Field Data from the Alternative Cover Assessment Program (ACAP): Conventional Covers

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ACAP Objectives:

- Collect field scale data characterizing field performance of alternative <u>and</u> conventional covers.

- Evaluate accuracy of hydrologic models used for final cover design

- Develop guidance for alternative cover designers

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Why Collect Data from Conventional Covers?

- Per RCRA Subtitle D, an alternative cover must provide performance that is equivalent to (or better) than that of the intended conventional cover.
- Data describing performance of conventional covers *scarce* (Hamburg study, Georgia and Washington study, Sandia study).
- What is performance? … control of erosion and *percolation*, along with acceptable gas control.

§ 258.60 Closure criteria.

(a) Owners or operators of all MSWLF units must install a final cover system that is designed to minimize infiltration and erosion. The final cover system must be designed and constructed to:

(1) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less, and

(2) Minimize infiltration through the closed MSWLF by the use of an infiltration layer that contains a minimum 18-inches of earthen material, and

(3) Minimize erosion of the final cover by the use of an erosion layer that contains a minimum 6-inches of earthen material that is capable of sustaining native plant growth.

(b) The Director of an approved State may approve an alternative final cover design that includes:

(1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (a)(1) and (a)(2) of this section, and

(2) An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph (a)(3) of this section.

Why Collect Field Data?

- Little verification of models used for predicting the hydrology of conventional covers.
- Large-scale field data provide the acid test for cover performance.

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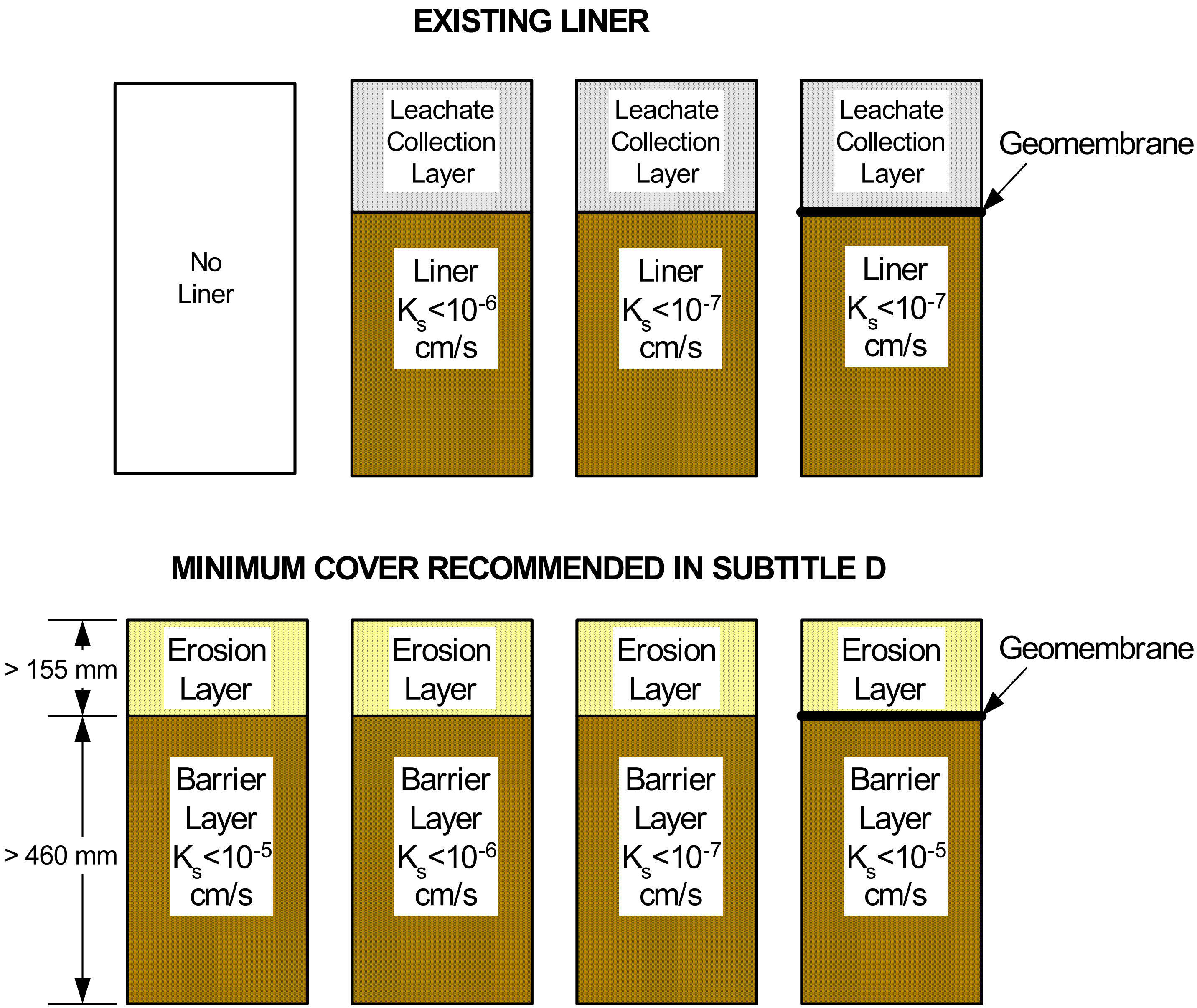
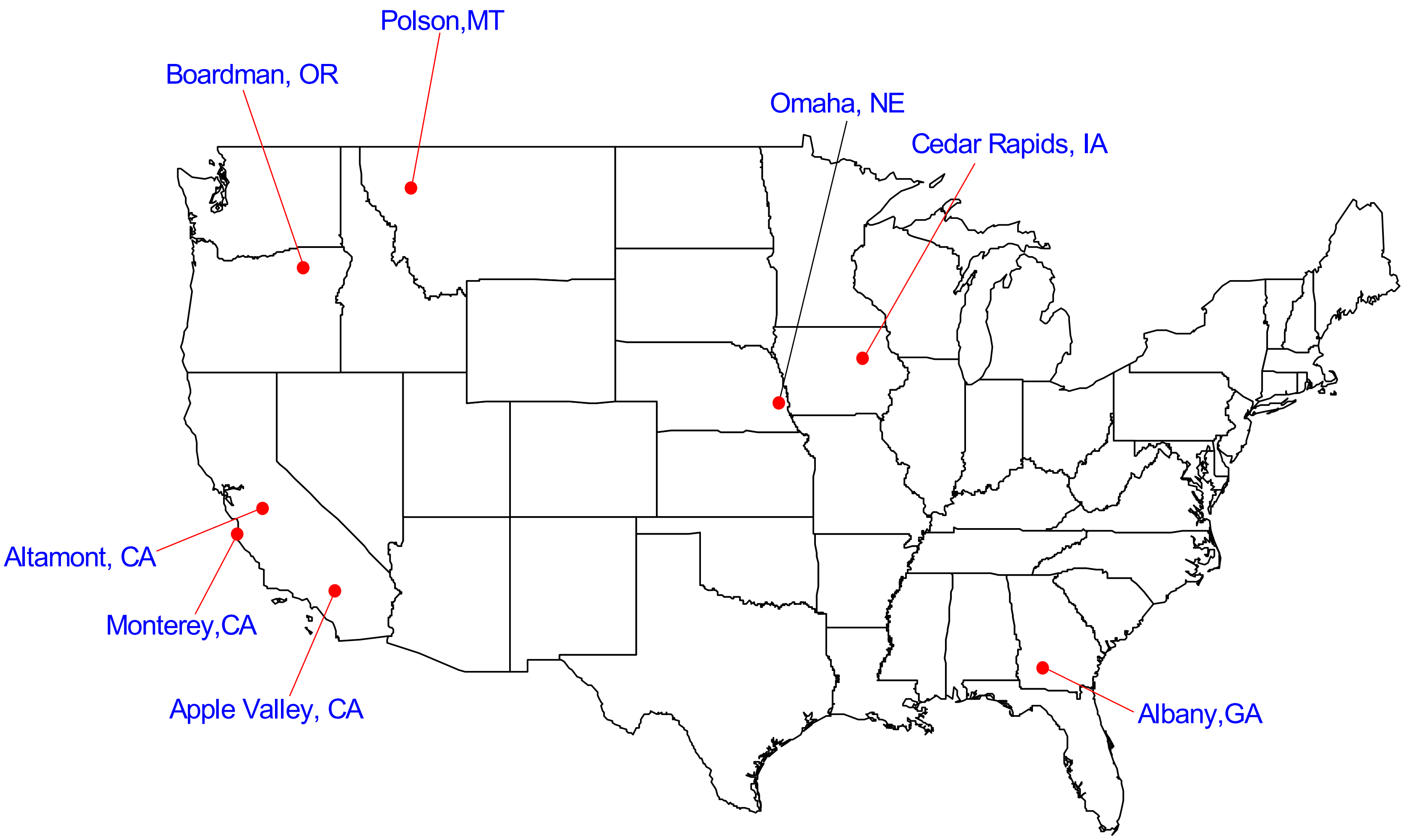
What Defines a Conventional Cover?



