North Texas GCD

Review of Well Spacing Rules

February 11, 2025

Advanced Groundwater Solutions, LLC

Outline

- **Review history of current rules**
- **Discuss next steps**

Purpose of Well Spacing Rules?

- **to limit a pumping well's impact on other wells**

- **Well spacing rules are <u>not intended</u> to regulate or manage the entire aquifer as per Desired Future Conditions (DFCs)**

Principles of Well Spacing Rules

- **No rule will protect every well**
  - Existing wells grandfathered
  - Pump settings
  - Wells that don't penetrate the full aquifer
- **High volume wells have the most impact**
- **"One-size-fits-all" rules difficult in Northern Trinity and Woodbine Aquifers**

How Does One Well Interfere With Another?

- In a confined aquifer, drawdown from a pumping well spreads in a cone of depression over a wide area
- How wide the cone of depression depends on aquifer parameters, pumping rate, and pumping duration
- Interference effects increase when wells are in close proximity

Implementation

- **If a site-specific formula approach is used**
  - Small and Medium capacity wells
    - simple spacing table in rules
  - Large capacity wells that have most impact
    - User-friendly tool developed for staff evaluate hydraulic properties and spacing
- **If one-size fits all rule is used**
  - Staff checks the spacing on application

Public Supply Well Capacities in North Texas GCD

COUNTY/Aquifer	Number of Wells	Max Capacity (gpm)	Average Capacity (gpm)
COLLIN			
Paluxy	12	420	212
Twin Mountains - Travis Peak	4	1000	443
Woodbine	36	500	221
COOKE			
Antlers	78	1214	193
DENTON			
Antlers	41	638	130
Paluxy	144	325	55
Twin Mountains - Travis Peak	102	2200	258
Woodbine	42	385	58

Calculation of spacing based on drawdown

$$r = \sqrt{\frac{0.3Tt}{S\left(10^{\frac{sT}{264Q}}\right)}}$$

where

r **= distance from pumping well (feet)**

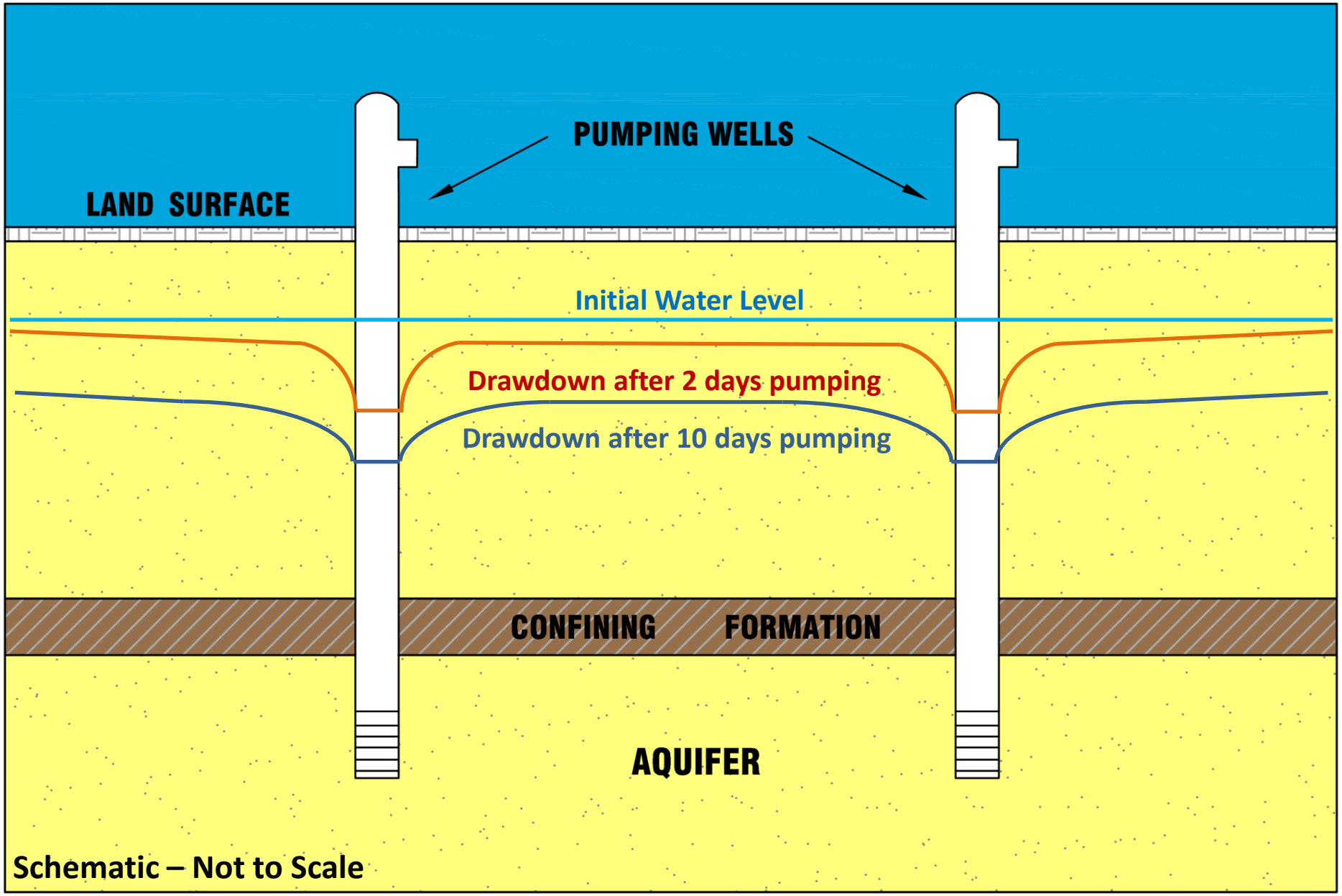
T **= transmissivity (gpd/ft)**

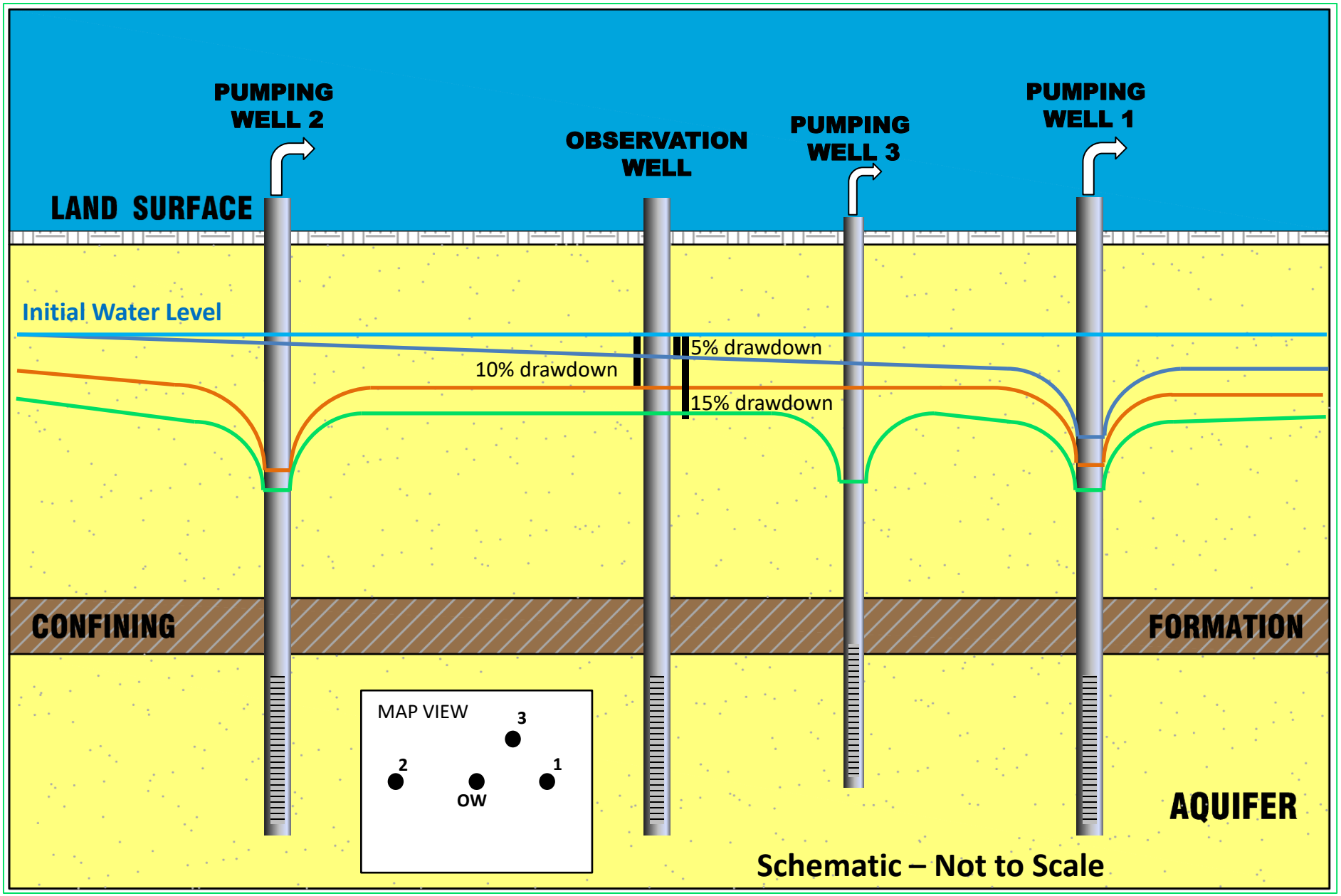
S **= storativity**

s **= drawdown at distance r (feet)**

Q = pumping rate (gpm)

t = pumping duration (days)


PUMPING WELLS
LAND SURFACE
Initial Water Level
Drawdown after 2 days pumping
Drawdown after 10 days pumping
CONFINING FORMATION
AQUIFER
Schematic – Not to Scale

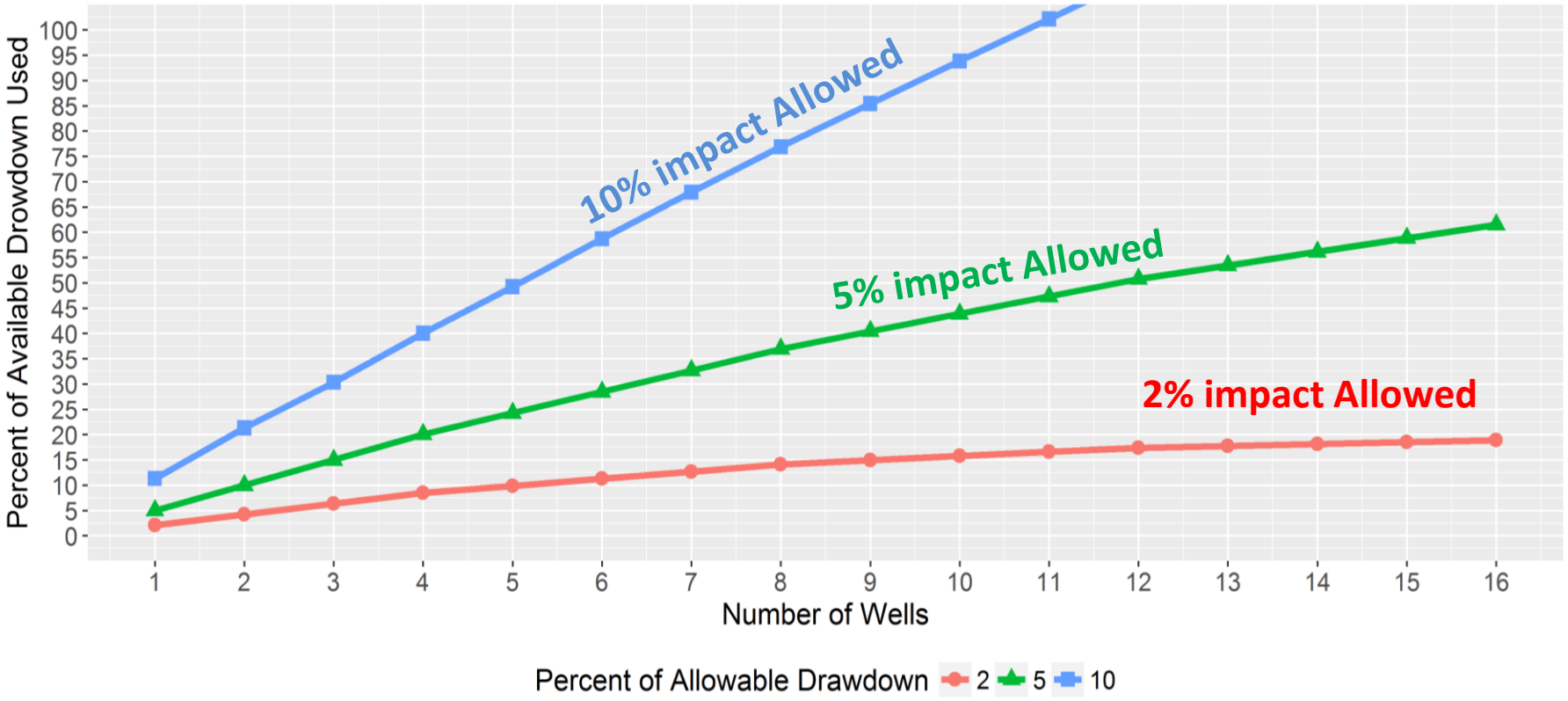

PUMPING WELL 2
OBSERVATION WELL
PUMPING WELL 3
PUMPING WELL 1
LAND SURFACE
Initial Water Level
5% drawdown
10% drawdown
15% drawdown
CONFINING
FORMATION
MAP VIEW
3
2
1
OW
AQUIFER
Schematic – Not to Scale

Making appropriate assumptions

- **Duration of pumping?**
  - Board said – look at 2 and 5 days
- **Allowable impact?**
  - Board said – look at 2 and 5 percent

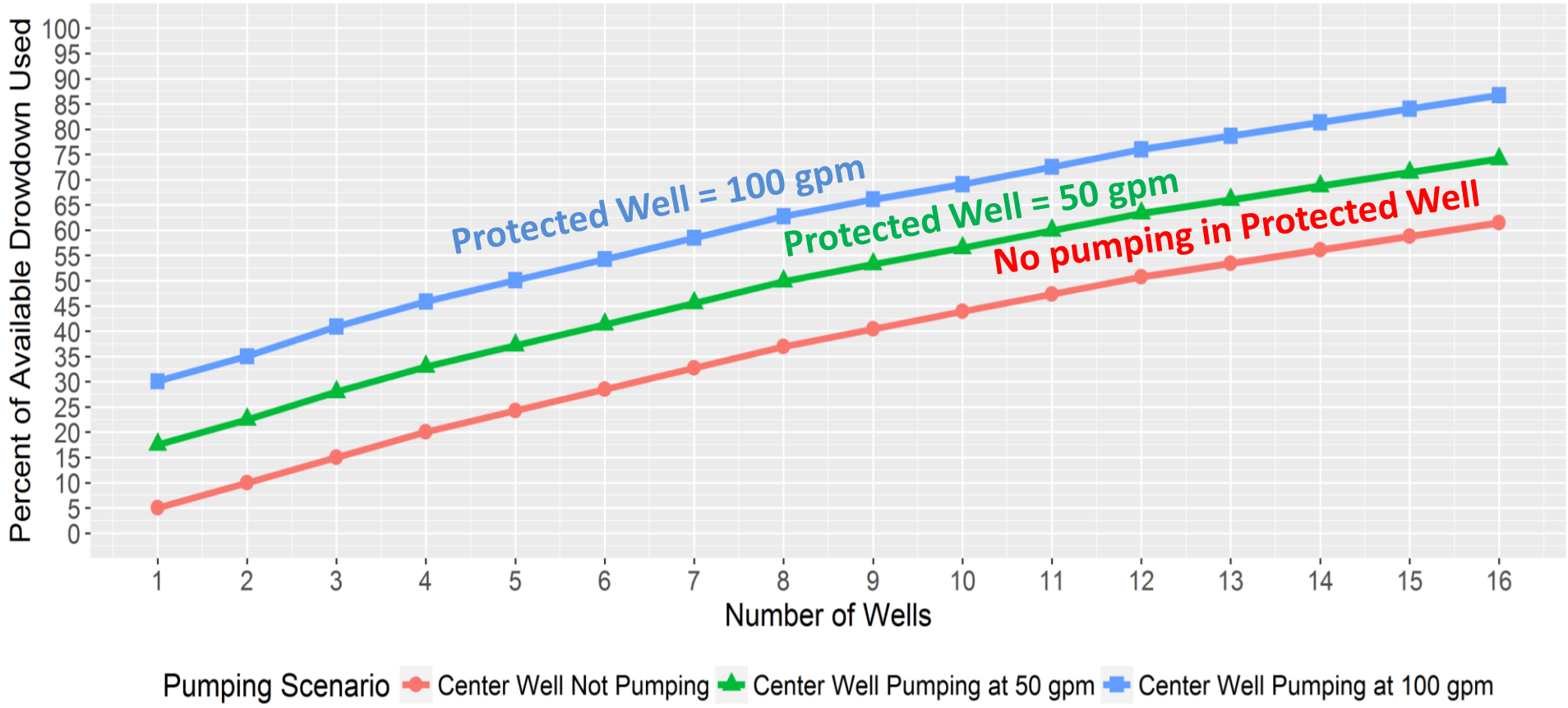
Percent of Available Drawdown Used by Nearby Wells

- Available Drawdown = 500 feet
- Q = 50 gpm, T = 1,000 gpd/ft, S = 10e-4, Time = 1 day
- Does NOT include drawdown caused by pumping in the “protected” well

