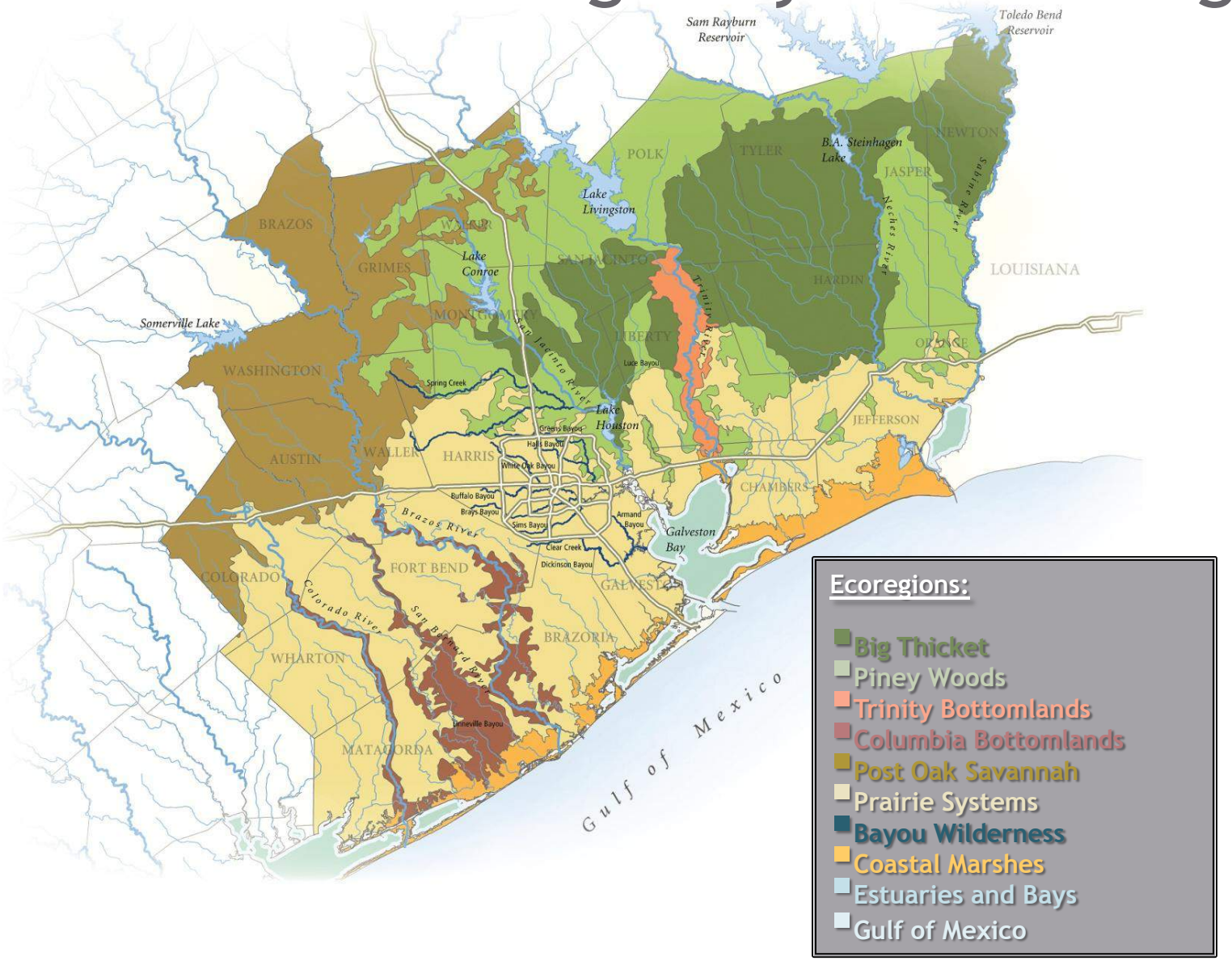
Ecosystem Services in the Greater Houston Region

