

Why focus on the round bale?

1. Single layer ambient storage
2. Uncouple baling from in-field hauling
3. Lower cost baler, lower power tractor---  
more opportunity for a wide range of  
different size farmgate contracts

# Labor Productivity

1. Single bale handling is not going to work
2. Uncoupling the unit operations in the logistic chain can maximize labor productivity (ton/h) for each operation

# Baling

1 bale every 2 minutes

Bale weighs 900 lb

Productivity: 13.5 ton/h

Suppose I want one operator to haul bales from the field to an SSL and have a labor productivity rate of 13.5 ton/h





$$\frac{10 \text{ bales/load} \times 900 \text{ lb/bale}}{2000 \text{ lb/ton}} = 4.5 \text{ ton/load}$$

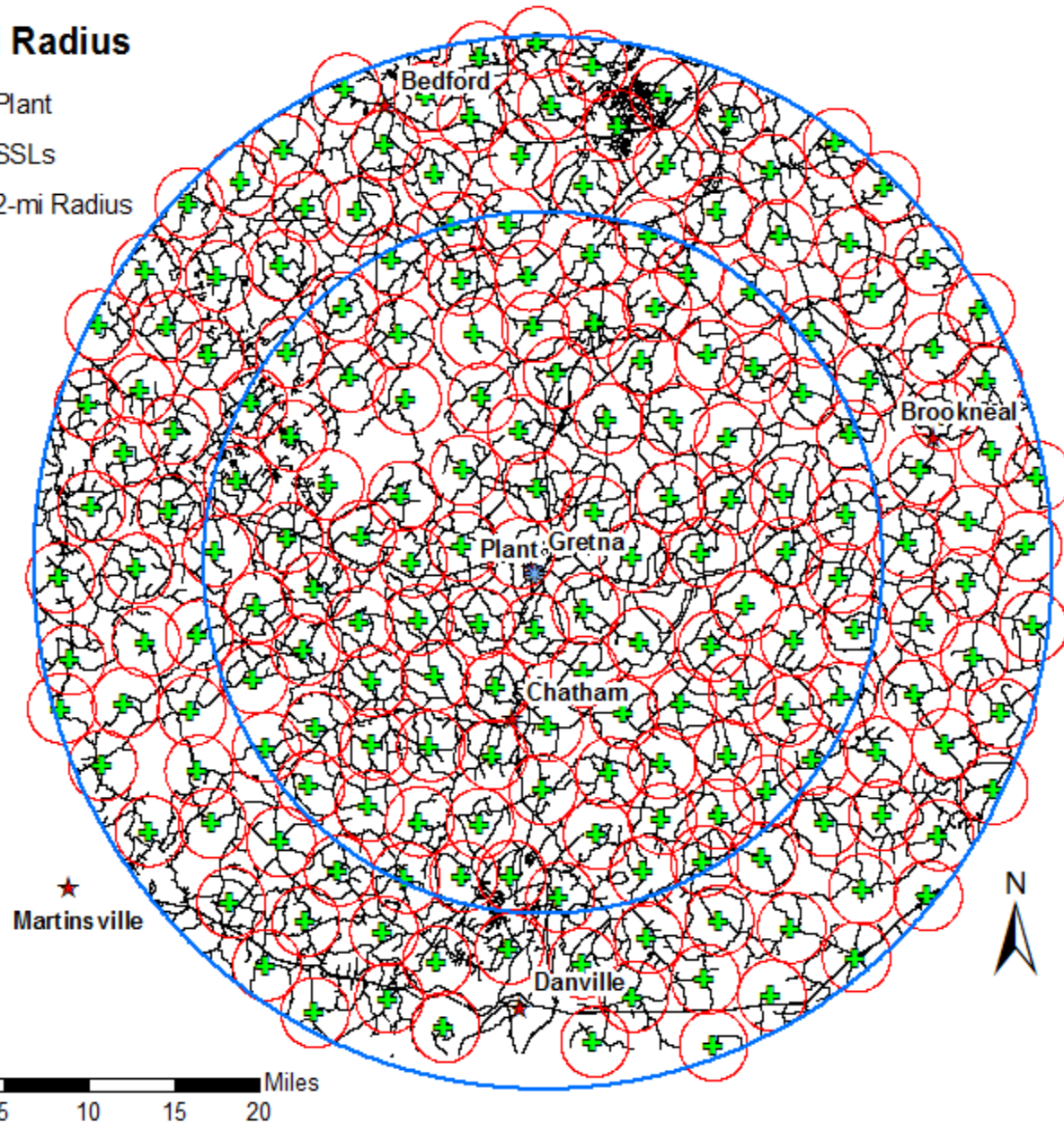
This means the distance from the field to the SSL cannot be more than 2 miles

