NC DPS Case Study: Natural and Working Land and Ecosystem Services Priority Overlays

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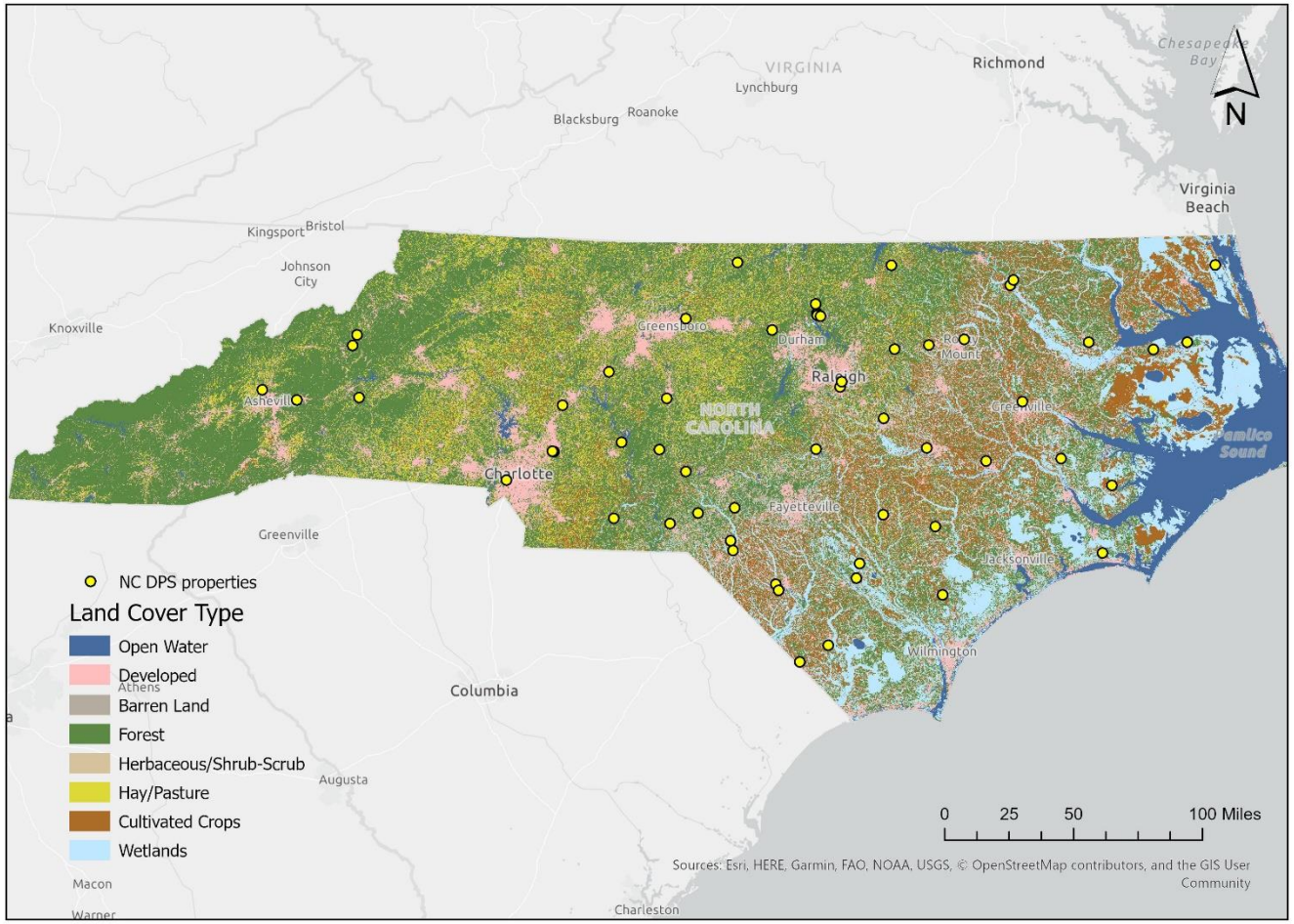
Overview and methods

NC DPS properties include natural and working lands (forests, wetlands, agricultural land) that can provide a variety of benefits when managed sustainably.

We applied a state-wide analysis of North Carolina's natural and working lands to DPS properties, to identify how existing forests and reforestation opportunities can contribute to community resilience (e.g., through flood attenuation and water supply protection) and carbon mitigation.

The methods for these analyses use state- and national-scale data sources (e.g., National Land Cover Database, Protected Areas Database, USFS forest yield tables, and data from a national assessment of natural climate solutions by Fargione et al. 2018). They were designed to provide an indication of potential scale of carbon and resilience opportunities in North Carolina, rather than specific estimates for small parcels. More information on methods is available here.

Land cover types on DPS properties



Based on national-scale land cover data (NLCD 2016), NC DPS properties are largely made up of forest, cultivated crops, wetlands, and developed land.

Land Cover Type	Number of properties with land cover	Total area across all DPS properties (acres)
Forest	55	9,987
Cultivated crops	35	7,235
Wetlands	32	3,162
Developed	55	2,714
Herbaceous/shrub -scrub	44	721
Hay/Pasture	31	524
Open water	21	207
Barren Land	10	18

Defining resilience benefits of DPS properties

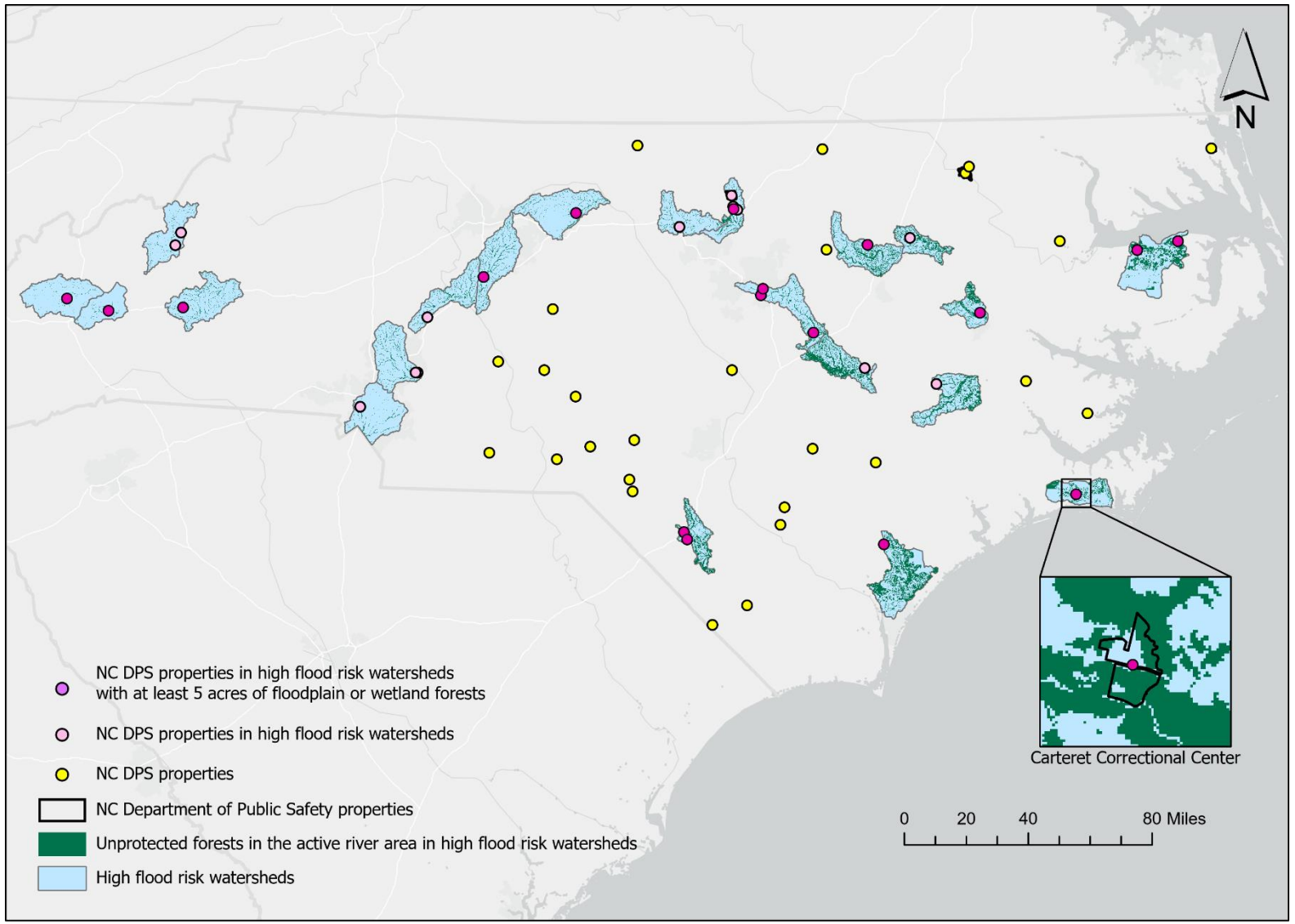
Forests can benefit community resilience in many ways. We considered 5 resilience benefits in this analysis:

- Flood attenuation by floodplain and wetland forests in high flood risk watersheds
- Water purification by floodplain and wetland forests in water quality hazard watersheds
- Air pollution reduction by forests in urban areas
- Water supply protection by forests in water supply watersheds
- Wild pollination potential by forests near pollinator-dependent crops

While even a very small amount of forest can provide some benefit, we focused on identifying properties with at least 5 acres of forest that contributes to one of these benefits and is not in a protected area. These are the properties where forest protection or management to ensure the forests continue to provide the benefit is most needed.

