 |
| 1.8 | | | | | 1.8 |
| 2.0 | | | | | 2.0 |


Electrical resistance meter
Meter
Blocks

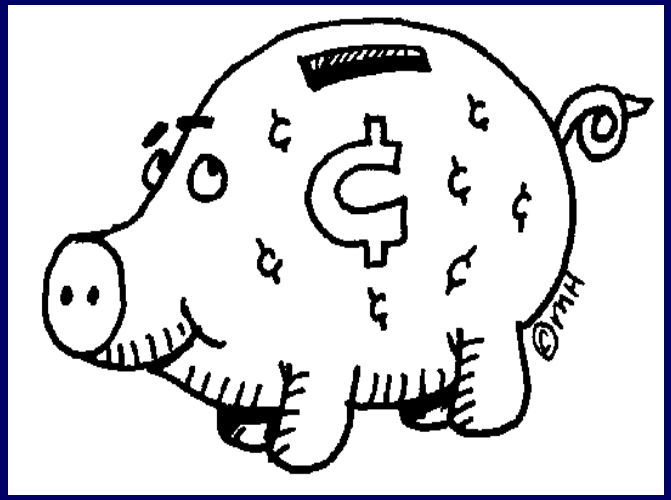

Tensiometers
Gages
Porus
tips

# Irrigation Scheduling Checkbook Method



# Think of your soil as a bank

Rainfall and irrigation water are deposit into the bank



Plant water use is a removal from the bank

# Rain Gauges

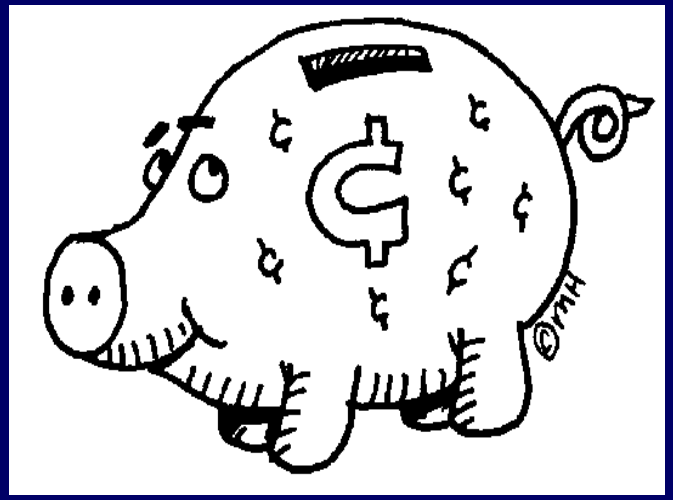
- Basic unit – 2 inch opening
- Cost less than $10.00
- 1-800-647-5368
- http://www.forestry-suppliers.com/product_pages/view_catalog_page.asp?id=5479

# Think of your soil as a bank

Water holding capacity:
The soil (bank) can hold only a given volume of water before it allow it to pass lower down.

Soil type :
Heavier soil can hold more water / foot of depth than light soils

Intake rate:
Water applied faster than the soil intake rate is lost.



Rooting depth:
The plant can only get water to the depth of it's roots.

Deletion:
Plants may can pull out only 30 – 60% of the water

Water lost from the bottom of the profile can wash out (leach) water soluble nutrients and pesticides.

# Estimates of ET

- Net radiation
- Max and min temperatures
- Relative humidly
- Wind

Purdue Agronomy web site – MichIna Irrigation Scheduler:

www.agry.purdue.edu/irrigation/IrrDown.htm

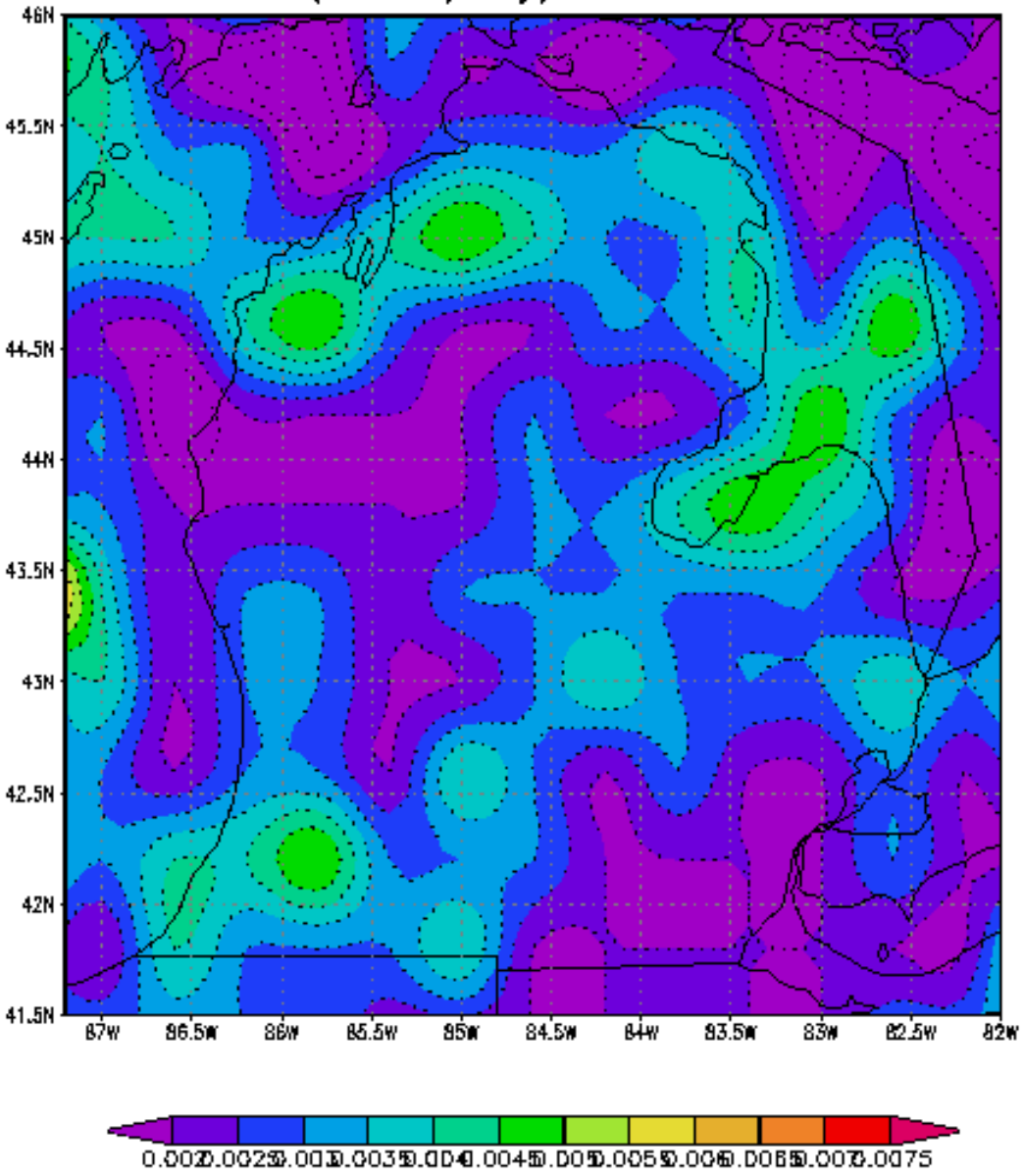
# Estimates of ET

U of Wisconsin web site -Next/rad radar : http://www.soils.wisc.edu/wimnext/

- Net radiation
- Max and min temperatures
- Relative humidly
- Wind

Provides the maximum water removal for the day

# Estimated ET (Inches/day) for 16 November 2003



# New Assistance Coming

Dr. Jeff Andresen and Steve Miller (MSU) are working to make available scheduling Tools

- Spreadsheet that uses the Wisconsin data for the base Et. and calculate accumulative removal by crop use.
- Update of the original NRCS “Scheduler”

