Natural Capital Accounting (NCA) for the U.S.: Subnational and National Pilots for Land, Water, and Ecosystem Accounts

Powell Natural Capital Accounting Working Group:

Zachary Ancona – *U.S. Geological Survey*
Kenneth Bagstad – *U.S. Geological Survey*
James Boyd – *Resources for the Future*
Carl D Shapiro – *U.S. Geological Survey*
Carter Ingram – *Ernst & Young*
Jeffery Adkins – *U.S. Nat. Oceanic and Atmos. Admin.*
Clyde F Casey – *U.S. Geological Survey*
Cliff Duke – *Ecological Society of America*
Pierre Glynn – *U.S. Geological Survey*
Monica Grasso – *U.S. Nat. Oceanic and Atmos. Admin.*
Julie Hass – *U.S. Bureau of Economic Analysis*
Mehdi Heris – *Univ. of Colorado - Denver*
Justin Johnson – *University of Minnesota*
Glenn-Marie Lange – *World Bank*
John Matuszak – *U.S. State Department*
Ann Miller – *U.S. Department of Interior*
Kirsten L.L. Oleson – *University of Hawaii*
Lydia Olander – *Duke University*
Charles Rhodes – *U.S. Env. Protection Agency*
Marc Russell - *U.S. Env. Protection Agency*
François Soulard – *Statistics Canada*
Austin Troy - *Univ. of Colorado - Denver*
Michael Vardon – *Australian National University*
Ferdinando Villa – *Basque Centre for Climate Change*
Brian Voigt – *University of Vermont*
Scott Wentland – *U.S. Bureau of Economic Analysis*
Katie Warnell – *Duke University*

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Abstract

An interdisciplinary working group comprised of experts in economics, accounting, and the natural sciences has worked to develop proof-of-concept natural capital accounts (land, water, and ecosystem services) for the United States. With support from the National Socio-Environmental Synthesis Center (SESYNC) and the USGS Powell Center, the group has endeavored to integrate data from multiple existing sources to assemble accounts following methods from the SEEA CF and SEEA EEA at national and subnational scales. This paper provides a short summary of our efforts to date, including preliminary results and discussions of the path forward. As part of this effort, we wish to solicit critical feedback on the scope, data sources, methodologies, and quality of these first-generation, experimental products for the United States.

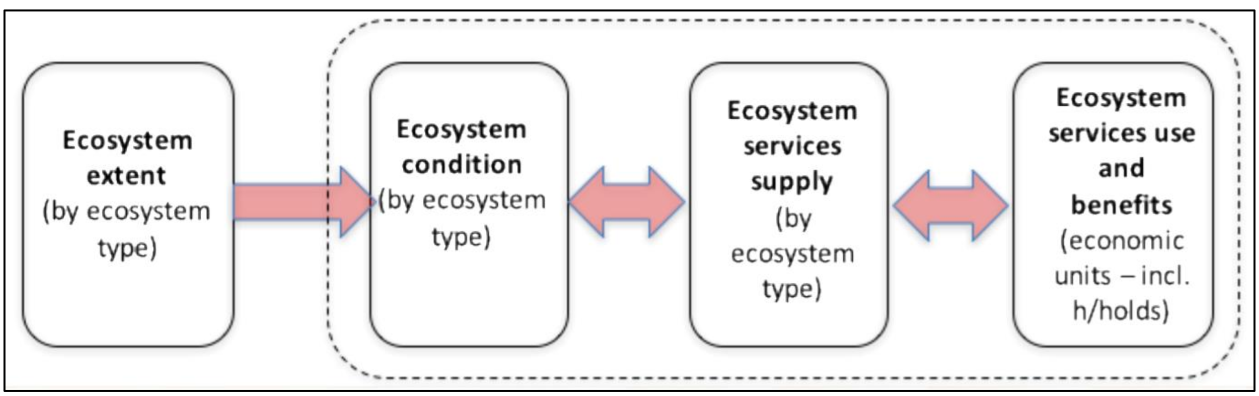
London Group Presenting Author: Scott Wentland (U.S. BEA – scott.wentland@bea.gov)

*Disclaimer: Any views expressed here are those of the authors and not necessarily those of the U.S. Department of Commerce, U.S. Department of Interior, U.S State Department, U.S. Environmental Protection Agency, Statistics Canada, World Bank, or agencies/organizations therein. This draft was prepared for circulation among outside experts to solicit feedback. For citing this work, please contact any of the PI's [Ken Bagstad (kjbagstad@usgs.gov), Carl Shapiro (cshapiro@usgs.gov), or Carter Ingram (jane.ingram@ey.com)] or the presenting author Scott Wentland for the latest draft of any or all of the three papers we summarize here.

I. Introduction – Developing a concept into a working design for the U.S.

The System of National Accounts (SNA) was developed over decades to inform decision makers about the size of physical and monetary stocks and flows among economic sectors and economies. These do not fully account for the productivity of nature, independent from resource management decisions. Natural Capital Accounting (NCA) is the attempt to better account for stocks and flows of key natural resources and ecosystem services in a way that can ultimately be integrated with the SNA, expanding the quantity and basic quality of accounting information.

