Integrated Watershed Protection and the Carbon Link

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Biochar 2018 Conference
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Reversing Ecological Debt

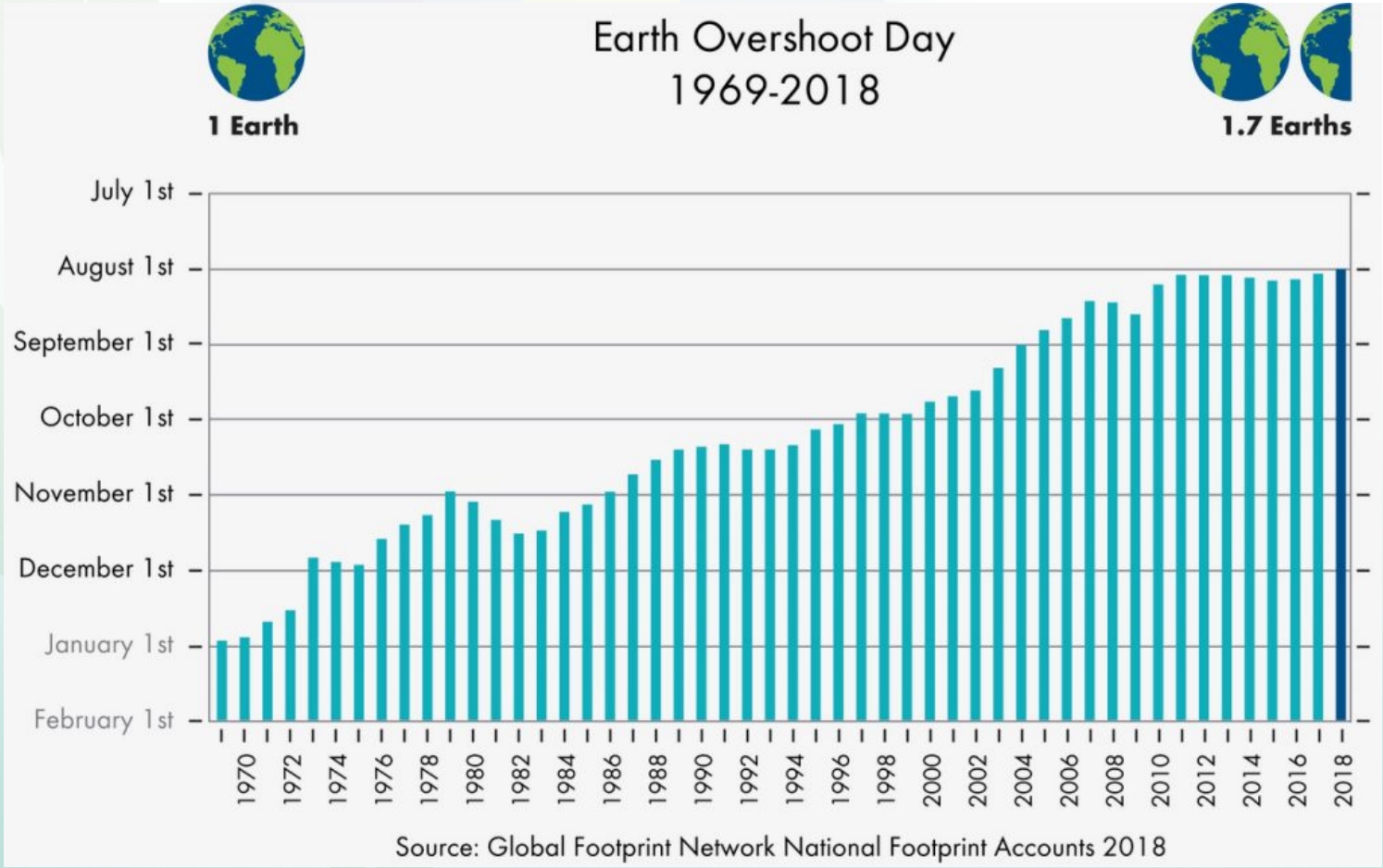
Moving to a Circular Economy

Earth Overshoot Day for 2018 Was August 1st

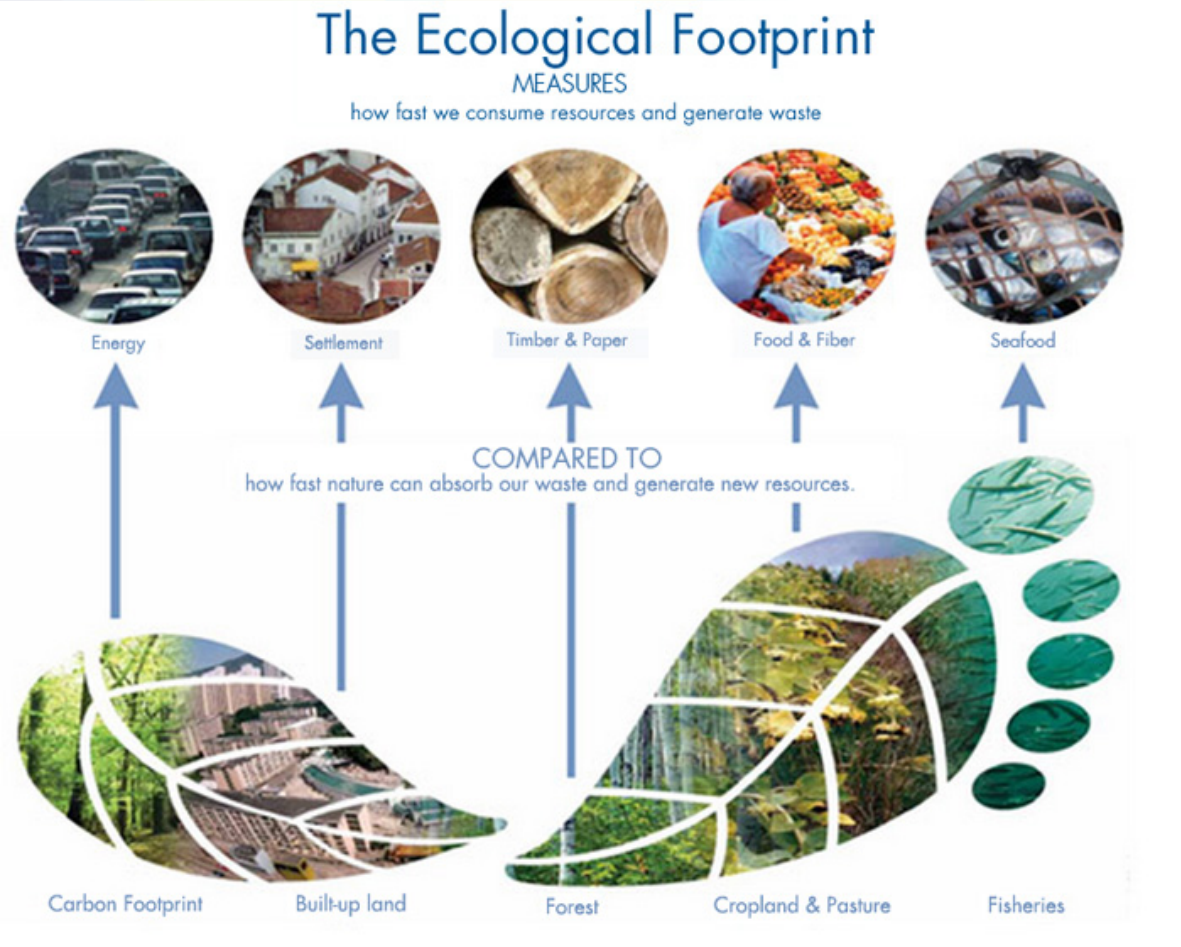
Earth Overshoot Day

More natural resources will have been used by that date than what the Earth can renew on its own within a year

EARTH'S REPORT CARD

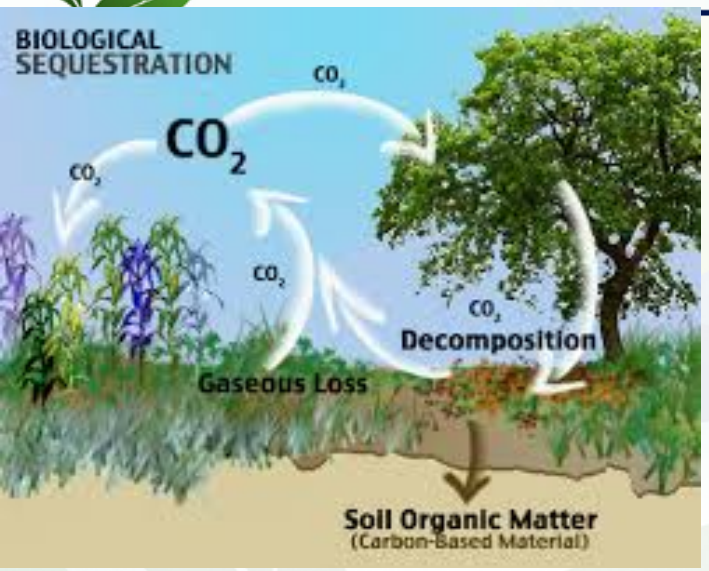


Ecological Debt



Global Footprint Network

Role of Carbon Sequestration in Reversing Ecological Impacts



Carbon sequestration refers to the capacity of agricultural lands and forests to remove carbon dioxide from the atmosphere in a manner that is not immediately remitted into the atmosphere.

FAO 2011

Carbon Sequestration as an Integral Part of Watershed Management

THREATS

- The world's watersheds face a wide variety of stresses that threaten to degrade their biological value and their ability to provide ecosystem services (World Resources Institute, 1998 and Millennium Ecosystem Assessment, 2005).
- Extreme weather events such as floods and droughts whose impacts especially depends on land use make communities both from upstream and downstream even more vulnerable.
- Degraded ecosystems are more sensitive to erosion and further degradation.

