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Nancy D. Brannon
University of Tennessee - Knoxville

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To the Graduate Council:

I am submitting herewith a dissertation written by Nancy D. Brannon entitled "Groundwater: A Community's Management of the Invaluable Resource Beneath its Feet." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Sociology.

Sherry Cable, Major Professor

We have read this dissertation and recommend its acceptance:

R. Scott Frey, Robert E. Jones, David L. Feldman

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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GROUNDWATER:
A COMMUNITY'S MANAGEMENT OF THE INVALUABLE RESOURCE
BENEATH ITS FEET

A Dissertation Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Nancy D. Brannon

December 2007

DEDICATION

When the well's dry, we know the worth of water. – Ben Franklin

This dissertation is especially dedicated to Dr. John W. Smith, who first made me cognizant of the importance of protecting groundwater, taught me much of what I know about hydrogeology and the physical aspects of groundwater, and gave me insight into the local politics of land use decision-making and aquifer protection.

It is dedicated to my husband Tommy and to my parents-in-law Phyllis and Tandy Brannon for supporting my work, inspiring and encouraging me to achieve higher goals.

It is dedicated to the Earth, on which our existence depends, and the efforts of countless people all over the world to protect it for ourselves and future generations.

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I wish to thank all those who helped me complete my Doctor of Philosophy degree in Environmental Sociology. I especially thank my committee chair Dr. Sherry Cable for her insight, guidance and many hours of consultation throughout the process. I thank my committee members Dr. Robert E. Jones for his brainstorming to organize ideas and theory; Dr. Scott Frey for his encouragement and research ideas, and Dr. David Feldman for his continual positive feedback for my work and the importance of this project.

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ABSTRACT

Understanding the impact of human decisions on vital resources is a core task of environmental sociology, which studies the interaction between human society and the environment. The overarching theme of this research is the economic-environmental relationship in U.S. public policy, using a case study of a specific environmental resource problem in a specific region. It fuses basic assumptions of two economic growth models (*treadmill of production* and the *urban growth machine*) to examine the extent to which these assumptions permeate the worldviews of policymakers and those who advise them. When the growth imperative is a priority in their worldviews, then the paradigm shapes policy decisions favorable to growth. When the growth imperative paradigm dominates the decision-making structure, then policy decisions favor economic growth over concerns for and at the expense of environmental resources. This is the case because economic growth requires unlimited commoditization and exploitation of finite resources. The results are impairment of both the quantity and quality of natural resources on which communities depend for growth and their existence.

This research examines the economic-environmental relationship in a case study of the Memphis, Tennessee area to ascertain how policy decisions that promote growth affect groundwater and may have sparked an inter-state water conflict. The State of Mississippi filed a federal lawsuit against Memphis and its utility Memphis Light, Gas and Water over rights to groundwater, the sole source of drinking water.

The study ascertains that the predominance of the growth paradigm is linked to policymakers' perspectives and reflected in their decisions that impair the quantity and quality of vital environmental resources. The case demonstrates how the growth imperative contributes to resource depletion, which can lead to conflict among users of a common resource.

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CHAPTER I RESEARCH PROBLEM

In October 2007, former U.S. Vice President Al Gore and the U.N.'s Intergovernmental Panel on Climate Change were awarded the Nobel Peace Prize for their efforts to spread awareness of man-made climate change and to propose solutions to counteract it. In a year-long series on climate change, National Public Radio (NPR) has covered various aspects of the problem and causes, writing, “Worldwide, tailpipes and smokestacks spew 25 billion tons of carbon dioxide every year, and there's no longer doubt that this gas is heating the Earth.” But public policies about the use of natural resources, particularly burning fossil fuels and deforestation, are slow to change to counteract present and looming catastrophes. Why do policymakers develop natural resource policies that are unsustainable when the stakes are so high?

Growth Models and Sustainability

A core task of environmental sociology is to examine the impact of human decisions on vital natural resources. Such decisions are made within a cultural and institutional context which frames the decision-making process and sets decision priorities. Blatter and Ingram (2001) emphasized framing the analysis of such problems through dominant policy paradigms. What are the dominant policy paradigms that lead to unsustainable natural resource policies?

Political economists explain unsustainable natural resource policies at the macro level of analysis with the prominence of the growth imperative and its influence on shaping policies that impact environmental resources in unsustainable ways. Two political economy models, the *treadmill of production* and *urban growth machine*, suggest a dominant policy paradigm in which economic growth priorities conflict with sustainable environmental resource use. They maintain that capitalism's requirement for continuous expansion exceeds the ability of environmental resources and systems to support that growth.

The *treadmill of production* posits a cycle of increasing technological development that requires increasing withdrawals of natural resources and increasing additions of pollutants to the environment, often beyond the point of sustainability. In the *urban growth machine* model, economic growth is based on the treatment of land as a commodity, requiring continuous expansion of land development and increasing withdrawal of natural resources to support population growth. A result of prioritizing land's exchange value over its use value is a treadmill of continuous land conversion from "raw" land to the built environment, spreading urbanization, and using up vital natural resources like water. "Growth coalitions" of interests who benefit from land development gain political power and promote development priorities in policy decisions, thereby supporting a system that degrades the environment and suppresses alternatives.

If these growth imperative models are accurate, the assumptions of the macro level models will be reflected at the micro level of analysis in the worldviews of

natural resource policy stakeholders. The social construction of reality holds that worldviews shape people's perceptions of objective reality, and that social actors interpret the relationship between humans and nature through their ideological perspectives. If the economic mode of production determines the general character of social and political processes, then economic material interests and class divisions are determining factors shaping decision-makers' worldviews (Marx 1859; Smelser 1973). Under capitalism, these worldviews reinforce growth ideologies and become manifest in policy decisions and priorities and social institutions.

Water is a critical natural resource for sustaining all forms of life and is the basis for many human economic activities. Consequently, water scarcities and the unequal distribution of water frequently lead to conflicts. Water conflicts can be seen in all areas of the U.S., especially in the west where water is scarce. *Cadillac Desert* is the classic tale of competition over surface water resources, battles over water rights, rivers diverted and dammed, and the ecological and economic disasters that follow (Reisner 1963). Similar conflicts over groundwater are found in the High Plains, where the Ogallala aquifer is threatened as humans consume water from the aquifer faster than nature can replenish it (Michigan Land Use Institute 2003).

Internationally, the world's water supply is under stress from increasing usage (Rowland 2005). Gleick (2004) compiled a history of global conflicts and tensions over water resources. Welsh (2000) and Adams (2000) documented the potential for wars over water in the Middle East, and the rapidly growing population and expanding urbanization in the Gaza Strip have increased pressure on aquifer waters

(Weinthal et al. 2005). As worldwide fresh water resources diminish, increased water conflicts, even in areas with historically plentiful supplies, can be expected.

The Case Study

An example of water conflict in a region of historically plentiful supply which draws attention to policymaking and the effects of public policy on vital natural resources is Memphis, Tennessee. On May 1, 2005 the *Commercial Appeal* reported that the State of Mississippi had filed a federal lawsuit against Memphis and its utility Memphis Light, Gas and Water (MLGW), seeking “hundreds of millions of dollars” in compensation and claiming “the city has pumped more than its fair share of water from a deep, high-quality aquifer serving public supplies across the Mid-South.” The “declining water levels and where the blame for them might lie represent key issues” in the lawsuit. The article alluded to “where the blame might lie” by describing “a riotous growth boom” near the state line in Olive Branch [Mississippi] with “large swaths of land being carved up for subdivisions and strip malls,” while “subtle but far-reaching changes are percolating about 170 feet underground.” There are dropping water levels in the wells supplying Olive Branch and other cities across North Mississippi; at one well “levels sank more than 16 feet in 30 years” (Charlier 2005).

Memphis Area Water History

The sole source of drinking water and the major source of all other public water supply in Memphis and its surrounding area is groundwater. While four main rivers run through the metropolitan area from approximately east to west and drain into the Mississippi River, the western boundary of Memphis, these waters have not proved to be reliable, pure, or economical sources of drinking water in the past. Following is a description of the groundwater system that serves the area and why it is such an important source of water.

In the southeastern United States, a series of fresh water aquifers lie in what is called the Mississippi Embayment (Groundwater Institute 2006), which contains one of the purest and most plentiful sources of water in the nation and one of the largest artesian ground water supplies in the world. It is a trough-shaped basin that lies along an axis that approximates the Mississippi River. It consists of six aquifers, formed from unconsolidated to semi-consolidated sediments of sand and gravel, separated by thick clay layers called confining units. Memphis and the metropolitan area lie over the north central part of the aquifer system. It is also present in other parts of west Tennessee, Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Mississippi, and Missouri. The Tennessee River marks the eastern limit of the embayment and Crowley's Ridge in Arkansas marks the western boundary (Criner et al. 1964; U.S.G.S. 2006, 1989abc, 1988).

Since 1889 the Memphis Sands aquifer, or 500-foot aquifer, has been the sole source of drinking water for Memphis and surrounding area. Before 1870, cisterns

were the primary source of water in Memphis (Wells, 1931), although Memphians also used artesian springs. After 1870, the Memphis Water Company contracted with the city to supply water to the public from the Wolf River. The first supply well was dug by the Bohlen-Huse Ice Company and in 1887 the Artesian Water Company contracted with the City of Memphis to sell water to the public from wells tapping the regional aquifer. By 1889, the Wolf River source was abandoned because of the superiority of the ground water supply. Since that time, groundwater has been the primary source of water for Memphis and the surrounding area.

Public knowledge and policy emphasis has historically focused on protecting from contamination the confined 500-foot aquifer, the Memphis Sands, which is the main source of Memphis' and the region's water supply. The confining clay layer has been presumed to be impermeable and found contiguously under Memphis and most of Shelby County. In adjacent counties like Fayette County, Tennessee, the Memphis Sands aquifer is unconfined and at or near the surface and therefore more susceptible to contamination from surface activities. Almost all of Fayette County is deemed an aquifer recharge area by U.S. Geological Survey (U.S.G.S.) and the Groundwater Institute (GWI).

The following excerpt from a University of Memphis press release expresses scientific consensus about the importance of the aquifer to the region. "Over the past century, the Memphis area has benefited from one of the largest artesian ground water supplies in the world. On a peak day, Memphis Light, Gas & Water Division and surrounding municipalities pump nearly 210 million gallons of water to more

than 1 million Shelby County residents. The water-bearing sands beneath the region historically hold an abundant supply of naturally pure water. The plentiful supply of pure water from the Memphis aquifer is a critical element in attracting and maintaining manufacturing jobs locally. These jobs include food processing, chemical production, paper/pulp and pharmaceutical manufacturing, all highly dependent on the sustainability and quality of this water supply. In the Memphis Metropolitan Area, there are some 84 companies providing 2,500 jobs with a \$1 billion annual economic impact directly affected by the aquifer. Arkansas relies on this same ground water system for agriculture, primarily rice production; Mississippi depends on it for both agriculture and urban growth. Eastern Arkansas produces about 40 percent of the nation's rice. DeSoto County is the fastest growing county in Mississippi and one of the fastest growing in the nation” (University of Memphis 2005).

Research by U.S.G.S. and the GWI has shown that in Memphis, Shelby County and some surrounding areas, the confining clay unit is not as contiguous and the deeper aquifers are not as protected by it as was once presumed. There are “breaches” in the confining clay unit under parts of Memphis, Shelby County and parts of north Mississippi through which surface contaminants can reach the aquifer. While the quantity of water is still plentiful, water levels are declining in some places as a result of over-pumping, withdrawing water at a faster rate than it is being replenished or recharged.

An alternative water source for the Memphis region could be the Mississippi River. But historically, surface waters have not proved to be pure, economical sources of water. If the river were to be used as a primary source, there would be considerably higher costs in water treatment to meet drinking water standards and in more extensive pipeline infrastructure. The inferior quality and increased costs make its use untenable at present.

The Groundwater Resource Problem

The interstate conflict over the groundwater resource brought public attention to burgeoning problems with the regional resource: declining water levels and conflict over a shared resource that historically has been plentiful. Charlier (2005) alluded to sprawling growth and development as a possible link to the kinds of public policy that can harm vital natural resources. “Although water remains plentiful for now, DeSoto officials are concerned about the future. ‘It’s certainly something all of us need to be looking at,’ Olive Branch Mayor Sam Rikard said” (Charlier 2005). The “riotous growth boom” described in the newspaper article is happening in DeSoto County, Mississippi, which abuts Memphis and Shelby County.

In the lawsuit, *State of Mississippi v. Memphis, Tennessee and Memphis Light, Gas, & Water Division (MLGW)*, Mississippi states that “MLGW owns and operates one of the largest artesian water systems in the world and...the City of Memphis is the largest city in the world that relies solely on artesian water wells for its water supply” (Hood and the State of Mississippi: 4). It alleges that “MLGW, the largest

user of the Aquifer, is currently, and has been for many years, taking massive quantities of Mississippi's portion of the groundwater ...overdrafting its rightful share of the Aquifer...and is withdrawing... thirty (30%), or about 60 MGD (million gallons per day) of the City of Memphis' water supply from portions of the aquifer underlying property owned by the State and Mississippi citizens" (Hood and the State of Mississippi: 4).

Mississippi further claims in the lawsuit that "as a result of MLGW's overdrafting its rightful share of the Aquifer...MLGW has damaged and diminished the Aquifer by various acts including...lowering the Aquifer groundwater table ...and injuring the Aquifer's ability to recharge." The lawsuit describes where "aquifer recharge, or replenishment, occurs along a broad outcrop belt that stretches across West Tennessee. Excessive overdrafting or ... illegal mining of the Aquifer by MLGW are diminishing and adversely impacting Aquifer recharge, thus causing long-term and permanent damage to the Aquifer and the State's rights and interests therein." The lawsuit further alleges that "excessive pumping of the Aquifer has created a tremendous, expanding cone of depression in the Memphis areas" and has "increased the risk of serious future contamination of the Aquifer by artificially increasing the rates of recharge into the Aquifer from polluted surficial water sources, such as creeks, waste disposal and abandoned dumpsites in the Memphis area" (Hood and the State of Mississippi: 6-7, 9, 10).

The federal interstate lawsuit raises important questions about the relationship of political boundaries to ecological, i.e., aquifer, boundaries; about interstate water

rights and public rights to groundwater. Both parties in the lawsuit are suppliers of public water and both draw water from the same regional aquifer. State and county political boundaries do not coincide with aquifer boundaries since the aquifer underlies several states and numerous counties within the states.

The water conflict could be interpreted as a “tragedy of the commons” (Hardin 1968) in which competing users of a common resource gradually deplete the resource by unsustainable use. Hardin’s argument about the fate of common resources, when used in a competitive manner with each user pursuing his/her own best interests and seeking to maximize their gain as if the resource were limitless, is that the common resource “will be overused and ultimately degraded” (Goldfarb 2000: 39; Hardin 1968). However, Hardin misses the point when he offers private ownership as a solution to the tragedy of the commons. The problem lies in the competitive use of a common, finite resource to maximize individual users’ interests. This is a zero-sum relationship whereby some entities win and others lose, creating a free-rider problem, with the eventual depletion of the resource. To maintain sustainability of the finite resource, a non-zero sum relationship is necessary, whereby all stakeholders obtain a sufficient amount of the finite resource while at the same time establish replenishment mechanisms.

The situation with multiple users with distinct political boundaries and independent decision-making raises questions of how resource management policy could be established on an interstate basis. Most resource management policy that covers interstate boundaries is the purview of the federal government. There are also

regional and interstate compacts and groundwater covenants that address such questions. The American Society of Civil Engineers (1997) compiled the several strategies used for groundwater protection across the U.S. The common elements they emphasize are a comprehensive approach through local government land use zoning and regulation. The specific strategies include establishing watershed management districts, mapping aquifer recharge areas, controlling development densities, establishing special groundwater protection areas and using best management practices. The Arizona Groundwater Management Act of 1980 includes a goal of “safe yield” which is a long-term balance of aquifer water withdrawal and recharge (ASCE 1997: 201).

The lawsuit also raises questions of what public policies may have led to the current situation. Surface land use decisions, in the form of local zoning ordinances, are the types of governmental decisions that have the greatest effects on aquifers. Yet local ordinances and water laws may not “adequately respond to the ecological laws...the most basic law related to water – the natural law of the water cycle” (Shiva, 2002:76).

An historical analysis of public policy and policy priorities can lead to understanding of how the situation evolved, which could inform possible solutions. Land development, i.e., conversion of “raw” land into the built environment, has been the standard pattern of growth in U.S. metropolitan areas since WWII, resulting in what many term sprawl. This has been the pattern of growth in Memphis and the region. In fact, Memphis owes its existence to a land grab in 1818 by Andrew

Jackson, General James Winchester, and Judge John Overton to clear the western lands for development. Over the decades, Memphis' boundaries have expanded from the Parkway system in the early 1900s, to the I-40/I-240 loop in the late 1900s, to the Hwy 385 loop near the county boundaries in the early 21st century. Growth through land development is promoted by planners, developers, banks, mortgage companies, real estate agents, the construction industry and others who profit from it in conjunction with local governments who benefit from the increased tax revenues that development generates.

This pattern of land use is shaped by zoning laws and public policy that prioritize economic development, often without considering or understanding the impact of those land use decisions on aquifers and other key resources. The main impact on aquifers comes from land use conversion of green space to the built environment. Such land conversion disrupts the natural water cycle by making permeable surfaces more impervious to rainfall penetration. At the same time, the impervious surfaces increase storm water runoff, which allows less rainfall to penetrate the ground to “recharge” the aquifer. Unless water withdrawals decrease as recharge is decreased, these contradictory forces can create long term unsustainable use of an aquifer. More often, withdrawals increase with increased development.

The Natural Resources Defense Council (NRDC 2002a) estimated the amount of groundwater filtration lost to imperviousness at “billions of gallons” that “are no longer recharging aquifers.” The NRDC compiled scales to measure the effects of large amounts of new development in various levels of imperviousness. For example,

in the period from 1982 to 1997 in Nashville, Tennessee, 216,000 acres of land were developed with the number of impervious acres increasing from 32,400 to 75,600. This resulted in a yearly infiltration loss increase from 17.3 to 40.5 billion gallons (NRDC 2002b). Morris et al. (1997) also found that urbanization has a major impact on recharge to aquifers and groundwater flow beneath cities. Their research showed that impacts on recharge come from surface impermeabilization, and groundwater abstraction results in a decline in aquifer water levels. They found that the consequences of large scale intra-urban groundwater abstraction can include aquifer depletion and land subsidence.

Murphy's (1990) research on Hebron, Connecticut parallels the situation in Memphis. The city was undergoing rapid expansion of commercial and residential development. In response, the Planning and Zoning Commission revised the town's zoning and subdivision regulations to add aquifer protection overlay zones. Surveying land use planning for rural groundwater protection in 41 towns in Vermont and northern New York, King and Harris (1990) found that most communities which had experienced contamination and or supply problems lacked the information necessary to be pro-active to prevent future problems. Neufield (2000) found that sustaining the human-ecological benefits of groundwater requires planned strategies for reducing the cumulative risks posed by diverse human actions. Because municipal governments play a key role in developing solutions to groundwater management and protection, Neufield believes the ecosystem approach

offers a comprehensive basis for designing community-based groundwater strategies in a regional context.

Given these relations between public policy and environmental impacts, the political economy models provide a way to understand these natural resource problems by framing the analysis through dominant policy paradigms. The Memphis case provides opportunity to ascertain whether the *urban growth machine* and *treadmill of production* models can explain the adverse effects on the resource. The approach focuses on the macro-micro linkages of the growth models to decision-making processes and policymakers' perspectives. Are the water problems a consequence of policymakers' adherence to the growth ethic and public policy pursuant to that ethic? Are these problems a result of economic growth priorities colliding with environmental sustainability?

The purpose of this project is to examine the attitudes and values of Memphis area policymakers and those who advise them to determine whether their micro-level, individual worldviews reflect the tenets of the macro-level growth models. In the next chapter, I analyze the literature on growth models to identify the major shared characteristics of the models. I then use those shared characteristics as the analytical framework for collecting and interpreting data from 53 in-depth interviews with representatives of some of the most influential groups in policymaking in Memphis: elected and non-elected officials; university research scientists; business leaders; and environmental advocates.

CHAPTER II LITERATURE REVIEW

Examining the economic-environmental relationship in U.S. public policy priorities can reveal the driving forces shape policymakers' perspectives and produce the environmental effects that threaten sustainability (Merchant 1989; York, Rosa, Dietz 2003:280). At the macro level, the *treadmill of production* and *urban growth machine* models hold that the capitalist growth imperative prioritizes economic interests in policy decisions, dominates alternative policy interests, and creates momentum for environmental disruption and depletion of resources. In this chapter, I review the literature in which the macro models are developed and used, identifying the major characteristics that the models share. I use that identification to link macro level policies with micro level perspectives of policy makers, which are manifest in resource appropriation policy, regarding water resources in particular.

Foundations of the Treadmill of Production and Growth Machine Models

The foundations of both macro level growth models derive from the analysis by Marx and Engels of how capitalism works and the social and environmental consequences stemming from this mode of production. Marx noted the continuous drive toward capital accumulation and expansion inherent in capitalism. Whereas previous types of societies were regulated by cultural value systems rather than economic laws, as capitalism became more embedded in societies, they became subservient to the dictates of economic laws. In this political economy perspective,

the roots of current environmental degradation lie in the structure of the capitalist mode of production with its unsustainable demands on an ecosystem's natural resources and services, which in turn, enable the means of production and make life possible. Anderson (1976) defined this relationship: "the manner in which people organize their materially productive activities is the crucial linkage between the social quality of life people experience and the reproductive viability of the physical life-support system" (14).

Marxist Foundations

Marx argued that humans' relation to 'nature' is shaped through the ways in which societies are organized. Marx and Engels saw human beings as continually remaking their relations to nature through the social system, which also becomes the basis for their alienation from nature. The mode of production, or economy, determines a society's relationship with the natural environment. As the foundational social structure, it determines the character of the legal and political structures and the forms of social consciousness (Marx 1959). The economic structure also becomes the basis for humans' alienation from nature.

The capitalist mode of production is the predominant means of developing material goods and services for societies and determining their value. Value is derived from the amount of capital produced from the surplus value of labor production, profit, land (ground-rent), and interest (Marx 1976: 814). Profit comes from human labor with the assistance of technology, and increased profit requires

growth. Capital is derived from the social production relation that is manifested in commodities, lending them a specific social character and values. The purposes of capital accumulation drive towards unlimited extension of production of commodities, even towards production as an end in itself, and unconditional development of the social productivity of labor. Capital and its self-expansion are the motive and the purpose of material production (Marx 1976: 250) under capitalism, not production for the common good. “In a social order dominated by capitalist production, even the non-capitalist producer is gripped by capitalist conceptions” (Marx 1967:39).

The basic logic of capitalism is expansion and growth, which becomes an integral part of economic production processes, manifested in labor-ownership stratification, consumer interests, and policy priorities (Marx 1991; Smelser 1973). “The capitalist mode of production involves a tendency towards absolute development of the productive forces, regardless of the value and surplus-value it contains, and regardless of the social conditions under which capitalist production takes place. The aim of capitalism is to preserve the value of the existing capital and promote its self-expansion to the highest limit” (Marx 1967: 249). Thus, expansion of the value of capital takes precedent over labor relations and environmental impacts.

Capitalism constantly presses exploitation to its limits, and then seeks new opportunities for exploitation. Because the size of the market limits expansion for any given innovation, the strategy is to expand the market. Improvement of

productive capacity through introduction of new machinery and development of new technology is the most potent source of capitalist growth and expansion. Industrial expansion creates the need for more raw materials and for larger markets, ultimately to international markets. Thus, internationalization of capital is the last strategy available before the contradictions of capitalism lead to its destruction (Smelser 1973: xxix-xxxii, 122; Hudis 2001). Marx argued that capitalism's need for growth would expand the economy to global proportions, would result in greater substitution of human labor by mechanization, and would lead to greater concentration of capital among a small proportion of capitalists or owners. He believed that its incessant need for growth would eventually lead to its collapse.

Capitalism changes historically to maintain growth, taking various forms, and often by commoditizing natural resources. A foundation concept illustrating the disjuncture between ecological and economic systems is Marx's *metabolic rift*, the idea that "capitalism has created an irreparable rift in the metabolic interaction between human beings and the earth, [a result of] the everlasting nature-imposed conditions of production" (Foster 2002: 2; Marx 1967). Linking the inherent nature of capitalism to grow incessantly and the limits of environmental resources to sustain growth, the metabolic rift between capitalism and environmental systems provides a theoretical basis to examine why policymakers develop natural resource policies that are unsustainable.

Marx's definitions of the use and exchange values of commodities (Marx 1959) form the basis for the *growth machine* model. A commodity is something produced

for the purpose of exchange and Marx differentiated a commodity's *exchange value* from its *use value*. Under capitalism, land has become a commoditized natural resource and the growth imperative determines that its exchange values, the mechanism that produces profits, dominate its use values.

Historically, as enclosure transformed as land into a commodity, land fragmentation in the countryside supplemented the beginning of industry in towns. In "Transformation of Surplus-profit into Ground-rent" Marx analyzed property in terms of the surplus-value produced by capital that falls to the landowner, as the capitalist mode of production dominated agriculture as well as manufacture. The possession of the land constituted one of the prerequisites of production, and ownership of land became the most advantageous condition for prosperity (Marx 1976: 614). Land ownership was dependent on the mortgage so that small land holders became enslaved by capital payment, pushing forward inevitable development. In addition to the mortgage imposed on it, small land holdings were burdened by taxes, the source of funding for state bureaucracies.

The amount of ground-rent grew with social development, as markets expanded along with increased demand for products from the land, which stimulated demand for land itself. Products [of the land] are commodities, or use-values, which have an exchange-value that can be converted into money. Under capitalism, they are not produced as immediate means of subsistence for the producers themselves, but as commodities, as products become use-values only by their transformation into exchange-values (money) (Marx 1967: 637).

As the market and the demand for agricultural products grew, the demand for the land itself grew directly, since it was a condition of production competed for by all branches of business, including non-agricultural ones. Rent and the value of land developed along with the market for the products of land and with the growth in the non-agricultural population. The nature of the capitalist mode of production constantly reduces the agricultural population in relation to the non-agricultural. In industry, the growth of constant capital in relation to variable capital is linked with an absolute growth in variable capital; while in agriculture the variable capital required for the cultivation of a particular piece of land declines absolutely and can therefore grow only in so far as new land is cultivated, which presupposes a still greater growth in the non-agricultural population (Marx 1991:775).

Further analysis of the capitalist economic system shows that its structure changes over time, while still retaining its basic characteristic of growth. Polanyi documented a major change in capitalism, the transition to market economy, which altered the basic relationship between the economic system and society, allowing the growth imperative to become the driving societal institution and embarking on a broad path of unlimited expansion and commodification, as the capitalist “growth imperative” increasingly transforms nature into a commodity. He saw market domination leading to "the devastation of the environment, deforestation, the pollution of rivers, and the degradation of labor" (Polanyi, 2001:182). He pointed to the “commodity concept” as the mechanism of the market that empirically defines objects produced for sale. “Accordingly every element of industry is regarded as

having been produced for sale. The commodity fiction, therefore, supplies a vital organizing principle in regard to the whole of society affecting almost all its institutions...” (75-76). The global capitalist system operates on the basis of this “commodity fiction,” inherently creating the notion that for an entity to have value, it must be commodified and be given some monetary worth. Otherwise, it has no value. Commodification of anything can lead to its over-use, depletion, and abuse. When profit and monetary value take precedent over other values, when profit encourages excessive use, when profit depends on constantly expanding markets and products, along with lowering the costs of production, the results are waste of resources and environmental degradation.

Transformations in Capitalism

Polanyi (1944, 1957, 2001) analyzed the transition of capitalist development to the market economy, which drastically transformed society from one that used markets as a tool of exchange to one in which human society is subservient to the economic mechanism (Polanyi 2001:60). Control of the economic system by the market brought overwhelming consequences to the whole organization of society. Instead of the economy being embedded in social relations, social relations became embedded in the economic system, subordinated to its limitless need for growth. The economic factor became so important that the running of society is an adjunct to the market (Polanyi 2001:60). Thus, economic concerns frame perspectives toward natural resources, supporting their commoditization and exploitation.

The capitalist market economy has the propensity to commoditize labor-produced goods and natural resources, as seen in Marx's "trinity formula" of capital, land, and human labor (Marx 1967:814). Commodities are particular equivalents of money and money is the commodity that functions as a measure of value and as the medium of circulation (Marx 1959). Labor, land, and money are essential elements of industry, Marx held, organized in markets, which form a vital part of the economic system. But Polanyi argued that labor, land, and money are obviously *not* commodities. Labor is another name for a human activity which goes with life itself. Land is only "another name for nature, an element of nature inextricably interwoven with man's [sic] institutions" (Polanyi 2001:75, 187). In Polanyi's view, the actual markets for labor, land, and money are organized around a "commodity fiction" which "supplies a vital organizing principle in regard to the whole of society affecting almost all its institutions," mainly by the principle that "no arrangement or behavior should be allowed to exist that might prevent the actual functioning of the market mechanism on the lines of the commodity fiction" (Polanyi 2001:75-76).

Commoditization of land through enclosure meant that enclosed land became worth double and treble the price of unenclosed land (Polanyi 2001: 36-37). Public policy began to categorize land use and give it artificial monetary values. In the 16th and 17th centuries, common law upheld the land "owner's right to improve his land profitably even if this involved grave dislocation in habitations and employment" (Polanyi 2001: 190-191). The exchange values of land, as incorporated into public

policy, implied to land owners a ‘right’ to the highest and best monetary value of their land.

The commodification of land, which prioritized its exchange value over use value, and the implied “guarantee” of the right of landowners to the highest monetary (exchange) value of their land are the precedents that set in motion the treadmill of land development that has resulted in present-day sprawled cities. The transition to the market system set the stage for subsequent changes in capitalism, as its growth imperative pressed toward globalization of markets and stressing environmental resources to their limits.

Growth Imperative Theme in Later works

Thorstein Veblen (1965; 1973; 1996; 1899; 1904; 1923) criticized the exploitative practices of capitalism that wastefully use natural resources and exacerbate environmental problems. His *Absentee Ownership* treatise (Veblen 1996; 1923) includes several chapters on the problems of the American economic system: the wanton destruction of natural resources. He documented patterns of natural resource scarcity and waste that plagued the U.S. in the mid-19th century. In his chapter “The Timber Lands and the Oil Fields,” he illustrated how absentee ownership functions to take over the country’s natural resources and use them up; and how corporate interests with government support expropriated land resources. He was writing in an era of rapidly evolving technologies and while many made better uses of natural resources, they were misused by business in their haste to

exploit natural resources. He argued that it was not technology per se that led to the misuse of natural resources, but the profiteers and mismanagement in industry, who shed responsibility and wasted natural resources in the process.

Veblen criticized the business class (capitalists), whom he deemed the “predatory class” because they “rely on competitive manipulations to maximize their own personal wealth and hinder the coordinated [sustainable] running of an advanced industrial society” (Mitchell 2001:392). Businesses perpetuate their interests through establishing monopolies, which is done through control of natural resources. Their motivation is essentially market domination and profiteering, which occurs to the detriment of mainstream society and environmental systems. He believed that natural resources could not be managed in any sustainable way if the land continued to be senselessly exploited. His analysis of the contradictions in capitalism in relation to the natural environment is relevant to understanding current environmental problems, especially how “profit making at any social or environmental cost is the guiding principle” (Mitchell 2001:399-402). His ecological economic theory of natural resource exploitation influenced the work of other scholars such as Allan Schnaiberg and Kenneth Gould, Baran and Sweezy (1996) and Kapp (1963) (Mitchell 2001: 401).

Schnaiberg (1980), Anderson (1976), Baran (1957), Baran and Sweezy (1966), Sweezy (1968, 1942), Sweezy and Magdoff (1972), and Smelser (1973) pursued further the theme that capitalism continuously presses resource exploitation to its limits, then seeks new opportunities for exploitation, so that the capital accumulation

process and growth imperative become a “treadmill” that creates momentum for environmental degradation. The constant need for expansion to produce capitalist profits leads to continuous resource extraction, while the need to externalize costs of production contributes to pollution (Dietz and Rosa 2002; Schnaiberg 1980; Schnaiberg & Gould 1994; Buttel 1997: 45-46).

The individual and collaborative critiques of capitalism by Sweezy, Baran, and Magdoff built on Marx’s premise that capitalism is inherently a globally expansive system, and its dependence on growth for survival threatens the survival of others by creating inequality and conflict. Sweezy (1942, 1968) emphasized how the drive to expand capital and consumption occurs through the means of production and labor power, both of which are bearers of exchange value.

Baran (1957) paralleled Polanyi’s analysis of how economic development has historically meant a far-reaching transformation of society’s economic, social and political structure; changes in the dominant organization of production, distribution and consumption (Baran 1957:3). He described a type of treadmill in which one investment act gives rise to another, and the second investment produces the rationale for the third. This synchronization and clustering of investments sets off the chain reaction such that investment tends to become self-propelling and is synonymous with economic development (Baran 1957:174-175). Economic surplus is appropriated by the state as the economic and social systems of capitalism and imperialism condemn multitudes to privation, degradation, and premature death (Baran 1957:201, 244).

Baran and Sweezy (1966) documented the changes in 20th century U.S. capitalism as it evolved from competitive into monopoly capitalism. In the transition, capitalism's basic economic unit changed from the business enterprise in competitive markets to the large corporation as the center of economic power and decision-making. This change produced increased profits through corporations' ability to control prices and drive down costs. They link the predominance of monopoly capitalism to political power in oligopoly.

Sweezy (1972) emphasized technological change as the central dynamic force in the capital accumulation process. Capitalists must constantly revolutionize the instruments of production which provide the basis of growth. Every unit of capital is inherently an expanding unit, which follows from the nature of capital as a self-expanding value (Sweezy 1972:43).

Sweezy and Magdoff (1972) observed that the essence of capitalism is expansion (Sweezy and Magdoff 1972:97; Marx *Capital* vol. 1 Part III Chap. 4 and Part IV Chap. 24, Section 3). They examined the two phases of capital's self-expansion process: competitive and monopolistic, focusing on the driving forces of capitalism's "unbridled expansionism." Monopoly profits make possible rapid growth, but the need to maintain monopoly prices dictates a policy of slowing down and carefully regulating the expansion of productive capacity. From this conjunction of factors there results a drive of the monopolistic firm to move beyond its historical field of operation to penetrate new industries, new markets – to go conglomerate and multinational (Sweezy and Magdoff 1972:100).