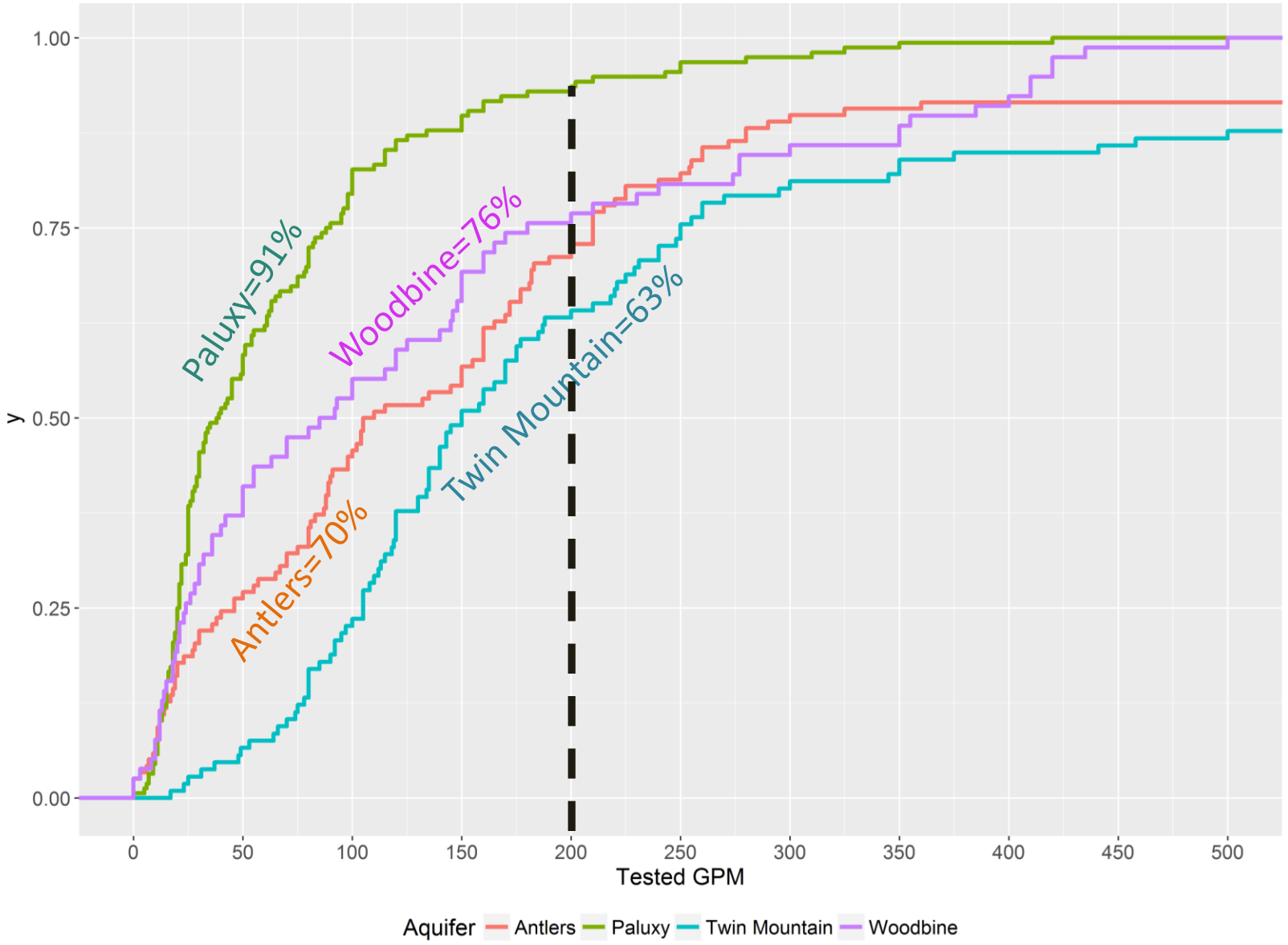


Drawdown from Multiple wells

- Available Drawdown = 500 feet
- Q = 50 gpm, T = 1,000 gpd/ft, S = 10e-4, Time = 1 day
- Allow 5% impact



% of wells <200 gpm capacity



Tiered Approach to Spacing

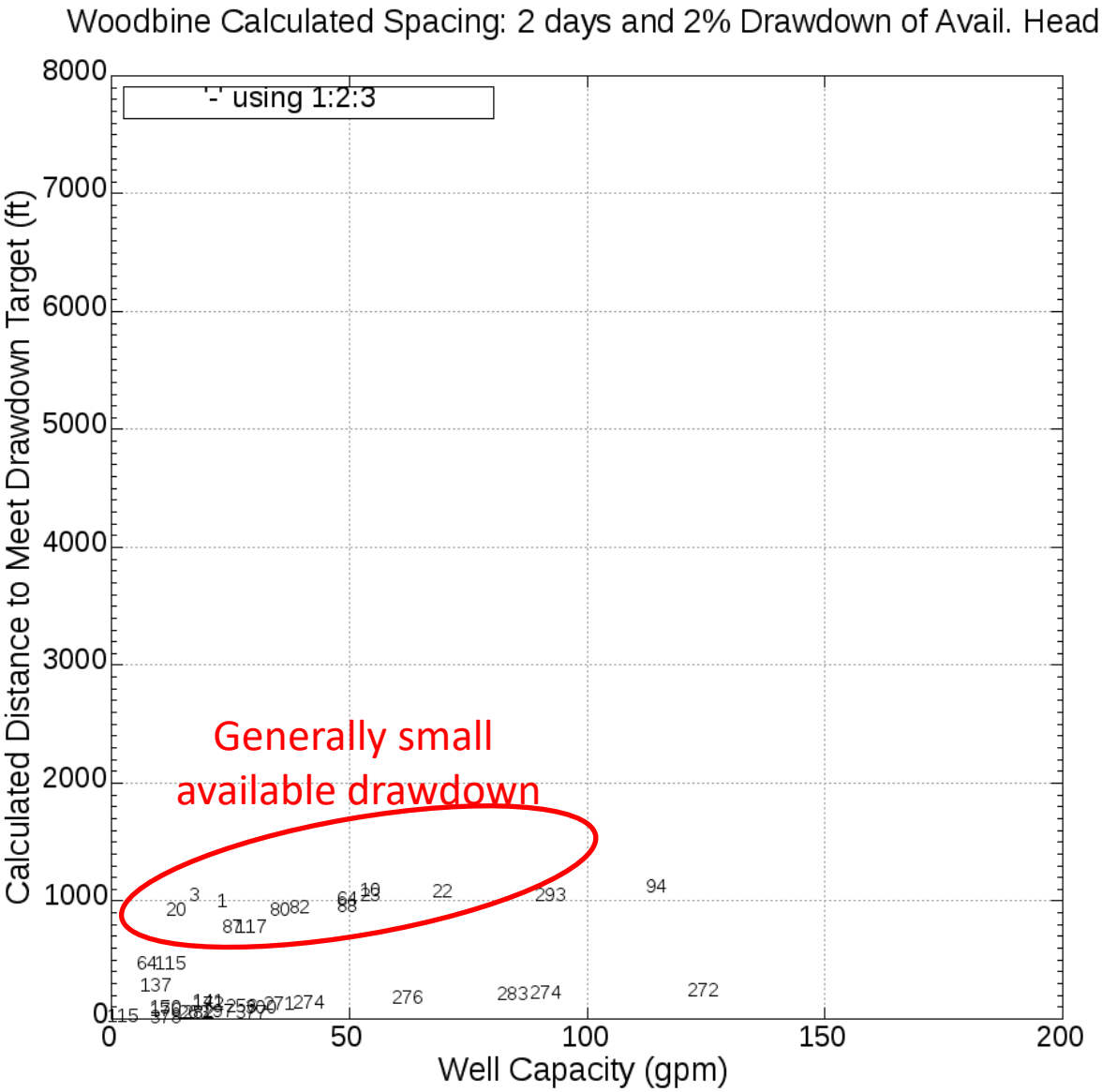
Tier	Production (gpm)	Spacing (feet)
1	≤ 25	100
2	> 25 – 200	100 + **X***gpm Alternative: Staff review
3	> 200	Formula

Formula → $$r = \sqrt{\frac{0.3Tt}{S\left(10^{\frac{sT}{264Q}}\right)}}$$

Tiered Approach to Spacing

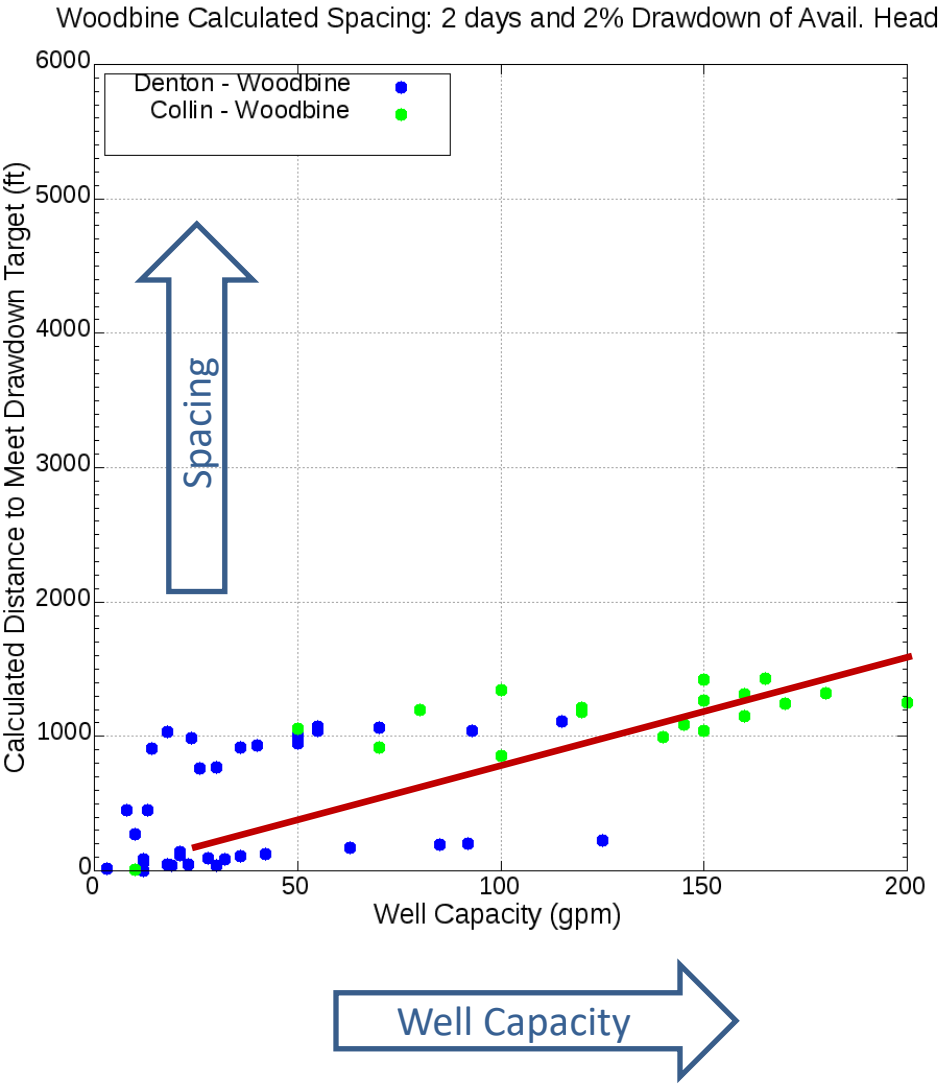
- Tier 1: ≤ 25 gpm at 100 foot spacing
  - Covers exempt wells
  - shown in table in rules
  - Variance requests go to Board
- Tier 2: > 25 gpm to ≤ 200 gpm
  - Table in rules that shows the 100 foot baseline spacing + __ * gpm
  - Staff Variance Process as an alternative for site-specific review
    - Scientific and objective; Map and formula driven
    - Allows for site-specific approach to the benefit of the landowner
- Tier 3: > 200 gpm
  - No table; only formulaic review using GAM
  - Would require hydrogeology report
  - Variance requests go to Board

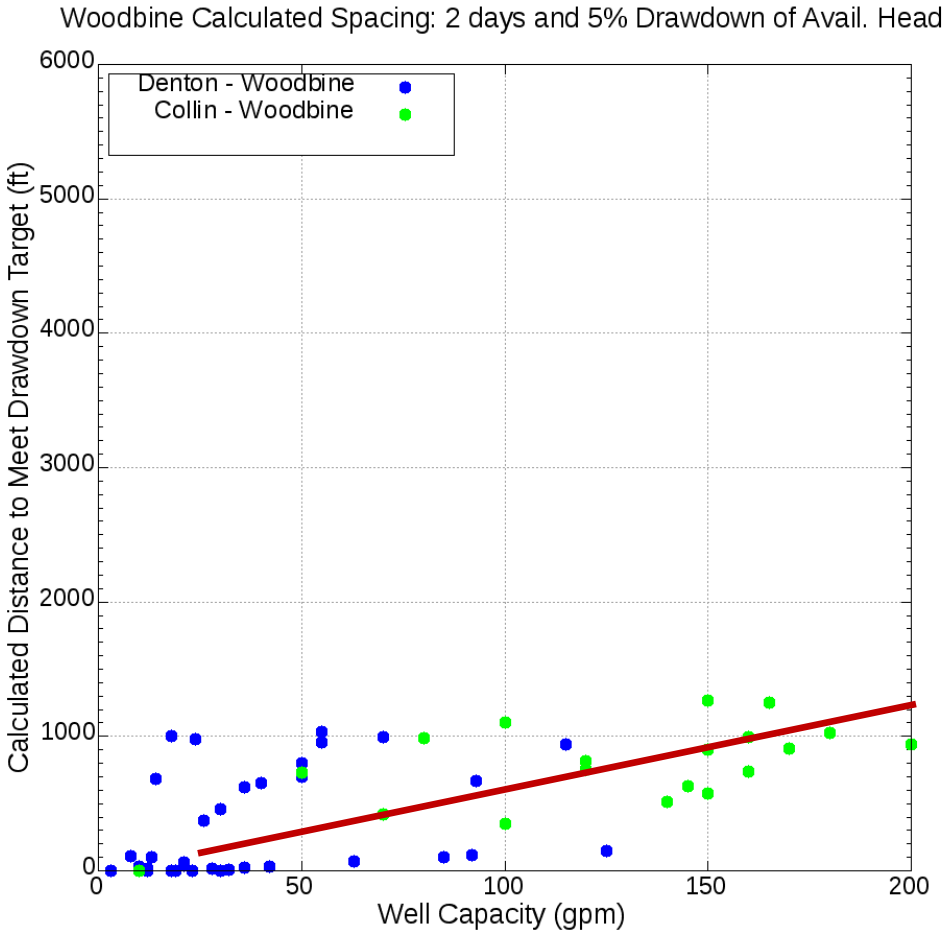
Woodbine - Available Drawdown Posted



Woodbine

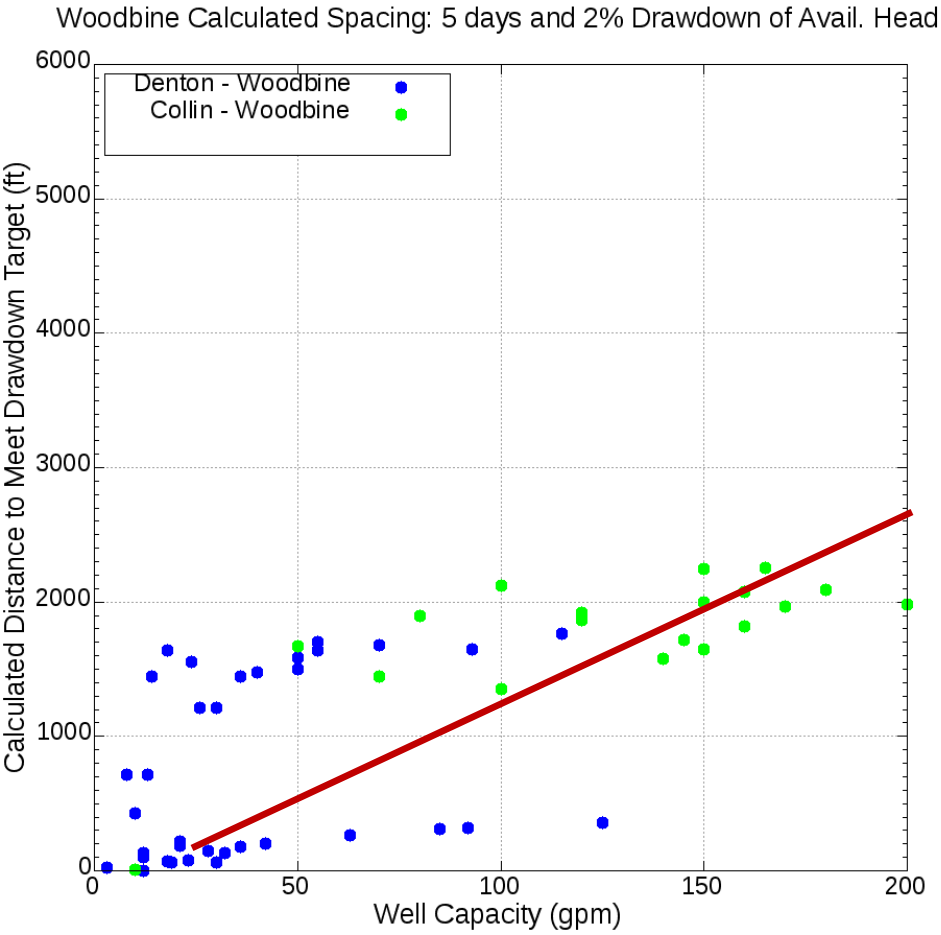
2 Days Pumping, 2% and 5% Allowable Drawdown

