



# Can Stormwater Management Co- Exist with Wetland Restoration?

## Yes!

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Senior Biologist

Senior Principal - Ecology



## Challenges:

- Construct Effective Stormwater Treatment
- Create Wetlands That Provide a Range of Functions and Values
- Manage Maintenance Activities
- Meet Restoration/Compensation Goals



# Potential Wetland Functions and Values

1. Groundwater Recharge/Discharge
2. Flood Flow Alteration
2. Wildlife Habitat
3. Sediment/Toxicant/Pathogen Retention
4. Nutrient Removal/Retention/Transformation
5. Educational/Scientific Value



# Stormwater Management Goals

## 1. Remove Nutrients

Nitrogen, Phosphorus and Potassium

## 2. Remove Suspended Solids

Sediment and Other Particulates

## 3. Reduce Flow Volume and Velocity

Non-Erosive

No Increase in Downstream Flooding



# Study Sites

1. Five Sites Located in Eastern Virginia
2. Constructed Between 1993 and 2003
3. Owned and Managed By Municipal and Private Entities

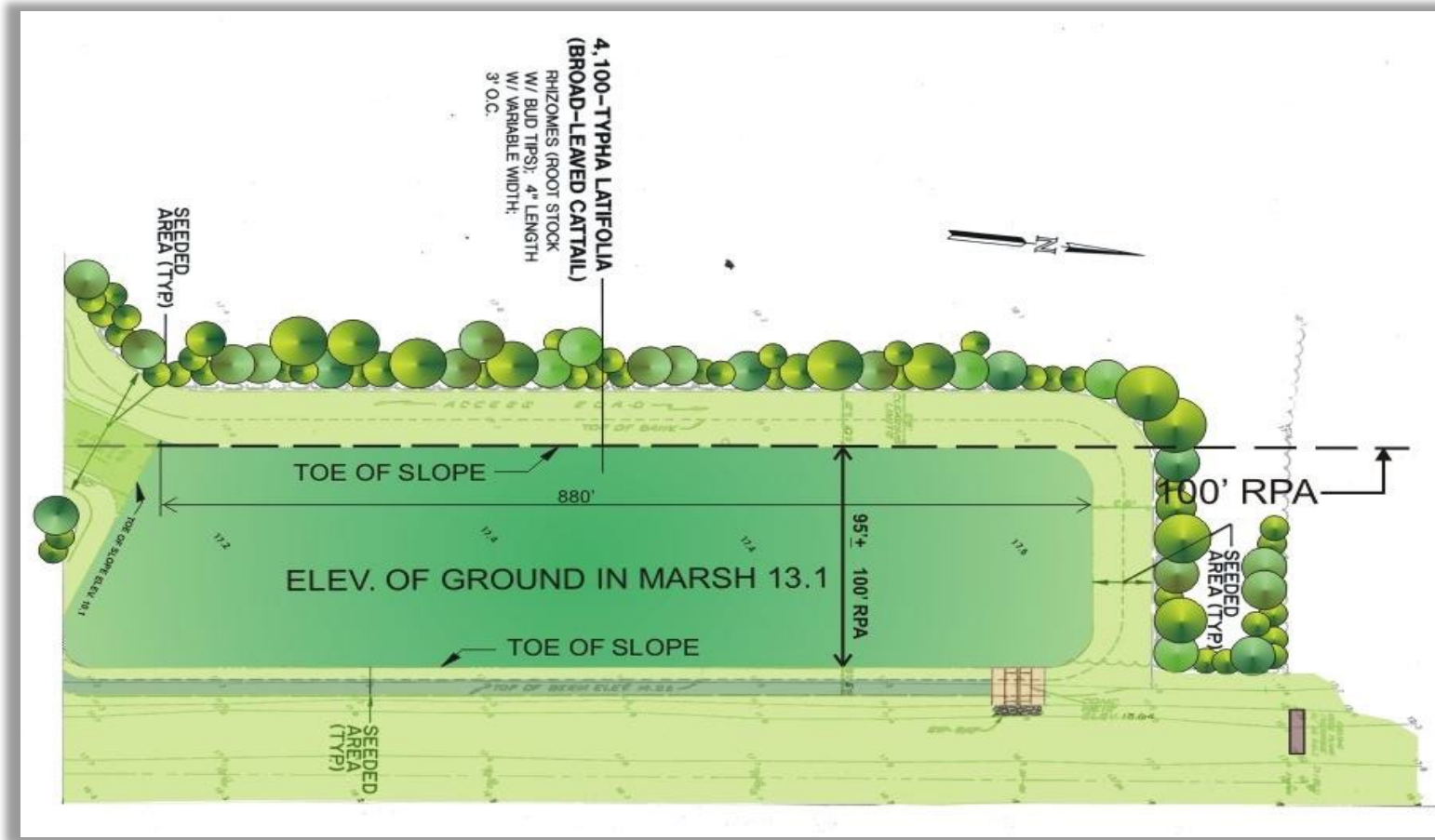
# SITE LOCATIONS



## CITY OF HAMPTON 1993

- 1.0 Acre Forested Wetland Compensation
- Includes Forebay
- One Planted Species (Corps Recommended)
  - Typha latifolia-broad leaved cattail
- Treats University Parking and Building Runoff

