Porous Asphalt Pavements

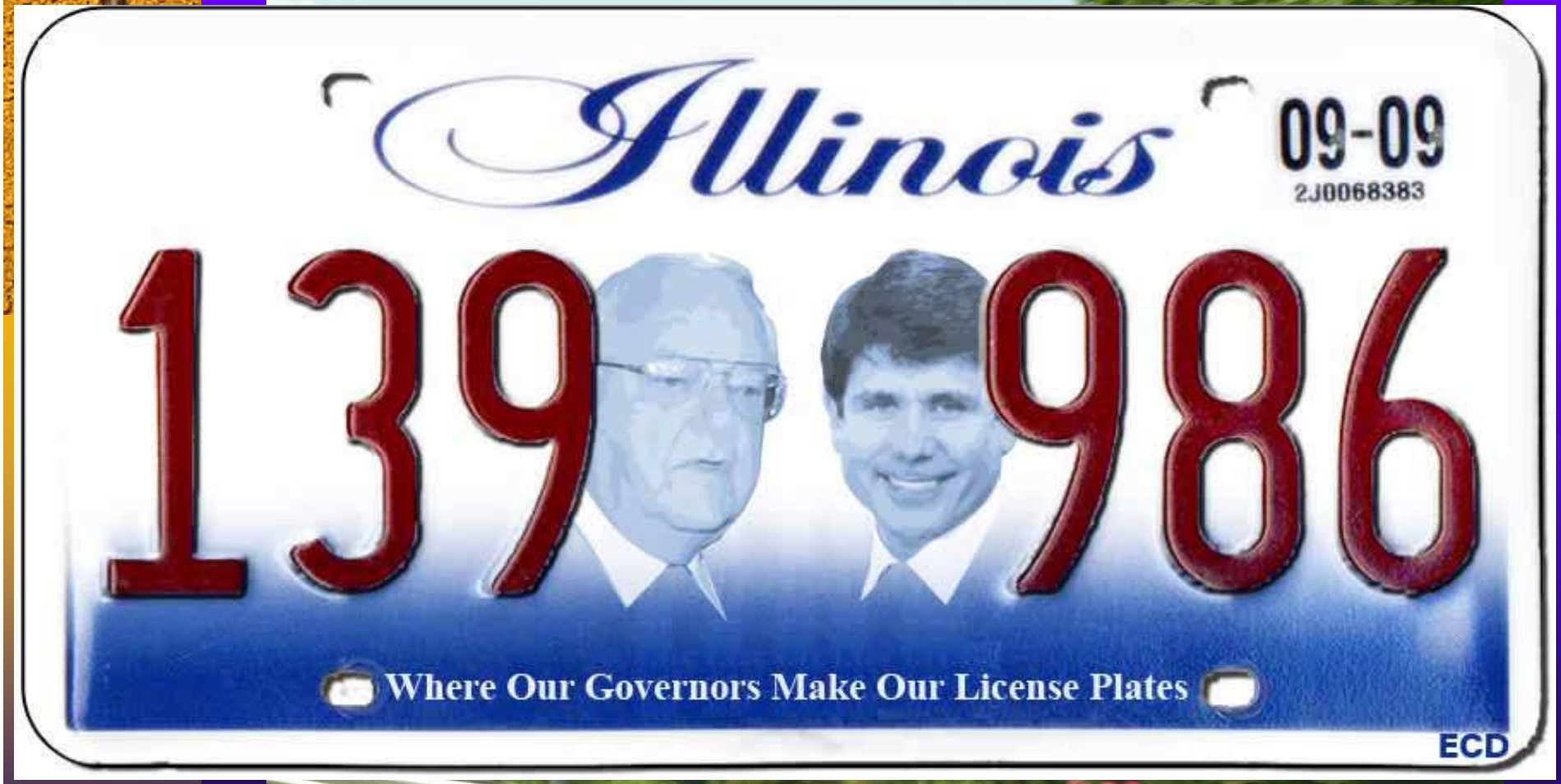
"Some cause happiness wherever they go; others, whenever they go."
- Oscar Wilde (1854-1900)

But really, I am here to work with you!

Timothy R. Murphy, P.E.
President

Murphy Pavement Technology

Hello OH…With Love from IL



Special Thanks and Resources

NAPA

University of Washington

Oregon Asphalt Pavement Association

Tom Cahill
Cahill Associates Environment Consultants

Storm water Best Management Practices (BMP's) in an Ultra-Urban Setting

- Porous asphalt has the potential to be an effective ultra-urban BMP.
- Porous asphalt works by allowing:
  - ✓streets,
  - ✓parking lots,
  - ✓sidewalks, and other impervious covers

  to retain their natural infiltration capacity while maintaining the structural and functional features of the materials they replace.

The Journey

Construction Must-Haves

1. Sufficient pavement thickness to reduce overstressing the sub-grade.
2. Quality base and sub-base materials that can support the applied loads.
3. Stable surface that serves as the wearing course for traffic.
4. Compaction of all materials to provide strength and to resist densification under traffic.

Things I Thought Would Never Happen

- White Sox would win the World Series.

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- Chief Illiniwek would be under attack from the outside.

Things I Thought Would Never Happen

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Things I Thought Would Never Happen

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- like a pirate.

Things I Thought Would Never Happen

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What are Porous Pavements?

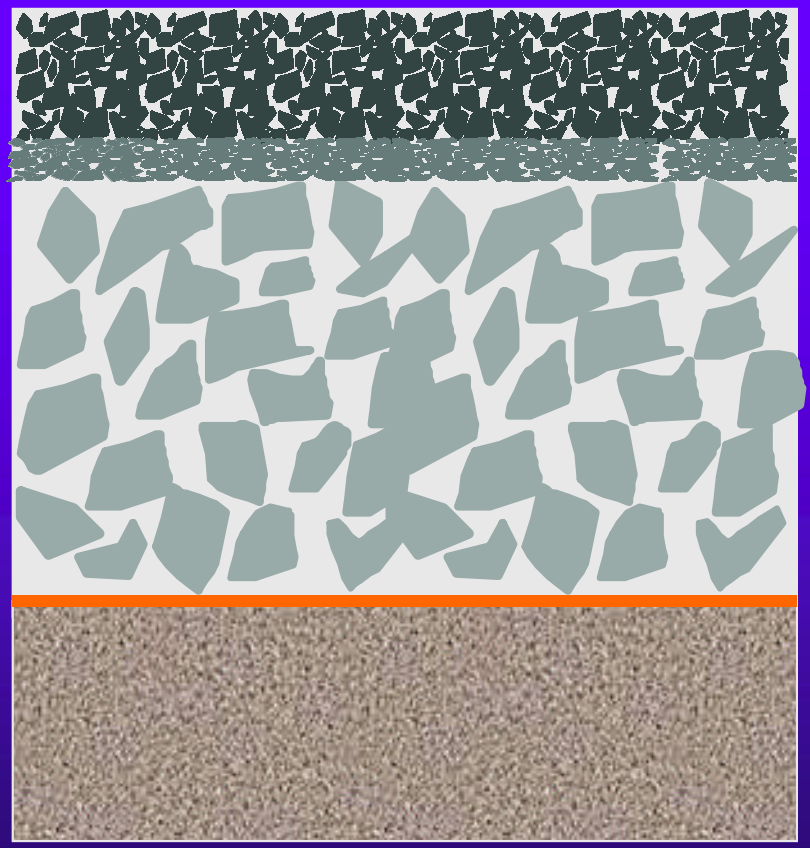
Open-Graded HMA ~ 2 ½” – 6”

½” Agg. (#57) ~ 1 – 3” Thick

Clean Uniformly Graded 2”-3” Crushed Agg. (#2) – 40% Voids for ~ 24” – 36”

