# Tolk Water Situation

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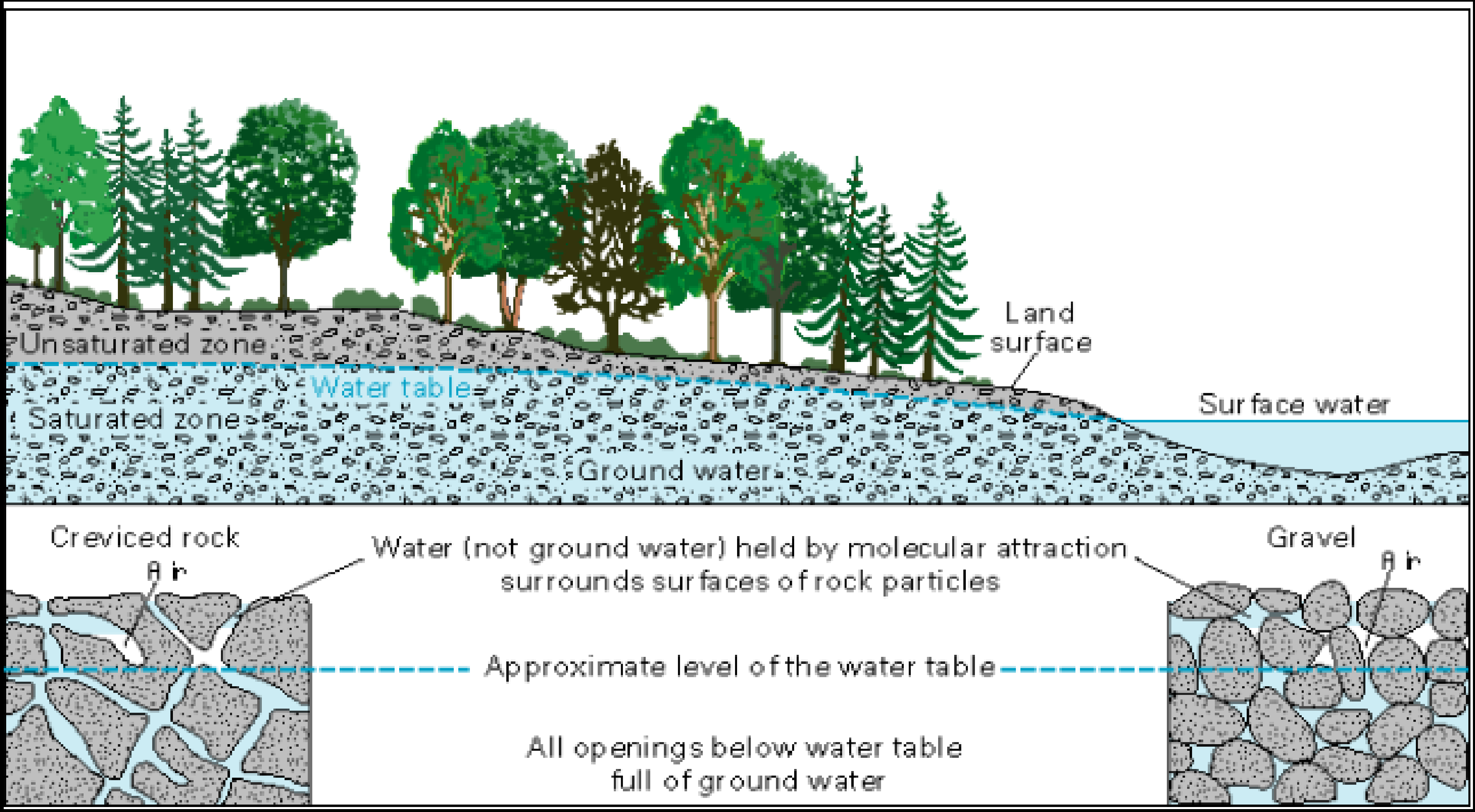
# What is an aquifer?

- Below a certain depth, the ground, if it is permeable enough to hold water, is saturated with water
- The upper surface of this zone of saturation is called the water table
- The saturated zone beneath the water table containing sediment and rock is called an aquifer, and aquifers are huge storehouses for water
- Wells can be drilled into the aquifers and water can be pumped out
- Precipitation eventually can add water (recharge) into the porous rock of the aquifer if the surface area is adaptive.