A case study analysis and recommendations for policy initiatives

HOUSTON WILDERNESS
It's Our Nature

Houston is an Ecologically Diverse Region

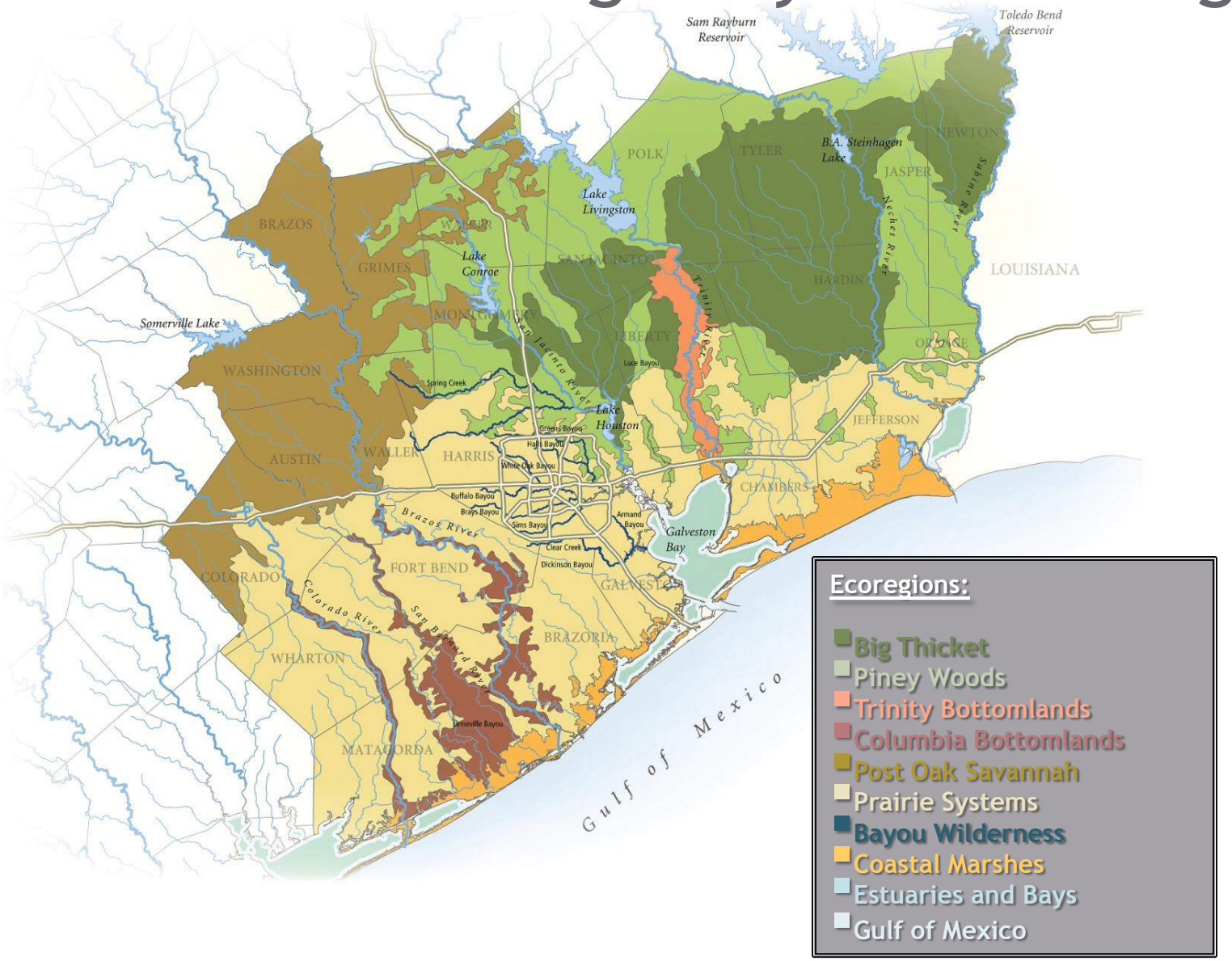


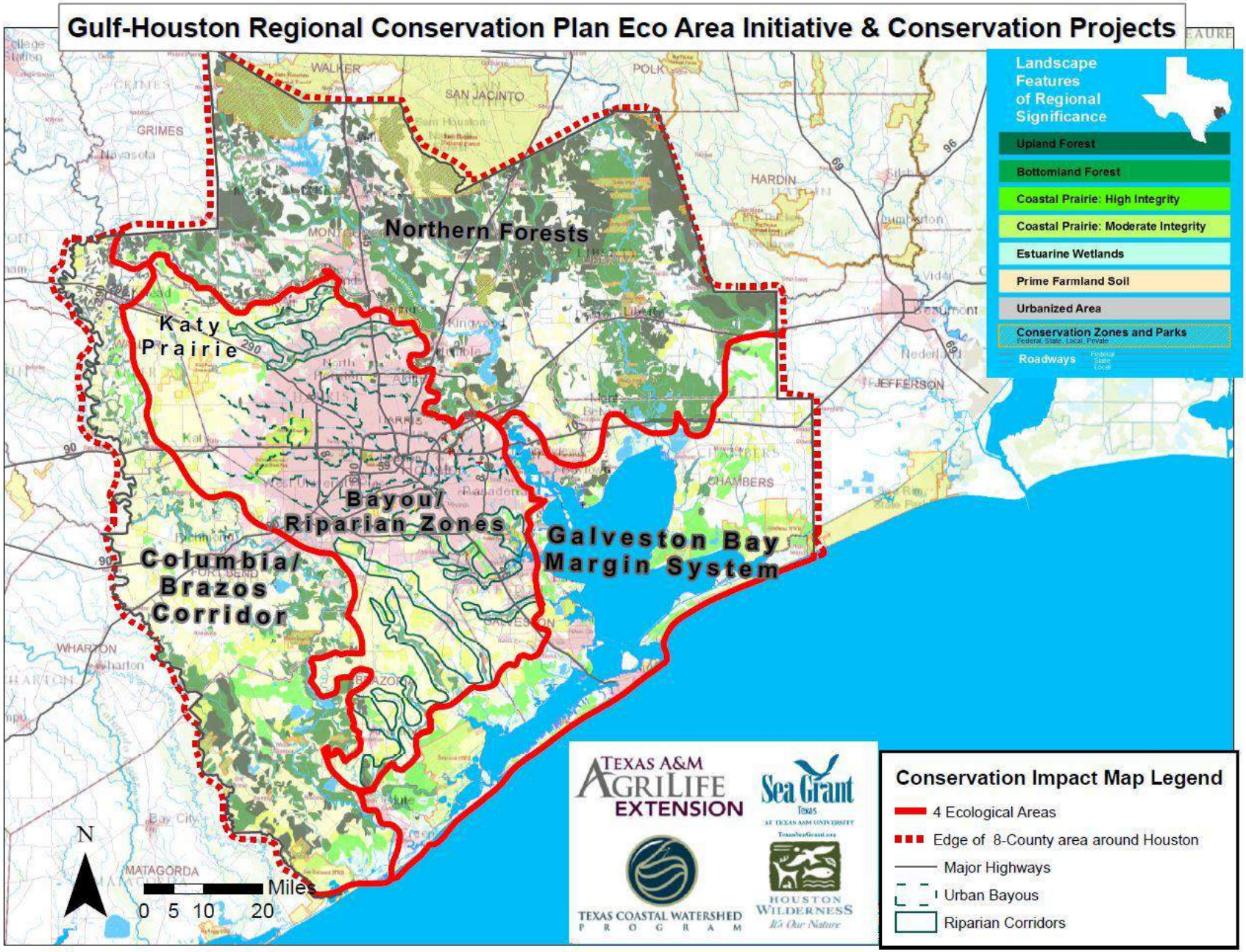
The 13+ County Region surrounding Houston has 10 distinct ecoregions

There are over 14 major bayous and creeks that run 40-miles each like fingers through the Houston Region and flanked by 3 major rivers