Non-Woven Geotextile

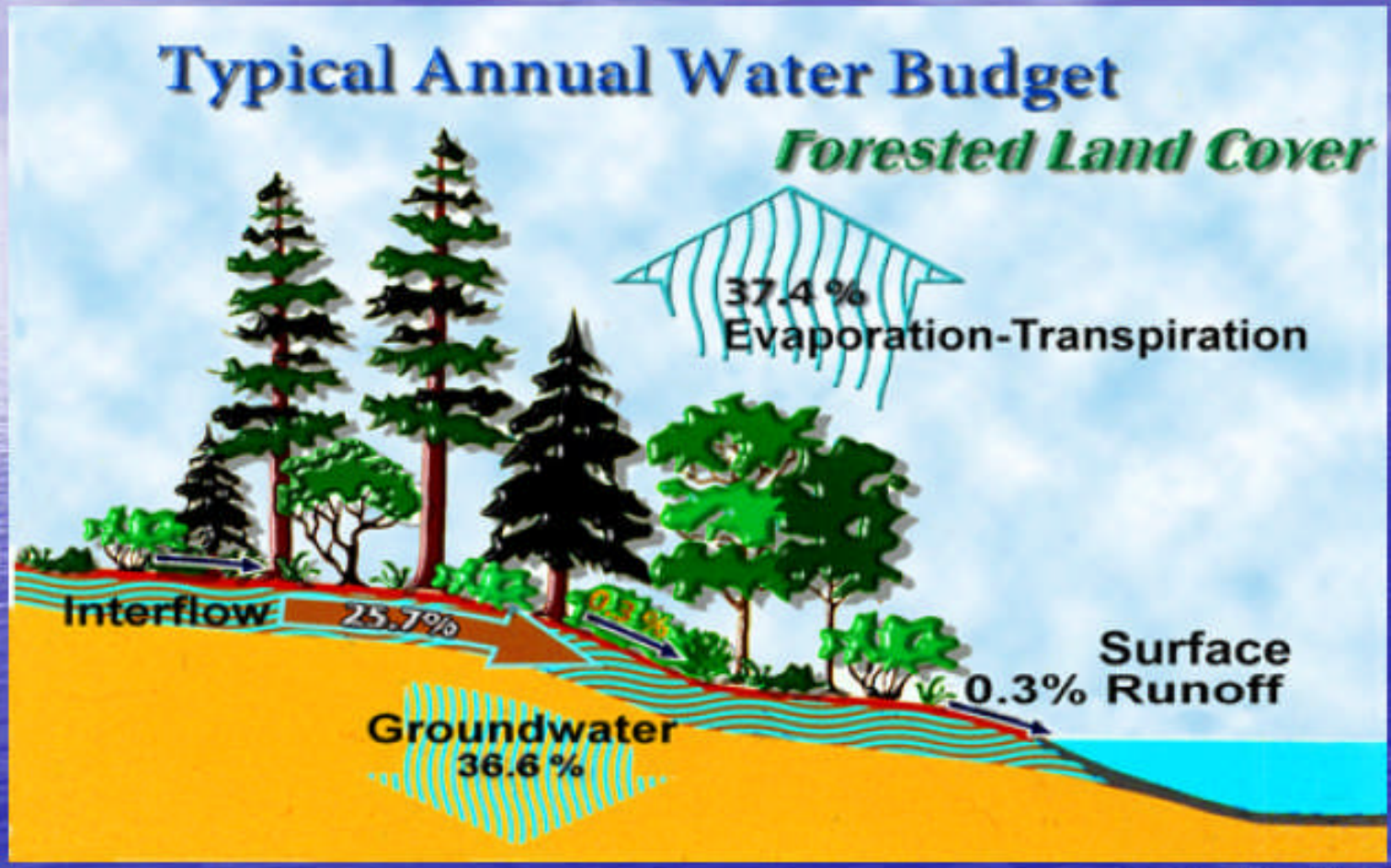
Uncompacted Subgrade



Porous Asphalt

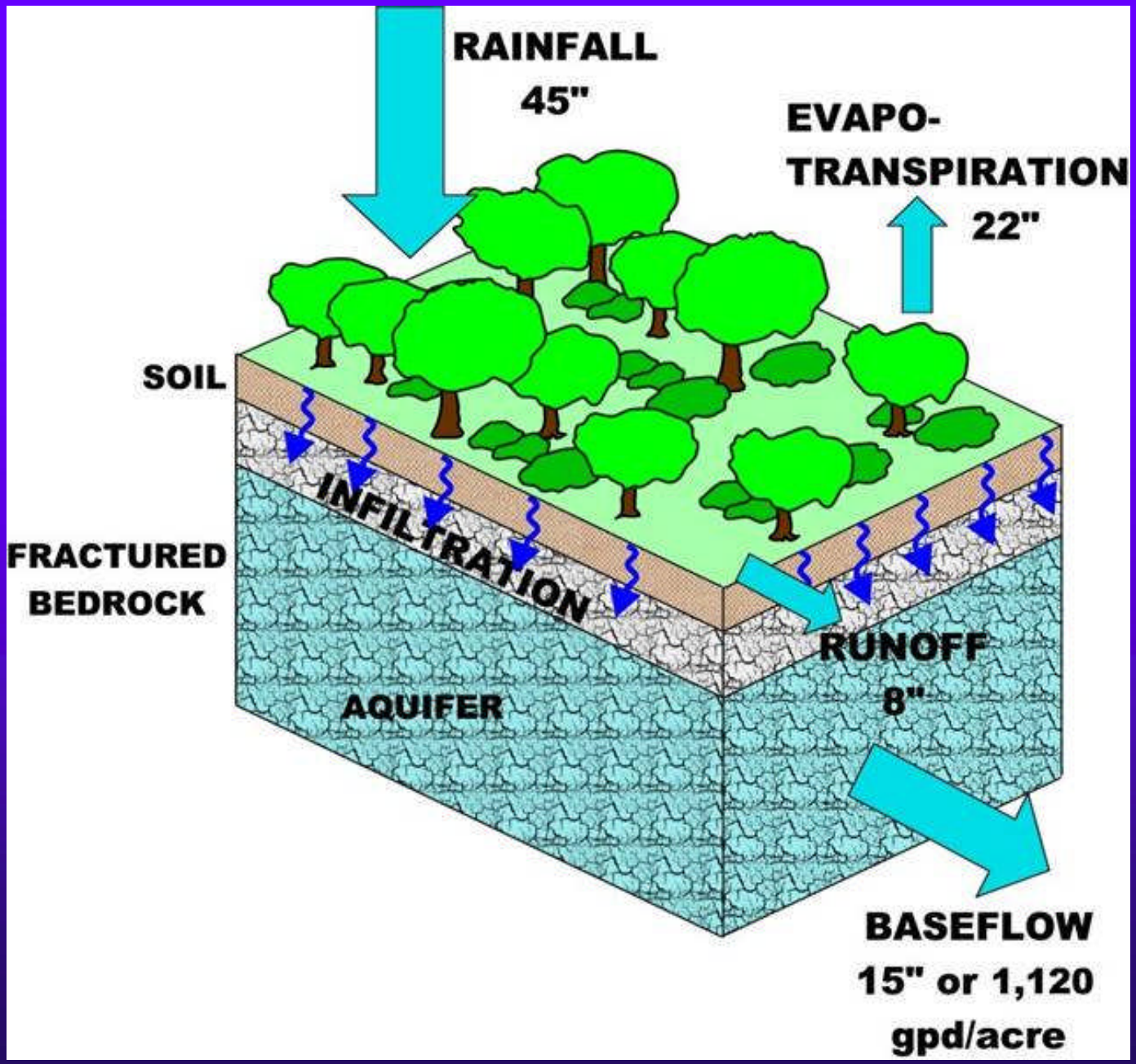
We have porous asphalt occasionally by accident…