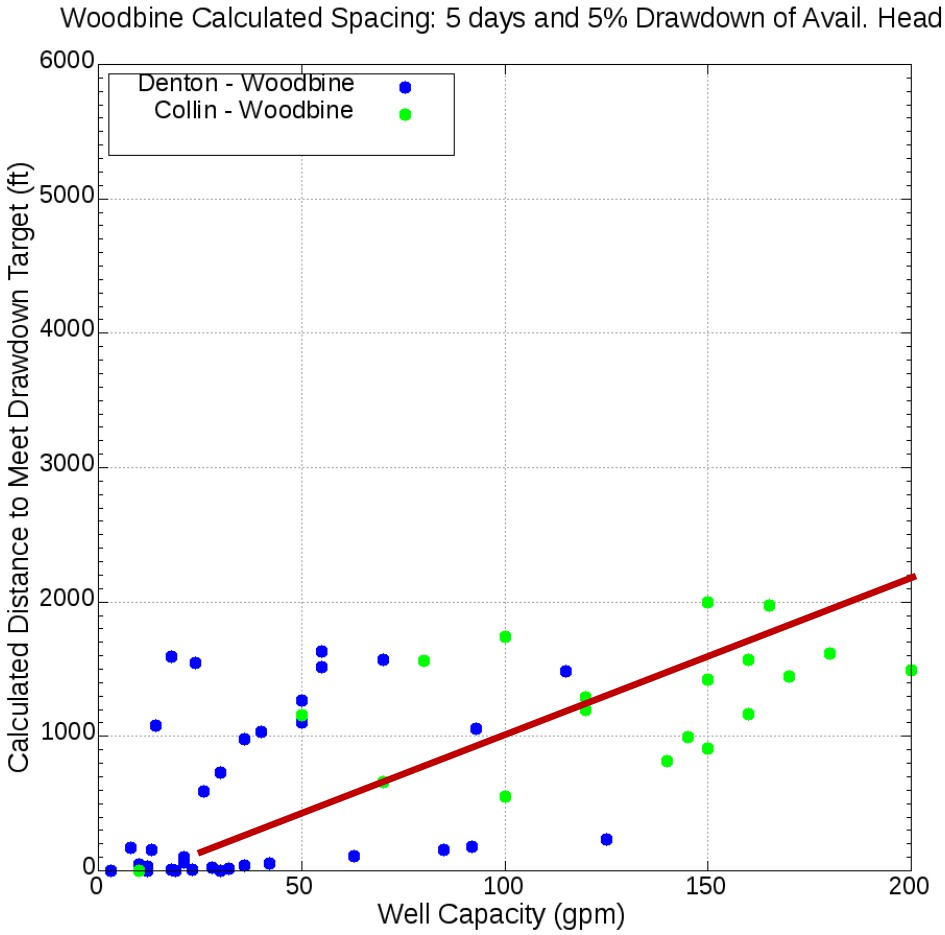




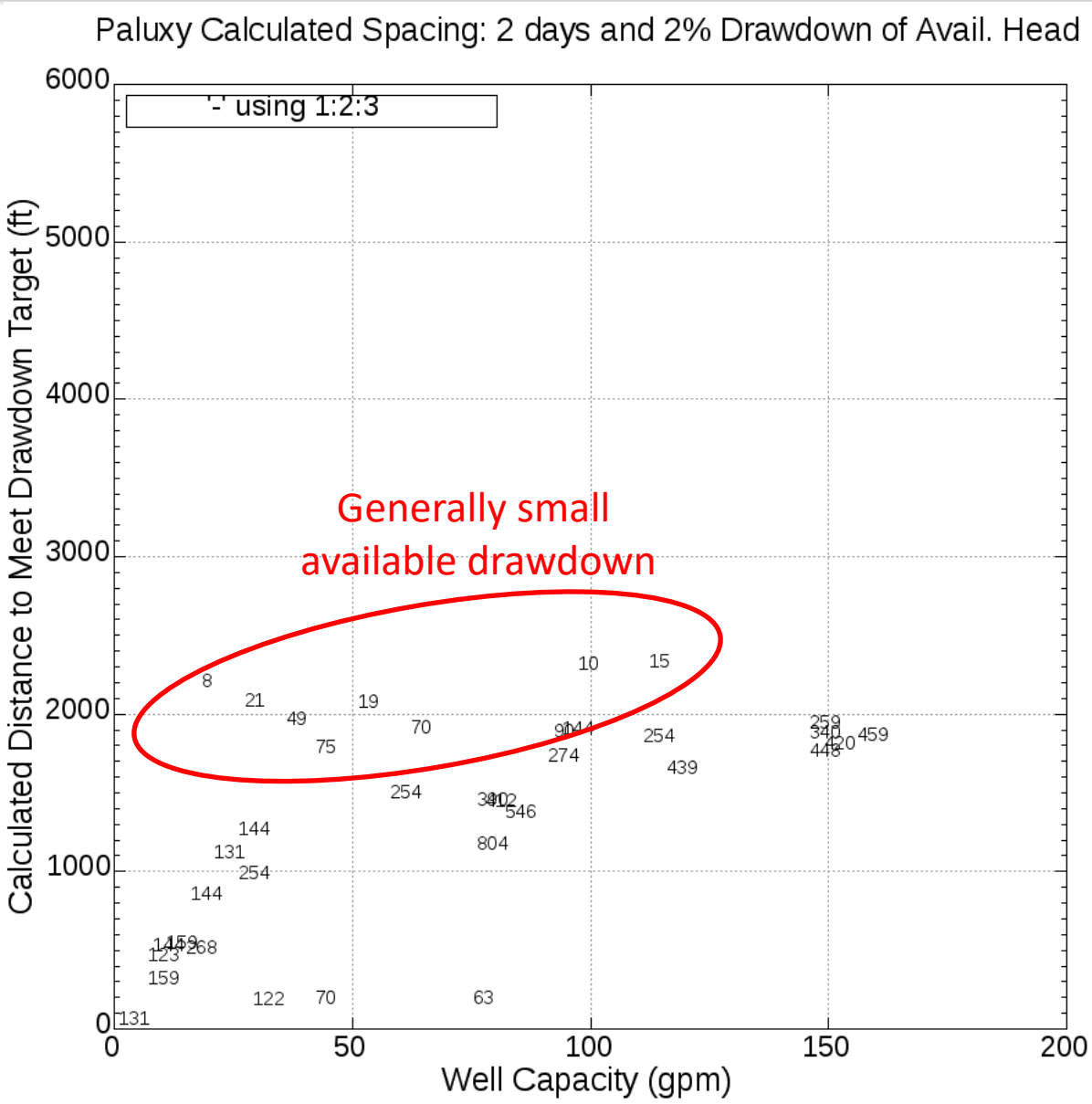
Woodbine

5 Days Pumping, 2% and 5% Allowable Drawdown





Paluxy - Available Drawdown Posted



Paluxy

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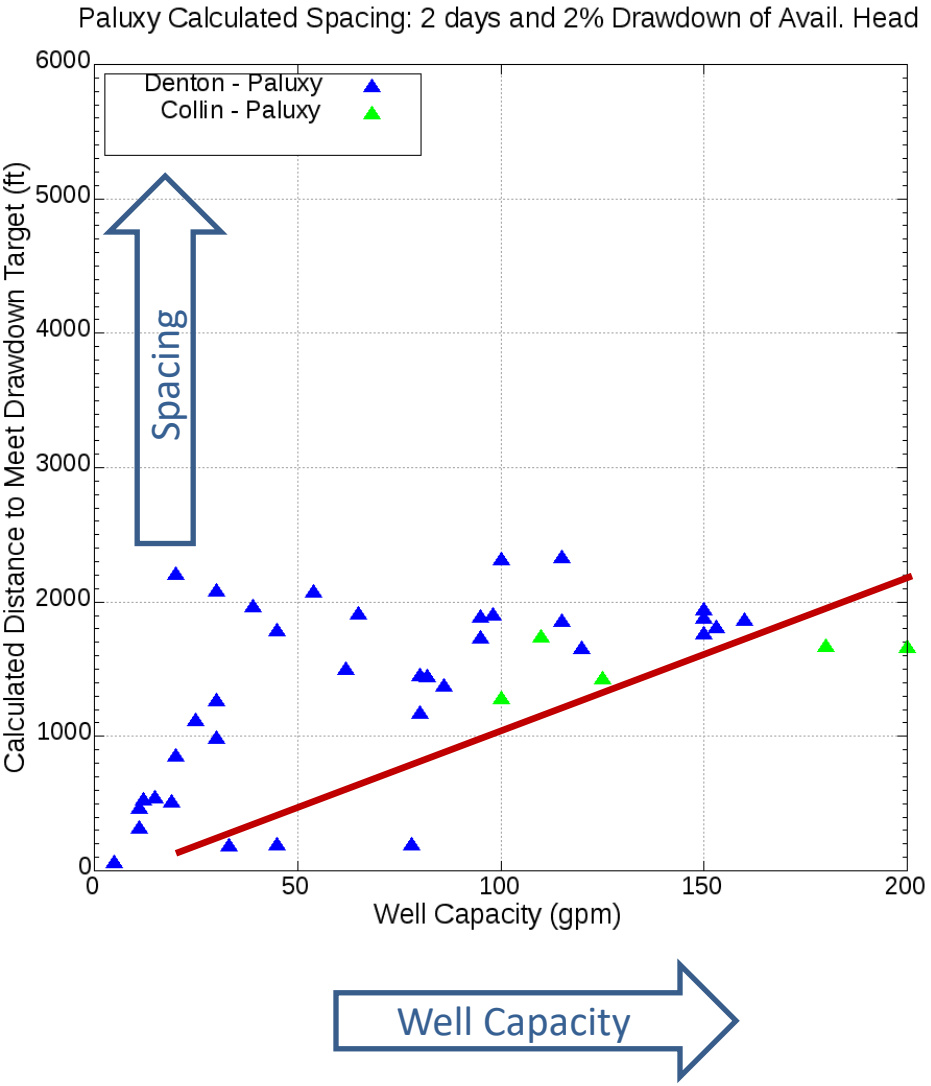

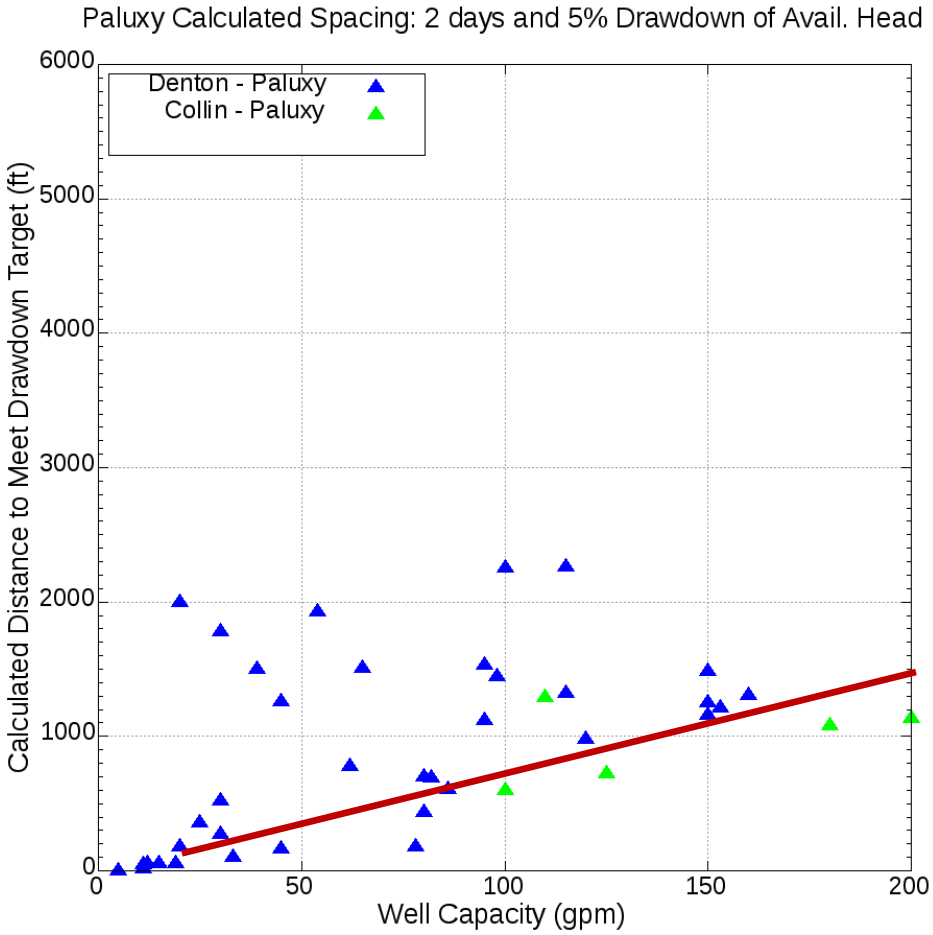

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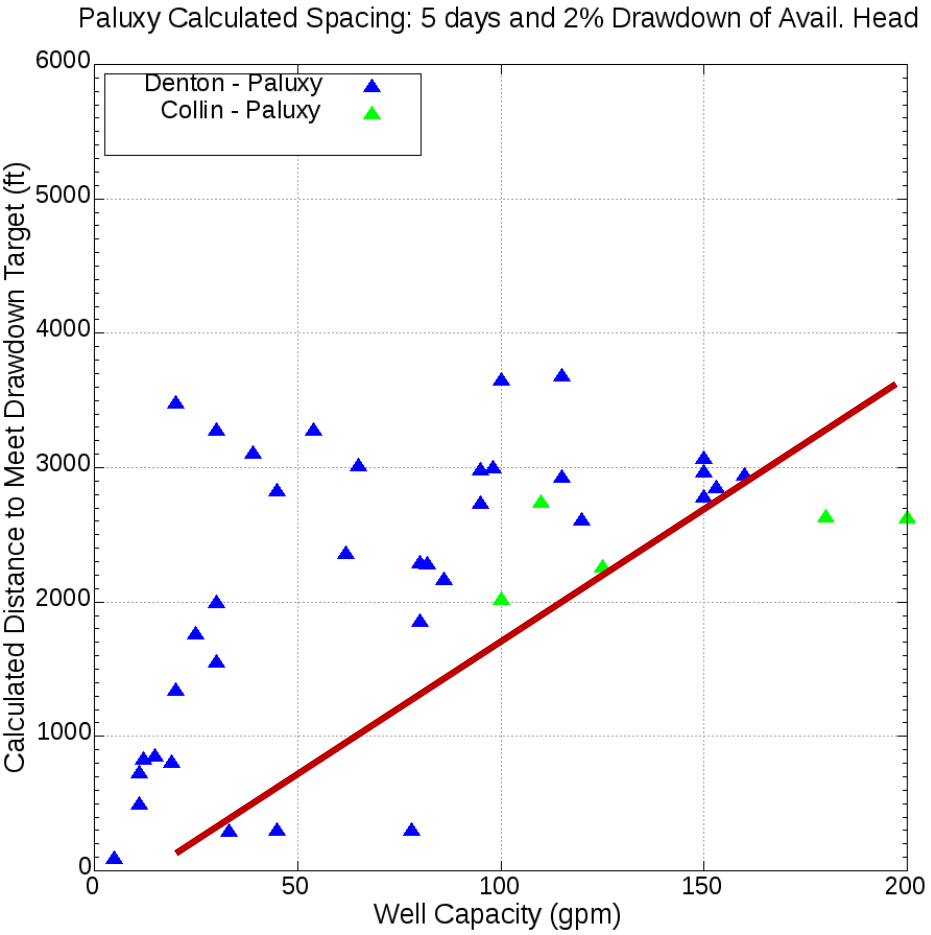
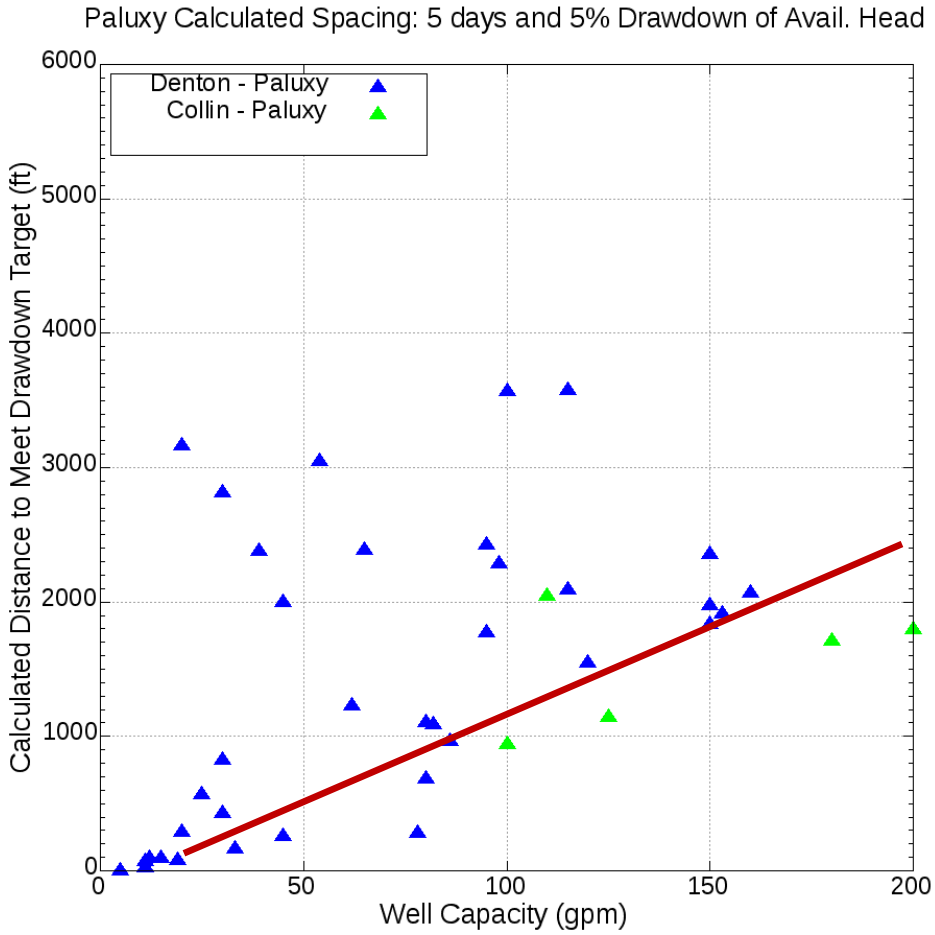
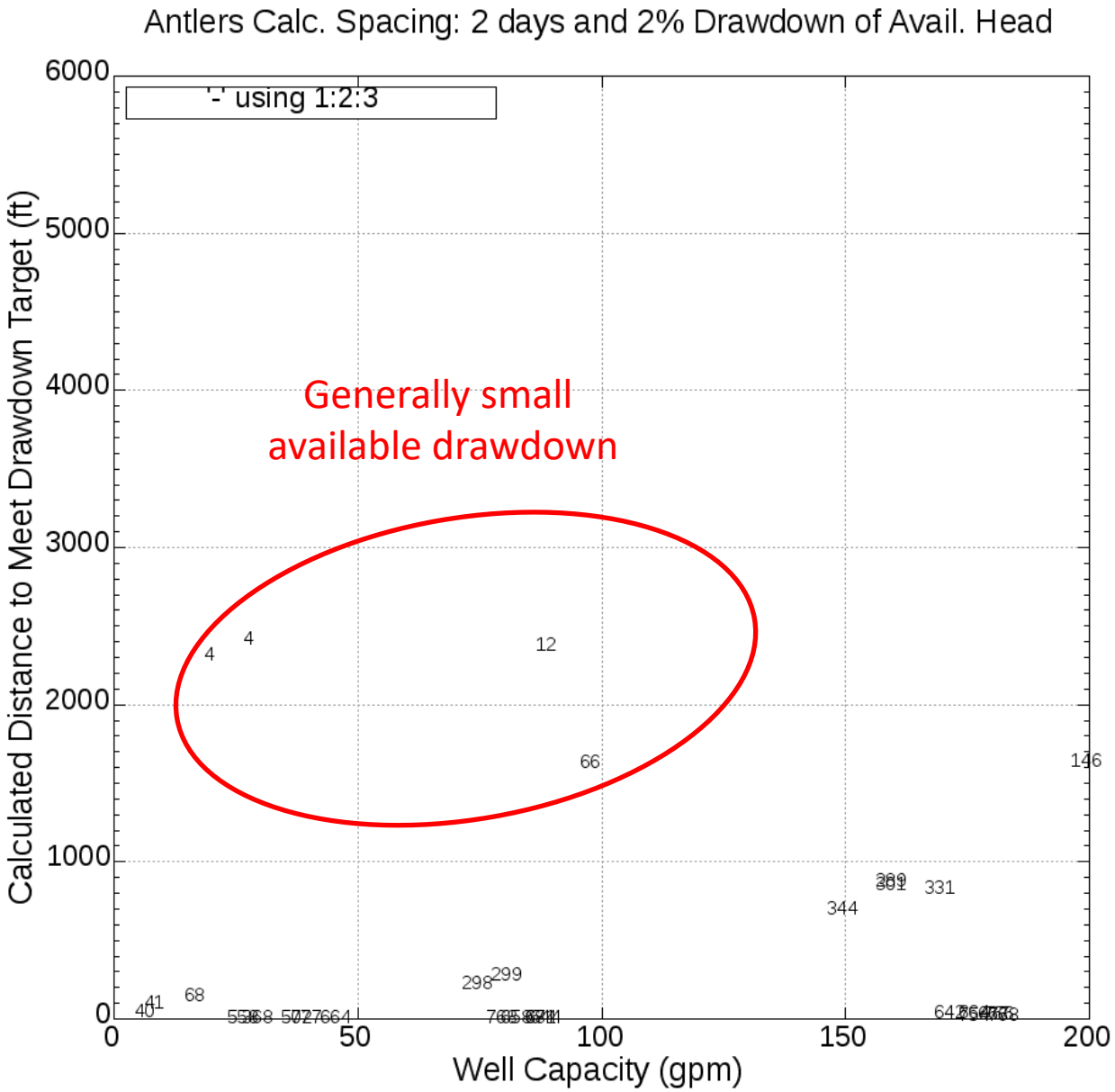