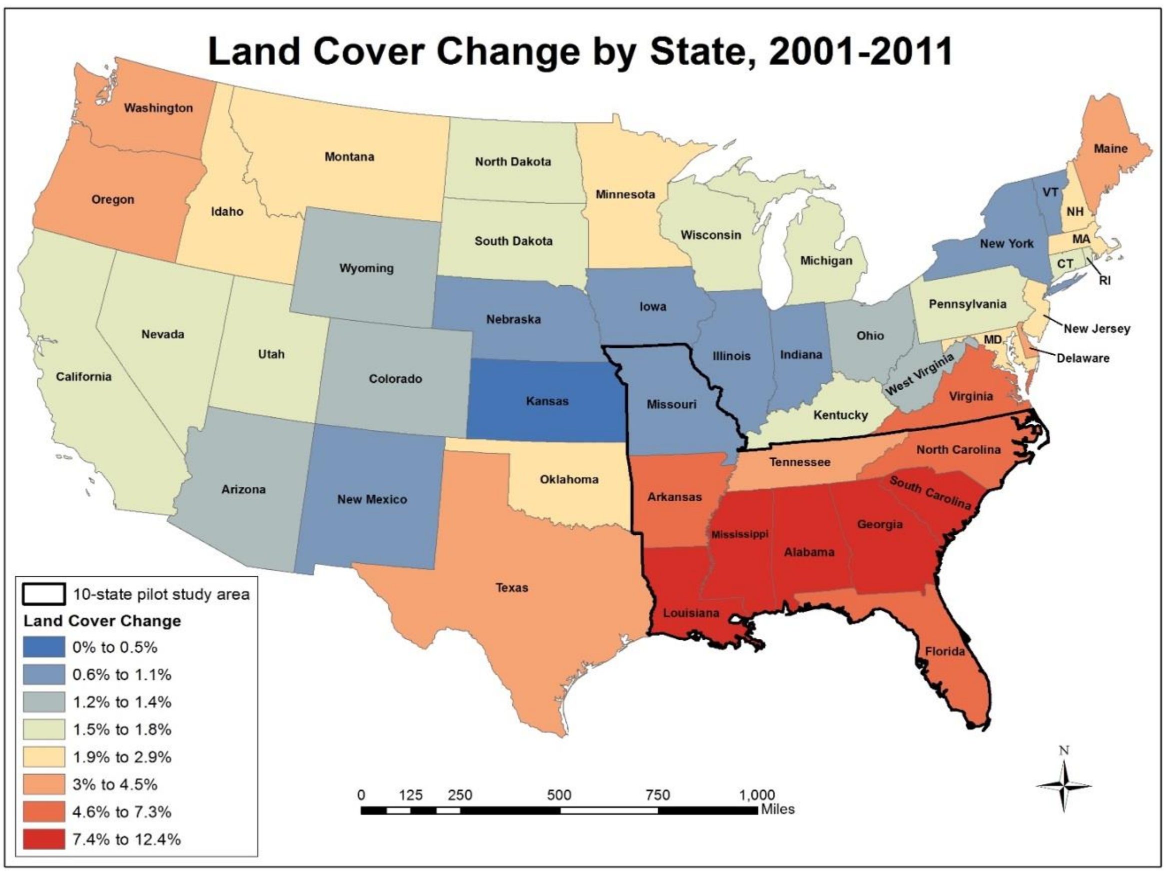
The United Nations has adopted the System of Environmental-Economic Accounting Central Framework (SEEA-CF) to account for natural resources and proposed a set of Experimental Ecosystem Accounts (SEEA-EEA) to record ecosystem extent, condition, flows of final ecosystem services, and cross-cutting "thematic" accounts for land, water, carbon, and biodiversity. This detail from a figure in a 2017 United Nations white paper (Technical Recommendations in support of the System of Environmental-Economic Accounting 2012–Experimental Ecosystem Accounting), shows that conceptually the supply of ecosystem services is contingent on ecosystem extent and condition, by ecosystem type:



Accounting approaches for natural capital and ecosystem services are gaining increasing traction worldwide as governments and the private sector use them to monitor integrated environmental and economic trends. From 2016-2019, with support from the USGS Powell Center and SESYNC, the U.S. Natural Capital Accounting Working Group has been exploring accounting frameworks, compiling NCA-relevant data, and running subnational and national models using high-performance computing and modeling to develop proof-of-concept land, water, and ecosystem accounts. Our Working Group is beginning with flexible account frameworks and developing open-access iterative modeling with the intention of demonstrating how time-series data can be generated reliably and cheaply for potential accounts in the future. At the earlier stages, the Working Group has largely focused physical accounts, but is currently developing monetary accounts for the valuation of land.

