Compaction Impacting Hydrology and Tree Growth on a Demonstration Mine in the Western Gulf

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Background

- Many mine lands were restored to low-productivity forests or woodlands due to the lack of a forest productivity standard in the original act (Rodrigue et al. 2002, Rodrigue and Burger 2004),
- Soil compaction caused by repeated passes of heavy equipment grading land back to the approximate original contour (Torbert and Burger 1996, Casselman et al. 2006)
- The absence of a requirement to select topsoil materials well-suited to tree growth (Burger et al. 2007, Emerson et al. 2009, Skousen et al. 2011).
- The Appalachian Regional Reforestation Initiative (ARRI) has developed a process called the Forestry Reclamation Approach (FRA) that addresses these problems (Burger et al. 2005, Zipper et al. 2011).

Demonstration mine and previous forested area

Forest Reclamation Approach

- Five step approach
  - Create a suitable rooting medium for good tree growth that is no less than 4 feet deep.
  - Loosely grade the topsoil or substitutes to create a non-compacted growth medium.
  - Use ground covers that are compatible with growing trees.
  - Plant two types of trees, an early succession species for wildlife and soil stability and a commercially valuable crop trees.
  - Use proper tree planting techniques.

arri.osmre.gov

Objectives

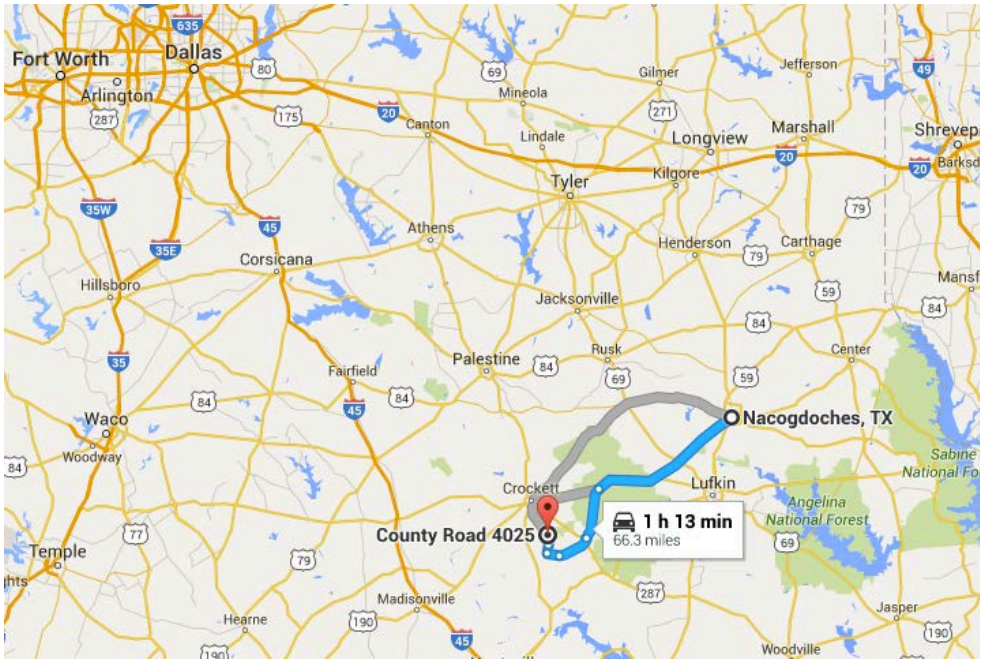
1) Install a demonstration area comparing conventional and Forestry Reclamation Approach (FRA) treatments in the Western Gulf Region

