# ASLA 2024 INSIGHT

**Conference on Landscape Architecture** OCTOBER 6-9 | Washington, DC

**From Waste to Resource:** Increasing Circularity in Engineered Soils Through Renewable Materials Speakers

Pia von Barby, PLA, ASLA, OLIN

Nic Esposito, Circular Philadelphia

Lindsay Reul, ASLA, Philadelphia Water Department

## **AIA Registered Provider**

The American Society of Landscape Architects is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This program is registered with the AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.





## Copyright

This presentation is protected by US and International Copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited.

© The American Society of Landscape Architects





### Disclaimer

The views and opinions expressed by presenters are their own and do not necessarily represent those of ASLA. ASLA disclaims any responsibility for the use and application of information presented in this education session.





### Introduction

## **Learning Objectives**

- Understand the impacts of material sourcing for engineered soils
- Contextualize opportunities and barriers to adoption of renewable materials in public works projects and private development
- Understand the properties of glass-sand as a component in engineered soils, including its performance in comparison to mined sand
- Demonstrate strategies for connecting local nonprofits, city departments, and small businesses with landscape architects and each other





### **Speakers**







Pia von Barby, PLA, ASLA OLIN Landscape Architect

ASLA 2024

Nic Esposito Circular Philadelphia Director of Policy + Engagement Lindsay Reul, ASLA Philadelphia Water Department Landscape Design Supervisor



## Assessing the Potential of Mixed Color Glass as a Component in Engineered Soils

### **OLIN Labs**



#### Initiatives



Climate Week 1023



Autonomous Urberism subsects



Green New Seal Superstudio

GREEN NEW DEAL SUPERSTUD

Inclusion and Access Revisiong Universal Owign



Worldiese

Pride

PrideScapes



Social Performance of a Small Libert Park

- Research Director: Skip Graffam
- Research Coordinators: Rebecca Popowsky + Julie Donofrio



Cecular Sel

### What is the Role of the Landscape Architect?

### **The Problem**



### The Question

#### GLASS + FOOD WASTE

#### LOCALLY-SOURCED HIGH-PERFORMING SOIL



### **The Process**

- Proof of concept:
  - Safety
  - Performance
  - Economics + logistics
- Open-source process guidance and systems planning

- Audience
  - Municipalities
  - Materials processors and recyclers
  - Design and construction industry



# **OLIN Labs Research**

#### Proof of concept

- Literature review
- Lifecycle assessment
- Greenhouse trial

Lab analysis

- Temple University
- Mesocosm study
- Hydraulic performance
- Leachate
- Microplastics











## **EPA SBIR Funded Research**

Developmental Investigation of Recycled Mixed Color Glass in Engineered Soils

- 2021: Phase I
- 2021-2023: Phase II



About + Funding + Reports + Showcase + Announcements + Resources +

OCornetile Queen

Humani A Award Details

#### Developmental Investigation of Recycled Color Mixed Glass in Engineered Soils

#### Award Information

Agency: Inverse and Policities Agency		Branche	
Contract: INHENCIICONAN		Agency Tracking Number: 52090 4000	
Amount: 220,040.00	Phase: Phase (	Program: 1541	
Solicitation Topic Code to commun	•	Solicitation Number:	
Teneire			
Solicitation Year: 2009	Award Year:	Award Start Dete (Proposal Award Date): 2023-05-05	Award End Date (Contract End Date): 2011 == 01
Sendil Bureau Information			
Olin Partnership, Ltd.	and the COLL		

ot 1001 Philadelphia, PA 10406 United States.



Team



Team Lead

Team



Project Advisor







### Technical Plan

- Defining a target material
- Economic benefits of diverting glass from municipal singlestream recycling were identified.





#### Greenhouse Trial

 No significant differences in biomass between glass-based and sand-based mixes.

#### Plant Growth Trial: Biomass

#### Calamagrostis 'Karl Foerster'

#### Watering Treatment Impacted Plant Growth

 There were significant differences in biomass between high and low watering treatments for both roots (p=<0.001) and shoots (p=<0.001).</li>

#### No Significant Interaction Effect between Watering Treatment and Soli Mix

#### Performance Difference between Sand and Glass-based Soils

- Soil mix had a significant effect on shoot biomass only (p=0.0058).
- Plants in the low watering treatment exhibited significantly higher shoot biomasses (p=0.0120) when grown in glass-based soil mix 0 than when grown in sand-based soil mix A.





