

CIVIL ENGINEERING APPLICATIONS OF TIRE DERIVED AGGREGATE

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Outline

- Why use Tire Derived Aggregate?
- Landslide stabilization
- Retaining wall backfill
- Landfill applications

Tire Derived Aggregate – *TDA*



Why use TDA?

- TDA has properties that civil engineers need
 - Lightweight (1/3 soil)
 - Low earth pressure (1/2 soil)
 - Good thermal insulation (8 times better)
 - Good drainage (10 time better)
 - Compressible
 - Vibration damping

Why use TDA?

- TDA is often cheapest alternative if you need their unique properties

Why use TDA?

- Can use lots of tires!!!
 - 75 tires per C.YD. of tire shred fill
 - 400,000 tires for landslide stabilization, Topsham, Maine
 - 1.2 million tires for highway embankment, Portland, Maine
 - 1 million tires for leachate collection system in Delaware

TDA as Lightweight Fill for Embankment Construction & Landslide Stabilization

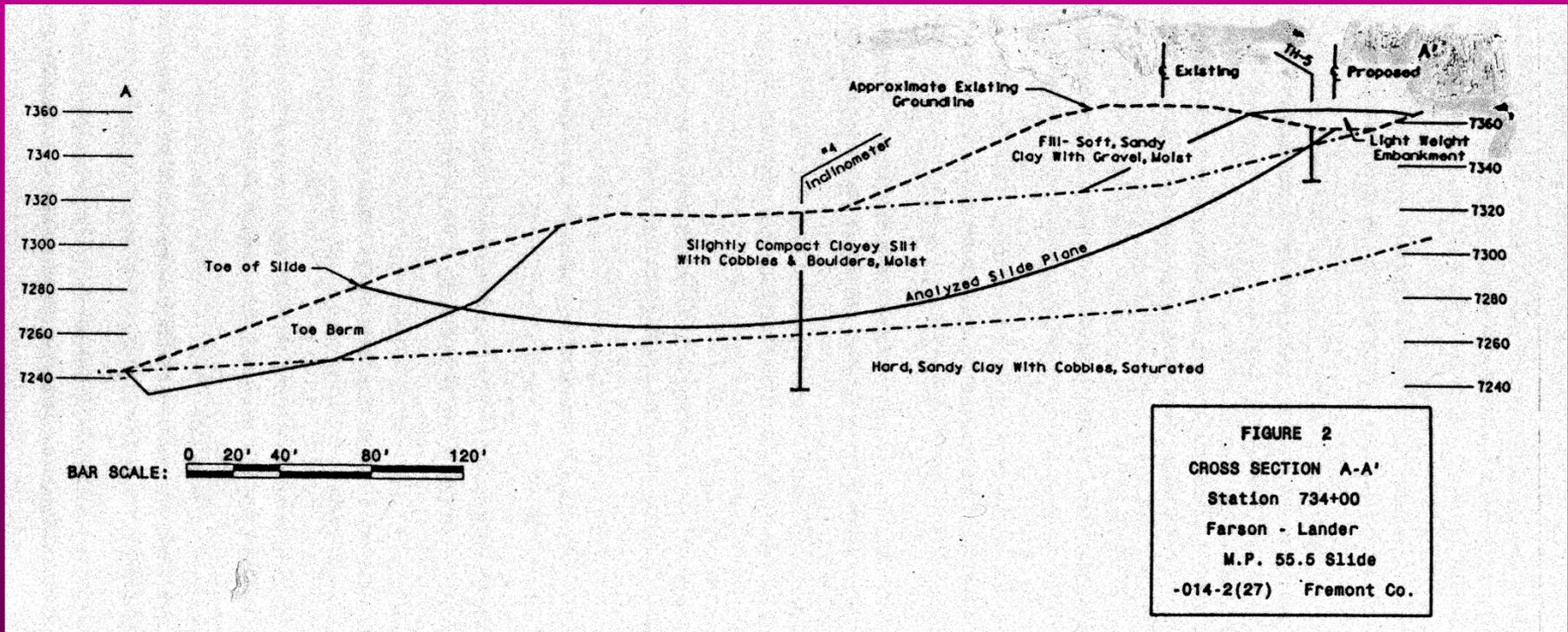
- Weak foundation soils
 - Increase slope stability
 - Reduce settlement
- Landslide stabilization

