

Adaptive Governance for Resilient Urban Watersheds

The Case of the Anacostia Watershed

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Overview

This poster identifies the key factors affecting the resilience of urban watershed governance to adapt to rapid and unprecedented socio-ecological changes. Adaptive governance is "the evolution of new governance institutions capable of generating long-term sustainable policy solutions to wicked problems through coordinated efforts involving previously independent systems of users, knowledge, authorities, and organized interests" (Scholz & Stiffel 2005).

Adaptive governance emerges to govern resources under complexity and uncertainty in socio-ecological systems. It is depicted as an evolving "blob in a box" shaped by enabling and boundary conditions (see Figure 1).

The resilience of social systems (e.g., politics, economies), ecological systems (e.g., watersheds), and institutions (e.g., laws, planning frameworks) depend on one another in complex, interlinked dynamics. Maladaptive institutional changes threaten cities' ecological and social resilience. Adaptive institutional changes often lag behind ecosystem and social changes, though (Olsson, Folke, Galaz, Hahn, & Schultz, 2007; Boland & Baumann, 2009). The Institutional-Social-Ecological Dynamics (ISED) Framework aids scholars, practitioners, and policy makers to understand these inter-systemic changes (see Figure 3).

Urban watersheds are useful scales for both analysis and governance of "wicked" urban water problems resulting from cross-system interactions at watershed scales. These dynamics are illustrated by the Anacostia River watershed in DC and MD (see Map below), as developed in a published paper by Arnold, Green, DeCaro, Chase, and Ewa (2014) as part of the Adaptive Water Governance Project, SESYNC NSF DBI-1052875

