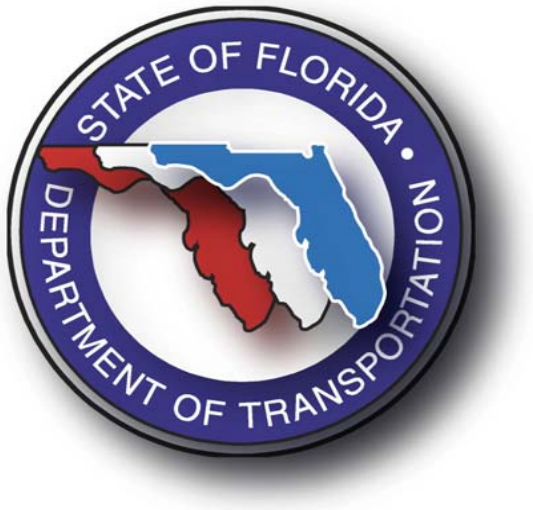
Using RAP In Florida



By: Jim Musselman
Florida Department of Transportation
Presented by: Brian Jory
Jory Engineering Sciences, Inc.

Florida

- Population: Over 15.9 million
  - 4th Largest State in the US
  - Increases by 1,200 people per day
- Roadways: 114,000 miles
- State Highway System
  - 12,000 miles of roadway
    - 44,000 lane miles
  - Carries 66% of all traffic in state

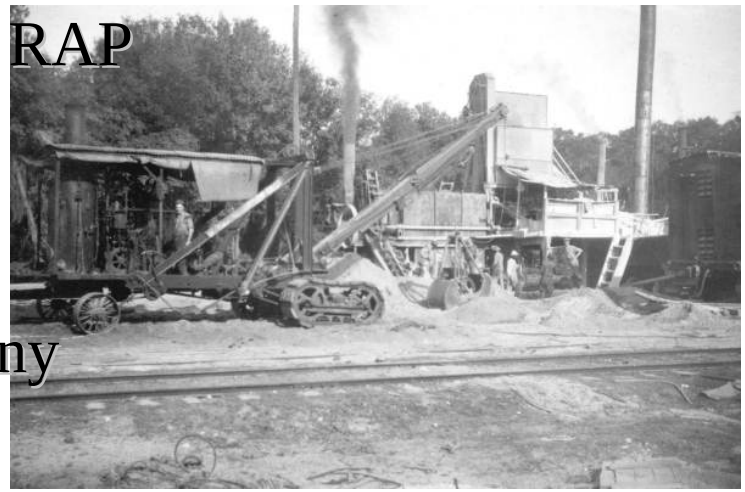
Florida

- Florida Department of Transportation
  - $3 billion construction budget
    - Approximately 500 Construction contracts/year
  - Approximately 5.2 million tons hot mix asphalt (HMA) placed per year
    - Total amount of HMA statewide = 19 million tons


2006
NATIONAL
CHAMPIONS
THE COACHES' TROPHY
THE NATIONAL CHAMPION
41-14
Stephen Spratley

History

- 1977: Palm Beach County
  - Rubin Construction
  - 28,000 tons HMA base w/25% RAP
    - RAP from another project
  - Batch plant (bypassed drier)
- 1978: Bay County
  - Florida Asphalt Paving Company
    - US-98 Panama City
  - Milled 1”
  - Leveling course w/30% RAP
  - Factory modified batch plant



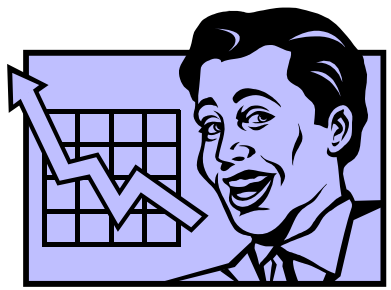
History

- 1979: Marion County
  - Okaloosa Asphalt
    - US-441
  - Recycled structural mix
  - 65% RAP + 35% Local Sand
  - Asphalt Emulsion Rejuvenator
  - 35,000 tons
  - Drum Mix Plant

Remember…there a two types of Research

- Academic Research:
  - Tons of data; limited conclusions
- State Agency Research:
  - Limited data; tons of conclusions

Performance of early projects is excellent after six months! Let's implement!



History

- 1980: Recycled HMA specifications developed as a standard practice
  - Used on selected projects that were considered good candidates for milling
  - **Contractor given ownership of RAP**
  - Allowed up to 60% RAP in mix
  - **FDOT monitored mix viscosity**
  - All other construction specifications the same
  - **FDOT Provided Pavement Composition Report**

Pavement Composition Report

COMPOSITION OF EXISTING PAVEMENT

Project No. [illegible]

FAP No. 1001-041-P

SR - 25

County - Hendry

From Km.P. 6.336 to Km.P. 21.337

From M.P. 3.937 to M.P. 13.258

NB & SB Traffic and Passing Lanes
(4)

	RANGE	AVERAGE
Viscosity @ 60°C (pa·s)	445 - 11,861	3,620
Viscosity @ 140°F (Poises)	4,450 - 118,610	36,200
Penetration @ 25°C (0.1 mm)	14 - 45	27
Asphalt Content (%)	5.1 - 6.7	6.0
Gradation - Percent Passing		
25 mm (1")	100	100
19 mm (3/4")	99 - 100	100
12.5 mm (1/2")	98 - 100	99
9.5 mm (3/8")	85 - 94	90
4.75 mm (No. 4)	57 - 71	63
2.00 mm (No. 10)	44 - 57	49
425 µm (No. 40)	28 - 35	31
180 µm (No. 80)	13 - 22	16
75 µm (No. 200)	5.5 - 8.5	6.8
Total Pavement Thickness (mm)	85 - 291	140
Thickness Evaluated (mm)	Top 60	
Total Pavement Thickness (in.)	3.35 - 11.46	5.51
Thickness Evaluated (in.)	Top 2.25	