II. Land accounts

Land accounts track changes to our nation's land over time, which is a key asset and input into the economy. Our pilot land accounts show changes in land cover and land uses (with land uses corresponding to NAICS 2-6 digit industrial classification levels) at national and subnational levels from 2001 to 2011. As a basic example, we depict land cover changes geographically, the map below depicts land cover change in the U.S. (percent of 30 m cells experiencing land cover change), highlighting 10 states where regional ecosystem accounts for the Southeast were developed:



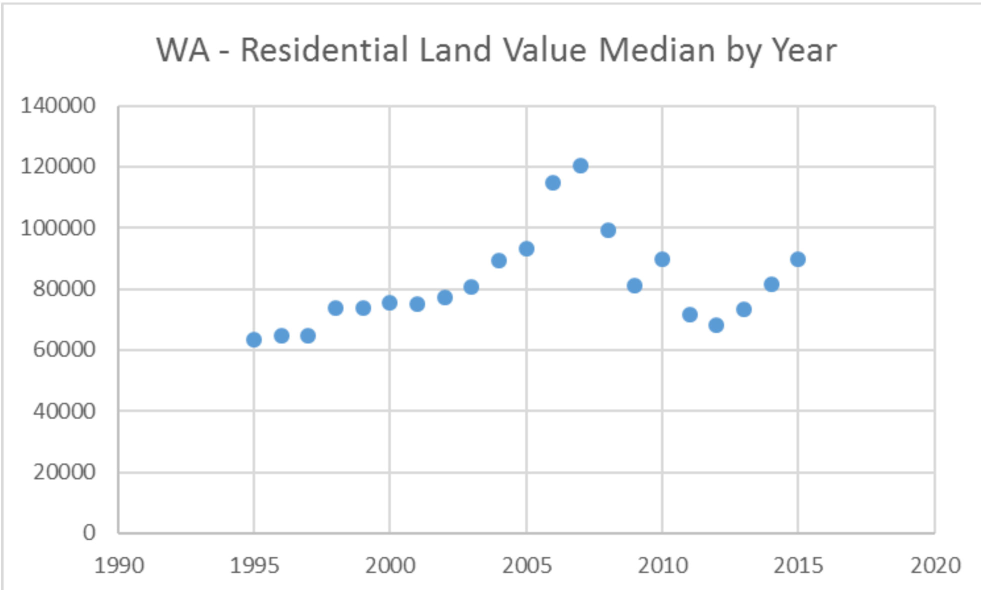
In addition to summarizing land cover and land use in a variety of ways (i.e., via tables and maps), the accounts will include monetary estimate that aggregate the value of land over time, based on data from Zillow, obtained through a partnership with the Bureau of Economic Analysis, and other sources. The Zillow data contains detailed information on hundreds of millions of real estate transactions in the U.S. spanning more than two decades in most states, which includes specific information on sales (sale price, sale date, mortgage information, etc.) and corresponding information for each property (characteristics of the structure – bedrooms, bathrooms, living area, etc. – and, importantly, the size of the plot of land).

Using this data set of market transactions and property characteristic information, we use hedonic regressions to construct estimates of land value following common methods used in the academic literature (e.g., Kuminoff and Pope, *Land Economics*, 2013). These value estimates are at the property-level, which means that we can aggregate them to any level of subnational geography that correspond to land cover and land use types (from Census tracts to counties to states). For each state and land use type, we separately estimate the following hedonic regression to decouple the value of land from the value of other property characteristics:

$$P_{jkt} = \alpha + \delta\, l_{jk} + \beta\, x_{jkt} + \varepsilon_{jkt}$$

where P is the price of property *j* in neighborhood (zip code) *k* in time period *t*, and *l* is the corresponding quantity of land (measured in acres). We control for a vector of property characteristics (number of bedrooms, number of bathrooms, living area (in square feet)., sq. ft * zip code interactions, age, whether it is new construction, whether it is a one-story home, whether it has a basement), allowing the value of a home’s living area to vary flexibly by neighborhood (zip code). Each year is estimated separately using market transactions within the state, and the resulting coefficients are applied to estimate the value of land for both homes that sold in that time period and ones that did not. Each land use type will be estimated using separate regressions to allow the coefficients to vary by land use type because structural characteristics generally play less of a role for the underlying land value of farms, for example, than a single-family residence.

Early subnational estimates of single-family residential land value from the state of Washington (WA) demonstrate the feasibility of this method using Zillow microdata, which we are in the process of scaling up to other states (ultimately aggregating to the national level) and across to other land use types beyond residential (i.e., agricultural, commercial, industrial, and even vacant land). The graph below depicts a year-by-year tabulation of the value of residential land in the state of Washington (per acre), which would be one of many tabulations that will ultimately comprise the land account tables.



Within the next 6-9 months, we expect new datasets on land cover (spanning the years 2001, 2004, 2006, 2008, 2011, 2014, and 2016) and land use (spanning the years 1990, 2000, and 2010). These will enable us to extend our time series for the land accounts, which coincides with the time period of much of the Zillow data coverage. This will culminate into a standalone paper documenting a full set of pilot land accounts for the U.S. in 2019.