ACAP Sites with Conventional Covers



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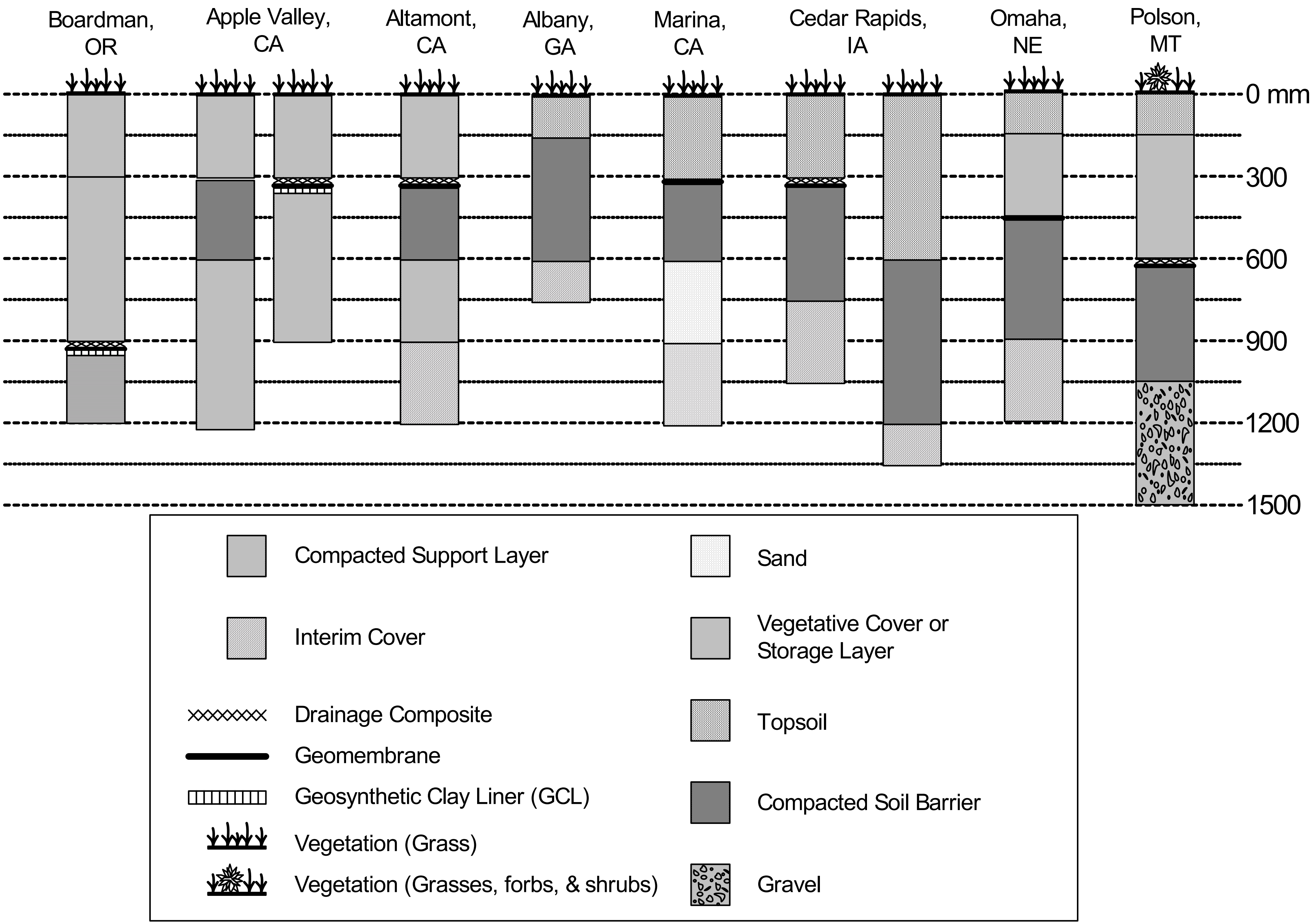
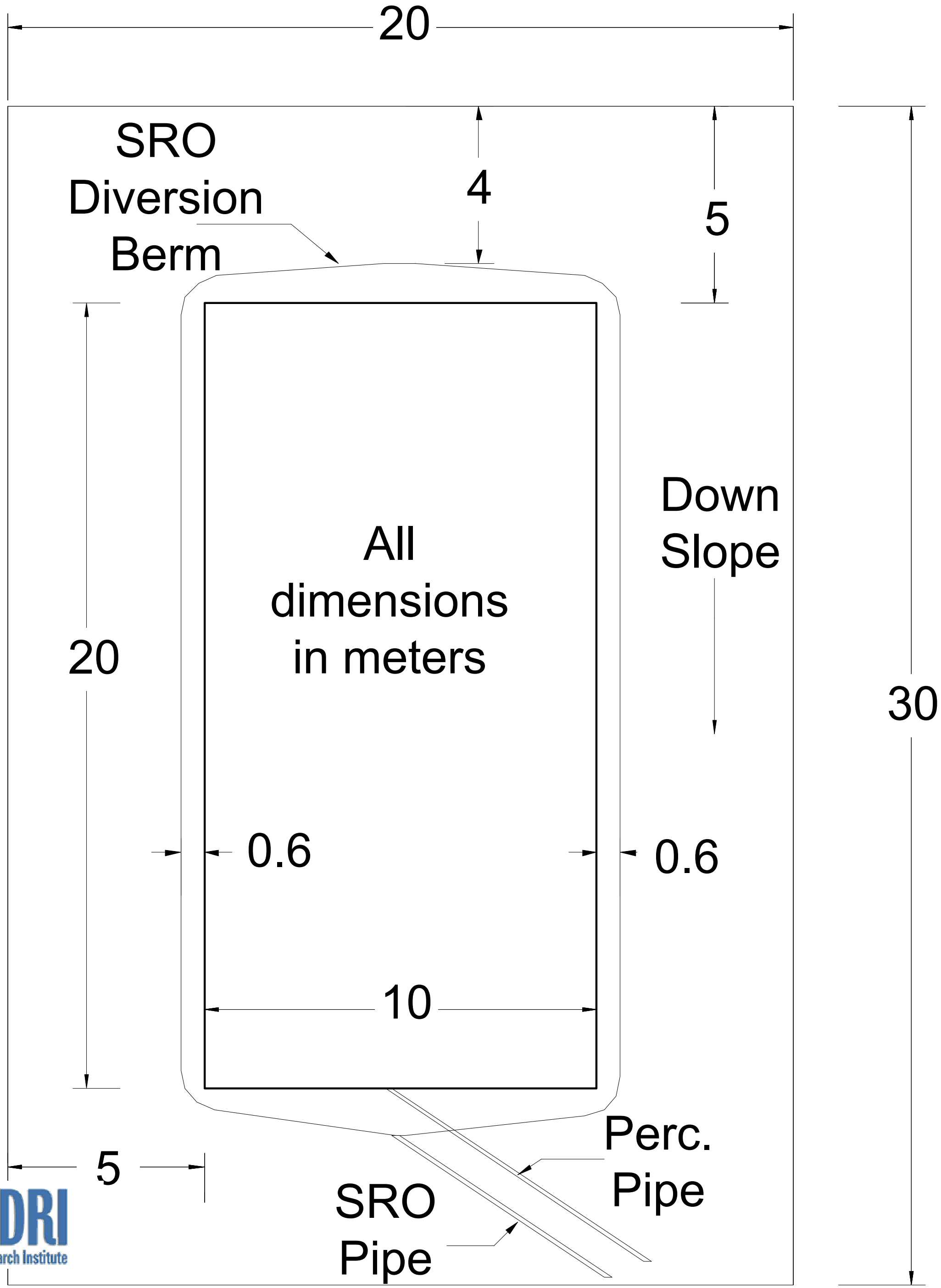
Conventional Cover Profiles Evaluated by ACAP