Sweezy and Magdoff (1972) saw implications of monopolistic corporations' trends toward conglomeration and multinationalization, as did Foster (2005) who felt that since its inception and by its logic the capitalist economic system has been a globally expansive system. They marked the trend toward internationalization in multinational corporations, because to internationalize ownership is one of many ways U.S. capitalists gained control over foreign capital. The trend had the effect of further removing top managers from the particulars of the production process and their concerns become increasingly purely financial. They also saw conflicts between the interests of multinationals and the foreign countries in which they operate, which generate political struggles.

Magdoff (1970; in Sweezy and Magdoff 1972) emphasized the close relationship between economic and political institutions. "Economic processes must be understood as part of a social organism in which political force plays a leading role" (Magdoff 1970:54). Magdoff noted these tendencies in capitalism: for productive capacity to outpace consumer demand; the use of credit to lubricate an expanding economy; persistent unemployment; continuous existence of large-scale poverty; and minorities serving as a reserve army of labor.

Commoner (1971) argued that the sources of modern environmental pollution lie in the drive for profit, and he described the crucial link between increased pollution and modern technology. The introduction of new technology markedly increased the profitability of post-World War II businesses, but at the same time greatly increased environmental pollution. He linked environmental pollution with the economics of

the private enterprise system in two ways: (1) pollution intensified by the replacement of older, less polluting technologies with newer, “ecologically faulty” technologies. Here, increased pollution became an unintended consequence of the drive to increase profitability. (2) The cost of environmental degradation is chiefly borne not by the producer, but by society as a whole, in the form of “externalities” subsidized by society.

Building on Commoner’s (1971) themes about the negative environmental impacts of technological development and expansion, Anderson (1976) wrote most strongly on the link between growth and environmental destruction. Economic and technological growth, especially ecologically faulty, wasteful technology (Anderson 1976:11, 27) is a prime force in the deterioration the environment. Economic growth both fuels and is fueled by technological growth and development, whose primary purpose is preserving and expanding profit. Economic interests can consciously and effectively manipulate technological development and bring it directly under their control (Anderson 1976:93).

While Anderson (1976) focused on capitalism, his analysis extends to any economy that is a “growth society,” even a state-planned economy like the Soviet Union approximates a growth society (Anderson 1976:3). He held that “advanced capitalism as a form of social organization” is inherently incompatible with human viability on Earth because its internal logic is growth of capital, of profit-producing wealth (Anderson 1976:6). Continued growth of capitalism threatens the environmental milieu within which society functions because “growth is a matter of

survival to the capitalist class” whereas the capacity of the earth to endure growth impacts is a concern to capitalists only as a limiting parameter (Anderson 1976:31). “Problems associated with growth tend to intensify under a capitalist regime and capitalism as a total way of life is incompatible with an environmentally permanent and economically stable society” (Anderson 1976:229).

Although the exploitation of nature was not originated by the growth society, industrialization as pursued in the growth society becomes an environmental onslaught because an essential aspect of a growth society is waste. Echoing Commoner’s thesis, Anderson (1976) finds the problem not in technological development per se, but in the particular technological manifestations of economic growth when highly energy-consumptive and non-degradable synthetics are substituted for natural products (Anderson (1976). He quotes Commoner’s notion that wealth is gained by rapid short-term exploitation of the environment (141; Commoner 1971:145) and echoes Paul Ehrlich’s (1968) theme in *Population Bomb* that increased technological (agricultural) development allows increased population growth, which raises demands on environmental resources (Anderson 1976:122, 133).

Anderson (1976) built on Marx’s comparison of capitalism to previous societies that were regulated by cultural value systems rather than economic laws. Like Marx’s concept of alienation (Anderson 1976:45) and Polanyi’s analysis of capitalism’s transformation, he saw how capitalism’s relentless drive for capital accumulation and expansion changes that relationship so that the laws of growth and

development are beyond the control of those subjected to them. As long as profit arises from the exchange of commodities, there exists a capitalist relation and basis for growth (Anderson 1976:47). He foreshadows Schnaiberg's treadmill theme: "We are cogs in an economic machinery which must grow in order to survive," a machine that is ultimately fueled by profit (Anderson 1976:52, 69).

Following Marx's prediction of the trend toward consolidation and monopolization Anderson (1976) analyzed the modern change from competitive to monopoly capitalism without quenching the drive for growth. The production and distribution of goods and services requires technology and the development of technology is shaped by society's mode of production. The capitalist growth system requires a technology that relegates human beings to the needs of profit, expansion, and control (Anderson 1976:87, 93). Not only are there internal problems of the growth system, there are external negative impacts of the growth system upon the social and natural environment. Most services within the growth society are directly dependent on the continued operation of resource extraction, processing, manufacture, distribution, and maintenance, while a portion of the surplus must be reinvested in production for capital to further grow (Anderson 1976:63-64, 66).

Government plays an important role in fostering capital accumulation and developing policy pursuant to the interests of the affluent at the expense of the non-affluent (Anderson 1976:76). Because growth is the life sustenance of the capitalist class, the capitalist society is inherently at odds with working democracy. Growth concentrates power and wealth (Anderson 1976:33) so that the capitalist class and its

representatives in the state hold power over the economy (Anderson 1976:52) and, thus, are better enabled to foster growth. Growth proponents are able to equate growth with the good society by making growth as an end in itself (Anderson 1976:26). While it is a secondary beneficiary of growth, government must also control and regulate the economic crises and social inequalities that capitalist growth creates.

Ideology plays an important role in the growth society. Economic growth is supported by an ethos of “man over nature” a secular philosophy that rationalizes the relationship to the natural world. The spirit of capitalism is a spirit of accumulation as an end in itself without regard to the consequences of the accumulative activity. There is not so much a directive to conquer nature as to conquer the economic competition and to survive the requirements of the capitalist structure. In order to survive, the capitalist has to move forcefully to exploit nature as rapidly and cheaply as possible of its “free” raw materials (Anderson 1976:119-121).

Udall (1963) both followed previous observers and set the precedent for Anderson and others by noting the environmental problems that accrue from conversion of land from open space to urbanized space. He blamed the “explosive pressures of expansion” for an unprecedented assault on the environment, along with tax structures that penalize property owners who want to preserve open space. He believed this prompted the need to rethink land attitudes and values.

With the emergence of capitalism the city was fundamentally altered, as urban growth rates outstripped general population growth rates. The engine of urbanization

in the growth society is economic accumulation, and decentralization outside of urban sprawl is not profitable. Urban overkill is another of the irrationalities of the growth society which moves according to the laws of its economic development (Anderson 1976:187-188, 190).

“Replete with contradictions, the growth system’s uncontrollable appetite for resources lays the groundwork for its own destruction” (Anderson 1976: 85) and lies at the heart of the wasteful use of resources and environmental problems. This impact of growth upon the environment is manifested in air and water quality declines. Fresh water consumption in the U.S. has more than tripled since 1900, resulting in declining water tables in many areas of the country and critical water shortages in the west. Errant technological development on behalf of maximum economic growth underlies ecological deterioration (Anderson 1976:125-127, 130).

Foster (1992) examined capitalism’s contradictions and called the second contradiction of capitalism the absolute general law of environmental degradation (also O’Connor 1988). Capitalism digs its own grave because private profit making proceeds at an accelerating pace at the cost of massive destruction of the very environment it needs for continued accumulation. Coupled with the second law of thermodynamics, continued levels of production will ensure increasing levels of waste (Foster 1992; Dickens 1997). “All living systems, including human socio-cultural systems, help to create the conditions that will eventually lead to their own demise unless they continually adapt and reorganize in response to changing conditions” (Peine et al. 1999; Holling 1995).

Evidence points to the way societies organize their mode of production, the expansionist nature of capitalism, and the supportive ideologies of domination and exploitation of natural resources for monetary gain as major factors in observed environmental degradation. I continue this line of inquiry by more closely examining the theoretical links between economic growth and environmental harm in the treadmill and growth machine models.

Growth Imperative Models

Both growth models typically refer to and critique capitalism arguing that by their nature, capitalist economies are geared toward economic expansion. However, analysts say that the growth models can apply to socialist or other types of societies that produce economic surplus. The effects of economic expansion priorities can generate ecological scarcities and irreversible (within human time frames) ecological degradation. Socialist economies can also subdue environmental concerns to economic priorities, generating environmental degradation, but the structure of production differs in key aspects from capitalist economies. In the socialist system, the centralized state control of production creates monopolization of specific types of industrial output. The monopolistic power of non-competitive producers can lead to adverse environmental impacts through high resource intensity production and creation of environmental externalities, i.e., pollution, which are discounted by governments or produced by manufacturing processes regardless of government intentions (Carlson and Bernstam 1990). However, Goldblatt (1996) finds that both

capitalism and state socialism are implicated in patterns of environmental destruction. He attributes this to their shared characteristics: their inequitable distribution of political power and economic logic of unrestrained demand for consumption.

Critically examining capitalist societies, political economy theory explains at the macro level the economic motivations that manifest in public policy and how they create natural resource scarcity and conflict. The *treadmill* and *growth machine* models argue that capitalism's incessant drive for growth produces unsustainable use of environmental resources and environmental degradation. Schnaiberg (1980) analyzed the expansionist logic of capitalism through technological development and its impact on ecological systems in his theory of the *treadmill of production*. Logan and Molotch (1987) showed how the expansionist logic is manifested through the manipulation of use and exchange values of land in their *urban growth machine* model. Both models focus on how the capitalist growth imperative prioritizes economic interests in policy decisions, dominates alternative policy interests, and creates momentum for environmental disruption and depletion of resources.

The Treadmill of Production Model

The *treadmill of production* focuses on technological growth and its consequence of environmental degradation. Schnaiberg (1980) developed the theory from his analysis of the major changes in technologies and production systems after 1945 and their impact on ecosystems. The postwar economic boom brought capital

mobilization for changes in production technology. The newer technologies were more energy and chemical-intensive and less labor-intensive than older technologies, but more profitable. They required greater raw material inputs, thus greater withdrawals from ecosystems, and added more pollutants to ecosystems.

The treadmill exposes the relationships between economic structure and political power in the decision-making process, in the realm of production technologies. Decisions about types of technologies, the use of labor, and volumes of production are made exclusively with the goal of increasing profitability, are not attuned to the impact on ecosystems, and are made outside the realm of consumer decision-making.

Schnaiberg's (1980) propositions about the incongruence between the ecological and human economic structures of production build on previous works in ecological economics. Georgescu-Roegen (1971) in *The Entropy Law and the Economic Process* argued that because of the Second Law of Thermodynamics, the capitalist economy faces limits to its growth. Meadows, et al. (1972) in *The Limits to Growth*, Jeremy Rifkin (1980) in *Entropy*, and Herman Daly (1977) in *Steady-State Economics* all argued that capitalism faces limits to growth, mainly due to the Second Law of Thermodynamics. Schnaiberg agreed that the environmental basis for every society, regardless of its nature, consists of two basic ecological laws, the first and second laws of thermodynamics (Schnaiberg 1980:13). The second law, entropy, is particularly contradictory to the structure of capitalism because societal production requires withdrawals which "disorganize biospheric systems"

(Schnaiberg 1980: 24). Consequently, this system of economic organization is unsustainable.

Capitalism requires constant acceleration of production to produce marginal social welfare benefits or to maintain the status quo, which results in ecosystem disruption through the destruction of land habitats, pollution and depletion of natural resources (Schnaiberg 1994: 67; Gould, et al. 1996: 7). Societal production entails environmental additions and withdrawals; excessive withdrawals deplete environmental resources and additions pollute the environment, both of which disorganize the biospheric systems on which societal production depends. Industrial societies have failed to develop an intelligence system attuned to environmental disruption because of the trends in production organization and the influence of producers (Schnaiberg 1980:44).

The logic of the treadmill of production includes: (1) increasing accumulation of wealth for a small proportion of owners of economic organizations who use ecological resources to expand production; (2) increasing movement of workers away from self-employment to employees in wage jobs; (3) increasing allocations of accumulated wealth to newer technologies, replacing labor with physical capital, to generate more profits for wealth holders; (4) increasing activities of governments to facilitate expanded accumulation of wealth; (5) greater ecological withdrawals and additions result from this process; (6) increased likelihood of ecological disorganization as economic pressures push greater extraction of market values from ecosystems; (7) societies become increasingly vulnerable to socioeconomic

disorganization as their ecological resource base becomes disorganized (Schnaiberg and Gould 1994:69). Those in power in the major institutions of society become committed to economic growth and accelerating the treadmill because they do not see any other way of sustaining themselves (Schnaiberg and Gould 1994:92-93).

The Urban Growth Machine Model

Development of the *urban growth machine* began with Molotch's (1976) study of the power structure and economic growth agenda that shape land use decisions in urban areas. The elite in the power structure make their fortunes from the exchange values of land as a commodity. Thus, the shape and development of cities is determined by their profit-seeking goals through the increasing intensification of land use.

Logan and Molotch (1987) examined the commoditization of place and the social context in which the conflict between those seeking gain from *exchange* value and those from *use* values of land takes place. Land is "a special sort of commodity: a place to be bought and sold, rented and leased, as well as used for making a life" (1-3). This study and a subsequent one by Molotch (1996) focused on how the profit-making process based on the sale and development of land drives the growth imperative. The capitalist elite work closely with government to manipulate the land values; land is parceled and zoned so that capitalists continually profit from its exchange value. As a commodity, land must be continually bought and sold for

profit, and the more it is “developed” or built upon, the greater its monetary value. This creates artificially inflated land values that fuel the growth machine.

Coalitions who benefit from the growth machine emerge from diverse segments of society and have the ability to shape policy pursuant to their interests. These growth coalitions arise from “coincidences of interest among spatially proximate (generally metropolitan) land-, real estate-, commercial-, and tourist-related development capitalists and local state officials” (Logan and Molotch 1987; Buttel 1997: 47). The model shows how coalitions of stakeholders committed to growth emerge and, as their interests come to dominate policy, capture even those not committed to the growth imperative. The policy priorities and institutional structures that support these growth coalitions include: (1) land as a market commodity providing wealth and power; (2) the political and economic essence of virtually any locality, in the present American context, is *growth*; (3) the desire for growth provides the key motivation for politically mobilized local elites; (4) the growth imperative is the most important constraint upon available options for local initiative in social and economic reform (Molotch 1996).

Environmental movements emerge as efforts to preserve use values as priority over exchange values, yet use value proponents face numerous structural impediments in opposing the dominance of exchange value proponents. Even those who merely wish to have and use their land are eventually co-opted to the exchange value side because the system only allows them the “fullest value” of their land through the market mechanism. Governments set policy to manage land and

environmental resources within this economic-ecological dialectic. But the environmentalists argue that human society imperils itself by the continual exploitation of earth's resources as commodities (Logan and Molotch 1987: 215-216).

Other Analysts' Elaborations of the Models' Themes

While not specifically using the treadmill or growth machine models, similar themes from the Marxist paradigm of growth-related environmental impacts appear in other analysts' work. Milbraith (1989) believed the underlying motives in human-environmental relations were: a dominating, competitive view toward the environment, a propensity to see nature only in part, and the maximization of profit taking priority over all other concerns. Under capitalism humans relate to nature through its commoditization, and in so doing actively appropriate, transform, and destroy it (Demeritt 2002). Within the American economy, "undeveloped" or open land is commonly seen as an unused and wasted resource ("vacant space") that will reach its full potential only when developed and put to a "productive" (developed) use (Brabec 1994).

Dietz and Rosa (2002) used the treadmill and growth machine models to analyze local community conflicts over growth and decreasing environmental resources, focusing on the mechanisms in public policy making. Growth produces profits for stakeholders; the treadmill and growth machine perpetuate growth, and also increases some benefits to labor and state tax revenues. The growth machine gains

the cooperation of government officials, making it difficult for any stakeholders to step off the treadmill (Dietz and Rosa 2002: 386). Dominant groups usurp political power and control the decision-making processes so that their ideas prevail over competing knowledge claims about the environment. Their ideology maintains the groups' hegemony, permitting them to exploit the political process in favor of their agenda.

Gould et al. (1996) combined the models in their research on community conflicts over growth policy and environmental resources. They found that use and exchange values of land are dialectically related (Gould et al. 1996: 54-58). The conflict between those seeking gain from exchange values and those seeking use value of land began with the encroachment of development into rural areas, brought by a small group of absentee land speculators who wanted to get the largest return on their investments. They continued to move farther into the countryside as other suburban areas became overdeveloped. Growth proponents argued that new development would increase the local tax base, provide jobs, raise the value of people's land, and expand the consumer base to make small businesses more profitable. However, achieving this meant commoditizing natural resources, particularly changing "vacant" land into subdivisions, roads, schools, businesses, etc. These economic practices created a scarcity of natural resources as the ecological system became constrained and reshaped (Gould et al. 1996:56).

Gould et al. (1996:57) argued that treadmill pressures force use-value proponents to adopt exchange-value perspectives, resulting in a zero-sum

relationship as those benefiting from exchange values dominate and restructure the politico-economic system to facilitate their interests. Land developers need unlimited access to cheap natural resources to effectively plan and operate, and need local governmental planning favorable to their interests to ensure continual expansion of land development. As proponents of land use values and exchange values converge on the same ecosystem, they create a contradictory situation in which open land becomes scarce and natural ecosystems cannot support unlimited production of development.

As land development stakeholders altered the local political economy toward their interests, communities became more centered on speculative growth and resources became scarcer as greater demand was made on them. Power became “increasingly concentrated in a few large producers, who preferred development” (Gould et al. 1996:66). The centrality of stakeholders’ concerns resulted from “the political economy of the treadmill of production” (Gould et al. 1996:76). These producers altered the local political economy, which made smaller developers and merchants unable to compete. As a result, most decisions favored growth-centered concerns, although there was some need to regulate production practices and open the decision-making process somewhat.

According to the findings of Gould et al. (1996), proponents of natural resource protection become increasingly unable to wield power because they have to compete with developers and state officials who have more resources. “Their position in the treadmill of production gave state officials and developers easy access to financial

capital, political ties with elected officials, time and technical expertise, resources which were a part of their everyday experiences” (Gould et al. 1996:58-59, 78). Protection proponents eventually found themselves locked out of the processes and faced chastisement by other community members who gave legitimacy to the growth pattern. As a result most public policy decisions come to favor growth-centered concerns (Gould et al. 1996: 1-3, 57), while creating ecological scarcity and environmental problems. In all the cases they studied, “conflict over the scarcity of natural resources emerged” as the various stakeholders experienced the diminished ecosystems differently (Gould et al. 1996: 75).

Characteristics of the Models

Both models attribute the development of modern capitalist forms of production as the core cause of environmental degradation in general. They posit that the current relations between human economic development and the environment are incongruent and unsustainable (Foster & York 2004). The economic system’s imperatives for growth operate in contradiction to ecological systems because it must continually commodify and withdraw natural resources at rates “faster than ecosystems can reproduce or replenish them” (Buttel 1996). Therefore, unlimited growth is not sustainable and eventually leads to resource scarcity or depletion and conflict over diminishing resources.

Economic priorities are so embedded in social institutions that they often trump other social and environmental concerns in decision-making. The beneficiaries of

growth obtain economic and political power to ensure that growth takes priority in policy decisions, which are supported by an ideology that growth is beneficial for everybody. The state is also co-opted into the growth paradigm because it benefits through increased tax revenues.

The *treadmill of production* asserts that capitalism requires constant acceleration of production for increased profit and capital accumulation, especially technological innovation to replace labor. This process “results in ever-increasing levels of production and resource extraction to improve economic growth” (Buttel 2004), a process which inevitably comes at the expense of environmental degradation.

The *urban growth machine* model focuses on land *use* and *exchange values* as this commoditized natural resource becomes the basis for capital accumulation in urban development. The buying and selling of land as a commodity requires continuous expansion of land development in order to increase its exchange value and capital accumulation. Members of the *growth coalition* both influence local government and hold positions in local government to support and promote the economic growth and development from which they prosper. Thus, land’s exchange values take priority in decision-making, and dominate use values and use-value proponents.

Assumptions of the treadmill of production model:

1. Growth is necessary to continually accumulate capitalist profits.
2. Economic expansion is core of social, economic, and/or environmental policy.
3. Those in power in major institutions of society become committed to economic growth and accelerating the treadmill because they see no other way of sustaining themselves.

4. There is increasing accumulation of wealth for small proportion of owners of economic organizations who use ecological resources to expand production.
5. There are increasing allocations of accumulated wealth to newer technologies, replacing labor with physical capital, to generate more profits for wealth holders.
6. increasing activities of government to facilitate expanded accumulation of wealth
7. Greater ecological withdrawals and additions result from this process.
8. There is increased likelihood of ecological disorganization as economic pressures push greater extraction of market values from ecosystems.
9. Societies become increasingly vulnerable to socioeconomic disorganization as their ecological resource base become disorganized.
10. The belief is that economic expansion will reduce social and ecological problems.
11. Economic expansion is fostered primarily through growth of large firms.
12. The alliances among capital, labor, and governments foster growth.

Assumptions of the urban growth machine model:

1. The political and economic essence of a locality is growth.
2. Growth is based on commoditization of land and place; land is a market commodity providing wealth and power.
3. Profit-making process is based on sale and development of land; land must be continually bought and sold for profit.
4. Growth coalitions who benefit from growth and development emerge and have the ability to shape public policy pursuant to their interests.
5. The desire for growth provides a key motivation for politically mobilized local elites.
6. Capitalist elites work closely with government to manipulate land values.
7. The more land is “developed” or built upon, the greater its monetary value.
8. Land is parceled and zoned so that capitalists continually profit from its exchange value.
9. Zoning categories and “development” create artificially inflated land values that fuel the growth machine.
10. The interests of coalitions of stakeholders committed to growth come to dominate policy, with results that even those not committed to growth imperative (and want to preserve land) are captured into the growth machine.

11. It describes the social context in which conflict between those seeking gain from exchange values of land and those from use values takes place.
12. The growth imperative is most important constraint on other options for local initiatives in social and economic reform.

Both macro level models include the role of the state and political decision-makers in fostering capital accumulation and expanding capitalist markets. Both show how the capitalist economy dominates other social institutions and captures all in an endless “treadmill” of growth. Both show how consumer markets for new technologies or the built environment have to be created, especially since land development often exceeds population growth. Both models emphasize the disjuncture between economic priorities and ecological capacity.

The Models’ Overlapping Explanations for Unsustainable Environmental Policies

Why do policymakers develop natural resource policies that are unsustainable?

Both models argue that the cause inheres in the characteristics of modern capitalist forms of production. To develop indicators of whether the policymakers’ perspectives and interests reflect adherence to, or lack of, the growth mentality, aspects of the *treadmill* and *growth machine* models are combined into a synthesized model with the following assumptions.

Macro level assumptions

1. The growth imperative, through land development, dominates the political agenda.

2. The growth imperative is based on the commoditization of land. This creates a “treadmill” of developed land production, whereby raw land (open space) must be continually converted to the built environment, bought and sold for profit.
3. Members of a growth coalition work closely with decision-makers, or occupy positions of decision-making to promote their development agenda. The interests of this coalition of stakeholders, who profit from growth through development, dominate the political process.
4. The growth coalition and policy makers manipulate land values through zoning classifications, which create artificially inflated land values. “Vacant” land is the least valued or seen as “potential development” land. The more land is developed or built upon, the greater its exchange (monetary) value.
5. An ideology that growth is good for the community and is necessary for the local economy dominates the thinking of decision-makers and supports growth policy.
6. The interests of growth and the exchange values of land dominate over use and ecological values of land.
7. Decision-makers’ views of reality and the environment are shaped by their material interests. Thus, policy makers see natural resources through a mechanistic view that objectifies environmental resources, such as land and water, and sees them as commodities to be sold or as basic requisites for economic growth to occur.
8. Environmental impacts of growth include increased resource (groundwater) extraction and environmental disruption.

Macro-Micro Linkages in Policymaking

Macro-micro sociological theories link individual behavior and perceptions to facets of the larger culture and social structure. These theories appear in the works of Mills (1959), linking personal troubles to public issues, and in Coleman’s (1986) integrative model using Weber’s Protestant Ethic thesis to link personal religious doctrine and individual values with orientations toward economic behavior and the capitalist economic system. Coleman (1986) said theory construction should characterize “how the purposive actions of the actors combine to bring about system-level behavior, and how those purposive actions are in turn shaped by constraints

that result from the behavior of the system” (Coleman 1976:1312). He saw the heart of Marx’s theory as the link between the macro-level variable, the means of production, and the micro-level variable, individual consciousness of economic and social interests (Coleman 1976:1322). The macro-micro link in this research ascertains whether the distinguishing characteristics of the macro-level theoretical model permeate policymakers’ worldviews that influence their policy decisions.

Humans do not experience and act upon the world objectively, but construct mental “frames of reference for organizing life’s activities” a worldview that shapes what and how we view objective reality. Perceptions are molded by the society in which we live and by our social location within that society. The power of a worldview is such that its hold over perceptions of reality is so internalized that it often goes unquestioned, and its individual adherents are mostly unconscious of how it affects the way they do things (Rifkin 1980:5). Worldviews guide decisions and actions.

If the economic infrastructure of a society determines the general character of the social and political processes, then material interests and class divisions shape views of reality and reinforce growth ideologies (Marx 1859; Smelser 1973). The increasing social and technical division of labor also has a profound effect on people’s understanding of and interaction with nature (Dickens 1996:105). The relation between people’s work and nature is mediated by a range of processes, technologies, and infrastructures. People are actively involved in the transformation

of nature, and changes in how nature's resources are used can also lead to changes in how human beings understand nature.

Dickens (1996) found that conventional economics operates contrary to the natural environment, favoring traditional forms of development (roads and housing developments), and is systematically prejudiced against the environment. The social construction of human dominance over nature works in partnership with economic interests to isolate "human life from the ecosystems that sustain it" (Cronin 1991:8). The human dominance perspective largely disregards any inherent biological and geologic functions of the environment, as it considers simply human use of land and environmental resources. This mechanistic worldview, the dominant ideology of industrial capitalism, is a framework that gives permission to exploit and dominate nature. The results are seen in the ecological crisis (Merchant 2002).

Micro level assumptions

1. Social constructions of nature and worldviews guide the ways people interact with and transform the physical environment.
2. Socio-economic and cultural conditions shape individuals' and group's environmental perceptions and their relationship with the natural environment.
3. Social meanings of the environment are constructed from the standpoint of differentiated social interests.
4. Since the economic infrastructure of society determines the general character of social and political processes, views of reality and growth ideologies are shaped by material interests and class divisions.
5. The perspectives, values, and interests (worldview) of policy makers influence their policy decisions. Their decisions determine the social appropriation of nature.
6. Ideologies are constructed which fortify and perpetuate economic interests.

7. Social construction of nature through a mechanistic worldview, which fragments and objectifies the world, justifies the exploitation and domination of nature.
8. Social interests and social constructions of nature orient stakeholders' perspectives and strategies which, in turn, orient their application of knowledge to public policy.

Analytical Framework of the Study: Applying the Assumptions of the Theoretical Models

Macro-level political economy theories argue that in the modern capitalist system, economic interests and growth imperatives permeate other social institutions and dominate policy priorities. Economic development influences both political system characteristics and policy outcomes (Dye 1966). Growth policy outcomes manifest in drastic changes to the landscape, the use of natural resources beyond their capacity for renewal, and increased pollution beyond the capacity of ecosystems to biodegrade it. In turn, these outcomes eventually harm the societies that generate them.

In the *urban growth machine* model, capital growth is attained through continuous commodification of land: buying, selling, and developing it (building on it) to increase its exchange value. Development requires continuous conversion of raw land, farmland, forests, pastureland and other forms of open space, to the built environment. Increased development also requires increased withdrawal of natural resources to support it. As withdrawal rates exceed the replenishment of the resource, supplies and availability decline, and conflicts can ensue over efforts to gain access to diminishing resources.

Micro-level worldviews incorporate growth model beliefs about the benefits economic growth and expansion with views of nature as commodity. As beneficiaries of growth and development come to dominate decision-making, they influence government policy-makers to create land use policies that foster development, thus creating a treadmill of producing new residential and commercial development.

The growth imperative poses contradictions and conflicts between those who wish to preserve the use value of land and environmental resources with those who profit from the development and exchange values of land. Those who wish to preserve open space, or just enjoy use of their land, have considerably less economic and political power that exchange value proponents to influence alternative land use policies.

As secondary beneficiaries, governments are inclined to support and promote development because they derive their tax revenue to operate from capital growth. Yet, development increases the need for additional infrastructure and services, requiring more capital outlay to accommodate these demands. And governments are responsible for managing the social and environmental problems that growth and development create.

The growth ideology relies on a mechanistic view of nature, which objectifies the environment as a resource store that humans can dominate and exploit. Thus, policy decisions promote growth and development through commoditization and overuse of natural resources, while neglecting the impacts on ecosystems and

environmental resources. Public policy decisions, then, reinforce an economic system that operates counter to environmental systems. Brown (2001) believes that “the economic policies that have yielded the extraordinary growth in the world economy are the same ones that are destroying its support systems.”

A core question from research on the "environmental state" by Schnaiberg et al. (2000) is: to what extent do local governments give equal considerations to ecological and economic impacts in their decision-making? As the economic infrastructure and its growth imperative come to dominate the general character of other social structures and political, they prioritize material and class interests over other social interests. These dominant structures and their corresponding ideologies reinforce modes of production and shape views of reality and the nature of public policy. Public policy then fosters continuous economic growth, which creates negative impacts on the environment through excessive resource extraction, addition of pollution, and creation of waste.

Public policy is ultimately shaped by the worldviews of policy-makers. Their social class values, attitudes and material interests shape their worldviews and their socially constructed views of nature, which guide the way they interact with and transform the physical environment. When growth imperatives dominate government and other social systems, policy-makers develop a worldview that growth and development are inevitable and necessary, even beneficial for the community. These beliefs reinforce the hegemony of growth proponents, permitting them to foster political processes favorable to growth and making it difficult for stakeholders to

step off the growth treadmill. Their ideas prevail over competing knowledge claims about the environment. The ideology of control, domination over nature and a mechanistic view toward nature support unlimited exploitation of resources, while little attention is given to their ecological value or to the ecological consequences of growth-oriented decisions.

In the next chapter, I describe the research strategy, case study methods, sampling and data collection, and coding procedures. I then present the data from interviews with policy makers and their advisors, showing their views on economic growth, local economic development, knowledge of the water source, and concern about environmental impacts. Finally, I describe my findings in the context of a synthesized growth model, formed from a distillation of characteristics of both models of development into a single measure.

CHAPTER III RESEARCH STRATEGY

The water conflict in Memphis provides an opportunity to study natural resource problems by framing the analysis through the dominant policy paradigm. Memphis serves as a test case to evaluate decision-makers' perspectives, and those who influence decision-makers, on adherence to the growth model and environmental decisions relevant to the regional aquifer. The research strategy is a case study of Memphis area policy makers and those who influence them, and their resulting policy decisions that affect natural resources. The study asks whether the macro-level assumptions of the combined growth models are manifest in the values and perceptions of Memphis policymakers and those who advise them. A sample of interviewees including public officials, business leaders, scientists, and environmental activists was drawn from public information sources. The original sample of those agreeing to participate which was expanded by the "snowball" method of selecting other interviewees from respondents' recommendations. The assumptions of the growth models were used to formulate a series of interview guides for conducting in-depth interviews with the respondents about their views on economic growth and environmental concern. Interview data were supplemented by the researchers' notes from observations; video-taping of a public forum where elected policy makers and candidates spoke about their economic, political and environmental interests; and archival data, including documents written by interviewees, newspaper and magazine articles, and published research.

Case Study Methods

The research methodology is a case study using a combination of in-depth interviews, observational and archival data. The case study is an idiographic examination of a single event, group, or society, relying on multiple sources of information to add depth and breadth and enrich understanding through triangulation. The case study is advantageous because it provides a fuller, more holistic picture of the situation and the researcher obtains more in-depth information than would be gleaned from a survey instrument. It can give the researcher information about stakeholders which may be unknown or unknowable by public means. Case studies help researchers connect the micro level actions of individuals to the macro level social structures that provide the context and frame for individual actions and decisions (Neuman 2003: 33). Since the purpose of this research is to connect macro level political economy theory concepts to micro level perceptions of actors, case study methodology is appropriately suited to these research goals.

This research, and case studies, primarily use in-depth interviews, a process of asking questions, listening, expressing interest, and recording what was said (Neuman 2003:390). The interviewer begins with a set of open-ended questions tailored to people from specific groups and situations, then listens carefully, responds with interest and elicits free response from the interviewee. In-depth interviews allow the researcher to get people to talk freely, giving information the researcher might not have thought of to ask and providing a rich data set for analysis.

Observations can fill in details of the situation that might not be gained through other research strategies.

Securing a legitimate, representative sample for this study would have been exceedingly difficult. Selection of a sample of interviewees began with names of public officials, business leaders, scientists and leaders of environmental groups available through public sources and mentioned in the media, then asked them for references to other prospective interviewees who would have knowledge of or interest in the research subject. This snowball sampling method gives the researcher names of respondents that might be otherwise unknown to the researcher and access to stakeholders through networking with respondents, whereas without the referral, they might be reluctant to be interviewed.

The interview and observational information is then subsidized with archival data that include existing documents such as written and/or public records, manuscripts, statistical records, and newspaper and magazine articles about events relative to the situation. Such data can give background information about events to which interviewees refer and supplement or clarify interview information; make links between sources, ascertain patterns, derive alternative explanations and generally provide a broader understanding of the case. The archival data are used to supplement, compare, corroborate, or contradict information from the interviewees.

A researcher must be concerned with the reliability and validity of the research in structuring the project. Construct validity requires the researcher to assure that the operationalization of theoretical concepts results in correct and accurate measures of

the variables. Internal validity requires the researcher to use multiple sources of information to establish relations between conditions and chains of evidence. Case studies raise questions of external validity, whether or not the case is generalizable beyond the immediate study. The external validity of this study is enhanced by its comparison with the literature on metropolitan development across the U.S. that shows similar patterns to Memphis' development patterns.

Triangulation of Methods: Interviews, Observations and Archival Data

My primary data source was a series of open-ended interviews with members of four stakeholder groups involved in water policy formation: elected and non-elected policymakers, business leaders, local scientists, and environmental advocates. Interviewees were first selected from publicly available sources of names of local policymakers, prominent business leaders, local groundwater scientists, and executive committee members of local environmental organizations. They were contacted by phone and/or email to request their participation in the study. Then snowball sampling was used by asking those who agreed to be interviewed for referrals to others who would be knowledgeable about or have interest in the research subject. Sometimes interviewees voluntarily recommended others for interviewing. A total of 53 people agreed to be interviewed. The 53 interviews were primarily conducted face-to-face; three were conducted by phone when a face-to-face meeting could not be arranged. All face-to-face interviews except one were recorded with a digital voice recorder by permission of the interviewees. Extensive

hand-written notes were taken during the interviews as well. Information from the three phone interviews was recorded through hand-written notes.

