
WG WatershedGeo®
Unearthing Solutions®
ClosureTurf®
Environmental Final Closure Solutions

Outline and Objectives

- Introductions
- ClosureTurf® Technology / Advantages
- Projects Case Study Discussion
- Open Discussion: Install, Cost & Maintenance

About Agru America…

AGRU
Kunststofftechnik GmbH
Bad Hall (Austria)

AGRU
Oberflächentechnik GmbH
Grünburg (Austria)

AGRU-FRANK GmbH
Wölfersheim (Germany)

AGRU America
Fernley (Nevada/USA)

AGRU America
Georgetown
(South Carolina/USA)

AGRU America
Andrews (South Carolina/USA)

Pennwalt AGRU Plastics Ltd.
Vadodara (Gujarat/India)

AGRU
China

WatershedGeo® Unearthing Solutions®

About Watershed Geosynthetics…

- Company founded in 2007 by Civil Engineers
- Based in Alpharetta, GA
- Over 100…
  - Years of landfill experience
    - Design, Construction, Maintenance and Management
  - Years of geosynthetic experience
  - Individual sites managed through closure & post-closure
  - Minority ownership held by Shaw Industries, A Berkshire Hathaway Company

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Shaw

BERKSHIRE HATHAWAY INC.

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Introduction to ClosureTurf

- Features and Benefits
- Key Performance Properties
- Projects

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- ClosureTurf ® is <u>NOT an exposed cover</u> system.

- ClosureTurf provides protection of the geomembrane by the added Geosynthetic layer (Engineered Turf). It is a "Hybrid" system that has all the advantages of a soil cover protection with out the disadvantages.

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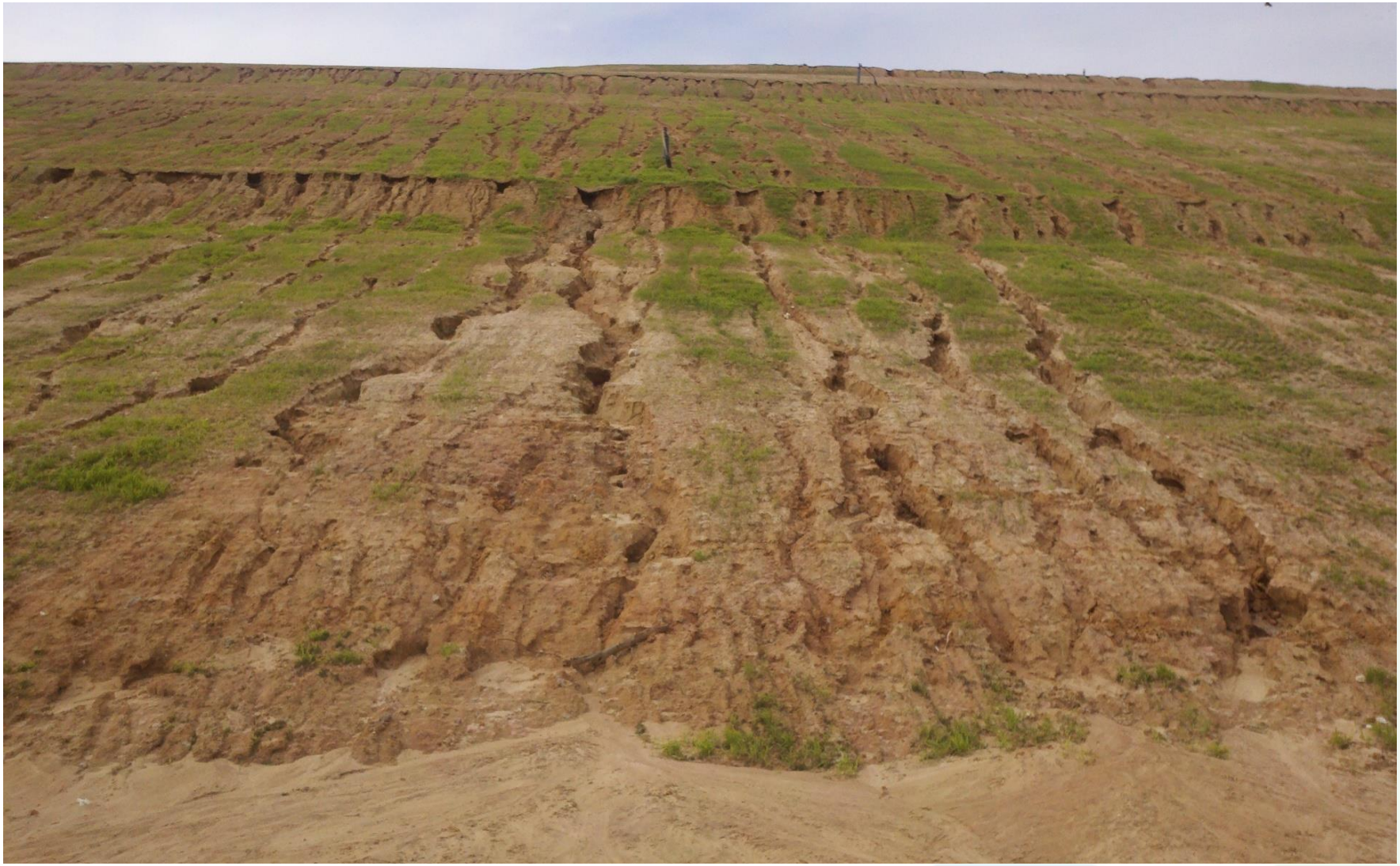

Slow Erosion Failures

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Desiccation and poor vegetative support

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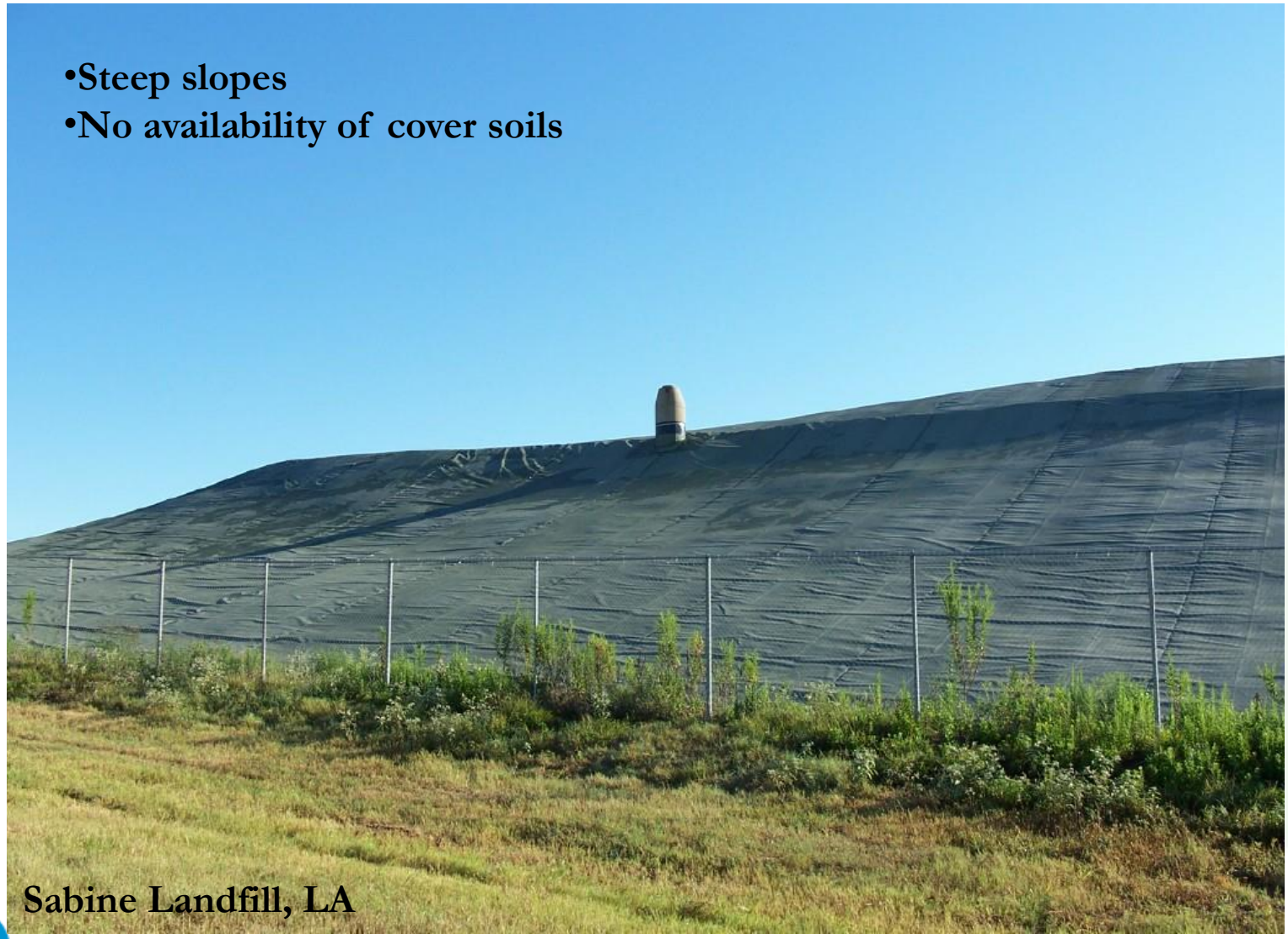
Veneer slope failure