# CITY OF HAMPTON 1993 – SITE MAP





# CITY OF HAMPTON 1993 – CURRENT SPECIES LIST

BOTANICAL NAME	COMMON NAME	PLANTED	COLINIZER
<b>TREES</b>			
<i>Acer rubrum</i>	red maple		X
<i>BetulaNigra</i>	river birch		X
<i>Liquidambar styraciflua</i>	sweet gum		X
<i>Nyssa sylvatica</i>	black gum		X
<i>Taxodium distichum</i>	bald cyprus		X
<b>SHRUBS</b>			
<i>Alnus serrulata</i>	common alder		X
<i>Cephalanthus occidentalis</i>	buttonbush		X
<i>Magnolia virginiana</i>	sweetbay magnolia		X
<i>Morella cerifera</i>	wax myrtle		X
<i>Vaccinium corymbosum</i>	highbush blueberry		X
<b>HERBACEOUS EMERGENT PLANTS</b>			
<i>Boehmeria cylindrica</i>	smallspike false nettle		X
<i>Eichhornia crassipes</i>	common water hyacinth		X
<i>Galium tinctorium</i>	stiff marsh bedstraw		X
<i>Juncus effusus</i>	soft rush		X
<i>Juncus sp.</i>	rush		X
<i>Leeria virginica</i>	rice cut grass		X
<i>Ludwigia sp.</i>	primrose-willow		X
<i>Mikania scandens</i>	climbing hempvine		X
<i>Nuphar lutea</i>	yellow pond-lily		X
<i>Polygonum sagittatum</i>	arrowleaf tearthumb		X
<i>Rhexia mariana</i>	MD meadowbeauty		X
<i>Scirpus cyperinus</i>	wool grass		X
<i>Typha latifolia</i>	broadleaf cattail	X	



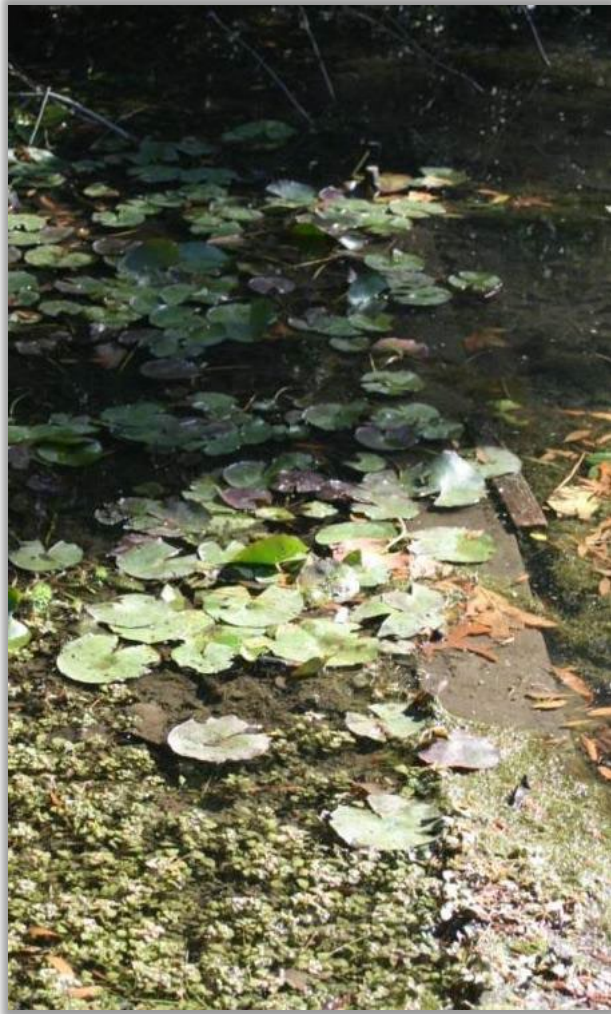
# CITY OF HAMPTON 1993 – 10<sup>th</sup> Yr SITE PHOTOS





# CITY OF HAMPTON 1993 – 10<sup>th</sup> Yr SITE PHOTOS

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JOHN LOWENTHAL | MAY 12TH, 2026 | 02:45 - 03:15P



# CITY OF HAMPTON 1993 – 18<sup>th</sup> Yr SITE PHOTOS

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# CITY OF HAMPTON 1993 – 33<sup>rd</sup> Yr SITE PHOTOS

