Comparison of One Well versus Many

From a Hydrogeologic perspective

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Mass balance / water budget

Aquifer: drawdown, well interference

Water quality: well to drain field, lot to lot

Stream depletion

One is better

Some ground rules…

Stream Depletion is (ultimately) equal to

$$\frac{Q_{well(s)}}{Periodicity}$$

For example: the stream depletion for a well pumped at 400 gpm for 3 months of each year is 100 gpm

$$\frac{400gpm}{12months/3months} = 100gpm$$

…this excludes direct runoff or return flow through ground water

Some ground rules…

Stream Depletion is independent of stream discharge
same effect whether 1000 cfs or 10 cfs

Unless, of course, you dry up the stream

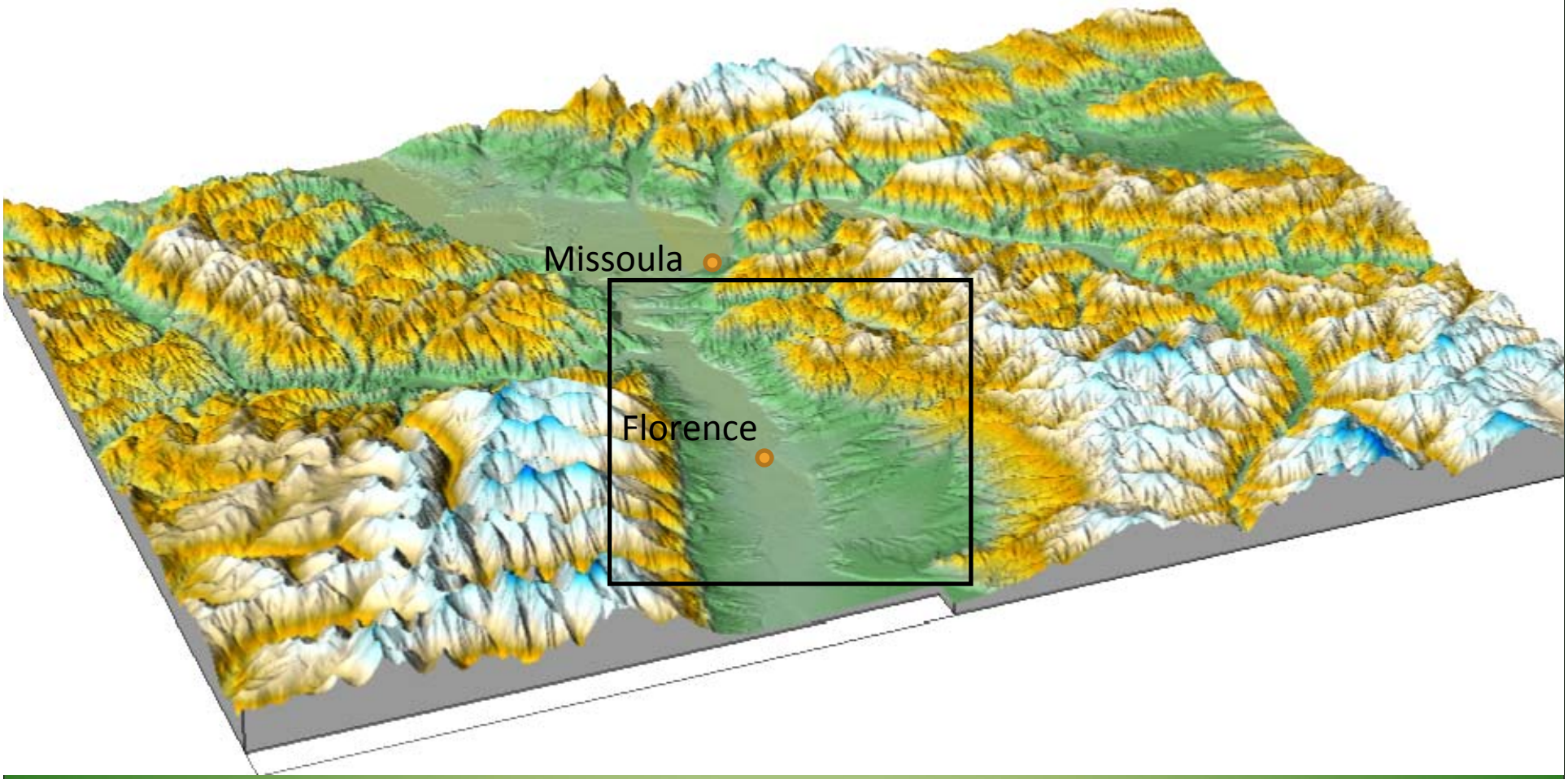
Stream Depletion is independent of well interference
it is both cumulative and additive
1 well pumping 500 gpm
has the same effect as
50 wells pumping 10 gpm

