



Linear Cathodic Protection: What, Why & How?

PRESENTED BY:

Wesley Avey, PMP

Director of Professional Services

NACE CP Specialist #39155

BASS

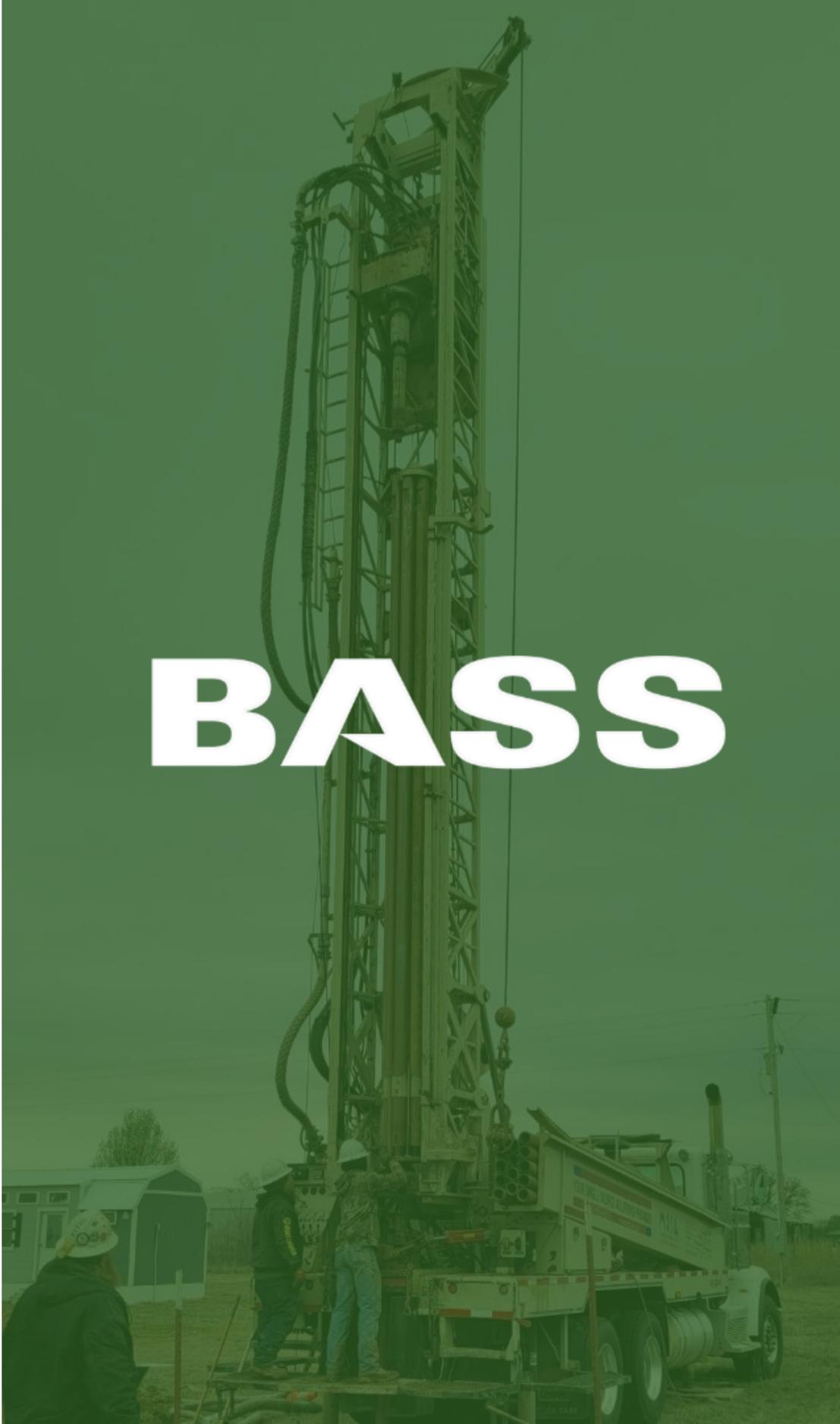
AGENDA

Linear Cathodic Protection

- Purposes
- Advantages / Disadvantages
- Materials

Linear CP Project Evaluators

- Project information
- Specific challenges
- Lessons learned

A large industrial drilling rig is mounted on a truck. The rig is tall and complex, with various pipes, ladders, and mechanical components. The truck is white with a large trailer. The scene is outdoors, possibly at a construction or industrial site. The word "BASS" is overlaid in large, bold, white letters across the center of the image.

BASS

BASS

Linear Cathodic Protection

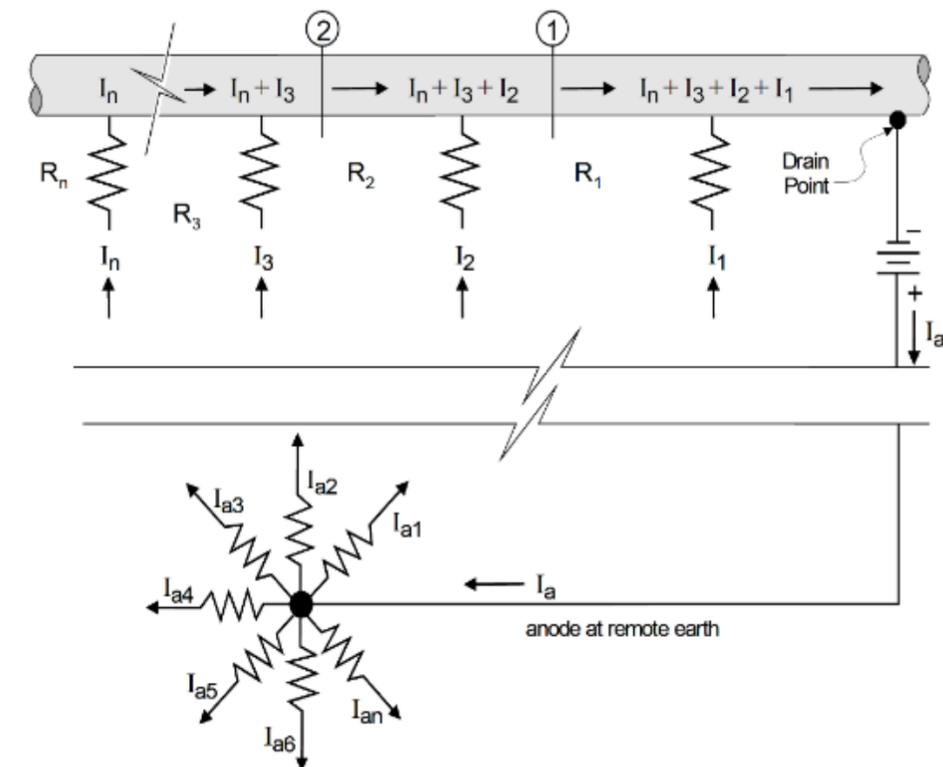
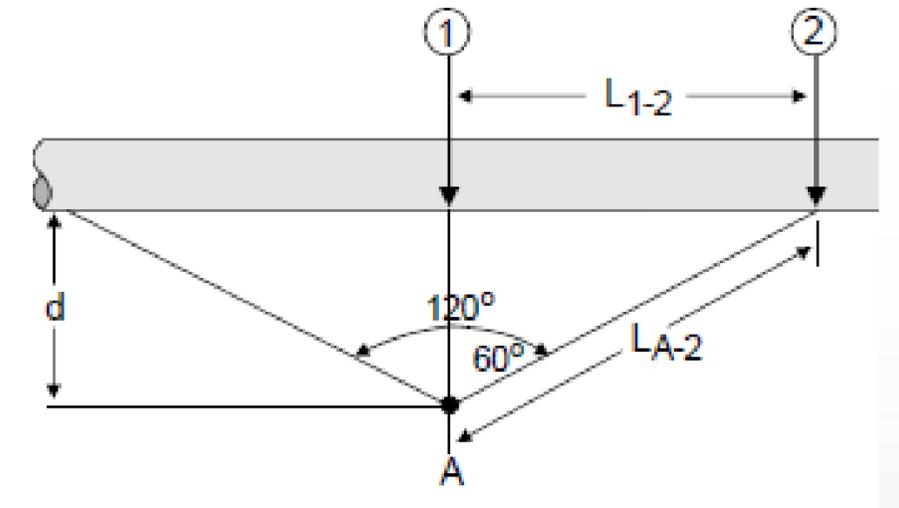
Purpose

- Supply cathodic protection to specific areas of a pipeline system.
- Supplement poor coated sections of a pipeline system.
- Provide cathodic protection current when not receiving remote current.
- Focus cathodic protection on intended structures in congested areas.

