ENVIROATLAS USE CASE

Mapping Potential Demand for Water Quality Trading in the United States

OCTOBER 2018

Ecosystem Marketplace
A FOREST TRENDS INITIATIVE

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Forest Trends' Ecosystem Marketplace
National Network on Water Quality Trading

This use case was developed in partnership with the National Network on Water Quality Trading (NNWQT), the United States Environmental Protection Agency (EPA) EnviroAtlas team, and the United States Department of Agriculture (USDA) Office of Environmental Markets. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of NNWQT, EPA, or USEPA.

Ecosystem Marketplace

A FOREST TRENDS INITIATIVE

Introduction

- Water quality trading is a promising tool that offers a flexible, more cost-effective approach to reducing pollution in our waterways than more traditional engineered solutions. Yet a lack of sufficient demand for credits has been a consistent barrier to scaling up water quality trading in the United States.

- The National Network on Water Quality Trading (NNWQT) is a network of diverse organizations representing agriculture, wastewater utilities, environmental groups, regulatory agencies, and the practitioners delivering water quality trading programs. In the fall of 2017, NNWQT partnered with Forest Trends' Ecosystem Marketplace and the US Environmental Protection Agency's EnviroAtlas project team to map watersheds where potential demand for water quality trading may exist. Findings will inform a new action agenda for stimulating demand for water quality credits and other market-based programs that can produce investments in nonpoint source water quality improvements as an alternative to traditional compliance strategies.

- Here, we present detailed results of a geospatial analysis mapping potential demand for both agriculture-generated water quality credits and stormwater credits. These maps are intended to inform the NNWQT in its work crafting a new national strategy for scaling up demand. Development of a suitability analysis has helped the NNWQT to test its assumptions about what drives demand for trading, identify where opportunities to influence demand drivers may exist, and communicate visually the potential scale of trading.

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INTRODUCTION

- This use case presents findings from two suitability analyses carried out to assess potential demand for agricultural water quality credit trading and stormwater trading. In each analysis, we considered a range of biophysical, economic, and policy/regulatory drivers of demand. Since agricultural water quality credit trading and stormwater trading may have somewhat different drivers, two different models were developed.

- Demand indicators were selected through a review of literature on water quality trading and extensive consultation with the National Network on Water Quality Trading's network coordinator, the Willamette Partnership, and the Network's Steering Committee. Indicator choice was also shaped by the availability of national-level, quantitative, spatially explicit datasets or the project team's ability to develop such datasets.

- Following this analysis, additional "ground-truthing" of its results will be required to evaluate potential demand in greater detail and specificity than a national-scale map can provide. The results presented here should be interpreted in light of the limitations of available data and our analytical approach. For example, indicators may be imperfect proxies for actual demand drivers, and our assumptions about which indicators to use and how they influence demand are fallible, even if they are based on best available knowledge and experience to date.

- Finally, our analysis did not capture qualitative factors that can influence demand, such as presence of a local champion or institutional culture within a regulatory field office. These "soft" factors are often tremendously important to a program's success, and should be considered carefully by anyone seeking to develop a trading program.

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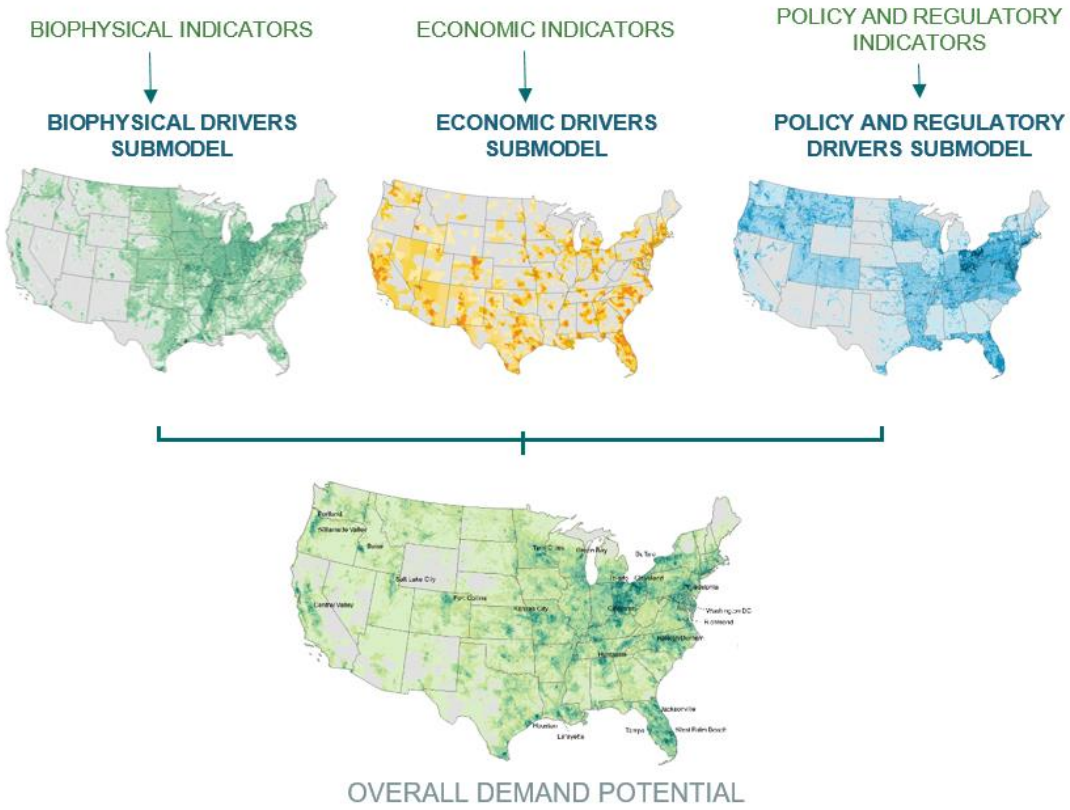
Research approach: We developed a suitability analysis based on biophysical, economic, and policy/regulatory indicators of demand.

Indices representing potential demand for agricultural water quality credit trading and stormwater trading were developed based on three submodels summarizing biophysical, economic, and policy/regulatory indicators of demand.

We normalized and combined these submodels to create a master overall map of potential demand: one for agricultural water quality credit trading, and one for stormwater trading.

Indicators were summarized and scored at the 12-digit HUC level unless otherwise noted. A full list of indicators and data sources are presented in the following slides.

Analytical Workflow for Agricultural Water Quality Credit Trading and Stormwater Trading Models



Demand drivers explained: A range of biophysical, economic, and policy/regulatory drivers of demand were considered in our analysis.

Biophysical drivers of demand are related to the degree and sources of water pollution in a watershed. A watershed struggling with serious water quality problems, where regulated point sources have a history of exceeding permit limits and where nonpoint sources are also a significant contributor to impairment, is potentially a good candidate for a trading program. Point sources must reduce their pollutant loads in order to comply with National Pollutant Discharge Elimination System (NPDES) permit limits, and there is scope for those reductions to be achieved through nonpoint source credits.

For agricultural water quality credit trading, a high percentage of agricultural land cover and data on the level of nonpoint source pollution in the watershed are useful indicators to consider in assessing demand. For stormwater trading, on the other hand, the amount of impervious surface cover is an important signal of whether demand might potentially exist for a trading program.

Indicator of Biophysical Demand for Trading	Agricultural Trading	Stormwater Trading
Share (%) of land cover in agriculture	X	
Share (%) of land cover in impervious surface		X
Presence of regulated point source facilities with permit limits discharging into impaired waters a pollutant potentially contributing to impairment, and which have a violation of effluent limits or compliance schedules in at least four of the last twelve quarters	X	X
Total annual load volume from NPDES sites (nitrogen [N], phosphorus [P], solids, and organics)	X	X
Total average temperature change from NPDES sites	X	X
Nonpoint source contribution to pollution: Metric tons of nutrients (N+P) annual loss	X	

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Demand drivers explained: A range of biophysical, economic, and policy/regulatory drivers of demand were considered in our analysis.

Economic drivers of demand are related to new growth that can increase the need for trading to address pollution.

For example, a growing population will put increasing pressure on wastewater treatment facilities such as publicly owned treatment works (POTWs), many of which already struggle with insufficient capacity. In response, water service providers can build new treatment facilities or upgrade existing ones. But they may also consider agricultural water quality credit trading as an alternative, especially if it is more cost-effective or delivers additional benefits to the community.

Expected growth in impervious surface coverage can similarly trigger demand for stormwater trading in urban areas as an alternative or complement to on-site stormwater controls. Finally, large urban areas (defined in this exercise as having more than 100,000 residents) are more likely to be able to support both agricultural water quality credit and stormwater trading, in terms of providing the resources to develop a trading program and generating enough demand to create an active market.

Indicator of Economic Demand for Trading	Agricultural Trading	Stormwater Trading
Presence of POTWs reporting insufficient capacity/level of treatment	X	
Projected population growth	X	X
Projected impervious surface growth		X
Presence of a city/municipality with >100,000 residents	X	X

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Demand drivers explained: A range of biophysical, economic, and policy/regulatory drivers of demand were considered in our analysis.

