



**PROVEN**

**Sustainable**

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## Who do we have online?

- a) Consulting Engineer
- b) Agency Engineer
- c) Public Works Employee
- d) Urban Planner
- e) RCP Industry Professional
- f) University Personnel
- g) Other

# Proven: **Sustainable**




## **But...**

- Cement is the 2<sup>nd</sup> most widely used substance on Earth
- It accounts for 7% of the global CO<sub>2</sub> production each year
- 8B tons of plastic in the last 60 years; 2 years production of concrete
- Is it even recyclable?



## What is the definition of Sustainable?

- 
- a) The ability of a system to resist, limit impacts, and rapidly recover after a disruptive event
  - b) Meeting our needs without compromising the ability of future generations to meet their own needs
  - c) An invented buzz-word that has no bearing on infrastructure issues



# Defining Sustainability

# The “S” Word

- Invented Buzz Word

Infrastructure



Function



Cost Effective



Aesthetic

- Reducing quality of life *today*



# The “S” Word

- Sustain
  - To support something or keep it going
- Infrastructure
  - Requires resources
    - Limited/finite resources
    - Maximize efficiency

*Sustainable infrastructure*



# The “S” Word

How can we maximize resource efficiency?





# The “S” Word



## Reduce:

- Consider long-life materials
- Build/Design for resiliency
- Design to conserve resources
- Diesel is money

## Reuse:

- Repurpose
- Retain/Remodel/Renovate

## Recycle:

- Maintain value/quality
- Achieve circular economy – recycling  
upcycling (?)
- Achieve spiral economy - downcycling







Sustainability

Resilience





**Sustainability**

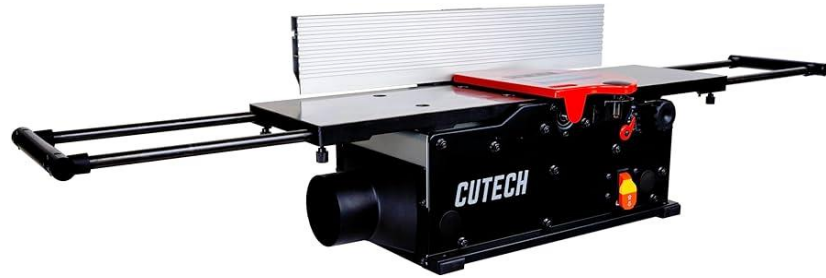
**Resilience**





SUSTAINABLE

# High-Value Sustainability



durability, high-value,  
and sustainability are  
not mutually exclusive







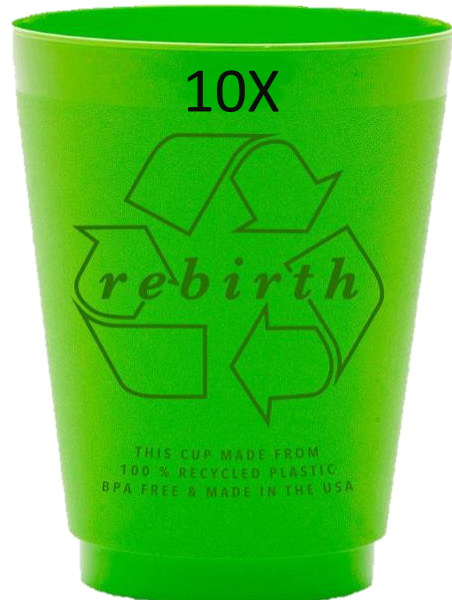
1X

50 / \$5.99



1000X

48 / \$383.50



10X

50 / \$32.00



21,000X

1 / \$11,000



In Australia over  
3 billion takeaway  
cups and lids are  
wasted every  
year

Modern culture is  
addicted to convenience.  
Lighter, faster, easier,  
cheaper...



1-Click Checkout



#DitchDisposables

# High-Value Sustainability

Products that offer durability *and* long-lasting resilience

- Conserves resources
- Decreases waste



# Low-Value Sustainability

Products that use inexpensive or single-use materials

- Conserves resources
- Commonly discarded
- Creates waste





# Sustainability

“Meeting our current needs without compromising the ability of future generations to meet their own needs”

- *International Institute for Sustainable Design*

A teal-colored triangle is located in the bottom-left corner of the slide, pointing towards the center.