And, over 10 million people living around these ecoregions and waterways

Houston is an Ecologically Diverse Region




Gulf-Houston Regional Conservation Plan Eco Area Initiative & Conservation Projects
Landscape Features of Regional Significance
Upland Forest
Bottomland Forest
Coastal Prairie: High Integrity
Coastal Prairie: Moderate Integrity
Estuarine Wetlands
Prime Farmland Soil
Urbanized Area
Conservation Zones and Parks
Federal, State, Local, Private
Roadways
Federal
State
Local
Northern Forests
Katy Prairie
Bayou/ Riparian Zones
Columbia/ Brazos Corridor
Galveston Bay Margin System
WALKER
SAN JACINTO
POLK
GRIMES
HARDIN
JEFFERSON
CHAMBERS
WHARTON
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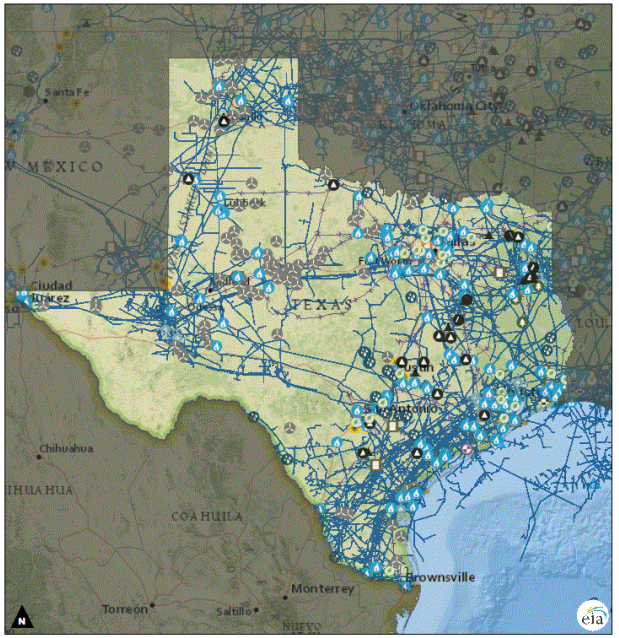
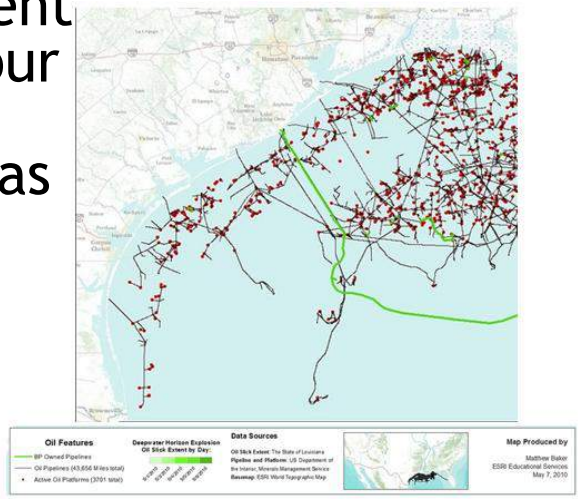
TEXAS A&M AGRILIFE EXTENSION
Sea Grant Texas
AT TEXAS A&M UNIVERSITY
TEXAS COASTAL WATERSHED PROGRAM
HOUSTON WILDERNESS
It's Our Nature
Conservation Impact Map Legend
4 Ecological Areas
Edge of 8-County area around Houston
Major Highways
Urban Bayous
Riparian Corridors

Gulf Coastal Wetlands Natural Capital, Protection for Energy

- Texas has 58,600 miles of pipeline, a significant portion residing in the coastal zone
- The broad protective swath of wetlands enabled the safe development of oil and gas architecture
- Wetlands are in different states of change and our coastal defenses need bolstering in some areas
- Restoring this natural protective defense is integral with energy security





Slide adapted from CH2M HILL. Images from EIA and Matthew Baker.

Ecosystem Function Vs. Service: The Frappuccino Example

Function

Service

http://weheartit.com/entry/177106938/via/starbucks, http://www.starbuckcoffee.net, http://www.huffingtonpost.ca/2014/03/17/water-and-weight-loss-_n_4979104.htm

Local Ecosystem Service Benefits

Wetlands and Estuaries

- 1. Recreation
- 2. Recharge aquifers
- 3. Flood prevention
- 4. Freshwater inflows to estuaries
- 5. Wildlife viewing
- 6. Carbon sequestration
- 7. Erosion control
- 8. Water quality improved

Prairies

- 1. Aesthetic beauty
- 2. Eco-tourism
- 3. Water supply
- 4. Decrease flooding
- 5. Biodiversity
- 6. Control soil erosion
- 7. Carbon sequestration
- 8. Avoided engineered system costs
- 9. Water quality

Forests

- 1. Recharge aquifer
- 2. Retains storm water
- 3. Eco-tourism
- 4. Adds aesthetics to city
- 5. Outdoor activities
- 6. Noise control, property values
- 7. Reduced health costs
- 8. Carbon sequestration
- 9. Reduced energy use/costs