Policy/regulatory drivers of demand for trading include both the regulations that impel entities discharging pollutants to comply with water quality standards, such as a 303(d) listing under the Clean Water Act, and also the policy and guidance that explicitly support water quality trading and/or set out the rules and framework for trading. Both increase the likelihood of interest in trading among potential buyers.

Many states have trading policies or guidance in place. Many tend to focus on an agricultural water quality credit trading model, although these frameworks can be theoretically adapted for stormwater trading. A number of municipal separate storm sewer system (MS4) permits include language that specifically allows for stormwater offsets or mitigation.

Finally, a history of trading nearby also suggests that both effective demand drivers and buyers familiar with trading may already exist in a watershed.

Indicator of Policy/Regulatory Demand for Trading	Agricultural Trading	Stormwater Trading
303(d) listed impaired waters: Kilometers of 303(d) listed impaired waters for N, P, temperature, total suspended solids, and/or dissolved oxygen in the watershed	X	X
Presence of water quality trading program with a trade completed in the last three years	X	X
Active or draft state-level trading regulation, policy, or guidance	X	X
Presence of a regulated MS4 with language supportive of stormwater offsets or mitigation		X

Potential Demand for Agricultural Water Quality Credit Trading

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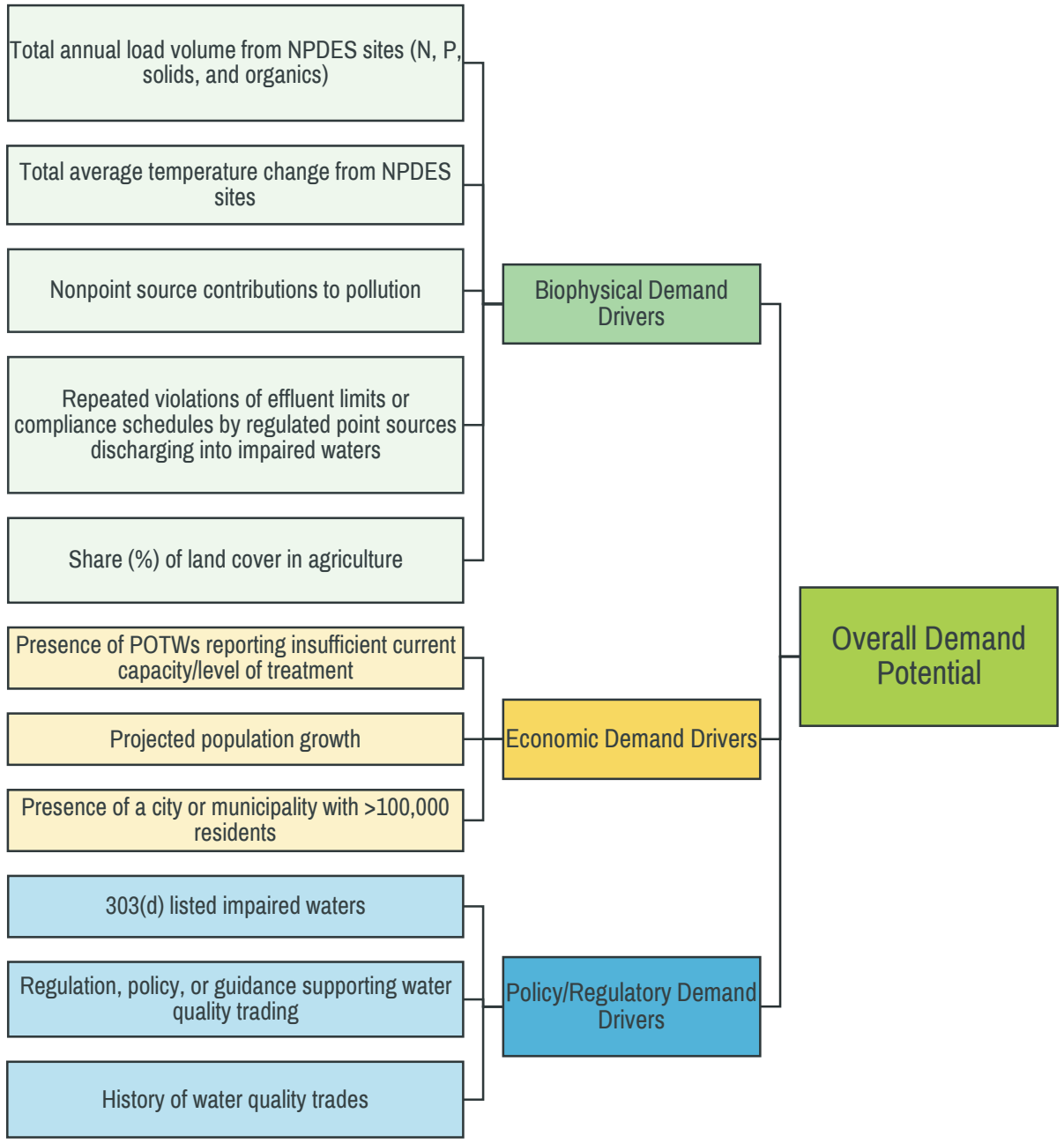
This chart shows biophysical, economic, and policy/regulatory indicators used to develop an overall demand potential score for agricultural water quality credit trading for each watershed in the United States.



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This table shows the data source, unit, and scoring approach for each indicator of biophysical demand.

Biophysical Demand Drivers for Agricultural Water Quality Credit Trading: Indicators, Data Sources, and Scoring Method

Indicator	Total annual load volume from NPDES sites (N, P, solids, and organics)	Total average temperature change from NPDES sites	Nonpoint source contribution to pollution: Metric tons of nutrients (N+P) annual loss
Data source	EPA National Pollutant Discharge Elimination System (NPDES)	EPA National Pollutant Discharge Elimination System (NPDES)	EnviroAtlas: Edge of field estimates for N and P deposition
Unit	Volume (lbs) per HUC-12	Average temperature change (°F per HUC12)	Metric tons per HUC-12
Scoring method	Quantile	Quantile	Quantile
Scores	-	-	-
1 (low potential demand)	0	0	0
2	0 - 204.54	0 - 55.75	0-4
3	204.54 – 1,132.24	55.75 - 58.65	4-12
4	1,132.24 – 3,891.67	58.65 - 61.02	12-24
5	3,891.67 – 9,695.38	61.02 - 63.77	24-42
6	9,695.38 – 19,996.08	63.77 - 67.10	42-69
7	19,996.08 – 45,836.76	67.10 - 69.92	69-110
8	45,836.76 – 116,362.90	69.92 - 73.18	110-174
9	116,362.90 – 399,003.03	73.18 - 77.77	174-286
10 (high potential demand)	399,003.03 – 1,810,492,416	77.77 - 3930.22	286-1981

[Table continues on next slide]

ENVIROATLAS USE CASE

This table shows the data source, unit, and scoring approach for each indicator of biophysical demand.

Biophysical Demand Drivers for Agricultural Water Quality Credit Trading: Indicators, Data Sources, and Scoring Method (continued)

Indicator	**Presence of regulated point source (PS) facility with permit limits, discharging into impaired waters a pollutant potentially contributing to impairment, and which has a violation in at least four of the last twelve quarters of effluent limits or compliance schedules**	**Share (%) of land cover in agriculture**
Data source	EPA National Pollutant Discharge Elimination System (NPDES) and EPA Enforcement and Compliance History Online (ECHO)	EnviroAtlas: National Land Cover Database
Unit	Facility	High/Low
Scoring method	Yes/No	High > 31.3022% (The average % in areas w/ a history of trading)
Scores		
1 (low potential demand)	No regulated PS	Low
2	-	-
3	-	-
4	-	-
5	>0 Regulated PS	-
6	-	-
7	-	-
8	-	-
9	-	-
10 (high potential demand)	>0 Regulated PS, including >0 PS Discharger(s) with Exceedances	High

