

EARTHWORKS ESTIMATION

FOR UTILITY SCALE SOLAR SITES USING DYNAMIC PROGRAMMING AND SIMULATED ANNEALING

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THE CHALLENGE

- Utility-scale solar projects are expanding rapidly, but ideal land is increasingly scarce.
- Traditional grading often results in excessive cut/fill, driving up costs and delaying schedules.
- Tracker system selection and pile reveal decisions significantly influence earthwork requirements.

OUR SOLUTION

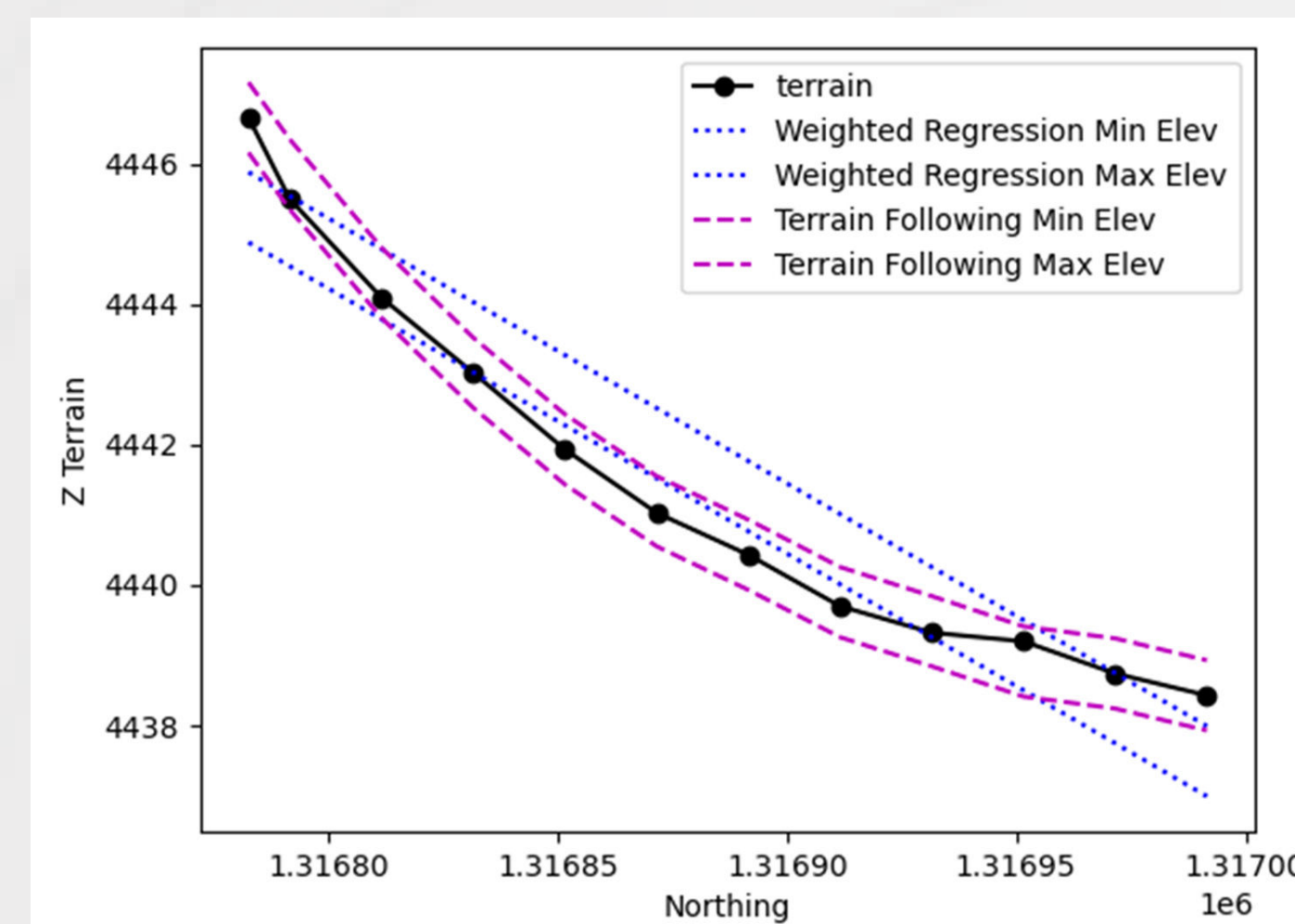
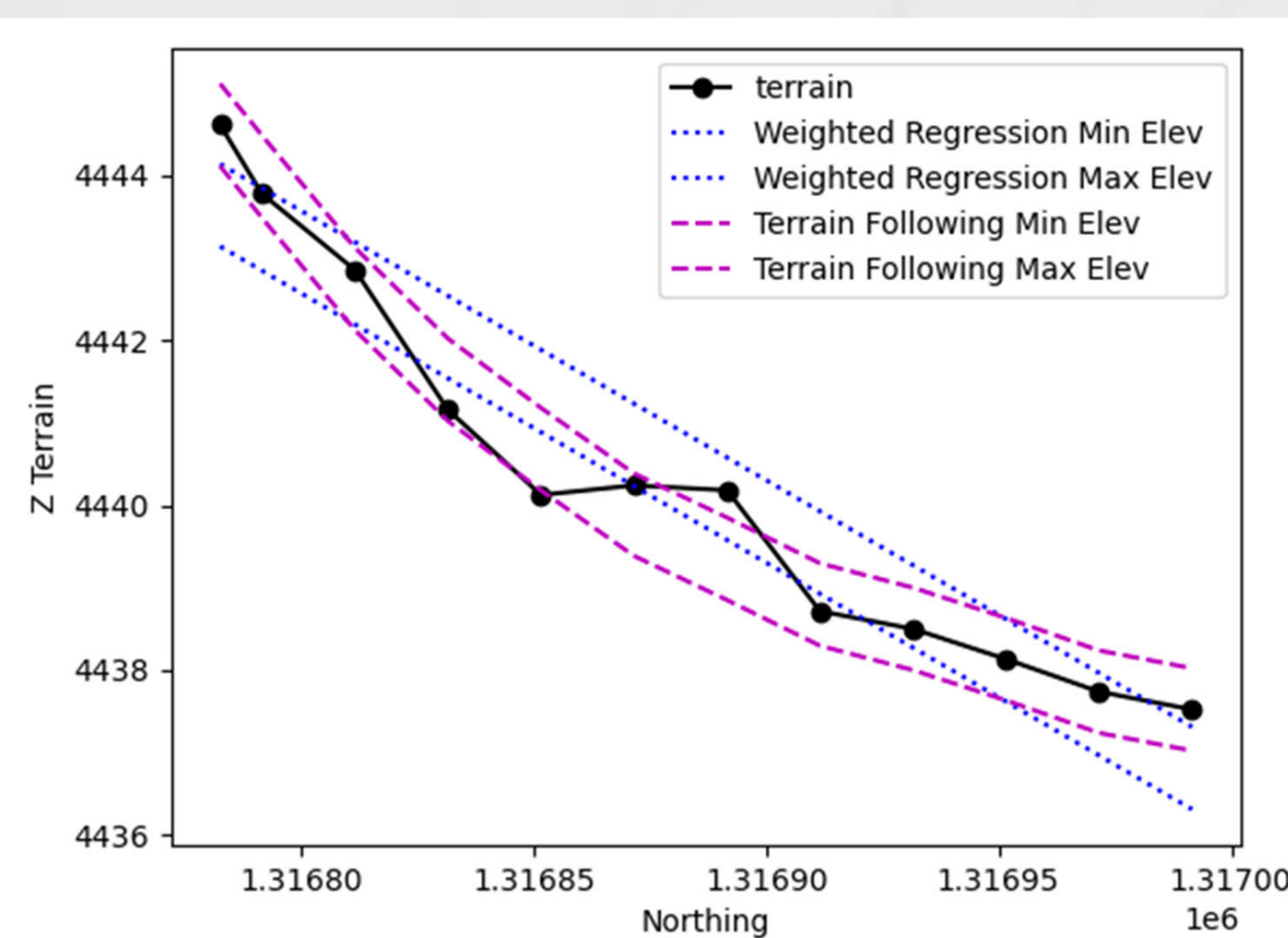
Leverage advanced algorithms to reduce earthwork, optimize pile design, and streamline solar site development.

Revamp's automation platform combines Python, QGIS, and advanced algorithms to optimize grading and pile design for utility-scale solar.