Natural Conditions

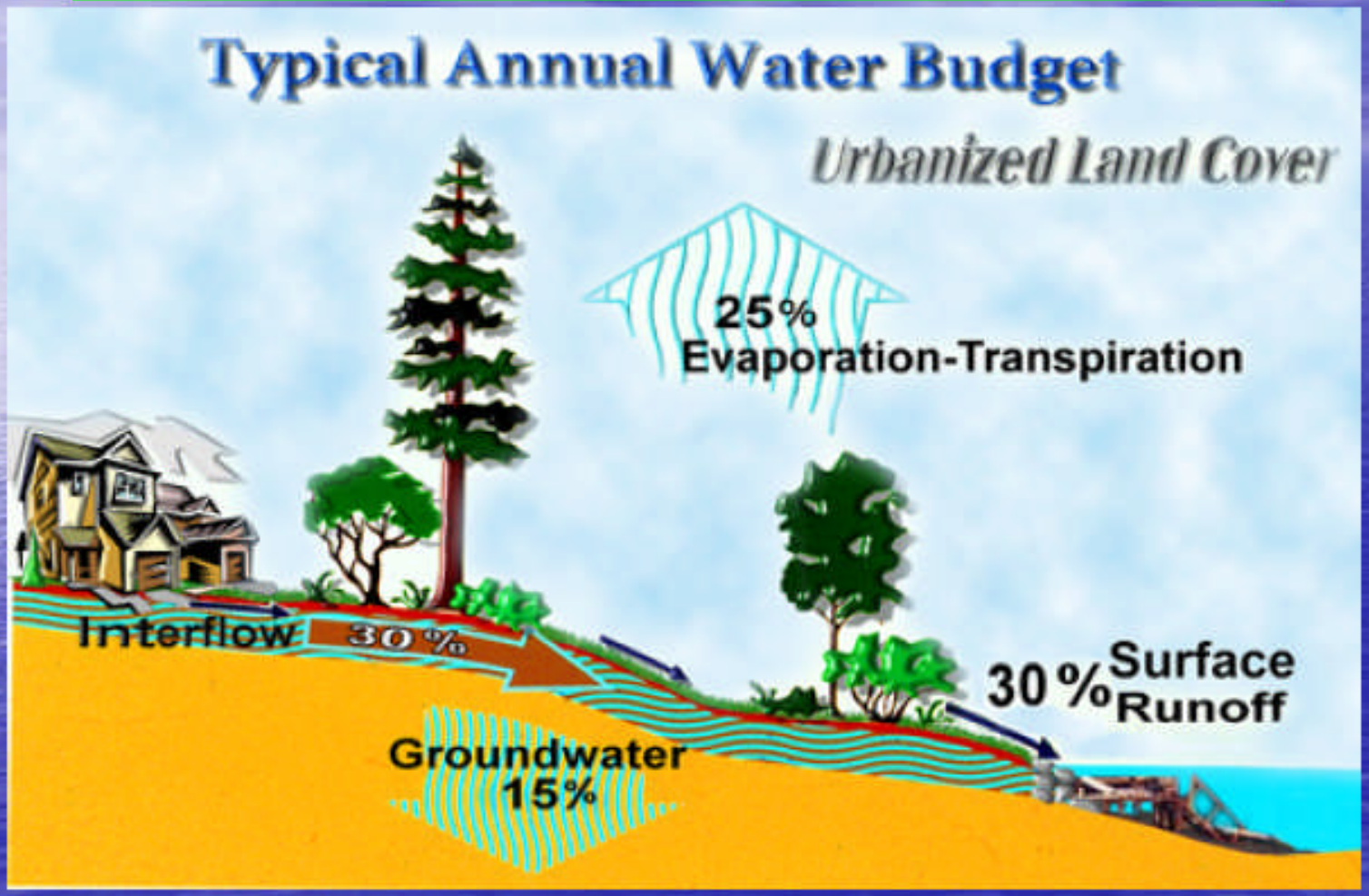


Courtesy May, U of W

Natural Conditions


RAINFALL
45"
EVAPO-
TRANSPIRATION
22"
SOIL
INFILTRATION
FRACTURED
BEDROCK
RUNOFF
8"
AQUIFER
BASEFLOW
15" or 1,120
gpd/acre