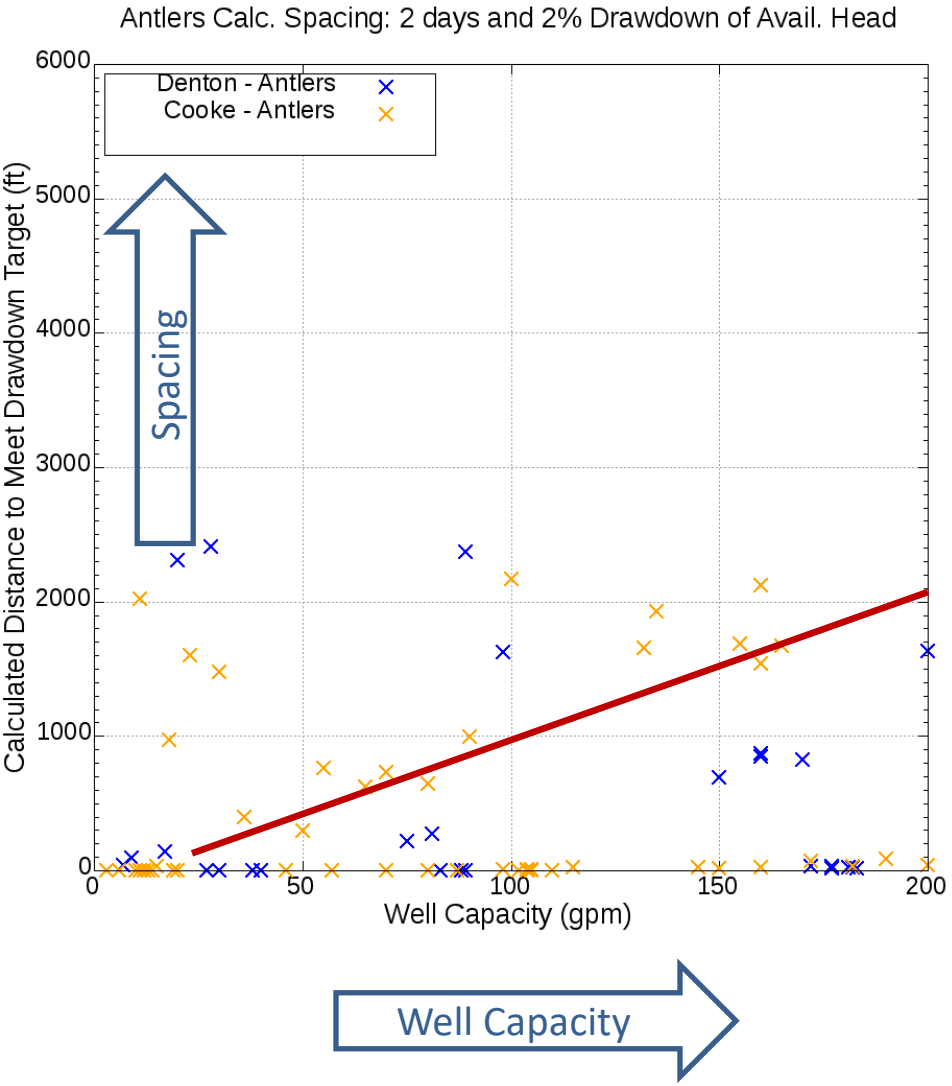


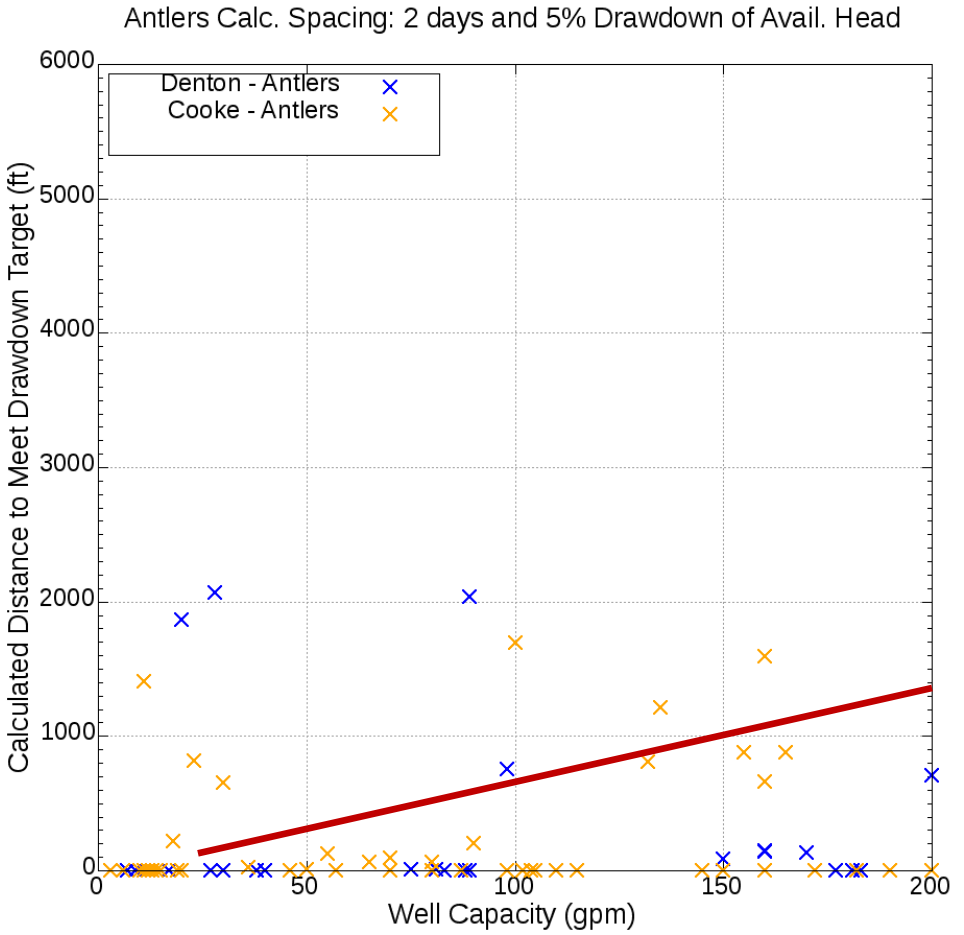
Antlers - Available Drawdown Posted



Antlers

2 Days Pumping, 2% and 5% Allowable Drawdown





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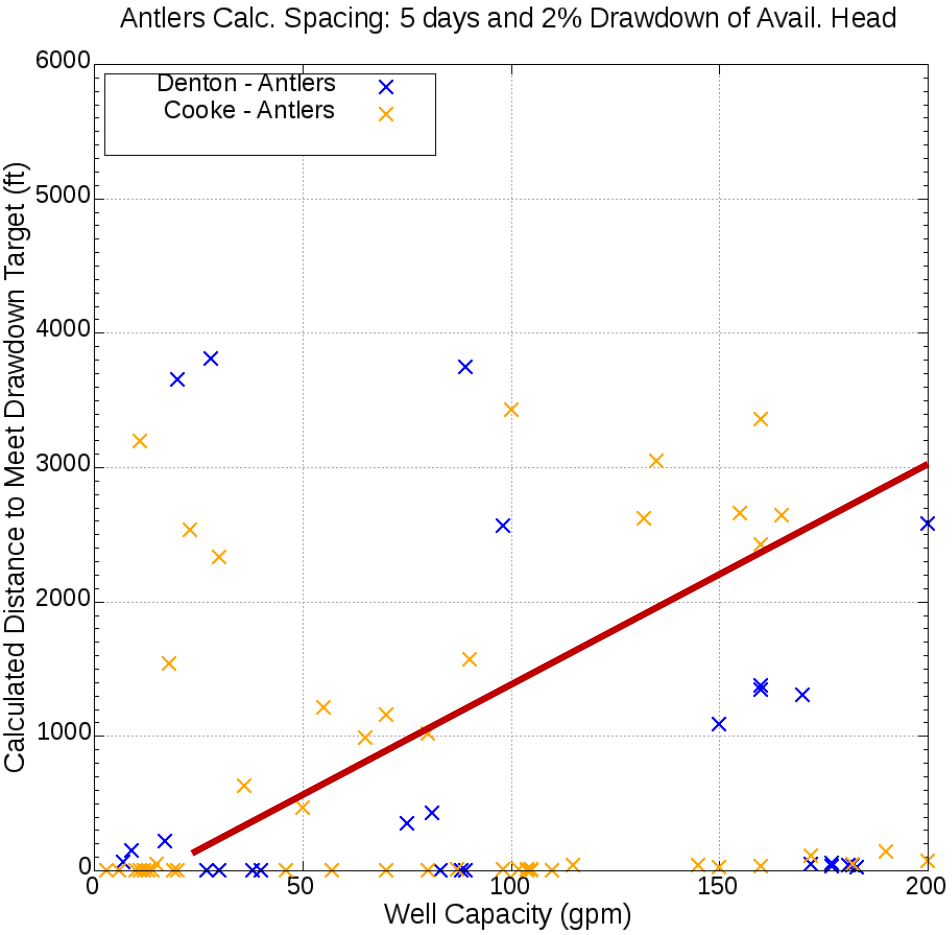
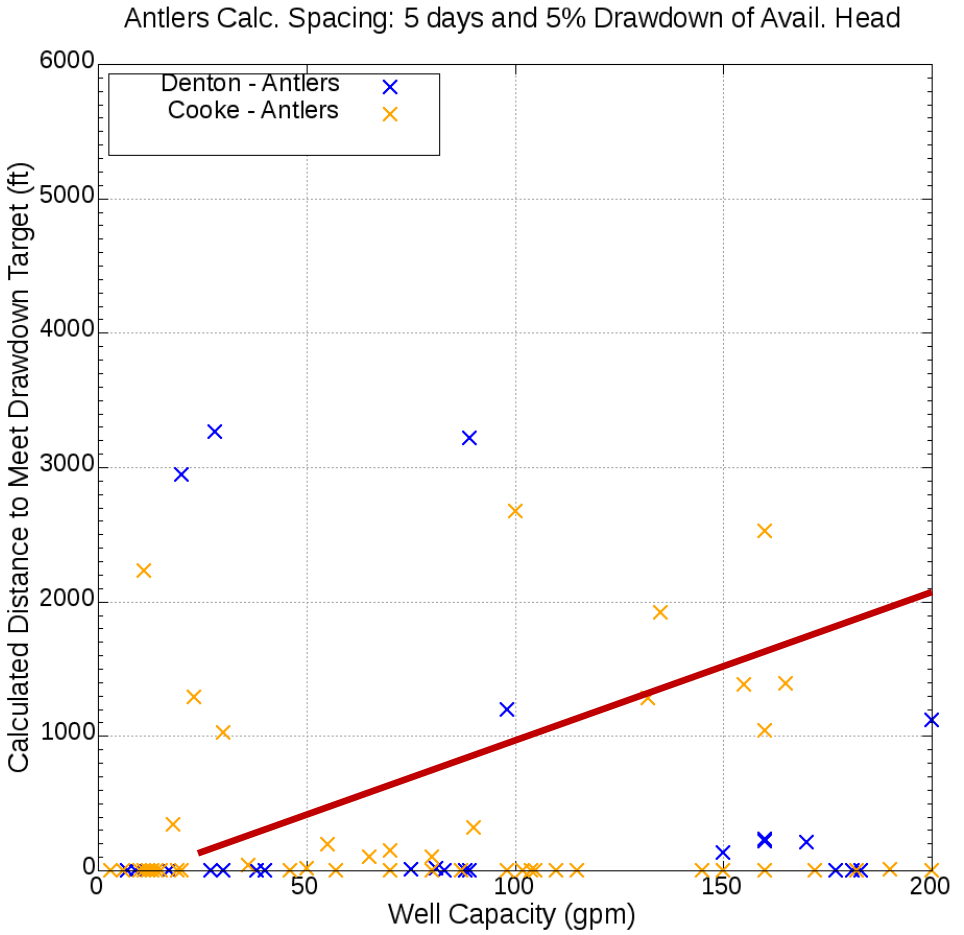
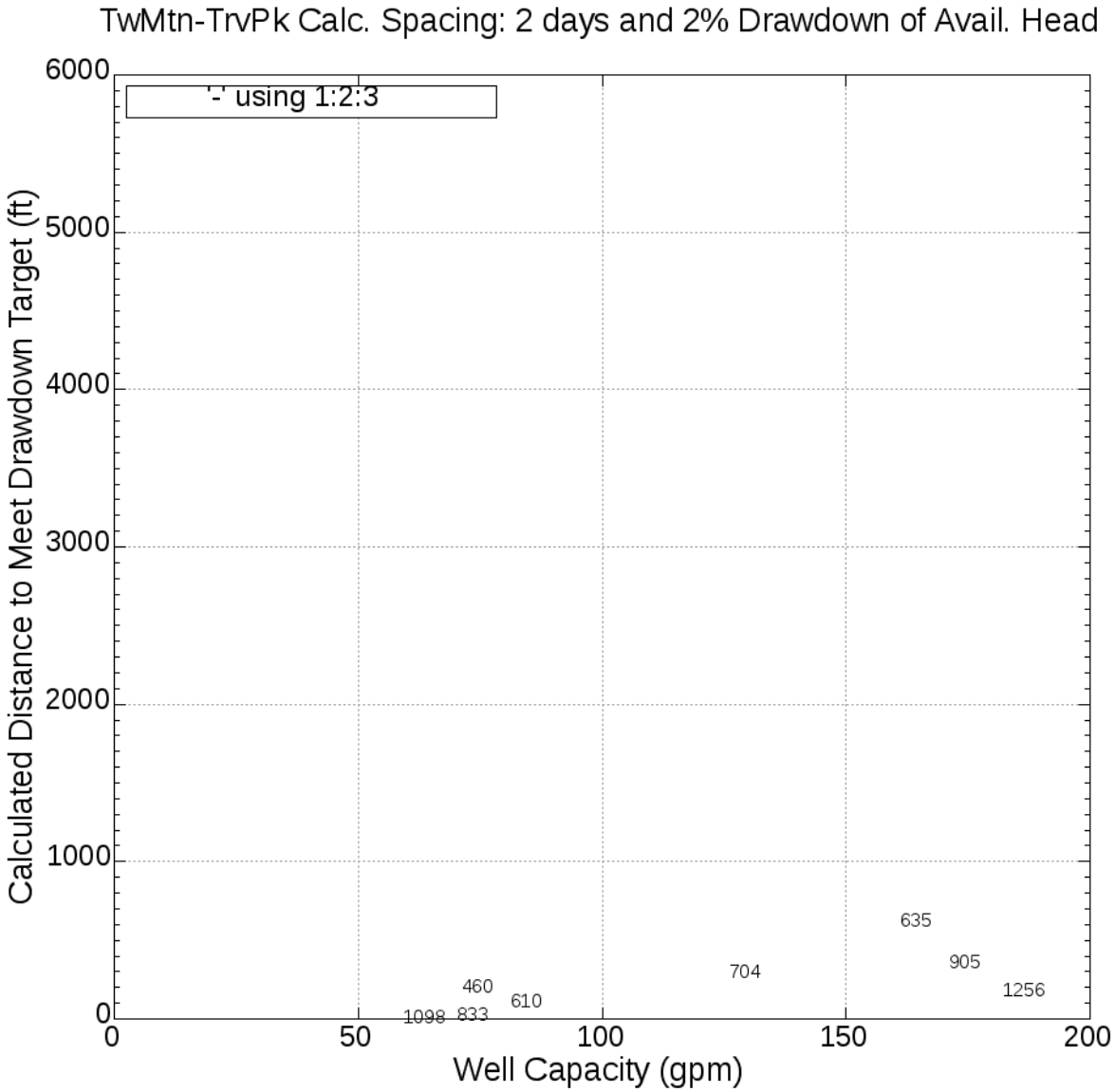