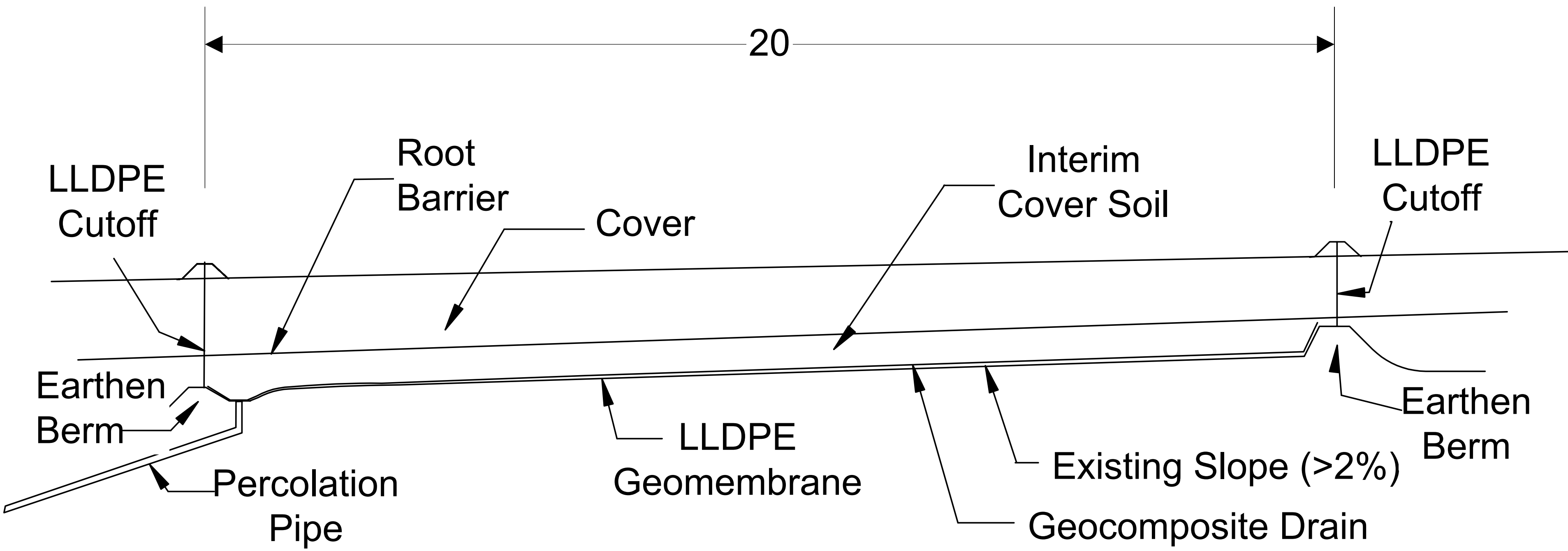




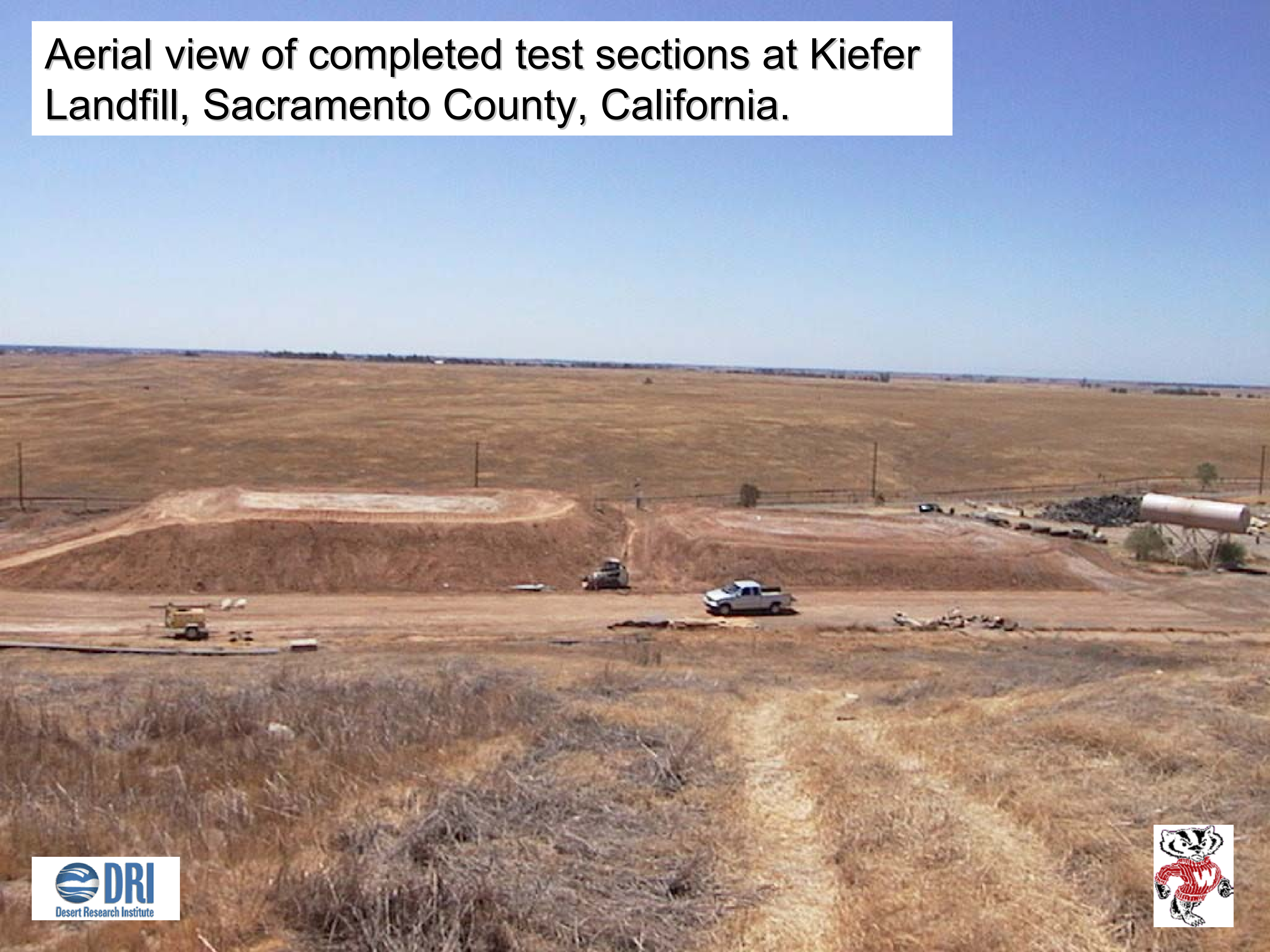
ACAP
Test Section
Plan View

Large bathtub filled with cover soil and instruments.

Typical Lysimeter Cross-Section



Aerial view of completed test sections at Kiefer Landfill, Sacramento County, California.



Kiefer Site:
Eight months after construction

Construction Methods

Tow-behind tamping foot compactor for clay barrier layer at Cedar Rapids site.

Used full-scale construction methods to greatest extent possible

Included single design hole in geomembrane (11 mm diameter) of composite barriers

Leak tested all geomembrane seams with conventional QA methods (air pressure, vacuum box).