Developed Conditions



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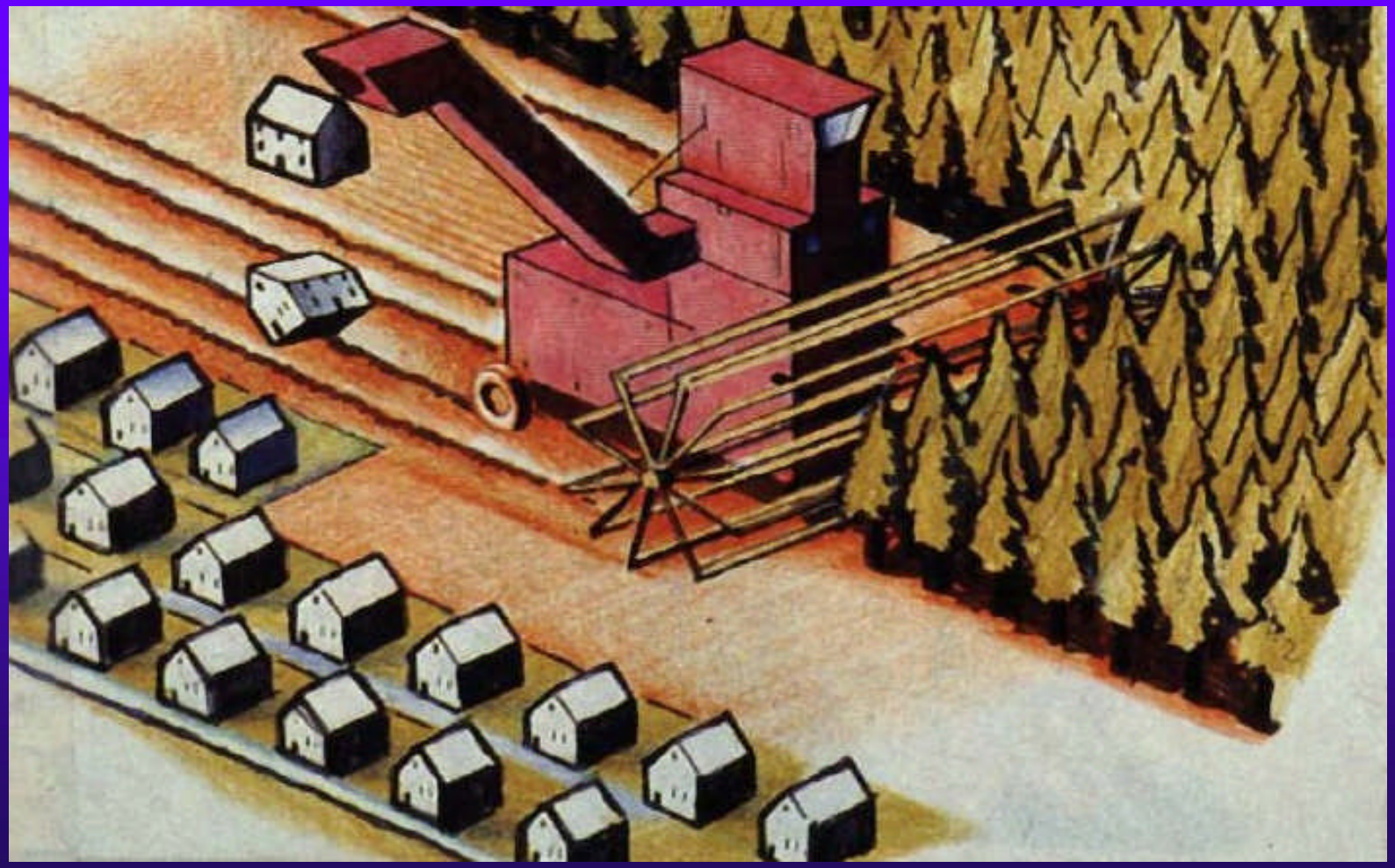
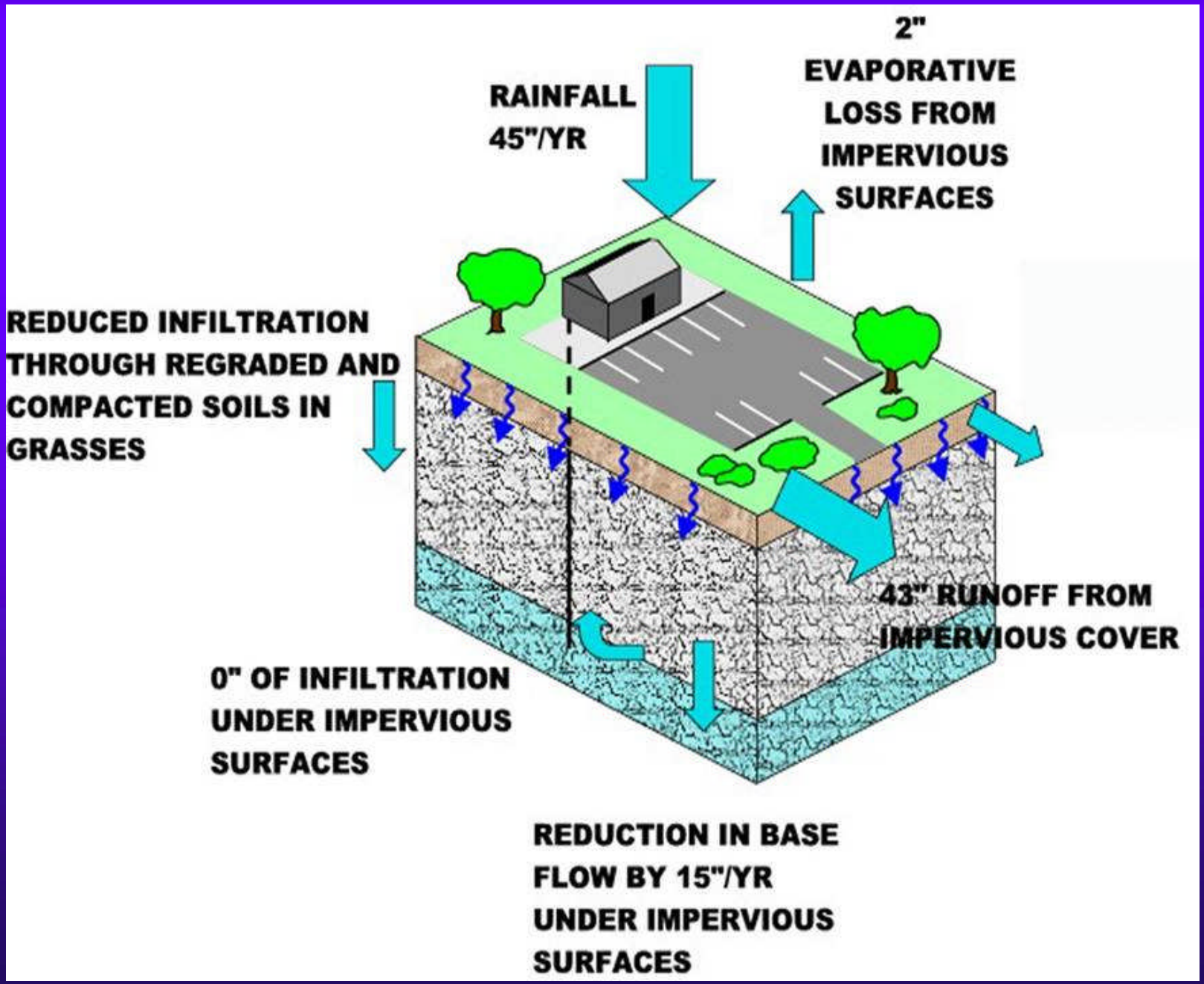
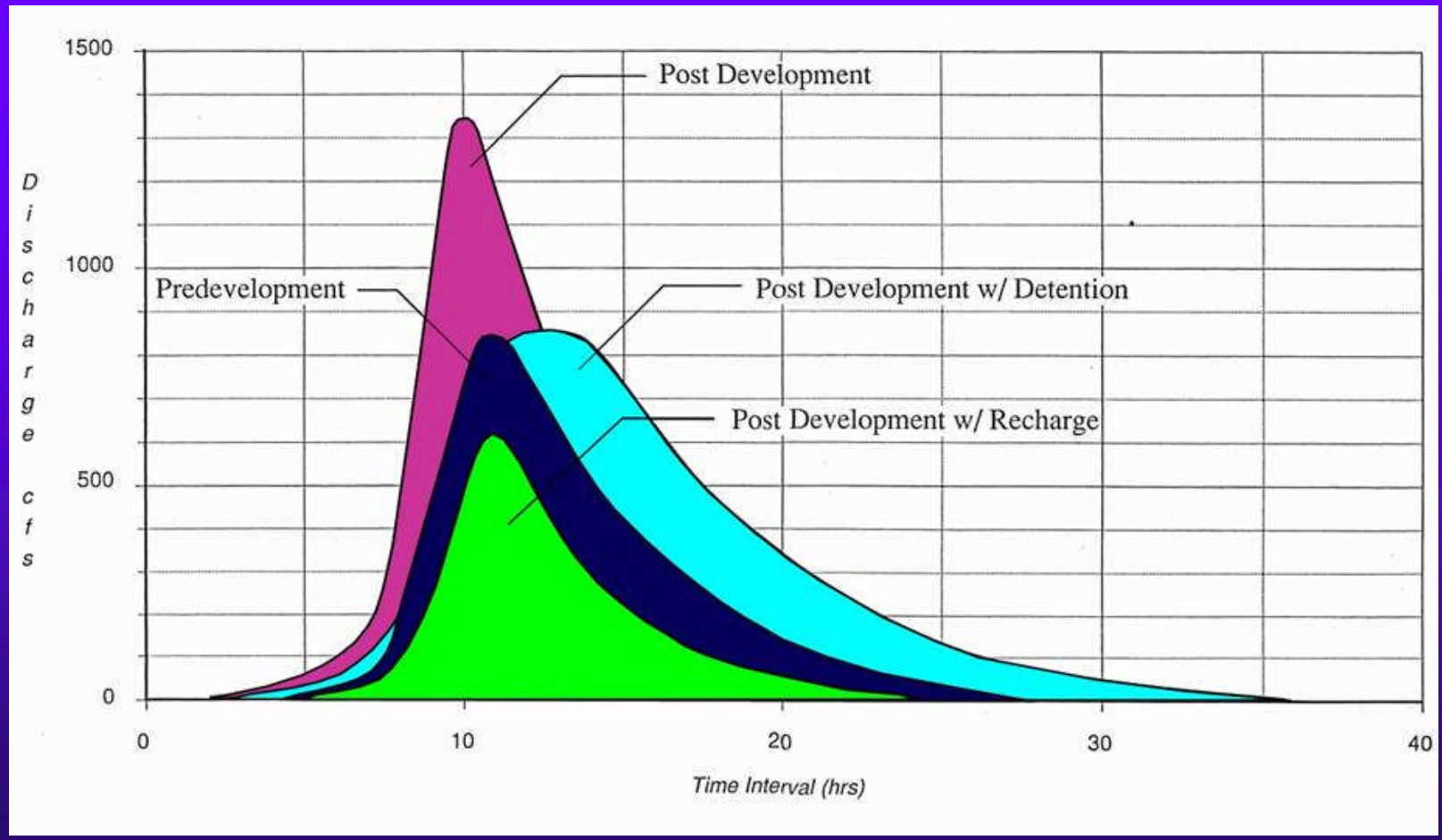
Developed Conditions