Ecosystem Services provided by a coastal wetland marsh

1. Water Recreation & Fishing

2. Aquifer Recharge

3. Flood Prevention by slowing storm surge

4. Improved habitat for juvenile fishery species

5. Wildlife habitat and Ecotourism

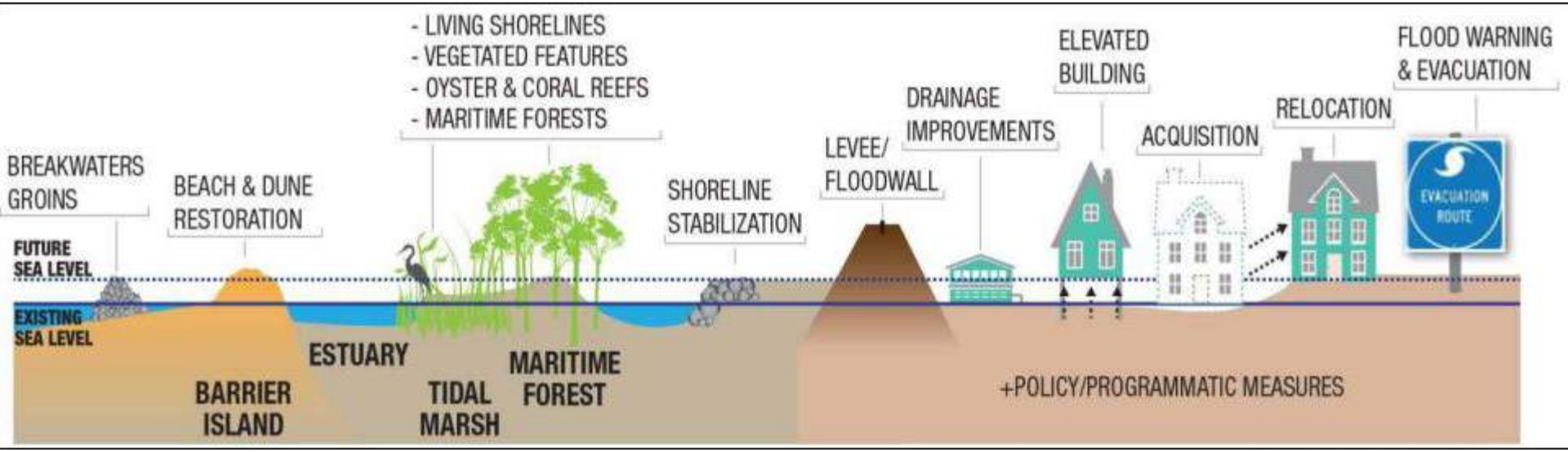
6. Carbon dioxide sequestration - reducing greenhouse gas air pollution

7. Erosion stabilizing of soil and roots system

8. Polluted water filtered through wetland grasses improving water quality

Integrated "Lines of Protection"

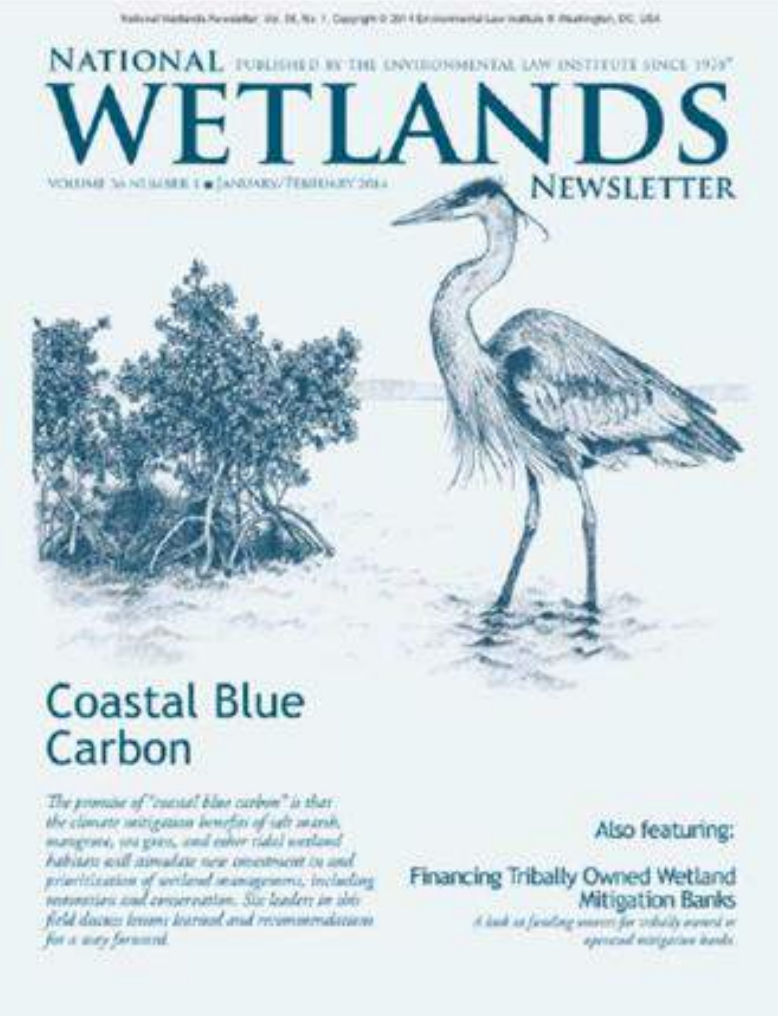
- Multiple Lines—combination of natural and structural features
- Increasing levels of protection from offshore to inshore



Slide adapted from GalvCorps, 2014 Coastal Protection & Restoration Project.

Blue Carbon

- Blue Carbon is opening paths for new revenue.
- Projects will be able to claim the benefits using carbon stocks.
- Wetlands are being explored as a sector.
- Verified Carbon Standard
- American Carbon Registry



Adapted from CH2M HILL

Ecosystem Services Provided by a Prairie

1. Aesthetic enhancement increasing property values

2. Increased wildlife habitat & ecotourism

3. Recharges groundwater

4. Flood control through Rainfall absorbtion by soil and plants

5. Provides seed bank for future agriculture and restoration projects

6. Roots prevent soil erosion

7. Absorption of carbon dioxide and other air pollutants

8. Replaces expensive drainage systems, retention ponds, and storm

9. Reduced runoff of pollution and nutrients into watersheds

Ecosystem Services Provided by a Forest

1. Cleaner water through root systems and recharges aquifers

2. Provides storm water retention

3. Provides habitat for wildlife and birds that people & ecotourism

4. Improved quality of life for residents

5. Provides outdoor recreational opportunities

6. Blocks noise coming from traveled roads, increasing property values

7. Improved air quality by absorbing city pollutants and greenhouse gases

8. Sequesters carbon

9. Reduced energy costs by shading buildings

http://jimolive.photoshelter.com/gallery-image/Memorial-Park/G0000tg7eebE3gkU/I0000tZ8P3.E6bbU/C0000wD6dE72H88s

Potential Reforestation Sites for Ozone Non-attainment Zones and NO_x Limited

- Reforestation of peri-urban lands could be a cost-competitive NO_x control approach in many other existing U.S. O_3 non-attainment areas.

