Managing Bottom Hole Pressure in Unstable Reservoirs

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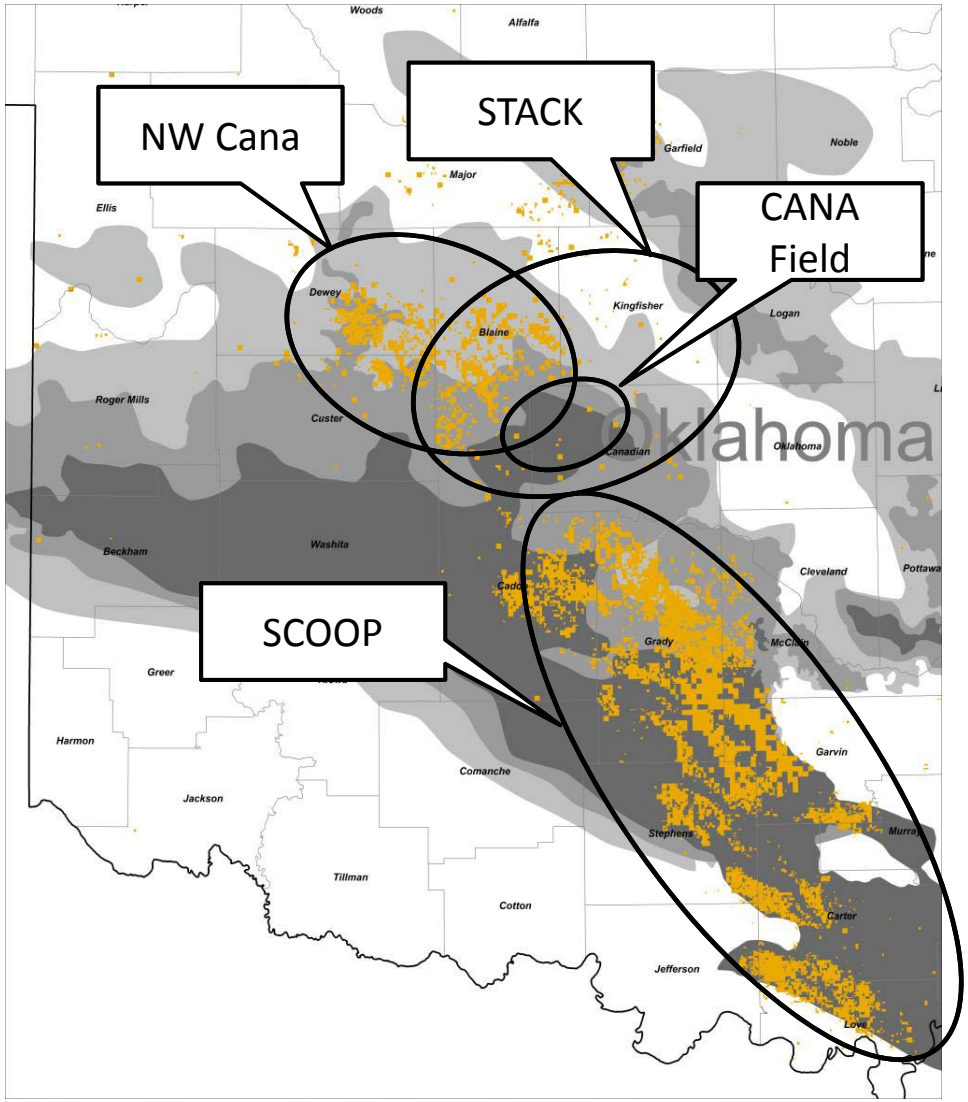
Continental RESOURCES