Observational data were collected via video-taping a “Public Issues Forum” held in Memphis in the summer of 2006 at which several Shelby County policymakers spoke on economic growth and environmental issues. The entire hour-and-a-half long forum was videotaped; the recording was then digitized and edited into a half-hour DVD showing each participant speaking about relevant groundwater and growth issues.

Archival data include written articles and public statements by interviewees; newspaper articles on related issues; public documents filed in the lawsuit; and published groundwater research documents. Once the verbatim and coded transcripts were completed, archival data relevant to respondents’ information was inserted into the texts as references and supplements to the interview data.

In this section, I first report my sampling procedures, offering a table that summarizes respondent characteristics. I then describe my operationalization of theoretical concepts in the construction of interview guides for each of the four groups of respondents.

Interviews with Memphis Area Policy Makers and Shapers

The pool of potential stakeholders for this study included elected officials who legally make public policy and non-elected officials who advise policymakers. Elected officials include state legislators, mayors, county commissioners, and city

council members. Non-elected officials include administrators in government agencies such as the Office of Planning and Development and the Memphis/ Shelby County Health Department, and members of policy advisory boards like Land Use Control Board and Ground Water Quality Control Board. The pool includes stakeholder groups like business leaders who influence policymakers on matters relative to business and the local economy. It also includes local businesses which depend upon the groundwater for their enterprises and have vested interests in water policy. The pool includes stakeholder groups who may educate and influence policymakers about natural resources such as scientists who are engaged in natural resource-related research to and environmental advocates, members of environmental organizations.

Identifying Stakeholders and Sampling Procedures

Specific contact information about the pool of potential interviewees was gleaned from public lists of city and county policymakers; businesses with their own wells for water used in their industrial processes; Memphis Light, Gas & Water officials; scientists involved in regional groundwater study such as the Groundwater Institute at the University of Memphis and MAT-RAS (Mississippi, Arkansas, Tennessee Regional Aquifer Study); and officers of local environmental NGOs such as Sierra Club, League of Women Voters conservation division, and Wolf River Conservancy.

From the larger pool of potential interviewees, I selected a sample from four stakeholder groups who either make policy or inform the policymakers on matters related to groundwater: (1) elected and non-elected policymakers; (2) business leaders; (3) local scientists; (4) active members of local environmental and political activist groups with interests in groundwater. Those selected were current members of local governmental bodies, leaders in businesses connected with groundwater use, such as MLGW or private businesses with their own wells, current or retired scientists at local groundwater research institutions, and directors and board members of local environmental and community activist NGO. Several interviewees were mentioned in news accounts. Initial contacts were made by phone, written letter or e-mail from information gleaned from the public lists available, noted above. From those initial contacts, other interviewees were selected by the snowball sampling method of soliciting references from initial respondents for other potential interviewees.

Policymakers

Contact information for Memphis City Council Members and Shelby County Commissioners was obtained from their web sites and by phone calls to their main offices. Initial contact with Shelby County Commissioners was made by formal letter, hand-delivered to the Board of Commissioners office, briefly describing my research project and asking for their participation in the project. Initial contact with Memphis City Council members was made by e-mail sent to each City Council

member, with the same information as in the letters to the county commissioners. When there was no initial response from some county commissioners and city council persons, follow-up phone calls and emails to their administrative staff were done to solicit their participation. Four Shelby County Commissioners agreed to be interviewed. Two Memphis City Council members responded; one agreed to be interviewed, but was unable to complete the interview because of conflict with budget hearing meetings. The other declined a full-length interview because he felt he did not know enough about groundwater to be helpful, but did forward by mail information he had solicited from MLGW about water quality.

Contact with city and county administrative officials and suburban municipality mayors and staff was made by both e-mail and phone calls. Those who agreed to be interviewed were both city and county Directors of Public Works, a Deputy Administrator in the Memphis/ Shelby County Office of Planning and Development, Director in the Division of Water Pollution control at Memphis/ Shelby County Health Department and liaison to the Shelby County Groundwater Quality Control Board, and a storm water project coordinator in the City of Memphis Public Works. Suburban mayors from Bartlett and Southaven agreed to interviews as did the Southaven and Fayette County Planning Directors and Lakeland Natural Resources Director. The county's State Senator, who is also majority leader in the Tennessee State Senate and serves on the Environment Committee, was interviewed; he is also a former Shelby County Commissioner. A total of 16 elected and non-elected

officials were interviewed from the 18 who responded with interest in the research project.

Business leaders

A partial list of businesses with their own wells, gleaned from a list of participants in GWI workshops held in the late 1990s and from a water official at Memphis/ Shelby County Health Department, was the initial list from which business leaders were contacted by phone and by e-mail. There are about 80 such industries in Memphis, but only ten could be specifically identified; information on the names of others was unavailable. Of these, two agreed to be interviewed. In addition to businesses with direct groundwater interests, the environmental reporter from the local newspaper who has covered the lawsuit and written several articles on water issues was interviewed. Other business leaders were recommended by respondents: the Chamber of Commerce manager of energy resources and economic development, an organic lawn care/landscaping business owner (who was also a City Council Candidate), the MLGW Past Presidents (one of whom was a Shelby County Mayoral candidate) and MLGW Past VP who is also a former member of the Shelby County Ground Water Quality Control Board (GWQCB). Head of the water quality lab at MLGW was contacted directly. The groundwater cleanup environmental engineer was recommended by a Sierra Club member. A total of 10 business leaders were interviewed.

Scientists

The initial list of scientists was composed of the Director and former Director of Groundwater Institute (GWI) at the University of Memphis and a list of attendees at the 2003 MATRAS conference. The Associate Director of GWI was recommended by both the current director and the Shelby County Director of Public Works. Both are primary leaders in the Mississippi Embayment Regional Aquifer Study, a current project funded by state and federal dollars to develop data for models to address groundwater overuse and contamination. Other groundwater scientists, the geologist, hydrologist, employees at U.S.G.S. and U.S. Army Corps of Engineers were recommended by other respondents. These scientists were identified as doing past and/or current research related to the regional aquifer system. While the two U.S. Army Corps of Engineers are not working directly on groundwater issues, their work on a surface water irrigation project in Arkansas is directly related to de-watering of the surficial aquifer in parts of Arkansas by overdrafting for irrigated rice farming. The Planning Professor, Ecosystem Ecology Professor, and Geography Professor were recommended by other respondents as having expertise on land uses and ecosystems management that directly relate to groundwater. Twelve scientists were interviewed. Two scientists had a large number of N/A responses on the majority of items because I was not able to conduct complete interviews with them. They were dropped from the final analysis, reducing the sample size of scientists from 12 to 10.

Environmental Advocates

The initial sample of environmental advocates was taken from a list of executive committee members of the local chapter of the Sierra Club and list of participants in previous GWI workshops. Four Sierra Club members and one League of Women Voters Past Conservation Chair, who also served on the EPA Source Water Assessment and Protection Program (SWAP) advisory committee, participated. The researcher also had contact by group e-mail with a community environmental advocacy group at Temple Israel: EDEN. A group e-mail was sent to all members asking for volunteer participants, from which two were recruited. The Director and past Director of the Wolf River Conservancy, Director of Shelby Farms Park Alliance, President of Grey's Creek Development Association, and an environmental writer for the *Herald and Tribune* were all recommended by other participants. Thirteen environmental advocates were interviewed.

Operationalization of theoretical concepts

The research task covered three main categories of inquiry into the perspectives of policymakers and those influential to them: (1) knowledge of the aquifer and the lawsuit; (2) general environmental concern and concern about the groundwater; and (3) values and beliefs regarding the growth model. The growth models' combined assumptions were distilled into seven concepts to measure the link between macro level assumptions and micro level aspects of policymakers' worldviews. A fourth

category of data included demographic items from respondents: age, gender, race, education level, occupation, income level, and county residency time.

An interview guide listing the initial questions to be asked of participants from each stakeholder group was compiled and during the interviews, follow-up questions were asked to encourage interviewees to provide additional relevant information. The questions in the interview guides are coded according to the variables for which they collect data. Groundwater Knowledge is designated by (K); lawsuit knowledge by (LSK); environmental concern by (EC); groundwater concern by (GWC); commodification of resources by (C); priority of economic institution by (EP); economic expansion by (EE); expansion of consumption and expansion of new markets by (ENM); unlimited growth by (UG); growth benefits everyone by (GB); and labor-reducing technology by (LRT). The interview guides are in the Appendices. The Research Strategy Chart, which also served as a reference guide during the interviews, is shown in Figure 1.

Demographic items

For each respondent group, data were collected on standard background demographic characteristics: age, gender, race, education level, occupation, income level, and county residency time. See questions number 22, 23, 29, 24 Demographic items, respectively for each of the four groups in the Interview Guides in the Appendices. Age is related to perceptions because the era in which one is born and socialized is a factor that shapes peoples' worldviews. Age was ascertained by

Research Strategy Chart

<u>Knowledge of water and water conflict</u>	<u>Values and beliefs re: environmental concern</u>	<u>Values and beliefs re: growth machine</u>	<u>Demographics</u>
<i>CONCEPTS:</i>			
Water conflict: the State of Mississippi vs. Memphis and MLGW.	-People are fundamentally different from all other creatures on earth, over which they have dominion.	- Commodification of resources	-Age
-Aquifers: definition of aquifer, its importance to humans, its ecological needs, natural and human stresses on them.	-People can determine their own destinies, can choose their own goals and learn whatever is necessary to achieve them.	- Priority of economic institution	-Sex
The Memphis aquifer: size, significance, location, problems.	-The world is vast and provides unlimited opportunities for humans.	- Economic expansion	-Race
	-The history of human society is one of progress, there is a solution to every problem, and progress need never cease.	- Expansion of consumption and new markets	-Education
	(Human Exemptionalist Paradigm, Catton & Dunlap 1980: 34)	- Unlimited growth	-Income
		-Growth benefits everyone.	-Occupation
		-Labor-reducing technologies	-County residency time

Figure 1: Research Strategy Chart

asking respondents the year of their birth. Gender and race have been shown to be important variables affecting people's societal treatment and experiences and shaping their perspectives. Gender has been associated with environmental concern and race and class have been associated with experiencing disproportionate harm from decisions about environmental resources. Gender and race characteristics were noted by observation. Educational level is associated with knowledge base and analytical thinking skills, both important factors in decision-making. For educational level, respondents were asked their highest degree achieved and any professional certifications they had. Social class is associated with shaping differential social experiences and perspectives regarding natural resources. Social class was measured by income level, and income levels were grouped by the scale shown below. Respondents were asked to pick a numbered category which best fit their annual income. Residency was measured by asking respondents how many years they had lived in the county or area.

- (1) <\$15,000 / year
- (2) \$15,000 - \$25,000 / year
- (3) \$25,000 - \$32,000 / year
- (4) \$32,000 - \$50,000 / year
- (5) \$50,000 - \$70,000 / year
- (6) \$70,000 - \$100,000 / year
- (7) \$100,000 - \$200,000 / year
- (8) >\$200,000 / year

Knowledge of groundwater and the lawsuit

Knowledge about the groundwater resource is a basic requirement for making informed decisions about the resource and understanding the impacts of those

decisions. If policymakers do not have adequate or accurate knowledge of natural resources and the impacts of human activities on them, then there is a greater likelihood their policy decisions will result in harm to the resources. Participants were asked questions that probed their knowledge of the resource: understanding where drinking water comes from, the aquifer structure, water quality, available quantity, and what factors might impair the quality or availability of the resource. Initial questions to ascertain their groundwater knowledge are questions number 1, 2, 19; 1, 2, 21; 1, 2, 3, 4, 27; 1, 2, 20, respectively for each of the four groups, designated (K) in the Interview Guides in the Appendices. What do you think about Memphis water? How do you think the public generally perceives it? What is the status of Memphis' source of water supply in terms of quality and quantity? Do you have information about the location of aquifer recharge areas? What needs to be done to protect the aquifer and the recharge areas, and to maintain a consistent or sustainable water level? I kept my questions targeted to information about the Mississippi Embayment regional aquifer, the subject of the study. Some interviewees did offer comments about water issues elsewhere in the U.S. and the world. Some expressed knowledge about watersheds and related ecosystems.

A question about the lawsuit was included to see if it might be a pivotal event, bringing official recognition to an existing and potentially growing environmental problem. See questions number 5; 7, 8; 6; 5, respectively for each of the four groups, designated (LSK) in the Interview Guides in the Appendices. What do you think about the lawsuit Mississippi filed against Memphis and its utility Memphis Light, Gas and Water (MLGW)? Has the lawsuit affected attitudes or public policy

regarding groundwater? If so, how? None of the Memphis lawyers or the Mississippi Department of Environmental Quality personnel involved in the lawsuit would agree to be interviewed.

Some questions related to the lawsuit and environmental concern asked interviewees for alternative ideas on how to best manage and protect the regional groundwater resource. Those are questions 19, 20, 21; 21, 22, 23; 27, 28, 29; 20, 21, 22, respectively for each of the four groups, as found at the end of each of the Interview Guides in the Appendices. The questions are: How can regional groundwater protection and equitable distribution be accomplished across political jurisdiction boundaries? How should Memphis and Shelby County work with Mississippi and surrounding counties to maintain adequate access to and protection of groundwater? Should there be an active regional groundwater board? If so, what should be its scope?

HEP values and beliefs regarding groundwater

How the interviewees value groundwater and whether or not they are concerned about protecting it from human activities is related to their knowledge about how the resource is affected by human activities, and will likely influence their decisions about the resource. To ascertain interviewees' values regarding groundwater concern, these questions were asked: 3, 4, 6, 8, 9, 11; 3, 4, 5, 6, 11, 12, 15; 3, 5, 7, 8, 10, 11, 12, 13, 24, 25, 26; 3, 4, 6, 7, 8, 12, 13, 14 respectively for each of the four groups, as designated by (GWC) in the Interview Guides in the Appendices. Do you think the groundwater source is one the region's assets? If so, is it being sufficiently

protected? If not, what kinds of additional protections are needed? Do you have concerns about the future of Memphis' water supply? Do you know of any possible threats to the groundwater resource? Does the current policy process take into consideration effects on the aquifer? Please describe the current policy process in terms of how it relates to land use and the water source (aquifer). How important is the groundwater to your business? What are some of the key issues/ environmental problems about groundwater, drinking water and environmental protection in this area? Do economic growth and development in the area have an effect on groundwater? If so, in what way? Please describe the current policy making process in terms of how it relates to your business interests, economic development, and the water source (aquifer). Does the aquifer affect (enable) economic development in the region? If so, how?

HEP values and beliefs regarding general environmental concern

The literature indicates that whether participants adhere to a high HEP or a low HEP paradigm in their general environmental concern is an important factor influencing decisions about natural resources. If they have a mechanistic view of natural resources, see them as commodities, the literature predicts they will be less likely to be concerned about their protection. To ascertain interviewees' values regarding general environmental concern, I asked questions number 6, 7, 8, 9, 10, 11; 10, 11, 13, 14, 15; 7, 8, 11, 12,17; 6, 7, 8, 11, 14 respectively for each of the four groups, designated (EC) in the Interview Guides in the Appendices. Does current land use decision-making take into account environmental effects of land change or

conversion? If so, how? If not, should it and how? Is there any change occurring in the way land use and zoning decisions are made, say to incorporate aquifer recharge protection areas or development that preserves green space? Do you think economic development policy decisions incorporate their corresponding environmental effects? If so, how? If not, should they? Does the current policy process consider the environmental effects of land use decisions? Does the current policy process sufficiently consider environmental effects of economic development? If not, what policy changes are needed?

Values and beliefs regarding the growth machine

The priority of economic growth in decision-making is a prominent feature in the literature shown to affect decisions about natural resources. A synthesized growth model abstracting and combining essential assumptions of the *treadmill of production* and *urban growth machine* models was derived to be the measure of participants' values and beliefs about economic growth priorities. In the synthesized model, assumptions drawn from the *treadmill of production* emphasize attitudes toward environmental resources, particularly resource depletion for economic goals, and are closely tied to the Human Exemptionalist Paradigm (HEP). Assumptions drawn from the *urban growth machine* emphasize elements of the pro-growth perspective. The assumptions of this *synthesized model* are:

1. The growth imperative, through land development, dominates the political agenda.
2. The growth imperative is based on the commoditization of land. This creates a "treadmill" of production, whereby land must be continually developed (raw land converted to the built environment), bought and sold for profit.

3. Members of a growth coalition work closely with, or occupy positions of, decision-makers to promote their development agenda. The interests of this coalition of stakeholders, who profit from growth through development, dominate the political process.
4. The growth coalition and policy makers manipulate land values through zoning classifications, which create artificially inflated land values. “Vacant” land is the least valued or seen as “potential development” land. The more land is developed or built upon, the greater its exchange (monetary) value.
5. An ideology that growth is good for the community and is necessary for the local economy dominates the thinking of decision-makers and supports growth policy.
6. The interests of growth and exchange values of land dominate over use and ecological values of land.
7. Decision-makers’ views of reality and the environment are shaped by their material interests. Thus, policy makers see natural resources through a mechanistic view that objectifies environmental resources, such as land and water, and sees them as commodities to be sold or as basic requisites for economic growth to occur.
8. Environmental impacts of growth include increased resource extraction and environmental disruption.

From the assumptions of this synthesized model, seven concepts were identified to ascertain respondents’ values and beliefs regarding adherence to the growth machine model. Those seven concepts are:

1. Commodification of resources - land and water
2. Priority of the economic institution
3. Economic expansion
4. Expansion of consumption and creation of new markets
5. Unlimited growth
6. Growth benefits everyone
7. Development of technologies that reduce labor costs

Questions about commodification of resources include numbers 3, 6, 7, 8, 9, 10, 11; 3, 4, 5, 6, 9, 10, 11; 5, 10, 11, 12, 24, 25; 3, 4, 6, 7, 8 respectively for each group

of respondents, designated (C) in the Interview Guides. Questions concerning priority of the economic institution include numbers 6, 12, 13; 9, 10, 11, 12, 14, 15; 15, 16, 17, 18; 9, 10, 11, 12, 13 respectively for each group, designated (EP) in the Interview Guides. Questions concerning economic expansion include numbers 13, 14; 12, 16; 16, 19; 10, 15 respectively for each of the four groups, designated (EE) in the Interview Guides. Questions concerning expansion of consumption and creation of new markets include numbers 14, 16; 16, 18; 19, 21; 15, 17, respectively for each group, designated (ENM) in the Interview Guides. Questions concerning unlimited growth include numbers 15, 16; 17, 18; 21, 21; 16, 17, respectively for each group, designated (UG) in the Interview Guides. Questions concerning the beneficiaries of growth include numbers 17, 19, 22, 18, respectively for each of the four groups, designated (GB) in the Interview Guides. Questions concerning their views of labor-reducing technologies include questions 18, 20, 23, 19, respectively for each of the four groups, designated (LRT) in the Interview Guides in the Appendices. Example questions are: What are priorities in decision-making? Are economic growth and development important to the area? Are they priorities in policy decisions? What do you think are the factors that foster economic growth and development? In what areas is economic growth occurring now? What are future areas of economic growth? Are there limits to growth and development in the community? If so, what would limit it? Or can growth and development continue indefinitely? Can any limits to growth be overcome? If so, how? Where might new markets and expanded growth occur? Do you think growth benefits everyone in the community? Do you think growth benefits some groups more than others? If so, which groups? The newspaper

reported that MLGW recently considered automating its meter reading system, which would eliminate about 200 jobs. What do you think of the role of labor-saving technology in our society? What is the impact of labor-saving technology on the community?

All of the questions in the Interview Guides are initial questions asked of the interviewees. Follow-up questions during the in-depth interviews enabled the researcher to glean more detailed information and probe interviewees' values and beliefs further on each of the concepts. Most of the questions asked to all the groups were the same, but a few questions were tailored to the specific interests of each group and did not apply to all groups.

Coding of Transcripts

The digital voice recordings of interviews were downloaded into a computer using the Sony Digital Voice Editor software program and were first transcribed verbatim in entirety, using the hand-written notes to clarify and supplement recorded information. A verbatim transcript for each participant, identified only by case number, was composed. The verbatim transcripts were then used as the basis for compiling twelve coded transcripts for each of the main categories of inquiry shown below.

1. demographic items
2. knowledge of the groundwater and lawsuit
3. HEP values and beliefs regarding groundwater concern
4. HEP values and beliefs of general environmental concern

5. commodification of resources
6. priority of economic institution
7. economic expansion
8. expansion of consumption and creation of new markets
9. unlimited growth
10. growth benefits everyone
11. labor-reducing technologies
12. stakeholder group

To construct the coded transcripts, information relevant to each category listed above was excerpted from each participant's verbatim transcript and transferred to the coded transcript for that category. Then within each coded transcript, narrative responses were grouped under the four respondent categories. Participants were divided according to stakeholder group: elected and non-elected policymakers, business leaders, scientists, and environmental advocates.

Demographic items

General demographic information was recorded for each interviewee, as shown below in Table 1. Information about their occupations or positions was recorded the way interviewees provided it. Policymakers often hold other occupations besides their political positions since the policymaking positions are usually considered part-time and short-term positions, such as Shelby County commissioner and attorney. Age was recorded by their year of birth. In coding for age, the participant's year of birth was subtracted from 2007 to determine their current age. Coding for gender is

Table 1: Respondents' Demographic Characteristics

<u>Case #</u>	<u>Stakeholder Group</u>	<u>Gender</u>	<u>Race</u>	<u>Education Level</u>	<u>Income</u>	<u>Residency</u>
	Policy makers					
17	elected official	M	W	Master's	6	30 years
6	elected official	M	W	BA, JD	6	7 years
14b	elected official	M	W	BS	7	41 years
6.12b	elected official	M	B	N/A	N/A	N/A
5.21	elected official	M	W	2 years college	7	35 years
5.22b	elected official	M	W	JD, Masters	7	54 years
5.30	elected official	F	W	2 years college	7	40 years
6.18	elected official	M	W	JD	1 (state senator)	27 years
12	non-elected official	M	W	MS	N/A	54 years
26b	non-elected official	M	W	BS	4	8 1/2 years
14a	non-elected official	F	W	Master's	5 & 6	30 years
15a	non-elected official	F	W	Master's	6	56 years

Table 1, continued.

<u>Case #</u>	<u>Stakeholder Group</u>	<u>Gender</u>	<u>Race</u>	<u>Education Level</u>	<u>Income</u>	<u>Residency</u>
	Policy makers					
23	non-elected official	M	W	BA	5 to 7	21 years
6.1b	non-elected official	M	W	Bachelors	6	21 years
6.14	non-elected official	F	W	Two associates degrees	4	10 Years
	Business					
13b	media	M	W	BA	N/A	20 years
5.22a	business leader	M	W	BS	7	71 years
5.29a	business leader	M	W	BS chemical engineering	7	17 years
5.29b	business leader	M	B	JD	1; usually 7 to 8	56 years
6.1a	business leader	M	W	MBA	8	40 years
6.4	business leader	F	B	MBA, CPA	7	53 years
6.7a	business leader	M	W	MBA	7	49 years

Table 1, continued.

<u>Case #</u>	<u>Stakeholder Group</u>	<u>Gender</u>	<u>Race</u>	<u>Education Level</u>	<u>Income</u>	<u>Residency</u>
	Business					
6.13b	business owner	M	W	JD	8	9 years
24a	business owner	M	W	BA & BS	6	32 years
13c	water quality lab	M	B	Bachelor's	N/A	61 years
	Scientists					
13a	groundwater scientist	M	W	PhD	N/A	35 years
19	groundwater scientist	M	W	PhD, PE	7	36 years
26a	groundwater scientist	M	W	PhD, PE	5	33 years
9	groundwater scientist; geologist	M	W	PhD	6	11 years
30	groundwater scientist	M	W	PhD, PE	7	37 years in Knoxville; 4 years in Memphis
6.27	groundwater scientist	M	W	N/A	N/A	N/A
5.7	hydrologist	F	W	Masters	7	30 years
5.8a	water scientist	M	W	PhD, PE	5	10 years
5.8b	water project coordinator	F	W	BS	6	6 years

Table 1, continued.

<u>Case #</u>	<u>Stakeholder Group</u>	<u>Gender</u>	<u>Race</u>	<u>Education Level</u>	<u>Income</u>	<u>Residency</u>
	Scientists					
6.13a	U of M faculty	F	W	PhD	N/A	N/A
27a	U of M faculty, Planning	F	W	PhD	N/A	16 years
27b	Rhodes College faculty, Ecology	F	W	PhD	N/A	2 years
	Environmental Advocates					
8	environmental advocate	M	W	BA, Master's equivalencies	2 to 3	10 years
7a	environmental advocate	M	W	BA, professional degree in architecture	3 to 5	22 years
7b	environmental advocate	F	W	BA, JD	1	30 years
24b	environmental advocate; retired non- elected official	M	W	BS	3	50 years
27c	NGO Past President	F	W	MA	8	29 years

Table 1, continued.

<u>Case #</u>	<u>Stakeholder Group</u>	<u>Gender</u>	<u>Race</u>	<u>Education Level</u>	<u>Income</u>	<u>Residency</u>
	Environmental Advocates					
6.6	environmentalist, student	M	W	HS, college sophomore	1	14 years MS., 6 years Memphis
6.7b	environmental advocate	F	W	MSW	1, formerly 5	10 years
6.8	NGO Executive Director	F	W	Bachelor's	5	44 years Memphis; 3 years DC, 2 years Tel Aviv
6.12a	NGO, attorney	M	W	BS, JD	last year 1, 4 usually	50 years
6.21	environmental advocate	F	W	N/A	N/A	N/A
6.15	NGO Exec. Dir.	M	W	Bachelor's	4	50 years
6.26	NGO President	M	W	Bachelor's	7	32 years
7.24	retired university faculty, environmental columnist	F	W	EDD	2 to 3	28 years

represented by an M (male) or F (female). Coding for race is represented by W (white) or B (Black), since “white” and African-American were the only two racial categories of people interviewed. Residency length is coded as the number of years participants said they had lived in the area.

Demographic Characteristics of Interviewees by Stakeholder Groups

In this sample, most of the interviewees have some interest in groundwater policy. Most of the policymakers either had an interest in groundwater protection or believed they knew enough about the groundwater to contribute to the research. The business leaders have ties to groundwater policy mainly through their businesses, which depend on the groundwater supply, or through positions they have held. The scientists are involved in research that is either directly or indirectly related to groundwater. The environmental advocates are engaged in volunteer activities that directly or indirectly relate to groundwater and/or general environmental protection.

Policymakers

Eight of the policymakers are elected officials and eight are non-elected officials. Elected officials serve as county commissioners, city council members, and mayors. Non-elected officials serve as directors of public works, a deputy administrator at the Office of Planning and Development (OPD), a public works storm water projects coordinator, planning directors, a municipality natural resources

director, and a Memphis/Shelby County Health Department water pollution control official.

The group is primarily white, male, college-educated with some advanced degrees, and fairly affluent. The majority are male (12) with only four females. All are white except one African-American participant. They range in age from 30 to 68 with the half in their mid-50s: 52 to 56. All have some college education, at least two years of college (2); one has an Associates degree; five had Bachelor's degrees; five have Master's degrees; and three have JDs. Their incomes range from level 4 to 7, with six having incomes at the 7 level, five at level 6, and two at level 4. The exception is a State Senator who would not give his total income; he only gave his salary as State Senator, which is in the 1 range. None were new comers to the region, having lived here at minimum 7 to 10 years and most for the majority of their lives.

Business leaders

The occupations and positions held by business leaders include an environmental reporter; the Safety, Health, and Environment manager at a major chemical company; CEO of a non-alcoholic bottling company; owner of a mostly-organic lawn landscaping company, who is also an attorney and City Council candidate; a consulting environmental engineer specializing in groundwater clean up, who is also a Sierra Club member; manager of Energy Resources and Economic Development at the Memphis Chamber of Commerce; two Past Presidents and one Past VP of MLGW, who also served on the Shelby County Groundwater Quality Control Board (GWQCB).

The group is predominantly white and male, with one African-American female and two African-American males. The group has a similar age range to policymakers: 35 to 71, with half of the group aged 49 to 57. All are college educated, half having a Bachelor's degree, three with MBA degrees, and two with JDs. Their incomes range from level 6 to 8. The majority have lived in the area a long time, with 8 years the least amount of time.

Scientists

The scientists are primarily groundwater scientists (6); two are surface water scientists - a hydrologist and hydraulic engineer, and one is a water project coordinator. Four are currently associated with the Groundwater Institute at the University of Memphis; two formerly worked at the Institute. Two work for the U.S. Geological Survey and two for the U.S. Army Corps of Engineers. The two non-water scientists are an Associate Professor of City and Regional Planning and an Assistant Professor of Ecosystem Ecology.

This group is all white and split on gender: half male (6) and half female (5). The group is similar in age range to the prior two groups: 39 to 64, with half aged 49 to 58 years. The group is highly educated with a majority having Ph.D.s (9), one Masters, and one Bachelor's degree. Four had Professional Engineer (PE) certification. Their incomes range from level 5 to 7. Four have lived in the area 30 years or more, one has lived in the area 16 years, and five have lived there 11 years or less.

Environmental Advocates

Most environmental advocates are affiliated with an environmental NGO and do volunteer or paid work with those NGOs. Four are officer members of the local Sierra Club; one is an officer in the League of Women Voters; two are members of the Temple Israel community environmental group EDEN; four are directors of local NGOs; and one is a retired university faculty member, who is also a retired officer in the League of Women Voters and currently writes an environmental column for a weekly newspaper. At the time of the interview, her recent column was on the Clean Water Restoration Act. The League of Women Voters officer is also a former member of the EPA Source Water Protection Advisory Committee. One environmental advocate is a former employee for the City of Memphis Public Works Storm Water Division. The non-NGO affiliated environmental advocate is a writer and judge's wife. In addition to their environmental group affiliations, their employed occupations are: two are attorneys, one an environmental attorney; one is an architect; one is a retired storm water employee for the City of Memphis; and one is a retired FedEx pilot.

This group is all white and split on gender: half males (7) and half females (6). The members are slightly older than the prior three groups: ages 50 to 70, with one 26-year-old college student. The majority of them have Bachelor's degrees (6), two have JDs, two have Master's degrees, one has an EDD, and the college student is a High School graduate. The incomes of this group range lower than the other three groups: most are in levels 3 to 5 or 6, and two have incomes in categories 7 to 8. Two do mostly volunteer work, so their incomes were in category 1. Most have lived

in the area a long time: four, most of their lives; five 22 to 32 years; and three 10 to 14 years.

Knowledge of groundwater and the lawsuit

People's perceptions about resources are based, in part, on what they "know" about the resources, and their decisions follow from what they think they "know," given limited exposure to alternative perspectives or sources of information. So knowledge of the groundwater was considered foundational for further evaluating the perspectives of the respondents on environmental concern. Knowledge of the aquifer included understanding the hydrogeologic structure of the aquifer, characteristics of water quality and quantity, and human impacts on the aquifer.

Respondents' answers to questions about their knowledge of the groundwater were coded as high, medium, or low. High indicated having an extensive knowledge of the hydrogeological structure of the aquifer; the water quality, its vulnerability to contamination and places of contamination; water quantity and amount being withdrawn; significance of age-dating; where recharge areas are and how human activities affect the aquifer. Medium indicated having a basic understanding of where Memphis gets its water, the aquifer structure, some idea of the importance of the age of the water, where recharge areas are and why they are important to aquifer sustainability. Low indicated not knowing much more than the aquifer exists and is the source of Memphis water.

Responses to questions about knowledge of the lawsuit were grouped according to a high, medium, low scale. High indicated a lot of knowledge about the lawsuit

and the issues involved: water rights, overuse of the water, changing groundwater flow, filing strategies and possible outcomes, precipitating events. Medium indicated basic knowledge of the lawsuit as reported in the newspaper: the parties involved, the core issue of the water rights, and possible reasons for the lawsuit. Low indicated simply knowing the lawsuit had been filed, who the opposing parties are, and that the dispute is over water.

Results from questions about knowledge of the lawsuit showed only six respondents rated high, as having substantial of knowledge of the lawsuit, three were scientists, two business leaders, and one environmental advocate. The lawsuit did not seem to be particularly influential on most policymakers; among elected officials, three had medium knowledge and five had low knowledge of it.

A typical low response came from a Shelby County commissioner, “I know there seems to be a dispute with Mississippi over some of that groundwater and that could potentially threaten our supply. So I’m hoping for a positive resolution of that. I’m not familiar with any other threats to the groundwater supply. I don’t have any reason to suspect that there’s a long term problem with the groundwater except for this dispute with the state of Mississippi. I’ve heard a little bit about it, but I don’t know much details. I guess one side would say you’re growing too much and using too much water and the water should be a shared resource and because of your growth you’re taking more than your share. I would imagine that could become an issue.” An OPD administrator saw growth and development related to the lawsuit, “The City of Memphis and DeSoto County, Mississippi are in a lawsuit with each other right now over stealing each other’s water from underground.” A State Senator,

also an attorney, thought the effects of the lawsuit, “Could be very far reaching, that a natural resource of that type could have multiple claims to ownership and use. You know, riparian rights and the thought that somehow the mineral rights or natural resources beneath your house belong to somebody other than the home owner. That’s radical stuff. Ultimately you may not be able to dig a well on your own property.”

However, the lawsuit also did not appear related to respondents’ values and beliefs toward the growth machine or their HEP values and beliefs regarding environmental and groundwater concern, so knowledge of the lawsuit was dropped from the final analysis.

HEP values and beliefs regarding groundwater concern

How highly natural resources are valued and whether or not people perceive that their actions have an effect on resources are important factors that affect decision-making about them. The importance the HEP paradigm is to provide an empirical model to validate the ideological predisposition of a decision-maker toward the growth imperative models. If people hold the human exemptionalist paradigm (HEP), their decisions will not necessarily consider impacts on the resource since humans are “exempt” and hold dominance over nature. Environmental concern and concern about the groundwater were measured by the “Measurement of HEP values” instrument, using basic concepts from Catton and Dunlap (1980) combined with similar statements from interviewees consistent with the HEP, as shown in Figure 2 below.

