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Living by the Symbolic River: Landscape Effects of Post-Industrial Water Narratives of the Susquehanna River

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Abstract: This paper examines ways in which human values toward surface water, especially large rivers, are relevant to land-use decisions in the watersheds. The study's focus is the symbolic riverscape constructed by residents local to the Susquehanna River at the confluence of its branches in central Pennsylvania. The main analytical tool is the cultural landscape, a conceptualization of the ways in which alteration of the physical world is the product of human value systems. The paper traces the symbolic weights apparent in discourses about the Susquehanna River with regard to environmental use and abuse in the watershed, through qualitative analysis of public expressions of meaning and valuation. The conclusions emphasize an evolution of the meaning of the river toward a central role as an integral and intricate part of the human experience on the landscape, rather than its earlier role as one functional part of the economic system. Land-use actions consonant with that new value are now favored. This work is offered to suggest that land system science, which is highly effective in understanding altered natural systems and their consequences, can benefit from a fuller engagement with more-intimate human aspects of landscape such as symbols, meaning, and narrative.

Keywords: land system science; cultural landscape; Susquehanna River; Pennsylvania; environmental history; symbolic adaptation



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1. Introduction

This paper focuses on the ways in which evolving human values toward surface water, especially large rivers, affect land-use decisions in the watersheds. From the perspective of the residents of the river towns lining its banks near the confluence of the two branches in central Pennsylvania, the Susquehanna River has always been a major shaper of land use and an agent of landscape structure and change beyond direct uses of its water. This paper examines the nature of the land-use influences at this place, and the ways they have evolved in conjunction with changes in human valuation of the river. The terms meaning, value, symbol, and narrative are used in common-language senses referring to human emotive engagement with the world and the ways people discuss that. The terms are not entirely distinct from each other in these usages.

All resources are culturally conditional to available technologies and to the demand for particular material outcomes, but the social context for valuation of surface water in this long-settled landscape—Europeanized since the 1750s—is far broader than economic needs and rewards. Beyond its role in the evolving economy, the river has had a strong symbolic weight upon the cultural landscape, and the direct and indirect uses of the Susquehanna are shaped by a range of meanings about the river held by local residents. The purely functional aspects of the river have reflected a progression of direct uses that track changes in transportation technology, industrial intensity, and governmental influence. Extra-economic river uses have responded to changing societal constructions of the river on axes such as clean/dirty environmental perceptions, level of flood-hazard concern, class-based evaluations of riverfront life, and the value of the river as a leisure and scenic amenity. This

history of river utility, and of observed and inferred symbolic constructions, spans from late Indigenous uses, through ruthless extraction of lumber and grain, to a post-industrial amenity river. The use of the landscape and, reciprocally, the effect of the landscape on the river reflect the nature of the symbolic river as much as the functional river.

The environmental aspects of this paper grow out of the field of land system science [LSS]. LSS seeks to comprehend the environmental effects that follow changes in land use and the factors that drive those changes. LSS has focused on the direct impact of humans on the landscape through land-use choices, and on the societal contexts of those choices; this paper seeks to demonstrate the value of extending the view of the field into human values, landscape meaning, and environmental symbology.

2. Linking Water Values and Land-Use Actions within LSS

A typical definition of land system science describes it as an effort to understand the processes that affect the alteration and evolution of land-use systems under human influence—“documenting and explaining land-use changes” [1] (p. 1291). By focusing on material effects such a definition risks overlooking many nuanced aspects of human-ecological action and activity, and thus a vast range of types of influence. Environmental change results from different processes that might be seen as a causal chain—one process (wind erosion of soil, say) is predicated by another process (expansion of agriculture?), which is predicated by another process (rising wheat prices?), and so forth. The evolution of LSS as a field of study in recent years has expanded its focus toward identifying increasingly early links in such a chain. This is clear in the language within disciplinary retrospectives and state-of-the-field reviews. The nominal root causes for LSS effects have shifted from local physical systems to societal systems, as human decisions are integrated into the chain: “This emergent research community seeks to improve: (i) observation and monitoring of land changes underway throughout the world, (ii) understanding of these changes as a coupled human-environment system . . . ” [2] (p. 20666). The human influences that are invoked are generally at a societal or policy level — economics and governance, especially. A “socio-ecological” system is cited at that level, “land management and the modes in which land is governed” [3] (p. 433).

These are productive advances in understanding land-use change causality. However, this approach does not yet harness the power of the social sciences effectively. This level of social science operates in generalities such as the economy, policy process, land management. These ideas stand in that discourse as weakly examined suprahuman components of a sociological black box, ideas that can hide extensive unexamined biases, for example. Crucial social questions can easily be avoided: Whose interests does this economy benefit? What policy actors dominate the decision process? How do landscape changes affect residents’ lives and worldviews? Whom does environmental harm affect most, and why? How would residents wish it to be different?

To continue a journey of LSS toward more humane and effective treatment of the human causes of land-use change and environmental degradation, it is necessary to step toward more complex models of human society. This article seeks to illuminate a path for LSS to move into a fuller consideration of human decision-making, one that brings to the foreground salient aspects of the humanities, especially studies of values, meaning, and culture. Presently some LSS research does involve a cultural perspective, of course, but that element is frequently secondary. Explicitly cultural work is unusual, and commonly points to the need for more of the same, e.g., de Waroux et al. state, in an article titled “The role of culture in land system science”, “. . . studies that explicitly address the causative role of culture in land systems have been fairly limited relative to those examining other structural dimensions (e.g., markets, policies, climate)” [4] (p. 450).

2.1. LSS & Cultural Landscape

A wider human context for LSS can be explored productively through the robust geographical concept of cultural landscape. Cultural landscape is a description of the world

as altered by humans within their cultural processes. The cultural landscape is therefore the world as it is known directly by humans, the world at an explicitly experiential scale. This is the scale at which human decisions are made, and at which decisions are in turn manifest to people on the land. It is therefore an appropriate conceptual framework for understanding human engagements with LSS: How is land-use change embedded within cultural landscapes?

Cultural landscape, as a major component of geography's approaches to human-environmental systems, comes to us finally from Carl Sauer who framed it this way in 1925: "The cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape is the result", [5] (p. 46). He used the idea as a tool to understand the historical geography of major human-ecological transitions, such as the origins of plant domestication or the evolution of human-affected ecologies during European capture of Native American lands. It has since been broadened into wider uses in anthropology, archaeology, planning, and related fields. (This use of 'cultural' might be seen as resurrecting an unfortunate suprahuman sense of culture as an independent agent (see Duncan's critique of 'culture' in cultural geography [6]), but culture here is meant as a descriptive summary of shared individual perspectives rather than an actor or explanation.) The central insight of the cultural-landscape approach might be maintaining focus on the links between space, culture, and environment. To an environmental anthropologist, for example, physical spaces used by humans have an "imputed meaning", a symbolic context that must be recognized to understand land-use choices [7].