Linear Cathodic Protection

Close Coupled Cathodic Protection vs. Remote Cathodic Protection

- Close coupled anodes:
 - Anodes installed close to the structure
 - Current flows directly from the anode to the structure through the soil between
 - Flashlight effect
- Remote anode beds:
 - Remote earth relationship
 - Most current goes to “remote earth” and collects on the pipe evenly
 - Current accumulates as it comes back to the rectifier



BASS

Linear Cathodic Protection

Advantages

- Focused CP Current
- Adjustable to reach desired potentials
- Extremely effective

Disadvantages

- Only provides CP to local area
- May be subject to seasonal changes in resistance
- Extremely costly

Anodes

- Polymer
- Mixed Metal Oxide (MMO)

Backfill

- Dry or wet pour in trench
- Sock around anode

Junction Boxes

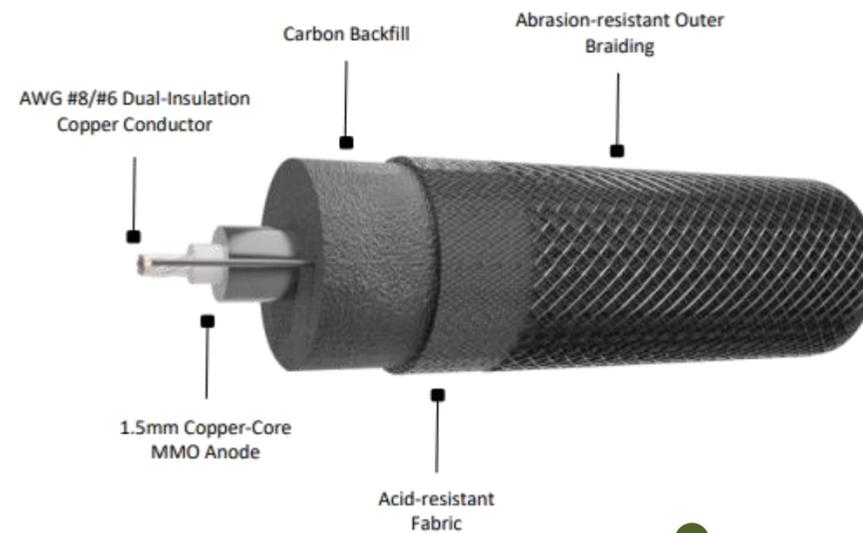
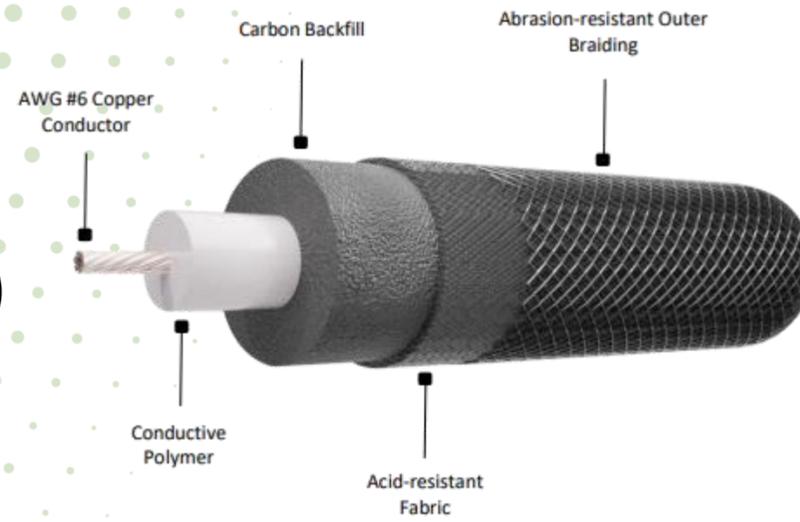
- Positive
- Negative