Developed Conditions


2"
EVAPORATIVE
LOSS FROM
IMPERVIOUS
SURFACES
RAINFALL
45"/YR
REDUCED INFILTRATION
THROUGH REGRADED AND
COMPACTED SOILS IN
GRASSES
43" RUNOFF FROM
IMPERVIOUS COVER
0" OF INFILTRATION
UNDER IMPERVIOUS
SURFACES
REDUCTION IN BASE
FLOW BY 15"/YR
UNDER IMPERVIOUS
SURFACES

Comparison of Detention vs. Infiltration Design Systems



We call this development…

Porous bituminous pavement

- Developed by the Franklin Institute – 1972
- Tested in pilot projects during 1970's
- Development of geo-textiles in 1979
- Current design since 1980
- CA has built over 150 projects since 1980
- Outstanding engineering project - 2000

Design

- **Rainfall**
  - ✓ **Typical designs for 6 month/24 hr storm**
  - ✓ **Conservative design for 20 year/24 hr storm range from 1.4 to 15 in./24 hr.**
- **Meet Local & State wastewater mitigation requirements.**

Keys to Success – Site Conditions

- Soil permeability/infiltration rate
  - ✓ EPA recommends 0.5”/hour
  - ✓ 0.1”/hour still OK
- Depth to bedrock > 2’
- Depth to high water > 3’
- Fill – not recommended
- Frost –pavement section should exceed frost depth

Soils Investigation

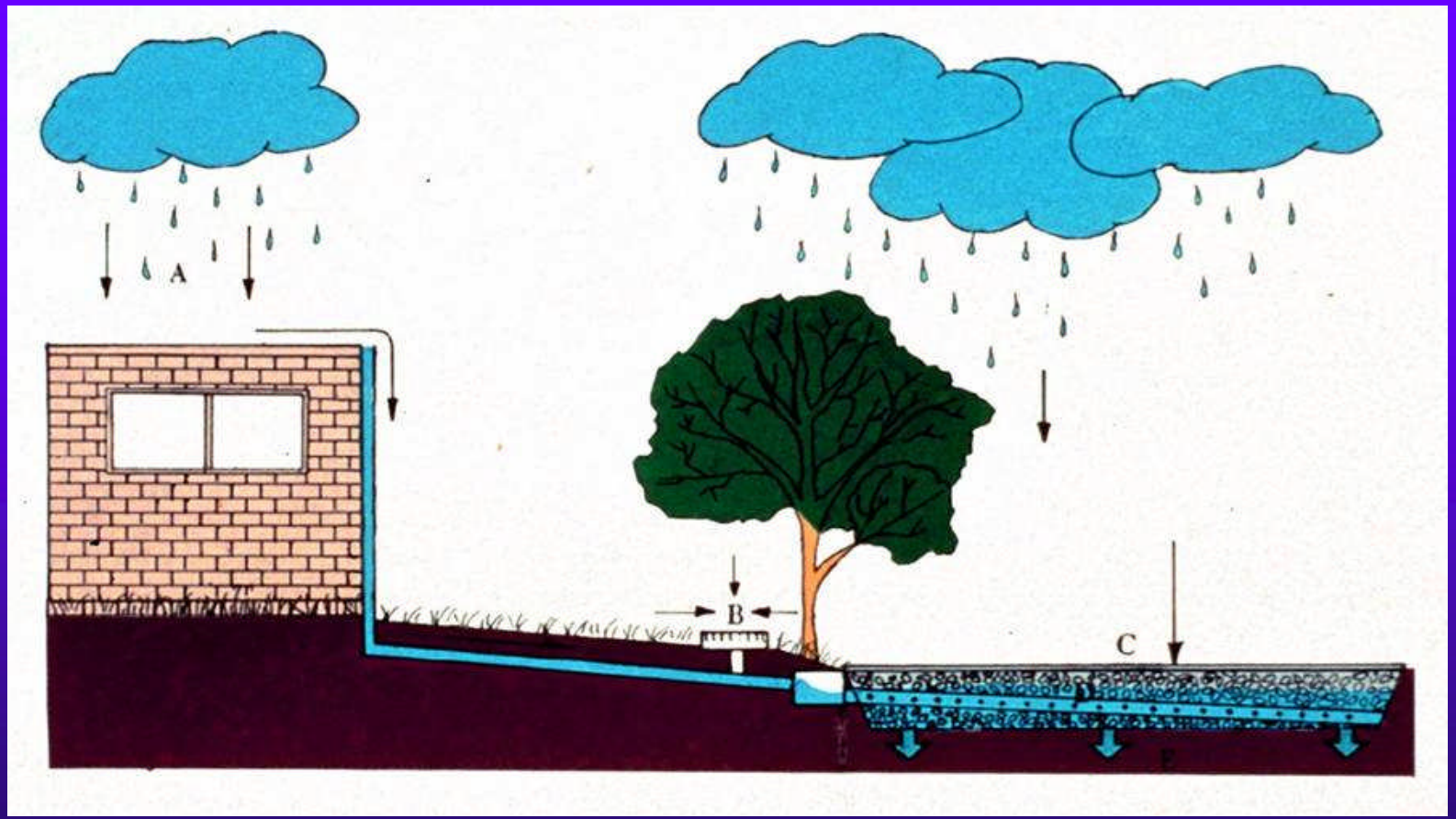
Borings and/or test pits

- Test permeability
- Determine depth to high water table
- Determine depth to bedrock