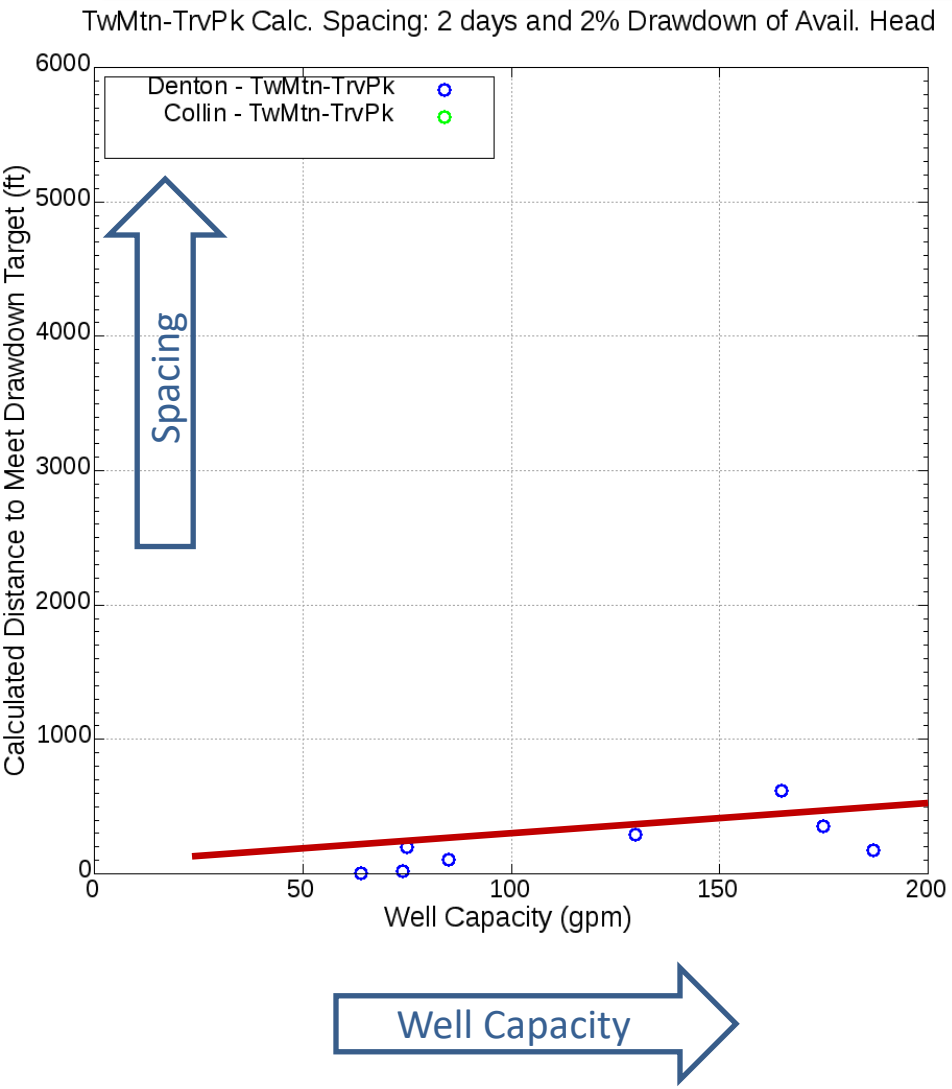


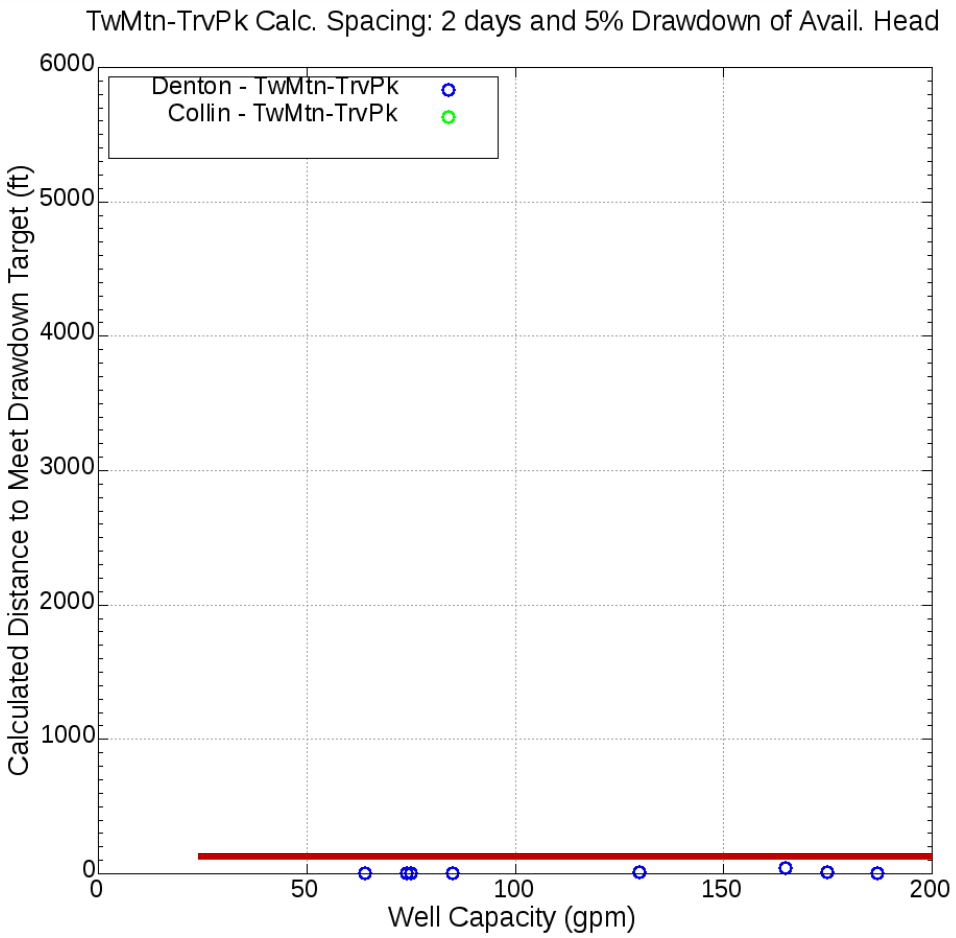
Twin Mountain
Available Drawdown Posted



Twin Mountain

2 Days Pumping, 2% and 5% Allowable Drawdown





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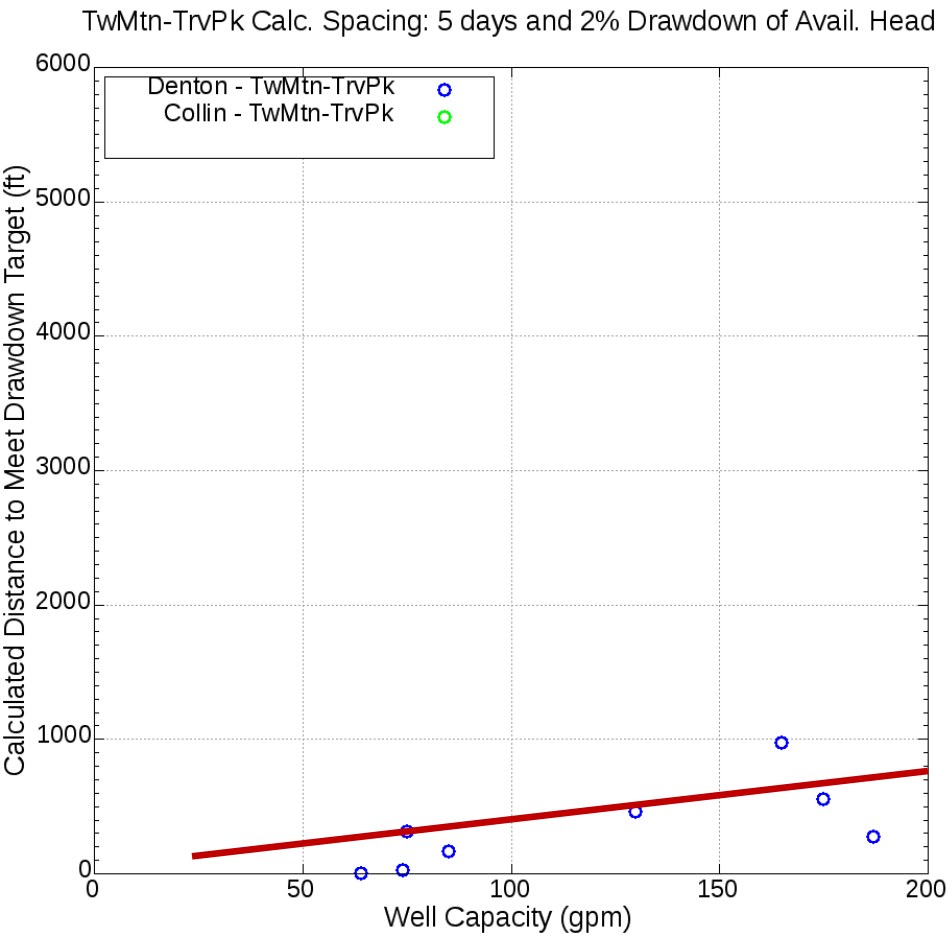
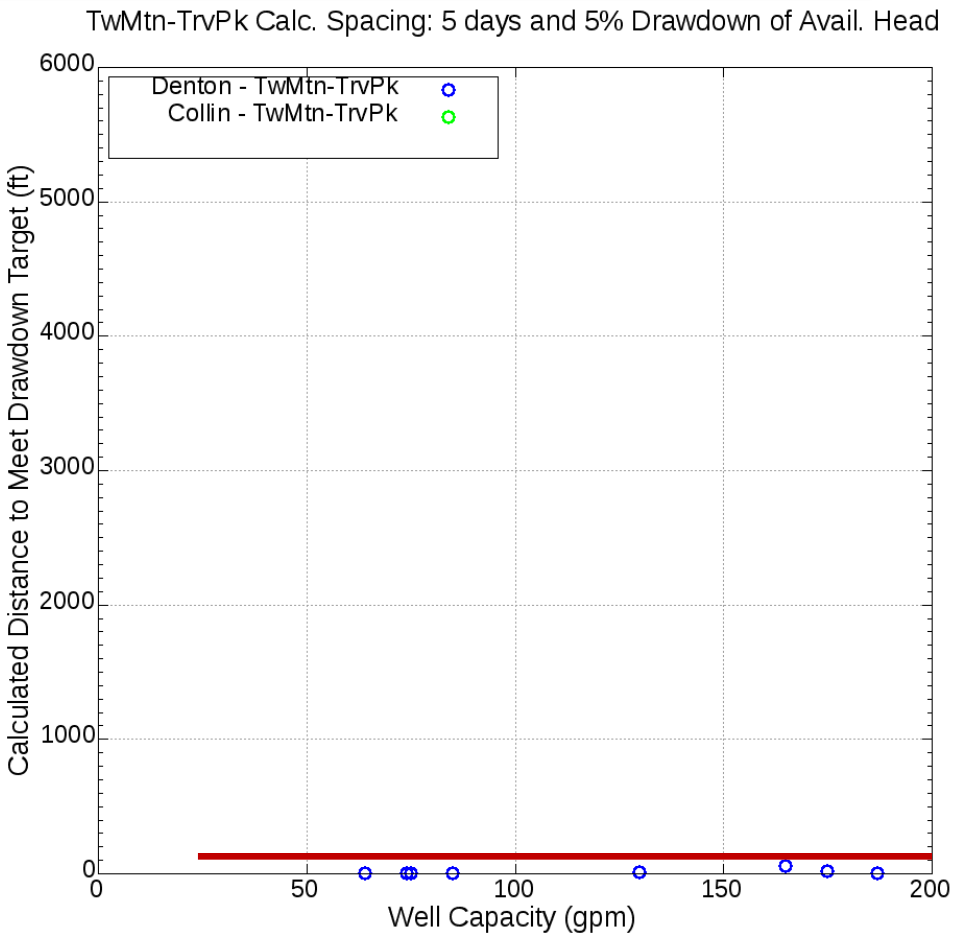
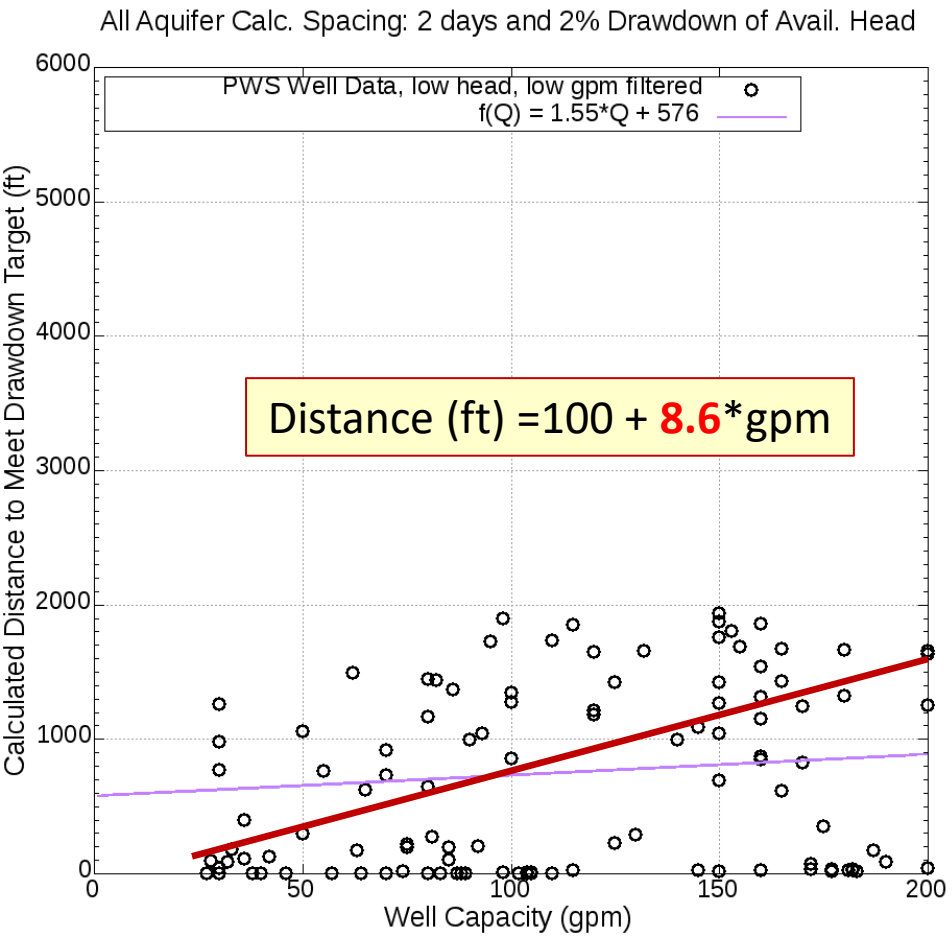
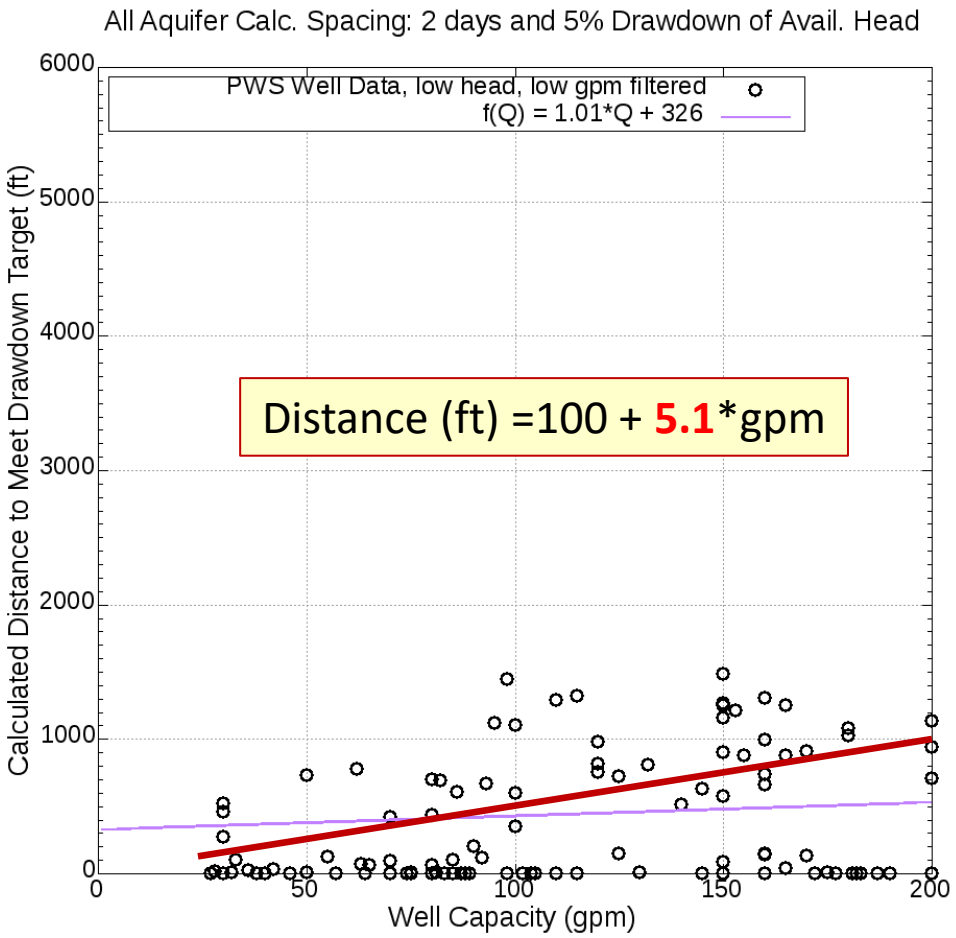