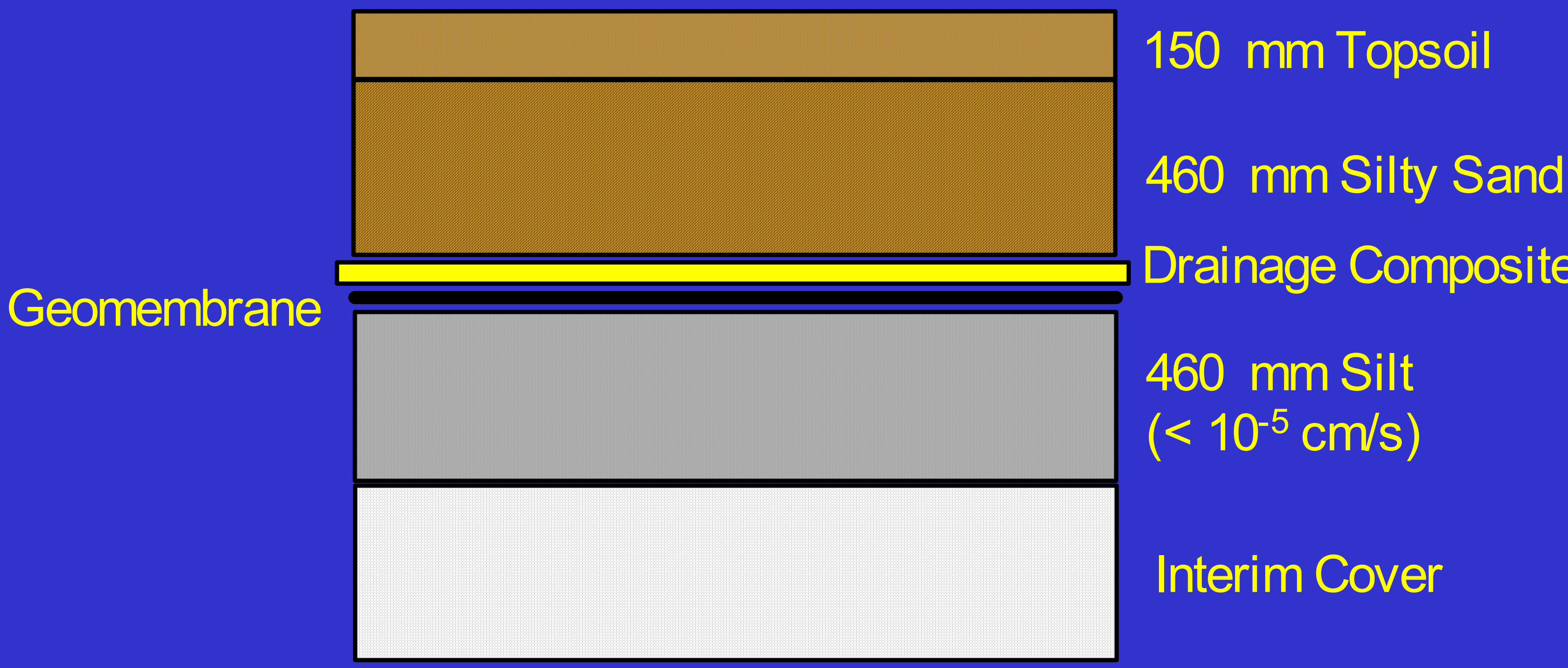
Data from Composite Covers: Semi-Arid Sites

Polson, MT: semi-arid and seasonal, snow

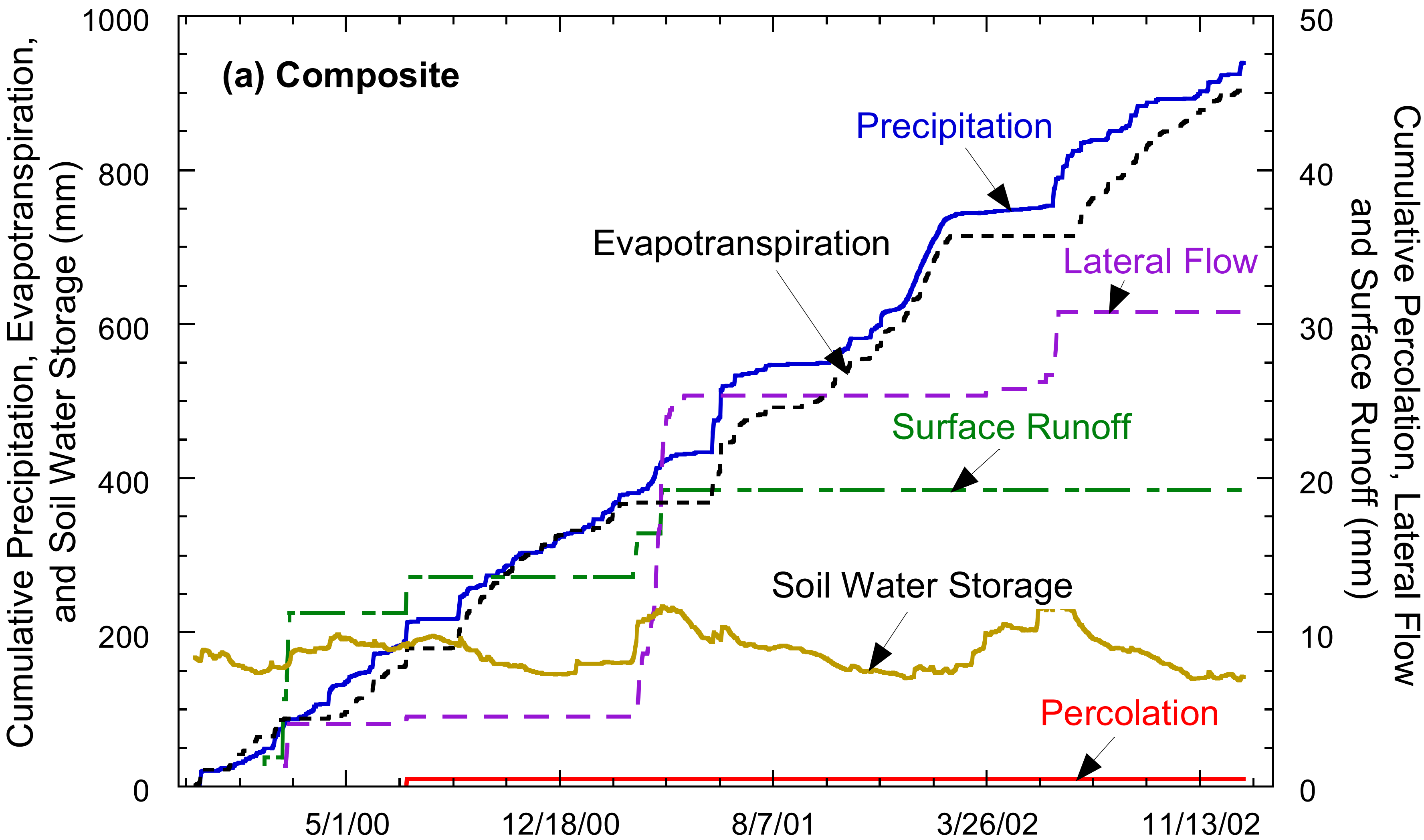
Altamont, CA: semi-arid and warm, no snow

Polson, MT

Cool and Seasonal Semi-Arid Climate
Conventional Composite Cover
(precipitation ~ 380 mm/yr)

