

Back On The Road: Emergency Highway Restoration After A Hurricane

Eddie Snell, Applied Polymer Systems, Inc.

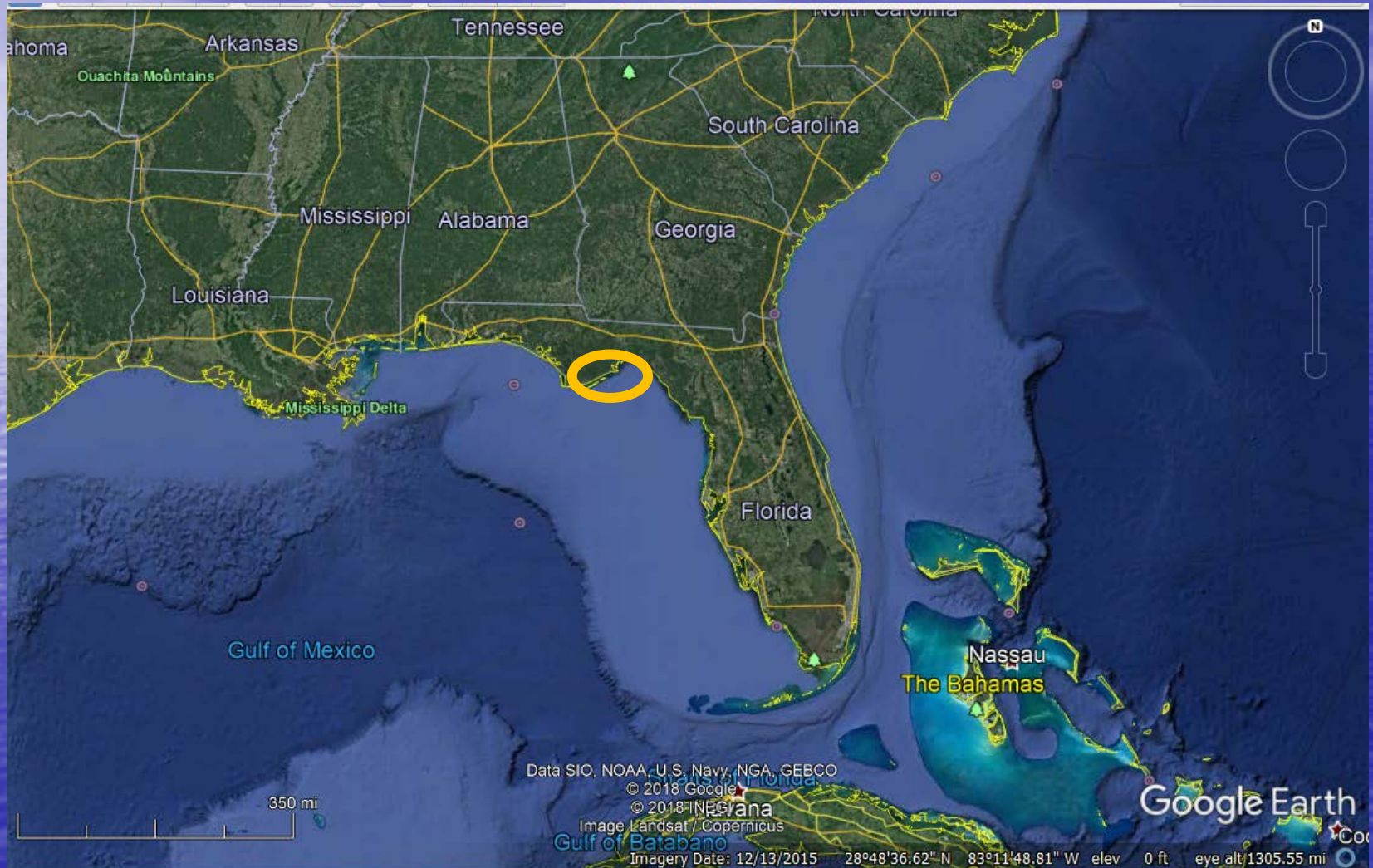
US 98 (Franklin County) Soft Armor Countermeasures Utilizing Polymer Technology (Case Study)