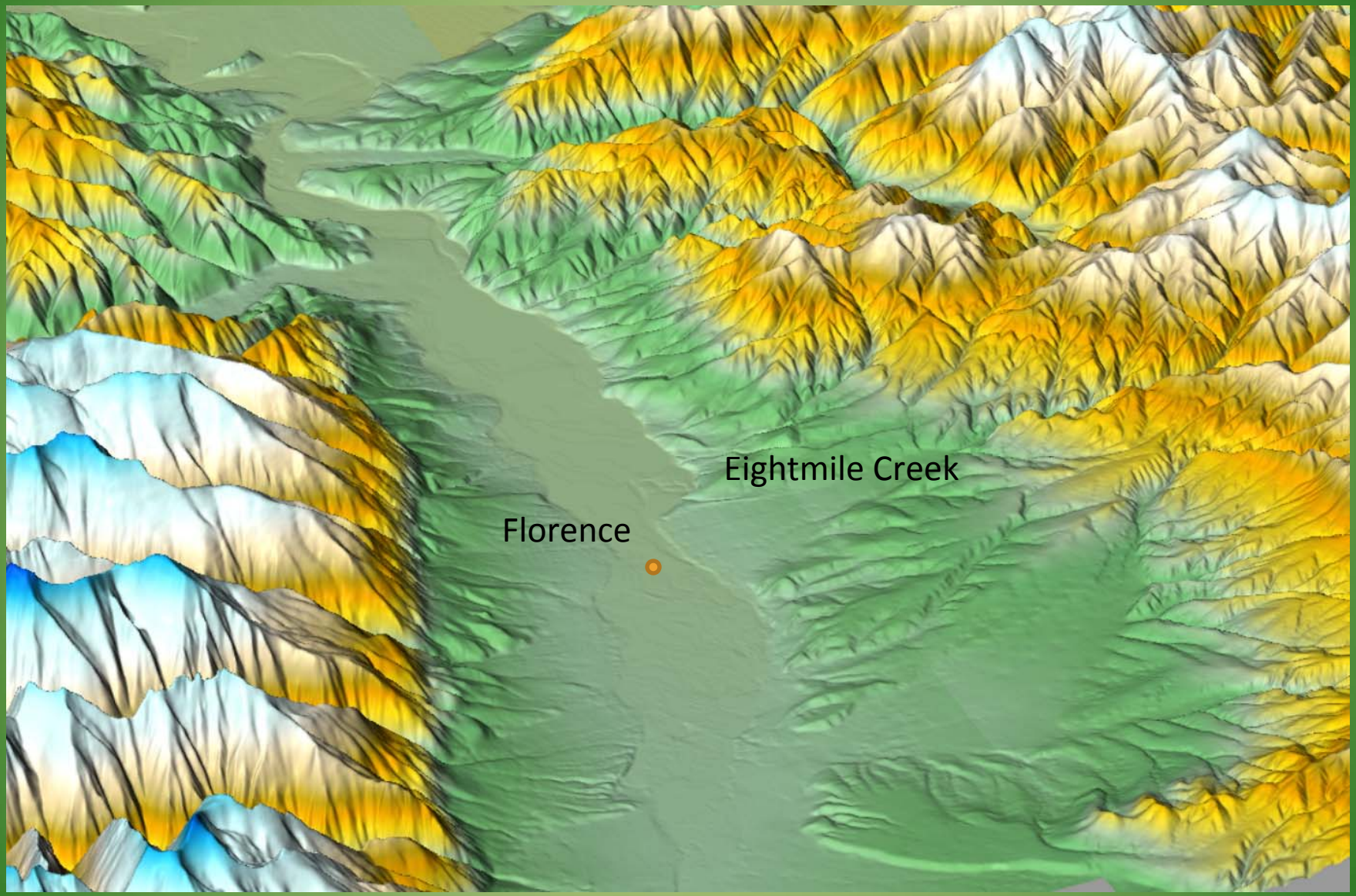
No difference between one and many wells…yet

Stream Depletion is independent of distance from the well(s) to the stream
BUT the **RATE** of depletion **IS** dependent on distance