Adaptive Governance System: Flexible, Innovation, Change

Rigid Rules and Intractable Conflict

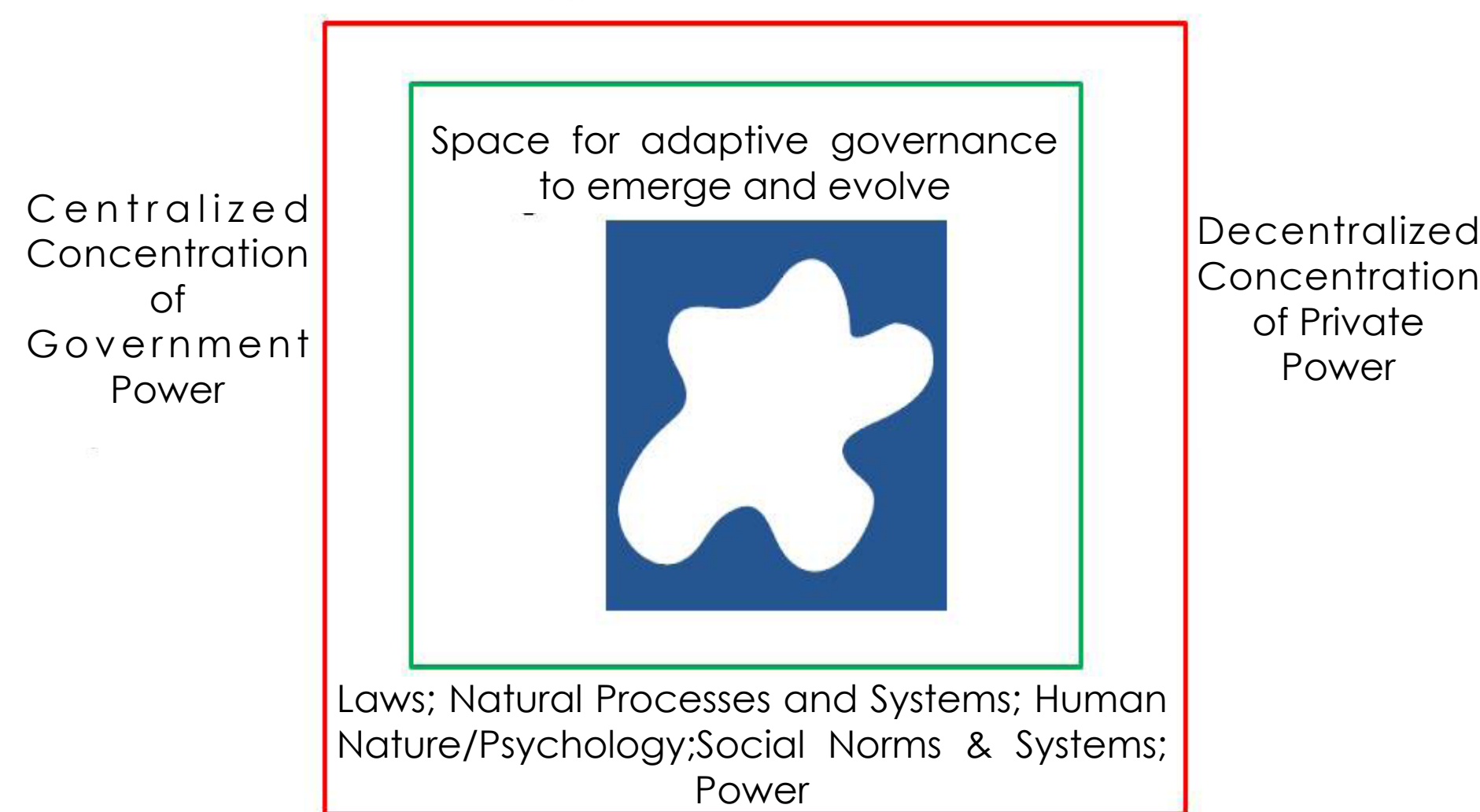


Figure 1: The Adaptive Urban Watershed Governance Framework
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Urban Social System Changes in the Anacostia Watershed

Major Societal Drivers of Urban Watershed Resilience:

Land Use and Urban-Suburban Growth Patterns	Perceived Value/Uses of Watershed Resources	Social Inequity and Social Movements
i. Developed watershed lands: > 70%; urban/suburban residential = 45% of watershed lands. ii. Population density: 2.66 → 7.1 persons/acre. iii. Urban water demand: 30 → 40%. iv. Watershed impervious cover: 25% (at threshold from bio/hydro impaired to bio/hydro non-supporting). v. Increasing urban/suburban green-infrastructure.	i. Historic river bed & waters altered for navigation, waste disposal, & land development. ii. Trees, soils, & wetlands destroyed for human use. iii. Annual discharge of 1.5-2.1 bn gal of combined sewer overflows (CSOs) & stormwater. iv. Public re-framing of river & watershed lands for valuable ecological, aesthetic, & recreational human purposes.	i. Slavery → de jure segregation → de facto segregation → gentrification & structural racism = neglect & exploitation of river & communities. ii. Emergent social-justice, civil-rights, & more-inclusive environmental movements. iii. Migration of minorities & low-/moderate-income people to suburbs.

Ecological Changes in the Anacostia Watershed

Major Ecological Drivers of Urban Watershed Resilience:

Flow Regimes & Water Storage Capacity	Water Quality Conditions	Aquatic Species' Health & Biodiversity	Wetland & Forest Functions
i. Sedimentation, stream structure alterations, & stormwater runoff patterns → shallow & sluggish river flow. ii. Streamflows & urban water consumption patterns → altered surface water-groundwater relationships & river structure.	i. Nutrients, suspended solids, polychlorinated biphenyls → impaired river & stream water quality. ii. Growing urban runoff & CSOs threaten fundamental hydrological functioning of watershed. iii. Legacy toxins in riverbed persist. iv. Reduction in pollutant levels & CSOs.	i. Once ranked highest in nation for fish liver & skin cancers; has improved with greater water pollution controls. ii. Extirpation of fish populations (sturgeon, white and yellow perch, pickerel, catfish, herring, etc.). iii. Submerged aquatic vegetation persistently in short supply, especially in tidal portion.	i. Destruction/alteration of 93% of tidal wetland acres & 63% of non-tidal wetland acres. ii. Deforestation of > 70% of watershed.

Urban Institutional Changes in the Anacostia Watershed

Major Institutional Drivers of Urban Watershed Resilience:

Land & Water Planning & Management Regimes	Emergence of Polycentric, Cross-Scale Watershed Governance	Legal Evolution
A. Historic Regimes (Develop Over Nature) i. Rivers & streams for commercial navigation, sediment & wastewater drainage, industrial development, & stormwater destination. ii. Land use promoted land clearance, industrialization, & urbanization with extensive impervious cover. B. New Regimes (Develop With Nature) i. Promotion of conservation & restoration through stormwater mitigation laws & regulations, & protecting brown trout and fish nursery waters. ii. Watershed-friendly land use planning & regulatory system (e.g., Montgomery County MD zoning amendment to protect watershed-sensitive lands).	A. Networked, Participatory & Collaborative Governance ii. Collaborative urban watershed decision-making among federal, state, & local agencies across the watershed. ii. 13 major watershed-level multi-stakeholder partnerships (e.g., Anacostia Watershed Restoration Plan; Anacostia Watershed Toxic Alliance, etc.) & 14 sub-watershed partnerships. iii. Institutionalized participation = grassroots mobilization and engagement of watershed residents (incl. low-income, minority, children, urban, suburban) through Anacostia Watershed Society and other neighborhood/local groups. B. Flexibility & Learning (Feedback Loops) in Governance i. Use of adaptive planning & adaptive management methods (incl. wetland restoration experiments). ii. Multiple plans, projects, & governance networks. iii. Formal & informal monitoring loops.	The evolution of laws & policies at the federal, state & local levels has had four cyclical effects (shown in Figure 2). i. Laws initially facilitated land clearance, industrialization, urbanization, & social inequities - <i>Stabilizing Enabling Conditions</i> . ii. Laws then became entrenched as boundaries preventing changes (e.g., private property rights) or as rigid environmental rules (e.g., Clean Water Act regulations) - <i>Stabilizing Boundary Conditions</i> . iii. Laws now stimulate innovation, change, & adaptation, such as CSO litigation leading to negotiated settlements or MS4 permit requirements facilitating new green-infrastructure policies - <i>Destabilizing Enabling Conditions</i> . iv. Institutionalizing the innovation, change & adaptations, such as codifying green infrastructure policies as zoning requirements, creates <i>destabilization boundary conditions</i> , which in turn also trigger the first phase conditions.