Cultural landscape is a method to understand human adaptation. I see it as describing three broad ways in which humans alter and respond to the land. The idea provides interacting frameworks linking (1) human adaptation, (2) the constructed environment, and (3) the symbolic landscape [8]. These map onto LSS in constructive ways. First, cultural landscape describes humans' adaptation to the natural environment (as that term is conventionally constructed), that is, the influences of environment and of humans upon each other. In traditional cultural or archaeological systems, for example, cultural landscape includes subsistence strategies, ethnomedicine, and seasonal migration on the one hand (humans adapting to the environment) and ecological depletion or soil erosion on the other hand (environmental responses to human actions). Within LSS this matches the long-standing central interest in land-use change as a product of human action and as an influence on human adaptation: "understanding of these changes as a coupled human-environment system" as in the Turner et al. quote above [2] (p. 20666).

The second useful framing within the cultural-landscape concept is the centrality and functionality of the constructed environment. The built environment is created to adapt the natural world to our needs, but it then constrains our evolving adaptations by its rigidity. In geography this includes physical infrastructure—roads, cities, waterworks, and agriculturally altered landscapes—which modulate the uncertainty of the natural environmental but also limit subsequent human responses to it. The built environment might also include the immaterial structures in economy, society, and policy that support and constrain our use of the land. This aspect of cultural landscape matches the ongoing expansion of interest in LSS into 'socio-ecological' factors—"land management and the modes in which land is governed," per the Verburg et al. quote above [3] (p. 233).

The third adaptive element of a cultural landscape is the symbolic landscape, the structures of meaning and values that people—individually and as groups—use to understand the world and evaluate possible changes in it. Cosgrove offered an early rigorous treatment of the symbolic landscape, describing landscape in general as "an external world mediated through subjective human experience"; that is, the landscape concept centers geography in subjectivity [9] (p. 13). We tell stories about the world in order to live in it successfully, to understand the past, and to choose futures. The symbolic landscape carries and reinforces ideologies of production, protection, and human value. The symbolic landscape is conceptually prior to the built environment and to human-environment adaptations. Although

many LSS studies can otherwise clearly be nested within cultural landscape research, the symbolic component is substantially de-emphasized in LSS studies.

To use cultural landscapes as an analytical or policy tool, researchers seek to explicate the uses and meanings implicit in human narratives, choices, valuations, and actions about the land (as studied within a culturally coherent population). For example, western NGO workers interested in supporting ecological conservation within a traditional cultural milieu might explicitly examine the indigenous valuation of ecological services and of ecologically significant landscape units to find ways to align the two value systems, such as in Walter and Hamilton's study of the knowledge systems behind community-based conservation practice in Melanesia [10]. As qualitative research into inner states of people living in the world, the study of the symbolic landscape typically relies on ethnographic research, as explained in the methods section below.

This article seeks to strengthen the capacities of LSS to understand land-use change and to understand acceptance or resistance to land-use policies. This effort proceeds by melding discussions of human values, narrative, and meaning into considerations of the physical and institutional aspects of LSS through the application of the idea of a symbolic landscape. The research starts by following the land-use/water-use history of a local watershed.

2.2. The Susquehanna as a Symbolic Riverscape

The specific land-use case that is considered here is the influence of geographically situated beliefs and symbolism (the symbolic landscape) toward streams as they affect land-use attitudes and decisions within a watershed. I focus on middle sections of the Susquehanna River near the confluence of the North and West Branches at Sunbury, Pennsylvania, (and especially near the small town of Lewisburg where I live). See Figure 1. This is an excellent location for a study such as this, in that the river has an extensive history of receiving negative water-quality impacts from a wide range of extractive activities (logging, coal mining, agriculture, fracking) and industrial enterprises (iron, lumber, milling, leather, cloth processing) within the diverse watershed. The human aspects of the river through time are well-recorded, as well, within a wide variety of sources from earliest European contact to the present [11].

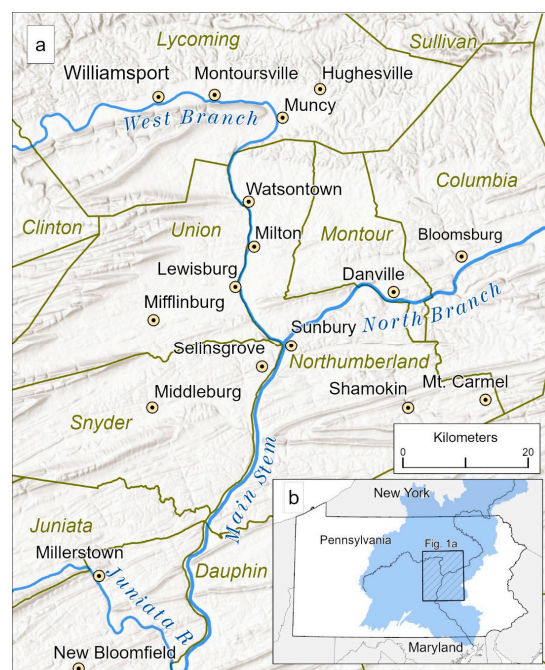


Figure 1. (a) Map of central Pennsylvania showing towns and county names, centered on the study region at the confluence of the branches of the Susquehanna River, and (b), its location within Susquehanna River watershed.

This work is a component of my ongoing examination of the effects of symbolic construction of the landscape in this region, as observed through a range of industrial and post-industrial activities including the symbolic landscapes of forest use, settlement and migration, mining, agriculture, urbanization, and governance. See, for example, my study of the symbolic landscape of coal towns [12].

3. Research Design

The central observation of this article is that public values toward the Susquehanna River as an element of people's lives are an essential way to understand trajectories of land-use change within the river's watershed. The values imbued by the residents into the symbolic riverscape are connected perceptually, politically, and aesthetically up onto the land that feeds water and impacts into the river. The geographical truism that the river is inseparable from its watershed is entering common discourse, and thus people's river experiences have melded with considerations about appropriate land uses. (That connection of water and land use is the focus of this Special Issue, an elaboration of an emerging theme in LSS.) This specific cognitive and emotional linkage is relatively new in the region, and continues to grow. It is constrained as a long-term solution to environmental problems at the present, however, by political and perceptual limits, as will be shown below.

This work is substantially ethnographic, using a mode of research that is gaining wider acknowledgment as a productive tool for the study of human-environmental action [13]. An example, and perhaps a fair model for this project, can be seen in Odgen et al. as they construct a "forest ethnography" of urban forests in Maryland [14]. Their project is parallel to this one, focused on the symbolic elements of landscape-scale shifts in urban forest cover. They term the social role of forest-related values "the production of forests" (p. 49), as they seek to be "attentive to the social life of urban forests". (p. 49) As they summarize it "[urban] forests are joint ecological and social phenomena", (p. 52).