III. Water accounts

Our pilot water accounts include (1) physical supply and use tables, (2) water productivity ($ GDP generated per 100 gallons of water use), (3) surface and groundwater quality accounts, (4) emissions accounts, and (5) an expert elicitation providing a conceptual model of the strength of impacts of water quality on different industries, and of industrial activity on water quality. These data generally cover the years 2000 to 2015 and are based on water use and water quality data compiled by the U.S. Geological Survey, U.S. EPA, and GDP data from BEA. We have identified data gaps limiting the completion of other SEEA Water accounts, such as water asset accounts – many of which are in the process of being addressed by USGS – as this will be a key step toward identifying a path forward for these accounts. We summarize our methodology, data sources, and some preliminary results below.

A. Physical supply and use accounts

USGS has tracked water use every five years since 1950 (Dieter et al. 2018). While the composition of water-use categories has changed somewhat over time, the goal of the USGS Water-Use Data and Research Program is to collect consistent data about the nation's water use from the local, state, and Federal government agencies that track water use, using modeling and interpolation to fill gaps where needed. Since the year 2000, water use has been reported across eight categories at the state and county level: public supply, domestic, irrigation, aquaculture, mining, thermoelectric power, industrial, and livestock.

We compiled data from USGS water-use reports for the years 2000 (Hutson et al. 2004), 2005 (Kenny et al. 2009), 2010 (Maupin et al. 2014), and 2015 (Dieter et al. 2018), and aligned these water use categories into PSUTs as best as possible using the NAICS 2017 industrial classification codes, acknowledging that the eight categories cover very broad swaths of the economy (Table 1).

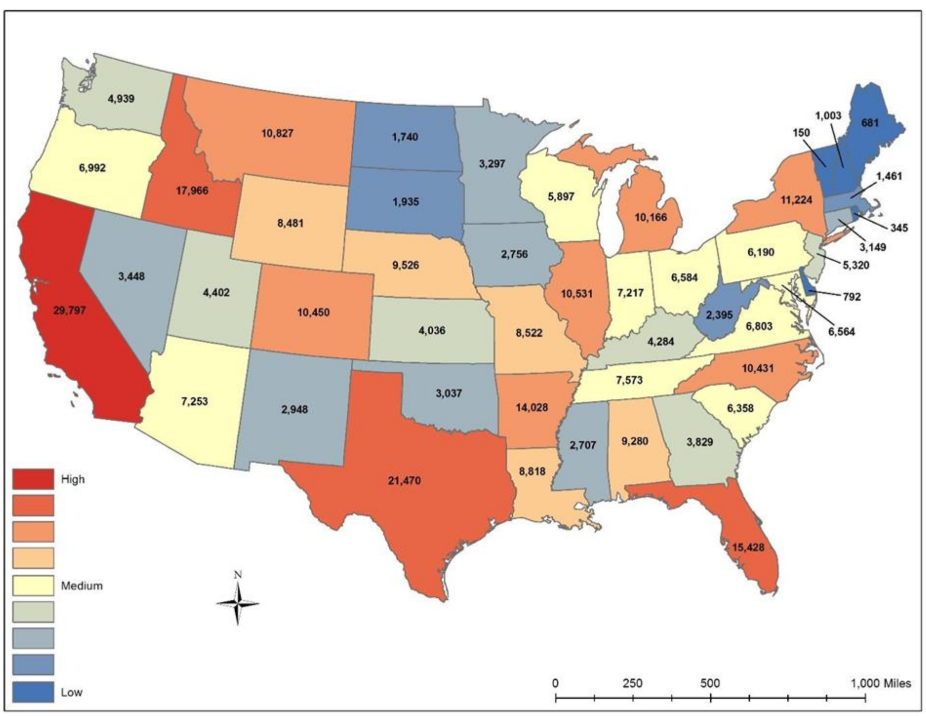
Water-use categories, descriptions and correspondence to NAICS industry classifications

USGS water use categories	**Description of category (Maupin et al. 2014) and the closest corresponding NAICS industry classification + households**
1. Public Supply	NAICS: 221310 - "water withdrawn by public and private water suppliers that provide water to at least 25 people or a minimum of 15 connections. Public-supply water is delivered to users for domestic, commercial, and industrial purposes, and also is used for public services and system losses."
2. Domestic	NAICS: 814 - "indoor and outdoor uses at residences" (13% self-supply, 87% from public supply deliveries in 2010; Maupin et al. 2014).
3. Irrigation	NAICS: 111 - "Water used to sustain plant growth in all agricultural and horticultural practices," including water lost in conveyance.
4. Aquaculture	NAICS: 112 - "water associated with raising organisms that live in water... for food, restoration, conservation, or sport."

5. Mining	NAICS: 21 - “water used for the extraction of minerals that may be in the form of solids..., liquids..., and gases.” This includes water used for extraction of fossil fuels.
6. Thermoelectric Power	NAICS: 2211 - Water “used in generating electricity with steam-driven turbine generators.”
7. Industrial	NAICS: 31-33 - Self-supplied water withdrawals for “fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation needs within the manufacturing facility.”
8. Livestock	NAICS: 112 - “water associated with livestock watering, feedlots, dairy operations, and other on-farm needs.”
Additional water use estimates presented	
9. Hydroelectric power generation	NAICS: 2211 - Water used for generating electricity at plants where turbine generators are driven by moving water, plus evaporative losses from hydroelectric power reservoirs.
10. Golf course irrigation	NAICS: 713910 - Water used to maintain vegetative growth on golf courses.