Early Approaches



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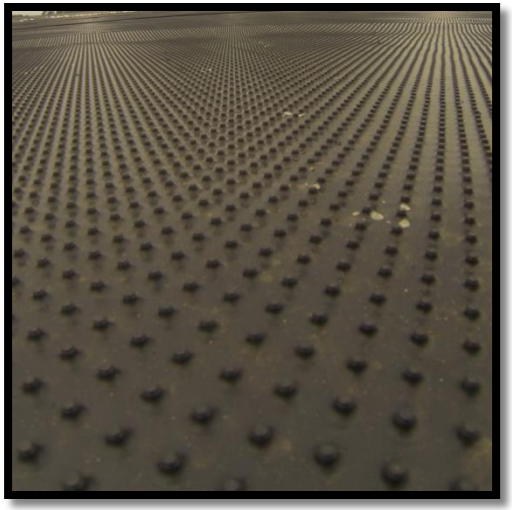
What is ClosureTurf®?



Three component system

1. Structured Geomembrane (Agru America)
2. Engineered Synthetic Turf
3. Infill – ASTM C-33 Sand, ArmorFill™ or HydroBinder®

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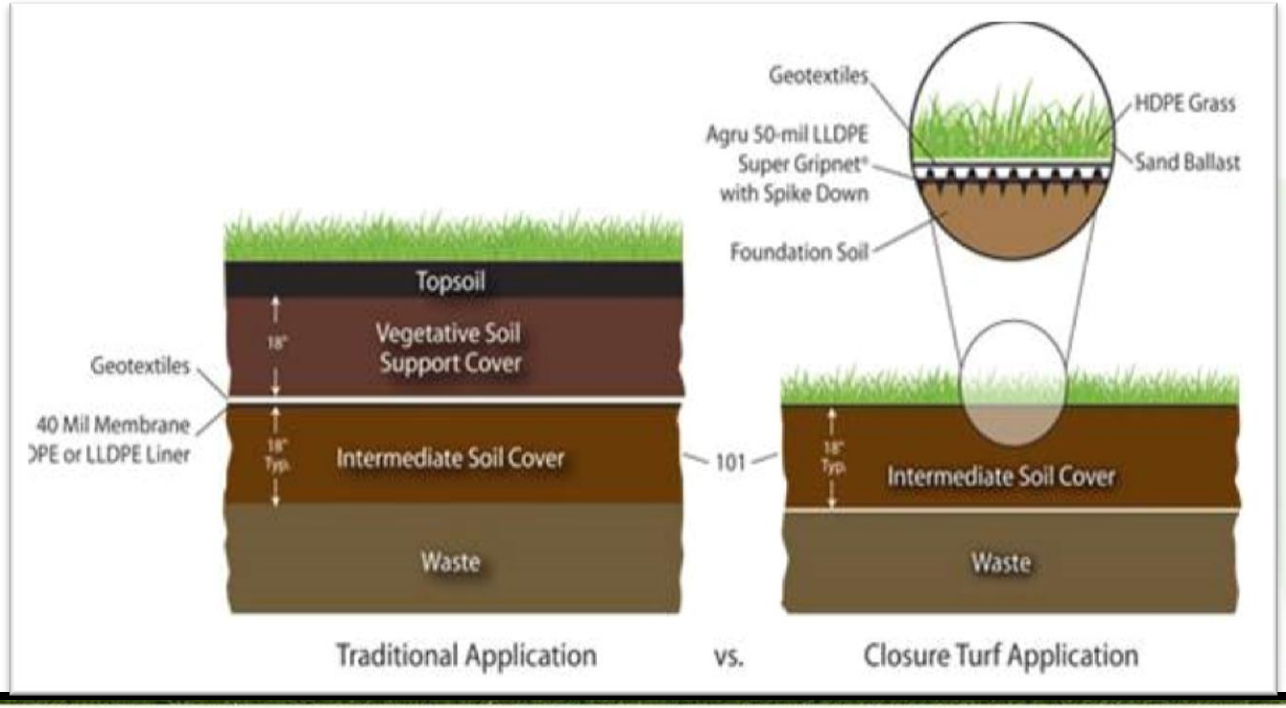
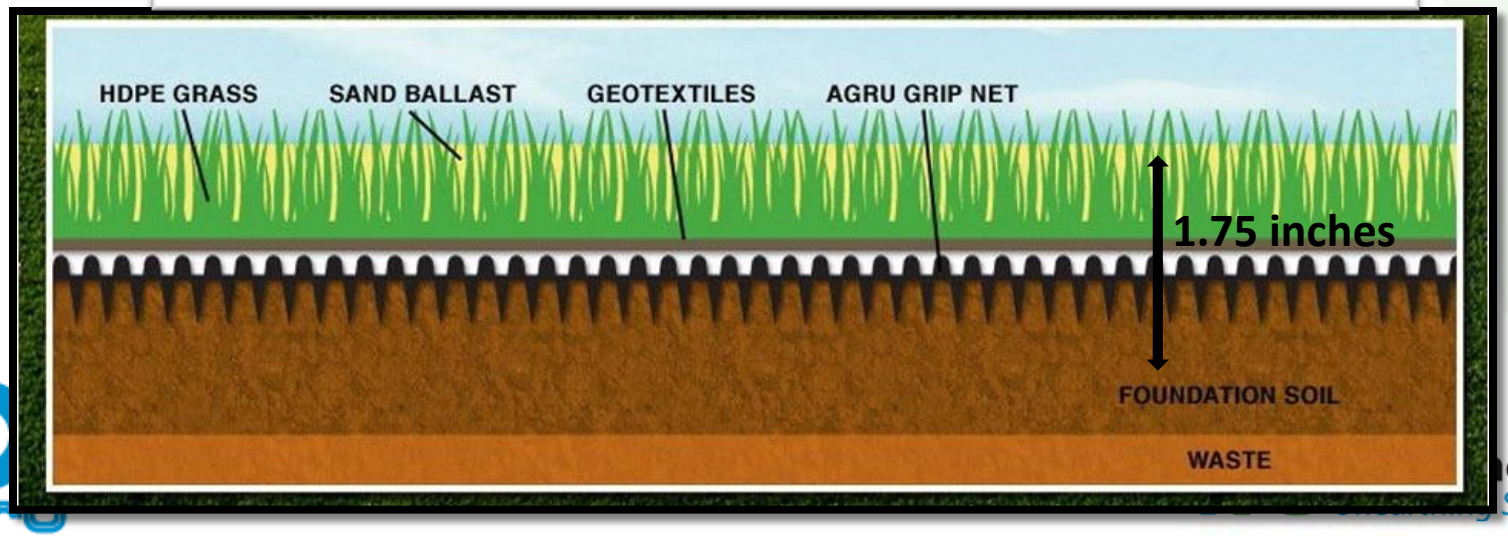
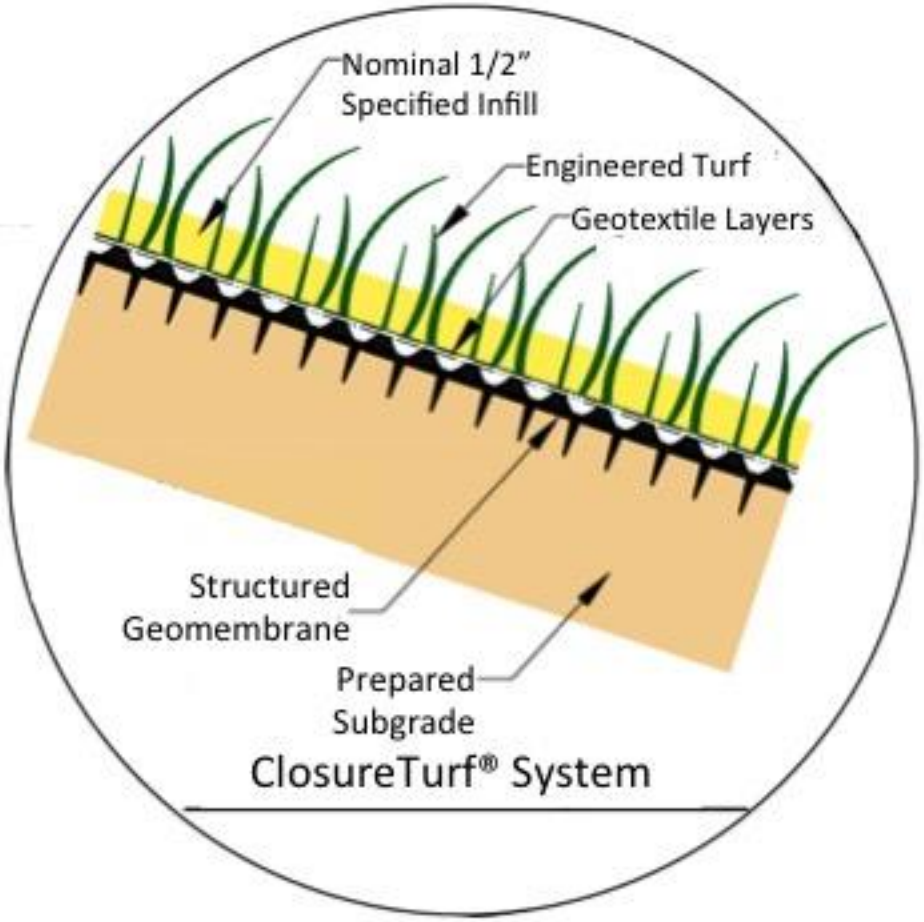
Traditional vs. ClosureTurf