Ethnographic research is different in fundamental ways from the research that scientists are most familiar with. First, it is not hypothesis-driven. In ethnographic research, qualitative evidence is assembled that will eventually support some set of assertions. Typically, the researcher follows ideas that emerge from their on-going observation and accumulated knowledge, rather than seeking to evaluate specific potential conclusions—hypotheses—through the research. After the experiences and stories are gathered, the researcher constructs summaries or integrative thoughts. Second, the evidence is often diffuse and subjective. Ethnographic methods are used effectively in LSS research elsewhere. An article about "bridging" analytical approaches, for example, by Vadjunec et al. concludes by pointing to "the importance of incorporating ethnographic approaches to study both formal and informal governance, and the potential role of community participation and co-production in creating co-adaptive governance structures" [15] (p. 15).

Scope and Limitations

This paper reports on direct and indirect evidence of residents' attitudes toward the Susquehanna River. The subjects are current and recent residents of the region who have expressed attitudes in my presence or in material I have read, as well as historic actors who left records in their actions and representations. The bulk of the evidence about the contemporary situation of the symbolic river is derived from extensive and general observational data, gathered by the author over a decades-long period. In the course of several research projects, I have conducted discussions and interviews about landscape values with public actors in the region over many years. I have read the local newspapers for decades. I have participated in official environmentally oriented governmental activities—I served on the board of the Union County Conservation District for over 30 years, working on soil and water conservation policy. I taught community-based research 'clinic' courses connected to a variety of local stakeholders within the Environmental Studies program at my university here for about 20 years. I worked with numerous local environmental, social service, and recreation non-profits. I observe and participate in symbolically rich

community and individual activities connected to the water such as the local town's floodplain taskforce and a community-awareness social media site about the river. I have talked, as one will, with neighbors and friends as I lived literally adjacent to the river since 1991.

From this wide context, it is often not possible to cite single sources for most observations; they are repeated in social performance and are recovered holistically from these frequent occurrences. As is expected for qualitative research, the result is the observations and perspectives of only one informed observer. It is not meant to be a definitive conclusion about the river and the region for all people, as some other kinds of social science research might seem to be. Rather it is intended to bring forward one compelling story to guide perspectives and future research. The specific observer (me) in this case is a mature white man with an advanced degree and a professional job. This situation inevitably colors the observations and interpretations in the report; for example, problems of hunger, unemployment, racism, or sexism might be less noted by me than by many others, while the actions of complex natural systems or the semiotics of culturally thick symbol sets could seem more significant to me than to observers less embedded in the academic project.

4. Susquehanna Watershed and Human Actions

The Susquehanna River dominates the hydrology and indeed the topography of eastern Pennsylvania [16]. It traverses the state from north to south, with the longer North Branch rising in New York State—at Cooperstown, conventionally—and the main trunk draining into the Chesapeake at Havre de Grace, Maryland 444 miles (715 km) later. See Figure 1b. Nearly half of Pennsylvania is in the watershed. Geomorphically the Susquehanna River is an ancient stream that has been slowly cutting down into the land over tens of millions of years. It heads in the incised Appalachian Plateaus of the north, cuts through the venerable linear mountains of the Ridge-and-Valley in the middle of the state, and finishes its journey entrenched into the low-relief topography of the Piedmont. It is the largest US river entering the Atlantic Ocean. As a result of its bedrock channel, first exposed as just kilometers upstream of its mouth, it is the largest unnavigable river in the nation [17].

The watershed of the Susquehanna features a range of very rich resources, generally at medium-sized scales that were highly appropriate to 19th-c. extraction technology. The region therefore underwent a series of early industrial-extraction booms [5]. Anthracite (hard coal) in the eastern Appalachian area of the state was heavily exploited for a century after 1840; soft coal in the northern region is still mined; medium-scale iron resources in the Ridge-and-Valley section peaked in production during the Civil War; vast timber lands across the mountainous regions were mostly cleared in a decades-long frenzy ending by 1910; and local resources like brick, stone, gravel, and scattered zinc beds were important at various times into the present. The most significant resource, which was critical before Europeans arrived and continues to dominate the rural economy, is good soil. The best soils are as good as any in the US east of the prairies, and decent soils are nearly ubiquitous across the central and southern parts of the watershed.

4.1. The River and Economic Development

These resources were formative to the development of industrial economies in the study region around the junction of the two branches of the Susquehanna River. The settlement pattern here is dominated by river towns, numerous modest settlements spaced six or seven kilometers apart that developed adjacent to the river. The towns benefited from their location for mill power from steep tributary streams; for trail, road, canal, and railroad transportation on the level floodplains; for abundant water supply for industrial uses; and for rich riverside soils. Land use in the region has been shaped by water from the start of European settlement and before.

Explicit statements about attitudes and landscape meaning are generally unavailable from historic times, but the enormous role of the river in people's lives then tells much

about the cognitive centrality of surface water. Patterns of river use shaped land use in numerous ways through history. Native populations were highly dependent on river resources and settled nearly exclusively near the river, to judge by the contact-era reports and the archaeological record [18]. Extensive areas of land back from the river were burned by Native people for many centuries to maintain ecologically preferable prairie, by the historic reports and evidence of the existence of grassland soil horizons, but sandy floodplains were the best village sites. The light floodplain soils were easily tilled, the river provided fish and waterfowl at critical times of the year, and small boats on the river offered an excellent way to travel to other riverside settlements. Flood risk was little threat for small communities built with light and easily reparable structures.

Early European visitors relied on borrowed Native American technologies and spatial decisions and on Native American village networks, so early settler patterns mimicked the pre-European ones in their riverward orientation [19]. The indigenous settlement called Shamokin, at the site of modern Sunbury (and distinct from the coal-mining town 15 km to the east that coopted the name in the 19th century), was the largest Native American community in Pennsylvania during the 1750s, immediately before the final westward expulsion of the Native population at the time of the French and Indian War. Indigenous Shamokin/Sunbury was thoroughly riverine—on the floodplain at the confluence of the branches and closely connected to annex settlements on nearby islands, as well as to distant settlements, by water transport [20]. The site had similar value to the early European occupants as to the Native people, and it transitioned directly into an English fort town and trading center after the departure of the indigenous inhabitants.

Surface water shaped the pattern of river towns in intricate ways. Starting in the 1780s, dozens of towns grew on the banks of the Susquehanna branches. Essentially every town was at the mouth of a tributary, the locus of a water mill that nucleated settlement and economic activity. Lewisburg, on the West Branch 9 km north of the confluence, is typical. In 1787 Ludwig Derr built a mill within 100 m of the river, powered by the waters of Bull Run, a modest tributary [21]. He laid out the rectilinear town grid in the square mile of land north of his homestead, which he first named Derrstown after himself. Lewisburg anchors a rich agricultural valley on the west bank of the river. More typically, river towns were laid out on the east bank, locations more easily approached cross-country from tidewater; again the river structured land use.