Measurement of HEP Values

High – indicators of HEP perspective

Low degree of environmental concern
Doesn't think much about human environmental impact
Believes humans actions don't have an effect on environment
Mechanistic, fragmented view of nature
Sees natural resources as commodities
Sees natural resources for their economic value
Doesn't see need to protect resources from human exploitation
Take resources for granted; believes they are unlimited
Have little or no understanding of how ecosystems work
Puts economic concerns as priority over environmental impacts/concern
Strict management approach to environmental resources for human use/ consumption
Value of resources is primarily economic
Risk, liability mindset of providing a non-contaminated product to consumers

Medium – some HEP, some low HEP in perspective

Medium degree of environmental concern
Incorporates some environmental concern into HEP perspective
Has some knowledge of how environment works
Sees natural resources mainly for human use/ exchange, but also sees need to incorporate human impacts on them in decisions
Sees value in holistic perspective of relationship between environment and human society, but still puts economic concerns as priority over environmental impacts/concern
Management approach to environmental resources tempered with value of resources for other purposes other than human use/ consumption
Value of resources is primarily economic, but sees resources also have other values
Risk, liability is to human health, human society

Low – indicators of low HEP perspective

High degree of environmental concern
Believes human actions do have an effect on environment
Natural resources have intrinsic values as well as human use values
Natural resources are valuable to other creatures besides humans
Does not take resources for granted; believes they can be decreased/ diminished
Sees need to protect resources from human exploitation
Has a solid understanding of how ecosystems work
Has a holistic perspective of relationship between environment & human society
Puts environmental impacts/concern as priority over economic concerns
Protection, preservation approach to environmental resources for purposes other than human use/ consumption
Risk, liability of contamination is to human health and overall environmental health

Figure 2: Measurement of HEP values

Responses were grouped into High, Medium, or Low. The High range included indicators of the HEP perspective, showing a low degree of concern for the groundwater; a cornucopia view that it is an unlimited, pure resource and that humans actions don't affect it or have limited effects on it; a mechanistic view of the resource as a "product" to be distributed to consumers for consumption, a raw material for industrial processes or for a value-added product; and little or no understanding of how the aquifer system works and how human activities affect it. The Low range included indicators of low HEP perspective, showing a high degree of environmental concern for protection and sustainability of the groundwater; belief that human actions do affect the groundwater, i.e., it has been contaminated and is being used unsustainably; there is a need to further protect the groundwater from pollution sources and overuse; a holistic perspective the need for sustainability of the resource. A middle category incorporated beliefs that were intermediate between the two perspectives and/ or combined beliefs and values from the two. Characteristics of the Medium view incorporate some groundwater concern into a basically HEP perspective; have some understanding of how ecosystems work; see groundwater as a resource mainly for human use and exchange, but also see the need to incorporate human impacts on groundwater in decisions; see value in a holistic perspective of the relationship between environment and human society, but still make decisions in a fragmented view and prioritizing economic concerns; delegate management and concern about groundwater to other agencies, while also recognizing partial responsibility to protect the resource.

HEP values and beliefs of general environmental concern

The way people value environmental resources, whether as essential for survival or simply as raw materials to be extracted for economic production, will result in different kinds of decisions about the resources. If they have a cornucopia view of nature, a belief in human dominion over nature, and a belief that human actions have little or no effect on natural resources, then their decisions about the resources will follow accordingly.

The same “Measurement of HEP values” instrument was used to group participants’ general environmental concern. Questions asked were: What are some of the key issues about groundwater and environmental protection in this area? What are the sources of these issues? What do you see as the possible solutions to these problems? Does current decision-making process take into account environmental effects, particularly those about land change or conversion? If so, how? If not, should it and how? Is there any change occurring in the way land use and zoning decisions are made, say to incorporate aquifer recharge protection areas or development that preserves green space? Do you think economic development policy decisions incorporate their corresponding environmental effects? If so, how? If not, should they?

Indicators of the High (HEP) perspective showed a low degree of environmental concern; belief that humans actions don’t have much effect on the environment, a mechanistic, fragmented view of nature; natural resources seen as raw materials for human processes and consumption; a cornucopia view of nature; and little or no understanding of how ecosystems work. Indicators of the Low (low HEP)

perspective showed a high degree of environmental concern; belief that human actions do have environmental effects; natural resources have intrinsic values as well as human use values, and have value to creatures other than humans; there is a need to protect resources from human exploitation; understands how ecosystems work; sees the relationship between the environment and human society holistically. A Medium category incorporated beliefs that were intermediate between the two perspectives and/ or combined beliefs and values from the two. This view incorporates some environmental concern into what is otherwise basically a HEP perspective; has some understanding of how ecosystems work; sees natural resources mainly for human use and exchange, but also sees a need to incorporate human impacts on them in decisions; sees value in holistic perspective of relationship between environment and human society, but still makes decisions in a fragmented view and puts economic concerns as priority over environmental impacts and concern; a management approach to environmental resources is tempered with valuing resources for other purposes other than human use/ consumption.

Commodification of resources

Coding the data for each of the seven concepts measuring respondents' values and beliefs regarding the growth machine used the "Measurement of HEP values" instrument to rank participants' responses into the high, medium, or low ranges. Respondents were asked about their perceptions of groundwater and land resources. How important is groundwater to your business? What are the current land uses and their values?

High range responses were indicated by views toward natural resources as commodities, such as viewing land for its monetary exchange value, referring to it as “developable land” and emphasizing “development rights” rather than for its value as wildlife habitat and ecosystems functions. Medium range views try to balance the exchange value and development of land with its use value to rural residents and give some consideration to environmental effects. Low range responses value land for its bucolic, esthetic values, its importance in ecosystems services, wildlife habitat, and contributing to quality of life.

Priority of economic institution

To ascertain the importance respondents give to economic growth, they were asked: Are economic growth and development important to the area? Are they priorities in policy decisions? Again, responses were ranked high, medium or low according to the “Measurement of HEP values” instrument. High views see economic growth as a top priority and a necessity. Medium range sees the necessity of economic growth but sees the need to control it and protect some green space. Low range responses question the value of economic growth and prioritize protection of the environment over economics.

Economic expansion

Continuous economic expansion is a primary tenet of the growth model. To ascertain respondents’ views on this, they were asked: What are the factors that foster economic growth and development? In what areas is economic growth

occurring now? What are future areas of economic growth? High responses were that economic expansion is good because we have to “grow the economy” or “grow our way out of problems” to bring “new sources of revenue and new jobs and opportunities to the community.” A Medium response emphasizes the need to make growth sustainable. A Low response is concerned about limiting or stopping growth and prioritizes protection of environmental resources.

Expansion of consumption and creation of new markets

Another tenet of the growth imperative is to create new markets and expand consumption. To gauge this, respondents were asked: In what areas is economic growth occurring now? What are future areas of economic growth? Where might new markets and expanded growth occur? A High response sees expansion of growth as desirable, inevitable, and beneficial. The Medium view recognizes the importance of economics; sees growth as desirable and beneficial to most, although some benefit more than others, but believes growth should be more managed and controlled than in the past. Often the term “smart growth” was used. The Low category sees constant expansion of markets as causing environmental harm.

Unlimited growth

Questions were asked about respondents’ beliefs that growth is unlimited or has limits. Are there limits to growth and development in the community? If so, what would limit it? Or can growth and development continue indefinitely? Can any limits to growth be overcome? If so, how? In the High category, respondents typically did

not see any limits to growth or any need to limit growth. A Medium response sees increasing physical limits to growth, as less and less land is available for development, but looks for new ways to expand. The Low category definitely sees limits to growth and the contradiction between unlimited economic expansion in a finite world.

Growth benefits everyone

Who benefits from growth was the focus of a series of questions such as: Do you think growth benefits everyone in the community? Do you think growth benefits some groups more than others? If so, which groups? A High response was the belief growth benefits absolutely everybody involved. A Medium response believes growth benefits most people and communities, but sees that some benefit more than others. The Low category says growth perpetuates economic gaps between the haves and have-nots as a few benefit greatly while most do not. A Low response sees growth as primarily benefiting a few while creating gaps between haves and have-nots and creating environmental problems.

Labor-reducing technologies

The growth paradigm posits that development of new technology, especially that which replaces labor, makes economies more efficient and helps them grow. During the time of the interviews, an article in the local newspaper reported that MLGW was considering automating their meter reading services. It provided a good segue into the question on the impact of labor-reducing technologies: The newspaper reported

that MLGW recently considered automating its meter reading system, which would eliminate about 200 jobs. What do you think of the role of labor-saving technology in our society? What is the impact of labor-saving technology on the community?

A High response saw technology as important for increasing economic productivity and a sure sign of progress. A Medium view sees that technology has advantages in increasing productivity, but it also decreases jobs and changes the nature of and educational requirements for jobs. Low responses emphasized how technology reduces employment, contributes to the inequitable global distribution of wealth, and is more environmentally destructive.

Stakeholder group

After the responses for all the concepts listed were coded according to concept, the responses on each coded transcript were then divided according to stakeholder group. This was done to ascertain what aggregate differences in perspectives, if any, might occur among the four groups.

Composite Codes

Because human perceptions are based on a combination of variables, it was appropriate to add some complexity to the concepts by combining the individual indicators into composite measures. This allows the measurement of complex concepts, such as pro-growth values, more adequately than by only the separate indicators.

To create a composite measure of interviewees' pro-growth machine values, the seven growth machine variables were combined into one. To do this, a score for each interviewee was computed by adding all the High scores for each of the seven growth machine concepts. This composite score represents their "pro-growth machine values," which ranges from (0-7), and is shown below in Table 2: "Composite Code: Respondents' Pro-Growth Machine Values." Only Highs were included because the research question is testing for indicators of adherence to the HEP in their views about economic growth.

To measure the reliability of the items used in the composite "pro-growth machine values" score, the Cronbach's Alpha measure of reliability was used to test the internal consistency of the items. Cronbach's Alpha estimates how strongly the scores obtained from the actual sample correlates with the scores that would have been obtained by another random sample. The score generally increases when the correlations between the items increase. A reliability score of 0.70 or higher is generally required for researchers to use a particular instrument. An inter-item correlation matrix for the seven items in this measure was run for all four groups, giving a Cronbach's Alpha score of .865. The only item in the item-total statistics that scored below .70 was "economic priority."

Next, the "pro-growth machine values" composite score was combined with respondents' values about general environmental concern showing the HEP perspective. To create this index, the new values from Table 2, the "pro-growth machine values" scores, were added to interviewees' High scores on their HEP values and beliefs regarding general environmental concern. This composite score

Table 2: Composite Code: Respondents' Pro-Growth Machine Values

Case #	Growth machine concepts							
Policy makers N = 16	Commodifi- cation of resources	Economic priority	Economic expansion	Consumption expansion, new markets	Unlimited growth	Growth benefits all	Labor- reducing technology	Pro- Growth Machine Values (0-7)
17	M	H	M	H	H	H	H	5
6	H	H	M	H	H	H	H	6
14b	H	H	H	H	H	H	H	7
6.12b	M	M	M	M	M	H	H	2
5.21	M	M	M	M	M	M	M	0
5.22b	M	M	M	M	M	M	H	1
5.30	H	H	M	H	H	H	H	6
6.18	M	H	M	M	M	H	H	3
12	H	H	H	H	H	H	H	7
26b	L	M	M	M	L	L	M	0
14a	H	H	H	H	H	H	M	6
15a	M	M	M	M	M	M	H	1
15b	M	M	M	M	H	H	H	3
23	H	M	H	H	H	H	H	6
6.1b	H	H	M	M	M	H	H	4
6.14	M	M	M	M	M	L	H	1

Table 2, continued.

Case #	Growth machine concepts							
Business N = 10	Commodifi- cation of resources	Economic priority	Economic expansion	Consumption expansion, new markets	Unlimited growth	Growth benefits all	Labor- reducing technology	Pro- Growth Machine Values (0-7)
13b	M	H	M	M	M	M	H	2
5.22a	M	M	M	M	M	M	H	1
5.29a	M	H	M	M	M	H	H	3
5.29b	H	H	H	H	H	H	H	7
6.1a	H	H	M	H	H	M	H	5
6.4	H	H	H	M	H	H	H	6
6.7a	M	H	M	M	M	M	H	2
6.13b	M	M	H	M	M	H	H	3
24a	M	M	L	M	L	L	M	0
13c	H	N/A	H	H	N/A	N/A	H	4
Scientists N = 10	Commodifi- cation of resources	Economics priority	Economic expansion	Consumption expansion, new markets	Unlimited growth	Growth benefits all	Labor- reducing technology	Pro- Growth Machine Values (0-7)
13a	M	M	M	M	H	N/A	N/A	1
19	M	M	M	M	M	L	M	0
26a	M	M	M	M	M	L	M	0
9	M	M	M	M	M	M	M	0
30	M	M	M	M	M	M	M	0
5.7	M	H	M	M	M	M	M	1
5.8a	M	M	M	M	M	L	L	0
5.8b	M	M	M	M	M	M	M	0
27a	L	L	L	L	L	L	L	0
27b	L	L	L	L	L	L	L	0

Table 2, continued.

Case #	Growth machine concepts							
Environment-al Advocates N = 13	Commodifi- cation of resources	Economics priority	Economic expansion	Consumption expansion, new markets	Unlimited growth	Growth benefits all	Labor- reducing technology	Pro- Growth Machine Values (0-7)
8	L	L	L	L	L	L	L	0
7a	L	L	L	L	L	L	L	0
7b	L	L	L	L	L	L	L	0
24b	L	L	L	L	L	L	M	0
27c	L	L	L	L	L	L	L	0
6.6	M	L	L	M	L	M	M	0
6.7b	L	L	M	L	L	M	M	0
6.8	L	M	L	L	L	M	M	0
6.12a	L	L	L	L	L	M	L	0
6.21	L	L	L	L	L	L	N/A	0
6.15	L	L	L	L	L	L	L	0
6.26	M	M	M	M	M	M	N/A	0
7.24	L	L	L	L	L	L	L	0

represents “respondents’ micro-level adherence to the growth model,” which ranges from (0-8), as shown in Table 3 below, “Measurement of Respondents' Micro-level Adherence to the Growth Model.” Combining both sets of values is consistent with growth model because low values of environmental concern go hand-in-hand with high values on pro-growth machine beliefs. The index will be an indicator of the propensity to make decisions that prioritize economic growth over environmental concern.

To determine reliability of this measure and the Memphis policy measure descriptive statistics were run, using the seven “pro-growth machine values” variables, plus the single “pro-growth machine” score, the HEP general scores, and the “micro-level adherence to growth model” variable. Descriptives were run for all groups combined, and separately for each of the four groups, locating the mean, standard deviation, and minimum and maximum values for each item. Next, Levene’s Test for Equality of Variances and t-tests for equality of means were run comparing policymakers to business, business to scientists, policymakers to scientists, and scientists to environmental advocates.

The Memphis Water Policy Model

The case study of Memphis policymaking about groundwater requires applying the general index above, “Respondents’ Micro-level Adherence to the Growth Model,” to the specific variable of concern here: groundwater. The creation of an index to measure perspectives toward growth and its effect on this resource requires the addition of two other variables: respondents’ groundwater knowledge and their HEP values and beliefs regarding groundwater.

Table 3: Measurement of Respondents' Micro-level Adherence to the Growth Model

Case #	HEP/ General Values	Pro-Growth Machine Values (0-7)	Micro-level Adherence to Growth Model (0-8)	Case #	HEP/ General Values	Pro-Growth Machine Values (0-7)	Micro-level Adherence to Growth Model (0-8)
Policy makers N = 16				Scientists N = 10			
17	M	5	5	13a	M	1	1
6	H	6	7	19	M	0	0
14b	H	7	8	26a	M	0	0
6.12b	M	2	2	9	M	0	0
5.21	M	0	0	30	L	0	0
5.22b	M	1	1	5.7	L	1	1
5.30	H	6	7	5.8a	L	0	0
6.18	M	3	3	5.8b	L	0	0
12	H	7	8	27a	L	0	0
26b	L	0	0	27b	L	0	0
14a	M	6	6				
15a	M	1	1				
15b	M	3	3				
23	H	6	7				
6.1b	H	4	5				
6.14	L	1	1				

Table 3, continued.

Business N = 10	HEP/ General Values	Pro-Growth Machine Values (7-0)	Micro-level Adherence to Growth Model (8-0)	Environmental Advocates N = 13	HEP/ General Values	Pro-Growth Machine Values (0-7)	Micro-level Adherence to Growth Model (0-8)
13b	M	2	2	8	L	0	0
5.22a	M	1	1	7a	L	0	0
5.29a	H	3	4	7b	L	0	0
5.29b	H	7	8	24b	L	0	0
6.1a	H	5	6	27c	L	0	0
6.4	H	6	7	6.6	L	0	0
6.7a	H	2	3	6.7b	L	0	0
6.13b	M	3	3	6.8	L	0	0
24a	L	0	0	6.12a	L	0	0
13c	H	4	5	6.21	L	0	0
				6.15	L	0	0
				6.26	M	0	0
				7.24	L	0	0

To create this index, the “Micro-level adherence to growth model” scores were meshed with High HEP values and beliefs regarding groundwater concern. This composite measure is the “Memphis Water Policy Model”, with values ranging from (0-8), as shown in Table 4. This table also displays their ratings on knowledge of the groundwater to give a more complete picture of their perspectives about growth, groundwater knowledge and concern. If policymakers’ perspective strongly adheres to the growth model, and their general environmental concern and concern about the groundwater reflect the human exemptionalist paradigm (HEP), then their decisions about the resource will be unlikely to consider the human impacts on it.

Next, the data from “The Memphis Water Policy Model” will be combined to give an aggregate measure of each group’s groundwater knowledge, HEP/ groundwater values, and their micro-level adherence to the growth model. The aggregate data will be used to analyze and compare the perspectives of each group to examine similarities and differences regarding how well the macro level characteristics of the growth model are reflected in each group’s micro-level values.

In the next chapter, I analyze the data to address the research question: do the micro-level values of the policymakers and those who advise them reflect the macro level characteristics of the growth model, as presented in the synthesized growth model?

Table 4: The Memphis Water Policy Model

Case #	Groundwater Knowledge	HEP/ Groundwater Values	Micro-level Adherence to Growth Model (0-8)	Case #	Groundwater Knowledge	HEP/ Groundwater Values	Micro-level Adherence to Growth Model (0-8)
Policy makers N = 16				Scientists N = 10			
17	M	M	5	13a	H	L	1
6	L	H	7	19	H	L	0
14b	M	H	8	26a	H	L	0
6.12b	H	M	2	9	H	L	0
5.21	H	L	0	30	H	L	0
5.22b	M	M	1	5.7	M	L	1
5.30	L	H	7	5.8a	M	L	0
6.18	M	L	3	5.8b	M	L	0
12	M	M	8	27a	M	L	0
26b	M	L	0	27b	M	L	0
14a	L	M	6				
15a	M	M	1				
15b	H	L	3				
23	M	M	7				
6.1b	M	M	5				
6.14	M	M	1				

Table 4, continued.

Business N = 10	Groundwater Knowledge	HEP/ Groundwater Values	Micro-level Adherence to Growth Model (0-8)	Environmental Advocates N = 13	Groundwater Knowledge	HEP/ Groundwater Values	Micro-level Adherence to Growth Model (0-8)
13b	M	M	2	8	M	L	0
5.22a	H	L	1	7a	M	L	0
5.29a	M	M	4	7b	H	L	0
5.29b	M	M	8	24b	H	L	0
6.1a	H	L	6	27c	H	L	0
6.4	M	M	7	6.6	L	M	0
6.7a	M	L	3	6.7b	L	L	0
6.13b	M	M	3	6.8	L	M	0
24a	H	L	0	6.12a	H	L	0
13c	M	M	5	6.21	M	L	0
				6.15	M	L	0
				6.26	M	M	0
				7.24	M	L	0

CHAPTER IV: UNSUSTAINABLE GROWTH AND POLICYMAKING IN MEMPHIS

The main questions addressed in this research are how public policy decisions that have detrimental effects on environmental resources are made and perpetuated. Do the micro-level values and perspectives of the Memphis policymakers and those who advise them reflect the macro-level characteristics of the synthesized growth model? Do Memphis policymakers and those who advise them manifest HEP values toward environmental resources, specifically groundwater? What do policymakers and their advisors know about the resource and do they understand the effects of their policy decisions on the resources? To answer these questions, analysis of the data centers on comparison of the aggregate perspectives of the four interview groups on each of the major concepts: their knowledge of the groundwater resource, their HEP values regarding concern for the groundwater, and their adherence to the growth model. Excerpts from their narrative responses are included to further illustrate and explain the score differences among the groups.

Stakeholder Groups' Perspectives on Main Concepts

The individual scores from the composite measure "Memphis Water Policy Model" were combined to develop an aggregate analysis of the general views of each stakeholder group. These data are shown in Table 5 below. To obtain comparison percentages for each of the major categories of inquiry, the total number of Highs was divided by the total number of interviewees in each group. A comparison of the aggregate views of the four groups on each of the main concepts follows, illustrated by data text excerpts.

Table 5: Group Scores: Knowledge, HEP/Groundwater Values, and Adherence to Growth Model

Respondent Group N = 49	Groundwater knowledge	HEP/ Groundwater Values	Micro-level Adherence to Growth Model
Policymakers N = 16	3/16 18.75%	3/16 18.75%	67/128 52%
Business N = 10	3/10 30%	0/10 0%	39/80 48.75%
Scientists N = 10	6/10 60%	0/10 0%	2/80 2.5%
Environ. Advocates N = 13	4/13 31%	0/13 0%	0/104 0%

Groundwater Knowledge

Accurate knowledge about natural resources is essential for making informed decisions about them and people’s perceptions are based on what they think they “know,” based on their experiences and limited exposure to alternative views. As King and Harris (1990) found, communities that experience groundwater contamination and supply problems often lack sufficient information to take action to prevent problems in the future. Historically, residents, water managers, scientists, and public officials have assumed the groundwater resource to be virtually unlimited in quantity and uncontaminated – so pure you could drink it straight out of the ground with no treatment – because a thick, impermeable clay confining layer protected it from surface and sub-surface sources of contamination. This “cornucopia” view of nature is characteristic of the human exemptionalist paradigm (HEP). If the groundwater resource is believed to be unlimited, people tend to use it without thought for conservation or monitoring

withdrawal, and without considering the impacts of their surface or sub-surface activities on it since they believe it is impermeable to contaminants.

Most interviewees had some knowledge about the aquifer, but many believed that the majority of the public and decision-makers don't know much about it and don't think much about it; that they take it for granted. Others, like water managers, some attorneys, environmental advocates, and business people, did have extensive knowledge of the aquifer system. Two, a groundwater scientist and an environmental attorney, gave extensive, in-depth histories of the aquifer formation and the sources of Memphis water.

Compared with other groups in this study, policymakers knew least about the aquifer, with only 18.75% (3/16) having high groundwater knowledge. Business leaders knew more, with 30% (3/10) having high groundwater knowledge. Scientists had the highest groundwater knowledge, 60% (6/10), as would be expected since 6 of the 10 interviewees are groundwater scientists. Environmental advocates' groundwater knowledge, at 31% (4/13), was nearly equal to that of business leaders.

Policymakers

Policymakers had the lowest percentage of High knowledge about the resource of all four groups. Only three policymakers ranked High on groundwater knowledge, while the majority (11) had moderate knowledge about the aquifer, and three knew very little. The three most knowledgeable were the Shelby County Director of Public Works, Shelby County mayor, and the mayor of a suburban Shelby County municipality. Those least knowledgeable were a Shelby County commissioner and the mayor of a suburban Mississippi municipality. One Shelby County commissioner described his colleagues,

“Most of the county commissioners don’t have a lot of awareness about groundwater. They have to deal with such a myriad of other issues, so that it becomes challenging to become knowledgeable about it. Not a lot of them know much about it.” He said there is a need to “raise public awareness and with local elected officials on this issue – to educate them about the aquifer. Most don’t understand the groundwater issues and the basis for the potential problems.”

Policymakers’ general knowledge and perceptions of the groundwater resource were reported to be similar to those of the general public: it’s taken for granted; it’s out of sight, out of mind; it’s assumed to be plentiful and practically unlimited in quantity; it’s very old, fossil water, maybe hundreds or thousands of years old; it has good taste; the price is relatively low, cheap and/or free; and policymakers generally don’t see a problem. Public officials find “our groundwater quality is fairly consistent and good.” A county commissioner said, “The source of our drinking water right now is excellent. As you know that the Mid-South is very fortunate to have best drinking water in the country.” A municipality mayor said, “Basically, it’s in its purest form and we pump it out and put chlorine in it and then send it on its way. There’s not a lot of treatment required for it. And of course it’s rated as some of the best water.” A Public Works Director described the water quality, “Other than the iron, our water’s good to go.”

Another county commissioner described his colleagues, “There are some city councilmen and county commissioners who are somewhat knowledgeable of the situation, but don’t have any idea of what they should be doing because, frankly, there hasn’t been public staff, public engineering, public works, like the water staff, who have advocated anything at all other than just advocate study.”

Another described what most local policymakers know about the aquifer, “It’s below the ground. It comes out through something called a well. Now beyond that, you could take any level of policymaker in Memphis, Shelby County, Germantown, Lakeland, Collierville and they know no more than that. They don’t know where it comes from; they don’t know contamination risk. And they basically don’t care.” This respondent referred to a suburban municipality mayor who “probably knows more about it than anyone else, among policymakers and that’s because [he] has chosen to get interested in it. The other policymakers and decision makers have put all their faith and their trust in their Public Works Directors or in MLGW. And until an issue comes up, they figure it’s out of sight, out of mind, and they don’t have anything to do with it. They are already desensitized about the problem.” The interview with this policymaker confirmed the observation.

The theme of policymakers relying on other departments or agencies for groundwater management responsibility was reflected in comments by a State Senator, who is also a former Shelby County Commissioner, “I think primarily they rely on the local utility for that. I don’t think they have any first hand knowledge or experience with it. I think they know that drinking water’s important and unlike most citizens, they have a better understanding of where it comes from. Most people still think it comes from the tap.” Another county commissioner shared this view of reliance on other administrative departments. In his answer to a question about knowledge of possible future impacts on the groundwater, he said, “I don’t; I’m sorry. We’re supposed to have development that’s sustainable and [with] runaway developments we could get to the point where we’re using water faster than it’s being replenished. I know that’s happened in other parts of the

world, other parts of the country. I don't know of anything right now that says that's a danger any time soon, but obviously it's something we've got to keep an eye on. The Department of Public Works gave a presentation on this not too long ago. If I'm not mistaken, I believe they received some federal grant money to help them do a study of the aquifer and [look at] some of the kinds of issues that you're talking about. So I know that the administration is looking into it."

A Mississippi suburban municipality mayor referred to "groundwater" as surface water, even though he has an engineering degree. He did not think the increasing water withdrawal rates related to increased population nor increased development in his municipality would affect the aquifer. His reply to a question of dropping aquifer levels due to usage was, "That was one foot over a number of years. If it dropped a foot in a year, yes, I would be greatly concerned! There has not been any scientific data presented to me that shows that the aquifer can't handle it, that it's not being recharged at an adequate rate." He believed "our aquifer actually starts getting recharged somewhere in Alabama," so he did not think local land use changes and withdrawal increases affected the aquifer. "It's not like if it rains here it recharges the aquifer."

Policymakers and their advisors have incomplete information about how much water is being withdrawn from the aquifer. The Health Department official said, "We don't really have an accurate pumping total for all of the wells within Memphis and Shelby County. We get the pumping rates from City of Memphis, MLGW, Town of Collierville, City of Bartlett, City of Germantown, and the City of Millington on a monthly basis." A compilation of the total volume of groundwater being withdraw is an on-going research

project by the U.S.G.S. hydrologist at the Groundwater Institute and results were not available at the time of this study.

In his “Groundwater Protection” statement, The Shelby County Mayor had this assessment, “The region does not have an integrated, consistent water management and urban growth master plan. We are faced with two major issues, the first being the lack of a water budget. We know the amount being withdrawn, almost 220 million gallons per day in Shelby County alone for Public, Domestic & Industrial, but we have no idea of what the deposits or recharges are. In the last century, the Memphis aquifer has dropped as much as 125 feet in some places. Compound that unknown with a second dilemma: the unknown impacts resulting from modern pollution or breaches or windows that provide a short circuit pathway for contamination to enter the Memphis Sands Aquifer.”

The natural resources director of a suburban municipality stressed the importance of educating policy makers about environmental impacts, giving them a holistic picture of the impacts on the land and community that result from their development decisions. He noted how the perspectives of his municipality’s planning advisory team had changed since a groundwater expert became part of the staff - the interim city engineer. As a consequence, he said planners now give more consideration to the impacts on groundwater from development in their planning decisions.

Business leaders

The business leaders had higher percentage knowledge of the groundwater than policymakers: H = 30% v. policymakers H = 18.75%. The higher percent groundwater knowledge may be attributed to the nature of the sample: four were affiliated with

MLGW, one a former member of the Shelby County GWQCB. For two, groundwater is essential for their businesses, which have their own wells. Another is an environmental engineer specializing in groundwater clean-up.

Some business leaders' views were similar to those of policymakers, describing the water source as having "high quality and availability;" there's a "virtually unlimited supply of groundwater." The head of MLGW's water quality lab described it as "Naturally good." An economic development manager in the Chamber of Commerce emphasized, "When you compare Memphis with other communities, the quality of the water is high compared to most." He said the groundwater is a resource that attracts businesses to move to Memphis.

Groundwater is important to about 80 industries in the Memphis area which have their own wells to pump groundwater for their processes. The Health Department interviewee gave names of some of the 80 industries, but did not provide a complete list. These include the former Coors Brewery, now Hardy Bottling Company; DuPont, Cargill, A. K. Karchmer and Sons, Buckeye Cellulose, Protein Technology, Shepherd Tissue, APAC asphalt plant, and DeSoto Concrete. He said all have private "wells that are used for industrial purposes" and most pump out of the Memphis Sands aquifer. "The ones on President's Island probably impact the shallow as well as the deeper aquifer. At New Core Steel, which was recently approved to bring a plant into Memphis at the old Birmingham Steel site, they have 5 wells that they use for that for their process." These private wells are not metered, so the cost of water is \$0 and their only expense is the cost of pumping.

The vast quantity and high quality of the water is especially important to a local bottling company. “We’re a beverage company and over 90% of whatever you buy from me is water. Water is the key ingredient, so if the water tastes bad, the product is going to taste bad,” said the company’s CEO. She reported that their wells are constantly pumping “about 165 thousand gallons a day. Whether I’m using it in the process or not, I have to keep the water moving. The wells can’t just sit there.” The safety, health and environmental manager at local chemical company said, “We use it for non-contact cooling, for process water, and utility water. It’s real high quality water.”

The Past President of MLGW described, “Going back in the history to the old Bolen Huse Ice Company when the first well was dug down off of Marshall St. We had a true artesian water system.” But water levels have changed through intense pumping over the years, as was expressed by the chemical company manager, “I think everybody would agree that the elevation of the Memphis Sands is not what it used to be when, at the turn of the century or before the turn of the century in the 1800s, you had artesian wells. And obviously the Memphis Sands is not at the level that it once was when Raleigh Springs used to have springs. But there’s still a definite availability of water.”

Another Past President of MLGW held these beliefs, “I think there is a natural balance that nature will maintain notwithstanding the use of it by several communities or all the communities that are fortunate enough to be planted over it. I think that it is a resource that would constantly be replenished by nature – or not, if we have a 40-year drought or something. But the odds of that seem to be somewhat remote. My view is that it’s naturally in a balance that will maintain itself over the course of the years, notwithstanding a given wet season or dry season or several year wet or dry season might

cause it to move one way or the other. It's ultimately going to go back to its natural level and balance because there are several aquifers."

A past MLGW Vice President said, "My perception is that there is a virtually unlimited supply of groundwater. I think that studies show there's 1100-1200 years based on current and projected use and it is being replenished or restored at the rate of somewhere between 15 and 25% a year. Which is a little bit different than several years ago when we thought that there was a confining clay layer and that there was very little exchange and it took 2,000 years to go from somewhere way out east to underneath the Memphis area where it could be withdrawn. Whereas several years ago we felt that this clay layer protected the deeper aquifer; we now know that it does not and that there are potential threats from contamination of the shallow aquifer. And that we have to be more aware of what happens there."

Two business people noted increases in the volumes of water being withdrawn from the aquifer. A newspaper environmental reporter linked increased consumption of water with new development and growth, "In Southaven, Mississippi daily consumption of water rose from 1.9 million gallons in 1994 to 3.3 million gallons in 2003. When you have places like Olive Branch pumping a lot more water and Southaven pumping a lot more water, it's going to drawdown parts of their aquifer more than they have had in the past. I can't remember how much these cities have increased, but it's quite a bit in the last 10 years." An MLGW past Vice President explained the results of increased pumping, "The water that's being drawn out of the aquifer in just one county in Arkansas, is using more water than Shelby County does every year. And it's already depleted their shallow aquifer and it's working on the deeper aquifer."

Scientists

Scientists had the highest percentage knowledge of the groundwater, H = 60%, which is expected since 6 of the 10 are groundwater scientists. They provided a comparison for the responses of others who are not solely engaged in aquifer study. Other scientists are in disciplines such as surface water at U.S.G.S. and planning, but they still had moderate knowledge about the aquifer.

Scientists provided the most extensive information about the status of the aquifer, its vulnerability to contamination and overuse, and the human impacts on it. But they also recognize the difficulty in finding complete information about it. “Trying to describe our aquifer system here holistically is like a blind man trying to describe an elephant,” explained one groundwater scientist. However, he went on to give a detailed history of Memphis water, description of the hydrogeology of the aquifer, past use of rivers for drinking water in Memphis and why the switch was made from surface water sources to groundwater. “The water was not good because the water that they had access to was surface water from the Mississippi River, which at that time carried sediment just like it does today. But obviously it didn’t have pesticides that it may be carrying today. The other three rivers that they had access to were the Loosahatchie, Wolf and Nonconnah. And they tried the same thing with the Wolf River: they tried to filter it, and it didn’t work. And as a consequence they turned to cisterns, which just captured rain water. And then the cisterns became the breeding ground for mosquitoes, which eventually led to the yellow fever epidemic. And that event brought separate sewer systems to Memphis.” The first supply well in Memphis was drilled by the Bohlen-Huse Ice Company in the late 1800s. In 1887 the Artesian Water Company contracted with the City of Memphis to sell

water to the public from wells tapping the regional aquifer. “We had a true artesian water system. It came out of the ground, spurted several feet. Then it was under pressure. As long as it was under pressure, there wasn’t the likelihood of it becoming contaminated.”

Until recently, the belief in the aquifer’s protection from surface sources of contamination by the impermeable clay layer persisted. “We’ve been providing water from a system that’s fairly well confined. There’s a low risk for contaminants reaching the system even if water is leaking into the system; it may take years and years for it to get to the depth where our wells are,” said a groundwater scientist.

Compiling data on how much water has been and is being pumped from the aquifer, a U.S.G.S. scientist at the Groundwater Institute said, “The U.S.G.S. here has collected groundwater data since the late 1800s. We have site specific pumpage from 1888, so we have information on who was pumping and, depending on what data were considered important at that time, we know the depths of the pumping, what aquifer layer. I’ve also been involved in publishing the first groundwater pumpage report for the state, and that includes Shelby County.” However, that pumpage report is not yet complete. When it is, it will be the first comprehensive pumpage report from all sources tapping the aquifer.