ClosureTurf® Section



CLOSURETURF INTERVIEWS

https://www.youtube.com/watch?v=HNBImCJToX0

System Features and Benefits

- Exceeds technical performance criteria established by EPA Subtitle D:
  - Significantly less leakage rate (HELP Model and JP Giroud Model)
  - Less Erosion (5 to 10 cy per acre per year for soil cover vs. negligible for CT)
  - Longevity (on-going maintenance in perpetuity for soil versus well over 100 plus years of stability for CT)

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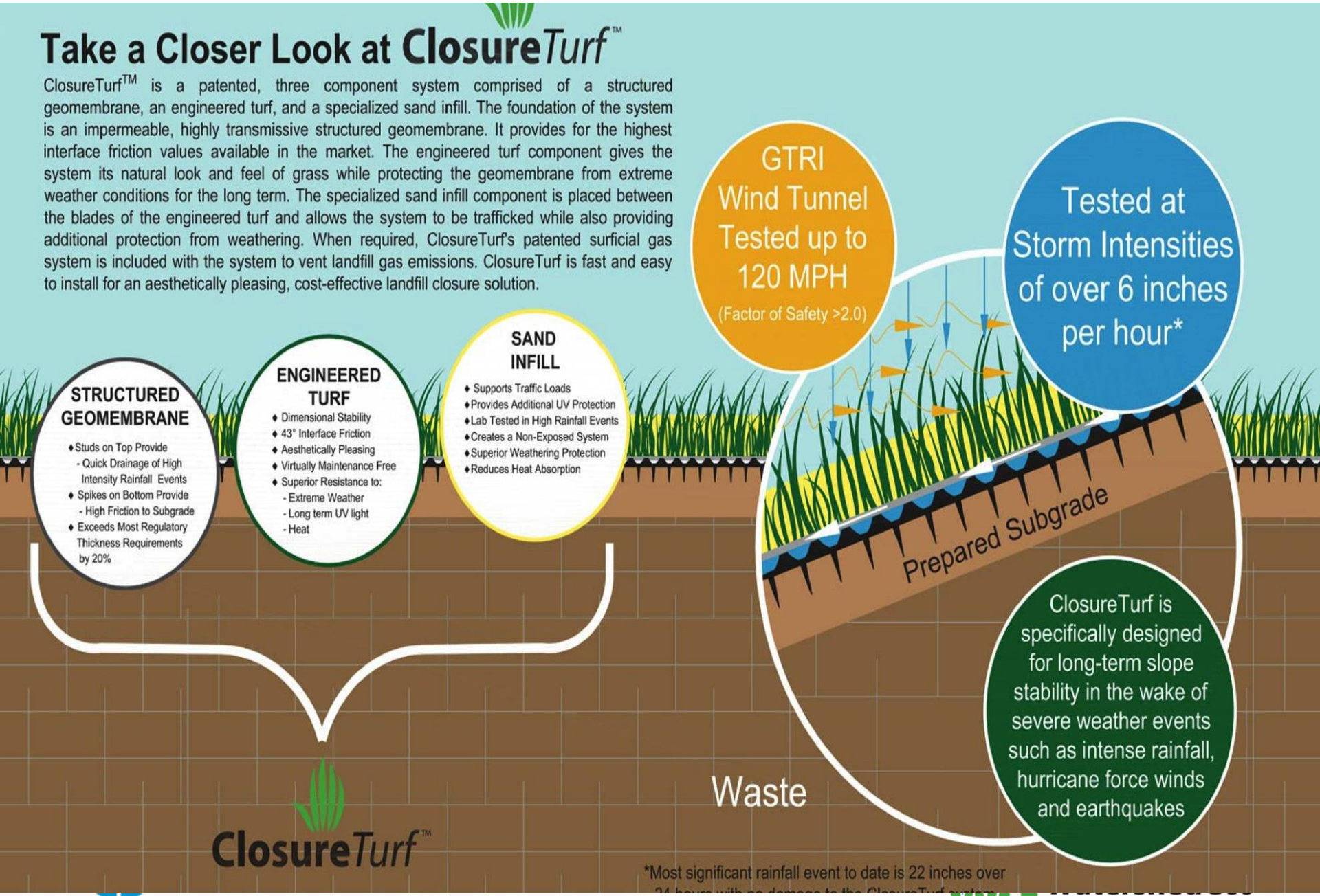
Take a Closer Look at ClosureTurf™

ClosureTurf™ is a patented, three component system comprised of a structured geomembrane, an engineered turf, and a specialized sand infill. The foundation of the system is an impermeable, highly transmissive structured geomembrane. It provides for the highest interface friction values available in the market. The engineered turf component gives the system its natural look and feel of grass while protecting the geomembrane from extreme weather conditions for the long term. The specialized sand infill component is placed between the blades of the engineered turf and allows the system to be trafficked while also providing additional protection from weathering. When required, ClosureTurf's patented surficial gas system is included with the system to vent landfill gas emissions. ClosureTurf is fast and easy to install for an aesthetically pleasing, cost-effective landfill closure solution.



*Most significant rainfall event to date is 22 inches over

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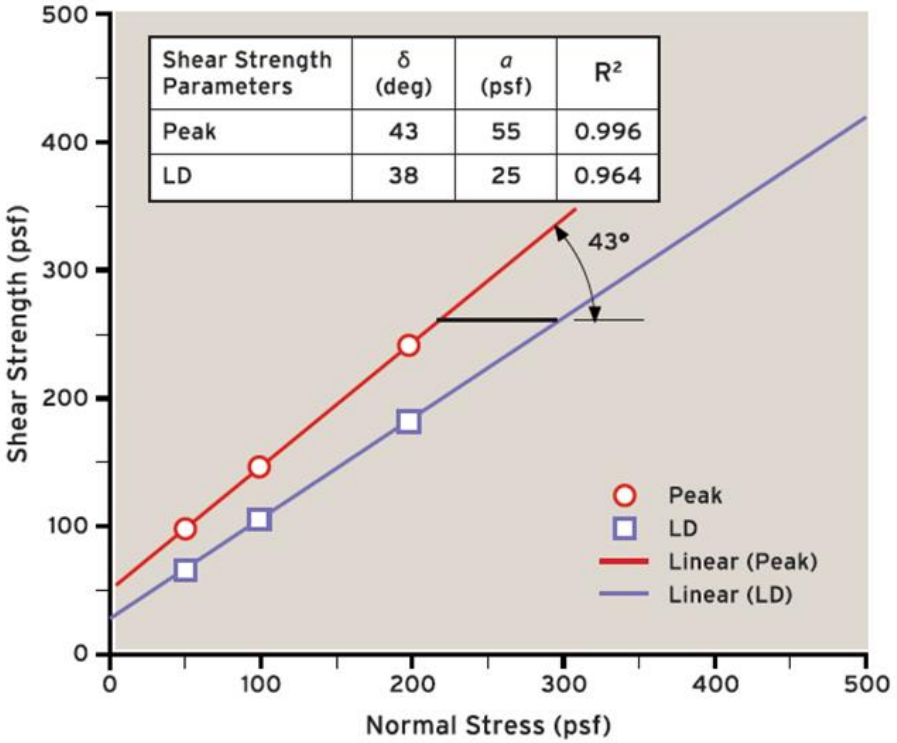
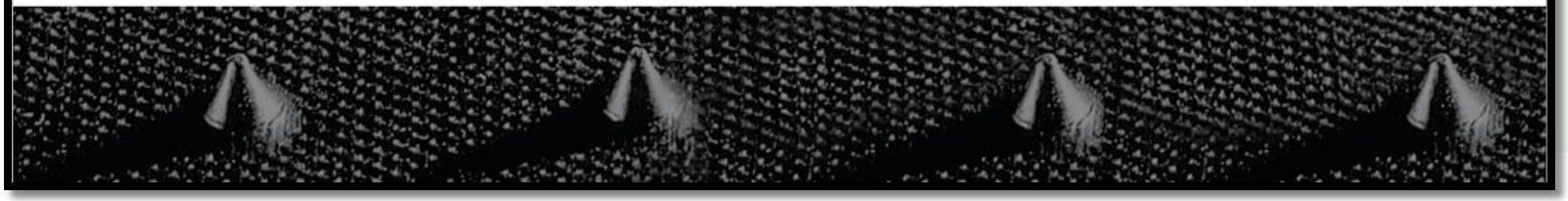
Turf and SGN Interface Evaluation