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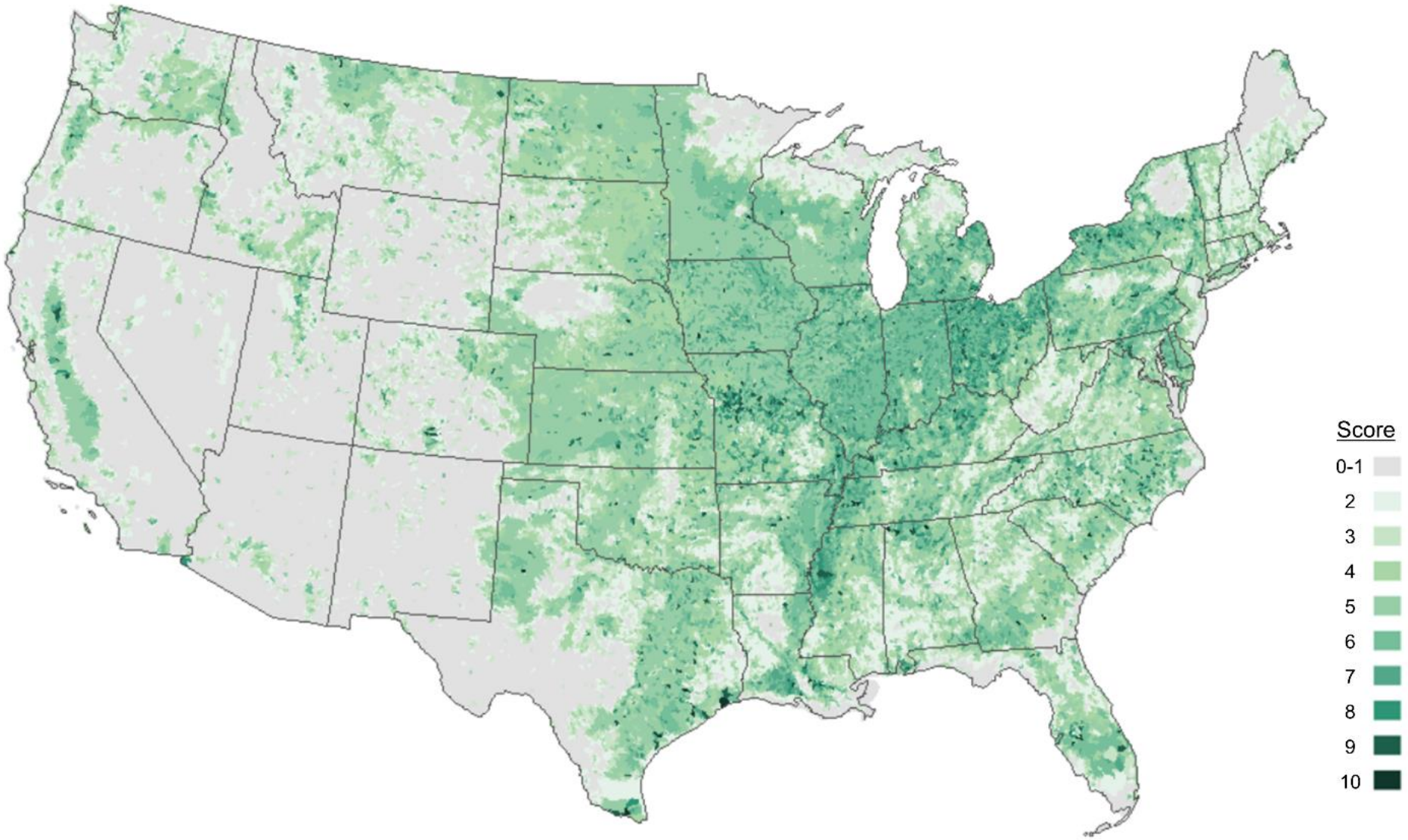
Results: This map displays regions (in dark green) with high scores for biophysical drivers of demand for agricultural water quality credit trading.

Results of Biophysical Demand Drivers Submodel: Agricultural Water Quality Credit Trading



ENVIROATLAS USE CASE

This table shows the data source, unit, and scoring approach for each indicator of economic demand.

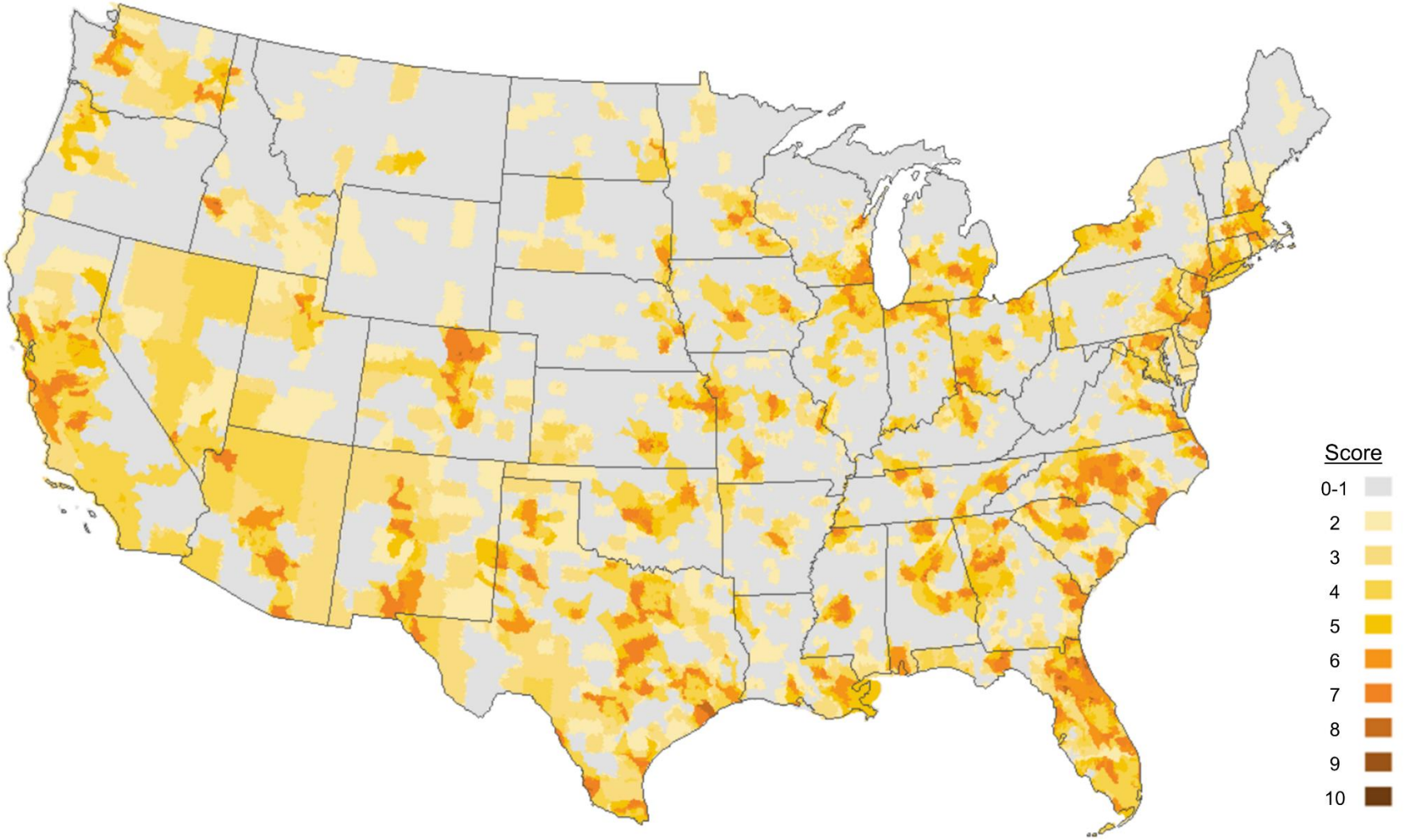
Economic Demand Drivers for Agricultural Water Quality Credit Trading: Indicators, Data Sources, and Scoring Method

Indicator	Presence of POTWs reporting insufficient current capacity/level of treatment	Projected population growth	Presence of a city/municipality with >100,000 residents
Data source	EPA Clean Water Needs Survey 2012	EPA Integrated Climate and Land-Use Scenarios (ICLUS)	USGS National Boundaries
Unit	Count of facilities per HUC-12	% Change between 2005 and 2020	Presence in HUC-8 watershed
Scoring method	Count	Quantile, except <0	Yes/No
Scores			
1 (low potential demand)	0	< 0	No
2	1	0 - 2	-
3	2	2 - 5	-
4	3	5 - 8	-
5	4	8 - 11	-
6	5	11 - 14	-
7	6	14 - 17	-
8	7	17 - 20	-
9	8	20 - 25	-
10 (high potential demand)	≥9	25 - 51	Yes

ENVIROATLAS USE CASE

Results: This map displays regions (in dark orange) with high scores for economic drivers of demand for agricultural water quality credit trading.

Results of Economic Demand Drivers Submodel: Agricultural Water Quality Credit Trading



ENVIROATLAS USE CASE

This table shows the data source, unit, and scoring approach for each indicator of policy/regulatory demand.