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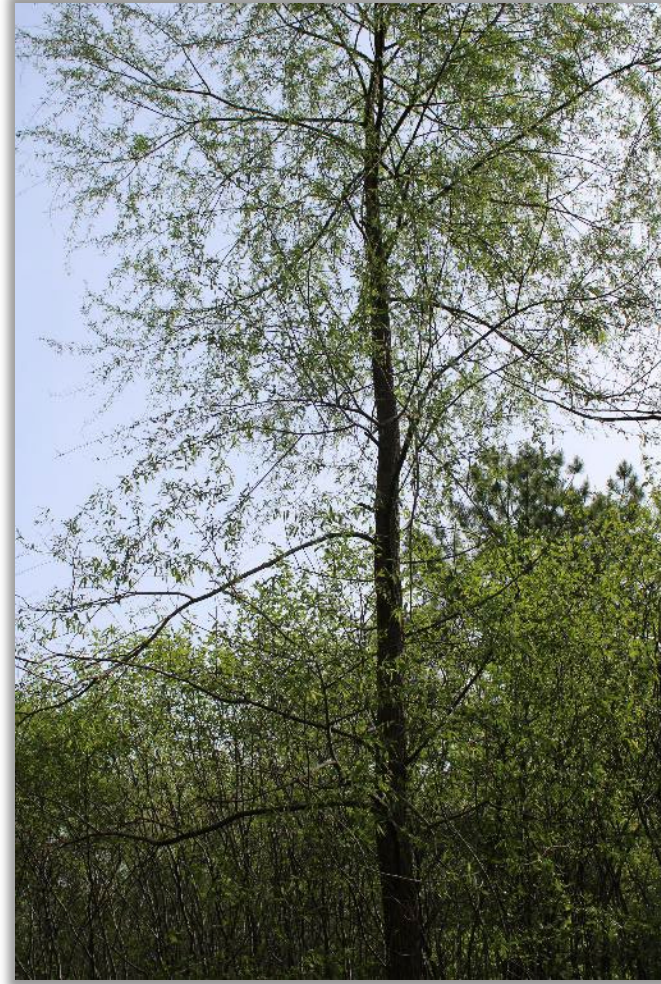
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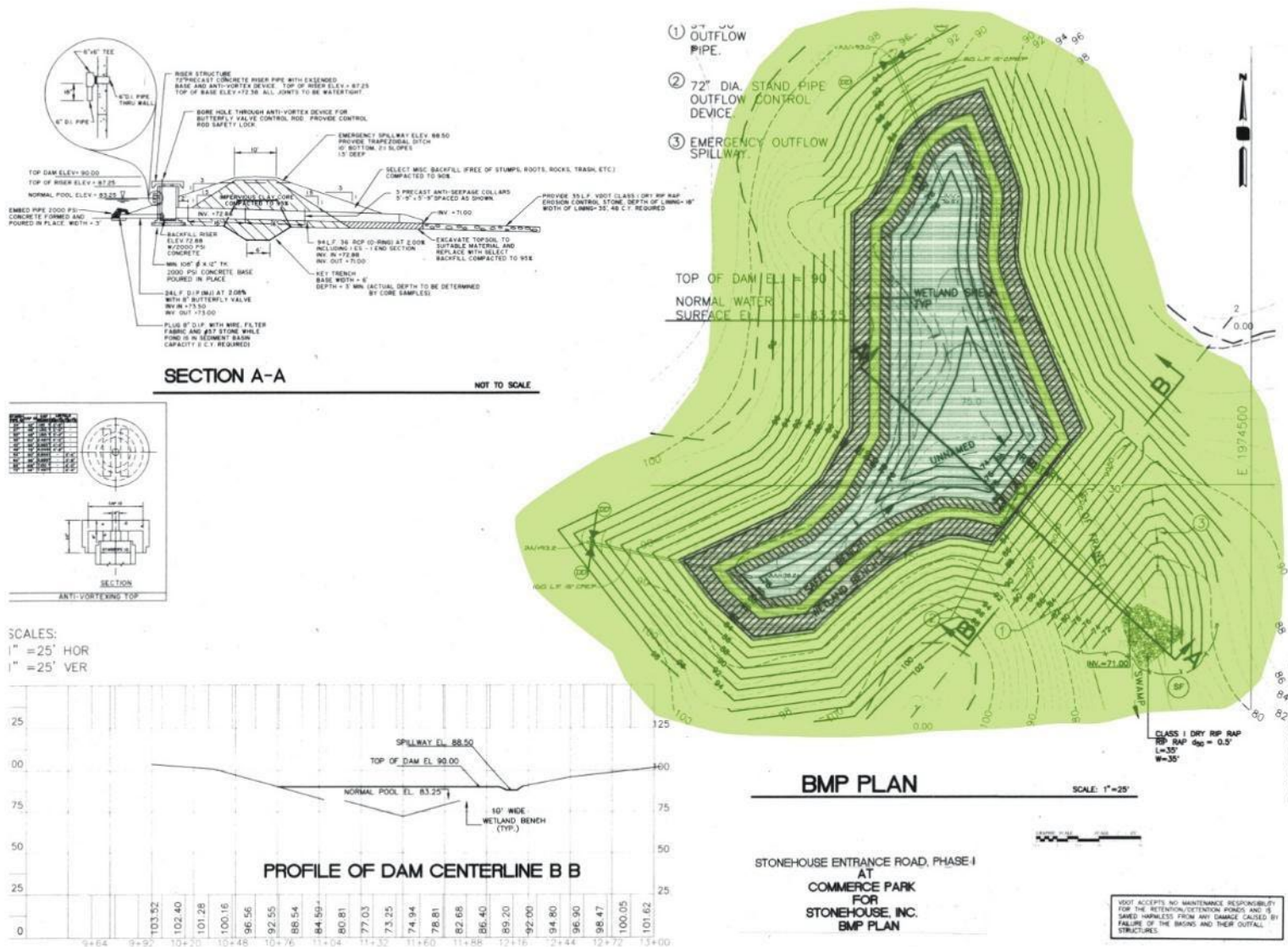




# JAMES CITY COUNTY 1995

- Wetland Bench
- 1/3 Acre Scrub-Shrub/Forested Compensation
- Beaver Impact
- Treats Industrial/Commercial Parking and Building Runoff

# JAMES CITY COUNTY 1995 - SITE MAP





# JAMES CITY COUNTY 1995 – SPECIES LIST

BOTANICAL NAME	COMMON NAME	PLANTED	COLINIZER
<i>Boehmeria cylindrica</i>	smallspike false nettle		X
<i>Carex lupulina</i>	hop sedge		X
<i>Echinochlea crus-galli</i>	barnyard grass		X
<i>Leersia virginica</i>	whitegrass		X
<i>Microsteqium vimineum</i>	Nepalese browntop		X
<i>Mikania scandens</i>	climbing hempvine		X
<i>Polygonum cespitosum var. longisetum</i>	oriental lady's thumb		X
<i>Scirpus cyperinus</i>	woolgrass		X
<i>Solidago rugosa</i>	wrinkleleaf goldenrod		X
<i>Typha latifolia</i>	broadleaf cattail		X
<i>Salix Nigra</i>	black willow		X
<i>Acer rubrum</i>	red maple		X



# JAMES CITY COUNTY 1995 - 10<sup>th</sup> Yr SITE PHOTOS

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# JAMES CITY COUNTY 1995 – 10<sup>th</sup> Yr SITE PHOTOS





