

Soil carbon sequestration in building life cycle assessment: Offsetting measure or site impact

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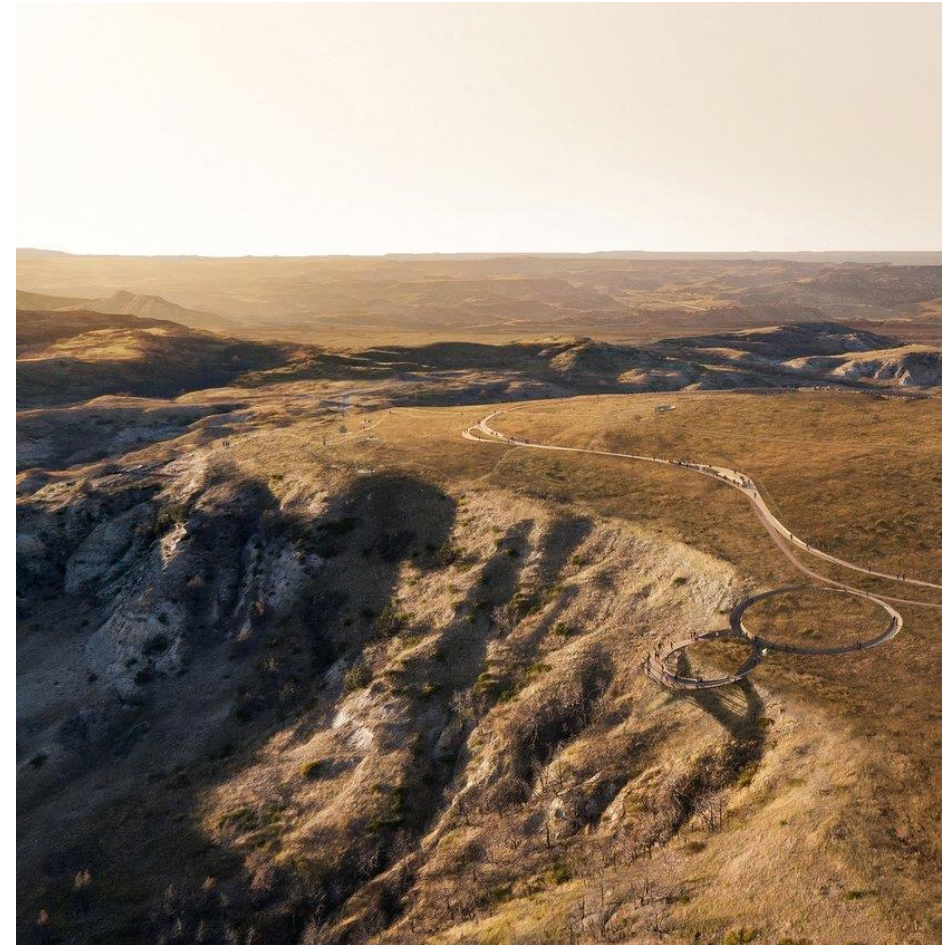
Project overview

Objective

- Assess how soil carbon sequestration (SCS) should be incorporated into building-scale life cycle assessments (LCAs)

Research Questions

- Does soil carbon sequestration meet requirements to be considered a carbon offset?
- How does SCS align with the life cycle stages of a built asset?
- What LCA methodology should be used to quantify SCS?



Presentation structure

- Introduction to soil carbon sequestration
- Potential soil carbon benefits – case study
- Review of carbon offset principles
- Soil carbon as an offset or site impact?
- Future work and next steps



Photo by [elizabeth lies](#) on [Unsplash](#)
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Soil carbon sequestration

What is it?