Double Nickel Slide

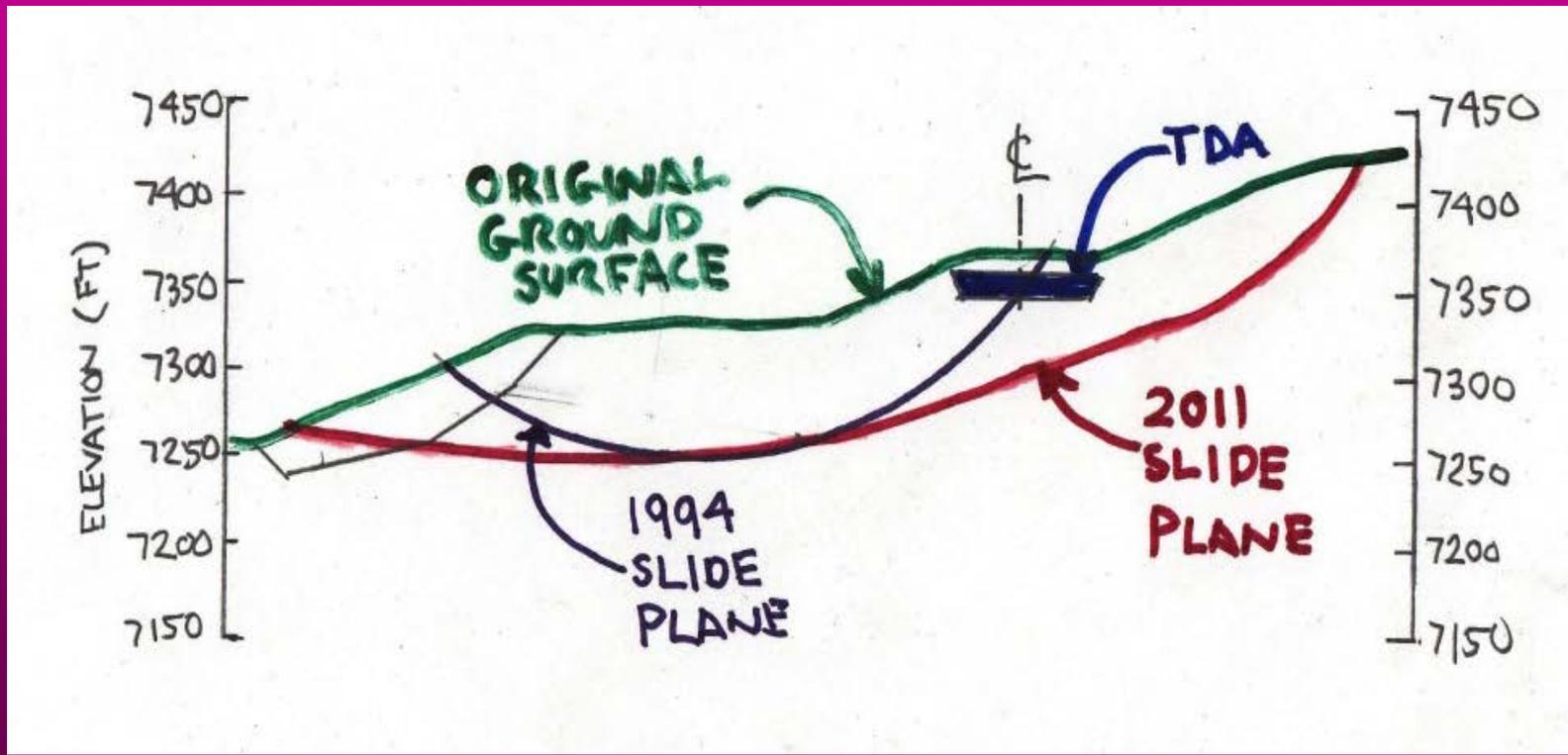
Route 28, South Pass, Wyoming

- PROBLEM: 1985 realignment initiated a slide
- SOLUTION:
 - 6-ft TDA layer as lightweight fill (500,000 tires)
 - Counterbalancing toe berm
 - Shift alignment
 - Lower grade
- COST: \$1.3-million
- LONG TERM: Continued movement; new stabilization program in 2012

Double Nickel Slide Route 28, South Pass, Wyoming



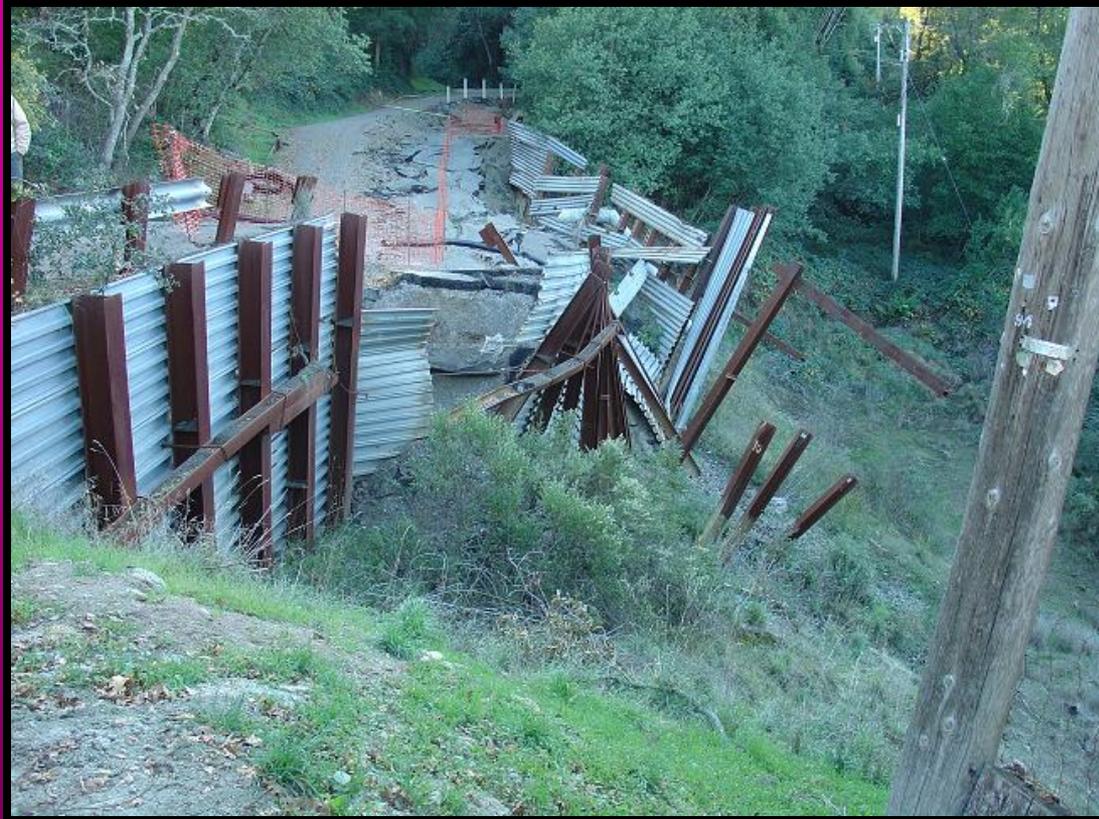
Comparison of assumed 1994 and 2011 slide surfaces