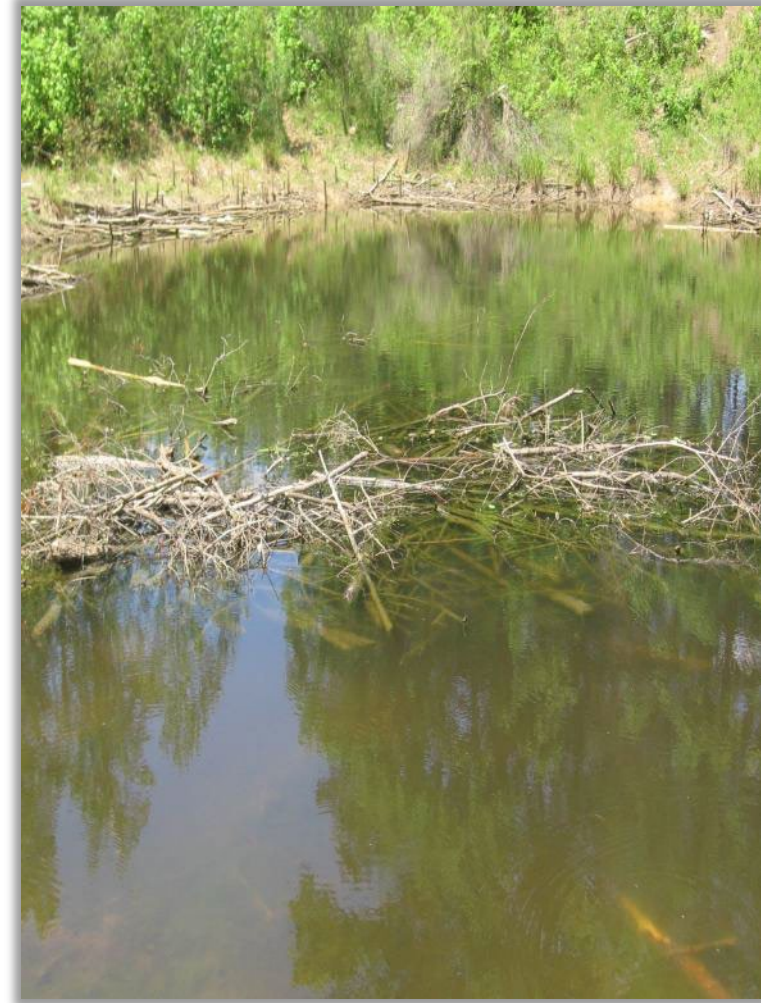
# JAMES CITY COUNTY 1995 - 16<sup>th</sup> Yr SITE PHOTOS

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# JAMES CITY COUNTY 1995 - 16<sup>th</sup> Yr SITE PHOTOS





# JAMES CITY COUNTY 1995 - 31<sup>st</sup> Yr SITE PHOTOS

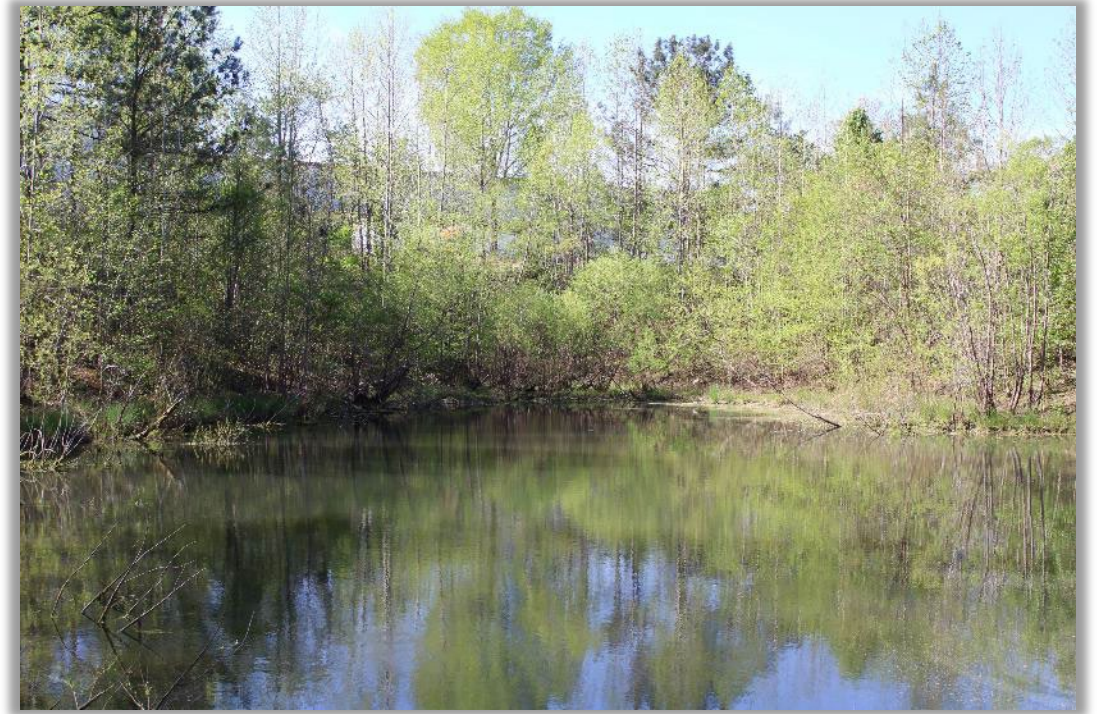
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# JAMES CITY COUNTY 1995 - 31<sup>st</sup> Yr SITE PHOTOS