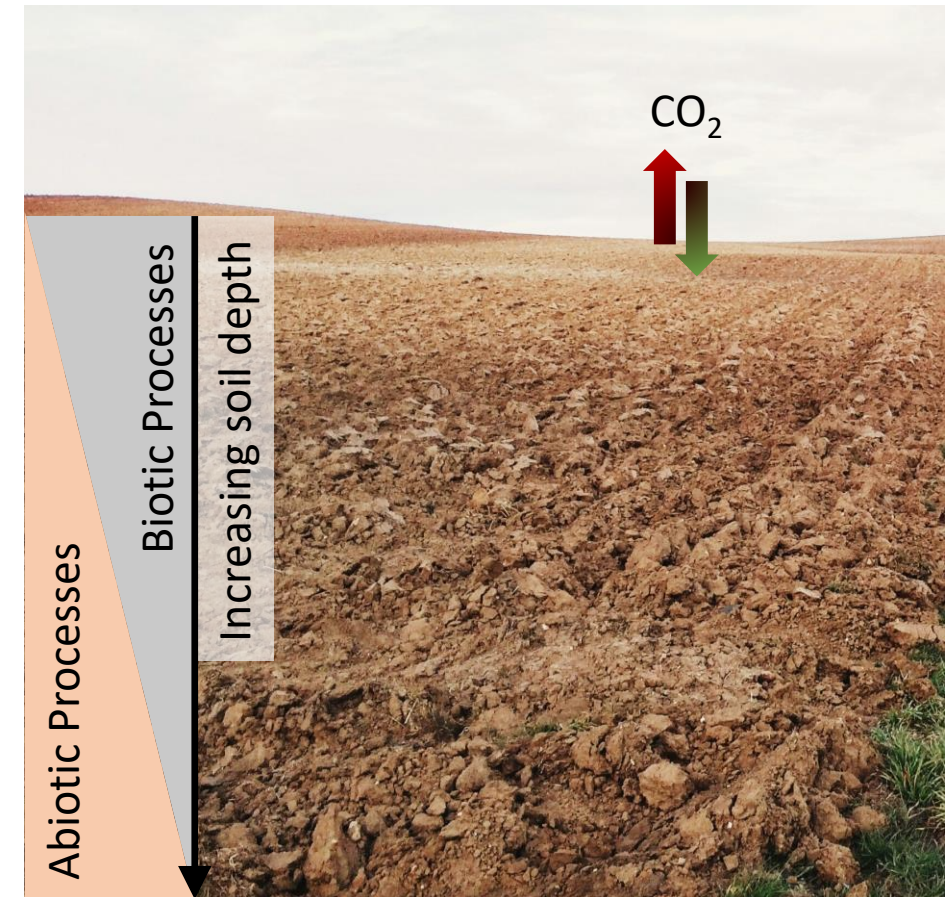
- Rate that carbon is exchanged between soil and the atmosphere

How does it work?

- Abiotic and biotic process influence rate carbon is sequestered and emitted from soil

Why should we care?

- Soil carbon is the second largest global carbon pool
- Excavation can have a large impact on soil carbon

