THE Event For The Utility Infrastructure Industry
Underground Construction Technology
International Conference & Exhibition

From Planning to Recycling: Avoiding Underground Pitfalls in Hard Rock Environments

Jeff Davis, Product Manager, HDD tooling
Seth Matthesen, Senior Product Manager, HDD

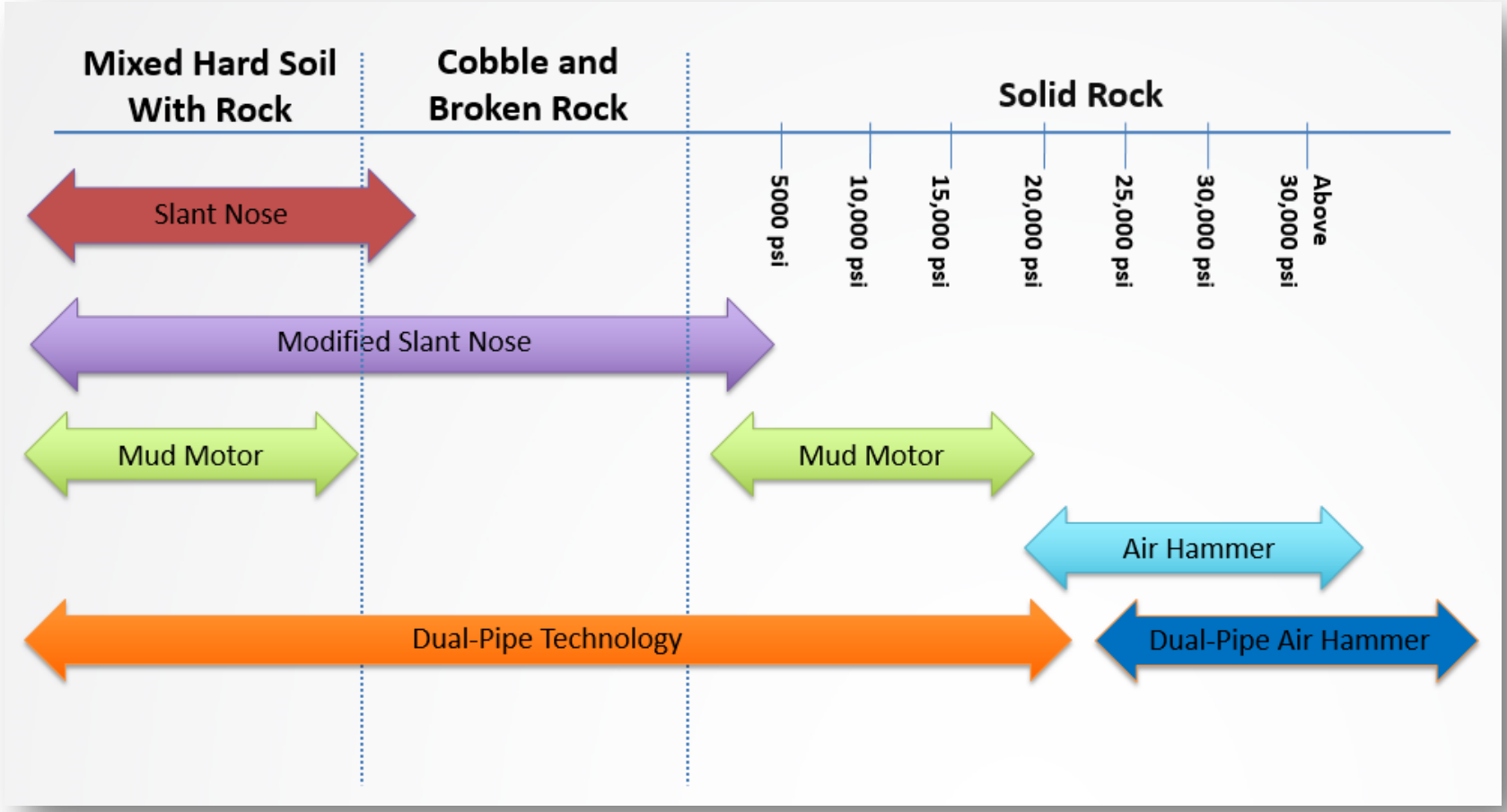
Agenda

- Preplanning for drilling
- Potential pitfalls to avoid
- Downhole tools for diverse ground conditions
  - Single-pipe downhole tools (DHT)
  - Dual-pipe downhole tools
- Importance of mud recycling
- Case studies
- Summary/Conclusion
- Questions