Josh Boan, FDOT EMO

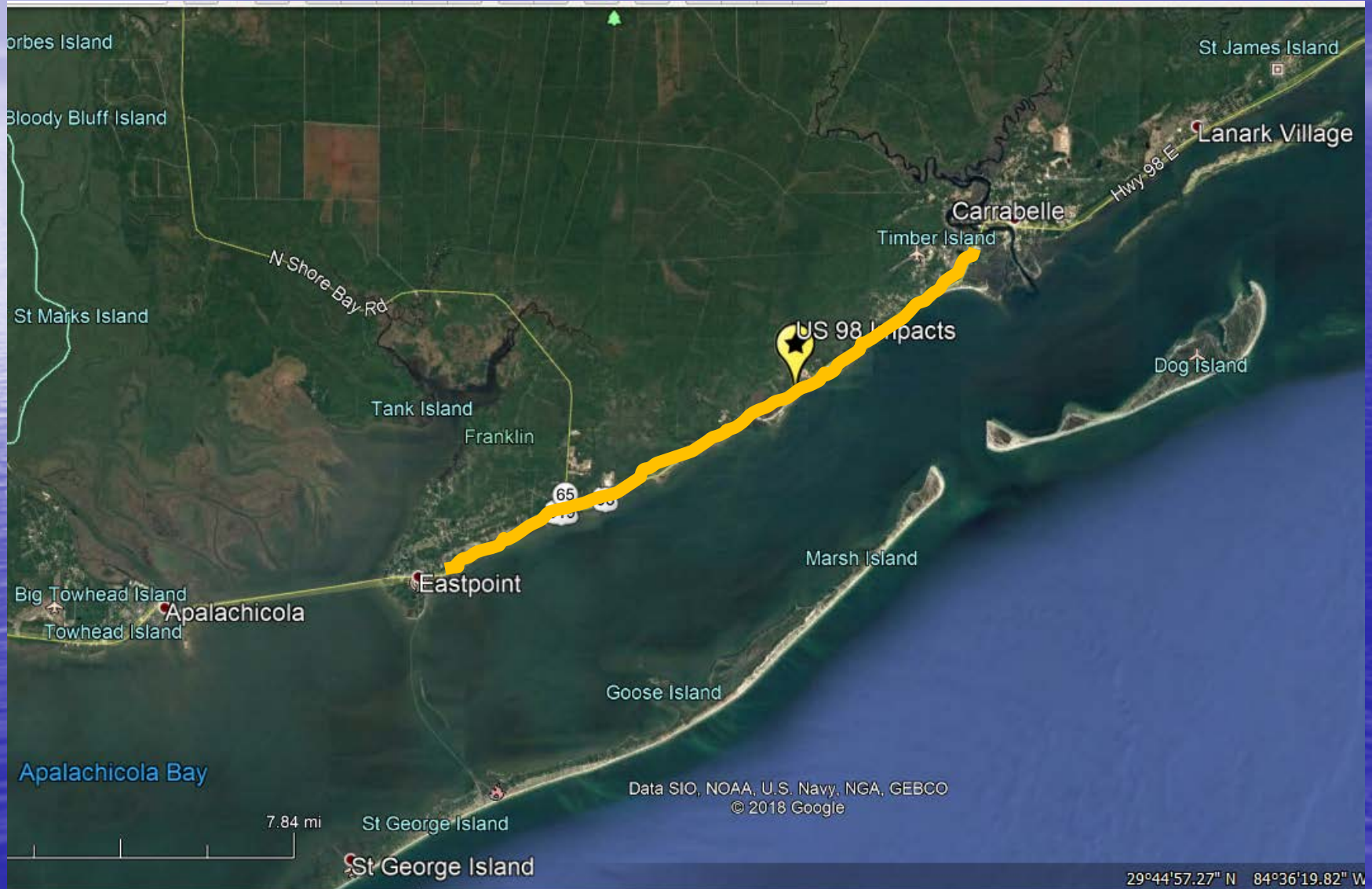
Michael Shepard, FDOT Drainage

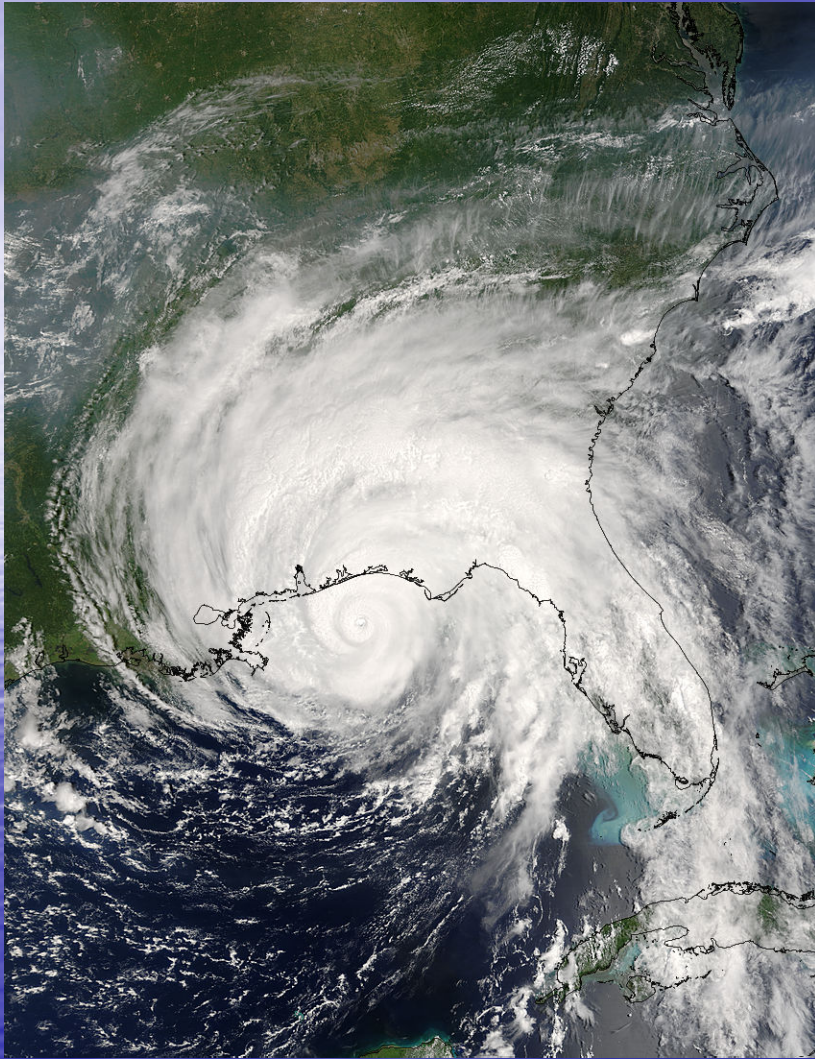
Steve Iwinski, Applied Polymer Systems, Inc.

Study Area: Florida Panhandle



US 98 Between Eastpoint & Carrabelle





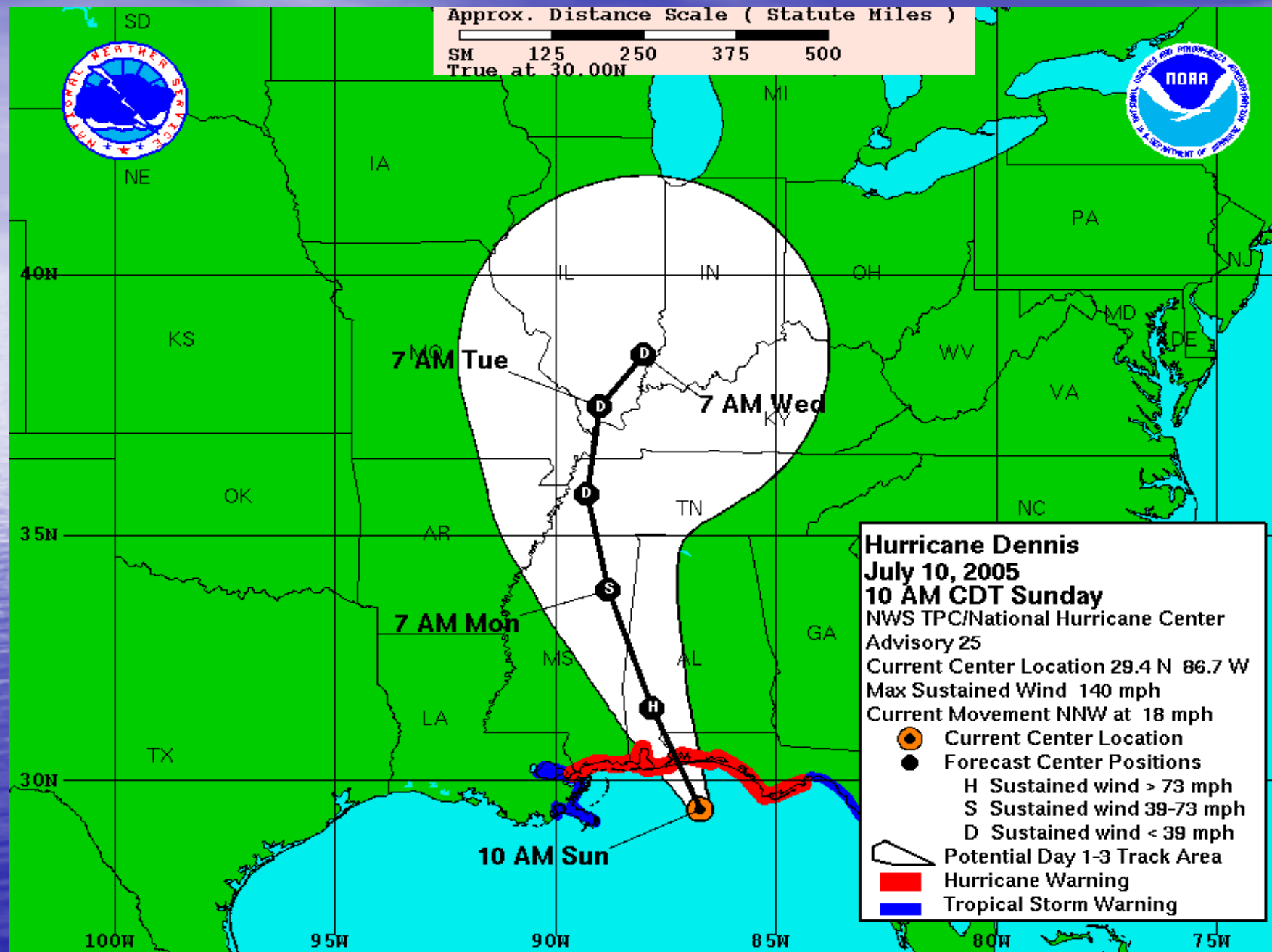
July 10, 2005 Hurricane Dennis

Hit the coast as a strong
Category 3 hurricane.

- Wind gusts > 120 mph
- Rainfall + 7 inches
- Storm surge + 7 feet

Approx. Distance Scale (Statute Miles)