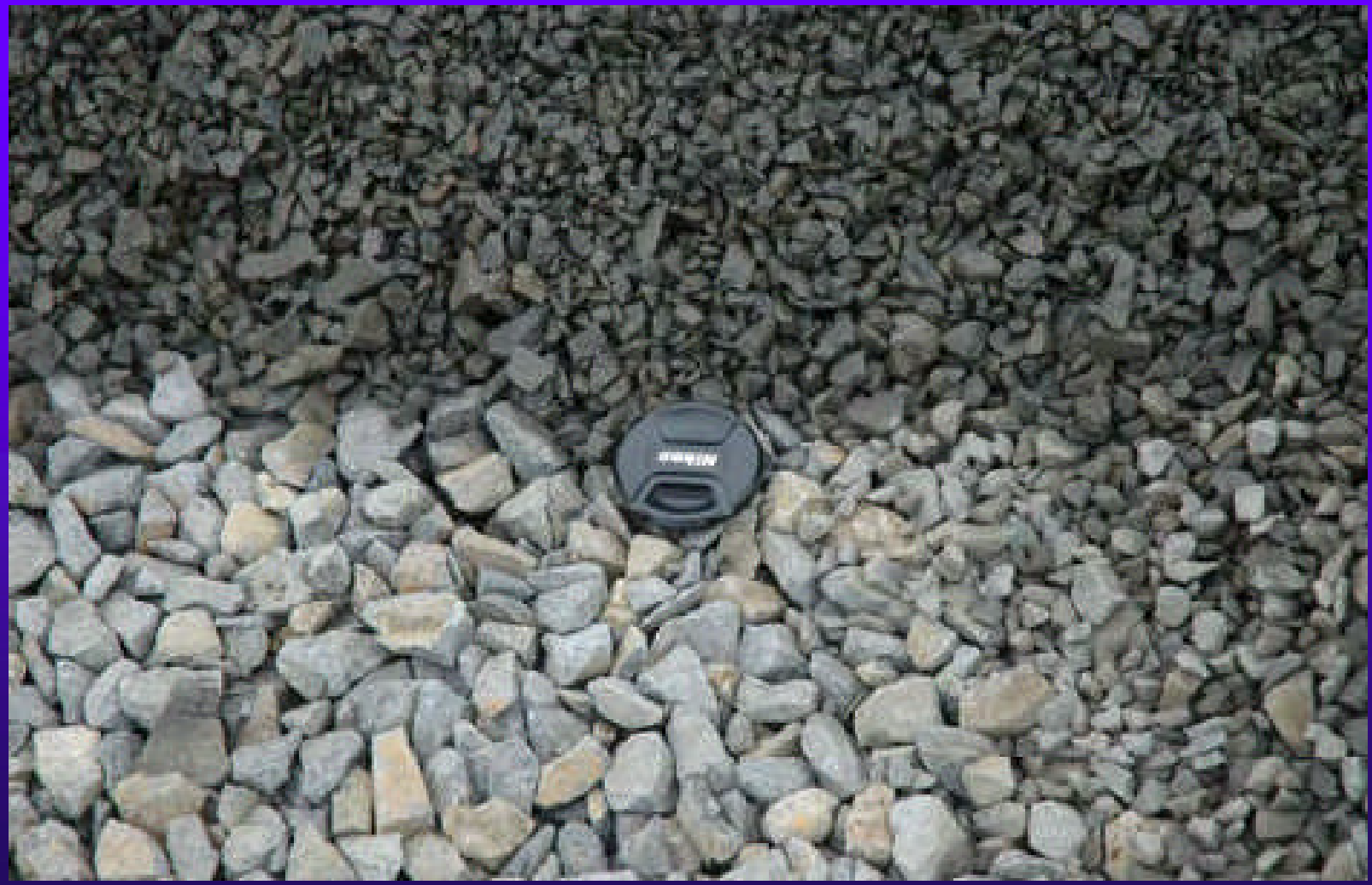
Keys to Success - Design

- **Slope – limit surface slope to 5%**
  - ✓ **Terrace when necessary**
  - ✓ **Use conventional HMA for steeper slopes**
- **Avoid piping water long distances**
- **Spread infiltration over largest area possible; 5:1 Impervious: Infiltration**