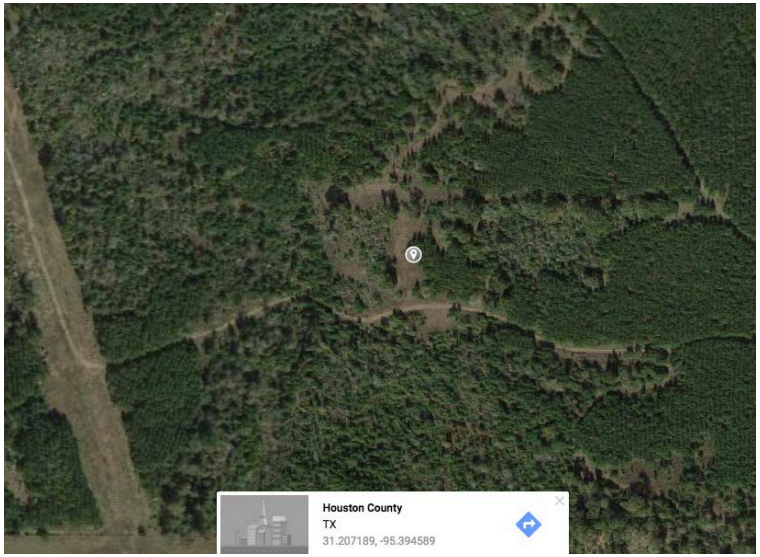
2) Examine the impacts of treatments on compaction, erosion, and surficial hydrology

3) Determine the effect of compaction in this drought-prone region on seedling growth and survival

Research Location

- Demonstration “Science” Mine
  - Gail Creek ST Property
- Reclamation Approach
  - Control
  - Pan Scraper
  - Adapted FRA