SM 125 250 375 500
True at 30.00N



Hurricane Dennis

July 10, 2005

10 AM CDT Sunday

NWS TPC/National Hurricane Center
Advisory 25

Current Center Location 29.4 N 86.7 W

Max Sustained Wind 140 mph

Current Movement NNW at 18 mph

● Current Center Location

● Forecast Center Positions

H Sustained wind > 73 mph

S Sustained wind 39-73 mph

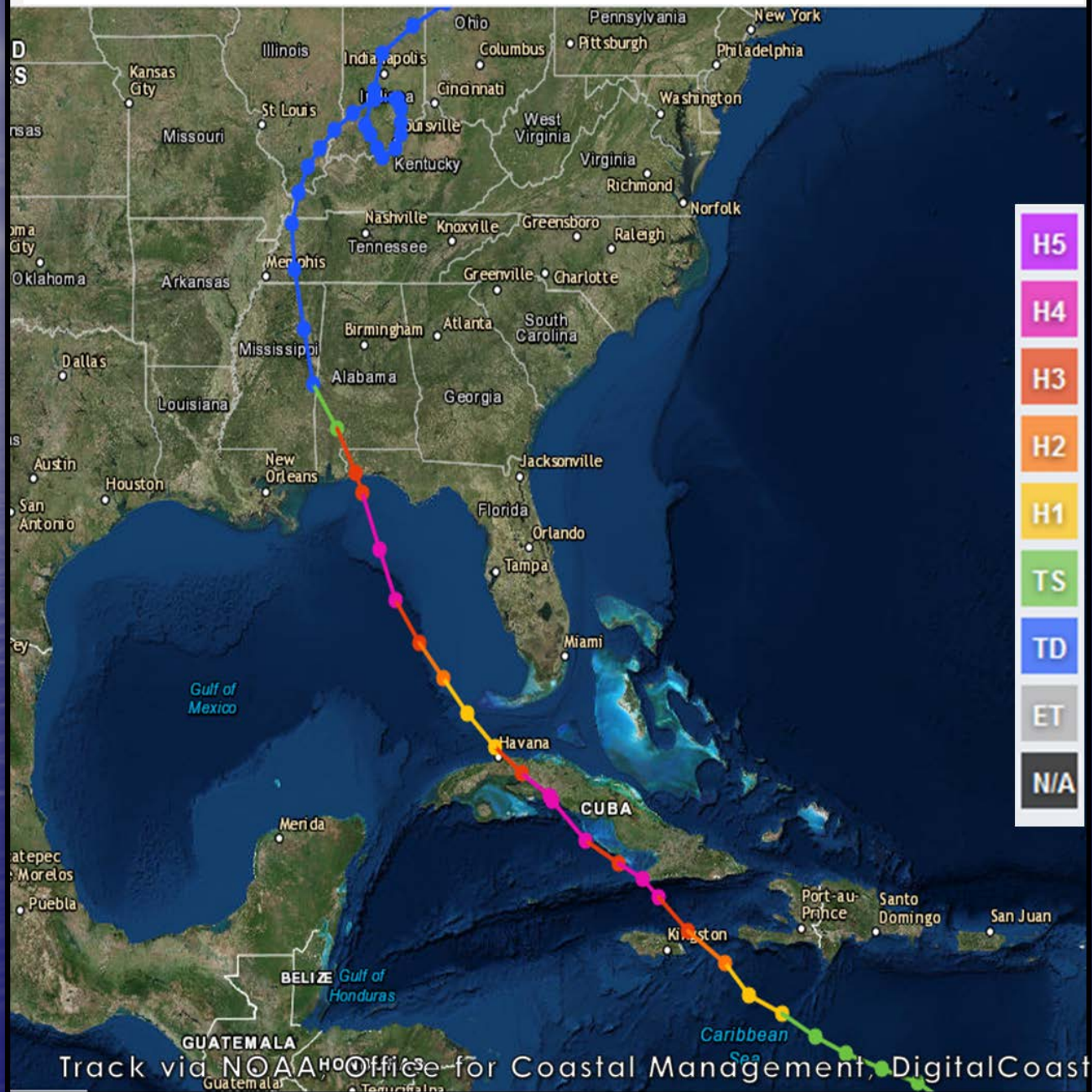
D Sustained wind < 39 mph

▭ Potential Day 1-3 Track Area

■ Hurricane Warning

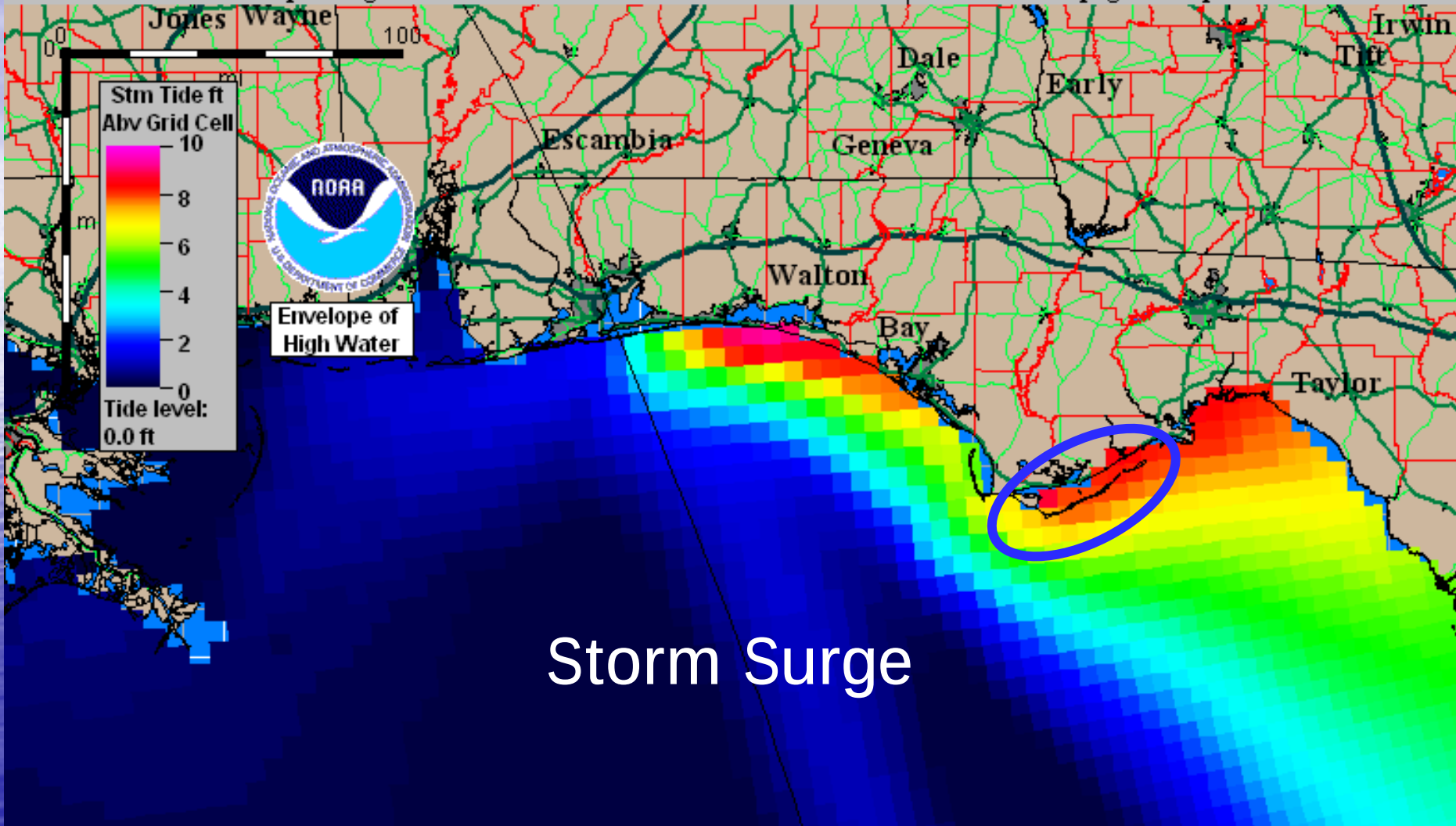
■ Tropical Storm Warning