Viscosity

Asphalt Content

Gradation

Pavement Composition Report

State of Florida Department of Transportation

Pavement Composition Data Sheet

Date: May 9, 2005 **Milling Depth :** 2.50 in. **Page:** 2 c

F. P. N. :	213003-2-52-01	S.R. No.:	I-10
F. A. P. No. :	0105 121 i	From :	Columbia C/L
County :	Baker	To :	US 90
No. of Lanes :	4	Beg M.P. :	0.000
		End M.P. :	8.884

Notes

Core No.	M.P.	Lane	Pavement Layers (in.)							Core Length (in.)	Percent Passing Sieves									
			FC-2	S-I	S-II	ARMI	S-I	Bind			3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 20
1	0.100	R-1	0.50	1.40	1.80	0.50	2.10	1.00	---	7.30										
2	0.400	R-1	0.70	1.40	1.50	0.50	2.10	1.00	---	7.20										
3	0.700	R-1	0.50	1.30	1.20	0.50	3.50	---	---	7.00	100.00	94.93	88.48	57.16	42.76	36.79	31.71	20.95	9.11	4.6
4	1.100	R-1	0.50	1.30	1.60	0.50	3.30	0.50	---	7.70										
5	1.400	R-1	0.70	1.10	1.50	0.50	4.30	---	---	8.10										
6	1.700	R-1	0.60	1.20	1.50	0.50	3.60	0.80	---	8.20	100.00	95.00	87.69	57.34	42.49	36.78	31.95	20.55	8.29	4.6
7	2.100	R-1	0.50	1.50	1.30	0.50	3.80	0.70	---	8.30										
8	2.400	R-1	0.80	1.60	1.70	0.50	2.40	1.30	---	8.30										
9	2.700	R-1	0.50	1.20	1.20	0.50	2.50	1.50	---	7.40	100.00	93.24	84.84	55.49	41.60	35.83	30.86	19.30	7.86	4.5
10	3.100	R-1	0.40	1.50	1.30	0.50	3.80	0.50	---	8.00										

DIST | 1-25 | 26-50 | 51-75 | 76-100 | 101-125 | 126-150 | 151-175 | 176-200 | 201-216

History

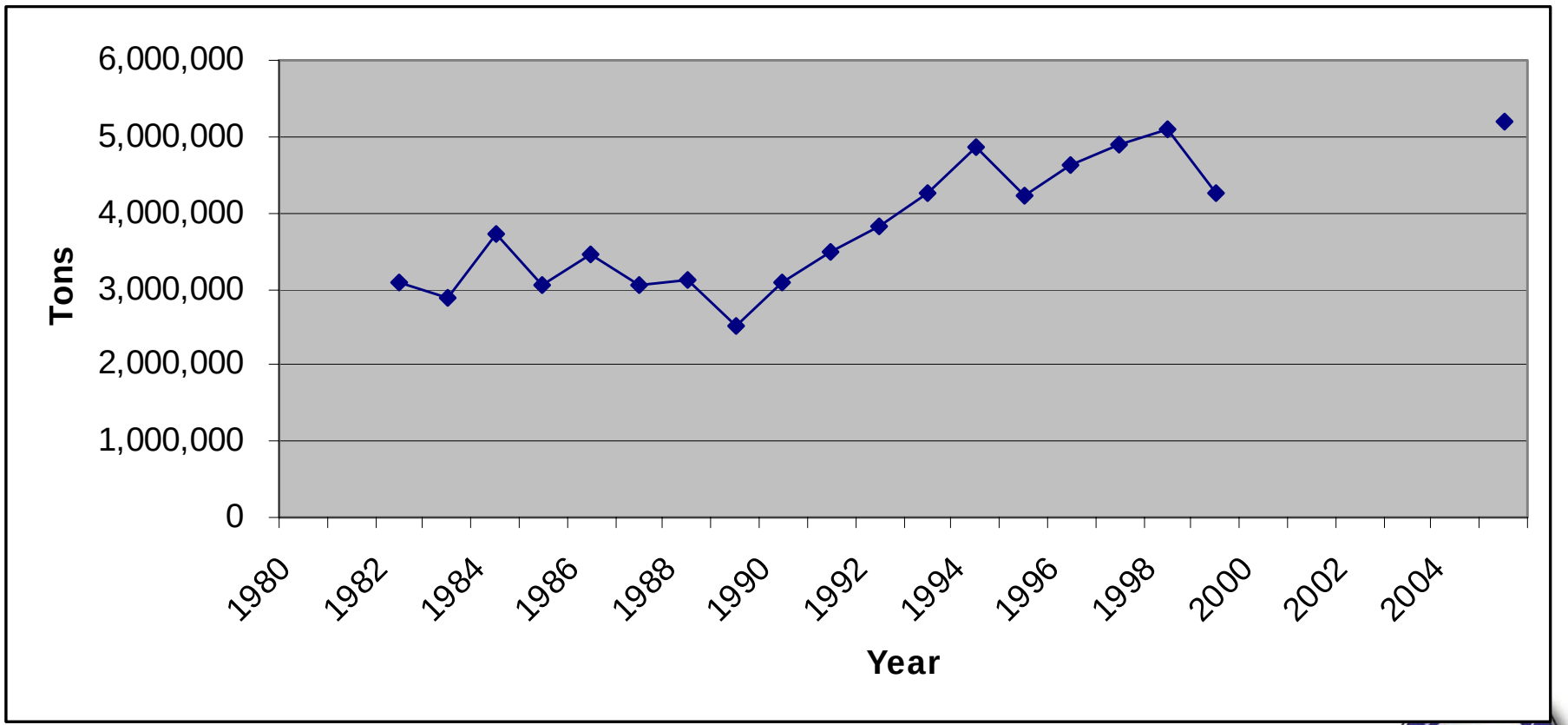
- Mid 1980's: FDOT experienced rutting problems…
  - Low in-place air voids/high dust
- Reduced maximum P-200 at design
- Implemented better controls of P-200 during production
- Began monitoring air voids during production
- Resulted in a reduction of RAP usage
  - RAP has high P-200