Policy/Regulatory Demand Drivers for Agricultural Water Quality Credit Trading: Indicators, Data Sources, and Scoring Method

Indicator	Kilometers of 303(d) listed impaired waters for N, P, temperature, total suspended solids, and/or dissolved oxygen in the watershed	Presence of water quality trading program with a trade completed in the last three years	Active or draft state-level trading regulation, policy, or guidance
Data source	EnviroAtlas	EnviroAtlas	EnviroAtlas
Unit	Km per HUC-12		
Scoring method	Quantile	Yes/No	Yes/No
Scores			
1 (low potential demand)	0	No	No
2	0 - 2.9	-	-
3	2.9 - 6.4	-	-
4	6.4 - 10.9	-	-
5	10.9 - 16.7	-	-
6	16.7 - 22.4	-	-
7	22.4 - 30.4	-	-
8	30.4 - 42.4	-	-
9	42.4 - 66.6	-	-
10 (high potential demand)	66.6 - 829.8	Yes	Yes

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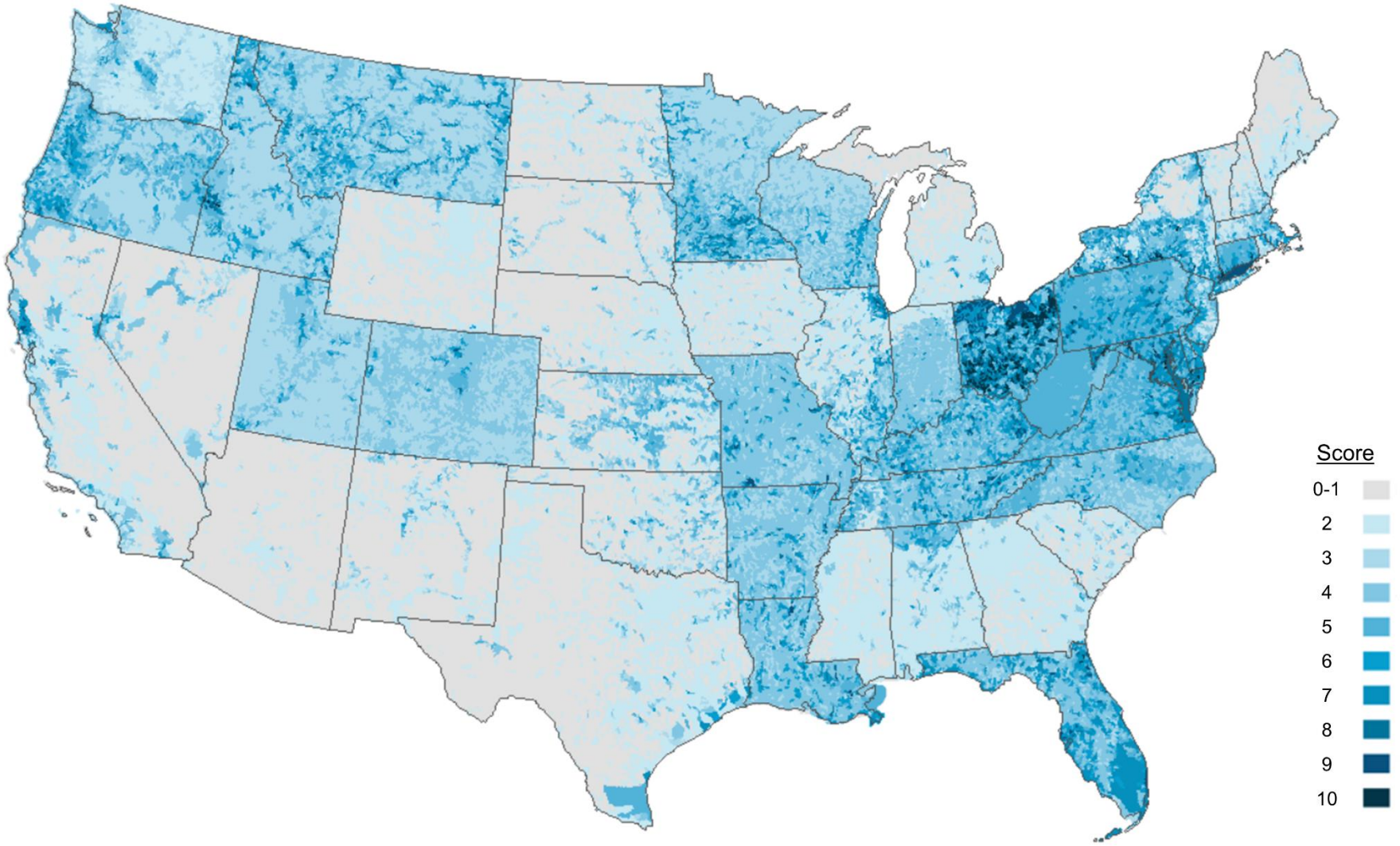
Results: This map displays regions (in dark blue) with high scores for policy/regulatory drivers of demand for agricultural water quality credit trading.

Results of Policy/Regulatory Demand Drivers Submodel: Agricultural Water Quality Credit Trading



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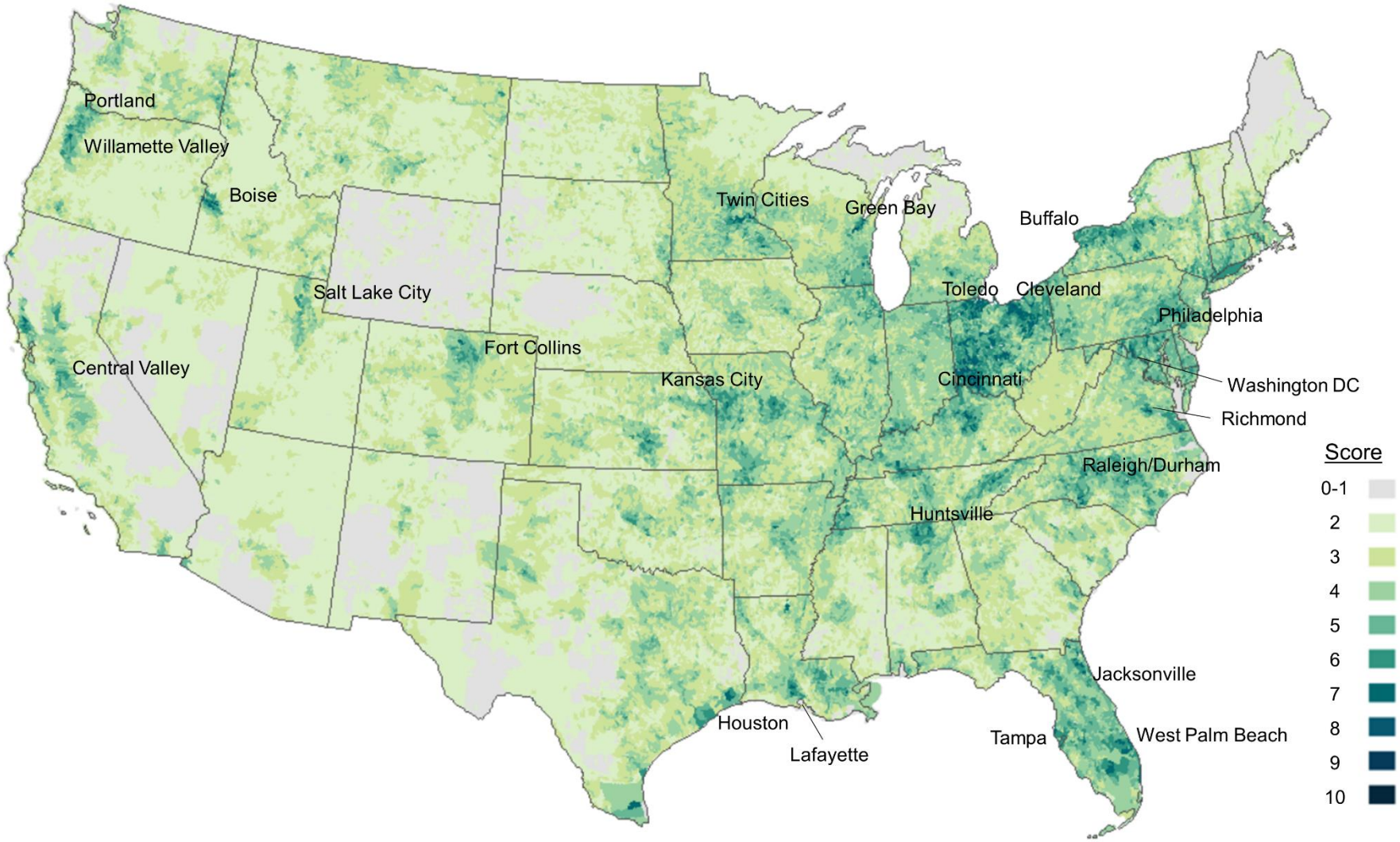
Results: This map displays regions (in navy blue) with high scores for overall combined biophysical, economic, and policy/regulatory drivers of demand for agricultural water quality credit trading.

Overall Potential Demand for Agricultural Water Quality Credit Trading in United States Watersheds (HUC-12)