The maps on the next 5 slides, and the tables on slides 14 and 16, use 5 acres as the cutoff for determining whether a property provides a particular resilience benefit.

Flood attenuation in high flood risk watersheds

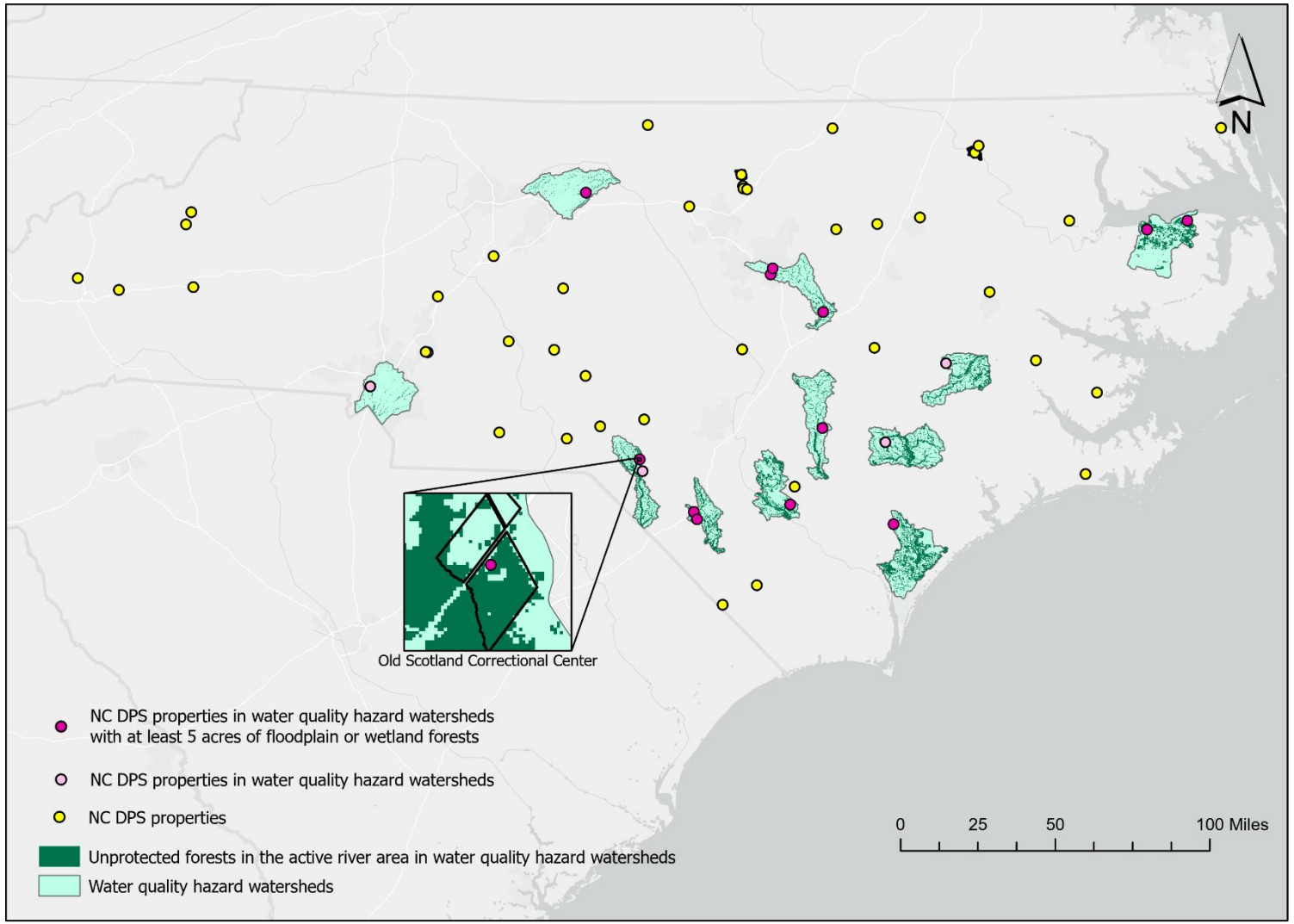


Forests and wetlands in the floodplain can slow flows of water, reducing downstream flooding and release of water pollutants from facilities and contaminated sites. Having forests and wetlands, rather than populated areas, in the floodplain also means that fewer people and less property are at risk of flooding.

High flood risk watersheds are HUC 10 watersheds in North Carolina with at least 3,000 people living in flood-prone areas. There are **30 DPS properties** within high flood risk watersheds, **17 of which have at least 5 acres of unprotected floodplain or wetland forests**.

Note: this map does not capture downstream flooding effects.

Water purification in water quality hazard watersheds

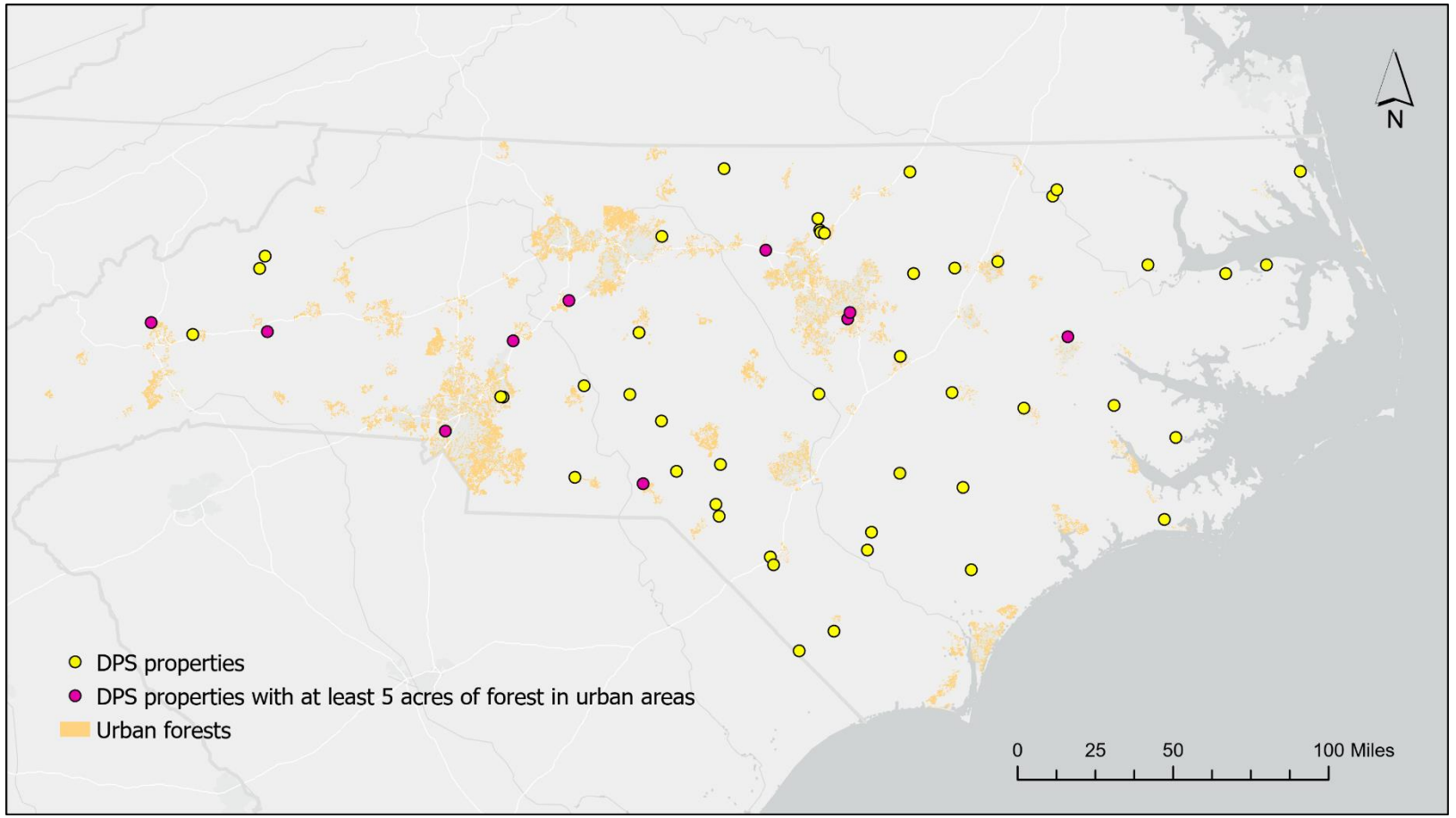


When flooded, point-source pollutants, such as sewer treatment plants and hazardous waste sites, can contribute nutrients, sediment, and pathogens to the water bodies within the watershed. Water quality hazard watersheds are HUC 10 watersheds in North Carolina with at least 10 point-source water quality hazards. Floodplain and wetland forests help to remove pollutants before they reach waterways.

There are **16 DPS properties** in water quality hazard watersheds**, 12 of which have at least 5 acres of unprotected floodplain and wetland forests**.