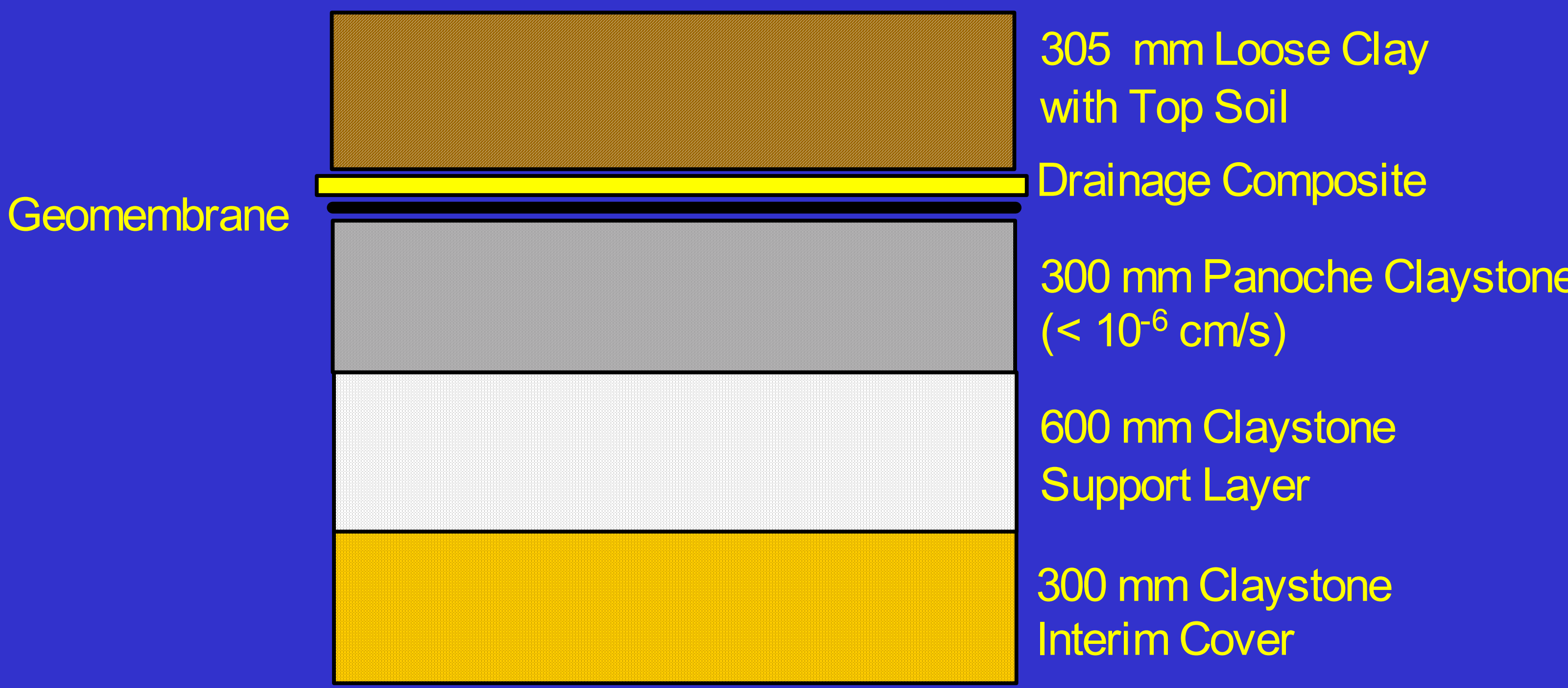


Polson, Montana



Altamont, California

Warm Semi-Arid Climate
Conventional Composite Cover
(precipitation ~ 358 mm/yr)



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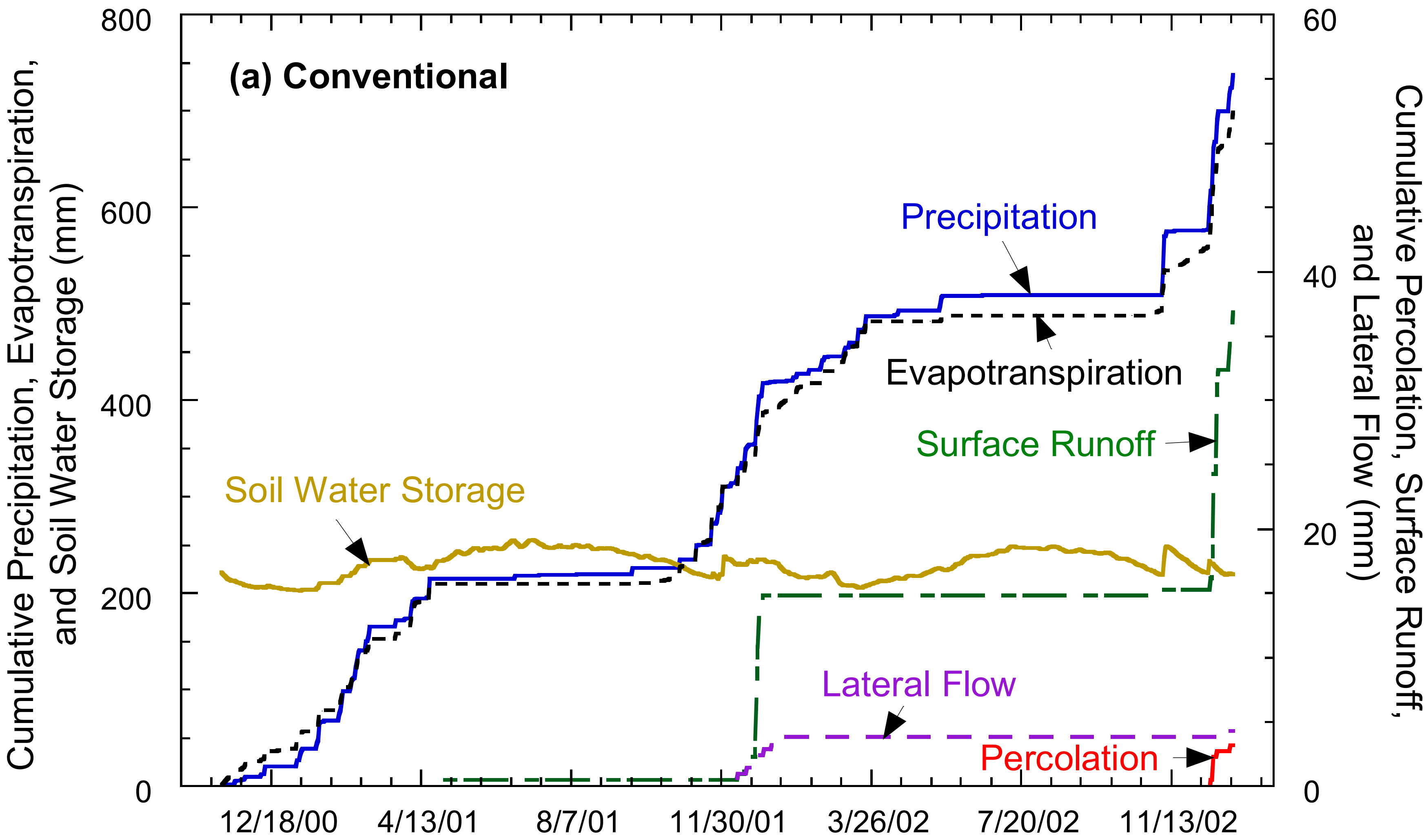
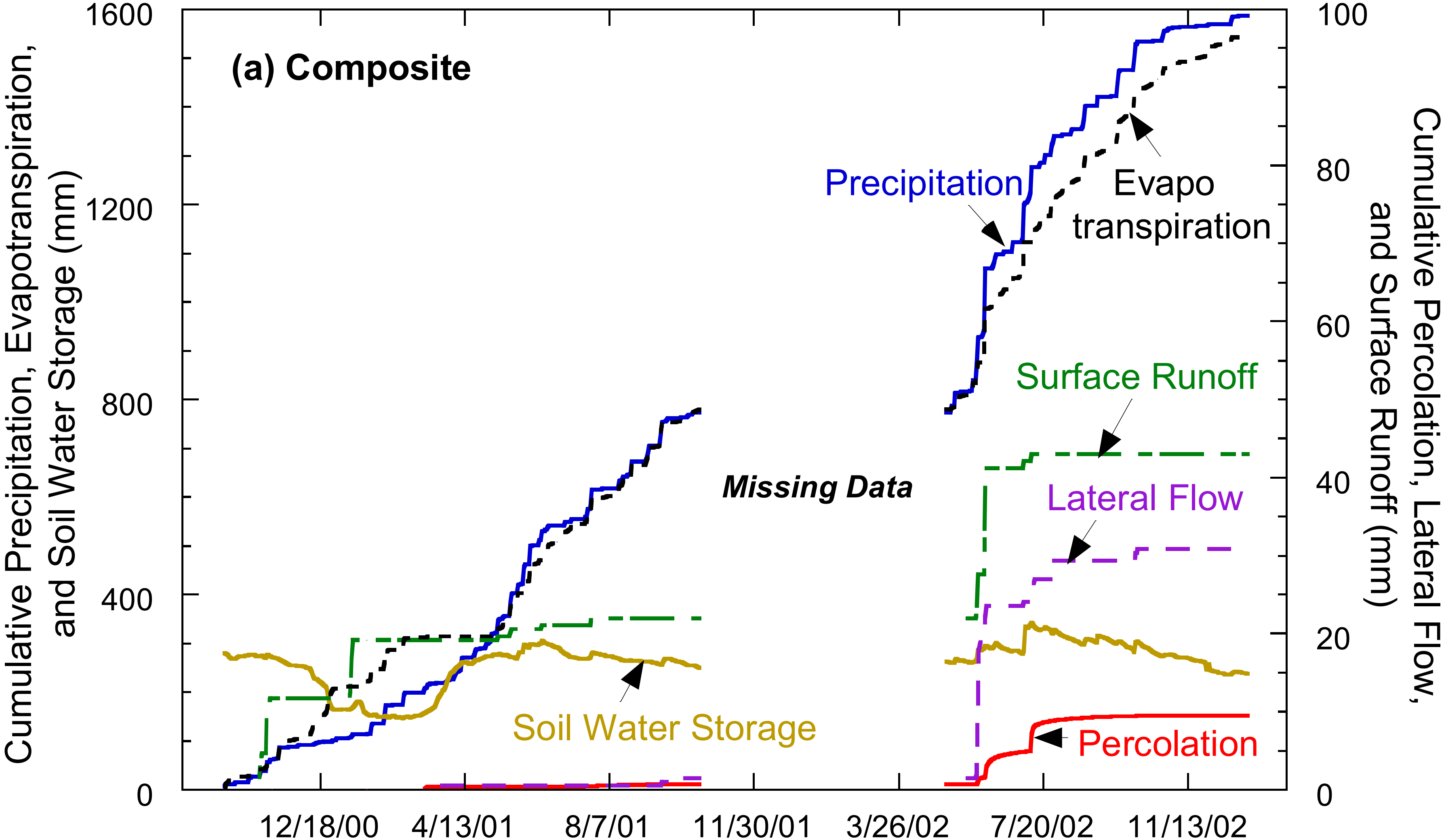
Altamont, California