Some data on amounts of withdrawal are currently available: the main municipal supplier MLGW pumps “220 to 230 million gallons a day just for domestic use,” a Public Works Director said. In “Southaven, Mississippi daily consumption of water rose from 1.9 million gallons in 1994 to 3.3 million gallons in 2003,” a local news source reported. One local bottler pumps “about 165 thousand gallons a day.” A local chemical company manager said, “We have 9 production wells.” Scattered throughout Shelby County there are “about 565” private or quasi-public wells used for “lake level retention, watering

livestock” and residential use, which the water quality branch of the Memphis/ Shelby County Health Department samples annually for “any bacteriological, total coliform, or chemical contamination.” The Town of Collierville water provides an average of 5.5 million gallons of water on a daily basis to its approximately 14,000 connections.

Recharge is an important part of the hydrological cycle to replenish the water taken from the aquifer. A groundwater scientist described the process and locations, “The recharge area for the aquifer is eastern Shelby County, Fayette County, half of Hardeman County; it goes down to DeSoto and Marshall [Counties, Mississippi] and looks just like a band that varies in width as you go north and south. And that’s just recharge by rainfall. There’s also artificial recharge which is slow water movement from one aquifer to another through the confining clay layers.”

The relationship between wetlands and the aquifer was another aspect of the hydrological cycle. “Groundwater has a certain quality to it. And if you get crummy water feeding into a wetland, that’s going to dilute it, so our groundwater quality has a role in the dependence of a wetland habitat on its presence,” said a groundwater scientist. Another groundwater scientist indicated that “rivers may be a great source of recharge.

Age-dating water is a method used to locate where aquifer recharge is taking place. It is also used to ascertain how surface level activities may be altering the quality and quantity of aquifer water. Finding “younger” water at particular MLGW well fields is an indication of de-saturation of the shallow aquifers at those locations, allowing faster penetration by local rainwater, carrying any surface contaminants to the deeper aquifers. Because of this, the shallow aquifers no longer serve as a buffer between deeper aquifers and surface level contaminants. Three groundwater scientists described the importance of

age-dating: “The young water, being less than 50 years old, helps us understand the areas most vulnerable to contamination. This young water is indicative of recent recharge. As demand lowers the potentiometric surface, recharge from near the surface comes to fill in that potentiometric hole. The concern is that water that may be getting in there may not be of highest quality. A lot of my research was based upon source water protection and trying to quantify the amount of modern versus very old water in the Memphis aquifer, and to try to describe how some of the mixing behavior in the more complex regions of the aquifer may be occurring. Part of that was driven by public sentiment to better understand risk.”

Environmental Advocates

The environmental advocates had approximately the same percentage knowledge as business, at 31%. Four had a high amount of knowledge, six had a moderate amount, and three knew little about it.

An environmental attorney had as extensive knowledge as that of the groundwater scientists; he described in great detail the history of the aquifer’s formation, its hydrogeologic structure, its status with regard to quantity and quality and threats to it. Another described what is left of springs that were once plentiful in the area, “There’s still one spring left at the corner of James and Hollywood” in the Raleigh-Frayser area. “It’s covered by concrete but usually year round there’s water oozing out of the concrete.”

A Sierra Club member and architect remarked, “I know that it’s a valuable resource. My understanding is that it’s very pure water. It has a good quality taste to it and it’s very

valuable. I use it as a quality measure against water that I would drink elsewhere in the world. I've always thought that this was an area of plentiful rain. Now they've had some pretty severe droughts in Arkansas in the last 5 years and we've had some drought here. I just think it's something that we need to be aware of and be very careful about, is our water usage. I think that people in Memphis tend to take water pretty much for granted, that it's free and cheap."

Another Sierra Club member spoke of the general perceptions about the aquifer, "Memphians, well-heeled economically, well-placed Memphians are still very, very undereducated about the Memphis Sands, what the heck an aquifer is. It's amazing how many people think we get it from the Mississippi. We do a really good job because it tastes OK for it being river water! Some of those who are proud of the fact that they know about the Memphis Sands aren't really sure if it's the ones that are 60 feet below or 800 below or get it confused with the New Madrid Fault 30 miles below."

An NGO executive director said, "Until recently I think all of us thought that our aquifers were impermeable and that the clean tap water that we enjoyed all our lives would go on forever. But it seems over the last number of years that we've really begun to hear more and more about the fact that that actually isn't the case. There are areas where we thought that the water was thousands, tens of thousands of years old and that some of the water is much newer than that. And we understand that what we do on our surface actually can affect our water over time. So, I have a very limited understanding of it, but I do understand our human relationship with our environment, including our air and our water and our weather and everything else needs to be thought out much more thoroughly than it was in the past."

Another NGO executive director, “The Memphis Sands, I’ve been told, are about 300-500 feet below Memphis where we are, but the layer slopes to the surface when you get to Collierville and the Fayette County line along the Wolf River. And the Memphis Sands form the bottom of the Wolf River from Fayette County all the way into its headwaters and start in the Holly Springs National Forest at Baker’s Pond. One of our proudest accomplishments, in working to protect the Wolf River and our precious aquifers, is the U.S. Corps of Engineers Wolf River Restoration Project. The cost is about \$12.5 million and it’s required a 35% local cost share. And we worked for 15 years to get it implemented.”

Another Sierra Club member spoke of politicians’ view, “politicians don’t worry about such things because they don’t expect to be in office when it becomes an issue – *if* they were even educated enough to even know about it.” She spoke of some water problems in south Memphis, a primarily African-American community, “In south Memphis especially it’s an issue. You turn on the tap down there and it tastes funny. When Steve’s office was down there, a friend of his was told by MLGW to run the water for 10 minutes before they made coffee. I don’t know if it’s the age of the pipes or something about the wells down there.”

A past League of Women Voters president told of her experiences on the “Metropolitan Area Environmental Task Force” with citizens led by “an activist, a black man named Rev. Green who had been calling different officials until they got a response from EPA, insisting that the Hollywood Dump was full of chemicals that were causing people to become quite ill. Then the EPA decided to establish a task force, and that was in the 1980s. There was a related incident of groundwater contamination in the

neighboring (across the Wolf River) white working class neighborhood of Frayser at about the same time.

Two Sierra Club members also talked about the “huge drawdown in eastern Arkansas of groundwater with these rice farms over there in the Arkansas delta on both sides of Crowley’s Ridge. They have drawn down so much of the groundwater that they’re talking about running some type of huge pipeline from the Mississippi to get water to grow their rice in. And nice toxic rice, I guess. You know, it’s a multi-million dollar pork barrel kind of a project. It’s just amazing to me whenever I go over to Arkansas the new amount of rice that’s been growing.” They also described “the recharge zone is out to the east of us in Fayette County.”

HEP/ Groundwater Values

High HEP values reflect a cornucopia view that the resource is unlimited and that humans actions have few or limited effects on it. It is a mechanistic view of the resource as a “product” to be distributed to consumers for consumption, a raw material for industrial processes, or the basis for a value-added product to be sold on the marketplace.

In this study, policymakers had 18.75% high HEP values regarding groundwater concern, and business leaders had 0% HEP values about groundwater. Scientists and environmental advocates also showed 0% high HEP values about the resource. The values show that all groups have some concern about the groundwater, with policymakers having less than the other groups.

Policymakers

Policymakers had the highest HEP values regarding groundwater concern among the four groups. Three (3) (18.75%) ranked in the High range, 9 (56.24%) in the Medium range and 4 (25%) in the Low range. Their general environmental concern was even more HEP-oriented, with 6 (37.5%) in the High range, 8 (50%) in the Medium range, and 2 (12.5%) in the Low range.

A State Senator had this view of peoples' environmental and groundwater views, "Human nature is self-centered, if not selfish. People don't worry about any of the things we're talking about until it affects them directly. Until they turn on the tap and no water comes out, then they'll care about what we're discussing." Asked if there are any particular threats to the groundwater from anything that people are doing, a county commissioner replied, "No, not that I'm aware of."

Some policymakers expressed concern about human impacts upon the aquifer. A Mississippi suburban municipality planner was concerned about surface activities like landfills that can affect the aquifer. A Shelby County planner referred to a *New Yorker* article about Amory Lovins and told how she had been influenced by his ideas. The article, "Mr. Green" by Elizabeth Kolbert, appeared in the January 22, 2007 issue of *The New Yorker*. It profiles how Lovins makes a living by providing solutions to the problems of waste and profligacy that plague the world from a long string of bad decisions. A Fayette County planner said, "Our concern is to prevent the pollution of groundwater with very local wastewater treatment. Much of Fayette County is not on public sewers; it is on septic systems. And a fair amount of our procedure and bureaucracy is designed to make sure that people don't pollute their drinking water with their waste water."

Several noted concern about the amount being withdrawn and concerns about adequate recharge. A county public works director, “It’s about 220 to 230 million gallons a day that we draw out just for domestic [use]. And we know from our friends in Arkansas that right now most of their farming takes about 7 billion gallons of water a day. Right now most of their wells are pumping out of the alluvial aquifer, that they’re dropping about 2 feet a year. And part of the concern is, when it drops, the sand basically collapses and you can’t get it to recharge. So you lose that resource. Even if you were to try to recharge it, you can’t and you won’t have the same system as you had before.” This information about withdrawal rates and collapse of sand in de-watered aquifers was corroborated by several other respondents.

A Health Department official in water pollution control spoke of withdrawal and contamination: “We do draw out close to 200 million gallons a day of groundwater here for usage through either Memphis Light, Gas & Water, lake level retention, watering livestock, or through DuPont, Cargill, or Coors, or other private industries that use it in their plant processes. But other than that, our groundwater quality is fairly consistent and good. We do sample about 565 wells on an annual basis to make sure that they are free of any bacteriological or chemical contamination, or that they don’t have any nitrates or nitrites in it.”

He told of past contamination at some Superfund sites, but said recent sampling showed “it’s not really moving into the Memphis Sand aquifer. Some of the wells that are out there, specifically in the Collierville area close to the Smalley-Piper plant, have not demonstrated any hexavalent chromium six contamination or anything. And we do sample for that specifically. And so, none of the wells have shown any type of

contamination within them.” Where pockets of contamination do exist, “They’ll be in the shallow aquifer more than anything else. We do have regulations in effect now that make sure that we can’t site a water well within a half a mile of the designated boundary of a Superfund site.”

Information about the contamination in Collierville was corroborated by these sources: from the Agency for Toxic Substances and Disease Registry (ATSDR) site:

http://www.atsdr.cdc.gov/HAC/pha/Smalley_Piper/SmalleyPiperPHA050806.pdf

And from NASA Scientific and Technical Aerospace Reports (Vol. 44:12, June 20, 2006): <http://aero-defense.ihs.com/news/star-06H1/star-0620-energy-production-conversion.htm>

An excerpt from the NASA site is below:

A release of chromium more than 20 years ago has led to contaminated groundwater in Collierville, Shelby County, Tennessee. The chromium is likely from past battery casing manufacturing at the Smalley-Piper site. Chromium is now present in groundwater under and beyond the site. In 2002, chromium was detected in the raw groundwater drawn by the Town of Collierville's Water Plant 2.

The non-elected official most concerned about the groundwater is a county director of public works who has taken the lead in promoting and securing federal funding for a comprehensive Mississippi Embayment Regional Groundwater Study, in conjunction with the Groundwater Institute. “What we want to do is to determine what’s happening underneath the ground. My understanding is that no one knows exactly where the aquifer is and that there’s a clay area one area and then a little bit further on there isn’t; it becomes intermittent. So that’s one of those gaps in knowledge. Right now we’re looking

at the study costing somewhere around \$10.5 million dollars, and that basically takes care of the immediate region. It covers about 4 or 5 counties in Tennessee, a couple of counties in Arkansas, and 3 counties in Mississippi.”

He continued, “We’ve thought about this question of the aquifer in determining the types of land uses that are appropriate in terms of the land’s particular characteristics. We want a set of best management practices (BMP) that have the windows mapped out, the clay layers mapped out and a series of practices that we can use to make land development decisions. We’re looking at things that are more environmentally friendly: treed landscapes, divided medians, rural drainage, more green than paved simply for the reason that...you want the system to recharge.”

He expressed two main concerns, “There are two sides to the aquifer: one is the potential for contamination and the other is making certain that the aquifer is replenished, that we don’t put so much impervious surface that the aquifer is not recharged. We’re concerned about the long term integrity of the system, the Memphis Sands aquifer. The whole idea behind the study is to sustain and protect the resource that we’ve got. And if we don’t, we can either pay for it now, or we can pay a monumental amount later. If we don’t do something in the near future, and I’m talking about 5 to 10 years, we will end up having to revert to surface treatment. And that’s going to cost us about \$20 million dollars a year in terms of surface treatment. And that doesn’t even include going into a capital improvement program of basically upgrading the plants that we’ve got.”

A Shelby County commissioner said, “I think it would probably be politically well received to start taking some action to protect the groundwater aquifer from pollution above and also from the old problems that directly affect the aquifer. But there’s nobody

proposed that anybody do anything.” Those old problems are, “old landfills and chemicals in the ground in certain places around town.” He was also concerned about sufficient recharge, “We need to let the water get in the ground, and be sure that we pave and build over that as little as possible.” He talked about man-made structures to encourage recharge and compensate for development land use changes, such as retention basins and permeable paving bricks. His opinion on the Mississippi Embayment Regional Aquifer Study was that it would not provide much additional information, “I think we’ve already got the answers. I think they’ll get the answers again. But somebody’s got to step up and provoke the actions. The groundwater activities that are going on now are just to spend a lot of money over the next 4 or 5 years for studies, period. I would submit to you that we already know what we need to do. Somebody needs to be an advocate; somebody that’s got competence in the area; we need a competent advocate, probably needs to be an engineer. It’s a role that MLGW could easily take on because they’re supposed to be supplying everybody in the county with public water. And they ought to do it to protect themselves and to protect the pricing of it. Because if we ever get to the point where we can’t use it, we’re going to have huge increases in the price of our water and water treatment.”

A suburban municipality mayor who was deemed very knowledgeable about groundwater by several respondents said, “I do think it important that we have as best understanding as possible, especially given where we’re located in the aquifer and the discussion between Arkansas, Mississippi and Tennessee over water rights. It hasn’t been as big as issue here until recently because people kind of felt like they had an unlimited source. I think everybody’s realizing that it may be so unlimited after all. And they felt it

was pretty much contamination free, that it took so long for it to recharge. But some of the more recent studies show that some of the top layers of the aquifer were getting some recharge maybe as early as 5 years. We need to find out where the recharge points are and try to create as much of a barrier in those areas as possible, so that we can remove or filter as many contaminants out before it even hits so that it goes into the recharge as clean as we can help make it happen.”

Business leaders

Business leaders interviewed showed concern about groundwater with 0 out of 10 respondents showing 0% High (HEP) values. Six ranked in the Medium range (60%) and four (40%) in the Low range. This concern about the groundwater is interesting contrast with their overall environmental concern, with 6 (60%) ranking High (HEP), 3 (30%) in the Medium range, and 1 (10%) in the Low range.

Business leaders are likely to be concerned about the resource because for some, it is essential to their business. The Past President of MLGW said groundwater protection is a concern to, “Businesses that use the groundwater in their end product: Plough is concerned about the groundwater. Any brewery is concerned about it. At one time I got the figures on Buckeye Cellulose and how much water they were using.” He has been one of the strongest advocates for groundwater protection, having received a “Groundwater Hero” award from the Groundwater Foundation, and was instrumental in establishing the Memphis/ Shelby County Groundwater Quality Control Board and the Groundwater Institute at University of Memphis.

He described the impact of pumping large volumes of water over a span of 100 years, “When I left there in May 2006, we had a peak capacity of close to 300 million gallons. At one time we were dropping the aquifer level in the Memphis Sands about a foot per year.” He said the latest information he received from the Ground Water Institute at University of Memphis “was that the Memphis Sands had somewhat stabilized and I think in some locations it even recharged. So it’s not dropping like it was. But it’s still a magnificent supply of water!” He said, “We always thought that this protective layer over the Memphis Sands was pretty continuous and about 70-80 feet thick. And Ground Water Institute (GWI) in studying it found, that where that layer existed, they did some permeability tests on it and there wasn’t anything much would go through it, not even naptha and tolulene and all these solvents. We were finding out there were lenses and the more we found out the more concerned we became. If we begin to pump it out faster than it’s replenishing, we will not only have the problem of diminishing supply but we will create a situation where it’s easier to introduce contaminants into it. Because it’s not like it was when it was artesian, when it was under pressure. So that’s to me a significant change and concern.”

Head of MLGW’s water quality lab expressed concerns about threats to the water quality, “Although the aquifer is confined, there are some areas where the clay is absent or thin. In those places there is potential for local contamination. There are also some areas near recharge areas that are known to be contaminated. The most notable is in Toone, Tennessee, contaminated by Velsicol. Within about 800 years those contaminants will move into the Memphis water supply. Groundwater moves very slowly; it has horizontal migration. So hopefully we will have the technology required to deal with such

types of pollution in the next 800 years.” The Past President of MLGW also referred to Velsicol’s contamination, “All the stuff that went on at Velsicol, all their contaminants ended up at Toone, Tennessee where they dumped a lot of stuff. I don’t think we ever found anything under that plant here.” But he went on to describe various places around Memphis where groundwater contamination had been documented “around Firestone, around the Nonconnah. I can tell you a story of something that happened in Millington on Navy Rd. at a service station out there. We were getting gas fumes into our electric substation out there on Navy Rd. I became quite concerned that we could have a tremendous explosion from gasoline fumes. We finally traced it back to that service station. They had leaking tanks and it was leaking into the soil and going into a creek out there. It was showing up in the sewers and everything.” He told another story about gasoline contamination of the aquifer from the MAPCO refinery on President’s Island: “There were millions of gallons of gasoline under the MAPCO refinery that was actually fuel grade material that could actually be pumped out and put in your car!”

A groundwater clean-up engineer expressed these concerns, “I would say it’s being used more than can be replenished, so basically not having water conservation. I think that’s probably the reason the levels are declining. I think it’s just mere usage. I know agriculture uses a lot; I don’t know how much that affects the aquifer we deal with underneath here.” He went on to outline “three threats. The biggest threat I hear about it is the threat of using it up. In the last 5 or 10 years I think there’s been a lot more knowledge of potential contamination. I guess the third threat that I heard mentioned is the threat of the recharge area being covered up with housing development.” He spoke more about contamination threats, “There are chemicals from industries that spill on the

ground and the tanks they have underground. It's a possible source. And surface water pollution basically becoming groundwater, the surface pollution runoff that then sinks into the aquifer from the streams and rivers, especially the recharge area in Fayette County. And there's a possibility there may be some recharge under the Nonconnah and maybe some under the Wolf."

A chemical company safety, health and environmental manager spoke of his company's groundwater clean-up efforts under their "Hazardous Solid Waste Amendments (HSWA) permit" where their "past manufacturing operations have contaminated the soils" and were declared "a RCRA facility. We were given a HSWA permit and that is what required us to do an assessment of the facility." When the permit was "renewed, with the corrective action permit through the State of Tennessee in August 2002, there were really only 3 things that we were going to need to do: that was just inspections and continue to do annual monitoring that we've done since about 1980. That's annual monitoring of soils and the alluvial groundwater. And we're not really having a major impact on the environment. This site manages its materials real well. And so what contamination there is, it wasn't suited to, nor required any remediation efforts."

An organic lawn care business owner explained about the current way people maintain their lawns, "under the current scheme that we have now, a lot of chemicals are used. They will spray chemicals over 100% of your yard to kill weeds, when you might only have a weed infestation of 3% to 5% or less. So what happens to all that chemical that's not absorbed by the plant? It eventually gets down into the groundwater." He explained how this poses a human health problem, and increases the need for irrigation. "Synthetic fertilizers, chemical fertilizers, have little coatings around the actual fertilizer

so it won't be absorbed too quickly by the plants. So they have to water the hell out of their lawns. You end up having to use a lot more water to get a green lawn, or green plants or healthy plants than you would if you used a more natural approach. The natural approach certainly does take a little bit longer, but it's not less effective. So from a groundwater use those are two big concerns. Runoff gets in our sewer systems, gets in our lakes and rivers; kills waterfowl, kills animal life, and then gets into our water system and then we have to clean the hell out of it just so we can use it. Then after you've cleaned and you're shipping it to the customer in this regard, the residential home owner or business, it can still get contaminated again through these chemical products." He believes, "Chemical uses for esthetic purposes needs to be stopped in its entirety."

The Chamber of Commerce manager also commented on excessive lawn irrigation, "You see a lot of pretty green lawns in Memphis and sometimes that's because you get plenty of rain and people are using all kinds of chemicals and fertilizers to make that happen. And you often see that even when there's not a lot of rain. And that's because people are watering because they want a nice looking lawn and because they can afford it." He advocated conservation measures, like xeriscaping to avoid a lot of lawn irrigation, because "when they drilled that first artesian well here in Memphis, water came up out of the ground several feet. Now the level of that water is dozens if not hundreds of feet below the surface. So it's definitely declining. We're pulling it out faster than it's going in."

He also talked of the large amount of withdrawals of groundwater in Arkansas, "Rice farmers in Arkansas are pumping quite large quantities of water out of the ground so that they can flood their fields, which is the traditional and perhaps the most efficient way to

grow rice when the water's free and they're just paying for the electricity for the pumps. That may not be the wisest method for growing crops or it might not be the right crop to grow now. That's a huge political situation where the rice farmers would probably disagree."

Scientists

Scientists showed concern about groundwater with 0 out of 10 respondents showing 0% High (HEP) values. None ranked in the Medium range (0%) and all 10 (100%) in the Low range, showing strong concern for the groundwater. Their groundwater concern was somewhat higher than their overall environmental concern, with 0 (0%) ranking High (HEP), 4 (40%) in the Medium range, and 6 (6%) in the Low range.

Scientists and environmental advocates had the highest concern about the aquifer. An immediate concern for many groundwater scientists, because of its effects on recharge to the aquifer and the hydrological cycle, is land use changes brought about by development, especially in recharge areas. Growth and development impair recharge to the aquifer by paving over and otherwise making land surface impervious to penetration by rainfall, while simultaneously increasing withdrawal of water to serve increasing populations. A groundwater scientist said, "Studies in other areas looking at development on aquifer systems' recharge areas have consistently shown that there's some detriment."

A groundwater scientist explained the problems resulting from continuing development, "As the development from Memphis moves eastward, into north Mississippi, towards Marshall County, out into Fayette County and subsequently into Hardeman, more and more people will come onto the public water supplies, as opposed

to their own well water sources. And at the same time that this development occurs, we know that much of the recharge occurs in eastern Shelby County, Fayette and Hardeman county, Marshall county and northward. As development occurs in this region, several things happen. First of all, much of the exposed land is going to be covered by impervious services. You're stripping the land of its natural cover, its natural interceptive process of the water from rain, which means that you're allowing the water, where it used to take a longer time to run off, now it takes a shorter time. So, its opportunity for infiltration is decreased. We're beginning to develop some indication that as the Loosahatchie and the Wolf go further east, they may be coming into direct contact with the Memphis Sands aquifer, as the aquifer ends up and outcrops to the east here, so that the rivers themselves may be a great source of recharge." He went on to explain concerns in areas already developed. "There are two things that we really should concern ourselves with, and to the best of my knowledge, all we're doing now is becoming aware." The first is to extend zone 2 Well-head Protection Areas (WHPA), which are designated capture zones of groundwater travel time in excess of 10 years. The second is "where these windows are, where those thinning clay units are or where there's an absence of clay, we might ought to be making sure" that there are no potential sources of contamination located in those areas and that "we stringently monitor operations that could" contaminate groundwater. He advised not developing "corridors along the streams" give more consideration to "development activities that can mitigate this loss of imperviousness, and that's called low-impact development." His concern is that policy may not keep pace with the needed groundwater protections. "Our policy-makers, our government officials, and I'm not talking about just local officials, I'm talking about state

as well, they don't see a problem here and as a consequence they don't... there's no squeaky wheel that gets the grease. I would say that we would be very remiss if we just say we can develop helter-skelter-wise without taking that into consideration."

Another groundwater scientist indicated that "rivers may be a great source of recharge. So, as a consequence, we want to certainly protect the rivers from contamination." A related phenomenon is channelization of rivers which disconnects surface waters from wetlands and groundwater recharge. A groundwater scientist explained, "Groundwater has a certain quality to it. And if you get crummy water coming in, that's going to dilute it, so our groundwater quality has a role in the dependence of a wetland habitat on its presence. ...Channelization of our rivers, because the rivers cut deep, has disconnected the rivers from the wetlands. So we channelized the rivers and that has disconnected our wetlands [from rivers]." Evidence of this lack of flooding due to channelization of the Wolf River, for example, is "the amount of privet that is now growing in those former wetland areas of Shelby Farms. Privet can't grow in a flooded environment, so because of the disconnect, when the Wolf River floods, you can't flood those wetlands there."

Three groundwater scientists described the importance of age-dating: "The young water, being less than 50 years old, helps us understand the areas most vulnerable to contamination."

"This young water is indicative of recent recharge. As demand lowers the potentiometric surface, recharge from near the surface comes to fill in that potentiometric hole. The concern is that water that may be getting in there may not be of highest quality."

“A lot of my research was based upon source water protection and trying to quantify the amount of modern versus very old water in the Memphis aquifer; and to try to describe how some of the mixing behavior in the more complex regions of the aquifer may be occurring. Part of that was driven by public sentiment to better understand risk.” That sentiment about risk came primarily from water managers, specifically MLGW, and was described as “a concern regarding the liability issues of delivering the water that may be contaminated. Their attitudes towards the resource were that that the resource is infinite.” Their research shows that at least two MLGW well fields show signs of shallow aquifer dewatering: Lichterman and Sheahan. Water dating shows “new water” of less than 50 years old entering wells at these locations, indicating local recharge and that the shallow aquifer at Lichterman has been de-watered.

Local newspaper articles covered concerns about storm water runoff and the age of water. A *Commercial Appeal (CA)* article reported on storm water runoff, “When it rains, pollution pours. Initial samples of storm water runoff in Memphis show that some fairly nasty stuff, including bacteria, nutrients, metals, and dirt, can get flushed off the city’s paved landscape during rains. The sampling showed typical problems associated with urban runoff. There were high readings for suspended solids, i.e., dirt and grit, and for fecal coliform bacteria, which indicates the presence of human or animal waste. EPA reported that urban runoff is the largest single source of water quality damage in estuaries and the second-leading contributor to wetland pollution. Storm water runoff can rival or exceed discharges from factories and sewage treatment plants as a pollution source. Mike Cook, director of the U.S. EPA’s office of wastewater management said citizens can

reduce storm water pollution by not dumping oil or other wastes into storm sewers and by controlling erosion from their properties” (Charlier 1998).

Another *CA* article reported on a study to age-date the aquifer water to ascertain where this “new water” might be entering the drinking water aquifer. “Lately scientists have found evidence that not all the city’s water is pristine. Instead of dating to a time when earth was unspoiled, some water beneath Memphis got there after chemical plants and garbage dumps began dotting the landscape.” The article told of a study by the Ground Water Institute (GWI) to age-date groundwater by analyzing it for traces of nuclear products, specifically Krypton-85, to identify places where younger water is present, indicating recharge areas. Water samples were analyzed at UT-Knoxville. “By tracing the path of modern water into the aquifer, researchers say they will get a better idea of the infiltration of pollutants” (Charlier 1999).

Concern with overuse of the aquifer was important to several groundwater scientists. This overuse of the aquifer is related to unequal distribution of the resource, as well. As one put it, “It goes back very much to a tragedy of the commons type concept, that the resource there is free and available, and it’s treated as free so people come in and mine it, almost from a gluttonous type standpoint without any type of concern about the impact to others. So the negative impact of that activity is shared by a global community, where the positive impact of the extraction is shared by very few. And so it really is very much a tragedy of the commons.”

A planning professor believed, “I think people need to be conscious of how their everyday decisions affect this tremendous resource that we just happen to have. I think we need to teach the children in school how important groundwater is and how their

personal decisions affect the groundwater. If we teach the children in school, you empower them, they go talk to their friends, their parents and then people just become more knowledgeable about their everyday lives and are in a better situation to make choices.”

A groundwater scientist said, “There’s nothing, other than good common sense, that says we need to be looking at protecting our good water. That’s what we elect public officials for – to be looking that forward. We need to be doing everything we can to protect it.”

Environmental Advocates

Environmental Advocates showed high concern for the groundwater with none (0%) of the 13 ranking High, 3 (23%) in Medium range and 10 (77%) in the Low range. These are similar to their overall environmental concerns, with none (0%) ranking High (HEP), 1 (0.76%) in the Medium range, and 12 (92%) in the Low range.

A Sierra Club member is concerned about the fact that, “we have windows, we have holes in our aquifer and that they are at risk, that we have a threatened water supply. And that concerns me. A former League of Women Voters president, “I see a huge problem with withdrawal. People seem to think that this is a never-ending source of water. And I don’t think it’s being recharged to the amount that it’s being withdrawn.” The comments from a retired professor of Conservation of Natural Resources showed her general environmental concern: “We have created a throw-away society which uses materials so rapidly which means they need to be re-mined, which means more landscapes are sacrificed and more forests felled.”

A retired City of Memphis storm water employee is monitoring the quality of Mississippi River water, which could potentially be a future source of Memphis' drinking water and is currently a "a recreation hot spot." He has found increased nitrates and nitrites in the water after rainfall events, attributing fluctuations in their levels that "appear to be a function of the runoff from the agricultural sector." He has also found "E. coli [bacteria]. We have one section of E. coli and that's because the Maynard G. Stiles Wastewater Treatment Plant does not chlorinate or use any other disinfection in its effluent. It's had a 'bye' from the state since the plant opened in 1977 to do that; they've never disinfected in 30 years." He has concerns because "There's a number of sea kayakers who go out there, and people out there with jet skis riding around on the river right there in that plume of stuff [effluent from north wastewater treatment plant]. It all hugs the Tennessee bank."

One community activist was concerned about a "public attention deficit disorder" in the lack of media coverage about protecting the groundwater and other environmental resources, and "the connections between tree protection, open space protection, groundwater, and storm water." Perhaps the lack of media coverage is because "there's nothing sensational about groundwater." A sociology undergraduate student believed, "There's definitely a lot of waste. But I think that goes along with Western attitudes about their place on the Earth as well as consumer attitudes."

A Professor of Ecosystems Ecology observed, "People don't know much about ecosystems services, about natural resource valuation, or environmental economics. Every time we change our environment we make the decisions that can impact that. I think that there has been a change in the past few years to try to minimize our human

impact on the environment, our negative impact. But still other forces are much more important when survival decisions are made.” The comments from a planning professor show the links between knowledge and concern: “We need to teach the children in school how important groundwater is and how their personal decisions affect the groundwater.”

Micro-level Adherence to the Growth Model

High HEP values and beliefs favoring economic growth combined with High HEP values and beliefs about general environmental concern indicates that people prioritize economic growth with little or no consideration of environmental effects in their decisions. A view that prioritizes economic growth over concern about resources is more likely to support activities that lead to practices and policy decisions that can deliberately or inadvertently harm the resources.

In this study, the policymakers showed the highest micro-level adherence to the growth model at 52% followed closely by business leaders at 48.75%. By contrast, scientists showed only 2.5% micro-level adherence to the growth model and environmental advocates showed none, 0%. The percentages show that policymakers and business groups are most conforming to the macro-level assumptions of the growth machine in their perspectives.

Most interviewees believed that growth is an essential part of any community’s economy. Common responses were: from a City of Memphis storm water employee, “Economy is what drives all of this.” A Chamber of Commerce manager, “Growth is typically essential for an economy.” A geologist, “Growth is a natural function of how cities mature.” A U. S. Army Corps of Engineers project coordinator, “Within most urban

communities economics drives the train.” A former MLGW Vice President, “Growth and development are what keep an economy moving forward.” A groundwater scientist, “We need to have growth; that’s the way the world works now.” An environmental advocate, “Growth and development is certainly a driving economic force, for jobs and everything. But that’s the biggest obstacle to regulations.”

Policymakers

On indicators of adherence to the growth model, policymakers had 67/128 responses (52%) that showed High (HEP) growth model adherence. They see Memphis as an economic hub for the region. They believe economic growth is necessary for jobs, which are related to quality of life. A public works director saw that, “It all fits together. You look at the Delta and they’ve got the highest unemployment rate; they’ve got the highest rate on social programs.” So “the key is to making sure the community continues to grow economically with jobs,” said a Shelby County Commissioner. A suburban municipality mayor believes, “you have to have some growth because it does help the economy. It provides jobs; the money turns over in the different retail establishments. There is an economic impact and you do want steady growth.” Development is often equated with economic growth, as the mayor of a Mississippi suburban municipality said, “In DeSoto County, development the major part of the economy.”

The property tax is a major source of revenue for municipalities, so respondents talked about the dependency on economic growth and development to generate the necessary income to provide infrastructure and services. A Shelby County commissioner explained, “Growth and development is essential. You have to have growth to maintain

the level of services that people want without raising an astronomical tax. There are certain services that you must have maintained by having economical growth. If you have 'smart growth' it's very beneficial."

On the limits to growth, "I don't know when and what would cause it to be limited." From a county public works director, "If you can't grow in one direction, you simply grow in another direction..." A state senator observed about cities that 'build out,' "Well, there are limits that way. They can see the end of the line for available land for new development. There are limits in terms of available space and what the market will bear."

On who benefits, a suburban Mississippi municipality mayor, "I think everybody pretty much observes that we benefit across the board." But a county commissioner said, "Developers are benefiting more than the average person from growth. But I still think that growth does benefit the community at large because it grows our tax base and that tax money is used to benefit everybody."

Land is valued as an economic commodity primarily in its development potential. The other perspective of land is as green space. When asked how people at OPD perceive raw land or vacant land, a deputy administrator replied, "I think they'd like it to be put to the highest and best use, whether that's pasture land or factory or whatever..."

The "developable land" perspective is typified by a Mississippi municipality that has fostered suburban development. "DeSoto County itself is the 35th fastest growing county in the entire nation right now. Southaven is over two-thirds of all that development. So our population is growing at an estimated 7% a year, and we, as of right now, only have 11% open space left for development. That 11% (of remaining 'developable' land) takes out flood plains, floodways and any other environmental constraints We've removed all

that from the viable land for development and what we have left is the 11%, which is just desirable and developable land.”

The concept of “development rights” was described by a deputy director at Office of Planning & Development, “As long as it’s privately owned land, we would regard that owner as having the right to bring it in for whatever type development it’s zoned for.” An environmental advocate agreed that “some things you can’t prevent. If something comes in by right and the zoning supports that use, you’re not allowed to say no. The law will prevent you from being arbitrary in that way.”