Slope angle	Slope	SF
33	1.5H: 1V	1.4
26	2.0 H: 1V	1.9
18	3.0H: 1V	2.8
14	4.0H: 1V	3.7





Interface Friction Evaluation and Slope Stability ASTM D-5321

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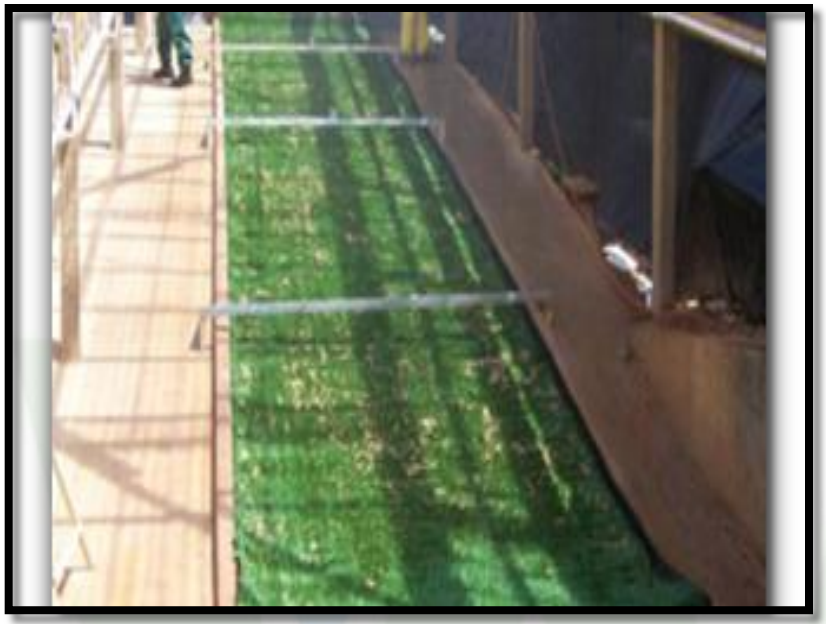

Hydraulic Performance Testing Program

- CSU Hydraulic Lab (ASTM D-7276 and ASTM D-7277)

-TRI Facility in South Carolina (ASTM D-6459 and ASTM D-6460)

- Tests replicate rain induced forces and concentrated flow forces

- Results concluded that the System outperforms vegetation and hard armor technologies in both instances

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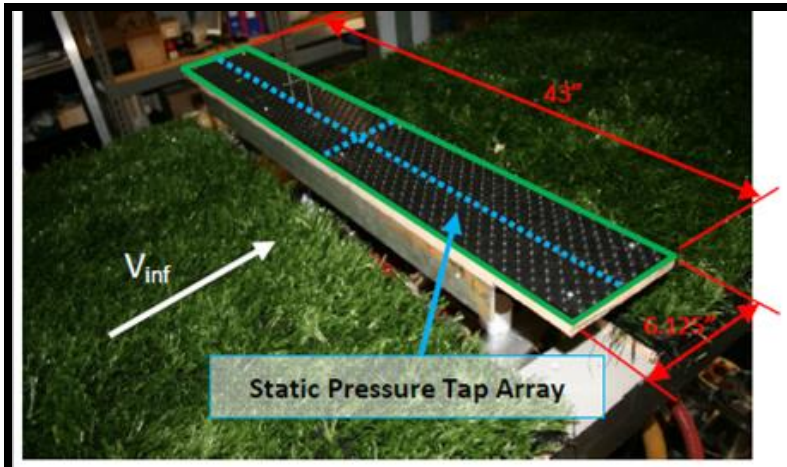