River-town economies, as established in the late 18th century, relied on technologies that would have been familiar to the Romans—animals for traction, low-head waterpower for milling grain and sawing wood, iron tools for manufacturing and extraction, and wooden wagons and boats for transport. A few decades after first settlement, the earliest transformations of American industrialization changed the local economies dramatically. Widespread use of steel tools increased labor productivity. Steam power began to replace waterpower in the middle of the 19th c., increasing the amount of work that could be done at a single site and freeing manufacturing from stream-side locations. The branches of the Pennsylvania Canal ran up along the banks of the two Susquehannas beyond the confluence in the 1840s, increasing the market area for local manufactured goods enormously [22]. Rail transport arrived two decades later. Coal production in the nearby anthracite region ramped up in the 1850s and 1860s. National advances in machinery design and chemical engineering expanded industries into many new kinds of manufactured products—large foundries, coal gas plants, industrial-scale tanning, naval stores—with many new kinds of waste products as well.

Industry grew through the 1830s to the end of the century. The 1880s were the pinnacle of industrialization and wealth generation in this area, a fact visible on the urban landscape by the elite residences, commercial buildings, and social clubs built in the distinctive massive red-brick Romanesque architecture of that era. Lewisburg's business directories of that time showed foundries, forges, knitting mills, tanneries, a coal-gas works, buggy shops, a steam waterworks, steam grist mills, and a canal-boat manufacturer [23].

Industry clustered at the waterfront, for access to transport and ready waste disposal. Fire was frequent.

Figure 2 is an 1884 commercially produced bird's-eye view of Lewisburg presenting a capitalistic ideology of the growing town near its industrial peak [24]. The image celebrates the industrial activities at the waterfront, showing an armored shoreline, bulky factory buildings and warehouses, hectares of materials yards, and hypertrophic billowing smokestacks. Few residential buildings are visible near the river at that time. Now no industry remains in the area covered by this image.

4.2. Environment of the Industrial River

This was a formative time in shaping the geography within the river towns. The waterfront was dominated by undesirable characteristics and characters. It was smoky from factories, and it was foul-smelling from the tanneries and from the coal gas company dumping waste coal tar on the banks. The river-front commercial district was crowded with wage-laborers, transient teamsters and canal workers, and the businesses that catered to them. Many of the houses along the riverside streets had origins as taverns, warehouses, or cheap boarding. Additionally, the river itself was foul-smelling and noxious—sewage, coal tar, tanning liquor, and factory effluents flowed freely into the river. In the local watersheds, soil eroded rapidly off steep farm fields and logged hillsides into the stream and river system; many small tributary streams show one or two meters of European-era sedimentation onto their floodplains. The unattractive riverfront was to be avoided as a place to live. Lewisburg never had many houses built along the river—perhaps only six houses built before 1900 now stand on the river side of the lowest streets. Some river towns—Liverpool on the main branch, e.g.,—have none.

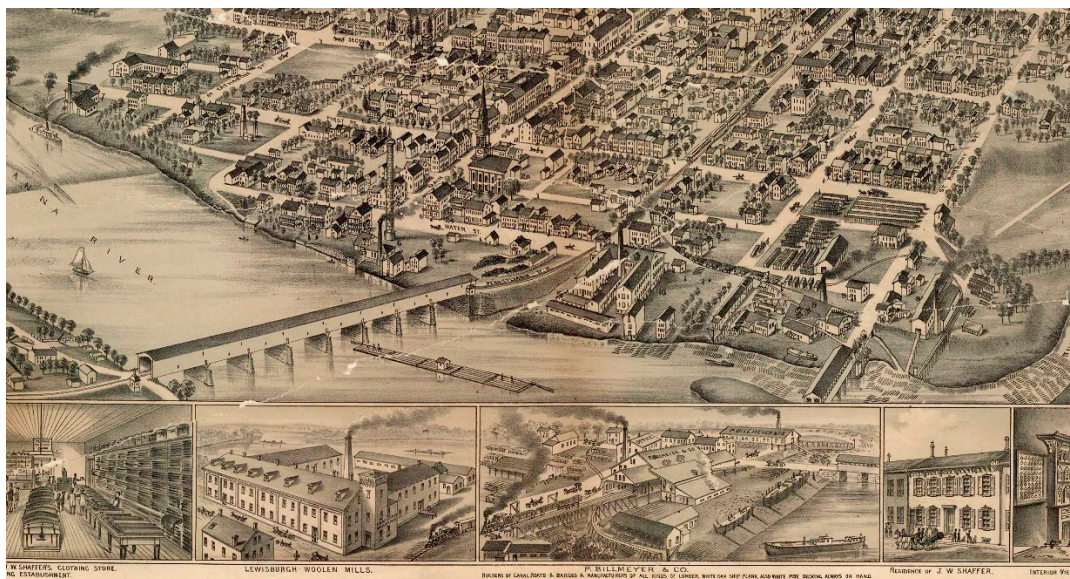


Figure 2. Detail from a bird's-eye rendition of the waterfront at Lewisburg in 1884 [24].

This is the nature of the industrial-era Susquehanna River edge—environmentally dangerous, aesthetically distressing, and socially threatening. These attributes of the river are each linked to land-use choices and changes—logging, farming, mining, transport, industry, urban structure, and residential construction. The LSS causal vector was from land-use toward river impact—land-use actions drove stream degradation. The potential opposite influence, of river quality on land-use decisions, is not seen; land-use choices were not apparently conditioned by their water impacts.

The industrial era of the river lasted well into the mid-20th c. Elderly people in Lewisburg told of swimming in the river as children, hurrying toward the middle of the channel to avoid the blue plume from the denim factory. They tell of how sewage pipes

from riverside houses discharged raw waste to the waters until 1950. Into the 1970s the river was a distinctive deep green when seen from underwater by a swimmer, because of the abundant growth of algae fed by fertilizer and sewage. Dozens of kilometers of the upper West Branch are still essentially devoid of vertebrate life from the acidic orange drainage from coal mines.

5. Evolving Symbolic Constructions of the Susquehanna River Environment

This paper is intended to show how the symbolic element of the cultural landscape is essential to understanding the other two elements—human-environment interactions and modification of the world through infrastructure—in order to suggest that LSS should further center values and meaning in its discourse. I will describe the cultural transitions that underlie the shift away from that industrialized riverscape, where human activities on the landscape were organized to maximize productivity in apparent indifference to their significant detrimental effect on the surface waters. An opposite condition is coming to the forefront: understanding of the interconnection of water and land use is becoming widespread, the value of the water to non-economic users seems universally accepted, and environmental arguments about land use frequently begin from the value of the river. I will trace specific conceptual, symbolic, and value-laden discourses about the river as they support a public argument that nests the river into the landscape and drives significant land-use choices toward maintaining water quality. The argument will be brief within the constraints of a journal article.

