Water Sources for Irrigation

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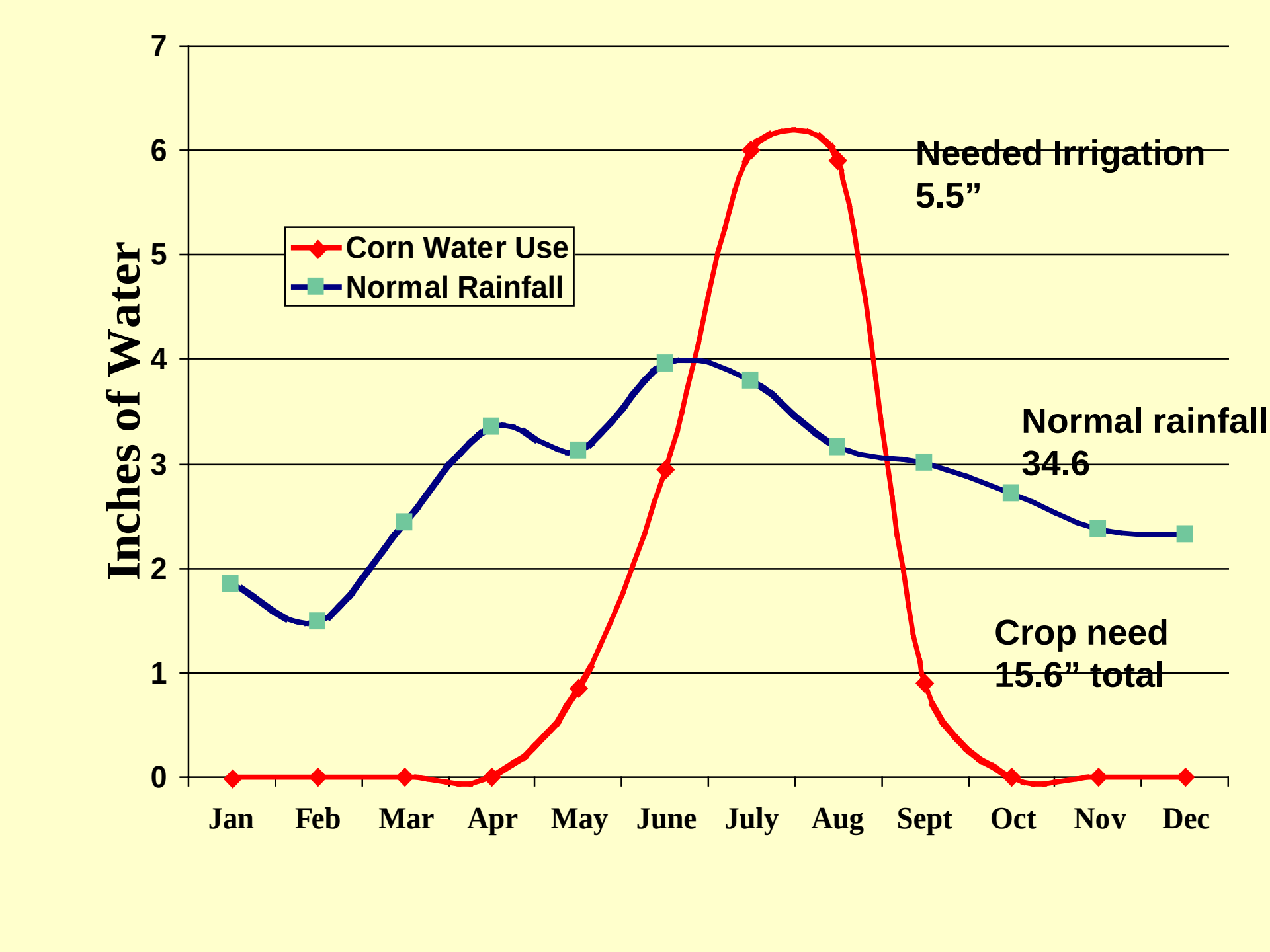
www.msue.msu.edu - find St. Joseph Co.

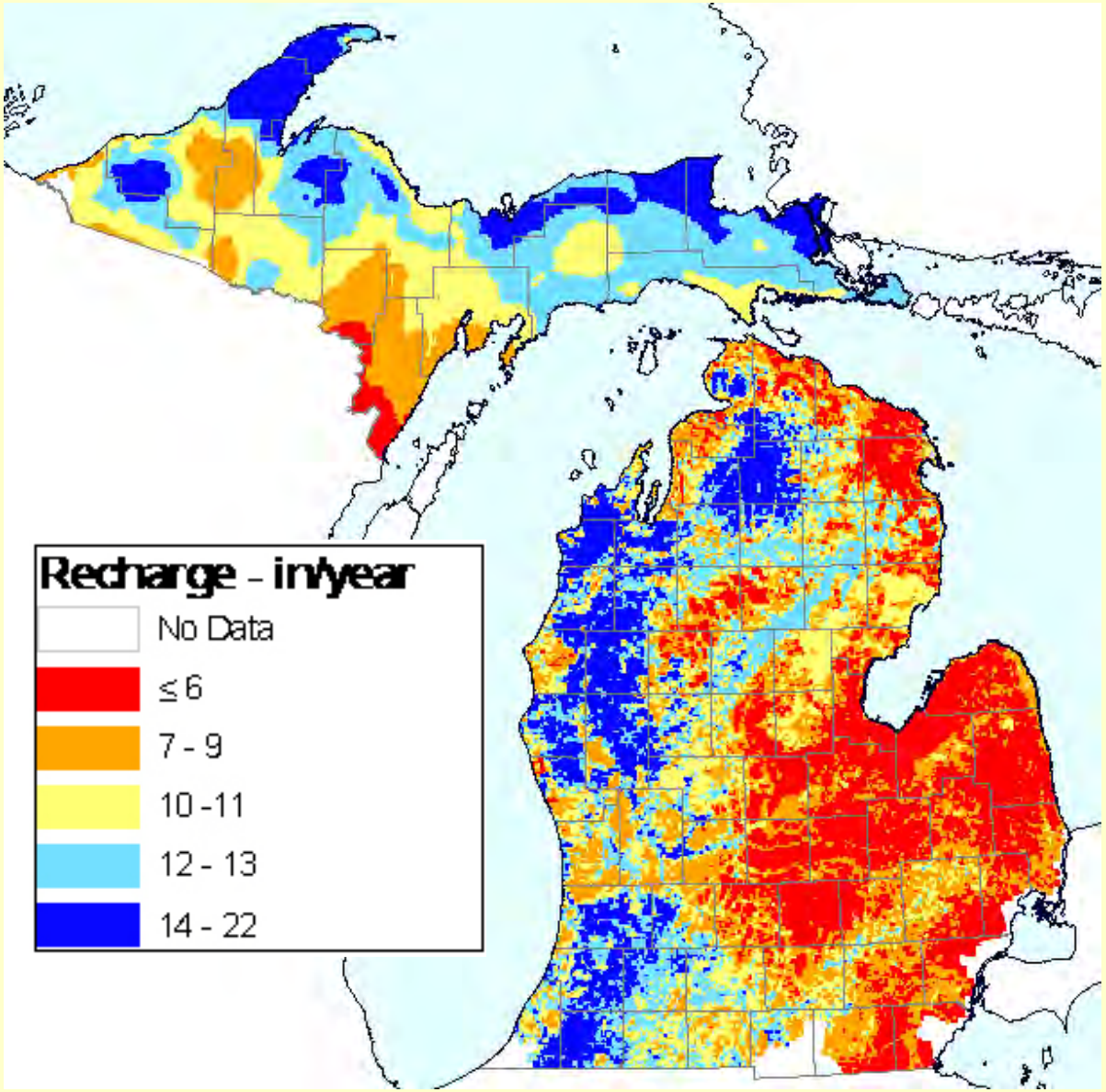
- then hit the Irrigation button

Water Sources for Irrigation

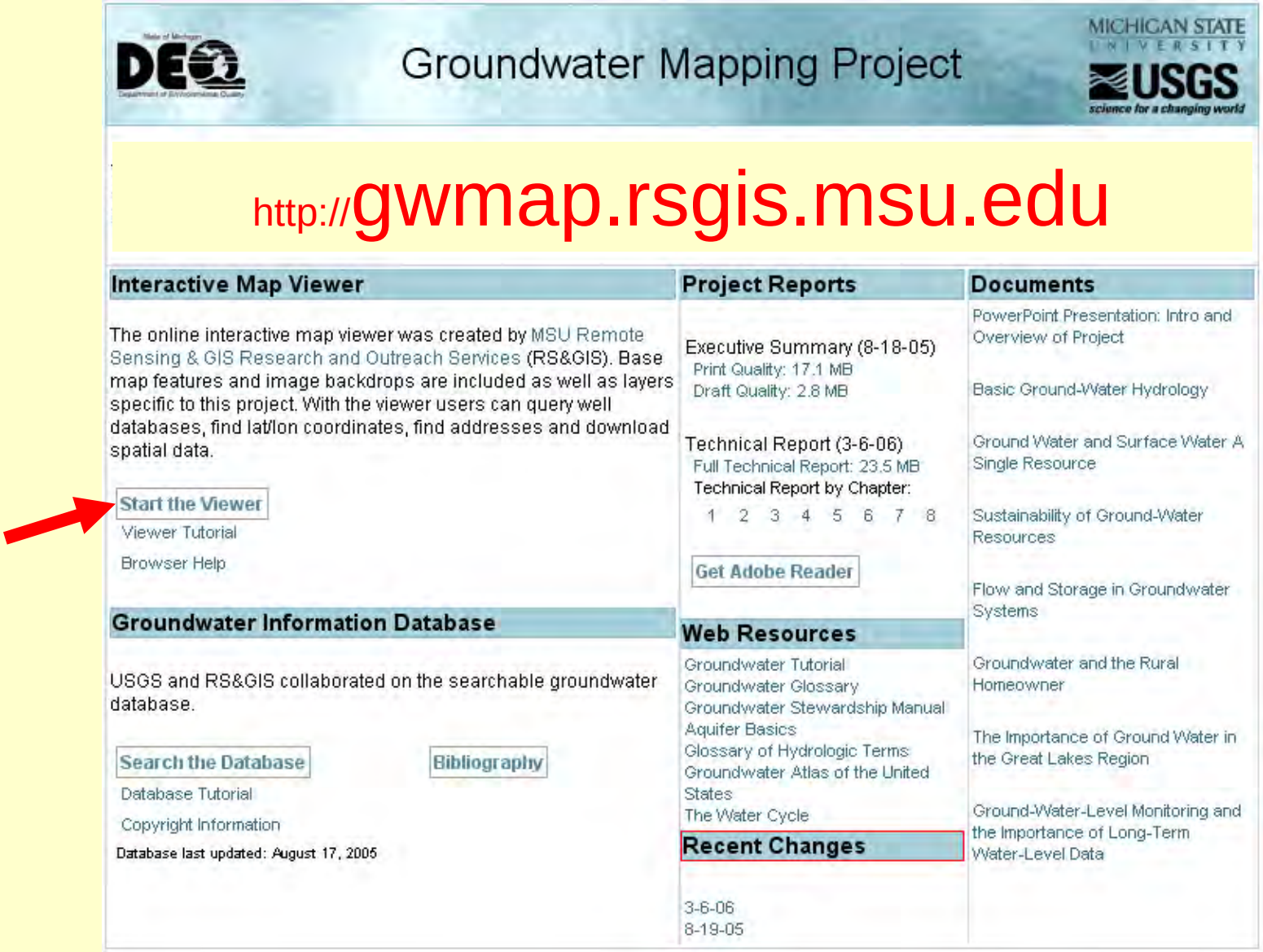
- Quantity needs
- Quality factors
- Surface water sources
- Groundwater sources
- Surface and groundwater combinations
- Certified well drillers and well code
- Conflict and competition for water


