The ACAP Lysimeters:

Monitoring for Performance and Processes

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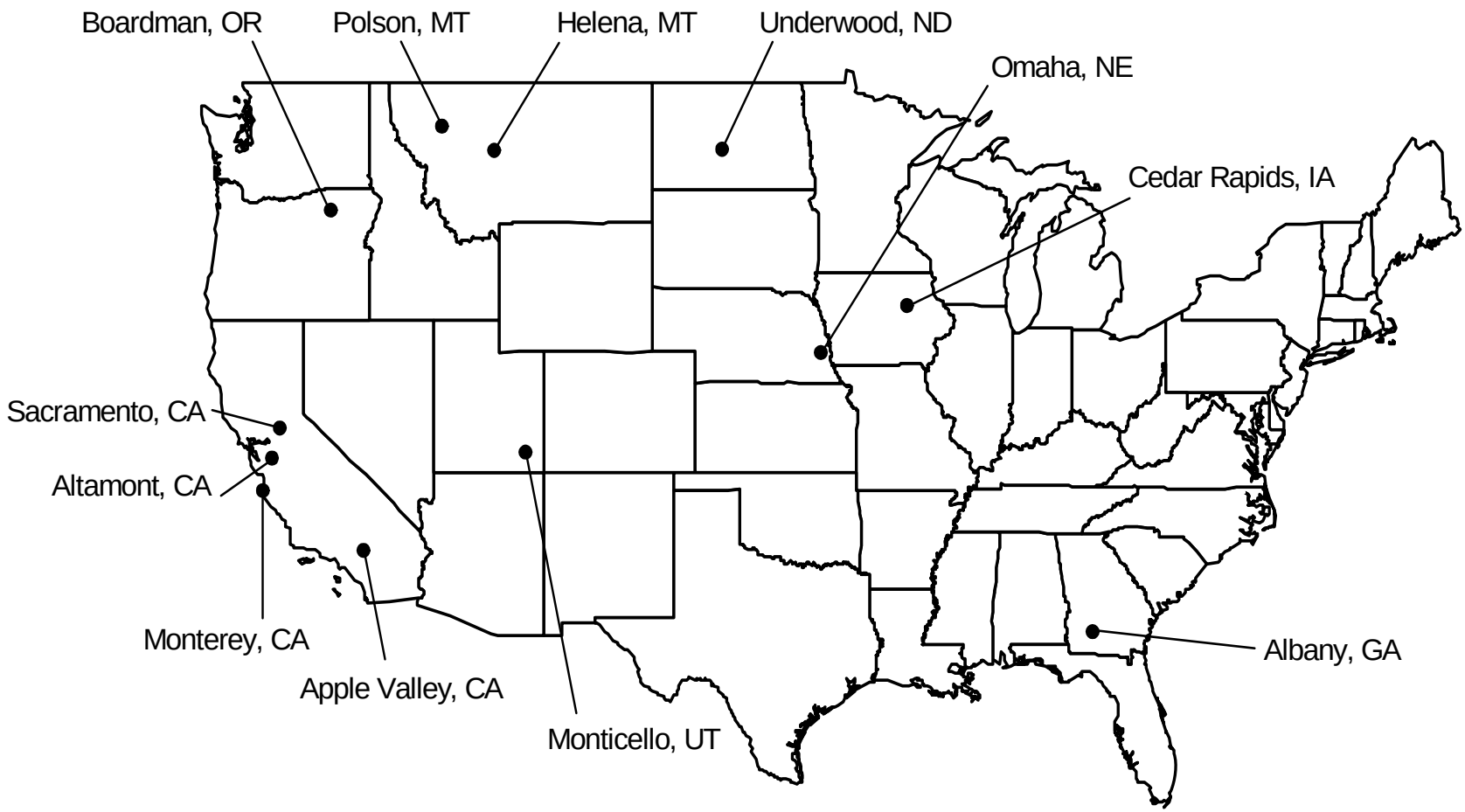
Alternative Cover Assessment Program Objectives and Methods