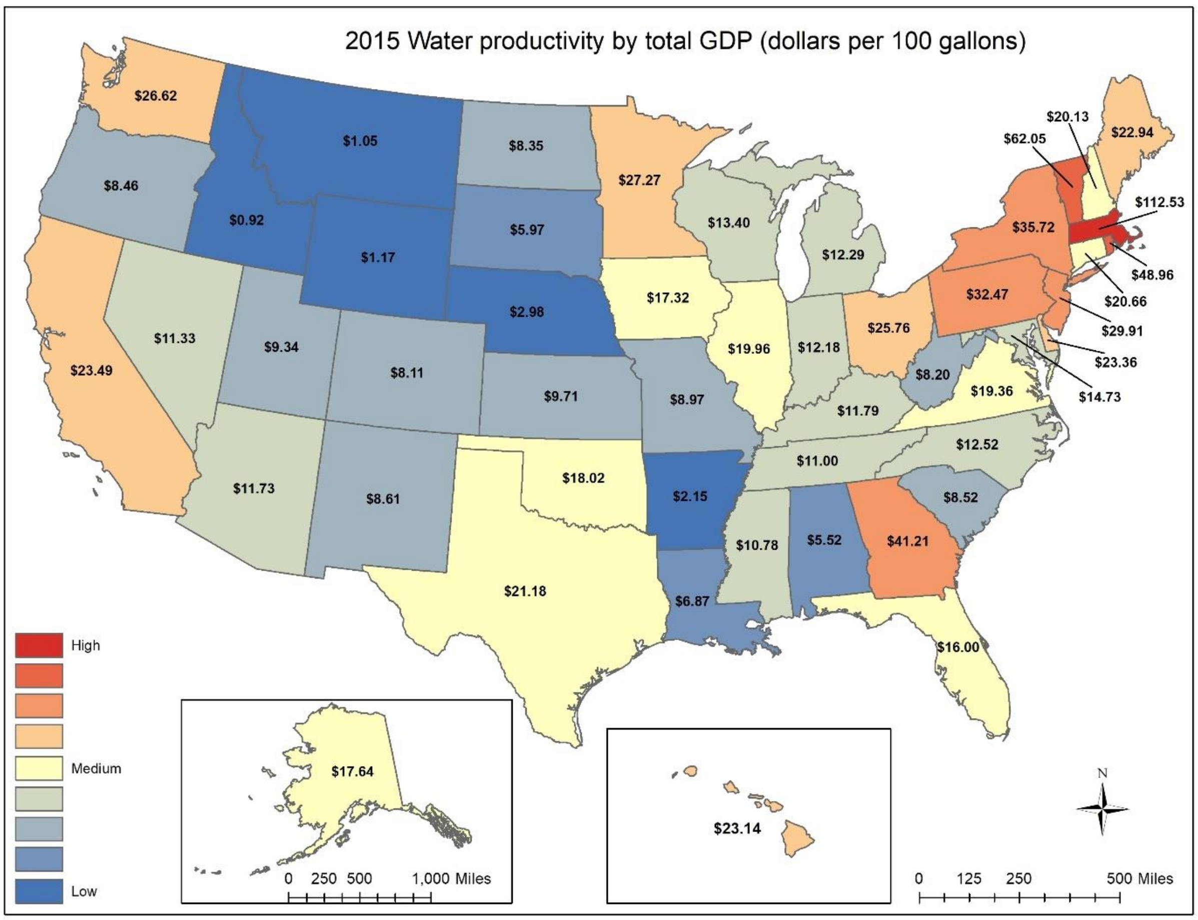
To the eight original USGS water use categories, we developed data for two additional categories – hydroelectric power generation and golf course irrigation.

Total water use by state, 2015 (million gallons/day)



B. Water productivity

We estimated water productivity at the state, regional, and national level for the years 2000, 2005, 2010, and 2015 by dividing state-level gross domestic product (GDP, BEA 2017) for four industries - agriculture (including irrigation, livestock, and aquaculture water uses) and mining - by water use in those industries from the PSUTs. We also compiled a total water use category that included all of the industries outlined above, adding golf course irrigation and evaporative water use by hydroelectric power generation and deducting domestic use. State-level GDP data are available annually in chained 2009 dollars at a much finer breakdown by industry than the available water use breakdown (BEA 2017), which unfortunately limit the number of industries for which water productivity data can be generated.



Initial results suggest that the mining generates higher water productivity than crop production in nearly all states. For the U.S., total water productivity increased from 2000 to 2015 in 49 states with 30 states having increases >50 percent.

C. Water quality accounts

The USGS National Water-Quality Assessment (NAWQA) Program, complementing previous USGS water quality monitoring, has tracked and reported nationwide data showing time trends for water quality in both surface-water bodies (Oelsner et al. 2017) and for groundwater (Lindsey and Rupert 2012). Drawing on state and national water quality databases, the final report synthesizes water quality trends for over 3,000 sites. Overall, this water quality monitoring network is opportunistic, including sites that are accessible and used for local, state, and federal agency monitoring efforts, rather than being systematically designed to provide a statistically representative national-level picture.