Preplanning

- Preparing for HDD jobsites, step one: test ground conditions
  - Common pitfalls when meeting unfamiliar terrain
    - Project delays
    - Increased costs
    - Decreased profits
    - Incorrect drilling method selection and improper bit selection for formation
    - Lack of preparation and operator frustration
- Testing will help operators correctly match tooling to ground conditions leading to:
  - Increased productivity
  - Reduced premature wear, increased tool longevity

Drilling Technology Effectiveness



Downhole Tools for Diverse Ground Conditions

- Single-pipe DHT
  - Conventional carbide tipped spade bits
    - Corse soils, dirt and gravel
  - Replaceable insert carbide tooth bits
    - Rocky, cobble soils
  - Single roller cone TCI rock bits
    - Layered rock
    - Solid rock
  - Air hammer with TCI bits
    - Layered rock
    - Solid rock
  - Mud motors with rotary bits and drag bits
    - Layered
    - Solid rock
- Dual-pipe DHT
  - Mechanical motors with TCI bits
    - Cobble rock
    - Solid rock
  - Mechanical motors with air hammer systems
    - Mixed soils, sandy loam
    - Solid rock

Downhole Tools for Diverse Ground Conditions

- Single-pipe downhole tools

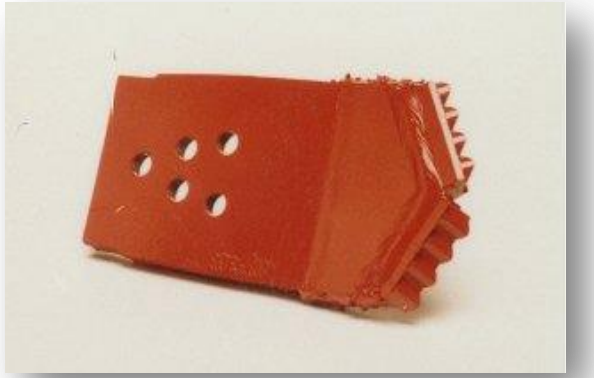
- Dual-pipe downhole tools

Potential Pitfalls

- Three important factors in rock drilling
  - RPM (rotation per minute)
    - Key factors for RPM in rotary bits are life of seals and bearings, and carbide cutting structure
  - WOB (weight on bit)
    - Very important when drilling in rock
    - Life factors of tooling
  - Drilling Fluids
    - One of the most important factors in rock drilling, mud is your friend – you must be able to move cutting out of the borehole to complete your job!

Single-pipe Downhole Tooling

- Conventional carbide tipped bits
  - Effective in most soil conditions, but primarily recommend for use in soft rock (sandstone, shale) and light cobblestone

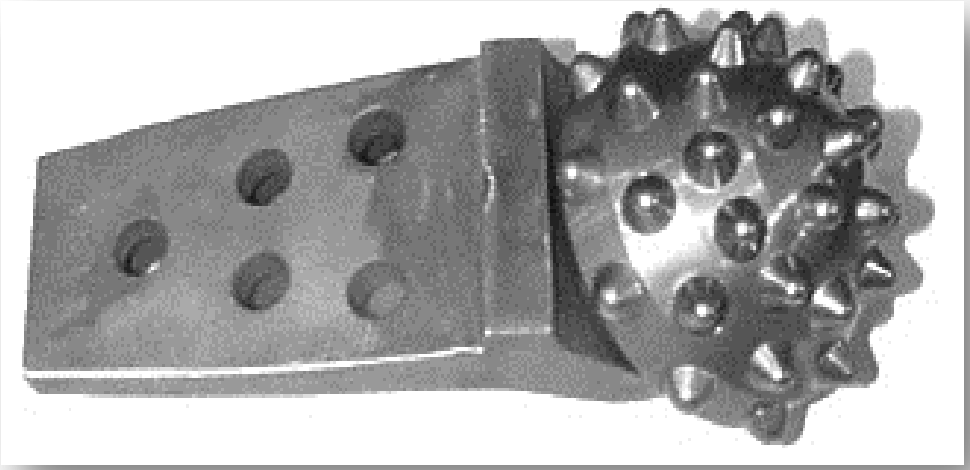


Single-pipe Downhole Tooling

- Replaceable insert carbide tooth bits
  - Effective for use in light rock and cobblestone