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Carbon Sequestration as an Integral Part of Watershed Management

SOLUTIONS

- **Heathy watersheds** provide multiple environmental, economic and social benefits.
- Adopting a **system of improved land and water management** based on an integrated approach to land resources development.
- **Healthy Soils/ Improved Carbon Balance** in soil important to sustainable agriculture and natural resources, e.g. watershed management, water management, drought management, sustainability of cropping systems, erosion control, flood risk management, water quality management and eco-tourism.

Carbon Sequestration as an Integral Part of Watershed Management

BIOCHAR – The "Environmental Superstar!"

Dr. Dorothy Hamill, NASA

Biochar is an organic charcoal that has an incredible range of environmental benefits - removing heavy metals from soils, enriching farmland, filtering groundwater, sequestering carbon from the carbon cycle that causes global warming..

BIOCHAR…

Our Motto…

It’s the Carbon Link to the Carbon Link!

What is Biochar?

- Carbon-rich solid produced by heating biomass in the absence of oxygen (pyrolysis)
- Residual product of bio-energy production
- Porous solid with a number of beneficial properties
- Properties depend upon feedstock, pyrolysis conditions and possibly modifications

Biochar & Activated Carbon

Both are excellent adsorbents!

Activated Carbon

Activated carbon is an adsorbent intended to remove something, typically organic compounds, from either vapor or liquid streams. It is produced through processes that increase the internal microporosity of the original carbon-rich source material.

ACTIVATED CARBON

- is porous, inexpensive and readily available for use as adsorbents, furnishing a large surface area to remove contaminants.

A teaspoon of activated carbon has more surface area than a football field.

Biochar Vs. Activated Carbon

Biochar - shares shares adsorption properties with activated carbon.

Biochar has a significant amount of ion exchange capacity, a property that is minimal or absent in traditional activated carbons.

Biochar is low density – as compared to higher density of AC. As soil amendment – provides **greater voidage, aeration, significant cation exchange capacity, and the ability to increase both nutrient uptake and soil fertility.**

Biochar needs 90% less energy to be produced than Activated Carbon!

	Biochar	Activated Carbon
Energy Demand	6.1 MJ/kg	97 MJ/kg
GHG emissions	- 0.9 Kg Co2e/kg	- 6.6 Kg Co2e/kg
Price	$5.00/kg	$5.50/kg

Finger Lakes Biochar

BIOCHAR IS A GREAT SOIL AMENDMENT!

The carbon in biochar is viewed as 'carbon-negative' –it will remain in the soil (and out of the atmosphere) for centuries or longer.

Why EPA and Biochar?

Biochar when used as a soil amendment

•Has beneficial and tunable remedial properties

•Can reduce exposure by limiting the exposure pathways and immobilizing contaminants

•Can help to restore soil quality and health

•Can enable site *in situ* remediation, re-vegetation and revitalization, and reuse

•Is a carbon negative material (i.e., removes CO2 from the atmosphere)

Biochar when used to remediate contaminated sites.

•Contaminated soils and sediments require remediation

•There are approximately 500,000 abandoned mines across the U.S. that pose a considerable and pervasive risk to human health

•Hundreds of thousands of acres of degraded soils across the U.S. that continued over-fertilization and overuse threatens air and water quality

Beneficial Uses of Biochar as a Soil Amendment

- **Improve soil water infiltration and water holding properties**
- **Soil rejuvenation**
  - Soil carbon addition
  - Refugia for microbes
- **Carbon sequestration**
  - Carbon negative soil amendment
- **Soil pH adjustment**
- **Increase and manage soil nutrient supply**
- **Reduce greenhouse gas emissions from soil**
- **Reduce exposure and movement of environmental contaminants - organic & inorganic**
  - Protecting water quality

Other Beneficial Uses of Biochar

- **Component of Green Roof Soil Mixtures**
  - Lightweight
  - High water holding capacity
  - Metal removal
- **Bioretention/Biofiltration**
  - Road or impervious surface runoff is diverted into engineered systems to flow through a planted bioretention media for treatment and infiltration into underlying soils
- ***In situ* Sediment Treatment**
  - Binds contaminants, reducing exposure
  - With or without mixing
- **Roadway Filter Strips**
  - Improve soil conditions along roadways
  - Remove pollutants in runoff before they enter waterways
- **Storm Water Filtration/Treatment**
  - Biochar filter beds remove metals and organics contained in storm water runoff

ACTIVATED CARBON – MARKET$$$

- World production = About 1 Million Tons/Yr
- Production primarily in Tropical and Asian countries.
- Majority of production is exported to North America and Europe for environmental and processing applications.

BIOCHAR MARKET$

The biochar marketplace has been steadily rising.

To date, few reliable suppliers of biochar products for market-scale demonstration.

However, rapid growth in biochar capacity and adoption is anticipated over the next decade.