The surface water quality data cover the years 1972 to 2012, quantifying decadal changes in chemical, pesticide, and ecological parameters (Oelsner et al. 2017). Water quality is monitored at a series of sites, with concentrations and loads reported for 19 different chemical parameters and 29 pesticide types, as well as over 30 biological metrics. We chose six water quality constituents to track in water quality accounts - constituents with broad geographic coverage and likely connections with waters users (based on a separate expert elicitation): chloride, nitrate, total nitrogen, total phosphorus, total suspended solids, and specific conductance.

We summarized trends for these six water-quality constituents at the state level because population, economic, and water use data are also available the state level. However, since site data are spatially explicit, they could easily be summarized by watersheds in the future. We reported data for 2002 to 2012, and quantified, at the state level, how many sites observed statistically significant increases, significant decreases, or no significant change in pollutant concentration. Groundwater data cover one decadal period, with the first NAWQA sampling period from 1988 to 2000 and the second from 2001 to 2010 (Lindsey and Rupert 2012). A third "decadal" sampling is currently underway, allowing a continuation of time trend data going forward. This sampling effort covers 1,235 individual wells in 56 well networks, which accounts for almost 80% of estimated groundwater withdrawals for drinking water in the U.S.

Monitored groundwater quality constituents include 13 inorganic compounds, six pesticides, and five volatile organic compounds (Lindsey and Rupert 2012). Of these we chose to include three water quality constituents with wide geographic coverage and likely connections to water users: chloride, nitrate, and dissolved solids. We reported, at the national scale, the number of networks observing significant increases, significant decreases, or no significant change in water quality from the opening to the closing period.

At the national scale, about 80% of surface water quality monitoring sites saw no statistically significant change in water quality for five constituents (total nitrogen and phosphorus, chloride, nitrate, specific conductance); just under 70% of sites saw no significant change for total suspended solids. For sites with significant increases or decreases in constituent concentration, five of the constituents saw more concentration increases than decreases (all but total nitrogen). At the regional scale, water quality declines outnumbered improvements for the Southeast, Plains, and Northwest regions, with nitrate and total phosphorus (all three regions), total suspended solids (Southeast and Northwest), and specific conductance (Plains and Northwest) having greater increases than decreases. For the Northeast, Midwest, and Southwest, water quality improvements outnumbered declines for total nitrogen (all three regions), chloride (Northeast and Midwest), nitrate (Northeast and Southwest), and total suspended solids (Midwest and Southwest).

Regional surface water quality changes: number of monitoring sites with statistically significant increases or decreases, 2002-2012.

Region		National (48 states)	Southeast	Northeast	Midwest	Plains	Southwest	Northwest
Total sites		974	255	117	160	245	108	89
Chloride	Decreased	25	7	1	8	6	2	1
	No change	245	59	16	50	81	31	8
	Increased	29	7	0	6	13	3	0
Nitrate	Decreased	31	12	7	5	4	2	1
	No change	307	86	44	94	38	20	25
	Increased	44	16	3	8	10	1	6
Specific conductance	Decreased	55	15	7	6	15	6	6
	No change	527	136	63	62	138	68	60
	Increased	62	15	9	5	17	9	7
Total nitrogen	Decreased	29	9	6	6	3	4	1
	No change	222	71	58	55	21	9	8
	Increased	19	14	0	2	2	1	0
Total phosphorous	Decreased	30	6	6	6	8	4	0
	No change	281	73	50	68	66	15	9
	Increased	48	19	4	7	12	5	1
Total suspended solids	Decreased	27	6	3	5	7	2	4
	No change	122	39	15	18	21	5	24
	Increased	28	12	3	0	5	0	8

While this section provides only a brief summary of the data and initial results to solicit feedback, we are in late stages of drafting a paper that will include more detail on all of the above and a full set of pilot water accounts (which will include more detailed tabulations and corresponding maps). We are on track for an initial draft of the water accounts paper by last quarter of 2018 and submission for publication to peer review in 2019.

IV. Ecosystem accounts

We are testing and refining methods proposed by the SEEA-EEA to develop a pilot set of ecosystem accounts for a 10-state region in the Southeastern U.S. Ecosystem accounts table entries are being developed for crop pollination by wild insects, water purification, carbon storage, recreational birdwatching, bird biodiversity, and air filtration by trees. Initial accounts cover the years 2001, 2006, and 2011 and include tables for both indicators of ecosystem condition and related biophysical supply and use tables. Land accounts will serve as our initial ecosystem extent account. Data permitting, our goal is to eventually extend these accounts produced for the U.S. Southeast to the entire Continental U.S.; such work is currently underway for crop pollination and urban ecosystem services. Work to extend ecosystem accounts to the Continental U.S. is currently funded through March 2021, allowing several years to refine and further develop U.S. ecosystem accounts.