Agenda

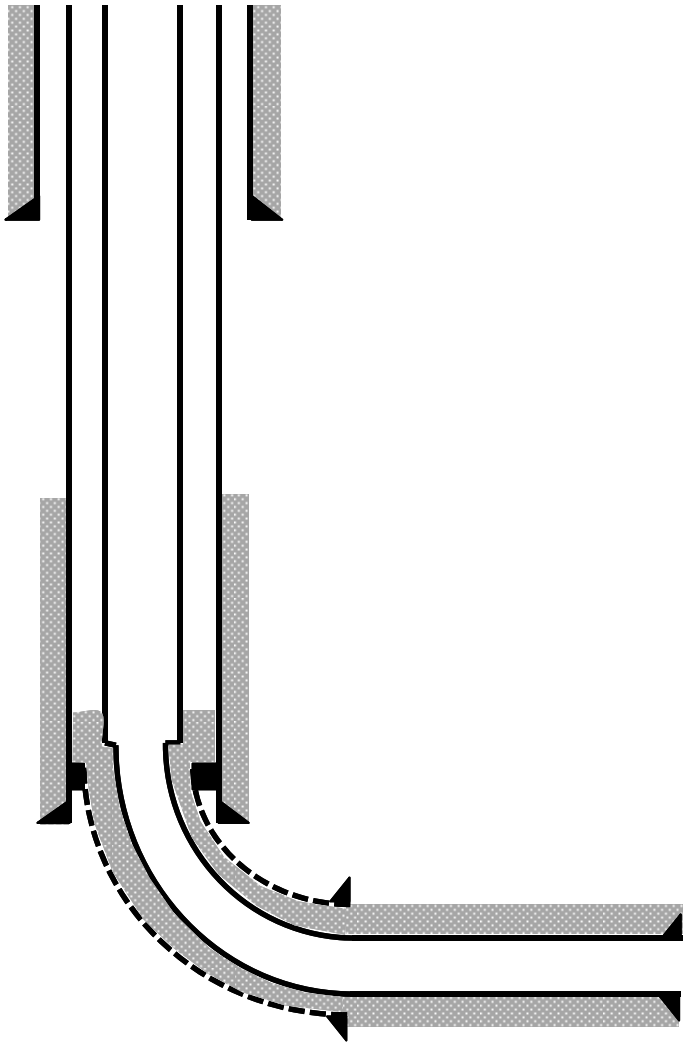
- SCOOP field overview
- Initial well design
  - 1st well summary
- Earth model results
- New well design – eliminated drilling liner
  - Planning
  - Execution
  - Conclusions

SCOOP Field Overview



- Woodford Shale
- Springer Shale
- 2015 Plans
  - 30% of CLR D&C budget
  - 16 Rigs

Initial Well Design



- 13-3/8” surface casing
- 9-5/8” intermediate casing
- 7-5/8” drilling liner (contingency)
  - Needed 7-5/8” for 5” production casing
- 5-1/2” production casing
  - 5-1/2” X 5” contingency
- Curve in 100% Shale
- KOP - 11,000’ – 13,000’ TVD

