Effects of Future Pumping on Shallow Groundwater Circulation

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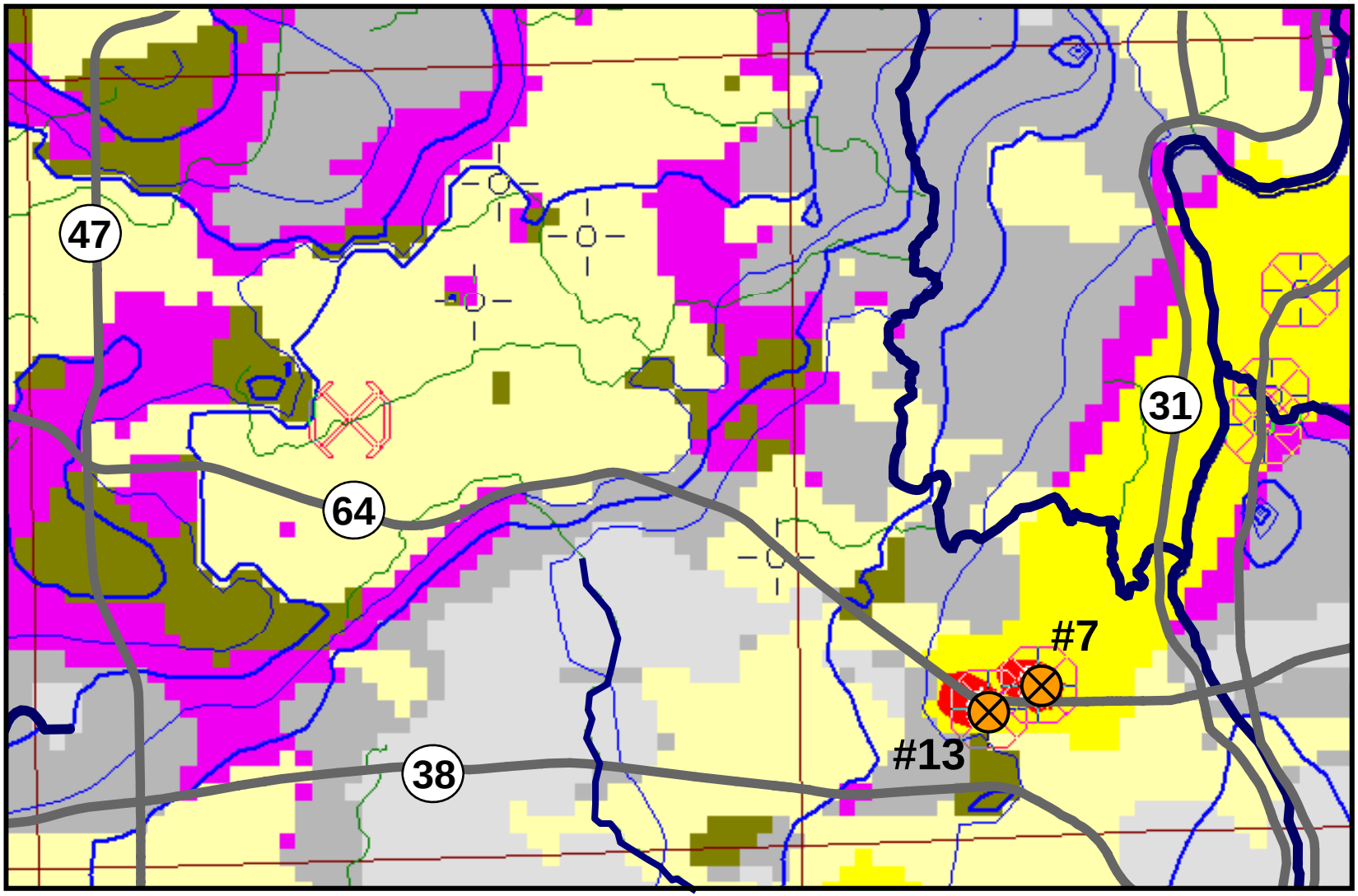
Shallow Aquifer Model – Toolbox for water supply planning

- Predictive scenarios
- Capture zone analysis
- Impact of future water use
- Interaction with streams
- Locating new wellfields

Predictive Scenarios

- Capture Zone Analysis
  - “Zone of Contribution” or “Recharge Area”
  - Track “virtual water particles” backwards through the flow system
  - Example from St Charles #7 and # 13