T45 =IF($M45<6,$S45,(((10*$M45^(-1.3))+(1.07-0.0088*M45))/2)*$S45)

| 120 DAY SEASON | LABEL | VALUE | CROP CODE | # |
|---|---|---|---|---|
| JOB NAME | FN | sod | CORN | 1 |
| UNIT IDENTIFICATION NUMBER | FIN | 1 | POTATOES | 2 |
| TODAY'S DATE(i.e. June 15 = 6.15) | TD | 9.1 | SOYBEANS | 3 |
| PLANTS TO BE IRRIGATED (CODE #) | CODE | 5 | DRYBEANS | 4 |
| LATITUDE OF LOCATION IN MICHIGAN (42 to 46) | LAT | 43 | ALFALFA | 5 |
| SCHEDULE INITIATION DATE (i.e. May 12 = 5.12) | ED | 5.13 | | |
| LENGTH OF GROWING SEASON-days | LGS | 150 | | |
| PROFILE ROOTING DEPTH-feet | PRD | 0.5 | | |
| TOTAL ROOT DEPTH AVAILABLE WATER-inches | PWHC | 0.5 | | |
| MINIMUM PROFILE MOISTURE CONTENT-% | MPMC | 50 | | |
| STARTING PROFILE MOISTURE CONTENT-% | EPMC | 100 | | |
| PROJECTED YIELD-units/acre or % | PY | 100 | | |

EVAPOTRANSPIRATION COEFF.
EVAPOTRANSPIRATION COEFF.
EVAPOTRANSPIRATION COEFF.
CROP GROWTH COEFF
CROP GROWTH COEFF
CROP GROWTH COEFF
CROP GROWTH COEFF
CROP GROWTH COEFF
TEMPERATURE COEFF.
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TEMPERATURE COEFF.
TEMPERATURE COEFF.
DAYLIGHT COEFF.
DAYLIGHT COEFF.
DAYLIGHT COEFF.
DAYLIGHT COEFF.
DAYLIGHT COEFF.

**OUTPUT - SUMMARY**

| | | |
|---|---|---|
| TODAY'S DATE IS | 254 | |
| TODAY'S EVAPOTRANSPIRATION RATE IS | 2E-16 | inches |
| TODAY'S PROFILE MOISTURE CONTENT IS | 2E-12 | percent of capacity |
| TODAY YOU CAN SAFELY ADD | 0.45 | inches |
| YOU CAN ADD 1 INCH OF WATER IN ANOTHER | 4E+15 | day(s) if rain does not occur |

I14= 134
I10= 254

**OUTPUT - DAILY**

| DATE dd-mm | TEMP -F- | DEV +or- | ETC -in- | RAIN -in- | IRR -in- | DEPL -in- | PMC -%- | PM GRAPH -relative- | YWI | YWOI | %PMC WOI | DSP NO. | TRD -ft- | PMC -in- | PGS -%- | KC -%- | P -%- | PETC -in- | AETC -in- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 134 | 55 | | 0.136 | | | 0 | 100 | $$$$$##### | 100 | 100 | 100 | 1 | 0.5 | 0.5 | 0 | 0.7464 | 0.334 | 0.136480978 | 0.1364809 |
| 135 | 55.5 | | 0.138 | 0.1 | | 0.0377 | 92.45 | $$$$$#### | 100 | 100 | 92.451 | 2 | 0.5 | 0.462 | 0.67 | 0.7493 | 0.333 | 0.137743867 | 0.1377438 |
| 136 | 56 | | 0.139 | | | 0.1768 | 64.65 | $$$$$# | 100 | 100 | 64.649 | 3 | 0.5 | 0.323 | 1.33 | 0.7522 | 0.332 | 0.139011335 | 0.1390113 |
| 137 | 56.5 | | 0.14 | 2 | | -0.14 | 128.1 | $$$$$##### | 100 | 100 | 128.06 | 1 | 0.5 | 0.64 | 2 | 0.755 | 0.332 | 0.140282889 | 0.1402828 |
| 138 | 57 | | 0.142 | | | 0.0013 | 99.74 | $$$$$##### | 100 | 100 | 99.745 | 2 | 0.5 | 0.499 | 2.67 | 0.7578 | 0.332 | 0.141557969 | 0.1415579 |
| 139 | 57.4 | | 0.143 | | | 0.1441 | 71.18 | $$$$$## | 100 | 100 | 71.178 | 3 | 0.5 | 0.356 | 3.33 | 0.7606 | 0.331 | 0.142835951 | 0.1428359 |
| 140 | 57.9 | | 0.144 | | | 0.2882 | 42.35 | $$$$ | 99.994 | 100 | 42.355 | 4 | 0.5 | 0.212 | 4 | 0.7633 | 0.331 | 0.144116151 | 0.1441161 |

# 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.

# Irrigation System Uniformity

**Basic system evaluation**

Collect enough uniform container to 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 machine at standard setting over the container.