Cables

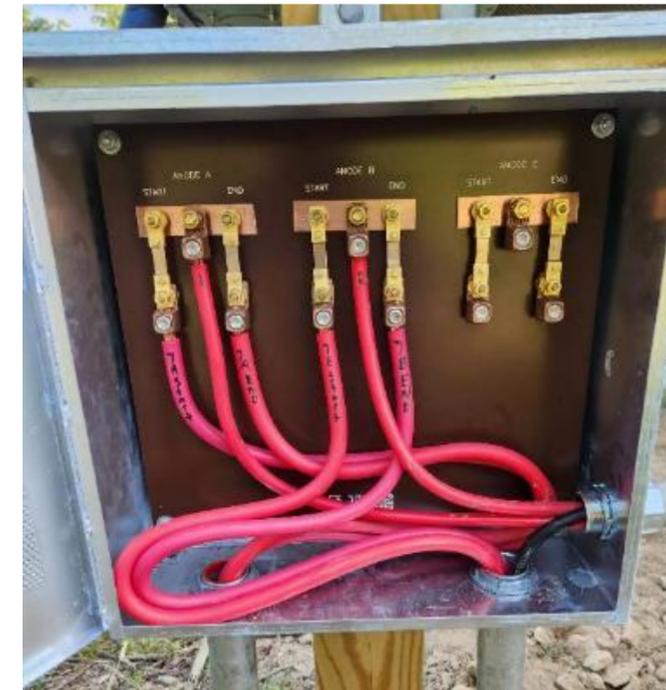
- Header
- Loop

Rectifier

- Dedicated
- Multiple lugs
- Sizing considerations



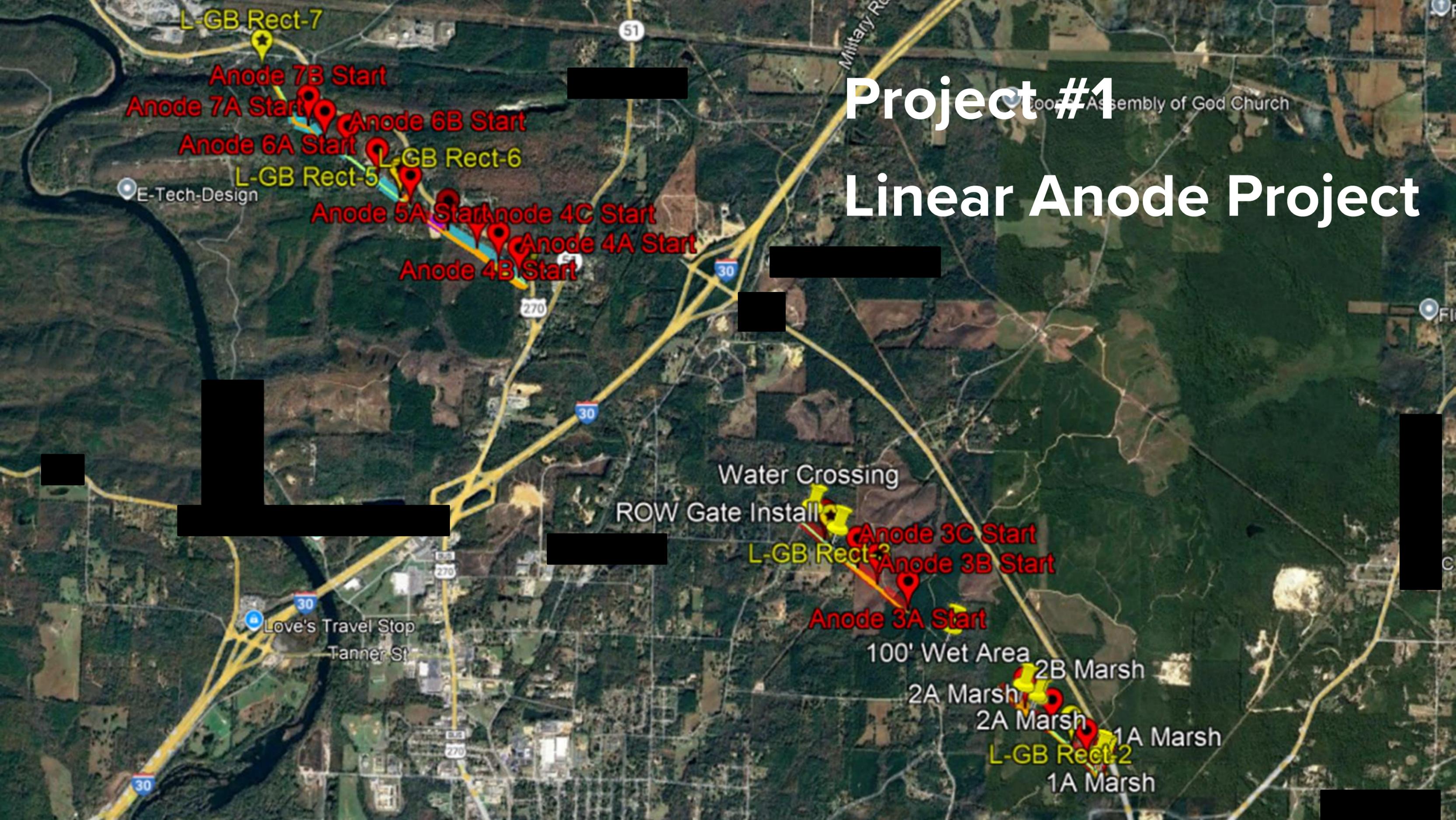
Material Selection



BASS

Project #1

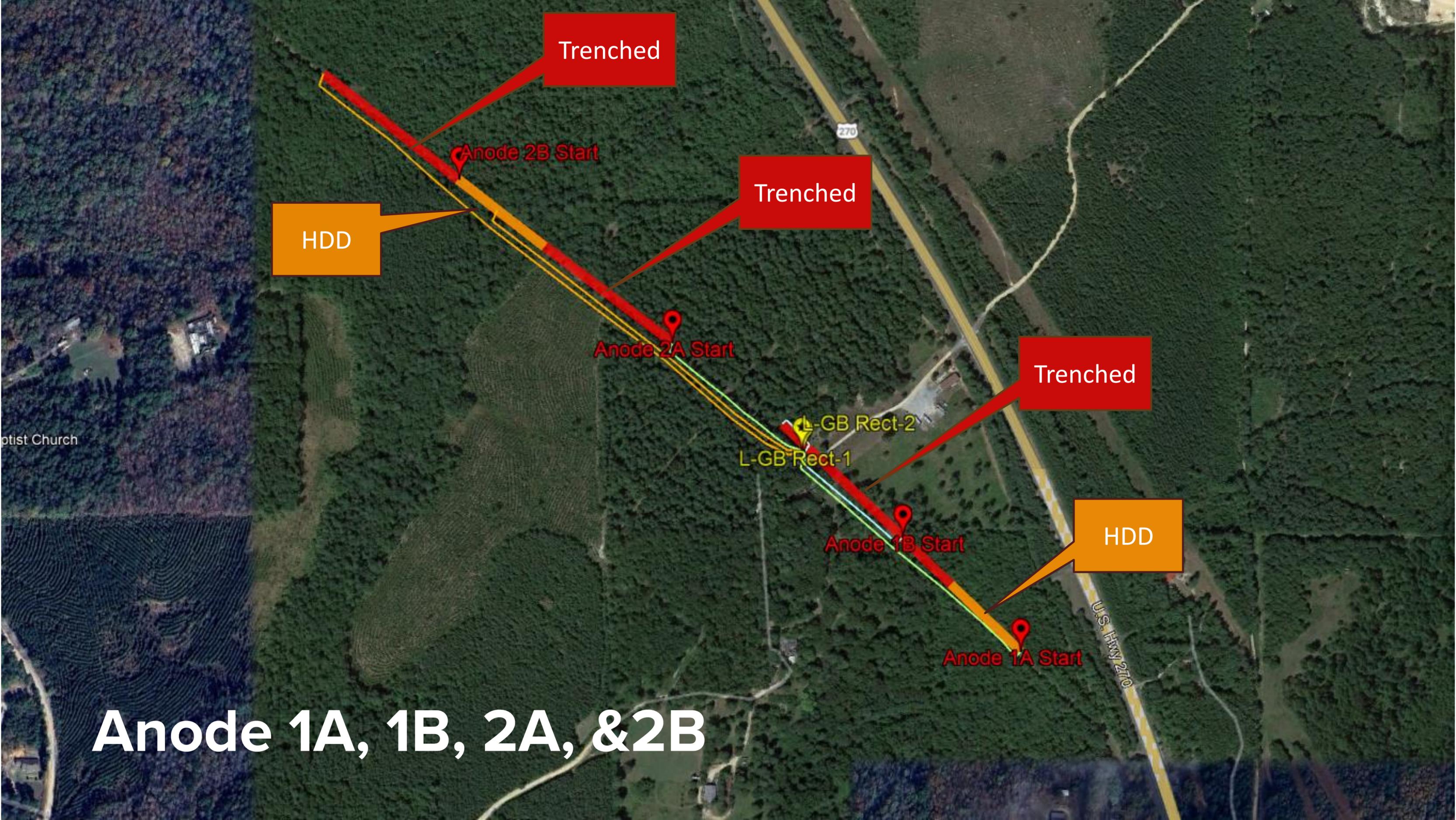
Linear Anode Project



BASS

Project #1: Linear Anode Project

- **12,280 feet of linear anode**
- **18 separate anodes**
- **10,620 feet #2 positive cable**
- **22,830 feet 1/0 positive cable**
- **Seven anode junction boxes**
- **Seven cathodic protection systems / rectifiers**
- **Across 5.5 miles (between end of anode 1A to rectifier 7)**