Potential Demand for Stormwater Trading

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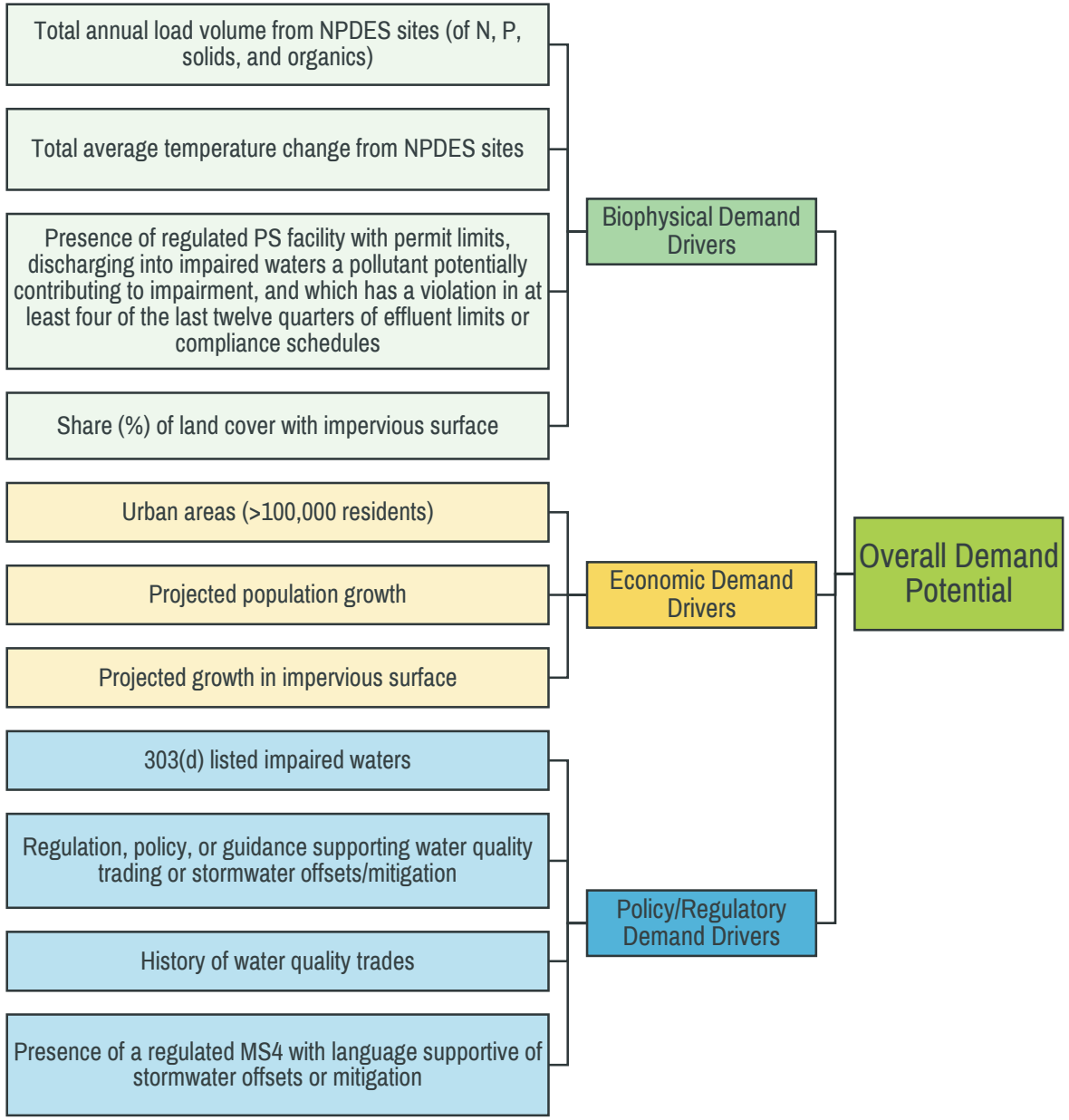
This chart shows biophysical, economic, and policy/regulatory indicators used to develop an overall demand potential score for stormwater trading for each watershed in the United States.



ENVIROATLAS USE CASE

This table shows the data source, unit, and scoring approach for each indicator of biophysical demand.

Biophysical Demand Drivers for Stormwater Trading: Indicators, Data Sources, and Scoring Method

Indicator	**Total annual load volume from NPDES sites (N, P, solids, and organics)**	**Total average temperature change from NPDES sites**	**Presence of regulated PS facility with permit limits, discharging into impaired waters a pollutant potentially contributing to impairment, and which has a violation in at least four of the last twelve quarters of effluent limits or compliance schedules**	**Share (%) of land cover with impervious surface**
Data source	EPA National Pollutant Discharge Elimination System (NPDES)	EPA National Pollutant Discharge Elimination System (NPDES)	EPA National Pollutant Discharge Elimination System (NPDES) and EPA Enforcement and Compliance History Online (ECHO)	EnviroAtlas: National Land Cover Database
Unit	Volume (lbs) per HUC-12	Average temperature change (°F per HUC12)	Facility	High/Medium/Low
Scoring method	Quantile	Quantile	Yes/No	
Scores	-	-		
1 (low potential demand)	0	0	No regulated PS	Low: < 5%
2	0 - 204.54	0 - 55.75	-	-
3	204.54 – 1,132.24	55.75 - 58.65	-	-
4	1,132.24 – 3,891.67	58.65 - 61.02	-	-
5	3,891.67 – 9,695.38	61.02 - 63.77	>0 Regulated PS	Medium: 5-15%
6	9,695.38 – 19,996.08	63.77 - 67.10	-	-
7	19,996.08 – 45,836.76	67.10 - 69.92	-	-
8	45,836.76 – 116,362.90	69.92 - 73.18	-	-
9	116,362.90 – 399,003.03	73.18 - 77.77	-	-
10 (high potential demand)	399,003.03 – 1,810,492,416	77.77 - 3930.22	>0 Regulated PS, including >0 PS Discharger(s) with Exceedances	High: > 15%

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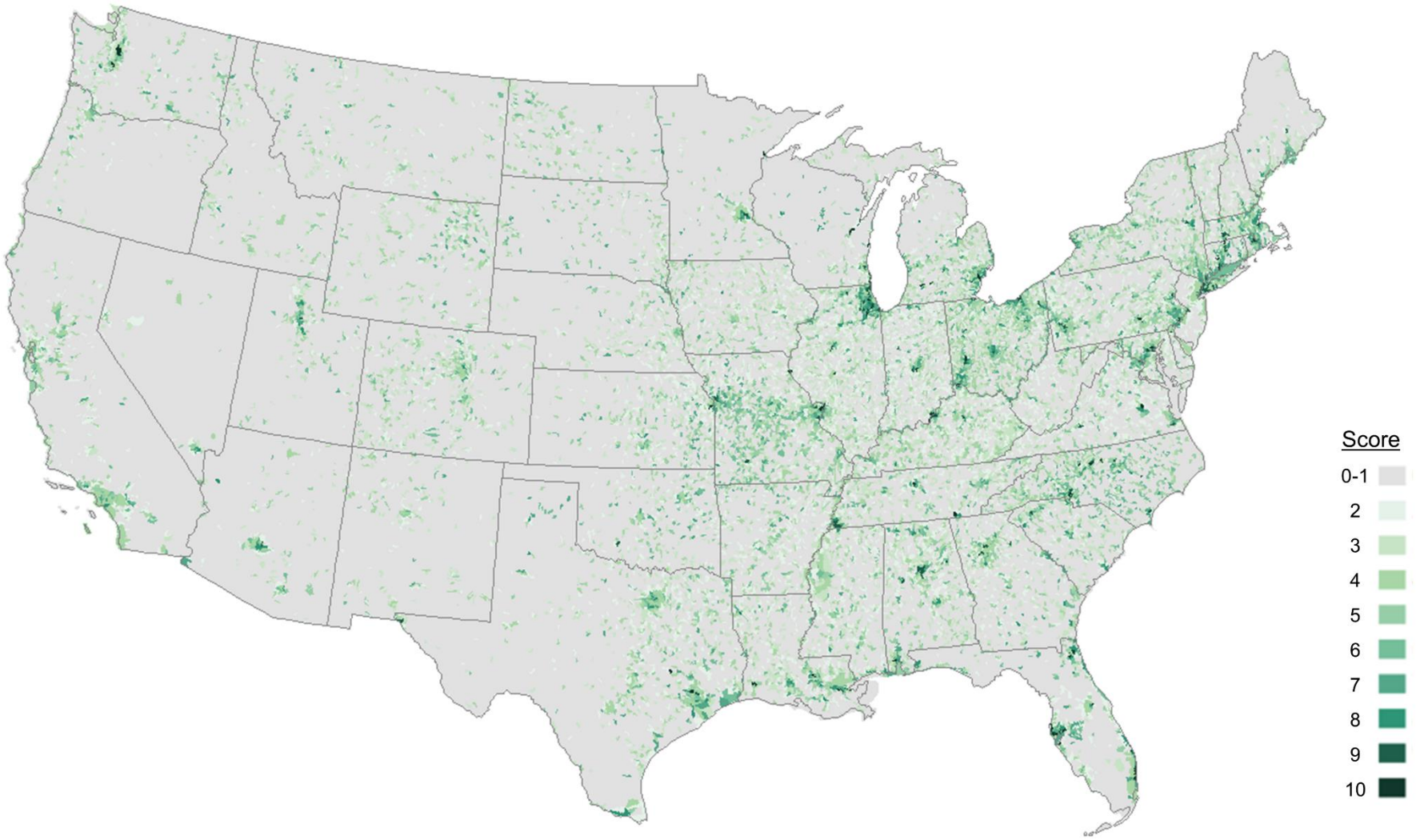
Results: This map displays regions (in dark green) with high scores for biophysical drivers of demand for stormwater trading.

Results of Biophysical Demand Drivers Submodel: Stormwater Trading



ENVIROATLAS USE CASE

This table shows the data source, unit, and scoring approach for each indicator of economic demand.