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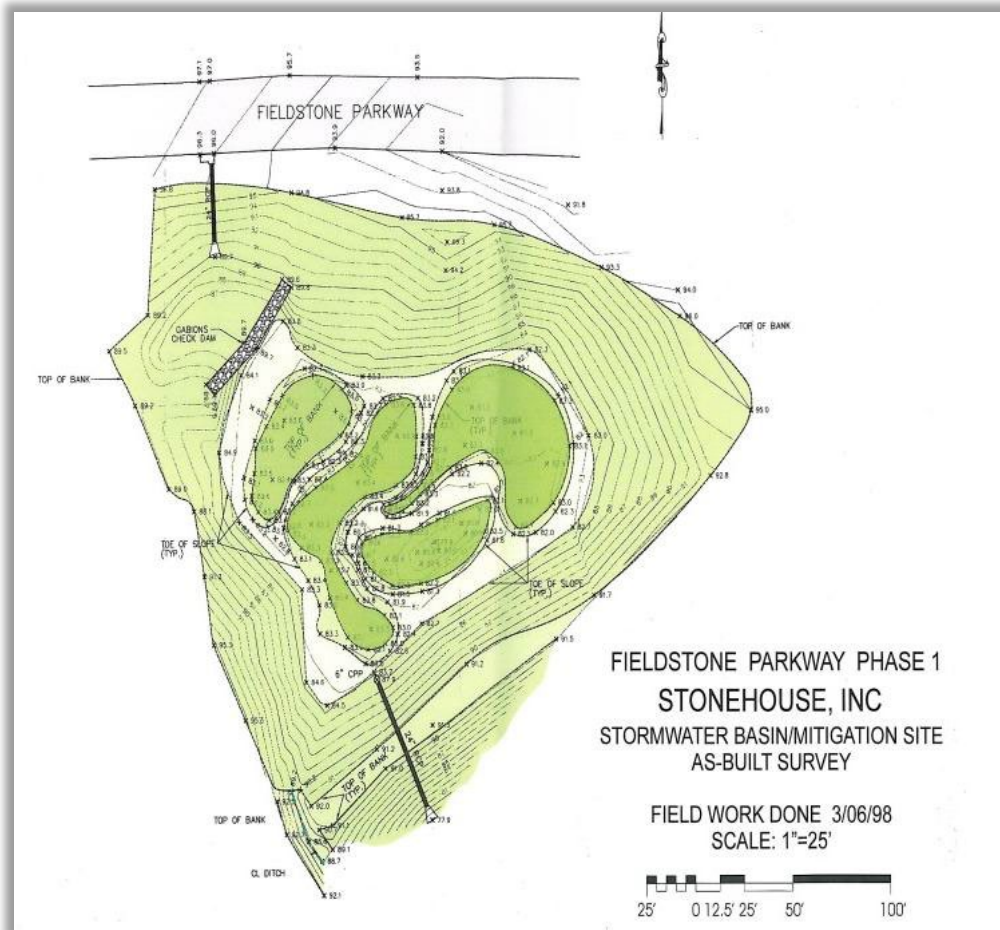




# JAMES CITY COUNTY 1998

- 1.0 Acre Forested Wetland Mitigation
- Includes Forebay
- Designed as Entrance Feature
- Treats Roadway Runoff
- Management Issues

# JAMES CITY COUNTY 1998 – SITE MAP





# JAMES CITY COUNTY 1998 – SPECIES LIST

BOTANICAL NAME	COMMON NAME	PLANTED	COLINIZER
<b>TREES</b>			
<i>Acer rubrum</i>	red maple	X	
<i>Chamaelirium thyoides</i>	atlantic white cedar	X	
<i>Fraxinus americana</i>	white ash		X
<i>Ilex opaca</i>	american holly	X	
<i>Liquidambar styraciflua</i>	sweet gum	X	
<i>Liriodendron tulipifera</i>	tuliptree	X	
<i>Nyssa aquatica</i>	swamp tupelo	X	
<i>Nyssa sylvatica</i>	black gum	X	
<i>Platanus occidentalis</i>	american sycamore		X
<b><i>Quercus alba</i></b>	<b>white oak</b>	<b>0</b>	
<b><i>Quercus coccinea</i></b>	<b>scarlet oak</b>	<b>0</b>	
<b><i>Quercus rubra</i></b>	<b>red oak</b>	<b>0</b>	
<i>Taxodium distichum</i>	bald cypress		X
<b>SHRUBS</b>			
<i>Baccharis halimifolia</i>	groundsel tree		X
<i>Callicarpa americana</i>	american beautyberry	X	
<i>Cephalanthus occidentalis</i>	common buttonbush		X
<i>Clethra alnifolia</i>	sweet pepperbush	X	
<i>Hibiscus moscheutos</i>	marsh hibiscus	X	
<i>Rhododendron viscosum</i>	swamp azalea	X	
<i>Vaccinium corymbosum</i>	highbush blueberry	X	