Humid Site: Cedar Rapids, IA

Humid Seasonal Climate with Snow
Conventional Composite Cover
(precipitation ~ 915 mm/yr)

Cedar Rapids, IA



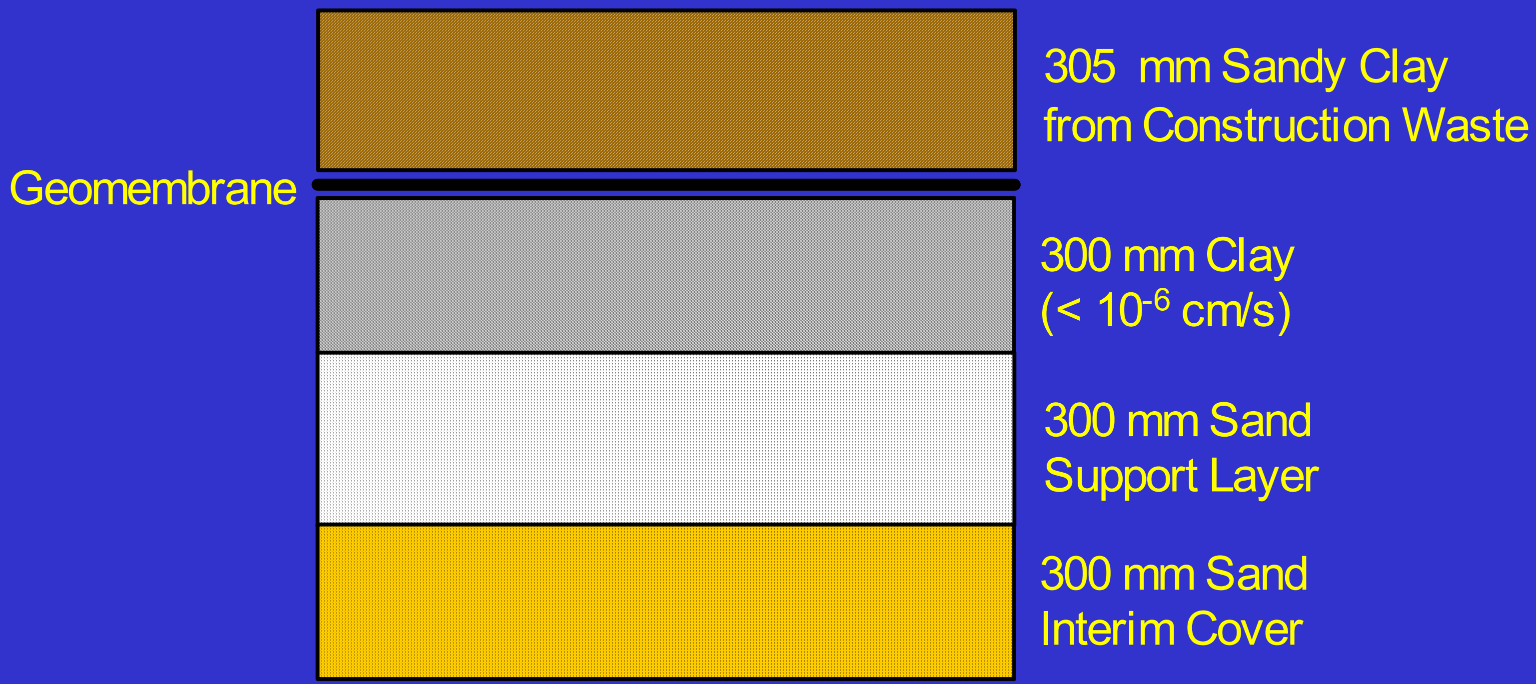
≈ 10 mm percolation to date

Summary: Composite Cover Performance

Site	Duration (d)	Slope (%)	Total Precip. (mm)	Avg. Annual Precip. (mm/yr)	Surface Runoff (mm/yr)	Lateral Flow (mm/yr)	Perc. (mm/yr)
Altamont, CA	781	5	737.1	358.4	17.2 (5.0%)	2.0 (0.6%)	1.6 (0.4%)
Polson, MT	1137	5	938.8	380.5	6.2 (2.0%)	9.9 (3.3%)	0.2 (0.1%)
Boardman, OR	747	25	258.3	225.3	0.0 (0.0%)	0.2 (0.2%)	0.0 (0.0%)
Apple Valley, CA	251	5	75.8	131.3	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)
Cedar Rapids, IA	621	5	1585.7	914.7	25.3 (2.7%)	18.1 (1.9%)	5.6 (0.6%)
Omaha, NE	797	25	995.4[c]	760.2	36.3 (8.0%)	12.5 (2.7%)	2.5 (0.6%)
Marina, CA	947	25	818.9	466.1	36.9 (11.7%)	10.3 (3.3%)	20.1 (6.4%)

An Anomaly: Marina, California

Costal Sub-humid Climate
Conventional Composite Cover
(precipitation ~ 466 mm/yr)



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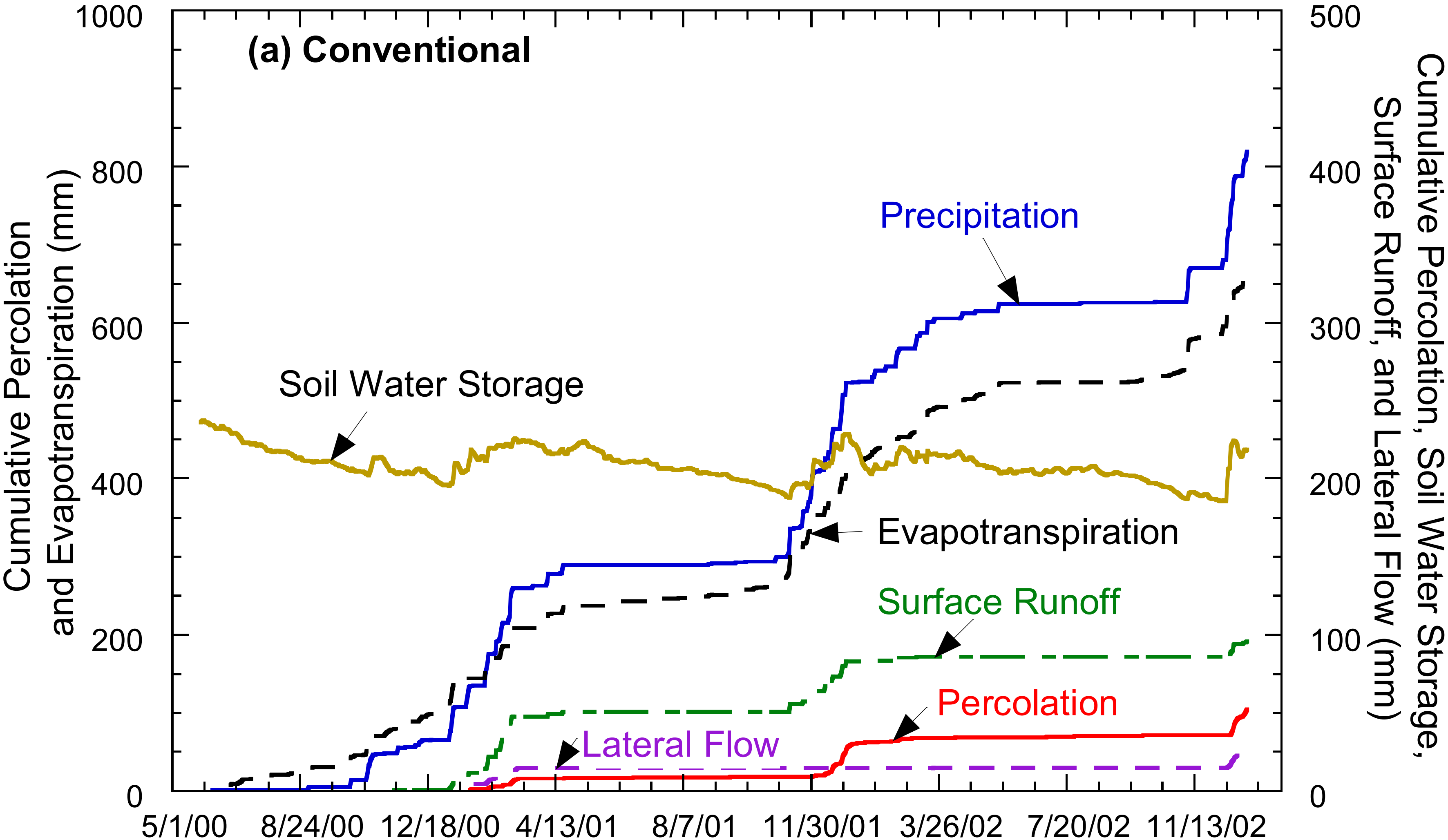
Marina, California