Trenched

HDD

Trenched

Trenched

HDD

Anode 2B Start

Anode 2A Start

L-GB Rect-2

L-GB Rect-1

Anode 1B Start

Anode 1A Start

270

U.S. Hwy 270

Baptist Church

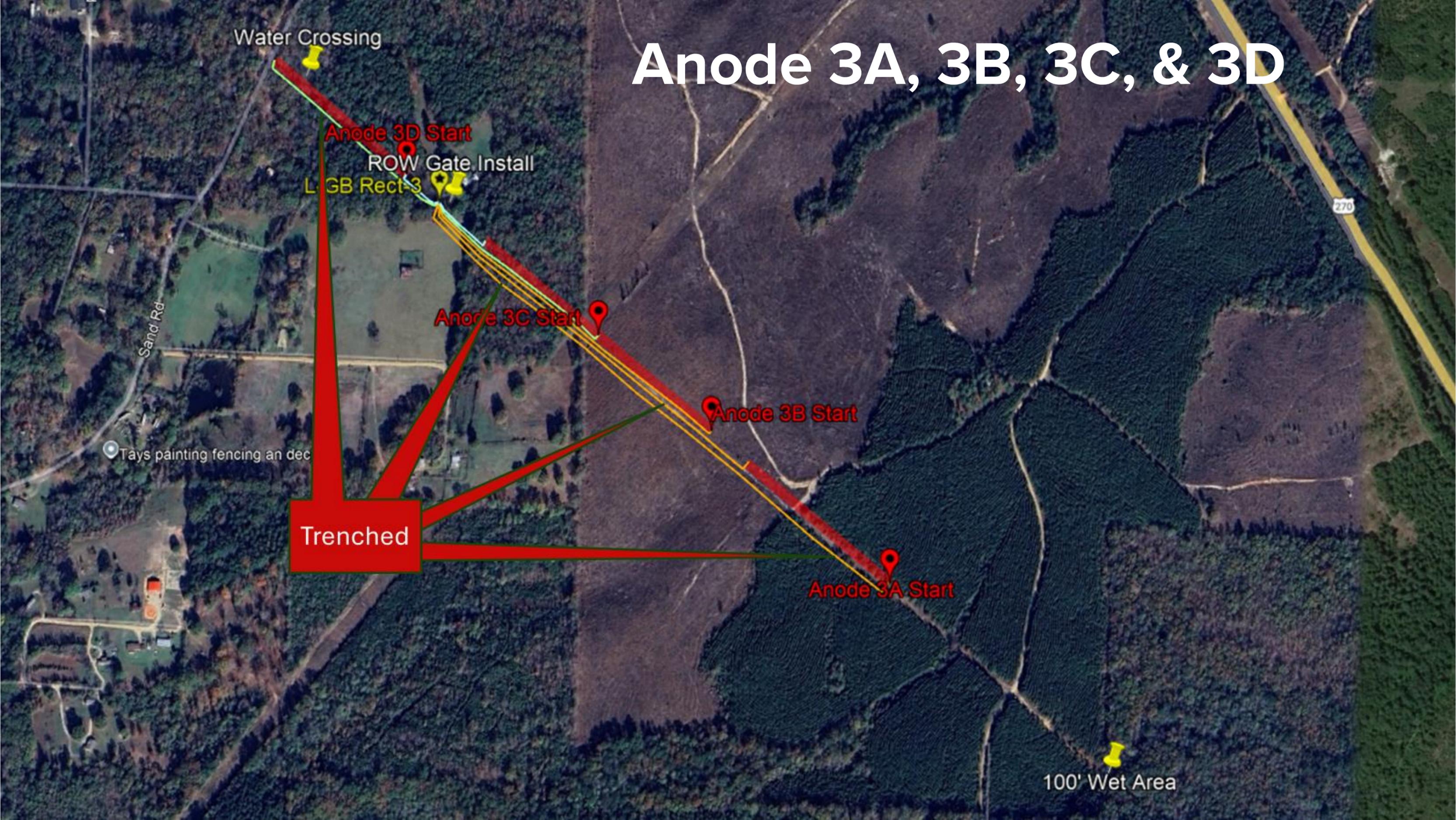
Anode 1A, 1B, 2A, & 2B

Linear Anode 1A, 1B, 2A, & 2B

- Approximately 400-ft of HDD to install the Southeastern portion of anode 1A, the remaining ~275 was able to be trenched in.
- 1B was able to be trenched in.
- 2A was trenched in.
- 2B was shifted to the Northwest to avoid some of the marsh area, an approximate 400-ft distance was HDD under the marsh area to install the positive cables.
- The difficulties on system 1 & 2 were the low laying marsh areas. Heavy equipment needed to be matted in order to provide a stable work area. HDD was utilized to install the anodes through the marsh areas. Trenching went smoothly where ground conditions were normal.