BOTANICAL NAME	COMMON NAME	PLANTED	COLINIZER
<b>HERBACEOUS EMERGENT PLANTS</b>			
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem		X
<i>Boehmeria cylindrica</i>	smallspike false nettle		X
<i>Commelina communis</i>	Asiatic dayflower		X
<i>Cyperus iria</i>	ricefield flatsedge		X
<i>Cyperus odoratus</i>	fragrant flatsedge		X
<i>Eupatorium capillifolium</i>	dogfennel		X
<i>Euthamia granifolia</i>	flat-top goldenrod		X
<i>Hibiscus laevis</i>	halberdleaf rosemallow		X
<i>Iris pseudacorus</i>	yellow flag iris	X	
<i>Juncus effusus</i>	common rush		X
<i>Laersia oryzoides</i>	rice cutgrass		X
<i>Lespedeza cuneata</i>	sericea lespedeza		X
<i>Microstegium vimineum</i>	Nepalese browntop		X
<i>Mikania scandens</i>	climbing hempvine		X
<i>Morella cerifera</i>	wax myrtle		X
<i>Murdannia keiskei</i>	wart-removing herb		X
<i>Penthorum sedoides</i>	ditch stonecrop		X
<b><i>Peltandra virginica</i></b>	<b>arrow arum</b>	<b>0</b>	
<i>Polygonum cespitosum</i> var. <i>longisetum</i>	oriental lady's thumb		X
<i>Polygonum hydropiperoides</i>	swamp smartweed		X
<b><i>Polygonum amphibium</i></b>	<b>water smartweed</b>	<b>0</b>	
<i>Polygonum sagittatum</i>	Arrowleaf tearthumb		X
<b><i>Pontederia cordata</i></b>	<b>pickleweed</b>	<b>0</b>	
<i>Rhexia mariana</i>	Maryland meadowbeauty		X
<i>Sagittaria graminea</i>	grassy arrowhead		X
<i>Sagittaria latifolia</i>	duck potato	X	
<b><i>Saururus cernuus</i></b>	<b>lizard's tail</b>	<b>0</b>	
<i>Scirpus cyperinus</i>	woolgrass		X
<b><i>Scirpus fluviatilis</i></b>	<b>river bulrush</b>	<b>0</b>	
<b><i>Scirpus pungens</i></b>	<b>common three-square</b>	<b>0</b>	
<i>Solidago rugosa</i>	wrinkleleaf goldenrod		X
<i>Solidago</i> sp.	goldenrod		X
<b><i>Sparganium americanum</i></b>	<b>eastern bur-reed</b>	<b>0</b>	
<b><i>Sparganium eurycarpum</i></b>	<b>giant bur-reed</b>	<b>0</b>	
<i>Typha latifolia</i>	broadleaf cattail		X

0 – Planted but not recorded 2008



# JAMES CITY COUNTY 1998 - GRADING



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# JAMES CITY COUNTY 1998 – AS BUILT SURVEY





# JAMES CITY COUNTY 1998 - PLANTING

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# JAMES CITY COUNTY 1998 – 2<sup>nd</sup> Yr GROWTH

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# JAMES CITY COUNTY 1998 – 10th Yr GROWTH FOREBAY

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# JAMES CITY COUNTY 1998 – 13th Yr GROWTH

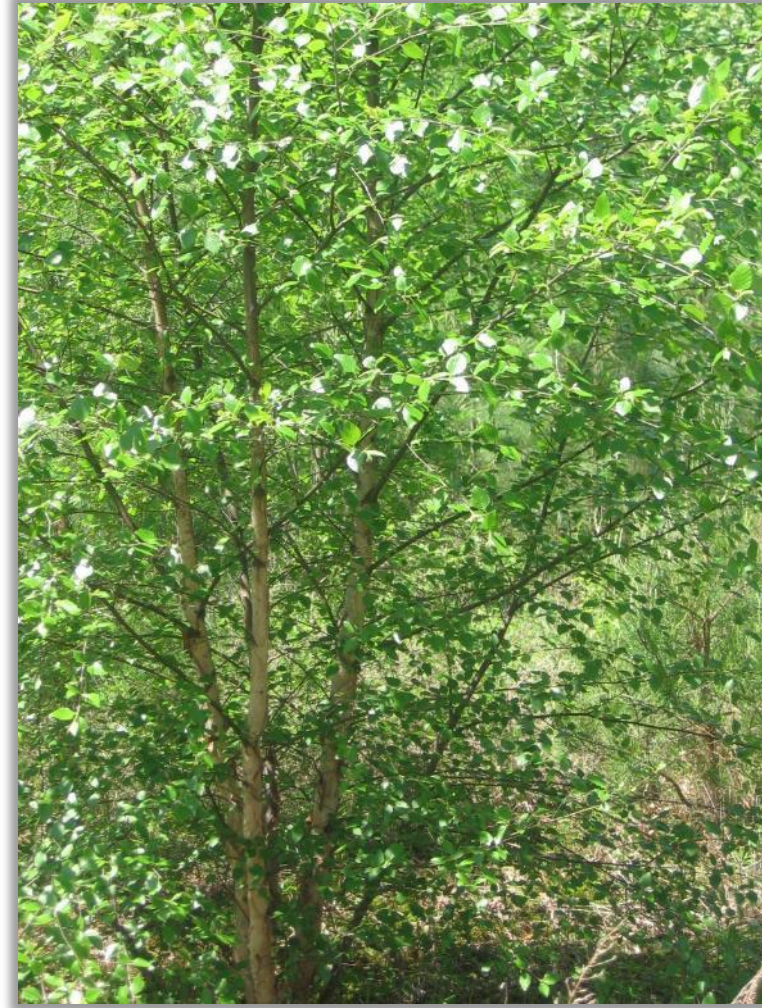
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# JAMES CITY COUNTY 1998 – 13th Yr GROWTH

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# JAMES CITY COUNTY 1998 – 28th Yr GROWTH

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# JAMES CITY COUNTY 1998 – 28th Yr GROWTH

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# JAMES CITY COUNTY 1998 - 28th Yr GROWTH