# Diagram of an Aquifer



# What is Saturated Thickness?

- Saturated thickness is the volume of the aquifer in which the pore spaces are completely filled (saturated) with water.

- For an unconfined aquifer like the Ogallala, the saturated thickness is the distance from the water table surface to the base of the aquifer

- It is the thickness that supplies water to wells. As water levels decline, so does the saturated thickness

# Regional Overview

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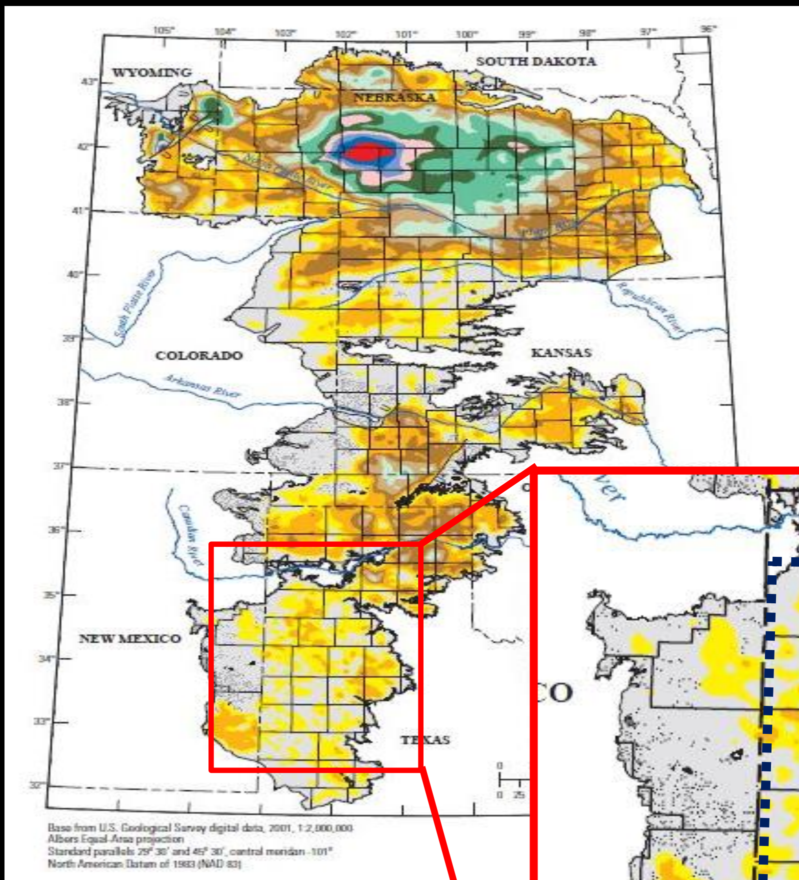
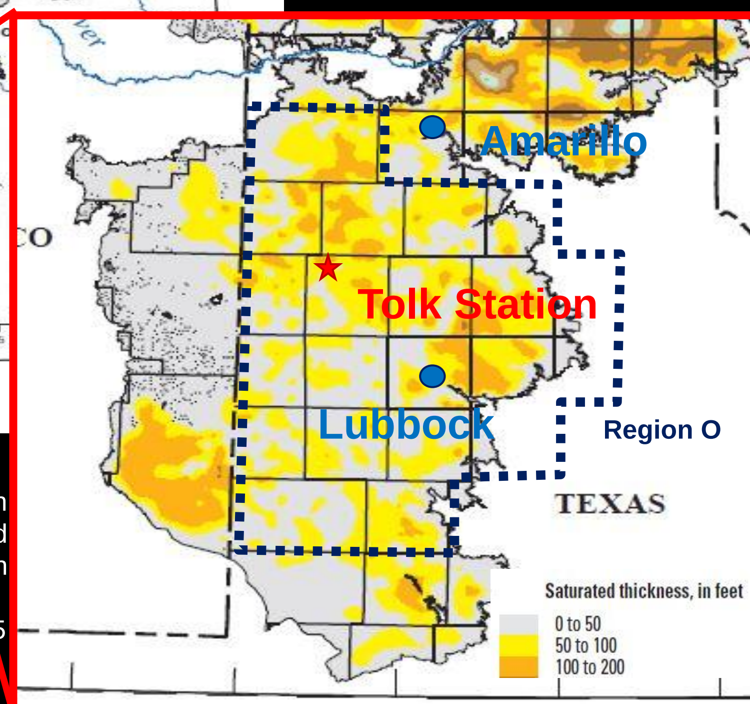