Single-pipe Rock Tooling

- Single roller cone rock bits
  - Effective for use in layered rock and solid rock

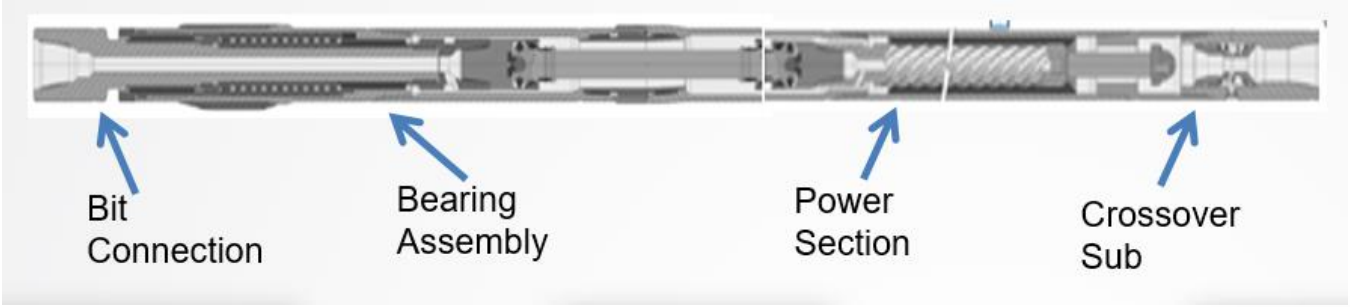


Single-pipe Rock Tooling

- Air hammer with TCI bits
  - Effective for use in layered rock and solid rock

Single-pipe Rock Tooling

- Mud motors with rotary bits and drag bits
  - Effective for use in cobble, layered and solid rock