# Sustainability & Resilience

Public systems which can effectively resist, quickly adapt and recover rapidly to conditions above and beyond design conditions

- Allowing emergency access, public evacuation, supply chain confidence, and community reentry



*code* +



Rank the most significant attributes of sustainable infrastructure:

- a) Reusability
- b) Recycled Content
- c) Recyclability
- d) Natural Materials
- e) Resilient Materials
- f) Reduced Waste Creation
- g) Other







Why Does it Matter?



# Why Focus on Sustainability

- Resources are *limited*
- Agency focus is often the Bottom Line
- Diesel is *Money*
- Sustainability saves dollars → resources  
→ environment
- We have an *ethical responsibility*



## **Micro Ethics**

Responsibilities of an individual



## **Macro Ethics**

Responsibilities of a profession as a collective group

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## **Sustainability**

Meeting today's needs without compromising the ability of future generations to meet needs of their own

## **Resilience**

Ability of a system to resist, limit impacts, and rapidly recover after a disruptive event



## Code of Ethics

### 2. NATURAL AND BUILT ENVIRONMENT

#### Engineers' Responsibility:

- a. adhere to the principles of sustainable development;
- b. consider and balance societal, environmental, and economic impacts, along with opportunities for improvement, in their work;
- c. mitigate adverse societal, environmental, and economic effects;  
*and*
- d. use resources wisely while minimizing resource depletion.

## Code of Ethics

### 2(d) Professional Obligations:

Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations.\*\*

\*\*“Sustainable development” is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

# ASCE The Engineer's Responsibility

- Balance impacts
  - societal, environmental, and economic
- Mitigate adverse effects
  - societal, environmental, and economic
- Use resources wisely while minimizing resource depletion

*HIGH VALUE SUSTAINABILITY*



# Professional Obligations – Sustainable Development

## *Professional Obligations - Principles of Sustainable Development*

- Meeting human needs of today
  - Natural resources, industrial products, energy, food, transportation, shelter, and effective waste management
- While conserving and protecting environmental quality and the natural resource base for future development





Proven: Sustainable

# RCP: Proven **Sustainable**

- Known Known
- Robust & Durable
- Resilient
- Reduce
  - Reuse
  - Recycle





# RCP: Known Knowns

“...there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns — the ones we don’t know we don’t know.”

– Donald Rumsfeld

<b>Knowns</b>	<b>Known Knowns</b> <i>Things we are aware of and understand.</i>	<b>Known Unknowns</b> <i>Things we are aware of but don't understand.</i>
	<b>Unknown Knowns</b> <i>Things we understand but are not aware of.</i>	<b>Unknown Unknowns</b> <i>Things we are neither aware of nor understand.</i>
	<b>Knowns</b>	<b>Unknowns</b>



# RCP: Known Known

- It isn't made from fossil fuels
- It is not being found in the stomachs of whales and seagulls
- Doctors haven't found concrete traces in our blood, our lungs, or our brains
- It isn't tangled in trees after a flood



# RCP: Robust & Durable

- It is the foundation of modern life
- Combined with steel, concrete ensures dams won't burst, towers won't fall, roads & bridges won't buckle
- Reinforced concrete is the one construction material engineers understand more than any other