Measure and record the water volume caught by each container

Note sample point varying greater than 10% of the average.

# Preventing Irrigation Runoff

(comparing irrigation application rate to soil infiltration rate)

Sprinkler package or nozzle selection along with pressure dictates water application rate .

Factors that **increase** runoff :

- Small Wetted area or throw of sprinkler
- Low Pressure
- Larger applications volumes
- Soil compaction
- Heavy soils
- Slope
- Row hilling

**Instructions for completing the *Evaluating Potential Irrigation Runoff* form :**

1. Identify the areas of the irrigated field that has the lowest infiltration rates. (heavy soils, slopes, surface compaction).

2. Select a transit line in the wetted area just behind the machine that covers the identified lowest infiltration rates of the field identified above.

## Instructions for completing the *Evaluating Potential Irrigation Runoff* form – continued

3. Pace or measure 50 feet between observations starting at the pivot point and progressing to the furthest reaches of the machine.

4. Record observations for each location; look at several (4-5 areas) representing the row contour and differences in row traffic of the location. Record any specific concerns that may affect the application (drips or leaks) or affect the soils ability to take in water (compaction, row contours)

**Key for *Observation* column**

**A**- no observed puddling, ponding or sheen between rows

**B**- puddling, ponding or sheen between rows identified, but no observed runoff or flow of water

**C**-observed runoff or flow of water

# Avoiding water use conflicts

**Except for cost, well water is the preferred water source for irrigation.**

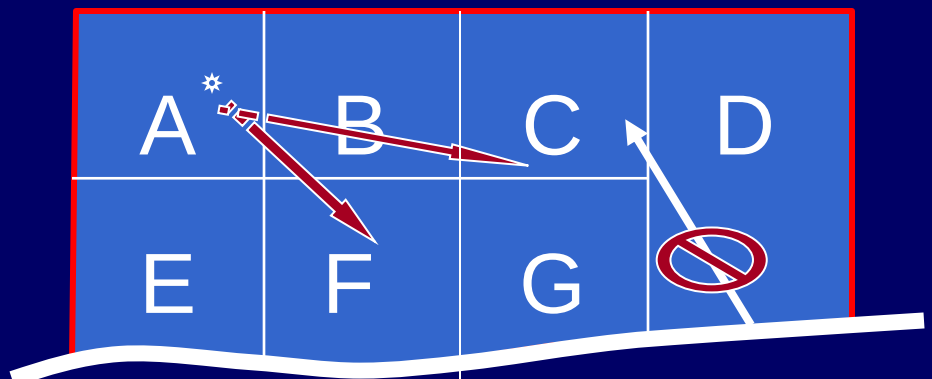
**A well owner may not diminish the use of well water of his neighbors**

**If a neighbor's well use is impaired you legally must rectify the situation if responsible.**

# Good irrigator response to neighbor's well problems:

- pump from another location –

  (There is no restriction on transport or use from other locations from wells).



# Consider Using Surface Water

**Riparian Doctrine –**Surface Water

-Reasonable use rule- allowing diminished flow for extraordinary use such as recreational, municipal, industrial or agriculture use, as long as other riparian owner Natural Uses where not impaired

-Extraordinary uses have been considered equal.