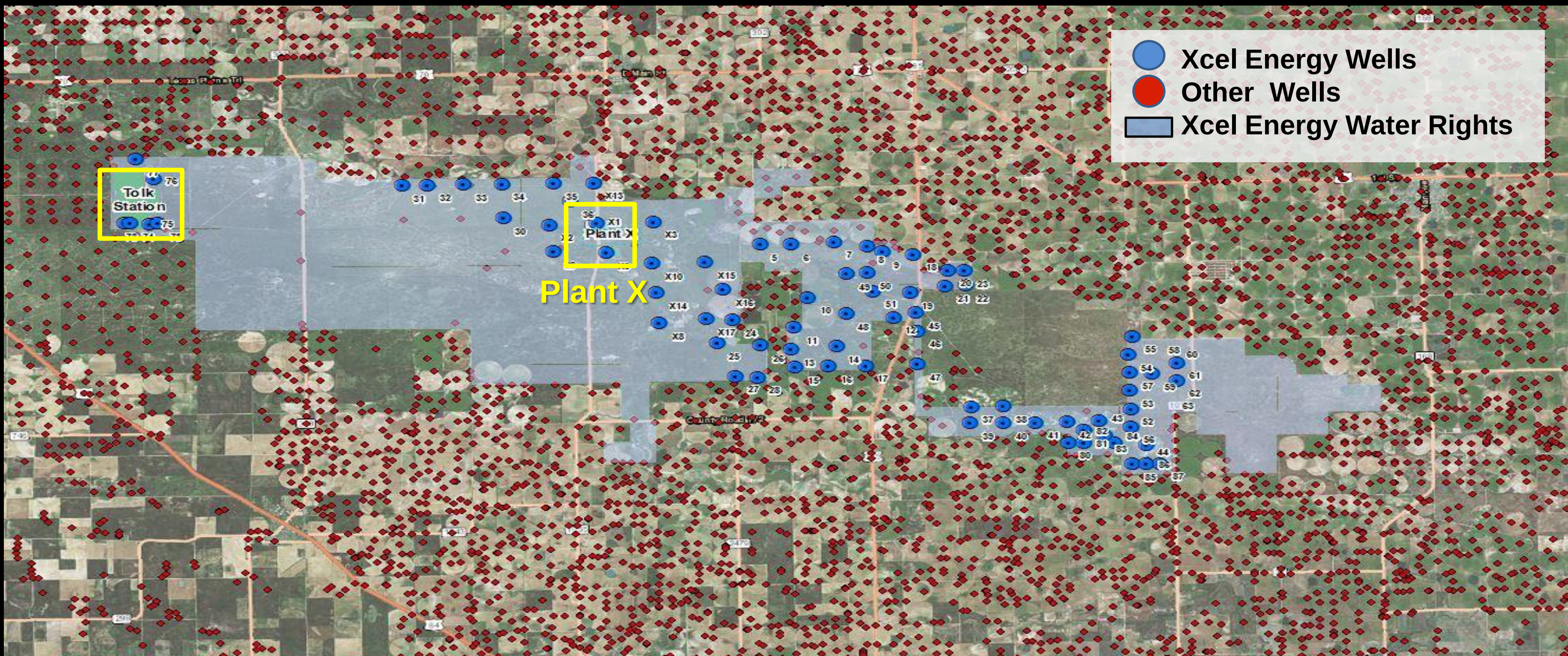

McGuire, V.L., Lund, K.D., and Densmore, B.K., 2012, Saturated thickness and water in storage in the High Plains aquifer, 2009, and water-level changes and changes in water in storage in the High Plains aquifer, 1980 to 1995, 1995 to 2000, 2000 to 2005, and 2005 to 2009: U.S. Geological Survey Scientific Investigations Report 2012–5177, 28 p.