Inches of Water
7
6
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Corn Water Use
Normal Rainfall
Needed Irrigation
5.5”
Normal rainfall
34.6
Crop need
15.6” total

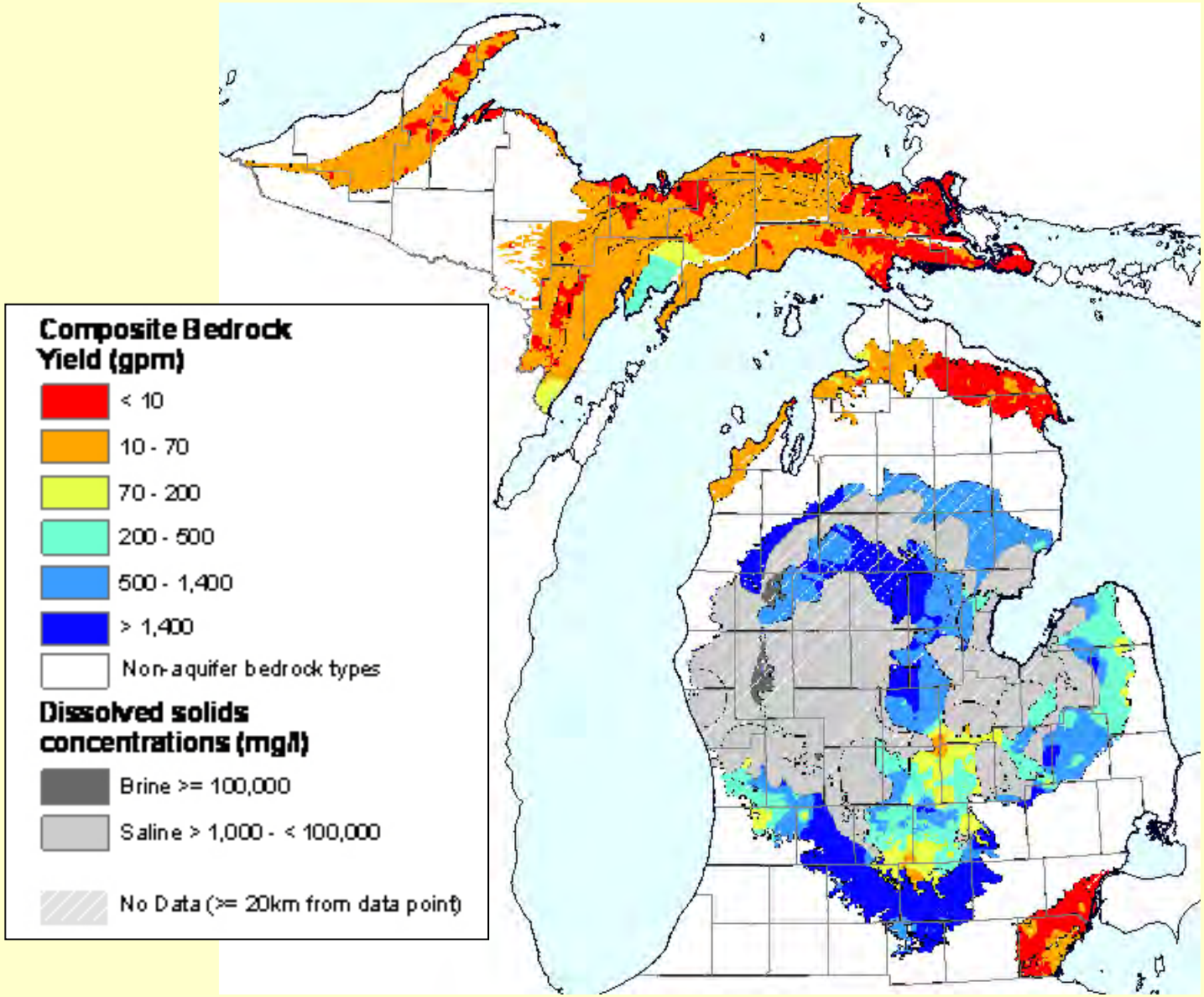
Recharge to Shallow Aquifers



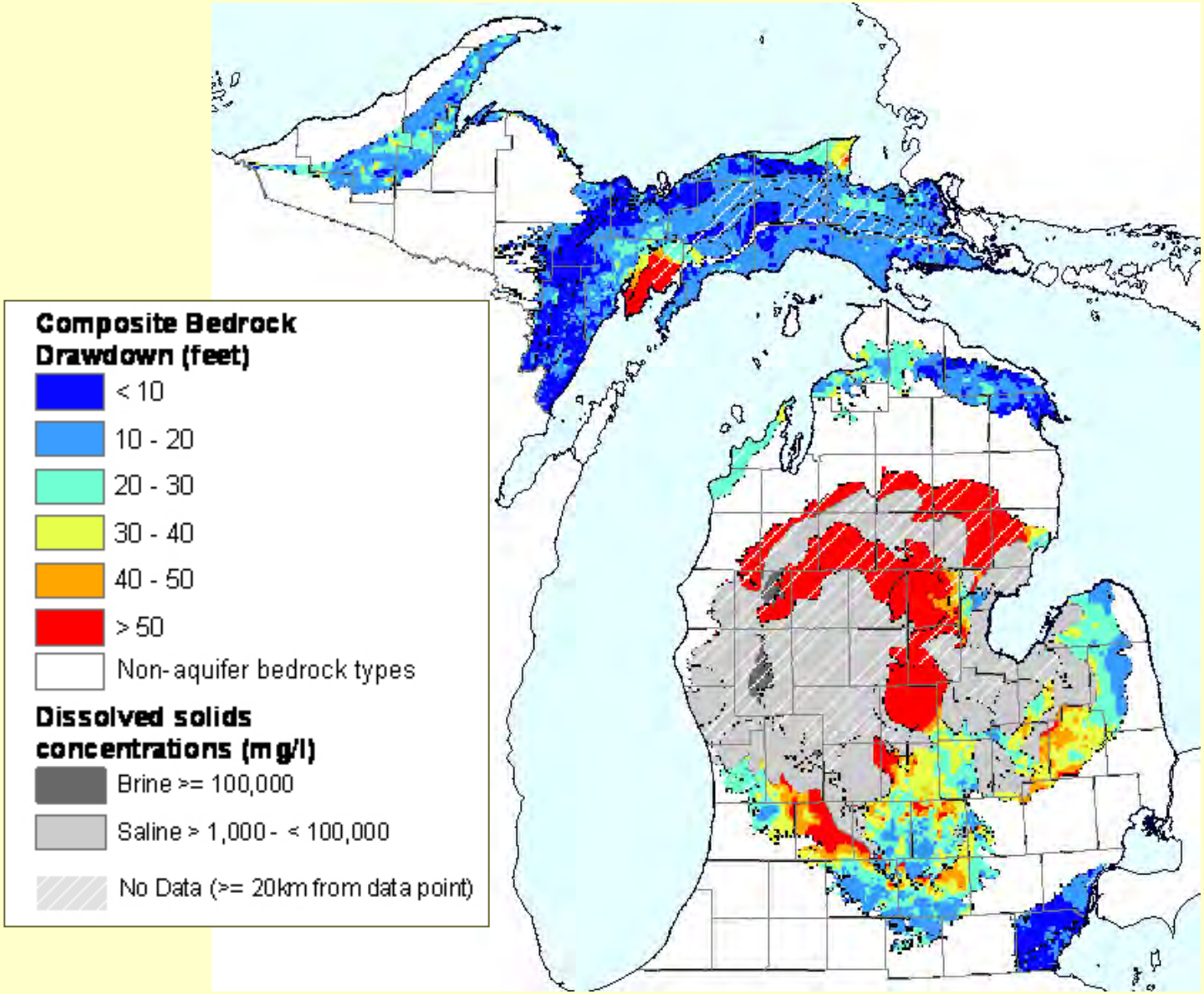
Groundwater Inventory & Mapping