History

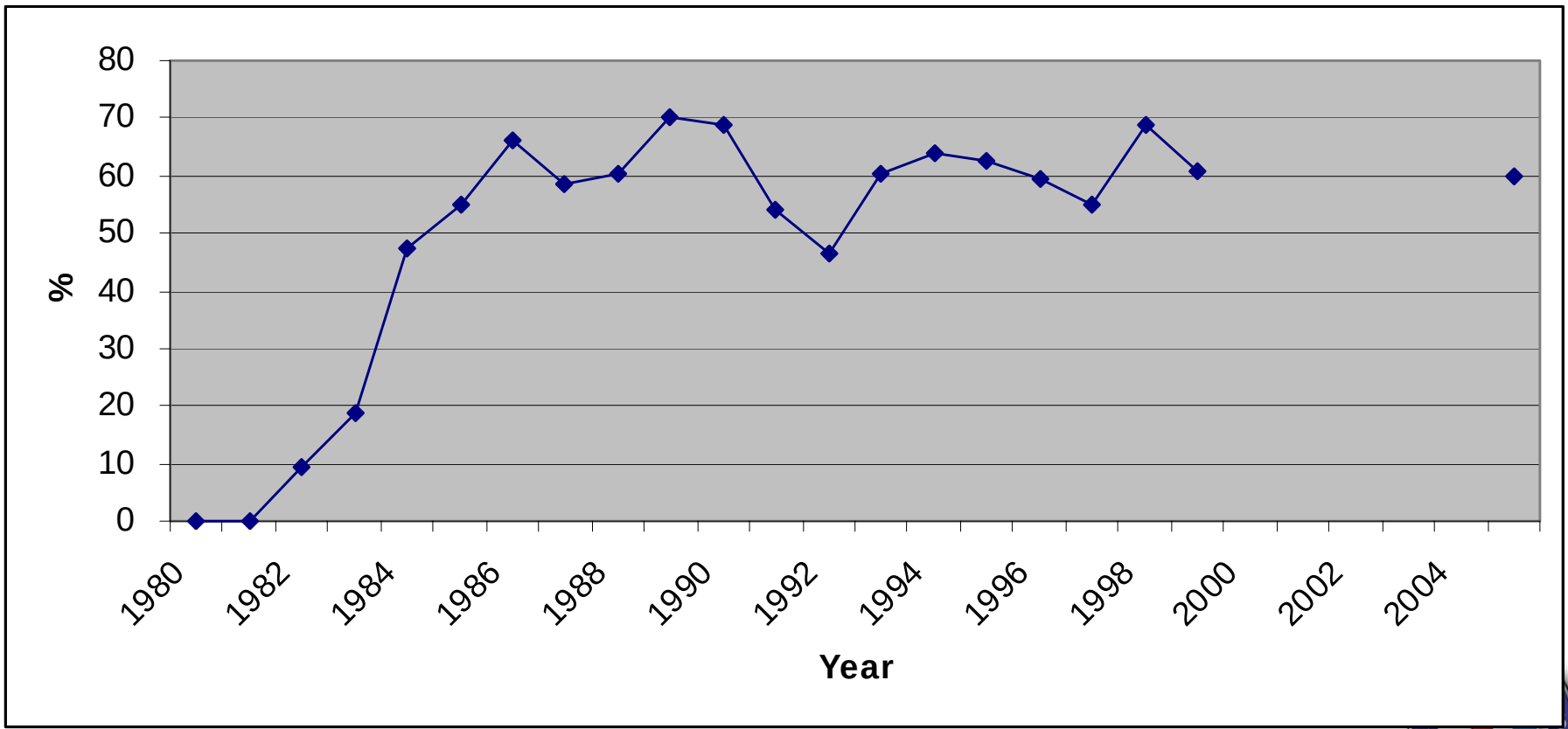
- Late 1990's: FDOT implemented Superpave…..
  - RAP usage declined further in order to meet VMA criteria
- Mid 2000's: FDOT increased use of polymer modified asphalts
  - Max 15% RAP