Figure 1a – Model Before Final Turf Layer

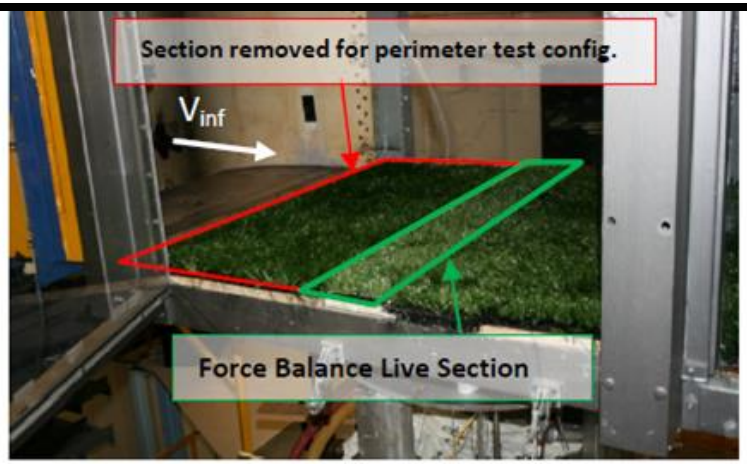
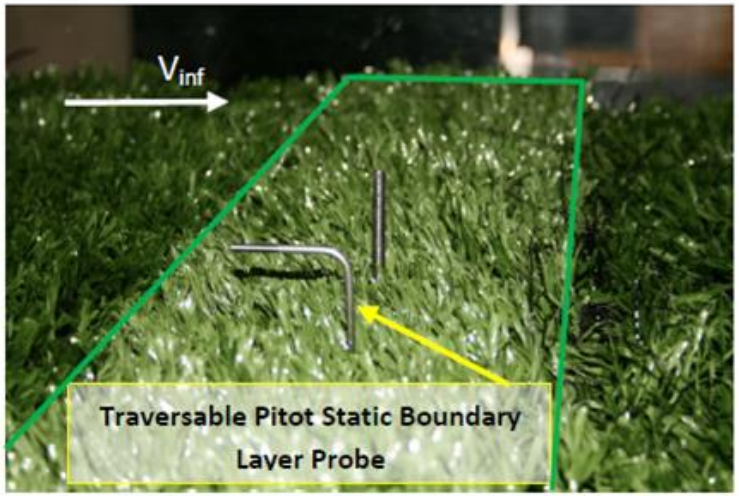
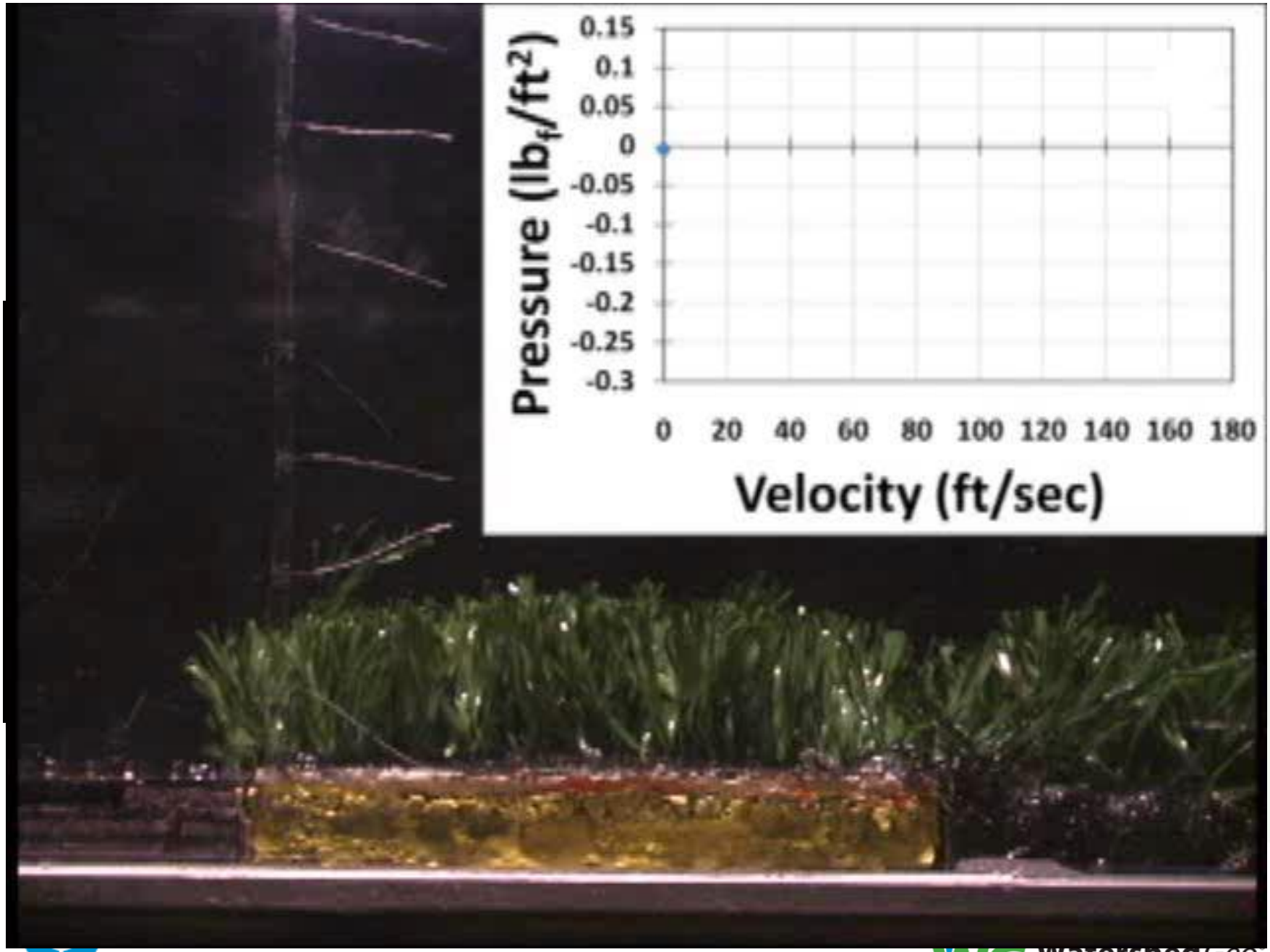
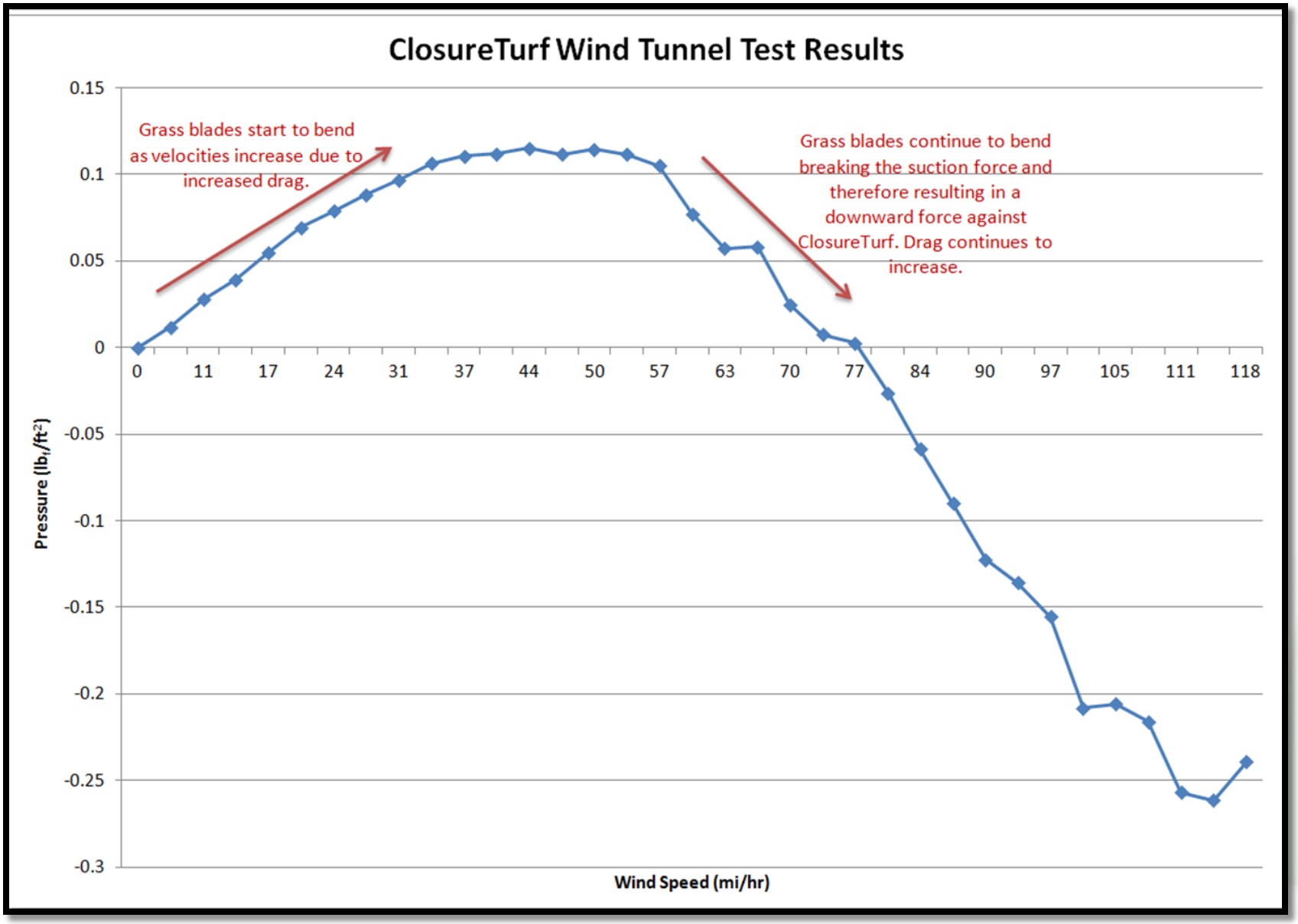


Figure 1b – Turf Installed & Model Lowered



Wind Tunnel Testing at Georgia Tech Research Institute





Resists Hurricane Force Winds (Category 3)

LONGEVITY

SAMPLING OF WEATHERED MATERIAL

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WEATHER AND UV RESISTANCE

- Great advancements in UV resistance of PE and PP
- Real world testing conducted at the Atlas Weathering Facility in New River, AZ
- Over ten years of data collected
- More than three (3) times the Tensile Strength is retained in the system when projected to 100 years

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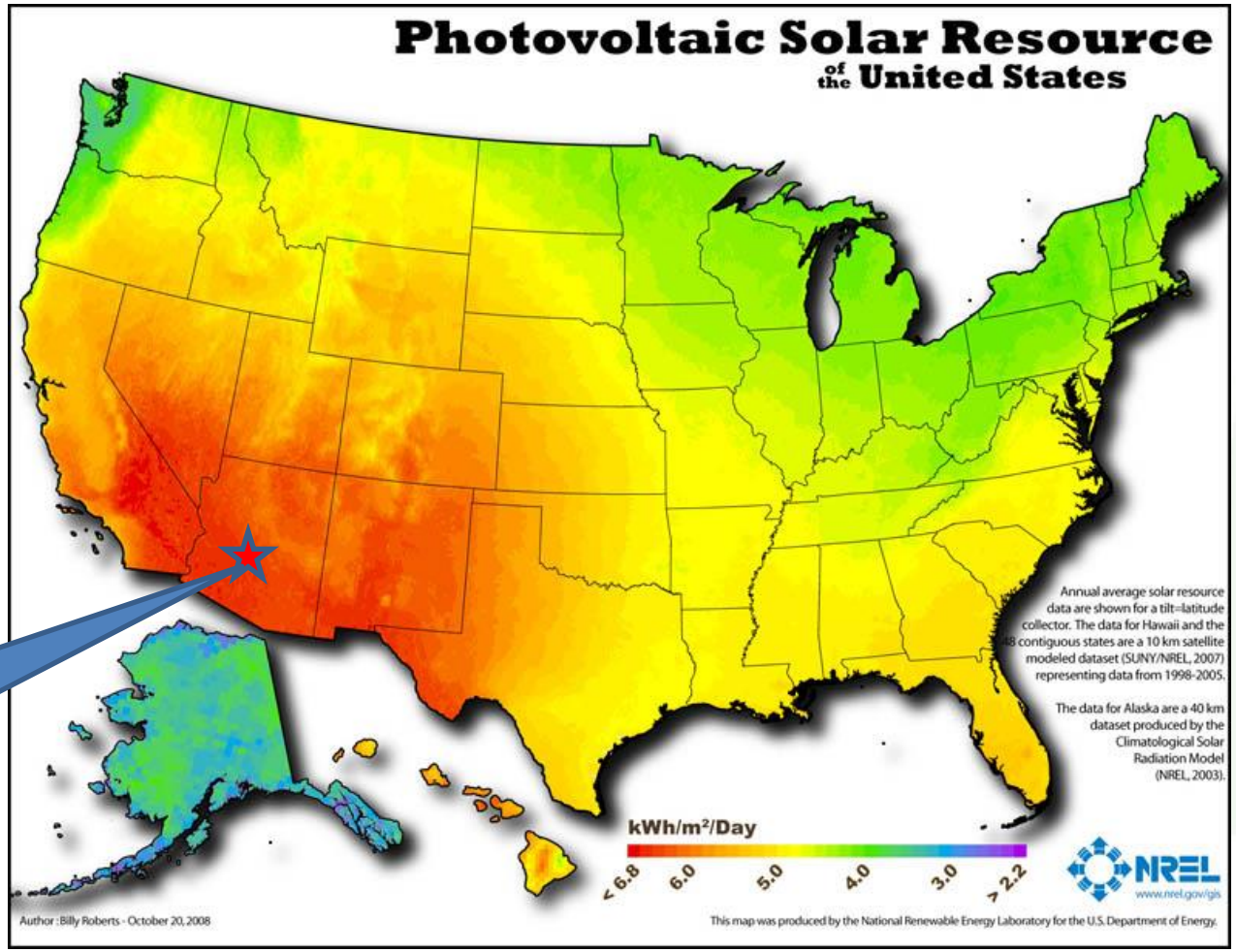
SYNTHETIC TURF FIBERS (PE) - FUNCTIONAL LONGEVITY