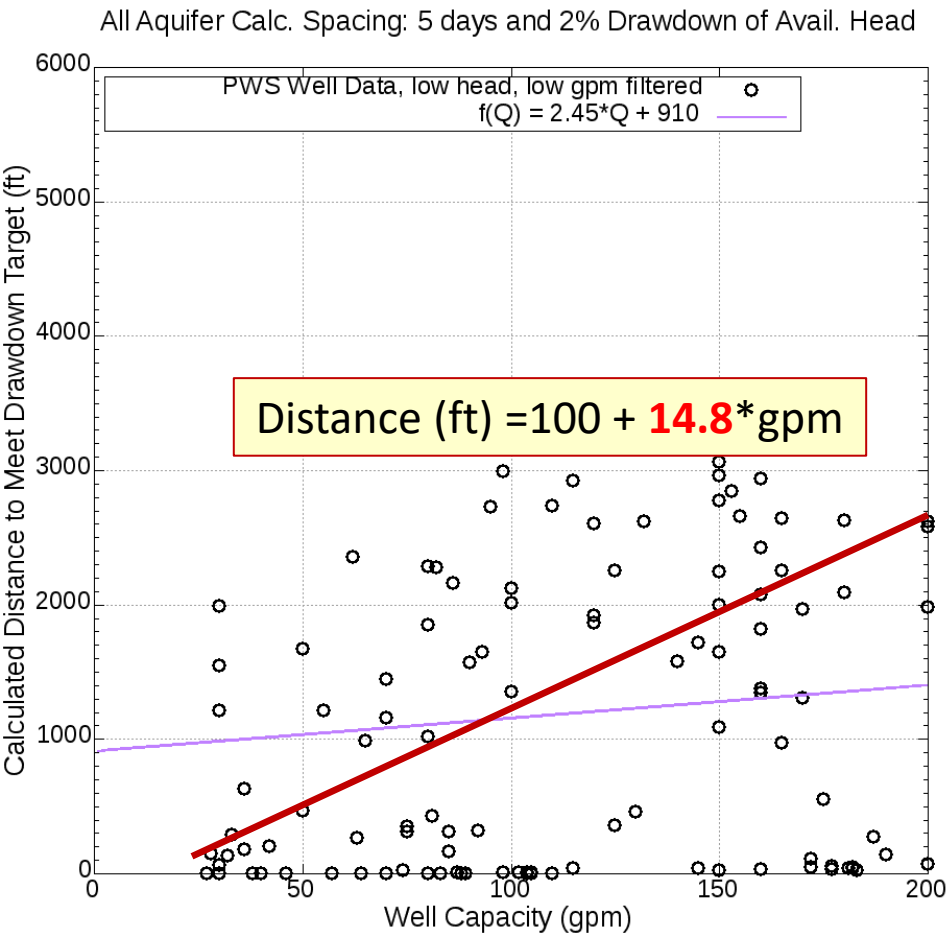


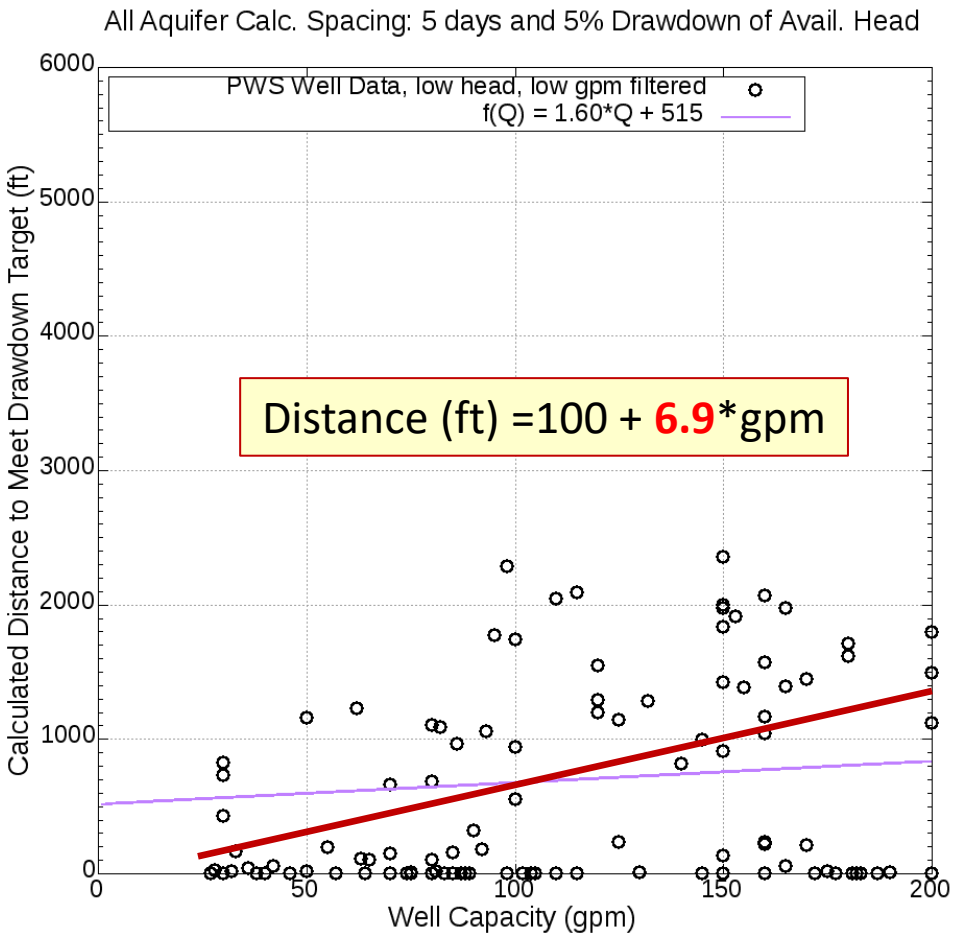
All Aquifers: 2 day



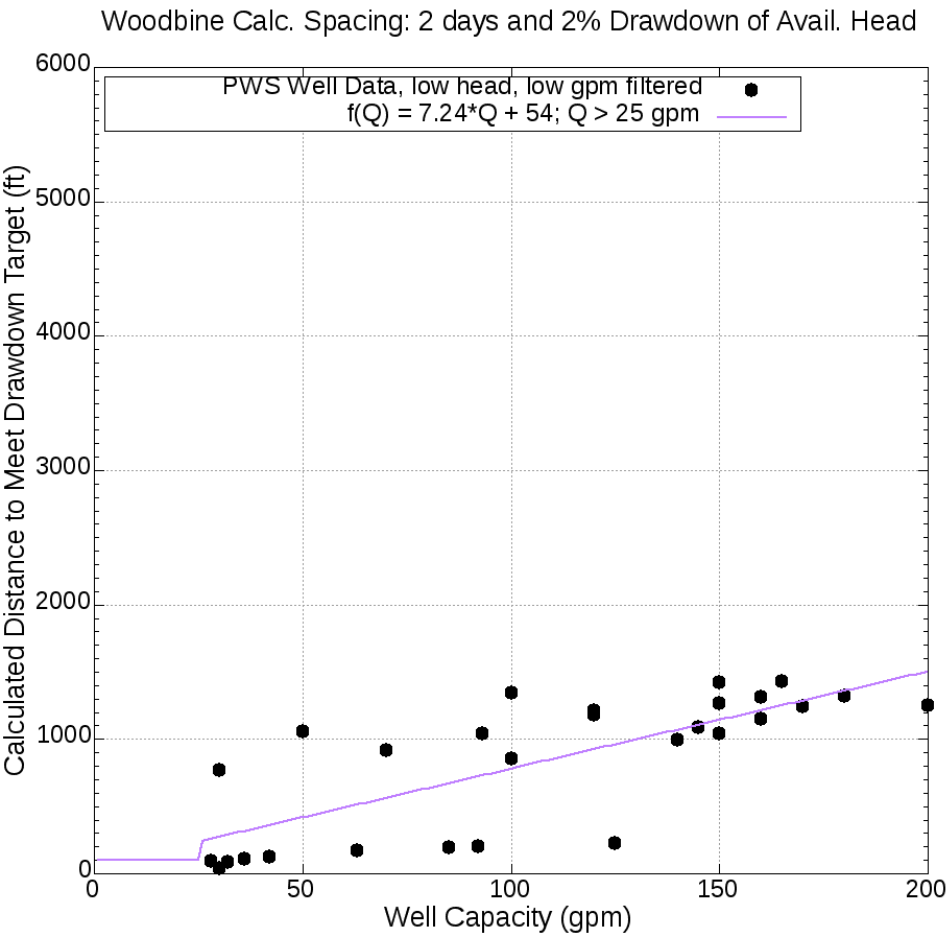


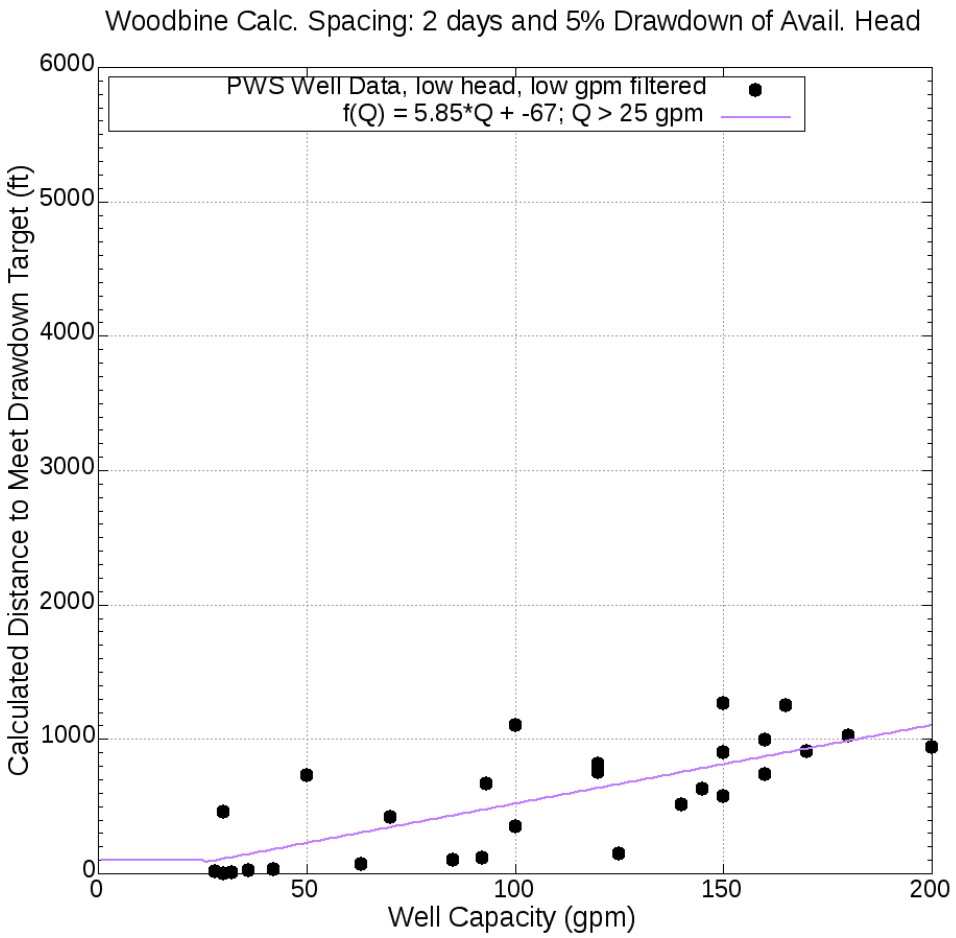
All Aquifers: 5 day



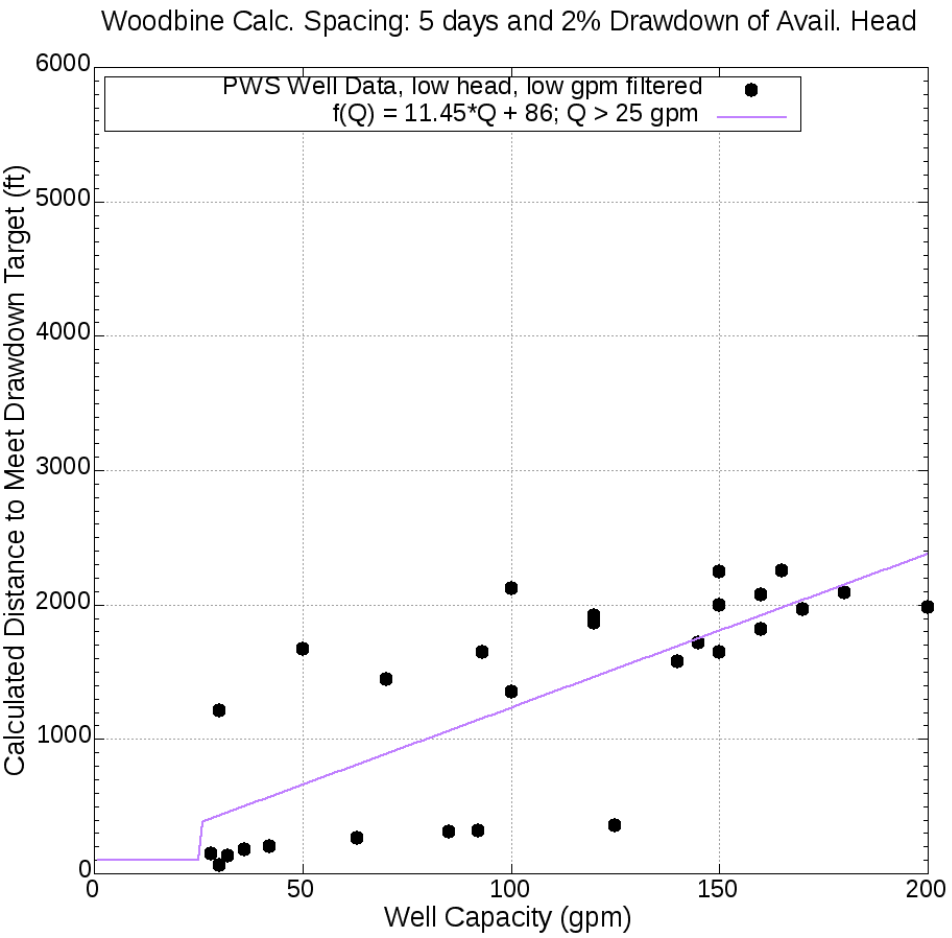


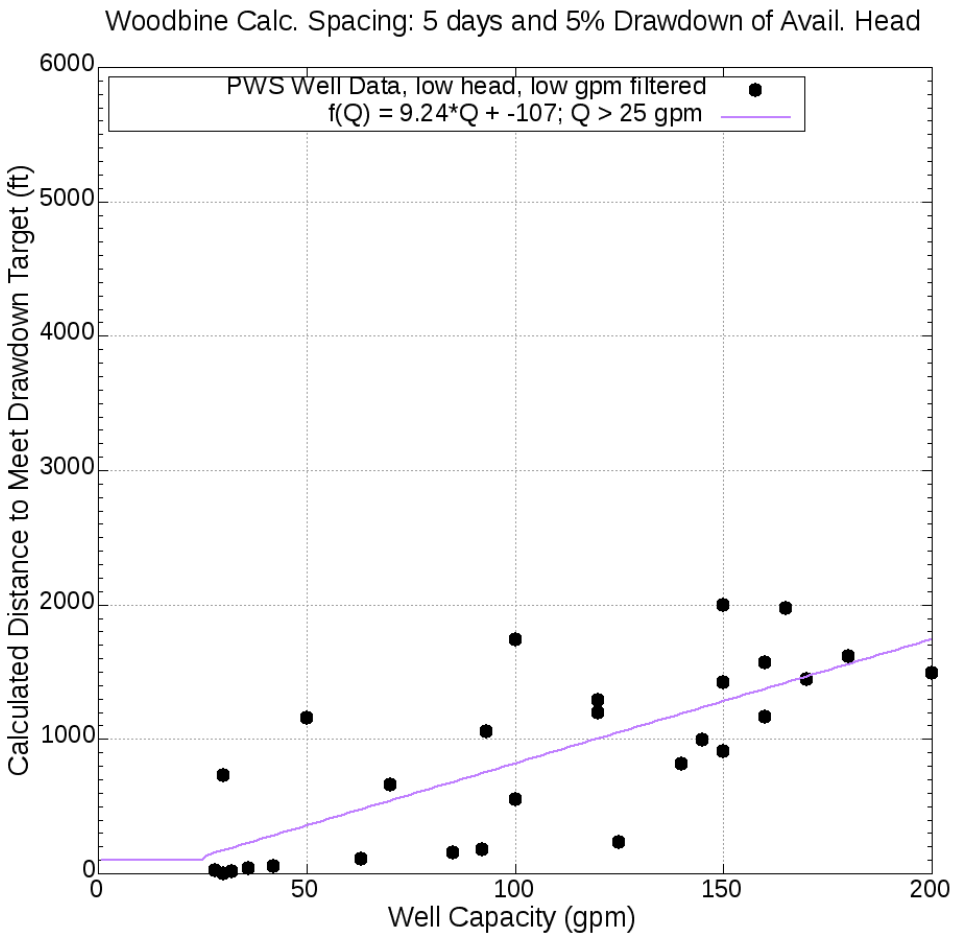
Woodbine: 2 day



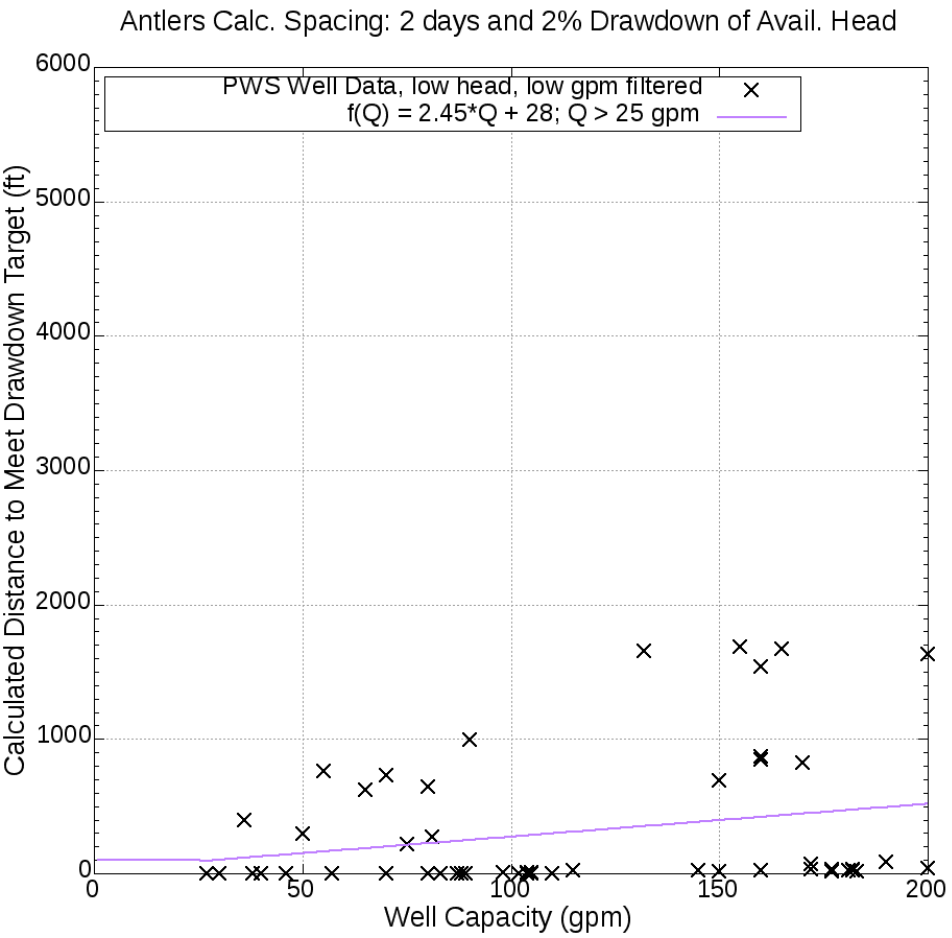


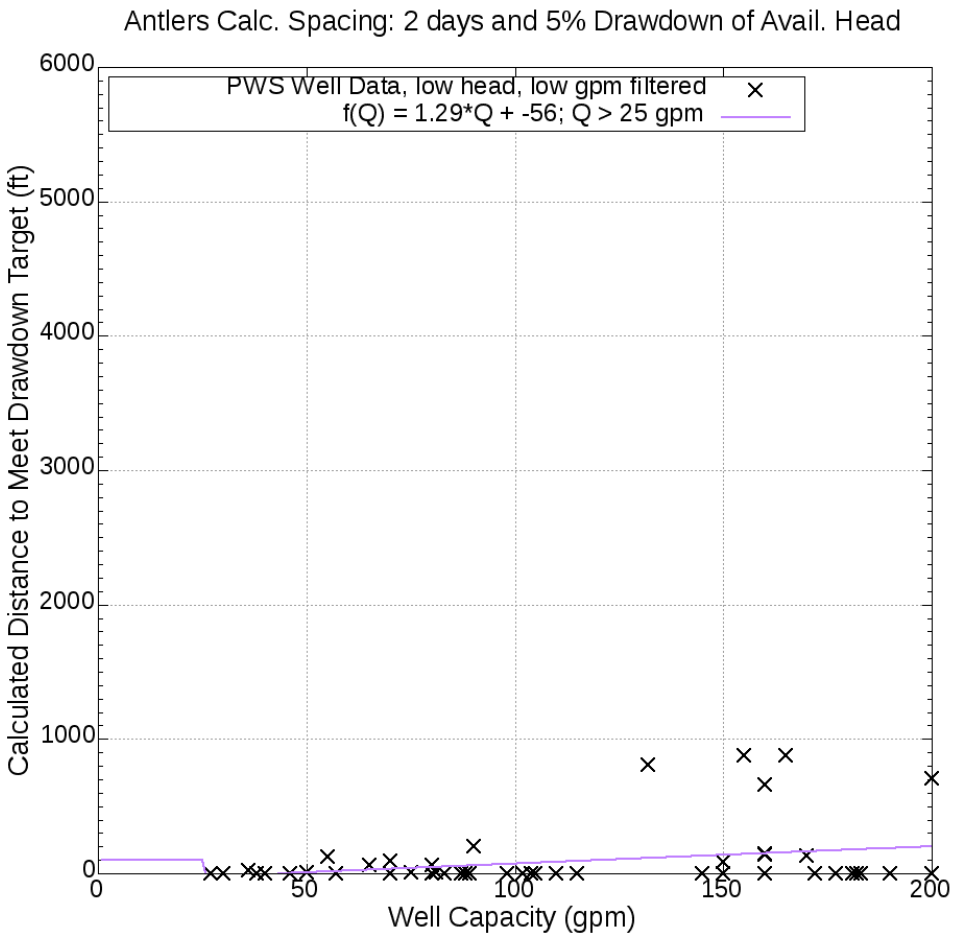
Woodbine: 5 day



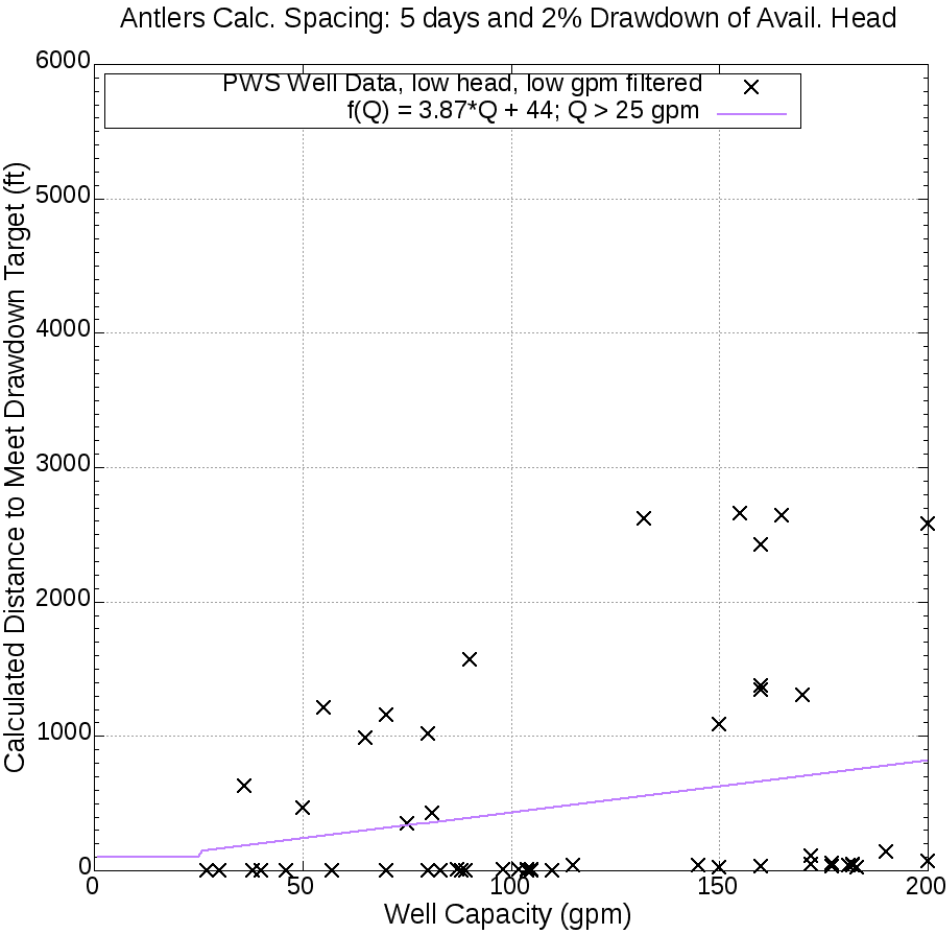


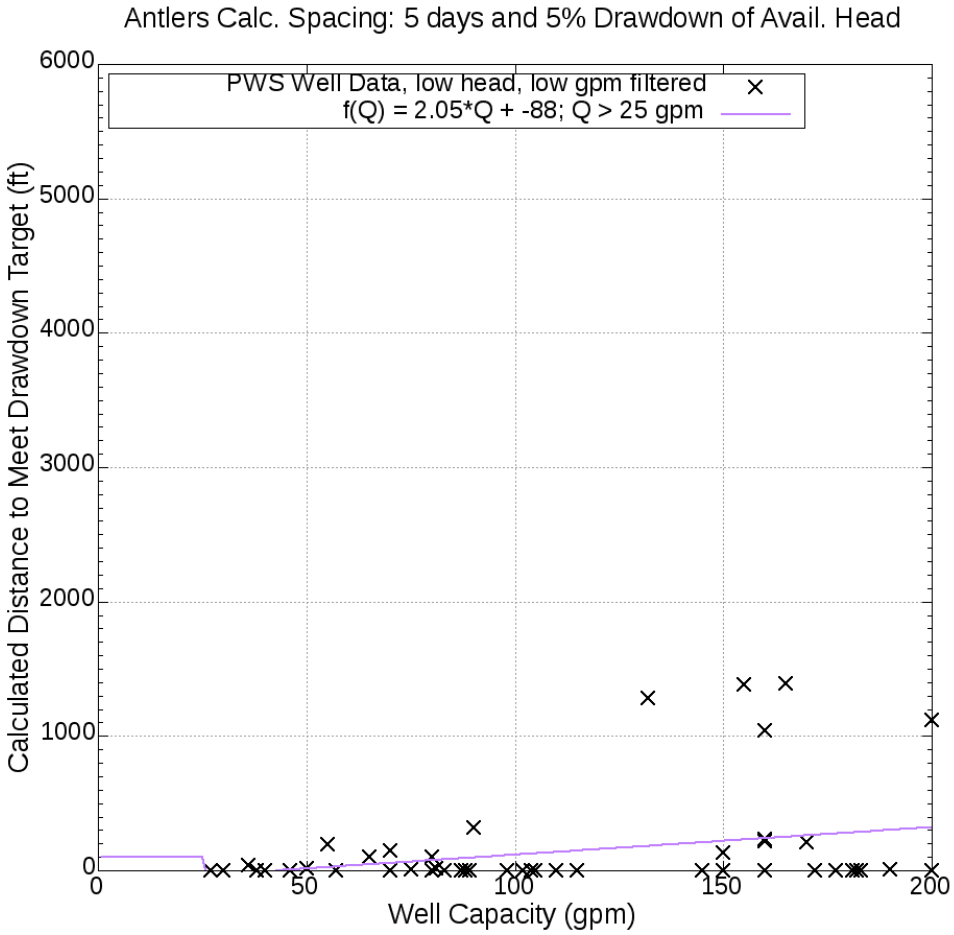