Anode 3A, 3B, 3C, & 3D



Water Crossing

Anode 3D Start

ROW Gate Install

L. GB Rect-3

Sand Rd

Tays painting fencing an dec

Trenched

Anode 3C Start

Anode 3B Start

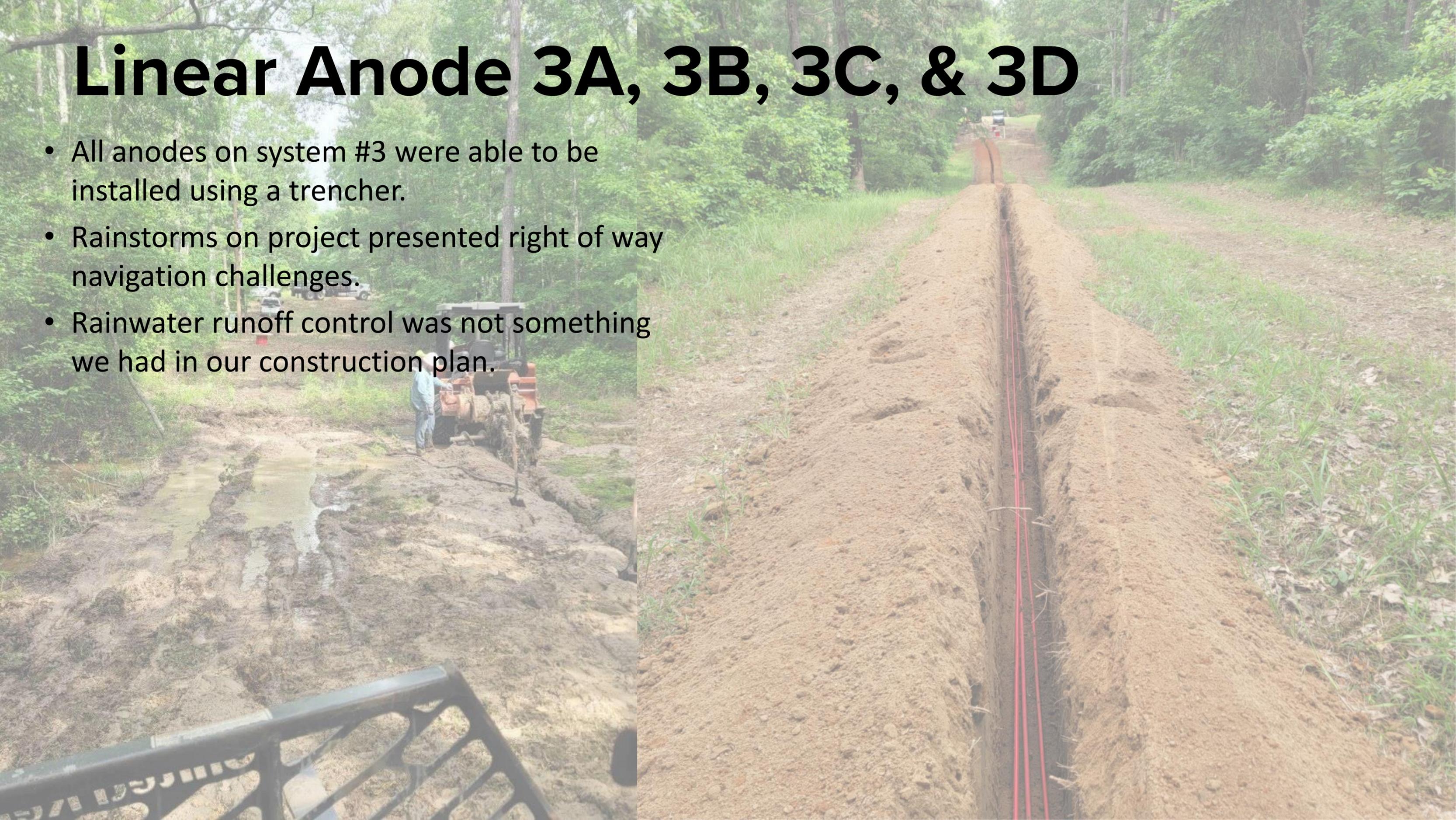
Anode 3A Start

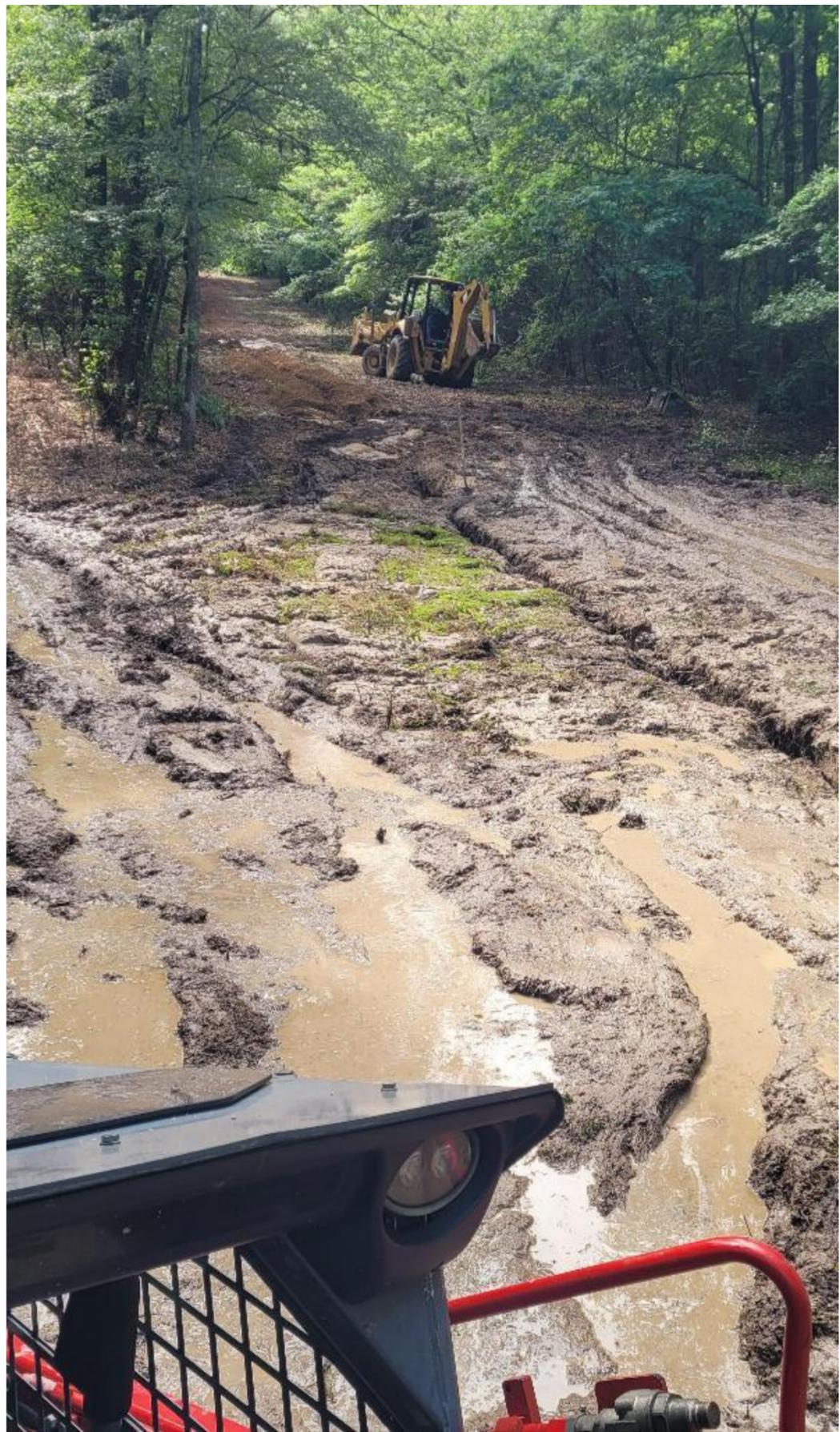
270

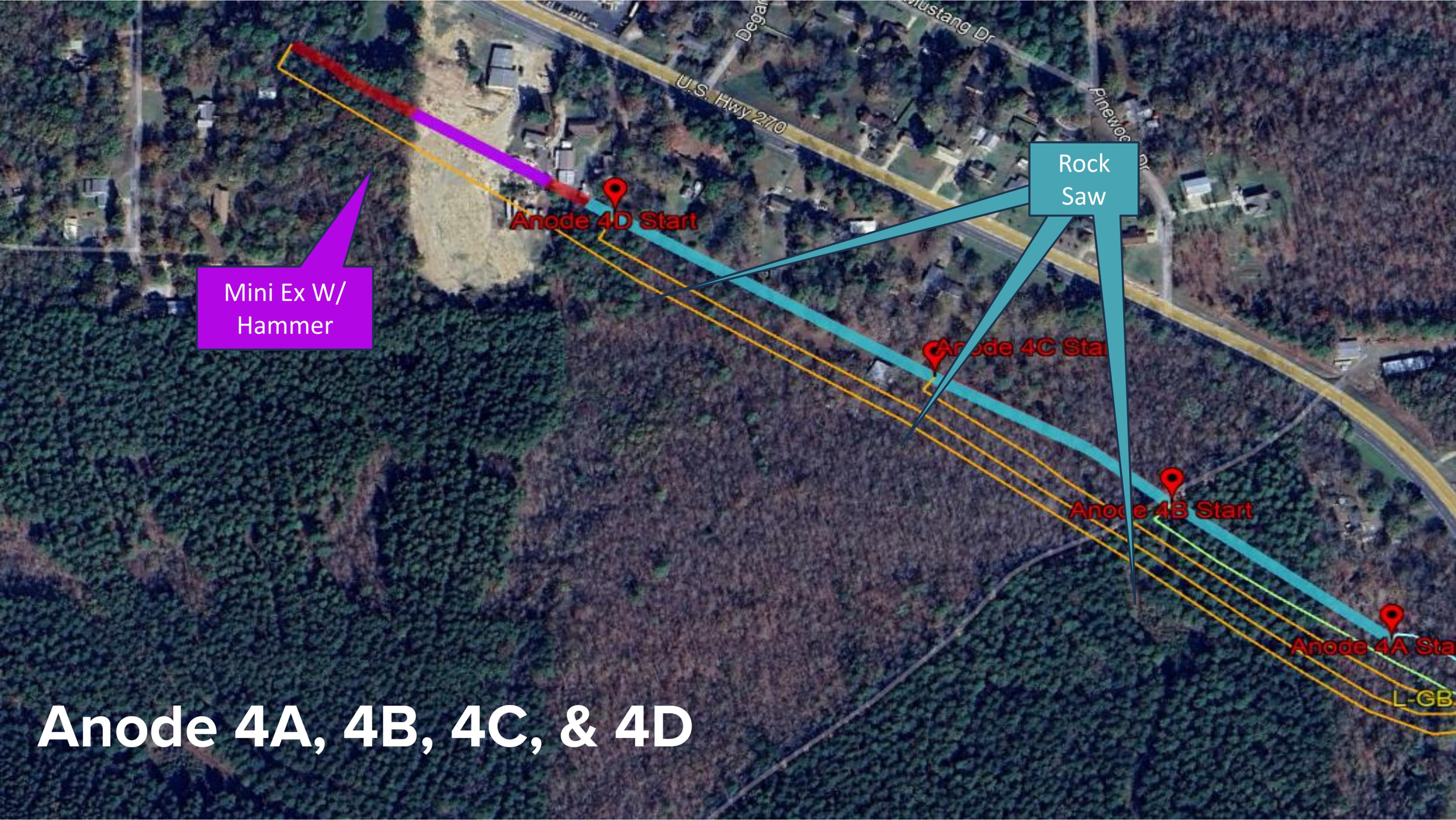
100' Wet Area

Linear Anode 3A, 3B, 3C, & 3D

- All anodes on system #3 were able to be installed using a trencher.
- Rainstorms on project presented right of way navigation challenges.
- Rainwater runoff control was not something we had in our construction plan.