- **Compare performance (percolation) of water balance and conventional (clay and geomembrane) covers**
- **Complicated by differences in design philosophy**
  - **Conventional covers are materials and methods designs and typically do not specify performance**
  - **Water balance covers are site-specific, design requires performance criteria**
- **Result: large instrumented drainage lysimeter**
  - **Lysimeter for direct measurement of percolation**
  - **Instruments for supplemental data**
  - **Combination allowed investigation of processes**

ACAP Site Locations



Lysimeter Design and Construction: A Brief Tour

Membrane installation

Sump detail

Multiple measurements of drainage

Fully lined facility results in direct determination of drainage

Full-scale equipment and methods

Lots of instruments

Lots of undisturbed samples

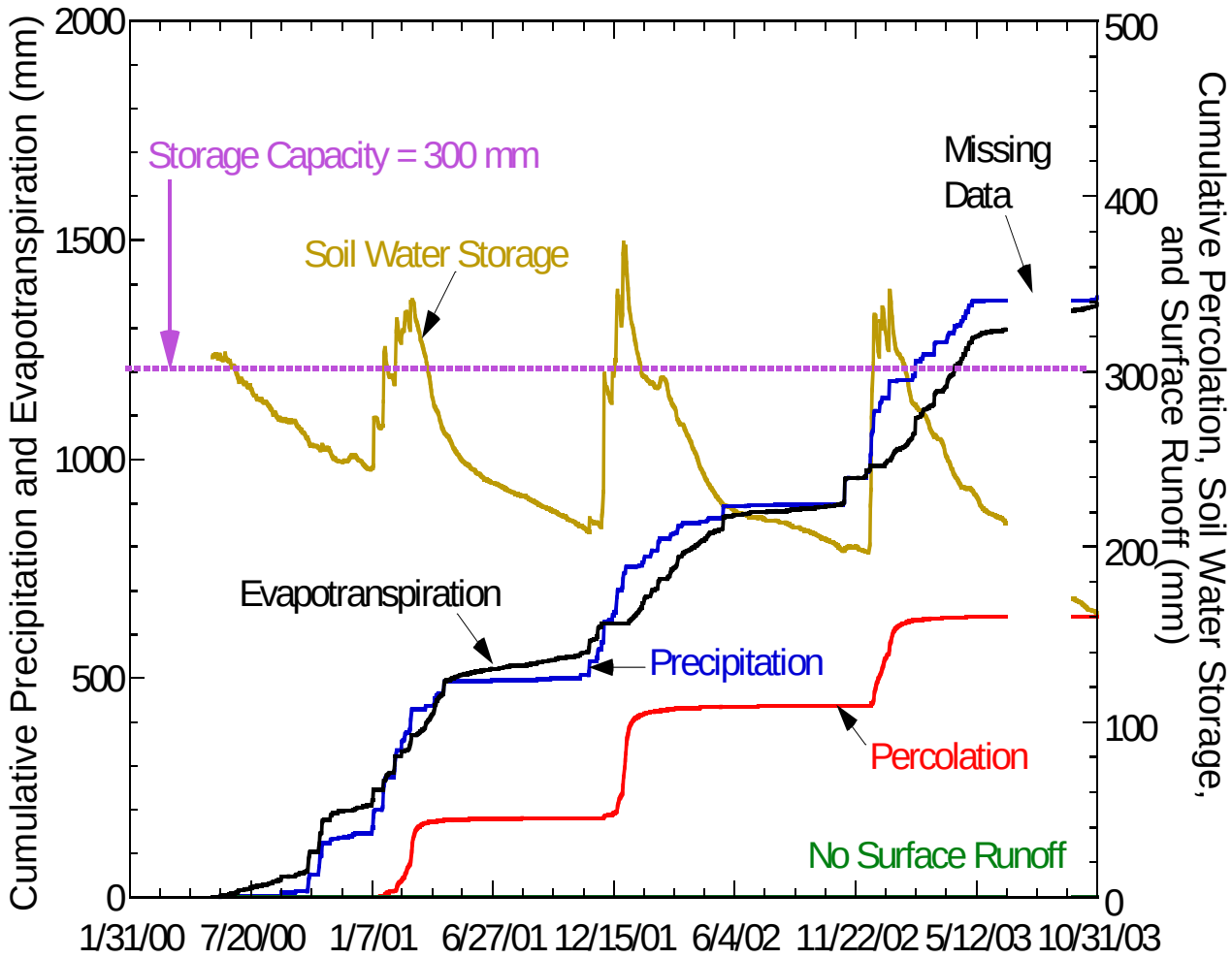
Last site, near completion

Sacramento site at 1 year

Georgia site at 3 years

Lysimeter + instruments confirm the expected…

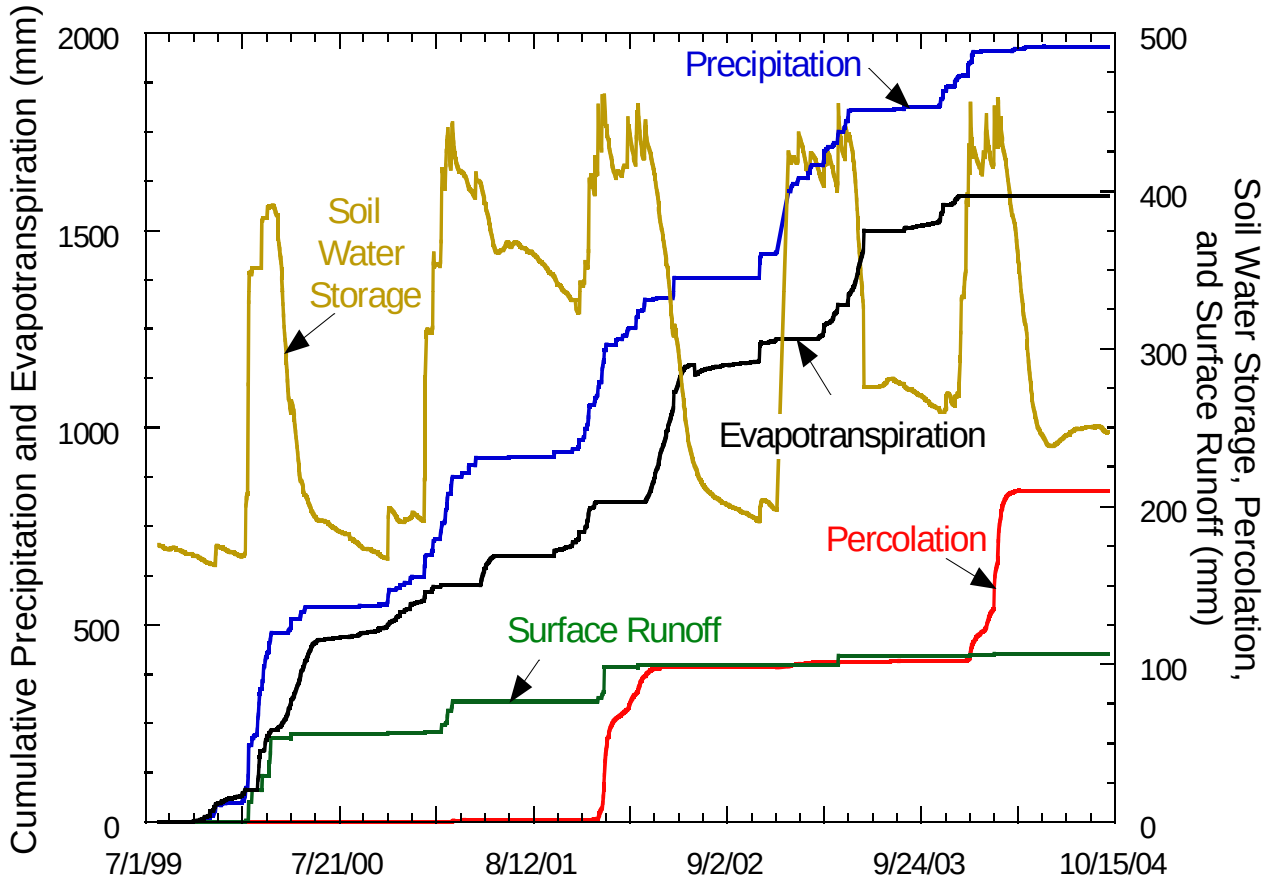
Percolation occurs every year when storage capacity is exceeded.



Water balance cover, Marina, CA

,,,and raise questions.