Material Replacement Methodologies

Pan Scraper

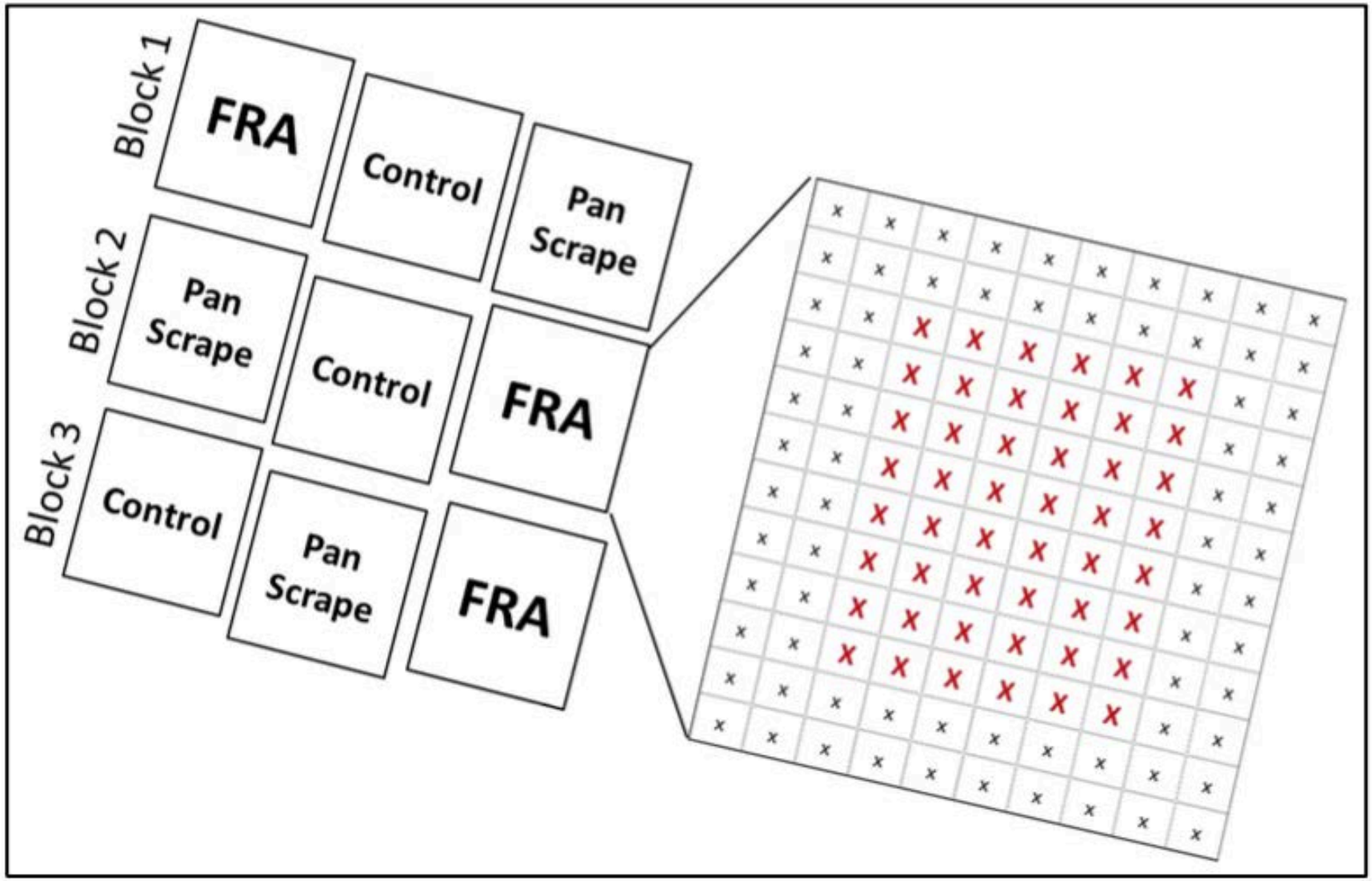
Adapted Forest Reclamation Approach

Hypotheses

1) Pan scraper treatments will have more compaction, runoff, and erosion and less infiltration, seedling survival, and seedling growth as compared to unmined control treatments.

2) FRA compliant treatments will have less compaction, runoff, and erosion and more infiltration, seedling survival, and seedling growth as compared to pan scraper treatments.

Site Layout


Block 1
FRA
Control
Pan Scrape
Block 2
Pan Scrape
Control
FRA
Block 3
Control
Pan Scrape
FRA

FRA Site

FRA Site

Pan Scraper Site

Pan Scraper site

Control

Control (no soil material removal)

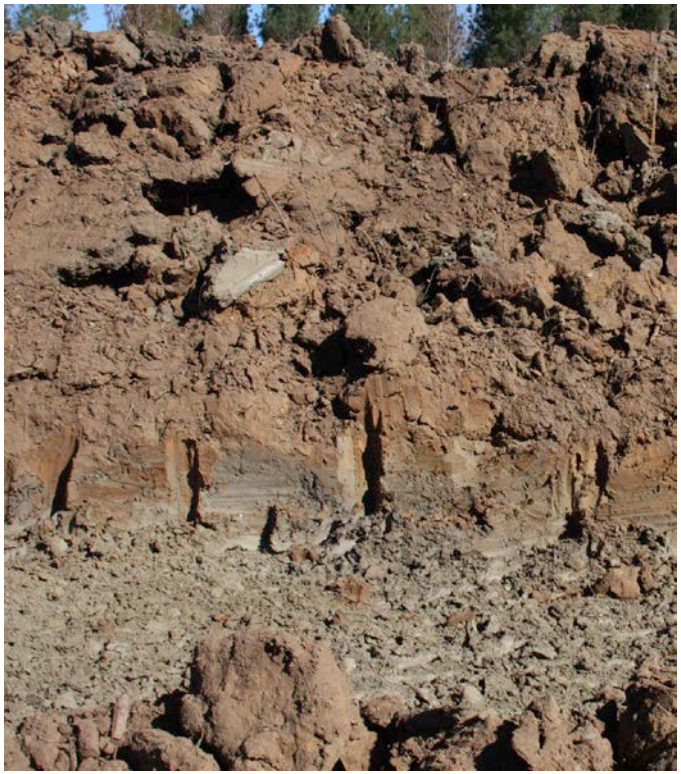
Pan Scraper

Tree Planting: February 2016

Loblolly pine (*Pinus taeda*) 1-0 bare-root seedlings at 2.4 x 2.7 m spacing

Methods of Study
Soil Physical Properties

- Soil Bulk Density (Db)
  - Slide hammer method
  - Total of 9 soil test pits
- Interior Db Cores
  - Water concentration
  - Total porosity
  - Particle density
  - Field capacity
  - Permanent wilting percentage



Soil profile at site

Methods of Study
Soil Physical Properties

- Penetration Resistance
  - Soil strength (cone index)
    - Hand-held electronic cone penetrometer

Methods of Study

Soil Lab Analyses

- Soil composite sample
  - Soil pH
  - Soil texture
  - Elemental concentration (C, N, Ca, Mg, K, P)