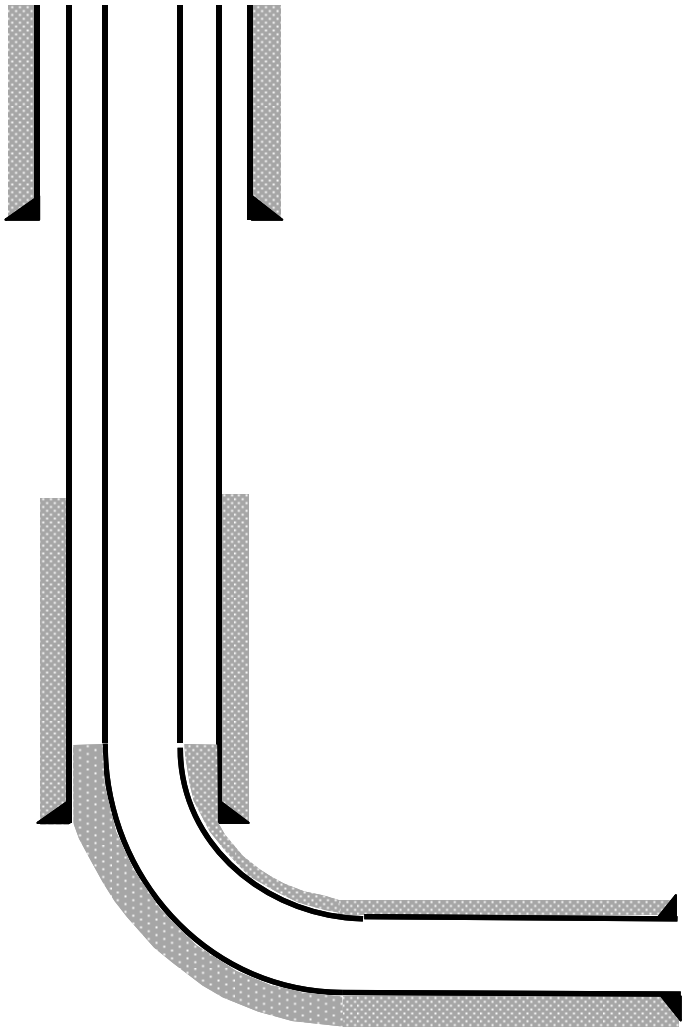
Initial Well

- Started Curve with ~11.1 ppg MW
- Hole unloading MW raised to 11.8
- Lost BHA in hole
- Sidetracked drilling curve with 13.0 – 14.4 ppg MW
  - Nearly lost 2nd BHA in hole
- Ran liner to hold curve back
- Cut MW to 13.4 while drilling lateral

Appraisal Wells Key Improvements

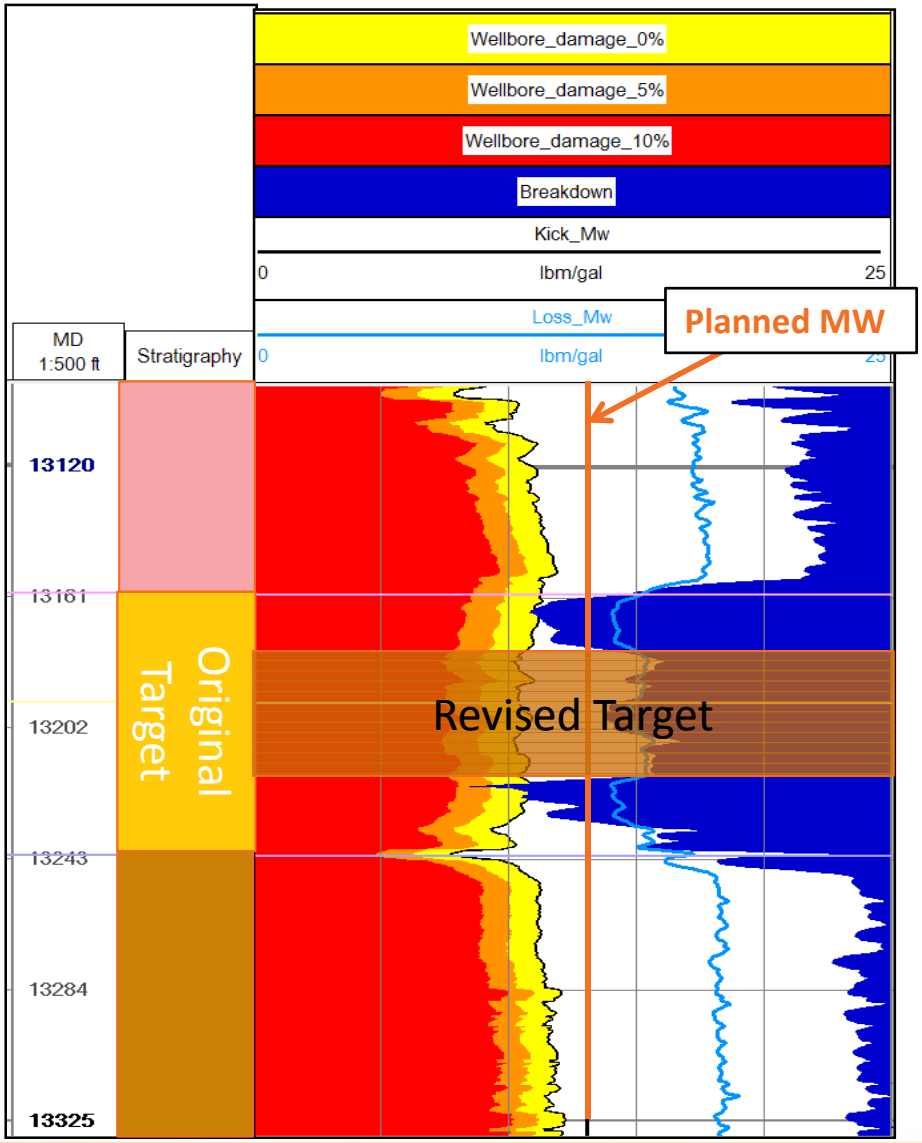
- Have mud properties at desired properties *prior* to starting curve
  - 300,000 PPM WPS
  - 13.8-14.2 ppg MW
- Drilling at a positive azimuth in curve (5-10 degrees) helped with stability/running liner
- 7-5/8" flush casing was difficult to get into curve (7 wells drilled with this design)
  - After stimulating first few wells, confirmed could downsize to 7" liner and 5-1/2" x 4-1/2" Production Casing
- Once liner was set, MW could be dropped to avoid losses in lateral
- Performed third party mechanical Earth Model from logs and offset reports