Quantities

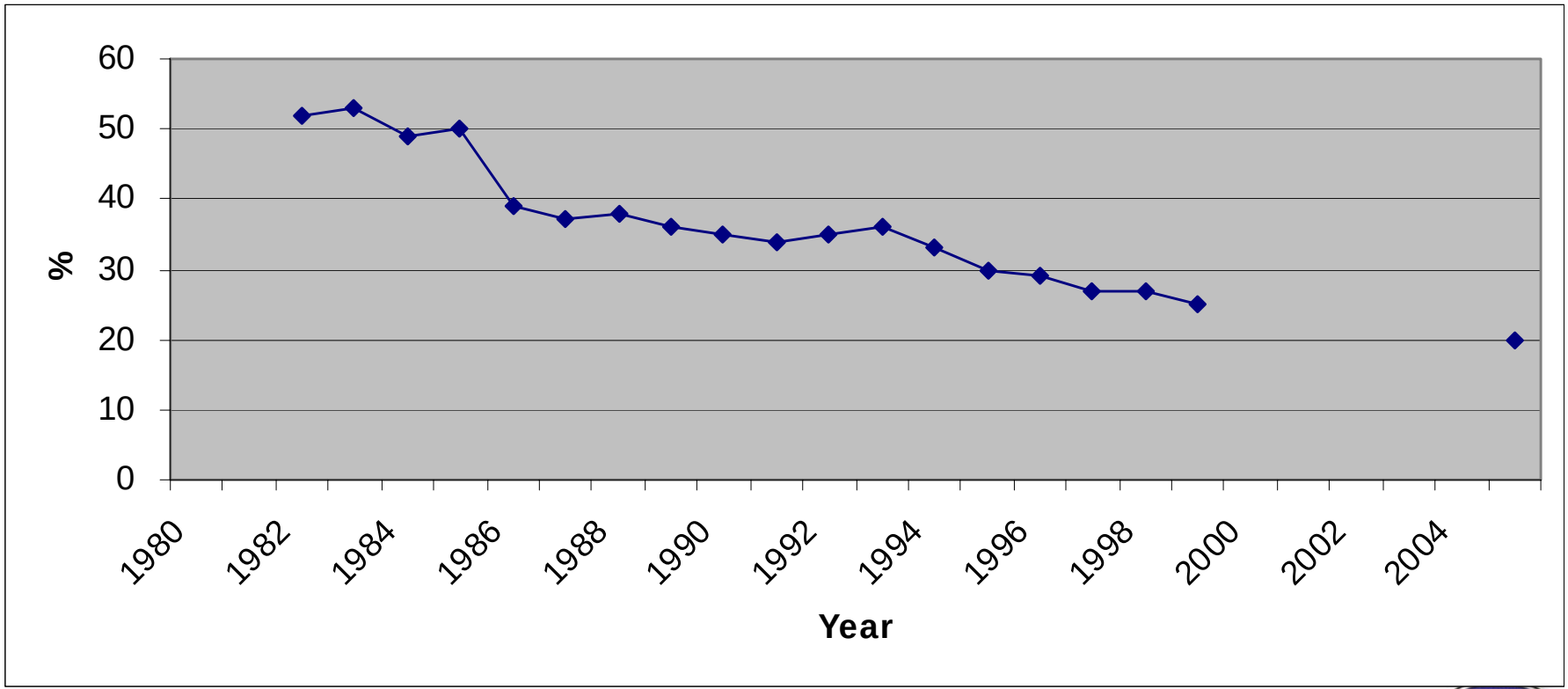
Total HMA


6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Tons
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year

Percentage of HMA Mixes Containing RAP



Average RAP Content



Benefits of Recycling

- **Saves money!**
- Conserves resources
  - Aggregate & Binder
- Conserves energy
- Allows milling as a standard practice, without generating waste material

Milling

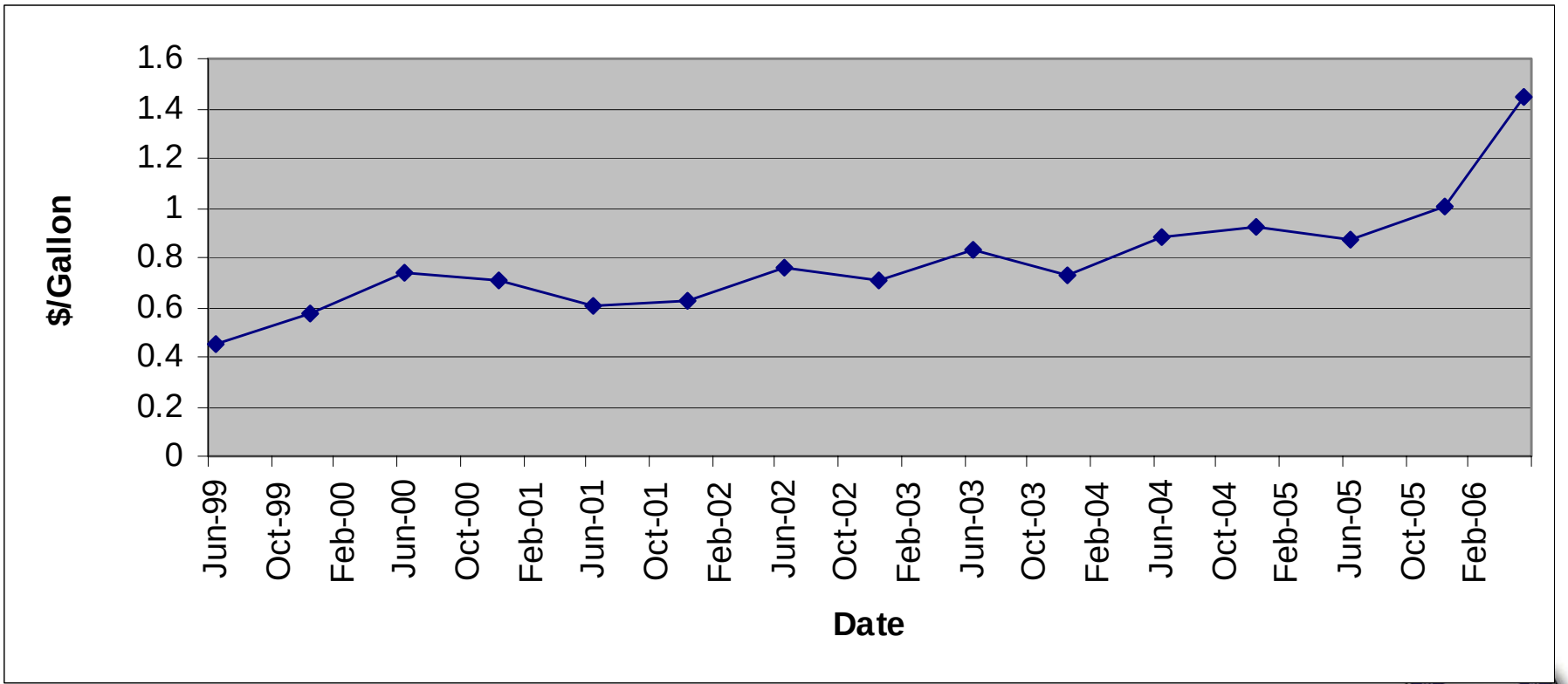
- **Removes old/distressed pavement**
- Eliminates costly shoulder work
- Maintains drainage features