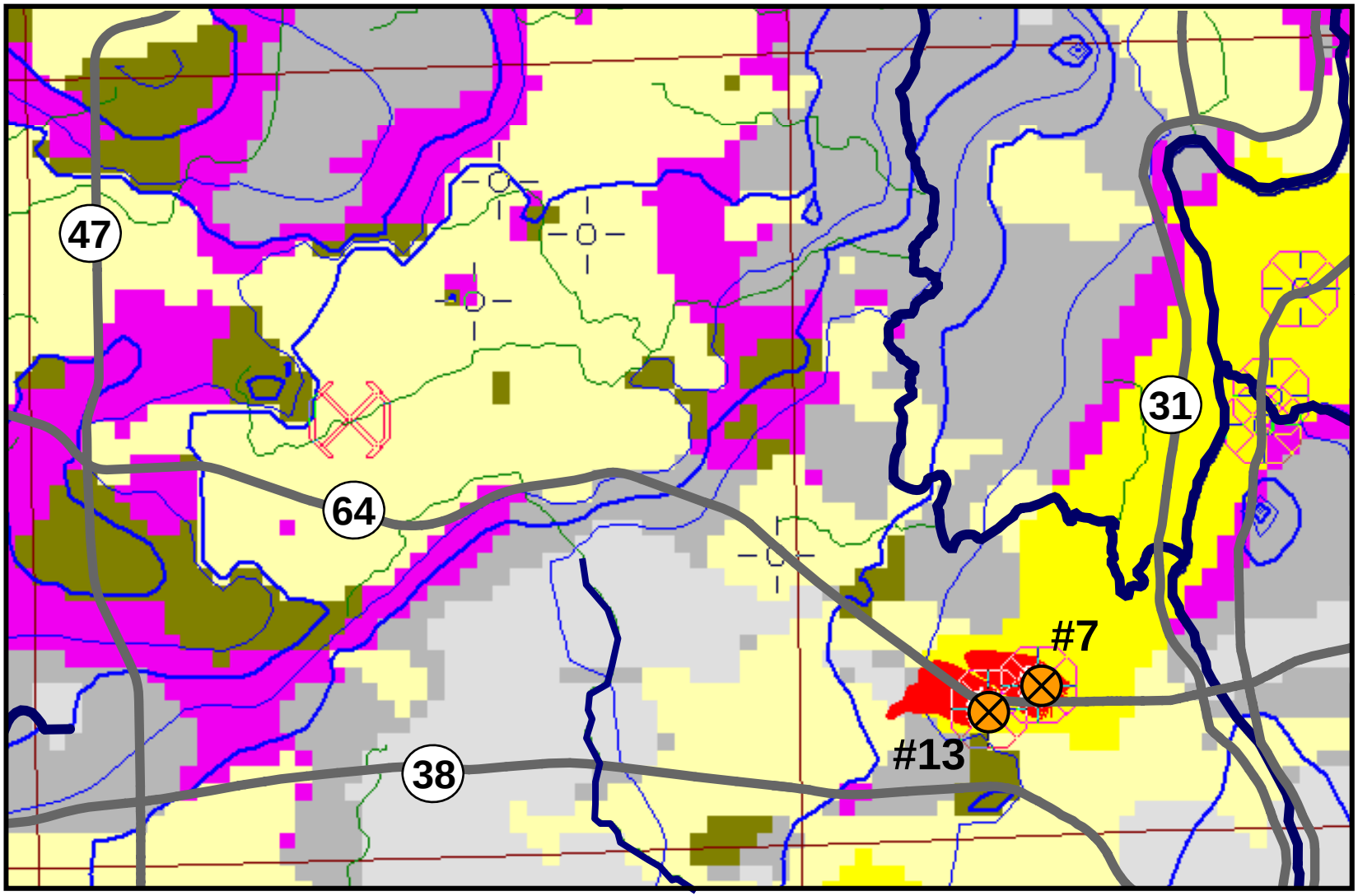
Capture Zone of St Charles #7 and #13



Layer 16

1 Year

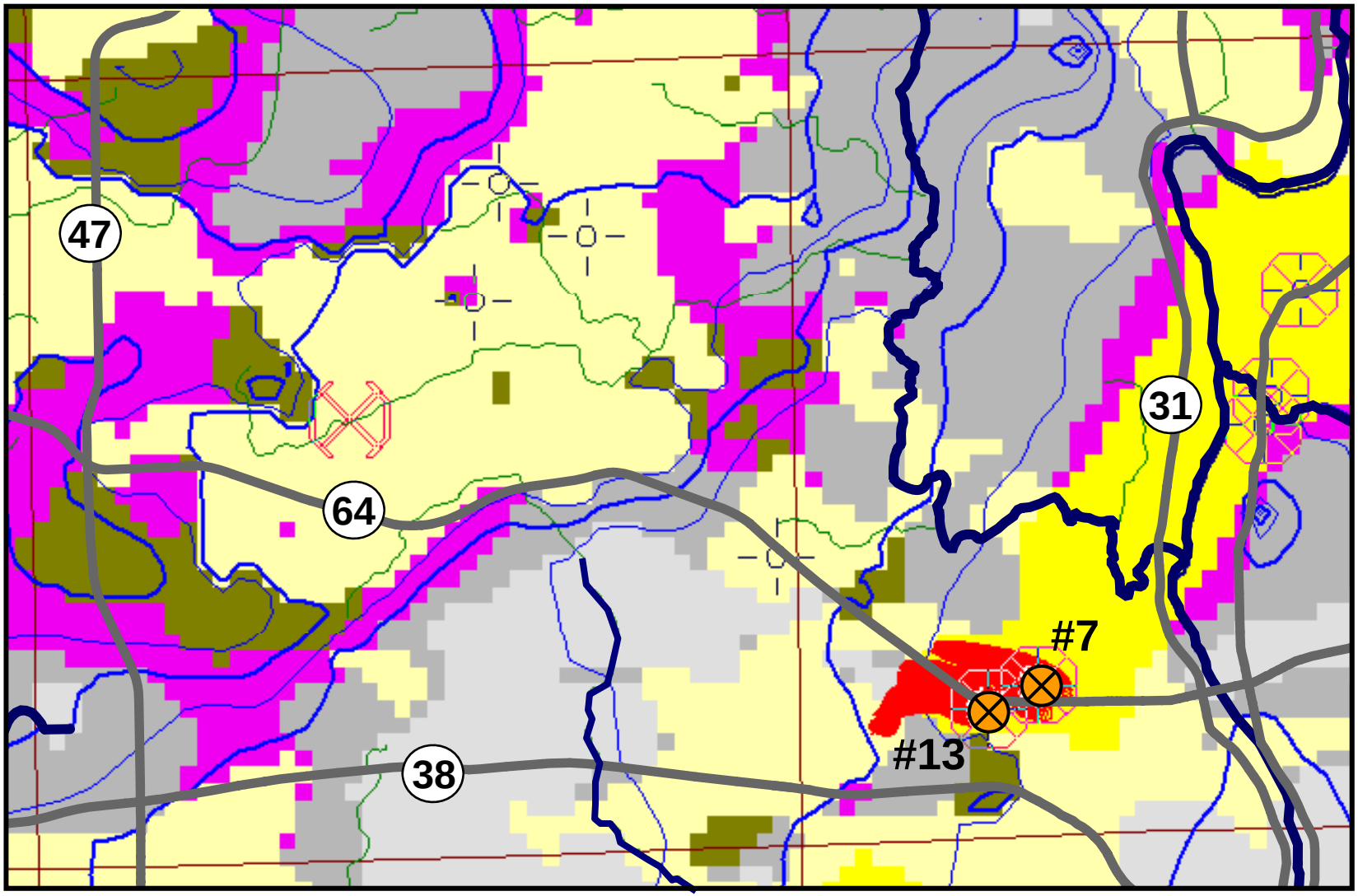
Capture Zone of St Charles #7 and #13



Layer 16

2 Years

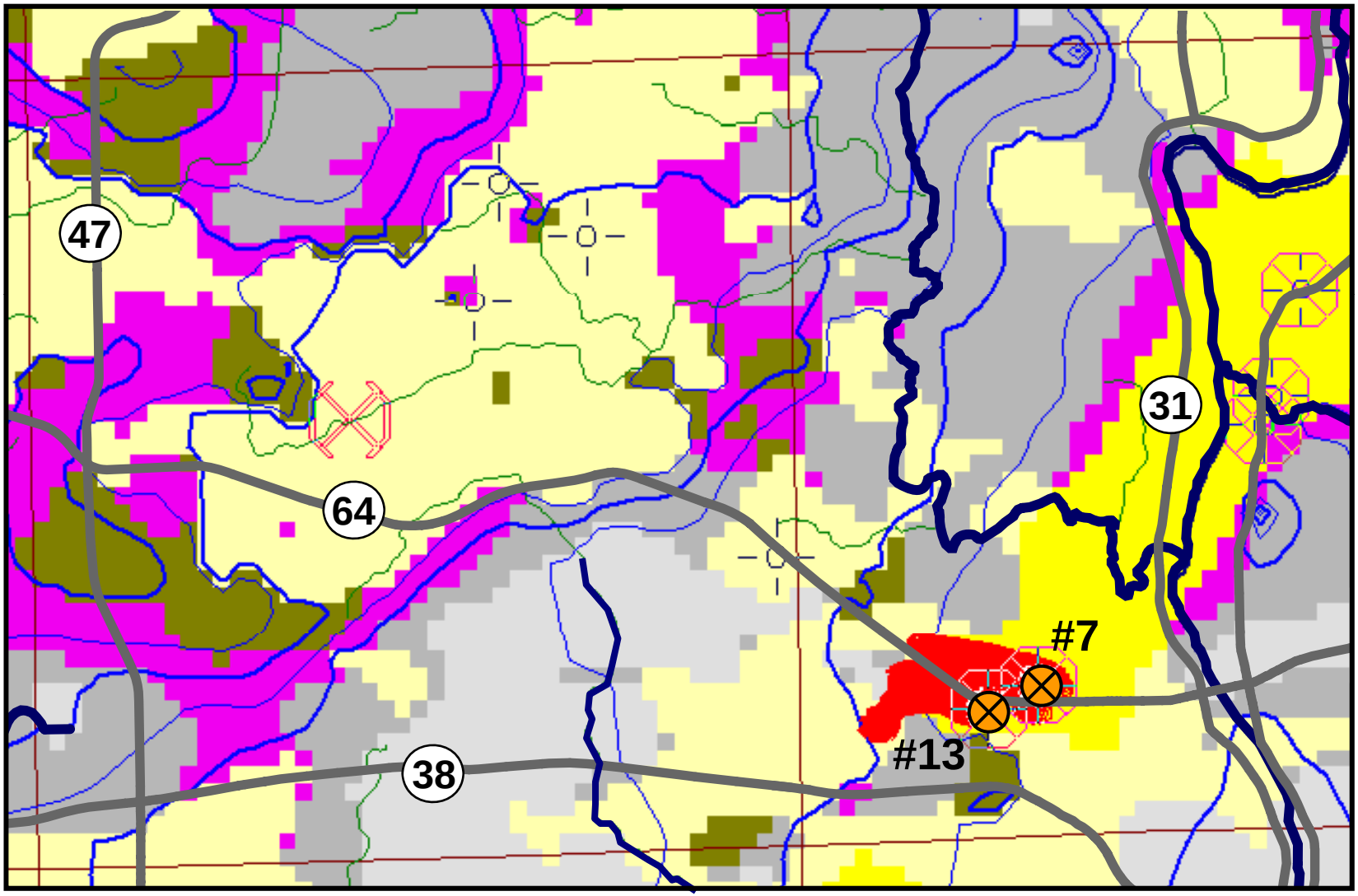
Capture Zone of St Charles #7 and #13



Layer 16

3 Years

Capture Zone of St Charles #7 and #13



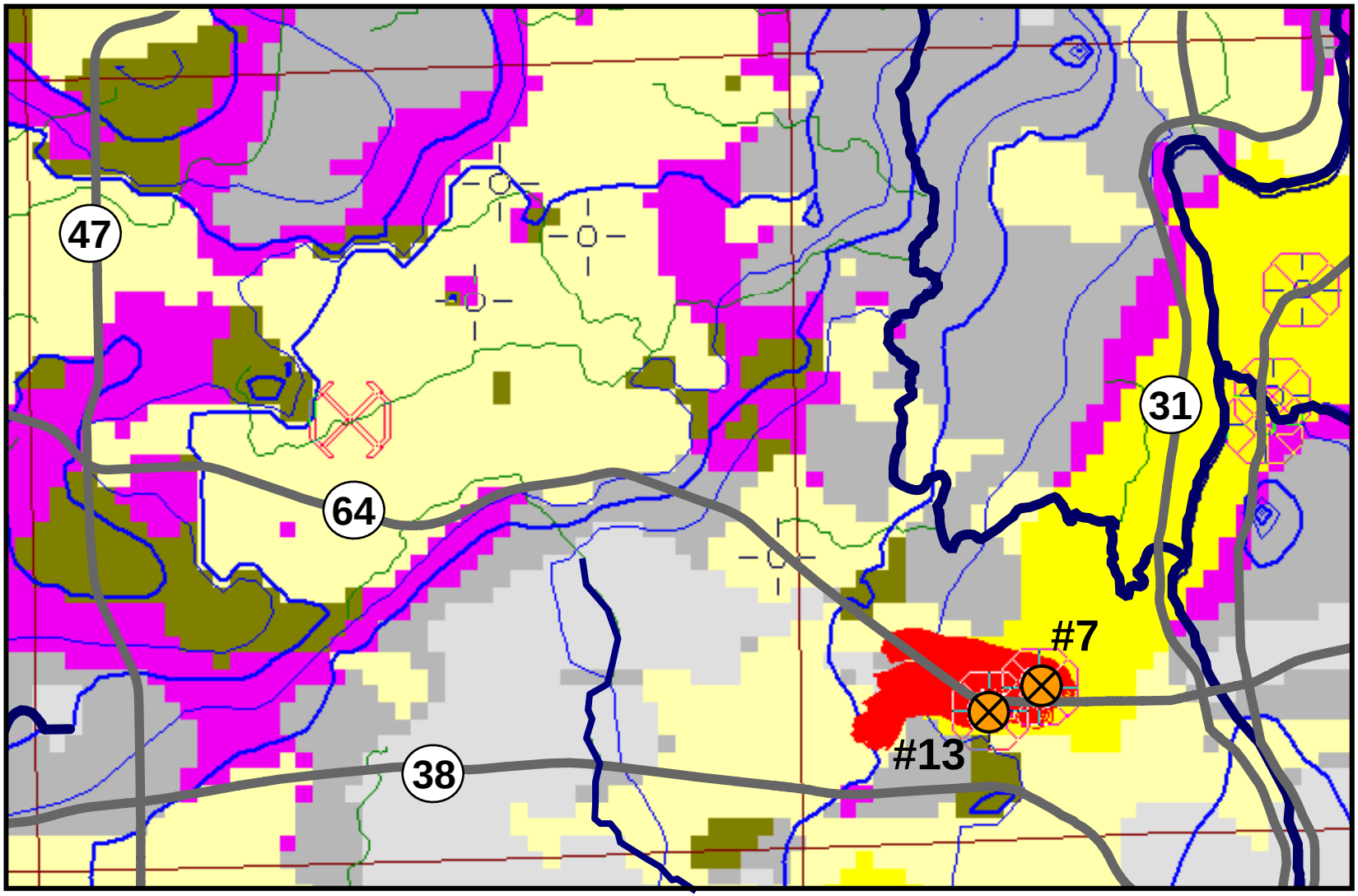
Layer 16

4 Years

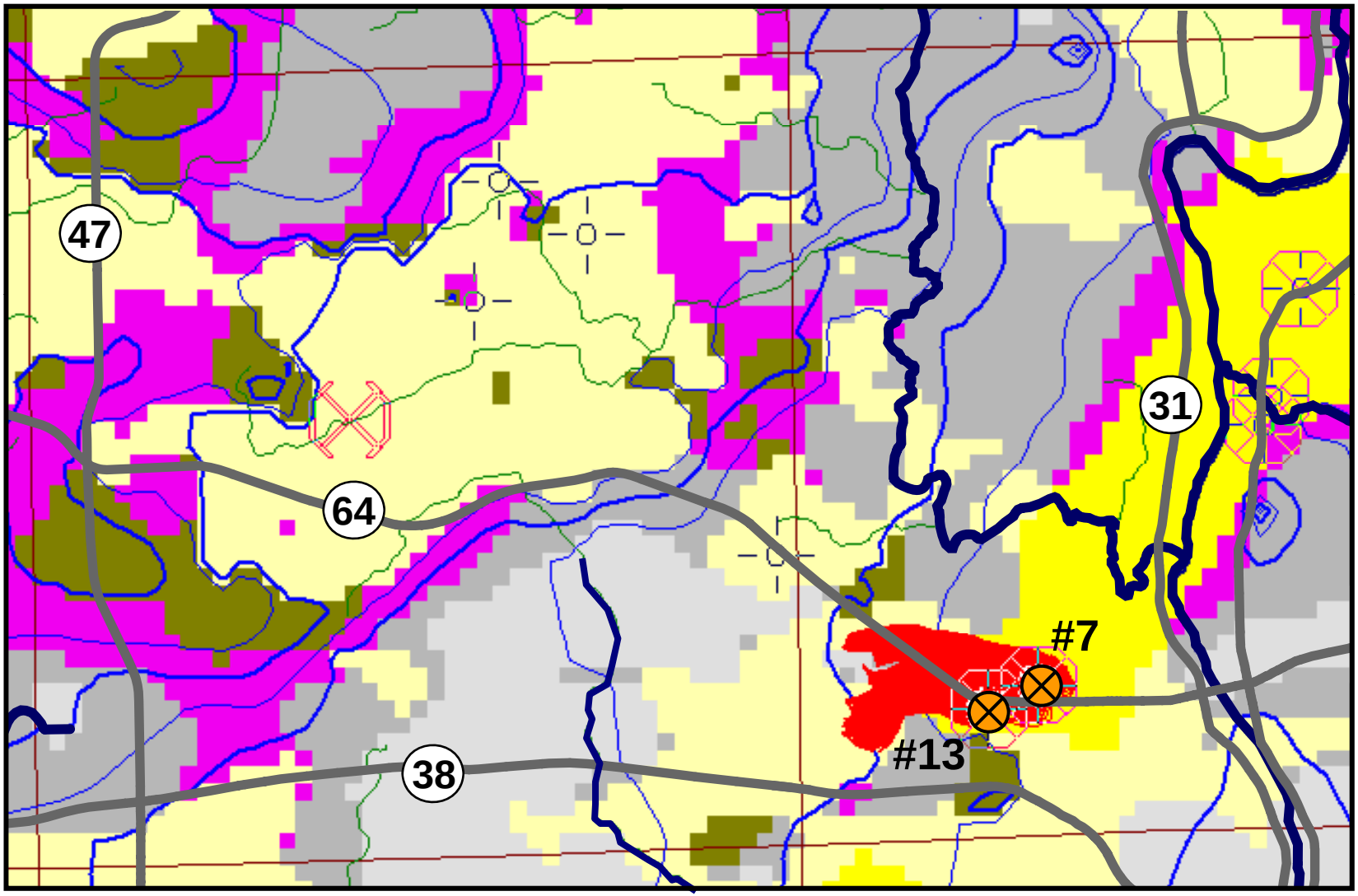
Capture Zone of St Charles #7 and #13

Layer 16

5 Years



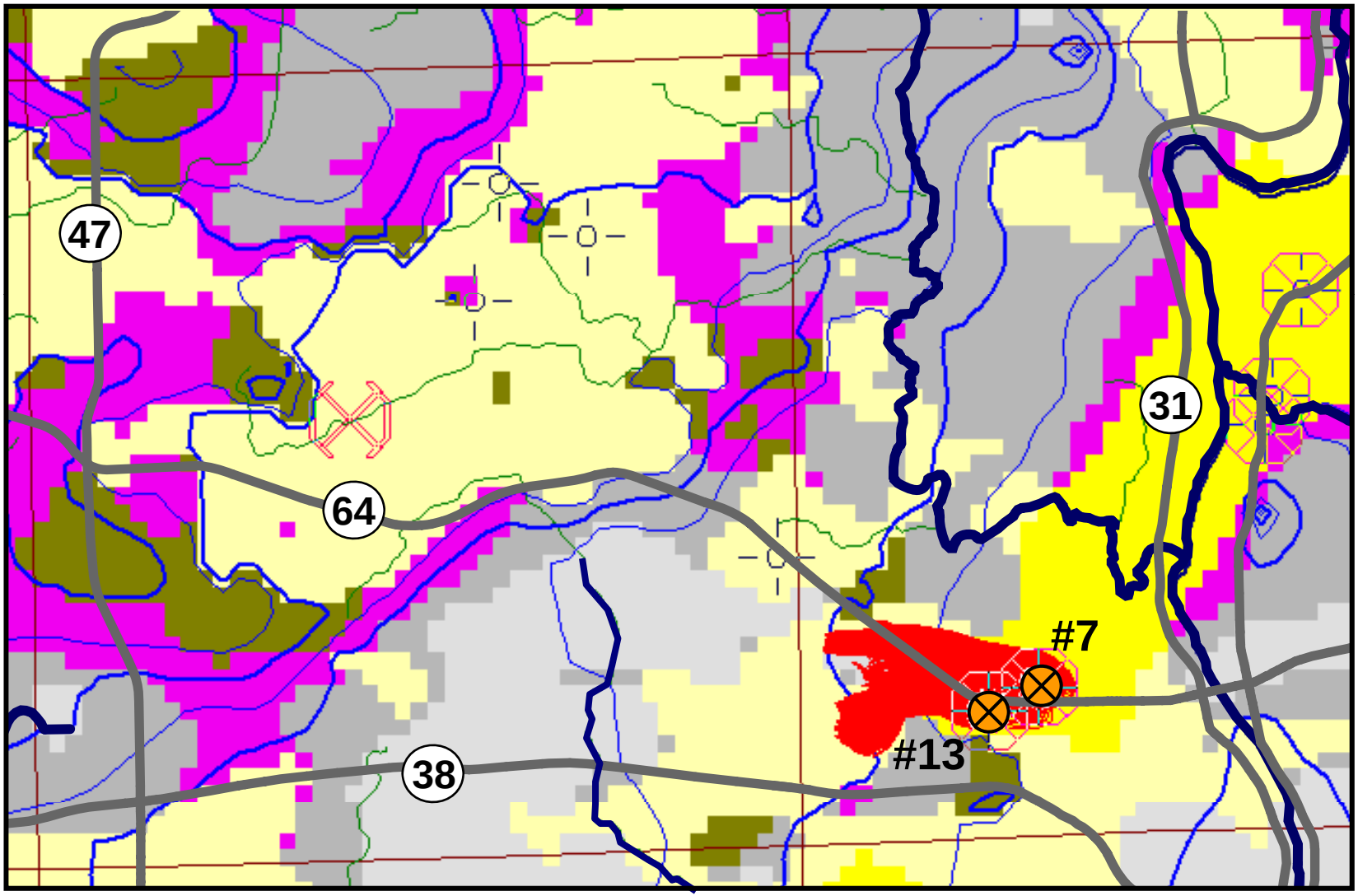
Capture Zone of St Charles #7 and #13



Layer 16