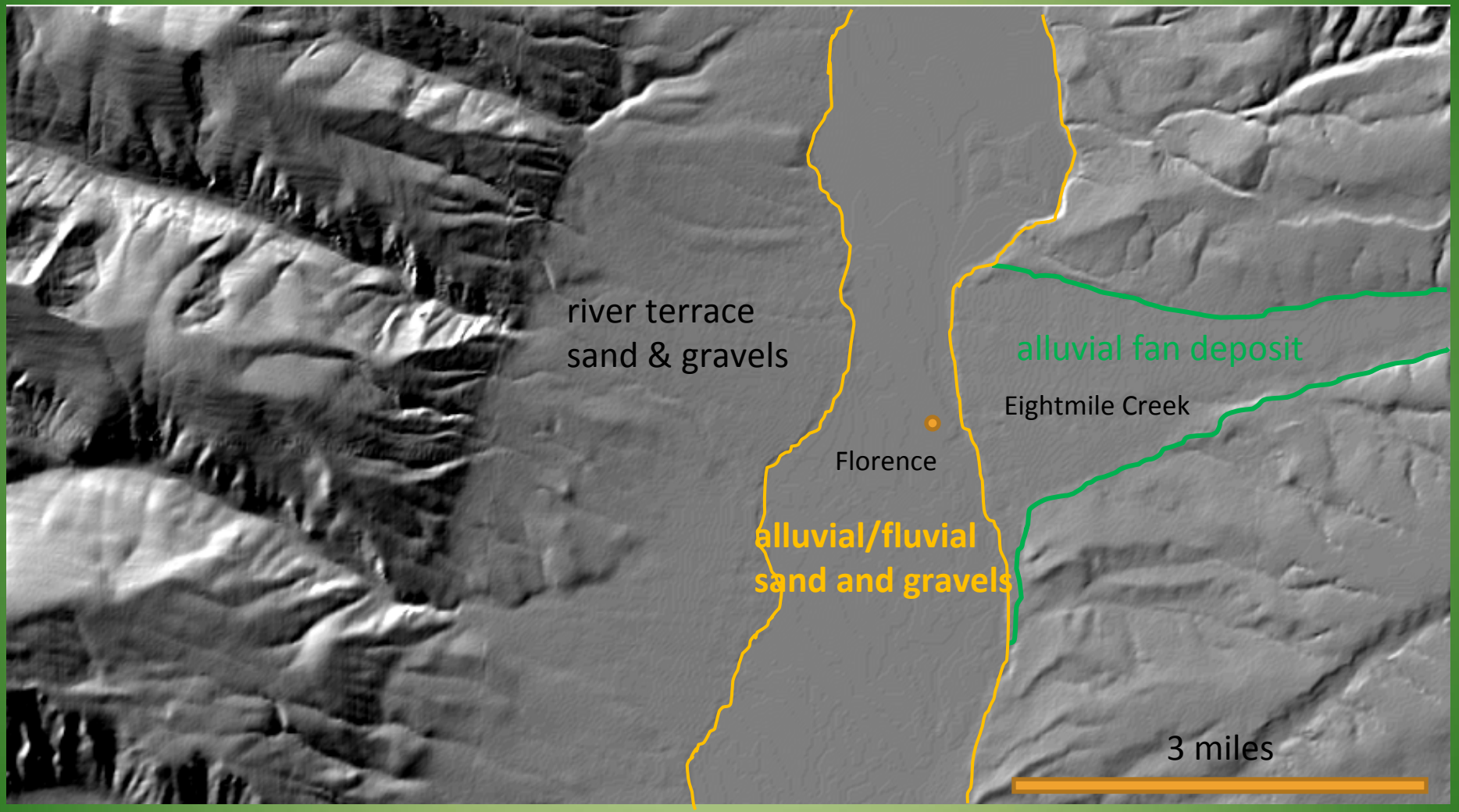
Stream depletion as a function of distance from the stream

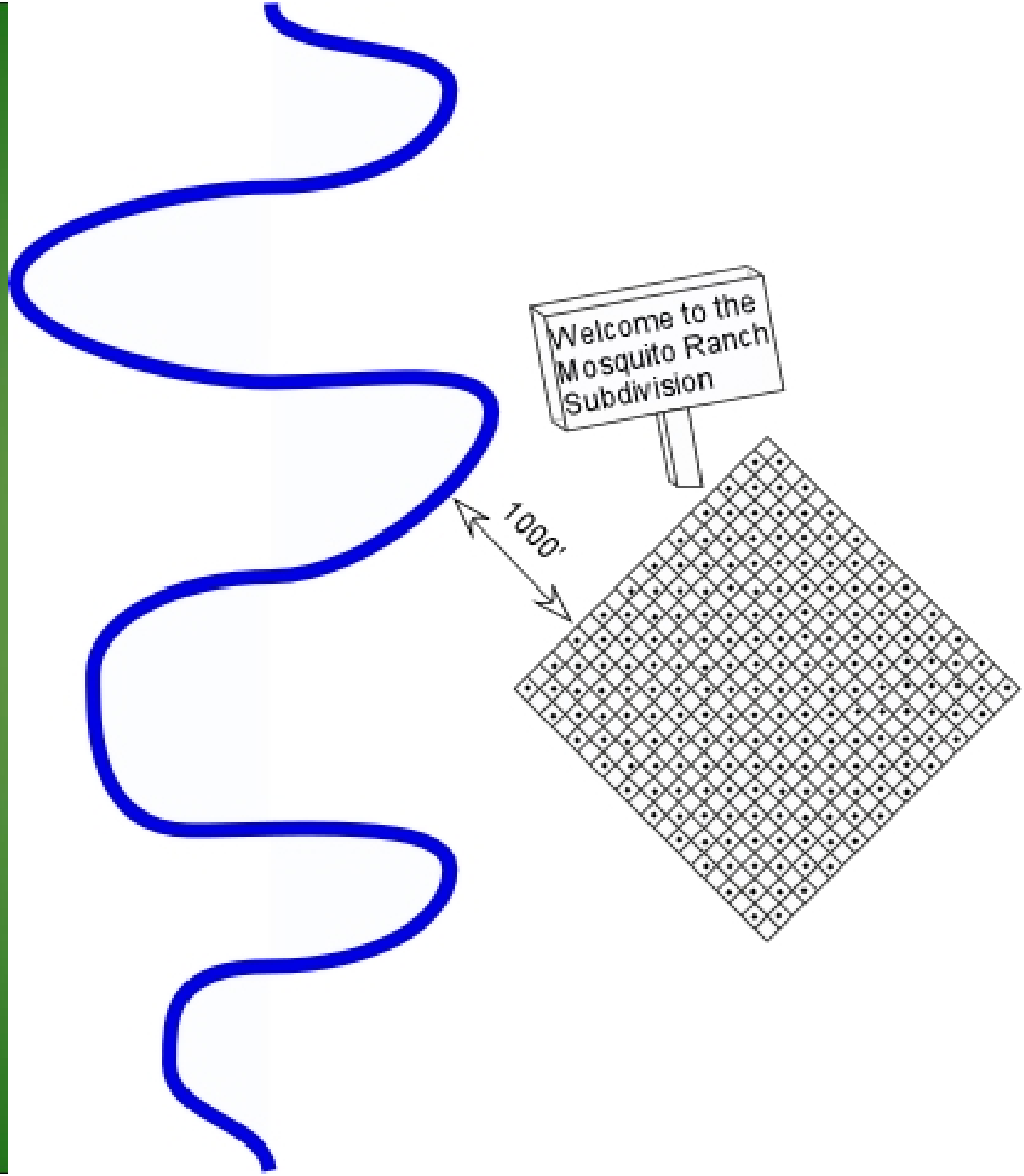
The only thing better than data is a model