# Proactive Options for Agricultural

**Legal aspects of groundwater use have not changed – A well owner may not diminish the use of well water of his neighbors**

A prudent response to a neighbors substantiated complaint of being negatively effect by an irrigation well is to offer to deepen their well and consider it an irrigation cost

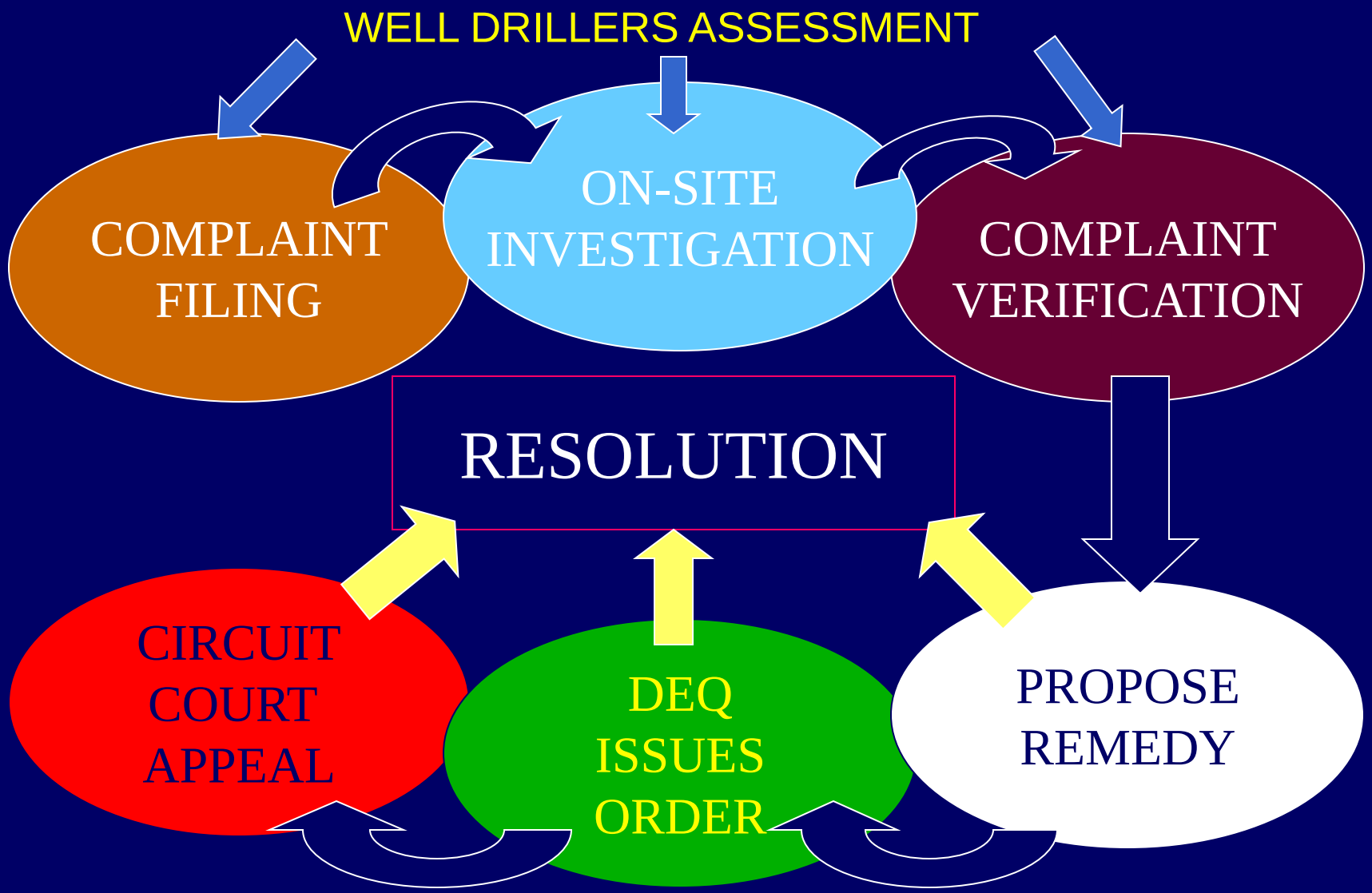
Identify the neighbor you may affect and layout a plan of action to prevent or provide remediation of the problem if it occurs.