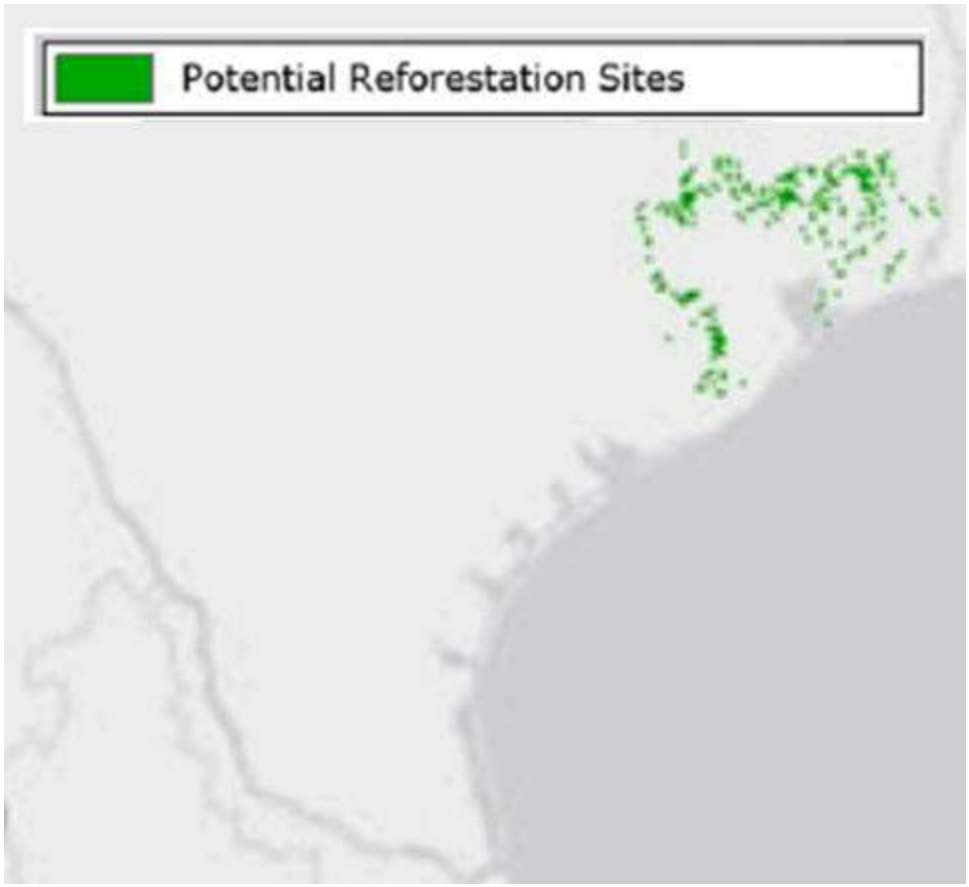


Image adapted from Kroeger et al., 2014 “Reforestation as a novel abatement and compliance measure for ground level ozone.”