***Known Knowns***

***Things we are aware  
of and understand.***



# RCP: Resilient

- Flotation
- Flammability





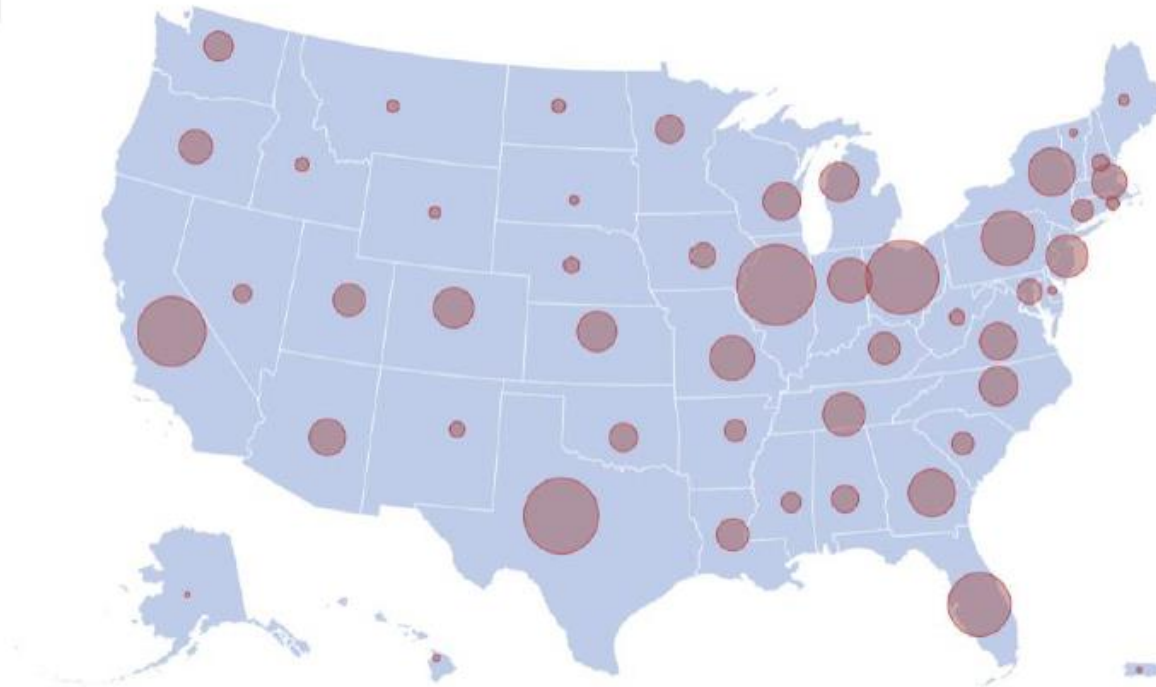
# RCP: Resilient

## Hazmat Incidents on Roads and Rail, 2013-2022

Hazmat incidents on roads and rails while vehicle was in-transit

Roads

25 100



Source: Pipeline and Hazardous Materials Safety Administration (PHMSA) • By Dilcia Mercedes, CBS News

**2014 – 2024**

**24,703:** # Events for In-Transit Highway Flammable Spills

**160:** # Cases w/ Spill Entered Storm Sewer

**90:** # Cases w/ Roadway Closed

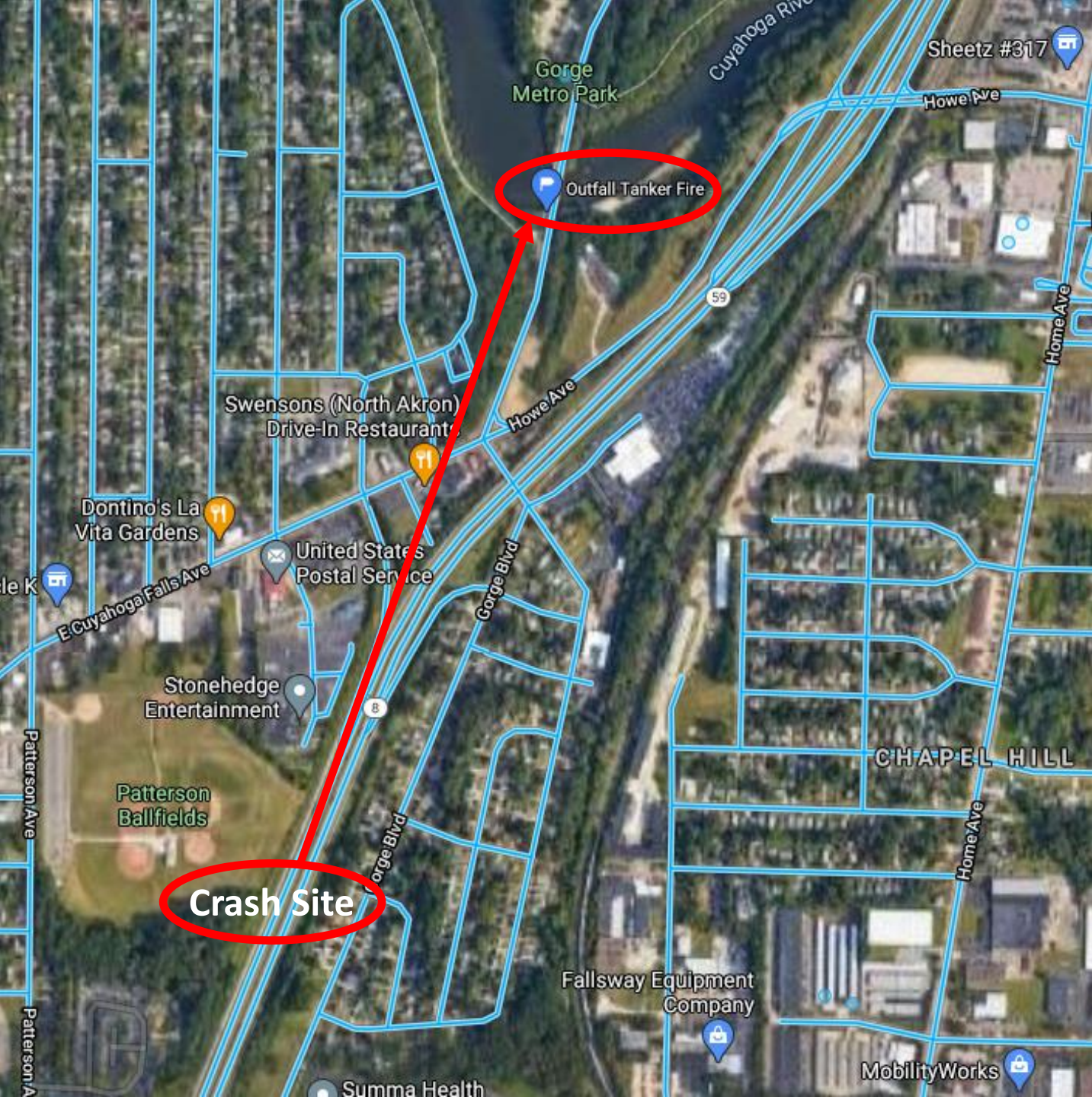
Source: [HAZMAT Incident Report Search Tool, PHMSA](#)