This discussion is arrayed on four themes within these public discourses about the connection of water-quality issues to land-use decisions. The first theme is the evolution of a broader understanding of the river's utility into that of being an amenity river; that is, the river's key modern function is to improve the lives of residents, and therefore its quality should be protected through aggressive methods including land-use controls. The second is the development of an understanding that the river is a systemically interconnected element of the watershed, therefore its quality can best be maintained by land-use choices. The third is the developing geographical perception of the river as a central structural and visual part of the human landscape, and therefore a belief that urban and other stream-side uses should respond to the opportunities and hazards that it presents. Additionally, the fourth discourse is of a developing sense of river cleanliness based on symbolic or perceptual standards of purity, standards rooted in cultural norms rather than in science of pollution and public health.

Huge blindresses remain within the constructions of the river. Two of the largest factors threatening the river are essentially absent in the public discourse: the ways that climate change is altering the stream, especially flood risk, and the huge impact of intensive animal farming on water quality. The large impact of invasive exotic species of aquatic animals and littoral plants is also not a widely shared concern.

5.1. *Perception of the River as an Affirmative Part of Our Lives*

The words 'river' and 'Susquehanna' currently carry strongly positive emotive weight whereas they recently were more neutral or abstract. A local NGO hired a consultant within the past five years to upgrade its public image. In surveys and focus groups they found that the mere addition of "River" into their name significantly improved public response. Over the last four decades, "Susquehanna Valley" and similar terms have shifted from being non-value-laden place indicators to being affirmative components of a carefully constructed local place identity.

A quick search can demonstrate the centrality of this new identity in the names of local organizations vying for regional support, such as Susquehanna Valley United Way, Greater Susquehanna Valley YMCA, Susquehanna River Valley Visitors' Bureau, *Susquehanna Life* regional lifestyle magazine, Greater Susquehanna Valley Chamber of Commerce, and Susquehanna River Heartland Coalition for Environmental Studies. The report of an "Envision the Susquehanna" initiative contains a sizable list of river-centric organizations,

many only a few years old [25]. Educational activities—high school and college classes, campus programming centers, etc.—have started using the river as the focus of regional and community studies, Native American studies, and environmental science initiatives, and students are receptive.

Figure 3 is the recently adopted webpage imagery for Sunbury [26]. The logo presents an ideology of a post-industrial river town, invoking the rippling blue waters of an idealized Susquehanna River formed into a heart. In fact, the waters at Sunbury are usually a stagnant pool of murky green-brown water, restrained by a low recreation dam just downstream. Sunbury, a highly stressed deindustrializing city, is completely isolated from the muddy banks of the river by a massive, drab concrete 1930s floodwall. The river is not visible from the streets of the town.

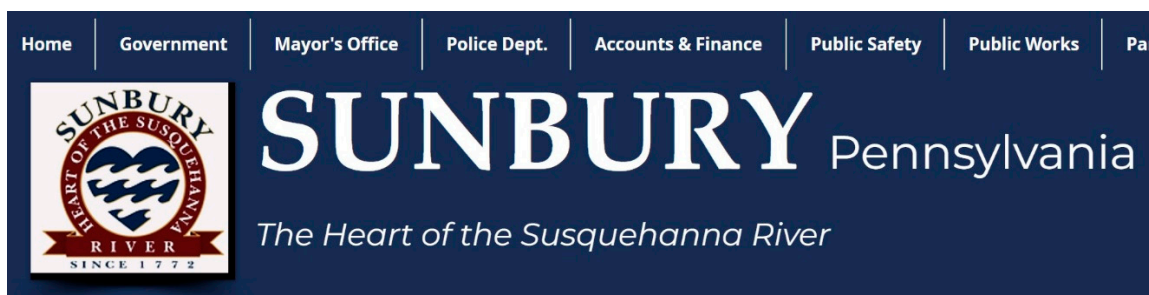


Figure 3. The recently adopted urban iconography at Sunbury, Pennsylvania [26].

5.2. The River as a Part of the Town

Formal and informal town planning and land-use actions have integrated the river much more fully into the lives of citizens. Designers and operators of municipal and state waterfront parks have become more intentional about the parks' function as connections to the river. New parks are built to face the river, which was literally noxious within human memory. Existing parks are redesigned to connect more fully with the river, by clearing sightlines and orienting trails and other facilities toward the water. The design of the state park on the island at Milton has been reoriented from a small sports and picnicking venue in a woods clearing, to an extended series of river-facing trails which are heavily used. Similarly, the municipal waterfront park at the Lewisburg bridge, established on an old industrial tract, was reoriented toward the river by moving tables and clearing sightlines; it is now site of wedding photoshoots throughout the summer. The visual connection between town and water is seen to be important as it never was in earlier times. Additional infrastructural connections are established, such as boat launches. Large stream-side concert venues are popular projects for which to seek Federal economic-development funding, although such projects are often severely underutilized after completion. Sunbury and Lock Haven (north of the focal region) each has one.

The verbal construction of the towns in their tourist literature and their public activities has brought the river into the center of community identity, with river festivals and annotated history walks proliferating, for example. Sunbury has a River Festival each August and Catawissa, 18 km up the North Branch, has an annual Watershed Festival. Towns take symbolic possession of adjacent parts of the river with clean-ups, getting residents to personally invest in the riverscape. Figure 4 shows residents pulling old tires from the bed of the West Branch at Lewisburg. The town worked to reclaim a sense of the Susquehanna as a clean stream and to facilitate an emotional investment in the water's quality by addressing a decades-long legacy of dumping.

Streamside paths for walking and biking are being developed on the river as well as along major tributaries. Heavily engineered flood protection structures often offer superb surfaces for river-side trails. Williamsport and Sunbury developed trails along their respective floodwalls. Many disused railroads and canal paths were adjacent to streams, so the connection of new trails to the stream is both fortuitous and inevitable. In return,

the trails provide a water-level 19th-c. perspective on the post-industrial landscape. Penns Creek and Pine Creek, at the western and northern edges of the study region, respectively, provide good examples. Interpretative signage accompanying the trails reminds users of the earlier, more destructive uses of the waterways such as logging and milling. The post-industrial landscape presents additional valuable opportunities for riverine recreation and leisure activities—abandoned mills and factories bring hospitality and residential spaces to the waterside, for example.



Figure 4. Lewisburg residents pull decades-old tires out of the muddy riverbed beneath the Market St. bridge in 2014.