Hurricane Dennis Track

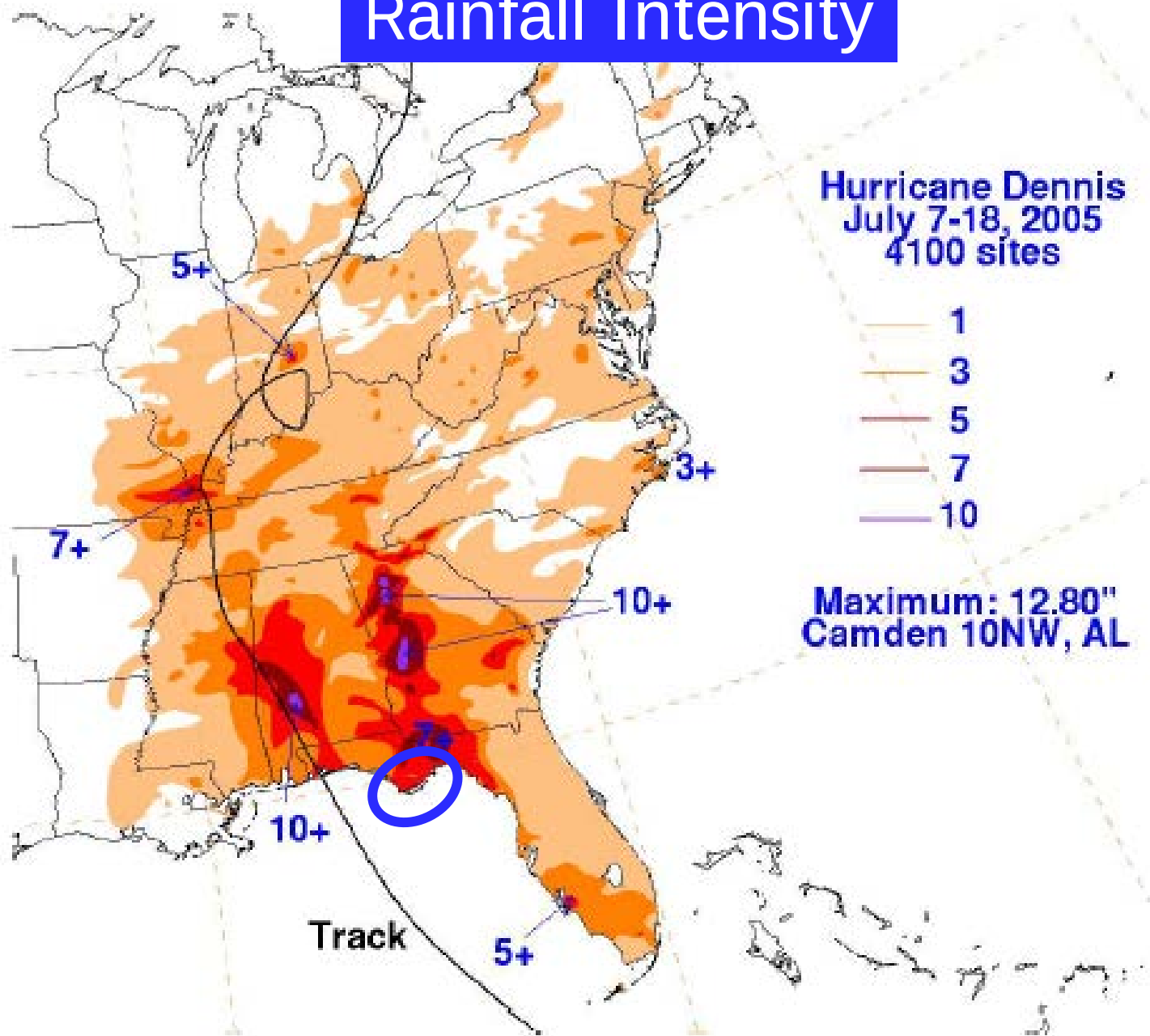


Basin: Gulf Coast ExtraTropic v2 <gll>

Storm: C:/slosh/pkg/sloshdsp/rexfiles/download/2005



Rainfall Intensity



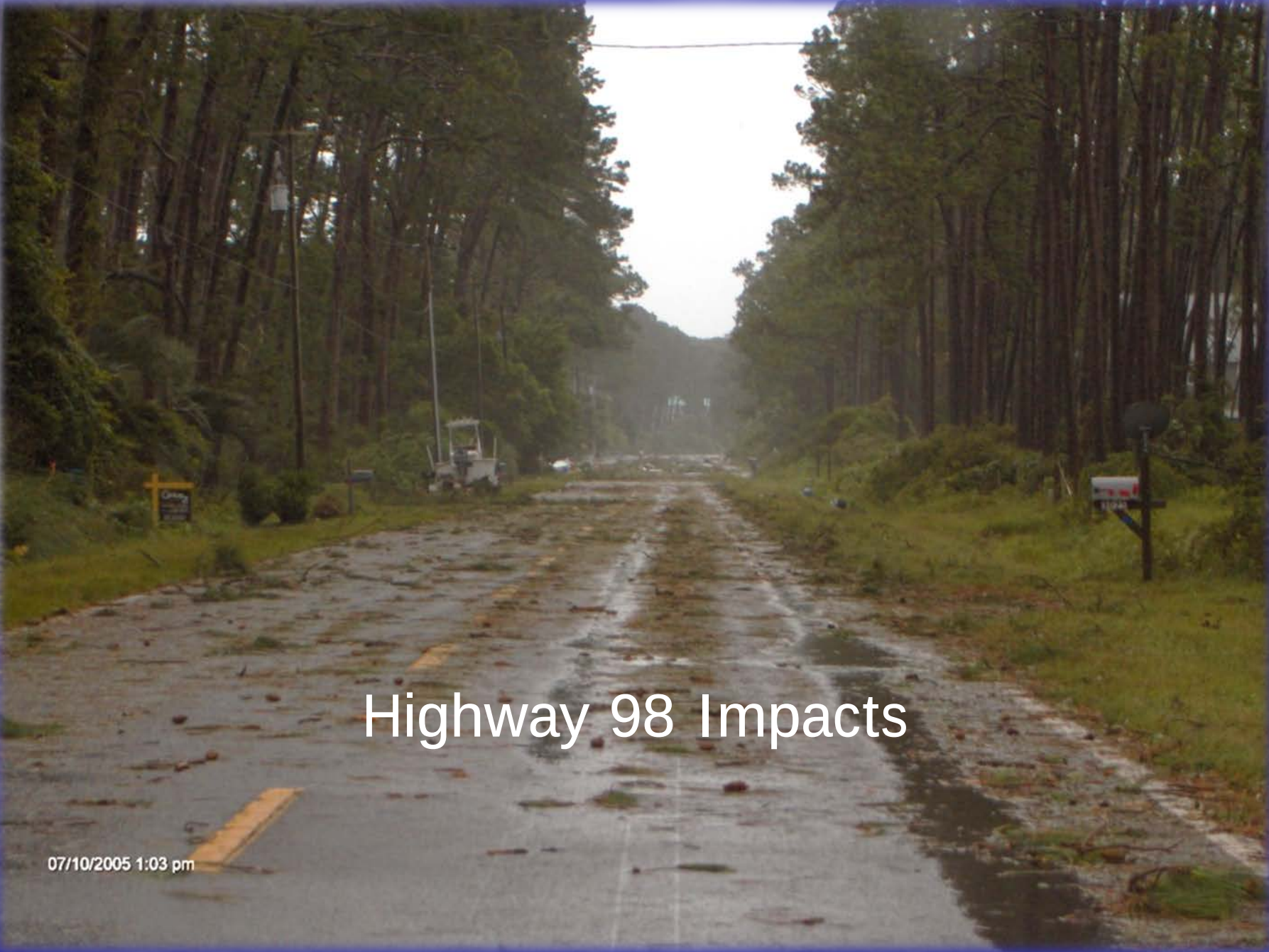


Severe structural damage to coastal dwellings.



Structural Damage From Hurricane Dennis



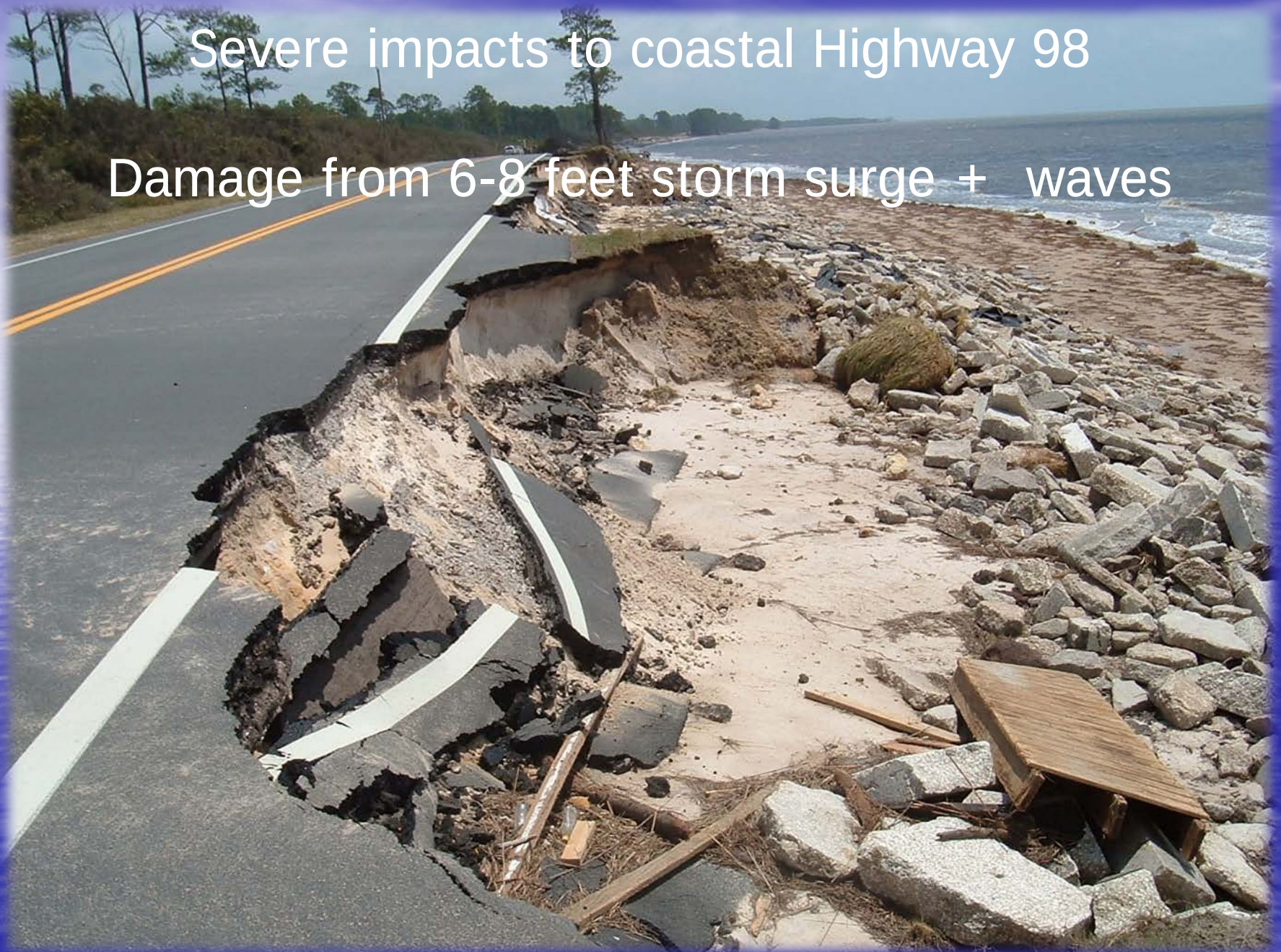


Highway 98 Impacts

07/10/2005 1:03 pm

Severe impacts to coastal Highway 98

Damage from 6-8 feet storm surge + waves











Emergency
Repairs
Needed!