Economic Demand Drivers for Stormwater Trading: Indicators, Data Sources, and Scoring Method

Indicator	Urban areas: Presence of a city/municipality with >100,000 residents in the watershed	Projected population growth	Impervious surface area
Data source	USGS National Boundaries	EPA Integrated Climate and Land-Use Scenarios (ICLUS)	EPA Integrated Climate and Land-Use Scenarios (ICLUS)
Unit	Presence in HUC-8 watershed	% Change between 2005 and 2020	% Change between 2010 and 2020
Scoring method	Yes/No	Quantile, except <0	Quantile, except <0
Scores			
1 (low potential demand)	No	< 0	< 0
2	-	0 - 2	0 - 0.5
3	-	2 - 5	0.5 - 1.1
4	-	5 - 8	1.1 - 2.1
5	-	8 - 11	2.1 - 3.4
6	-	11 - 14	3.4 - 4.9
7	-	14 - 17	4.9 - 6.9
8	-	17 - 20	6.9 – 9.9
9	-	20 - 25	9.9 - 15.3
10 (high potential demand)	Yes	25 - 51	15.3 - 127.4

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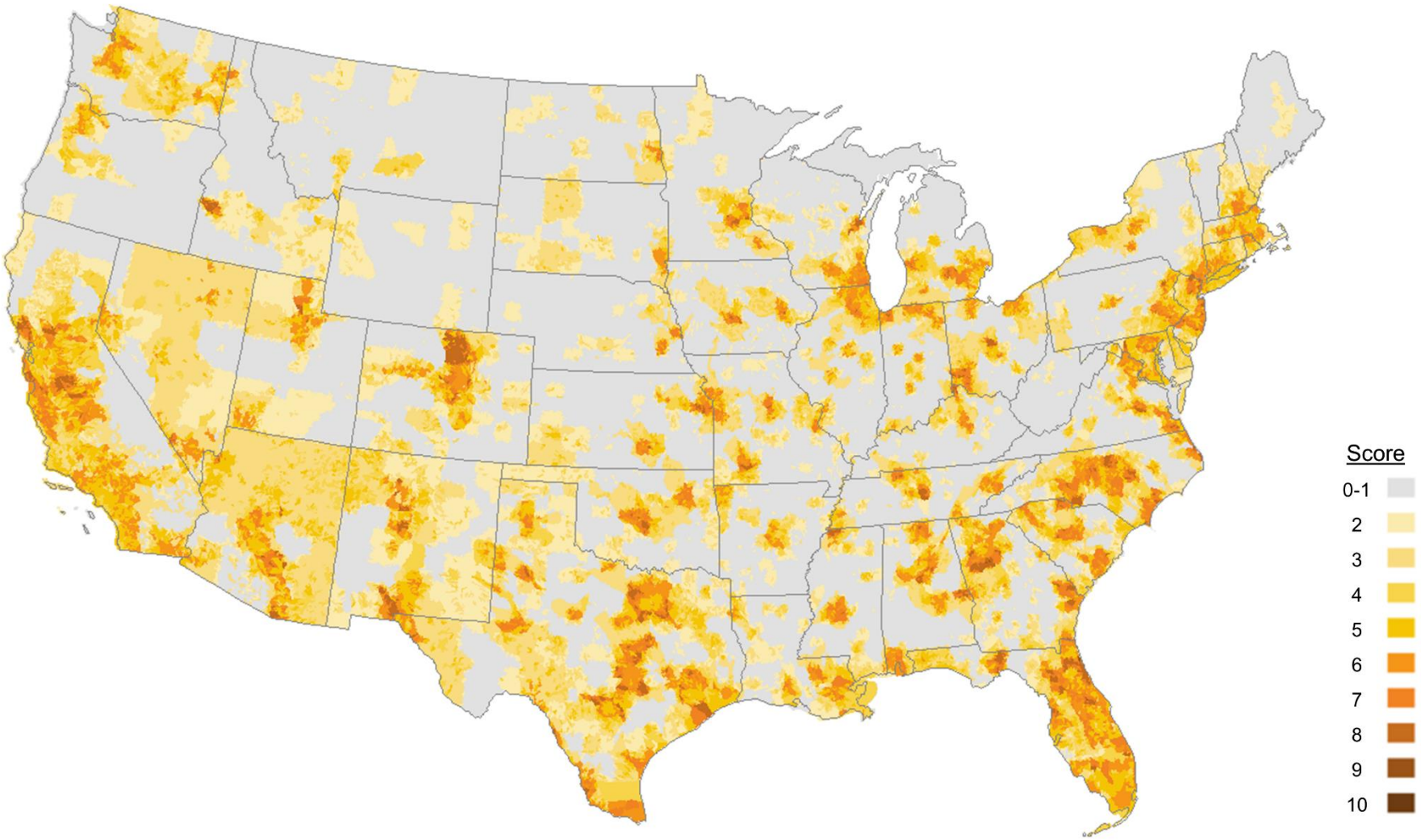
Results: This map displays regions (in dark orange) with high scores for economic drivers of demand for stormwater trading.

Results of Economic Demand Drivers Submodel: Stormwater Trading



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This table shows the data source, unit, and scoring approach for each indicator of policy/regulatory demand.

Policy/Regulatory Demand Drivers for Stormwater Trading: Indicators, Data Sources, and Scoring Method

Indicator	Kilometers of 303(d) listed impaired waters for N, P, temperature, total suspended solids, and/or dissolved oxygen in the watershed	Presence of water quality trading program with a trade completed in the last three years	Active or draft state-level trading regulation, policy, or guidance	Presence of a MS4 with language supportive of stormwater offsets or mitigation
Data source	EnviroAtlas	EnviroAtlas	EnviroAtlas	EPA National Pollutant Discharge Elimination System (NPDES)
Unit	Km/huc 12			
Scoring method	Quantile	Yes/No	Yes/No	Yes/No
Scores				
1 (low potential demand)	0	No	No	No
2	0 - 2.9	-	-	-
3	2.9 - 6.4	-	-	-
4	6.4 - 10.9	-	-	-
5	10.9 - 16.7	-	-	-
6	16.7 - 22.4	-	-	-
7	22.4 - 30.4	-	-	-
8	30.4 - 42.4	-	-	-
9	42.4 - 66.6	-	-	-
10 (high potential demand)	66.6 - 829.8	Yes	Yes	Yes

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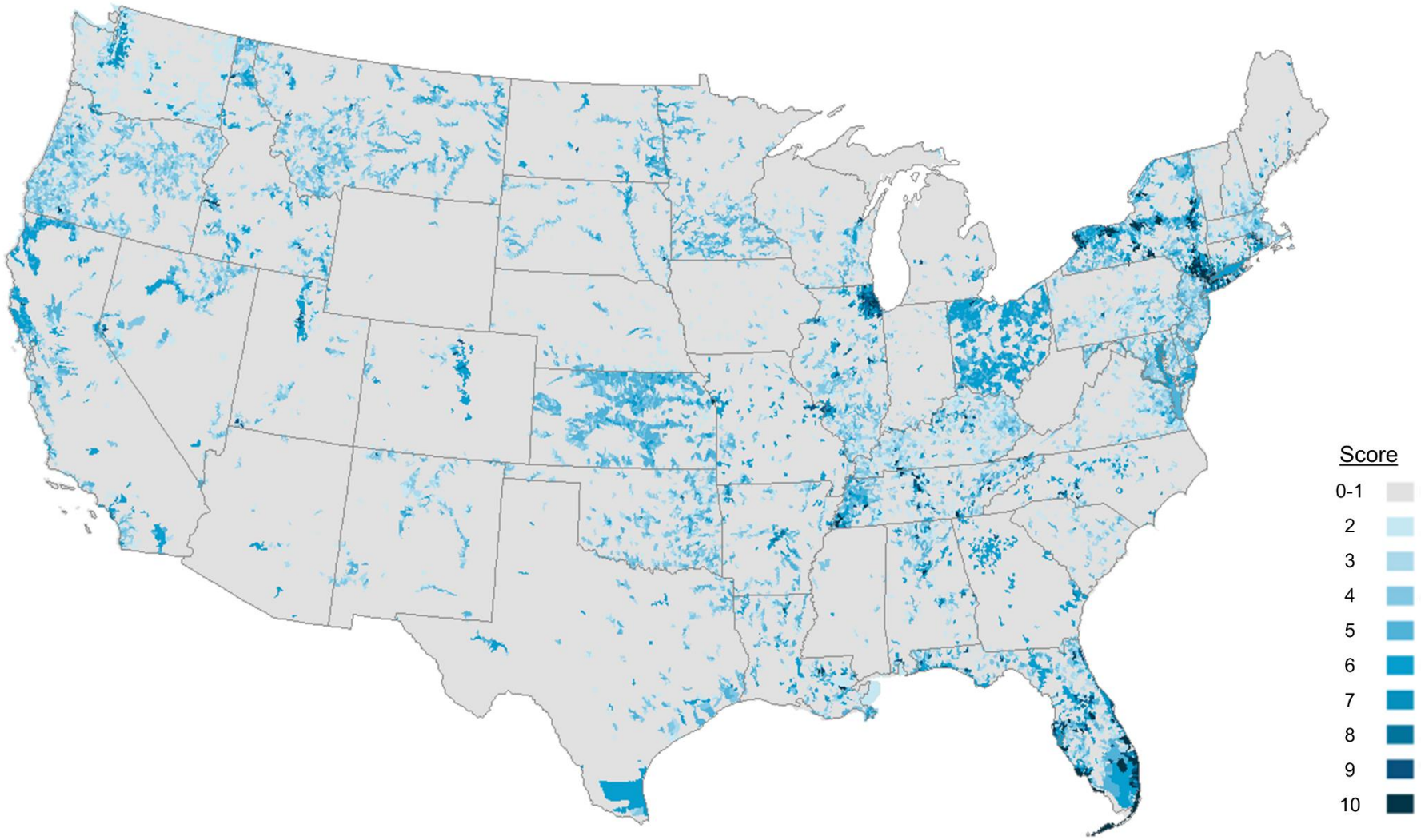
Results: This map displays regions (in dark blue) with high scores for policy/regulatory drivers of demand for stormwater trading.