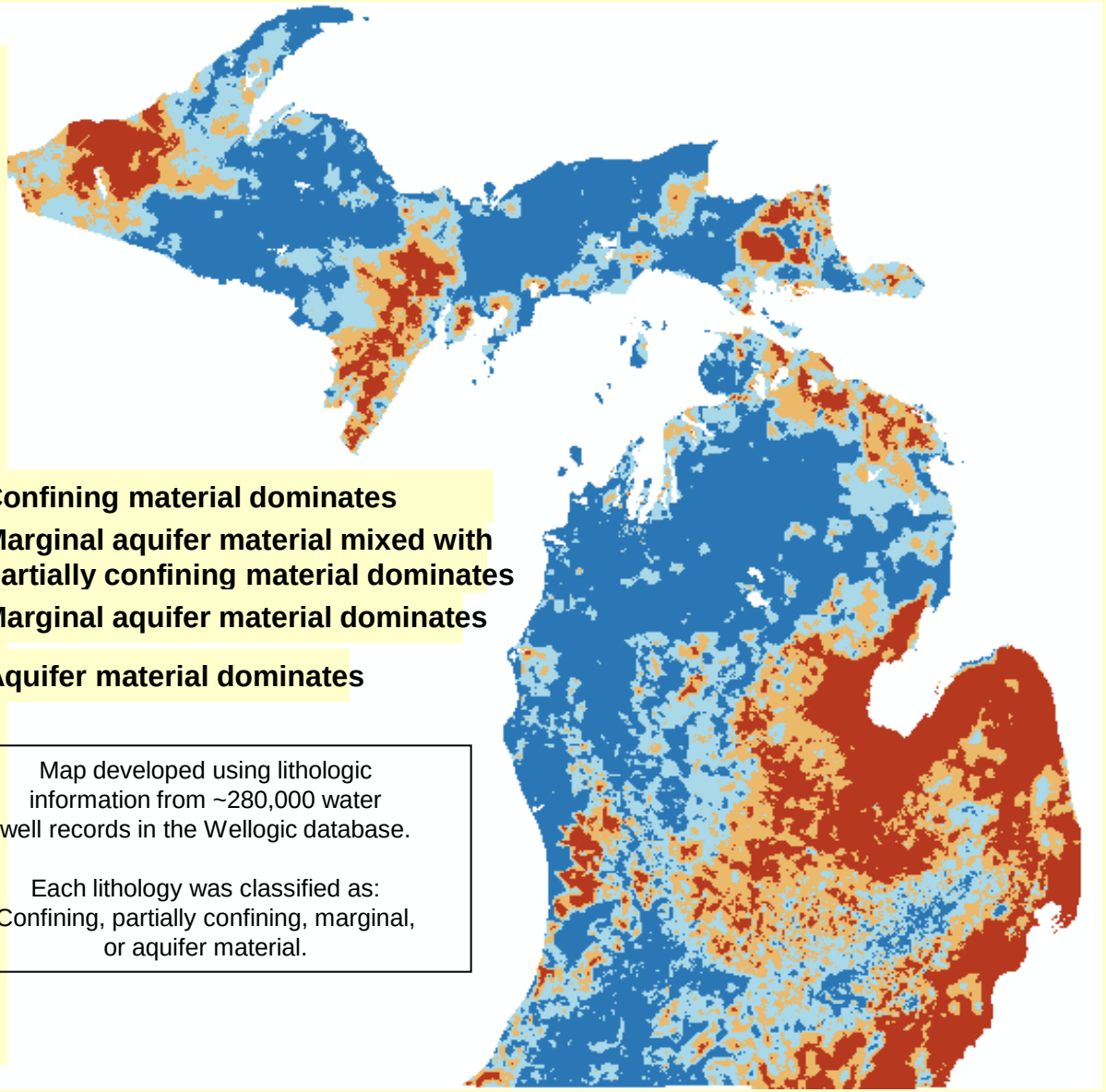
Yield from Bedrock Aquifers



Drawdown from Bedrock Aquifers



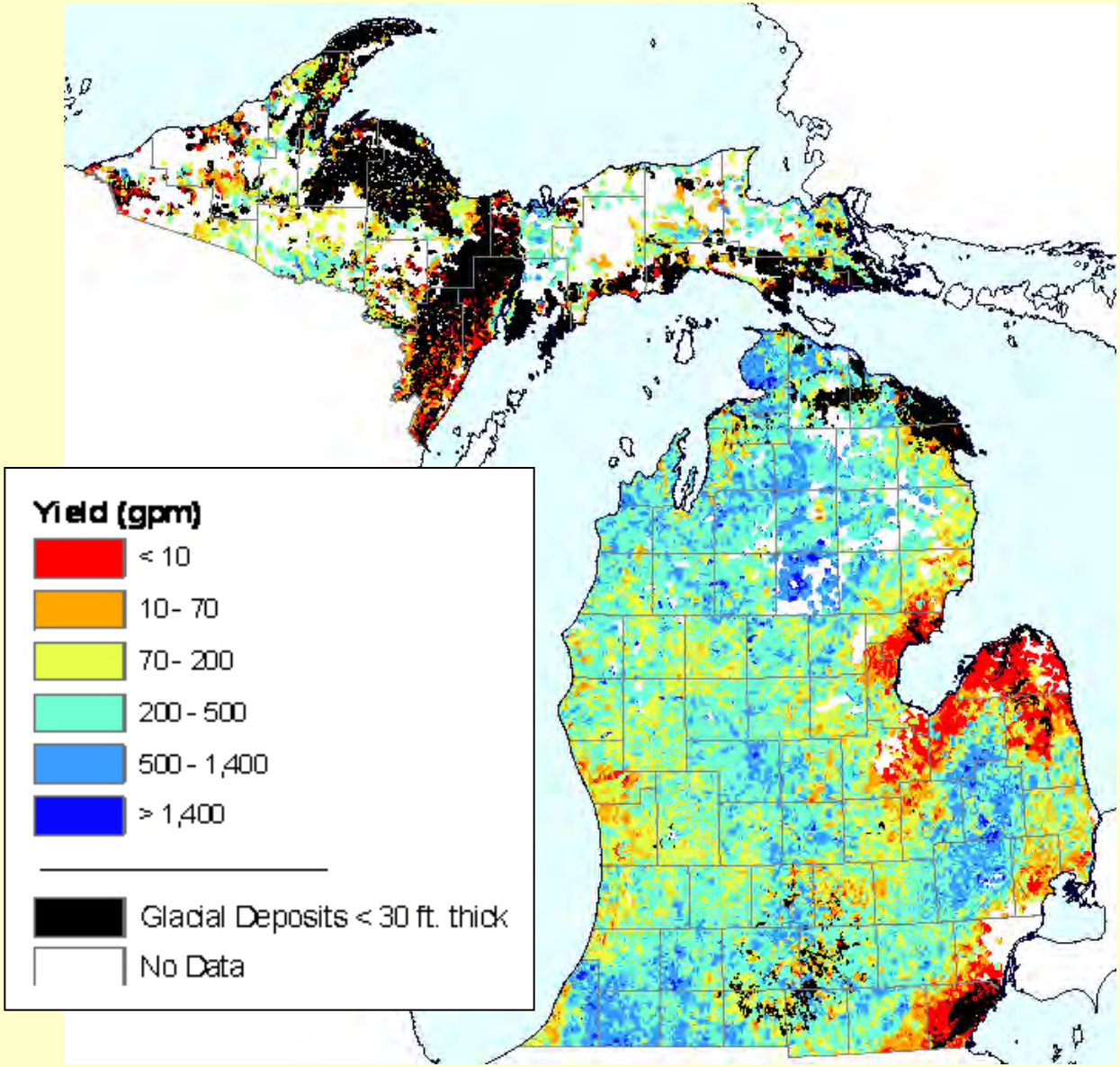
Glacial Aquifer Characterization



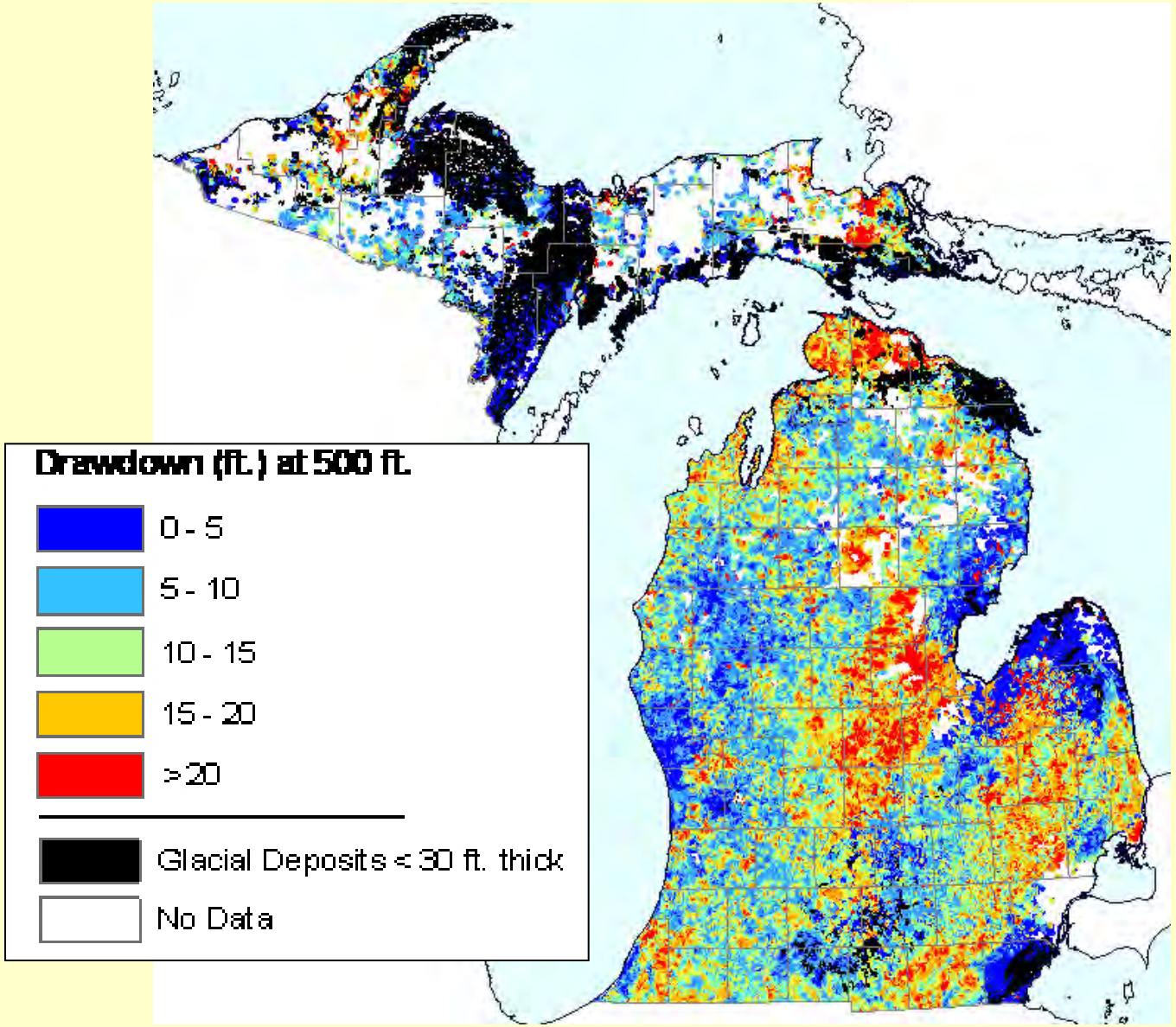
Map developed using lithologic information from ~280,000 water well records in the Wellogic database.