≈ 50 mm percolation to date

Why is Percolation Rate High at Marina Site?

- Exact cause unclear.
- Soil placed above geomembrane contained construction debris, and no cushion was placed between the geomembrane and the soil.
- Punctures probably occurred, causing more percolation than anticipated.
- Illustrates the importance of construction quality control.

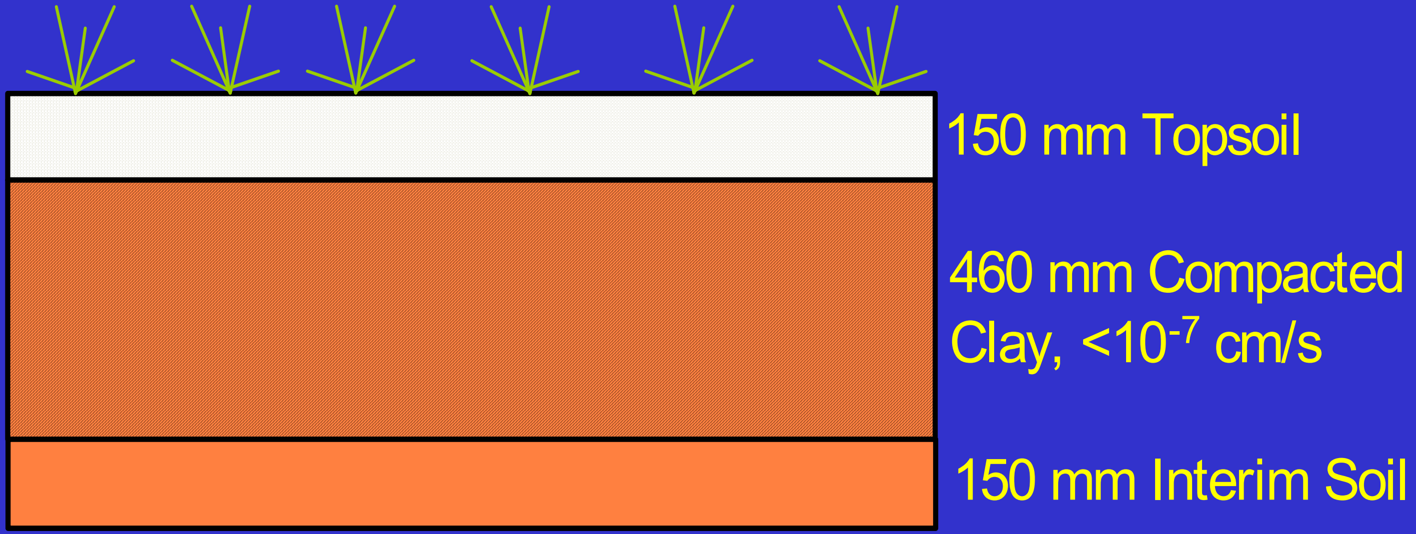
Data from Clay Covers: Humid Sites

Albany, GA: humid to subtropical, no snow

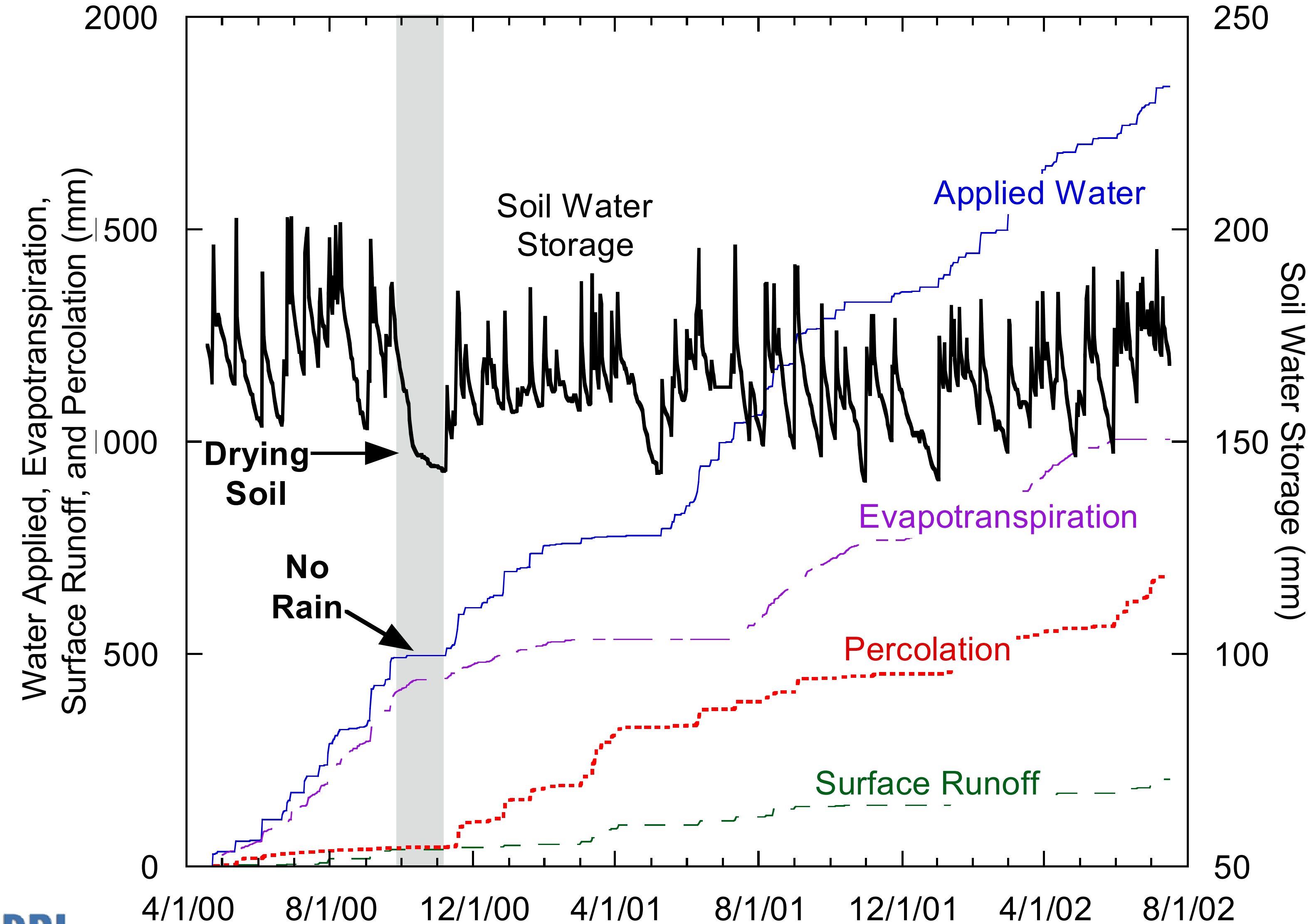
Cedar Rapids, IA: seasonal, freezing, snow

Albany, Georgia

Humid Seasonal Climate
Conventional Composite Cover
(precipitation ~ 1265 mm/yr)



