Anti-Collision Best Practices Developed for Horizontal Drilling Across Pre-existing Horizontal Wellbores

Erin Britton & Rachel Grande

Speaker Information

Erin Britton, Sr. Drilling Engineer
Petroleum engineer with over 9 years energy industry experience specializing in drilling engineering with a focus in project management. Holds a B.S. in Petroleum Engineering from the University of Oklahoma and a Masters of Energy Business from the University of Tulsa. Experience across multiple basins & plays including extended reach and multilateral drilling projects.

Rachel Grande, Sr. Geologist
Geologist with over 9 years energy industry experience specializing in operational geology and field development. Holds a B.S. in Geological Sciences from Ball State University. Experience in multiple basins & plays including Bakken, Powder River, and Eagle Ford.

Anti-Collision Best Practices
presented by Erin Britton and
Rachel Grande

Overview

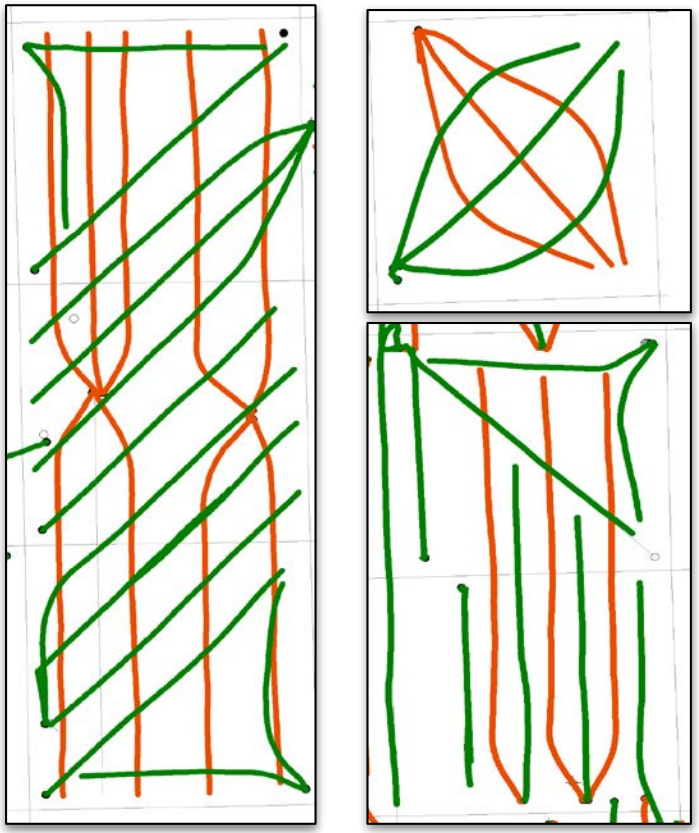
- Current Anti-Collision Practices
- Williston Basin Overview
- Geologic Considerations and Planning
- Risk Management
- Drilling Considerations
- Stoplight Method
- Case Studies
- Conclusion

Anti-Collision
Industry View

Standard view errs towards avoidance mentality:

- Total Avoidance
- Azm. Avoidance

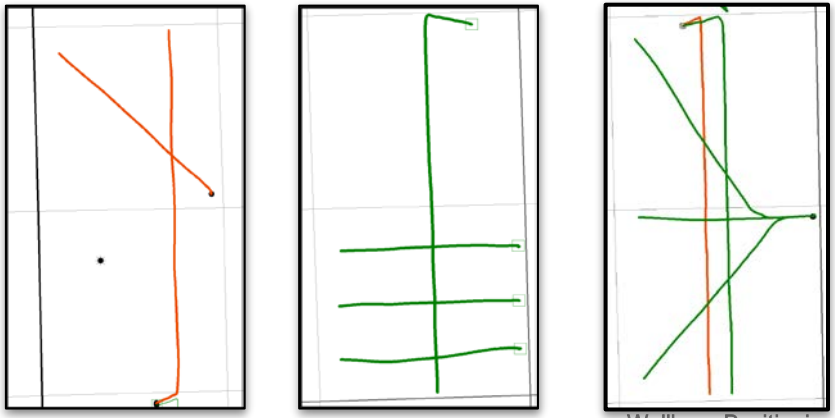
Limited support and documentation for alternative processes when avoidance is not an option.