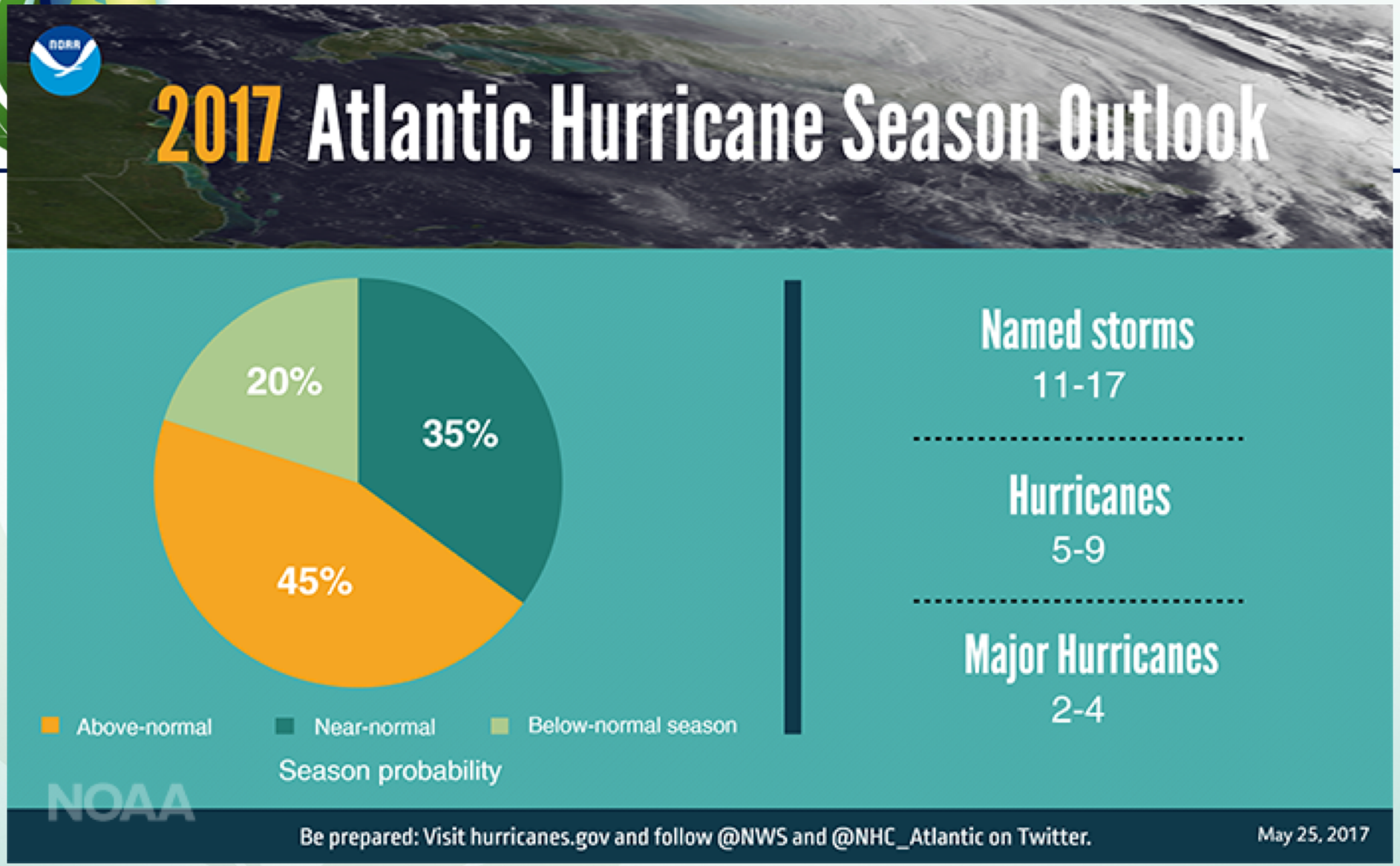
A Key Market Driver of Biochar Is Its Important Link to Waterhsed Sustainability & Resilience!