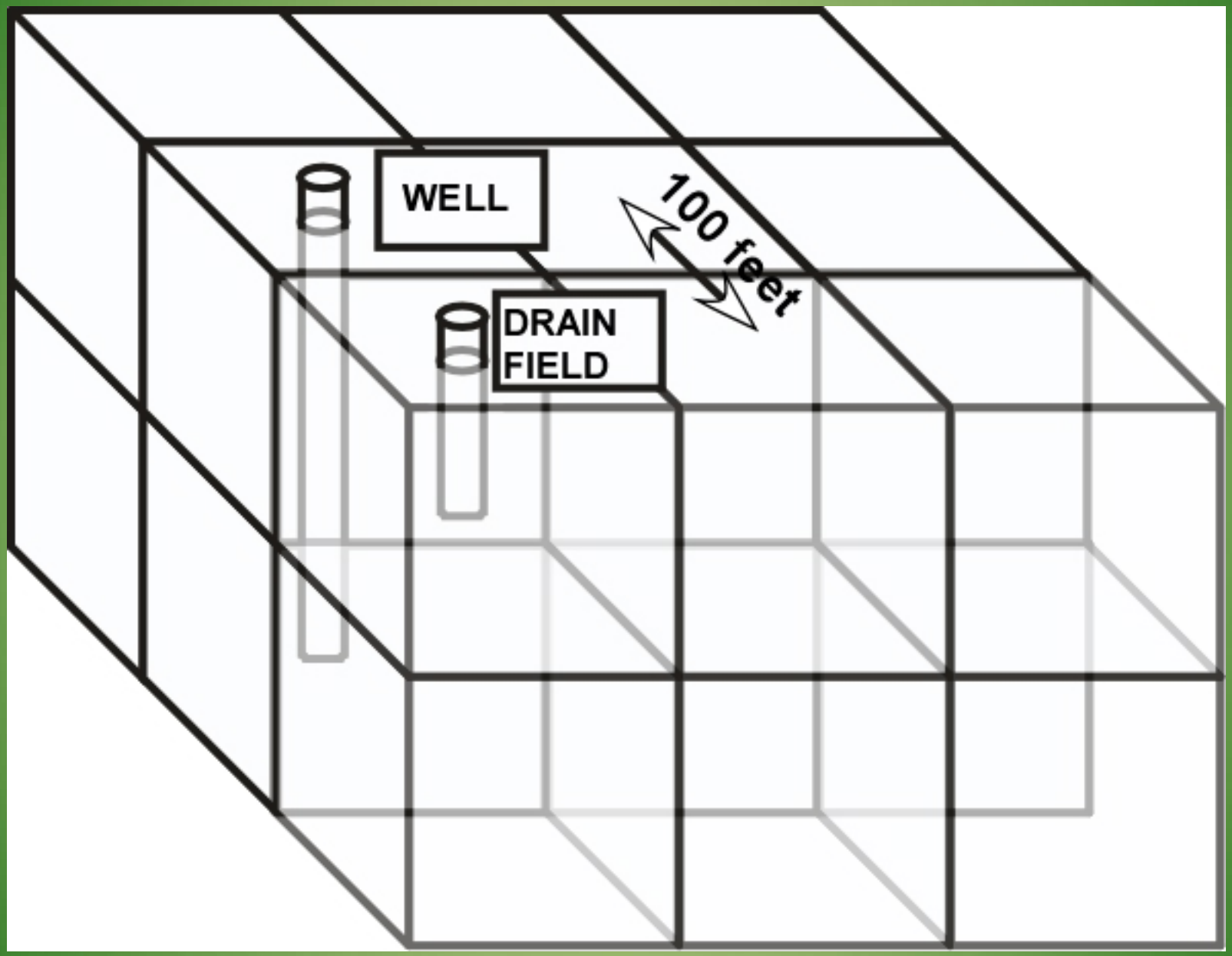

Missoula
Florence


Eightmile Creek
Florence

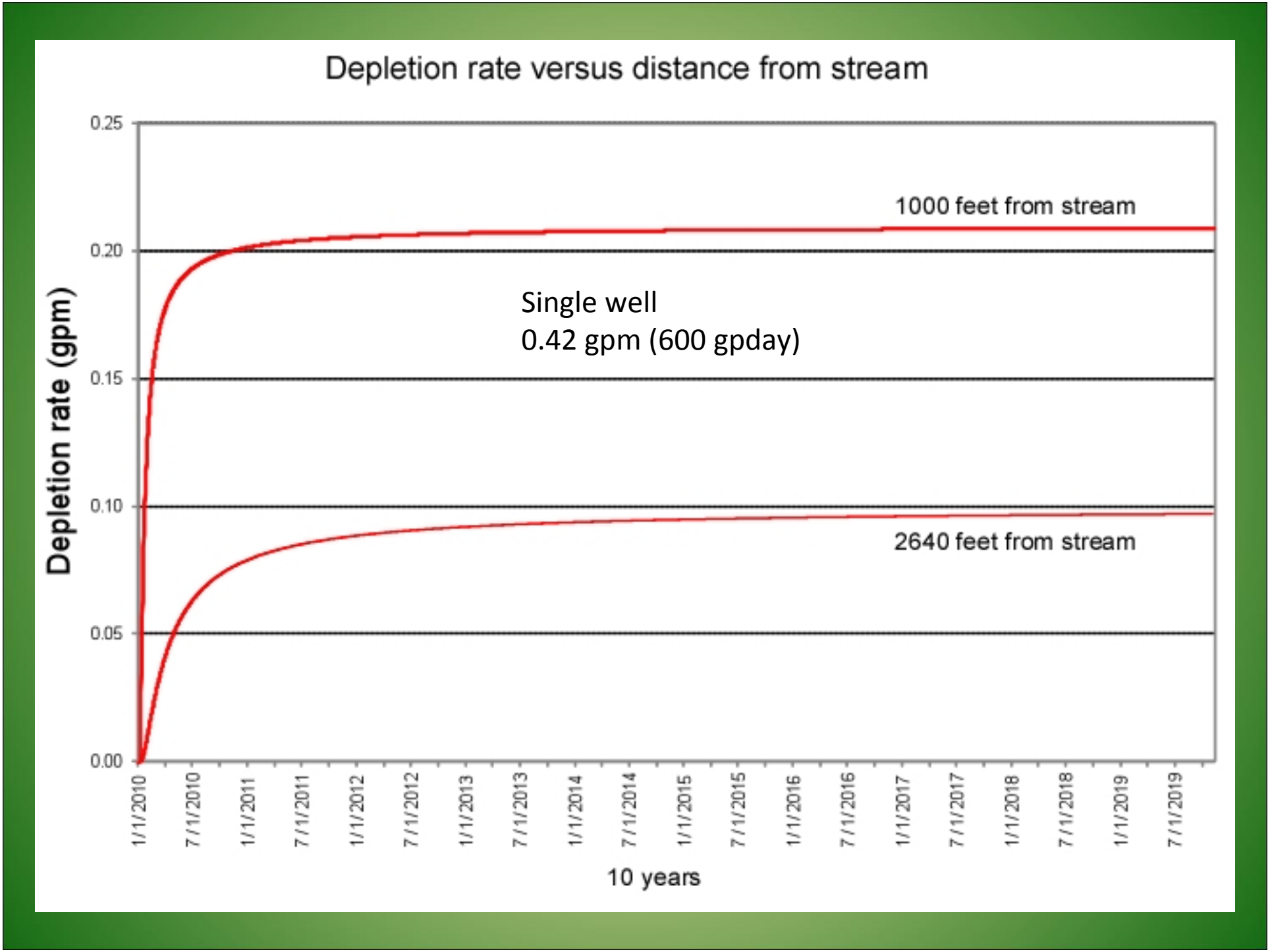
Local geology




Welcome to the
Mosquito Ranch
Subdivision
1000'