People’s reactions to the river as a visual landscape element tend to emphasize a ‘scenic’ experience of the river rather than closer-in experiences focused on physical or ecological aspects of the river. For a number of years I have helped run a Facebook page featuring imagery, stories, and community activities associated with the river at Lewisburg [27]. This page provided a natural experiment about which images collect the most ‘likes’ as being evocative of people’s connections to the river. Pictures furthering direct engagement with aquatic ecology, stream processes, or hydrological aspects of the river—which are well-received by my academic friends—are barely noted, while the flashy sunset, rainbow, or misty morning light earns heavy engagement. The same bias toward of the landscape-scale image is apparent in tourist literature, other towns’ web presences, and regional life-style publications: the river is most often represented from high above, snaking diagonally across a sunlit countryside.

5.3. *Amenity River*

Direct uses of the river surface have shifted tectonically over recent decades, and the structure of the human environment is altered to support this. Echoing broad changes in recreational use on the land toward biking and running and away from a dominance by motorized uses, most new users of the river have embraced the kayak as the canonical experience. See Figure 5. Kayaks are an elegant way to access the river. They are relatively cheap at entry level, they are usually inherently solo crafts, but easy to move in large clusters in as well. New kayakers describe the exhilaration at the proximity to the water, at their capacity to move easily across the water surface, and at the distinctive new perspective on the landscape from beneath the wooded banks.

Kayaks were nearly unknown a few decades ago; now dozens, or hundreds, of kayaks may pass a river town on a summer weekend day. Nationally, kayak use has been increasing at over 10% per year [28] (p. 3). Motorized uses, like bass boats and unwieldy pontoon family boats, are present but are proportionately less important. Kayaking clearly manifests the class characteristics of the modern reconnection to the river—kayakers are more likely to earn high incomes and more likely to be college-educated than the average person, but these are also the demographics of people with stronger environmental concerns and greater policy impact [28] (p. 5). This is especially true compared to the demographics of motorized river users, who more frequently fish and hunt and drive pickups, while kayakers are more likely bird watchers. Municipalities race to provide infrastructure for these human-powered uses, offering new boat launches and even loaner-boat programs.



Figure 5. A colorful flotilla of kayakers on the West Branch retreating from a summer shower under the Market St. bridge at Lewisburg; kayaking has become the dominant use of the surface of the waterway in recent years.

5.4. Watershed-River Links

The perceptual transition that most directly illustrates the changes in the symbolic landscape affecting LSS is the growing acceptance within public discourse that the character of the river is a product of the conditions in the watershed. Public awareness lags policy in this case by decades, and policy severely lagged science as well. In the late 1980's the Union County Conservation District (a county-level governmental environmental agency whose region includes Lewisburg) proposed a well-planned pilot project to improve the water quality of Buffalo Creek—anchor of the major watershed within the county—to remediate effects of poor farming, especially sedimentation and nutrient loading from plowed row crops. The US Department of Agriculture rejected the proposal by explicitly explaining that it unacceptable because it was not designed to protect soil, the agricultural resource; water quality should only be a side effect. However, within a little over a decade, USDA was vigorously pushing the Chesapeake Bay Watershed Initiative that was specifically

premised on implementing land-use and barnyard changes to stabilize the water quality in the politically important Bay. Hundreds of millions of dollars have been provided for land-use changes within Pennsylvania through this initiative, including major efforts to shift marginal lands out of agricultural production [29]. A similar explicit statutory connection of land use to water quality is enshrined in stormwater-runoff and erosion-and-sediment-control laws [30].

Advocacy organizations often adopt a discourse connecting land use to water quality. Opposition to pipeline projects is very commonly presented in water-quality terms, arguing that pipelines threaten water quality during construction and subsequently through spills [31]. Fracking—hydrofracturing in support of the extraction of fossil fuels, especially of the natural gas within the Marcellus Formation in Susquehanna watershed in northern Pennsylvania—is frequently opposed on the stated grounds of its impact on surface waters, as well as on residential groundwater supplies. This oppositional discourse about fracking has been effective enough that new residents moving in central Pennsylvania express fear that all surface waters, including the major rivers and streams far from the gas fields, are dangerous. The fights against pipelines and fracking are good examples of how the public perception of land-use impacts on waterways are driving opinion and, to some extent, policy to affect landscape protection. Several development projects in Lewisburg were opposed by nearby homeowners on the pretexts that the hectare or less of new impervious surface would meaningfully increase the flood stage of the big river. The symbolic landscape acts to control the built environment.

5.5. *Land-Use Blindnesses—Agriculture*

There are dramatic limits to public concern about land-use effects on water quality. Many close observers would argue that animal agriculture is the most significant negative effect upon surface water quality, through the required intensive grain production, and through poor management of the excessive manure produced by the animals, yet public opposition to animal agriculture is rare. Union County had an inventory of chickens totaling 2,700,000 in the 2017 Census of Agriculture—almost 70 birds per human resident of the county [32]. Scores of intensive operations dot the landscape for these chickens, as well as for 43,500 pigs and 23,500 cattle and cows. A quick calculation suggests that these animals produce about 33 tons of manure per cropped hectare, which would roughly match the total nutrient demand for the crops if it were distributed optimally. Animal operations, however, are far from evenly distributed in the county (they are concentrated in the central and eastern sections nearer large through-roads), and many farms do not receive any manure from concentrated animal operations, relying on commercial fertilizer. The simple mass-balance and spatial characteristics of the system assure significant excess applications of manure, inevitably resulting in damage to waterways. Beaver Run, a small stream rich with dairy farms in the center of the county, has shown nitrate concentrations of 20 to 35 ppm in autumn for many years, according to annual measurements in a field course of mine. This is several times the EPA safe drinking water maximum (10 ppm). Scattered opposition to animal operations is present in the region, but it is based primarily on animal-suffering concerns, or on the persistent problem of odor. The link between animals on the land and water quality is not widely noted. Farmers seem to be inoculated politically by the fact that they produce food, and by their position within the venerable agrarian ideals of American culture.

5.6. *Land-Use Blindnesses—The Floodplain, Flood Insurance, and Climate Change*

Within the river towns, the challenges of residential occupation of the floodplain may be the dominant social expression of conflict between land use and the river. River towns are at least partially threatened by river flooding unless they are isolated by floodwalls and levees (like Sunbury). GIS analysis done by university students for the town government's semi-official floodplain task force shows that Lewisburg has about 30% of its housing within the FEMA statutory 100-year-flood zone, a higher percentage than most nearby

river towns. Much of the land was build-up before the pattern of flooding was noted—the two biggest historic floods in Lewisburg were in 1936 and 1972, well after most houses were built.