Annue A logariteria francisco quide et la subscription de la subscription de la second database. Toro you ACDA you fair unor la annue d'Exercice e discriminatione e autoritation and annue de la second d'Exercice frances and annue fair e la second d'Exercice frances. Al second a decidad and alla e runs



#### **Open-Source Trial Specifications**

#### PRODUCT DATA: GLASS CULLET FOR SOIL MIXES

This product data shaul is for counted recycled plana culat for sea in soil missio an animal send replacement. The counterclass aggregate is made from obtence aware given considing of mixed glass bottles, plade glass, meaning or other types of class series glass. We havened tables, Pyres, inided glass, in CRT tables shall be used in the glass cubict.

All crusting occurs at the Markets Recovery Tracity (MW) with proper elowers and uses locally isolected water place from residential and/or commencial suborners. The process aniumer that instead does not have executed tables, paper or plant instead and initial.

The plass matural is crushed to need the following criteria with its particle size following below and is equivalent to be on the fine size of ASTM C23 - Fine Aggregate.

Particle Stan Class	Passing Sieve No. ABTM F 1632/01	Range in Percent Passing	
gtavel.	4	101	
fine chevel	10	10 - 100	
medium same	80	540	
Very first saind	213		
1.2.	Chemical		
DH .	ASTM D 4872-19	12.10	
EG	ARTM G 187 - 18	<2.0 cBass	
	Physical		
Poniga Organica	YESH 1- (812-11)	~0.5 by revight	



#### GREEN INFRASTRUCTURE SYSTEMS DESIGNED FOR INFILTRATION

PART 1 – GENERAL

- 1.1 SUMMARY
- A. SCOPE:

This specification is to use recycled glass cullet as a sand replacement at a mix ratio needed for infiltration for GSI systems. Excess use of glass cullet within the soil mix reduces infiltration rates.

- 1. Evaluation of rough subgrade water infiltration.
- 2. Design for infiltration for sizing and infiltration rates.
- 3. Final Mix.
- B. LEEDs and SITES Documentation:
- 1. This material will qualify for recycled content components for LEEDS and SITES:
  - a. Declare Label.
  - b. Cradle to Cradle product certification.
  - c. Environmental Product Declaration (EPD).
- 2. Specific project goals that may impact this area of work include: use of recycled-content materials, and use of locally-manufactured materials. The Contractor shall ensure that the requirements related to these goals, as defined in the Articles below, are implemented to the fullest extent. Substitutions, or other changes to the work proposed by the Contractor or their Subcontractors, shall not be allowed if such changes compromise the aforementioned environmental and LEBD goals.
- Sustainable Design Documentation: Provide documentation per Sustainable Design Requirements to demonstrate compliance with LEED requirements for this material.
  - a. Credit MRc3 Building product disclosure and optimization Sourcing of Raw Materials:
    1) Recycled Content.
  - Regional Materials.
  - b. Credit MRc4 Building product disclosure and optimization Material Ingredients.
- SITES Credits: Provide documentation per Sustainable Design Requirements to demonstrate compliance with SITES requirements for this material.
  - a. Credit 5.4 Reuse salvaged materials and plants
  - b. Credit 5.5 Use Recycled Content Materials
- C. Qualifications:
  - Analysis and Testing of Materials Qualifications: For each type of packaged material required for the work of this Section, provide manufacturer's certified analysis. For all other materials, provide complete analysis by a recognized laboratory made in strict compliance with the standards and procedures of the following:
    - American Society of Testing Materials (ASTM) American Society of Agronomy Soil Science Society of America (SSSA)

Team



Team Lead







Team



Commercial Team



Technical Plan

• How can glass-sand be integrated into the City's existing soil procurement system?