6 Years

Capture Zone of St Charles #7 and #13



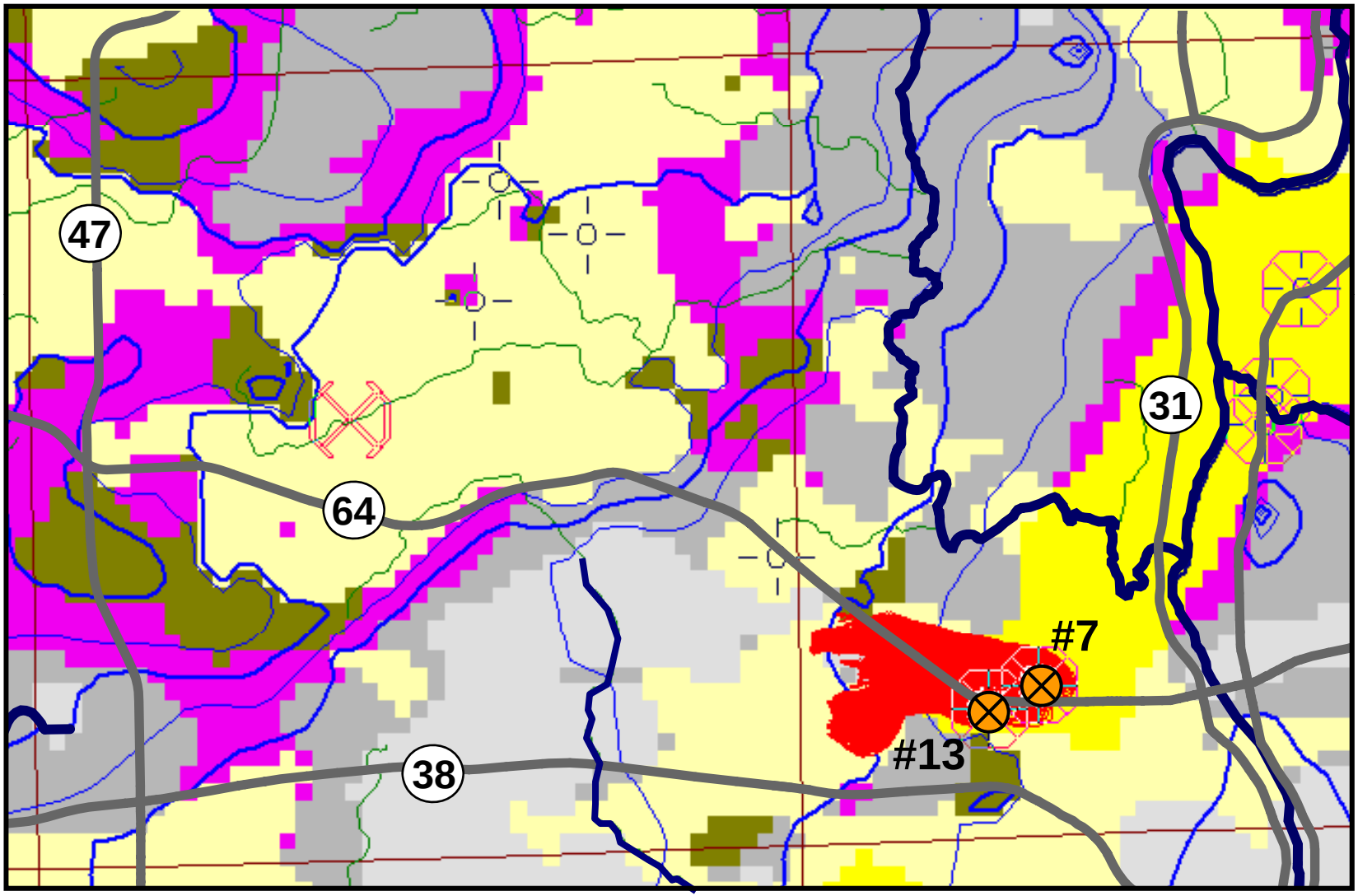
Layer 16

7 Years

Capture Zone of St Charles #7 and #13

Layer 16

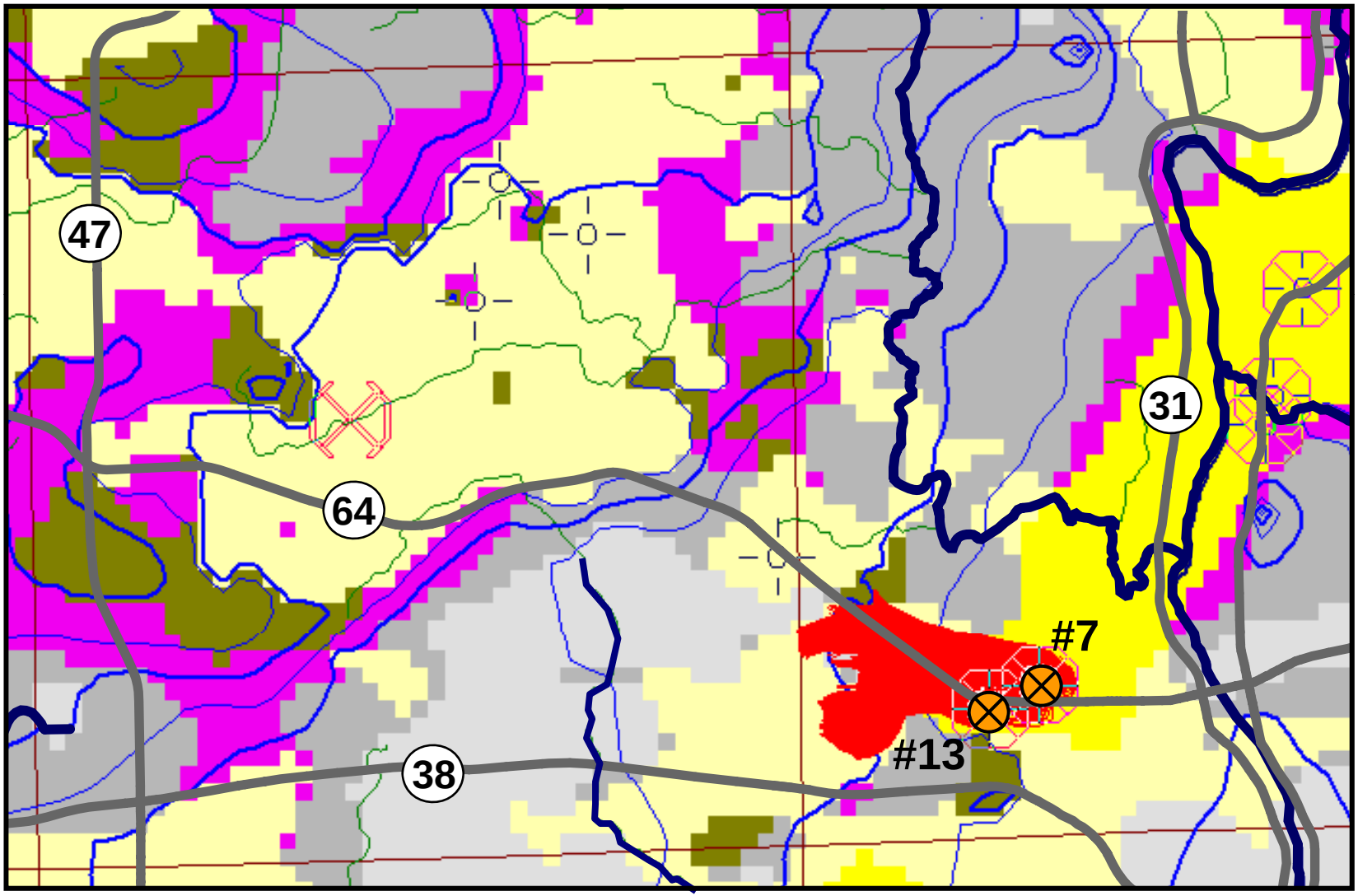
8 Years



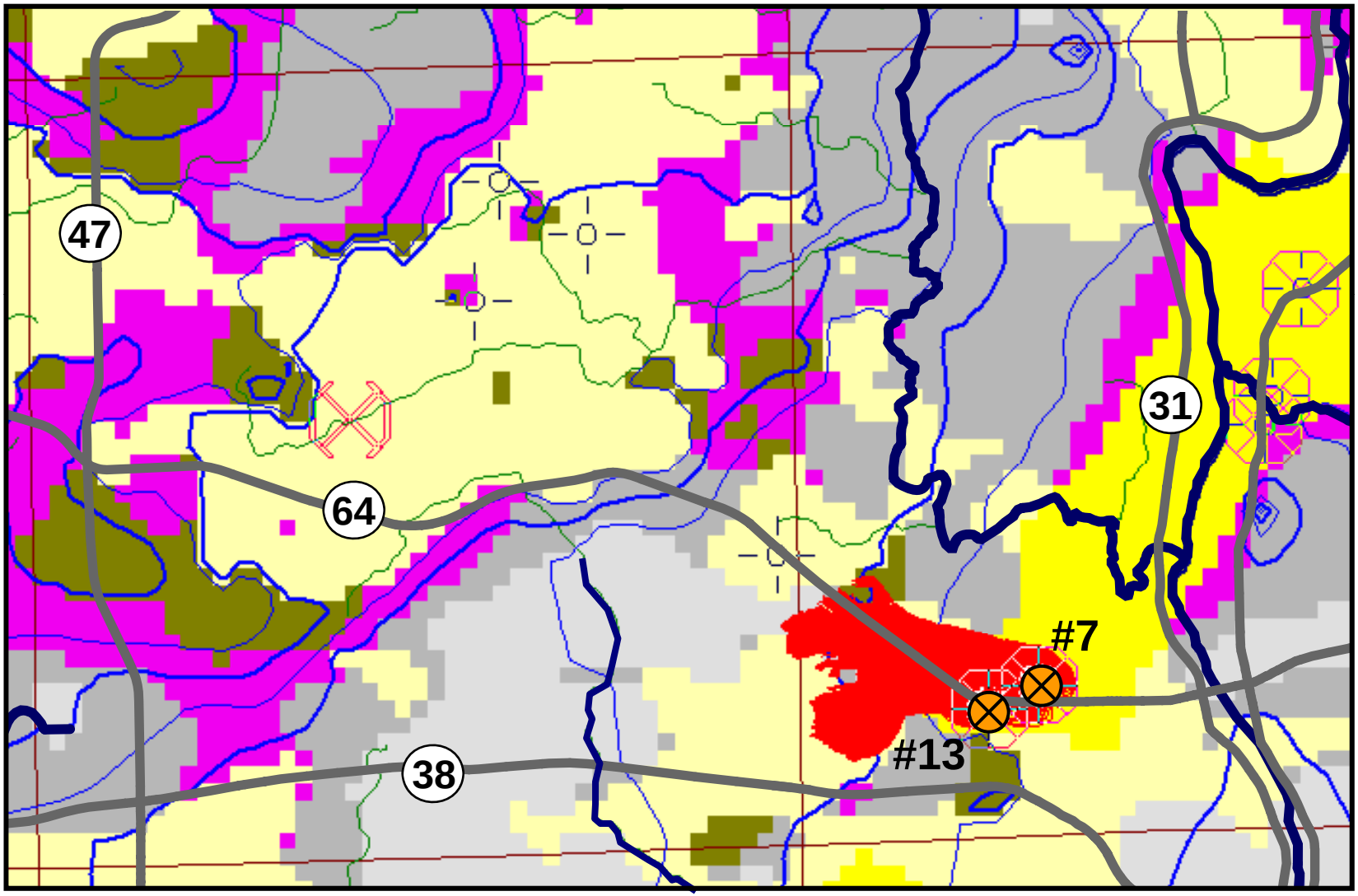
Capture Zone of St Charles #7 and #13

Layer 16

9 Years



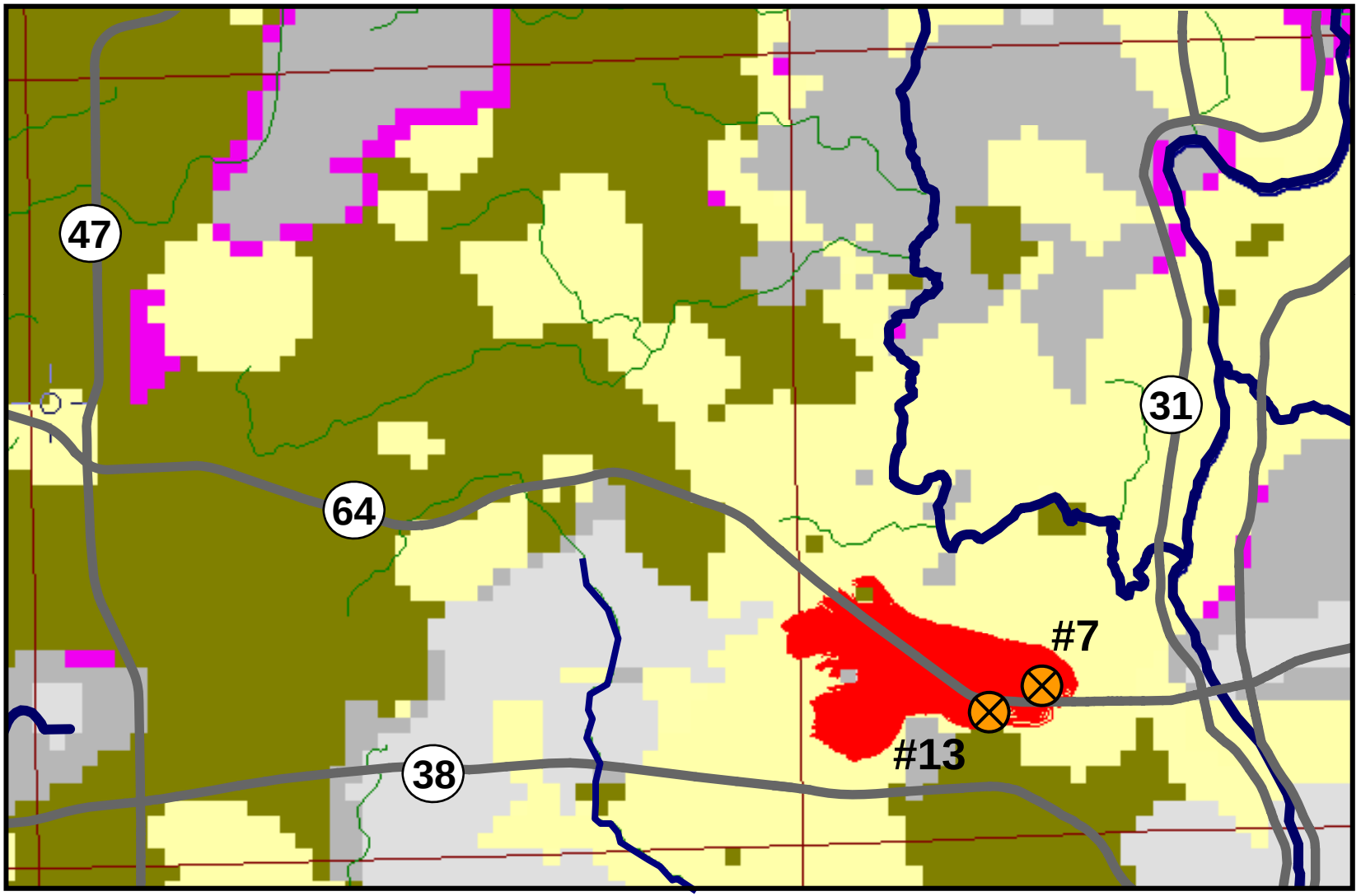
Capture Zone of St Charles #7 and #13



Layer 16

10 Years

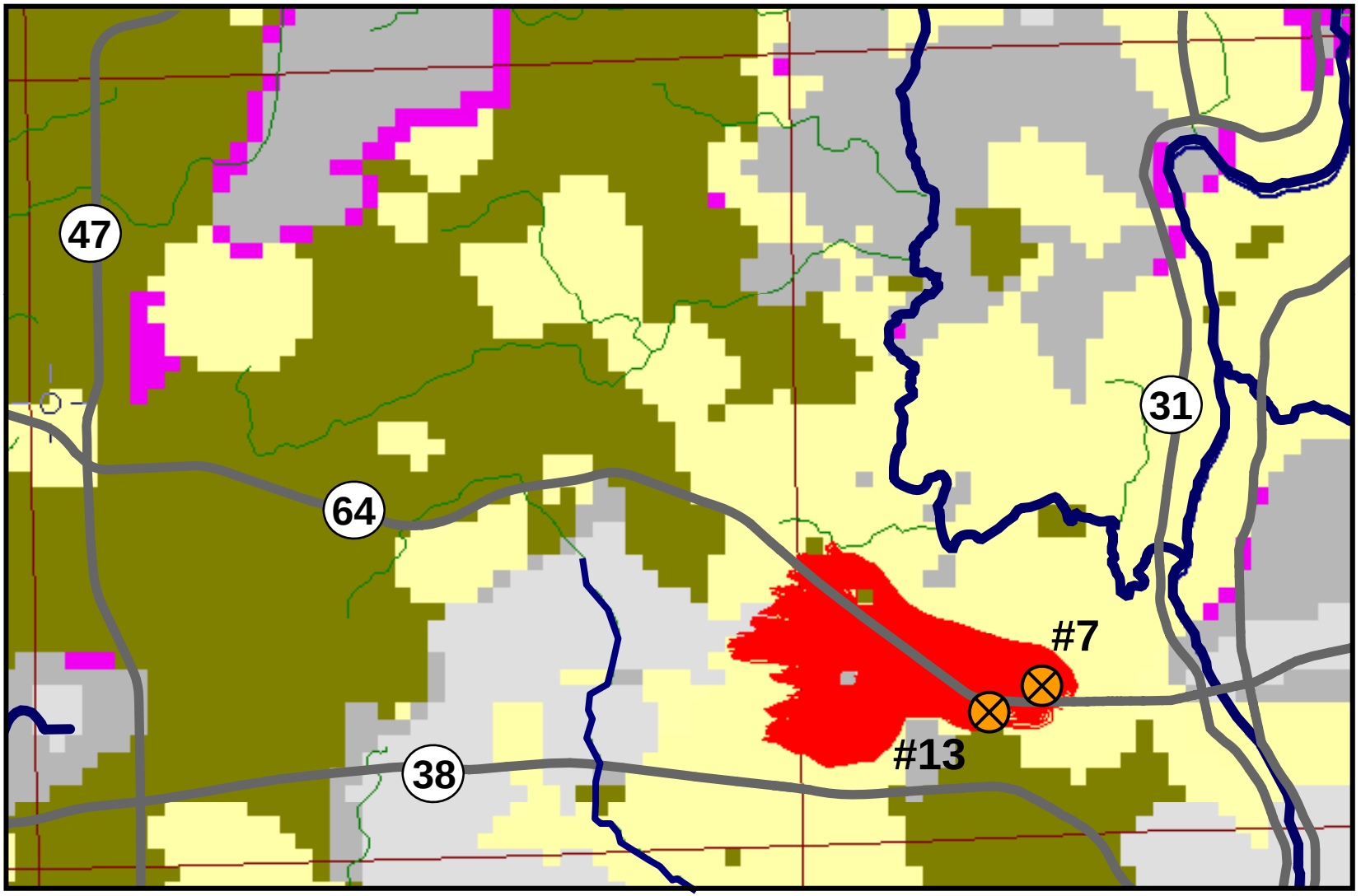
Capture Zone of St Charles #7 and #13



Layer 14

10 Years

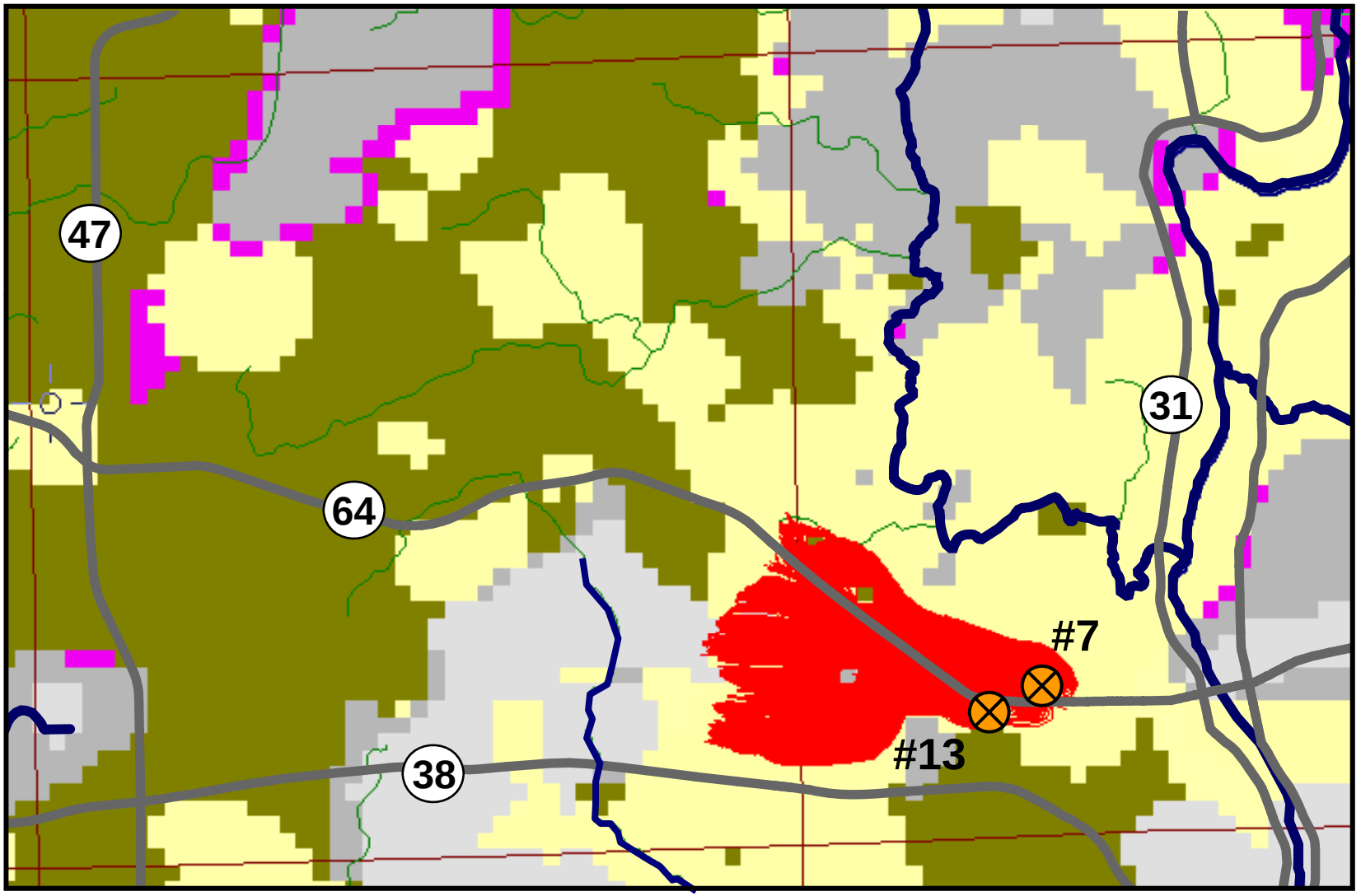
Capture Zone of St Charles #7 and #13