Over the decades the towns have adapted and adjusted to the mismatch of flooding and infrastructure. Some land has been yielded to the river and abandoned, either in a planned retreat by government buy-outs of repeatedly flooded properties, or catastrophically cleared by major flooding. (The best in-town park in Lewisburg is located where 2 square blocks of buildings were destroyed after a major flood in 1972.) However, the towns are still far out of balance between flood risk and community resilience; future catastrophic disruption is probably assured. Cheap federally subsidized flood insurance disguised the imbalance for decades following passage of the National Flood Insurance Act of 1968. Recently, federally subsidized flood insurance rates have risen dramatically as the larger flood insurance system copes with massive losses following devastating storms such as Sandy in the New York/New Jersey coastal region in 2010 and Harvey in Houston in 2017. Now federally supported insurance rates—which erroneously flatten the huge risk differences between, for example, wave assault on highly vulnerable coastal housing vs. shallow flooding of city streets in Pennsylvania—have increased several-fold [33]. Flood insurance in Pennsylvania, which is required for nearly all mortgages in the statutory floodplain, is vastly overpriced. It now costs about 3% of the exposed value per year, about the same as a typical mortgage's interest cost, even for a house with only a crawlspace below the statutory flood depth. This represents an absurd statistical presumption that each vulnerable house will lose all value every thirty-three years—in towns full of 100-plus-year-old houses. The excessive price of flood insurance has frozen much of the real estate market in river towns, or it has decreased housing value for affected properties by 20% or more, by the report of local real estate professionals. Real estate agents often steer buyers entirely away from any house on—or even near—the floodplain because of the complexity of the risk perception and the paperwork, as well as the direct insurance costs. Thus, in the past the price of flood insurance was too low, and occupation of the floodplain was encouraged; now it is too high, so residents' housing equity (and therefore cities' tax bases) are diminished.

However, the correct price of flood insurance is thoroughly unknowable in the volatile climate regime the towns occupy. There is strong evidence, beyond the global trends, that the historic flood records in central Pennsylvania vastly underestimate future flooding [34]. Portions of Lycoming County, the next county north of Union County, have suffered two separate flood events in the last decade that were semi-formally identified in the newspapers as 500-year discharges. Columbia County, 40 km to the east, has recently had several similarly outsized flood events in recent years associated with simply very wet weather and not a named weather system at all. The West Branch has been quiescent for a couple decades compared to its historic patterns—since a few years after the Agnes flood of 1972, which is the flood of record on the West Branch. Who can doubt that the disruptions that are seen in other places (increased storm frequency and intensity in the Gulf Coast and the Carolinas) or at other scales (extreme small-stream flooding throughout the region) will affect the Susquehanna, and will cause unprecedented flooding along the rivers? The floodwall that protects the city of Sunbury, for example, would be topped by a 200-year flood as estimated under the historic regime, but such floods may be far more likely than that today.

Climate-change discourses are essentially absent from local land-use discussions. Flood risk is still evaluated on the basis of the historic records that FEMA uses, and many other land-use evaluations are made on the basis of the same outdated data. Locally important uses such as stormwater calculations, soil-erosion predictions, agricultural nutrient leaching and runoff estimations, wetland boundaries, and highway engineering (as examples) are predicated on assumptions about stable future rainfall intensities, intensities about which actually we know little. Additionally, political will to ask difficult questions about the future conditions seems to be entirely absent.

This is not the only venue in which a lack of curiosity about the climate future has stymied action, of course. Uncertainty is one of the most incapacitating human mental states and climate-change denial is baked into conservative politics of small towns. Local planners acknowledge that discussions of future risk cannot use polarizing words like ‘climate change’ if they are to be heard at all. Using scientifically precise climate-change language can end otherwise-productive discussions with local politicians. The symbolic landscape can hinder action as well as to encourage it.

6. The Culture of River and Land Use: Discussion

Land use in central Pennsylvania is responding to changing values, meanings and narratives about the river, as the human value assigned to it shifts from a settler- and industrial-era emphasis on economic utility to a post-modern appreciation of the river as an aesthetic, lifestyle, and amenity component of the landscape. The popular understanding and valuation in the relationship between the landscape of central Pennsylvania and the Susquehanna River have evolved significantly over the last several decades. I believe that these changes reflect a number of important cultural shifts that affect this human-natural system, and any LSS research in places like this.

I see three major components in this cultural shift. First, there is an enlargement of systems thinking that permits people to approach the natural world by foregrounding the connections between the elements, rather than just observing the elements themselves. This vision helps people understand that the condition of the river is a product of the state of the watershed, for example, and that land-use issues are also stream-value issues. Systems thinking is an explicit element of modern environmental education, as well as of ecology, engineering, etc., and the changes may reflect a widespread incorporation of these intellectual tools into the education system. College-educated residents are more likely to use this perspective.

The second shift is a fundamental change in the ways landscapes are valued; the degree to which the natural world is primarily seen to be composed of useful resources meant for exploitation is decreasing. The industrial-era incarnation of the region created wealth by using all materials available to it with little regard to the effects on the land, water, or people. The ruthless exploitation of the land and residents in the nearby anthracite coal regions might epitomize this approach, or the total deforestation of the local mountains by the first years of the 20th century. However, in the amenity-centered, service-oriented region of today, society mostly consumes material resources that are transported to here from afar through the economic system, and it now produces local wealth more by marketing affirmative lifestyles and experiences to residents and visitors. That is, the key local resources are less material and more affective: aesthetics, affirmative outdoor experiences, and the river as a place-anchor. A large coal-mine owner operating in the far northern reaches of the watershed told me that he thinks that the ultimate goal of state coal policy is to end mining entirely because undisturbed land is more valuable than mines.

Third, the river as-such is increasingly visualized as a central part of the region. This applies to tributaries as well; streams are important parts of the central Pennsylvania place discourse. The names of organizations and of landscape features show this through the expanding use of the name of the river and of streams in place discourses. Regional planning ventures (such as the extensive Susquehanna Greenway Partnership), tourist publicity, and newspaper reports all increasingly structure the perceptual geography of residents according to a relationship to the rivers and major streams.

Although these changes are affirmative from an environmental protection or sustainability perspective, there are severe limits to their capacity to effect long-term improvements. One limit is cognitive, that people have a constrained understanding of the natural system. Residents significantly overrate the significance of hard-to-see influences on the river that have been constructed in the popular environmental literature to be dangerous. Fracking fluids or other perceived pollutants from Marcellus-gas extraction are the most obvious examples—low concentrations of highly toxic materials are believed to have major negative

impact. In contrast, massive farm-chemical runoff and sedimentation from field crops are underrated as impacts on the water. This disjunction follows expected patterns from risk-perception research: a cryptic threat or a material with slight, but potentially catastrophic, impacts (low concentrations of poorly understood carcinogens) weighs heavily in people's perceived risk evaluations when compared to familiar, marginally toxic, but highly damaging pollutants like animal waste [34].