Mini Ex W/
Hammer

Rock
Saw

Anode 4D Start

Anode 4C Start

Anode 4B Start

Anode 4A Start

L-GB

Anode 4A, 4B, 4C, & 4D

Linear Anode 4A, 4B, 4C, & 4D

- Attempted to trench in anodes on system #4 and encountered hard rock. A rock saw was brought out to cut through the rock.
- Through the packed parking lot of an industrial yard a mini excavator with a hydraulic hammer attachment utilized.
- The rock saw was successful in some areas but cutting through solid rock slowed progress. The saw began to overheat when cutting in solid hard rock.
- When cutting through solid rock additional coke breeze was installed in the ditch line around the linear anode.





Rock Saw /
Hydraulic Hammer

Trenched

HDD

L-GB Rect-5

Anode 5B Start

Anode 5A Start

Anode 5A & 5B



Linear Anode 5A & 5B

- For anode 5A HDD equipment was used to bore under the roads and landowner yards.
- Rock saw started having more difficulty in solid rock areas. Tracked excavators were brought out with pneumatic hammers to break up rocks and then removed from the ditch.
- Additional coke breeze was installed in areas of solid rock.
- Tracked equipment was required to complete the anode installations.
- Steep terrain required tracked equipment while working on inclines.





Excavator /
Hydraulic Hammer

Anode 6B Start

Excavator /
Hydraulic Hammer

Linear Anode 6A & 6B

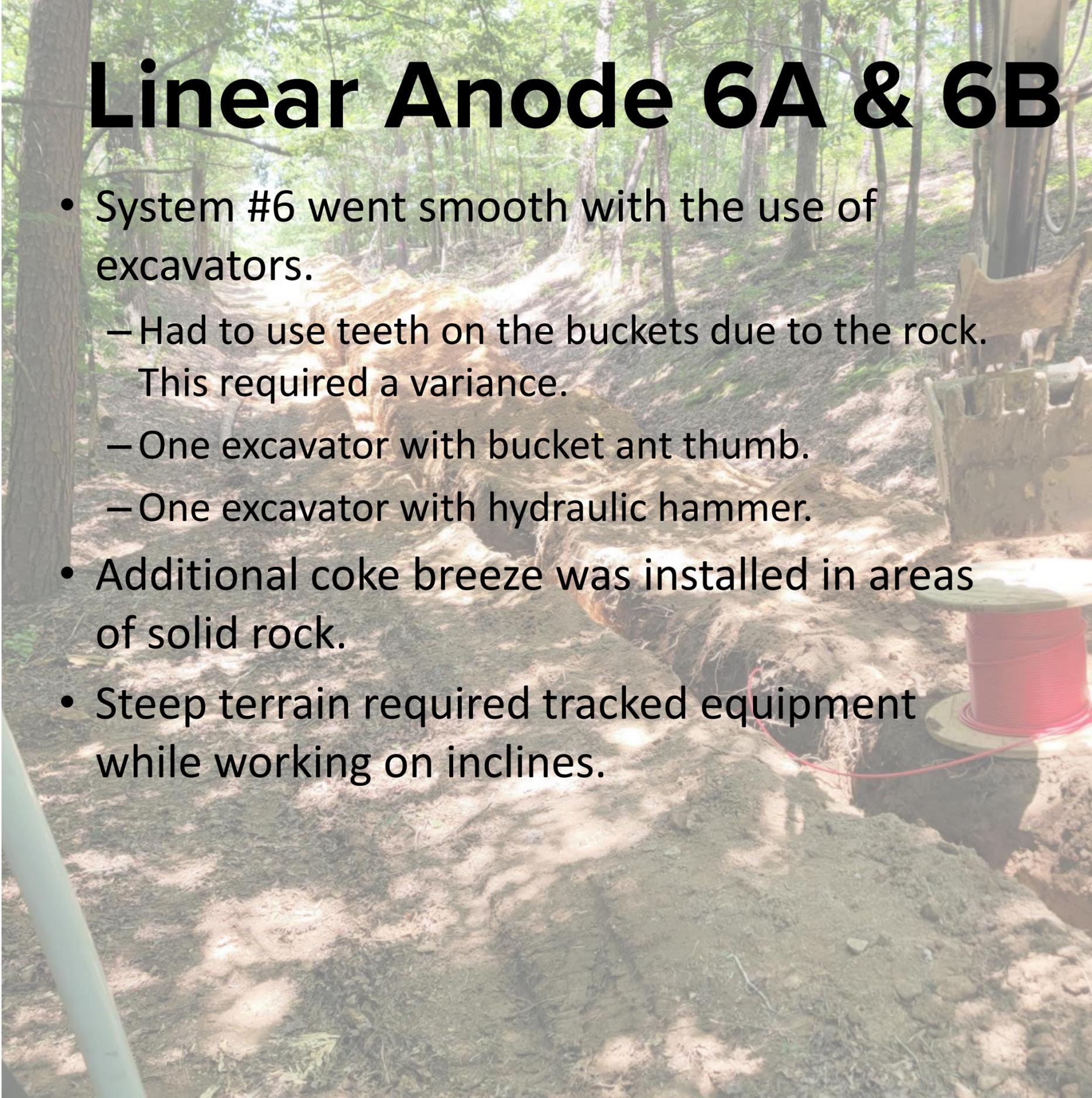
Anode 6A Start

L-GB Rect-6



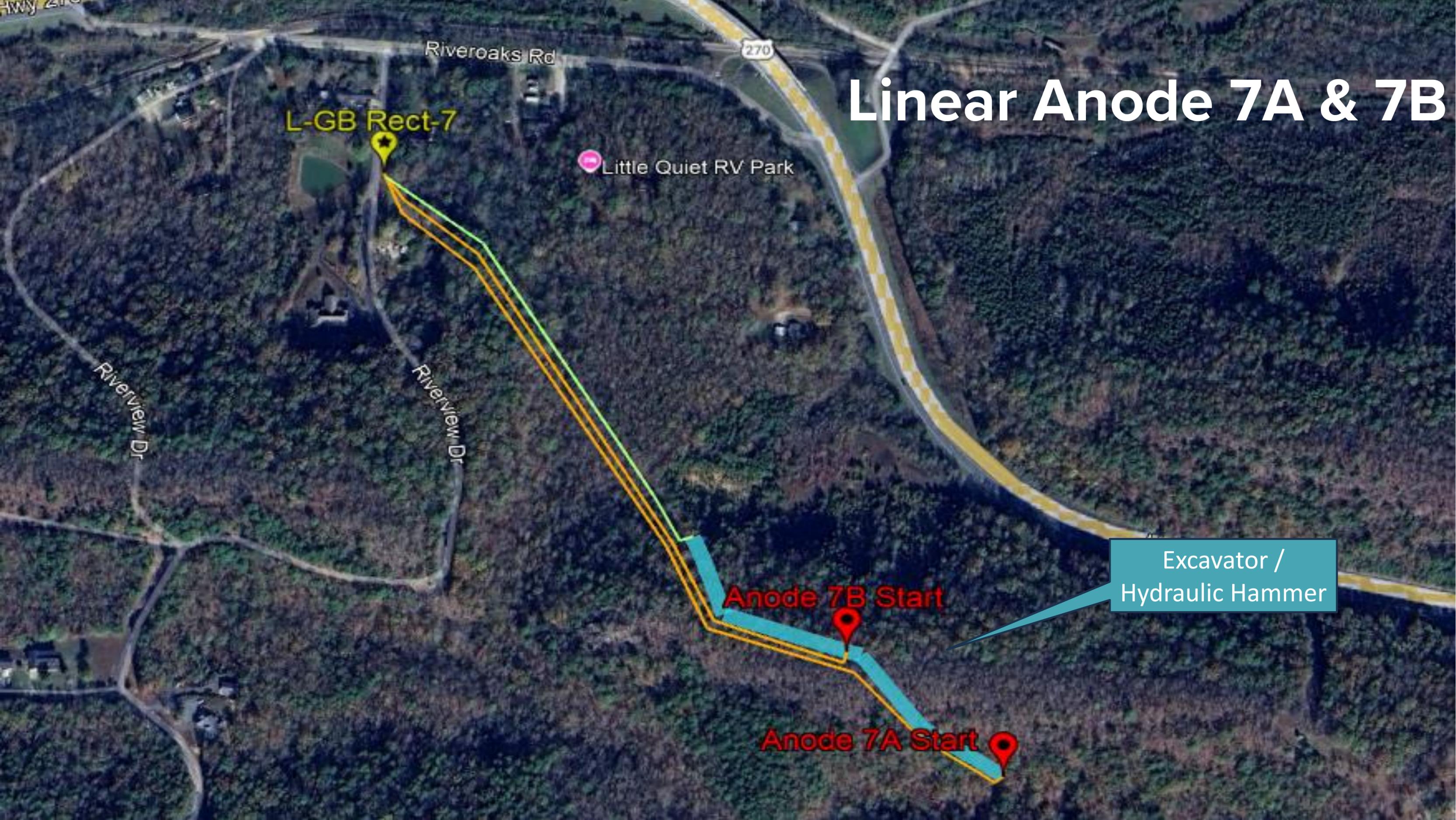
Linear Anode 6A & 6B

- System #6 went smooth with the use of excavators.
 - Had to use teeth on the buckets due to the rock. This required a variance.
 - One excavator with bucket ant thumb.
 - One excavator with hydraulic hammer.
- Additional coke breeze was installed in areas of solid rock.
- Steep terrain required tracked equipment while working on inclines.





Linear Anode 7A & 7B



L-GB Rect-7

Little Quiet RV Park

Riveroaks Rd

270

Riverview Dr

Riverview Dr

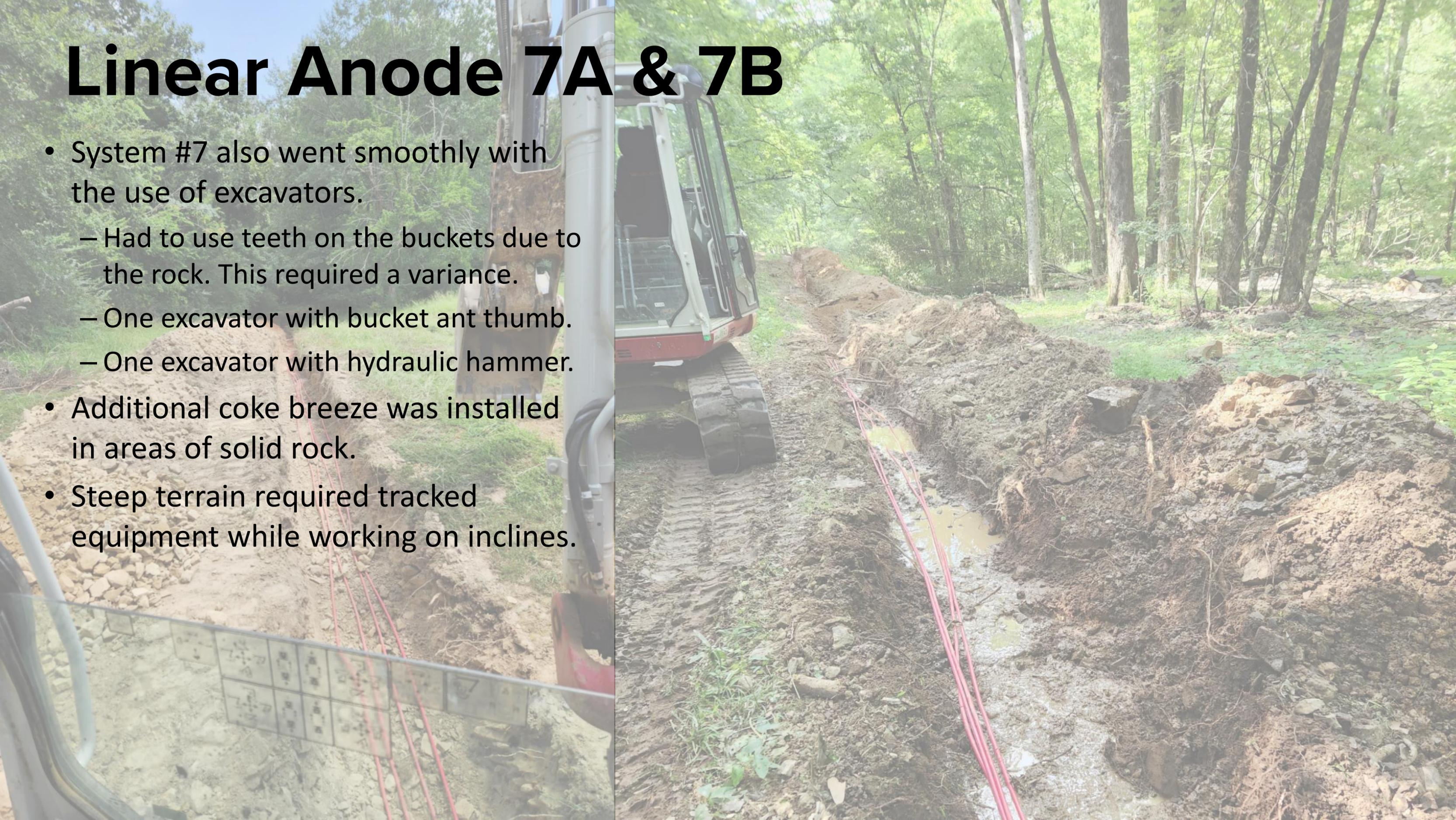
Anode 7B Start

Anode 7A Start

Excavator /
Hydraulic Hammer

Linear Anode 7A & 7B

- System #7 also went smoothly with the use of excavators.
 - Had to use teeth on the buckets due to the rock. This required a variance.
 - One excavator with bucket ant thumb.
 - One excavator with hydraulic hammer.
- Additional coke breeze was installed in areas of solid rock.
- Steep terrain required tracked equipment while working on inclines.