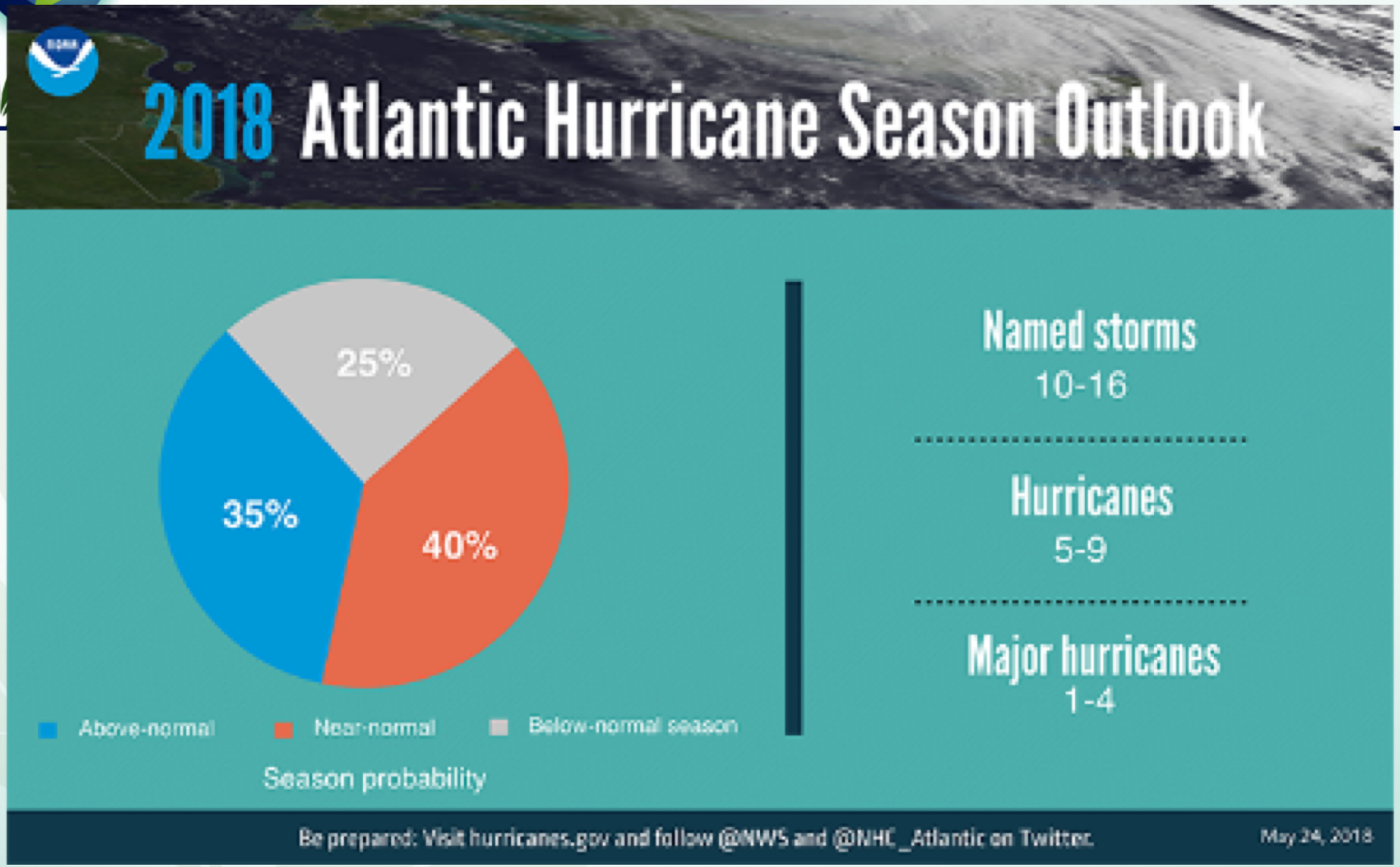
Introducing the "Smart Green Corridor"

Innovative and efficient designs, practices, technologies and development come together in a **smart, green corridor** to drive job creation, improve water and soil resources, and enhance community and economic value. These complimentary technologies amplify social and environmental benefits while lowering overall costs.

THINK "SMART-SHED"

WHY Smart Green Corridors?


2017 Atlantic Hurricane Season Outlook
20%
35%
45%
Above-normal
Near-normal
Below-normal season
Season probability
Named storms
11-17
Hurricanes
5-9
Major Hurricanes
2-4
NOAA
Be prepared: Visit hurricanes.gov and follow @NWS and @NHC_Atlantic on Twitter.
May 25, 2017


2018 Atlantic Hurricane Season Outlook
25%
35%
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Above-normal
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Season probability
Named storms
10-16
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5-9
Major hurricanes
1-4
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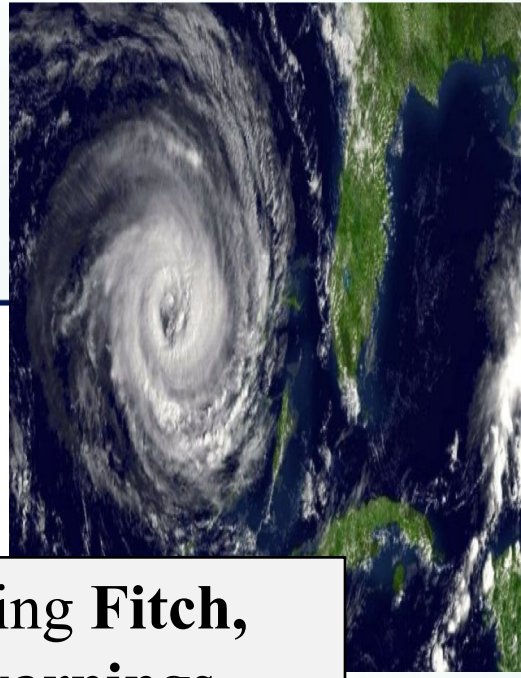
May 24, 2018

In 2017, Congress spent **$ 130 billion <u>more</u> <u>than it had allocated</u> to hurricane recovery in a year due to massive damage from Hurricanes Harvey, Maria and Irma.**



- In the past five years, credit ratings agencies including **Fitch, Moody's and Standard and Poor's have issued warnings.**
- **Downgrades make municipal bonds less attractive to investors and more expensive for communities.** Persistent flooding makes an area undesirable, and housing prices, along with the tax base, also stand to take a hit.