	Number of Sewer Treatment Plants	**Number of Hazardous Waste Sites**
Within water quality hazard watersheds that have DPS properties	14	527
Within DPS property boundaries	0	2

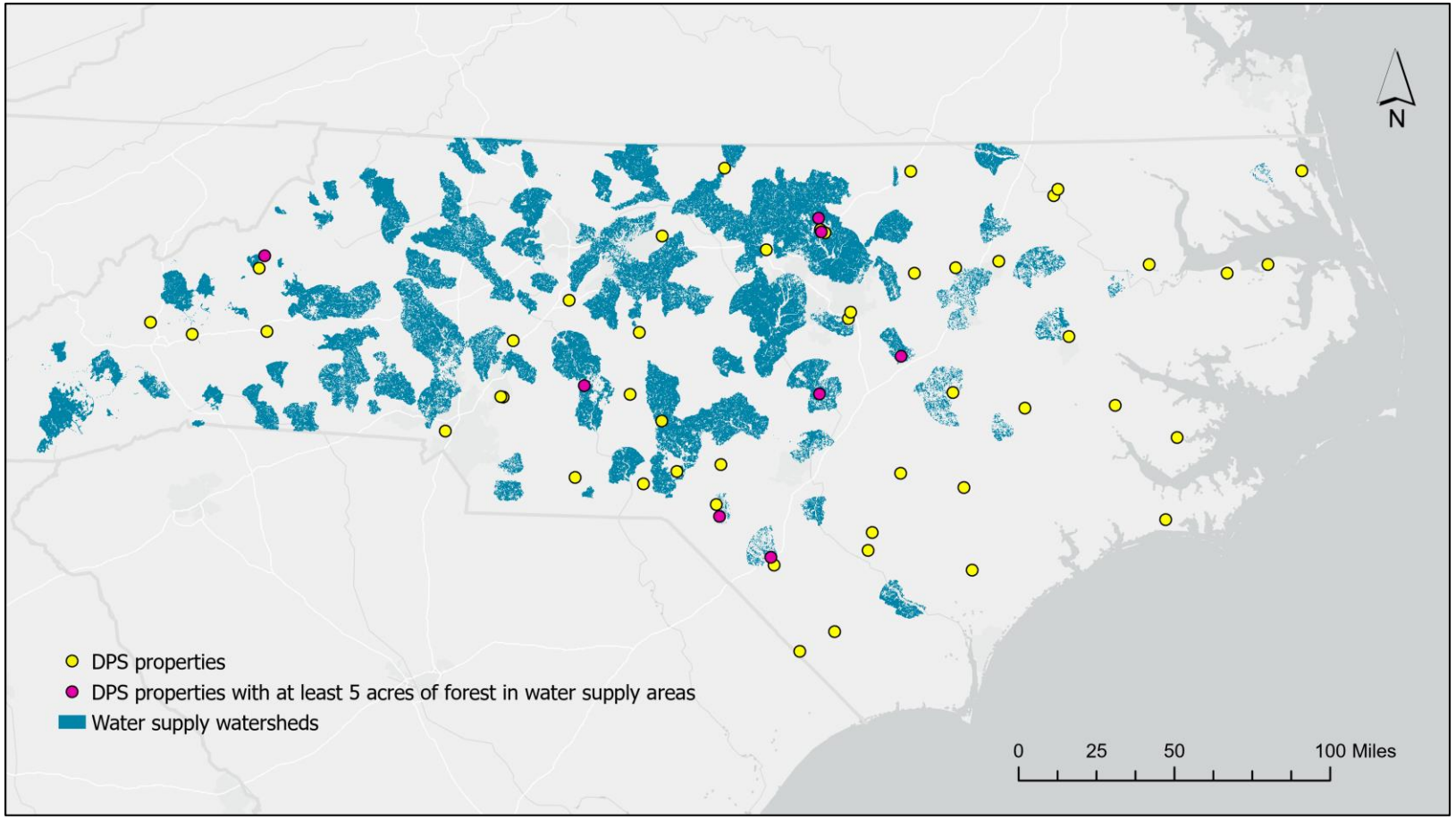
Air pollution reduction in urban areas



Forests in urban areas remove air pollutants and help to offset urban heat effects, which can reduce electricity use.

There are **10 DPS properties with at least 5 acres of unprotected forest in urban areas**.

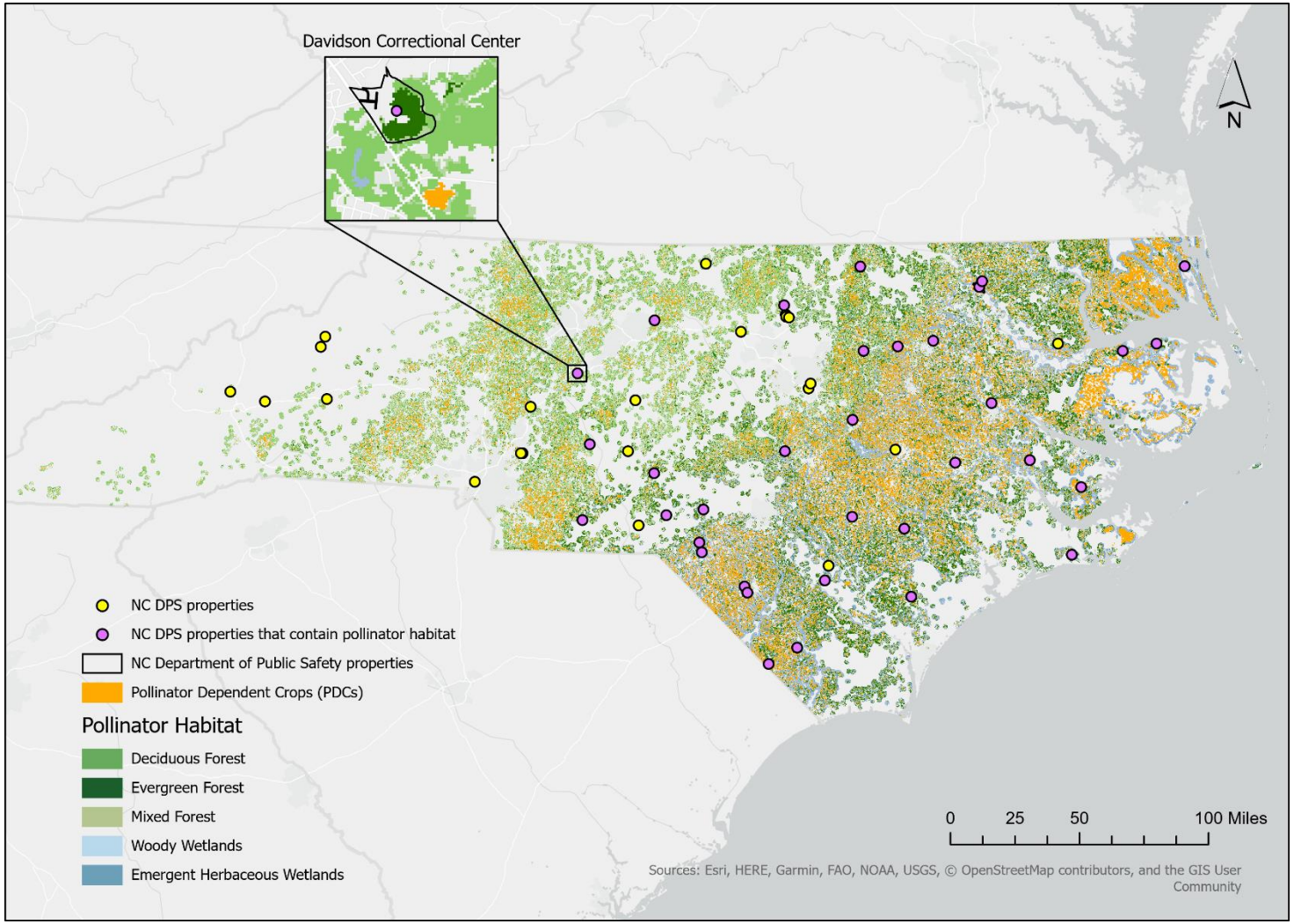
Water supply protection in water supply watersheds



Forests in water supply watersheds (HUC 10 watersheds) protect drinking water supplies by filtering out pollutants before they reach waterways.

There are **8 DPS properties with at least 5 acres of unprotected forests in water supply watersheds**.