These “development rights” reinforce the commodification of land for development. A state senator who has sponsored “transfer of development rights” (TDRs) legislation explained, “I think foremost is preserving the importance of private property rights.” Brownfields development is also related to TDRs: “We passed legislation here in the last couple of years to make it easier for subsequent purchasers to redevelop previously contaminated land. So you’re using, it’s more effective use, more efficient use of readily available land,” the state senator said.” Most people tend to think in terms of the pristine properties that have never been developed. But on the other hand there are readily available areas even in the inner city.”

The mayor of a suburban municipality explained, “There are still land rights in Tennessee and in the United States. We’ve got some areas that are really hard to develop. We [Bartlett] budget on the basis of about 350 [new] homes a year. Last year we had a lot of development and we had a windfall because of it. But now we also have 700 or 800 lots in inventory, so there’s also the concern, what happens if those guys start having economic trouble, what are they going to build on those? So we know we’ve got more

lots than be consumed this year.” But at the same time, the mayor of this municipality is concerned about preserving some land for green space. “It [growth] has to be sustainable. That’s the biggest argument I get into with developers. I tell them, you guys are in here for a buck, but 20 years from now somebody sitting in this office has got to figure out how to deal with that subdivision and hope that it has become a neighborhood,” said the mayor. “We [Bartlett] don’t want to get to the point that some areas decline so much that it’s cheaper to buy it than to buy the green. I don’t want to abandon any area. That means to people in the neighborhoods, you’re got an education process because they don’t want it to change. If it doesn’t change, it dies in some cases; not always.”

A suburban municipality mayor said, “You just don’t want the economy to become stagnant. There has to be movement of some type in order to continue to provide services without raising taxes. Growth has to be sustainable. The idea is you create a sustainable economy.” A public works director said, “We want economic growth, but in order to make it ‘smart growth,’ then you have to look at some other things a little more closely than you did in the past.” An Office of Planning and Development deputy administrator commented, “For many years there was pressure to continue development out in the county. I sense that is lessening now and there’s more of the point of view that we want to allow the proper type of development, but steer the development back into the already developed area, rather than continuing to put development out in the greenfields.”

One suburban Shelby County municipality has incorporated natural resource protection in its planning decisions. Its Natural Resources Director has inventoried the community’s existing natural resources, mainly forests, and is actively involved in advising the Board of Commissioners on development decisions. He explained their

change in development decision-making, “The three departments that analyze new developments are Planning, Engineering, and Natural Resources. So the three departments consult with each other. We use broad-based maps, land cover type, which consist of several different classifications. We have forested, agriculture, grassland, and then the two urbanized sections of development. Our definition of urban is a natural resources definition meaning very little canopy and a lot of impervious surface. So we look to see where a particular development project fits in that land use scheme. We’re finding a lot of our wooded areas are on steep slopes and we feel like that contributes a lot to community character. If we have a green belt preserved ...the first step is you establish an agricultural preserve. Preserve means no development. We prioritize those conservation areas by overlaying those resources. We key in on priorities because we can’t protect everything, but if we get some priorities that way, we can steer the development a little bit, or at least the impact of the development. We used to analyze each site in isolation and now we have a way of tying it to the surrounding lands to see how it fits into the overall picture for the whole city. If you look at it in a broader perspective, you can maybe find a corridor to connect to high value resources areas that aren’t on a project. So it’s helped us identify those corridors that we need to protect and then prioritize the resources on that site. We just had a development plan where we ended up with 50% open space and even more than that if you consider areas on the lot that are not going to be graded. We were excited.” He regularly “utilizes Randall Arendt’s ideas in our department all the time. We give copies of his diagrams to developers, to the Planning Commission members, to the public. Protection of natural resources is the

number one goal. It's important because it preserves community character and protects water."

The mayor of another suburban Shelby County municipality emphasized the importance of "planning for open space," in his community, and gave an example of "over 400 acres that is undeveloped at this point, and we're trying to decide how to hold onto that gem and make it real valuable to the children." A Shelby County Commissioner echoed the need to preserve green space, "When we're talking about approving individual developments, we make sure that a certain amount of green space is being set aside. We want parks and playgrounds in the neighborhoods, plenty of trees, plenty of tree cover, just green space in general. And with public green space, we're working right now on trying to preserve Shelby Farms and establish the Greenline whereby Shelby Farms and other parks are all connected with walk-able or bicycle-able trails so that they'll be one large park system and green space."

A Shelby County Commissioner said, "I don't think growth and development is something you can stop. But I think it has to be planned growth. And we need more and more to incorporate the concerns about our water system in our growth. And I see some of that beginning to happen, but I don't think there's enough of it."

Business

On indicators of adherence to the growth model, business leaders had 39/80 responses (48.75%) showing High (HEP) growth model adherence. As would be expected, economic growth is a priority for business leaders.

A Chamber of Commerce manager said, “Growth is typically essential for an economy.” A former MLGW Vice President: “Growth and development are what keep an economy moving forward.” A chemical company manager said, “I think of our capitalist society is the best thing going.” An environmental reporter said growth “is the main force in the economy, in terms of just shuffling people around. It’s a part of Memphis, and in the outlying communities and counties, even into Mississippi and Fayette County, it’s one of the biggest components of the economy.”

The president of a local bottling company believes, “We need to expand, but we need to look at what we’re expanding. Warehousing doesn’t hurt the groundwater, other than it brings in more trucks. Manufacturing discharges things. So we have to make sure that we’re controlling that growth; you’ve got to balance all that. Business growth in Memphis has to continue [to] attract jobs that pay a living wage. We need to continue to push companies that pay the right wage here in town.”

An environmental reporter commented, “Urban sprawl is the kind of growth we’re having. I don’t know if it’s something we necessarily want, but it is inevitable.” Two U.S. Army Corps of Engineers described the economic value of land. “People own land, it’s valuable, and they’ve come to a point in their life where they’re ready to cash in on that value. And people are wanting a suburban life. Land owners have land and they’re ready to make their profit.” “Well, the value of farmland is different from the value of development, the price a developer would pay to buy the same land. So if you’re living on the city limit fringe, why would I keep that as a family farm if I knew that was going to be retirement income?”

The groundwater is an important base for economic growth. A public works director and a Chamber of Commerce manager explained, “This groundwater is part of that economic base; it is literally an economic engine with which we can attract industry. We get a billion dollars of direct economic benefit from our groundwater. We’ve got 80+ industries that rely on our water. Our Chamber [of Commerce] uses our aquifer as a sell point.” A former MLGW Vice President, “Now, reasonable and responsible growth and development is a good question. And actually there’s some relationship to recharge if you’re using an aquifer as your source of water.” A Past President of MLGW added, “We need to more incorporate the concerns about our water system in our growth. And I see some of that beginning to happen, but I don’t think there’s enough of it.”

An environmental reporter listed some factors that perpetuate growth and development: “A lot of things perpetuate it. It’s the lure of new houses rather than an 80-year-old house in midtown. Also, land prices are real cheap. You have the on-going schools issue with the city of Memphis and the taxes issue with the city of Memphis. The city schools don’t perform well, so they’d rather have their kids in the higher performing system. They see Shelby County schools as higher performing and they see Shelby County as less vulnerable to politics than the city schools.”

Asked if there are limits to growth, a Past President of MLGW he said, “Yes, physical space. There is still some growth potential through Cordova and some in Collierville. There is potential for growth in rural north Shelby County. But it’s hard to get adequate restrictions on development.”

Perspectives of labor-reducing technologies as a natural progression of economic growth were seen in such statements as: “They are inevitable; all sectors of economy are

replacing humans with machinery to reduce costs of production. It's just progress." "I think labor-reducing technologies are a fact of life." A chemical company manager saw some positive aspects of technology in its environmental effects, "Some automation does require changes in energy consumption. It can increase energy consumption, water consumption, things like that, or it can drastically reduce water consumption by recycling coolants."

A consulting environmental engineer saw an obstacle to developing forward looking policy because policy-makers, "being reactive by nature, make a decision based upon cost and cost to their constituency. But they won't really make a decision until it's brought to them; they're reactive in nature," said. He observed, "Some communities are more oriented toward preservation of natural resources than others. Even Memphis and Shelby County have gone about this in a planned way of putting economic development, industrial and commercial, into their zoning plans. And, hopefully, when those zoning plans have been developed, they considered conservation and protection of natural resources."

However some policymakers' perceptions may be changing, economic growth still remains a priority over natural resource protection. A consulting environmental engineer pointed out the economic and legal barriers that limit restrictions on development and protection of natural resources. "Are they considered to the point where the destruction of wetlands, or the destruction of critical environmental features, would weigh heavier than economic growth? No. Our legal system says that if we want to develop an area that is a wetland or has a stream running through it, then there are mechanisms to mitigate that. And as long as we're playing by the rules, and it can be mitigated according to the law,

then the local politician, decision-maker, has very little recourse. He has to accept the fact that I have here an alternative, that yes we'll destroy some wetlands or damage a stream. However, according to the law the developer can mitigate it, so in being in compliance with all local, federal, and state laws, therefore it's a no-brainer. Development should occur. I don't know that they could change that. To change that, they would have to be arbitrary and capricious. And I think they'd end up being sued for that. But we've made it easy for people to move into wetland and floodplain areas to mitigate it, and therefore be able to develop paved areas, and buildings, whereas before it was open space and had certain natural aspects. But we made it easier for them to mitigate it and move on. Most of DeSoto County has been treated that way. You can get permits to change stream locations and to build in wetlands as long as you comply with the state and federal regulations on mitigation. Until the regulations are changed, or until the laws reflect that importance, then the local decision makers have little or no choice. They can always enact local ordinances that are more restrictive than the state or the federal, but they have to have some cause and effect proof to do that. But there's not that definitive proof."

An environmental engineer saw conflict between the short-term perspective of policy-makers and the long-term environmental effects. With policy-makers, "You're in the four-year horizon when you're talking about potential long-term [environmental] impacts. Most of them are thinking 4 years and out, or 8 years at the most; there are term limits now. And, therefore, if it's not immediately on my watch, it's somebody else's problem. And term limits has spawned that attitude."

Scientists

On indicators of adherence to the growth model, scientists had 2/80 responses (2.5%) High (HEP) growth model responses, showing very low adherence to the growth model. A theme that emerged in their responses was one of balancing economic growth with minimizing environmental and groundwater impacts. However, they still accepted that, “Within most urban communities, economics drives the train,” as a U.S. Army Corps of Engineers project coordinator said, and a geologist said, “Growth is a natural function of how cities mature.”

The theme of inevitability of economic growth yet it should be balanced with consideration of its groundwater/ environmental impacts is exemplified by these statements. A groundwater scientist said, “Development’s going to happen no matter what. And development’s good; it’s just being able to have development occur in such a way that it minimizes the impact to the aquifer system. People, even the politicians, being aware of what impacts there could be, is important. You have to have the data to prove it.” Another groundwater scientist thought, “I’m not anti-economic development. I think that if you’re smart and you’re willing to think beyond your boundaries, then you can figure out how to do economic development and resource management in a very cohesive, equitable manner.”

A geologist believed, “Controlling growth and planning growth in a manner that is most harmonious with the environment, economics, and the resources is essential. The degree to which that’s done probably varies from place to place. Any type of growth plan needs to be evaluated by professionals that deal in all these areas that are concerned; and all the stakeholders need to be brought into the forum for discussion; that would include

that environmental groups, industrial representatives or retailers that are interested in putting in stores in the area, the actual subdivision contractors who will, by their plans, determine the density, style of housing and so forth.”

Regarding water’s use as a commodity, a groundwater scientist said, “No matter how we’re using it, it’s a mined quantity. The physical water extraction, coal extraction, sand and gravel extraction – all of those things that are being removed have an impact on the system, but the impact on the system is very rarely taken into full value, full evaluation.” He said this is due to the “engineering mentality” that is “less sensitive” to ecosystem processes, more mechanical in its approach. It goes back very much to a tragedy of the commons type concept, that the resource there is free and available, and it’s treated as free so people come in and mine it, almost from a gluttonous standpoint without any concern about the impact to others. So the negative impact of that activity is shared by a global community, where the positive impact of the extraction is shared by very few. And so it really is very much a tragedy of the commons.”

A groundwater scientist/engineer spoke of labor-reducing technology, “You’re not going to stop it. If you look at any sector of the economic, any sector at all, manufacturing or service providers or whatever, and the one thing they’re all trying to do is replace people with devices, replace people with machinery. And the reason is very simple. The wage rates go up, the benefits constantly go up, and you always have a person as an overhead on your production whether your production is there or not. If production is down, you turn that machine off and it doesn’t cost anything. Plus the fact that machine works at a certain level of productivity usually day in and day out whether you’ve had a bad day or not, or a bad weekend or not. Quality control issues have been

replaced, too. I work with the industrial society, the industrial sector and I constantly see people fighting the problems of skilled workers and responsible workers and listen to them complain about the biggest problem they've got is getting, providing adequate workers, and looking at automation to replace it.”

Environmental Advocates

On indicators of adherence to the growth model, environmental advocates had 0/104 responses or 0% showing High (HEP) growth model adherence. As would be expected their views prioritized environmental protection. However, several observed that economic growth always trumps concern for environmental impacts. “The environment’s always secondary to economic development in this area,” said an architect. An environmental advocate concurred, “Groundwater is one of the major victims of economic growth.” Yet “there are individuals that realize that being green produces green.”

An environmental NGO director said, “Certainly, growth and development are major forces driving policy in this area. They constitute the greatest threat to the Wolf River. Development is the number one threat because it’s irreversible generally. Once you clear land and build on it, you’ll never get it back.” Another environmental advocate’s emphasized “the connections between tree protection, open space protection, groundwater and storm water.”

A judge’s wife put it bluntly, “Development is a major problem. It is a horrendous assault on the earth. But no one thinks of development as affecting the groundwater. The mix of heavy farm use for irrigation and sprawl are the two main factors affecting the

groundwater. And sprawl is not so much a fast growing thing, but it is steady growing. It's like the story of the frog in the water. You put the frog in tepid water and things are just fine. You keep gradually turning up the heat and eventually the frog boils to death! That's how sprawl happens: slow enough that people are blind to its effects."

An NGO president felt, "The problem in the area lies with unrestricted development. The issue over paving over the aquifer recharge zones came about because of unrestricted development approved by former elected officials. There is a strong argument to be made to minimize development there and to protect the recharge area. But when you talk about the recharge area it doesn't get much attention." An environmental attorney summarized, "The primary land use issues are development, snapping up raw land and developing it. That's the major impact on our aquifer."

A League of Women Voters past president commented on sprawl in Atlanta, "Atlanta is a devourer" of water and land and resources. An environmental advocate/ attorney said, "Growth and development is certainly a driving economic force period, as far as jobs and everything. But that's the biggest obstacle to regulations. Developers don't want any regulation on their property as a rule, or if they do, they want the same regulation on all. You've got to have the science first to back up [regulation]. Even if the local politicians had the will to regulate it [development], we're going to protect everybody's deal, even if it seems like a recharge area. Without the science, developers who would seem to lose millions of investment dollars on land they have bought with the intent to develop, they would sue and they would win. You can't regulate property without good science that shows that the human health and welfare of society outweighs private interest."

One environmental advocate said growth affects us in, “Many ways: over-consumption, pollution, simplification of ecosystems, modification of ecosystems, loss of biodiversity, loss of quality of life. And I quote E. O. Wilson: it’s very much an impact on our mental health.”

A retired university professor and environmental activist said, “Specifically with regard to drinking water, water in particular has been treated as a commodity. Local or public water suppliers have tended to use the income from water sales to cover various municipal revenues, or municipal expenditures. That is clearly use of it as a commodity and therefore they want to sell the more the better. And therefore they have typically used a rate structure that favors higher sales by giving them a lower price. I think in the most direct way that kind of rate structure represents the commodification of water. And probably, I mean this goes back to the thinking that since water is free, the more the better.” “In terms of the natural system, I think you’re going to see other leaders emerging” who emphasize “green development,” said the director of a research NGO.

It is important to note that three respondents out of the 49 interviewed saw unlimited economic growth as a “myth,” describing the economic growth machine and how residential development proceeds at a rate higher than population growth.

A university planning professor explained, “There is this economic myth that has been perpetuated by the federal government about home prices and construction rates. There is this sense that we need to build new houses regardless of what the population is doing. The rate of housing construction in Memphis and Shelby County is far higher than the growth rate of population and households. The city council and many people in the government offices are completely oblivious to fact that annexation policies just

exacerbate the problem. Our urban area is not growing economically or socially. It is just spreading out thinner and thinner and much of the population movement into the county is from the inner city areas. Our spread is sprawl that is partly from growth, but partly it's from just re-shifting of the population further out. The schools are a big driving force in the suburbanization and the sprawl." She believes that, "A lot of the problems in our world [result because] people are so removed from the natural world in their lives, that people are being so pulled by this economic machine. They have to have bigger cars, more television sets; they have to have this and that. And they're working so hard...what about quality of life?"

An Ecological Economics Professor said, "My belief that this presumption that the more and faster and random development occurs is good for us economically; this presumption is, in fact, not proven." A retired ETSU university professor added, "There is nothing unlimited in a limited world. There is only so much space on the planet and there is only so much green space left and there's only so much water recharge area left. Economically the main beneficiaries are the people in the building industry and banking and real estate, particularly the building industry."

A professor of Ecosystem Ecology spoke of the things in society that remove us from the natural world. "Technology, of course, and the idea that it's much easier to live in a world where everything is controlled, human made." But with an event "like Katrina, you cannot decide to do with Katrina. Nature decides. Humans feel powerless in this world."

Analysis

Schnaiberg (1980) developed the *treadmill of production* theory 27 years ago and Logan and Molotch (1987) developed their *urban growth machine* theory 20 years ago. In the interim, research by Gould et al. (1996) and by Dietz and Rosa (2002) applied a combination of these models to studies of community growth policies and impacts on environmental resources, and they found the basic tenets of the *treadmill* and *growth machine* theories still occurring. The question this research asks is whether after a lapse of two decades the basic tenets of the theories, as tested here in the synthesized growth model, are still applicable to current policy decisions and their environmental impacts. The answer is generally yes, but this research also finds some changes occurring in policy and policymakers' perceptions.

Summary of this study's findings

To summarize the findings using this synthesized growth model, policymakers were the least knowledgeable about the aquifer (18.75% high responses) of all four groups. They had the highest (3/16; 18.75% HEP responses) HEP values regarding concern for the groundwater and even higher HEP (6/16; 37.5% HEP responses) values regarding general environmental concern. They scored the highest (52%) on micro-level adherence to the growth model.

Business leaders were slightly more knowledgeable about the aquifer (30% High responses) than policymakers, equally knowledgeable as environmental advocates. They showed no (0%) high HEP responses on groundwater concern, but their general environmental concern showed considerably higher HEP responses (6/10; 60% HEP

responses) than policymakers. Their micro-level adherence to the growth model (48.75%) was nearly equal that of policymakers.

Scientists had the highest groundwater knowledge (60%) and the highest level of groundwater concern (0% HEP scores), with 10/10 or 100% of their groundwater concern responses in the Low range on the HEP scale. They also have fairly high general environmental concern with 4/10 or 40% Medium responses and 6/10 or 60% responses in the Low range on the HEP scale. They had the second lowest score (2.5%) on their micro-level adherence to the growth machine, very close to that of environmental advocates.

Environmental advocates' knowledge about the groundwater (31% High responses) was nearly equal to that of business leaders. As would be expected they had the highest environmental concern in general (0% HEP responses), with 12/13 or 92% of their responses in the Low range on the HEP scale. Their groundwater concern (0% HEP responses) was second to that of scientists, and 10/13 or 77% of their responses about groundwater concern were in the Low range of the HEP scale.

Relation to previous studies' findings

These data replicate many of the findings of earlier studies, such as the growth imperative still dominates public policymaking and is resulting in ecosystem disruption through the destruction of land habitats and depletion of natural resources (Schnaiberg 1994; Gould et al. 1996). The elite in the power structure who make their fortunes from the exchange values of land as a commodity still shape the development of cities through commodification of place and increasing intensification of land use (Molotch 1976;

Logan and Molotch 1987). The *urban growth machine* still has the cooperation of government officials and it is difficult for stakeholders to step off the treadmill of development (Dietz and Rosa 2002). There is still conflict between those seeking use value of their land and those who gain from prioritizing the exchange values of land (Gould et al. 1996), with development continuing to encroach on rural areas, pushing those who wish a rural lifestyle further out from the urban fringe. Public policy still facilitates the interests of the beneficiaries who profit from prioritizing exchange values and development of land, and government planning still fosters continued expansion of land development. Communities are still centered on growth, and resources are becoming scarcer as greater demand is made on them (Gould et al. 1996). This is particularly seen in diminishing open land as municipalities become “built out” and as aquifer water levels drop generally, and some aquifer layers become depleted in specific areas.

Elements of the HEP are still found in policymakers’ and their advisors’ perspectives, as Milbraith (1989) found: a dominating, competitive view toward the environment; seeing nature only in part, and maximization of profit taking priority over other concerns. Humans still relate to nature through its commodification (Demeritt 2002), where “undeveloped” land is valued higher when “developed” land (Brabec 1994). Policymakers still adhere to the idea that development will increase the local tax base, provide jobs, raise the value of people’s land and expand the consumer base. This is accomplished by commodifying natural resources, particularly changing “vacant” land into subdivisions, commercial development, roads, etc. (Gould et al. 1996).

Indications of change

While the policymakers in this study still accept the growth imperative, they are changing somewhat their perspectives about growth in response to the consequences that previous policy emphases on unmanaged growth have brought: debt, declining neighborhoods, and diminishing environmental resources. These incremental changes can be seen by examining their Medium level responses, which incorporate some environmental concern with general HEP values about growth and the environment (see Figure 2: Measurement of HEP values). Looking at just the Medium values for policymakers, they show half (8/16; 50%) expressed slightly more environmental concern than strictly HEP values (6/16; 37.5%); slightly more than half (9/16; 56.25%) expressed concern about groundwater. Their “pro-growth machine” scores were nearly equal in High responses and Medium responses: 58/112 H or 52% and 50/112 M or 45%. These changes were expressed in their comments about managing growth, controlling growth, interest in establishing or preserving more green space in their communities, and use of the term “smart growth.”

Similar trends are seen in the Medium responses of business leaders on their “pro-growth machine values” responses: 33/70 H or 47% High; 31/70 M or 44% Medium. Their Medium responses on “pro-growth machine values” were nearly equal to their High HEP responses on pro-growth machine values. Business leaders showed little incorporation of dominant HEP values with environmental concern: Medium HEP values regarding general environmental concern were 3/10 or 30%, compared with 6/10 or 60% High HEP values. They did show more concern about the groundwater: 6/10 or 60% Medium responses.

The data suggest that decision-making will still tend to favor economic growth, while tempered with some environmental, especially groundwater, concern. The beneficiaries of growth still maintain economic and political power to ensure that growth takes priority in policy decisions, and this is supported by the ideology that growth is beneficial for everybody. Policymakers and business leaders did express concern about the groundwater and their perspectives showed an interest in changing development policies to be somewhat more “environmentally friendly.” Policymakers are still co-opted into the growth paradigm because they benefit, at least in the short-term, through increased tax revenues. This situation poses a contradiction for those policymakers who favor greater protection for environmental resources, especially groundwater, and protection for environmental factors like green space that contribute to “quality of life” in the community.

Influences on policymakers’ perceptions and policy

Who are policymakers likely to listen to in their decision-making? The data show that the groups most powerful in making public policy, policymakers and their advisors and business leaders, are more closely aligned in their worldviews than with scientists or environmental advocates. Environmental advocates and scientists are more aligned in their worldviews. People are more inclined to listen to and heed the advice of those with whom they have similar perspectives and interests.

Who did policymakers say they would likely listen to regarding groundwater protection policy? A county commissioner surmised, “They would have to have some technical competence about it. But somebody needs to get to be an advocate for it.

Somebody that's got competence in the area and that's what we need the worst. Need a competent advocate. Probably needs to be an engineer." However, Departments of Engineering policy generally proscribe engineers from engaging in advocacy work. However, one groundwater scientist did see the need for scientists and engineers to increase their communication with and education of policymakers. "Communication is real big and education of our policy makers, so that they know what risks there are so they can best determine the policies needed to maintain the vitality of their municipalities. We at GWI could be more proactive in providing that information and saying what information we have, but not come across as being an activist, still maintain that neutrality. Sometimes people just don't know what information exists or understand the information that does exist."

Who are policymakers listening to now? One policy advisor, a director of public works, has become a strong advocate for groundwater study and protection. He was described as a person who "Has taken this almost as a personal cross to bear, because he sees the benefit to the community, as well, in good water..." He is closely working with a groundwater scientist at GWI on the Mississippi Embayment Regional Aquifer study.

What interests are policymakers likely to favor in policy decisions? Policymakers see business development as a basic necessity for the community, so their decisions prioritize economic growth. In addition, the position of policymaker is, in many cities and states like Tennessee, considered to be a part-time position and policymakers usually have business occupations whose interests may coincide with their policy decisions. For example, most of the members of the Land Use Control Board are affiliated with development, construction, and real estate businesses. An OPD deputy administrator

revealed that some county commissioners were also developers. Or it may be a “revolving door” in which business leaders rotate in and out of policymaking positions, a situation likely to occur with the advent of term limits.

What is the nature of decision-making in terms of view points: holistic v. fragmented view of nature and related social issues; long-term v. short term view of nature and policy effects? At least two respondents stressed the necessity of a holistic view in decision-making. An Office of Planning and Development (OPD) official said one county commissioner “has probably one of the most comprehensive views of all on this. He explains how all these elements tie together, how it’s interrelated: the fiscal, the regional, the environmental, the transportation – all of it.”

The nature of policymakers’ term of office-holding generally inculcates a short-term time perspective, whereas the impacts of policy decisions on ecological cycles and natural resources are long-term time effects. This was described by a groundwater scientist, “You’re in the four-year horizon, and you’re talking about long-term impacts and potential long-term impacts, and most of them [policymakers] are thinking four years and out or eight years at the most; there are term limits now. And, therefore, if it’s not immediately on my watch, it’s somebody else’s problem.” A Professor of Ecosystem Ecology said, “Politicians, policy-makers, always think short term; they only worry about tomorrow, about the next time, so their values have to change.” Asked how short term thinking affects decisions, she replied, “Because we only worry about what’s going to happen maybe next year; that’s about it. Ecological systems have a cycle that’s a 100-year cycle, 50-year cycle. And all that’s unlike your representation of the economic system and the ecological system. It’s a different time scale; it’s a different spatial scale.”

Policymakers were described as being reactive rather than proactive in their decision-making, being “crisis management type people.” So the kinds of proactive groundwater protection measures that scientists see as necessary don’t fit with the reactive nature of the decision-making process. There are indications that this is changing, with the reports of one suburban municipality mayor who is seen as taking a long view, proactive approach to groundwater protection.

What is the relationship between knowledge of the resource, decision-making perspectives, and knowledge of the consequences of decisions? Four interviewees stressed the links between knowledge of the resource, a long term, holistic viewpoint, and knowledge of decision consequences. These were described as three necessary ingredients to making effective policy to protect groundwater and environmental resources. If, as a Professor of Ecosystems Ecology pointed out, “people don’t understand how ecosystems work,” their policy decisions cannot fully take into account all the ramifications. Environmental awareness is part of this equation. A planning professor explained how people are disjointed from the natural environment: “...a lot of the problems in our world [result because] people are so removed in their lives from the natural world; people are being so pulled by this economic machine.” A Professor of Ecosystem Ecology also thinks people are removed from the natural world and she referred to E. O. Wilson’s theory of the human connection to the environment in his “biophilia hypothesis.” Both professors held that “environmental awareness starts in elementary schools.”

Scientists are an important nexus among the three groups. Members of the three groups expressed their dependence on the data and “scientific evidence” collected by

them as a basis for sound decision making, resource management, and environmental protection advocacy. An environmental attorney put it, “You’ve got to have the science to back this stuff up. You’ve got to have the science first. Without the science, developers who would seem to lose millions of investment dollars on land they have bought with the intent to develop; they would sue and they would win. You can’t regulate property without good science that shows that the human health and welfare of society outweighs private interest.” Reliance upon groundwater professionals for information and education of decision-makers is important, but there is limited contact between the two groups and a lack of advocacy from groundwater professionals to decision-makers.

Evidence of the Growth Machine in a Treadmill of Development

The hypothesis that the capitalist growth imperative prioritizes economic interests in policy decisions and creates momentum for environmental disruption and depletion of resources is confirmed by this study. Growth and development historically and currently top decision-making priorities in the Memphis area. “Development” is defined as the transformation of rural land or open space into suburban residential subdivisions, shopping malls, and other commercial and industrial establishments. It is and has been a dominant pattern of economic growth and a major part of the economy in the area. The result has been ever-expanding urbanization of the landscape, creating surface land changes that negatively impact the aquifer. The preponderance of suburban development has occurred not only in response to population growth, but has also outpaced population growth, resulting from population migration outward from urban centers to new suburban centers and dispersing the population over a wider land surface area. The impacts on the

aquifer have been two-fold: increased withdrawal of groundwater in volumes that outpace recharge and surface land use changes that interrupt the hydrological cycle and recharge to the aquifer. Participants' answers to the seven concepts of the growth machine model, shown above in the composite measure of their Micro-level adherence to the Growth model, also revealed how the growth imperative creates a treadmill of development.

Commodification of water and land resources

Commodification of water was revealed in the views of it as a "product" that MLGW manages and distributes to public consumers, as the raw material for bottled water and other beverage products, and as the raw material in industrial processes. The view is that "Memphis is blessed with probably one of the most productive and potentially practically endless supplies of groundwater if it is managed properly." Access to this abundant and pure resource, for which costs of treatment and distribution are fairly low, makes expanded development possible.

Land as commodity, which prioritizes its exchange values over use values, implies the "guarantee" to land owners a right to the highest exchange value of their land. This translates to the concept of development rights, an important element of the growth machine model. "As long as it's privately owned land, we would regard that owner as having the right to bring it in for whatever type development it's zoned for," said a deputy director at OPD. Like the Monopoly game, the structure of land values is based on whether and how it is developed and used. A county commissioner explained, "If it's worth a lot of money it's worth a lot to develop. The value of property is a function of

what you can do with it.” That means that open space land has little value. “And there has been historically no argument that property within a floodplain couldn’t be developed, so it’s not priced for that thing. It’s not priced much at all; in fact it’s almost got a negative value.” This structure lowers the monetary value of “undeveloped” agricultural land, or raw land, green space, often called “vacant land.” An OPD deputy administrator explained, “We don’t consider the critters living there as it being occupied.”

Property tax structure

An urban economy based on commodification of land in which exchange values take priority over use values shapes economic growth primarily in the form of land development. The taxing structure of municipalities reinforces this structure because a primary source of their income is in property taxes. A county commissioner explained, “The city and county live on property taxes. And frankly if you don’t keep the property values up, the tax rate has to go up to keep taxes the same in effect.”

Property tax revenues are a main mechanism fostering development. Participants described about how growth is necessary for “maintaining the tax base” to pay for required services and infrastructure maintenance. Some said it was needed to “increase the tax base” so that taxes don’t have to be raised. Policymakers “don’t want to increase property taxes” because the public doesn’t like it and will move to places with lower taxes. The importance of the exchange value of property was explained by a county commissioner, “If you don’t keep the property values up, the tax rate has to go up to keep taxes the same, in effect. The city and county live on property taxes.”

The primary municipal and county sources of revenue are property tax, sales tax, federal dollars and these sources of revenue influence their land use and development decisions. One municipality has no property tax, so they emphasize commercial development for the sales tax revenues. “For us the commercial development weighs a lot more heavily because they pay state sales tax and we get a portion of that back. It’s a share of the state sales tax and we depend on a lot of that for our survival.” However, he recognized, “Even with a property tax you usually lose money on residential development. You usually don’t generate enough in property tax to offset the costs of providing services to those residents. It always costs less to serve agricultural land than it generates in tax. I guess the argument is balance with commercial, residential, and agricultural. Plan for some agriculture to remain in your community. You never want to zone out all agricultural uses,” said the natural resources director.

A Mississippi municipality has a “homestead exemption” which “if you own multiple properties, basically you file on your most expensive property and it takes you down to a third of the taxes that would be required there. And that is your county tax for that property from then on out. That will set your county tax for that property until you sell it. I think it encourages home ownership, property ownership.” The mayor of this municipality also emphasized the development balance, “You hope that by the time you get built out you’ve got a good enough cross section of commercial, industrial, and residential to distribute the costs of doing, providing services across the board.” However, tax waivers on industry can reduce municipality sources of revenue and contribute to debt. “It’s the same with industrial. I mean we’re not very heavily dependent upon their taxes that they pay because they’re waived to 10 years, or a portion

of their taxes are waived for 10 years. So you don't really become dependent on their tax base," said the Mississippi suburban municipality mayor.

A scientist explained how growth, with its increasing property values and taxes, is harmful to some groups. It's a classic explanation of the conflict between those who want to preserve the use values of their land in a system that prioritizes exchange values. "I think in many respects growth is a detriment, that it actually harms people. I look at the area right around in here where you have a lot of permitted growth and development and I look at the impact upon the taxes of people who have owned property here for 20-30 years. Their taxes are constantly going up at a rapidly escalating rate because somebody's allowing houses to be developed and now we need [infrastructure]. And those people are sitting there on property they've owned for 30 years and all they're seeing is their taxes going up and the property is not. It may be of more book value to them, but it's not of any more value to them because they only want to live there. And the logic that people use is, they could sell it for so much more, but where are they going to go if they sold it? Fayette County? Probably. That's where most of them are going. So, I think unlimited rapid growth actually harms certain segments of society. And I think it harms both ends of the economic spectrum. Because those who own a lot of land and pay a lot of property taxes, because that's where our tax is based, and those who are on a poor level who own very little land, but they still have to pay property taxes and they get very little benefit out of it. And we think of Memphis in that, but it's happening in Fayette County the same way."

Economic expansion, expansion of consumption and new markets

Two primary means of economic expansion are by expanding municipal urban growth boundaries and by annexation. Municipal leaders believe they must continually “grow” by annexing more areas of land into their boundaries or extending their urban growth boundaries. Such measures reward sprawling development by taking on the responsibilities for long-term provision of services and maintenance of infrastructure. The developers may have paid initial fees, like development fees or an adequate facilities tax, and provided some initial infrastructure like roads and donated land for schools, but municipalities eventually incur long-term debt because they bear the costs for maintaining roads, installing sewer lines and building sewage and water treatment facilities, building and maintaining schools and providing the services required by an urban environment, such as police, fire protection.