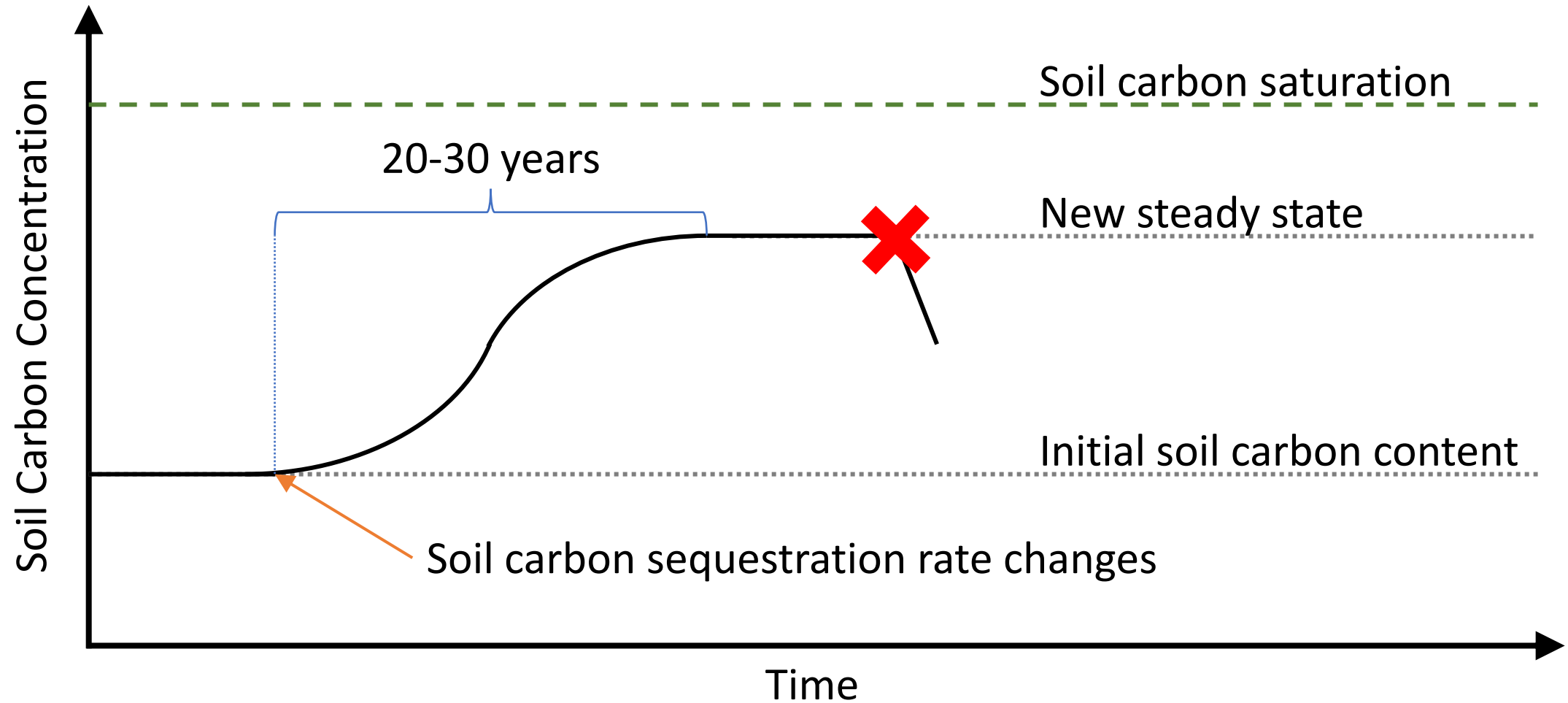


Adapted based on Bai & Cotrufo (2022)
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Factors influencing soil organic carbon

Natural Processes	Interventions
Weather patterns	Grazing patterns
Extreme weather events	Fertilizer use
Soil erosion	Crop / vegetation rotation
Microbial organisms	Drainage
Fire	Tillage
	Land use change
	Biochar application

Soil carbon principles



Case study project

Project Specifications

- Location: Midwest, United States
- Site area: 12 hectares (30 acres) grazing area

Project Goals

- Restore historic grazing land
- Improve soil carbon through improved land management

Sustainability Ambitions

- Living Building Challenge full certification
- LEED Platinum
- SITES Platinum



Site soil carbon potential

Initial conditions

- Measured via 21 boreholes
- Soil organic carbon (SOC): 5.3 kgC/m²
- Total organic carbon = 53% of total organic matter