Each lithology was classified as: Confining, partially confining, marginal, or aquifer material.

Yield from Glacial Aquifers

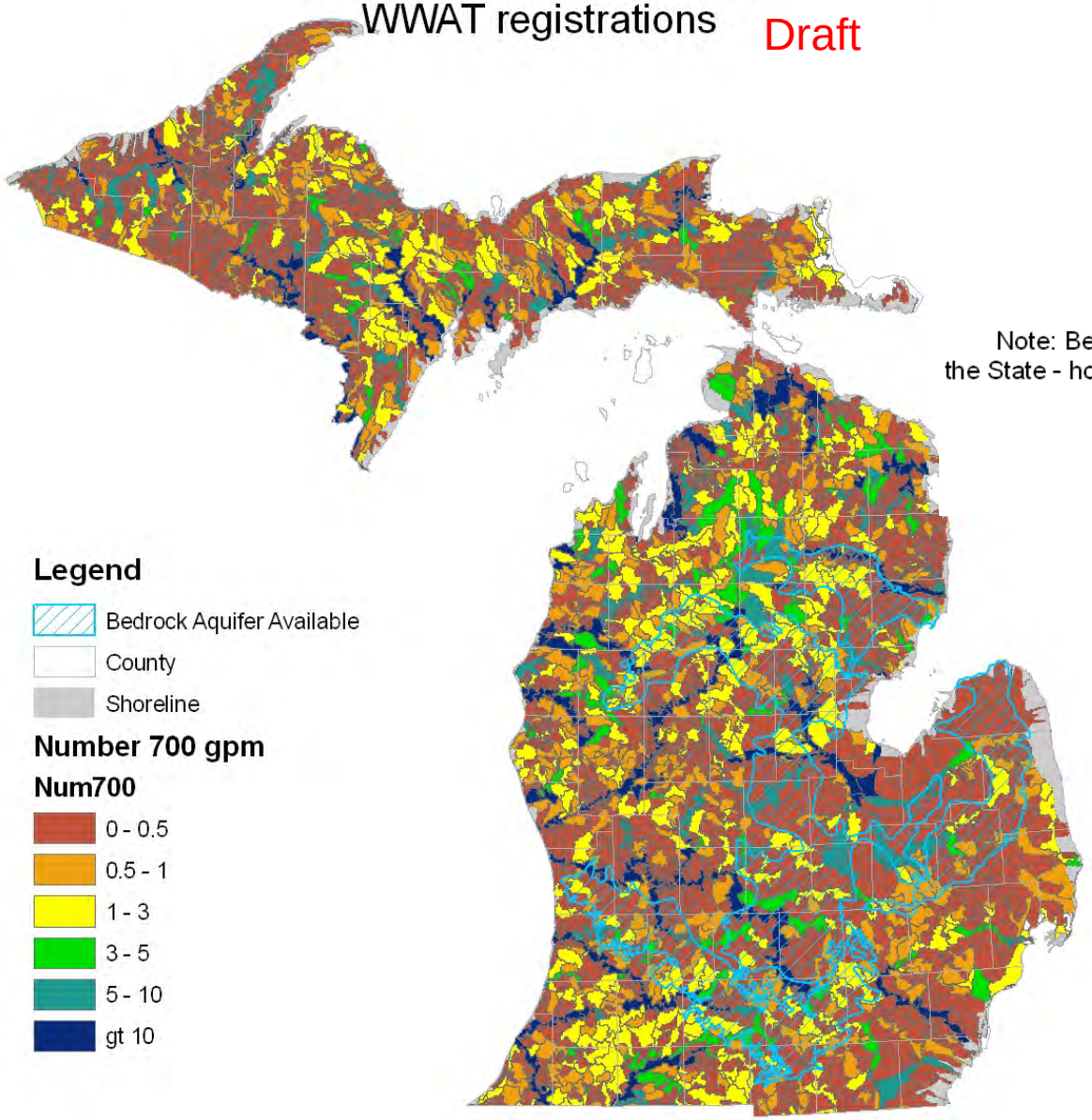


Drawdown from Glacial Aquifers



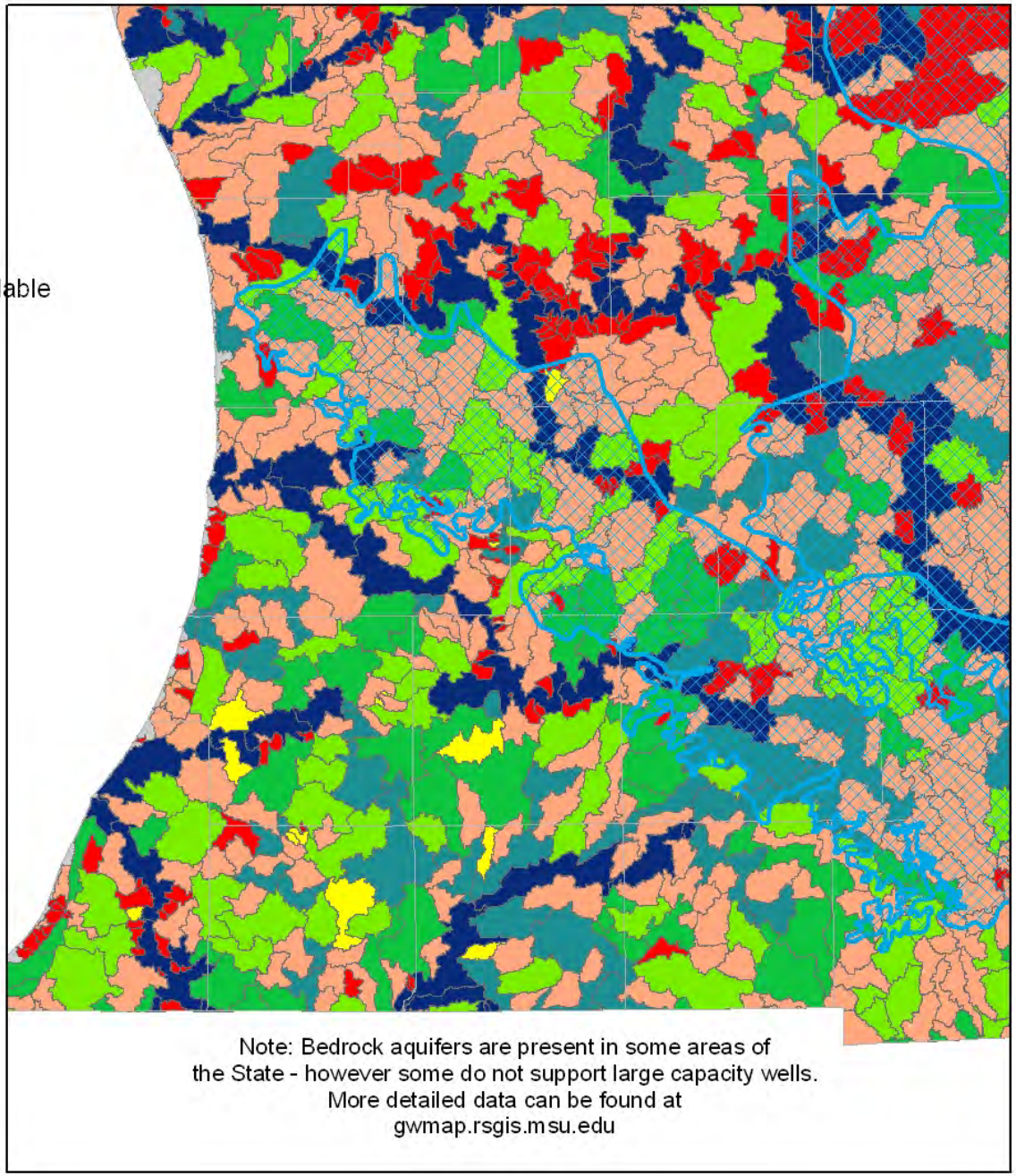
Max number of 700 gmp direct withdrawals per watershed
Does not account for any new withdrawals since 2006
Also does not account for WWAT registrations

Draft



Note: Bedrock aquifers are present in some areas of the State - however some do not support large capacity wells. More detailed data can be found at gwmap.rsgis.msu.edu

WWAT water available GPM
11-23-09



Bedrock option

Site specific review

Ave. Irr withdrawal = 700 gpm

Wells may cut impact by 75%

Prior Appropriation

West of Mississippi

- first in use, first in right
- allows transfer of water rights

Riparian Doctrine

East of Mississippi

- based on Common Law
- handed down from British law
- legal “doctrines”
- interpreted by the courts
  - sets precedents
- may be modified by legislative action
- **Reasonable use doctrine**

- **Reasonable use doctrine**
  - Permits a landowner to make use of water on, adjacent to, or under their property, so long as such use does not
    1) unreasonably interfere with the rights of adjacent or neighboring landowners to the reasonable use of water from their property

- **Reasonable use doctrine**
  - Permits a landowner to make use of water on, adjacent to, or under their property, so long as such use does not

    2) decrease the value of the adjacent or neighboring land for legitimate uses, and

    3) unreasonably impair the quality of the water leaving their property.