Results of Policy/Regulatory Demand Drivers Submodel: Stormwater Trading



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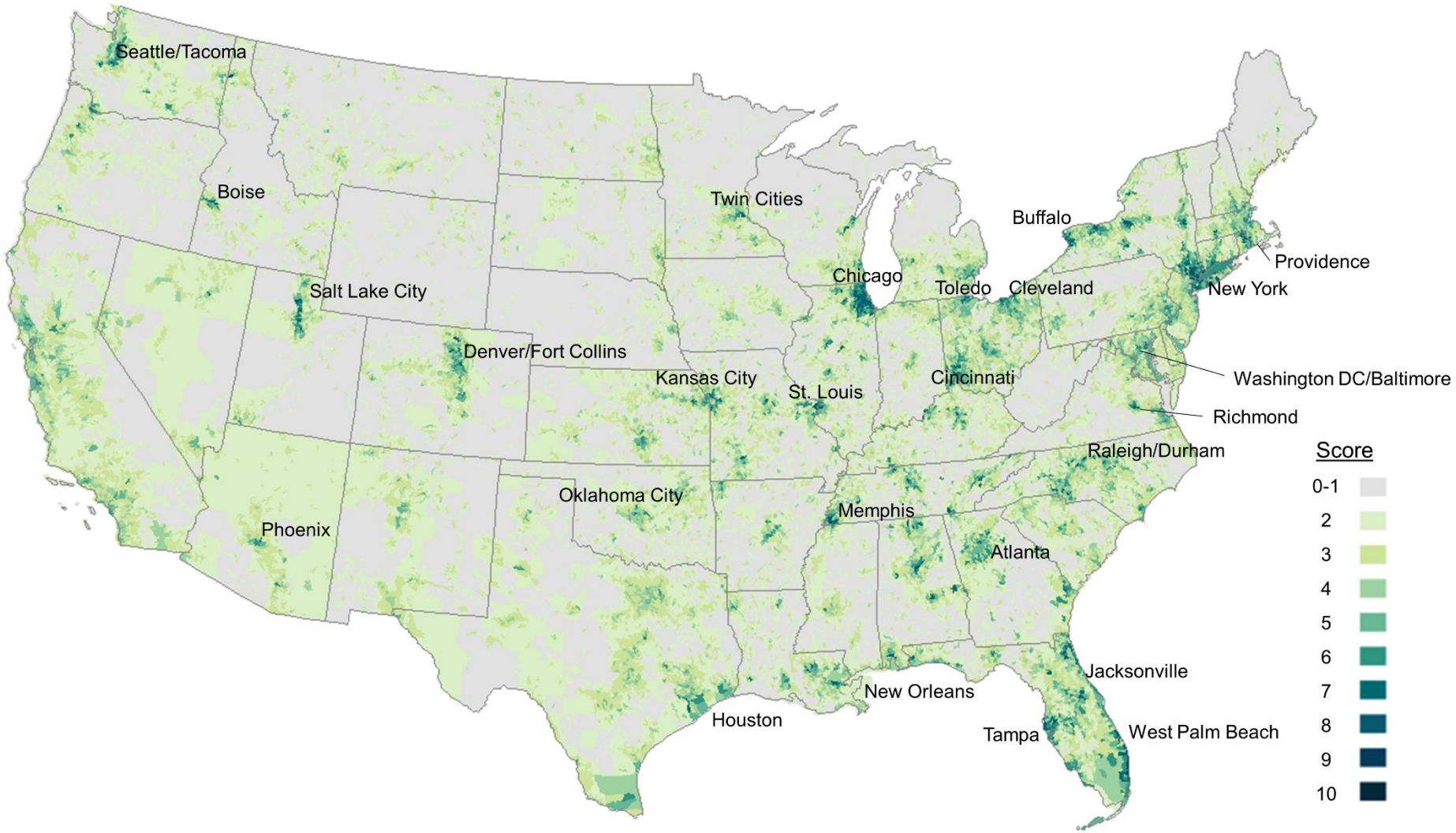
Results: This map displays regions (in navy blue) with high overall combined biophysical, economic, and policy/regulatory scores for drivers of demand for stormwater trading.

Overall Potential Demand for Stormwater Trading in United States Watersheds (HUC-12)



Implications for a Demand Strategy

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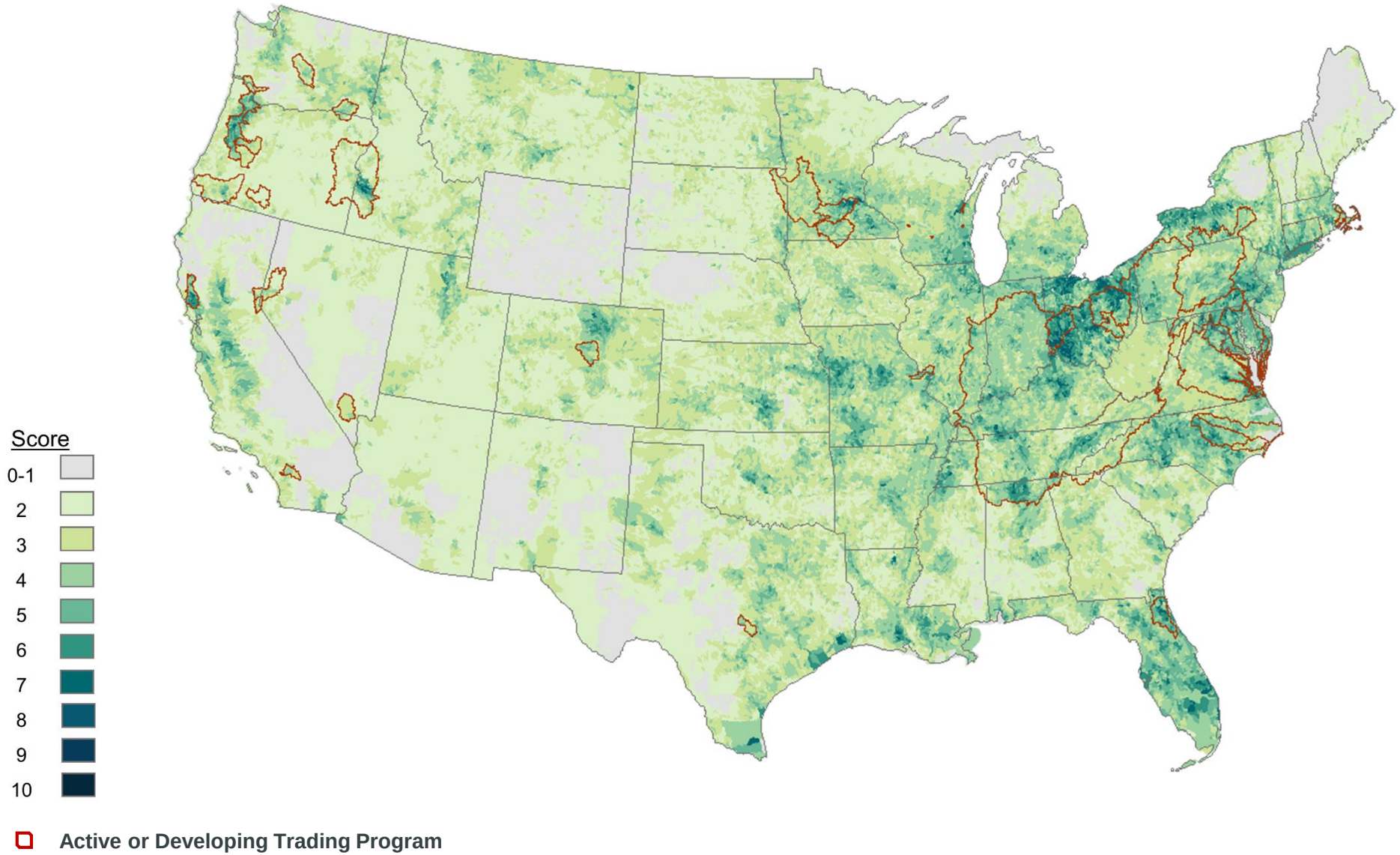
Our results include regions where trading is already active or in development, including Chesapeake Bay Basin states, North Carolina, the Willamette Valley, the Ohio River Basin, and Boise. Other areas suggest future potential, such as Sacramento, Akron, Cleveland, Toledo, Buffalo, Lexington, Fort Collins, Kansas City, and a number of major cities in Florida and along the Gulf Coast including Houston and Lafayette.