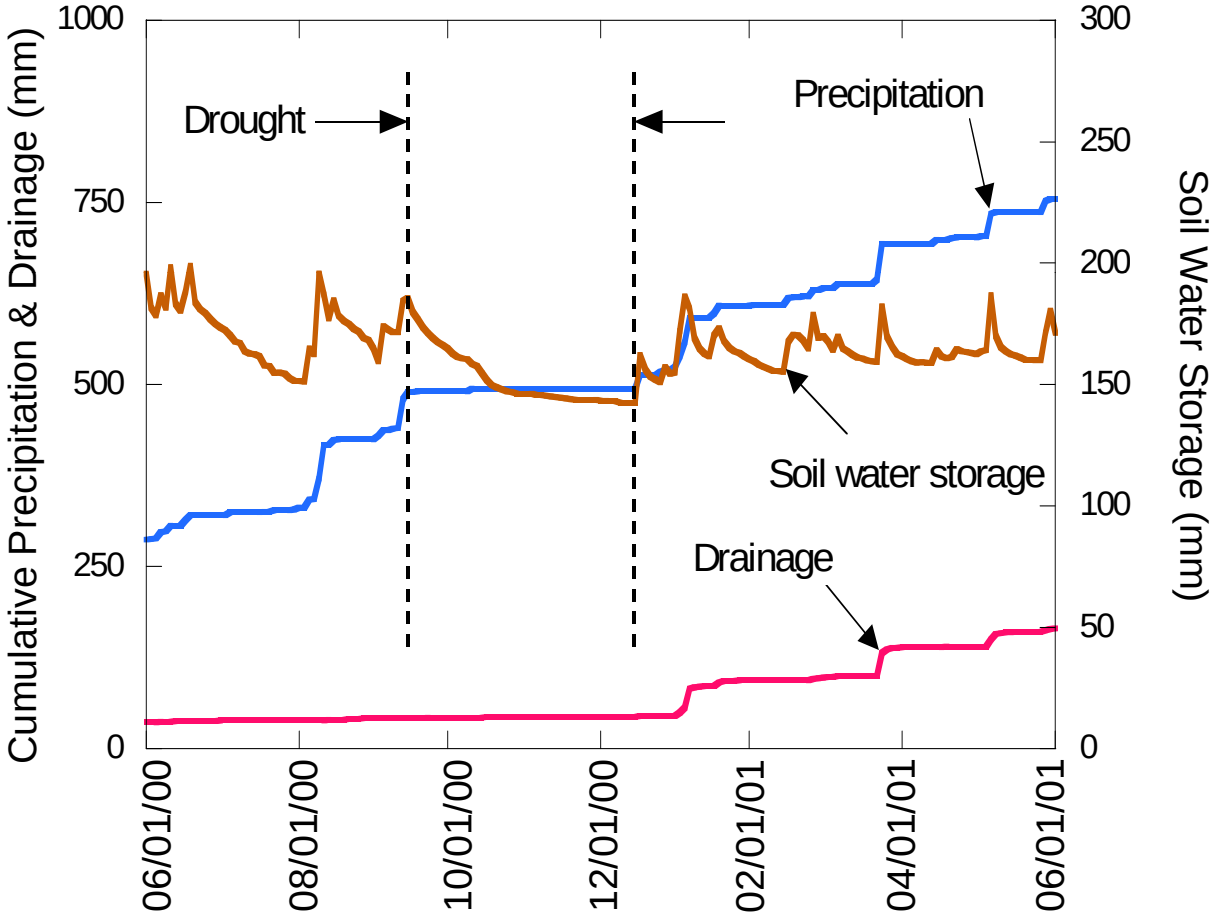
Percolation occurs <u>some</u> years when "storage tank" is not emptied. Reasons not clear.



Water balance cover, Sacramento, CA

Lysimeters + instruments can point to processes that change or degrade performance….