Who Gets Riparian Surface Water Rights?

Yes

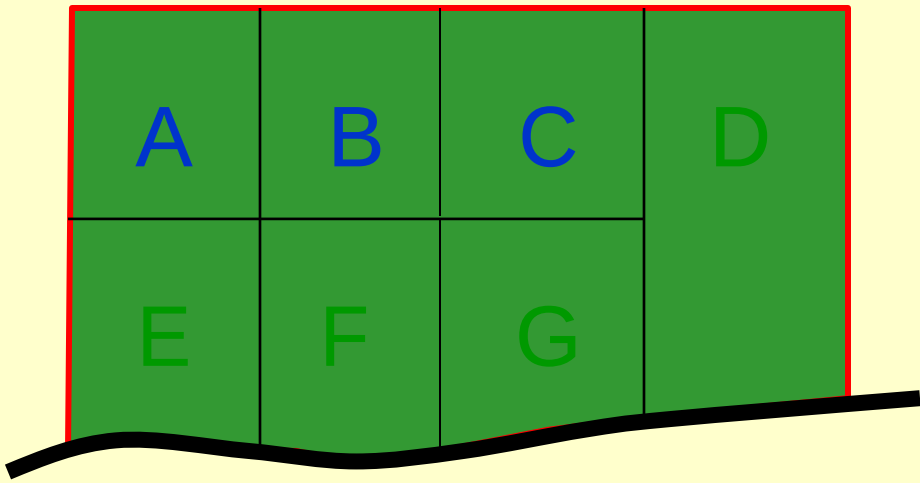
- Owners of property actually touching the water

  (D E F or G)

No

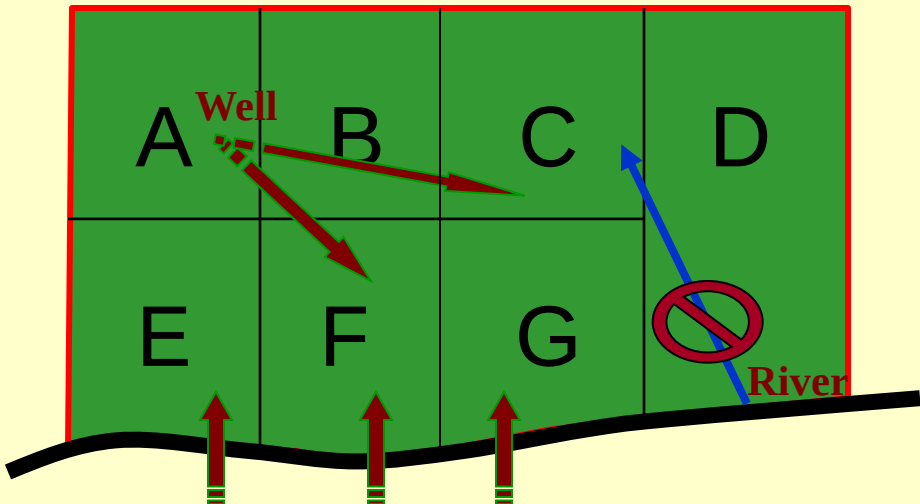
- Everyone else may get access rights

  (A B or C)



Riparian Doctrine, Severance Rule

- Once a parcel has been subdivided, the parcels no longer retaining waters edge loose their Riparian Rights.
- Once rights are lost they may not be regained (reattachment of subdivided parcels does not re-establish their water rights)
- Commonly violated, but one of the easiest ways to get injunction against a neighbor.
- Does not apply to ground water.



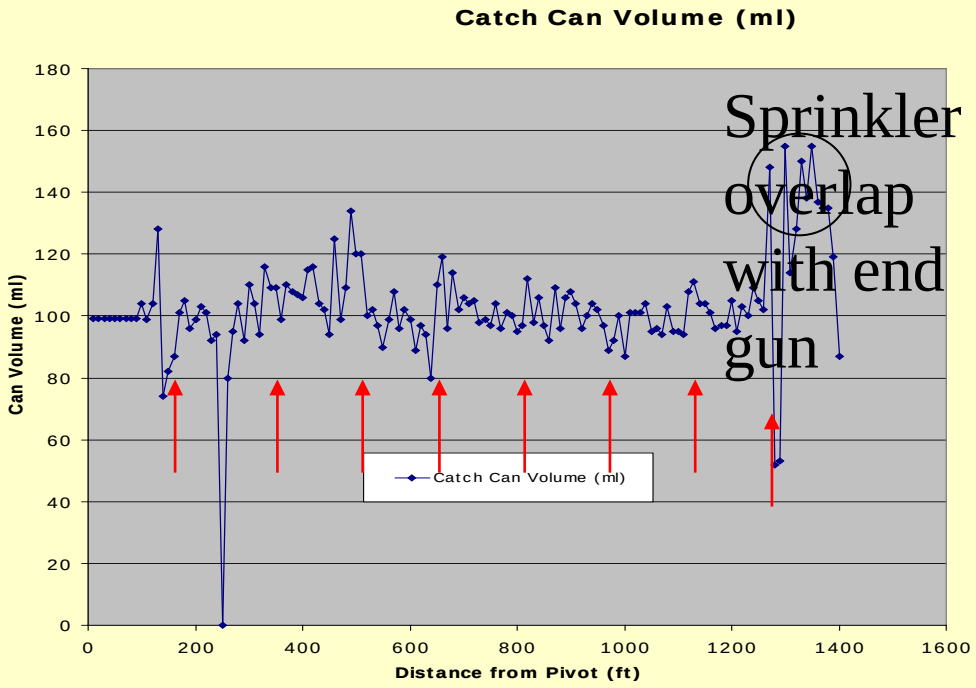
Quantity needed

- Irrigation water replaces the plant water use
- Water use is directly correlated to light interception
- 50% light interception results in 50% of the maximum water use
- Maximum water use mid-July early August, full light interception, highest temperatures and brightest days.

Three factor reducing effective water application

2. Lack of system uniformity

- 5-35% loss in effectiveness



1. Irrigation Runoff

(comparing irrigation application rate to soil infiltration rate) 0 -30 % loss

3. Evaporative loss to the air

- Minimal loss in our humid area
- 0 – 6%
- Estimated 4-6% loss in Nebraska

Necessary application rate to achieve effective evapo-transportation rates at various application efficiencies

	Average application efficiency					
Desired Inches of effective application	**70%**	**75%**	**80%**	**85%**	**90%**	**95%**
0.16	**0.21**	**0.20**	**0.19**	**0.18**	**0.18**	**0.17**
0.18	**0.23**	**0.23**	**0.22**	**0.21**	**0.20**	**0.19**
0.20	**0.26**	**0.25**	**0.24**	**0.23**	**0.22**	**0.21**
0.22	**0.29**	**0.28**	**0.26**	**0.25**	**0.24**	**0.23**
0.24	**0.31**	**0.30**	**0.29**	**0.28**	**0.26**	**0.25**
0.26	**0.34**	**0.33**	**0.31**	**0.30**	**0.29**	**0.27**
0.28	**0.36**	**0.35**	**0.34**	**0.32**	**0.31**	**0.29**
0.30	**0.39**	**0.38**	**0.36**	**0.35**	**0.33**	**0.32**
0.32	**0.42**	**0.40**	**0.38**	**0.37**	**0.35**	**0.34**

Quantity Needed

- Maximum water use for most crops is .27 - .32 in./day
- 3 gal/minute/acre pump capacity = 1”/week
- 5 gal/minute/acre pump capacity = .25 in./day
- 7 gal/minute/acre pump capacity =.33 in./day, 1”every 3 days
- 500 gal/minute pump can provide 1” every 4 days on 100 acres

Quantity Needed

In a hot 1st week of August John's corn crop ET. was .30 in./day
John's field has a AWC of **3.0 in.** (Available water capacity)

He started irrigating when the AWC was **1.0 in.** down

John's irrigation system can apply .20 in./day.

By the end of the week how far behind is John? (.30 -.20) x 7 **=.70 in.**

During 2nd week of August, ET. remains .30 in./day, John shuts down 2 days for repair. By week end how far behind is John?
(.5 +.6)= **1.1in.** **2.80 in. total deficit**

3rd. week, no rain, John's corn field is hurting.

Converting acre inches to gallons for trickle irrigation

- **Calculate the % of area covered by trees (% of area you intend to water/tree)**
- **One acre = 43,560 sq.ft.**
- **One acre inch = 27,154 gallons**

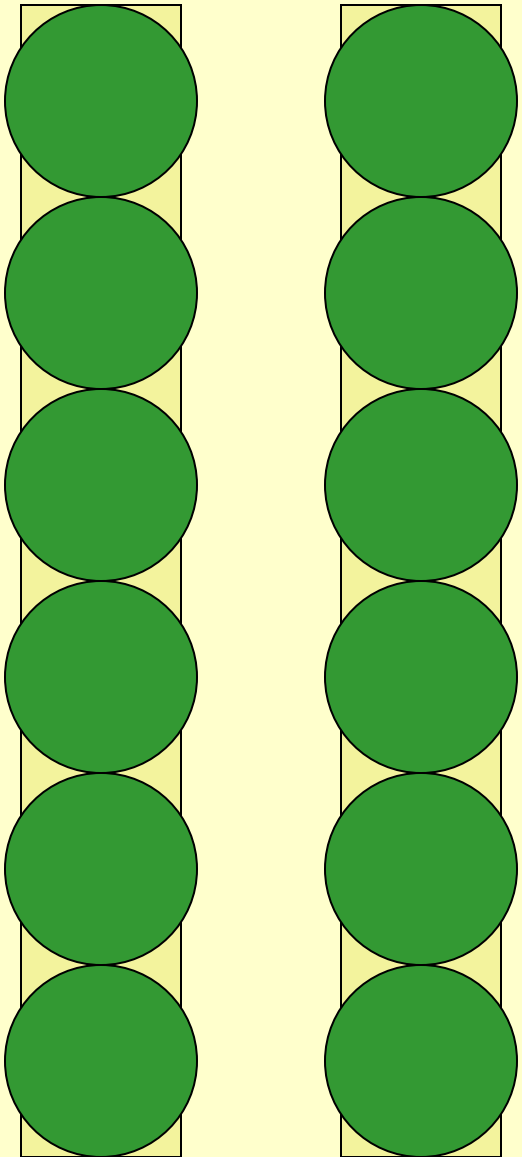
Example:

The trees you are watering have a diameter of 6.5 ft.