- **Agencies have already downgraded several cities,** including New Orleans; Galveston, Texas; and Toms River, N.J., "due to residual economic effects of major storms."

*John A. Miller University of Pennsylvania Credit Downgrade Threat as a Non-regulatory Driver for Flood Risk Mitigation and Sea Level Rise Adaptation," May, 2018, University of Pennsylvania

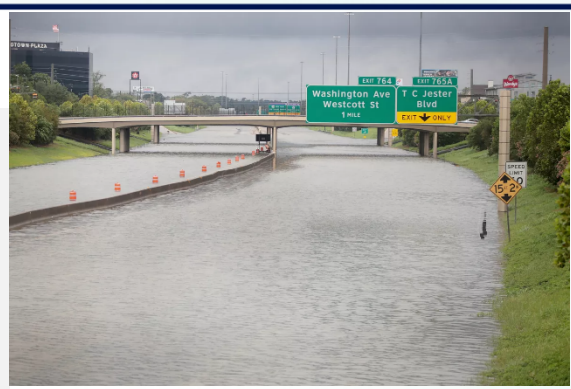
Credit Downgrade Threat as a Non-regulatory Driver for Flood Risk Mitigation and Sea Level Rise Adaptation for US Coastal Communities

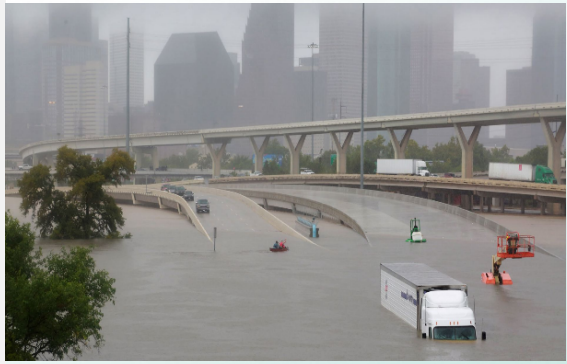
"If you're issuing a 30 to 40-year bond, your investors are already looking toward, say, 2050." By that time, more than 300,000 properties in the U.S. currently worth $136 billion could be rendered unusable by routine flooding…"*

*John A. Miller University of Pennsylvania Credit Downgrade Threat as a Non-regulatory Driver for Flood Risk Mitigation and Sea Level Rise Adaptation," May, 2018, University of Pennsylvania

Houston, Texas Flooding

- Hurricane Harvey
- 75 fatalities
- Major flood event on June 18, 2018
  - Received approximately 52 inches of rain
    - Most rain associated with one storm event in U.S. history
- Estimated to be 500-year storm event
- 203,000 homes damaged
- $125 billion in damages
- More damages than any other event other than Hurricane Katrina