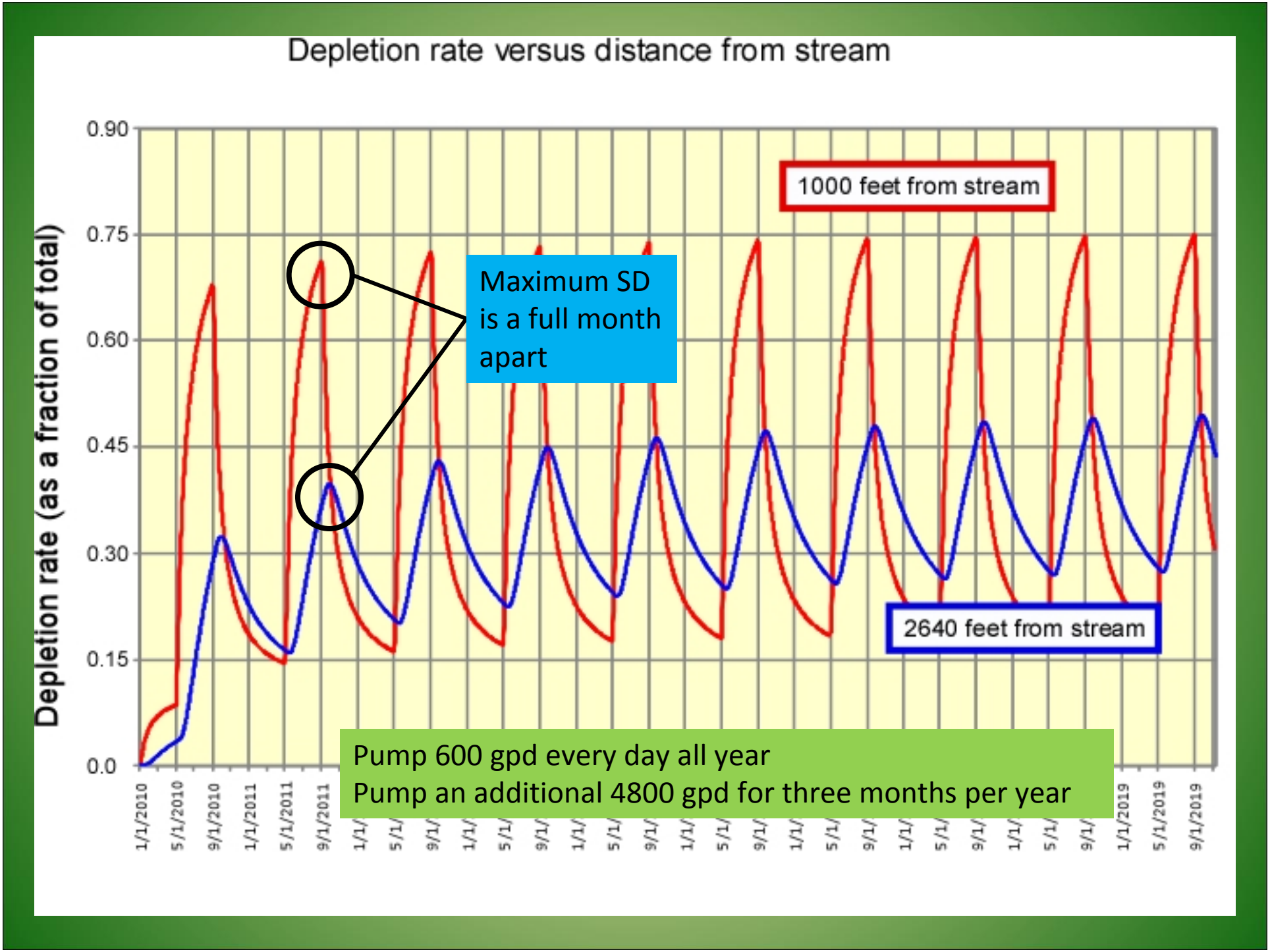

WELL
100 feet
DRAIN
FIELD

Simplest case: single well, constant discharge


Depletion rate versus distance from stream
Depletion rate (gpm)
0.25
0.20
0.15
0.10
0.05
0.00
1000 feet from stream
Single well
0.42 gpm (600 gpday)
2640 feet from stream
1/1/2010
7/1/2010
1/1/2011
7/1/2011
1/1/2012
7/1/2012
1/1/2013
7/1/2013
1/1/2014
7/1/2014
1/1/2015
7/1/2015
1/1/2016
7/1/2016
1/1/2017
7/1/2017
1/1/2018
7/1/2018
1/1/2019
7/1/2019
10 years

Not so simple case: multiple wells with two pumping cycles:

Cycle 1: 600 gallons per day every day all year
Cycle 2: an additional 10 gpm for 8 hours per day
for 90 days each year (600 + 4800 gpd)