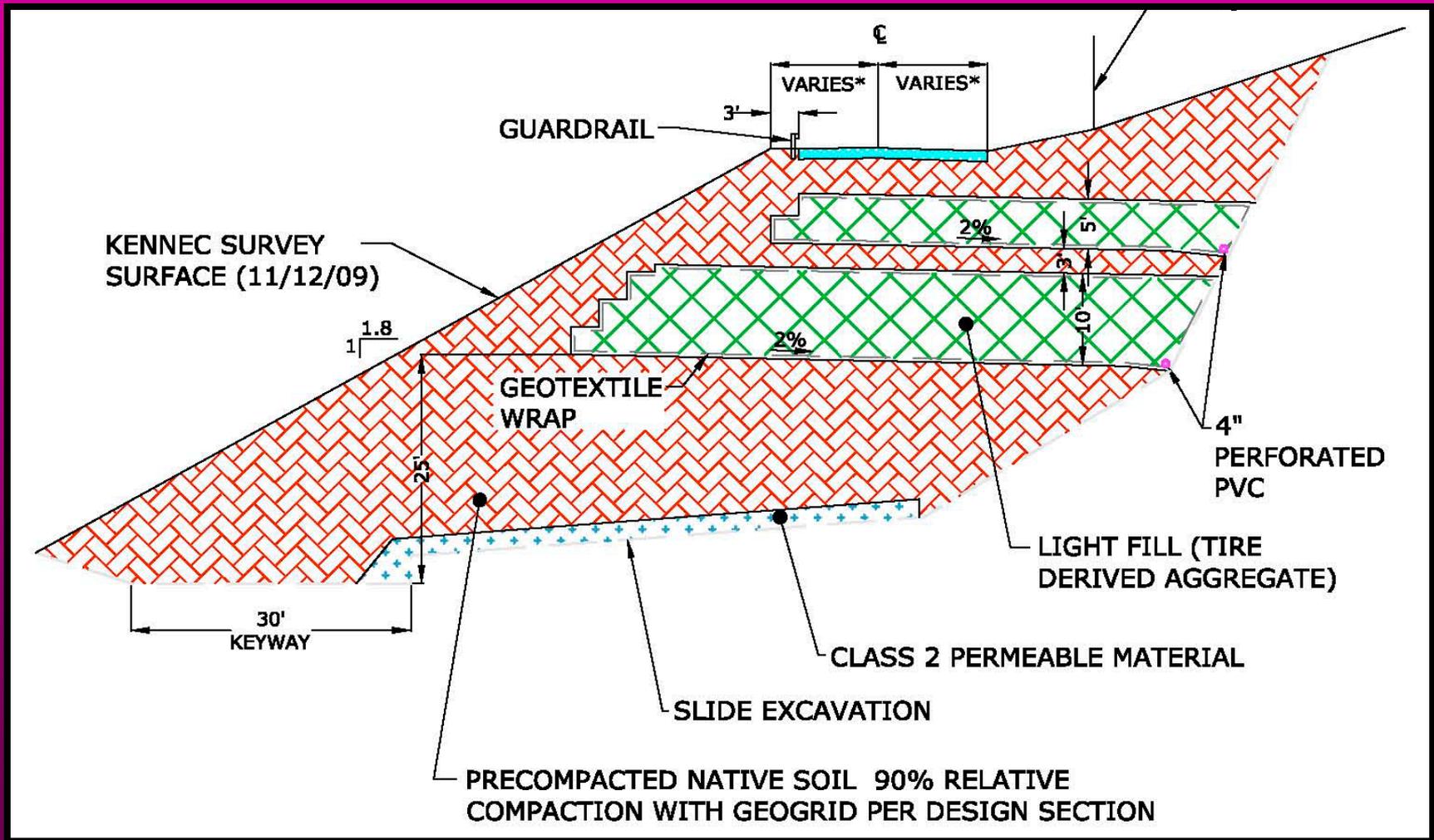
2012 Repairs

- Four rows of 12-in. diam. shear piles placed 6-ft on center
- Piles embedded minimum 20 ft below slide surface
- Construction cost: \$5.8-million

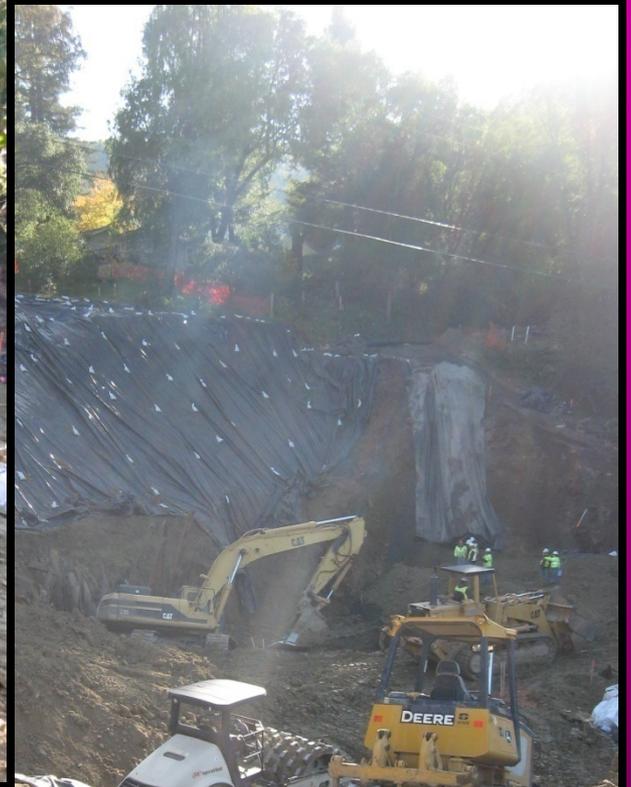
Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Sonoma Mountain Road slide repair



Why use TDA for retaining wall backfill?