6.5 ft. x 6.5 ft. = 42 sq.ft. roughly 1/1000 of an acre

26 to 27 gallon / tree = 1” of irrigation

(include uncontrolled grass or weed area that is watered in tree area)

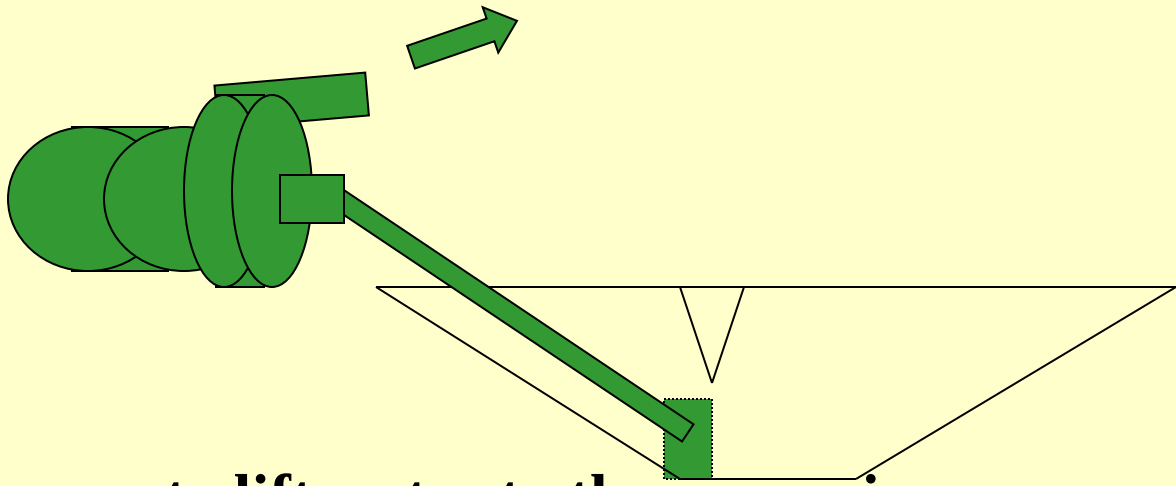


Quality Factors

- Foreign material – clogs pumps, screen and nozzles-sand, algae, aquatic plants and fish/frogs
- Salt – salinity (western problem)
- Calcium – and other elements that deposit in pipes
- Disease agents – manure effluent, waste treatment facilities, warm surface water
- Aquatic weed treatment-lake algae milfoil treatment

Surface Water Sources

- Lakes
- Rivers
- Streams
- Drainage ditches
- Private ponds



Surface pump creates vacuum to lift water to the pump, issues:

- Plugged inlet- screens, rotary screens and wash systems, aquatic weed control
- Loss of vacuum, creates a vortex, maintain > 3’ of water over inlet, water guides/flow diverters

Solid pump base needed < 8’ from water surface for standard pump

Surface Water Sources

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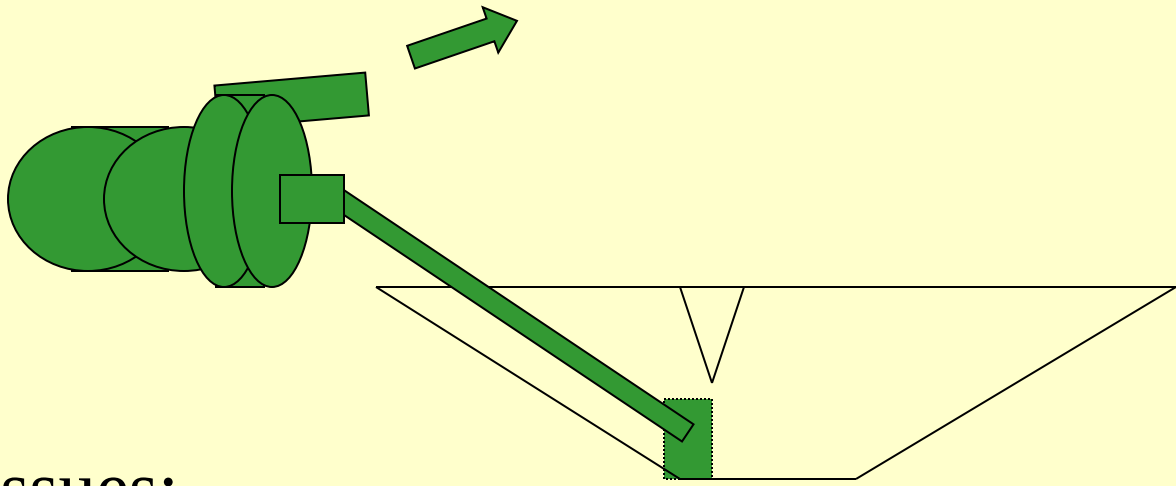
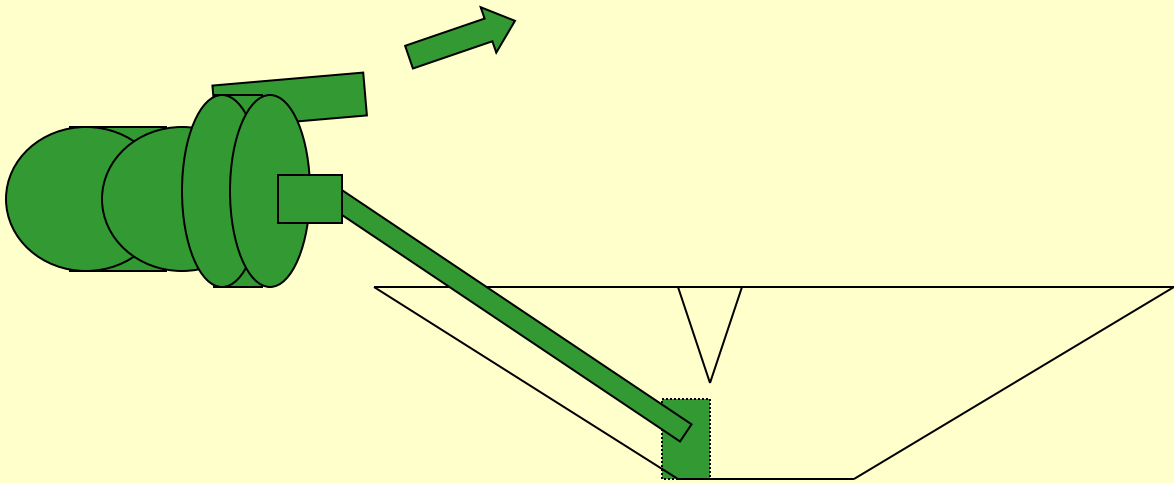


Surface water quality issues:

- Consider outlets from municipal treatment plants and other contamination sources
- Consider plant disease potential, warm/contaminated water (Phytophra root rot, bacterial stalk rot)
- Economics - location is often not centered to water use.
- Economics - low initial and annual cost.

Surface Water Sources

- Lakes
- Rivers
- Streams
- Drainage ditches
- Private ponds



Advantages:

- Inexpensive: $5-8,000 for pump inlet and vacuum pump
- Investment “$$$” is more flexible in the future. “I can move the location.”
- Low pumping cost, lift is minimal

Surface Water Sources

- Lakes
- Rivers
- Streams
- Public drain meeting the definition of a stream

"Public -Waters of the State"

1. Use is limited to the amount that does not negatively effect other riparian users.
2. Old English common law.
3. Limited to land units that are riparian, adjacent to water.
4. Legally cannot interfere with others travel on the water.

Riparian Doctrine, Severance Rule

- Once a parcel has been subdivided, the parcels no longer retaining waters edge loose their Riparian Rights.
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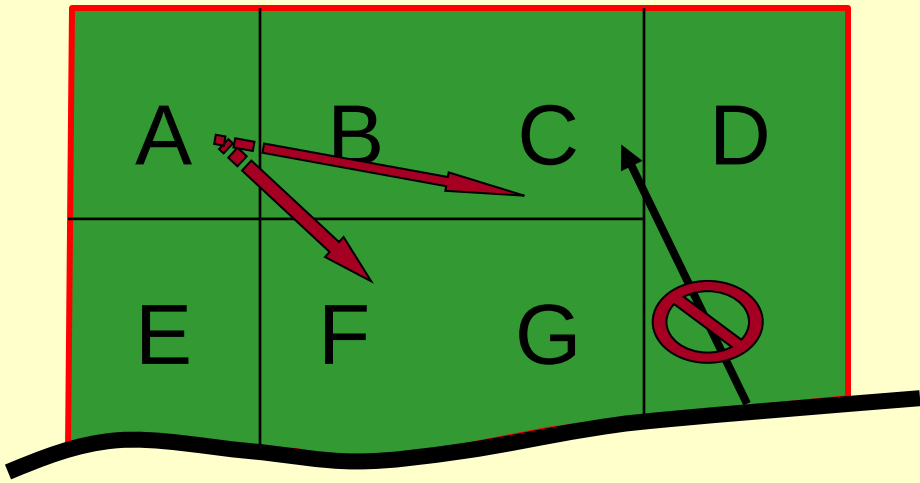