New well Design – Goal eliminate drilling liner



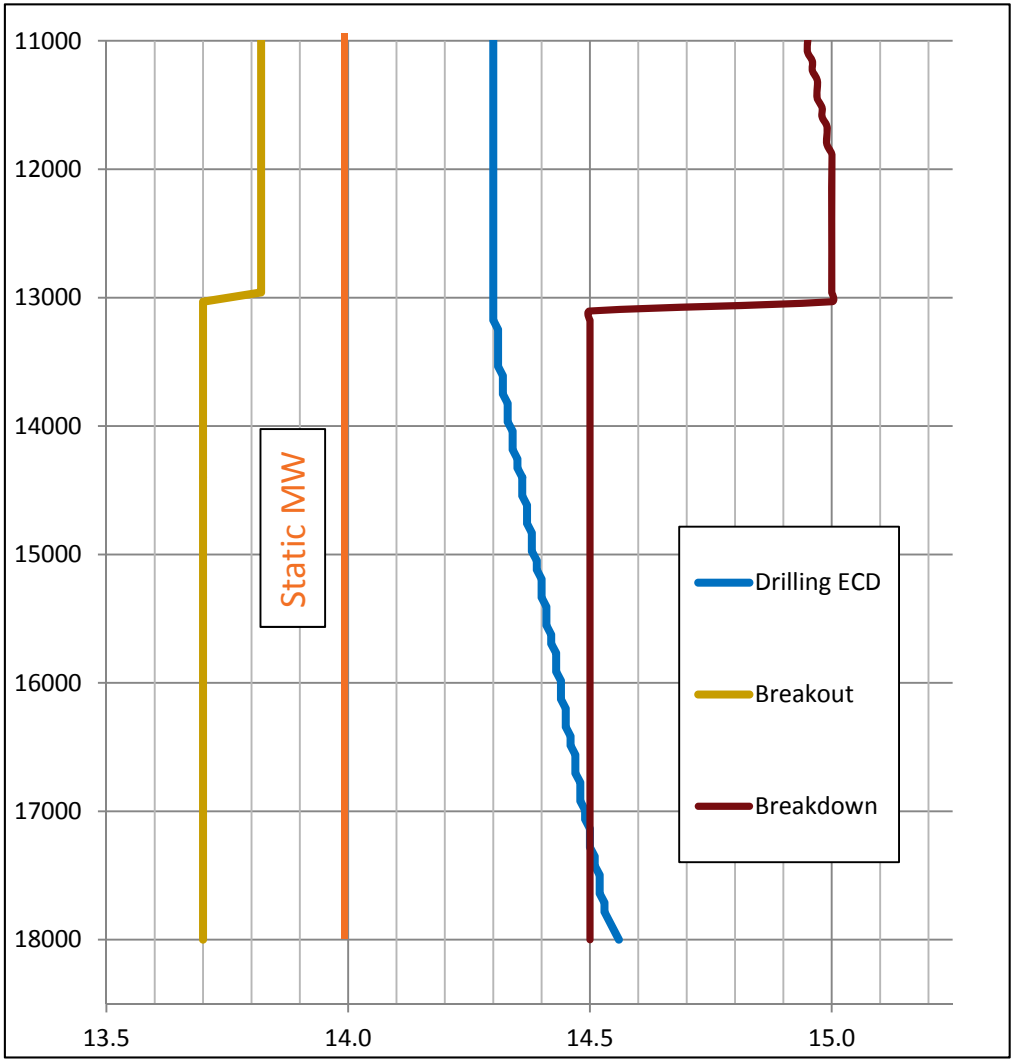
- 13-3/8” surface casing
- 9-5/8” intermediate casing
- 5-1/2” production casing
- Still have 7” contingency liner