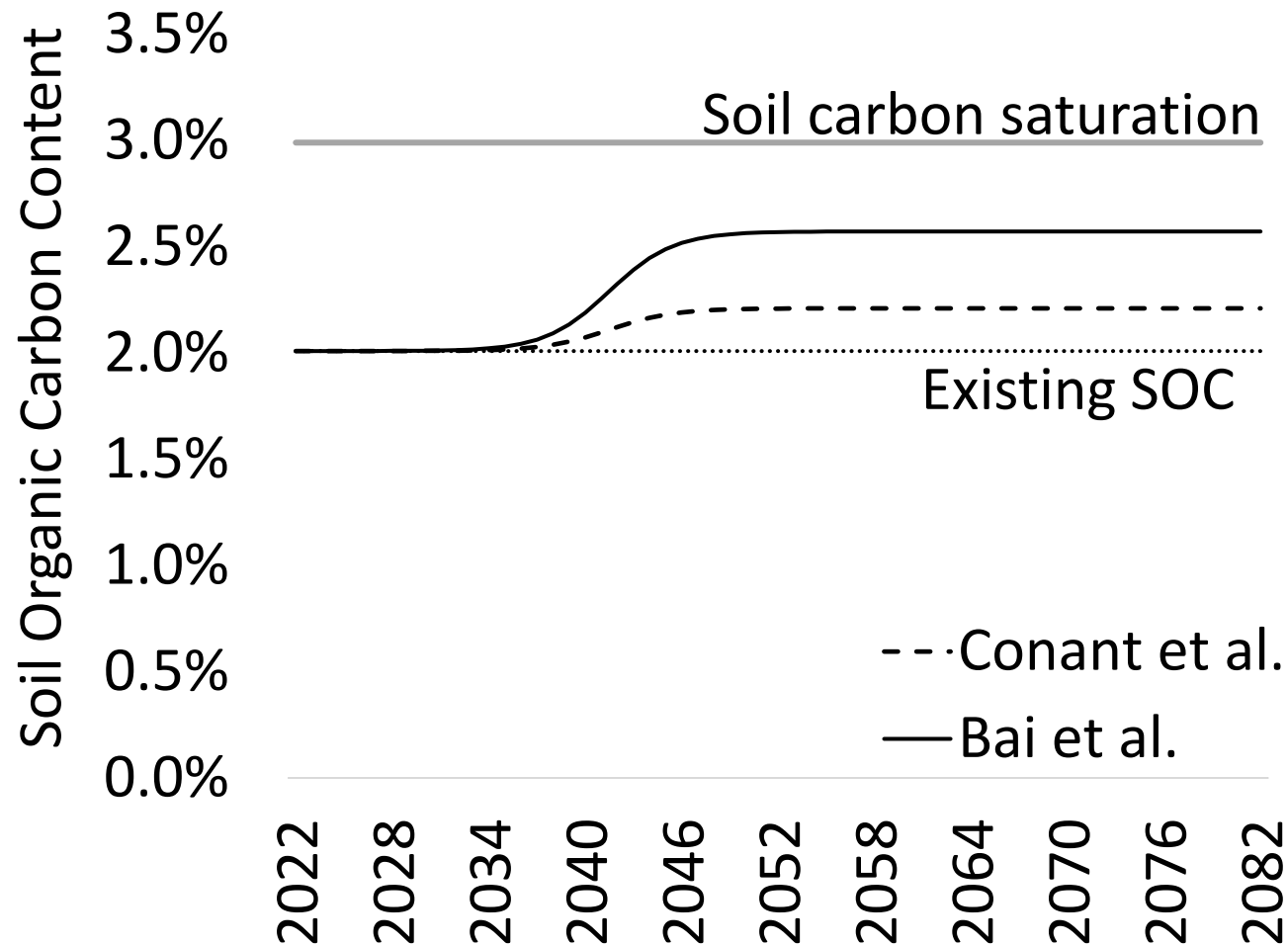
Potential change from grazing management