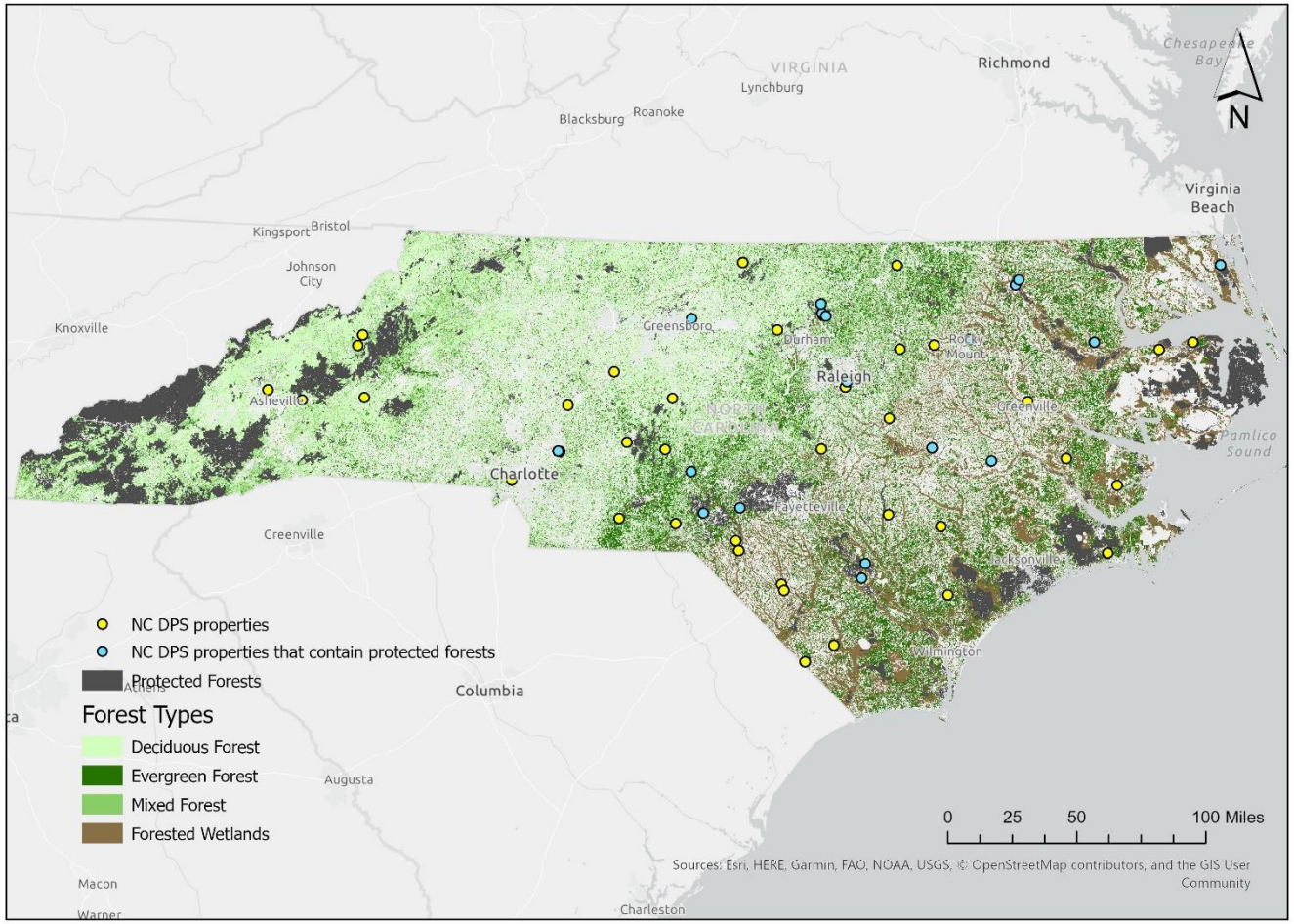
Wild pollination potential



Forests and other natural land cover on DPS properties provide habitat for wild pollinators, which increase yields of pollinator-dependent crops when they are within flight range of the crops.

There are **34 DPS properties** that have at least 5 acres of pollinator habitat near pollinator-dependent crops within their boundaries.

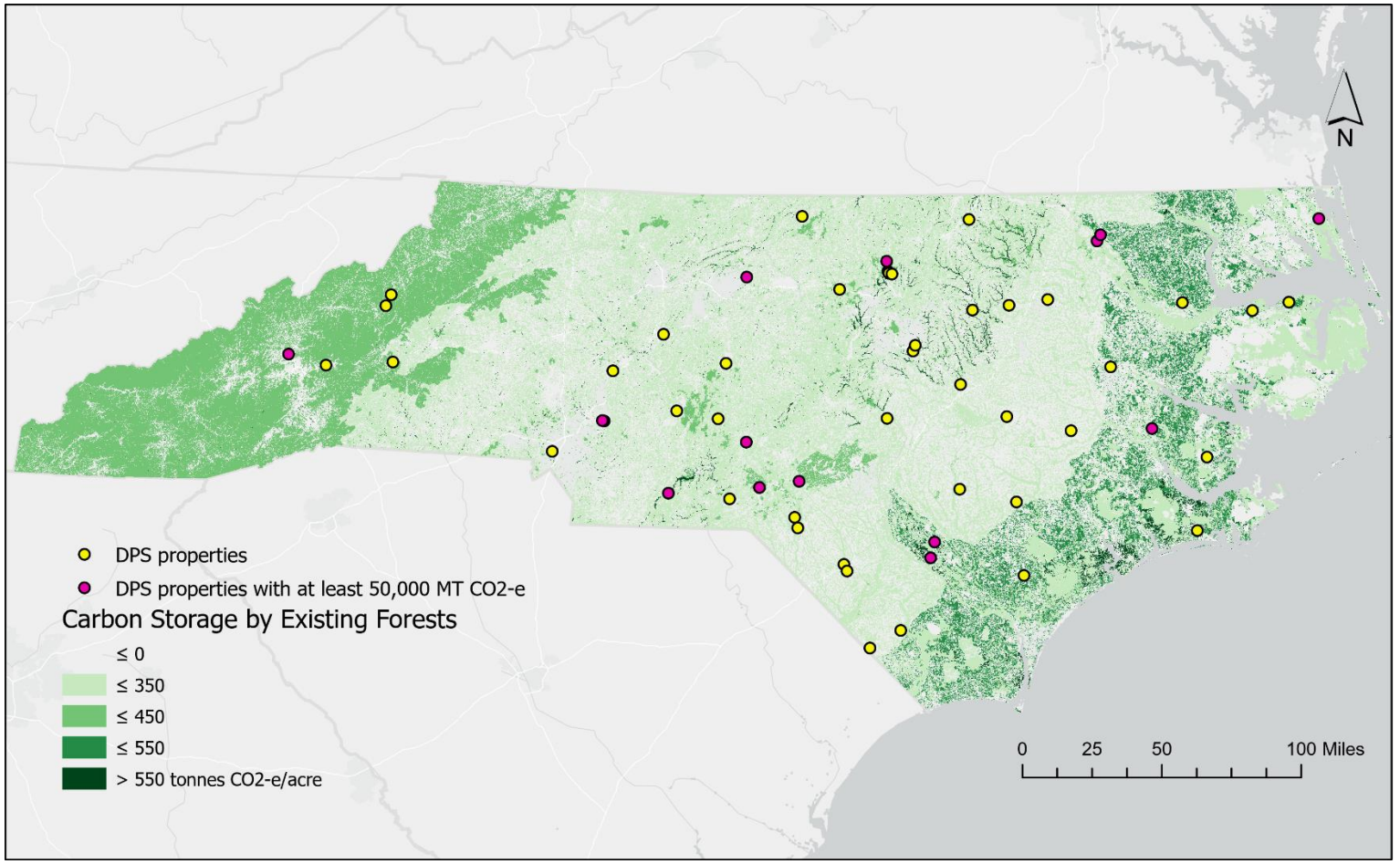
Forest types on DPS properties



There are about **13,000 acres of forests and forested wetlands** across all 56 DPS properties. Most of these forests are unprotected. However, there are **19 properties that have protected land** within their boundaries.

Forest Type	Number of properties with forested land cover in boundaries	Total area of this forest type across all DPS properties (acres)
Evergreen Forest	52	5,996
Forested Wetlands	32	3,107
Deciduous Forest	39	2,294
Mixed Forest	45	1,696

Carbon storage in existing forests



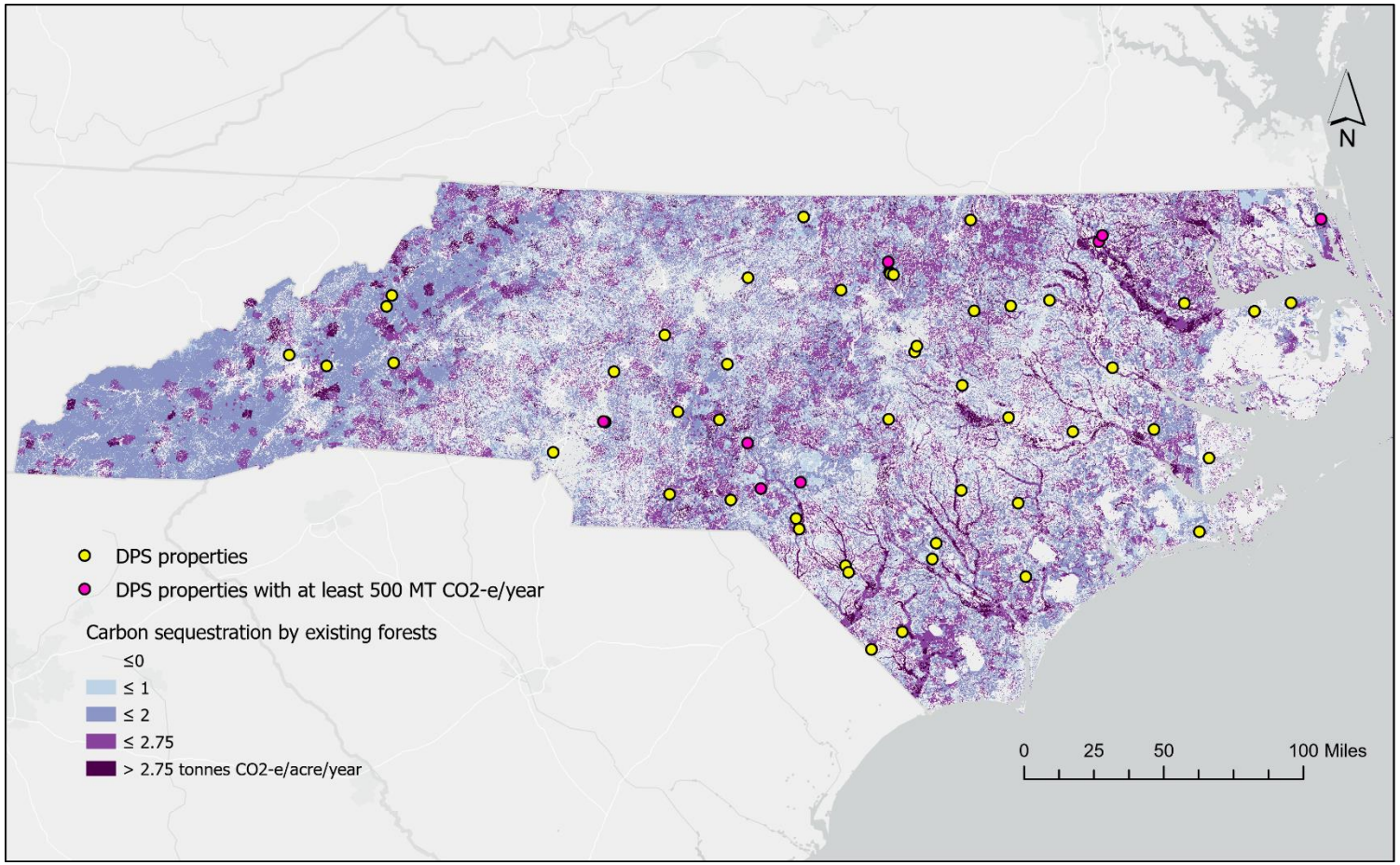
Existing forests store carbon in their biomass and soil. The forests and forested wetlands within the DPS properties currently store approximately **4.6 million metric tons** of carbon dioxide equivalent. If all of this carbon were released, it would be about equal to North Carolina's total GHG emissions* for 11 days.