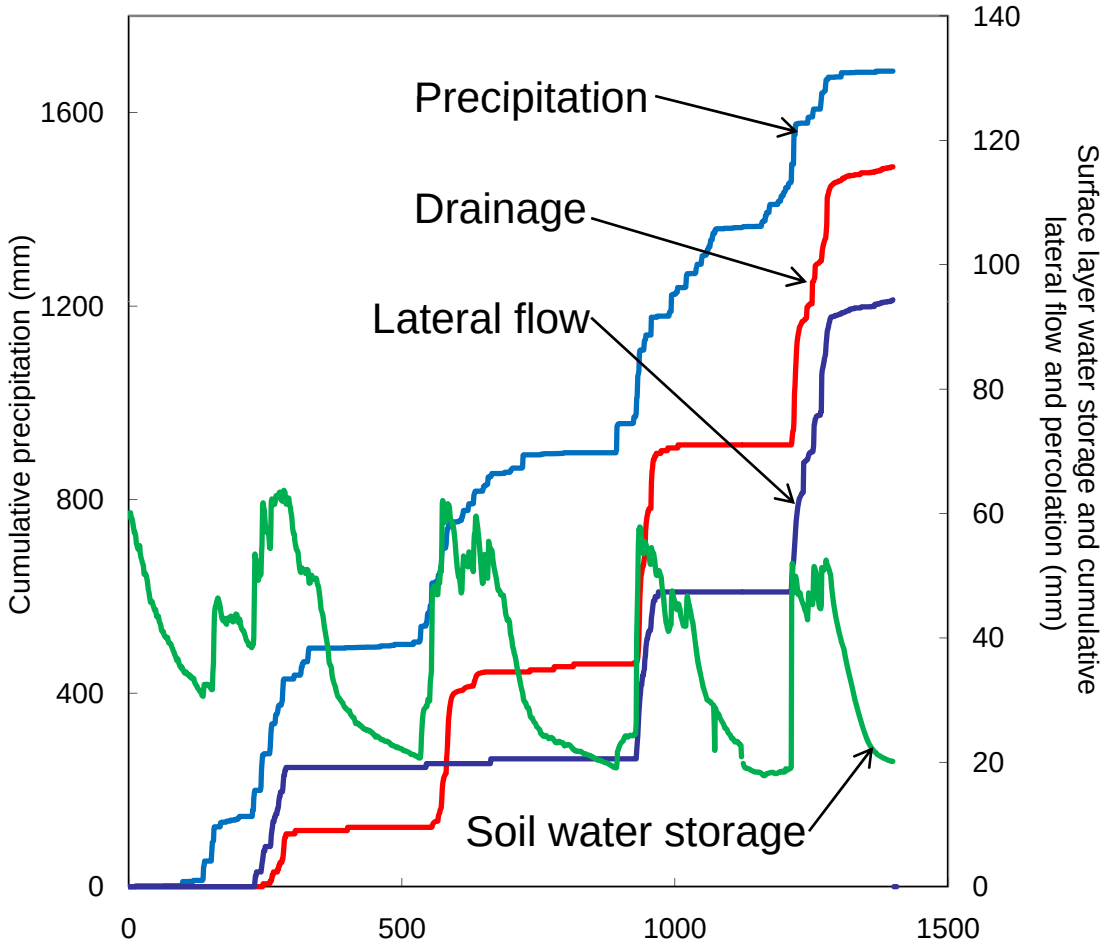
- Soil dried for first time during 6-week drought
- Change in response of percolation to precipitation events
  - Quantity
  - "Stair step" response
- No evidence that defects in clay barrier healed when soil water increased
- Needed verification from measurement of change in hydraulic properties



Conventional compacted clay cover, Albany GA

…and the importance of construction practice

- Percolation coincides with precipitation, surface and lateral flow
- Relatively high rate of percolation
- No cushion between the geomembrane and the soil, punctures likely in geomembrane
- Illustrates importance of careful geomembrane installation



Conventional composite cover, Marina, CA

Exhumations of the ACAP test sections

We found roots in the clay barriers…

Roots where we expected none…

Roots? Here?