Layer 14

15 Years

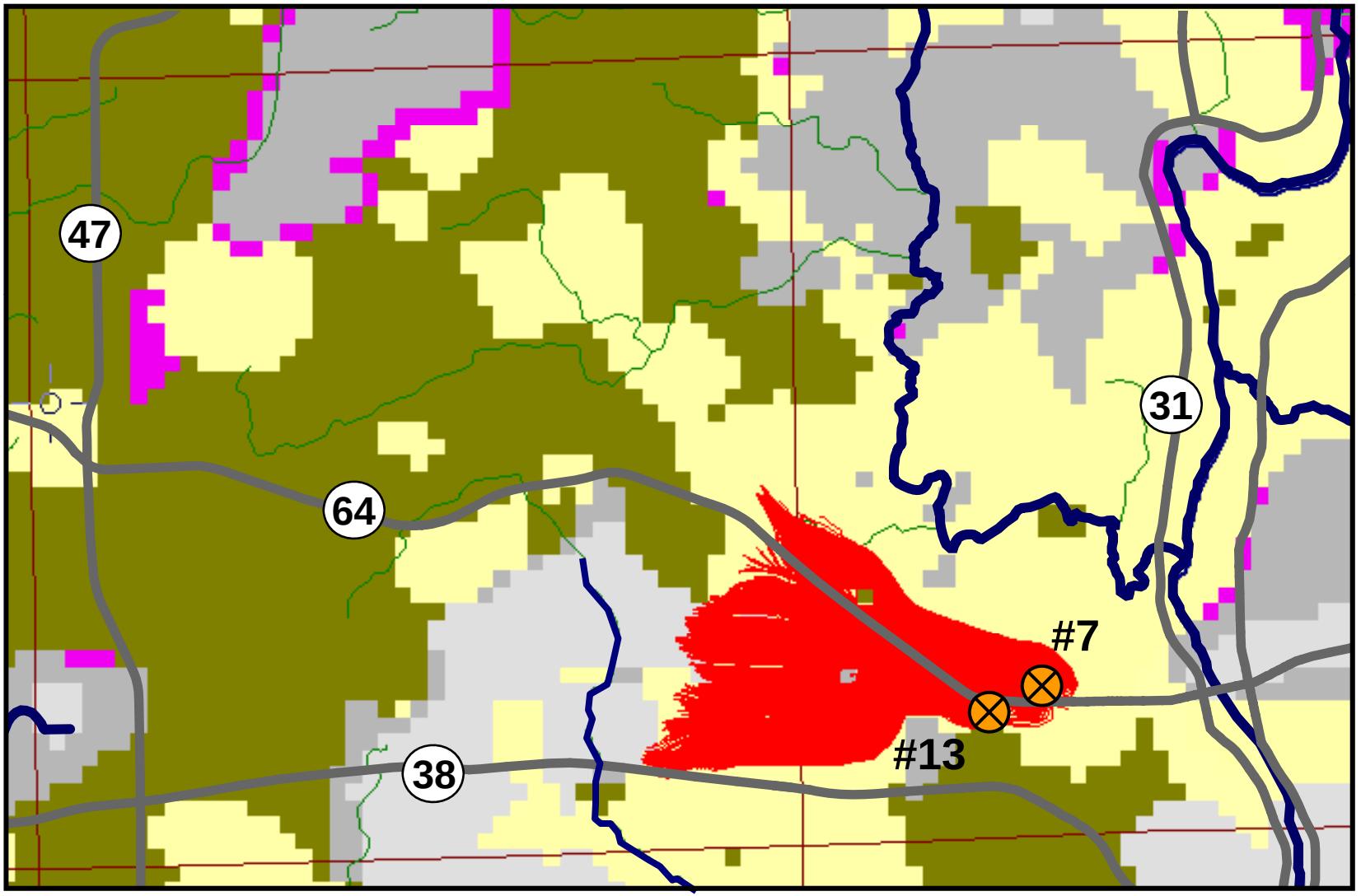
Capture Zone of St Charles #7 and #13



Layer 14

20 Years

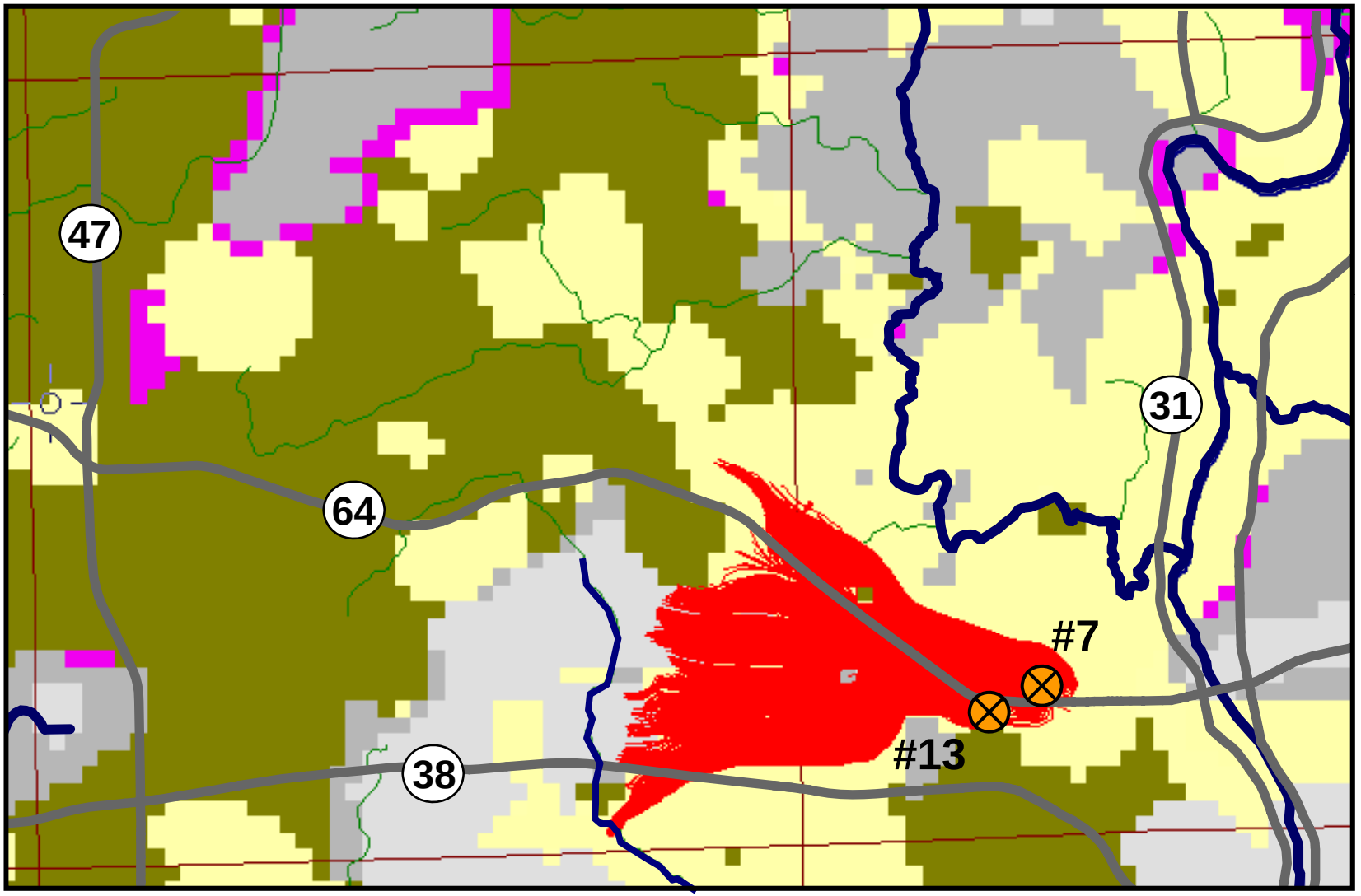
Capture Zone of St Charles #7 and #13



Layer 14

25 Years

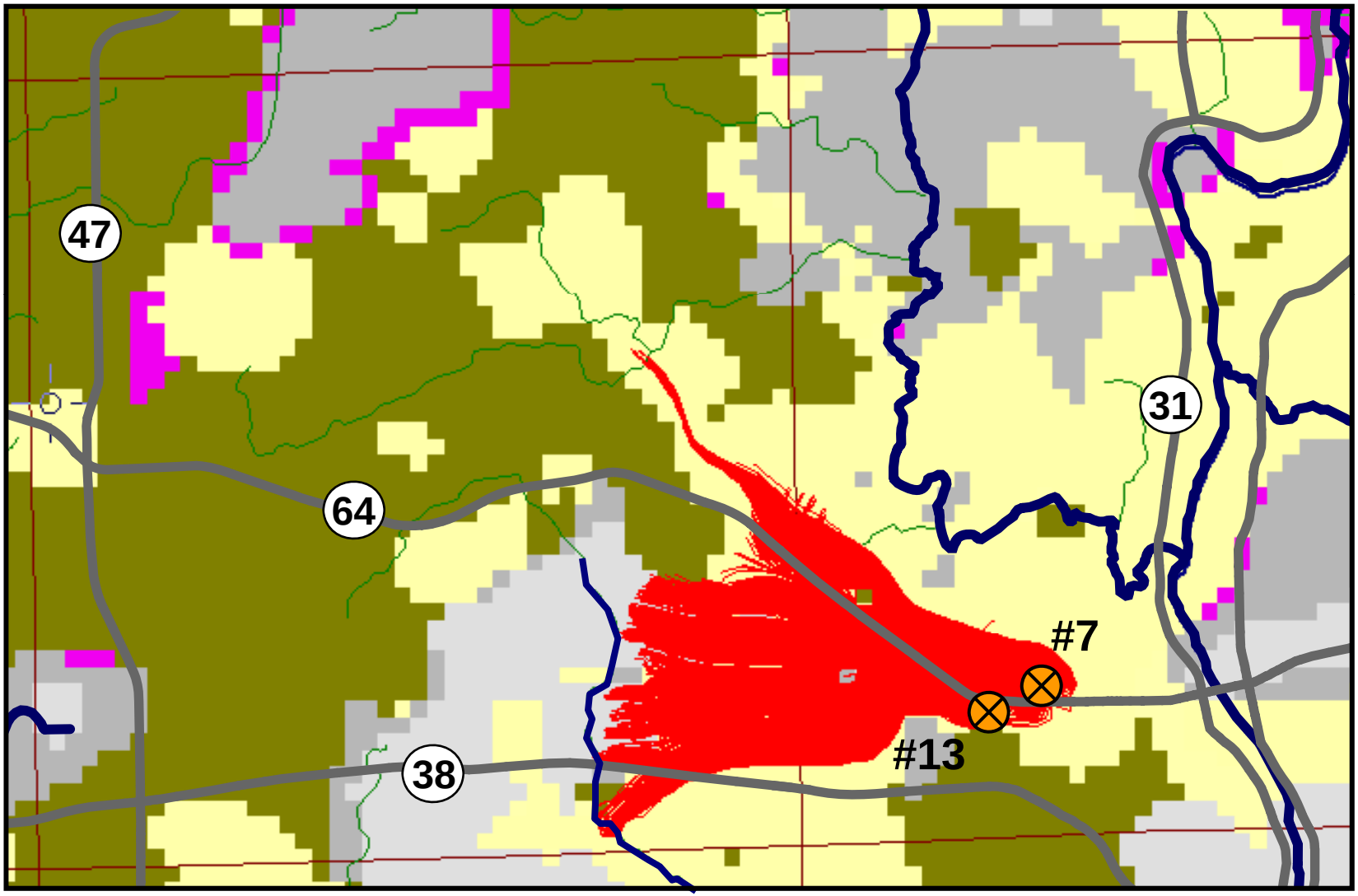
Capture Zone of St Charles #7 and #13



Layer 14

30 Years

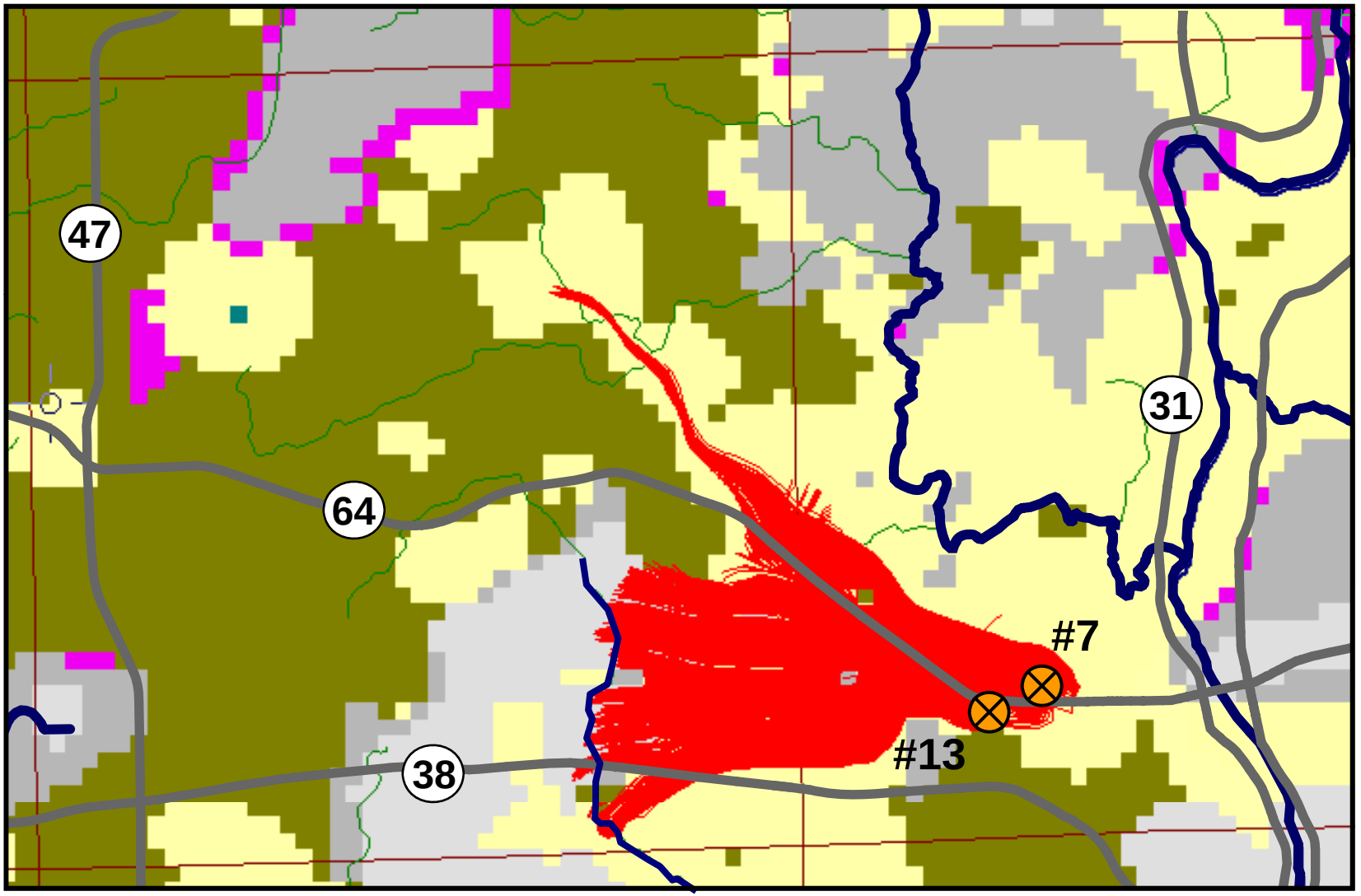
Capture Zone of St Charles #7 and #13



Layer 14

35 Years

Capture Zone of St Charles #7 and #13



Layer 14

40 Years

Predictive Scenarios

- Increase pumpage to year 2050
  - Existing wells

- Example from Algonquin #7, #8, and #9