14 DPS properties store at least 50,000 metric tons of CO_2-e.

Carbon density in DPS forests ranges from 300-500 metric tons CO2-e per acre.

*Based on NC 2017 GHG Inventory

Carbon sequestration in existing forests



These forests also continue to sequester carbon each year. Younger forests sequester carbon more quickly than older forests.

The forests in the DPS properties accumulate approximately **24,800 metric tons** of carbon dioxide equivalent each year, which is comparable to taking 5,360 cars off of the road each year.*

8 DPS properties accumulate more than 500 metric tons CO2-e per year.

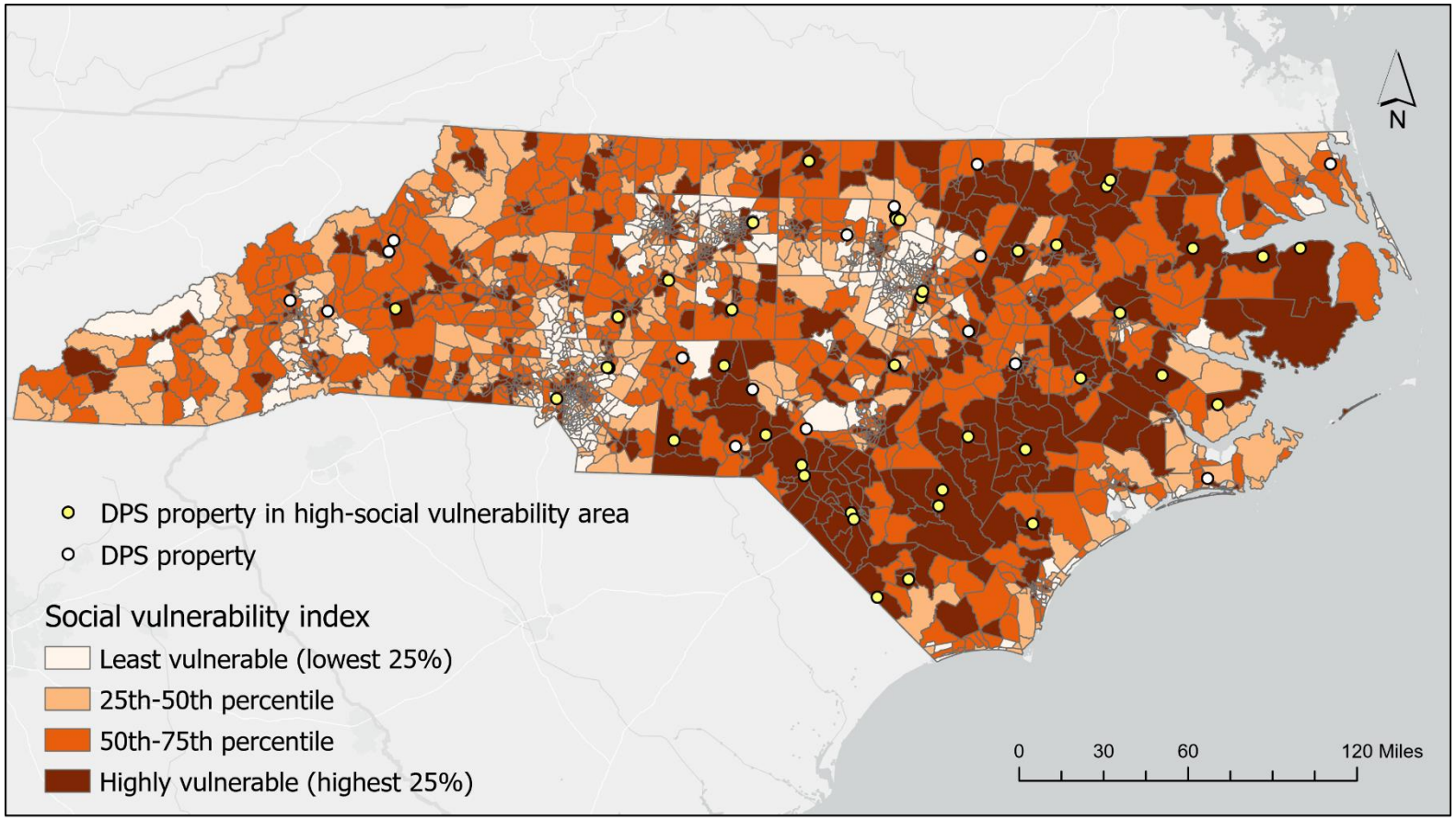
Mean carbon sequestration by DPS forests ranges from 0.5 to 2.7 metric tons CO2-e per acre per year.

*Based on the US EPA's Greenhouse Gas Equivalencies Calculator

DPS properties and social vulnerability

The CDC's Social Vulnerability Index (SVI) indicates the relative vulnerability of every U.S. Census tract, based on 15 social factors, which are grouped into 4 themes. Each tract receives a ranking for each census variable and for each of the four themes, as well as an overall ranking.

39 DPS properties are in high-social vulnerability Census tracts.



Overall Vulnerability

Socioeconomic Status

1. Below Poverty
2. Unemployed
3. Income
4. No High School Diploma

Household Composition & Disability

5. Aged 65 or older
6. Aged 17 or younger
7. Older than age 5 with a disability
8. Single-parent households

Minority Status and Language

9. Minority
10. Speaks English "Less than Well"

Housing Type & Transportation

11. Multi-unit structures
12. Mobile homes
13. Crowding
14. No vehicle
15. Group quarters

Existing forest resilience benefits summary

Benefit (definition of area contributing to benefit)	# of DPS properties with this benefit (# in high social vulnerability areas)	Total area of DPS properties contributing to this benefit, acres (area in high social vulnerability areas)
Flood attenuation (DPS properties with at least 5 acres of unprotected floodplain and wetland forests in a high flood risk watershed)	17 (13)	431 (323)
Water purification (DPS properties with at least 5 acres of unprotected floodplain and wetland forests in a water quality hazard watershed)	12 (11)	382 (367)
Air pollution reduction (DPS properties with at least 5 acres of unprotected forests in urban areas)	10 (7)	566 (278)
Water supply protection (DPS forests with at least 5 acres of unprotected forests in water supply watersheds)	8 (4)	433 (280)
Wild pollination (DPS properties with at least 5 acres of wild pollinator habitat within flight range of pollinator-dependent crops)	34 (25)	4,717 (2,743)

Existing forest carbon benefits summary

Benefit	Total carbon storage or sequestered, metric tons CO2-e (total carbon storage or sequestered in high social vulnerability areas)
Carbon storage – total	4.66 million metric tons CO2-e (1.72 million metric tons CO2-e)
Carbon storage in unprotected forests	956,400 metric tons CO2-e (670,000 metric tons CO2-e)
Carbon storage in unprotected forests that provide at least one resilience benefit	501,360 metric tons CO2-e (310,600 metric tons CO2-e)
Carbon sequestration – total	24,800 metric tons CO2-e (8,200 metric tons CO2-e)
Carbon sequestration in unprotected forests	4,780 metric tons CO2-e (3,400 metric tons CO2-e)
Carbon sequestration in unprotected forests that provide at least one resilience benefit	2,700 metric tons CO2-e (1,800 metric tons CO2-e)