UV RESISTANCE (1)

- Direct Exposure 45° South
- ASTM G147 and G7
- Four (4) Exposure Durations
  - 11,280 hours (1.3 years),
  - 43,800 hours (5 years),
  - 61,320 hours (7 years), and
  - 87,600 hours (10 year)

Atlas Weathering Laboratory in New River, AZ



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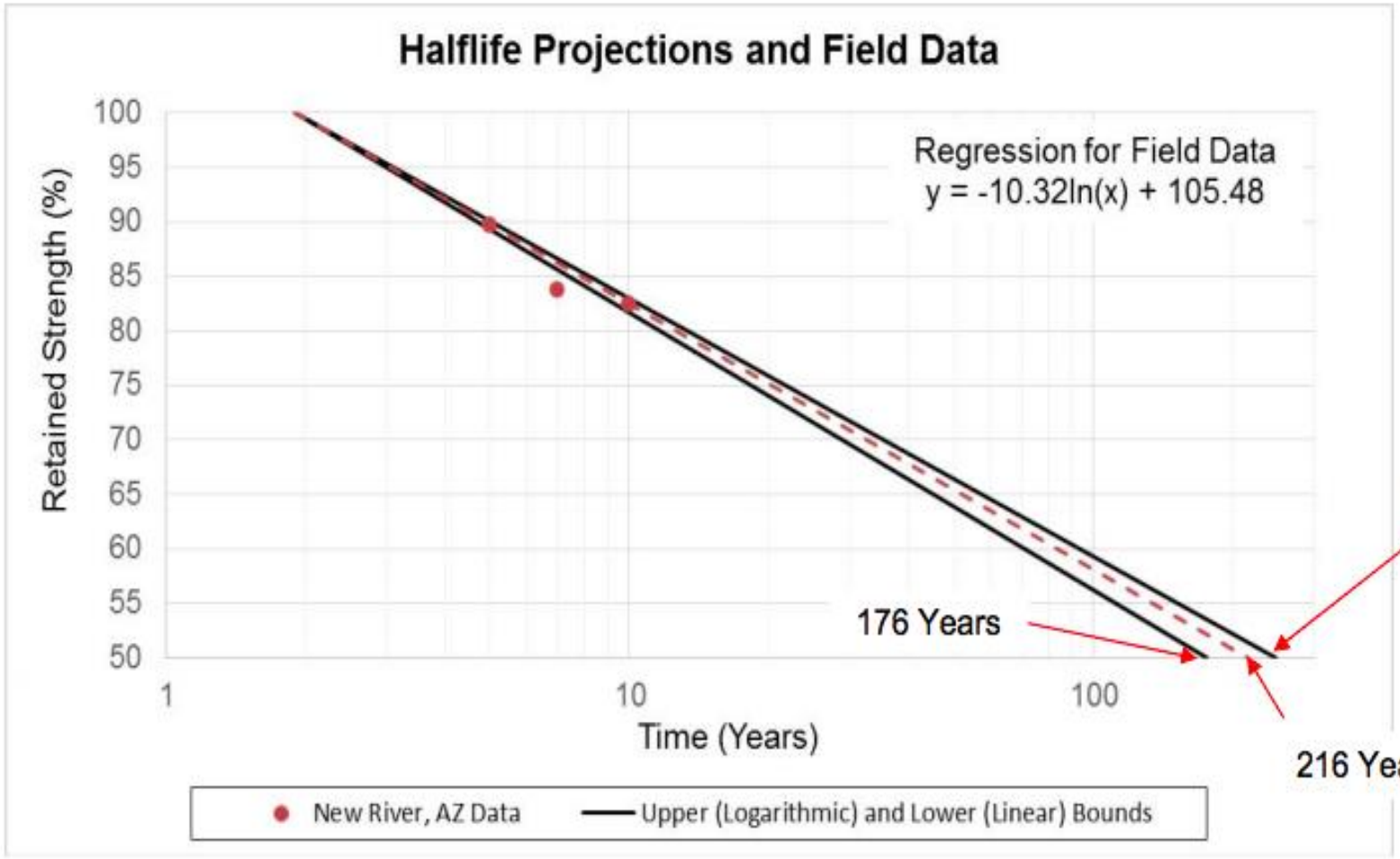

LONGEVITY ANALYSIS

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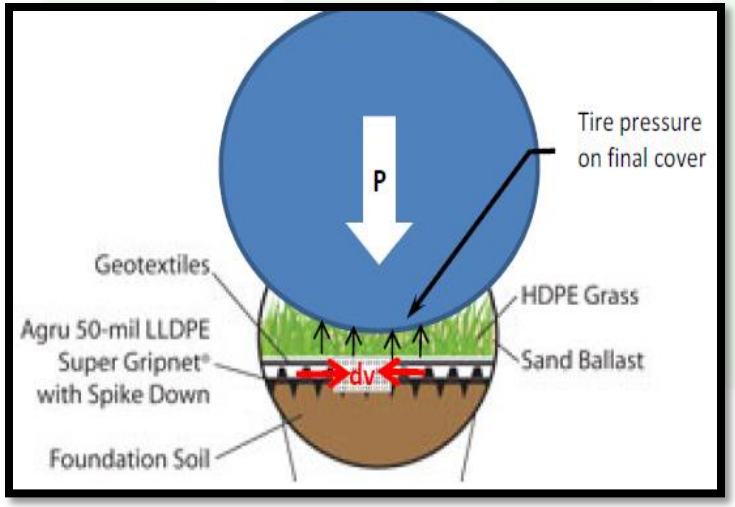
Increased Geotechnical Stability



Factors of Safety for heavy vehicle static weight and braking forces all above 1.5

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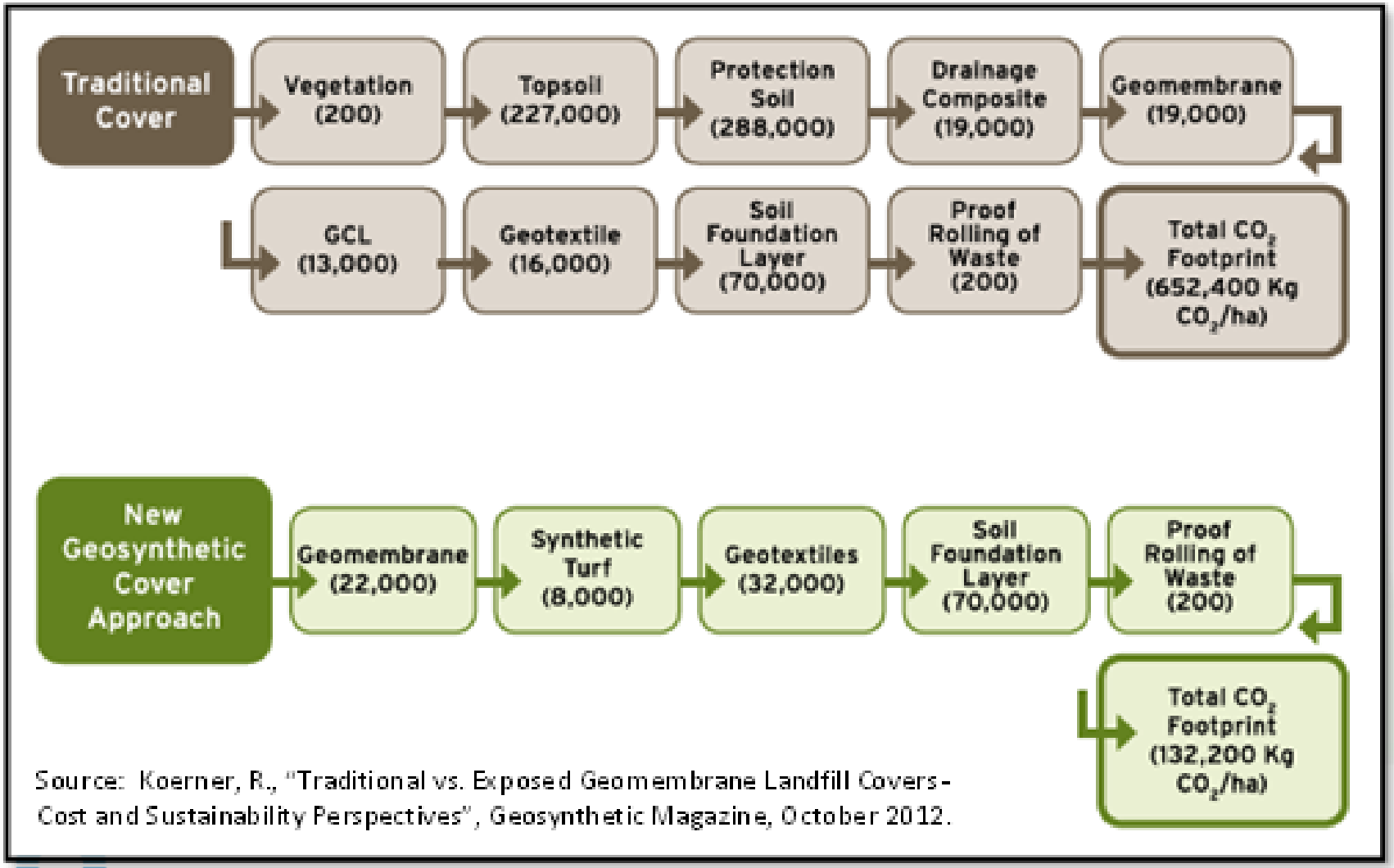
- **CT's carbon footprint = ~20% of traditional soil cover**