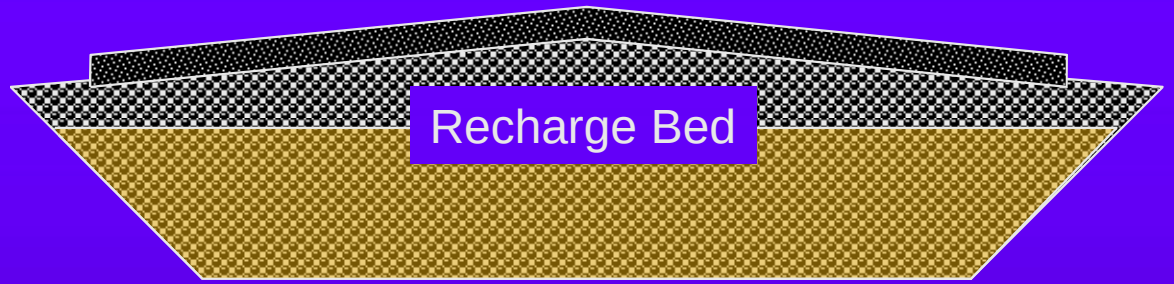
Avoid piping long distances

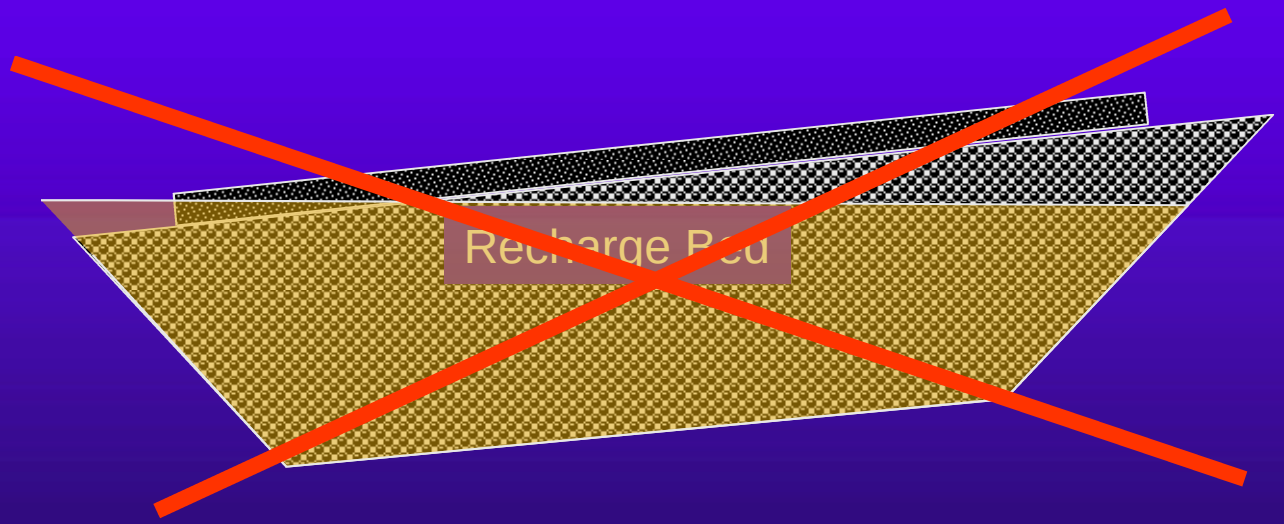


Reservoir and choker stone



Bottom Must Be Flat

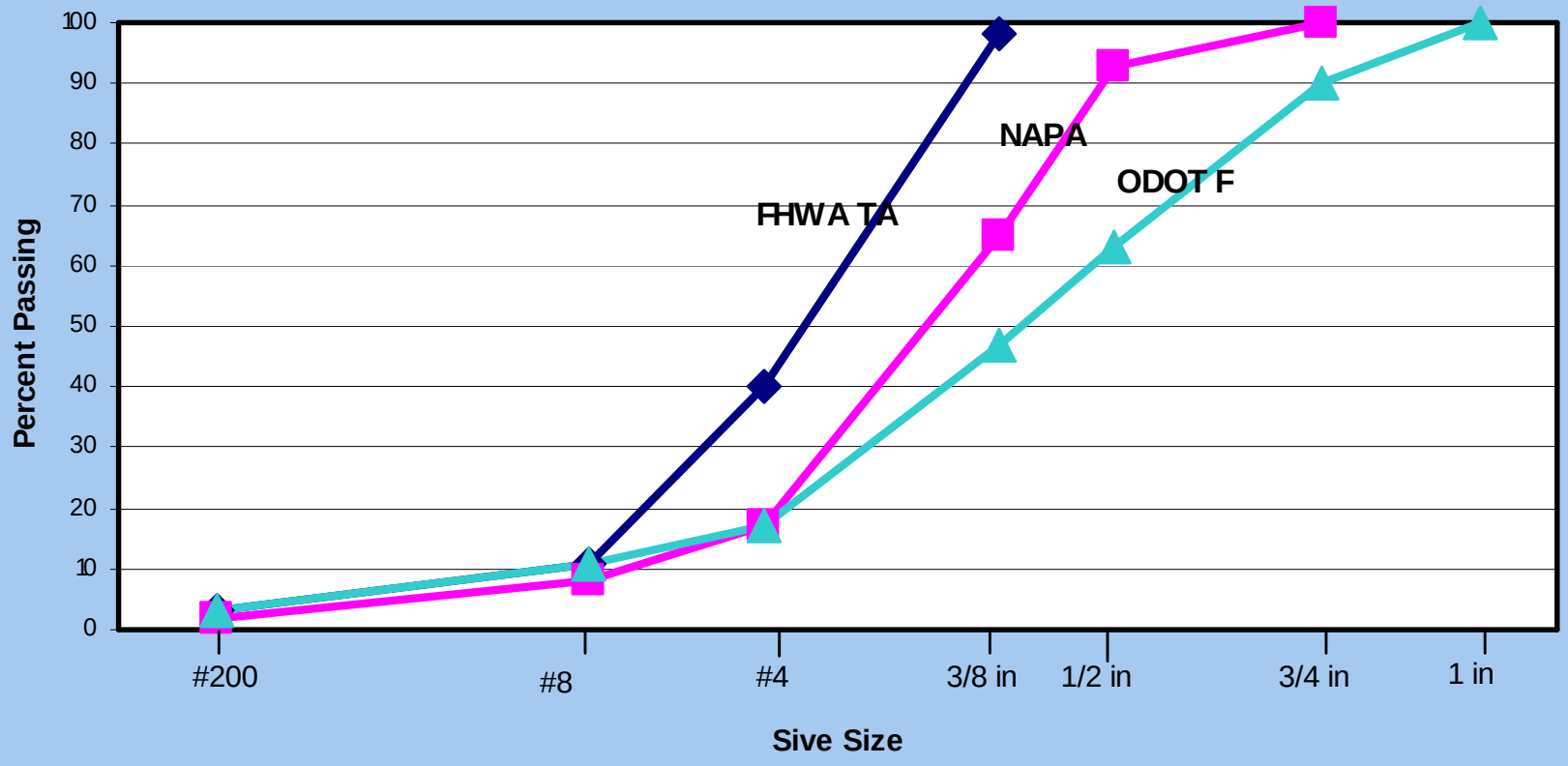




Keys to Success – Design

- Usage / Vehicle Loading; Lightly loaded areas such as:
  - ✓ Parking lots
  - ✓ Low volume roads (limited truck use)
  - ✓ Recreational Areas
- Establish structural requirements

Porous HMA Surface



Open-Graded HMA

Keys to Success – Construction

- Build porous
  - ✓Protect fr
  - ✓Protect fr
- Protect site f
- Excavate to
  - ✓Don’t com
  - ✓Place filte

Keys to Success – Construction

- Place r… 3” stone (if granul… uble fractu…
- Place 1… ne to stabili… servoir course…
- Place p… 2” to 4”) usuall… asses of a 10-ton…

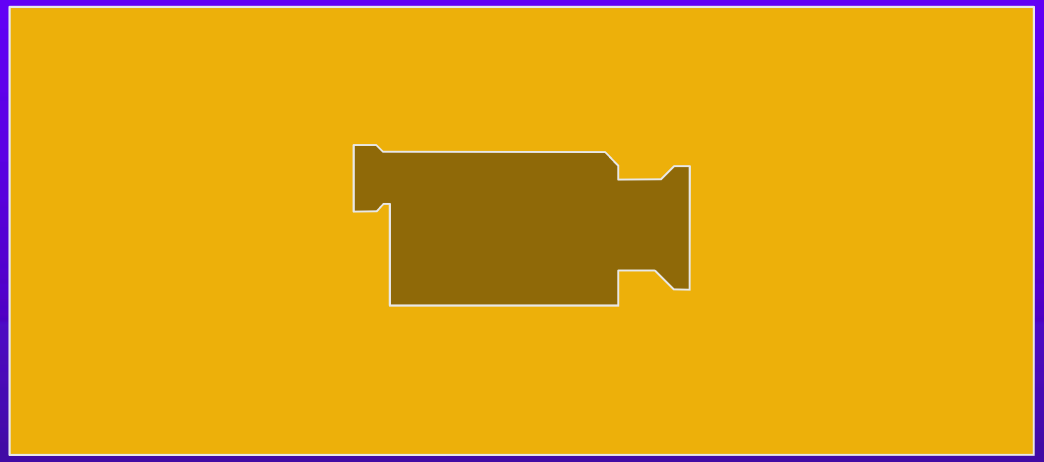
Paving and Compaction

- Paving as usual – recommend track paver
- Minimize truck movement over aggregate
- Static compaction

Construction Guidelines

- R
- P
  c

Final construction step…
…does it work?



Maintenance

- Inspect several times first few months during storm events.
- Inspect annually thereafter.
- Pavement surface may be flushed or jet washed.
- Damage pavement can be repaired using dense hot mix provided <10% area.

Have a plan B

Cost

- Cost of pavement structure more
- May be offset by reducing drainage structure costs

Keys to Success

- M
- P
  a

Morris Arboretum
Philadelphia, PA

1984

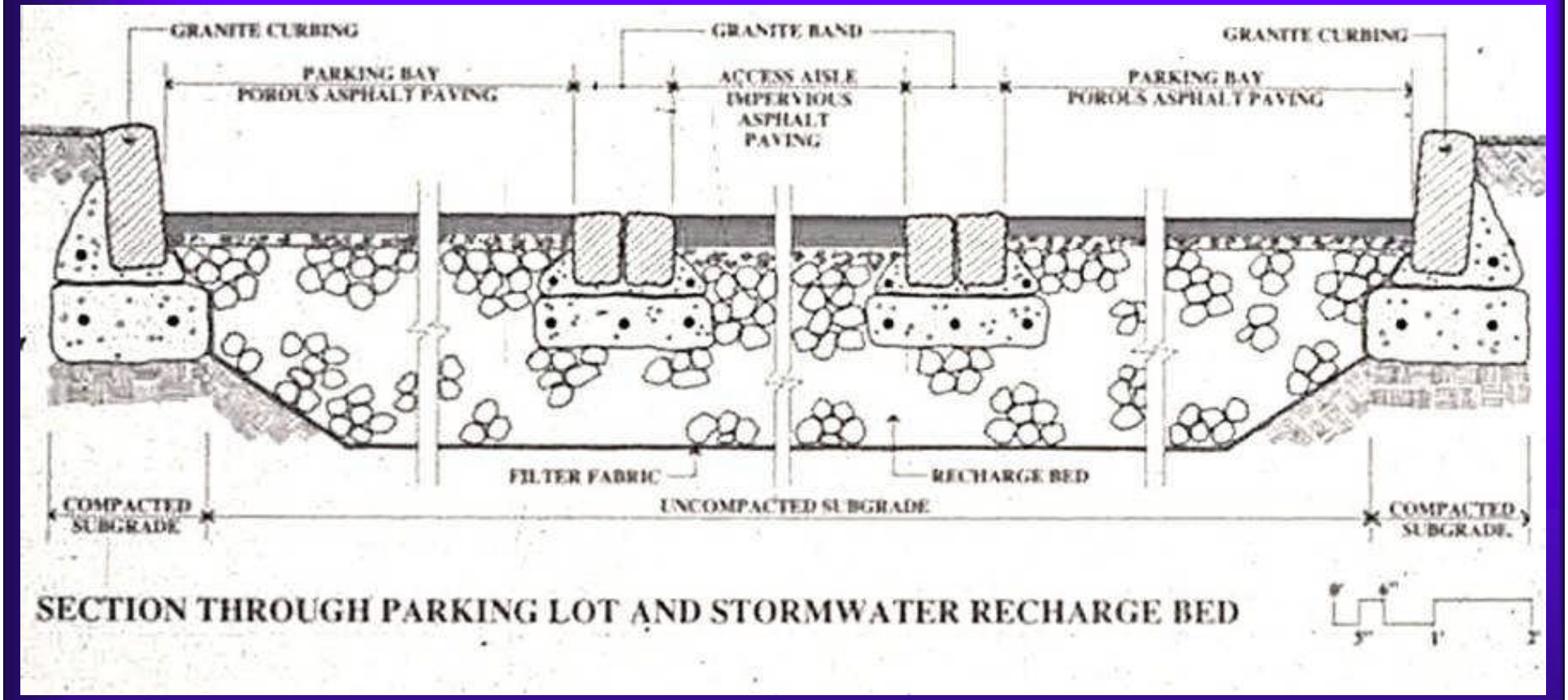


Diagram of infiltration bed at Morris Arboretum

What about alleys?