Financial Savings

Current costs of aggregate, binder and hot mix asphalt are at an all time high!

- Binder: 1.72 $/gal (401 $/ton)
- Aggregate: 18 – 23 $/ton
- HMA: >90 $/ton

Cost of Asphalt Binder in Florida



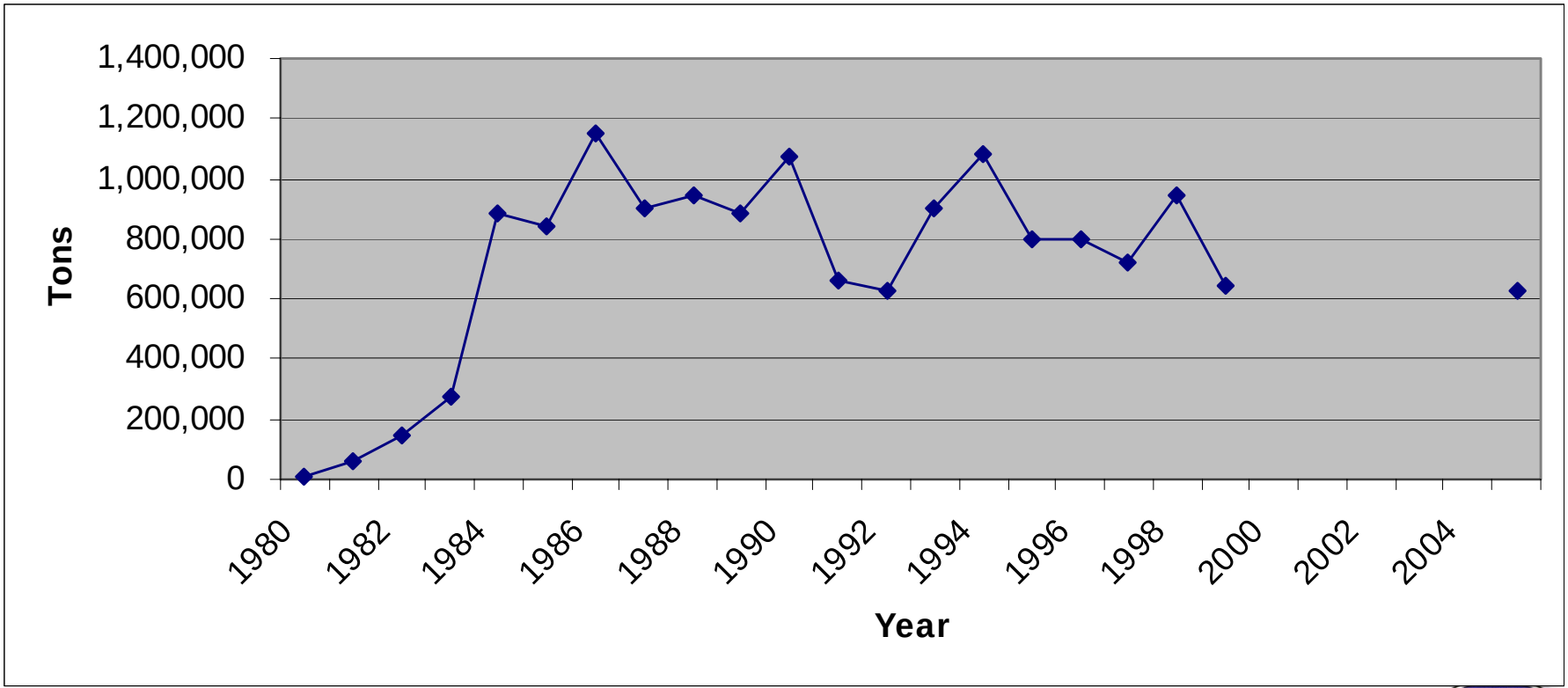
Conservation of Resources

- 2005:
  - 5.2 million tons HMA
  - 60% of HMA mixes contained RAP
  - Average RAP content = 20%
  - Used 624,000 tons of RAP