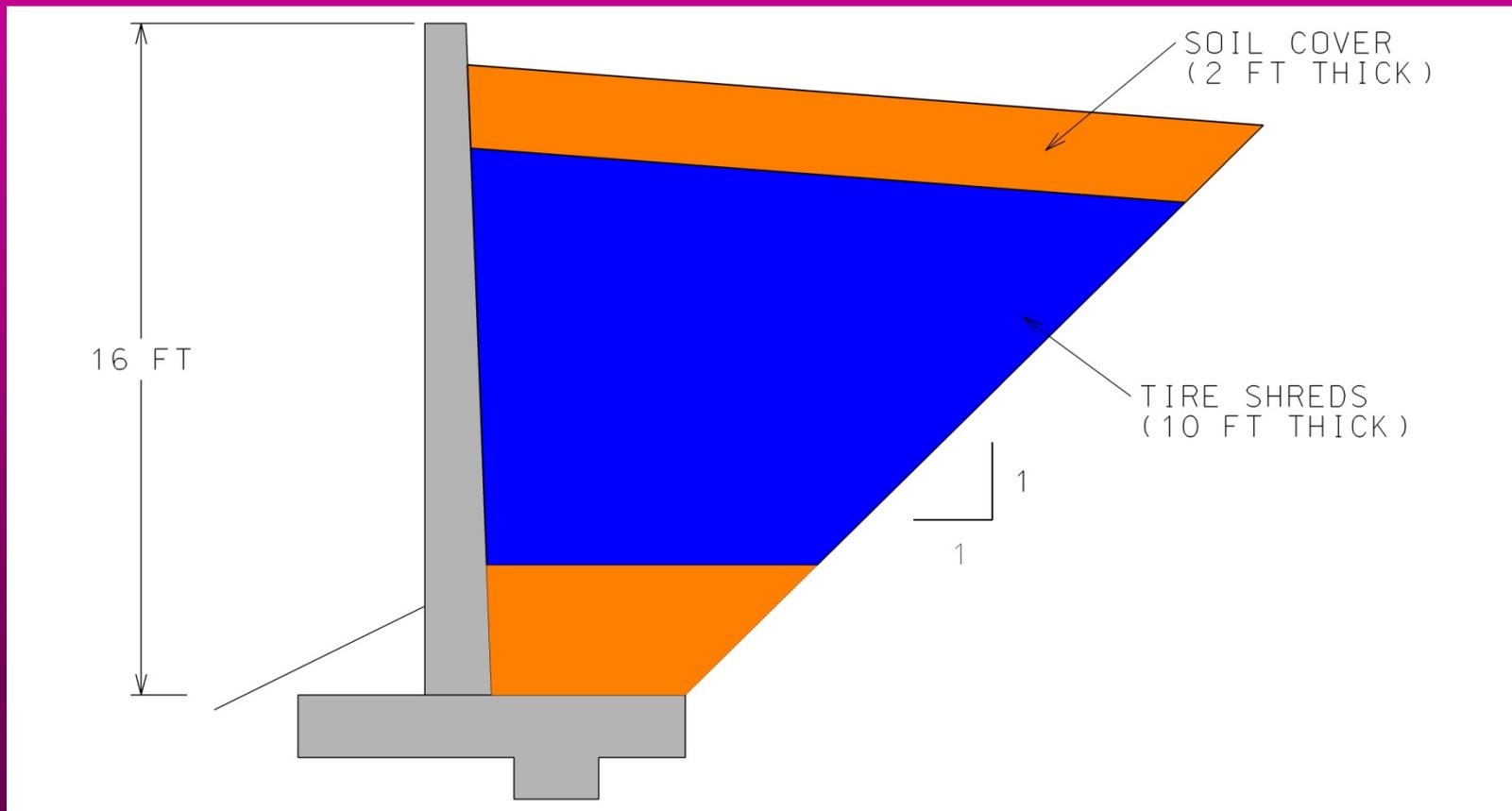
- Low unit weight (50 lb/ft³)
- Free draining ($k > 1$ cm/s)
- Good thermal insulation (8 x better than soil)
- 75 tires per YD³!