EMERGENCY REPAIR CONTRACT

- \$10.8 Million Contract awarded - C.W. Roberts
- Goal to re-construct and open traffic on US 98 (approximately 14 miles)
- Emergency repairs to be completed in 14 days



07/18/2005





07/18/2005



07/18/2005



07/18/2005



07/18/2005

August 2, 2005

- ✓ **Emergency Contract Complete**
- ✓ **Travel Lanes Reconstructed**
- ✓ **Traffic Restored**





<One week later, problems!

Rainfall runoff causing erosion of
coastal slope and shoulder

18 8 2005

Rill erosion on slopes



18 8 2005

Fill material eroding beneath new sod









Slope Repair Design Objectives

- Quickly Protect & minimize erosion of front slopes and shoulders
 - Requires low maintenance solution
 - Vegetation that can resist harsh environment
 - Short-term (1-2 years) solution until more “permanent” countermeasures are identified
 - Accommodates future construction of paved shoulders
 - Cost effective design

Initial Design Considerations

- Curb and Gutter
- Placement of Rolled Erosion Control Product (RECP) with Seed or Sod
 - Erosion Control Blanket (ECB)
 - Temporary, Degradable
 - Moisture Retention
 - Desirable to use with Polymers
 - Cost Effective

Initial Design Considerations

- Turf Reinforcement Mat (TRM)
 - Permanent, Non-degradable
 - High Tensile Strength
 - Predominately used for High Velocity Channels or Steep Slopes
 - Costly (\$12-\$15 SQ YD)

District 3 and CO Coordination

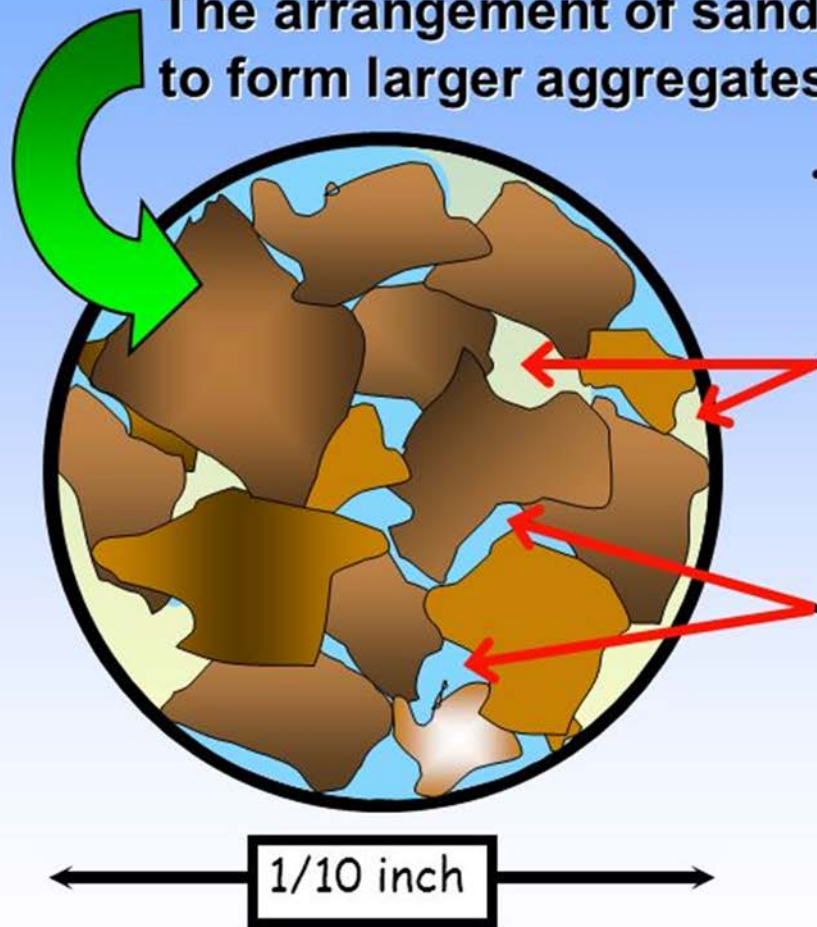
- Reviewed sample of proposed TRM
- Field Review of site conditions
 - Slopes
 - Soils
 - Existing Vegetation
 - Other Site Challenges
- Reviewed alternative solutions
- Consulted with polymer vendor

Final Selection of Soft Armor Countermeasure Matrix

- Soft Armoring Technique
 - Cost Effective
 - Meets All Design Objectives
- Key components
 - Compost
 - Jute Erosion Control Blanket (ECB)
 - Polyacrylamide (PAM) Holds Soil Structure
 - Vegetation (Bermuda Sod)

Soil Structure

The arrangement of sand, silt, and clay particles to form larger aggregates.



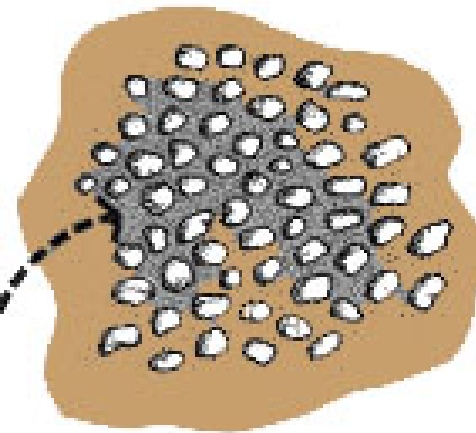
- Organic matter is the glue that holds the aggregates together

Large pores (spaces) between aggregates are filled with air in a moist soil.

Small pores are filled with water in a moist soil. Even smaller pores inside the aggregates (not shown) are also filled with water.