We took in-situ measurement of hydraulic properties…

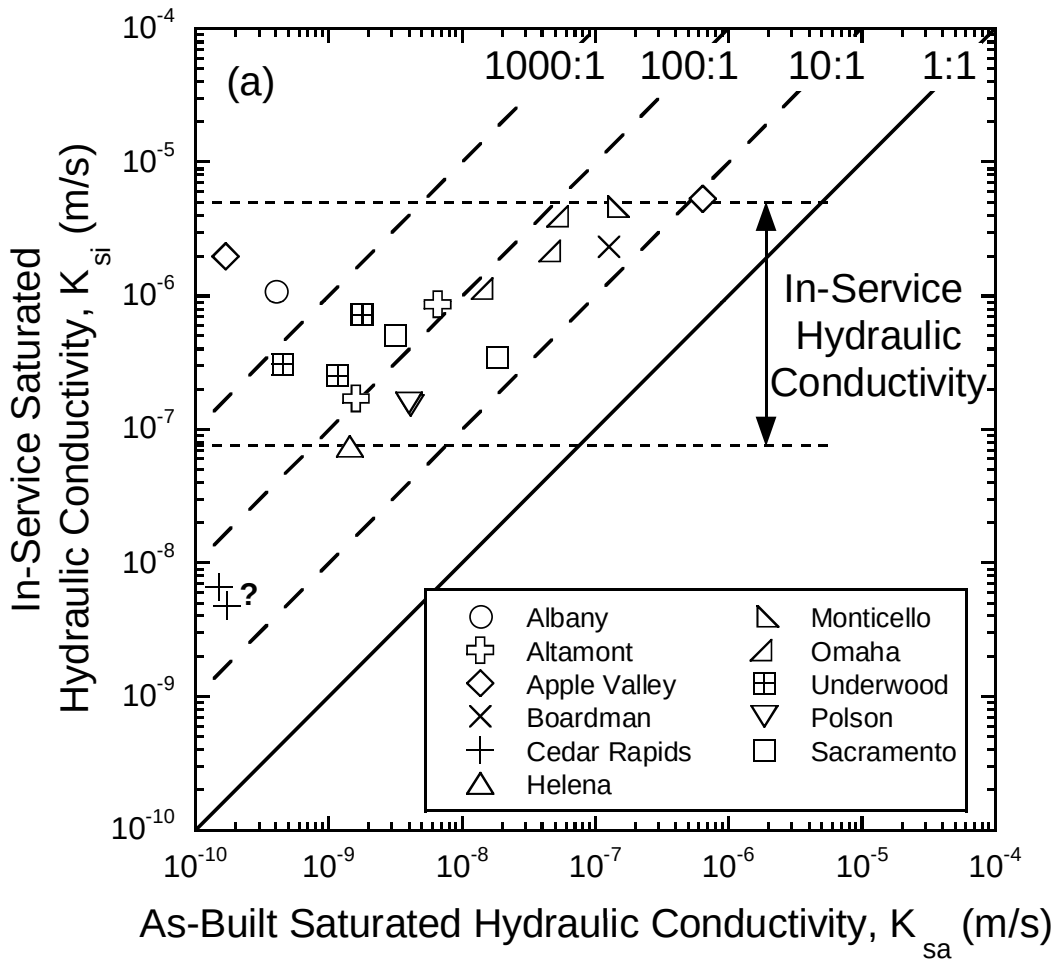
…and larger measurements of hydraulic properties