- 10% increase in SOC on grazing based on 50 studies¹
- 28% increase in SOC²

¹ Conant et al. 2017. DOI:10.1002/eap.1473

² Bai & Cortufo. 2022. DOI: 10.1126/science.abo2380

Site soil carbon potential



10% ↑
235,000 kgCO₂
500 kgCO₂/hectare/year

28% ↑
660,000 kgCO₂
1350 kgCO₂/hectare/year

Annual values normalized for 40 years

Carbon Offset Principles

Governance

- Effective governance
- Tracked
- Transparent
- Verified

Emissions Impact

- Additional
- Permanent
- Robust quantification
- No double-counting

Sustainable Development

- Sustainable development benefits
- Contribution to net-zero transition

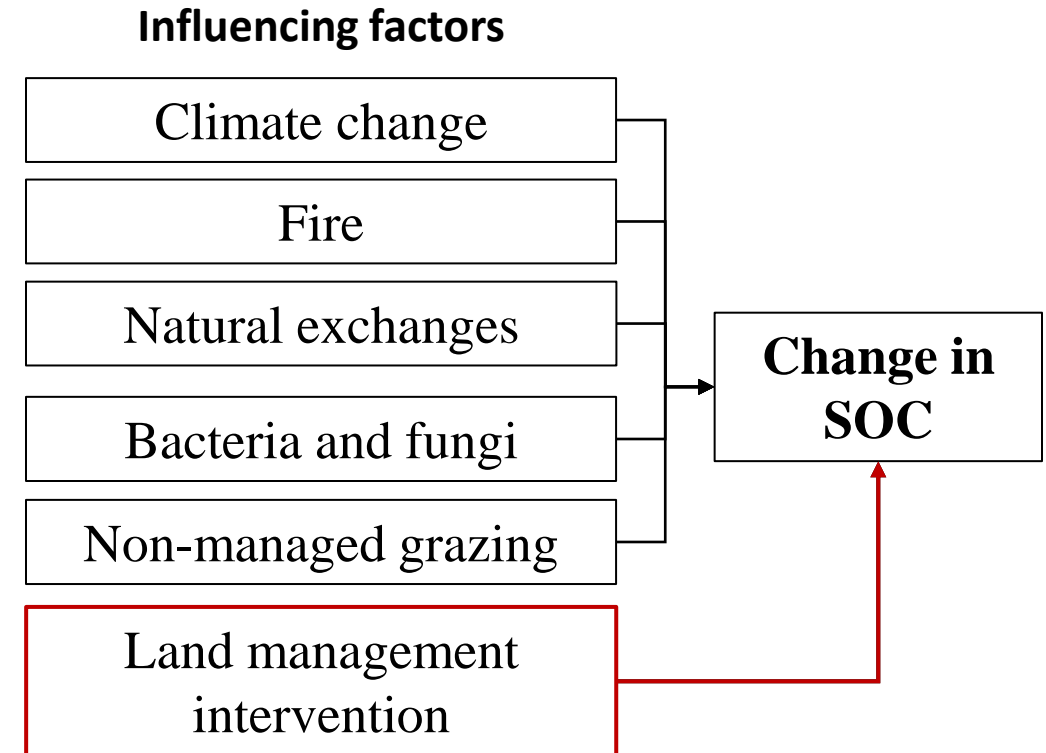
Soil carbon as a carbon offset?

Additionality

- Reduction of emissions would NOT have occurred without the offset program

Challenges for soil carbon

- Soil carbon fluctuates naturally
- Susceptible to rapid lose of carbon
- Multiple influencing factors
- Need to isolate change in soil carbon from specific intervention