Earth Model



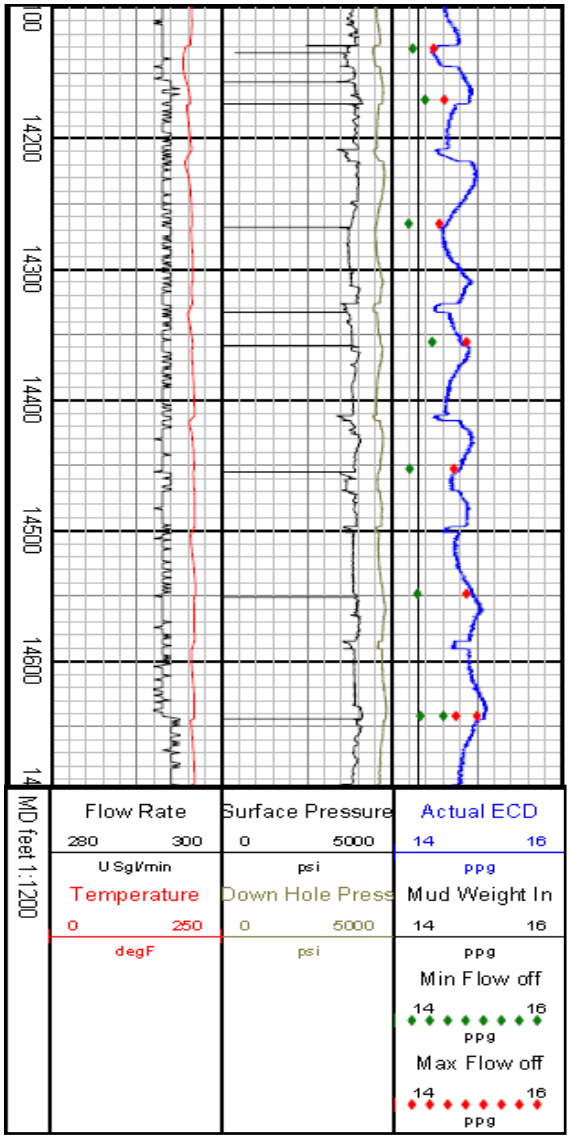
- Tight MW window in curve (60-70 degrees)
- Breakout threshold
- Breakdown < Loss vs. Loss < Breakdown