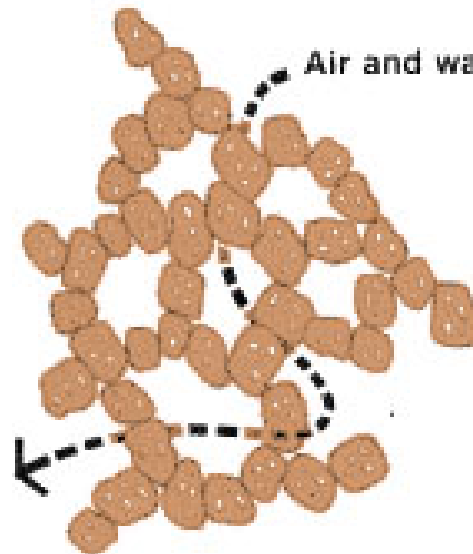
BAD STRUCTURE

Air and water circulate badly

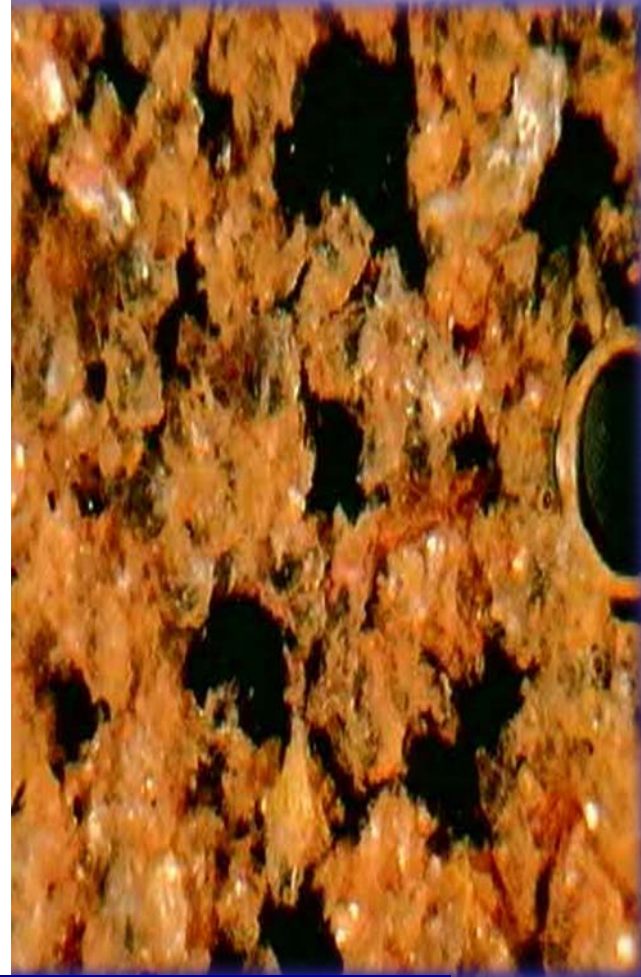
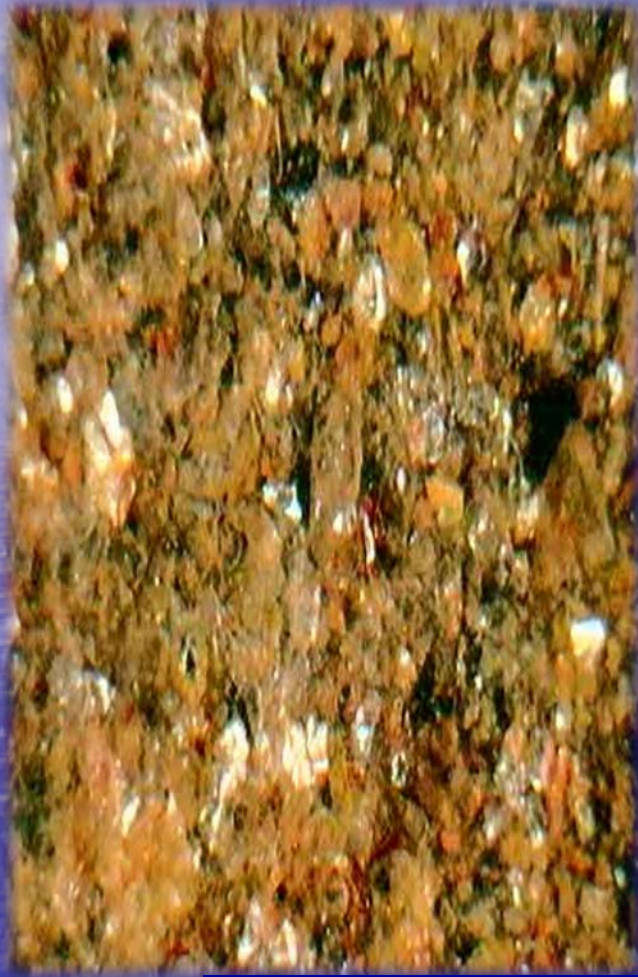