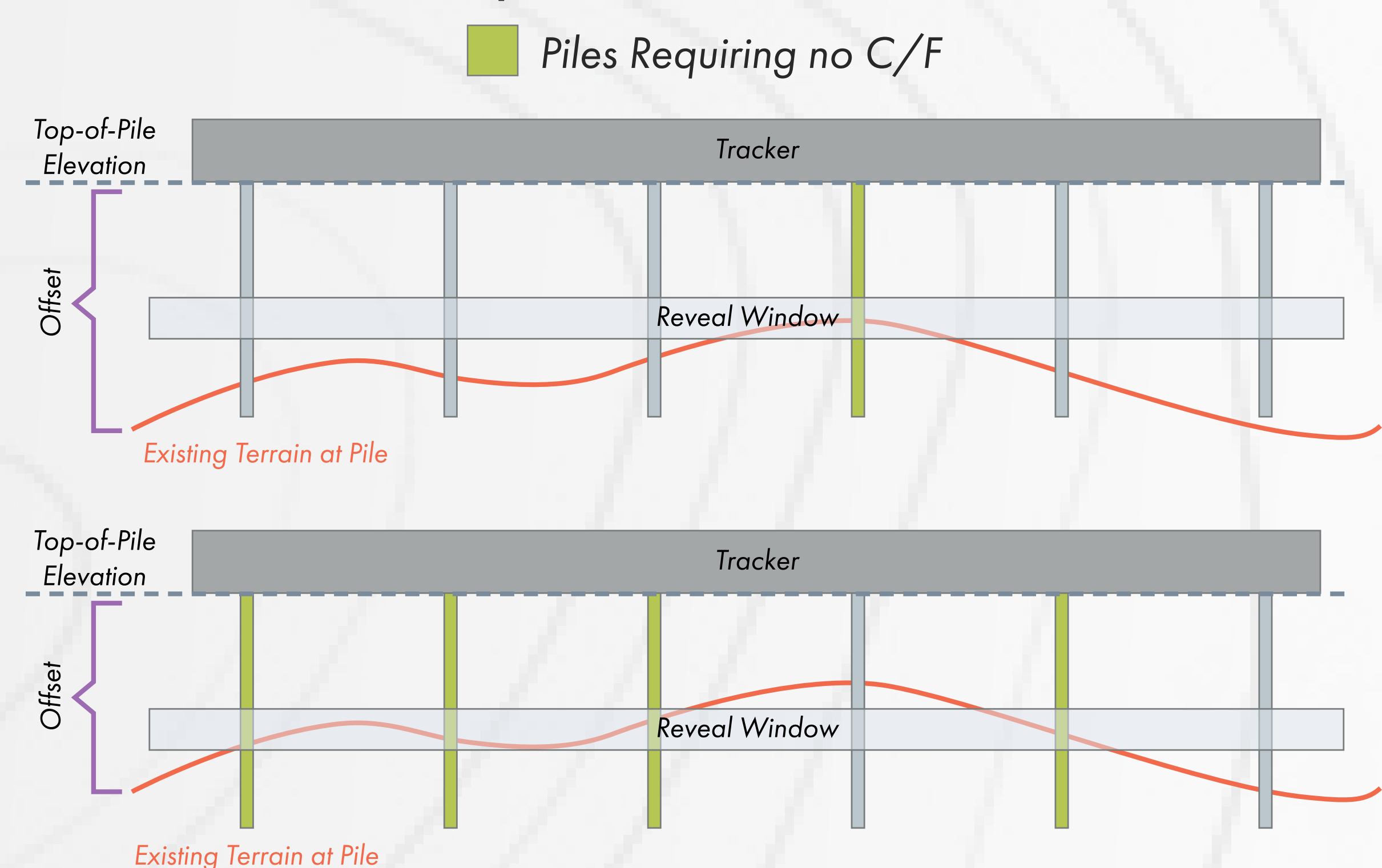
- **Weighted Regression (WR):** Aligns torque tube racking by prioritizing outer piles in elevation calculations to reduce constructability and drainage issues seen with standard regression.
- **Dynamic Programming (DP):** Adjusts pile elevations for terrain-following trackers within bend limits to reduce grading and reveal violations.
- **Simulated Annealing (SA):** Uses probabilistic optimization to refine tracker offsets and reduce grading through iterative improvements.