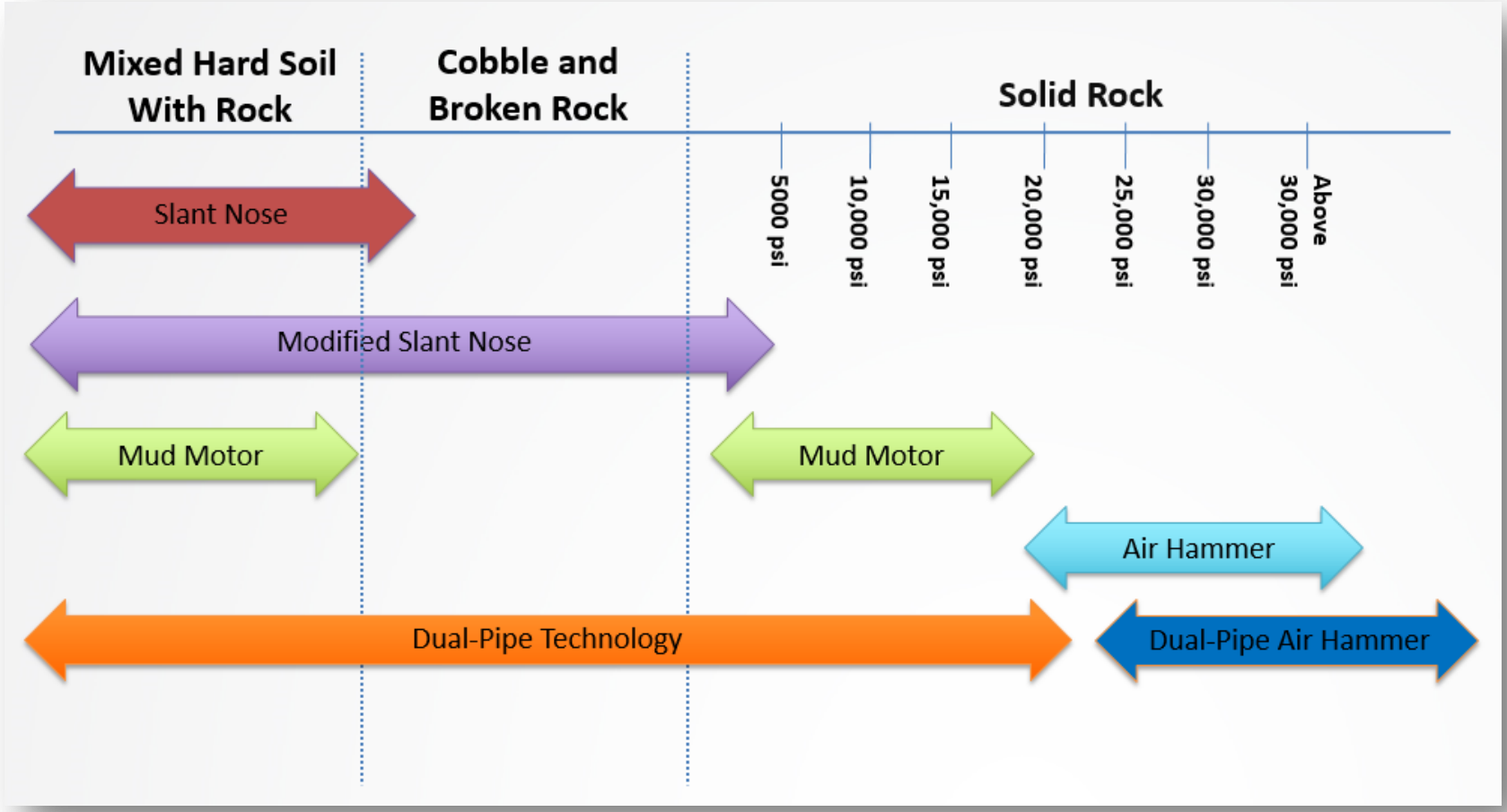
Dual-pipe Rock Tooling

- Mechanical motors with rotary bits and drag bits
  - Effective for use in cobble, layered or solid rock
  - Mechanical bit drive (inner rod)
  - Low drill fluid requirement (+/- 30 lpm)
  - Outer body rotation locked for steering
  - Outer body rotating to go straight

Dual-pipe Rock Tooling

- Dual-pipe mechanical motor with air hammer system
  - Effective for us in solid rock

Drilling Technology Effectiveness



Backreaming in Diverse Ground Conditions

- Solid rock formations
  - Important factors:
    - RPM: low
    - WOB: manufacturers spec
    - Fluid flow: determined by size

Backreaming in Diverse Ground Conditions

- Cobble and chunk rock formations
  - Important factors:
    - RPM: midrange speed
    - WOB: manufacturers specs
    - Fluid flow: generally determined by size

Backreaming in Diverse Ground Conditions

- PDC bit reamers
  - Solid formations:
    - RPM: high
    - WOB: manufacturer's spec
    - Fluid flow: determined by size

Recycling HDD Fluids

Drilling Fluids

- Drilling fluids are essential in any HDD installation
- Disposing of used fluid can be time consuming and costly
- Recycling drilling fluids can:
  - Reduce the overall volume of fluid on a jobsite
  - Reduce fluid disposal costs
  - Conserve water
  - Improve drilling productivity
  - Impacts carbon footprint
  - Limits disturbance to the environment