Antlers: 2 day



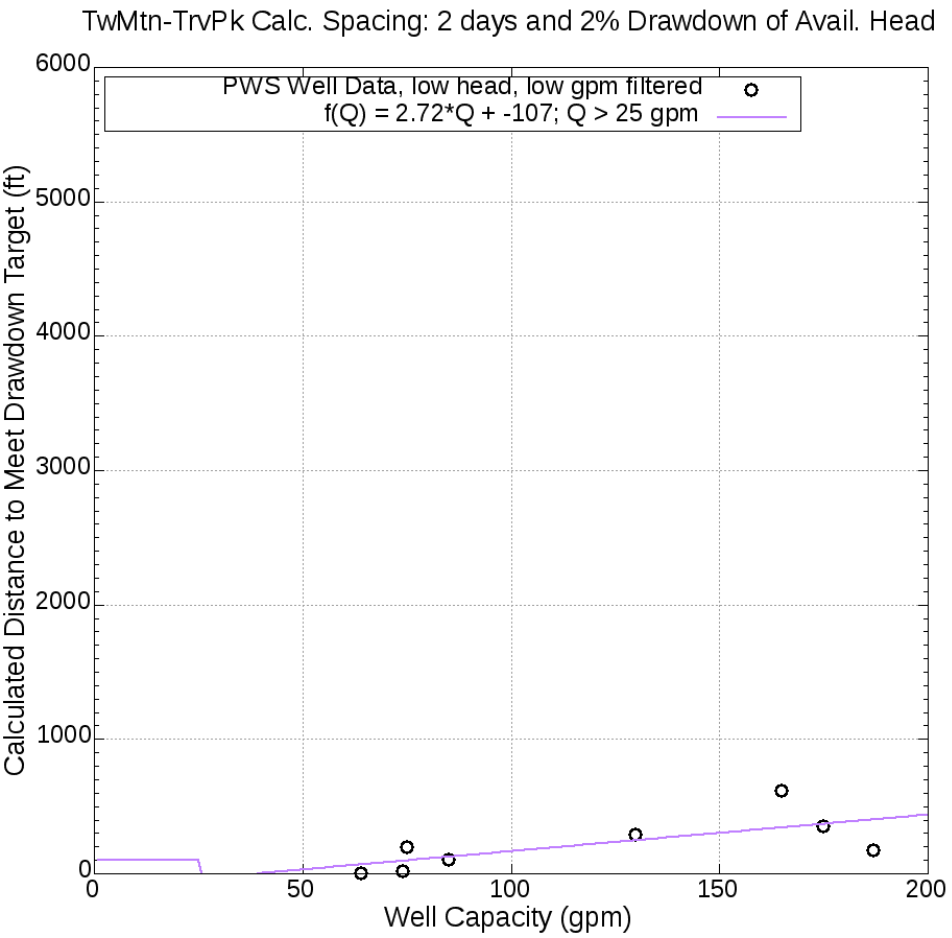


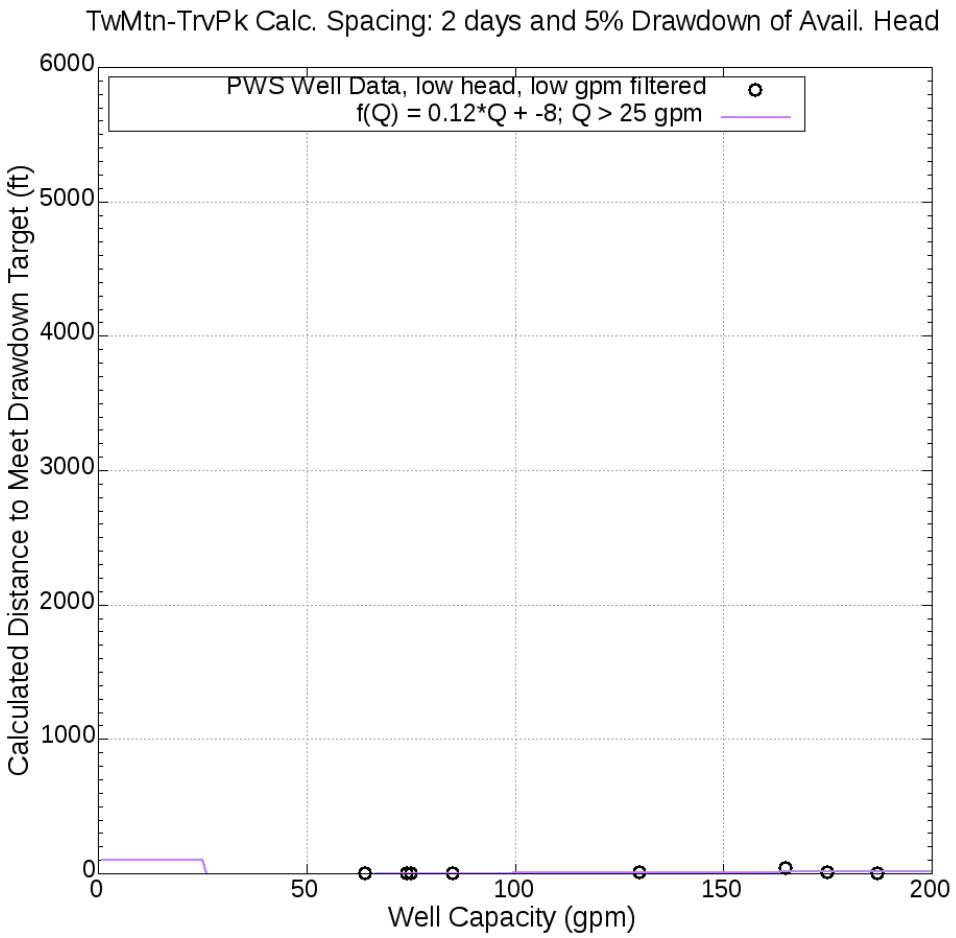
Antlers: 5 day



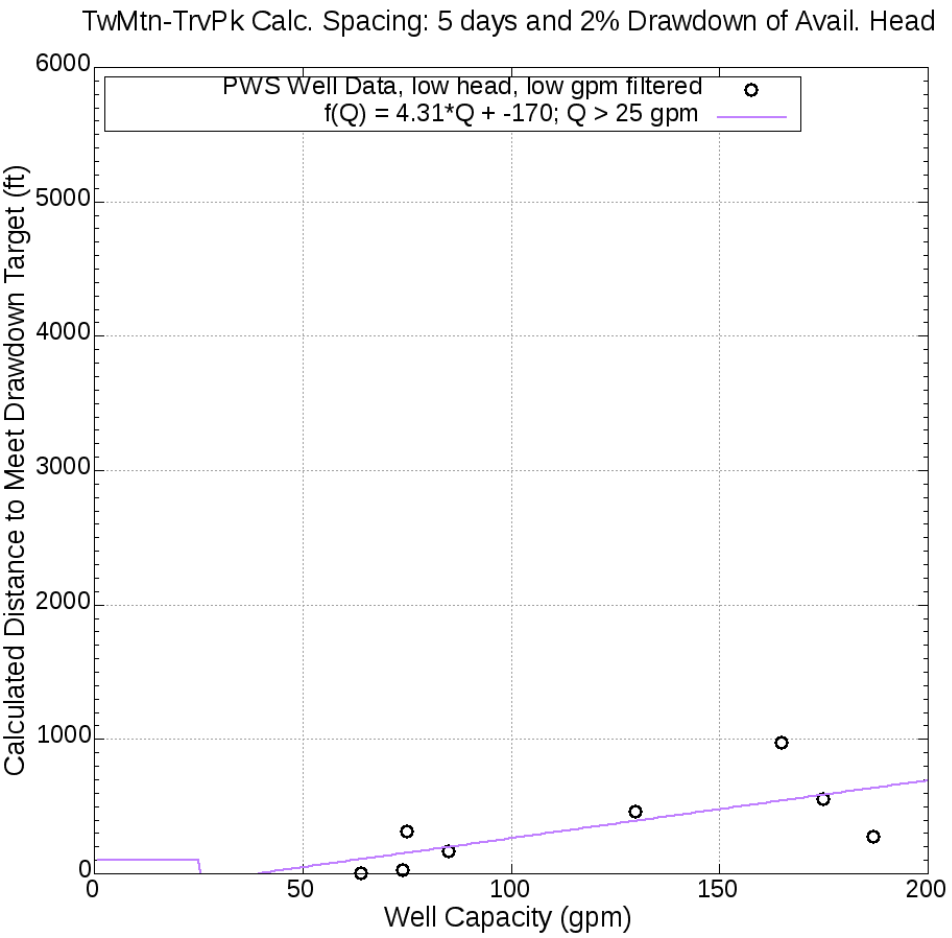


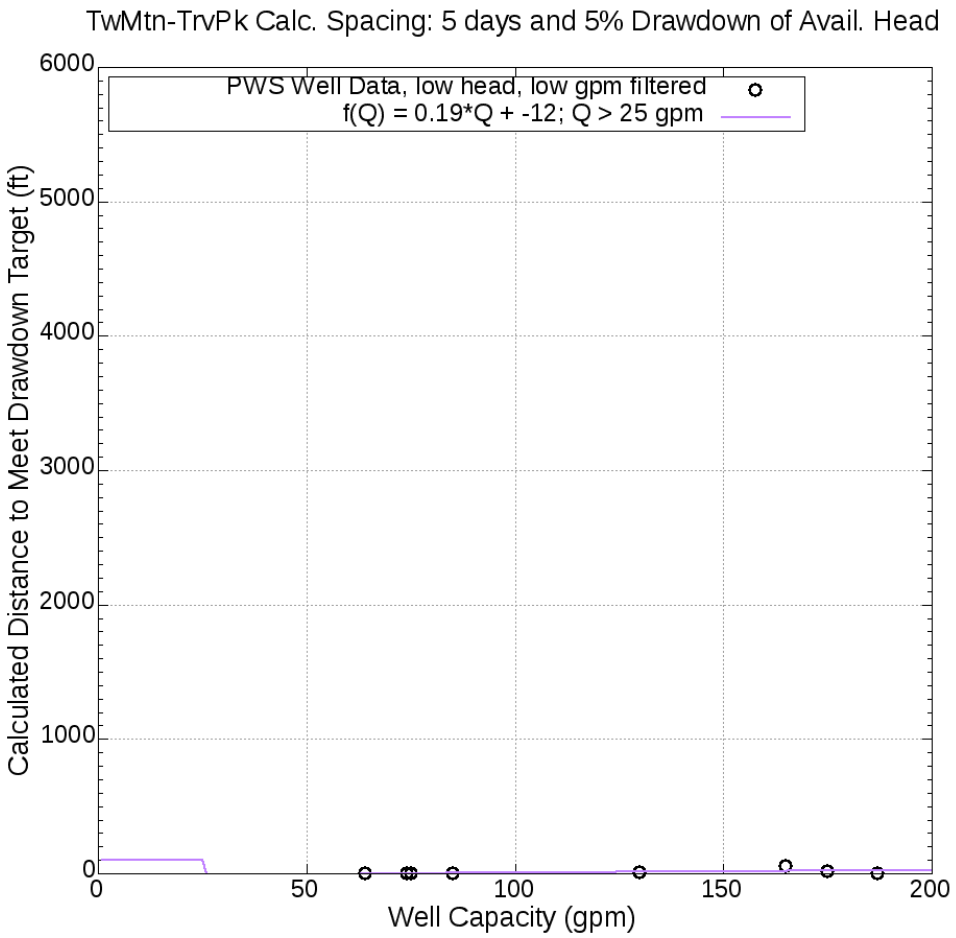
TM/TP: 2 day


TwMtn-TrvPk Calc. Spacing: 2 days and 2% Drawdown of Avail. Head
PWS Well Data, low head, low gpm filtered
f(Q) = 2.72*Q + -107; Q > 25 gpm
Calculated Distance to Meet Drawdown Target (ft)
Well Capacity (gpm)
0
1000
2000
3000
4000
5000
6000
0
50
100
150
200