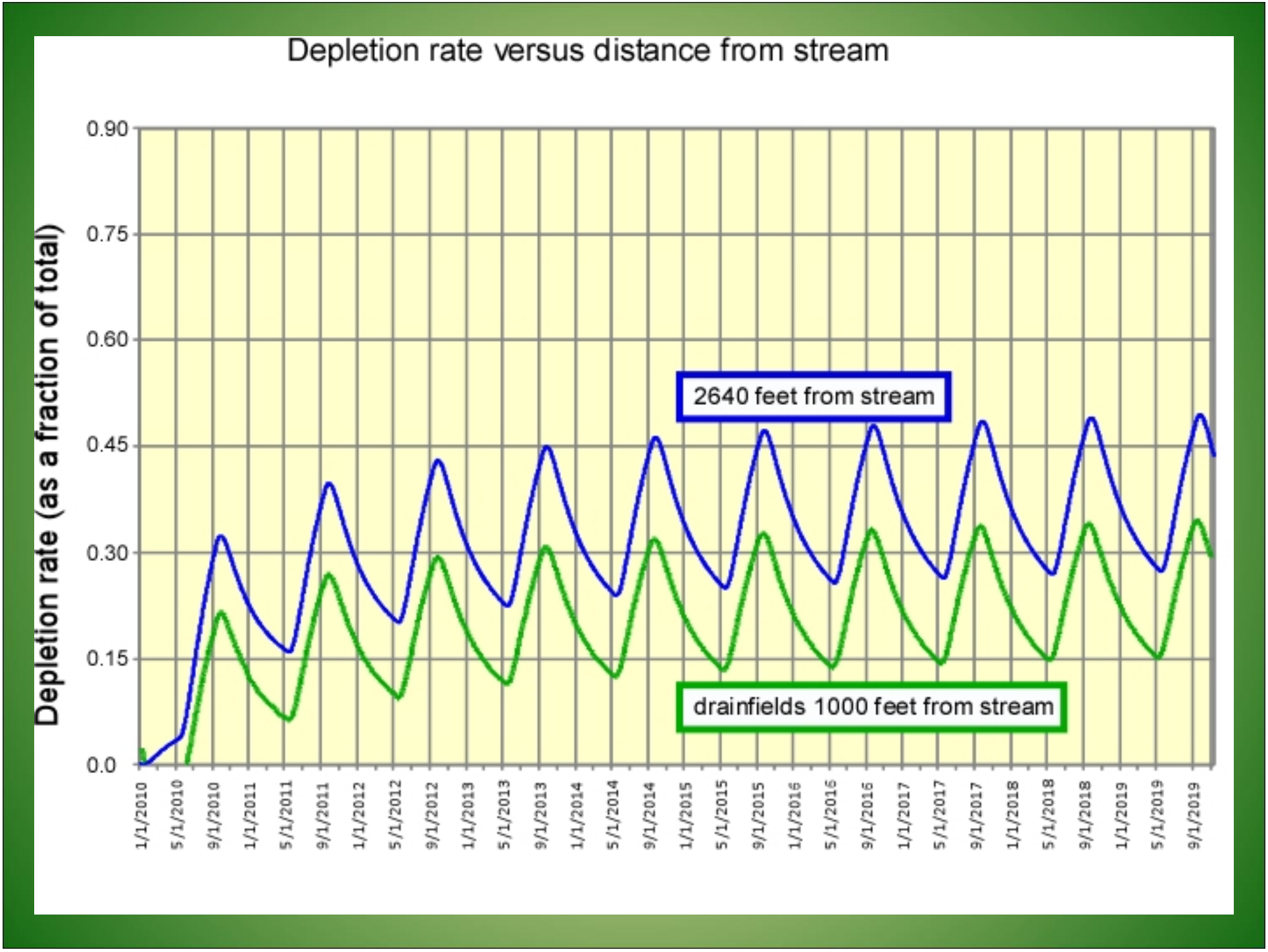

Depletion rate versus distance from stream
Depletion rate (as a fraction of total)
0.90
0.75
0.60
0.45
0.30
0.15
0.0
1000 feet from stream
2640 feet from stream
Maximum SD is a full month apart
Pump 600 gpd every day all year
Pump an additional 4800 gpd for three months per year
1/1/2010
5/1/2010
9/1/2010
1/1/2011
5/1/2011
9/1/2011
1/1/2019
5/1/2019
9/1/2019

By moving the point of withdrawal away from the stream we reduce the rate of stream depletion AND we change the timing of maximum depletion in the annual cycle (in this case one month: from September to October).

Now, about those drain fields…

Not so simple case: multiple wells with two pumping cycles
AND drain field return flow:

Cycle 1: 600 gallons per day every day, all year
Cycle 2: an additional 10 gpm for 8 hours per day
for 90 days each year (600 + 4800 gpd)
600 gpd recharge every day, all year