# JAMES CITY COUNTY 1998 – 28th Yr GROWTH

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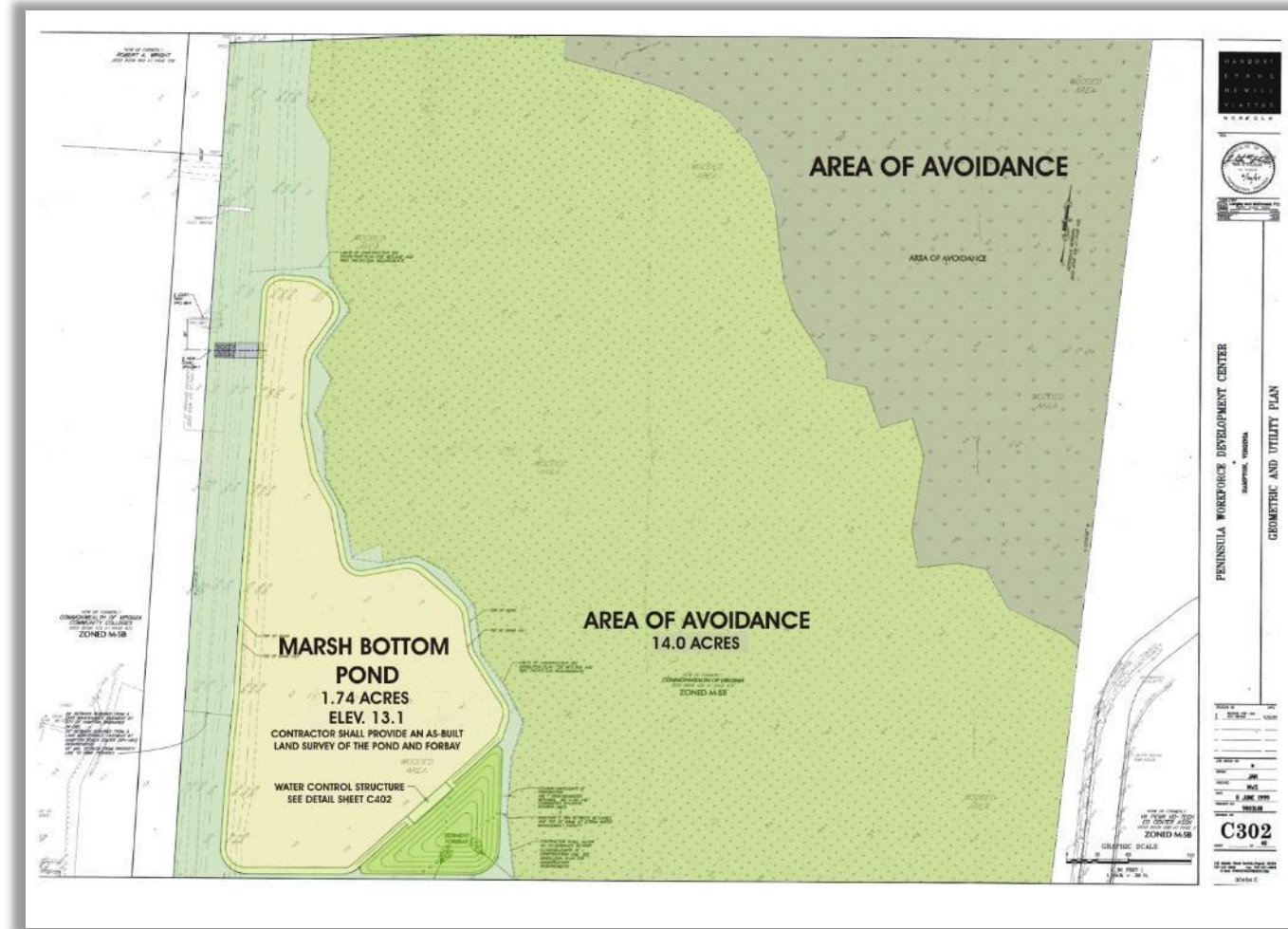




# CITY OF HAMPTON 2001

- 1.5 Acre Forested Wetland Mitigation
- Includes Forebay
- Treats Workforce Development Center Parking and Building Runoff
- Air Force BASH Concerns

# CITY OF HAMPTON 2001 – SITE MAP





# CITY OF HAMPTON 2001 – SPECIES LIST

BOTANICAL NAME	COMMON NAME	PLANTED	COLINIZER
<u>TREES</u>			
<i>Liquidambar styraciflua</i>	sweetgum		X
<i>Salix nigra</i>	black willow		X
<i>Taxodium distichum</i>	bald cypress	X	
<u>SHRUBS</u>			
<i>Alnus serrulata</i>	common alder	X	
<i>Boehmeria cylindrical</i>	smallspike false nettle		X
<i>Cephalanthus occidentalis</i>	buttonbush	X	
<u>HERBACEOUS EMERGENT PLANTS</u>			
<i>Dichanthelium sp.</i>	Rosette grass		X
<i>Eichhornia quadrangulata</i>	squarestem spikerush		X
<i>Elocharis sp.</i>	spikerush		X
<i>Galium tinctorium</i>	stiff marsh bedstraw		X
<i>Hydrocotyle umbellata</i>	marshpennywort		X
<i>Juncus effusus</i>	soft rush	X	
<i>Juncus repens</i>	lesser creeping rush		X
<i>Leeria virginica</i>	rice cut grass	X	
<i>Ludwigia sp.</i>	primrose-willow		X
<i>Lycopus virginicus</i>	Virginia water horehound		X
<i>Mikania scandens</i>	climbing hempvine		X
<i>Phragmites australis</i>	common reed		X
<i>Polygonum hyrapiperoides</i>	swamp smartweed		X
<i>Polygonum sagittatum</i>	arrowleaf tearthumb		X
<i>Rhexia mariana</i>	Maryland meadowbeauty		X
<i>Rhynchospora capitellata</i>	brownish beaksedge		X
<i>Rhynchospora sp.</i>	beakrush		X
<i>Scirpus cyperinus</i>	wool grass	X	
<i>Solidago sp.</i>	goldenrod		X
<i>Typha latifolia</i>	broadleaf cattail		X



# CITY OF HAMPTON 2001 – PLANTING





# CITY OF HAMPTON 2001 – 6 MONTHS





# CITY OF HAMPTON 2001 – 3rd Yr Growth





# CITY OF HAMPTON 2001 – 7th Yr Growth

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# CITY OF HAMPTON 2001 – 7th Yr Growth





# CITY OF HAMPTON 2001 – 7th Yr Growth





# CITY OF HAMPTON 2001 – 10th Yr Growth





# CITY OF HAMPTON 2001 – 10th Yr GROWTH





# CITY OF HAMPTON 2001 – 25th Yr SITE PHOTOS

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# CITY OF HAMPTON 2001 – 25th Yr SITE PHOTOS