In an iterative process, our Working Group discussed the SEEA-EEA framework for ecosystem accounting, relevant data sources for the United States, and how these data would best fit into the existing framework, according to the data considerations described below. We used the National Ecosystem Services Classification System (NESCS) to characterize the type of information suitable for inclusion in the pilot condition and physical supply and use accounts. We selected a set of ecosystem services and condition metrics to include in the pilot accounts to test that process and explore the sensitivity of our metrics to changes in ecosystem extent and condition in the U.S. Southeast – the most rapidly changing part of the country. Recognizing that our pilot accounts are just a subset of potential ecosystem services and metrics that could be included in ecosystem accounts, we also created a list of ecosystem services that, in our opinion, could feasibly be included in ecosystem accounts for the United States within the next five years. This list can help guide future efforts to compile more comprehensive ecosystem accounts for the United States.

The nature and purpose of the ecosystem condition and supply-use accounts raises several considerations about the data and methods used to populate the accounting tables. We used three criteria to select data and quantification approaches for the Southeast pilot accounts: data and methods must be (1) publicly accessible, (2) available at a broad spatial scale (ideally the entire United States; at least the 10-state southeastern region), and (3) available for multiple years (so that a time series can be constructed) and likely to be collected and available into the future (so that the accounts can be updated). The accounts currently cover the years 2001, 2006, and 2011, but with the December 2018 release of the 2016 National Land Cover Database, the accounts will be extended to cover the years 2001, 2004, 2006, 2008, 2011, 2014, and 2016.

For both the Southeast and nationwide products, we are developing shared, public code repositories that enable (1) ecosystem service model code to be viewed, edited, and contributed to by collaborators and other scientists, (2) an interface with high-performance computing necessary to run the more computationally intensive ecosystem service models at moderate resolution (i.e., 30 m) for the entire Continental U.S. These repositories will allow accounts to be updated as new data become available and for new contributors to add to and refine model code. We view these steps as essential to making the ecosystem services modeling underlying the ecosystem accounts transparent and fast enough to allow for the continuous updating of accounts in future years, building the needed time series to generate decision-relevant ecosystem accounts.

The condition table for the entire 10-state region, shown below, includes a variety of condition metrics (rows), each identified by the ecosystem service or process to which it relates (far left). The inclusion of multiple years in the same table simplifies tracking changes in condition over time. The full table (not shown here) also allows for comparison across each of the ten states within a year. The columns of the condition table are ecosystem types; the results for each condition metric are filled in under the relevant ecosystem type, with the other cells (under ecosystem types for which the metric is not relevant) left blank.

Condition table for the southeastern United States, 2001-2011[1]

			Ecosystem Types (Land Cover)																
			Offshore	Open Water - non-freshwater	Open Water - freshwater	Developed - Open	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland/Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands
Pollination	Area of pollinator habitat near pollinator-dependent crops (sq km)*	2001									5,471	2,516	1,336	1,290	165			7,061	172
		2006									4,152	2,125	1,459	2,191	423			11,539	371
		2011									53,679	30,441	6,670	18,388	9,314			43,104	3,354
	Area of pollinator-dependent crops in range of pollinator habitat (sq km)*	2001															11,182		
		2006															21,581		
		2011															65,818		
	Ratio of pollinator habitat to pollinator-dependent crops*	2001															1.66		
		2006															1.05		
		2011															2.55		
Water purification	Area of purifying land cover types between NPS sources and waterways (sq km)	2001									31,542	20,238	6,959		5,385			25,463	3,379
		2006									31,453	19,780	6,678		5,997			25,427	3,504
		2011									31,005	19,330	6,353		6,192			25,151	3,789
	% of flowpath between NPS sources and waterways in purifying land cover types	2001			30.6%														
		2006			30.4%														
		2011			29.9%														
Bird biodiversity	Bird species richness (160 species modeled)	2001	158		157	156	149				160	160				160	160	158	148
		2006	158		157	156	150				160	160		145		160	160	159	150
		2011	158		157	156	150				160	160		144		160	160	159	147

Data for ecosystem accounts will include tables tracking aspects of ecosystem condition that affect ecosystem services like wild pollination, use of water that nature has purified, and recreational birdwatching. This table shows elements of a Condition account, highlighting elements that may correlate with the supply of biophysical end-products of nature that are used in ecosystem services.

Ecosystem services are also tracked in separate Supply-Use tables. The supply table below includes a row for each ecosystem service and year of analysis. The columns are the ecosystem types that provide the ecosystem service. The amount of each service supplied by each ecosystem type is filled in under the appropriate column; ecosystem types that do not provide a given ecosystem service receive a "0." The rows in the use table are the same as in the supply table, but

[1] National-scale cropland data are available only from 2008 onward; pollination-dependent crops data are thus not directly comparable between years.

the columns in the use table are various economic units that use the ecosystem services. Again, the amount of each service used by an economic unit is filled in under the appropriate column; entities that do not use a particular ecosystem service receive a "0." Because an ecosystem service is by definition used by some economic unit or individual, the total supply of a certain ecosystem service in a given year must equal the total use of that service in the same year. The following two tables allow comparison of the supply and use of recreational birding, breathing clean air, and carbon storage in the Southeast across multiple years; the full tables also allow for comparison across individual states within the region.