August 25, 2020





**USMH: 300265**  
**DSMH: 300266**  
UPSTREAM



**Line Left**

55.0 ft.

**USMH: 522162**  
**DSMH: 281744**  
DOWNSTREAM



**Surface Damage Aggregate Visible**

171.5 ft.

9/3/2020  
09:36



# Climate Change is a *Risk* Multiplier

Severe Storms  
Tropical Storms  
Flooding  
Fires  
Extreme Temperatures  
Winter Storms  
Intentional Harm  
Vehicle Accidents  
Chemical Spills  
Poor Installation  
Future Construction  
Utility Drilling

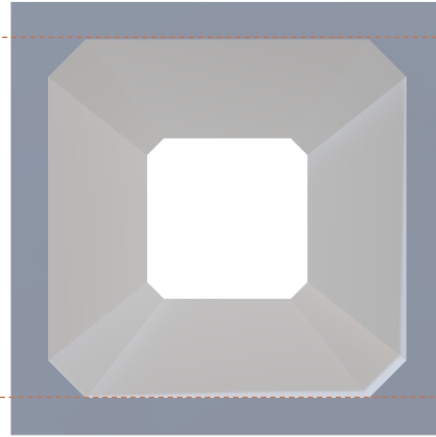
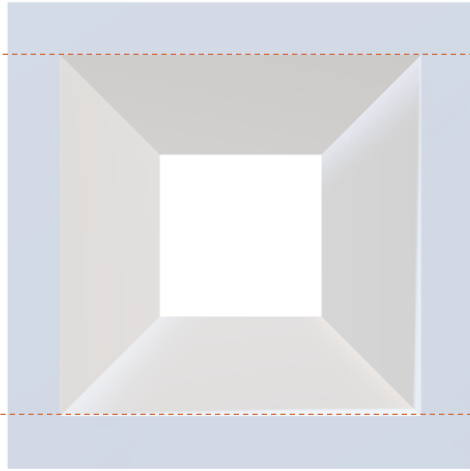