Source: Koerner, R., "Traditional vs. Exposed Geomembrane Landfill Covers - Cost and Sustainability Perspectives", Geosynthetic Magazine, October 2012.

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Case Studies

Over 25,000,000 square feet in service.

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Increased Stability

- Industrial site in SE US
- 70 acres, wet industrial sludge
- CBR <1 in upper ~10’ (3 m)
- Closed w/ClosureTurf in 2014 without fully dewatering
  - Precipitation eliminated
  - Dewatering continues
  - Settled areas to be filled and capped accordingly
- Closure of 68 acres additional acres underway.

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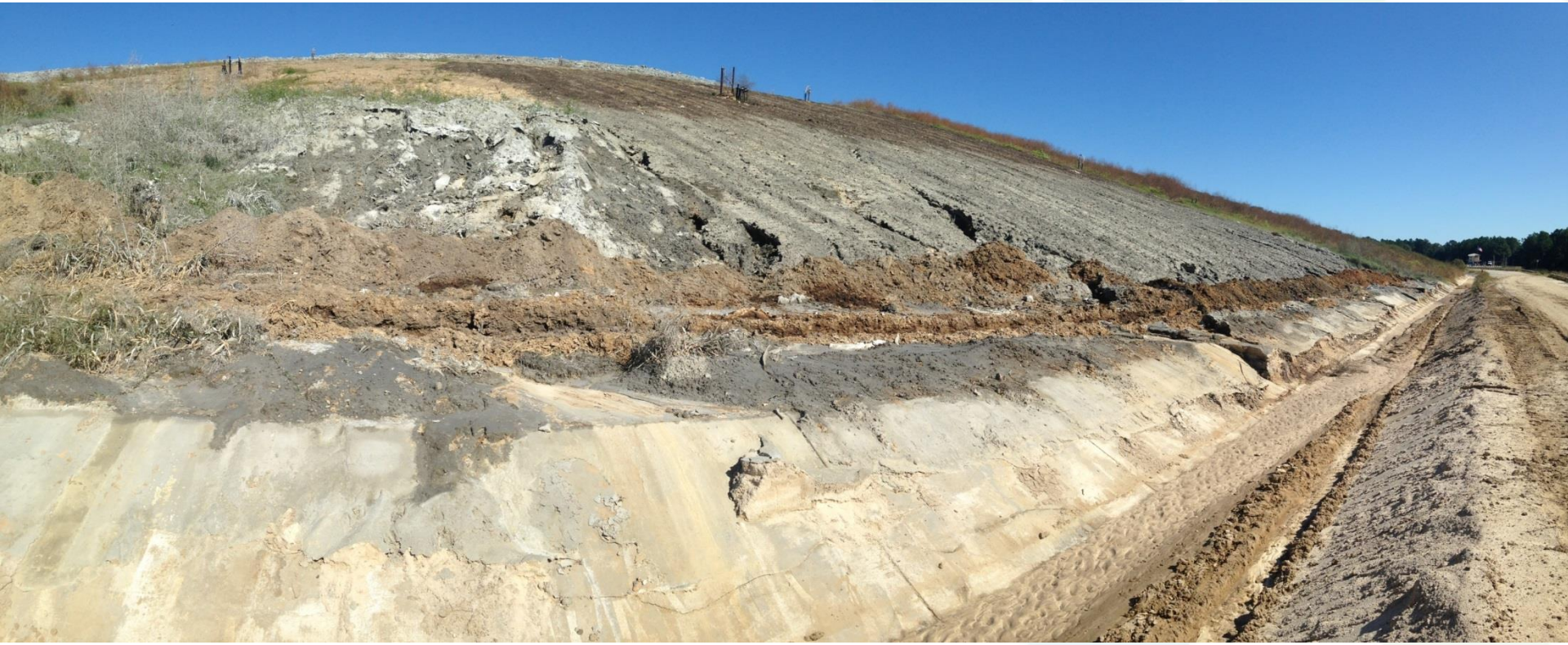
70-Acre ASH and Sludge

CKD Landfill Catskill, New York



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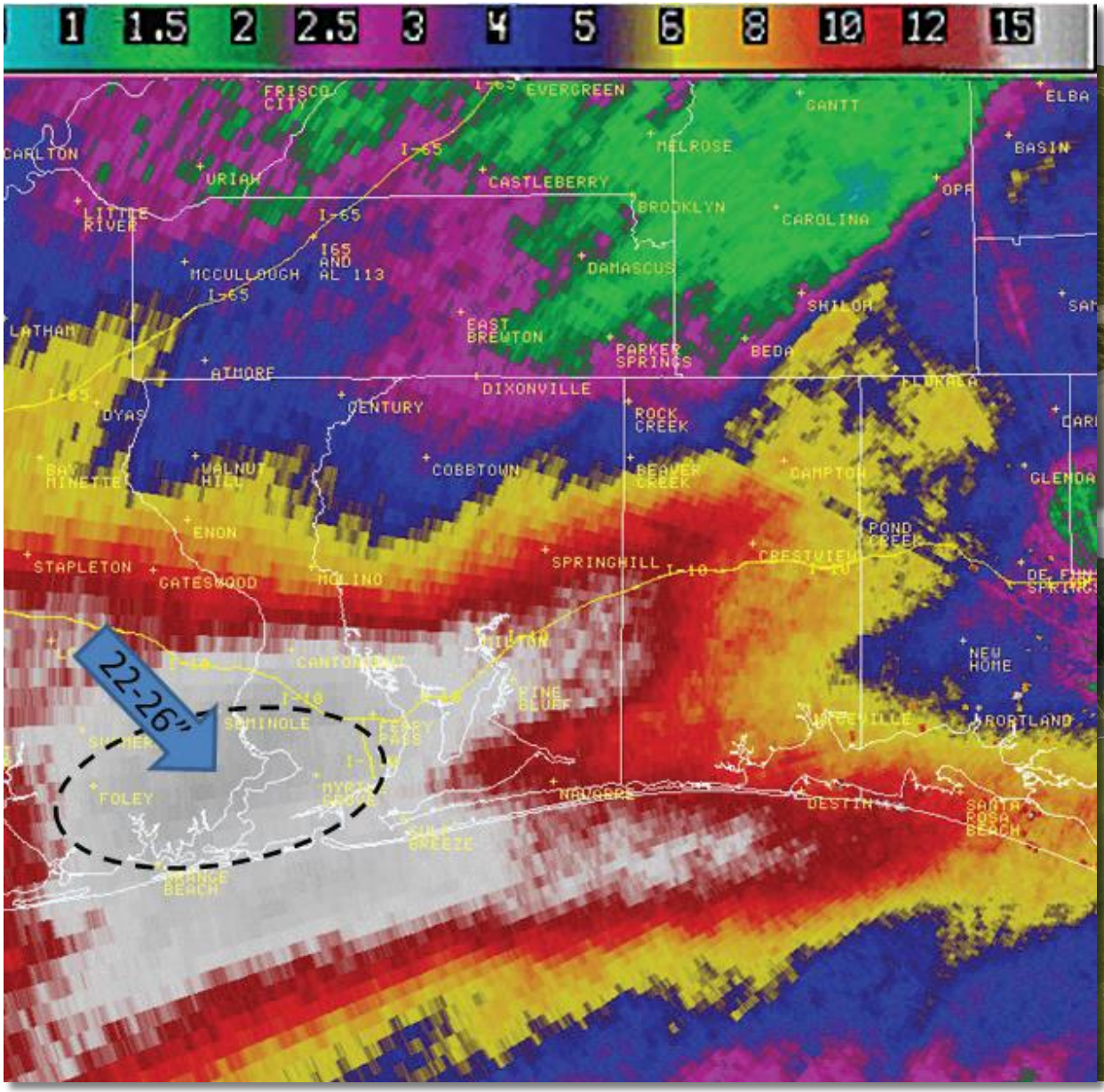
April 12, 2013