GOOD STRUCTURE

Air and water circulate well



PAM Supports Good Soil Structure



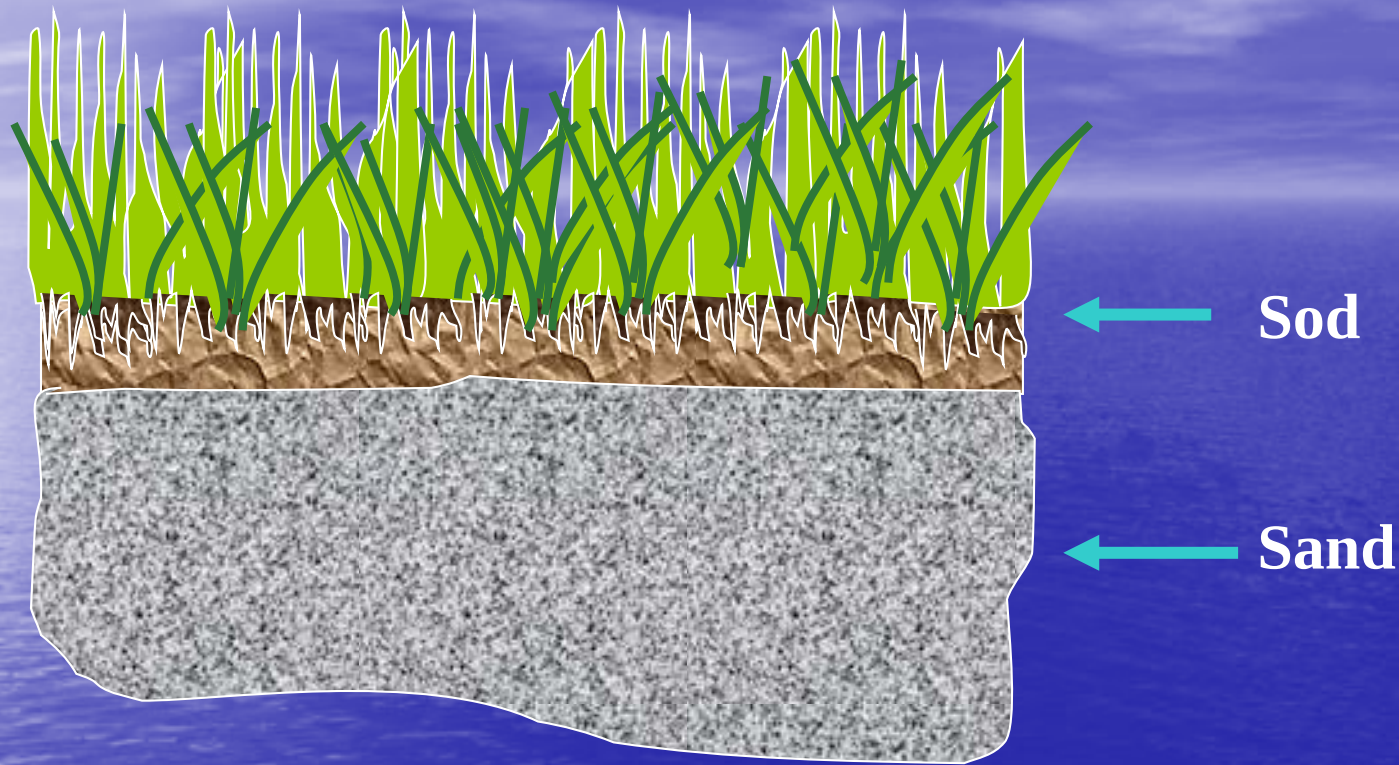
Untreated vs. Treated

Why Soil Structure Is Critically Important

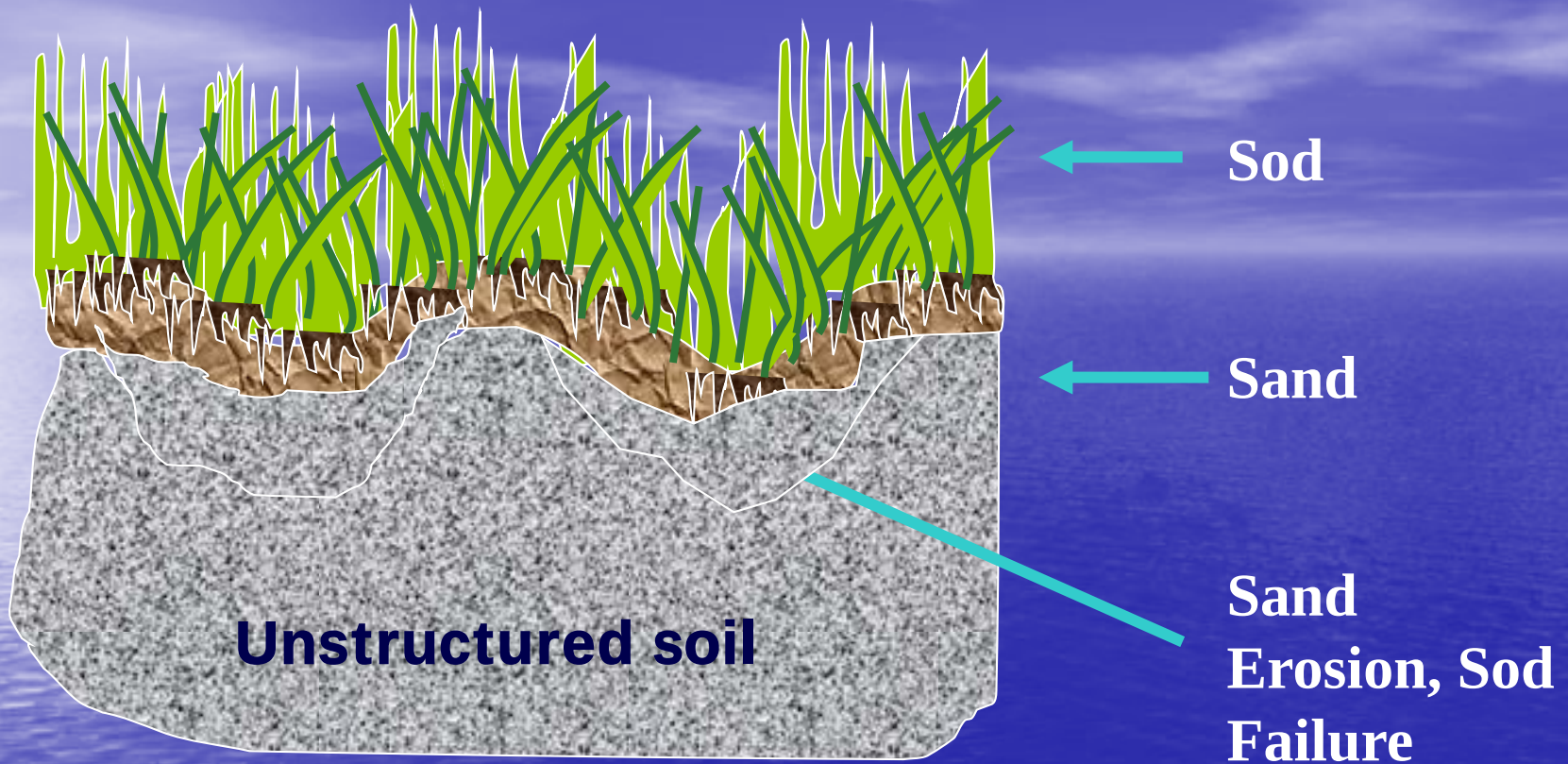
Poor soil
structure



Good soil
structure



Sod installation on sand failed shortly after repair due to unstructured soil exposed to inundation. Sod roots failed to penetrate for stabilization of soil.



Stormwater inundated loose, unstructured soil which separated from sod causing erosion failure

University of Central Florida Stormwater Academy Testing

Polymer
Treated



Untreated

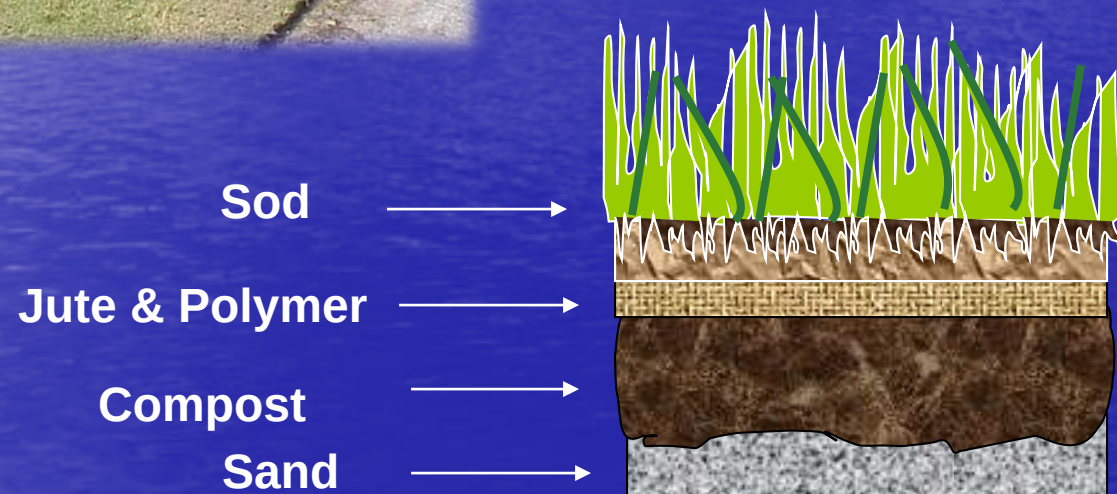
POLYMER ENGINEERING USDA

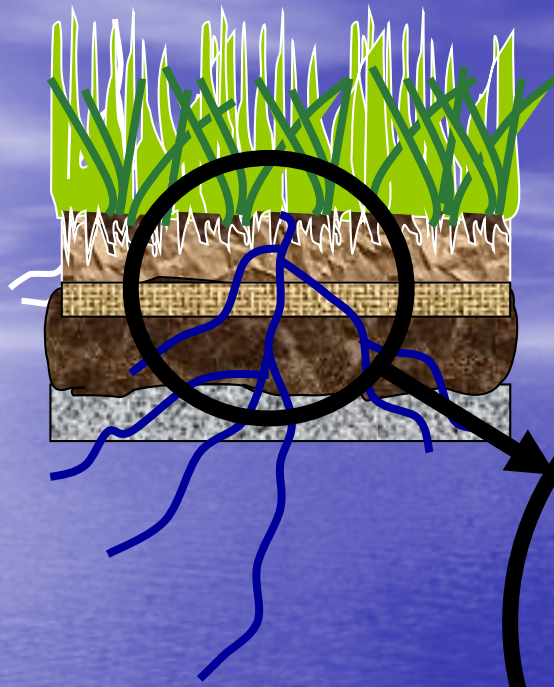


PAM increases vegetative root structure

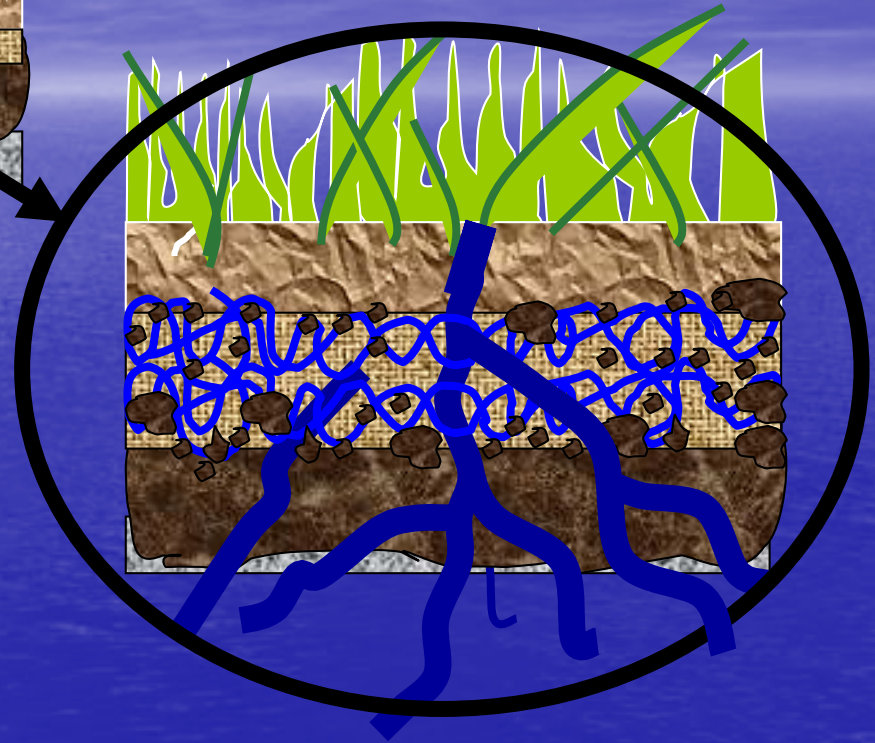


Rolled Bermuda sod was recommended as final cover over the polymer enhanced BMP





PAM holds soil structure together and retains moisture in compost. The compost encourages deep root penetration through jute, PAM, and compost.



Enhanced soft armoring BMP creates a flexible matrix of deep vegetative roots and articulating jute fiber. This builds strong soil structure.

Scope of Services

Work consists of:

- removing existing turf
- blade/shape existing shoulders & front slopes
- preparation & placement of 2" depth compost
- erosion control blanket (jute mat)
- polyacrylamide powder (QPL# M-0203)
placed at 25lb/ac as directed by the engineer
& Bermuda grass sod









09/14/2005

GROUND "SOD" STAPLES
6"X1"X6"

GROUND "SOD" STAPLES
6"X1"X6"
100 PIECES





Granular PAM powder applied at
25 lbs./acre over jute



Rolled Bermuda sod applied as final vegetative cover



11/23/2005

Contract Quantities and Cost

Pay Item	Description	Unit	Quantity	Unit Price	Total
101-1	Mobilization	LS	1	75000.00	75,000
102-1	MOT	LS	1	30000.00	30,000
577-70	Shoulder Rework	SY	71,000	2.00	142,000
104-13	Sitl Fence Staked Type III	LF	32,500	2.00	65,000
162-3-100	Finish Soil Layer (Compost) (2")	SY	71,000	2.00	142,000
575-1-6	Sodding	SY	71,000	2.65	188,150
104-1-100	Silt Stop Powder QPL M- 203 Misc Erosion Control	LB	300	50.00	15,000
104-1	Artificial Covering	SY	51,000	1.50	76,500
570-9	Water for Grassing	MG	440	25.00	11,000
				Total	\$744,650

The background is a deep blue gradient, transitioning from a lighter blue at the top to a darker blue at the bottom. A bright, horizontal line of light, representing the sun's reflection on the ocean, stretches across the middle of the image. The overall effect is serene and expansive.