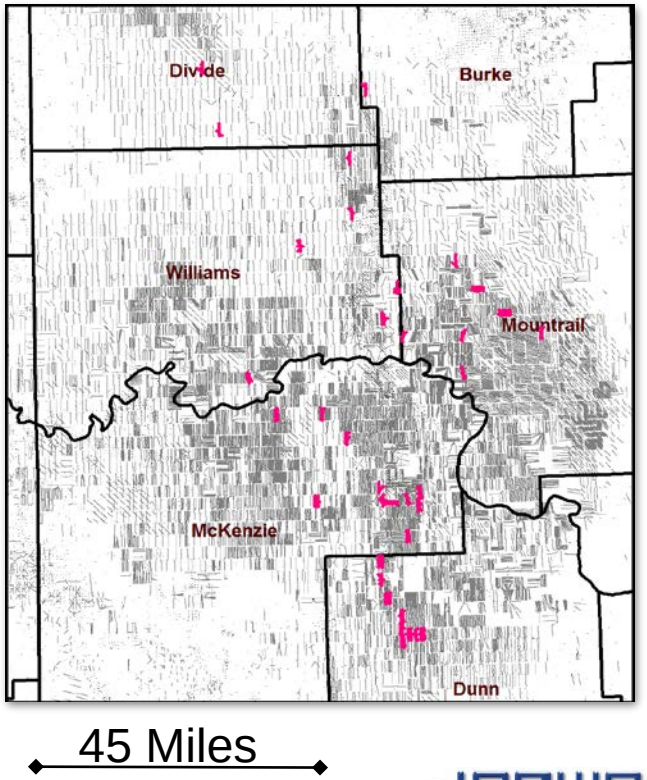


Anti-Collision Case Study

Williston Basin
- 13,000 vertical wells,
- 15,000 horizontal wells,
- 1,000 re-entry/directional wells.

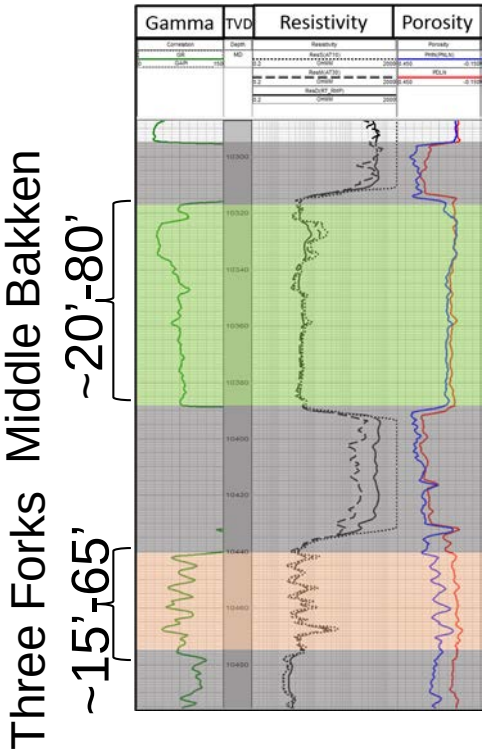
Developed for horizontal drilling across pre-existing horizontal wellbores in the Williston Basin.
- Drilled as close as 10 feet wellbore - wellbore





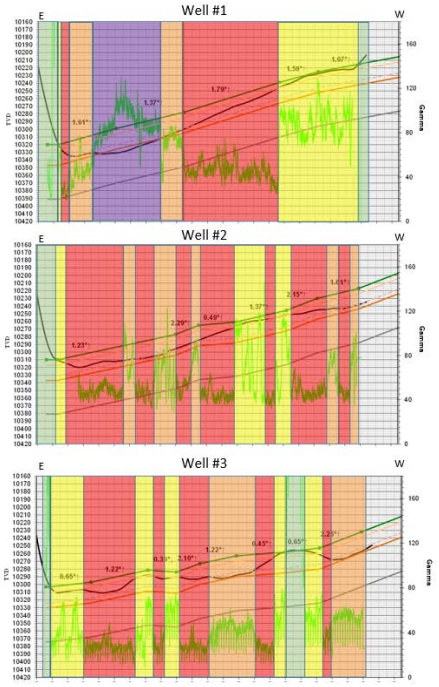
Geologic Considerations
Anti-Collision Program Constraints