Another way to “grow” economically is to lure new businesses into an area, a practice called “boosterism.” Municipalities compete with each other for growth, so they rarely engage in regional planning or cooperative planning. A suburban municipality planner explained this competition, “They just don’t communicate; they don’t get along; they don’t see the interaction with development that’s having an effect on either side, and if they do, they just don’t care. Different states, different government ideals and they just don’t get along. And it’s very scary in a situation where Memphis is the stronghold and there’s three states touching each other right here.”

The CA reported July 28, 2007, “Three cities in Fayette County are moving to lock up all the land along the western edge of the county, anticipating an expected economic boom to follow the completion of Tenn. 385. Gallaway, Oakland and Piperton this week

submitted revised Urban Growth Boundaries seeking to add thousands of acres in Fayette County to their future annexation areas” (Kelley 2007). Other CA articles described this development expansion: “1,000 times 25” about the projected growth in residential building in Piperton of swelling the small community’s population by 1,000 new residents. The town offers “bargain basement tax rates” and the “best PILOT (payment in lieu of taxes) program in West Tennessee,” according to the mayor (Stout 2007). “Fayette farms yield crops, subdivisions,” about development spreading from Shelby County that is “changing the county from rural to suburban” (Sparks 2007). “DeSoto continues building boom” about the “growth spurt” in new residential housing in DeSoto County, Mississippi (Risher (2007). “DeSoto’s sizzling all over,” about the conversion of farmland to “suburban commercial/ retail development and subdivisions” (Wright 2007). “Annexed, but no sewers,” about the Eads community having been annexed by Memphis but after 5 years Memphis had not yet provided sewer services to the area (Charlier 2007). “Memphis blues,” about newly annexed Cordova where residents are asking “what’s in it for me?” and believe “Memphis is not doing a very good job managing what it has, much less taking on more” Downing (2007).

As municipalities become “built out,” using up all available open land on which to build, then “development moves further out into the countryside,” said a Mississippi municipality mayor. Several interviewees described how development expands outward from Memphis like spokes in half a wheel north to Tipton County, east to Fayette and Hardeman Counties, and south to counties in north Mississippi like DeSoto and Marshall. The expansion is made possible by the flat terrain that makes land development easy and water availability, as two U.S. Army Corps of Engineers employees described.

Expansion and creation of new markets is perpetuated by migration patterns. The push factors that were attributed to people's decisions to move away from Memphis were primarily schools, taxes, crime, and urbanization. An environmental advocate said part of the migration pattern is, "How you relate to your neighbors determines whether or not you want to move." Other respondents saw racism and classism related to migration from the city; crime related to a sense of not seeing any future, "so why think about the consequences; and crime reduction related to greening and re-forestation as greenways create stronger neighborhood networks.

The pull factors luring people away from Memphis were listed as: lower taxes; better schools (in Shelby County v. Memphis); cheap land prices and a desire for rural environment. A suburban Mississippi municipality planner described it, "That's probably the biggest argument in all of DeSoto County: you're taking away agricultural properties. And what you'll find is the people who really want that area are just going to go further."

An environmental reporter described the "green migration" patterns when people leave Memphis going to places like Fayette or DeSoto County, and then when that gets built up, people move farther out. "There are some people who just want to be in the country and when the country quits being country they move again." He saw the limits as "eventually you get out too far where it's not convenient. And since we're not attracting a whole lot of new people to the overall area, there's only going to be so much reshuffling of the population that we can stand."

The head of MLGW's water lab described how such migration affects the utility. "The MLGW service area is not experiencing a lot of growth and development. Most of it is basically outside the city because of taxes (people perceive they pay high property

taxes) and the price on land (raw land prices relatively cheap in outlying areas).

Businesses and residents both are choosing to locate outside the city. They want the benefits of the city but not the downside, like crime. Businesses are also locating outside the city to get tax breaks. For MLGW this means declining revenues because of the lack of growth, while operating costs continue to increase. You have to balance increasing operating costs by either raising rates or decreasing services. They are looking at ways to cut costs because their revenues are not increasing at the rate that costs rise. It's a problem for MLGW that revenues are not increasing at the same rate that costs are increasing. MLGW supplies the city of Memphis and the unincorporated areas, but most of the municipalities have their own water systems.”

The cycle of ‘green migration’ patterns was described by a natural resources director as really just “potential development. “People want to get out of the city and move to the country to a relaxed atmosphere and a pastoral setting, bucolic setting, and then if you repeat that pattern that they’re living in over and over, that setting is gone and they can’t understand what happened to their rural surroundings when, in fact, their surroundings were just ‘future development’ lands waiting to happen.”

A groundwater scientist described what enables people to choose where they live. “There are two models for that. There’s the person who can live any where they want to and they make a choice about where they want to and just choose to market themselves to that community. And there’s the person that is economically deprived and can only live where they can afford to live. And so they are forced into a scenario to only look for a home or a living area that basically they can afford to live in. They don’t have the resources to move, not locally, not regionally and certainly not globally to choose where

they live. So they're trapped and maybe they don't care for their community and they think that they're being treated poorly. And there's a visual component to that. There's no pride in the community, so things begin to happen that would not otherwise happen. But there's also an intellectually debilitating component to that as well and that resources are not made available in the community. And that's not just inner city; that's also rural areas as well." A suburban Mississippi municipality planner agreed on the visual component, "The more property you develop out, there's a decrease in the esthetics of that entire community."

Who benefits from growth

The political power of developers and related economic interests to shape public policy was revealed in two ways: (1) in how the decision-making process favors beneficiary stakeholders and "cools out" opposition; and (2) in the close relationship between some stakeholders and policymakers.

The political process

The relationship between policymakers and those who advise them helps perpetuate development. The decision-making process on development applications begins with various agencies reviewing the plans and giving staff reports to the OPD. The "technical review committee meets once per month to go over all subdivisions, planned developments," review the plans, make comments and send staff reports to OPD, said a Health Department official who makes comments on behalf of the Memphis/ Shelby County Health Department Water Quality Branch. Other agencies reporting include city

and county Departments of Engineering, Fire Department, and other departments that may be involved depending on the nature of the application. OPD then “formalizes that staff report” and makes recommendations to “The Land Use Control Board, they have members on there that are architects, engineers, as well as developers, they’re appointed by both City of Memphis and Shelby County,” said a Health Department official. “I’ll be there to speak in behalf of either the Health Department or Water Quality Branch at the Land Use Control Board meeting. We make recommendations to the Land Use Control Board. Land Use Control Board then acts on that and then they would make a recommendation to City Council or Shelby County Commission. And the County Commission and the City Council are the ones that have the final say-so.” In addition to LUCB, on groundwater issues, the Shelby County GWQCB can make comments through the Health Department official. “The city and Shelby County appoint members to the Ground Water Quality Control Board. So, in essence, they act through the GWQCB and they have given the GWQCB the authority to promulgate rules and regulations for the protection of groundwater within Memphis and Shelby County.”

The political process of land use decision-making is “a one-sided process,” a county commissioner explained, with the applicant, often a developer having advantages over the neighborhood and general public. It is adversarial; the meeting times of the decision-making bodies are inconvenient for the working public; developers can wear out or ‘cool out’ opposition by deferring cases; developers are often large financial contributors to policymakers’ campaigns and help get them elected in other ways; the policymakers only apparently listen to public comments, but they already made up their minds before the public meeting. He explained, “The process by nature is adversarial because the applicant

shows up usually well-funded and has a political plan for his development already in place. And if it's going to be tweaked or opposed, it's going to be done by the staff or the neighbors. The staff is semi-prepared because they don't have as many technical planners. Most of the neighbors are not sophisticated, don't understand the process. The applicants can wear their opponents out just by deferring cases. The Land Use Control Board meets in the afternoon; the City Council meets in the afternoon; so does the County Commission. So if you work for a living, as most do, or have children who are in school and you need to take care of them when they get home, it couldn't be more inconvenient. So the applicant gets to come down there at the last minute and say, we're not quite ready today, so they postpone it for two weeks. And people just get worn out. They have to pay to park; they've got to go through security to get in the building. And besides that, you don't know when the case is going to be heard; you could sit there and wait for three hours. And unless the planning department is really on its toes, then you have an elected body that look like they're listening, but they made up their mind five weeks ago."

A League of Women Voters participant reported similar experiences, "When I have gone down to City Council meetings, I have been very disappointed when I have seen something in verbal conflict between developers and someone who lives in that area and doesn't want it developed. And the developers *always* win the City Council vote, even when the Office of Planning and Development has ruled against it." She told of her work over a span of 18 months with the City Council on removing illegal billboards and how, at one committee meeting, a City Council member who "had never been to a meeting, walked in the door, slammed down in their chair, literally, and said, 'I think billboards

are beautiful and I vote for them.’ There wasn’t even anything on the floor to vote for at that moment.”

This information parallels the findings of Gould et al. (1996): proponents of natural resource protection were unable to wield decision-making power because developers and state officials had more resources. Developers had easy access to capital and technical expertise, resources which were a part of everyday business, and political ties with elected officials. The structure of decision-making favors development and growth over environmental protection. It effectively prevents opposition voices and forces from having significant input into the decision-making process. If the same system is found in other municipalities, which appears to be the case from newspaper reports, then sprawl-type development will continue to be perpetuated in the region as a whole and groundwater protection overlay zones will be difficult to implement, especially in neighboring counties where recharge areas exist.

The growth coalition

As shown above, the LUCB is an important intermediary body which recommends policy to those who codify it. I was not able to interview members of the LUCB for this research, but I was able to obtain a list of LUCB members from a City of Memphis administrator. I was not provided contact information and requests for information about their occupations received no response. However, a search through Memphis directories for information about them uncovered the occupations and business associations for eight of the nine regular members and five of the eight alternate members. Their occupations/positions are: realtors, architect, president of a construction company, home builder,

developer/realtor, daughter and business partner of a prominent developer in the area, and owner of an engineering and building construction company. Those of the alternate members are: President of “one of the largest residential building and development companies in Memphis and Shelby County,” according to information from his web site; owner of a real estate company; architect with a company that frequently receives contracts with local municipalities; corporate real estate advisor; and Vice President of Greenscape, Inc. It can be concluded that the general interests of LUCB members are tied with real estate development.

Chambers of Commerce also promote economic growth, as a Chamber official commented, “New housing, new development, new roads, new infrastructure, more roofs, ...when people are building houses and all those things are going on, that’s employment. And that employment is probably the basis for a strong growing economy. And from the standpoint of building new houses, it’s good from an employment standpoint. Having a less than fully utilized existing infrastructure in the city, whether that’s roads or utility services or roofs or housing can in many cases be viewed as a negative.”

An OPD deputy administrator explained the close relationship between developers and decision-makers, “The former County Commission: not only did they have influence over them [developers], but they were the same people! There’s still influence [by developers]. It might be more on the city side now than the county side. I don’t know if this commission has been sitting there long enough to determine that. And I think the council is going through some changes, too.”

A county commissioner noted the relationship between two developers and some policymakers in campaign financing. “A good number of elected officials have received

most of their campaign financing from two guys and their friends. Two guys! These two guys are big time developers, and they pretty well controlled the majority of commissioners, before this present county commission and city council [were elected]. Now the recent ‘Tennessee Waltz’ [FBI investigation of political corruption] and whatever they called that thing downtown, [he refers to ‘Main Street Sweeper’ FBI investigation of political corruption] has caused a lot of this activity to absolutely freeze.”

A former City of Memphis employee and environmental advocate also referred to the link, “I’ve never heard a politician say they were anti-growth because it’s political suicide to say that. They all say it. I think sometimes they say it, too, because of their campaign contributions. You know, developers do give money to politicians, and then they expect something in return.”

Additional archival evidence supported the links between developers and policymakers. The *Commercial Appeal* (CA) reported on a “Billboard owner’s ...relationship to the Memphis City Council’s money-for-votes scandal” in 2006 (Aaronson 2006). This article was one of several that also covered the “indictments of [two] City Councilmen” for receiving money in exchange for their support of removing a Board of Adjustment chairman to replace him with a chairman who would “benefit clients” such as the billboard owner. The *Commercial Appeal* published a “Tennessee Waltz Status Report” in December 2006 listing the state and local officials indicted on charges of political corruption (Buser 2006).

The *Memphis Flyer* reported about city government ties with developers being initiated and carried out by the city’s chief financial officer, who is also “head of the Division of Housing and Community Development, executive director of the Memphis

Housing Authority, chairman of the board of LeMoyne-Owen College, and the mayor's representative on committees exploring new uses for The Pyramid and the fairgrounds.” The *Flyer* reported how he and the city mayor teamed up with developers for “history-making change: the end of public-housing projects” in Memphis. “Spurred by loss of residents and a stinging federal audit in 1997, Memphis Housing Authority began demolishing them and building \$122 million worth of mixed-income communities” (Branston 2006)

The *Memphis Flyer* and *Commercial Appeal* have printed several articles on the relationship between developer Rusty Hyneman and a \$40,000 Rolex watch that he gave to State Senator John Ford allegedly “in return for special legislative favors” (Perruquia 2006; Williams 2007). The *CA* reported several articles on the “indictment of 12 public officials and aids in 2005, including former county commissioner... and his son, former school board member” (Jones 2006). Another reported the City Council Chairman resigned his position as architectural consultant for Memphis City Schools after the *CA* “detailed how he and business partner... received more than \$4.8 million from fiscal year 2003 and 2006 as consultants for both Memphis City Schools and the city Board of Education” (Aaronson 2007d). Another article reported the FBI undercover evidence against the Shelby County Commission’s former top aid: a tape recording “that an unidentified developer told him he had saved him nearly \$1 million because of how a commission vote turned out.” The aid “was recorded boasting that he would pay former county commissioner...to support the grant.” The alleged bribe was to support “Glenview Community Development Partners with a \$100,000 grant proposal and that [the aid] would encourage commissioners to approve the grant (Buser 2007). An in-depth

Commercial Appeal series of articles on the corruption indictments included “that \$1,000 bribe for a zoning vote” that cost a city councilman “two years in federal prison” (Perrusquia 2007).

Another City Councilman was “among an increasingly embattled cadre of local politicians whose business interests in Memphis City Schools create uneasy intersections with public duties. Since he took office in November 2005, [his] law firm has collected \$113,247 in legal fees from Memphis City Schools – an agency whose annual budget is approved by the City Council – as [he] has served as an outside attorney for the school system” (Aaronson 2007a).

Charges of undue political influence were made against MLGW President Lee and a City Council member who was influential in getting him appointed to the post and then received forbearance and preferential treatment on his \$16,000 utility debt (Aaronson 2007b). The crux of the case against the City Councilman is that he “used his position on the City Council to benefit MLGW improperly in exchange for leniency on his more than \$16,000 in debt to the city-owned utility” (Aaronson 2007e). A former MLGW President told of a meeting he had with Lee shortly before he was sworn because “Lee doesn’t know anything about the utility business, so he should have qualified people to advise him. I gave Lee the names of competent, qualified people [at MLGW] who could help him. Then when Lee became President, he got rid of all the people I recommended to him who could help him run MLGW well. In fact, the best was escorted out of the building with no retirement or severance package whatsoever.”

The relationship between business interests and policymakers extends beyond the bounds of Shelby County. In a Mississippi municipality, the planning director explained,

“There’s a lot of trust between developers and government down here because the developers are, in fact, residents and have been forever down here. You know, most of the landowners are the developers of the land. It’s family owned land and there’s probably 5 families that own most of the land in DeSoto County.” She also revealed, “My step-father was a very large developer in Memphis.”

In Fayette County, Tennessee, “Construction is a real important part of Fayette County’s economy,” according to the county planner. “Still, we try to cluster it, we try to control the timing, pace, the location, and density of development out here. We have some growth management tools in place and have had for about 15 years. We like to see the towns grow by the use of the land they’ve already got, not by pushing out the borders of their urban growth boundaries to accommodate the ambitions of some developers who want to more easily be able to sprawl their development. They’re often pushing the towns to do this because the county is in the growth management business and the towns really aren’t. And if they can induce the towns to expand their urban growth boundaries,” then they have more land to develop.

Indications are that development is a major “industry” in the Memphis area. A business owner said, “Development is the economic driving force of the entire United States. That’s a given fact. Developers in this city are one of the largest employers.”

The treadmill of development is like a “Catch 22” system. Policymakers feel they must have growth and development for jobs, for community vitality, for quality of life, and primarily for the tax money to pay for required services and infrastructure construction and maintenance, the costs of which keep increasing. So policymakers believe they either have to increase their tax base or increase taxes. And no politician

wants to increase taxes. The competition among cities for new industries, “boosterism” ends up costing them further reductions in potential revenues because of the “incentives” they believe they have to offer to attract new business.

Changing nature of decision-making

Decision makers are changing their perceptions about the long-term value of unlimited development and now emphasize “smart growth” and managing growth. A natural resources director explained, “Growth is going to come to your community and when people that try to stop it, ultimately those efforts fail and you end up with growth somewhat uncontrolled. For us, the key is to manage it. Not try to stop it, but just manage it and make sure you get something that’s going to be valuable to the community. If a development doesn’t look like it’s going to provide long term value and be something we can be proud of in the future, something’s wrong that we should look at pretty closely.”

The change in thinking has resulted from the fiscal debt problems that unlimited growth with unlimited obligations for public services brings, which the tax base cannot handle. A natural resources director explained the dilemma, “Even with a property tax you usually lose money on residential development. You usually don’t generate enough in property tax to offset the costs of providing services to those residents. And they always say you should balance things with agricultural; it always costs less to serve agricultural land than it generates in tax, and commercial. Always be careful to balance commercial, residential, and agricultural. And plan for some agriculture to remain in your community. You would hope that we wouldn’t be that short-sighted to think that agriculture’s not an important part of our community.”

He also explained differences between short-term benefits and the long-term debt cycle: “Unmanaged growth is detrimental to any community. Maybe not immediately; it might have an immediate perceived positive impact [on the] tax base, and with the rooftops comes commercial development. But if it’s not managed, I think the community will pay for it in the long run. They’ll wish they hadn’t done that. They’ll have some of the infrastructure problems to fix and then they’ll have no financial means to do it. They’ll see themselves starting to go into a fiscal hole and then they will probably realize they’ve lost the character of their community and what made it attractive in the beginning for people to move there. And then property values don’t go up enough; they either plateau or start to decline.” And that perpetuates the cycle of migration and sprawling development.

Other factors that contribute to change are term limits and exhaustion of natural resources. In Shelby County, term limits that have replaced a number of long-standing county commissioners with people not so closely tied to development. Several municipalities are nearing or becoming “built out,” that is, using up all available raw land (‘developable land’) to ‘develop’ into residential, commercial, or industrial uses. Memphis and Shelby County and some municipalities like Germantown are now emphasizing infill and redevelopment of declined neighborhoods. Lakeland, which has no property tax, is stricter in kinds of residential development it allows, although non-office commercial development is promoted because it generates sales tax revenues for the municipality.

Development codes are also in the process of change. An OPD deputy administrator described these changes in zoning and development regulations, “A Uniform

Development Code has been worked on over the last year and a half. Whatever code comes out at the end will certainly be an improvement over what we have now, because well-meaning people who [previously] set the rules in place, were progressive at the time they were adopted, but now they're creating these landscapes that are not what we want. And so we have to go back and re-do those regulations." She also said the changes will allow "more control over where and what form development takes," and the "trend toward preserving green space." She talked about better "ways to determine cost of services and how much development can be afforded." The natural resources director recommended using the American Farmland Trust formula. A groundwater scientist agreed with the need to "develop greenway systems. And that helps the economics of the area because people take interest in and investment in their communities because there's trees and lakes..." and more green space for a better quality of life.

Conclusions: The Treadmill of Development

Why do policymakers develop natural resources policies that are unsustainable when the ecological stakes are so high? The data show the dominant policy paradigm that contributes to these unsustainable policies is the growth paradigm, which promotes a treadmill of development that uses land and water resources unsustainably. The assumptions of the synthesized growth model are reflected in the perspectives of policymakers and business leaders. Businesses interests are a strong influence on policymakers and their interests are often prioritized in policy decisions.

Policymakers' decisions perpetuate a treadmill of development, in which economic growth and development take priority. Policymakers believe they must have continuous

economic growth and development in order to generate the income needed to provide the on-going requirements for services and infrastructure (and infrastructure maintenance) and to create the jobs in their communities. They feel pressures to increase the tax base without raising taxes. This means that they must keep property values up to generate needed revenue, but as property values go up, so do taxes. Then those taxpayers who can move to areas of lower taxes do move, and those who cannot or choose not to move, must 'make up the difference,' which is difficult if one lives in an area of declining property values. The new growth, in turn, creates additional requirements and costs for services and infrastructure construction and maintenance. So growth must be expanded to generate the required additional revenue and policymakers become dependent on new development. The development treadmill relies on commodification of land, prioritizing its exchange value, and converting open space land to the built environment, which results in declining open space/ green space.

The result is a cycle of boom and bust in which newly developed residential communities and their concomitant commercial shopping areas are vibrant for a while, and then when circumstances prompt the more affluent residents to migrate to the next "new" development, the communities they leave behind begin a downward economic decline as business also migrate to the "new" development areas. This leaves municipal governments with ever-expanding obligations for providing services and maintaining infrastructure for populations. Some have termed this, "dual" obligations, maintaining older established areas and newly developing areas. As a result, municipalities incur debt because the income from established communities, tied to property values which may be declining, does not meet the financial requirements to meet their obligations. So

municipalities must annex more land areas to keep up with the migrating more affluent population.

Recently, there have been some changes in policymakers' views about approving virtually all new development. The costs of these "dual" obligations have been a main factor in changing their thinking. Emphasis is moving toward managing development and "smart growth" concepts that emphasize infill and re-development, encouraging growth in established areas where no new infrastructure construction is required. Smart growth beliefs include clustering development, mixed uses, and incorporation of more green space. Development codes are being revised in conjunction with these changing views.

The treadmill of development, with its continuous and unlimited requirement for growth, works in contradiction to the finite natural resources that support it – limits to available open space land to build upon and limits to the water resources available to support unlimited growth. While policymakers' views in Shelby County and a few other communities, some of which are becoming "built out," may be changing toward managed growth and "smart growth," there is evidence that traditional forms of sprawling development continue. Policymakers in counties adjacent to Shelby County may still be focused on the short-term benefits from increased development, while not considering the long-term indebtedness this growth will generate. Some have the belief that this increased development will not affect the aquifer. An OPD deputy administrator sees these policymakers as making the same mistakes that Shelby County policymakers made in the past. The problem is that the treadmill of development is now moving into the largest aquifer recharge area, where land use changes are forecast to have detrimental long-term effects on the availability of water resources.

There are strong indications that development and its consequent land use changes will continue to infringe on a main aquifer recharge area in Fayette County. The completion of Hwy. 385, I-69 along the Shelby County/Fayette County border promises to bring expansion of development to that area. The municipalities in Fayette County have already asked to expand their urban growth boundaries. A several-thousand-acre piece of undeveloped land east of Collierville on the Tennessee-Mississippi border is slated for development, as was reported July 12, 2007 in the *CA*, "Piperton land buy beckons suburbia." The article described, "One of the largest land deals in the history of Fayette County could turn 3,200 rural acres into suburban subdivisions, shopping centers and possibly a school." This will all be built atop a main recharge area. In Fayette County communities like LaGrange, "The sandy hills that LaGrange sits on *are* the Memphis Sands. So it's *not in* the ground. You're standing on a big sandy hill side that's the top of the Memphis Sands!" said an environmental advocate/attorney.

The treadmill of development continues into counties in northern Mississippi. An OPD Deputy Administrator forewarned, "Wait until Marshall County [MS] starts really developing. There's a lot of recharge area down there. It's a regional issue." Laying public water lines in Marshall County, Mississippi is a first step for more development into that part of the recharge area. This information was received by e-mail from a resident there: "Marshall County just got a grant to put in water to our area. I know they are wanting us to get on the system as they have tried to do so in the past. At that time we had and still have a community well for this road. Paul and I put in our own private well several years ago. It is a deep well not shallow and I think I would prefer to stay on it if we have that option which we may not have."

The treadmill of development could have some possible impacts in already developed areas, too. The latest groundwater research information presented by GWI on October 3, 2007 shows a number of breaches in the clay layer where surface water and its concomitant pollutants can more quickly reach the deeper Memphis Sands aquifer. These breaches are all within the limits of Memphis and Shelby County. With the emphasis of growth and development in the forms of infill, re-development, and brownfields development within the City of Memphis, what will be the impact of this additional urbanization and possibly increased withdrawal have on the aquifer? What will happen in the area around Lichterman well field where the shallow aquifer has already been depleted?

The Memphis area is at a critical point at which decisions made about land use, development, and groundwater protection from now on will have substantial impacts on the sustainability of the aquifer that sustains human communities in the region. Even though the lawsuit had little or no impact on the perspectives of most stakeholders, it has brought the attention to the critical point from which future decisions about land use and aquifer withdrawal will determine affect its sustainability. It was a catalyst for the county director of public works to spearhead another study of the aquifer and sparking his concern about having a set of “best management practices” to guide future land use decisions.

But to an environmental advocate/attorney, the lawsuit seems unlikely to prompt the real changes needed, “We need to have a good idea of how much recharge area is needed to sustain. We are way behind the curve in getting that because there’s really no incentive. You’d think the lawsuit would be an incentive to get busy, but it’s certainly

not.” If that information is not available and development continues, “You’re going to be covering up recharge areas that you don’t even know you had.”

He speculated on the likely outcomes of the lawsuit, which can also predict the routes future decision-making could take. “If we lose, it’s going to cost the taxpayers a whole lot of money and we’ll be getting some drinking water out of the Mississippi River. That’s going to be a shock to everybody. If we win, there’ll be no outcome. Nobody cares and it just goes away. So if there’s something in between, which is the best outcome, where this kind of tri-state conference pulls together, like MAT-RAS or something...” alluding to the need for a regional organization or compact to coordinate and oversee decisions that impact the aquifer. “We’ve got a limited window of opportunity to regulate in the next 5 to 10 years; beyond that, we’re going to lose it. And that’s a shame. This Mississippi lawsuit, it’s not a positive step, but it’s a first step to pushing the issue.”

Several interviewees see the solution to the emerging problems of maintaining the quality and quantity of the groundwater in the future: an immediate need for a regional aquifer protection regulatory body or regional compact. A groundwater clean-up engineer explained his experience with California’s water regions, “That’s how California is set up. They have a thing called CAL-EPA, which is their version of TDEC or EPA. They have nine regional water quality control boards and they’re divided by the watersheds, not divided by political boundaries. And each regional water board sets their own standards so they can make them stricter for water quality and then they oversee the cleanup of these underground tank projects. They have final say over the NPDES program.”

Such a body would need regulatory power to carefully weigh the impacts of land use changes on the aquifer; would need accurate, reliable, and continuously updated information about the amount of water being withdrawn and the power to regulate withdrawals; would require the cooperation among scientists and universities in the three states, like a continuation of MAT-RAS, to continue accumulating knowledge of the aquifer and human impacts on it. They saw the structure and functions similar to that of an expanded Groundwater Quality (and Quantity) Control Board, or like the Chickasaw Basin Authority, or something like a watershed authority with multi-political boundary jurisdiction. Some saw the need for federal regulatory authority since it is a multi-state issue.

What route decision-making about aquifer protection takes from now on will determine whether future generations will have the same pure quality and abundant resource that present and past generations have enjoyed. There is evidence that a small number of concerned policymakers, business people, scientists, and environmental advocates are interested in making that policy. But it remains to be seen whether this small group can influence a majority of policymakers toward regional aquifer protection.

CHAPTER V

CONCLUSIONS: STEPPING OFF THE TREADMILL OF DEVELOPMENT

The region currently faces some serious damage to its water source from over-pumping, land changes that impair recharge, and increased risk of contamination if public policymaking continues on the same pro-growth track as it has in the past. This chapter presents the current fiscal and environmental problems that have resulted from pro-growth policy, possible alternative models for policymaking to incorporate protection of environmental resources, and the prospects of local policymakers' willingness to step off the treadmill of development. Solutions to the current dilemma require a holistic, long-term view and a pro-active approach that exposes the interests and factors perpetuating the treadmill and replaces them with a comprehensive, democratic decision-making process that incorporates the cumulative environmental impacts of policy. The problem is a regional problem and requires coordination among the tri-state policymakers, researchers, stakeholders and the public.

Current and Foreseeable Groundwater Problems

On October 3, 2007 at the University of Memphis, the Groundwater Institute presented results from its recent groundwater research to an invited group of local policymakers, business people, scientists, and environmental advocates. Three "foreseeable concerns" about the integrity of the area's drinking water are: (1) how contiguous is the protective clay layer over the primary drinking water aquifer, and to what extent do breaches in the clay layer exacerbate the potential for contamination? (2) Is the consumption rate of groundwater greater than the rate of natural replenishment? (3)

As development moves into the groundwater recharge areas, what impact will there be on water sustainability and quality? (Groundwater Institute presentation packet)

The importance of concerns #1 and #3 lie in the relationship of the aquifer structure to land use decisions. Areas where the confining clay unit is thin or missing and areas where the aquifer is unconfined and is directly recharged by local rainfall are the places where the aquifer is most impacted by surface land changes. In places where there are “breaches,” the aquifer is more susceptible to contamination from urban runoff. And in places where the aquifer is unconfined, the aquifer is also susceptible from contamination and recharge is impaired by land changes that make permeable land surfaces less permeable or impermeable. In this case and others like it throughout the U.S., land use decisions and their concomitant land changes primarily result from the priorities of economic growth and development, the commodification of land and priority of its exchange value, and development as a major part of the economy.

Concerns #1 and #3 are about potential changes in the quality of the aquifer water, i.e., risk of contamination. High quality water is very important not only for public health, but also because a pure resource considerably cuts the costs of treatment before use by consumers. Contaminated groundwater is extremely difficult and expensive to clean up. The map locating the breaches presented by GWI shows that the most of them lie within the bounds of the City of Memphis. As economic growth policy decisions direct development toward infill and redevelopment of existing neighborhoods, these aquifer impacts should be taken into consideration.

Concern #2 is whether withdrawal rates exceed natural replenishment rates. Over-pumping an aquifer can result in water shortages; water conflicts over decreased supplies;

can permanently damage the aquifer structure and its capacity to hold water, and such damage can be followed by land subsidence. Information presented by GWI, taken from U.S.G.S. 2000 data, show in millions of gallons per day (mgd) the withdrawals by the three states that are primary users of the aquifer. The percentages withdrawn are categorized by users: agriculture, industrial, thermoelectric, and public supply. The data show that Mississippi withdraws 2,180 mgd, with 75% of that water used for agriculture. Arkansas withdraws 6,920 mgd, with 97% of that water used for agriculture. Tennessee withdraws 417 mgd, with 84% of that water used for public supply (University of Memphis Groundwater Institute presentation packet). From these figures, the cumulative amount being withdrawn is 9,517 mgd in the tri-state region. That totals 3,473,705,000,000 gallons per day per year or nearly 3 ½ trillion gallons per year.

Concern #3 about development in the recharge areas is an issue in which political boundaries do not coincide with ecological boundaries. Recharge in the immediate area takes place in southeast Shelby County, nearly all of Fayette County extending into Hardeman County, Tennessee and into Marshall County, Mississippi. The fact that aquifer boundaries and recharge areas overlap numerous political boundaries creates the need for a regional approach to aquifer protection.

Lambin and Geist (2007) researched the diversity of causes of land-use changes historically and globally. They found:

...a limited number of syndromes of land use-change processes are observed repeatedly around the world. Despite the diversity of causes of land-use change, there are some generalizable patterns of change that result from recurrent interactions between driving forces. Even though these sequences may play out

differently in specific situations, their identification may confer some predictive power by analogy with similar pathways in comparable regional and historical contexts.

From the twelve general causes of land use changes they identified, the ones that fit this region are: “urbanization-driven changes in regional consumption patterns and income distribution with impacts on rural land use;” and “policy interventions that drive modifications of landscapes and ecosystems.”

Pro-growth and development-oriented policy has brought these urbanization-driven land changes and indications are that it continues into neighboring Fayette, DeSoto, and Marshall Counties, all of which are groundwater recharge areas.. The treadmill of development is the main barrier to groundwater protection. As long as it remains in place, urbanization land changes will continue, protecting rural areas and setting aside green space will continue to be difficult, and it will be most difficult to limit or prohibit development in the recharge areas. The treadmill is also the barrier that “green migrants” face in trying to maintain use values of their land and rural landscapes where they wish to live. If groundwater is to be used sustainably used and protected for the future, then growth-oriented public policy must be reconsidered.

Treadmill of Development

In the Memphis area the growth imperative historically has been and currently continues to top decision-making priorities. “Development,” defined as the transformation of rural land or open space into suburban residential subdivisions, shopping malls, and other commercial and industrial establishments, is and has been a

dominant pattern of economic growth and a major part of the economy in the area for decades. Smart Growth America (2004) compiled a “Sprawl Index for Memphis, TN – AR – MS Metropolitan Statistical Area (MSA)” rating it on four sprawl-related factors: residential density; mix of homes, jobs, & services; strength of town centers; and accessibility of street network. The area’s overall sprawl index score was 92.15, on a scale of 0 – 200 with lower scores indicating more sprawling. Smart Growth America ranked it 31st most sprawling of 83 metro areas measured.

Trends in the Memphis MSA 1980-1990:

- City of Memphis population declined by 36,000 people
- Shelby County population increased by 50,000 people
- Population in unincorporated areas of Shelby County increased from 60,000 to 120,000 people
- City of Memphis lost approximately \$12,600,000 in State shared taxes during the decade, primarily due to population shifts
- City of Memphis lost an estimated \$35 million in state tax apportionments between 1996-2000 due to population losses
- School enrollment: 1980: city, 112,396; county, 25,968
- School enrollment: 1990: city, 104,720; county 37, 675
- Demand for new schools in non-urban growth areas of county to serve 46,000 new students generated need for \$560 million for new school construction

Trends in the Memphis MSA 1990-2000:

- 1990 Memphis MSA population: 1,107,306
- 2000 Memphis MSA population: 1,135,614
- Percent change 1990-2000: 12.7%
- 1990 suburban population: 396,969
- 2000 suburban population: 485,514
- 1990 Core city population: 610,337
- 2000 Core city population: 650,100
-

(Data from interviewees, U.S. Bureau of Census and University of Memphis Regional Economic Development Center, Sehenk 2005)

Ciscel (2001) described key features of “economies of sprawl,” typified by the regional economy of the Memphis, Tennessee area. Defining *sprawl* as “geographic

growth unrelated to population pressures,” he described how Memphis has experienced considerable sprawl during the last half of the twentieth century. While sprawl creates new economic and social burdens, they “are not immediately apparent. For most urban residents sprawl seems to be a fundamental part of the process of urbanization” (406). Suburban development in the area has occurred not only in response to population growth, but has also outpaced population growth, resulting from population migration outward from urban centers to new suburban centers and dispersing the population over a wider land surface area. The result has been ever-expanding urbanization of the landscape.