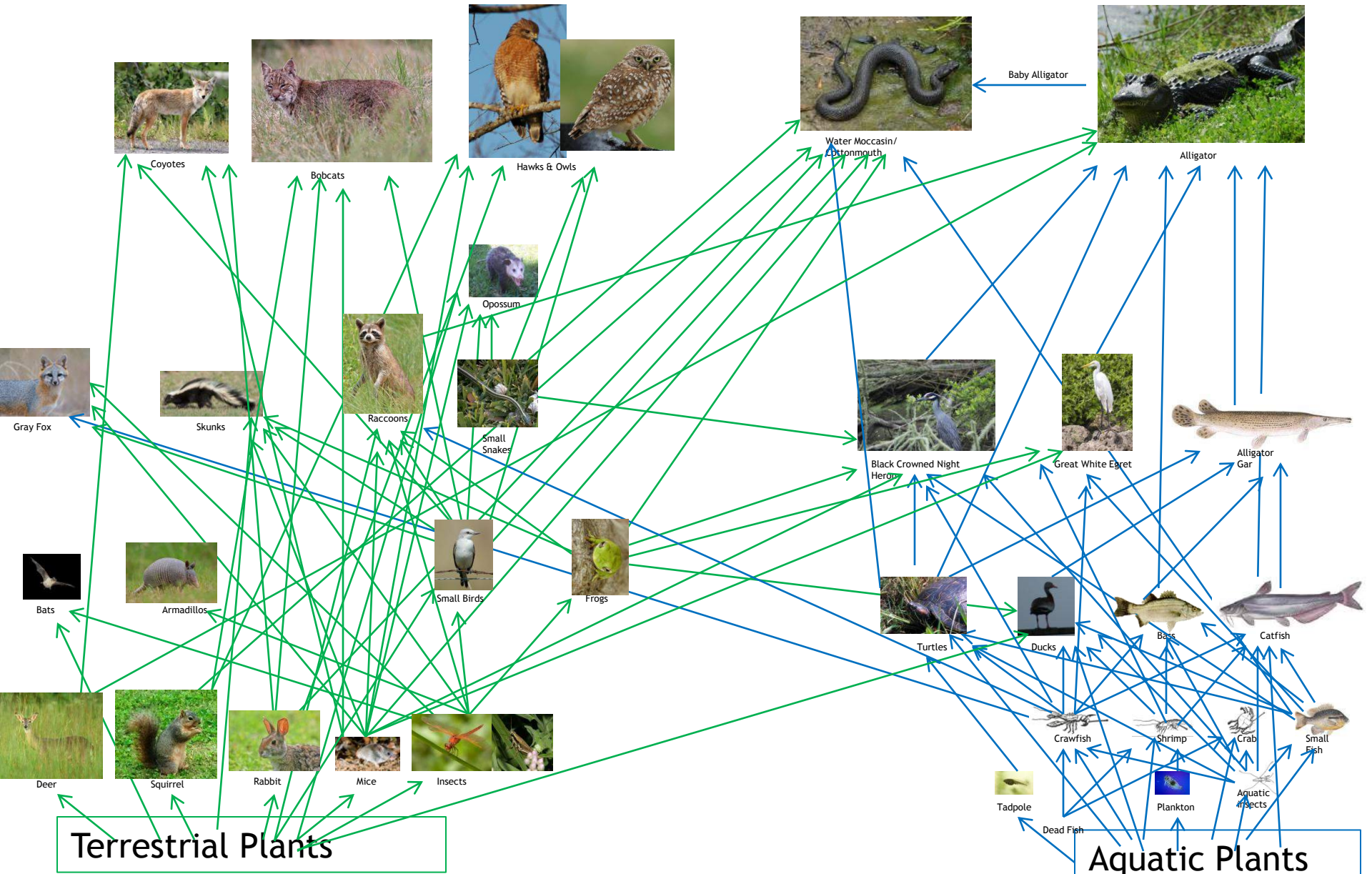
Services Provided by Local Ecosystems

	Water Supply	Water Quality	Erosion Control	Flood Protection	Air Quality	Energy Savings	Carbon Sequestration	Recreation/ Wildlife Habitat
Wetlands/ Estuaries	✓	✓		✓	✓		✓	✓
Prairies	✓	✓	✓	✓	✓		✓	✓
Forests	✓	✓	✓	✓	✓	✓	✓	✓

Realizing the true value of ecosystem services and the potential economic burden on the region if those services are compromised depends on local ecosystem services studies

When the tangible value of services is understood, policy decisions can be made that take into consideration all economic factors, including ecosystem services.

Houston's Bayous & Rivers Food Web



Ecosystem Service Policy Integration in Houston

Prairies

- Prairie land conservation and restoration is a way to control flooding in the Houston area
- Katy Prairie currently conducting infiltration study to show effectiveness of prairie system flood control
- Katy Prairie Conservancy studying drought resistant native prairie turf for yards

Bayous and Riparian Systems

- Harris County Flood Control District using bayous and associated green spaces as flood control measures
- Project Brays and Buffalo Bayou project both increasing flood water retention and green space
- Cypress Creek land use study currently being implemented: improve runoff quality affecting Lake Houston
- Riparian forests help control erosion
- Living along the bayou systems leads to increased property values

Coastal Wetlands and Oyster Reefs

- Texas Coastal Exchange designed to give value to the hurricane protection services provided by coastal wetlands and natural areas
- Oyster reef restoration creates surge buffer as well as boosts commercial oyster industry
- Oyster reefs improve water quality

Oyster reef photo: http://www.sustainablebrands.com/news_and_views/articles/dow-unilever-build-business-case-green-infrastructure

Urban Forests

- COH tree planting and protection ordinance, Chapter 33 COH Code of Ordinances
- Houston maintaining current Tree City USA designation
- Coastal woodlot conservation for migratory bird habitat attracts birders from around the world
- Tree planting initiatives increase property values

Gray v. Green Infrastructure

Gray Infrastructure

- Mechanical processes
- Man-made
- Facilities, buildings
- Artificial
- Complete a function

Green Infrastructure

- Naturally occurring processes
- Existing or engineered/ enhanced natural areas
- Ecosystem services
- Complete a function

Green infrastructure is the most direct way to include ecosystem services into development decisions

Case Studies on Ecosystem Services

- **Local:**
  - Project Brays
  - Dow Chemical- Seadrift
  - Texas Medical Center Prairie Project
- **National:**
  - Whole Farm Program- New York

Local Examples of Green Infrastructure

Project Brays

- Develop natural marshlands and green spaces along Brays Bayou
- Improve water quality and reduce the need for treatment
- Provide recreation and tourism opportunities for the community

Infrastructure need:
Water Quality, Water Quantity, Water Detention/Retention and Flood Control

Solution(s):
•Filtration and absorption of pollutants using wetland and prairie grasses
•Community recreational park

•**Cost to Construct:**
$3.2 Million

In 2008, the Brays Bayou Marsh at Mason Park, near the mouth of the bayou was completed.

http://www.projectbrays.org/about.html

Local Examples of Green Infrastructure

Dow Chemical- Seadrift, TX

- Engineered wetlands
- Reduce nutrient loads of effluent that caused the manufacturing facility to exceed discharge permit criteria
- Saved millions of dollars
- Improved habitat and aesthetics of the surrounding area
- Completely effective for over 15 years

Infrastructure need:
Water Quality, Water Detention/Retention
Soil Erosion and Reduce Nutrient Load

Solution:
- Reduction in suspended solids and balance of pH levels
- Provide wildlife habitat and aesthetic for surrounding community

- **Cost to Construct:** $1.4 Million

Dow Chemical- Valuing Nature

- Dow Chemical's Seadrift, Texas project to use reconstructed wetland for wastewater treatment has yielded more than $200 million in net present value.

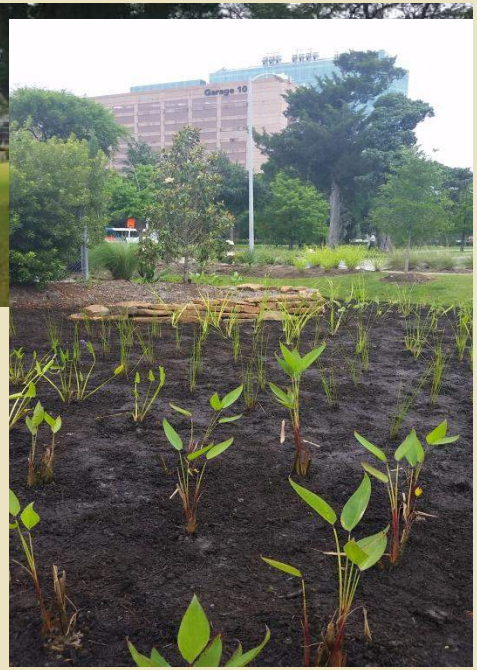
- The cost of construction for the wetland was $1.4 million and took 18 months to complete. The gray infrastructure alternative, a sequencing batch reactor, would have cost $40 million and taken 48 months to complete construction.