Soil carbon as a site impact

Current system boundary

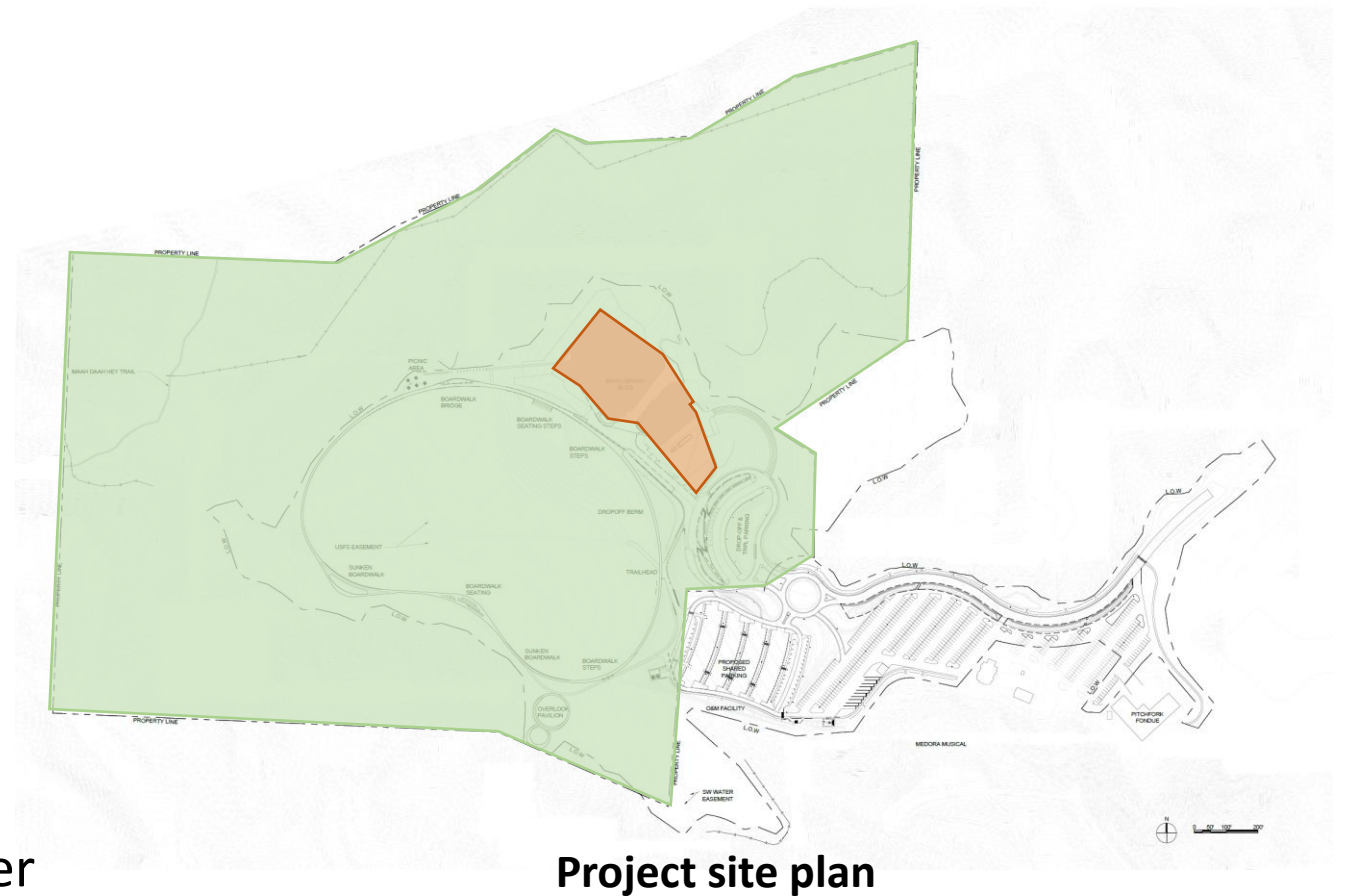


- Building footprint and envelope
- Normalized by building area

Proposed system boundary



- Project boundary
- Site impacts normalized by area and year
- Change in soil carbon reported in B1
- Should not report benefit of soil carbon sequestration without other site impacts



Current outlook

Soil carbon as site impact?

- Can be monitored throughout project
- Site is included in assessment definition from EN 15978:2011 & ISO 21931-1:2022

Soil carbon as carbon offset?

- Requires isolation of change due to intervention
- Requires robust baseline of soil carbon levels without intervention
- Additionality and permanence remain challenging to verify

Next steps

Site impact requirements

- Alignment of site activities with life cycle stages
- Quantification, and reporting guidelines for site impacts

Prospects as an offsetting measure

- Robust baseline development
- Isolation of change from other influencing factors
- Guidelines to ensure permanence



Thank you

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