# Proactive Options for Agricultural

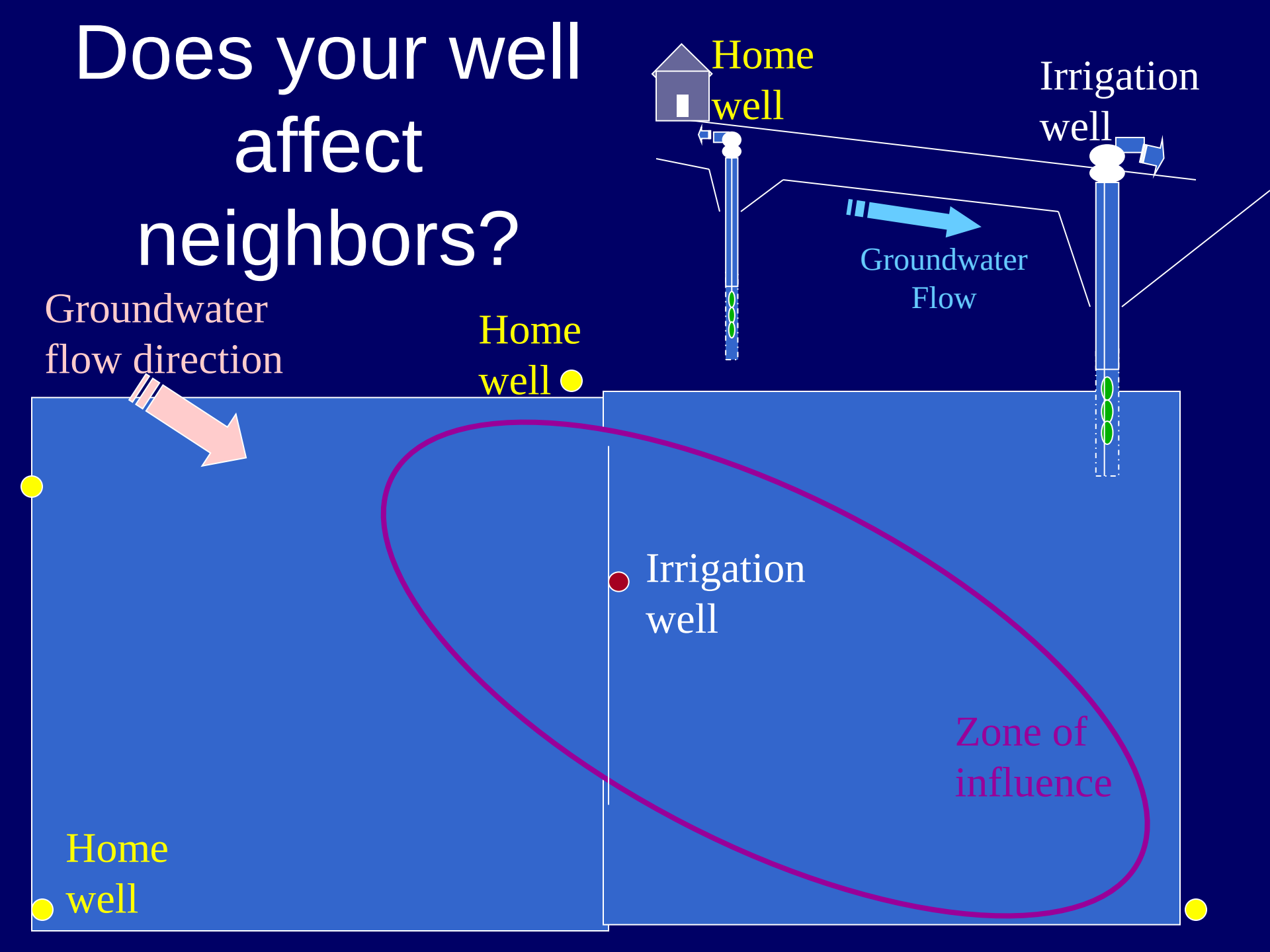
Identify the neighbor you may affect and layout a plan of action for remediation of the problem if it occurs.

- You can get scanned well logs off of the internet (1999 and older) by Township and section at:
  - www.deq.state.mi.us/well-logs
- Well logs that are 2000 and newer are available on WELLOGIC at:
  - http://dwrp.deq.state. mi.us/wellogic
  - You need a username and password for wellogic, (issued to registered well drillers and agencies)

# GW DISPUTE RESOLUTION PROCESS: PA. 177



# Does your well affect neighbors?



# PROACTIVE GROUNDWATER DISPUTE RESOLUTION

# Ground Water Dispute Resolution Prior to PA. 177