### 30-mi Radius

⊛ Plant

⊕ SSLs

□ 2-mi Radius

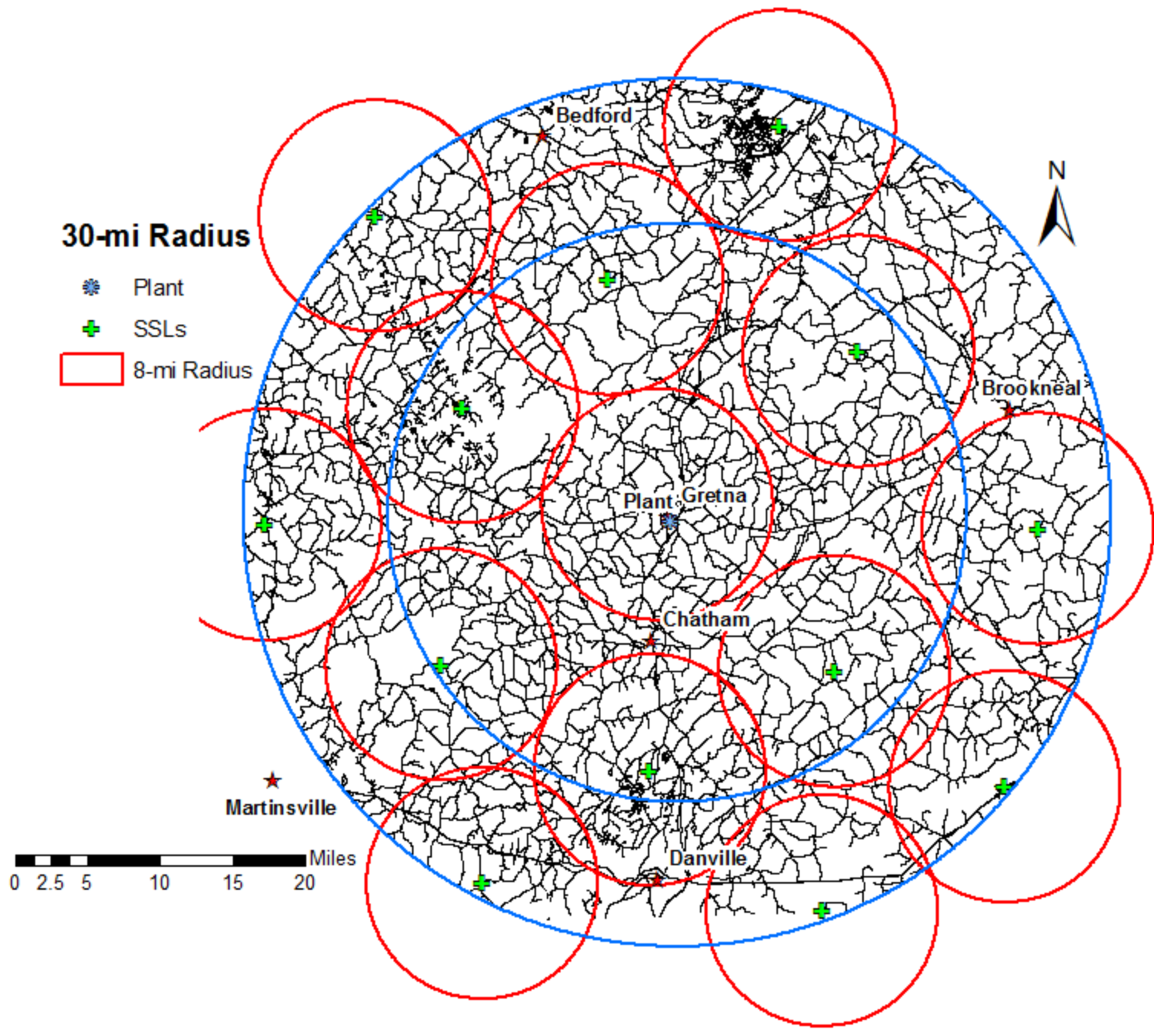


### 30-mi Radius

☼ Plant

⊕ SSLs

□ 8-mi Radius



# Highway Hauling

Suppose I have a crew of two workers loading the truck

How many bales do these two workers need to load in a 10-h workday to have a labor productivity of 13.5 ton/h?

$$13.5 \text{ ton/h} \times 2 \text{ workers} \times 10 \text{ h/d} = 270 \text{ ton/d}$$

$$\frac{270 \text{ ton/d} \times 2000 \text{ lb/ton}}{900 \text{ lb/ton}} = 600 \text{ bales/d}$$

Can two workers load 600 5-ft diameter round bales on trucks in a 10-h workday?

# Biomass Logistics Consortium

- 3 companies
- 3 universities

Goal: Develop equipment to load 480  
bales in a 10-h workday

$$\frac{480 \text{ bales/d} \times 900 \text{ lb/bale}}{2000 \text{ lb/ton}} = 216 \text{ ton/d}$$

$$\frac{216 \text{ ton/d}}{10 \text{ h/d}} = 21.6 \text{ ton/h}$$

$$\frac{216 \text{ ton/d}}{2 \text{ workers}} = 10.8 \text{ ton/h}$$

Or 20% less than the baler operator

Labor: \$20/h

Baling: \$1.48/ton

In-field hauling: \$1.48/ton

Loading: \$1.85/ton

Suppose I want the truck driver to have a labor productivity of 13.5 ton/h

Truck load is 32 bales

$$\frac{32 \times 900 \text{ lb/bale}}{2000 \text{ lb/ton}} = 14.4 \text{ ton/load}$$

$$\frac{14.4 \text{ ton/load}}{13.5 \text{ ton/h}} = 1.07 \text{ h/load}$$

1. 10 min to load
2. 10 min to unload
3. Average road speed 45 mph

How far can I haul?

I can haul about 25 mi from the SSL to the bioenergy plant, if I want the truck driver to have a labor productivity of 13.5 ton/h