  - Assume no conservation
  - Pumping rate increases by 0.04 MGD per year
    - 2005 - 2.27 MGD
    - 2050 - 4.00 MGD

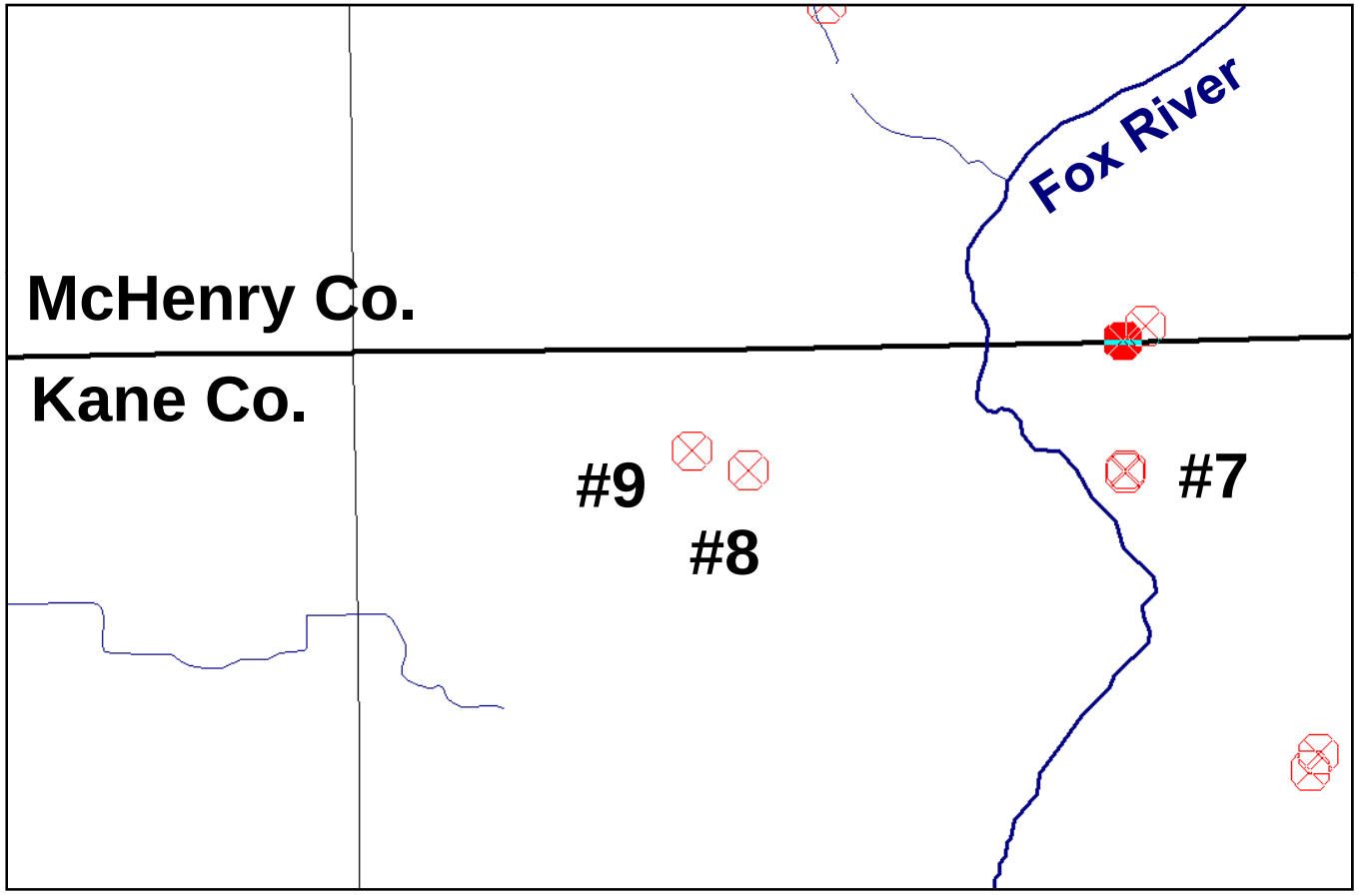
Drawdown at Algonquin #7, #8, and #9

Year
2005

Pumping
rate (MGD)

#7 – 1.08
#8 – 0.26
#9 – 0.93

Total – 2.27



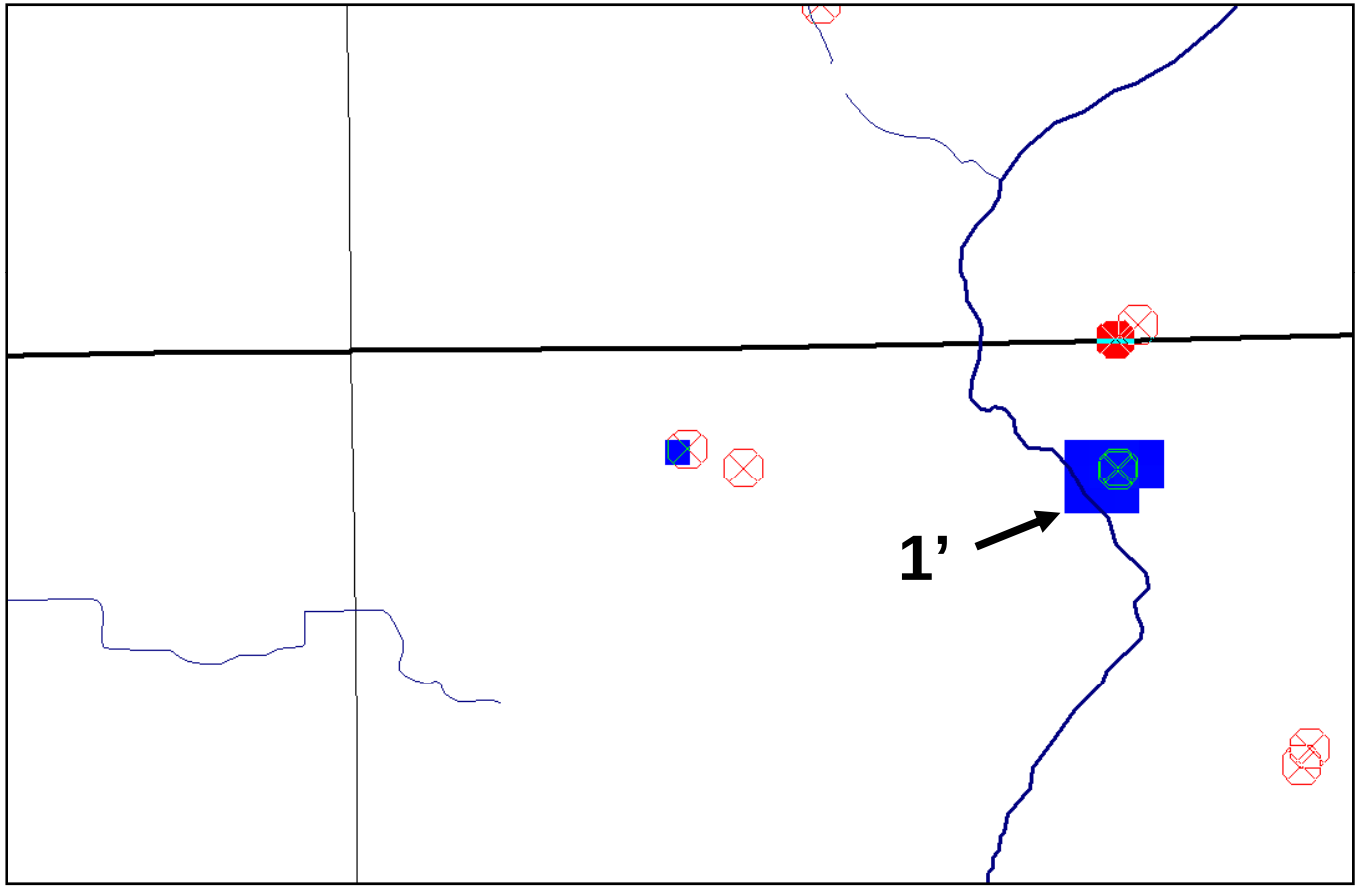
Drawdown at Algonquin #7, #8, and #9

Year
2010

Pumping
rate (MGD)

#7 – 1.17
#8 – 0.28
#9 – 1.00

Total – 2.45



Minimum color shading: 1 foot

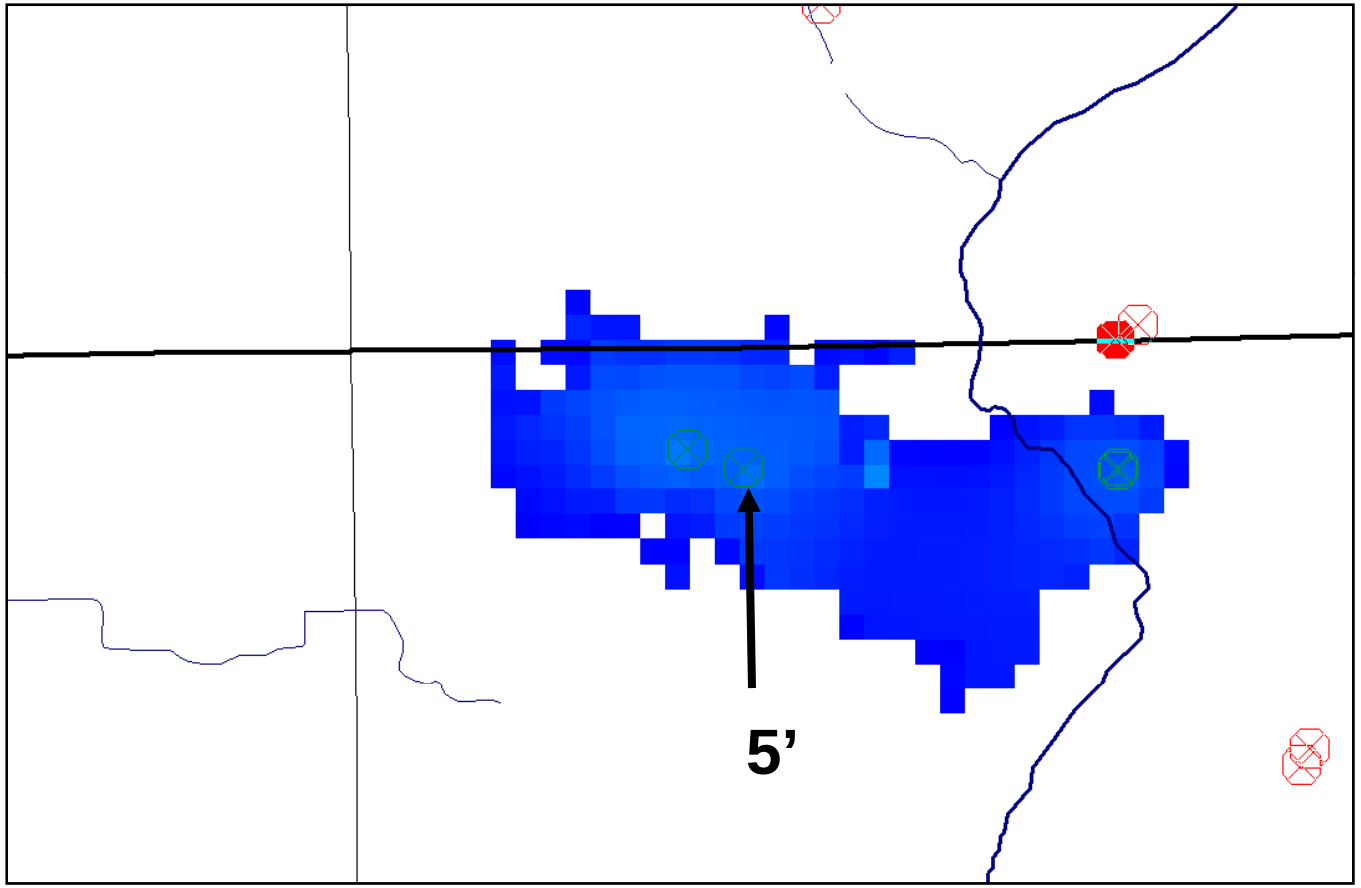
Drawdown at Algonquin #7, #8, and #9

Year
2015

Pumping
rate (MGD)