Methods of Study
Hydrology

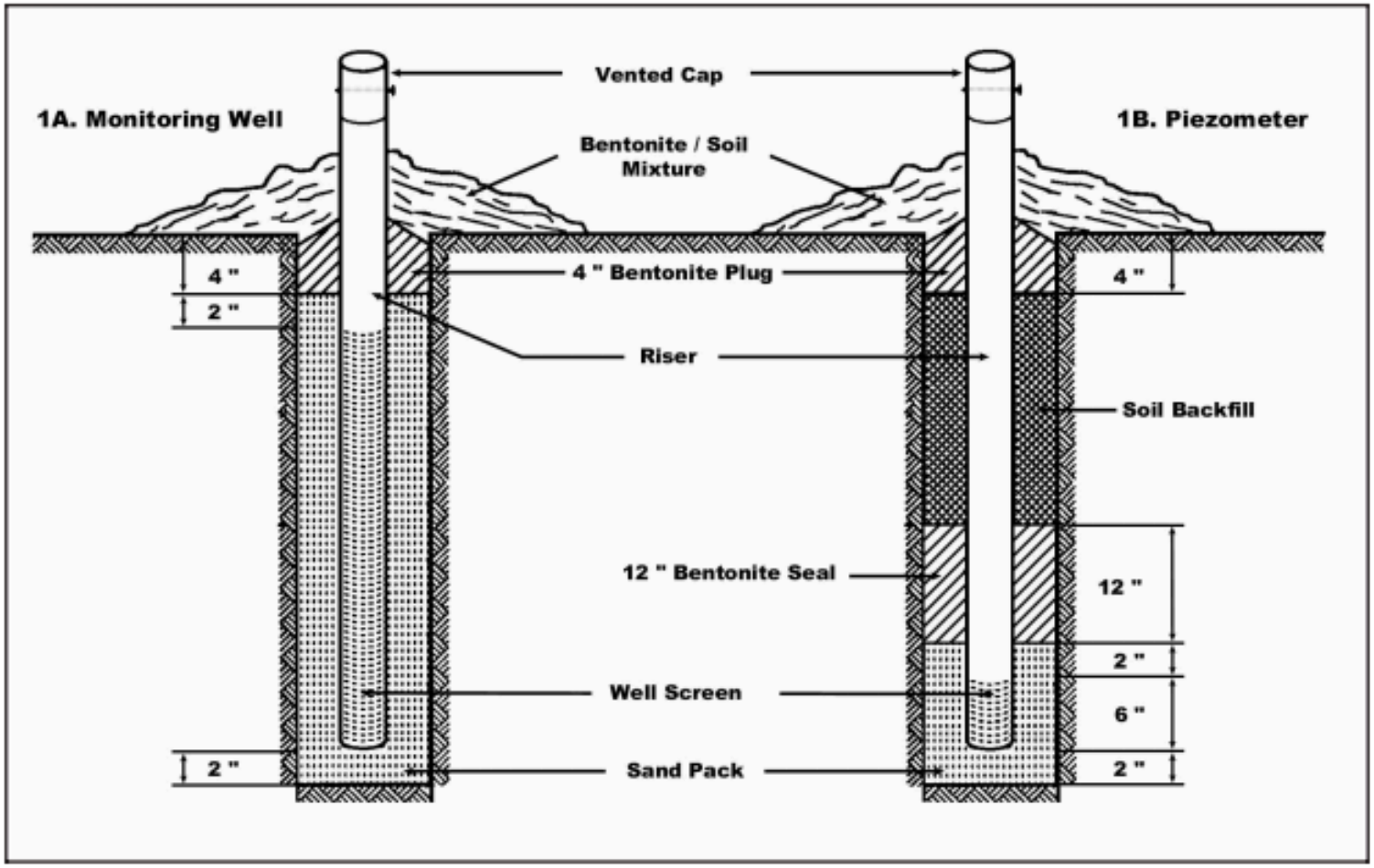


Figure 1. Schematic diagram of installed monitoring well and piezometer. A. Shallow monitoring well. B. Piezometer

Methods of Study
Tree Seedling Response

- 120 trees per sampling plot
  - Ground line diameter (mm)
  - Height (cm)
- First year survival and growth
  - Volume index
  - Above and belowground bimass
  - Plant water relations LI-3100 leaf area meter
  - October 2016

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Data Collection 2016: Now and Ahead

- To Be Completed
  - Soil test pits – summer
  - Piezometers and weather station installation— dry soil season
  - Lab analyses
  - First year growth and survival – October
  - Imazapyr application to control plots – Fall
  - Sulfometuron methyl application to control plots – Spring 2017

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QUESTIONS?