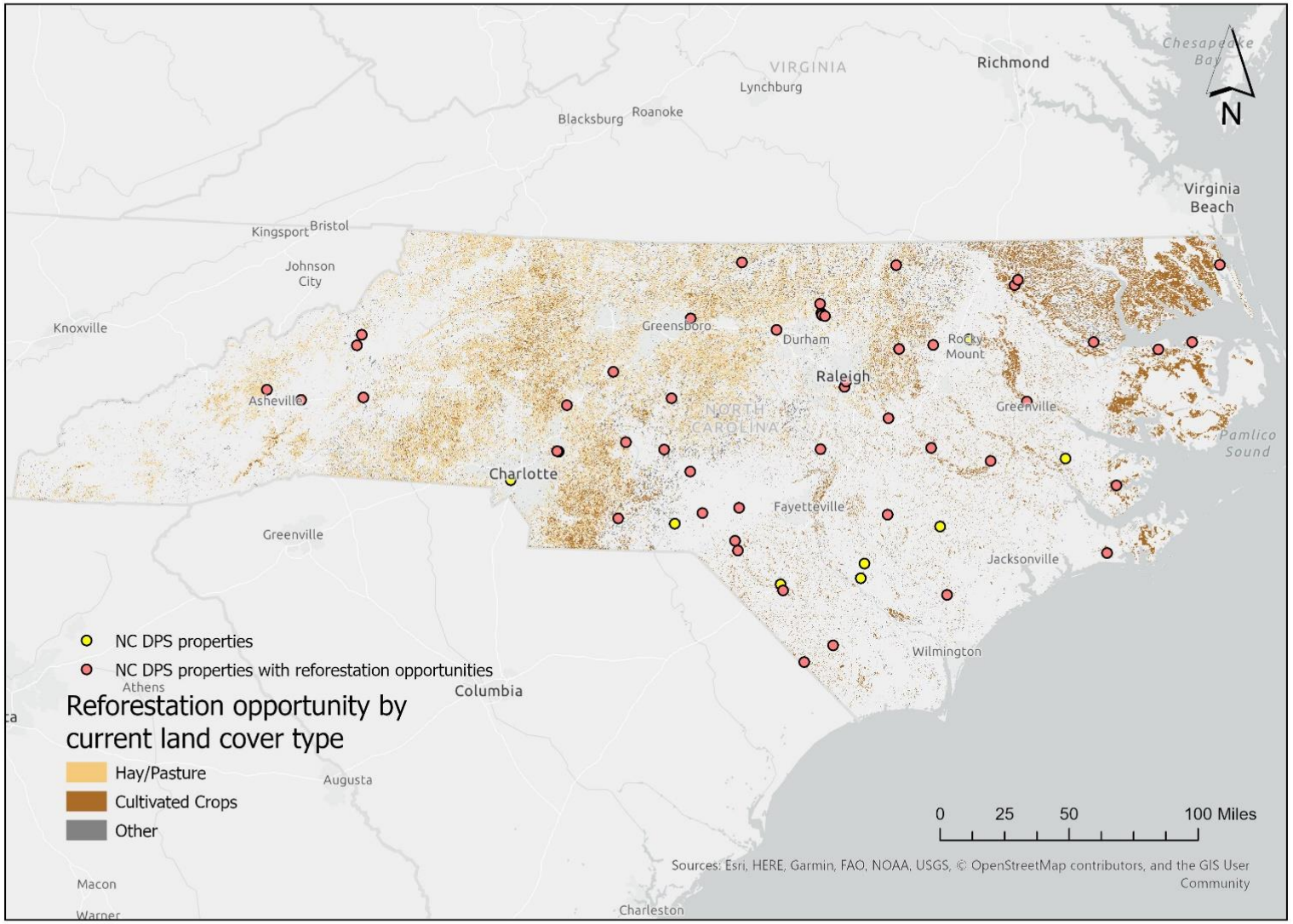
Existing forest benefits by DPS property

Showing properties with at least 100 acres of unprotected forest. Full list available in spreadsheet (see slide 23).
Green text indicates that the property has at least 5 acres contributing to the benefit.

in high social vulnerability Census tract

	Acres of unprotected forest contributing to resilience benefits					Carbon benefit (MT CO2-e)	
Property name	Flood attenuation	Water quality risk reduction	Air pollution reduction	Water supply protection	Wild pollination	Carbon storage, total	Annual carbon sequestration, total
Craggy Correctional Center	**21.3**		**241.1**			95,412.3	422.1
National Guard Armory Readiness Center	**51.6**	**52.3**			**10.1**	53,305.9	311.1
Brown Creek Correctional Institution					**61.2**	51,732.6	337.7
Craven Correctional Institution					**124.8**	66,092.0	128.8
Harnett Correctional Institution				**115.0**	**139.5**	45,855.5	242.6
Old Scotland Correctional Center		**104.1**			**47.3**	43,309.4	293.4
Dan River Prison Work Farm						36,951.9	191.4
Polk Correctional Institution	**6.7**			**113.0**		36,313.5	264.0

Reforestation opportunities by current land use



We identified areas with reforestation potential, defined as land that is not currently forested, wetland, or developed and could support forest.

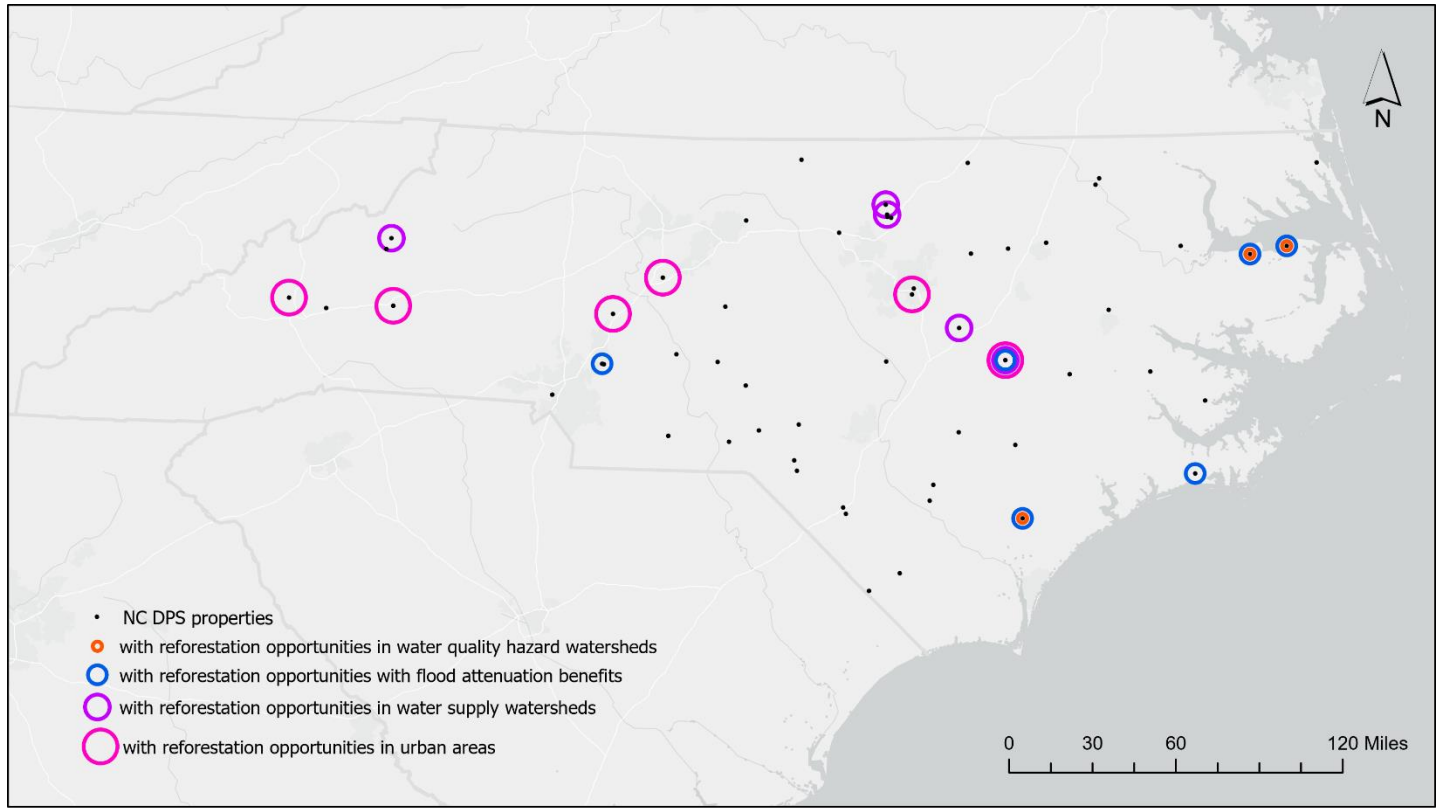
Because most of this land is currently being used for pasture or crops, we do not expect the majority of land with reforestation potential to actually be reforested. However, there may be some low-productivity areas that make sense to reforest.

47 DPS properties have some potential for reforestation, with a total of **5,900 acres of reforestation opportunity**.

DPS land with reforestation potential by current land cover type	Area of reforestation potential across all DPS properties (acres)
Hay/Pasture	416
Cultivated Crops	5,110
Other	373