Ciscel (2001) demonstrated the economic inefficiency of sprawl, how it “raises the costs of operating urban infrastructure. The short-run competitive advantage of new suburban malls and neighborhoods becomes a long-run disadvantage in higher maintenance expenses. And the structure of urban sprawl, with its functional segregation of residential and commercial activities, is the clear source of the cost inefficiency” (406).

Other factors contributing to sprawl are race and class. Ciscel (2001) showed the highly segregated nature of housing between Memphis and Shelby County suburban areas in terms of income level and race. “Slightly more than 80% of households with income less than \$25,000 per year lived in the city, as did 90.4% of food stamp recipients. Almost 80% of housing costing less than \$450 per month was in the city, while almost 70% of housing costing more than \$1,000 per month was in suburban Shelby County. Nine out of ten African Americans lived in the city, but only six out of ten whites. Suburban Shelby County had higher median household incomes and fewer

households living in poverty or receiving food stamps.” Median family income in Shelby County suburbs is double that in Memphis: \$52,263 and \$25,050 respectively (407).

Racial divides perpetuate movement to the suburbs and dual school systems. “The city school system is predominantly black, while the county school system is mostly white. Movement to the suburbs by middle class parents – both black and white- is precipitated by the perception that the city schools are inferior. Both systems have become considerably more expensive to operate [and have] experienced expenditure growth in excess of inflation” (Ciscel 2001: 408).

Sprawl’s reliance on automobiles and commuting results in increased gasoline energy use and air pollution. “In the Memphis MSA, personal vehicles provided transportation for 91.8% of workers. The automobile is almost the only form of transportation used or available for intra-city trips. The car encourages the low-density, sprawled city but the costs imposts are three-fold: lost labor income from commuting time, high automobile operating costs, and reduced environmental quality”(Ciscel 2001: 407).

“The new sprawled city is expensive both in terms of investment capital and maintenance costs” (Ciscel 2001:407). The maintenance of dual and expanding infrastructure systems (city and county) is increasing the debt to Shelby County government and local officials now recognize its difficult manageability. “From 1988 to 1999, local governmental debt rose rapidly. Total long term debt rose 189.3%; city and county school debt rose 367.7%; Shelby County government debt rose 309.8% while Memphis city government debt rose only 53.4%” (Ciscel 2001: 408).

“Ironically, the choices presented in today’s sprawling cities contribute to its inefficiency. Residents are tempted to abandon older neighborhoods in favor of new ones.

Sprawl increases social costs of infrastructure construction and maintenance” (Ciscel 2001: 409). As an alternative to sprawl, he refers to the “reform movement aimed at a more compact urban environment” called New Urbanism, “developed by researchers and writers who believe the modern city and its suburban companions are not viable for the long run; that sprawling cities are dysfunctional” (409). Yet he contends that is the economic efficiencies of urbanism that have spawned the inefficiencies of sprawl. “The data imply an alarming characteristic of the modern metropolitan area – it is becoming less cost-efficient. Growth brings a long-term condition of geographic diseconomies of scale, notably in commuting and infrastructure provision” (Ciscel 2001: 409).

The small urban municipalities in Fayette County face the same pressures that Shelby County suburbs have already experienced: pressure from developers who want to build more on rural, suburban land; citizens who want to move further away from the city, yet demand urban-level services, and want a small town atmosphere with green space and no city property taxes. The formula for growth through the treadmill of development is unsustainable and leads to fiscal indebtedness for governments because it creates “geographic diseconomies of scale.” It creates a need for duplicate infrastructures, an insufficient tax base, and a cost-benefit analysis scheme that has not incorporated the full costs of development. The fundamental issue of how to finance the embedded costs of this new development over the long-term is rarely addressed, yet it can substantially increase the population in communities with demands for increased infrastructure and services.

The treadmill of development serves the interests of those who financially benefit from development, who also hold decision-making power, while the public in general

bears the long-term costs of “externalities.” This is the case because system of taxation never generates sufficient revenues to pay the costs of new development, so governments incur long-term debt because they are reluctant to have those who benefit from the system pay the true costs of the system. The ever-expanding urbanization permanently alters the landscape and these surface land changes negatively impact the aquifer: (1) increased withdrawals of groundwater in volumes that in some places outpace recharge and (2) surface land use changes that interrupt the hydrological cycle and make pervious surfaces less permeable.

Sprawl has been a nation-wide phenomenon for U.S. metropolitan cities since World War II. Freilich (1999) traced the history of sprawl type growth beginning in the post-World War I years to the 1950s Interstate Highway system, which spawned the pattern of sprawling, low-density residential development nationwide. “While sprawl seemingly accommodates the greatest amount of growth, it requires significant development of new facilities and services, with accompanying abandonment and underutilization of existing facilities. Sprawl also increases development coats to the suburbs, diminished the environmental factors needed to sustain viable economic growth, and requires consumption of the greatest amount of agricultural land, energy, and natural resources.” Further, “sprawl has been dominated by social forces which reflect the desire for a rural lifestyle coupled with an urban income” and urban amenities. It is fostered by “the political power of development interests and supported by legislative mandates” such as “income tax deductions for single-family mortgage payments and property taxes” (Freilich (1999: 16). He lists six major crises that sprawl has engendered for metropolitan

areas in the U.S.:

- Deterioration of existing built-up areas
- Environmental degradation – loss of wetlands and sensitive lands, poor air and water quality
- Over consumption of gasoline energy
- Fiscal insolvency, transportation congestion, infrastructure deficiencies, and taxpayer revolts
- Agricultural land conversion
- Unaffordable housing

Freilich makes a strong case for the need for “smart growth” as he documents the effects of suburban migration on the central city, focusing on the “exclusionary techniques designed to keep the ‘undesirables’ from moving into predominantly middle-class suburban areas (253). The resulting economic and racial separation between the city and suburbs drain the central city of many of its resources. He states that “redeveloping cities need to devise strategies and implement policies to address a web of entangled and mutually reinforcing dilemmas” (254). Interviewees in this research noted a similar interconnected web of urban problems that are related to groundwater protection and effective protection of recharge areas from excessive suburban development.

The plea for “smart growth” has also been part of the Sierra Club’s answer to sprawling growth for a decade. An article in *The Tennes-Sierran* promoted managed growth ideas that include clustering homes and businesses in pedestrian-friendly town centers surrounded by farms and open space (Kelly and Butcher 1999). Another Sierra Club publication, *The Planet*, described how taxes on the general public subsidize sprawl. “When a new residential or commercial development springs up outside an existing community, roads, sewer systems, water lines, schools, police and emergency services” all have to be built and/or expanded. “In most cases, neither the developers nor the new

residents pay their full, fair share.” The rest of the population must make up the difference. The article cited the example of Pima County, Arizona which allows “wildcat subdivisions.” Each new home” costs the county \$23,000” in costs for new services and infrastructure, while “contributing only about \$1,700 in new property taxes” (Cain 2000). Thus, sprawl-type development increases county expenditures and general taxes, which interviewees cited as a major reason for migrating from Memphis to outlying areas.

Changes in policymakers’ perceptions and policy process

There is some indication that unlimited growth policy is undergoing change. This research shows the beginnings of a paradigm shift in some policymakers’ perceptions about uncontrolled, sprawl-type growth. Many participants talked of “smart growth” and managed growth policies, rather than approving every proposed development as if all were good for the community. Another indication of change is that new codes for land use zoning are being developed and updated into a Uniform Development Code (UDC) for Memphis and Shelby County. Evaluation of the pro-growth orientation of the new UDC and its environmental protection capability is outside the purview of this research.

However, the reported changes are a reaction to several impacts of sprawl-type growth policy. (1) Cities are becoming physically limited in the available land space to “develop.” Interviewees noted several cities which are nearing or are already “built out,” yet municipalities still budget on a percentage of new houses/ development per year. (2) Shelby County has incurred long term indebtedness, mainly resulting from the expense of maintaining two sets of infrastructure and the larger population areas to which they are responsible for providing services. (3) Cycles of boom and bust in neighborhoods

contribute to the loss of tax base, as more affluent residents migrate to newly developing areas and declining neighborhoods do not generate the level of tax revenues (both sales and property) that they did when “booming.”

A main question is whether this limited “paradigm shift” this may evolve into a broader paradigm shift toward sustainable public policy that incorporates consideration of the impacts on natural resources and ecosystems in all policy decisions, particularly land uses. As a director of public works said, “The whole idea ... is to sustain and protect the resource that we’ve got. And if we don’t, we can either pay for it now, or we can pay a monumental amount later. ...and when I say near future I’m talking about 5 to 10 years...” The idea to sustain and protect “what we’ve got” can be applied in a more holistic context to alternative ways that municipalities can sustain themselves without relying on a “treadmill of development.” As policymakers have experienced, if growth is not controlled and if they don’t pay now, they will pay later.

A groundwater scientist commented on the influences that sway policymakers’ decisions away from groundwater protection. “I think the non-governmental voice of society has too long been silent in the area of water supply. Historically the University has been an independent voice making citizen and government officials alike aware of the need for change. A former president of MLGW once told me that the University’s role was to prepare to answer the questions which will be asked ten years from now. Unfortunately, he has been fired and those who replaced him have not found his vision. Government officials only have a four-year horizon of sight. When strategic planning is practiced, the results are ignored the closer one approaches election year. Without an independent voice reminding the elected leaders, they will continue to be reactionary,

always trying to come up with a last minute fix. With our form of government, the issue boils down to dollars – limited resources with an almost unlimited need. The challenge is how to work with the inefficient form of government that we have with the incompetent, sometimes criminal, element who ‘serve.’”

Existing Alternative Models For Economic and Equitable Growth

There are several existing models for ways that policy can better incorporate consideration of and mitigation of environmental impacts and other problems resulting from sprawl. The models, albeit not all-inclusive, are listed and described below.

Development Impact Assessment

The development impact assessment is a process “to comprehensively evaluate the consequences of development in a community” and provides a framework for addressing the problems created by sprawl. The “systematic process for identifying, describing and evaluating community natural and human resources in order to improve decisions about their management” includes four main types of impacts: fiscal, environmental, socio-economic, and traffic (Edwards 2000).

Ecologically-based Municipal Land Use Planning

Honachefsky (2000) outlines a practical guide to incorporating ecological principles into land-use decision making. They include: examining the impacts of local decisions in a regional context; planning for the long-term; avoiding land uses that deplete natural resources; retaining large contiguous or connected areas that contain critical habitats;

avoiding or compensating for the effects of development on ecological processes; making preservation of a community's ecological infrastructure a paramount priority.

Geonomics

Butcher's (2001) treatise on "Geonomics and Community Power" offers an alternative taxing system. He defines geonomics as "a method of assuring that both the use of the commons, the natural environment, and the accumulation of wealth created by society as a whole is not hoarded by private interests, but appropriated for the common good..." (Butcher 2001:4). It is the theory behind the practical mechanism, the "land value tax or site value tax," which is based on the market value of particular parcels of land rather than the market value of improvements upon them. Theoretically it is a mechanism through which the "products of labor and capital are privatized and the gifts of nature are socialized. The strategy is to raise the tax on the site value and lower the tax on the improvements," thereby shifting the tax burden off homeowners and onto commercial interests (Butcher 2001:5-6). The theory emphasizes the democratic process and "the right of citizens to be involved in setting the political agenda." This model purports to counteract the "growth machine" in which "local elites with substantial local land holdings dominate community policymaking; their common interest lies in promoting growth; they seek to co-opt political leaders by bringing them into the pro-growth machine. The elites of the growth machine are local real estate owners, bankers, developers, construction companies, and central city newspapers" (Butcher 2001:8).

Community Culture and the Environment

The EPA compiled *Community Culture and Environment: A Guide to Understanding a Sense of Place* (2002) to “address the social and cultural aspects of community-based environmental protection.” The purpose is to provide tools for all community stakeholders to understand the human dimension of environmental issues and to make democratically make decisions on environmental protection efforts (U.S. EPA 2002:3). It is a holistic approach combining an assessment of a community’s assets, issues, and goals with scientific research on the issue(s), and using focus groups to pull together stakeholders, communicate ideas, and collaboratively make decisions. Such community planning processes could be a part of Memphis’ neighborhood revitalization programs.

Alternative decision-making processes

Generally, policymakers’ perspectives are incongruent with environmental processes in several ways: a mechanistic view toward environmental resources rather than a sustainable view of nature. Pro-growth values promote the interests of a select group of development beneficiaries, whose practices harm environmental resources. Decisions on projects tend to be made on a case-by-case, fragmented and short-term context rather than seeing them in the holistic, long-term, and cumulative context of community and environmental impacts. Their decisions tend to be reactive to crisis situations rather than pro-active to avoid crisis situations.

For long-term sustainability of communities, to assure that the natural resources upon which societies depend for their existence are not irrevocably damaged or

diminished, the impacts on environmental resources must be an integral part of the policymaking process and their protection an element of the resulting policy. Since the treadmill of development is a major barrier to groundwater protection, the problems that the treadmill induces must be addressed as part of the process of resource protection.

Paying the piper

Governments need to foster a stable tax base if they are to avoid this indebtedness, but, ironically, the treadmill actually pushes out a portion of the population that makes up that permanent tax base. That tax base is to be found in residents who simply want the use values of their land, many of whom are the “green migrants” whom development pushes further out as their rural landscapes are encroached by suburban development.

There are at least two mechanisms that could be implemented to hold onto and draw back this segment of the population that could provide part of a stable tax base. Duany’s transect model is one way to accommodate the variety of land use types that residents want, including the rural lifestyle, which the treadmill of development does not include. Another is to implement a comprehensive farmland protection strategy. The American Farmland Trust has legislative models that have been used in other states to accomplish this. As one municipality natural resources director recommended, plan on incorporating farmland into a community’s overall plan. Agricultural markets add to the local economy and with the growing market for organically grown fruits, vegetables, and meat, as well as plant sources for biofuels, agriculture can be a boon to the local economy.

Democratization of the decision-making process

As shown, the treadmill and the power of its adherents effectively prevent opposing views from fully participating in the decision process. Involving the public in decision-making from the beginning, rather than giving only a scant comment period or opposition opportunity after the plan is established, can incorporate a broader array of interests into policy, especially those who advocate environmental and land protection.

Charrettes were the community-involvement tool used in the development of the Gray's Creek Plan, in the "Lakeland Green" planning, and in the Governor's Alliance for Regional Excellence. Focus groups are a similar tool that can be used. The important point is that communities have a legislative voice in policymaking and implementation.

A result of the Gray's Creek planning process is that now there is a community organization that scrutinizes any planned development for that area. If it complies with the plan, there is no community opposition. But if a proposed development does not, then public officials can expect a community representative at their meetings reminding them of the need to stick to the plan. In this regard, the Gray's Creek plan has become more than just a shelved advisory plan that is never consulted. In fact, developers consult with the community to get their agreement prior to going through the formal process. The community works in conjunction with the administrative and political processes and policymakers give credence to community leaders' input. The Board of Commissioners still makes the final approval or disapproval decisions, but they are more likely to be in congruence with the Gray's Creek plan than making exceptions to it.

Protect natural resources and green space

Natural resource protection can be effectively incorporated into the policymaking process by recognizing the contribution of “environmental capital” to a community’s existence and quality of life. There are also university professionals in the area whose work specializes in valuing ecosystems and ecosystems services. For example, a proactive approach that values and protects forested lands, which absorb CO₂ and other air pollutants, could help Memphis better meet its air pollution control attainment requirements. One suburban community provides an example of resource protection through its natural resources inventory, which is used to evaluate proposed developments in a holistic, cumulative context and thereby to pro-actively protect the community’s existing resources. Protection of “environmental capital” could be an integral part of a larger county-wide or regional decision-making process, with particular consideration to aquifer recharge areas or where aquifer “breaches” exist. There are some trends in this direction, as seen by the successful efforts of Greening Greater Memphis, the Memphis Greenline, and Wolf River Restoration projects.

Fiscal and land use improvements can be made by incorporating and expanding the preservation of agricultural land use in the region. One suburban municipality uses the American Farmland Trust’s formula for evaluating fiscal impact of development, which recommends that agricultural land be an integral part of a community’s broader land-use plans. Agriculture contributes to urban economies and environments in several ways. Locally grown and distributed food to both grocery stores and restaurants can cut costs of food (particularly shipment costs) and improve freshness and quality. There is a growing biofuels industry in Memphis area. Increased use of land for agricultural purposes could

raise the raw materials for biofuels production. Boarded-up or vacant properties in declining neighborhoods could be de-constructed and converted to agricultural use and/or green space that could “developed” into various types of ecosystems for environmental education programs in schools.

Changing the way municipal sewage is treated can reduce costs of sewage treatment, decrease pollution of local streams, and increase productivity in agricultural land. Sheaffer and Stevens (1983) in *Future Water* describe how changing from a linear model to a circular model of wastewater treatment can bring this about by utilizing green spaces to spread treated water. There are examples of other types of sewage treatment, such as natural wetlands, that could be explored for feasibility.

Protecting land in aquifer recharge areas will be especially difficult in a system that promotes development and prioritizes the exchange value of land. Presuming the concept of “development rights” is legally defensible, it is expected that landowners would require economic compensation to forego development on their land. Transfer of development rights along with conservation easements are existing tools to meet this goal. Other existing programs could be modified to protect rural land. A model such as the Conservation Reserve Program (CRP) that compensates farmers not to cultivate highly erodible land could be adapted to compensate landowners for not developing in recharge areas.

Another model that could be adapted to preserve aquifer recharge areas is the Alaska Permanent Fund, which pays residents an annual dividend from the state’s oil trust account. The region could establish a water trust account whereby all users, including those current free-riders, would pay for the water they withdraw from the aquifer.

Dividends from this fund could then be distributed to landowners in recharge areas for engaging in land conservation and aquifer protection practices.

Reducing groundwater withdrawals

A variety of conservation measures could be implemented to reduce the amount of water being withdrawn from the aquifer. Each of the groups of users must be addressed with specific measures: agriculture, industry, residential use. As described in *Future Water*, circular wastewater treatment systems can be used for agricultural irrigation, as grey water can be used for lawn and landscaping irrigation. As one interviewee mentioned, xeriscaping can reduce need for urban lawn irrigation.

The problem of users who are free-riders, who withdraw large volumes of groundwater and pay nothing for the water must be addressed. One industry reported it is looking for ways to either reduce or hold constant its withdrawals. Using alternative surface water sources for industrial purposes was mentioned by interviewees as a way to decrease groundwater withdrawals. Models for water recycling systems are available in many cities, e.g., Las Vegas.

Environmental Education

Policymakers in the region need to be further educated about the impacts of their development decisions on the aquifer. Business leaders and the general public also need to be educated on how their actions affect the aquifer and other vital resources.

Improving the City's school system was cited as a community need. Interviewees believed an important part of education systems is teaching about the ecosystems and

natural resources on which we depend for existence, how people's actions affect natural resources, and the consequences people incur. They advocated implement environmental education as a basic part of the curriculum including outdoor classrooms. Lewin-Benham's (2005) *Possible Schools: The Reggio Approach to Urban Education* shows a viable, alternative approach that could be used to improve city schools. The "full service schools" researched and applied by Kronick (2002) is another way to meet community needs through educational institutions.

Interviewees also saw the need to educate students for technically skilled jobs. With renovation of older neighborhoods increasing, there is growing job market for persons with a variety of building skills to rehab older houses and buildings, whereas construction workers generally are oriented only to new construction. Developing such skills could expand job markets that pay higher wages than service jobs.

Resource Protection Priorities

In order to avoid burgeoning environmental problems, like those related to groundwater in the Memphis area, policymakers will need to re-evaluate their decision-making priorities. To develop sustainable economies and communities, policymakers will need to not only address the problems that sprawl policies have created, but also to step off the treadmill of development and give higher priority to protecting the environmental resources on which communities depend for their existence. Sustainable policy requires a holistic, cumulative, long-term, pro-active approach. It requires the collaboration of many minds to generate feasible solutions, rather than the current politics of excluded

alternatives. The policy process must be transparent and open to the public; it must involve and give all stakeholders an equal voice in decision-making.

The “tragedy of the commons” is that it allows free riders, allows some groups to benefit at the expense of many others, and eventually destroys the natural resource that supports all. Preventing a tragedy of the commons in the Memphis region means developing regional groundwater protection policy that conforms to the boundaries of the natural systems. It involves the collaboration and cooperation, rather than competition, among policymakers, businesses, scientists, and environmental advocates across political boundaries. The stakes are high. When we destroy an ecosystem or impair vital resources, it is virtually impossible to get them back. In spite of all our money and technological expertise and resources, like mountaintops removed, Humpty Dumpty can’t be put back together again.

Sociology asks two basic questions of any societal structure: who benefits? Who does not benefit? These are good questions to evaluate any public policy and the test of a socially just policy. If the answer is that everyone benefits, including the Earth and non-human creatures, it is a socially just, sustainable policy. If some benefit more than others, or to the detriment of others including the Earth and non-human creatures, then it is not a socially just, sustainable policy.

Wendell Berry (1999) wrote in *The Great Work*: “We are experiencing a moment of grace different in its significance from any previous moment. For the first time the planet is being disturbed by humans in its geological structure and its biological functioning” in a manner unprecedented in human history. “The cause is from an economy that is disturbing the life-systems of the planet in a manner and to an extent the Earth has not

known previously. Moments of grace are transient moments” and transition moments. “The transformation must take place within a brief period. Otherwise it is gone forever” (Berry 1999:198-201). Memphis is experiencing a moment of grace – an opportunity to rethink the consequences of past policies and to engender a paradigm shift to holistic, long-term thinking that prioritizes protecting and sustaining the vital resources that make human society possible.

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APPENDICES

STUDY INFORMATION

My name is Nancy Brannon and I am a Ph.D. student in Sociology at the University of Tennessee. You are invited to participate in a study that I am conducting on ground water management in a major metropolitan area.

If you consent to an interview, I will ask you questions about your personal knowledge of ground water, public policy on use of the regional aquifer, and land use decisions that impact the aquifer. The interview will take less than two hours, and you are free to end it any time.

Your interview will be digitally voice-recorded and you need not say anything that you do not want recorded. Data you provide, including audio, will be stored in a locked file cabinet and will be marked with a number in place of your name. Thorough steps will be taken to protect your identity, and no information that you believe jeopardizes your legal status will be required or should be given.

The information you provide will be kept confidential. Data will be stored securely and will be made available only to persons conducting the study. No reference will be made in verbal or written reports which could link you to the study. There are few risks from participating in this study, perhaps job-related or political or involvement in the ground water conflict. But the probability of these risks to you is estimated to be very low. The risks will be minimized to the greatest extent possible by measures taken to assure your confidentiality.

Your participation in this study is voluntary and you may decline to participate at any time. You can refuse to answer any questions and can drop out of the research at any time. If you drop out of the research project, any information you have given will be destroyed.

If you have any questions about the study, you may contact the researcher, Nancy Brannon, at (901) 581-5013 (cell) or (856) 974-6021, Department of Sociology, 901 McClung Tower, University of Tennessee, Knoxville, 37996.

Sincerely,

Nancy Brannon

INFORMED CONSENT

It is my understanding that by agreeing to participate in the project, “Ground Water: A Community’s Management of the Invaluable Resource Beneath Its Feet,” my rights, welfare and privacy will be maintained in the following ways:

- I have had the details of the research project explained to me by the project director.
- I understand the procedures to be used and have been made aware of any possible risk involved.
- All responses I give to questions will be confidential and accessible only to the project director and her faculty advisor.
- Should the results of this project be published, I will be referred to only by a research pseudonym assigned by the project director.
- In signing this consent form, I have not waived any of my legal rights nor have I released this institution/agency from liability for negligence.

I have been informed of this information in (a) written _____ or (b) verbal _____ from. All of my questions have been answered. If further questions arise about the project, I can call the project director, Nancy Brannon, at (901)581-5013 (cell) or (865) 974-6021 (sociology office). I freely and voluntarily agree to participate in the project.

Signature of Volunteer	Date
Signature of Witness	Date

INTERVIEW GUIDE 1 for policymakers

1. What do you think about Memphis water? How do you think the public generally perceives it? (K)
2. What is the status of Memphis' source of water supply in terms of quality and quantity? (K)
3. Do you think the aquifer is one of the region's assets? If so, is it being sufficiently protected? If not, what kinds of additional protections are needed? (GWC/C)
4. Do you have concerns about the future of Memphis' water supply? Do you know of any possible threats to the groundwater resource? (GWC)
5. What do you think about the lawsuit MS filed against Memphis and MLGW? Has the lawsuit affected attitudes or public policy regarding groundwater? If so, how? (LSK)
6. Please describe the current policy process in terms of how it relates to land use and the water source (aquifer). (EP/EC/GWC/C)
7. What are the current land uses and their values? (EC/C)
8. Does the current policy process take into consideration effects on the aquifer of land use decisions? (GWC/EC/C)
9. If not, what information is needed to allow present planning activities to incorporate aquifer effects consideration? (GWC/EC/C)
10. Does current land use decision-making taking into account environmental effects of land change or conversion? If so, how? If not, should it and how? (EC/C)
11. Is there any change occurring in the way land use and zoning decisions are made, say to incorporate aquifer recharge protection areas or development that preserves green space? (GWC/EC/C)
12. What are priorities in decision-making? Are economic growth and development important to the area? Are they priorities in policy decisions? (EP)
13. What do you think are the factors that foster economic growth and development? (EP/EE)
14. In what areas is economic growth occurring now? What are future areas of economic growth? (EE/ENM)
15. Are there limits to growth and development in the community? If so, what would limit it? Or can growth and development continue indefinitely? (UG)
16. Can any limits to growth be overcome? If so, how? (UG) Where might new markets and expanded growth occur? (ENM)
17. Do you think growth benefits everyone in the community? Do you think growth benefits some groups more than others? If so, which groups? (GB)
18. The newspaper reported that MLGW recently considered automating its meter reading system, which would eliminate about 200 jobs. What do you think of the role of labor-saving technology in our society? What is the impact of labor-saving technology on the community? (LRT)
19. How can regional groundwater protection and equitable distribution be accomplished across political jurisdiction boundaries?
20. How should Memphis and Shelby County work with Mississippi and surrounding Tennessee counties to maintain adequate access to and protection of groundwater?

21. Should there be an active regional groundwater board? If so, what should be its scope?
22. Demographic items: age, gender, race, occupation, education level, income level.

INTERVIEW GUIDE 2 for business leaders

1. What do you think about Memphis water? How do you think the public generally perceives it? (K)
2. What is the status of Memphis' source of water supply in terms of quality and quantity? (K)
3. Do you think the groundwater source is one the region's assets? If so, is it being sufficiently protected? If not, what kinds of additional protections are needed? (GWC/C)
4. How important is the groundwater to your business? (GWC/C)
5. Do you have concerns about the future of Memphis' water supply? (GWC/C)
6. Do economic growth and development in the area have an effect on groundwater? (GWC/C)
7. What do you think about the lawsuit MS filed against Memphis and MLGW? Has the lawsuit affected business in the region? If so, how? (LSK)
8. Has the lawsuit affected perceptions toward the aquifer and water distribution? If so, how? (LSK)
9. How important is economic growth to the area? (EP)
10. Please describe the current policy making process in terms of how it relates to your business interests, economic development, environmental protection and the water source (aquifer). (EP/EC/GWC/C)
11. Does the aquifer affect (enable) economic development in the region? If so, how? (EP/EC/GWC/C)
12. What are factors that foster economic growth and development? (EP/EE)
13. Do economic growth and development in the area have an effect on groundwater and the environment? If so, in what way? (EP/EC/GWC/C)
14. Do you think economic development policy decisions incorporate their corresponding environmental effects? If so, how? If not, should they? (EP/EC)
15. How can economic concerns be balanced with aquifer and environmental protection? (EP/EC/GWC)
16. In what areas is economic growth occurring now? What are future areas of economic growth? (EE/ENM)
17. Are there limits to growth and development in the community? If so, what would limit it? Or can growth and development continue indefinitely? (UG)
18. Can any limits to growth be overcome? If so, how? (UG)Where might new markets and expanded growth occur? (ENM)
19. Do you think growth benefits everyone in the community? Do you think growth benefits some groups more than others? If so, which groups? (GB)
20. The newspaper reported that MLGW recently considered automating its meter reading system, which would eliminate about 200 jobs. What do you think of the

- role of labor-saving technology in our society? What is the impact of labor-saving technology on your business and the community? (LRT)
21. How can regional groundwater protection and equitable distribution across political jurisdiction boundaries be accomplished?
 22. How should Memphis and Shelby County work with Mississippi and surrounding counties to maintain adequate access to and protection of groundwater?
 23. Should there be an active regional groundwater board? If so, what should be its scope?
 24. Demographic items: gender, race, age, educational level.

INTERVIEW GUIDE 3 for scientists

1. What is your area of research expertise in groundwater issues? (K)
2. Please tell me more about your research and your findings in relation to the aquifer? (K)
3. What do you think about Memphis water? How do you think the public generally perceives it? (K/GWC)
4. What is the status of Memphis' source of water supply in terms of quality and quantity? (K)
5. Do you think the aquifer is one of the region's assets? If so, is it being sufficiently protected? If not, what kinds of additional protections are needed? (GWC/C)
6. What do you think about the lawsuit MS filed against Memphis and MLGW? Has the lawsuit affected attitudes or public policy regarding groundwater? If so, how? (LSK)
7. What are some of the key issues about groundwater and environmental protection in this area? (GWC/EC)
8. What are the sources of these issues? What do you see as the possible solutions to these problems? (GWC/EC)
9. How has the water level in the aquifer changed and over what period of time? (K)
10. Do you have concerns about the future of Memphis' water supply? (GWC/C)
11. What is the relationship of the aquifer to land surface activities? How are the aquifer and environment affected by land use changes? (GWC/EC/C)
12. What priorities currently determine land use decisions as related to water distribution and aquifer and environmental protection? (GWC/EC/C)
13. Do you have information about the location of aquifer recharge areas? (K)
14. What needs to be done protect the aquifer and the recharge areas, and to maintain a consistent or sustainable water level? (GWC/K)
15. How important is economic growth to the area? Are economic growth and development priorities in public policy decision-making? (EP)
16. What are some of the factors that foster economic growth and development in the area? (EP/EE)
17. Does the current policy process consider the environmental effects of economic development and land use decisions? (EP/EC)

18. Does the current policy and land use decision-making process take into account effects on the aquifer? If not, what information is needed to allow present planning activities to incorporate aquifer effects consideration? (EP/GWC)
19. In what areas is economic growth occurring now? What are future areas of economic growth? (EE/ENM)
20. Are there limits to growth and development in the community? If so, what would limit it? Or can growth and development continue indefinitely? (UG)
21. Can any limits to growth be overcome? If so, how? (UG) Where might new markets and expanded growth occur? (ENM)
22. Do you think growth benefits everyone in the community? Do you think growth benefits some groups more than others? If so, which groups? (GB)
23. The newspaper reported that MLGW recently considered automating its meter reading system, which would eliminate about 200 jobs. What do you think of the role of labor-saving technology in our society? What is the impact of labor-saving technology on your research capabilities and the community? (LRT)
24. What are the current land use designations regarding aquifer protection? (GWC/C)
25. What should be done with land in areas where there is known relationship between surface activities and groundwater? (GWC/EP/C)
26. What potential problems with groundwater may come up in the future? What should be done about these problems? (GWC)
27. How can regional groundwater protection and equitable distribution across political jurisdiction boundaries be accomplished?
28. How should Memphis and Shelby County work with Mississippi and surrounding counties to maintain adequate access to and protection of groundwater?
29. Should there be an active regional groundwater board? If so, what should be its scope?
30. Demographic items: gender, race, age, educational level.

INTERVIEW GUIDE 4 for environmental advocates

1. What do you think about Memphis water? How do you think the public generally perceives it? (K)
2. What is the status of Memphis' source of water supply in terms of quality and quantity? (K)
3. Do you think the aquifer is one of the region's assets? If so, is it being sufficiently protected? If not, what kinds of additional protections are needed? (GWC/C)
4. Do you have concerns about the future supply of Memphis' water supply? (GWC/C)
5. What do you think about the lawsuit MS filed against Memphis and MLGW? Has the lawsuit affected attitudes or public policy regarding groundwater? If so, how? (LSK)
6. What are some of the key issues/ environmental problems that you see about groundwater and drinking water in this area? (EC/GWC/C)

7. What are the sources and possible consequences of these issues/ problems?
(EC/GWC/C)
8. What do you see as possible solutions to these problems? (EC/GWC/C)
9. How important is economic growth and development to the area? Are they priorities in public policy decision-making? (EP)
10. What are some of the factors that foster economic growth and development in the area? (EP/EE)
11. Does the current policy process sufficiently take into consideration environmental effects of economic development? If not, what policy changes are needed?
(EP/EC)
12. Does current policy consider the effects on the aquifer of economic growth and land use decisions? (EP/GWC)
13. If not, what information is needed to allow present planning activities to incorporate aquifer effects consideration? (EP/GWC)
14. Is there any change occurring in the way land use and zoning decisions are made, say to incorporate aquifer recharge protection areas or development that preserves green space? (GWC/EC/C)
15. In what areas is economic growth occurring now? What are future areas of economic growth? (EE/ENM)
16. Are there limits to growth and development in the community? If so, what would limit it? Or can growth and development continue indefinitely? (UG)
17. Can any limits to growth be overcome? If so, how? (UG) Where might new markets and expanded growth occur? (ENM)
18. Do you think growth benefits everyone in the community? Do you think growth benefits some groups more than others? If so, which groups? (GB)
19. The newspaper reported that MLGW recently considered automating its meter reading system, which would eliminate about 200 jobs. What do you think of the role of labor-saving technology in our society? What is the impact of labor-saving technology on your research capabilities and the community? (LRT)
20. How can regional groundwater protection and equitable distribution be accomplished across political jurisdiction boundaries?
21. How should Memphis and Shelby County work with Mississippi and surrounding counties to maintain adequate access to and protection of groundwater?
22. Should there be an active regional groundwater board? If so, what should be its scope?
23. Demographic items: gender, race, age, educational level.

VITA

Nancy D. Brannon was born in Kingsport, Tennessee on August 10, 1949. She was raised in Gate City, Virginia and went to grade school and junior high school at Shoemaker Elementary and Eighth Grade in Gate City. She graduated from Gate City High School in 1967. From there, she went to the University of Tennessee, Knoxville and received a B.A. in English in 1971. She moved to Memphis, where she received her M.A. in Sociology from the University of Memphis in 1978, and from 1983 to 2002 she served as adjunct faculty in the Department of Sociology at the University of Memphis. She returned to the University of Tennessee in 2002 to pursue a Doctorate in Sociology. After receiving her Doctorate in Sociology from the University of Tennessee, Knoxville, in 2007 she plans to publish an environmental newspaper and do environmental sociological research and consulting work in the Memphis area.