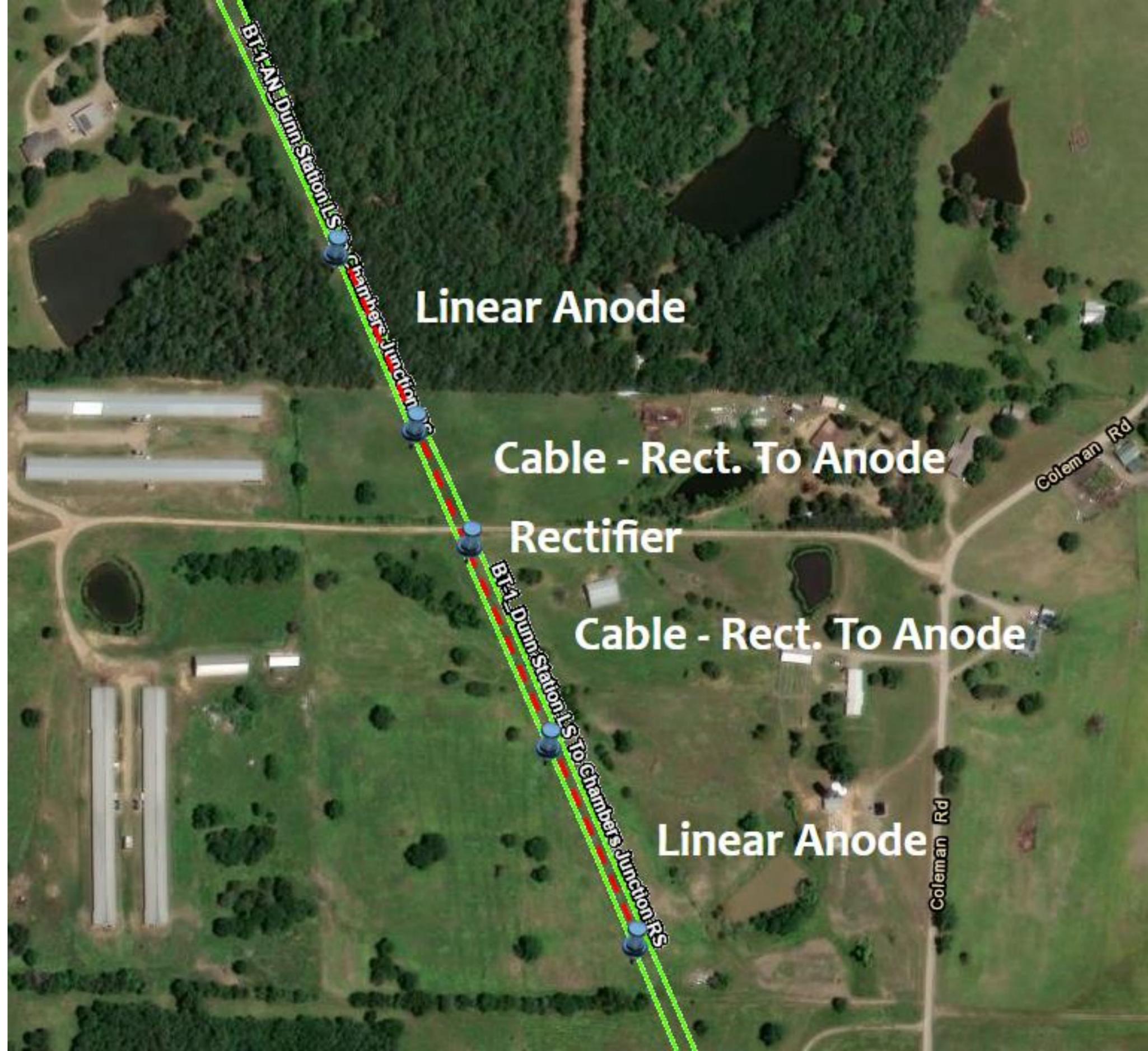




BASS

Project #2: Linear Anode Bed

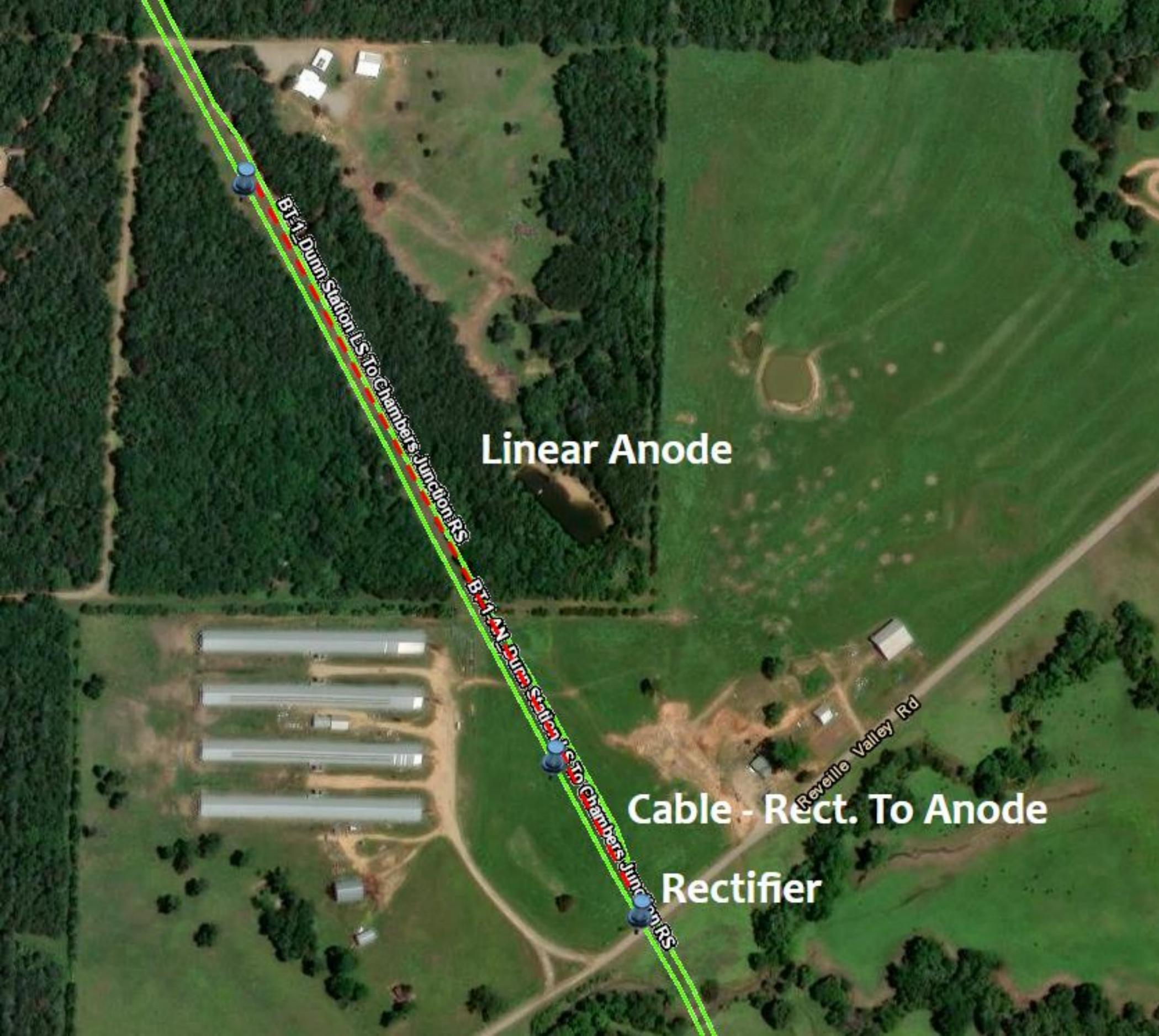
- 860 feet of linear anode
 - Anode #1 = 400'
 - Anode #2 = 460'
- Anodes installed between pipelines
- Anode junction box
- Negative junction box installation



BASS

Project #3: Linear Anode Bed

- 1,465 feet of linear anode (one anode)
- Anode installed between pipelines
- Negative junction box installation







Lessons Learned

- **Areas with non-locatable taps should have local crew identified for quick response if poly gas lines are damaged when they are unable to be located.**
- **Be prepared for ROW cleaning and maintenance.**
 - Tree trimming and clearing brush.
 - Laying seed and straw for more than a few hundred feet.
 - ROW rainwater runoff management and berm building.
- **Steep terrain restricted use of wheeled equipment.**
- **Changing subsurface conditions required multiple types of equipment for various installation methods to be available.**
 - Backhoe, trencher, rock saw, skid steer, HDD rig, excavators w/ hydraulic attachments.
 - Equipment moves / logistics

QUESTIONS?

Wesley Avey, PMP
NACE CP Specialist #39155
wesley.avey@bass-eng.com
918-891-5654

BASS