Community resilience benefits from reforestation

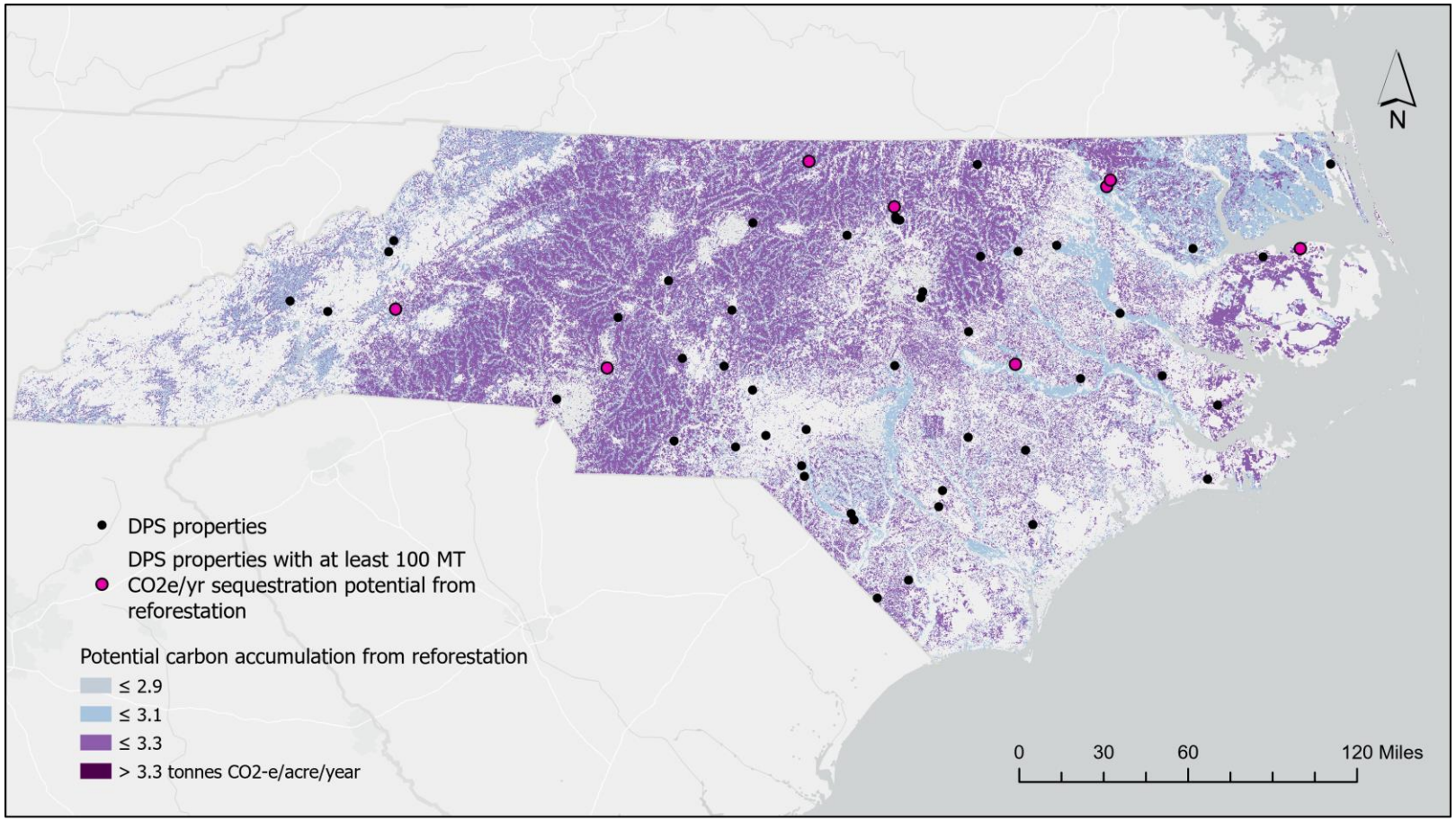
Reforestation has the potential to provide the same resilience benefits that existing forests do. These include reducing flood risk, protecting water quality, and improving urban air quality. **15 DPS properties** have the potential to contribute to one or more community resilience benefits through reforestation.



Reforestation Opportunities…	# of DPS properties with at least 5 acres of opportunity for this benefit	Total area of reforestation opportunity that would provide this benefit across all DPS properties (acres)*
Contributing to community resilience through flood attenuation	6	124
Contributing to community resilience through reduced water quality risk	3	70
Contributing to air quality in urban areas	6	133
Contributing to water quality in water supply watersheds	5	335

*Some reforested areas would provide multiple benefits, so these areas cannot be added together.

Potential carbon sequestration from reforestation



Reforestation promotes rapid carbon accumulation as trees grow. If all of the reforestation opportunities (land that is not currently forested, wetland, or developed, but could support forest) within DPS properties were reforested, the new forest would sequester about **18,170 metric tons** of carbon dioxide equivalent per year. This would be comparable to taking 3,900 cars off of the road each year.* Because much of this land is being used for agriculture, we would not expect reforestation to occur on most of the land where it is feasible.

8 DPS properties have the potential to sequester at least 100 metric tons CO2-e/year if reforested.

*Based on the US EPA's Greenhouse Gas Equivalencies Calculator

Reforestation resilience benefits summary

Benefit (definition of area contributing to benefit)	# of DPS properties with this benefit (# in high social vulnerability areas)	Total area of DPS properties contributing to this benefit, acres (area in high social vulnerability areas) OR total carbon storage or sequestered
Flood attenuation (DPS properties with at least 5 acres of reforestation opportunity in the floodplain of a high flood risk watershed)	6 (4)	124 (76)
Water purification (DPS properties with at least 5 acres of reforestation opportunity in the floodplain of a water quality hazard watershed)	3 (3)	70 (70)
Air pollution reduction (DPS properties with at least 5 acres of reforestation opportunity in urban areas)	6 (4)	133 (85)
Water supply protection (DPS properties with at least 5 acres of reforestation opportunity in a water supply watershed)	5 (0)	335 (0)

Reforestation carbon benefits summary

Benefit	**Total potential carbon sequestration, metric tons CO2-e/year** **(Total potential carbon sequestration in high social vulnerability areas)**
Potential carbon sequestration from reforestation	18,170 metric tons CO2-e/year (16,800 metric tons CO2-e/year)
Potential carbon sequestration from reforestation in areas that would provide at least one resilience benefit	1,320 metric tons CO2-e/year (450 metric tons CO2-e/year)

Reforestation benefits by DPS property

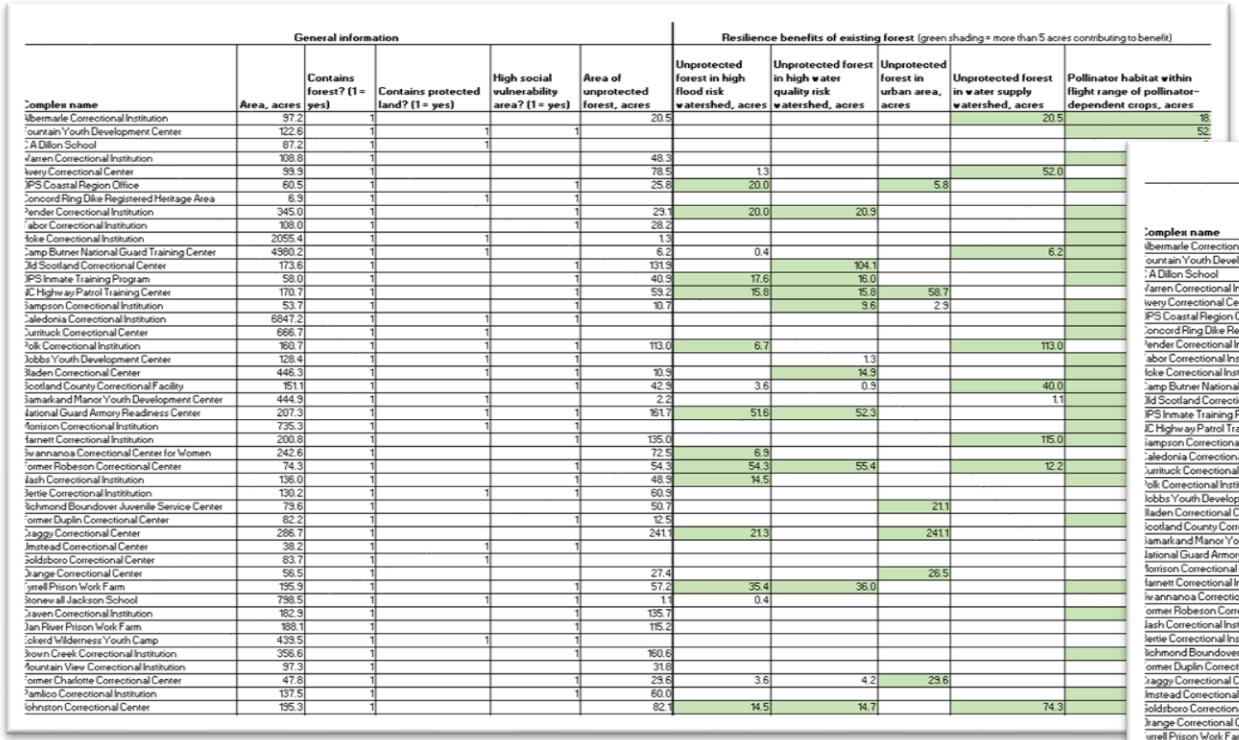
Showing properties with at least 40 acres of reforestation opportunity. Full list available in spreadsheet (see slide 23).
Green text indicates that the property has at least 5 acres of reforestation potential that would contribute to the benefit.