Planning - Hydraulics



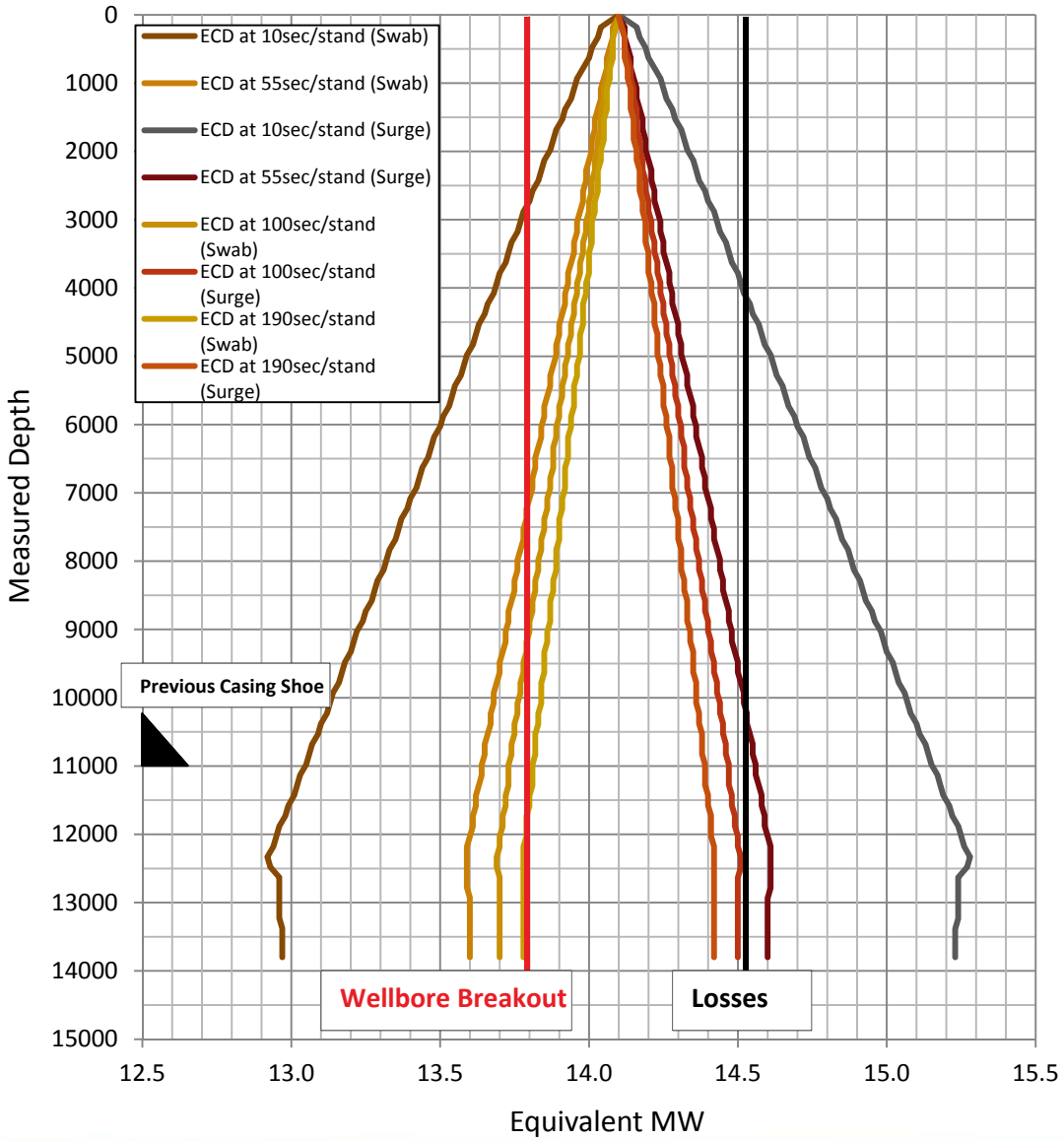
- Breakdown pressure in Lateral is less than Curve
- Drilling ECD near TD approaches breakdown pressures
- Mud weights often cut while drilling, then slowly raised for trips