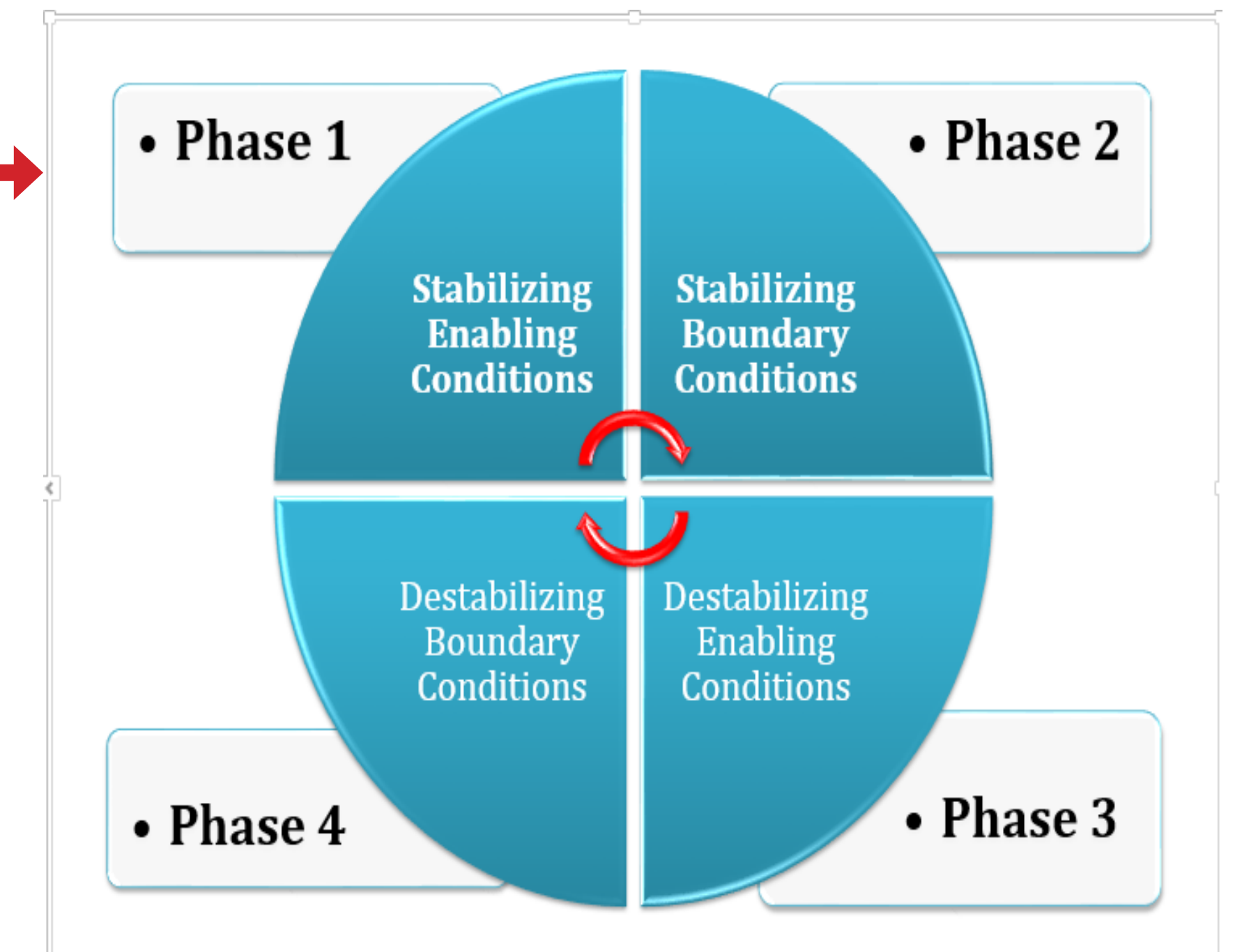


Figure 2: The Effects of Legal Evolution on Watershed Governance
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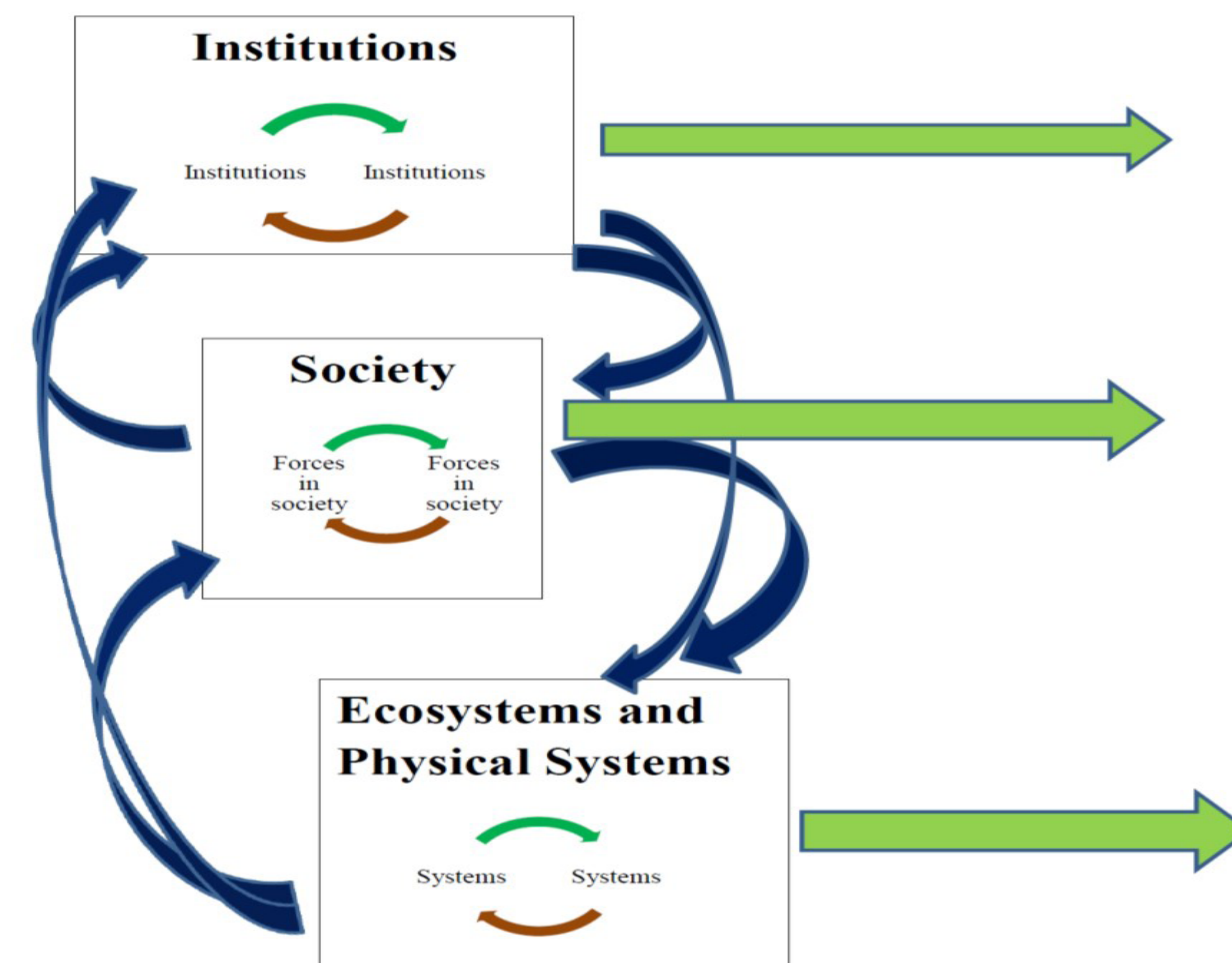


Figure 3: The Institutional-Social-Ecological Dynamics (ISED) Framework
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Conclusion

Adaptive governance for resilient urban watersheds, like the Anacostia, is an evolving undefined system of governance that emerges within a governing space as shown by the "blob in the box" (Figure 1).