Rt. 91 Wall in Riverside, CA

- Freeway widening
- Objective: show that reduced earth pressures can reduce overall wall construction costs
- Length: 260 ft
- Tires used: 75,000 PTE

Rt. 91 wall cross section



Rt. 91 wall during construction



Unloading TDA



Spreading TDA



Compacting TDA



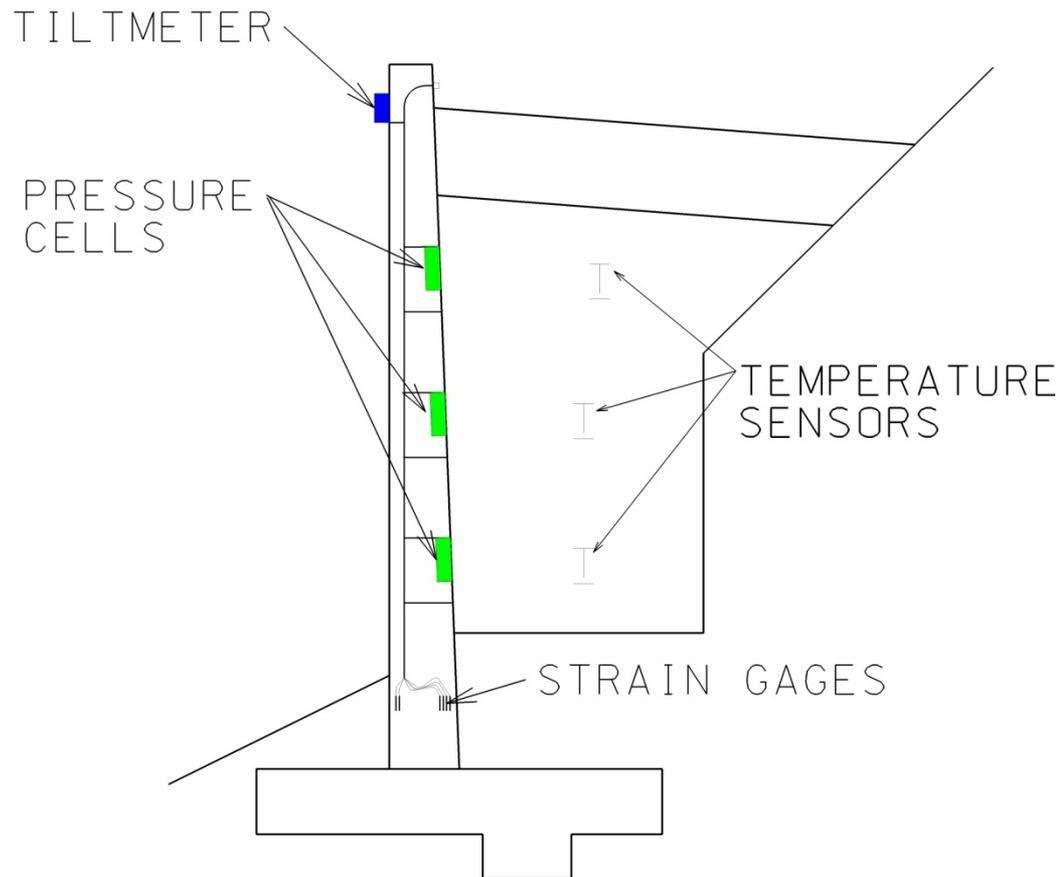
Close-up of TDA



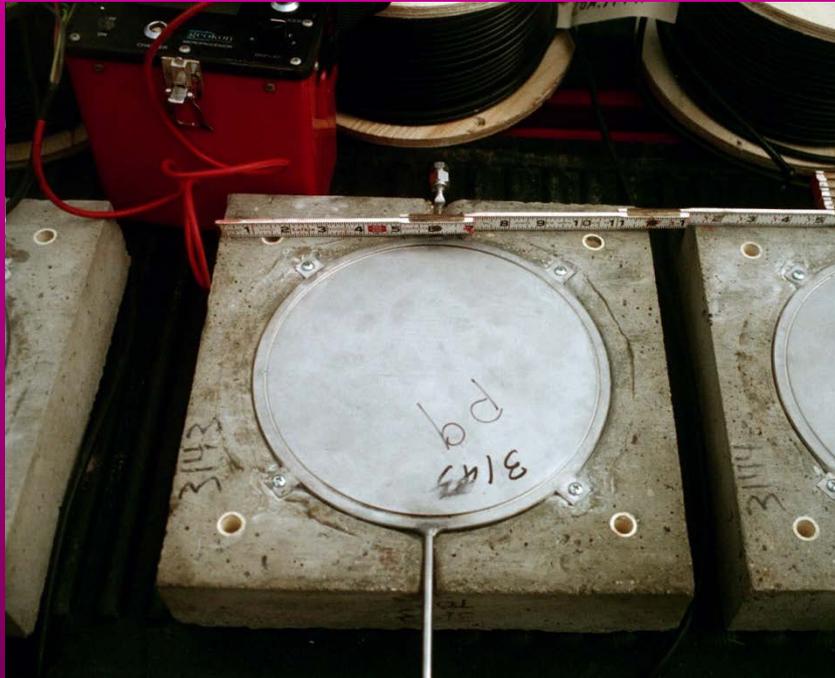
Half of TDA in Place



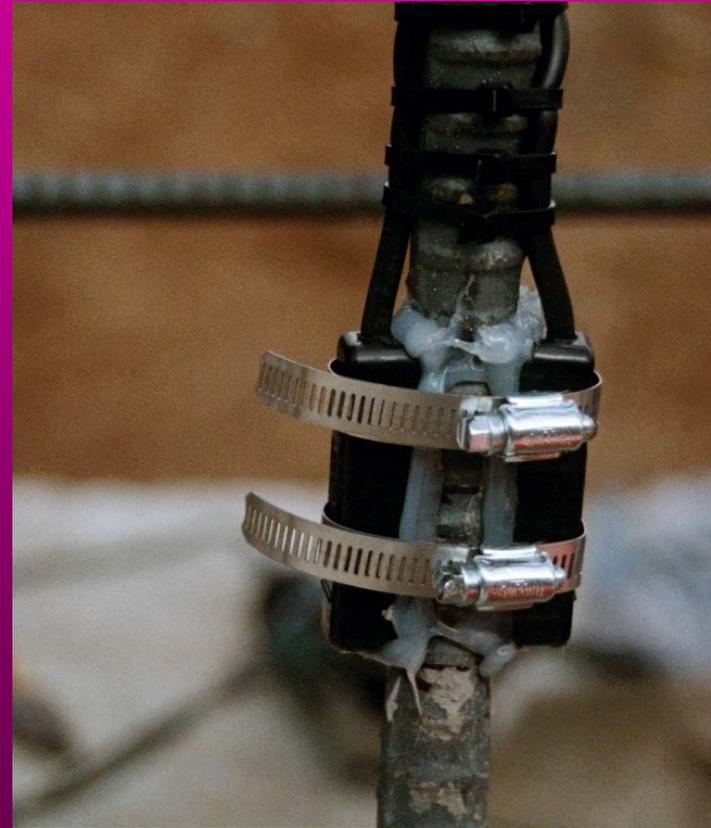
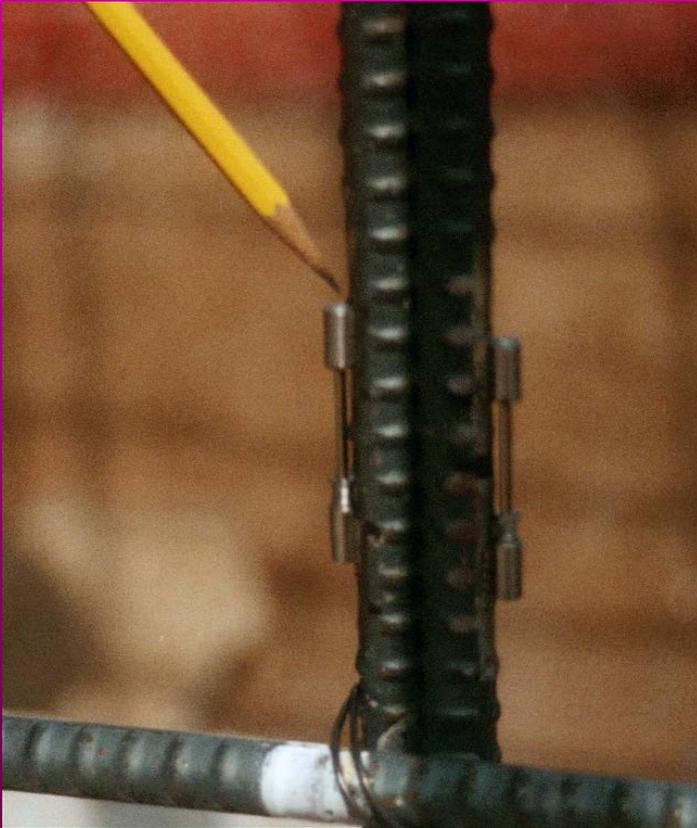
Rt. 91 wall instrumentation