Execution - Hydraulics



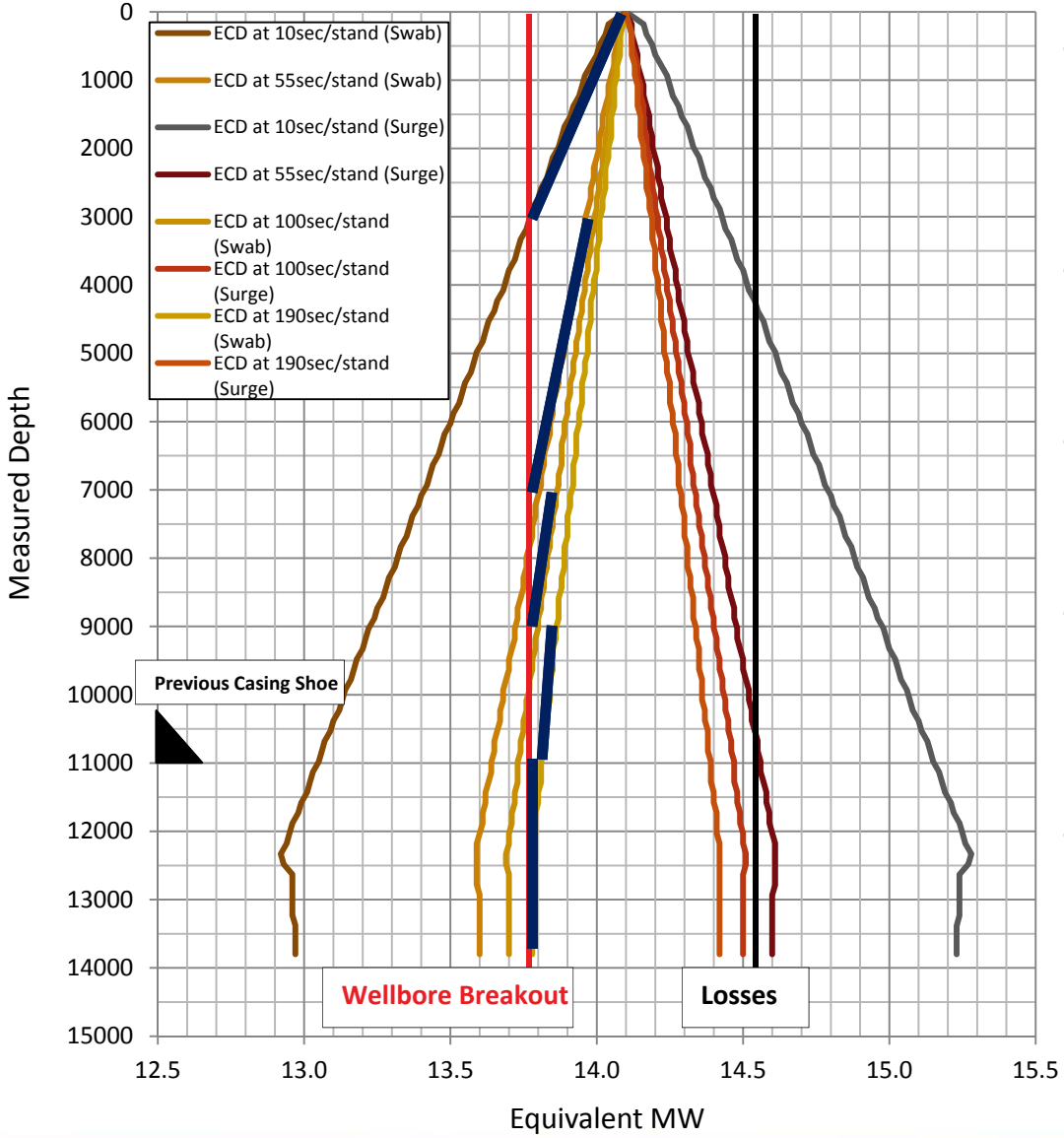
- Monitor ECD realtime – WITS into EDR
- Clean-up cycles based off ECD
- Validated modeling
  - Use most conservative model
    - Power Law
    - Herschel Buckley
    - Modified Herschel Buckley