Limitations

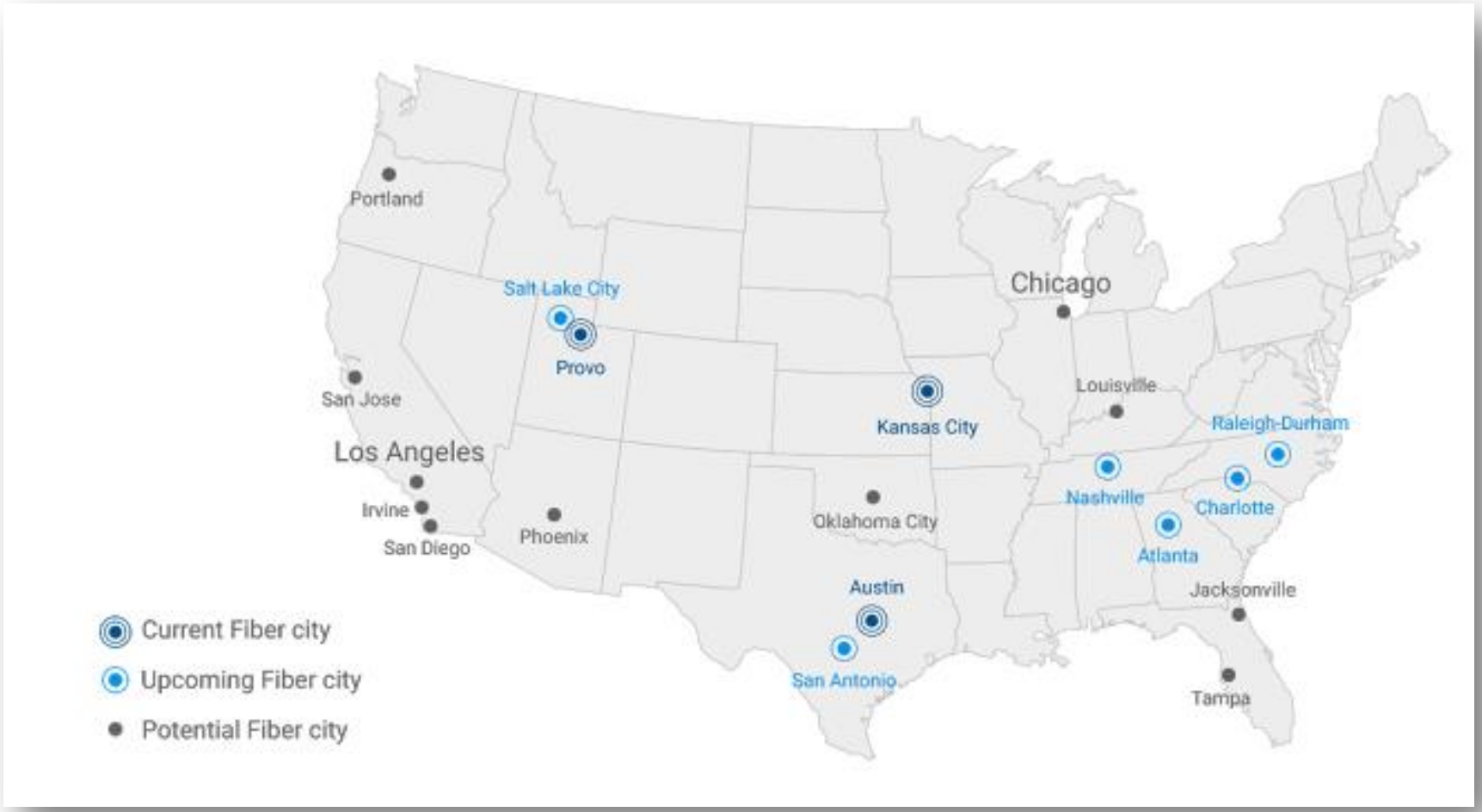
- May not be effective for all soil conditions
  - Clay-based soil
  - Fractured zones
- Change in methodology
  - More means less
- Training effort

Fluid Recycling: Savings

	3,000 gallons		1,000 gallons
	Cost Per Day		Cost Per Day
Mixing system	$134.76	Micro recycling system	$277.63
Water	$15.00	Water	$5.00
Fuel used on vac/truck for mud recovery	$84.50		
Drilling additive cost for the day	$99.00	Drilling additive cost for the day	$33.00
Fuel used on mixing system	$50.00	Fuel used on micro recycling system	$66.60
Cost of dumping mud (determined from volume pumped/day)	$249.75	Cost of dumping mud (determined from volume pumped/day)	$64.80
Fuel used hauling mud off	$133.20	Fuel used hauling mud off	$44.40
Hourly charge of vacs being pulled (wear and tear)	$300.00	Cost of screens	$55.00
Hourly charge on trucks hauling mud off (wear and tear)	$150.00		
Total cost for the day of drilling	$1,216.21	Total cost for the day of drilling	$546.43

TOTAL SAVINGS IN ONE DAY	$669.78
TOTAL SAVINGS FOR MONTH OF EQUAL USAGE	$13,395.60

Case study: Google-MasTec; Austin, TX



Case study: Google-MasTec; Austin, TX

Case study Summary

- Environmentally sensitive region
- Limited disposal sites
- Limited CDL labor force
- Additional revenue of $10,000 per month
  - Savings of fluid and disposal
  - Increased production


ANY
QUESTIONS
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