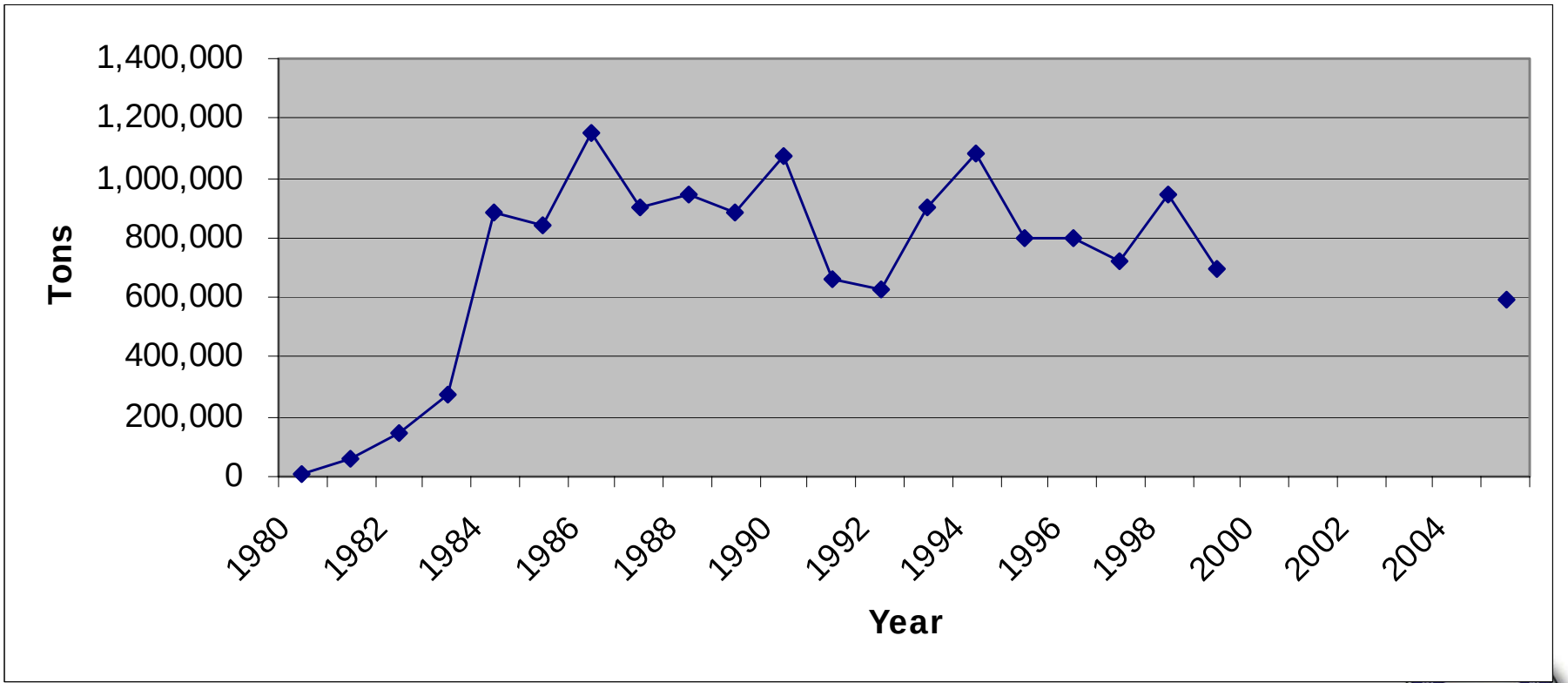
Conservation of Resources

- Typical RAP Contains:
  - 5.5% binder
  - 94.5% aggregate
- Example:
  - Resources conserved in 2005:
    - 589,680 tons aggregate
    - 34,320 tons binder
      - 8 million gallons