#7 – 1.26
#8 – 0.30
#9 – 1.09

Total – 2.65



Minimum color shading: 1 foot

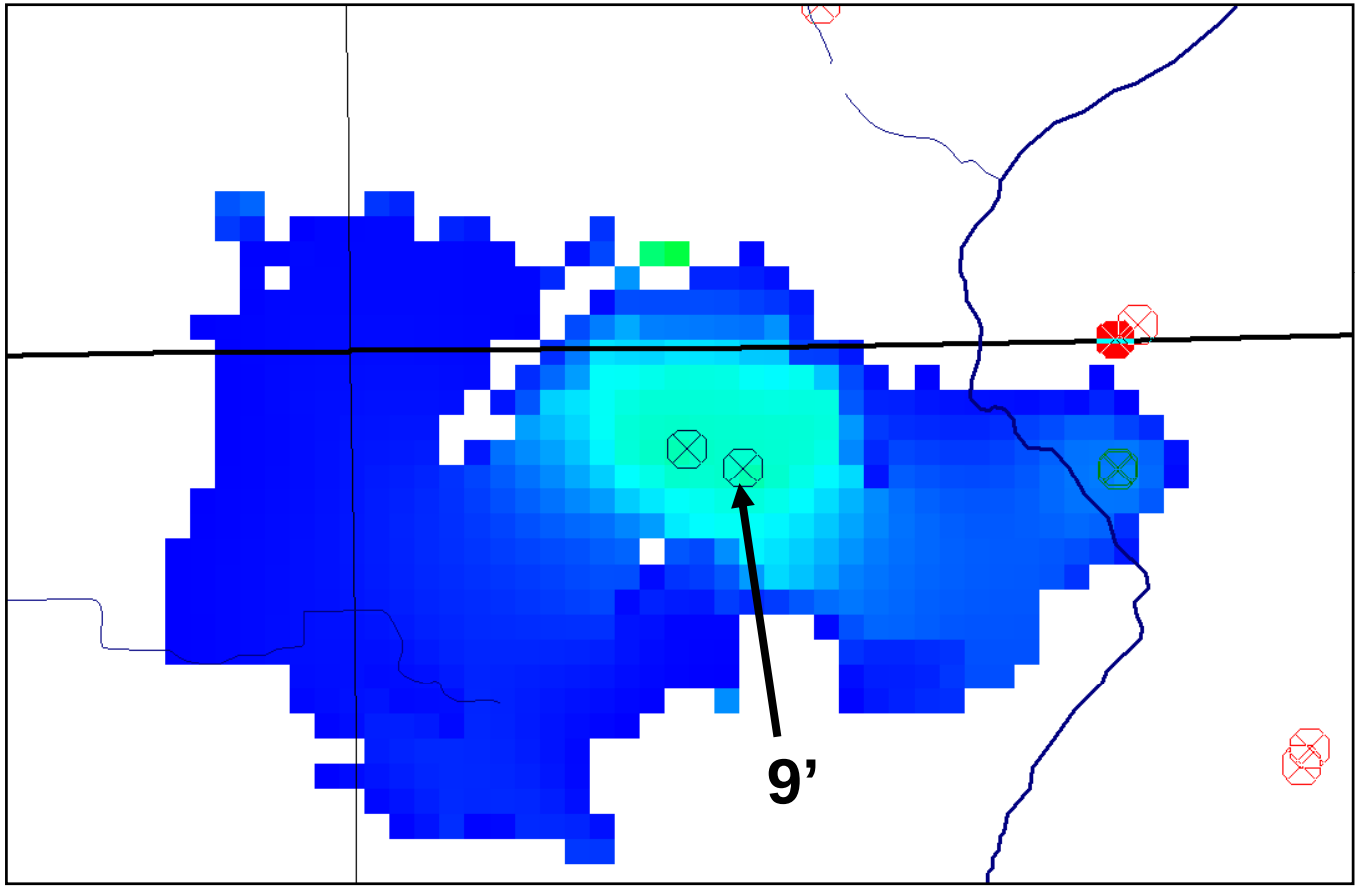
Drawdown at Algonquin #7, #8, and #9

Year
2020

Pumping
rate (MGD)

#7 – 1.35
#8 – 0.32
#9 – 1.16

Total – 2.83



Minimum color shading: 1 foot

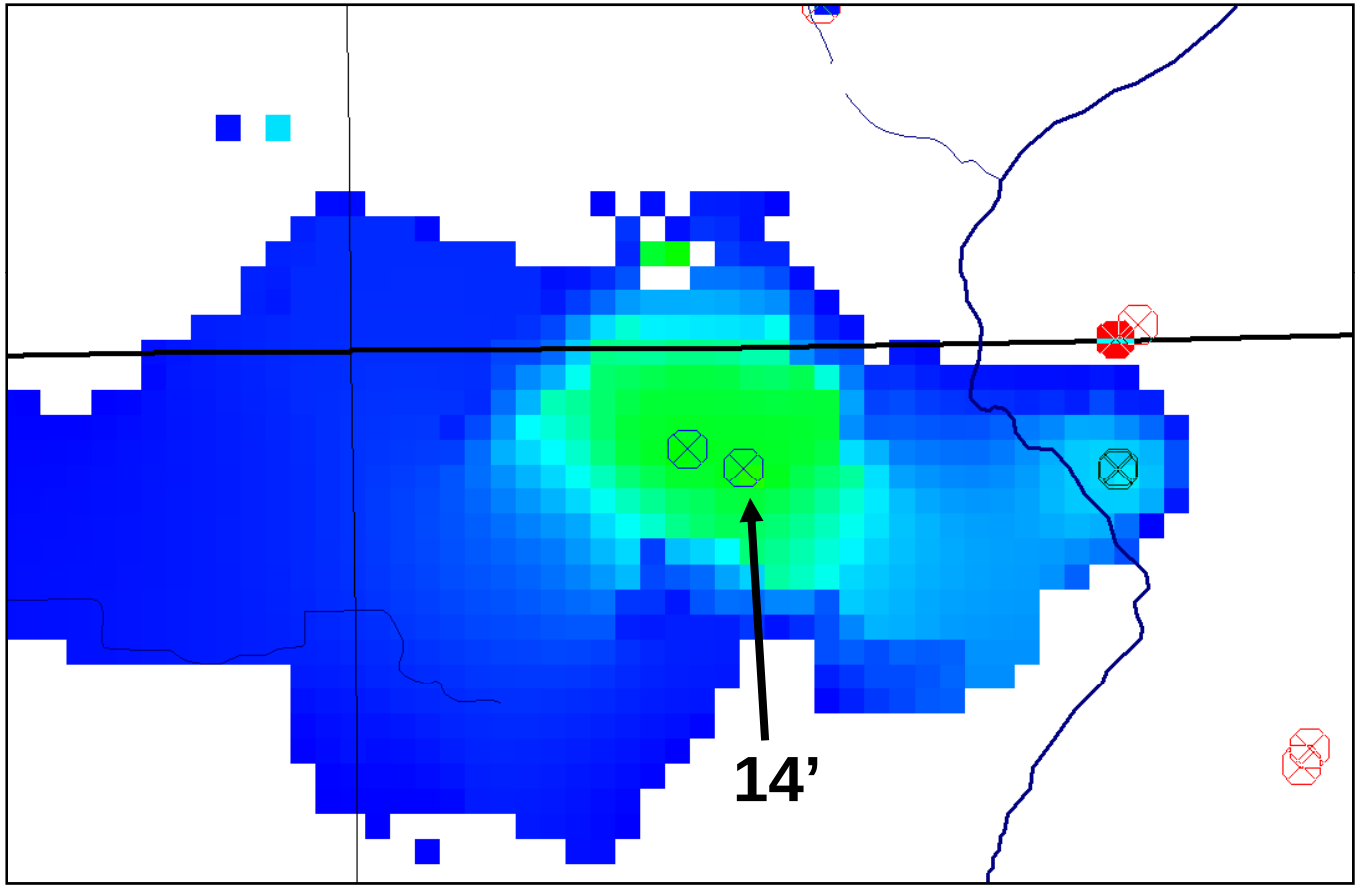
Drawdown at Algonquin #7, #8, and #9

Year
2025

Pumping
rate (MGD)

#7 – 1.44
#8 – 0.34
#9 – 1.24

Total – 3.02



Minimum color shading: 1 foot

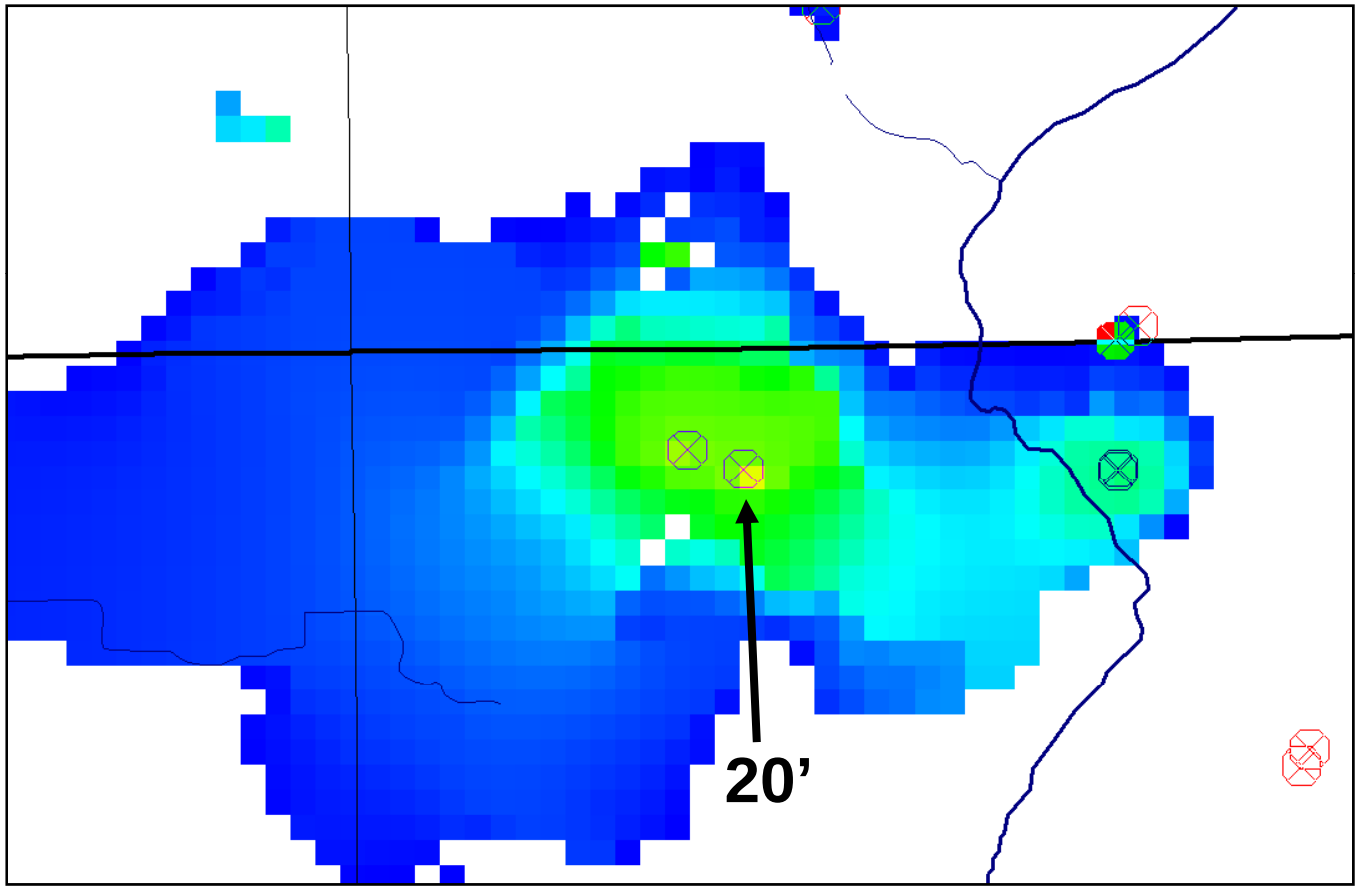
Drawdown at Algonquin #7, #8, and #9

Year
2030

Pumping
rate (MGD)

#7 – 1.53
#8 – 0.36
#9 – 1.32

Total – 3.21



Minimum color shading: 1 foot

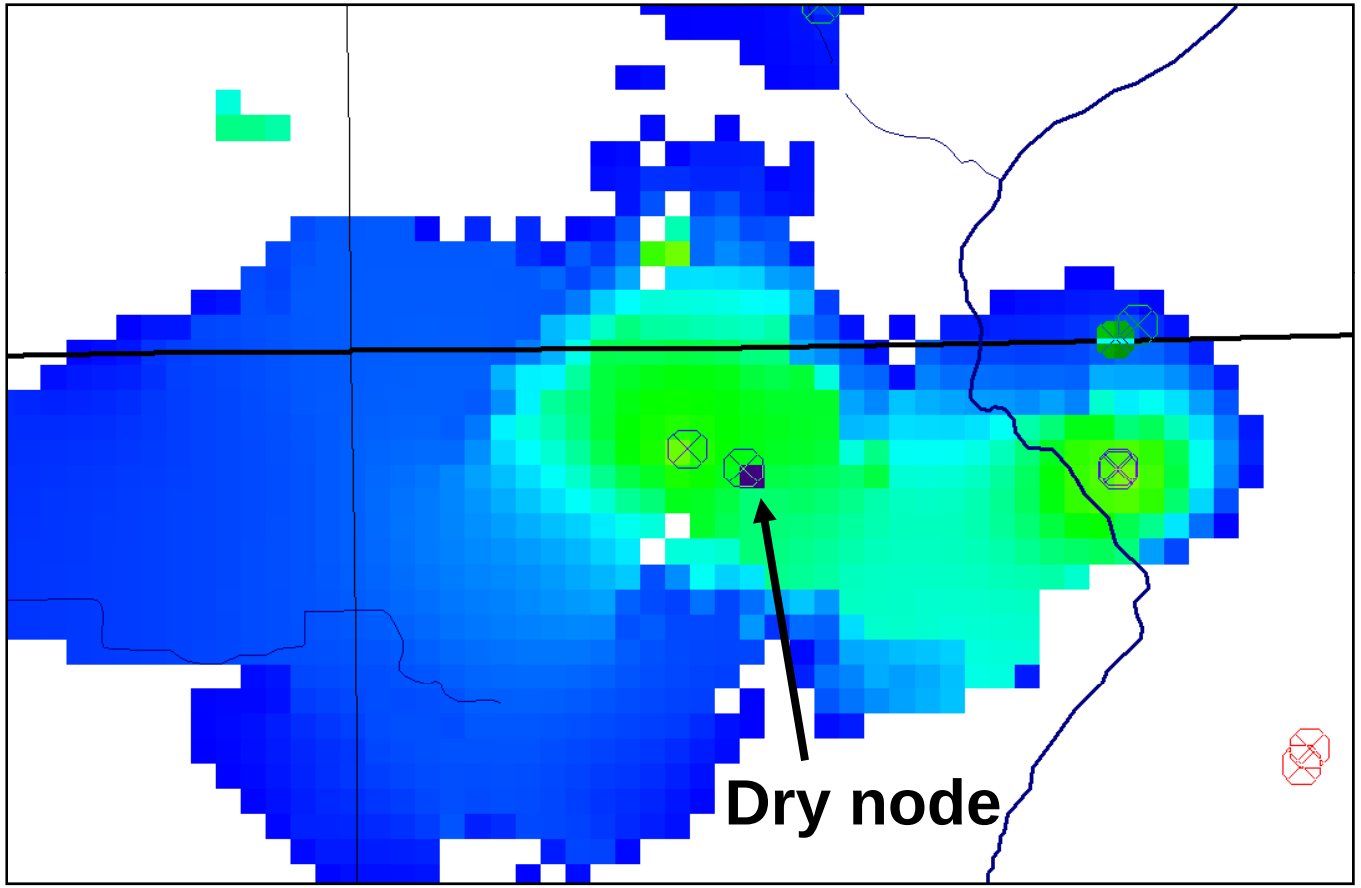
Drawdown at Algonquin #7, #8, and #9

Year
2035

Pumping
rate (MGD)