- **In Lamb Co. (HPWD, 2016)**
  - **~50-foot avg saturated thickness**
  - **~16-foot avg saturated thickness decline since 2006**
- **At ~40-foot saturated thickness, high-capacity well production collapses**

- **TWDB Region O Plan**
  - **Annual 2.9M acre-foot supply deficit by 2020**
- **High Plains Water District**
  - **No strict water production limit and no required usage metering for agricultural water users**

# Competition for Water




- 90+% of regional water usage for agriculture
- 50K acre wellfield with ~80 wells (Approximately 32 miles to furthest well)
- Both declining wellfield volume & wellfield peak productivity concerns
- Lack of agricultural water use measurement = forecast uncertainty

# Operational Issues

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## Tolk aquifer depletion - 2 issues

### Issue 1 - Aquifer longevity

**When will the plant run out of water?**

- Tolk & X generation
- Aquifer storage
- Aquifer geology
- Water use by others

### Issue 2 - Peak production

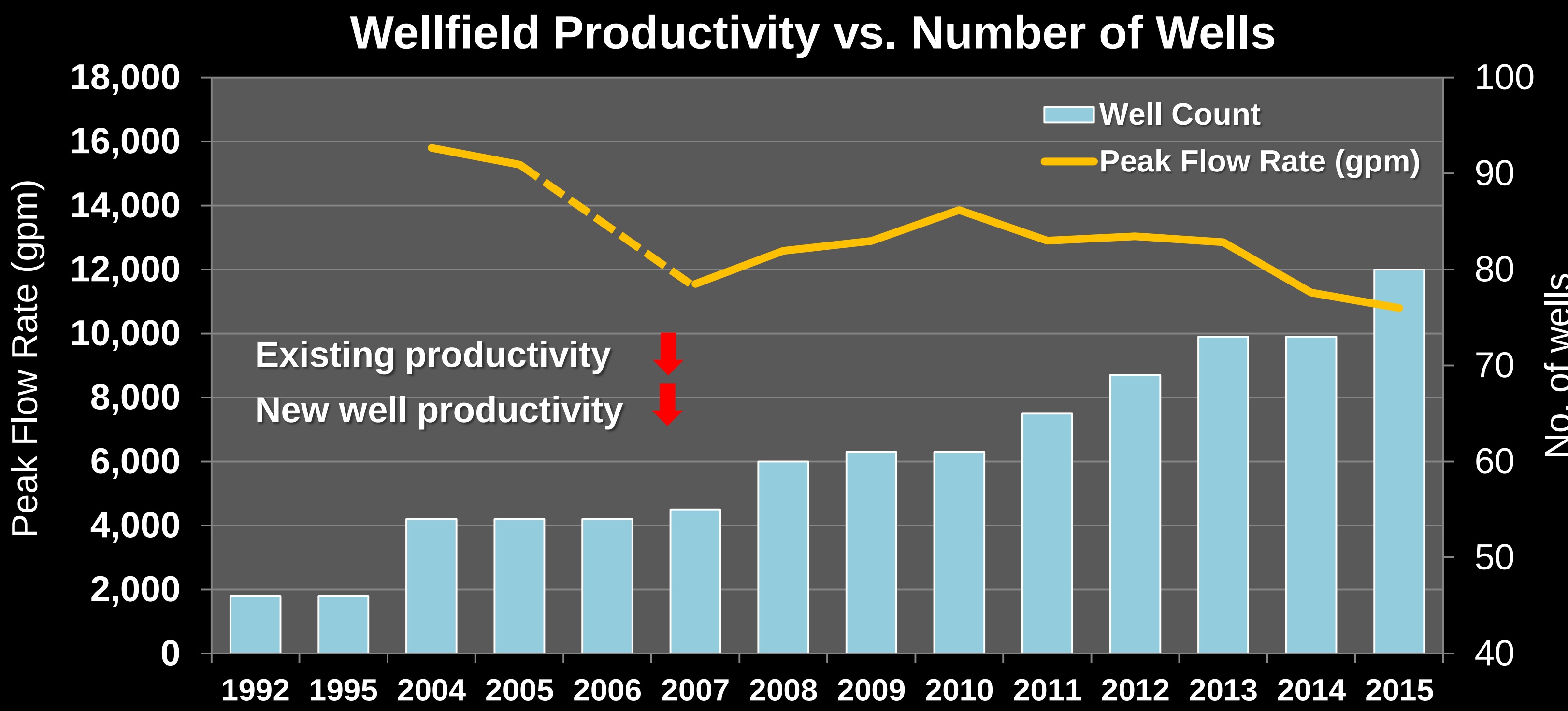
**Can we get the water we need to run the plant?**