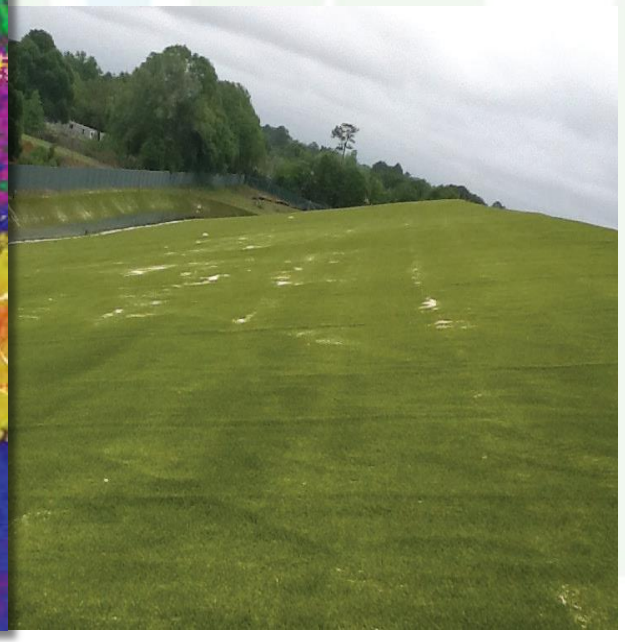
April 20, 2013

April 24, 2013

May 23, 2013

22-Acre Facility in Pensacola, FL





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Solving Water Quality Impacts and NOV's

Tangipahoa Parish, LA

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Enhanced Water Quality

- ClosureTurf improves water quality, decreases sediment loading of cover runoff by ~97%

TO

*Nephelometric Turbidity Units
(*Photographs courtesy of Tangipahoa Parrish, LA*)

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PORTOLA LANDFILL PROJECT

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CAT
CATERPILLAR

Case Study: Hartford MIRA Landfill

ClosureTurf® was the best solution for a sensitive, high-visibility site.

Case Study: Hartford MIRA Landfill

CT DEEP is now evaluating Solar *Turf*™ on brownfields and landfills statewide.

38-Acre Facility with a 5-Acre Solar Array in Hartford, CT

Hartford Landfill w/PV Solar Array

Case Study: Crazy Horse Landfill

OVERVIEW

- **Owner: Salinas Valley Solid Waste Authority**
- **Location: Salinas, CA**
- **Completed: 2013**
- **Closure Area: 68 acres**
- **Solar Capacity: 2.5 MW**

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Case Study: Crazy Horse Landfill

CLOSURE CHALLENGES

- **Required capping slopes of 2.25:1**
  - **ClosureTurf® eliminated slope failures from seismic loads**
  - **Nearly eliminated maintenance activities for SVSWA**
- **Available borrow soil was expensive and contaminated with agricultural chemicals**
  - **Difficult to meet water quality requirements.**
  - **ClosureTurf eliminated dirty storm water run off**
- **Carbon footprint of borrow soil and heavy equipment**
  - **Over 28 thousand truck trips eliminated from the local roads**

ClosureTurf® reduced the projects carbon footprint by over 70%

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Case Study: Crazy Horse Landfill

SOLAR OPPORTUNITY

- **Project co-sited with Ameresco landfill gas generator**
- **Eligible for Local Government Renewable Energy Self-Generation Bill Credit Tariff (RES-BCT) in PG&E**
- **2.5 MW credited against Monterey County usage saving taxpayers over $10M (20 years)**

OWNERS' DECISIONS FOR USE of CT taken from Questionnaires:

1. Regulatory compliance
2. Accelerated project schedule
3. Safety
4. Sustainability
5. Water quality
6. Geotechnical Factors of Safety
7. Water conservation
8. Cost savings (Upfront construction and ongoing maintenance)
9. Land Conservation
10. Eliminate Truck trips
11. Post-closure oversight less critical
12. Ideal Foundation for Ballasted Solar Array

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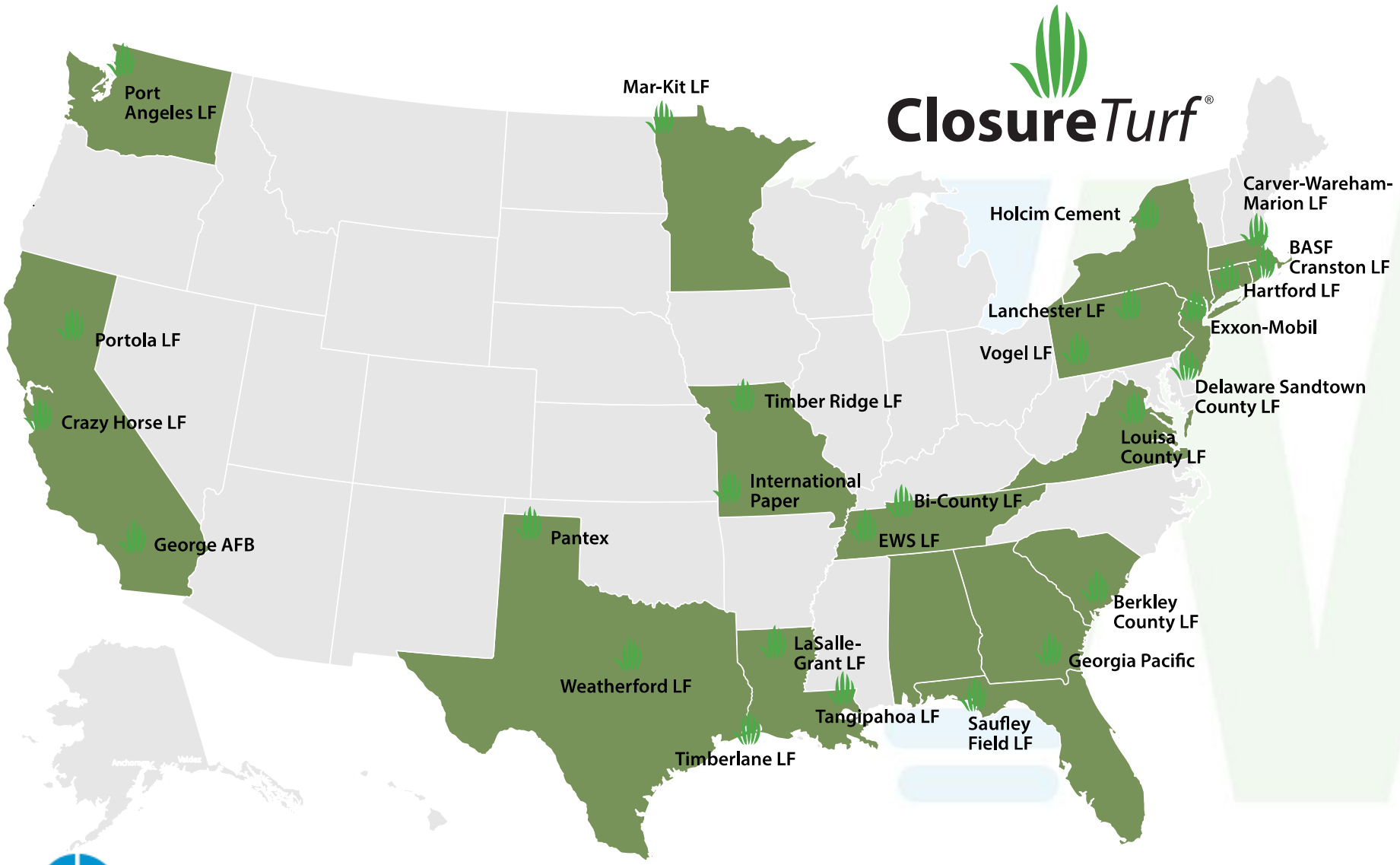
Over 25 million square feet installed in 18 states and closing...



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Engineered Synthetic Turf– 100% Green

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WG WatershedGeo® Unearthing Solutions®

Engineered Synthetic Turf– 100% Tan

Engineered Synthetic Turf–
75% Green / 25% Tan

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THANK-YOU!

ClosureTurf®