#7 – 1.63
#8 – Dry
#9 – 1.40

Total – 3.03



Minimum color shading: 1 foot

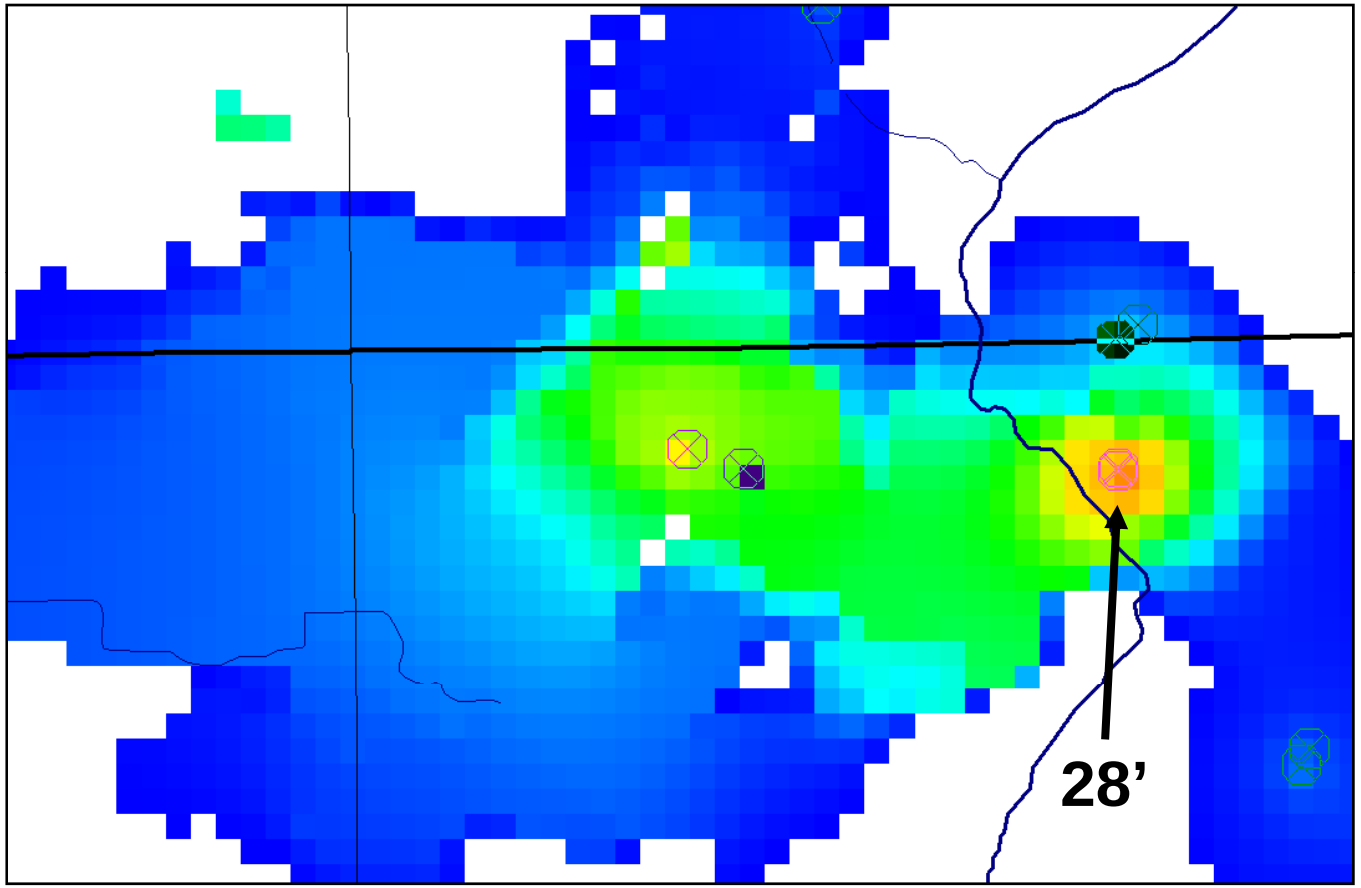
Drawdown at Algonquin #7, #8, and #9

Year
2040

Pumping
rate (MGD)

#7 – 1.72
#8 – Dry
#9 – 1.48

Total – 3.20



Minimum color shading: 1 foot

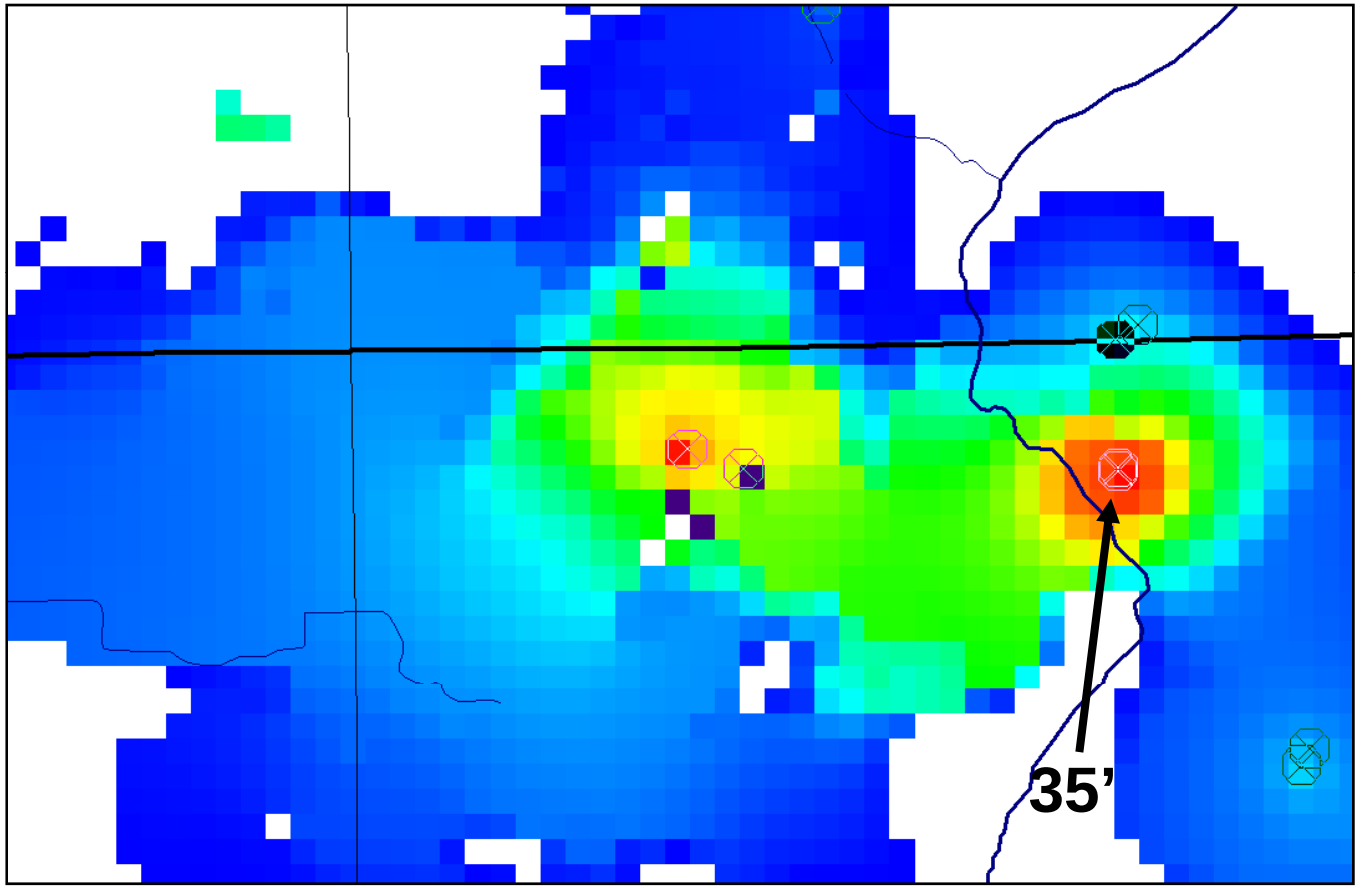
Drawdown at Algonquin #7, #8, and #9

Year
2045

Pumping
rate (MGD)