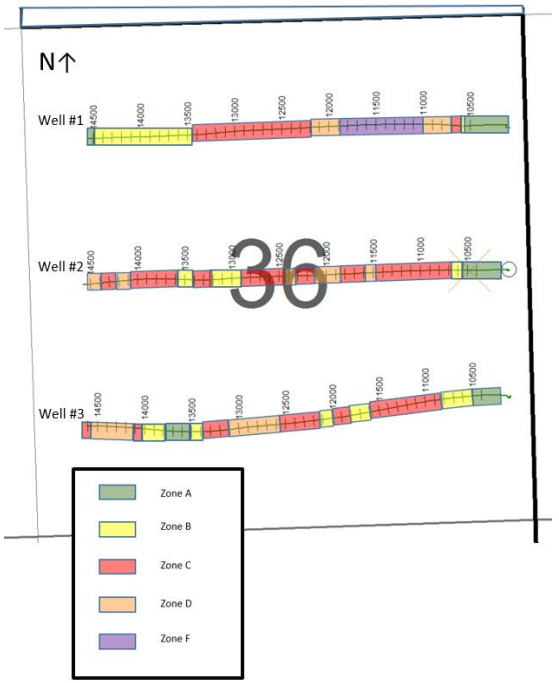
- Laterally Continuous Formation
- Well Control
- Quality Data
- Clear Steering Markers
  - Gamma
  - Resistivity



Geologic Planning
Anti-Collision Methodology

- Reinterpretation
  - * Profiles
  - * Structure
- Organization of Stratigraphic position
- Wellbore Placement
- Target Selection





Drilling Considerations
Risk Management Program

Potential Risks

- Impact vs. Probability

Common Indicators

- Operational Parameters
- Geologic
- Directional/Survey
  - Survey Error
  - Ellipse of Uncertainty

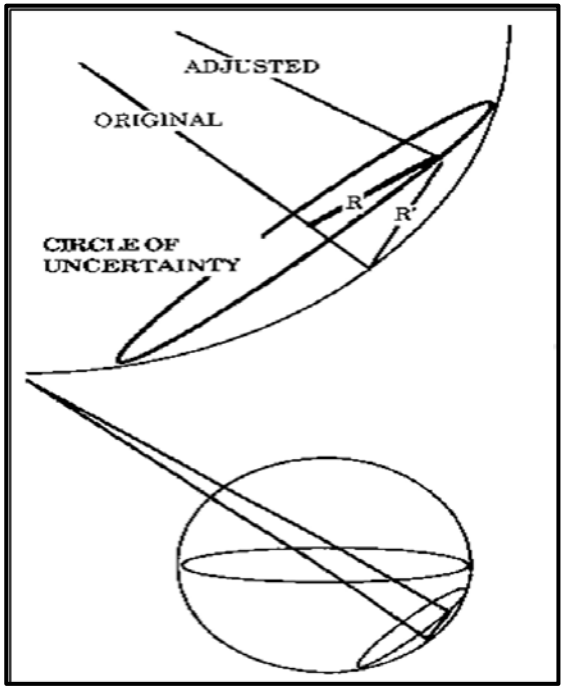
Risk Matrix

Likelihood \ Impact	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Drilling Uncertainty
Ellipsoids of Uncertainty

Major Concern Affecting Anti-Collision Planning

- Survey Error: MWD Error and interference concerns.
  - Azimuth Uncertainty
  - Inclination Uncertainty
  - Surface Location Uncertainty
- Ellipse of Uncertainty: Expanding ellipse from surface onwards.



Netwas Group Oil, 2017

Mitigating Risk & Accounting for Error
Risk Management Meets Geology

Ability to simplify risk with the combination of drilling & geologic considerations.

- Expected Structure
- Apparent Dip
- Distinct Stratigraphic Markers

} Confirmation of “Y” or TVD direction

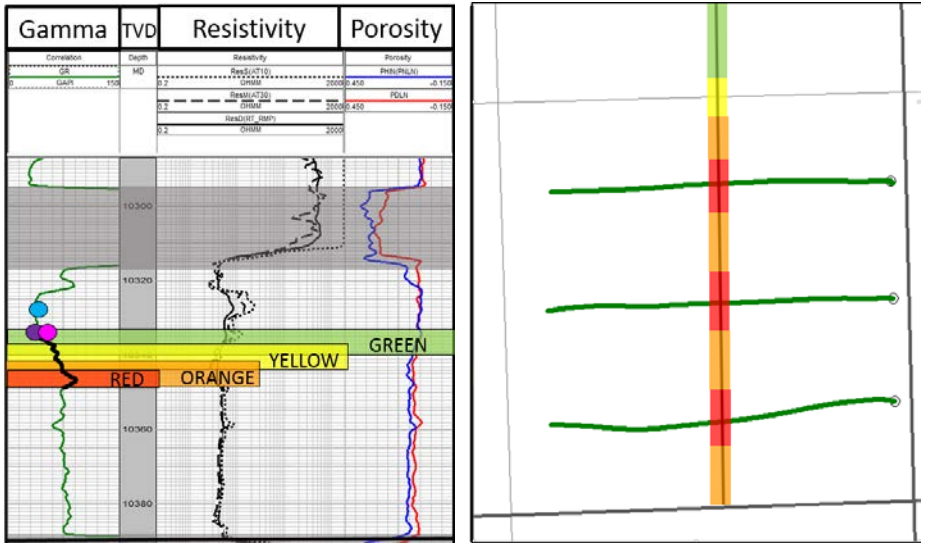
Ellipse of uncertainty becomes plane of uncertainty with no expansion in the Y direction.