These changes in the symbolic riverscape suggest that we should see systemic improvements in residents' interest in supporting environmentally appropriate choices about land-use decisions. However, these changes are, at present, each small steps, and together they confront widespread challenges to becoming effective responses to environmental problems. A major issue is political, that the population exhibiting these new perspectives—about nature, outdoor activities, and communal urban planning—is a socio-economically privileged minority in central Pennsylvanians. These people are well-educated, outdoor-oriented, middle-class, and generally otherwise politically progressive. In contrast, much of the region, as judged for example by letters-to-the-editor in local newspapers and recent presidential election results, is highly conservative; people favor little government involvement in property-related action, and express limited support for social projects that help people other than themselves or for engagement in the non-human world. For example, motorized uses of natural environments, including the river, snowy forestry roads, and the rural countryside, remain the norm for most of the population despite the obvious expansion of hiking, biking, and kayaking among a sector of the population. According to environmental educators and public-land managers I've talked to, another long-term limit to citizens' responsiveness to environmental threats is the increasing isolation of children from nature, which stifles the development of a strong symbolic connection to the natural landscape. Fewer children play outside, fewer children have rural upbringings, fewer people enter adulthood with an ingrained understanding of and commitment to natural systems; "when screens replace backyards", as Edwards puts it [35].

7. The Emergence of Humanities Approaches in LSS, and in Environmental Studies

A way to contextualize the stage that the LSS is in as an environmental-intellectual endeavor is to examine it as a subset of the scholarly activities subsumed within environmental studies and then look at the evolution of that broader and more mature field for a map of the ongoing development of LSS. Like LSS, environmental studies was rooted in technical understandings of human environmental impacts. The seminal texts of the 1960s and before came primarily from biologists, and grew from "monitoring and modelling", as described above for early LSS. Leopold [36], Carson [37], and Hardin [38] exemplify this group, examining nascent environmental problems through an explicitly ecological lens and, frequently, constructing ill-formed social-science models from their biology perspectives. This matches the early 'observation and monitoring' goals of LSS. This stage also aligned with the first, 'human-environment relations', element of the cultural-landscape concept.

Economists and policy experts ascended in the field through the 1970s and 1980s, as the role of markets and laws emerged in public discourse. Economist like Daley [39] and politicians like Udall and Muskie [40] represent this era when large-scale institutional forces were seen as the central human factors that affected the environment. At a general level, this stage matches much language about 'socio-ecological' causality in LSS today. Market, policy, and management are treated as powerful, but often weakly differentiated, forces. These institutional and technological interventions represent the second, 'built-environment', element of the cultural-landscape concept.

Since that time, environmental studies has introduced two important threads that vastly improved researchers' comprehension of the causes and effects of environmental change by looking at the processes from a more humanistic perspective and by reaching for symbolic-landscape aspects of environmental issues. One was a shift from an aggregate view of human action—the undifferentiated consideration of 'society' or 'economics'—toward centering the individual in discussions. The emerging attention to environmental

racism is a good representation of this shift, as the academic discipline comes to understand that some individuals' experiences of environmental challenges may be very different from those of others, according to their location in societal structures of race, class, gender, etc. [41,42]. The second was the integration of values, meaning, and narrative into understanding of human environmental action. Environmental history, environmental ethics, and environmental ethnography are parts of environmental studies that demonstrate this, such as the work of historian Cronon [43], ethicist Marshall [44], and ethnographer Norgaard [45].

A comparison of the longer history of environmental studies with the present state of LSS suggests that productive next steps for LSS might be to foreground the roles of individual experiences and individual values in the causal chains that LSS studies. That is, it is broadly acknowledged that the physical land-use system is responding to societal forces, therefore we now need to ask what human values and meanings the societal forces are, in turn, responding to. We need to center individuals and their values into LSS analyses. This is the goal of this paper, to trace the genesis of land-use decisions back into human value and meaning with regard to surface water.

8. Conclusions: LSS and the 'Cultural Riverscape'

The strongest possible approach to understanding the relationship between land-use studies and the human environmental experience within LSS will need to use the ideas of cultural landscape in toto. The first two parts of the concept—the environmental interactions by humans with the natural environment, and the physical and institutional structures that moderate our vulnerabilities—are well-integrated into LSS, but full appreciation for the symbolic landscape that underlies and precedes human action is lacking.

This is relevant to understanding the relationship between water and land use in LSS. I have shown how people in central Pennsylvania, as in similar situations elsewhere, increasingly see themselves as intimately connected to healthy waterways, including rivers that are accessible for their direct use and for emotional connections. These inclinations serve to guide important aspects of people's interest in managing the environment through supporting policy, land-use decisions, and civic action that further the preservation of a healthy and accessible river, using action that therefore influences LSS components of the landscape.

The example of the Susquehanna River shows that symbolic landscape is a useful tool to understand and to guide policy and action in situations where land use and water are linked. Trends suggest that people will support increasing investment in landscape choices that optimize post-industrial river values, and in policy choices favoring these river values that will also support healthy LSS outcomes. The overall evolution of residents' symbolic relationship to the Susquehanna River system supports increasing environmental protection of the entire landscape through systemic connections with the river. This vision inherently connects water-related values to land-use choices and therefore supports a holistic approach to sustaining the world residents live in.

At a policy level, a set of river narratives is a highly functional element of community efforts to support environmental protection, which includes land-use protections related to LSS components that affect streams. These constructions of the river as an element of the symbolic environment serve to help the community decide what to land-use choices to invest in through policy or the work of NGOs, for example. They serve to help people decide what land to protect in their own lives as homeowners or as parts of political or social units. The components of the landscape that affect river quality and usability therefore receive attention and investment.

At a social level, the symbolic landscape of the river is a powerful guide for steering collective action. Many local groups are organized on the basis of environmental affinities, and expansions of systemic thinking is important for them. Hunting, fishing, recreational, historic, and nature-appreciation organizations may seem to be disparate in their goals about specific land uses, but their recognition of shared valuations of natural systems and

the parallel narratives of that valuation help people in these groups work together to guide political choices.

And, at a cultural level, this symbolic landscape represents a fundamental characteristic of who we are as a people. The symbolic landscape is an idealization of how people should operate in the environment—what we are like, what we value, how the environment is a piece of people’s lives. It is true for a modern society as it was for earliest users of the land that we have an environmental dimension to our identity; our vision of ourselves includes an inseparable element that is this story of how we fit into the land. The river becomes increasingly important in those identities, and therefore is defended through land-use choices.

People in many communities will support significant LSS-related policy initiatives and investment to preserve aspects of the river as a critical component of the human environment, frequently through changes in the land-use practices or policies. The riverscape and the watershed are, indeed, “joint ecological and social phenomena” [14], as the human regard for the river guides landscape action, and as the environmental state of the river affects human regard. Stories guide our actions, and the new stories being shared about the Susquehanna are guiding us toward greater public concern about how watershed land use should support healthy streams.

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