Planning - Tripping



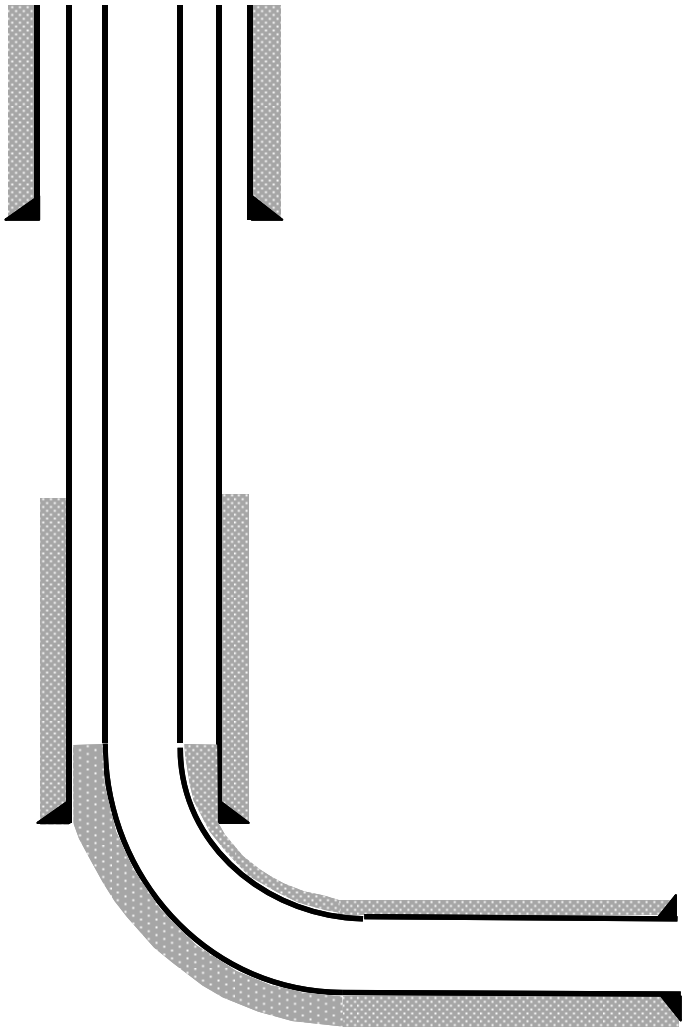
- With planned MW of 14.1 ppg bottomhole pressure should be able to be kept in manageable zone with proper practices
- Looking at ~65 degrees in Curve
- Maintaining a thinner low end rheology makes a large difference
  - 10% increase in 6 rpm can make .1-.15 ppge difference

Execution - Tripping



- Plans developed based of that days Mud report and sent to rig prior to trip
- Max Swab is normally planned <.3ppg
- Max surge is to not exceed modeled ECD in the curve
- Most modeling software does not model pumping out of the hole (net of ECD and swab)
- Example trip out plan:
  - Pump out to casing shoe
  - 30 fpm to 9,000'
  - 60 fpm to 7,000'
  - 100 fpm to 3,000'
  - 150 fpm to surface

New Well Design - Conclusions



- Same design as previous to 9-5/8” intermediate
- FIT 15-15.5 ppge
- Mud weights 13.8-14.5 depending on offset success
- Constant monitoring of PWD and cuttings returns is paramount
- Models revised throughout the well while drilling below KOP
- New design has been successful on 17 out of 19 wells attempted

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Questions?