Assumptions & Variability

What affects outcomes: geometry, cycles observed, intervention count

Make uncertainty explicit so decisions stay defensible.
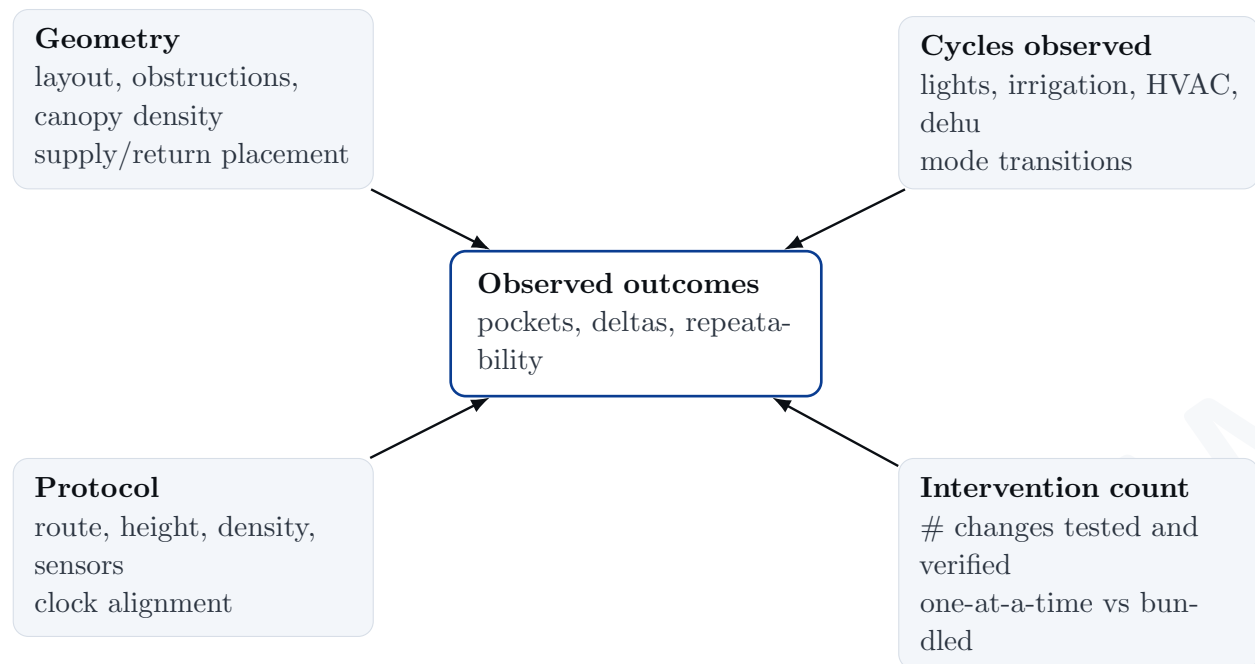
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1. Purpose

Why this exists

This document lists the **assumptions** behind pocket/zone mapping and the **sources of variability** that can change outcomes. It is designed to be forwarded internally so stakeholders understand what results mean, what they do *not* mean, and what must be controlled for defensible go-live decisions.

2. Primary Drivers of Variability (Schematic)

Mental model

Outcomes are a function of geometry, operating cycles, and how many interventions are tested (and verified). The schematic below is a simple "driver map."

Geometry
layout, obstructions,
canopy density
supply/return placement

Cycles observed
lights, irrigation, HVAC,
dehu
mode transitions

Observed outcomes
pockets, deltas, repeatability

Protocol
route, height, density,
sensors
clock alignment

Intervention count
changes tested and
verified
one-at-a-time vs bundled

3. Assumptions (What we assume unless stated otherwise)

Baseline assumptions

- **Comparable-condition verification:** before/after evidence is collected under comparable cycle windows (or differences are explicitly documented).
- **Protocol consistency:** route, canopy height(s), sampling density, and sensor placement rules are consistent between runs.
- **Same-clock validity:** streams compared in time are aligned to a shared clock (or corrected within tolerance).
- **Spatial primacy:** canopy measurements are treated as truth; wall sensors provide context but do not define pass/fail alone.
- **Change traceability:** interventions are logged with timestamps, locations, settings, and intent.

4. Variability Factors (What changes results)

4.1 Geometry

Factor	How it affects outcomes
Bench/canopy layout	Creates airflow shadows and localized accumulation zones
Obstructions	Fans, lights, trellis, ducting, walls, equipment block mixing
Supply/return placement	Drives where gradients form and where recovery is slow
Canopy density	Changes local transpiration load; pockets can appear/disappear with growth stage
Zoning and doors	Open/closed doors and partitioning change pressure and mixing

4.2 Cycles observed

Cycle / event	Why it matters
Lights ramp / lights on	Temperature and VPD shifts reveal stratification and distribution limits
Irrigation windows	Post-irrigation moisture load can expose slow-recovery pockets
Dehumidification staging	Different stages/runtimes change recovery curves and pocket persistence
HVAC mode changes	Defrost, economizer, setpoint chasing can create repeatable signatures
CO_2 events (if used)	Correlates with mixing patterns and operational modes

4.3 Intervention count and sequencing

> **Why number of interventions matters**
> Testing many changes without clean verification can produce "improvement narratives" that are not causally attributable.

Approach	Impact on interpretability
One intervention at a time	Highest causal clarity; easiest to produce defensible receipts
Bundled interventions	Faster operationally, but requires stronger change logs and larger verification effort
Interventions without timestamps	Breaks traceability; hard to claim "fixed"
No repeatability checks	Risk of a lucky window; pockets can return on next comparable cycle

5. What This Means for Decisions

Practical guidance

When results are used for go-live decisions, control the variables that matter:

- Document geometry changes (equipment moves, door states, canopy density shifts).
- Define the cycle windows that matter and verify against those windows.
- Limit intervention batching (or increase verification rigor and logging).
- Require before/after deltas *and* repeatability across *[N]* cycles.

6. Common Misinterpretations (Avoid)

Do not conclude

- "The room is stable" because wall sensors look stable.
- "It's fixed" based on a single after run with different operating conditions.
- "This intervention caused the improvement" if multiple changes were made without timestamps.
- "Pockets don't exist" if trigger cycles were not observed during baseline.

7. Checklist: What to Record During a Pilot

Item	Record	Done
Geometry snapshot	Photos/diagram; supply/return; fan placement; doors/partitions state	
Cycle schedule	Lights, irrigation, HVAC/dehu modes and event timestamps	
Protocol parameters	Route, heights, density, sensor IDs/locations, calibration notes	
Interventions	What changed, where, settings, timestamp, intent, owner	
Verification bundle	Before/after maps, deltas, cycle overlays, repeatability summary	

8. Appendix (Optional)

8.1 Change log

Version	Date	Notes
v1.0.0	January 19, 2026	Initial assumptions & variability template (aligned styling; TikZ driver schematic included)