The Anacostia's urban governance space (inner part of the box) is characterized by changing legal, social and political processes, which offer flexible enabling conditions but are constrained by relatively inflexible boundary conditions (e.g., laws of nature, human psychology, deep-seated norms, legal rules).

The resilience of the Anacostia River is now improved by an evolving urban watershed governance system which is polycentric, flexible, participatory and adaptive to changing socio-ecological conditions.

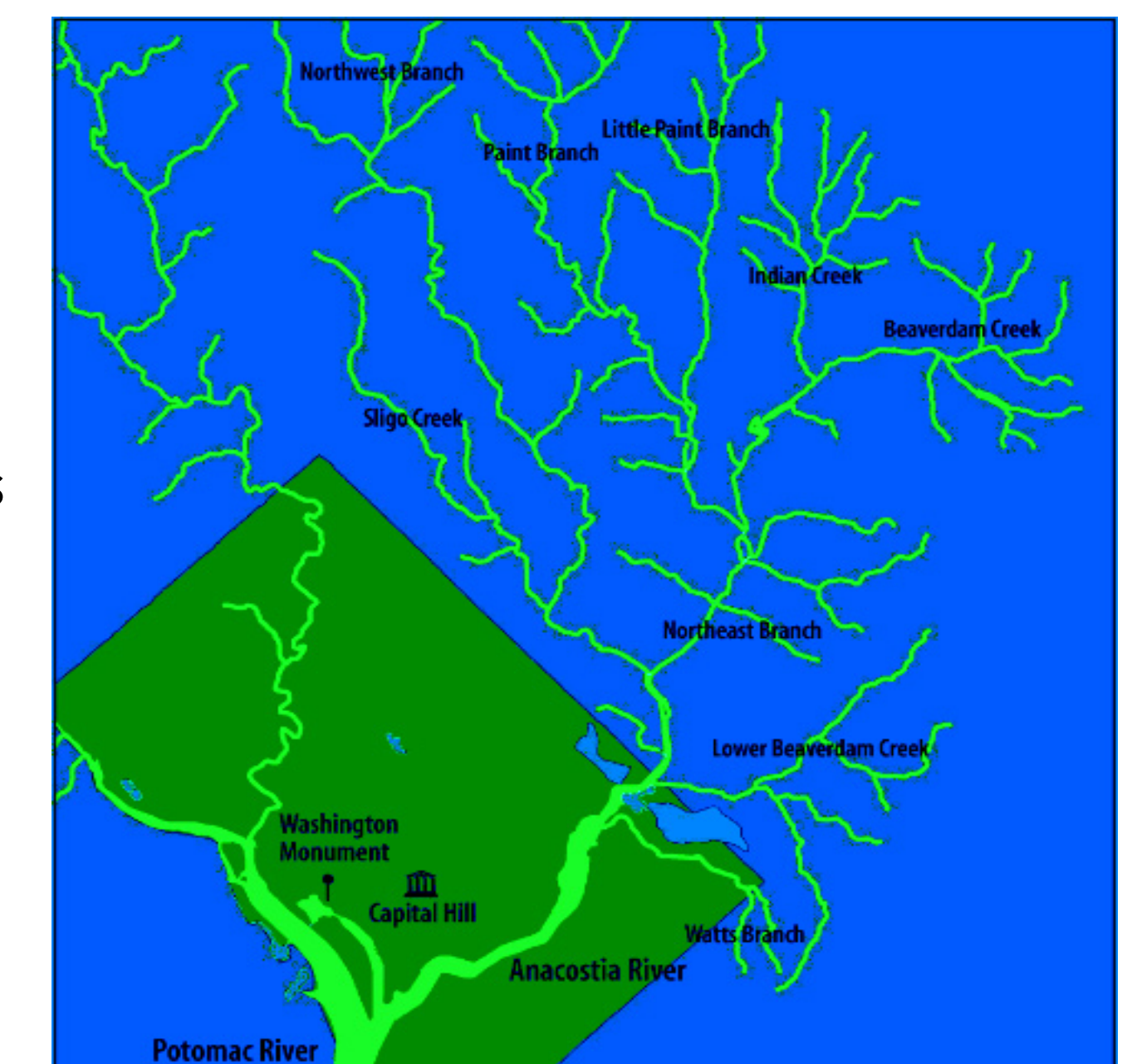


Figure 4: The Anacostia Watershed
Source: The Anacostia Watershed Society