What about roads?

Roads

- Challenges
  - ✓Cuts and fills
  - ✓Slope
  - ✓Variable soil conditions
  - ✓Utilities
- Limited use

Residential Streets

Residential Streets

Residential Streets

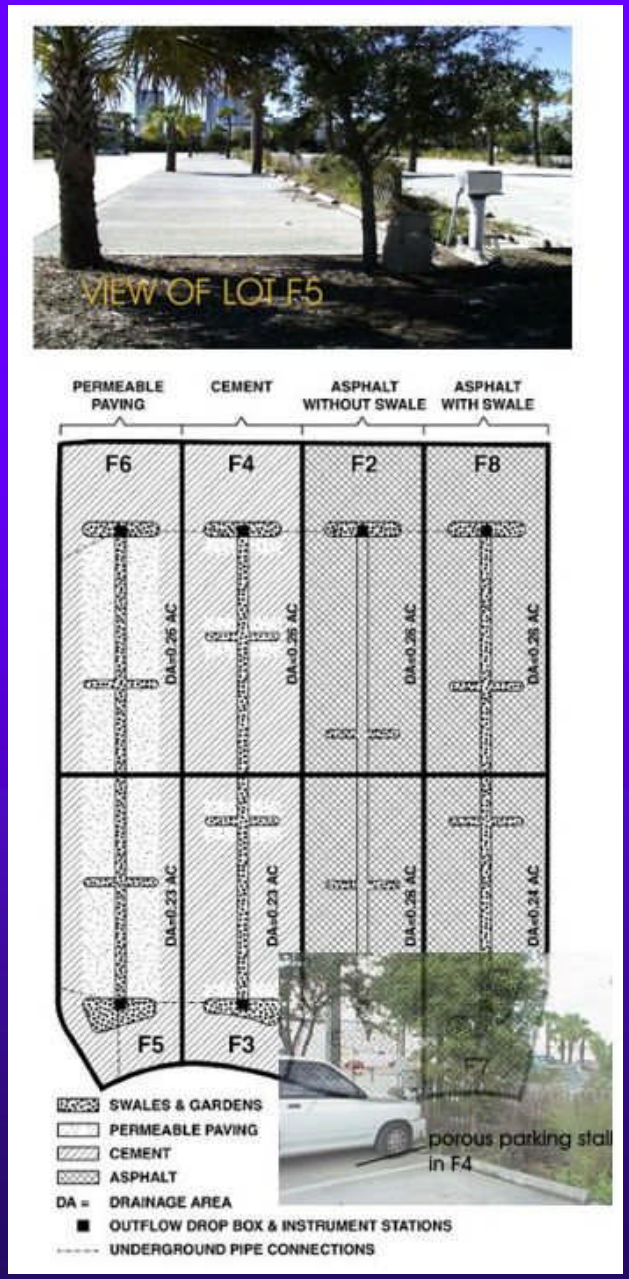
Residential Streets

Port of Portland

It does rain in Arizona

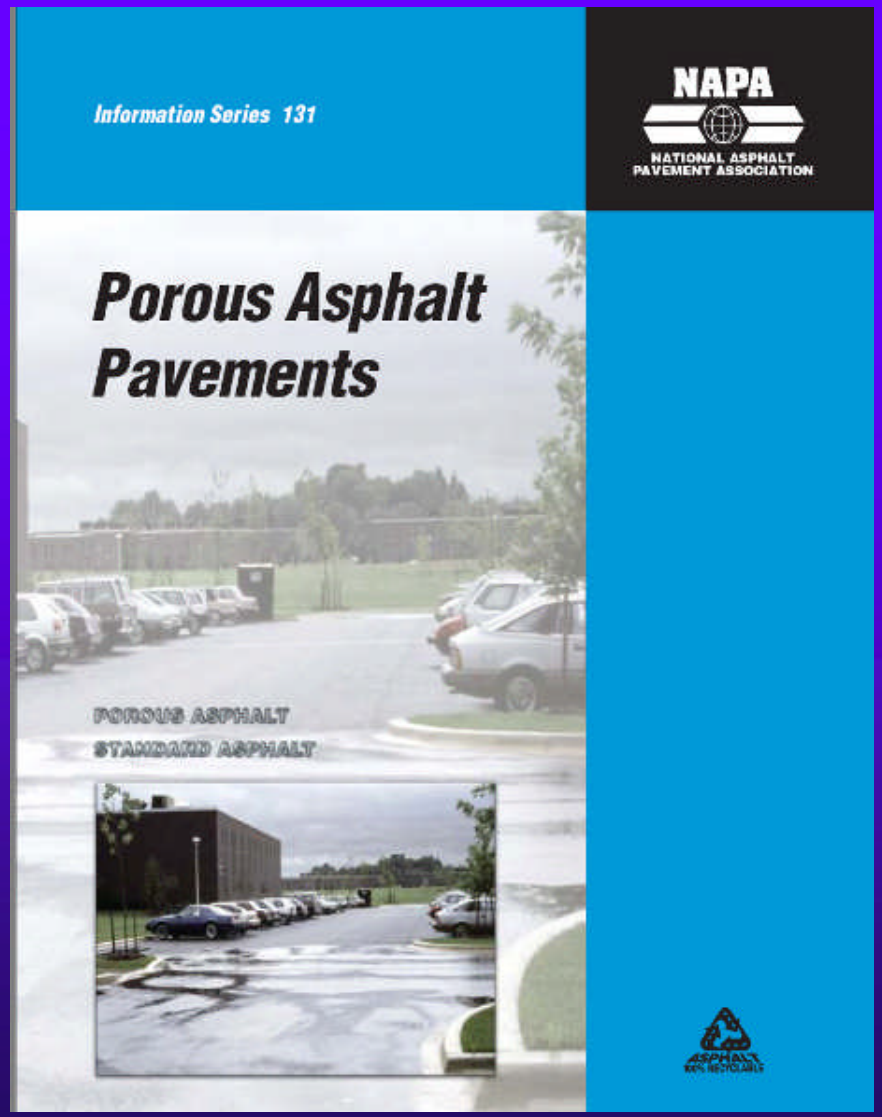

18 Years Later

- Parking lot at the Florida Aquarium in Tampa.
- Serves 700,000 visitors annually.
- Designed as a research and demonstration project.
- Results found that load removal efficiencies for metals (copper, iron, lead, manganese and zinc) ranged from 23 to 59% for asphalt pavement with a swale.



Conclusions

- Porous pavements offer good alternative to conventional storm water mitigation.
- Site Conditions must be right.
- Need to protect pavement from contamination during and after construction.
- Properly designed and constructed will last more than 20 years.



In particular HMAT Magazine Vol. 13, # 3 Titled *Greening the Blacktop*

Sustainability Counts in Today's Market

Questions before I leave for the Windy City?

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