# RCP: Reduce

- Design
- Go Local
- Conserve native fill
- Use high value sustainable products



# RCP: Reduce - Design



## TXDOT: 4x4 Cast in Place Box

- 30 ft fill
- AASHTO LRFD Design
- 3,500 psi concrete
- 7" thick walls/slabs

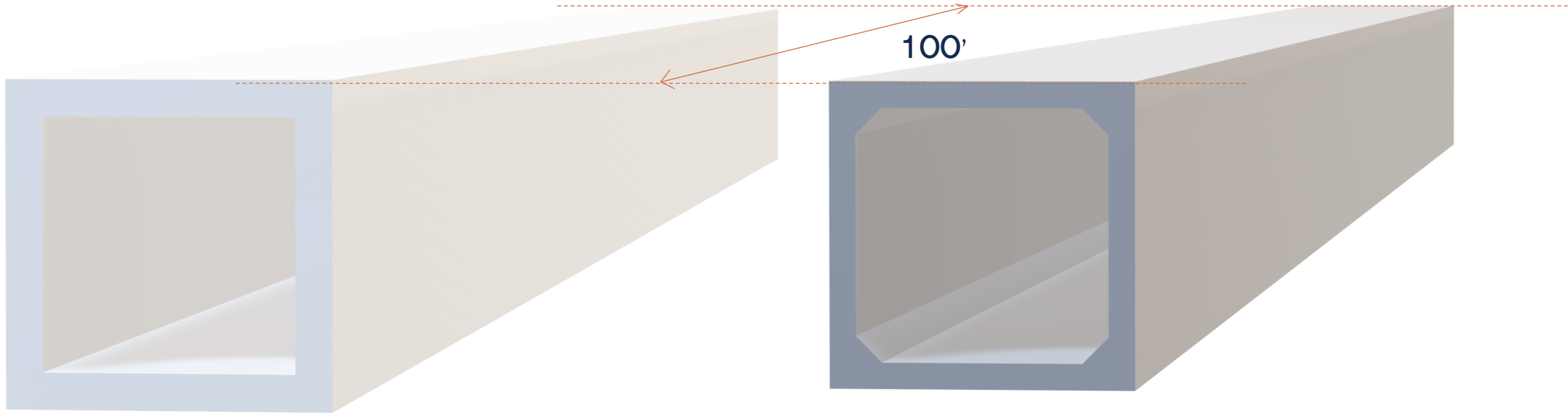
## C1577: 4x4 Precast Box

- 30 ft fill
- AASHTO LRFD Design
- 5,000 psi concrete
- 5" thick walls/slabs





# RCP: Reduce - Design



## TXDOT: 4x4 Cast in Place Box

- 30 ft fill
- AASHTO LRFD Design
- 3,500 psi concrete
- 7" thick walls/slabs
- 0.4 CY/LF = 40 CY@100

## C1577: 4x4 Precast Box

- 30 ft fill
- AASHTO LRFD Design
- 5,000 psi concrete
- 5" thick walls/slabs
- 0.28 CY/LF = 28 CY@100

# RCP: Reuse



# RCP: Reuse

**Tangier Sound Reef Site  
Chesapeake Bay, Maryland**



# RCP: Recycle

- Concrete Pipe is infinitely recyclable
  - Reinforcing Steel
  - Crushed concrete
- Most RCP Producers never send “junk” concrete to the landfill