#7 – 1.81
#8 – Dry
#9 – 1.56

Total – 3.37



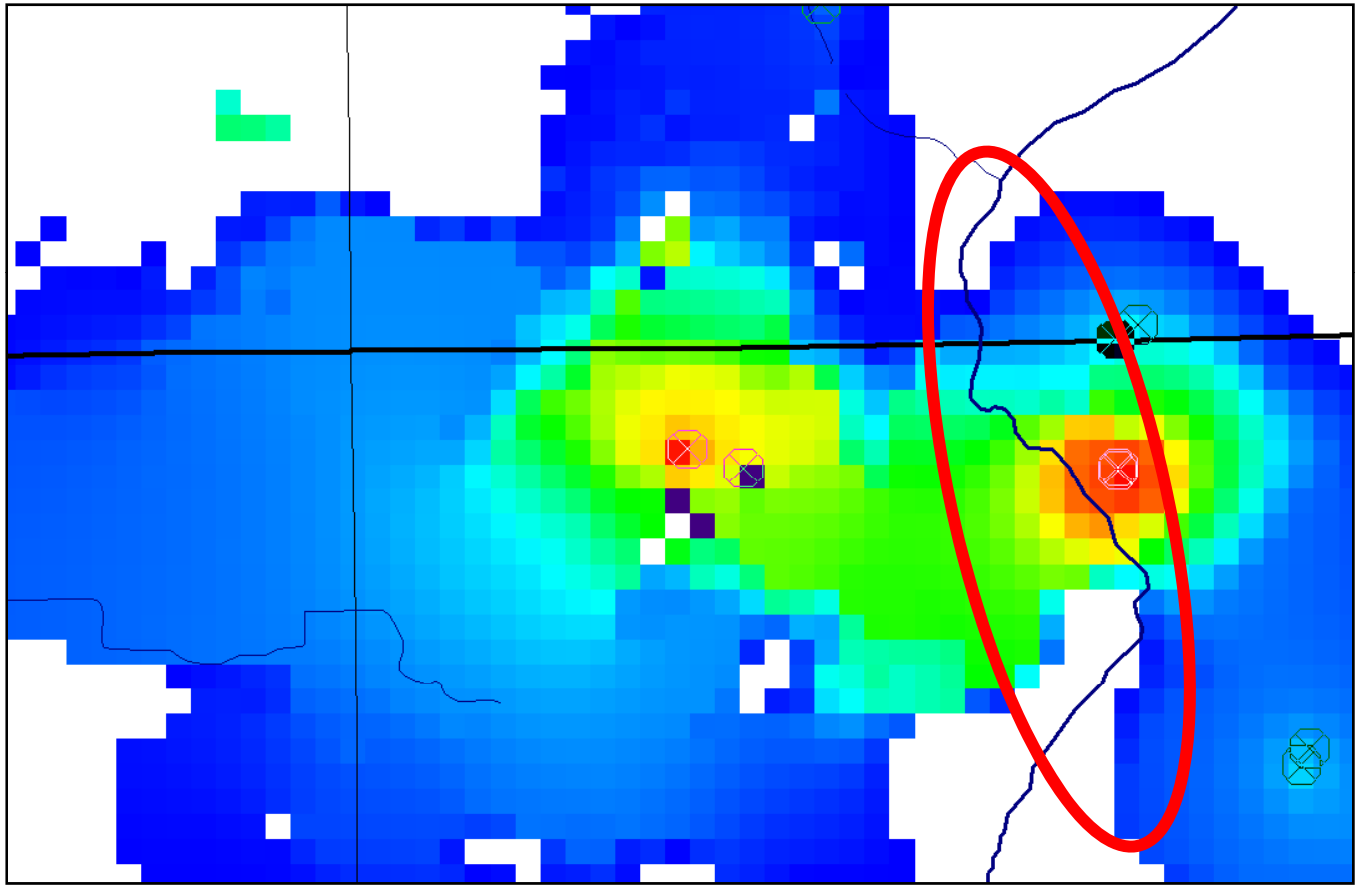
Minimum color shading: 1 foot

Drawdown at Algonquin #7, #8, and #9

Year
2045

Discharge to Fox River decreased by 0.66 MGD

60% of 1.10 MGD increase in pumpage



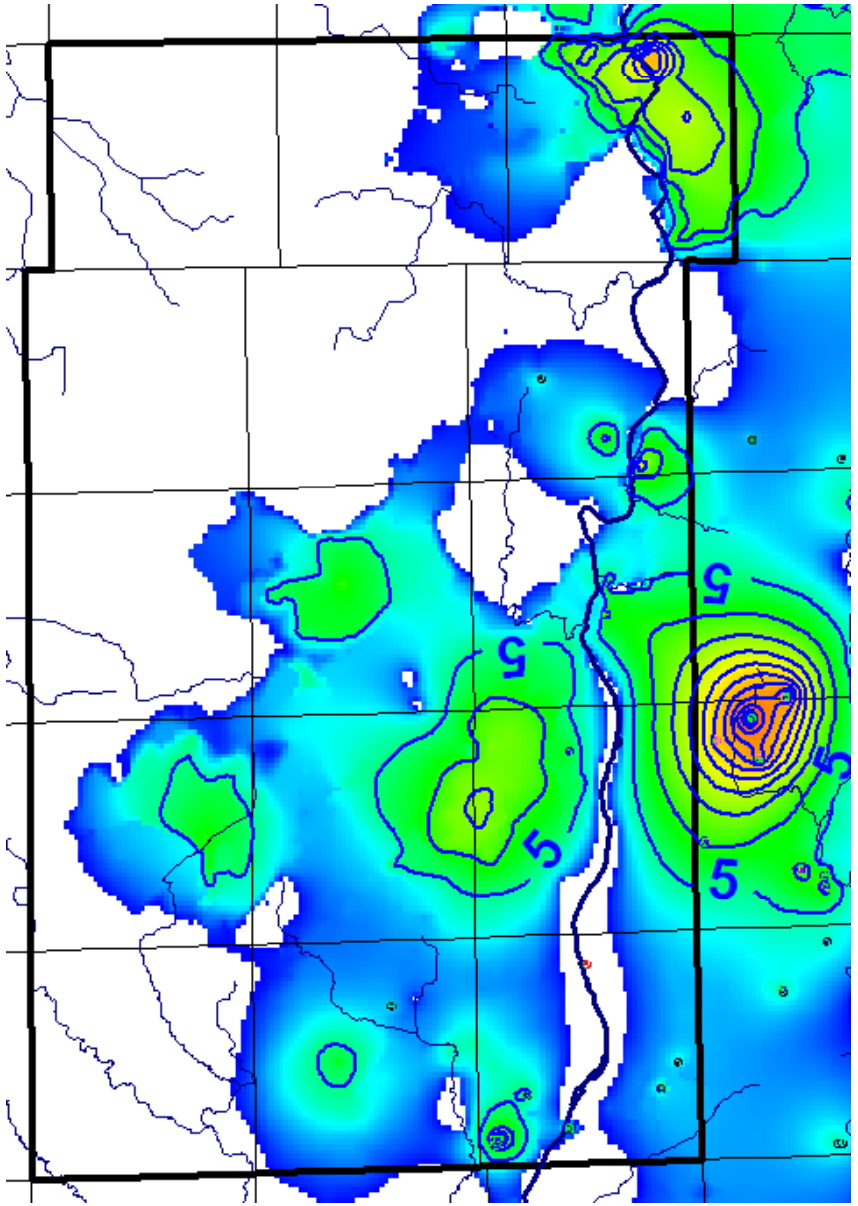
Minimum color shading: 1 foot

Drawdown at 2050

- Shallow Bedrock Aquifer

Minimum color shading: 1 foot

Contour interval: 5 feet

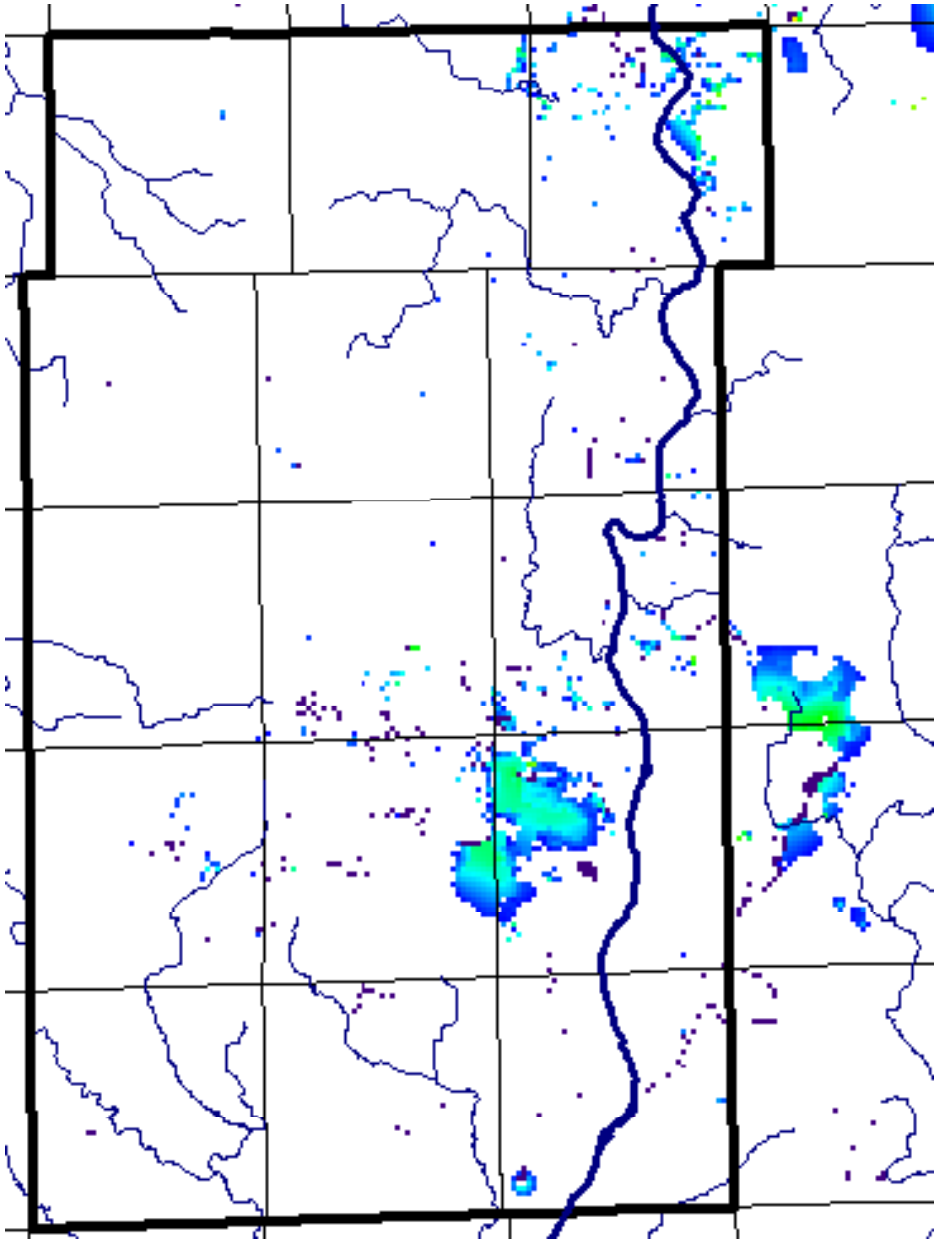


Drawdown at 2050

- Batestown Outwash Aquifer
  (above Tiskilwa Till)

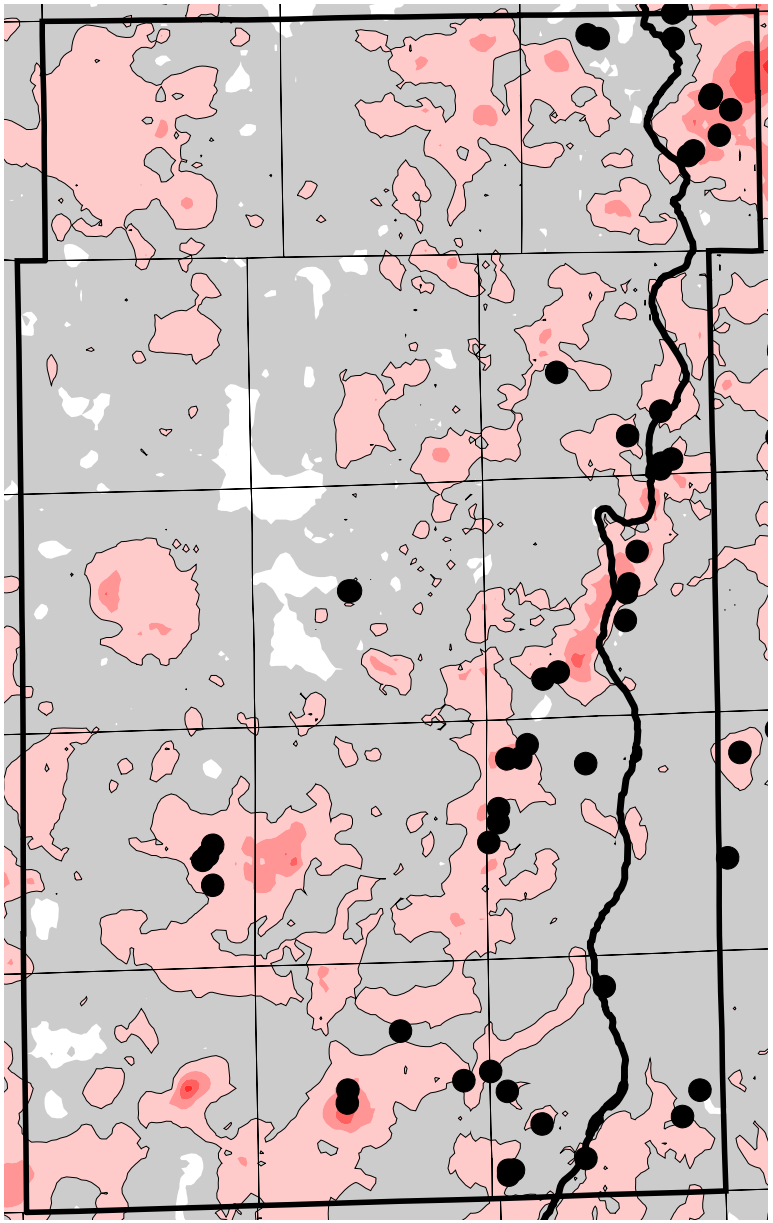
Minimum color shading: 1 foot

Contour interval: 5 feet



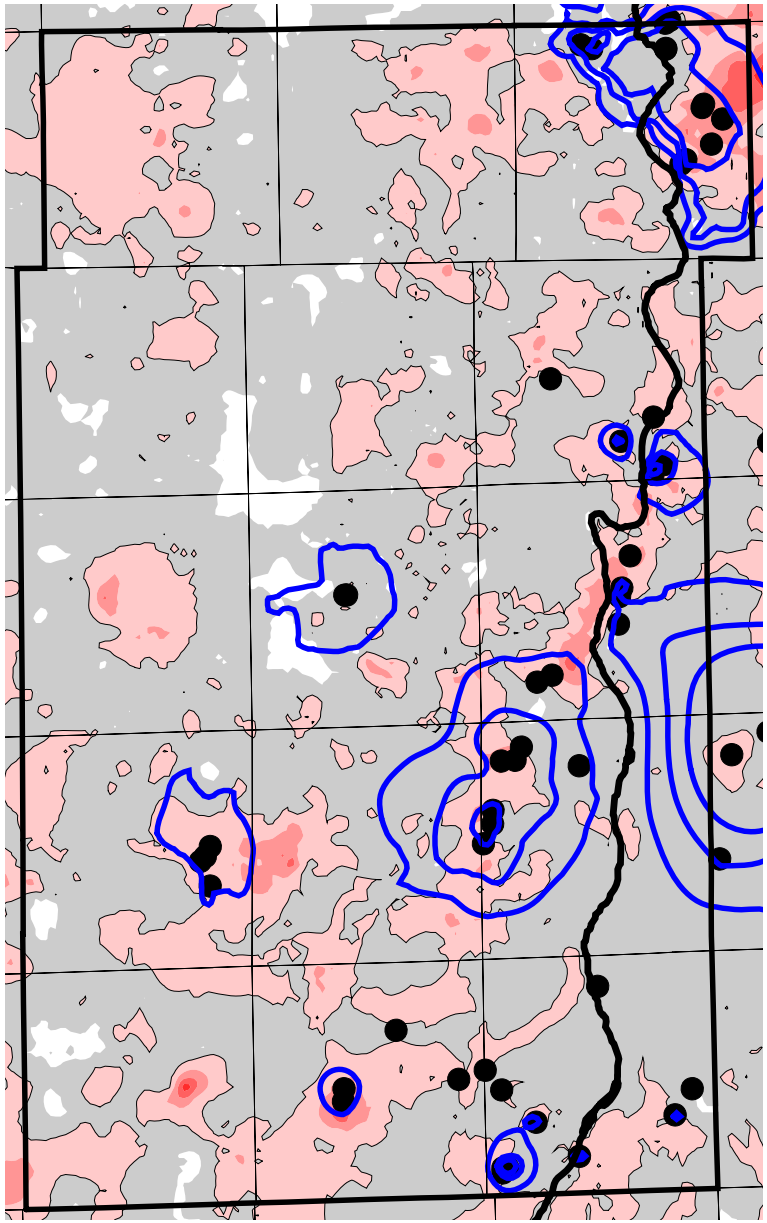
Where can new wellfields be located?

- **Transmissivity (thickness x permeability)**



Where can new wellfields be located?

- **Transmissivity (thickness x permeability)**
- **Drawdown (> 5 feet)**



ft^2/day

20000

15000

10000

5000

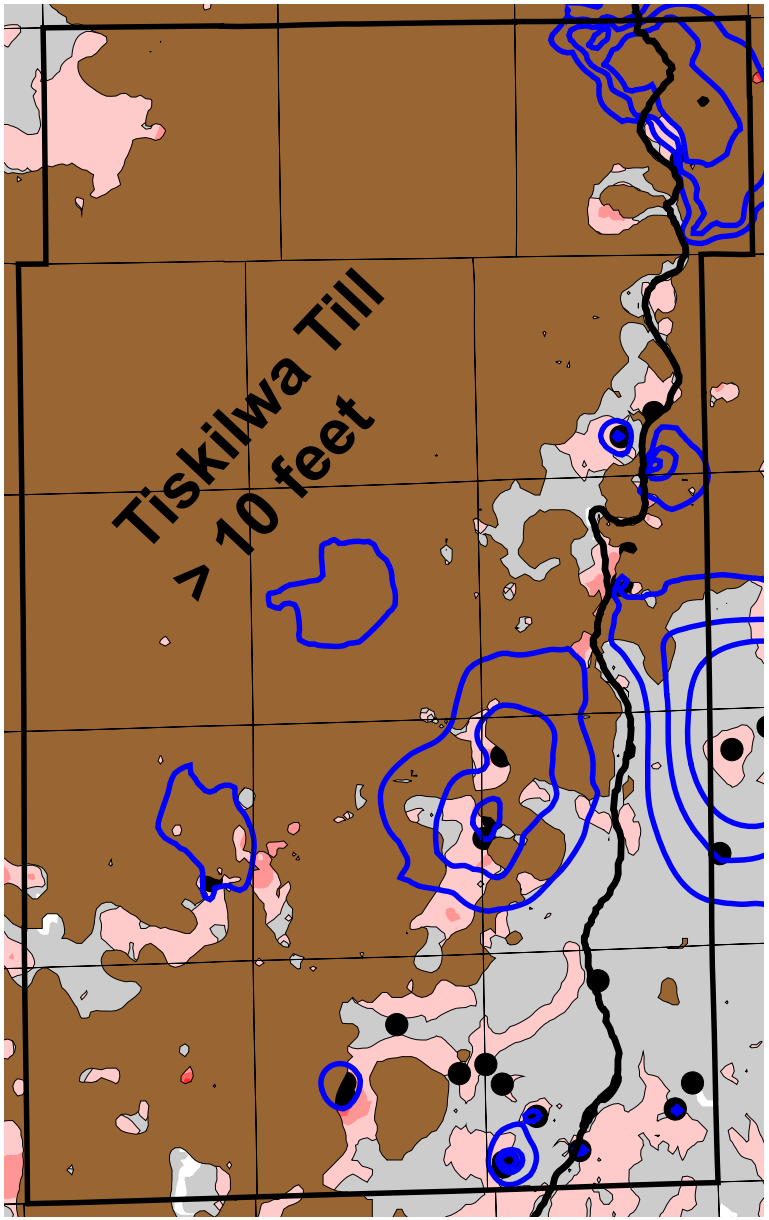
1000

0

● High use wells

Where can new wellfields be located?

- **Transmissivity (thickness x permeability)**
- **Drawdown**
- **Tiskilwa till aquitard**



Summary – Shallow Aquifer Model

- Toolbox for water supply planning
- Results of future use scenarios dependant on local geology and hydrology
  - Connection and flow in streams
  - Presence of the Tiskilwa Till
  - Aquifer properties
- Development of new large wellfields
  - Many of the prime locations are currently used
  - Impacts to existing users
  - Impact to low flows in streams