From Dow Chemical 2025 Sustainability Goals & DiMuro et al., 2014. "A Financial and Environmental Analysis of Constructed Wetlands for Industrial Wastewater Treatement.

Local Examples of Green Infrastructure

M.D. Anderson – The Prairie Project

- Developed prairie and wetland green spaces throughout the Texas Medical center
- Serves as a filter for storm water and reduces run off
- Provides a habitat for many species of wildlife
- Provides recreation opportunities for the patients, visitors and staff in the community



Infrastructure need: Water Quality, Water Detention/Retention, and Recreation
Solution: Reduction run off in the area, restored wildlife habitat and created recreation opportunities and stress reducing aesthetic for surrounding community
Cost to Construct: **$1 Million**

Green Infrastructure: New York City

Problem

- Water supply under threat from non-point sources of pollution
- Supply comes from large privately-owned, agricultural based watershed

Solution

- Created the Whole Farm Program:
  - Farmers create custom pollution control designs and implement themselves
  - Compensated for efforts, avoid regulatory enforcement

Results

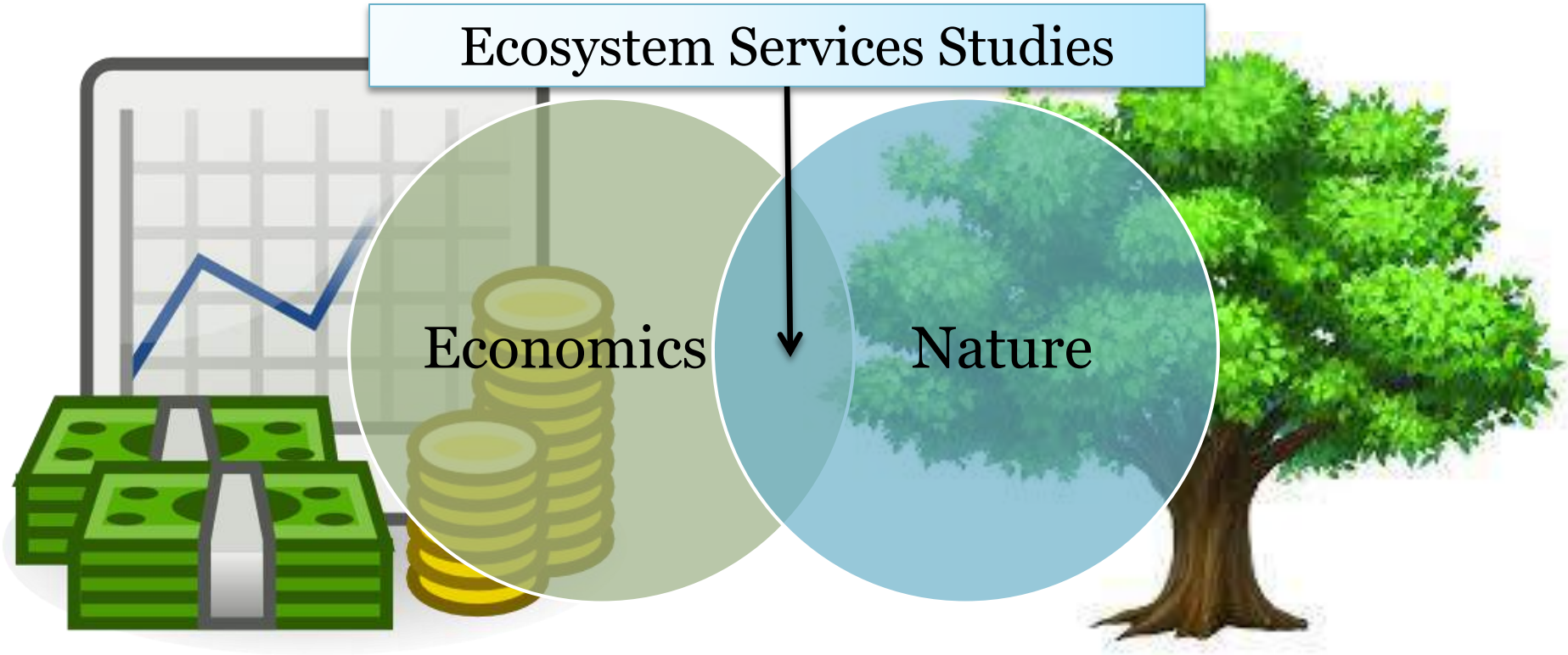
- Protected pristine water supply
- Avoided building treatment facilities
- Saved Billions of dollars

Implications

- Demonstrated importance of stakeholder engagement in protecting ecosystem services
- Voluntary/incentivized cooperation is proven to be most effective strategy

http://www.foodsystemsnyc.org/node/2193

Field of Ecosystem Services Studies



Understanding ecosystem services value allows for informed communication between scientists, industry, and policymakers regarding the benefits of ecosystems to human wellbeing.

http://www.clipartbest.com/cliparts/jcx/E9k/jcxE9kKgi.png

Millennium Ecosystem Assessment (MEA) Classification of Ecosystem Services

- ***Provisioning*** **– provides direct material and consumable benefits**
  - Food and fiber
  - Timber and minerals
  - Fuels
  - Medicinal resources
- ***Cultural Services*** **– provides direct social and spiritual benefits**
  - Recreation
  - Spiritual and historic
  - Science and education
- ***Regulating*** **– provides direct benefits to support and maintain control of ecosystems**
  - Climate regulation
  - Waste treatment
  - Water regulation
  - Nutrient regulation
- ***Supporting Services*** **– provides direct benefits to support and maintain control of ecosystems**
  - Primary production
  - Nutrient cycling
  - Water cycling