Advantage: WR, DP, and SA enable flexible, tracker-level optimization that cuts earthwork, improves constructability, and accelerates design. Engineers validate final outputs to meet specifications.

Exploration of Reveal Windows and Pile Compliance for DP vs. WR

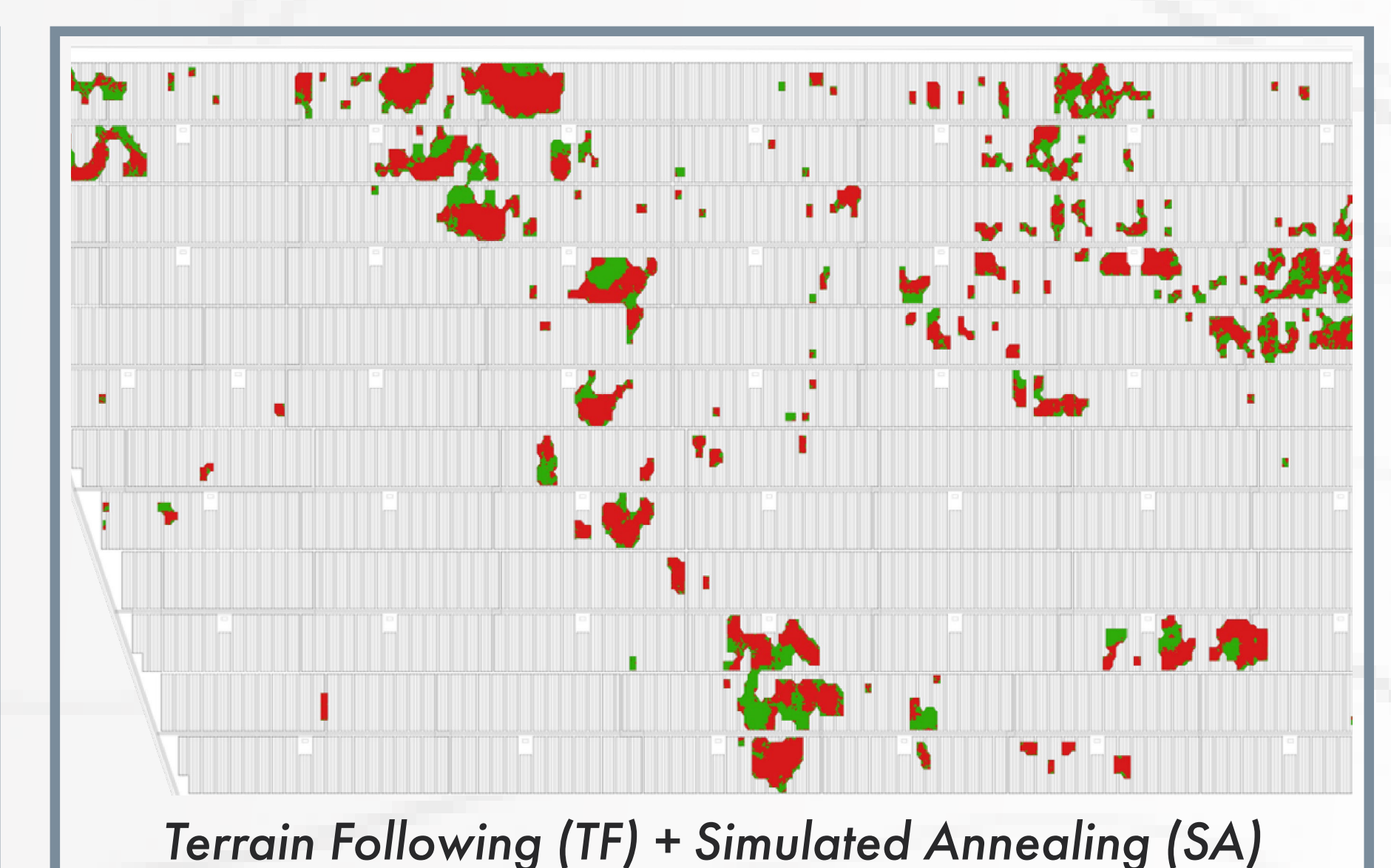
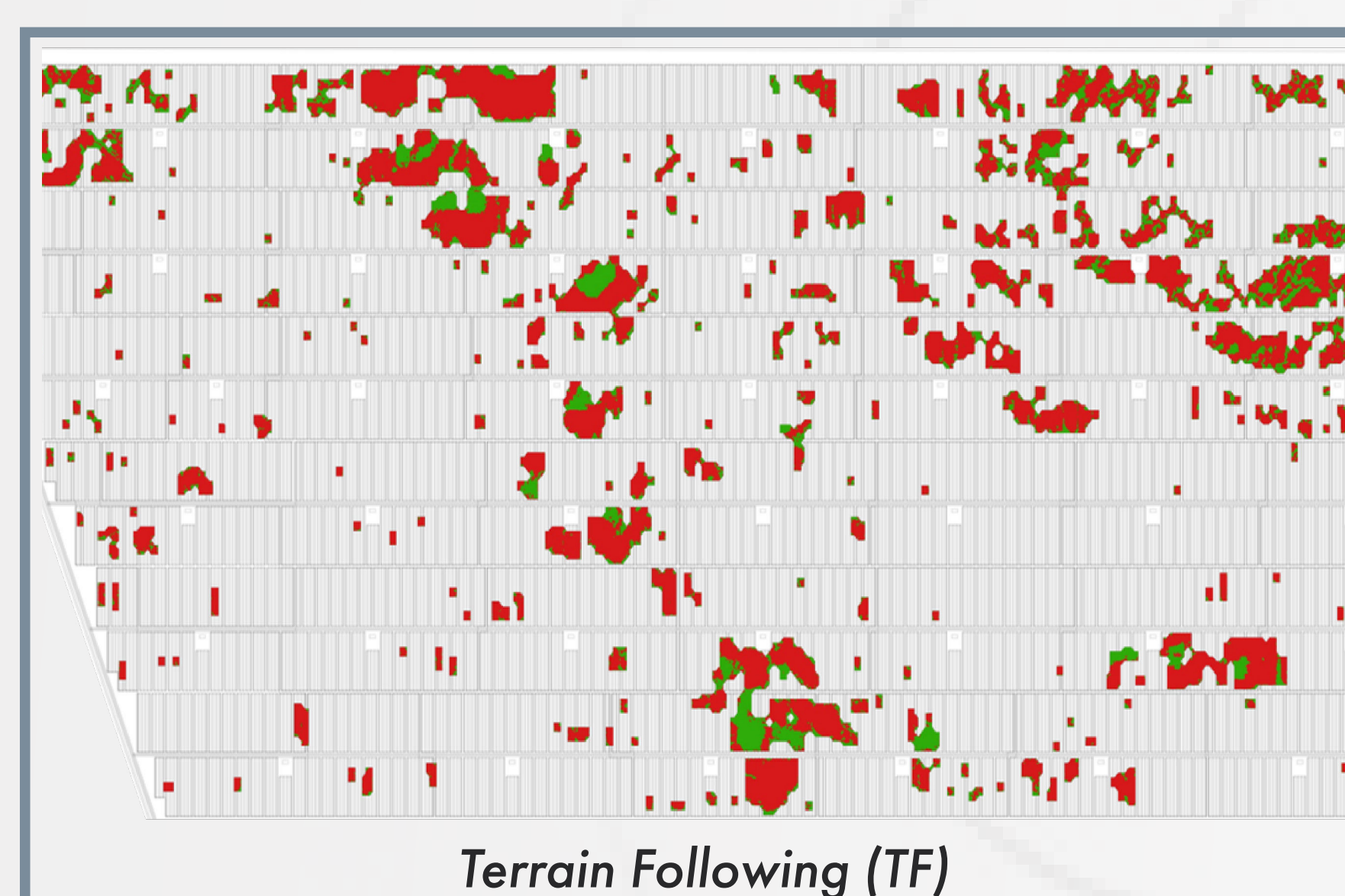
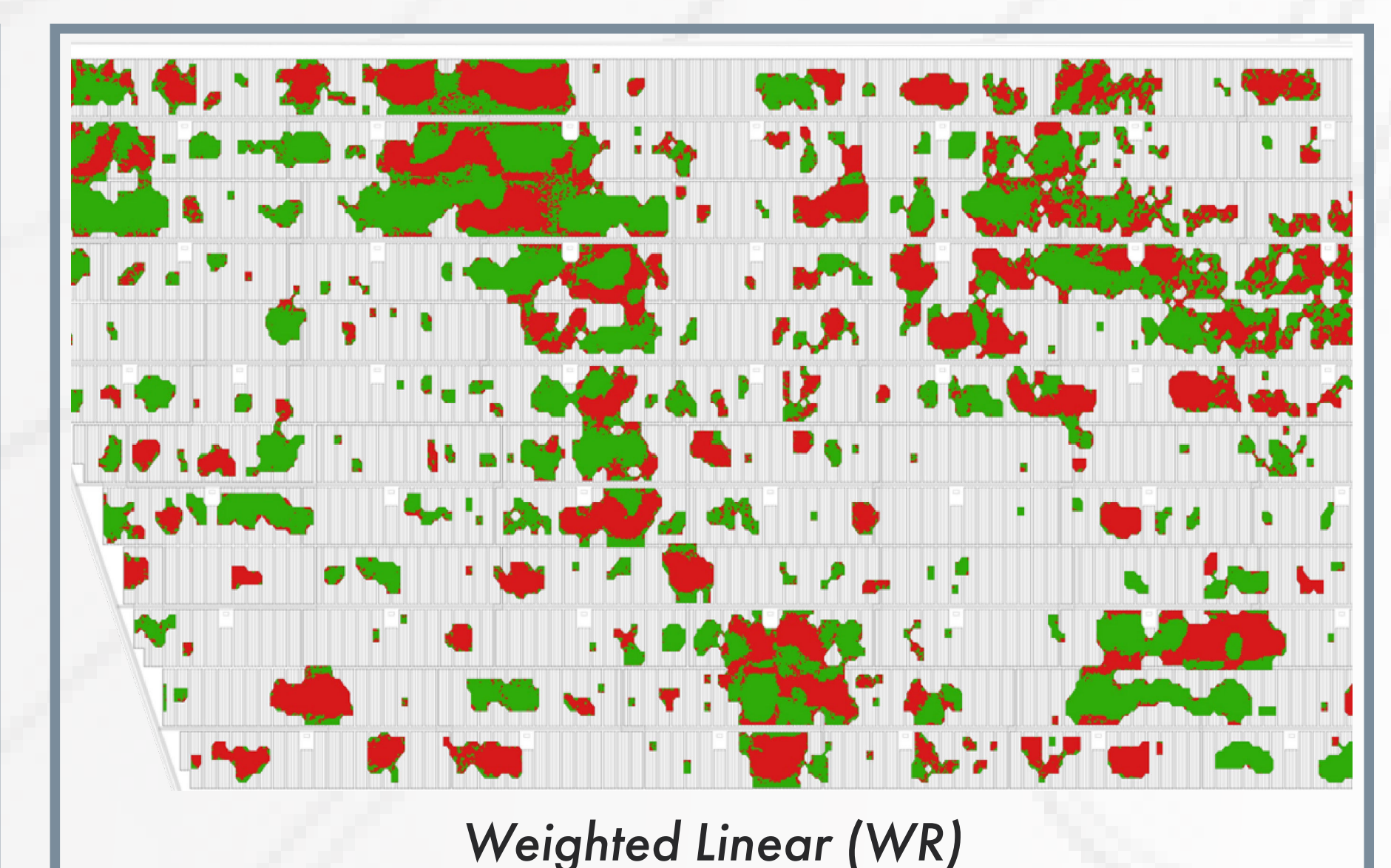