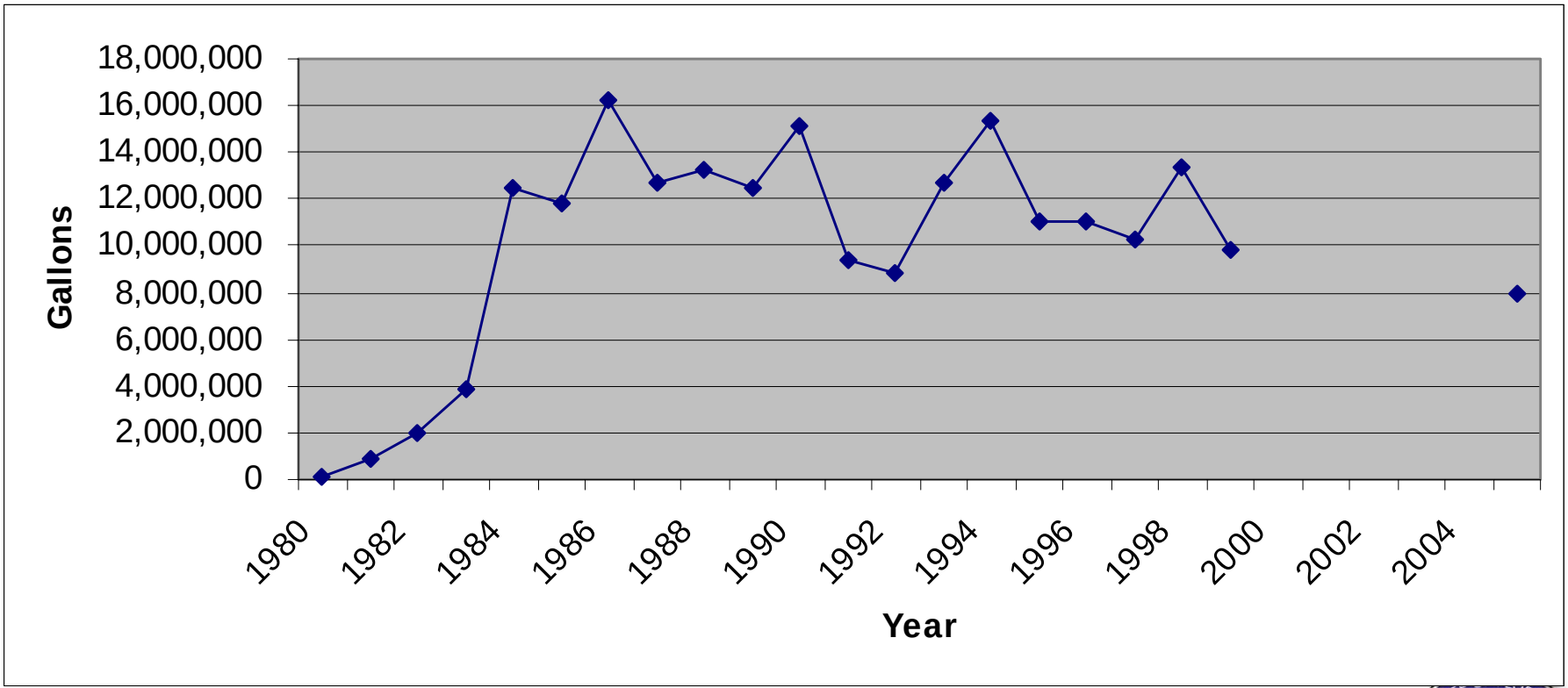
RAP Usage


1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Tons
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year

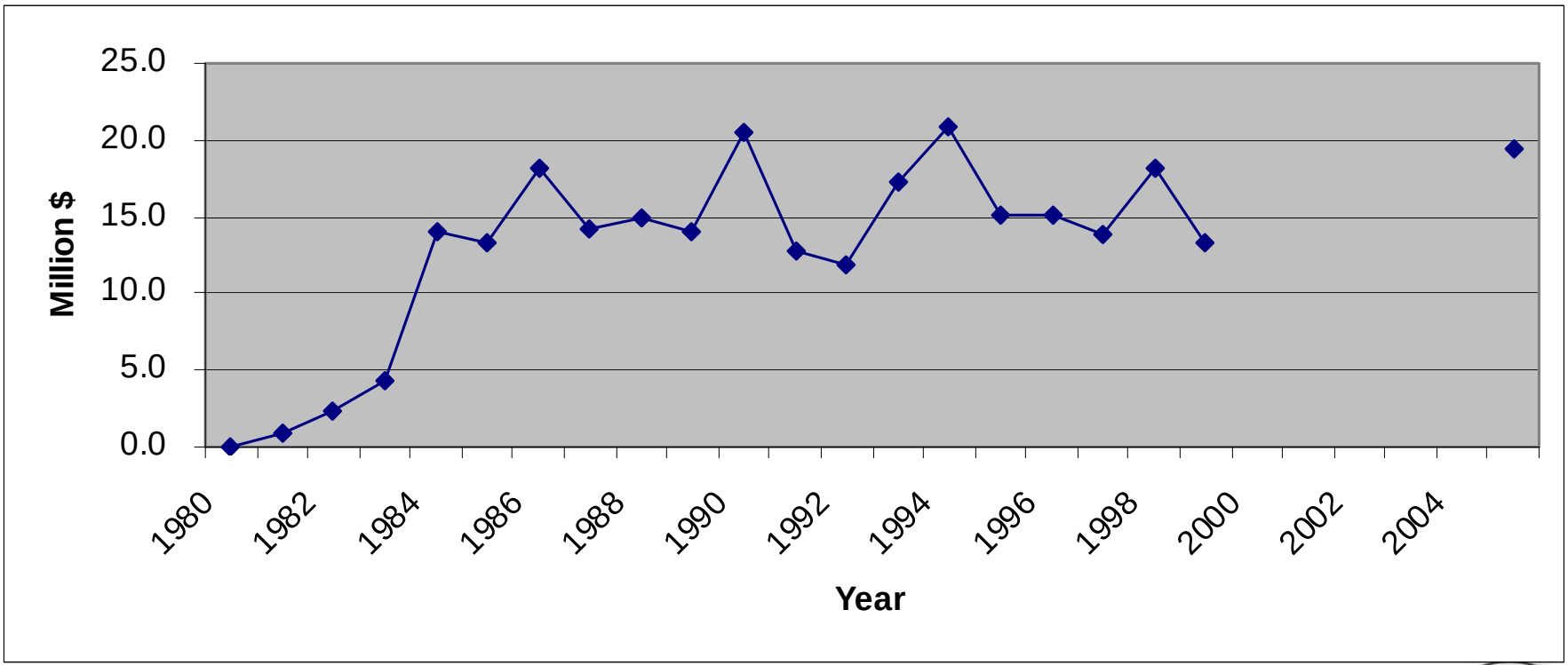
Aggregate Savings



Binder Savings

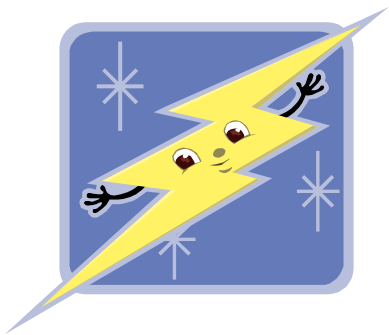


Savings in Materials Costs



Conservation of Energy

- It is estimated that the usage of 1 ton of HMA containing RAP conserves 200,000 BTU's of energy
  - Less aggregate to mine, process & deliver
  - Less asphalt to refine & deliver