8 MONTHS LATER:

Still Performing







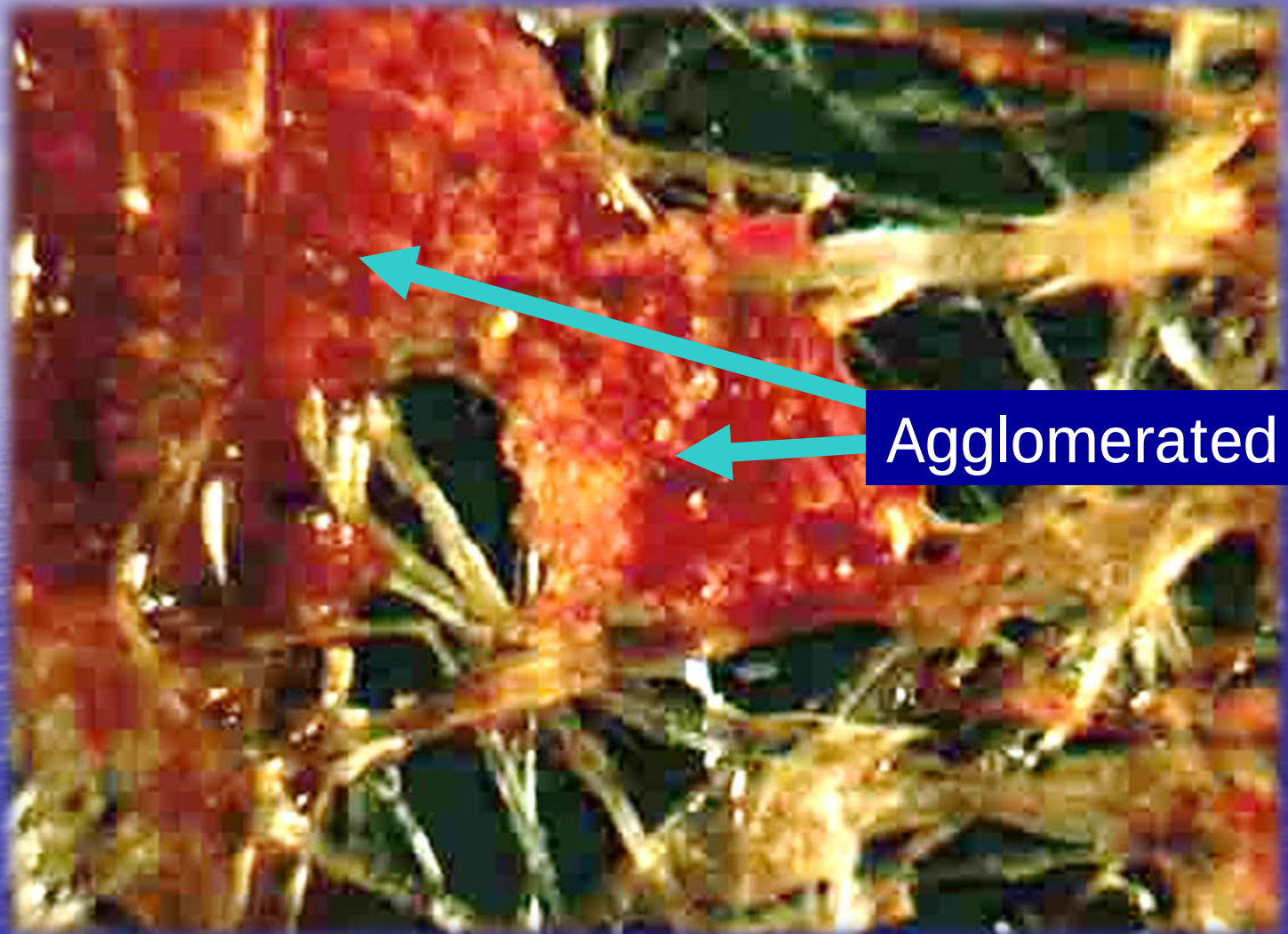


06/13/2006

One year after placement showed no erosion or need for further repair. This area was hit by a tropical depression and a category 1 hurricane within 100 days after initial installation.



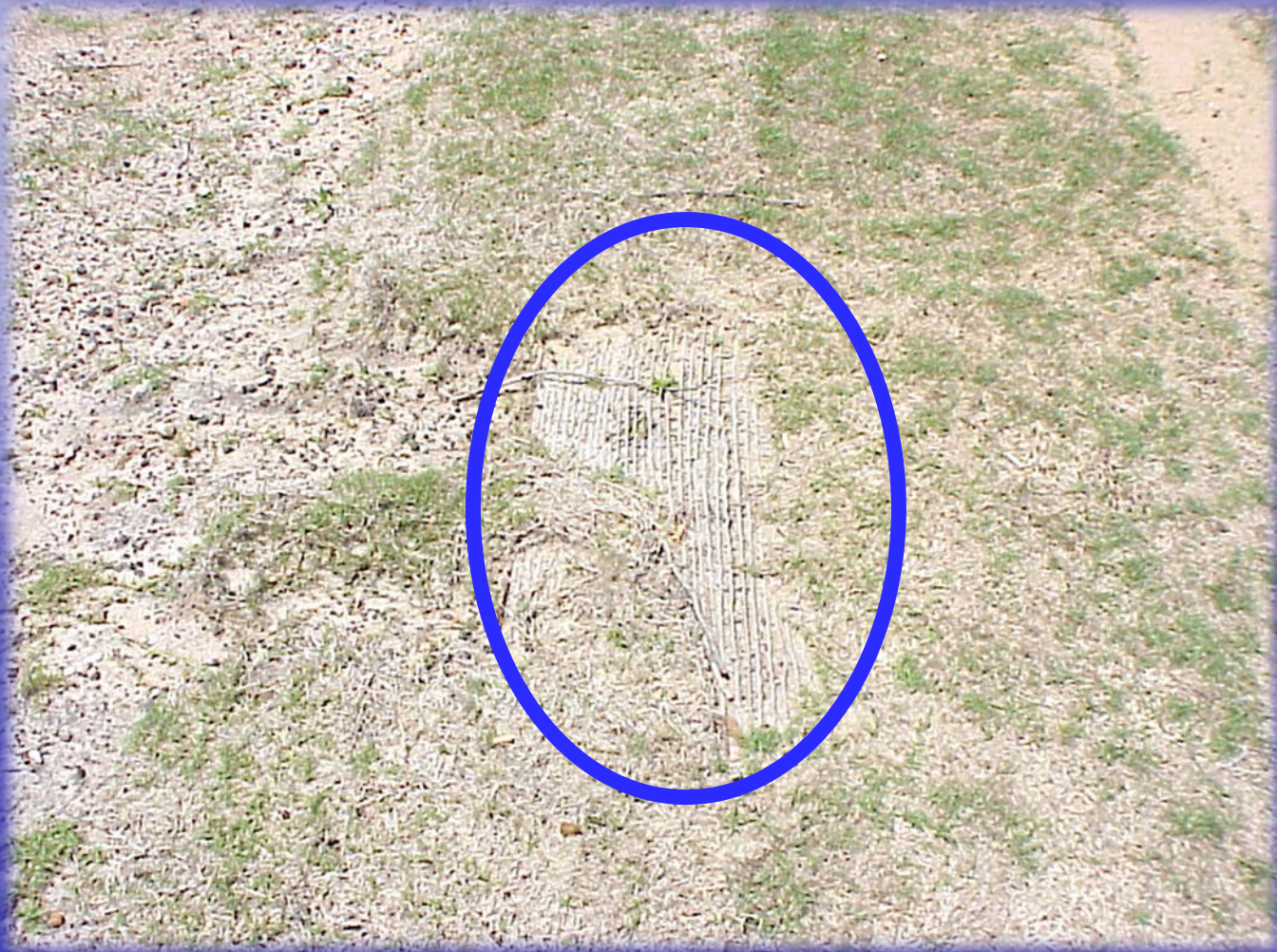
For several years no erosion was reported over the 22.5 km (14 miles) showing that beach sands can be stabilized even under hurricane conditions.



Agglomerated Soil

Polymer + Soil + Surface Area = Bonded Matrix

**The agglomerated matrix held even after
sod wear by traffic**



Summary:

- Roadways difficult to stabilize in sandy soils (unstructured soil)
- Soil structure temporarily held with PAM
- Vegetative root structure enhanced with compost and PAM
- Cost effective (more when planned work)
- Soft armor BMP should be considered in emergency repair guidelines

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