Depletion rate versus distance from stream
Depletion rate (as a fraction of total)
0.90
0.75
0.60
0.45
0.30
0.15
0.0
2640 feet from stream
drainfields 1000 feet from stream
1/1/2010
5/1/2010
9/1/2010
1/1/2011
5/1/2011
9/1/2011
1/1/2012
5/1/2012
9/1/2012
1/1/2013
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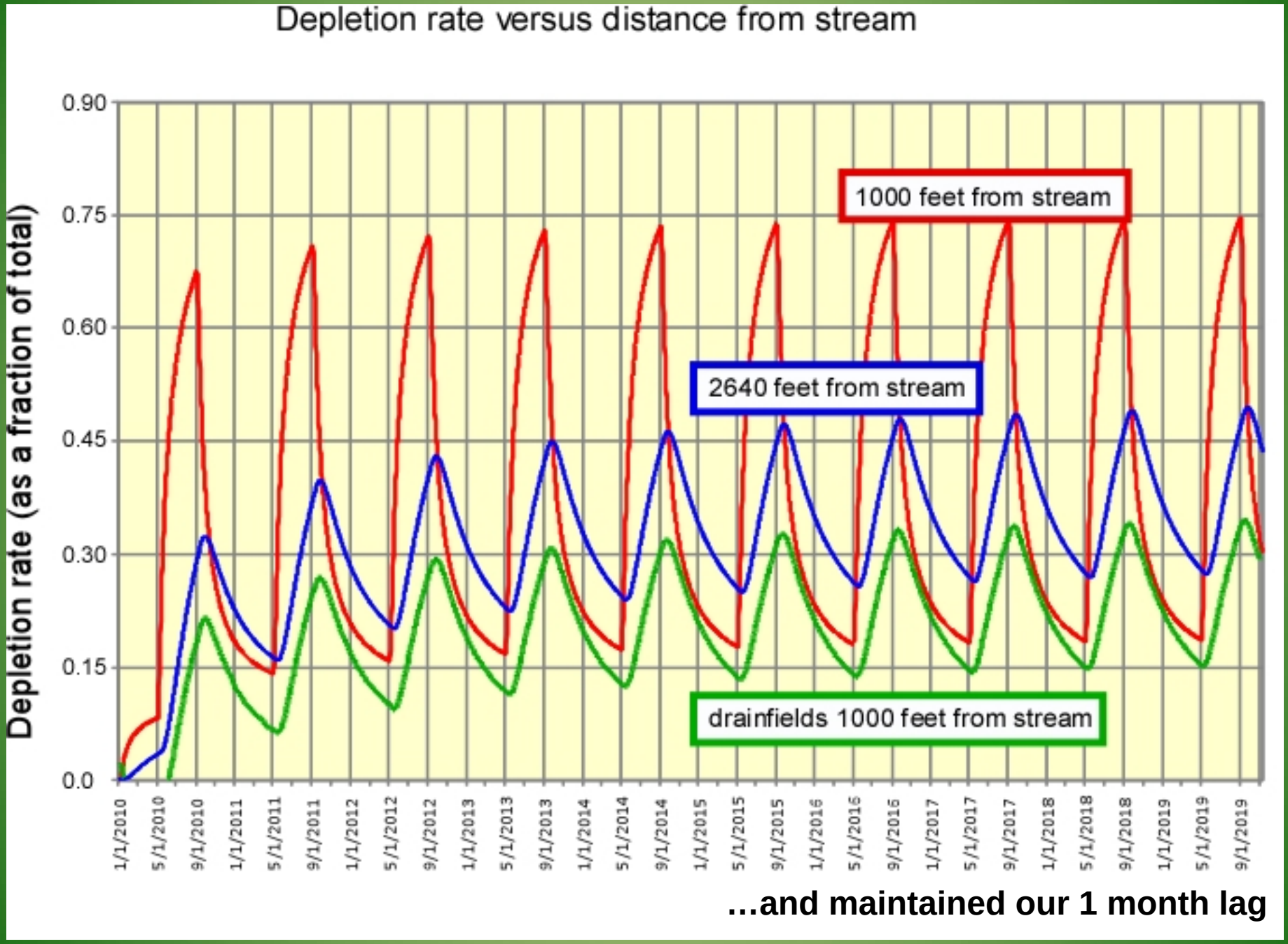
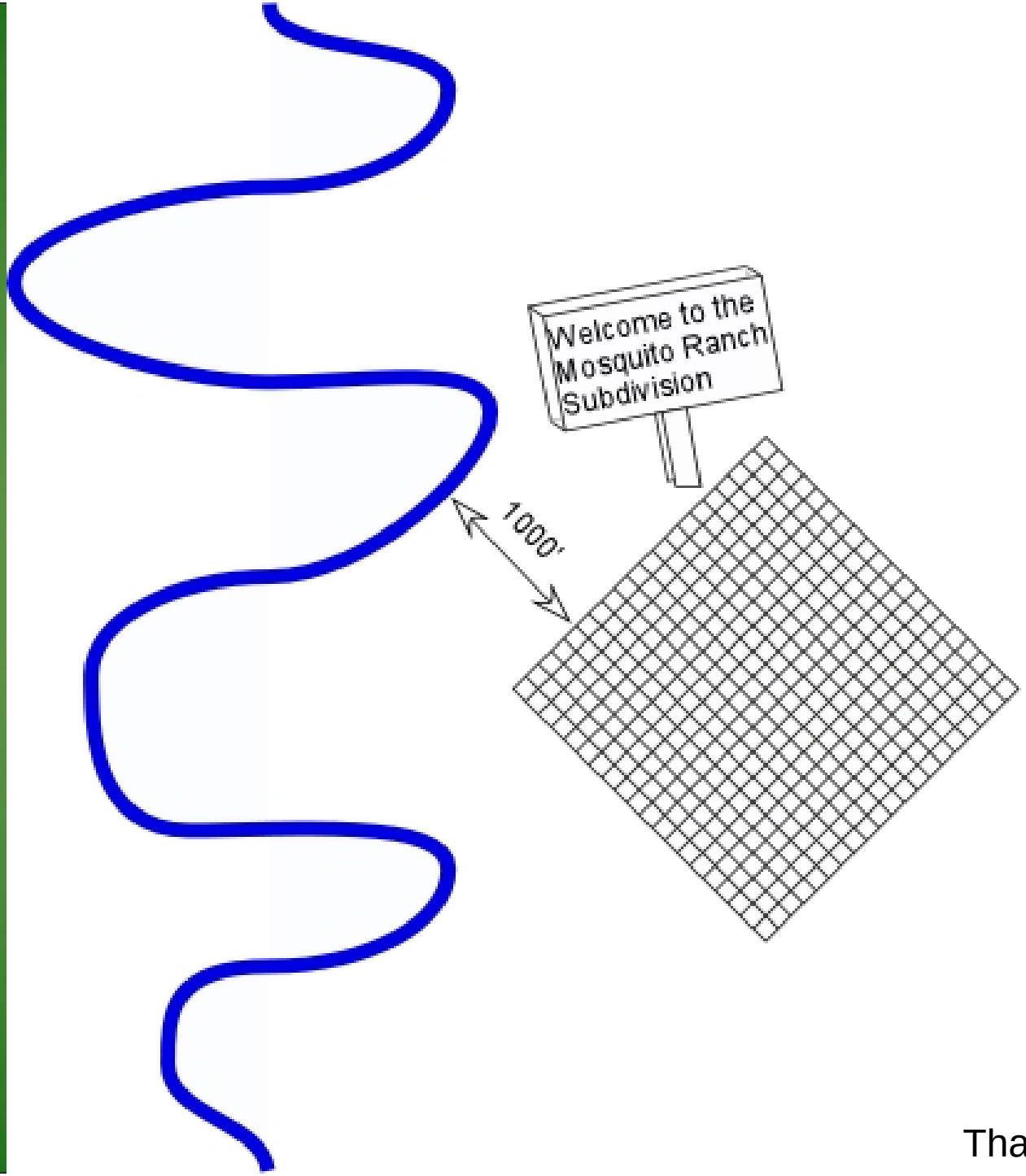
9/1/2019



…and maintained our 1 month lag



That’s why fewer is better

Comparison of One Well versus Many

From a Hydrogeologic perspective

If management is conducted on an annual basis, this approach is not likely to be effective

If monthly response is important, this can provide a lot of flexibility – **IF** a few wells are used

So, move the wells, not the subdivision - not one mosquito loses a meal

Potential BONUS: water quality - all wells up gradient of all septic systems

Caution: stream depletion is NOT reduced nor is it mitigated

One site does not fit all

local hydrologeology must be characterized