Overall Potential Demand for Agricultural Water Quality Credit Trading for United States Watersheds (HUC-12), and Active and Developing Trading Programs in 2018



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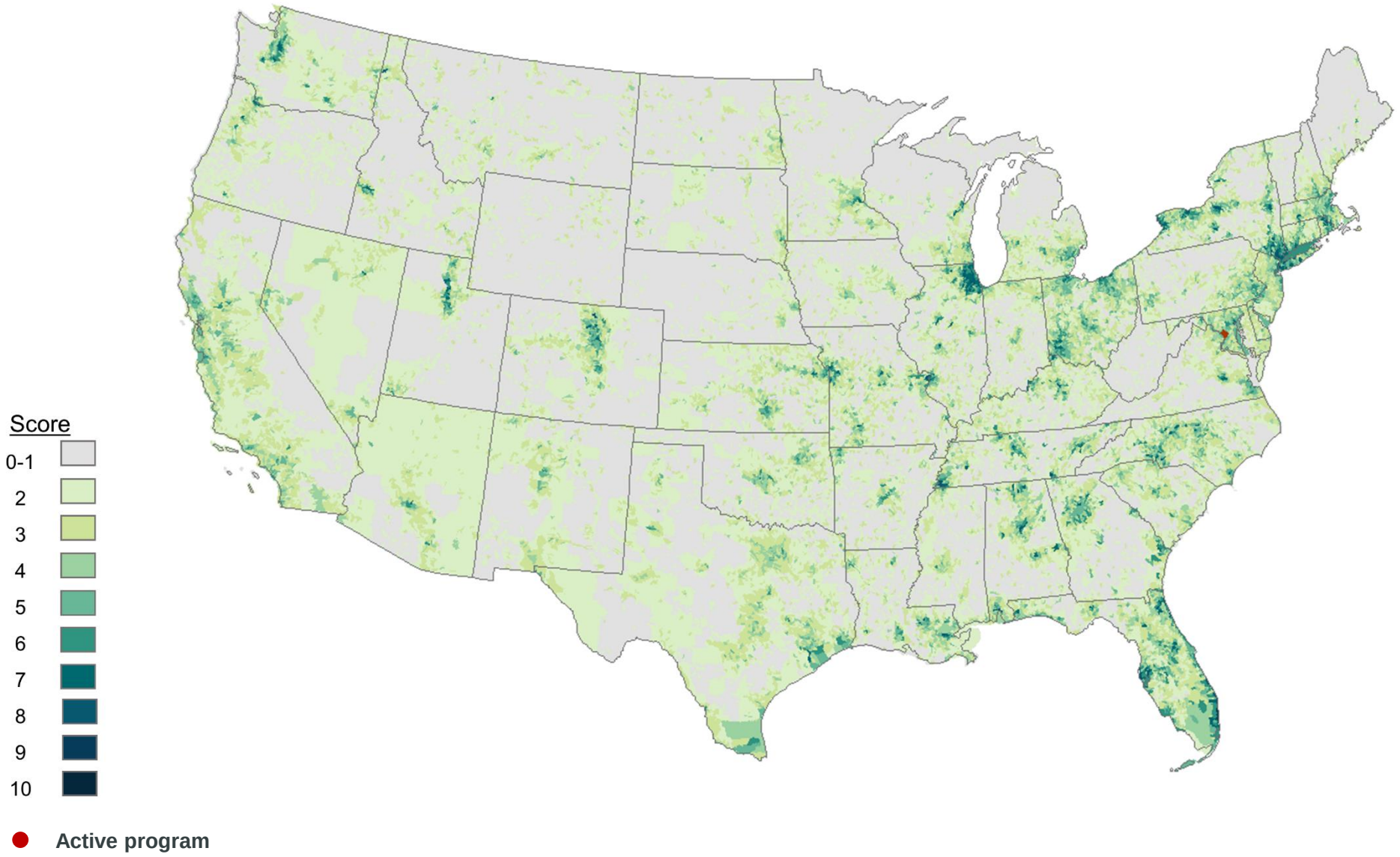
Our stormwater model suggests that demand potentially exists in a number of urban areas across the United States. At present, only Washington, DC has an active trading program. The Greater New York City area, Rochester, Syracuse, Ithaca, Providence, Greater Chicago, Green Bay, Coeur d'Alene, Fort Collins, St. Louis, Lexington, Chattanooga, Greater Charlotte, Durham, Memphis, Birmingham, Mobile, New Orleans, and most of Florida's major cities all received scores of 8 or higher.

Overall Potential Demand for Stormwater Trading for United States Watersheds (HUC-12), and Active Stormwater Trading Programs in 2018



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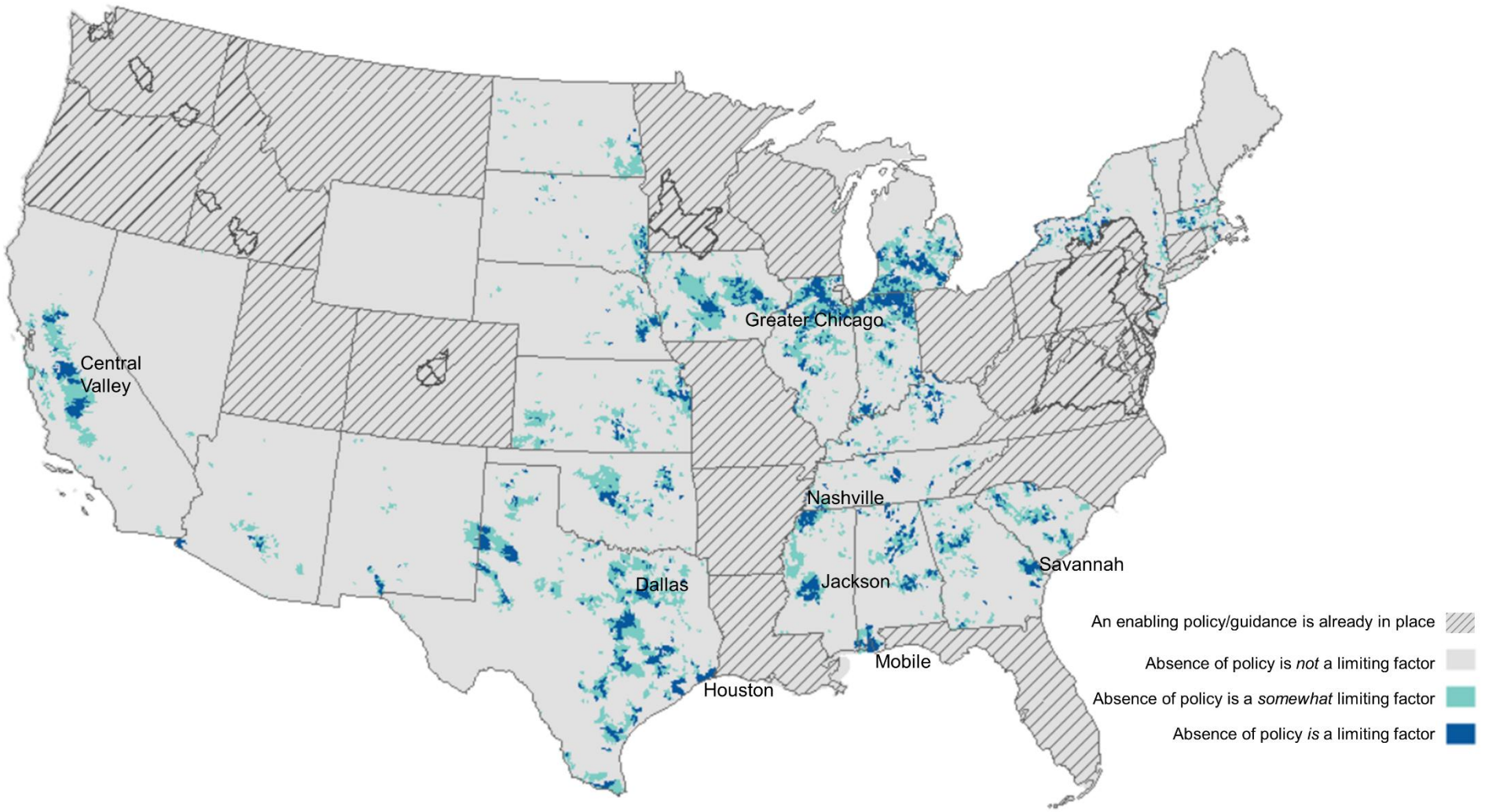
Mapping can also help identify opportunities for enabling policy. This map shows watersheds that scored well in biophysical and economic demand, but where low policy/regulatory demand scores were a limiting factor (defined as receiving a score of 5 or lower), suggesting that creating enabling policy/ regulatory conditions in these areas could help drive new growth in trading.

Regions with Low Policy/Regulatory Demand Scores but High Biophysical and Economic Demand Scores, Agricultural Water Quality Credit Trading



Interested in learning more?

- Read the National Network on Water Quality Trading (NNWQT)'s new action agenda, Priority Actions for Advancing Water Quality Trading.
- View a short Story Map summarizing high-level findings from this analysis.
- Download a copy of NNWQT's guidance book, *Building a Water Quality Trading Program*.
- Check out EnviroAtlas to view 300+ layers on scientific, demographic, and market indicators for ecosystem services, including many of the datasets used to develop this use case.
- View additional use cases like this one, evaluating ecosystem market opportunities in the United States.