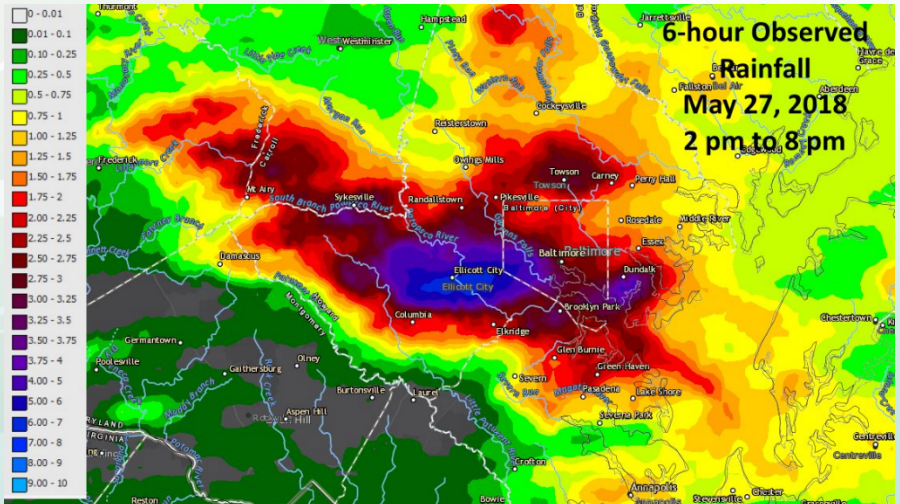


Ellicott City, Md. Flood Damage 2018

Damaged roadway

AP Photo/David McFadden

Flood waters in Ellicott City



Ellicott City, Md. Flood Damage 2016

Sidewalk washed away from store fronts

Jen Rynda / Baltimore Sun Media Group

Flooded cars in the Patapsco River

Amy Davis / Baltimore Sun

Houghton, Michigan – June, 2018

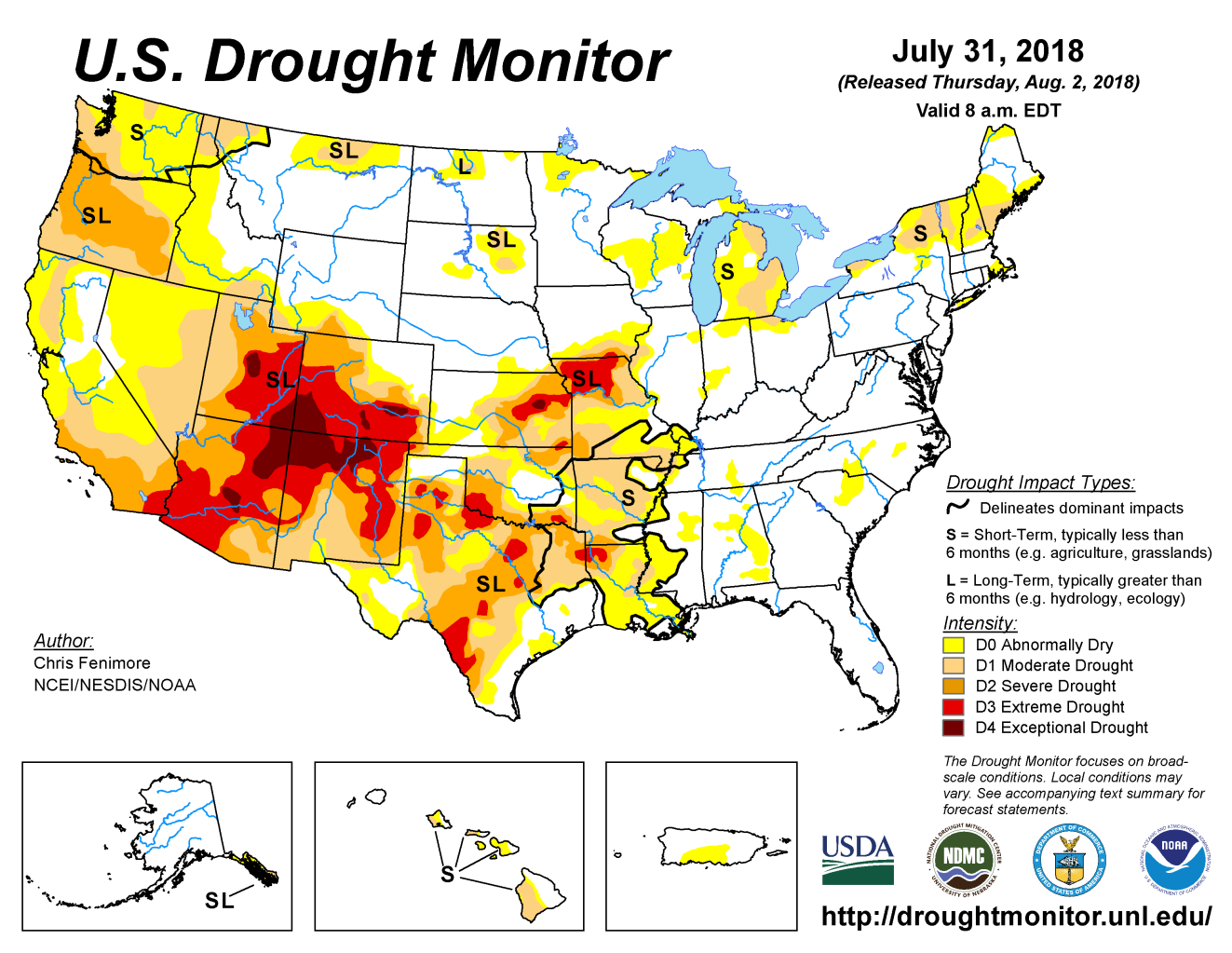
Source: WZZM

Source: The Detroit News

Source: Detroit Free Press

Source: The Detroit Free Press

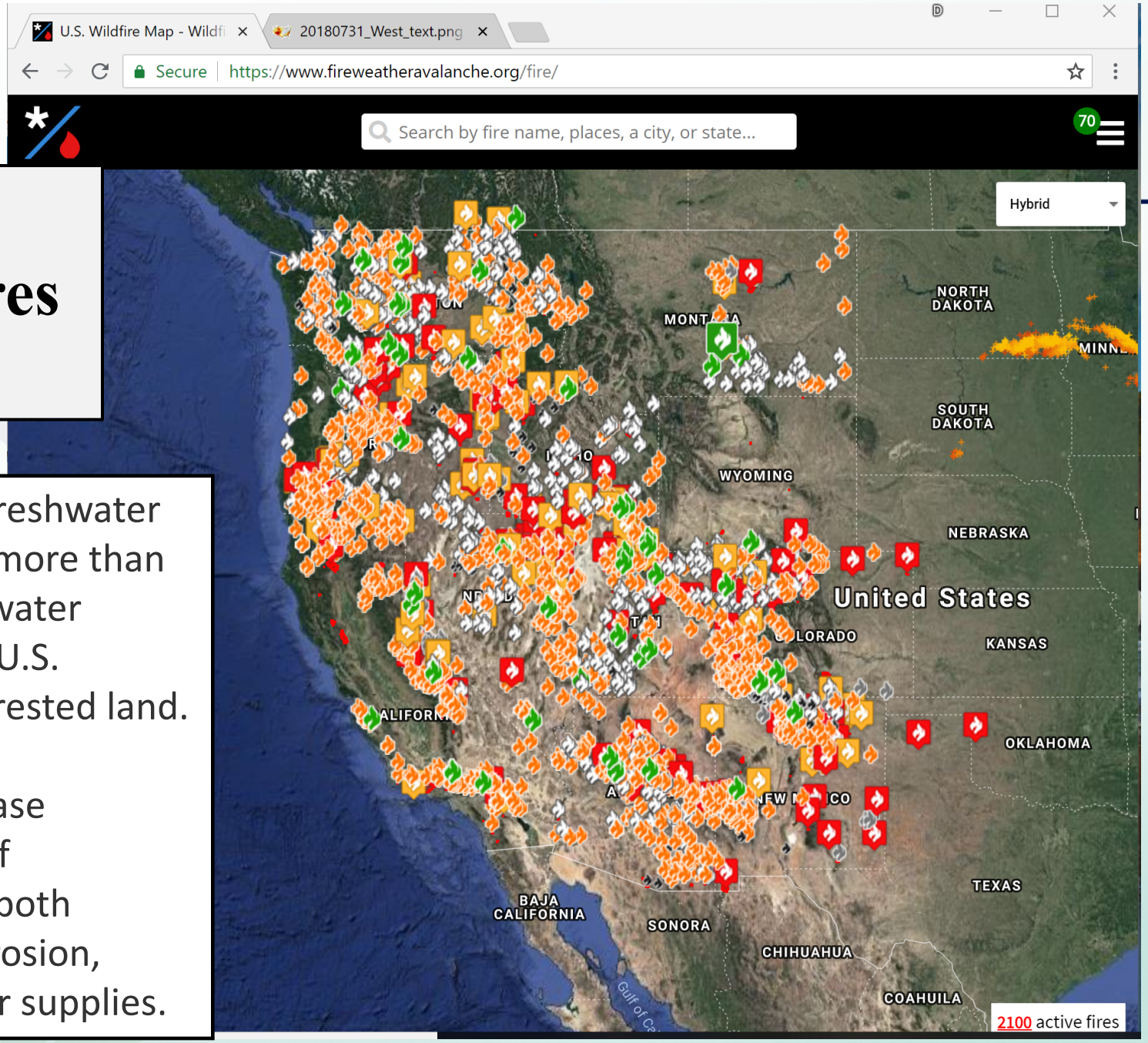
OTHER IMPACTS TO WATER/INFRASTRUCTURE CORRIDORS



US Wildfires 2918

80 percent of freshwater resources and more than 3400 drinking water systems in the U.S. originate on forested land.

Wildfires increase susceptibility of watersheds to both flooding and erosion, impairing water supplies.



Smart Green Corridor - Practices

Integrated Green Infrastructure & Water

- **Use watershed-driven systems.**
- **Integrate multiple techniques and technologies to treat water onsite.**
- **Reduce potable water use *by capturing, treating and storing stormwater* for reuse.**
- **Establish substantial tree canopy and riparian buffers.**
- **Use intelligent design and adaptive management tools and technologies.**
- **Incorporate long-term maintenance.**
- **Enhance community connectivity with nature.**

Biochar!

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Smart Green Corridor - Practices

Regenerative Landscapes and Ecosystems

- **Protect and support threatened and endangered species.**
- **Restore ecological function of existing natural systems.**
- **Ensure all green space provides multiple benefits.**
- **Pursue cradle-to-cradle uses.**
- **Maximize connectivity between residents and adjacent watershed resources.**
- **Partner with local schools and universities to integrate the educational opportunities.**

Smart Green Corridor- Practices

Renewable Energy

- **Develop the Corridor to be a renewable energy exporter.**
- **Use energy conservation.**
- **Use high performance building envelopes, solar and other renewable energy technologies.**
- **Use of net zero energy efficient technologies for WW and DW treatment.**
- **Waste-to-Energy – biogas and biochar production.**
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“Environmental Superstar!”

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BIOCHAR - The “DNA” of a SMART GREEN CORRIDOR!

BIOCHAR...

It's the Carbon Link to the Carbon Link!

Integrated Watershed Protection and the Carbon Link

Thank you!

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