Stoplight Method
A Disciplined Approach

Multidisciplinary approach using:

- Geologic Considerations
- Operations Best Practices
- Risk Management

Geologic overlapping target windows by color zone implemented across the planned wellbore based on the risk management plan considerations.



Existing Wellbore Stratigraphic Placement

- Red : High Risk
- Orange: Med. Risk
- Yellow: Low Risk
- Green: No Risk

Stoplight Method
Risk Parameters

Red: High Risk

- Controlled Operations & “high alert” communication
- Precise Steering target required

Orange: Medium Risk

- Controlled operations and heighted communication procedures
- Overlap zone for steering adjustments

Yellow: Low Risk

- Standard operations & communication procedures
- Begin steering considerations

Green: No/Low Risk

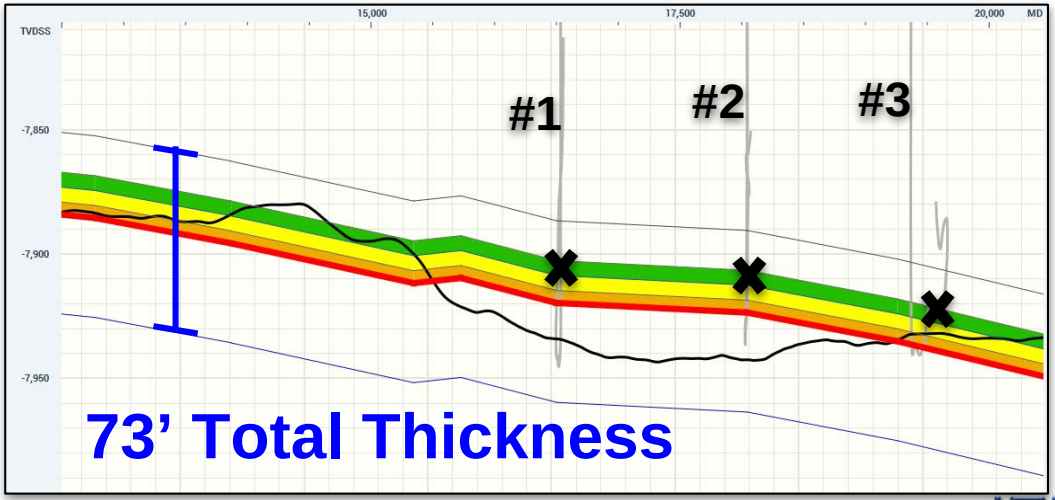
Case Study A
Stoplight Method

Drilled 32’ above existing wellbore.

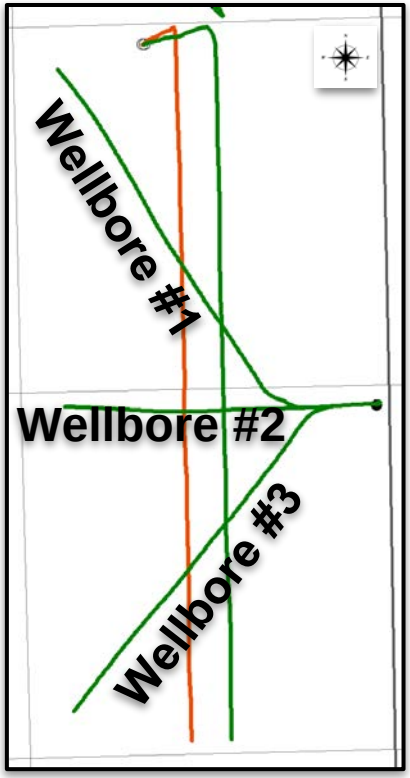
Case Study B
Stoplight Method

Drilled across 3 existing laterals.

- Drilled 26’ below wellbore #1.
- Drilled 34’ below wellbore #2.
- Drilled 8’ below wellbore #3.