Dye tracer to identify preferential flow

Undisturbed soil sample for lab analysis of in-service hydraulic properties

…and debated plant ecology vs. geotech engineering

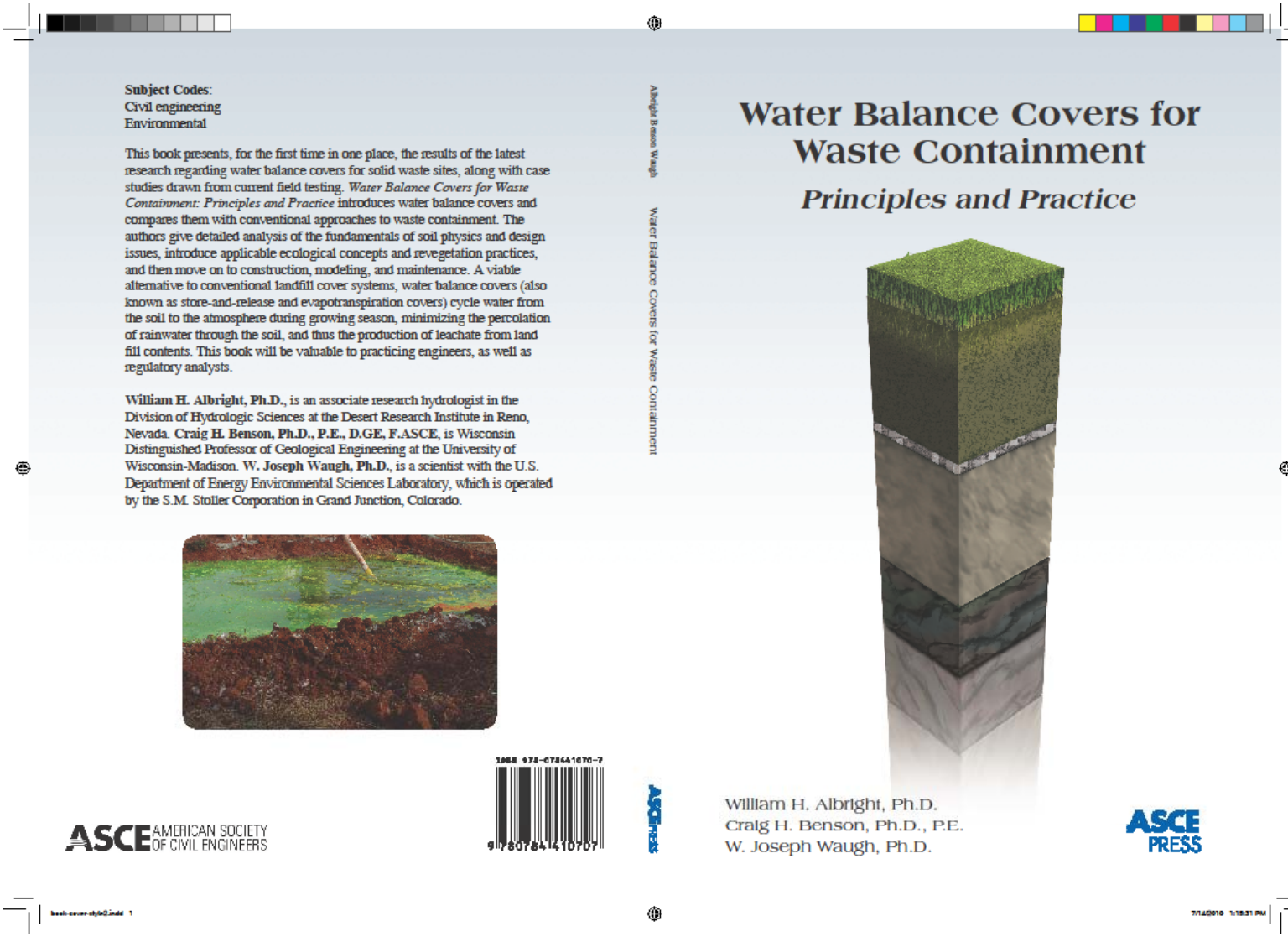
Study of processes over time can contribute to future design



Monitoring the ACAP Lysimeters: Lessons Learned

- **Monitoring should include:**
  - **performance (percolation) data from lysimeters for context**
  - **supplemental (soil water) data for interpretation and indication of changes over time**
- **Buffer areas for invasive, time-series sampling for plant parameters, ecological processes, and changes in hydraulic properties**
- **Need long-term monitoring to capture long-term processes.**

...and finally


Subject Codes:
Civil engineering
Environmental
This book presents, for the first time in one place, the results of the latest research regarding water balance covers for solid waste sites, along with case studies drawn from current field testing. Water Balance Covers for Waste Containment: Principles and Practice introduces water balance covers and compares them with conventional approaches to waste containment. The authors give detailed analysis of the fundamentals of soil physics and design issues, introduce applicable ecological concepts and revegetation practices, and then move on to construction, modeling, and maintenance. A viable alternative to conventional landfill cover systems, water balance covers (also known as store-and-release and evapotranspiration covers) cycle water from the soil to the atmosphere during growing season, minimizing the percolation of rainwater through the soil, and thus the production of leachate from land fill contents. This book will be valuable to practicing engineers, as well as regulatory analysts.
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Water Balance Covers for Waste Containment
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