Supply table for the southeastern United States, 2001-2011[2]

		Ecosystem Types (Land Cover)																
		Offshore	Open Water	Developed - Open	Developed - Low	Developed - Medium	Developed - High	Barren	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland/Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Total
Recreational birding (thousands of birding days)	2001	2,015	8,471	6,935	5,897	1,850	978	416	6,586	3,441	365	1,075	1,498	2,285	4,614	7,106	3,343	56,874
	2006	518	4,418	8,552	9,451	4,368	1,129	780	6,273	3,433	531	2,208	2,808	2,833	3,658	6,196	2,204	59,360
	2011	1,236	5,207	10,022	7,420	3,553	1,046	1,408	7,173	3,816	692	1,966	1,833	4,050	2,634	4,964	3,695	60,715
Breathing clean air	2001																	
	2006																	
	2011																	
Carbon storage* (kilotons of C)	2001	0	0	307,170				0	11,039,035			1,211,205	601,250	4,941,118		19,020		18,118,798
	2006	0	0	361,629				0	11,074,236			1,282,818	713,026	4,897,046		28,981		18,357,735
	2010*	0	0	384,934				0	10,935,461			1,464,086	740,303	4,887,533		31,455		18,443,771

The next steps in the process for the United States are to expand the pilot accounts presented here in both geographic extent and the number of ecosystem services and condition metrics included. Ideally, the next version of these accounts should cover the entire continental United States with an even broader scope that integrates with the other accounts and SNA more directly. To ensure that future iterations of the accounts are aligned with the needs of managers and decision-makers, input from both groups should be sought about what services and metrics would be most useful to include. The table of feasible ecosystem services for inclusion in supply and use tables can provide a starting point for consideration. The accounts should also be updated

[2] Note: Carbon storage is not considered an ecosystem service in the NESCS framework, but has been included in the pilot accounts because it is commonly included in other ecosystem accounting efforts. The data source for carbon storage used more aggregated land cover types than the National Land Cover Database, so the carbon storage estimates in this table are in merged cells that include all of the relevant NLCD classes.

to include 2016 when all available relevant data (for example, the 2016 National Land Cover Dataset, planned for released in December 2018). An initial draft for the Southeastern United States is currently in development (as summarized above) and is expected to be completed by the end of 2018 and submitted for a peer reviewed publication in 2019.

Use table for the southeastern United States, 2001-2011[3]

		Economic units (NAICS codes)			
		Households (814110)	Industry (11-72)	Government (92)	Total
Recreational birding (thousands of birding days)	2001	56,874	0	0	56,874
	2006	59,360	0	0	59,360
	2011	60,715	0	0	60,715
Breathing clean air	2001				
	2006				
	2011				
Carbon storage* (kilotons of C)	2001				18,118,798
	2006				18,357,735
	2010*				18,443,771

V. Summary and Questions for London Group

Even though natural capital contributes substantially to the nation's economic well-being, our current ways of measuring the U.S. economy do not track how natural capital assets change over time. NCA integrates information in terms that are useful for policy and management. With this information, decision makers can more effectively invest in key contributions to the economy, such as water purification and crop pollination that support food production. NCA information is helpful to evaluate policies, examine trends, and explore future scenarios. NCA also provides more complete and useful information for cost-benefit analyses and broad integrated assessments of the whole economy.

[3] Carbon storage is not considered an ecosystem service in the NESCS framework, but has been included in the pilot accounts because it is commonly included in other ecosystem accounting efforts. Because stored carbon is not directly used by people, only the total amount is shown in the use table.

The Working Group aims to make NCA information accessible and engaging with a wide variety of governmental and business stakeholders involved in natural resources management and policy. Understanding the needs of potential users of the accounts and communicating what NCA results mean will help to integrate ecosystem services into decision-making. With this in mind, the U.S. team raises the following questions for the London Group regarding our recent work on pilot accounts, hoping to open up dialogue and discussion at our next meeting.

- *Land*: For countries that have monetary accounts for land, what are the most practical strategies for valuing vacant, government-owned land, or other land types that have infrequent monetary transactions?
- *Water*: For countries with developed water accounts, what value/use cases have you found to be the most common applications for your accounts?
    - To what extent are your water accounts linked to other environmental accounts you produce (e.g. fisheries, forestry, land/soils, ecosystems)? And, how specifically has this provided value to users?
- *Ecosystem services*: For countries that have developed ecosystem services accounts, how have you dealt with the issue of carbon storage and other issues regarding the alignment of SEEA-EEA and NESCS? Is our use of ecosystem condition metrics (to account for ecosystem service-relevant indicators without direct final end users) consistent with your past use of condition metrics?
- *Integration*: Is there a level of geographical aggregation that makes the most practical sense for integrating land accounts, water accounts, and ecosystem services?
- *All (general)*: are there policy applications or demands from users that were not anticipated prior to making the accounts that would have been useful to know *ex ante*, so that the final products would be more user friendly or applicable to potential users of the accounts?