### **EPA SBIR Phase** Pilot Glass-Sand Manufacturing



Credit: Chris Baker Evens Photography

THE R. LEWIS

### **EPA SBIR Phase II** Pilot Glass-Based Soil Blending

### **EPA SBIR Phase II** Monitored Field Trial





#### Monitored Field Trial



Credit: OLIN / AKRF

#### Monitored Field Trial

Comparative Analysis

- Transpiration
- Infiltration
- Compaction
- Soil Moisture

#### Performance Target

- pH
- Temperature
- Turbidity
- Flow Rate





#### Monitored Field Trial

#### рΗ

- Target = 6.5 8.5
- Average pH = 7.25
- Std Deviation = 0.11
- Slight upward trend
- pH is relatively stable and within range for water quality standards



### Monitored Field Trial

Soil Infiltration & Compaction

- Glass-based mix infiltration is more than 2 times the infiltration rate of standard soil
- Compaction comparable between soils – Glass soils 8% less compacted on average



### Monitored Field Trial

Soil Moisture

 Glass-based mix can hold on to soil moisture better during dry periods



Less decline in

### Monitored Field Trial

Plant Transpiration

- Stomatal conductance used as proxy for plant transpiration
- No localized trends observed in each zone
- Average ratio of glass / standard stomatal conductance = 104%
- Plant transpiration was comparable for glass-based and standard soil mix amongst all species



#### Monitored Field Trial

Vegetative Cover

- No statistical evidence that glasssand reduced vegetative cover
- For the trial test plots, mean cover began slightly lower and ended slightly higher, suggesting that, if glass-sand did influence plant growth, it shifted the timing.



### Monitored Field Trial

Vegetative Cover

- No statistical evidence that glasssand reduced vegetative cover
- For the trial test plots, mean cover began slightly lower and ended slightly higher, suggesting that, if glass-sand did influence plant growth, it shifted the timing.



### Monitored Field Trial

Vegetative Cover

- No statistical evidence that glasssand reduced vegetative cover
- For the trial test plots, mean cover began slightly lower and ended slightly higher, suggesting that, if glass-sand did influence plant growth, it shifted the timing.



Plant height

- The height difference of three taxa were statistically in the standard soil vs glass-based soil
- Results may be due to several factors including the presence of glass-sand, site access, human occupation, surface runoff from the street and parking lot, and uneven sun exposure.



#### Monitored Field Trial



Environmental Soil Test Report							
Analyte.	Result	LOQI	Units	Method	Analyst	Analysis date	Qualifier
Arsenio, As	< 0.75	0.75	mglkg	EPA 3050B + 6010	PS/PA	1/4/2024	none

Soil Lead Level (Total Sorbed Lead Test)	Level of Lead Contamination mg/kg or ppm			
Less than 150	None to very low			
From 150 to 400	Low			
From 400 to 1,000	Medium			
From 1,000 to 2,000	High			
Greater than 2,000	Very high			









#### Circular Soils - Pilot Site

E GEREN FORME SERVICE

100

GLIH

This rain percent is tooling a new Gase-Based Sel Mix. This new type of sel internantially replaces con-excessible reined sack with recycled glass-sand mode from locally cellisited recycling in Priladophia interacted is October 2012 with the Philadophia Inportant of Parks & Resistantian, employ mentioning of the rain parter, includes with mainty not includes the



And the second system is the fact that the second secon

#### Monitored Field Trial

Results

- Glass-based soil (GBS) outperforms standard sand-based GSI soil in several key hydrologic metrics.
- GBS has higher infiltration rates, lower compaction, and higher moisture retention than standard soils.
- GBS has little to no effect on plant growth and soil health (microorganisms and fungal biomass).
- Glass-sand and GBS is safe to handle and can be blended using typical soil blending techniques and equipment.
- Levels of exchangeable metals very low, per US Composting Council recommendations (EPA Method 3050B + 6010)

## **Market Research Findings**

- Use the spec to drive the market
  - Market to the companies already on contract with public agencies
- Match the price, consistency and quality of New Jersey sand
  - But a premium would be paid for a higher quality product
- Focus on bulk deliveries rather than bagged product
  - However bagged product could work for garden supply stores
- Marketing will be key with a focus on performance and safety

2023

SI PARTNERS



#### Soilless Soils: Investigation of Recycled Color-Mixed Glass in Engineered Soils

Honor Award Research

Philadelphia, Pennsylvania, United States OLIN Client: U. S. Environmental Protection Agency



#### Pilot Program

A 2019 plot greenhouse that showed that glass-based sols supported plant, growth as well as a control minod-sand mix. Share This

5 of 16











# ASLA 2024 INSIGHT

**Conference on Landscape Architecture** OCTOBER 6-9 | Washington, DC

From Waste to Resource: Increasing Circularity in Engineered Soils Through Renewable Materials Speakers

Pia von Barby, PLA, ASLA, OLIN

Nic Espositio, Circular Philadelphia

Lindsay Reul, ASLA, Philadelphia Water Department