# “Circular” Economy

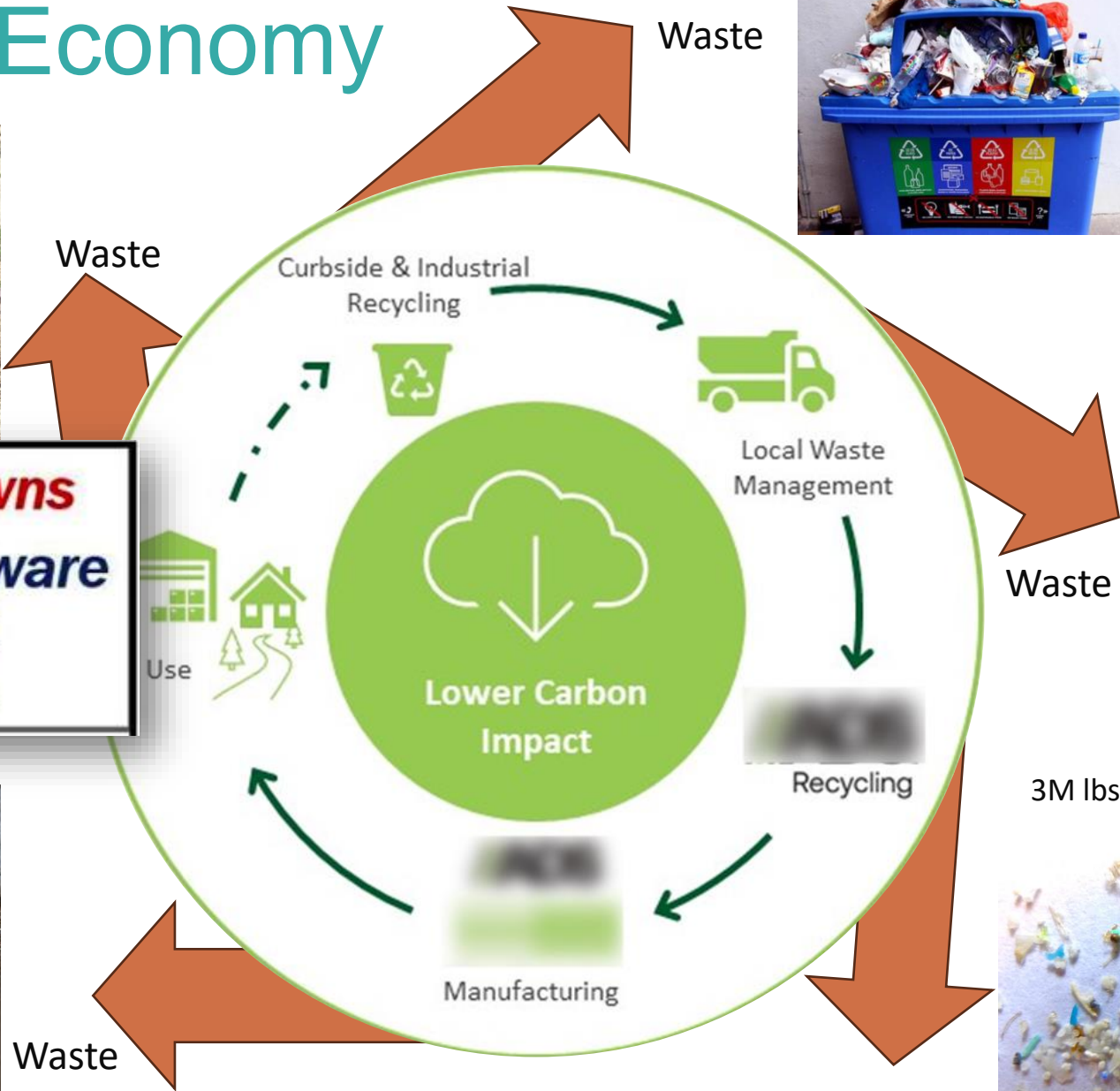


# “Circular” Economy



**Known Unknowns**  
Things we are aware of but don't understand.

450,000 tn/yr

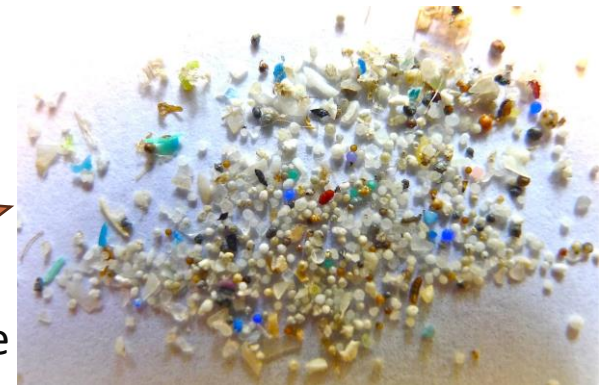


25% of recycling contaminated

5-9% of all plastics are recycled



3M lbs microplastics/facility/yr



~~“Circular” Economy~~ → *Spiral*

Downcycle

Reuse



Reduce

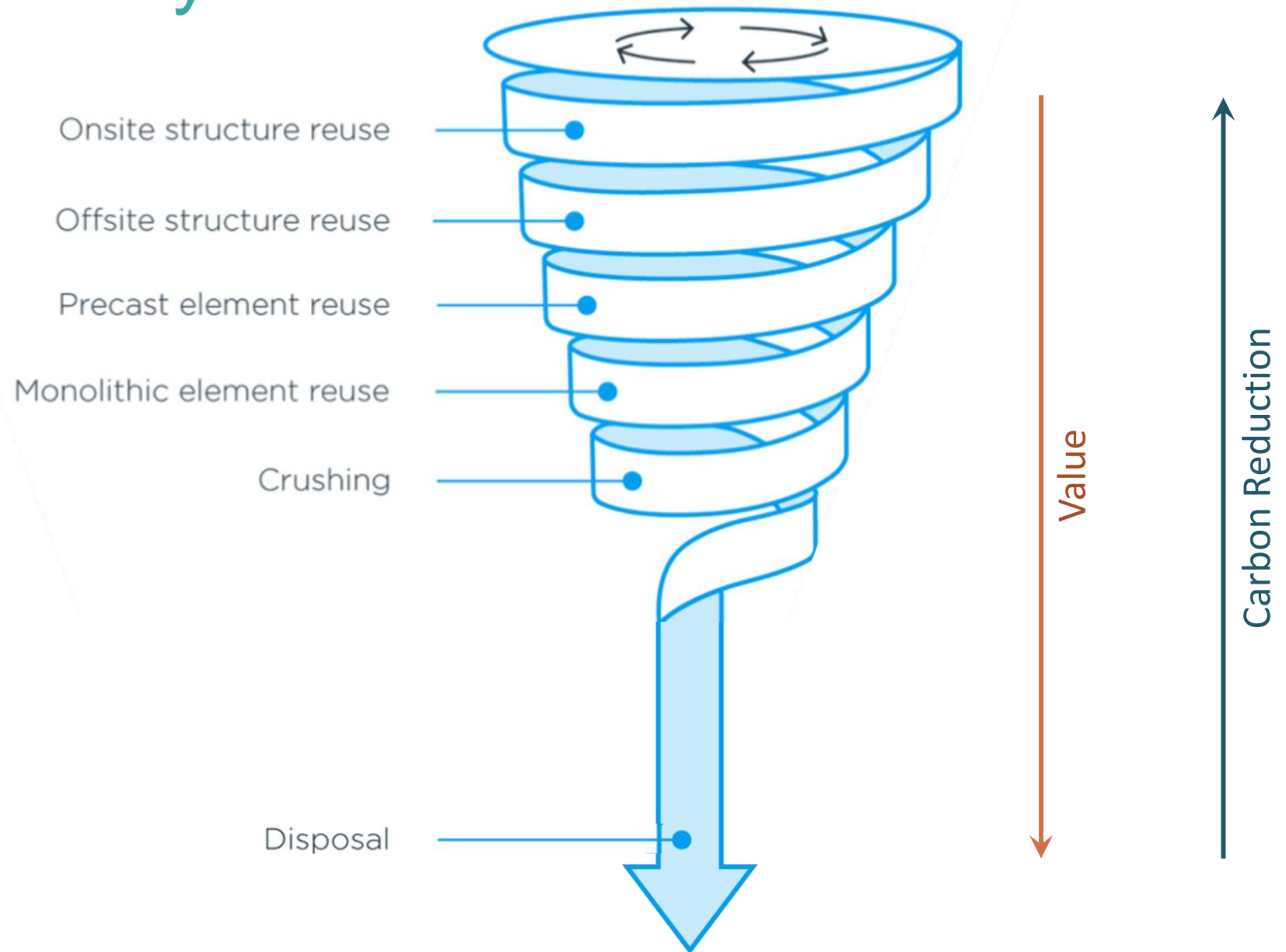
Incinerate

*(Recycle)*

Landfill



# Spiral Economy - Concrete



Sustainable → Attainable



# Attainable Design

- Consider the full life cycle
- Incorporate principles of resilience into your design
- Take advantage of engineered products/systems
  - structural & risk adaptive
- Reduce/Reuse/Recycle
- Diesel is money

# Envision Sustainability Program

Institute for Sustainable Infrastructure: AEC industry professionals committed to fostering sustainable, equitable, and resilient civil infrastructure

- ASCE
- ACEC
- APWA



Envision Sustainability Professional  
In-Person Workshop  
Tampa, FL – Oct 6<sup>th</sup>, 2024

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