Surface Water Sources

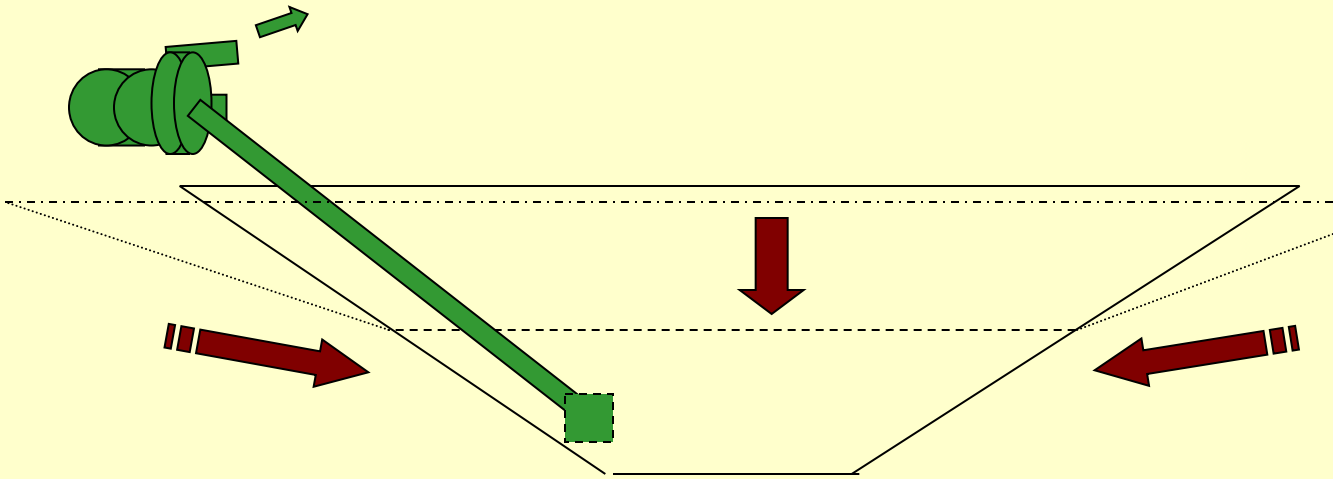
- Private ponds “ non-contiguous waters” often not considered “Public - Waters of the State”
- Ditches ??? Beware of Adverse resource standards ???

1. In most areas, use is limited only by your ability to pull the water.
2. Common to have local conflict, legal gray area.
3. Structure and impediments to flow are regulated by drain commissioner on public drains (sediment).

Surface Water Sources

Ponds

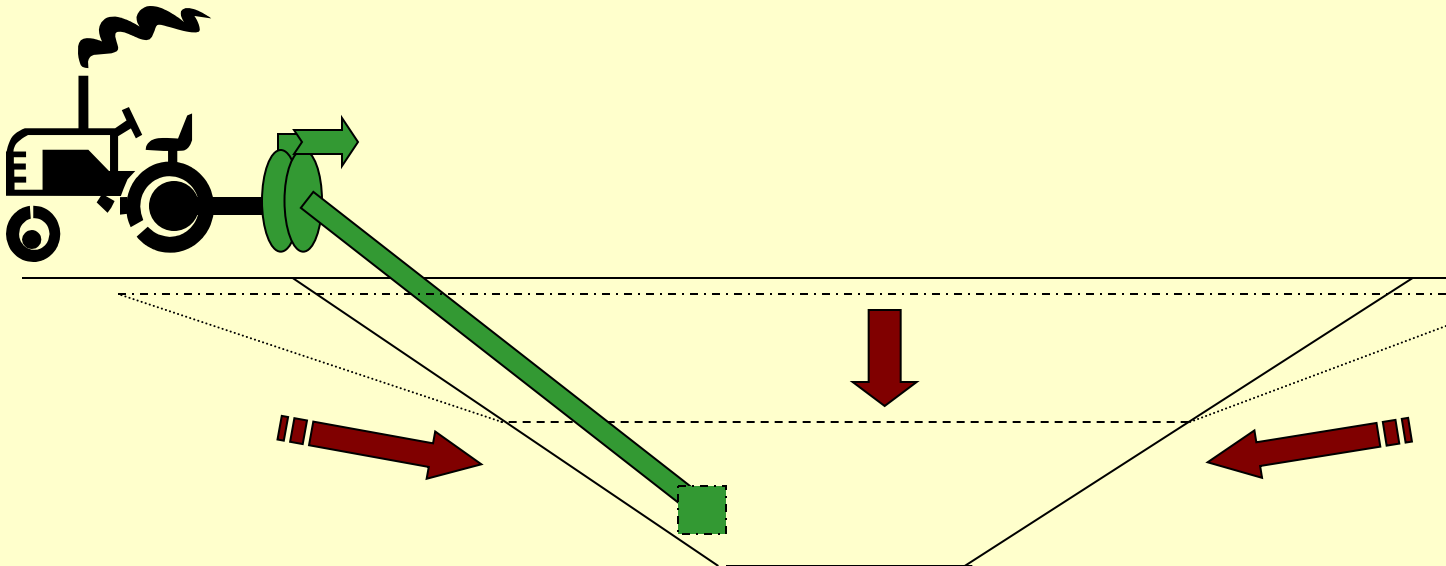
- Recharge capacity far more important than volume
- Volume indicates storage capacity allowing pumping rate higher than recharge
- Many natural ponds will have slow recharge



Surface Water Sources

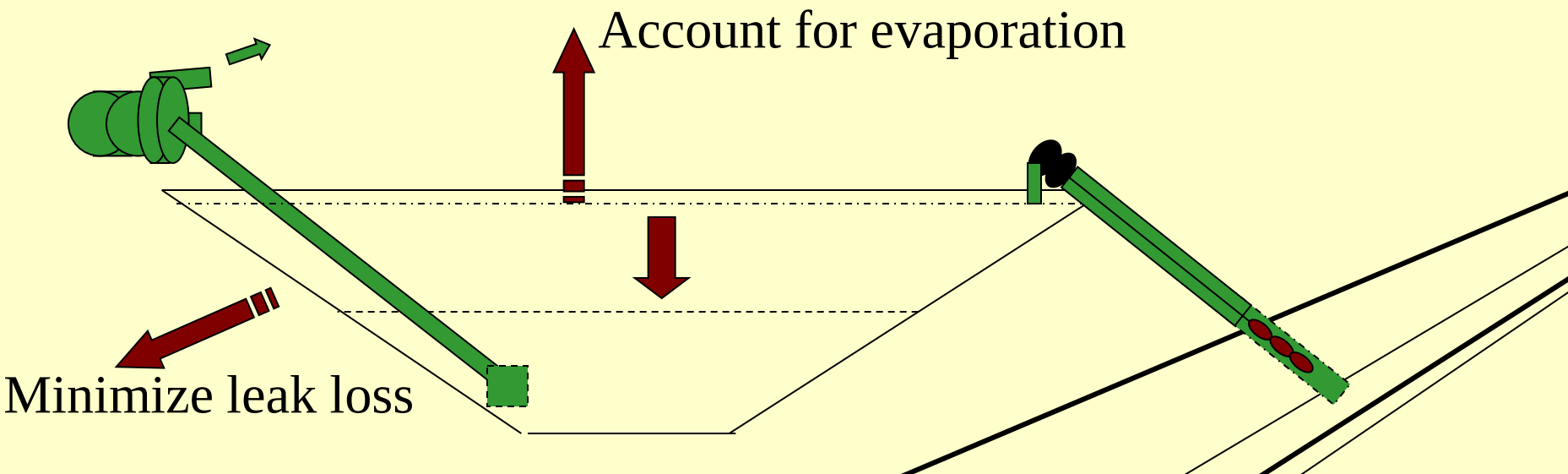
Ponds- testing

- Pump test pond early in August, during a dry summer for 24 hrs or until intake problem arises - monitor time it took for level to recover.
- Recovery < 12 hours best, expect some draw down 8-12”
- Local NRCS office may have design services or information
- Perspective pond site best evaluated by local excavator with irrigation pond experience
- Test hole and fill rate information aid in the decision.