in high social vulnerability Census tract

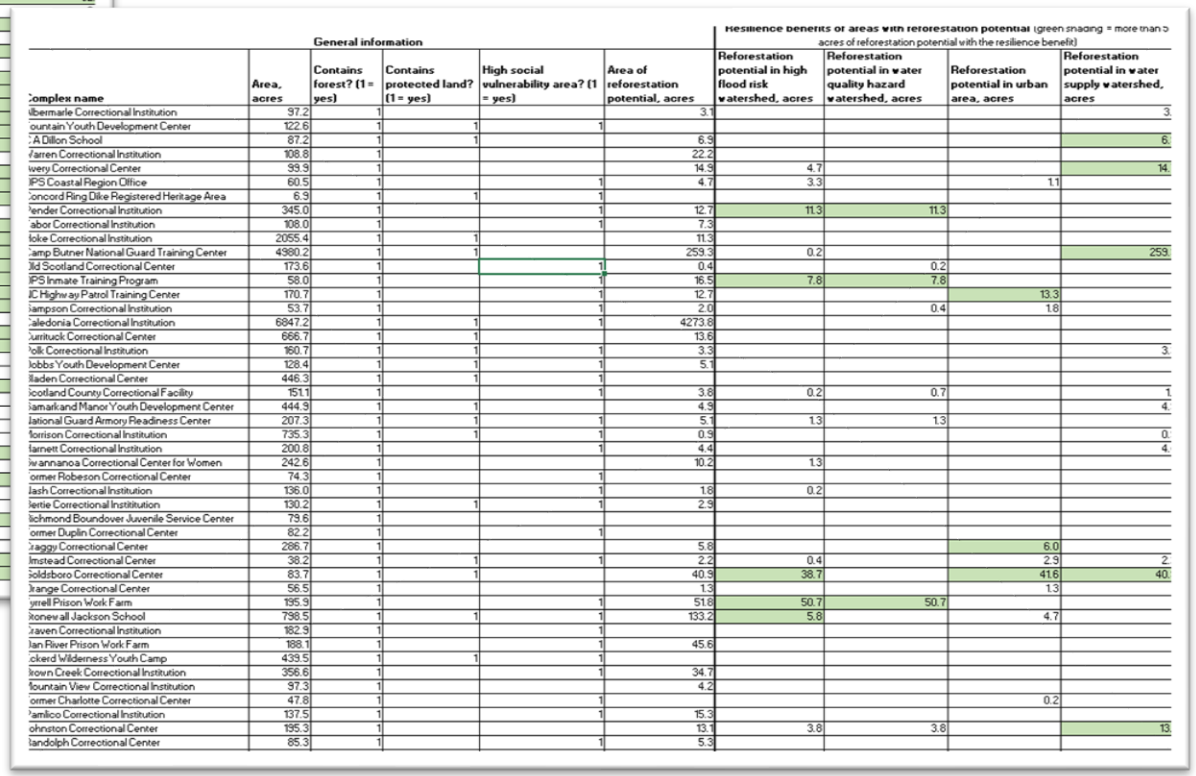
Property name	Total reforestation opportunity, acres	acres contributing to benefit				Potential carbon sequestration (MT CO2-e/year
		Flood attenuation	Water quality risk reduction	Air pollution reduction	Water supply protection	
Caledonia Correctional Institution	4,273.8					13052.7
Odom Correctional Institution	727.5					2363.3
Camp Butner National Guard Training Center	259.3	0.2			**259.3**	817.9
Stonewall Jackson School	133.2	**5.8**		4.7		410.8
Tyrrell Prison Work Farm	51.8	**50.7**	**50.7**			163.4
Marion Correctional Institution	50.0	3.3		**51.8**		157.1
Dan River Prison Work Farm	45.6					142.8
Goldsboro Correctional Center	40.9	**38.7**		**41.6**	**40.9**	124.6

DPS property spreadsheet

The spreadsheet attached along with the slide deck contains details on resilience and carbon benefits provided by existing forests (tab 1) and potentially provided by reforestation (tab 2) on all 56 DPS properties.



	General information					Resilience benefits of existing forest (green shading = more than 5 acres contributing to benefit)				
Complex name	Area, acres	Contains forest? (1 = yes)	Contains protected land? (1 = yes)	High social vulnerability area? (1 = yes)	Area of unprotected forest, acres	Unprotected forest in high flood risk watershed, acres	Unprotected forest in high water quality risk watershed, acres	Unprotected forest in urban area, acres	Unprotected forest in water supply watershed, acres	Pollinator habitat within flight range of pollinator-dependent crops, acres
lbermarle Correctional Institution	97.2	1			20.5				20.5	18.
ountain Youth Development Center	122.6	1	1	1						52.
A Dillon School	87.2	1	1							
Warren Correctional Institution	108.8	1			48.3					
wery Correctional Center	99.9	1			78.5	1.3			52.0	
PS Coastal Region Office	60.5	1		1	25.8	20.0		5.8		
oncord Ring Dike Registered Heritage Area	6.9	1	1	1						
ender Correctional Institution	345.0	1		1	29.1	20.0	20.9			
abor Correctional Institution	108.0	1		1	28.2					
oke Correctional Institution	2055.4	1	1		1.3					
amp Butner National Guard Training Center	4980.2	1	1		6.2	0.4			6.2	
ld Scotland Correctional Center	173.6	1		1	131.9		104.1			
PS Inmate Training Program	58.0	1		1	40.5	17.6	16.0			
C Highway Patrol Training Center	170.7	1		1	53.2	15.8	15.8	58.7		
ampson Correctional Institution	53.7	1		1	10.7		9.6	2.9		
aledonia Correctional Institution	6847.2	1	1	1						
urrituck Correctional Center	666.7	1	1							
olk Correctional Institution	160.7	1	1	1	113.0	6.7			113.0	
obbs Youth Development Center	128.4	1	1	1			1.3			
laden Correctional Center	446.3	1	1	1	10.9		14.9			
cotland County Correctional Facility	151.1	1		1	42.9	3.6	0.9		40.0	
amarkand Manor Youth Development Center	444.9	1	1		2.2				1.1	
ational Guard Armory Readiness Center	207.3	1	1	1	161.7	51.6	52.3			
orrison Correctional Institution	735.3	1	1	1						
arnett Correctional Institution	200.8	1		1	135.0				115.0	
wannanoa Correctional Center for Women	242.6	1			72.5	6.9				
ormer Robeson Correctional Center	74.3	1		1	54.3	54.3	55.4		12.2	
ash Correctional Institution	136.0	1		1	48.9	14.5				
ertie Correctional Institution	130.2	1	1	1	60.9					
ichmond Boundover Juvenile Service Center	79.6	1			50.7			21.1		
ormer Duplin Correctional Center	82.2	1		1	12.5					
raggy Correctional Center	286.7	1			241.1	21.3		241.1		
mstead Correctional Center	38.2	1	1	1						
oldsboro Correctional Center	83.7	1	1							
range Correctional Center	56.5	1			27.4			26.5		
rrell Prison Work Farm	195.9	1		1	57.2	35.4	36.0			
tonewall Jackson School	798.5	1	1	1	1.1	0.4				
raven Correctional Institution	182.9	1		1	135.7					
an River Prison Work Farm	188.1	1		1	115.2					
ckerd Wilderness Youth Camp	439.5	1	1	1						
rown Creek Correctional Institution	356.6	1		1	160.6					
ountain View Correctional Institution	97.3	1			31.8					
ormer Charlotte Correctional Center	47.8	1		1	29.6	3.6	4.2	29.6		
amlico Correctional Institution	137.5	1		1	60.0					
ohnston Correctional Center	195.3	1			82.1	14.5	14.7		74.3	



	General information					Resilience benefits of areas with reforestation potential (green shading = more than 5 acres of reforestation potential with the resilience benefit)			
Complex name	Area, acres	Contains forest? (1 = yes)	Contains protected land? (1 = yes)	High social vulnerability area? (1 = yes)	Area of reforestation potential, acres	Reforestation potential in high flood risk watershed, acres	Reforestation potential in water quality hazard watershed, acres	Reforestation potential in urban area, acres	Reforestation potential in water supply watershed, acres
lbermarle Correctional Institution	97.2	1			3.1				3.
ountain Youth Development Center	122.6	1	1	1					
A Dillon School	87.2	1	1		6.9				6.
Warren Correctional Institution	108.8	1			22.2				
wery Correctional Center	99.9	1			14.9	4.7			14.
PS Coastal Region Office	60.5	1		1	4.7	3.3		1.1	
oncord Ring Dike Registered Heritage Area	6.9	1	1	1					
ender Correctional Institution	345.0	1		1	12.7	11.3	11.3		
abor Correctional Institution	108.0	1		1	7.3				
oke Correctional Institution	2055.4	1	1		11.3				
amp Butner National Guard Training Center	4980.2	1	1		259.3	0.2			259.
ld Scotland Correctional Center	173.6	1		1	0.4		0.2		
PS Inmate Training Program	58.0	1		1	16.5	7.8	7.8		
C Highway Patrol Training Center	170.7	1		1	12.7			13.3	
ampson Correctional Institution	53.7	1		1	2.0		0.4	1.8	
aledonia Correctional Institution	6847.2	1	1	1	4273.8				
urrituck Correctional Center	666.7	1	1		13.6				
olk Correctional Institution	160.7	1	1	1	3.3				3.
obbs Youth Development Center	128.4	1	1	1	5.1				
laden Correctional Center	446.3	1	1						
cotland County Correctional Facility	151.1	1		1	3.8	0.2	0.7		1.
amarkand Manor Youth Development Center	444.9	1	1		4.3				4.
ational Guard Armory Readiness Center	207.3	1	1	1	5.1	1.3	1.3		
orrison Correctional Institution	735.3	1	1	1	0.9				0.
arnett Correctional Institution	200.8	1		1	4.4				4.
wannanoa Correctional Center for Women	242.6	1			10.2	1.3			
ormer Robeson Correctional Center	74.3	1		1					
ash Correctional Institution	136.0	1		1	1.8	0.2			
ertie Correctional Institution	130.2	1	1	1	2.9				
ichmond Boundover Juvenile Service Center	79.6	1							
ormer Duplin Correctional Center	82.2	1		1					
raggy Correctional Center	286.7	1			5.8			6.0	
mstead Correctional Center	38.2	1	1	1	2.2	0.4		2.9	2.
oldsboro Correctional Center	83.7	1	1		40.9	38.7		41.6	40.
range Correctional Center	56.5	1			1.3			1.3	
rrell Prison Work Farm	195.9	1		1	51.8	50.7	50.7		
tonewall Jackson School	798.5	1	1	1	133.2	5.8		4.7	
raven Correctional Institution	182.9	1		1					
an River Prison Work Farm	188.1	1		1	45.6				
ckerd Wilderness Youth Camp	439.5	1	1	1					
rown Creek Correctional Institution	356.6	1		1	34.7				
ountain View Correctional Institution	97.3	1			4.2				
ormer Charlotte Correctional Center	47.8	1		1				0.2	
amlico Correctional Institution	137.5	1		1	15.3				
ohnston Correctional Center	195.3	1			13.1	3.8	3.8		13.
andolph Correctional Center	85.3	1		1	5.3				

Additional maps and data available

We have additional maps and data related to the following benefits that forests can provide. These were not included in the current slide deck because they require public access and therefore may not be relevant to DPS properties. Please let us know if you're interested in seeing these benefits summarized for DPS properties.

- Open space recreation access
- Recreational birding