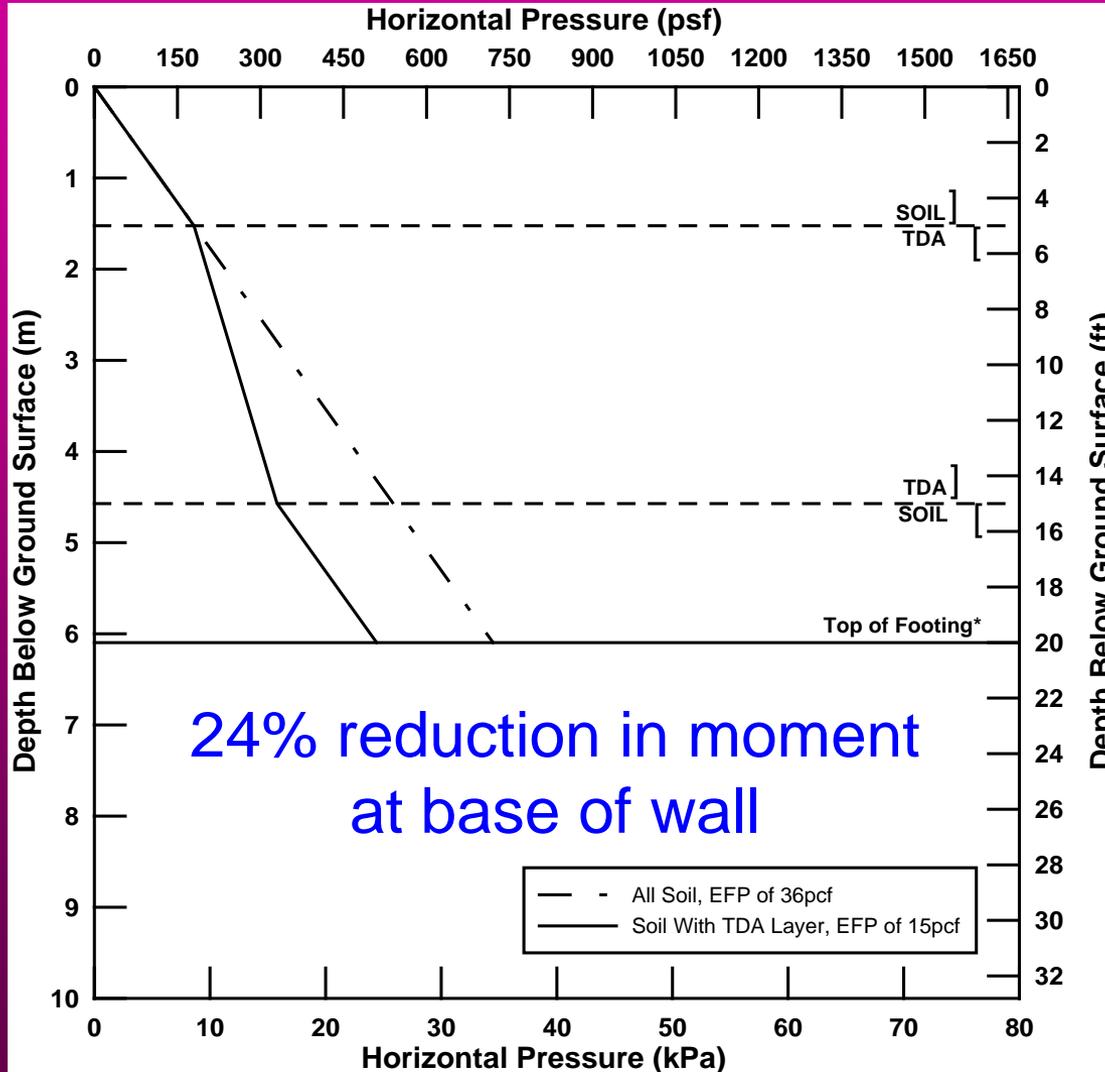
Rt. 91 pressure cells



Rt. 91 strain gages



Example of Potential Benefits

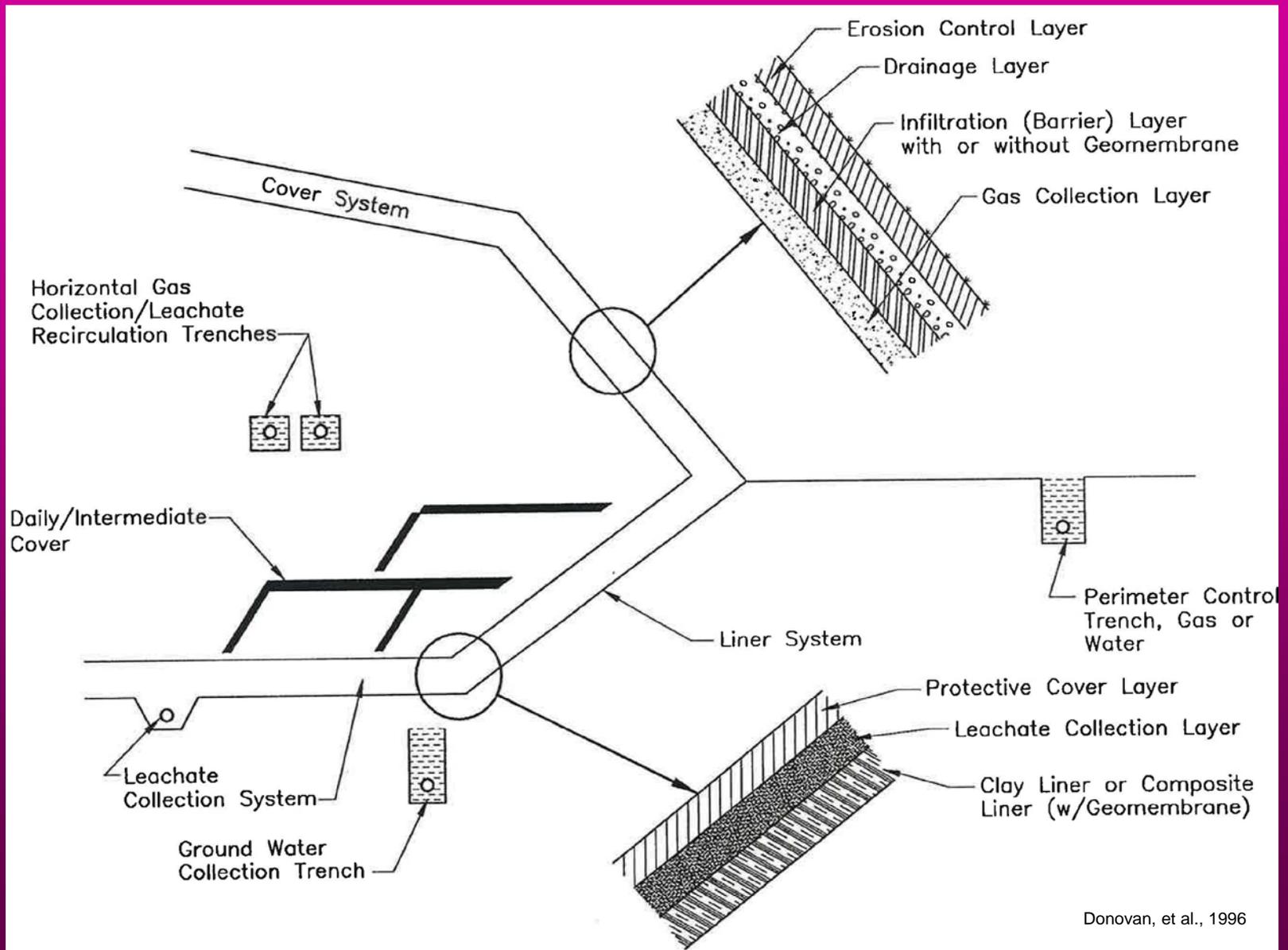


TDA FOR LANDFILL CONSTRUCTION

Why use TDA for landfill construction?

- High permeability*
- Cost savings
- Recycling (> 90,000 tires/acre)

TDA use in landfills



Use of TDA in Leachate Collection System



Key players:

Pasquale S. Canzano, P.E.

Delaware Solid Waste Authority

John J. Wood, P.E.

Camp Dresser and McKee

Joseph R. Matteo

Magnus Environmental Corp.

Dana N. Humphrey, P.E.