From Jim Lester

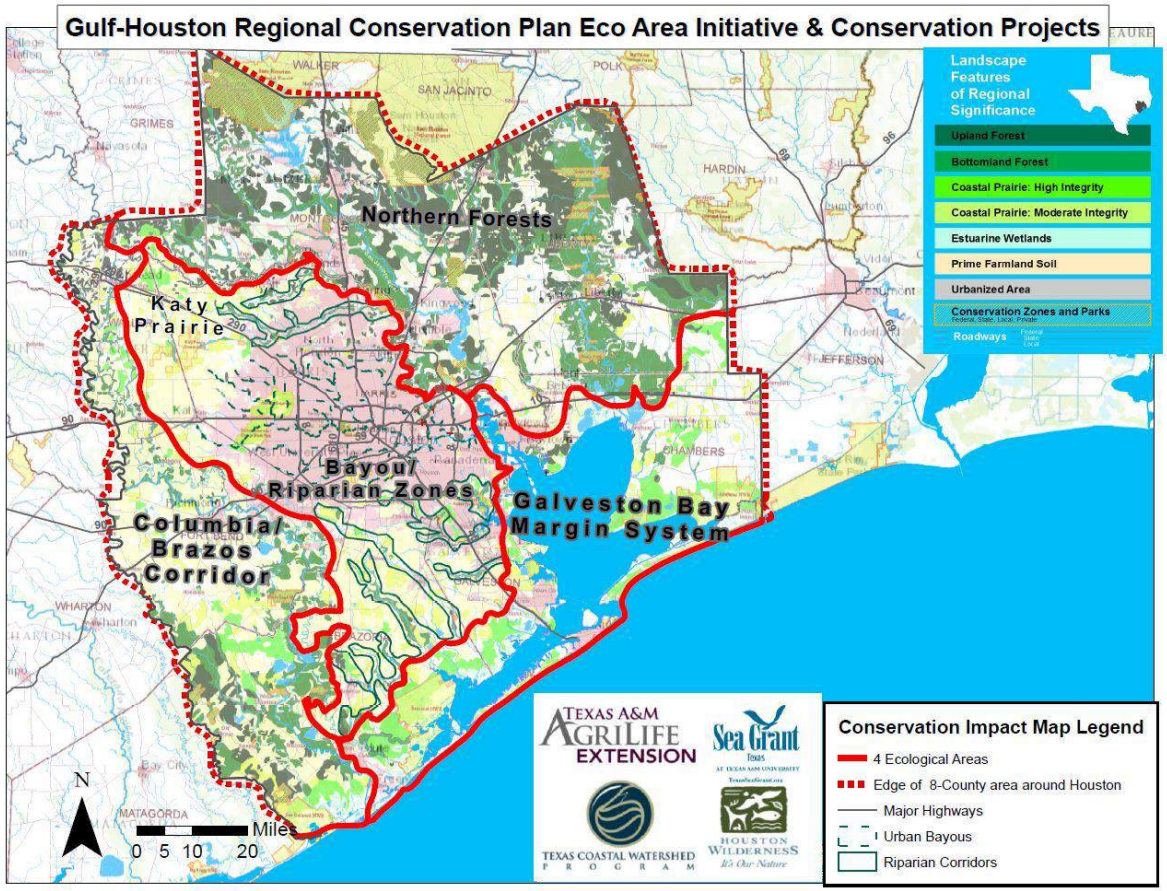
Ecosystem Services Valuation Methods

Ecosystem Services	Type of MEA	Direct/ Indirect Use and Nonuse	ESS Valuation Target Area	Option Value (future)	Method of Valuation	Approach Categories
Water Quality, Stormwater, Carbon Seq. , Erosion, Air Quality, Ecotourism	Regulating and Cultural	I/D	ESS Replacement Cost (development)	Yes	Avoided Cost (CBA); Replacement, Mitigation and Restoration	Direct Market
Water Quality, Air Quaility, Water Supply	Regulating	I	Existing Gray Vs. Green Equivalency Capacity)	No	Replacement Cost Methods(CBA)	Direct Market
Water Quality, Air Quality	Regulating	I	Statistical Analysis With water/air quality monitoring stations	Yes	Ecol. Production Function;Mitiga-tion /Restoration Cost	Onsite Valuation
Water Quality, Water Supply, Erosion, Storm Water	Regulating	I/D	Spatial large Scale (Valuation by area)(greenspace)	Yes	Ecol. Production Function; Mitiga-tion /Restoration Cost	Onsite Valuation, Direct Market
All	Regulating	I and I/D	Need to Build Something New;Gray vs. Green Infrastructure	Yes	Ecol. Production Function; Mitiga-tion /Restoration Cost	Onsite Valuation, Direct Market

Valuation Methods for Case Studies

- Project Brays
  - Onsite Valuation (Ecological Production Function Analysis)
  - Statistical Analysis
  - Avoided Cost Method
  - Mitigation/Restoration Cost Method
- Dow Chemical-Seadrift, TX
  - Replacement Cost Method vs. Restoration Cost Method
- M.D. Anderson Prairie
  - Mitigation or Restoration Cost Method
  - Group Valuation Method

The *Gulf-Houston Plan* contains two phases. Projects and initiatives in Phase One include **280,000 acres** of land acquisition, **15,000** acres in land easements and restoration, and development of over **250 recreational trail miles.**



Through policy intervention and green infrastructure, the city of Houston and the Greater Houston Region can:

- Improve the natural capital of the city
- Improve the economy by saving infrastructure funds
- Retain more long-term businesses and residents
- Attract more visitors and capital to the region
- Create jobs through restoration and green infrastructure
- Improve health of residents by improving air/water quality
- Reduce the risk of damage caused by flooding and natural disasters- lowering insurance rates, improving safety of residents and reducing damage costs to the city

Moving Forward

Recognition	• Provide more opportunities for regional recognition and support of the 10 unique ecoregions in the Greater Houston Region.
Studies	• Engage in more region-based studies and projects on ecosystem services to better understand natural benefits and the resulting understanding of cost-effective infrastructure solutions
Value	• Compare the economic value of *ecosystem services* to other alternative approaches when making public policy decisions regarding land-use and infrastructure.
Integration	• Incorporate ecosystem services into infrastructure decisions.

Thank you!

Deborah January-Bevers

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More information:

www.houstonwilderness.org

HOUSTON WILDERNESS

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