- Tolk & X generation
- Wellfield capacity
- Other plant operations
- Water conveyance
- Production decline

## Water balance spreadsheet

- **Quickly evaluate changes/interactions between both issues**
- **Changes in capacity factor/retirement date for subsequent charts**

# Plant Wellfield Decline




- August 2016 – Tolk/Plant X water supply issues (recovery during short outage)
- Annual groundwater modeling – LBG-Guyton Associates
- Bi-annual total system supply testing

# Well Development Approaches

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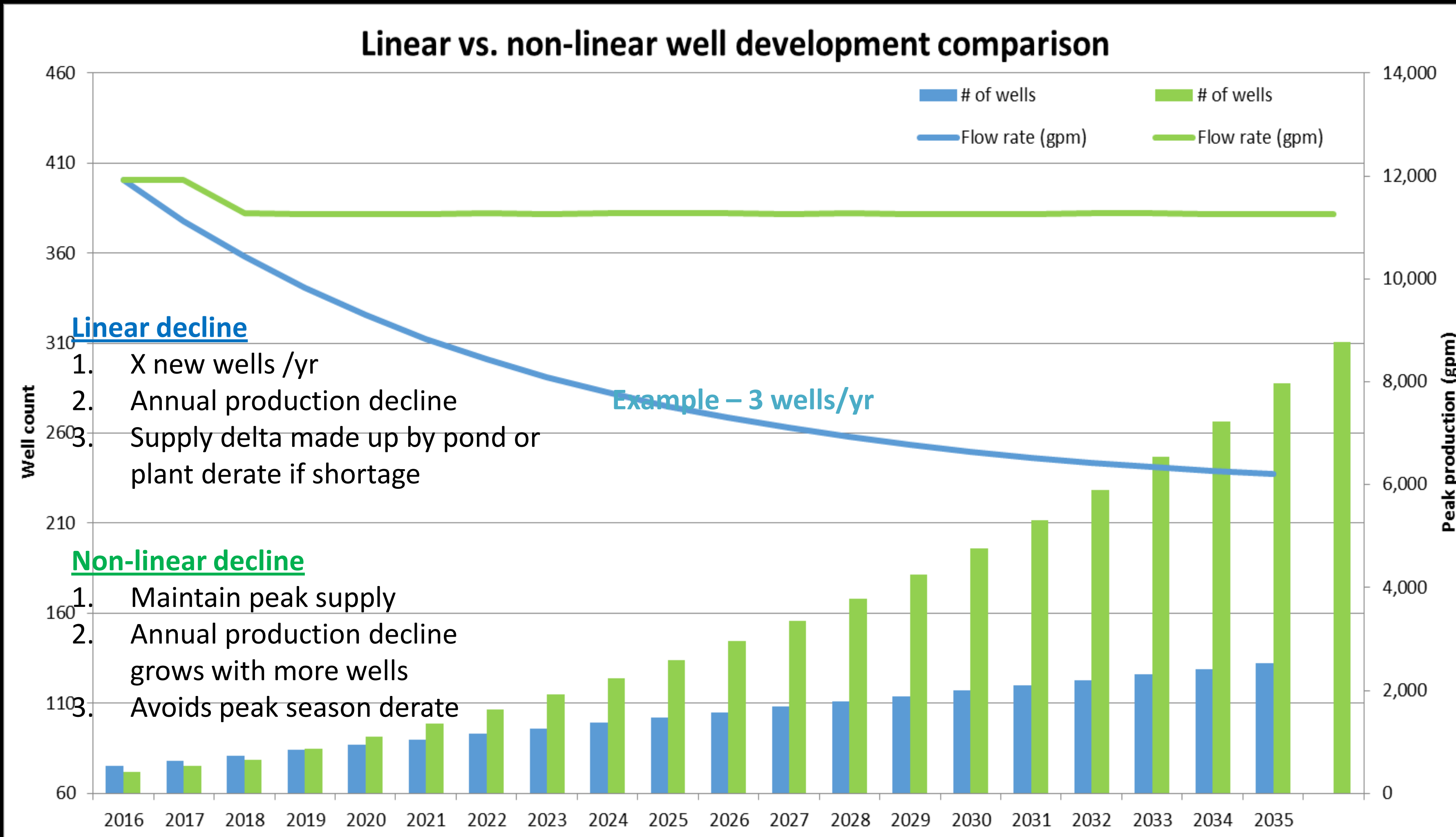