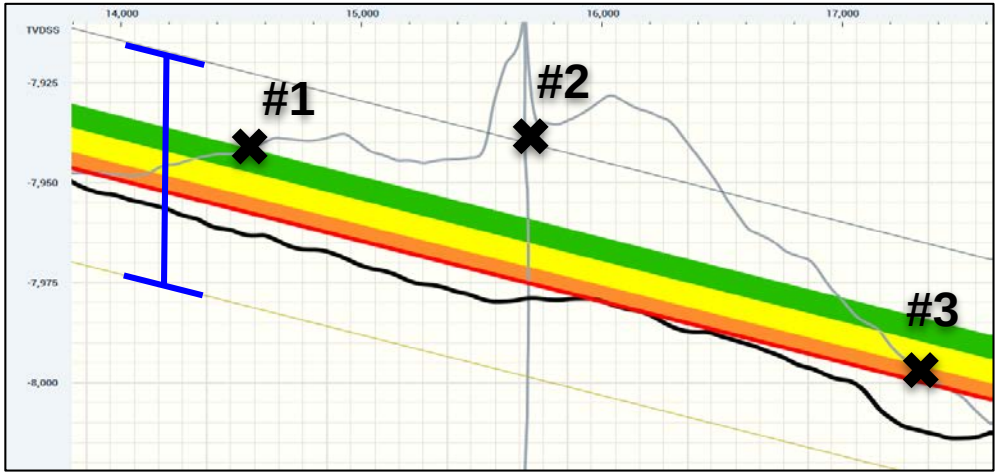


Case Study C
Stoplight Method



Drilled across 3 existing laterals.

- Drilled 20’ below wellbore #1.
- Drilled 36’ below wellbore #2.
- Drilled 15’ below wellbore #3.



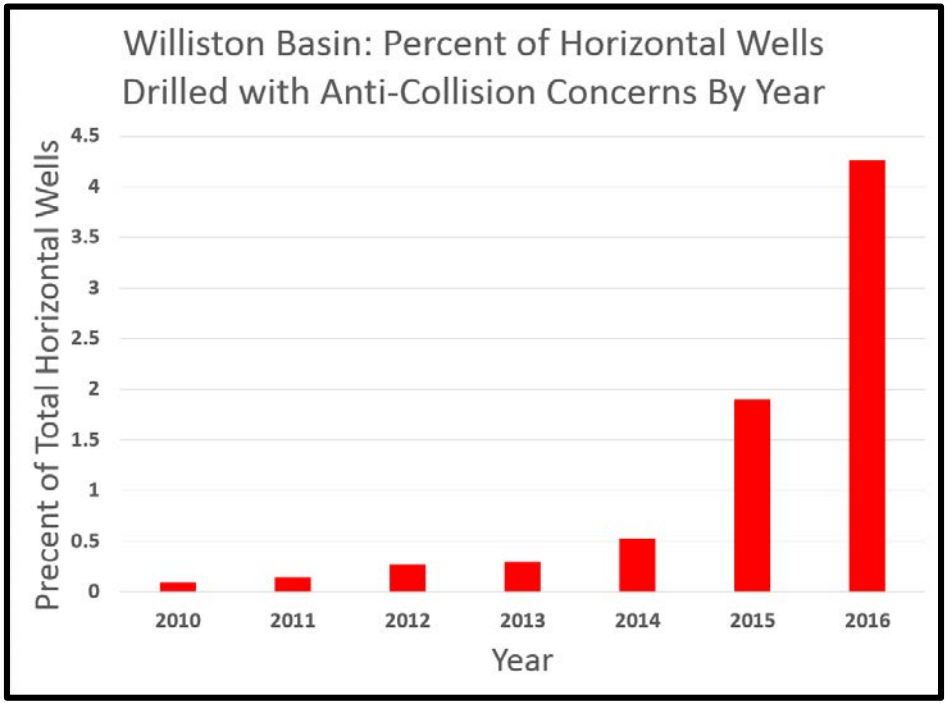
48’ Total Thickness

Anti-collision Moving Forward
Advancement in Practices

Mature Basin Development requires industry progression towards complex wellbore trajectories with significant collision concerns.

Williston Basin anti-collision wells historical percent:

- 2010 ~ < 0.1%
- 2016 ~ 4.25%



Conclusions
Industry Advancement

The progression towards increasingly complex wellbores requires Industry advancements in anti-collision practices and theories outside of avoidance mentality.

- Proactive approach to development for infill wells.
- Inclusive geological and engineering considerations.

The Stoplight Methodology simplifies complex multidisciplinary considerations including hazards and stringent operational requirements into easily recognizable plan.

Green = Go, Red = Stop

Thank You

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