# CITY OF HAMPTON 2001 – 25th Yr SITE PHOTOS

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## YORK COUNTY 2003

- 2- 0.5 Acre Forested Wetland Compensation Sites
- Treats County Park Parking, Picnic and Ball Fields
- Provides Flood Water Management



# YORK COUNTY 2003 – SPECIES LIST

BOTANICAL NAME	COMMON NAME	PLANTED	COLINIZER
<u>TREES</u>			
<i>Acer rubrum</i>	red maple	X	
<i>Betula nigra</i>	river birch	X	
<i>Nyssa sylvatica</i>	black gum	X	
<i>Salix nigra</i>	black willow		X
<i>Taxodium distichum</i>	bald cypress	X	
<u>SHRUBS</u>			
<i>Alnus serrulata</i>	common alder	X	
<i>Cephalanthus occidentalis</i>	buttonbush	X	
<i>Clethra alnifolia</i>	coastal sweet pepperbush	X	
<i>Magnolia virginiana</i>	sweetbay magnolia	X	
<i>Vaccinium corymbosum</i>	highbush blueberry	X	
<u>HERBACEOUS EMERGENT PLANTS</u>			
<i>Alisma subcordatum</i>	american water plantain		X
<i>Bidens sp.</i>	beggarticks		X
<i>Clethra alnifolia</i>	coastal sweet pepperbush		X
<i>Iris versicolor</i>	blueflag Iris	X	
<i>Juncus effusus</i>	soft rush	X	
<i>Leeria virginica</i>	rice cut grass	X	
<i>Sagittaria sp.</i>	arrowhead		X
<i>Scirpus cyperinus</i>	wool grass	X	
<i>Typha latifolia</i>	broadleaf cattail		X



# YORK COUNTY 2003 – GRADING

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# YORK COUNTY 2003 – GRADING





# YORK COUNTY 2003 – PLANTING





# YORK COUNTY 2003 – PLANTING





# YORK COUNTY 2003 – PLANTING





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# YORK COUNTY 2003 – 1st Yr GROWTH

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# YORK COUNTY 2003 – 4th Yr GROWTH

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# YORK COUNTY 2003 – 4th Yr GROWTH

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# YORK COUNTY 2003 – 5th Yr GROWTH

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# YORK COUNTY 2003 – 5th Yr GROWTH

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# YORK COUNTY 2003 – 5th Yr GROWTH

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# YORK COUNTY 2003 – 5th Yr GROWTH

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# YORK COUNTY 2003 – 8th Yr GROWTH

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# YORK COUNTY 2003 – 8th Yr GROWTH

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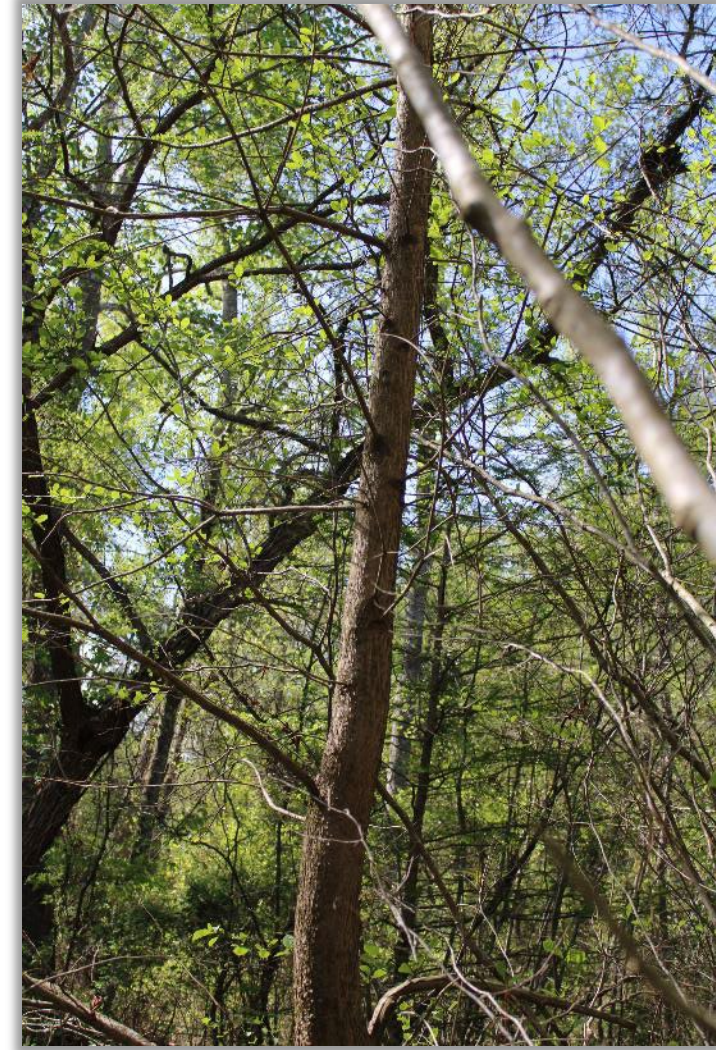


# YORK COUNTY 2003 – 23rd Yr GROWTH





# YORK COUNTY 2003 – 23rd Yr GROWTH





# YORK COUNTY 2003 – 23rd Yr GROWTH





# YORK COUNTY 2003 – 23rd Yr GROWTH

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# YORK COUNTY 2003 – 23rd Yr GROWTH

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# CONCLUSIONS

## Proper Management:

Good Growth

Good Colonization

## Mismanagement:

Plant Mortality

Interrupted Succession

## Succession in Progress:

Emergent ⇒ scrub shrub ⇒ forested

## Good Wildlife Usage:

Birds

Mammals

Amphibians

Fish

# Questions ??

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