Albany, Georgia

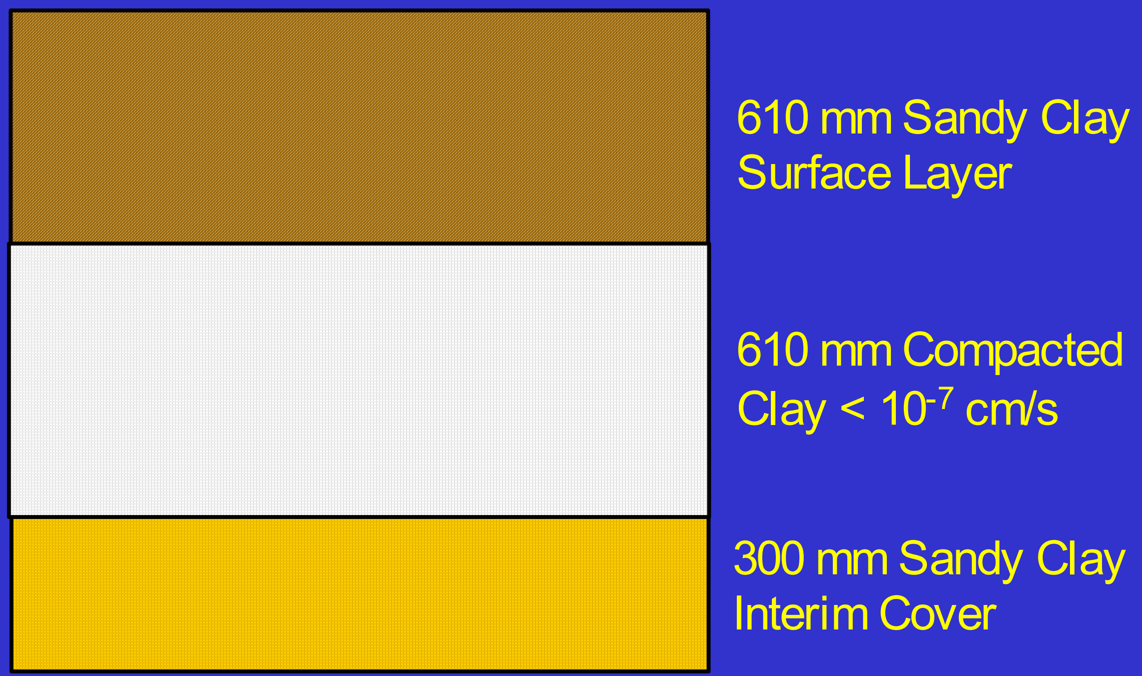


Field Percolation Rates

- Prior to dry October 2000: ~ 30 mm/yr
- After dry October 2000: ~ 400 mm/yr, with sudden jumps in percolation record corresponding closely with precipitation events
- Field investigation showed desiccation cracking of clay barrier

Cedar Rapids, IA

Humid Seasonal Climate with Snow
Conventional Composite Cover
(precipitation ~ 915 mm/yr)



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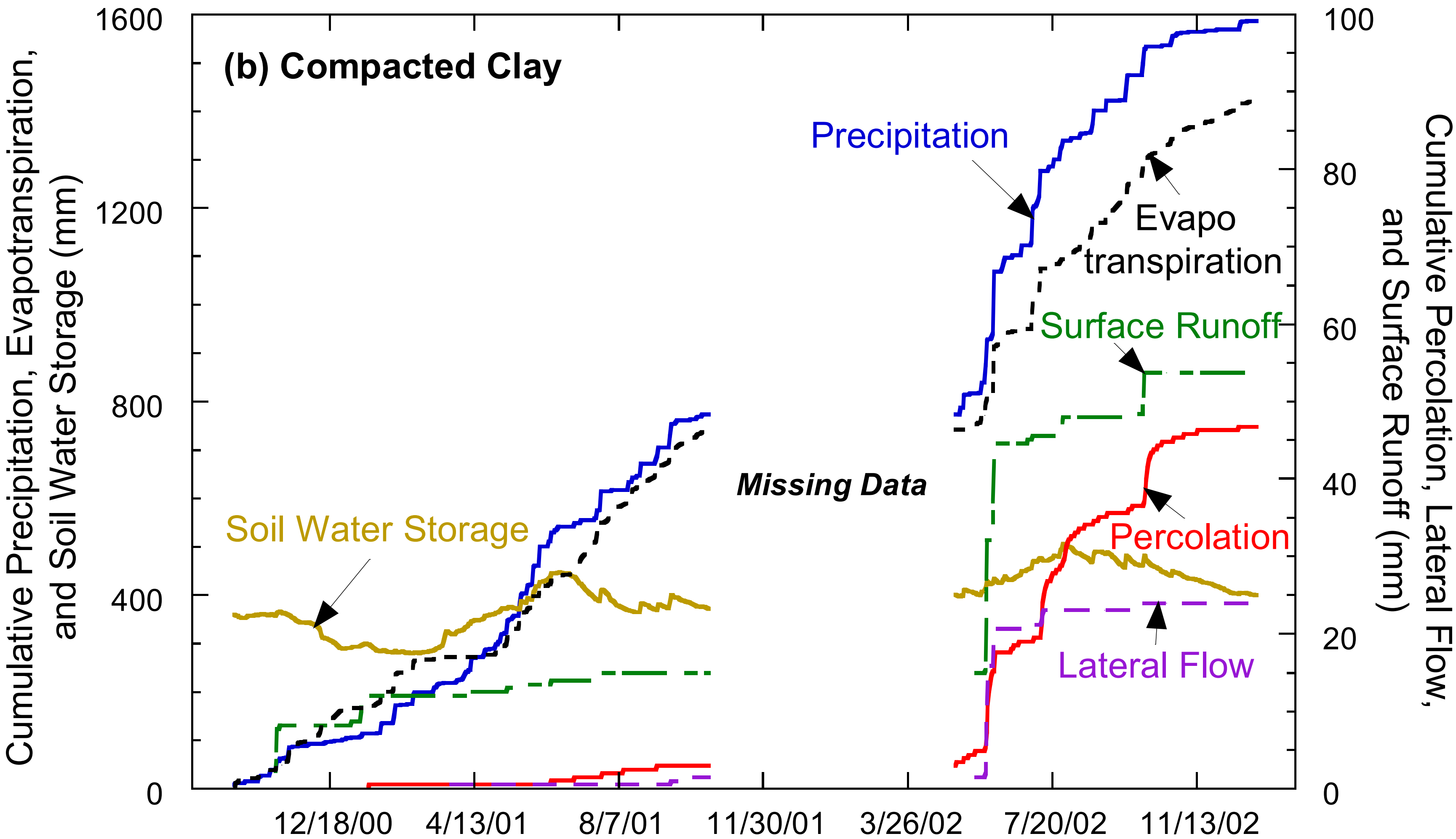
Cedar Rapids, Iowa



≈ 43 mm in 2002, < 10 mm expected

Summary: Clay Cover Performance

Site	Dura-tion (d)	Slope (%)	Total Precip. (mm)	Avg. Annual Precip. (mm/yr)	Surface Runoff (mm/yr)	Lateral Flow (mm/yr)	Perc. (mm/yr)
Apple Valley, CA	251	5	75.8	131.3	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)
Albany, GA	985	5	2552.7	1263.4	104.2 (10.9%)	NA	258.6 (27.0%)
Cedar Rapids, IA	621	5	1585.7	914.7	31.5 (3.4%)	14.1 (1.5%)	27.5 (2.9%)

2002 only

Albany: 238 mm/yr (16.2%)

Cedar Rapids: 66 mm/yr (5.4%)

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Summary of Composite Cover Performance

- Percolation rates are very low:
  - < 1.5 mm/yr in semi-arid and arid climates
  - < 5 mm/yr in humid climates

- Surface runoff is a small fraction of the water balance:
  - < 5% of precipitation in semi-arid and arid climates
  - < 10% of precipitation in sub-humid and humid climates

- Lateral drainage is a small fraction of the water balance: < 3.5% of precipitation

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Summary of Clay Cover Performance

- Percolation rates are much higher than expected:
  - 260 mm/yr at Albany, GA
  - appears dominated by preferential flow
- Damage to clay caps occurs over short service life (consistent with decades of experience in agriculture)
- Long-term effectiveness of clay caps questionable.

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Sponsors

- USEPA, USDOE, USMC
- Waste Management, Inc., Waste Connections Inc.
- Monterey Solid Waste Management District, Bluestem Solid Waste Agency
- Lake County, MT, Lewis and Clark County, MT

More Information

- www.acap.dri.edu

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