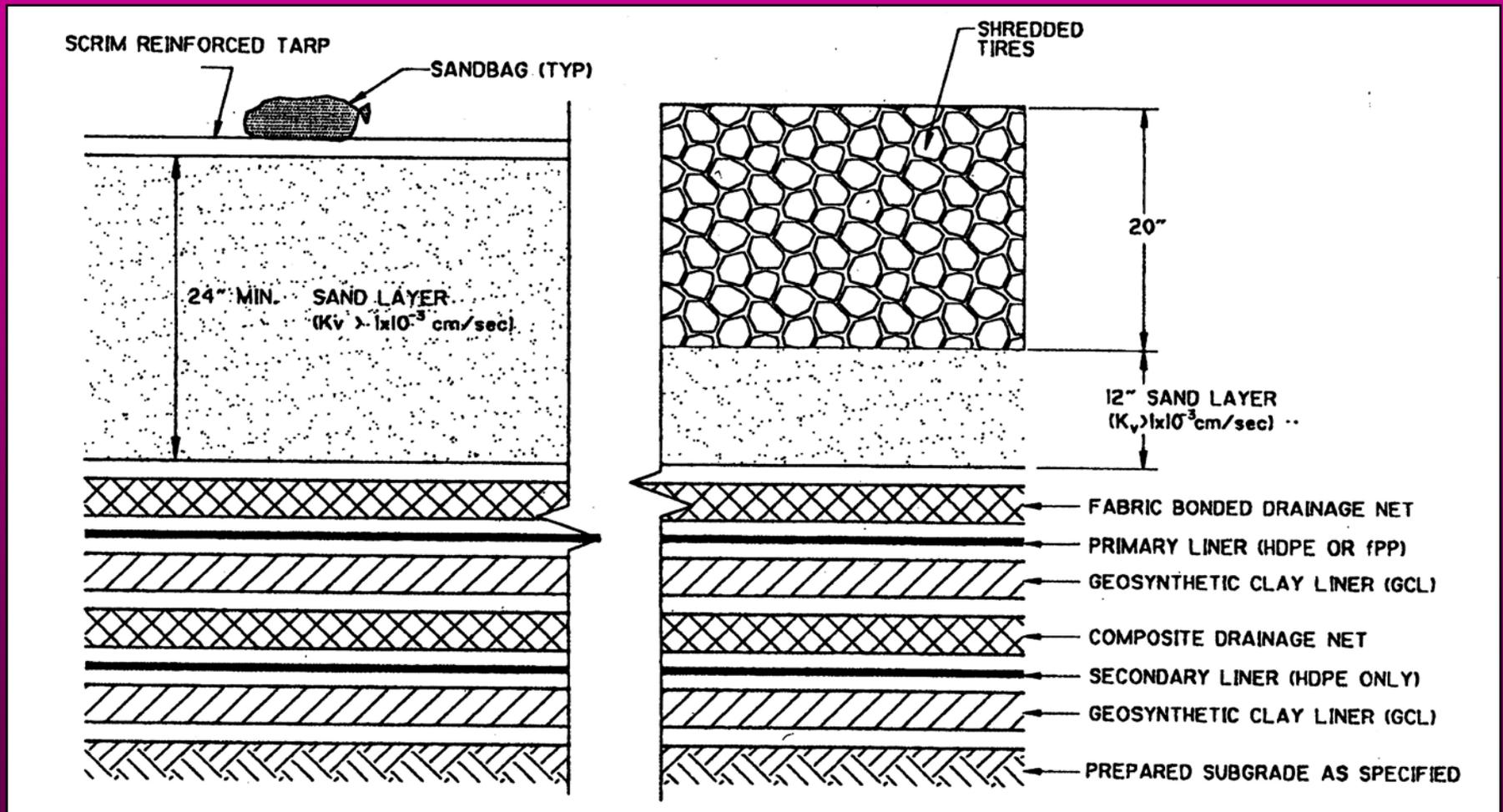
University of Maine



TDA in the leachate collection layer

- Use TDA in drainage layer
 - Drainage is important!
- Need to maintain a permeability similar to sand
- Used more than 1 million tires

Replace of a portion of the sand in the leachate collection layer



Size of TDA



Results of bid process

Contractor	Sand (\$/cy)	Tire Shreds (\$/cy)
A	\$ 8.33	\$ 7.88
B	\$ 11.25	\$ 12.75
C	\$ 11.60	\$ 20.93
D	\$ 11.25	\$ 12.75
E	\$ 9.00	\$ 10.50
F	\$ 18.00	\$ 54.00
G	\$ 15.00	\$ 12.00
Average	\$ 12.06	\$ 18.69

Results of bid process excluding one contractor

Contractor	Sand (\$/cy)	Tire Shreds (\$/cy)
A	\$ 8.33	\$ 7.88
B	\$ 11.25	\$ 12.75
C	\$ 11.60	\$ 20.93
D	\$ 11.25	\$ 12.75
E	\$ 9.00	\$ 10.50
F	\$ 18.00	\$ 51.00
G	\$ 15.00	\$ 12.00
Average	\$ 11.07	\$ 12.80

CASE HISTORY - Chaquita Landfill, Los Angeles County, CA

- 3-ft x 3-ft trenches excavated into existing waste; perforated pipe placed in center
- TDA covered with geotextile

Chaquita Landfill



Chaquita Landfill



Conclusions

- TDA has properties that engineers need
- TDA can be cost effective
- Civil engineering applications an important use for scrap tires
 - Multiple highway and landfill applications
- Specifications and guidelines available
- Negligible environmental effects



QUESTIONS?