Performance

Deficient Pavements:

Criteria	2003	2004	2005
Ride	2.6% 1063 Miles	6.3% 2556 Miles	3.8% 1575 Miles
Crack	15.8% 6410 Miles	16.5% 6718 Miles	15.8% 6559
Rut	1.5% 596 Miles	1.2% 498 Miles	0.9% 384 Miles

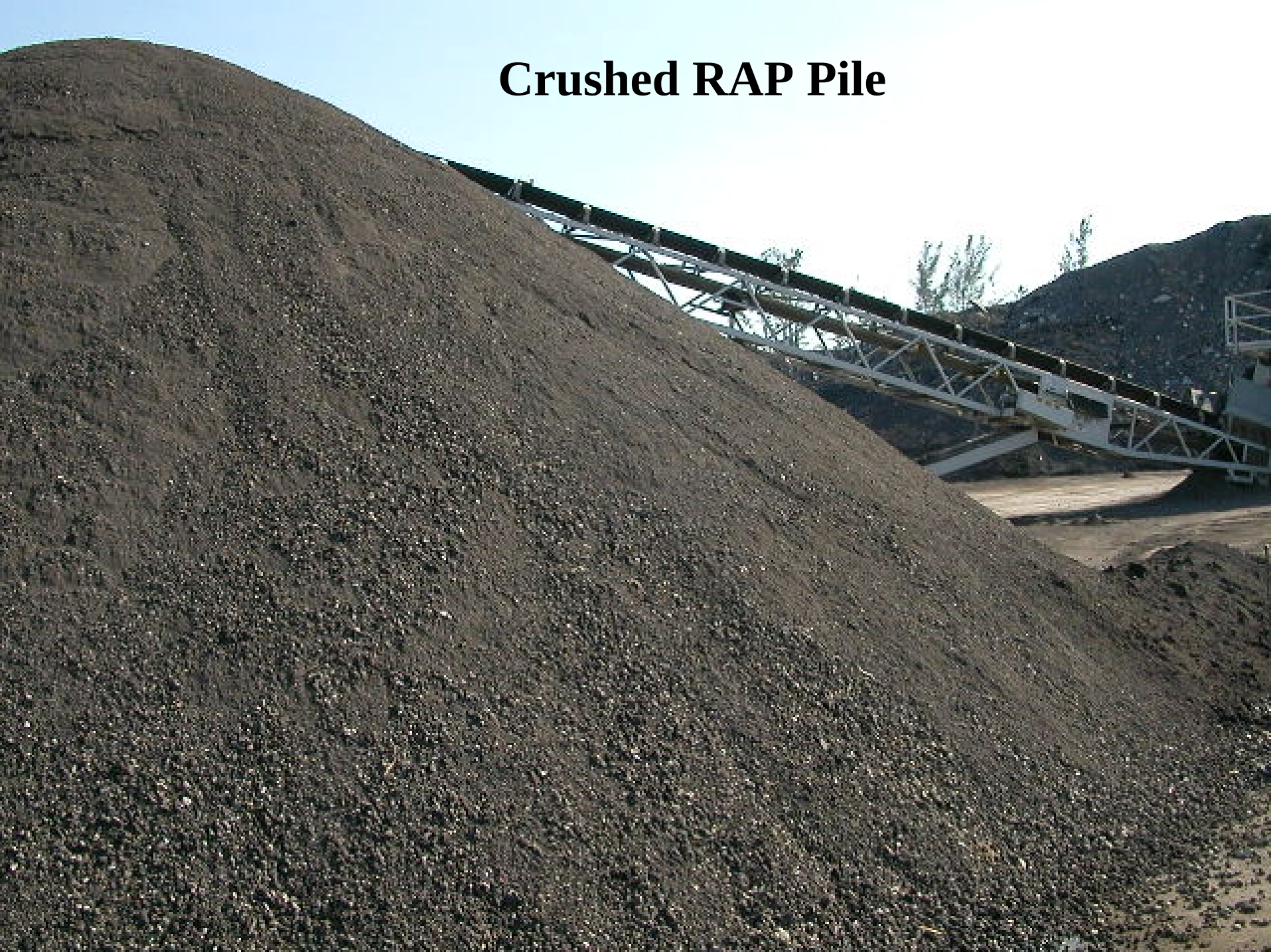
Current Practices

Various Source RAP Pile….aka GOK RAP


Various Source RAP

RAP Crusher

Crushed RAP Pile



Future

Fractionated RAP


FRAP
COARSE
FRAP
FINE

Top Ten Reasons FDOT has had a successful HMA recycling program

10) Allows milling without generating waste

9) Pavement Composition Reports

8) Three good projects 25 years ago!

7) Wasn't mandated by Congress

6) Viscosity monitoring during production

Top Ten Reasons FDOT has had a successful HMA recycling program

5) It's good for the environment

4) Receptive/innovative Contractor & Agency personnel – 25 years ago!

3) Giving the RAP to the Contractor

2) It conserves energy

1) It saves money!


Thank you!