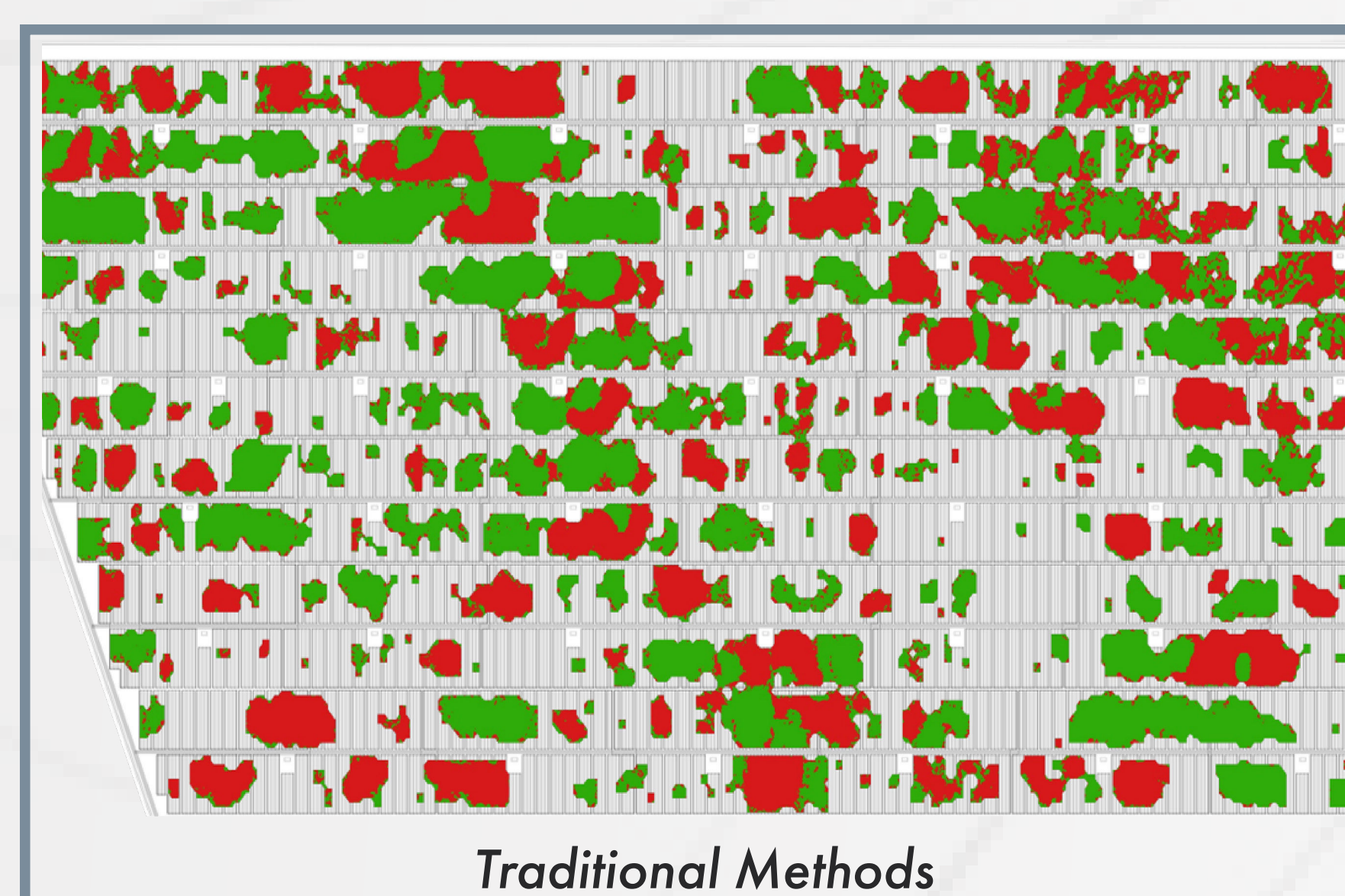


Iteration One (top) vs. Iteration Four (bottom) of SA



RESULTS + BENEFITS

- **Faster Design Cycles:** Iterates grading and racking options in days instead of weeks.
- **Lower Costs:** Optimizes tracker alignment and pile reveal to cut earthwork and steel costs.
- **Improved Feasibility:** Adjusts designs to match site conditions, making challenging terrain more viable for development.
- **Flexible Across Manufacturers:** Supports quick pivots between tracker systems without major redesign.
- **Enhanced Engineering Confidence:** Combines algorithmic checks with engineer review to ensure designs meet tolerances and are ready for field execution.



Method	2D Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)	Totals (Cu. Yd.)
Traditional Methods	21,353,417	211,135	171,750	-39,385	382,885
Weighted Linear (WL)	14,607,711	116,947	91,147	-25,800	208,094
Terrain Following (TF)	6,673,246	88,172	10,206	-77,966	98,378
TF + Simulated Annealing	3,611,578	50,759	10,604	-40,155	61,363

Learn more at revamp-eng.com

Revamp's proprietary civil grading software is currently patent pending.