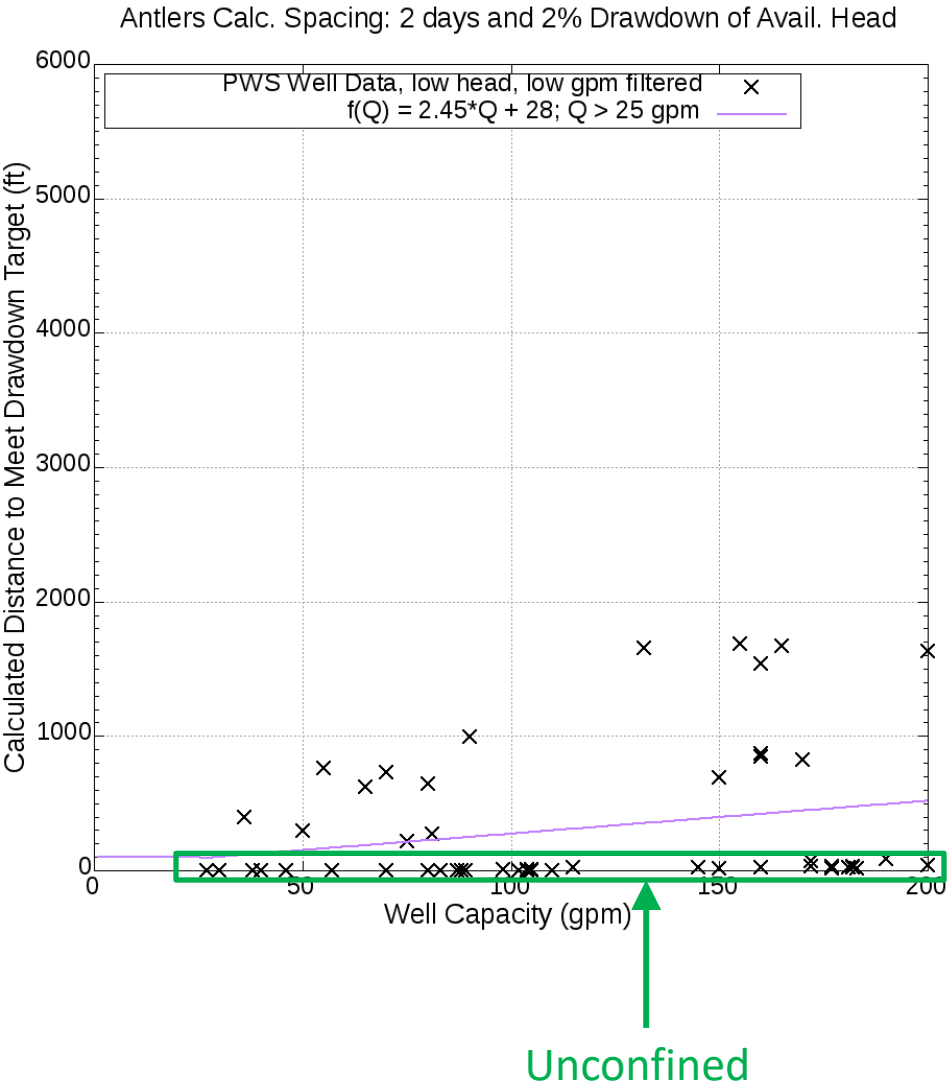

TwMtn-TrvPk Calc. Spacing: 2 days and 5% Drawdown of Avail. Head
PWS Well Data, low head, low gpm filtered
f(Q) = 0.12*Q + -8; Q > 25 gpm
Calculated Distance to Meet Drawdown Target (ft)
Well Capacity (gpm)
0
1000
2000
3000
4000
5000
6000
0
50
100
150
200

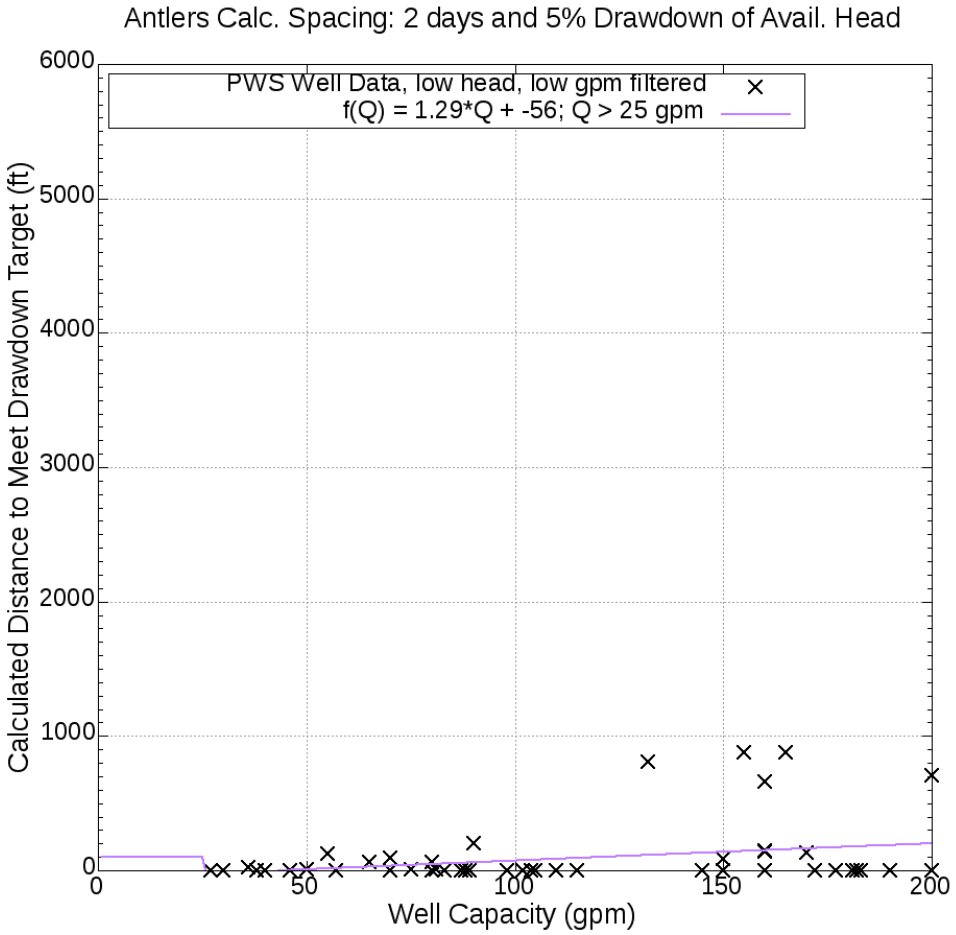
TM/TP: 5 day


TwMtn-TrvPk Calc. Spacing: 5 days and 2% Drawdown of Avail. Head
PWS Well Data, low head, low gpm filtered
f(Q) = 4.31*Q + -170; Q > 25 gpm
Calculated Distance to Meet Drawdown Target (ft)
Well Capacity (gpm)
0
1000
2000
3000
4000
5000
6000
0
50
100
150
200

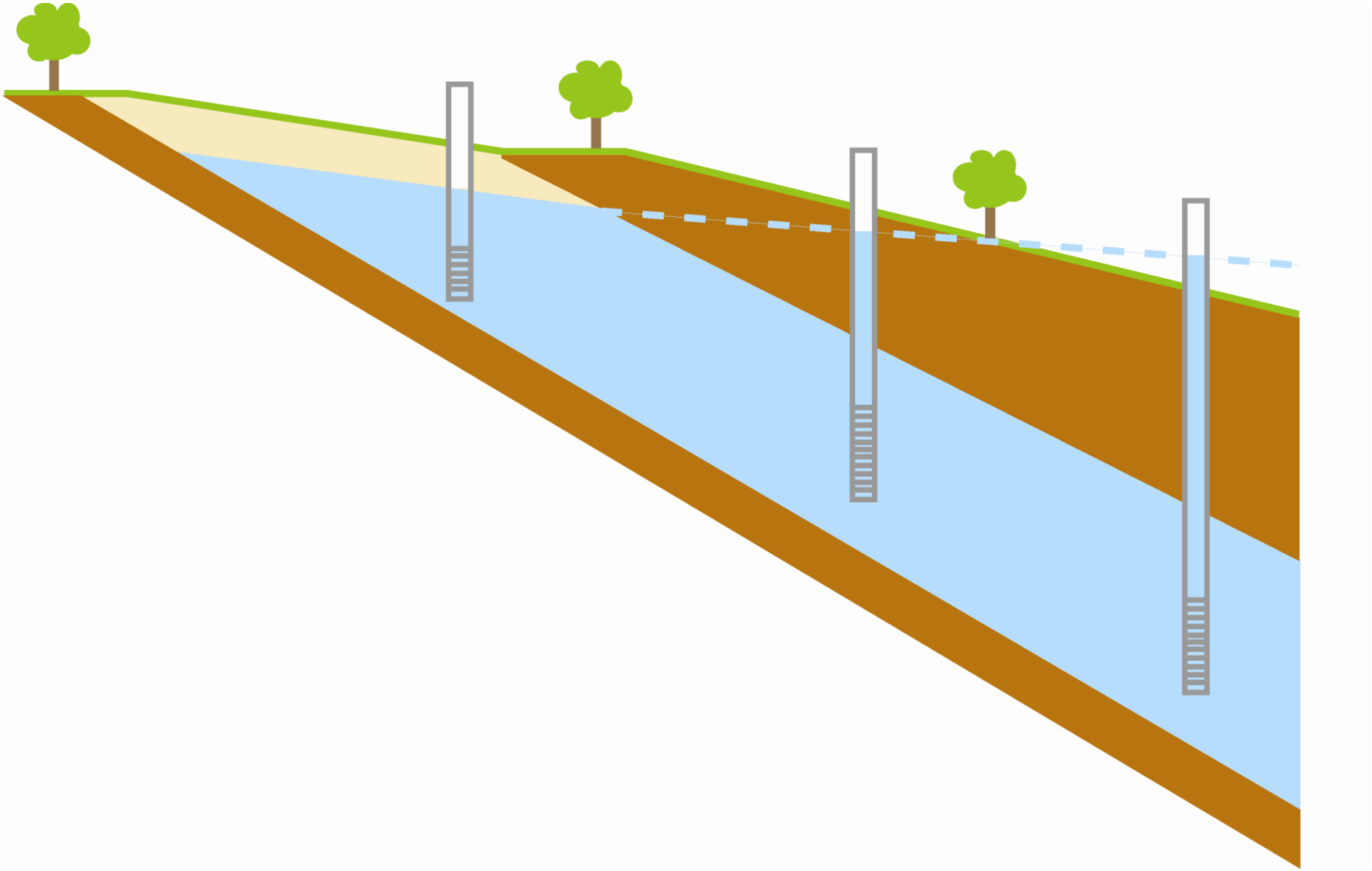

TwMtn-TrvPk Calc. Spacing: 5 days and 5% Drawdown of Avail. Head
PWS Well Data, low head, low gpm filtered
f(Q) = 0.19*Q + -12; Q > 25 gpm
Calculated Distance to Meet Drawdown Target (ft)
Well Capacity (gpm)
0
1000
2000
3000
4000
5000
6000
0
50
100
150
200

Antlers: 2 day

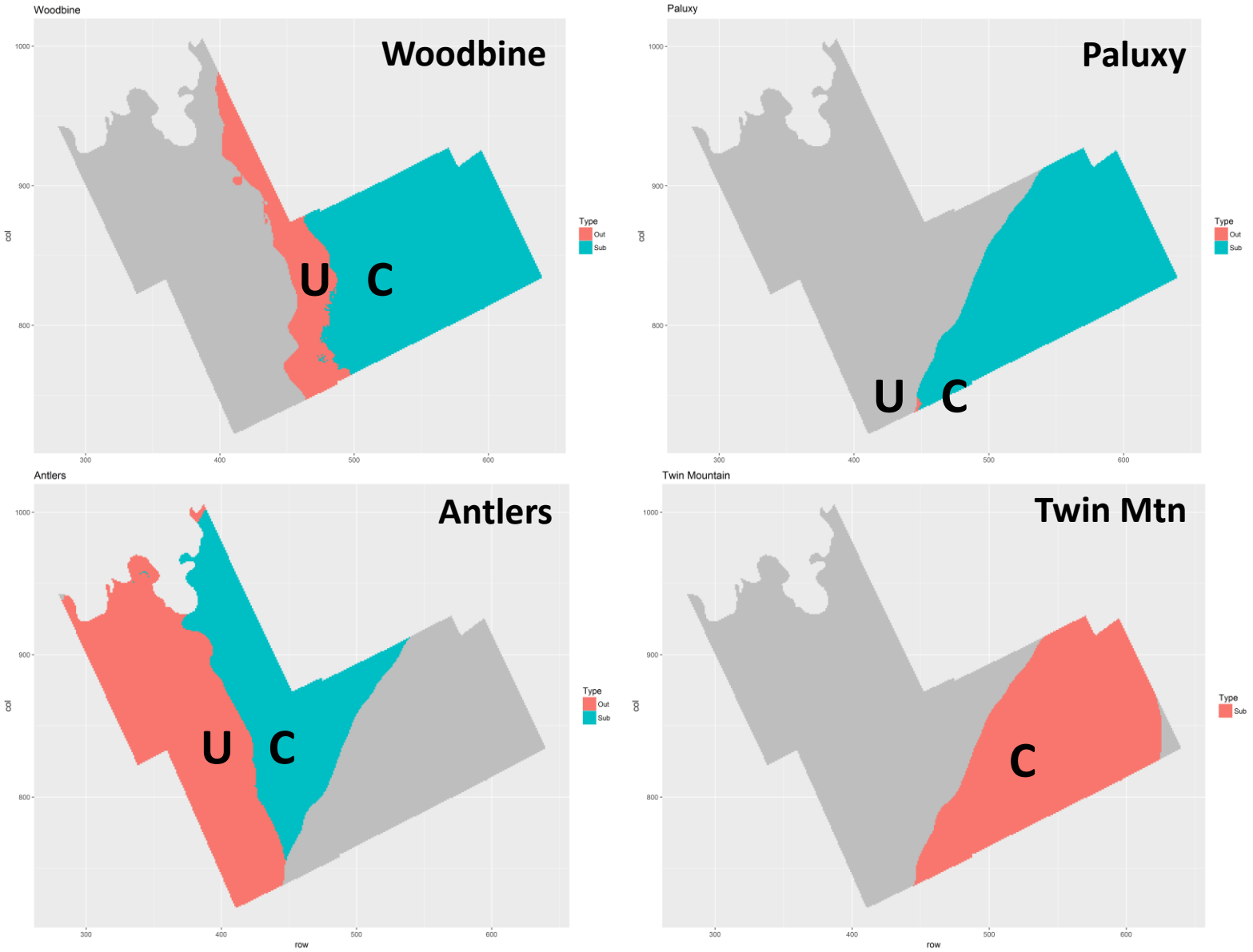




same aquifer: **unconfined and confined**



Unconfined / Confined



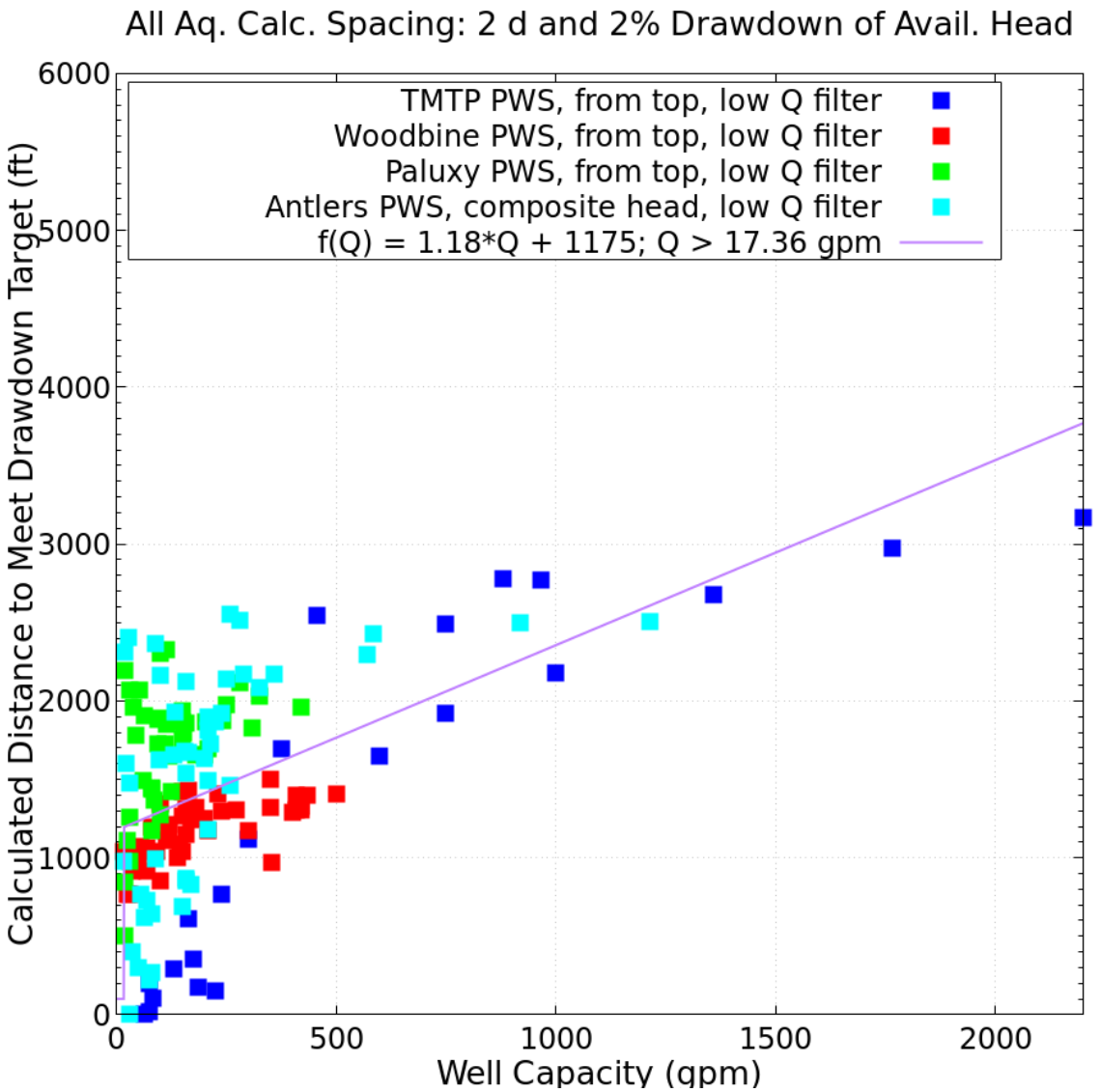
Unconfined Spacing

- **Issues to consider**
  - Some areas that are unconfined respond relatively quickly to recharge from precipitation
  - If there are areas of small saturated thickness and high demand, it may take some time to recharge to replace drained groundwater
  - Therefore, spacing rules may want to consider a policy that increases spacing requirements (above that needed to meet confined zone spacing criteria) to protect long-term well capacity in these areas

Observations/Discussion

- **Tiered approach is practical**
- **It is reasonable to develop rules for confined and unconfined**
- **For Tier 2**
  - Confined : one rule for all aquifers is reasonable
  - Unconfined: consider spacing as protection for production
- **Thoughts behind setting rule**
  - Depicted in red and purple lines in previous slides

All Aquifers - 2 Days Pumping, 2% Allowable Drawdown from Top of Aquifer, Non-Exempt Wells, Exempt Cutoff 17.36 gpm



Current Rule

Minimum Spacing Requirements for All New Wells in the District
Applies to all aquifers

Maximum Capacity of Well	Spacing from Property Line	Spacing from Existing Wells Completed in the Same Aquifer (in feet)
17.36 gpm or less	50 feet	100 feet
Greater than 17.36 gpm	50 feet	1,175 feet + [1.2 x (gpm of proposed well)]

Potential Next Steps

- **Update well information for analysis?**
- **Review**
- **Consider changes**

Recommended deletion from Hydrogeologic Report Guidelines

E. Desired Future Condition (DFC) and Modeled Available Groundwater (MAG) Analysis

1. Discussion of the proposed pumping amount in relation to the MAG, as well as the impact of the proposed pumping on the adopted DFC.