# Future Projections

Adequate water supply
Concerns, may have peak production challenges
Water supply nearly exhausted, peak and annual production challenges

**Tolk/X Wellfield - Long-term water supply alternatives**

| Alternative ID | WR Cost Est. ($M) | Dev Cost Est. ($M) | Total Cost ($M) | Cumulative Cost ($M) | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Current* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |
| + future phase 4 (~5,000 acres) | 17.50 | 12.50 | 30.00 | 89.72 | | | | | | | | | | | | | | | | | | | | | |
| + future phase 5 (~5,000 acres) | 17.50 | 12.50 | 30.00 | 119.72 | | | | | | | | | | | | | | | | | | | | | |
| + future phase 6 (~5,000 acres) | 17.50 | 12.50 | 30.00 | 149.72 | | | | | | | | | | | | | | | | | | | | | |
| *Lubbock pipeline (2019 in-service)* | - | 192.00 | 192.00 | 192.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 ac) | 8.34 | 6.50 | 14.84 | 206.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 ac) | 8.58 | 5.60 | 14.18 | 221.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (2,690 ac) | 9.10 | 12.50 | 21.60 | 242.62 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 1 (U1 2020; U2 2022)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 3 (U1 2024; U2 2028)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 9.10 | 12.50 | 21.60 | 50.62 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 4 (U1 & U2 2028)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 5 (2018 derate; U1 2023; U2 2025)* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 6a (2018 derate to 47%)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |
| *Scenario 6b (2020 derate to 47%)* | - | | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | |
| + Northern Agriculture II (2,390 acres) | 8.34 | 6.50 | 14.84 | 14.84 | | | | | | | | | | | | | | | | | | | | | |
| + Barrett East (2,450 acres) | 8.58 | 5.60 | 14.18 | 29.02 | | | | | | | | | | | | | | | | | | | | | |
| + Smith, et al. (5,190 acres) | 18.20 | 12.50 | 30.70 | 59.72 | | | | | | | | | | | | | | | | | | | | | |

- Dynamic operational model created to monitor / predict life remaining of well field
- TWDB and consults confirm that aquifer is dropping with serious future consequence

# Mitigation Alternatives Considered

| Alternatives | Cost |
| --- | --- |
| Hybrid cooling tower retrofit | $200M+ & technology risk |
| | |
| Wastewater effluent pipeline | ~$200M |
| Ongoing water right acquisition & wellfield expansion (acquisition challenges due to reluctance to sell farm businesses) | Price is uncertain |
| Horizontal well development | ~$3M |
| Reduced Tolk/Plant X generation | Currently being studied |

# Ongoing Activities

- Wellfield Saturation Thickness and Production Monitoring
- Plant Process Review for Water Conservation/ Production Optimization
- Groundwater Model Update (Internal and External)

# Questions and Discussion

# IRP Information

- Web Page:

https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/sps_2019-2038_integrated_resource_plan

*Note: After navigating to the webpage, in the upper left-hand corner of the page, make sure that "New Mexico" is selected. Click on Public Advisory Meeting then click on the link for the second meeting.*

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  - Phone: Ashley (303) 571-2813 and Ben (303) 571-6705
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# Topics For Future Meetings

- Environmental Update
- Aging Generation Fleet
- Gas & Power Markets
- Coal Supply
- Demand-side Management and Energy Efficiency
- Storage

# Next Meeting

- **Date:**
  - **Tuesday, January 30, 2018**
- **Time:**
  - **10:00am to 12:00pm (Mountain Time)**
- **Location:**
  - **Webinar meeting**

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