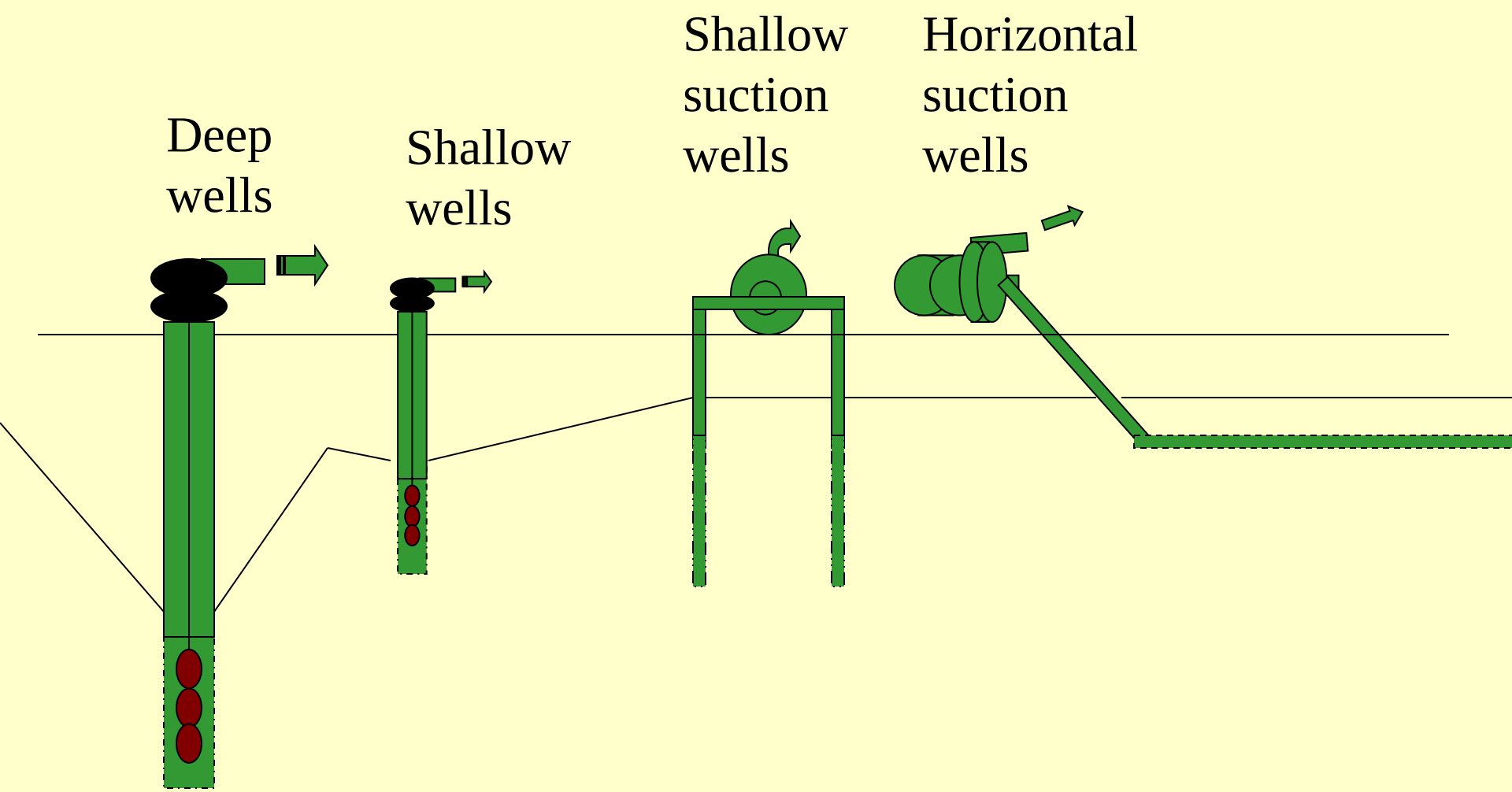


Water Storage reservoirs

- Allows use of spring high drain flows
- Storage capacity must include total need plus evaporative loss and leak loss.

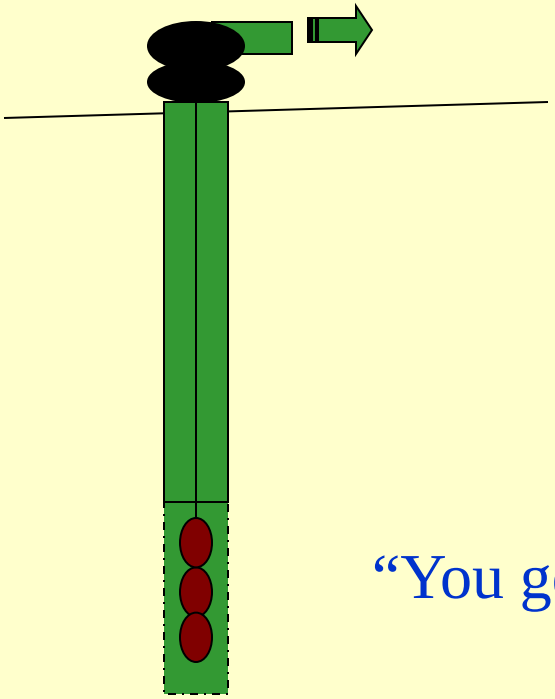


Groundwater Sources



Groundwater

Deep wells



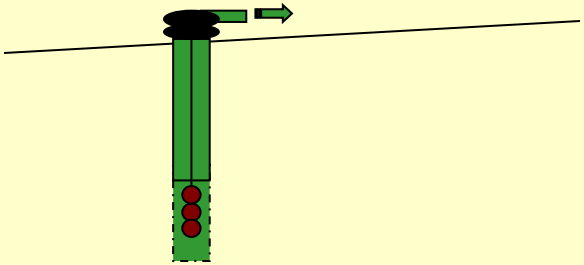
- Size-4,5,6,8 and 12”
- Depth- 20’ plus screen to 200’+
- Screens- stainless and plastic
- Pumps-shaft and turbine or submersible
- Flow 25 to 1600 gal/min
- Gravel pack or developed
- Cost $2,000 –70,000

-Test wells
-Monitoring wells
-Hydrology studies
-Screen matched to test hole samples

“You get what you pay for” and Risk Management

Groundwater sources

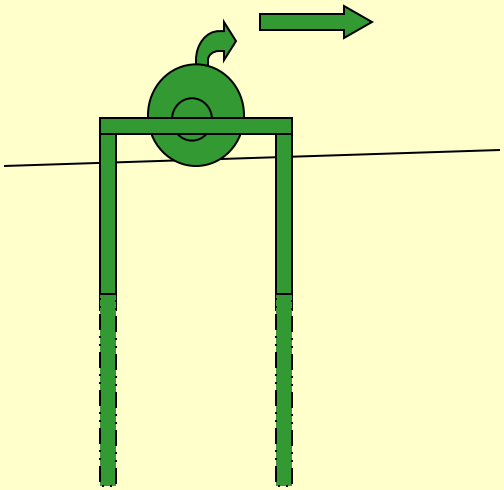
Shallow wells



- Size-4,5,6,8 and 12”
- Depth- 20’ plus screen to 40’
- Screens- stainless and plastic
- Pumps-shaft and turbine or submersible
- Flow 25 to 800 gal/min
- Developed
- Cost $2,000 –20,000

Groundwater sources

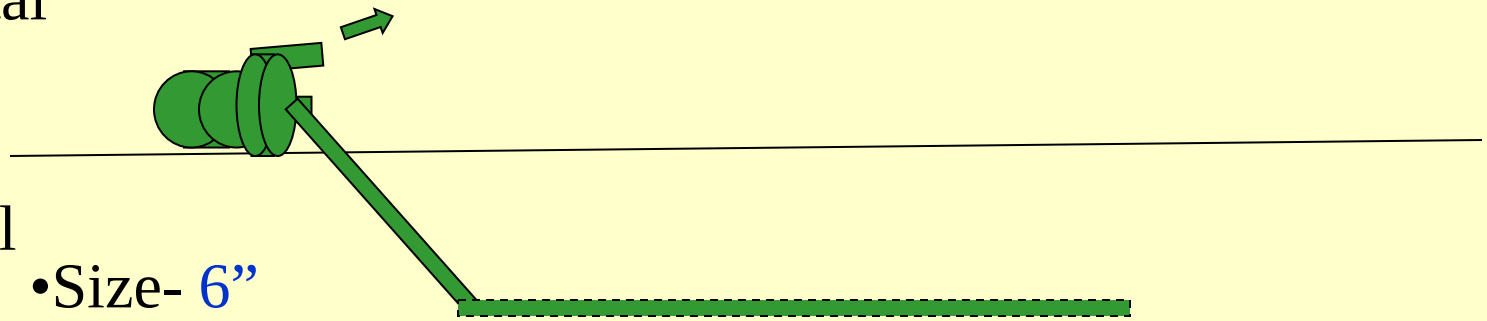
Shallow suction wells



- Size-4”,5”& 6”
- 1, 2 or 3 wells tied together
- Depth- 20’ plus screen to 30- 40’
- Screens- stainless and plastic
- Pump-vacuum pump
- Flow 25 to 600 gal/min 150-200 per well
- Developed
- Cost $2,000 –20,000

Groundwater sources

Horizontal suction wells or sock well



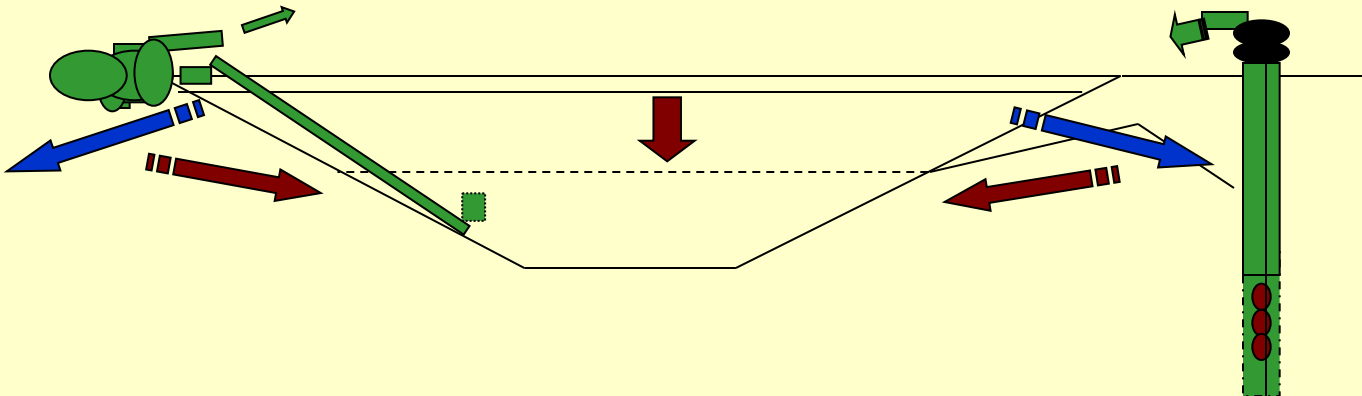
- Size- 6”
- 1or 2 tile with sock tied together
- Depth- 12-20’
- Screen- synthetic sock over perforated tile
- Pump-vacuum pump.
  -high vacuum pressures for high capacity
- Flow 200 to 600 gal/min
- Developed
- Cost $2,000 –20,000

Surface and Groundwater Combinations

- Pumping small well into pond as a reservoir
- Allows a smaller pump, pumping continuously to store water for larger pump to pump for shorter time
- Very inefficient

  -Requires pumping water twice

  -Ponds are very leaky reservoirs



Michigan Certified Well Drillers and Well Code

- Certified well drillers following the well code may construct wells and file well logs without inspection by the state.
- A list of certified well drillers are available at: http://www.deq.state.mi.us/documents/deq-dwrpd-gws-wcu-Reg-Contractors-By-County.pdf
- A copy of the well construction code is available at: http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3694-9194--,00.html